# **CONCEPTUAL STAGING NARRATIVE**

Draft Report







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# 1. Conceptual Staging Overview

The conceptual staging plans for the construction of the CRC Columbia River bridges and approaches include 7 stages of construction for the overall construction and 10 phases specific to the bridge construction within the stages. The details of each are described later in this report.

## 1.1 Stages

The proposed staging concept demonstrates one way the project could be constructed while maintaining traffic operations on I-5 and the connecting interchanges. The proposed staging progresses as outlined in the following simplified description of the construction sequence:

- Start building the River Crossing (RC) structures.
- Shift the I-5 traffic and ramps to the east on Hayden Island and at the SR-14 interchange. This will include constructing temporary alignments for some of the movements at the SR-14 interchange.
- Start building the southbound approaches.
- When the southbound RC structure is completed, move southbound traffic onto the new southbound RC structure.
- After completing additional construction, shift the northbound to the southbound RC structure.
- Complete the northbound approaches and the northbound structure and shift the northbound traffic onto the northbound structures.
- Make final adjustments and complete the ramps and shoulders of the new I-5 Columbia River bridges and approaches.

In addition to vehicle traffic, bicycle and pedestrian traffic will also need to be staged during construction. Bicyclists and pedestrians will continue to use the existing river bridges to cross the Columbia River until all of the northbound traffic is taken off of the northbound structure. This is necessary because the Hayden Island to I-5 northbound traffic will continue to use the northbound bridge until the new northbound River Crossing and approaches are completed. Conflicts between the existing bridges and the proposed shared-use path prohibit completion of the shared-use path prior to relocation of the northbound traffic.

Another noteworthy item is the need to establish and maintain tolls collection throughout construction. These steps are briefly discussed in this document. This work consists of installing and maintaining all the necessary equipment for collecting the tolls during construction. This means that temporary toll collection equipment will be installed a number of times as the traffic is shifted between stages until it is located in its final position.

# 1.2 Columbia River Bridge Construction

The 10 proposed phases focus on one way the bridge construction and existing bridge removal may occur and demonstrate how the navigation channels will be maintained during construction.

The phase methodology and sequence was developed to confirm constructability of the proposed design. Once a construction contract is awarded, the contractor may sequence the construction in a way that may not conform exactly to the conceptual methodology and sequence described herein, but which best utilizes the materials, equipment, and personnel available to perform the work. While the contractor will be allowed some flexibility, any changes to construction sequencing or schedule will need to minimize impacts to navigation during construction.

The amount of work that can be conducted at any one time is limited, and is based on three factors:

- Maintaining at least one channel for navigation to minimize the impacts to navigation during construction.
- The amount of equipment available to build the project will likely be limited. Based on equipment availability, it is estimated that only two drilled shaft operations would likely occur at a given time.
- 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 the attached conceptual River Bridge staging plans.

The new two new bridges across the Columbia River will likely be constructed concurrently starting from the south shore on Hayden Island and progressing across the river to the north shore in Vancouver. Generally, there are three elements that will be constructed at a given pier locations. These are:

- Foundation This element generally includes installation of temporary in-water structures (work bridges/platforms), installation of large diameter drilled shafts, and removal of the temporary in-water structures.
- Bent This element generally includes installation of the shaft cap on the previously installed drilled shafts, columns and a bent cap will then be installed on the shaft cap.
- Superstructure This element generally includes the erection of the structure between piers and placement of the reinforced concrete deck.

The details of the phase sequencing within each stage are outlined in the following section.

# 2. Detailed Staging Description

Appendix A shows how the navigational clearance changes horizontally and vertically over time during construction. Appendix B provides a more detailed view of the relationship of the designated channels to the existing and proposed bridge structures. As demonstrated in Appendix A, the primary channel is left unchanged until the superstructure for the new bridge is constructed over the channel at the end of 2016, after that point the primary channel will be restricted vertically to 100' as illustrated in Appendix C. During this time the channel will be reduced horizontally to a width of 150' because of the space requirements for the construction equipment around the piers. The vertical restriction will remain at 100' until the wide span of the existing bridge is removed at the beginning of 2019 at which time the final vertical clearance of 116' and the new primary channel will be established and put into operation.

The following sections describe the general progression of the overall construction and the phases of bridge construction within each phase as depicted in Appendix D and E, the Highway Construction Staging Plans and Appendix F, the Columbia River Bridge Construction Sequence.

## 2.1 Staging Description

### 2.1.1 Stage 1

This stage consists of demolition and construction needed to shift northbound I-5 traffic to the east of the current locations in the SR-14 interchange area. Work will begin on the River Crossing bridges.

- The existing on and off ramps will be adjusted to match the shifted mainline traffic.
- Retaining walls along the Right-of-Way in Vancouver and pre-completion tolling equipment will be installed.
- The Evergreen Boulevard structure over I-5 will also be replaced.
- Work on Hayden Island is limited to installing the pre-completion tolling equipment for southbound traffic, structure removal and ground improvements.
- River Crossing bridge work begins with Phase 1 through Phase 3, progressing as ordered below:
  - o Phase 1
    - Pier 1 (on-land) Construct foundation and bent.
    - Pier 2 Construct foundation.

- o Phase 2
  - Pier 2 Construct bent.
  - Pier 3 Construct foundation.
- o Phase 3
  - Pier 2 Construct superstructure.
  - Pier 3 Construct bent.
  - Pier 4 Construct foundation. Alternate Barge Channel is closed

### 2.1.2 Stage 2

Stage 2 primarily consists of detour construction at the SR-14 interchange and continued work on the River Crossing bridges.

- Detours for the I-5 southbound to SR-14 eastbound, Washington Street to SR-14 eastbound, and SR-14 westbound to I-5 southbound are constructed. These detours include a temporary structure over I-5.
- A temporary alignment for southbound traffic is installed so the tolling equipment for the next stage can be tested.
- Hayden Island work consists of demolition, more ground improvements, and construction needed for shifting I-5 traffic to the east.
- River Crossing bridge work continues on Phase 4 through Phase 7, progressing as ordered below:
  - o Phase 4
    - Pier 3 Construct superstructure
    - Pier 4 Construct bent.
    - Pier 5 Construct foundation. Barge Channel is closed
  - o Phase 5
    - Pier 4 Construct superstructure. Temporary Alternate Barge Channel opens with a restricted 200-foot horizontal clearance.
    - Pier 5 Construct bent.
    - Pier 6 Construct foundation.

- o Phase 6
  - Pier 5 Construct superstructure. Temporary Alternate Barge Channel closes briefly during superstructure erection.
- o Phase 7
  - Pier 6 Construct bent.
  - Pier 7 Construct foundation. Primary Channel is restricted to a 150-foot horizontal clearance.

### 2.1.3 Stage 3

In Stage 3 the southbound approaches are completed and are ready to carry staged southbound traffic.

- Southbound traffic is taken off the temporary alignment and shifted back to the east after testing of the tolling equipment is completed.
- Work on the SR-14 alignment and the transit improvements on the City of Vancouver streets begin.
- The southbound approach, ramps, and transit alignment are constructed at SR-14 and on Hayden Island.
- Toll collection sites and bicycle and pedestrian routes remain largely unchanged up to this point.
- The River Crossing structures are completed with work in Phases 8 through 10, progressing as ordered below:
  - o Phase 8
    - Pier 6 Construct superstructure.
    - Pier 7 Construct bent.
    - Pier 8 (on land) Construct foundation and bent.
  - o Phase 9
    - Pier 7 Construct superstructure. Primary Channel is restricted to a 150-foot horizontal clearance and a 100-foot vertical clearance.
  - o Phase 10
    - Pier 8 Complete superstructure.

## 2.1.4 Stage 4

Stage 4 begins with shifting the southbound traffic to the new southbound River Crossing structure. Construction focuses on work needed to shift the northbound traffic to the southbound River Crossing structure and work to complete the northbound bridge.

- The northbound River Crossing superstructure is completed first within Phase 10.
- Traffic is shifted through the staged toll collection sites.
- Another temporary alignment is constructed for testing of the following staged tolling equipment.
- Northbound structures needed for the I-5 northbound to SR-14 eastbound movement are completed.
- The southbound mainline, and a crossover ramp onto the northbound River Crossing structure, are completed on Hayden Island.
- A ramp for Hayden Island to I-5 northbound traffic is connected to the northbound River Crossing structure.
- The southern spans of the existing southbound bridge are removed and a ramp for bicycles and pedestrians is constructed up to the remaining southbound structure and opened.
- Construction of the Shared Use Paths in Oregon and Washington is started where possible.

## 2.1.5 Stage 5

Northbound traffic is shifted onto the southbound River Crossing structure to begin stage 5 and construction is focused on completing the Shared Use Path and northbound approaches. Removal of the existing I-5 bridges begins as well.

- A detour for I-5 northbound to SR-14 eastbound traffic is opened on the northbound River Crossing structure.
- A detour for Hayden Island to I-5 northbound traffic is established through the Columbia House Boulevard interchange on SR-14.
- Traffic is shifted through a combination of staged and final tolling equipment.
- The southern spans of the existing northbound bridge are removed and the Hayden Island to I-5 North and shared-use path structures are completed. Bicycles and pedestrians continue to use the existing southbound river bridge until the shared-use path structure opens after its completion in both WA & OR.

- The northbound approaches are constructed at both the SR-14 and Hayden Island interchanges and the SR-14 westbound to I-5 southbound ramp is completed in Vancouver.
- Hayden Island to I-5 northbound traffic is removed from the existing I-5 structure and placed on a staged alignment that joins I-5 at the future Martin Luther King Blvd to I-5 N ramp location.
- The east barrier on the North Portland Harbor structure is also upgraded to a trafficrated barrier during this stage.
- Removal of the existing I-5 structures begins. Removal will initially focus on the long spans of the existing Interstate Bridges. This will allow for the 116-foot vertical clearance to be available in the new Primary Channel as soon as practicable. Bridge removal will then focus on opening the remaining channels.

### 2.1.6 Stage 6

In Stage 6 the northbound traffic is shifted to the northbound River Crossing structure and the focus is on removing detours, completing final alignments and continuing the bridge removal.

- Detours are removed at the SR-14 interchange and the remaining structures, ramps and surface streets are built.
- Another temporary alignment is set up in Vancouver while the permanent toll equipment is tested.
- Southbound traffic is also shifted on the WA-approach to allow the final southbound toll equipment to be tested as well.
- Crossovers and detours are removed and the medians in WA and OR are reconstructed and/or completed.
- Hayden Island to I-5 northbound ramp is constructed and the ramp traffic placed in its final location.
- After navigation channels are open, removal of the existing river bridges continues.

### 2.1.7 Stage 7

Stage 7 is dominated by the construction of the Evergreen Community Connector (which lids over I-5) in Vancouver.

- Surface streets and northbound ramps on Hayden Island are completed and shifted into their final alignments.
- Ground improvements are completed where the existing river crossing structures were located.

• At SR-14, the barriers and other elements of the northbound and southbound collector distributer ramps and the Evergreen Community Connector will be constructed.

# 3. Potential Vessel Impacts During Construction

<u>Horizontal clearances</u>. As illustrated in Appendix A there will be an extended period (approx. 40 months) during which the maximum horizontal clearance in the navigation channels available for passage may be limited to 150 ft. While that is less than the horizontal clearances in the existing channels, and also less than the 300 ft for each of the proposed new channels, it matches the available horizontal clearance at the BNSF swing span approximately one mile downriver of the I-5 bridge. With appropriate safety measures in place we do not anticipate that the limited horizontal clearances in place during construction will restrict marine navigation.

<u>Vertical clearances</u>. Appendix A shows two periods where construction staging will result in vertical clearances that are less than the proposed final clearance of 116 ft. The first period, with an anticipated duration of approximately one month, will provide a maximum vertical clearance of 72 ft above 0 CRD. A second, longer duration construction period (approximately 23-24 months) will limit vertical clearance to 100 ft. above 0 CRD.

All vessels/river users inventoried in 2012 in support of the General Bridge Permit application were reviewed to determine potential impacts due to limited vertical clearances during bridge construction. The review considered four distinct operating scenarios for each of the two construction periods:

- Ordinary High Water (OHW, 16 ft above 0 CRD) with a 10 ft. air gap;
- OHW with a 5 ft. air gap;
- A river level of 8.65 ft (exceeded < 20 % of the year on average) with a 10 ft. air gap; and
- A river level of 8.65 ft with a 5 ft. air gap.

Potential impacts during the two construction periods were evaluated by vessel class as described below:

## 3.1 Commercial Tugs and Tow Vessels

<u>Period 1</u>. As illustrated in Figure 3-1, a 72 ft vertical clearance would constrain a total of 25 tugs at OHW with an assumed air gap of 10 feet. However, the number of constrained vessels drops to five with a 5 ft air gap, and is further reduced to two or less if a river stage of 8.65 feet is assumed.

<u>Period 2</u>. No tugs would be affected by the 100 ft. vertical clearance during Period 2.

#### FIGURE 3-1. TUG AND BARGE VESSELS POTENTIALLY HEIGHT-CONSTRAINED DURING CONSTRUCTION

**Two Periods Considered:** 

1) Short term (1 month or less) closure of the primary shipping channel, 72 ft. clearance provided by alternate barge channel 2) Limited vertical clearance (100 ft.) during construction over the primary shipping channel, 23-24 month duration.

= Potential impact during Period 1 = Potential Impact during Period 2 Period 2 = 100 ft vertical clearance Period 1 = 72 ft vertical clearance Air @ Ord. High Water \* @ River Level = 8.65' \*\* @ Ord. High Water \* @ River Level = 8.65' \* Owner Vessel Name Draft Air gap = 10 feet 5 feet 10 feet 5 feet 5 feet 10 feet 10 feet 5 feet Bernert Barge Lines Kathryn B 52 1 Lori B 52 2 Bernert Barge Lines 3 Foss Pacific Explorer 61 PJ Brix 58.3 4 Foss SDS Lumber Company 55 5 Dauby 6 Shaver Cascades 51 7 Shaver 51 Clearwater Shaver 51 8 Deschutes 51 9 Shaver Lassen 51 10 Shaver Umatilla 11 Shaver Willamette 51 Tidewater 50 12 Betty Lou 13 Tidewater Captain Bob 51 14 Tidewater 49 Challenger 15 Tidewater Clarkston 49 16 Tidewater 49 Defiance 17 Tidewater Hurricane 49 18 Tidewater 48 Invader 19 Tidewater Legend 51 20 Tidewater Maverick 52 21 Tidewater Outlaw 53 22 Tidewater 48 Rebel 23 Tidewater Sundial 48 24 Tidewater The Chief 50 25 50 Tidewater Tidewater

\* Ordinary High Water = 16 ft above 0 Columbia River Datum

\*\* River levels at the I-5 were below 8.65 feet 80 percent of the days for the past 40 years.

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## 3.2 Marine Contractor Vessels

<u>Period 1.</u> Up to 49 contractor barges would be constrained by a 72 ft clearance, and most (43) would be constrained under all the scenarios evaluated, as shown in Figure 3-2. Mitigating factors to consider are that the construction barges do not routinely transit through the project area, but are deployed as needed for projects. As a result, a limited duration restriction may have little practical impact. In addition, it is likely that some of the listed barges would be associated with the bridge construction contract.

<u>Period 2.</u> Up to 29 construction barges would be limited by a 100 ft clearance at OHW and a 10 ft air gap. The river stage and air gap have a major influence on the number of impacted vessels: at an 8.65 ft river stage with a 5 ft air gap, six construction barges would be affected.

## 3.3 Marine Industry and Fabricator Vessels (see Figure 3-3)

<u>Period 1.</u> This vessel/user class includes the three fabricators located at the Columbia Business Center (CBC), plus the Christensen Shipyards, located adjacent to the CBC in Vancouver. With a 72 ft vertical bridge clearance, none would be able to pass under any of the river stage/air gap scenarios tested.

<u>Period 2.</u> With a 100 ft vertical clearance, Christensen Shipyards would not be affected. However, the three fabricators would be limited to products that would pass within the available clearance.

## 3.4 Federal Government Vessels (see Figure 3-4)

<u>Period 1</u>. This vessel class includes the Navy ships used for transporting nuclear materials to Hanford, the *M/V Ironwood* (a Job Corps training vessel), and the US Army Corps of Engineers (USACE) dredge *Yaquina*. The Period 1 vertical clearance limitation of 72 ft would restrict nearly all federal vessels at OHW. The only exception would be the *YP 701 Liberty Bay*, which could pass with a 5 ft air gap. At a river level of 8.65 ft the nuclear transporters would be restricted to the use of the *YP 701 Liberty Bay* and the *Barge 4*. The *M/V Ironwood* and the dredge *Yaquina* would not be able to pass under any conditions during this period.

<u>Period 2.</u> With a vertical clearance of 100 ft, the *M/V Ironwood* would be able to pass at OHW with a 5 ft air gap. The USACE dredge *Yaquina* would not be able to pass with a 5 ft air gap for the river stages considered. However, since the routine dredging upriver of the bridge occurs in August-September each year, we can more closely consider the river levels that typically occur during that period. For the period 1973-2011, the average daily low water levels ranged from 1.2 – 2.7 ft above 0 CRD, and average daily high water levels ranged from 4.3 - 5.6 ft above 0 CRD. With an air draft of 92 ft, the *Yaquina* could pass at daily low water periods with an air gap greater of 5 feet or more.

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#### FIGURE 3-2. MARINE CONTRACTOR VESSELS POTENTIALLY HEIGHT-CONSTRAINED DURING CONSTRUCTION

**Two Periods Considered:** 

1) Short term (1 month or less) closure of the primary shipping channel, 72 ft. clearance provided by alternate barge channel 2) Limited vertical clearance (100 ft.) during construction over the primary shipping channel, 23-24 month duration.

