



Bus Base North

Technical Memorandum: Bus Base North Transportation Report

June 2020

Consultant Quality Control Form

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Acronyms and Abbreviations

BRT	bus rapid transit
ETL	express toll lane
HCM	Highway Capacity Manual
HSS	Highways of Statewide Significance
LOS	level-of-service
SR	State Route
ST	Sound Transit
WSDOT	Washington State Department of Transportation

1 INTRODUCTION

This technical memorandum documents the transportation analysis results and findings related to the proposed Bus Base North project. Also identified in this memorandum are potential project refinements (as needed) to facilitate bus rapid transit (BRT) travel between the I-405 Express Toll Lanes and Bus Base North. Key sections of this technical memorandum include the following (in sequential order):

- **Study Area and Analysis Scenarios:** Description of site selection and characteristics, BRT access and transportation analysis approach.
- **Existing Conditions (2019):** Review of existing data, new data collection and compilation (intersection turning movements for study area intersections). Assessment of existing multimodal transportation conditions (intersection traffic delays and level-of-service [LOS]). Review of existing bicycle and pedestrian network and volumes.
- **Future No Build Conditions:** Projections of future traffic and transit in the vicinity of the Bus Base North site for years 2024 and 2042 without the Bus Base North project. Analysis of future year 2024 and 2042 without the Bus Base North project.
- **Future Conditions with Project:** Projections of future traffic, transit, and site-related trip generation in the vicinity of the Bus Base North site for years 2024 and 2042 with the Bus Base North project. Analysis of future year 2024 and 2042 with the Bus Base North project.
- **Potential Mitigations (as needed):** Identification and development of transit mobility and access enhancements, as needed, for safe, effective, and reliable bus operations to/from Bus Base North.

2 PROJECT DESCRIPTION

2.1 Location

As identified in the *Sound Transit 3 (ST3) System Plan* (Sound Transit 2016), Sound Transit is planning for a new bus operations and maintenance facility, referred to as Bus Base North, to be located near the Interstate 405/State Route (SR) 522 corridors.

The proposed site for the Bus Base North project is on 20th Avenue SE, just east of SR 527 near the planned I-405 BRT service corridors in the Canyon Park area of Bothell, as shown in **Figure 2-1**.

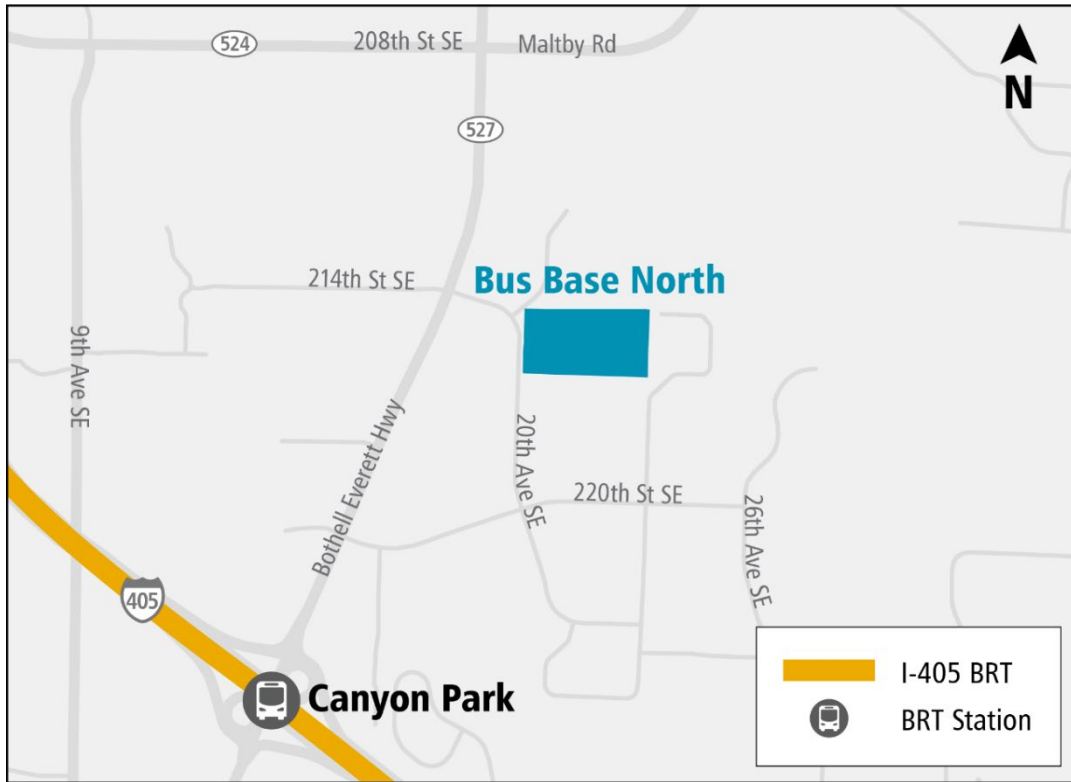


Figure 2-1 Bus Base North site

2.2 Bus Base North operations

2.2.1 Overview

Bus Base North would service and maintain vehicles across Sound Transit’s bus service lines, which includes BRT and ST Express bus. Sound Transit anticipates completion of Bus Base North at a date prior to the initiation of BRT service in 2024 to allow for accommodation of the BRT bus fleet.

Bus Base North would be a new bus operations and maintenance facility for the I-405 BRT Project. The planned proximity to the I-405 BRT corridor would minimize the amount of non-revenue¹ travel and the physical distance required for BRT vehicles to access the facility, thus reducing projected operating costs.

¹ Bus trips for repositioning fleet and which do not involve the transport of ticketed riders

Bus Base North would be ST’s first facility designed and built to operate and maintain BRT bus operations. The conceptual layout of the facility (shown in **Figure 2-2**) is designed to accommodate up to 80 articulated coaches to support BRT service and 40 double-decker hybrid diesel buses to serve ST Express service in the Snohomish County area. At Bus Base North, buses would be stored, maintained, fueled, and washed. The facility would also house offices for operations staff and support areas for drivers and operations staff. It is anticipated that Bus Base North would operate 24 hours a day, 7 days a week, in support of planned transit and BRT operations. ST currently anticipates that approximately 254 employees would operate from this new facility.



Figure 2-2 Bus Base North proposed ground-level plan

Two major transit functions for the BRT bus fleet would be operated from Bus Base North: transit operations with operational/fleet support services, and transit vehicle maintenance.

For operations, bus drivers would arrive and park their private vehicles in the proposed above-grade parking deck. They would report into the operations offices and receive assignments and instructions from dispatchers and then proceed to the bus parking area under the above-grade parking deck to perform pre-trip inspections before leaving for their route. When drivers return to the site, they would park their buses in designated bus parking areas under the above-grade parking deck and return to the operations offices where they would file any necessary reports, etc. At the end of their shift, drivers would then leave the operations area and pick up their personal vehicles from the parking deck and exit the site.

For maintenance, personnel would work three shifts to perform varied tasks seven days per week. The facility would house general maintenance, inspection, tire, brake, paint and body, parts distribution, detail clean, and other daily maintenance functions. Maintenance activities would be performed during all shifts. During the evening shift, personnel would primarily be servicing the vehicles through the fuel and wash cycle; however, during all shifts it is possible for any of the many different maintenance activities to be performed.

The greatest amount of intra-site traffic would occur in the evening between 6:00 PM and 1:00 a.m. During this time, service personnel would drive buses to be fueled/washed and into detail clean areas and maintenance areas for both scheduled and unscheduled maintenance activities if required.

