

Streetcar Loop Project Before-and-After Study (2016)

Portland, Oregon



U.S. Department
of Transportation

**Federal Transit
Administration**

Learn more:

www.transit.dot.gov/before-and-after-studies

Streetcar Loop Project; Portland, Oregon

The project is a 3.3-mile streetcar line extending from the existing Portland streetcar system east across the Willamette River and south through the Portland Eastside Industrial District to the Oregon Museum of Science and Industry. Figure 4 is a map of both the existing 4.1-mile streetcar line west of the river and the eastside Streetcar Loop project.

The project was a significant increment toward, but not the completion of, the planned streetcar loop in the Portland core. The loop has since been completed with the September 2015 opening of the Portland-Milwaukie light rail project. That project added a new bridge, the Tillicum Crossing, over the Willamette River that carries both the Milwaukie light rail line and the now-completed streetcar loop. The Portland-Milwaukie light rail project and its impacts on the streetcar loop are not part of this study. A separate Before-and-After Study will document the outcomes and accuracy of predictions for that project.

The City of Portland owns the streetcar system. The City contracted with Portland Streetcar, Inc. (PSI) for design and construction management of the Streetcar Loop project. The City operates and maintains the entire system with its own employees as well as staff contracted from PSI and the Tri-County Metropolitan Transit District (TriMet).

A Central City transit loop was one element of the Portland Central City Plan adopted in 1988 and the Central City Transportation Management Plan developed in 1995. Between 2001 and 2007, the City opened four streetcar segments, proceeding south from the Pearl District to Portland State University initially, and then with incremental extensions to and through the South Waterfront District for a total of 4.1 miles.

The Streetcar Loop project entered into Project Development (PD) in April 2007 and received a grant from the Small Starts program of the Federal Transit Administration (FTA) in October, 2009. The project opened to service in September 2012. The “before” time-point for this Before-and-After Study was 2011 and the “after” time-point was 2015.

Physical scope

The streetcar project is double-tracked over its entire 3.3 miles and therefore comprises 6.6 track-miles. Except for 0.45 track-miles that are located in exclusive trackway, tracks are embedded in existing streets. East of the Willamette River, the tracks are located on separate, parallel streets one block apart so that each street has one track embedded primarily in a curb lane. Except for 440 feet of elevated structure at its southern terminus and the segment that uses the pre-existing Broadway Bridge, the entire extension is at-grade.

Other elements of the project include: the retrofit of the Broadway Bridge to carry the streetcar extension to the east side of the river; retrofits of four arterial street overpasses on the east side of the river; 28 new streetcar stops with shelters, fare-collection equipment, and dynamic displays of next-train arrival times; six new double-articulated low-floor streetcars; overhead trolley-wire electrification and five new electrical substations; the addition or modification of traffic signals at 49 intersections with signal priority at eight locations; and a new maintenance-and-storage facility for the streetcars.



Figure 4. Map of the Portland Streetcar Loop Project and the Streetcar System

The predictions of the scope of the project at entry into PD and at the FTA grant award accurately anticipated the as-built project. The dual role of the City of Portland contributed to the accuracy of the predictions. The City was both a co-sponsor of the project and a principal permitting and regulatory agency. Consequently, inclinations to add elements to the project scope during the permitting process were tempered by the direct understanding of implications for project costs.

Capital cost

The actual cost of the project was \$148.8 million in year-of-expenditure (YOE) dollars including \$128.8 for all project elements except the six additional streetcars that were purchased separately by the City of Portland at a total cost of \$20.0 million. Aggregate unit cost of the project was \$44.9 million per mile – \$38.9 million per mile without the vehicles. The costs of guideway construction and vehicle procurement represented 82 percent of all project costs.

Predictions of project costs prepared during the planning and development of the project were quite accurate. The prediction at PD-entry was \$151.9 million in YOE dollars (2 percent higher than the actual cost). The prediction at the FTA grant award was \$148.8, matching the actual cost.

Transit service

In the three-year interval between the opening of the Eastside project in 2012 and the completion of the entire streetcar loop in 2015, service on the project was provided by the “Central Loop” streetcar line. Figure 1 shows the alignment of this 4.5-mile line – extending from the project’s southern terminus on the Eastside north to the Broadway bridge crossing and then south on the pre-existing streetcar line as far as Portland State University. This service operated on a 15-minute headway from 5:30 a.m. to 11:30 p.m. seven days a week.

End-to-end run times on the entire Central Loop line varied between 33 and 40 minutes (6.7 mph to 8.2 mph) depending on the time of day. Run times on the 3.3-mile project itself varied between 22 and 28 minutes (7.0 mph to 9.0 mph).

