

**Alaskan Way Viaduct Replacement
Program Expert Review Panel
Updated Report**

April 3, 2015

THE ALASKAN WAY VIADUCT REPLACEMENT PROGRAM

Updated Report of the Expert Review Panel

April 2015

The enclosed Report conveys the findings of the Expert Review Panel (“ERP”) instituted under the provisions of Bill 1175 to assess the viability and feasibility of the Alaskan Way Viaduct (“AWV”) Replacement Program’s (“Program”) Finance Plan and to review key assumptions for the Program’s schedules, risk identification and management, and cost estimates to assure they are reasonable.

Based on the information available to the ERP today, the ERP remains confident that the Program can be completed and there does not appear to be a need for additional State or local funds above the amounts already contained in the \$3.1 billion budget. This confidence is tempered by the understanding that (a) the re-commencement of tunneling will present important challenges that may impact budget and schedule; (b) the Program’s success continues to depend on maintaining positive relationships with key stakeholders, Seattle Tunnel Partners (“STP”), and government agencies; and (c) actions are still needed to secure important agreements and tolling funding sources.

This 2015 Report recommends actions that would keep the Program moving toward successful completion.

The ERP stresses that it is common for issues to arise in tunnel projects. The tunnel portion of the Program continues to benefit from decisions and actions that were previously taken in anticipation of such issues. It was appropriate that the Washington State Department of Transportation (“WSDOT”) retained a world-class tunnel contractor that would understand how risks are identified, managed, and mitigated. It is important that WSDOT has engaged STP’s services through a design-build contract that establishes expectations and accountability for both parties. WSDOT used good foresight when it developed a risk management plan (“RMP”) that identified potential risks along with mitigating actions, working to address potential monetary and delay impacts. WSDOT and the citizens of Washington will be best served by WSDOT using the contract provisions to manage the work, asking appropriate questions but also taking advantage of the tunnel contractor’s expertise.

The ERP is encouraged by the entry of the Tunnel Boring Machine (“TBM”) into the repair shaft, the successful lift of the TBM’s cutter head from the repair shaft, and the repairs that are currently underway. Significant work is to be conducted over the next several months including planned resumption of mining in August 2015, the cost estimating process between the City and WSDOT regarding the Alaskan Way surface street to be completed in June 2015 and the WSDOT Program Management Team reorganization that has recently been implemented. It will be important to use new information to understand the issues regarding cost and schedule impact that have resulted from the TBM’s stoppage. Therefore, the ERP recommends that the Governor and Legislature consider a semi-annual ERP review.

The ERP deeply appreciates the responsiveness of both WSDOT and STP and for their support throughout our review. We were continually impressed with the skill and experience WSDOT staff brought to this process. We also commend the Governor and the Legislature for their continued commitment to this Program, since without their leadership, the construction of this key public infrastructure would be impossible.

Dr. Patricia D. Galloway, P.E., Chair

John Rose

Robert Goodfellow, P.E.

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ACRONYM AND ABBREVIATION LIST

<i>Acronym/Abbreviation</i>	<i>Full Definition/Listing</i>
ACTT	Advisory Committee on Tolling and Traffic Management
AWV	Alaskan Way Viaduct
CEVP	Cost Estimating Validation Process
City	City of Seattle
Code	Code of Practice for Risk Management of Tunnel Projects
DBE	Disadvantaged Business Enterprise
DMR	Deformation Mitigation and Repair
DRB	Dispute Resolution Board
DSC	Differing Site Condition
ERP	Expert Review Panel
FHWA	Federal Highway Administration
H2K	Holgate to King Streets
HITZ	Hitachi-Zosen
ITIG	International Tunnel Insurance Group
Port	Port of Seattle
Program	Alaskan Way Viaduct Replacement Program
RMP	Risk Management Plan
STP	Seattle Tunnel Partners
TBM	Tunnel Boring Machine
the State	State of Washington
TPA	Transportation Partnership Act
WSDOT	Washington State Department of Transportation

1. EXECUTIVE SUMMARY

This April 2015 Report is the third annual update of the Expert Review Panel’s (“ERP”) initial report published in February 2012, regarding the viability and feasibility of the Alaskan Way Viaduct (“AWV”) Replacement Program’s (“Program”) Finance Plan and key assumptions for the Program’s schedule, risk identification and management, and cost estimates.

The ERP was originally appointed in September 2011 by the Governor and Legislature under the provisions of ESHB 1175. The ERP was re-authorized by the 2013 Legislature. ESHB 5024.PL, Section 306, Proviso 10 provided that:

“The department shall reconvene an expert review panel of no more than three members as described under RC 47.01.400 for the purpose of updating the work that was previously completed by the panel on the Alaskan Way Viaduct replacement project and to ensure that an appropriate and viable financial plan is created and regularly reviewed.”

ERP members have performed their work under contracts which call for the ERP to *“Conduct Independent Financial and Technical Review of the Project’s Key Assumptions, Financial, and Technical Review of the Project’s Key Assumptions, Financial Plans, and Risk Management Plan”* and *“[p]resent annual reports to Joint Transportation Committee, Governor, and Office of Financial Management.”*

The \$3.1 billion AWV megaprogram is comprised of numerous individual project elements including:

- Previously completed projects essential to the Viaduct’s replacement including, but not limited to, the removal and replacement of the Viaduct from Holgate to King streets (“H2K”);
- The central Viaduct replacement project including a design-build deep-bored tunnel contract;
- Other smaller projects including projects that tie-in the south and north end of the deep-bored tunnel contract; and,
- Post-tunnel projects, including demolition of the existing Viaduct, de-commissioning of the Battery Street Tunnel and relocation of the Alaskan Way surface street.

The ERP’s reports have reviewed and this Report continues to review the Program’s Finance Plan for its viability and feasibility, identify risks that might impact the Program’s goals and objectives, and recommend actions to mitigate risks and contribute to the Program’s success.

1.1 General Findings

All parties remain committed to the successful completion of the Program. Based on what is known today, the ERP continues to be confident that the Program can be completed and that there does not

appear to be a need for additional State or local funds over the amounts already contained in the \$3.1 billion budget.

There remain significant construction, cost, and schedule risks specifically related to the tunnel portion of the Program. The tunnel contractor, Seattle Tunnel Partners (“STP”)¹, and its Tunnel Boring Machine (“TBM”) manufacturer have the corporate experience and resources to address the risks that have arisen to date and remain committed to successfully completing the tunnel project. In addition, the design-build contract contains the mechanisms to address these risks. If disputed issues can be resolved, this may contribute to the long-term success of the Program. We discuss the specifics of these decisions in the body of our Report.

There has been significant progress made on the Program since the ERP’s last update in February 2014. Some of the more significant accomplishments include:

- Swift resolution by WSDOT and STP of the Disadvantaged Business Enterprise (“DBE”) issues that ERP identified in its last report. The Federal Highway Administration (“FHWA”) now reports this Program as having the largest minority participation of any federally funded project in the nation.
- The Holgate to King Stage 3 project was completed on time and below budget and is open to traffic. This has significantly improved freight access to the Port of Seattle (“Port”) and the Port and other freight-handling stakeholders are pleased with the outcome of this project.
- Significant progress has been achieved on the non-mining portion of STP’s design-build contract. This work includes near completion of the north and south end cut and cover tunnel; work at the north and south portals; south operations building; installation of approximately 450 feet of interior tunnel structure; and procurement of major items needed for tunnel completion including the manufacture of all tunnel segment rings.
- Formation of a WSDOT Restart Team to monitor STP’s work and risk and mitigation efforts throughout the planning for TBM repair and re-launch.
- Program contingency funds have been protected by avoiding scope increases and recouping savings from retired risks returned to the contingency fund.
- Costs for non-tunnel projects have been controlled, resulting in their on-budget status.

The primary findings of the ERP as of the date of this Report include the following:

The STP Design-Build Tunnel Contract

- The design-build contract provides useful risk reduction measures for implementation early in the TBM’s mining to minimize risks during the extended mining of the tunnel. The “tunneling in a box” allowed early mining to take place in a controlled environment.

¹ STP is a Joint Venture of Dragados USA and Tutor Perini Corporation

- The use of “tunneling in a box” proved successful and the worthiness of the strategy has been proven since the TBM stoppage has caused minimal impact to the Viaduct, even though the construction is very close by.
- Planned Safe Havens along the first 1500 feet of the alignment allow for inspection of the machine and the cutter head of the TBM to assess the status of the cutting tools, and allow for adjustments or changes to be made as necessary before resuming mining. The opportunity exists to check the TBM again at Safe Haven 3, the last checkpoint of mining once the TBM is re-launched.
- The Cost Estimating Validation Process (“CEVP”) undertaken by WSDOT before commencement of the contract recognized risks that have manifested to date on the tunnel project. Using what was learned in the CEVP process, WSDOT carefully crafted a design-build contract between WSDOT and STP that includes mitigation strategies for handling the type of tunnel issues that have arisen and may arise within the project.
- The design-build contract is a well thought through document, and if used as intended, should assist WSDOT and STP in finding shared solutions for complex issues that arise.
- The design-build contract appropriately does not address what happens should the costs exceed the budget, but does address how significant potential risk factors are to be dealt with administratively, through the use of shared contingency funds, insurance coverage, and the Dispute Resolution Board (“DRB”).