2.2.2 Planned hours of operation

It is anticipated that Bus Base North would operate on a continuous schedule - 24 hours a day, 7 days a week. Projected bus and private vehicle trips associated with BBN are discussed in Section 6; however, in general transit operators and essential operations staff would arrive at the facility starting at approximately 4:00 a.m. by private vehicle in order to provide operators the necessary time for shift check-in and to perform a vehicle condition report prior to the morning pull. While detailed operating plans for the BRT routes have not been defined, when service begins in 2024 it is expected that BRT vehicles would begin to leave the facility by 4:30 a.m. to enter service at approximately 10-minute intervals, with the majority of the in-service fleet off the site by 7:00 a.m. Similarly, ST Express buses would begin leaving the facility around 4:30 a.m. and are conservatively estimated to also leave the facility at 10-minute intervals. Some buses would return to the site by 11:00 a.m. Later shifts have start and end times that are staggered throughout the day. To reflect a more intensive operating schedule by the 2042 horizon year, peak-period headways for BRT service were assumed to decrease from 10 to 7.5 minutes, slightly increasing the number of bus trips generated by the facility.

The PM peak period would likely show lower trip activity than the morning period. Operators would arrive at the facility by private vehicle at approximately 2:00 p.m. Buses would start to leave the facility by 2:30 p.m. at approximately 10-minute intervals with the majority of afternoon shift buses off the site by 4:00 p.m. It is likely, however, that p.m. shift changes would be staggered between the less frequent mid-day service and the PM peak.

Vehicle maintenance staff and support staff are assumed to work a traditional three-shift schedule with the majority arriving between 6:00 a.m. and 7:00 a.m. and departing between 3:00 p.m. and 4:00 p.m. The second shift (predominantly fleet maintenance staff) would likely extend from around 4:00 p.m. to midnight with the third shift starting approximately between 10:00 p.m. and midnight and ending sometime between 6:00 a.m. and 8:00 a.m.

2.3 Vehicular access to/from Bus Base North

2.3.1 Overview

All vehicles, including BRT buses, ST Express buses, employee vehicles, and vendor vehicles, would enter and exit the facility via two driveways on 20th Avenue SE at the southwest corner of the site (**Figure 2-3**). To safely accommodate the different types of traffic on the site, bus and personal vehicles would be separated on site as much as possible. In the proposed plan, there are separate site entrances for buses (south driveway) and personal vehicles (north driveway), thus personal vehicle traffic does not mix with bus traffic on the site.

Both bus and private vehicle access to and from the facility would require an alteration to the roadway median (raised curb) separating the northbound and southbound lanes of 20th Avenue SE. This would include removal of a short section of median curb near the employee/visitor entrance to allow left turns into and out of the facility. The median would also need to be shortened on the south end to allow bus ingress and egress.

The planned vehicle routes between Bus Base North and the transportation network are described below and illustrated in **Figure 2-4**. A direct access ramp connecting 17th Avenue SE to I-405 will be utilized by BRT buses.

2.3.2 Bus access to and from Bus Base North to I-405

Buses would depart and arrive through the bus entrance/exit drive at the southwest corner of the facility as shown on **Figure 2-4**. They would take a left turn as they exit the facility and travel south on 20th Avenue SE to 220th Street SE. They would head westbound on 220th Street SE and turn left to southbound 17th Avenue SE to connect with I-405 on the direct access ramp that the Washington State Department of Transportation (WSDOT) is building in the vicinity of 17th Avenue SE. It is anticipated that buses returning to the facility would follow the reverse pattern from the express toll lanes (ETL) direct access ramps (planned to be constructed by 2024) to Bus Base North. It is also possible that some buses, including some serving SR 522/NE 145th BRT, may use 220th Street SE and SR 527 to travel to and from I-405, in lieu of 17th Avenue SE and the ETL direct access ramps. A greater proportion of buses may also use 220th Street SE and SR 527 to travel to and from I-405 if warranted based on unexpected traffic conditions or if the I-405 facilities are not completed prior to the start of BRT service. In this scenario, buses would turn right as they exit the facility and travel west along 214th Street SE and turn left onto SR 527. Buses would then travel south along SR 527 through the intersection with 220th Street SE and then enter/exit I-405 at the general-purpose ramps with SR 527. Inbound buses would follow the same routing in the opposite direction. Results of this alternate routing are discussed in Chapter 6.

Private vehicle trips, including employee vehicles and vendor vehicles, are expected to arrive at the facility via 214th Street SE accessed from SR 527 as shown on **Figure 2-4**. The figure also shows the anticipated directional distribution of private vehicle traffic associated with Bus Base North based on existing travel patterns reflected in current traffic counts. It is possible that some of these trips could also arrive via 220th Street SE, but given the known existing congestion at the SR 527 and 220th Street SE intersection, vehicles accessing the facility during the peak hours are expected to use the less congested route via 214th Street SE. Vehicles using 214th Street SE would head southeast from SR 527 on 214th which turns into 20th Avenue SE adjacent to the facility. Employee and visitor vehicle traffic would enter the facility by turning left into the employee/visitor entrance. Private vehicle traffic would follow a reverse pattern(s) when leaving the facility.

