Request for Marine Mammal Protection Act Letter of Authorization

Columbia River CROSSING

November 2010

CITATION

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EXECUTIVE SUMMARY

The Federal Transit Administration (FTA) and Federal Highway Administration (FHWA) request the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) issue a 5-year Letter of Authorization (LOA) for potential harassment of individuals of three marine mammal species during the Interstate 5 (I-5) Columbia River Crossing (CRC) project bridge construction and demolition activities from July 2013 through June 2018. This request is pursuant to Section 101 (a)(5)(A) of the Marine Mammal Protection Act (MMPA), 16 United States Code (USC) 1371 (a)(5); 50 Code of Federal Regulations (CFR) Part 216, Subpart I.

Portions of the project, namely the demolition of the existing Columbia River bridges, are expected to extend beyond the 5-year LOA period. These activities may extend to March 2021. CRC will coordinate with NMFS at a later date to ensure that activities extending beyond the 5-year LOA are properly permitted under the MMPA.

Small numbers of Pacific harbor seals (*Phoca vitulina richardsi*), California sea lions (*Zalophus californianus*), and Steller sea lions (*Eumetopius jubatus*) may be incidentally and unintentionally "taken" by Level B harassment during the course of the construction of bridges over the Columbia River and North Portland Harbor and demolition of the existing bridges in the Columbia River. Potential incidental harassment of individuals of these species is associated with noise from pile installation or other in-water construction activities that may temporarily harass individuals transiting the CRC project area. Any Level B harassment that may occur will be short in duration, and is not expected to be injurious, lethal, or have long-term negative consequences for pinniped populations, their habitat, or prey species. Furthermore, there will be no adverse impact on the availability of seals or sea lions for subsistence harvest by the Northwest Treaty Tribes.

Each of the first 14 chapters of this application addresses 1 of the 14 specific items required for an LOA request pursuant to Section 101 (a)(5)(A) of the MMPA (50 CFR Part 216, Subpart I).

1. Detailed Description of the Activity

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

The Interstate 5 (I-5) Columbia River Crossing (CRC) project is a multimodal transportation project focused on improving safety, reducing congestion, and increasing mobility of motorists, freight, bicyclists, and pedestrians along a 5-mile section of the I-5 corridor connecting Vancouver, Washington and Portland, Oregon, and extending the TriMet Yellow Line Metropolitan Area Express (MAX) from Delta Park in Portland to Clark College in Vancouver. The CRC project area stretches from State Route (SR) 500 in northern Vancouver, south through downtown Vancouver, and over the I-5 bridges across the Columbia River to just north of Columbia Boulevard in north Portland (Figure 1-1).

There are significant congestion, safety, and mobility problems in the 5-mile CRC project area. The existing northbound bridge was built in 1917, and the southbound bridge was added in 1958. These bridges have been classified as functionally obsolete because they do not meet current or future demands for interstate service, resulting in long delays from congestion. If no changes are made, the daily congestion period is projected to grow from today's 6 hours to 15 hours by 2030 (CRC 2008). In addition, this section of I-5 has an accident rate more than double that of similar urban highways. Narrow lanes, short on-ramps, and non-standard shoulders on the bridges contribute to accidents. Bridge lifts to allow passage of river traffic stop all traffic using I-5 over the mainstem Columbia River, resulting in delays on connecting roadways and adding to unsafe driving conditions.

Current transit service between Vancouver and Portland is limited to bus service and constrained by the limited capacity in the I-5 corridor and is subject to the same congestion as other vehicles, which affects transit reliability and operations. Bicycle and pedestrian (bike/ped) facilities are currently substandard in much of the project area.

Seismic safety is also an important issue. Recent geotechnical studies have shown that the sandy soil under the mainstem Columbia River bridges would likely liquefy to a depth of 85 feet during an earthquake greater than Magnitude 8. This could cause irreparable damage to the bridges and potential loss of human life.

To remedy these deficiencies, the CRC project proposes to:

- Replace the existing Columbia River bridges with two new structures.
- Widen the existing North Portland Harbor Bridge, and construct three new structures across the harbor.
- Improve seven interchanges and roadways along and adjacent to I-5 in Portland and Vancouver.
- Improve highway safety and mobility along I-5 in Portland and Vancouver.
- Extend light rail transit (LRT) from north Portland to downtown Vancouver.
- Add improved bike/ped access on the new bridges and surrounding areas.
- Construct three new park and ride facilities in Vancouver.
- Expand the Ruby Junction Maintenance Facility to accommodate additional LRT vehicles.
- Construct stormwater best management practices (BMPs) and provide a high level of stormwater runoff treatment.
- Demolish existing Columbia River bridges.

Figure 1-1. Highway and Transit Elements Near the Columbia River

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The project presented in this request for an LOA is a result of a conscious effort by the design team to minimize impacts to aquatic species and their habitats through multiple design refinements. The major design changes incorporated into the project description are listed in the items 1 through 3 below. In addition, the project has chosen a conservative treatment method for stormwater. This methodology is listed in item 4.

1. The permanent in-water piers of the Columbia River and North Portland Harbor crossings will be constructed using drilled shafts, rather than impact-driven piles. Originally, the CRC project proposed to drive numerous 96-inch steel piles, involving over 200 days of in-water impact pile installation and creating noise levels that would far exceed injury thresholds for marine mammals throughout large portions of the Columbia River and North Portland Harbor within the project area. The current design significantly reduces the amount of impact pile installation, the size of the piles, and the amount of in-water noise. Drilled shafts have been minimized from 16 shafts per pier in the original design to a maximum of nine shafts per pier in the current design.
2. Earlier alternatives considered three bridges across the Columbia River: one for I-5 northbound traffic, one for I-5 southbound traffic, and one for LRT and bike/ped traffic. The current design proposes a stacked alignment, with LRT conveyed under the deck of the southbound structure and a bike/ped path beneath the northbound structure. This design reduces the number of in-water piers in the Columbia River by approximately one-third, and greatly reduces both the temporary construction impacts and the permanent effects of in-water piers.
3. The project proposes six in-water pier complexes for a total of 12 piers for the Columbia River bridges. Earlier designs considered up to 21 in-water piers, but the design has been refined to the minimum number necessary for a safe structure. This design greatly reduces the temporary construction impacts to marine mammals.
4. The project provides a high level of stormwater treatment. The project area intersects several jurisdictions, each of which has different standards for stormwater treatment. The CRC project team will employ the most restrictive water quality requirements project-wide, meaning that in many cases, the level of stormwater treatment exceeds that of the local jurisdiction. In addition to treating the new impervious surfaces created by the project, the project has identified approximately 188 acres of existing impervious surfaces that will be retrofitted to meet current stormwater treatment standards. Together, these measures are expected to reduce impacts to the environmental baseline to a greater degree than by using the standards of the individual jurisdictions.

Only the in-water components of the CRC project bridge construction and demolition are expected to have potential impacts to marine mammals. Therefore, this application describes only the over-water and in-water bridge construction and demolition portion of the project. The full CRC project description, which includes improvements to seven interchanges, upland LRT and roadway improvements, park and rides and other upland project elements not associated with impacts to marine mammals, is available in the CRC project's biological assessment (BA) (CRC 2010).

1.1 Overview

1.1.1 Columbia River Bridges

The existing structures over the Columbia River consist of two separate bridges that are functionally obsolete (i.e., the existing configuration does not meet current bridge standards and traffic demand). The existing structures include lift spans that must be raised for certain river traffic, and that causes automobile traffic delays when lifted. Each has three lanes, substandard shoulders, and a bike/ped sidewalk that does not meet current Americans with Disabilities Act (ADA) accessibility standards.

The new Columbia River crossing will carry traffic on two separate bridges and include a new LRT line and improved bike/ped facilities. Each new bridge will carry three through-travel lanes and two to three auxiliary lanes for traffic entering and exiting the highway in each direction, as well as full standard safety shoulders. The eastern structure will carry northbound traffic on its upper deck, with bike/ped traffic below; the western structure will carry southbound traffic on its upper deck, with LRT below. Both existing bridges will be removed after the new bridges are constructed and related interchange work is completed.

The new bridges will be subject to multiple clearance constraints. Vertical clearances underneath the bridges must accommodate river traffic below. The project team, in consultation with the U.S. Coast Guard (USCG) and industry representatives, established a vertical minimum of 95 feet of clearance for the new bridges, so that the new structure could be built without a lift span. In addition, the bridges must not be so high as to interfere with flights from Portland International Airport (PDX) and Pearson Field, a historic airport just to the east of the project area. The top of deck of the new bridges will range in elevation from approximately 100 to 135 feet (North American Vertical Datum of 1988 [NAVD88]) over the Columbia River. Because of these elevation restrictions and the need to construct curved structures to match existing on-land infrastructure, suspension or cable-stay bridge designs are not practicable.

The new structures over the Columbia River will not include lift spans, allowing more free-flowing automobile and river traffic. In addition, grades on the proposed structure will meet current ADA standards for pedestrian accessibility.

1.1.2 North Portland Harbor Bridges

The project will seismically upgrade the existing I-5 bridge over North Portland Harbor and will add four new bridges adjacent to the existing bridge. Starting from the east, these structures will carry:

- The new structure on the east side of I-5 will serve as an on-ramp for traffic merging onto I-5 northbound.
- Two structures west of the existing bridge will carry traffic merging onto or exiting off I-5 southbound.
- The fourth new structure will be built slightly farther west and would include a two arterial lanes for local traffic to and from Hayden Island, light rail transit, and a multi-use path for pedestrians and bicyclists.

The bottom of the bridges over North Portland Harbor will be at approximately 40 to 45 feet elevation (NAVD88). The structures over North Portland Harbor do not and will not include lift spans.

1.2 Columbia River Bridges

The project will construct two new bridges across the Columbia River downstream (to the west) of the existing interstate bridges. Each of the structures will range from approximately 91 to 136 feet wide, with a gap of approximately 15 feet between them. The over-water length of each new mainstem bridge will be approximately 2,700 feet (Table 1-1).

Table 1-1. Columbia River Bridges Over-Water Dimensions

Bridge	Approximate Length Over Water	Approximate Width
I-5 Northbound	2,700 feet	Varies: 91 to 130 feet
I-5 Southbound (with LRT)	2,650 feet	Varies: 91 to 136 feet

The Columbia River bridges will consist of six in-water pier complexes of two piers each, for a total of 12 in-water piers. Each pier will consist of up to nine 10-foot-diameter drilled shafts topped by a shaft cap. In-water pier complexes are labeled Pier 2 through Pier 7, beginning on the Oregon side. Pier complex 1 is on land in Oregon and pier complex 8 is on land in Washington. Portions of pier complex 7 occur in shallow water (less than 20 feet deep). Piers are designed to withstand scouring without armor-type scour protection (e.g., riprap).

Figure 1-2 shows the basic configuration of these bridges, the span lengths, and the layout of the bridges relative to the Columbia River shoreline and navigation channels. More detailed design information on pier size, depth, and other specifications is provided the Section 1.6.

The USCG will require bridge lighting on the new bridges to be brighter than the background lighting. While there is likely to be a large amount of illumination on the bridge spans high above the water, permanent lighting at the water surface will likely be minimal, limited to navigation lights, which are typically small, dim, and not cast directly on the water surface.

1.3 Columbia River Bridge Design

The proposed Columbia River mainstem crossing design uses dual stacked bridge structures. The western structure will carry southbound I-5 traffic on the top deck, with LRT on the lower deck. The eastern structure will carry northbound I-5 traffic on the top deck, with bike/ped traffic on the lower deck (Figure 1-3).

Each bridge will consist of a dual-level superstructure constructed on top of a series of six in-water piers. Each in-water pier will be constructed on a column, which will in turn be constructed on a shaft cap supported by up to nine 10-foot-diameter drilled shafts. The basic configuration of each pier is shown in Figure 1-4.

Figure 1-2.
Proposed Layout of Columbia River Bridge Showing Piers and Existing Navigation Channels

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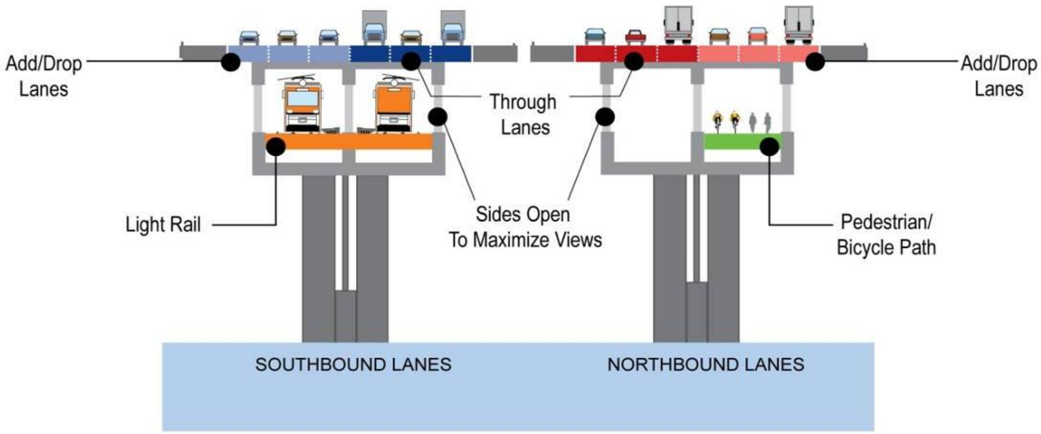


Figure 1-3. Schematic Representation of the Stacked Transit/Highway Bridge Configuration

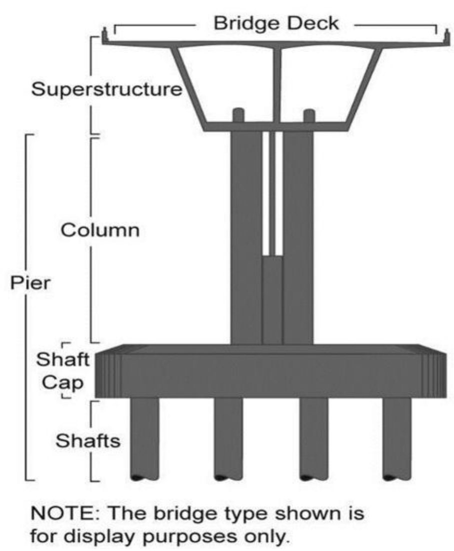


Figure 1-4. Schematic Representation of the Bridge Configuration

At each pier complex, sequencing will occur as listed below. Details of each activity are presented in the following sections.

- Install temporary cofferdam (applies to pier complexes 2 and 7 only).
- Install temporary piles to moor barges and to support temporary work platforms (at pier complexes 3 through 6) and work bridges (at pier complexes 2 and 7).
- Install drilled shafts for each pier complex.
- Remove work platform or work bridge and associated piles.
- Install shaft caps at the water level.
- Remove cofferdam (applies to pier complexes 2 and 7 only).

- Erect tower crane.
- Construct columns on the shaft caps.
- Build bridge superstructure spanning the columns.
- Remove tower crane.
- Connect superstructure spans with mid-span closures.
- Remove barge moorings.

All the activities listed above may occur at more than one pier complex at a time as shown in Appendix A.

All activities will require the use of artificial lights for safety. Temporary over-water lighting sources will include the barges, work platforms/bridges, and tower cranes. The project will implement measures that minimize the effects of lighting on fish. Measures may include using directional lighting with shielded luminaries to control glare and direct light onto work areas, instead of surface waters.

1.4 Columbia River Bridge Construction Sequencing

A construction sequence was developed for building the new Columbia River bridges and demolishing the existing structures. The sequence was developed to prove constructibility of the proposed design and is a viable sequence for construction of the river bridges. Once a construction contract is awarded, the contractor may sequence the construction in a way that may not conform exactly to the proposed schedule but that best utilizes the materials, equipment, and personnel available to perform the work. However, the amount of in-water work that can be conducted at any one time is limited, and is based on three factors:

1. The amount of equipment available to build the project will likely be limited. Based on equipment availability, the CRC engineering team estimated that only two drilled shaft operations could occur at any time.
2. The physical space the equipment requires at each pier will be substantial. The estimated sizes of the work platforms/bridges and associated barges are shown in Appendix A. This is a conceptual design developed by the CRC project team to provide a maximum area of impact. The actual work platforms will be designed by the contractor; therefore, actual sizes will be determined at a later date. The overlap of work platforms/bridges and barge space limits the amount and type of equipment that can operate at a pier complex at one time.
3. The USCG has required that one navigation channel be open at all times during construction, to the extent feasible.

The 10-phase sequence is shown graphically in Appendix A.

1.4.1 Columbia River Bridge Construction Timeline

Construction is currently estimated to occur between 2013 and 2017.

1.5 Temporary Structures

1.5.1 Cofferdams

Pier complexes 2 and 7 will each require one temporary cofferdam. Cofferdams will consist of interlocking sections of sheet piles to be installed with a vibratory hammer or with press-in methods. Table 1-2 provides an estimate of the dimensions of the cofferdams and Table 1-3 estimates the duration that they will be present in the water. Cofferdams will be removed using a vibratory hammer or direct pull.

Table 1-2. Potential Dimensions of Temporary Cofferdams Used in Columbia River Bridge Construction

Length (ft)	Width (ft)	Height (ft)	Area per Cofferdam (sq. ft.)	Total Cofferdams	Total Area of Cofferdams (sq. ft.)
105	75	30	7,875	2	15,750

Table 1-3. Construction Summary for Cofferdams in Columbia River

Location	Duration to Install (Days)	Duration of Construction (Days)	Duration to Remove (Days)
Pier Complex 2	70	330[a]	20
Pier complex 7	70	470 [a]	20

Days represent approximate number of calendar days, cofferdam are in place. This duration represents approximately 240 to 300 working days.

Cofferdams will be installed in a manner that minimizes fish entrapment. Sheet piles will be installed from upstream to downstream, lowering the sheet piles slowly until contact with the substrate. When cofferdams are used, fish salvage must be conducted according to protocol approved by the Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and NMFS. Cofferdams will not be dewatered.

1.5.2 In-Water Work Structures

The project will include numerous temporary in-water structures to support equipment and materials during the course of construction. These structures will include work platforms, work bridges, and tower cranes. They will be designed by the contractor after a contract is awarded, but prior to construction.

Work platforms will be constructed at pier complexes 3 through 6. Figure 11 of Appendix A shows a conceptual design of a temporary in-water work platform. Work platforms are each estimated to be approximately 18,225 sq. ft. in area and will surround the future location of each shaft cap. Work bridges will be installed at pier complexes 2 and 7 so that equipment can access these pier complexes directly from land. Temporary work bridges will be placed only on the landward side of these pier complexes (Appendix A, Figures 1 and 4). The bottom of the temporary work platforms and bridges will be a few feet above the water surface. The decks of the temporary work structures will be constructed of large, untreated wood beams to accommodate large equipment, such as 250-ton cranes. After drilled shafts and shaft caps have been constructed, the temporary work platforms and their support piles will be removed.

After work platforms/bridges are removed at a given pier complex, one tower crane will be constructed between each pair of adjacent piers that makes up the pier complex. The crane will construct the bridge columns and the superstructure. Following construction of the columns and superstructure, the tower cranes and their support piles will be removed.

Both battered and vertical steel pipe piles will be used to support the structures. In addition, four temporary piles could surround each of the drilled shafts (see Appendix A, Figure 11). Due to the heavy equipment and stresses placed on the support structures, all of these temporary piles will need to be load-bearing. Load-bearing piles will be installed using a vibratory hammer and then proofed with an impact hammer to ensure that they meet project specifications demonstrating load-bearing capacity. The number and size of temporary piles for these structures is listed in Table 1-4.

Table 1-4. Summary of Steel Pipe Piles Required for Temporary Overwater Structures During Construction of Columbia River Bridges

Type of Structure	Number of Structures	Pile Diameter	Pile Length	Piles per Structure	Total Number of Piles
Work platforms/bridges	6	18”–24”	70’–90’	100	600
		42”–48”	120’	32	192
Tower cranes	6	42”–48”	120’	8	48
Barge moorings	N/A	18”–24”	70’–90’	Varies	80
Total	**12**	**---**	**---**	**---**	**920**

Not all of these structures will be in place at the same time. It is estimated that only 120 to 400 steel piles will be in the water at any one time.

1.5.3 Barges

Barges will be used as platforms to conduct work activities and to haul materials and equipment to and from the work site. Barges will be moored to non-load-bearing steel pipe piles and adjacent to temporary work structures (Appendix A, Figures 1-10). The approximate dimensions of mooring piles are listed in Table 1-4.

Several types and sizes of barges will be used for bridge construction. The type and size of a barge will depend on how the barge is used. No more than 12 barges are estimated to be moored or moving equipment for Columbia River bridge construction at any one time throughout the construction period (see Appendix A, Figures 1-10). The number and the area of the barges are estimated in Table 1-5.

1.5.4 Area and Duration of Temporary Structures

Table 1-5 summarizes the area of temporary structures required for construction in the Columbia River as well as their duration in the water. The number of temporary platforms or bridges in the Columbia River at one time will vary between zero and three during construction for a maximum over-water footprint of 54,675 square feet (sq. ft.). Up to four work platforms and two work bridges will be required to install drilled shafts and construct shaft caps. Each work platform/bridge will require 22 to 25 work days to install. Each work platform/bridge will be in place for approximately 260 to 300 work days. Each tower crane will require approximately 2 work days to drive support piles and an additional 13 work days to construct the platform. Each tower crane will be in place for approximately 153 to 272 work days.

Barges will be moored around each pier complex. Approximately 80 mooring piles will be installed over the life of the project, each in place for approximately 120 work days. Up to 12 barges at one time would be on the site over the life of the project. Barges vary in size, but can be up to 30,000 sq. ft. in area. With several barges on the site, the over-water footprint could be up to 100,000 sq. ft. at any one time (estimate based on worst case of 12 barges in Appendix A, Figure 4).

Table 1-5. Summary of Temporary Structures Required for Construction in the Columbia River

Type of Structure	Structures	Total Piles (all sizes)	Total In-Water Area for Piles (sq. ft.)	Total Over-Water Area/ Footprint (sq. ft.)	Approx. Time to Install (Days/Platform)[a]	Duration Present in Water (Days-Each)
Work platforms/ bridges	6	792	3,393	148,000	22-25	260-315
Tower cranes	6	48	603	3,200	15	153-262
Barge moorings	N/A	80	251	N/A	N/A	120/mooring
Barges (cumulative, at a single time)	Up to 12	N/A	N/A	Up to 100,000[b]	N/A	Varies
Total	**Varies**	**920**	**6,844**	**Up to 251,200**	**---**	**---**

a Assumes two crews.
b Assumes more than one barge (Appendix A, Figure 4).

1.5.5 Installation of Temporary Piles

Temporary piles will be used for mooring barges and to support in-water work structures. Mooring piles will be vibrated into the sediment until refusal. Vibratory installation will take between 5 and 30 minutes per pile.

Load-bearing piles (used for work platforms/bridges and tower cranes) will be vibrated to refusal (approximately 5 to 30 minutes per pile), then driven and proofed with an impact hammer to confirm load-bearing capacity. An average of six temporary piles will be installed per day using vibratory installation to set the piles, and up to two impact drivers to proof them. Rates of installation will be determined by the type of installation equipment, substrate, and required load-bearing capacity of each pile. Temporary piles will be installed and removed throughout the construction process. No more than two impact pile drivers will operate at one time. Use of two impact pile drivers will primarily occur within a single pier complex.

In general, temporary piles will extend only into the alluvium to an approximate depth of 70 to 120 feet. Standard pipe lengths are 80 to 90 feet, so some piles may need to be spliced to achieve these depths.

Estimated pile installation specifications[1] are provided in Table 1-6. The number of pile strikes was estimated by WSDOT Geotechnical and CRC project engineers, based on information from past projects and knowledge of site sediment conditions. The actual number of pile strikes will vary depending on the type of hammer, the hammer energy used, and substrate composition. The strike interval of 1.5 seconds (40 strikes per minute) is also estimated from past projects and is based on use of a diesel hammer. This estimate is within the typical range of 35–52 strikes per minute for diesel hammers (HammerSteel 2009). As shown in Table 1-6, for any one 12-hour daily pile driving period, less than 1 hour of pile driving will occur.

[1] Number of piles driven per day, strikes per pile, total strikes per day, and duration of driving per day are estimates rather than maximums. The size and extent of this project requires contractor flexibility while minimizing effects to listed fish species. The CRC project is proposing performance measures that use these variables, in addition to the amount of attenuation, to calculate "exposure factors" for fish on a weekly basis. Additional information on the performance measures for exposure to fish and the calculation of exposure factors are discussed in Section 7 and Appendix K of the CRC BA.

Table 1-6. Pile-Strike Summary for Construction in Columbia River

Pile Size	Estimated Piles Installed per Day	Estimated Strikes per Pile	Estimated Maximum Strikes per Day	Hours of Pile Driving/12-hr Daily Pile Driving Work Period
18" – 24"	3	300	600	0.25
42" – 48"	3	300	1,200	0.50
Total	**6**	**--**	**1,800**	**0.75**

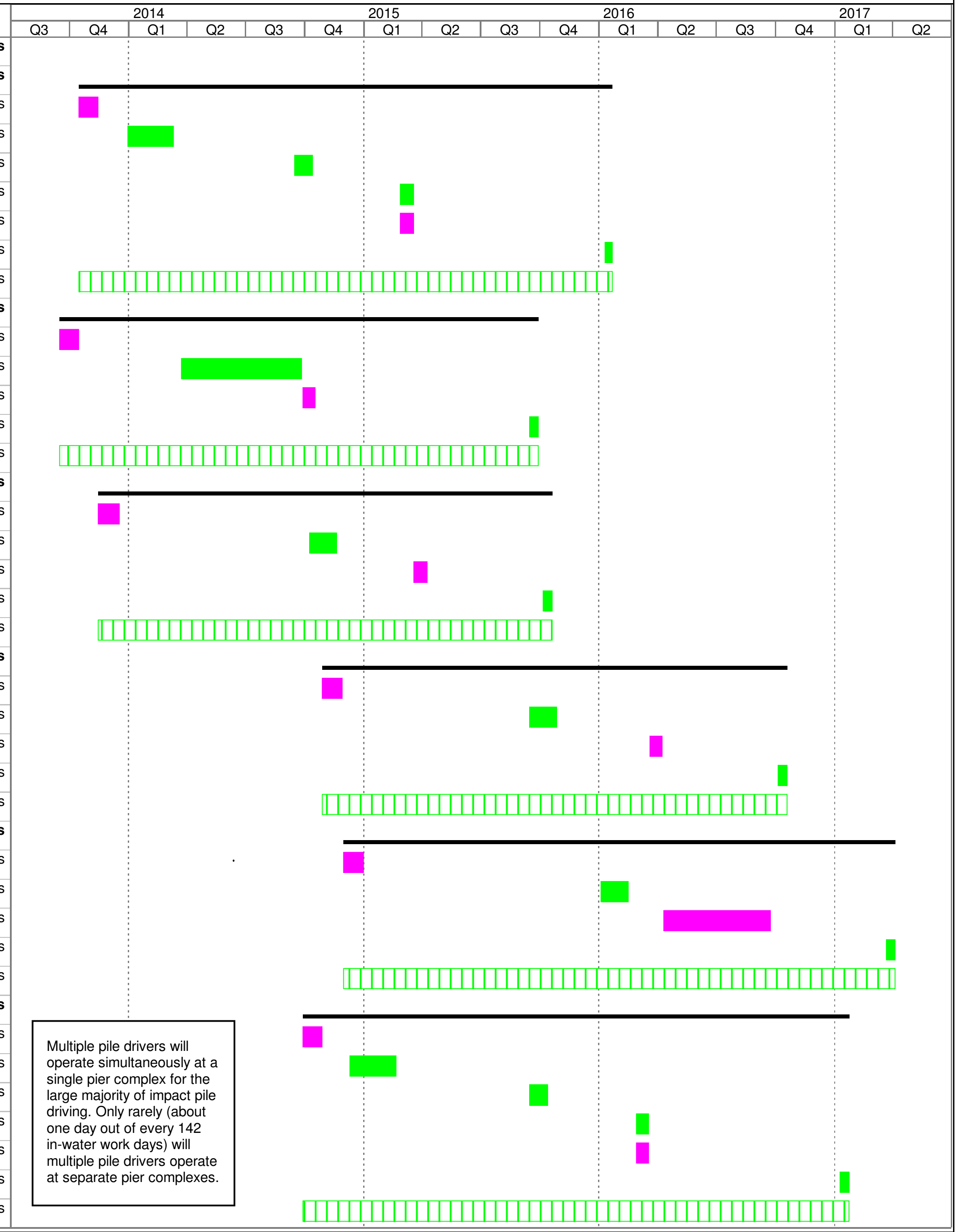
a This scenario assumes just one pile being driven at a time. During construction, up to two piles may be driven at the same time in the Columbia River. If this were to occur, the strike numbers would stay the same, but the actual driving time would decrease.

Figure 1-5 illustrates the schedule of impact and vibratory pile driving, based on the assumption that the first impact pile driving will start on September 15, 2013. The exact timing will vary as the start date varies, but will likely follow the general timeline as shown in Figure 1-5. Impact pile driving could potentially occur between September 15 and April 15; however, impact pile driving is more likely to occur in the first 18 months of construction as pier complexes are started. After the first 18 months, most of the pier complexes will be well underway, leaving only the work required to finish a couple of pier complexes and provide bases for superstructure construction.

In accordance with an approved hydroacoustic monitoring plan (see Section 11.2.5) a noise attenuation device will be used during all impact pile driving, with the exception of during hydroacoustic monitoring when the noise attenuation device will be turned off to measure its effectiveness. A period of up to 7.5 minutes per week with no attenuation device has been allocated in the analyses and hydroacoustic minimization measure (see Section 11.2.5) to allow for monitoring and for time to shut-down activities should an attenuation device fail. If the attenuation device fails, pile driving activities will cease as soon as practicable and resolution of the problem will occur. By incorporating this time into the analysis, the project may still proceed in the event of an equipment failure without exceeding the thresholds listed in the hydroacoustic minimization measure. With the exception of hydroacoustic monitoring, intentional impact pile driving without a noise attenuation device is not proposed nor will it be allowed. In addition, to limit hydroacoustic effects, there will be a consecutive 12-hour period of no impact pile driving for every 24-hour day.

Figure 1-5. Sequencing of Pile Driving and Removal for Construction in the Columbia River

Task Name	Start	Finish	Duration
Bridge Construction Scenario 2/5/13	**9/16/13**	**4/5/17**	**928 days**
Pier 2	**10/16/13**	**1/22/16**	**593 days**
Install Work Bridge Piles (Vibratory & Impact Pile Driving)	10/16/13	11/14/13	22 days
Install Cofferdam (Vibratory Installation)	12/31/13	3/11/14	51 days
Remove Work Bridge & Piles (Vibratory Removal)	9/16/14	10/13/14	20 days
Remove Cofferdam (Vibratory Removal)	2/27/15	3/19/15	15 days
Erect Tower Crane (Vibratory & Impact Pile Driving)	2/27/15	3/19/15	15 days
Remove Tower Crane (Vibratory Removal)	1/11/16	1/22/16	10 days
Barge Moorings (Vibratory Installation & Removal)	10/16/13	1/22/16	593 days
Pier 3	**9/16/13**	**9/29/15**	**532 days**
Install Work Bridge Piles (Vibratory & Impact Pile Driving)	9/16/13	10/15/13	22 days
Remove Work Platform & Piles (Vibratory Removal)	3/24/14	9/26/14	135 days
Erect Tower Crane (Vibratory & Impact Pile Driving)	9/29/14	10/17/14	15 days
Remove Tower Crane (Vibratory Removal)	9/16/15	9/29/15	10 days
Barge Moorings (Vibratory Installation & Removal)	9/16/13	9/29/15	532 days
Pier 4	**11/15/13**	**10/20/15**	**503 days**
Install Work Bridge Piles (Vibratory & Impact Pile Driving)	11/15/13	12/17/13	23 days
Remove Work Platform & Piles (Vibratory Removal)	10/9/14	11/19/14	30 days
Erect Tower Crane (Vibratory & Impact Pile Driving)	3/20/15	4/9/15	15 days
Remove Tower Crane (Vibratory Removal)	10/7/15	10/20/15	10 days
Barge Moorings (Vibratory Installation & Removal)	11/15/13	10/20/15	503 days
Pier 5	**10/29/14**	**10/19/16**	**516 days**
Install Work Bridge Piles (Vibratory & Impact Pile Driving)	10/29/14	11/28/14	23 days
Remove Work Platform & Piles (Vibratory Removal)	9/16/15	10/27/15	30 days
Erect Tower Crane (Vibratory & Impact Pile Driving)	3/21/16	4/8/16	15 days
Remove Tower Crane (Vibratory Removal)	10/6/16	10/19/16	10 days
Barge Moorings (Vibratory Installation & Removal)	10/29/14	10/19/16	516 days
Pier 6	**12/1/14**	**4/5/17**	**613 days**
Install Work Bridge Piles (Vibratory & Impact Pile Driving)	12/1/14	12/31/14	23 days
Remove Work Platform & Piles (Vibratory Removal)	1/5/16	2/15/16	30 days
Erect Tower Crane (Vibratory & Impact Pile Driving)	4/11/16	9/23/16	120 days
Remove Tower Crane (Vibratory Removal)	3/23/17	4/5/17	10 days
Barge Moorings (Vibratory Installation & Removal)	12/1/14	4/5/17	613 days
Pier 7	**9/29/14**	**1/23/17**	**606 days**
Install Work Bridge Piles (Vibratory & Impact Pile Driving)	9/29/14	10/28/14	22 days
Install Cofferdam (Vibratory Installation)	12/11/14	2/20/15	52 days
Remove Work Bridge & Piles (Vibratory Removal)	9/16/15	10/13/15	20 days
Remove Cofferdam (Vibratory Removal)	2/29/16	3/18/16	15 days
Erect Tower Crane (Vibratory & Impact Pile Driving)	2/29/16	3/18/16	15 days
Remove Tower Crane (Vibratory Removal)	1/10/17	1/23/17	10 days
Barge Moorings (Vibratory Installation & Removal)	9/29/14	1/23/17	606 days



Conceptual Schedule Only

Pier Activitiy Summary — Vibratory and Impact Activities

Vibratory Activities — Vibratory Activities (Intermittent)

Note: This is a proposed schedule, so activity dates are likely to change.

April 2010

1.6 Construction of Permanent Piers

In-water drilled shaft construction consists of installing large diameter steel casing to a specified depth to the top of the competent geological layer known as the Troutdale Formation. The top layer of river substrate is composed of loose to very dense alluvium (primarily sand and some fines), beneath which is approximately 20 feet of dense gravel, underlain by the Troutdale Formation.

A vibratory hammer, oscillator, or rotator will be used to advance a casing (up to -270 feet NAVD88). If casings are installed by a vibratory hammer, installation is estimated to be 1 work day per casing. If casings need to be welded together, 1 work day is estimated for the weld. No more than two casings are estimated per shaft. Soil will be removed from inside the casing and transferred onto a barge as the casing is advanced. The soil will be deposited at an approved upland site. Drilling will continue below the casing approximately 30 feet into the Troutdale Formation to a specified tip elevation. After excavating soil from inside the casing, reinforcing steel will be installed into the shaft and then the shaft will be filled with concrete.

During construction of the drilled shafts, uncured concrete will be poured into water-filled steel casings, creating a mix of concrete and water. As the concrete is poured into the casing, it will displace this highly alkaline mixture. The project will implement best management practices (BMPs) to contain the mixture and ensure that it does not enter any surface water body. Once contained, the water will be treated to meet state water quality standards and either released to a wastewater treatment facility or discharged to a surface water body. The steel casing may or may not be removed, depending on the installation method. Figure 1-6 through Figure 1-9 depict typical drilled shaft operations and equipment.

No contaminated sediments have been documented within the installation areas. Adherence to the terms of water quality certifications and implementation of impact minimization measures will ensure that, should contaminated sediments be encountered, that they will be dealt with properly.

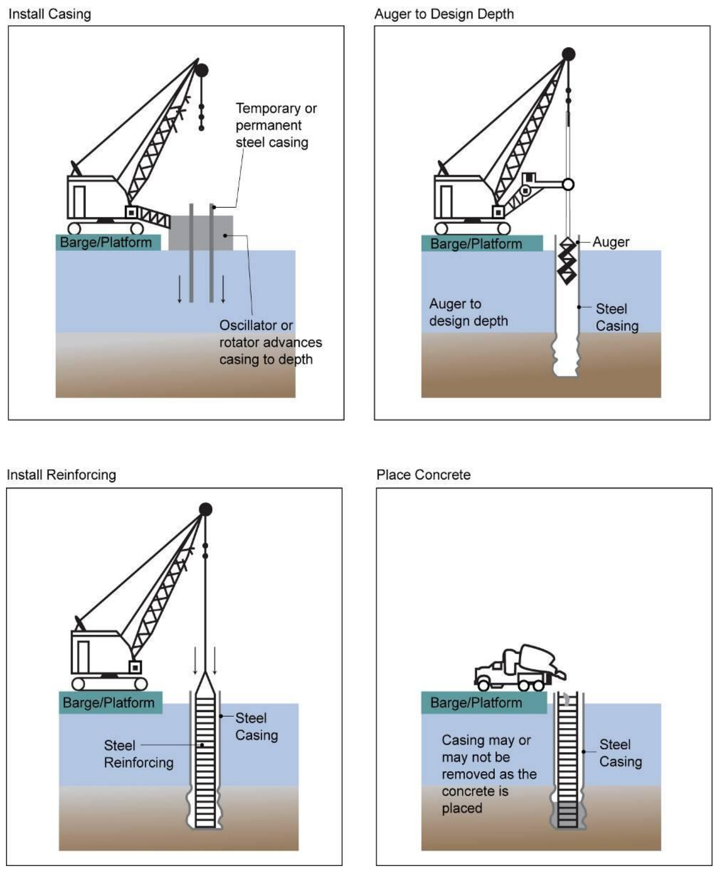


Figure 1-6. Typical Drilled Shaft Installation from Barge or Platform

Figure 1-7. Water-Based Drilled Shaft Installation

Figure 1-8. Clamshell Used for Removing Material from Drilled Shaft Casing

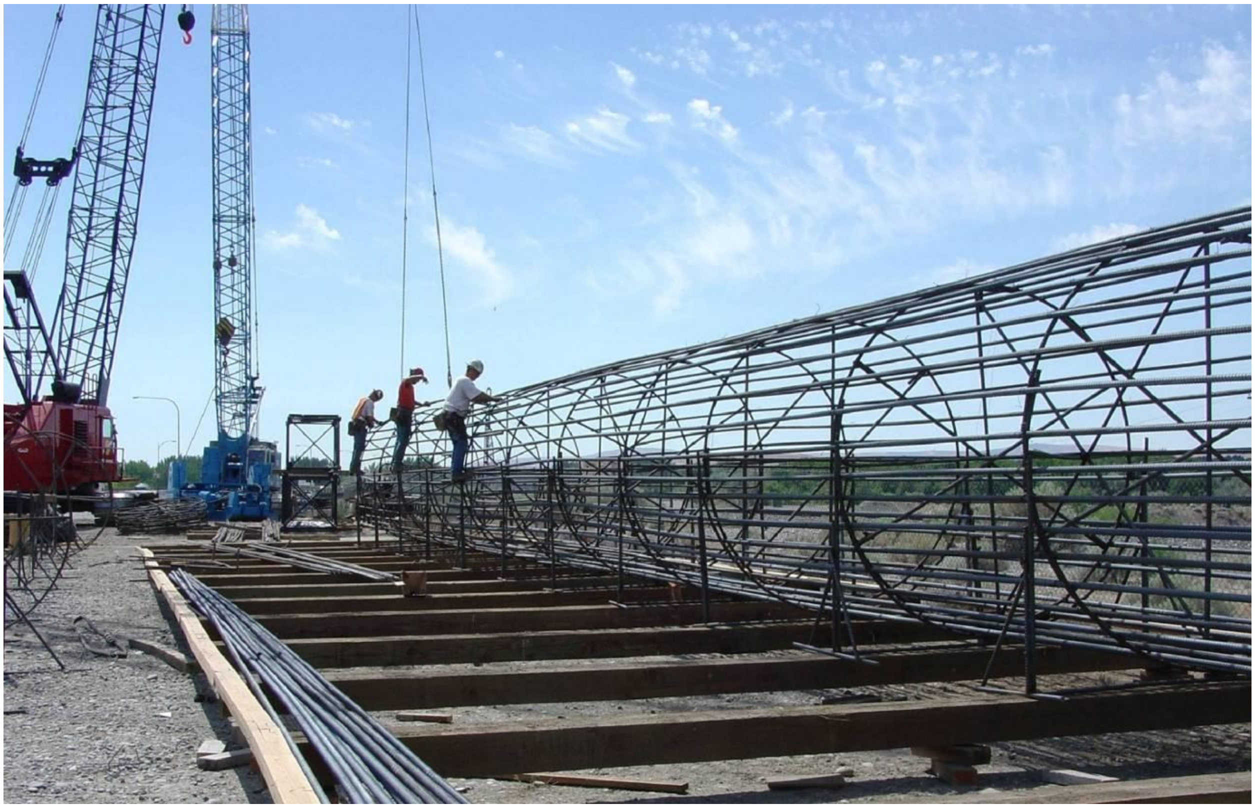


Figure 1-9. Preparation of a Steel Reinforcement Cage for a Drilled Shaft

1.6.1 Duration of Installation of Permanent Shaft

The total duration of the permanent shaft installation could vary considerably depending on the type of installation equipment used, the quantity of available installation equipment, and actual soil conditions. Installation of each drilled shaft is estimated to take approximately 10 days. With the limited in-water work window for impact pile driving and construction phasing constraints, the total duration of drilled shaft installation will be approximately 30 months. Phasing of construction is anticipated to follow the conceptual schedule shown in Figure 1-5.

1.6.2 Quantity of Permanent Shafts

Table 1-7 summarizes the permanent shafts to be constructed for each bridge over the Columbia River.

Table 1-7. Summary of Permanent Shafts in the Columbia River

Location	Shafts per Pier	Total Shafts	Total Plan Area of Shafts (sq. ft.)	Approx. Depth from Observed Lowest Water (0' CRD)
Piers 3–6 on northbound structure	Varies: 6 to 9	32	2,513	Varies: 24 to 32
Piers 3–6 on southbound structure	Varies: 6 to 9	32	2,513	Varies: 24 to 32
Pier complex 2	6	12	942	Varies: 21 to 25
Pier complex 7	6	12	942	Varies: 20 to 27
Total	**---**	**88**	**6,910**	**---**

Note: CRD = Columbia River datum.

