Basis of Design
90% Submittal

Port of Neah Bay
Makah Dock Extension

Submitted to

Port of Neah Bay
Neah Bay, Washington

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Submitted by

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BASIS OF DESIGN

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BASIS OF DESIGN
COMMERICAL DOCK REPLACEMENT
PORT OF NEAH BAY, NEAH BAY, WASHINGTON

This report sets forth the Basis of Design for the Makah dock extension located within the Port of Neah Bay, Neah Bay, Clallam County, Washington and adjacent to the existing newly completed Makah Commercial Fishing Dock.

GENERAL INFORMATION

Project Information

An emergency response towing vessel (ERTV) and associated vessels have been stationed at Neah Bay since 1999 under contract to Washington State Department of Ecology (Ecology). The ERTV is contracted for oil spill response contingency plan citation and for use during vessel emergencies by owners or operators of vessels transiting through the Strait of Juan de Fuca (except for transits extending no further west than Rack Rocks light). The Jeffery Ross (tug) is stationed at the marina in Neah Bay under charter to the Washington State Maritime Cooperative (WSMC) per a service agreement with the ERTV Compliance Group. It is the understanding of BergerABAM that the current mooring structures at the marina are not adequate for the ERTV and their required operations. The proposed dock extension would provide a permanent mooring location for the vessels and allow greater functionality for vessel loading and unloading operations.

Project Location

The Makah dock extension is located within the Port of Neah Bay in Neah Bay, Washington. Neah Bay is located on the northwestern corner of the Olympic Peninsula along the entrance to the Strait of Juan de Fuca; Latitude 48° 22′ N, Longitude 124° 36.7′ W.

Units, Datum, Project Survey Control

Survey data is provided relative to the Washington coordinate system grid, north zone, and North American Datum of 1983 (2011) epoch 2010.00. The vertical datum used for the survey and the drawings is mean lower low water (MLLW) as published on NOAA benchmark data sheets for Station ID 9443090.

Site-specific Data

Dock Dimensions and Layout

The proposed dock will provide a 20-foot-wide, 520-foot-long approach main trestle leading to two 24-foot wide piers. Pier 1 is approximately 240 feet long and Pier 2 is approximately 300 feet long. Main trestle support bents will be placed nominally at 40 feet on center while bents supporting the piers will be spaced nominally at 30 feet on center. Two, 180 foot floating concrete docks for small crafts are located on the north side of the main trestle and are accessed via the trestle by aluminum or steel gangways. Access for two future floating concrete docks on the southern side of the main trestle has been incorporated into the design should addition berth space be deemed necessary.

Bathymetry

The existing bathymetry ranges from approximately -3 feet mean lower low water (MLLW) at the shoreline side of the dock extension to approximately -20 feet MLLW at the north end of the finger slips. Dredging is required for this project to provide enough water depth for vessel draft at the mooring positions. The basins around the finger slips will be dredged to an elevation of -25 feet MLLW and extend out to the -25 foot contour, which is approximately a length of 1,200 feet. The width of the dredging will be approximately 800 feet. The dredging work will include a small amount of maintenance dredging around the existing commercial fishing dock to an elevation of -15 feet (MLLW).

Deck Levels

The elevation of the existing commercial fishing dock is approximately 16.5 feet (MLLW). The new dock will be constructed to match. Finish deck elevations will vary to allow for storm water drainage.

Environmental Conditions

Water levels and atmospheric data are developed from the Strait of Juan de Fuca, Neah Bay, Washington, station datum of the National Ocean Service (NOAA), No. 9443090. The station Epoch datum is 2.02 feet North American Vertical Datum (NAVD 88).