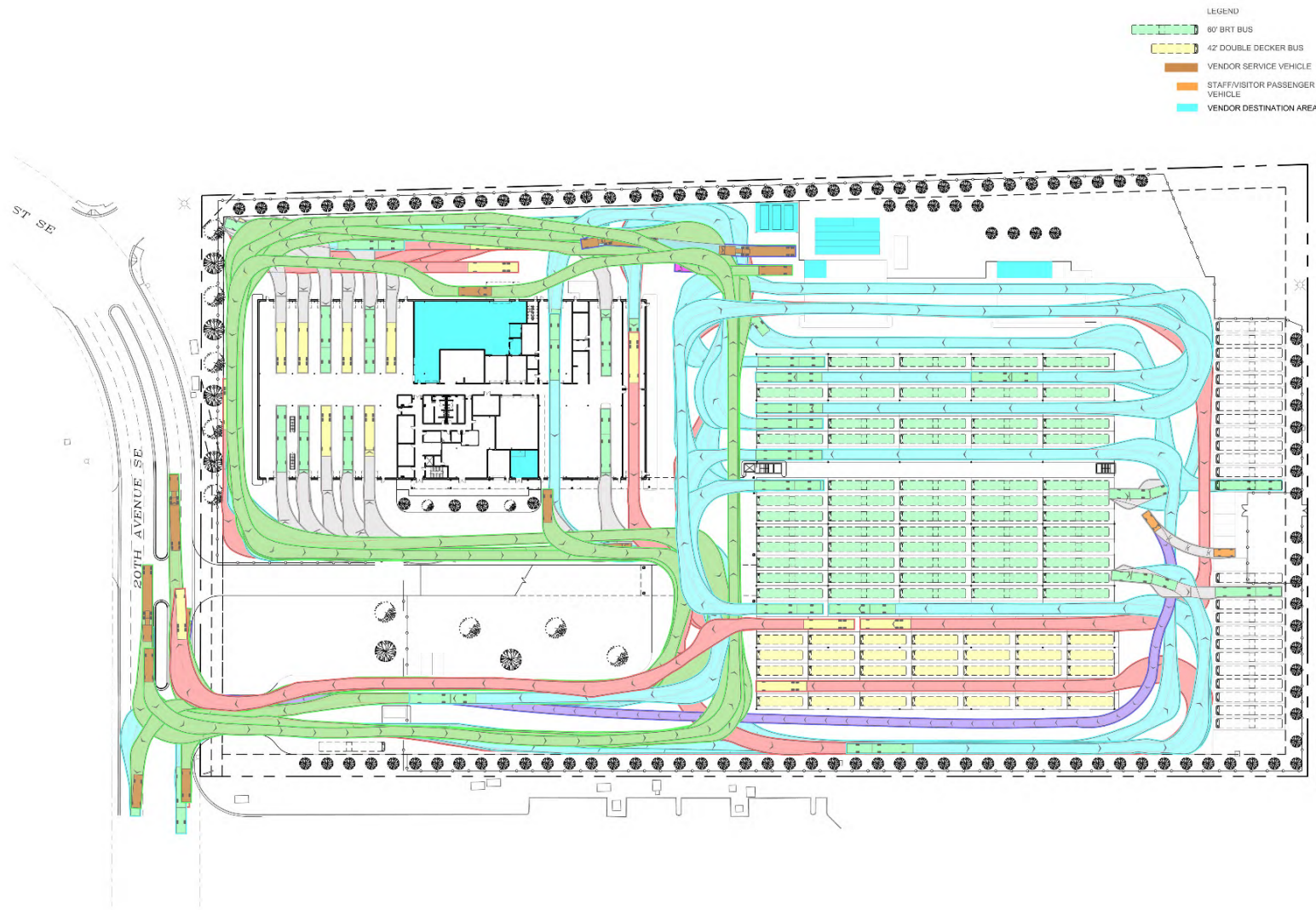


Figure 2-3 Site vehicle circulation plan

DRAWING NUMBER	SK-15
DRAWING TITLE	OVERALL VEHICLE TRAFFIC FLOW PLAN
WSP USA INC. 3000 PARK ROW HOUSTON, TEXAS 77064 PAX: (281) 765-5104	WSP
PROJECT TITLE	SOUND TRANSIT BUS OPERATIONS & MAINTENANCE FACILITY
PROJECT NO.	16028392
DRAWN BY	PMB
DATE	08/12/18
SCALE	2000' = 1" = 400' / 1" = 800'

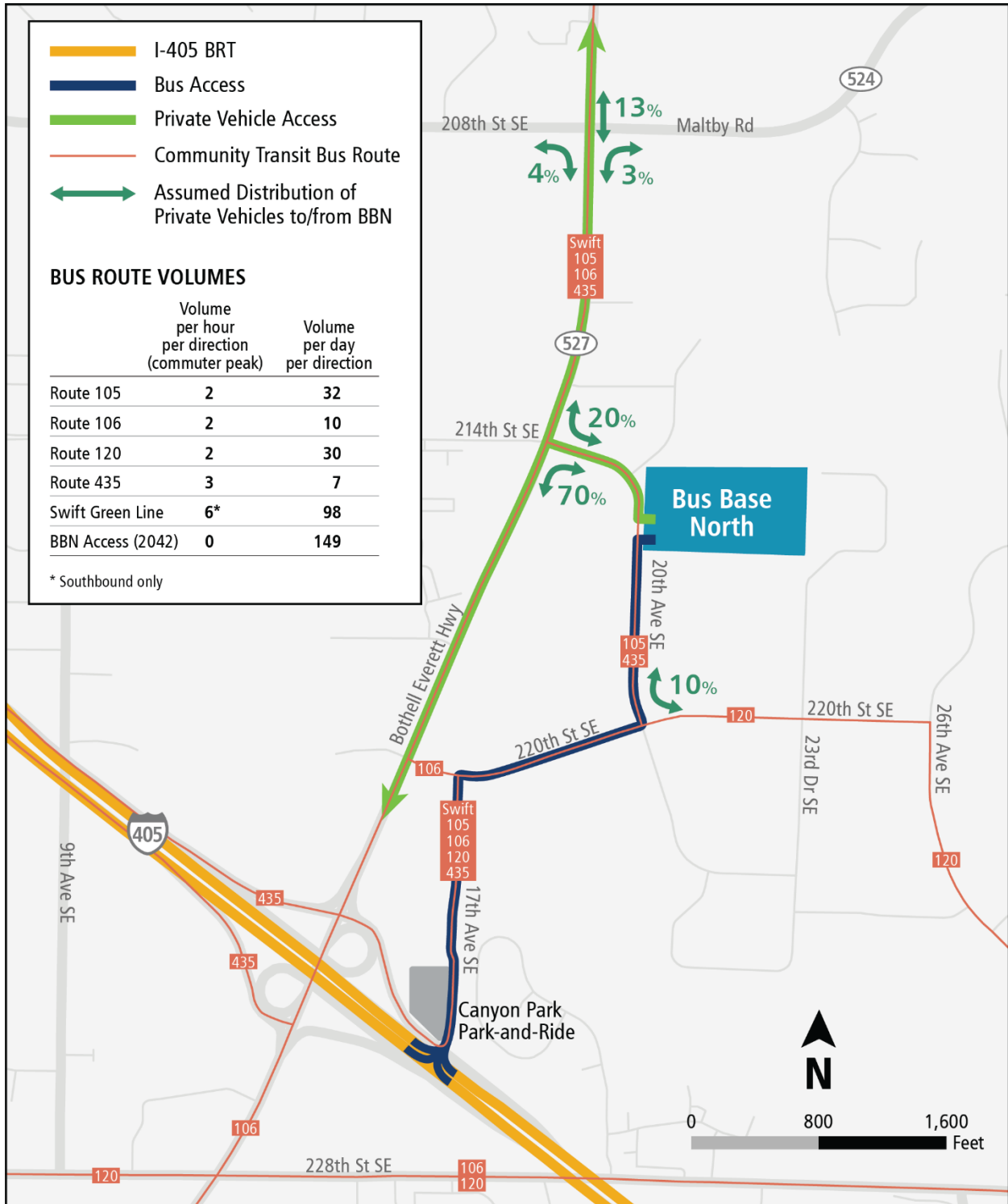


Figure 2-4 Proposed vehicle access between Bus Base North and I-405

3 REGULATORY CONTEXT

3.1 Level-of-service standards

LOS is a qualitative measure used to characterize traffic operating conditions. Six letter designations, A through F, are used to define LOS. LOS A designates the highest level-of-service and represents good traffic operations with no delay to motorists. LOS F is the lowest level-of-service and represents poor traffic operations with substantial delays.

The City of Bothell’s LOS is measured by delay across a defined “corridor” expressed in terms of average delay per vehicle in seconds experienced during an analysis hour. Overall, if a transportation facility’s operations are better than the LOS standard with the proposed project, then that corridor is considered to meet the city’s standard and does not require mitigation. The City of Bothell “corridor LOS” approach (City of Bothell, 2019) captures the average delay experienced by drivers over a length of roadway. The city evaluates traffic congestion at the corridor level, as measured by the volume-weighted average delay of vehicles at individual intersections. The City of Bothell’s standard is LOS E for corridors, meaning that if a project causes a corridor to fall below LOS E, then mitigation would be required to bring it back to LOS E or better.

WSDOT also has LOS standards for state routes. There are two designations: (1) Highways of Statewide Significance (HSS), and (2) non-HSS highways. SR 524 and SR 527 are identified as Tier 1 Non-HSS roadways, and WSDOT’s LOS standard for these facilities is “LOS E Mitigated.”

3.2 Requirements by jurisdictions

Jurisdictional LOS requirements within the study area are shown in **Table 3-1**.

Table 3-1 Level-of-service requirements by jurisdiction

Jurisdiction	Arterials and collectors	City center arterials	Non-city center arterials and non-state highways	Local streets (urban/rural)
City of Bothell	E (corridor-based LOS)	E (corridor-based LOS)	E (corridor-based LOS)	E (corridor-based LOS)
WSDOT	E Mitigated	N/A	N/A	N/A

SOURCE: Sound Transit 2019

NOTES: LOS = level-of-service; N/A = not applicable; WSDOT = Washington State Department of Transportation; “E Mitigated” means that congestion should be mitigated when PM peak-hour LOS falls below LOS E (Source WSDOT 2010)

4 METHODOLOGY

4.1 Traffic analysis

The traffic analysis for the Bus Base North project was performed based on the approach outlined in the *I-405 BRT Traffic Analysis Methodology and Assumptions Technical Memorandum* attached as **Appendix A**. This Methodology Memorandum was sent to all I-405 BRT Project interagency group members with the opportunity to review and comment.

The analysis utilized existing travel time data combined with intersection LOS analysis reflecting existing (2019), year of opening (2024), and long-range (2042) conditions. Synchro 10 software was used with *Highway Capacity Manual* (HCM) 2010 methodology. The 2024 horizon year reflects the year of opening for the I-405 BRT system, and 2042 corresponds to the approximate completion of all transit projects and elements included in the voter-approved ST3 program. Additionally, since the City of Bothell uses a corridor LOS standard on designated corridors, corridor LOS was calculated using intersection volumes and calculated delays to develop a peak-hour, volume-weighted average delay across intersections in the SR 527 corridor.

