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LINKING A WORLD OF OPPORTUNITY

FAIRVIEW CONTAINER TERMINAL
Phase 2 North Expansion

April 2015
Emil Tomescu, MBA, P.Eng., P.E., FEC
Director, Project Engineering and Asset Maintenance

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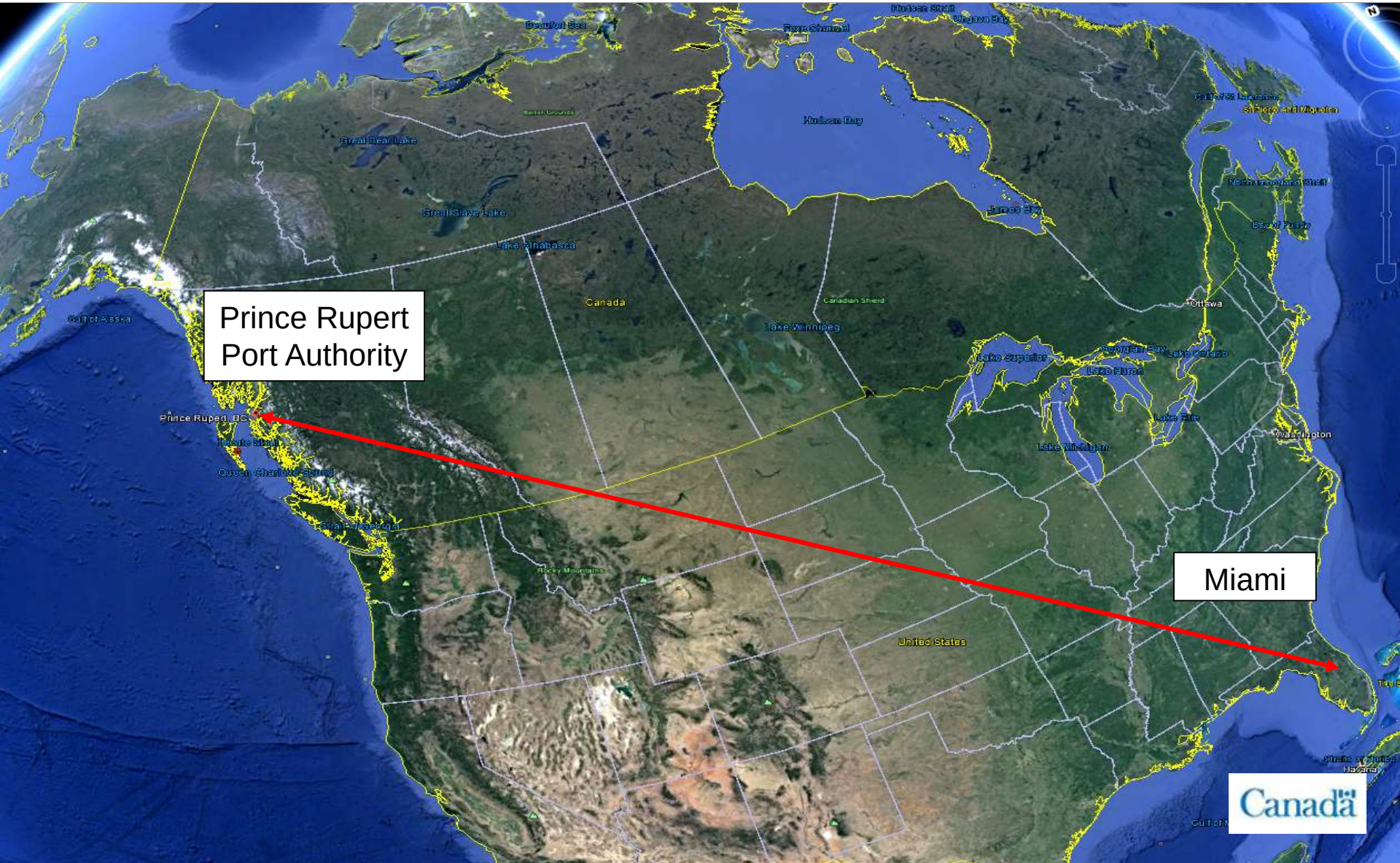

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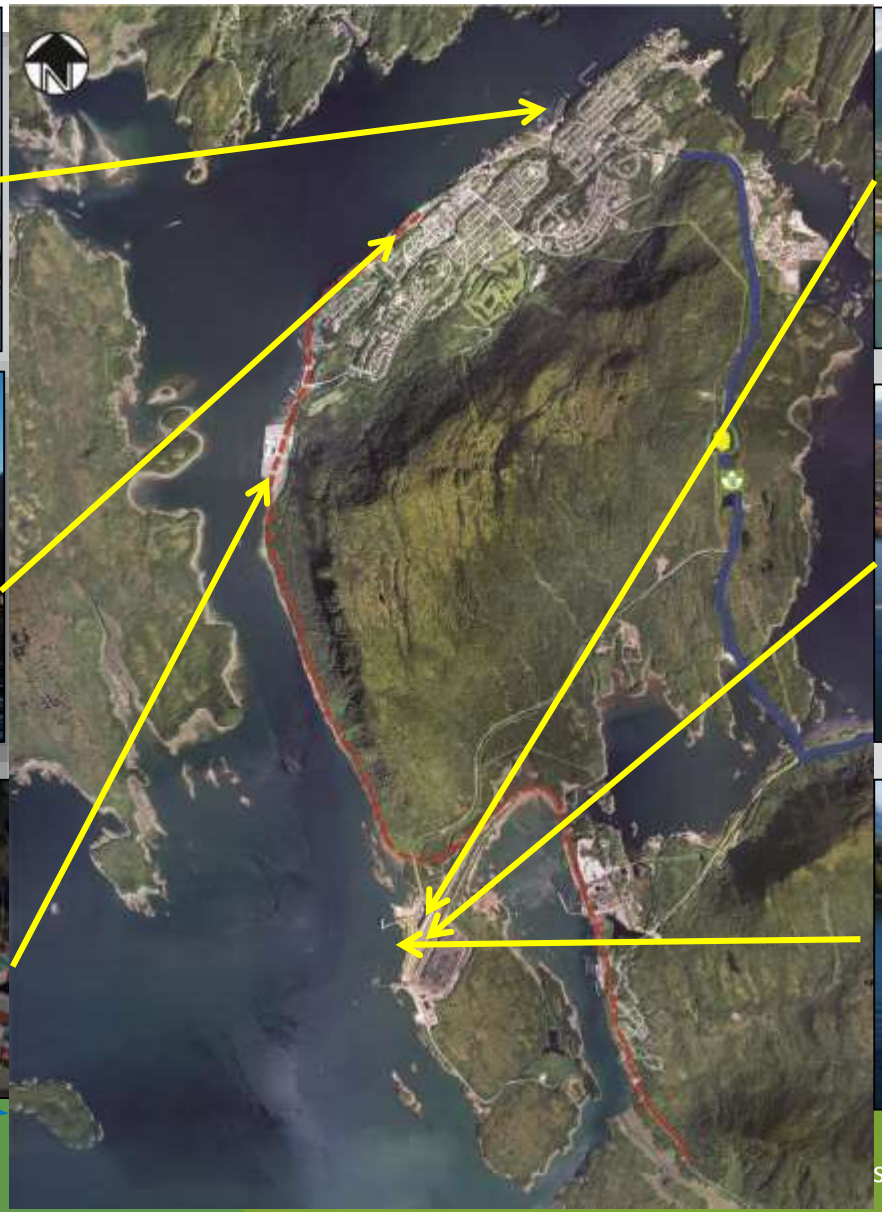

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FAIRVIEW CONTAINER TERMINAL

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A three-year projection.
Increasing the wharf length to 800 m in total and throughput to 1.2 million TEU per annum.

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- The Prince Rupert Port Authority has been redeveloping Fairview Terminal as a major international terminal since 2007. It is the first dedicated intermodal (ship to rail) container terminal in North America. Maher Terminals Holding Corporation of New Jersey signed a 50-year agreement with the PRPA to operate the Terminal after the development of Phase I expansion.
- Phase II North Expansion project is funded by Maher Terminals.

PROJECT CONSULTANTS:

- Engineering Design / Project Management: Maher & Cullen Grummitt & Roe.
- Geotechnical Subconsultant: Golder Associates.
- General Contractor: Fraser River Pile & Dredge / BelPacific JV.
- PRPA's Peer Review: Moffatt and Nichol.

MAIN WORK INCLUDES:

- Dredging and Disposal
- Rock/Mountain Cut
- Site Clearance and Demolition
- Reclamation and Rock Bund
- Small Craft Harbours Facility Modifications
- New Caisson Wharf
- New Suspended Wharf
- Pavements and Services
- Headwall
- Dolphins and Walkway
- Electrical Infrastructure
- Intermodal Rail Yard
- Conveyor System

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WITH A DESIGN LIFE OF 50 YEARS THE EXPANSION COMPRISES OF:

- Reclamation of approximately 3.7 hectares of land at the north end of the terminal for additional container yard storage as well as modifications to structures associated with the Small Craft Harbours facility.
- Construction of a 155 m long and 40 m wide piled concrete wharf extension to the north of the existing wharf.
- Construction of a 250 m long and 20 m wide of wharf apron structure at the along the west side of the existing quay wharf to tie in with the existing wharf.
- Construction of approximately 36 m long and 20 m wide of wharf apron structure at the southern end of the existing quay wharf to tie in with the existing wharf.
- Construction of two mooring dolphin structures at each end of the wharf.

- Excavation and construction of an empty container park at the east of the terminal.
- Installation of crane rails on the new wharf expansion to develop a total of 800 meters of crane operated quay length.
- Upgrade of rail capacity services with the addition of 4working.

