

Memo

August 17, 2022

To: Brooke Belman, Interim CEO
From: Kimberly Farley, Deputy CEO
Subject: Action plans to address current Link construction risks

Since April, Sound Transit has been flagging that the timelines for opening our East Link, Lynnwood, Federal Way and Downtown Redmond Link extensions will be delayed by challenges that our staff and contractors are continuing their intensive work to address. These include some current issues and trends that are global in nature, and others that are local and specific to our projects.

Starting in December 2021, a concrete delivery strike that went on for more than four months began to significantly impact Sound Transit's construction in King County. The strike created additional challenges on top of the COVID-19 pandemic's project delays, workforce impacts and supply chain issues. In many cases, these challenges compounded others related to our contractors' work, project designs and/or project oversight.

Sound Transit today operates 26 miles of accessible, high-capacity, carbon-neutral light rail, with 25 stations. We continue to advance expansions that in a very short period will more than double the Link system to 62 miles and 50 stations. One of these expansions will be the first in the world to build and operate rail across a floating bridge. This is truly historic. No other region of our country has so much transit infrastructure concurrently under construction and preparing to enter service in such a compact timeline.

Sound Transit has a strong track record of completing major light rail construction on or ahead of schedule. However, the complex nature of our work to open these current segments, especially East Link, requires solving challenges that surpass what we've encountered with our previously completed projects.

This memo provides a detailed overview of these challenges and what we are doing about them.

METHODOLOGY FOR UNDERSTANDING RISKS AND IDENTIFYING NEW OPENING DATES

In April 2022, as our contractors resumed concrete placement amid backlogged regional demand and continued challenges from the pandemic, Sound Transit began a process that will ultimately lead us to identifying new opening dates for our projects. As described below, we are in the middle of that process, continuing our assessment.

1. The first step we took was to conduct thorough analyses of the risks for each project. This memo summarizes these project-level analyses, detailing the nature of the high-impact risks that we are working with our contractors to address.

These risk analyses are conducted throughout project development, design and construction, and they reflect a snapshot in time of the risks an individual project faces.

These analyses allow us to **identify the range of impacts that risks could have on the project's success**, including opening timeframes. From these most recent project-specific risk analyses, **actual schedule impacts will be determined through ongoing work to mitigate the risks.**

Some risks can be mitigated (resolved or reduced) concurrently, while others need to be addressed sequentially and therefore add to the “critical path” for project completion, meaning the elements that add up to the minimum possible time to complete the project.

2. The second step, now underway, is to analyze the implications of projects' current status at a programmatic level. A programmatic risk analysis will **evaluate shared resources** (such as staff and capacity for conducting safety certifications) needed across the projects opening in similar timeframes. It will also look at **project sequencing**.

The programmatic analysis is critical to making sure our limited resources are spread appropriately and realistically to support activating 36 miles of current light rail extensions. Once that complex analysis is complete, we will have greater confidence in assessing project opening timeframes.

Ultimately, new timelines for opening our projects will be determined by 1) our success mitigating the impacts and risks that exist for each project, and 2) completing the above-described programmatic analysis, which must happen before we are able to establish new opening timeframes.

Our intent is to continue intensive focus on eliminating or reducing risks and to open the projects as rapidly as possible without compromising their safety and quality—including providing positive passenger experiences from the first day of service through many decades to come.

PROJECT CHALLENGES AND RISKS

The following sections for each of the four projects summarize the primary risks and challenges we are working to resolve. As appropriate, these summaries will seek to address the origin of the challenges.

We've had limited ability to control external factors such as the concrete delivery strike and COVID-19 impacts. In other cases, we are committed to learning from project delivery challenges such as construction quality deficiencies, design-related issues and project oversight/inspection deficiencies, where Sound Transit and/or our construction management consultants did not identify contractors' mistakes quickly enough.