Some roadway improvements in the study area are expected to be in place when the BBN begins operations and are accounted for in the future No Build traffic analysis. These include the WSDOT direct access ramp to the I-405 ETL system (which will be accessed via 17th Avenue SE), reconstruction of 17th Avenue SE and its intersection with 220th Street SE, and channelization improvements on the 220th Street SE approach to SR 527.

4.2 Data sources

The existing condition was based upon 2019 traffic counts combined with LOS analysis for the roadways and study intersections. Future year study area traffic volumes for 2024 and 2042 without the Bus Base North are based on forecasts developed by the WSDOT I-405 Program team for the environmental documentation work being conducted for the North I-405 ETL Expansion Project. Peak-hour trip distribution from traffic generated by the Bus Base North facility is identified in Appendix B.

4.3 Other transportation characteristics

In addition to vehicular traffic, traffic safety, non-motorized facilities (pedestrian and bicycle), parking, freight mobility and access, and pavement conditions in the vicinity of the project site were qualitatively examined by reviewing documents and performing a desktop review and inventory of facilities in Google Earth to identify potential impacts of the BBN on these modes.

4.4 Transit

Existing transit route information and plans for new routes and changes in service were obtained from *METRO CONNECTS 2025* (King County Metro 2017), Community Transit, and Sound Transit. This task included compilation of information on routes that travel along SR 527 as well as on some roadways within the Canyon Park business park, as shown on **Figure 2-4**. Bus route information gathered included service areas and hours of service (including schedule/frequency).

4.5 Local, regional, and state transportation plans

Capital Improvement Programs and/or Transportation Facilities Plans, including planned and funded improvements in and around the Bus Base North area, were reviewed. This effort included identification of all committed improvements (programmed and funded) assumed for the No Build Alternative, including arterial projects and I-405 widening efforts for future ETLs and direct access ramp facilities.

5 AFFECTED ENVIRONMENT

This section presents a summary of existing conditions for the targeted study areas of the Bus Base North Project. Data collection activities within the study area to document the affected environment reflect existing conditions in 2019, unless otherwise noted.

5.1 Site characteristics

The Bus Base North site consists of a parcel totaling 12.5 acres with no existing structures present. The site is bordered to the south by two-story office and laboratory-type buildings and a driveway into those facilities.

The north side of the site is primarily bordered by the Northshore School District Transportation Center/City of Bothell shared vehicle maintenance facility. Details about the school bus operations include the following²:

- Currently 126 school buses operate out of the Northshore transportation center
- Buses all leave by 6:15 a.m.
- Buses all return at 9:30 a.m.
- Buses leave again at 1:45 p.m.
- Buses all return by 5:00 p.m.

On the west, the site is bordered primarily by 20th Avenue SE, a private street, and a parcel across 20th Avenue SE that is currently vacant. Along the northernmost approximately 450 feet of the site, the abutting land use is a vacant parcel not currently in ownership by Sound Transit. No other property boundaries abut an existing street.

² Based on phone conversation with Connie Noll, Northshore School District transportation manager

5.2 Transportation network

5.2.1 Roadway network

The Bus Base North site is located approximately 0.14 mile to the east of SR 527 with access to SR 527 via 214th Street SE, and approximately 0.7 mile to the north of I-405 with access via 214th Street SE and SR 527 for general-purpose traffic. Roadway access to the Bus Base North site from the east is indirect and limited.

SR 527 (Bothell-Everett Highway) has two full lanes in each direction, with painted bike lanes on the shoulder and sidewalks throughout the study area.

East of SR 527, 214th Street SE/20th Avenue SE is a median-separated roadway with two full lanes in each direction, and a narrow hard shoulder. 214th Street SE has sidewalks between SR 527 and 20th Avenue SE. 20th Avenue SE does not have continuous sidewalks, although the North Creek Trail, a multi-use path, runs along the west side of the street between 220th Street SE and 214th Street SE. West of SR 527, 214th Street SE is a local street with one lane in each direction, no bicycle lanes, and a 100-foot-long sidewalk on the south side of the approach to SR 527.

17th Avenue SE has one lane in each direction, no median, limited hard shoulder, and no sidewalks. 17th Avenue SE becomes one-way (southbound) and transit-only as it leaves the Canyon Park Park-and-Ride facility and provides direct connection for buses to I-405/SR 527 North.

SR 524 (208th Street SE west of SR 527, Maltby Road east of SR 527) is an urban arterial with two full lanes in each direction and a center-turn lane. The roadway has a narrow (approximately 4-foot) shoulder with a short (70-foot) bike lane for the eastbound approach to the intersection with SR 527. There are continuous sidewalks along SR 524 within the study area.

5.2.2 Study intersections

As described in **Appendix A**, the study area for this traffic analysis was developed to include intersections where traffic generated by Bus Base North would be most concentrated. The eight study intersections, five of which are WSDOT intersections located along SR 527, are shown in **Figure 5-1**, and are all located in Bothell. They are as follows:

- SR 527 and 208th Street SE/ Maltby Road (intersection ID #1)
- SR 527 and 214th Street SE (ID #2)
- 214th Street SE and 20th Avenue SE (ID #3)
- SR 527 and 220th Street SE (ID #4)
- SR 527 and I-405 Northbound Ramps (ID #5)
- SR 527 and I-405 Southbound Ramps (ID #6)
- 17th Avenue SE and 220th Street SE (ID #17)
- 20th Avenue SE and 220th Street SE (ID #20)



Figure 5-1 Location of study intersections

The intersection ID numbers were developed at the corridor wide level for the complete I-405 BRT Project, as documented in the *I-405 BRT Traffic Analysis Methodology and Assumptions Technical Memorandum* (Sound Transit 2020).

The city identifies seven major corridors to evaluate for corridor LOS operations (City of Bothell, 2019). These were selected because they represent the city’s key principal and minor arterials that run along primarily high-density/commercial corridors. One of these corridors—the SR 527 Corridor between SR 524 and SR 522 as shown in **Figure 5-2**—runs through the Canyon Park Subarea and was analyzed for the Bus Base North project for AM and PM peak-hour LOS.

