RAPIDRIDE

METHODS AND ASSUMPTIONS MEMO

Contents

Background

Memo Purpose

This memo summarizes the detailed methods used to perform corridor evaluations and support the prioritization process. The memo includes methodologies used for traffic analysis and forecasting, ridership forecasting, and capital cost development. Methods and assumptions detailed include among other items: study area/intersections, data collection methods and locations, modeling tools, analysis years and peak periods, and performance metrics, as well as analysis methodologies related to transit operations and layover, traffic safety, system connectivity, and transit ridership.

This memo will document proposed work as part of the RapidRide Prioritization Plan (RRPP) project as well as the team's ability to leverage and build on prior work efforts. In particular, the project team will refer to documentation within the RapidRide Expansion Program, such as the RapidRide Standards and Implementation Guidance.

Two additional detailed memos will be produced with additional information on traffic analysis and costing; therefore the information in this memo is aimed at conveying a high-level summary of key points.

Project Purpose and Goals

The purpose of this project is to provide planning and related services to King County Metro (Metro) to determine the candidate corridors for the expansion of and reinvestment in Metro's RapidRide network. RapidRide is an integral part of the region's high-capacity transit network that improves mobility along major corridors and connects key destinations and regional growth centers. The current RapidRide network consists of seven lines (A-F, H) with three additional lines under construction (G) or in the planning and design stage (I and J). An additional two lines, the K Line and the R Line are planned to be the next RapidRide lines developed following the J Line.

The RapidRide Expansion Program (completed in 2018) established new standards for RapidRide service and conducted evaluations of six suburban corridors. Additionally, the Metro Connects long-range plan, adopted in 2021, identified a pool of eight candidates for new or significantly modified RapidRide routes (Figure 1).

Figure 1 Metro Connects Interim Network RapidRide Candidates

Current Equivalent Routes	Metro Connects Corridor Number	Representative Alignment in RRPP
Route 36 and 49	1064	U. District, Beacon Hill, Othello
Route 40	1993	Northgate, Ballard, Seattle CBD, First Hill
Route 44	1012	Ballard, Wallingford, UW Hospital/Husky Stadium
Route 150	1049	Kent, Southcenter, Seattle CBD
Route 165	1056	Highline CC, Kent, Green River CC
Route 181	1052	Twin Lakes, Federal Way, Green River CC
B Line and 226	1999	Redmond, Overlake, Eastgate
B Line and 271	3101 + 1028	Crossroads, Bellevue, U. District

The ordinance adopting Metro Connects requires the creation of the RRPP to determine the specific candidates to be developed as part of the interim network. The RRPP will be submitted to the Regional Transit Committee for review and acceptance by motion no later than **June 2024**.

The project will develop a Prioritization Plan to determine the number and specific candidates to be developed as RapidRide lines as part of the interim network. To do this, this project will identify a reasonable conceptual alternative for each candidate corridors and conduct a preplanning level corridor study for each candidate corridor that does not have an existing study. These corridor studies will consider route alignment options, operations plan, capital investment needs, potential ridership, and develop planning level cost estimates for each candidate corridor.

Traffic Analysis

Analysis Overview

Traffic modeling and analysis will be conducted to support the evaluation of the eight candidate Metro RapidRide corridors (including one corridor with two alignment alternatives). This chapter outlines the methods and assumptions that will be used to perform the traffic analysis for existing, future baseline, and future improved conditions for the Metro RapidRide prioritization study.

Study Area and Intersections

Study Intersection Selection Process

The selection of study intersections to be analyzed across the candidate corridors was based on control type and transit delay. A total of approximately 430 signalized intersections were identified as potential study intersections across all eight candidate corridors.

Due to the high number of intersections, the first screen was to eliminate all uncontrolled and stop controlled intersections as potential study intersections. The second screen was to eliminate potential intersections that experienced limited or low levels of transit delay (generally less than 40 minutes of total passenger delay per mile per trip) to focus on intersections with the most potential need to improve transit travel times. A delay metric of total passenger minutes of delay per trip per mile was used to screen intersections since it considers both traffic delay and ridership. A total of 118 study intersections across the candidate corridors were identified for analysis as part of this study.

Figure 2 provides a summary of the study intersections group by candidate corridor; a complete list of study intersections is included in Appendix A: Full List of Study Intersections and includes maps of the study intersections by candidate corridor.

Figure 2 Study Intersection Screening by Corridor[1]

Route	Metro Connects ID	# of Total Signals	Study Intersections Identified
Route 36 and 49	1064	41	28
Route 40	1993	77	33
Route 44	1012	45	27
Route 150	1049	43	19
Route 165	1056	117	9
Route 181	1052	69	9
B Line and 226	1999	33	2
B Line and 271	3101 + 1028	71	15
	Total	**496**	**142**

A variety of transportation and transit related data is required for the proposed traffic analysis and modeling effort. Key jurisdictions where data will be collected from include the cities of Seattle, Tukwila, Kent, and Bellevue, WSDOT, and King County. The sections below provide a description of the key data collected and gathered for this study.

Data Collection and Gathering

Transit Data

Transit route data was provided by Metro to assist in the analysis effort. Data provided by Metro includes the following items:

- Transit delay and speed data, stop to stop (through Metro AVL data from Fall 2021)
- Route alignment data
- Bus stop/station locations
- Transit ridership data (Spring 2023)

The transit data will be used to calibrate corridor travel times as well as to help evaluate proposed transit improvements along each of the candidate corridors.

Traffic Volumes

Vehicle traffic volumes were collected at the study intersections during the week of June 11th, 2023. Volumes were collected during the morning peak (7-9 AM) and evening (4-6 PM) peak periods. An AM and PM system peak hour for each corridor will be determined based on the data

[1] Total number of intersections includes intersections that overlap across routes. The total number of distinct intersections is approximately 430. "Study Intersections Identified" represents intersections that have met both of the following screening criteria, a) Operates as a signalized intersections and b) Experiences greater than 40 minutes of total passenger delay per mile per trip.

collected. Turning movement volumes for the system peak hour will then be used within the traffic modeling and analysis effort.

Roadway, Channelization, and Signal Timing Data

Intersection channelization, traffic control type, and lane geometry will be collected at each study intersection through either the use of GIS/online map and specific site visits. Signal timings plans for each of the study intersections will be gathered from the local agencies for input into the traffic analysis and modeling tools.

Analysis Scenarios, Forecasting, and Operational Analysis

The following sections provide specific details related to the traffic modeling and forecasting tasks.

Analysis Years and Scenarios

For analysis purposes an existing year of 2023 and a future forecast year of 2035 will be used for the traffic modeling effort. The following scenarios will be analyzed as part of the study:

- 2023 Existing Conditions – Includes current year volumes and intersection geometry.
- 2035 Future Baseline – Includes forecasted 2035 volumes and future planned background improvements for transit and roadway projects.
- 2035 Future Improved - Includes forecasted 2035 volumes, future planned improvements, and proposed transit improvements for each candidate corridor.

