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High Capacity Transit Technical Evaluation:

Direct and Indirect Connection Options to PCC Sylvania Campus

March 11, 2016

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INTRODUCTION

In October 2015, the Southwest Corridor Steering Committee requested additional data to inform a decision regarding high capacity transit service to the Portland Community College (PCC) Sylvania campus. In December 2015, project staff released the 'PCC Sylvania Enhanced Connection Options' memo to provide some additional information and introduce new concepts identified since the October 2015 steering committee meeting. The purpose of this report is to supplement the December memo with more detailed quantitative information on the trade-offs and comparative performance between various options for direct and indirect high capacity transit (HCT) connection to the campus, using criteria based on the steering committee's expressed goals for a successful connection to PCC Sylvania.

Two potential HCT station locations to serve the Sylvania campus are under consideration – one north of the campus at SW Barbur Boulevard and SW 53rd Avenue, requiring an approximately ten-minute walk to the heart of the campus, and one on campus. While an on-campus station could attract more redevelopment and result in higher ridership compared to a station on Barbur, for each mode there are trade-offs for the line:

- For light rail (LRT), an expensive tunnel would be required to avoid steep grades, which could result in a shorter overall alignment or other cost-saving measures.
- For bus rapid transit (BRT), reaching the campus would add three to four minutes of travel time over a Barbur or adjacent to I-5 alignment, resulting in higher ridership at PCC Sylvania but little change in overall line ridership.

Capital costs for an on-campus BRT station would be substantially similar to an indirect BRT connection, however. In addition, PCC Sylvania access is one of many factors informing the selection of a preferred mode. As a result, this report focuses only on light rail options.

Please note that Metro's regional travel demand model is calibrated to provide accurate projections of travel behavior at a large scale. The differences between some of the options explored in this document can be trivial when viewed through a regional lens. Consequently, the accuracy of projections reported in this document may not be as strong as for the alignment and mode comparisons presented in other reports. The steering committee should take these limitations into consideration when reviewing this information and making decisions.

Decision timeline

In May 2016 the Southwest Corridor Steering Committee is scheduled decide whether to advance a light rail tunnel to PCC Sylvania into the Draft Environmental Impact Statement for further study.

To inform this decision, and the related decision on the preferred HCT mode, project staff will release a recommendation report in April that synthesizes and interprets the information included in this evaluation report and previous relevant documents. Staff will present their recommendations at the April steering committee meeting.

Although the steering committee decision will focus on whether to continue studying a light rail tunnel to PCC Sylvania, it is anticipated that the staff recommendation and committee decision will also include direction on which other connection options, if any, should be studied further. Public comments on these options can be emailed to swcorridorplan@oregonmetro.gov.

Project background

The Southwest Corridor Plan is a collaborative effort between project partners Portland, Sherwood, Tigard, Tualatin, Beaverton, Durham, King City, Washington County, ODOT, TriMet and Metro. It is a comprehensive approach to achieving community visions through integrated land use and transportation planning. The Plan is rooted in the adopted local land use plans of the corridor communities, including the Barbur Concept Plan, the Tigard High Capacity Transit Land Use Plan, Linking Tualatin and the Sherwood Town Center Plan. In support of these community visions, the Southwest Corridor Plan Steering Committee has recommended a Shared Investment Strategy that includes key investments in transit, roadways, active transportation, parks, trails and natural areas.

Project goals

The Southwest Corridor Plan Purpose and Need statement, adopted January 2014, includes thirteen project goals:

1. Serve the existing and projected transit demand in the corridor
2. Improve transit service reliability in the corridor
3. Improve transit frequency and travel times
4. Provide options that reduce overall transportation costs
5. Improve multimodal access to a range of housing types and businesses in growing communities
6. Improve potential for housing and commercial development in the corridor and encourage development in centers and transit-oriented development at stations along the corridor
7. Ensure benefits and impacts promote community equity
8. Increase multimodal transportation options and improve mobility in the corridor
9. Complete multimodal transportation networks in the corridor
10. Advance transportation projects that increase active transportation and encourage physical activity
11. Provide transit service that is cost effective to build and operate with limited local resources
12. Advance transportation projects that are sensitive to the environment, improve water and air quality and help reduce carbon emissions
13. Catalyze improvements to natural resources, habitat and parks in the corridor

ABOUT PCC SYLVANIA

Information on the students attending PCC Sylvania will help inform upcoming and future decisions on how best to serve the transportation needs of the campus. The graphs on this and the following pages convey the wide range of experiences and possible needs of the students. PCC Sylvania hosts a mix of full- and part-time students, classes throughout daytime and evening, and a wide range of races, ethnicities and ages. A majority of PCC credit students receive financial aid, a factor to consider in planning the type and cost of transportation options.

Connecting students to the Sylvania campus is hampered by the wide distribution of residences. Southwest Portland and western Washington County host the majority of students, but places as dispersed as Sherwood, Amber Glen and southeast Portland are home to many Sylvania students. Because not all students travel to campus directly from home (or vice versa), the available information on where students live does not tell the whole story about travel patterns to campus.

The majority (70 percent) of PCC Sylvania students drive alone to school most of the time, while a notable minority (ten percent) usually take TriMet. These numbers are similar to other PCC campuses, although Sylvania has the lowest proportion of transit users and the highest rate of PCC shuttle users (seven percent). Sylvania students primarily use PCC's inter-campus shuttle system to reach Portland State University and PCC Southeast. About one third of PCC students who use the shuttle system start their day at the Sylvania campus.

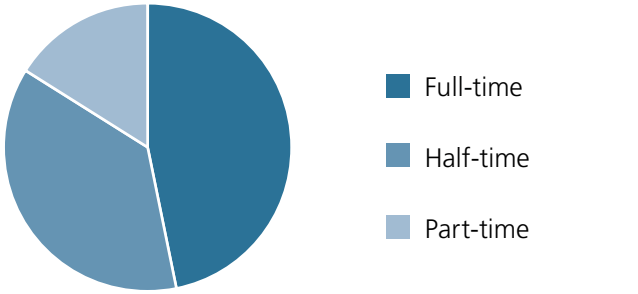
The majority of Sylvania students, faculty and staff say they would regularly take the bus/MAX to campus under the right circumstances. Several reasons for not using transit now are cited, mainly that the travel time is too long, and that transit service is either not close enough to where people live or requires transferring to access the campus.

14,200 *fall 2015 student headcount*

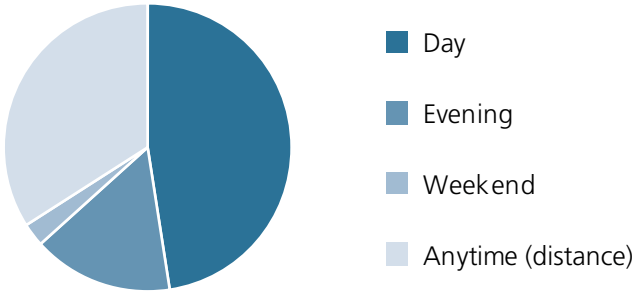
5,360 *students at Sylvania during a typical day*

Fall 2014 PCC Sylvania student headcount by...