1.6.3 Shaft Caps

Precast shaft caps will be placed on top of the drilled shafts. The shaft caps will be fabricated off-site at a casting yard and then transported to the site. Installation of the shaft caps will require cranes, work barges, and material barges. Table 1-8 summarizes the dimensions of each shaft cap.

Table 1-8. Summary of Shaft Caps in the Columbia River

Type	Number	Width	Length	Total Area (sq. ft.)
Pier complexes 3–6	8	75	75	45,000
Pier complexes 2 & 7	4	75	45	13,500
Total	**12**	**---**	**---**	**58,500**

1.7 Column Construction

Columns will be constructed of cast-in-place reinforced concrete or precast concrete. Precast columns will be fabricated at a casting yard. Column construction is estimated to take 120 days for each pier complex. Construction columns will require cranes, work barges, and material barges in the river year-round (Figure 1-12).

Figure 1-10. Typical Column and Superstructure Construction Using Barge-Mounted Cranes

1.8 Superstructure

The superstructure will be constructed of structural steel, cast-in-place concrete, or precast concrete. Precast elements will be fabricated at a casting yard. Construction will require cranes, work barges, and material barges in the river year-round. Figure 1-10 and Figure 1-11. depict typical activities related to construction of the superstructure.

Figure 1-11. Platform-Mounted Crane Placing a Winch on a Superstructure Element

1.9 North Portland Harbor Bridge

The existing North Portland Harbor bridge will be upgraded to meet current seismic standards. The seismic retrofit activities will consist solely of minor modifications to the bent caps and girders that will not require in-water work. In addition, four new bridge structures will be constructed across North Portland Harbor. The bridges are illustrated in Figure 1-12 and are named from west to east: the arterial/LRT/MUP bridge, I-5 southbound off-ramp, I-5 southbound on-ramp, existing mainline, and I-5 northbound on-ramp.

1.10 North Portland Harbor Bridge Design

The existing North Portland Harbor bridge was constructed in the early 1980s of prestressed concrete girders and reinforced concrete bents. The bents are supported by driven steel piling. Two previous bridges, constructed in 1917 and 1958, were built at the same location as the current bridge, but may not have been fully removed during subsequent replacement efforts. These bridges had reinforced concrete bents supported on timber piles. Some of this material may still be present, but this will not be confirmed until construction begins. Some removal of previous bridge elements is anticipated prior to installation of the new bridge shafts. Removal of remnant bridge elements will be with a clamshell dredge.

Table 1-9 gives the approximate dimensions of the new or improved bridges over the North Portland Harbor. Bridge widths will vary due to merging of lanes on some structures. The four new bridge structures will consist of spans of varying lengths (Figure 1-12).

Table 1-9. Bridge Over-Water Dimensions for North Portland Harbor

Bridge	Arterial/LRT/ MUP Bridge	I-5 Southbound Off-Ramp	I-5 Southbound On-Ramp	Existing Mainline	I-5 Northbound On-Ramp
Width Over Water	Approx. 95 ft	Varies 45 ft	Approx. 40 ft	Approx. 150 ft	Approx. 50 ft
Length Over Water	Approx. 895 ft	Approx. 925 ft	Approx. 950 ft	Approx. 990 ft	Approx. 1,025 ft

Note: CRD = Columbia River datum.

Each new bridge will have three to five in-water bents, consisting of one to three 10-foot-diameter drilled shafts (Figure 1-12). Unlike the Columbia River piers, shafts will not be topped by a shaft cap. Current designs place all of the bents in shallow water (less than 20 feet deep). Bents are designed to withstand the design scour without armor-type scour protection (e.g., riprap).

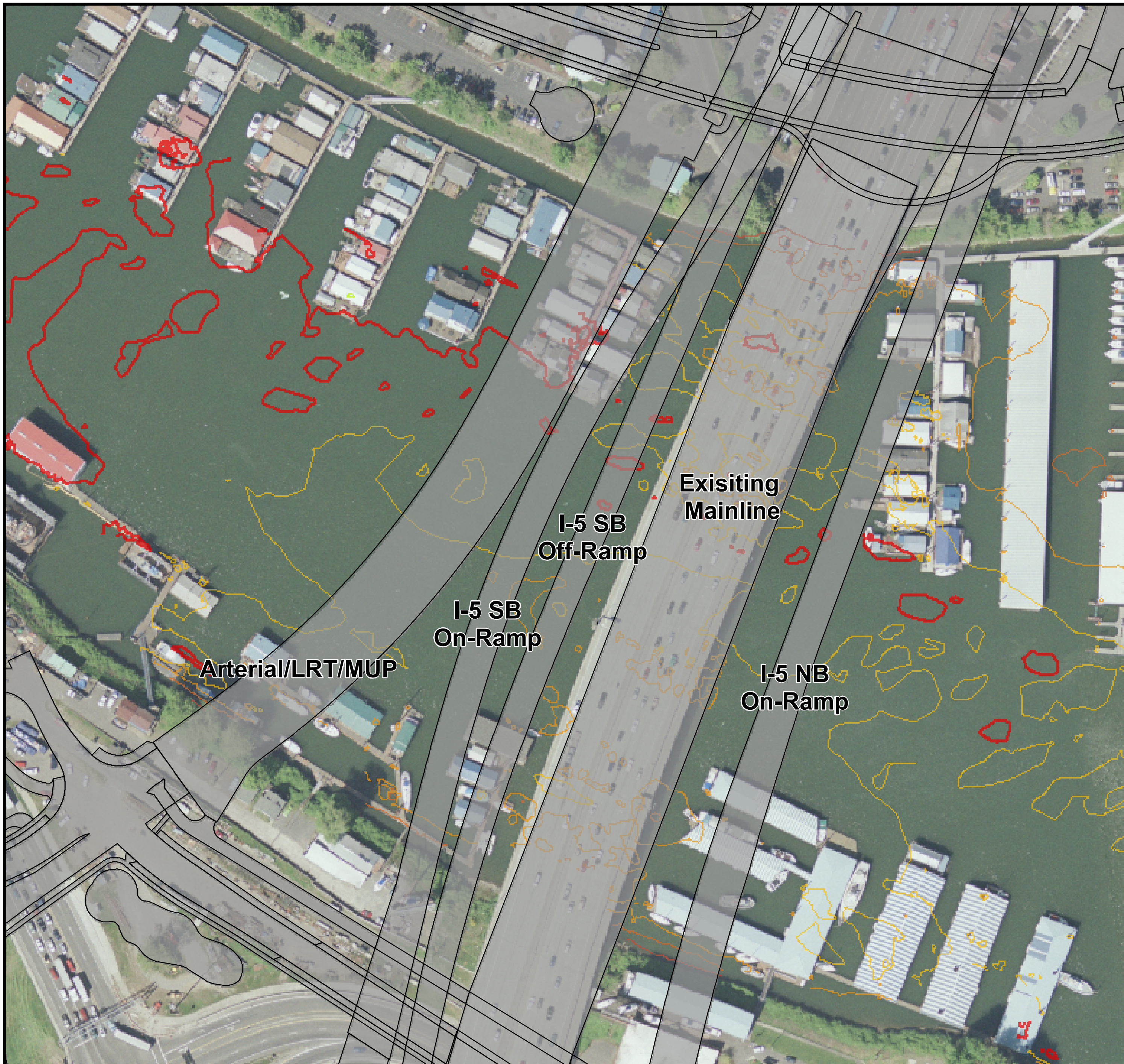


Figure 1-12. Proposed Layout of North Portland Harbor Bridges

Project Footprint

Bathymetry

Depth (CRD, ft.)

0
5
10
15
20
25
30
35
40
45
50
55

N
W
E
S

0 110 220
Feet

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Oct. 26, 2010: File Name: HydroSound_MG246_NPH_LPAOptA.mxd

1.10.1 North Portland Harbor Bridge Construction Sequencing

Construction is expected to be sequential, beginning with either of the most nearshore bents of a given bridge and proceeding to the adjacent bent. The actual sequencing will be determined by the contractor once a construction contract is awarded. No more than three of the five bridges are likely to have in-water work occurring simultaneously.

For the bents closest to shore, construction will occur from work bridges. At the other in-water bents, construction will likely occur from barges and oscillator support platforms.[2]

General construction activities to build the bents and superstructure are similar to those for the Columbia River bridges, except that shaft caps will not be used and bridge decks will be placed on girders instead of balanced cantilevers. General sequencing of the construction of a single bridge appears below.

- Construct oscillator support platforms and work bridges using vibratory and impact pile drivers.
- Vibrate temporary piles to moor barges.
- Extract large pieces of debris as needed to allow casings to advance.
- Install drilled shafts at each bent.
- Construct columns on the drilled shafts.
- Construct a bent cap or crossbeam on top of the columns at a bent location.
- Erect bridge girders on the bent caps or crossbeams.
- Place the bridge deck on the girders.
- Remove temporary work bridges, oscillator support platforms, and supporting piles.

Some of these activities will occur simultaneously at separate bents.

1.10.1.1 North Portland Harbor Bridge Construction Timeline

Construction is currently estimated to occur between 2013 and 2020.

1.10.2 Temporary In-Water Work Structures

At the bents closest to shore, up to nine temporary work bridges will be constructed to support equipment for drilled shafts. In addition, at each of the 31 bent locations, one oscillator support platform will be constructed, each consisting of four load-bearing piles. The bridges and oscillator support platforms will be designed by the contractor after a contract is awarded, but prior to construction. The bottom of the temporary work structures will be between 0 and 5 feet above the water line. Due to the heavy equipment and stresses placed on these structures, the supporting piles will need to be load bearing. All will be installed first with a vibratory hammer and then proofed with an impact hammer to ensure that they meet specifications for load-bearing capacity. The number and size of piles for temporary in-water work structures are listed in Table 1-10.

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[2] Oscillator support platforms are used to support the oscillators used to install the steel casing for drilled shafts. Although this document uses the term oscillator support platform throughout, the platform may support equipment for vibratory or rotator installation of steel casings.

Table 1-10. Approximate Number of Steel Pipe Piles Required for Construction of North Portland Harbor Bridges

Type of Structure	Structures	Temporary Pile Diameter (inches)	Temporary Pile Length (feet)	Average Piles per Structures	Total Piles
Work bridges for drilling shafts	9	18–24	70–120	25	225
Oscillator support piles	31	36–48	120	4	124
Barge Moorings	N/A	36–48	120	N/A	216
Total	**40**	**---**	**---**	**29**	**565**

Following installation of the drilled shafts, the temporary work structures, and their support piles will be removed through vibratory methods.

Other temporary piles will be installed to moor barges adjacent to the new bents (Table 1-10). These piles will not need to be load bearing, and therefore, they will be installed through vibratory methods only.

The installation of steel pipe piles will be staged over the construction period. Steel piles will be installed and removed during the multi-year construction of the temporary support structures. Although the project will use over 500 piles in the North Portland Harbor, only 100 to 200 piles are estimated to be in the water at any one time.

1.10.2.1 Barges

Barges will be used as platforms for conducting work activities and to haul materials and equipment to and from the work site. Barges will be moored with steel pipe piles adjacent to temporary work bridges or bents. The approximate number, size range, and length of mooring piles are listed in Table 1-10.

Several types and sizes of barges will be used according to specific function. No more than nine barges are estimated to be present in North Portland Harbor at any one time during the construction period.

1.10.2.2 Number, Area, and Duration of Temporary Structures

The number, area, and duration of temporary work platforms, support piles, mooring piles, and barges in water are summarized in Table 1-11.

Table 1-11. Summary of Temporary Overwater Structures in North Portland Harbor

Type of Structure	Structures	Total Area in Water (piles) (sq. ft.)	Total Area Over Water (sq. ft.)	Duration to Install (days/platform)[a]	Duration Present in Water (days)
Work bridges for drilling shafts	9	2,790	29,640	12	20–42
Oscillator supports platform	31	900	27,900	2	10–34
Barge moorings	N/A	679	N/A	N/A	30
Barges (at one time)	Up to 9	N/A	105,000	N/A	10–34
Total	**Varies**	**4,369**	162,540	**---**	**---**

a Assumes one crew.

1.10.2.3 Installation of Temporary Piles

As with the mainstem Columbia River bridges, temporary piles will be required to support in-water work bridges or to moor barges during construction of the North Portland Harbor bridges. Unlike the Columbia River bridges, cofferdams are not necessary.

Piles used for the temporary work bridges and the oscillator support platforms must be load bearing. They will first be vibrated to refusal, and then proofed with an impact hammer to confirm load-bearing capacity. An average of three load-bearing piles will be installed per day using vibratory installation to set the piles, with one impact driver to proof. Rates of installation will be determined by the type of installation equipment, substrate, and required load-bearing capacity of each pile.

Temporary mooring piles will be installed and removed throughout the construction process. Installation of these mooring piles could occur year-round and at any time of the day. These piles will be installed using vibratory methods only.

In general, temporary piles will extend only into the alluvium to an estimated depth of 70 to 120 feet. Standard pipe lengths are 80 to 90 feet, so some piles may need to be welded to achieve the lengths required to drive them to these depths.

Estimated pile installation specifications are provided in Table 1-12. Estimates of required number of strikes per pile and total strikes are the same as for the Columbia River. However, only one impact driver at a time will be used. Impact pile driving is proposed to occur only during a 31-week period from approximately September 15 to April 15. No impact pile driving will occur outside of the approved dates.

Table 1-12. Temporary Piles Installed Per Day and Strike Numbers for Construction in North Portland Harbor

Pile Size	Estimated Piles Installed per Day	Estimated Strikes per Pile	Estimated Maximum Strikes per Day	Hours of Pile Driving/12-hr Daily Pile Driving Work Period
Temporary Work Bridge				
18“– 24”	3	300	900	0.375
Oscillator Supports				
36” – 48”	3	300	900	0.375

A noise attenuation device will be used during all impact pile driving[3] with the exception of during hydroacoustic monitoring when the noise attenuation device will be turned off to measure its effectiveness. In addition, to limit hydroacoustic effects, there will be a consecutive 12-hour period of no impact pile driving for every 24-hour day.

[3] In addition, a period of up to 5 minutes per week for the North Portland Harbor with no attenuation device has been allocated in the performance measure for ESA-listed fish which caps incidental take from impact pile driving to ESA-listed fish. The application of this grace period allows time for problem detection and shut-down should an attenuation device fail. If the attenuation device fails, shut-down will occur as soon as practicable and resolution of the problem will occur. This allows the project to proceed in event of an equipment failure without exceeding the incidental take of listed fish in the biological opinion. It does not authorize work without a noise attenuation device. Therefore, a worst-case scenario, where there is limited attenuation device failure is built into the performance measure for listed fish. Therefore, the performance measure results in a worst-case estimate for incidental take of ESA-listed fish.

1.11 Bent Construction

In-water drilled shaft construction for the North Portland Harbor is described in the section above.

1.11.1 Debris Removal

Debris from previous structures, including foundations from the 1917 and 1953 bridges, may be present in North Portland Harbor at some locations where drilled shafts will be installed. This debris is likely to consist of large rock or old concrete. Because casings cannot advance through this type of material, it must be removed. Removal will consist of capturing the debris in a clamshell bucket. Capture of sediment will be limited. Debris will be placed in an upland location, and disposed of at a landfill if appropriate. Debris removal activities would be limited to the designated in-water work window of November 1 through February 28. Removal activities will take no more than 10 days over the course of construction.

Before debris removal begins, divers will pinpoint the location of the material. Debris removal will only occur in the precise locations where material overlaps with the footprint of the new shafts, greatly minimizing the areal extent of the activity. The amount of material in this location is unknown; however, assuming a worst-case scenario (that the area of the material is the same as the same as the footprint of the drilled shafts), the project will remove debris in no more than 31 locations over an area of roughly 2,433 sq. ft. No more than 90 cubic yards of material will be removed.

If any items are found during excavation that contain potential contaminants (buried drums, car bodies containing petroleum products, etc.) activities to control and clean up contaminants will be implemented in accordance with the Spill Prevention, Control, and Countermeasures (SPCC) plan as described in Section 11.

1.11.2 Duration of Permanent Shaft Installation

Installation of each drilled shaft is estimated to take approximately 10 days. However, the total duration of this activity could vary considerably depending on the type of equipment used, the quantity of available equipment, and on-site soil conditions. The total duration of drilled shaft installation will be approximately 18 months.

1.11.3 Quantity of Permanent Shafts

No more than 31 shafts will be installed for the North Portland Harbor bridges. Each bridge will have four to seven spans, each a maximum of 255 feet long. Each bridge will have three to five in-water bents, consisting of one to three 10-foot-diameter drilled shafts. Unlike the Columbia River piers, shafts will not be topped by a shaft cap. Current designs place all of the bents in shallow water (less than 20 feet deep). Bents are designed to withstand the design scour without armor-type scour protection (e.g., riprap).

1.12 Column Construction

Columns will be constructed of cast-in-place reinforced concrete. Construction of cast-in-place columns will require cranes, work barges, and material barges continuously throughout this period.

1.13 Superstructure

The superstructure will consist of girders and a deck. Girders will be constructed of structural steel, cast-in-place concrete, or precast concrete. Precast girders may be fabricated at a casting yard. A cast-in-place concrete deck will be placed on the girders.

1.14 Columbia River Bridge Demolition

The existing Columbia River bridges will be demolished after the new Columbia River bridges have been constructed and after associated interchanges are operating. The existing Columbia River bridges will be demolished in two stages: 1) superstructure demolition and 2) substructure demolition.

1.14.1 Columbia River Bridges Superstructure Removal

Demolition of the superstructure will begin with removal of the counterweights. The lift span will be locked into place and the counterweights will be cut into pieces and transferred off-site via truck or barge. Next, the lift towers will be cut into manageable pieces and loaded onto barges by a crane. Prior to removal of the trusses, the deck will be removed by cutting it into manageable pieces; these pieces will be transported by barge or truck or by using a breaker, in which case debris will be caught on a barge or other containment system below the work area. After demolition of the concrete deck, trusses will be lifted off of their bearings and onto barges and transferred to a shoreline dismantling site.

The existing Columbia River bridge structures comprise 11 pairs of steel through-truss spans with reinforced concrete decks, including one pair of movable spans over the primary navigation channel and one pair of 531-foot-long span trusses. The remaining nine pairs of trusses range from 265 to 275 feet in length. In addition to the trusses, there are reinforced concrete approach spans (over land) on either end of the bridges.

Table 1-13 describes the approximate area of the overwater portions of the existing bridges.

Table 1-13. Approximate Area of Existing Columbia River Bridges

	Northbound	Southbound
Steel Trusses	168,096 sq. ft.	176,943 sq. ft.
Reinforced Concrete Approach Structure	18,250 sq. ft.	18,950 sq. ft.
Total Structure Area	**186,346 sq. ft.**	**195,893 sq. ft.**

1.14.2 Columbia River Bridge Pier Removal

Nine sets of the 11 existing Columbia River bridge piers are below the ordinary high water (OHW) level and are supported on a total of approximately 1,800 driven timber piles. Demolition methods are not finalized; however, the final design will consider factors such as pier depth, safety, phasing constraints, and impacts to aquatic species. Demolition of the concrete piers and timber piling foundations will be accomplished using one of two methods:

1. After removal of the trusses, a cofferdam will be installed at each of the nine in-water bridge piers to contain demolition activities. Cofferdams will not be dewatered. The piers will be broken up and removed from within the cofferdam. Timber piles that pose a navigation hazard will then be extracted or cut off below the mud line.
2. A diamond wire/wire saw (Figure 1-13) will be used to cut the piers into manageable chunks that will be transported offsite. Cofferdams will not be used. Timber piles will then be extracted or cut off below the mud line.

With either method, the pieces of the piers will be removed via barge.

Although ODOT maintenance personnel regularly inspect the existing bridge, the timber piles located underneath the existing piers are inaccessible and have not been inspected. Therefore, it is unknown whether these timber piles have been treated with creosote, but given their age and intended purpose, it is assumed that they have been so treated. Only piles that could pose a navigation hazard will be removed or cut off below mud line. These piles include those that are present in the proposed navigation channels and any that extend above the surface of the river bed. Piles will be removed (using a vibratory extractor, direct pull, or clam shell dredge) or cut off below the mud line using an underwater saw. The exact number of piles to be removed is unknown.

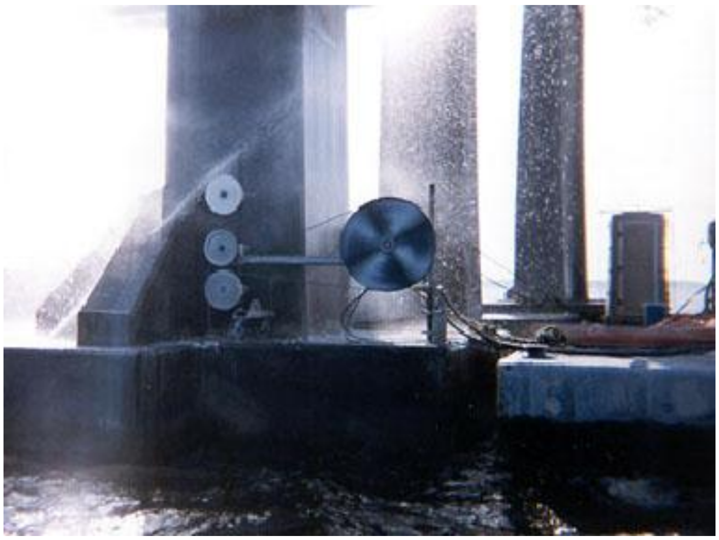


Figure 1-13. Wire/Diamond Saw

1.14.3 Columbia River Bridge Demolition Sequencing

A conceptual demolition sequence was determined based on the amount of equipment likely available to build the project and the physical space the equipment requires at each pier. The sequence is provided in Appendix A, Figures 12–16. The actual construction sequence will be determined by the contractor once a construction contract is awarded.

1.14.4 Columbia River Bridge Demolition Timeline

Demolition will occur after the new Columbia River replacement bridges are built. Demolition activities will take approximately 18 months from approximately September 2019 until March 2021.

1.14.5 Use of Temporary Cofferdams and Piles During Bridge Demolition

Temporary cofferdams will be required to isolate work activities and temporary piles will be installed to anchor work and material barges during demolition of the spans and in-water piers.

1.14.5.1 Cofferdams

If the diamond wire/wire saw is not used, a temporary cofferdam consisting of interlocking sections of sheet piles will be used to isolate demolition activities at each of the nine in-water piers. Table 1-14 describes the estimated dimensions, area, and number of temporary cofferdams that will be used during bridge demolition.

Table 1-14. Approximate Cofferdam Specifications for Columbia River Bridge Demolition

Application	Length	Width	Height	Area per Cofferdam (sq. ft.)	Number of Cofferdams	Total Area of Cofferdams (sq. ft.)
Demolition of existing in-water piers	150	50	30	7,500	9	67,500

Sheet piles for cofferdams will be installed with a vibratory hammer or a press-in method. Table 1-15 describes the estimated number of sheet piles and duration for cofferdam installation as well as the total duration any one cofferdam will be present in-water. Up to three cofferdams will be in place at any given time. Sheet piles will be removed using a vibratory hammer or direct pull.

Cofferdams will be installed in a manner that minimizes fish entrapment. Sheet piles will be installed from upstream to downstream, lowering the sheet piles slowly until contact with the substrate. When cofferdams are used, fish salvage must be conducted according to protocol approved by ODFW, WDFW, and NMFS.

Table 1-15. Demolition Summary for Cofferdams in the Columbia River

Number of Cofferdams	Number of Sheet Piles/ Cofferdam	Total Number Sheet Piles	Duration to Install Sheet Pile (#/Day)	Duration to Install One Cofferdam (days)	Duration Present in Water (days)	Duration to Remove One Cofferdam (days)
9	200	1,800	6	11	20	10

1.14.5.2 Barges

Barges will be used as platforms to perform the demolition and to haul materials and equipment to and from the work site (see Appendix A, Figures 8–10).

Several types and sizes of barges are anticipated to be used for bridge demolition. The type and size of each barge will depend on how the barge is used. Up to six stationary or moving barges are expected to be present at any one time during bridge demolition. Number of barges and barge area for each phase of demolition are summarized in Table 1-11.

1.14.6 Temporary Pipe Piles

Demolition is currently anticipated to occur from barges. Over 300 18- to 24-inch steel pipe piles (each approximately 70 feet long) will be used to anchor and support the work and material barges necessary for demolition. Table 1-16 summarizes temporary pile use during bridge demolition.

Table 1-16. Summary of Barges and Temporary Piles Used in Bridge Demolition

Application	Locations	Barges/ Location	Area of Barges[a] (sq. ft.)	Piles/ Barge	Piles	Area of Piles (sq. ft.)	Duration in Water (days/ location)
Span Removal	9	4-6	18,000	4	160	503	30
Pier Demolition	9	4	10,500	4	144	452	30
Total	**---**	**---**	**28,500**	**---**	**304**	**995**	**---**

a Cumulative at any one time.

1.14.6.1 Installation and Removal of Temporary Pipe Piles

All temporary piles will be installed using a vibratory hammer or push-in method. They will be extracted using vibratory methods or direct pull. Piles will be installed and removed continuously throughout the demolition process.

1.14.7 Equipment Necessary for Bridge Demolition

Equipment required for bridge demolition includes barge-mounted cranes/hammers or hydraulic rams. Vibratory hammers will be used to install and remove sheet piles for cofferdams and pipe piles for barge moorings. New permanent piles will not be required for demolition of the Columbia River bridges.

1.14.8 Proposed Bridge Construction and Demolition Minimization Measures

Throughout construction of the bridges over the Columbia River and North Portland Harbor and demolition of the existing Columbia River bridges, impact minimization measures will be used in accordance with regulations, permits, and state department of transportation specifications. These measures include methods to prevent pollutants from entering the water, salvage fish during isolation activities, utilize a noise attenuation device during impact pile driving, and monitor in-water noise, as well as monitoring and shutdown procedures to prevent injury to seals and sea lions. Detailed measures to avoid and/or minimize impacts from bridge construction activities are provided in Section 11 of this document.

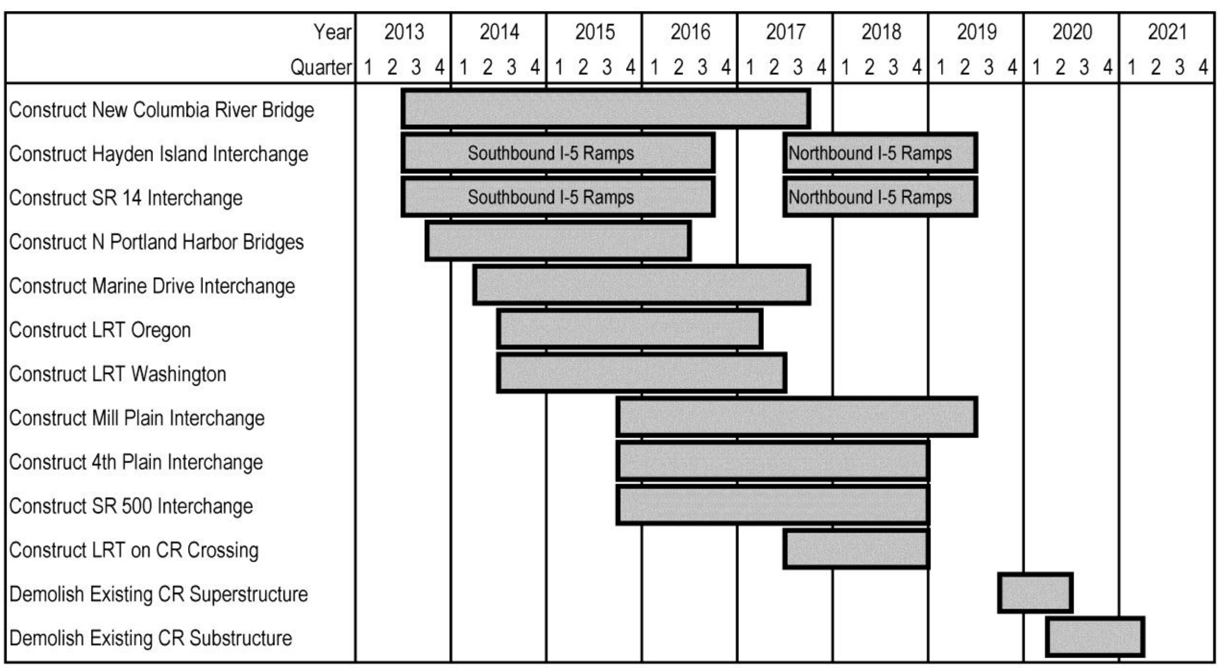
2. Dates, Duration, and Region of Activity

The date(s) and duration of such activity and the specific geographical region where it will occur.

2.1 Dates and Duration of Construction and Demolition activities

Construction activities for both the Columbia River and North Portland Harbor bridges are estimated to begin in 2013. Construction activities for the Columbia River bridges are estimated to end in 2017, while construction activities for the North Portland Harbor bridges are estimated to end in 2016. Demolition of the existing Columbia River bridges is expected to occur for 18 months from approximately September 2019 until March 2021. However, some demolition could possibly occur at some point during the 5-year LOA period (July 2013 to June 2018).

Figure 2-1 provides an overview of the anticipated CRC project timeline and sequencing of project elements. Funding will be a large factor in determining the overall sequencing and construction duration. Contractor schedules, weather, materials, and equipment could also influence construction duration.



CR = Columbia River; LRT = Light Rail Transit; N = North; SR = State Route

Figure 2-1. Representative Schedule of CRC Project Construction Activities

The ODFW and WDFW in-water work window for this portion of the Columbia River and North Portland Harbor is November 1 through February 28. Because of the large amount of in-water work involved, the CRC project will not be able to complete the in-water work during this time period. Therefore, the CRC project will request a variance to the published in-water work window. Some in-water construction activities are proposed to occur year-round (Table 2-1), while impact pile driving will occur within the September 15 to April 15 window.

1 **Table 2-1. Proposed Timing of In-Water Work in the Columbia River and North Portland Harbor**

Activity	Description	Activity Duration (2013-2021)	Timing
1. Install small-diameter piles (≤48") with impact methods.[a]	Small-diameter piles will be used in the construction of temporary work bridges/platforms, tower cranes, and oscillator support platforms.	45 min/day (impact hammer operation) with up to 7.5 min./week of unattenuated driving in CR and 5 min./week of unattenuated driving in NPH. 138 days in CR, 134 days in NPH.	Only within approved extended in-water work window of September 15 through April 15 each year.
2. Install small-diameter piles (≤48") with non-impact methods.	Small-diameter piles will be used in the construction of temporary work bridges/platforms, barge moorings, tower cranes, and oscillator support platforms.	Length of work day is subject to local noise ordinances, however could be up to 24 hours/day. 138 days in CR, 134 days in NPH.	Year-round provided work does not violate water quality standards.
3. Extract small-diameter piles (≤48") (not including cofferdams).	Removal of small-diameter piles will be done using vibratory equipment or direct pull.	Length of work day is subject to local noise ordinances, however could be up to 24 hours/day.	Year-round provided work does not violate water quality standards.
4. Install/remove cofferdam for construction of Columbia River bridges.	Used to construct piers nearest to shore in the Columbia River (Pier complexes 2 and 7). Steel sheet pile sections to be installed by non-impact means to form a cofferdam. Sheet pile removal can be direct pull or use a vibratory hammer.	Cofferdams could be in place for a maximum of 250 work days each. Installation and dewatering of each cofferdam will not take more than 65 workdays; cofferdam removal will not take more than 25 workdays. Length of work day is subject to local noise ordinances.	Year-round provided work does not violate water quality standards.
5a. Install large-diameter drilled shaft casings (≥72") using vibratory hammer, rotator, or oscillator outside of a cofferdam.	Used to construct piers and bents not immediately adjacent to shore in the Columbia River and North Portland Harbor.	CR: 110 – 120 days / pier complex NPH: ~8 days/shaft	Year-round provided work does not violate water quality standards.
5b. Install large-diameter drilled shaft casings (≥72") using vibratory hammer, rotator, or oscillator inside of a water- or sand-filled cofferdam.	Used to construct piers and bents nearest to shore in the Columbia River and North Portland Harbor.	CR PC 2 and PC 7: ~84 days each NPH: ~ 8 days/shaft	Year-round provided work does not violate water quality standards.
6. Clean out shafts and place reinforcing, concrete inside steel casings.	Applies to all piers and shafts. All activities/materials will be contained within the casings and have no contact with the water.	CR: 110 – 120 days / pier complex NPH: ~8 days/shaft	Year-round provided work does not violate water quality standards.

Activity	Description	Activity Duration (2013-2021)	Timing
7a. Perform placement of reinforcement and concrete for a cast-in-place pile cap.	Possible construction method for shaft cap at pier complexes 2 and 7. All activities and materials will be contained within forms and will have no contact with the water. The bottom of the pier caps may sit below the mud line.	Estimate 95 work days per pier.	Year-round. For pier caps nearest shore: year-round if work occurs within a de-watered cofferdam.
7b. Place a prefabricated pile cap, form, pile template, or similar element into the water.	At CR pier complexes 3 - 6. Potentially at pier complexes 2 and 7. Assume contact with the water surface, but not with the riverbed.	100 work days per pier.	For deep water piers: year-round provided work does not violate water quality standards. For piers nearest shore: year-round if work occurs within a de-watered cofferdam.
8. Install and remove cofferdam for demolition of existing Columbia River bridges.	Steel sheet pile sections will be installed with a vibratory hammer or pushed in, to form a cofferdam. Sheet pile removal can be direct pull or with a vibratory hammer. More than one cofferdam is to be in use at a time.	~ 370 days Installation: 10 work days per pier, Demolition: 20 work days per pier, Removal: 10 work days per pier.	Year-round provided work does not violate water quality standards.[b]
9a. Perform wire saw/diamond wire cutting outside of a cofferdam at or below the water surface.	Used throughout for demolition of existing bridges to cut concrete piers into manageable pieces. These pieces will then be loaded onto barges and transported off site.	Pier cutting and removal to take approximately 7 work days per pier.	Year-round provided work does not violate water quality standards.
9b. Perform wire saw/diamond wire cutting or a hydraulic breaker inside of a cofferdam.	Used for demolition of the existing Columbia River bridges. Used in water to cut concrete piers into manageable pieces. Cofferdam will not be dewatered.	Pier cutting and removal to take approximately 7 work days per pier.	Year-round provided work does not violate water quality standards.
10. Remove material from river bed.	Old pier/bent foundations or riprap from North Portland Crossing will be removed if obstructing construction. Will use bucket dredge.	Less than 7 work days during the published standard in-water work window per pier.	No variance requested. November 1 to February 28.
10a. Spot remove debris and riprap from river bed.	Guided removal (likely underwater diver assisted) of specific pieces of debris or large riprap only in the location where the shaft will be drilled. In North Portland Harbor only. Will use bucket dredge.	Up to 2 hrs/day. Less than 7 work days.	Year-round provided work does not violate water quality standards.

Note: Proposed timing is contingent upon obtaining an in-water work variance from all relevant regulatory agencies.

a As a minimization measure, temporary piles that are load-bearing will be vibrated to refusal, then driven and proofed with an impact hammer to confirm load-bearing capacity.

b In the event water quality monitoring determines that work exceeds water quality standards, all in-water work will be suspended until corrective measures can be implemented.

Neither state nor federal agencies have formally accepted the proposed in-water work window. NMFS is currently reviewing the BA and will approve or modify the work window in the Biological Opinion (BO). The ODFW and WDFW will review and approve or modify the work window during their review of permit applications. However, the CRC project team has been meeting with these agency representatives for several years. Over the past 18 months, analysis of the in-water work window for numerous activities has been discussed. While no official approval can be granted at this time, the agency representatives have acknowledged that the proposed in-water work window will likely be acceptable to them.

The rationale for the proposed in-water work window takes into account listed and unlisted fish and wildlife. Sixteen federally listed fish species (listed also as evolutionarily significant units [ESUs] or distinct population segments [DPSs] within some species) pass through the CRC project area. Three of these listed fish species are listed as endangered and occur in the interior Columbia Basin upriver from the project site. Listed fish species are present at the project site during all times of the year. During pre-consultation meetings for the Section 7 consultation in August and September 2009, NMFS informed the project that incidental take of interior Columbia River basin listed species will need to be completely avoided for the project to successfully make it through consultation. The current Federal Columbia River Power System (FCRPS) BO had provided an analysis of the viability of these populations and it reduces the ability for NMFS to allow incidental take of these species.

Since that time, CRC has worked with state fish and wildlife staff, NMFS, the Columbia River Fish Passage Advisory Committee, and other species experts to refine run-timing specific to the project area and develop run-timing curves based on best available science for each listed species, as well as to model project impacts from impact pile driving to listed fish species. The result of our initial analysis was high estimated impact to listed fish runs that transited the project area during the proposed in-water work window (lower basin listed ESUs and DPSs). Subsequent modifications to construction methods were made to provide additional minimization to all interior and lower river basin listed fish runs. Modifications to the proposed in-water work window were explored and defined based on modeling of hydroacoustic impacts. Results of these modeling efforts and input on fish-run timing data and timing curves from NMFS and state fish and wildlife staff were discussed at meetings held from January through June 2010. Final species timing, abundance data, and run-timing curves, as well as modeled impacts, were incorporated into an addendum to Appendix K of the CRC BA.

Avoiding and minimizing impacts to listed fish species, some of which have populations that are at a high or very high risk of extinction, has been a priority for the CRC project. The project's timing for impact pile driving overlaps with pinniped presence (primarily January through May) from approximately January through April 15. Our current proposed in-water work timing reflects the difficult balance we have tried to achieve by choosing timing for impact pile driving that impacts the less vulnerable of the listed fish species. These less vulnerable species are largely the lower river runs that still have populations that are in low numbers at or above our project site (Columbia River chum, lower Columbia River coho, lower Columbia River steelhead, and lower Columbia River Chinook). Therefore, as with some of the listed fish runs, project timing to avoid impact pile driving during the time of year when seals and sea lions are present is not ideal. However, because seal and sea lion presence is transient at the project site, they occur in low numbers, and, with mitigation measures proposed, impacts to them will result only in potential temporary changes in behavior. We expect that with the minimization measures proposed in this application, the CRC project will:

- Avoid any potential injury from noise levels produced from impact pile driving during construction.
- Will not have any effect on breeding animals, pups, or populations.
- Will temporarily produce sound near the project area that may impact pinniped behavior, but will not have any long term impacts to pinnipeds or their habitat.

Activities taking place outside of the normal in-water work window will occur in coordination with ODFW, WDFW, NMFS, and USFWS, and in compliance with the terms and conditions of all regulatory permits obtained for this project.

2.2 Region of Activity

The I-5 bridges are located at RM 106 (RKm 171) of the Columbia River. The I-5 bridges cross the Columbia River from Vancouver, Washington to the North to Hayden Island in Portland, Oregon, to the south. From Hayden Island, a single I-5 bridge crosses North Portland Harbor to the mainland in Portland, Oregon. The North Portland Harbor is a large side channel of the Columbia River that flows between the southern bank of Hayden Island and the Oregon mainland. The channel branches off the Columbia River approximately 2 RM upstream (east) of the existing bridge site, and flows approximately 5 RM downstream (west) before rejoining the mainstem Columbia River.

In the Columbia River and North Portland Harbor, hydroacoustic impacts from pile installation[4] are the farthest reaching extent of project aquatic impacts. We have defined the Region of Activity as the area in which marine mammals will be directly impacted by noise generated by in-water construction activities. Due to the curvature of the river and islands present, underwater noise from pile installation is expected to encounter land before it reaches the 120 dB re: 1 μPa RMS disturbance threshold.[5] Noise from pile installation is not expected to extend beyond Sauvie Island, approximately 5.5 RM downstream, and Lady Island, 12.5 RM upstream, i.e., the extent of the Region of Activity downstream and upstream of CRC project construction activities (Figure 2-2). This distance encompasses the Columbia River from approximately RM 101 to 118 (RKm 163 to 190). Within North Portland Harbor, underwater noise is expected to extend 3.5 miles downstream and 1.9 miles upstream of CRC project construction activities.

2.3 General Description of Geographic Area of the Region of Activity

The Region of Activity is located within the Lower Columbia River subbasin. The Columbia River and its tributaries are the dominant aquatic system in the Pacific Northwest. The Columbia River originates on the west slope of the Rocky Mountains in Canada and flows approximately 1,200 miles to the Pacific Ocean, draining an area of approximately 219,000 square miles in Washington, Oregon, Idaho, Montana, Wyoming, Nevada, and Utah. Saltwater intrusion from the Pacific Ocean extends approximately 23 miles upstream from the river mouth at Astoria, Oregon. Coastal tides influence the flow rate and river level up to Bonneville Dam at RM 146.1 (RKm 235) (USACE 1989).

The project area is highly altered by human disturbance, and urbanization extends up to the shoreline. There has been extensive removal of streamside forests and wetlands. Riparian areas have been further degraded by construction of dikes and levees and the placement of streambank armoring. For several decades, industrial, residential, and upstream agricultural sources have contributed to water quality degradation in the river. Additionally, existing levels of disturbance are high due to heavy barge traffic.

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[4] Impacts may also include steel casings for drilled shafts if they are installed by a vibratory hammer. These distances are expected to be similar to vibratory installation of steel piles (i.e., they will extend until they encounter land).

[5] No background noise level measurements have been taken at the project site. One measurement of 60 Pa (or 136 dB peak) has been reported for the lower Columbia River at RM 45 (Carlson et al. 2001), but this measurement is not applicable to the CRC project area due to substantial differences in river characteristics, including tidal influence in that location.

Figure 2-2.
Region of Activity

Maximum Extent of Underwater Noise from Pile Installation

Design Shapes

Project Bridge Piers

Project Footprint

N
W
E
S

0 1 2
Miles

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: June 11, 2010: File Name: HydroSound_MG246_MultipleDrivers.mxd

Twelve major dams located in the Columbia Basin are the primary factors affecting flow conditions in the Region of Activity. Consequently, the Columbia River, including the Region of Activity, is a highly managed waterbody that resembles a series of slack-water lakes rather than its original free-flowing state. The second major contributor to stream flow conditions in the area is tidal influence from the Pacific Ocean. Although the saltwater wedge does not extend into the Region of Activity, high tide events affect flow and stage in the Columbia up to Bonneville Dam.

Hydrology in the Region of Activity has been profoundly altered from historical conditions. Natural landforms and constructed landforms (e.g., dikes and levees) are the dominant floodplain constrictions, while bridge footings are the subdominant floodplain constrictions. Within the CRC project area, nine pairs of the existing Columbia River bridge piers are located below OHW and six bents are located below OHW in North Portland Harbor. A flood control levee runs along the south bank of North Portland Harbor, forming a boundary between the adjacent neighborhoods and the harbor. Numerous upstream dams, levees located along shorelines, and channel modifications (e.g., armoring, reshaping) have restricted habitat-forming processes such as sediment transport and deposition, erosion, and natural flooding. Therefore, habitat complexity is significantly reduced from historic conditions. Shoreline erosion rates are likely slower than they were historically due to flow regulation. The river channel is deeper and narrower than under historical conditions.

