OAKLAND HARBOR TURNING BASINS WIDENING, CA

NAVIGATION STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX B1:
Channel Design

April 2023

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Introduction

The US Army Corps of Engineers (USACE) San Francisco District (SPN) collaborated with the Port of Oakland to develop measures to improve the operational efficiency of vessels in the federal navigation channels. This channel design appendix is developed to document the assumptions, methodologies, and analyses that led to the recommended alternative to move forward to the Preconstruction Engineering & Design (PED) phase of the project and prepared in accordance with ER 1110-2-1150 (August 1999), Engineering and Design for Civil Works Projects. Sections and sub-sections numbers may be given in parenthesis (#) for this Introduction.

This appendix gives a brief Project Area Description (Section 2) describing the location and features of the existing harbor turning basins. A more detailed project description can be found in the main report and other appendices, such as the Coastal Engineering appendix, B4.

The existing surveys and maps (Section 3) were used to create a surface model of the existing grade using Autodesk AutoCAD Civil 3D. The surface model was then used for comparison with as-built plans, geotechnical data, and USGS data. After the comparison, they were incorporated into the surface model for the areas that do not have any surveys. The model, along with professional judgement from experts were ultimately used to calculate the estimated quantities to be used for cost estimating. The Surveying, Mapping, and Other Geospatial Data section (3) is followed by the Design Considerations (4).

The Project Delivery Team's (PDT) description of the (field) reconnaissance on 24 August 2021 is presented in the Design Considerations section (4). The reconnaissance was conducted to verify the existing conditions in the as-built drawings. Because of limited funding no new tests or surveys were performed at this stage of the study. Therefore, the design assumptions are listed and described in this section of the appendix. The vessel inventory and future forecast are described, showing smaller vessels being replaced by larger vessels. The design vessel and the channel design diameters are explained then recommended design is described.

The recommended design is provided with the design parameters and inputs from numerous PDT meetings with the Port of Oakland and other stakeholders. Utilities were found in as-built plans; above-ground utilities can be verified in the field. Although we have as-built drawings for many of the structures, a new utility survey is recommended in the planning/engineering/design (PED) phase of the study to determine the degree of impacts to existing utilities in the project area. The report also lists dredging equipment (4.7, Dredging), and an estimated volume of dredged material for construction.

During the planning stage, eight (8) turning basin variations (or footprints) were developed, and two (2) footprints were further developed and revised into the final alternatives or Tentative Selected Plan (TSP) Selection. The eliminated footprints are described in the Eliminated Alternatives section (6). Section 5 is the Proposed Variations in the Alternatives for the TSP. The following variations (options) are shown as preferred:

- Variation A (Figure 12) at the inner harbor;
- and Variation 2.1 (Figure 24) at the outer harbor.

The alternatives for the tentative selected plan are described in the appendix. Initially, Variation

3 was chosen due to the total amount of land impacted, but after further investigation and community concerns Variation A was proposed. Variation A impacts the least amount of existing land compared to the other inner harbor variations, as well as minimizing the impact to existing owners. Variation 2.1 (outer harbor) is a revised version of Version 2 for the original turning basin design. It was adjusted to incorporate a bigger buffer from 60-ft to 135-ft to ensure a clearance for the vessels, as well as allowed vessels to be able to berth along the existing channel. Pertinent cross sections of the proposed work variations are also shown in this section.

The Quantity Estimates are given in Section 7 of the appendix. Due to limited data, assumptions were made for the estimated quantities with the assistance from the Port of Oakland. Theses estimated quantities were used for the cost estimates, Cost Estimate Appendix.

In the Construction Section 8 of the appendix, equipment and production assumptions are presented. The construction schedule and dredging schedules (for the NEPA analyses) are shown in Attachment I. Because the schedules were developed using professional judgment, a disclaimer statement is presented regarding to the level of detail and accuracy of the schedules. Construction schedules, means, and methods are usually developed by the Contractor near the time of bid award.

The main appendix ends with the Further Analysis and Design Development Needs (Section 9). In this section, topographic, bathymetric and utility surveys, soil testing, a ship simulation are recommended to be conducted for the next phases, Planning, Engineering, and Design (PED), if the study is approved to move forward.

1. Project Area Description

The Port of Oakland and the Oakland Inner and Outer Harbors are located on the eastern side of the San Francisco Bay in Alameda County, California. They are approximately 4 miles east of the Ferry Building in San Francisco. The outer harbor is located directly south of the San Francisco-Oakland Bay Bridge and the inner harbor is located between the cities of Alameda and Oakland. See Figure 1 for Project Location, next page.

1.1. Existing Outer Harbor Turning Basin

The Oakland Outer Harbor turning basin is in the outer harbor channel near berths 25 through 30. The turning basin is in a bend of the outer harbor channel. The diameter of the turning basin is 1,650 ft. The basin is maintained to a depth of -50 ft by annual dredging.

1.2. Existing Inner Harbor Turning Basin

The Oakland Inner Harbor turning basin is located approximately 18,000 ft to the east of the Oakland Harbor entrance. The diameter of the turning basin is 1,500 ft. It is maintained to a depth of -50 ft by annual dredging.

2. Surveying, Mapping, and Other Geospatial Data

2.1. Surveys

The survey sets that were used to create the existing condition of the project area were the hydrographic survey and LiDAR survey. The hydrographic survey inside the channel limit was performed by SPN from the annual dredging program. The survey consisting of cross sections was taken of the channel in 2020. The topographic LiDAR survey on the land side was obtained from Alameda County Public Works Agency. The LiDAR survey (taken in 2007) was used for the Inner Harbor. As the preliminary designs progressed, these surveys were compared with existing cross sections from Port of Oakland's Geotechnical Investigation, Oakland Harbor Navigation Improvement (-50 Foot) Project Final Report (Port of Oakland,1999), prepared by SCI Engineering, and as-built drawings provided by the Port of Oakland (Port of Oakland, 1980) (Port of Oakland, 1981). During the Preconstruction Engineering & Design (PED) phase, new hydrographic and topographic surveys should be performed to improve the accuracy of the existing conditions, which is needed to refine quantities, and prepare plans and specifications for construction.

2.2. Maps

Maps from Google Earth and ArcGIS, of the vicinity were used during the initial and plan formulation phases. Google Map was turned on in AutoCAD for drawings and analyses.

2.3. Datum

2.3.1. Horizontal

The Alameda County Public Works Agency LiDAR dataset for the Civil 3D surface model used the North American Datum of 1983 (NAD 83) NAD83 California State Plane Zone III (U.S. Survey Feet).

2.3.2. Vertical

The Alameda County Public Works Agency LiDAR dataset used NAVD88. The vertical datum of Mean Lower Low Water (MLLW) was used for calculating new work volumes.

2.3.3. Vertical Datum Comparison

Multiple ground surface evaluations were acquired for different sources (County, as-built plans, and USGS data). At Howard Terminal, the existing County LiDAR survey and SPN bathymetric survey were first used to create a surface model in Autodesk AutoCAD Civil 3D. The surface model was then used for comparison with as-built plans (Figure 2), USGS data (Figure 3) and the SCI Geotechnical Investigation Report (Port of Oakland, 1999). After comparison, information from as-built plans and the SCI Geotechnical Investigation Report, along with subjective judgement from experts, were incorporated into the model and ultimately used for calculating the quantities of the measures in the alternatives. The difference between the different sources is relatively small with no new topographic survey conducted at this planning stage of the project.

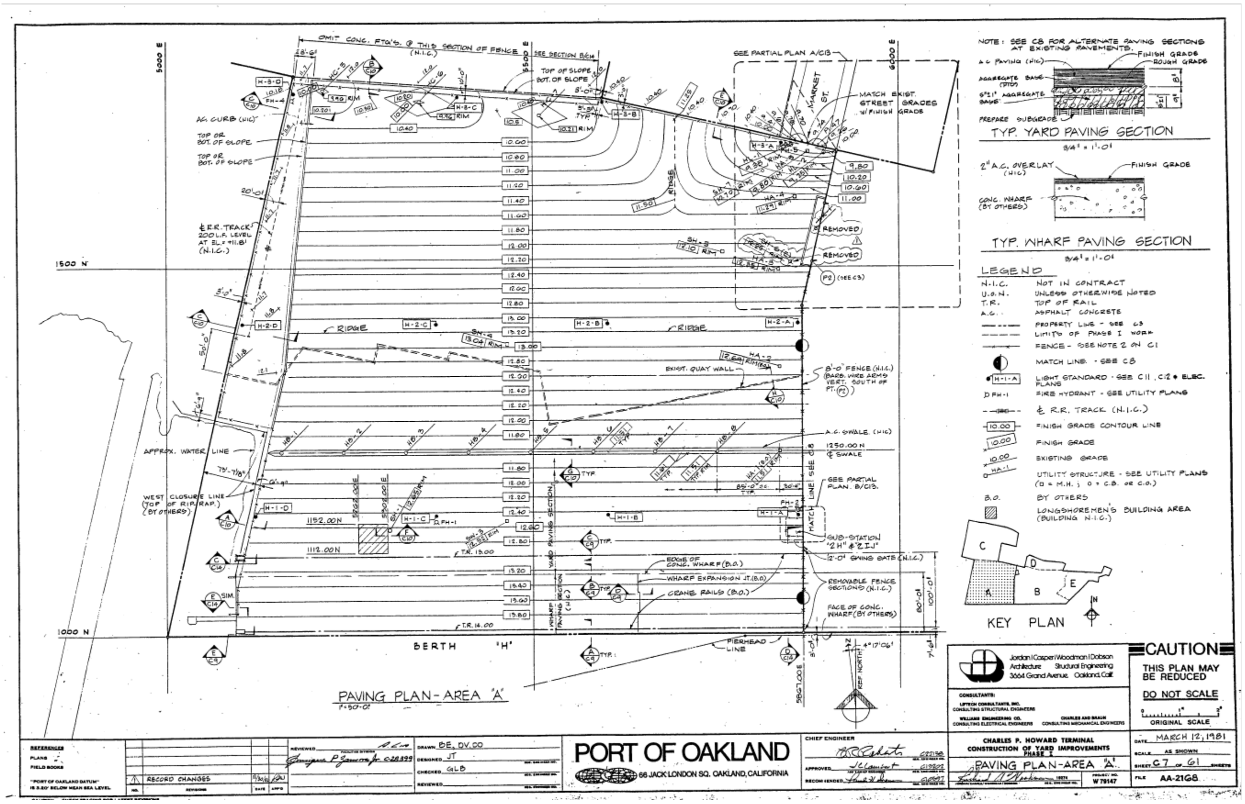

Figure 1: Sheet C-7 of Howard Terminal Yard As-Built Drawings (AA-2168, dated 1981) shows partial plan of wharf deck and backlands pavement.