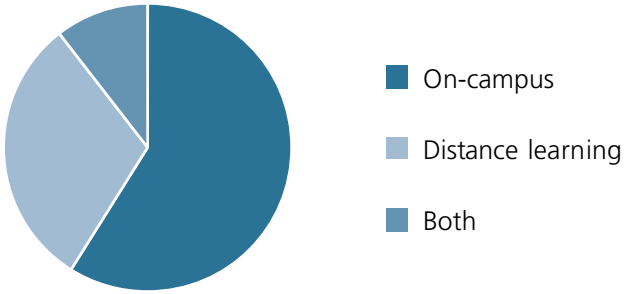
...enrollment status



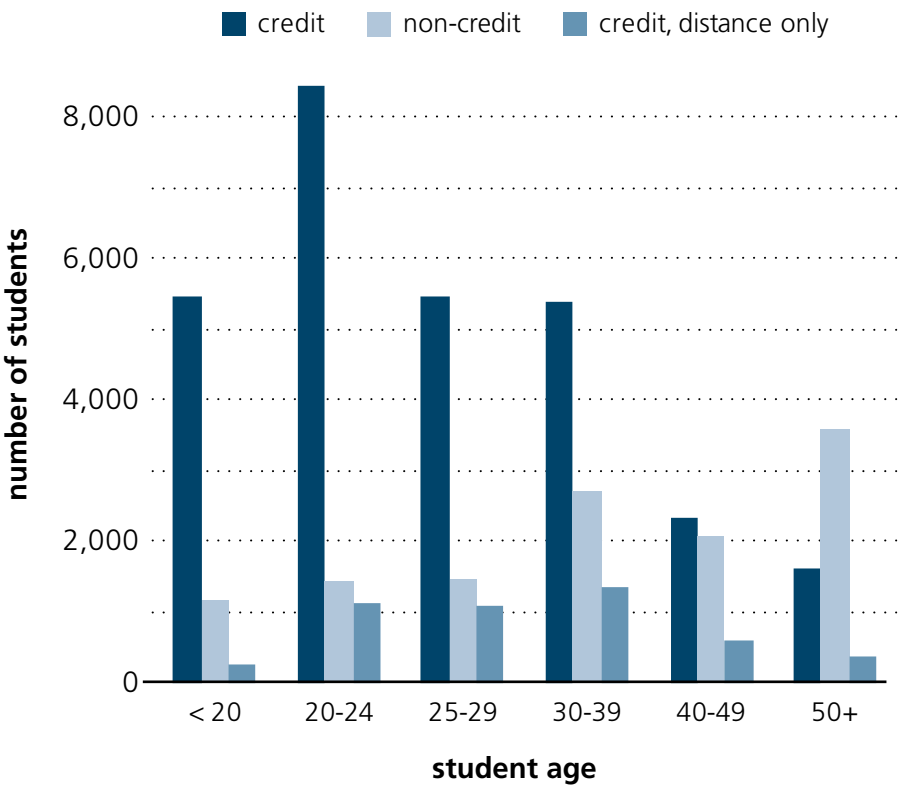
...class time of day



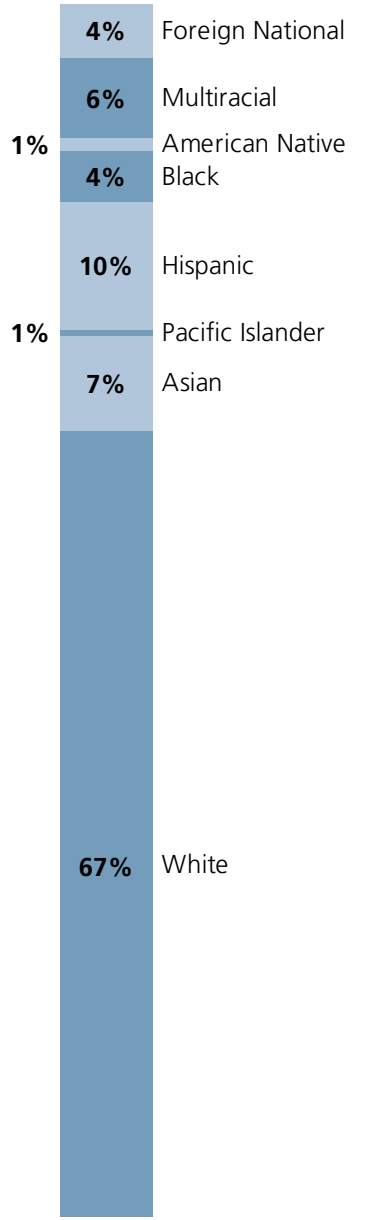
...course delivery method



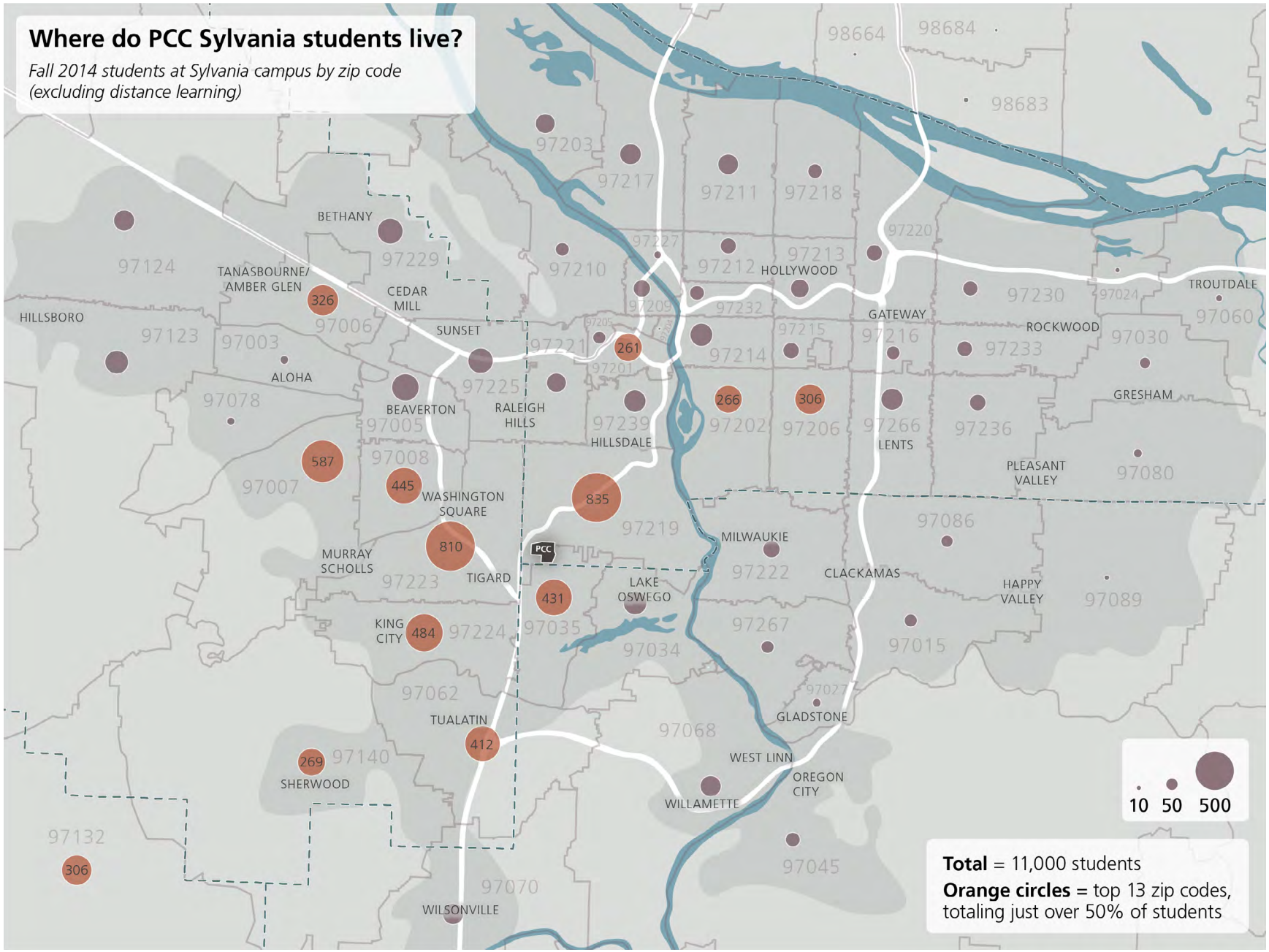
Fall 2015 PCC college-wide enrollment by age



Fall 2015 PCC Sylvania headcount by race/ethnicity

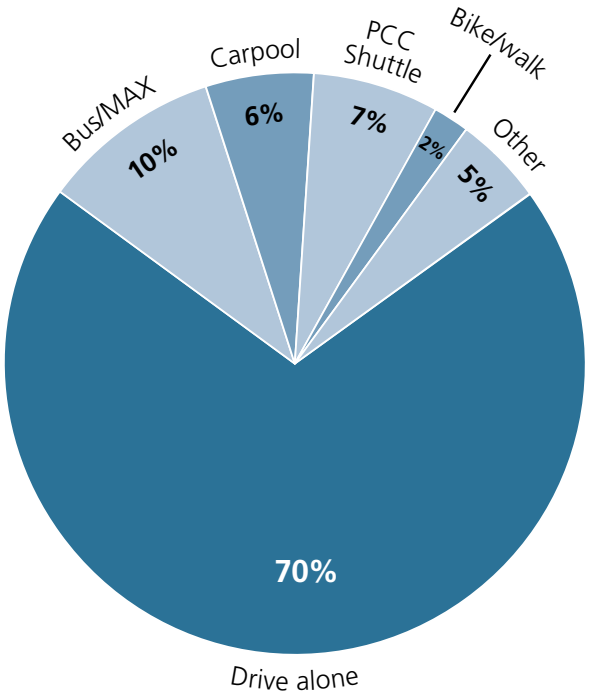


59% *of PCC students college-wide receive financial aid (fall 2014)*


Where do PCC Sylvania students live?
Fall 2014 students at Sylvania campus by zip code
(excluding distance learning)
BETHANY
TANASBOURNE/
AMBER GLEN
CEDAR
MILL
HILLSBORO
SUNSET
ALOHA
BEAVERTON
RALEIGH
HILLS
HILLSDALE
HOLLYWOOD
GATEWAY
ROCKWOOD
TROUTDALE
GRESHAM
LENTS
PLEASANT
VALLEY
MILWAUKIE
CLACKAMAS
HAPPY
VALLEY
LAKE
OSWEGO
MURRAY
SCHOLLS
TIGARD
WASHINGTON
SQUARE
KING
CITY
TUALATIN
SHERWOOD
WEST LINN
OREGON
CITY
WILLAMETTE
GLADSTONE
WILSONVILLE
PCC
326
261
266
306
587
445
835
810
431
484
412
269
306
10 50 500
Total = 11,000 students
Orange circles = top 13 zip codes,
totaling just over 50% of students

How Sylvania students, staff and faculty travel to PCC most of the time

(2011 PCC Transportation Online Survey, Sylvania respondants)

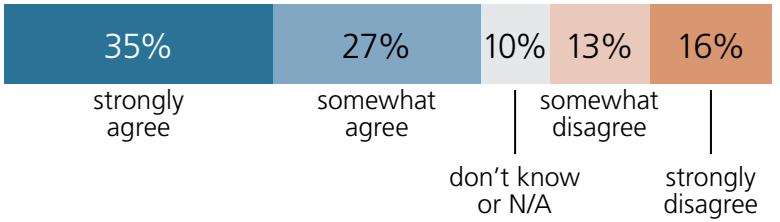


Key reasons Sylvania students drive alone:

(2011 PCC Transportation online survey, Sylvania respondants)

- The travel time is too long (58%)
- Service is not direct from my home (22%)
- Service is not close enough to my home (21%)
- I can't rely on the bus/MAX to get me there on time (17%)
- The bus/MAX fare is too expensive (10%)
- The bus/MAX doesn't run often enough (8%)
- The bus/MAX doesn't operate late enough in the night (2%)

"I would regularly take the bus/MAX to PCC under the right circumstances (i.e. proximity, travel time, cost-effectiveness, availability)" *(2011 PCC Transportation Online Survey, Sylvania respondants)*

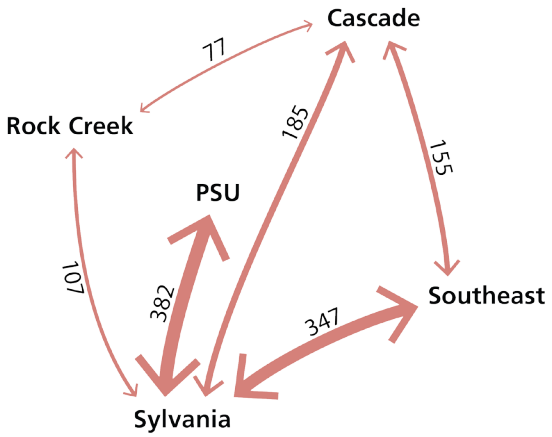


2,421 *parking spaces at Sylvania campus*

86-96% *of spaces are full in the morning*

2012 TRANSPORTATION DEMAND MANAGEMENT REPORT

Fall 2015 average daily PCC shuttle usage



GOALS AND EVALUATION MEASURES

The following table shows the goals identified by project staff for a successful transit connection to the PCC Sylvania campus, paired with the associated measures that have been evaluated in this document. The goals and measures are organized by geographic scale, ranging from regional considerations such as system-wide transit ridership to campus-focused measures such as transit ons and offs on the Sylvania campus.