Memo

East Link Extension

The East Link project, with 14 miles of alignment, 10 stations and two garages, is Sound Transit's longest and most complex light rail segment to date. It has generated more construction quality challenges than the agency has encountered with previous projects.

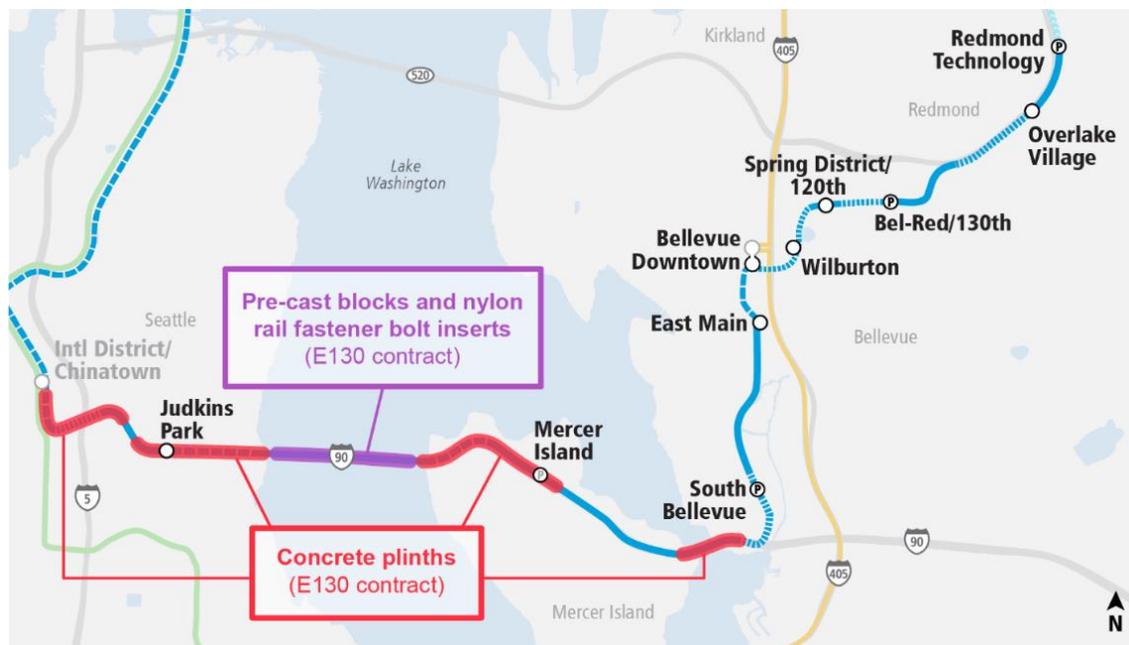
However, these issues are fully surmountable and will be resolved through continuing intensive efforts to prioritize long-term operability, durability and safety. Sound Transit will not compromise in these areas, and construction quality issues outlined here will in no way impede the agency from launching the world's first-ever light rail service crossing a floating bridge.

Together with the contractor, our focus is on developing and implementing solutions and on mitigating the impacts. Where there are construction quality issues, the contractor is performing the repair work at its cost. Where there are spillover issues that entail costs for other contractors or Sound Transit, their resolution will be negotiated.

While it is too early to accurately assess the resulting East Link project delay, we expect it to be at least one year. The below sections describe these issues in a rough order of their severity. Currently, the first item related to concrete plinths is the only issue on the critical path.

Work to open the project also includes implementing less intensive mitigation efforts that are not summarized here.

Fig. 1: Sections of East Link Extension alignment affected by top two project risks.



1. Concrete plinths on the east and west sides of Lake Washington

The primary risk to the East Link schedule is driven by track construction quality issues along approximately four miles of the I-90 segment (E130 contract), on the east and west sides of the floating bridge. Repairs by the contractor (Kiewit-Hoffman JV) are underway to address quality issues with cast-in-place concrete plinths.

