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Quantitative Risk Assessment

Based on WSDOT CEVP® Methodology

March 2023

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Based on WSDOT CEVP® Methodology

Prepared for:



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ACRONYMS AND ABBREVIATIONS

CDF	cumulative distribution function
CEVP	Cost Estimate Validation Process
CN	construction
CPDM	capital program development and management
CPMS	capital program management system
DB	design-build
DBB	design-bid-build
DOT	department of transportation
FEIS	final environmental impact statement
FFGA	Full Funding Grant Agreement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HI	Hayden Island
IB	Interstate Bridge
IBR	Interstate Bridge Replacement
LRT	light rail transit
MD	Marine Drive
Modified LPA	Modified Locally Preferred Alternative
NB	northbound
NEPA	National Environmental Policy Act
NPH	North Portland Harbor
NTP	notice to proceed
ODOT	Oregon Department of Transportation
Ott-Sakai	Ott-Sakai & Associates, LLC
PE	preliminary engineering
PM	program management
PMF	probability mass function
QRA	Quantitative Risk Assessment
RBS	Risk Breakdown Structure
RFP	request for proposal
ROD	Record of Decision
ROW	right of way

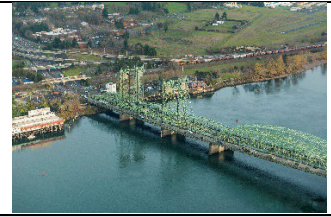
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SB	southbound
SEIS	Supplemental Environmental Impact Statement
SME	subject matter expert
SR	State Route
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
WSDOT	Washington State Department of Transportation
WSP	WSP USA Inc.
YOE	year-of-expenditure

Summary

Interstate Bridge Replacement Program

QUANTITATIVE RISK ASSESSMENT



Program Description

The Interstate Bridge Replacement (IBR) program is a multimodal corridor investment program addressing congestion, limited mobility, and safety on I-5 between SR 500 in Vancouver, Washington, and Victory Boulevard in Portland, Oregon. Project elements include:

- New earthquake-resilient multimodal bridge.
- Light rail extension from Portland to Vancouver, and bus on shoulder and express bus connectivity.
- Modifications to seven closely spaced interchanges.
- Enhanced pedestrian and bicycle paths throughout the program area.
- Transportation demand management features.
- Addition of auxiliary lanes and safety shoulders.

Program Benefits

The program will result in the following benefits:

- Improves safety, congestion and travel reliability.
- Creates an earthquake-resilient corridor.
- Improves freight movement and connections.
- Expands travel choices, including alternatives to single-occupancy vehicles.
- Supports tens of thousands of jobs and generates nearly two times return on investment during construction.
- Supports climate goals of both states.

Key Assumptions

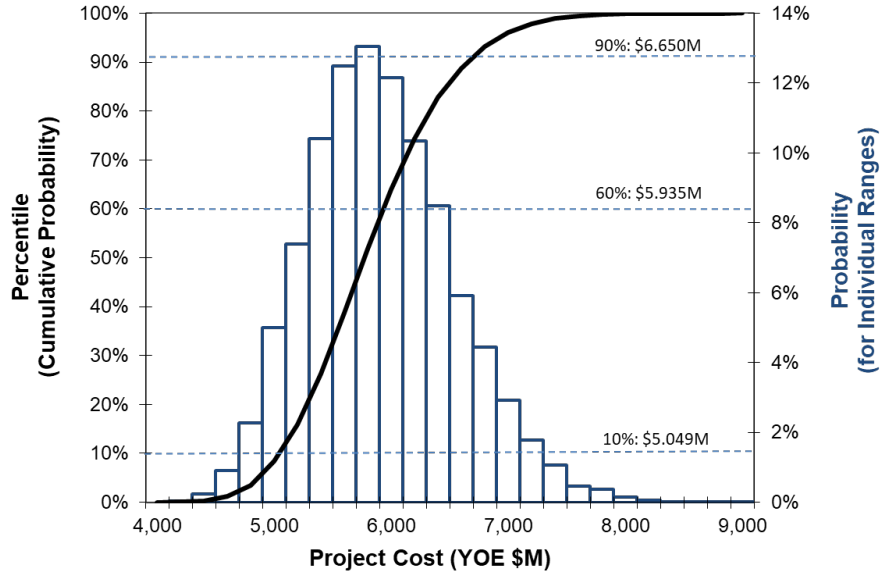
- Results are based on the Modified LPA as defined in the main body of the report.
- Program is to be delivered through a mix of traditional and alternative delivery methods.
- Potential for elective deferral or cancellation of the program was not included.
- A two-bridge stacked configuration is assumed.
- Risks to the implementation of tolling were not included.
- Cost escalation rates are based on WSDOT CPDM/CPMS indices. Uncertainty in these forecasts was not included.
- Potential "Acts of God" are not explicitly considered in the analysis, although allowances for "minor" and unidentified risks are included.

Program History (key dates)

- 2004: Columbia River Crossing (CRC) initiated.
- 2011: Record of Decision (ROD) issued.
- 2014: CRC was discontinued.
- 2019: CRC reinitiated as IBR program.

Quantitative Risk Assessment (QRA) Cost Range

(considering potential risk mitigation)



QRA Schedule Range *(considering potential risk mitigation)*

Program Completion	August 2035 to September 2037	10th to 90th Percentile
---------------------------	-------------------------------	--------------------------------

Key Program Cost Risks (mean impact value in January 2022 dollars)

- Indirect cost of project delay (owner + contractor; +\$155.1M).
- Uncertain market conditions: competition and pricing (+\$100.4M).
- Miscellaneous change orders (+\$73.1M).
- Evergreen (near) park-and-ride design/scope changes (-\$64.4M; opportunity).
- Design innovation (River Bridge + other packages; -\$41.5M; opportunity).
- Waterfront Station complexity (+\$29.4M).

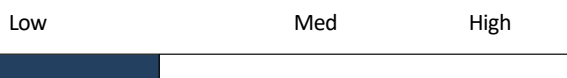
Key Program Estimating Uncertainties (mean impact value in January 2022 dollars)

- Construction: price uncertainty (+\$72.8M).
- Construction: quantity uncertainty (+\$72.4M).
- Oregon highway: indeterminates uncertainty (+\$62.3M).
- Columbia River bridges: indeterminates uncertainty (+\$58.2M).
- Vancouver light rail transit: indeterminates uncertainty (+\$55.6M).
- Vancouver highway: indeterminates uncertainty (+\$53.3M).

Key Program Schedule Risks (approximate mean impact to critical path)

- State funding delays (+4 months).
- Bridge substructure/foundation changes during construction (+3 months).
- Post-ROD legal challenge (+2 months).
- Inadvertent discoveries (+1 month).
- Section 106 analysis (+1 month).
- Bid protest (+1 month).

Level of Project Design



January 2023



EXECUTIVE SUMMARY

A Quantitative Risk Assessment (QRA) was performed for the Interstate Bridge Replacement (IBR) program and was based on the Washington State Department of Transportation (WSDOT) Cost Estimate Validation Process (CEVP®) methodology. The objectives of the QRA were to provide independent review of project cost and schedule estimates and to quantify uncertainty and risk associated with those estimates. A risk assessment workshop was held October 10 through 14, 2022, and was attended by project team members and subject matter experts (SMEs) from WSDOT, Oregon Department of Transportation (ODOT), local agency partners and industry. The risk workshop was followed by a series of focused meetings to develop management strategies to control the key project risks. Probabilistic risk analysis was performed for both the “pre-mitigation” and “post-mitigation” scenarios.

Base Schedule Review

The assumed project “base” schedule was summarized in the form of a flowchart that graphically depicts the project strategy at an appropriate level of detail for the risk analysis. The flowchart defines a set of key activities, milestones and precedence relationships and is used to model the project schedule (including delays or accelerations due to risk events) and to calculate escalated year-of-expenditure (YOE) project costs. The schedule flowchart was reviewed during the risk workshop and comments were incorporated. The base project completion date (prior to consideration of risk) is June 2034.

Base Cost Review

The project cost estimate was reviewed by independent cost estimation experts and additional SMEs representing a variety of technical disciplines prior to, during and after the risk workshop. Contingencies and allowances for indeterminates were removed to develop a stripped base cost estimate of approximately \$3,675 million in January 2022 dollars. This deterministic base cost excludes escalation, estimating uncertainties and risk, which are addressed through the risk analysis. In addition, “base uncertainty” ranges for unit prices, quantities and indeterminates were assessed for major items in the estimate. The uncertainties were assessed in terms of ranges (e.g., 10th to 90th percentile) relative to the deterministic base cost. The professional judgment of the cost estimation and risk SMEs was used to inform the uncertainty ranges and associated correlations.

Risk Assessment

A risk register was developed for the project, which included identification and characterization of specific risks (threats and opportunities) to the project cost and schedule. The risk register is organized around the specific categories based on the WSDOT Risk Breakdown Structure (RBS). A total of 243 risks were identified, of which 116 were determined to be significant (the remainder either fell below predetermined screening thresholds and were thus considered to be “minor,” were

excluded, or have been resolved and retired). Risks were characterized and quantified primarily on the basis of the consensus (i.e., collective professional judgment) of the SMEs assembled for the workshop. The risk quantifications included potential impacts to direct project cost and/or schedule (relative to the base assumptions) and the likelihood of those impacts occurring. The initial risk quantifications reflected the status quo condition at the time of the workshop and did not consider the potential for risk reduction through additional proactive risk mitigation by the project team.

Risk Mitigation

Following the risk workshop, a series of 15 focused working sessions were conducted with SMEs representing each major technical discipline to 1) identify specific risk mitigation strategies and actions that may be undertaken to reduce the most significant project threats (or exploit opportunities), and 2) re-quantify selected risks to reflect the potential impact of successful risk mitigation strategy implementation.

Risk Analysis

The inputs developed in the workshop (including base cost, schedule, risks and uncertainties) were loaded into a probabilistic, integrated model (i.e., cost-loaded schedule) that incorporated Monte Carlo simulation techniques to generate probability distributions of key performance measures related to cost and schedule, along with prioritized risk rankings. The simulation involved the generation of 10,000 independent potential outcomes and statistical compilation of selected results. Separate model runs were performed using the pre- and post-mitigation scenarios (using the same base cost and schedule inputs with differing risk quantifications).

Results

Results from probabilistic analyses are commonly communicated in terms of the probability of not exceeding a particular value (also known as a percentile or, less formally, confidence level). For example, the 60th percentile means there is a 60% likelihood that the value will not exceed that amount (conversely, there is a 40% likelihood that the value will be greater than that amount).

For the project as defined in this QRA, the 60th percentile cost for the post-mitigation scenario in YOE dollars is \$5,935 million and the 10th to 90th percentile (i.e., 80% confidence level) range is \$5,049 million to \$6,650 million.

The 60th percentile project completion date for the post-mitigation scenario is October 2036, with a 10th to 90th percentile range of August 2035 to September 2037.

Key cost risks for the post-mitigation scenario include the following (values are mean cost changes in January 2022 dollars):

- Indirect cost of project delay (owner + contractor; +\$155.1 million).
- Uncertain market conditions: competition and pricing (+\$100.4 million).

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- Miscellaneous change orders (+\$73.1 million).
- Park and ride near Evergreen design/scope changes (-\$64.4 million; opportunity).
- Design innovation (River Bridge + other packages; -\$41.5 million; opportunity).
- Waterfront Station complexity (+\$29.4 million).

Key estimating uncertainties (related to base cost), which apply to both the pre- and post-mitigation scenarios, include the following (values are mean cost changes in January 2022 dollars):

- Construction: price uncertainty (+\$72.8 million).
- Construction: quantity uncertainty (+\$72.4 million).
- Oregon Highway: indeterminates uncertainty (+\$62.3 million).
- River Bridge: indeterminates uncertainty (+\$58.2 million).
- Vancouver Light Rail Transit (LRT): indeterminates uncertainty (+\$55.6 million).
- Vancouver Highway: indeterminates uncertainty (+\$53.3 million).

Key schedule risks for the post-mitigation scenario include the following (values are approximate mean impacts to the program development critical path):

- State funding delays (+4 months).
- Bridge substructure/foundation changes during construction (+3 months).
- Post-Record of Decision (ROD) legal challenge (+2 months).
- Inadvertent discoveries (+1 month).
- Section 106 analysis (+1 month).
- Bid protest (+1 month).

Assumptions and Exclusions

Following are the major assumptions and exclusions that apply to the results described in this report:

- Results represent the Modified Locally Preferred Alternative (LPA) base design option, which includes a single auxiliary lane, an at-grade station near Evergreen Boulevard, and direct fixation track for light rail transit at all locations except intersections.
- The project is assumed to be delivered through a mix of traditional and alternative delivery methods. Potential changes to packaging or delivery assumptions were not included.
- The potential for elective deferral or cancellation of the project (or individual work elements) was not included.

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- A two-bridge cross stacked configuration is assumed across the Columbia River. A “stacked bridge” is a truss structure in which automobiles and trucks travel on the top and transit and active transportation modes travel underneath. The stacked configuration is included in the Modified LPA.
- Risks related to the implementation of tolling that would prevent it from being one of the planned funding sources were not included.
- Cost escalation rates are based on WSDOT Capital Program Management System (CPMS) indices. Uncertainty in these forecasts was not included.
- The post-mitigation scenario assumes successful implementation of all identified risk mitigation strategies.

Finally, the results represent a “snapshot in time” as of the date of the evaluation. The project is currently at an early stage of design following reinitiation; thus, uncertainties are large and project assumptions will change with National Environmental Policy Act (NEPA) review and design progression. Current assumptions related to project packaging, sequencing and delivery methods will be updated with the expectation that the next CEVP review will reflect new and more refined information related to the IBR program design and context. It is expected that schedules, estimates and risk profiles will be refined (and uncertainties reduced) as the program progresses.

1. INTRODUCTION

1.1 Overview

A Quantitative Risk Assessment (QRA) was performed for the Interstate Bridge Replacement (IBR) program. The objectives of the QRA were to provide independent review of project cost and schedule estimates and to quantify uncertainty and risk associated with those estimates. A risk assessment workshop was held October 10 through 14, 2022, and was attended by project team members and subject matter experts (SMEs) from Washington State Department of Transportation (WSDOT), Oregon Department of Transportation (ODOT), local agency partners and industry (Appendix A). WSP USA Inc. (WSP) facilitated the workshop and performed risk analysis (“Risk Lead”), and Ott-Sakai & Associates, LLC (Ott-Sakai) led the cost review portion of the workshop (“Cost Lead”). The risk workshop was followed by a series of focused meetings to develop management strategies to control the key project risks. The mitigation strategy development was led by Parametrix (“Risk Manager”). Probabilistic risk analysis was performed for both the “pre-mitigation” and “post-mitigation” scenarios.

1.2 Methodology

The QRA was based on WSDOT Cost Estimate Validation Process (CEVP®) methodology. The WSDOT Strategic Analysis and Estimating Office maintains a library of CEVP support information, including common assumptions for its risk assessments. The current list of assumptions is contained within the Project Management Online Guide at <https://www.wsdot.wa.gov/publications/fulltext/CEVP/ProjectRiskManagementGuide.pdf>.

The general methodology is summarized in the following steps:

1. Establish a common understanding of the project among the participants, including overall scope, strategy, status, existing conditions and key assumptions.
2. Develop a “base” schedule in the form of a flowchart depicting the high-level sequence of key activities and milestones, including their durations and predecessor-successor relationships, that represents the assumed project schedule if “everything goes as planned” (e.g., no built-in contingency, float or other consideration of potential risk is included).
3. Establish a base cost that represents the “best estimate” for the project if “everything goes as planned” (e.g., both explicit and implicit contingencies are removed). The base cost typically includes allowances for “known but not quantified” items (incidentals).
4. Quantify “base uncertainty” in the base estimates where appropriate to represent the potential variation (due to variability and/or lack of information) in the base values (e.g., unit price, quantity, indeterminates, duration, escalation rates), consistent with the assumptions used to prepare the base estimates.
5. Identify potential risks, considering both threats and opportunities for each key discipline associated with the project. Risks are defined as events characterized by a probability of occurrence and an impact if the event occurs (in terms of deltas relative to the base cost and/or

schedule for specific flowchart activities) and are documented in a risk register. For risks determined to be significant (based on a predefined cutoff threshold), the direct cost and schedule impacts and associated probability (prior to mitigation) are quantified based on the professional judgment of the SMEs. Potential mitigation strategies for major risks are discussed as time allows during the workshop and subsequently developed in greater detail.

6. Develop a probabilistic model that integrates the base cost and schedule (including uncertainties, where applicable), explicitly represents individual risks, and includes correlations and dependencies as appropriate. The model is used to generate probability distributions for project cost and schedule milestone completion dates, along with an importance analysis ranking of the input factors (base uncertainties and risks) relative to the cost and schedule outputs to guide future risk management. The resulting probability distributions can be used to evaluate potential contingency levels for cost and schedule. A risk-based contingency level for cost or schedule can be determined from the difference between the output value at a chosen percentile (e.g., 60th) and the base value with contingencies (including allowances for unquantified items) removed. This initial analysis is referred to as the pre-mitigation scenario.
7. Using the risk rankings, coordinate with the SMEs for each major technical discipline to develop detailed risk mitigation strategies, including specific actions and assignments, designed to reduce the probability and/or impact of key project threats (or increase the probability/impact of opportunities). The risk are then re-quantified to reflect the anticipated impact of the risk mitigation efforts (considering any implementation costs).
8. The probabilistic risk model is updated and reanalyzed to reflect the changes in risk quantified associated with the risk mitigation efforts. This subsequent analysis is referred to as the post-mitigation scenario.

2. PROJECT STATUS AND ASSUMPTIONS

2.1 Project Overview

The IBR program will provide a suite of multimodal transportation enhancements focused on improving safety; reducing congestion; and increasing mobility of motorists, freight traffic, transit riders, bicyclists and pedestrians along the Interstate 5 (I-5) corridor connecting Vancouver, Washington, and Portland, Oregon.

The base cost established and studied during the QRA reflects the Modified Locally Preferred Alternative (Modified LPA) and some of the following assumptions. The transit component would extend light rail from the Expo Center in Portland north to a terminus near Evergreen Boulevard in Vancouver on an alignment that hugs I-5. The transit investments include new stations at Hayden Island, at the Vancouver waterfront, and near Evergreen Boulevard, along with park and ride locations and operation and maintenance facilities.

Assumptions include:

- At-grade light rail transit (LRT) stations near Evergreen Boulevard and the Vancouver waterfront
- Aerial LRT station at Hayden Island.
- Underground parking garage near Evergreen and an above-grade parking garage at the Vancouver waterfront
- Overnight LRT facility.
- Embedded track only at intersections and direct fixation track at all other locations.

The highway improvements include 5 miles of I-5 from State Route (SR) 500 north of downtown Vancouver to just north of Columbia Boulevard in north Portland.

Assumptions include:

- A replacement bridge built west of the existing bridge.
- Improvements to seven interchanges, north and south of the Columbia River, as well as related enhancements to the local street network.
- Addition of one auxiliary lane in each direction between Marine Drive and Mill Plain Boulevard to accommodate the safe movement of vehicles and freight.
- Safety shoulders in the program area, including on the bridges.
- Variable rate tolling for motorists using the river crossing.
- Construction of a partial interchange at Hayden Island and a full interchange at Marine Drive, designed to minimize impacts to freight and workforce traffic while making improvements, along with active transportation on Hayden Island and Marine Drive.

2.2 Scenarios and Sensitivity Analyses

The results presented in the main body of this report represent the Modified LPA base design option as defined by the scope and assumptions described in Section 2.1.

The following additional design options were also evaluated through the QRA:

- Design Option A: Same as Modified LPA base but with all embedded track for LRT.
- Design Option B: Same as Modified LPA base but with all embedded track and a grade-separated LRT station near Evergreen Boulevard.
- Design Option C: Same as Modified LPA base but with all embedded track and two auxiliary lanes on the Columbia River and North Portland Harbor (NPH) bridges.

Summary results for these additional design options are presented in Appendix E, including both the pre- and post-mitigation scenarios.

2.3 Exclusions

Assumptions are necessary for any analysis, and the results of the analysis must clearly state the assumptions upon which they are based. Probabilistic assessments attempt to include all relevant uncertainties so that the results are as inclusive and robust as possible (i.e., the results will “stand the test of time”). The more uncertainties that are excluded, the more “constrained” or “conditional” the results are. In many cases, however, an owner has good reason to exclude particular uncertainties from the analysis. The items below represent issues that were discussed during the workshop but were not quantified or modeled for this analysis. Therefore, the reader should be mindful of these exclusions when reviewing and interpreting the results.

- The project is assumed to be delivered through a mix of traditional and alternative delivery methods. Potential changes to packaging or delivery assumptions were not included.
- The potential for elective deferral or cancellation of the project (or individual work elements) was not included.
- A two-bridge stacked configuration is assumed across the Columbia River. A “stacked bridge” is a truss structure in which automobiles and trucks travel on the top and transit and active transportation modes travel underneath. The stacked configuration is included in the Modified LPA.
- Risks related to the implementation of tolling for the IBR program that would prevent it from being one of the planned funding sources were not included.
- Cost escalation rates are based on WSDOT Capital Program Management System (CPMS) indices. Uncertainty in these forecasts was not included.
- The post-mitigation scenario assumes successful implementation of all identified risk mitigation strategies.

Finally, the results represent a “snapshot in time” as of the date of the evaluation. The project is currently at an early stage of design following reinitiation; thus, uncertainties are large and project assumptions will change with National Environmental Policy Act (NEPA) review and design progression. Current assumptions related to project packaging, sequencing and delivery methods will be updated, with the expectation that the next CEVP review will reflect new and more-refined information related to the IBR program design and context. It is expected that schedules, estimates and risk profiles will be refined (and uncertainties reduced) as the program progresses.

3. BASE COST AND SCHEDULE REVIEW

3.1 Base Schedule

The assumed project base schedule was summarized in the form of a flowchart that graphically depicts the project strategy at an appropriate level of detail for the risk analysis. The flowchart defines a set of key activities, milestones and precedence relationships and is used to model the project schedule (including delays or accelerations due to risk events) and to calculate escalated year-of-expenditure (YOE) project costs. The schedule flowchart was reviewed during the risk workshop and comments were incorporated.

At the current stage of project development, a detailed contract packaging and delivery plan has not yet been developed nor have detailed construction staging analyses been performed. Thus, the flowchart reflects broad assumptions regarding the timing and sequence of major work elements and the following working delivery assumptions:

- River Bridge: Design-Build (DB) delivery.
- Existing River Bridge demolition: DB delivery.
- Oregon roadway construction (including Marine Drive, NPH and Hayden Island): Design-Bid-Build (DBB) delivery.
- Washington roadway construction (including SR 14, SR 500, Mill Plain Interchange, Fourth Plain Interchange): DB delivery.
- Oregon LRT (including overnight facility): DBB delivery.
- Washington LRT (including park and rides): DBB delivery.
- LRT systems: DBB delivery.
- LRT vehicle procurement: DBB delivery.

The base project completion date (prior to consideration of risk) is **June 2034**. The base completion dates for additional key schedule milestones are summarized in Table 3-1.

Table 3-1. Base Schedule Milestone Completion Dates (All Scenarios)

Milestone	Base Targeted Completion Date
Toll Authorization (Washington)	April 2023
State Department of Transportation (DOT) Funding	July 2023
Issue Record of Decision (ROD)	July 2024

Milestone	Base Targeted Completion Date
Finance Plan Complete	April 2025
Federal Transit Administration (FTA) Full Funding Grant Agreement (FFGA)	September 2027
Shift I-5 to New Southbound (SB) Bridge	July 2030
LRT Revenue Operations	September 2032
I-5/Roadway Improvements Complete	July 2033
Project Complete	June 2034

The schedule flowchart is shown in Appendix B. The red colors on the flowchart reflect the base critical path to project completion.

3.2 Base Cost

The project cost estimates were reviewed by the Cost Lead and other SMEs representing various technical disciplines prior to, during and following the risk workshop. Contingencies (including allowances for unquantified items) were removed from the project estimate to develop a deterministic base cost estimate for use in the risk analysis, expressed in January 2022 dollars (i.e., without future cost escalation). Costs were divided among program management (PM), right of way (ROW), and construction (CN).

In addition, base uncertainty ranges for unit prices, quantities and indeterminates were assessed for major items in the estimate. The uncertainties were assessed in terms of ranges (e.g., 10th to 90th percentile), relative to the deterministic base cost for major cost items. Uncertainty ranges were individually established for those cost items, collectively constituting 80% of the construction cost, while a representative generic range was assessed for the remaining 20% of cost items. Correlations were applied based on professional judgment to reflect the potential for interrelationship in the uncertainties among individual line items (e.g., due to underlying commodity prices, estimator tendency). These base uncertainty ranges were used in the Monte Carlo simulation results included herein.

Table 3-2 summarizes the base cost estimate for the Modified LPA base design option and includes both the deterministic estimate and the mean value of the base uncertainty ranges for associated line items. In some cases, the uncertainty ranges for unit price or quantity are asymmetrical relative to the base (e.g., -10% to +20%) to reflect a consensus opinion that the estimate value is either somewhat optimistic or conservative. In such cases, the mean value for the ranged estimate differs from the deterministic value. In addition, ranges were established for each major cost item to reflect expected ancillary costs that have not yet been estimated (“indeterminates”). These ranges for indeterminates were defined to have a minimum value of zero, along with most likely and 90th percentile values.

Thus, the mean value of the ranged base estimate, **\$4,130 million**, exceeds the deterministic base value of **\$3,675 million** by **\$455 million**.

Table 3-2. Base Cost Summary (Modified LPA Base, January 2022, Millions of Dollars)

Cost Component	Deterministic Base Estimate	Mean Value of Ranged Base Estimate	Difference
Oregon LRT	\$374.2	\$426.1	\$51.9
Vancouver Base Highway	\$738.3	\$824.4	\$86.0
River Bridge	\$690.0	\$784.2	\$94.1
Washington LRT	\$486.3	\$559.5	\$73.2
Oregon Base Highway	\$826.7	\$928.4	\$101.7
Interstate Bridge Demo	\$82.3	\$100.0	\$17.7
LRT Operations and Maintenance Facility Expansion	\$36.2	\$43.4	\$7.2
Construction Subtotal	\$3,234.1	\$3,666.0	\$431.9
ROW Subtotal	\$168.7	\$168.7	\$0.0
Programmatic Cost Subtotal	\$272.4	\$295.5	\$23.2
Project Total (January 2022 dollars)	\$3,675.2	\$4,130.2	\$455.1

Cost escalation was addressed as follows:

- The base cost estimate was allocated to the base schedule activities to develop a summary-level cost loaded schedule.
- Costs were escalated to the midpoint of each activity per the schedule model (with considerations for potential delays due to risk events).
- Separate rates of inflation were defined, by fiscal year, for construction (including commodities), right-of-way and program management/engineering costs using WSDOT's inflation indices for the same. The indices are acquired from a third party and periodically adopted by the office of Capital Program Development and Management (CPDM). The available inflation indices at the time of this study were adopted in June 2022 from forecasts dated Q1 2022, where they are provided via the CPMS.

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The deterministic base cost escalated to the base schedule using the assumed escalation rates is **\$4,407 million** (prior to inclusion of base uncertainty ranges or risks).

Additional discussion of the estimating approach and methodology is provided in Appendix C, along with the CPDM/CPMS inflation tables for preliminary engineering (PE), ROW and CN used in the analysis, base uncertainty ranges, correlation matrices and flowchart activity allocation.

4. RISK ASSESSMENT

4.1 Risk Register (Pre-Mitigation)

Prior to and during the risk workshop, the participants reviewed and developed a risk register for the project, which included identification and characterization of specific threats and opportunities to the project cost and/or schedule (Appendix D). The risk register is organized around the specific categories based on the WSDOT Risk Breakdown Structure (RBS). These risks span all aspects of the project, including construction, design, environmental, ROW, procurement, management and stakeholder interactions. Under each major heading, such as *Construction*, the table lists the identified cost and schedule risks (i.e., threats and opportunities) for the project. The risks are complementary to the base cost and schedule described in Appendices B and C (including base uncertainty ranges). Therefore, the risk register should be used in conjunction with the base cost and schedule and the key project assumptions summarized in Sections 2 and 3.

The risk register includes some risks that are identified as “minor” because the expected (mean) value of those risks falls below the established threshold screening criteria (see notes at end of table in Appendix D). For the project assessment, the combined effect of the minor risk issues was accounted for using an “aggregated minor risk” item. Similarly, a category of “unidentified risks” attempts to account for any issues that were not explicitly identified by the workshop participants. The same approach was used (separately) for minor and unidentified cost and schedule threats and opportunities.