The 2035 Future Baseline and 2035 Future Improved scenario will be used to quantify travel time benefits if candidate corridors were to advance to a RapidRide route designation.

Future Baseline Background Projects

The following transit projects will be incorporated into the Future Baseline and Future Improved scenarios as planned background projects:

- Metro Connects 1012
    - Add J-Line improvements where intersections overlap with candidate corridor.
    - Add 24/7 BAT lane between Pacific and 43rd along 15th.
- Metro Connects 1064
    - Protected bike lane along 12th between Jackson and Jose Rizal bridge
    - Project improvements associated with the Beacon Hill Safety Project (formerly Beacon Hill Bike Lane Project)
- Metro Connects 1993
    - Southbound 24/7 BAT lane between 1st Ave. NW and Fremont Bridge along N. 36th Street
    - BAT Lanes between 24th Ave. NW and 22nd Ave. NW on Market Street
    - Northbound 24/7 BAT lane between Market Street and 20th Ave. NW on Leary Avenue

In addition to the transit projects listed above, local planned improvements will also be incorporated along the candidate corridors.

Traffic Forecasting

Within the City of Seattle, future year (2035) vehicular volume forecasts will be developed using a growth rate derived from data in the Seattle 2035 Comprehensive Plan Arterial Screenline Forecast, which is the most recent available modeling data. The screenline volumes along the candidate corridors will be compared against the volume data collected in June 2023 to develop a representative growth rate for each corridor within the City of Seattle.

For the other candidate corridors that are not within the City of Seattle, other regional forecasting models will be utilized to develop a representative growth by corridor. The forecasting resources that will be reviewed to develop those growth rates include:

- Bellevue-Kirkland-Redmond (BKR) Travel Demand model (City of Bellevue)
- WSDOT SR 509, SR 167, and I-405 Forecasting models (Kent, Tukwila areas)
- PSRC Regional Travel Demand models (Kent, Tukwila areas)

All forecasting assumptions and growth rates will be documented and reviewed by Metro before implementation into the traffic modeling.

Traffic Operational Analysis

Traffic operational analysis will be conducted for both the AM and PM peak periods to capture peak period traffic demand at each of the study intersections for the candidate corridors using Synchro 11 software. Synchro model key parameters assumptions are included in Figure 3.

Figure 3 Traffic Analysis: Key Parameters and Assumptions

Arterial Intersection Parameter	2022 Existing	2035 Future Year
Peak Hour Factor (PHF)	From count and by intersection	Use 0.95 for all intersections except where existing PHF is greater than 0.95.
Ideal Saturation Flow	1,750 vehicles per hour	Same as existing
Signal Timings	Existing signal timing cards from local jurisdictions	Optimize signal timings/phasing per future volumes and improvements
Forecasting of Future Year Vehicle Trips	N/A	Based on Seattle 2035 Comprehensive plan and other regional forecasting tools

Performance Metrics

The following measures of effectiveness will be used to quantify impacts and benefits for each of the candidate corridors.

- Overall and approach intersection delay and Level of Service (LOS)
- Volume to Capacity (V/C) ratio
- Movement delays for the study intersection approaches being used by transit for inbound and outbound travel (seconds per vehicle)
- 95th-percentile queue length in feet for movements used by transit at study intersections.
- Representative corridor travel time; calculated as [unimpeded bus travel time] + [bus approach delay at study intersections] + [estimated approach delay at signalized non-study intersections]

Since only a sub-set of the intersections along a corridor are being modeled, delay for the transit movement at each non-study intersection will be estimated based on existing transit delay data (AVL data) provided Metro. In addition, since each candidate corridor has different characteristics and lengths, a normalized travel time value will use a "per-mile" or "per-segment" basis or similar metric will be calculated to allow for better comparisons between the candidate corridors.

Ridership Forecasting

The ridership forecasting subtask will incorporate several datasets as inputs in additional to application of the Sound Transit Incremental Ridership Model (ST Model) using the EMME/2 version. This model accounts for land use using the Puget Sound Regional Council (PSRC) land use model.

Data and Model Application

The project team will review Metro-provided data to summarize corridor-level peak and daily ridership for existing year (Spring 2023). The ST Model will be updated to incorporate all known alignment and project plans with Sound Transit Link Light Rail, Stride, and ST Express along with known changes to the King County Metro network (separate from the potential RapidRide corridors) for a horizon year of 2042 (unless a different year is preferred for comparison of the corridors). A separate transit network model scenario for each RapidRide corridor will be created in the ST Model includes the preferred alignment pathway, proposed headways, and estimated run-times. Other potential RapidRide corridors will remain unchanged from existing conditions for the purpose of isolating the ridership benefit for each corridor with conversion to RapidRide. Each RapidRide line under evaluation will be updated in the ST Model to incorporate the proposed stop locations identified in concurrent subtasks (Note: the coarseness of the model may only allow for standard half-mile stop spacing at key intersections).

Operating Assumptions

The ST Model includes two time periods for generating a daily forecast: PM peak period and off-peak. Each RapidRide corridor will be updated in the ST Model to include the proposed service headways for both peak and off-peak time periods. The project team will confirm with Metro staff how to effectively assess an "average" off-peak headway given the potential differences in proposed midday versus evening frequencies. The forecast end-to-end runtimes incorporated in the ST Model will be based on the traffic operations analysis subtasks that will identify proposed capital investments to improve transit speed & reliability. The running time estimated by the project's traffic model (2034/5) will be assumed as an input for ridership forecasting for the horizon year 2042.

Ridership Summary

Ridership results for each RapidRide corridor will be summarized from the ST Model by combining the peak and off-peak ridership forecasts to generate a daily ridership total[2]. Ridership forecasts will be provided at a corridor-level to convey a total daily boardings for the forecast horizon year. For the stop-level ridership forecasts, the results will be summarized as a relative "high", "medium", and "low" level that is consistent with potential stop sizing/typology definitions.

Additional Ridership Detail

- If possible (requires some more time to confirm):
  - Leverage previously generated outputs from the PSRC Activity-based Model (ABM) that provides a summary of travel demand changes by household and person characteristics including race and income
  - The outputs from the ABM will be integrated with the ST Ridership Model outputs to provide a relative comparison of ridership growth associated with communities of color and low-income households

Capital Cost Development

The following cost estimating methodology will be used to generate the planning level cost estimates for proposed RapidRide prioritization capital projects. It will help develop consistent planning level/Order of Magnitude cost estimates for each selected capital project, despite varying differences of scope across the corridors. Each estimate will be comprised of the following key cost elements: construction cost, right-of-way, escalation, and soft costs. Together, these costs will result in a total project cost, excluding any operational costs in the future.

[2] Assumed methodology will be multiplying peak hour ridership by two and adding to off-peak ridership.

Overview of Cost Basis

Order of Magnitude cost estimates developed during the typical project planning phase are high-level estimates that generally use parametric factors and broad assumptions of scope to identify anticipated costs. This typically occurs between the 0 percent to 5 percent design level. In some cases, depending on how defined the project scope is, more detailed cost estimation based on unit pricing and measurable quantity take-offs will be used. A combination of both may be used for the development of cost estimates.