As seen in the image below, plinths are raised concrete structures that support the tracks in locations where they aren't resting on ties supported by ballast rock. Quality issues affect nearly all the plinths and rail fasteners in this segment.

Fig. 2: Image showing concrete plinths supporting light rail tracks.



We first began identifying these issues in 2019. They included concrete placements that were too low, and, in some cases, comprised of poorly consolidated concrete, with voids below rail fasteners. To address the low concrete placement and voids, the contractor installed repair mortar that was approved by Sound Transit to make up the difference.

Beginning in fall 2020, repair mortar placed under the fasteners was first observed as failing. This led to an investigation by the project team that identified further quality issues encompassing several types of poor concrete workmanship, including concrete placements that were too low, too high, constructed to the wrong geometry, or resulting in voids under rail fasteners.

Working with Sound Transit, the contractor proposed several solutions to address these various issues. First, the failing repair mortar was removed. Where installing an approved repair mortar was a viable solution, the contractor proposed doing so. Where that solution was not viable, the contractor has been demolishing concrete from the plinths to a level that would allow reconstruction to the quality required by the design.

Most of 2021 was spent determining the extent of the needed repairs, further developing solutions and starting the repair mortar removal/replacement and initial concrete demolition. In some cases, entire plinths, or the top portions of plinths, needed to be demolished and replaced.

In the process of implementing those repair mortar fixes, Sound Transit's inspectors discovered further deficiencies, such that the overall scope of the challenges has increased rather than decreased.

Beginning in 2022, the repair work progressed to a point where the steel reinforcing bars (rebar) embedded within the plinths could start to be seen. At this stage, additional quality issues and deviations from the design were identified, including instances where there is 1) too little or too much concrete covering the rebar; 2) incorrect rebar spacing and embedment within the plinth; and 3) missing rebar. These deficiencies raised concerns regarding the integrity and durability of the plinths.

To help evaluate the repairs initiated last year, Sound Transit hired Wiss Janney Elstner (WJE), a nationally recognized forensic engineering firm. In addition to consulting on the repair procedures, WJE has been testing various products, performing site survey and in-field testing.

The contractor has been working collaboratively with Sound Transit's in-house and consultant engineers to develop solutions. This month, the team has developed plans for plinth replacement on the aerial structures and a concept that includes strengthening the at-grade plinths to resolve the rebar issues. These solutions will be further developed over the next month to work out specific details as well as to determine repair durations. Solutions will be adjusted as needed, based on continued engineering efforts.

One focus of continuing investigation toward establishing a repair schedule follows the June 2022 discovery of delamination and cracking of the repair mortar applied under rail fasteners. Approximately one third of the fastener locations were repaired before the problem with the new repair material was discovered. Sound Transit directed the contractor to stop using the repair mortar, and we're working with the contractor, engineers and our forensic engineer to identify a suitable replacement.

2. Pre-cast blocks and nylon rail fastener bolt inserts on the I-90 floating bridge

In addition to the concrete plinth issues described in the first section, work by the contractor (Kiewit) on this segment also includes actions to address the following potential risks to the schedule:

- Cracked and spalled pre-cast concrete blocks: The tracks on the Homer M. Hadley floating bridge are supported by pairs of pre-cast concrete blocks, which weigh less than typical plinths and are attached to the bridge with

epoxy to protect bridge deck integrity and avoid issues with stray current. In March 2022, inspectors noticed three of these blocks showed unexplained cracking and flaking, or spalling. To investigate, spalled and representative pre-cast blocks were removed from the bridge and sent to our forensic engineer's testing facility in Illinois for examination and testing. We are pleased that preliminary results suggest that while some of the blocks have hairline cracks, the blocks do not need to be replaced. Additional testing is ongoing to confirm those preliminary results. Following continuing inspections, we have observed spalling in nine blocks to date, or approximately 1% of the 900 blocks examined in the field. There are approximately 7,500 total pre-cast blocks. Any spalled blocks will be removed from the bridge and replaced.