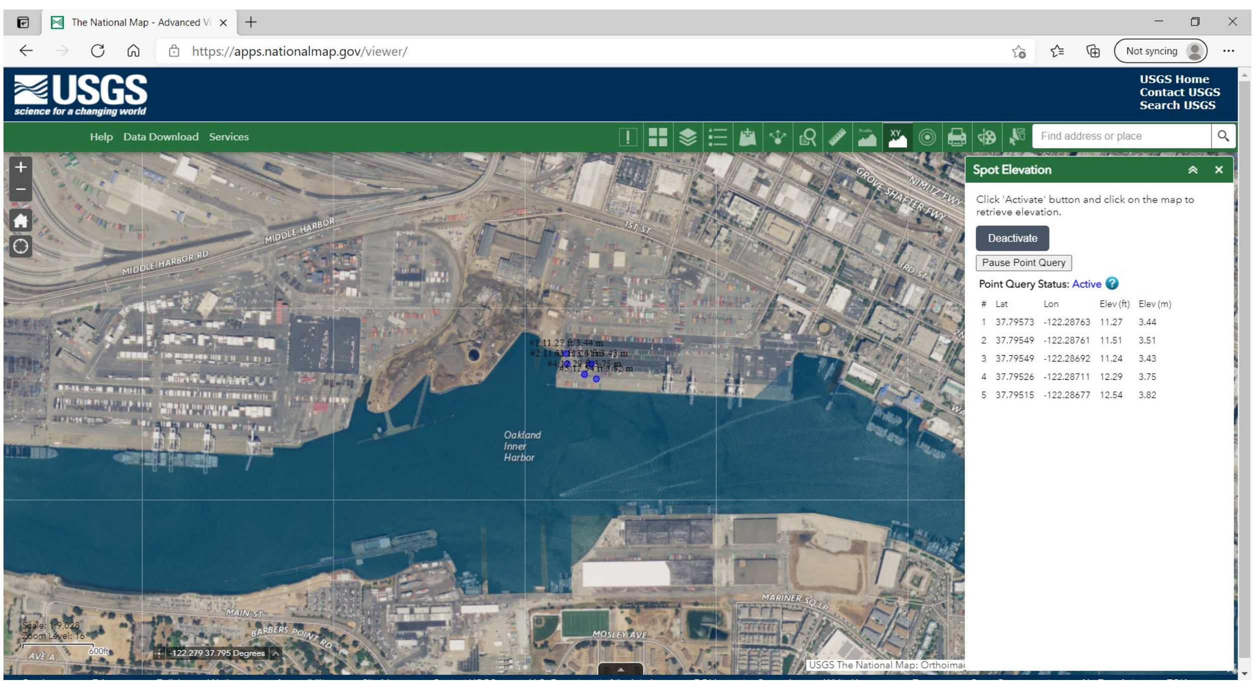

Figure 2: Elevation spot check in Howard Terminal (USGS)

3. Design Considerations

3.1. Field Verification of Existing Conditions

The main purpose of the reconnaissance was to observe the areas which will be affected by the basin widening, verify the information on the as-built drawings for the project locations, and confirm what other demolition and excavation work may be needed as the project proceeds.

The reconnaissance was conducted at the Port of Oakland office at 530 Water Street at 0900 on 24 August 2021 with Port of Oakland representatives. Weather was overcast with a bit of sun and temperature was between 58°F and 68°F. The first location of the reconnaissance was at Howard Terminal. First note was that the ground surface layer was asphalt. Upon further observation, the asphalt concrete (finish grade) was supported by the concrete wharf (see Figure 4). The evidence shown in Figure 4 reflected the typical wharf paving section in Sheet C7 of Charles P. Howard Terminal Construction of Yard Improvements Phase I (Port of Oakland, 1981). Measurements were taken to verify the offset of 100 ft from the face of the wharf. The Team was also able to verify that the reinforced precast concrete piles holding up the wharf were approximately 24 inches (hexagonal). As it was low tide, the condition of the piles as well as the rip rap on the rock dike were observed (see Figure 5). The evidence shown in Figure 5 reflected multiple sheets (C-8, C-13, etc.) of the Charles P. Howard Terminal Construction of Dike, Fill, and Concrete Wharf as-built plans (Port of Oakland, 1980).

Figure 3: Typical Wharf Paving Deck Elevation, Howard Terminal

Figure 4: Rip-rap on the Rock Dike, Howard Terminal

SPN Civil Design PDT was able to verify that the as-builts and existing dimensions were close in measurement.

Figure 5: Cranes, Howard Terminal

Per communication with the Port's representative, the crane structures (Figure 6) would be relocated along the wharf to accommodate the construction of the widened turning basin. Another potential obstruction for the project included utility light poles (see Figure 7).

Figure 6: Light Pole (Potential Obstruction), Howard Terminal

Schnitzer Steel was not visited during the reconnaissance due to activity. The wharf/port was actively being occupied at the time of the reconnaissance. Additionally, the new water tank/holding structure at the Schnitzer Steel facility was close in proximity to the demolition site.

The second location of the reconnaissance was on the Alameda Wharf (Figure 8).

Figure 7: Alameda Wharf

The PDT verified the vertical dimension of the wharf structure from the SCI Geotechnical report

(Port of Oakland, 1999). Some of the measurements are shown in Figure 9 and Figure 10. The existing concrete cap (Figure 11) matches the Widening of Inner Harbor Turning Basin at the Port of Oakland Phase 1A project.

Figure 8: Measurement showing six feet distance between the top sediment layer and top of concrete surface, Wharf, Alameda

Figure 9: Concrete structure, Wharf, Alameda

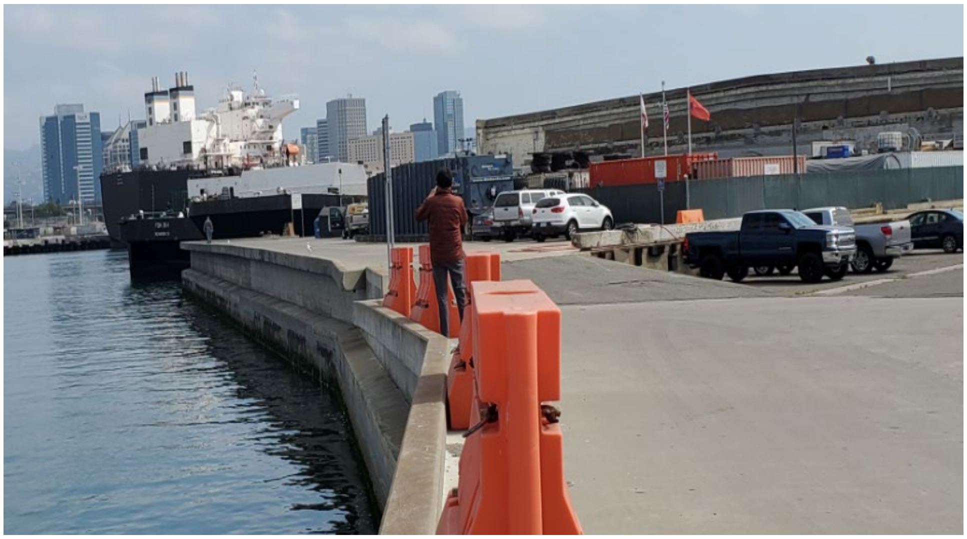

Figure 10: Existing Concrete Cap for -50 ft Dredging Project, Alameda

3.2. Design Assumptions

Because there is no ship simulation study in the feasibility phase, the design (footprint or variation) is based on a turning basin multiplier. A turning basin multiplier of 1.4 was used for the inner harbor area and 1.5 was used for the outer harbor. Next, it is assumed that the bulkhead clearance is 50 feet from the proposed channel limit. The bulkhead buffer distance is the distance between the proposed channel and the location of the bulkhead.

3.3. Vessel Inventory and Forecast

From the report summary:

> The authorized Federal project at Oakland includes channels that are 50' deep (MLLW), 900' wide at the Entrance and Outer Harbor, and 800' wide in the Inner Harbor. The original design vessel (circa 1998) for the Oakland Harbor Deepening Study was a 1,139-foot long (or length overall, LOA) containership of about 6,500 TEU (Twenty-foot Equivalent Unit) capacity. Today, vessels with more than double the capacity of the original design vessel call at the Port. Table 2 displays the fleet mix and associated dimensions of container ships that call at the Port of Oakland. The table displays the fleet in order of size, smallest to largest. Sub-Panamax (SPX) and Panamax (PX), generally 4,800 TEUs and below, refer to those vessels that fit through the Panama Canal locks prior to its redesign. Post-Panamax Generation I and II (PPX Gen I and Gen II), generally 9,900 TEUs and below, refer to those vessels that were too large to fit through the original Panama Canal. Post-Panamax Generation III (PPX Gen III), generally 15,000 TEUs and below, refers to the "New Panamax" vessels that were designed to fit through the expanded Panama Canal locks, which opened in 2016. Finally, Post-Panamax Generation IV (PPX Gen IV) refers to those vessels that are too large to fit through the expanded Panama Canal (i.e., the "new" Post-Panamax vessels), with capacities generally above 15,000 TEUs. All vessel classes listed in Table 1 regularly call at the Port, except for the Post-Panamax Gen IV (PPX Gen IV). However, while currently infrequent, the Port has received calls from PPX Gen IV vessels. The

frequency and number of PPX Gen IV vessels calling the Port is expected to increase into the future.

Table 1: Container Vessel Fleet Subdivisions and Dimensions

VESSEL FLEET SUBDIVISION (CONTAINERSHIPS)		FROM	TO
Sub Panamax	**Beam**		98
	Draft	8.2	38.1
	LOA	222	813.3
	TEUs		2,800
Panamax	**Beam**	98	106
	Draft	30.8	44.8
	LOA	572	970
	TEUs	2,801	4,800
Post-Panamax Generation I (Post-Panamax)	**Beam**	106	138
	Draft	35.4	47.6
	LOA	661	1045
	TEUs	4,801	6,800
Post-Panamax Generation II (Super Post-Panamax)	**Beam**	138	144
	Draft	39.4	49.2
	LOA	911	1,205
	TEUs	6,801	9,900
Post-Panamax Generation III (New Panamax, or Ultra Post-Panamax)	**Beam**	144	168
	Draft		51.2
	LOA	Up to	1220
	TEUs	9,901	15,000
Post-Panamax Generation IV (New Post-Panamax)	**Beam**	168	200
	Draft		52.5
	LOA	1,295	1,315
	TEUs	15,000	23,000

Table 2 displays the number of container calls by vessel class at the Port between 2014 and 2019. Over this period, the use of Panamax vessels at the Port of Oakland is trending downward while the use of larger vessels is trending upward. Most vessel calls have shifted from PPX Gen I in 2014 to PPX Gen II by 2019. This shift can be attributed to smaller vessels (i.e., Panamax) being replaced with larger vessels that carry more tonnage on a single voyage, as evidenced by the increase in cargo tonnage and TEUs, and decrease in vessel calls, since 2014. The trend to reduce voyages is an effort to realize economies of scale in the container shipping market.

Table 2: Container Vessel Fleet Port Calls by Class, 2014-2019 (Sources: USACE, 2018; Port of Oakland, 2020)

	SUB-PANAMAX	PANAMAX	PPX GEN I	PPX GEN II	PPX GEN III	PPX GEN IV	TOTAL
2014	109	485	518	273	174	0	1,558
2015	76	277	424	268	208	1	1,252
2016	112	316	508	378	247	2	1,563
2017	99	232	492	416	205	0	1,442
2018	96	163	498	398	231	0	1,386
2019	175	140	352	371	210	0	1,248

While no PPX Gen IV vessels called from 2017-2019, there were three calls in 2020, and three more so far in 2021, according to the Port.

3.4. Design Vessel

The design vessel LOA is 1310 feet which was agreed to among the USACE and Port of Oakland PDT at the beginning of planning.

3.4.1. Turning Basin (Design) Diameters

Using design vessel LOA x turning basin multipliers, the recommended turning basin diameters are:

Inner Harbor Diam. = 1310 ft. x 1.4 = 1834, rounded to 1835 feet

Outer Harbor Diam. = 1310 x 1.5 = 1965 feet

The design diameters were agreed among the USACE and Port of Oakland PDT at the beginning stage of planning.