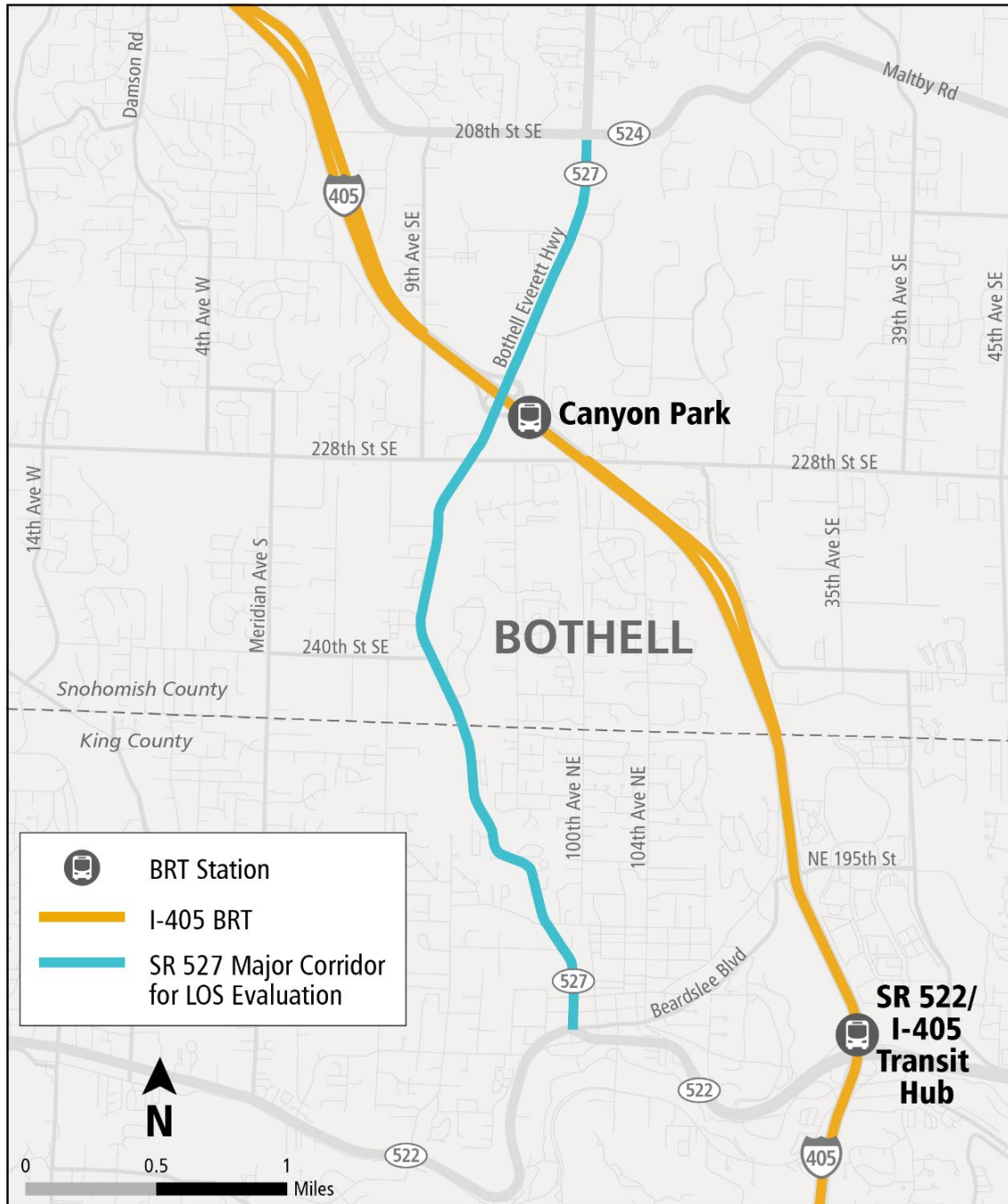


Figure 5-2 SR 527 Corridor

5.3 Traffic analysis

Turning-movement counts for AM and PM peak periods were conducted in June and July of 2019 at each of the study intersections to establish existing conditions. Counts included movements by articulated trucks as well as light and medium class vehicles, bicycles, and pedestrians. The complete turning-movement counts are included in Appendix B. Based on these counts, it was determined that the AM peak hour for the BBN study area occurs from 7:45 a.m. to 8:45 p.m.; and the PM peak hour occurs between 4:30 and 5:30 p.m.

Year 2019 average delay and intersection LOS were determined at each of the study intersections for the AM and PM peak hours. The results of this intersection analysis are shown in **Table 5-1**. For detailed movement delay, average queue, and 95th percentile queue, see Appendix B.

Table 5-1 Average intersection level-of-service, existing conditions 2019

ID	Intersection	Average delay AM	Average LOS AM	Average delay PM	Average LOS PM
1	SR 527 and 208th Street SE/ Maltby Road	69	E	48	D
2	SR 527 and 214th Street SE	22	C	59	E
3	214th Street SE and 20th Avenue SE (unsignalized)	2	A	2	A
4	SR 527 and 220th Street SE	29	C	61	E
5	SR 527 and I-405 Northbound Ramps (WSDOT)	7	A	13	B
6	SR 527 and I-405 Southbound Ramps (WSDOT)	11	B	7	A
17	17th Avenue SE and 220th Street SE	18	B	22	C
20	20th Avenue SE and 220th Street SE (unsignalized)	40	E	66	F

SOURCE: I-405 BRT Project, 2019
 NOTES: LOS = level-of-service

The traffic analysis demonstrates various existing LOS at the study intersections ranging from A to F, with LOS F being experienced at the unsignalized intersection of 20th Avenue SE and 220th Street SE. The average intersection delay ranges between a high value of 66 seconds during the PM peak period at 20th Avenue SE and 220th Street SE and a low value of approximately 2 seconds during the PM peak period at 214th Street SE and 20th Avenue SE.

Except for 20th Avenue SE and 220th Street SE, all intersections analyzed meet the LOS standards required by WSDOT and the City of Bothell.

In order to be consistent with the City of Bothell’s traffic impact analysis procedures, Corridor LOS was also calculated for SR 527, as shown in **Table 5-2**. SR 527 is estimated to be at a corridor LOS D in the PM peak hour, which currently meets the City of Bothell’s corridor LOS standard.

Table 5-2 SR 527 corridor PM level-of-service, existing conditions 2019

Intersection	Traffic Control	Existing Conditions		
		TEV	LOS	Delay
SR 527/Bothell-Everett Highway/Bothell Way NE Corridor: Between SR 524 and SR 522				
1. SR 527/208th Street SE	Signal	5,005	D	48
2. SR 527/214th Street SE	Signal	3,455	E	59
3. SR 527/220th Street SE	Signal	4,270	E	61
4. SR 527/I-405 Northbound Ramp	Signal	5,025	B	13
5. SR 527/I-405 Southbound Ramp	Signal	4,700	A	7
6. Bothell-Everett Hwy/228th Street SE	Signal	5,195	E	66
7. Bothell-Everett Hwy/240th Street SE	Signal	2,115	C	24
8. Bothell Way NE/NE 190th Street	Signal	2,095	C	23
9. Bothell Way NE/NE 185th Street	Signal	1,705	B	14
10. Bothell Way NE/NE 183rd Street	Signal	1,385	A	8
11. Bothell Way NE/Main Street	Signal	1,430	B	11
12. Bothell Way NE/SR 522 (Woodinville Dr)	Signal	4,010	D	36
Weighted Average Delay Along Corridor			D	36

SOURCE: Sound Transit 2020

NOTES: LOS = level-of-service, TEV = total entering vehicles

5.4 Vehicle crash summary

Vehicle crash data were provided by WSDOT for the study area intersections and roadway segments for a five-year period (2014 through 2018). **Figure 5-3** shows the location and types of vehicle crashes along SR 527, 20th Avenue SE, 214th Street SE and 220th Street SE in the vicinity of the Bus Base North site. Vehicle crashes were categorized by year, type, and direction and compiled in Appendix C. Particularly high concentrations of crashes are shown on the approaches to and at the intersection of SR 527 and 208th Street SE/Maltby Road, as well as along SR 527 both north and south of 220th Street SE. Crashes on roads within the business park are relatively few in number.