A total of **243** risks (threats and opportunities) were identified, of which **116** were determined to be significant and **49** were determined to be minor (the remainder are either classified as “watch list” items, were specifically excluded, or have been resolved and retired). Risks were characterized and quantified primarily on the basis of the consensus (i.e., collective professional judgment) of the SMEs assembled for the workshop.

The pre-mitigation risk register is summarized by RBS category in Table 4-1.

Table 4-1. Summary of Pre-Mitigation Risk Register

RBS Category	Number of Identified Risks	Number of Minor Risks	Number of Significant Risks
Construction	24	8	10
Contracting and Procurement	29	4	11
Design/PS&E	33	15	12
Environmental	30	1	24

RBS Category	Number of Identified Risks	Number of Minor Risks	Number of Significant Risks
External	22	5	9
Management and Funding	16	0	5
Railroad	5	3	1
Right-of-Way	18	1	10
Structural and Geotechnical	19	5	8
Transit	27	3	18
Utilities	16	4	4
Other	4	0	4
Total	243	49	116

4.2 Risk Register (Post-Mitigation)

Risk response planning is one of the most important steps in the risk management process and supports the basis of a post-mitigation state of the risk register. Following the initial risk identification and prioritization, risk management working sessions were conducted in November 2022, with the objective of developing risk response strategies. SMEs representing key technical disciplines participated in 15 working sessions. Once risks were identified and prioritized, actionable risk response strategies were developed to manage risks and reassess potential impacts. Unmanaged risks represent potential impacts to the project in terms of cost and/or schedule that could push project costs and schedules past even conservative initial estimates.

4.2.1 Risk Response Strategies

Risk response strategies were developed with input from relevant SMEs. These responses focus on the driver or cause of each risk. Each risk response strategy was categorized based on the following risk response types (Table 4-2). The most appropriate response strategy is chosen based on the nature of the risk.

Table 4-2. Risk Mitigation Strategy Types

Response Strategy Types for Threats	Response Strategy Types for Opportunities
Mitigate	Enhance
Transfer	Exploit
Avoid	Share
Accept	Accept

As an example, if there is a risk that could delay the approval of a permit, it would be a threat-type risk event such as “Permit Delay.” In this case, a team would be most likely to brainstorm potential “mitigate” response strategies before potentially considering strategies to “transfer” or “avoid” the threat. If no response strategies can be brainstormed, the team could consider “accepting” the risk. Each identified risk response strategy and action plan is documented in the risk register.

4.2.2 Post-Mitigation Probability and Impact Range Specification

Following the development of risk mitigation strategies, the team reevaluated each risk’s probability and cost and schedule impacts, assuming successful implementation of the identified strategies. The reevaluated probability and impact for each risk is called the post-mitigation state. The post-mitigation probabilities documented in the risk register indicate how likely a given risk event was to occur (i.e., the relative likelihood that the risk happens). Similar to the pre-response case, the IBR team documented ranges of cost and schedule impacts in terms of the anticipated low-range (10th percentile), most likely (also 50th percentile, if range is symmetrical) and high-range (90th percentile) impacts in the post-mitigation state.

4.3 Risk Analysis

The inputs developed in the workshop (including base cost, schedule, risks and uncertainties) were loaded into a probabilistic, integrated (i.e., cost-loaded schedule) model that incorporated Monte Carlo simulation techniques to generate probability distributions of key performance measures related to cost and schedule, along with prioritized risk rankings. The simulation involved the generation of 10,000 independent potential outcomes and statistical compilation of selected results. Separate model runs were performed for the pre- and post-mitigation scenarios (using the same base cost and schedule inputs, with differing risk quantifications).

4.4 Results (Post-Mitigation)

Probability distributions for project cost for the post-mitigation scenario are shown in Figures 4-1 and 4-2 as overlain probability mass functions (PMFs) and cumulative distribution functions (CDFs). Figure

4-1 is in base year (January 2022) dollars, while Figure 4-2 is in YOE dollars. Figure 4-3 shows the probability distribution for the program completion date for the post-mitigation scenario. These probability distributions reflect the base cost and schedule, base uncertainties, and risk and opportunity (as documented in the risk register). The total project cost includes simulated additional indirect/overhead costs related to project delays.

A PMF graphic is useful because it readily portrays the range of values and the most likely value. The most likely value is the value with the highest probability (tallest bar on the plot). (Note: The most likely value is not necessarily the same as the mean or median [50th percentile]). Conversely, a CDF graphic depicts the cumulative probability of not exceeding a particular value (also known as a percentile or, less formally, confidence level). For example, the 60th percentile means that there is a 60% likelihood that the value will be less than or equal to that amount (conversely, there is a 40% likelihood that the value will be greater than that amount).

The corresponding tabular results for project cost are presented in Table 4-3, along with the breakdown of PE/PM, ROW and CN costs, in the form of tabular CDFs. The statistics for key milestone completion dates are provided in Table 4-4.

Figure 4-1. Probability Distribution for IBR Program Cost in January 2022 Dollars (Modified LPA Base; Post-Mitigation Scenario)

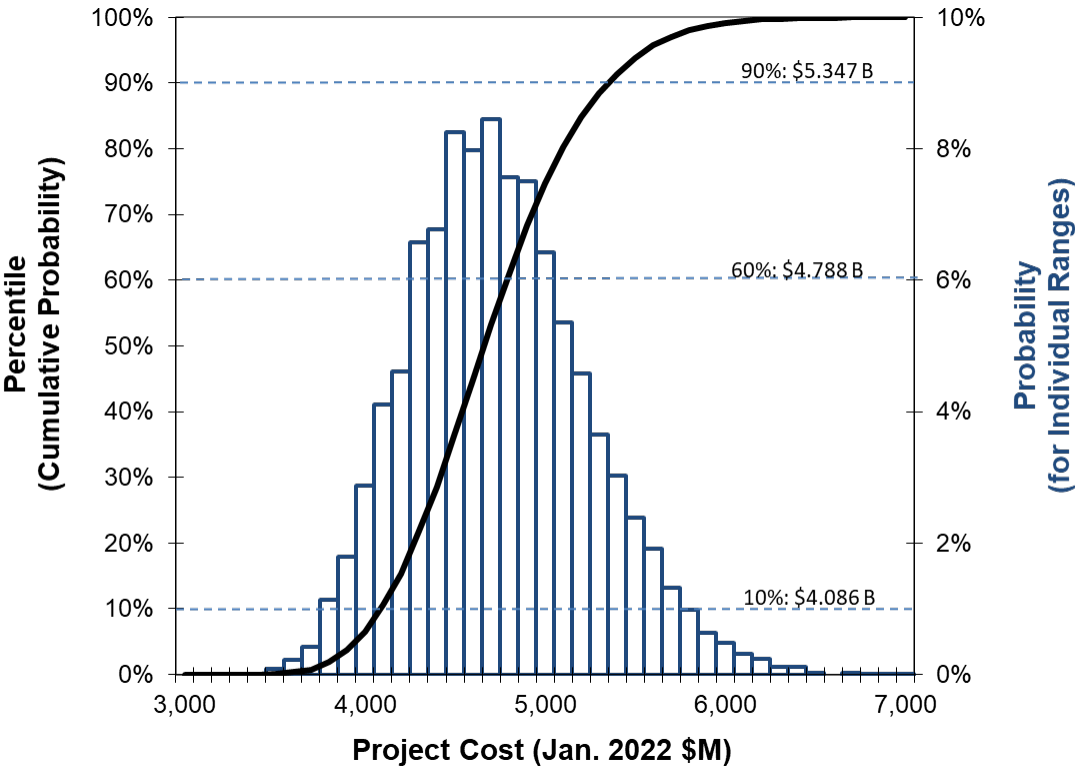


Figure 4-2. Probability Distribution for IBR Program Cost in YOE Dollars
(Modified LPA Base; Post-Mitigation Scenario)

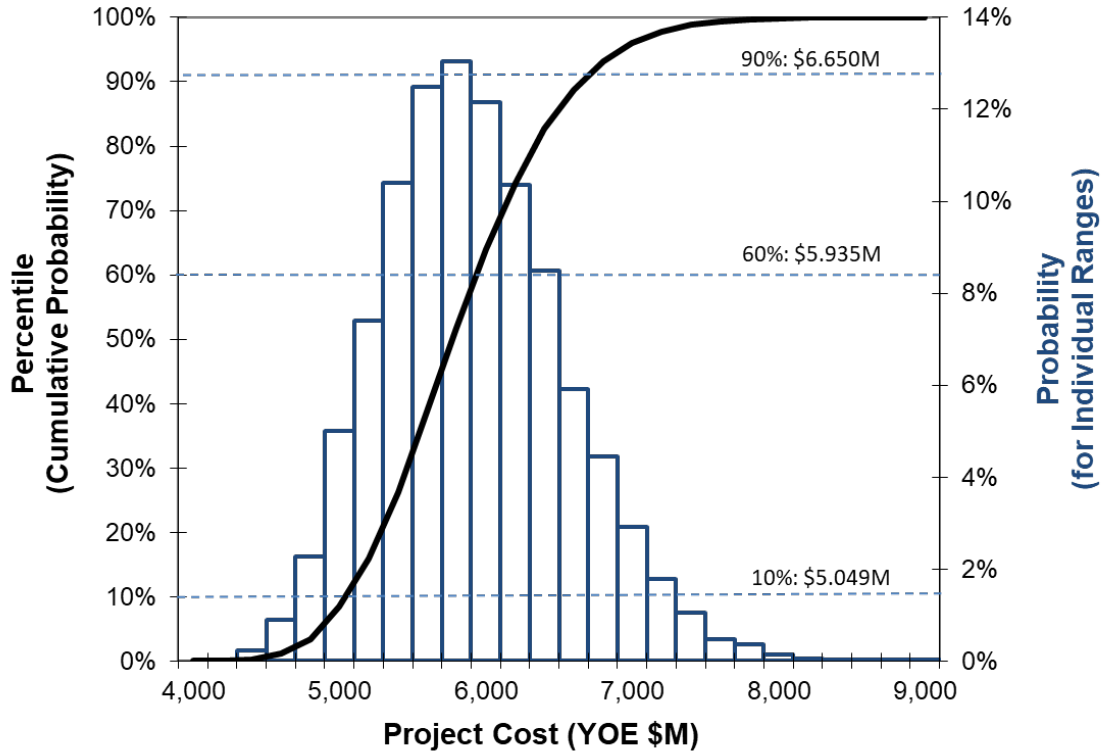
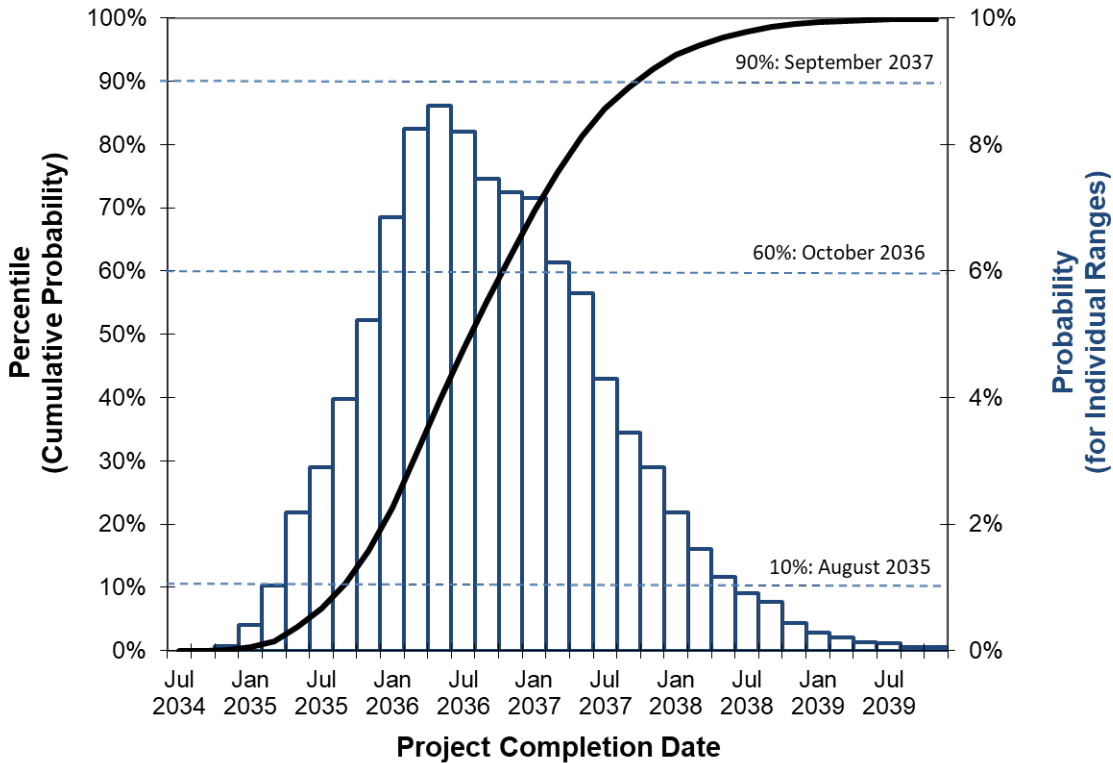


Figure 4-3. Probability Distribution for IBR Program Completion Date (Modified LPA Base; Post-Mitigation Scenario)



The following notes apply to Tables 4-3 through 4-5:

1. Table 4-3 and Table 4-4: The *mean* component costs may be added to obtain the *mean* total project cost. In general, however, the sum of the xth percentile for component costs is not the xth percentile of the total project cost. For example, the sum of the 60th percentiles for PE, ROW and construction (in YOE dollars) *is not* the 60th percentile of the total project cost (in YOE dollars).
2. Table 4-3 and Table 4-4: “Risk at target percentile” represents the percentage difference between the 60th percentile and deterministic base costs (i.e., corresponding to a risk-based contingency at the target amount).
3. Table 4-5: “Risk at target percentile” equals (milestone date at target percentile – base milestone date) / (base milestone date – schedule reference date as shown on flowchart).

Table 4-3. IBR Program Cost Statistics (Summary; Modified LPA Base; Post-Mitigation Scenario)

	Program Cost (January 2022, millions of dollars)	Program Cost (millions of YOE dollars)	Base Cost (January 2022, millions of dollars)	Risk Cost (January 2022, millions of dollars)	Escalation Cost (millions of YOE dollars)
Deterministic Base	3,675.2	4,407.2	3,675.2	0.0	732.0
Mean	4,695.1	5,818.6	4,130.2	564.8	1,123.6
Standard Deviation	488.9	622.3	395.5	258.7	147.6
1%	3,728.2	4,583.9	3,337.8	115.9	841.0
5%	3,952.6	4,876.1	3,524.2	224.7	904.6
10%	4,086.4	5,049.0	3,630.4	284.6	946.2
20%	4,273.7	5,280.8	3,778.7	359.1	996.7
30%	4,414.5	5,460.5	3,901.9	416.0	1,036.5
40%	4,536.4	5,620.7	4,006.6	468.3	1,073.1
50%	4,661.1	5,771.8	4,110.3	522.0	1,111.3
60%	4,787.7	5,935.3	4,212.2	580.5	1,150.4
70%	4,922.6	6,110.8	4,323.9	650.6	1,190.4
80%	5,095.7	6,324.1	4,456.6	747.0	1,243.4
90%	5,347.3	6,649.7	4,662.1	911.5	1,317.9
95%	5,562.2	6,913.5	4,821.2	1,062.7	1,382.1
99%	5,974.9	7,427.8	5,141.0	1,351.9	1,530.0
Risk at Target Percentile (%)	30.3%	34.7%	14.6%		57.1%

Table 4-4. IBR Program Cost (Cost Components; Modified LPA Base; Post-Mitigation Scenario)

	Program Management Cost (January 2022, millions of dollars)	Program Management Cost (millions of YOE dollars)	ROW Cost (January 2022, millions of dollars)	ROW Cost (January 2022, millions of dollars)	Construction Cost (January 2022, millions of dollars)	Construction Cost (millions of YOE dollars)
Deterministic Base	272.4	303.8	168.7	201.7	3,234.1	3,901.7
Mean	391.4	451.7	215.4	260.1	4,088.3	5,106.8
Standard Deviation	54.1	67.1	36.6	44.2	467.4	592.0
1%						
5%	286.8	322.5	142.7	172.5	3,173.9	3,941.1
10%	310.6	351.9	159.5	192.5	3,379.5	4,215.8
20%	324.8	369.6	169.7	204.7	3,511.9	4,380.0
30%	344.0	392.9	183.4	221.4	3,682.7	4,593.5
40%	359.8	412.4	193.8	234.0	3,816.2	4,762.8
50%	373.5	429.6	203.8	246.1	3,935.4	4,915.3
60%	387.3	446.1	213.3	257.6	4,052.3	5,063.8
70%	401.5	463.4	222.8	269.1	4,173.2	5,214.7
80%	416.6	482.6	233.3	281.8	4,310.1	5,386.1
90%	436.2	506.7	245.9	296.9	4,469.5	5,588.0
95%	464.6	542.1	264.1	318.9	4,714.5	5,897.9
99%	487.9	571.2	278.8	337.0	4,921.0	6,163.0
Risk at Target Percentile (%)	47.4%	52.6%	32.0%	33.4%	29.0%	33.7%

Table 4-5. IBR Program Milestone Statistics (Modified LPA Base; Post-Mitigation Scenario)

	Issue ROD	Toll Authorization (Washington)	State DOT Funding	Finance Plan Complete	FTA FFGA	LRT Revenue Operations	Shift I-5 to New SB Bridge	I-5/Roadway Improvements Complete	Project Complete
Deterministic Base	Jul 2024	Apr 2023	Jul 2023	Apr 2025	Sep 2027	Sep 2032	Jul 2030	Jul 2033	Jun 2034
Mean	Mar 2025	Sep 2023	Mar 2024	Nov 2025	Feb 2029	Mar 2035	Apr 2032	Nov 2035	Aug 2036
Standard Deviation (months)	4.2	8.6	11.3	7.0	13.0	13.0	9.3	9.3	9.8
1%	Jul 2024	Apr 2023	Jul 2023	Apr 2025	Sep 2027	Mar 2033	Dec 2030	May 2034	Feb 2035
5%	Sep 2024	Apr 2023	Jul 2023	Apr 2025	Sep 2027	Aug 2033	Mar 2031	Sep 2034	May 2035
10%	Oct 2024	Apr 2023	Jul 2023	Apr 2025	Nov 2027	Nov 2033	May 2031	Dec 2034	Aug 2035
20%	Nov 2024	Apr 2023	Jul 2023	May 2025	Jan 2028	Apr 2034	Sep 2031	Mar 2035	Dec 2035
30%	Dec 2024	Apr 2023	Jul 2023	Jun 2025	Mar 2028	Aug 2034	Nov 2031	May 2035	Feb 2036
40%	Jan 2025	Apr 2023	Jul 2023	Jul 2025	Aug 2028	Nov 2034	Jan 2032	Jul 2035	May 2036
50%	Feb 2025	Apr 2023	Jul 2023	Aug 2025	Dec 2028	Feb 2035	Mar 2032	Oct 2035	Jul 2036
60%	Mar 2025	Apr 2023	Nov 2023	Sep 2025	Aug 2029	Jun 2035	Jun 2032	Dec 2035	Oct 2036
70%	Apr 2025	Apr 2023	Jul 2025	Jun 2026	Oct 2029	Sep 2035	Sep 2032	Mar 2036	Jan 2037
80%	Jun 2025	May 2024	Jul 2025	Jun 2026	Dec 2029	Feb 2036	Dec 2032	Jun 2036	Apr 2037
90%	Aug 2025	Apr 2025	Jul 2025	Jul 2026	Aug 2030	Sep 2036	May 2033	Nov 2036	Sep 2037
95%	Oct 2025	May 2025	Aug 2025	Dec 2026	Jan 2031	Feb 2037	Oct 2033	Apr 2037	Jan 2038
99%	Apr 2026	Jun 2025	Aug 2025	Jun 2027	Dec 2031	Jan 2038	Jun 2034	Dec 2037	Oct 2038
Risk at Target Percentile (%)	40.6%	0.0%	53.9%	19.2%	37.3%	27.9%	24.1%	22.2%	19.6%

4.4.1 Sensitivity Analysis (Post-Mitigation Scenario)

The most significant cost risk factors (including threats/opportunities and base uncertainty ranges) for the post-mitigation scenario are presented in terms of their contribution to the mean project cost in current dollars and mean substantial completion date in calendar months (the individual factors are defined in the cost estimate summary in Appendix C and risk register in Appendix D). Figures 4-4 through 4-6 present the rankings for the most significant (top 20 ranked by absolute mean value impact) cost risks, base cost uncertainty ranges, and schedule risks, along with an indication of the range of potential impact for each risk or base uncertainty item. Each bar depicts the 95% simulated range (percentile 2.5 to percentile 97.5) of the risk impact to unescalated project cost (Figures 4-4 and 4-5) and to the overall schedule critical path (Figure 4-6). The simulated impact ranges consider both the likelihood of occurrence and any uncertainty in impacts if the risk occurs. Note that the schedule risk rankings are somewhat approximate but take into consideration the interaction with other risks and flowchart logic, including base float, potentially changing critical paths, and work windows as applicable.

Figure 4-4. Most Significant Threats and Opportunities to Project Cost (Modified LPA Base; Post-Mitigation Scenario)

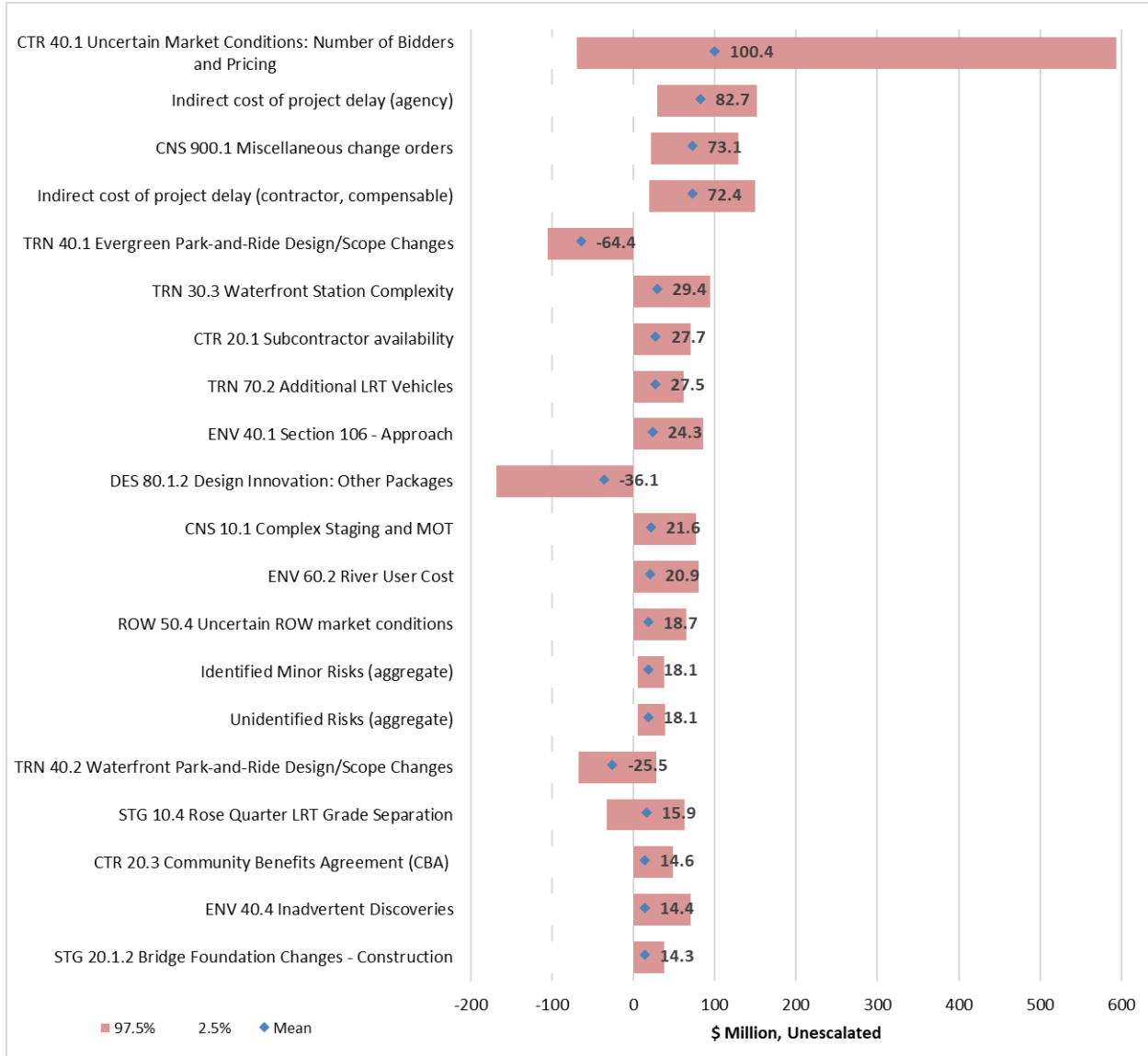


Figure 4-5. Most Significant Base Cost Uncertainties
(Modified LPA Base; Pre- and Post-Mitigation Scenarios)