With the opening of the Central Loop line, service on the pre-existing streetcar line went from 12-minute to 15-minute headways. Where the two lines share tracks on the west side, the resulting headway is 7.5 minutes. TriMet made no changes to any bus routes with the extension of streetcar service to the Eastside.

At the “after” milestone, individual trips on the streetcar system required either a \$1.00 ticket that was valid for two hours or a \$23 monthly pass. TriMet tickets and passes are also valid for trips on the streetcar system.

Anticipated service plans for the project varied somewhat from the actual outcome. At PD-entry, the service plan anticipated more frequent service (12-minute headways compared to the actual 15-minute headways) and a longer Central Loop service – extending 0.9 miles further south on the west side past Portland State University (PSU) to a terminus in the South Waterfront District. The service plan called for 38,300 annual vehicle-hours of service compared to 27,100 vehicle-hours in the actual outcome. At the FTA grant award, in response to uncertainties in TriMet

operating funds, the service plan anticipated streetcar service on the project that would be confined to the project itself, requiring riders to transfer between the project and the west side streetcar line. Subsequent resolution of funding uncertainties permitted the actual service on the project to be through-routed to the west side as far as PSU.

Operating and maintenance (O&M) costs

Actual system-wide streetcar O&M costs were \$12.3 million in TriMet fiscal year 2014, an increase of \$3.4 million compared to fiscal year 2012 before opening of the project. This increase reflects the introduction of the Central Loop service both on the project itself and extending onto the pre-existing line on the west side. It also reflects the reduction in service frequency on the west-side line and a 15 percent decrease in the average per-vehicle-hour O&M cost caused by modest economies of scale in the expanded streetcar system.

Allocating system-wide costs based on vehicle-hours of service, actual O&M costs for the entire Central Loop line were \$5.0 million and for the part of that service that operated on the project itself were \$3.9 million.

Variations in predicted O&M costs primarily reflected differences in the amount of service anticipated in the service plan for the project at each milestone. The prediction at PD-entry, when the service plan more closely resembled the actual outcome, was \$7.0 million – an overestimate of \$2.0 million (40 percent). The overestimate is the direct result of the 0.9-mile longer Central Loop line and more frequent service planned at PD-entry compared to the actual outcome. The overestimate was offset somewhat by the incorrect per-hour labor costs employed in the predictions. The predictions implied an average cost of \$181 per vehicle hour – reflecting the direct costs of streetcar service but omitting \$35 per-vehicle-hour of indirect costs (a 16 percent understatement of the full unit cost).

Ridership

In 2015, before the opening of the Tillicum Crossing bridge and consequent completion of the entire streetcar loop, the project carried an average of 2,500 trips per weekday (where trips on the project include any trip that boarded and/or exited the Central Loop streetcar line at a new streetcar station on the east side). The average length of these trips was 1.7 miles, including the distance some of those trips traveled on the pre-existing west-side line.

Ridership on the project comprises two primary markets: first, the 1,700 circulation trips that begin and end within the Central City (67 percent of all project trips); and, second, the distribution of transit trips made to and from the Central City by residents of other areas (23 percent). Other small markets comprise the remaining 10 percent of all trips on the project, including the collection of trips made by residents of the Central City who transfer to regional transit service to travel to and from outlying areas.

Circulation trips on the project are, by the definition used in this analysis, made exclusively via streetcar and exclusively within the Central City. Streetcar riders making these trips may be residents of the Central City or workers and other visitors to the Central City. (Data limitations prevent differentiation between these two groups of riders on the project.) Some 63 percent of circulation trips have one end at the rider's residence. The other end of the trip is work (46

percent), college (9 percent), or other non-work activities (44 percent). Half of these residence-based circulation trips are made by residents of 0-car households.

The remaining 37 percent of circulation trips have neither end at home; 36 percent of these trips have one end at the rider's workplace but most (64 percent) are made between two non-work and non-home activities. Some 29 percent of non-home-based circulation trips are made by residents of 0-car households. This fraction is lower than for home-based circulation trips because many of the riders making non-home-based trips have traveled to the Central City from residences in outlying areas (where auto-ownership is higher) and are using the streetcar to circulate within the area over the course of their day.

The largest attractors of all circulation trips on the project are the Central Eastside District and, just to its north, the Lloyd District. These two districts are also the largest producers of circulation trips, along with the Pearl District and Old Town on the west side of the river.

The 500 distribution trips on the project comprise 23 percent of all project trips and require, by definition, a transfer between the streetcar and a regional bus or rail line for residents of outlying areas traveling to and from the Central City. Of these trips, 55 percent are to/from work, 10 percent are to/from college, and 32 percent are to various other purposes (shopping, personal business, etc.).

