APPENDIX E:

RIVERFRONT ACCESS, DREDGING AND MARINE INFRASTRUCTURE ASSESSMENT REPORT

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RIVERFRONT ACCESS, DREDGING, AND MARINE INFRASTRUCTURE ASSESSMENT REPORT

BARLOW POINT

Prepared for

KPFF

1601 5th Avenue, Suite 1600

Seattle, Washington 98101

Prepared by

Anchor QEA, LLC

720 Olive Way, Suite 1900

Seattle, Washington 98101

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LIST OF ACRONYMS AND ABBREVIATIONS

CRD	Columbia River Datum
DNR	Washington Department of Natural Resources
ESA	Endangered Species Act
HPA	Hydraulic Project Approval
MLLW	mean lower low water
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
PMA	Port Management Agreement
Port	Port of Longview
RM	river mile
ROE	right-of-entry
SMS	Sediment Management Standards
SR	State Route
USACE	U.S. Army Corps of Engineers
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources

EXECUTIVE SUMMARY

In 2010, the Port of Longview (Port) purchased the 275-acre property at Barlow Point, with an additional 7.5 acres acquired in 2012, for a total of 282.5 acres for future Port industrial development. The property is located downstream of the current developed Port at approximately river mile 64 (RM 64), which is on the west side of the City of Longview, Washington. In order to better understand the full potential of the Barlow Point site, the Port determined that a comprehensive master planning process should occur. The first step in that process was to perform a due diligence study to assess the development feasibility of Barlow Point into a marine terminal. Market analysis and conceptual site planning exercises were performed in late 2014 through early 2015 to identify possible types of use and site layouts. Two options arose from those processes, which focus on production and export of dry or liquid bulk commodities. Specific industry types were identified from the market analysis to be the basis to analyze demand and capacity requirements for Barlow Point. The dry bulk option (Option 1) includes potash (export only), urea (production and export), and wood pellets (export only). The liquid bulk option (Option 2) includes crude oil (export only), methanol (production and export), and biodiesel (production and export).

As part of the due diligence study, this report summarizes physical site conditions and regulatory requirements that could potentially impact siting of proposed development of marine infrastructure at Barlow Point ("fatal flaws"). This "fatal flaws" assessment is based on a review of a preliminary search of publicly available data and discussions with Port staff and other design engineers. Specifically, this report reviews wind, water level, and current data near the project site; potential wind wave and wake conditions at the project site; permitting of construction and anticipated maintenance dredging; and other related considerations with the potential to impact development of Barlow Point or inform siting of the marine infrastructure. Where applicable, this report also identifies data gaps and next steps in the design process.

In general, based on the results of this evaluation, no significant impacts were identified that would preclude riverfront access or development of marine infrastructure at the site. Additional design considerations associated with vessel mooring and operational requirements will need to be incorporated in future designs to evaluate and address site-

specific wind, wave, current, mooring, berthing, and passing vessel forces. However, none of the design criteria associated with these design considerations are currently anticipated to be excessive to the point that they could not be reasonably mitigated by design. Additionally, maintenance dredging is anticipated to be required on a regular basis to maintain operational depth at berth; however, volumes are anticipated to be less than the capital construction dredging. Maintenance dredging volumes will ultimately be dependent on the preferred alternative (i.e., pier lengths) and corresponding post-construction bathymetry.

1 WIND, WAVE, CURRENT, AND WATER LEVEL INFORMATION

1.1 Existing Conditions

To investigate physical site conditions at Barlow Point, readily available data sources were reviewed, including the following:

- Hourly wind data from the following two local sources:
  - Southwest Washington Regional Airport (KKLS; Western Regional Climate Center 2015a, b)
  - National Oceanic and Atmospheric Administration (NOAA) station #9440422 (tides) and co-located land-based meteorological station LOPW1 (Columbia River at Longview, Washington, 4.1 miles upstream of Barlow Point; NOAA 2015)
- Water level information:
  - NOAA tide station #9440422, at Longview, Washington (CO-OPS 2015)
- Current information:
  - Instantaneous velocity data from NOAA meteorological station LOPW1 in the Columbia River at Longview, Washington (NOAA 2015)
  - Predicted flood frequency velocities at the approximate project location from the Federal Emergency Management Agency (FEMA) Preliminary Flood Insurance Study for the project site (FEMA 2013)

These sources were reviewed to get a general sense of both operational and extreme conditions at the project site in an effort to identify concerns with the proposed marine infrastructure development at Barlow Point.