	Goals for a successful connection to PCC Sylvania	Associated measures
REGION	Increased transit ridership system-wide Affordable and cost-efficient transit system operations Support for regional climate goals	New system transit trips Operating and maintenance cost Operating and maintenance cost per rider
CORRIDOR	Fast and reliable travel times on the project Feasible to fund and construct the project	Light rail line ridership Light rail travel time Total project capital cost
NEIGHBORHOOD	Understand neighborhood impacts and benefits, both short-term and long-term	Property impacts Construction impacts Hourly buses on neighborhood streets
CAMPUS	Broad transit access to campus - from north, south, east and west Fast and reliable transit travel times to the campus Support for future campus development Support for College's transportation and climate goals	Households with one-seat ride to campus Households within 60 minutes from campus by transit Transit ons and offs at PCC Sylvania Transit travel times to campus from key places around the region

CONNECTION OPTIONS TO PCC SYLVANIA

Options evaluated in this document

This document presents detailed technical information on the performance of options for improving access to PCC Sylvania in conjunction with a light rail transit alignment through the Southwest Corridor. The six options described below are evaluated in this document, including four surface alignment options and two tunnel options.

Surface alignment options: LRT station at Barbur Boulevard and 53rd Avenue

A	**Walk/bike connection only** *(enhanced walk/bike connection included in all options)* Light rail on Barbur or adjacent to I-5 between Capitol Highway and 60th Avenue, with a station at 53rd Avenue and an enhanced walk/bike connection to the campus.
B	**Bus hub** New bus connections to the campus from the south and west, stopping at a centralized bus transfer station on campus. Dedicated bus lanes on campus, a new transit bridge over I-5, and a shared transitway segment in the Tigard Triangle could improve bus travel times and reliability.
C	**TriMet shuttle** New shuttle bus connecting Sylvania campus to LRT stations at Barbur Transit Center and Tigard Triangle with timed transfers.
D	**Aerial tram** Aerial tram connecting Sylvania campus to LRT station at Barbur Boulevard and 53rd Avenue.

Tunnel alignment options: underground LRT station on campus

E	**Tunnel: Bridgeport Village terminus** Bored tunnel with underground LRT station on campus: full LRT alignment.
F	**Tunnel: Tigard Transit Center terminus** Bored tunnel with underground LRT station on campus: shortened LRT alignment.

In addition to these six options, a 'no build' scenario has been evaluated to provide a point of comparison relative to the various LRT build alternatives. For the purpose of this analysis, the no build assumes continued local bus service to the PCC Sylvania campus and no new high capacity transit line in the Southwest Corridor.

Alignment assumptions for analysis

For the purpose of evaluation, certain assumptions have been made about which alignments to use for ridership projections, travel times and costs. The surface alignment connection options B, C and D pivot off of the following base alignment, which is represented by option A:

- Naito Parkway in South Portland
- Barbur Boulevard from Naito to 60th Avenue, including a station at 53rd Avenue with a park-and-ride lot and an enhanced walk/bike connection to PCC campus
- 68th/70th Avenue couplet in the Tigard Triangle
- Ash Avenue option in downtown Tigard
- Adjacent to freight rail in Southeast Tigard
- Terminus at Bridgeport Village

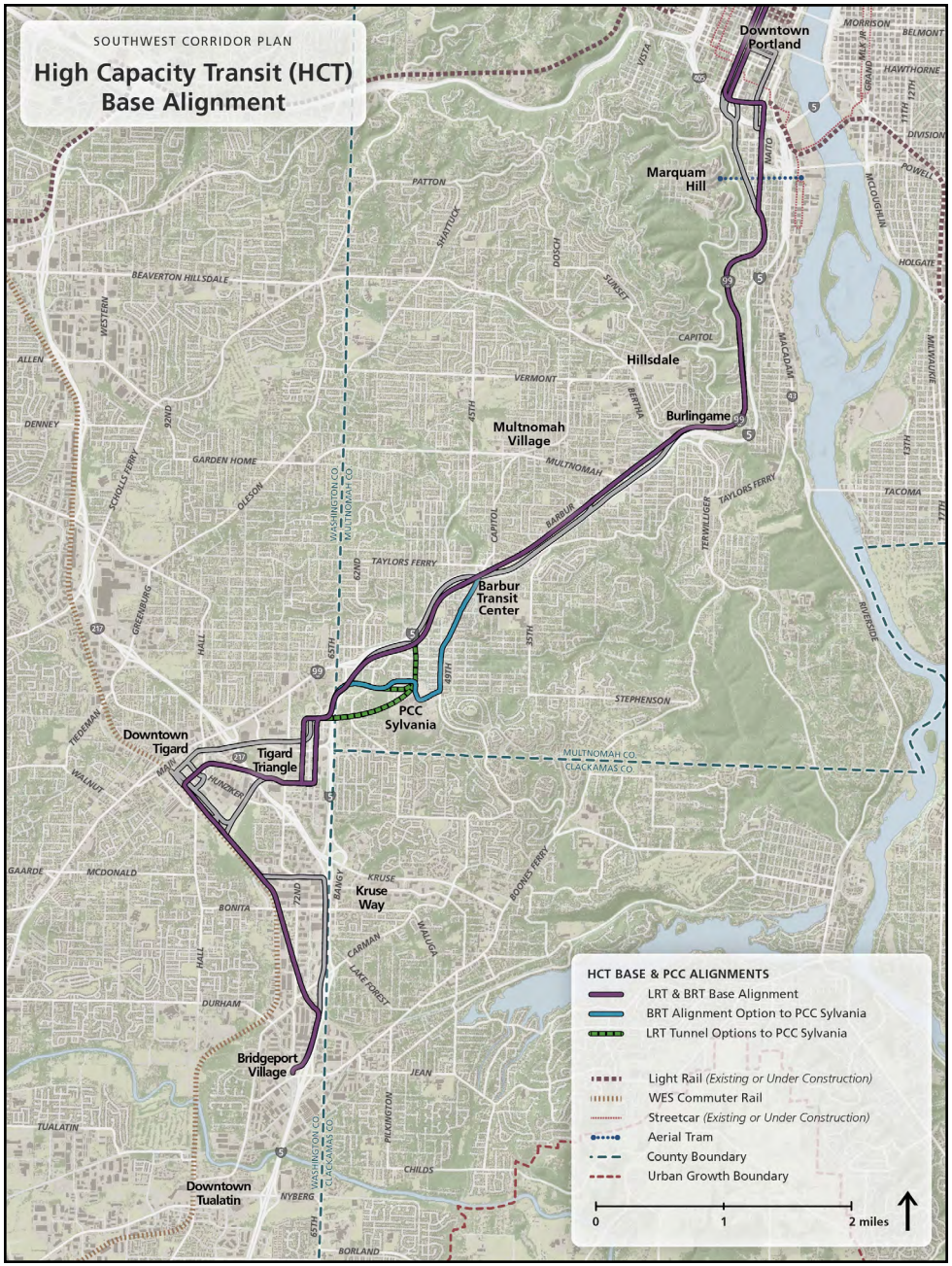
Option E, the tunnel with a Bridgeport Village terminus, is the same as the base alignment except between 53rd Avenue and the Tigard Triangle:

- Long bored tunnel from 53rd Avenue to Tigard Triangle
- Station with park-and-ride lot at 53rd Avenue
- Underground station on the north side of campus

Option F, the tunnel with a Tigard Transit Center terminus, is the same as option E but with a shorter overall alignment that does not serve stations at Bonita Road, Upper Boones Ferry Road, and Bridgeport Village.

For more information on the base alignment and related assumptions, see the December 2015 'Southwest Corridor High Capacity Transit Mode Comparison' report, available at www.swcorridorplan.org.

Note: *the base alignment is for analysis purposes only and does not indicated a preferred alignment.*



Other options under consideration

LRT tunnel via 53rd Avenue and new bridge over I-5: cut-and-cover construction

For the purpose of analysis, the 'long' bored tunnel has been used as the representative LRT tunnel to PCC Sylvania (see page 21 for evaluation results). The three tunnel options currently under consideration are distinguished by their construction method and whether they go under I-5 in the tunnel or cross over it on a new bridge, with resulting differences in the location and severity of construction impacts. Travel time, ridership and capital cost would be relatively similar between the three tunnel options.

This tunnel option would include light rail on Barbur Boulevard to 53rd Avenue, with a cut-and-cover tunnel underneath 53rd Avenue and through the PCC Sylvania campus. The southern portal of the tunnel would be located near Lesser Road and G Street. The light rail alignment would cross Lesser to a new bridge across I-5 into the northern Tigard Triangle.

Relative to the long bored tunnel evaluated in this document and the short bored tunnel below, the cut-and-cover tunnel would have more construction impacts to residents along 53rd Avenue.

LRT tunnel via 53rd Avenue and new bridge over I-5: bored construction

This tunnel option follow would follow the same alignment as the cut-and-cover tunnel under 53rd Avenue, but using a bored tunnel construction method instead.

Relative to the long bored tunnel evaluated in this document, this 'short' bored tunnel would have more construction impacts near the southern tunnel portal at Lesser Road and G Street. Relative to the cut-and-cover tunnel above, the short bored tunnel would have fewer construction impacts to residents along 53rd Avenue.

Barbur shared transitway options

These options would route a bus connection from PCC Sylvania to downtown Portland via the exclusive light rail transitway running in Barbur Boulevard or adjacent to I-5. This configuration would function similar to transit operations on the Tilikum Crossing, with bus and light rail vehicles sharing the same transitway. The intent is to allow the PCC bus connection to avoid traffic congestion in the Barbur corridor, resulting in greater reliability and shorter travel times.

