→ Craig Lewis, PE
Melissa Burns, PE

Alaska's Critical Port Infrastructure – *Cold Region Container Terminal Replacement Safeguards*

Welcome

Presentation Agenda

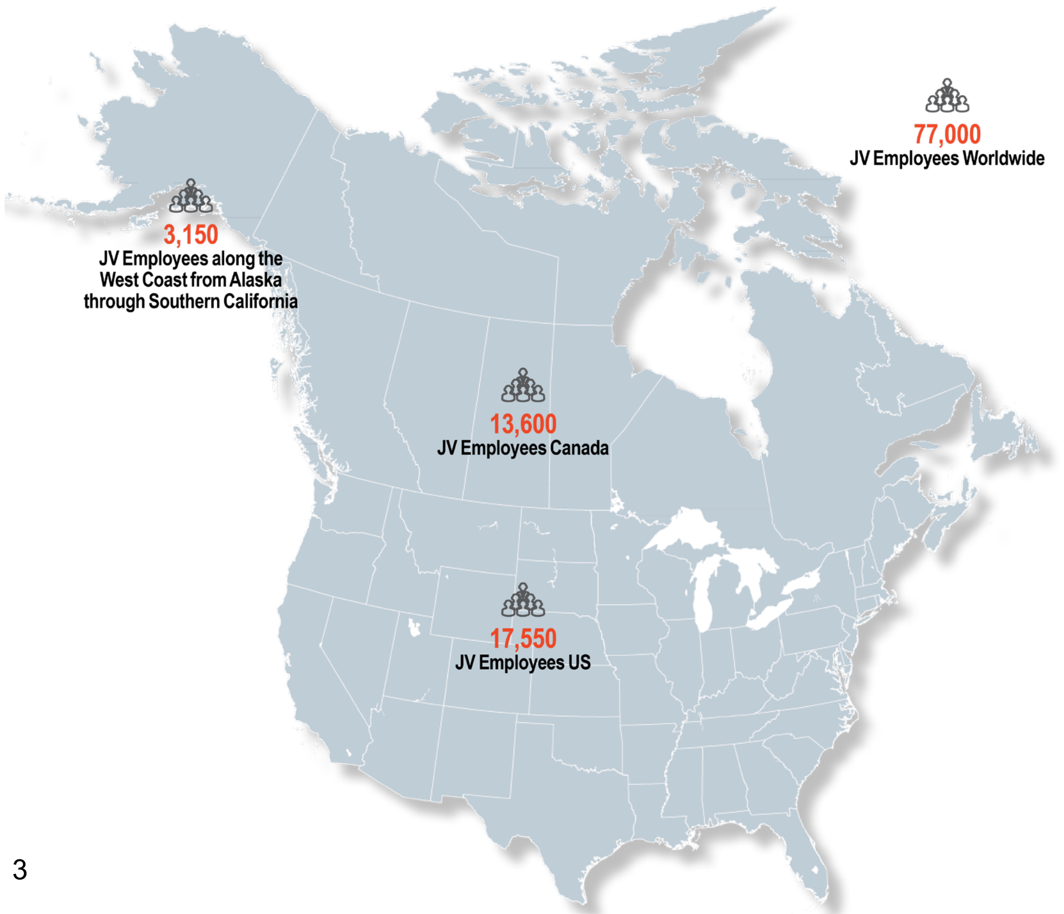
1 **Project Team**

2 **Project Background**

3 **Design Engineering Challenges & Solutions**

4 **Q&A Session**

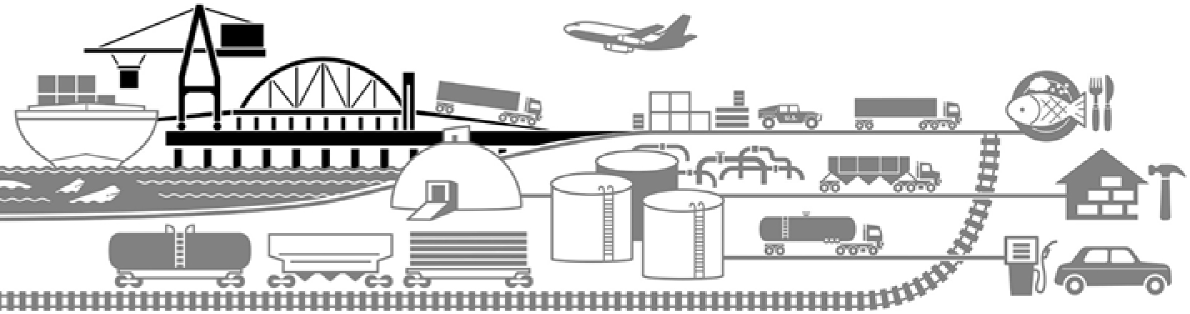
1 Project Team



- Owner: Port of Alaska
  - Port Director – Steve Ribuffo, AMPE
  - PAMP Engineering Manager - John Daley, PE
  - PAMP Program Manager - Eric Adams, PE
  - PAMP Project Manager – Doug Playter

- GHD-WSP JV
  - Project Manager – Craig Lewis, PE (GHD)
  - Deputy Project Manager – Melissa Burns, PE (GHD)
  - Marine Structural Discipline Lead – Joe Galloway, PE (WSP)
  - Electrical Discipline Lead – Rick Guggiana, PE (GHD)
  - Civil Discipline Lead – Josh Voecks, PE (WSP)
  - Corrosion Discipline Lead – Craig Stuart, PE (GHD)
  - Geotech Discipline Lead – John Thornley, PE (WSP)
  - Fire Prot. Discipline Lead – Ron Mahlman, PE (GHD)
  - Dredge Discipline Lead – Craig Dengate (GHD)
  - Water Lead – Matt Edge, PE (CRW)
  - Building Lead – Jason Arnold, AIA (RIM/GHD)
  - Petroleum Lead – Aaron Athanas (KRC)
  - Environmental Discipline Lead – Kate Lomac-Macnair (OwlRidge)
  - Ice Engineering Lead – Gary Van Der Vinnie (NHS)

2 Project Background



- **Project Objective:**
  - Design the replacement of the Port of Anchorage’s Terminal 1 Berth, located in Anchorage, Alaska. Design replaces the existing terminal 140 feet seaward and consists of a seismically capable structure improving berthing safety, sedimentation impact, and allows construction of the new terminal while existing terminals remain operational.

- **Critical infrastructure**
  - State of Alaska’s primary inbound cargo facility:
    - Moves goods handled by 90% of the state’s population
    - Accounts for more than 90% of the vans and containers shipped to Southcentral Alaska Ports
    - Accounts for 75% of all non-petroleum marine cargo shipped to Alaska
    - Accounts for 50% of all freight shipped to Alaska, by all modes
    - 5.2M tons of fuel and cargo in 2022
    - Supports $14B in commercial activity in Alaska as a freight and fuel distribution center in 2019

References: About Port of Alaska | Don Young Port of Alaska

2 Project Background

- **Critical infrastructure: Food security**
  - 95% of the food Alaskans purchase is imported
  - Most grocery stores only have a food supply that will last about one-week
  - Port of Alaska handles more than 3.5M tons of food and other consumable goods
  - The Port's freight distribution reached approximately 660,000 Alaskans in more than 150 communities
- **A failure of the Port Terminals would severely harm Alaska's import supply chain and access to food throughout the state**
  - The existing terminal 1 was constructed +55 years ago and is nearing end of its operational life
  - During recent inspections, the majority of structural piling damage was categorized as either "major" or "severe" indicating extreme structural vulnerability