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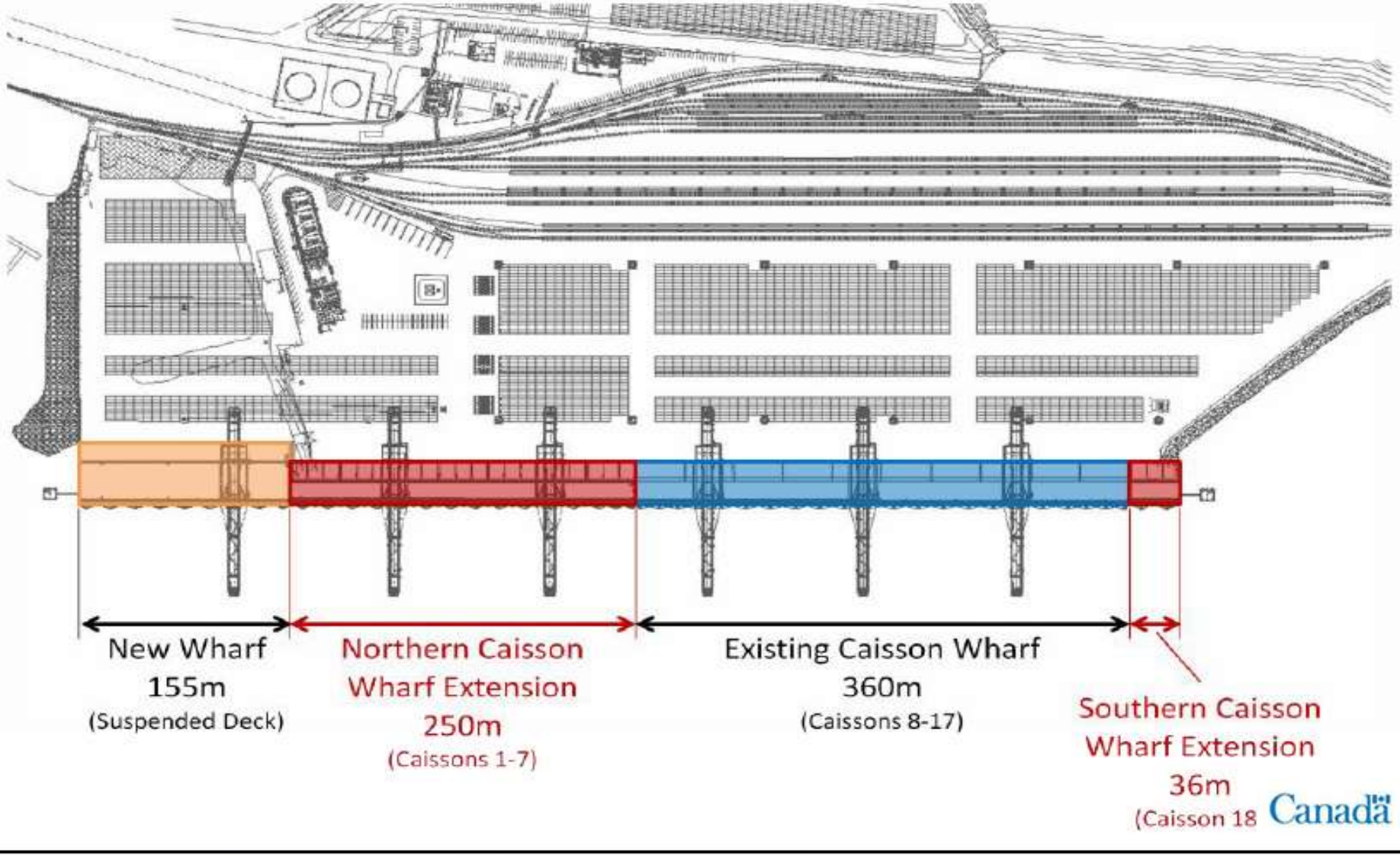

FIGURE 1: EXTENT OF CAISSON WHARF EXTENSIONS

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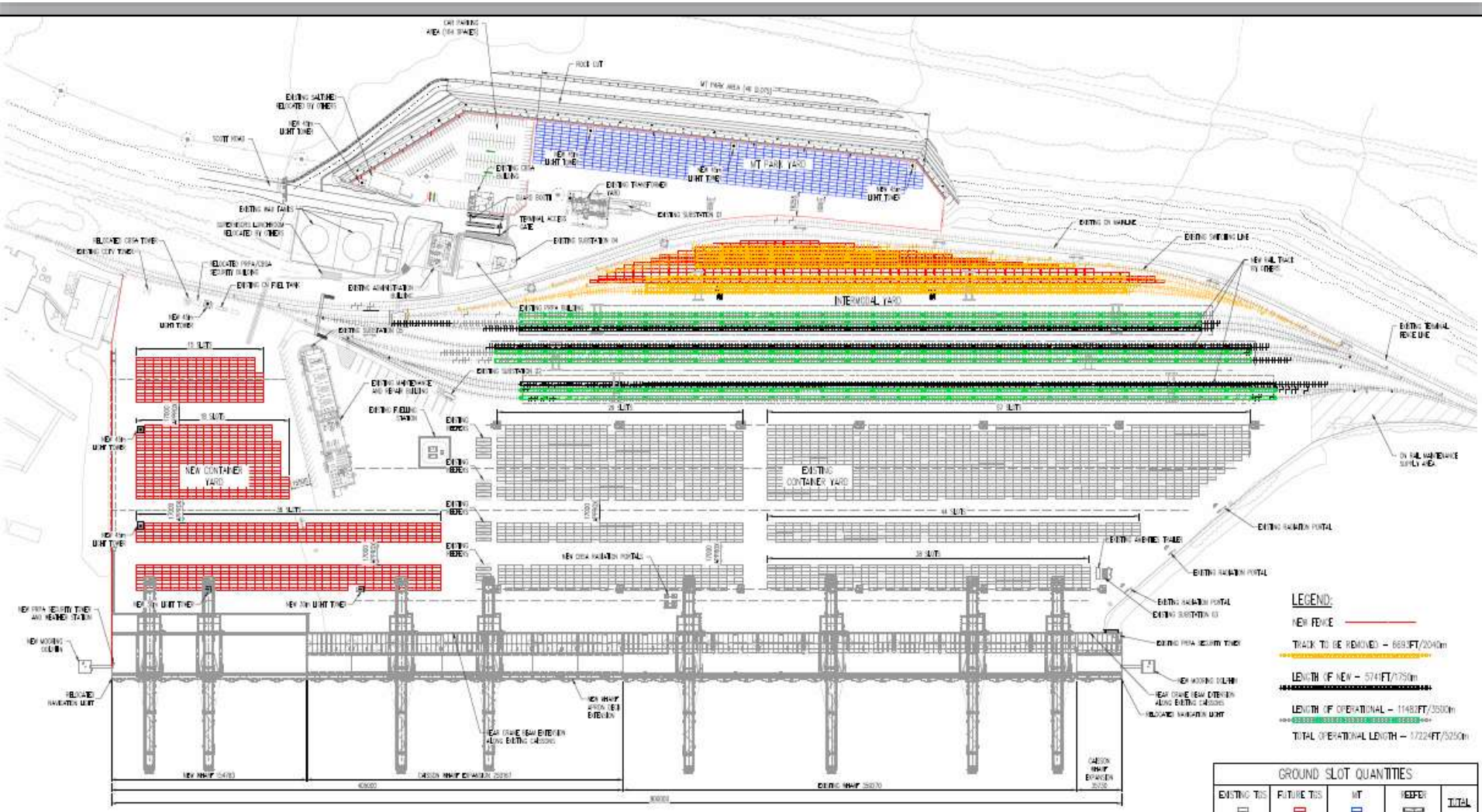
GENERAL ARRANGEMENT:



GROUND SLOT QUANTITIES

EXISTING TGS	FUTURE TGS	MT	REEFER	TOTAL
2,849	1,567	572	48	5,036

PLAN

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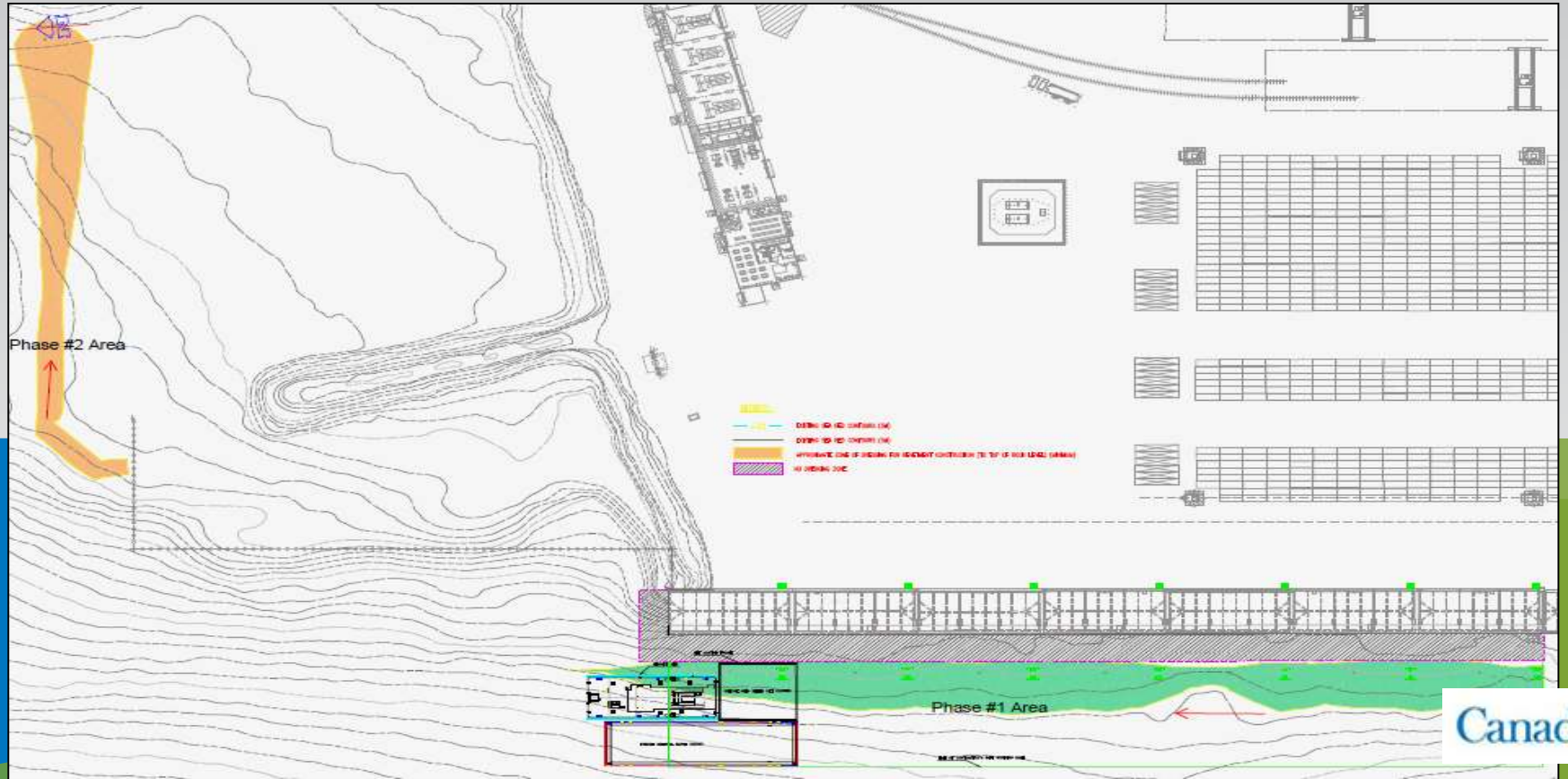
DREDGING / DISPOSAL:

