

Memorandum



To: Jenny Bailey, Senior Planner

From: Bill Schultheiss, P.E. (WA. P.E. #46108)

Lisa Enns

Date: June 20, 2017

Re: East Lake Sammamish Trail Demand Analyses

King County has asked Toole Design Group (TDG) to update and supplement the May 19, 2016 analysis estimating bicycle volumes on the East Lake Sammamish Trail (ELST), a significant link in the King County Trail network. The King County trail network is an important component of the overall transportation network, connecting major population and employment centers via safe, comfortable off-street facilities. In addition to serving transportation needs, the benefits of trail facilities include supporting recreational activity, increasing public health and wellness and boosting the economy.

The methodology presented in this memorandum estimates peak hourly volumes should be anticipated to be above 600 users per hour, and 5,000 to 7,000 users per day when the trail is complete (split approximately 50% pedestrians/bicyclists). As part of the regional trail network, the trail should be designed to anticipate growing use and be able to handle projected future demands while providing a safe operating environment for all users.

The ELST runs along the east side of Lake Sammamish for approximately 11 miles, connecting Issaquah and Redmond through Sammamish. The ELST will directly connect these cities via a flat, paved, high quality trail that provides a safe and comfortable alternative to riding on roadways, and is a vital link in the 44-mile regional trail corridor, linking Puget Sound to east King County and the Cascade Foothills.

The East Lake Sammamish Trail (ELST) will provide the City of Sammamish a connection to this regional trail network. The ELST will connect to the I-90 trail on the south end and the Sammamish River trail via Marymoor park on the north end. Future plans, in conjunction with the new light rail station, will connect the ELST to the Bear Creek Trail and the Redmond Central Connector Trail. The ELST will provide residents the opportunity to walk and bicycle to destinations, including the regional growth centers in Redmond and Issaquah, Marymoor Park, Lake Sammamish