Parametric level and unit price estimates for these estimates are expected to be generated from a variety of sources, such as recent project bid history from Metro, historical databases from local jurisdictions, including WSDOT, and direct experience on related projects. Cost information associated with modifications to the overhead contact system will be sourced from the recently completed Trolley Expansion Strategic Plan. Cost estimates for improvements on S Jackson Street will be prepared using estimates developed for the R Line Pre-Design Study. This ensures that unit costs are consistent across corridors and ongoing planning projects within King County Metro.

Some capital projects may require property acquisition to complete the project. Where this is evident, property acreage and location will need to be estimated. Locations would be very generic but include enough detail to understand the general area and existing land use. That information would then be used to evaluate land costs using current assessor information about property values. Those costs will be escalated to include costs associated with the typical federal property purchase process and requirements. Property costs will be included in the total cost of the project.

Typical corridor project elements that may be estimated include:

- Passenger facility improvements
- Roadway and signal improvements
- Communication and technology
- Layover
- Charging Infrastructure[3]
- Trolley Infrastructure

Risk and Contingencies

Risk is estimated at the highest level at the Order of Magnitude stage of a project, resulting in a higher contingency allowance. This risk and contingency level is reflective of the project having not yet engaged the bulk of internal (project) and external (jurisdictional) technical design expertise.

Planning effectively for risk and contingency allowance at this phase is critical. At this point of planning level project, the overall risk and contingency allowance is in the range of 30 to 40

[3] For non-trolley routes only.

percent. Selection of the appropriate contingency level depends on the complexity of the estimated improvement and the vicinity of the project location. The allowance selected will be based upon the level of design in consultation with Metro. At this level of project maturity, the risk allowance is based on qualitative assessments.

Soft Costs

Metro Engineering staff recommend soft costs based on recent trolley projects and the results of the Metro Capital Project Soft Cost Versus Hard Cost Analysis (January 2021). The Order of Magnitude level soft costs are based on the total construction cost, construction contingency, risk contingency, and sales tax. They are as follows:

- Project Management: 10%
- Engineering/Design: 20%
- Construction management: 20% (can vary from less than 5% to 20%, depending on the project size and location)
- Environmental Review and Permitting: 5%

Documentation

All cost estimates will have sufficient quantity backup based on design utilizing GIS level and aerial photographic images. No survey or CADD will be prepared to support or inform the cost estimates. The standard Metro Planning Level Estimate Template shall be used for each identified capital project. Following the form’s layout, each estimate will include construction costs (broken out by major components), soft costs, and other costs. These costs will result in an order of magnitude of cost for each specific project.

Environmental Classification Review

Guiding Regulations

Development of the RapidRide corridors will require environmental review. Depending on funding sources, the following policies, laws, and regulations may govern or influence the environmental impact analysis and include the following:

- **National Environmental Policy Act (NEPA)/The Washington State Environmental Policy Act (SEPA).** NEPA requires federal agencies to assess the environmental impacts of their proposed actions, including transportation projects. Depending on the nature of the project and the significance of the impacts, these environmental impacts can be evaluated through a Categorical Exclusion (CE) or Documented Categorical Exclusion (DCE), an Environmental Assessment (EA), or an Environmental Impact Statement (EIS). The SEPA process identifies and analyzes environmental impacts associated with projects undertaken or permitted by state agencies. These decisions may be related to issuing permits for private projects, constructing public facilities, or adopting regulations, policies, and plans. The various levels of reviews include Categorical Exemption, SEPA checklist, or EIS.

- **Section 106.** Section 106 of the National Historic Preservation Act (NHPA) protects historic and cultural resources. The project must identify and assess potential impacts on historic sites, structures, and archaeological resources, and consult with appropriate agencies to develop mitigation measures.
- **Section 4(f).** Section 4(f) refers to the consideration of park and recreation lands, wildlife and waterfowl refuges, and historic sites during transportation project development.
- **Endangered Species Act (ESA).** Section 7 of the ESA protects endangered and threatened species and their habitats. The project should evaluate potential impacts on wildlife and consult with relevant agencies to mitigate any adverse effects on protected species.
- **Other federal, state, and local permits and approvals**. These may include permits or approvals for impacting critical areas, complying with land use regulations, water resource management plans, noise ordinances, and transportation planning guidelines.

It is important to note that the source(s) of funding used to implement improvements to the RapidRide corridors will influence the level of required documentation. For purposes of this methodology, it is assumed that development of all new RapidRide lines would require NEPA and SEPA review.

Data Needs and Sources

A variety of data will be collected and assembled to analyze the environmental-related effects of the project. These data sets may include natural and built environment resources that could be affected by the project, such as critical areas and wetlands, water bodies, air quality, noise levels, historic sites, parks, and residential areas. Integrating GIS data and desktop tools for such things as critical areas, land cover, topography, hydrology, and infrastructure will provide for spatial analysis that can help identify potential environmental impacts and proximity to sensitive areas. No field work will need to be performed for this analysis.

Recommended level of review for NEPA/SEPA Compliance

Determining the recommended level of review for NEPA or SEPA compliance will involve a high-level assessment of the complexity and potential impacts for each project corridor. The recommendations will be based on locations and the potential significance of impacts to the natural and built environment, including whether proposed improvements could impact factors such as traffic operations, circulation, parking, and encroachment on rights-of-way and private property with potential displacements. The recommendations will fall into one of the three NEPA classifications: a CE, EA, or EIS and one of three SEPA classifications: Categorical Exception, SEPA checklist, or EIS.

The project team will work with Metro staff to estimate the level of effort for NEPA and SEPA review depending on the classification determination. Review will depend on various factors, including the complexity of the proposed project, the potential environmental impacts, the level of agency coordination required, public involvement, and the specific requirements of the classification process.

Corridor Features: Transit Service, Capital, Operations

The RRPP will generally base assumptions and methods on the King County Metro RapidRide Standards and Implementation Guidance Report, which provides direction on design of RapidRide corridors as summarized below.

Figure 4 RapidRide Standards

	Minimum Standard	Desired Standard	Methodology for RRPP Planning
Service Levels			
Service Span	7 days per week 18 hours (6 a.m. to 12 a.m.)	7 days per week 24 hours	Assume desired standard
Service frequency	Peak: 10-minutes Off-Peak: 15-minutes Evening and Night: 30-minutes	Peak: 7.5 minutes Off-Peak: 10-minutes or better Evening: 15-minutes or better Night and Late Night: 30-minutes or better	Assume desired standard
Speed and Reliability			
Bus Lanes and HOV lanes	At least 40% of centerline route miles in transit only lanes or BAT lanes	At least 50% of centerline route miles in TOLS or BAT lanes	Meet minimum standard and aim to meet desired standard
Transit signal priority (TSP)	Transit signal priority should be applied to all signalized intersections with LOS D or E.	Transit signal priority should be applied to all signalized intersections with level of service (LOS) C, D, or E.	Meet minimum standard and aim to meet desired standard
Traffic control and roadway modifications	Implement features along RapidRide corridor where intersection delays are at LOS F and high-level channelization improvements and transit lane tools such as TOLs or BAT lanes are not viable.	Implement features along RapidRide corridor where intersection delays are at LOS D, E, or F and high-level channelization improvements such as TOLs or BAT lanes are not viable	Meet minimum standard and aim to meet desired standard
Travel time savings	NA	NA	Assume 20% goal for travel time savings. This can be achieved through bus lanes, TSP, in-lane stops, channelization and signal modifications.