1.1.1 Wind

Wind data were collected from the Southwest Washington Regional Airport (KKLS) and NOAA Station 9440422 (NOAA 2015; Western Regional Climate Center 2015a, b) on meteorological station LOPW1, in the Columbia River at Longview, Washington, in the immediate vicinity of the State Route (SR) 433 Bridge to Oregon (4.1 miles south-southeast/upstream of Barlow Point). Wind speed averages range from 0 to 11 knots, with slightly higher averages occurring in March, November, and December. Average wind gusts,

reported daily, range from 1 to 15 knots, with higher ranges occurring in the same month periods. Recorded peak wind gusts have been measured between 22 and 43 knots at the nearby NOAA meteorological station in Longview (NOAA 2015).

The dominant wind direction was generally observed to be from the southeast in the winter months and from the west-northwest during the summer months. This corresponds roughly to the river channel alignment at Barlow Point, which is parallel to the proposed dock alignments. Winds do occur from the southwest and northeast directions, perpendicular to the proposed dock alignments, but with much less regularity. This implies that the majority of the mooring load from winds would be parallel to the dock, and may be focused on the bow lines or stern lines depending on the orientation of the ship at berth and the time of year. Wind loads perpendicular to the ship are possible but will likely be smaller in magnitude than the in-line forces.

1.1.2 Waves

Wind-waves at the site are not expected to be significant due to the small fetch distance available for wind-wave generation in the Columbia River at the project site. Wakes from passing vessels are anticipated to be larger (on average) than wind-generated waves and may pose a concern to some of the proposed vessel operations at the site. It is noted that gabion baskets are currently on the site shoreline, indicating that wind-wave or vessel wake impacts are likely a consideration for shoreline erosion at the project location.

1.1.3 Water Levels

Water levels within the Columbia River at the Barlow Point site are influenced by both tides and river flows from upstream. Operational or "everyday" water levels in the Columbia River at the site are due to the influence of tides. Tidal data for the project site were taken from the NOAA tide station at Longview, Washington (#9440422; CO-OPS 2015), located just upstream of the site, and are summarized in Table 1. Tidal data are provided relative to three vertical data: mean lower low water (MLLW), North American Vertical Datum 1988 (NAVD88), and Columbia River Datum (CRD). CRD is most commonly used by agencies for

projects along the Columbia River.[1] Table 2 provides conversion factors between the three vertical data at the site.

Table 1
Tidal Datum at Longview, Washington (NOAA Station #9440422)

Tidal Datum	Elevation in Feet		
	Relative to MLLW	Relative to NAVD88[a]	Relative to CRD[b]
Mean higher high water	4.6	9.5	7.0
Mean high water	4.1	9.0	6.5
Mean tide level	2.2	7.1	4.6
Mean low water	0.4	5.2	2.7
Mean lower low water	0.0	4.9	2.4

Notes:
CRD = Columbia River Datum
MLLW = mean lower low water
NAVD88 = North American Vertical Datum of 1988
NOAA = National Oceanic and Atmospheric Administration

Table 2
Vertical Datum Conversion Factors

Datum	From MLLW	From CRD	From NAVD88
MLLW Datum	0	2.4	4.9
CRD Datum	-2.4	0	2.5
NAVD88 Datum	-4.9	-2.5	0

Notes:
Measurements are in feet.
MLLW datum based on NOAA Station #9440422
CRD = Columbia River Datum
MLLW = mean lower low water
NAVD88 = North American Vertical Datum 1988

In addition, extreme water levels at the project location can be much higher than those related to the tides (such as mean higher high water) due to flood events. The FEMA 10- and 100-year recurrence interval water surface elevations in the Columbia River at the project

[1] CRD is a U.S. Army Corps of Engineers non-tidal datum defined at distinct river miles relative to NAVD88, and is used as chart datum above RM 23 on the Columbia River.

location are approximately 16 feet NAVD88 (13.5 feet CRD) and 18 feet NAVD88 (15.5 feet CRD), respectively (FEMA Flood Insurance Study preliminary revision, May 31, 2015).