- Replacement of rail fastener inserts: As part of the electrical stray current protection system for the floating bridge, nylon rail fastener bolt inserts were used. These inserts hold the bolts from the rail fastener body that are used to fasten the rail to the pre-cast blocks. Using nylon instead of typical metal inserts was part of the rigorous design solution to protect the floating bridge from corrosion that might occur due to stray electrical current. Numerous nylon inserts were becoming stripped during rail installation. The contractor began replacing some of the stripped inserts in March, and to ensure long-term durability, Sound Transit will have all of them replaced.

Steps taken to improve quality

Sound Transit has taken several steps to help ensure we're receiving the necessary quality on the E130 and other contracts. We have:

- Increased the number of construction engineers and inspectors to make sure we have sufficient staff to observe all of the work.
- Increased the training of Sound Transit staff and consultants to ensure they understand the required tolerances and scopes of work being installed.
- Created "hold points" in the repairs process, where ST staff or construction management consultants need to witness or approve the work before moving to the next step.
- Hired third-party experts to review the repairs and provide material testing (laboratory and in-field).
- Began rotating construction engineers and inspectors on a schedule to mitigate complacency.
- Increased emphasis on contractors' quality control programs to assure compliance.

- Increased use of construction mock-ups to demonstrate proper installation methods and establish standards of performance to judge the installed work.

Analysis of causes and responsibility

Sound Transit's expansion program, combining ST2 and ST3, is the largest in the nation, contributing to our challenges. As we analyze issues summarized in this memo, the factors described below are among those that have contributed to project impacts.

- It was, and continues to be, difficult to hire enough qualified workers with transit experience—from designers and engineers to skilled tradespersons to construction management personnel—based on pandemic-linked labor market volatility and other factors. We continue to look for qualified staff from across the country and internationally, as appropriate.
- COVID-19 has affected the projects in direct and subtle ways that have contributed to some of the quality issues. Sound Transit shut down most of the projects for the month of April 2020. With new COVID-19 protocols, contractors and ST staff and consultants saw productivity and oversight challenges. Key staff were working remotely, making it harder to inspect and oversee the work. COVID-19 productivity losses continue to linger today. We see it in onsite challenges, material delivery delays, and delays from key consultant and contractor technical staff travelling less frequently.
- Contractors are responsible for quality assurance, quality control, and the quality of the finished product. On the E130 project, the contractor's quality control program did not perform properly, as demonstrated by the extent of the quality defects in the track plinth construction.
- While Sound Transit relies on the contractor to inspect and perform the work in accordance with the contract, Sound Transit has a role of quality verification and observation. Sound Transit periodically audits the contractor's quality assurance and control program to verify that it is performing at a level commensurate with contractual requirements. In our reviews, we did not identify the issues. Our program was not robust enough to identify the problems with the contractors' QA/QC program. Since these issues have been revealed, we have taken steps to go from observation to inspection and bolster Sound Transit's verification program. In addition, Sound Transit's construction management consultant personnel identified the defects visually in the E130 track plinth construction, however, they did not report observing the rebar defects prior to concrete placement.

Federal Way Link Extension

The primary risk potentially affecting on-time completion of the Federal Way Link Extension is an unforeseen geological issue encountered during the construction of the alignment in a specific location along I-5, as shown in the map at right.

While it is too early to accurately assess the resulting construction delay, we now expect the project completion to extend some number of months into 2025. The delay will depend on solutions that are currently under development, with focus by the staff and contractor on minimizing the impact.

