NELSON
NYGAARD

MEMORANDUM

To: Oregon Metro and TriMet

From: Nelson\Nygaard Team

Date: June 25, 2019

Subject: Central City Transit Capacity - Screening Report

The Central City Transit Capacity Analysis (CCTCA) project is an effort to define a representative project that addresses light rail capacity and reliability issues in the Central City and that improves regional mobility by eliminating major sources of rail system delay. A representative project is intended to give project sponsors and partners enough information to scope and estimate costs for future operational, engineering, and environmental studies. The representative project will also provide conceptual, preliminary information for stakeholders and the general public.

The Portland Central City is the economic and cultural center of the region, with the densest population of people and jobs in Oregon. It is home to numerous regional destinations, including the Oregon Convention Center, Rose Quarter, Union Station, the Pearl District and Old Town/Chinatown, Downtown, Portland State University, and Providence Park. Traffic congestion, surface transit limitations, limited Willamette River crossings, and Steel Bridge rail capacity and reliability issues all impact the movement of people to and through downtown Portland and between Regional and Town Centers. Projected population and employment growth in the Central City and throughout the region will exacerbate the problem in the future. Improvements to the light rail system are among the most critical, sustainable, and cost-effective means to ensure access to Central City and provide the regional mobility needed to support job and population growth.

The project, including this Screening Report, are guided by a Technical Group composed of representatives from local partner agencies. The Technical Group includes delivery and project management staff to provide guidance as to the technical feasibility of alternatives, relevant plans and studies, and major infrastructure study processes. Technical Group members include those listed in the Table below.

621 SW MORRISON ST., SUITE 1250 PORTLAND, OR 97205 503-227-3463 FAX 503-228-2320
www.nelsonnygaard.com

Figure 1 CCTCA Technical Group Roster

Agency	Participants
Oregon Metro	Matt Bihn
	Eryn Kehe
TriMet	Dave Unsworth
	Liz Higgins
Oregon Department of Transportation	Rory Renfro
Portland Bureau of Transportation	Mauricio LeClerc
	April Bertelsen
Portland Bureau of Planning and Sustainability	Mark Raggett
Multnomah County	Megan Neill
	Jon Henrichsen
Washington County	Chris Deffebach
Clackamas County	Karen Buehrig
Port of Portland	Philip Healy

Evaluation Framework

CCTCA builds on work completed in the Steel Bridge Transit Improvements (SBTI) study and previous studies evaluating transit supportive river crossings. The intent of the CCTCA evaluation framework is to:

- Quickly assess bridge and tunnel crossing alternatives to identify the most viable and beneficial alternatives.
- Provide the technical team with comparative benefit, cost, and impacts for each of the alternatives.
- Provide clear and quantifiable measures to report to stakeholders, and to be used during public engagement opportunities.
- To select a representative project alternative and identify environmental study costs that can be considered for Metro's potential 2020 transportation funding measure.

The evaluation framework builds on the project goals and objectives developed by the interagency Technical Group. Evaluation criteria are aligned with project goals to ensure decision makers have a broad understanding of tradeoffs between alternatives. Criteria are both quantitative and qualitative.

The project Technical Group received an Evaluation Framework technical memorandum on April 30, 2019, provided revisions and comments on the framework and draft initial screening results at a joint meeting, and provided written comments and edits. This report incorporates the evaluation framework comments and changes contributed by the group.

The evaluation approach includes two tiers or phases, each served by variations on the performance measures, described below.

1. An ***initial screening*** applies higher level metrics based on qualitative information and syntheses of past technical analysis. Initial screening criteria ensure the next phase of technical

and detailed evaluation focuses resources on alternatives that meet baseline thresholds of performance, such as meeting TriMet's minimum light rail system on-time performance (OTP) standards. These criteria help stakeholders identify potential infrastructure alternatives that meet goals and objectives, and do not have fatal flaws that obviate the need for further analysis.

