



SOUNDTRANSIT

ST3 COST ESTIMATE & GENERAL ASSESSMENT SERVICES

TASK 1: Draft Report of Significant Findings and Recommendations

(RTA/RP 0229-20)

REVISED APPENDIX A

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INTRODUCTION

In January of 2021 estimates were provided to Sound Transit Board of Directors (Board) indicating substantial increases in the cost to complete the ST3 expansion program. These increases, combined with reduced revenues because of COVID-19, could require adjustment to the original timelines for completion of ST3 unless there are alternative revenues sources.

Through a realignment process and after gaining input from the public and partner organizations, the Board will establish clear expectations about updated project delivery timelines.

To confirm affordability of the ST3 plan the Board retained a team led by Triunity Inc. with team members Ott-Sakai & Associates, Commonstreet Consulting, Capo Projects Group, and Arcadis (Assessment Team) to perform an independent review and analysis of four of the ST3 projects: West Seattle and Ballard Link Extensions (WSBLE), Tacoma Dome Link Extension (TDLE), Operations & Maintenance Facility South (OMFS) and Bus Rapid Transit (BRT) program.

The assessment is to be performed on the ST3 (2016), the Phase 1 (2019) and Phase 2 (2020) cost estimates.

This independent review is comprised of three tasks with a report to the Board as a deliverable for each of the tasks:

- **Task 1:** Review, analyze, and prepare an independent assessment of the cost estimate trends for specific ST3 capital projects.
- **Task 2:** Programmatic review and analysis of the agency's cost estimating methodology used to develop the ST3 construction and real estate estimates.
- **Task 3:** Review of and recommendations for the WSBLE project management oversight structure.

This report is the deliverable for **Task 1**.

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1.0 EXECUTIVE SUMMARY

This report is the deliverable for the first of three tasks in the Cost and General Assessment reports to the Board.

It provides a review, analysis, and preparation of an independent assessment of the cost estimate trends for specific ST3 capital projects: West Seattle and Ballard Link Extensions (WSBLE), Tacoma Dome Link Extension (TDLE), Operations & Maintenance Facility South (OMFS) and Bus Rapid Transit (BRT) program.

The below are specifically addressed in this report:

- a. Assessment of the cost estimates for WSBLE, TDLE, OMFS and the BRT program in 2019 dollars, including the methodology used by the Assessment Team to perform this work.
- b. Identify the main factors contributing to the variance between the cost estimates performed at different levels of design from the ST3 Plan (2016), alternatives screening (2019), and conceptual engineering (2020).
- c. Identify whether all elements have been captured in the cost estimates, including whether conditions require modifications to the estimating methodology.

The report considers both capital costs and associated real estate. For the Board's information, the Appendix provides information on peer agency's cost increases for mega-projects. The cost estimates previously presented to the Board for the four projects (I-405 BRT, SR-522 BRT and Bus Base North is considered one project for the report) at the various stages of development is shown in the below table:

<i>Project</i>	<i>ST3 Plan (2016)</i>	<i>Phase 1 (2019)</i>	<i>Phase 2 (2020)</i>
WSBLE	\$7,094M	\$7,929M	\$12,103 - \$12,581M ¹
TDLE	\$2,431M	\$2,999M	\$3,308M
OMFS	\$649M	\$759 - \$1,366M	\$1,167 - 2,424M ²
I-405 BRT	\$1,037M	\$1,088M	\$1,016M
SR-522 BRT	\$481M	\$658M	\$544M
Bus Base North	\$191M	\$208M	\$238M

¹ – range reflects the two elevated preferred alternatives in Alaska Junction

² – range reflects the three preferred alternatives at S. 344th St, S 336th St, and Midway Landfill

The numbers in the table above are based on 2019 dollars. Since the actual expenditures will happen after 2019 the dollar amounts adjusted for inflation will be greater than those shown.

▪ West Seattle and Ballard Link Extensions (WSBLE)

Summary of the WSBLE assessment is below. A more detailed description can be found in Section 3.0 of this report:

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the WSBLE Phase 2 (2020) cost estimates are appropriate for an approximately 10% design.
- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** The project saw a dramatic rise in the cost estimate from ST3 (2016) to Phase 2 (2020). The project saw cost increases spread across almost every cost category with the largest increases in right-of-way, sitework/environmental, and guideway.
- c. **Capture of Phase 2 (2020) Elements:** The Assessment Team believes most areas of the estimate are captured in the Phase 2 (2020) estimate. The team would recommend further investigation into bridge type assumptions for aerial guideway as a possible savings to the project, and sitework/ground conditions and tunneling as areas of potential cost increases.
- d. **Recommendations:** The Assessment Team recommends that the ST design team address the findings of this report and revise the cost estimate, as necessary. While ranges will be explored in more detail during the methodology report, the design team should consider providing future revised estimates as a range of values for each project.

▪ Tacoma Dome Link Extension (TDLE)

Summary of the TDLE assessment is below. A more detailed description can be found in Section 4.0 of this report:

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the TDLE Phase 2 (2020) cost estimates are appropriate for an approximately 10% design.
- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** Rapidly rising real estate costs and other inflationary pressures over the time period is one of the main reasons for the cost increases. From Phase 1 (2019) to Phase 2 (2020), the elevated profile of the guideway increased substantially. Therefore, there is a direct correlation between the price increase in guideway from Phase 1 (2019) to Phase 2 (2020) and the method of how the guideway is to be constructed. Furthermore, due to the increase in bridge span length and the complexity of construction, the aerial structures increased from ST3 (2016) to Phase 2 (2020).
- c. **Capture of Phase 2 (2020) Elements:** The Assessment Team believes all areas of the estimate are captured in the Phase 2 (2020) estimates. One possible exception is the central control center. With the addition of multiple extensions, including TDLE, it is possible that the existing central control center will not be able to accommodate the expansions. If that is the case, TDLE's estimate should reflect a portion of this expansion cost.
- d. **Recommendations:** The Assessment Team recommends that the ST design team address the findings of this report and revise the cost estimate, as necessary. While ranges will be explored in more detail during the methodology report, the design team should consider providing future revised estimates as a range of values for each project.

▪ Operations and Maintenance Facility – South (OMFS)

Summary of the OMFS assessment is below. A more detailed description can be found in Section 5.0 of this report:

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the OMFS Phase 2 (2020) cost estimates are appropriate for an approximately 10% design.
- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** The ST3 (2016) cost estimates did not have a final location determined for the facility. There were three front runners. All three locations saw increases in cost from ST3 (2016) to Phase 2 (2020). For 334th and 336th the primary drivers in cost increases were increased structure heights, demolition, earthwork, drainage vaults replacing retention ponds, and landscaping allowance. For the Midway Landfill location, the major cost drivers were disposal of hazardous materials, refiguration of demolition and earthwork requirements, the use of drainage vaults instead of retention ponds, and additional piling cost.
- c. **Capture Phase 2 (2020) Elements:** The Assessment Team believes all areas of the estimate are captured in the Phase 2 (2020) estimates. The team would recommend further investigation into ground conditions along the alignment as this appears to be the project's largest risk, particularly at Midway Landfill. Another risk is the building cost for Heavy Maintenance Facility.
- d. **Recommendations:** The Assessment Team recommends that the ST design team address the findings of this report and revise the cost estimate, as necessary. While ranges will be explored in more detail during the methodology report, the design team should consider providing future revised estimates as a range of values for each project.

▪ Bus Rapid Transit (BRT) – I-405, SR-522, and Bus Base North

Summary of the BRT assessment is below. A more detailed description can be found in Section 6.0 of this report:

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the I-405 & SR-522 BRT Phase 2 (2020) cost estimates are appropriate for an approximately 10-20% design. Bus Base North does not appear appropriate, and it is recommended that a bottoms-up estimate be performed utilizing the latest design and site investigation information.
- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** Projects within the BRT program saw only minor changes in cost from ST3 (2016) to Phase 2 (2020). There were no major cost drivers on cost.

- c. **Capture Phase 2 (2020) Elements:** For I-405 and SR-522, the Assessment Team believes the project has adequately captured all areas of the estimate during Phase 2 (2020). There are still risks to the cost, however. These risks include but are not limited to the extent of contaminated soil, and fiberoptic requirements, as well as their relationship to both WSDOT infrastructure and local BRT tie-in points. For Bus Base North, the Assessment Team believes there are many missing items in the Phase 2 (2020) estimate. Some of these include site work, environmental, and equipment.
- d. **Recommendations:** The Assessment Team recommends that the ST design team address the findings of this report and revise the cost estimates, as necessary. While ranges will be explored in more detail during the methodology report, the design team should consider providing future revised estimates as a range of values for each project.

2.0 APPROACH TO THE COST ESTIMATE ASSESSMENT

The Assessment Team assigned a separate team to each of the four ST3 projects. A total of 17 estimators were used, including experts in tunnels, bridges, maintenance facilities, real estate, systems and environmental.

These teams performed an investigation and assessment of the ST3 (2016) plan vs Phase 1 (2019) and Phase 2 (2020) estimates, for each of the four projects. Each of the projects were broken into the three alignment types (at-grade, elevated, and underground). Then for each alignment type the three estimates were compared. This comparison provided the percent change. Costs were then aligned with the unit prices from Sound Transit's unit price library and the Federal Transit Administration's Standard Cost Categories (FTA SCC) for comparison.

2.2.1 Federal Transit Administration's Standard Cost Categories (FTA SCC)

For consistency of cost estimate assessments and unit price comparisons across all four of the projects, the Assessment Team used the Federal Transit Administration's Standard Cost Categories (SCC) format to collect, collate, compare, and contrast the estimate data and calculation methods between the ST3 (2016) Plan to the Phase 1 (2019) estimate and between the Phase 1 (2019) estimate and the Phase 2 (2020) estimates that were provided by ST staff.

FTA provides a 'New Starts' worksheet for developing capital cost estimates for any transit project in the planning and preliminary engineering phase, and for any agency seeking federal funding assistance via a Full-Funding Grant Agreement (FFGA). The FTA's new starts worksheet organizes all capital project cost elements into functional transit asset categories, called the Standard Cost Categories (SCC).

A brief description of the SCC items is provided below for reference, along with a listing of *Risks to Cost and Schedule* that typically exist for complex transit projects like those in this assessment:

▪ SCC Overall (10-100) 'Build Main' Worksheet

- Covers 100% of Transit Project costs for designing and building all Assets and Scope.
- The SCC cost breakdown is based on a traditional Design-Bid-Build model. For Design-Build, the construction costs must be separated from design, administration, testing, etc.
- Includes all labor and construction materials regardless of whom is performing the work.

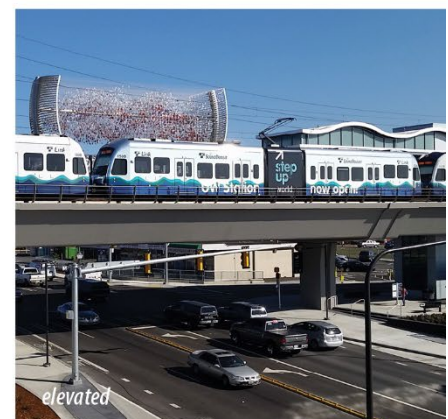
▪ SCC 10 – Guideway

- Includes guideway and track costs for all transit modes (light rail, BRT, etc.)
- The unit of measure is route miles of guideway, regardless of width.
- Includes costs for rough grading, excavation, and concrete base (supporting structures, such as bridges and tunnels), where applicable.

Typical Risks to Cost and Schedule:

- » *Elevated and Underground guideways require much more schedule time, labor, construction equipment and materials (like steel and concrete), than At-Grade guideways.*
- » *Any shared guideway with Freight Rail, DOT/Highways or other transit system operations.*

SCC 10 - Guideway



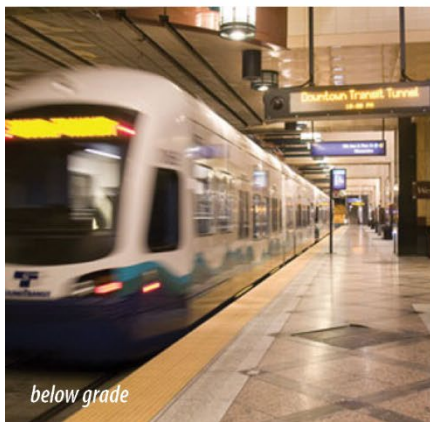
▪ **SCC 20 – Stations**

- At-Grade
- Aerial (Elevated)
- Underground
- Parking Structures
- Elevators and Escalators
- Include costs for rough grading, excavation, station structures, enclosures, finishes, equipment; mechanical and electrical components including HVAC, ventilation shafts and equipment, station power, lighting, public address/customer information system, safety systems such as fire detection and prevention, security surveillance, access control, life safety systems, etc.

Typical Risks to Cost and Schedule:

- » *Elevated and Underground stations require substantially more schedule time, labor, construction equipment and materials (like steel and concrete), than At-Grade stations.*

SCC 20 - Stations



▪ **SCC 30 – Support Facilities**

- Includes costs for rough grading, excavation, support structures, enclosures, finishes, equipment; mechanical and electrical components including HVAC, ventilation shafts and equipment, facility power, lighting, public address system, safety systems such as fire detection and prevention, security surveillance, access control, life safety systems, etc. Include fueling stations.

Typical Risks to Cost and Schedule:

- » *Expansion and improvement of pre-existing operational facility.*
- » *Interfaces between Construction Contractors/Activities and Live Transit Operations.*
- » *Typically, the Operators hired to operate and maintain a new facility will want modifications to the finished facility to enhance the operational efficiencies.*

SCC 30 - Support Facilities



▪ **SCC 40 – Sitework & Special Conditions**

- Demolition, clearing, earthwork
- Site utilities, utility relocation
- Hazardous materials, contaminated soil removal/mitigation, ground water treatments
- Environmental mitigation (e.g. wetlands, historic/archeologic, parks)
- Site structures including retaining walls, sound walls
- Pedestrian/bike access and accommodation, landscaping
- Automobile, bus, van accessways including roads, parking lots
- Temporary facilities and other indirect costs during construction

Typical Risks to Cost and Schedule:

- » *Unknown existing ground conditions; unmarked or abandoned underground utilities, structures, geological, archeological, and environmental hazards and impact mitigations.*

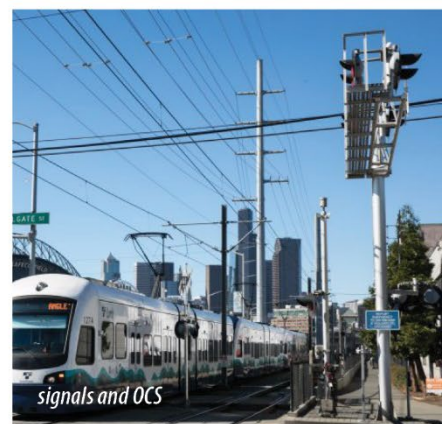
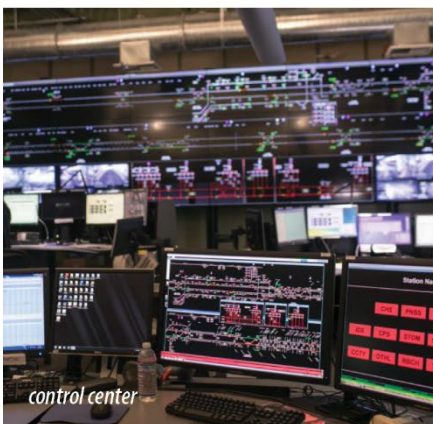
SCC 40 - Sitework & Special Conditions



▪ **SCC 50 – Systems**

- Train control and signals
- Traffic signals and crossing protection
- Traction power supply: substations (TPSS)
- Traction power distribution: catenary (OCS) and third rail
- Communications/SCADA/passenger information
- Fare collection system and equipment
- Central Control

SCC 50 - Systems



Typical Risks to Cost and Schedule:

- » *Interfaces between Civil/Structural elements (i.e. ductbanks/conduits/cabinets) and Systems elements (i.e. electrical/equipment) require integrated designs and close coordination of construction and quality control activities.*

» *System Integration Testing on large, complex projects typically takes more iterative troubleshooting and rework (i.e. time and cost), than originally planned.*

▪ **SCC 60 – ROW, Land, Existing Improvements**

- Purchase or lease of real estate; including permanent surface and subsurface easements
- Relocation of existing households and businesses

Typical Risks to Cost and Schedule:

- » *Unknown which parcels will require condemnation (typically a minimum 18-month process).*
- » *Unpredictable real estate market escalation and valuations.*

SCC 60 - ROW, Land, Existing Improvements



▪ **SCC 70 – Vehicles (Rolling Stock)**

- Light Rail
- Heavy Rail
- Commuter Rail
- Bus
- Non-revenue vehicles
- Spare parts

SCC 70 - Vehicles (Rolling Stock)



▪ **SCC 80 – Professional Services (Soft Costs)**

- Project Development (Environmental Clearance and Preliminary Engineering of Preferred Alternative)
- Engineering (Final Design)
- Project Management for Design and Construction
- Construction Administration and Management

- Professional Liability and other Non-Construction Insurance
- Legal; Permits; Review Fees by other agencies, cities, etc.
- Surveys, Testing, Investigation, Inspection
- Start up (Systems Integration and Commissioning)

SCC 80 - Professional Services (Soft Costs)



- **SCC 90 – Unallocated Contingency**
 - Contingency or project reserves for unknown or incomplete scope definition.
 - Unallocated Contingency is typically based on level of design development maturity and is normally calculated as a percentage (%) of SCC 10-80 costs.
- **SCC 100 – Finance Charges**
 - Finance Charges are not typically included in the capital project cost estimates, however the FTA granting authority wants to know what (if any) finance charges will be accrued and paid during construction and reimbursed in whole or part with FFGA funds.

A general observation/finding was that all three of the ST3 project estimates assessed, and the unit price library content, are aligned with the FTA SCC categories; however, not all categories included cost estimate data for each project.

For instance, all project estimates assessed did not include costs for SCC 70 – Vehicles since it is a separate project.