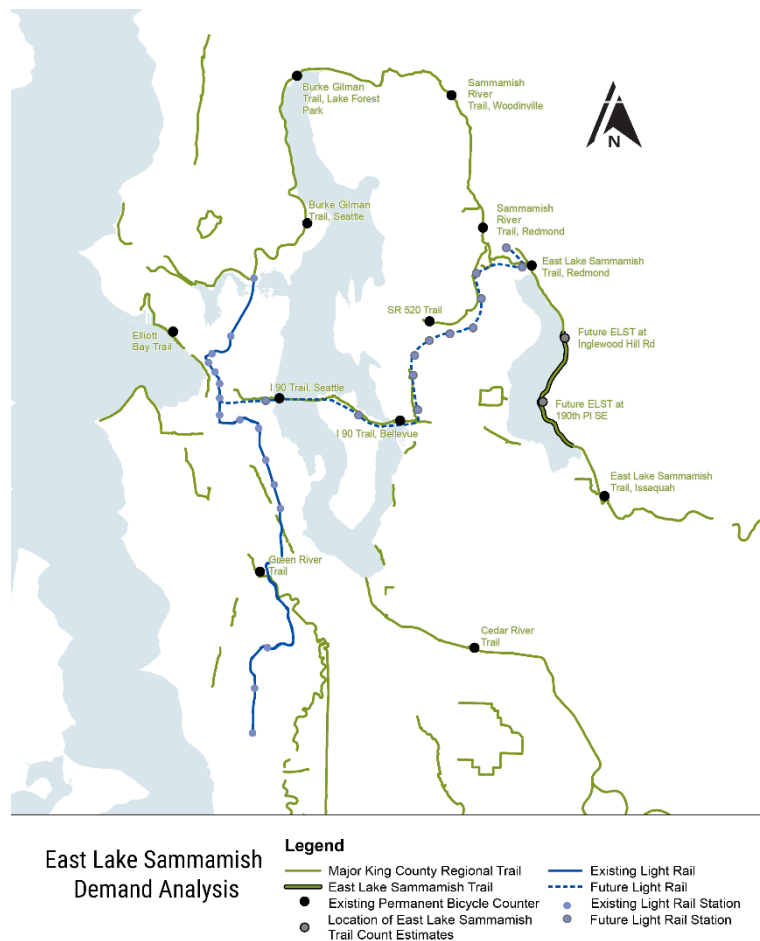


Figure 1 - King County Regional Trail System

State Park, and the new light rail stations planned for Downtown Redmond and SE Redmond. Both Issaquah and Redmond's comprehensive plans call for concentrating growth and development in mixed use centers and offering multiple options for transportation. The ELST will connect Sammamish with the planned light rail station in SE Redmond with a 5 mile bike ride, and will connect Sammamish and Issaquah with a 7 mile ride. Issaquah and Redmond will be connected with a safe, flat route of less than 10 miles. The City of Sammamish recognizes this benefit, and the ELST is called out as a key facility in multiple plans, including the Sammamish Trails, Bikeways and Paths Plan. Goal 6.2 of this plan emphasizes access to the regional trail network. Specifically, the plan recommends that the "City shall plan for connections to the proposed East Lake Sammamish Trail corridor and other significant regional trails," and for the purposes of prioritizing non-motorized projects, the Trails, Bikeways, and Paths Plan assigns a weighting factor of 2 (out of 3) for any project that provides a direct link to the East Lake Sammamish Trail. Further stressing the benefit of non-motorized transit, the Transportation Element of the Comprehensive Plan states that adding non-motorized facilities to arterial roadways increases capacity, and is an alternative to adding additional travel lanes on roadways such as East Lake Sammamish Parkway.

The City of Sammamish and King County recognize the role of trails for a healthy life style. The City of Sammamish Trails, Bikeways, and Paths plan, states that "Trails encourage physical fitness and healthy lifestyles for all age groups in the community. For the most part, trail development is an inexpensive method to encourage regular exercise for the general citizenry." Additionally, trails and paths provide safe transportation options for everyone in the community, along with providing an economical mode of travel and reducing vehicle trips.

The City of Sammamish's Comprehensive Plan clearly states a goal of providing greater options and mobility to support their residents. Goal T.2 of the Transportation Element is to "Invest in transportation systems that offer greater options, mobility and access in support of the city's growth strategy.", with supporting policies that include encouraging the integration of transportation systems, promoting the mobility of people and goods, addressing the needs of a non-driving population, and encouraging and increasing the proportion of trips made by other modes than driving alone. The ELST will be a key component in meeting the goals of the Transportation Element.

Recognizing that the East Lake Sammamish trail will be a vital link to the King County trail system and an important amenity for Sammamish residents, the demand analysis presented in this document aims to provide the project team with a means to inform the overall design of the trail, including width as well as traffic control measures that will ensure a safe and enjoyable user experience.

Direct Demand Model

The initial Environmental Impact Statement for the East Lake Sammamish Trail estimated peak use based on comparisons to best available data on the Burke-Gilman and Sammamish River Trails. Since publication of the EIS, the quality of data available for bicycling on trails in King County has increased. Several permanent trail counters were installed by the Seattle Department of Transportation (SDOT) in 2014, and the Washington Department of Transportation (WSDOT) has been installing permanent counters throughout the state. The additional data allows for the use of a more sophisticated trail estimation methodology than was previously available.

Also since the development of the EIS, there has been new research into trail demand modeling. The National Cooperative Highway Research Program's (NCHRP) Report 770¹, Estimating Bicycling and Walking for Planning and Project Development: A Guidebook, was consulted to select the best method for this analysis. NCHRP Report 770 is the result of a multi-year research effort that developed improved methods for estimating bicycling and walking for planning and project development purposes. Some of the methods only account for commute trips, so a direct

¹ Transportation Research Board, NCHRP Report 770, "Estimating Bicycling and Walking for Planning and Project Development: A Guidebook," Research sponsored by the American Association of State Highway and Transportation Officials (AASHTO) in cooperation with the Federal highway Administration, Final Report, 2014

demand model, which accounts for all trip purposes (including recreational use), was chosen for this analysis. This model is one of the most widely used tools to predict bicycle and pedestrian volumes. This process uses characteristics of the built environment and existing trail counts to provide an estimate of volumes on a new facility. Note that the direct demand model only takes into account bicycle volumes. Pedestrian volumes are factored into the estimate via a mode split analysis based on similar trails.