Ridership forecasts prepared for PD-entry used the regional travel model maintained by Metro, the metropolitan planning organization for the Portland area. The forecasts predicted that 8,100 average weekday trips would be made on the project in its opening year. A comparison of that prediction to a survey of riders on the initial streetcar segment on the west side led Metro, TriMet, and FTA to pursue a second ridership forecasting method to prepare forecasts that would be available at the FTA grant-award milestone. The second method used a "direct-generation" approach that predicted the average number of streetcar trips generated per household and per job located in proximity to the project. The rates were computed from the number of trips on the west side streetcar line at the time and the numbers of households and jobs proximate to that line. Application of the alternative method yielded a prediction of 3,900 weekday trips on the project in its opening year.

Analysis of the difference between the regional model's prediction of 8,100 trips on the project and the actual 2,500 trips leads to several observations:

- Part of the difference was caused by the more frequent service on the project anticipated during project planning and development – 12-minute headways versus the actual 15 minutes.
- The predicted number of circulation trips on the project was largely accurate: 1,950 predicted trips versus 1,700 actual trips.
- Almost all of the difference was accounted for by collection/distribution trips – those made by transit riders either coming into the Central City from residences elsewhere and transferring to the streetcar to reach their destinations (and later making the reverse trip to return home) or traveling from Central City residences via streetcar and a transfer to a

regional line to travel to destinations elsewhere. The model predicted 5,900 of these trips compared to the actual 700 collection/distribution trips made on the project.

- The source of the difference in the collection/distribution trips estimate was apparently the component of the regional travel model that simulates the way that transit travelers choose specific travel paths through the transit system. Transit trips that arrive in the Central City on a regional bus or light rail line have the choice of walking from that line to their destination or, for Eastside destinations, transferring to the Central Loop streetcar. The model appears to have overstated the attractiveness of the streetcar-transfer option for these trips compared to direct walks to Eastside destinations.

Metro has since adjusted the regional travel model to deal more accurately with these trips. This experience with the regional model highlights the challenges inherent in applying regional models to ridership prediction for relatively small-scale transit projects in the urban core.

Economic development

At this point in time it is difficult to discern the specific development impacts of the Portland Loop Project portion of the streetcar line, as it only opened in 2012. However, in 2015, the City of Portland and Portland Streetcar, Inc. commissioned a study of development in the urban core, focusing specifically on the influence of proximity to the full streetcar system. The analysis examined the combined effects of both regional land development policies and the streetcar, and did not attempt to separate their individual contributions to development outcomes. Factors that likely contributed to development impacts during the time period covered by the study include:

- Coordinated policies at the state, metropolitan, and local levels in regards to land use and urban growth controls. Since 1973, the State of Oregon has maintained a strong statewide program for top-down land use planning based goals that emphasize infill growth, transit development, and transit usage.
- Aggressive implementation of policies for areas targeted for growth, including re-zoning, financial incentives, publicly-funded packages of amenities, and transit-supportive development. In the Portland metropolitan region, the Central City was designated as the main focus of growth, followed by lesser regional and town centers, all within an adopted urban growth boundary.
- Robust demand for new housing and commercial space supported by the nearby presence of a thriving central business district.
- Development of the streetcar system in close coordination with other regional investments such as the expansion of the light-rail system.

Some key findings of the 2015 study include:

- Since the 1997 decision to build the streetcar system, \$4.5 billion of market value has been developed in the targeted areas of the urban core, including 7.7 million square feet of commercial space and over 18,000 residential units. Existing properties have increased by \$7.1 billion in market value. Overall, market value in the targeted areas has increased from 11 percent to 17 percent of the total market value in the City of Portland.

- A detailed analysis of the 7,000 residential condominium sales within two miles of the streetcar found a price premium associated with proximity to the package of infrastructure improvements, the streetcar line, and the transit-supportive policies. Controlling for building features, neighborhood amenities, and macro-economic trends, the long-term price premium appears to be 10 to 20 percent for condominium units adjacent to the line and nine percent for units one-quarter mile from the line. The price premium dissipates completely beyond one-half mile.
- The analysis estimated that, without the increased property values associated with the development policies and streetcar implementation, 35 percent (2.7 million square feet) of the commercial development and 41 percent (7,400 units) of the residential development would not have occurred.

Efforts to extrapolate the Portland experience to other metropolitan areas should be mindful of the full set of characteristics of the Portland setting and actions taken by state and local governments in the area, in addition to investments in the Central City streetcar network.