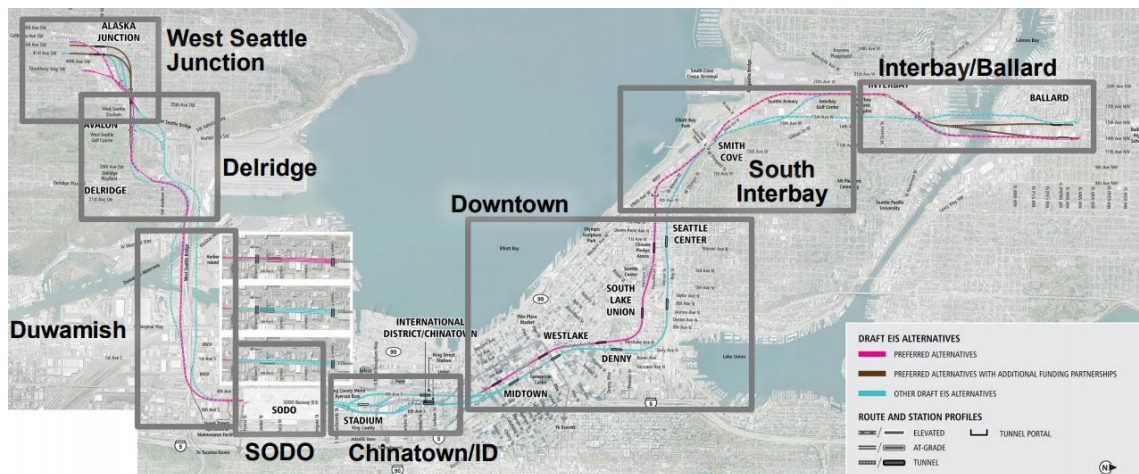
The vehicle project is not a part of the scope of this assessment. Also, none of the LRT projects assessed included estimated costs for SCC 40.08 – Temporary Facilities and other indirect costs during construction. FTA Guidelines for SCC 40.08 state:

"As a general rule and to the extent possible, appropriately allocate indirect costs among the construction costs in Categories 10 through 50. Where that is not possible, include in 40.08 Temporary Facilities costs for mobilization, demobilization, phasing; time and temporary construction associated with weather (heat, rain, freezing, etc.); temporary power and facilities; temporary construction, easements, and barriers for storm water pollution prevention, temporary access and to mitigate construction impacts; project and construction supervision; general conditions, overhead, profit."

3.0 West Seattle and Ballard Link Extensions (WSBLE)

3.1 WSBLE Key Findings

- Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the WSBLE Phase 2 (2020) cost estimates are appropriate for an approximately 10% design. The Assessment Team focused particularly on aerial guideway, tunneling, stations, sitework/environmental, systems, and right-of-way.
- ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** From ST3 (2016) to Phase 1 (2019) the alignment type and cost (adjusted for inflation) showed consistency throughout the estimates. This was followed by a dramatic 53-59% rise from Phase 1 (2019) to Phase 2. The project saw cost increases spread across almost every cost category with the largest increases in right-of-way, sitework/environmental, and guideway. Details on the FTA SCC categories for WSBLE is below.
- Capture of Phase 2 (2020) Elements:** The Assessment Team believes most areas of the estimate are captured in the Phase 2 (2020) estimate. The Assessment Team would recommend further investigation into bridge type assumptions for aerial guideway as a possible savings to the project, and sitework/special conditions and tunneling as areas of potential cost increase. The team would also recommend a more transparent way to assess indirect costs. The cost estimating methodology used, specifically Sound Transit's unit cost library (UCL), is thorough and in many ways more advanced than peer agencies; however, it was difficult for the Assessment Team to extract key pieces of the estimate (i.e. temporary facilities and other indirect costs during construction). These types of costs are often overlooked and are key to accurately forecasting overall project costs during the evolutionary estimating phases.



3.2 WSBLE SCC Details

Following is a detailed description of the WSBLE findings by SCC:

■ SCC 10 – Guideway

ST3 (2016) to Phase 1 (2019) to Phase 2 (2020) show no significant route feet (RF) changes to the alignment but did experience unit cost increases. The two areas with the largest unit cost increases were along the elevated and underground guideway. The Assessment Team did an investigation into these two areas and came up with the following:

The aerial guideway standard sections used in the Phase 2 (2020) cost estimate includes a standard Precast Segmental Box Girder. The Assessment Team examined two potential and more economical options based on regional experience: WSDOT I-Girders and WSDOT Precast Tub Girders. The Assessment Team performed an analysis of cost savings for PA 201 (Elevated), which is elevated in West Seattle and Ballard, and PA 202 (Tunnel), which is tunneling in West Seattle and Ballard, and the results are as follows:

- WSDOT I-Girders:
 - » PA 201 (Elevated): Savings of \$200-\$210M

- » PA 202 (Tunnel): Savings of \$105-\$115M
- WSDOT Precast Tub Girders:
 - » PA 201 (Elevated): Savings of \$170-\$175M
 - » PA 202 (Tunnel): Savings of \$80-\$85M

There were discrepancies between what is currently present in the Phase 2 (2020) estimates and what is shown on the roll plots contained in AE 0036-17 04.02 Conceptual Engineering DEIS Cost Estimate Draft 4 as they pertain to long-span bridges. Based on the analysis from the Assessment Team, the missing items should be included in the current estimate and the results are as follows:

- Duwamish and Salmon Bay Long Span Bridges:
 - » PA 201 (Elevated): Addition of \$70-\$75M
 - » PA 202 (Tunnel): Addition of \$30-\$35M

The second pertains to tunneling costs. The Assessment Team performed the tunneling analysis based on previous regional experience and the provided information from roll plots contained in AE 0036-17 04.02 Conceptual Engineering DEIS Cost Estimate Draft 4. The results are as follows:

- Tunneling:
 - » PA 201 (Elevated): Addition of \$170-\$175M
 - » PA 202 (Tunnel): Addition \$180-\$185M

▪ **SCC 20 – Stations**

- The Assessment Team found no significant changes from ST3 (2016) to Phase 1 (2019) to Phase 2 (2020) for this section. The team prepared a cost analysis on similar stations in the regional area and found that the current Phase 2 (2020) estimates fall in line with expectations at the current design phase.

▪ **SCC 30 – Support Facilities**

- Operations and Maintenance Facility (OMF) costs for WSBLE included in OMFS project estimate.

▪ **SCC 40 – Sitework & Special Conditions**

The costs for sitework were decreased from ST3 (2016) to Phase 1 (2019) by 28%. This was followed by a 240% increase from Phase 1 (2019) to Phase 2 (2020). The addition of drainage vaults increased environmental mitigation, and new hazardous material allowances all played a big part in the rise in cost from Phase 1 (2019) to Phase 2 (2020). In addition, the Assessment Team found multiple ground improvement items identified on the roll plots contained in AE 0036-17 04.02 Conceptual Engineering DEIS Cost Estimate Draft 4 that were excluded from the Phase 2 (2020) estimate. The Assessment Team recommends these be added, and the results are as follows:

- Ground Improvements:
 - » PA 201 (Elevated): Addition of \$80-\$85M
 - » PA 202 (Tunnel): Addition of \$75-\$80M

It is also worth noting that SCC 40.08 items are excluded from the estimates and thought to be captured in the individual unit costs. While its clear to the Assessment Team that some of these items have been captured, a further examination of the unique project specific items will be performed in Task 2.

- The below is a detail breakout of SCC 40.03 Hazardous material, contaminated soil removal / mitigation, ground water treatments for **PA 201 (Elevated)**:

ST3 (2016)					
	QTY	Unit	Rate	Total	Total w/ DA
Light	36,500	RF	100	3,650,000	4,745,000
Medium	1,777	RF	200	355,400	462,020
Heavy	4,600	RF	360	1,656,000	2,152,800
Removal of Contaminated Soil	300	CY	260	78,000	101,400
TOTAL	42,877				7,461,220

Phase 1 (2019) – PA 201 (Elevated)					
	QTY	Unit	Rate	Total	Total w/ DA
Light	23,895	RF	116	2,771,820	3,603,367
Medium	10,792	RF	231	2,503,744	3,254,868
Heavy	27,610	RF	418	11,540,980	15,003,274
Removal of Contaminated Soil	-	-	-	-	-
TOTAL	62,297				21,851,509

Phase 2 (2020) – PA 201 (Elevated)					
	QTY	Unit	Rate	Total	Total w/ DA
Light	32,426	RF	123	3,988,398	5,184,917
Medium	21,098	RF	247	5,211,107	6,774,439
Heavy	12,189	RF	445	5,424,105	7,051,337
Removal of Contaminated Soil	-	-	-	-	-
TOTAL	65,713				19,010,693

- Review of ST3 (2016) vs the Phase 2 (2020) documents show an increase of:

DOLLARS		
ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Hazmat Removal & Mitigation	Hazmat Removal & Mitigation	Hazmat Removal & Mitigation
\$7.5 M	\$21.9 M	\$19.0 M

QUANTITY (ROUTE FEET)		
ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Hazmat Removal & Mitigation	Hazmat Removal & Mitigation	Hazmat Removal & Mitigation
42,877	62,297	65,713

RATE (\$)			
	ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Hazardous Material Removal Allowance, <i>Light</i>	100	116	123
Hazardous Material Removal Allowance, <i>Medium</i>	200	232	247
Hazardous Material Removal Allowance, <i>Heavy</i>	360	418	445

Key Changes from ST3 (2016) to Phase 2 (2020)

- 42,877RF ST3 (2016) to 62,297RF (Phase 1) then to 65,713RF (Phase 2) of Hazmat Removal and Mitigation
- 24% increase in unit rate from ST3 (2016) to Phase 2 (2020)
- ST3 (2016) to Phase 1 (2019) had significant change in RF calculation. Large change from Light calculations to Medium and Heavy Allowances Quantities in Phase 1 (2019).

QUANTITY			
	ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
<i>Light</i>	36,500	23,895	32,426
<i>Medium</i>	1,777	10,792	21,098
<i>Heavy</i>	4,600	27,610	12,189

- The below is a detail breakout of SCC 40.03 Hazardous material, contaminated soil removal / mitigation, ground water treatments | **PA 202 (Tunnel)**

ST3 (2016)					
	QTY	Unit	Rate	Total	Total w/ DA
Light	36,500	RF	100	3,650,000	4,745,000
Medium	1,777	RF	200	355,400	462,020

Heavy	4,600	RF	360	1,656,000	2,152,800
Remove of Contaminated Soil	300	CY	260	78,000	101,400
TOTAL	42,877	-	-	-	7,461,220

Phase 1 (2019) – PA 202 (Tunnel)					
	QTY	Unit	Rate(\$)	Total	Total w/ DA
Light	24,530	RF	116	2,845,480	3,699,124
Medium	7,428	RF	232	1,723,296	2,240,285
Heavy	33,901	RF	418	14,170,618	18,421,803
Remove of Contaminated Soil	-	-	-	-	-
TOTAL	65,859	-	-	-	15,370,419

Phase 2 (2020) – PA 202 (Tunnel)					
	QTY	Unit	Rate(\$)	Total	Total w/ DA
Light	36,999	RF	123	4,550,877	5,916,140
Medium	15,420	RF	247	3,808,888	4,951,554
Heavy	12,814	RF	445	5,702,230	7,412,899
Remove of Contaminated Soil	-	-	-	-	-
TOTAL	65,233	-	-	-	18,280,594

General Approach

Review comments:

- Review of ST3 (2016) vs the Phase 2 (2020) documents showed an increase of:

DOLLARS		
ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Hazmat Removal & Mitigation	Hazmat Removal & Mitigation	Hazmat Removal & Mitigation
\$7.5M	\$15.4M	\$18.3M

QUANTITY (ROUTE FEET)		
ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Hazmat Removal & Mitigation	Hazmat Removal & Mitigation	Hazmat Removal & Mitigation
42,877	65,859	65,233

RATE(\$)			
	ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Hazardous Material Removal Allowance, <i>Light</i>	100	116	123
Hazardous Material Removal Allowance, <i>Medium</i>	200	232	247
Hazardous Material Removal Allowance, <i>Heavy</i>	360	418	445

Key Changes from ST3 (2016) to Phase 2 (2020)

- 42,877RF ST3 (2016) to 65,859RF Phase 1 (2019) then to 65,233RF Phase 2 (2020) of Hazmat Removal and Mitigation.
- 24% increase in unit rate from ST3 (2016) to Phase 2 (2020).
- ST3 (2016) to Phase 1 (2019) had significantly change in RF calculation. Large increase Heavy Allowances into Phase 1 (2019). Then reversing back slightly at Phase 2 (2020) into the Medium category.

Checked budgets using sample estimates

- Created sample estimates based on information on existing design and historical construction methods
- The 2021 overall budget looks to cover for typical conditions with no allowances for potential large costs (further review may be required)

Midway Landfill vs. Interbay Landfill

MIDWAY LANDFILL



INTERBAY LANDFILL



- » The length of impacted area due to the routing of the ST line is similar. Roughly 2,200LF.
- » We know at Midway the ST line will be on grade vs at Interbay aerial station, but future contractor will need access to work.
- » Roughly 200,000T of landfill soils was disposed of from the Midway site.
- » Replacement of 200,000T of exported material can add \$30/T = \$6M in addition to the disposal costs.
- » Total \$11M disposal + \$6M import = \$17M potential add.

SCC 40.04 Environmental Mitigation | PA 201 (Elevated)

ST3 (2016)					
	QTY	Unit	Rate(\$)	Total	Total w/ DA
Light	26,897	RF	82	2,205,554	2,867,220
Medium	12,740	RF	230	2,930,200	3,809,260
Heavy	3,240	RF	390	1,263,600	1,642,680
TOTAL	42,877	-	-	-	8,319,160

Phase 1 (2019) – PA 201 (Elevated)					
	QTY	Unit	Rate(\$)	Total	Total w/ DA
Light	40,578	RF	95	3,863,025	5,0210,934
Medium	4,787	RF	267	1,278,129	1,661,568
Heavy	16,982	RF	453	7,692,846	10,000,700
TOTAL	62,347	-	-	-	16,684,202

Phase 2 (2020)					
	QTY	Unit	Rate(\$)	Total	Total w/ DA
Light	-	RF	-	-	-
Medium	31,077	RF	284	8,825,953	11,473,739
Heavy	34,636	RF	482	16,694,311	21,702,604
Allowance	1	LS	-	138,400,000	179,920,000
TOTAL	65,713	-	-	-	213,096,343

201 – General Approach

Review comments:

- Review of ST3 (2016) vs Phase 1 (2019) vs Phase 2 (2020) documents showed an increase of:

DOLLARS		
ST3 (2016) – 2016	Phase 1 (2019)	Phase 2 (2020)
Environmental Mitigation	Environmental Mitigation	Environmental Mitigation
\$8.3M	\$16.7M	\$213.1M

QUANTITY (ROUTE FEET)		
ST3 (2016) – 2016	Phase 1 (2019)	Phase 2 (2020)
Environmental Mitigation	Environmental Mitigation	Environmental Mitigation
42,877	62,347	65,713

RATE			
	ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Environmental Mitigation Allowance, <i>Light</i>	82	95	
Environmental Mitigation Allowance, <i>Medium</i>	230	267	284
Environmental Mitigation Allowance, <i>Heavy</i>	390	453	482

Key Changes from ST3 (2016) to Phase 2 (2020)

- 42,877RF to 65,713RF of Environmental Mitigation.
- 23% increase in unit rate.
- No quantities for Light Mitigation in Phase 2 (2020). Only Medium and Heavy quantities in Phase 2 (2020).

Lump Sums Adjust by 179.2% Multiplier

ST provided the following table with allowances carried for each section and mitigation categories. However, without further explanation on reasoning for the added allowances, the Assessment Team made the following assumptions and comments:

Segment	Alternative	Total	Historic	Archaeology	Ecosystems	Parks	Transportation	Navigation
SODO (W. Sea)	All	900,000	600,000	300,000				
Duwamish	South Crossing (DUW-1a)	53,100,000	600,000	23,400,000	27,900,000	1,200,000		
Delridge	Preferred Dakota Street Station (DEL-1a)	2,900,000	900,000	600,000		1,500,000		
Alaska Junction	All WSJ Alternatives	1,200,000	700,000	600,000				
SODO (Bal)	SODO-1b	2,000,000	600,000				1,500,000	
CID	5th Ave Shallow (CID-2a)	18,700,000	6,400,000	800,000			11,500,000	
Downtown	Preferred 5th Ave/Harrison St (DT-1)	20,800,000	2,400,000	11,200,000			7,200,000	
South Interbay	Preferred Galer St Station/Central Interbay (SIB-1)	18,200,000	1,200,000	2,800,000		14,300,000		
Ballard	Preferred Elevated 14th Ave (IBB-1a)	20,600,000	1,200,000	6,700,000	12,600,000	100,000		

Assessment Team Assumptions:

- Ecosystem mitigation** – \$27.9M @ Duwamish and \$12.9M @ Ballard
 - Assumed at Lake Washington Ship Canal crossing and Duwamish river crossing. Based on conversation with environmental engineer, the Assessment Team feels this is a good allowance for mitigation work at these locations. It was noted that the change in administration may have impact on the cost of this type of work and confirmed that the amount allowed is appropriate.
- Parks mitigation** – \$14.3M @ South Interbay

- Assumed at the Interbay Golf Course. It is not clear what this item is allocated for; therefore, the Assessment Team made the assumption of golf course shut down and repairs, or possible agreed upon amount with the parks department. However, if the park or golf course was to be completely redone after the light rail construction, this may be light to cover for the costs of complete parks project as the cost of a park typically cost \$50/sf for just construction only.
- **Transportation mitigation** - \$11.5M @ CID and \$7.2M at DT
 - Assumption this will be needed at and around the downtown core due to complication of street closures and interfacing with existing rail and bus lines. Examples: Streetcar relocation at Westlake Station, vehicular and pedestrian access, detours, business operation, and bus routes.
- **Historic mitigation** - \$14.6M @ WSBLE
 - Assume due to the historic areas that WSBLE would be traveling through, Assessment Team feels this is appropriate.
- **Archeological mitigation** - \$23.4M @ Duwamish and \$11.2M @ DT and \$6.7M at Ballard
 - Assumption is this will cover for slowdowns in construction and archeological work. This looks to be appropriate at currently design level. Experience from Assessment Team on similar project for other agencies have included significant slowdowns in construction and costs for archeological work. In past projects we have seen costs of \$1.6M per mile vs \$3.7M on WSBLE looks to be sufficient.