The direct demand model recommended in NCHRP Report 770 follows this six-step process to estimate trail volumes:

1. Gather data from existing permanent trail counters.
2. Create a “catchment area” around the permanent trail counters.
3. Summarize land use characteristics within the catchment area.
4. Analyze trail characteristics, such as connectivity.
5. Explore models including factors gathered in steps 3 and 4 to determine which factors influence trail usage.
6. Apply factors discovered in step 5 to surrounding land use and trail characteristics of the proposed East Lake Sammamish Trail.
7. Estimate pedestrian/bicycle mode split and apply pedestrian adjustment to calculate total trail volumes.

This process was previously used by Toole Design Group to model trail volumes for the ELST, and is summarized in a memo dated May 19, 2016. This demand analysis follows the same process, taking into account new data points that were not available a year ago. This model also explores potential impacts to ELST use related to light rail, which opened three new stations in 2016 and is now funded to extend into Redmond and Issaquah².

The following sections explain how estimated trail volumes were developed following this process.

1. Bicycle Counts

The first step in a direct demand model is to gather existing bicycle volumes. The Seattle Department of Transportation has 12 permanent bicycle counters that gather bicycle volumes continuously. This data is available from the City’s website summarized by hour. We selected only off-street, paved trail count locations, similar to the proposed East Lake Sammamish trail. Data from WSDOT counters was downloaded from WSDOT’s data portal. The following permanent counters were used (**new** marks counts that were not available in early 2016)

- Burke-Gilman Trail in Lake Forest Park (**new**)
- Burke-Gilman Trail in Seattle, just north of NE 70th St
- Cedar River Trail just east of 154th PI SE (**new**)
- East Lake Sammamish Trail in Issaquah
- East Lake Sammamish Trail in Redmond
- Sammamish River Trail in Woodinville (**new**)
- Sammamish River Trail in Redmond
- Green River Trail in Cecil Moses Memorial Park (**new**)
- I-90 Trail in Bellevue
- I-90 Trail in Seattle
- SR 520 Trail in Bellevue
- Elliot Bay Trail

The Chief Sealth, Lake to Sound, and Soos Creek Trails were also examined for inclusion in the analysis. These trails were not included for the following reasons:

- The Chief Sealth trail had many characteristics that were not typical of the rest of the network. The trail is unconnected and hilly, with a parrallel, flatter route on a road.
- The Lake to Sound Trail opened recently and therefore only had three months of data available.

² <https://www.soundtransit.org/Projects-and-Plans>

- The Soos Creek Trail counter had only one month of data available, from mid-November to mid-December, 2016.

Some of the counters did not have a full year of data available, but had at least six months of data. Using the Federal Highway Administration’s Traffic Monitoring Guide methodology outlined in Chapter 4, “Traffic Monitoring for Non-Motorized Traffic,” the missing volumes were extrapolated to estimate annual counts. Peak and average daily and hourly volumes were calculated from the existing dataset.

The goal of this analysis is to identify the volumes of trail traffic on the ELST at different times of the year, week, and day. To represent the spectrum of volumes expected, six volume metrics were pulled from each counter: annual, peak weekday, peak weekend day, average weekday, average weekend day, and the peak hour.

1. Catchment Area

In order to gather land use characteristics in areas near the trail, a catchment buffer was created. A GIS software analysis tool was used to find all trail access points within a 2 mile distance from each trail with a bicycle counter. From the access points, 2-mile proximity buffer around the trail was selected, based on research which shows bicyclists will go up to a total of 3 miles out of their way to access high quality/low stress bicycle facilities (including bike lanes, bicycle boulevards, low traffic streets, and multi-use paths).³ The road and trail network, including the East Lake Sammamish Trail, was used to determine the catchment areas which results in the buffer’s irregular shapes. Once on the trail, we assumed that a bicyclist would stay on the trail for 2-4 miles.