	Minimum Standard	Desired Standard	Methodology for RRPP Planning
Stop spacing and location in the Right-of-Way			
Station Spacing	1/4-mile minimum spacing between stations (station-to-station distance, not average over the corridor), except where there are environmental constraints or when land use or density of form warrants. Closer station spacing may be appropriate on a case-by-case basis (e.g., dense areas or in order to facilitate access to key destinations or facilities).	1/3- to 1/2-mile spacing between stations in consistently built-up areas. 1/2- to 1-mile spacing between stations in locations meeting the following criteria: - Areas with sporadic, low-density, auto-oriented development - Where other service operates in the corridor to provide local access between more widely spaced RapidRide stations Spacing may be wider than the desired distance where the bus operates: - On a limited-access roadway - Where there are gaps in demand due to land use - Where topography or built form limit access to the corridor - Where there is other transit service that operates regularly throughout the day; underlying service should be every 30-minutes or better for 18 hours a day, 7 days a week	Meet minimum standard and aim to meet desired standard
Station location at intersections	Same as desired	Place RapidRide stations at the far side of intersections in most cases. The heads of far-side bus zones are set back from crosswalks at intersections by a minimum of 130 feet in order to accommodate two buses at a time. The rear of the bus zone should be 5 feet from the crosswalk	Meet minimum standard and aim to meet desired standard

Appendix A: Additional Detail on Study Intersections

Figure 5 List of Study Intersections by Corridor

Route #	Intersection ID	Street 1	Street2
Metro Connects ID 1012 – 27 Intersections			
44	101	NW Market St	Barnes Ave NW
44	102	17th Ave NW	NW Market St
44	103	15th Ave NW	NW Market St
44	104	14th Ave NW	NW Market St
44	105	8th Ave NW	NW Market St
44	106	3rd Ave NW	NW Market St
44	107	Phinney Ave N	N 46th St
44	108	Fremont Ave N	N 46th St
44	109	Greenlake Way N	N 46th St
44	110	Stone Way N	N 45th St
44	111	Densmore Ave N	N 45th St
44	112	Wallingford Ave N	N 45th St
44	113	Meridian Ave N	N 45th St
44	114	Thackeray Pl NE	NE 45th St
44	115	Latona Ave NE	NE 45th St
44	116	I-5 SB Ramp	NE 45th St
44	117	I-5 NB Ramp	NE 45th St
44	118	Roosevelt Way NE	NE 45th St
44	119	11th Ave NE	NE 45th St
44	120	12th Ave NE	NE 45th St
44	121	University Way NE	NE 43rd St
44	122	15th Ave NE	NE 43rd St
44	123	15th Ave NE	NE 42nd St
44	124	15th Ave NE	NE 41st St
44	125	15th Ave NE	NE Campus Pkwy
44	126	15th Ave NE	NE 40th St
44	127	15th Ave NE	NE Pacific St
Metro Connects ID 1049 – 19 intersections			
150	201	4th Ave S	Holgate St
150	202	4th Ave S	Lander St
150	203	4th Ave S	Spokane St

Route #	Intersection ID	Street 1	Street2
150	204	Interurban Ave S	I-405 Ramp
150	205	Interurban Av	Southcenter Blvd
150	206	66th Ave S	Southcenter Blvd
150	207	Southcenter Blvd	61st Ave S
150	208	Tukwila Pkwy	61st Ave S
150	209	Tukwila Pkwy	I-405 Ramp
150	210	Andover Park W	Tukwila Pkwy
150	211	Andover Park W	Strander Blvd
150	212	Andover Park W	Minkler Blvd
150	213	Andover Park W	S 180th St
150	214	Andover Park E	S 180th St
150	215	68th Ave S	S 212th St
150	216	68th Ave S	S 228th St
150	217	64th Ave S	S 228th St
150	218	Washington Ave	W James St
150	219	4th Ave N	W James St
Metro Connects ID 1052 – 9 intersections			
181	301	21st Ave SW	SW 336th St
181	302	21st Ave SW	SW 334th St
181	303	21st Ave SW	SW 320th St
181	304	1st Ave S	S 320th St
181	305	Pacific Hwy S	S 320th St
181	306	23rd Ave S	S 320th St
181	307	A St SW	2nd St SW
181	308	A St SE	2nd St SE
181	309	Auburn Way S	2nd St SE
Metro Connects ID 1056 – 9 intersections			
165	401	SR 99	SR 516
165	402	64th Ave S	W Meeker St
165	403	Washington Ave	W Meeker St
165	404	4th Ave N	W Smith St
165	405	Central Ave N	E Pioneer St
165	406	Central Ave N	Smith St
165	407	104th Ave SE	SE 256th St
165	408	108th Ave SE	Kent-Kangley Rd
165	409	132nd Ave Se	Kent-Kangley Rd

Route #	Intersection ID	Street 1	Street2
Metro Connects ID 1064 – 28 intersections			
49	501	15th Ave NE	NE Campus Pkwy
49	502	University Way NE	NE Campus Pkwy
49	503	Brooklyn Ave NE	NE Campus Pkwy
49	504	Broadway Ave E	E Mercer st
49	505	Broadway Ave E	E Republican St
49	506	Broadway Ave E	E Harrison St
49	507	Broadway Ave E	E Thomas St
49	508	Broadway Ave E	E Olive Way
49	509	Broadway Ave E	E Denny Way
49	510	Broadway Ave E	E Pike St
49	511	Broadway Ave E	E Union St
49	512	Broadway Ave	Madison St
49	513	Broadway Ave	Columbia St
49	514	Broadway Ave	Cherry St
49	515	Broadway Ave	James St
49	516	Broadway Ave	Jefferson St
49	517	Boren Ave	Broadway Ave
49	518	Boren Ave	Yesler Way
49	519	Boren Ave	12th Ave S
36	520	12th Ave S	S Jackson St
36	521	12th Ave S	S King St
36	522	12th Ave S	S Weller St
36	523	15th Ave S	Beacon Ave S
36	524	Beacon Ave S	S Hanford St
36	525	Beacon Ave S	S Spokane St
36	526	Beacon Ave S	S Columbian Way
36	527	Beacon Ave S	S Graham St
36	528	Beacon Ave S	S Myrtle St
Metro Connects ID 1993 – 33 intersections			
40	601	I-5 Express Ramps	NE 103rd St
40	602	5th Ave NE	NE 103rd St
40	603	5th Ave NE	NE Northgate Way
40	604	I-5 NB Ramp	NE Northgate Way
40	605	Corliss Ave NE	NE Northgate Way
40	606	Meridian Ave N	N Northgate Way