- Dredging was required to remove soft seabed deposits prior to installation of a perimeter berm and to accommodate placement and performance of imported mattress and berm rock fills. An estimated 12,000 m^3 of material was removed. A silt curtain was used to contain silt migration.

Along the northern face of the wharf

Along the western face of the wharf



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DREDGING & DISPOSAL:

- A floating marine derrick with a GPS controlled, 200 tonne Liebherr conventional crawler crane was used for dredging.
- The dredged material was loaded onto flat-bottom barges and towed to an existing RO-RO facility. A front-end loader was utilized to offload the dredged material from the barges into dump trucks, which were loaded to their 80% of their capacity and the tailgates to prevent spillage.

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DREDGING & DISPOSAL:

- The dredgeate was transported to PRPA's disposal area on Ridley Island.

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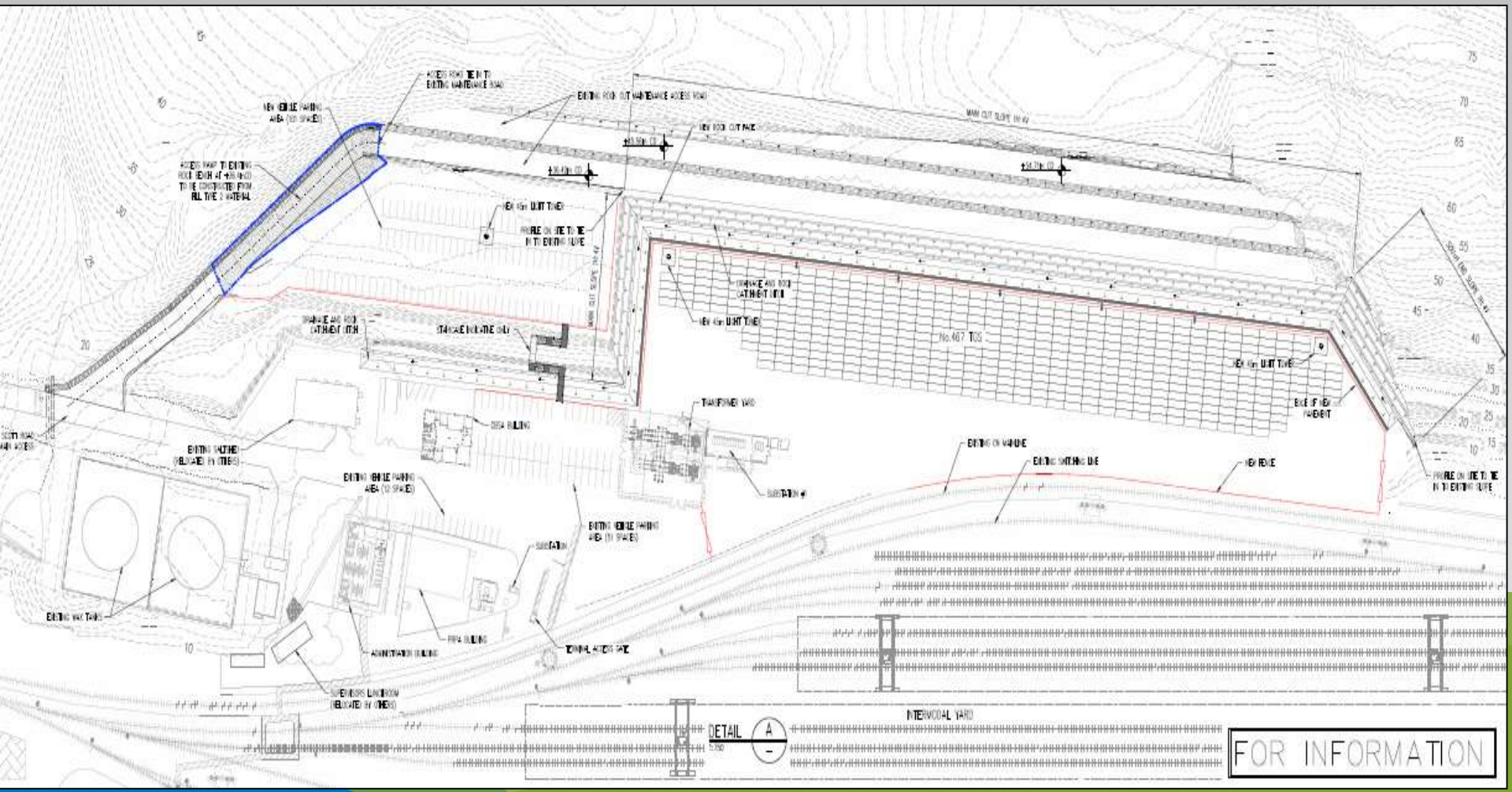
ROCK CUT & DRAINAGE TRENCH:



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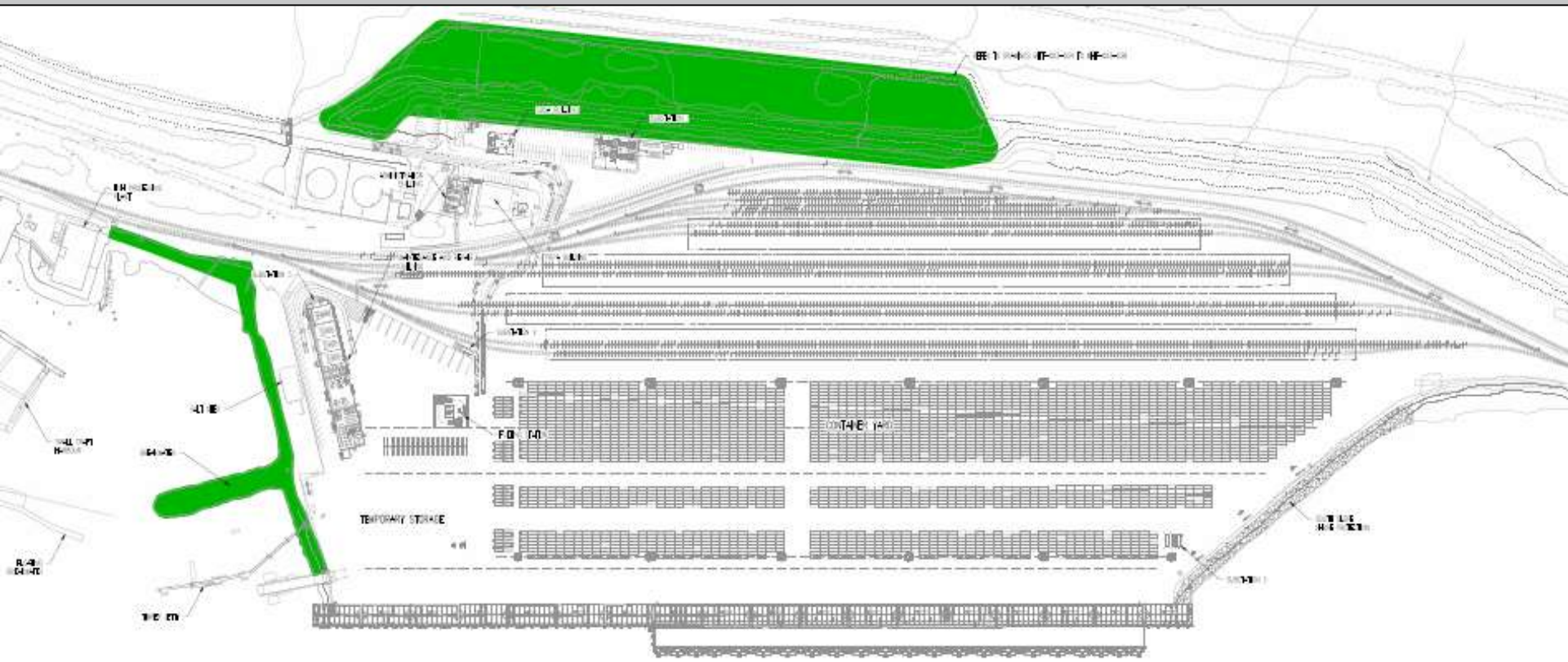
SITE CLEARING AND DEMOLITION:

- The upslope area was cleared of vegetation to allow for an in-depth geotechnical investigation of the slopes prior to excavation.