Original Data From ST

Segment	Alternative	for QTO*	Total	Historic	Archaeology	Ecosystems	Parks	Transportation
SODO (W. Sea)	All	900,000	1,600,000	1,100,000	500,000			
Duwamish	South Crossing (DUW-1a)	53,100,000	95,143,152	1,000,000	42,000,000	50,000,000	2,143,152	
Delridge	Preferred Dakota Street Station (DEL-1a)	2,900,000	5,278,940	1,600,000	1,000,000		2,678,940	
Alaska Junction	All WSJ Alternatives	1,200,000	2,200,000	1,200,000	1,000,000			
SODO (Bal)	SODO-1b	2,000,000	3,600,000	1,000,000				2,600,000
CID	5th Ave Shallow (CID-2a)	18,700,000	33,600,000	11,400,000	1,500,000			20,700,000
Downtown	Preferred 5th Ave/Harrison St (DT-1)	20,800,000	37,200,000	4,300,000	20,000,000			12,900,000
South Interbay	Preferred Galer St Station/Central Interbay (SIB-1)	18,200,000	32,711,008	2,150,000	5,000,000		25,561,008	
Ballard	Preferred Elevated 14th Ave (IBB-1a)	20,600,000	36,850,000	2,100,000	12,000,000	22,500,000	250,000	

- SCC 40.04 Environmental Mitigation | PA 202 (Tunnel)

ST3 (2016)					
	QTY	Unit	Rate	Total	Total w/ DA
Light	26,897	RF	82	2,205,554	2,867,220
Medium	12,740	RF	230	2,930,200	3,809,260
Heavy	3,240	RF	390	1,263,600	1,642,680
TOTAL	42,877	-	-	-	8,319,160

Phase 1 (2019) – 202 Alignment					
	QTY	Unit	Rate	Total	Total w/ DA
Light	44,288	RF	95	4,216,288	5,481,083
Medium	11,637	RF	267	3,107,079	4,039,203
Heavy	9,934	RF	453	4,500,102	18,421,803
TOTAL	62,347	-	-	-	16,684,202

Phase 2 (2020) – 202 Alignment					
	QTY	Unit	Rate	Total	Total w/ DA
Light	-	RF	-	-	-
Medium	36,395	RF	284	10,336,265	13,437,145
Heavy	28,829	RF	482	13,895,578	18,064,251
Allowance	1	LS	-	130,800,000	170,040,000
TOTAL	65,224	-	-	-	201,541,396

202 – General Approach

Review comments:

- Review of ST3 (2016) vs Phase 1 (2019) vs Phase 2 (2020) documents showed an increase of:

DOLLARS		
ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Environmental Mitigation	Environmental Mitigation	Environmental Mitigation
\$8.3M	\$15.4M	\$201.5M

QUANTITY (ROUTE FEET)		
ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Environmental Mitigation	Environmental Mitigation	Environmental Mitigation
42,877	65,859	65,224

RATE			
	ST3 (2016)	Phase 1 (2019)	Phase 2 (2020)
Environmental Mitigation Allowance, <i>Light</i>	82	95	
Environmental Mitigation Allowance, <i>Medium</i>	230	267	284
Environmental Mitigation Allowance, <i>Heavy</i>	390	453	482

Key Changes from ST3 (2016) to Phase 2 (2020)

- 42,877RF to 65,859 then to 65,713RF of Environmental Mitigation.
- 23% increase in unit rate from ST3 (2016) to Phase 2 (2020).
- ST3 (2016) to Phase 1 (2019) had large increase in quantity but mostly in the Light category.
- From Phase 1 (2019) to Phase 2 (2020) No quantities for Light Mitigation in Phase 2 (2020). Only Medium and Heavy quantities in Phase 2 (2020).

Lump Sums Adjust by 179.2% Multiplier

Segment	Alternative	Total	Historic	Archaeology	Ecosystems	Parks	Transportation	Navigation
SODO (W. Sea)	All	900,000	600,000	300,000				
Duwamish	South Crossing (DUW-2a)	53,100,000	600,000	23,400,000	27,900,000	1,200,000		
Delridge	Dakota Street Station Lower Height Alternative (DEL-2a)	5,700,000	900,000	600,000		4,200,000		
Alaska Junction	All WSJ Alternatives	1,200,000	700,000	600,000				
SODO (Bal)	SODO-1b	2,000,000	600,000				1,500,000	
CID	5th Ave Shallow (CID-2a)	18,700,000	6,400,000	800,000			11,500,000	
Downtown	Preferred 5th Ave/Harrison St (DT-1)	20,800,000	2,400,000	11,200,000			7,200,000	
South Interbay	Preferred Galer St Station/Central Interbay (SIB-1)	18,200,000	1,200,000	2,800,000		14,300,000		
Ballard	Preferred Tunnel 14th Ave (1BB-2a)	10,200,000	800,000	6,700,000	2,800,000			

- The difference noted in the allowances for 201 vs 202 alignment a show a \$10M drop in costs for ecosystem mitigation at the Lake Washington Ship Canal crossing. However, no adjustments were made for Archaeology. The same \$6.7M was carried is both alignments. The tunnel option might provide less impact due to less surficial disturbances.
- Addition \$3M was added for Parks. It is not clear if this would be the golf course or Dragonfly Garden.

SCC 50 – Systems

The costs fluctuated down in price between ST3 (2016) and the Phase 1 (2019) estimates due primarily to an 11% reduction in alignment RF. From Phase 1 (2019) to Phase 2 (2020) the RF increased back by 5% with a corresponding increase in cost. Overall, from ST3 (2016) to PH2 the costs have been consistent and have dropped slightly from ST3 (2016) to PH 2. The Assessment Team analyzed the unit cost library (UCL) for the SCC 50 subcodes 50.01 – 50.07 and found significant variation between the ST units costs and the Assessment Team’s comparison unit costs. The variations were up to 50% of the unit cost. Some indicated the ST unit costs were too low, while some too high. Combined, the fluctuations in cost accounted for the total dollars within the SCC 50 codes to be very close to the project budgets as a whole. The Assessment Team will expand its analysis on the UCL as it related to SCC 50 during the methodology review.

Lastly, the Assessment Team recommends a review of the communications backbone unit cost scope of work and the interface to the guideway unit costs as it relates to the ductbank.

▪ **SCC 60 – Right-of-Way (ROW), Land, Existing Improvements**

Based on this review, in conjunction with interviews with ST staff and project team leads, it was determined that the ST ROW Cost Estimating Methodology was applied appropriately and consistently across the three levels of the estimates.

In certain cases, as the design was refined, appropriate deviations from the methodology were made to specifically address significant ROW impacts.

The Assessment Team also compared actual sale prices of residential and non-residential properties throughout the corridor to the assessed values to test the reasonableness of the real estate adjustment multipliers used in the ROW estimates. We found that the multipliers used in the estimates fall within the range of appropriate adjustment factors indicated by the actual sales.

The Assessment Team further estimated relocation costs based on occupancy on several of the parcels along the alignment to compare to the relocation costs estimated as a part of the project contingency. The results varied widely as the estimate methodology relies on costs to average out over the whole project.

SCC 60 Comparison of Estimates

ST3 (2016) Plan to Phase 1 (2019)

Overall ROW costs increased from \$162 million in the ST3 (2016) plan to \$678 million, representing an increase of 318%. As the design was further developed, the total area of impacted ROW increased by 11%; however, as the ROW impacts were further analyzed, it was determined that the number of full takes increased from 65 in the ST3 (2016) Plan to 100 in Phase 1 (2019).

Rising real estate values in Seattle over the three-year period also largely contributed to the change in overall ROW Costs (see bullet points below).

The increase in the overall contingency from 55% to 75% also made a significant contribution (36% on top of higher property values) to the increased ROW costs.

Phase 1 (2019) to Phase 2 (2020)

Overall ROW costs increased from \$678 million in the ST3 (2016) plan to ~\$3 billion (PA 201 (Elevated)) and \$2.58 billion (PA 202 (Tunnel)), representing an increase of 342% (PA 201 (Elevated)) and 280% (PA 202 (Tunnel)).

The area of impacted ROW measured in square feet (sf), including full acquisitions, increased from 2.4 million sf in Phase 1 (2019) to 6.7 million sf (PA 201 (Elevated)), representing a 174% increase, and 6.3 million sf (PA 202 (Tunnel)), representing a 162% increase, in Phase 2 (2020), with associated full takes increasing from 100 in Phase 1 (2019) to 298 (PA 201 (Elevated)) and 259 (PA 202 (Tunnel)) in Phase 2 (2020).

The single greatest reason for the increase in cost appears to be the use of the buffer method for estimating private property impacts in the ST3 (2016) Plan and Phase 1 (2019) cost estimates, in contrast to the use of a more refined project footprint in Phase 2 (2020). This footprint resulted in a more accurate understanding of the ROW impacts, with a significant increase in the number of full acquisitions (see above) as well as more impactful partial acquisitions. In fact, real estate impacts associated simply with construction (not including TCE's) account for \$1.4 billion (PA 201 (Elevated)) and \$1.2 billion (PA 202 (Tunnel)). These costs are particularly noticeable in the downtown segment.

The other significant factors include rising real estate costs and redevelopment of parcels to higher density uses.

- Seattle multifamily residential sale prices increased from \$315,460/unit in 2016 to \$410,567/unit in 2020, equal to appreciation of 8%/yr.
- Between 2016 and 2020, only 643 multifamily residential units were demolished, whereas 31,139 were built, illustrating lower density uses being replaced with higher density uses.
- Seattle office sale prices increased 6%/year in the same time frame with approximately 2.9 million sf of deliveries/year compared to 65,000 sf of demo.
- Retail and industrial values/sf increased by 5%/year and 12%/year, respectively.

- King County median assessed values for single family residential increased 44% from 2016-2020, equal to 11%/yr.
- These market conditions are reflected in higher real estate values in the estimate, with a significant jump in the RE Adjustment Multiplier used for commercial properties (from 1.67 in Phase 1 (2019) to 1.90 in Phase 2 (2020)).
- **SCC 70 – Vehicles**
 - *Vehicle costs for WSBLE included in ‘LRV Fleet Expansion’ project estimate, outside of this assessment scope.*
- **SCC 80 – Professional Services (Soft Costs)**
 - Soft Costs (for Professional Services) calculated as a percentage (%) of Construction Costs (SCC 10-50). These percentages were estimated in the ST3 (2016) planning phase and have been carried consistently throughout the various estimate phases, which can be found in the Table below. Sub-items not shown but included in the roll up include TOD planning, sustainability, access, and integration facilities. The Assessment Team believes these are appropriately allocated and fall within industry standards.

80.00	PROFESSIONAL SERVICES (SOFT COST)	Soft Cost %
80.03	Agency Administration	6.00%
80.01	Preliminary Engineering	5.00%
80.02	Final Design & DSDC	10.00%
80.05	Third Parties	2.00%
80.06	Permitting	0.50%
80.08	Start-up	1.50%
80.04	Construction Management	9.00%

- » *Admin is calculated on subtotal of SCC 10-70 plus all other SCC 80 items*
- » *TOD costs are included in the associated Professional Services category*
- » *Permitting and Startup costs are included in the Construction (SCC 10-50) for the ST3 (2016) Phase*

- **SCC 90 – Unallocated Contingency**
 - Unallocated Contingency based on Design maturity and calculated as a percentage (%) of SCC 10-80. UC is currently calculated at 10% for current design level which falls within industry standards.
 - Project Reserve of 7% was calculated for ST3 (2016) and Phase 1 (2019) estimates but not presented as total cost of the project. There are no Project Reserves accounted for in the Phase 2 (2020) estimate.

4.0 Tacoma Dome Link Extension (TDLE)

4.1 TDLE Key Findings

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the TDLE Phase 2 (2020) cost estimates are appropriate for an approximately 10% design. The Assessment Team focused primarily on at-grade and aerial guideway, stations, sitework/environmental, systems, and right-of-way.
- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** From ST3 (2016) to Phase 1 (2019) the alignment type shifted from roughly 1.7 miles of at-grade and 8.1 aerial to 4.0 miles of at grade and 5.8 miles of aerial. This should have been a cost-effective measure, but the overall cost estimate increased by \$657M. Rapidly rising real estate costs and other inflationary pressures over the 3-year period appear to be the main reasoning. From Phase 1 (2019) to Phase 2 (2020), the elevated profile of the guideway changed from 55% aerial to nearly 90% aerial. Therefore, there is a direct correlation between the price increase in guideway from Phase 1 (2019) to Phase 2 (2020) and the method of how the guideway was to be constructed. Furthermore, due to the increase in bridge span length and the complexity of construction, the aerial structures increased further from Phase 1 (2019) to Phase 2 (2020) analysis.
- c. **Capture of Phase 2 (2020) Elements:** The Assessment Team believes all areas of the estimate are captured in the Phase 2 (2020) estimates. The team would recommend further investigation into ground conditions along the alignment as this appears to be the project’s largest risk. It is worth noting, at the time of this report the dollars allocated to this category appear to be appropriate for the level of information available. Another apparent risk involves central control. As transit systems grow, many times the existing central control infrastructure is not capable of incorporating new alignments without considerable modifications or a completely new central control facility. The dollars allocated to the individual projects (such as TDLE) for central control modifications are appropriate for incorporating new alignments to a facility that can accommodate the expansion. If the addition of the multiple new projects extends the current central control facility beyond its capacity and major reconstruction or a new facility is required, the current allocations will not be sufficient.

4.2 TDLE SCC Details

Following is a detailed description of the TDLE findings by SCC:

- **SCC 10 – Guideway**

The guideway cost increased on the basis that the track alignment changed vertically in many segments. Because the guideway track could not be constructed at-grade level due to many obstacles and 3rd party conflicts, the track profile must be on an elevated structure. From Phase 1 (2019) to Phase 2 (2020), the elevated profile of the guideway changed from 55% aerial to nearly 90% aerial. Therefore, there is a direct correlation between the price increase in guideway from Phase 1 (2019) to Phase 2 (2020) and the method of how the guideway was to be constructed. Furthermore, due to the increase in bridge span length and the complexity of construction, the aerial structures increased further from Phase 1 (2019) to Phase 2 (2020) analysis.

Project: TDLE SCC: 10 (Guideway Only)	Estimated Cost Comparison (Millions)							
	ST3 Plan (2016)		Phase 1 (2019)			Phase 2 (2020)		
	Miles	2015\$	Miles	2019\$	%Change	Miles	2019\$	%Change
At-Grade	1.7	\$ 33.45	4.0	\$ 137.51	311%	1.1	\$ 34.34	-75%
Elevated	8.1	\$ 796.49	5.8	\$ 877.32	10%	8.7	\$ 1,086.73	24%
Underground	0.0	\$ -	0.05	\$ 16.02		0.0	\$ -	-100%
TOTALS:	9.7	\$ 829.93	9.9	\$ 1,030.85	24%	9.9	\$ 1,121.07	9%

An illustration of the guideway differentials between estimate phases

SCC 20 – Stations

For SCC 20 Stations, cost increased because of two factors. A planned at-grade station during ST3 (2016) changed to an elevated station based on the guideway alignment becoming aerial in Phase 1 (2019) and the station then having to match the profile height. Additionally, over \$100M cost increased from Phase 1 (2019) to Phase 2 (2020) in the station estimates. The cost increase is a result of adding mezzanines, elevators, and escalators to the stations. There was a revised increase in quantity for all these elevated transportation methods as Phase 1 (2019) had a limited amount in their estimate.

SCC 30 – Support Facilities

- Operations and Maintenance Facility (OMF) costs for TDLE included in OMFS project estimate.

SCC 40 – Sitework & Special Conditions

The drainage scope increased the site work costs substantially. In the ST3 (2016) estimate there was very limited site work cost allocated for drainage systems relative to the length of the project. In Phase 1 (2019), there were unit costs derived for the length of the project, but it does not appear any drainage method was chosen. In the Phase 2 (2020) estimate, drainage vaults were outlined as a required design method. Therefore, costs more than doubled in the drainage construction. Constructing concrete drainage vault structures require a higher material cost, equipment cost and labor cost than the previous assumed alternative of retention ponds.

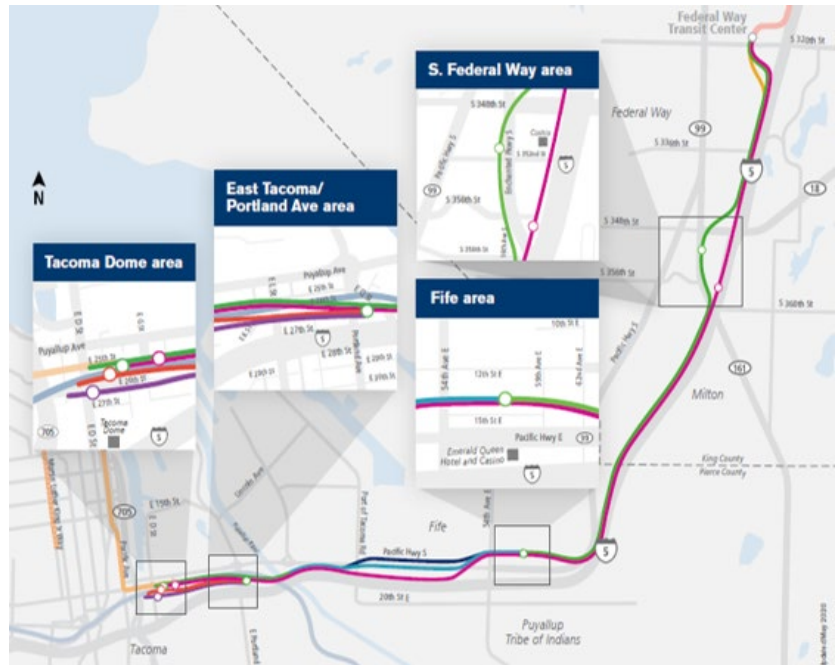
Project: TDLE SCC: 40 (Sitework Only)	Estimated Cost Comparison (Millions)							
	ST3 Plan (2016)		Phase 1 (2019)			Phase 2 (2020)		
Alignment Type:	Miles	2016	Miles	2019\$	%Change	Miles	2019\$	%Change
At-Grade	1.7	\$ 29.42	4.0	\$ 116.26	295%	1.1	\$ 55.49	-52%
Elevated	8.1	\$ 136.25	5.8	\$ 168.42	24%	8.7	\$ 435.34	158%
Underground	0.0	\$ -	0.05	\$ 1.43		0.0	\$ -	-100%
TOTALS:	9.7	\$ 165.67	9.9	\$ 286.10	73%	9.9	\$ 490.84	72%

Further evaluation of site specific environmental.