3.4.2. Recommended Design

The recommended design diameter for Variation A is 1,835 feet for the inner harbor and Variation 2.1 is 1,965 feet for the outer harbor. The tangent lines were created for the design diameters and are the proposed channel limit. Buffers of 50 feet (inner harbor) and 135 feet (outer harbor) were added for the spacing and slope clearance for the vessels. The larger buffer at Outer Harbor provides additional space for vessels berthed at the adjacent Port wharves.

4. Utilities

Potential existing underground utility that could cause obstructions on the Howard Terminal (Oakland) side can be found in as-built drawings from the early 1980s. Potential existing above ground utility (such as light poles) that could cause obstructions were observed during the reconnaissance on 24 August 2021. No utility information is available outside the Howard Terminal area. Because the plans are from the 1980s, a new utility survey should be performed in the PED phase to determine the degree of impacts to existing utilities. There are known utilities on the Alameda side which will be relocated and/or demolished or abandoned in place.

5. Dredging

The dredging equipment that is likely to be used for the project are crane with clamshell, barge ship/scow, and tugboat. The total estimated exposed inner harbor sediments to be dredged is 144,000 cubic yards (CY). The total estimated inland inner harbor soil to be dredged is 493,000 CY. The total estimated exposed outer harbor sediments to be dredged is 1,300,000 CY. The dredging for the widening of the turning basins would follow the 26-week dredging season.

The expansion from Variation A in the Inner Harbor and Variation 2.1 in the Outer Harbor will result in an increase of approximately 65,000 CY /year of paid volume (standard depth and 1st foot overdepth) for maintenance dredging. Total overall volume increase should be approximately 70,000 CY /year (standard depth + all overdepth). Similar to the federal annual dredging in the area, the maintained depth is -50 feet, with an additional 1-foot paid overdepth and 1-foot unpaid overdepth. A maintenance dredging work window is proposed to follow a yearly schedule between 1 June through 30 November for the project.

6. Proposed Variations in Alternatives for TSP

Refer to the Draft Integrated Feasibility Report/Environmental Assessment (Draft IFR/EA) for a detailed discussion of the variations that were studied and eliminated.

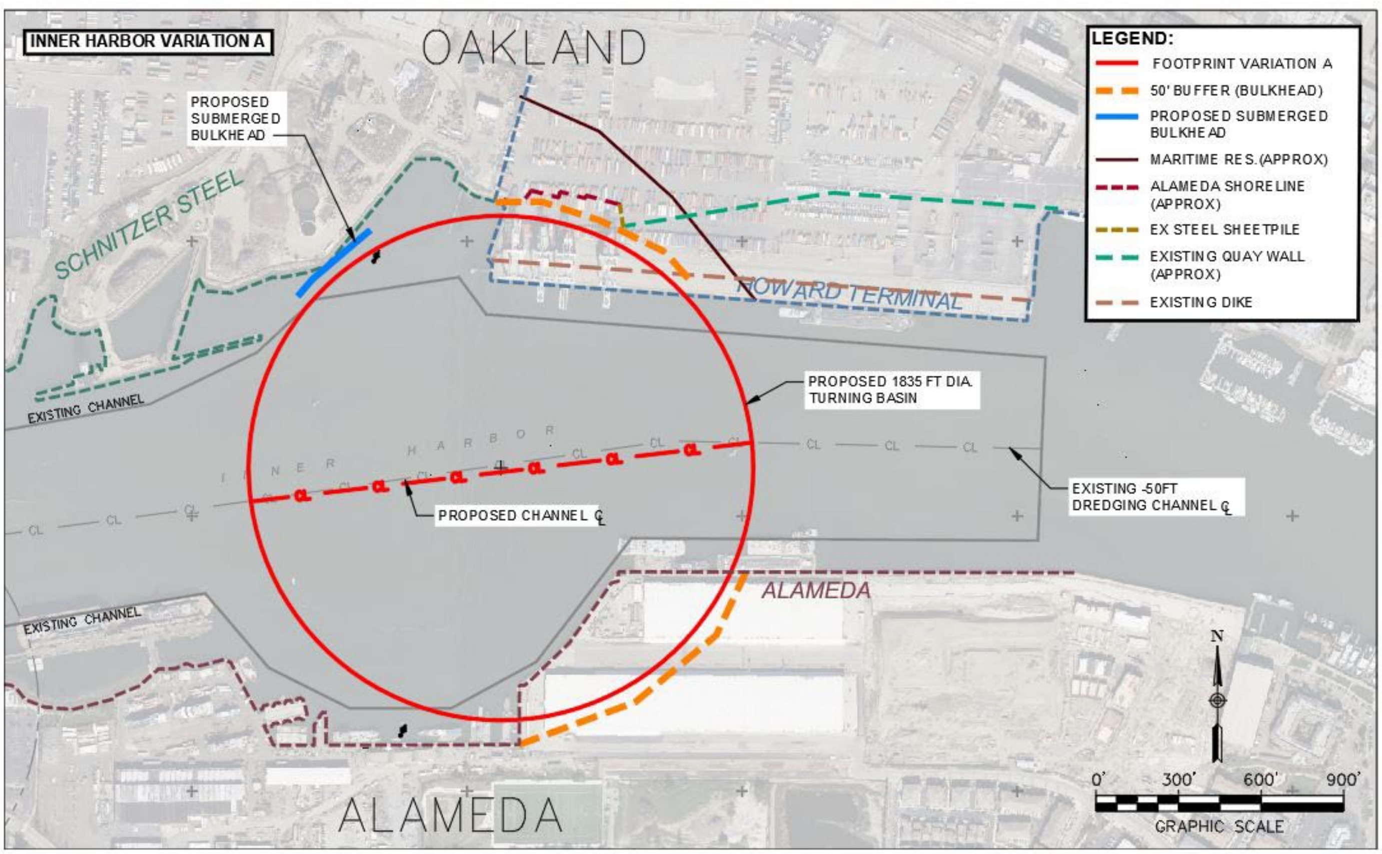

Figure 11: Inner Harbor Variation A Site Plan (preferred Alternate or TSP)