There are two primary Barbur shared transitway options under consideration:

- Branded line 44 with shared transitway north of Hillsdale. This option would improve access to PCC Sylvania from the north and east through improvements to the line 44. Travel times on the 44 could be improved by reducing signal delay time, spacing stops farther apart, and operating on the light rail transitway north of Hillsdale. The option would require a reduction in the local bus stops in the Hillsdale and Multnomah Village areas in order to improve travel times for people accessing PCC, and would not improve access to PCC for people coming from south and west of the campus.
- New branded bus line with shared transitway north of Barbur Transit Center. This option would improve access to PCC Sylvania from the north and east through a new bus line to the campus via Barbur Boulevard. The buses would operate on the light rail transitway north of the Barbur Transit Center to downtown Portland.

The feasibility, related capital and operating costs, and possible effects on light rail travel times of a shared transitway approach need to be studied further before detailed analysis is possible.

Mechanized connections between campus and light rail stations

In the August 2015 memo on PCC Sylvania light rail options, several other mechanized connection options were described that could potentially improve access between the campus and nearby light rail stations, including autonomous vehicles/shuttles in mixed traffic and personal rapid transit vehicles on a dedicated guideway.

For the purpose of analysis, the shuttle option evaluated in this document serves as a representative option for a mechanized connection between the campus and nearby light rail stations in the Tigard Triangle and at the Barbur Transit Center. Similarly, the aerial tram option evaluated in this document serves as a representative option for a mechanized connection between the campus and a light rail station at Barbur and 53rd Avenue.

Options considered and removed

Two other bored tunnel options to PCC Sylvania were removed from consideration in June 2014 because the cut-and-cover tunnel option along 53rd Avenue would provide a similar benefit at a lower capital cost. Further study of the cut-and-cover tunnel revealed that a bored tunnel along the same 53rd Avenue alignment could be accomplished at a relatively similar capital cost due to the necessary tunnel depth. The original two bored tunnel options were revisited at that time, but were not proposed for further study because their longer alignments would result in a higher capital cost than the shorter 53rd Avenue bored tunnel options currently under consideration. Additionally, the 53rd Avenue tunnel alignments currently under consideration would allow for a station and park-and-ride lot at Barbur and 53rd, which would not be feasible with either of the two previously removed tunnels.

LRT tunnel via Capitol Highway and 49th Avenue

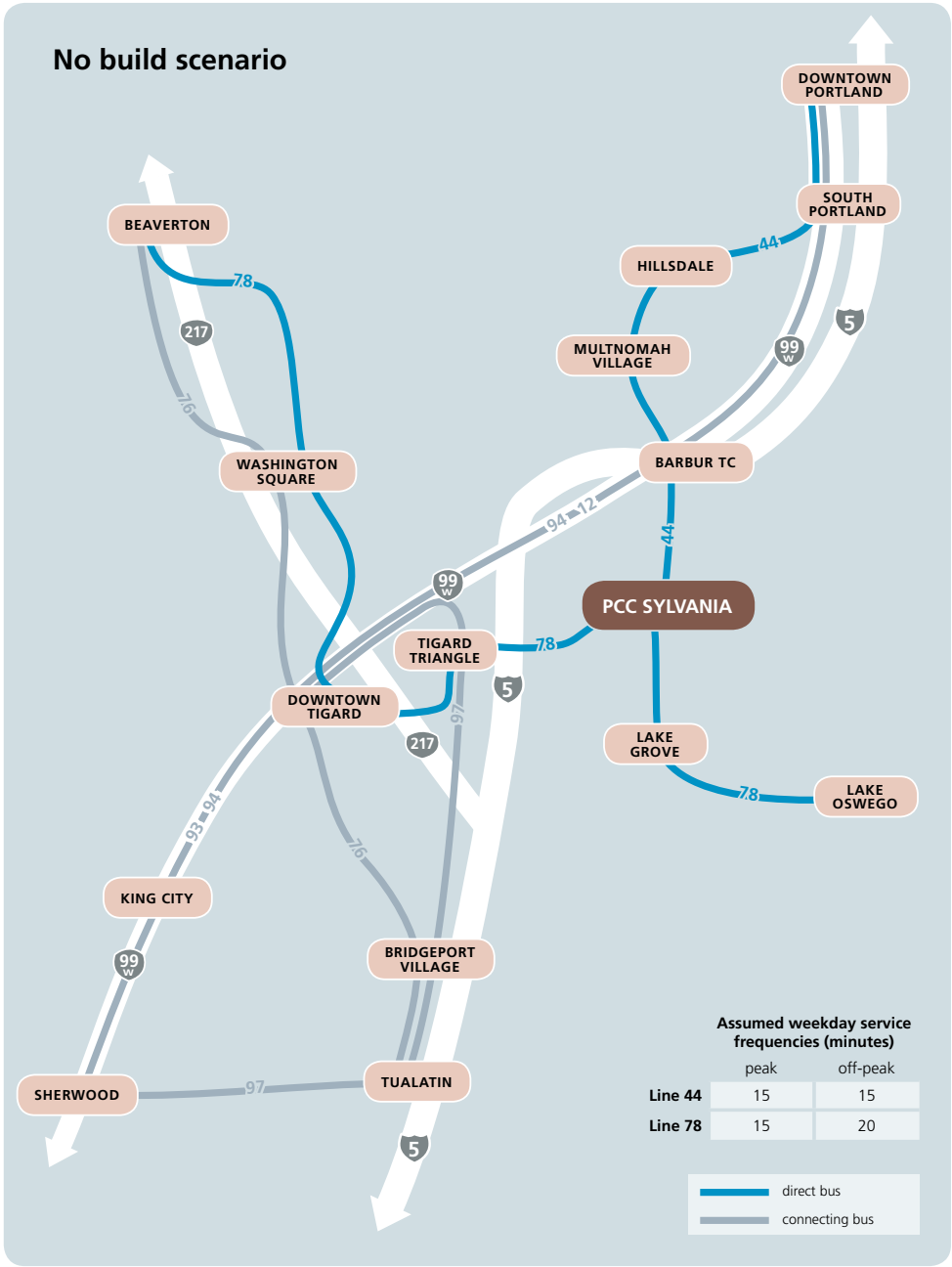
With this tunnel option, light rail would turn onto Capitol Highway near the Barbur Transit Center and include a station near the Capitol Hill Library and Holly Farm Park, similar to the BRT to PCC alignment. Light rail would descend into a bored tunnel along 49th Avenue near Coronado Street and serve the campus via an underground station. Similar to the 'long' bored tunnel currently under consideration, the southern portal would be located on the west side of I-5 near Atlanta Street and 68th Avenue.

LRT tunnel via Barbur Boulevard and 51st Avenue

This tunnel option would be similar to the 'long' bored tunnel currently under consideration, except that it would be located under 51st Avenue instead of 53rd Avenue to the north of the PCC Sylvania campus. As a result, this tunnel would have a longer alignment than the 53rd Avenue tunnel and would not be able to access a potential station and park-and-ride lot location at Barbur and 53rd.

No build scenario

For the purpose of this analysis, the no build scenario assumes that the bus lines 44 and 78 would continue to provide local bus service to the PCC Sylvania campus as they do today, with an upgrade to frequent service (15 minutes or better all day) for the line 44. The no build also includes the line 97, which will open for service in the summer of 2016 on Tualatin-Sherwood Road. In the 2035 no build, line 97 is assumed to continue north from Bridgeport Village to the Tigard Triangle along 72nd Avenue and to downtown Tigard via 99W.



A. Walk/bike connection only

This option assumes a light rail alignment on Barbur Boulevard or adjacent to I-5 near PCC Sylvania, with a station and park-and-ride lot at 53rd Avenue and an enhanced walk/bike connection along 53rd to the campus.

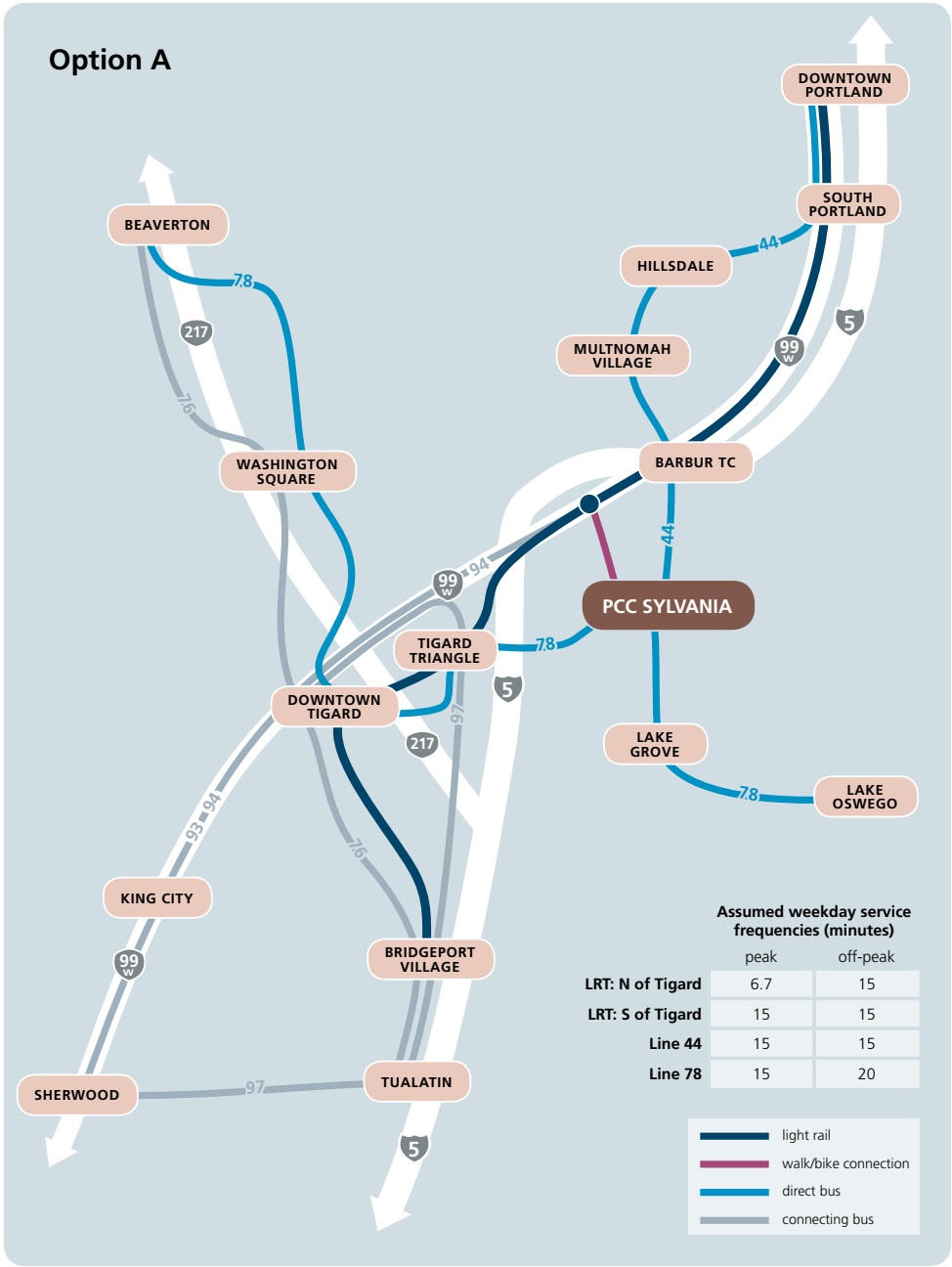
Performance

This option would improve access to PCC Sylvania by providing a station within walking distance from the campus and improving the pedestrian and bike route to campus. Enhancements could include pavement, sidewalks and other amenities.