SCC 40.03 Review comments:

- Estimating methodology (Light, Medium, Heavy) and unit rates differed between the estimates.
- Route Feet increased by 0.2% from ST3 (2016) (51,925RF) to Phase 2 (2020) (52,026RF).
- Project cost increased by 253% from ST3 (2016) (\$12.9M) to Phase 2 (2020) (\$45.4M) but decreased by 17% from Phase 1 (2019) (\$54.9M).
- Scope of work allowance changed from Light to a mix of Light, Medium, and Heavy thus increase in unit rate, adding \$11.4M for 40.03 and \$8.1M for 40.04 in Phase 2 (2020).
 - 40.03 ST3 (2016) - 51,925RF was priced as Light with a unit rate of \$130/RF.
 - 40.03 Phase 2 (2020) – 22,617RF was priced as Light with a unit rate of \$160.72/RF, 8,975RF was priced as Medium with a unit rate of \$321.44/RF and 20,433RF was priced as Heavy with a unit rate of \$579.14/RF.
 - 40.04 ST3 (2016) - 51,425RF was priced as Light with a unit rate of \$106.60/RF and 1,150RF was priced as Heavy with a unit rate of \$507.00/RF.
 - 40.04 Phase 2 (2020) – 21,881RF was priced as Light with a unit rate of \$131.90/RF, 30,014RF was priced as Medium with a unit rate of \$369.93/RF and 130RF was priced as Heavy with a unit rate of \$627.63/RF.

- New item of 1 LS was added in Phase 2 (2020) for 40.04, adding \$13M at Puyallup River Crossing for clear span crossing (Tribes Ceremonial Grounds, Water Quality and Fishery Impacts).
 - 2000LF x both sides of Puyallup River @\$300/LF, equates to \$1.2M.
 - 9 acres of site disturbance around Puyallup River. Assuming worst case scenario, 1:1 ratio, at \$1M per acre which equates to \$9.0M.
 - Total cost equates to \$10.2M plus 30% contingency for Design, PM, Survey and Monitoring. \$13.0M in Phase 2 (2020) appears adequate for the Environmental mitigation at this site.

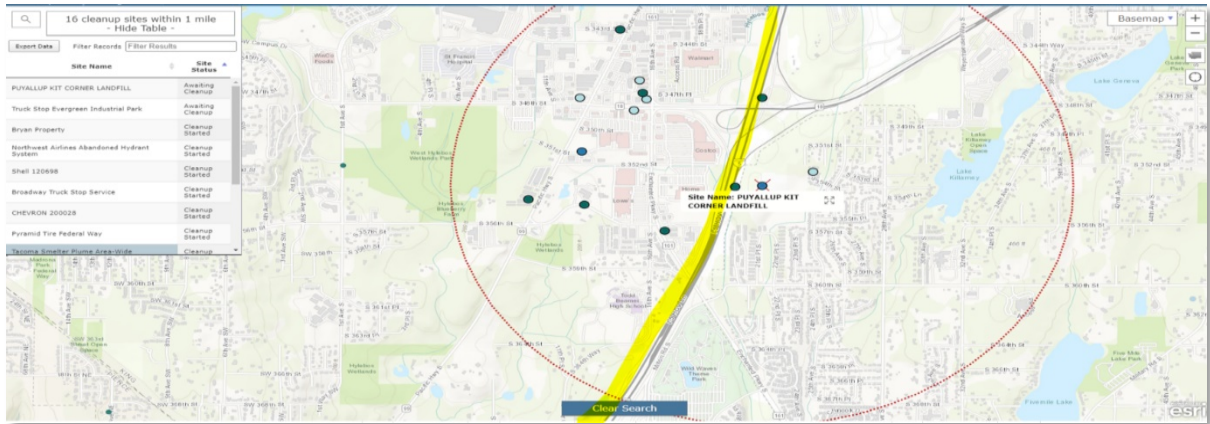


Alignment Type:	ST3 Plan (2016)				Phase 1 (2019)				Phase 2 (2020)			
	QTY	UOM	Rate	2015\$	QTY	UOM	Rate	2019\$	QTY	UOM	Rate	2019\$
Elevated - Segment A												
40.03	12280			\$ 1,596,400.00	23485			\$ 4,992,468.00	23435			\$ 6,488,177.00
Light	12280	RF	130.00	\$ 1,596,400.00	23485	RF	212.58	\$ 4,992,468.00	15760	RF	160.72	\$ 2,532,918.00
Medium		0 RF	0.00	\$ -		0 RF	0.00	\$ -	1900	RF	321.44	\$ 610,729.00
Heavy		0 RF	0.00	\$ -		0 RF	0.00	\$ -	5775	RF	579.14	\$ 3,344,530.00
40.04	12280			\$ 1,309,048.00	23485			\$ 7,964,869.00	23435			\$ 6,759,097.00
Light	12280	RF	106.60	\$ 1,309,048.00	23485	RF	339.15	\$ 7,964,869.00	8025	RF	131.90	\$ 1,058,495.00
Medium		0 RF	0.00	\$ -		0 RF	0.00	\$ -	15410	RF	369.93	\$ 5,700,602.00
Elevated - Segment B												
40.03	21330			\$ 2,772,900.00	18759			\$ 4,210,185.00	18955			\$ 6,833,784.00
Light	21330	RF	130.00	\$ 2,772,900.00	4209	RF	193.79	\$ 815,677.00	6007	RF	160.72	\$ 965,471.00
Medium		0 RF	0.00	\$ -	14550	RF	233.30	\$ 3,394,508.00	6325	RF	321.44	\$ 2,033,084.00
Heavy		0 RF	0.00	\$ -		0 RF	0.00	\$ -	6622	RF	579.14	\$ 3,835,229.00
40.04	21330			\$ 2,273,778.00	18759			\$ 4,627,421.00	18955			\$ 5,343,347.00
Light	21330	RF	106.60	\$ 2,273,778.00	4209	RF	249.21	\$ 1,048,927.00	7150	RF	131.90	\$ 943,121.00
Medium		0 RF	0.00	\$ -	14550	RF	245.94	\$ 3,578,494.00	11674	RF	369.93	\$ 4,318,634.00
Heavy		0 RF	0.00	\$ -		0 RF	0.00	\$ -	130	RF	627.63	\$ 81,592.00
Elevated - Segment C												
40.03	18315			\$ 2,549,950.00	9928			\$ 4,688,391.00	9636			\$ 5,031,651.00
Light	17815	RF	130.00	\$ 2,315,950.00	6719	RF	438.22	\$ 2,944,332.00	850	RF	160.72	\$ 136,610.00
Medium		0 RF	0.00	\$ -	3210	RF	543.41	\$ 1,744,059.00	750	RF	321.44	\$ 241,077.00
Heavy	500	RF	468.00	\$ 234,000.00		0 RF	0.00	\$ -	8036	RF	579.14	\$ 4,653,964.00
40.04	17815			\$ 2,359,539.00	9928			\$ 28,388,161.00	9636			\$ 14,968,410.00
Light	16665	RF	106.60	\$ 1,776,489.00	6719	RF	4166.06	\$ 27,990,950.00	6706	RF	131.90	\$ 884,519.00
Medium		0 RF	0.00	\$ -	3210	RF	123.76	\$ 397,211.00	2930	RF	369.93	\$ 1,083,891.00
Heavy	1150	RF	507.00	\$ 583,050.00		0 RF	347.10	\$ -	0	RF	0.00	\$ -
Puyallup River Crossing		0 LS	0.00	\$ -		0 LS	0.00	\$ -	1	LS	13000000.00	\$ 13,000,000.00
TOTALS:				\$ 12,861,615.00				\$ 54,871,495.00				\$ 45,424,466.00

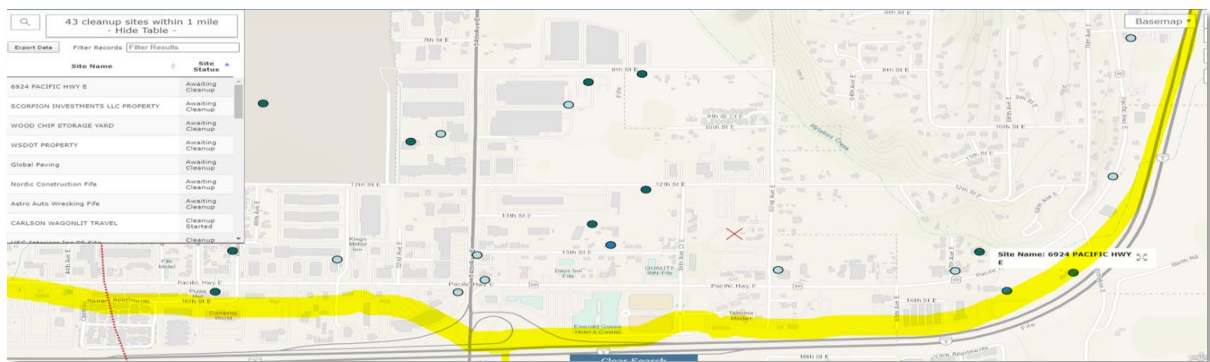
SCC 40 Clarifications / Questions / Recommendations:

- Minimum effects to Hylebos Creek and Wapato Creek – preserving wetlands, trees, and vegetation.
- Minimum archaeological affect near Puyallup River for the Puyallup Tribe of Indians – cultural and human remains due to alignment type change

Ecology Figure 1



Ecology Figure 2



Ecology Figure 3



■ **SCC 50 – Systems**

The SCC 50 scopes saw cost increase attributed to two main factors. There was a 13% cost increase from ST3 (2016) to Phase 1 (2019) attributed to escalation as the total systems quantities did not change significantly. Cost increased from Phase 1 (2019) to Phase 2 (2020) by 8% attributed to an overall increase in the systems quantities due to an increase in track footage. The Assessment Team analyzed the unit cost library (UCL) for the SCC 50 subcodes 50.01 – 50.07 and found significant variation between the Sound Transit units costs and the Assessment Team’s comparison unit costs. The variations were up to 50% of the unit cost. Some indicated the Sound Transit unit costs were too low, and some too high. Combined, the fluctuations in cost accounted for the total dollars within the SCC 50 codes to be very close to the project budgets as a whole. The Assessment Team will expand its analysis on the UCL as it relates to SCC 50 during the methodology review.

▪ SCC 60 – ROW, Land, Existing Improvements

Overview

The Assessment Team reviewed ROW cost estimates for ST3 (2016) Plan, Phase 1 (2019) and Phase 2 (2020) for the TDLE project in comparison to project design and planning documents that were made available. Based on this review, in conjunction with interviews with ST staff and project team leads, it was determined that the ST ROW Cost Estimating Methodology was applied appropriately and consistently across the three levels of the estimates.

The Assessment Team also compared actual sale prices of residential and non-residential properties throughout the corridor to the assessed values to test the reasonableness of the real estate adjustment multipliers used in the ROW estimates. We found that the multipliers used in the estimates fall within the range of appropriate adjustment factors indicated by the actual sales.

The Assessment Team further estimated relocation costs based on occupancy on several of the parcels along the alignment to compare to the relocation costs estimated as a part of the project contingency. The results varied widely, as the estimate methodology relies on costs to average out over the whole project.

SCC 60 Comparison of Estimates

ST3 (2016) Plan to Phase 2 (2020)

Specifically, we examined End-to-End Scenario 2 in depth to compare ROW costs from one level of estimate to the next. Due to discrepancies in naming conventions and project segmentation, we were unable to determine the appropriate Phase 1 (2019) alternatives to correspond to their Phase 2 (2020) counterparts. Therefore, we compared costs from the ST3 (2016) Plan estimate to the Phase 2 (2020) estimate.

Overall ROW costs increased from \$107M in the ST3 (2016) plan to \$201M, representing an increase of 88%.

Alignment changes and design refinement led to an increase in the total number of impacted parcels, from 139 in the ST3 (2016) Plan estimate to 194 in the Phase 2 (2020) estimate, including 97 parcels being reclassified as easement acquisitions in Phase 2 (2020).

The ST3 (2016) plan estimate characterized parcels as being impacted either by elevated track or at grade track, whereas the Phase 2 (2020) estimate with its refined design included 33 parcels that were characterized as having both elevated and at grade impacts. This category, though consisting of fewer parcels than the other two, accounts for nearly half of the total project cost (\$94.9 M).

The total area of impacted ROW increased from approximately \$3.5M sf in the ST3 (2016) Plan Estimate to \$5.8M sf in the Phase 2 (2020) estimate (67% increase), with the number of full takes increasing from 42 to 54 (29% increase).

Other significant factors include rapidly rising real estate costs in the Greater Seattle Metro Area:

- Seattle Metro multifamily residential sale prices increased from \$273k/unit in 2016 to \$339k/unit in 2020, equal to appreciation of 24%, or 8%/yr.
- Seattle Metro office sale prices increased from \$394 per sf in 2016 to \$473 per sf in 2020, equal to appreciation of 20% or 5% per year.
- Retail and industrial values/sf increased by 15% and 42%, respectively.
- King County median assessed values for single family residential increased 44% from 2016-2020, equal to 11%/yr, and Pierce County median assessed values for single family residential increased 47% from 2016-2020, equal to 12%/yr.
- These market conditions are reflected in higher real estate values in the estimate, with a significant jump in the RE Adjustment Multipliers used for the properties in King and Pierce Counties:
 - » Residential – 1.18 to 1.40 (PC) and 1.30 (KC) → 10%-19% increase
 - » Commercial – 1.23 to 1.40 (PC) and 1.67 (KC) → 14%-36% increase

Additionally, the ST3 (2016) plan estimate used an overall contingency of 55% compared to a median contingency of 75% in the Phase 2 (2020) estimate, equal to a 36% increase to contingency values.

Conclusion

Given the changes in alignment, the refinement of the design elements, and the overall increase of property values, along with the increased multipliers and contingencies, the difference in ROW costs between the two estimates appears to be adequately explained.

▪ **SCC 70 – Vehicles**

- *Vehicle costs for TDLE is included in LRV Fleet Expansion project which is outside of this scope.*

▪ **SCC 80 – Professional Services (Soft Costs)**

- Soft Costs (for Professional Services) calculated as a percentage (%) of Construction Costs (SCC 10-50). These percentages were estimated in the ST3 (2016) planning phase and have been carried consistently throughout the various estimate phases, which can be found in the table below. Sub-items not shown but included in the roll up include TOD planning, sustainability, access, and integration facilities. The Assessment Team believes these are appropriately allocated and fall within industry standards.

80.00	PROFESSIONAL SERVICES (SOFT COSTS)	Soft Cost %
80.03	Agency Administration	6.00%
80.01	Preliminary Engineering	5.00%
80.02	Final Design & DSDC	10.00%
80.05	Third Parties	2.00%
80.06	Permitting	0.50%
80.08	Start-up	1.50%
80.04	Construction Management	9.00%

- » *Admin is calculated on subtotal of SCC 10-70 plus all other SCC 80 items*
- » *TOD costs are included in the associated Professional Services category*
- » *Permitting and Startup costs are included in the Construction (SCC 10-50) for the ST3 (2016) Phase*

▪ **SCC 90 – Unallocated Contingency**

- Unallocated Contingency based on Design maturity and calculated as a percentage (%) of SCC 10-80. UC is currently calculated at 10% for current design level which falls within industry standards.
- Project Reserve of 7% was calculated for ST3 (2016) and PH1 estimates but not presented as total cost of the project. There are no Project Reserves accounted for in PH2 estimates.

5.0 Operation & Maintenance Facility South (OMFS)

5.1 OMFS Key Findings

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the OMFS Phase 2 (2020) cost estimates are appropriate for an approximately 10% design. The Assessment Team focused on support facilities, sitework/environmental, systems, and right-of-way.
- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** For ST3 (2016) estimates no location had been decided. It appears many options were explored from Phase 1 (2019) to Phase 2 (2020) and the three front runners (S. 344th St, S 336th St, and Midway Landfill) were used for this assessment. All three locations saw increases in cost in the amount of 54%, 66%, and 89%, respectively. For 334th & 336th, the primary drivers of this increase were increased structure heights resulting in higher unit cost, further detail in demolition and earthwork requirements, drainage vaults were added instead of retention ponds, and landscaping allowances were added. For the Midway Landfill location, the major cost drivers were disposal of hazardous materials, refiguration of demolition and earthwork requirements, the use of drainage vaults as opposed to retention ponds and additional piling cost. Details of the FTA SCC categories is shown below.
- c. **Capture of Phase 2 (2020) Elements:** The Assessment Team believes all areas of the estimate are captured in the Phase 2 (2020) estimates. The Assessment Team would recommend further investigation into ground conditions along the alignment as this appears to be the project's largest risk, particularly at Midway Landfill.