New Cargo Terminal = Food security

 References: Contractors – POA Modernization

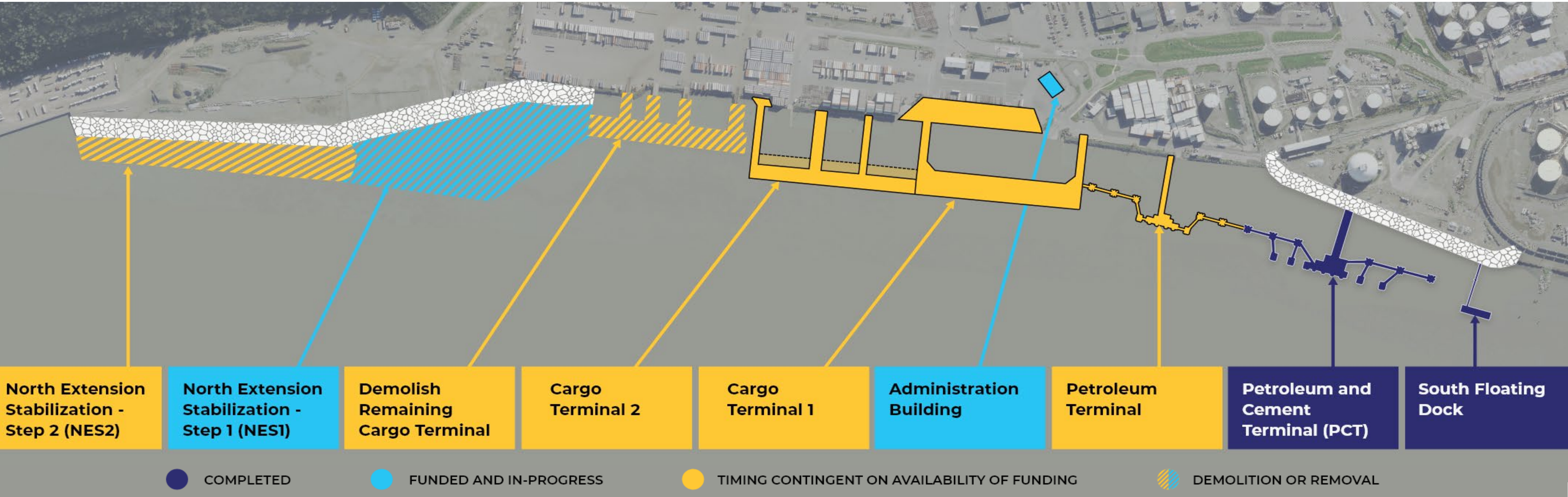
2 Project Background

- **Project History:**
  - Port of Alaska Modernization Program (PAMP) created in 2014 to provide four new terminals via a phased program (8 individual projects)
  - The Terminal 1 replacement a portion of one of these large projects in the program
  - Terminal 1 replaces the existing cargo terminal facility and will support cargo operations, military deployments, and cruise operations

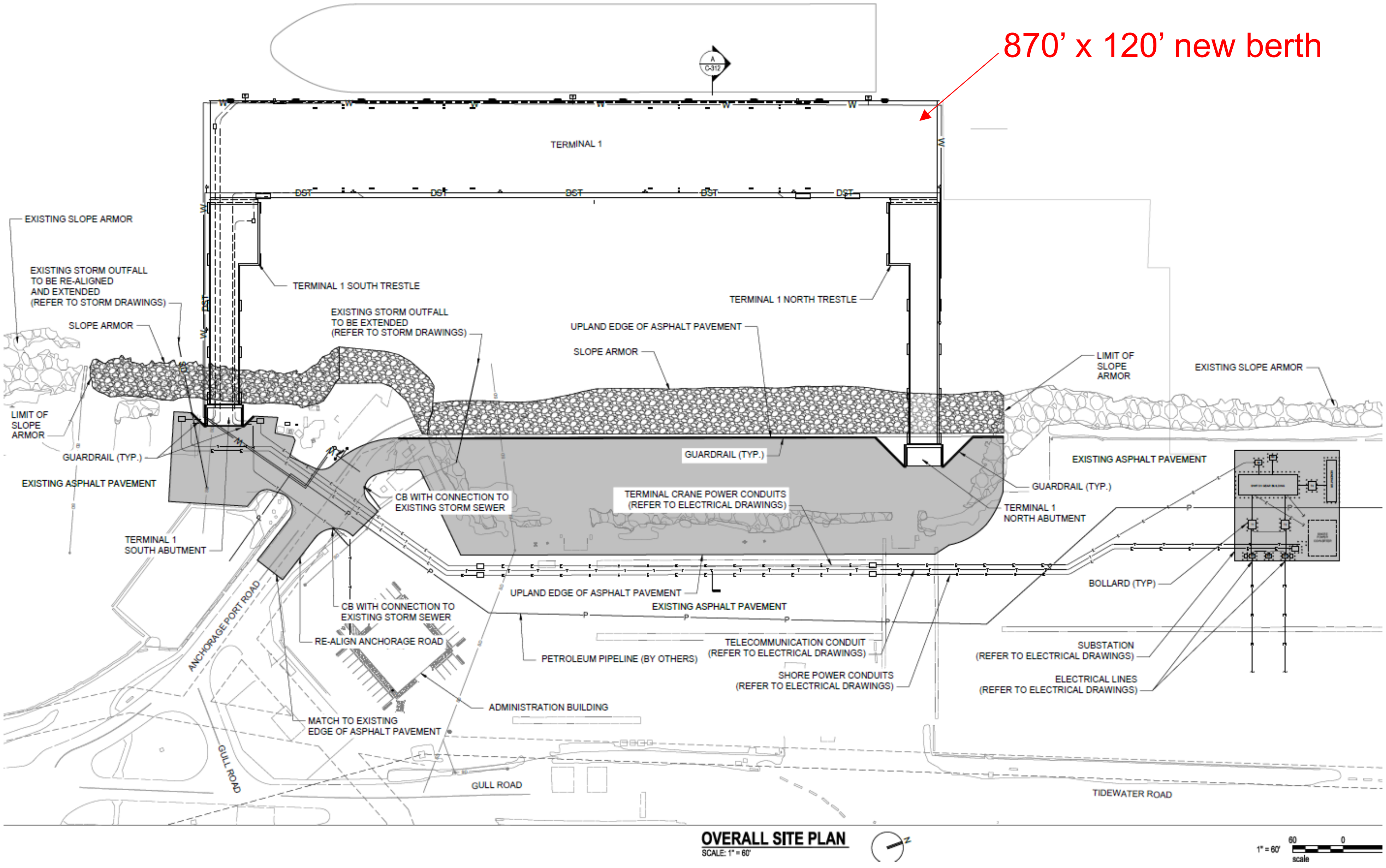
- **Stakeholders:**
  - Matson
  - TOTE
  - Cruise
  - Oil & Gas
  - Additional Port user groups

- **Timeline:**
  - 2022 Concept Design
  - 2024 IFC Design (GHD-WSP JV)
  - 2025 Construction bid-phase

- **Funding:**
  - Combination of Federal & State grants, POA Funds, low interest rate federal loan and Port Revenue Bonds



2 Project Background



References: Projects – POA Modernization

3 Design and Engineering Challenges

- **Major Operational Design Requirements:**
  - Lift on/off container terminal (gantry crane), also to support military and cruise operations
  - Designated Seismic Berth
  - Terminal Structure – 75 year design life

- **Major design considerations:**
  - Environment
  - Siltation Rate
  - Construction phasing
  - Geotechnical Constraints
  - Seismic operability requirements
  - Extremely corrosive environment
  - Navigation & Berthing
  - Utilities

References: *Projects – POA Modernization*

3 Design and Engineering Challenges: Environment

- **Ice Floes** – schedule limitation to only 6-months of in-water work in the construction season.
  - Typically late April to late October, fluctuates annually
- **Earthquakes –** One of the most seismically active regions in the world
- **Tidal fluctuation** – 40-feet tidal ranges dictate robust and adjustable anchoring systems for working vessels, both in construction and dictating design
- **Beluga Whale & Harbor Seal**– Endangered Cook Inlet Beluga While requires special operations and restricts design flexibility and limits construction methods
  - Construction must stop if species enters zone of disturbance
  - Limited number of incidents per project- possibility of stopping work indefinitely if not compliant
  - Construction methodology to lessen sound installation- bubble curtains and large diameter piles
- **Corrosion –** As an extremely aggressive environment, normal corrosion mixed with continually abrasive ice collection, floes, and seasonal siltation lends to an extremely susceptible structural system to weakening by corrosion. Robust prevention system must be in place from day 1.