Compared to the no build scenario, this option would result in:

- Twenty-nine percent more weekday transit ons and offs at the Sylvania campus in 2035, including light rail or bus riders walking to/from the station at Barbur and 53rd
- Approximately 93,000 households across the region gaining transit access to the Sylvania campus within 60 minutes, which represents a 56 percent increase over the no build scenario
- Approximately 34,000 households across the region gaining a one-seat ride to the Sylvania campus by transit (including light rail with a walk/bike connection to campus), which is a 65 percent increase over the no build scenario

Among the options evaluated in this document with a Bridgeport Village light rail alignment terminus, option A would have the lowest capital cost and the least construction and property impacts to the PCC campus and the surrounding neighborhood.



B. Bus hub

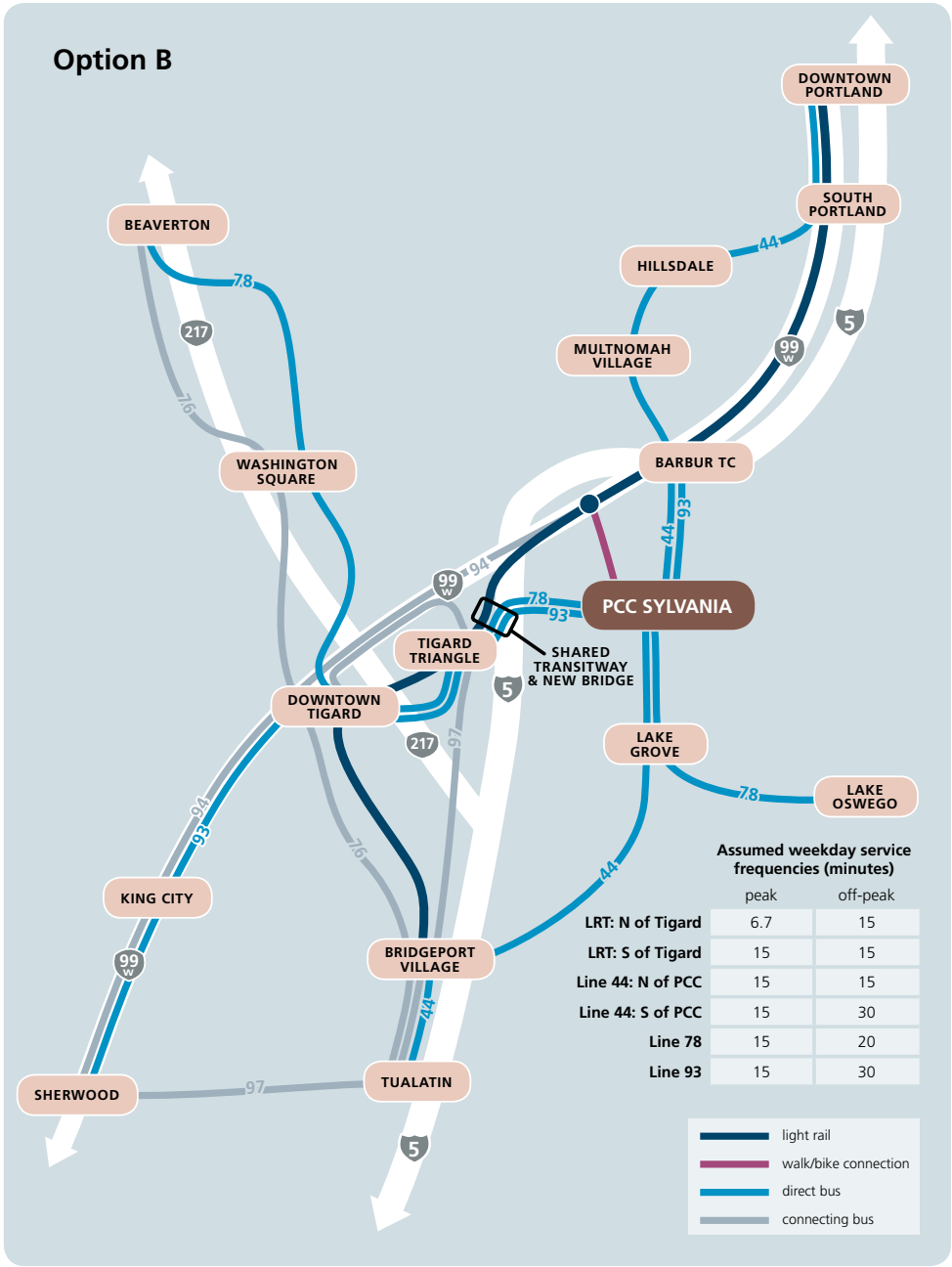
The bus hub option would supplement the walk/bike connection on 53rd Avenue with additional local bus routes serving the campus directly. These buses would provide new opportunities for one-seat rides to PCC Sylvania from south and west of the campus. The light blue lines in the adjacent map show buses that would directly serve the PCC Sylvania campus. The map also illustrates the assumptions used for the bus hub for the purpose of modeling analysis.

Note that unlike the TriMet shuttle and aerial tram options, the bus hub lines would not have reduced service when the campus is closed or not in session. (Currently, the 78 routes along 49th Avenue, Capitol Highway, and Lesser Road when the campus is closed. The 44 turns around on campus except in snow events, when it turns around at Barbur Transit Center.)

Other potential bus hub scenarios

Although the December 2015 PCC Sylvania Enhanced Connection Options memo suggested extending the line 97 to Sylvania via Lake Grove, the modeled bus hub scenario instead extends line 44 to Tualatin from the campus in order to maintain all-day service on 72nd Avenue with line 97 (as proposed in TriMet's Southwest Service Enhancement Plan). Another possible scenario would keep the line 97 on 72nd, but route it onto the shared transitway and over OR-217 to provide another direct connection to PCC Sylvania.

If the bus hub is studied further, the particular bus routing and associated capital investments will be developed in greater detail. Bus routing changes to improve access to the campus could be combined with any of the other connection options under consideration.



Performance

Compared to option A, the walk/bike connection only, the bus hub would improve transit service to campus by:

- Increasing transit service frequency between the campus and downtown Tigard, Barbur Transit Center, and Lake Grove
- Providing new one-seat ride opportunities to an on-campus station from Sherwood, King City, Lake Grove, Bridgeport Village, Tualatin and other areas along OR-99W and Boones Ferry Road

As a result of these service changes, the bus hub would result in modest improvements over option A, walk/bike improvements only:

- One percent fewer weekday light rail line riders in 2035 compared to option A, because some riders shift to the new competing bus lines
- Eleven percent more weekday new system transit trips in 2035 compared to option A, due to improved bus headways and service to new areas
- Five percent more weekday transit ons and offs at the Sylvania campus in 2035 compared to option A, or an increase of 35 percent compared to the no build scenario
- Around 9,000 households along the line 93 and the new line 44 extension would gain a one-seat ride to the Sylvania campus, and around 5,000 households would gain transit access to the campus within 60 minutes (based on 2035 weekday evening rush hour times)

These increases in system-wide and campus transit ridership would largely result from the increase in bus service hours, which equates to an additional $3.5 million in annual operating and maintenance costs relative to option A.

Beyond the additional bus service, the bus hub is assumed to include a new transit bridge over I-5 that would connect to a segment of shared transitway on the light rail alignment, and a dedicated busway through the Sylvania campus. These improvements are estimated to add around $30 million, or two percent, to the total project capital cost compared to option A, the walk/bike connection only (2014$, not including finance costs).

These additional capital improvements would also add some property and construction impacts relative to option A:

- Property impacts to developed and undeveloped lands resulting from the new bridge over I-5, and construction impacts on the surrounding neighborhood
- Property and construction impacts on the Sylvania campus resulting from the dedicated busway and other bus hub improvements

Although the goal of the new bridge and shared transitway segment would be to improve bus travel times and reliability between the campus and downtown Tigard, the model showed little improvement in travel time. As a result, the line 93 extension attracted few additional riders in the model because the line 94 provided a faster connection to the campus from Sherwood and King City using the Barbur and 53rd Avenue station and the improved walk/bike connection. Additionally, line 78 lost some riders due to the line 93 extension providing a competing connection between the Tigard Transit Center and the Sylvania campus. It appears that the majority of the bus hub's new system transit trips in the model resulted from the extension of the line 44 through Lake Grove and Bridgeport Village to Tualatin.

Further study of the bus hub could re-examine the travel times assumed for the shared transitway and new bridge relative to the existing line 78 travel times via Haines Street and Lesser Road. Additionally, further analysis could identify other opportunities for travel time reductions between downtown Tigard and the Sylvania campus, such as a new bridge over OR-217, which could allow buses to bypass the congested intersection of 72nd Avenue and Hunziker Street. A more comprehensive analysis of travel patterns to PCC Sylvania could reveal other opportunities for routing bus lines direct to campus that could provide a greater benefit for students, faculty and staff.

C. TriMet shuttle

This option would supplement the walk/bike connection with shuttle buses running between PCC Sylvania and the light rail stations at Barbur Transit Center and in the Tigard Triangle. Unlike the bus hub option, the shuttle would only need to run when the campus is in session and could be timed with light rail train arrivals in order to minimize waiting time.