Tunnel Boring Machine

- Based on discussions with STP and WSDOT and the review of information provided by STP to WSDOT to date, the ERP finds that the TBM Repair Plan appears to be viable and is reasonably confident that the TBM can be repaired. The plan presumably reflects the current understanding of the tunnel contractor based upon STP’s internal investigation of the breakdown. The Repair Plan may change as more is learned.
- Since the TBM stopped on December 6, 2013, STP and the TBM manufacturer Hitachi-Zoomlion (“HITZ”) investigated the reasons for the stoppage. Any conclusions drawn by HITZ or STP will need to be reconsidered once the main drive and the cutter head of the TBM are removed, allowing additional internal investigations to be completed. The causes of the stoppage are the subject of on-going legal and commercial discussions between STP and WSDOT.
- STP and its TBM manufacturer appear to be taking appropriate steps to redesign and repair the TBM. WSDOT is taking appropriate steps to monitor this process.
- STP and WSDOT experts have worked collectively (without direction from WSDOT) to share information regarding how to improve the future function of the TBM. It appears that many of WSDOT’s comments have been considered in the redesign and Repair Plan.

Relations with the Tunnel Contractor

- Relations between STP and WSDOT at the working project level are good, and the ERP recognizes ongoing efforts from both parties to maintain good project communication while the parties engage in difficult negotiations over legal and commercial matters.
- The DRB process has not been effective as envisioned by either STP or WSDOT in settlement of disputes to date due to both parties' reluctance to acknowledge the decisions made in the process. The reluctance appears primarily related to disputed issues that may have legal context not conventionally considered by DRB boards.
- Achievement of a timely resolution by WSDOT and STP of the outstanding legal and commercial issues may be beneficial to maintaining a positive working relationship.

Schedule

- The tunnel project will not achieve STP's original completion date of December 2015. Time lost by the current stoppage has been partly mitigated by the execution of strategies identified by STP. Schedule mitigation work includes additional progress on the north and south cut and cover tunnels, the north and south access shafts and the internal tunnel structure. A specific completion date for the tunnel project and the overall Program cannot be predicted until TBM repairs are confirmed, mining resumes, and the TBM's performance is reassessed at Safe Haven 3.
- The City of Seattle's ("City") Seawall project is proceeding with no anticipated adverse impact on the tunnel project. The tunnel project is not expected to have any adverse impact on the Seawall.

Budget

- Based on information available today, the ERP finds that with assertive leadership by both STP and WSDOT, the completion of the Program can still be accomplished with no additional State or local funds beyond those already contained in the \$3.1 billion budget.
- Unplanned issues with the TBM stoppage have increased the tunnel contractor's costs, costs for which the design-build contract provides mechanisms for resolution.

Funding Sources

- Funds potentially available to cover additional costs that have arisen to date under the design-build tunnel contract include various contractual contingency funds within the budget, insurance claims under existing policies, and savings from post-tunnel projects.

- Toll Revenues are not secured. Important decisions remain regarding diversion standards. The reported decision to use General Obligation Bonds and not Toll Revenue Bonds creates the opportunity to increase proceeds available for the Program.
- The projections of toll rates and the resulting amount of bond proceeds available for the Program are not sufficiently detailed to provide a sound basis for budgeting.
- Any transit funding to mitigate potential impacts during the remainder of the Program should not come from the Program budget, as all available Program funds may be required for successful completion of the Program.

Program Management

- WSDOT has implemented several of the ERP's February 2014 recommendations, and with its partners, has achieved significant successes since the ERP's February 2014 report.
- The WSDOT Program Management Team has demonstrated success in managing the Program. The Secretary of Transportation advised the ERP that she and the Governor have complete confidence in the current WSDOT Program Management Team.
- The ERP finds that both WSDOT and STP have retained qualified personnel to execute the work. Continuity in both the WSDOT and STP project teams has assisted in maintaining the current good working relationship.
- The current management decision-making and authority levels of both WSDOT and STP are not reflective of approaches and levels of authority typically seen in megaproject construction. Tiered decision-making is the norm, and if applied here would allow the tunnel project to proceed more efficiently and effectively.
- The need for WSDOT Program Management staff to focus on relations with outside parties may have limited their ability to assist staff responsible for implementation of the Program. Organization changes are being implemented which may alleviate this issue.
- WSDOT and the STP Joint Venture must remain united in their essential goal – to continue to build the tunnel project safely, efficiently and effectively.

Stakeholder Communications

- The Program would benefit from a regular forum for the City and State political leaders to meet and discuss the Program that could contribute to better communication and understanding.
- Communication protocols between WSDOT and the City are not clearly identified as would be expected at this point during a megaproject of this size and this level of complex stakeholder involvement. Clear protocols would minimize miscommunication, and as a result improve the efficiency and effectiveness of the decision-making process.

- Issues with ground settlement led to heightened concerns by the City and a breakdown in communication between WSDOT and the City. Official communication protocols are being established with clear reporting lines of communication should future issues arise.
- WSDOT and the City have not completed a formal agreement regarding the post-tunnel projects. There remains an urgent need for a formal agreement regarding their respective expectations, roles, and responsibilities. For Program budgeting purposes, it is essential to know the amount WSDOT will be contributing to the Alaskan Way surface street.

Risk Management

- The risk management process is succeeding in identifying risks early. WSDOT and STP have identified several significant risks that could emerge over the course of the Program along with their potential impact to cost and schedule. The risks identified are not abnormal for tunnel megaprojects.
- WSDOT and STP accepted and implemented a previous ERP recommendation from 2012 and 2013 to jointly assess, mitigate, and track risks and identify their potential impact to the tunnel project. The joint risk register process has been effective at identifying risks but less effective at mitigating these risks or minimizing the consequences.
- The flow of information necessary to mitigate the identified technical risks may be impeded by legal and commercial positioning of both parties over existing disputes.

1.2 Recommendations

Broadly stated, all stakeholders are best advised to focus on actions they can effect to conclude the Program. This will require working through adversarial relationships and a concentration on making important decisions as discussed below.

Based on its independent review, the ERP makes the following specific recommendations:

ERP Reporting

The ERP strongly recommends that the Governor and Legislature consider a semi-annual ERP review. A significant amount of work will be conducted over the next several months including the planned resumption of mining in August 2015, the completion of the City and WSDOT estimate of the costs for the Alaskan Way surface street and the recent implementation of the WSDOT Program Management reorganization. The new information will be important to update findings and recommendations regarding cost and schedule impact to the overall Program.

The Design-Build Tunnel Contract

- WSDOT and STP should continue to utilize the mechanisms and options established within the design-build contract and continue their current negotiation efforts to resolve all current legal and commercial issues. Timely resolution of issues may reduce future risk exposure and increase future collaboration between the parties.

Tunnel Boring Machine

- The ERP recommends that safety and the return of the TBM to operation should be everyone's primary objectives.
- STP and its TBM manufacturer should consider enhancing its Repair Plan as the investigation continues to include comments from all parties, allowing for minimized risks and an enhanced probability of successfully completing mining operations.
- Though WSDOT should not direct STP's actions, WSDOT and STP should spend time discussing risk mitigation and contingency plans that will create confidence within the project team that the TBM will perform effectively on the project.
- STP, HITZ, and WSDOT should consider conducting a workshop in the near term so that any remaining questions and comments on the redesign and Repair Plan can be considered by STP and HITZ. Such a workshop could create increased confidence for WSDOT in the future performance of the TBM.

Schedule

- A revised project schedule for the tunnel project and a Program completion date should be established at the earliest practical time after TBM performance is assessed at Safe Haven 3.
- WSDOT and STP should continue to identify steps to mitigate factors that are delaying project completion. Opportunities for schedule savings should be entered on the WSDOT and STP jointly developed risk register. Such opportunities should be tracked until completely realized.
- STP should share schedule recovery options with WSDOT in order to provide confidence in a realistic completion date, allowing WSDOT to monitor against an optimized recovery schedule.

- Projects to be completed post-tunnel construction must continue to proceed on schedule. The need for increased interactions with management regarding these follow-on projects will increase as the tunnel project proceeds.

Budget

- The ERP again recommends that Program contingency funds be protected. Program scope should not be expanded.
- Any unanticipated savings from future or completed projects should be returned to the Program contingency fund.

Program Costs

- STP should proceed promptly in submitting complete change order and claim documentation, including financial information that would facilitate the resolution of outstanding issues.
- WSDOT should continue its negotiations with STP on outstanding change orders and proceed promptly to respond to outstanding change orders.

Funding Sources

- All parties should work together to maximize funding sources that would reduce or eliminate the need for an increase in State funds needed to complete the Program.
- Legislative direction should be given as to acceptable amounts of traffic diversion and the priority for use of toll funds.
- Detailed analysis should be completed to determine the amount of proceeds for the Program that can be generated using the toll rates identified in the Advisory Committee on Tolling and Traffic Management (“ACTT”) report.
- WSDOT and STP should work together to maximize legitimate claims under existing insurance policies to mitigate financial impacts to the tunnel project and to the Program as a whole.
- If funding is to be extended for transit services to mitigate the impacts during construction, this funding should not come from the existing Program budget.

Program Management

- WSDOT should retain the entire current Program Management Team. Turnover in the Program leadership would be harmful to the Program, as the tunnel project continues to be in a critical phase.
- STP should also retain its entire project management team for the same reasons.

- STP should be unified across the Joint Venture in its approach to benefit the tunnel project without reference to individual company positions.
- WSDOT should consider specific policies for decision-making authority associated with the Program that take into consideration the unique size and characteristics of the Program, allowing for more efficient and timely decisions.
- WSDOT and STP should consider instituting a parallel three-tier management structure giving WSDOT and STP management similar decision-making authority and appropriate financial authorities that match their counterparts, allowing them to implement agreed upon solutions and changes.
- Executive leadership should allow incidents to be fully investigated before making judgments, drawing conclusions, or communicating hypotheses externally.