= Potential impact during Period 1

= Potential Impact during Period 2

|    |                                |                  |              | Pei                  | riod 1 = 72 ft      | vertical cleara      | ince                | Perio                | d 2 = 100 ft        | vertical clea            | rance               |
|----|--------------------------------|------------------|--------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|--------------------------|---------------------|
|    | Owner                          | Vessel Name      | Air<br>Draft | @ Ord. Hi            | gh Water *          | @ River Lev          | el = 8.65' **       | @ Ord. Hi            | gh Water *          | @ River Level = 8.65' ** |                     |
|    |                                |                  |              | Air gap =<br>10 feet | Air gap =<br>5 feet | Air gap =<br>10 feet | Air gap =<br>5 feet | Air gap =<br>10 feet | Air gap =<br>5 feet | Air gap =<br>10 feet     | Air gap =<br>5 feet |
| 1  | Advanced American Construction | DB 125           | 78           |                      |                     |                      |                     |                      |                     |                          |                     |
| 2  | Advanced American Construction | DB 4000          | 79.5         |                      |                     |                      |                     |                      |                     |                          |                     |
| 3  | Advanced American Construction | DB 4041          | 71           |                      |                     |                      |                     |                      |                     |                          |                     |
| 4  | Advanced American Construction | DB 4100          | 92           |                      |                     |                      |                     |                      |                     |                          |                     |
| 5  | Advanced American Construction | Paul Bunyon      | 78           |                      |                     |                      |                     |                      |                     |                          |                     |
| 6  | Bergerson Construction Inc.    | Betsy Ross       | 70           |                      |                     |                      |                     |                      |                     |                          |                     |
| 7  | Bergerson Construction Inc.    | Carr Barge       | 70           |                      |                     |                      |                     |                      |                     |                          |                     |
| 8  | Bergerson Construction Inc.    | Sectional Barge  | 70           |                      |                     |                      |                     |                      |                     |                          |                     |
| 9  | Diversified Marine             | BMC 44           | 78           |                      |                     |                      |                     |                      |                     |                          |                     |
| 10 | Diversified Marine             | Cougar           | 50           |                      |                     |                      |                     |                      |                     |                          |                     |
| 11 | Diversified Marine             | DB Freedom ***   | 61           |                      |                     |                      |                     |                      |                     |                          |                     |
| 12 | Diversified Marine             | DB Lucy          | 85           |                      |                     |                      |                     |                      |                     |                          |                     |
| 13 | Diversified Marine             | DB Vulcan        | 89           |                      |                     |                      |                     |                      |                     |                          |                     |
| 14 | Diversified Marine             | DMI 100          | 60           |                      |                     |                      |                     |                      |                     |                          |                     |
| 15 | Diversified Marine             | DMI 50           | 60           |                      |                     |                      |                     |                      |                     |                          |                     |
| 16 | Diversified Marine             | DMI 60           | 84           |                      |                     |                      |                     |                      |                     |                          |                     |
| 17 | Dutra Group                    | Derrick No. 24   | 70           |                      |                     |                      |                     |                      |                     |                          |                     |
| 18 | Dutra Group                    | Paula Lee        | 77.5         |                      |                     |                      |                     |                      |                     |                          |                     |
| 19 | General Construction           | D.B. Alameda     | 71           |                      |                     |                      |                     |                      |                     |                          |                     |
| 20 | General Construction           | D.B. Columbia    | 64           |                      |                     |                      |                     |                      |                     |                          |                     |
| 21 | General Construction           | D.B. General     | 93           |                      |                     |                      |                     |                      |                     |                          |                     |
| 22 | General Construction           | D.B. Los Angeles | 67.2         |                      |                     |                      |                     |                      |                     |                          |                     |
| 23 | General Construction           | D.B. Oakland     | 78.8         |                      |                     |                      |                     |                      |                     |                          |                     |
| 24 | General Construction           | D.B. Olympia     | 70.1         |                      |                     |                      |                     |                      |                     |                          |                     |
| 25 | General Construction           | D.B. Pacific     | 86.5         |                      |                     |                      |                     |                      |                     |                          |                     |

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| 26 | General Construction        | D.B. Seattle   | 85.9 |  |  |  |  |
|----|-----------------------------|----------------|------|--|--|--|--|
| 27 | General Construction        | D.B. Vancouver | 62   |  |  |  |  |
| 28 | Hickey Marine Enterprises   | Sea Hawk       | 75   |  |  |  |  |
| 29 | Hickey Marine Enterprises   | Sea Horse      | 88   |  |  |  |  |
| 30 | Hickey Marine Enterprises   | Sea Lion       | 75   |  |  |  |  |
| 31 | Hickey Marine Enterprises   | Sea Vulture    | 75   |  |  |  |  |
| 32 | J.E. McAmis                 | Heidi Renee    | 81   |  |  |  |  |
| 33 | JT Marine                   | Cristy T       | 50   |  |  |  |  |
| 34 | JT Marine                   | DB Astoria     | 80   |  |  |  |  |
| 35 | JT Marine                   | DB Taylor **** | 80   |  |  |  |  |
| 36 | JT Marine                   | Stacy T        | 55   |  |  |  |  |
| 37 | Knife River                 | KR-1           | 48.5 |  |  |  |  |
| 38 | Manson Construction         | Derrick No. 24 | 99   |  |  |  |  |
| 39 | Manson Construction         | Haakon         | 84   |  |  |  |  |
| 49 | Mark Marine Service         | Barge #7       | 80   |  |  |  |  |
| 41 | Mark Marine Service         | DB Camas       | 75   |  |  |  |  |
| 42 | Mark Marine Service         | DB Columbia    | 66   |  |  |  |  |
| 43 | Mark Marine Service         | Patricia       | 48   |  |  |  |  |
| 44 | Mark Marine Service         | Umatilla       | 50   |  |  |  |  |
| 45 | Port of Portland            | Dredge Oregon  | 103  |  |  |  |  |
| 46 | Ross Island Sand and Gravel | RI Dredge no.6 | 77   |  |  |  |  |
| 47 | Ross Island Sand and Gravel | RI Dredge no.7 | 77   |  |  |  |  |
| 48 | Ross Island Sand and Gravel | RI Dredge no.8 | 77   |  |  |  |  |
| 49 | Ross Island Sand and Gravel | RI Dredge no.9 | 77   |  |  |  |  |

\* Ordinary High Water = 16 ft above 0 Columbia River Datum

\*\* River levels at the I-5 were below 8.65 feet 80 percent of the days for the past 40 years.

\*\*\* Diversified Marine has indicated that the crane boom for the DB Freedom can be lowered to a horizontal position, leaving the crane gantry as the highest fixed point on the vessel (61 ft.)

Mitigation discussions are underway to provide for modification of the DB Taylor to allow the boom to be lowered to a horizontal position. When that occurs the highest points on the vessel will be the raised spuds at \*\*\*\* 80 ft.

#### FIGURE 3-3. MARINE INDUSTRY AND FABRICATOR VESSELS POTENTIALLY HEIGHT-CONSTRAINED DURING CONSTRUCTION

**Two Periods Considered:** 

1) Short term (1 month or less) closure of the primary shipping channel, 72 ft. clearance provided by alternate barge channel 2) Limited vertical clearance (100 ft.) during construction over the primary shipping channel, 23-24 month duration.

= Potential impact during Period 1

= Potential Impact during Period 2

|   |                           |                              | Air<br>Draft | Perio                | od 1 = 72 ft        | vertical cle          | arance              | Period 2 = 100 ft vertical clearance |                     |                      |                     |
|---|---------------------------|------------------------------|--------------|----------------------|---------------------|-----------------------|---------------------|--------------------------------------|---------------------|----------------------|---------------------|
|   | Owner                     | Vessel Name                  |              | @ Ord. High Water *  |                     | @ River Level = 8.65' |                     | @ Ord. High Water *                  |                     | @ River Level = 8.65 |                     |
|   |                           |                              |              | Air gap =<br>10 feet | Air gap =<br>5 feet | Air gap =<br>10 feet  | Air gap =<br>5 feet | Air gap =<br>10 feet                 | Air gap =<br>5 feet | Air gap =<br>10 feet | Air gap =<br>5 feet |
| 1 | Christensen Shipyards LTD | Various                      | 60           |                      |                     |                       |                     |                                      |                     |                      |                     |
| 2 | Greenberry Industrial     | Future poss ble shipment     | 165          |                      |                     |                       |                     |                                      |                     |                      |                     |
| 3 | Oregon Ironworks          | Future poss ble shipment     | 125          |                      |                     |                       |                     |                                      |                     |                      |                     |
| 4 | Thompson Metal Fab Inc    | Largest Reported<br>Shipment | 141          |                      |                     |                       |                     |                                      |                     |                      |                     |

\* Ordinary High Water = 16 ft above 0 Columbia River Datum

\*\* River levels at the I-5 were below 8.65 feet 80 percent of the days for the past 40 years.

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### FIGURE 3-4. MARINE INDUSTRY AND FABRICATOR VESSELS POTENTIALLY HEIGHT-CONSTRAINED DURING CONSTRUCTION

Two Periods Considered:

Short term (1 month or less) closure of the primary shipping channel, 72 ft. clearance provided by alternate barge channel
Limited vertical clearance (100 ft.) during construction over the primary shipping channel, 23-24 month duration.

= Potential impact during Period 1 = Potential Impact during Period 2 Period 1 = 72 ft vertical clearance Period 2 = 100 ft vertical clearance @ River Level = 8.65' @ River Level = 8.65' Air @ Ord. High Water @ Ord. High Water \* Vessel Name Owner Draft Air gap = 10 feet 10 feet 5 feet 10 feet 5 feet 10 feet 5 feet 5 feet Nuclear transporters (Puget 1 Barge 40 51.25 Sound Naval Shipyard) Nuclear transporters (Puget 2 YP 701 L berty Bay 47 Sound Naval Shipyard) Nuclear transporters (Puget 3 YTT 10 Battle Point 74 Sound Naval Shipyard) Tongue Point Job Corps M/V Ironwood 77 4 Maritime Training Program US Army Corps of Engineers 92 Yaquina 5

\* Ordinary High Water = 16 ft above 0 Columbia River Datum

\*\* River levels at the I-5 were below 8.65 feet 80 percent of the days for the past 40 years.

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## 3.5 Passenger Cruise Vessels (see Figure 3-5)

<u>Period 1.</u> A total of eight passenger cruise vessels could potentially be impacted by a 72 ft vertical clearance, depending on the time of year and river stage that this phase of construction would be implemented. At a river stage of 8.65 ft and assuming a 5 ft air gap, the number of potentially impacted vessels would be reduced to four.

<u>Period 2.</u> With a vertical clearance of 100 ft., all passenger cruise vessels other than the *Lady Washington* would be able to pass at OHW. At a river stage of 8.65 ft., the *Lady Washington* would be able to pass with a 5 ft air gap. With an air draft of 85 ft, and an air gap of 5 ft, the *Lady Washington* could pass at times of the year when the river stage is at 10 ft above 0 CRD or less, which occurred on average more than 90% of the days between 1972 and 2012.

## 3.6 Recreational Sailboats (see Figure 3-6)

<u>Period 1.</u> The vessel inventory identified up to 30 sailboats that would potentially be affected by a 72 clearance during this phase. Most (22) would be unable to pass under any of the river stage/air gap scenarios tested.

<u>Period 2.</u> Two recreational sailboats, the *Radiance* and the *Rage* would be potentially constrained during this phase of construction. However, with allowance for a 5 ft air gap, both could pass at least 80% of the time. With an air draft of 85 ft, and an air gap of 5 ft, the *Radiance* could pass at times of the year when the river stage is at 10 ft above 0 CRD or less, which occurred on average more than 90% of the days between 1972 and 2012. Similarly, with an air draft of 80 ft, and a 5 ft air gap, the *Rage* could pass at times of the year when the river stage is at 15 ft above 0 CRD or less, which occurred on average more than 98% of the days during the same period.

## 3.7 Potential Mitigation for Construction-Related Navigation Restrictions

<u>Period 1.</u> Due to the potentially large number of impacted vessels, and the short anticipated duration of this construction period, proposed mitigation efforts will include direct advance notice to all potentially affected parties, as well as more broadly distributed construction bulletins to appropriate outlets (e.g., the USCG Local Notice to Mariners), so that potentially affected river users can schedule passages through the construction zone outside of the constricted time period.

As described above, the number of potentially impacted vessels/river users will depend on the time of year when this phase of construction takes place. The current schedule anticipates Phase 1 to occur in December, which is typically a period of lower activity on the river, particularly for recreational activity. Federal vessels are a special case for this phase of construction. Since the *Yaquina* is used routinely for maintenance dredging in August/September each year, contract requirements for the bridge contractor should include restrictions on the time of year that this Period could be implemented, including a prohibition on implementing Period 1 during August-September.

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#### FIGURE 3-5. PASSENGER CRUISE VESSELS POTENTIALLY HEIGHT-CONSTRAINED DURING CONSTRUCTION

Two Periods Considered:

\*

\*\*

Short term (1 month or less) closure of the primary shipping channel, 72 ft. clearance provided by alternate barge channel
Limited vertical clearance (100 ft.) during construction over the primary shipping channel, 23-24 month duration.

= Potential impact during Period 1

= Potential Impact during Period 2

|   |  |                                 |              | Perio                | od 1 = 72 ft        | vertical cle          | arance              | Period 2 = 100 ft vertical clearance |                     |                       |                     |
|---|--|---------------------------------|--------------|----------------------|---------------------|-----------------------|---------------------|--------------------------------------|---------------------|-----------------------|---------------------|
|   | Owner  | Vessel Name                     | Air<br>Draft | @ Ord. High Water *  |                     | @ River Level = 8.65' |                     | @ Ord. High Water *                  |                     | @ River Level = 8.65' |                     |
|   |  |                                 |              | Air gap =<br>10 feet | Air gap =<br>5 feet | Air gap =<br>10 feet  | Air gap =<br>5 feet | Air gap =<br>10 feet                 | Air gap =<br>5 feet | Air gap =<br>10 feet  | Air gap =<br>5 feet |
| 1 | American Cruise Lines                            | Queen of the West               | 64.3         |                      |                     |                       |                     |                                      |                     |                       |                     |
| 2 | American Safari Cruises/<br>InnerSea Discoveries | Safari Legacy                   | 52           |                      |                     |                       |                     |                                      |                     |                       |                     |
| 3 | American Waterways Inc.                          | Crystal Dolphin                 | 50           |                      |                     |                       |                     |                                      |                     |                       |                     |
| 4 | American Waterways Inc.                          | Portland Spirit                 | 54           |                      |                     |                       |                     |                                      |                     |                       |                     |
| 5 | Grays Harbor Historical<br>Seaport               | Hawaiian Chieftain              | 74           |                      |                     |                       |                     |                                      |                     |                       |                     |
| 6 | Grays Harbor Historical<br>Seaport               | The Lady Washington             | 85           |                      |                     |                       |                     |                                      |                     |                       |                     |
| 7 | Linblad Expeditions, Inc                         | National Geographic Sea<br>Bird | 59           |                      |                     |                       |                     |                                      |                     |                       |                     |
| 8 | Linblad Expeditions, Inc                         | National Geographic Sea<br>Lion | 59           |                      |                     |                       |                     |                                      |                     |                       |                     |

Ordinary High Water = 16 ft above 0 Columbia River Datum

River levels at the I-5 were below 8.65 feet 80 percent of the days for the past 40 years.

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#### FIGURE 3-6. RECREATIONAL SAILBOATS POTENTIALLY HEIGHT-CONSTRAINED DURING CONSTRUCTION

Two Periods Considered:

Short term (1 month or less) closure of the primary shipping channel, 72 ft. clearance provided by alternate barge channel
Limited vertical clearance (100 ft.) during construction over the primary shipping channel, 23-24 month duration.

= Potential impact during Period 1

= Potential Impact during Period 2

|    |                       |               |              | Perio                | od 1 = 72 ft        | vertical cle         | arance                      | Period 2 = 100 ft vertical clearance |                     |                       |                     |  |
|----|-----------------------|---------------|--------------|----------------------|---------------------|----------------------|-----------------------------|--------------------------------------|---------------------|-----------------------|---------------------|--|
|    | Owner                 | Vessel Name   | Air<br>Draft | @ Ord. H             | @ Ord. High Water * |                      | @ River Level = 8.65'<br>** |                                      | h Water *           | @ River Level = 8.65' |                     |  |
|    |                       |               |              | Air gap =<br>10 feet | Air gap =<br>5 feet | Air gap =<br>10 feet | Air gap =<br>5 feet         | Air gap =<br>10 feet                 | Air gap =<br>5 feet | Air gap =<br>10 feet  | Air gap =<br>5 feet |  |
| 1  | Legendary Yachts, Inc | Radiance      | 85           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 2  | McClure Loving Trust  | Nancy Riley   | 71           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 3  | Portland Yacht Club   | Camelot       | 62           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 4  | Portland Yacht Club   | Galatea       | 61           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 5  | Portland Yacht Club   | Halsey        | 66           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 6  | Portland Yacht Club   | High Flight   | 51           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 7  | Portland Yacht Club   | Luscious      | 65           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 8  | Portland Yacht Club   | Moondance     | 59           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 9  | Portland Yacht Club   | Runaway       | 70           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 10 | Portland Yacht Club   | Rya           | 66           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 11 | Portland Yacht Club   | Saphira       | 54           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 12 | Portland Yacht Club   | Sargasso      | 65           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 13 | Portland Yacht Club   | Sovereign     | 58           |                      |                     |                      |                             |                                      |                     |                       |                     |  |
| 14 | Private Owner         | Stella Polare | 68           |                      |                     |                      |                             |                                      |                     |                       |                     |  |

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| <b>—</b> |                           | 0.1.1           |      |  |  |  |  |
|----------|---------------------------|-----------------|------|--|--|--|--|
| 15       | Portland Yacht Club       | Sylvia          | 58   |  |  |  |  |
| 16       | Portland Yacht Club       | Tropicale       | 61   |  |  |  |  |
| 17       | Portland Yacht Club       | Whisper         | 74   |  |  |  |  |
| 18       | Private Owner             | Autumn Wind     | 72   |  |  |  |  |
| 19       | Private Owner             | Benicia         | 50   |  |  |  |  |
| 20       | Private Owner             | Magic Pearl     | 56   |  |  |  |  |
| 21       | Private Owner             | Mistral         | 65   |  |  |  |  |
| 22       | Private Owner             | Moonstruck      | 63   |  |  |  |  |
| 23       | Private Owner             | Riva            | 64.5 |  |  |  |  |
| 24       | Private Owner             | Wakadui         | 66   |  |  |  |  |
| 25       | Private Owner             | Wind Dancing    | 66   |  |  |  |  |
| 26       | Private Owner             | Crystal Swan    | 63   |  |  |  |  |
| 27       | Private Owner             | Down Wind Drift | 59   |  |  |  |  |
| 28       | Rose City Yacht Club      | Draco           | 60   |  |  |  |  |
| 29       | Rose City Yacht Club      | Morgan Le Fay   | 58   |  |  |  |  |
| 30       | Schooner Creek Boat Works | Rage            | 80   |  |  |  |  |

\* Ordinary High Water = 16 ft above 0 Columbia River Datum

\*\* River levels at the I-5 were below 8.65 feet 80 percent of the days for the past 40 years.