The Terminal 1 replacement project is the very rare case that an extremely similar project was completed adjacent in the past 5 years to improve upon innovation in design and construction methods within the extreme environment!

Construction Marine Mammal Observers

Image Reference Environment – POA Modernization

3 Design and Engineering Challenges: Construction Phasing

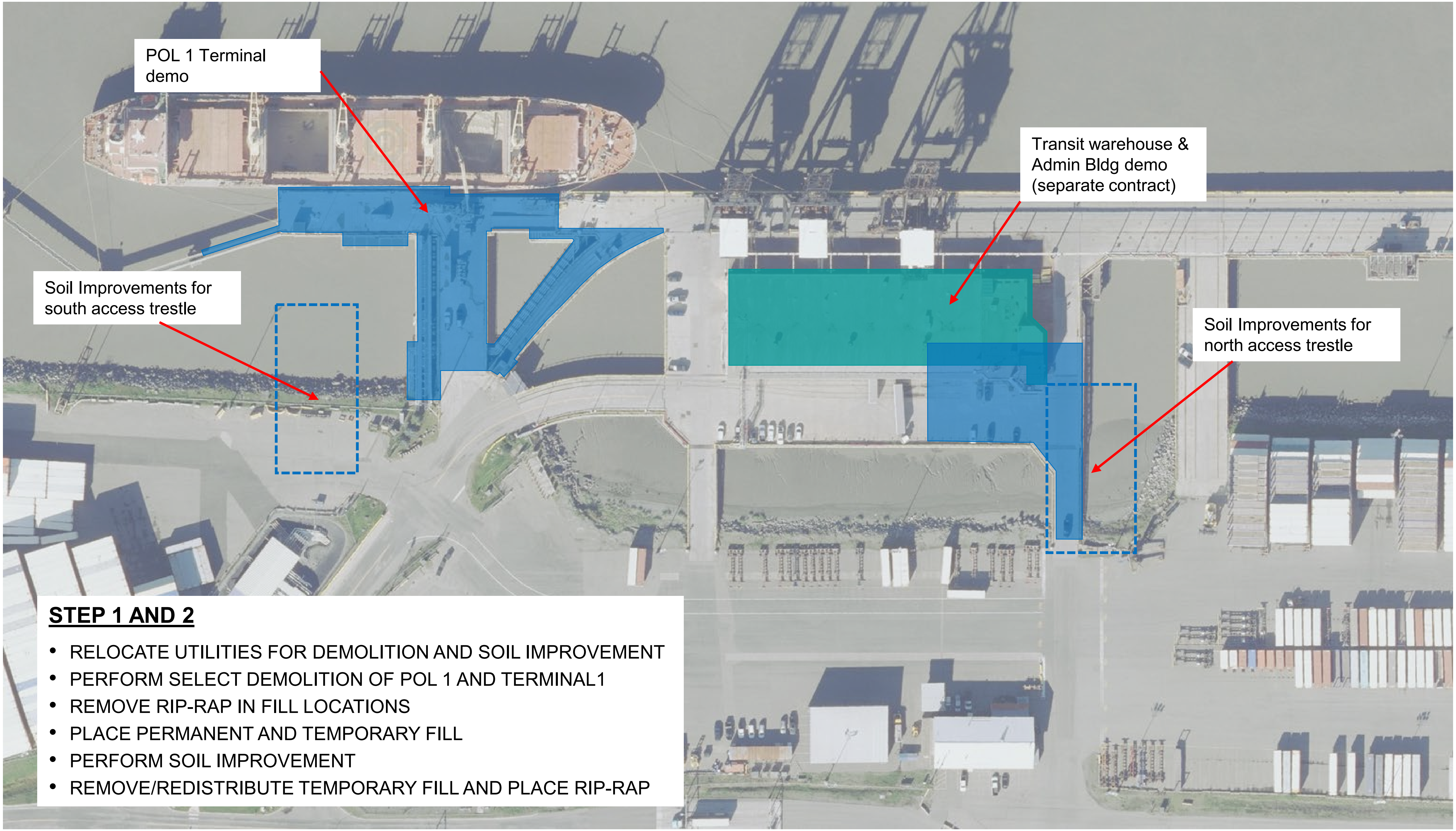
 References: Projects – POA Modernization

3 Design and Engineering Challenges: Construction Phasing

- **Driver: Continual site operability during construction**
  - Design was dictated by construction to minimize site work
  - Very large precast components to be fabricated offsite, installed, closed
  - Larger piles = longer spans, less piles, less in water work
  - Consideration of future projects: tie in to Terminal 2, future redundancy

- Design considered winter shutdown in construction and partially constructed phases
- Commissioning required consideration of partially operational phases
- Complex construction and port operation movements to consider
- Normal operative maintenance, such as dredging, must still occur to keep berths operable