Performance

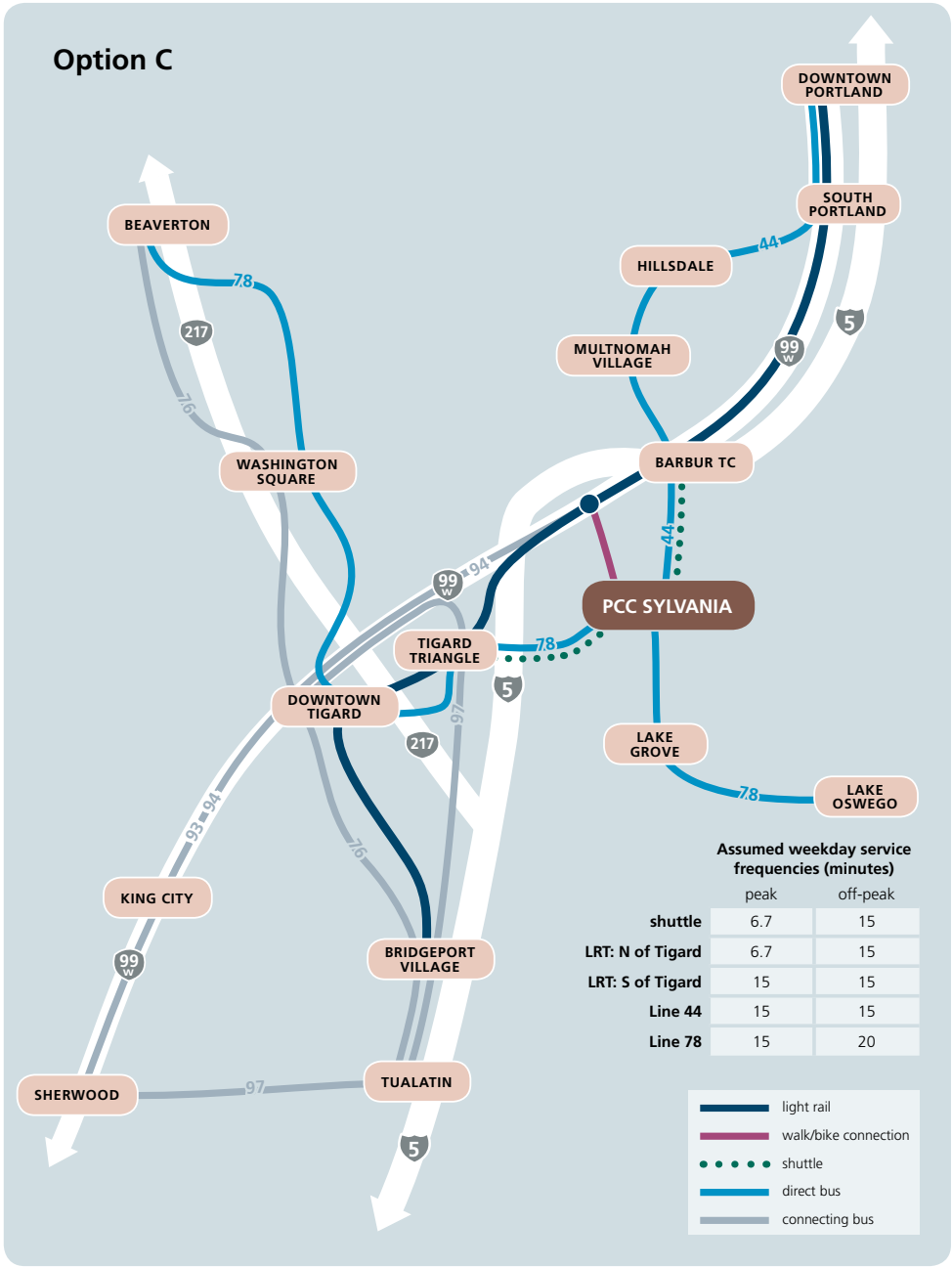
Several model runs were completed to evaluate the performance of the TriMet shuttle. However, additional work will be required to fully understand the ridership implications of the shuttle because of its unique service characteristics, including timed transfers with light rail. In addition, the model is designed to compare alternatives at a regional scale; when focusing on a single specific location, in this case the Sylvania campus, relatively minor changes in input assumptions can lead to wide ranging outcomes.

Initial modeling indicates that a transit connection between the Sylvania campus and nearby light rail stations, such as a shuttle, could improve transit mode share to the campus. At this time, the scale of that improvement is not clear, and further modeling work will be undertaken to refine results.

The shuttle would improve access to PCC Sylvania by providing a faster connection between the light rail alignment and the campus than the walk connection along 53rd Avenue:

- Three minute travel time savings in the peak for riders transferring to the shuttle at Barbur Transit Center
- Five minute travel time savings in the peak for riders transferring to the shuttle in the northern Tigard Triangle

These times do not reflect riders' perceptions of transferring or walking, which affect path choice in the model. For example, riders may choose a one-seat ride with a longer walk over a transfer with a shorter walk despite a longer total travel time.



As a result of the travel time savings described above, the shuttle could provide transit access to the campus within 60 minutes for approximately 10,000 new households around the region compared to option A, the walk/bike connection only.

Initial ridership projections indicate a range of 100 to 500 new average weekday system trips and transit ons and offs at the Sylvania campus in 2035. This range equates to an increase in transit ridership on campus of three to 15 percent over the walk/bike connection only, or 33 to 52 percent over the no build scenario. If the shuttle is studied further, refinements will continue to more accurately estimate the potential transit mode share increase on the Sylvania campus.

The shuttle is estimated to cost approximately $1.6 million to operate annually, and would add around $10 million, or less than one percent, to the total project capital cost to cover the purchase of additional buses and improvements on the Sylvania campus (2014$, not including finance costs).

D. Aerial tram

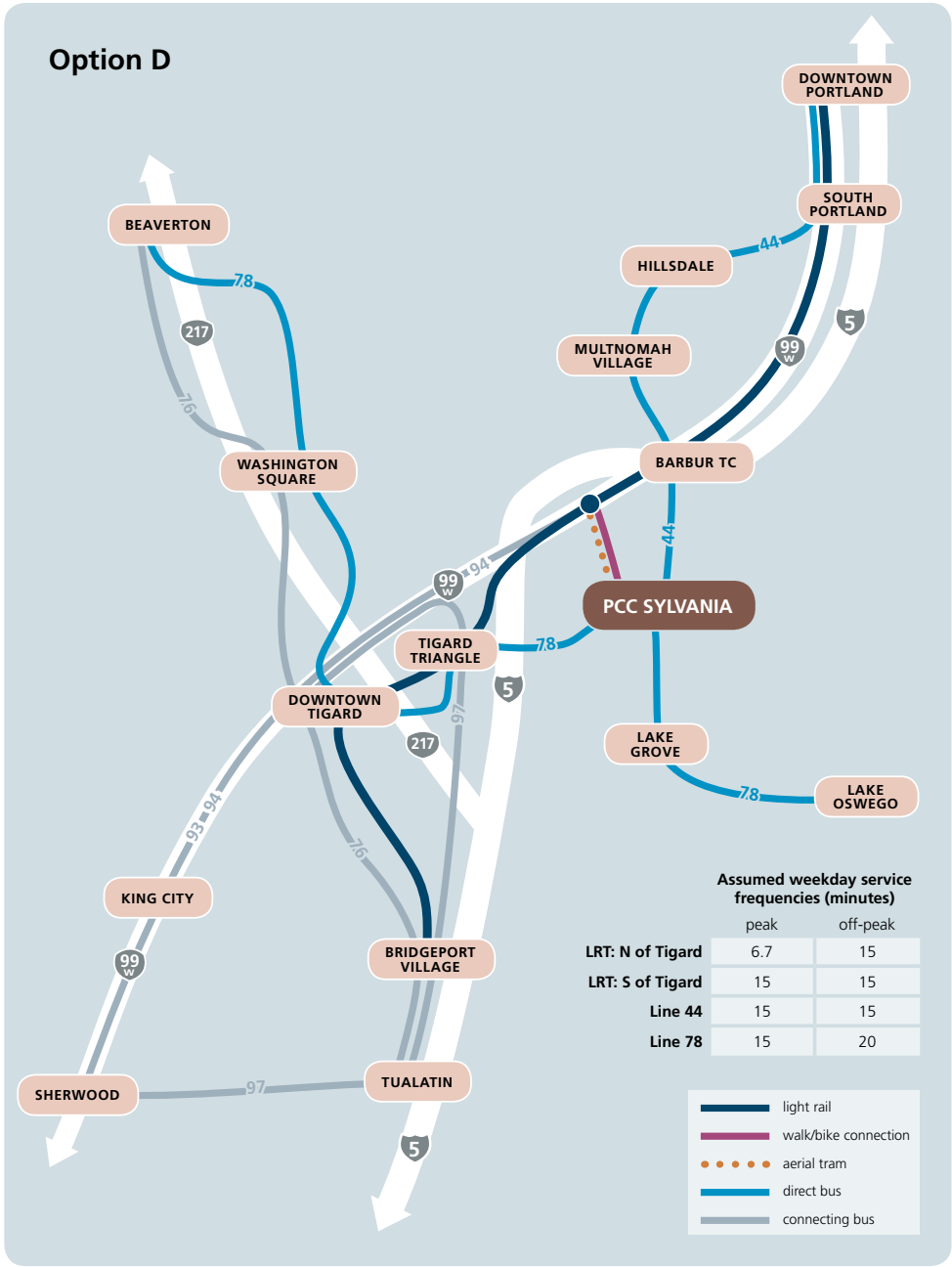
This option would supplement the walk/bike improvements with an aerial tram along 53rd Avenue, providing a fast, frequent and accessible connection between the campus and a station at Barbur and 53rd. As with the TriMet shuttle option, an aerial tram would only need to run when the campus is in session.

Performance

The tram would save transit riders traveling to PCC Sylvania an estimated three minutes compared to walking from the 53rd Avenue light rail station. A tunnel to campus (options E or F) would save riders traveling to the campus an additional three minutes from the north or four minutes from the south.