SITE PLAN

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RECLAMATION & ROCK BUND:

Slope Stability

Stability analyses were undertaken to demonstrate the stability of all perimeter bunds and revetment slopes. In the static case, the minimum factor of safety against slip or slope instability will be achieved.

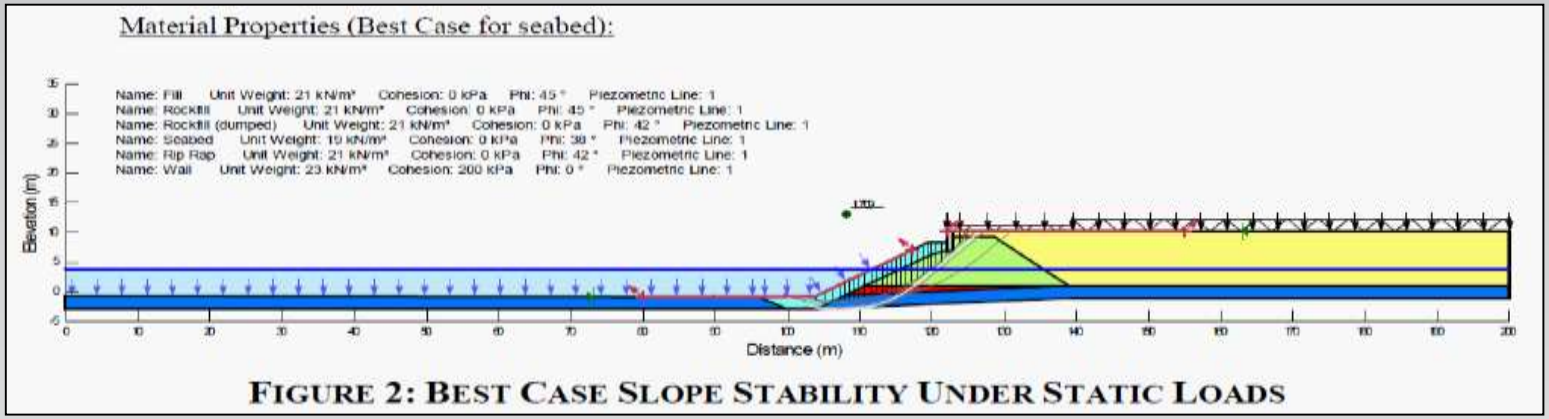

FIGURE 2: BEST CASE SLOPE STABILITY UNDER STATIC LOADS

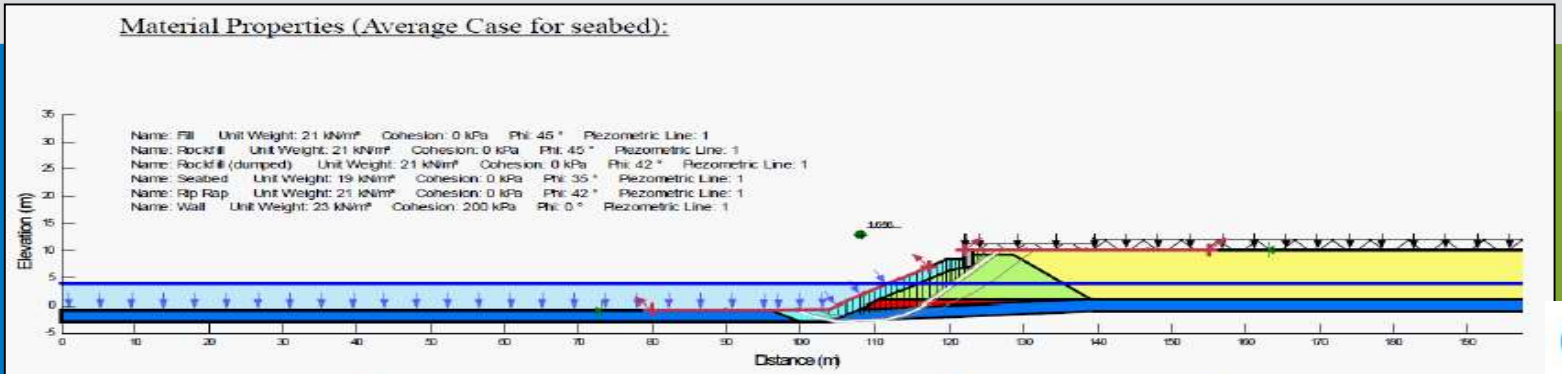

FIGURE 3: AVERAGE CASE SLOPE STABILITY UNDER STATIC LOADS

RECLAMATION & ROCK BUND:

Compaction & Preloading:

- A “mud wave” filling technique involves forming the reclamation by end tipping the fill material in a fashion so as to promote slip circle failure of the underlying soft marine mud (loose sand, silty sand and gravel). The slip circle failures allow the newly placed fill to sink into the seabed while displacing the mud up in front of the face of the reclamation as a mud wave. This technique has been used in the past to good effect and allows the poor material to be pushed out from underneath the new fill, reducing the depth of soft material remaining in the permanent works. If the mud wave “stalls” in front of the new material, it can be removed by excavator and disposed. The ‘mud wave’ can be achieved through the placement of reclamation fill to approximately +4.5 meters.

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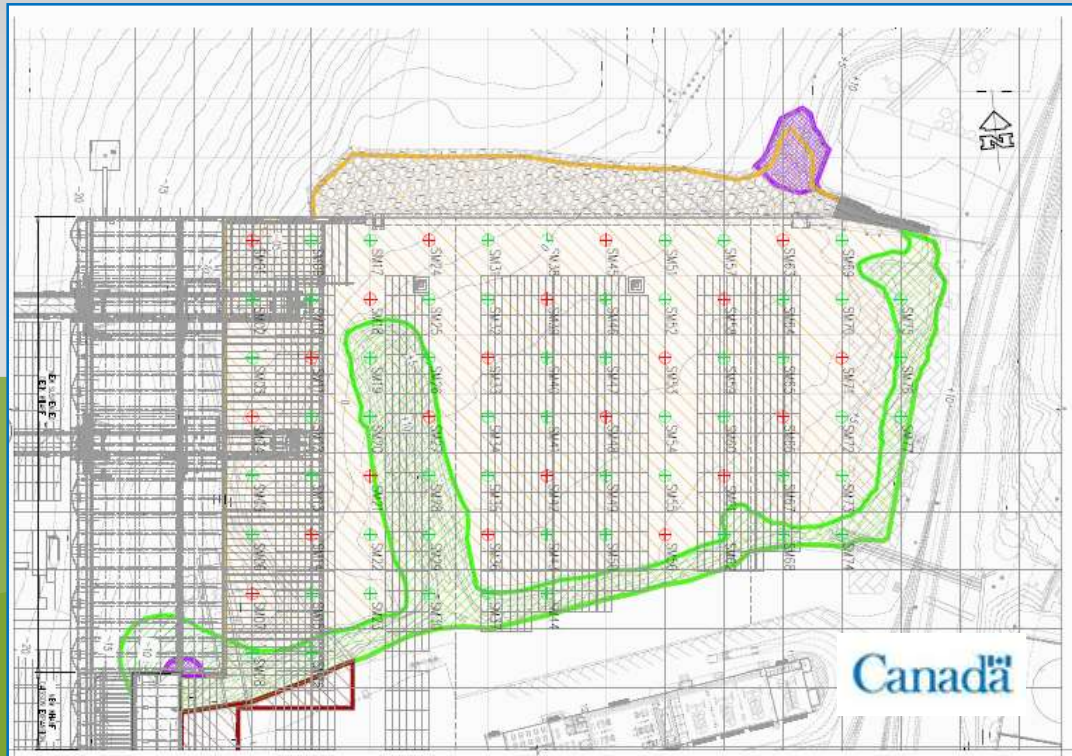
RECLAMATION & ROCK BUND:

Overall Settlement across will not exceed the acceptable levels specified in the design criteria over various lengths of time based on two different average loads. The northern bund will be left in place for a minimum of 12 months from placement and settlement closely monitored.

Differential Settlement

The maximum allowable differential ground settlement measured by any two points and the out-of-plane tolerance in any direction between any four points on the site, are based on a well determined grid / rectangle.

Settlement Measuring Points



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ROCK REVENTMENT DESIGN:

- The armour rock has been designed for the relevant environmental loads as per the design criteria below, including current and wave forces. It has not been designed to accommodate the forces imposed by vessel bow thrusters or propellers, given that no major container vessel activity will occur along the northern boundary.

- The thickness of the armour layers is sufficient for placement of two pieces of rock armour in one layer, taking into account an appropriate layer thickness coefficient.