2. An ***alternatives evaluation*** is designed to assess candidate alternatives and provide a more comprehensive understanding of how well the alternatives meet the goals and objectives. The alternatives evaluation will be quantitative, and use technical tools such as rail and regional travel demand model resources.

Draft Project Goals and Objectives

The project team, in coordination with the CCTCA Technical Group and Strategy Group, developed the following project goals and objectives. Goals and objectives guide the project evaluation criteria and process.

Improve regional mobility.

- Significantly improve transit travel times to and through the Central City
- Improve transit operations and service reliability to increase ridership
- Increase train frequency and capacity to meet future demand
- Increase the transit system's resiliency to seismic and environmental changes
- Support future expansion of the transit network
- Improve mobility for low-income households and communities of color
- Provide convenient transfer opportunities between transit modes

Support regional and Central City economic vitality.

- Improve access from housing to jobs, key destinations, education, and social opportunities both in and across the region's core
- Create development opportunities near station areas that align with community visions
- Support local and regional land use and development goals
- Expand job creation in regional and town centers by increasing mobility and accessibility

Improve regional equity.

- Improve transit travel time between affordable housing and employment opportunities
- Reduce overall transportation and housing burden for low-income households
- Improve commute reliability for workers with inflexible schedules

Enhance quality of life.

- Provide travel options that avoid traffic congestion
- Improve transportation safety and remove mode conflicts
- Enhance public health

Minimize impacts to the natural and built environment.

- Minimize impacts to historic and cultural resources
- Minimize impacts to existing mobility infrastructure
- Increase transit mode share to contribute to regional and state climate goals
- Minimize adverse impacts to communities
- Avoid impacts to the Willamette River

Assumptions

The screening and evaluation will be based on several critical assumptions that help guide the process:

- Initial screening will be based on planning level assessment, order-of-magnitude estimates where travel and other data analysis is not readily available.
- 2040 will be used as the primary analysis year (although certain criteria may be based on longer out year timeframes).
- Metro will support the evaluation by providing Regional Travel Demand Model runs, including ridership forecasts.
- Demographic and socioeconomic (i.e. land use) data will be aligned with the 2040 regional forecasts for the Metro 2040 Regional Transportation Plan.
- Analysis will typically use the 2040 constrained Transportation network, which includes Southwest Corridor High Capacity Transit to Tualatin, TriMet Enhanced Transit Corridor network, and Vancouver High Capacity Transit.

Screening and Evaluation Criteria

The table below summarizes the evaluation framework: a set of criteria and methods guiding the first phase initial screening and second phase alternatives evaluation processes. The criteria are organized by project goal. The methods describe primarily the quantitative process supporting the evaluation phase. The "use" column indicates whether the criteria is part of both the initial screening and alternatives evaluation (phase 1 and 2) or only the alternatives evaluation (phase 2). The criteria include suggested changes from the Technical Group.

Figure 2 Evaluation Criteria (Bold Text Indicates Phase 1 Screening Measures)

Criteria	Measures	Evaluation Methods	Notes	Use
IMPROVE REGIONAL MOBILITY				
Travel Time	Light rail travel time for representative segments (2040)	▪ Measure travel time on key north-south and east-west segments (e.g., Interstate Branch travel time from Albina to Pioneer Square, Hillsboro Branch travel time from Hollywood Transit Center to Pioneer Square) ▪ Peak period and midday data	▪ SBTI data where relevant for initial screening ▪ TriMet rail travel time data for alternatives evaluation (TriMet) ▪ Rail Traffic Control model used for representative project only	▪ Screening ▪ Evaluation
Ridership	Light Rail Ridership (2040), Transit System Ridership (2040), and Central City Transit Ridership (2040)	▪ Forecast using the Metro Regional Travel Demand Model	▪ Ridership forecasts for individual light rail lines, light rail system and overall transit system (Metro and Central City)	▪ Evaluation
On-Time Performance	% of trips in TriMet's policy on-time performance range (2040)	▪ Use Rail Traffic Control model approach from SBTI study ▪ Peak and midday periods	▪ SBTI data where relevant for screening ▪ Rail Traffic Control data for alternatives evaluation and representative project	▪ Screening ▪ Evaluation
Capacity	Ability to accommodate project passenger demand beyond 2040	▪ Measure projected peak loads by key segment and theoretical maximum passenger capacity ▪ Frequency dependent on assumed train-control systems and switch movements ▪ Consider 4-car train option ▪ Evaluate projected peak load vs. total available capacity by segments	▪ Future peak load points (Metro) ▪ SBTI theoretical maximum capacity by segment	▪ Screening ▪ Evaluation