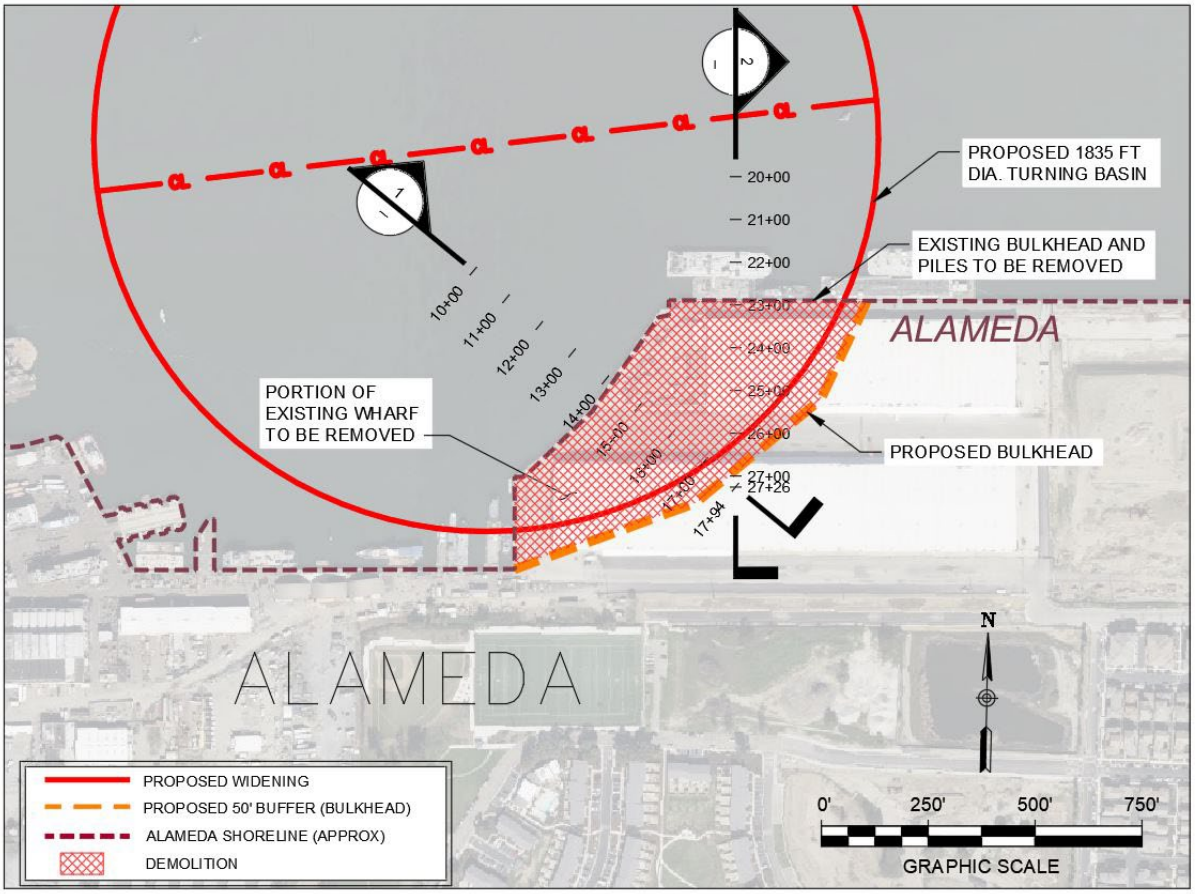

Figure 12: Alameda Wharf Plan View for Cross Sections

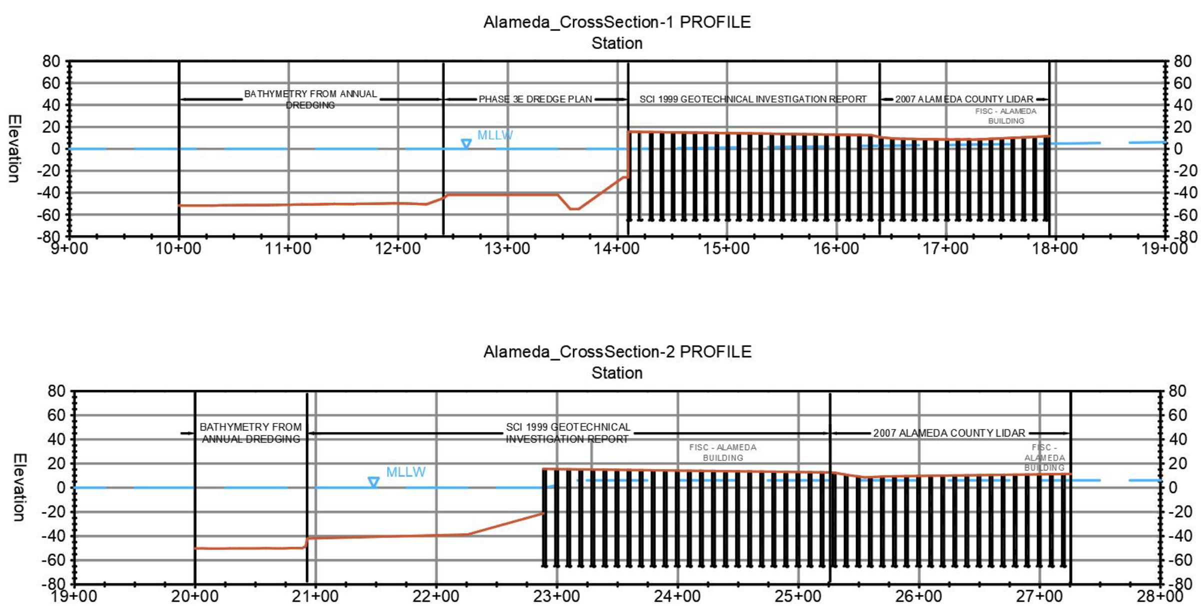

Figure 13: Alameda Cross Sections at Existing Wharf

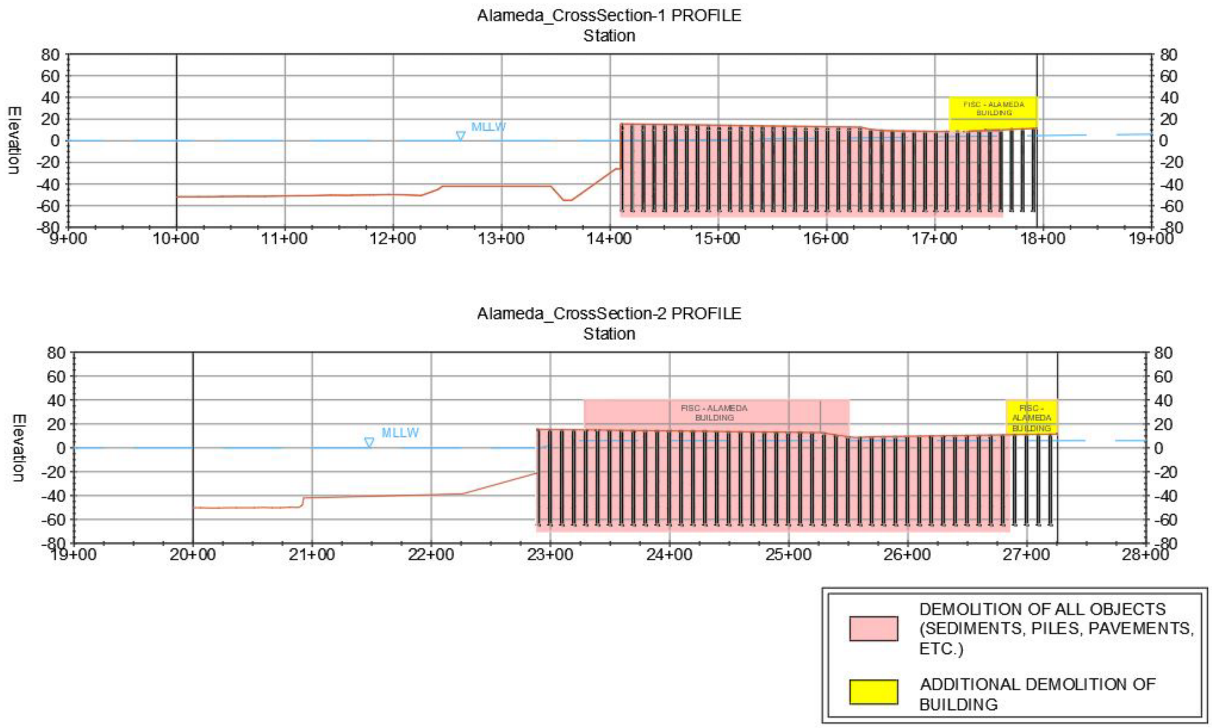

Figure 14: Alameda Wharf Demolition, Cross Sections with (E) bulkhead elevations

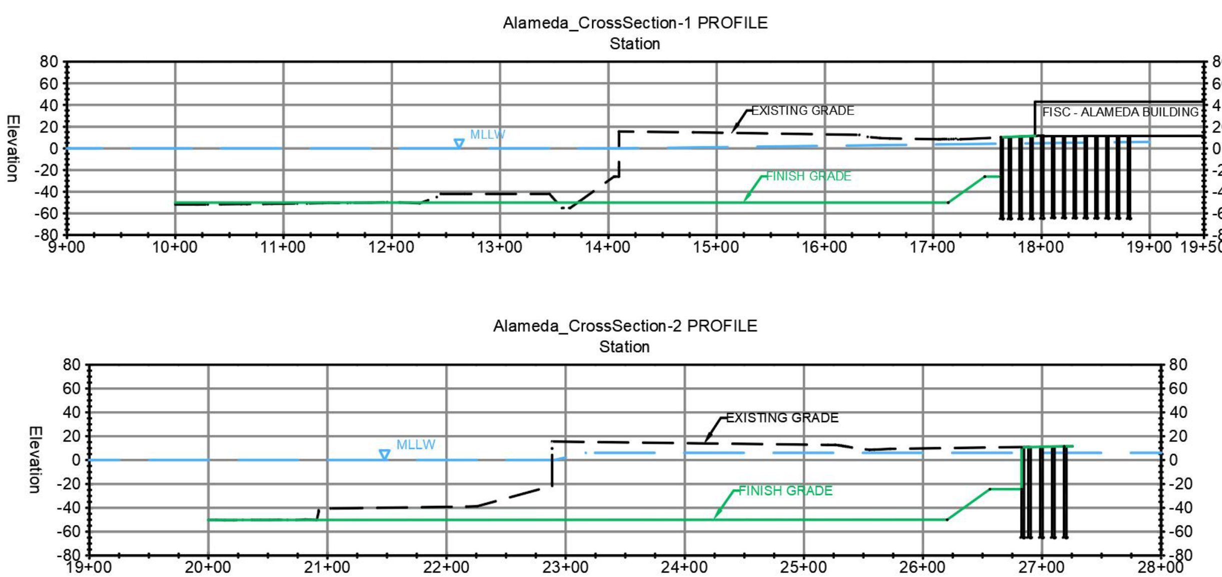

Figure 15: Alameda Wharf Proposed Design Typical Cross Sections

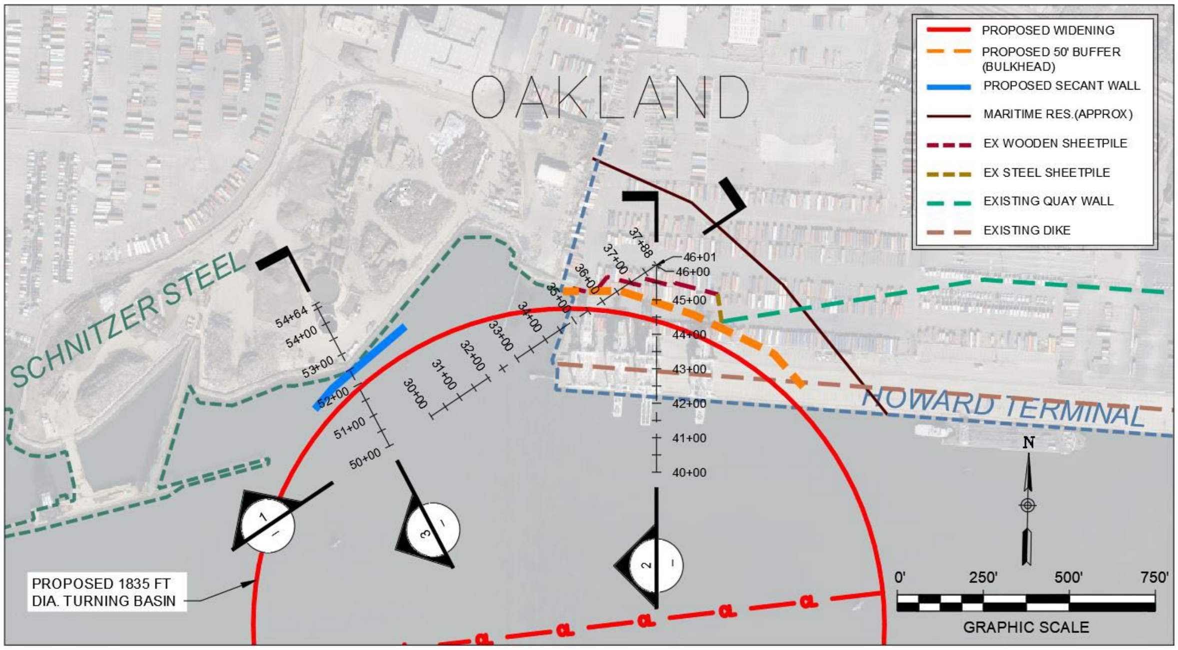

Figure 16: Howard Terminal Plan View for Cross Sections

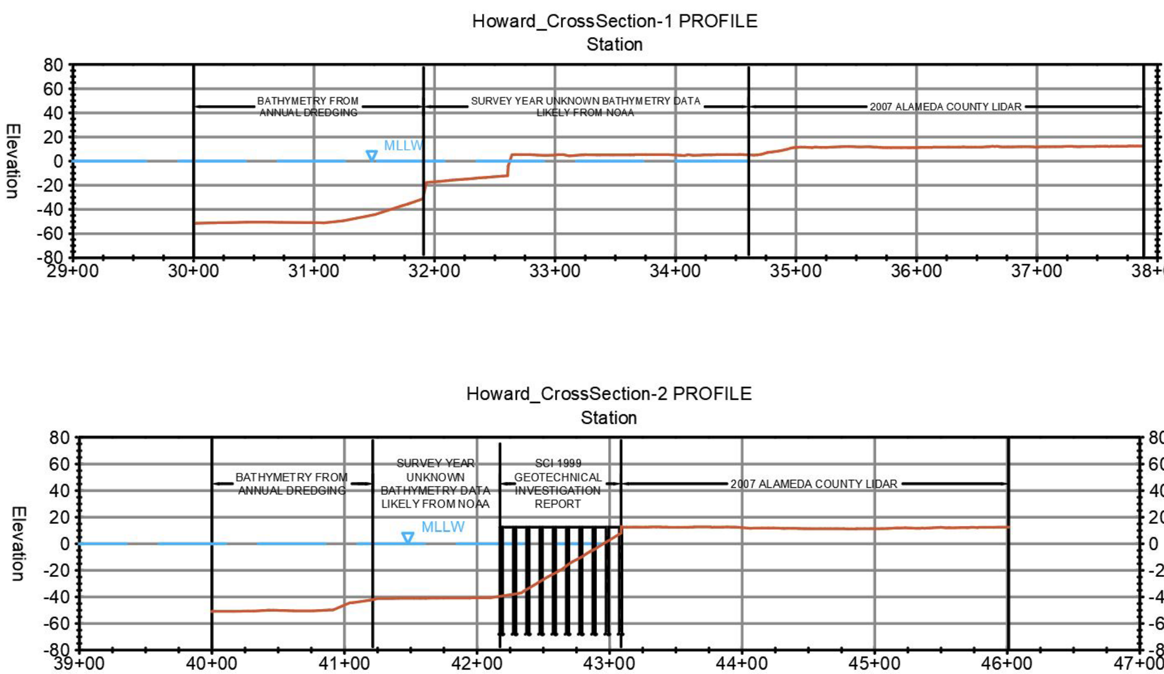

Figure 17: Howard Terminal Cross Sections of the Existing Grade

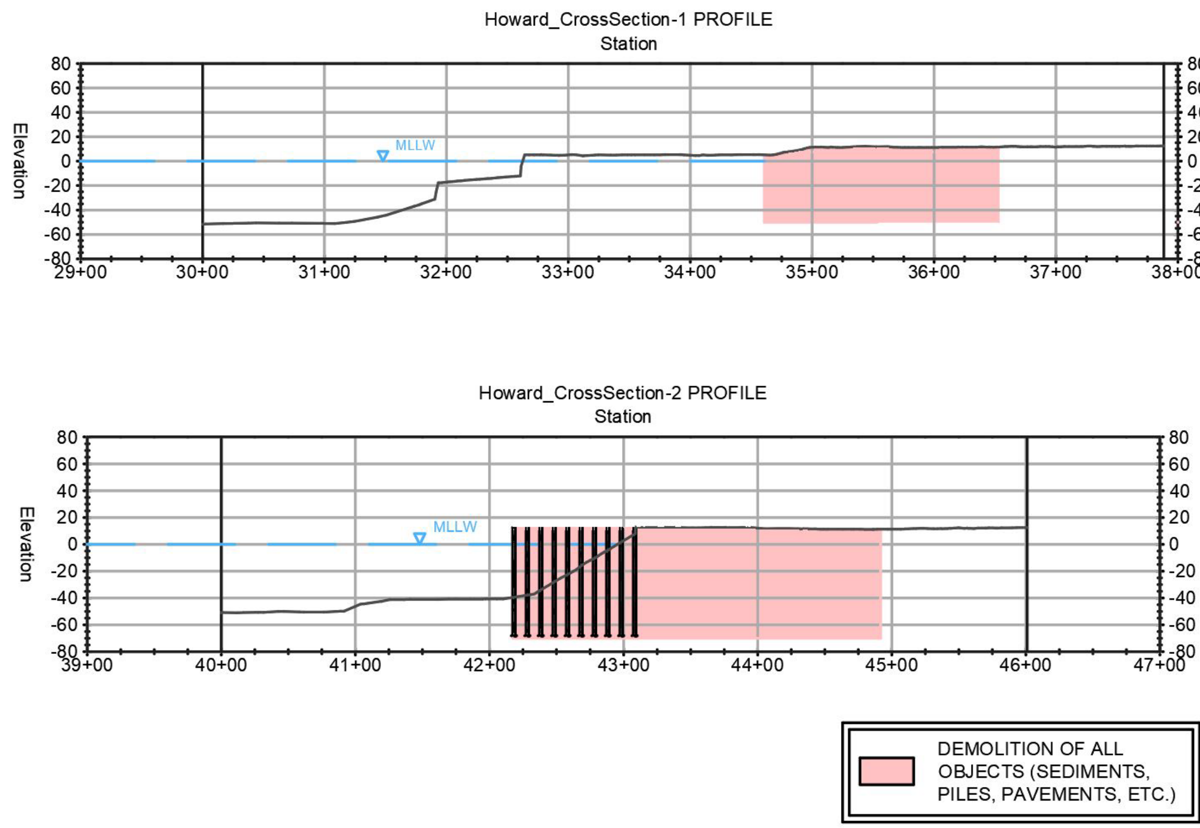

Figure 18: Howard Terminal Demolition Typical Cross Section

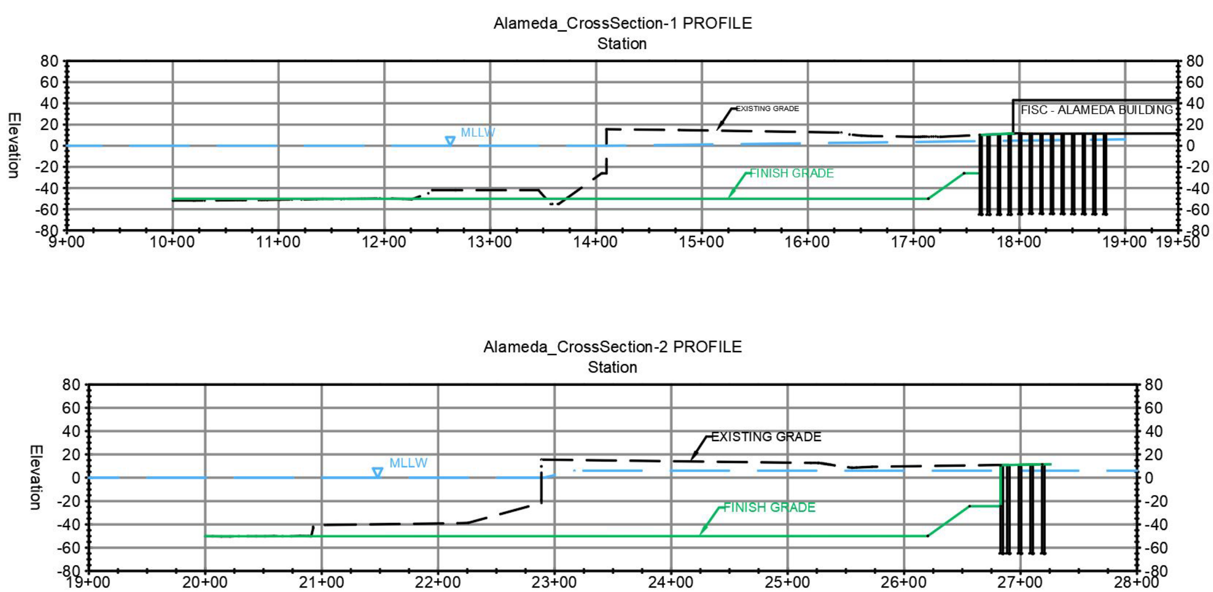

Figure 19: Howard Terminal Proposed Design Typical Cross Section

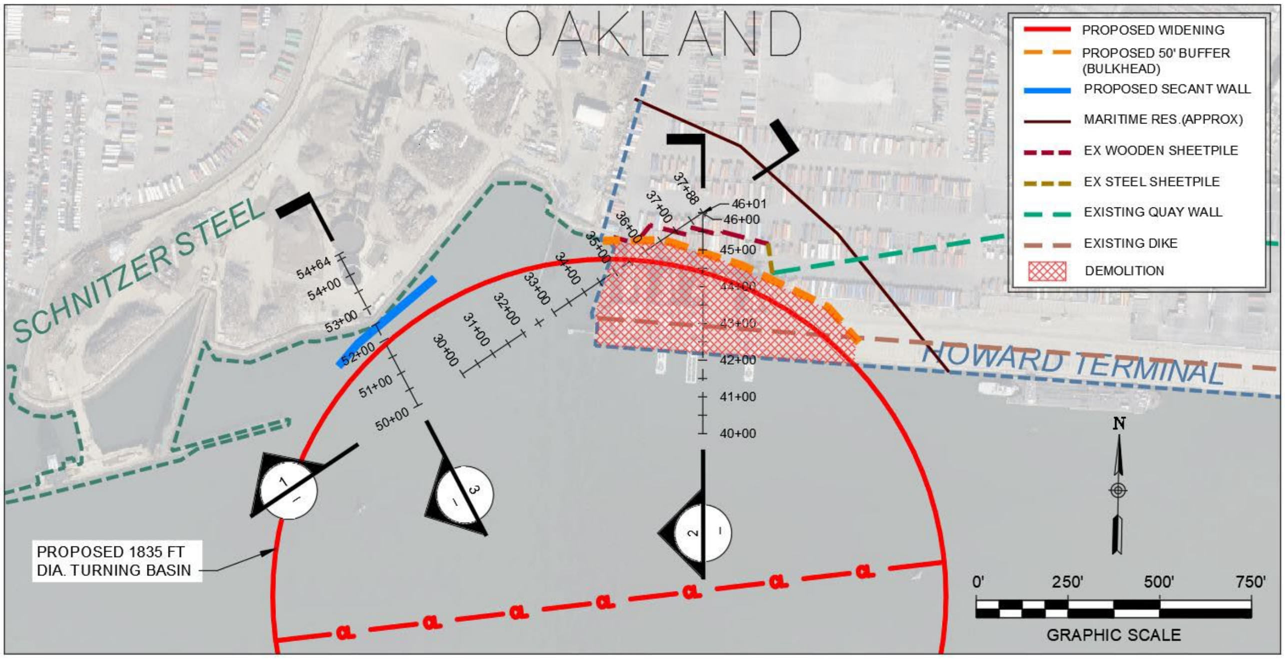