Similar to the TriMet shuttle option, the tram option introduces complexities in accurately representing the service and its interaction with light rail in the model. The regional transportation model considers not only walk, wait, and in-vehicle times in choosing route combinations to transit users, but also factors in perceptions of those times and penalizes transfers. Slight changes in input assumptions result in relatively large changes in outcomes, especially when examining a specific location in the regional model.

Preliminary model runs of the aerial tram show results similar to the TriMet shuttle, including a range of 100 to 500 additional new system transit trips and transit ons and offs on campus compared to option A. This range equates to an increase in transit ridership on campus of three to 15 percent over the walk/bike connection only, or 33 to 52 percent over the no build scenario. Staff will further refine modeling for both the tram and the TriMet shuttle as the two concepts become more clearly defined.



The operating cost for the OHSU tram is approximately $2.1 million annually. It is anticipated that operations costs for a new tram at PCC would be similar to the OHSU tram, though the cost could be reduced somewhat if the tram only operates while the campus is in session.

In comparison to the OHSU aerial tram connecting Marquam Hill to the South Waterfront, a tram at PCC Sylvania would be slightly shorter and have less elevation change. The shallow nature of the alignment raises design challenges related to backyard privacy for the homes below.

An aerial tram would have more property and construction impacts in the neighborhood than the walk/bike connection alone, but the particular impacts would depend on the location of support structures. Because a PCC Sylvania tram has not been designed, potential property impacts are not clearly defined at this time.

E. Tunnel: Bridgeport Village terminus

The analysis in this document assumes the long bored tunnel option to PCC Sylvania with the LRT alignment terminating at Bridgeport Village. Tunnel portals would be located near Barbur and 53rd Avenue and near Atlanta Street and 68th Avenue in the northern Tigard Triangle.

Performance

Of the connection options evaluated in this memo, option E would have the best performance in terms of corridor and system-wide transit ridership, as well as transit ridership to the PCC Sylvania campus. Compared to option A, this alignment would result in:

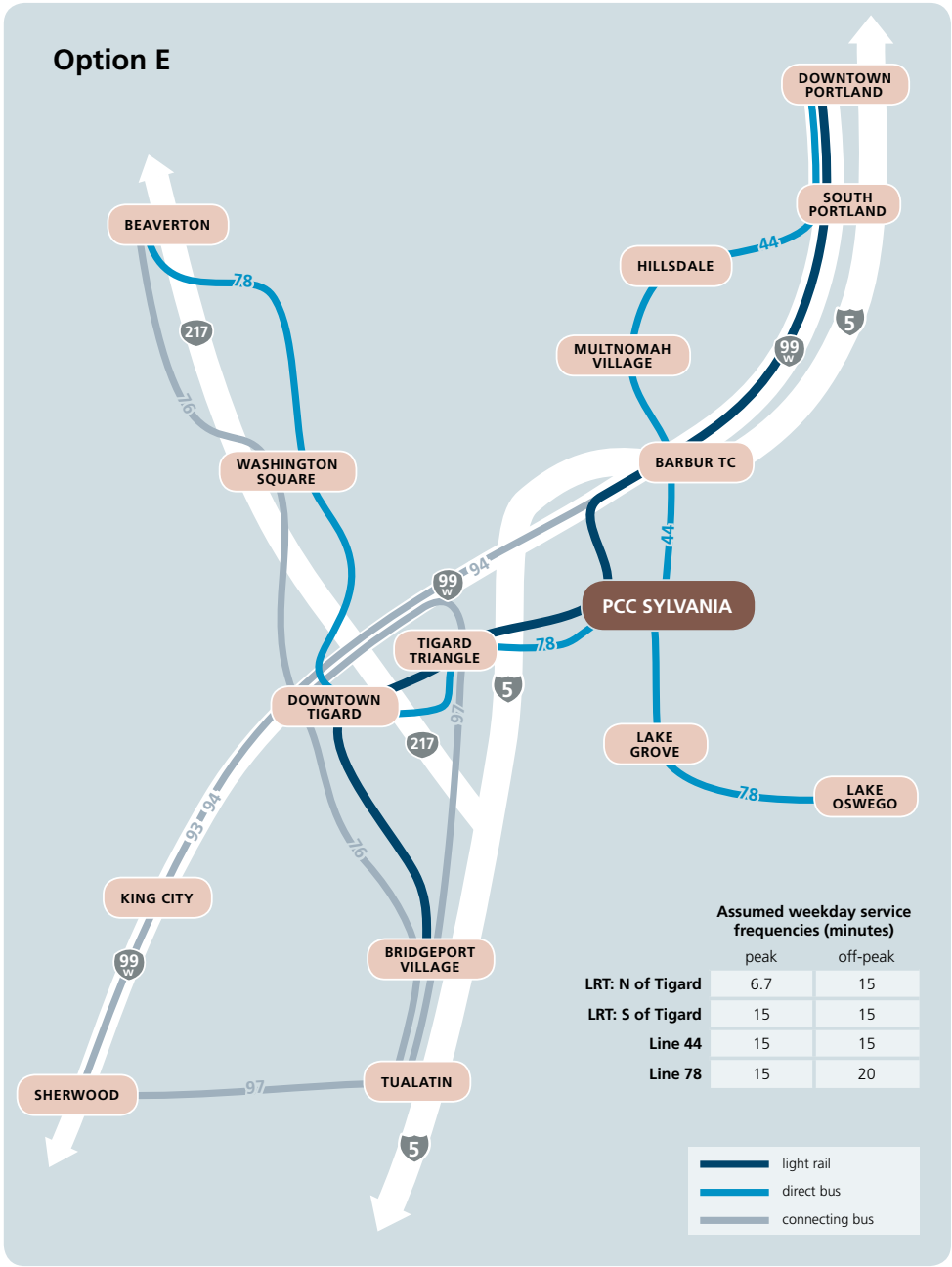
- Six percent more weekday line riders and 17 percent more weekday new system transit trips in 2035
- Seventy-five percent more average weekday ons and offs at the campus in 2035, which indicates that the direct access to campus via light rail is a more competitive option to driving than bus connections and indirect light rail access

However, the tunnel to PCC Sylvania would also be more expensive compared to the surface alignment options, assuming the same alignment terminus of Bridgeport Village:

- A 21 percent increase in capital cost ($370 million) compared to the surface alignment with only a walk/bike connection, resulting in a total project cost of $2.15 billion (2014$, not including finance costs)

Additionally, the tunnel would result in more construction and property impacts to the neighborhood surrounding the Sylvania campus than a surface light rail alignment:

- More permanent and temporary impacts to properties along Barbur Boulevard and 53rd Avenue



- Increased area and severity of noise and vibration impacts compared to surface alignment options
- Increased traffic impacts from additional truck hauling activities during construction compared to surface alignment options
- Longer duration of construction impacts compared to surface options
- Increased construction impacts on the Sylvania campus compared to surface alignment options resulting from large-scale excavation to construct the underground station

F. Tunnel: Tigard Transit Center terminus

This tunnel option assumes the same long bored tunnel to PCC Sylvania described on the previous page, but with the LRT alignment terminating at Tigard Transit Center. This option would provide an on-campus light rail station for approximately the same total project capital cost as for a surface alignment with a Bridgeport Village terminus and the walk/bike connection to the campus.

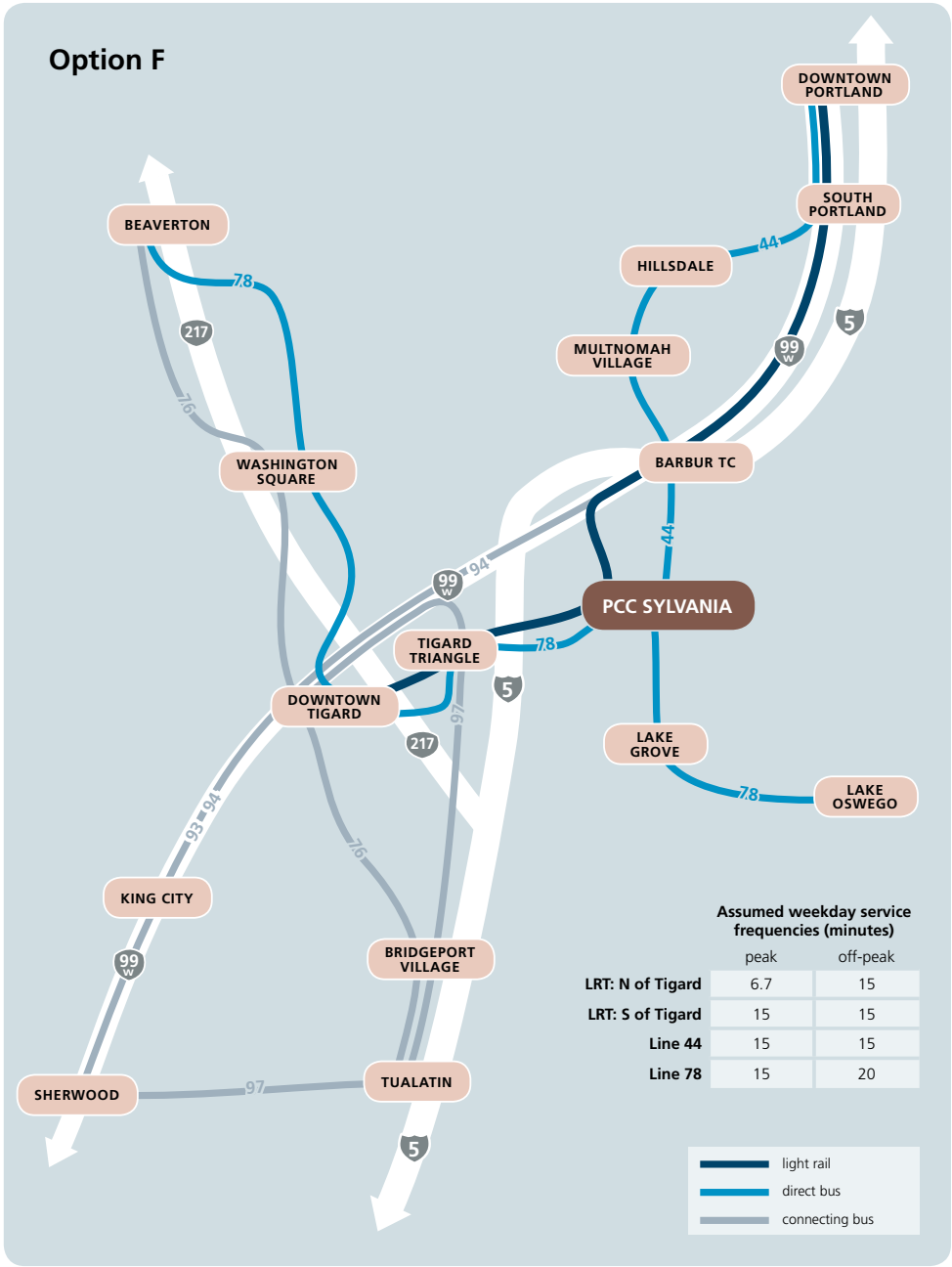
Performance

Of the connection options evaluated in this memo, option F would have the worst performance in terms of corridor and system-wide transit ridership due to the shortened alignment and resulting loss of riders south of downtown Tigard:

- Eleven percent fewer weekday line riders and 18 percent fewer weekday new system transit trips in 2035 compared to option A, the surface alignment with only a walk/bike connection
- Sixteen percent fewer weekday line riders and 30 percent fewer weekday new system transit trips in 2035 compared to option E, the tunnel with a Bridgeport Village terminus

Despite attracting fewer line riders and new system transit trips than other options, the shortened tunnel alignment would perform relatively well in terms of transit ridership to the Sylvania campus, though slightly worse than option E, the full tunnel alignment:

- Sixty-nine percent more average weekday ons and offs at the campus in 2035 compared to option A, the surface alignment with walk/bike connection, due to the reduced walk time between the light rail station and the Sylvania campus
- Four percent fewer average weekday ons and offs at the campus in 2035 compared to option E, the full tunnel alignment with a terminus at Bridgeport Village



The shortened tunnel alignment would have approximately the same capital cost as option A, the surface alignment with a walk/bike connection. While the tunnel segment would add $370 million to the total cost, terminating at Tigard Transit Center would reduce the cost by $370 million, resulting in the same total cost of $1.78 billion (2014$, not including finance cost).

Option F would have the same property and construction impacts in the PCC Sylvania area as the full tunnel alignment. South of the light rail alignment terminus in downtown Tigard, however, option F would have no construction or property impacts.

SUMMARY TABLE

Part 1: Main table

			Surface alignment options: *all Bridgeport Village terminus*			Tunnel alignment options	
		A	B	C	D	E	F
		No build	**Walk/bike connection only**	**Bus hub**	**TriMet shuttle**	**Aerial tram**	**Tunnel** *Bridgeport Village terminus*	**Tunnel** *Tigard Transit Center terminus*
REGION	**new system transit trips** *2035 average weekday vs. no build*	N/A	13,500	15,000	13,600-14,000[1]	13,600-14,000[1]	15,800	11,100
REGION	**operating cost** *2035 annual, in 2014$*	N/A	$20.4 million	$23.9 million	$22.0 million	$22.5 million	$20.4 million	$19.8 million
REGION	**operating & maintenance cost per rider** *2035 annual average, in 2014$*	N/A	$1.46	$1.67[2]	$1.56-1.57[1]	$1.60-1.61[1]	$1.38	$1.60
CORRIDOR	**light rail line ridership** *2035 average weekday*	N/A	43,200	42,800	43,300-43,600[1]	43,300-43,600[1]	45,700	38,300
CORRIDOR	**light rail travel time** *2035 average weekday off-peak to peak PSU to Tigard Transit Center*	N/A	23.6 - 24.3 min	23.6 - 24.3 min	23.6 - 24.3 min	23.6 - 24.3 min	24.7 - 25.4 min	24.7 - 25.4 min
CORRIDOR	**capital cost** *2014$ excluding finance*	N/A	$1.78 billion	$1.81 billion	$1.79 billion	$1.85 billion	$2.15 billion	$1.78 billion
NEIGHBORHOOD	**property impacts** *to neighborhood surrounding campus*	N/A	minimal	medium	minimal	medium	high	high
NEIGHBORHOOD	**construction impacts** *to neighborhood surrounding campus*	N/A	low	medium	low	medium	high	high
NEIGHBORHOOD	**hourly buses on neighborhood streets** *2035 peak / off-peak*	Capitol: 4/4 Lesser/G: 4/3 Haines: 4/3	Capitol: 4/4 Lesser/G: 4/3 Haines: 4/3	Capitol: 8/6 Lesser/G: 8/5 Haines: 0/0	Capitol: 13/8 Lesser/G: 13/7 Haines: 13/7	Capitol: 4/4 Lesser/G: 4/3 Haines: 4/3	Capitol: 4/4 Lesser/G: 4/3 Haines: 4/3	Capitol: 4/4 Lesser/G: 4/3 Haines: 4/3
CAMPUS	**households with one-seat ride to campus by transit** *2035, includes access via station at Barbur/53rd*	52,000	86,000	95,000	86,000	86,000	86,000	83,000
CAMPUS	**households with transit access to campus ≤ 60 min** *2035 peak, includes wait, walk, transfer, in-vehicle time*	165,000	258,000	263,000	268,000	267,000	275,000	263,000
CAMPUS	**transit ons and offs on PCC Sylvania campus** *2035 weekday average*	2,520	3,240	3,410	3,340-3,740[1]	3,340-3,740[1]	5,680	5,470
CAMPUS	**transit travel times to PCC Sylvania from key places around the region**	*See separate table on the other side of this sheet.*						

[1] *This information is presented as a range due to the sensitivity of the model to assumptions about tram/shuttle operational considerations that are not yet clearly defined.*

[2] *For this calculation for the bus hub, bus riders were estimated based on increase in system transit trips*

Part 2: Transit travel times to PCC Sylvania

All times are based on the 2035 PM rush hour and include initial wait time, in-vehicle time, transfer wait time, and walk time from station/stop to Sylvania campus center. Because travel choices in the model are based on perceived times, ridership projections are not directly correlated to the actual travel times shown below.

		Surface alignment options				Tunnel alignment options	
		A	**B**	**C**	**D**	**E**	**F**
	No build	**Walk/bike connection only**	**Bus hub**	**TriMet shuttle**	**Aerial tram**	**Tunnel** *Bridgeport Village terminus*	**Tunnel** *Tigard Transit Center terminus*
NE of campus	**Portland State University**	38 min *via line 44*	30 min *via SW LRT*	30 min *via SW LRT*	27 min *via SW LRT to shuttle*	27 min *via SW LRT to tram*	24 min *via SW LRT*	24 min *via SW LRT*
NE of campus	**Sellwood-Westmoreland**	53 min *via 43 to 44*	49 min *via Orange Line to SW LRT*	49 min *via Orange Line to SW LRT*	46 min *via Orange Line to SW LRT to shuttle*	46 min *via Orange Line to SW LRT to tram*	43 min *via Orange Line to SW LRT*	43 min *via Orange Line to SW LRT*
NE of campus	**Barbur Transit Center**	14 min *via line 44*	14 min *via line 44*	14 min *via line 44*	14 min *via line 44*	14 min *via line 44*	11 min *via SW LRT*	11 min *via SW LRT*
NW of campus	**Beaverton Transit Center**	50 min *via line 78*	46 min *via WES to SW LRT*	46 min *via WES to SW LRT*	41 min *via WES to SW LRT to shuttle*	43 min *via WES to SW LRT to tram*	39 min *via WES to SW LRT*	39 min *via WES to SW LRT*
SW of campus	**Tigard Transit Center**	21 min *via line 78*	22 min *via SW LRT* 21 min *via line 78*	22 min *via SW LRT* 21 min *via line 78*	17 min *via SW LRT to shuttle*	19 min *via SW LRT to tram*	15 min *via SW LRT*	15 min *via SW LRT*
SW of campus	**Bridgeport Village**	35 min *via line 97 to line 78*	32 min *via SW LRT*	32 min *via SW LRT* 30 min *via line 44*	27 min *via SW LRT to shuttle*	29 min *via SW LRT to tram*	25 min *via SW LRT*	28 min *via multiple lines to SW LRT*
SW of campus	**Downtown Tualatin**	40 min *via multiple lines to line 78*	40 min *via multiple lines to SW LRT*	35 min *via line 44*	35 min *via multiple lines to SW LRT to shuttle*	37 min *via multiple lines to SW LRT to tram*	33 min *via multiple lines to SW LRT*	38 min *via multiple lines to SW LRT*
SW of campus	**Sherwood**	47 min *via line 94 to line 78*	53 min *via line 94*	48 min *via line 93* 53 min *via line 94*	53 min *via line 94*	50 min *via line 94 to tram*	45 min *via lines 93 or 94 to SW LRT*	45 min *via lines 93 or 94 to SW LRT*
SE of campus	**Lake Grove**	24 min *via lines 37 or 38 to line 78*	24 min *via lines 37 or 38 to line 78*	20 min *via line 44*	24 min *via lines 37 or 38 to line 78*	24 min *via lines 37 or 38 to line 78*	24 min *via lines 37 or 38 to line 78*	24 min *via lines 37 or 38 to line 78*
Other PCC campus locations	**Southeast**	71 min *via Green Line or 4 to 44*	66 min *via Green Line or 4 to SW LRT*	66 min *via Green Line or 4 to SW LRT*	63 min *via Green Line or 4 to SW LRT to shuttle*	63 min *via Green Line or 4 to SW LRT to tram*	59 min *via Green Line or 4 to SW LRT*	59 min *via Green Line or 4 to SW LRT*
Other PCC campus locations	**Cascade**	65 min *via 72 to 44*	60 min *via 72 to SW LRT*	60 min *via 72 to SW LRT*	57 min *via 72 to SW LRT to shuttle*	57 min *via 72 to SW LRT to tram*	53 min *via 72 to SW LRT*	53 min *via 72 to SW LRT*
Other PCC campus locations	**Rock Creek**	94 min *via 67 to 78*	92 min *via 67 to SW LRT*	92 min *via 67 to SW LRT*	87 min *via 67 to SW LRT to shuttle*	89 min *via 67 to SW LRT to tram*	83 min *via 67 to SW LRT*	83 min *via 67 to SW LRT*