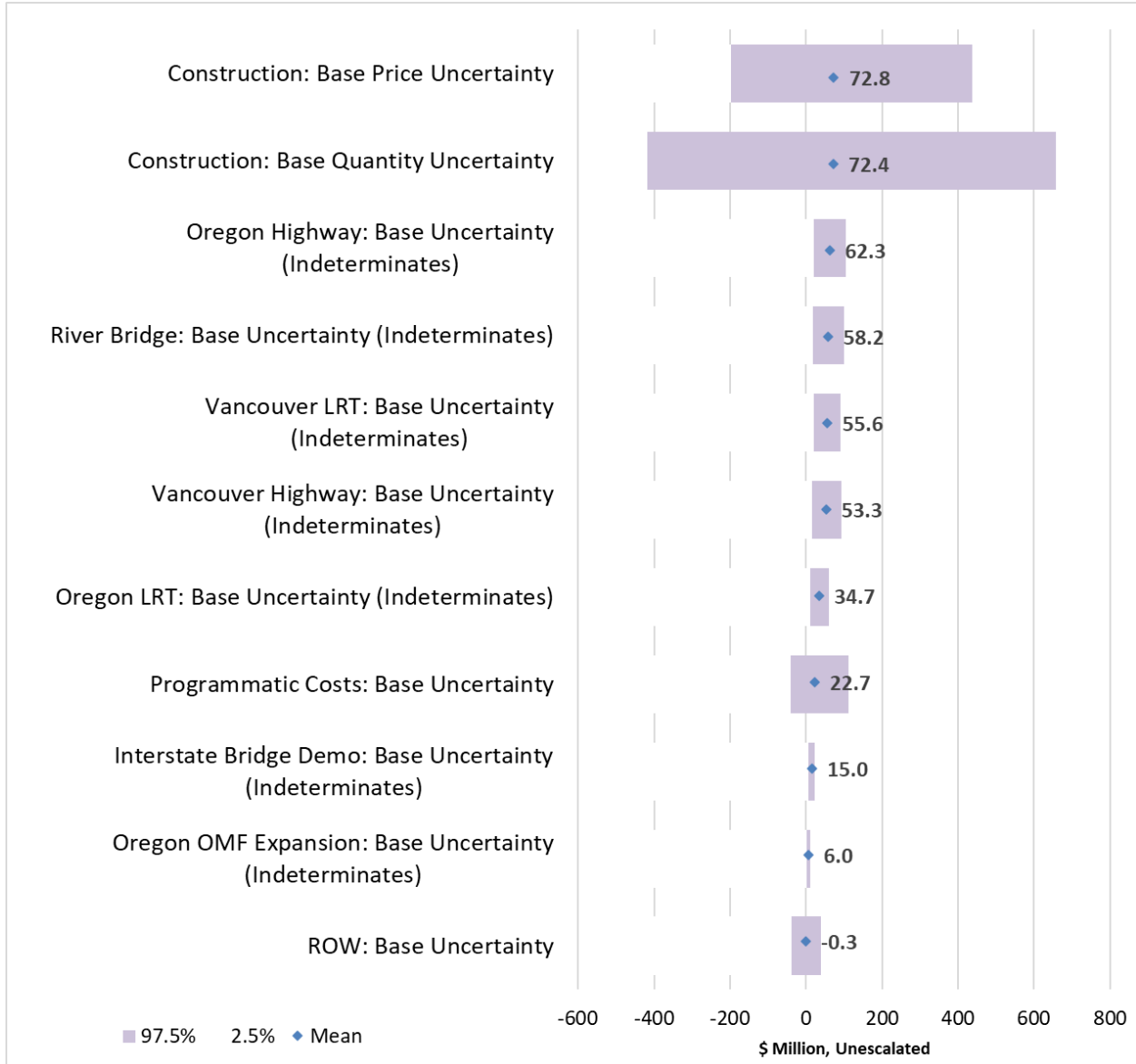
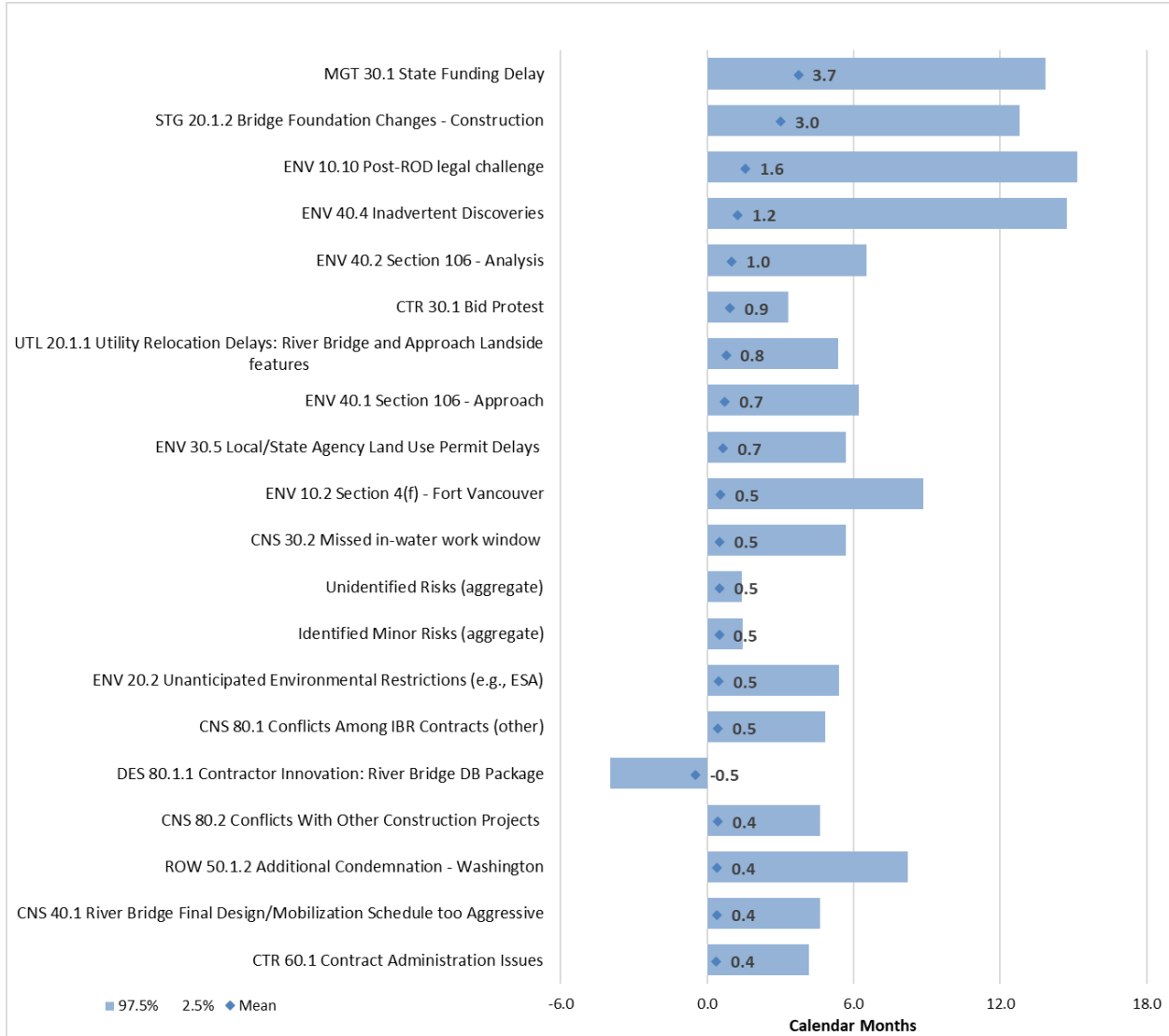


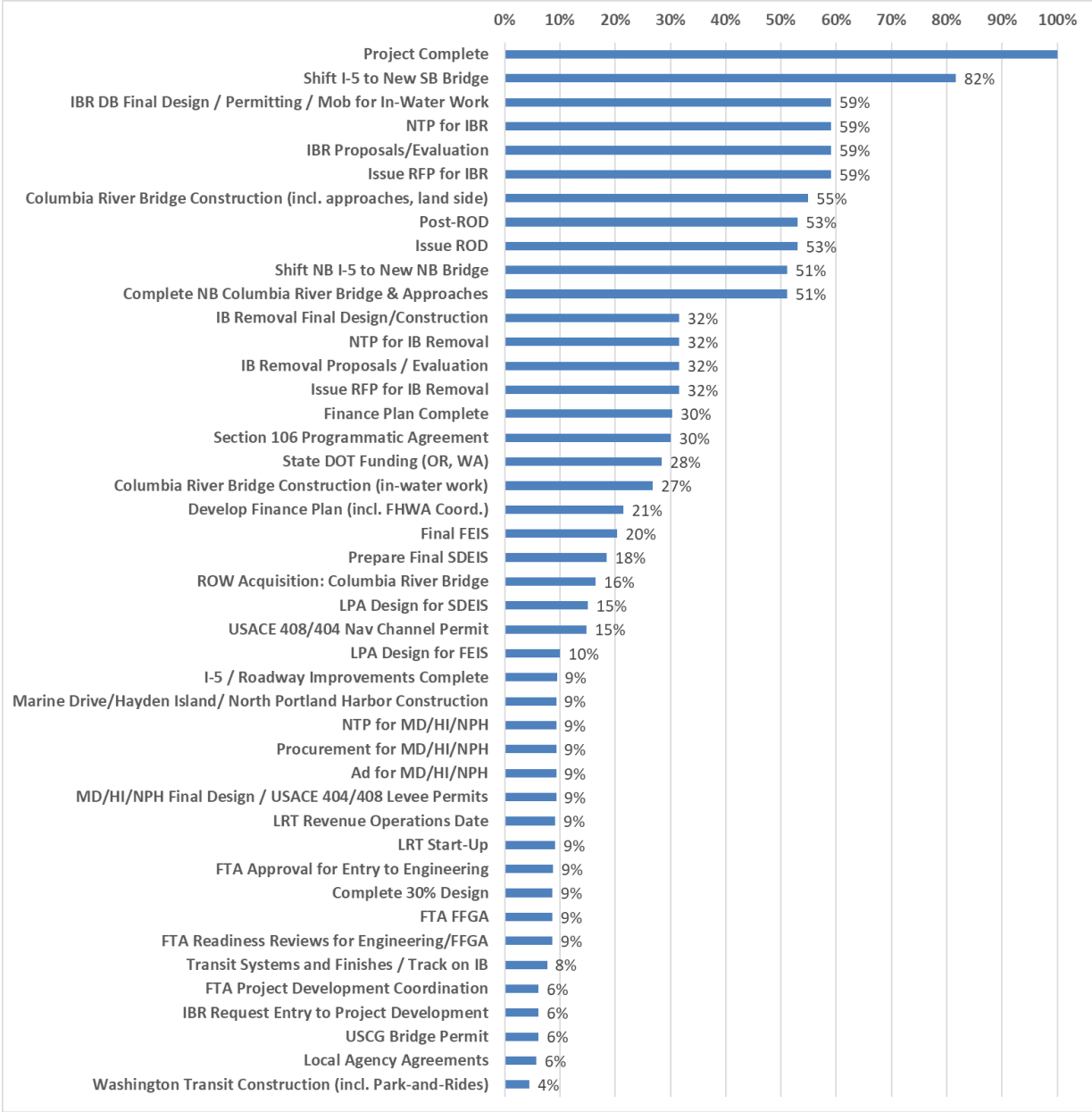
Figure 4-6. Most Significant Threats and Opportunities to Project Schedule (Modified LPA Base; Post-Mitigation Scenario)



4.4.2 Schedule Critical Path Analysis (Post-Mitigation Scenario)

Figure 4-7 summarizes the results of the schedule analysis for the post-mitigation scenario, including the probability that each major activity or milestone is on the overall critical path (“criticality”) to project completion. For example, the milestone “Shift I-5 to New SB Bridge” falls on the overall critical path to program completion on 82% of the Monte Carlo realizations performed for this scenario. Note that some activities/milestones may be co-critical on some realizations.

Figure 4-7. Probability of Key Activities/Milestones Being on Critical Path (Modified LPA Base; Post-Mitigation Scenario)



4.5 Results (Comparison of Pre- and Post-Mitigation)

Figures 4-8 and 4-9 provide comparisons of program cost and schedule results, respectively, for the pre- and post-mitigation scenarios. The difference between the two scenarios at the 60th percentile is **\$588 million (\$6,523 million minus \$5,935 million)** in YOE dollars. Similarly, the difference between the 60th percentile completion dates is **17 months (March 2038 versus October 2036)**. These differences are due to the re-quantification of project risks, assuming successful implementation of the risk mitigation strategies identified. The pre- and post-mitigation risk registers are contained in Appendix D.

Figure 4-8. Comparison of Cost Results for Pre- and Post-Mitigation Scenarios (Modified LPA Base)

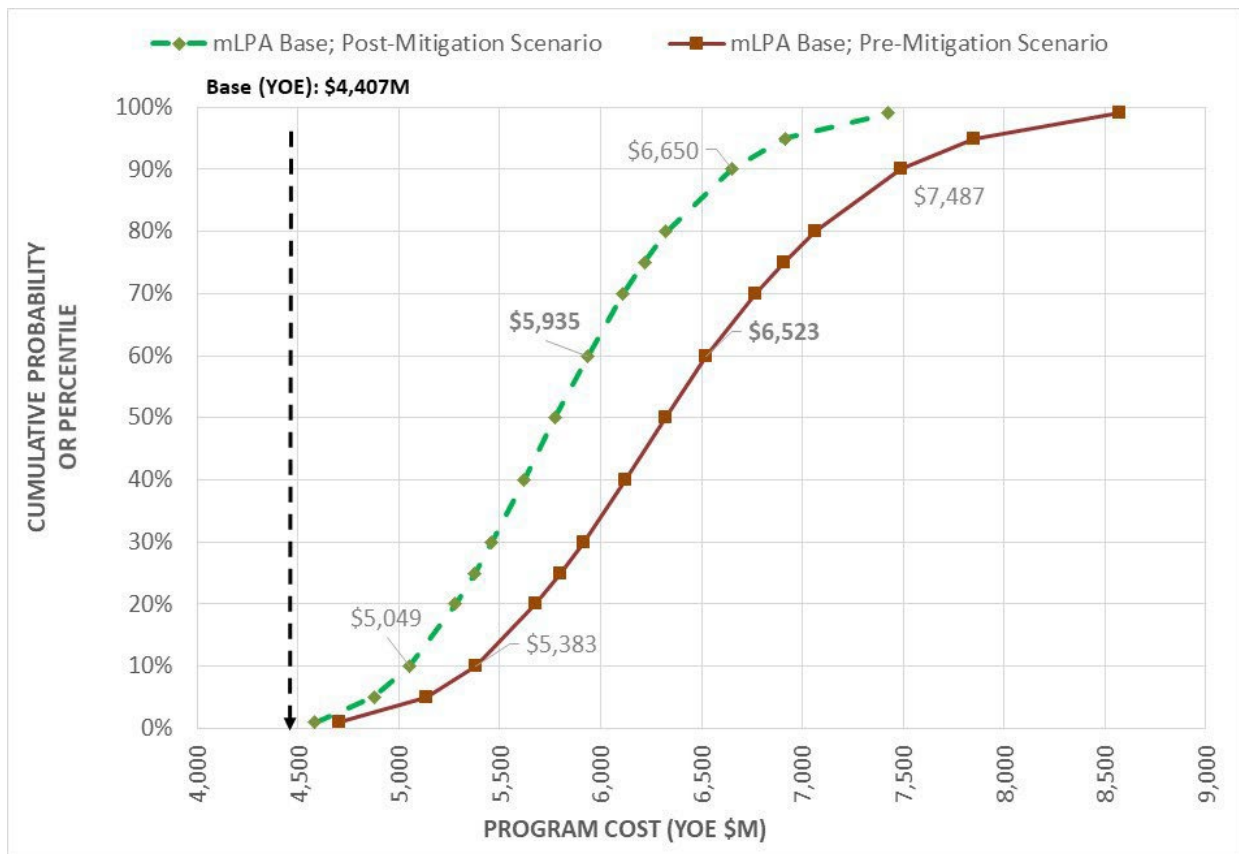
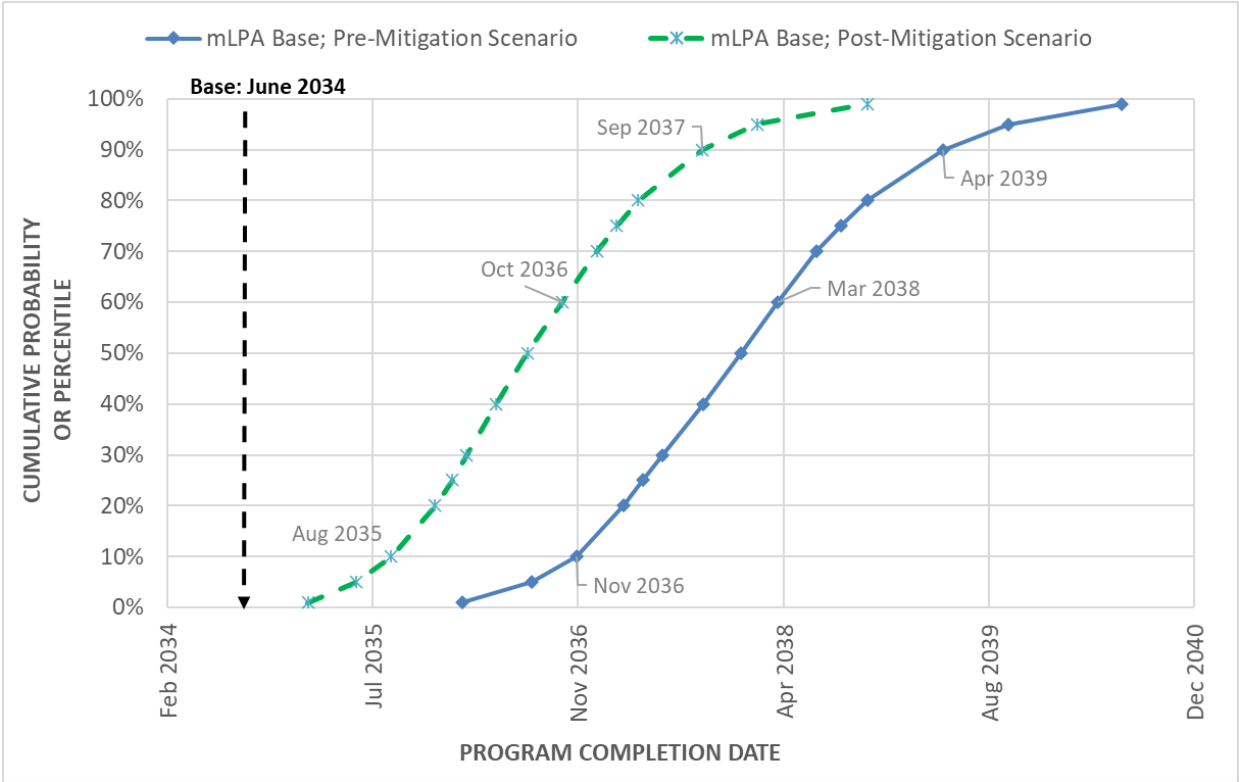


Figure 4-9. Comparison of Schedule Results for Pre- and Post-Mitigation Scenarios (Modified LPA Base)



5. RISK MANAGEMENT

It is imperative that the IBR program continue to engage in active risk management to minimize the threats and maximize the opportunities the program may be exposed to. Continuing to utilize the risk management process to identify, analyze, respond to, and monitor and control risk will support effective program management and provide a source of information for action in the proper handling of risk effects. If action to manage risk is not taken and decisions are not made in a timely fashion, the impacts of the risks may be incurred, particularly in the form of schedule delays; however, if the necessary risk response strategies and action plans are proactively deployed, the impacts of the associated risks can be minimized to the extent feasible.

Risk management is a collaborative, continuous and cyclical process that requires input from key program partners and stakeholders. Future risk management activities will include continued focus on risks with the highest relative risk severity identified and monitoring of the risks at consistent intervals. Should risks begin to materialize, execution of risk response strategies as early as possible is imperative. Should new risks materialize, it is recommended to go through the process of identification and evaluation to identify impacts and appropriate response mechanisms as documented in the program's risk register. It is important to clarify that this phase is continued throughout project implementation so that each project risk is managed until it can be retired or until the project completes closeout.

To facilitate the continuous application of proactive risk response planning, the IBR program technical leads will provide monthly risk register updates and the IBR program team will meet quarterly to review and validate the risks and action plans. Routine risk monitoring and control will ensure timely decision-making and aid in the continued acknowledgment of uncertainties that may significantly impact the program's progression and cost.

Appendix A – Workshop Agenda and Participation



CEVP® WORKSHOP AGENDA

Interstate Bridge Replacement Project

October 10-14, 2022

In-Person Participation:

IBR Office Large Conference Room

IBR Office 500 Broadway Suite 200 Vancouver WA 98660

Virtual Participation:

Microsoft Teams

Workshop Objectives:

1. Common understanding among participants of the CEVP® Process.
2. Describe Project scope, characteristics, and key assumptions/exclusions.
3. Validate schedule flow-chart logic and base activity durations.
4. Validate base cost estimates and quantify estimating uncertainties.
5. Develop comprehensive and non-overlapping project risk register and quantify all significant risks.

NOTE: Sequence and durations of agenda items in the workshop process may vary somewhat from those planned.

Participants: Core attendees (or representatives) attend all sessions. Other participants attend sessions as noted on agenda.

Core Attendees (attend for the duration):

CEVP Team:

Risk Lead: Alan Keizur

Cost Lead: Forrest Dill

Risk Modeler/Assistant: Feng Li

Project Team:

IBR Project Leadership (WSDOT): Casey Liles, Frank Green

IBR Project Leadership (ODOT): Shilpa Mallem

IBR Project Leadership (Program Manager): Rich Huang, Mike Oborn

IBR Risk Register: Greg Brink, Alex Mannion, Lisa Stensby

Date/Time	Topic	Leading	Additional Participants
Day 1 – Monday, October 10, 2022			
8:15 am	Kickoff/Introduction <ul style="list-style-type: none"> ▪ Welcome, Sign-in, Introductions ▪ Safety Orientation ▪ Agenda review for today ▪ Brief CEVP/CRA process overview 	Project Leadership / Alan Keizur	All
8:45 am	Project Overview <ul style="list-style-type: none"> ▪ Project scope and key assumptions ▪ Exclusions (if any) ▪ Major risks and issues 	Project Team	All
9:30 am	Schedule Review / Flowchart <ul style="list-style-type: none"> ▪ Review key activities and milestones ▪ Review predecessor linkages and activity base durations ▪ Validation and concurrence 	Alan Keizur	All
10:15 am	BREAK		
10:30 am	Base cost validation & concurrence (overview) <ul style="list-style-type: none"> ▪ ○ ▪ Unit prices and quantities ▪ Allowances and Markups ▪ Base cost uncertainty ranges 	Forrest Dill	Core Team, SMEs with interest in cost estimate review
12:00- 1:00	LUNCH		
Remainder of Workshop	Begin discipline-specific cost/risk reviews <ul style="list-style-type: none"> • Review/validate any remaining discipline-specific cost items • Establish any remaining base uncertainty ranges • Identify discipline-specific risks • Quantify risks determined to exceed significance threshold 	Alan Keizur, Forrest Dill	See below
1:00 pm	Environmental: Roadway/Transit <ul style="list-style-type: none"> ▪ NEPA/ESA/Environmental Justice ▪ Permitting ▪ Habitat Mitigation ▪ Archaeological / Section 106 / Tribal Coordination ▪ Fish passage ▪ etc. 	Alan Keizur	Core Team, Environmental SMEs

Date/Time	Topic	Leading	Additional Participants
3:00 pm	BREAK		
3:10 pm	Right of Way: Roadway/Transit <ul style="list-style-type: none"> ▪ ROW Plans ▪ Access management ▪ Appraisals & Acquisitions 	Alan Keizur	Core Team, ROW SMEs
4:55 pm	Daily wrap-up <ul style="list-style-type: none"> ▪ Additional information ▪ Clarifications ▪ Improvements ▪ Tomorrow's plan 	Alan Keizur Forrest Dill	Core Team
5:00 pm	ADJOURN		
Day 2 – Tuesday, October 11, 2022			
8:15 am	Roadway Design: Washington <ul style="list-style-type: none"> ▪ Roadway/geometric, interchange design ▪ Hydraulic/Stormwater Design ▪ Deviations, exceptions, approvals 	Alan Keizur	Core Team, Roadway Design SMEs, Hydraulic Design SMEs
10:00 am	BREAK		
10:15 am	Roadway Design: Oregon <ul style="list-style-type: none"> ▪ Roadway/geometric, interchange design ▪ Hydraulic/Stormwater design ▪ Deviations, exceptions, approvals 	Alan Keizur	Core Team, Roadway Design SMEs, Hydraulic Design SMEs
12:00 – 1:00	LUNCH		
1:00 pm	Traffic Design: Roadway <ul style="list-style-type: none"> ▪ ITS, ATMS, Tolling ▪ Lighting, Signage, Striping, etc. 	Alan Keizur	Core Team, Traffic Design SMEs
2:00 pm	BREAK		
2:15 pm	Structure and Geotech Risk Review: Marine Structures <ul style="list-style-type: none"> ▪ Bridge substructure & superstructure design ▪ Marine Construction ▪ Ground conditions 	Alan Keizur	Core Team, Structural, Geotechnical SMEs

Date/Time	Topic	Leading	Additional Participants
3:45 pm	Structure and Geotech Risk Review: Land Side Structures (Roadway) <ul style="list-style-type: none"> ▪ Bridge substructure & superstructure design ▪ Walls ▪ Ground conditions 	Alan Keizur	Core Team, Structural, Geotechnical SMEs
4:55 pm	Daily wrap-up <ul style="list-style-type: none"> ▪ Additional information ▪ Clarifications ▪ Improvements ▪ Tomorrow's plan 	Alan Keizur Forrest Dill	Core Team
5:00 pm	ADJOURN		
Day 3 – Wednesday, October 12, 2022			
8:15 am	Stakeholder Coordination <ul style="list-style-type: none"> ▪ Interagency agreements ▪ Local agency coordination ▪ Local street improvements 	Alan Keizur	Core Team, Management SMEs, Interagency Partners
10:30 am	BREAK		
10:45 am	Utilities: Roadway/Transit <ul style="list-style-type: none"> ▪ Utility agreements ▪ Utility Relocations ▪ Unidentified utilities 	Alan Keizur	Core Team, Utility SMEs
12:00 – 12:30	LUNCH		
12:30 pm	Contracting / Market Conditions <ul style="list-style-type: none"> ▪ Inflation and Market Conditions ▪ Delivery method ▪ Contracting and packaging ▪ Procurement 	Alan Keizur	Core Team, Management SMEs, Contracting SMEs
2:30 pm	BREAK		
2:45 pm	Construction: Roadway <ul style="list-style-type: none"> ▪ Constructability ▪ Construction staging ▪ Construction phasing ▪ Maintenance of access & services ▪ Traffic control 	Alan Keizur	Core Team, Construction SMEs

4:45 pm	Daily wrap-up <ul style="list-style-type: none"> ▪ Additional information ▪ Clarifications ▪ Improvements ▪ Tomorrow's plan 	Alan Keizur Forrest Dill	Core Team
5:00 pm	ADJOURN		
Day 4 – Thursday, October 12, 2022			
8:15 am	Transit: Alignment and Civil Elements <ul style="list-style-type: none"> ▪ SCC 10 (Guideway and Track) cost elements and associated risks ▪ SCC 20 (Stations, Intermodal) cost elements and associated risks ▪ SCC 30 (Support Facilities) cost elements and associated risks ▪ SCC 40 (Sitework and Special Conditions) cost elements and associated risks ▪ Express Bus-on-Shoulder ▪ Express Bus Transit Centers and Support Facilities 	Alan Keizur	Core Team, Transit SMEs, Structural/Geotechnical SMEs
10:30 am	BREAK		
10:40 am	Transit: Systems and Vehicles <ul style="list-style-type: none"> ▪ SCC 50 (Systems) cost elements and associated risks: train control, signals, traction power, communications, central control, etc. ▪ SCC 70 (Vehicles) cost elements and associated risks ▪ Express Bus Vehicles and Systems 	Alan Keizur	Core Team, Transit SMEs (Systems, Vehicles)
12:00 – 1:00	LUNCH		
1:00 pm	Transit: Professional services <ul style="list-style-type: none"> ▪ SCC 80 cost elements and associated risks: engineering, PM/CM, FTA coordination ▪ Express Bus Programmatic Issues 	Alan Keizur	Core Team, Transit SMEs (Management, FTA)
2:30 pm	BREAK		

2:45 pm	Transit: Construction <ul style="list-style-type: none"> ▪ Transit construction issues, including testing/commissioning 	Alan Keizur	Core Team, Transit SMEs, Construction SMEs
3:45 pm	Railroad Coordination: Roadway/Transit <ul style="list-style-type: none"> ▪ Railroad agreements ▪ Construction coordination 	Alan Keizur	Core Team, Railroad SMEs, Construction SMEs
4:30 pm	Next Steps, Assignments, Wrap-up, Action Items & Milestones: <ul style="list-style-type: none"> ▪ Schedule/next steps: <ul style="list-style-type: none"> ▪ Finalization of inputs ▪ Preliminary “unmitigated” model results preview ▪ Preliminary results presentation ▪ Draft report & comment period ▪ Post-Mitigation update ○ Final Report 	Alan Keizur Forrest Dill	Core Team
4:45 pm	ADJOURN		
Day 5 – Friday, October 14, 2022			
8:15 am	Management <ul style="list-style-type: none"> ▪ Funding ▪ Project Management ▪ Interagency agreements 	Alan Keizur	Core Team, Management SMEs
10:00 am	Hold for Risk Register Review / Parking Lot Items (as needed)	Alan Keizur	Core Team
12:00 pm	ADJOURN		

Table A-1. Workshop Participants

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Appendix B – Schedule Flowchart

Reference Date: October 1, 2022

Interstate Bridge Replacement DRAFT Flowchart for Schedule Risk Analysis November 7, 2022

Notes:

1. Activities and milestones highlighted in red are on the base critical path for a given project (prior to consideration of risk) to project completion.
2. Durations shown are in calendar months.
3. Individual construction packages and linkages between work elements have not yet been defined.
4. Project Controls (activities #67a/67b) extends throughout the project duration to capture project management/administration costs (both fixed and subject to inflation).
5. Allowable in-water work windows extend from September 15 to April 15 (yellow highlights)