Route #	Intersection ID	Street 1	Street2
40	607	Aurora Ave N	N 105th St
40	608	Dayton Ave N	N 105th St
40	609	Greenwood Ave N	Holman Rd NW
40	610	15th Ave NW	Holman Rd NW
40	611	15th Ave NW	NW 85th St
40	612	24th Ave NW	NW 57th St
40	613	24th Ave NW	NW Market St
40	614	Ballard Ave NW	NW Market St
40	615	22nd Ave NW	NW Market St
40	616	NW Market St	Barnes Ave NW
40	617	17th Ave NW	NW Market St
40	618	15th Ave NW	NW Market St
40	619	15th Ave NW	NW Leary Way
40	620	14th Ave NW	NW Leary Way
40	621	Leary Way NW	NW 39th St
40	622	Phinney Ave N	N 36th St
40	623	Dayton Ave N	N 36th St
40	624	Fremont Ave N	N 35th St
40	625	Fremont Ave N	N 34th St
40	626	Dexter Ave N	Nickerson St
40	627	Westlake Ave	Highland Dr
40	628	Westlake Ave	Valley St
40	629	Westlake Ave	Mercer St
40	630	Westlake Ave N	Republican St
40	631	Westlake Ave	Harrison St
40	632	Boren Ave	Broadway Ave
40	633	Broadway Ave	Jefferson St
Metro Connects ID 1999 – 2 intersections			
226	701	145th Pl SE	SE 16th St
B-Line	702	156th Ave NE	NE 8th St
Metro Connects ID 3101+1028 – 15 intersections			
271	801	Univ Hospital Dr	NE Pacific St
271	802	Montlake Blvd NE	NE Pacific St
271	803	Montlake Blvd E	E Shelby St
271	804	Montlake Blvd E	E Hamlin St
271	805	Montlake Blvd E	E Lake Wash Blvd

Route #	Intersection ID	Street 1	Street2
271	806	Bellevue Way NE	NE 8th St
B-Line	807	108th Ave NE	NE 6th St
B-Line	808	110th Ave NE	NE 6th St
B-Line	809	112th Ave NE	NE 6th St
B-Line	810	112th Ave NE	NE 8th St
B-Line	811	116th Ave NE	NE 8th St
B-Line	812	120th Ave NE	NE 8th St
B-Line	813	140th Ave NE	NE 8th St
B-Line	814	148th Ave NE	NE 8th St
B-Line	815	156th Ave NE	NE 8th St

Study Intersection Maps

Figure 5 Route 44 Study Intersections

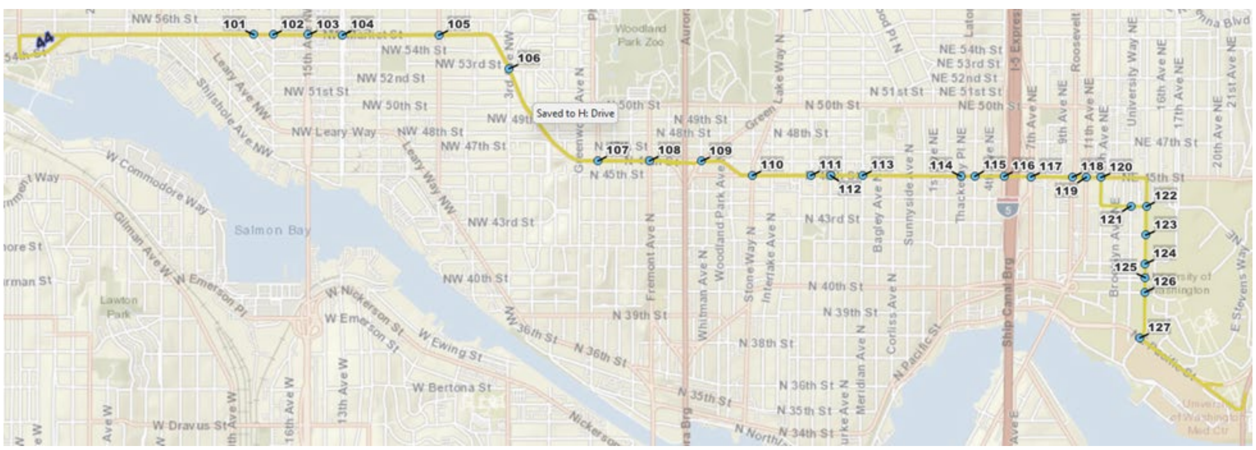

Figure 5 shows the map referenced above.

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Figure 6 Route 150 Study Intersections