3. Species and Numbers of Marine Mammals in Area

A description of the species and numbers of marine mammals likely to be found within the Region of Activity.

Marine mammal species that have been observed within the Region of Activity consist of the Pacific harbor seal, California sea lion, and Steller sea lion. The sea lions use this portion of the river primarily for going to and from Bonneville Dam for foraging on migrating salmon, steelhead, and sturgeon concentrated below the dam. An active sea lion hazing, trapping, and permanent removal program is in place below the dam. Much of the information presented in this application is based on research conducted as part of the Bonneville Dam sea lion program. Harbor seals rarely, but occasionally, transit the Region of Activity.

There are no seal or sea lion haulout sites in the Region of Activity. The nearest haulout sites, shared by harbor seals and California sea lions, are near the Cowlitz River/Carroll Slough confluence with the Columbia River southeast of Longview, Washington, approximately 45 miles downriver from the Region of Activity (Jeffries et al. 2000). The nearest known haulout for Steller sea lions is a rock formation (Phoca Rock) near RM 132 (Tennis, pers. comm. 2009) approximately 8 miles downstream of Bonneville Dam and 26 miles upstream from the Region of Activity. Steller sea lions are also known to haul out on the south jetty at the mouth of the Columbia River, near Astoria, Oregon. There are no harbor seal or sea lion rookeries located in or near the Region of Activity.

3.1 Pacific Harbor Seals

The Oregon/Washington coastal stock of Pacific harbor seals consisted of about 25,000 animals in 1999 (Carreta et al. 2007a). This harbor seal stock includes coastal estuaries (Columbia River) and bays (Willapa Bay and Grays Harbor). The harbor seal coastal stock increased at an annual rate of 7 percent from 1983 to 1992 and at 4 percent from 1983 to 1996 (Jeffries et al. 1997). Based on analyses of Jeffries et al. (2003) and Brown et al. (2005), both the Washington and Oregon portions of this stock have reached carrying capacity and are no longer increasing, and the stock is believed to be within its optimum sustainable population level (Jeffries et al. 2003; Brown et al. 2005). Pacific harbor seals are infrequently observed at Bonneville Dam or in the Region of Activity. In 2009 and again in 2010, two harbor seals were observed at the dam (Stansell et al. 2009; Stansell and Gibbons 2010). The number of harbor seals expected to occur in the Region of Activity is very low based on the number of seals observed in the Columbia River and the location of haulout sites at least 45 miles downstream from the Region of Activity.

3.2 California Sea Lions

The U.S. stock of California sea lions was estimated to be 238,000 in the 2007 Stock Assessment Report (SAR) and may be at carrying capacity, although more data is needed to verify that determination (Carretta et al. 2007). This species was considered rare in Washington waters prior to the 1950s. Currently, peak numbers of 3,000–5,000 animals move into northwest waters (Washington and British Columbia) during the fall and remain until late spring when most return to breeding rookeries in California and Mexico (Jeffries et al. 2000). Generally, California sea lions in the Pacific Northwest are subadult or adult males (NOAA 2008).

California sea lions are known to occur in several areas of the Columbia River during much of the year, except the summer breeding months of June through August. Approximately 1,000 California sea lions have been observed at haulout sites at the mouth of the Columbia River, while approximately 100 individuals have been observed in past years at the Bonneville Dam between January and May prior to returning to their breeding rookeries in California at the end of May (Stansell, pers. comm. 2010). In 2009, 54 California sea lions were observed at Bonneville Dam, the fewest since 2002 (Stansell et al. 2009). However, in 2010, 89 California sea lion individuals were observed at Bonneville Dam (Stansell et al. 2010). In recent years, up to four California sea lions have been observed at Bonneville Dam during the September-January period (Stansell, pers. comm. 2010), and eight California sea lions have been observed feeding on threatened, endangered, and non-listed salmonids, including Columbia River spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*O. mykiss*) in the Willamette River below Willamette Falls (NOAA 2008). Willamette Falls is approximately 26 miles upriver from where the Willamette River enters the Columbia River. The mouth of the Willamette River is approximately 5 miles downstream of the CRC project area and is within the Region of Activity. The earliest known report of California sea lions at Willamette Falls was in April 1975 when two sea lions were reported taking salmon and hindering fish passage at the fish ladder. Other than the 1975 sighting, there were no reports of sea lions at Willamette Falls until the late 1980s when personnel at the fish ladder reported California sea lion sightings below the falls. California sea lions were sighted sporadically near the falls until 1995 when they began occurring almost daily from February through late May (Scordino 2010). Of the 621 California sea lions individually marked by 2006, eight have been observed feeding on salmonids in the area below Willamette Falls (NOAA 2008).

3.3 Steller Sea Lions

The eastern stock of Steller sea lions is estimated to be between 45,095 and 55,832 individuals based on 2002–2005 pup counts (Allen and Angliss 2010). They can be found year-round at the mouth of the Columbia River. In 2003, during surface observations of California sea lions, three Steller sea lions were first observed in the tailrace of Bonneville dam foraging on white sturgeon and salmonids. Over the last several years, Steller sea lions have been observed in the waters below Bonneville Dam as early as November (Tackley et al. 2008a and b). In 2008, anecdotal observations of Steller sea lions below Bonneville Dam were made in October (Stansell et al. 2009) and in 2009, observations of Steller sea lions below Bonneville Dam were made in September (Stansell et al. 2010). Steller sea lions generally leave area below the dam by the end of May (Tackley et al. 2008a and b; Stansell et al. 2009; Stansell and Gibbons 2010). Seventy-five Steller sea lions were observed in 2010 at Bonneville Dam, the most on record and almost triple the number of the previous year (26 individuals) (Stansell et al. 2009, Stansell et al. 2010).

4. Status and Distribution of the Affected Species

A description of the status, distribution, and seasonal distribution (when applicable) of the affected species or stocks of marine mammals likely to be affected by such activities.

Seals and sea lions follow prey species into freshwater up to Willamette Falls (RM 26) in the Willamette River and Bonneville Dam (RM 145) in the Columbia River. The Willamette River enters the Columbia River approximately 5 miles downstream of the CRC project area and is within the Region of Activity. Seals and sea lions remain in upstream locations for a couple of days or longer, feeding heavily on salmon, steelhead, and sturgeon (NOAA 2008), although the occurrence of harbor seals near Bonneville Dam is much lower than sea lions (Stansell et al. 2009). Bonneville Dam concentrates adult salmon returning to natal streams, providing for increased foraging efficiency by California sea lions and Steller sea lions. Sea lions congregate at Bonneville Dam during the peaks of salmon return, from March through May each year, and a few California sea lions have been observed feeding on salmonids in the area below Willamette Falls during the spring adult fish migration (NOAA 2008).

4.1 Pacific Harbor Seal

Harbor seals are members of the true seal family (*Phocidae*). For management purposes, differences in mean pupping date (Temte 1986), movement patterns (Jeffries 1985; Brown 1988), pollutant loads (Calambokidis et al. 1985), and fishery interactions have led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988). The three distinct stocks are: 1) inland waters of Washington State (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), 2) outer coast of Oregon and Washington, and 3) California (Carretta et al. 2007). The seals in the Region of Activity are from the outer coast of Oregon and Washington stock.

4.1.1 Status

Harbor seals are not considered to be “depleted” under the MMPA or listed as “threatened” or “endangered” under the ESA. Based on currently available data, i.e., marine mammal observer data, self-reported fisheries information, and stranding data, the level of human-caused mortality and serious injury is less than 10 percent of the potential biological removal (PBR) of 1,343 harbor seals per year (Carretta et al. 2007). Therefore, the Oregon and Washington outer coast stock of harbor seals is not classified as a “strategic” stock. The stock is also considered within its Optimum Sustainable Population level (Jeffries et al. 2003 and Brown et al. 2005, as cited in Carretta et al. 2007).

4.1.2 Distribution

In general, harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the continental U.S., British Columbia, and Southeast Alaska, west through the Gulf of Alaska and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. Harbor seals are non-migratory with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Scheffer and Slipp 1944; Fisher 1952; Bigg 1969, 1981). They are not known to make extensive pelagic migrations, although some long distance movement of tagged animals in Alaska (174 km), and along the U.S. west coast (up to 550 km), have been recorded (Pitcher and McAllister 1981; Brown and Mate 1983; Herder 1986).

Harbor seals haulout on rocks, reefs, beaches, and drifting glacial ice and feed in marine, estuarine, and occasionally fresh waters. Harbor seals display strong fidelity for haulout sites (Pitcher and Calkins 1979, Pitcher and McAllister 1981). Group sizes range from small numbers of animals on intertidal rocks to several thousand animals found seasonally in coastal estuaries.

The harbor seal is the most commonly observed and widely distributed pinniped found in Oregon and Washington (Jeffries et al. 2000; ODFW 2010). Harbor seals use hundreds of sites to rest or haulout along the coast and inland waters of Oregon and Washington, including tidal sand bars and mudflats in estuaries, intertidal rocks and reefs, beaches, logbooms, docks, and floats in all marine areas of the two states. Numerous harbor seal haulout sites are found on intertidal mudflats and sand bars from the mouth of the lower Columbia River to Carroll Slough at the confluence of the Cowlitz and Columbia Rivers. They can be found throughout the year at the mouth of the Columbia River. Peak harbor seal abundances in the Columbia River occur during the winter and spring when a number of upriver haulout sites are used. Peak abundances and upriver movements in the winter and spring months are correlated with spawning runs of eulachon smelt and out migration of salmonid smolts.

Within the Region of Activity, there are no known harbor seal haulout sites. The nearest known haulout sites (two) to the Region of Activity are located at Carroll Slough at the confluence of the Cowlitz and Columbia Rivers approximately 45 miles west of the western-most edge of the Region of Activity. Pupping seasons vary by geographic region with pups born in coastal estuaries (Columbia River, Willapa Bay, and Grays Harbor) from mid-April through June and in other areas along the Olympic Peninsula and Puget Sound from May through September (WDFW 2000). The locations of where pupping occurs and known haulouts, and the low number of observations of harbor seals at Bonneville Dam over the years (one to three from 2002 to 2010), suggest that very few harbor seals transit through the Region of Activity (Stansell et al. 2010).

4.2 California Sea Lion

California sea lions are members of the family *Otariidae* or eared seals (sea lions and fur seals). The California sea lion includes three subspecies: *Z. c. wollebaeki* (on the Galapagos Islands), *Z. c. japonicus* (in Japan, but now thought to be extinct), and *Z. c. californianus* (found from southern Mexico to southwestern Canada; herein referred to as the California sea lion) (Carretta et al. 2007). The breeding areas of the California sea lion are on islands located in southern California, western Baja California, and the Gulf of California (Carretta et al. 2007). These three geographic regions are used to separate this subspecies into three stocks: 1) the United States stock begins at the U.S./Mexico border and extends northward into Canada, 2) the Western Baja California stock extends from the U.S./Mexico border to the southern tip of the Baja California Peninsula, and 3) the Gulf of California stock which includes the Gulf of California from the southern tip of the Baja California peninsula and across to the mainland and extends to southern Mexico (Lowry et al. 1992). The Region of Activity occurs within the geographic boundaries of the “U.S. Stock.”

4.2.1 Status

California sea lions are not listed as "endangered" or "threatened" under the ESA or as "depleted" under the MMPA. They are not considered a "strategic" stock under the MMPA, because total human-caused mortality, although unknown, is likely to be less than the PBR (8,511) (Carretta et al. 2007).

4.2.2 Distribution

California sea lions breed on islands off Baja, Mexico, and southern California. Females generally do not migrate, remaining in waters near their breeding rookeries off the coast of California and Mexico (Jeffries et al. 2000). Only male California sea lions migrate into northern waters.

California sea lions do not breed in Oregon. Though a few young animals may remain in Oregon during summer months, most return to California's Channel Islands to breed (ODFW 2010). Male California sea lions are commonly seen in Oregon from September through May. During this time period California sea lions can be found in many bays, estuaries and on offshore sites along the coast, often hauled-out in the same locations as Steller sea lions. Some pass through Oregon to feed along coastal waters to the north during fall and winter months (ODFW 2010).

The California sea lion is the most frequently sighted otariid found in Washington waters and uses haulout sites along the outer coast, Strait of Juan de Fuca, and in Puget Sound (Jeffries et al. 2000). Haulout sites are located on jetties, offshore rocks and islands, log booms, marina docks, and navigation buoys. This species also may be frequently seen resting in the water (rafted) together in groups in Puget Sound. All age classes of males are present in Washington waters (Jeffries et al. 2000). The nearest known haulout sites to the Region of Activity are near the Cowlitz River/Carroll Slough confluence with the Columbia River southeast of Longview, Washington approximately 45 miles west of the western-most edge of the Region of Activity (Jeffries et al. 2000).

An intensive sea lion monitoring program that has used surface observations since 2002 to evaluate seasonal presence, abundance, and predation activities of pinnipeds has been conducted in the Bonneville Dam tailrace by the U.S. Army Corps of Engineers (USACE). Monitoring began as a result of the 2000 FCRPS BO (section 9.6.1.5.3, action item 106), which required an evaluation of pinniped predation in the tailrace of Bonneville Dam. The objective of the study was to determine the timing and duration of pinniped predation activity, estimate the number of fish caught, record the number of pinnipeds present, identify and track individual California sea lions, and evaluate various pinniped deterrents used at the dam (Tackley et al. 2008a). The study period for monitoring was January 1 through May 31 beginning in 2002. During the study period, pinniped observations began after consistent sightings of at least one animal occurred. Tackley et al. (2008a) notes that sightings began earlier each year from 2002 to 2004. Although some sightings were reported earlier in the season, full-time observations began March 21 in 2002, March 3 in 2003, and February 24, 2004 (Tackley et al. 2008a). In 2005 observations began in April, but in 2006 through 2010 observations began in January or early February (Tackley et al. 2008a and b, Stansell et al. 2009, Stansell and Gibbons 2010).

California sea lion arrival and departure dates at Bonneville Dam are compiled from the reports listed in the preceding paragraph in Table 4-1. If arrival and departure dates were not available, the timing of surface observations within the January through May study period were recorded. Because regular observations in the study period generally began as California sea lions were observed below Bonneville Dam, and sometimes reports stated that observations stopped as sea lion numbers dropped, the observation dates only give a general idea of first arrival and departure. Because tracking data indicate that sea lions travel at fast rates between hydrophone locations above and below the CRC project area, dates of first arrival at Bonneville Dam and departure from the dam are assumed to coincide closely with potential passage timing through the CRC project area.

Table 4-1. Arrival and Departure Dates for California Sea Lions Below Bonneville Dam

	2002	2003	2004	2005	2006	2007	2008[3]	2009	2010
Arrival	3-21[1]	3-3[1]	2-24[1]	4-11[1]/1-21	2-09	1-08	1-11[1]	1-14[1]	1-08[1]
Departure	5-24[1]	6-02[1]	5-30[1]	5-31[1]/6-10	6-02	5-26[2]	5-31[1]	5-19[4]	6-04 +

1 Dates are dates observations were taken and not when sea lions were first seen. In 2005 through 2007, observations were made intermittently until sea lions were seen consistently (Tackley et al. 2008a). In 2005, surface observations were made from April 11 through May 31. However, the first California sea lion arrived January 21 and departed on June 10 (Tackley et al. 2008a).

2 A single sighting was made on November 7 (Tackley et al. 2008a).

3 Three California sea lions were observed between September and December 2008. These observations were opportunistic and outside the regular observation period of January through May (Stansell et al. 2009).

4 Observations ended because few sea lions were present (ODFW http://www.dfw.state.or.us/fish/sealion/docs/2009_Trapping_Summary_Web.pdf.). One California sea lion was in the Bonneville Dam forebay through at least August 11, 2009 (Stansell et al. 2009).

Based on the information presented in Table 4-1, California sea lions have generally been observed at Bonneville Dam between early January and early June, although beginning 2008, a few individuals have been noted at the dam as early as September and as late as August. Therefore, the vast majority of California sea lions are expected to pass the project site beginning in early January through early June. Stansell and Gibbons (2010) and Stansell et al. (2009) show California sea lion abundance below Bonneville Dam peaks in April, when it drops through about the end of May. In 2010, California sea lions stayed below the dam until almost mid-June, which was late historically and enters into the time they normally depart for southern breeding grounds. Wright et al. (2010) reported a median start date for the southbound migration from the Columbia River to the breeding grounds of May 20 (range: May 7 to May 27; n = 8 sea lions).

The highest number of California sea lions observed in the Bonneville Dam tailrace over the last 9 years was 104 in 2003 (Stansell et al 2010). However, Tackley et al. (2008a) noted that numbers of sea lions estimated from early study years were likely underestimated, because the observers' ability to uniquely identify individuals increased over the years. In addition, the high number of 104 individual present below the dam in 2003 occurred prior to hazing (started in 2005) or permanent removal (started in 2008) activities. The high for the 2008 through 2010 time period is a minimum of 89 individuals in a year (Stansell et al. 2010).

The Pacific States Marine Fisheries Commission (PSMFC) leads a tagging and tracking program for California sea lions, observing that the transit time for California sea lions between Astoria and Bonneville Dam is 30–36 hours (upstream), and 15 hours from Bonneville Dam to Astoria (downstream) (Tennis, pers. comm. 2009). ODFW studied the migration of male California sea lions during the non-breeding season by satellite tracking 26 sea lions captured in the lower Columbia River over the course of three non-breeding seasons between November and May in 2003–2004, 2004–2005, and 2006–2007. Fourteen of the sea lions had previously been observed in the Columbia River ("river type") and 12 animals were "unknown" types. Wright et al. (2010) found there was considerable within and between individual variation in spatial and temporal movements, which presumably reflected variation in foraging behavior. Many sea lions repeatedly alternated between several haulout sites throughout the non-breeding season.

Twenty of the 26 satellite-tagged sea lions remained within the waters of Oregon and Washington during the time they were monitored; the remainder made forays north to British Columbia or south to California. All 14 of the previously known "river" sea lions were later documented upriver (either by tracking or direct observation); none of the 12 "unknown" animals were detected upriver. Southward departure dates from the Columbia River ranged from May 7 to June 17. Travel time to the breeding grounds ranged from 12 to 21 days. Only one animal was tracked back to the Columbia River; it returned on 18 August after a 21-day trip from San Miguel Island (Wright et al. 2010).

Movement of sea lions to the base of Bonneville Dam to forage on salmonids was documented in only a fraction of the sea lions tracked. This suggests that the problem of pinniped predation on Columbia River salmonid stocks should be addressed primarily at upriver sites such as Bonneville Dam rather than in the estuary where sea lions of many behavioral types co-occur (Wright et al. 2010).

4.3 Steller Sea Lion

The Steller sea lion is the largest member of the eared or otariid family. Steller sea lions forage near shore and in pelagic waters. They are capable of traveling long distances in a season and can dive to approximately 1,300 ft (400 m) in depth. They also use terrestrial habitat as haulout sites for periods of rest, molting, and as rookeries for mating and pupping during the breeding season. At sea, they are seen alone or in small groups, but may gather in large "rafts" at the surface near rookeries and haulouts. Steller sea lions prefer the colder temperate to sub-arctic waters of the North Pacific Ocean. Haulouts and rookeries usually consist of beaches (gravel, rocky or sand), ledges, and rocky reefs. In the Bering and Okhotsk Seas, sea lions may also haulout on sea ice, but this is considered atypical behavior (NOAA 2010a).

Limiting factors for recovery of Steller sea lions include reduced food availability, possibly resulting from competition with commercial fisheries; incidental take and intentional kills during commercial fish harvests; subsistence take; entanglement in marine debris; disease; pollution; and harassment. The change in food availability, associated with lowered nutritional status of females and consequent reduced juvenile recruitment, may be the primary cause of the decline (60 FR 51968). Declines of this species in the early 1980s were associated with exceedingly low juvenile survivorship, whereas declines in the 1990s were associated with disproportionately low fecundity (Holmes and York 2003). Steller sea lions are also sensitive to disturbance at rookeries (during pupping and breeding) and haulout sites.

4.3.1 Status

Steller sea lions were listed as threatened range-wide under the ESA on November 26, 1990 (55 FR 49204). After division into two stocks, the western stock was listed as endangered under the ESA on May 4, 1997 and the eastern stock remained classified as threatened (62 FR 24345). In 2006, the NMFS Steller sea lion recovery team proposed removal of the eastern stock from listing under the ESA based on its annual rate of increase of approximately 3 percent since the mid-1970s. Because the eastern stock is listed under the ESA, it is designated as “depleted” under the MMPA. As a result, this stock is classified as a strategic stock. Both stocks are thus classified as strategic. Critical habitat was designated for Steller sea lions on August 27, 1993 (58 FR 45269), but is not present within the Region of Activity. Critical habitat is associated with breeding and haulout sites in Alaska, California, and Oregon. Steller sea lions are listed as “depleted” under the MMPA

4.3.2 Distribution

Steller sea lions are distributed mainly around the coasts to the outer continental shelf along the North Pacific Ocean rim from northern Hokkaido, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to California. The population is divided into the Western and the Eastern DPSs at 144° West longitude (Cape Suckling, Alaska). The Western DPS includes Steller sea lions that reside in the central and western Gulf of Alaska, Aleutian Islands, as well as those that inhabit the coastal waters and breed in Asia (e.g., Japan and Russia). The Eastern DPS extends from California to Alaska, including the Gulf of Alaska, to 144° W longitude (a line near Cape Suckling, AK) (62 FR 24345; May 5, 1997).

The abundance of the Eastern DPS of Steller sea lions is increasing throughout the northern portion of its range (Southeast Alaska and British Columbia), and stable or increasing slowly in the central portion (Oregon through central California). In the southern end of its range (Channel Islands in southern California), it has declined significantly since the late 1930s, and several rookeries and haulouts have been abandoned. Changes in ocean conditions (e.g., warmer temperatures) may be contributing to habitat changes that favor California sea lions over Steller sea lions in the southern portion of the Steller's range (NMFS 2007). The overall annual rate of increase for the eastern DPS is 3.1 percent throughout most of the range (Oregon to southeastern Alaska) (Pitcher et al. 2007). The total population of the eastern DPS of Steller sea lions is estimated to be approximately 45,095 to 55,832 animals (Allen and Angliss 2010). The most recent minimum count for Steller sea lions in Oregon and Washington was 5,813 in 2002 (Pitcher et al. 2007, Allen and Angliss 2010). Trend counts in Oregon were relatively stable in the 1980s, with uncorrected counts between 2,000 and 3,000 sea lions (NMFS 1992). Counts in Oregon have shown a gradual increase from 1,486 animals in 1976 to 4,169 animals in 2002 (NMFS 2008b).

In Oregon, Steller sea lions are found on offshore rocks and islands. Most of these haulout sites are part of the Oregon Islands National Wildlife Refuge and are closed to the public (ODFW 2010). Oregon is home to the largest breeding site in U.S. waters south of Alaska, with breeding areas at Three Arch Rocks (Oceanside), Orford Reef (Port Orford), and Rogue Reef (Gold Beach). Steller sea lions are also found year-around in smaller numbers at Sea Lion Caves and at Cape Arago State Park. Although the population of Steller sea lions in Oregon is stable and slightly increasing, they are listed as a threatened species under the ESA (ODFW 2010).

In Washington, Steller sea lion numbers vary seasonally with peak counts of 1,000 animals present during the fall and winter months. Haulout sites are found on jetties, offshore rocks and coastal islands (Jeffries et al. 2000) but no breeding rookeries occur in Washington. Haulout sites primarily occur along the outer coast from the Columbia River to Cape Flattery, as well as along the Vancouver Island side of the Strait of Juan de Fuca.

Although Steller sea lions occur primarily in coastal habitat in Oregon and Washington, they are present year-round in the lower Columbia River, usually downstream of the confluence of the Cowlitz River (RM 70) (ODFW 2008). However, adult and subadult male Steller sea lions have been observed at Bonneville Dam, where they prey primarily on white sturgeon (*Acipenser transmontanus*) and some Chinook that congregate below the dam. In 2002, the USACE began monitoring seasonal presence, abundance, and predation activities of marine mammals in the Bonneville Dam tailrace (Tackley et al. 2008b). Steller sea lions have been documented every year since 2003; the lowest abundance was two Steller sea lions in 2004, and the highest was 75 in 2010 (Stansell et al. 2009, Stansell et al. 2010).

Steller sea lions use the Columbia River for travel, foraging, and resting as they move between haulout sites and the dam. There are no known haulout sites within the portions of the Region of Activity occurring in the Columbia River, Willamette River, or North Portland Harbor. The nearest known haulout in the Columbia River is a rock formation (Phoca Rock) approximately 8 miles downstream of Bonneville Dam (approximately 26 miles upstream from the current I-5 bridges) (Tennis pers. comm. 2009). Steller sea lions are also known to haulout on the south jetty at the mouth of the Columbia River, near Astoria, Oregon. There are no rookeries located in or near the Region of Activity. The nearest Steller sea lion rookery is on the northern Oregon coast at Oceanside (ODFW 2010), approximately 70 miles south of Astoria, i.e., more than 150 miles from the Region of Activity.

Steller sea lions arrive at the dam in late fall (Tackley et al. 2008b), although occasionally individuals are sighted near Bonneville Dam in the months of September, October, and November (Stansell et al. 2009, Stansell et al. 2010). Steller sea lions are present at the dam through May, and can travel between the dam and the mouth of the Columbia River several times during these months (Tackley et al. 2008b). Table 4-2 compiles data from surface observations by the USACE for the Bonneville Dam tailrace. If arrival and departure dates were not available, the timing of surface observations within the January through May study period were recorded. Because regular observations in the study period generally began when California sea lions are observed below Bonneville Dam, and sometimes reports stated that observations stopped as sea lion numbers dropped, the observation dates only give a general idea of first arrival and departure for Steller sea lions. Because tracking data indicate that sea lions travel at fast rates between hydrophone locations above and below the CRC project area (Brown et al. 2010), dates of first arrival at Bonneville Dam and departure from the dam are assumed to coincide closely with potential passage timing through the CRC project area.

Based on the information presented in Table 4-2, Steller sea lions are expected to pass the project site beginning with a few individuals as early as September and most individuals in January through early-June. Stansell et al. (2010) and Stansell et al. (2009) show Steller sea lion abundance below Bonneville Dam increases through approximately mid-April, then drops through about the end of May.

Table 4-2. Arrival and Departure Dates for Steller Sea Lions Below Bonneville Dam

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Arrival	N/A	3-3[1]	2-24[1]	4-11[1]	2-10[1,2]	1-08[1,2]	1-11[1,3]	1-14[1,4]	1-08[1,6]
Departure	N/A	6-02[1]	5-30[1]	5-31[1]	5-31[1,2]	5-26[1,2]	5-31[1]	5-19[5]	6-04+

1 Dates are dates observations were taken and not when sea lions were first seen. Observations were made in 2002, but no Steller sea lions were observed. In 2005 through 2007, observations were made intermittently until sea lions were seen consistently (Tackley et al. 2008a). Observation dates for 2006-2007 from Scordino 2010.

2 Report states in 2006 and 2007 Steller sea lions were seen regularly in the tailrace area from January to early March. Report notes anecdotal information on sightings of Steller sea lions in November and December. Report states that after March when hazing activities began, fewer Steller sea lions were observed through May (Tackley et al. 2008a).

3 Report states “Steller sea lions were known to be catching and consuming white sturgeon in the Bonneville Dam tailrace and farther downstream as early as November” (Tackley et al. 2008b).

4 Report states “Steller sea lions were known to be catching and consuming white sturgeon in the Bonneville Dam tailrace and farther downstream at early as October, 2008” (Stansell et al. 2009).

5 Observations ended because few sea lions were present (ODFW http://www.dfw.state.or.us/fish/sealion/docs/2009_Trapping_Summary_Web.pdf.).

6 Report states that Steller sea lions were observed downriver of the Bonneville Dam tailrace as early as September 2009 (Stansell et al. 2010).

ODFW tagged eight Steller sea lions with acoustic and/or satellite-linked transmitters from March 30 through May 4, 2010 (Wright, pers. comm. 2010a). Preliminary data through May 2010 shows that the eight individuals only made one or two roundtrips from Bonneville during the 1 or 2 months they were tracked. This study will continue in 2011 and more information will be available to determine both the number of roundtrips from Bonneville and the time to transit between Bonneville and the mouth of the Columbia River. Although transit times between the mouth of the Columbia River and Bonneville Dam are not available for Steller sea lions, they are available for California sea lions. The PSMFC leads a tagging and tracking program for California sea lions, observing that the transit time for California sea lions between Astoria and Bonneville Dam is 30–36 hours (upstream), and 15 hours from Bonneville Dam to Astoria (downstream) (Tennis pers. comm. 2009). The CRC project assumes similar transit times for Steller sea lions, using California sea lions as the closest available proxy. Steller sea lions have generally been observed at Bonneville Dam between early January and late May, although individuals have been noted at the dam as early as September (Stansell et al. 2010). Thus, Steller sea lions are likely to be transiting in the Columbia River and North Portland Harbor during the time that in-water work will take place.

5. Type of Incidental Take Authorization Requested

The MMPA defines ''harassment'' as: any act of pursuit, torment, or annoyance which: (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (50 CFR, Part 216, Subpart A, Section 216.3 - Definitions).

Section 101(a)(5)(A - D) of the MMPA (16 USC. 1371(a)(5)) provides for "incidental take" authorizations for specific activities other than commercial fishing, provided NMFS finds the takings are of small numbers of marine mammals and will have no more than a "negligible impact" on the species or stock and not having an "unmitigable adverse impact" on subsistence harvests of these species. LOAs are issued for up to 5 years and require that regulations be promulgated and published in the Federal Register. Incidental Harassment Authorizations (IHA) are granted for relatively short-term activities that might inadvertently harass marine mammals, but have no potential for serious injury or mortality or the potential for serious injury or mortality can be negated through mitigation requirements that could be required under the authorization. After the type of authorization is determined, the applicant must submit a written request to the NMFS Office of Protected Resources and the appropriate NMFS Regional Office where the specified activity is planned. These requests must address 14 specific items before being considered by NMFS (NOAA 2010b).

Because the CRC project may non-intentionally harass a small number of seals and sea lions during in-water project construction, the CRC environmental team planned to apply for an IHA. On March 25, 2009, the CRC environmental team, federal project partners, and staff of NMFS met to discuss the MMPA IHA authorization for the project. NMFS requested CRC apply for an LOA instead of an IHA, because the project would occur over multiple years, even though only incidental behavioral harassment (Level B) is expected to occur.

Therefore, under Section 101(a)(5)(A) of the MMPA, the CRC project requests an LOA from July 2013 to July 2018 for incidental behavioral harassment of harbor seals, California sea lions, and Steller sea lions that could occur during construction of bridges over the Columbia River and North Portland Harbor, and demolition of the existing Columbia River bridges, described in this application. The incidental take is expected to be in the form of Level B harassment.

5.1 Method of Incidental Taking

Vibratory and impact pile installation may result in Level B harassment, i.e., behavioral disturbance. In addition to pile installation, behavioral disturbance could also be caused by airborne noise from the equipment and human work activity, as well as underwater noise from debris removal, vessels, and physical disturbance. It should be noted that no pinniped haulout or rookery sites occur in or near the vicinity of the Region of Activity where airborne and underwater noise is estimated to extend.

NMFS is currently developing comprehensive guidance on sound levels likely to cause injury and behavioral disturbance in the context of the MMPA. Until formal guidance is available, NMFS uses conservative thresholds of sound pressure level likely to cause injury or disturbance to seals and sea lions (Table 5-1) (NMFS 2008a; WSDOT 2009).

Table 5-1. Pinniped Disturbance and Injury Thresholds for Underwater and Airborne Noise

Airborne Noise	In-Water Noise		
Level at Which Pinniped Haulout Disturbance Has Been Documented	Vibratory Pile Installation Disturbance Threshold	Impact Pile Driving Disturbance Threshold	Injury Threshold
90 dB RMS (unweighted) for harbor seals 100 dB RMS (unweighted) for all other pinnipeds	120 dB RMS	160 dB RMS	190 dB RMS

Note: In-air thresholds are referenced to 20 μPa and in-water thresholds are referenced to 1 μPa.

A description of potential effects to pinnipeds from CRC project activities is provided below. A description of how project-generated noise levels and the hydroacoustic area of effect were determined is provided in Appendix B.

5.2 Noise from Pile Installation

Appendix C provides background information on seal and sea lion responses to noise.

5.2.1 Impact Pile Driving

Table 5-2 and Table 5-3 quantify the extent, timing, and duration of impact pile-driving noise that will exceed threshold levels for disturbance and injury to seals and sea lions. Impact pile driving is expected to take place only within a 31-week in-water work window, ranging from Week 38 of one year to Week 16 of the next (or approximately from September 15 to April 15) over the bridge construction period. There will be a total of about 138 days of impact pile driving in the Columbia River and about 134 days of impact pile driving in North Portland Harbor for the entire project from the start of bridge construction in 2013 to its anticipated completion in 2017 (approximately 4.25 years for both Columbia River and North Portland Harbor Bridges). Impact pile driving in the mainstem Columbia River will occur at more than one pier complex on about 1 or 2 days total during the course of the approximately 4-year construction period (see text box in Figure 1-5 of the LOA application). Impact pile driving will be restricted to approximately 45 minutes per 12-hour work day. After initial hydroacoustic monitoring to test its effectiveness, a noise attenuation device will be used during all other impact pile driving. Each work day will include a period of at least 12 consecutive hours with no impact pile driving in order to minimize disturbance to aquatic animals. Impact pile driving will only occur during daylight hours.

Table 5-2. Summary of Impact Pile Driving Noise Above 190 dB RMS Underwater Injury Threshold

	Columbia River			North Portland Harbor		
Pile Size and Number	**Distance (m)**	**Duration**	**No. Days**	**Distance (m)**	**Duration**	**No. Days**
Without Attenuation Device						
18- to 24-inch pile	9	7.5 min/week	38	9	2.5 – 5 min/week	18
36- to 48-inch pile	54	7.5 min/week	38	54	2.5 – 5 min/week	31
With Attenuation Device						
18- to 24-inch pile	2	45 min/day	138	2	45 min/day	72
36- to 48-inch pile	12	45 min/day	138	12	45 min/day	62

Note: Elevated noise levels will occur throughout the 5-year in-water work period. Potential exposure may only occur from approximately September through May, the range of months when seals and sea lions have been observed at Bonneville Dam and could be present in the Region of Activity. However, seals and sea lions will actually not be exposed to injurious levels of noise, because impact pile driving will stop when seals and sea lions approach the injury isopleth, i.e. the area where underwater noise is at or above 190 dB RMS.

Table 5-3. Summary of Impact Pile Driving Noise Above 160 dB RMS Underwater Disturbance Threshold

	Columbia River			North Portland Harbor		
Pile Size and Number	**Distance (m)**	**Duration**	**No. Days**	**Distance (m)**	**Duration**	**No. Days**
Without Attenuation Device						
18- to 24-inch pile	858	7.5 min/week	38	858	2.5 – 5 min/week	18
36- to 48-inch pile	5,412	7.5 min/week	38	3,058 - U 5,412 - D	2.5 – 5 min/week	31
With Attenuation Device						
18- to 24-inch pile	185	45 min/day	138	185	45 min/day	72
36- to 48-inch pile	1,166	45 min/day	138	1,166	45 min/day	62

U = upstream, D = downstream.

Note: Elevated noise levels will occur throughout the 5-year in-water work period. Potential exposure may only occur from approximately September through May, the range of months when seals and sea lions have been observed at Bonneville Dam and could be present in the Region of Activity.

5.2.2 Vibratory Pile Driving – Pipe Pile and Sheet Pile

Table 5-4 summarizes the extent, timing, and duration of noise above the 120 dB RMS disturbance threshold during vibratory installation of pipe pile and sheet pile. Vibratory installation of pipe pile is likely to occur throughout the entire 5-year LOA period during construction of all new in-water piers or bents and for installation of mooring piles. Vibratory installation of sheet pile will only occur in the Columbia River during construction of the new Columbia River bridges and demolition of the existing Columbia River bridges. This activity will occur intermittently throughout the construction and demolition period. This activity is not restricted to an in-water work window, and therefore may take place during any time of the year.

Table 5-4. Summary of Vibratory Pile Driving Noise Above 120 dB RMS Underwater Disturbance Threshold – Pipe Pile and Sheet Pile

		Columbia River			North Portland Harbor		
Pile Type	**Timing**	**Distance (m)**	**Hours/ Day**	**No. Days**	**Distance (m)**	**Hours/ Day**	**No. Days**
Pipe Pile	Year-round	20,166 - U 8,851 - D	Up to 5	1,470–1,620	3,058 - U 5,632 - D	Up to 5	~334
Sheet Pile	Year-round	6,962	Up to 24	99	N/A	N/A	N/A

U = upstream, D= downstream

Note: Elevated noise levels will occur throughout the in-water work period. Potential exposure may only occur from approximately September through May, the range of months when seals and sea lions have been observed at Bonneville Dam and could be present in the Region of Activity.

5.2.3 Vibratory Installation of Steel Casings

If steel casings for drilled shafts are vibrated into place, the CRC project design team estimates that installation of the 10-foot diameter casings will take approximately 90 days in the Columbia River and 31 days in North Portland Harbor. Vibratory installation of casings is not restricted to the in-water work window and therefore may take place any time during the in-water construction period. Table 5-5 summarizes the estimated extent, timing, and duration of noise above the injury and disturbance thresholds during vibratory installation of steel casings. Hydroacoustic monitoring will be conducted to field verify the distances within which noise exceeds these thresholds.

Table 5-5. Summary of Vibratory Pile Driving Noise above Disturbance and Injury Thresholds – Steel Casings

		Columbia River		North Portland Harbor	
Threshold	**Timing**	**Distance (m)**	**No. Days**	**Distance (m)**	**No. Days**
120 dB RMS	Year-round	20,166 - U 8,851 - D	90	3,058 - U 5,632 - D	31
190 dB RMS	Year-round	5	90	5	31

U = upstream, D= downstream

Note: Elevated noise levels will occur throughout the 4-year in-water construction period. Potential exposure may only occur from approximately September through May, the range of months when seals and sea lions have been observed at Bonneville Dam and could be present in the Region of Activity.

5.2.4 Airborne Pile-Driving Noise

Table 5-6 and Table 5-7 summarize the extent, timing, and duration of airborne impact pile-driving noise above disturbance thresholds for sea lions and seals, respectively. Airborne noise effects will occur on the same schedule as those described for impact pile driving above.

Table 5-6. Summary of Impact Pile Driving Noise Above 100 dB RMS Airborne Disturbance Threshold for Sea Lions

Location	Distance from Source (m)	Mins/Day	No. Days
Columbia River	196	≤45	138
North Portland Harbor	196	≤45	134

Note: Elevated noise levels will occur throughout the approximately 4-year in-water work period. Potential exposure may only occur from approximately September through May, the range of months when seals and sea lions have been observed at Bonneville Dam and could be present in the Region of Activity.

Table 5-7. Summary of Exposure to Impact Pile Driving Noise Above 90 dB RMS Airborne Noise Disturbance Threshold for Harbor Seals

Location	Distance from Source (m)	Mins/Day	No. Days
Columbia River	650	≤45	138
North Portland Harbor	650	≤45	134

Note: Elevated noise levels will occur throughout the approximately 4-year in-water work period. Potential exposure may only occur from approximately September through May, the range of months when seals and sea lions have been observed at Bonneville Dam and could be present in the Region of Activity.

5.3 Behavioral Effects

The project is likely to create noise above threshold levels for airborne and underwater behavioral disturbance to pinnipeds. Table 5-3 through Table 5-7 outlines the extent, timing, and duration of this effect.

Studies on behavioral effects to seals and sea lions are limited (Southall et al. 2007), and because the few available studies show wide variation in response to underwater and airborne noise, it is difficult to quantify exactly how pile driving noise will affect pinnipeds. The literature shows that elevated underwater noise levels could prompt a range of effects, including no obvious visible response, brief visual orientation towards the noise, curiosity (or movement towards the source), or habituation to the sound (Southall et al. 2007). For underwater noise, Southall et al. (2007) note that there is little evidence that high levels of pulsed noise, ranging between 150 and 180 dB RMS relative to 1 µPa, will prompt avoidance of an area. For airborne noise Southall et al. (2007) note there is extremely limited data suggesting very minor, if any, observable behavioral responses by pinnipeds exposed to airborne pulses of 60 to 80 dB relative to 20 µPa; however, given the paucity of data on the subject, we cannot rule out the probability that avoidance of noise in the Region of Activity area could occur.

In an effort to gauge potential sea lion response to disturbance, CRC reviewed reports of sea lion response to harassment from hazing techniques just below Bonneville Dam. The deterrence efforts below Bonneville Dam began in 2005 and have used Acoustic Deterrent Devices (ADDs), boat chasing, above-water pyrotechnics (cracker shells, screamer shells or rockets), rubber bullets, rubber buckshot, and beanbags (Stansell et al. 2009). Review of deterrence activities by the West Coast Pinniped Program noted “USACE observations from 2002 to 2008 indicated that increasing numbers of California sea lions were foraging on salmon at Bonneville Dam each year, salmon predation rates increased, and the deterrence efforts were having little effect on preventing predation” (Scordino 2010). In the USACE status report through May 28, 2010, boat hazing was reported to have limited, local, short term impact in reducing predation in the tailrace, primarily from Steller sea lions. ODFW and WDFW reported that sea lion presence did not appear to be significantly influenced by boat-based activities and several “new” sea lions (initially unbranded or unknown from natural markings) continued to forage in the observation area in spite of shore- and boat-based hazing. They suggested that hazing was not effective at deterring naïve sea lions if there were large numbers of experienced sea lions foraging in the area (Brown et al. 2010). Observations on the effect of ADDs, which were installed at main fishway entrances by mid-June of 2007, noted that pinnipeds were observed swimming and eating fish within 20 feet of some of the devices with no deterrent effect observed (Tackley et al. 2008a, Tackley et al. 2008b, Stansell et al. 2009, Stansell et al. 2010). Many of the animals returned to the area below the dam despite hazing efforts (Stansell et al. 2009, Stansell and Gibbons 2010). Relocation efforts to Astoria and the Oregon coast were tried in 2007; all but 1 of 14 relocated animals returned to Bonneville Dam within days (Scordino 2010).