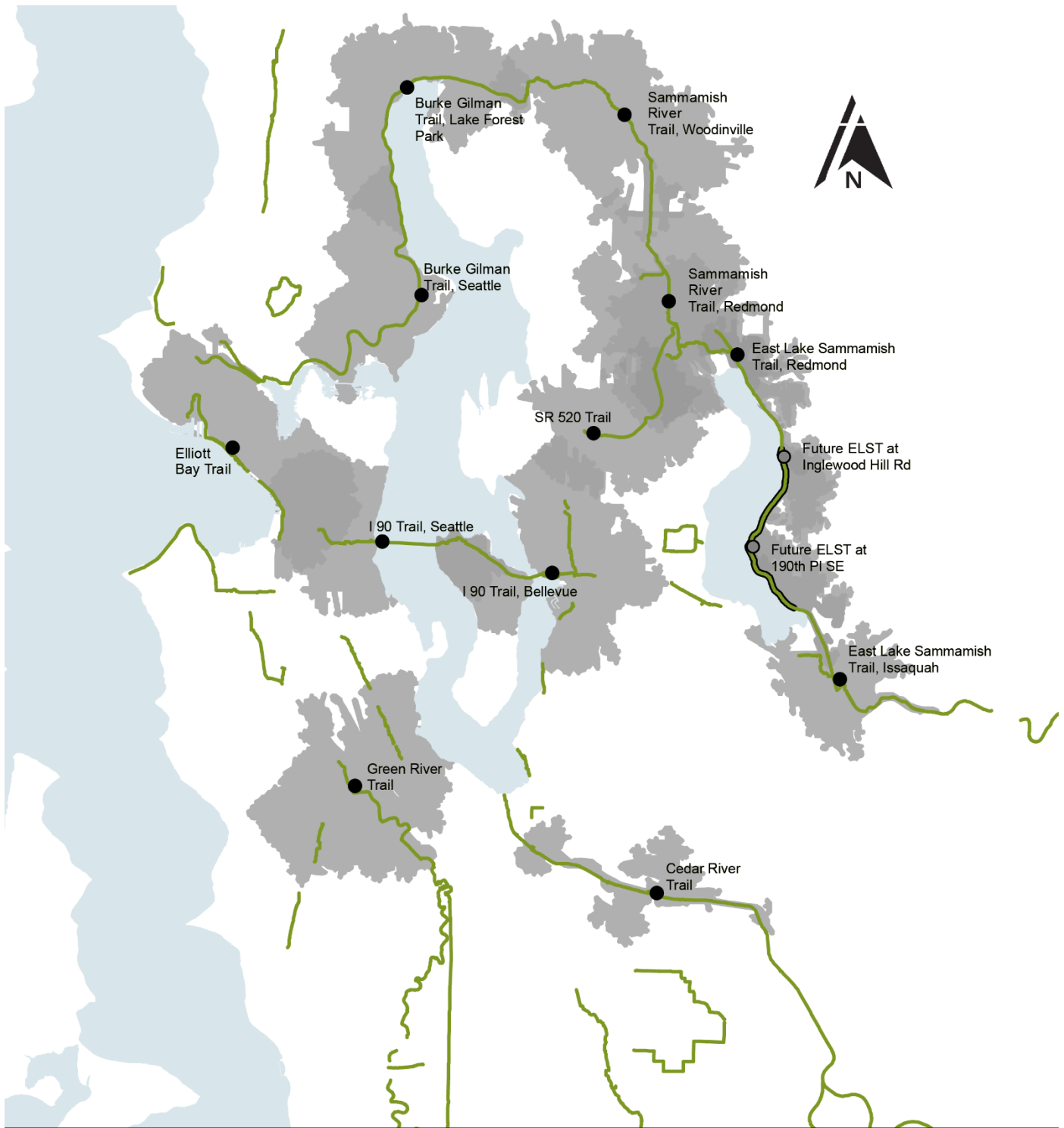
Two future potential counter locations were created on the ELST, near 190th PI SE, and one near Inglewood Hill Road. These locations were used for trail volume estimates. The catchment area process was then applied to both locations.

The result of this process is a catchment area around each counter location for people who have easy access to the trail, either by bicycle or a short car drive. Some trail users will likely drive or bicycle more than two miles to a trail access point, thus the catchment areas shown are likely conservative estimates. This methodology accounts for trips that pass through the trail counter location, and may miss trips that are under five miles. For example, on the Burke-Gilman trail, there are two trail counters over 5 miles apart. Any shorter trips that enter and exit the trail between the trail counters are not accounted for. Five miles is approximately a 30 minute bicycle trip. According to the 2012 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors, approximately 40% of trips are under 30 minutes. The following table shows common bicycle trip lengths.