Project Completion
6/19/2034

Preliminary Draft Working Copy

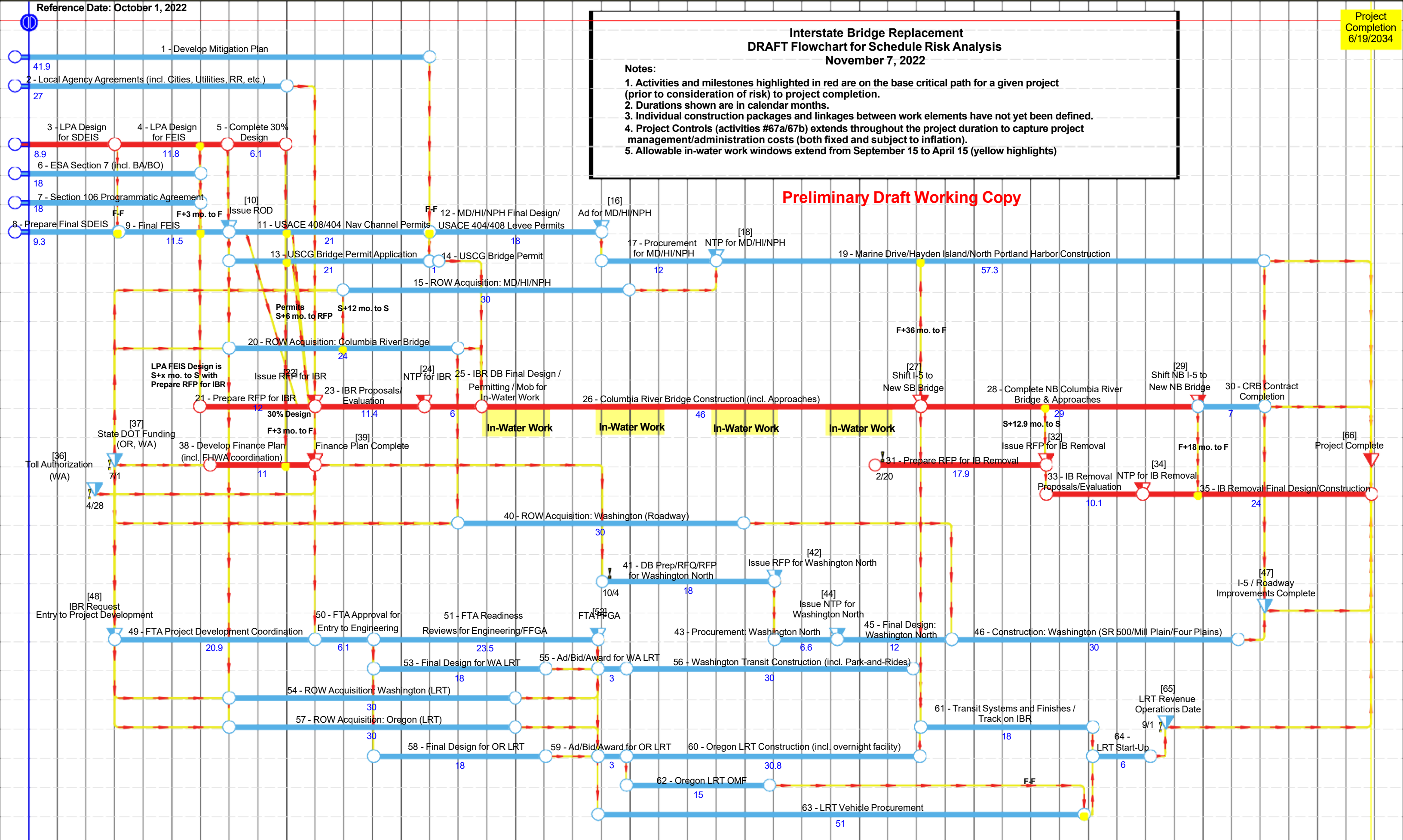


Table B-1. Flowchart Logic Summary

Activity	Predecessor(s)	Successor(s)
1 – Develop Mitigation Plan	-	11 (F-F)
2 – Local Agency Agreements	-	22
3 – LPA Design for Draft Supplemental Environmental Impact Statement (Draft SEIS)	-	4, 8 (F-F)
4 – LPA Design for Final Supplemental Environmental Impact Statement (Final SEIS)	3	5, 10, 21 (S+9 mo. to S)
5 – Complete 30% Design	4	38 (F+3.2 mo. to F)
6 – ESA Section 7 (including BA/BO)	-	9 (F+3 mo. to F)
7 – Section 106 Programmatic Agreement	-	9 (F+3 mo. to F)
8 – Prepare Draft SEIS	3 (F-F)	9
9 – Final SEIS	8, 6 (F+3 mo. to F), 7 (F+3 mo. to F)	10
10 – Issue ROD	4, 9	10'
10' – Post-ROD	10	11, 13, 15, 20, 22, 40, 54bl, 57bo
11 – U.S. Army Corps of Engineers (USACE) 408/404 Navigation Channel Permit	10', 1 (F-F)	12, 14, 22 (S+6 mo. to S)
12 – Marine Drive/Hayden Island/North Portland Harbor (MD/HI/NPH) Final Design/USACE 404/408 Levee Permits	11	16
13 – U.S. Coast Guard (USCG) Bridge Permit Application	10'	14, 22 (S+6 mo. to S)
14 -USCG Bridge Permit	11, 13	26, 26'
15 – ROW Acquisition: MD/HI/NPH	10', 20 (S+12 mo. to S), 37AS	18
16 – Ad for MD/HI/NPH	12	17

Quantitative Risk Assessment

Activity	Predecessor(s)	Successor(s)
17 – Procurement for MD/HI/NPH	16	18
18 – Notice to Proceed (NTP) for MD/HI/NPH	15, 17	19
19 – MD/HI/NPH Construction	18, 27 (F+36 mo. To F)	47
20 – ROW Acquisition: Columbia River Bridge	10', 37	26, 26', 40, 15 (S+12 mo. to S)
21 – Prepare RFP for IBR	4 (S+9 mo. to S)	22
22 – Issue RFP for IBR	10', 21, 2, 11 (S+6 mo. to S), 13 (S+ 6 mo. to S), 39	23
23 – IBR Proposals/Evaluation	22	24
24 – NTP for IBR	23	25
25 – IBR DB Final Design/Permitting/Mobilization for In-Water Work	24	26, 26'
26 – Columbia River Bridge Construction (including approaches, land side)	25, 14, 20, 26' (F-F)	27
26' – Columbia River Bridge Construction (in-water work)	25, 14, 20	27, 26 (F-F)
27 – Shift I-5 to New SB Bridge	26	28, 19 (F+36 mo. to F), 61
28 – Complete Northbound (NB) Columbia River Bridge and Approaches	27	29, 32 (S+12.9 mo. to S)
29 – Shift NB I-5 to New NB Bridge	28	30, 35 (F+18 mo. to F)
30 – Interstate Bridge (IB) Contract Completion	29	47
31 – Prepare RFP for IB Removal	-	32
32 – Issue RFP for IB Removal	31, 28 (S+12.9 mo. to S)	33
33 – IB Removal Proposals/Evaluation	32	34
34 – NTP for IB Removal	33	35

Quantitative Risk Assessment

Activity	Predecessor(s)	Successor(s)
35 – IB Removal Final Design/Construction	34, 29 (F+18 mo. to F)	66
36 – Toll Authorization (Washington)	-	39
37 – State DOT Funding (Oregon, Washington)	-	15, 20, 38, 40, 48, 54, 57
38 – Develop Finance Plan (including FHWA coordination)	37, 5 (F+3.2 mo. to F)	39
39 – Finance Plan Complete	36, 38	22, 41, 50
40 – ROW Acquisition: Washington (roadway)	10', 20, 37	46
41 – Design-Build Prep./RFQ/RFP for Washington North	39	42
42 – Issue RFP for Washington North	41	43
43 – Procurement: Washington North	42	44
44 – Issue NTP for Washington North	43	45
45 – Final Design: Washington North	44	46
46 – Construction: Washington (SR 500/Mill Plain/Fourth Plain)	40, 45	47
47 – I-5/Roadway Improvements Complete	19, 30, 46	66
48 – IBR Request Entry to Project Development	37	49
49 – FTA Project Development Coordination	48	50
50 – FTA Approval for Entry to Engineering	39, 49	51, 53, 58
51 – FTA Readiness Reviews for Engineering/FFGA	50	52
52 – FTA FFGA	51	55, 59, 63
53 – Final Design for Washington LRT	50	55
54 – ROW Acquisition: Washington (LRT)	10', 37	55
55 – Ad/Bid/Award for Washington LRT	52, 53, 54	56

Activity	Predecessor(s)	Successor(s)
56 – Washington Transit Construction (including park and rides)	55	61
57 – ROW Acquisition: Oregon (LRT)	10', 37	59
58 – Final Design for Oregon LRT	50	59
59 – Ad/Bid/Award for Oregon LRT	52, 57, 58	60, 62
60 – Oregon LRT Construction (including overnight facility)	59	61
61 – Transit Systems and Finishes/Track on IB	27, 56, 60	64
62 – Oregon LRT Operations and Maintenance Facility	59	63 (F-F)
63 – LRT Vehicle Procurement	52, 62 (F-F)	64
64 – LRT Start-Up	61, 63	65
65 – LRT Revenue Operations Date	64	66
66 – Project Complete	35,47, 65	67b (F-F), Finish
67a – Program Management (FY23)		67b
67b – Program Management (FY24+)	67a	-

Appendix C – Cost Estimate Summary

COST ESTIMATE METHODOLOGY EXECUTIVE SUMMARY

INTRODUCTION

The Interstate Bridge Replacement (IBR) Program cost estimating process supports all phases of program development and is used across multiple disciplines, including design, environmental review documentation and financial planning. Products associated with the cost estimating process also must support the requirements of the Cost Estimate Validation Process (CEVP) as well as satisfy the needs of agencies and partner agencies. This summary focuses on the cost estimating methodology and progress made during the conceptual design phase.

CONCEPTUAL DESIGN PHASE COST ESTIMATE

The IBR Program Team evaluated the various design options and established a Modified Locally Preferred Alternative (Modified LPA).

Current planning work has defined the physical and contextual changes that have occurred in the program area since 2013 and builds upon previous planning efforts accomplished as part of the Columbia River Crossing (CRC) project. To address these changes, the IBR program, in coordination with program partners and the community, developed design options, desired outcomes, and transit investments, in order to identify a Modified LPA to be further studied through a Supplemental Draft Environmental Impact Statement (SDEIS) in compliance with the National Environmental Policy Act (NEPA). A Modified LPA identifies the foundational elements local partners agree should move forward for further evaluation, including potential benefits and impacts and formal public comment. Detailed evaluation of the IBR program's Modified LPA is currently underway. In order to analyze the Modified LPA, a conceptual design of the Modified LPA was developed and was used in this cost estimating process.

During the Conceptual Design Phase, a base cost estimate was developed in three phases:

1. Cost estimates for the screening of design options prior to identification of the Modified LPA.
2. Cost estimates for the Modified LPA in preparation for the CEVP Workshop.
3. Revised base cost estimate for the Modified LPA incorporating comments from the CEVP Workshop.

Cost Estimate Methodology Development

During the design option screening phase, a cost estimating methodology was developed that could be used in the CEVP workshop and potentially through 10% phase of design. Cost estimating was performed on seven design options and was used to compare the options.

The methodology below was developed and tested during the design option screening phase:

- Review past estimates to build upon the CRC Program cost estimates.

Cost Estimate Methodology Executive Summary

- Development of a “cost library”; a tool to compare costs for design options from the same basis of understanding.
- Develop cost activities and identify cost activities commensurate with the design detail available.
- Develop cost backup: provide justification for costs of each cost activity.
- Utilize engineering plans and Concept Station design software to estimate quantities of the built-up composite cost activities.
- Develop comparative estimates between design options providing a relative difference in cost.

Cost Estimates Preparing for the CEVP Workshop

A base cost estimate of the Modified LPA was developed using the cost methodology described above. Four cost estimates representing variations of the Modified LPA (design options) were evaluated through the CEVP process for comparative purposes:

- Modified LPA Base: A single auxiliary lane in each direction on the Columbia River Bridge, embedded track only at intersections and direct fixation track in all other locations, at-grade light rail stations at Evergreen and the Vancouver waterfront, underground parking garage at Evergreen and an above-grade parking garage at the waterfront, Vancouver bus improvements, overnight LRT facility
- Design Option A: the same as the Modified LPA Base, except with all embedded track.
- Design Option B: the same as the Modified LPA Base, except with all embedded track and an elevated station at Evergreen.
- Design Option C: the same as the Modified LPA Base, except for all embedded track and two auxiliary lanes on the Columbia River Bridge and North Portland Harbor Bridge.

Cost Estimates After the CEVP Workshop

A base cost estimate for the Modified LPA incorporated comments received during and after the CEVP Workshop. This base cost estimate focuses on the Modified LPA and breaks down the estimate by categories of Washington and Oregon project elements and by Highway and Transit elements. Below are the significant revisions to the base cost estimate:

- Split the river crossing structure costs into 75% highway and 25% transit. Also provided the total river crossing structure costs, regardless of the highway/transit cost split.
- Moved all costs associated with owner-provided preliminary engineering services into the base cost estimate, similar to the CRC 2012 estimate.
- Adjusted the GEC component of the PM+PC costs to include the environmental, planning, and permitting costs and included labor costs for the management the IBR Program.
- Eliminated all allowances from the base cost estimate. Allowances and risks were quantified in the Monte Carlo simulation as part of CEVP.
- Provided level of uncertainty for cost items that are similar to the uncertainties identified in the CRC 2012 estimate. The uncertainties were used in the Monte Carlo simulation:
 - Price uncertainty: +/-%

Cost Estimate Methodology Executive Summary

- Quantity uncertainty: +/-%
- Indeterminant Uncertainty, known unknowns - +/-% (new since the 2012 CRC estimate)

CONCEPTUAL DESIGN PHASE COST ESTIMATE SUMMARY

For the Post-CEVP base cost estimate in 2022 dollars for the Modified LPA, refer to Table 3-2 in the main body of this report.

Figure C-1. Base Uncertainty Range Assessments

IBR Unique ID No	Major Cost Item	Unit Price Uncertainty		Quantity Uncertainty		Indeterminates Uncertainty		
		10th Percentile	90th Percentile	10th Percentile	90th Percentile	Minimum Value	Most Likely Value	90th Percentile
11580	Landside Bridge	-10%	10%	-10%	15%	0%	4%	5%
11050	River Bridge - Two Bridge Option	-10%	10%	-10%	15%	0%	7%	10%
11790	Mobilization	0%	0%	-20%	20%	0%	1%	2%
11020	Bridge, North Portland Harbor	-10%	10%	-10%	15%	0%	8%	10%
11800	Traffic Control	0%	0%	-15%	15%	0%	13%	15%
11750	Environmental/Cultural Resource mitigation	-10%	10%	-	-			
11905	River User Cost	-10%	10%	-	-			
10890	Light Rail Vehicle	-10%	10%	-	-	0%	2%	10%
11730	Wall, Fill, MSE 2-Stage	-10%	10%	-15%	15%	0%	15%	25%
11740	Wall, Cut, Soldier Pile	-10%	10%	-15%	15%	0%	15%	25%
11745	Wall, Cut, Secant Pile	-10%	10%	-15%	15%	0%	15%	25%
11650	Interstate Bridge Removal, In Water	-30%	30%	0%	0%	0%	25%	30%
11370	AC Pavement	-5%	5%	-5%	20%	0%	3%	10%
11080	Ground improvements - OR RC - Double	-10%	10%	-10%	30%	0%	25%	30%
11082	Ground improvements - OR Tran	-10%	10%	-10%	30%	0%	25%	30%
11084	Ground improvements - OR Hwy	-10%	10%	-10%	30%	0%	25%	30%
11470	LRT Station, center platform	-10%	10%	-10%	10%	0%	15%	20%
11475	LRT Aerial Station - Center Platform w/o Mezzanine (2 Car)	-10%	10%	-10%	10%	0%	18%	20%
11100	Parking structures	-15%	15%	-	-	0%	20%	25%
11110	Parking structures - below grade	-15%	15%	-	-	0%	25%	25%
11030	Community Connector ("The Lid")	-10%	10%	-	-	0%	20%	30%
11145	LRT OMF Facility - Expansion at Ruby Junction	-15%	15%	-	-	0%	20%	30%
11200	Utility Relocation, High	-20%	20%	-20%	20%	0%	25%	30%
10760	Grade Separation Improvements for LRT near Steel Bridge	-10%	20%	-	-	0%	25%	30%
11660	Multi-Use Path Ramp to Structure	-10%	10%	-10%	20%	0%	25%	30%
10970	Elevator, with housing	-10%	10%	-15%	10%	0%	8%	10%
11410	Escalators, 40'-80' rise	-10%	10%	-15%	15%	0%	20%	25%
11420	Elevators, 20'-40' rise for elevated station	-10%	10%	-15%	15%	0%	20%	25%
11430	Stairs, 40' for elevated station	-10%	10%	-15%	15%	0%	20%	25%
11450	Sustainability Allowance for elevated station	-10%	10%	-15%	15%	0%	22%	25%
	<i>Embedded Track Structural Premium</i>	-20%	20%	-10%	10%	0%	25%	30%
	Other cost items not individually ranged	10%	10%	-10%	20%	0%	10%	15%

Figure C-2. Base Cost Uncertainty

Component	Deterministic Base	Base Uncertainty							Mean Adjusted Base	Delta
		Unit Price Uncertainty		Quantity Uncertainty		Indeterminates Uncertainty				
		10th	90th	10th	90th	Min	Most Likely	90th		
HI + MD Base LRT	\$374.2	-3.6%	9.8%	-8.0%	12.5%	0.0%	8.9%	13.2%	\$426.1	\$51.9
Vanc Base Highway	\$738.3	-3.5%	9.0%	-8.6%	13.6%	0.0%	7.0%	10.2%	\$824.4	\$86.0
River Bridge	\$690.0	-3.7%	9.1%	-10.8%	17.4%	0.0%	8.3%	11.8%	\$784.2	\$94.1
Vancouver LRT	\$486.3	-5.2%	10.6%	-6.4%	9.6%	0.0%	11.8%	15.3%	\$559.5	\$73.2
Oregon Base Highway	\$826.7	-3.9%	9.4%	-10.5%	16.2%	0.0%	7.5%	10.4%	\$928.4	\$101.7
Interstate Bridge Demo	\$82.3	-16.7%	22.1%	-4.3%	7.0%	0.0%	19.2%	23.9%	\$100.0	\$17.7
OR OMF Expansion	\$36.2	-7.0%	12.4%	-4.3%	7.0%	0.0%	15.9%	23.9%	\$43.4	\$7.2
Construction Subtotal	\$3,234.1								\$3,666.0	\$431.9
ROW Subtotal	\$168.7	-15.0%	15.0%						\$168.7	\$0.0
Programmatic Cost Subtotal	\$272.4	-10.0%	30.0%						\$295.5	\$23.2
Project Total (Jan 2022 \$M)	\$3,675.2								\$4,130.2	\$455.1

Notes:

1. Base uncertainty ranges for major cost items were translated to the above equivalent ranges based on the weighting of each cost item within each major construction component in the base estimate.
2. Mean adjusted base value represents the deterministic base value plus adjustments for unit price, quantity, and indeterminates uncertainty ranges at the mean values.

Figure C-3. Base Uncertainty Correlation Matrices

Base Uncertainty - Price												Assume perfect correlation among price ranges for construction; partial correlation among ROW and PM	
	HI + MD Base LRT	Vanc Base Highway	River Bridge - Double: OR	River Bridge - Double: WA	Option M LRT: OR	Option M LRT: WA	Option 20 Hwy	Bridge Demo: OR	Bridge Demo: WA	OR OMF Expansion	ROW	Management	
HI + MD Base LRT	1												
Vanc Base Highway	1	1											
River Bridge - Double: OR	1	1	1										
River Bridge - Double: WA	1	1	1	1									
Vanc Option M LRT: OR	1	1	1	1	1								
Vanc Option M LRT: WA	1	1	1	1	1	1							
HI + MD Option 20 Hwy	1	1	1	1	1	1	1						
Interstate Bridge Demo: OR	1	1	1	1	1	1	1	1					
Interstate Bridge Demo: WA	1	1	1	1	1	1	1	1	1				
OR OMF Expansion	1	1	1	1	1	1	1	1	1	1			
ROW	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1		
Program Management	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	

Base Uncertainty - Quantity												Assume perfect correlation among quantity ranges for construction	
	HI + MD Base LRT	Vanc Base Highway	River Bridge - Double: OR	River Bridge - Double: WA	Vanc Option M LRT: OR	Vanc Option M LRT: WA	HI + MD Option 20 Hwy	Interstate Bridge Demo: OR	Interstate Bridge Demo: WA	OR OMF Expansion	ROW	Management	
HI + MD Base LRT	1												
Vanc Base Highway	1	1											
River Bridge - Double: OR	1	1	1										
River Bridge - Double: WA	1	1	1	1									
Vanc Option M LRT: OR	1	1	1	1	1								
Vanc Option M LRT: WA	1	1	1	1	1	1							
HI + MD Option 20 Hwy	1	1	1	1	1	1	1						
Interstate Bridge Demo: OR	1	1	1	1	1	1	1	1					
Interstate Bridge Demo: WA	1	1	1	1	1	1	1	1	1				
OR OMF Expansion	1	1	1	1	1	1	1	1	1	1			

Base Uncertainty - Indeterminates												Assume perfect correlation among quantity ranges for construction	
	HI + MD Base LRT	Vanc Base Highway	River Bridge - Double: OR	River Bridge - Double: WA	Vanc Option M LRT: OR	Vanc Option M LRT: WA	HI + MD Option 20 Hwy	Interstate Bridge Demo: OR	Interstate Bridge Demo: WA	OR OMF Expansion	ROW	Management	
HI + MD Base LRT	1												
Vanc Base Highway	1	1											
River Bridge - Double: OR	1	1	1										
River Bridge - Double: WA	1	1	1	1									
Vanc Option M LRT: OR	1	1	1	1	1								
Vanc Option M LRT: WA	1	1	1	1	1	1							
HI + MD Option 20 Hwy	1	1	1	1	1	1	1						
Interstate Bridge Demo: OR	1	1	1	1	1	1	1	1					
Interstate Bridge Demo: WA	1	1	1	1	1	1	1	1	1				
OR OMF Expansion	1	1	1	1	1	1	1	1	1	1			

Note: Values represent the assumed correlations (i.e., indirect relationships due to common underlying factors such as labor, equipment and material prices, estimator tendency) between line items in the base estimates. A value of 1 indicates a perfect positive relationship, and a value of 0 indicates no relationship (independence). Additional correlations are captured in the integrated cost/schedule model through risk events, including potential changes in regional market conditions.

Table C-1. Cost Escalation Rates

Fiscal Year	Preliminary Engineering (%/year)	Right of Way (%/year)	Construction (%/year)
2022	3.65%	14.87%	8.37%
2023	2.77%	9.02%	6.11%
2024	1.96%	1.44%	0.69%
2025	2.07%	-0.05%	-0.69%
2026	2.16%	0.62%	0.48%
2027	2.17%	1.02%	1.51%
2028	2.14%	1.03%	1.99%
2029	2.18%	0.97%	2.15%
2030	2.15%	1.11%	2.22%
2031	2.16%	1.69%	2.28%
2032	2.17%	2.89%	2.29%
2033	1.85%	4.12%	2.65%
2034	1.81%	4.82%	3.16%
2035	1.90%	5.06%	3.32%

Notes:

1. Rates based on WSDOT CPDM/CPMS tables for PE/ROW/CN dated June 2022.
2. Fiscal year 2023 began July 1, 2022.

Table C-2. Base Cost Loaded Schedule Summary (Modified LPA)

Activity ID	Activity Name	Base Start Date	Base Completion Date	Base Cost (January 2022, millions of dollars)	Base Cost (millions of YOY dollars)
0	Previous Costs	-	-	29.1	29.1
1	Develop Mitigation Plan	10/2/2022	4/2/2026	0.0	0.0
2	Local Agency Agreements	10/2/2022	1/3/2025	0.0	0.0

Activity ID	Activity Name	Base Start Date	Base Completion Date	Base Cost (January 2022, millions of dollars)	Base Cost (millions of YOE dollars)
3	LPA Design for Draft SEIS	10/2/2022	6/30/2023	0.0	0.0
4	LPA Design for Final SEIS	6/30/2023	6/24/2024	0.0	0.0
5	Complete 30% Design	6/24/2024	12/27/2024	0.0	0.0
6	ESA Section 7 (including BA/BO)	10/2/2022	4/3/2024	0.0	0.0
7	Section 106 Programmatic Agreement	10/2/2022	4/3/2024	0.0	0.0
8	Prepare Final Draft SEIS	10/2/2022	7/13/2023	0.0	0.0
9	Final SEIS	7/13/2023	7/4/2024	0.0	0.0
10	Issue ROD	7/4/2024	7/4/2024	0.0	0.0
10'	Post-ROD	7/4/2024	7/4/2024	0.0	0.0
11	USACE 408/404 Navigation Channel Permit	7/4/2024	4/5/2026	0.0	0.0
12	MD/HI/NPH Final Design/USACE 404/408 Levee Permits	4/5/2026	10/6/2027	0.0	0.0
13	USCG Bridge Permit Application	7/4/2024	4/5/2026	0.0	0.0
14	USCG Bridge Permit	4/5/2026	5/6/2026	0.0	0.0
15	ROW Acquisition: MD/HI/NPH	7/5/2025	1/6/2028	80.9	96.9
16	Ad for MD/HI/NPH	10/6/2027	10/6/2027	0.0	0.0
17	Procurement for MD/HI/NPH	10/6/2027	10/6/2028	0.0	0.0
18	NTP for MD/HI/NPH	10/6/2028	10/6/2028	0.0	0.0
19	MD/HI/NPH Construction	10/6/2028	7/24/2033	826.7	1009.3
20	ROW Acquisition: Columbia River Bridge	7/4/2024	7/6/2026	16.0	19.0
21	Prepare RFP for IBR	3/31/2024	4/1/2025	0.0	0.0
22	Issue RFP for IBR	4/5/2025	4/5/2025	0.0	0.0
23	IBR Proposals/Evaluation	4/5/2025	3/19/2026	0.0	0.0

Activity ID	Activity Name	Base Start Date	Base Completion Date	Base Cost (January 2022, millions of dollars)	Base Cost (millions of YOE dollars)
24	NTP for IBR	3/19/2026	3/19/2026	0.0	0.0
25	IBR DB Final Design/Permitting/Mobilization for In-Water Work	3/19/2026	9/18/2026	47.0	52.4
26	Columbia River Bridge Construction (including approaches, land side)	9/18/2026	7/22/2030	360.7	416.2
26'	Columbia River Bridge Construction (in-water work)	9/18/2026	3/17/2030	0.0	0.0
27	Shift I-5 to New SB Bridge	7/22/2030	7/22/2030	0.0	0.0
28	Complete NB Columbia River Bridge and Approaches	7/22/2030	12/23/2032	227.4	281.3
29	Shift NB I-5 to New NB Bridge	12/23/2032	12/23/2032	0.0	0.0
30	CRB Contract Completion	12/23/2032	7/24/2033	54.9	70.5
31	Prepare RFP for IB Removal	2/20/2030	8/19/2031	0.0	0.0
32	Issue RFP for IB Removal	8/19/2031	8/19/2031	0.0	0.0
33	IB Removal Proposals/Evaluation	8/19/2031	6/23/2032	0.0	0.0
34	NTP for IB Removal	6/23/2032	6/23/2032	0.0	0.0
35	IB Removal Final Design/Construction	6/23/2032	6/25/2034	82.3	106.2
36	Toll Authorization (Washington)	4/28/2023	4/28/2023	0.0	0.0
37	State DOT Funding (Oregon, Washington)	7/1/2023	7/1/2023	0.0	0.0
38	Develop Finance Plan (including FHWA coordination)	7/1/2023	4/5/2025	0.0	0.0
39	Finance Plan Complete	4/5/2025	4/5/2025	0.0	0.0
40	ROW Acquisition: Washington (roadway)	7/6/2026	1/6/2029	20.0	24.2

Activity ID	Activity Name	Base Start Date	Base Completion Date	Base Cost (January 2022, millions of dollars)	Base Cost (millions of YOE dollars)
41	Design-Build Prep./RFQ/RFP for Washington North	10/4/2027	4/5/2029	0.0	0.0
42	Issue RFP for Washington North	4/5/2029	4/5/2029	0.0	0.0
43	Procurement: Washington North	4/5/2029	10/23/2029	0.0	0.0
44	Issue NTP for Washington North	10/23/2029	10/23/2029	0.0	0.0
45	Final Design/Construction: Washington North	10/23/2029	10/24/2030	211.0	252.3
46	Construction: Washington North	10/24/2030	4/26/2033	527.4	656.2
47	I-5/Roadway Improvements Complete	7/24/2033	7/24/2033	0.0	0.0
48	IBR Request Entry to Project Development	7/1/2023	7/1/2023	0.0	0.0
49	FTA Project Development Coordination	7/1/2023	3/29/2025	0.0	0.0
50	FTA Approval for Entry to Engineering	4/5/2025	10/8/2025	0.0	0.0
51	FTA Readiness Reviews for Engineering/FFGA	10/8/2025	9/25/2027	0.0	0.0
52	FTA FFGA	9/25/2027	9/25/2027	0.0	0.0
53	Final Design for Washington LRT	10/8/2025	4/10/2027	0.0	0.0
54	ROW Acquisition: Washington (LRT)	7/4/2024	1/5/2027	17.0	20.2
55	Ad/Bid/Award for Washington LRT	9/25/2027	12/26/2027	0.0	0.0
56	Washington Transit Construction (including park and rides)	12/26/2027	6/28/2030	398.8	465.8
57	ROW Acquisition: Oregon (LRT)	7/4/2024	1/5/2027	34.9	41.5
58	Final Design for Oregon LRT	10/8/2025	4/10/2027	0.0	0.0
59	Ad/Bid/Award for Oregon LRT	9/25/2027	12/26/2027	0.0	0.0

Activity ID	Activity Name	Base Start Date	Base Completion Date	Base Cost (January 2022, millions of dollars)	Base Cost (millions of YOE dollars)
60	Oregon LRT Construction (including overnight facility)	12/26/2027	7/22/2030	306.8	359.1
61	Transit Systems and Finishes/Track on Columbia River Bridge	7/22/2030	1/22/2032	116.2	142.1
62	Oregon LRT Operations and Maintenance Facility	12/26/2027	3/27/2029	36.2	41.8
63	LRT Vehicle Procurement	9/25/2027	12/29/2031	0.0	0.0
64	LRT Start-Up	1/22/2032	7/23/2032	38.7	48.5
65	LRT Revenue Operations Date	9/1/2032	9/1/2032	0.0	0.0
66	Project Complete	6/25/2034	6/25/2034	0.0	0.0
67	Program Management	10/2/2022	6/25/2034	243.3	276.6
	Total			3,765.2	4,407.2