Criteria	Measures	Evaluation Methods	Notes	Use
Transit Mode Share	Percent of regional trips on transit (2040) Peak period and total	▪ Mode share forecast using the Metro Regional Travel Demand Model	▪ Travel demand model mode share (Metro)	▪ Evaluation
Resiliency	Redundancy across the Willamette River	▪ Redundancy of rail crossings (# of track crossings, # of separate facilities with track crossings, etc.) ▪ Seismic resiliency	▪ Qualitative analysis	▪ Screening ▪ Evaluation
Deliverability	Cost-effectiveness Ability to construct in phases	▪ Order-of-magnitude assessment of total estimated project cost ▪ Qualitative assessment of potential phasing	▪ Qualitative Analysis	▪ Screening ▪ Evaluation
Reliability	Number of at-grade switch movements, crossings, and conflict points	▪ Evaluate the number of train switch movements and at grade crossings required under an alternative;	▪ Qualitative analysis	▪ Screening ▪ Evaluation
Capital Cost	Total project capital cost estimate	▪ Planning level cost estimate	▪ SBTI assumptions or update costs from TriMet	▪ Evaluation
SUPPORT REGIONAL AND CENTRAL CITY ECONOMIC VITALITY				
Access to Employment and Housing	Forecasted number of jobs and households accessible by transit in 30 minutes, 45 minutes, and 60 minutes (2040)	▪ Isochronal analysis to assess the number of jobs and households accessible by transit in a given travel time from select representative neighborhoods / areas, including several locations in the Central City.	▪ GIS Analysis ▪ Regional Travel Demand Model travel time (Metro) ▪ See Metro Regional Transportation Plan measure Access to Jobs	▪ Evaluation

Criteria	Measures	Evaluation Methods	Notes	Use
Access to Regional Destinations	Regional destinations served	▪ Regional destinations that fall within 1/4 mile or better of transit stations ▪ Regional destinations are employment, recreation and activity centers	▪ GIS Analysis ▪ TD model travel time (Metro) ▪ See Metro Regional transportation Plan measure Access to Jobs	▪ Screening ▪ Evaluation
Support of Growth Regional and Local Growth Plans	Alignment of capacity and access improvements with regional and local jurisdiction plans	▪ Qualitative assessment of regional growth projections/growth capacity & light rail system capacity/performance improvements ▪ Qualitative assessment of urban design impacts, benefits or opportunities to align with envisioned/planned urban character	▪ Qualitative	▪ Evaluation
IMPROVE REGIONAL EQUITY				
Access to Opportunity	Number of essential destinations (community places) accessible by transit within 30 minutes, 45 minutes, 60 minutes for low-income minority, senior and disabled populations in year 2040	▪ Number and percentage of community places accessible by transit from equity focus areas ▪ Community places include services, retail, civic and medical facilities, as identified in Metro Regional Transportation Plan ▪ Equity focus areas have higher concentrations of low-income, minority, seniors and people with disabilities, as identified in Metro Regional Transportation Plan.	▪ Travel Demand Model travel time (Metro) ▪ GIS data (Metro) ▪ "Community Places" defined / identified in Metro Regional Transportation Plan Access to Community Places	▪ Evaluation
Commute Reliability	Improved travel time between affordable housing and service sector jobs	▪ Number and percent of service sector jobs accessible by transit from areas with high number of low-income households, and/or equity focus areas within a given travel time.	▪ Forecasted population and employment (Metro) ▪ Travel Demand Model travel time (Metro) ▪ See Metro Regional Transportation Plan measure Access to Jobs	▪ Evaluation