<u>Period 2.</u> For construction barges, the extended duration of Phase 2 means that passages can be planned to occur at non-peak river stages. In addition, a reduced air gap of 5 ft. is adequate for a temporary condition. This limits the number of potentially impacted vessels to 6 -16 (depending on river stage). Some may be deployed to work on the bridge construction. Others that may be deployed to work elsewhere upriver of the bridge may need to consider temporary modifications such as removing spuds or reconfiguring crane gantries.

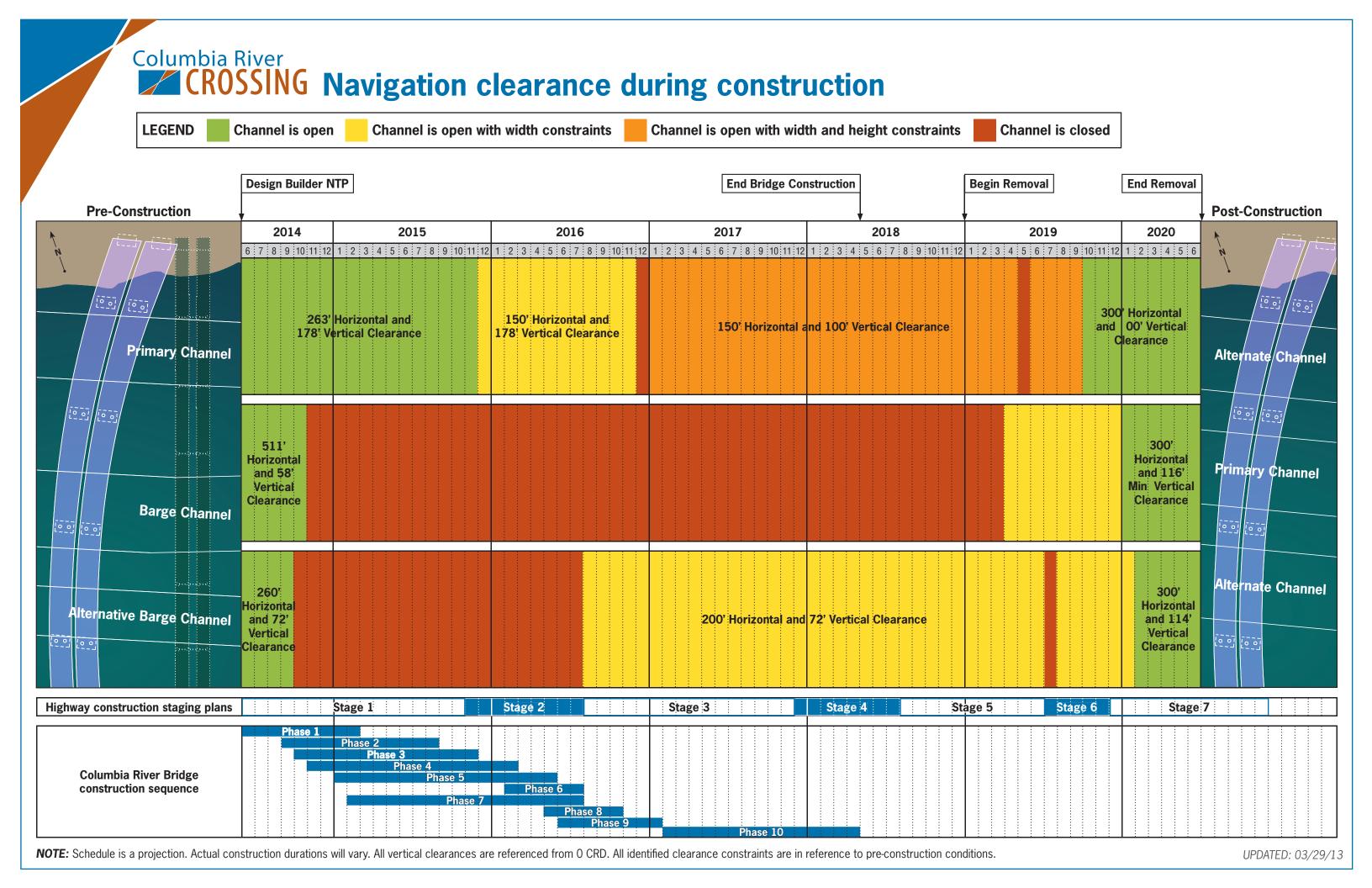
For the fabricators, the vertical limitations during construction will restrict their ability to ship large products during both Period 1 and Period 2. Such restrictions should be considered in the discussion of mitigation needs for the fabricators.

For federal vessels no mitigation is anticipated, as the *M/V Ironwood* can pass at OHW with a 5 ft air gap, and the dredge *Yaquina* can pass with a 5 ft air gap under average river stage conditions for August and September.

No mitigation is anticipated for passenger cruise vessels or recreational sailboats, as all identified vessels can pass during a high percentage of the days during this construction period.

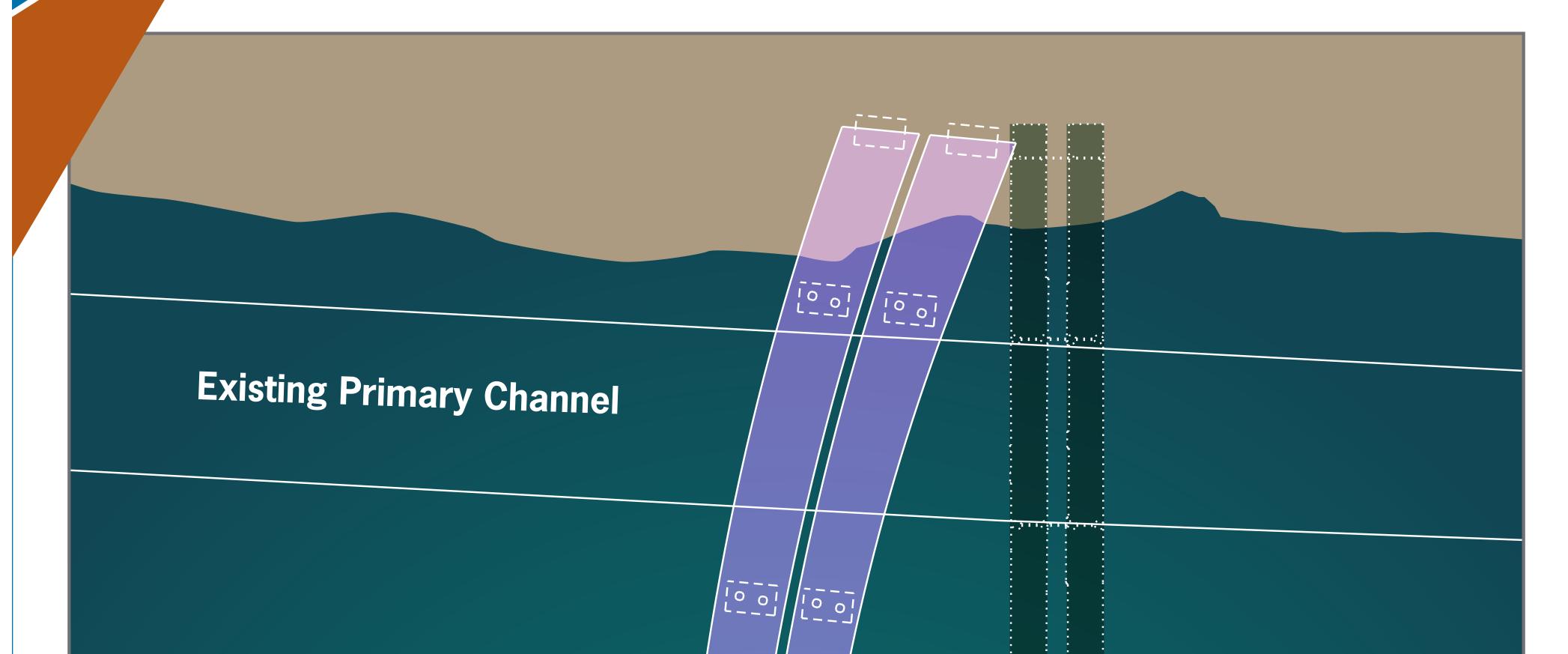
3-20 Conceptual Staging Narrative Draft Report

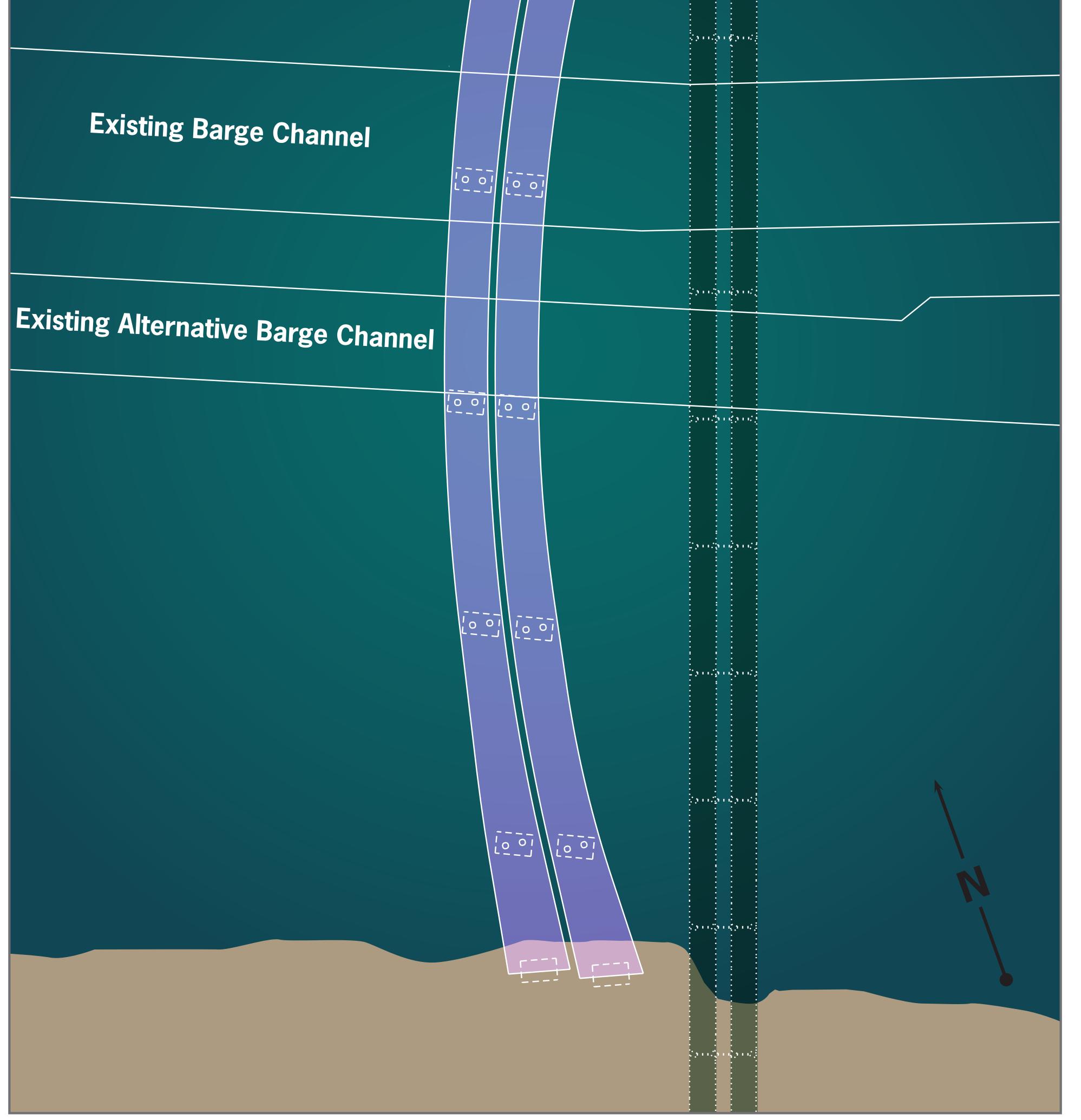
Appendix A Plan View of Navigation Channels



Appendix B Profile View of Existing Primary Navigation Channel

## Columbia River CROSSING Navigation Channels



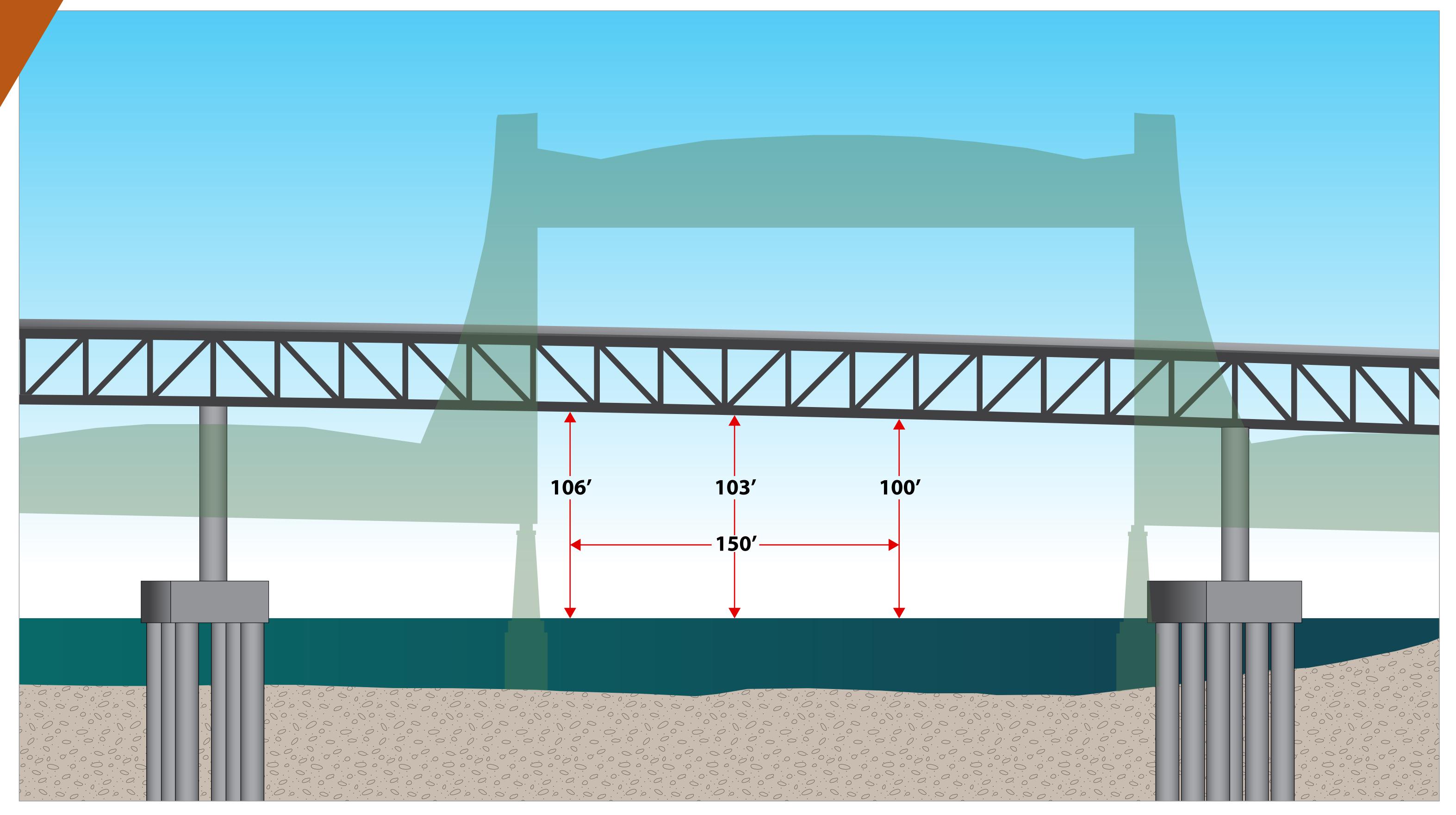


For illustration purposes only, not to scale.