Appendix D – Risk Registers

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling		Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
CNS 10.1	Complex Staging and MOT	Threat	+10	+30	+50				50%	Split among activities 19, 26, 28, 46, 56, 60	Y	Active	9/28/2022	9/28/2022
CNS 10.2	Staging and Phasing Among Contracts: NPH Bridges and Connections	Threat				6.0	12.0	18.0	50%	Applied to activity 19	Y	Active	10/7/2022	10/7/2022
CNS 10.3	Arterial Bridge Sequencing	Opportunity								Minor opportunity	Y	Watch List	9/28/2022	9/28/2022
CNS 10.4	Maintenance of Traffic (MOT) Mitigation	Threat								Cost assumed to be captured in MOT percentages; schedule needs to be evaluated. Quantify risk in a future CEVP.	Y	Watch List	9/22/2022	9/28/2022
CNS 10.5	MOT cost reduction opportunity	Opportunity								Addressed in base quantity uncertainty range	Y	Active	10/10/2022	10/10/2022
CNS 10.6	Civil and Systems Contractor Interface / Coordination	Threat				1.0	2.0	3.0	50%	Activity 61	Y	Active	9/22/2022	9/28/2022
CNS 20.1	Construction Noise and Vibration	Threat								Minor Risk	Y	Active	9/28/2022	9/28/2022
CNS 30.1	In-Water Work Windows are More Restrictive	Threat	\$0 M	\$0 M	\$0 M	2.0	3.0	4.0	10%	Applied to activity 26' (in-water work portion). Schedule impact represents impact to in-water work only; calendar alignment calculated through schedule model.	Y	Active	9/22/2022	9/27/2022
CNS 30.2	Missed In-Water Work Window	Threat								Activity 26' (impacts are automatically calculated by the schedule risk model considering window timing and delays due to other specific risks)	Y	Active	10/12/2022	10/12/2022
CNS 40.1	River Bridge Final Design/Mobilization Schedule too Aggressive	Threat	\$10 M	\$20 M	\$30 M	1.0	3.0	6.0	30%	Activity 25	N	Active		
CNS 50.1	River Conditions Impact In-Water Construction	Threat				1.0	2.0	4.0	50%	Activity 26' (in-water work)	Y	Active	9/26/2022	9/26/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling			Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
CNS 50.2	River Traffic Accidents	Threat								Minor Risk	N	Watch List	9/22/2022	9/28/2022
CNS 50.3	Existing Bridge Demolition	Threat								Minor Risk	N	Active	9/22/2022	9/28/2022
CNS 60.1	Differing Site Conditions	Threat								Minor Risk	Y	Watch List	9/22/2022	9/28/2022
CNS 60.2	Construction Staging	Threat								Minor Risk	Y	Active	9/28/2022	9/28/2022
CNS 60.3	Severe Weather Conditions	Threat								Minor Risk	Y	Active	9/28/2022	9/28/2022
CNS 60.4	Workforce Transportation	Threat								Minor Risk	Y	Active	9/22/2022	9/28/2022
CNS 80.1	Conflicts Among IBR Contracts (other)	Threat				1.0	3.0	6.0	20%	Applies independently to activities 28, 46, 56, 60	Y	Active	9/22/2022	9/28/2022
CNS 80.2	Conflicts With Other Construction Projects	Threat				1.0	3.0	6.0	20%	Applies independently to activities 19, 28, 46, 56, 60	Y	Active	9/22/2022	9/28/2022
CNS 80.3	USACE Levee Project Coordination	Threat				6.0	9.0	12.0	25%	Activity 19	Y	Active	9/28/2022	10/3/2022
CNS 80.4	Coordination with I-5 Rose Quarter Project	Threat								Conditional upon non-occurrence of steel bridge opportunity STG 10.4 Scenario "A".	Y	Watch List		
CNS 80.5	Coordination with Burnside Bridge	Threat								Conditional upon non-occurrence of steel bridge opportunity STG 10.4 Scenario "A".	Y	Watch List		
CNS 900.1	Miscellaneous change orders	Threat	+1%	+2%	+3%				100%	Percentage of base construction cost; applies to all contractor activities 19, 25/26/28/30, 35, 45/46, 56, 60, 61/64, 62	Y	Active	10/12/2022	10/12/2022
CTR 10.1	Change in Project Delivery Method / Contract Packaging	Threat									Y	Watch List	9/22/2022	9/30/2022
CTR 20.1	Subcontractor availability	Threat	+0.5%	+0.8%	+1.6%				75%	Percentage of base construction cost; applies to all contractor activities 19, 25/26/28/30, 35, 45/46, 56, 60, 61/64, 62	Y	Active	9/22/2022	9/27/2022
CTR 20.2	Community Workforce Agreement (CWA) / PLA	Threat	\$3 M	\$5 M	\$10 M				75%	Activity 67b (program management)	Y	Active	9/22/2022	9/27/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling			Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
CTR 20.3	Community Benefits Agreement (CBA)	Threat	+0.4%	+0.8%	+1.2%				50%	Percentage of base construction cost; applies to all contractor activities 19, 25/26/28/30, 35, 45/46, 56, 60, 61/64, 62	Y	Active	9/22/2022	9/27/2022
CTR 20.4	Claims Associated with 3rd Party Agreements	Threat								Watch list item - within project control	Y	Watch List		
CTR 20.5	OCIP Opportunity	Opportunity	-0.5%	-1.5%	-2%				30%	Savings as percentage of construction cost Applies to all contractor activities: 19, 25/26/28/30, 35, 45/46, 56, 60, 61/64, 62	Y	Active	10/11/2022	10/11/2022
CTR 30.1	Bid Protest	Threat				0.5	1.0	2.0	75%	Applies independently to activities 17, 23, 33, 43, 55, 59	Y	Active	9/22/2022	9/28/2022
CTR 40.1.1	Uncertain Market Conditions: Number of Bidders and Pricing (River Bridge Contract)	Uncertainty	-1% 0% +5%	-2% 0% +10%	-3% 0% +20%				10% 65% 25%	Impacts represent percentage of base contract value. Applies to activities 25, 26, 26', 28, 30	N	Active	9/22/2022	9/27/2022
CTR 40.1.2	Uncertain Market Conditions: Number of Bidders and Pricing (Other Contracts)	Uncertainty	-1% 0% +5%	-2% 0% +10%	-3% 0% +20%				10% 65% 25%	Impacts represent percentage of base contract value. Applies to activities 19, 35, 45, 46, 56, 60, 61, 62, 64	Y	Active	9/22/2022	9/27/2022
CTR 40.2.1	Limited Qualified Bidders Results in Re-Procurement: River Bridge Contract	Threat	\$2 M	\$4 M	\$8 M	4.0	8.0	12.0	5%	Activity 23	Y	Active	9/28/2022	9/28/2022
CTR 40.2.2	Limited Qualified Bidders Results in Re-Procurement: Other Contracts	Threat								Minor	Y	Active	9/28/2022	9/28/2022
CTR 50.1	Buy American Provisions	Threat								Minor Risk	Y	Active	10/7/2022	10/7/2022
CTR 50.2.1	Material Procurement Delays: Roadway	Threat				1.0	2.0	3.0	10%	Applies independently to activities 19, 26/28 (split), 46	Y	Active	9/27/2022	9/27/2022
CTR 50.2.2	Material Procurement Delays: Transit	Threat				1.0	2.0	6.0	10%	Applies independently to activities 56, 60, 61	Y	Active	9/27/2022	9/27/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling			Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
CTR 50.3	Limited Availability of Critical Equipment: Roadway	Threat								Minor Risk	Y	Watch List	9/22/2022	9/28/2022
CTR 60.1	Contract Administration Issues	Threat				1.0	2.0	6.0	30%	Split between activities 26, 28	Y	Active	9/22/2022	9/28/2022
CTR 70.1	Labor disruptions	Threat								Minor Risk	Y	Active	10/7/2022	10/7/2022
CTR 70.2	Skilled Labor Availability	Threat								Cost elsewhere (covered under escalation uncertainty) Schedule delay Minor.	Y	Active	9/22/2022	9/27/2022
CTR 900.1	Uncertainty in Future Construction Cost Escalation	Uncertainty								Excluded	Y	Active	9/22/2022	9/27/2022
CTR 900.2	Uncertainty in Future ROW Cost Inflation	Uncertainty								Excluded	Y	Active	9/22/2022	10/3/2022
CTR 900.3	Uncertainty in future PE (Professional Services) Cost Inflation	Uncertainty								Excluded	Y	Active	9/22/2022	10/3/2022
CTR	Title VI Compliance	Threat									Y	Watch List	9/22/2022	9/29/2022
DES 10.1	Shift Alignment of I-5 in Vancouver	Threat	\$15 M	\$17 M	\$30 M				40%	Activity 40	N	Active	9/28/2022	10/3/2022
DES 10.2	Changed Design/Configuration of SR-14 Interchange	Threat								Minor Risk	N	Active	9/22/2022	10/3/2022
DES 10.3	Changed Design/Configuration of Fourth Plain Interchange	Threat								Minor Risk	N	Active	9/22/2022	10/3/2022
DES 10.4	Removal of C Street Ramps	Opportunity	\$12 M	\$20 M	\$24 M				25%	Activity 46	N	Active	9/28/2022	10/3/2022
DES 10.5.2	Second Auxiliary Lane	Threat								Addressed as an alternative scenario (separate model run - Alt. C)	N	Active	9/22/2022	10/3/2022
DES 10.6	Change to Design/Configuration of Hayden Island Interchange	Threat				6.0	12.0	18.0	40%	Activity 2	N	Active	9/22/2022	10/3/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling			Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
DES 10.7	Alt. Interchange at Marine Drive	Opportunity	\$10 M	\$20 M	\$30 M				25%	Activity 19	N	Active	10/3/2022	10/3/2022
DES 10.8	Victory Braid Design Changes	Threat								Minor Risk	N	Active	9/22/2022	10/3/2022
DES 10.9	Cross Section Elements May Increase in Width - COP	Threat								Minor Risk	Y	Active	9/22/2022	10/3/2022
DES 10.10.1	Local Street Scope - Portland	Threat	\$10 M	\$15 M	\$20 M				25%	Activity 19	N	Active	9/22/2022	10/11/2022
DES 10.10.2	Local Street Scope, Vancouver	Threat								Minor / Elsewhere	N	Active	9/22/2022	10/3/2022
DES 10.11	Additional full depth reconstruction	Threat								Minor risk	N	Active	9/22/2022	10/3/2022
DES 20.1	Non-Approval of Assumed Design Deviations/ Exceptions	Threat								Minor Risk	N	Active	9/28/2022	10/3/2022
DES 20.2	Approval of ARR / Intersection Control Decisions	Threat								Minor Risk	N	Watch List	10/11/2022	10/11/2022
DES 30.1	Additional Aesthetic Treatments: Other	Threat								Minor Risk	N	Active		
DES 40.1	FEMA Flood Map Revisions	Threat								Minor Risk	Y	Active	10/5/2022	10/5/2022
DES 40.2	Stormwater Facilities	Threat	\$5 M	\$10 M	\$15 M				20%	Split between activities 19 and 46	N	Active	9/22/2022	10/3/2022
DES 40.3	Use of Existing Pipes	Threat								Minor Risk	Y	Active	9/22/2022	10/3/2022
DES 40.4	Lack Of Downstream Conveyance Capacity	Threat				1.0	3.0	6.0	25%	Cost impact addressed in base indeterminates uncertainty range Time to each of activities 12, 41	N	Active	9/22/2022	10/3/2022
DES 40.5	Modification of 60" Culvert Beneath I-5	Threat								Minor Risk	N	Active	9/30/2022	9/30/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling			Risk Status	
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
DES 50.1.1	Changes to Travel Demand Modeling Parameters: Pre-ROD	Threat				3.0	4.5	6.0	50%	Split between activities 3, 4	Y	Active	9/22/2022	10/3/2022
DES 50.1.2	Changes to Travel Demand Modeling Parameters: Post-ROD	Threat	\$30 M	\$50 M	\$70 M				10%	Split between activities 19 and 46	N	Active	10/11/2022	
DES 50.2.1	Detours and Closures - COP	Threat								Minor Risk	Y	Active	9/22/2022	10/3/2022
DES 50.2.2	Detours and Closures - COV	Threat								Minor Risk	Y	Active	9/22/2022	10/3/2022
DES 60.1	Additional Features Added to Project within ROW	Threat								Assumed to be captured in base allowance for indeterminates uncertainty range	N	Active	9/22/2022	10/3/2022
DES 70.1	Additional ATMS / Toll Infrastructure	Threat								Minor Risk	N	Watch List	10/11/2022	
DES 70.2	OR Toll Operator Contract	Threat	\$2 M	\$4 M	\$6 M				50%	Activity 26	N	Active		
DES 80.1.1	Contractor Innovation: River Bridge DB Package	Opportunity	-1%	-2%	-3%	-1.0	-3.0	-6.0	35%	Cost expressed as percentage of base contract value and applies to activities 25, 26, 28, 30 Time split between activities 26 and 28	N	Active	9/28/2022	10/3/2022
DES 80.1.2	Design Innovation: Other Packages	Opportunity	-2%	-4%	-6%	-1.0	-3.0	-6.0	35%	contract value. Applies to civil contract activities 19, 35, 45, 46, 56, 60	N	Active	9/28/2022	10/3/2022
ENV 10.1	Section 4(f) - Delta Park	Threat				1.0	2.0	6.0	5%	Split between activities 8, 9	Y	Active	9/22/2022	10/3/2022
ENV 10.2	Section 4(f) - Fort Vancouver	Threat				6.0	12.0	18.0	15%	Split between activities 8, 9	Y	Active	10/3/2022	10/3/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling		Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
ENV 10.3	Section 4(f) - Steel Bridge	Threat				6.0	9.0	18.0	40%	Conditional on non occurrence of scenarios 'B' or 'C' of risk STG 10.4. Split between 8, 9	Y	Active	10/3/2022	10/3/2022
ENV 10.4	Supplemental EIS (SEIS)	Threat	\$0 M	\$0 M	\$0 M	1.0	3.0	6.0	50%	Split between activities 8, 9	N	Active	9/22/2022	9/27/2022
ENV 10.5	Public Comments on Supplemental Draft EIS (SDEIS)	Threat				3.0	6.0	12.0	50%	Activity 9	N	Active	9/22/2022	9/22/2022
ENV 10.6	Scope added outside of current NEPA footprint (OR Active Transportation)	Threat				1.0	3.0	6.0	25%	Split between activities 8, 9	N	Active	10/11/2022	10/11/2022
ENV 10.7	External Agency NEPA Reviews	Threat				1.0	3.0	6.0	30%	Split between activities 8, 9	N	Active	9/22/2022	9/22/2022
ENV 10.8	FHWA and FTA NEPA Review	Threat				3.0	6.0	9.0	75%	Split between activities 9,10	N	Active	9/22/2022	9/27/2022
ENV 10.9	Delay to Record of Decision	Threat								Elsewhere (e.g., ENV 10.8)	Y	Active	9/22/2022	9/27/2022
ENV 10.10	Post-ROD legal challenge	Threat	\$1 M	\$5 M	\$10 M	6.0	12.0	18.0	50%	Activity 10' (post-ROD)	Y	Active	9/22/2022	9/27/2022
ENV 20.1	ESA Section 7 Delays	Threat	\$0 M	\$0 M	\$0 M	0.5	1.5	3.0	25%	Activity 6	N	Active	9/22/2022	9/27/2022
ENV 20.2	Unanticipated Environmental Restrictions (e.g., ESA)	Threat	\$0 M	\$0 M	\$0 M	0.0	3.0	6.0	10%	Apply independently to activities 12, 25, 35, 45, 53, 58	Y	Active	9/22/2022	9/27/2022
ENV 20.3	Fish passage improvements	Threat								Minor Risk	N	Watch List	10/10/2022	10/10/2022
ENV 30.1	USACE Failure to Separate Nav Channel and Levee Permits	Threat				6.0	9.0	12.0	15%	Activity 11	Y	Active	10/10/2022	10/10/2022
ENV 30.2	USACE Permitting Delays (Nav Channel)	Threat				1.0	3.0	6.0	20%	Activity 11	Y	Active	9/22/2022	9/27/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling		Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
ENV 30.3	USACE Permitting Delays (Levee)	Threat				3.0	6.0	9.0	30%	Activity 12	Y	Active	9/22/2022	9/27/2022
ENV 30.4	USCG Bridge Permit Delay	Threat				1.0	3.0	6.0	10%	Activity 14	N	Active	9/22/2022	9/30/2022
ENV 30.5	Local/State Agency Land Use Permit Delays	Threat				3.0	4.5	6.0	10%	Applies independently to activities 12, 25, 35, 45, 53, 58,	N	Active	9/22/2022	9/27/2022
ENV 40.1	Section 106 - Approach	Threat	\$30 M	\$50 M	\$80 M	3.0	6.0	9.0	75%	Time to Activity 7 Cost split between activities 19 and 46 (no markup)	N	Active	9/22/2022	10/5/2022
ENV 40.2	Section 106 - Analysis	Threat	\$1 M	\$4 M	\$8 M	3.0	6.0	9.0	60%	Activity 7	N	Active	9/22/2022	9/27/2022
ENV 40.3	Tribal Consultation - Fisheries	Threat	\$10 M	\$20 M	\$40 M	3.0	4.5	6.0	60%	Time split between activities 6 and 11 Cost split between activities 19 and 46 (no markup)	Y	Active	9/22/2022	10/5/2022
ENV 40.4	Inadvertent Discoveries	Threat	\$5 M	\$15 M	\$50 M	3.0	6.0	18.0	75% (probability of at least one occurrence)	Applied independently to activities 19, 26, 46, 56 (individual probability of 29.3% per activity [trial] produces assessed probability of at least one occurrence with 4 trials)	N	Active	9/22/2022	9/22/2022
ENV 50.1	Hazardous Materials - Liability Associated With Property Acquisition	Threat	\$10 M	\$20 M	\$30 M	1.0	2.0	3.0	20%	Applied independently to activities 15, 20, 40, 54, 57 Cost impact split among affected activities Schedule impact applied to each affected activity	Y	Active	9/22/2022	9/27/2022
ENV 60.1	Natural Resource Mitigation and Conservation	Threat	\$10 M	\$25 M	\$50 M	3.0	6.0	9.0	35%	split between activities 19 and 46 (no markup)	Y	Active	9/22/2022	9/27/2022
ENV 60.2	River User Cost	Threat	\$30 M	\$60 M	\$90 M				35%	split between activities 19 and 46 (no markup)	N	Active	10/11/2022	10/11/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling			Risk Status	
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
ENV 900.1	Additional Measures to Achieve Climate Conditions	Threat	\$5 M	\$15 M	\$25 M				35%	Split between 19, 26, 46, 56, 60	N	Active	10/5/2022	10/5/2022
ENV	Climate and Equity	Threat								Captured in public comments (ENV 10.5), community engagement (PSP 20.1), additional climate measures (ENV 900.1), and legal challenges (ENV 10.10)	N	Active	9/22/2022	9/27/2022
MGT 10.1	Program Coordination Issues	Threat								Fully within program control - "manage list" item	N	Watch List	9/22/2022	9/26/2022
MGT 10.2	Succession Planning	Threat								Fully within program control - "manage list" item	N	Watch List	9/26/2022	9/26/2022
MGT 20.1	Late Decisions on Program Elements (other)	Threat				1.0	4.0	12.0	25%	Split between activities 3, 4, 5	Y	Active	9/22/2022	9/27/2022
MGT 30.1	State Funding Delay	Threat					0 +12 +24		60% 8% 32%	Milestone 37 (OR State Funding)	N	Active	9/28/2022	9/28/2022
MGT 30.2	IBR Toll Authorization Delay (WA)	Threat					0 +12 +24		50% 25% 25%	Milestone 36 (toll authorization)	Y	Active	9/22/2022	9/27/2022
MGT 30.3a	Changes to IBR Toll Operations Assumptions	Threat								Excluded (delay to toll implementation would not necessarily impact opening of the river bridge; cost impacts of WSDOT taking ownership of toll implementation could not be quantified)	N	Active	10/14/2022	10/14/2022
MGT 30.3b	ODOT Toll Operations Schedule	Threat								Excluded (primarily risk to timing of revenue availability)	N	Active	9/28/2022	9/28/2022
MGT 30.4	Tolling Policies	Threat								Excluded (primarily risk to revenue)	Y	Active	9/27/2022	9/27/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling		Risk Status			
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
MGT 30.5	Conditions tied to Funding	Threat								Elsewhere (see various scope/design risks)	Y	Active	9/27/2022	9/27/2022
MGT 40.1	Uncertainty with Legal Authority	Threat				3.0	6.0	12.0	10%	Activity 21 (Prepare RFP)	Y	Active	9/28/2022	9/28/2022
MGT 40.2	Delay to OR/WA Authorizations/Agreements	Threat							15%	Captured elsewhere (see MGT 30.3a, MGT 40.1, PSP 40.2, TRN 80.1, etc.)	Y	Active	9/22/2022	9/22/2022
MGT 60.1	Cash Flow/Program Administration Constraints	Threat								Excluded from consideration in CEVP (results are conditional on non-occurrence)	Y			
PSP 20.1	Additional Community Engagement	Threat				1.5	2.0	3.0	20%	Split between activities 3, 4	Y	Active	9/22/2022	9/29/2022
PSP 30.1	Community Connector Size Reduction	Opportunity	\$6 M	\$9 M	\$12 M				20%	Activity 46 (no markup)	N	Active	9/30/2022	10/3/2022
PSP 30.1	Aesthetics Agreements with Partner Agencies	Threat				3.0	6.0	9.0	50%	Split between activities 3, 4	Y	Active	9/22/2022	9/29/2022
PSP 30.2	Local Parking	Threat								Minor Risk	Y	Active	9/22/2022	9/27/2022
PSP 30.3	Betterments	Threat								Minor Risk	Y	Active	10/12/2022	
PSP 40.1.1	Partner Agency Design Approval Processes - 30% Design Package	Threat				1.0	3.0	6.0	30%	Activity 5	Y	Active	10/12/2022	10/12/2022
PSP 40.1.2	Partner Agency Design Approval P	Threat				1.0	2.0	3.0	20%	Applies independently to activities 12, 25, 45, 53, 58	Y	Active		
PSP 40.2	Partner Agency Agreement Delays: Roadway	Threat				1.0	3.5	6.0	20%	Activity 2	Y	Active	9/22/2022	9/27/2022
PSP 40.3	Loss of Alignment with Partner Agencies	Threat								Minor Risk	Y	Active	9/22/2022	9/27/2022
PSP 40.4	Partner Requests	Threat								Minor Risk	Y	Active	9/22/2022	9/27/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling			Risk Status	
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
PSP 40.5	Turnover of Current Elected	Threat				6.0	12.0	18.0	30%	Activity 2	Y	Active	9/22/2022	9/27/2022
PSP 40.6	Delay to FTA Letter of No Prejudice	Threat								Minor Risk	Y	Watch List	10/13/2022	10/13/2022
PSP 50.1.1	Shared Use Path Extension (WA)	Threat	\$15 M	\$20 M	\$30 M				20%	Split between activities 46 and 56	Y	Active	10/3/2022	10/3/2022
PSP 50.1.2	Multi-Use Bike/Ped Path Design (OR)	Threat	\$10 M	\$15 M	\$25 M				25%	Activity 19	N	Active	9/22/2022	10/3/2022
ROW 10.1	Need for Additional ROW Acquisition Identified (Other)	Threat	\$10 M	\$30 M	\$50 M				25%	Cost impact split among activities 15, 20, 40, 54, 57	Y	Active	9/22/2022	10/3/2022
ROW 10.2.1	Late Changes in Design - ROW Schedule (Columbia River Bridge)	Threat				6.0	9.0	12.0	20%	Activity 20	Y	Active	9/22/2022	10/3/2022
ROW 10.2.2	Late Changes in Design - ROW Schedule (Other)	Threat				6.0	9.0	12.0	40%	Applied independently to activities 15, 40, 54, 57	Y	Active	9/22/2022	10/3/2022
ROW 10.3	BNSF Property Rights Resolution	Threat				12.0	18.0	24.0	10%	Activity 2	Y	Active	9/28/2022	10/3/2022
ROW 10.4	Sunken Boats	Threat								Minor Risk.	N	Active	9/22/2022	9/27/2022
ROW 20.1	Private Development	Threat	\$20 M	\$40 M	\$60 M				30%	Cost impact split among activities 15, 20, 40, 54, 57	Y	Active	9/22/2022	10/3/2022
ROW 50.1.1	Additional Condemnation - Oregon	Threat				3.0	4.5	6.0	5%	Applied independently to activities 15 and 57	Y	Active	9/22/2022	10/3/2022
ROW 50.1.2	Additional Condemnation - Washington	Threat				6.0	12.0	18.0	5%	Applied independently to activities 20 and 54 (activity 40 is linked via flowchart logic and thus would also be impacted)	Y	Active	10/10/2022	
ROW 50.2	Lack of Appraisers	Threat				3.0	4.5	6.0	25%	Applies independently to activities 20, 54, 57	Y	Active	9/22/2022	10/3/2022
ROW 50.3	Relocation delays	Threat				3.0	6.0	9.0	10%	Applied independently to activities 15, 40, 54, and 57	Y	Active	9/22/2022	10/3/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling			Risk Status		
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
ROW 50.4	Uncertain ROW market conditions	Threat	+17	+34	+59				50%	Split among activities 15, 20, 40, 54, and 57	Y	Active	10/12/2022	10/12/2022
RR 10.1	BNSF Agreement Delays	Threat				3.0	6.0	12.0	30%	Activity 2	Y	Active	9/22/2022	10/3/2022
RR 10.2	Railroad Agreement Term Sheets Delays	Threat								elsewhere	Y	Active	9/22/2022	10/3/2022
RR 10.3	Union Pacific Property Coordination	Threat								Minor	Y	Watch List	10/3/2022	10/3/2022
RR 20.1	BNSF Coordination Issues During Construction	Threat								Minor	Y	Active	10/3/2022	10/3/2022
RR 20.2	BNSF Crew Change Access	Threat								Minor	Y	Active	10/3/2022	10/3/2022
STG 10.1	Navigational Clearance	Threat	\$400 M	\$500 M	\$600 M	12.0	18.0	24.0	1%	Activity 26	N	Active	9/22/2022	10/11/2022
STG 10.2	Three Bridge Cross Section	Threat								Excluded from consideration in CEVP (results are conditional on non-occurrence)	Y	Active	9/26/2022	9/26/2022
STG 10.3.1	Structure Aesthetic Changes - River Bridge	Threat	\$45 M	\$50 M	\$60 M				50%	Split between activities 26, 28	N	Active	9/26/2022	9/26/2022
STG 10.3.2	Structure Aesthetic Changes - NPH Bridges	Threat	\$20 M	\$25 M	\$30 M				15%	Activity 19	N	Active		
STG 10.4	Rose Quarter LRT Grade Separation		-\$5 M \$0 M +\$10 M	-\$15 M \$0 M +\$25 M	-\$27 M \$0 M +\$40 M				10% 40% 50%	Applies to activity 60	Y	Active	9/22/2022	10/3/2022
STG 20.1.1	Bridge Foundation Changes - Design	Threat								Minor Risk	Y	Active	9/22/2022	9/26/2022
STG 20.1.2	Bridge Foundation Changes - Construction	Threat	\$5 M	\$10 M	\$15 M	3.0	6.0	12.0	50%	Applies independently to activities 19, 26	Y	Active	10/11/2022	10/11/2022
STG 20.2	Additional or Changed Method of Ground Improvement	Threat								Minor Risk	N	Active	9/22/2022	10/11/2022