Figure 20: Schnitzer Steel Plan View for Cross Sections

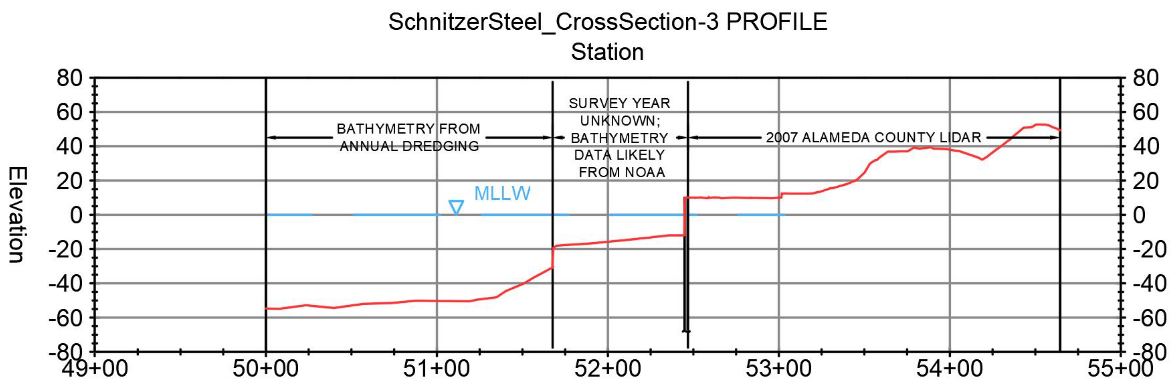

Figure 21: Schnitzer Steel Cross Sections of the Existing Grade

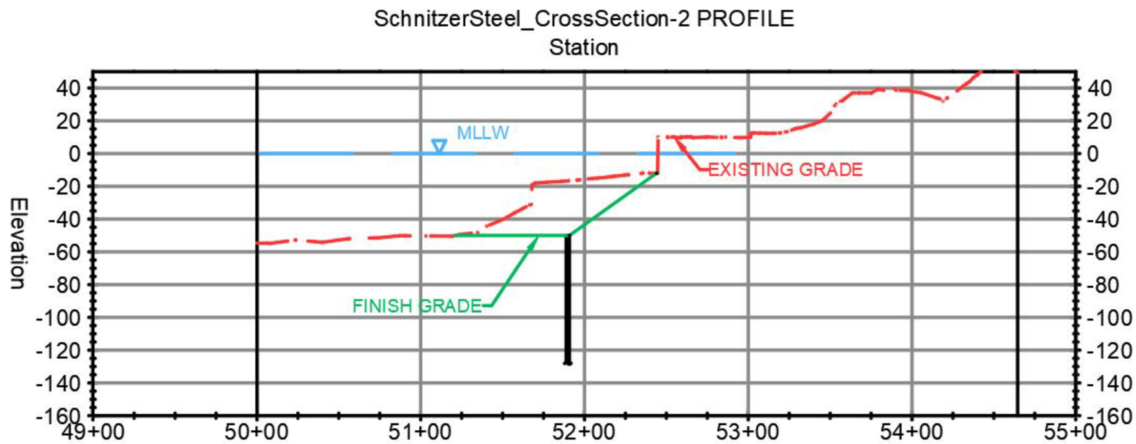

Figure 22: Schnitzer Steel Proposed Design Typical Cross Section

Variation 2.1 (Figure 24) in the outer harbor follows the existing turning basin. The estimated quantities are shown in Section 7 Quantity Estimates. It has no land impact and therefore it does not require any existing bulkhead modifications nor new bulkhead(s). It requires less impacted underwater area than Variation 1 in the outer harbor. It may require minor channel alignment/boundary modifications. Figures 25 to 28 display the plan view of cross sections of the existing grade, cross sections of the existing grade, demolition cross section and proposed design cross section for the area of the variation.