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Appendix C Navigation Clearance During Construction

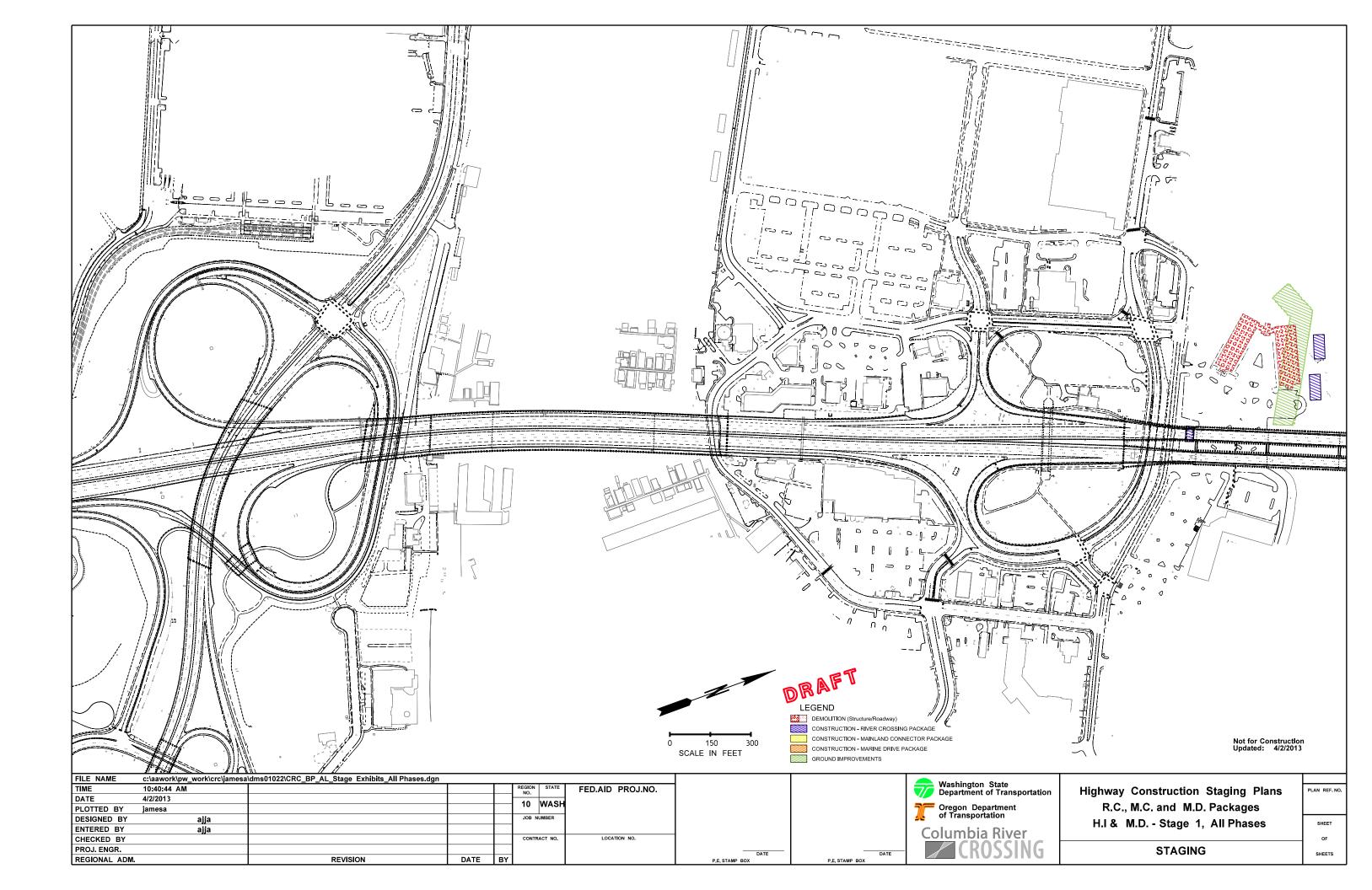
## Columbia River CROSSING Existing Primary Navigation Channel

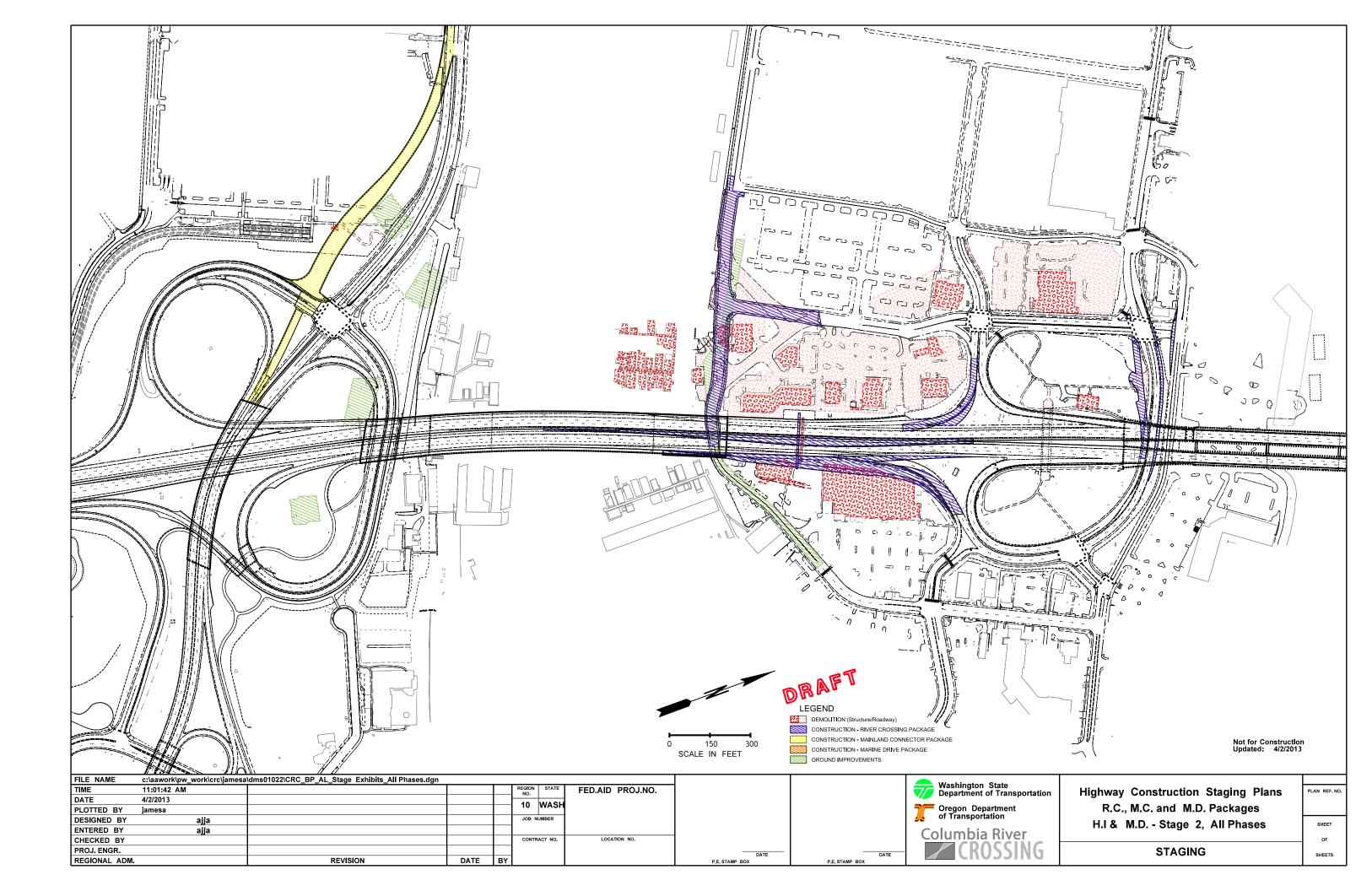


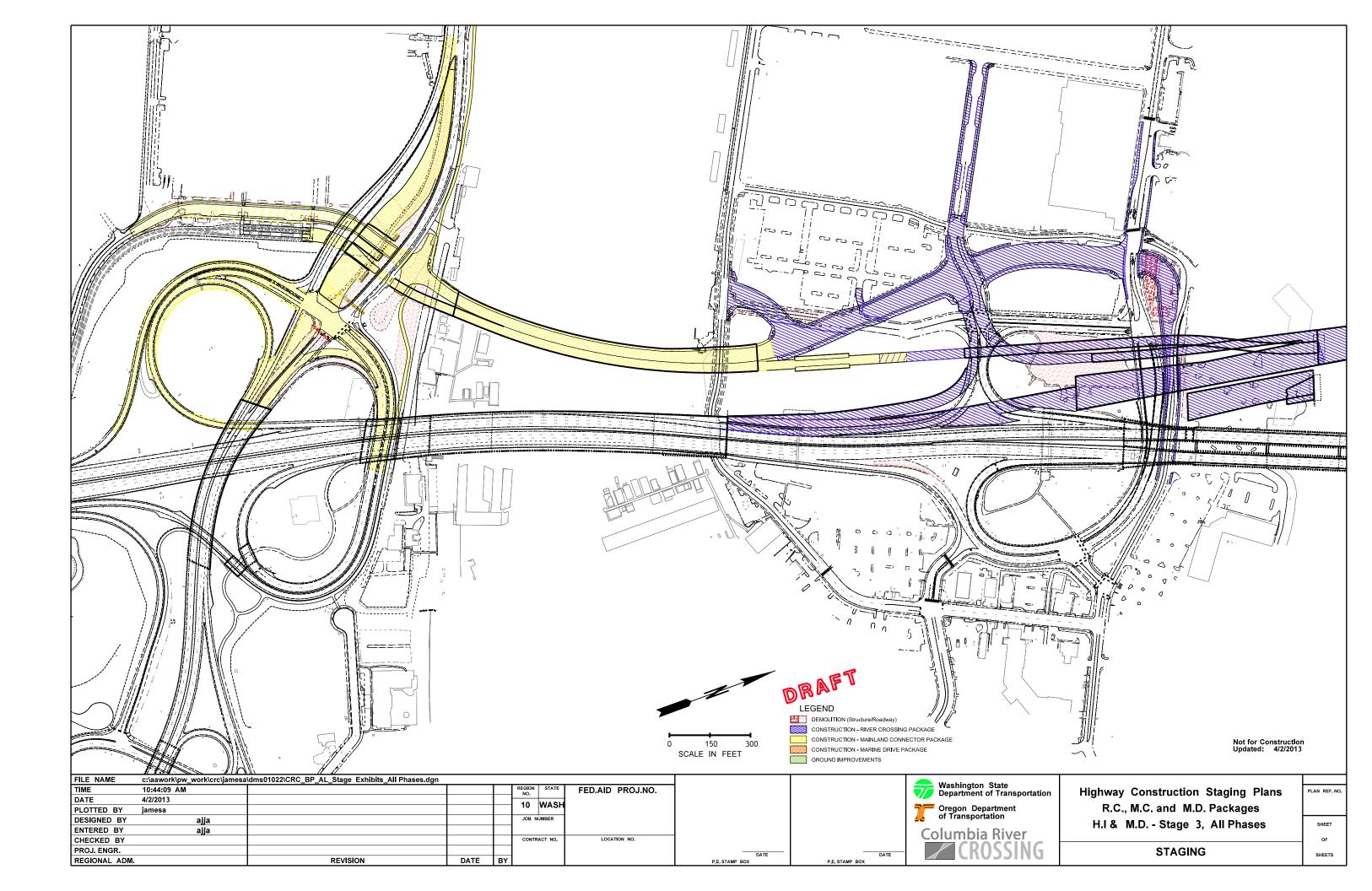
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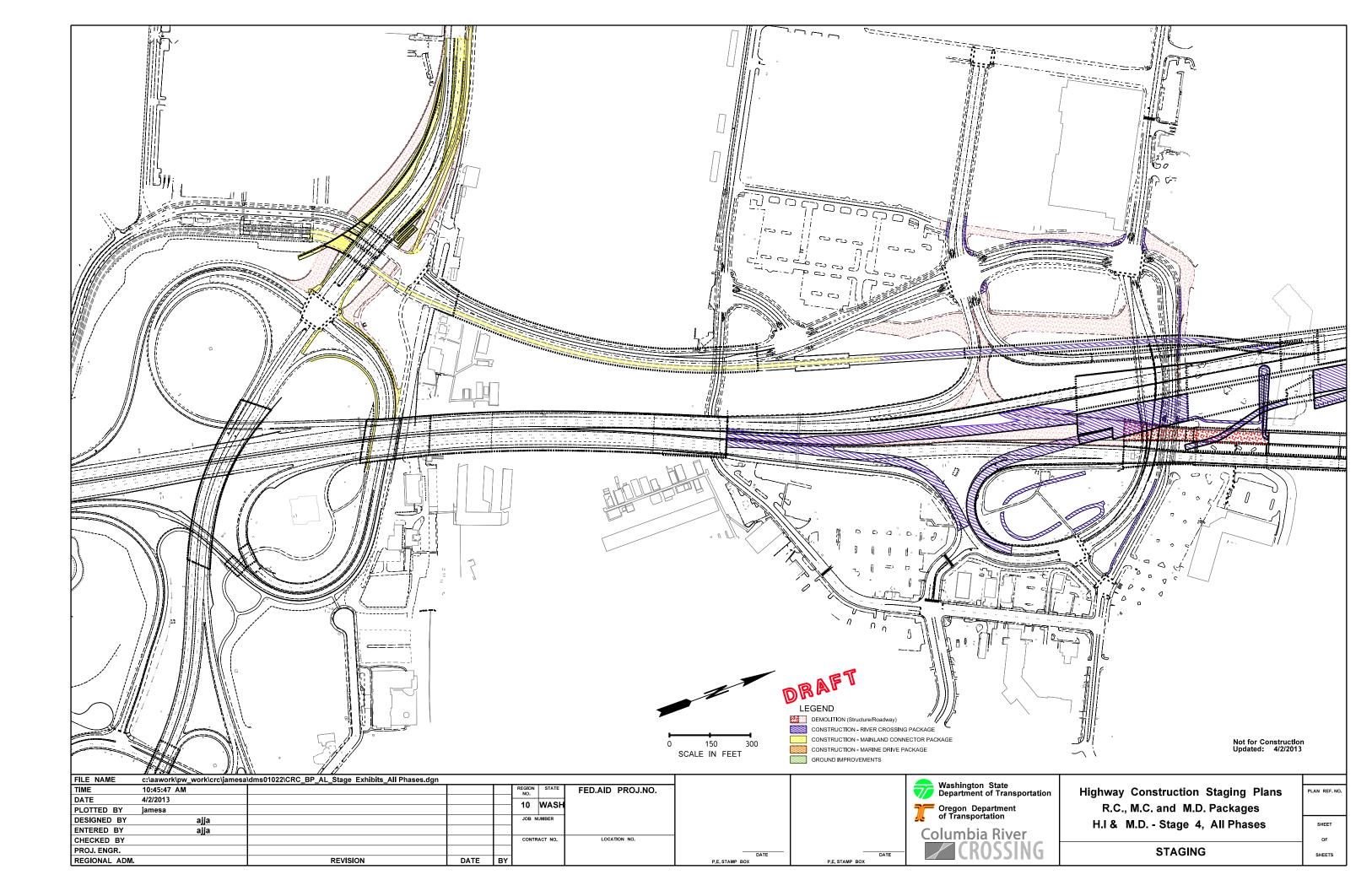
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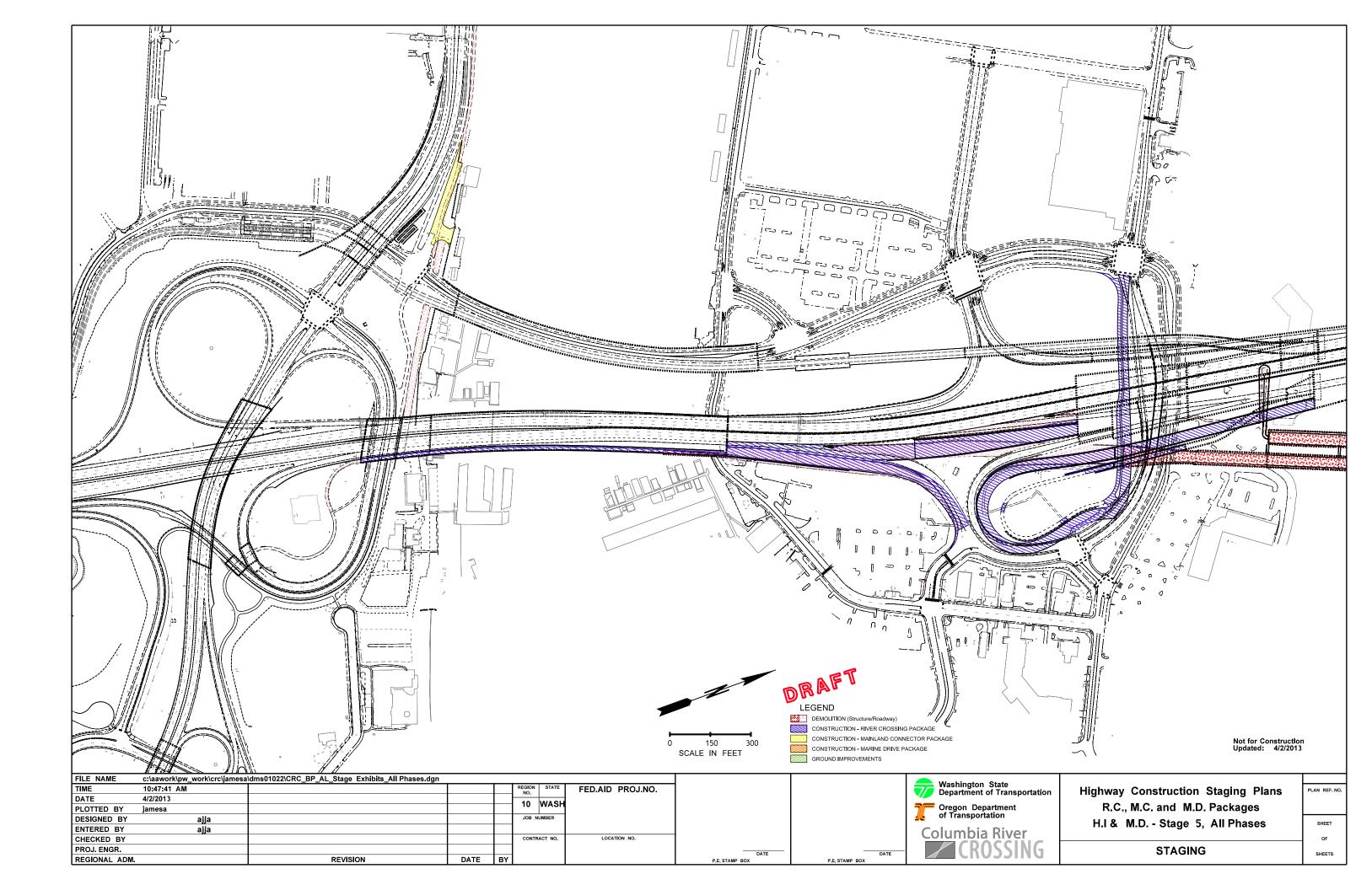
Appendix D Stage Exhibits Hayden Island