PRELIMINARY DRAFT - WORKING VERSION

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RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
STG 20.3	Conflicts With Existing Foundations	Threat	\$3 M	\$5 M	\$7 M	1.0	2.0	3.0	30%	Applies independently to activities 19 and 26'.	N	Active	9/22/2022	9/26/2022
STG 20.4	Historic Landfill on Hayden Island	Threat								Minor Risk	Y	Active	10/11/2022	10/11/2022
STG 20.5.1	Damage/Settlement of Post Hospital	Threat								Minor Risk	N	Active	9/22/2022	9/22/2022
STG 20.5.2	Damage to adjacent structures (other)	Threat								Minor Risk	Y	Active	10/10/2022	10/10/2022
STG 20.6	Settlement of fill walls	Threat				3.0	6.0	9.0	30%	Activity 19	N	Active	10/11/2022	10/11/2022
STG 30.1	Changed seismic design criteria	Threat	+60	+90	+120				25%	Split among activities 19, 26, 28, 46, 56, 60	Y	Active	10/11/2022	10/11/2022
TRN 10.1	Evergreen LRT Grade Separation	Threat								Addressed as an alternative scenario (separate model run): Alt. B.	Y	Active	9/28/2022	10/3/2022
TRN 10.2	Advance with Direct Fixation Track	Opportunity							50%	Included in mLPA Base alternative	Y	Active	9/22/2022	10/3/2022
TRN 10.3	Uncertainty in Structural Premium for Embedded Track	Uncertainty	-\$5M	\$0 M	+\$30M				100%	Applies to Joint Transit Use scenarios only (Alts. A, B, C). Cost represents percentage increase in structural premium for embedded track. Split among activities 26, 28, 56, 60	Y	Active	10/18/2022	10/18/2022
TRN 10.4	Additional Measures Needed to Facilitate Joint Transit Use: shared transitway with joint operations concurrently	Threat	\$40 M	\$80 M	\$120 M				75% (if joint transit use)	Applies to Joint Transit Use scenarios only (Alts. A, B, C). Assessed to be independent of structure width risk. Split between activities 56, 60 (no markup)	Y	Active	10/13/2022	10/13/2022
TRN 10.5	Additional structure width needed to facilitate joint transit operations	Threat	+\$62 M	+\$82 M	+\$102 M				75% (if joint transit use)	Applies to Joint Transit Use scenarios only (Alts. A, B, C). Assessed to be independent of operations risk. Split between activities 26, 56, 60	Y	Active	10/13/2022	10/13/2022

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RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
TRN 20.1	Delta Park Station	Threat								Minor Risk	Y	Active	10/3/2022	10/3/2022
TRN 20.2	Hayden Island Station Scope/Design Changes	Threat	\$5 M	\$10 M	\$15 M				25%	Activity 60	Y	Watch List	10/3/2022	10/3/2022
TRN 20.3	Added Aesthetics to Station Features	Threat								Captured elsewhere (see PSP 30.1, TRN 20.2, TRN 30.2, etc.)	Y	Watch List	9/22/2022	10/3/2022
TRN 30.1	Expo Center Station Modifications	Threat	\$5 M	\$20 M	\$50 M				25%	Activity 60	Y	Active	10/3/2022	10/3/2022
TRN 30.2	Eliminate Separate LRT Overnight Facility at Expo Center	Opportunity	\$7 M	\$10 M	\$17 M				75%	Activity 60	Y	Active	9/28/2022	10/3/2022
TRN 30.3	Waterfront Station Complexity	Threat	+20M	+40M	+60M				50%	Activity 56	Y	Active	10/3/2022	10/3/2022
TRN 30.4	Expo Center Impacts	Threat								Minor	Y	Active	10/9/2022	10/9/2022
TRN 30.5	Additional Elements Required to Facilitate Future Transit O&M	Threat								Assumed to be captured in base uncertainty and/or separate OMF risk (TRN 30.2)	Y	Watch List	9/22/2022	10/3/2022
TRN 40.1	Evergreen Park-and-Ride Design/Scope Changes	Opportunity		\$0 M -\$37M -\$73M					10% 60% 30%	Activity 56	Y	Active	9/28/2022	10/3/2022
TRN 40.2	Waterfront Park-and-Ride Design/Scope Changes	Uncertainty	-\$20M \$0 M +\$3M	-\$30M \$0M +\$7M	-\$43M \$0 M +\$20M				65% 10% 25%	Activity 56	Y	Active	9/28/2022	10/3/2022
TRN 40.3	Express Bus Shoulder Improvements	Threat									Y	Watch List	10/3/2022	10/3/2022
TRN 40.4	Active Transportation (AT) Scope at Stations	Threat									Y	Watch List	9/22/2022	10/3/2022
TRN 50.1	Portland Transit Service Level	Threat	\$2 M	\$10 M	\$50 M				10%	Activity 60	Y	Active	10/3/2022	10/3/2022
TRN 50.2	Yellow Line Intersection Improvements	Threat	\$5 M	\$10 M	\$15 M				75%	Activity 60	Y	Active	10/3/2022	10/3/2022

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RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
TRN 70.1	TriMet LRT Vehicle Procurement Delays	Threat								Minor	Y	Active	10/13/2022	10/13/2022
TRN 70.2	Additional LRT Vehicles	Threat	\$6 M	\$18 M	\$36 M	1.0	2.0	3.0	90%	Activity 63	Y	Active	10/13/2022	10/13/2022
TRN 70.3	C-TRAN Express Bus Vehicle Procurement	Uncertainty	-\$2M \$0 M +\$1.2 M	-\$6M \$0M +\$1.5 M	-\$10 M \$0 M +\$2.4 M				50% 40% 10%	Activity 56	Y	Active	10/3/2022	10/3/2022
TRN 80.1	Transit O&M Agreement	Threat				6.0	12.0	24.0	25%	Flowchart: tied to FFGA (Activity 51). Assumption that high end would be tied to slip to next long legislative session	Y	Active	9/28/2022	10/3/2022
TRN 80.2	FTA Approval Delayed for Entry into Engineering or FFGA	Threat				3.0	6.0	12.0	50%	Split between activities 50, 51	Y	Active	9/22/2022	9/22/2022
TRN 80.3	Transit O&M Funding	Threat				3.0	6.0	12.0	25%	Activity 38 (Finance Plan)	Y	Active	9/28/2022	9/28/2022
TRN 80.4	Systems Testing or Start-Up Delays	Threat				3.0	6.0	18.0	50%	Activity 64	Y	Active	9/22/2022	10/3/2022
UTL 10.1	Uncertainty in utility costs	Uncertainty								Addressed in base quantity uncertainty range	Y	Active	10/12/2022	10/12/2022
UTL 10.2	Utility Service Connection Uncertainty	Threat								Potential opportunity captured in base uncertainty range (UTL 10.1)	Y	Active	9/22/2022	10/3/2022
UTL 10.3	Delayed completion of utility agreements	Threat								Minor		Active	10/12/2022	10/12/2022
UTL 10.4	City of Vancouver Underground Utilities	Threat								Minor	Y	Active	9/22/2022	10/3/2022
UTL 10.5	Pump Station at Waterfront	Threat								Minor	Y	Active	10/12/2022	10/12/2022
UTL 20.1.1	Utility Relocation Delays: River Bridge and Approach Landside features	Threat				2.0	4.0	6.0	30%	Activity 28	Y	Active	9/22/2022	10/3/2022
UTL 20.1.2	Utility Relocation Delays: OR Transit	Threat								Minor	Y	Active	10/3/2022	10/3/2022
UTL 20.1.3	Utility Relocation Delays: WA Transit	Threat				1.0	3.0	6.0	20%	Activity 56	Y	Active	10/3/2022	10/3/2022

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis							Risk Modeling			Risk Status	
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
UTL 20.1.4	Utility Relocation Delays: WA North Highways	Threat				1.0	3.0	6.0	20%	Activity 46	N	Active	10/3/2022	10/3/2022
UTL 20.2	Unidentified utilities encountered during construction	Threat				1.0	2.0	3.0	20%	Applies independently to activities 19, 28, 46, 56, 60	Y	Active	10/12/2022	10/12/2022
OTH 1	Indirect cost of project delays (owner, PM)	Threat								Calculated by integrated cost/schedule model Activity 67b	Y	Active	10/15/2022	10/15/2022
OTH 2.1-2.6	Indirect cost of project delays (contractor, compensable)	Threat								Calculated by integrated cost/schedule model 2.1 : River Bridge: Split between activities 26, 28, 30 2.2 : Bridge Demo: activity 35 2.3 : Oregon Roadway Packages: activity 19 2.4 : Washington Roadway Packages: 46 2.5 : Oregon LRT: activity 60 2.6 : Washington Transit: activity 56 2.7 : OMF: activity 62	Y	Active	10/15/2022	10/15/2022
OTH 2.3	Aggregate minor risks / opportunities			+5%			+5%		50%	Based on percentage of modeled risk. Applies to all activities.	Y	Active	10/15/2022	10/15/2022
OTH 2.4	Unidentified risks / opportunities			+5%			+5%		50%	Based on percentage of modeled risk. Applies to all activities.	Y	Active	10/15/2022	10/15/2022

Notes:

- Cost and schedule impacts are to specific identified activities, regardless of the critical path which will be calculated by the integrated cost/schedule risk model (see Flowchart). In some cases where the impacts are spread over many activities, for simplicity the impacts might be assigned to one or a few activities.
- Ranges in impacts are expressed by their 10th and 90th percentiles, and typically truncated at zero. They are assumed to be normally (Gaussian) distributed unless otherwise noted. Ranged impacts are assumed to be independent of
- All cost impacts are assessed in current terms and do not include indirect (extended overhead) costs resulting from project delays. Cost escalation and extended overheads are calculated automatically through the simulation model.
- When significant dependencies among risk or opportunity events were identified during the workshop, they were generally assessed using an event tree and combined into a single event in this register. This approach ensures that the important dependencies and related conditional probabilities are assessed explicitly. Otherwise, the uncertainties, risks, and opportunities in this register have been defined to be (i.e., are assessed to be) independent of one another. Note that some events in this register are a function of base costs or durations. When those base costs or durations are assessed to be uncertain (see flowchart and cost estimate summary), the corresponding event should consider (include) changes to the base resulting from the simulated base uncertainty.
- Subsets of risks, denoted as X.1, X.2, etc. are separate risks. Possible scenarios (which are mutually exclusive) for a given risk are denoted as XA, XB, etc.
- Except for "soft cost" uncertainties that are addressed separately, and unless noted otherwise, all cost impacts in this table are assumed to represent "raw" values without associated markups. Markups that are treated as a percentage of the construction subtotal in the cost estimate (e.g., traffic control, mobilization, contract administration, sales tax, etc.) are added automatically in the simulation model. Aggregate markup on direct construction costs is 51%.
- "Minor" means potential impacts for individual risks or opportunities of less than \$10M or 2 mo., OR probability of larger impacts less than 5% (1:20).

PRELIMINARY DRAFT - WORKING VERSION

IBR PROJECT RISK REGISTER (PRE-MITIGATION SCENARIO)														
Risk Identification			Quantitative Analysis						Risk Modeling		Risk Status			
RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Modeling Notes	Transit Impacts ?	Status	Date Identified	Date Last Updated
			Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						

8. To account for minor and potentially-missing items, it has been assessed that there is a 50% chance each of minor risks, minor opportunities, missing risks and missing opportunities for each activity (independent among activities). Based on the 80:20 rule, it has been further assessed that, if they occur, these items will be approximately proportional to the other simulated risk and opportunity impacts, so that each impact is up to approximately 20% of the simulated total risk or opportunity (as appropriate) for each activity. Due to the thorough nature of the risk register for this project, the missing/unidentified risk allowance was reduced relative to a typical project and the minor risk allowance for schedule was also reduced.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis					Risk Status			Risk-Response Strategies			
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State					Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken	
				Direct Cost Impact (\$M)			Schedule Impact (months)								
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
1	DES 40.2	Stormwater Facilities	Threat	\$5 M	\$10 M	\$15 M				10%	Active	9/22/2022	11/15/2022	Mitigate	1) Conduct a stormwater facilities size evaluation in July 2023, and advance stormwater design (evaluate cost assumptions).
2	DES 40.3	Use of Existing Pipes	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Engage in early coordination with USACE to garner approval for use of pipes through levees during construction.
3	DES 40.4	Lack Of Downstream Conveyance Capacity	Threat				1.0	3.0	6.0	25%	Active	9/22/2022	11/15/2022	Mitigate	1) Conduct the downstream capacity investigation as early as possible.
4	STG 20.5.2	Damage to adjacent structures (other)	Threat								Active	10/10/2022	10/10/2022	Mitigate	1) Agency to consider performing supplemental analyses to define applicable design criteria. 2) Agency to consider requiring a work plan submittal in the applicable specifications detailing the Contractor's means and methods of protecting adjacent structures. 2) Contractor to conduct settlement and other applicable damage monitoring/control in the construction areas.
7	CNS 40.1	River Bridge Final Design/Mobilization Schedule too Aggressive	Threat	\$10 M	\$20 M	\$30 M	1.0	3.0	6.0	15%	Active	10/10/2022	11/10/2022	Mitigate	1) When preparing RFP identify opportunities to facilitate Final Design process for contractor. 2) Identify permitting needs and requirements to mitigate risk (i.e., stormwater, USCG). Consider owner procurement of critical permits. 3) Perform industry outreach / engage early with contractors to highlight risk. 4) Consider transferring risk to contractor (potential for increased bid costs).
8	CNS 10.1	Complex Bridge Staging and MOT	Threat	\$10 M	\$30 M	\$50 M				50%	Active	9/28/2022	11/12/2022	Mitigate	1) Consider including in RFP, a contractor requirement to propose additive alternative or deductive bid item for their proposed staging/laydown area. 2) Incorporate allowance in estimate to account for contractor staging/laydown.
9	CNS 10.3	Arterial Bridge Sequencing	Opportunity								Watch List	9/28/2022	9/28/2022	Exploit	1) Develop preliminary sequencing of the arterial bridge to evaluate potential property impacts.
10	CNS 50.1	River Conditions Impact In-Water Construction	Threat				0.5	0.5	0.5	5%	Active	9/26/2022	11/18/2022	Transfer	1) Conduct studies to determine typical high water levels and plan around them. 2) Contractor to create a contingency plan for high-level water windows.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

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ID #	RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
11	CNS 50.2	River Traffic Accidents	Threat								Watch List	9/22/2022	9/28/2022	Mitigate	1) Engage stakeholders early to garner agreement for traffic hazard control plans, congestion mitigation, and extreme weather plans.
12	CNS 50.3	Existing Bridge Demolition	Threat								Active	9/22/2022	9/28/2022	Mitigate	1) To quantify the required action plan, conduct a River bridge demolition plan evaluation early as possible.
13	CNS 10.5	MOT cost reduction opportunity	Opportunity								Active	10/10/2022	11/12/2022	Exploit	1) Evaluate cost estimate and validate MoT premium.
14	CNS 10.2	Staging and Phasing Among Contracts: NPH Bridges and Connections	Threat				3.0	6.0	12.0	15%	Active	10/7/2022	11/12/2022	Mitigate	1) Coordinate with Industry Specific to determine assumptions and basis of CRC schedule and risk. 2) Review the CRC construction schedule in November 2022, determine assumptions and sequencing, and how it was incorporated into current schedule. 3) Revise base schedule to include Staging and Phasing for NPH bridges and connections to support identification of project interface points and possible solutions to sequencing and packaging of work.
15	CTR 50.2.1	Material Procurement Delays: Roadway	Threat				0.0	1.0	2.0	5%	Active	9/27/2022	11/10/2022	Mitigate	1) Consider early (owner provided) material procurements where it makes sense to do so without introducing potential conflict with contractor design or approach.
16	CTR 50.2.2	Material Procurement Delays: Transit	Threat				0.0	1.0	2.0	5%	Active	9/27/2022	11/10/2022	Mitigate	1) Consider early (owner provided) material procurements where it makes sense to do so without introducing potential conflict with contractor design or approach (e.g., track).
17	CTR 50.3	Limited Availability of Critical Equipment: Roadway	Threat								Watch List	9/22/2022	9/28/2022	Mitigate	1) Consider early equipment procurements where it makes sense without introducing potential conflict with contractor design or approach.
18	CNS 60.1	Differing Site Conditions	Threat								Watch List	9/22/2022	9/28/2022	Mitigate	1) Engage in proactive site condition investigation (borings, survey and divers) as needed to more fully determine site conditions.
19	CNS 20.1	Construction Noise and Vibration	Threat								Active	9/28/2022	9/28/2022	Mitigate	1) Conduct early site noise evaluation to determine noise acceptability levels.
20	CTR 70.1	Labor disruptions	Threat								Active	10/7/2022	10/7/2022	Mitigate	1) Base assumes use of a PLA, which will be crafted to cover all trades and should effectively mitigate the risk of labor stoppage.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis					Risk Status			Risk-Response Strategies			
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State						Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken	
				Direct Cost Impact (\$M)			Schedule Impact (months)								Likelihood of Impact Occurring
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
21	CNS 60.2	Construction Staging	Threat								Active	9/28/2022	9/28/2022	Mitigate	1) Demonstrate potential staging areas in drawings for each area of construction.
22	CNS 60.3	Severe Weather Conditions	Threat								Active	9/28/2022	9/28/2022	Accept	1) Monitor and review weather TIAs as received. 2) Contractor to consider sequencing weather-sensitive work in the appropriate season.
23	CNS 60.4	Workforce Transportation	Threat								Active	9/22/2022	9/28/2022	Mitigate	1) Engage stakeholders early to garner agreement on a workforce transportation plan.
25	CNS 10.6	Civil and Systems Contractor Interface / Coordination	Threat				1.0	2.0	3.0	10%	Active	9/22/2022	11/10/2022	Mitigate	1) Ensure design coordination between civil and systems teams to mitigate construction coordination risk (utilize iTWINS). 2) Consider potential coordination opportunities when making packaging and delivery method selections for transit elements.
26	CTR 40.2.1	Limited Qualified Bidders Results in Re-Procurement: River Bridge Contract	Threat	\$2 M	\$4 M	\$8 M	4.0	8.0	12.0	5%	Active	9/28/2022	11/28/2022	Mitigate	1) Proactively engage the industry early and often, especially through the systematic use of RFIs and follow-up meetings prior to initiation of formal procurement, and preferably prior to deciding on the contracting methods. 2) Ensure that risk transfer provisions are reasonable, and if risks are transferred to the contractor where the contractor has less than complete control, include an allowance or other cost-sharing mechanism. Regardless of delivery method, use a contractor selection process that maximizes ability to screen for quality. 3) Determine what is an acceptable number of bidders. 4) Conduct workshop/analysis to determine optimal river bridge contract packaging and delivery methods.
27	CTR 40.2.2	Limited Qualified Bidders Results in Re-Procurement: Other Contracts	Threat								Active	9/28/2022	11/28/2022	Mitigate	1) Proactively engage the industry early and often, especially through the systematic use of RFIs and follow-up meetings prior to initiation of formal procurement, and preferably prior to deciding on the contracting methods. 2) Ensure that risk transfer provisions are reasonable, and if risks are transferred to the contractor where the contractor has less than complete control, include an allowance or other cost-sharing mechanism. Regardless of delivery method, use a contractor selection process that maximizes ability to screen for quality. 3) Determine what is an acceptable number of bidders. 4) Conduct workshop/analysis to determine optimal river bridge contract packaging and delivery methods.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis				Risk Status			Risk-Response Strategies				
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State						Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Direct Cost Impact (\$M)			Schedule Impact (months)								
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
28	CTR 30.1	Bid Protest	Threat				0.5	1.0	2.0	50%	Active	9/22/2022	11/28/2022	Mitigate	1) Consider including time for protest into the procurement schedule. 2) Develop clear contracting documents. 3) Ensure quick responses in bid review process.
29	CTR 50.1	Buy American Provisions	Threat								Active	10/7/2022	10/7/2022	Accept	
30	CTR 20.4	Claims Associated with 3rd Party Agreements	Threat								Active		10/7/2022	Mitigate	1) Include necessary substantive provisions in the agreements, as well as "flow-down" language for activity-specific "sub-agreements" (often MUAs and UAs, respectively); incorporate allowances, other cost-sharing mechanisms in the contract to the degree problematic 3rd-party agreement provisions are unavoidable. Do not simply transfer the risk via contract. This will discourage good contractors from proposing, and the provisions are often unenforceable in court.
32	CTR 10.1	Change in Project Delivery Method / Contract Packaging	Threat								Active	9/22/2022	11/28/2022	Mitigate	1) Conduct Project Delivery Method / Contract Packaging workshops/analysis to determine packaging early, scheduled for early 2023.
36	ENV 20.1	ESA Section 7 Delays	Threat	\$0 M	\$0 M	\$0 M	0.5	1.5	3.0	25%	Active	9/22/2022	10/10/2022	Mitigate	1) Work closely with NMFS and coordinate regular check-in meetings throughout consultation process. 2) Submit BA/BO materials for review as early as possible. 3) Utilize Director to Director level coordination/communication.
37	CNS 30.1	In-Water Work Windows are More Restrictive	Threat	\$0 M	\$0 M	\$0 M	2.0	3.0	4.0	10%	Active	9/22/2022	10/10/2022	Mitigate	1) Ensure contractual requirements and validated construction schedule based on biddable means and methods is fully vetted.
38	ENV 20.2	Environmental Regulations Change	Threat	\$0 M	\$0 M	\$0 M	0.0	3.0	6.0	10%	Active	9/22/2022	10/10/2022	Mitigate	1) Conduct continuous and thorough surveying throughout project development. 2) Designate a liaison as part of the project team to ensure coordination and communications with regulatory agencies. 3) Ensure coordination and communications to obtain early notice of any potential status changes regarding sensitive and/or endangered species.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

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				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring					
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
39	ENV 40.2	Section 106 - Analysis	Threat	\$1 M	\$4 M	\$8 M	3.0	6.0	9.0	50%	Active	9/22/2022	11/17/2022	Mitigate	1) Complete Programmatic Agreement mitigation updates as early as possible. 2) Engage in early coordination and consultation with Tribes and other stakeholders/agencies. 3) Add resources for investigations (Task AD) to support 106 analysis. 4) Add resource for consulting party communication. 5) Investigate opportunities to define contracts, clearing specialty consultants, and sequencing activities to mitigate potential schedule constraints.
40	ENV 40.4	Inadvertent Discoveries	Threat	\$5 M	\$10 M	\$35 M	1.0	3.0	18.0	45%	Active	9/22/2022	11/17/2022	Mitigate	1) Ensure there is an inadvertent / late discovery plan and contractor has an understanding of the plan requirements and provisions. 2) Enforce contract language which should include provisions to keep contractors working during construction. 3) Conduct earth moving in sensitive areas early in project timeframe, where possible, or seek archaeological permits to test areas of high probability, where possible. 4) Engage with interested Tribes early on and contract with qualified Tribal cultural resource experts to be on-site in areas of high probability to improve coordination when emergency archaeological permits and immediate decisions on eligibility may be needed. 5) Consider a programmatic agreement with WA and OR SHPOs to streamline review process on discovery of certain sites/artifacts. 6) Coordinate with Clark County coroner to integrate staff with onsite monitoring. 7) Leverage IBR professional expertise to work with DAHP to streamline process. 8) Investigate opportunities to shift working areas during construction.
41	ENV 10.1	Section 4(f) - Delta Park	Threat				1.0	2.0	6.0	5%	Active	9/22/2022	10/10/2022	Mitigate	1) Engage in early coordination with Portland Parks and Recreation (PP&R).
42	ENV 10.2	Section 4(f) - Fort Vancouver	Threat				6.0	12.0	18.0	10%	Active	10/3/2022	11/17/2022	Mitigate	1) Engage early and maintain timely contact with NPS. 2) Coordinate with all four legal teams to advance 4(f) strategy.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies	
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State							Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring					
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
43	ENV 10.3	Section 4(f) - Steel Bridge	Threat				6.0	9.0	18.0	40%	Watch List	10/3/2022	11/16/2022	Mitigate	1) Coordinate construction planning and activities with the Rose Quarter as early as possible. 2) Confirm as early as possible if there are impacts to 4(f). 3) Maintain timely contact with resource agencies and SHPO.
44	ENV 10.4	Supplemental EIS (SEIS)	Threat	\$0 M	\$0 M	\$0 M	1.0	3.0	6.0	30%	Active	9/22/2022	11/16/2022	Mitigate	1) Conduct/maintain periodic meetings with agencies during preparation of the SEIS to identify required analyses as early as possible. 2) Consider internal direction and coordination regarding change management.
45	ENV 10.5	Public Comments on Supplemental Draft EIS (SDEIS)	Threat	\$0 M	\$0 M	\$0 M	1.0	2.0	3.0	25%	Active	9/22/2022	11/16/2022	Mitigate	1) Continue robust public involvement process, emphasizing the Purpose and Need of the project being met. 2) Ensure training and utilization of software to track comments. 3) Consider hiring additional resources.
46	ENV 10.7	External Agency NEPA Reviews	Threat				1.0	3.0	6.0	30%	Active	9/22/2022	10/10/2022	Mitigate	1) Maintain ongoing communication and coordination with various approving agencies to keep reviewers engaged. 2) Develop a highly detailed schedule of permit deliverables and review times for review by design team, partners, and regulatory agencies. 3) Make use of Portland's permit streamlining committee (as a template to create one for this program) for projects, or establish a separate re-occurring meeting with specialists from each agency's regional office due to complexity and size of project.
47	ENV 10.8	FHWA and FTA NEPA Review	Threat				1.0	3.0	6.0	50%	Active	9/22/2022	11/16/2022	Mitigate	1) Identify staff resource as a point of contact (139j, other) for FHWA and FTA to engage in communication and coordination throughout NEPA process. 2) Work with agencies to develop agreement to work on internal agreement process that IBR follows.
49	ENV 10.10	Post-ROD legal challenge	Threat	\$1 M	\$5 M	\$10 M	3.0	6.0	18.0	25%	Active	9/22/2022	11/16/2022	Mitigate	1) Obtain separate legal sufficiency reviews by relevant lead agencies prior to publishing each major document. 2) Consider an early legal review of process to date and develop recommendations to ensure outreach and process cannot be rationally questioned. 3) Identify post-ROD actions to advance Program and start litigation timing as early as possible prior to large contract work.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies	
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				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring					
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
50	ENV 30.1	USACE Failure to Separate Nav Channel and Levee Permits	Threat				3.0	4.5	6.0	15%	Active	10/10/2022	11/16/2022	Mitigate	1) Designate a point of contact to engage in early coordination with USACE. 2) Fallback action is to assign additional resources to expedite the design to mitigate schedule impacts. 3) Continue to engage with staff at all levels within USACE, and engage federal lead resources to help. 4) Consider having the contract go to RFP with contractor at RISK.
51	ENV 30.2	USACE Permitting Delays (Nav Channel)	Threat				1.0	3.0	6.0	10%	Active	9/22/2022	11/16/2022	Mitigate	1) Designate a point of contact to engage in early coordination with USACE. 2) Continue to engage with staff at all levels within at USACE, and engage federal leads resources to help. 3) Work with USACE to develop agreement on process to secure the 408 authorization.
52	ENV 30.3	USACE Permitting Delays (Levee)	Threat				3.0	6.0	9.0	15%	Active	9/22/2022	11/16/2022	Mitigate	1) Designate a point of contact to engage in early coordination with USACE. 2) Continue to engage with staff at all levels within at USACE, and engage federal leads resources to help. 3) Work with USACE to develop agreement on process to secure the 408 authorization.
53	ENV 30.4	USCG Bridge Permit Delay	Threat				1.0	3.0	6.0	10%	Active	9/22/2022	10/10/2022	Mitigate	1) Engage in early and frequent communication with USCG during permit process.
54	ENV 30.5	Local/State Agency Land Use Permit Delays	Threat				3.0	4.5	6.0	10%	Active	9/22/2022	11/16/2022	Mitigate	1) Obtain LUFO modification for project-specific facilities. 2) File for pre-application conferences to obtain best information on upcoming review processes and criteria. 3) Submit for land use reviews as soon as possible since staff often fail to recognize applicable requirements during pre-application conferences. 4) Request completeness reviews to end once reasonable requirements have been met, as allowed by state law.
56	ENV 60.1	Natural Resource Mitigation and Conservation	Threat	\$10 M	\$25 M	\$50 M	3.0	6.0	9.0	20%	Active	9/22/2022	11/16/2022	Mitigate	1) Conduct early investigations to determine likely impacts and mitigations required 2) Continue outreach with Tribes and agencies. 3) Construct a general agreement document between stakeholders.
57	ENV 60.2	River User Cost	Threat	\$30 M	\$60 M	\$90 M				35%	Active	10/11/2022	11/16/2022	Mitigate	1) Conduct early investigations to determine likely impacts and mitigations required. 2) Include mitigation efforts in the cost estimate once more information is known.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