Stakeholder Relations

- Stakeholder leaders should seek to limit their own actions and discourage the actions of others that distract the Program Management Team from the tasks of managing the construction itself.
- The ERP again recommends that WSDOT and the City move expeditiously to complete a binding agreement that clarifies management and financial responsibility for the post-tunnel projects. The agreement should specify that the State's financial responsibility for these projects is limited to costs WSDOT would have incurred if it had executed the work.
- WSDOT and the City should move expeditiously to complete and implement the formal communication protocol between WSDOT and the City to avoid future misunderstandings that can arise between both WSDOT and the City's executive levels.

Risk Management

- Freer flow of information between STP and WSDOT is needed. STP should provide additional information to WSDOT to provide increased confidence in risk minimization to the tunnel portion of the design-build contract.
- STP and WSDOT should continue to engage in discussions to mitigate identified risks with special focus on the immediate risks of the TBM repair, restart, and operation.

2. INTRODUCTION

2.1 Project History/Description

The Program includes projects led by WSDOT, the City, and King County. A more detailed history of the Program is included in the ERP's February 2012, February 2013, and February 2014 reports, which are available on the WSDOT website at: <http://wsdot.wa.gov/Projects/Viaduct/Library/Reports>.

2.2 Independent Expert Review Panel Formation and Charge

The history of the ERP's formation, its charge, and detailed biographies are included in the ERP's prior reports, which are available at the WSDOT website noted above.

The composition of the ERP remains the same since its formation. The ERP is chaired by **Dr. Patricia D. Galloway**, a licensed Professional Engineer with expertise in megaprojects, transportation programs, and delivery. Dr. Galloway has 36 years of megaproject experience, including major transportation projects around the world. Additional panel members include:

- **Robert Goodfellow**, a licensed Professional Engineer who has over 20 years of tunnel and underground design and construction experience on major projects all over the world, specializing in technical and contractual management of risk; and,
- **John Rose**, who has more than 30 years of experience in public sector budgeting and financing, including prior experience as King County Budget Director and as President and CEO of Seattle-Northwest Securities Corporation.

2.3 Key Program Assumptions

One focus of the ERP was to assess the soundness of the key Program assumptions. This included an assessment of key assumptions for successful delivery of the Program by identifying any potential risks to both cost and schedule that could affect the Program's Finance Plan and an assessment of ways to maximize the opportunities for successful delivery. Specific items that the ERP reviewed included the:

- STP design-build tunnel contract and progress;
- Program Management and governance structure;
- Finance Plan; and
- Risk Management Plan ("RMP").

2.4 Process Followed by the Expert Review Panel

The ERP's work focused on the events that have occurred since the ERP's February 2014 report. The ERP also toured the Program area and the tunnel construction site to provide context to the material

reviewed and to observe actual progress underway, including construction of the repair shaft for the TBM repair.

As is appropriate with an independent review panel, the format of the work of the ERP was left up to the chair and panel members, with one exception this year. As the ERP's work should be independent, it made specific requests for Program materials, briefings, and meetings with stakeholders of the Project. All of its requests were granted, with one exception. The ERP requested an interview with the TBM manufacturer, but the meeting did not take place. In all other instances, the ERP's requests were fulfilled. The ERP met with multiple stakeholders and reviewed thousands of pages of information in response to the panel requests to gain a full perspective and understanding of the Program's status, and learn of any real or perceived threats to its successful completion.

The ERP has prepared this Independent Report of its observations, findings, and recommendations based on the information received and reviewed, the presentations made to the ERP, the interviews conducted, and the ERP's experience and expertise. The Report represents the ERP's independent view of this very complex megaprogram.

2.5 ERP Observations, Findings, and Recommendations

The ERP's Report is divided into six main sections corresponding to the ERP's charge:

- Megaproject Construction;
- The Design-Build Contract;
- The Tunnel Boring Machine;
- Program Decision-Making Process and Governance Structure;
- Program Finance Plan; and
- Risk Management during Program Implementation.

Within each section are subsections that detail the topic areas reviewed in the meetings described earlier, along with Program accomplishments, issue identification, potential challenges, and the ERP's recommendations.

3. MEGAPROJECT CONSTRUCTION

It is a reality of megaprojects that there are always multiple internal and external stakeholders, which have deep interest in the workings and outcomes of the megaproject. Coordinating requirements of all internal and external stakeholders is generally difficult and always time consuming. Often times the requirements and demands of the stakeholders will conflict or be extraneous to the actual construction delivery.

There are always planning and execution challenges on megaprojects including:

- Identifying and contracting the full scope of work;
- Estimating the full costs of the work within each project and across the entire program;
- Creating an efficient program and project management organization;
- Permitting, reporting, and interfacing challenges; and,
- Identifying and effectively managing risks.

It is important to understand how this Program differs from the State's typical construction projects. The ERP has extensive experience with megaproject construction around the globe, including tunneling projects, and believes it important to provide a framework underlying the ERP's 2015 findings, observations, and recommendations. Thus, this **Section 3** does not contain findings, observations, or recommendations, but rather provides context for the ERP's subsequent findings, observations, and recommendations specific to the Program. A sound contextual basis against which to examine and judge the decisions made and actions taken by management during the execution of a construction project can lead to more accurate assessments of the reasonableness or prudence of decisions made.

Unlike traditional projects executed by WSDOT, the AWV Program consists of multiple individual projects, which together total over \$1 billion USD, the threshold for defining a megaproject. A megaproject is generally defined within the industry as a very large-capital investment project (costing more than \$1 billion USD) that attracts a high level of public attention or political interest because of substantial direct and indirect impacts on the community, environment, and companies that undertake such projects. Since the AWV Program has numerous projects to implement, all of which must work together seamlessly upon completion of the facility, it is not just a megaproject, it is a megaprogram.

Other attributes of a megaproject include:

- execution of an engineered facility or structure which is complex or unusual;
- an extended execution schedule (greater than four years measured from initial concept development to final completion);
- multiple equipment and material suppliers;

- multiple specialty trade contractors;
- multiple project stakeholders/investors; and,
- multi-national party stakeholder involvement.

The challenges of a megaproject are orders of magnitude more challenging than those challenges of a typical construction project.

Not all megaprojects are the same. While the term megaproject is defined using the attributes listed above, each megaproject presents different challenges. Because of the size, duration, and complexity of any megaproject, establishing the context within which the management and execution of that project should be examined and judged must be individually set to reflect the factors that existed during the execution of that project.

Actual management of a megaproject is in itself more complex than the management of a typical construction project. For example, in a megaproject, there is simply not a “one-size-fits-all” or “best” methodology for allocating or contracting for the numerous different sub-scopes of work required in a megaproject. The sheer size and complexity of most megaprojects generally results in an execution methodology that involves multiple delivery methodologies and contracting approaches. Ultimately, it is not just size and duration, it is the complexity of planning and executing the full scope of work involved, that differentiates the megaproject.

The only thing anyone really knows about the future insofar as a megaproject is concerned is that there will be changes that will impact the planned execution of the megaproject and that these changes must be managed. If issues or events arise over time which impact, or have the potential to impact the execution of the project, the situation must be analyzed, options evaluated, and execution approaches changed to mitigate events or issues.

As will be discussed in the design-build contract **Section 4** below, WSDOT had the foresight to understand the differences and challenges that would face the AWV Program as a megaproject. With this foresight, WSDOT developed a design-build contracting strategy for the tunnel portion of the Program that included appropriate contracting mechanisms to deal with the type of issues that have arisen on the tunnel contract to date.

The greatest difference in how management over a megaproject differs from management over a typical construction project lies in management’s willingness to understand and accept that over the life of the megaproject, conditions will change. Management and control personnel, approaches, processes, procedures and systems must be flexible and adaptable to those changing conditions. Megaproject management must be able to adjust its focus repeatedly among a multitude of competing forces in order to maintain the greatest possible control over the project environment as it evolves. Management of a megaproject never gets the opportunity to simply sit back and say, “Everything is going according to plan,” because the plan may, and often does change. As the project environment evolves, management decisions and actions should also evolve to meet those changing conditions.

It is not possible to rigidly follow an execution plan that is set early in a megaproject for the megaproject's entire duration. All construction projects are executed within a dynamic environment. Megaprojects are confronted with an even greater range of issues requiring adjustments to a project's execution plans. The ERP has used these megaproject concepts in evaluating progress and status to date, including how the parties have reacted to changes in the Program environment as the Program moves through its execution cycle.

4. DESIGN-BUILD CONTRACT

The design-build tunnel contract is one of several under the Program and constitutes approximately 35 percent of the overall \$3.1 billion Program budget. Given the unique aspects of the tunnel contract and the first-of-a-kind nature of the TBM proposed, WSDOT and the State had the foresight to create a design-build contract that mitigates and allocates risks that typically arise during underground construction projects. The contract has been designed to address risks that are unique to this particular project, such as soil conditions, the location of the facility in a dense urban environment, and the need to tunnel under the aging Alaskan Way Viaduct.

WSDOT and the bidders spent nearly eight months discussing the needs of WSDOT and the State and the specific project requirements. WSDOT developed robust selection criteria for evaluation of the bidders prior to making its final determination to award the tunnel contract to STP. There were several aspects of STP's proposal that provide benefit to the State, including a plan that would allow an opportunity to review and test the operation of the TBM and its mining performance prior to its journey under the Viaduct and the City. In addition, STP proposed a method to protect the Viaduct by "tunneling in the box," while evaluating the TBM in the first 1500 feet of mining.