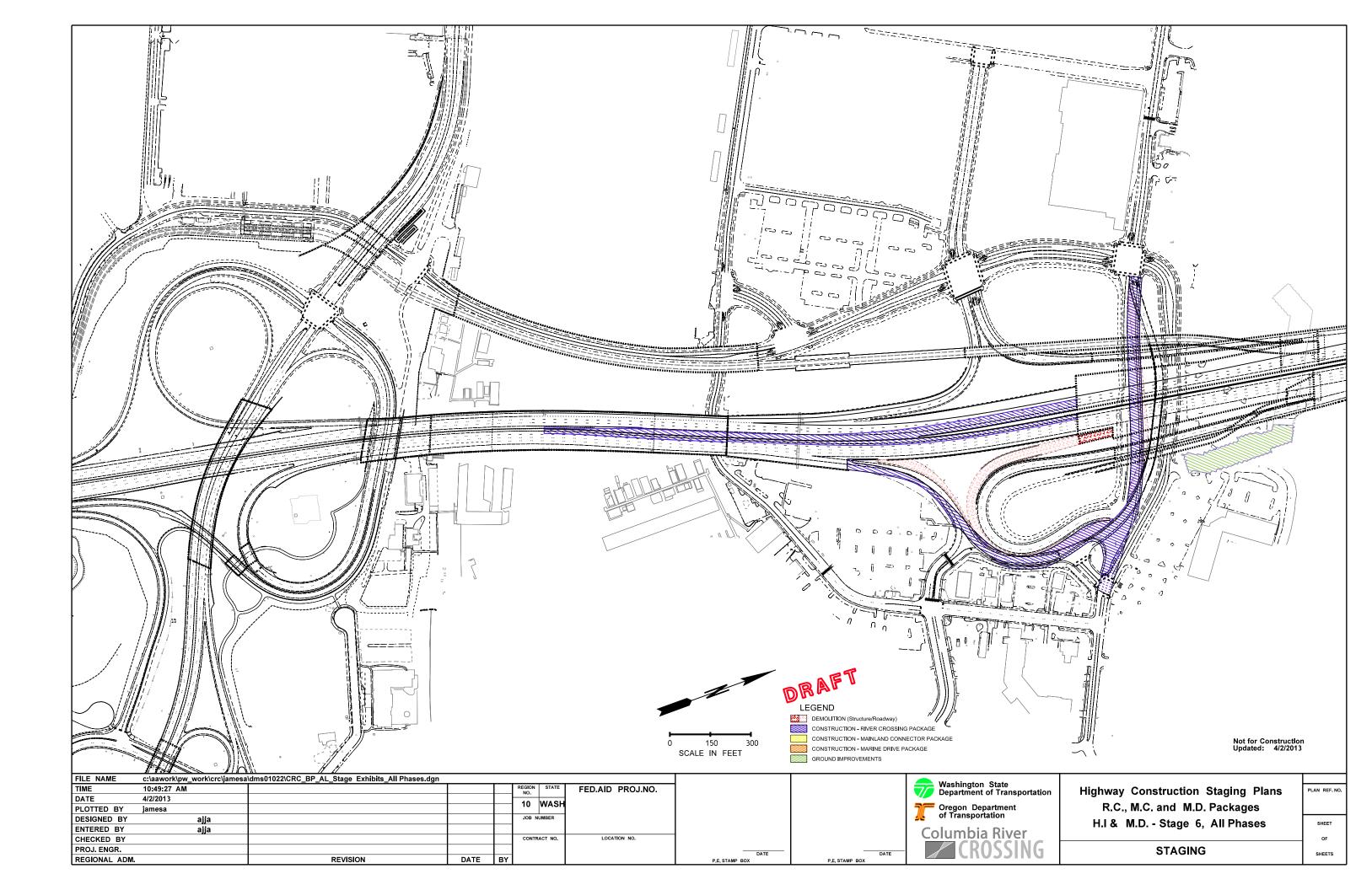


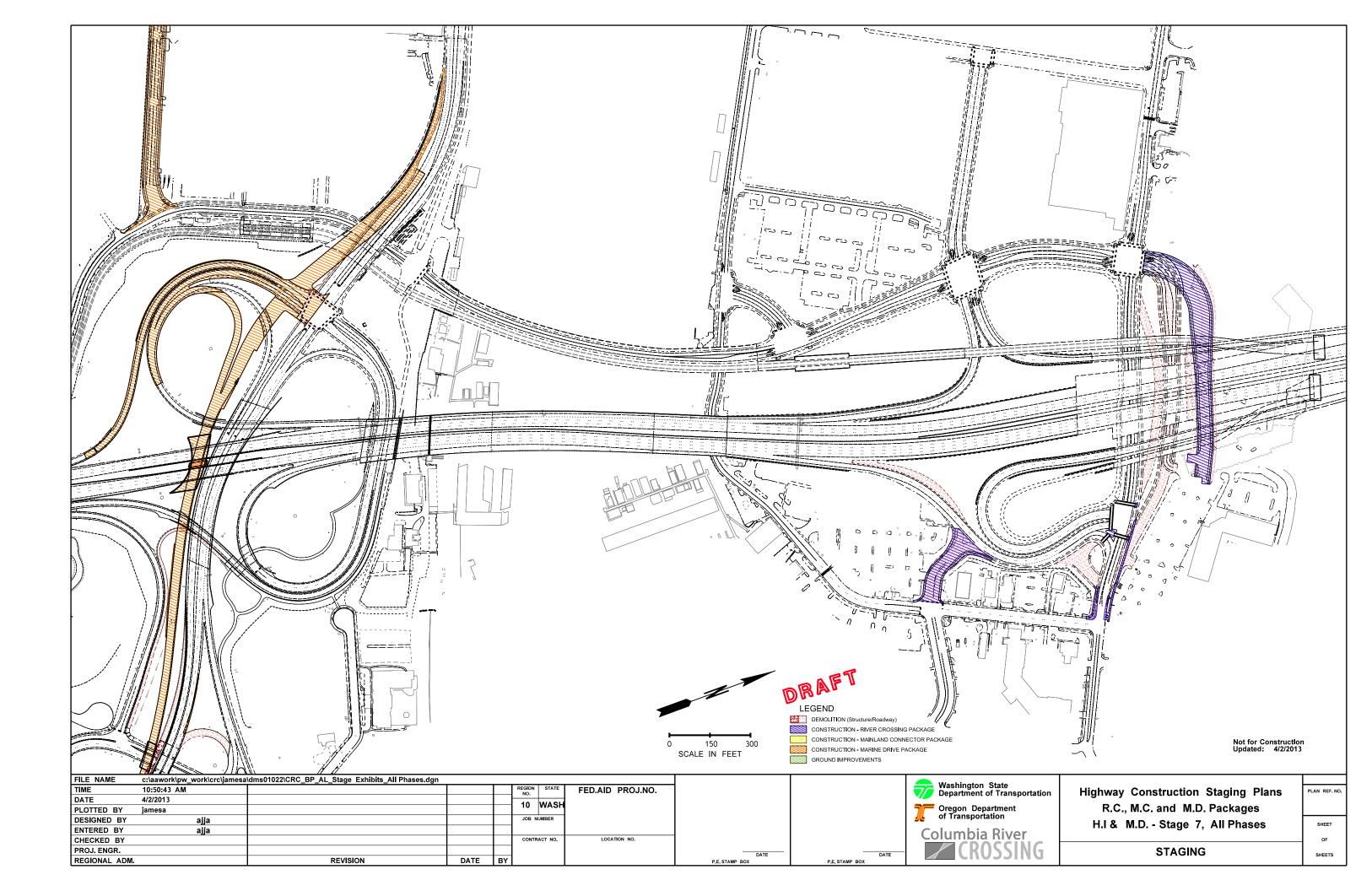




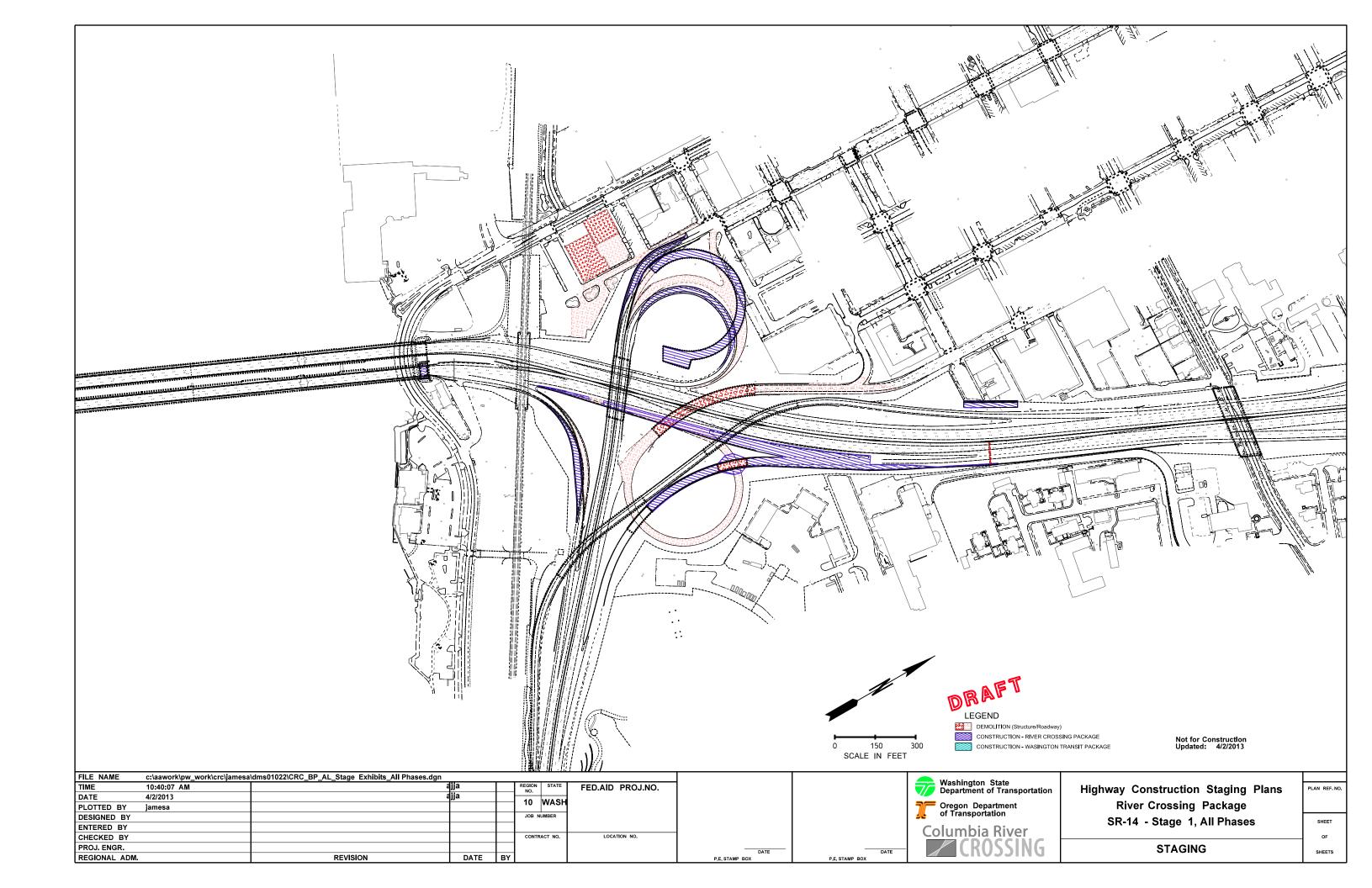


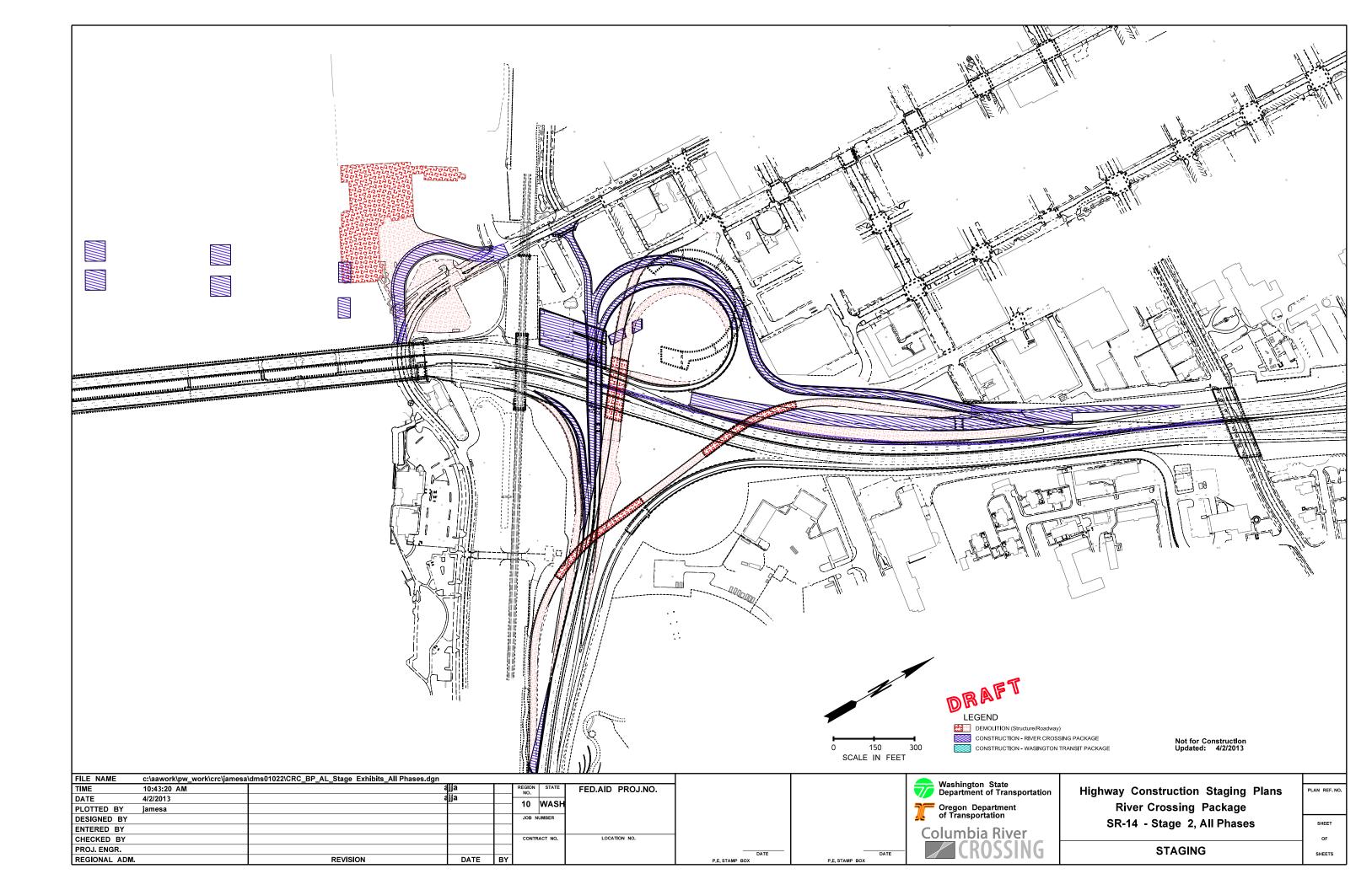


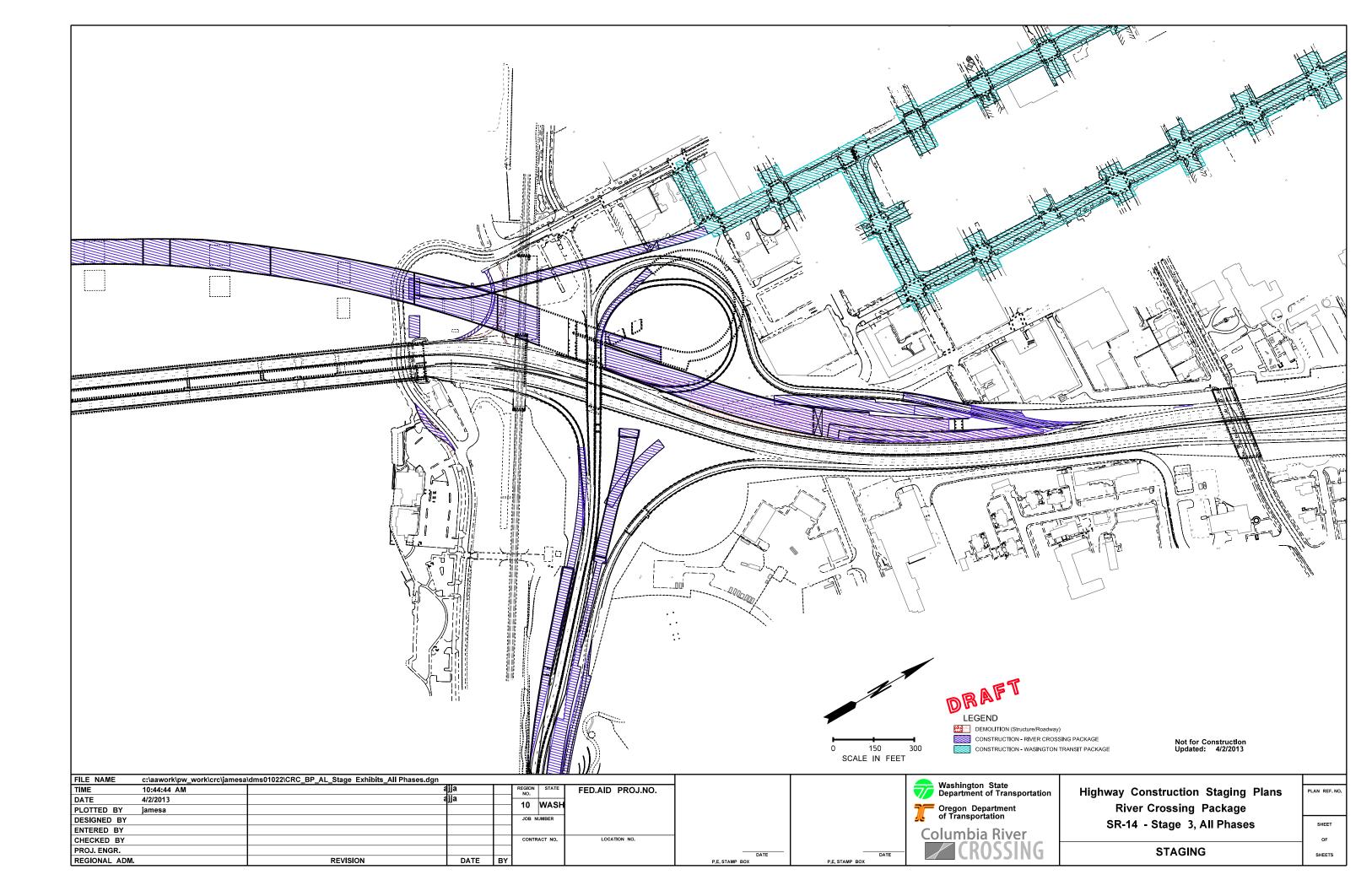


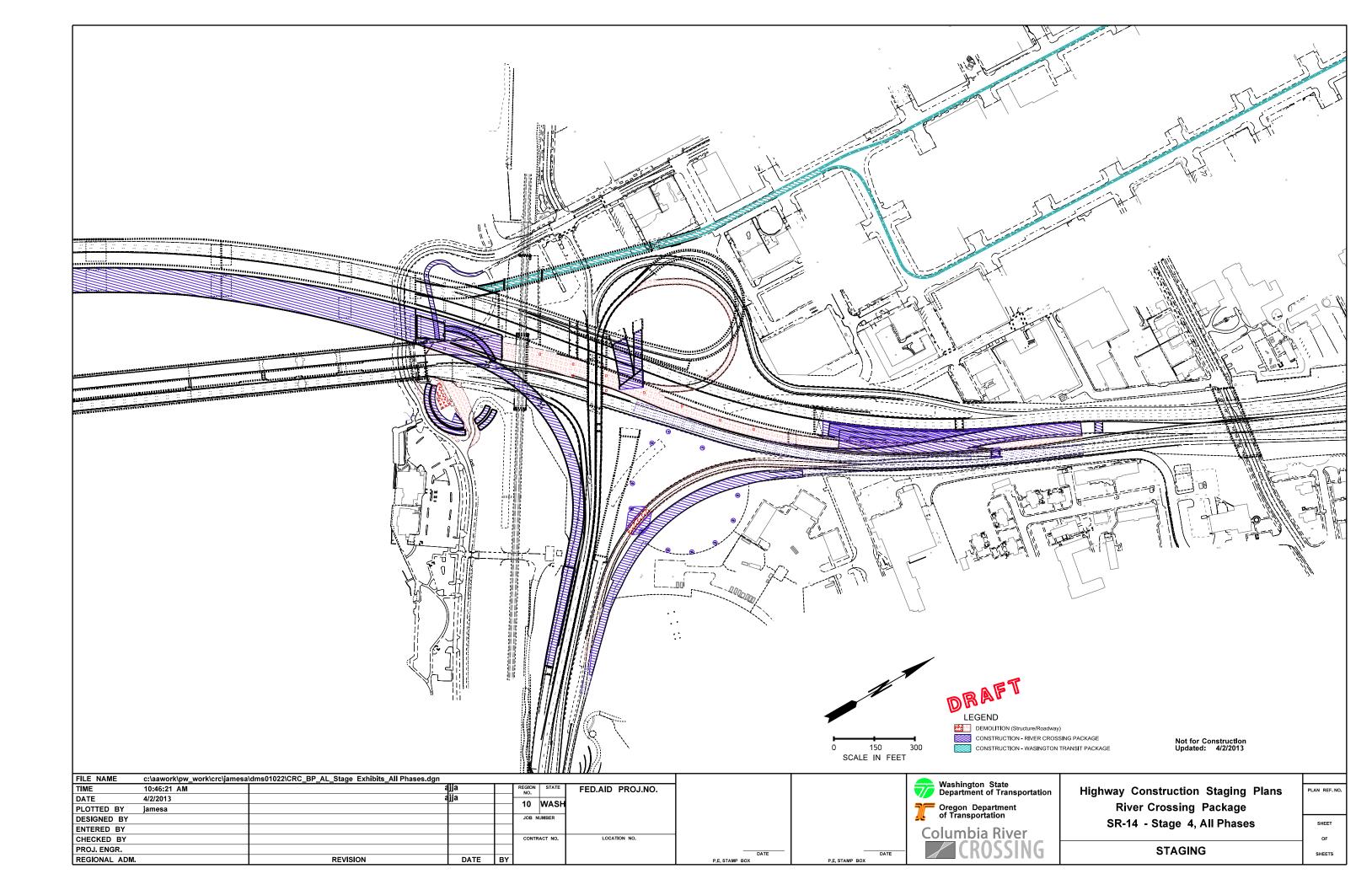


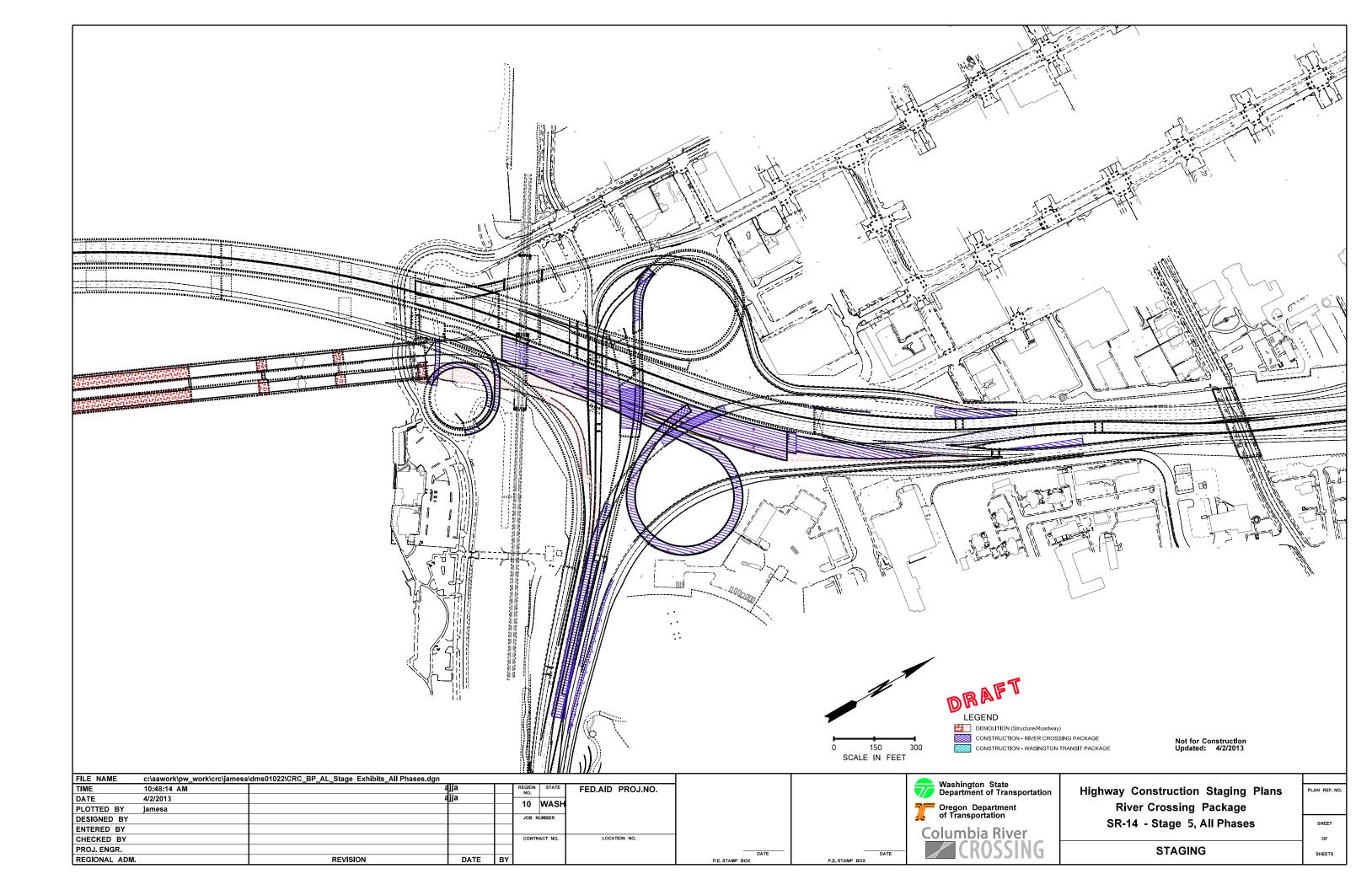
Appendix E Stage Exhibits SR-14

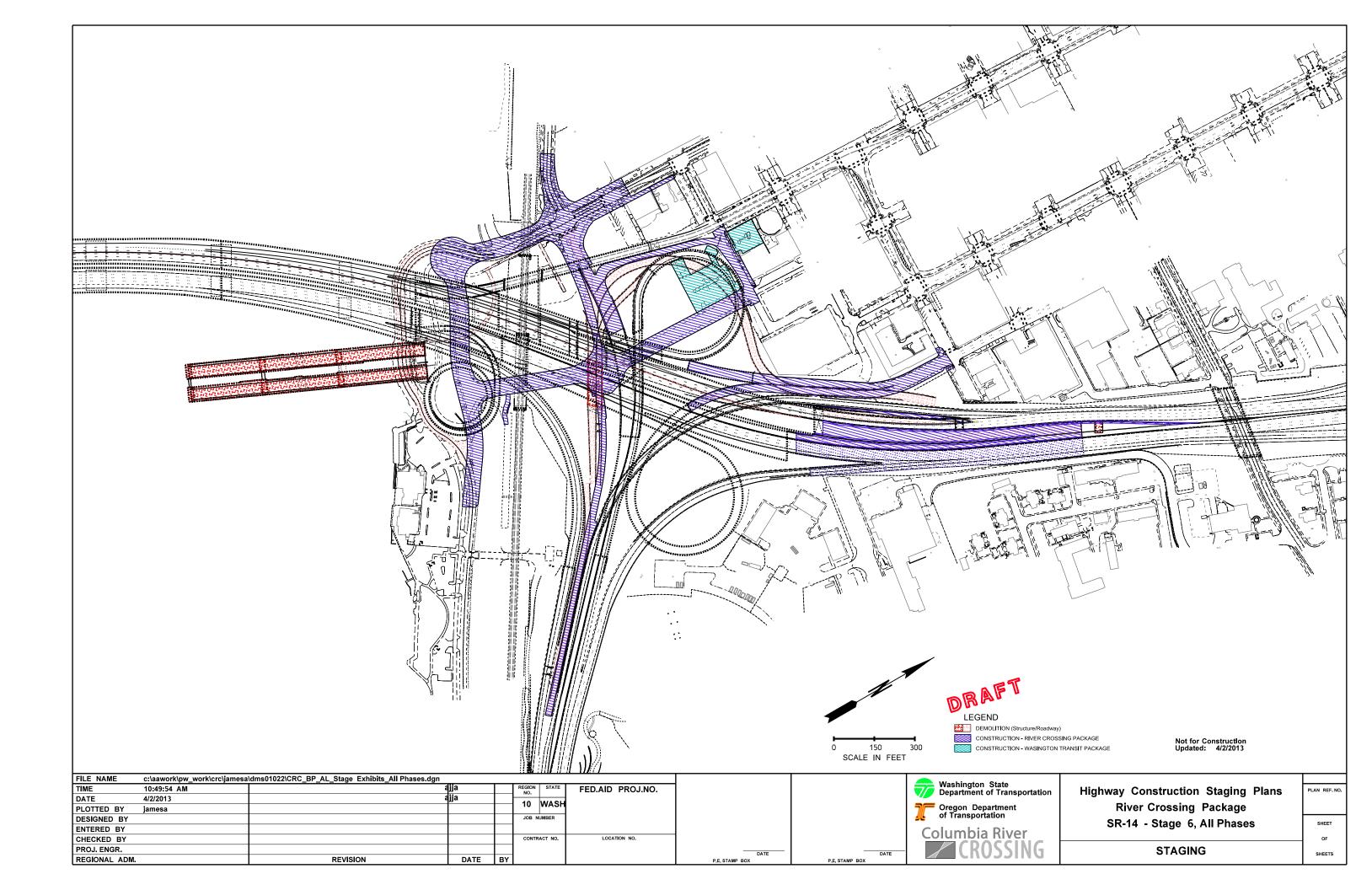


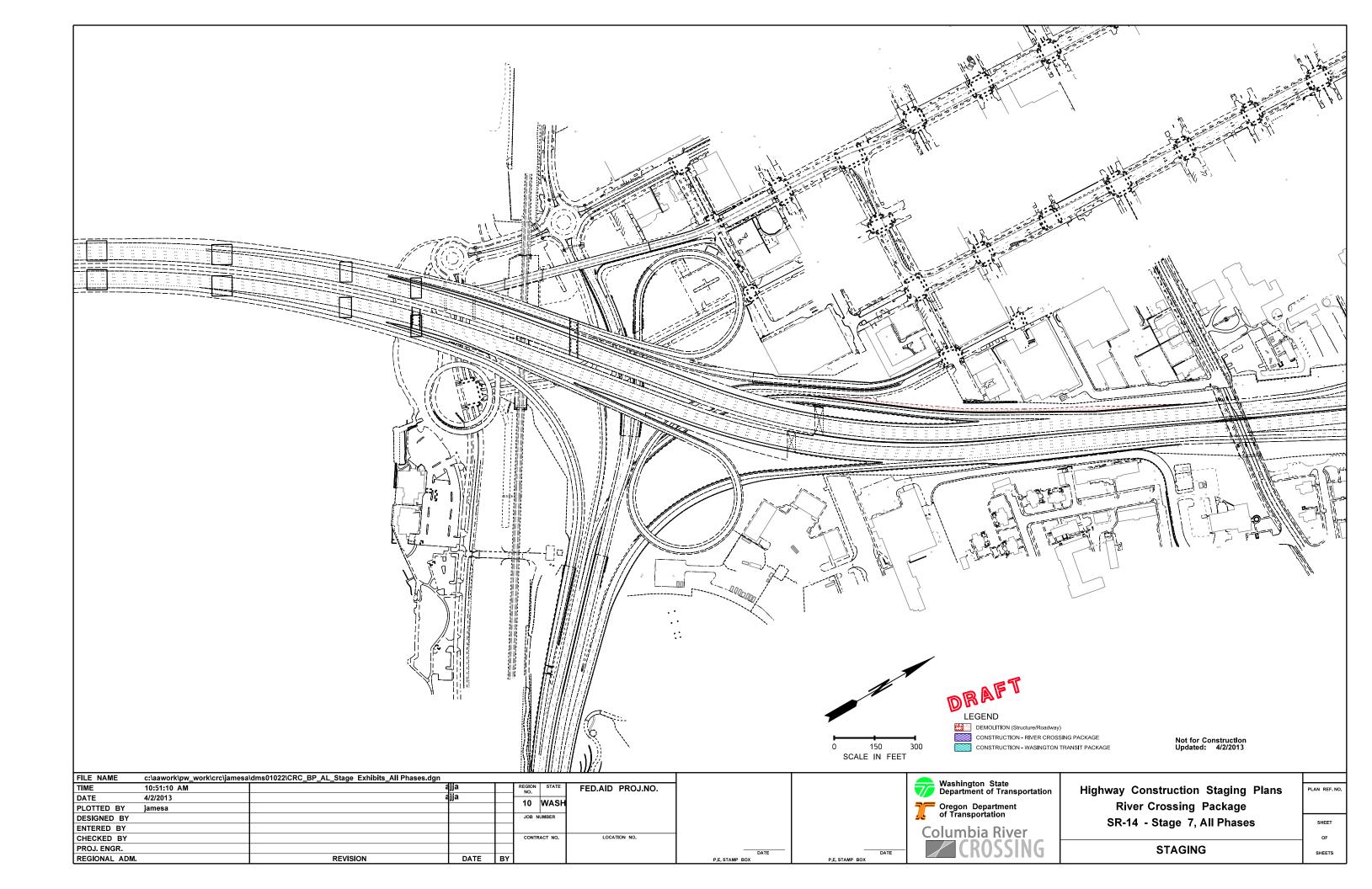




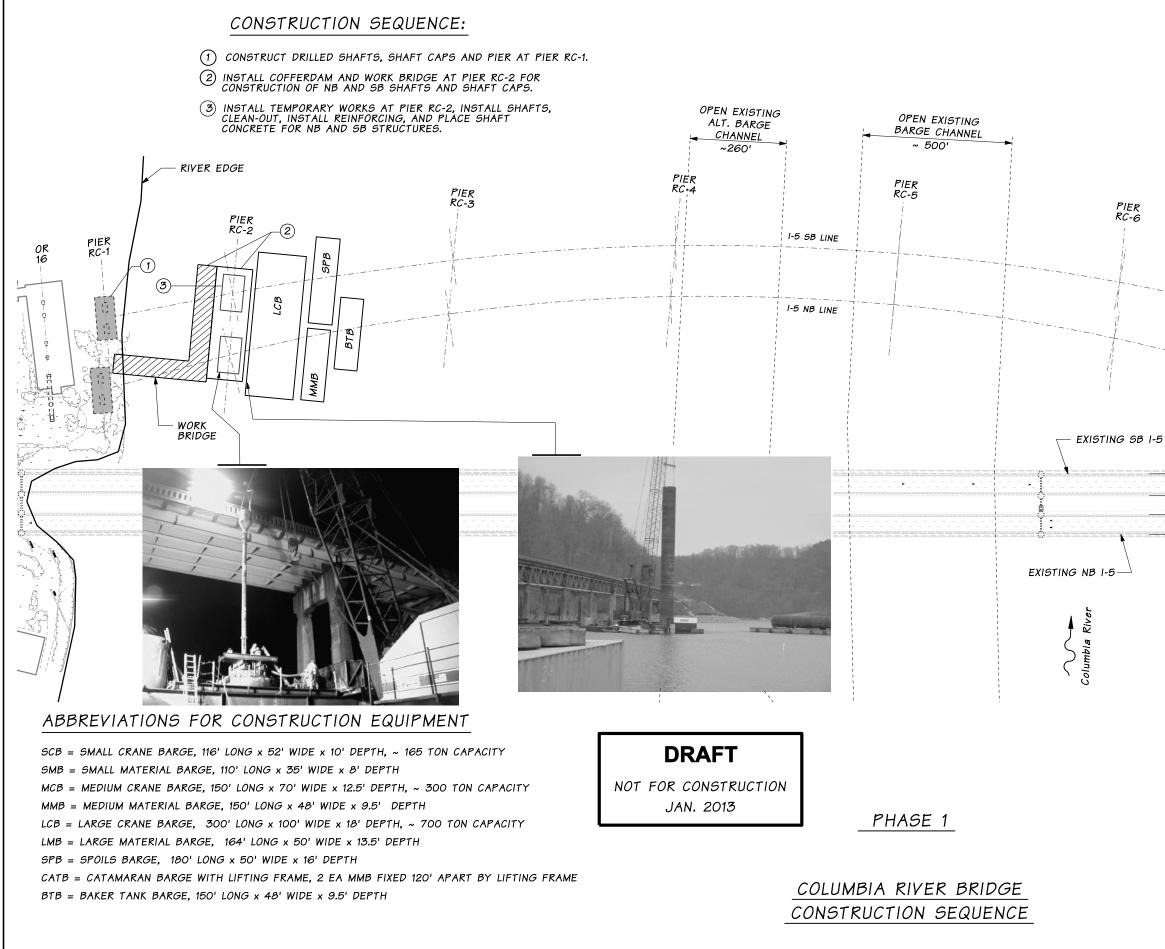




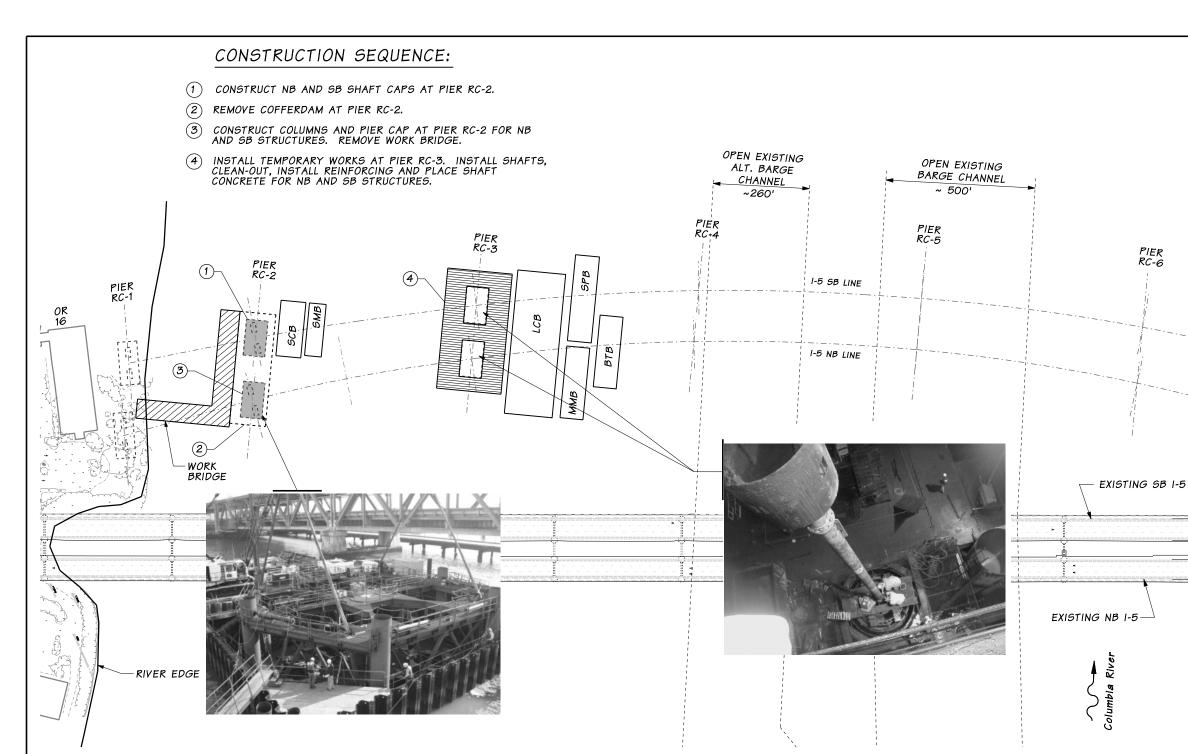




Appendix F Columbia River Bridge Construction Sequence



## DRAFT OPEN EXISTING PRIMARY CHANNEL ~ 260' PIER RC-PIER RC-8 RIVER EDGE 50 **CONCEPTUAL DESIGN** Columbia River CROSSING \*



### 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
- BTB = BAKER TANK BARGE, 150' LONG x 48' WIDE x 9.5' DEPTH

DRAFT NOT FOR CONSTRUCTION JAN. 2013

PHASE 2