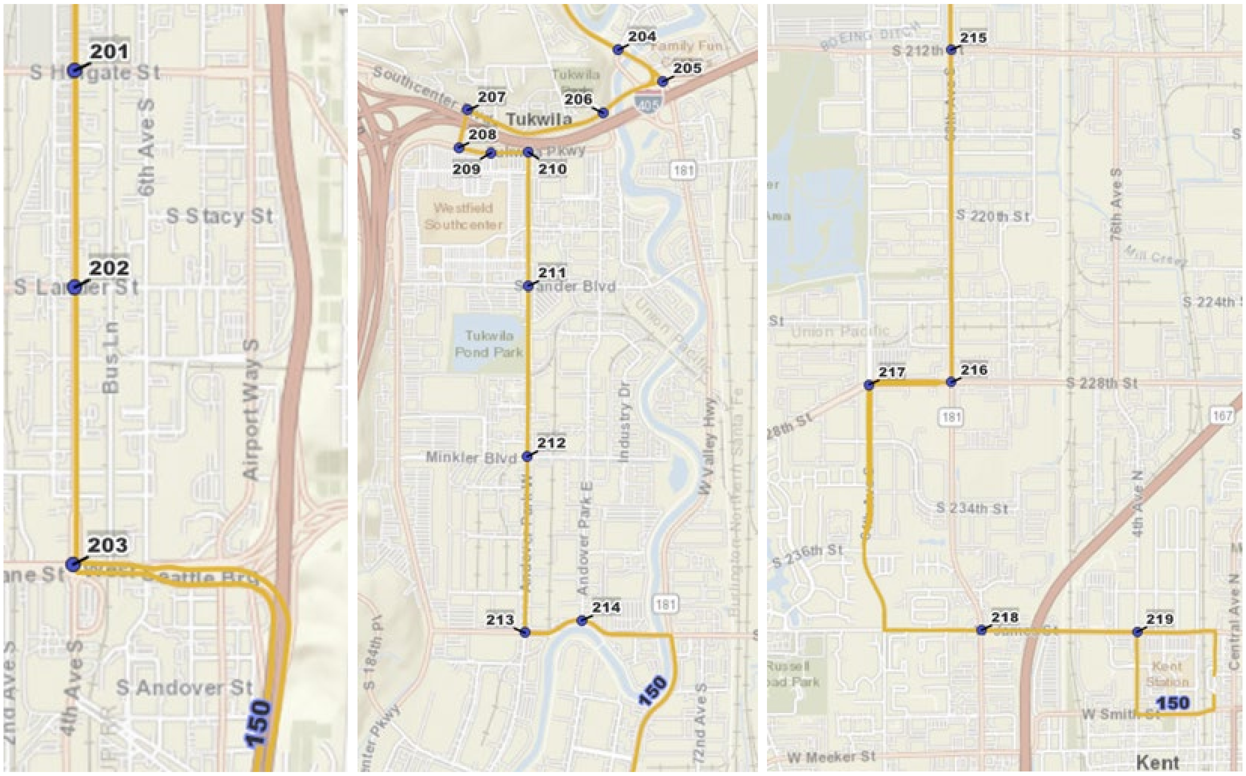

Figure 7 Route 181 Study Intersections

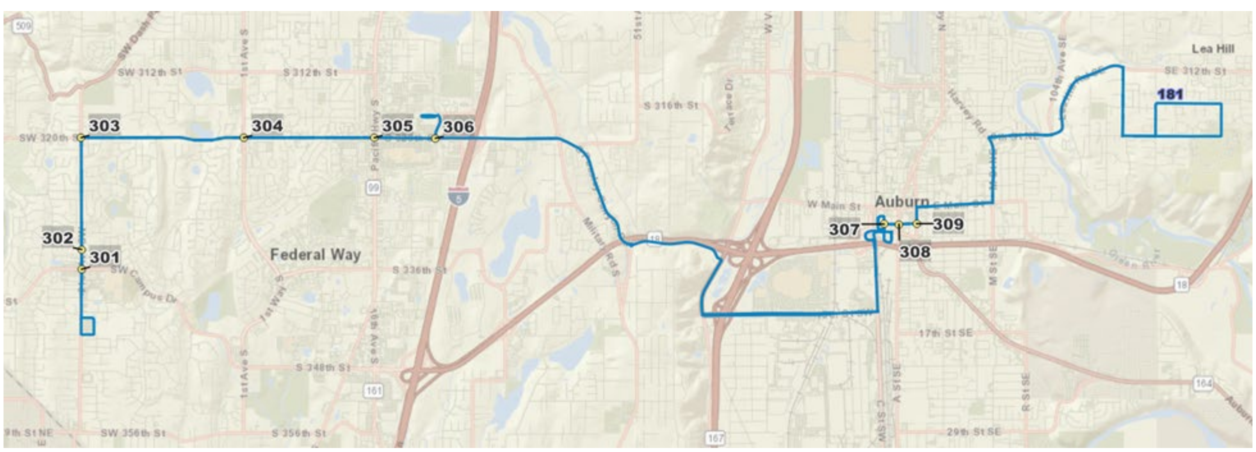

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Figure 8 Route 165 Study Intersections