The design-build tunnel contract between WSDOT and STP is proving to have important strengths, including provisions for handling the type of issues that have arisen within the tunnel project, identifying potential risk issues, and allowing these issues to be managed within the confines of the contract. Examples include:

- The winning contract proposal included important features that have proved useful in dealing with the unexpected. In some areas, the ground is expected to be unstable because of high groundwater levels. The winning proposal included innovative mechanisms to test the TBM's ability to perform in such conditions prior to making a deep dive under the Viaduct and the City. These mechanisms include the construction of three closed boxes within the first 1500 feet of the alignment, referred to as "Safe Havens." As discussed in **Section 5** in more detail, these Safe Havens allow inspection of the machine and the cutter head of the TBM to evaluate the status and behavior of the cutting tools, allowing the tunnel contractor to make adjustments or changes necessary before resuming mining. The Safe Haven strategy is proving its worth.
- WSDOT made provisions within the design-build contract that anticipated what would happen if potential risks came to fruition during the course of the tunnel project and provided provisions that address how these risks would be managed within the confines of the contract and the

Program budget. These provisions included the use of incentives, shared contingency funds, and the use of interim and potential unilateral change orders to be issued by WSDOT to allow STP to be paid for agreed work while negotiating the specific costs. Other useful provisions describe the use of insurance coverages where necessary, and processes for resolving disputes through the DRB.

- Shared contingencies and incentives within the design-build contract are creative ways to address risks. If used as intended, shared contingencies and incentives provide mechanisms to address and resolve the types of issues that have arisen to date. Further, building mitigation strategies into the contract should alleviate some anxiety for both parties about claims – it was understood up front that there could be issues, and therefore contingencies were put into the contract to assist in addressing these issues.

In short, the design-build contract is a well thought through document, and if used as intended, should assist WSDOT and STP in finding shared solutions for complex risk issues.

5. THE TUNNEL BORING MACHINE

The most significant risk to successful completion is the function of the TBM itself. This fact has not changed since the early planning stage of the tunnel project. This will remain as the single most significant project risk until the TBM breaks through at the north end of the tunnel alignment.

TBM tunnel construction, while often presented in terms of average progress per day, is not a smooth or steady process. Full days of mining production are interrupted by maintenance activities that can take up to several hours per day. It is conventional that more significant maintenance events are planned at regular intervals. These events can result in several days or weeks of zero tunnel progress, but they are essential for smooth operation of mechanical equipment over the entirety of the project. Unplanned minor equipment breakdowns are also to be expected that would prevent the TBM from progressing for a short period. These events could occur anywhere in the excavation process, from cutter head tools being broken, to blockages in the screw conveyor, to issues with spoil disposal, or to issues with concrete segment erection. Any issue impacting the tunneling process halts the entire system.

It is normal that daily TBM tunnel progress rates would range from zero up to a distance of double (or more) the planned average rate of progress. For illustrative purposes only, for planned average progress of 40 feet per day, the TBM might be expected to progress anywhere from 0-80 feet in any given day.

The Program is using the largest TBM in the world. The TBM manufacturer, HITZ, is an experienced TBM manufacturer, having manufactured over 1,000 TBMs for use in tunnel construction worldwide. The Joint Venture partners of STP are also highly experienced in large, complex, and highly sensitive urban tunnel projects in major cities around the world. The participants' experience was an important part of the selection process for the STP team.

STP and HITZ, recognizing the many start-up risks associated with a large diameter TBM, created a specialized tunneling approach that comprised of starting the TBM, located at the south end of the

project, in a “box.” This allowed early TBM operation to take place in a controlled environment, giving designers and operators the opportunity to learn how their one-of-a-kind TBM would function, and allowing operational issues to be mitigated. The worthiness of this strategy has been proved since the TBM stoppage caused minimal impact to the Viaduct, even though construction is very close by.

It is rarely acknowledged that the WSDOT risk management planning process (CEVP) undertaken by WSDOT before commencement of the contract recognized risks that have manifested on the tunnel project, including a potential TBM bearing and seal failure. While these risks were considered unlikely, it was understood that they would have high consequences if they occurred. Risk events of such low probability and high consequence are addressed by use of contingency planning and other strategies, including the purchase of insurance. These considerations were incorporated by WSDOT in the design-build contract. In the case of a failed bearing risk, the risk mitigation strategy was to have a spare main bearing available; in addition, WSDOT included a requirement for project insurance with specific policy provisions which may apply to the rare and unfortunate occurrences of the type that have recently occurred.

The TBM stopped on December 6, 2013. STP and the TBM manufacturer have spent the time necessary since then to investigate the reasons for the stoppage. The reasons will not be completely verified until the cutter head and the main drive of the TBM are removed, allowing additional internal investigations to be completed. The causes of the stoppage are the subject of an on-going legal and commercial discussion between STP and WSDOT.

Over the past year, STP has constructed a repair shaft where the TBM is being accessed for repair. The repair shaft excavation was completed on January 30, 2015; the TBM support cradle completed on February 8, 2015; dewatering drains installed under the TBM completed on February 17, 2015; and the TBM resumed mining on February 17, 2015, entering the repair shaft on February 19, 2015 and moving into final position to commence repair on March 3, 2015. The cutter head was removed on March 31, 2015 and repair works are currently underway. The current stoppage of the TBM is unusually long due to the magnitude of the needed repair and associated investigation as well as constructing in an urban area with geotechnical challenges.

In looking at the TBM, it is beneficial to consider that several TBM components have not just been subject to repair, but have in fact been redesigned. Below, the ERP has commented on the redesign and Repair Plan from two aspects, including:

- HITZ and STP redesign and Repair Plan; and
- WSDOT response and monitoring.

5.1 HITZ and STP Redesign and Repair Plan

The redesign and Repair Plan has been outlined publicly and remains in general terms similar to that appearing in several locations, notably in an STP video presentation that can be seen at the link below:

<https://www.youtube.com/watch?v=mfdITDpt6nI&feature=youtu.be>

The ERP has based its findings and observations solely on the ERP's review of the TBM Repair Plan, discussions with both WSDOT and STP personnel involved in the TBM repair activities to date, and information provided by STP to WSDOT as the ERP was not able to meet with HITZ as noted previously.

As the reasons for the failure are the subject of on-going legal and commercial discussions between STP and WSDOT with full verification pending, they have not been disclosed to WSDOT or to the ERP. Based on its review of the Repair Plan, discussions with both WSDOT and STP personnel, and information provided by STP to WSDOT, the ERP finds the Repair Plan appears to be viable and presumably reflects STP's current knowledge based upon STP's internal investigation of the breakdown. It should be acknowledged that the redesign and Repair Plan may change depending on what is discovered upon examination of the TBM. Confidence in the redesign and Repair Plan would be enhanced with further, and increasingly open, discussions between WSDOT, STP, and HITZ and the provision of additional information requested by WSDOT from STP.

5.2 WSDOT Response and Monitoring

WSDOT has retained a highly experienced and skilled team of consultants to review and monitor repairs to the TBM. This team is focused only on the repair and re-launch of the TBM. The team meets with STP regularly to discuss the risks and contractual requirements of the redesigned TBM.

WSDOT experts have met with STP personnel and have discussed potential improvements to the redesign and Repair Plan. WSDOT's Program Management Team has not directed the tunnel contractor to carry out any aspect of the work. The ERP finds this to be a typical and appropriate approach under design-build contracting, as to do otherwise would create the potential for claims from the contractor.

STP has used the opportunity provided by the TBM stoppage to apply some lessons learned while mining the initial reach of the tunnel. These lessons contributed to decisions to increase the stiffness of the TBM, change the configuration of the cutter head, potentially change the type of screw conveyor, and modify the allowable ranges of operational parameters during mining. Under the current plan, STP will implement improvements and redesign the TBM to address these and other noted areas of potential improvement.

STP and WSDOT experts have worked collectively (without direction from WSDOT) to share information regarding how to improve the future function of the TBM. It appears that many of WSDOT's comments have been considered in the redesign and Repair Plan.

Recommendations

- The ERP recommends that safety and the return of the TBM to operation should be everyone's primary objectives.
- STP and its TBM manufacturer should consider enhancing its Repair Plan as the investigation continues to include comments from all parties, allowing for minimized risks and an enhanced probability of successfully completing mining operations.

- Though WSDOT should not direct STP's actions, WSDOT and STP should spend time discussing risk mitigation and contingency plans that will create confidence within the project teams that the TBM will perform effectively on the project.
- STP, HITZ, and WSDOT should consider conducting a workshop in the near term so that any remaining questions and comments on the redesign and Repair Plan can be answered by STP and HITZ. Such a workshop could create increased confidence or WSDOT in the future performance of the TBM.

6. PROGRAM DECISION-MAKING PROCESS AND GOVERNANCE STRUCTURE

A functional and effective program management structure and efficient decision-making protocols are essential elements of successful public megaprograms. While the current focus and a key component of the Program is the deep-bored tunnel, the related issues associated with this Program, which involves multiple stakeholders, are exceptionally complex. These issues require careful and deliberate coordination so that the diverse needs and objectives of all the associated stakeholders are understood and met as appropriate.