COLUMBIA RIVER BRIDGE CONSTRUCTION SEQUENCE

## DRAFT OPEN EXISTING PRIMARY CHANNEL ~ 260' PIER RC-PIER RC-8 RIVER EDGE 53 **CONCEPTUAL DESIGN** Columbia River CROSSING \*

### CONSTRUCTION SEQUENCE: (5) INSTALL TEMPORARY BENTS ON THE PILE CAP AT EACH SIDE OF PIER RC-2 NB. 6 ERECT THE NB TRUSSES FROM PIER RC-1 ACROSS THE TEMPORARY BENT (5 TOTAL PANELS). (1) FLOAT-IN PREFABRICATED SHAFT CAP AT PIER RC-3. CONSTRUCT NB AND SB SHAFT CAPS. 7 ERECT THE NB TRUSSES AT PIER RC-2 USING BALANCED CANTILEVER METHODS ACROSS THE TEMPORARY BENTS (4 PANELS BACK STATION AND 3 PANELS AHEAD STATION). 2 CONSTRUCT COLUMNS AND PIER CAP AT PIER RC-3 FOR NB (8) CLOSE THE NB TRUSSES IN SPAN 1. AND SB STRUCTURES. REMOVE TEMPORARY WORKS. 9 REMOVE TEMPORARY BENTS FOR NB BRIDGE AND REPEAT PROCEDURE FOR SPAN 1 INSTALL TEMPORARY WORKS AT PIER RC-4, INSTALL SHAFTS, CLEAN-OUT, INSTALL REINFORCING, AND PLACE SHAFT CONCRETE FOR