Criteria	Measures	Evaluation Methods	Notes	Use
ENHANCE QUALITY OF LIFE				
Congestion benefit	Change in vehicle miles traveled	▪ Change in vehicle miles traveled forecast using the Metro Regional Travel Demand Model	▪ Travel demand model vehicle miles traveled (Metro)	▪ Evaluation
MINIMIZE IMPACTS ON THE NATURAL AND BUILT ENVIRONMENT				
GHG Emissions	Reduction in GHG emissions (2040)	▪ Change in vehicle miles traveled forecast using the Metro Regional Travel Demand Model ▪ GHG reduction based on change in vehicle miles traveled and standard Metro approach for calculating greenhouse gas emissions from transportation	▪ Travel demand model vehicle miles traveled (Metro) ▪ Likely small differences by alternative	▪ Evaluation
Environmental Impacts	Potential impacts to natural and built environment	▪ Very high-level assessment of historic, cultural, community, natural, and infrastructure impacts ▪ Built: Number of buildings affected, including historic properties ▪ Natural: qualitative, effects to Willamette River ▪ Construction period: qualitative, disruption to streets, transportation systems, and neighborhoods	▪ Qualitative assessments	▪ Screening ▪ Evaluation

Infrastructure Concepts Considered

Potential transit infrastructure alternatives have stemmed from several sources, including the Steel Bridge Transit Improvements (SBTI) study, a regional transit network study (ongoing as part of this project), and ongoing technical analyses carried out by TriMet and other regional partners. The alternatives considered include:

- No Build
- Steel Bridge 4-Track
- Replacement Bridge
- Supplemental Bridge
- Tunnel

Each is described in greater detail below.

No Build Existing Conditions

The Steel Bridge was built in 1912. TriMet maintains and operates light rail on the inside lanes of the upper deck through a sublease agreement with the Oregon Department of Transportation, who leases the upper deck from the Union Pacific Railroad. In 2017, TriMet operated 40 light rail trains across the Steel Bridge in each of the single busiest morning and evening peak hours, or one train every 90 seconds. The bridge would not be able to accommodate the 20-year forecast demand of 64 trains in the peak hour. Even today, the bridge and interlockings at the approaches frequently cause reliability issues for TriMet.

A traffic signal on the bridge's east side at Interstate Avenue affects access to the bridge. This signal is located at the same point as the track interlocking from the Yellow Line to the Red / Blue / Green Lines. This signal regulates conflicting train movements as well as vehicular traffic and pedestrian crossings – all of which can result in delays on the light rail system. On the west side, the interlockings on the Steel Bridge connecting to the Transit Mall (the 5th and 6th Avenues) constrain the light rail system.

Currently, it takes 22 minutes to travel from Lloyd Center to Goose Hollow – a three-mile trip with 12 stops. The alignment runs through an urban grid of intersections roughly every 200 feet. As the population has grown, so has congestion with different modes of travel competing for limited space. Downtown, frequent vehicular intrusions into the light rail right-of-way interfere with rail operations, resulting in delays and crashes. Between 2011 and 2017, 65 crashes occurred along the Yamhill and Morrison Street light rail corridor resulting in significant delays that rippled throughout the system. As the region continues to expand and mobility demands increase, the constraints of the urban landscape increasingly challenge the transit system.

Steel Bridge 4-Track

The 4-Track Steel Bridge concept would add two additional sets of tracks to the existing Steel Bridge on the outside lanes, and grade-separate the light rail from vehicle traffic at Interstate Avenue. General purpose traffic would be restricted from using the bridge (buses would be allowed). This alternative is assumed to retrofit the Steel Bridge with needed structural

improvements and seismic upgrades. There would be no change to navigational clearance, Harbor Wall access, or landings on either side of the Willamette River.