No information on in-water noise levels of hazing activities at Bonneville Dam has been published other than ADDs produce underwater noise levels of 205 dB in the 15 kHz range (Stansell et al. 2009). Durations of boat-based hazing events were reported at less than 30 minutes for most of the 521 boat-based events in 2009, but ranged up to 90 minutes (Brown et al. 2009). Durations of boat-based hazing events were not reported for 2010. However, 280 events occurred over 44 days during a 5-month period using a total of 4,921 cracker shells, 777 seal bombs, and 97 rubber buckshot rounds (Brown et al. 2010). Based on knowledge of in-water noise from construction activities, the CRC project has proposed that noise levels from in-water construction and demolition activities that seals and sea lions will be potentially exposed to (non-injurious Level B behavioral harassment), does not have noise levels as high as those of hazing techniques.

In addition, sea lions are expected to traverse through and not remain in the project area. Tagging studies of California sea lions indicate they pass hydrophones upriver and downriver of the CRC project site quickly. Wright et al. (2010) reported minimum upstream and downstream transit times between the Astoria haul-out and Bonneville Dam (river distance ~20 km) were 1.9 and 1 day, respectively, based on 14 trips by 11 sea lions. The transit speed was calculated to be 4.6 km/hr in the upstream direction and 8.8 km/hr in the downstream direction. Graphics of the six individuals acoustically tagged in 2009 show they made a combined total of 11 upriver or downriver trips quickly through the CRC project site to or from Bonneville Dam and Astoria (Brown et al. 2009). Graphics from four acoustically tagged California sea lions in 2010 also indicate that the animals move though the area below Bonneville Dam down to the receivers located below the CRC project site rapidly both in the upriver or downriver directions (Wright draft report graphics from pers. comm. 2010b). Although the data apply to California sea lions, Steller sea lions and harbor seals have no incentive to stay near the CRC project area and have no haul-outs near the project area, and are expected to also pass the project area quickly. Therefore, sea lions and seals are not expected to be exposed to a long duration of construction noise.

Underwater noise generated by impact pile driving will be over the threshold for Level B harassment and may cause minor disruption of movement through the area and feeding activities, but based on travel data and haul-out locations, exposure is expected to be brief. Additionally, because many of the individuals transiting the area are already habituated to high ambient disturbance levels from existing commercial and recreational vessel traffic and to hazing at Bonneville Dam, we expect that they will not be sensitive to pile driving noise. Although brief, temporary, behavioral harassment will occur within the disturbance threshold areas, elevated noise levels from impact pile driving are expected to have only a negligible effect on foraging and transiting of individual seals and sea lions, and no effect on the overall populations.

Safe passage concerns during pile installation and removal at more than one pier complex were raised by NMFS. Given the 800-meter width of the Columbia River and the rarity of impact pile driving on opposite sides of the river (approximately 1 or 2 days total throughout the approximately 4-year construction period), passage should not be hindered. Vibratory installation or removal of piles at more than one pier complex will likely occur at the same time on occasion during construction and demolition. During construction and demolition, space limitations due to barge size and limitations on the amount of equipment available are anticipated to be limiting factors for the contractor. Vibratory installation of steel casings, pipe piles, and sheet piles are calculated to exceed behavioral disturbance thresholds at between 6,962 and over 50,000 meters. In this case, the entire width of the channel will be affected by noise above the disturbance threshold even if only one pier complex was being worked on. As stated above, not enough information on Columbia River pinniped reaction to vibratory driving is available to determine whether individuals will alter their movement patterns in this industrial area and some seals or sea lions may not pass the construction site due to noise and general construction activity. However, the safety of the animals will not be compromised by these noise levels.

If in-water work for pile installation or removal occurs simultaneously on both sides of the river and results in changes to pinniped behavior so they do not pass the project site, it will be due to behavioral harassment from incidental exposure to a short duration of non-injurious noise levels and general construction activity. Sea lions are expected to traverse through the area and not be exposed to a long duration of noise. Also, based on observations from the Bonneville Dam sea lion removal program over 6 years, many individual sea lions appear motivated to reach the Bonneville Dam tailrace to forage, undeterred by directed noise hazing techniques. Many individual sea lions return repeatedly, even after being exposed to hazing and being captured, herded, and branded. Therefore, we anticipate that the less intense, short duration, non-injurious noise levels from installation and removal of pipe piles, casings, and cofferdams will not affect the behavior of many of the individual sea lions in the Region of Activity.

Harbor seals occur sporadically in low numbers in the Region of Activity, so they are less likely to be exposed to the short periods when impact or vibratory installation and removal noise could occur on both sides of the Columbia River simultaneously.

5.4 Temporary Threshold Shift

Temporary Threshold Shift (TTS) is reversible hearing loss caused by fatigue of hair cells and supporting structures in the inner ear. Technically, TTS is not considered injury, as it consists of fatigue to auditory structures rather than damage to them. Impact pile driving will produce maximum underwater source pulsed noise levels estimated at 210 dB peak and 176 dB SEL with 10 dB of attenuation from an attenuation device (214 dB peak and 186 dB SEL without an attenuation device). Summarizing existing data, Southall et al. (2007) assumed that pulses of underwater noise result in the onset of TTS in pinnipeds when levels reach 212 dB peak or 171 dB SEL. They did not offer criteria for non-pulsed sounds. Although these suggested criteria have not been adopted by any regulatory body, they are presented as a starting point to discuss the likelihood of TTS occurring during the CRC project. The literature has not drawn conclusions on levels of underwater non-pulsed noise (e.g., vibratory pile installation) likely to cause TTS. With a noise attenuation device, TTS is not likely to occur based on our estimated source levels. Without a noise attenuation device, we estimate that the extent of the area in which underwater noise levels could potentially cause TTS is somewhere in between the extent of where the injury threshold occurs (2 to 54 m from the noise source as shown in

Table 5-2) and the extent of where the disturbance threshold occurs (Table 5-3 and Table 5-7) (74 FR 63724).

Although underwater noise levels produced by the CRC project may exceed levels produced in studies that have induced TTS in pinnipeds (Southall et al. 2007), there is a general lack of controlled, quantifiable field studies related to this phenomenon. Existing studies have had varied results (Southall et al. 2007). Therefore, it is difficult to extrapolate from these data to site-specific conditions on the CRC project. For example, because most of the studies have been conducted in laboratories, rather than in field settings, the data are not conclusive as to whether noise will cause seals and sea lions to avoid the Region of Activity, thereby reducing the likelihood of TTS, or whether noise will attract seals and sea lions, increasing the likelihood of TTS. In any case, there are no universally accepted standards for the amount of exposure time likely to induce TTS. Lambourne (2010 personal communication) posits that, in most circumstances, free-roaming Steller sea lions are not likely to remain in areas subjected to high noise levels long enough to experience TTS unless there is a particularly strong attraction, such as an abundant food source. While we may infer that TTS could conceivably result from the CRC project, it is impossible to exactly quantify the magnitude of exposure, the duration of the effect, or the number of individuals likely to be affected.

Impact pile driving will produce initial airborne noise levels of approximately 112 dB peak at 160 feet from the source, as compared to the level suggested by Southall et al. (2007) of 143 dB peak referenced to 20 µPa for onset of TTS in pinnipeds from multiple pulses of airborne noise. It is not expected that airborne noise levels will prompt TTS in individual seals and sea lions. Exposure is likely to be brief because seals and sea lions use the Region of Activity for transiting, rather than breeding or hauling out. In summary, we expect that elevated noise will have only a negligible probability of causing TTS in individual seals and sea lions.

5.5 Injury

The CRC project is not likely to injure pinnipeds, thus, authorization for Level A incidental take or injury is not being requested. Although impact pile driving noise is likely to exceed the injury threshold, this effect will be limited to a distance of 2 to 54 m from the noise source, depending on the number and size of the piles. Vibratory installation of steel casings may also exceed the injury threshold within 5 m of the source. Additionally, as impact pile driving noise will be sporadic, occurring only about 45 minutes per day, pinnipeds will likely avoid it as an unfamiliar source of disturbance. Similarly, installation of the steel casings will be very limited. We would therefore expect them to avoid the injury zone rather than becoming habituated, thus reducing the potential for exposure.

The CRC project will further limit the potential for injury to pinnipeds through the implementation of a monitoring plan. Marine mammal monitors will ensure that the CRC project curtails impact pile driving if seals and sea lions approach the 2- to 54-meter injury isopleth, known as the safety zone, for impact pile driving. For added protection, the safety zone will be a minimum of 50 meters even though the injury isopleth may actually be smaller. Additionally, if vibratory installation of 10-foot diameter steel casings produces noise above the injury threshold, this activity will cease before seals or sea lions enter the potential safety zone for vibratory pile driving. The project will perform hydroacoustic monitoring to confirm injury zone isopleths. Monitoring zones may be refined accordingly, but will never be less than 50 meters.

Measures to avoid injury to seals and sea lions, including details of the monitoring plan and shut-down procedures, are described in Section 11. Because injurious noise levels will extend only a short distance and marine mammals will be monitored approaching these areas, it is reasonable to expect that qualified marine mammal monitors will be able to detect seals and sea lions within these areas. Impact pile driving will not occur at night, making the probability of detection very high. Vibratory installation of 10-foot-diameter steel casings may occur at night; however, marine mammal monitors will use night-vision/night-detection equipment to ensure detection of seals or sea lions within the safety zone while this activity is taking place. For these reasons, we believe that avoidance of injury through implementation of a monitoring plan is attainable. While injury is theoretically possible, it is not probable. Therefore, CRC project-generated noise is not likely to injure seals and sea lions.

5.6 Debris Removal

Debris removal may occur in North Portland harbor at the location of each of the new piers where there is anecdotal evidence that riprap occurs within the pier footprints. Debris removal in the North Portland Harbor, if it occurs, is likely to create noise at or above the 120 dB RMS disturbance threshold for continuous noise in underwater portions of the Region of Activity.

Few studies have been conducted on noise emissions produced by underwater debris removal. A review of the literature indicates that underwater debris removal will produce noise in the range of 135 dB to 147 dB RMS at 10 m (Dickerson et al. 2001; OSPAR 2009; Thomsen et al. 2009), i.e., greater than the 120 dB RMS disturbance threshold for non-pulsed noise.

Underwater debris removal is not expected to generate significant airborne noise. The air-water interface creates a substantial sound barrier and reduces the intensity of underwater sound waves by a factor of more than 1,000 when they cross the water surface. The above-water environment is, thus, virtually insulated from the effects of underwater noise (Hildebrand 2005). Therefore, we do not expect underwater debris removal to measurably increase ambient airborne noise. Noise will be well below the level of Level B harassment.

Table 5-8 shows the calculated distance at which underwater debris removal noise attenuates to the underwater disturbance threshold for continuous noise (120 dB RMS).

Table 5-8. Underwater Noise Attenuation for Debris Removal Noise – Calculated Values

Noise Level (dB RMS)	Distance from Source (m) Bucket Dredge Source Sound Pressure Level 147 at 10 m
150	7
140	30
130	136
120	631

5.6.1 Potential Exposure of Pinnipeds to Underwater Debris Removal Noise

Table 5-9 summarizes potential exposure of pinnipeds to underwater debris removal noise in the North Portland Harbor. Exposure is presented as an overlap of the areal extent of noise at or above the disturbance threshold, combined with the duration and timing of the impact and the time periods when seals and sea lions are likely to be present in the Region of Activity.

Debris removal is not certain to occur, but is included to present the fullest disclosure of effects. It is possible that debris removal will occur in North Portland harbor at the location of each of the new piers where there is anecdotal evidence that riprap occurs within the pier footprints. The exact quantity of this material is unknown, but as a worst-case scenario, this activity will remove approximately 90 cubic yards of material over an area of approximately 2,433 sq. ft. from all piers combined.

Table 5-9. Summary of Debris Removal Noise Above 120 dB RMS Underwater Disturbance Threshold

Noise Source	Location[a]	Underwater Distance (m)	Hours/ Day	No. Days	Timing[b]
Bucket dredge	Potentially at all new NPH piers	631	≤12	7 days	Nov 1 – Feb 28

a NPH = North Portland Harbor
b Over the course of in-water construction period in the North Portland Harbor: 2013 to 2017.

5.6.2 Effects of Exposure to Debris Removal Noise

The reactions of pinnipeds to debris removal noise have received virtually no study. Previous studies indicate that dredging noise has resulted in avoidance reactions in marine mammals; however, the number of studies is few, limited to only a handful of locations. Thomsen et al. (2009) caution that, given the limited number of studies, the existing published data may not be representative and that it is therefore impossible to extrapolate the potential effects from one area to the next.

In a review of the available literature regarding the effects of dredging noise on marine mammals, Richardson et al. (1995) found studies only related to whales and porpoises, and none related to pinnipeds. The review did, however, find studies related to the response of pinnipeds to "other construction activities," which may be applicable to dredging noise. Three studies of ringed seals during construction of artificial islands in Alaska showed mostly mild reactions ranging from negligible to temporary local displacement. Green and Johnson (1983, as cited in Richardson et al. (1995)) observed that some ringed seals moved away from the disturbance source within a few kilometers of construction. Frost and Lowry (1988, as cited in Richardson et al. [1995]) and Frost et al. (1988, as cited in Richardson et al. 1995) noted that ringed seal density within 3.7 km of construction was less than seal density in areas located more than 3.7 km away. Harbor seals in Kachemak Bay, Alaska, continued to haulout despite construction of hydroelectric facilities located 1,600 m away. Finally, Gentry and Gilman (1990) reported that the strongest reaction to quarrying operations on St. George Island in the Bering Sea was an alert posture when heavy equipment occurred within 100 m of northern fur seals.

In their study about sea lion hazing at Bonneville Dam, Stansell et al. (2009) note that sea lions showed only temporary behavioral responses to underwater loud noises, such as ADDs and seal bombs, and above-water pyrotechnics, which did not cause any measurable interference with foraging or transiting. Sea lions quickly habituated to the noise, some foraging within 20 feet of intense noise. The results suggest that some of individuals that transit through the Region of Activity either are already habituated to some loud noises or could readily become habituated.

5.6.3 Effect of Exposure to Debris Removal Noise at the CRC Project

There are no established levels of underwater debris removal noise shown to cause injury to seals and sea lions. However, since the maximum expected debris removal noise levels on the CRC project are below any known injury thresholds (190 dB RMS, for impulsive noises), it is unlikely that this activity will produce noise levels that are injurious to seals and sea lions. Additionally, the limited body of literature does not include a single report of injuries caused by noise from underwater excavation.

Debris removal noise is likely to exceed the disturbance threshold (120 dB RMS for non-pulsed continuous noises) for only a short distance from the source (approximately 631 m). Specific responses to noise above this level may range from no response to avoidance to minor disruption of migration and/or feeding. Alternatively, seals and sea lions may become habituated to elevated noise levels (NMFS 2005; Stansell 2009). This is consistent with the literature, which reports only the following behavioral responses to these types of noise sources: no reaction, alertness, avoidance, and habituation. NMFS

(2005) posits that continuous noise levels of 120 dB RMS may elicit responses such as avoidance, diving, or changing foraging locations.

Debris removal is only estimated to occur for up to 7 days over the 4-year construction period in North Portland Harbor. If this activity overlaps with pinniped presence, behavioral disturbance is expected to be brief and temporary, restricted to individuals that are transiting the North Portland Harbor portion of the Region of Activity. Because many of the individual sea lions transiting the Region of Activity are already habituated to hazing at Bonneville Dam and to high levels of existing noise throughout the lower Columbia River, we expect that they will not be especially sensitive to a marginal increase in existing noise. Thus, due to the short duration of this noise, its location only in North Portland Harbor and the high level of existing disturbance throughout the lower Columbia River, noise generated from debris removal is not expected to result in behavioral disturbance that would rise to the level of Level B harassment.

5.7 Vessel Noise

Various types of vessels, including barges, tug boats, and small craft, will be present in the Region of Activity at various times. Vessel traffic will continually traverse the in-water CRC project area, with activities centered on Piers 2 through 7 of the Columbia River and the new North Portland Harbor bents. Such vessels already use the Region of Activity in moderately high numbers; therefore, the vessels to be used in the Region of Activity do not represent a new noise source, only a potential increase in the frequency and duration of these noise types.

There are very few controlled tests or repeatable observations related to the reactions of pinnipeds to vessel noise. However, Richardson et al. (1995) reviewed the literature on reactions of pinnipeds to vessels, concluding overall that seals and sea lions showed high tolerance to vessel noise. One study showed that, in water, sea lions tolerated frequent approach of vessels at close range, sometimes even congregating around fishing vessels. Because the Region of Activity is heavily traveled by commercial and recreational craft, it seems likely that seals and sea lions that transit the Region of Activity are already habituated to vessel noise, thus the additional vessels that will occur as a result of CRC project activities will likely not have an effect on these pinnipeds. Therefore, CRC project vessel noise in the Region of Activity is unlikely to rise to the level of Level B harassment.

5.8 Physical Disturbance

Vessels, in-water structures, and over-water structures have the potential to cause physical disturbance to seals and sea lions, although in-water and over-water structures will cover no more than 20 percent of the entire channel width at one time (CRC 2010). As previously mentioned, various types of vessels already use the Region of Activity in high numbers. Tug boats and barges are slow moving and follow a predictable course. Seals and sea lions will be able to easily avoid these vessels while transiting through the Region of Activity, and they are probably already habituated to the presence of numerous vessels, as the lower Columbia River and North Portland Harbor receive high levels of commercial and recreational vessel traffic. Therefore, vessel strikes are extremely unlikely and, thus, discountable. Potential encounters will likely be limited to brief, sporadic behavioral disturbance, if any at all. Such disturbances are not likely to result in a risk of Level B harassment of seals and sea lions transiting the Region of Activity.

5.9 Conclusion

Noise above the behavioral disturbance threshold for both impact pile driving and vibratory pile installation will occur, but effects to seals and sea lions are expected to be brief and temporary, as individuals move through the affected area, impacting only a small number of adult and subadult sea lions and adult seals transiting the Region of Activity. No noise disturbance will occur at breeding areas or haulouts. Noise is not expected to significantly interfere with foraging, transiting, breathing, or other essential life functions.

The disturbance and safety zones related to pile installation will be monitored by qualified marine mammal monitors. Exposure of pinnipeds to injurious sound pressure levels is expected to be avoided by shutting down impact pile driving if an animal approaches the injury isopleth (190 dB RMS for pinnipeds), estimated at 2 to 54 m from the noise source. Vibratory pile installation is not likely to produce noise at levels that are injurious to seals and sea lions. However, if vibratory installation of 10-foot-diameter steel casings produces noise above the injury threshold, this activity will cease before seals and sea lions enter the potential safety zone. Thus, we are requesting authorization for Level B harassment, but no authorization for Level A incidental take is being requested. If pinnipeds are seen in the disturbance zone for impact pile driving or the disturbance zone for vibratory pile installation, their behavior will be documented.

Noise from debris removal and increased vessel traffic, and physical disturbance of the in-water environment, are not likely to have a significant effect on seals and sea lions that transit the Region of Activity. Behavioral disturbance is expected to be brief and temporary, because they have the ability to avoid activity areas, and they are known to habituate to vessel traffic. It is expected that seals and sea lions transiting the Region of Activity will probably already be habituated to the presence of numerous vessels, as the lower Columbia River and North Portland Harbor currently receive high levels of commercial and recreational vessel traffic.

6. Number of Marine Mammals That May Be Affected

6.1 Method of Estimation

Assumptions regarding numbers of pinnipeds and number of round trips per individual per year in the Region of Activity are based on information from ongoing pinniped research and management activities conducted in response to concern over California sea lion predation on fish populations concentrated below Bonneville Dam. An intensive monitoring program that has used surface observations since 2002 to evaluate seasonal presence, abundance, and predation activities of pinnipeds has been conducted in the Bonneville Dam tailrace. Minimum estimates of the number of pinnipeds present in the tailrace from 2002 through 2010 are presented in Table 6-1. Bonneville Dam is the first dam on the river located at river kilometer 235 and is upriver of the CRC project site located at approximately river kilometer 170. The primary California sea lion haul-out in the Columbia River is located in the Columbia River estuary in Astoria, approximately 151 river kilometers downstream of the project. This haul-out is the site of trapping, tagging, and some removal activities for research and monitoring of pinnipeds that reach the Bonneville Dam tailrace.

Table 6-1. Minimum Estimated Total Number of Pinnipeds Present at Bonneville Dam from 2002 through 2010 (Stansell et al. 2010)

Species	2002	2003	2004	2005**	2006	2007	2008	2009	2010
California Sea Lions	30	104	99	81+	72	71	82	54	89
Steller Sea Lions*	0	3	3	4+	11	9	39	26	75
Harbor Seals	1	2	2	1+	3	2	2	2	2

*Animals not uniquely identified through 2007. Numbers represent the highest number seen on any one day for each year (Tackley et al. 2008a).
**Regular observations did not begin until March 18 in 2005 (Tackley et al. 2008a).

Monitoring began as a result of the 2000 FCRPS BO (section 9.6.1.5.3, action item 106), which required an evaluation of pinniped predation in the tailrace of Bonneville Dam. The objective of the study was to determine the timing and duration of pinniped predation activity, estimate the number of fish caught, record the number of pinnipeds present, identify and track individual California sea lions, and evaluate various pinniped deterrents used at the dam (Tackley et al. 2008a). The study period for monitoring was January 1 through May 31 beginning in 2002. During the study period pinniped observations began after consistent sightings of at least one animal occurred. Tackley et al. (2008a) notes that sightings began earlier each year from 2002 to 2004. Although some sightings were reported earlier in the season, full-time observations began March 21 in 2002, March 3 in 2003, and February 24, 2004 (Tackley et al. 2008a). In 2005 observations began in April, but in 2006 through 2010 observations began in January or early February (Tackley et al. 2008a and b, Stansell et al. 2009, Stansell and Gibbons 2010). California sea lion and Steller sea lion arrival and departure dates at Bonneville Dam are compiled from the reports above in Table 6-2 and Table 6-3 along with any other recorded observations. If arrival and departure dates were not available, the timing of surface observations within the January through May study period were recorded. Because regular observations in the study period generally began as sea lions were observed below Bonneville Dam, and sometimes reports stated that observations stopped as sea lion numbers dropped, the observation dates only give a general idea of first arrival and departure. Because acoustic telemetry data indicate that sea lions travel at fast rates between hydrophone locations above and below the CRC project area (see Brown et al. 2010), dates of first arrival at Bonneville Dam and departure from the dam are assumed to coincide closely with potential passage timing through the CRC project area.

The level of effort for sea lion observation at the Bonneville Dam tailrace is listed in Table 6-2 from 2002 through 2010. In addition to the hours reported in the table, during the 2005 to 2007 study periods, an additional 248 hours of observation occurred downstream of the tailrace study area (Tackley et al. 2008a). In 2008, 16 additional observation hours were conducted 1 hour before and 1 to 2 hours after regular daylight observations in April and May, 303 additional observation hours were conducted by students from Tanner Creek to the upstream tip of Ives Island for 76 days between January 13 and May 19, an 180 additional observation hours were conducted over 33 days in the area between the tailrace study area and Tanner Creek by Washington Department of Fish and Wildlife personnel (Tackley et al 2008b).

Table 6-2. Hours of Observation in the Study Area in the Bonneville Dam Tailrace as Reported in Tackley et al. 2008a., 2008b, and Stansell et al. 2009, Stansell et al. 2010

Study Year	Total Hours Observed
2002	662
2003	1,356
2004	553
2005	1,108
2006	3,647
2007	4,433
2008	5,131
2009	3,455
2010	3,609

Pinniped species presence is determined by likelihood of occurrence near the CRC project construction activities based on general abundance at Bonneville Dam and the number of times individuals are estimated to make the trip to and from the dam in a year. We know that numbers observed at the dam are known to have passed the project site at least once; however, most individuals, but not every individual, that passes the project will go all the way to the dam (Norberg pers. comm. 2009). Therefore, by using abundance at Bonneville Dam, we are underestimating numbers of individuals slightly. Our estimates also assume that all seals and sea lions that pass the project site will be exposed to project activities (e.g., pile installation will occur every time they pass the project site). However, project activities that may impact seals or sea lions will not occur 24 hours a day; therefore, numbers that pass through the Region of Activity also likely overestimate exposure.

6.1.1 Harbor Seal

During most of the year, very small numbers of adult and subadults of both sexes are expected to transit through the Region of Activity. Therefore, the estimates of Level B harassment for harbor seals are split equally between males and females.

In general, harbor seals remain close to haulout sites when foraging and bottom/surface resting (Lambourne, pers. comm. 2010)). As described in Section 4, within the Region of Activity, there are no known harbor seal haulout sites. The nearest known haulout sites are at least 45 miles west of the Region of Activity. Pupping sites are generally restricted to coastal estuaries and other areas along the Olympic Peninsula and Puget Sound.

Harbor seals exposed to impact pile driving noise below water may be temporarily displaced from the disturbance zone. If they enter the disturbance zone, they may suffer a TTS. Harbor seals are not expected to be missed by monitors within a safety zone due to the small size of the zones (50 to 54 m,). Impact pile driving or steel casing vibratory installation will cease if any harbor seals are seen approaching a safety zone. Vibratory pile installation noise does not reach the level of injury.

Harbor seals transit through the Region of Activity because they have been observed near Bonneville Dam (Stansell et al. 2009, Stansell and Gibbons 2010). Observations of individual harbor seals made during the pinniped predation and deterrent activities at Bonneville Dam are listed in Table 6-1. One to three harbor seals were documented below the dam in all 9 years of surface observations. Estimates are minimums and are based on observations made only within the January through May timeframe even though harbor seals were observed in very low numbers year-round near Bonneville Dam (Tackley et al. 2008a). However, based on salmon and steelhead run timing, as well as lamprey and smelt timing, seals would most likely occur during the same January through May period when sea lions are present.

Based on the preceding information, we estimate a minimum of one to three adult or subadult harbor seals will be potentially exposed to in-water project activities each year. Based on the limited data, we are assuming that the number of individuals that actually pass by the CRC project area would be slightly higher than the highest minimum observed at the dam. To be conservative, we estimated six individuals per year would potentially pass the project site. Therefore, CRC requested behavioral harassment for six individuals per year of in-water work. This may overestimate the number in some years. However, based on the consistency in the data, the number of individuals that have the potential to be exposed to project activities is likely to remain small in future years.

The number of round trips made per year is hard to discern from the data. Because harbor seals were not uniquely identified in the observations, repeat observations of the same individual may have been reported on different observation days. In any one year, we can estimate that each harbor seal will not make more than three roundtrips past the project as they go to and from the dam each year. The more likely scenario, based on counts of up to three seals in the observation period, is that they make only one or two round trips. If the individuals observed at the dam were all unique individuals observed in any year, it is likely they make only one round trip past the CRC project site. If they were the same individual observed multiple times in any observation year, they would make up to three round trips past the CRC project site. Therefore, we can conclude that one to three round trips would be made by each individual past the project site, based on the minimum number of individuals observed at the dam in a year. However, there is a lack of data regarding seal movement. We do know they occur infrequently and therefore, only a limited number of roundtrips could occur per individual. Therefore we request two roundtrips per individual.

6.1.1.1 Summary of Request

The locations of where pupping occurs and known haulouts, and the low number of observations of harbor seals at Bonneville Dam over the years, suggest that very few harbor seals transit through the Region of Activity, and those that do are subadults or adults.

While it is impossible to predict the number of transiting harbor seals in the Region of Activity, we estimate that up to six subadult or adult harbor seals (double the maximum number observed at Bonneville Dam to date) may transit the Region of Activity up to four times per year (two round trips) during the 5-year LOA period (Table 6-1).

6.1.2 California Sea Lion

California sea lions are observed in the winter and spring (January through May) with only a limited number of exceptions. No haulout sites are located within the Region of Activity and no breeding or pupping occurs in the Region of Activity. All animals documented in the Columbia River were adult or juvenile males (Jeffries et al. 2000). Therefore, potential exposure to impacts from construction activities will be to male California sea lions swimming through a disturbance zone during pile installation or vibratory installation of steel casings.

California sea lions exposed to pile or vibratory steel casing installation noise above the behavioral disturbance threshold, either above or below water, may be temporarily displaced or, if close enough to an impact driver, may suffer a TTS. Sea lions are not expected to be missed by monitors within a safety zone due to the small size of the zone (from 50 to 54 m). Impact pile driving or steel casing vibratory installation will cease if any California sea lions are seen approaching a safety zone. Vibratory pile installation noise does not reach the level of injury.

Table 6-1 lists the number of individual California sea lions observed below Bonneville Dam. Numbers are presented as minimums, because not all sea lions are able to be uniquely identified in all observations and therefore are not in the count. Tackley et al. (2008) noted that the numbers of sea lions estimated from 2002 through 2007 were likely underestimated, because individuals were not uniquely identified and therefore were not represented in the counts. In 2005, Tackley et al. (2008a) noted in their report that during part of the season, observers did not to have adequate training to uniquely identify individuals, making estimates of individual sea lion numbers even less certain. Tackley et al. (2008a) estimated that from 2002 through 2007, an additional 15 to 35 California sea lions may have been present, but observers were not able to uniquely identify them and therefore they are not represented in the counts. In addition, the high number of 104 individual present below the dam in 2003 occurred prior to hazing (started in 2005) or permanent removal (started in 2008) activities. We believe the high number is not representative of current extensive efforts to haze and remove sea lions.

Permanent removal of 40 individuals occurred during the 2008 through 2010 time period (Stansell et al. 2010). In 2010, the number of individual sea lions observed was a minimum of 89 individuals. Of the 89 individuals, 14 were removed (Stansell et al. 2010).

Typically, the percentage of “new” California sea lions at Bonneville Dam has been approximately 30 percent; however, in 2010 the percentage of new individuals was approximately 65 percent (51 were first time visitors below the dam) (Stansell et al. 2010). Over 38 of the individuals identified in 2010 qualify for removal (Stansell and Gibbons 2010). An additional six animals were added to the removal list in June 2010 (NMFS 2010).

Projections of the number of California sea lions passing the CRC project site during construction 3 to 11 years from now are impossible to make accurately. Trends are particularly hard to discern because numbers passing the project site will be a reflection of the number of returning sea lions, numbers of sea lions successfully removed in subsequent years at Bonneville Dam, and numbers of “new” sea lions. Based on 2010 data, new animals will likely largely replace those removed (e.g., in 2010, 14 animals were removed and 51 were first time visitors below the dam) and still possibly result in an overall increase in California sea lion numbers. Numbers of animals reported below Bonneville Dam are reported as minimums, so using counts from below Bonneville Dam will likely underestimate the number of individual sea lions passing the project site.

The minimum number of animals projected in future years would be expected to be at least 89 individuals, not considering any decrease in numbers due to removal efforts. It is possible that a more effective method of deterrence will be developed in the future, or continued removal efforts will result in the number of California sea lions stabilizing or decreasing in future years. However, spring Chinook returns to the Columbia River in 2010 were the third largest on record since 1938 (CBB 2010) based on a preliminary summary (ODFW and WDFW 2010). If the numbers remain high, it is possible that the numbers of sea lions foraging near Bonneville Dam may increase.

Based on recent trends, we estimate that the number of sea lions passing the project site will be slightly higher than the minimum of 89 individuals (the minimum high count for the 2008 through 2010 time period), with no increase estimated due to more "new" individuals than removed individuals. We therefore estimate up to 89 California sea lions will pass the project site annually. We realize there is a substantial amount of uncertainty in this estimate and; therefore, request that NMFS include an adaptive methodology in the CRC LOA to estimate California sea lions potentially present in each year of in-water project work using the most recent data and trends available.

The CRC environmental team examined satellite-linked and acoustic tracking reports of California sea lions to help estimate the number of times individual sea lions may pass the CRC project site. Tracking has been conducted on an almost annual basis since 2004 (Wright pers. comm. 2010b). Based on data from 100 to 150 animals, annual California sea lion round trips to the dam range from one to five trips per individual (Wright pers. comm. 2010b). Movements of 26 satellite-tagged sea lions captured in the Columbia River during three non-breeding seasons (2003-2004, 2004-2005, and 2006-2007) are described by Wright et al. (2010). Duration below the Bonneville Dam ranged from 2 days to 43 days (Wright et al. 2010). The authors noted that sea lions captured in the Columbia River had considerable within and between animal variation in their movements, and that estimating the mean number of trips to Bonneville Dam in a given season is problematic given that many animals were tagged after they may have already made one or more such trips (Wright et al. 2010). In 2009, six California sea lions were tagged in early April with acoustic transmitters, and four of those tagged had relatively long datasets (approximately 1–1.5 months) (Brown et al. 2009). After tagging, three of the animals made one round trip from Astoria to Bonneville Dam, and one made two round trips prior to their departure from Bonneville Dam by the end of May (Brown et al. 2009). The animals may have made additional trips prior to tagging in early April. Data from five animals tagged in 2010 indicate that at least one to four round trips were made to Bonneville Dam from Astoria (Brown et al. 2010). Four animals were tagged in March or April for 22 to 51 days. Of these four individuals, two made at least four trips, one made two trips and one made one trip. The fifth animal was tagged in May at the end of the season and departed immediately after capture. Again, the preliminary data do not include trips taken prior to tagging.

Based on past data, the number of times an individual sea lion will pass the CRC project site ranges from at least 2 to 10 times per year (1 to 5 roundtrips per year). However, the actual number is quite variable depending on the individual. Therefore, based on the data available, we estimate a maximum of 10 trips (5 roundtrips) past the project site.

6.1.2.1 Summary of Request

Based on the number of California sea lions identified at Bonneville Dam in recent years, we estimate up to 89 California sea lions may travel through the Region of Activity, annually, in future years. This is because the nearest haulout site is 45 miles from the Region of Activity, California sea lion hazing and removal efforts at Bonneville Dam are expected to continue, and we do not estimate a large increase in the numbers of California sea lions traveling up the Columbia River to Bonneville Dam. Also, it's likely that sea lions transiting the Region of Activity will sometimes transit outside of the harassment isopleths or when no pile installation or vibratory installation of steel casings is occurring. Therefore, we estimate that up to 89 California sea lions could be behaviorally harassed as they swim into a disturbance zone up to 10 times per year (5 round trips) (Table 6-3).

6.1.3 Steller Sea Lion

Steller sea lions are likely to be exposed to elevated noise levels in the Region of Activity. Exposure is likely to occur from November through May when primarily adult and subadult male Steller sea lions typically forage at Bonneville Dam. Steller sea lions are known to migrate through the Region of Activity as they transit between the dam and the ocean during this time period, often making multiple round-trip journeys. Beginning in 2008, individual sea lions have also been present from September, October or November, but in low numbers (Stansell et al. 2009; Tackley et al. 2008b; Stansell et al. 2010). Therefore, exposure during this time is possible, but less likely.

There are no Steller sea lion haulouts or breeding sites in areas likely to be exposed to elevated noise. The nearest known haulout is located approximately 26 miles upstream of the CRC project area (Tennis, pers. comm. 2009). The nearest breeding site is located more than 200 miles from the CRC project area (NMFS 2008b). Therefore, elevated noise levels will have no effect on individuals at breeding or haulout sites.

Steller sea lions use the Region of Activity primarily for transiting only and are expected to be highly mobile when exposed to noise above the threshold levels for disturbance occurring in the Region of Activity. Additionally, Lambourne (2010 personal communication) notes that Steller sea lions are likely to avoid unfamiliar noises, unless there is a particular attraction keeping them in the area. As the Region of Activity does not contain any such attractions (for example, an especially rich food source, breeding area, or haulout site), Steller sea lions will presumably avoid portions of the Region of Activity exposed to high levels of elevated noise (for example, impact pile driving) when possible. Therefore, they will likely experience only brief, temporary behavioral disturbance or harassment as a result of impact pile-driving noise. Lambourne (2010 personal communication) also added that Steller sea lions could become habituated to noises that are continuous and occurring over longer periods of time (such as vibratory pile-driving noise or vibratory steel casing installation).

Steller sea lions exposed to pile or vibratory steel casing installation noise above the behavioral disturbance threshold, either above or below water, may be temporarily displaced or, if close enough to an impact driver, may suffer a TTS. Sea lions are not expected to be missed by monitors within a safety zone due to the small size of the zone (from 50 to 54 m). Impact pile driving or vibratory installation of steel casings will cease if any Steller sea lions are seen approaching a safety zone. Vibratory pile installation noise does not reach the level of injury.

Like California sea lions, projections of Steller sea lions estimated to pass the CRC project site during construction 3 to 11 years from now are impossible to make accurately. Unlike California sea lions, Steller sea lions are not authorized for removal by the states under Section 120 of the MMPA. Table 6-1 provides minimum estimates of total numbers of Steller sea lions observed at Bonneville Dam from 2002 through 2010. Regular observations from 2002 through 2010 showed a steady increase in minimum numbers observed from 0 to 75 individuals, even though hazing efforts at the fish ladder entrances started in 2005 and boat based hazing began in 2006 (Scordino 2010, Tackley et al. 2008a, Stansell et al. 2009). In 2010, the minimum number observed of 75 individuals was approximately triple the 2009 minimum of 26 individuals (Stansell and Gibbons 2010).

The minimum number of animals projected in future years would be expected to be at least 75 individuals and is likely to continue to increase based on the past trends. However, there is very little certainty in this estimate, especially when it is projected into the future. We are hesitant to suggest the increase will follow the trends of the past few years as individuals nearly triple from 2009 to 2010. It is possible a more effective method of deterrence will be developed in the future and the number of Steller sea lions may stabilize or decrease in future years. However, if trends in the numbers of fish continue, it is also possible that the number of Steller sea lions present will continue to increase.

Acoustic and satellite-linked tracking data for Steller sea lions in the Columbia River are only available for six individuals, and most were only tracked for 1 month beginning at the end of March or during April of 2010 (Wright pers. comm. 2010a). Additional data are available from two individuals that were tagged with only satellite-linked transmitters (which do not provide in-river movement data). From the limited dataset, seven individuals made one round trip from marine areas, and one individual made two round trips (Wright draft report graphics attached to pers. comm. 2010a). The number of round trips made earlier in the season, prior to tagging, is not included in the estimate and could increase the number of trips per individual and, like California sea lions, considerable variation within and between individuals may exist. Acoustic and satellite-linked data collection efforts will continue in 2011 (Wright pers. comm. 2010a) and will better inform the estimate of number of round trips Steller sea lions are likely to make past the CRC project area.

Based on past data, the number of times an individual Steller sea lion will pass the CRC project site ranges from a minimum of two to four times per year (one to two roundtrips). Therefore, we are requesting six times per year (three roundtrips) to account for early season trips to Bonneville Dam. Because there is substantial uncertainty in this estimate, we request that NMFS include an adaptive methodology in the CRC LOA to annually estimate the number of times an individual Steller sea lion will be potentially exposed in each year of in-water project work using the most recent data and trends available.

6.1.3.1 Summary of Request

Based on trends in Steller sea lions identified below Bonneville Dam in recent years, we estimate a tripling of the minimum of 75 individuals seen in 2010 and request 225 individuals that will pass the project site six times (three roundtrips) each per year. Numbers of trips are based on initial results from one season's tagging. It is likely that sea lions transiting the Region of Activity will sometimes transit outside of the harassment isopleths or when no pile installation or vibratory installation of steel casings is occurring. Therefore, we estimate that up to 225 Steller sea lions could be behaviorally harassed as they swim into a disturbance zone up to six times per year (three round trips) (Table 6-3).

Table 6-3. Estimated Number of Pinnipeds That May Be Affected By CRC Project

Species	Method of Affect	Individuals Affected/Year	Number of Occurrences/ Individual/Year	Pups	Subadult/Adults M/F
Pacific Harbor Seal	Vibratory or Impact Pile Installation/ Vibratory Steel Casing Installation	6	4 (2 roundtrips)	0	6 adult males or females
California Sea Lion	Vibratory or Impact Pile Installation/ Vibratory Steel Casing Installation	89	10 (5 roundtrips)	0	89 subadult and adult males
Steller Sea Lion	Vibratory or Impact Pile Installation/Vibratory Steel Casing Installation	225	6 (3 roundtrips)	0	225 subadult and adult males

7. Anticipated Impact of the Activity on the Species or Stock

An increased level of in-water noise from the construction activities, specifically pile installation or vibratory installation of steel casing, is the primary concern to pinnipeds transiting the Region of Activity. Pinnipeds may also be exposed to elevated sound pressure levels (SPL) above airborne disturbance thresholds while surfacing in the vicinity of impact pile driving. Anticipated in-water and in-air impacts are temporary disturbances during pile or casing installation. This may alter behaviors and cause individuals to temporarily disperse from the area. Temporary disturbance could also be caused by other construction activities, the presence of additional vessels, humans, etc. These disturbances could cause animals to avoid travel through the Region of Activity, but existing traffic noise, commercial vessels, and recreational boaters already occur in the area. Thus, it is likely that seals and sea lions are habituated to these disturbances while transiting the Region of Activity.

By incorporating the proposed mitigation measures, including pinniped monitoring and shut-down procedures described in Section 11, harassment to individual seals and sea lions from installation of piles or steel casings is expected to be limited to temporary behavioral impacts. Behavioral changes are expected to potentially occur only when an animal is transiting a disturbance zone during pile or casing installation. Therefore, impacts to behavior are expected to be short-lived. Also, because seal and sea lion exposure will be limited to transiting a disturbance zone, the probability of experiencing TTS is negligible.

A detailed description of in-water and in-air impacts expected to occur to individual seals and sea lions expected to transit through the Region of Activity is provided in Section 5. The following discussion puts into context what those effects mean to the respective populations or stocks of each of the pinniped species addressed in this LOA.

7.1 Harbor Seal

The Oregon/Washington coastal stock of Pacific harbor seals consisted of about 25,000 animals in 1999 (Carretta et al. 2007). This harbor seal stock includes coastal estuaries (Columbia River) and bays (Willapa Bay and Grays Harbor). The harbor seal coastal stock increased at an annual rate of 7 percent from 1983 to 1992 and at 4 percent from 1983 to 1996 (Jeffries et al. 1997). Based on analyses of Jeffries et al. (2003) and Brown et al. (2005), both the Washington and Oregon portions of this stock have reached carrying capacity and are no longer increasing, and the stock is believed to be within its optimum sustainable population level (Jeffries et al. 2003, Brown et al. 2005). Incidental harassment, in the form of Level B, is requested for up to six subadult or adult harbor seals four times per year during the 5-year LOA period. This is a very small amount of incidental harassment of harbor seals by Level B harassment in a large, stable population of approximately 25,000, and is not expected to impact recruitment or survival of the stock. Because the type of incidental harassment is not expected to actually remove individuals from the population or significantly decrease their ability to feed or interfere with breeding, this amount of incidental harassment is anticipated to have a negligible impact on the stock.