NB AND SB STRUCTURES. (3) OF THE SB BRIDGE. OPEN EXISTING CLOSED EXISTING BARGE CHANNEL ALT. BARGE ~ 500' (4) CONSTRUCT TEMPORARY BENT NEAR PIER RC-1 NB. CHANNEL ~260' PIER PIER RC-5 ВТВ RC+4 PIER RC-3 PIER RC-2 PIER RC-6 1)-1-5 SB LINE PIER RC-1 ane SCB あ OR CB 16 11 (2)-1-5 NB LINE (5)

# RIVER EDGE

IMCB

-(8

-(4)

6

- 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

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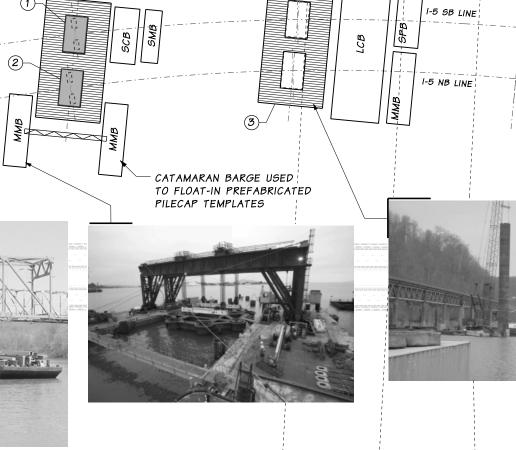
BTB = BAKER TANK BARGE, 150' LONG x 48' WIDE x 9.5' DEPTH

PHASE 3

COLUMBIA RIVER BRIDGE

.....

EXISTING NB 1-5



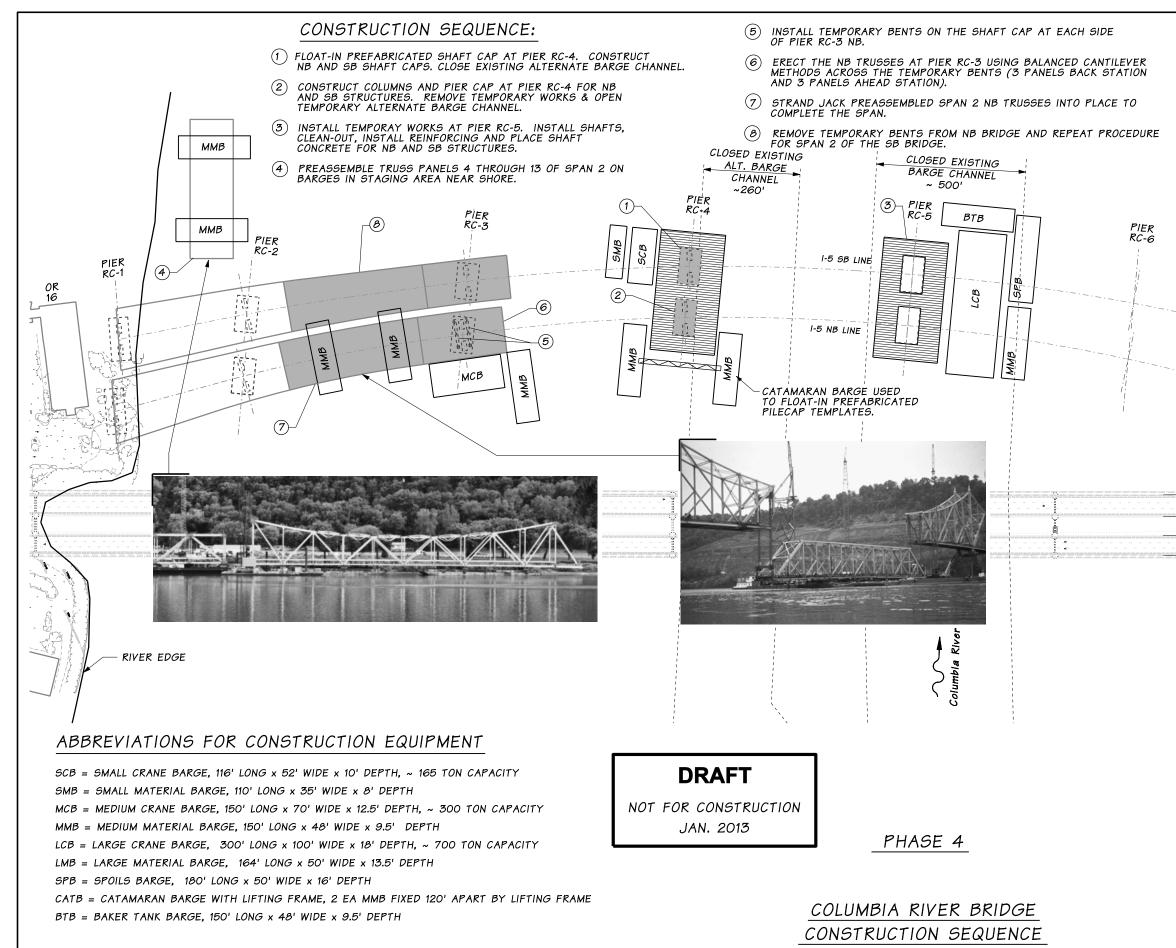
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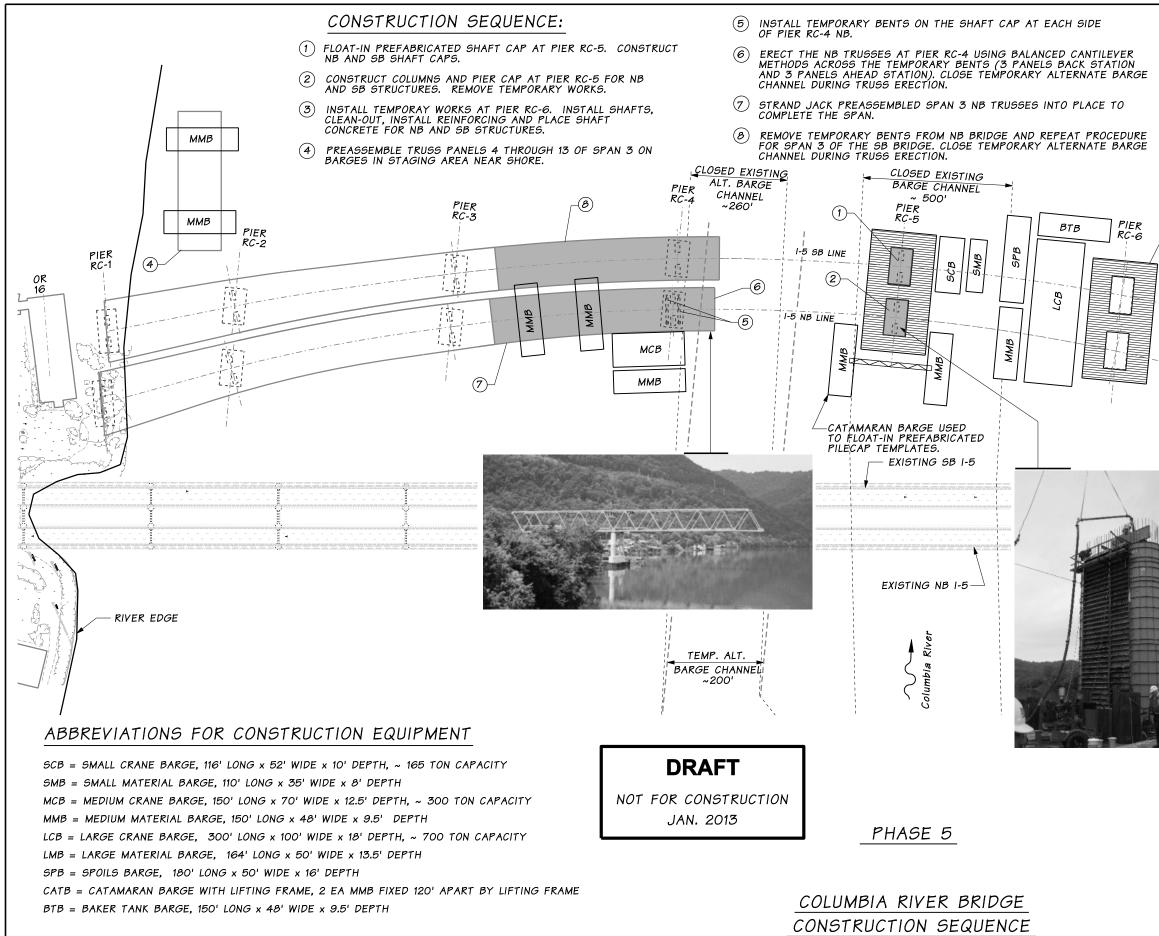
JAN. 2013

### DRAFT The R OPEN EXISTING PRIMARY CHANNEL ~ 260' PTER RC-PIER RC-8 EXISTING SB 1-5 RIVER EDGE -53 **CONCEPTUAL DESIGN** Columbia River CROSSIN