Water Levels:	Lowest observed water level (11/26/2007)	-3.94 feet
	Mean Lower Low Water (MLLW)	0.00 feet
	North America Vertical Datum (NAVD88)	0.71 feet
	Mean Low Water (MLW)	1.59 feet
	Mean sea level (MSL)	4.32 feet
	Mean tide level (MTL)	4.35 feet
	Mean high water (MHW)	7.11 feet
	Mean higher high water (MHHW)	7.95 feet
	Highest observed water level (11/30/1951)	12.30 feet
Flood Levels:	100-year flood zone V3	V3
	100-year flood elevation (NAVD88)	19.81 feet
Waves:	None considered. The project does not have floating structures; therefore, the wave loading is insignificant to the pier. A breakwater from the adjacent marina provides protection.	
Wind on Structure:	Ultimate Design Wind Speed, (3-second gust)	150 mph
	Exposure	D
Wind on Vessel:	Basic Wind Speed (30-second gust)	103 mph [90knots]
	Exposure	D

Current:	Current is 2.0 knots parallel to the berth	
Temperature:	Average annual high (July) Average annual low (January)	60.0 (F) 38.7 (F)
Rainfall:	Average annual rainfall days Average annual precipitation	186 days 102.4 inches
Snowfall:	Average yearly snowfall Design snow load	8.6 inches 30 psf
Atmospheric Ice:	None considered	
Seismic:	The project will be designed in conformance with the current International Building Code (IBC, 2015). The IBC design methodology uses two spectral response coefficients, S_S and S_1, corresponding to periods of 0.2 and 1.0 second to develop the design earthquake spectrum. The spectral response coefficients were obtained from the U.S. Geological Survey (USGS) Uniform Hazard Response Spectra Curves for the coordinates of 48.36° N latitude and 124.61° W longitude. The S_S and S_1 coefficients identified for the site are 1.238 g and 0.626 g, respectively. These bedrock spectral ordinates are adjusted for Site Class D with the short- and long-period site coefficients, Fa and Fv, based on the soil profile in the upper 100 feet in accordance with Section 20.4.1 of ASCE 7.	
Tsunami:	Not Considered	
Geotechnical Hazards:	The geology of the site is made up of a dense layer of sand from approximately 5 feet below mudline to approximately 40 feet below mudline. Below this is a medium dense layer of silty sand. Per the geotechnical engineer, the medium dense silty sand layer has liquefaction potential during the design earthquake event.	

Permits and Approvals

This project requires permits and project approvals from Tribal, Federal, State and local agencies including:

- U.S. Army Corps of Engineers(Corps): Section 10/404 (Section 106 Cultural Resources Review and Section 7 Endangered Species Act Consultation also required)
- United States Department of Agriculture, National Environmental Policy Act (NEPA) review
- Makah Indian Tribe 401 Water Quality Certifications

- Makah Indian Tribe Coastal Zone Consistency Determination
- Washington Department of Fish and Wildlife: Hydraulic Project Approval
- Washington Department of Natural Resources: Right of Entry for State-Owned Aquatic Lands
- Clallam County Shoreline Conditional Use Permit

Design Life

The design life of the various components comprising the new facility is 50 years.

Demolition

Spot demolition of the existing commercial fish dock is required along the west edge of the access trestle. Demolition includes partial removal of the concrete vehicle barrier and adjacent pavement.

DOCK STRUCTURAL ENGINEERING

Codes

- 2015 International Building Code
- 2015 International Fire Code
- American Concrete Institute "Building Code Requirements for Structural Concrete" (ACI 318-14)
- American Institute of Steel Construction "Steel Construction Manual 14th Edition" (AISC 360-16)
- American Society of Civil Engineers "Seismic Design of Piers and Wharves" (ASCE 61-14)

References

1. California State Lands Commission, Marine Facilities Division, "Marine Oil Terminals, Engineering and Maintenance Standards," May 2002
2. U.S. Department of Defense "Piers and Wharves," October 1987 (MIL-DBK-1025/1)
3. U.S. Department of Defense "Mooring Design," July 1999 (MIL_HDBK_1026/4A)
4. USGS "Seismic Hazard Curves and Uniform Hazard Response Spectra for the United States," Version 3.10, March 2001

Design Loads

In addition to self-weight, the deck will be designed to resist the following loads. Load rating signage will be placed on the dock. All vehicle and concentrated loads will have a 15 percent impact factor increase.