References: Projects – POA Modernization

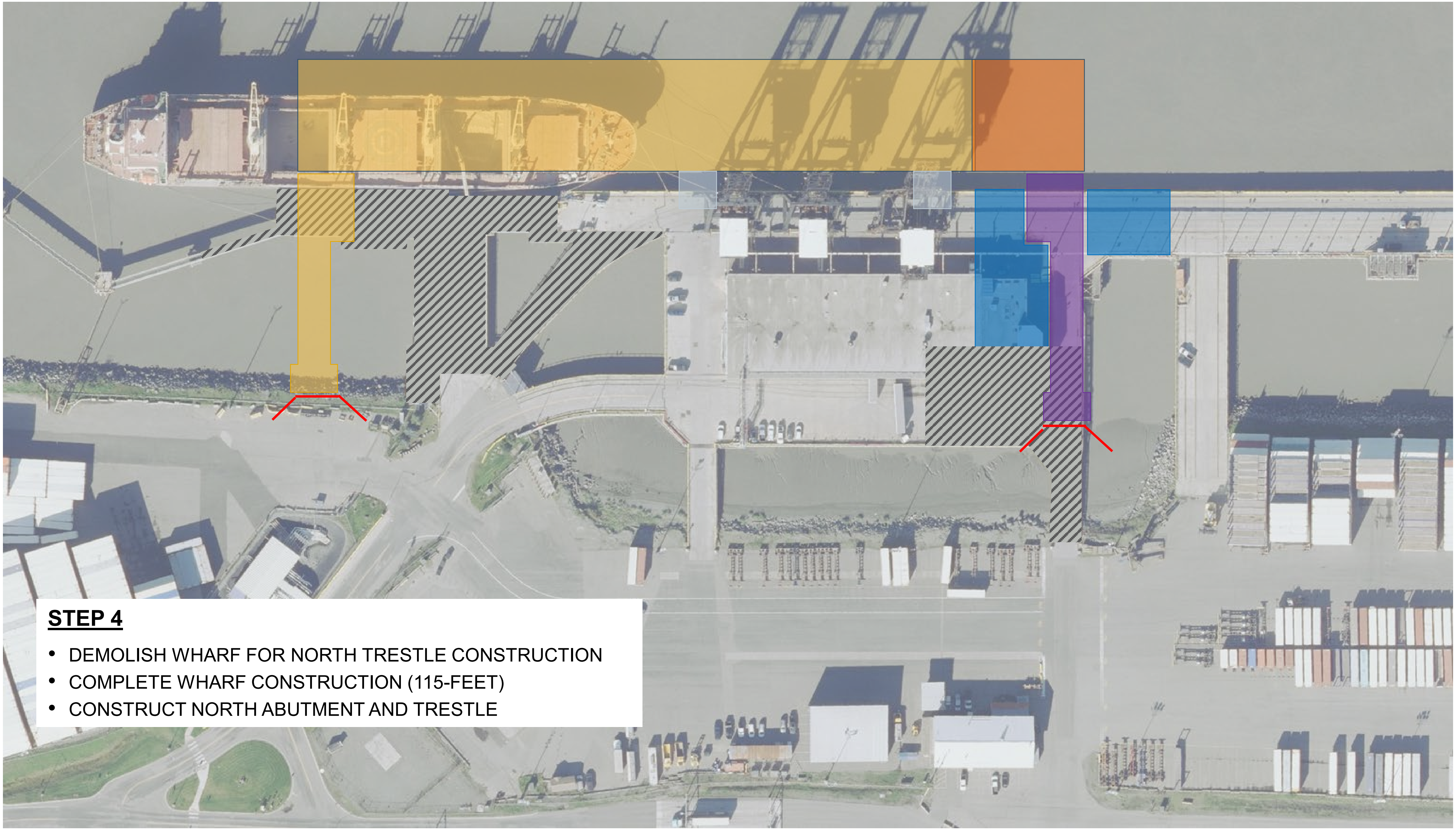


STEP 1 AND 2

- RELOCATE UTILITIES FOR DEMOLITION AND SOIL IMPROVEMENT
- PERFORM SELECT DEMOLITION OF POL 1 AND TERMINAL1
- REMOVE RIP-RAP IN FILL LOCATIONS
- PLACE PERMANENT AND TEMPORARY FILL
- PERFORM SOIL IMPROVEMENT
- REMOVE/REDISTRIBUTE TEMPORARY FILL AND PLACE RIP-RAP

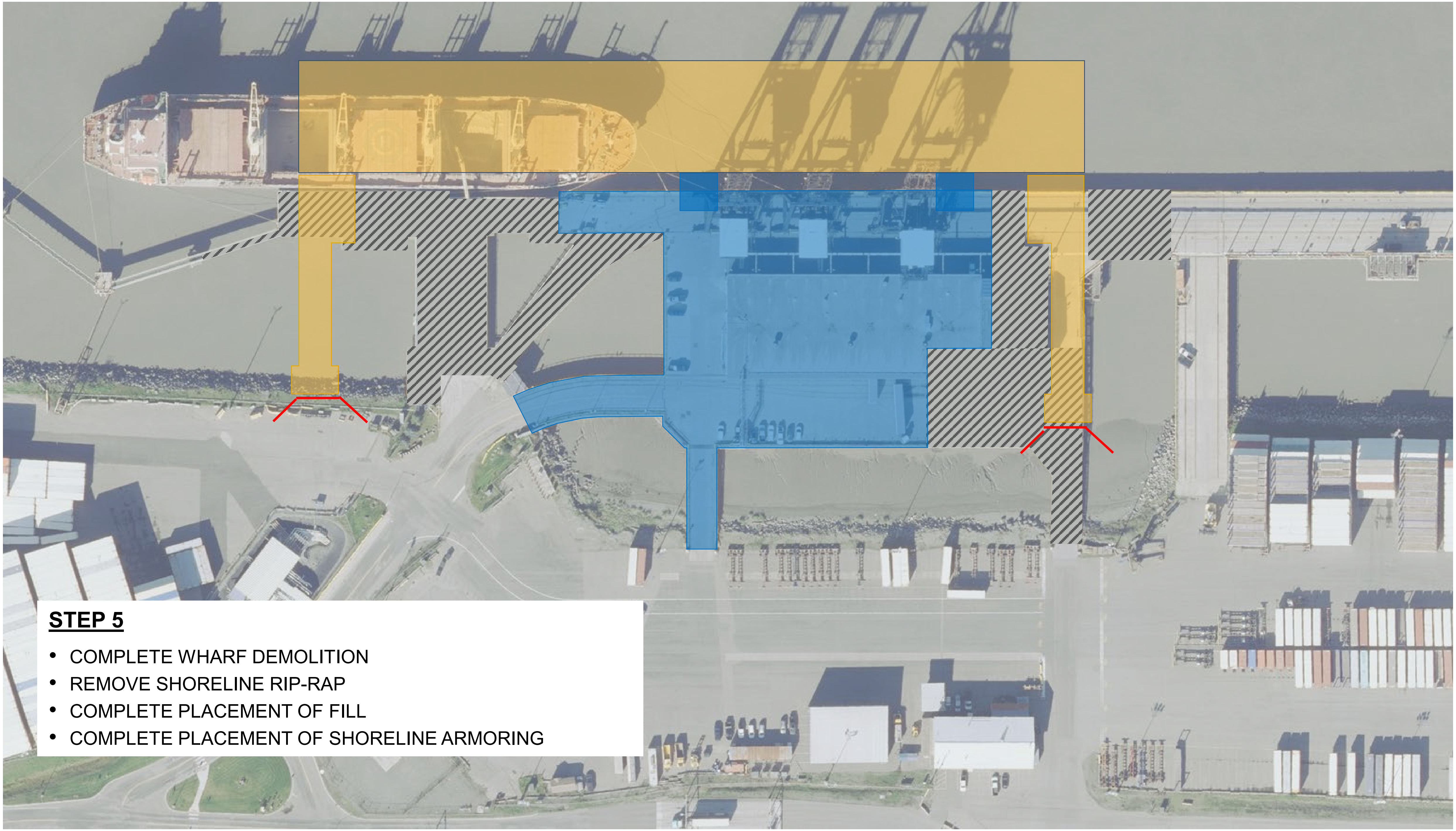
STEP 3

- CONSTRUCT SOUTH ABUTMENT, TRESTLE AND WHARF (755-FEET)
- CONSTRUCT SOUTH DOLPHIN AND CATWALK
- INSTALL TEMPORARY TRANSFER SPANS
- TERMINAL1 WHARF WILL BE CAPABLE OF RECEIVING STS CRANES AT END OF STEP 3