Canyon Park Crash Map - Collision Type & Crash Severity

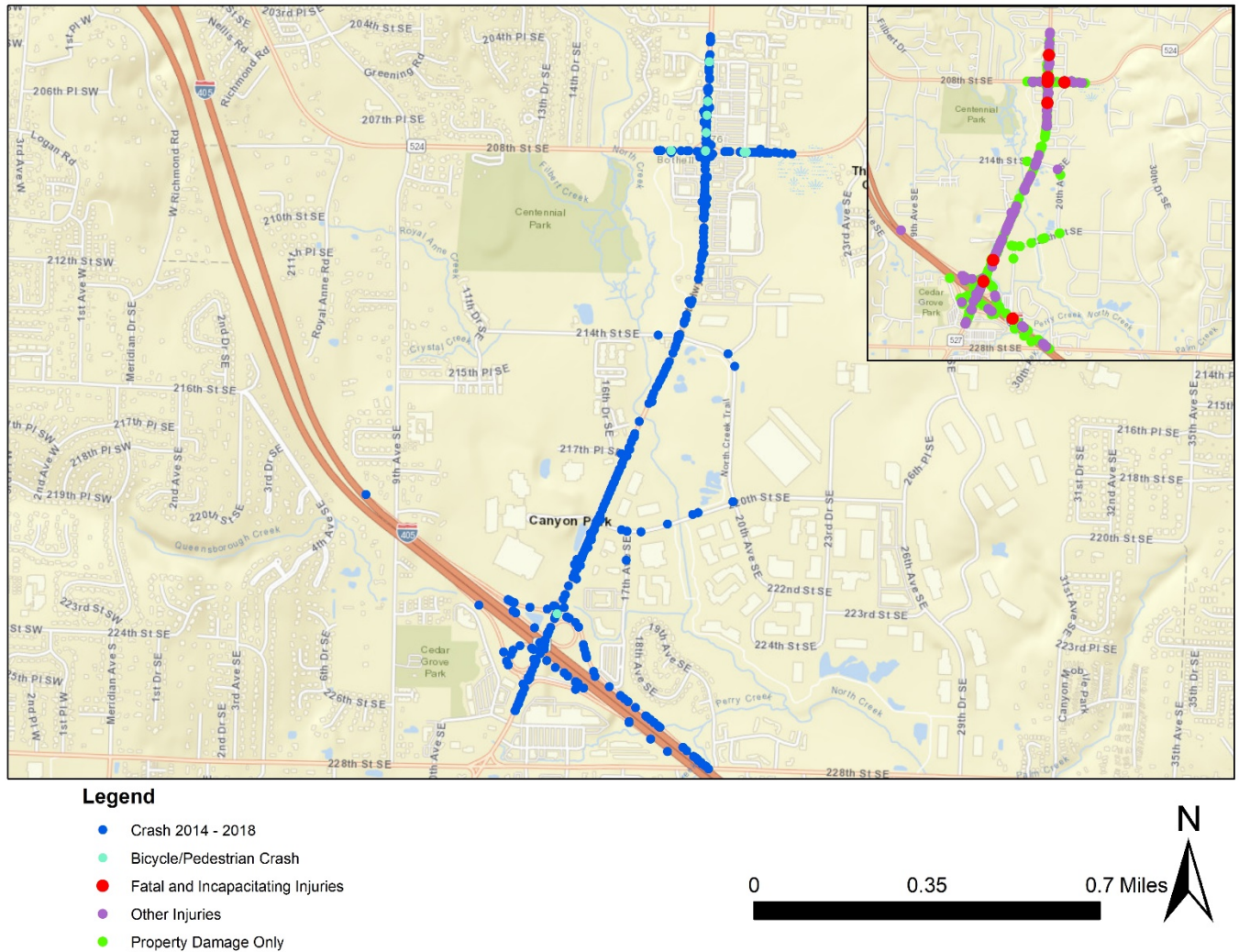


Figure 5-3 Vehicle crashes in the Study Area, 2014-2018

The vehicle crash summary indicates a large proportion of rear-end crashes (59 percent), which is typical of highly congested roadway segments, especially during peak weekday traffic periods. With no project-related changes to the roadway, and forecasted low project generated traffic volume, there would not be any expected changes to existing roadway safety within the study area. The other common types of crashes in the area are entering at an angle (16 percent) and sideswipe (12 percent). For detailed crash tables by roadway segment, see Appendix C.

5.5 Transit service

Scheduled ST Express bus operations do not currently utilize the study area intersections. Community Transit currently has four bus routes that use study area intersections along SR 527: Swift Green Line (six buses per direction per hour), Route 105 (two buses per direction per hour), Route 106 (two buses per direction per hour), and Route 435 (three buses per direction per hour). These routes are shown on **Figure 2-4**. As discussed in Section 5.1, the Northshore School District Transportation Center/City of Bothell shared vehicle maintenance facility is just north of the BBN site. The school buses accommodated at this facility access it from SR 527 via 214th Street SE per agreement with the Canyon Park Business Center. Thus, under expected operations where BRT vehicles access I-405 via 20th Avenue SE, 220th Street SE, and 17th Avenue SE to the planned ETL direct access ramps, they would not travel on the same roadways.

5.6 Non-motorized facilities

The number of pedestrians and bicycles in crosswalks at each of the six study intersections were collected during the AM and PM peak periods. Details of these counts are included in Appendix B.

Several of the crosswalks in the study area were not utilized by bicycles or pedestrians during the peak hours. The SR 527 and 220th Street SE intersection experienced zero bicycles or pedestrians in any of its crosswalks during the PM peak hour.

The highest bicycle-pedestrian utilization among the study area intersections occurred at SR 527 and 208th Street SE/Maltby Road with 66 total crossings in the PM peak hour.

The North Creek Trail also runs through the study area along portions of 220th Street SE, 20th Avenue SE, and 214th Street SE. This trail is a multi-use paved regional trail facility that ultimately connects south to the Burke Gilman Trail, and north to a terminus at Maltby Road.

6 TRANSPORTATION NETWORK IMPACTS

6.1 Traffic generation

Based on assumed operations of Bus Base North as described in Chapter 2, trips generated by the project were estimated. For trip generation rates, guidance from the Institute of Transportation Engineers favors the use of local data over published rates, particularly when published rates are not available for a given use (such as in this case). Hence, trip generation was developed based on assumed operations of the bus base, taking into account the expected number of employees at the base, the number and timing of maintenance staff work shifts, the number of buses to be accommodated at the facility, and the expected deployment of those buses. Details of the bus base operations are contained in Section 2.2. **Table 6-1** and **Table 6-2** show estimated hourly trips generated for the morning and afternoon peak periods by trip type for years 2024 and 2042, respectively. Also, indicated in the two tables are the current AM and PM commuter peak hours for the Canyon Park Subarea, as indicated by traffic counts collected for area intersections and identified in Section 5.3. As shown in the tables, very few trips associated with Bus Base North are expected to occur during the normal commuter peak hour for the subarea.

It is anticipated that buses housed at the facility would access revenue service routes via I-405. The planned outbound route for buses between Bus Base North and I-405 is expected to be south from the facility via 20th Avenue SE, west along 220th Street SE, and then south on 17th Avenue SE to the Canyon Park Park-and-Ride lot and the proposed direct access ramp into the ETLs. The inbound route for BRT buses (return trip to base) would be the reverse of the outbound route.

Operation of Bus Base North would generate traffic movements along the routes illustrated in **Figure 2-4**. The volume of trips to be generated by the facility was estimated for the AM and PM peak hours and for a full day. These estimates are shown by trip type in **Table 6-3** and **Table 6-4** for years 2024 and 2042, respectively. Trips generated by Bus Base North during peak hours would be very limited due to the nature of bus operations schedules. Peak-hour trips starting at 7:45 a.m. (15 trips entering and 5 exiting for both 2024 and 2042) and 4:30 p.m. (20 trips entering and 15 exiting for both 2024 and 2042), were used in the traffic analysis to assess potential peak-hour traffic impacts.

The site-generated volumes identified in **Table 6-3** and **Table 6-4** were distributed based on the percentages and pathways highlighted in **Figure 2-4** and added to the traffic volumes provided by WSDOT for 2024 and 2042, respectively, to determine the total traffic volumes for the 2024 and 2042 "With Project" condition. Detailed distribution of the BBN-related peak-hour trips are contained in Appendix B. Of the estimated 610 trips entering/exiting the site daily in 2024 and 808 trips entering/exiting the site daily in 2042, approximately 30 percent would be buses, with the remaining trips being generated by passenger vehicles (maintenance or driver employees).