1.1.4 Currents

Current velocities in the Columbia River at the site are also influenced by both tides and flood events (flows from upstream). Operational, or "everyday," currents due to average river flows and tides increase or decrease with tidal phase, but the current direction is consistently downstream (toward the mouth of the Columbia). The "everyday" current velocity, based on available data, generally ranges from 0 to 3 feet per second (0 to 1.8 knots), depending on the tidal phase. These currents were measured at Longview, Washington (NOAA meteorological station LOPW1; NOAA 2015) and are expected to be representative of the project site. However, the bend in the river at Barlow Point may induce localized velocities at the project site higher than those reported upstream at Longview, Washington, where the river is in a straighter alignment.

Currents due to extreme flood events are higher than the "everyday" velocities. Predicted velocities at the site location due to the 100-year recurrence flood are expected be about 4.7 feet per second (2.8 knots; FEMA Flood Insurance Study preliminary revision, May 31, 2013).

1.2 Key Development Considerations

The following are development considerations based on the data and information compiled, reviewed, and presented in the previous section:

- Water levels and currents in the Columbia River at the project site are dependent on both tides and flows from upstream. Water level and current velocities due to flood events can be significantly higher than typical daily conditions due to tides. Piers and other marine infrastructure proposed for the Barlow site will need to be designed with these extreme water levels and currents in mind. The design life of these structures will also need to be taken into account.
- The average direction of the currents is expected to be at an angle to the dock face due to the location of the site on the bend in the river. This will induce a torque on vessels at berth and will need to be evaluated in design of the mooring system at the

project site. This may also be a consideration for berthing maneuvers and placement/design of fenders, dolphins, or other elements used for berthing of vessels at the site.

- Typical daily river currents are not expected to induce significant scour around piling at the proposed piers. However, extreme flood events (i.e., 10-year or 100-year flood) could result in significant scour in the local vicinity of the piles. In addition, propeller wash from vessels operating at the site could also cause significant localized scour around the site based on specific operations. These significant scour depths are likely to range from 5 to 10 feet below existing bed elevations, but would need to be evaluated in design to verify the vertical and spatial extent of anticipated scour due to floods and propeller wash.
- If outfalls are constructed to facilitate stormwater or other discharges, there is potential for associated scour around the outfall due to typical daily tidal velocities and flood events. Standard best management practices, such as outfall scour protection armoring, would likely minimize the potential for impacts to marine infrastructure. Any proposed outfalls must be carefully sited to minimize potential scour, and potential impacts from scour should be quantified prior to final outfall siting.

1.3 Fatal Flaws Considerations

No specific fatal flaws were identified in the review of these forces. The values are within average to low ranges to other comparable sites and can generally all be addressed through appropriate design measures.

1.4 Potential Mitigating Measures

No specific mitigation measures would be required to address the forces described in this section; however, adequate engineering and construction of infrastructure is required to provide marine infrastructure built to withstand the anticipated impacts and forces from winds, waves, water levels, and currents.

2 DREDGING SCENARIO ANALYSIS

2.1 Existing Conditions

The riverfront portion of Barlow Point is bounded to the southwest by the Columbia River navigation channel, with the upstream reach referred to as the Barlow Point Channel and the downstream reach known as the Walker Island Channel. The existing site bathymetry is characterized as a transition zone from a nearshore shelf at approximately -30 feet CRD to the deeper adjacent navigation channel, which is currently authorized to a depth of -43 feet CRD. Required capital dredging will create berths at the proposed elevation of -46 feet CRD. Capital dredging is referred to in this document as dredging required to provide initial operational depths during construction of the marine infrastructure. Based on nearby and upstream dredging actions conducted in the last 5 years, sediment at Barlow Point is expected to be a mix of silts and sands. In general, Barlow Point is not anticipated to be an area of sediment deposition, based on the river geometry being on a convex bend in the river; however, dredging will create modified bathymetry that may instigate local areas of deposition within the site boundaries. It should also be noted that immediately downstream of the site is an existing shoal area. This area is a depositional feature. The current level of analysis for this report is not detailed enough to determine the future post-construction dynamics of this area, including whether local drift and deposition patterns will be modified to the point that shoaling conditions may not be present in the future.

Adjacent sediment quality was reviewed by accessing the Washington State Department of Ecology's Environmental Information Management System database. Only a few adjacent sediment sampling locations were reported, most notably immediately upstream at the Former Reynolds Metals site. These sediment cores showed minimal observed contamination, with the exception of minor exceedances over Sediment Management Standards (SMS; Washington Administrative Code 173-204), in the immediate vicinity of an outfall. No other exceedances were reported, notably in the five downstream samples from the outfall, the furthest of which is immediately adjacent to the Barlow Point site. Two additional characterization cores were collected by the U.S. Army Corps of Engineers (USACE) offshore of Barlow Point as part of previous channel deepening efforts; however, the characterization of these cores was limited to physical characteristics. There are no indications from existing information that there would be contamination present in the

proposed dredge footprints associated with the marine infrastructure at Barlow Point; however, confirmation sampling will be required as part of pre-design or permitting investigations to verify this assumption.