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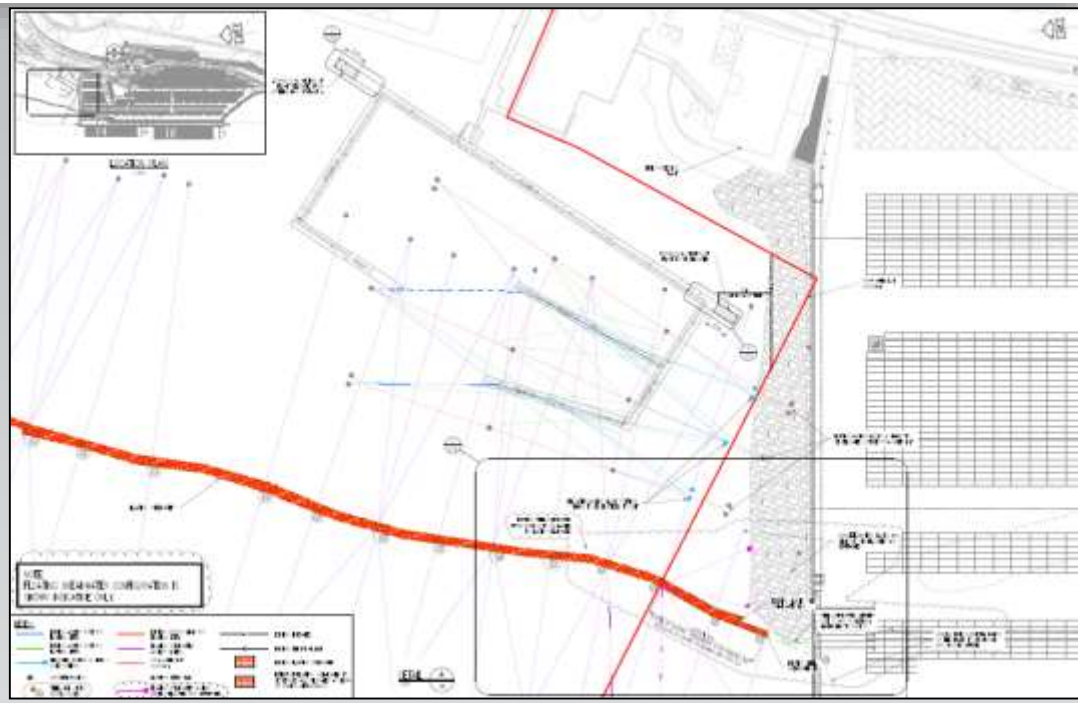
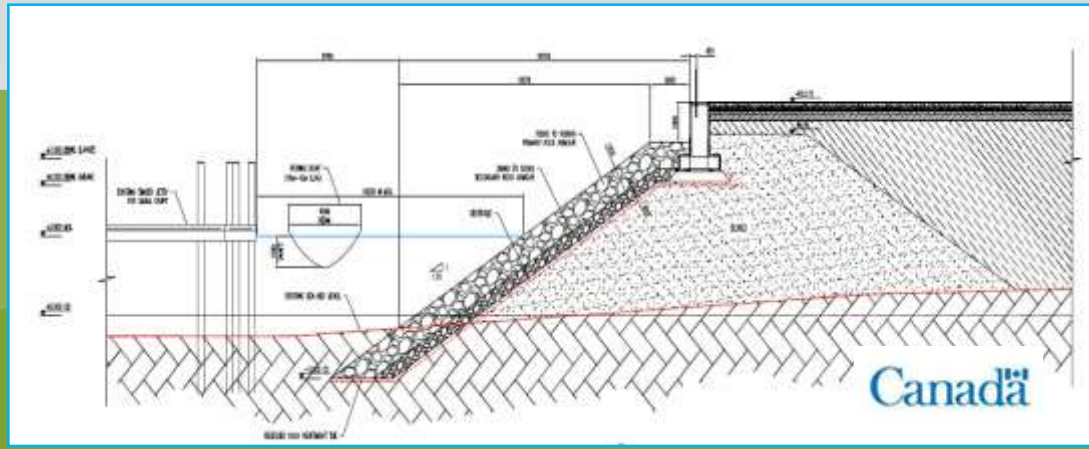
SMALL CRAFT HARBOURS FACILITY MODIFICATIONS:

To maintain a clearance of 20 meters between the structure of Float A of the Small Craft Harbours facility and the rock revetment along the northern boundary of the expansion at +1m CD water level, the following will be performed:

- Relocation of an section of the Float A structure from south to the north of the Float A.
- Removal of a section of the breakwater at a natural breakpoint.
- Rearrangement of the seabed concrete anchor blocks and associated fixings.





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NEW CAISSON WHARF STRUCTURE:

- Design and construction methodologies, base geometry and element sizing have been modelled on the existing wharf structure for structural continuity.
- The structure has then been checked for conformity to the project's design criteria, functional and environmental specifications, including all appropriate design load combinations. The main difference is the adopted pile length.

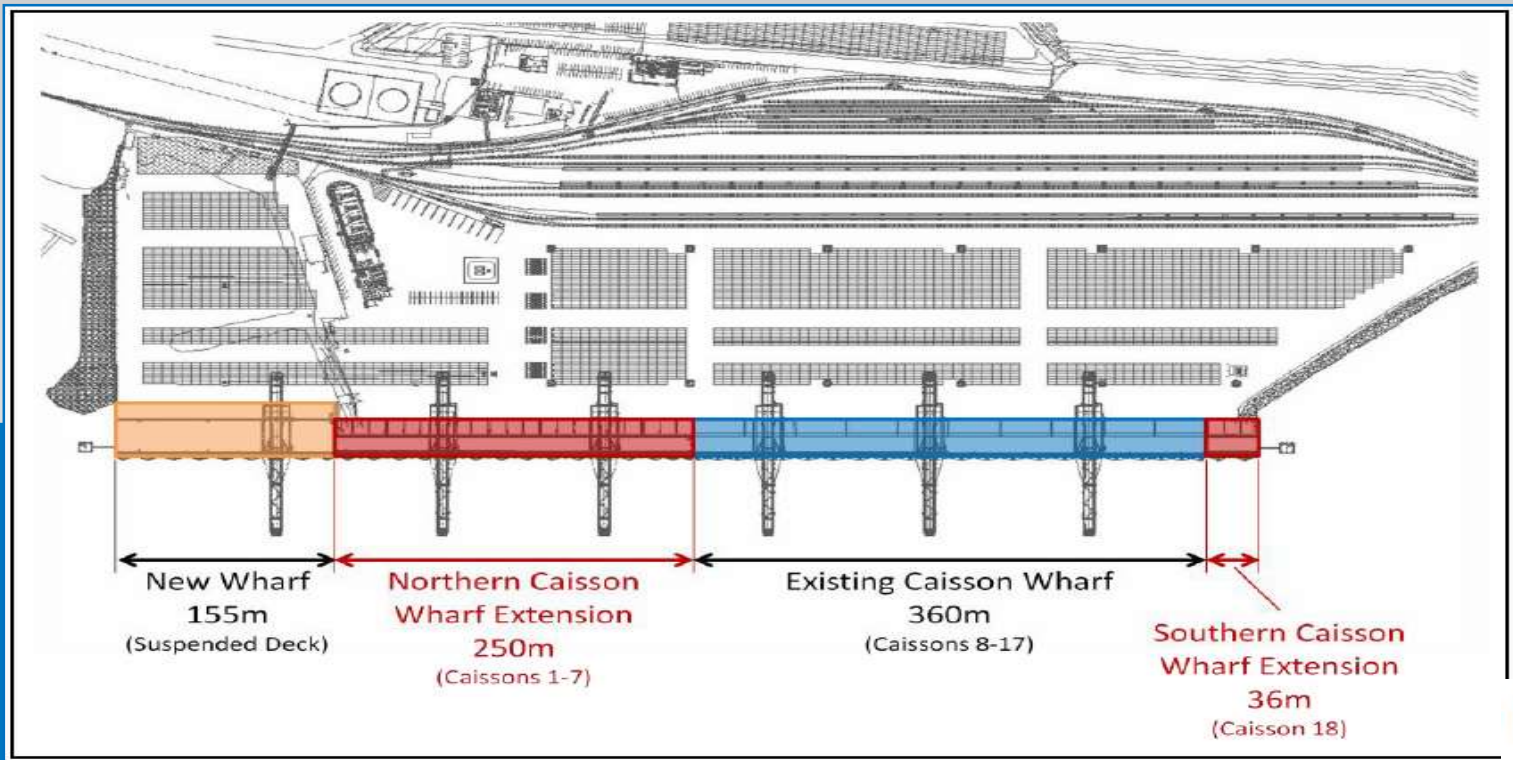

FIGURE 1: EXTENT OF CAISSON WHARF EXTENSIONS

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NEW CAISSON WHARF STRUCTURE:

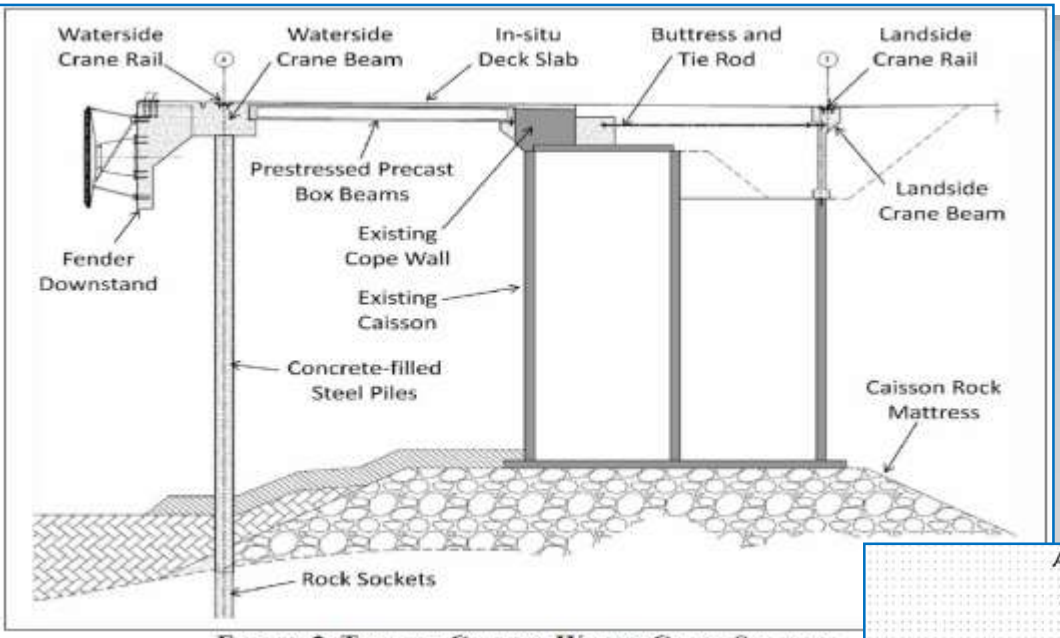
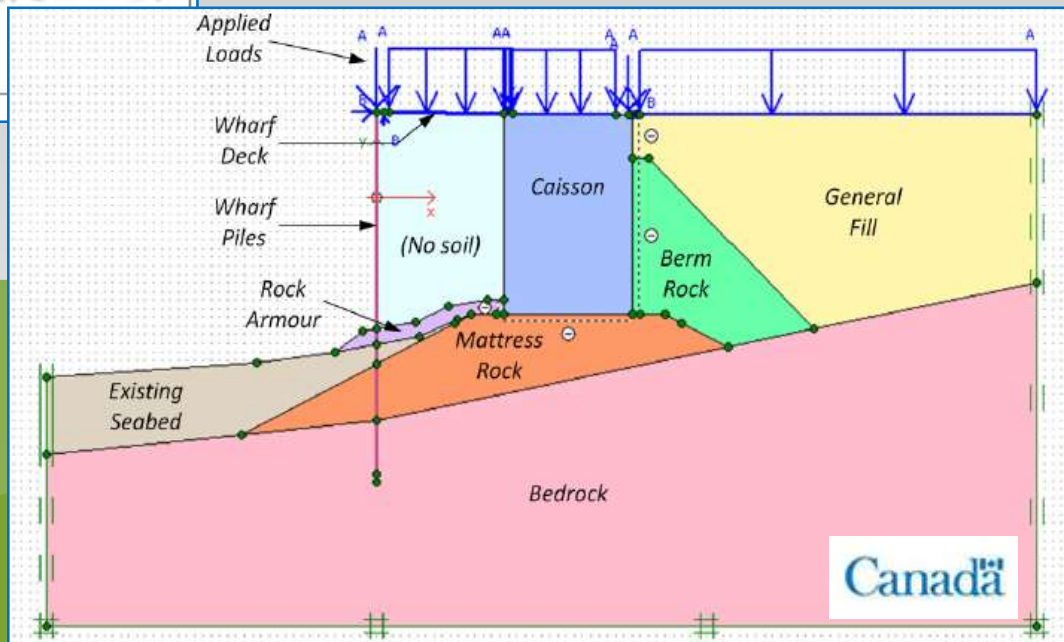