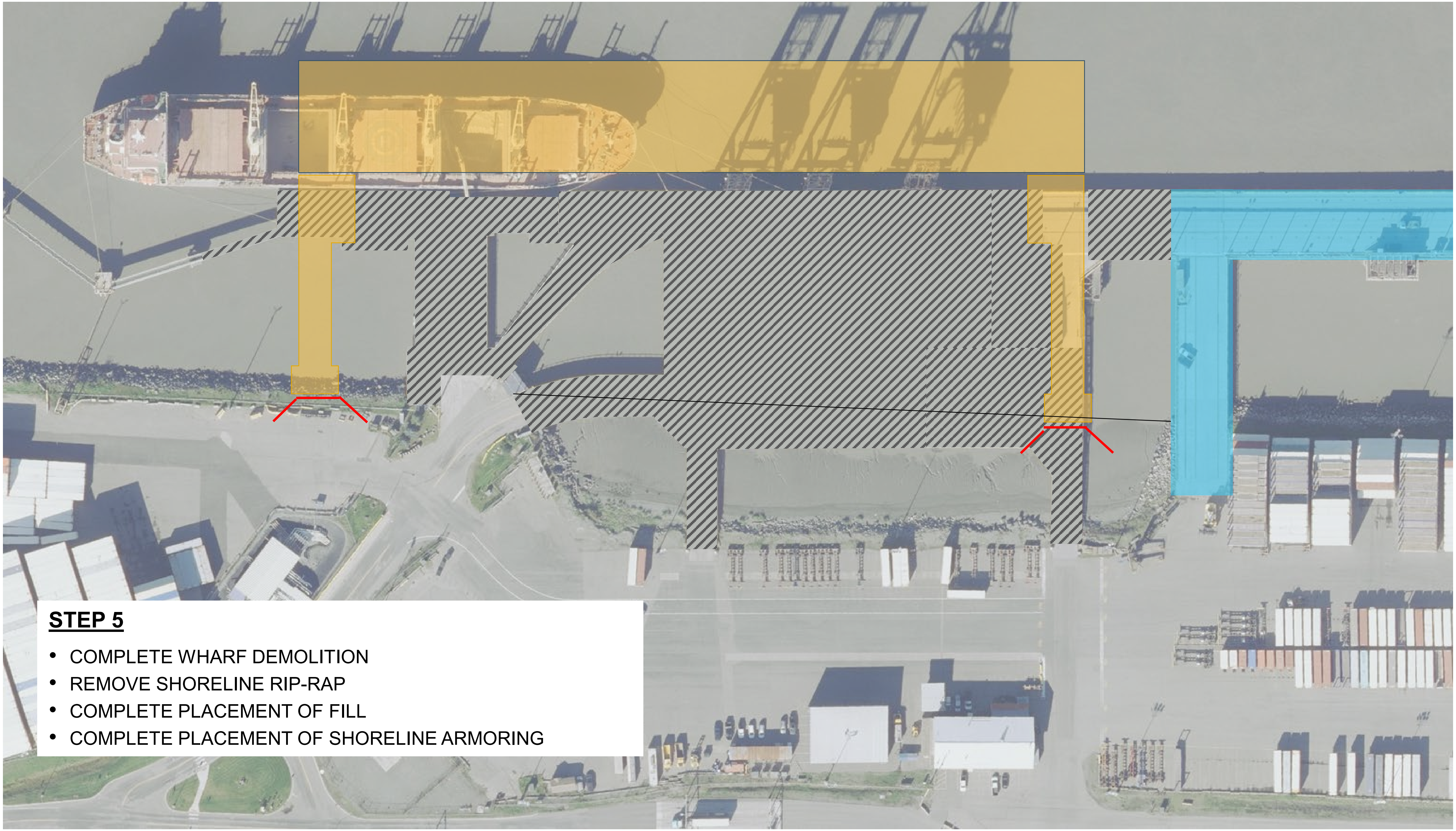
STEP 4

- DEMOLISH WHARF FOR NORTH TRESTLE CONSTRUCTION
- COMPLETE WHARF CONSTRUCTION (115-FEET)
- CONSTRUCT NORTH ABUTMENT AND TRESTLE



STEP 5

- COMPLETE WHARF DEMOLITION
- REMOVE SHORELINE RIP-RAP
- COMPLETE PLACEMENT OF FILL
- COMPLETE PLACEMENT OF SHORELINE ARMORING



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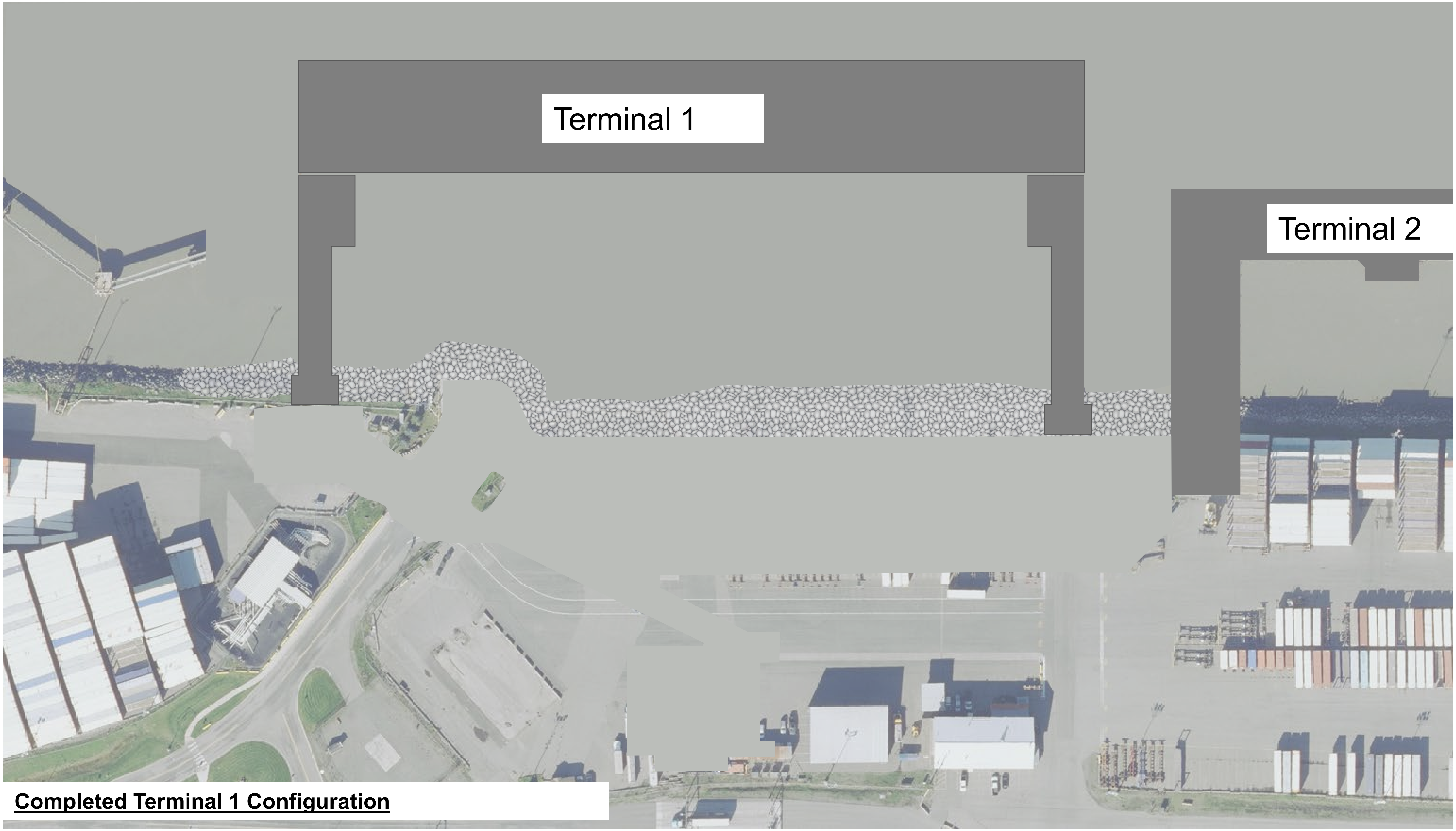
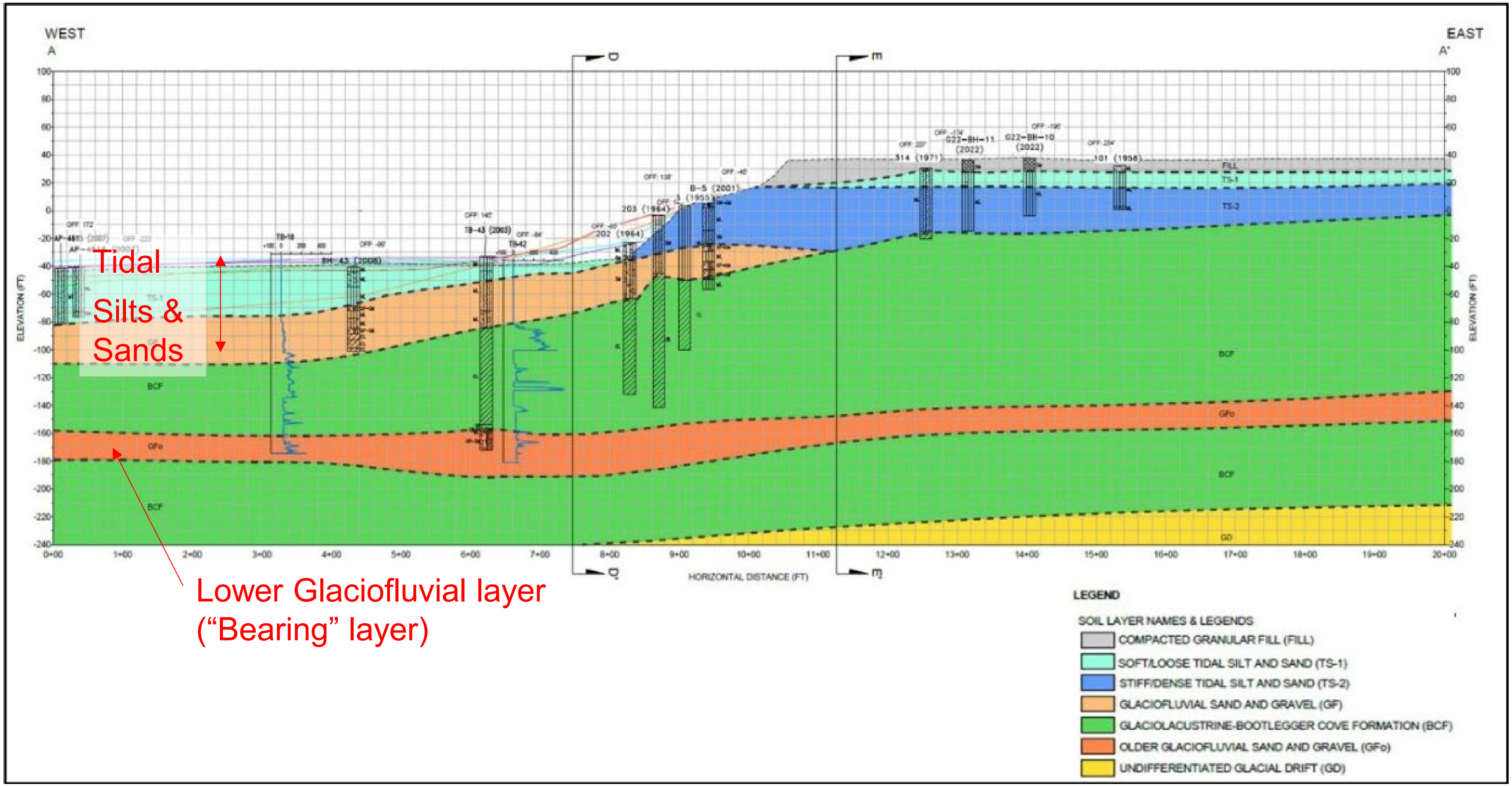