7.2 California Sea Lion

The U.S. Stock of California sea lions was estimated to be 238,000 in the 2007 Stock Assessment Report and may be at carrying capacity, although more data is needed to verify that determination (Carretta et al. 2007). Generally, California sea lions in the Pacific Northwest are subadult or adult males (NOAA 2008).

They are not considered a "strategic" stock under the MMPA, because total human-caused mortality, although unknown, is likely to be less than the potential biological removal (8,511) (Carretta et al. 2007).

Incidental harassment, in the form of Level B harassment, is requested for up to 89 subadult or adult male California sea lions 10 times per year during the 5-year LOA period. This is a small amount of incidental harassment of California sea lions by Level B harassment in a large population of approximately 238,000. Individuals that may be disturbed will be males, so the Level B type of incidental harassment is not expected to impact recruitment or survival of the stock. Because the type of incidental harassment is not expected to actually remove individuals from the population or decrease significantly their ability to feed or breed, this amount of incidental harassment is anticipated to have a negligible impact on the stock.

7.3 Steller Sea Lion

The total population of the eastern DPS of Steller sea lions is estimated to be approximately 45,095 to 55,832 animals with an overall annual rate of increase of 3.1 percent throughout most of the range (Oregon to southeastern Alaska) (Allen and Angliss 2010). In 2006, the NMFS Steller sea lion recovery team proposed removal of the eastern stock from listing under the ESA based on its annual rate of increase of approximately 3 percent since the mid-1970s. Under the MMPA, all Steller sea lions are classified as “strategic stocks” and are considered “depleted” (Allen and Angliss 2010).

Incidental harassment, in the form of Level B, is requested for up to up to 225 subadult or adult male Steller sea lions six times per year during the 5-year LOA period. This is a small amount of incidental harassment of Steller sea lions by Level B harassment in a population of approximately 50,000. Individuals that may be disturbed are expected to be subadult and adult males, so the Level B type of incidental harassment is not expected to impact recruitment or survival of the stock. Because the type of incidental harassment is not expected to actually remove individuals from the population or decrease significantly their ability to feed or breed, this amount of incidental harassment is anticipated to have a negligible impact on the stock.

8. Anticipated Impact on Subsistence Uses

No impacts to the availability of harbor seals, California sea lions, or Steller sea lions to the Pacific Northwest treaty tribes will occur as a result of this project.

9. Anticipated Impact of the Activity on the Habitat of the Marine Mammal Populations and the Likelihood of Restoration of the Affected Habitat

Construction activities will have temporary impacts to pinniped habitat in the Columbia River and North Portland Harbor by producing temporary disturbances primarily through increases in airborne noise and in-water sound pressure levels during installation of pipe pile, sheet pile, and steel casings. Other potential temporary changes are passage obstruction and changes in prey species distribution during construction. Permanent impacts will be produced primarily through changes to habitat from the presence of new bridge piers in the Columbia River and in North Portland Harbor and removal of the existing piers in the Columbia River. A limited amount of debris removal in the North Portland Harbor may occur.

9.1 Noise Disturbance

For pinnipeds, NMFS is currently using underwater noise injury thresholds of 190 dB RMS and disturbance thresholds of 160 dB RMS for impulse noise and 120 dB RMS for continuous noise. The in-air thresholds are 90 dB RMS for harbor seals and 100 dB RMS for sea lions. The only construction activities expected to reach the injury threshold is the impact driving of steel piles and installation of steel casings. The disturbance threshold will be exceeded during both impact and vibratory pile installation and vibratory installation of steel casings (see Section 5).

There are several short-term effects from noise exposure that may affect the in-water habitat of seals and sea lions, including impaired foraging efficiency and potential effects on prey (Southall et al. 2007) (see Section 5). However, due to the timing of the in-water work and the limited amount of pile driving that may occur on a daily basis, these effects on pinniped habitat will be temporary and limited in duration. Very few harbor seals are present and most of the sea lions are in route to forage below Bonneville Dam where fish concentrate. Any impact to individuals is expected to be of short duration as they pass through areas with noise levels above the disturbance threshold and be in the form of Level B harassment only. No injurious impacts (Level A) will occur. The direct loss of habitat available during construction due to noise impacts is expected to be minimal.

9.2 Passage Obstruction

The new overwater bridge structures will permanently decrease the overall footprint of piers below the OHW in the Columbia River and permanently increase the overall footprint of the piers below the OHW in North Portland Harbor. The permanent changes will be to riverine habitat and are not in pinniped breeding habitat or near haulout sites. They will not open up or block passage for pinnipeds measurably. Therefore, permanent changes due to bridge piers will not affect pinnipeds measurably.

There are a variety of temporary structures that could potentially obstruct passage of pinnipeds including barges, moorings, tower cranes, cofferdams, and work platforms. Although there will be many such structures in the Region of Activity, they will cover no more than 20 percent of the entire channel width at one time. There will still be ample room for seals and sea lions to navigate around these structures. Seals and sea lions may need to slightly alter their course as they move through the construction area to avoid these structures, but there is no potential for physical structures to completely block upstream and downstream movement. Due to the small size of the structures relative to the remaining portion of the river available, delays to their movements will be negligible. Therefore, the effect of in-water and overwater structures on the ability of seals and sea lions to pass upstream and downstream will be insignificant.

9.3 Changes in Prey Species Distribution and Quality

Fish are the primary dietary component of all of the pinniped species in the Region of Activity. The Columbia River and North Portland Harbor provides migration and foraging habitat for sturgeon and lamprey, migration and spawning habitat for eulachon, and migration habitat for juvenile and adult salmon and steelhead, as well as some limited rearing habitat for juvenile salmon and steelhead.

There are no physical barriers to fish passage within the Region of Activity, nor are there fish passage barriers between the Region of Activity and the Pacific Ocean. The proposed project will not involve the creation of permanent physical barriers and, thus, long-term changes in seal and sea lion prey species distribution are not expected to occur.

Any adverse effects to prey species will occur during project construction and are temporary. All project activities will be conducted using the BMPs and minimization measures outlined in Section 11. Given the large numbers of fish in the Columbia River, the short-term nature of effects to fish populations, and extensive BMPs and minimization measures to protect fish during construction, as well as conservation and habitat mitigation measures that will continue into the future, the project is not expected to have measurable effects on the distribution or abundance of potential prey species in the long term. Therefore, temporary habitat impacts are expected to have a negligible impact to habitat for pinniped prey species. These effects to prey species are summarized below and are outlined in more detail in Sections 6.1 to 6.3 of the CRC project BA.

Noise from pile installation may harm (impact driving) or cause behavioral disturbance to fish (impact or vibratory installation of steel pipe pile, vibratory installation of steel pipe pile, sheet pile, and steel casings for drilled shaft placement). Avoidance and minimization measures will be implemented to limit effects to fish due to noise from impact pile-driving. These measures include: use of drilled shafts for bridge foundation rather than impact driving of 8-foot-diameter steel pipe piles, minimization of the number of in-water piers or bents, restricting impact pile driving to the amount needed for proofing of load-bearing piles only, timing windows for in-water impact pile driving to avoid the majority of fish runs, use of a noise attenuation devices, vibratory installation of piles to the extent practicable, a hydroacoustic performance measure to monitor and limit the extent of potential incidental fish take, and on-site biological monitors. Nevertheless, impact pile-driving will likely create a temporary migration barrier to all life stages of fish using the Columbia River and North Portland Harbor, although this would be localized. Cofferdams and temporary in-water work structures also may create partial barriers to the migration of juvenile fish in shallow-water habitat. Impacts to fish species distribution will be temporary during in-water work and hydroacoustic impacts from impact pile driving will only occur for limited periods during the day and only during the in-water work window established for this activity in conjunction with ODFW, WDFW, and NMFS. The overall effect to the prey base for seals and sea lions will be insignificant.

Prey may be affected by turbidity, contaminated sediments, or other contaminants in the water column. The CRC project will minimize, avoid, or contain all potential sources of contamination, minimizing the risk of exposure to prey species of seals and sea lions. The CRC project involves several activities that could potentially generate turbidity in the Columbia River and North Portland Harbor, including pile installation, pile removal, installation and removal of cofferdams, installation of steel casings for drilled shafts, and debris removal. Turbidity is not expected to cause mortality in the fish species using the Region of Activity, and effects will probably be limited to temporary avoidance of the discrete areas of elevated turbidity (no more than 300 feet from the source) for approximately 4 to 6 hours at a time (CRC 2010). Therefore, turbidity will have only insignificant effects to fish and, thus, insignificant effects on seals and sea lions.

In-water work is extremely unlikely to mobilize contaminated sediments (CRC 2010). Well in advance of in-water work, the CRC project team will perform an extensive search for evidence of contamination, pinpointing the location, extent, and concentration of the contaminants. Then, BMPs will be implemented to ensure that the CRC project: 1) avoids areas of contaminated sediment or 2) enables responsible parties to initiate cleanup activities for contaminated sediments occurring from construction activities within the Region of Activity. These BMPs will be developed and implemented in coordination with regulatory agencies. Because the CRC project will identify the locations of contaminated sediments and use BMPs to ensure that they do not become mobilized, there is little risk that the prey base of seals and sea lions will be greatly affected by or exposed to contaminated sediments.

In-water and near-water construction will employ numerous BMPs and will comply with numerous regulatory permits to ensure that contaminants do not enter surface water bodies. In the unlikely event of accidental release, numerous BMPs and a Pollution Control and Contamination Plan (PCCP) will be implemented to ensure that contaminants are prevented from spreading and are cleaned up quickly. Therefore, contaminants are not likely to significantly affect fish and, thus, effects on the seal and sea lion prey base will also be insignificant.

9.4 Physical Loss of Prey Species Habitat

The project will lead to temporary physical loss of approximately 20,700 sq. ft. of shallow-water habitat. Project elements responsible for temporary physical loss include the footprint of the numerous temporary piles associated with in-water work platforms, work bridges, tower cranes, oscillator support piles, cofferdams, and barge moorings in the Columbia River and North Portland Harbor.

The in-water portions of the new structures will result in the permanent physical loss of approximately 250 sq. ft. of shallow-water habitat at pier complex 7 in the Columbia River. Demolition of the existing Columbia River structures will permanently restore about 6,000 sq. ft. of shallow-water habitat, and removal of a large overwater structure at the Quay will permanently restore about 600 sq. ft. of shallow-water habitat. Overall, there will be a net permanent gain of about 5,345 sq. ft. of shallow-water habitat in the Columbia River (CRC 2010). At North Portland Harbor, there will be a permanent net loss of about 2,435 sq. ft. of shallow-water habitat at all of the new in-water bridge bents. Note that all North Portland Harbor impacts are in shallow water.

Physical loss of shallow-water habitat is of particular concern for rearing or subyearling migrant salmonids. In general, in-water structures that completely block the nearshore may force these juveniles to swim into deeper-water habitats to circumvent them. Deep-water areas represent lower quality habitat because predation rates are higher there. Numerous studies show that predators such as walleye and northern pikeminnow occur in deepwater habitat for at least part of the year (Johnson 1969; Ager 1976; Paragamian 1989; Wahl 1995; Pribyl et al. 2004). In the case of the CRC project, in-water portions of the structures will not pose a complete blockage to nearshore movement anywhere in the Region of Activity. Although these structures will cover potential rearing and nearshore migration areas, the habitat is not rare and is not of particularly high quality. These juveniles will still be able to use the abundant shallow-water habitat available for miles in either direction. Neither the permanent nor the temporary structures will force these juveniles into deeper water, and therefore pose no added risk of predation.

Physical loss of shallow-water habitat will have only negligible effects on foraging, migration, and holding of salmonids that are of the yearling age class or older. These life functions are not dependent on shallow-water habitat for these age classes. Furthermore, the lost habitat is not of particularly high quality. There is abundant similar habitat immediately adjacent along the shorelines of the Columbia River and throughout North Portland Harbor. The lost habitat represents only a small fraction of the remaining habitat available for miles in either direction. There will still be many acres of habitat for yearling or older age-classes of salmonids foraging, migrating, and holding in the Region of Activity. Physical loss of shallow-water habitat will have only negligible effects on eulachon and green sturgeon for the same reason as above. The effects to these elements of seal and sea lion habitat will, thus, be minimal.

The CRC project will cause a temporary physical loss of approximately 16,635 sq. ft. of deep-water habitat, consisting chiefly of coarse sand with a small proportion of gravel. CRC project elements responsible for temporary physical loss include the cofferdams and numerous temporary piles associated with in-water work platforms and moorings. The in-water portions of the new structures will result in the permanent physical loss of approximately 6,300 sq. ft. of deep-water habitat at pier complexes 2 through 7 in the Columbia River. Demolition of the existing Columbia River piers will permanently restore about 21,000 sq. ft. of deep-water habitat. Overall, there will be a net permanent gain of about 15,000 sq. ft. of deep-water habitat in the Columbia River.

Although there will be a temporary net physical loss of deep-water habitat, this is not expected to have a significant impact on listed fish. The lost habitat is not rare or of particularly high quality, and there is abundant similar habitat in immediately adjacent areas of the Columbia River and for many miles both upstream and downstream. The lost habitat will represent a very small fraction (far less than 1 percent) of the remaining habitat available. Additionally, the in-water portions of the permanent and temporary in-water structures will occupy no more than about 1 percent of the width of the Columbia River. Therefore, the structures will not pose a physical barrier to fish migration.

In addition, compensatory mitigation for direct permanent habitat loss to jurisdictional waters from permanent pier placement will occur in accordance with requirements set by USACE, Oregon Department of State Lands (DSL), Washington Department of Ecology (Ecology), ODFW, and WDFW. To meet these requirements, CRC is proposing to restore habitat in the lower Lewis River and lower Hood River. At the Hood River site, 1 mile of a historic side channel will be reconnected to the lower Hood River and an existing 21-acre wetland resulting in habitat benefits to salmonids and eulachon. At the Lewis River site, restoration of 18.5 acres of side channels will occur between the lower Lewis River and the lower Columbia River resulting in habitat benefits to salmonid and other native species. Therefore, permanent habitat loss is expected to have a negligible impact to habitat for pinniped prey species.

Due to the small size of the impact relative to the remaining habitat available, and the permanent benefits from habitat restoration, both temporary and permanent physical habitat loss will be insignificant to fish and, thus, to the habitat and foraging opportunities of seals and sea lions.

10. Anticipated Impact of the Loss or Modification of Habitat

The impact of temporary and permanent habitat changes from bridge construction is expected to be minimal to pinnipeds. The effects to seals and sea lions from temporary and permanent habitat changes are summarized below.

- **Noise disturbance:** Temporary modification of habitat during in-water construction from noise may affect pinniped foraging; however, very few seals are in the Region of Activity and most sea lions are swimming upriver to forage below Bonneville Dam. Noise disturbance will not be continuous, will only occur temporarily as animals pass through the area and will be in the form of Level B harassment only. No TTS is anticipated from project activities and no injurious Level A incidental take will occur.
- **Passage obstruction:** The permanent changes to the overall footprint of the bridges in the Columbia River and North Portland Harbor will not affect pinniped breeding habitat or haulout sites and will not affect passage measurably. Temporary structures during construction will not cover more than 20 percent of the entire channel and are not likely to significantly affect the ability of pinnipeds to pass through the construction area or delay their movements.
- **Changes in prey distribution and quality:** The CRC project is likely to impact a small percentage of all salmon and steelhead runs that swim through the Region of Activity as a result of in-water work including pile installation. This impact will be temporary and will only occur during construction of the bridges in the Columbia River and North Portland Harbor and during demolition of the existing Columbia River Bridges. BMPs and minimization measures will avoid or limit the extent of the impact to prey species from noise, changes to water quality, and temporary structures. Short-term impacts to the prey base from project work do not represent a large part of the seal and sea lion prey base in comparison to prey available through the entirety of their foraging range, which includes the Columbia River from Bonneville Dam to the mouth and foraging grounds off the Pacific Coast. Overall, effects to the prey base will be temporary, limited to the in-water work period over the CRC project duration, and will not cause measurable changes in the distribution or quality of prey available to seals and sea lions.
- **Physical changes to prey species habitat:** The new bridge structures will permanently decrease the overall footprint of piers below the OHW in the Columbia River and permanently increase the overall footprint of the piers below the OHW in North Portland Harbor. Habitat mitigation for direct permanent habitat loss to fish from permanent pier placement will occur in the lower Lewis River and lower Hood River that will provide long-term benefits to fish species in the lower Columbia River, resulting in long-term benefits to the seal and sea lion prey base. Therefore, permanent habitat loss is expected to have a negligible impact to habitat for pinniped prey species. Temporary physical loss of habitat from temporary structures will only occur during the period of in-water work in the Columbia River and North Portland Harbor. These temporary losses are not expected to measurably affect the prey base for seals and sea lions.

11. Impact Minimization Methods

CRC project activities are subject to federal, state, and local permit regulations. Through consultation with agencies, CRC has developed BMPs and minimization measures (MMs) to avoid and minimize (to the greatest extent practicable) impacts to the environment, ESA-listed fish species, Steller sea lions, designated critical habitats, California sea lions, and harbor seals.

Timing restrictions will be used to avoid in-water work when ESA-listed fish are most likely to be present. Impact pile driving will only occur between September 15 and April 15. Timing restrictions imposed to avoid impacts to ESA-listed fish will also reduce effects to pinnipeds and their prey species. Vibratory pile installation may occur year-round.

11.1 General Measures

11.1.1 General Measures and Conditions

- A biologist shall re-evaluate the project for changes in design and evaluation methods not previously employed to assess potential impacts associated with those changes, as well as the status and location of listed and protected species, every 6 months until project construction is completed. Re-initiation of consultation under the ESA with the Services is required if new information reveals project effects that may affect listed species or critical habitat in a manner or to an extent not previously considered. Re-initiation of consultation under ESA is also required if the identified action is modified in a manner that causes an effect to species that was not considered in the project's BA or if a new species is listed or critical habitat is designated that may be affected by the action.
- All work shall be performed according to the requirements and conditions of the regulatory permits issued by federal, state, and local governments. Seasonal restrictions, e.g., work windows, will be applied to the project to avoid or minimize potential impacts to listed or proposed species based on agreement with, and the regulatory permits issued by DSL, WDFW, and USACE in consultation with ODFW, USFWS, and NMFS.
- Drilled shafts will be installed while water is still in the cofferdam. The drilled shaft casing will function to contain and isolate the work. Cofferdams will be installed to minimize fish entrapment. Sheet piles will be installed from upstream to downstream, lowering the sheet piles slowly until contact with the substrate. When cofferdams are used, fish salvage must be conducted, according to protocol approved by ODFW, WDFW, and NMFS.
- Contractor shall provide a qualified fishery biologist to conduct and supervise fish capture and release activity as to minimize risk of injury to fish, in accordance with ODOT Standard Specification 00290.31(i) or its equivalent; and/or the 2009 WSDOT Fish Exclusion Protocols and Standards, or its equivalent.
- The contractor shall prepare a Water Quality Sampling Plan for conducting water quality monitoring for all projects occurring in-water in accordance with the specific conditions issued in the Oregon and Washington 401 Water Quality Certifications. The Plan shall identify a sampling methodology as well as method of implementation to be reviewed and approved by the engineer. If, in the future, a standard water quality monitoring plan is adopted by ODOT and/or WSDOT, this plan, with the agreement of NMFS and USFWS, may replace the contractor plan.
- State DOT policy and construction administration practice in Oregon and Washington is to have a DOT inspector on site during construction. The role of the inspector will ensure contract and

permit requirements. ODOT/WSDOT environmental staff will provide guidance and instructions to the onsite inspector to ensure the inspector is aware of permit requirements.

- If in-water dredging is required outside of a cofferdam, a clamshell bucket shall be used. Dredged material shall be disposed of in accordance with relevant permits and approvals.
- Piles that are not in an active construction area and are in place 6 months or longer will have cones or other anti-perching devices installed to discourage perching by piscivorous birds.
- All pumps must employ a fish screen that meets the following specifications:
  - An automated cleaning device with a minimum effective surface area of 2.5 sq. ft. per cubic foot per second, and a nominal maximum approach velocity of 0.4 feet foot per second, or no automated cleaning device, a minimum effective surface area of 1 square foot per cubic foot per second, and a nominal maximum approach rate of 0.2 foot per second; and
  - a round or square screen mesh that is no larger than 2.38 millimeters (mm) (0.094") in the narrow dimension, or any other shape that is no larger than 1.75 mm (0.069") in the narrow dimension; and
  - Each fish screen must be installed, operated, and maintained according to NMFS fish screen criteria.

11.1.2 Spill Prevention/Pollution Control

- The contractor shall prepare a Spill Prevention, Control, and Countermeasures (SPCC) Plan prior to beginning construction. The SPCC Plan shall identify the appropriate spill containment materials; as well as the method of implementation. All elements of the SPCC Plan will be available at the project site at all times. For additional detail, consult ODOT Standard Specification 00290.00 to 00290.90 and/or WSDOT Standard Specification 1-07.15(1). For transit construction in Oregon, consult TriMet Standard Specification 01450{1.04}).
- The contractor will designate at least one employee as the erosion and spill control (ESC) lead. The ESC lead will be responsible for the implementation of the SPCC Plan. The contractor shall meet the requirements of; and follow the process described in ODOT Standard Specifications 00290.00 through 00290.30 and/or WSDOT Standard Specification 8-01.3(1)B. The ESC lead shall be listed on the Emergency Contact List as part of ODOT Standard Specification 00290.20(g) and/or WSDOT Standard Specification 1-07.15(1).
- All equipment to be used for construction activities shall be cleaned and inspected prior to arriving at the project site, to ensure no potentially hazardous materials are exposed, no leaks are present, and the equipment is functioning properly. Identify equipment that will be used below OHW. Outline daily inspection and cleanup procedures that will insure that identified equipment is free of all external petroleum- based products. Should a leak be detected on heavy equipment used for the project, the equipment shall be immediately removed from the area and not used again until adequately repaired. Where off-site repair is not practicable, the implemented SPCC Plan will prevent and/or contain accidental spills in the work/repair area to insure no contaminants escape containment to surface waters and cause a violation of applicable water quality standards.
- Operation of construction equipment used for project activities shall occur from on top of floating barge or work decks, existing roads or the streambank (above OHW). Any equipment operating in the water shall use only vegetable-based oils in hydraulic lines.

- All stationary power equipment or storage facilities shall have suitable containment measures outlined in the SPCC Plan to prevent and/or contain accidental spills to insure no contaminants escape containment to surface waters and cause a violation of applicable water quality standards.
- Process water generated on site from construction, demolition or washing activities will be contained and treated to meet applicable water quality standards before entering or re-entering surface waters.
- No paving, chip sealing, or stripe painting will occur during periods of rain or wet weather.
- For projects involving concrete, the implemented SPCC Plan shall establish a concrete truck chute cleanout area to properly contain wet concrete as part of ODOT Standard Specification 00290.30(a)1 and/or WSDOT Standard Specification 1-07.15(1).

11.1.3 Site Erosion/Sediment Control

- The contractor shall prepare a Temporary Erosion and Sediment Control (TESC) Plan and a Source Control Plan and implemented for the project requiring clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation. The BMPs in the plans will be used to control sediments from all vegetation removal or ground -disturbing activities. The engineer may require additional temporary control measures beyond the approved TESC Plan if it appears pollution or erosion may result from weather, nature of the materials or progress on the work. For additional detail, consult ODOT Standard Specifications 00280.00 to 00280.90 and/or WSDOT Standard Specification 1-07.15. For transit construction, consult TriMet Standard Specification 02276.
- As part of the TESC Plan, contractor shall delineate clearing limits with orange barrier fencing wherever clearing is proposed in or adjacent to a stream/wetland or its buffer and install perimeter protection/silt fence as needed to protect surface waters and other critical areas. Location will be specified in the field, based upon site conditions and the TESC Plan. For additional silt fence detail, consult ODOT Standard Specification 00280.16(c) and/or WSDOT Standard Specification 8-01.3(9)A.
- The contractor shall identify at least one employee as the ESC lead at preconstruction discussions and the TESC Plan. The contractor shall meet the requirements of; and follow the process described in ODOT Standard Specifications Section 00280.30 and/or WSDOT Standard Specification 8-01.3(1)B. The ESC lead shall be listed on the Emergency Contact List as part of ODOT Standard Specification 00290.20(g) and/or WSDOT Standard Specification 1-05.13(1). The ESC lead will also be responsible for ensuring compliance with all local, state, and federal erosion and sediment control requirements.
- All TESC measures shall be inspected on a weekly basis. Contractor shall follow maintenance and repair as described in ODOT Standard Specifications 00280.60 to 00280.70 and/or WSDOT Standard Specification 8-01.3(15). Inspect erosion control measures immediately after each rainfall, and at least daily during for precipitation events of more than 0.5 inches in a 24-hour period.
- For landward construction and demolition, project staging and material storage areas shall be located a minimum of 150 feet from surface waters, in currently developed areas such as parking lots or managed fields, unless a site visit by an ODOT/WSDOT biologist determines the topographic features or other site characteristics allow for site use closer to the edge of surface waters. Excavation activities (dredging not included) shall be accomplished in the dry. All surface water flowing towards the excavation shall be diverted through utilization of cofferdams and/or

berms. Cofferdams and berms must be constructed of sandbags, clean rock, steel sheeting, or other non-erodible material.

- Bank shaping shall be limited to the extent as shown on the approved grading plans. Minor adjustments made in the field will occur only after engineer's review and approval. Bio-degradable erosion control blankets will be installed on areas of ground-disturbing activities on steep slopes (1V:3H or steeper) that are susceptible to erosion and within 150 feet of surface waters. Areas of ground-disturbing activities that do not fit the above criteria shall implement erosion control measures as identified in the approved TESC Plan. For additional erosion control blanket detail, consult ODOT Standard Specification 00280.14(e) and/or WSDOT Standard Specification 9-14.5(2)A.
- Erodible materials (material capable of being displaced and transported by rain, wind or surface water runoff) that are temporarily stored or stockpiled for use in project activities shall be covered to prevent sediments from being washed from the storage area to surface waters. Temporary storage or stockpiles must follow measures as described in ODOT Standard Specification 00280.42 and/or WSDOT Standard Specification 8-01.3(1).
- All exposed soils will be stabilized as directed in measures prescribed in the TESC Plan. Hydro-seed all bare soil areas following grading activities, and re-vegetate all temporarily disturbed areas with native vegetation indigenous to the location. For additional detail, consult ODOT Standard Specifications 01030.00 to 01030.90 and/or WSDOT Standard Specification 801.3(1).
- Where site conditions support vegetative growth, native vegetation indigenous to the location will be planted in areas disturbed by construction activities. Re-vegetation of construction easements and other areas will occur after the project is completed. All disturbed riparian vegetation will be replanted. Trees will be planted when consistent with highway safety standards. Riparian vegetation will be replanted with species native to geographic region. Planted vegetation will be maintained and monitored to meet regulatory permit requirements. For additional detail, consult ODOT Standard Specifications 01040.00 to 01040.90 and/or WSDOT Standard Specification 8-01.3(2)F.

11.1.4 Work Zone Lighting

- Site work shall follow local, state and federal permit restrictions for allowable work hours. If work occurs at night, temporary lighting should be used in the night work zones. The work area and its approaches shall be lighted to provide better visibility for drivers to travel safely travel through the work zone, and illumination shall be provided wherever workers are present to make them visible.

During overwater construction, contractor will use directional lighting with shielded luminaries to control glare and direct light onto work area; not surface waters.

11.1.5 Pile Installation Measures

11.1.5.1 Minimization Measure 1 – Drilled Shafts for Foundations

Permanent foundations for each in-water pier will be installed by means of drilled shafts. This approach significantly reduces the amount of impact pile driving, the size of piles, and amount of in-water noise.

11.1.5.2 Minimization Measure 2 – Piling Installation with Impact Hammers

Installation of piles using impact driving may only occur between September 15 and April 15 of the following year. On an average work day, six piles could be installed using vibratory installation to set the piles; then impact driving to drive the piles to refusal per project specifications to meet load-bearing capacity requirements. This method reduces the number of daily pile strikes over 90 percent. No more than two impact pile drivers may be operated simultaneously within the same waterbody channel.

In waters with depths more than 0.67 meter (2 feet), a bubble curtain or other sound attenuation measure will be implemented for impact driving of pilings. If a bubble curtain or similar measure is used, it will distribute small air bubbles around 100 percent of the piling perimeter for the full depth of the water column. Any other attenuation measure (e.g., temporary noise attenuation pile) must provide 100 percent coverage in the water column for the full depth of the pile.

A performance test of the noise attenuation device in accordance with the approved hydroacoustic monitoring plan shall be conducted prior to any impact pile driving. If a bubble curtain or similar measure is utilized, the performance test shall confirm the calculated pressures and flow rates at each manifold ring.

11.1.5.3 Minimization Measure 3 – Impact Pile Installation Hydroacoustic Performance Measure

Sound pressure levels from an impact hammer will be measured in accordance with the hydroacoustic monitoring plan. Recording and calculation of accumulated sound exposure levels shall be performed. Analysis of the data shall be used to calculate exposure factors as defined in Appendix K of the CRC BA.

11.1.5.4 Minimization Measure 4 – Hydroacoustic Monitoring

The project will conduct underwater noise monitoring to test the effectiveness of noise attenuation devices. Testing will occur based on an underwater noise monitoring plan based on the most recent version of the Underwater Noise Monitoring Plan Template.[6] This template has been developed in cooperation with the NMFS, USFWS, and WSDOT, and has been approved by NMFS and USFWS for use in Section 7 consultation for transportation projects in Washington.

Testing will occur according to protocols outlined in an Underwater Noise Monitoring Plan (WSDOT 2008). Underwater noise monitoring will occur as follows:

- Hydroacoustic monitoring will occur for a representative number of piles per structure (minimum of five piles installed with an impact hammer).
- Monitoring will occur for piles driven in water depths that are representative of typical water depths found in the areas where piles will be driven.
- Ambient noise will be measured as outlined in the template in the absence of pile driving.

A report that analyzes the results of the monitoring effort will be submitted to the Services as outlined in the monitoring plan template.

Unattenuated impact pile driving for obtaining baseline sound measurements will be limited to the number of piles necessary to obtain an adequate sample size for the project, as defined in the final Hydroacoustic Monitoring Plan.

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[6] Available at: http://www.wsdot.wa.gov/Environment/Air/Noise.htm.

11.1.5.5 Minimization Measure 5 – Biological Monitoring

A qualified biologist will be present during all impact pile driving operations to observe and report any indications of dead, injured, or distressed fishes, including direct observations of these fishes or increases in bird foraging activity.

11.2 Marine Mammal Monitoring

11.2.1 Coordination

Briefings will be conducted between the CRC project construction supervisors and the crew, marine mammal observer(s), and acoustical monitoring team prior to the start of all pile-driving activity, and when new personnel join the work, to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures. The CRC project will contact the Bonneville Dam to obtain information on the presence or absence of pinnipeds prior to initiating pile driving in any discrete pile driving time period described in the project description.

11.2.2 Establishment of Monitoring Zones

For impact pile driving, a safety zone (defined as where SPLs equal or exceed 190 dB RMS) and a disturbance zone (defined as where SPLs equal or exceed 160 dB RMS) will be established. The initial safety and disturbance zones will be established based on the worst-case underwater sound modeled from impact driving of 36- to 48-inch steel pile, but will not be less than 50 m.

For vibratory pile or vibratory steel casing installation, an initial disturbance zone (defined as where SPLs equal or exceed 120 dB RMS) will be established based on the worst-case sound modeled from vibratory installation of 36- to 72-inch steel pile for pipe piles or the loudest value modeled for sheet piles. Noise levels for vibratory installation of steel sheet or pipe piles are not anticipated to be above the 190 dB RMS thresholds based on literature values; therefore, no safety zone for vibratory installations of steel pile is anticipated. If steel casings for drilled shafts are installed by a vibratory hammer, an initial safety zone of 50 m will be established.[7]

Once impact or vibratory installation begins, the disturbance zones will either be enlarged or reduced based on actual recorded SPLs from the acoustic monitoring. The safety zones will remain at 50 m or be enlarged based on actual recorded SPLs from the acoustic monitoring, but will not be less than 50 m. If new zones are established based on SPL measurements, NMFS requires each new zone be based on the most conservative measurement (i.e., the largest zone configuration).

Table 11-1 and Table 11-2 show initial monitoring distances for safety and disturbance zones in the Columbia River and North Portland Harbor, respectively.

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[7] No published information is available on vibratory installation of 120-inch steel casings. Published information from Caltrans (2007) shows that 36-inch pile produced up to 175 dB RMS and 72-inch pile produced up to 180 dB RMS, both measured at 5 m from the pile. By extrapolating from these published values, the project assumes the energy imparted through a larger casing would be up to 10 dB RMS (an order of magnitude) higher than the highest value for a 72-inch pile. That is, vibratory installation of a 120-inch steel casing may yield a maximum value of 190 dB RMS 5 m from the pile. As noted, monitoring will be conducted to determine actual values and distances.

Table 11-1. Initial Underwater Distance to Safety and Disturbance Monitoring Zones in the Columbia River

		Calculated Distance to Monitoring Zones (meters)[a]		
Pile Type	**Hammer Type**	**190 dB RMS[b] Safety Zone**	**160 dB RMS Disturbance Zone (impulse noise)**	**120 dB RMS Disturbance Zone (continuous noise)**
18- to 24-inch steel pipe	Impact	50	858	N/A
36- to 48-inch steel pipe	Impact	54	5,412	N/A
48-inch steel pipe	Vibratory	N/A	N/A	20,166 upriver 8,851 downriver
120-inch steel casing	Vibratory	50	N/A	20,166 upriver 8,851 downriver
Sheet pile	Vibratory	N/A	N/A	6,962

a Monitoring zones based on worst case modeled values where the attenuation device is not operating. Upriver and downriver distances vary if a landform is encountered prior to noise attenuating to a threshold value. A minimum distance of 50 m is used for all safety zones, even if initial calculated distances or actual distances are less.

b All values unweighted and relative to 1 µPa.

Table 11-2. Initial Underwater Distance to Safety and Disturbance Monitoring Zones in North Portland Harbor

		Calculated Distance to Monitoring Zones (meters)[a]		
Pile Type	**Hammer Type**	**190 dB RMS[b] Safety Zone**	**160 dB RMS Disturbance Zone (impulse noise)**	**120 dB RMS Disturbance Zone (continuous noise)**
18- to 24-inch steel pipe	Impact	50	858	N/A
36- to 48-inch steel pipe	Impact	54	3,058 upriver 5,412 downriver	N/A
48-inch steel pipe	Vibratory	N/A	N/A	3,058 upriver 5,632 downriver
120-inch steel casing	Vibratory	50	N/A	3,058 upriver 5,632 downriver

a Monitoring zones based on worst case modeled values where the attenuation device is not operating. Upriver and downriver distances vary if a landform is encountered prior to noise attenuating to a threshold value. A minimum distance of 50 m is used for all safety zones, even if initial calculated distances or actual distances are less.

b All values unweighted and relative to 1 µPa.

11.2.3 Visual Marine Mammal Monitoring

A monitoring protocol (Appendix D) will be implemented that will require collection of sighting data for each pinniped species observed during activities that includes impact or vibratory installation of steel pipe or sheet pile or steel casings. Behavior, numbers of individuals observed, frequency of observation, and the time will be included. A qualified biologist will be present on site at all times during impact or vibratory installation of steel pile or steel casings. In order to be considered qualified; the biologist will meet the following criteria for marine mammal observers:

- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target.

- Advanced education in biological science, wildlife management, mammalogy, or related fields (Bachelor's degree or higher is preferred).
- Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience).
- Experience or training in the field identification of pinnipeds, including the identification of behaviors.
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations.
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of pinnipeds observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury from construction noise of pinnipeds observed within a defined safety zone; and pinniped behavior.
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on pinnipeds observed in the area as necessary.

The CRC project proposes the following marine mammal monitoring procedures for steel impact and vibratory sheet or pipe pile or vibratory casing installation:

- Monitoring of safety and disturbance zones will occur for all impact pile driving activities. Monitoring of the disturbance zone will occur for all vibratory pipe or sheet pile installation. No SPLs above 190 dB RMS are anticipated for vibratory installation of pipe or sheet piles; therefore, a safety zone will not be established. If hydroacoustic monitoring of vibratory installation of steel casings for drilled shafts indicates SPLs of 190 dB RMS or higher, then a safety zone will be established and monitored for vibratory installation of steel casings.
- Through acoustic monitoring, the CRC project will determine the actual distance to safety or disturbance zones and establish the new zones at that distance.
- Until determination of safety and disturbance zones is accomplished, monitoring will occur for the area within the calculated zones.
- Safety and disturbance zones will be monitored from a work platform, barge, the existing bridge, or other vantage point, or by driving a boat along and within the radius of the zones while visually scanning the area. For activities within a safety zone, full observation of the safety zone will occur. If a small boat is used for monitoring, the boat will remain 50 yards from swimming pinnipeds in accordance with NMFS marine mammal viewing guidelines (NMFS 2004).
- If vibratory installation of steel pipe piles or casings occurs after dark, the disturbance zone will be monitored with a night vision scope and/or other suitable device. Vibratory installation of steel pipe piles or sheet piles is not expected to produce SPLs at or above 190 dB RMS; therefore, no safety zone will be established or monitored for these activities. If hydroacoustic monitoring of vibratory installation of steel casings for drilled shafts indicates SPLs of 190 dB RMS or higher, then a safety zone will be established and monitored with a night vision scope and/or other suitable device.
- If the safety zone is obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire safety zone is visible.
- The safety zone will be monitored for the presence of sea lions before, during, and after any pile driving activity.

- The safety zone will be monitored for 30 minutes prior to initiating the start of pile driving. If sea lions are present within the safety zone prior to pile driving, the start of pile driving will be delayed until the animals leave the safety zone.
- Monitoring of the safety zone will continue for 20 minutes following the completion of pile driving.
- Monitoring will be conducted using high quality binoculars. When possible, digital video or still cameras will also be used to document the behavior and response of sea lions to construction activities or other disturbances.
- Each monitor will have a radio or cell phone for contact with other monitors or work crews.
- A GPS unit or electric range finder will be used for determining the observation location and distance to sea lions, boats, and construction equipment.
- Data collection will include a count of all sea lions observed by species, sex, age class, their location within the zone, and their reaction (if any) to construction activities, including direction of movement, and type of construction that is occurring, time that pile driving begins and ends, any acoustic or visual disturbance, and time of the observation. Environmental conditions such as wind speed, wind direction, visibility, and temperature will also be recorded.

11.2.4 Ramp-Up and Shutdown Procedure

The objective of a ramp-up is to alert any animals close to the activity and allow them time to move away, which will expose fewer animals to loud sounds, including both underwater and above water noise. This procedure also ensures that any pinnipeds missed during safety zone monitoring will move away from the activity and not be injured.

From January 1 through June 15 of any year, the following ramp-up procedures will be used for in-water pile installation.

- To allow any marine mammals that may be in the immediate area to leave before pile driving reaches full energy, a ramp-up technique will be used at the beginning of each day's in-water pile driving activities or if pile driving has ceased for more than 1 hour.
- If a vibratory driver is used, contractors will be required to initiate noise from vibratory hammers for 15 seconds at reduced energy followed by 1-minute waiting period. The procedure will be repeated two additional times before full energy may be achieved.
- If a non-diesel impact hammer is used, contractors will be required to provide an initial set of strikes from the impact hammer at reduced energy, followed by a 1-minute waiting period, then two subsequent sets. (The reduced energy of an individual hammer cannot be quantified because they vary by individual drivers. Also, the number of strikes will vary at reduced energy because raising the hammer at less than full power and then releasing it results in the hammer "bouncing" as it strikes the pile resulting in multiple "strikes").
- If a diesel impact hammer is used, contractors will be required to turn on the noise attenuation device (e.g. bubble curtain or other approved noise attenuation device) for 15 seconds prior to initiating pile driving to flush seals or sea lions from the area.

The safety zone will also be monitored throughout the time required to drive a pile (or install a steel casing if applicable). If a sea lion is observed approaching or entering the safety zone (190 dB RMS isopleth for pinnipeds), piling operations will be discontinued until the animal has moved outside of the safety zone. Pile driving will resume only after the sea lion is determined to have moved outside the safety zone by a qualified observer or after 15 minutes have elapsed since the last sighting of the sea lion within the safety zone.

11.2.5 Hydroacoustic Monitoring

Hydroacoustic monitoring will be conducted for impact driving of steel piles. Hydroacoustic monitoring will be conducted on a representative number of piles as described in the monitoring plan template (http://www.wsdot.wa.gov/Environment/Biology/BA/BAtemplates.htm#Noise) that has been developed with and approved by NMFS and USFWS for Section 7 consultations. The number, size, and location of piles monitored will represent the variety of substrates and depths, as necessary, in both the Columbia River and North Portland Harbor. Hydroacoustic monitoring will be conducted during vibratory installation of at least one steel pipe pile of the largest diameter used by the project to confirm the distance to the 120 dB RMS threshold level. If steel casings are installed with a vibrator hammer, hydroacoustic monitoring will occur for the first casing installed. This will represent a worst-case for size, depth, and substrate for vibratory installation of casings. For standard underwater noise monitoring, one hydrophone positioned at midwater depth and 10 m from the pile is used. Some additional initial monitoring at several distances from the pile is anticipated to determine site-specific transmission loss and directionality of noise. This data will be used to establish the radii of the safety and disturbance zones for sea lions.

11.3 Marine Mammal Monitoring Reporting

Reports of the data collected during sea lion monitoring will be submitted to NMFS weekly. In addition, a final report summarizing all sea lion monitoring and construction activities will be submitted to NMFS annually.

12. Arctic Subsistence Uses, Plan of Cooperation

The proposed activity will take place in the Columbia River (RM 106), and no activities will take place in or near a traditional Arctic subsistence hunting area. Therefore, this element is not applicable to this project.

13. Monitoring and Reporting

A monitoring protocol (Appendix D) will be implemented that will require collection of sighting data for each pinniped species observed in the Region of Activity during activities that includes impact or vibratory installation of steel pipe or sheet pile or steel casings (see Section 11). Species, behavior, numbers of individuals observed, frequency of observation, and the time would be included. A final report summarizing all sea lion monitoring and construction activities will be submitted to NMFS annually.

14. Coordinating Research to Reduce and Evaluate Incidental Take

Reports of the data collected during sea lion monitoring will be submitted to NMFS weekly. In addition, the information will be made available to the USACE Fisheries Field Unit at Bonneville Lock and Dam tasked with conducting a monitoring and deterrent program for pinnipeds in coordination with state and federal agencies (Stansell 2009). This information will also be made available to regional, state, and federal resource agencies, scientists, and professors, upon request. Terrestrial and underwater noise will be localized at the CRC project area while work is taking place. Mitigation measures will be in place to avoid potential injury and minimize behavioral disturbance to pinnipeds transiting the CRC project area (see Section 11).