5.2 OMFS SCC Details

Globally, the cost of 336th Street and 344th Street are close. Cost increases occurred in each iteration of the estimate stages. Originally, the ST3 (2016) cost was approximately \$537M for the building and site improvements. The Phase 1 (2019) estimate increased to around \$750M, which was based on utilizing actual unit costs for the OM from comparative projects. The Phase 2 (2020) estimate increased to approximately \$1.15 billion. There were several reasons why the expected cost rose between these estimates. Largely: building size increase, the addition of drainage vaults, and injection of environmental mitigation allowances.

Following is a detailed description of the OMFS findings by SCC:

- **SCC 10 – Guideway**
 - *No specific findings to report.*
- **SCC 20 – Stations**
 - *Not applicable.*
- **SCC 30 – Support Facilities**

For SCC 30 OMF building costs, the price increased 16% from ST3 (2016) estimate to the Phase 1 (2019) estimate. For Phase 1 (2019), the Sound Transit team utilized unit prices from existing projects and incorporated escalation into the estimate. From Phase 1 (2019) to Phase 2 (2020), the price of the facility increased slightly. Added costs for additional yard track and alignment were added in Phase 1 (2019). However, the actual building cost decreased from an expected \$249M in Phase 1 (2019) to an expected \$181M in Phase 2 (2020). It is the understanding that the building square footage increased by 36% in Phase 1 (2019). While details are limited at the currently level of the design, the Assessment Team forecasts this could add upward cost pressures to the facility cost.

- **SCC 40 – Sitework & Special Conditions**

The changes to the SCC 40 Sitework items were substantial between the estimate phases. The ST3 (2016) budgeted projected cost was approximately \$48M. For the 336th site and 344th site, the expected cost of sitework is now approximately \$310M. The main reason for the drastic rise in cost center around two scopes: the additional drainage structures and the additional environmental measures. Drainage vault construction is the planned methodology to alleviate the water run-off design requirements. The original plan was to utilize retention ponds. This design change added over \$120M in construction costs to the site.

The sitework costs at the Midway landfill are significant. The most expensive option would be the platform construction alternative. Majority of the increased cost between Phase 1 (2019) and Phase 2 (2020) is yet another design change. Due to the information on the ground boring data, it appears that approximately 700 drilled shafts are needed for the platform erection. The Phase 1 (2019) estimate had an initial expectation of 185 drilled shafts for the platform. The more in-depth analysis of the design criteria for the platform created a more than \$300M increase. The Assessment Team believes that the sitework cost for the full excavation carry substantial risk. According to the boring data, the landfill appears to span in depths of more than 150 feet deep in some areas. Extensive shoring, erosion protection, and rain-event protection would be needed to perform a full excavation.

Project: OMFS SCC: 40 (Sitework Only)	Estimated Cost Comparison (Millions)							
	ST3 Plan (2016)		Phase 1 (2019)		%Change	Phase 2 (2020)		
	Miles	2015\$	Miles	2019\$		Miles	2019\$	%Change
S 344th Street	0.0	\$ 47.69	0.0	\$ 101.78	113%	0.0	\$ 314.34	209%
S 336th Street			0.0	\$ 74.84	57%	0.0	\$ 304.18	306%
Landfill (Midway)-Platform			0.0	\$ 491.14	930%	0.0	\$ 1,182.83	141%
Landfill (Midway)-Hybrid						0.0	\$ 878.94	79%
Landfill (Midway)-Full-Ex						0.0	\$ 784.26	60%

Additionally, the Assessment Team would recommend analyzing the confidence of adhering to the settlement requirements for either the hybrid or full excavation operations. The settlement tolerances of one inch over 50 years and a differential settlement of 3/4 inch over 100 feet are stringent. In excavation zones that range from 50-150 feet, substantial cost is required to make these tolerances achievable.

Operations and Maintenance Facility South – 344th Street, Federal Way

- This location was not specifically determined in ST3 (2016).
 - » ST3 (2016) – I5 and SR18
 - » Phase 1 (2019) & 2 (2020) – I5 and S344th St
- Estimating methodology (Light, Medium, Heavy) and unit rates differed between the estimates.
- Route Feet increased by 219% from ST3 (2016) (1,420RF) to Phase 2 (2020) (4,527RF).
- Project cost increased by 585% from ST3 (2016) (\$815,932) to Phase 2 (2020) (\$5.6M).
- Scope of work allowance changed from Light to Medium and Heavy, thus increase in unit rate, adding \$833,518 in Phase 2 (2020).
 - » 40.03 ST3 (2016) – 1,420RF was priced as Heavy with a unit rate of \$468/RF.
 - » 40.03 Phase 2 (2020) – 4,527RF was priced as Light with a unit rate of \$160.72/RF.
 - » 40.04 ST3 (2016) – 1,420RF was priced as Light with a unit rate of \$106.60/RF.
 - » 40.04 Phase 2 (2020) – 3,467RF was priced as Medium with a unit rate of \$369.93/RF and 1,061RF was priced as Heavy with a unit rate of \$627.63/RF.
- Increase in site square footage thus a new item of 440,456SF was added in Phase 2 (2020) for 40.03, adding \$2.9M.



Alignment Type:	ST3 Plan (2016)				Phase 1 (2019)				Phase 2 (2020)			
	QTY	UOM	Rate	2015\$	QTY	UOM	Rate	2019\$	QTY	UOM	Rate	2019\$
40.03	1420			\$ 664,560.00	3700			\$ 557,960.00	4527			\$ 3,590,577.00
Light	0	RF	0.00	\$ -	3700	RF	150.80	\$ 557,960.00	4527	RF	160.72	\$ 727,613.00
Light (SF Basis)	0	RF	0.00	\$ -	0	RF	0.00	\$ -	440456	SF	6.50	\$ 2,862,964.00
Heavy	1420	RF	468.00	\$ 664,560.00	0	RF	0.00	\$ -	0	RF	0.00	\$ -
40.04	1420			\$ 151,372.00	3700			\$ 1,284,270.00	4527			\$ 2,000,395.00
Light	1420	RF	106.60	\$ 151,372.00	0	RF	0.00	\$ -	0	RF	0.00	\$ -
Medium	0	RF	0.00	\$ -	3700	RF	347.10	\$ 1,284,270.00	3467	RF	369.92	\$ 1,282,343.00
Heavy	0	RF	0.00	\$ -	0	RF	0.00	\$ -	1061	RF	627.63	\$ 665,792.00
Allowance	0	RF	0.00	\$ -	0	RF	0.00	\$ -	1	LS	52260.00	\$ 52,260.00
TOTALS:				\$ 815,932.00				\$ 1,842,230.00				\$ 5,590,972.00

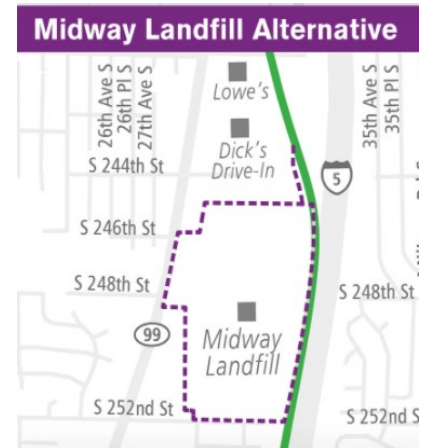
Ecology Figure 4



Operations and Maintenance Facility South – Midway Landfill (Platform)

Review comments:

- This option was not part of ST3 (2016).
- Estimating methodology (Light, Medium, Heavy) and unit rates differed between the estimates.
- Route Feet increased by 159% from Phase 1 (2019) (2,350RF) to Phase 2 (2020) (6,081RF).
- Project cost increased by 2,425% from Phase 1 (2019) (\$1.5M) to Phase 2 (2020) (\$38.3M).
- Scope of work allowance changed, thus increase in unit rate, adding \$2.5M in Phase 2 (2020).
 - » 40.03 Phase 1 (2019) – 2,350RF was priced as Heavy with a unit rate of \$493.28/RF.
 - » 40.03 Phase 2 (2020) – 1,747RF was priced as Light with a unit rate of \$160.72/RF and 4,334RF was priced as Heavy with a unit rate of \$579.14.
 - » 40.04 Phase 1 (2019) – 2,350RF was priced as Light with a unit rate of \$152.27/RF.
 - » 40.04 Phase 2 (2020) – 4,334RF was priced as Light with a unit rate of \$131.90/RF and 1,747RF was priced as Medium with a unit rate of \$369.93.



Alignment Type:	ST3 Plan (2016)				Phase 1 (2019)				Phase 2 (2020)			
	QTY	UOM	Rate	2015\$	QTY	UOM	Rate	2019\$	QTY	UOM	Rate	2019\$
At-Grade - Landfill (Midway) Platform												
40.03	0			\$ -	2350			\$ 1,159,210.00	6081			\$ 37,087,388.00
Light	0	RF	\$ -	\$ -	0	RF	0.00	\$ -	1747	RF	160.72	\$ 280,775.00
Heavy	0	RF	\$ -	\$ -	2350	RF	493.28	\$ 1,159,210.00	4334	RF	579.14	\$ 2,510,013.00
Wastewater Management - surface water & landfill	0		\$ -	\$ -	0		0.00	\$ -	52	AC	4550.00	\$ 236,600.00
Wet Season Erosion & Sediment Control	0		\$ -	\$ -	0		0.00	\$ -	4	YR	65000.00	\$ 260,000.00
Final Capping System	0		\$ -	\$ -	0		0.00	\$ -	52	AC	650000.00	\$ 33,800,000.00
40.04	0			\$ -	2350			\$ 357,838.00	6081			\$ 1,217,925.00
Light	0	RF	\$ -	\$ -	2350	RF	152.27	\$ 357,838.00	4334	RF	131.90	\$ 571,659.00
Medium	0	RF	\$ -	\$ -	0	RF	0.00	\$ -	1747	RF	369.93	\$ 646,266.00
TOTALS:				\$ -				\$ 1,517,048.00				\$ 38,305,313.00

- New item of \$236,600 was added for wastewater management to treat and dispose of the contaminated surface water. The assumption is this will be used for dust control during construction.
 - » Assuming 6 x 750 GPM Mobile Treatment Solutions at \$35,000 = \$210,000
 - » Assuming 2 x Dissolving Tank at \$20,000 = \$40,000
 - » Assuming temporary piping and connections at \$25,000
- New item of \$260,000 was added for Erosion and Sediment Control which seems adequate.
 - » 52 acres of GeoNet, 3:1 slope at \$0.50 per SF = \$302,016

- New item of \$33.8M was added for Final Capping System for complete replacement of liner and landfill gas collection system. It seems to be high, but it may cover for unknowns/risks since it is a landfill.

Excavation & Site prep - 5' deep	419467	CY	15.00	\$	6,292,000.00
Remove existing gas collection system	52	AC	12750.00	\$	663,000.00
Gas Probes	11.4	EA	10,000.00	\$	114,000.00
Wells	52	EA	30,000.00	\$	1,560,000.00
Pipes - 6" PVC	10400	LF	150.00	\$	1,560,000.00
Flare	2	EA	400,000.00	\$	800,000.00
Gas Management System	52	AC	75,000.00	\$	3,900,000.00
Maintenance	52	AC	18,000.00	\$	936,000.00
Survey and Permits	1	LS	400,000.00	\$	400,000.00
Remove existing liner	52	AC	13068.00	\$	679,536.00
Geosynthetic clay liner	52	AC	43,560.00	\$	2,265,120.00
60mil HDPE liner	52	AC	32,670.00	\$	1,698,840.00
CQA - Liner	52	AC	20,000.00	\$	1,040,000.00
Design/PM/Testing	30%		21,908,496.00	\$	6,572,548.80
				\$	28,481,044.80

Clarifications / Questions / Recommendations:

- Wastewater management to treat and dispose of the contaminated surface water.
 - This scope of work is difficult to price since unit treatment costs are always dependent on the level of treatment necessary to remove the specific contaminants of concern to gain the final water quality required.
 - Assume the water would be used for daily cover amendment and dust control. If that is the case, the water has a positive value to the landfill, so there would be lower or no disposal cost.
- Midway Landfill Option 2 (Hybrid) and Option 3 (Full Excavation) was only included in Phase 2 (2020).
 - New item of \$304,200 was added for dewatering, which seems adequate.

Drainage trench	1392	CY	100.00	\$	139,222.22
Pumping	730	Day	175.00	\$	127,750.00
				\$	266,972.22

- New item of \$6.8M was added for temporary capping system which seems to be enough.

Gas Probes	11.4	EA	10,000.00	\$	114,000.00
Wells	105	EA	12,000.00	\$	1,260,000.00
Pipes - 6" PVC	10400	LF	150.00	\$	1,560,000.00
Flare	2	EA	400,000.00	\$	800,000.00
Permits	1	LS	400,000.00	\$	400,000.00
Design/PM/Testing	30%		4,134,000.00	\$	1,240,200.00
				\$	5,374,200.00



OMFS – 336th Street, Federal Way | SCC 40 Review comments:

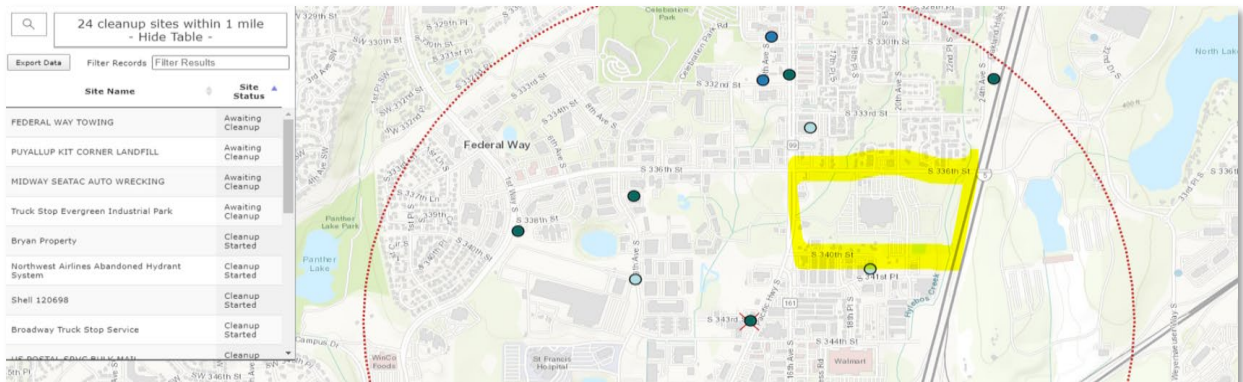
- Estimating methodology (Light, Medium, Heavy) and unit rates differed between the estimates.
- Route Feet increased by 23% from Phase 1 (2019) (3,500RF) to Phase 2 (2020) (4,309RF).
- Project cost increased by 3,844% from Phase 1 (2019) (\$1.7M) to Phase 2 (2020) (\$68.7M).
- Scope of work allowance changed from Light to Medium, thus increase in unit rate, adding \$544,029 in Phase 2 (2020).
 - » 40.03 Phase 1 (2019) – 3,500RF was priced as Light with a unit rate of \$150.80/RF.
 - » 40.03 Phase 2 (2020) – 4,309RF was priced as Light with a unit rate of \$160.72/RF.
 - » 40.04 Phase 1 (2019) – 3,500RF was priced as Medium with a unit rate of \$347.10/RF.
 - » 40.04 Phase 2 (2020) – 4,309RF was priced as Medium with a unit rate of \$369.93/RF.
- Increase in building square footage thus a new item of 101,114SF was added in Phase 2 (2020) for 40.03, adding \$657,241.
- Site shows some wetlands and streams that will need Environmental Mitigation which was not assumed during Phase 1 (2019) but was included in Phase 2 (2020) worth \$65.8M. (5:1 ratio, \$250,000/Acre for land cost, \$500,000/Acre for wetland mitigation and \$25,000/Acre for wetland maintenance costs)
 - » 5 acres of Wetland.
 - » 3,300 LF of Stream x 10' wide which equates to 0.76 acre.
 - » 15 acres of wetland/stream buffer.
 - » Cost includes for wetland relocation.
 - » Assuming worst case scenario, 5:1 ratio, at \$1M per acre which equates to \$43.8M plus 30% contingency for Design, PM, Survey and Monitoring. \$65.78M in Phase 2 (2020) seems adequate.



Alignment Type:	Phase 1 (2019)				Phase 2 (2020)			
	QTY	UOM	Rate	2019\$	QTY	UOM	Rate	2019\$
40.03	3500			\$ 527,800.00	4309			\$ 1,349,812.00
Light	3500	RF	150.80	\$ 527,800.00	4309	RF	160.72	\$ 692,571.00
Light (SF Basis)	0	RF	0.00	\$ -	101114	SF	6.50	\$ 657,241.00
Heavy	0	RF	0.00	\$ -	0	RF	0.00	\$ -
40.04	3500			\$ 1,214,850.00	4309			\$ 67,374,108.00
Light	0	RF	0.00	\$ -	0	RF	0.00	\$ -
Medium	3500	RF	347.10	\$ 1,214,850.00	4309	RF	369.93	\$ 1,594,108.00
Heavy	0	RF	0.00	\$ -	1	LS	65780000.00	\$ 65,780,000.00
TOTALS:				\$ 1,742,650.00				\$ 68,723,920.00

Clarifications / Questions / Recommendations

- Does WSDOT has wetland/mitigation bank in the neighborhood that can be used?



▪ SCC 50 – Systems

The SCC 50 scopes were difficult to evaluate for changes from ST3 (2016), Phase 1 (2019) and Phase 2 (2020). ST3 (2016) and Phase 1 (2019) did not break out systems for the yard and yard track separate from larger yard pricing. Phase 2 (2020) broke out the systems elements into the SCC 50 categories which appears appropriate. The Assessment Team analyzed the unit cost library (UCL) for the SCC 50 subcodes 50.01 – 50.07 and found significant variation between the Sound Transit units costs and the Assessment Team’s comparison unit costs. The variations were up to 50% of the unit cost. Some indicated the Sound transit unit costs were too low, and some too high. Combined, the fluctuations in cost accounted for the total dollars within the SCC 50 codes to be very close to the project budgets as a whole. The Assessment Team will expand its analysis on the UCL during as it related to SCC 50 during the methodology review.