Completed Terminal 1 Configuration

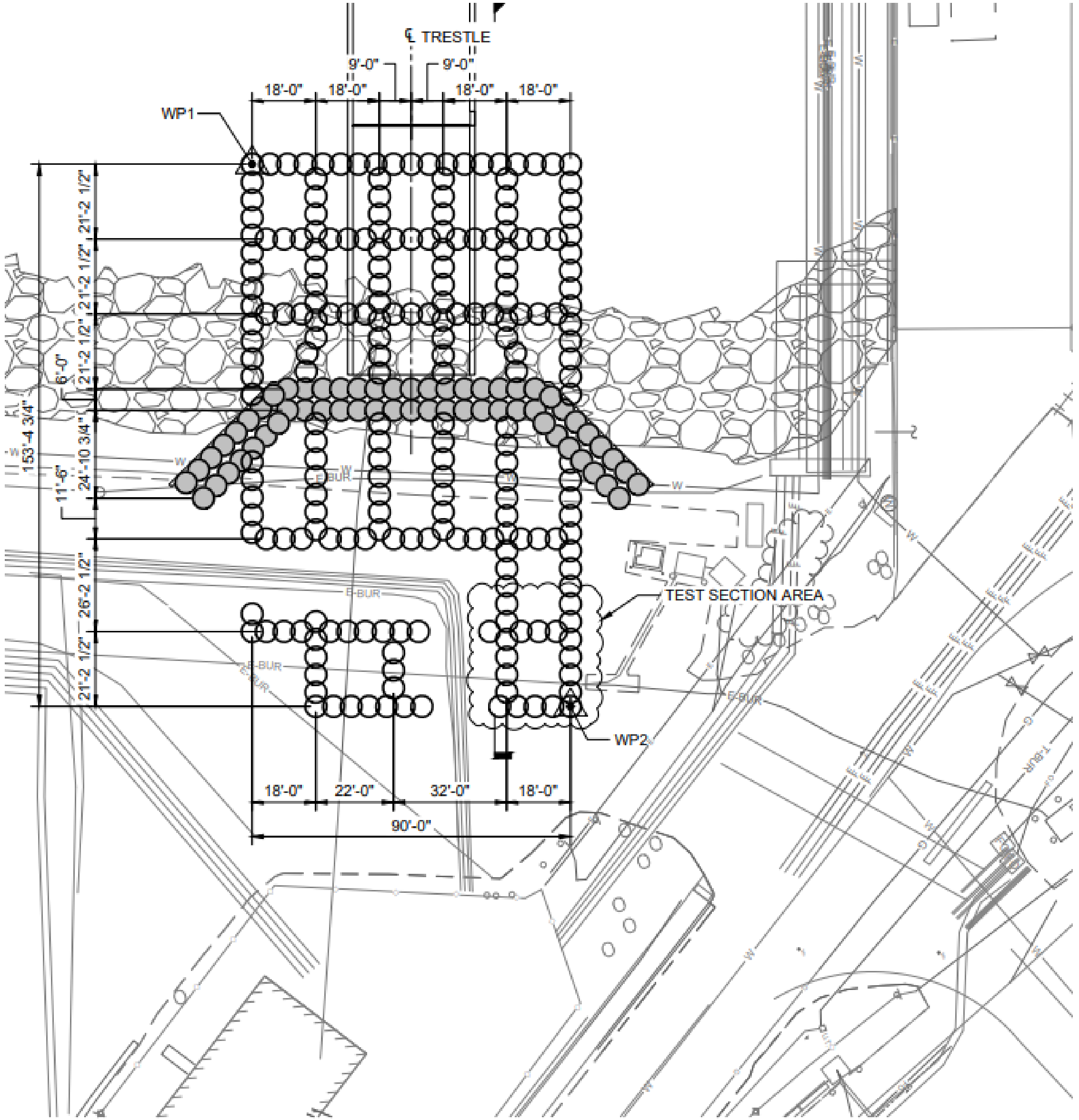
3 Design and Engineering Challenges: Geotechnical