FIGURE 2: TYPICAL CAISSON WHARF CROSS SECTION



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NEW SUSPENDED WHARF STRUCTURE:

The new reinforced concrete wharf structure comprises of :

- Steel piles with reinforced concrete socket into the hard bedrock layer. The piles are connected to the superstructure by reinforced concrete plug. Steel piles including the sacrificial 0.08 mm/year corrosion allowance.
- Continuous slab spanning between headstocks and transferring the load onto headstocks.
- Transverse headstocks transferring the loads onto the piles.
- Longitudinal crane beams supporting the gantry crane rail and transferring the loads onto the piles.

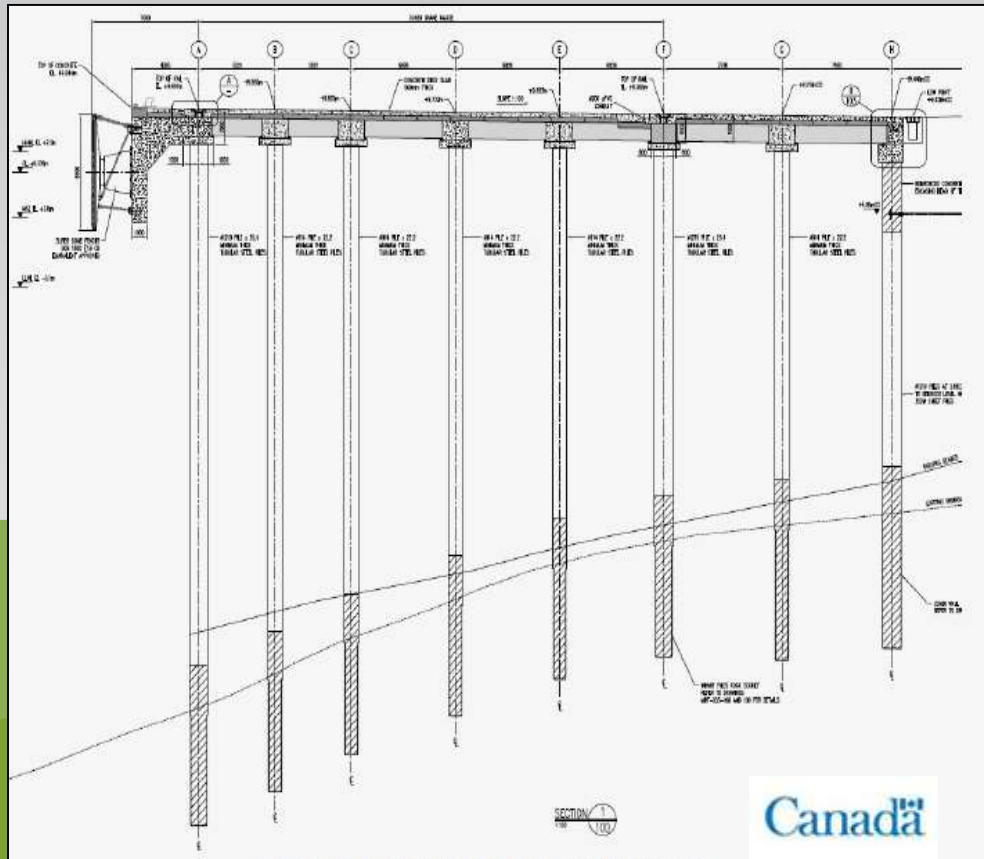

FIGURE 2: NEW WHARF CROSS SECTION

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NEW SUSPENDED WHARF STRUCTURE:

- All concrete elements are modeled as rectangular elements symmetrical about their axis. The new suspended wharf design also incorporates various loads: dead, live, berthing, mooring, fenders, quay cranes, wind, wave, current, snow, thermal, seismic and liquefaction.

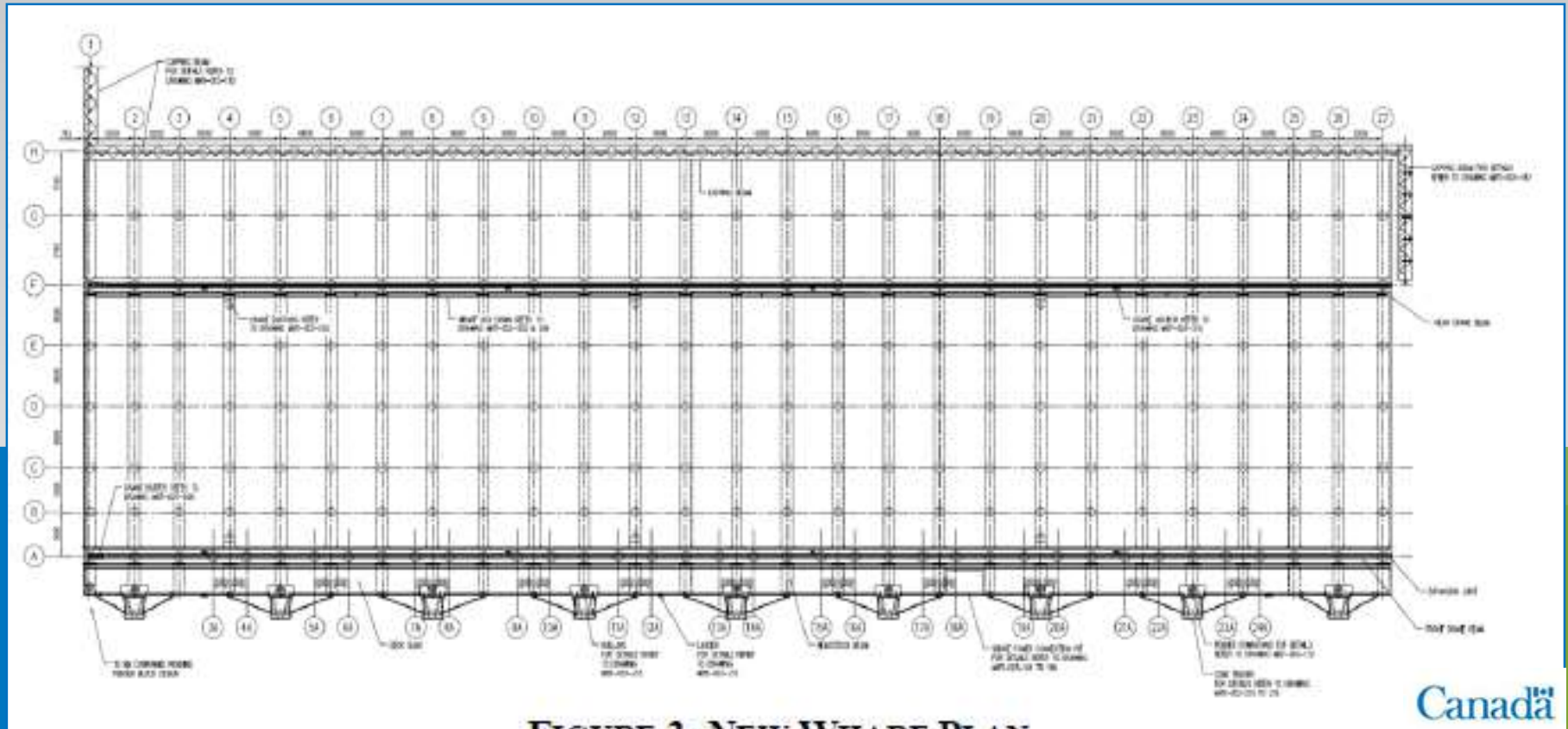

FIGURE 3: NEW WHARF PLAN

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PAVEMENT, DRINAGE, ELECTRICAL & OTHER SERVICES:

- The pavement design takes into consideration wheel loading loads, corner casting loads, distribution of container weights as well as the number of vehicle passes.