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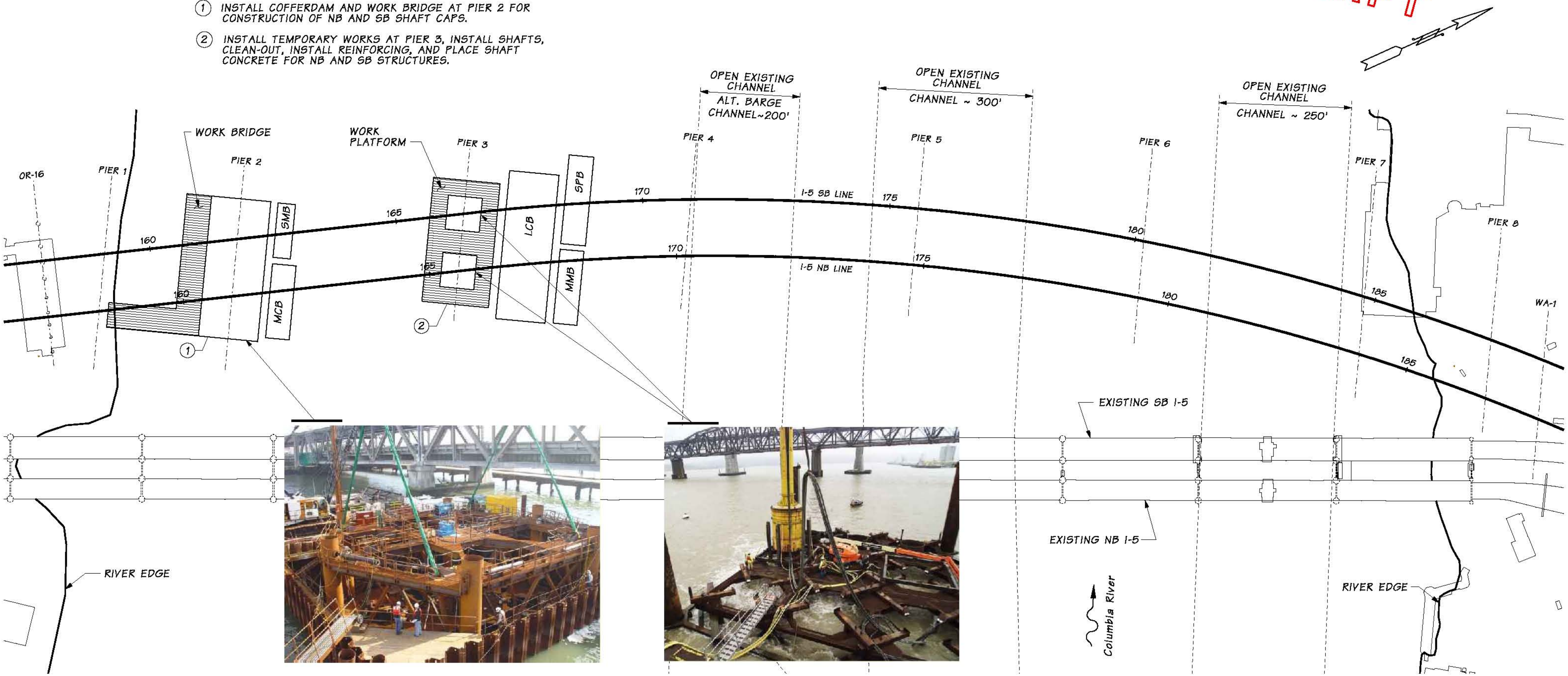
APPENDIX A

Draft Columbia River Bridge Construction Sequence Sheets

CONSTRUCTION SEQUENCE:

1. INSTALL COFFERDAM AND WORK BRIDGE AT PIER 2 FOR CONSTRUCTION OF NB AND SB SHAFT CAPS.
2. INSTALL TEMPORARY WORKS AT PIER 3, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES.

DRAFT



ABBREVIATIONS FOR CONSTRUCTION EQUIPMENT

SCB = SMALL CRANE BARGE, 116' LONG x 52' WIDE x 10' DEPTH, ~ 165 TON CAPACITY
SMB = SMALL MATERIAL BARGE, 110' LONG x 35' WIDE x 8' DEPTH
MCB = MEDIUM CRANE BARGE, 150' LONG x 70' WIDE x 12.5' DEPTH, ~ 300 TON CAPACITY
MMB = MEDIUM MATERIAL BARGE, 150' LONG x 48' WIDE x 9.5' DEPTH
LCB = LARGE CRANE BARGE, 300' LONG x 100' WIDE x 18' DEPTH, ~ 700 TON CAPACITY
LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 1

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-1.

CONCEPTUAL DESIGN

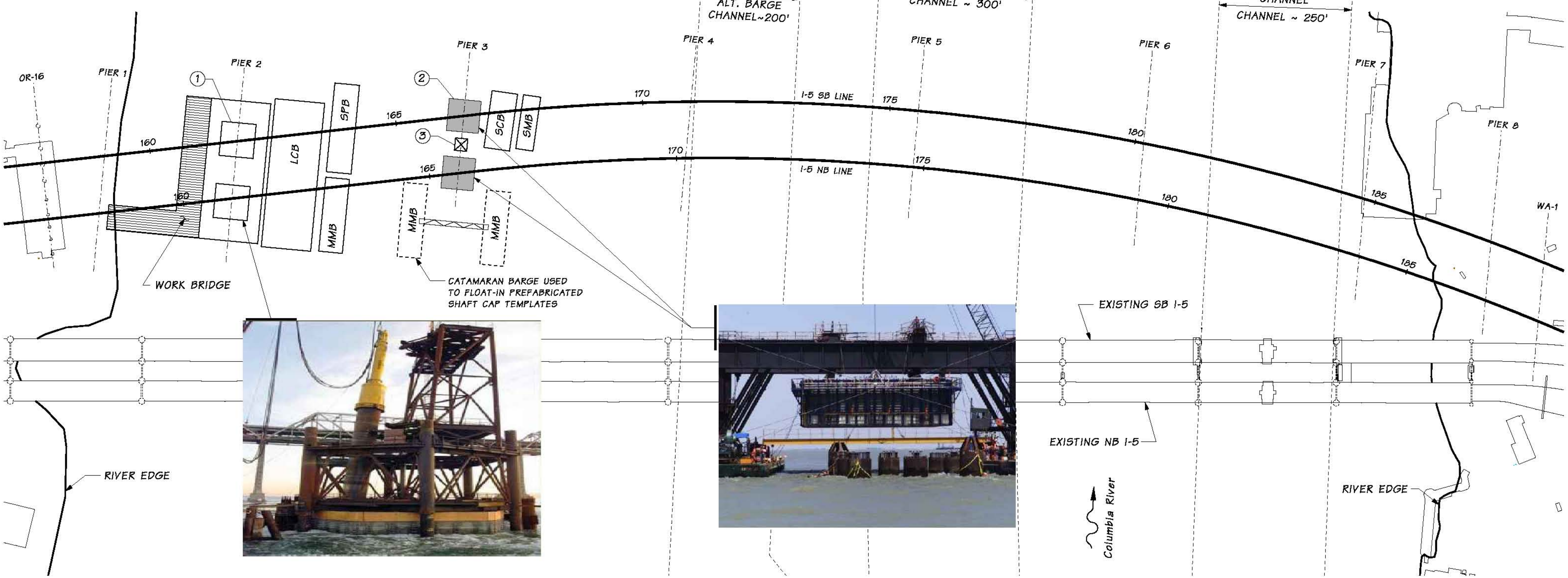
Columbia River CROSSING

$DATE$ 9:38:24 AM $FILEL$

DRAFT

CONSTRUCTION SEQUENCE:

1. INSTALL TEMPORARY WORKS AT PIER 2, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES.
2. FLOAT-IN PREFABRICATED SHAFT CAP AT PIER 3, CONSTRUCT NB AND SB SHAFT CAPS.
3. INSTALL TOWER CRANE AT PIER 3.



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LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 2

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-2.

CONCEPTUAL DESIGN

Columbia River CROSSING

$DATE$ 9:41:01 AM $FILEL$

CONSTRUCTION SEQUENCE:

1. CONSTRUCT SHAFT CAPS AT PIER 2 FOR NB AND SB STRUCTURES.
2. REMOVE COFFERDAM AND WORK BRIDGE AT PIER 2.
3. INSTALL TOWER CRANE AT PIER 2.
4. CONSTRUCT COLUMNS AND PIER TABLES AT PIER 3 FOR NB AND SB STRUCTURES.
5. INSTALL TEMPORARY WORKS AT PIER 4, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES.

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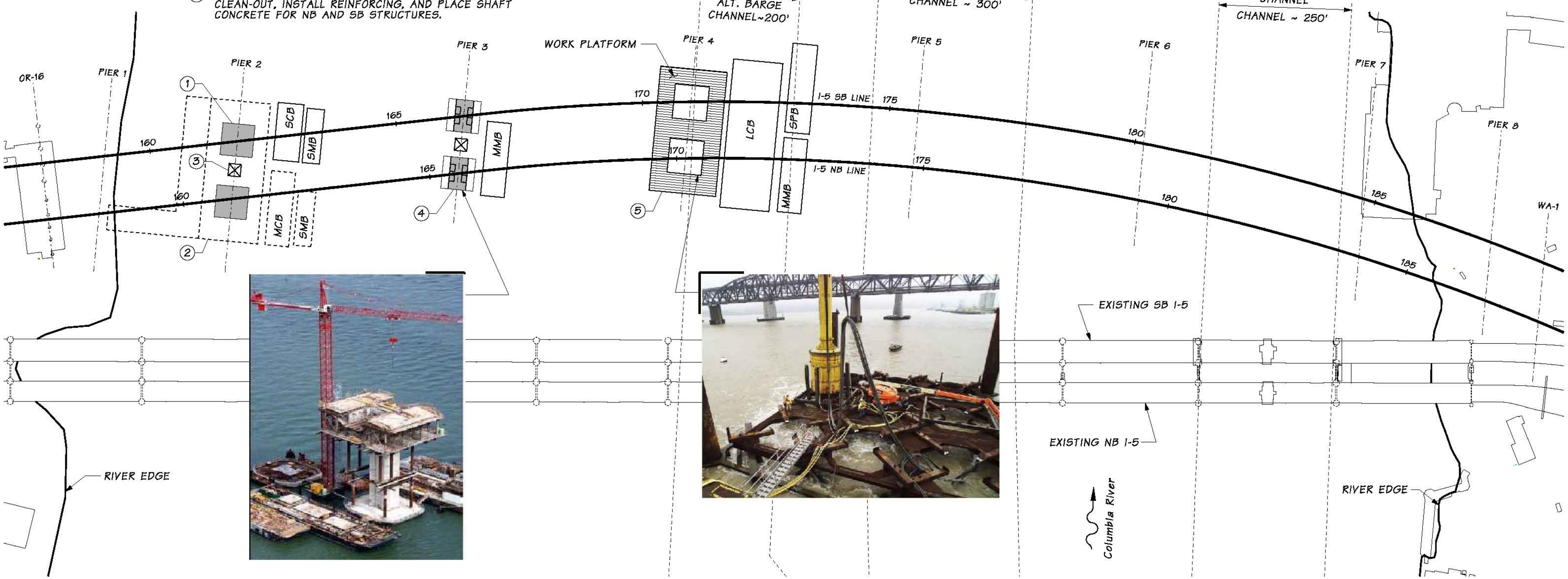

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SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 3

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-3.

CONCEPTUAL DESIGN

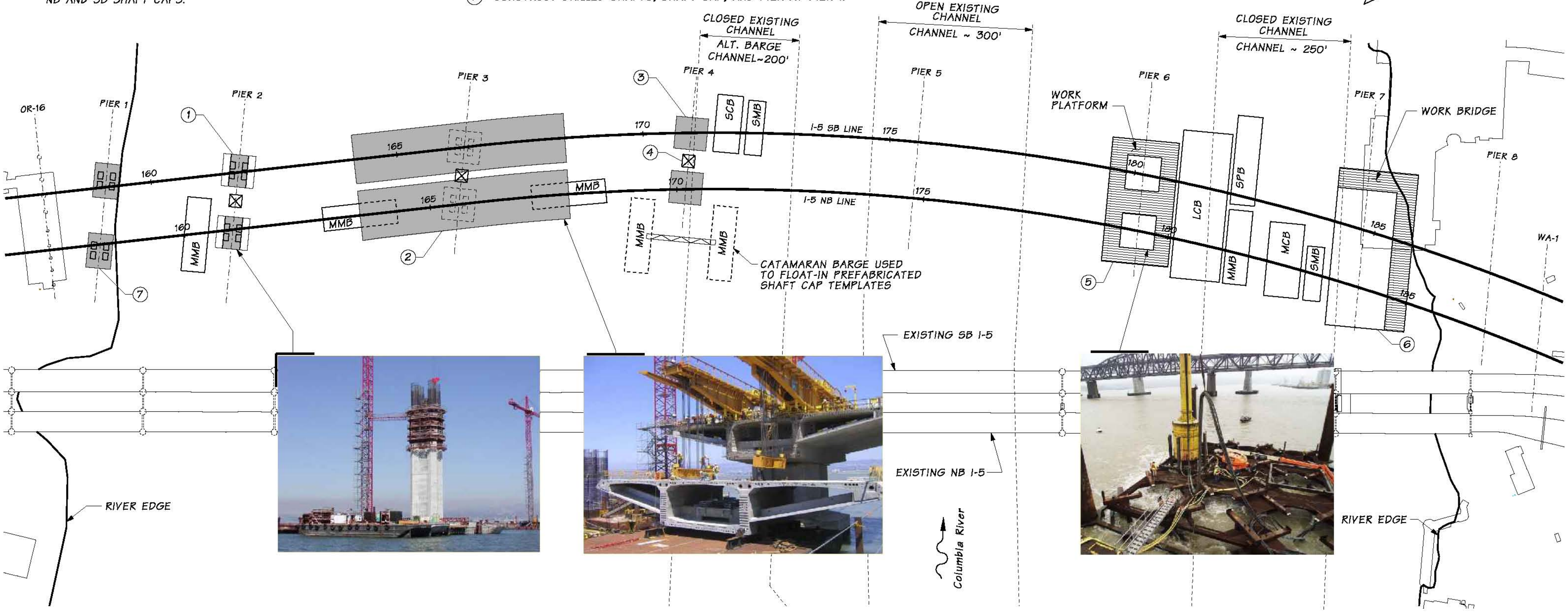
Columbia River CROSSING

$DATE$ 9:46:45 AM$FILEL$

DRAFT

CONSTRUCTION SEQUENCE:

1. CONSTRUCT COLUMNS AND PIER TABLES AT PIER 2 FOR NB AND SB STRUCTURES.
2. ERECT BALANCED CANTILEVERS AT PIER 3 FOR NB AND SB STRUCTURES.
3. FLOAT-IN PREFABRICATED SHAFT CAP AT PIER 4, CONSTRUCT NB AND SB SHAFT CAPS.
4. ERECT TOWER CRANE AT PIER 4.
5. INSTALL TEMPORARY WORKS AT PIER 6, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES.
6. INSTALL COFFERDAM AND WORKBRIDGE AT PIER 7 FOR CONSTRUCTION OF NB AND SB PILECAPS.
7. CONSTRUCT DRILLED SHAFTS, SHAFT CAP, AND PIER AT PIER 1.



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MMB = MEDIUM MATERIAL BARGE, 150' LONG x 48' WIDE x 9.5' DEPTH
LCB = LARGE CRANE BARGE, 300' LONG x 100' WIDE x 18' DEPTH, ~ 700 TON CAPACITY
LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 4

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-4.

CONCEPTUAL DESIGN

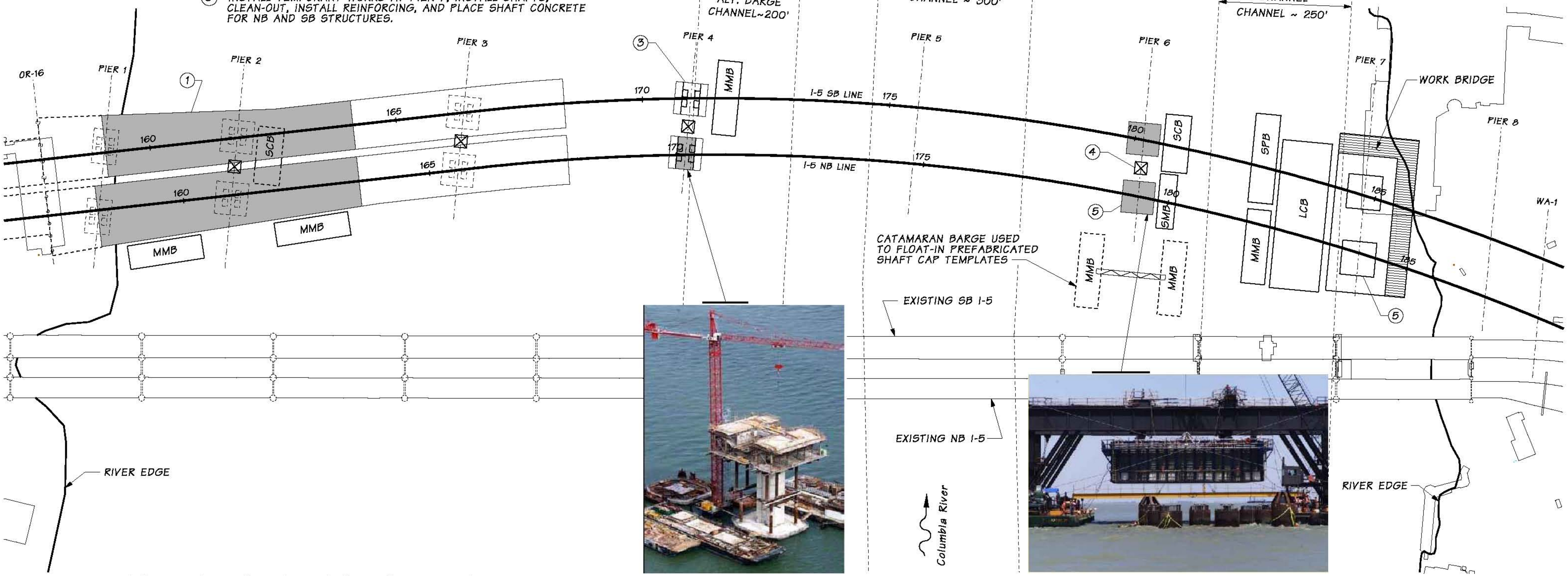
Columbia River CROSSING

$DATE$ 10:07:45 AM $FILE$

DRAFT

CONSTRUCTION SEQUENCE:

1. ERECT BALANCED CANTILEVERS AT PIER 2 FOR NB AND SB STRUCTURES.
2. CONSTRUCT COLUMNS AND PIERS TABLES AT PIER 4 FOR NB AND SB STRUCTURES.
3. FLOAT-IN PREFABRICATED SHAFT CAP AT PIER 6, CONSTRUCT NB AND SB SHAFT CAPS.
4. ERECT TOWER CRANE AT PIER 6.
5. INSTALL TEMPORARY WORKS AT PIER 7, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES.



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LCB = LARGE CRANE BARGE, 300' LONG x 100' WIDE x 18' DEPTH, ~ 700 TON CAPACITY
LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 5

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-5.

CONCEPTUAL DESIGN

Columbia River CROSSING

$DATE$ 10:10:03 A$FILEL$

CONSTRUCTION SEQUENCE:

1. ERECT BALANCED CANTILEVERS AT PIER 4 FOR NB AND SB STRUCTURES.
2. CAST MIDSPAN CLOSURE BETWEEN PIERS 3 AND 4 FOR NB AND SB STRUCTURES.
3. CONSTRUCT COLUMNS AND PIER TABLES AT PIER 6 FOR NB AND SB STRUCTURES.
4. CONSTRUCT SHAFT CAPS AT PIER 7 FOR NB AND SB STRUCTURES.
5. REMOVE COFFERDAM AND WORK BRIDGE AT PIER 7.
6. INSTALL TEMPORARY WORKS AT PIER 5, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES.
7. INSTALL TOWER CRANE AT PIER 7.

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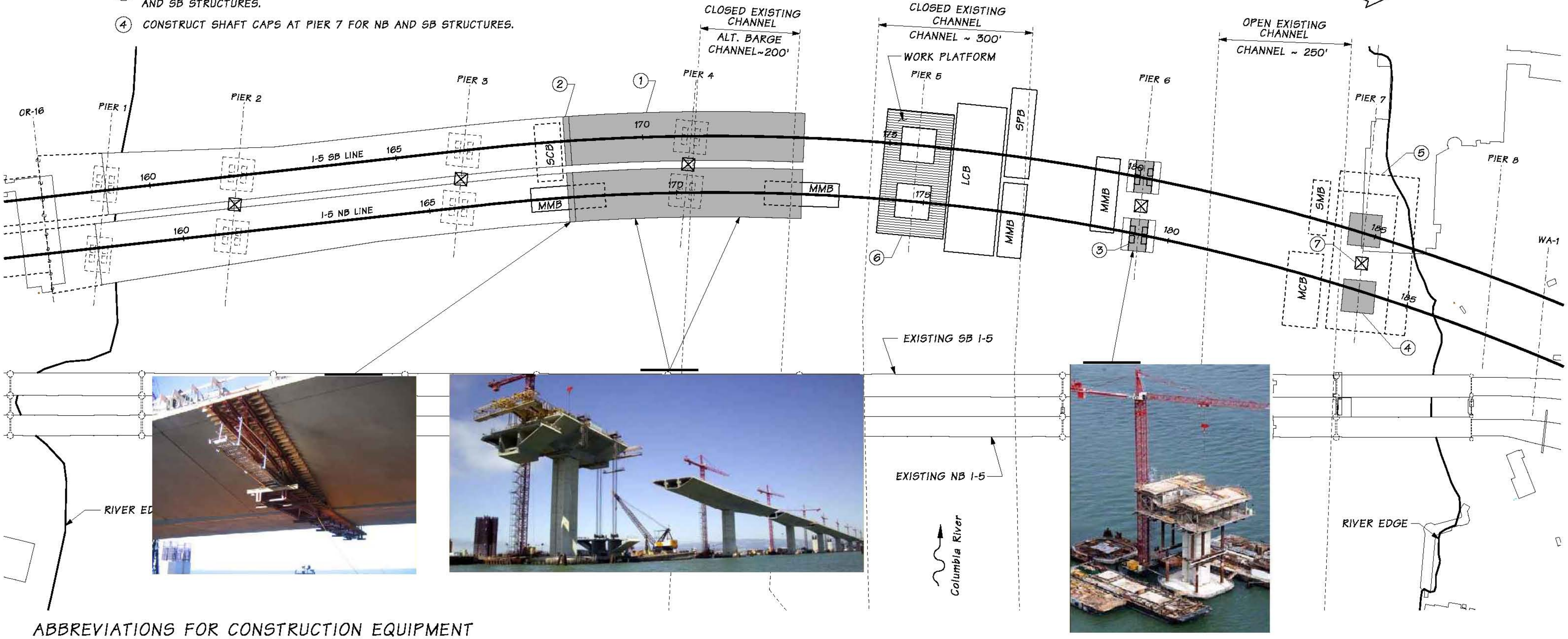

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LCB = LARGE CRANE BARGE, 300' LONG x 100' WIDE x 18' DEPTH, ~ 700 TON CAPACITY
LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 6

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-6.

CONCEPTUAL DESIGN

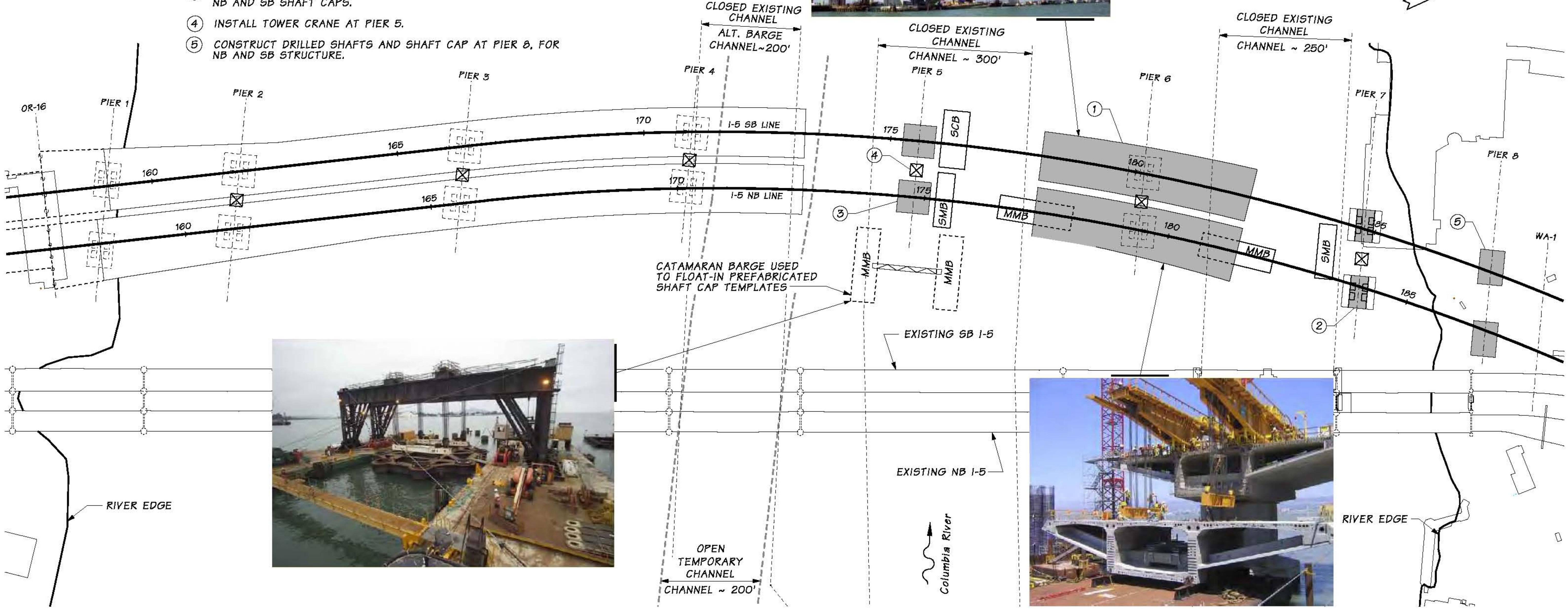
Columbia River CROSSING

$DATE$ 10:13:24 AM $FILE$

DRAFT

CONSTRUCTION SEQUENCE:

1. ERECT BALANCED CANTILEVERS AT PIER 6 FOR NB AND SB STRUCTUES.
2. CONSTRUCT COLUMNS AND PIERS TABLES AT PIER 7 FOR NB AND SB STRUCTURES.
3. FLOAT-IN PREFABRICATED SHAFT CAP AT PIER 5, CONSTRUCT NB AND SB SHAFT CAPS.
4. INSTALL TOWER CRANE AT PIER 5.
5. CONSTRUCT DRILLED SHAFTS AND SHAFT CAP AT PIER 8, FOR NB AND SB STRUCTURE.



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LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 7

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-7.

CONCEPTUAL DESIGN

Columbia River CROSSING

$DATE$ 3:44:00 PM $FILE$

CONSTRUCTION SEQUENCE:

1. CONSTRUCT COLUMNS AND BENT CAPS AT PIER 8 FOR NB AND SB STRUCTURE USING A LAND-BASED CRANE.
2. CONSTRUCT COLUMNS AND PIER TABLES AT PIER 5 FOR NB AND SB STRUCTURES.
3. ERECT BALANCED CANTILEVERS AT PIER 7 FOR NB AND SB STRUCTURES.
4. CAST MIDSPAN CLOSURE BETWEEN PIERS 6 AND 7 FOR NB AND SB STRUCTURE.

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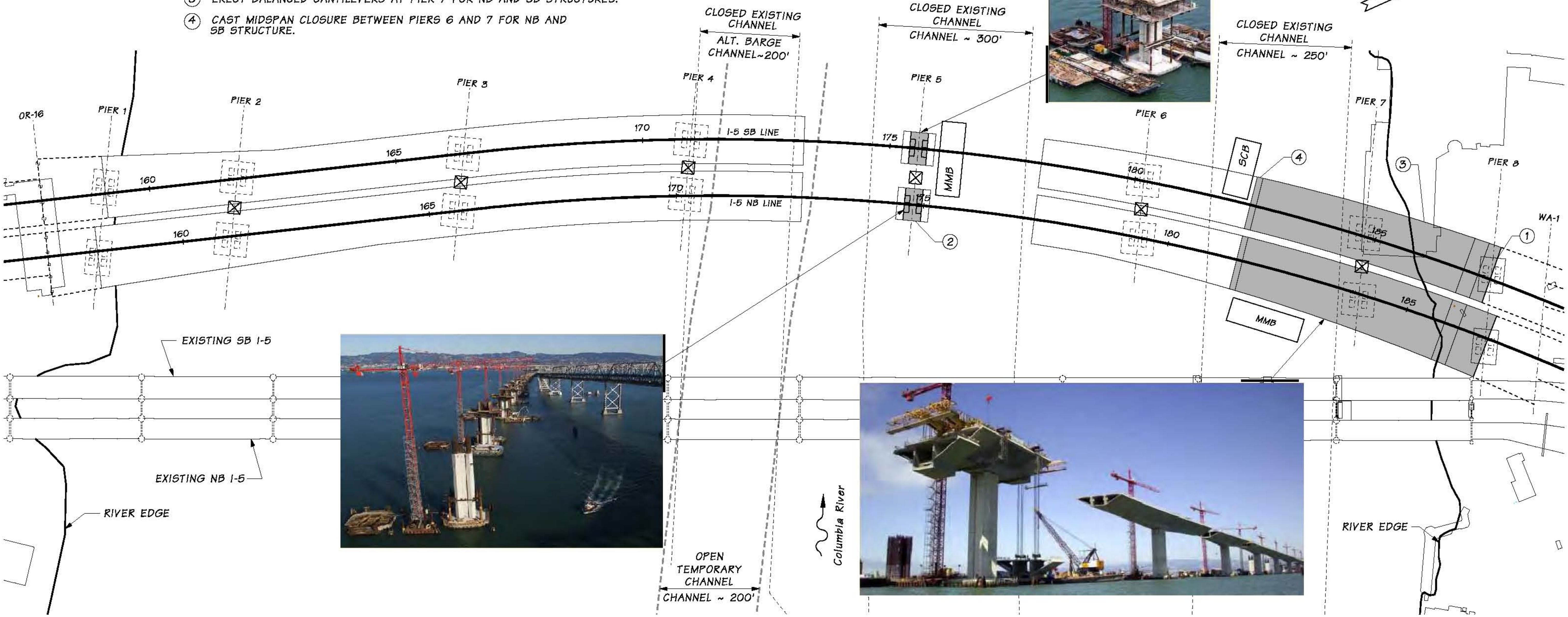

ABBREVIATIONS FOR CONSTRUCTION EQUIPMENT

SCB = SMALL CRANE BARGE, 116' LONG x 52' WIDE x 10' DEPTH, ~ 165 TON CAPACITY
SMB = SMALL MATERIAL BARGE, 110' LONG x 35' WIDE x 8' DEPTH
MCB = MEDIUM CRANE BARGE, 150' LONG x 70' WIDE x 12.5' DEPTH, ~ 300 TON CAPACITY
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LMB = LARGE MATERIAL BARGE, 164' LONG x 50' WIDE x 13.5' DEPTH
SPB = SPOILS BARGE, 180' LONG x 50' WIDE x 16' DEPTH
CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 8

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-8.

CONCEPTUAL DESIGN

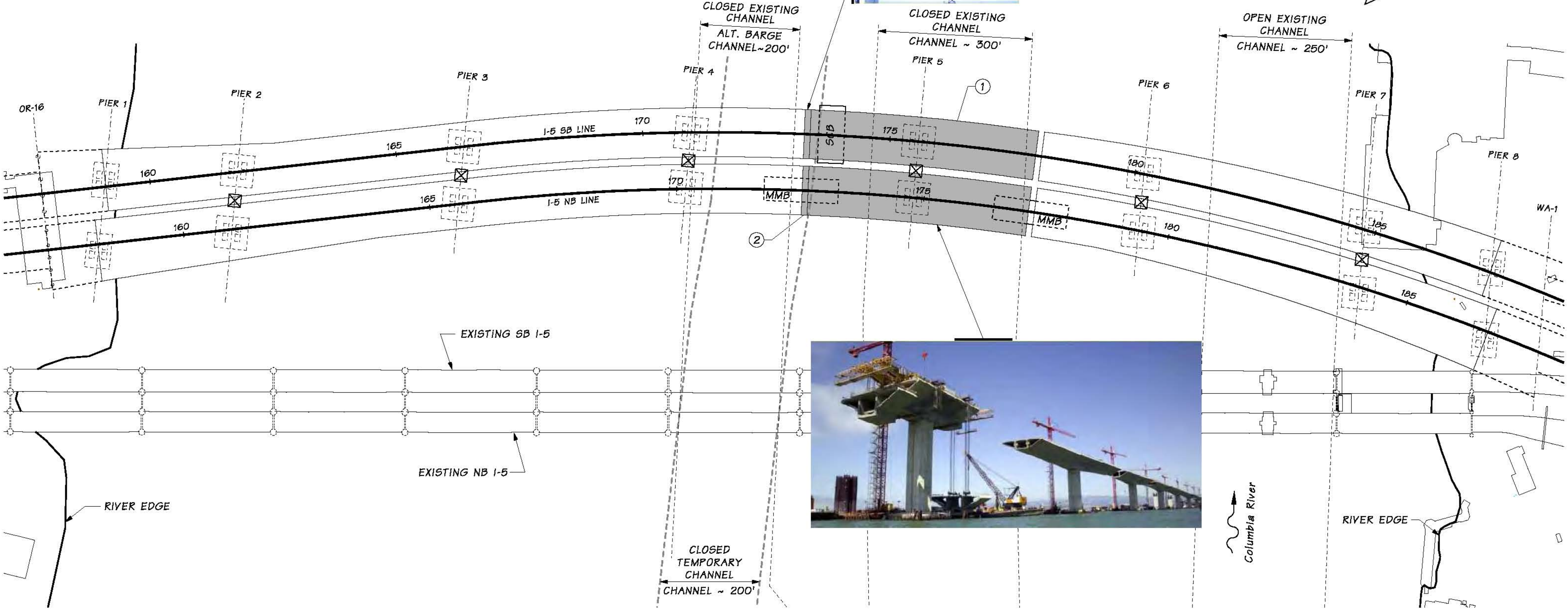
Columbia River CROSSING

$DATE$ 10:13:00 AM$FILE$

DRAFT

CONSTRUCTION SEQUENCE:

1. ERECT BALANCED CANTILEVERS AT PIER 5 FOR NB AND SB STRUCTURES.
2. CAST MIDSPAN CLOSURE BETWEEN PIERS 4 AND 5 FOR NB AND SB STRUCTURES.



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CATB = CATAMARAN BARGE WITH LIFTING FRAME, 2 EA MMB FIXED 120' APART BY LIFTING FRAME

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 9

COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-9.

CONCEPTUAL DESIGN

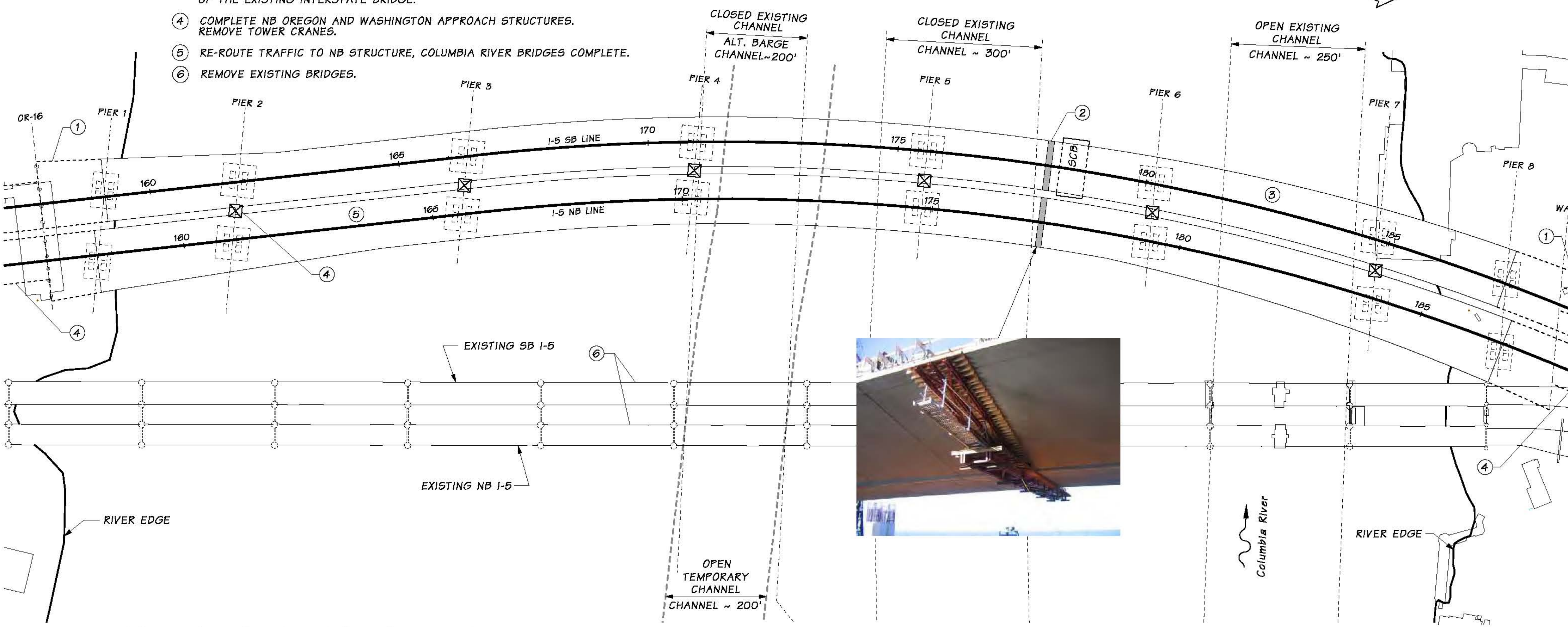
Columbia River
CROSSING

$DATE$ 10:16:50 AM$FILEL$

CONSTRUCTION SEQUENCE:

1. COMPLETE SB OREGON AND WASHINGTON APPROACH STRUCTURES.
2. CAST MIDSPAN CLOSURE BETWEEN PIERS 5 AND 6 FOR NB AND SB STRUCTURES.
3. RE-ROUTE TRAFFIC TO SB STRUCTURE TO BEGIN DEMOLITION OF THE EXISTING INTERSTATE BRIDGE.
4. COMPLETE NB OREGON AND WASHINGTON APPROACH STRUCTURES. REMOVE TOWER CRANES.
5. RE-ROUTE TRAFFIC TO NB STRUCTURE, COLUMBIA RIVER BRIDGES COMPLETE.
6. REMOVE EXISTING BRIDGES.

DRAFT



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CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE 10

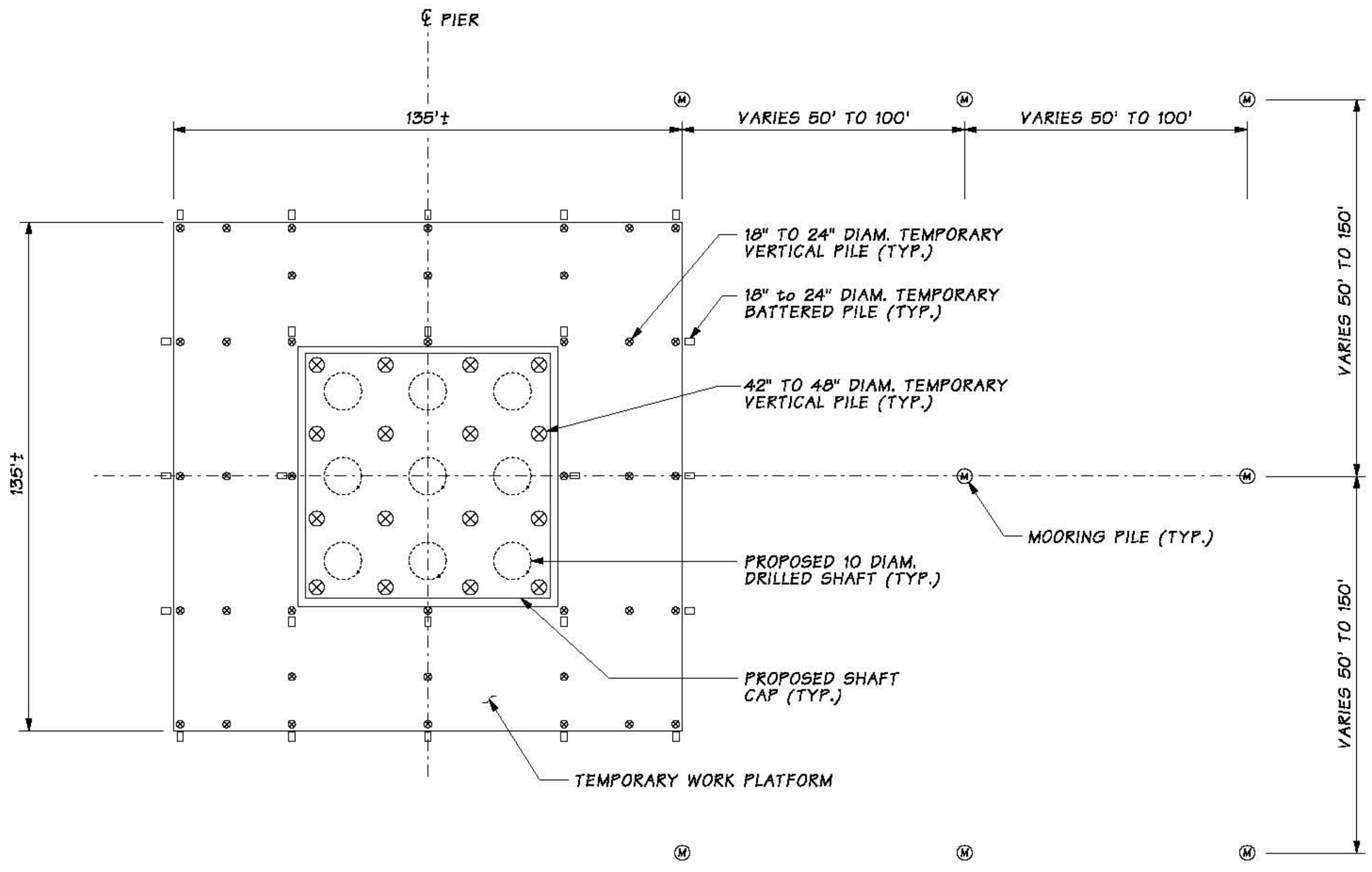
COLUMBIA RIVER BRIDGE
CONSTRUCTION SEQUENCE

Figure A-10.