References: Projects – POA Modernization

3 Design and Engineering Challenges: Geotechnical

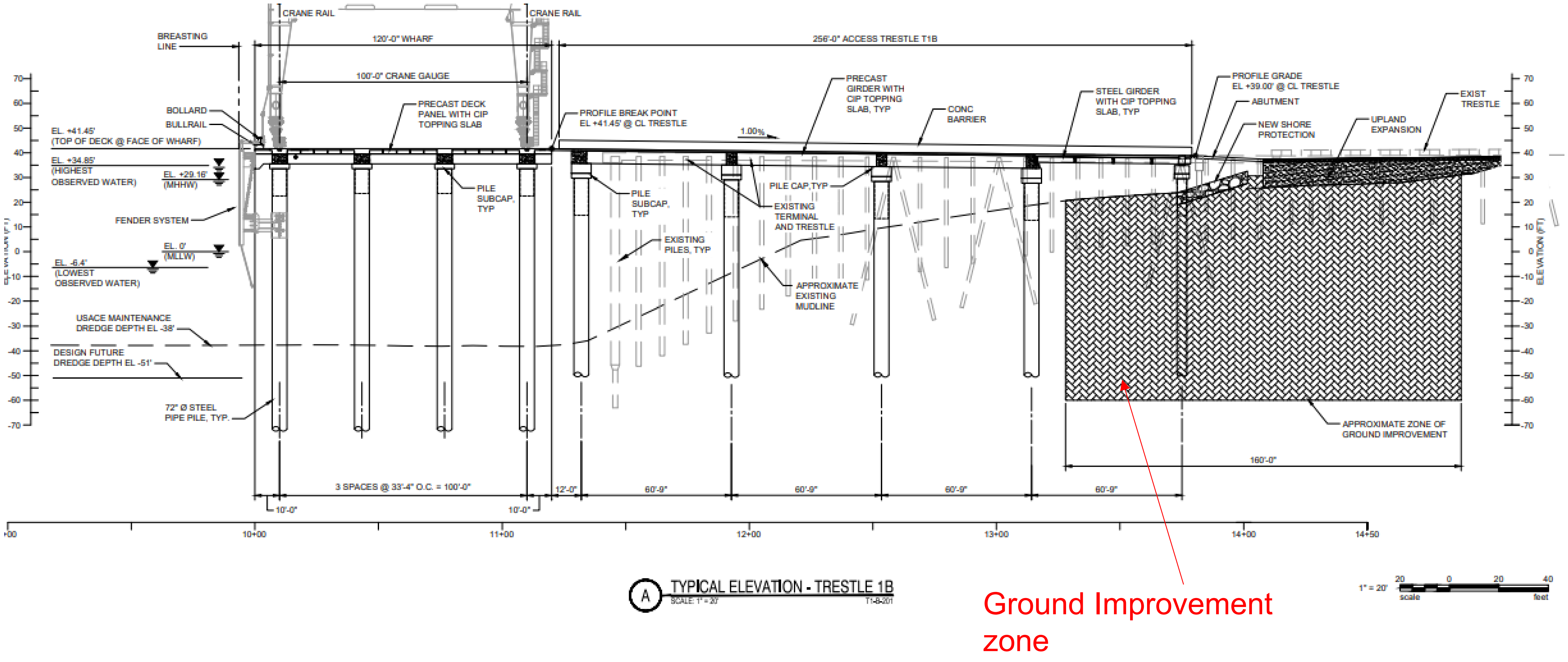
- **Extremely close analysis of geostructural interaction have been completed**
- Soil conditions relatively unique, particularly when combined with environmental loading
- Explorations 2000's-2024 including an in-depth Test Pile program in 2016
- ***The challenge, in Layman's terms: Minimal and variable bearing layer, extremely silty and sandy in one of the most extremely seismic aeras on earth (which liquifies silty sands), with extreme structural loading***
- Solutions: Detailed review of the seismic operability loading and requirements
- Additional CPT borings for exact locations of proposed terminal piling
- Detailed review of pile placement, depth, material, thickness, and installation methods
- Shoreline soil improvements – Deep soil mixing designed at trestle abutments to mitigate potential of seismically induced slope failure



GROUND IMPROVEMENT LAYOUT AT TRESTLE 1A
SCALE: 1" = 25'

References: Projects – POA Modernization

3 Design and Engineering Challenges: Geotechnical



 References: Projects – POA Modernization

3 Design and Engineering Challenges: Seismic operability

- Project followed PAMP Seismic Design Criteria and ASCE 61 design standard

– The following are the Terminal Seismic Performance Requirements

Structure	Design Classification	Seismic Hazard Level	Seismic Performance Level
Terminal 1 Wharf and Trestles	Seismic Berth	OLE	Minimal Damage
	Seismic Berth	CLE	Minimal Damage
	Seismic Berth	SLE[c]	Controlled and Repairable Damage[a,b]
Terminal 1 Mooring Dolphin	Seismic Berth	SLE	No Damage[d]

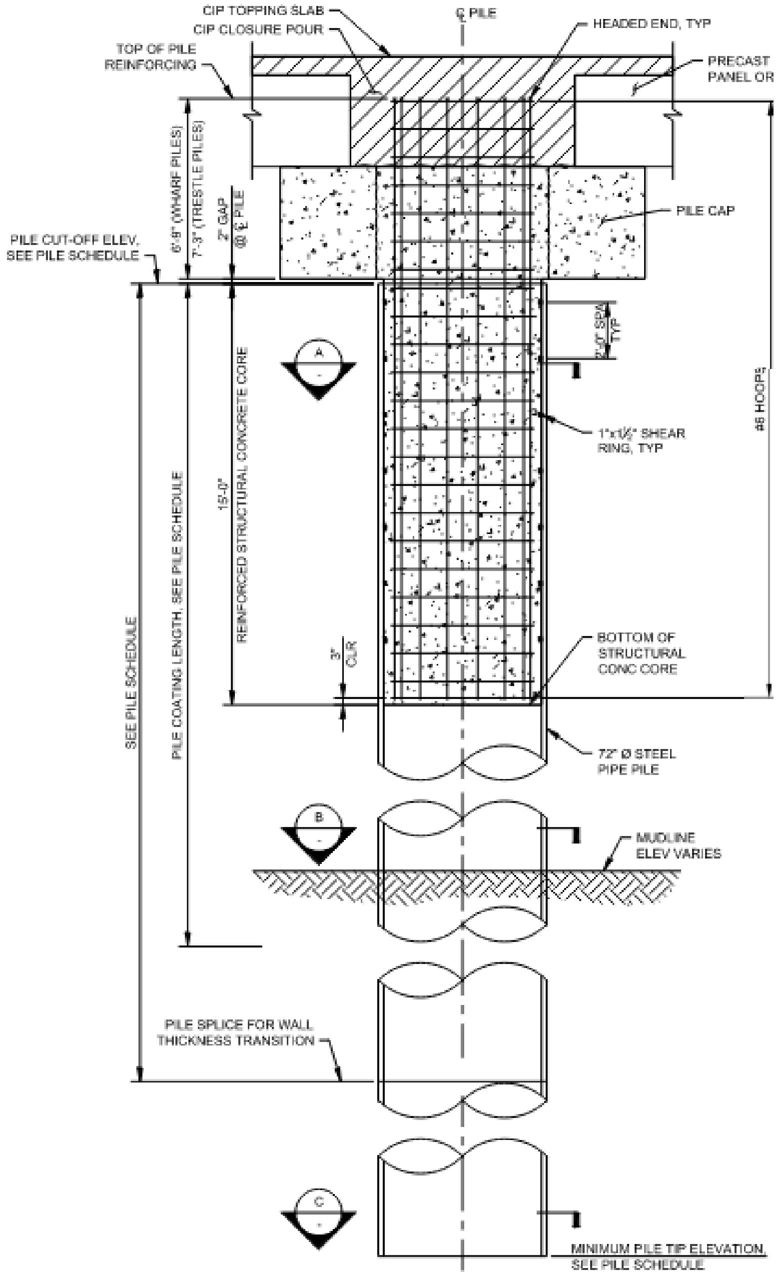
Notes:

[a] The seismic performance level exceeds that required by ASCE/COPRI 61.

[b] Controlled and repairable damage is defined as being operable within 7 days.

[c] SLE level, described in the latest ASCE/COPRI 61 revision, is based upon 975-year return period surface uniform ground motion time histories. While the ASCE/COPRI 61 revision requires a Seismic Performance of life safety protection, the MOA has adopted the GAC recommendation design classification of “high” for seismic berths as described in ASCE/COPRI 61 Section 2.2.1.