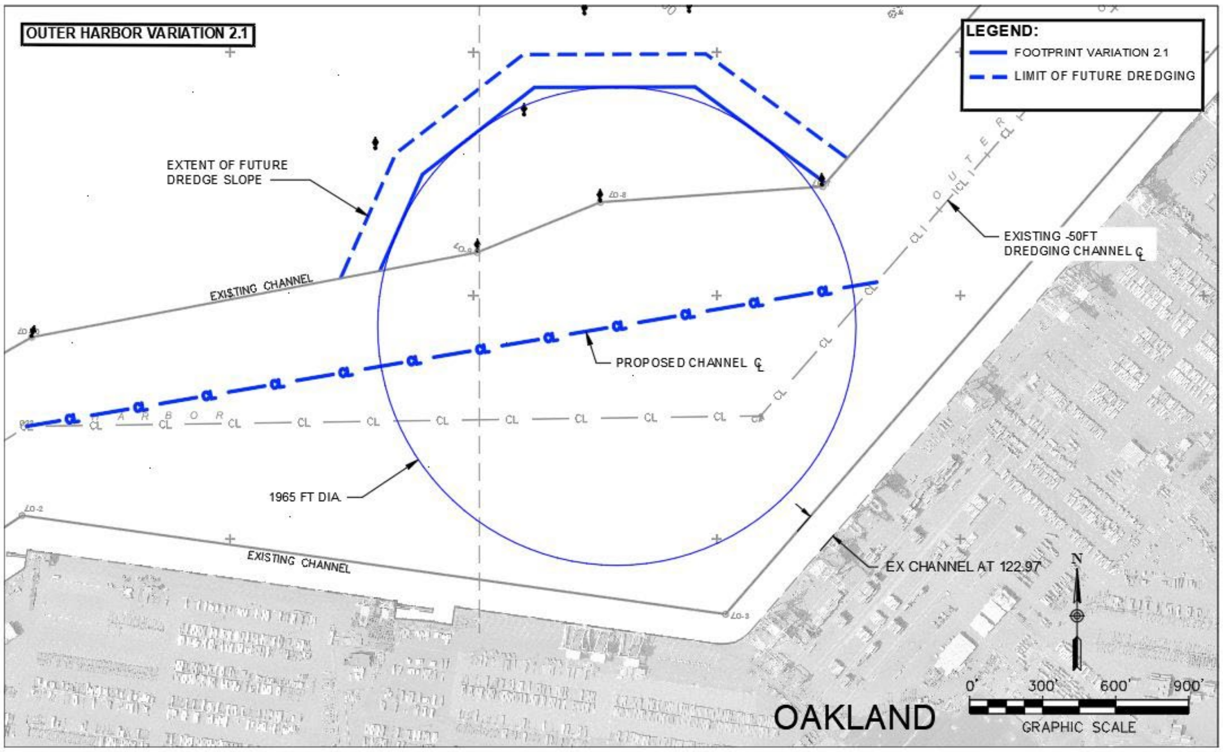

Figure 23: Variation 2.1 for Outer Harbor (TSP, preferred plan)