As summarized by Bob Prieto, author of the Chapter "Program Management" within the book *Managing Gigaprojects-From Those That Have Been There Done That* (2012 ASCE Press), well executed megaprograms feature strong governance frameworks that build on the following key factors for success:

- Strong and decisive leadership by senior management, supported by clear and appropriate allocation of responsibility and authority without ambiguity;
- Early, consistent and direct involvement of frontline staff with appropriate feedback mechanisms to encourage, collect, and analyze criticism without fear of retribution;
- Leadership by example and strong "sponsorship" by the executives are essential to programmatic success;
- Team building and alignment processes;
- Governance structure must provide the program manager with the ability to act in parallel versus sequentially within an accelerated change time horizon;
- Owner organization must transition to an outcomes-based management style versus more traditional input control management styles;
- Appropriate resourcing of the program management role with sufficient flexibility to migrate the organization structure and skills mix as the program evolves; and

- Program management’s need for a more robust structure and control is understood in light of the larger impact their failure can have.

In light of these factors, the ERP has made the following observations regarding Program decision-making and governance structures as they relate to management of the tunnel design-build contract and relationships with key stakeholders such as the City:

- The Program would benefit from a regular forum for City and State political leaders to meet and discuss the Program that could contribute to better communication and understanding.
- The current management decision-making and authority levels between WSDOT and STP are not reflective of approaches and levels of authority typically seen in megaproject construction. Tiered decision-making is the norm, and if applied here would allow the tunnel project to proceed more efficiently and effectively. The aligned authority levels should be established and utilized by both WSDOT and STP.
- Communication protocols between WSDOT and the City are not clearly identified as would be expected at this point during a megaproject of this size and this level of complex stakeholder involvement. Clear protocols would minimize miscommunication, and as a result improve the efficiency and effectiveness of the decision-making process.

The ERP’s findings and recommendations relative to these observations are discussed below.

6.1 Managing Relations with Program Stakeholders

Stakeholders in the Program include the State, WSDOT, FHWA, the City, King County, and the Port. The ERP has observed that, consistent with the attributes of good program management as identified earlier, each of these stakeholders recognize the need to work collaboratively to deliver a successful project.

6.2 Managing Written Agreements with Project Stakeholders

Successful program management includes management of the multiple agreements entered into with various stakeholders. WSDOT has entered into agreements with the City, Port, King County, utilities, and others that address policies, procedures, schedules, funding commitments, and other topics.

Over the past year, the WSDOT Program leadership has spent a significant amount of time working with the City to finalize their agreement relative to the post-tunnel construction projects. The Program Management Team’s relations and communication with the City are complicated as leadership positions on both sides have changed personnel, and because the Program Management Team must work with the multiple layers and interested parties that comprise City government. Program leaders have active relations with the Mayor and his office, with City Council members, and with Departments including the Department of Transportation, the Department of Public Utilities, Seattle City Light, and others.

The ERP recommended in its February 2012 and February 2013 reports that WSDOT finalize its agreement with the Port to secure funding for the Program and to define the roles and responsibilities of WSDOT and the Port. This agreement was finalized on August 27, 2013, and defines expectations between the Parties and provides certainty to a major funding source for the Project.

WSDOT and the City continue to engage in activity that will form the basis for the formal agreement between WSDOT and the City regarding the post-tunnel projects. There remains an urgent need for a formal agreement regarding their respective expectations, roles and responsibilities as well as an agreed methodology for how post-tunnel projects will be funded. The ERP finds this agreement to be of critical importance to the State because:

- (a) the public may not differentiate between the City versus the State in executing this work, potentially affecting the public's view of the State's performance at the completion of its Program,
- (b) the successful completion of both the State's and the City's projects depend on both projects' timely completion, and,
- (c) the Waterfront Redevelopment project and the Seawall Replacement project are viewed by many in the public as being part of the AWV Program regardless of the fact that they are separate projects with separate funding sources.

WSDOT and City staff have indicated that the funding agreement discussed above will be completed by the end of 2015, and apportionment of costs will be determined through a CEVP workshop process to begin in April. Currently, WSDOT and the City are finalizing the scope of work anticipated for the Alaskan Way surface street and affiliated facilities that will be the subject of the CEVP workshop and report. It is anticipated that the cost report, which is the foundation of the funding agreement, will be available in draft form in June 2015, and will be finalized in August. Negotiations on the agreement will overlap with this work. As is discussed in more detail in **Section 7**, without an agreement between WSDOT and the City, post-tunnel projects risk lack of available funding for completion.

Recommendation

- The ERP again recommends that WSDOT and the City move expeditiously to complete a binding agreement that clarifies management and financial responsibility for the post-tunnel projects. The agreement should specify that the State's financial responsibility for these projects is limited to costs WSDOT would have incurred if it had executed the work.

6.3 Program Management

6.3.1 Management of the Tunnel Contract

WSDOT made the decision to execute the tunnel project using a design-build contract delivery approach. This was an appropriate decision given the features of the tunnel project as discussed in **Section 4** of this Report.

Several factors continue to strain the relationship between STP and WSDOT leadership. Irritations *perceived* by both WSDOT and STP include a perceived slowness in responding to issues by both parties, a quickness to make issues public by both parties, and a tendency to assign blame rather than to work together to solve problems. The ERP also perceives differences between the members of the Joint Venture partnership that appear to be straining the relationship with WSDOT as well as within STP.

Perceptions notwithstanding, the ERP has actually observed significant progress in the working relationship between WSDOT and STP since its 2014 report. An important example was the parties' quick work to resolve the DBE issues noted in the February 2014 report. The FHWA now cites the AWW Program as exemplary for the use of DBE firms on federally funded projects.

Many of the positive advancements made over the past year are attributable to the WSDOT Program Management Team and its improved working relationship of the STP Joint Venture. Together, the two project teams have been instrumental in moving the tunnel project forward amidst challenging risks.

Megaprojects typically have a multi-tier decision-making approach. Lower level managers are assigned higher authorities for spending and management matters than would be seen on a typical project, and such authorities increase at higher levels of management. This authority structure allows managers to make more effective and timely changes when needed. In addition, this type of structure creates needed autonomy for the project decision-making, and has the added significant benefit of keeping political issues at bay as much as possible.

The ERP finds that both WSDOT and STP have retained qualified personnel to execute the work. Relations between STP and WSDOT at the working project level are good, and the ERP recognizes ongoing efforts from both parties to maintain good project communication while the parties engage in difficult negotiations over legal and commercial matters. Although the project level teams are working well together, each lacks the necessary approval authorities needed to effectively manage the day-to-day operations of the tunnel contract. On typical megaprojects, this level of authority would be between \$1 million and \$3 million. If an issue cannot be resolved at the project level, it would be pushed upwards to the next level, in this case, the Program Administrator and his STP counterparts. Typically at this level, their authority would be somewhere between \$5 million and \$10 million. If resolution is not reached at this level within the megaproject, resolution is pushed upwards again to the executive level, or in this case, with the WSDOT State Construction Engineer and the STP Project Executives. This level of authority would typically be able to resolve any differences within the confines of the contract and the Program Budget. For larger multi-issue resolution, requirements for detailed justification should be modified to require less detail. If issues cannot be resolved at these levels, ultimate decision-makers at each entity would include the Secretary of Transportation, the Governor and Legislature, and the respective CEOs and/or Boards of Directors of Dragados USA and Tutor Perini Corporation.

The DRB process has not been effective as envisioned by either STP or WSDOT in settlement of disputes to date due to both parties' reluctance to acknowledge the decisions made in the process. The reluctance appears to be primarily related to disputed issues that may have legal context not

conventionally addressed by DRB boards. If both parties do not see the DRB as a helpful tool in issue resolution, other remedies should be considered.

Despite the issues the ERP observes in WSDOT and STP resolving the commercial and legal issues, the ERP has observed that WSDOT and STP are taking proactive measures to resolve current change order requests within the confines of the design-build contract and the overall Program budget. While these negotiations are still underway, the ERP believes that more timely and effective resolution could be obtained by establishing a tiered level of decision-making authority more closely aligned with best practices for megaproject construction.

Achievement of a timely resolution by WSDOT and STP of the outstanding legal and commercial issues may be beneficial to maintaining a positive working relationship. Very recent focus by both WSDOT and STP in this area appears to be making positive progress in resolving issues.

The ERP notes that successful negotiations increase the number of issues that are resolved by persons with active knowledge of the project, and reduces the number of issues to be resolved by third parties (i.e. an arbitrator or a jury) who do not have such knowledge.

Recommendations

- WSDOT should retain the entire current Program Management Team. Turnover in the Program leadership would be harmful to the Program, as the tunnel continues to be in a critical phase.
- STP should also retain their entire project management team, for the same reasons.
- STP should be unified across the Joint Venture in its approach to benefit the tunnel project without reference to the individual company positions.
- WSDOT should consider revising its policies regarding megaprojects and managers' decision-making and spending authority and justification requirements.
- WSDOT should consider specific policies for decision-making authority associated with the Program that take into consideration the unique size and characteristics of the Program, allowing for more efficient and timely decisions.
- WSDOT and STP should consider instituting a parallel three-tier management structure giving WSDOT and STP management similar decision-making authority and appropriate financial authorities that match their counterparts, allowing them to implement agreed upon solutions and changes.
- Executive leadership should allow incidents to be fully investigated before making judgments, drawing conclusions, or communicating hypotheses externally.
- WSDOT and STP should continue to utilize the mechanisms and options established within the design-build contract and continue their current negotiation efforts to resolve all current legal

and commercial issues. Timely resolution of issues may reduce future risk exposure and increase future collaboration between the parties.

6.3.2 Overall Program Management

As discussed throughout this Report, over the past year, the WSDOT Program Management Team has met with multiple challenges including the TBM stoppage and restart efforts, ground settlement issues, communication issues with the City, and the resolution of outstanding STP pending change order requests and claims brought to the DRB. These challenges have resulted in external stakeholder pressures that have consumed a significant portion of the senior Program Management Team, constraining the team's ability to manage the Program effectively and efficiently. In recognition of the need to address external stakeholder needs and to improve communication between stakeholders and the public, the Program Management Team has instituted additional organizational restructuring measures that will provide additional assistance to the Program and Deputy Program Administrators, allowing them to focus more of their time to more efficiently and effectively execute the Program Management. Organization changes were recently announced, however the ERP cannot yet assess the success of the implementation of these changes on the Program.