Table 6-1 Bus Base North estimated peak traffic generation by time of day (2024)

Hour starting		Entering							Exiting						
		Buses			Private vehicles				Buses			Private vehicles			
		BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total	BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total
Morning	3:30			0	36			36			0				0
	4:30			0	26			26	18	18	36		15		15
	5:30			0	3	36		39	12	14	26				0
	6:30			0		30		30	3		3				0
	7:30			0		10	5	15			0			5	5
	8:30			0	5			5			0				0
	9:30			0				0	5		5				0
	10:30			0				0			0				0
	11:30	17	16	33				0			0			5	5

Hour starting		Entering							Exiting						
		Buses			Private vehicles				Buses			Private vehicles			
		BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total	BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total
Afternoon/Evening	12:30	16	16	32			5	5			0			5	5
	1:30			0	32		5	37			0	36			36
	2:30	5		5				0	16	16	32	29	36		65
	3:30			0			5	5			0	5	30	5	40
	4:30			0		15	5	20			0		10	5	15
	5:30			0				0			0				0
	6:30			0				0			0				0
	7:30			0			5	5			0			5	5
	8:30			0			5	5			0			5	5
	9:30			0				0			0				0
	10:30			0				0			0				0
	11:30	16	16	32		15		15			0				0
12:30			0				0			0	32	15		47	

Subarea AM peak hour

Subarea PM peak hour

SOURCE: Sound Transit 2020

NOTE: BRT = bus rapid transit

Table 6-2 Bus Base North estimated peak traffic generation by time of day (2042)

Hour starting		Entering							Exiting						
		Buses			Private vehicles				Buses			Private vehicles			
		BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total	BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total
Morning	3:30			0	54			54			0				0
	4:30			0	38			38	36	18	54		15		15
	5:30			0	4	36		40	24	14	38				0
	6:30			0		30		30	4		4				0
	7:30			0		10	5	15			0			5	5
	8:30			0	5			5			0				0
	9:30			0				0	5		5				0
	10:30			0				0			0				0
11:30	32	16	48				0			0			5	5	

Hour starting		Entering							Exiting						
		Buses			Private vehicles				Buses			Private vehicles			
		BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total	BRT	ST Express	Total	Coach operators	Base employees	Misc. (deliveries/vendors/visitors)	Total
Afternoon/Evening	12:30	32	16	48			5	5			0			5	5
	1:30			0	48		5	53			0	54			54
	2:30	5		5				0	32	16	48	42	36		78
	3:30			0			5	5			0	5	30	5	40
	4:30			0		15	5	20			0		10	5	15
	5:30			0				0			0				0
	6:30			0				0			0				0
	7:30			0			5	5			0			5	5
	8:30			0			5	5			0			5	5
	9:30			0				0			0				0
	10:30			0				0			0				0
	11:30	32	16	48		15		15			0				0
12:30			0				0			0	48	15		63	

Subarea AM peak hour

Subarea PM peak hour

SOURCE: Sound Transit 2020
 NOTE: BRT = bus rapid transit

Table 6-3 Bus Base North estimated traffic generation daily totals (2024)

Vehicle type	One-way trips entering	One-way trips exiting
AM Peak*		
Maintenance base employees	10	0
Coach operators	0	0
BRT coaches	0	0
Miscellaneous trip activity	5	5
Totals	15	5
PM Peak*		
Maintenance base employees	15	10
Coach operators	0	0
Buses	0	0
Miscellaneous trip activity	5	5
Totals	20	15
Daily		
Maintenance base employees	91	91
Coach operators	102	102
Buses	102	102
Miscellaneous trip activity	10	10
Totals	305	305

SOURCE: Sound Transit 2020

NOTE: BRT = bus rapid transit

* Represents the highest volume peak hour for each particular category of trip, which for most trip types does not coincide with the commuter peak hour for the Canyon Park Subarea. See **Table 6-1** for estimates of actual time of day occurrence.

Table 6-4 Bus Base North estimated traffic generation daily totals (2042)

Vehicle type	One-way trips entering	One-way trips exiting
AM Peak Hour*		
Maintenance base employees	10	0
Coach operators	0	0
BRT coaches	0	0
Miscellaneous trip activity	5	5
Totals	15	5
PM Peak Hour*		
Maintenance base employees	15	10
Coach operators	0	0
BRT coaches	0	0
Miscellaneous trip activity	5	5
Totals	20	15
Daily		
Maintenance base employees	91	91
Coach operators	149	149
BRT coaches	149	149
Miscellaneous trip activity	15	15
Totals	404	404

SOURCE: Sound Transit 2020

NOTE: BRT = bus rapid transit

* Represents the highest volume peak hour for each particular category of trip, which for most trip types does not coincide with the commuter peak hour for the Canyon Park Subarea. See **Table 6-2** for estimates of actual time of day occurrence.

6.2 Traffic analysis

For comparison purposes, the City of Bothell considers an adverse impact to occur when the corridor LOS for the Build condition would be LOS E or below. For the purposes of this State Environmental Policy Act analysis, an adverse impact is also identified when project traffic causes operations at an intersection to fall to LOS E or below. However, in cases where the No Build condition would already be at LOS E or below—for both an intersection or a corridor—an adverse impact would be defined by an increase in facility delay of more than 15 seconds as documented in the *Traffic Analysis Methodology and Assumptions Technical Memorandum* prepared for the I-405 BRT Project (Sound Transit 2020). The following results show no adverse intersection or corridor LOS impacts.

6.2.1 2024 No Build vs. Build (with Project) Conditions

The analysis considered a near-term year of opening horizon (2024) and utilized forecasted traffic volumes for 2024 developed by the WSDOT I-405 Program team (see Section 4.2, Data Sources). No Build conditions capture anticipated traffic levels and travel conditions without the Bus Base North project, accounting for traffic growth resulting from development growth unrelated to the project, while Build conditions capture these conditions with estimated traffic generated by the facility added to them.

Average delay and intersection LOS were determined at each of the study area intersections for the AM and PM peak hour. Average delay and levels-of-service results by study area intersection for the 2024 Build and No Build conditions are compared in **Table 6-5**. A comparison of 2024 No Build and Build corridor LOS results is shown in **Table 6-6** for the four roadway segments analyzed. LOS E is the performance standard for all intersections and corridors within the study area.

**Table 6-5 Intersection level-of-service, 2024 AM/PM Peak Hour
No Build vs. Build**

ID	Intersection	AM Peak				PM Peak			
		2024 No Build		2024 Build		2024 No Build		2024 Build	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
1	SR 527 and 208th St SE/Maltby Rd (WSDOT)	80	F	80	F	86	F	86	F
2	SR 527 and 214th St SE (WSDOT)	25	C	25	C	34	D	34	C
3	214th St SE and 20th Ave SE	2	A	2	A	2	A	2	A
4	SR 527 and 220th St SE (WSDOT)	37	D	37	D	54	D	54	D
5	SR 527 and I-405 Northbound Ramps (WSDOT)	8	A	8	A	33	C	33	C
6	SR 527 and I-405 Southbound Ramps (WSDOT)	11	B	11	B	9	A	9	A
17	17th Avenue SE and 220th Street SE	12	B	12	B	22	C	22	C
20	20th Avenue SE and 220th Street SE	52	F	52	F	145	F	145	F

SOURCE: Sound Transit 2020

NOTE: LOS = level-of-service; WSDOT = Washington State Department of Transportation

Table 6-6 Corridor level-of-service, 2024 AM/PM Peak Hour No Build vs. Build

Corridor Intersection	Traffic Control	2024 Without Project			2024 With Project		
		TEV	LOS	Delay	TEV	LOS	Delay
SR 527/Bothell-Everett Highway/Bothell Way NE between SR 524 and SR 522							
1. SR 527/208th Street SE	Signal	6,500	F	86	6,510	F	86
2. SR 527/214th Street SE	Signal	4,480	C	34	4,515	C	34
3. SR 527/220th Street SE	Signal	5,670	D	54	5,700	D	54
4. SR 527/I-405 Northbound Ramp	Signal	5,350	C	33	5,365	C	33
5. SR 527/I-405 Southbound Ramp	Signal	5,170	A	9	5,180	A	9
6. Bothell-Everett Hwy/228th Street SE	Signal	6,125	E	67	6,130	E	67
7. Bothell-Everett Hwy/240th Street SE	Signal	2,635	D	37	2,635	D	37
8. Bothell Way NE/NE 190th Street	Signal	2,750	D	53	2,750	D	53
9. Bothell Way NE/NE 185th Street	Signal	2,490	C	23	2,490	C	23
10. Bothell Way NE/NE 183rd Street	Signal	1,955	B	10	1,955	B	10
11. Bothell Way NE/Main Street	Signal	2,005	B	13	2,005	B	13
12. Bothell Way NE/SR 522 (Woodinville Drive)	Signal	5,090	E	77	5,090	E	77
Weighted Average Delay Along Corridor			D	47		D	47