Replacement Bridge – Moveable Span

The Replacement Bridge concept is a new 4-track bridge for east-west light rail lines approximately 130 feet south of the Steel Bridge. Buses would continue to operate on the Steel Bridge. Given the grades, the this alternative would not meet requirements for an Americans with Disabilities Act (ADA)-compliant pedestrian path. ADA access would be provided via the existing bike/pedestrian path on the lower deck of the existing Steel Bridge or the sidewalks on the upper deck.

The representative Replacement Bridge Concept reflects a minimum navigational vertical clearance of 114 feet, with approximately 118 feet at the center of the channel and a movable span in the center of the river to accommodate large waterborne vessels. The bridge would include a lift span to (infrequently) accommodate large ships. The Bridge includes approach grades of up to 6.2 percent, with critical touchdown points at Interstate 5 on the east side of the Willamette River and at 1st Avenue and Burnside Street on the west side. On the east side, the existing Rose Quarter and Interstate/Rose Quarter Stations would be consolidated and relocated to a new elevated station. This would provide an opportunity to reconfigure traffic circulation around the Rose Quarter. The Old Town/Chinatown Station would be eliminated because the track would not return to grade until Burnside Street. Couch Street would need to be closed at 1st Avenue.

Replacement Bridge – Fixed Span

The Replacement Bridge Fixed Span concept is the same as the new 4-track Replacement Bridge described above for east-west light rail lines. This Bridge would have a fixed span, however, allowing large naval vessels to pass below it without raising the deck. This requires a 150-foot clearance, similar to the Steel Bridge today at its full lift height. The bridge would carry the same rail routes.

The landings, or where the bridge returns tracks to street levels would be much further than with a moveable span bridge. The east-west tracks (Blue and Red Lines today) would pass over Burnside Street and return to grade near Pine Street. The north-south tracks (Yellow and Green Lines today) would run elevated until turning onto 5th and 6th Streets. On the west side of the Willamette River, the tracks would run elevated to I-5 and the existing Rose Quarter Station.

Supplemental Bridge

The Supplemental Bridge concept is a 2-track bridge with vertical clearance similar to that of the upper deck of the Steel Bridge. It would cross the river diagonally between Peace Memorial Park on the east side and NW Davis Street on the west side. The concept could also include a seismic retrofit of the Steel Bridge to allow some light rail lines to continue to operate on the Steel Bridge. This would include a lift span to (infrequently) accommodate large ships. The Supplemental Bridge alternative would have insufficient horizontal and vertical clearances at the Harbor Wall and would limit anchoring opportunities along the wall.

Tunnel

The representative tunnel concept consists of a twin-bore east-west transit tunnel from the Lloyd District area to near Goose Hollow. It would have a west portal on Jefferson Street near SW 16th

Avenue and an east portal near NE Holladay Street and NE 16th Drive. The tunnel concept includes potential underground stations at Lloyd Center, Rose Quarter, Union Station, Pioneer Square, and Portland State University, and Goose Hollow. These stations would be designed to accommodate 4-car trains. The north-south light rail lines would use existing surface alignments and stations. The Steel Bridge and related tracks would be retained for auxiliary use and for redundancy in case of service disruption. The Tunnel was recommended as a viable concept in the Steel Bridge Transit Improvements study.

Initial Screening Evaluation Results

The initial screening is intended to help stakeholders understand which options would best meet the project goals and objectives. The evaluation relies on work completed through the SBTI study and evaluation of previously identified bridge and tunnel alternatives. The quantitative on-time performance, travel time, and ridership results from the SBTI study relate to the study area, which extended from Goose Hollow to the Lloyd Center districts. The table below summarizes the results for each initial infrastructure concept.

The symbols used in the screening matrix are described below.