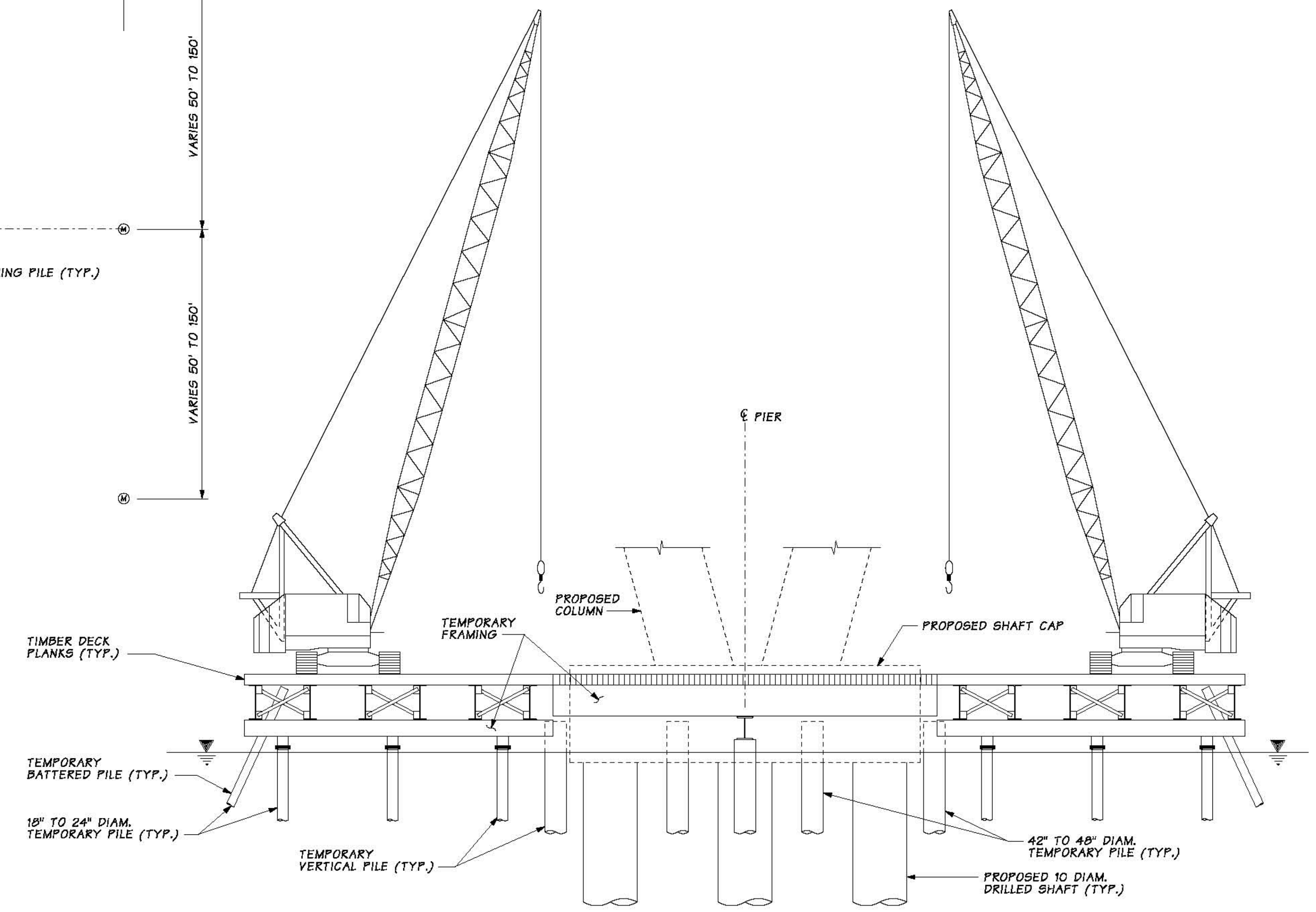
CONCEPTUAL DESIGN

Columbia River CROSSING

$DATE$ 3:50:34 PM $FILE$



PLAN



ELEVATION

CONCEPTUAL

NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

CONCEPTUAL TEMPORARY WORKS

CONCEPT - I

Figure A-11.

CONCEPTUAL DESIGN

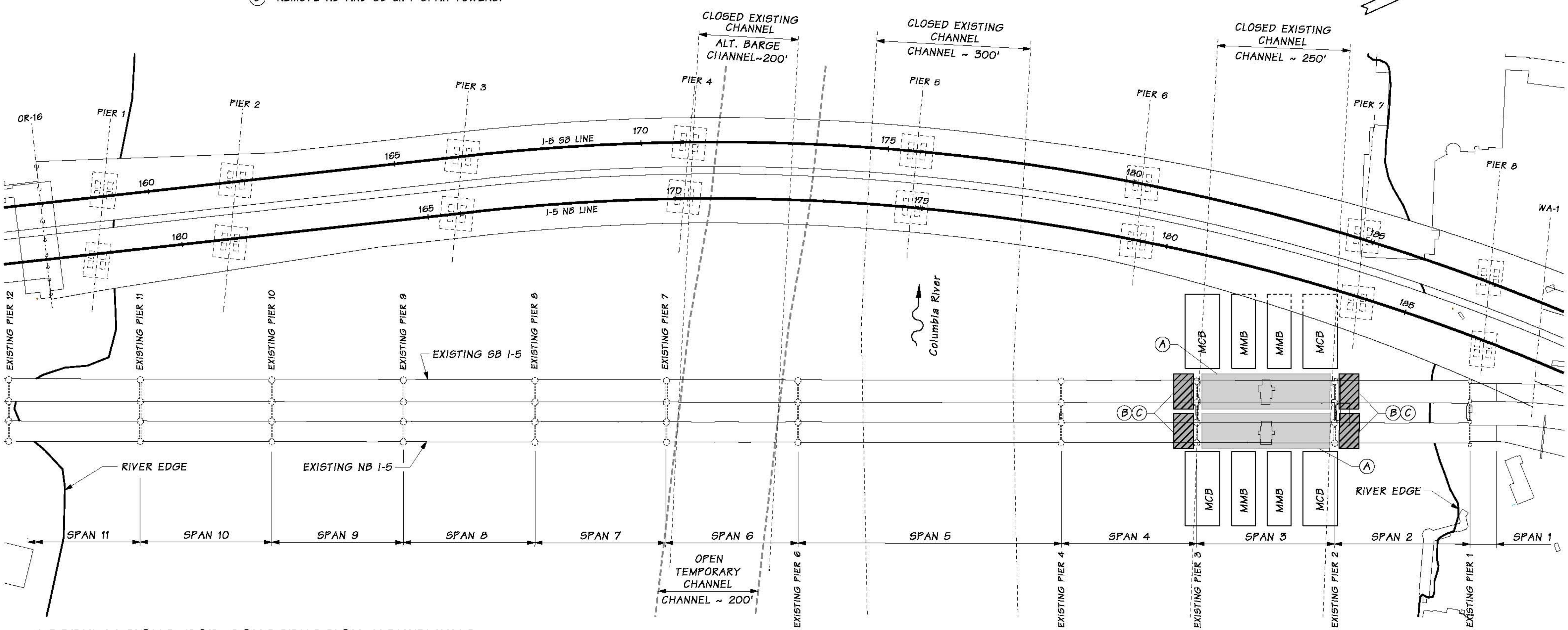
Columbia River CROSSING

$DATE$ 3:52:48 PM $FILEL$

DRAFT

DEMOLITION SEQUENCE:

- (A) LOCK NB AND SB LIFT SPAN 3.
- (B) LOWER AND REMOVE COUNTERWEIGHTS.
- (C) REMOVE NB AND SB LIFT SPAN TOWERS.



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CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

KEY:
- WORK BEING COMPLETED AT ELEMENT.
- FULL REMOVAL (DEMOLITION) OF ELEMENT.

PHASE A

INTERSTATE BRIDGE
DEMOLITION SEQUENCE

CONCEPTUAL DESIGN

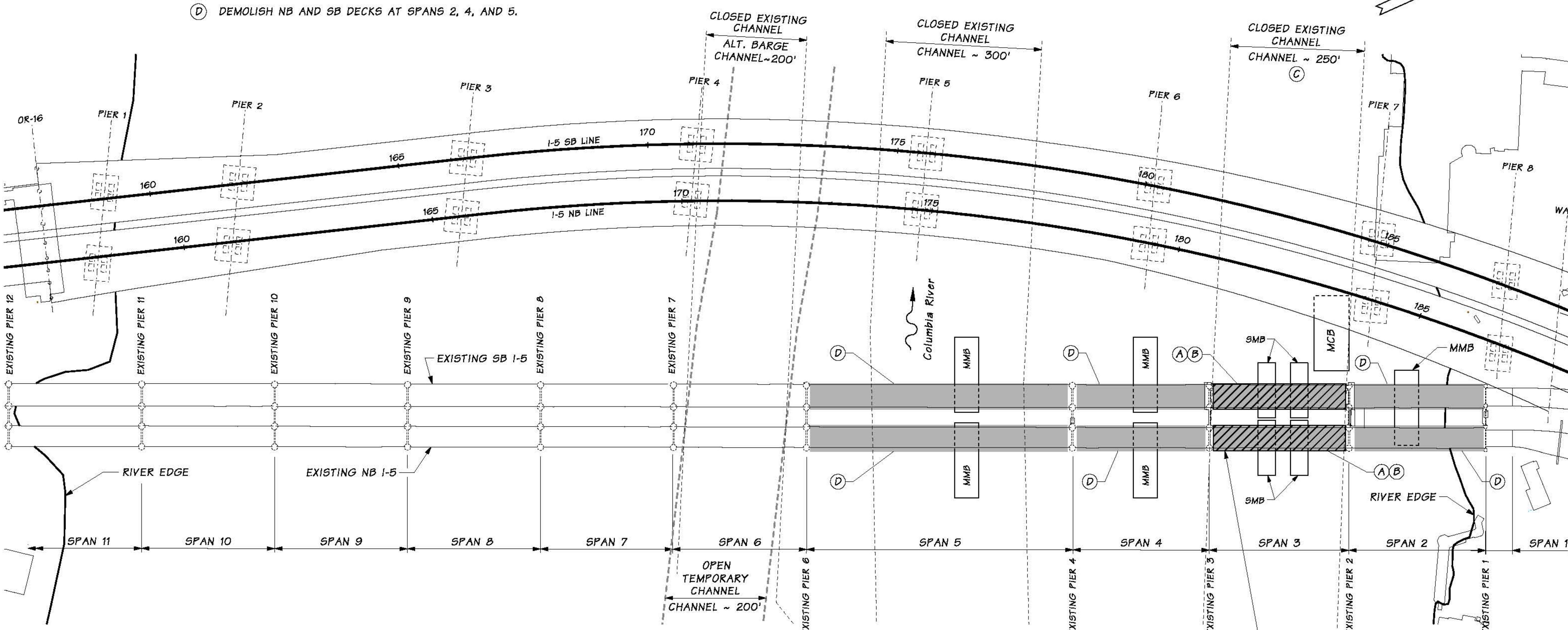
Figure A-12.

Columbia River CROSSING

$DATE$ 10:19:32 AM $FILEL$

DEMOLITION SEQUENCE:

- (A) DEMOLISH NS AND SB DECKS AT SPAN 3.
- (B) LIFT AND REMOVE NB AND SB SPAN 3 VIA BARGE.
- (C) OPEN PRIMARY CHANNEL.
- (D) DEMOLISH NB AND SB DECKS AT SPANS 2, 4, AND 5.



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CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE B

KEY:
- WORK BEING COMPLETED AT ELEMENT.
- FULL REMOVAL (DEMOLITION) OF ELEMENT.

INTERSTATE BRIDGE DEMOLITION SEQUENCE

Figure A-13.

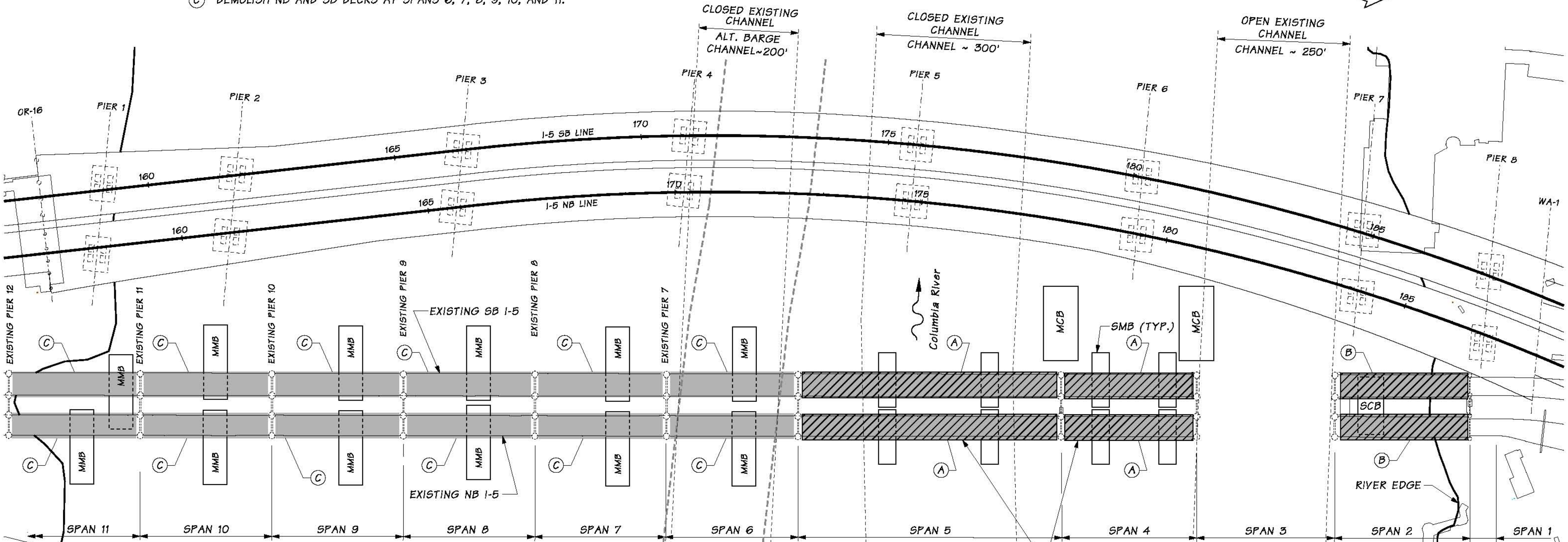
CONCEPTUAL DESIGN

Columbia River CROSSING

DRAFT

DEMOLITION SEQUENCE:

- (A) LIFT AND REMOVE NB AND SB SPANS 4 AND 5 VIA BARGE.
- (B) DEMOLISH NB AND SB SPAN 2 USING LAND-BASED CRANE.
- (C) DEMOLISH NB AND SB DECKS AT SPANS 6, 7, 8, 9, 10, AND 11.



PHASE C

ABBREVIATIONS FOR CONSTRUCTION EQUIPMENT

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CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

KEY:
- WORK BEING COMPLETED AT ELEMENT.
- FULL REMOVAL (DEMOLITION) OF ELEMENT.

INTRSTATE BRIDGE DEMOLITION SEQUENCE

Figure A-14.

CONCEPTUAL DESIGN

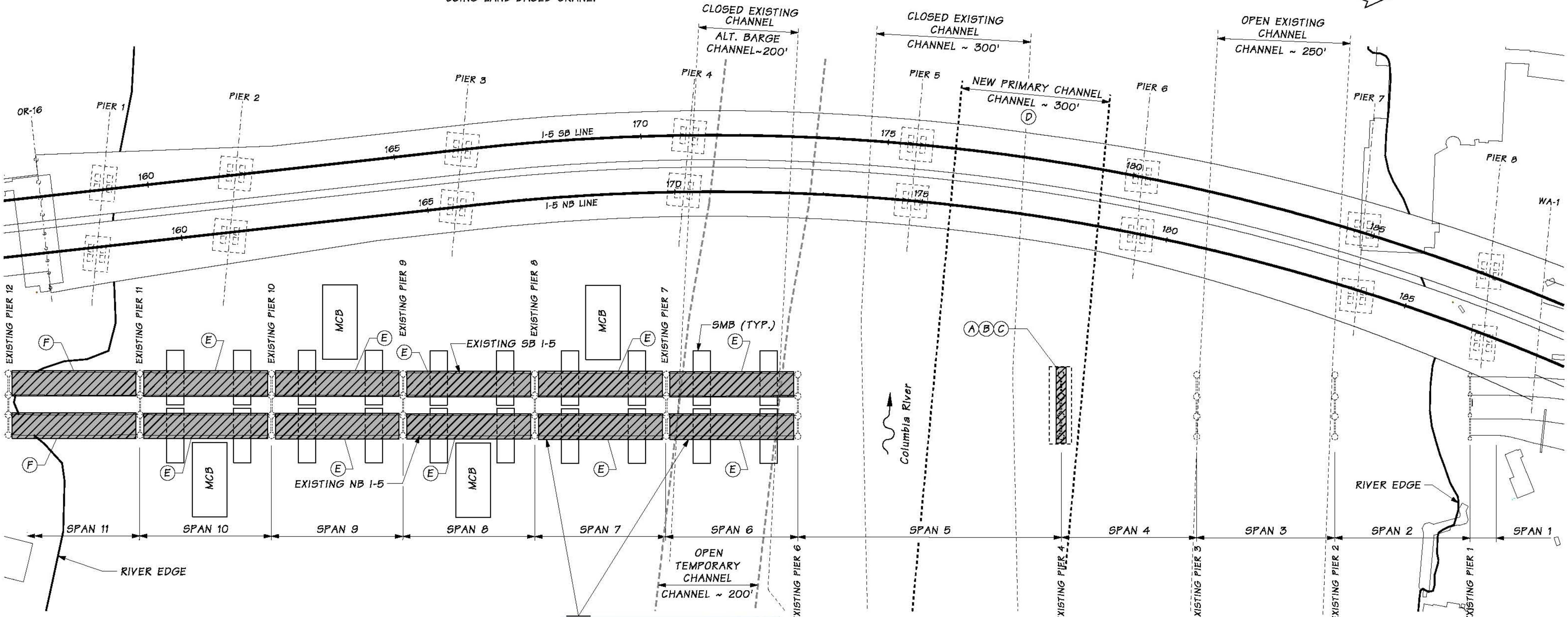
Columbia River CROSSING

$DATE$ 10:25:13 A$FILEL$

DRAFT

DEMOLITION SEQUENCE:

- (A) INSTALL COFFERDAM AT PIER 4 FOR REMOVAL OF PIER.
- (B) WIRE CUT AND REMOVE PIER 4, CUT-OFF PILES.
- (C) REMOVE COFFERDAM AT PIER 4.
- (D) OPEN NEW PRIMARY CHANNEL.
- (E) LIFT AND REMOVE VIA BARGE NB AND SB SPANS 6, 7, 8, 9, AND 10.
- (F) DEMOLISH NB AND SB SPAN 11 USING LAND-BASED CRANE.



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PHASE D

CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

KEY:

- WORK BEING COMPLETED AT ELEMENT.
- FULL REMOVAL (DEMOLITION) OF ELEMENT.

CONCEPTUAL DESIGN

INTERSTATE BRIDGE
DEMOLITION SEQUENCE

Figure A-15.

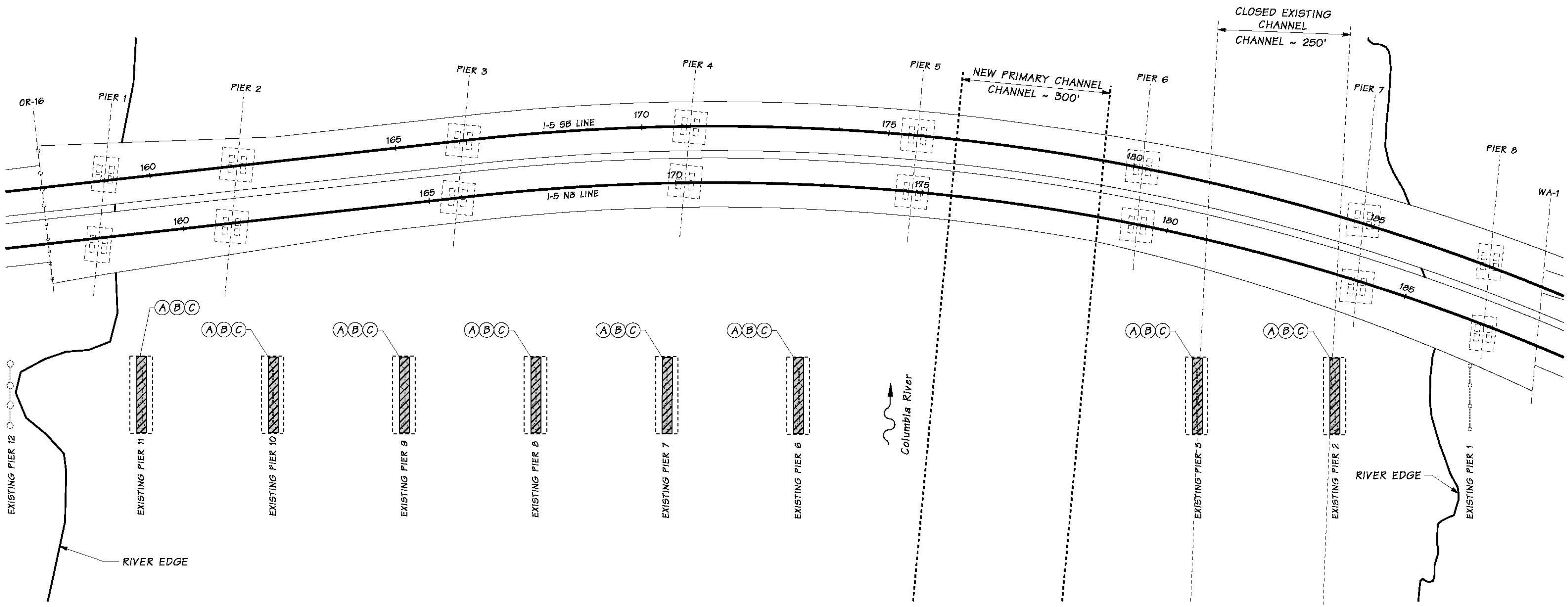
Columbia River CROSSING

$DATE$ 10:38:08 AM $FILEL$

DRAFT

DEMOLITION SEQUENCE:

- (A) INSTALL COFFERDAM AT PIERS 3, 2, 6, 7, 8, 9, 10, AND 11.
- (B) WIRE CUT AND REMOVE PIERS 3, 2, 6, 7, 8, 9, 10, AND 11.
- (C) REMOVE COFFERDAM AT PIERS 3, 2, 6, 7, 8, 9, 10, AND 11.



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CONCEPTUAL
NOT FOR CONSTRUCTION
NOVEMBER 11, 2009

PHASE E

KEY:
FULL REMOVAL (DEMOLITION) OF ELEMENT.

INTERSTATE BRIDGE
DEMOLITION SEQUENCE

Figure A-16.

CONCEPTUAL DESIGN
Columbia River CROSSING

$DATE$ 10:39:18 AM$FILEL$

APPENDIX B

Estimating Noise Levels and Hydroacoustic Area of Effect

Appendix B

Estimating Noise Levels and Hydroacoustic Area of Effect

Pile Driving

The extent of project-generated noise both in and over water was calculated for the locations where pile driving will occur in the Columbia River and North Portland Harbor. The extent of underwater noise was modeled for several pile driving scenarios:

- For two sizes of pile: 18- to 24-inch pile and 36- to 48-inch pile.
- For single impact pile drivers operating both with and without an attenuation device. Use of an attenuation device was assumed to decrease initial SPLs by 10 dB, as outlined in the CRC project BA (Appendix K).
- For vibratory driving of pipe pile and sheet pile.

The extent of airborne noise was modeled for impact driving only.

Impact Pile Driving – Underwater Noise

The Practical Spreading Loss Model was used to calculate the distances from the source within which impact pile driving noise is likely to exceed the underwater injury and disturbance thresholds for seals and sea lions. This model is described in detail in the BA (Appendix K). This model assumes 4.5 dB of transmission loss with each doubling distance, per the following equation:

$$\text{Distance 1} = \text{Distance 0} \times 10^{(TL/15)}$$

Where Distance 1 is the distance from the pile for which SPLs are being calculated, Distance 0 is the distance from the pile for which there is a known decibel level (typically 10 meters from the pile), and TL (transmission loss) is the initial sound pressure level minus the relevant threshold level.

We estimated initial noise levels[1] as 201 dB RMS for 36- to 48-inch pile and 189 dB RMS for 18- to 24-inch pile (CRC project BA, Appendix K). For the smaller pile, the results indicate that noise levels will exceed the injury threshold within 2 meters from the pile when a noise attenuation device is in use and within 9 meters when no attenuation device is in use. Behavioral disturbance was estimated to occur within 185 meters of the pile when a noise attenuation device is in use and within 858 meters when no attenuation device is in use (Table B-1 and Figures B-1 and B-2).

[1] All underwater noise levels are referenced 1 µPa.

Table B-1. Distance to Underwater Noise Thresholds from Source – Impact Driving of 18- to 24-inch Piles – Calculated Distances

Threshold	Distance Without Attenuation Device (meters)	Distance With Attenuation Device[a] (meters)
Injury: 190 dB_{RMS}	9	2
Disturbance: 160 dB_{RMS}	858	185

a Assumes 10 dB of noise attenuation.

For the larger pile, the model calculated that noise levels will exceed the injury threshold within 12 meters of the pile when a noise attenuation device is in use and within 54 meters when no attenuation device is in use. Behavioral disturbance was estimated to occur within 1,166 meters of the pile when a noise attenuation device is in use and within 5,412 meters when no attenuation device is in use (Table B-2 and Figures B-3 and B-4).

Table B-2. Distance to Underwater Noise Thresholds from Source – Impact Driving of 36- to 48-inch Piles – Calculated Distances

Threshold	Distance Without Attenuation Device (meters)	Distance With Attenuation Device[a] (meters)
Injury: 190 dB_{RMS}	54	12
Disturbance: 160 dB_{RMS}	5,412	1,166

a Assumes 10 dB of noise attenuation.

Note that in both cases, the use of a noise attenuation device shrinks the distance at which noise exceeds the threshold by about 80 percent.

Table B-1 and Table B-2 show calculated distances, assuming a free field of spreading with no obstructions. In North Portland Harbor, noise will encounter landforms before reaching some of these calculated distances. Table B-3 shows noise attenuation to threshold levels during impact pile driving of 36- to 48-inch pile in North Portland Harbor, accounting for the distances at which noise will encounter landforms. For 18- to 24-inch pile in both water bodies, and for 36- to 48-inch pile in the Columbia River, the actual, site-specific distances are the same as the calculated distances (Table B-1 and Table B-2).

Table B-3. Distance to Underwater Noise Thresholds from Source for Impact Driving of 36- to 48-inch Pile in North Portland Harbor

Threshold	Distance Without Attenuation Device (meters)	Distance With Attenuation Device [a] (meters)
Injury: 190 dB_{RMS}	54	12
Disturbance: 160 dB_{RMS}		
Upstream	3,058	1,166
Downstream	5,412	1,166

a Assumes 10 dB of noise attenuation.

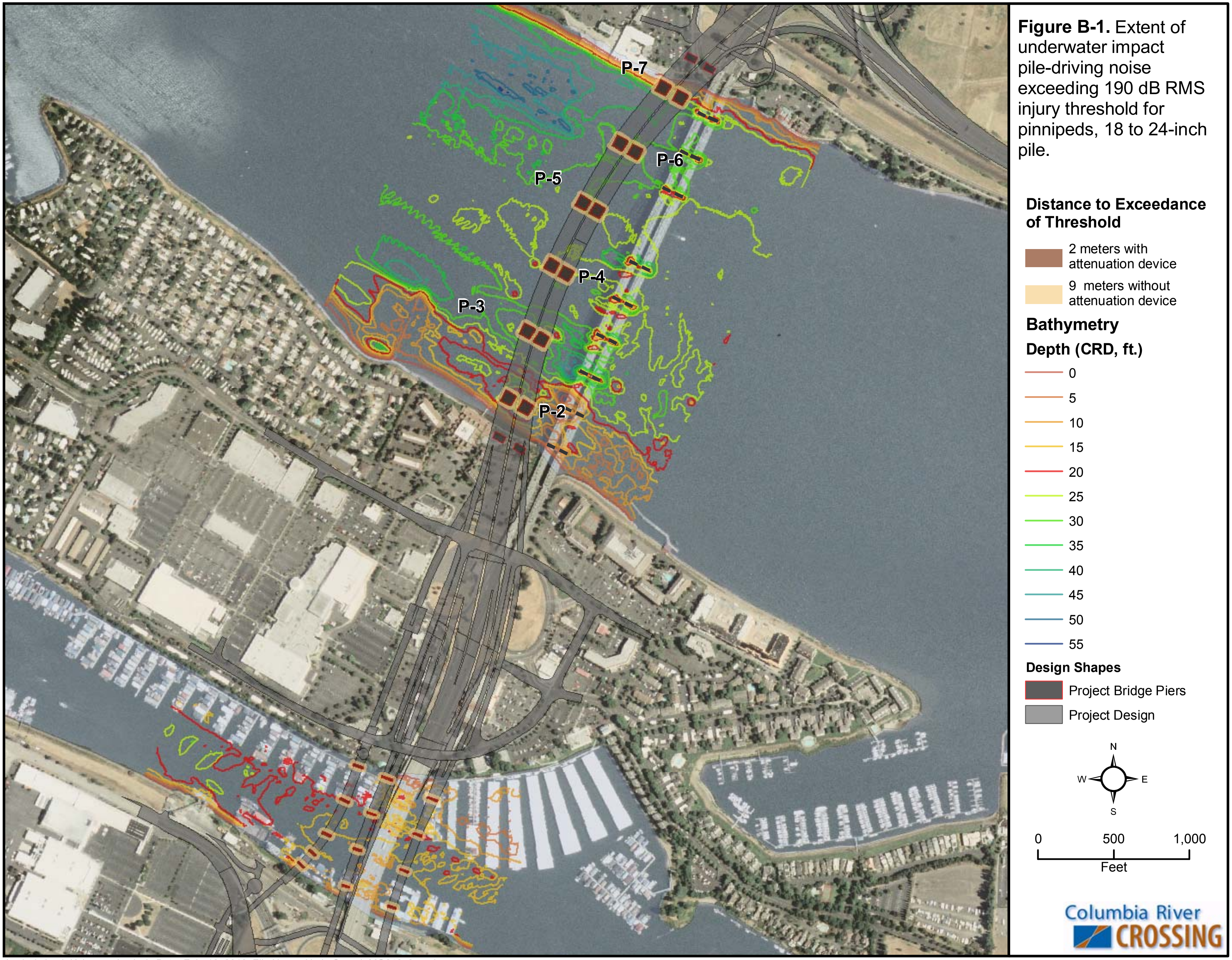

Figure B-1. Extent of underwater impact pile-driving noise exceeding 190 dB RMS injury threshold for pinnipeds, 18 to 24-inch pile.

Analysis by J. Koloszar; Analysis Date: Feb. 16, 2010: File Name: HydroSound_MG246_3.mxd

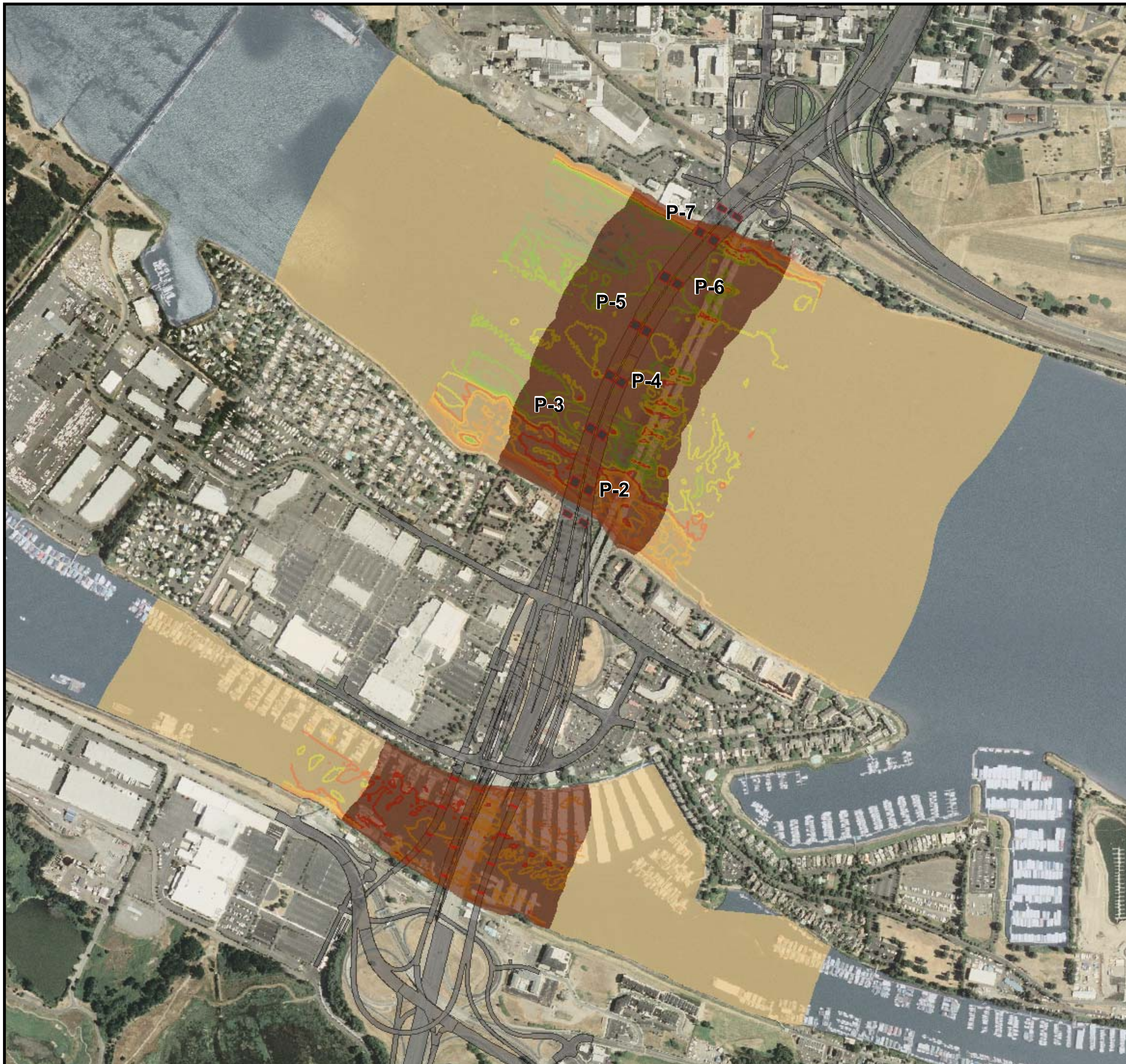

Figure B-2. Extent of underwater impact pile-driving noise exceeding 160 dB RMS injury threshold for pinnipeds, 18 to 24-inch pile.

Analysis by J. Koloszar; Analysis Date: Feb. 16, 2010: File Name: HydroSound_MG246_3.mxd

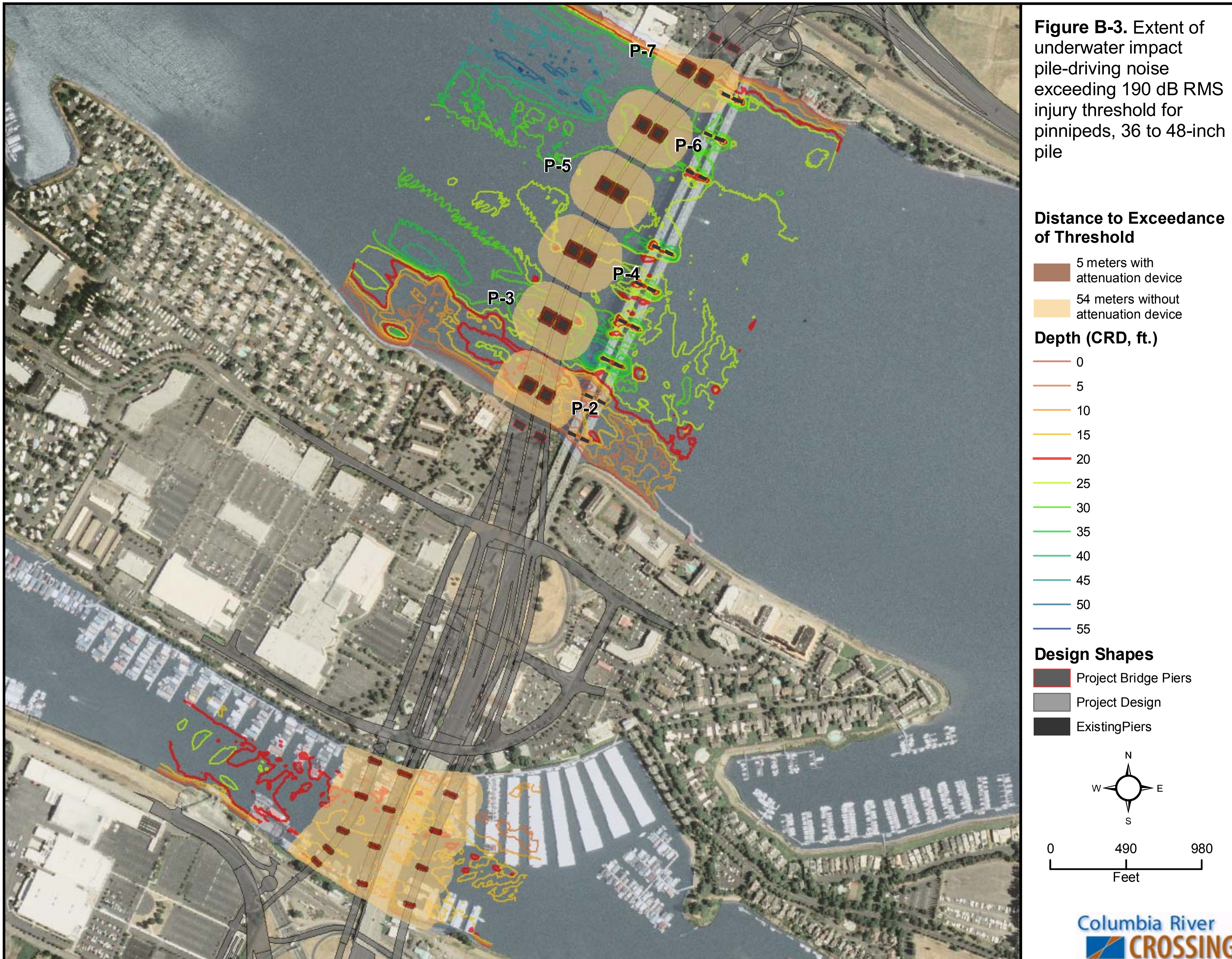

Figure B-3. Extent of underwater impact pile-driving noise exceeding 190 dB RMS injury threshold for pinnipeds, 36 to 48-inch pile

Analysis by J. Koloszar; Analysis Date: Feb. 16, 2010: File Name: HydroSound_MG246.mxd

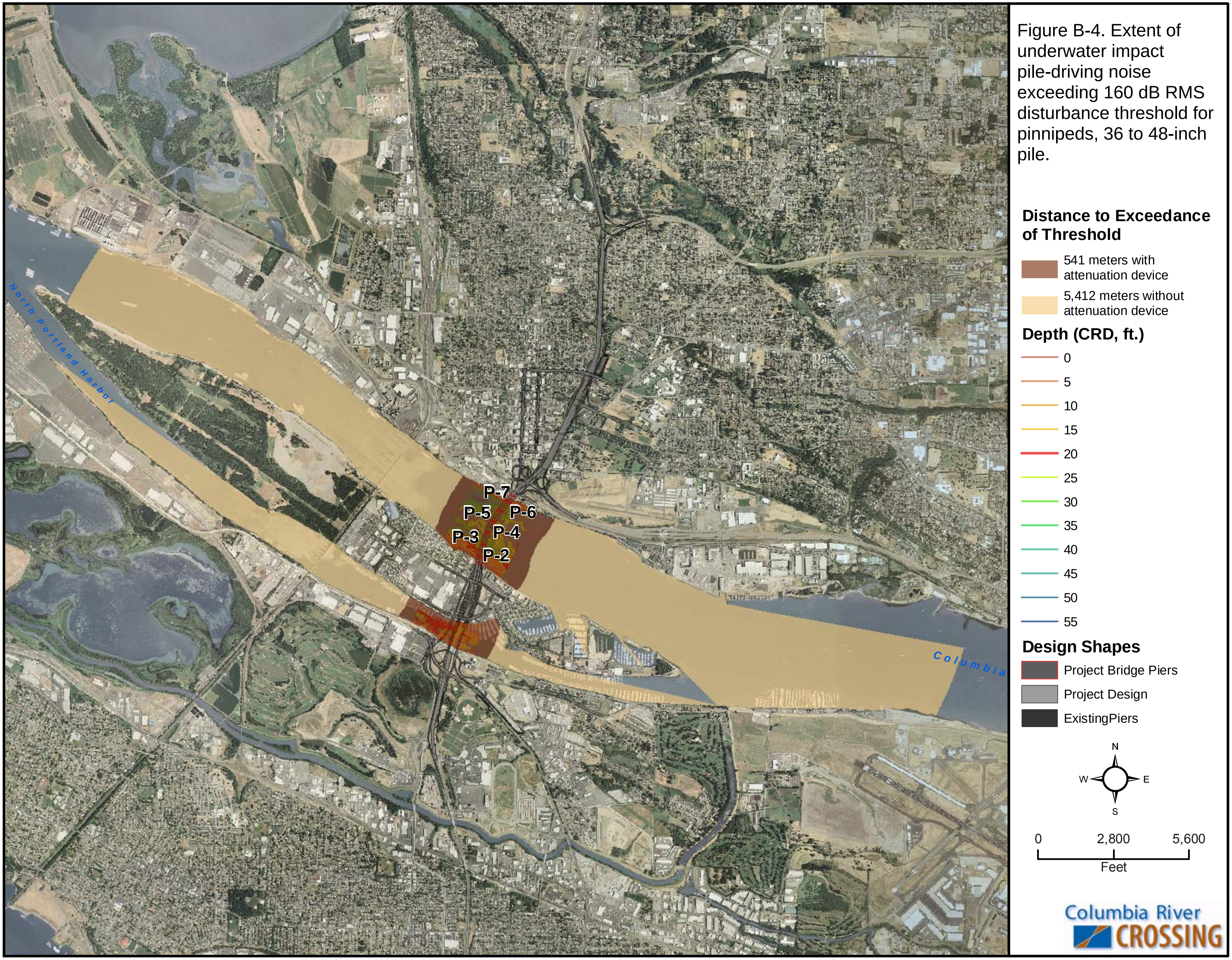

Figure B-4. Extent of underwater impact pile-driving noise exceeding 160 dB RMS disturbance threshold for pinnipeds, 36 to 48-inch pile.