2.2 Key Development Considerations

2.2.1 Structure Siting

The ultimate siting of marine infrastructure will include consideration of the balance between capital construction costs versus maintenance dredging costs and frequency. A range of sedimentation rates was estimated using data from the Port of Longview (Port) deepening project at Berths 8 and 9 based on dredging volumes provided by the Port. Upon reviewing the actual amount of material required to deepen the berths versus the estimated amount solely based on dredge depths and area, it was estimated that a sedimentation rate at these berths ranged from almost no deposition (0.05 foot per year) to 3 feet per year. These rates are likely on the high end for Barlow Point, based on site geometry, but provide an indication of potential sedimentation rates. Extrapolating these rates out to the Barlow Point site indicates that maintenance dredging may be required every 1 to 2 years based on required underkeel allowances for the design vessel. As noted above, changing conditions at Barlow Point due to capital dredging make the actual determination of sedimentation rates difficult to determine without additional data evaluation and/or modeling. Additionally, dredging may create a sedimentation basin in certain portions of the site, increasing sedimentation relative to what would be anticipated.

2.2.2 Dredging Permitting Considerations

Dredging projects in the Columbia River to create and maintain berthing areas and access require obtaining a suite of local, state, and federal permits, as well as characterizing sediment to identify dredge material placement options. Dredging adjacent to the Columbia River Federal Navigation Channel would require USACE review and approval under Section 408 of the Rivers and Harbors Act due to the presence of USACE-maintained infrastructure (the federal channel and Columbia River levees). It is anticipated that development at Barlow Point would include dredging and construction of wharves, piers, docks, or other shoreline components (i.e., marine infrastructure) to provide suitable berthing access for the vessels expected to utilize those facilities. Therefore, any initial capital dredging would be

included as part of the proposed overall marine infrastructure permitting effort and permitted as a component of the larger project. It may also be possible to build into the permitted action a maintenance dredging plan for the berths.

Generally, prior to dredging, sediments must be characterized to determine a suitable placement or disposal option. As discussed previously, existing information suggests that sediment in the vicinity of Barlow Point is generally clean sediment, with minimal to no measured contaminants present. However, characterization of the sediment adjacent to Barlow Point would still be required to satisfy permitting conditions. At this time, it is anticipated that the sediment would be considered suitable for open-water placement or beneficial reuse, and upland disposal at a permitted landfill would not be required.

Approvals for the Sediment Characterization Sampling process include the following:

- USACE Nationwide Permit 6 for survey and research activities including the following:
  - Environmental Species Act (ESA) Consultation
  - Section 106 Consultation
  - Confirmation of 401 consistency
- Washington Department of Fisheries and Wildlife (WDFW) Hydraulic Project Approval (HPA)
- Washington Department of Natural Resources (WDNR) Right of Entry (ROE)/Aquatic Use Authorization
- Cowlitz County Shoreline Exemption

Approvals to complete subsequent capital and maintenance dredging include the following:

- USACE Section 10/404 Individual Permit. This permit could be developed to provide approval for the initial dredging action and allow for 5 to 10 years of regularly occurring maintenance dredging. Typically this permit is authorized for a maximum amount (in cubic yards) of sediment to be removed over the life of the permit. Associated approvals would include:

  - ESA Consultation
  - Section 106 Consultation
- WDFW HPA
- Ecology Section 401 water quality certificate
- WDNR ROE/Aquatic Use Authorization
- Cowlitz County Shoreline Permit

Note that the Port is considering requesting this area to be included in their Port Management Agreement (PMA) with WDNR. As part of the PMA request, the Port should consider including all dredging actions as part of the PMA to eliminate the need for specific approvals from WDNR for each dredge event.