- Provides the lowest or no performance improvements
- Provides minimal performance improvements compared to other alternatives
- Provides some performance improvements on par with other alternatives
- Provides good performance improvements, greater than most other alternatives
- Provides the greatest performance improvements

Figure 3 Initial Screening Evaluation Summary

Criteria	No Build	Steel Bridge 4-Track	Replacement Bridge - Moveable	Replacement Bridge - Fixed	Supple-mental Bridge	Tunnel
Travel Time	○	◔	◔	◔	◔	●
On-Time Performance	○	◔	◔	◔	◔	●
Service Reliability	○	○	◔	◔	◒	●
Frequency & Capacity	○	◔	◔	◔	◔	●
Access	◒	◒	◔	◔	◔	◒
Resiliency	○	○	◒	◒	◕	◒
Environment Built/Natural	●	◕	◔	○	◔	◔

The following sections provide more detailed justification of the initial screening results.

4-Track Steel Bridge

The 4-Track Steel Bridge concept provides some added capacity and less environmental impact to the natural and built environment than other new construction options. Two key factors limit the effectiveness of this option relative to the other alternatives.

1. The added track offers little added capacity to move more people through the area, as most existing switches, crossovers, and conflicts with street traffic remain. This would result in continued on-time performance and reliability challenges.
2. The extended deck creates potential for imbalanced weight loads that would cause deck uplift on the side opposite a moving train. The frequent loads and movement would require significant additional maintenance and engineering to ensure safe and effective use.

Figure 4 Steel Bridge 4 Track Screening Description

Criteria	Justification
Travel Time	▪ **Minor improvement**: less than 2 minutes improvement over existing between Goose Hollow and Lloyd Center ▪ Grade separation, removing automobile conflicts
On-Time Performance (Target 90%)	▪ Minor improvement, but does not meet standard: Less than 86% as modeled ▪ Does not change rail conflict points
Service Reliability	▪ **No improvement** due to periodic bridge lifts, and no change to track crossovers. This does not avoid major conflict/congestion points, and restricts train speed
Frequency & Capacity	▪ **Minor improvement** by removing some traffic conflicts at Interstate Avenue, and at SW 3rd Avenue and SW Glisan Street
Access	▪ **No improvement**: maintains existing access to neighborhoods and cross-region travel
Resiliency	▪ **Relatively little seismic improvement** from retrofits compared to alternatives ▪ No additional redundancy from new transit facility
Environment	▪ **Minor impacts from construction** ▪ No new impacts to natural and built resources
Other	▪ Fatal flaw from deck imbalance and movement when tracks are extended beyond the existing lines. This would result in greater maintenance needs ▪ Daily Boardings: +3,000 ▪ Estimated cost: $220 M - $470 M

Supplemental Bridge

The Supplemental Bridge concept offers advantages of adding tracks crossing the Willamette River on a seismically up-to-date facility. The proposed alignment may increase travel time on some routes by reducing one stop. The concept fails to significantly increase travel times or improve on-time performance to TriMet's standard. This is due to continued reliance on the Steel Bridge for the full light rail network, and retaining most track crossovers and switch movements. The concept also has a fatal flaw in that the available bridge alignment would eliminate docking area on the Harbor Wall for large ships.

Figure 5 Supplemental Bridge Screening Description

Criteria	Justification
Travel Time	▪ Minor improvement: Less than 2 minutes travel time improvement between Goose Hollow and Lloyd Center ▪ Faster travel time by removing Old Town station and grade separating from roadway traffic.
On-Time Performance (Target: 90%)	▪ Minor improvement, but does not meet standard: The on-time performance was not modeled in previous studies. Given the continued use of the Steel Bridge, it is likely to be the same as the 4-Track Steel Bridge concept at about 86%
Service Reliability	▪ Minor improvements due to some track updates at Rose Quarter ▪ Retains track crossover and signal delays ▪ Bridge would require infrequent lifts for river navigation
Frequency & Capacity	▪ Minor improvements due to new tracks adding flexibility ▪ Capacity is still limited at surface crossovers
Access	▪ Minor reduction: all stations have comparable access to no-build with exception of Old Town/Chinatown station which is removed due to required touchdown location.
Resiliency	▪ Moderate improvement due to redundancy from two bridges, seismically secure new bridge. TriMet would still rely on the Steel Bridge for some lines.
Environment	▪ Moderate improvement: add redundancy, seismically secure new bridge
Other	▪ Fatal flaw: Horizontal and vertical clearances at the Harbor Wall would be insufficient for large ships and would limit anchoring opportunities. ▪ Difficult implementation with planned ODOT Rose Quarter/ I-5 improvements ▪ Daily boardings +3,000