Recommendation

- Stakeholder leaders should seek to limit their own actions and discourage the actions of others that distract the Program Management Team from the tasks of managing the construction itself.

6.3.3 Communication with Major Stakeholders

The ERP previously cautioned that changes in leadership with Program Stakeholders could result in the loss of institutional knowledge and create the risk of miscommunication, especially if special efforts were not made to keep new leaders up to speed. This risk has manifested itself this past year with respect to the understanding of ground settlement within the areas around WSDOT and the City's projects and the apparent lack of understanding between the parties about what communication channels were to be taken to obtain and convey information.

Communications between WSDOT and the City have improved over the past months and steps are being taken jointly to develop formal communication protocols. The ERP is advised that such protocols are to be finalized in the coming weeks, with review and approvals of those protocols to be jointly undertaken by the Deputy Mayor and the Secretary of Transportation. The ERP believes that such formal communication protocols will be helpful in allowing WSDOT and the City to timely share information and respond to questions as they arise.

Recommendation

- WSDOT and the City should move expeditiously to complete and implement the formal communication protocol between WSDOT and the City to avoid future misunderstandings that can arise between both WSDOT and the City's executive levels.

7. PROGRAM FINANCE PLAN

The ERP's 2015 update includes a review of current cost estimates, identified funding sources, and the State's relationship to projects where the City or King County have responsibilities that may affect the State's Finance Plan.

The ERP finds that with assertive leadership, and based on the information available to the ERP today, it appears that the Program can be successfully completed with no additional State or local funds beyond those already contained in the \$3.1 billion budget if:

- WSDOT succeeds in minimizing its responsibility for cost increases incurred by the tunnel contractor;
- WSDOT continues to successfully keep the scope of the Program from increasing; and
- Actions are successful in securing sources of funds that can be resources for the Program.

The following sections provide recommendations for controlling costs and securing sources of funds.

7.1 FHWA Approval

The ERP reviewed the Program's Finance Plan and the Financial Plan provided to the FHWA as part of the initial approval process for the Program.

FHWA approved the State's 2014 Finance Plan Annual Update via letter dated November 3, 2014. The letter made note of a \$4 million increase in the Program's estimated expenses and the significant changes in the schedule related to the TBM stoppage.

The plan however does not tell the complete financial story, and as such is not of extensive value to the Legislature. For example:

- The information is not up to date. For example, the FHWA report notes an expectation that TBM mining will resume in March 2015, but this is not the case.
- The FHWA certification does not fully recognize the remaining challenges of obtaining construction funds from tolling.
- The FHWA certification does not cover projects not included in the Final Environmental Impact Statement for the Program. Importantly, this does not include the replacement and realignment of the Alaskan Way surface street, a project whose cost will be an important determinant of the Program's ability to stay within budget.

7.2 Program Costs

Projected Program costs as provided by WSDOT are shown below in **Table 7.2-1**:

Table 7.2-1
Estimated Alaskan Way Viaduct Replacement Program Costs
 (Year of Expenditure, Rounded to Millions of Dollars)

Project	2015 Revised Amount ⁽¹⁾	2014 Revised Amount ⁽²⁾	2013 Estimate ⁽³⁾	2011 Estimate ⁽⁴⁾
Moving Forward	687.9	691.3	698.0	745.7
Central Waterfront	2053.2	2,059.1	2,052.0	2,010.7
Bored Tunnel	1617.4	1,630.3	1,650.6	1,656.3
North and South Access	109.2	111.6	103.8	121.7
ROW Acquisition	182.2	182.2	161.9	126.9
Preliminary Engineering	135.1	134.9	135.7	105.7
Other Components	321.3	319.7	320.0	320.0
Surface Street Restoration	291.7	290.0	290.0	290.0
Construction Mitigation	29.7	29.7	30.0	30.0
Program Management	75.0	75.0	75.0	75.0
Total	\$3,137.4	\$3,145.0	\$3,145.0	\$3,151.4

(1) Source: WSDOT, taken from AWV Program 15-17 Biennium Budget Submittal

(2) Source: AWV Program 2014 Supplemental Budget Submittal to Washington State Legislature

(3) Source: WSDOT 2013-15 Budget submittal

(4) Source: Initial 2011 Financial Plan, Figure 4

The ERP's 2014 Report concluded that, "the revised cost estimate of \$3,145,000,000 remains valid based on the information known as of the date of this Report." This conclusion is unchanged, in part because completed and current contracts outside of the tunnel project have consistently been within budget as shown below in **Table 7.2-2**.

Table 7.2-2
Major Non-Tunnel Contracts
Original vs. Current Budget ⁽¹⁾

Contract Title	Original Contract Budget	% Complete	Current Budget	Current as % of Original
Electrical Line Relocation	21,763,723	100%	20,685,932	95%
Holgate Stage 1	19,733,756	100%	13,146,417	67%
Other H2K	359,279,924	99%	151,460,847	42%
H2K Stage 3	41,945,129	99%	37,813,762	90%

Contract Title	Original Contract Budget	% Complete	Current Budget	Current as % of Original
North Access Connection	58,091,590	54%	55,992,214	96%
South Access Drilled Shafts	1,590,554	99%	2,063,166	130%

(1) Source: WSDOT March 2015

Future contracts pose less risk to the budget. Their size is smaller than the earlier contracts, and engineers' estimates are supported by past success in achieving contracts within estimates. Potential variances from engineers' estimates are within an expected range at this stage of the Program as shown below in **Table 7.2-3**.

Table 7.2-3
Remaining AWW Contracts⁽¹⁾
Assumes November 2016 Opening

Contract Title	Design Status	Projected Ad Date	Budget Request to 2015 Legislature	Budget Request to 2014 Legislature
South Access	96%	April 2015	47,392,082	51,730,082
North Surface	0%	May 2017	9,514,059	9,514,059
Battery Street Tunnel Decommission/Viaduct Demolition	15%	April 2016	91,338,551	90,000,000

(1) Source: WSDOT January 2015

7.3 Costs Related to the Tunnel Boring Machine

The ERP's 2014 report noted that *"The final resolution of the cost impacts of the TBM stoppage will depend on many things and may well be resolved through formal dispute resolution procedures."* This statement is still accurate. In the meantime, for the purposes of this Report, the ERP believes it would be useful to attempt to provide more specificity as to the potential costs facing the parties under the tunnel design-build contract.

The ERP's findings on the TBM stoppage are described in **Section 5** of this Report. The ERP's findings on the likely financial impacts of the stoppage include the following:

- The TBM stoppage has led to increased costs for the tunnel contractor. Sources of the increases include:
 - Unanticipated costs for repair of the TBM;
 - Costs related to the extended schedule for completion of the tunnel; and

- WSDOT payments are reduced during the stoppage, while the tunnel contractor’s expenses continue.
- It is likely that the tunnel contractor will seek compensation for increased costs from multiple sources including:
 - Through WSDOT’s contractual provisions, including the mitigation funding pool that was identified in the contract for these types of issues; and
 - Through contractually required insurance, which is currently in place to assist with such potential issues.
- What portion of those costs will be borne by WSDOT will be determined by dispute resolution processes described in the design-build contract, by negotiations, and/or through litigation.

The ERP is not able to predict the outcome of these processes or negotiations. However, the ERP notes that mechanisms exist within the design-build contract to assist both STP and WSDOT in resolving each parties’ positions relative to cost entitlement. The ERP also recognizes that based on its experience in resolving complex issues on megaprojects such that have arisen on the tunnel project, each party bears risk as to the ultimate responsibility if resolution does not occur until the conclusion of the project. This risk is due to differences being determined by others who will have no personal knowledge of the project facts or the personnel who actually were involved in the project. In that context, the ERP has provided its understanding of the current view of “worst case” potential costs (**Table 7.3-1** below) as well as a summary of potential sources available to pay for such costs (**Table 7.4-3** below).

The ERP’s description of potential cost increases is based on:

- Actual change orders presented to date not yet approved;
- Estimates of future change orders, known but not yet presented by STP to WSDOT to date; and
- Estimates of future WSDOT administrative costs related to the Program’s extended schedule.

The ERP asked STP to provide estimates of these sources of potential cost increases. It is not within the ERP’s scope to evaluate whether STP is entitled to the full value of the change orders.

Table 7.3-1 below is the ERP’s best effort to identify worst-case change order costs based on work performed to date. The ERP makes no effort to predict actual costs that might result from required contract processes or negotiations. The ERP’s experience is that awards of contractors claims are often *substantially less* than the sums requested by contractors. Change order amounts are those requested by the contractor and *do not* reflect WSDOT’s evaluation or determination nor the ERP’s expectations of final amounts. The ERP provides this information to inform the Legislature and Governor that based on costs known as of the date of this Report the Program can still be completed without additional State or local funds.

Table 7.3-1

Potential Tunnel Related Cost Increases (\$ in millions)

Potential Costs	Estimate
Submitted Change Orders ⁽¹⁾	\$207.5
Future Known Change Orders ⁽²⁾	85.0
WSDOT Admin Costs due to Schedule Change ⁽³⁾	25.0
Total Estimated Worst Case Costs Known to Date	\$317.5

(1) Source: WSDOT and STP, January 2015

(2) Source: STP, January 2015

(3) Source: WSDOT, January 2015

Recommendations

- STP should proceed promptly in submitting complete change orders and claim documentation, including financial information that would facilitate the resolution of outstanding issues.
- WSDOT should continue its negotiations with STP on outstanding change orders and proceed promptly to respond to outstanding change orders.