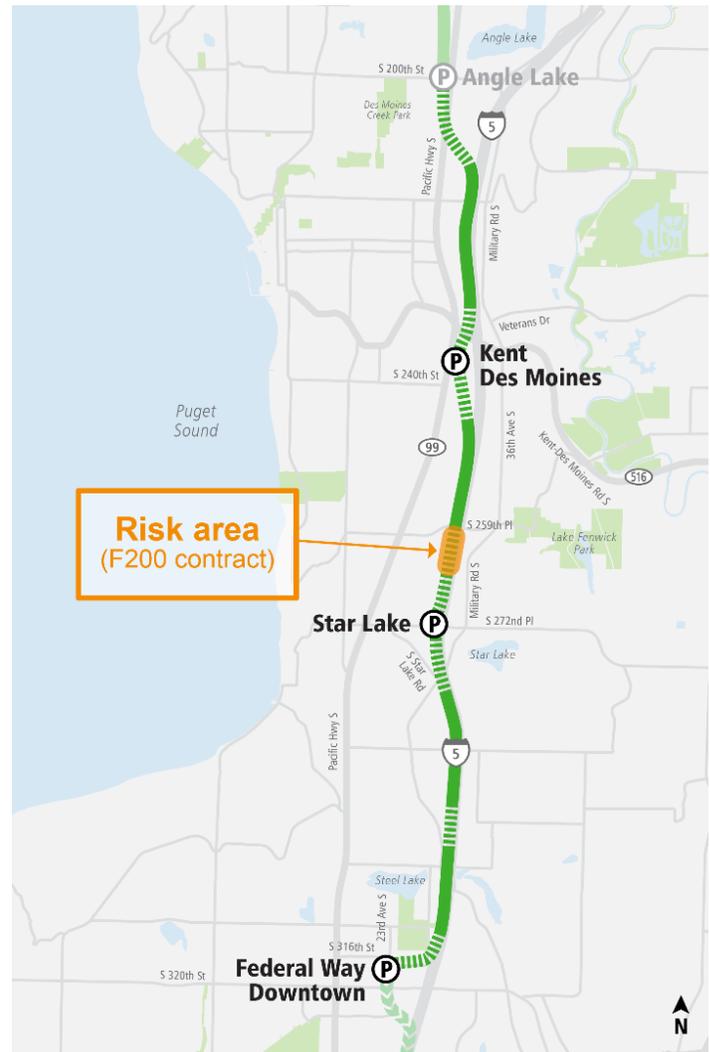
The Federal Way Link Extension passes through a wetland area in Kent adjacent to southbound I-5. Prior to the request for proposals, Sound Transit conducted a limited analysis of the area in connection with the procurement of this design/build contract.

We contractually obligated the design/builder (Kiewit) to perform a broader analysis as part of the design/build process. That further analysis, conducted during the design phase following the notice to proceed, revealed a liquefiable layer of soil deep underground. To address this complicated hydrogeological condition, the agency took the necessary time to work collaboratively with the design/builder to develop a solution.

In April and May 2022, however, there were slope movements in some areas that required stabilization measures. Then, on July 19, about 200 feet of embankment slid approximately nine feet, necessitating a precautionary closure of a lane on I-5 for nearly three days until the embankment, which is downslope from the freeway, could be stabilized.

In light of the recent failure, which now appears to be stabilized, the agency, Kiewit and the Washington State Department of Transportation are currently reevaluating possible permanent design solutions.

Fig. 3: Section of Federal Way Link Extension alignment crossing liquefaction zone.



Memo

A lesser, additional risk to the Federal Way Link opening timeline relates to its traffic mitigation commitments. Traffic mitigation is an environmental requirement to lessen impacts related to the operation of the extension and includes 10 separate sites for improvements to intersections. These improvements are expected to be completed prior to the opening of the Federal Way Link Extension, and there are risks related to a few of the sites. These include:

- Delays or legal challenges to right-of-way possession, use and acquisition that prevents the ROW being acquired in a timely manner.
- Local jurisdictions requiring additional design modifications.
- Delays in necessary utility relocations.

The project team is exploring whether the improvements can be completed after the opening of the extension. If they can, the project likely would not experience any impact to its opening date arising from this issue.