Trip Lengths, by percent	Percent
0-30 minutes	42
31-60 minutes	36
61-120 minutes	15
121 minutes or longer	7
Average Trip	65.2 minutes

Table 1: The 2012 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors, Highlights Report.

³ Jennifer Dill and John Gliebe, "Understanding and measuring bicycling behavior: a focus on travel time and route choice," Final report OTREC-RR-08-03 prepared for Oregon Transportation Research and Education Consortium (OTREC), December 2008.



East Lake Sammamish Demand Analysis

Legend

- Major King County Regional Trail
- East Lake Sammamish Trail
- Existing Permanent Bicycle Counter
- Location of East Lake Sammamish Trail Count Estimates
- Catchment Area

Figure 2: Catchment Areas

2. Land Use Information

The NCHRP Report 770 lists several factors that may influence bicycle use, including population and employment densities, land use mix, facility characteristics, transit availability, and major generators. These factors, along with other readily available factors, were gathered and represent existing conditions and data as provided from the King County data sets. All factors represent current conditions. The following describes each factor considered in this process:

High Capacity Transit Access

High capacity transit access was calculated by the ease of access to a light rail station. If there was a station within a half of a mile of the trail within 6 miles of the counter location, the trail was assigned a value of “1” for transit access.

Population

2015 population estimates from the American Community Survey were used to provide a population estimate in each area. Projections from the Puget Sound Regional Council, which assume growth will be concentrated in regional growth centers including Issaquah and Redmond, were used to predict future trail volumes.

Employment

Employment values are 2014 census estimates, from onthemap.ces.census.gov.

Street Network

A connected street network can be a factor in influencing bicycle rates. The number of intersections was summed in each catchment area, and the intersection density per mile was used as a tested as a factor in the model.

Access Area

The total square mileage of each catchment area was calculated. A larger catchment area means that the trail is easier to access.

College Enrollment

Colleges are major activity generators for a region. The King County “schsite_point” layer was used to find colleges and universities within each catchment area, and each school’s website was used to estimate enrollment.

Demographics

Two demographic factors were tested in the model; the average household income, and the demographic characteristics in the catchment area. Average household income was not found to influence the model, but the demographic characteristics in the catchment area did factor in to the model.

2. Trail Characteristics

In addition to surrounding land use, characteristics of the trail or facility itself influence bicycle ridership. The trails selected for analysis all have similar characteristics to the future East Lake Sammamish Trail, but there are a few differences that were explored.

Connectivity

Trail connectivity may drive trail use, as bicyclists on longer rides may prefer a connected trail network. Multiple factors were explored as a way to measure connectivity.

Total mileage of King County Regional Trails in the catchment area

King County has a robust regional trail network. Most of the network is off-road, paved trails. However, on-street connections were included in this factor as a measure of connectivity.

Paved, off-street trail extension past the catchment area

An additional measure of trail connectivity was also explored in the model; the trail was considered not extended if it did not connect to any other paved trails on either end of the catchment area, semi-connected if the trail connected on one end of the catchment area (SR 520 Trail) and very connected if it connected on both ends (Burke Gilman, Sammamish River).

User Experience

The 520 and I-90 trails run directly adjacent to a freeway. Noise and stress level of freeway trails may deter some riders, and many recreational riders may prefer to ride on a flat path near a body of water. Qualitative values for user experiences were assigned as follows:

- 0- Along freeway or high speed road (example: SR520 Trail)
- 1- Along freeway or high speed road *and* river or lake (example: I-90 Trail)
- 1- Neutral, neither along freeway or body of water (example: East Lake Sammamish Trail in Issaquah)
- 2- Along river (example: Sammamish River Trail)
- 3- Along large body of water (example: Elliott Bay Trail)



Figure 3: Example of the qualitative trail comfort rating. The Elliott Bay trail, on the left, was assigned a comfort rating of 3, and the SR 520 trail, on the right, was assigned a comfort level of 0.