Vertical Live Loads

Uniform:	250 psf Uniform – Main Trestle
	250 psf – Piers
	40 psf – Small Craft Floats
Highway Truck:	AASHTO HS-20-44
Forklift:	10-ton capacity forklift

Design Vessels

Vessel	LOA [ft.]	Beam [ft.]	Draft [ft.]	Displacement [T]
Jeffrey Foss	120	31	11.5	307
Garth Foss	155	46	18.5	350
Oil Spill Response Vessels (Small)	70	22	6	115
Oil Spill Response Vessels (Large)	210	44	14	1400
Oil Spill Response Barge	250	76	17*	2200

*The displacement and design berthing energy is based on a vessel draft of 4 feet

Lateral Forces

Berthing and Mooring Forces – Lateral forces resulting from berthing and mooring of vessels are determined using the design criteria and methods outlined in MIL-HDBK-1025/1 and MIL HDBK-1026/4A. Consideration is given to the effects of the fenders and fender pile system on the magnitude of these forces.

The design wind and current velocities used to determine the mooring forces on a light draft ship are 90 knots (103 mph, 30 second gust), and 2.4 knots, respectively.

The design vessel approach velocity is 1 knot, and the velocity perpendicular to the dock is 0.4 knots. The design vessel approach angle is 10 degrees. This design criteria results in a maximum design berthing energy of 20 k-ft with an accidental berthing energy of 30 k-ft.

Seismic Forces – Seismic demand on the dock and trestle will be per a non-linear static pushover analysis. Base shears and member forces will be determined from the analysis model, hinging and yielding of seismic force resisting system members will be limited to the supporting piles. The design will be based on displacement and ductility criteria from ASCE-61. Design Level Earthquakes:

- Operational Level Earthquake – 72 year return period, operational limit on utilities with minor repair to regain dock operations.
- Contingency Level Earthquake – 2/3 of Maximum Considered Earthquake (2,475 year return period), life safety, collapse prevention

Relative Movement – Relative horizontal and vertical movement, including that caused by seismic, shrinkage, temperature change, and mooring and berthing, shall be accommodated at all deck joints, including the deck/trestle interface.

Description of Structural Framing

The structural system of the piers consists of steel plumb piles; precast concrete pile caps; and precast, prestressed concrete haunched deck panels. The main trestle is constructed of steel plumb piles; precast concrete pile caps; and precast, prestressed concrete channel beams with concrete closure pours. Topping consists of AC paving for both the trestle and piers.

Gravity loads are transferred through the paving to the haunched deck panels or channel beams in bearing, the panels or channel beams to the pile caps in bearing, pile caps to the piles in bearing, and piles to the soil in end bearing and skin friction.

Lateral loads, including wind, current, seismic, and berthing are transferred through the deck panels or channel beams the pile caps in shear friction. The deck panels and channel beams with closure pours act as a structural diaphragm to distribute the loads between bents in proportion to the bent relative stiffness. The pile caps and piles act as moment frames in the transverse direction of framing to resist loads in shear and flexure. The pile caps, piles, and panels or

channel beams act as moment frames in the longitudinal direction of framing to resist the loads in shear and flexure.

Deck Fixtures and Fittings

Bollards/Cleats
Vessel mooring will be completed using cleats and bollards cast into the top of the deck. The bollards are designed to resist a mooring line load of 50 tons and the cleats are designed to resist a mooring line load of 25 tons.

Bollards and cleats are designed to accommodate the following angles of line pull.

Horizontal Range: 0 to 180 degrees
Vertical Range: 0 to 30 degrees

Fendering
Mooring and berthing loads will be resisted by a fender system attached to the dock. The fender system will consist of steel fender piles spaced nominally at 15-feet on center around the perimeter of the piers. Fender piles will be driven into the earth to a depth sufficient enough to react to the vessels calling to the dock. Connection to the deck will be through a steel wale spanning to energy absorbing rubber fenders connected to the structural pile caps.

Utility Vaults
Utility vaults will be located at utility hook-ups.

Ladders
Ladders will be constructed of galvanized steel and spaced within 200 feet of work areas.

Deck Drainage
Design shown in 90% Submittal Package - Deck drainage will be accomplished by sloping the topping slab and providing surface drains within the deck. All surface water will directly drain into Neah Bay through scuppers integral with the bull rail.

Future Design Intent –
Stormwater treatment is required on the dock due to the presence of vehicle operations. Drainage will be directed to in-deck vaults for treatment prior to discharge to the bay.

Trestle
Deck drainage on the trestle will be accomplished by sloping a HMA (Hot-mix asphalt) topping into water quality treatment catch basins located at discrete locations along the length of the trestle.