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				Direct Cost Impact (\$M)			Schedule Impact (months)								
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
58	DES 40.1	FEMA Flood Map Revisions	Threat								Active	10/5/2022	10/10/2022	Mitigate	1) Early coordination with USACE.
59	ENV 20.3	Fish passage improvements	Threat								Active	10/10/2022	10/10/2022	Mitigate	1) Conduct field studies to identify possible areas of impact.
60	ENV 50.1	Hazardous Materials - Liability Associated with Property Acquisition	Threat	\$10 M	\$20 M	\$30 M	1.0	2.0	3.0	20%	Active	9/22/2022	11/16/2022	Mitigate	1) Conduct Phase I and II hazardous materials identification as early as possible prior to acquisition.
63	ENV 900.1	Additional Measures to Achieve Climate Conditions	Threat	\$5 M	\$15 M	\$25 M				35%	Active	10/5/2022	11/16/2022	Mitigate	1) Engage in early communication with partner agencies.
65	DES 40.5	Modification of 60" Culvert Beneath I-5	Threat								Active	9/30/2022	9/30/2022	Mitigate	1) Conduct a Culvert suitability investigation as early as possible to quantify the required action plan. 2) Early engagement with partner agencies.
67	TRN 80.2	FTA Approval Delayed for Entry into Engineering or FFGA	Threat				0.0	6.0	12.0	50%	Active	9/22/2022	11/10/2022	Mitigate	1) Monitor and track the status and completeness of required deliverables to move through PD, Engineering, and FFGA. 2) Engage in early coordination with Partner Transit Agencies and FTA.
68	TRN 80.3	Transit O&M Funding	Threat				3.0	6.0	12.0	25%	Active	9/28/2022	11/10/2022	Mitigate	1) Transit O&M workgroup has been established and is meeting regularly to identify issues and assist with drafting scope of agreement. 2) Identify key milestone dates. 3) Coordinate early with Legislature to identify required statutory changes for transit O&M funding. 4) Fallback action is to engage working group/stakeholders early to agree on a plan of action in case of delays in Transit O&M Funding and quantify required efforts.
69	MGT 40.2	Delay to OR/WA Authorizations/Agreements	Threat							15%	Active	9/22/2022	9/22/2022	Mitigate	1) Engage in ongoing communications and coordination with stakeholders to avoid disruption to project. 2) Draft agreements early to allow sufficient time for parties to review and execute agreements. 2) Fallback action is to engage stakeholders early to agree on a plan of action in case of delays in OR/WA Authorizations/ Agreements and quantify required efforts.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies	
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				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring					
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
70	MGT 30.2	IBR Toll Authorization Delay (WA)	Uncertainty				0.0	12.0	24.0	25%	Active	9/22/2022	11/10/2022	Mitigate	1) Continue to lobby for full authorization in 2023 session. 2) Fallback is to develop financial plan based on intent to toll without commitment - to seek federal grants.
71	MGT 30.1	State Funding Delay	Uncertainty				0.0	12.0	24.0	40%	Active	9/28/2022	11/10/2022	Mitigate	1) Consider early coordination with stakeholders (OR) to garner resolution for funding constraints. 2) Factor funding uncertainties into program phasing, and planned use of other funding sources. 3) Move forward with an assumed finance plan.
72	MGT 30.3b	ODOT Toll Operations Schedule	Threat								Active	9/28/2022	9/28/2022	Mitigate	1) WSDOT and ODOT would need to discuss if delaying IBR tolling or pivoting to WSDOT Tolling Program makes the most sense. 2) WSDOT and ODOT would need to assess and determine if expected implementation and opening timeframes warrant a change, and if WSDOT Tolling Program can assume IBR tolling operations.
73	MGT 30.3a	Changes to IBR Toll Operations Assumptions	Threat								Active	10/14/2022	10/14/2022	Mitigate	1) WSDOT and ODOT would need to assess and determine if expected implementation and opening timeframes warrant a change, and if WSDOT Tolling Program can assume IBR tolling operations.
77	STG 20.1.1	Bridge Foundation Changes - Design	Threat								Active	9/22/2022	9/26/2022	Mitigate	1) Engage stakeholders early to validate bridge foundation design criteria changes and quantify required actions.
78	STG 20.1.2	Bridge Foundation Changes - Construction	Threat	\$5 M	\$10 M	\$15 M	3.0	6.0	12.0	50%	Active	10/11/2022	11/15/2022	Mitigate	1) Consider supplemental subsurface investigations. 2) Agency to implement proposal requirement that Bidders demonstrate ability to install foundations of the sizes and depths in the contract with similar environmental constraints. 3) Consider requiring the contractor to include a test shaft.
79	STG 20.2	Additional or Changed Method of Ground Improvement	Threat								Active	9/22/2022	10/11/2022	Mitigate	1) Conduct method of ground improvements evaluation as early as possible.
82	STG 20.3	Conflicts With Existing Foundations	Threat	\$3 M	\$5 M	\$7 M	1.0	2.0	3.0	25%	Active	9/22/2022	11/15/2022	Mitigate	1) Conduct underwater GPR to confirm existing foundation locations. 2) Require Work Plan submittal in the applicable specifications detailing the Contractor's mitigation plan to deal with remnant foundations.
83	STG 20.4	Historic Landfill on Hayden Island	Threat								Active	10/11/2022	10/11/2022		

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84	STG 20.5.1	Damage/Settlement of Post Hospital	Threat								Active	9/22/2022	9/22/2022	Mitigate	1) Conduct settlement monitoring in the Park Hospital area vicinity.
85	STG 20.6	Settlement of Fill Walls	Threat				1.0	3.0	6.0	10%	Active	10/11/2022	11/15/2022	Mitigate	1) Consider supplemental subsurface investigations. 2) Consider lightweight fills if allowable. 3) Consider ground improvement or surcharge.
86	PSP 40.1.1	Partner Agency Design Approval Processes - 30% Design Package	Threat				1.0	3.0	6.0	20%	Active	10/12/2022	11/17/2022	Mitigate	1) Identify all agencies, and define purpose ("what") of reviews to help partner agencies to identify needed staff/reviewers. 2) Ensure that expectations and potential consequences of delays are clear to support negotiations and decisive decision making. 3) Establish a cadence of regular check-ins with partner agencies to facilitate design review process. 4) Ensure appropriate resource availability to address review comments and needed changes. 5) Ensure senior leadership is involved through the design review process.
87	PSP 40.1.2	Partner Agency Design Approval Processes - Subsequent Packages, 60%, 90%	Threat				1.0	2.0	3.0	20%	Active	10/12/2022	11/17/2022	Mitigate	1) Identify all agencies, and define purpose ("what") of reviews to help partner agencies to identify needed staff/reviewers. 2) Ensure that expectations and potential consequences of delays are clear to support negotiations and decisive decision making. 3) Establish a cadence of regular check-ins with partner agencies to facilitate design review process. 4) Ensure appropriate resource availability to address review comments and needed changes. 5) Ensure senior leadership is involved through the design review process.
88	PSP 40.2	Partner Agency Agreement Delays: Roadway	Threat				1.0	3.5	6.0	20%	Active	9/22/2022	11/17/2022	Mitigate	1) Ensure clear communication channels among partners and the Program. 2) Create protocols for documenting key interagency communications (i.e., technical and policy meeting notes). 3) Ensure that all divisions within IBRP are coordinated and that there is consistent, clear intra-Program communication. 4) Clear identification of asset ownership, operation and maintenance, and design authority prior to agreements

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

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89	PSP 30.1	Aesthetics Agreements with Partner Agencies	Threat				1.0	2.0	4.0	25%	Active	9/22/2022	11/17/2022	Mitigate	1) Engage with partners and the community to clearly define the prioritization of aesthetics vs. traffic (or vice-versa). This is especially important once traffic modeling is further refined. 2) Define the range of possibilities to partner agencies and mediate requests from partner agencies
90	PSP 30.2	Local Parking	Threat								Active	9/22/2022	9/27/2022	Mitigate	1) Engage stakeholders early to validate affected parking spaces/locations and quantify required actions.
91	PSP 40.3	Loss of Alignment with Partner Agencies	Threat								Watch List	9/22/2022	9/27/2022	Mitigate	1) Engage stakeholders early to agree on a plan of action in case of Loss of Alignment with Partner Agencies and quantify required efforts.
92	PSP 30.3	Betterments	Threat								Active	10/12/2022		Mitigate	1) Engage stakeholders early to validate betterments scope and area limits and quantify required actions.
93	PSP 40.4	Partner Requests	Threat								Active	9/22/2022	9/27/2022	Mitigate	1) Engage stakeholders early to validate partner requests and quantify required actions.
94	CTR	Title VI Compliance	Threat								Watch List	9/22/2022	9/29/2022	Mitigate	1) Conduct Title VI Compliance evaluation as early as possible to quantify the required action plan. 2) Early engagement with partner agencies.
99	TRN 30.3	Expo Center Impacts	Threat								Watch List	10/9/2022	10/9/2022		
101	CNS 10.4	Maintenance of Traffic (MOT) Mitigation	Threat								Watch List	9/22/2022	9/28/2022	Mitigate	1) Develop preliminary construction staging and phasing concepts to evaluate schedule and potential MOT costs.
102	CNS 80.1	Conflicts Among IBR Contracts (other)	Threat				0.0	1.0	3.0	15%	Active	9/22/2022	11/10/2022	Mitigate	1) Ensure early coordination of MOT contract discussions to mitigate potential execution conflicts. 2) Develop robust work zone transportation plans including interfaces between contracts. 3) Track overlapping contracts throughout construction.
103	CNS 80.2	Conflicts With Other Construction Projects	Threat				0.0	1.0	3.0	15%	Active	9/22/2022	11/10/2022	Mitigate	1) Engage other agencies to coordinate a workable MOT construction schedule and quantify any mitigation actions required. 2) Develop robust work zone transportation plans including interfaces between contracts.

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				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
104	CTR 900.1	Uncertainty in Construction Cost Inflation Rate	Uncertainty								Active	9/22/2022	11/12/2022		1) Continue to engage in proactive risk management to minimize delays and reduce potential construction escalation impacts.
105	CTR 40.1.1	Uncertain Market Conditions: Number of Bidders and Pricing (River Bridge Contract)	Uncertainty	-\$15 M	\$150 M	\$300 M				100%	Active	9/22/2022	11/10/2022	Mitigate	1) Engage in early outreach and coordination with construction contracting market. 2) Consider structuring contracts to reduce complexity and encourage bidders.
106	CTR 40.1.2	Uncertain Market Conditions: Number of Bidders and Pricing (Other Contracts)	Uncertainty	-\$5 M	\$50 M	\$100 M				100%	Active	9/22/2022	11/10/2022	Mitigate	1) Engage in early outreach and coordination with construction contracting market. 2) Consider structuring contracts to reduce complexity and encourage bidders.
107	CTR 70.2	Skilled Labor Availability	Threat								Active	9/22/2022	9/27/2022	Transfer	1) Consider early coordination with stakeholders to address skilled labor availability, and create any countermeasures as necessary.
108	CTR 20.1	Subcontractor availability	Threat	\$50 M	\$80 M	\$160 M				75%	Active	9/22/2022	11/10/2022	Mitigate	1) Perform outreach to prime and DBE contractor communities to better understand market conditions. 2) Review DBE percentages prior to RFP issuance and carefully consider goals. (Clarify requirements vs. aspirational goals) 3) Consider structuring contracts to reduce complexity and encourage bidders.
110	CTR 900.3	Uncertainty in PE (Professional Services) Cost Inflation Rate	Uncertainty								Active	9/22/2022	10/3/2022		
111	MGT 40.1	Uncertainty with Legal Authority	Threat				2.0	4.0	12.0	10%	Active	9/28/2022	11/17/2022	Mitigate	1) Immediately establish whether actions to date (i.e., via relevant legislation and agreements) have established the necessary authority. If not, immediately take the measures necessary to establish this authority. This authority must be established before the agency publicly presents itself as having the authority. 2) Conduct project contract packaging workshop to identify needs. 3) Engage in early communication OR DOJ.
112	CTR 20.5	OCIP Opportunity	Opportunity							30%	Active	10/11/2022	10/11/2022	Exploit	1) Engage stakeholders early to agree on the Owner Controlled Insurance Program (OCIP) action plan.

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				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring						
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)							
113	MGT 30.5	Conditions tied to Funding	Threat									Active	9/27/2022	9/27/2022	Mitigate	1) Consider early coordination with stakeholders to garner agreement for funding constraints.
114	MGT 60.1	Cash Flow/Program Administration Constraints	Threat									Active	9/26/2022	9/26/2022	Mitigate	1) Consider early coordination with stakeholders to garner agreement for adverse cash flow/program administration constraints mitigation.
115	MGT 20.1	Late Decisions on Program Elements (other)	Threat				1.0	2.0	3.0	25%		Active	9/22/2022	11/17/2022	Mitigate	1) Identify elements of work that may be introduced that would trigger an SDEIS (e.g., aux lane, transit, greenhouse gas). 2) Determine/set key decision milestones to reduce potential schedule impacts if major changes are required. 3) Establish PMO / org chart and systematic decision making model, by Q1 2023.
117	CTR 60.1	Contract Administration Issues	Threat				1.0	2.0	6.0	20%		Active	9/22/2022	11/17/2022	Mitigate	1) Conduct project contract packaging workshop to identify needs. 2) Develop programmatic guidance documents, establish program specifications and guidance for contract administration and procedures. 3) Establish IBR (or member agency, if preferred) authority to manage the contractor and enforce 3rd-party agreements immediately. Note that this specifically pertains to transit and associated systems. 3B) If it is the member agency that will do this, make sure, again immediately, that it has proper authority on both sides of the river and in all necessary jurisdictions to deliver its part of the IBR program, and ensure that other IBR implementing agencies have necessary (and reciprocal) authority to coordinate and deliver in their own right. 4) Once this authority is established, prepare organizational guidance so that assigned staff and decision-makers can implement this authority. 5) Then the responsible parties must put in place the organizational structures and processes necessary to avoid and/or mitigate the impacts described.
118	MGT 10.1	Program Coordination Issues	Threat									Watch List	9/22/2022	9/26/2022	Mitigate	1) Conduct regular and frequent cross-departmental meetings for project status updates.
119	MGT 10.2	Succession Planning	Threat									Watch List	9/26/2022	9/26/2022	Mitigate	1) Engage in frequent coordination with partnering agencies to solicit updates on agency leadership and expected changes.

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121	PSP 40.5	Turnover of Current Elected	Threat				1.0	3.0	6.0	30%	Active	9/22/2022	11/15/2022	Mitigate	1) Engage in early and frequent communication with agencies, stakeholders, and elected officials. 2) Seek to secure funding commitments and budget recommendations before the end of the current Presidential term.
122	CTR 20.2	Community Workforce Agreement (CWA) / PLA	Threat	\$3 M	\$5 M	\$10 M				75%	Active	9/22/2022	11/15/2022	Mitigate	1) Review CWA/PLA language to maximize participation.
123	CTR 20.3	Community Benefits Agreement (CBA)	Threat	\$40 M	\$80 M	\$120 M				50%	Active	9/22/2022	11/15/2022	Mitigate	1) Coordinate and conduct ongoing public outreach. 2) Program is planning to create CBA working group in 2023. 3) Create CBA sideboard for the working group to ensure appropriate and clear scope is included in the CBA.
124	MGT 30.4	Tolling Policies	Threat								Active	9/27/2022	9/27/2022	Mitigate	1) Engage stakeholders/partner agencies early to garner a Tolling policy agreement.
127	PSP 20.1	Additional Community Engagement	Threat				1.0	1.0	3.0	20%	Active	9/22/2022	11/29/2022	Mitigate	1) Coordinate and conduct ongoing public outreach. 2) Engage in frequent communication with technical/design leads. 3) Consider developing a workplan with technical and design milestones that informs a Community Engagement Plan.
129	RR 10.1	BNSF Agreement Delays	Threat				1.0	3.0	6.0	15%	Active	9/22/2022	11/16/2022	Mitigate	1) Engage in early and frequent coordination and communication with BNSF. 2) Start coordination with BNSF during conceptual design (now). 3) Engage Jones Lang Lasalle for ROW coordination. 4) Request BNSF initial draft overpass agreement. 5) Review design guidelines early.
130	RR 10.2	Railroad Agreement Term Sheets Delays	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Work closely with railroad partners to track status updates on railroad term sheets.
131	RR 20.1	BNSF Coordination Issues During Construction	Threat								Active	10/3/2022	11/16/2022	Mitigate	1) Engage in early and frequent coordination and communication with BNSF. 2) Define an envelope at the 30% design. 3) Request to clearly define what is restricted prior to signing contract.
132	RR 20.2	BNSF Crew Change Access	Threat								Active	10/3/2022	11/16/2022	Mitigate	1) Engage in early and frequent coordination and communication with BNSF. 2) Define design criteria/restrictions for crew change access. 3) Define requirements for temporary utilization impacts.

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133	RR 10.3	Union Pacific Property Coordination	Threat								Watch List	10/3/2022	10/3/2022	Mitigate	1) Establish property use needs early and communicate to UPRR. 2) Engage in early and frequent coordination with UPRR.
135	ROW 20.1	Private Development	Threat	\$10 M	\$20 M	\$30 M					Active	9/22/2022	11/14/2022	Mitigate	1) Track development plans around the project area, establish a cadence of regular check-ins with ROW (i.e., quarterly). 2) Develop an early acquisition approach for acquiring parcels and plan for costly acquisitions if necessary.
136	ROW 10.1	Need for Additional ROW Acquisition Identified (Other)	Threat	\$10 M	\$30 M	\$50 M					Active	9/22/2022	11/14/2022	Mitigate	1) Identify potentially impacted properties as early as possible. 2) Develop an early acquisition approach for acquiring parcels. 3) Update ROW Acquisition costs in 2023.
137	ROW 50.1.1	Additional Condemnation - Oregon	Threat				3.0	4.5	6.0		Active	9/22/2022	11/14/2022	Mitigate	1) Identify potentially impacted properties as early as possible. 2) Prioritize ROW acquisitions by evaluating the potential cost and schedule impact. 3) Ensure there is a schedule activity to account for the condemnation process. 4) Early engagement with property owners.
138	ROW 50.1.2	Additional Condemnation - Washington	Threat				6.0	12.0	18.0		Active	10/10/2022	11/14/2022	Mitigate	1) Identify potentially impacted properties as early as possible. 2) Prioritize ROW acquisitions by evaluating the potential cost and schedule impact. 3) Ensure there is a schedule activity to account for the condemnation process. 4) Early engagement with property owners.
139	ROW 50.2	Lack of Appraisers	Threat				1.0	1.5	2.0		Active	9/22/2022	11/14/2022	Mitigate	1) Prioritize appraisals based on acquisition approach. 2) Contract with appraisers early.
140	ROW 50.3	Relocation delays - Oregon	Threat				1.0	2.0	3.0		Active	9/22/2022	11/14/2022	Mitigate	1) Identify potentially impacted properties as early as possible. 2) Early engagement with property owners.
141	ROW	Relocation delays - Washington	Threat				1.0	2.0	3.0		Active	10/10/2022	11/14/2022	Mitigate	1) Consider providing protective rent payments to property owners. 2) Identify potentially impacted properties as early as possible. 3) Early engagement with property owners.
144	ROW 10.2.1	Late Changes in Design - ROW Schedule (Columbia River Bridge)	Threat				1.0	2.0	3.0		Active	9/22/2022	11/14/2022	Mitigate	1) Conduct utility surveys as early as possible as major design changes are realized. 2) Coordinate with contractor mitigate schedule risk.

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145	ROW 10.2.2	Late Changes in Design - ROW Schedule (Other)	Threat				1.0	2.0	3.0	20%	Active	9/22/2022	11/14/2022	Mitigate	1) Conduct utility surveys as early as possible as major design changes are realized. 2) Coordinate with contractor mitigate schedule risk.
146	ROW 10.3	BNSF Property Rights Resolution	Threat				0.0	6.0	12.0	10%	Active	9/28/2022	11/14/2022	Mitigate	1) Plan early discussions and establish regular check-in meetings with ROW and vested parties (BNSF,NPS, DOD & WSDOT).
151	CTR 900.2	Uncertainty in ROW Cost Inflation Rate	Uncertainty								Active	9/22/2022	11/10/2022	Mitigate	1) Consider early acquisition of ROW.
152	ENV 10.6	Scope Added Outside of Current NEPA Footprint (OR Active Transportation)	Threat				1.0	2.0	3.0	20%	Active	10/11/2022	11/15/2022	Mitigate	1) Ensure clear list of involved stakeholders/agencies and their role on the project to reach concurrence on scope. 2) Engage in early coordination and consultation with stakeholders and other involved agencies. 3) Consider separate NEPA process if MLK upgrades are required by city
153	DES 10.1	Shift Alignment of I-5 in Vancouver	Threat	\$15 M	\$17 M	\$30 M				40%	Active	9/28/2022	11/15/2022	Mitigate	1) Conduct design impact investigation as early as possible as major design changes are realized to quantify required ROW action plan. 2) Engage in early communication and coordination with NPS.
154	DES 10.2	Changed Design/Configuration of SR-14 Interchange	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Conduct design impact investigation as early as possible as major design changes are realized.
155	DES 10.3	Changed Design/Configuration of Fourth Plain Interchange	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Conduct design impact investigation as early as possible as major design changes are realized. 2) Early engagement with City regarding other projects near 4th Plain.
156	PSP 30.1	Community Connector Size Reduction	Opportunity	-\$12 M	-\$9 M	-\$6 M				20%	Active	9/30/2022	11/15/2022	Exploit	1) Engage stakeholders early to garner design change agreements that will include reduced community connector size.
157	DES 10.4	Removal of C Street Ramps	Opportunity	\$12 M	\$20 M	\$24 M				25%	Active	9/28/2022	11/15/2022	Enhance	1) Evaluate design with removal of C Street ramps.
158	DES 10.5.2	Second Auxiliary Lane	Threat		\$94 M						Active	9/22/2022	10/3/2022	Mitigate	1) Engage freight community early to garner design agreements for the singular auxiliary lane and address stated concerns as necessary.

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159	DES 20.1	Non-Approval of Assumed Design Deviations/ Exceptions	Threat								Active	9/28/2022	10/3/2022	Mitigate	1) Create a design deviation/exception resistor to keep track of design changes and approval status.
160	DES 10.11	Additional full depth reconstruction	Threat								Active	9/22/2022	11/12/2022	Mitigate	
163	PSP 50.1.1	Shared Use Path Extension (WA)	Threat	\$15 M	\$20 M	\$30 M				20%	Active	10/3/2022	11/15/2022	Mitigate	1) Conduct design impact investigation as early as possible as design changes are realized. 2) Identify potentially impacted properties along the pathway as early as possible. 3) Engage in early coordination with the City.
164	DES 60.1	Additional Features Added to Project within ROW	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Engage in communication with agencies and stakeholders.
165	DES 10.6	Change to Design/Configuration of Hayden Island Interchange	Threat				3.0	6.0	9.0	20%	Active	9/22/2022	11/15/2022	Mitigate	1) Conduct design evaluation for potential major configuration changes of the Hayden Island interchange. 2) Engage partner agencies early to reach concurrence on configuration. 3) Analysis and documentation in IARR 4) Decision needed by summer of 2023.
166	DES 10.7	Alt. Interchange at Marine Drive	Opportunity	\$10 M	\$20 M	\$30 M				25%	Active	10/3/2022	11/15/2022	Exploit	1) Evaluate alternatives for Marine Drive interchange. 2) Engage stakeholders early to garner alternative design agreements.
167	DES 10.8	Victory Braid Design Changes	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Conduct design impact investigation as early as possible as design changes are realized to quantify required action plan.
168	DES 10.9	Cross Section Elements May Increase in Width - COP	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Conduct design impact investigation as early as possible. 2) Early engagement with COP.
169	CNS 80.3	USACE Levee Project Coordination	Threat				1.0	2.0	3.0	10%	Active	9/28/2022	11/15/2022	Mitigate	1) Track Levee Project development plans around the project area, establish a cadence of regular check-ins with USACE. 2) Evaluate Levee Project status as early as possible to incorporate Levee design into IBR program if necessary.
170	PSP 50.1.2	Multi-Use Bike/Ped Path Design (OR)	Threat	\$1 M	\$5 M	\$10 M				20%	Active	9/22/2022	11/15/2022	Mitigate	1) Ensure clear list of involved stakeholders/agencies and their role on the project to reach concurrence on scope. 2) Engage in early coordination and consultation with stakeholders and other involved agencies.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis					Risk Status			Risk-Response Strategies			
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State						Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Direct Cost Impact (\$M)			Schedule Impact (months)								
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
171	DES 10.10.1	Local Street Scope - Portland	Threat	\$10 M	\$15 M	\$20 M				25%	Active	9/22/2022	11/15/2022	Mitigate	1) Engage in early coordination and consultation with City of Portland to reach agreement on scope for local street improvements. 2) Draft EIS will provide data needed for decision making.
173	DES 80.1.1	Contractor Innovation: River Bridge DB Package	Opportunity	-\$10 M	-\$20 M	-\$30 M	-1.0	-3.0	-6.0	35%	Active	9/28/2022	11/15/2022	Exploit	1) Incentivize contractor innovations.
174	DES 80.1.2	Contractor Innovation: Other DB Packages	Opportunity	-\$60 M	-\$80 M	-\$120 M	-1.0	-3.0	-6.0	35%	Active	9/28/2022	11/15/2022	Exploit	1) Incentivize contractor innovations.
175	DES 10.5.1	Loss of Freight Support for Single Aux Lane	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Conduct study and analysis to determine/show that one auxiliary lane will be sufficient. 2) Engage in frequent and consistent communication with the freight communities.
176	STG 10.1	Navigational Clearance	Threat	\$400 M	\$500 M	\$600 M	12.0	18.0	24.0	1%	Active	9/22/2022	11/15/2022	Mitigate	1) Early coordination with USCG to reach concurrence on navigational clearance.
177	STG 10.2	Three Bridge Cross Section	Threat								Active	9/26/2022	9/26/2022	Mitigate	1) Engage stakeholders early to garner design bridge crossing decision.
178	STG 10.3.1	Structure Aesthetic Changes - River Bridge	Threat	\$45 M	\$50 M	\$60 M				10%	Active	9/26/2022	11/15/2022	Mitigate	1) Engage stakeholders early to garner aesthetic design agreement. 2) Continue to develop aesthetic design concepts.
179	STG 10.3.2	Structure Aesthetic Changes - NPH Bridges	Threat	\$20 M	\$25 M	\$30 M				10%	Active	9/26/2022	11/15/2022	Mitigate	1) Engage stakeholders early to garner aesthetic design agreement. 2) Continue to develop aesthetic design concepts.
180	DES 30.1	Additional Aesthetic Treatments: Other	Threat								Active			Mitigate	1) Engage stakeholders early to garner aesthetic design agreement.
182	STG 30.1	Changed Seismic Design Criteria	Threat	\$60 M	\$90 M	\$120 M				10%	Active	10/11/2022	11/15/2022	Mitigate	1) Continue to monitor and track changes to seismic design criteria.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies		
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State							Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken	
				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring						
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)							
185	DES 50.1.1	Changes to Travel Demand Modeling Parameters	Threat				1.0	2.0	3.0		20%	Active	9/22/2022	11/15/2022	Mitigate	1) Ensure that incorporation of travel analysis numbers are not required at the SDEIS. 2) Continue to track policy changes that may impact travel demand modeling requirements. 3) Plan for updated model in 2023.
186	DES 50.1.2	Travel Demand Modeling Post-ROD	Threat	\$0 M	\$1 M	\$70 M					5%	Active	10/11/2022	11/15/2022	Mitigate	1) Continue to track land use changes that may impact travel demand modeling requirements. 2) Carry design allowances for changes/refinements to interchanges in estimate. 3) Evaluate other options/alternatives at Marine Drive to flyover.
187	DES 50.2.1	Detours and Closures - COP	Threat									Active	9/22/2022	10/3/2022	Mitigate	
188	DES 50.2.2	Detours and Closures - COV	Threat									Active	9/22/2022	10/3/2022	Mitigate	
189	DES 70.1	Additional ATMS / Toll Infrastructure	Threat									Watch List	10/11/2022		Mitigate	1) Engage in communication with agencies and stakeholders.
190	DES 20.2	Approval of ARR / Intersection Control Decisions	Threat									Watch List	10/11/2022	10/11/2022	Mitigate	1) Engage in communication with agencies and stakeholders.
191	TRN 50.1	Portland Transit Service Level	Threat	\$2 M	\$10 M	\$50 M					10%	Active	10/3/2022	10/3/2022	Mitigate	1) Conduct early Transit Service Level evaluation to determine service level adequacy, then quantify the required action plan. 2) Early engagement with partner agencies.
192	TRN 30.1	Expo Center Station Modifications	Threat	\$5 M	\$20 M	\$50 M					25%	Active	10/3/2022	11/29/2022	Mitigate	1) Conduct design evaluation for potential modifications to the existing Expo Station and realignment. 2) Engage in early communication and coordination with Transit stakeholders to confirm required modifications.
193	TRN 20.1	Delta Park Station	Threat									Active	10/3/2022	10/3/2022	Mitigate	1) Engage stakeholders early to garner Delta Park Station closure or contingency plans agreement and quantify required actions.
194	TRN 20.2	Hayden Island Station Scope/Design Changes	Threat	\$5 M	\$10 M	\$15 M					25%	Watch List	10/3/2022	10/3/2022	Mitigate	1) Engage stakeholders early to acquire the Hayden Island Station design agreement and quantify required actions.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis					Risk Status			Risk-Response Strategies			
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State			Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken			
				Direct Cost Impact (\$M)	Schedule Impact (months)										
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
195	TRN 30.2	Eliminate/Reduce Separate LRT Overnight Facility at Expo Center	Opportunity	-\$17 M	-\$10 M	-\$7 M				75%	Active	9/28/2022	11/29/2022	Enhance	1) Engage design team for Ruby Junction facility to identify more efficient layout. 2) Engage TriMet early to acquire agreement on a path forward concerning design/requirement of separate LRT overnight facility at Expo Center.
197	STG 10.4	Rose Quarter Transit Center Modifications	Uncertainty	-\$15 M	\$0 M	\$25 M				100%	Active	9/22/2022	10/3/2022		1) Engage stakeholders early to acquire the Rose Quarter Transit Center design modifications agreement and quantify required actions.
198	CNS 80.4	Coordination with I-5 Rose Quarter Project	Threat								Watch List			Mitigate	1) Consider early coordination with I-5 Rose Quarter Project to mitigate potential execution conflicts and quantify the required action plan. 2) Early engagement with stakeholders.
199	CNS 80.5	Coordination with Burnside Bridge	Threat								Watch List			Mitigate	1) Consider early coordination with Burnside Bridge Project to mitigate potential execution conflicts and quantify the required action plan. 2) Early engagement with stakeholders.
200	TRN 30.5	Waterfront Station	Threat	\$20 M	\$40 M	\$60 M				50%	Active	10/3/2022	11/29/2022	Mitigate	1) Engage consultant team to determine optimal bridge structure configuration to lower risk.
201	TRN 10.1	Evergreen LRT Grade Separation	Threat								Active	9/28/2022	10/3/2022	Mitigate	1) Engage stakeholders early to acquire the Evergreen LRT Grade Separation design agreement and quantify required actions.
202	TRN 40.1	Evergreen Park-and-Ride Design/Scope Changes	Opportunity	\$0 M	-\$34 M	-\$73 M				60%	Active	9/28/2022	11/12/2022	Enhance	1) Engage stakeholders early to acquire the Evergreen Park-and-Ride design/scope change agreement.
203	TRN 40.2	Waterfront Park-and-Ride Design/Scope Changes	Uncertainty	-\$20 M	\$0 M	\$20 M				100%	Active	9/28/2022	11/12/2022		1) Engage stakeholders early to acquire the Waterfront Park-and-Ride design/scope change agreement and quantify required actions.
204	TRN 10.2	Advance with Direct Fixation Track	Opportunity	-\$240 M	-\$200 M	-\$160 M				75%	Active	9/22/2022	11/29/2022	Enhance	1) Conduct design evaluation to select options. 2) Engage leadership from transit agencies in securing decision by Jan 2023.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis					Risk Status			Risk-Response Strategies			
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State						Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Direct Cost Impact (\$M)			Schedule Impact (months)								
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
205	TRN 10.4	Additional Measures Needed to Facilitate Joint Transit Use: shared transitway with joint operations concurrently	Threat	\$60 M	\$150 M	\$300 M				25%	Active	10/13/2022	11/29/2022	Mitigate	1) Engage stakeholders early to agree on additional measures that foster design for Joint Transit use.
206	TRN 10.5	Additional structure width needed to facilitate joint transit operations	Threat							75%	Active	10/13/2022	10/13/2022	Mitigate	1) Engage stakeholders early to agree on additional structures that foster design for Joint Transit use.
207	TRN 20.3	Added Aesthetics to Station Features	Threat								Watch List	9/22/2022	10/3/2022	Mitigate	1) Consider early coordination with stakeholders to garner agreement for added aesthetics to station features. 2) Early engagement with stakeholders.
209	TRN 40.3	Express Bus Shoulder Improvements	Threat								Watch List	10/3/2022	10/3/2022	Mitigate	1) Engage stakeholders early to agree on the Express Bus Shoulder Improvements.
210	TRN 50.2	Yellow Line Intersection Improvements	Threat	\$5 M	\$10 M	\$15 M				75%	Active	10/3/2022	10/3/2022	Mitigate	1) Engage stakeholders early to agree on the Yellow Line Intersection Improvements.
211	TRN 40.4	Active Transportation (AT) Scope at Stations	Threat								Watch List	9/22/2022	10/3/2022	Mitigate	1) Engage stakeholders early to agree on the Active Transportation (AT) Scope at Stations and quantify required actions.
212	TRN 70.1	TriMet LRT Vehicle Procurement Delays	Threat								Active	10/13/2022	10/13/2022	Mitigate	1) Consider early equipment procurements where it makes sense. 2) Early engagement with partner agencies.
213	TRN 70.2	Additional LRT Vehicles	Threat	\$0 M	\$6 M	\$12 M	1.0	2.0	3.0	5%	Active	10/13/2022	11/29/2022	Mitigate	1) Conduct early study/investigation to best determine LRT vehicle needs to achieve operational requirements. 2) Engage in early and frequent coordination and communication with TriMet on expected LRT vehicle needs. 3) Finalize LRV total with rail fleet management plan at end of project development.
214	TRN 70.3	C-TRAN Express Bus Vehicle Procurement	Uncertainty	-\$6 M	\$0 M	\$1.5 M				40%	Active	10/3/2022	10/3/2022	Mitigate	1) Engage in early and frequent coordination and communication with appropriate partnering agency to track bus and storage facility needs.