▪ SCC 60 – ROW, Land, Existing Improvements

Based on this review, in conjunction with interviews with ST staff and project team leads, it was determined that the ST ROW Cost Estimating Methodology was applied appropriately and consistently across all three levels of the estimates. In certain cases, as the design was refined, appropriate deviations from the methodology were made to specifically address significant ROW impacts.

The Assessment Team also compared actual sale prices of residential and non-residential properties throughout the corridor to the assessed values to test the reasonableness of the real estate adjustment multipliers used in the ROW estimates. We found that the multipliers used in the estimates fall within the range of appropriate adjustment factors indicated by the actual sales.

The Assessment Team further estimated relocation costs based on occupancy on several of the parcels within the proposed alternatives to compare to the relocation costs estimated as a part of the project contingency. The results varied widely, as the estimate methodology relies on costs to average out over the whole project.

Comparison of Estimates

Three alternative sites were compared for the purposes of this analysis: 344th (Trucking Site), 336th (Christian Faith Center Site), and the Midway Landfill Site.

ST3 (2016) Plan to Phase 1 (2019)

The baseline ST3 (2016) Plan estimate was based on a proposed site location near the SR-18 and I-5 Interchange. The original estimate assumed 8 impacted parcels with a total cost of \$30.68 million.

For the Phase 1 (2019) estimates, we analyzed the three alternatives that were also used in Phase 2 (2020), which are all different than the original ST3 (2016) Plan site.

- **344th site:** costs increased to \$97.35M, an increase of 217%, with 36 impacted parcels.
- **Midway landfill site:** costs increased to \$53.56M, an increase of 75%, with 9 impacted parcels.
- **336th site:** costs increased to \$107.58M, an increase of 251%, with 16 impacted parcels.

In all cases, the primary reason for the substantially disparate costs is due to the difference in site locations, with unique ROW impacts. Secondly, rapidly rising real estate costs also contributed to overall cost increases, all other factors being equal.

Phase 1 (2019) to Phase 2 (2020)

In each of the proposed site alternatives, design refinements occurred between Phase 1 (2019) and Phase 2 (2020), resulting in a more accurate understanding of the ROW impacts.

- **344th (Trucking Site)**

Total acquisition area increased from \$1.79M sf to \$2.86M sf (60%), however, the costs **only** increased from \$97.35M to \$105.33M (8%).

- **Midway Landfill Site**

Total acquisition area increased from \$1.92M sf to \$3.10M sf (62%), increasing from 16 parcels to 44 parcels (175%); however, the costs decreased from \$53.56M to \$33.79M (-37%). The increased ROW impacts were a result of design refinements, including the addition of 21 new partial takes, but the decreased cost is the result in another appropriate

deviation from the ST3 (2016) methodology. Due to the environmental/site conditions of the landfill, and the proposal of a long-term lease instead of a fee acquisition, a market rent appraisal was obtained and the associated real estate adjustment factors and contingencies were removed from this parcel. This results in a more accurate estimation of ROW costs.

- **336th** (Christian Faith Center Site)

Total acquisition area increased from \$2.13M sf to \$2.73M sf (28%), increasing from 9 parcels to 32 parcels (256%); however, the costs decreased from \$107.56M to \$103.31M (-4%). The increased ROW impacts were a result of design refinements, including the addition of 14 new partial takes, but the decreased cost is the result in another appropriate deviation from the ST3 (2016) methodology. In Phase 1 (2019), the relocation cost associated with the Church property was grossly overinflated due to use of a 20% contingency based on the real estate value, thus skewing the entire estimate to the high end. For Phase 2 (2020), this parcel was re-examined, and a relocation cost was estimated based on actual occupancy, rather than simply relying on a percentage of the real estate costs. This results in a more accurate estimation of ROW costs.

We note that rapidly rising real estate values in the Greater Seattle Metro Area, as shown below, did cause an upward trend on estimated values:

- Seattle Metro multifamily residential sale prices increased from \$273k/unit in 2016 to \$339k/unit in 2020, equal to appreciation of 24%, or 8%/yr.
- Seattle Metro office sale prices increased from \$394 per sf in 2016 to \$473 per sf in 2020, equal to appreciation of 20% or 5% per year.
- Retail and industrial values/sf increased by 15% and 42%, respectively.
- King County median assessed values for single family residential increased 44% from 2016-2020, equal to 11%/yr, and Pierce County median assessed values for single family residential increased 47% from 2016-2020, equal to 12%/yr.
- These market conditions are reflected in higher real estate values in the estimate, with a significant jump in the RE Adjustment Multipliers used for the properties in King and Pierce Counties:
 - » Residential – 1.18 to 1.40 (PC) and 1.30 (KC) → 10%-19% increase
 - » Commercial – 1.23 to 1.40 (PC) and 1.67 (KC) → 14%-36% increase
- However, the change in property values was offset by the design refinements and the deviations from the ST3 (2016) methodology.

- **SCC 70 – Vehicles**

- *Vehicle costs for OMFS were included in the LRV Fleet Expansion project which is outside of this scope.*

- **SCC 80 Professional Services (Soft Costs):**

- Soft Costs (for Professional Services) calculated as a percentage (%) of Construction Costs (SCC 10-50). These percentages were estimated in the ST3 (2016) planning phase and have been carried consistently throughout the various estimate phases, which can be found in the Table below. Sub-items not shown but included in the roll up include TOD planning, sustainability, access, and integration facilities. The Assessment Team believes these are appropriately allocated and fall within industry standards

80.00	PROFESSIONAL SERVICES (SOFT COSTS)	Soft Cost %
80.03	Agency Administration	6.00%
80.01	Preliminary Engineering	5.00%
80.02	Final Design & DSDC	10.00%
80.05	Third Parties	2.00%
80.06	Permitting	0.50%
80.08	Start-up	1.50%
80.04	Construction Management	9.00%

- » *Admin is calculated on subtotal of SCC 10-70 plus all other SCC 80 items*
- » *TOD costs are included in the associated Professional Services category*

» *Permitting and Startup costs are included in the Construction (SCC 10-50) for the ST3 (2016) Phase*

▪ **SCC 90 – Unallocated Contingency**

- Unallocated Contingency based on Design maturity and calculated as a percentage (%) of SCC 10-80. UC is currently calculated at 10% for current design level which falls within industry standards.
- Project Reserve of 7% was calculated for ST3 (2016) and Phase 1 (2019) estimates but not presented as total cost of the project. There are no Project Reserves accounted for in Phase 2 (2020) estimates.

6.0 BRT Projects (I-405, SR-522, and Bus Base North)

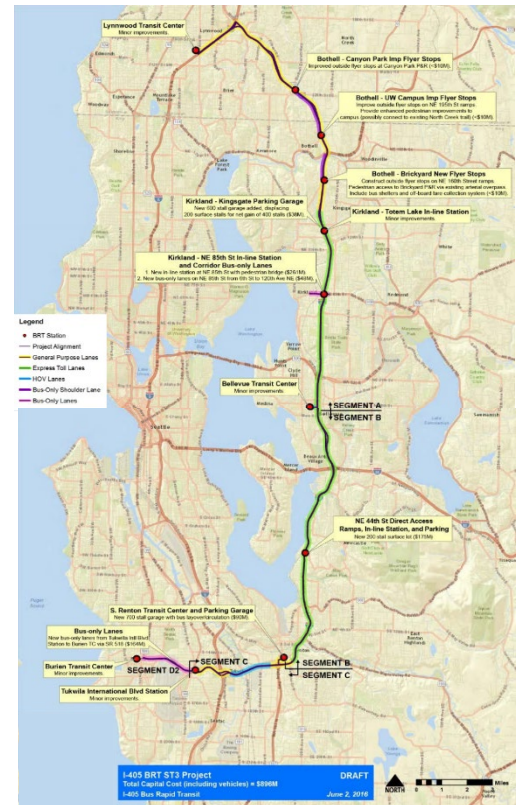
6.1.1 BRT Projects Key Findings

- a. **Accuracy of the Phase 2 (2020) Estimate:** The Assessment Team believes the I-405 & SR-522 BRT Phase 2 (2020) cost estimates are appropriate for an approximately 10-20% design.

Bus Base North does not appear appropriate, and it is recommended that a bottoms-up estimate be performed utilizing the latest design and site investigation information.

- b. **ST3 (2016) to Phase 2 (2020) Main Cost Drivers:** The project saw only minor changes in cost from ST3 (2016) to Phase 1 (2019) to Phase 2 (2020). It appears the project was able to capitalize on many WSDOT partnership opportunities throughout the estimate phases. That coupled with minimal right-of-way impacts due to alignment type aided the project and kept costs consistent throughout the estimating phases. Details of the BRT FTA SCC is shown below.

- c. **Capture of Phase 2 (2020) Elements:** The Assessment Team believes the I-405 & SR-522 projects have adequately captured all areas of the estimate during Phase 2 (2020) but risks still exist. These risks include the extent of contaminated soil and fiberoptic requirements and their relationship to both WSDOT infrastructure and local BRT tie-in points. As mentioned above, it is recommended that Bus Base North receive a new bottoms-up estimate.



6.1.2 I-405 BRT SCC Details

Following is a detailed description of the I-405 BRT findings by SCC:

- **SCC 10 – Guideway**
 - *No specific findings to report.*
- **SCC 20 – Stations**
 - *No specific findings to report.*

SCC 30 – Support Facilities

- No specific findings to report.

SCC 40 – Sitework & Special Conditions

- Overall SCC 40 reduction due in part to the redesign of retaining walls and the footprints of multiple stations thereby reducing overall area needed.
- Wall type modification in Phase 2 (2020) led to \$8M deduction in cost.

Review comments:

- Estimating methodology (Light, Medium, Heavy) and unit rates differed between the estimates.
- Route Feet decreased by 100% from ST3 (2016) (35,859RF) to Phase 2 (2020) (0RF).
- cost decreased by 81% from ST3 (2016) (\$8.6M) to Phase 2 (2020) (\$1.7M).
- 40.03 cost per RF was removed from Phase 2 (2020) but a new item of 1 LS of \$1.67M was added for removal of contaminated soil.
 - » 21,185SF at Burien TC
 - » 391,745SF at South Renton TC
 - » 45,881CY x \$91/CY = \$4.18M removal of spoils
 - » \$1.67M does not seem adequate if the whole site needs to be cleaned but it is enough if a portion of site to be cleaned.
- 40.04 cost were removed from Phase 2 (2020) since there are no known impacts.



Alignment Type:	ST3 Plan (2016)				Phase 1 (2019)				Phase 2 (2020)			
	QTY	UOM	Rate	2015\$	QTY	UOM	Rate	2019\$	QTY	UOM	Rate	2019\$
I405												
40.03	35859			\$ 4,872,270.00	18110			\$ 2,730,988.00	1			\$ 1,666,370.00
Light	34559	RF	130.00	\$ 4,492,670.00	18110	RF	150.80	\$ 2,730,988.00	0	RF	0.00	\$ -
Medium	1100	RF	260.00	\$ 286,000.00	0	RF	0.00	\$ -	0	RF	0.00	\$ -
Heavy	200	RF	468.00	\$ 93,600.00	0	RF	0.00	\$ -	0	RF	0.00	\$ -
Removal of Contaminated Soil	0	LS	0.00	\$ -	0	LS	0.00	\$ -	1	LS	1666370.00	\$ 1,666,370.00
40.04	34708			\$ 3,757,592.80	18110			\$ 3,491,998.00	0			\$ -
Light	34408	RF	106.60	\$ 3,667,892.80	12510	RF	123.76	\$ 1,548,238.00	0	LS	0.00	\$ -
Medium	300	RF	299.00	\$ 89,700.00	5600	RF	347.10	\$ 1,943,760.00	0	LS	0.00	\$ -
TOTALS:				\$ 8,629,862.80				\$ 6,222,986.00				\$ 1,666,370.00

SCC 50 – Systems

Station communications were consistent between the Phase 1 (2019) and Phase 2 (2020) estimates. The approach to the fiber optic work has shifted between the various revisions with the latest scope assuming interconnection with the WSDOT fiber backbone and including a plug price for fiber optic laterals for each station. This area appears to be an area of possible risk and is suggested to define the scope further. The Assessment Team analyzed the unit cost library (UCL) for the SCC 50 subcodes 50.01 – 50.07 and found significant variation between the Sound Transit units costs and the Assessment Team’s comparison unit costs. The variations were up to 50% of the unit cost. Some indicated the Sound transit unit costs were too low, and some too high. Combined, the fluctuations in cost accounted for the total dollars within

the SCC 50 codes to be very close to the project budgets as a whole. The Assessment Team will expand its analysis on the UCL during as it related to SCC 50 during the methodology review.

▪ **SCC 60 – ROW, Land, Existing Improvements**

Based on this review, in conjunction with interviews with ST staff and project team leads, it was determined that the ST ROW Cost Estimating Methodology was applied appropriately and consistently across the three levels of the estimates.

Assessment Team also compared actual sale prices of residential and non-residential properties throughout the corridor to the assessed values to test the reasonableness of the real estate adjustment multipliers used in the ROW estimates. We found that the multipliers used in the estimates fall within the range of appropriate adjustment factors indicated by the actual sales.

Assessment Team further estimated relocation costs based on occupancy on several of the parcels along the alignment to compare to the relocation costs estimated as a part of the project contingency. The results varied widely, as the estimate methodology relies on costs to average out over the entire project.

As will be discussed below, the ROW backup data spreadsheets provided appear to present an inconsistent total ROW cost than what is reported in the SCC 60 category of the Phase 1 (2019) and Phase 2 (2020) estimates. Our overall analysis and recommendations are limited by this factor.

Comparison of Estimates

ST3 (2016) Plan to Phase 1 (2019)

Overall ROW costs decreased from \$54M in the ST3 (2016) plan to \$51M, representing a decrease of 7%. Based on the ROW backup data provided by ST staff, the total number of impacted parcels appears to have decreased from 58 properties to 23 properties. Rising real estate values in the Seattle Metro Area over the three-year period had an upward influence on ROW Costs (see bullet points below); however, this appears to be offset by design refinements and decreased project requirements. We note that the backup ROW data provided appears to be inconsistent with the SCC 60 costs utilized in the Phase 1 (2019) Cost Estimate. The ROW backup data provided appears to indicate a total ROW cost of approximately \$40M.

Phase 1 (2019) to Phase 2 (2020)

Overall ROW costs appear to have decreased from \$51M in Phase 1 (2019) to approximately \$25M in Phase 2 (2020). Based on the ROW backup data, the total number of impacted parcels appears to have decreased from 23 properties to 12 properties, with the number of full acquisitions decreasing from four (4) to zero (0). It is our understanding that the project underwent significant design refinements between Phase 1 (2019) and Phase 2 (2020), which significantly reduced ROW needs.

As noted above, rising real estate values in the Seattle Metro Area had an upward influence on ROW Costs, but appear to be offset by design refinements and decreased project requirements:

- Seattle Metro multifamily residential sale prices increased from \$273k/unit in 2016 to \$339k unit in 2020, equal to appreciation of 24%, or 8%/yr.
- Seattle Metro office sale prices increased from \$394 per sf in 2016 to \$473 per sf in 2020, equal to appreciation of 20% or 5% per year.
- Retail and industrial values/sf increased by 15% and 42%, respectively.
- King County median assessed values for single family residential increased 44% from 2016-2020, equal to 11%/yr.

However, as previously stated the rising real estate costs are more than offset by the significant reduction of property impacts due to the design refinements.

The ROW backup data provided appears to indicate a total ROW cost of approximately \$15.6M instead of the \$25M used in the SCC 60 category of the Cost Estimate. We further note that the S Renton Transit Center, which has already been purchased by Sound Transit, appeared to be absent from the Phase 2 (2020) spreadsheets. Although the necessary right of way has already been purchased, the failure to include the approximately \$30M associated with this transit center may skew the overall budget in a lower direction than what is appropriate.

Recommendations

- In depth analysis (either by appraisers or qualified R.E. professionals) of the higher value properties and the more complex partial acquisitions to refine estimate.
- Analysis of potential TCE impacts based on actual/perceived construction needs, rather than a percentage of real estate costs.
- **SCC 70 – Vehicles**
 - SCC 70 – Experienced scope growth through increase of additional buses and BEB’s throughout project development.
- **SCC 80 – Professional Services (Soft Costs)**
 - Soft Costs (for Professional Services) calculated as a percentage (%) of Construction Costs (SCC 10-50). These percentages were estimated in the ST3 (2016) planning phase and have been carried consistently throughout the various estimate phases, which can be found in the Table below. Sub-items not shown but included in the roll up include TOD planning, sustainability, access, and integration facilities. The Assessment Team believes these are appropriately allocated and fall within industry standards.

80.00	PROFESSIONAL SERVICES (SOFT COSTS)	Soft Cost %
80.03	Agency Administration	6.00%
80.01	Preliminary Engineering	5.00%
80.02	Final Design & DSDC	10.00%
80.05	Third Parties	2.00%
80.06	Permitting	0.50%
80.08	Start-up	1.50%
80.04	Construction Management	9.00%

- » Admin is calculated on subtotal of SCC 10-70 plus all other SCC 80 items.
- » TOD costs are included in the associated Professional Services category.
- » Permitting and Startup costs are included in the Construction (SCC 10-50) for the ST3 (2016) Phase.

- **SCC 90 – Unallocated Contingency**
 - Unallocated Contingency based on design maturity and calculated as a percentage (%) of SCC 10-80. UC is currently calculated at 10% for current design level which falls within industry standards.
 - Project Reserve of 7% was calculated for ST3 (2016) and PH1 estimates but not presented as total cost of the project. There are no Project Reserves accounted for in PH2 estimates.

6.2.1 SR 522 BRT Key Findings

Globally, costs were steady between Phase 1 (2019) and Phase 2 (2020) due to continued focus on design refinement, scope reduction (or shifting of scope to adjacent/partner municipalities) and addressing potential high-cost issues.