Analysis by J. Koloszar; Analysis Date: Feb. 16, 2010: File Name: HydroSound_MG246.mxd

Vibratory Pile Driving – Underwater Noise

No studies were available that measured site-specific initial noise levels generated by vibratory pile driving in the Region of Activity. However, Table B-5 outlines a range of typical noise levels produced by vibratory pile driving as measured by Caltrans during hydroacoustic monitoring of several construction projects (Caltrans 2009).

Table B-5. Summary of Unattenuated Underwater Sound Pressures for Vibratory Pile Driving

Pile Type and Approximate Size	Water Depth	SPLs (dB RMS)*
0.30-meter (12-inch) steel H-type	<5 meters	150
0.30-meter (12-inch) steel pipe pile	<5 meters	155
1-meter (36-inch) steel pipe pile – typical	~5 meters	170
0.6-meter (24-inch) AZ steel sheet – typical	~15 meters	160
0.6-meter (24-inch) AZ steel sheet – loudest	~15 meters	165
1-meter (36-inch) steel pipe pile – loudest	~5 meters	175
1.8-meter (72-inch) steel pipe pile – typical	~5 meters	170
1.8-meter (72-inch) steel pipe pile – loudest	~5 meters	180

Source: Caltrans 2009, Appendix I.

* Impulse level (35 millisecond average).

We estimated a worst-case scenario of installing 48-inch steel pipe pile (the largest pile size to be used on the CRC project) at the loudest measured SPLs. Since there were no data for 48-inch pile, we assumed that noise levels for 48-inch pile would be intermediate between noise levels generated by 36-inch pile and 72-inch pile (Table B-5). Thus, we assumed that initial SPLs for vibratory driving of pipe pile would range from 175 to 180 dB RMS. Table B-6 shows the distances at which noise is expected to attenuate to the 120 dB RMS vibratory pile driving disturbance threshold, as per the Practical Spreading Model.

Table B-6. Distance to Underwater Noise Thresholds from Source for Vibratory Driving of Pipe Pile – Calculated Values

	Distance from Source (m)	
Estimated Noise Level (dB RMS)	Initial SPLs 175 dB RMS at 5 Meters	Initial SPLs 180 dB RMS at 5 Meters
120	23,208	50,000

Landforms in the Columbia River and North Portland Harbor will block underwater noise well before it reaches either of these distances. Table B-7 shows site-specific values for the maximum distance within which noise is likely to exceed ambient levels until contact with landforms (Figure B-5).

Table B-7. Distance to Underwater Noise Thresholds from Source for Vibratory Driving of Pipe Pile – Site-Specific Values

Water Body	Direction	Distance (m)
Columbia River	Upstream	20,166
	Downstream	8,851
North Portland Harbor	Upstream	3,058
	Downstream	5,632

The project may also install sheet pile in numerous locations in the Columbia River. In general, installation of sheet pile produces lower SPLs than pipe pile. Using the Practical Spreading Loss Model, assuming initial SPLs of 160 to 165 dB RMS at a distance of 15 meters (Table B-5), we estimated that noise from vibratory driving of sheet pile will likely attenuate to the 120 dB disturbance threshold at a distance of 6,962 to 15,000 meters from the source (Table B-8). In the Columbia River, noise will not attenuate to the threshold before encountering landforms, and therefore the site-specific values are the same as the calculated values (Figure B-5).

Table B-8. Distance to Underwater Noise Threshold for Vibratory Driving of Sheet Pile in the Columbia River

	Distance from Source (m)	
Estimated Noise Level (dB RMS)	**Initial SPLs 160 dB RMS at 15 Meters**	**Initial SPLs at 165 dB RMS at 15 Meters**
120	6,962	15,000

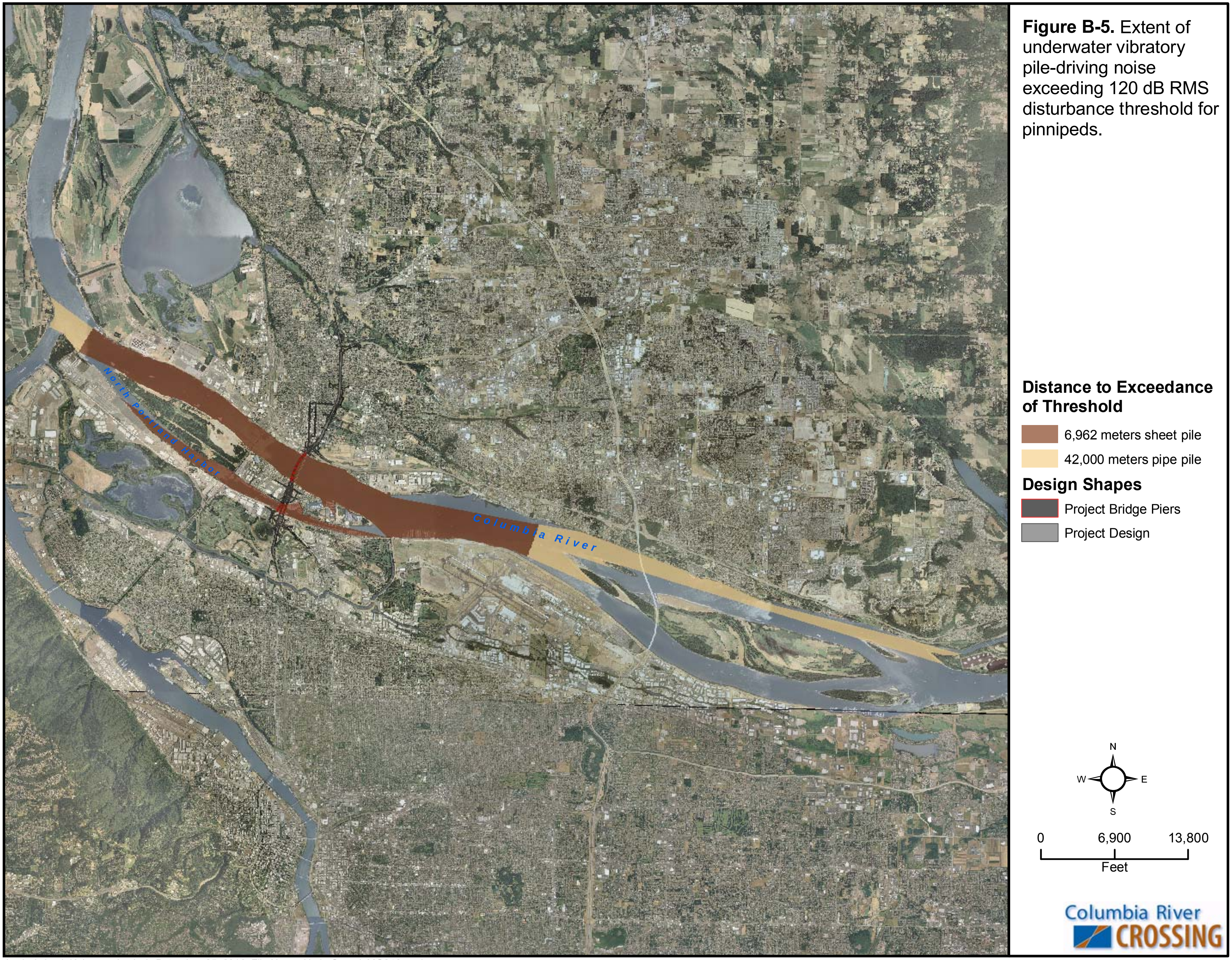

Figure B-5. Extent of underwater vibratory pile-driving noise exceeding 120 dB RMS disturbance threshold for pinnipeds.

Analysis by J. Koloszar; Analysis Date: Jan. 25, 2010: File Name: HydroSound_MG246.mxd

Airborne Noise

For calculating the levels and extent of project-generated airborne noise, we assumed a point noise source and hard-site conditions because pile drivers will be stationary, and work will largely occur over open water and adjacent to an urbanized landscape. Thus, calculations assumed that pile driving noise will attenuate at a rate of 6 dB per doubling distance, based on a spherical spreading model. The following formula was used to determine the distances at which pile-driving noise attenuates to the 90 dB RMS and 100 dB RMS airborne disturbance thresholds:

$$D_1 = D_0 * 10^{((\text{initial SPL} - \text{airborne disturbance threshold})/\alpha)}$$

where D_1 is the distance from the pile at which noise attenuates to the threshold value, D_0 is the distance from the pile at which the initial SPLs were measured, and α is the variable for soft-site or hard-site conditions. These calculations used α = 20 for hard-site conditions.

Our estimate of initial noise level is based on the results of noise monitoring performed by WSDOT during pile driving at Friday Harbor Ferry Terminal in the town of Friday Harbor, Washington (Laughlin 2005b). The results showed airborne RMS noise levels of 112 dB RMS re: 20 μPa taken at 160 feet from the source during impact pile driving. This project drove 24-inch steel pipe pile, which is only half the size of the largest pile proposed for use on the CRC project. However, airborne noise levels are independent of the size of the pile (Michael Minor 2009 personal communication), and therefore the noise levels encountered at Friday Harbor are applicable to the CRC project.

The model used 112 dB RMS at 48.8 meters (160 feet) from the source as the initial noise level for a single pile driver. Because multiple pile drivers will not strike piles synchronously, operation of multiple pile drivers will not generate noise louder than that of a single pile driver. Therefore, initial noise levels for multiple pile drivers were assumed to be the same as for a single pile driver.

The CRC project is not likely to use an airborne noise-attenuation device. Therefore, we did not model transmission of airborne noise with use of an airborne attenuation device.

Table B-9 shows that noise generated by impact pile driving in the Columbia River and North Portland Harbor is likely to exceed the 100 dB RMS airborne disturbance threshold within 195 meters of the source and is likely to exceed the 90 dB RMS airborne disturbance threshold within 650 meters of the source (Figure B-6).

Table B-9 Calculated Distance to NMFS In-air Disturbance Thresholds for Pinnipeds

Reference Level dB RMS	Airborne Pinniped Disturbance Threshold	
	Harbor Seal 90 dB RMS (unweighted)	All Other Pinniped Species 100 dB RMS (unweighted)
112 [1]	650 m (0.40 miles)	196 (0.12 miles)

Note: In-air Practical Spreading assumes 6 dB reduction per doubling of distance.

1 Measured at 49 meters from the pile.

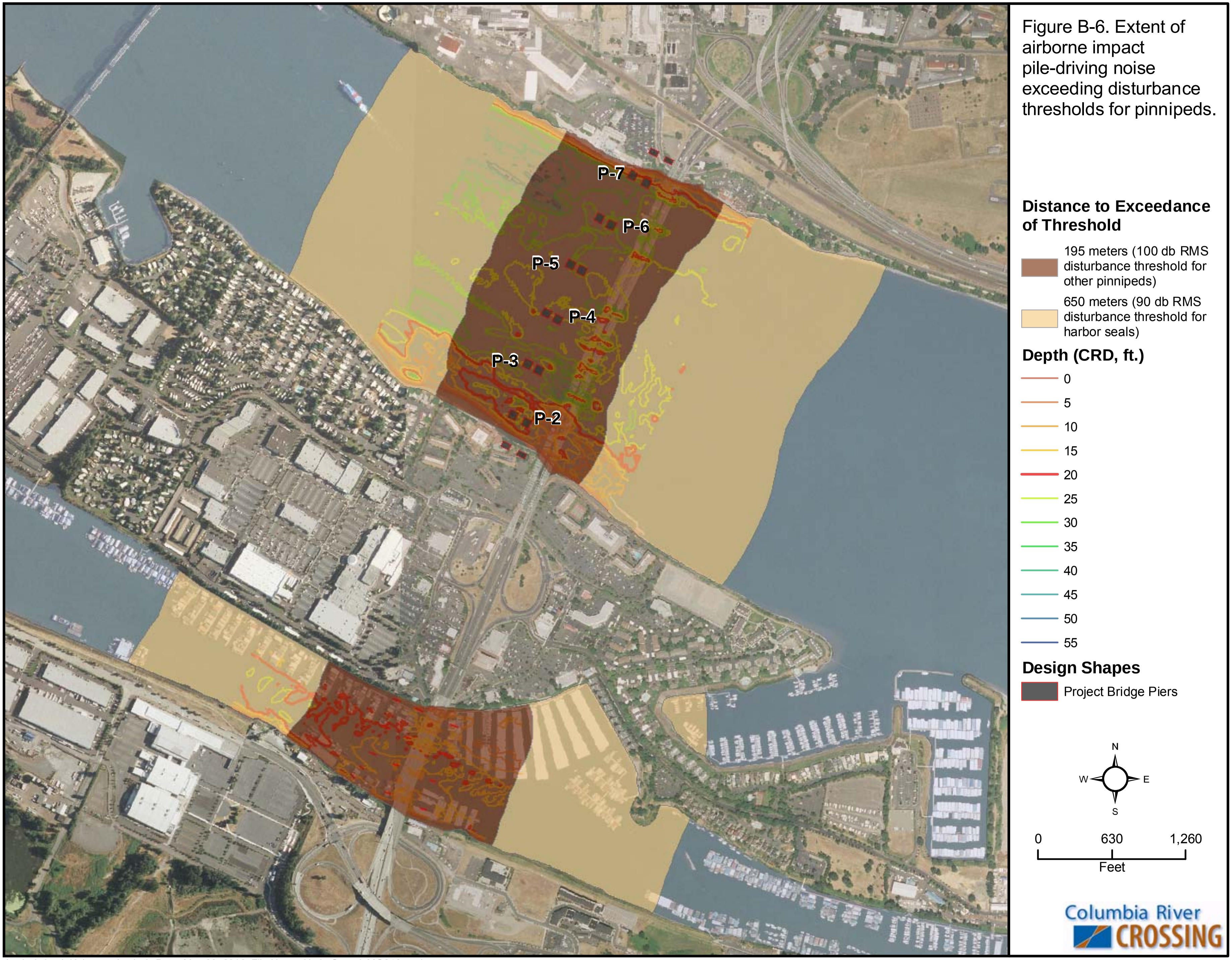

Figure B-6. Extent of airborne impact pile-driving noise exceeding disturbance thresholds for pinnipeds.

Analysis by J. Koloszar; Analysis Date: May 09, 2010: File Name: HydroSound_MG246.mxd

APPENDIX C

Potential Acoustic Effects to Pinnipeds from Pile Driving

Appendix C

Potential Acoustic Effects to Pinnipeds from Pile Driving

CRC project-generated noise, including impact and vibratory pile driving, may have impacts to seals and sea lions, which transit through the CRC project area. The following sections present background information about how seals and sea lions respond to noise, criteria for noise levels likely to cause injury or disturbance to seals and sea lions.

How Pinnipeds Respond to Noise

There are few studies that quantify reactions of pinnipeds to noise, and even fewer that have directly observed reactions of pinnipeds to pile-driving noise (Southall et al. 2007). Southall et al. (2007) performed a literature review of all known studies on the effects of noise on marine mammals. The review offers guidelines on how seals and sea lions exhibit behavioral effects, temporary hearing loss, and injury resulting from elevated levels of underwater and airborne noise.

Behavioral Effects

Behavioral response to sound is dependent on a number of site-specific characteristics, including the intensity of the noise source, the distance between the noise source and the individual, and the ambient noise levels at the site (Southall et al. 2007). Behavioral response is also highly dependent on the characteristics of the individual animal. Marine mammals that have been previously exposed to noise may become habituated, and therefore may be less sensitive to noise. Such animals are less likely to elicit a behavioral response.

Behavioral responses have been observed experimentally and have been determined to be highly variable. In some cases, marine mammals may detect a sound and exhibit no obvious behavioral responses. In other cases, marine mammals may exhibit minor behavioral responses, including annoyance, alertness, visual orientation towards the sound, investigation of the sound, change in movement pattern or direction, habituation, alteration of feeding and social interaction, and temporary or permanent avoidance of the area affected by sound. Minor behavioral responses do not necessarily cause long-term effects to the individuals involved. Severe responses include panic, immediate movement away from the sound, and stampeding, which could potentially lead to injury or mortality (Southall et al. 2007).

In their comprehensive review of available literature, Southall et al. (2007) noted that quantitative studies on behavioral reactions of seals and sea lions to underwater noise are rare. A subset of only three studies observed the response of pinnipeds to underwater multiple pulses of noise (a category of noise types that includes impact pile driving), and were also deemed by the authors as having results that are both measurable and representative.

- Harris et al. (2001) observed the response of ringed, bearded, and spotted seals to underwater operation of a single air gun and an eleven-gun array. Received exposure levels were 160 to 200 dB RMS re: (referenced to) 1 μPa. Results fit into two categories. In some instances, seals exhibited no response to noise. However, the study noted significantly fewer seals during operation of the full array in some instances. Additionally, the study noted some avoidance of the area within 150 meters of the source during full array operations.

- Blackwell et al. (2004) is the only study directly related to pile driving. The study observed ringed seals during impact installation of steel pipe pile. Received underwater SPLs were measured at 151 dB RMS re: 1 μPa at 63 meters. The seals exhibited either no response or only brief orientation response (defined as "investigation or visual orientation"). It should be noted that the observations were made after pile driving was already in progress. Therefore, it is possible that the low-level response was due to prior habituation.
- Miller et al. (2005) observed responses of ringed and bearded seals to a seismic air gun array. Received underwater sound levels were estimated at 160 to 200 dB RMS re: 1 μPa. There were fewer seals present close to the noise source during air gun operations in the first year, but in the second year the seals showed no avoidance. In some instances, seals were present in very close range of the noise. The authors concluded that there was "no observable behavioral response" to seismic air gun operations.

Southall et al. (2007) conclude that there is little evidence of avoidance of SPLs from pulsed noise ranging between 150 and 180 dB RMS re: 1 μPa. Additionally, they conclude that behavioral response in ringed seals is likely to occur at 190 dB RMS. It is unclear whether or not these data apply to other seals or sea lions. Given that there are so few data available, it is difficult to draw conclusions about what specific behaviors pinnipeds will exhibit in response to underwater noise.

Southall et al. (2007) also compiled known studies of behavioral responses of marine mammals to airborne noise, noting that studies of pinniped response to airborne pulsed noises are exceedingly rare. The authors deemed only one study as having quantifiable results.

- Blackwell et al. (2004) studied the response of ringed seals within 500 meters of impact driving of steel pipe pile. Received levels of airborne noise were measured at 93 dB RMS re: 20 μPa at a distance of 63 meters. Seals had either no response or limited response to pile driving. Reactions were described as "indifferent" or "curious."

Due to the extremely limited data on this topic, it is not possible to draw definitive conclusions about what specific behaviors seals and sea lions will exhibit in response to airborne noise generated by impact pile driving. Several field observations indicate that sea lions exhibit mixed responses to elevated noise levels.

During a Caltrans installation demonstration project for retrofit work on the East Span of the San Francisco Oakland Bay Bridge, California, sea lions responded to pile driving by swimming rapidly out of the area, regardless of the size of the pile-driving hammer or the presence of sound attenuation devices (74 FR 63724).

Dyanna Lambourne, marine mammal research biologist at WDFW, noted that Steller sea lions generally avoid unfamiliar loud noises. In response to pile driving, they would be likely to exit areas exposed to elevated noise, unless there were a particularly strong attraction, such as an abundant food source (Lambourne 2010 personal communication). Lambourne also stated that Steller sea lions could become habituated to noises that are continuous and occurring over longer periods of time.

For the past 5 years, the USACE has conducted hazing of sea lions at Bonneville Dam in an attempt to decrease rates of predation on listed salmonids and sturgeon. The 2009 monitoring report (Stansell et al. 2009) documented the response of both California sea lions and Steller sea lions to several types of deterrents, including Acoustic Deterrent Devices (ADDs). These devices produce noise levels of 205 dB in the frequency range of 15 kHz. (The report did not specify whether these values referred to airborne or underwater noise.) The crews also employed above-water pyrotechnics (cracker shells, screamer shells, or rockets) and underwater percussive devices called seal bombs. Hazing occurred seven days a week from March 2 to the end of May. The study did not differentiate between Steller sea lions and California sea lions, so it is uncertain whether these two species respond differently to hazing. The observers reported that sea lions tended to spend more time underwater and temporarily avoided the area while hazing activities were occurring, but returned to forage soon after the activities ceased. They concluded that hazing only slowed the rate of predation, rather than effectively deterring it. The sea lions slightly shifted foraging times, preying more heavily at dawn and dusk, when hazing activities were beginning or ending. Nevertheless, despite active hazing, the rate of predation on salmon and sturgeon was still quite high. Observers noted that sea lions swam to within 20 feet of the ADDs to forage.

The explosive and percussive noises produced during these hazing activities are quite different from pile-driving noise, as they are abrupt and non-pulsed. These results may not be applicable to pile-driving projects; however, the results were included to demonstrate that high SPLs alone do not necessarily cause significant behavioral responses in sea lions. Also, the study is specific to sea lion behavior in the lower Columbia River, and it observed the same individuals that transit through the CRC project area. The results suggest that these individuals either are already habituated to some loud noises or could readily become habituated.

Temporary Threshold Shift

Temporary Threshold Shift (TTS) is reversible hearing loss caused by fatigue of hair cells and supporting structures in the inner ear. Technically, TTS is not considered injury, as it consists of fatigue to auditory structures rather than damage to them. Pinnipeds have demonstrated complete recovery from TTS after multiple exposures to intense noise, as described in the studies below (Kastak et al. 1999, 2005).

There are no studies of the underwater noise levels likely to cause TTS in Steller sea lions. However, TTS studies have been conducted on harbor seals, California sea lions, and northern elephant seals. Southall et al. (2007) report several studies on non-pulsed noise (a category that includes vibratory pile-driving noise), but only one study on pulsed noise.

- Finneran et al. (2003) studied responses of two individual California sea lions. The sea lions were exposed to single pulses of underwater noise, and experienced no detectable TTS at received noise level of 183 dB peak re: 1 μPa, and 163 dB SEL re: 1 μPa^2-s.

There were three studies conducted on pinniped TTS responses to non-pulsed underwater noise. All of these studies were performed in the same lab and on the same test subjects, and, therefore, the results may not be applicable to all pinnipeds or in field settings.

- Kastak and Schusterman (1996) studied the response of harbor seals to non-pulsed construction noise, reporting TTS of about 8 dB.
- Kastak et al. (1999) exposed a harbor seal, California sea lion, and elephant seal to octave-band noise at 60 to 70 dB above their hearing thresholds. After 20 to 22 minutes, the subjects experienced TTS of 4 to 5 dB.
- Kastak et al. (2005) used the same test subjects above, exposing them to higher levels of noise for longer durations. The animals were exposed to octave-band noise for up to 50 minutes of net exposure.
    - The study reported that the harbor seal experienced TTS of 6 dB after a 25-minute exposure to 2.5 kHz of octave-band noise at 152 dB re: 1 μPa and 183 dB SEL re: 1 μPa^2-s.
    - The California sea lion demonstrated onset of TTS after exposure to 174 dB re: 1 μPa and 206 dB SEL re: 1 μPa^2-s.
    - The northern elephant seal demonstrated onset of TTS after exposure to 172 dB re: 1 μPa and 204 dB SEL re: 1 μPa^2-s.

Combining the above data, Southall et al. (2007) assume that pulses of underwater noise result in the onset of TTS in pinnipeds when underwater noise levels reach 212 dB peak or 171 dB SEL. They did not offer criteria for non-pulsed sounds.

Southall et al. 2007 reported only one study on TTS in pinnipeds resulting from airborne pulsed noise:

- Bowles et al. (unpublished data) exposed pinnipeds to simulated sonic booms. Harbor seals demonstrated TTS at 143 dB peak re: 20 µPa and 129 dB SEL re: 20 μPa^2-s. California sea lions and northern elephant seals experienced TTS at higher exposure levels than the harbor seals.

Two studies examined TTS in pinnipeds resulting from airborne non-pulsed noise. These studies may not be relevant to the CRC project, but are provided for general reference.

- Kastak et al. (2004) used the same test subjects as in Kastak et al. 2005, exposing the animals to non-pulsed noise (2.5 kHz octave-band noise) for 25 minutes.
  - The harbor seal demonstrated 6 dB of TTS after exposure to 99 dB re: 20 µPa and 131 dB SEL re: 20 μPa^2-s.
  - The California sea lion demonstrated onset of TTS at 122 dB re: 20 µPa and 154 dB SEL re: 20 μPa^2-s.
  - The northern elephant seal demonstrated onset of TTS at 121 dB re: 20 µPa and 163 dB SEL re: 20 μPa^2-s.
- Kastak et al. (2007) studied the same California sea lion as in Kastak et al. 2004 above, exposing this individual to 192 exposures of 2.5 kHz octave-band noise at levels ranging from 94 to 133 dB re: 20 µPa for 1.5 to 50 minutes of net exposure duration. The test subject experienced up to 30 dB of TTS. TTS onset occurred at 159 dB SEL re: 20 μPa^2-s. Recovery times ranged from several minutes to 3 days.

Southall et al. (2007) assume that multiple pulses of airborne noise result in the onset of TTS in pinnipeds when levels reach 143 dB peak or 129 dB SEL. Lambourne (2010 personal communication) noted that, in a field setting, Steller sea lions are unlikely to remain in areas exposed to noise levels high enough to cause hearing loss, unless there is a particular attraction keeping them in the area.

Injury – Permanent Threshold Shift

Permanent threshold shift (PTS) is irreversible loss of hearing sensitivity at certain frequencies caused by exposure to intense noise. It is characterized by injury to or destruction of hair cells in the inner ear. Southall et al. (2007) note that there are no empirical studies demonstrating the noise levels that prompt PTS in marine mammals. Furthermore, they found that there is virtually no understanding of the relationship between TTS and PTS in marine mammals, as no studies have been performed.

Southall et al. (2007) propose that noise levels inducing 40 dB of TTS may result in onset of PTS in marine mammals. The authors present this threshold with precaution, as there are no specific studies to support it. Because direct studies on marine mammals are lacking, the authors base these recommendations on studies performed on other mammals. Additionally, the authors assume that multiple pulses of underwater noise result in the onset of PTS in pinnipeds when levels reach 218 dB peak or 186 dB SEL. In air, noise levels are assumed to cause PTS in pinnipeds at 149 dB peak or 144 dB SEL (Southall et al. 2007).

Criteria for Injury and Disturbance

NMFS is currently developing comprehensive guidance on sound levels likely to cause injury and behavioral disruption in the context of the Marine Mammal Protection Act. Until formal guidance is available, NMFS uses conservative thresholds of sound pressure levels likely to cause injury or disturbance to pinnipeds (Table C-1) (NMFS 2008f; WSDOT 2009b).

Table C-1. Injury and Disturbance Thresholds for Seals and Sea Lions

Location	Threshold
Underwater – impact pile driving	Injury: 190 dB RMS re: 1 µPa Disturbance: 160 dB RMS re: 1 µPa
Underwater – vibratory pile driving	Injury: None designated Disturbance: 120 dB RMS re: 1 µPa
Above water	Injury: None designated Disturbance: 90 dB RMS re: 20 µPa (unweighted) for harbor seals 100 dB_{RMS} re: 20 µPa (unweighted) for all other pinnipeds

Source: NMFS (2009), WSDOT (2009).

APPENDIX D

Marine Mammal Monitoring Protocol

APPENDIX D – MARINE MAMMAL MONITORING PROTOCOL

Objective

The intent of the monitoring is to:

- Comply with the requirements of the Endangered Species Act (ESA) Section 7 consultation and the Marine Mammal Letter of Authorization;
- Avoid injury to pinnipeds through visual monitoring of identified safety zones for impact installation of steel pile or steel casings; and
- Record the number, species, and behavior of pinnipeds in disturbance zones for impact pile driving, vibratory installation of steel pile, or vibratory installation of steel casings.

All methods identified herein have been developed through coordination between the National Marine Fisheries Service (NMFS) and the design and environmental teams at the Columbia River Crossing Project. The methods are based on these parties' professional judgment supported by their collective knowledge of pinniped behavior, site conditions, and proposed project activities. Because pinniped monitoring has not previously been conducted at this site, aspects of these methods may warrant modification. Any modifications to this protocol will be coordinated with NMFS.

Monitoring Activities

Establishment of Monitoring Zones – Monitoring for pinnipeds will be conducted in specific zones established to avoid or minimize effects of in-water noise generated by pile installation. For impact pile driving, a safety zone (defined as where SPLs equal or exceed 190 dB RMS) and a disturbance zone (defined as where SPLs equal or exceed 160 dB RMS) will be established. The initial safety and disturbance zones will be established based on the worst-case underwater sound modeled from impact driving of 36- to 48-inch steel pile.

For all vibratory pile driving, an initial disturbance zone (defined as where SPLs equal or exceed 120 dB RMS) will be established based on the worst-case sound modeled from vibratory installation of 36- to 72-inch steel pile for pipe piles or the loudest value modeled for sheet piles. Noise levels for vibratory installation of steel sheet or pipe piles are not anticipated to be above the 190 dB RMS thresholds based on literature values (see Appendix C); therefore, no safety zone for vibratory installation of steel pile is anticipated. If steel casings for drilled shafts are installed by a vibratory hammer, an initial safety zone will be established at 5 meters based on extrapolation of values from 36- and 72-inch steel pipe pile[1].

Once impact or vibratory installation begins, the safety and disturbance zones will either be enlarged or reduced based on actual recorded SPLs from the acoustic monitoring (see below). The zones will be based on actual acoustic monitoring results collected at approximately 10 meters from monitored piles or casings. If new zones are established based on SPL measurements, NMFS requires each new zone be

[1] No published information is available regarding noise levels generated by vibratory installation of 120-inch steel casings. Published information from Caltrans (2007) shows that 36-inch pile produced up to 175 dB RMS and 72-inch pile produced up to 180 dB RMS, both measured at 5 m from the pile. By extrapolating from these published values, the team assumes that noise levels generated by a 10-foot steel casing would be up to 10 dB RMS (an order of magnitude) higher than the highest value for a 72-inch pile. That is, vibratory installation of a 120-inch steel casing may yield a maximum value of 190 dB RMS, 5 m from the pile. As noted, monitoring will be conducted to determine actual values and distances.

based on the most conservative measurement (i.e., the largest zone). Table 1 and Table 2 show initial monitoring distances for safety and disturbance zones in the Columbia River and North Portland Harbor, respectively.

Table D-1. Initial Underwater Distance to Safety and Disturbance Monitoring Zones in the Columbia River

		Calculated Distance to Monitoring Zones (meters)[a]		
Pile Type	**Hammer Type**	**190 dB RMS[b] Safety Zone**	**160 dB RMS Disturbance Zone (impulse noise)**	**120 dB RMS Disturbance Zone (continuous noise)**
18- to 24-inch steel pipe	Impact	9	858	N/A
36- to 48-inch steel pipe	Impact	54	5,412	N/A
48-inch steel pipe	Vibratory	N/A	N/A	20,166 upriver 8,851 downriver
120-inch steel casing	Vibratory	~5[c]	N/A	20,166 upriver 8,851 downriver
Sheet pile	Vibratory	N/A	N/A	6,962

a Monitoring zones based on worst case modeled values where the attenuation device is not operating. Upriver and downriver distances vary if a landform is encountered prior to noise attenuating to a threshold value.

b All values unweighted and relative to 1µPa.

c No source value available. To obtain a worst case estimate, distance is based on extrapolation of vibratory sound values from 36- and 72-inch piles.

Table D-2. Initial Underwater Distance to Safety and Disturbance Monitoring Zones in North Portland Harbor

		Calculated Distance to Monitoring Zones (meters)[a]		
Pile Type	**Hammer Type**	**190 dB RMS[b] Safety Zone**	**160 dB RMS Harassment Zone (impulse noise)**	**120 dB RMS Harassment Zone (continuous noise)**
18- to 24-inch steel pipe	Impact	9	858	N/A
36- to 48-inch steel pipe	Impact	54	3,058 upriver 5,412 downriver	N/A
48-inch steel pipe	Vibratory	N/A	N/A	3,058 upriver 5,632 downriver
120-inch steel casing	Vibratory	~5[c]	N/A	3,058 upriver 5,632 downriver

a Monitoring zones based on worst case modeled values where the attenuation device is not operating. Upriver and downriver distances vary if a landform is encountered prior to noise attenuating to a threshold value.

b All values unweighted and relative to 1µPa.

c No source value available. To obtain a worst case estimate, distance is based on extrapolation of vibratory sound values from 36- and 72-inch piles.

Hydroacoustic Monitoring – Hydroacoustic monitoring will be conducted for impact driving of steel piles. Monitoring will be conducted on a representative number of piles as described in the Underwater Noise Monitoring Plan Template[2] that has been developed with and approved by NMFS and USFWS for Section 7 consultations. The number, size, and location of piles monitored will represent the variety of substrates and depths, as necessary, in both the Columbia River and North Portland Harbor.

[2] Available at: http://www.wsdot.wa.gov/Environment/Air/Noise.htm.

Hydroacoustic monitoring will be performed for vibratory installation of at least one steel pipe pile, and for the first steel casing of the largest diameter used by the project. The intent of this monitoring is to obtain the actual distance to the 120 dB RMS threshold level; the first casing will represent a worst-case for size and depth for vibratory installation. For standard underwater noise monitoring, one hydrophone positioned at midwater depth and 10 meters from the pile is used. Some additional initial monitoring at several distances from the pile is anticipated to determine site-specific transmission loss and directionality of noise. This data will be used to establish the radii of the safety and disturbance zones for sea lions.

Visual Monitoring of Zones – Prior to initiation of monitoring, the monitoring biologist will contact the U.S. Army Corps of Engineers (USACE) Fisheries Field Unit at Bonneville Dam (see contact info below) to obtain a report of numbers of seals and seal lions at the Bonneville Dam and any hazing or capture operations recently conducted. This information will provide some indication of the level of pinniped activity that may or could occur during monitoring activities.

A qualified monitoring biologist (see below) will be present on site at all times during impact or vibratory installation of steel pile or steel casings. Using scopes and binoculars, monitoring biologists will search for pinnipeds within the required monitoring zone where pile installation activities are scheduled to occur. If no pinnipeds are within the safety zone, the monitors will notify the Department of Transportation field inspector to begin pile installation. Pinniped monitoring of disturbance and safety zones associated with pile installation activities will be conducted as follows:

- Safety and disturbance zones will be monitored from a work platform, barge, the existing bridge, or other vantage point, or by driving a boat along and within the radius of the zones while visually scanning the area. The entire safety zone must be visible from the selected vantage point. If a small boat is used for monitoring, the boat will remain 50 yards from swimming pinnipeds in accordance with NMFS marine mammal viewing guidelines (NMFS 2004).
- If any vibratory installation occurs after dark, the disturbance zone will be monitored with a night vision scope and/or other suitable device. If hydroacoustic monitoring of vibratory installation of steel casings for drilled shafts indicates SPLs of 190 dB RMS or higher, then a safety zone will be established and monitored with a night vision scope and/or other suitable device.
- If the safety zone is obscured by fog or poor lighting conditions, pile driving will not be conducted until the entire safety zone is visible.
- The safety zone will be monitored for the presence of seals and sea lions before, during, and after any pile driving activity.
- The safety zone will be monitored for 30 minutes prior to initiating the start of pile driving. If seals or sea lions are present within the safety zone prior to pile driving, the start of pile driving will be delayed until the animals leave the safety zone.
- Monitoring of the safety zone will continue for 20 minutes following the completion of pile driving.
- Monitoring will be conducted using high-quality binoculars. When possible, digital video or still cameras will also be used to document the behavior and response of seals and sea lions to construction activities or other disturbances.
- Each monitor will have a radio or cell phone for contact with other monitors or work crews.
- A GPS unit or electric range finder will be used for determining the observation location and distance to seals and sea lions, boats, and construction equipment.

Shutdown Procedure – All monitors will have two-way radios to allow for effective communication during in-water impact or vibratory pile driving. During pile installation operations, monitors will continue to monitor the safety zone. If a seal or sea lion is observed approaching or entering the safety zone (190 dB RMS isopleth for pinnipeds), pile driving operations will be discontinued until the animal has moved outside of the safety zone. Pile driving will resume only after the sea lion is determined to have moved outside the safety zone by a qualified observer or after 15 minutes have elapsed since the last sighting of the seal or sea lion within the safety zone.

If pinnipeds move into the disturbance zone (but remain outside of the safety zone) during impact or vibratory pile installation, the monitors will observe and record the animal's behavior, but pile installation will not stop.

Documentation

The monitoring biologists will document all pinnipeds observed in the monitoring area. Special attention will be placed on identifying ESA-listed Steller sea lions. Data collection will include a count of all pinnipeds observed by species, sex, age class, their location within the zone, and their reaction (if any) to construction activities, including direction of movement, and type of construction that is occurring, time that pile driving begins and ends, any acoustic or visual disturbance, and time of the observation. Environmental conditions such as wind speed, wind direction, visibility, and temperature will also be recorded.

Timing and Duration

Monitoring of a safety zone will commence 30 minutes before the initiation of pile driving and will continue for 20 minutes following pile driving. Impact pile driving will not occur after dark. If the safety zone is obscured by fog or poor lighting conditions, pile driving will not occur until the entire safety zone is visible.

If vibratory installation of steel pipe piles or casings occurs after dark, the disturbance zone will be monitored with a night vision scope and/or other suitable device. If hydroacoustic monitoring of vibratory installation of steel casings for drilled shafts indicates SPLs of 190 dB RMS or higher, then a safety zone will be established and monitored with a night vision scope and/or other suitable device.

Locations

The monitoring area is defined as the area in which pinnipeds could be disturbed or injured by in-water pile installation noise, i.e., disturbance and safety zones. For the CRC project, the area of potential disturbance is defined as the distance at which underwater sound attenuates to 120 dB RMS for vibratory pile installation, and 160 dB RMS for impact pile driving. The area of potential injury is the safety zone defined as the distance at which underwater sound attenuates to 190 dB RMS for all vibratory or impact pile installation. This distance will differ depending on the type of pile installation and the diameter of the piles.

Limitations

No monitoring will be conducted during inclement weather that creates potentially hazardous conditions as determined by the biologist. No monitoring will be conducted when visibility is significantly limited, such as during heavy rain or fog. During these times of inclement weather, in-water work that may produce noise levels in excess of 190 dB RMS will be halted. In-water construction that may produce noise levels above 190 dB RMS will not commence until monitoring has started for the day.

Contingency

In the unlikely event that a pinniped is perceived to be injured by pile installation, all pile installation will cease and NMFS will be contacted immediately. The CRC environmental coordinator will work with NMFS to make necessary changes to the monitoring protocol as described in the section above. Pile installation cannot resume until the protocol has been amended.

Reporting

Reports of data collected during monitoring will be submitted to NMFS weekly. In addition, a final report summarizing all seal and sea lion monitoring and construction activities will be submitted to NMFS annually. Reports shall be sent to the attention of Alison Agness (NMFS). The report shall include:

- Observation dates, times, and conditions; and
- Copies of field data sheets or logs.

Interagency Communication

Prior to the initiation of monitoring, the CRC environmental coordinator and representatives from NMFS will meet to review the proposed monitoring location and logistics concerns that may have developed during monitoring preparation. The CRC environmental coordinator will keep NMFS informed of the progress and effectiveness of the monitoring activities.

The CRC environmental coordinator will notify NMFS of any problems and/or necessary modification to the monitoring protocol. The CRC environmental coordinator will coordinate with NMFS in the development of a modified approach and will seek NMFS approval for such modifications. The CRC environmental coordinator and/or monitoring biologists will contact the USACE at Bonneville Dam to obtain information on pinniped activity, and hazing and capture efforts occurring at the dam.

Primary points of contact at NMFS in Seattle, WA are:

Alison Agness – phone: (206) 526-6152

Brent Norberg – phone: (206) 526-6550

Lynne Barre – phone: (206) 526-4745

Primary points of contact at Columbia River Crossing are:

Steve Morrow, CRC – phone: (360) 816-8892

Marion Carey, Washington State Department of Transportation – phone: (360) 705-7404

Primary points of contact at the USACE, Fisheries Field Unit, Bonneville Lock and Dam, in Cascade Locks, OR are:

Robert Stansell – phone: (541) 374-8801

Karrie Gibbons – phone: (541) 374-8801

Personnel Qualifications and Training

All monitoring personnel must have appropriate qualifications as identified below. These qualifications include education and experience identifying pinnipeds in the Columbia River; and understanding and documenting animal behavior.

All monitoring personnel will meet at least once for a training session with representatives of NMFS. Topics will include: implementation of the protocol, identifying marine mammals, and reporting requirements.

All monitoring personnel will be provided a copy of the final biological opinion and LOA for the project. Monitoring personnel must read and understand the contents of the biological opinion and LOA related to coordination, communication, and identifying and reporting incidental harassment of seals and sea lions.

Minimum Qualifications for Marine Mammal Observers

In order to be considered qualified; monitoring biologists will meet the following criteria for marine mammal observers:

- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target;
- Advanced education in biological science, wildlife management, mammalogy, or related fields (Bachelors degree or higher is preferred);
- Experience and ability to conduct field observations and collect data according to assigned protocols (this may include academic experience);
- Experience or training in the field identification of pinnipeds, including the identification of behaviors;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to prepare a report of observations including but not limited to the number and species of pinnipeds observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury from construction noise of pinnipeds observed within a defined safety zone; and pinniped behavior; and
- Ability to communicate orally by radio, cell phone, or in person, with project personnel to provide real-time information on pinnipeds observed in the area as necessary.

Monitoring Biologist Equipment

- Binoculars - quality 8 or 10 power;
- Spotting scopes;
- Marine mammal identification guides;
- Log books;
- Life vest or other personal flotation device for observers when in boats; and
- Two-way radio or cell phone to contact CRC environmental coordinator or NMFS if necessary.

References

Caltrans. 2007. Compendium of Pile Driving Sound Data. Sacramento, California.

NMFS . 2004. Marine Wildlife Viewing Guidelines. January 2004. Available at: http://www.nmfs.noaa.gov/pr/pdfs/education/viewing_wildlife.pdf. Accessed May 2010.