Piers
Deck drainage on the piers will be accomplished by sloping the HMA topping towards a constant depth (low profile) trench drain incorporated into a cast-in-place topping slab that

runs the length of the piers. The structure and drain will slope down to the north at 0.50% into water quality treatment catch basins mounted on the north end of the piers

Railings
Steel 3-bar guardrails will be provided along the main trestle. Traffic barriers will not be provided because traffic is expected to be minimal. No railings will be provided on the piers, as it is a working marine facility.

Life Rings
Life rings will be placed per OSHA requirements in fiberglass cabinets.

Foundation

- A subsurface investigation report and geotechnical site conditions were developed by Landau Associates, Inc. in the following report:
    - "Draft Geotechnical Engineering Report Port of Neah Bay Dock Extension, Neah Bay, Washington" by Landau Associates, Inc. dated February 13, 2017.
- The foundation design shall conform to the recommendations included in the Landau Report.
    - Gravity & Static Lateral Force Foundation Design: During normal gravity and lateral wind loading conditions, the supporting piles will bear in the dense sand and or medium dense silty sand at or near 40 feet below mudline.
    - Seismic Foundation Design: During a design seismic event, the underlying soil strata approximately 40 feet below the mudline may liquefy, eliminating pile end bearing resistance. Settlements of approximately 6-inches are possible and may be differential, causing damage to the dock, during the 2/3 MCE earthquake.
- Coated steel plumb piles shall be used for the foundation of the dock and trestle. Piles shall be designed to resist the vertical and lateral forces and loads in conformance with the referenced documents and as stated herein.
- Fender piles will be coated steel pipe piles and shall be designed to resist the lateral forces from berthing and mooring.
- Guide piles will be coated steel pipe piles and shall be designed to resist the lateral forces induced by the floating concrete docks.

Material

Reinforced Concrete
- Reinforcing Steel
    - Reinforcing Bars – Deformed steel bars conforming to ASTM A 615, Grade 60
    - Weldable Reinforcing Bars – Deformed steel bars conforming to ASTM A 706, Grade 60

  - Prestressing Steel – Low relaxation, stress-relieved strand conforming to ASTM A 416, Grade 270

- Precast Concrete
  - Precast concrete pile caps and precast/prestressed concrete deck panels and channel beams – Compressive strength, f'c=7,000 psi at 28 days

- Cast-in-place Concrete
  - Compressive strength, f'c=5,000 psi at 28 days.

Grout

- Grout for dowels in pile to pile cap connection
  - Nonshrink, nonmetallic, cementitious grout
  - Compressive strength, f'c=8,000 psi at 28 days

Structural Steel

- Wide flange-conforming to ASTM A 992, Grade 50
- Angles, channels and plate conforming to ASTM A 36
- Hollow structural shapes conforming to ASTM A 500, Grade B
- Pipes and sleeves conforming to ASTM A 53, Grade B
- High Strength Bolts, ASTM A 325 (ASTM A 492 for threaded bars)
- Economy Bolts, ASTM A 307
- Stainless Steel Nuts and Bolts, ASTM A316
- Anchor Rods, ASTM F1554, Grade 55 to 105
- Welding, E70, Low Hydrogen Electrodes

Steel Piles

- Steel pipe piles conforming to ASTM A 252, Grade 3 with modifications

Coatings

- Steel pipe plies will be coated with a 3-coat, 2-part marine epoxy.
- All miscellaneous steel items, except cleats, will be hot-dip galvanized in accordance with ASTM A 123 for shapes and plates and ASTM A 153 for threaded fasteners. Bollards will be painted. Galvanized materials exposed to rainwater will be coated to reduce zinc leaching.

CIVIL

The new dock extension will have an HMA topping that overlays the concrete deck to permit grading of the structure for stormwater runoff. Due to the vehicular traffic, stormwater on the dock and trestle will be captured and treated in water quality treatment catch basins prior to release into the receiving water body.

Codes and References

The project is under the jurisdiction of the City, which is subject to Washington State codes and City amendments.