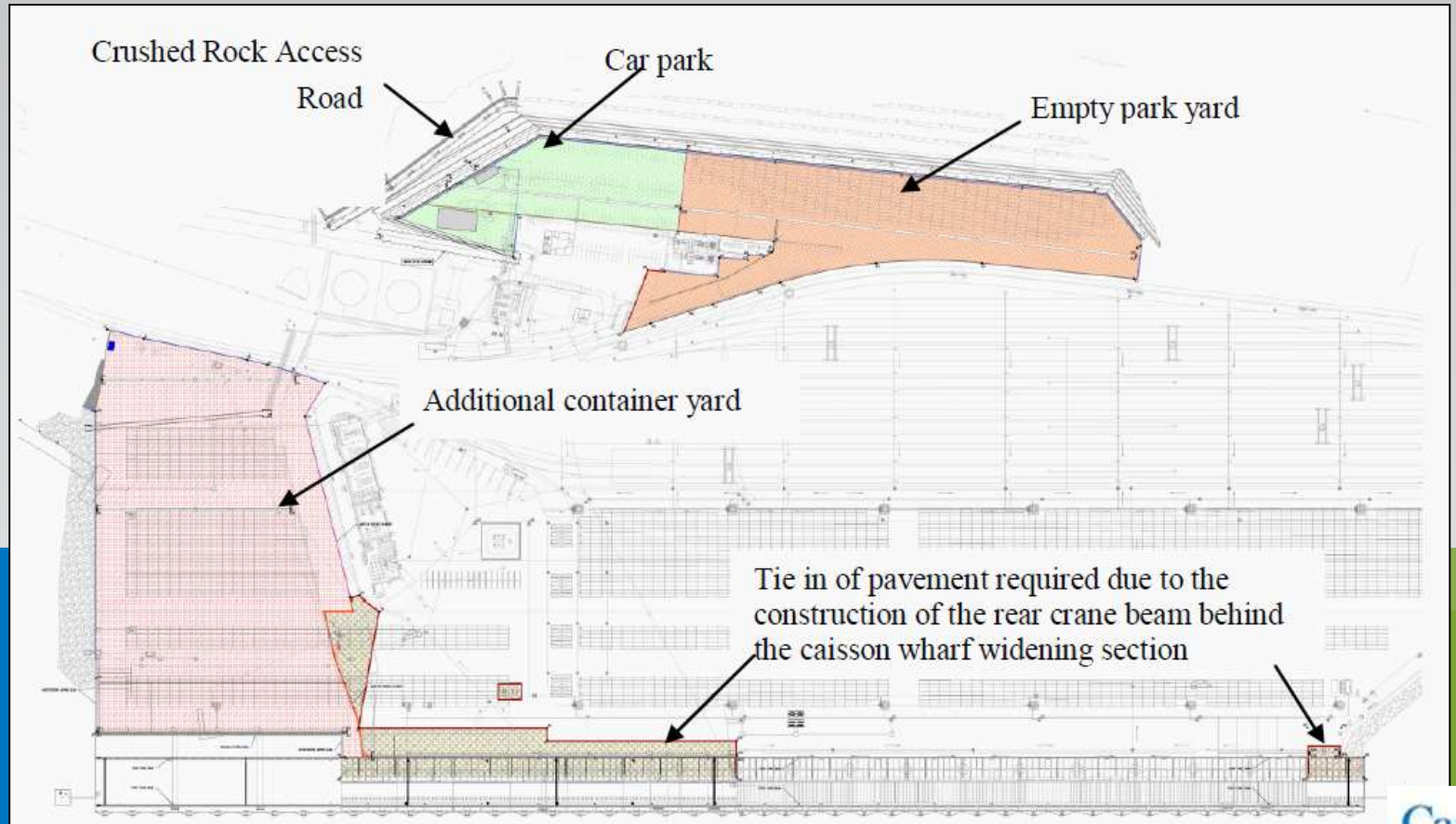

FIGURE 1: PAVEMENT LAYOUT

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PAVEMENT, DRINAGE, ELECTRICAL & OTHER SERVICES:

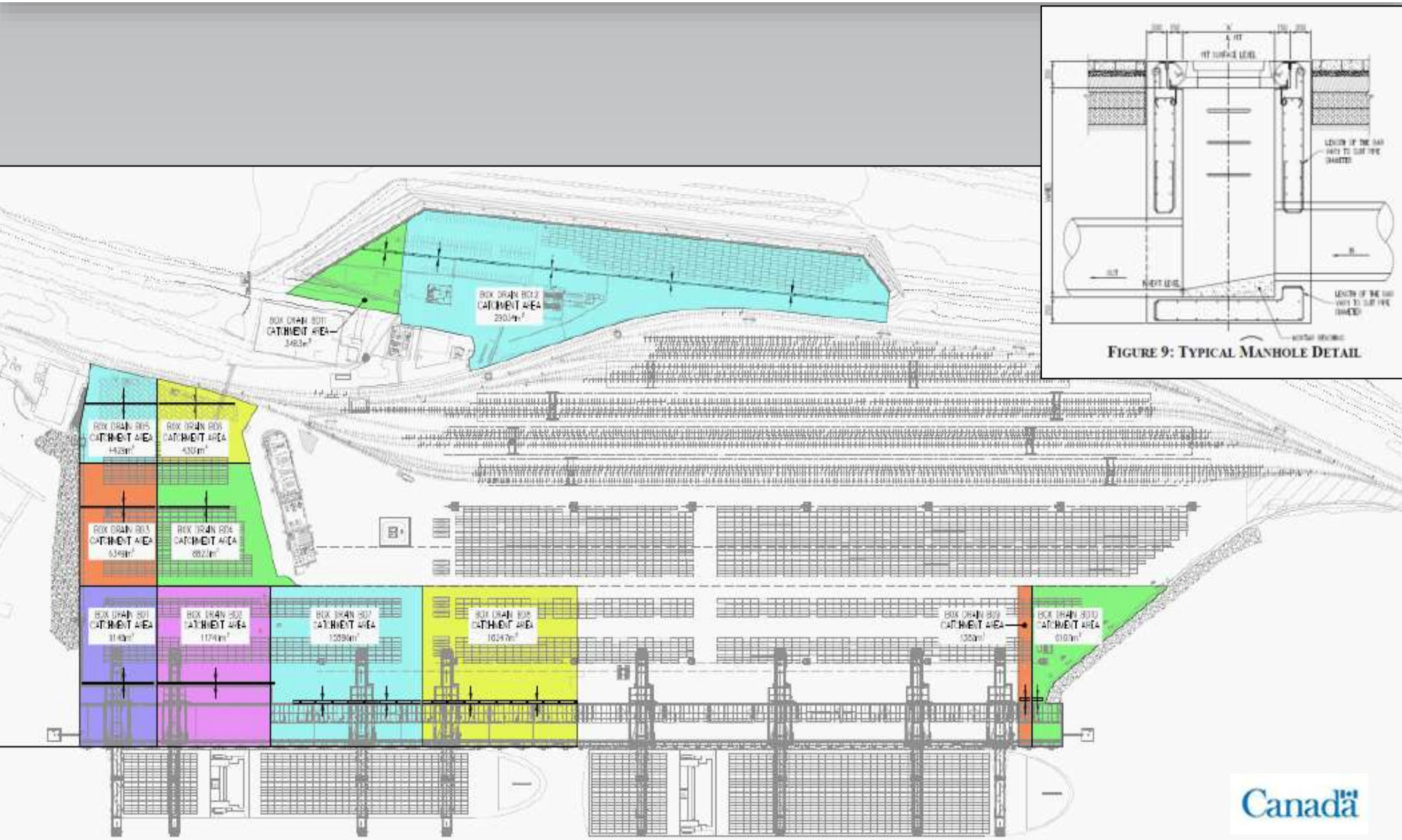

FIGURE 9: TYPICAL MANHOLE DETAIL

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PAVEMENT, DRINAGE, ELECTRICAL & OTHER SERVICES:

Shore Power Capability:

- The current capability of the Fairview Terminal to shore power one vessel at the time will increase to two vessels at the time at the completion of the project.

China Shipping Xin Ya Zhou on Shore Power

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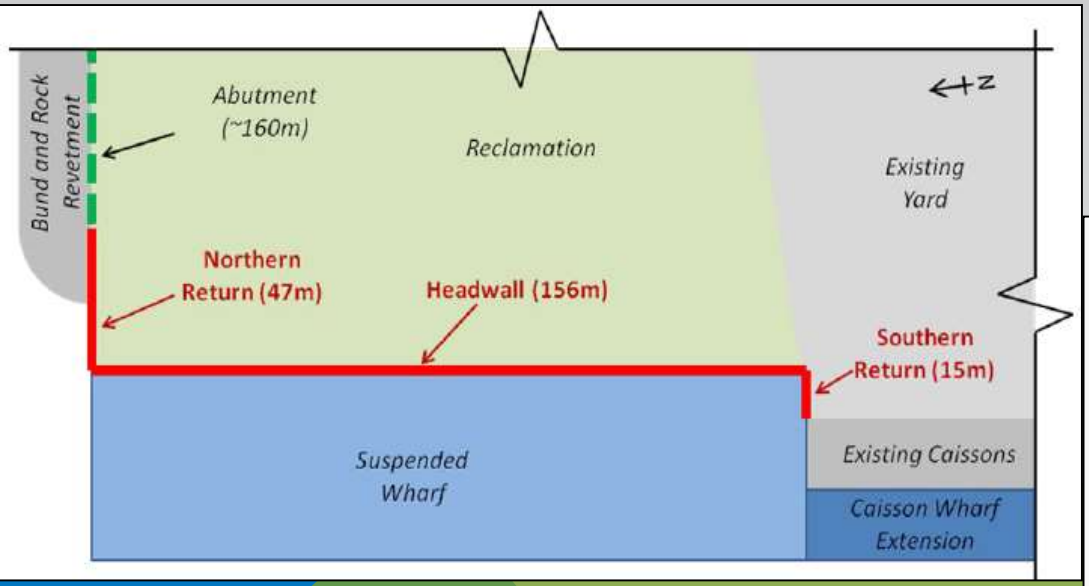
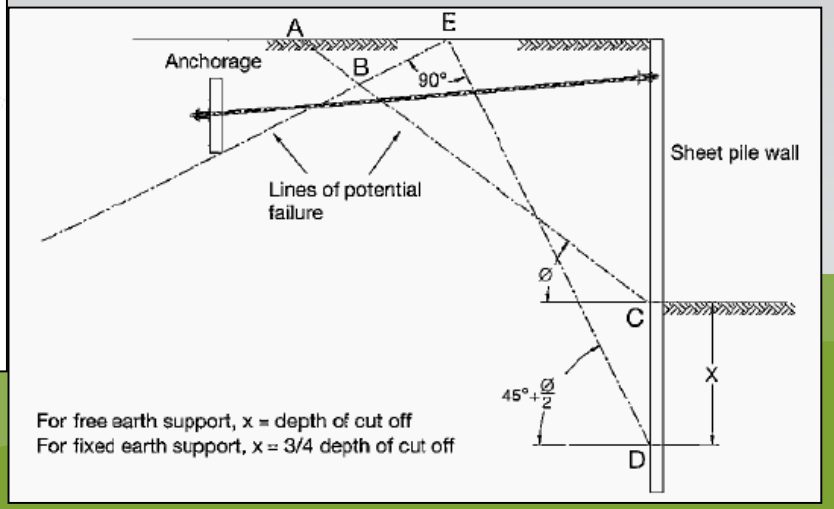
HEADWALL STRUCTURE:

- Consists of a combi-wall of tubular steel king piles joined by sheet piles, anchored by 33 meter long tie-rods to a sheet pile anchor wall.
- Various loads were taken into consideration for the headwall design, e.g. construction, operational and seismic.





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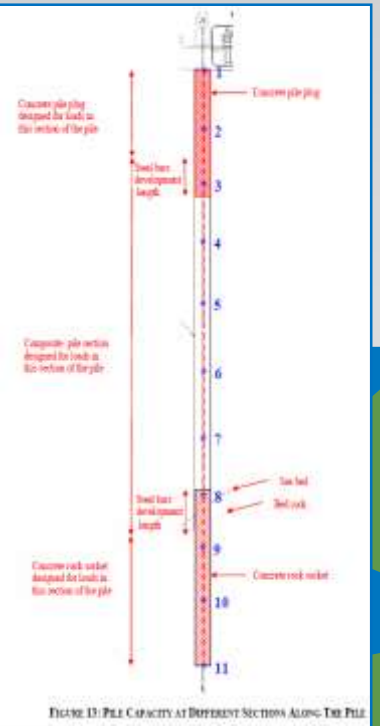
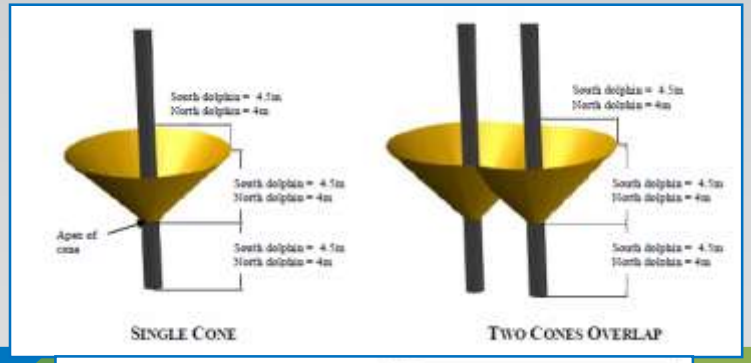
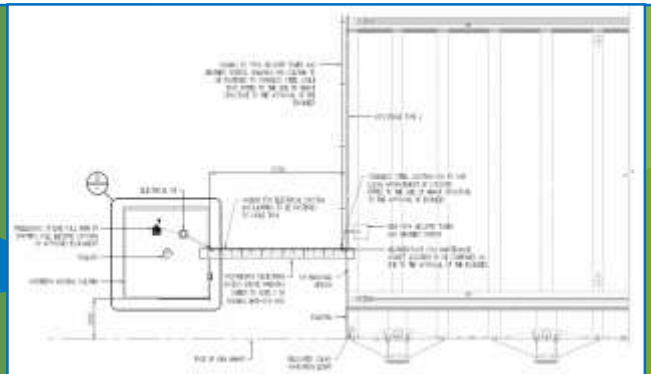
DOLPHIN & WALKWAYS:

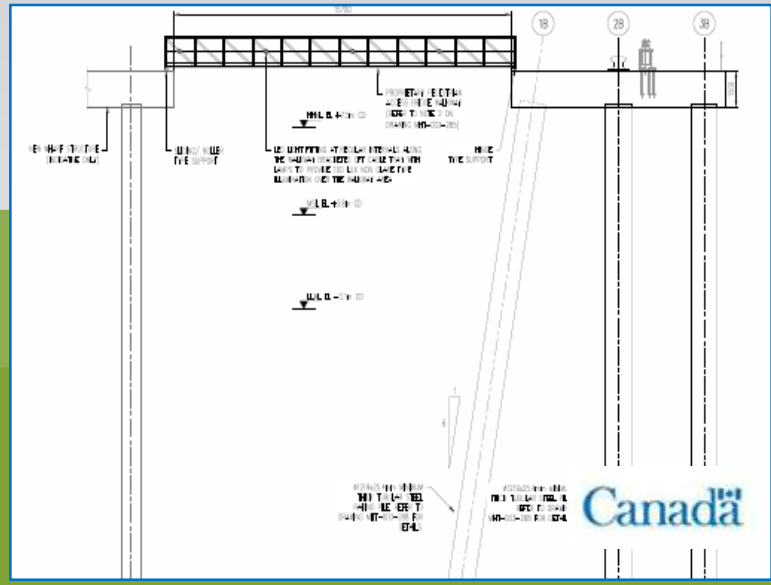
- Mooring Dolphins: Are open tubular steel piles filled with concrete with reinforced concrete socket into the hard bedrock layer. The piles are connected to the reinforced concrete deck by a reinforced concrete plug. The deck slab will be constructed in-situ. The pile spacing has been appropriately set on a grid and a sliding/roller type support at the wharf end is capable of spanning from the wharf.
- Walkways: Hinge type support at dolphin end to each mooring dolphin.





Pile Rock Pull Out Cone





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INTERMODAL YARD/ RAIL EXPANSION:

- Consists of upgrading the rail capacity with the addition of four working tracks.

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INTERMODAL YARD / RAIL EXPANSION:

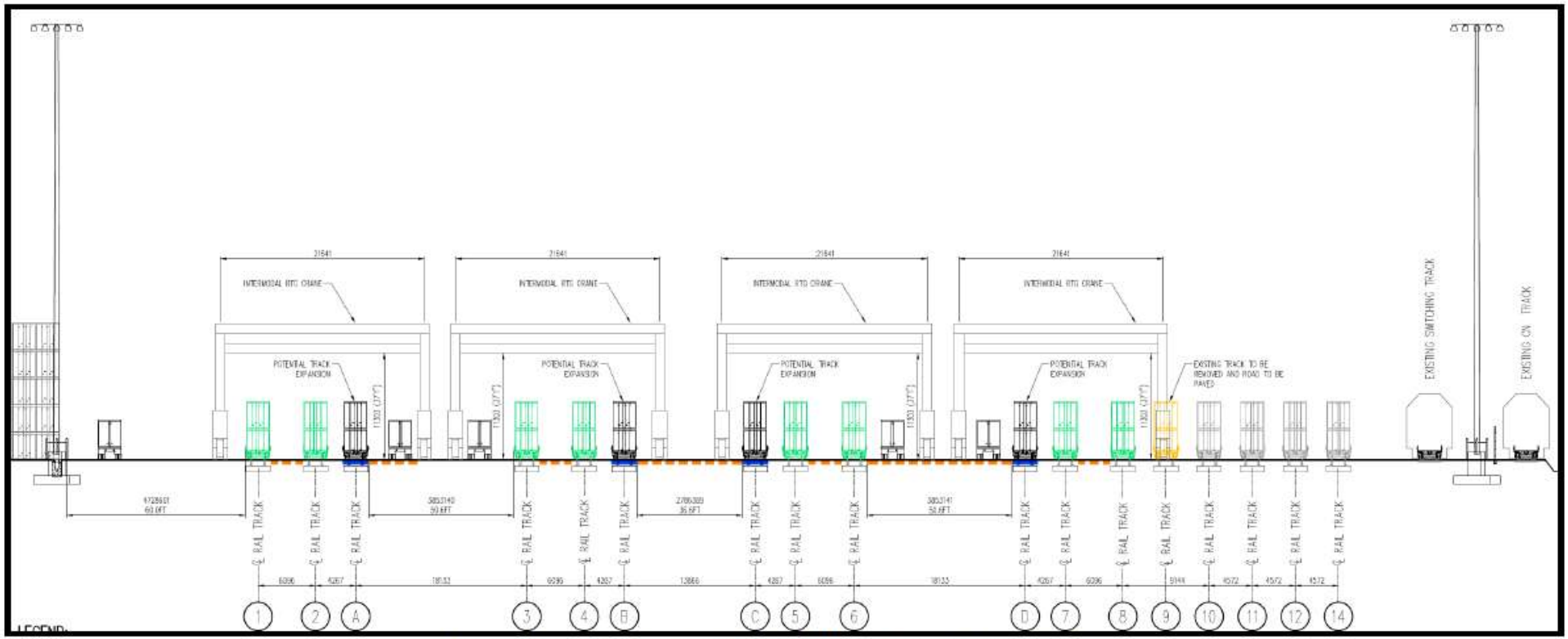

FIGURE 4: CROSS SECTION THROUGH INTERMODAL TERMINAL

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THANK YOU

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