- Roadway construction costs were reduced from \$174.3M to \$132.4 from Phase 1 (2019) to Phase 2 (2020) (offset by increase of \$54M in third party costs).
- Total construction costs were reduced from \$267M to \$234.9M Phase 1 (2019) to Phase 2 (2020).

6.2.2 SR 522 BRT SCC Details

Following is a detailed description of the SR 522 BRT findings by SCC:

▪ SCC 10 – Guideway

- *No specific findings to report*

▪ SCC 20 – Stations

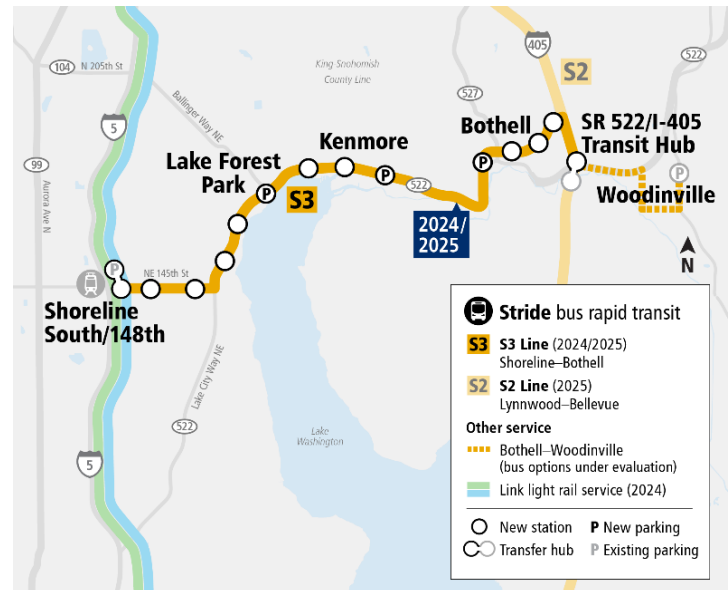
- Station costs were assessed and proved to be in alignment with regional costs.
- Parking stall count increased 40% from Phase 1 (2019) to Phase 2 (2020), and costs increased 22%.
- Parking Garages vary from \$63k to \$74k in direct construction cost per stall, this should be analyzed further for concurrence (expectation is around \$50k in cost), which would realize a savings of \$13M to \$24M on the garages.

▪ SCC 30 – Support Facilities

- The ST3 (2016) estimate included \$2.8M. This was shifted in Phase 1 (2019) and Phase 2 (2020) removing all SCC 30 costs.

▪ SCC 40 – Sitework & Special Conditions

- ST3 (2016) to Phase 1 (2019) increases include scope growth and a few minor refinements between Phase 1 (2019) and 2 (2020) estimates.
- Overall direct costs were reduced between Phase 1 (2019) and Phase 2 (2020) but were offset by the increase in third party costs tied to cooperative agreements.
- Based upon the retaining walls called out on the LFP segment, analysis is not able to be provided to match takeoff quantities listed in the Phase 2 (2020) estimate; quantities identified on the plans are 45% to 95% less than those identified in the estimate (this is especially important as the LFP represents over 25% of the cost in the SCC 40 roadway work).
- Asphalt work (AC paving and overlay) represent a large balance of the cost and should be analyzed in a detailed estimate.
- There are several driveway reconstructions where partial ROW takes are occurring, and a unit rate of \$100/SY was used. This unit rate appears low with an estimated potential cost increase is approximately \$3M.

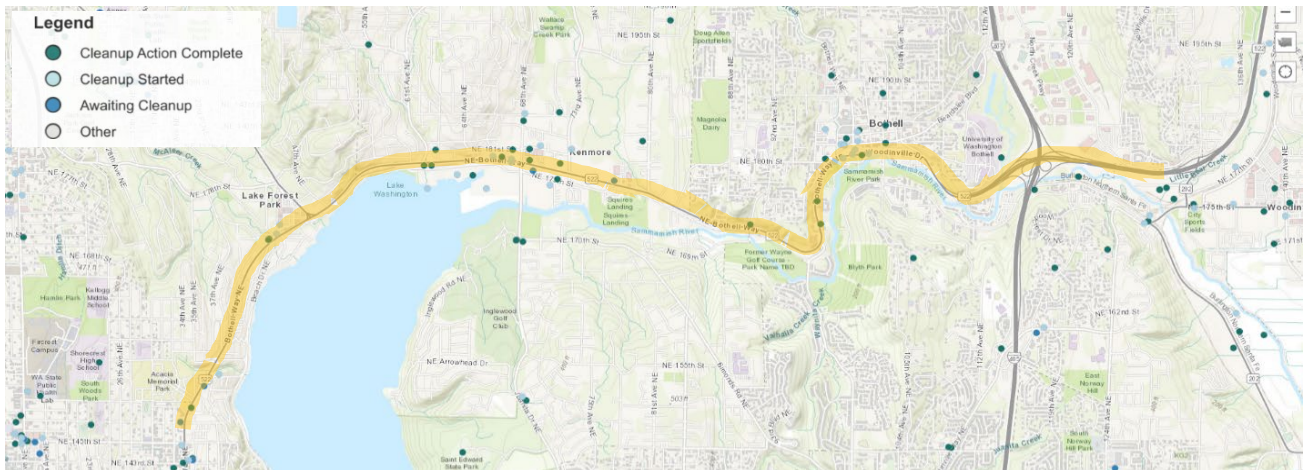


40.04 Review comments:

- Estimating methodology (Light, Medium, Heavy) and unit rates differed between the estimates.
- Route Feet increased by 51% from ST3 (2016) (13,760RF) to Phase 2 (2020) (20,806RF).
- Project cost increased by 83% from ST3 (2016) (\$5.5M) to Phase 2 (2020) (\$10M).
- New item of 1 LS was added in Phase 2 (2020) for 40.04 at Lake Washington/Wetland, adding \$1.1M (Lake Forest PG).
 - » *Assuming worst case scenario, 1:1 ratio, at \$1M per acre (0.75 acre) which equates to \$0.75M plus 30% contingency for Design, PM, Survey and Monitoring. \$1.1M in Phase 2 (2020) is adequate for the Environmental mitigation at this site.*
- New item of 1 LS was added in Phase 2 (2020) for 40.04 at Kenmore Heron Rookery / Wetland, adding \$2.1M (Kenmore PG).
 - » *Assuming moderate scenario, 1:1 ratio, at \$750,000 per acre (3 acre) which equates to \$2.25M plus 30% contingency for Design, PM, Survey and Monitoring. \$2.1M in Phase 2 (2020) seems to be low.*

- New item of 1 LS was added in Phase 2 (2020) for 40.04 at Sammamish River/Wetland, adding \$1.3M (Bothell PG).
 - » Assuming moderate scenario, 1:1 ratio, at \$750,000 per acre (2 acre) which equates to \$1.5M plus 30% contingency for Design, PM, Survey and Monitoring. \$1.3M in Phase 2 (2020) seems to be low.

Alignment Type:	ST3 Plan (2016)				Phase 1 (2019)				Phase 2 (2020)				
	QTY	UOM	Rate	2015\$	QTY	UOM	Rate	2019\$	QTY	UOM	Rate	2019\$	
SR522													
40.03	13760			\$ 1,788,800.00	13900			\$ 2,096,120.00	20806			\$ 2,914,203.00	
Light	13760	RF	130.00	\$ 1,788,800.00	13900	RF	150.80	\$ 2,096,120.00	2882	RF	129.23	\$ 372,450.00	
Light		0	RF	0.00	\$ -	0	RF	0.00	\$ -	17924	RF	141.81	\$ 2,541,753.00
40.04	18260			\$ 3,678,116.00	18100			\$ 4,130,400.00	20806			\$ 7,099,746.00	
Light	9260	RF	106.60	\$ 987,116.00	10600	RF	123.50	\$ 1,309,100.00	2882	RF	109.07	\$ 314,340.00	
Medium	9000	RF	299.00	\$ 2,691,000.00	7500	RF	347.10	\$ 2,603,250.00	17924	RF	123.16	\$ 2,207,499.00	
Allowance (Kenmore PG)	0	LS	0.00	\$ -	1	LS	218050.00	\$ 218,050.00	1	LS	2124669.00	\$ 2,124,669.00	
Allowance (Lake Forest PG)	0	LS	0.00	\$ -	0	LS	0.00	\$ -	1	LS	1145516.00	\$ 1,145,516.00	
Allowance (Bothell PG)	0	LS	0.00	\$ -	0	LS	0.00	\$ -	1	LS	1307722.00	\$ 1,307,722.00	
TOTALS:				\$ 5,466,916.00				\$ 6,226,520.00				\$ 10,013,949.00	



▪ **SCC 50 – Systems**

Systems costs were steady between Phase 1 (2019) and Phase 2 (2020). The pricing included for the scope described appears appropriate. The current approach to fiber connectivity is to use adjacent WSDOT infrastructure. A deeper look into the site interfaces between ST and WSDOT facilities is encouraged to define the fiberoptic scope of work more and to limit project risk. The Assessment Team analyzed the unit cost library (UCL) for the SCC 50 subcodes 50.01 – 50.07 and found significant variation between the Sound Transit units costs and the Assessment Team’s comparison unit costs. The variations were up to 50% of the unit cost. Some indicated the Sound transit unit costs were too low, and some too high. Combined, the fluctuations in cost accounted for the total dollars within the SCC 50 codes to be very close to the project budgets as a whole. The Assessment Team will expand its analysis on the UCL during as it related to SCC 50 during the methodology review.

▪ **SCC 60 – ROW, Land, Existing Improvements**

Comparison of Estimates

ST3 (2016) Plan to Phase 1 (2019)

Overall ROW costs increased from \$57M in the ST3 (2016) plan to \$121M, representing an increase of 113%. Based on the ROW backup data provided, the total number of acquisition area appears to have increased from just under 500,000 sf

to over \$1.1M sf. It should be noted that rising real estate values in the Seattle Metro Area over the three-year period clearly had an upward influence on ROW Costs (see bullet points below).

We note that the backup ROW data provided appears to be inconsistent with the SCC 60 costs utilized in the ST3 (2016) and Phase 1 (2019) Cost Estimates. The ROW backup data provided appears to indicate a total ROW cost of approximately \$55M instead of \$57M in ST3 (2016), and \$97M instead of \$121M in Phase 1 (2019). We further note that the ROW backup data spreadsheets seem to indicate \$0 values for the Kenmore and Bothell parking garages in Phase 1 (2019), which is inconsistent with the costs included in the actual SCC 60 category of the Phase 1 (2019) estimate. Additionally, there appears to be a discrepancy of approximately \$22M between the SCC 60 category in the Phase 1 (2019) cost estimate and the ROW backup data spreadsheets provided for the Seattle/Shoreline (145th) segment.

Phase 1 (2019) to Phase 2 (2020)

Overall ROW costs appear to have decreased from \$121M in Phase 1 (2019) to approximately \$67M in Phase 2 (2020). Based on the ROW backup data provided, the total number of acquisition area appears to have decreased from approximately \$1.1M sf to \$1M sf, with the number of full acquisitions decreasing from 27 to 6. The project appears to have undergone substantial design refinements between Phase 1 (2019) and Phase 2 (2020), which significantly reduced ROW needs.

As noted above, rising real estate values in the Seattle Metro Area had an upward influence on ROW Costs, but appear to be offset by design refinements and decreased project requirements:

- Seattle Metro multifamily residential sale prices increased from \$273k/unit in 2016 to \$339k/unit in 2020, equal to appreciation of 24%, or 8%/yr.
- Seattle Metro office sale prices increased from \$394 per sf in 2016 to \$473 per sf in 2020, equal to appreciation of 20% or 5% per year.
- Retail and industrial values/sf increased by 15% and 42%, respectively.
- King County median assessed values for single family residential increased 44% from 2016-2020, equal to 11%/yr.

However, as previously stated the rising real estate costs are more than offset by the significant reduction of property impacts due to the design refinements.

The Phase 2 (2020) ROW backup data provided appears to indicate a \$0 acquisition cost for the Kenmore Garage in Phase 2 (2020), and a substantial discrepancy of around \$7M between the SCC 60 category in the Phase 2 (2020) cost estimate and the ROW backup data spreadsheets provided for the Seattle/Shoreline (145th) segment.

▪ **SCC 70 – Vehicles**

- Vehicle costs increased 9% from ST3 (2016) to Phase 1 (2019) and 42% from Phase 1 (2019) to Phase 2 (2020).

▪ **SCC 80 – Professional Services (Soft Costs)**

Soft Costs (for Professional Services) calculated as a percentage (%) of Construction Costs (SCC 10-50). These percentages were estimated in the ST3 (2016) planning phase and have been carried consistently throughout the various estimate phases, which can be found in the Table below. Sub-items not shown but included in the roll up include TOD planning, sustainability, access, and integration facilities. The Assessment Team believes these are appropriately allocated and fall within industry standards.

- Soft cost increased rose most dramatically for third party allowance items as noted above where scope was shifted to adjacent/partner municipalities

80.00	PROFESSIONAL SERVICES (SOFT COSTS)	Soft Cost %
80.03	Agency Administration	6.00%
80.01	Preliminary Engineering	5.00%
80.02	Final Design & DSDC	10.00%
80.05	Third Parties	2.00%
80.06	Permitting	0.50%
80.08	Start-up	1.50%
80.04	Construction Management	9.00%

- » *Admin is calculated on subtotal of SCC 10-70 plus all other SCC 80 items.*
- » *TOD costs are included in the associated Professional Services category.*
- » *Permitting and Startup costs are included in the Construction (SCC 10-50) for the ST3 (2016) Phase.*

▪ **SCC 90 – Unallocated Contingency**

- Unallocated Contingency based on Design maturity and calculated as a percentage (%) of SCC 10-80. UC is currently calculated at 10% for current design level which falls within industry standards.
- Project Reserve of 7% was calculated for ST3 (2016) and Phase 1 (2019) estimates but not presented as total cost of the project. There are no Project Reserves accounted for in Phase 2 (2020) estimates.

6.3.1 Bus Base North Key Findings

The direct construction costs increase from Phase 1 (2019) to Phase 2 (2020) in SCC 10-50 are roughly equal to the costs combined between the Central Systems and Battery Electric Bus (BEB) Charging Infrastructure (both of which were not included in Phase 1 (2019) but were present within the Phase 2 (2020) estimate). Outside of these changes, the remaining overall costs were roughly steady between Phase 1 (2019) and Phase 2 (2020). The Assessment Team found the Phase 2 (2020) to be unrealistic based on the information provided. The latest site investigation work shows junk material on site, as well revealing soil contaminates and potential wetland impacts. These sitework conditions will likely require additional foundation reinforcements to deal with poor soil conditions.

6.3.2 Bus Base North SCC Details

Following is a detailed description of the Bus Base North findings by SCC:

▪ **SCC 10 – Guideway**

- *No specific findings to report*

▪ **SCC 20 – Stations & Parking Garages**

- The two-level garage carries a cost of roughly \$41k per stall and appears to be insufficient for the amount of shoring and formwork that will be required for the bus bays.
 - *Assessment team believes this cost could be a \$4-6M addition to the current estimate.*



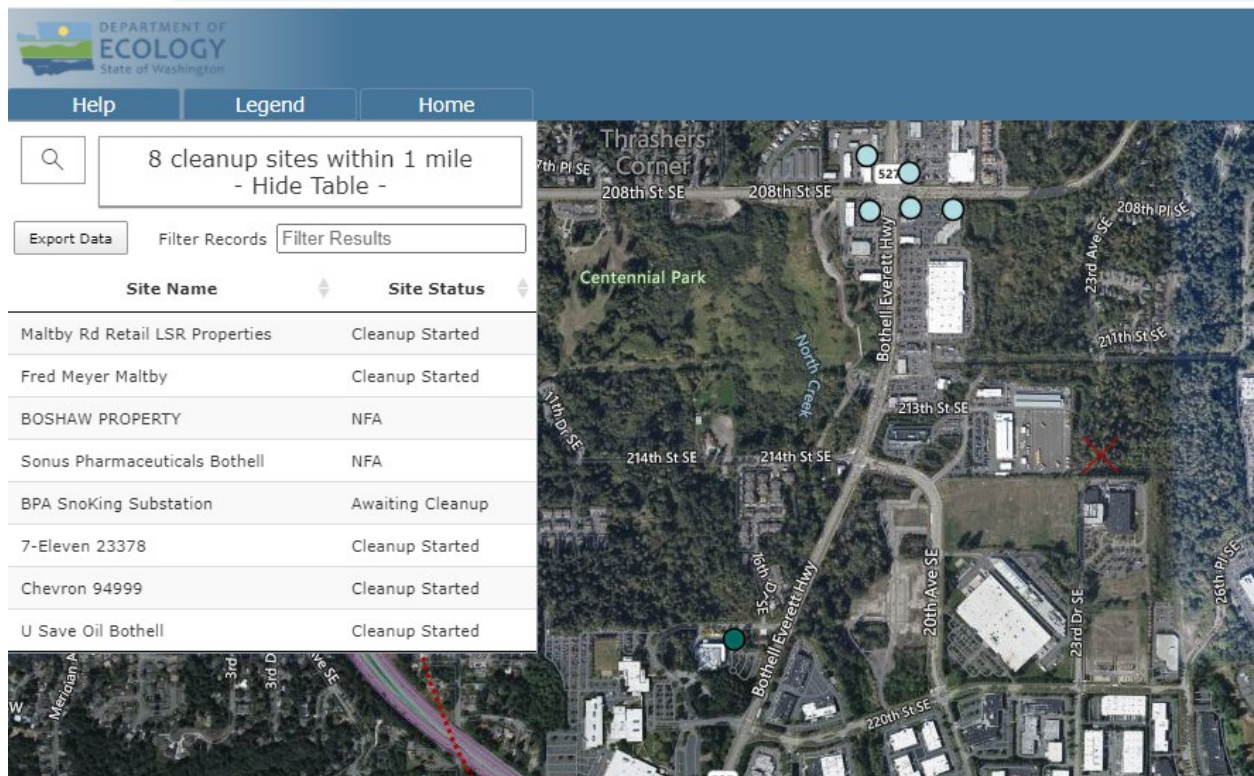
▪ **SCC 30 – Support Facilities**

- Reallocated \$25.7M of cost in Phase 1 (2019) to SCC 40 in Phase 2 (2020) based on methodology.
- Size of the Operations and Maintenance building increased, and the Fuel and Wash building decreased from Phase 1 (2019) to Phase 2 (2020).
- BEB Charging Infrastructure was also added within Phase 2 (2020).
- Building costs ranges of \$269/SF to \$319/SF looks to be sufficient.
- Furniture and equipment appear to be significantly low.
 - *Assessment team estimates a potential \$4-5M add is necessary.*

▪ **SCC 40 – Sitework & Special Conditions**

- Per the Geotechnical Report provided and conversation with the Bus Base North project team, it appears that the likelihood of significant site work will be required to create a workable site. The cost of import and export of fill, as well as foundation reinforcements will add significant costs to the project.
- With the high water table and resultant near certainty of extensive dewatering, waterborne hydrocarbons, arsenic or other contaminates in excess of discharge limits will require pre discharge treatment which will increase overall cost and complexity of dewatering.