Washington State Codes and/or References

- Washington State Department of Ecology, Stormwater Management Manual for Western Washington, August 2012

National Codes and/or References

- U.S. Department of Transportation, Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2009
- Department of Justice, ADA Standards for Accessible Design, September 15, 2010
- National Marine Fisheries Service

Authorities Having Jurisdiction (AHJ)

- Makah Tribal Council
- Clallam County - Department of Community Development

Design Criteria

Stormwater

Stormwater runoff from impervious areas subject to vehicular traffic will be subject to the requirements of Ecology. Runoff will be captured and treated before being released to the receiving body of water. Determination of treatment flow rates will be based on Ecology guidelines, using the Western Washington Continuous Simulation Hydraulic Model. This model determines a water quality flow rate for design that is defined as that which 91 percent of the runoff volume, as estimated by the model, will be treated using a 15-minute time series. Flow control is not required since the runoff will be released directly into a receiving body of water. Basic treatment will be provided using emerging technologies that have General Use Level Designation (GULD) from Ecology. Because the majority of impervious surfaces on this project are related to the trestle and dock, it is not a good candidate for implementation of Low Impact Development (LID) strategies. It is assumed the landside runoff can be conveyed to an existing 18-inch CMP outfall located in the vicinity of the project site. For conveyance design, a 100-year 24-hour event will be used with the Santa Barbara Unit Hydrograph (SBUH) method for evaluating peak flows in a conveyance system. A fixed time of concentration of 5 minutes will be used in the model.

Pavement

Due to the slow moving and braking truck traffic, it is recommended a PG70-22 mix design be used with a polymer modified binder.

Materials
All land side utility components and Civil-related materials will be industry standard and comply with the Makah Tribe codes and standards.

MECHANICAL & PLUMBING
The new pier structure will be concrete construction, which does not require fire sprinkler protection on the underside but will require standpipes for the dock area. Piping for potable water and fire protection will be extended from the existing access trestle onto the extension. Seismic joints are included at the interface between the commercial dock trestle and the extension trestle, as well as between the extension trestle and the extension finger piers.

Potable water will be extended from the existing 3-inch pipe on the existing access trestle and out to freeze-protected hose-bib stations for the vessels to fill tanks and nominal washdown.

The fire protection line under the existing dock does not have sufficient capacity for the dock extension. Therefore, a new dry-standpipe will be installed adjacent to the existing dock's abutment and new fire protection line run under the existing trestle out to the dock extension.

Codes and References
The project is under the jurisdiction of the City, which is subject to Washington State codes and City amendments.

Washington State Codes
- 2015 International Building Code
- 2015 International Mechanical Code
- 2015 Uniform Plumbing Code
- 2015 Washington State Non-Residential Energy Code
- Washington State Department of Health, Water System Design Manual, December 2009

National Fire Protection Association (NFPA) Codes
- NFPA-14, Standpipe and Hose Systems, 2016 edition
- NFPA-303, Marinas and Boatyards, 2016 edition
- NFPA-307, Marine Terminals, Piers, and Wharves, 2016 edition

Authorities Having Jurisdiction (AHJ)
- Makah Tribal Council
- Clallam County - Department of Community Development
- Neah Bay Fire Department

Design Criteria
Provide a potable water system, and dry standpipe system for fire protection to serve the dock extension.

Fire Suppression
Provide a manual dry standpipe for the dock extension. Size the standpipe main hydraulically based on 500gpm flow at the most remote hose valve outlet at 100psi. Assume inlet flow of 500gpm and pressure of no more than 150psi at the FDC. Minimum main size is 4inch or larger as required per calculations in accordance with NFPA 14.

Locate hose valve manifolds along the edge of the trestle, protected from impact, with hose valves at a nominal height of 30 inches above the trestle walking/driving surface. Install FDC on the along the edge of the trestle, protected from damage, adjacent to the transition to shore. Install FDC at a nominal height of 30 inches above the trestle walking/driving surface. Standpipe main shall be installed on the underside of the trestle, coordinated with other trades. At the hose valve manifold and FDC locations, loop the standpipe under the beam edge of the trestle and up to appropriate mounting elevation for the hose valves and FDC inlets. Main will be subject to freezing temperatures. Slope all pipe in accordance with NFPA 14 (minimum ¼" per 10ft) and to avoid creating locations where water can be trapped. Provide a means to drain any low points and trapped sections.