7.4 Funding Sources

There are several sources of funds that could be made available to cover additional costs. These sources all require decisive action. They cannot be counted on in advance of such actions, but they are useful to enumerate and prepare for in a timely manner.

7.4.1 Existing Project Contingency Funds

Substantial sums remain unspent in the Program’s Contingency Funds.

There are three Contingency Funds established in the Program that may provide funds available to cover additional costs. These Funds are described in **Table 7.4-1**.

**Table 7.4-1
Available Program Contingency Funds (\$ in millions) ⁽¹⁾**

Name	Original Amount	Current Balance
Schedule Incentive	\$25.0	\$25.0
Differing Site Condition (“DSC”) and Unanticipated Intervention Risk	40.0	40.0
Unallocated Program Wide Contingency	100.3	59.2
Total Available	\$165.3	\$124.2

(1) Source: WSDOT January 2015

In the event that the DSC is only partially spent, the design-build contract specifies that the unspent balance is to be split, 75% to STP and 25% to WSDOT. Currently, these funds are unspent and available. In addition, there is \$20,000,000 set aside and currently unspent in in the Deformation Mitigation and

Repair Fund (“DMR”). However, these funds are set aside to address any building issues that may arise when the TBM passes under buildings. The DMR is therefore not viewed by the ERP as available for any current known cost increases.

Another contingency fund outside of the tunnel contract is the “Program Wide Unallocated Contingency” as shown below in **Table 7.4-2**. The most recent accounting of that fund reflects the result of several uses of the fund to pay for unexpected events, as well as several additions to the fund as risks are retired and contracts completed.

Table 7.4-2
Program-Wide Unallocated Contingency Fund (\$ in million) ⁽¹⁾

Beginning Balance	\$100.3
Transfers through January 2015	
Transfers In	51.8
Transfers Out	(92.9)
Current Balance	\$59.2

(1) Source: WSDOT January 2015

The ERP notes that the continued availability of funds in the unallocated contingency is a result in part of WSDOT’s success in retiring unrealized risks, constantly completing Program projects under budget, and avoiding “scope creep,” consistent with the ERP’s 2014 recommendation:

“Project contingency funds should be vigorously protected. Project scope should not be expanded at this time, and Project savings or unanticipated revenue should be retained in the contingency fund. Contingency funds will be adequate only if scope discipline is maintained.”

Success in avoiding scope creep was assisted by the Legislature’s action to include language in the 2013-15 budget providing that new costs for transit mitigation not be paid out of the AWV Replacement Program appropriation.

Recommendations

- The ERP again recommends that Program contingency funds be protected. Program scope should not be expanded.
- Any unanticipated savings from future of completed projects should be returned to the Program contingency fund.

7.4.2 Potential Savings from Post-Tunnel Projects

The ERP's 2013 and 2014 reports recommended that WSDOT and the City complete a written binding agreement regarding their roles, responsibilities and the scope for the projects that follow the completion of the deep-bored tunnel, including the:

- Alaskan Way surface street relocation;
- Western/Elliott connection;
- Viaduct removal;
- Battery Street Tunnel decommissioning; and
- Marion Street pedestrian overpass.

As discussed in **Section 6** above, as of this date there is still no written agreement between WSDOT and the City. Without an agreement between WSDOT and the City, post-tunnel projects are at risk, as they may lack the funding necessary for completion.

Specifically important to **Section 7**, there is no agreement on the expected costs of the State's obligation for these projects, although, as was the case this time last year, both WSDOT and SDOT report that the estimating process is underway for the Alaskan Way surface street replacement and is now to be completed by June 2015.

The outcome of these negotiations is of considerable importance because of their potential impact on a Program budget that may be strained.

The Program's initial and current budget includes up to \$290,000,000 for these post-tunnel projects.

WSDOT Program leadership continues to believe that the post-tunnel projects can be completed for substantially less than this amount. While a new cost estimating process is currently underway, the ERP has received no additional information that would change from what was reported to the ERP in its 2014 review. Therefore, those potential savings remain unchanged from the ERP's 2014 Report, which was at that time estimated to be as high as \$70,000,000. The ERP notes that City officials anticipate there may be no savings over the current \$290,000,000 budget.

The ERP is advised that WSDOT and the City have agreed that WSDOT will be responsible for management of the Viaduct's demolition and the decommissioning of the Battery Street Tunnel, while the City will be responsible for construction of the new Alaskan Way surface street.

The CEVP process being used to estimate the cost for the Alaskan Way surface roadway is a methodology commonly used by WSDOT, though the process in this case is being run by the City with participation from WSDOT staff. The cost estimating will be based on the City's design, but WSDOT has reasonably required that a related analysis provide the estimate of costs that would be required where the designed facility would be limited to State standards. This second analysis has the effect of

preventing the State from paying for “betterments.” An important part of this cost estimating methodology is the decision to base the estimate at the 60% probability level, the risk probability level used by WSDOT in its CEVP process.

The potential for savings related to the Alaskan Way surface roadway project may be an important source of reserves for WSDOT to use in dealing with increased costs to the tunnel portion of the overall Program.

7.4.3 Tolling

There has been little progress in the last year toward securing toll revenues for the Program. WSDOT’s request to the Legislature for bond authorization is now delayed until 2016. The Program’s delayed construction schedule allows for this, as proceeds from tolling are not needed until the tunnel is complete. Officials report that when bonding authority is requested in 2016, the request will seek the issuance of General Obligation bonds (and not toll revenue or Motor Vehicle Fuel Tax bonds). That decision is consistent with the recommendation in the ERP’s 2014 report.

As noted in the ERP’s 2014 report, it would be useful to build on the findings of the 2014 ACTT report by giving Legislative direction as to acceptable amounts of traffic diversion and the priority for use of toll funds. Such direction could potentially increase the amount of toll funds available for the Program’s capital budget without increasing the toll rates identified by the ACTT.

The ERP’s 2014 report also noted that further analysis of bond structures is needed to determine the amount of capital funds that can be generated from tolling. The ACTT’s report found that an acceptable toll strategy will produce \$200,000,000 for the tunnel’s construction budget. However, that finding is not based on a specific analysis of how toll revenues translate to bond proceeds. There was no assumption made about interest rates or about the structure of the bonds that would produce the \$200,000,000. The State has optional bond structures available to it that significantly affect how much capital can be produced from a given revenue stream.

Delayed decision making on tolling matters creates the risk that future decision makers may have reduced willingness to authorize tolling for the Program. Absent tolling, current funding sources are not sufficient to complete the post-tunnel projects, the most costly of which is the construction of the new Alaskan Way surface street.

Recommendations

- Legislative direction should be given as to acceptable amounts of traffic diversion and the priority for use of toll funds.
- Detailed analysis should be completed to determine the amount of proceeds for the Program that can be generated using the toll rates identified in the ACTT report.

7.4.4 Liquidated Damages

The design-build contract provides for STP's payment to the State of liquidated damages in the amount of \$50,000 per day for each day beyond the contract Substantial Completion Date (currently January 17, 2016), and this amount increases to \$100,000 per day for each day beyond the contract performance period (currently November 9, 2016). As of the date of this Report, WSDOT has extended the Substantial Completion Date by 15 days, to January 17, 2016. These dates may change through change orders or negotiations, but without such changes, WSDOT estimates the potential amount of liquidated damages to be \$50,450,000.

7.4.5 Insurance

The ERP is advised that STP has initiated claims under a Builders Risk and Contractors Plant and Equipment insurance policy held by AON. The policy names both STP and WSDOT as named insureds. Section 2 of the policy documentation explicitly provides that it *"indemnifies the insured parties in respect of damage to the Tunnel Boring Machine."* The policy includes a limit of \$85,000,000 for Contractors Plant and Equipment, with a \$1,000,000 deductible per occurrence. Should such claims be made and found valid, the insurance payments would be a source for covering STP's increased costs. The ERP has no ability to predict or quantify the result of such claims.

Recommendation

- WSDOT and STP should work together to maximize legitimate claims under existing insurance policies to mitigate financial impacts to the tunnel project and to the Program as a whole.

7.4.6 Summary of Potential Cost Impacts

The ERP has summarized its findings in **Table 7.4-3** below regarding potential worse case additional costs known to date along with possible available sources to illustrate that based on what is known as of the date of this Report, no additional State or local funds would be required to complete the Program within the \$3.1B Budget. The ERP emphasizes that none of these sources are assured, and they all require assertive action. The ERP also emphasizes actual costs may be substantially less than the numbers shown.

**Table 7.4-3
Potential Costs and Potential Sources of Funds (\$ in millions)**

Potential Sources	Amount	Potential Costs (Worst Case Known To Date)	Amount
Post-Tunnel Savings	\$70.0	Submitted Change Orders	\$207.5
Contingency Funds	124.2	Future Known Change Orders	85.0
Liquidated Damages ⁽¹⁾	50.4	WSDOT Admin. Costs	25.0
Insurance (TBM)	85.0		
Total Potential Sources of Funds	\$329.6	Total Potential Worst Case Costs To Date	\$317.5

(1) This number is based on STP requesting time extensions from contract dates (Substantial Completion Date) and assuming no State liability for the extension and no additional excusable delay extension. In the contract, liquidated damages for delay of the Substantial Completion Date are capped at \$58.1 million.