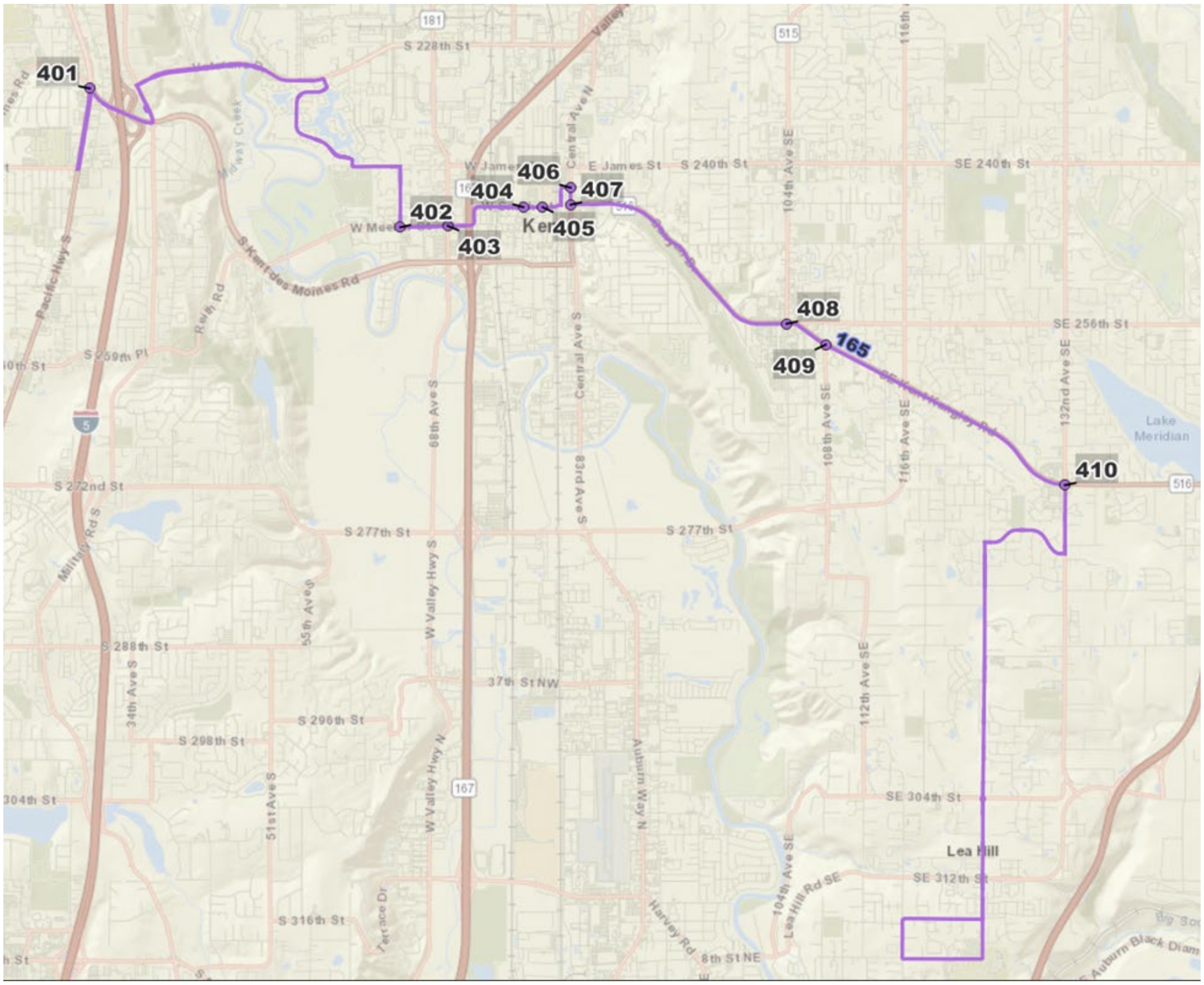

Figure 9 Route 36/49 Study Intersections

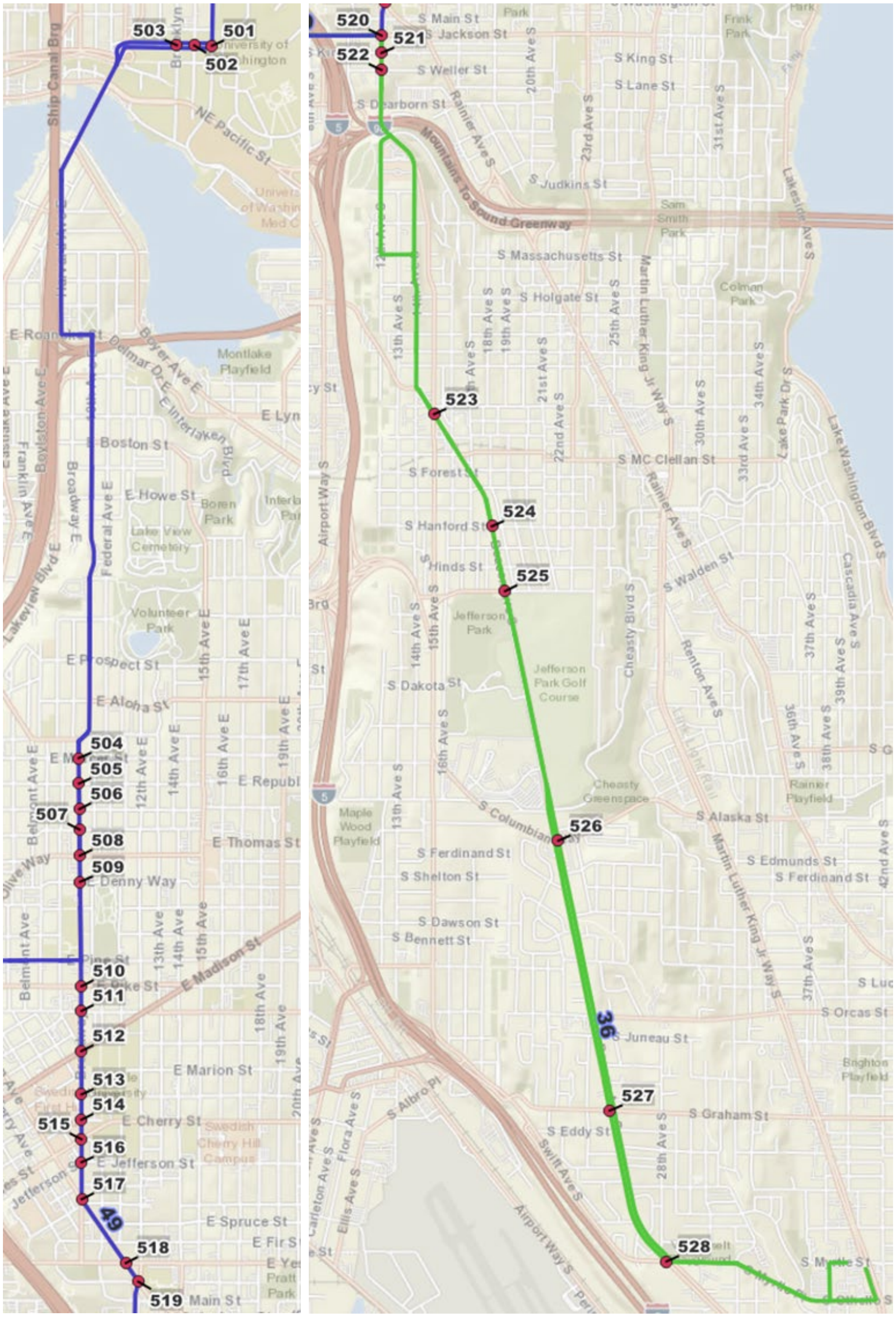

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Figure 10 Route 40 Study Intersections

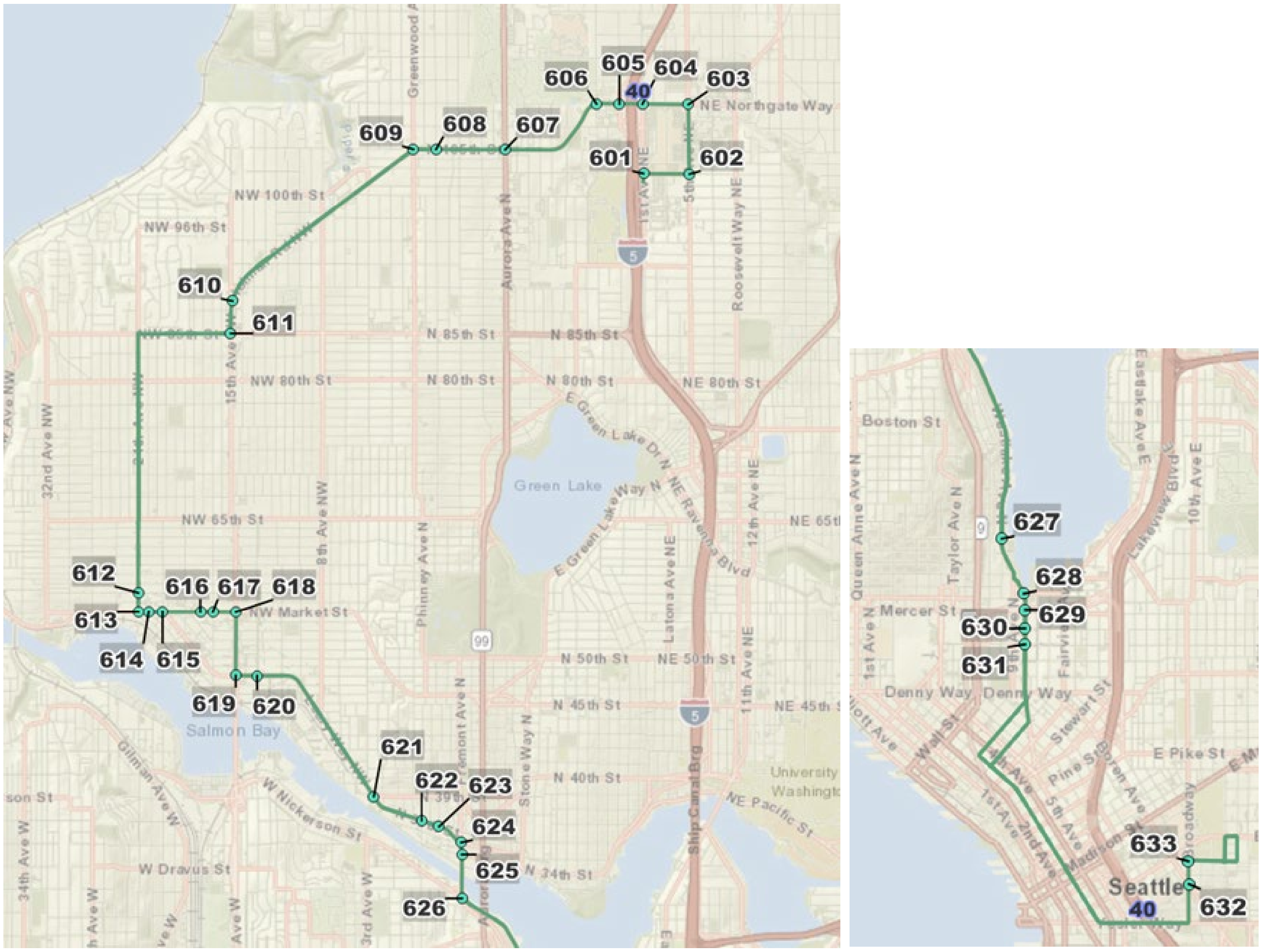

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Figure 11 B Line/Route 226 Study Intersections