Lynnwood Link Extension

As with other projects, the Lynnwood Link Extension has been impacted by the concrete delivery strike as well as COVID-19. The strike came at a critical time for construction on the Lynnwood extension, when concrete needs were especially important. The strike primarily affected L200, the southern segment of the project, which runs north from the existing Northgate Station to just south of the Snohomish County line. Due to lack of work, the contractor (Stacy and Witbeck/Kiewit/Hoffman) had to temporarily lay off some craftspeople. This resulted in a lag time for returning to work once the strike ended.

The strike and COVID-related shutdowns and restrictions eroded much of the project's eight-month float. As a result, future risks have the potential to further delay the opening of the project.

Fortunately, known risks specific to the project are relatively limited. They include general risks such as challenges that can arise from staffing and supply chain issues, as well as completing fiber-optic connectivity, with work already underway to mitigate risks for the latter.

While it is too early to accurately assess the resulting construction delay, we believe it could be in the range of four to six months.

Downtown Redmond Link Extension

Anticipated delays for Downtown Redmond Link construction completion were also driven primarily by the concrete delivery strike and COVID-19. Construction schedule impacts due to these two factors have been quantified and negotiated with the contractor to be four and a half months, which is mitigated in part by owner-controlled float in the project schedule.

Fortunately, known schedule risks specific to the project are relatively limited. Those include general risks such as challenges that arise from staffing and supply chain issues, managing potential changes in design as lessons are learned on other projects, and work that is necessarily performed by others, such as:

- **Power connections:** There are several issues related to power for the light rail system that have the potential to cause delays. These include design and construction of the service connections and a new monitoring system, which is work performed by Puget Sound Energy.
- **Staffing shortages affecting oversight by permitting authorities:** Lack of skilled workers and increasing demand is a concern across the industry, not only in construction trades. One example is in the support from Washington State Labor and Industries, where the Sound Transit contractors have hired private consulting firms to supplement L&I review. This same approach may also be implemented for installation inspections.

PROGRAMMATIC RISK ASSESSMENT

As we identify next steps for opening projects, a programmatic analysis is essential because, in short, each project is not a world unto itself. The staff and contractors as well as some external partners involved with executing rail startup activities have duties across each of the projects, as well as with current operations.

Since we're opening so many extensions in a short period of time, this analysis will overlay projects on top of each other to see what impacts they might have on one another. This is the first time the agency will be opening more than two extensions in a short amount of time, and it is critical that our plans remain realistic and safety-centric.

Analyzing potential operating challenges

Sound Transit's focus is on solving the identified risks and, if possible, opening the projects without changing the order in which they enter operations (East Link followed by Lynnwood, Federal Way and then Redmond).

Our analyses have reflected that with each of the four current projects, significant risks related to ensuring adequate operations and maintenance staffing for startup and operations must be overcome through close partnership with our operating contractor, King County Metro Transit. While intensive work must continue in this area, Sound Transit maintains very high confidence that we will successfully solve this staff capacity risk, allowing projects to proceed into activation in an orderly sequence as construction work wraps up.

We are also analyzing a scenario in which East Link does not open first, impacting regular use and access to the Operations and Maintenance Facility East. The OMF East provides expanded maintenance base capacity for serving all the coming projects, and we need to ensure enough clean, safe vehicles to support expanded service. Without

Memo

mainline access to the OMF East, service on the 1 Line will be limited by OMF Central capacity and more dependent on reliable performance of the new light rail vehicle fleet operated out of the base in Seattle.

We are analyzing operating strategies to mitigate impacts and to determine what service levels can be provided if the 1 Line expands to Lynnwood and/or Federal Way before East Link crosses Lake Washington.

NEXT STEPS

Our commitment as we embark on the programmatic risk analysis is to prioritize safety and the long-term operability and durability of the system while ensuring high confidence in revised timelines. We appreciate the support we have heard from Board members to make sure that as we re-group, we get it right and maintain transparency.

Our current estimate is that by the fourth quarter 2022 we will have completed our programmatic analysis and will be in a good position to provide further updates to the Board and public.