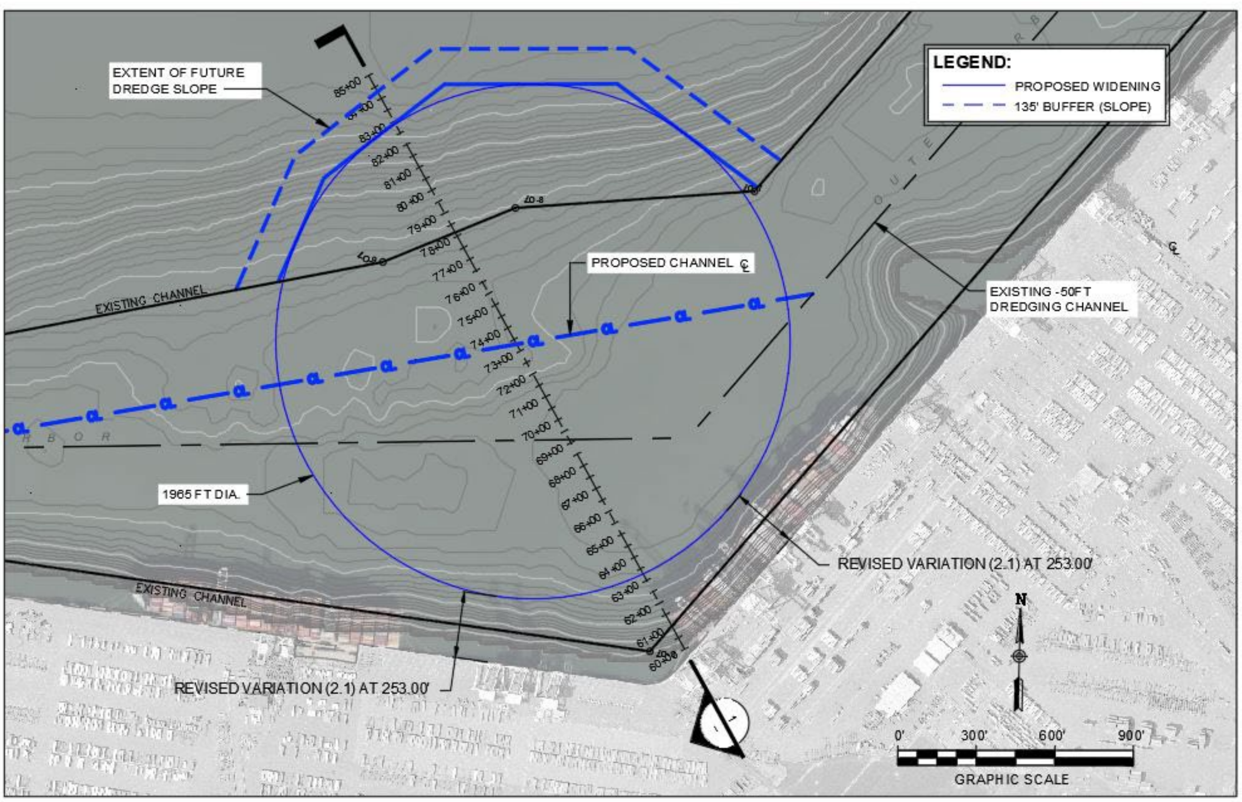

Figure 24: Outer Harbor Plan View for Cross Sections, Stationing

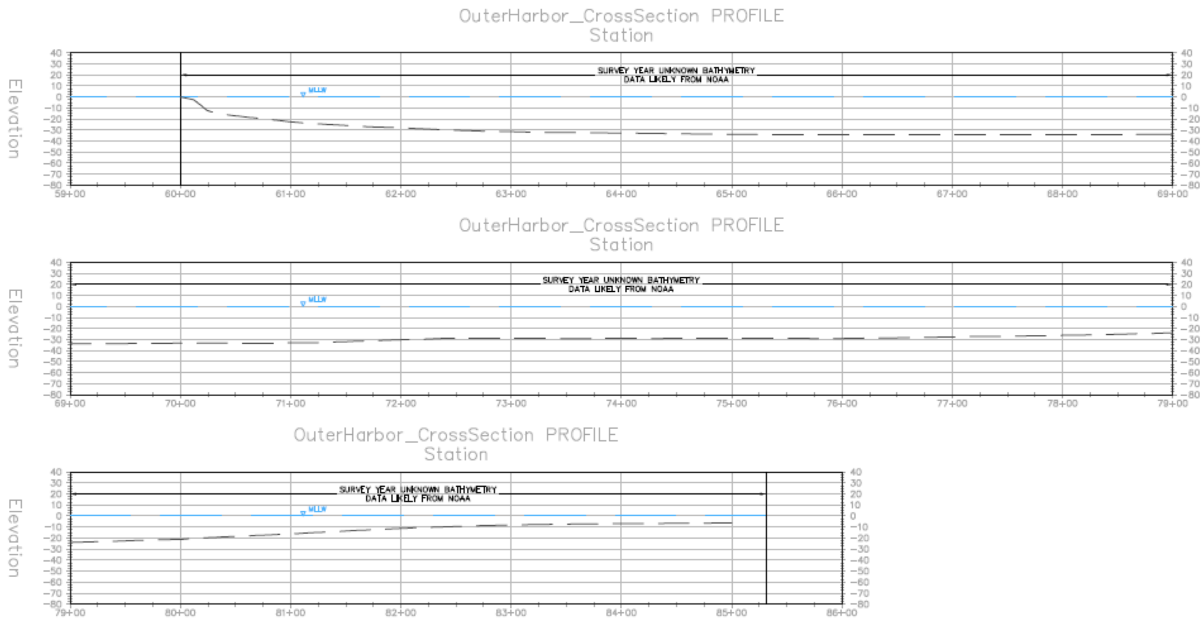

Figure 25: Outer Harbor Cross Sections of the Existing Grade

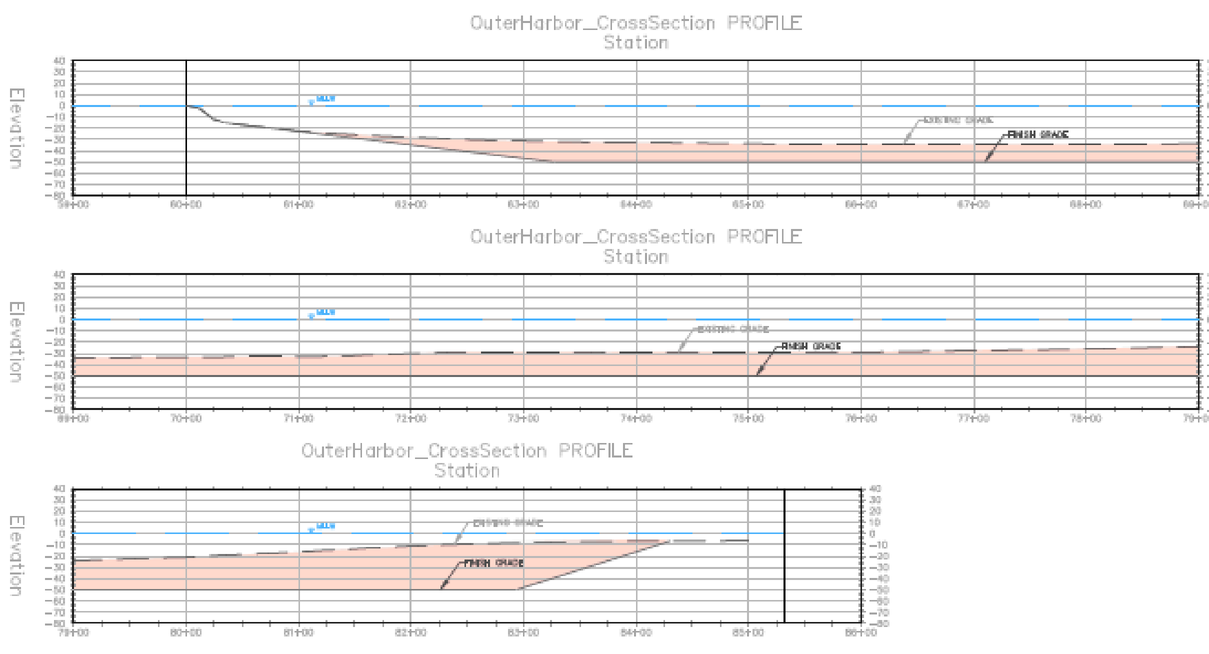

Figure 26: Outer Harbor Demolition Plan

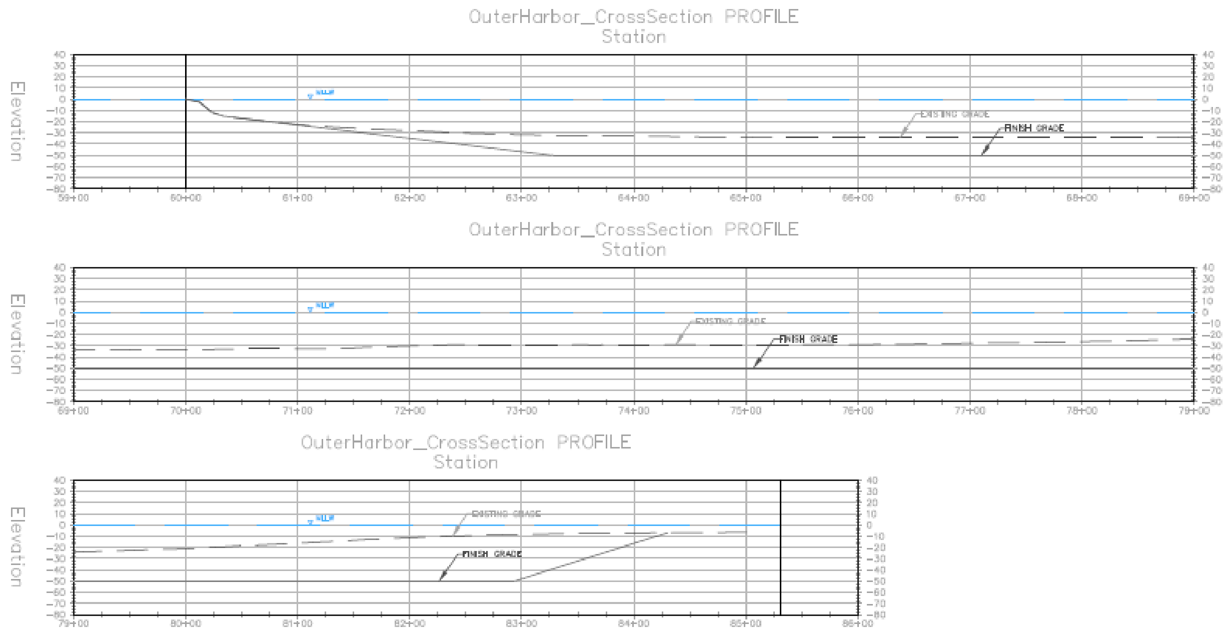

Figure 27: Proposed Design Plan

7. Eliminated Alternatives

Refer to the Plan Formulation Appendix for discussion of the numerous alternatives that were considered and eliminated.

8. Quantity Estimates

8.1. Existing Bathymetry

Using past topographic and bathymetric surveys, dredging plans, and geotechnical investigation reports, cross sections were created of the existing grade for each impacted area of the inner harbor and outer harbor. Figures 14, 18, 22 and 26 show the cross sections of the existing grade in the impacted area of the project. Note that the cross section from the closest location in 1999 SCI Investigation Report was used to create the existing grade. A typical cross section in Phase 3E Dredge Plan was used in creating the existing grade.

The cross sections of the existing grade, along with field verification, assumptions, and professional judgment were used to estimate the quantities for the project. In the next phase of the study, topographic and bathymetric surveys are recommended to be performed to update the existing grade.

8.2 Field Verification of Existing Condition

The existing conditions for the quantity estimates (such as existing bulkheads, types of pavement, etc.) were verified during the reconnaissance on 24 August 2021.

8.3 Estimate Assumptions

The volume calculation for the area without existing survey is based on the closest cross sections from 1999 SCI Geotechnical Investigation report, 3:1 slope assumption for sediment, and professional judgment. The depths of different soil layers in the project area were assumed by working with the Port and their consultant in numerous PDT meetings (verbal and written communication). The assumptions were reviewed and compared with the Geotechnical Investigation Report from SCI (1999). The following assumptions, along with the table in Attachment II, were provided by the Port of Oakland on 24 May 2021.

Howard Terminal:

- Top 15' (Below Ground Surface (BGS) to lowest level of groundwater contact); Assume 90% material will require disposal at a Class II Landfill; assume the remaining 10% of material requires Class 1 Landfill disposal.
- 15' BGS to contact with Old Bay Mud/Merritt Sand/Posey Formation (OBM/MS) Suitable for Wetland Non-Cover (Montezuma Wetlands).
- Below contact point with OBM/MS, suitable for any reuse (wetland cover, construction, ocean disposal)
- Groundwater can be released to the Bay during construction unless the historic sheet pile wall behind the wharf is breeched for construction. In that case, groundwater will require treatment prior to release to the Bay (or alternative disposal). Further, the new bulkhead will need to be constructed to prevent discharges to the Bay unless the groundwater is completely remediated.

Alameda:

- Top 15' BGS to lowest level of groundwater contact: Assume 95% material will require disposal at a Class II Landfill and 5% of the volume will require Class I landfill disposal.
- 15' BGS to contact with OBM/MS Suitable for Wetland Non-Cover (Montezuma Wetlands).
- Below contact point with OBM/MS, suitable for any reuse (wetland cover, construction, ocean disposal).
- Groundwater can be released to the Bay during construction.

Schnitzer Steel:

- Assume 75% of the volume of the soil down to 15' BGS requires Class II landfill disposal and 25% requires Class I disposal.
- Material from 15' BGS to contact with OBM/MS will need Class II landfill disposal.
- OBM/MS suitable for any reuse or disposal.
- Groundwater within the site liner will require treatment and off-site disposal. Groundwater below monitoring wells can be discharged to the Bay.
- Any bulkhead will need to be designed to meet environmental mitigation needs (contain and possibly treat groundwater).

All Exposed Inner Harbor Sediments (currently not under land):

- Young Bay Mud (and Recent Bay Mud) acceptable as Wetland Non-Cover at Montezuma Wetlands.
- OBM/MS Suitable for any reuse.
- For the basin area between Schnitzer and Howard Terminal assume 20% of the volume excavated between Schnitzer and Howard require Class II disposal. That is, this material will require placement at Berth 10 – dredge rehandling site – for drying prior to landfill disposal.

All Exposed Outer Harbor Sediments (currently not under land):

- Young Bay Mud (and Recent Bay Mud) acceptable as Wetland Non-Cover at Montezuma Wetlands.
- OBM/MS Suitable for any reuse.

From these assumptions, along with meetings with the Port, the depths for the volume calculation in each location of the inner harbor are presented in the Table 3 to Table 5.

Table 3: Howard Terminal Soil Depth

Howard Terminal

Type of Soil (Fast Land Side)	Depth (ft)
Class II (Excavation), 90%	15.30
Class I (Excavation), 10%	1.70
OBM/MS Formation (Dredging)	30.00
Below OBM/MS (Dredging)	15.00

Table 4: Alameda Soil Depth

Alameda

Type of Soil (Fast Land Side)	Depth (ft)
Class II (Excavation), 95%	16.15
Class I (Excavation), 5%	0.85
OBM/MS Formation (Dredging)	30.00
Below OBM/MS (Dredging)	15.00

Table 5: Schnitzer Steel Soil Depth

Schnitzer Steel

Type of Soil (Fast Land Side)	Depth (ft)
Class II (Excavation), 75%	12.75
Class I (Excavation), 25%	4.25
OBM/MS Formation (Class II) (Dredging)	20.00
Below OBM/MS (Dredging)	25.00

Other assumptions include:

- Land-impacted areas (Howard, Alameda and Schnitzer) were calculated using AutoCAD, and they are within ±20% accuracy.
- Length of the existing sheet removal and bulkhead installation were calculated using AutoCAD and contingency to reflect the early phase of investigation.

8.4 Quantity Estimates for Inner Harbor

The quantities for the inner harbor are separated in different tables (Table 6 to Table 10).

Table 6: Demolition and Construction Quantities for Inner Harbor

Demolition and Construction		
Activity	**Qty**	**Unit**
Demo (Pavement Removal)	17,346	CY
Demo (Pile Removal, Howard)	798	EA
Demo (Pile Removal, Alameda)	4,188	EA
Demo (Batter Pile Removal)	54	EA
Existing Sheet Pile Removal	897	LF
Bulkhead Installation (Land side)	2,375	LF
Rip Rap Installation	26,054	CY
Bulkhead Installation (In-water)	534	LF
Batter Pile Installation (Howard & Alameda)	243	EA
Batter Pile Installation (In-water)	55	EA

Table 7: Soil Volumes for Disposal from Howard Terminal

Type of Soil (Fast Land Side)	Vol (CY)
Class II (Excavation)	22,362
Class I (Excavation)	2,485
Fill (Below 15’)	47,766
Rock Dike	60,077
OBM/MS Foundation (Dredging)	136,304

Table 8: Soil Volumes for Disposal from Alameda

Type of Soil (Fast Land Side)	Vol (CY)
Class II (Excavation)	151,875
Class I (Excavation)	7,993
Rip Rap	13,472
Young Bay Mud (YBM)	266,447
Below OBM/MS (Dredging)	213,158

Table 9: Sediment Volume for Disposal in Inner Harbor

All Exposed Inner Harbor Sediments

Type of Sediment (Water Side) (Dredging)	Volume (CY)
Schnitzer in front of prop wall (80%)	11,996
Schnitzer in front of prop wall (20%)	2,999
Btw Schnitzer & Howard (80%)	26,762
Btw Schnitzer & Howard (20%)	6,691
OBM/MS North of Channel (Dredging)	84,509
Alameda	10,335

Table 10: Pile Volume for Disposal, all sites

Howard Terminal (Precast Concrete) Pile Removal

Number of Piles	Length of Piles (ft)	Width (in)	Total Vol (CY)
798	125	24	11,593

Alameda Wharf (Precast Concrete) Pile Removal

Number of Piles	Length of Piles (ft)	Width (in)	Total Vol (CY)
4,188	65	24	31,656

Alameda Bulkhead (Steel Pipe) Pile Removal

Number of Piles	Length of Piles (ft)	Diameter (in)	Total Vol (CY)
54	115	24	722

Using the information provided by the Port and the estimated quantities, Table 11 presents the quantities of material for each disposal site.

Table 11: Volume of Material to Disposal Site for Inner Harbor

Inner Harbor

Material Type	Volume (CY)	Disposal Location
Debris/Concrete	124,375	Recycler
Debris/Concrete	82,561	Montezuma (upland)
Class II Landfill	187,281	Keller Canyon
Class I Landfill	10,851	Kettleman Hills
YBM (Young Bay Mud)	370,472	Montezuma (non-cover)
Below (OBM/MS)	156,750	Montezuma (cover)
Old Bay Mud (OBM/MS)	297,667	Any Re-Use

8.5 Estimates for Outer Harbor

Using the estimated quantities and the information provided by the Port, Table 11 shows the quantities of material for each of the disposal site for the outer harbor.

Table 12: Volume of Material to Disposal Site for Outer Harbor

Outer Harbor

Material Type	Volume (CY)	Disposal Location
YBM (Young Bay Mud)	1,341,853	Montezuma (non-cover)

9. Construction

9.1. Construction Phasing

Using the assumptions above, the construction phasing was created for each impacted area of the project (Tables 13 to 17). See related Attachment I, Construction and Dredging Schedule.