3. Exploratory Models

The direct demand model attempts to explain observed levels of bicycle activity on facilities as related to surrounding land uses or facility characteristics. Because the explanatory variables act simultaneously to influence demand, we need a way to control for their influence in order to understand how important one variable is in comparison to another. We do this through regression analysis, which allows us to mathematically estimate the influence of each variable compared to all of the other variables. Additionally, we can use the regression outputs to determine how significant each relationship is—that is, how likely it is that the observed relationship is due to a real relationship as opposed to chance. The regression analysis compared estimated demand on the East Lake Sammamish Trail to segments of the larger King County trail system. The first step of a regression analysis is exploratory regression, which entails producing many different models to find out which variables best predict volumes.

After running various models to determine the best fit, the following variables were found to have the highest influence on trail ridership.

- Population
- Trail experience
- Miles of trail in the catchment area
- Demographic characteristics of the catchment area

The following data used in the models is the best available data for current conditions, meaning that the resulting volumes are an estimate of what trail usage would be if the ELST were built today. Future estimates are discussed in the following section.

While the model would benefit from additional count locations, Washington is on the forefront of bicycle data collection, with an ongoing program to install more permanent counters. The methodology used in this memo is based on best available count data.

4. Application of Predictive Model

After testing several models in the exploratory phase, final models were selected based on a combination of the highest R squared value (a measure of how much of the variation in bicycle volumes can be explained by the model), the statistical significance of the variables (a measure of how likely it is that the observed relationship is real and not just by chance), and minimal multicollinearity (a measure of how much the variables are related to each other). A separate model was built for each volume estimate: annual, peak hour, average weekday, average weekend day, peak weekday, and peak weekend day. Separate models are necessary to account for different factors that influence weekend vs. weekday and peak vs. average ridership. For example, in the weekend models, surrounding population accounts for a much smaller percentage of ridership, because a larger percentage of bicyclists access the trail via car on the weekends.⁴ During the week transit related and work influenced trips have a greater influence on trip generation. Trail experience and miles of connected trail have a greater influence on weekend volumes.