- \$164,666 was carried for erosion control. The site may require multiple Baker tanks and with the known arsenic contamination sand filtration and pumps. However, construction of the detention system on site maybe in consideration with cleaner water systems.
 - *Assessment Team recommends adding \$15-\$25M for site improvements*



40.04 Review comments:

- It appears that wetland mitigation was not carried in the Phase 2 (2020) estimate. Conversation with ST project team regarding wetlands include the following options:
 - Purchase mitigation credits from the Keller land bank
 - Fee in lieu of mitigation. Fee would be paid to the City to improve wetlands within the same drainage basin within Bothell City Limits
 - Mitigate on site and reduce the developable area
- Estimating recommendations
 - There looks to be roughly 1/2 acre in wetland that may be impacted. At a budget of \$1M/acre on the high end.
 - » *The Assessment Team recommends \$500K - \$1M be carried for wetland mitigation*

▪ SCC 50 – Systems

The estimate appears appropriate for the scope shown in the preliminary documents. The feeder cable line items within the estimate appear to be quite high for the scope shown. These items may have excess budget allocated to them in the \$1M-2\$M range. However, as the design is in the early stage this apparent excess budget may be needed for other systems elements that may not have enough budget allocated.

▪ SCC 60 – ROW, Land, Existing Improvements

ROW costs were not evaluated in assessment as all property has been previously purchased.

▪ **SCC 70 – Vehicles**

Vehicle costs are excluded from assessment as cost is carried in individual BRT project estimates.

▪ **SCC 80 – Professional Services (Soft Costs)**

Soft Costs (for Professional Services) calculated as a percentage (%) of Construction Costs (SCC 10-50). These percentages were estimated in the ST3 (2016) planning phase and have been carried consistently throughout the various estimate phases, which can be found in the Table below. Sub-items not shown but included in the roll up include TOD planning, sustainability, access, and integration facilities. The Assessment Team believes these are appropriately allocated and fall within industry standards.

- Soft cost increased rose most dramatically for third party allowance items as noted above where scope was shifted to adjacent/partner municipalities

80.00	PROFESSIONAL SERVICES (SOFT COSTS)	Soft Cost %
80.03	Agency Administration	6.00%
80.01	Preliminary Engineering	5.00%
80.02	Final Design & DSDC	10.00%
80.05	Insurances	0.00%
80.06	Third Party	2.50%
80.08	Start-up	1.50%
80.04	Construction Management	9.00%

- » *Admin is calculated on subtotal of SCC 10-70 plus all other SCC 80 items.*
- » *TOD costs are included in the associated Professional Services category.*
- » *Permitting and Startup costs are included in the Construction (SCC 10-50) for the ST3 (2016) Phase.*

▪ **SCC 90 – Unallocated Contingency**

- Unallocated Contingency based on Design maturity and calculated as a percentage (%) of SCC 10-80. UC is currently calculated at 10% for current design level which falls within industry standards.
- Project Reserve of 7% was calculated for ST3 (2016) and Phase 1 (2019) estimates but not presented as total cost of the project. There are no Project Reserves accounted for in Phase 2 (2020) estimates.

7.0 APPENDIX

Peer Agency Mega-Projects Estimate Trends Review

For the purposes of this review a megaproject is defined as greater than \$750M.

A review of recent mega transit projects at peer agencies was conducted to evaluate potential trends in cost projections during various stages of project planning and development. This review was conducted based on a request from the Board and has limitations due to a large variety of factors which make a true 'apples to apples' comparison difficult at this scale. For this evaluation, the following ten projects were selected based on similarities in transit technology, scope, geography, and complexity:

- **EAGLE P3 (RTD, Denver) – 40-mile EMU commuter rail and maintenance facility**
 - Initial estimate - \$1.25B; latest estimate - \$2.27B
- **Transbay Phase 1 (SF) - large scale multi modal transit facility**
 - Initial estimate - \$1.90B; latest estimate - \$2.26B
- **Transbay Phase 2 (SF) - 1.3-mile underground commuter / high speed railway tunnel**
 - Initial estimate - \$3.0B; latest estimate - \$3.94B
- **Honolulu Rail Transit Project – 20-mile elevated urban rail rapid transit system**
 - Initial estimate - \$4.0B; latest estimate \$10.0B
- **Translink Broadway Subway (Vancouver) - 3.5-mile tunneled extension of rapid transit system**
 - Initial estimate - \$1.98B; latest estimate - \$2.80B
- **Metro Green Line Extension (Minneapolis) - 11-mile light rail extension**
 - Initial estimate - \$2.20B; latest estimate - \$2.30B
- **Crenshaw LAX (LA Metro) - 8.5-mile light rail extension**
 - Initial estimate - \$1.75B; latest estimate \$2.15B
- **Purple Line Extension 1, 2 & 3 (LA Metro) - 7-mile heavy rail subway corridor**
 - Initial estimate - \$8.20B; latest estimate - \$9.50B
- **Regional Connector (LA Metro) - 1.9-mile light rail subway tunnel**
 - Initial estimate - \$1.25B; latest estimate - \$1.83B

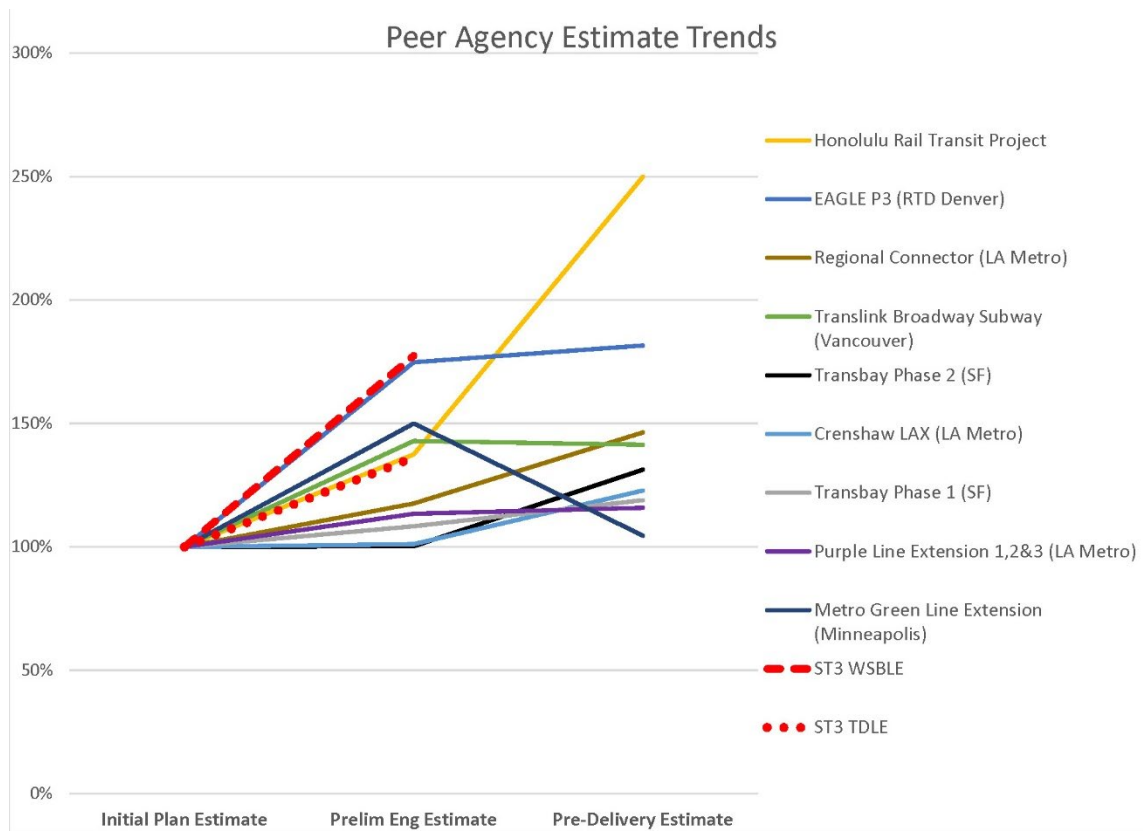
Published cost estimate data was collected for each project at three phases of the project Planning and Development lifecycle:

- Initial Planning
- Early Project Design and Preliminary Engineering phase
- Final Design and Pre-Delivery (where available)

The data was obtained from publicly available sources and was not adjusted to reflect either inflation or year of expenditure. The data is summarized in the Peer Agency Estimate Trends illustration on the following page and reflects how each project varied over time.

There are many reasons why megaprojects may overrun initial estimates, including:

- Scope growth
- Missing elements
- Unforeseen conditions
- Schedule delays
- Economic changes
- Lack of conservatism in early estimates
- Unfunded mandates (third party)



	Rough-Order-of-Magnitude (ROM) for Funding/Voter Approved Plan	Revised with Preliminary Engineering at 10-30% Design Developed (FEIS/FEIR)	Revised with 100% Design Developed and Construction Contracts in place	
Project	Initial Estimate (\$B)	Interim (\$B)	Current/Final Estimate/Costs (\$B)	Years
EAGLE P3 (Denver)	\$1.25	\$2.19	\$2.27	(2004, 2011, 2019)
Transbay Phase 1 (San Francisco)	\$1.90	\$2.06	\$2.26	(2013, 2015, 2016)
Transbay Phase 2 (San Francisco)	\$3.00	\$3.01	\$3.94	(2008, 2013, 2016)
Honolulu Rail Transit Project (Hawaii)	\$4.00	\$5.50	\$10.00	(2006, 2010, 2017)
Translink Broadway Subway (Vancouver)	\$1.98	\$2.83	\$2.80	(2014, 2018, 2020)
Metro Green Line Extension (Minneapolis)	\$2.20	\$3.30	\$2.30	(2014, 2015, 2017)
Crenshaw LAX (Los Angeles)	\$1.75	\$1.77	\$2.15	(2008, 2011, 2020)
Purple Line Extension 1,2&3 (Los Angeles)	\$8.20	\$9.30	\$9.50	(2008, 2016, 2020)
Regional Connector (Los Angeles)	\$1.25	\$1.47	\$1.83	(2009, 2016, 2020)
ST3 WSBLE (Seattle)	\$7.09	\$12.58	N/A	(2016, 2020, TBD)
ST3 TDLE (Seattle)	\$2.43	\$3.31	N/A	(2016, 2020, TBD)

Conclusion

The projects were selected for review based on similarities. As can be seen, in general cost estimates increased with the projects as the design progressed. The result of the peer review indicated that changes in cost projections were reflective of the unique site conditions and circumstances of each. For some projects, the scope changed over time resulting in changes in cost projections. For others, the original estimates did not include essential items, or were not conservative enough given the level of design information available. While most of the changes in cost projections for these projects relate to the items identified in the table above, it is challenging to draw overall conclusions on an industry-wide basis because each project must be reviewed within its overall context to determine whether the cost projections are reasonable.

Appendix A - Added 11/15/2021

No.	Recommendation	Section	Responsible Party (TBD by ST)
1	"Recommend further investigation into bridge type assumptions for aerial guideway as a possible savings to the project" – such as I-girder or tub girder (p. 3).	1.0 Executive Summary – West Seattle and Ballard Link Extensions (WSBLE)	
2	"Recommend further investigation into...sitework/ground conditions and tunneling as areas of potential cost increases" (p. 3).	1.0 Executive Summary – West Seattle and Ballard Link Extensions (WSBLE)	
3	"The Assessment Team recommends that the ST design team address the findings of this report and revise the cost estimate, as necessary. While ranges will be explored in more detail during the methodology report, the design team should consider providing future revised estimates as a range of values for each project" (p. 3).	1.0 Executive Summary – West Seattle and Ballard Link Extensions (WSBLE)	
4	"It is possible that the existing central control center will not be able to accommodate the (multiple) expansions. If that is the case, TDLE's estimate should reflect a portion of this expansion cost" (p. 4).	1.0 Executive Summary – Tacoma Dome Link Extensions (TDLE)	
5	"Recommend further investigation into ground conditions along the alignment as this appears to be the [OMFS] project's largest risk, particularly at Midway Landfill" (p. 4).	1.0 Executive Summary – Operations and Maintenance Facility – South (OMFS)	
6	"Recommend further investigation into...the building cost for Heavy Maintenance Facility" (p. 4).	1.0 Executive Summary – Operations and Maintenance Facility – South (OMFS)	
7	Recommend "a bottoms-up estimate be performed [for Bus Base North] utilizing the latest design and site investigation information" (p. 4).	1.0 Executive Summary – Bus Rapid Transit (BRT) – I-405, SR-522, and Bus Base North	
8	"Recommend a more transparent way to assess indirect costs... (i.e. temporary facilities and other indirect costs during construction)" (p. 11).	3.1 WSBLE Key Findings / c. Capture of Phase 2 (2020) Elements	
9	<p>"The Assessment Team performed an analysis of cost savings for Preferred Alternative (PA) 201 (Elevated), which is elevated in West Seattle and Ballard, and Preferred Alternative 2022 (Tunnel), which is tunneling in West Seattle and Ballard, and the results are as follows:</p> <ul style="list-style-type: none"> • WSDOT I-Girders in lieu of standard Precast Segmental Box Girder: <ul style="list-style-type: none"> ○ For PA 201 (elevated): Savings of \$200-\$210M ○ For PA 202 (tunnel): Savings of \$105-\$115M 	3.2 WSBLE SCC Details / SCC 10 - Guideway	

	<ul style="list-style-type: none"> • WSDOT Precast Tub Girders in lieu of standard Precast Segmental Box Girder: <ul style="list-style-type: none"> ○ For PA 201 (elevated): Savings of \$170-\$175M ○ For PA 202 (tunnel): Savings of \$80-\$85M” (p. 11-12) 		
10	<p>The Assessment Team analyzed discrepancies related to long-span bridges. “Based on the analysis from the Assessment Team, the missing items should be included in the current estimate and the results are as follows:</p> <ul style="list-style-type: none"> • For PA 201 (elevated): Addition of \$70-\$75M is • For PA 202 (tunnel): Addition of \$30-\$35M” (p. 12) 	3.2 WSBLE SCC Details / SCC 10 - Guideway	
11	<p>“The Assessment Team performed the [WSBLE] tunneling analysis and...the results are as follows:</p> <ul style="list-style-type: none"> • For PA 201 (elevated): Addition of \$170-\$175M • For PA 202 (tunnel): Addition \$180-\$185M” (p. 12) 	3.2 WSBLE SCC Details / SCC 10 - Guideway	
12	<p>“The Assessment Team recommends these [additional ground improvement items] be added, and the results are as follows:</p> <ul style="list-style-type: none"> • For PA 201 (elevated): Addition of \$80-\$85M • For PA 202 (tunnel): Addition of \$75-\$80M” (p. 12) 	3.2 WSBLE SCC Details / SCC 40 – Sitework & Special Conditions / Ground Improvements	
13	<p>The landfill is “possibly a higher risk area [and ST] may want to include more than the allowed Medium Risk in the historically industrial areas [for major removal of landfill material for the OMFS project]. Design analysis or pot holing studies for any potential risks at the Interbay Landfill site and vicinity would be recommended in identifying contamination” (p. 15).</p>	3.2 WSBLE SCC Details / SCC 40 – Sitework & Special Conditions / Known risks	
14	<p>“Recommend further investigation into ground conditions along the alignment as this appears to be the largest risk” for TDLE and OMFS (p. 22 and 28).</p>	4.1 TDLE Key Findings / c. Capture of Phase 2 (2020) Elements & 5.1 OMFS Key Findings / c. Capture of Phase 2 (2020) Elements	
15	<p>“Assessment Team recommends a review of the communications backbone unit cost scope of work and the interface to the guideway unit costs as it relates to the [WSBLE] ducktbank” (p. 20).</p>	3.2 WSBLE SCC Details / SCC 50 – Systems	
16	<p>“Recommend analyzing the confidence of adhering to the settlement requirements for either the hybrid or full excavation operations” for OMFS (p. 29).</p>	5.2 OMFS SCC Details / SCC 40 – Sitework & Special Conditions	
17	<p>Explore whether “...WSDOT has wetland/mitigation bank in the neighborhood [of OMFS] that can be used” (p. 32).</p>	5.2 OMFS SCC Details / SCC 40 – Sitework & Special Conditions	
18	<p>“The current approach to fiber connectivity is to use adjacent WSDOT infrastructure. A deeper look into the</p>	6.2.2 SR 522 BRT SCC Details / SCC 50 – Systems	

	site interfaces between ST and WSDOT facilities is encouraged to define the fiber optic scope of work more and to limit project risk” (p. 40)		
19	“Recommend \$500K - \$1M be carried for wetland mitigation” for Bus Base North (p. 43).	6.3.2 Bus Base North Key Findings / SCC 40 – Sitework & Special Conditions	