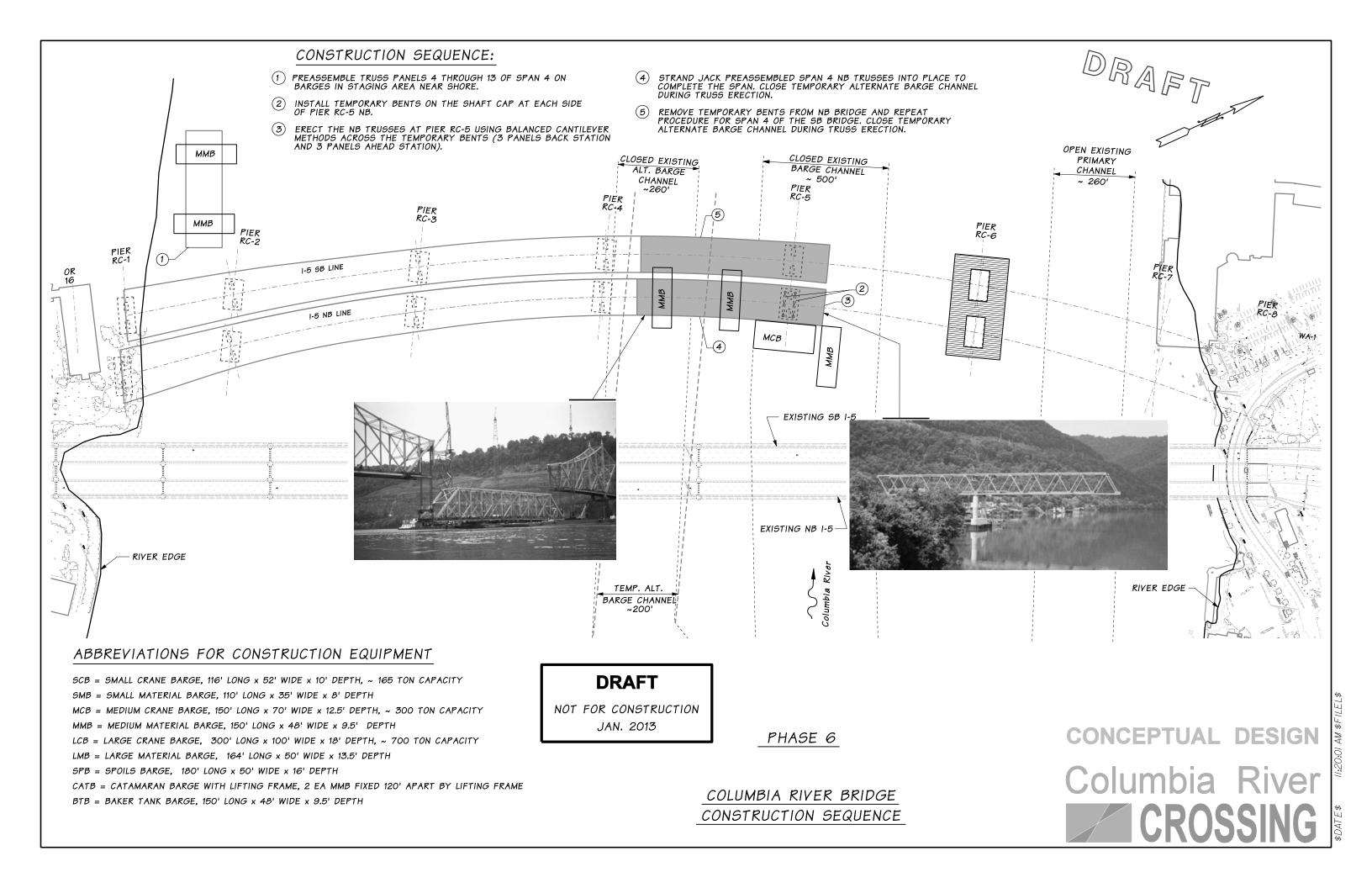
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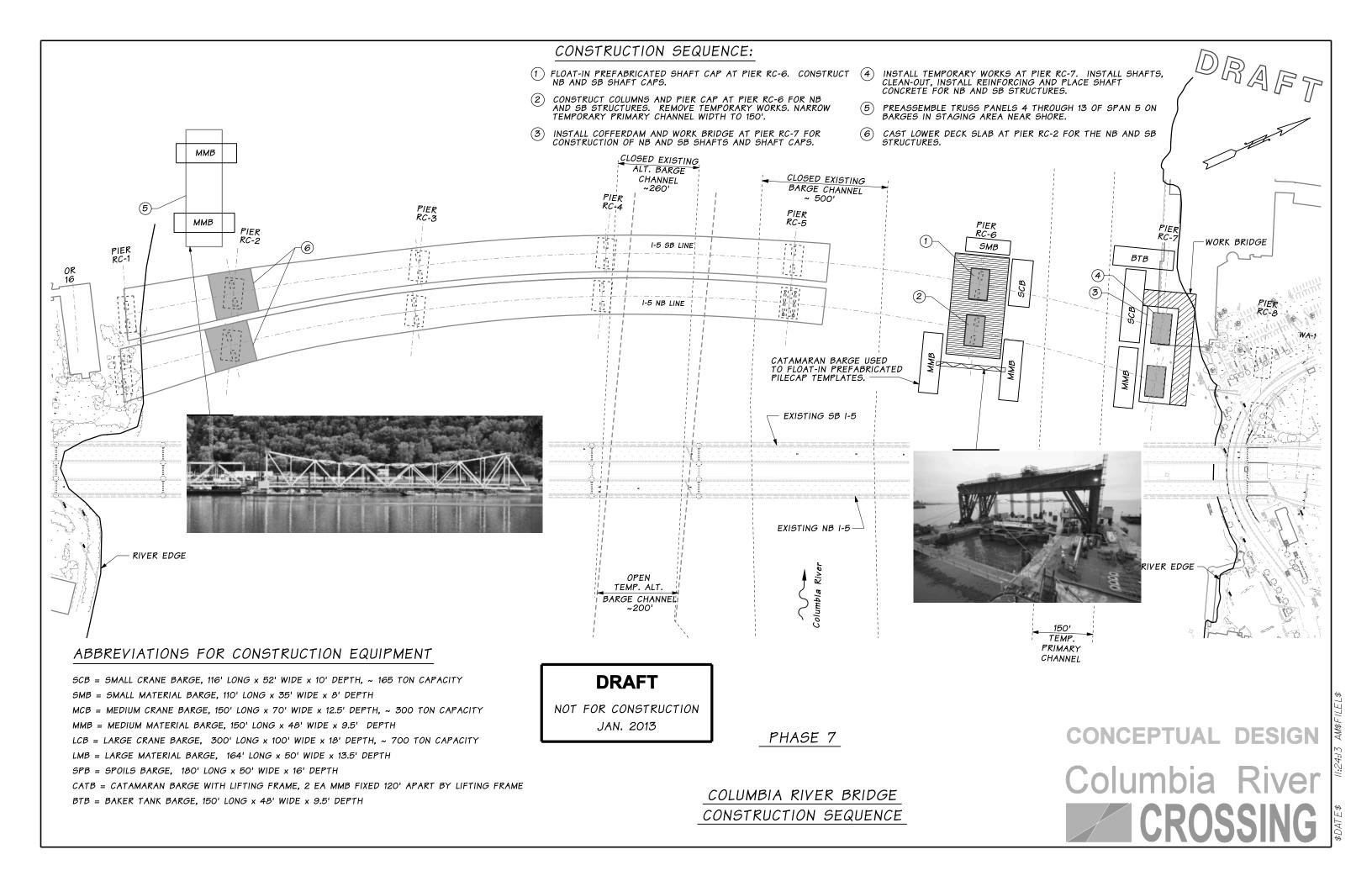


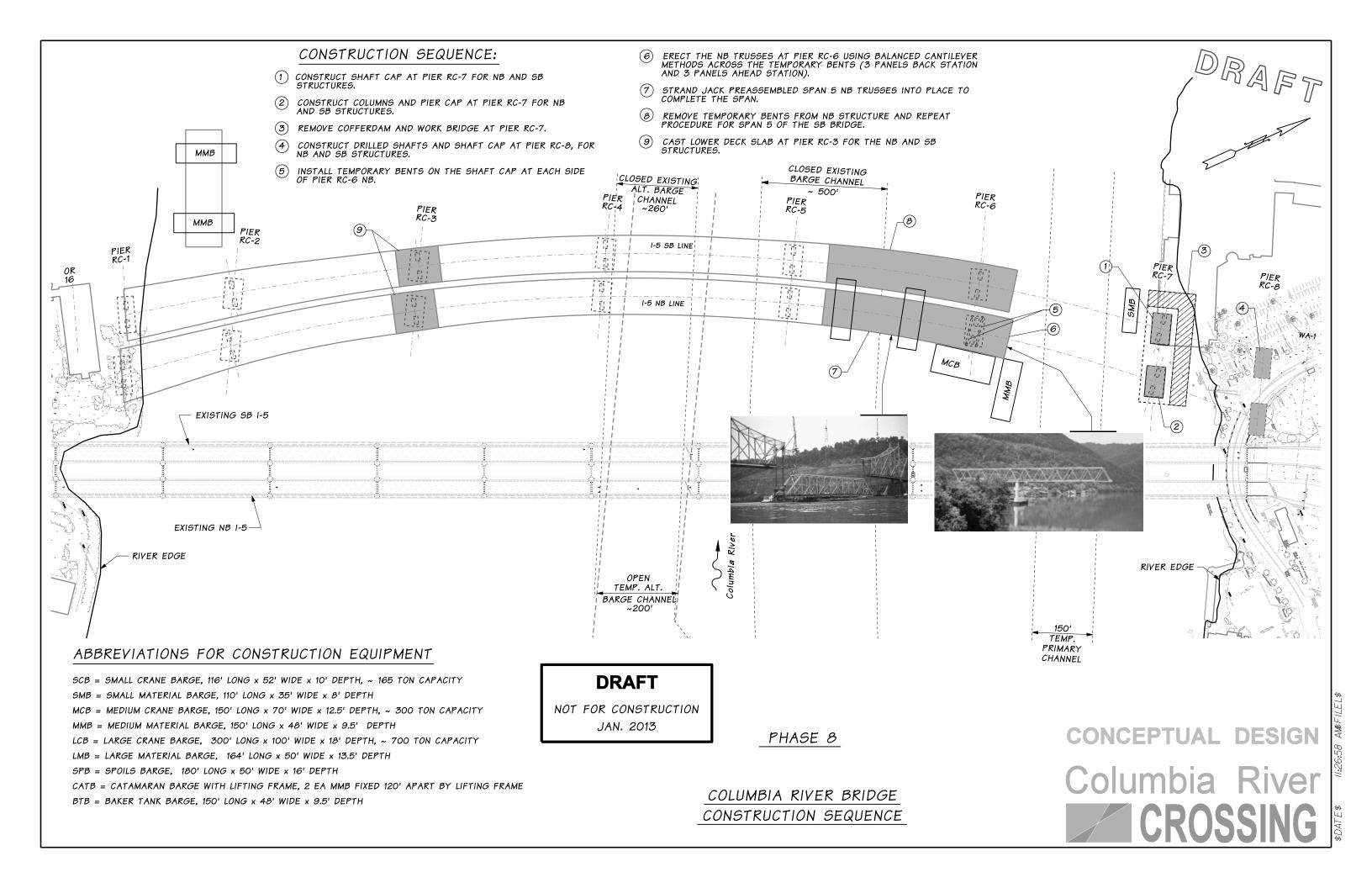
### DRAFT The E OPEN EXISTING PRIMARY CHANNEL ~ 260' PIER RC-PIER RC-8 EXISTING SB 1-5 EXISTING NB 1-5 RIVER EDGE (FA) **CONCEPTUAL DESIGN** Columbia River CROS.

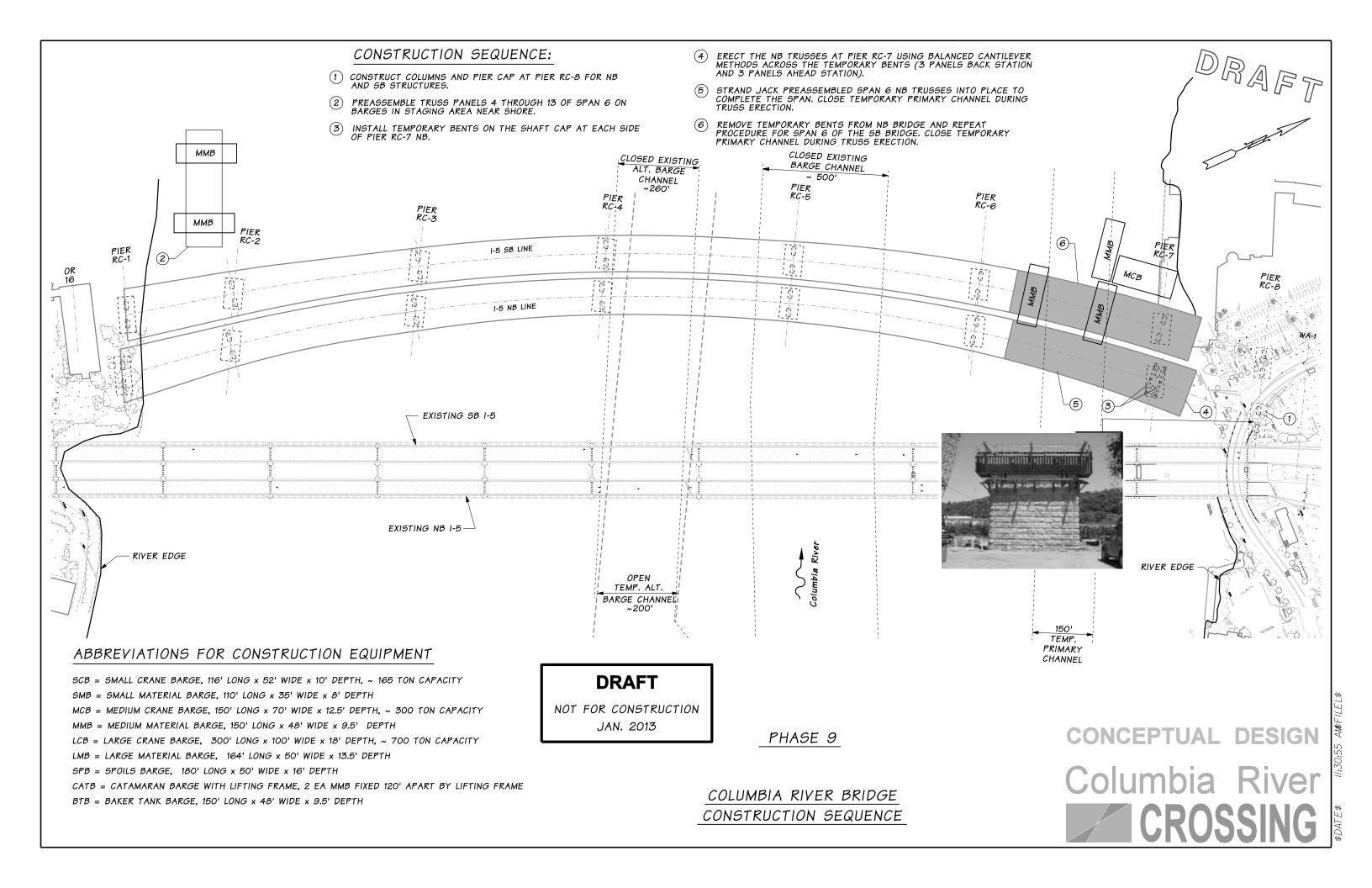


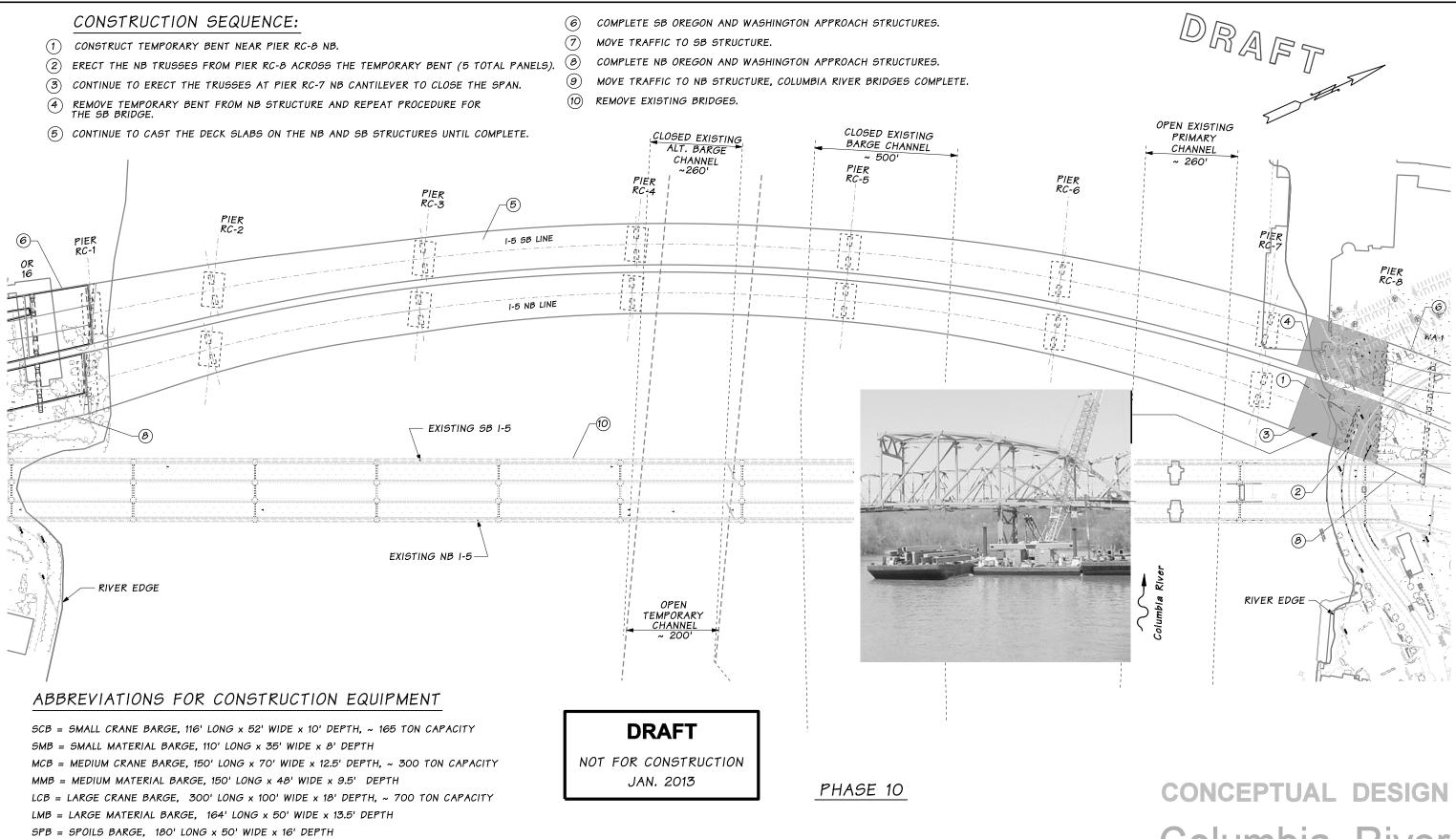
## DRAFT AL Y OPEN EXISTING PRIMARY CHANNEL ~ 260' -3 PIER RC-7 RC-8 RIVER EDGE 16 1503 **CONCEPTUAL DESIGN** Columbia River **CROSSIN**











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

BTB = BAKER TANK BARGE, 150' LONG x 48' WIDE x 9.5' DEPTH

COLUMBIA RIVER BRIDGE CONSTRUCTION SEQUENCE

# Columbia River CROSSING \*