Replacement Bridge - Moveable

The Replacement Bridge addresses redundancy, eliminates rail to surface conflicts (pedestrian, bicycle, vehicle), and moderately improves operations. Travel times would be reduced primarily by eliminating the Old Town/Chinatown Station, but on-time performance is expected to remain approximately 86 percent – less than TriMet's 90 percent target. Some train delay would result at curves at the east end of the new bridge, the new station platform at Rose Quarter, and track crossovers. The Replacement Bridge concept would not meet requirements for an Americans with Disabilities Act (ADA)-compliant pedestrian path due to the steep span grade required (6.2%). The bridge would include a lift for very high, and infrequent, naval ships.

Figure 6 Replacement Bridge Screening Description

Criteria	Justification
Travel Time	▪ Minor improvement: Less than 2 minutes travel time improvement between Goose Hollow and Lloyd Center ▪ Faster travel time by removing Old Town station and an elevated Rose Quarter station.
On-Time Performance (Target: 90%)	▪ Minor improvement, but does not meet standard: Less than 86% as modeled ▪ Does not change rail conflict points
Service Reliability	▪ Moderate improvement due to some track updates at Rose Quarter ▪ Infrequent bridge lifts ▪ Retains track crossover and signal delays
Frequency & Capacity	▪ Minor improvement due to new tracks adding flexibility ▪ Capacity still limited at surface crossovers and signal delays
Access	▪ Reduction: Touchdowns at I-5 on east side (elevated Interstate/Rose Quarter station), and Skidmore Fountain on west side (close Old Town station).
Resiliency	▪ High improvement by replacing the Steel Bridge structure, creating a seismically secure modern structure
Environment	▪ Major impacts from construction, removal of buildings
Other	▪ Daily boardings +3,000 ▪ Estimated cost: $300 M - $650 M

Replacement Bridge – Fixed

CCTCA Technical Group participants were interested in the reliability improvements that may be gained by creating a fixed-span bridge, or one that would not require movable (lift) span to allow naval vessel passage. The fixed-span Replacement Bridge would still address redundancy, eliminate rail to surface traffic conflicts, and moderately improve operations. Travel times would be reduced primarily by eliminating the Old Town/Chinatown and possibly the Skidmore Fountain Stations. On-time performance would be expected to remain about 86 percent, in that the option would not reduce rail crossovers and switch movements. As with the movable span, some train delay would occur at the east end of the new bridge, a new station platform at Rose Quarter, and track crossovers. The fixed-span Replacement Bridge concept would also not meet requirements for an ADA-compliant pedestrian path due to the steep span grade required. The reduced access due to closed and elevated stations would particularly affect existing transportation disadvantaged neighborhoods.

Figure 7 Fixed-Span Replacement Bridge Screening Description

Criteria	Justification
Travel Time	▪ Minor improvement: Less than 2 minutes travel time improvement between Goose Hollow and Lloyd Center ▪ Faster travel time by removing Old Town station and an elevated Rose Quarter station.
On-Time Performance (Target: 90%)	▪ Minor improvement, but does not meet standard: Less than 86% as modeled ▪ Does not change rail conflict points
Service Reliability	▪ Minor improvement due to some track updates eliminating infrequent bridge lifts ▪ Retains track crossover and signal delays
Frequency & Capacity	▪ Minor improvement due to new tracks adding flexibility ▪ Capacity still limited at surface crossovers and signal delays
Access	▪ Reduction: Touchdowns beyond I-5 on east side (highest elevation Interstate/Rose Quarter station), and possibly beyond Skidmore Fountain on west side (closed Old Town station, possibly Skidmore Fountain).
Resiliency	▪ High improvement by replacing the Steel Bridge structure, creating a seismically secure modern structure
Environment	▪ Major impacts from construction, removal of buildings, view shed
Other	▪ Daily boardings +3,000 ▪ Estimated cost: $500 M +