Table 13: Howard Terminal Construction Phasing

Howard Terminal

Item No.	Project Item	QTY		Crew No.	Working Days
01H	Concrete Pavement Removal Area	12,780	SY	1	13
02H	Sheetpile/ Bulkhead Installation	42,250	SF	1	121
06H	Howard Pile Removal Activity	300	EA	1	33
10H	Pile Hauling	300	EA	1	17
03H	Land Excavation	72,407	CY	1	48
04H	Hauling	72,407	CY	1	48
05H	Anchor/ Tie back Installation	1,300	LF	1	4
07H	Sheetpile/ Bulkhead Removal	58,500	SF	1	59
08H	Dredging	191,667	CY	1	27

Table 14: Alameda Construction Phasing

Alameda (Wharf Property)

Item No.	Project Item	QTY		Crew No.	Working Days
09A	Warehouse Demo Activity	260,000	SF	1	26
01A	Concrete Pavement Removal Area	24,000	SY	1	24
02A	Sheetpile/ Bulkhead Installation	68,250	SF	1	195
03A	Land Excavation	135,370	CY	1	90
04A	Hauling	135,370	CY	1	90
06A	Alameda Pile Removal Activity	2,300	EA	1	128
10A	Pile Hauling	2,300	EA	1	128
05A	Anchor/ Tie back Installation	2,100	LF	1	7
06A	Sheetpile/ Bulkhead Removal	81,250	SF	1	81
07A	Dredging	358,333	CY	1	51

Table 15: Schnitzer Steel Construction Phasing

Schnitzer Steel					
Item No.	Project Item	QTY		Crew No.	Working Days
01S-W	Bulkhead Installation - In Water	23,100	SF	1	33
02S-W	Batter Pile Installation - In Water	2,361	LF	1	5
03S-W	Rip Rap Installation	5,997	CY	1	19

Table 16: All Exposed Inner Harbor Sediments Construction Phasing

All Exposed Inner Harbor Sediments (Dredging)					
Item No.	Project Item	QTY		Crew No.	Working Days
07IN	Dredging	143,291	CY	1	24
11IN	Berth 10: Class II Loading	9,690	CY	1	2
12IN	Hauling (Berth 10)	9,690	CY	1	13

Table 17: Outer Harbor Sediment Construction Phasing

Outer Harbor Sediment Dredging					
Item No.	Project Item	QTY		Crew No.	Working Days
07OH	Dredging - YBM	1,341,853	CY	1	224

9.2. Construction and Dredging Schedule

The construction and dredging schedule were created using the assumptions in Section 8.1. The schedules are shown in Attachment I.

9.3. Disclaimer

The equipment, labor and production rate assumptions were created using past construction experience from SPN PDT. The construction schedule for the NEPA analyses is created from the equipment, labor, and production rate assumptions. A dredging schedule is also created. The schedules are developed using professional judgment. Construction means and methods are usually developed by the Contractor. The level of detail is high level and only appropriate for NEPA analyses. The schedules are subject to change at the time of construction.

10. Further Analysis and Design Development Needs

To meet budget constraints, no new data were collected for analysis during the feasibility study. Limited data from the prior harbor deepening study, discussions with the Port, and professional judgment were used for the analysis. While this is acceptable in the feasibility phase, suggested data collection and analysis to be conducted during the PED phase are discussed below.

10.1. Topographic & Bathymetric Survey

Topographic and bathymetric surveys are recommended in the areas without any survey. Also, surveys are recommended in the entire project area to refine the cost, since the surveys used in the feasibility study are outdated.

10.2. Soil Testing

Soil testing is recommended to refine the quantities of different types of soil and sediment, including contaminated soil, in the project areas.

10.3. Utility Survey

Utility survey is needed for construction plans and specifications.

10.4. Ship Simulation

Because the proposed footprints (variations) were created using a turning basin multiplier, a ship simulation is recommended in the PED phase to verify that the proposed footprints would work in the project.

11. References

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EM 1110-2-1613 (May 2006), Hydraulic Design of Deep-Draft Navigation Projects

EM 1110-5025 (July 2015), Dredging and Dredged Material Management

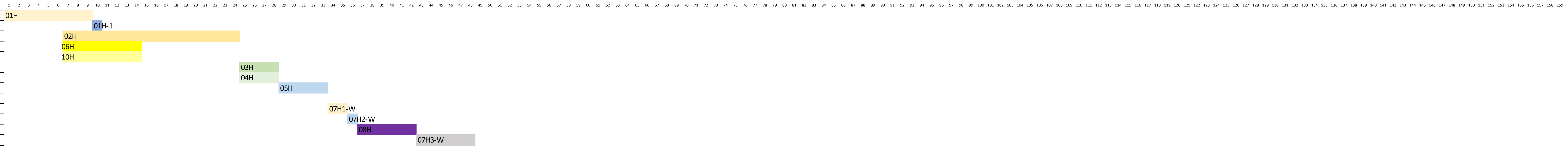
ER 1110-2-1150 (August 1999), Engineering and Design for Civil Works Projects

ER 1130-2-520 (Nov. 1996), Navigation and Dredging Operations and Maintenance Policies

Attachment I: Construction and Dredging Schedule

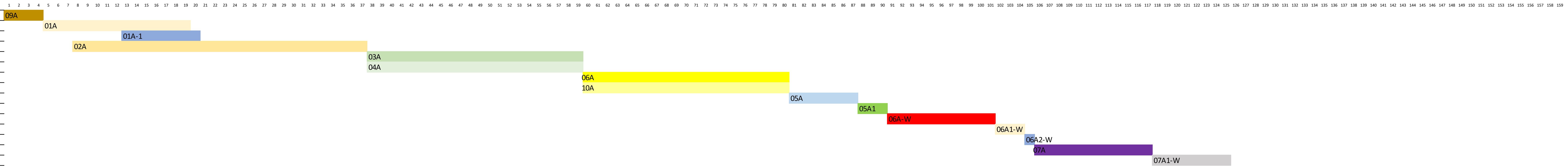
Howard Terminal

	Activity	ADJ QTY	
01H	Concrete Pavement Removal	6,689	CY
01H-1	Concrete Pavement Hauling	6,689	CY
02H	Sheetpile/ Bulkhead Installation	59,675	SF
06H	Howard Pile Removal Activity	798	EA
10H	Pile Hauling	798	EA
03H	Land Excavation	24,847	CY
04H	Hauling	24,847	CY
05H	Batter Pile Installation	10,005	LF
~~07H-W~~	~~Sheetpile/ Bulkhead Removal~~	0	
07H1-W	Bulkhead Installation - **In water**	5,968	SF
07H2-W	Batter Pile Installation - **In Water**	1,000	LF
08H	Dredging (below 15')	244,148	CY
07H3-W	Rip Rap Installation	8,361	CY



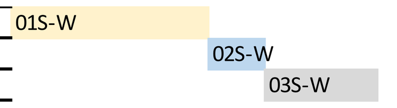
Alameda

	Activity	QTY	
09A	**Warehouse Demo Activity**	175,900	SF
01A	Concrete Pavement Removal	10,658	CY
01A-1	Concrete Pavement and Warehouse Debris Hauling	58,385	CY
02A	Sheetpile/ Bulkhead Installation	83,468	SF
03A	Land Excavation	159,868	CY
04A	Hauling	159,868	CY
06A	Alameda Pile Removal Activity	4,188	EA
10A	Pile Hauling	4,188	EA
05A	Batter Pile Installation	14,030	LF
05A1-W	Removal Existing Batter Pile	54	EA
06A-W	Sheetpile/ Bulkhead Removal	62,755	SF
06A1-W	Bulkhead Installation - **In Water**	8,347	SF
06A2-W	Batter Pile Installation - **In Water**	1,404	LF
07A	Dredging (Below 15')	493,077	CY
07A1-W	Rip Rap Installation	11,696	CY



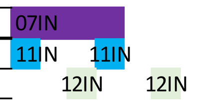
Schnitzer Steel

01S-W	Bulkhead Installation - **In Water**	23,100	SF
02S-W	Batter Pile Installation - **In Water**	2,380	LF
03S-W	Rip Rap Installation	5,997	CY



Inner Harbor Sediments

07IN	Dredging	143,291	CY
11IN	Berth 10 Class II Loading	9,690	CY
12IN	Hauling (Berth 10)	9,690	CY

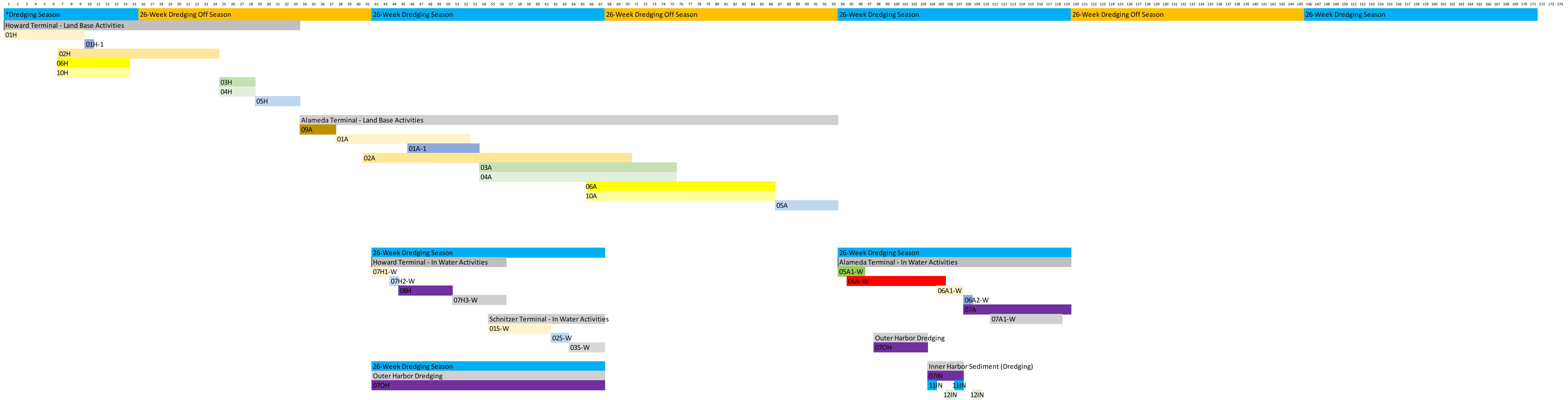


Outer Harbor

07OH	Dredging	1,341,853	CY

Turning Basin Combined Construction Schedule

*Assuming construction starts in Fall 2027



Attachment II: Oakland Harbor Turning Basins Feasibility Study

SOIL/SEDIMENT SUITABILITY ASSUMPTIONS			
Howard Terminal		**Disposal**	
	Top 15' BGS	90% Class II Landfill, 10% Class I Landfill	
	15' BGS to OBM/MS	Wetland Non-Cover	
	Below OBM/MS	SF-DODS or Wetland Cover	
Alameda		**Disposal**	
	Top 15' BGS	95% Class II Landfill, 5% Class I Landfill	
	15' BGS to OBM/MS	Wetland Non-Cover	
	Below OBM/MS	SF-DODS or Wetland Cover	
Schnitzer		**Disposal**	
	Top 15' BGS	75% Class II landfill, 25% Class I Landfill	
	15' BGS to OBM/MS	Class II Landfill	
	Below OBM/MS	SF-DODS or Wetland Cover	
All Exposed Inner Harbor Sediments		**Disposal**	
	YBM	Wetland Non-Cover	
	OBM/MS	SF-DODS or Wetland Cover	
	Basin between Schnitzer/Howard	20% Class II Disposal	
All Exposed Outer Harbor Sediments		**Disposal**	
	YBM	Wetland Non-Cover	
	OBM/MS	SF-DODS or Wetland Cover	
Notes			
	Based on information provided in 5/9/21 APEX memo and 5/21/21 AECOM memo		
	"BGS" = Below Ground Surface		
	"OBM" = Old Bay Mud		
	"MS" = Merrit Sand		
	"YBM" = Young Bay Mud		