[d] For capacity protection of pile-to-pile cap connection against shear force corresponding to plastic hinging of pile controlled and repairable damage performance level is considered



TYPICAL PILE ELEVATION

References: Draft Plans, BOD

3 Design and Engineering Challenges: Seismic operability

- Entire terminal design was driven by the structural importance, post seismic event, including structural integrity, crane tie-downs, pile redundancy, upland stabilization, and seismic isolations in utility lines

- The terminal structural design strategy:
  - Ductile plumb pile system
  - Strong-deck-weak-pile concept
  - Pile to cap connection detailed to develop plastic hinge
  - Deck framing is capacity protected
  - Design does not rely on or allow in-ground pile hinging
  - Considered complexity in dynamic seismic mass – gantry cranes, ice accretion mass

- *Looking to learn more on the seismic structural approach to this design? Find our WSP Partners at ASCE Ports '25 Conference in June in Rhode Island!*

 References: Projects – POA Modernization

3 Design and Engineering Challenges: Corrosion

- **The unmitigated corrosion rate of the cook inlet can be up to 30+ mils/year in the accelerated low water corrosion zone**
  - Over the life of a 75 year design structures, that is up to 2,500+ mils without corrosion protection… that is 2.5 inches!
  - In comparison... Alaska is recorded to have corrosion rates almost more than 4 time as aggressive as sites in Southern California

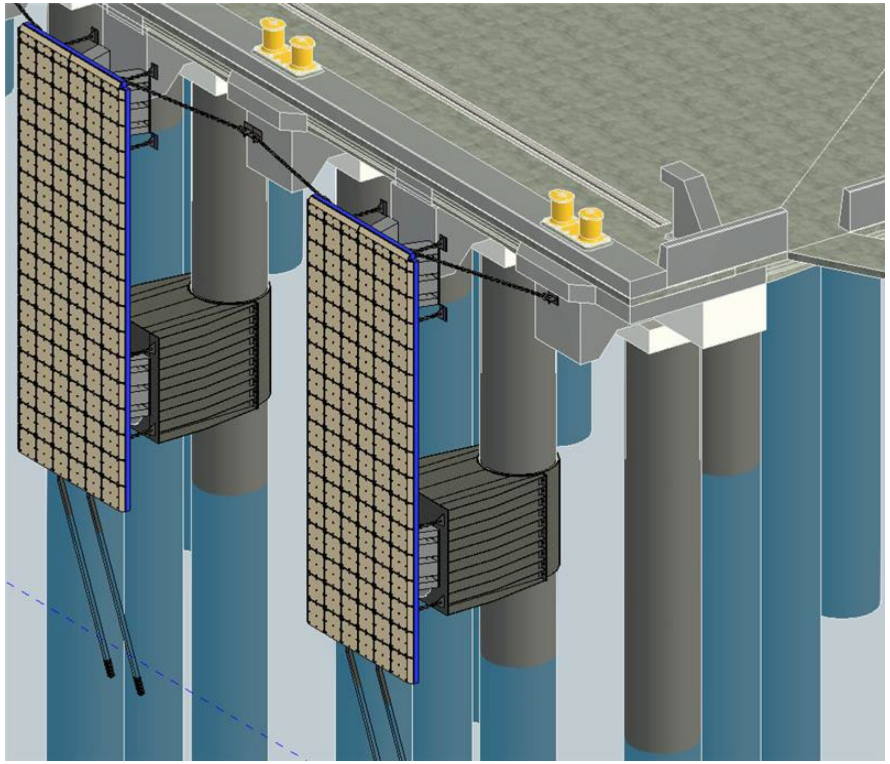
- Multi-faceted protection system, specific to large diameter steel pipe piles, is key
  - Corrosion Allowance: pile thickness increased beyond structural necessity for sacrificial thickness
  - Pile coating: plural component urethane from well below mudline to pile cutoff
  - Impressed current cathodic protection (ICCP): anode sleds powered by dedicated switch mode power supply units

- Cathodic protection also considered in fender design, concrete reinforcing, crane rails, consideration of adjacent terminal ICCP interaction, and terminal wide material selection
- Landside monitoring and maintenance program will make certain the system remains operable and inevitable future section loss identified early for repair and protection

References: Contractors – POA Modernization

3 Design and Engineering Challenges: Navigation

- Primary use of terminal 1 is for the lift on/ lift off operation currently, and predicted future, operated by Matson
  - Primary design vessels are Matson vessels
  - Design must allow for wide range of vessels while also considering extreme tidal fluctuations
- Extremely robust fendering system with complex attachments



References: Projects – POA Modernization

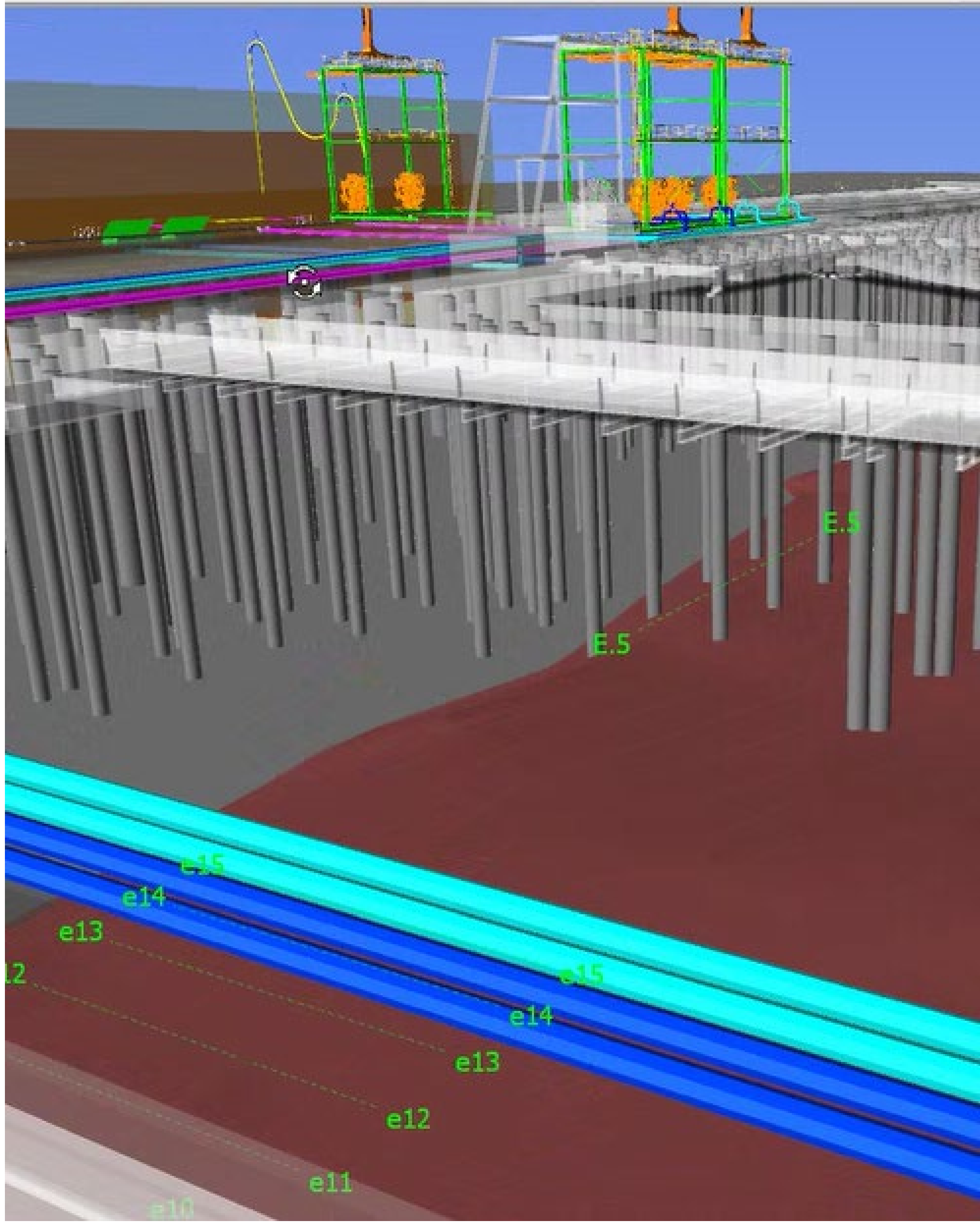
3 Design and Engineering Challenges: Utilities & Operations

- **Existing infrastructure on an extremely busy and operational Port + removal of aged utility and infrastructure + abandoned utility and structure = Challenge!**

- Key design challenge was to determine, as accurately as possible, locations of operational and abandoned utility lines
- Work included in project include
  - Modification to existing utilities
  - New potable water
  - New fire protection
  - New power service for terminal including gantry cranes and future power

- In tandem with T1: New electrical substation will be a separate design-build project

- Feasibility study of adding petroleum services as a backup system to other POL facilities at the Port
  - Complex interaction with conveyance systems and primary purpose gantry cranes



* Thank You

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