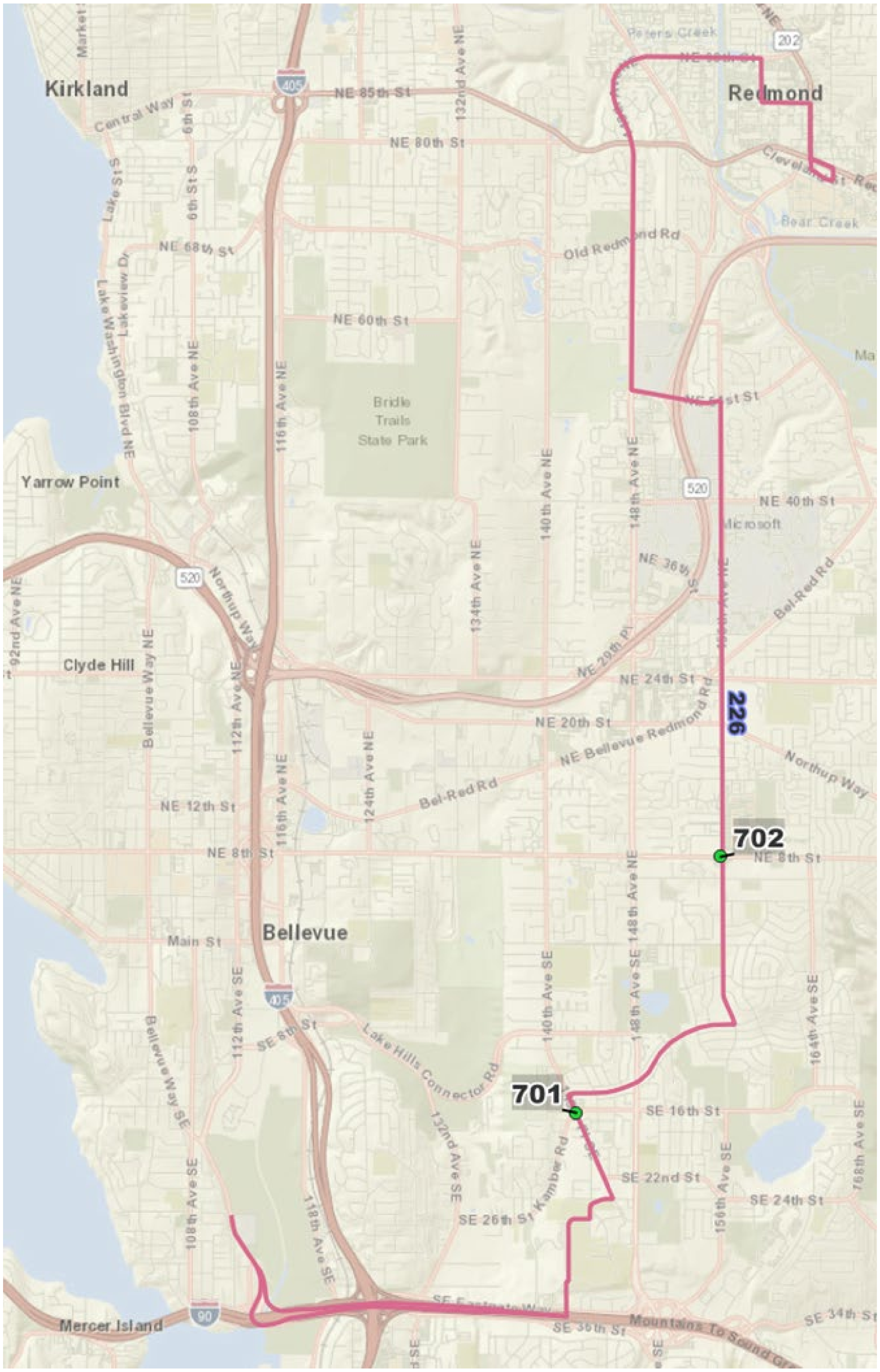

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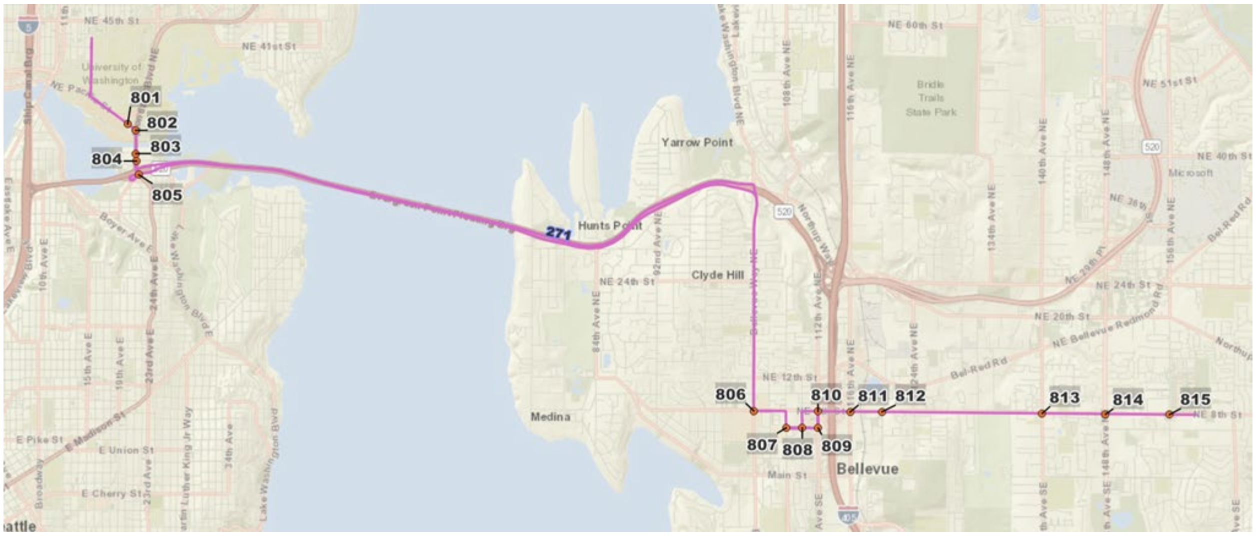
Figure 12 B Line/Route 271 Study Intersections



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