Fire sprinkler protection is not required under the new pier as it is concrete and noncombustible.

Potable Water
Potable water service will be provided for the new building per the Uniform Plumbing Code. Piping shall be insulated and heat-traced, and protected by exterior jacketing. Ship service connections shall include isolation valving, backflow preventers, and quick-connect fittings. Post hydrants shall be located along the pier with stand ¾" hose connections.

Materials

Fire Suppression
The fire sprinkler system shall be composed of galvanized piping with hot-dip galvanized fittings. The standpipe system shall be galvanized piping with hot-dip galvanized fittings. Hose connections shall be brass or bronze. Flexible connections or swing joints shall be provided at all locations where piping crosses seismic joints.

Piping insulation shall be jacketed fiberglass with aluminum final jacket. Heat trace systems shall be rated for use on fire protection piping systems. Fire pump systems shall be electric powered.

Potable Water
Potable water service piping shall be constructed of stainless steel piping. Piping shall be insulated per Energy Code requirements. Connections shall be suitable for potable water service and constructed of bronze or stainless steel. Flexible connections shall be provided at all locations where piping crosses seismic joints.

Piping insulation shall be elastomeric foam with aluminum jacketing.

ELECTRICAL

Power for the extension will be provided by new switchgear and transformers located on the new trestle. Medium-voltage power will be brought out to the existing trestle in parallel to the existing medium-voltage feed and extend onto the new trestle. On the new trestle, the medium voltage will be stepped down to 480 volt and 240 volt power for ship connections, lighting, and industrial power. Remote reading meters will be provided at each ship power station. Extra ducts were installed in the existing pier to allow both power and communication to be extended onto the new dock. Additional conduits will be extended onto the new trestle and to each ship berth. It is assumed that future communications service providers will install needed wire and outlets for the individual berths, paid by the future tenant. Security lighting will be provided on a photocell with full cutoff, LED, pole-mounted fixtures. Additional operational lighting will be provided for night operations. Photocell and timer will control operational lighting and will be turned on only when needed.

Codes and References

The project is under the jurisdiction of the Makah Indian Tribe and subject to Washington State codes.

Washington State Codes

- 2015 International Building Code
- 2015 International Fire Code
- 2015 Washington State Non-Residential Energy Code

National Fire Protection Association (NFPA) Codes

- NFPA 70: National Electrical Code, 2017 Edition
- NFPA 101: Life Safety Code, 2017 Edition

Authorities Having Jurisdiction (AHJ)

- Electrical Inspector – Washington State Labor & Industries
- Fire Department - Makah Tribe
- Clallam County PUD – Electric Utility
- CenturyLink – Telephone Utility

Lighting Design Reference

- IESNA: Illuminating Engineering Society of North America

Design Criteria

Provide electrical distribution system for new pier, vessel shore power, area lighting, and communications distribution. System will be sized based on known equipment to be connected and for 25 percent future capacity.

Power System on Dock

Provide new 1,200A, 480/277-volt, 3-Phase, 4 wire, main service equipment with dry-type transformers to provide, 208/120V, 3-Phase, 4 wire and 240/120-volt, single phase distribution on the dock to power lights, ship connections, and miscellaneous equipment on the dock. Detail

design will determine requirements for cable routing within the dock and style of shore power boxes. Area classification based on requirements of 2008 NEC will be reviewed to determine compliant equipment and possible hazardous installation areas in relation to fuel dispensing equipment.

All exterior exposed electrical transformers, panels, and enclosures will be T316 stainless steel for long-term durability. PVC-coated rigid galvanized steel, Schedule 80 PVC, and fiberglass conduits will be allowed, depending on location. All conductors and busses shall be copper.

All exterior exposed electrical junction boxes and enclosures will be T316 stainless steel for long-term durability.

Lighting

All security lighting are full cutoff, LED fixtures to reduce "sky glow." Consideration was provided for good color rendering as opposed to high-pressure sodium, which is a yellow light source.

Lighting on the dock will be a combination of 20-foot steel poles on the trestle and 12-foot steel poles on the piers. All lighting will have automatic/manual controls and meet the current Washington State Non-Residential Energy Code for wattage and controls.

Stainless steel bird spikes will be provided on exterior light fixtures and poles to discourage birds and the related health hazards.