Recommendation:

- All parties should work together to maximize funding sources that would reduce or eliminate the need for increase in State funds needed to complete the Program.

7.4.7 Transit Funding

There continue to be actual and potential adverse impacts to public transit resulting from the AWW Program.

There are two current agreements totaling \$8,267,000 between WSDOT and King County Metro for transit mitigation during construction. They cover the period of July 1, 2014 through June 30, 2015.

The Legislature's 2014 budget proviso language required that WSDOT not use AWW Program funds for transit mitigation. The funds for the agreements were transferred as part of an allocation adjustment for projects funded by the Nickel and Transportation Partnership Act ("TPA") packages.

The Legislature is currently considering a \$17 million budget request that would fund continuation of the AWW Program construction traffic transit mitigation activities for the next biennium (July 1, 2015 through June 30, 2017). No funds have been identified should the Legislature choose not to fulfill this budget request or if the Program's construction impacts extend beyond June 30, 2017.

Recommendation

- If funding is to be extended for transit services to mitigate the impacts during construction, this funding should not come from the existing Program budget.

8. RISK MANAGEMENT DURING PROGRAM IMPLEMENTATION

Risk is defined as the result of an uncertain event or condition that, if it occurs, has a consequence (the consequence can be negative or positive; positive outcomes are usually called “opportunities”). Risk is quantified as the combination of the probability of an event and the resulting consequence.

The ERP finds that the WSDOT Program Management Team is abiding by the established RMP for the Program and that this RMP is in conformance with or exceeds industry standards for risk management.

In reviewing and updating the ERP’s opinion on the sufficiency of the risk management processes for the Program, the tunnel design-build contract was used as a primary example of how risk will be managed because the potential exposure to risk is highest within this specific component. Three aspects of management of risk were examined for this update:

1. Review of the risk management tools used;
2. The RMP content for both WSDOT and STP; and
3. The execution of those plans to this point of the Program.

In the discussion below, the ERP provides its observations and findings, followed by conclusions and, where appropriate, recommendations for consideration.

8.1 Review of Contractual Cost and Risk Management Tools

As previously discussed in the ERP’s February 2012 report, WSDOT has one of the best risk management programs of any state for major infrastructure projects. The planning, design, bidding, and risk allocation processes are proven and successful in delivering major projects within the planned budget and schedule. As the Program uses the WSDOT processes, the ERP finds that the Program risk management processes are adequate to manage this megaprogram successfully.

Additional detail on the risk management tools employed by the Program Management Team is included in the ERP’s February 2012 report.

8.2 Execution of the Risk Management Plan

The International Tunnel Insurance Group (“ITIG”) published a Code of Practice for Risk Management of Tunnel Projects (the “Code”) in 2006. The Code has become the industry standard for risk management and is referenced in the design-build tunnel contract. WSDOT is adhering to the principles of this Code; and given the magnitude and urban location of the tunnel project, the ERP finds this to be prudent. In accordance with the Code, both WSDOT and STP have established a RMP for the tunnel portion of the Program that has been issued and revised periodically since the beginning of construction. The RMP has not been updated since the last review and the reader is referred to previous reports for details on implementation of the RMP.

The overall risk exposure during execution of the Program is divided into three areas:

- Program risk;
- Cost risk; and
- Schedule risk.

Each of these areas are discussed in detail below.

8.2.1 Program Risk

Risk registers that meet industry practice have been developed for the Program. As stated above, there are risk registers established for the tunnel project that are updated and managed well using a thorough and collaborative process between the STP and WSDOT teams for the tunnel project. The system of qualitative review and assessment in the risk registers has allowed separate registers to be set up for the program, the tunnel project, and for the TBM restart team effort. These registers have been created in a useful format where actions and mitigations taken to address a given risk are clearly described.

The essence of risk management is to use an established process to monitor each identified risk. The intent of this process is to minimize the likelihood of occurrence of each risk and to mitigate as much as possible the impact of those risks that do occur. Prudent management of risk requires the Program Management Team and STP to continue monitoring so that:

- All members of the project team understand what the tunnel project risks are;
- All members of the project team are empowered to identify new risks and suggest mitigation actions;
- All front line supervisors are aware of the mitigation plans and actively implement them within their teams;
- The risk management team update risk registers at appropriate intervals and oversee implementation of mitigation plans; and
- Executive and senior project management with WSDOT and STP are aware of the status of major project risks and mitigation measures.

While the effort taken to identify potential risks has been successful, the mitigation to prevent these risks from manifesting has been less successful. The project would benefit from a more collaborative attitude from both WSDOT and STP towards mitigation of tunnel risk. This would help to reduce risk exposure for all parties. Additional effort on risk mitigation and prevention of damaging consequences should be a focus of the whole project team as well as their respective teams' leadership.

Ground settlement has occurred historically across the Pioneer Square area and has continued since the TBM stoppage in December 2013. This regional settlement is widespread and reasonably constant

across the project area and therefore has imparted no deformation or distress to buildings along the tunnel alignment. STP has asked to superimpose the contractual deformation on top of the regional settlement that has taken place since the stoppage began. Discussions on this issue are currently taking place between STP and WSDOT. It is evident that this decision is being considered from a risk perspective and with the safety and security of the public and of third party infrastructure as the highest priority.

This example shows the value of risk management early in project execution and highlights the ongoing efforts of both teams, WSDOT and STP, to manage risks actively and effectively.

Recommendations

- Freer flow of information between STP and WSDOT is needed. STP should provide additional information to WSDOT to provide increased confidence in risk minimization to the tunnel portion of the design-build contract.
- STP and WSDOT should continue to engage in discussions to mitigate identified risks with special focus on the immediate risks of TBM repair, restart, and operation.

8.2.2 Cost

In its examination, the ERP found that each specific risk contingency fund currently contains sufficient funds for the expected “post-mitigation” level of risk allocated (**Section 7, Table 7.4-1**). The Program Management Team must continue to work through each issue on a day-by-day basis and mitigate each risk thoroughly so that the total value of risk realized does not exceed these values. In a program of this size and complexity, it is prudent for the team to expect that the constant application of the established WSDOT and program risk management protocols by experienced practitioners will identify new and previously unforeseen risks for analysis and mitigation by the team. The purpose of a well-executed risk management process is to manage risks that have been identified.

From **Table 7.4-1** the following should be noted:

1. Additional DSC risks may emerge, which would make further demands made on the DSC fund that may exceed the capacity of this fund.
2. The \$20 million risk contingency fund needed to address deformation and repair of structures should be preserved and held in reserve because the risk exposure for which this fund is dedicated will potentially manifest only when tunneling under downtown.
3. Other unused contingency funds that are part of the established Program budget, such as the schedule incentive fund, any remainder from the post-tunnel projects fund, and the remainder of the unallocated contingency fund should be protected and used to replenish any project risk contingency funds that are exhausted.

WSDOT continues to demonstrate that close attention is being paid to the management of risk on the Program. All contingency funds continue to be tracked carefully by the WSDOT Program Management Team. These two factors and ongoing efforts to improve processes and collaboration with STP lead the ERP to a finding of confidence regarding cost control on the Program, providing outside influences do not prevail in expanding the scope burden on the Program budget.

8.2.3 Schedule

In tunneling, cost impacts can often be mitigated by gaining knowledge of the ground and ground behavior and learning more about these risks as the project proceeds. However, because of the linear nature of tunnel construction, recovering schedule loss after a major event such as a bearing failure is almost impossible. In previous reports, the ERP has stated its view that STP's contract schedule is aggressive. STP's original schedule was always extremely challenging and now this schedule will not be achieved.

Significant re-structuring of construction activities by STP has occurred that mitigates some of this delay. This is encouraging as it is evidence of its commitment to complete the project as quickly and efficiently as possible. These mitigating activities include:

- Completing the underground structure of south operations building.
- Re-designing the mechanical and electrical systems to be routed to the west side of the tunnel so that they can be installed and commissioned in sections as they reach every control room. This saves significant time over having to install and commission all systems at the end of tunneling.
- Continuing work at north and south end cut-and-cover sections, reaching two milestones, allowing turnover of construction sites to adjacent contracts (north and south access contracts). These milestones were achieved on time.

As of the time of this Report, potential additional schedule impact is difficult to predict. Until the TBM is accessed, and the extent of redesign and repair is fully appreciated, it is premature to predict any tunnel completion date.

Based on the ERP's discussions with STP and WSDOT, the ERP notes the following with regard to the tunnel project schedule:

- The original schedule as reviewed by the ERP in its February 2013 report was considered aggressive.
- The current stoppage means that not all contractual schedule dates will be met.
- There are opportunities to recover some of the schedule lost during the TBM stoppage.
- The TBM performance while it was mining was progressing more quickly than the project team expected and made gains on the anticipated schedule.

Any additional schedule mitigation (obtained from realizing schedule opportunities, better than expected TBM performance, and refining plans for later activities) should be preserved to assist in managing other potential schedule risks that have not yet manifested.

Recommendations

- A revised project schedule for the tunnel project and a Program completion date should be established at the earliest practical time after TBM performance is assessed at Safe Haven 3.
- WSDOT and STP should continue to identify steps to mitigate factors that are delaying project completion. Opportunities for schedule savings should be entered on the WSDOT and STP jointly developed risk register. Such opportunities should be tracked until completely realized.
- STP should share schedule recovery options with WSDOT in order to provide confidence in a realistic completion date, allowing WSDOT to monitor against an optimized recovery schedule.
- Projects to be completed post-tunnel construction must continue to proceed on schedule. The need for increased interactions with management regarding these follow-on projects will increase as the tunnel project proceeds.