Maintaining the net overall sediment volumes (i.e., open-water placement) within the Columbia River system is preferred to removing them (i.e., upland beneficial re-use) based on input from regulatory agencies, particularly WDFW, as some concerns have been raised (although not directly supported by studies or research findings) that the lower Columbia River is operating with a sediment deficiency. In addition, there are ESA concerns regarding placement of dredged sediment in the uplands in the Barlow Point area, not only due to the presence of ESA-listed salmonids, but also because of the presence of eulachon. The Cowlitz River is a key spawning river for eulachon, and larval eulachon are believed to be carried out from their natal rivers attached to sediments. There is concern that removal of surface sediments, in particular during the out-migration of larval eulachon, may result in entrainment. As a result, placing dredged sediment back in the river (i.e., open-water placement) is currently viewed as favorable by the regulatory agencies.

2.3 Fatal Flaws Considerations

No fatal flaws were identified in association with proposed capital dredging or routine maintenance dredging. Adjacent sediment quality suggests that there are no contaminants of concern present in the sediments at Barlow Point. Additionally, review of adjacent sites indicates that sedimentation can be expected to be moderate with maintenance dredging frequencies similar to other Columbia River facilities in this area of the river (i.e., annually or every other year). Finally, permitting of both capital and maintenance dredging can be

included as part of the marine infrastructure and would be comparable in complexity and duration to other permitted dredging projects in the vicinity completed by the Port or others.

2.4 Potential Mitigating Measures

No specific mitigation measures would be required to facilitate development of the marine infrastructure, with respect to dredging. The following are additional considerations, but are all considered to be typical elements of a design process:

- Structure siting will be coordinated with structural engineers to minimize overall cost expenditures.
- Discussions are recommended with Columbia River pilots to determine an appropriate design depth and to include their input into the final siting of the pier structures.

3 OTHER INFORMATION TO INFORM SITING OF THE MARINE STRUCTURES

In addition to wind, wave, water level, and current impacts and dredging considerations, there are additional operational considerations that should be addressed and incorporated in design to facilitate development of marine infrastructure at Barlow Point. These include the following:

- Integrating the structures with the existing levee heights and the potential for future levee height expansion
- Structural and operational considerations associated with design of the marine infrastructure mooring systems
- Flexibility around the setback of the structures from the navigational channel to facilitate future beam requirements, should the site uses change and wider ships call at the site
- Specific operational requirements of the site users and associated vessel loading and offloading requirements.

Review of these items for the purposes of this report has consisted of a general investigation based on available information and best professional judgement and is provided here to identify design elements that should be considered during conceptual design. None of these items are considered issues that would restrict development of the site, but they are provided here for completeness and to facilitate design efforts incorporating flexibility for future development considerations.

3.1 Existing Conditions

Existing conditions at the site that are relevant to these items are generally limited to data provided previously in this report, such as wind/wave/current forces (Section 1.0) and existing levee elevations. The existing levee has an approximate elevation of +30 feet NAVD88 and is within the levee easement, as shown in project proposed development drawings provided by KPFF. An additional existing condition is the proximity of the proposed structures to the navigation channel. While this is currently undefined, the ultimate distance will have an impact on both the potential for vessels with increased beam widths in the future, as well as the impact of passing vessel forces.

3.2 Key Development Considerations

Several considerations should be incorporated into the project design to facilitate both the initial proposed development and potential future uses.

The levee elevations are currently fixed, but may require future modification to address potential adjustments by the USACE regarding the appropriate flood frequency requirements. The current requirement is for levees that meet 100-year flooding events; however, the USACE is currently evaluating whether this should be a 500-year flood event. The increase in the flood event may translate to taller levees at the site. The design will need to consider this potential eventuality when tying in the marine infrastructure with the existing levees.

Wind/wave/current forces, including routine peak events, will need to be considered in developing an appropriate mooring system that meets end user docking requirements, particularly with respect to potentially sensitive aspects of the loading/unloading process and requirements for vessels not moving while at berth.

Passing vessel effects need to be accounted for in design of the vessel mooring. This is similar to a suction-like force on the moored ships due to vessels passing in the adjacent navigation channel. The passing vessel effects are a function of vessel draft, speed, and proximity between the passing and moored vessels.

3.3 Fatal Flaws Considerations

No fatal flaws are currently identified regarding the additional information provided in this section with respect to the marine infrastructure, although accurately combining cumulative design forces will require careful consideration to accurately capture site conditions.

3.4 Potential Mitigating Measures

Design considerations should be adequate for mitigating the additional information items described in this section. Designers of the marine infrastructure will need to consider an allowance for passing vessel effects with structure mooring, as well as necessary operational requirements for end users. The inclusion of accidental collisions from passing vessels may also be a consideration as part of the mooring and structure design.

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