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies	
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State							Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring					
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
215	TRN 80.1	Transit O&M Agreement	Threat				3.0	6.0	9.0	20%	Active	9/28/2022	11/29/2022	Mitigate	1) Assembly O&M workgroup to identify and secure funding sources. 2) Evaluate and finalize O&M costs (for WA and OR transit orgs). 3) Confirm Roles and Responsibilities between two transit agencies, and establish the deal points for the agreements.
216	PSP 40.6	Delay to FTA Letter of No Prejudice	Threat								Watch List	10/13/2022	10/13/2022	Mitigate	1) Begin early coordination with the FTA on the LONP to track progress and ensure it is provided in a timely manner
217	TRN 30.4	Additional Elements Required to Facilitate Future Transit O&M	Threat								Watch List	9/22/2022	10/3/2022	Accept	1) Engage stakeholders early to agree on additional elements for the Future Transit O&M and quantify required efforts.
218	TRN 80.4	Systems Testing or Start-Up Delays	Threat				3.0	6.0	9.0	40%	Active	9/22/2022	11/29/2022	Mitigate	1) Develop startup plan during project development, as early as possible. 2) Consider adding a start-up manager to the IBR implementation team during design (entry into engineering). 3) Startup manager to manage cross contract systems interface schedule.
220	ENV 40.1	Section 106 - Approach	Threat	\$30 M	\$50 M	\$80 M	2.0	4.0	9.0	45%	Active	9/22/2022	11/17/2022	Mitigate	1) Engage in early coordination and consultation with Tribes and other stakeholders/agencies. 2) Continue to engage FPOs at FTA and FHWA. 3) Dedicate staff to liaise with necessary parties for agreements. 4) Dedicate funding within estimate/budget for 106 mitigation.
221	ENV 40.3	Tribal Consultation - Fisheries	Threat	\$10 M	\$20 M	\$40 M	1.0	3.0	6.0	30%	Active	9/22/2022	11/17/2022	Mitigate	1) Engage in early coordination and consultation with Tribes and other stakeholders/agencies. 2) Dedicate staff to liaise with necessary parties for agreements. 3) Dedicate funding within estimate/budget for fisheries mitigation. 4) Focus on upriver fisheries for mitigation efforts. 5) Share biological assessment with tribal partners as early as possible in process.
223	UTL 10.1	Uncertainty in Utility Costs	Uncertainty								Active	10/12/2022	11/12/2022		

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies	
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Post-Managed State						Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken
				Direct Cost Impact (\$M)			Schedule Impact (months)								
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)						
224	UTL 10.2	Utility Service Connection Uncertainty	Opportunity								Active	9/22/2022	10/3/2022	Exploit	1) Meet with PDOT and COV utility groups to initiate planning discussions.
225	UTL 10.3	Delayed Completion of Utility Agreements	Threat								Active	10/12/2022	10/12/2022	Mitigate	1) Engage stakeholders early to validate the utility relocation schedule.
226	UTL 20.1.1	Utility Relocation Delays: River Bridge and Approach Landside features	Threat				2.0	4.0	6.0	30%	Active	9/22/2022	11/14/2022	Mitigate	1) Engage in early and frequent coordination with third party utilities. 2) Research franchise agreements.
227	UTL 20.1.2	Utility Relocation Delays: OR Transit	Threat								Active	10/3/2022	10/3/2022	Mitigate	1) Engage in early and frequent coordination with third party utilities. 2) Research franchise agreements.
228	UTL 10.4	City of Vancouver Underground Utilities	Threat								Active	9/22/2022	10/3/2022	Mitigate	1) Engage in early communication with City of Vancouver.
229	UTL 10.5	Pump Station at Waterfront	Threat								Active	10/12/2022	10/12/2022	Mitigate	
231	UTL 20.1.3	Utility Relocation Delays: WA Transit	Threat				1.0	3.0	6.0	20%	Active	10/3/2022	11/14/2022	Mitigate	1) Engage in early and frequent coordination with third party utilities. 2) Research franchise agreements.
232	UTL 20.1.4	Utility Relocation Delays: WA North Highways	Threat				1.0	3.0	6.0	20%	Active	10/3/2022	11/14/2022	Mitigate	1) Engage in early and frequent coordination with third party utilities. 2) Research franchise agreements.
233	UTL 20.2	Unidentified Utilities Encountered During Construction	Threat				1.0	2.0	3.0	20%	Active	10/12/2022	11/14/2022	Mitigate	1) Engage in early and frequent coordination with third party utilities. 2) Conduct an update SUE evaluation within the construction area vicinity as early as possible. 3) Coordinate planned utility relocation schedule with utility owners and integrate into the master schedule.
239	ROW 50.4	Uncertain ROW market conditions	Threat	\$17 M	\$34 M	\$59 M				50%	Active	11/12/2022	11/12/2022		

Interstate Bridge Replacement (IBR) - PROJECT RISK MANAGEMENT PLAN

Risk Identification				Quantitative Analysis							Risk Status			Risk-Response Strategies		
ID #	RBS Code	Risk Event Title	Threat or Opportunity	Direct Cost Impact (\$M)			Schedule Impact (months)			Likelihood of Impact Occurring	Status	Date Identified	Date Last Updated	Strategy	Actions to be Taken	
				Low (10% CI)	Most Likely	High (90% CI)	Low (10% CI)	Most Likely	High (90% CI)							
240	TRN 10.3	Uncertainty in Structural Premium for Embedded Track	Threat	-\$5 M	\$0 M	\$30 M					100%	Active	10/18/2022	11/12/2022	Mitigate	1) Develop specific bridge design for joint transit use including additional structural slab for embedded track to support a more robust structure estimate to reduce this uncertainty.
241	OTH 2.1	Indirect cost of project delays (owner, PM)	Threat									Active	10/15/2022	11/12/2022	Mitigate	
242	OTH 2.2	Indirect cost of project delays (contractor, compensable)	Threat									Active	10/15/2022	11/12/2022	Accept	
243	OTH 2.3	Aggregate minor risks / opportunities	Threat									Active	10/15/2022	11/12/2022	Accept	
244	OTH 2.4	Unidentified risks / opportunities	Threat									Active	10/15/2022	11/12/2022	Accept	
245	UTL 20.1.4	Utility Relocation Delays: OR Marine Drive	Threat				1.0	3.0	6.0		20%	Active	11/14/2022	11/14/2022	Mitigate	1) Engage in early and frequent coordination with third party utilities. 2) Research franchise agreements.

Appendix E – Additional Scenario Results

Figure E-1. Comparison of Cost Results for Pre- and Post-Mitigation Scenarios (Design Option A)

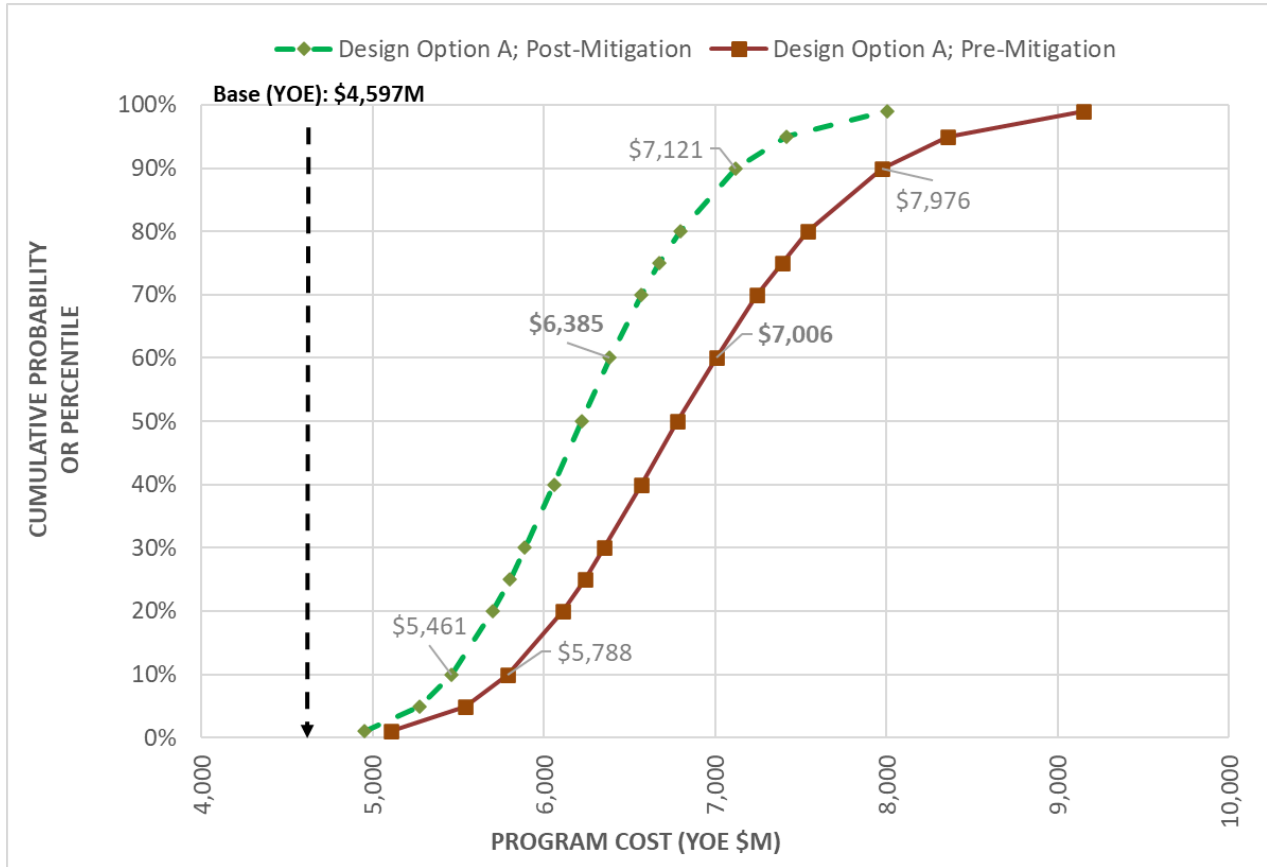


Figure E-2. Comparison of Schedule Results for Pre- and Post-Mitigation Scenarios (Design Option A)

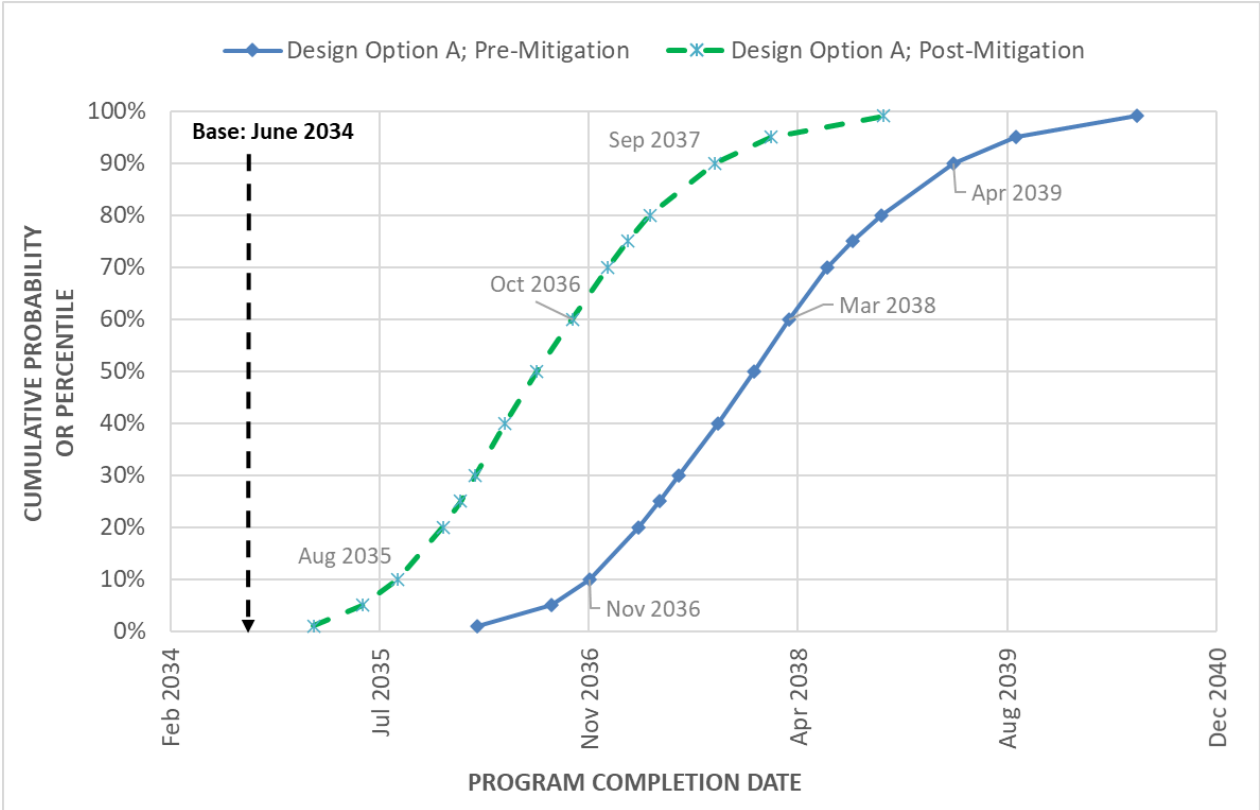


Figure E-3. Comparison of Cost Results for Pre- and Post-Mitigation Scenarios (Design Option B)

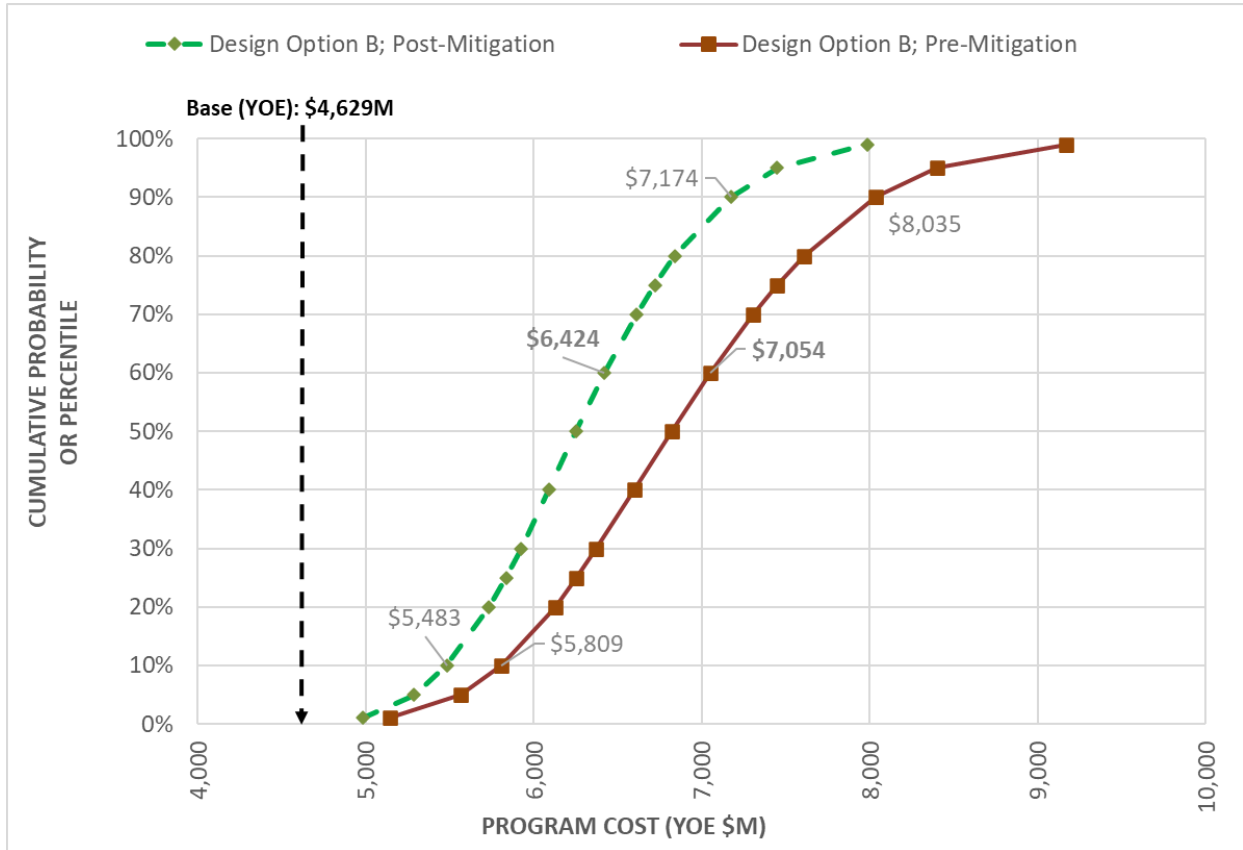


Figure E-4. Comparison of Schedule Results for Pre- and Post-Mitigation Scenarios (Design Option B)

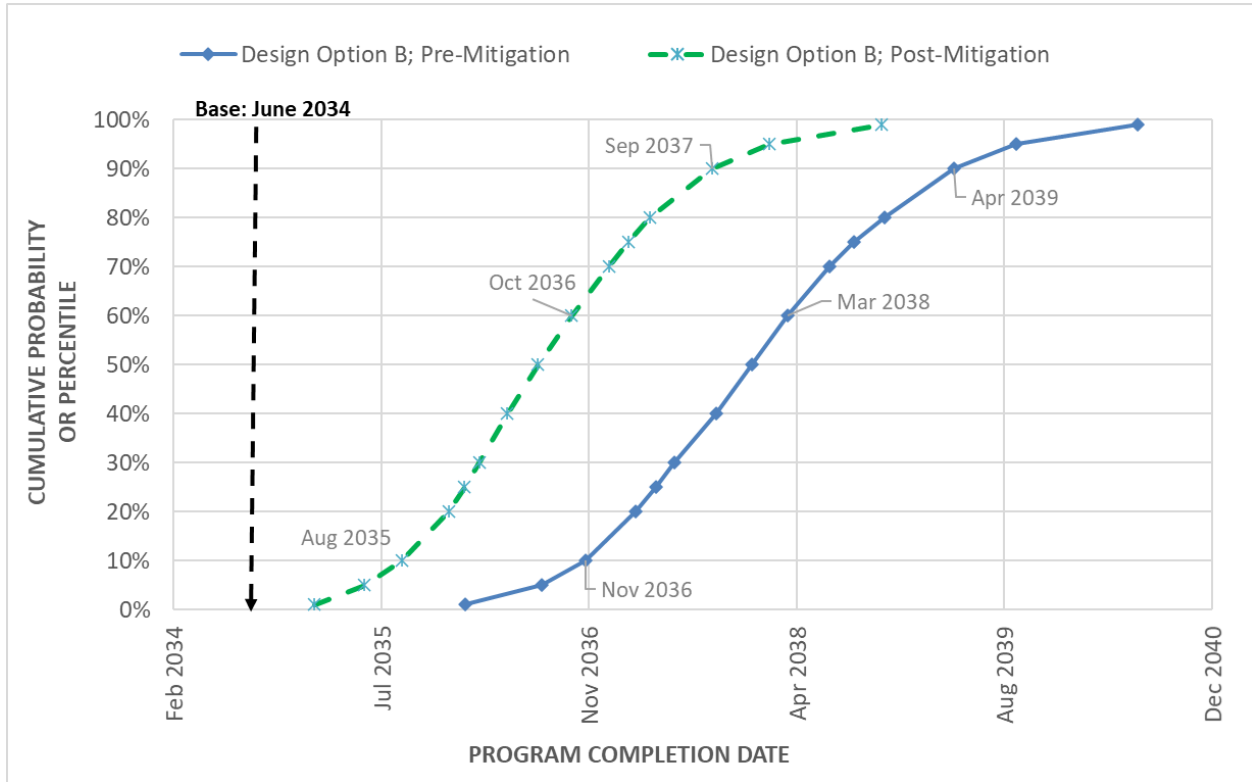


Figure E-5. Comparison of Cost Results for Pre- and Post-Mitigation Scenarios (Design Option C)

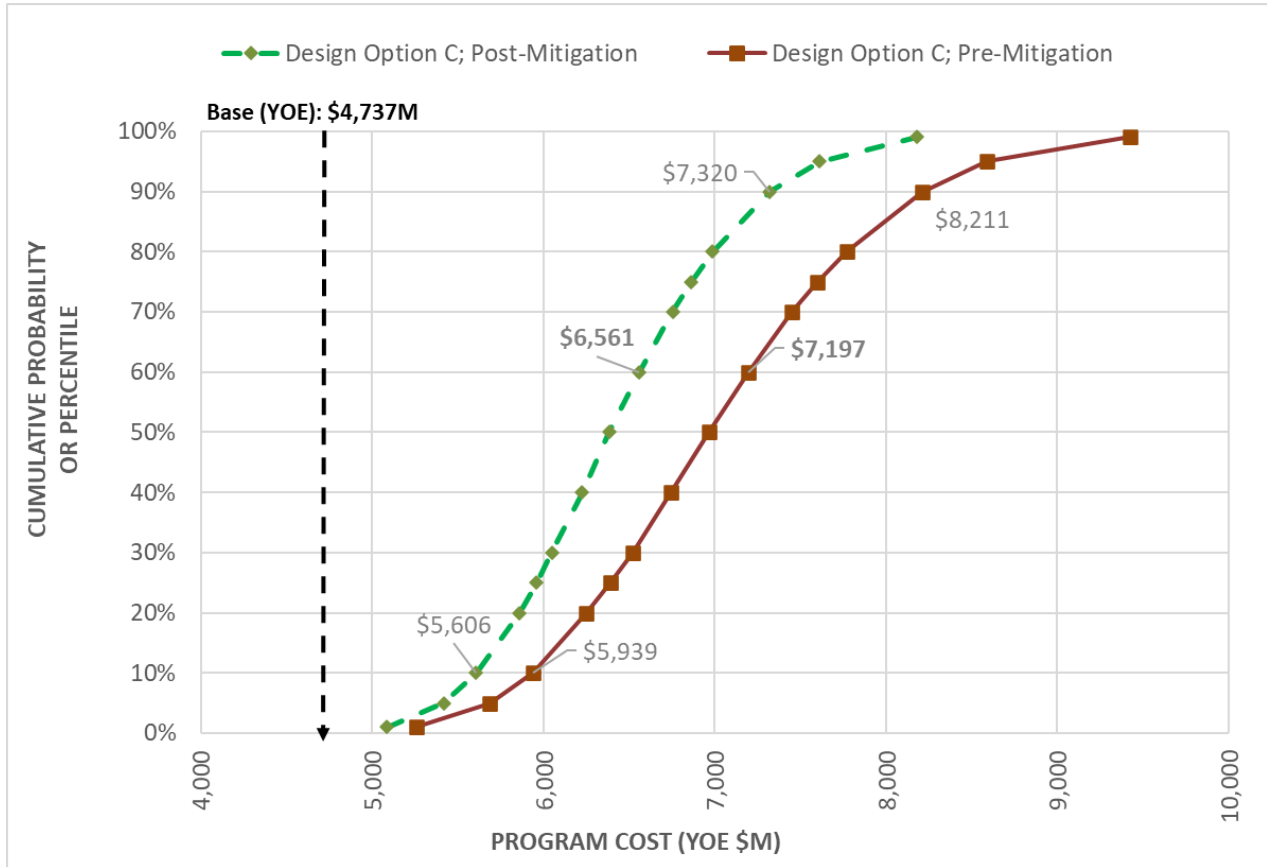


Figure E-6. Comparison of Schedule Results for Pre- and Post-Mitigation Scenarios (Design Option C)