East Lake Sammamish Volumes

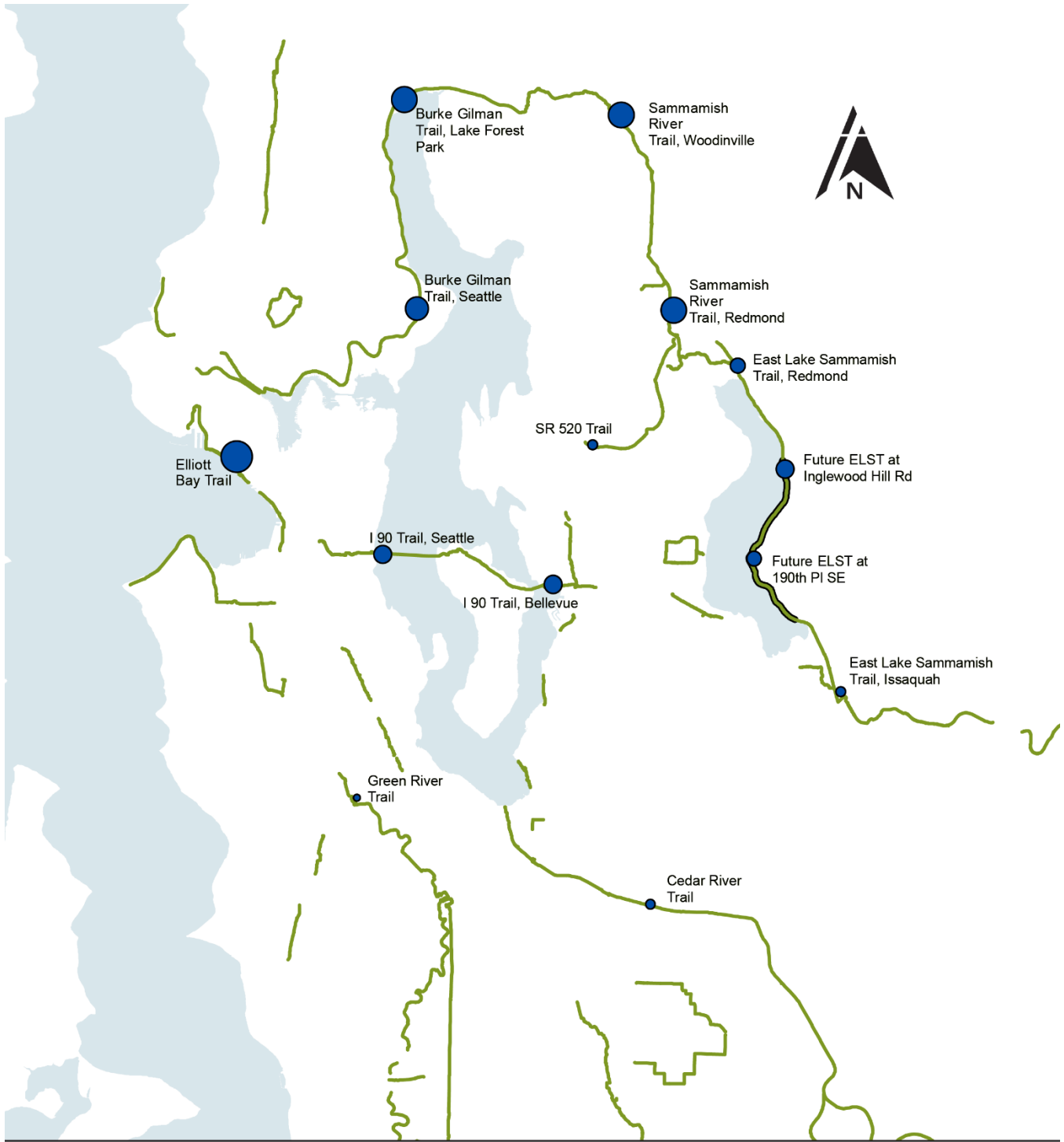
The results of the analysis are well in line with other permanent trail counters in King County. Figure 4 shows the predicted 2015 volumes for the East Lake Sammamish trail along with other King County trails, and Figure 5 summarizes the annual bicycle volumes. The trail is expected to exhibit a recreational profile, with high weekend peaks. In addition to providing a healthy recreational outlet for City of Sammamish, City of Issaquah, City of Redmond, and King County residents, the trail will provide weekday commuting and recreation options for people commuting to and from Sammamish, Issaquah, and Redmond. Average weekday volumes are predicted to be similar to the SR 520 trail, the Green River Trail, and the Cedar River Trail. Average weekend volumes are predicted to be similar to the Elliott Bay Trail and the I-90 Trail. Peak weekend volumes are expected to approach those of the Burke-Gilman trail, reaching around 3,500 bicyclists on a peak weekend day. This is unsurprising as the trail directly serves the most popular regional park, Marymoor Park, which serves over 3 million visitors annually, and is located in a naturally beautiful area along Lake Sammamish with a high degree of separation from motorized traffic. It is anticipated that as the trail is completed, many visitors to Marymoor Park, Lake Sammamish Park, and Sammamish Landing Park will also use the East Lake Sammamish Trail for walking or bicycling trips. Additionally, when the Redmond extension of light rail is complete, many more King County residents will have direct access to the ELST, eliminating barriers currently in place, and many more Sammamish, Issaquah, and Redmond residents will use the trail to access light rail.

⁴ King County Trails Regional Plan, p. 62

Peak and Average Bicycle Volumes at Trail Locations in King County



Figure 4: Peak and Average Trail Volumes



East Lake Sammamish Demand Analysis

Legend

- Major King County Regional Trail
- East Lake Sammamish Trail

Annual Bicycle Counts

- 34,000
- 420,000

Figure 5: Annual Bicycle Counts

Using the Land Use Vision population forecast from the Puget Sound Regional Council, we can apply the anticipated increase in population to the model to predict future ridership. The Land Use Vision forecast assumes growth will be concentrated in regional growth centers, including Issaquah and Redmond. The population forecast accounts for future land use changes, with mixed use centers in the regional growth areas. The areas around the ELST are already outpacing PSRC forecasts, at a value of 2% for the area near 190th PI SE, and 4% for the area near Inglewood Hill Rd. Assuming these trends continue, the future bicycle volumes for the East Lake Sammamish Trail are summarized in Table 2

Table 2: Predicted bicycle volumes for two locations on the East Lake Sammamish Trail⁵