Transit Tunnel

The twin bore Tunnel Concept evaluated in the SBTI study provides the greatest mobility and access improvements of all the concepts in the screening. The grade separated tracks eliminate the most conflicts between light rail and surface travel modes (pedestrians, bicycles, and general purpose traffic) for east-west trips, improving travel time by about 15 minutes in the SBTI study area between Goose Hollow and Lloyd Center. The separated ROW also frees up capacity on the surface light rail network, leading to study area on-time performance reaching 97%, or 7 percentage points above TriMet's performance target. The Tunnel concept has the greatest potential to provide improvements to the regional transit system of all the alternatives considered.

Figure 8 Transit Tunnel Screening Description

Criteria	Justification
Travel Time	▪ **Major improvement**: at about 15 minute travel time savings between Goose Hollow and Lloyd Center
On-Time Performance (Target: 90%)	▪ **Major improvement**: reaching 97% as modeled in the study area ▪ Removes conflicts at Lloyd Center, Rose Quarter, Union Station, and Pioneer Square ▪ Improves on-time performance on both subway and surface lines by reducing crossovers
Service Reliability	▪ **Major improvement** by providing separated ROW, fewest track crossovers, and no street traffic conflicts
Frequency & Capacity	▪ **Major improvement** by providing separated ROW, fewest track crossovers, and no street traffic conflicts
Access	▪ **Moderate improvement:** Adds new transit facility and greatly improves travel times in the study area. Maintains existing stations. Adds underground stations with greater reach in station access points.
Resiliency	▪ **Moderate improvement** by providing a seismically secure facility and some redundancy ▪ One twin-bore tunnel still relies on Steel Bridge for full light rail network
Environment	▪ **Major impacts** from construction ▪ Fewer permanent urban/ street impacts than bridge touchdown points.
Other	▪ Daily boardings +7,500 to +15,200 ▪ Estimated cost: $900 M - $1,940 M

Conclusions

- *The Transit Tunnel* provides the most benefits in terms of travel-time savings (approximately 15 minutes between Goose Hollow and Lloyd Center Stations), increases system ridership, and improves system on-time performance (97 percent for all lines within the study area). The Tunnel alternative was cited as viable in the SBTI study. **The CCTCA Technical Group recommended exploring the Tunnel alternative as the most feasible alternative to address the expected CCTCA goals.**
- *The Replacement Bridge – Moveable* alternative provides some operational performance improvements, and would reduce the transit network reliance on the Steel Bridge. However, the Replacement Bridge does not improve on-time performance above the 90% target, and delivers only minor travel time improvements in the study area. **The CCTCA Technical Group did not recommend advancing this alternative for further consideration.**
- *The Replacement Bridge – Fixed* alternative provides performance similar to the moveable alternative: it does not improve on-time performance and delivers only minor travel time improvements in the study area. The increased elevation and distance required for bridge touchdowns would disrupt neighborhoods and have further negative effects on access. **The CCTCA Technical Group did not recommend advancing this alternative for further consideration.**
- *The Supplemental Bridge* alternative provides some operational performance improvements in the study area, and would reduce some transit network reliance on the Steel Bridge. This alternative has a fatal flaw, in that it restricts naval vessel access to the Harbor Wall, which is a required element of infrastructure design. **The CCTCA Technical Group did not recommend advancing this alternative for further consideration.**
- *The 4-Track Steel Bridge* alternative offers minimal travel time and on-time performance improvements in the study area. It would not address transit network resiliency due to continued reliance on the Steel Bridge. The Steel Bridge 4-Track alternative has a fatal flaw, in that the track additions would create uneven load on the structure with passing trains, increasing maintenance requirements and potential structural risks. **The CCTCA Technical Group did not recommend advancing this alternative for further consideration.**