	Average Weekday	Average Weekend⁶	Peak Weekday	Peak Weekend	Peak Hour	Annual
2015 Inglewood Hill Rd	424	789	615	3,395	348	160,914
2025 Inglewood Hill Rd	451	789	653	3,491	348	168,861
2040 Inglewood Hill Rd	469	789	678	3,549	348	173,813
2015 190th PI SE	270	659	447	2,858	302	104,078
2025 190th PI SE	282	659	466	2,923	302	107,554
2040 190th PI SE	289	659	477	2,961	302	144,014

The model is a conservative estimate for ridership. Both peak weekday and peak weekend volumes depend on miles of connected trail. The completion of the Eastside Rail Corridor and the SR 520 trail will add over 10 miles to the regional network, and increase peak bicycle volumes.

Weekday volumes will likely increase with the opening of the Redmond extension of light rail. Light rail was tested in the demand model, but with only one regional trail that directly accesses light rail, there were not enough data points to include it. A conservative rough estimate of mode share based on the current bicycle mode share at the University of Washington station (currently the only station directly accessible by trail) and projected ridership numbers for the Redmond extension estimates approximately 70 people will access the light rail stations via bike on an average weekday, and approximately 100 or more on a peak weekday. If we estimate that half of those people will arrive via the ELST, the 2040 average weekday estimates become 324 for the ELST at 190th PI SE, and 504 at Inglewood Hill Rd. Peak weekday estimates with the addition of light rail become 527 at 190th PI SE and 728 at Inglewood Hill Rd in 2040. Actual numbers will likely be higher than these estimates as the region gains population and bicycle mode splits increase. Even before the light rail opens, the ELST will provide vital connections to transit. Data from King County shows that Park and Rides on the East side are nearing capacity. Issaquah Transit Center’s P&R is at 99% capacity, Redmond’s at 97%, and Bear Creek at 99%.⁷ Even before light rail opens, the ELST will provide Sammamish residents with a safe, pleasant commuting alternative to access major transit centers.

⁵ Volumes were estimated at two locations. The Inglewood Hill Road location was added since the May 2016 calculations to provide additional detail.

⁶ Population of the surrounding area did not appear as a significant factor in the average weekday model. Therefore, this number is not shown as increasing. However, we can assume this number will indeed increase, as regional population grows and the trail network is built out.

⁷ King County Metro Transit Park-and-Ride Utilization Report, Fourth Quarter 2015.

<http://metro.kingcounty.gov/am/reports/2015/2015-par15q4.pdf>

Future Bicycle and Pedestrian Use Estimate

The model above only considers bicycle volumes. To estimate trail use including pedestrians, a mode split factor was applied. The mode-split factor was determined by calculating how many users of the trail system, on average, are bicyclists. All trail counts from step 1 which included both pedestrian and bicyclists counts were assessed to identify an average mode split for trails in this region. The average trail mix consisted of 50% bicyclists with 50% pedestrians. Applying this factor to Table 3 calculates expected total trail usage.

Table 3: Predicted future bicycle and pedestrian volumes on the East Lake Sammamish Trail

	Average Weekday	Average Weekend	Peak Weekday	Peak weekend	Peak Hour	Annual
2017 Inglewood Hill	847	1,578	1,230	6,790	696	321,829
2025 Inglewood Hill	903	1,578	1,307	6,982	696	337,724
2040 Inglewood Hill	938	1,578	1,356	7,097	696	347,626
2017 Segment B	541	1,317	894	5,715	603	208,151
2025 Segment B	565	1,317	932	5,846	603	215,109
2040 Segment B	579	1,317	954	5,921	603	219,177

The East Lake Sammamish trail will become a critical transportation facility for residents and employees in East King County. As part of the King County Regional trail system, the trail will provide a safe, pleasant non-motorized transportation and recreation option for the entire region. The estimates of volumes of bicyclists that will use this trail are similar to other regional trails, with peak volumes near those of the I-90 trail and the Elliott Bay trail. **Peak hourly volumes should be anticipated to be above 600 users per hour when the trail is complete. As part of the regional trail network, the trail should be designed to anticipate growing use and be able to handle projected future demands while providing a safe operating environment for all users.**