SOURCE: Sound Transit 2020

NOTE: LOS = level-of-service; TEV = total entering vehicles WSDOT = Washington State Department of Transportation;

The intersection analyses for the 2024 AM and PM peak-hour conditions show that most of the study area intersections meet the LOS E standard, except for SR 527 and 208th Street SE/ Maltby Road, and 20th Avenue SE and 220th Street SE - both of which are LOS F in the AM and PM peak hours for the No Build and Build conditions. However, there is no change in delay for these locations with the addition of the project. The corridor LOS analysis shows that the SR 527 corridor is expected to meet the city’s LOS E standard, operating at LOS D in the PM peak hour. All of the analyses show no change in overall delay and no change in peak hour LOS between No Build to Build, indicating that the Bus Base North project is not expected to cause adverse impacts related to traffic operations in 2024.

6.2.2 2042 No Build vs. Build Conditions

Year 2042 represents post-completion of the ST3 program elements for Link light rail and Sounder commuter rail. Forecasted traffic volumes used for year 2042 were based on future traffic volume projections developed by the WSDOT I-405 Program team (see Section 4.2). No Build conditions capture anticipated traffic levels established by WSDOT I-405 ETL Expansion planning efforts and travel conditions without the Bus Base North project, while Build conditions capture these conditions with traffic generated by the facility added to them.

Average levels-of-service by study intersection are compared for the 2042 No Build and Build conditions in **Table 6-7**. LOS E is the performance standard for all intersections within the study area.

Table 6-7 Intersection level-of-service, 2042 AM/PM Peak Hour No Build vs. Build

ID	Intersection	AM Peak				PM Peak			
		2042 No Build		2042 Build		2042 No Build		2042 Build	
		Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
1	SR 527 and 208th St SE/ Maltby Rd (WSDOT)	101	F	101	F	107	F	107	F
2	SR 527 and 214th St SE (WSDOT)	27	C	27	C	60	E	60	E
3	214th St SE and 20th Ave SE	2	A	2	A	2	A	2	A
4	SR 527 and 220th St SE (WSDOT)	49	D	49	D	60	E	60	E
5	SR 527 and I-405 Northbound Ramps (WSDOT)	12	B	12	B	44	D	44	D
6	SR 527 and I-405 Southbound Ramps (WSDOT)	11	B	11	B	8	A	8	A
17	17th Avenue SE and 220th Street SE	16	B	16	B	24	C	24	C
20	20th Avenue SE and 220th Street SE	82	F	82	F	228	F	228	F

SOURCE: Synchro 10, 2020

NOTE: LOS = level-of-service; WSDOT = Washington State Department of Transportation

Similar to the 2024 analysis results, the intersection analyses for the 2042 AM and PM peak-hour conditions show only one of the five study area intersections along SR 527 as potentially exceeding the WSDOT LOS E standard - SR 527 and 208th Street SE/ Maltby Road, which is projected to operate at LOS F in the AM and PM peak hours for both the No Build and Build conditions. There is no change in delay for this location with the addition of the project. Only one of the other intersections analyzed within the Canyon Park Business Center is expected to exceed LOS E - the unsignalized intersection of 20th Avenue SE and 220th Street SE. That intersection is expected to be at LOS F in both the No Build and Build conditions, with no change in delay estimated between the No Build and Build conditions.

6.2.3 Alternate bus routing

It is possible that, at the time of service commencement, some buses (including those serving SR-522/NE145th BRT), may use 214th Street SE and SR 527 to travel to and from I-405, in lieu of 17th Avenue SE and the proposed direct access ramps. A greater proportion of buses may also use 214th Street SE and SR 527 to travel to and from I-405, if warranted, based on unexpected traffic conditions or if the I-405 facilities are not completed prior to the start of BRT

service. However, given that no buses would be entering or exiting the facility during peak traffic hours, no additional analysis is necessary to reflect this effect on the peak hour traffic operations.

6.3 Traffic safety

Based on the minimal change to traffic volumes and delay, it is expected that the project (Build condition) would not adversely affect safety conditions at the study area intersections or along roadways serving the site, as compared to the No Build condition.

6.4 Non-motorized facilities

Bus Base North is not anticipated to substantially increase bicycle and pedestrian trips in the area. A small percentage of the 185 employee/driver roundtrips may be made via walking and cycling; these trips can be accommodated by the existing pedestrian and bicycle facilities.

The addition of bus, employee, and vendor vehicle trips accessing the proposed Bus Base North site **would not affect** the ability of pedestrians and bicyclists to use the existing sidewalks, crosswalks, and trails in the vicinity of the Bus Base North site.

The North Creek Trail is planned to have a new crossing of 220th Street SE in the future, possibly at a mid-block location between 17th Avenue SE and 20th Avenue SE. The buses accessing the proposed ETL direct access ramps via 17th Avenue SE would use 220th Street SE and travel through the future North Creek Trail crossing. At peak volumes, the frequency of these buses would be less than one per minute. Hence, given that it is assumed that the crossing would be designed with proper sight distances and otherwise to design standards, the additional traffic to/from Bus Base North is not anticipated to adversely affect the trail crossing.

6.5 Transit service

Planned ST Express bus operations would not provide revenue service through the study area intersections. Community Transit currently has four bus routes that are planned to access study area intersections along SR 527: Swift Green Line (six buses per direction per hour), Route 105 (two buses per direction per hour), Route 106 (two buses per direction per hour), and Route 435 (three buses per direction per hour). Given that the BBN project is not expected to increase congestion or delay at study area intersections, the project is not expected to adversely impact these current or any future transit operations.

6.6 Parking

Adequate parking for buses and employees would be provided on the Bus Base North property. The facility is not expected to physically or otherwise affect parking within the study area. The project would provide space to park 120 standard, articulated, and/or double-decker transit coaches. In addition, the project would include an elevated parking deck for employee and visitor parking with approximately 250 parking stalls. Adequate parking for buses and employees would be provided on the project site, and the facility is not expected to physically, or otherwise, affect parking elsewhere in the project vicinity.

6.7 Freight mobility and access

Based on the analysis results that no to minimal additional delay would be added to intersections in the study area, the operation of Bus Base North is not likely to impact the movement of freight on roadways in the vicinity of Bus Base North.

6.8 Pavement conditions

The Bus Base North facility is designed to accommodate up to 80 articulated coaches to support BRT service and 40 double-decker hybrid diesel buses to serve ST Express service in the Snohomish County area. It is anticipated that buses housed at the facility would access revenue service routes via I-405. The planned *outbound* route for buses between Bus Base North and I-405 is expected to be south from the facility via 20th Avenue SE, west along 220th Street SE, and then south on 17th Avenue SE to Canyon Park Park-and-Ride lot and the proposed direct access ramp into the ETL system. The inbound route for BRT buses (return trip to base) would be the reverse of the outbound route starting from the I-405 ETLs. The main BRT route is shown in **Figure 6-1** along with the estimated total daily volumes and bus volumes for existing year, 2024 and 2042 conditions.

Trips associated with Bus Base North are expected to increase future daily traffic levels on the internal Canyon Park Business Center roadways from approximately 1.7 percent to 4.3 percent depending on the specific location and future horizon year considered. The added volume of buses to these segments of roads may have an adverse effect on pavement conditions, including increased live and dead loads leading to potential added wear on the roadway and pavement markings. Sound Transit will coordinate with the Canyon Park Business Center throughout the development of the Bus Base North to continue to assess these potential effects.

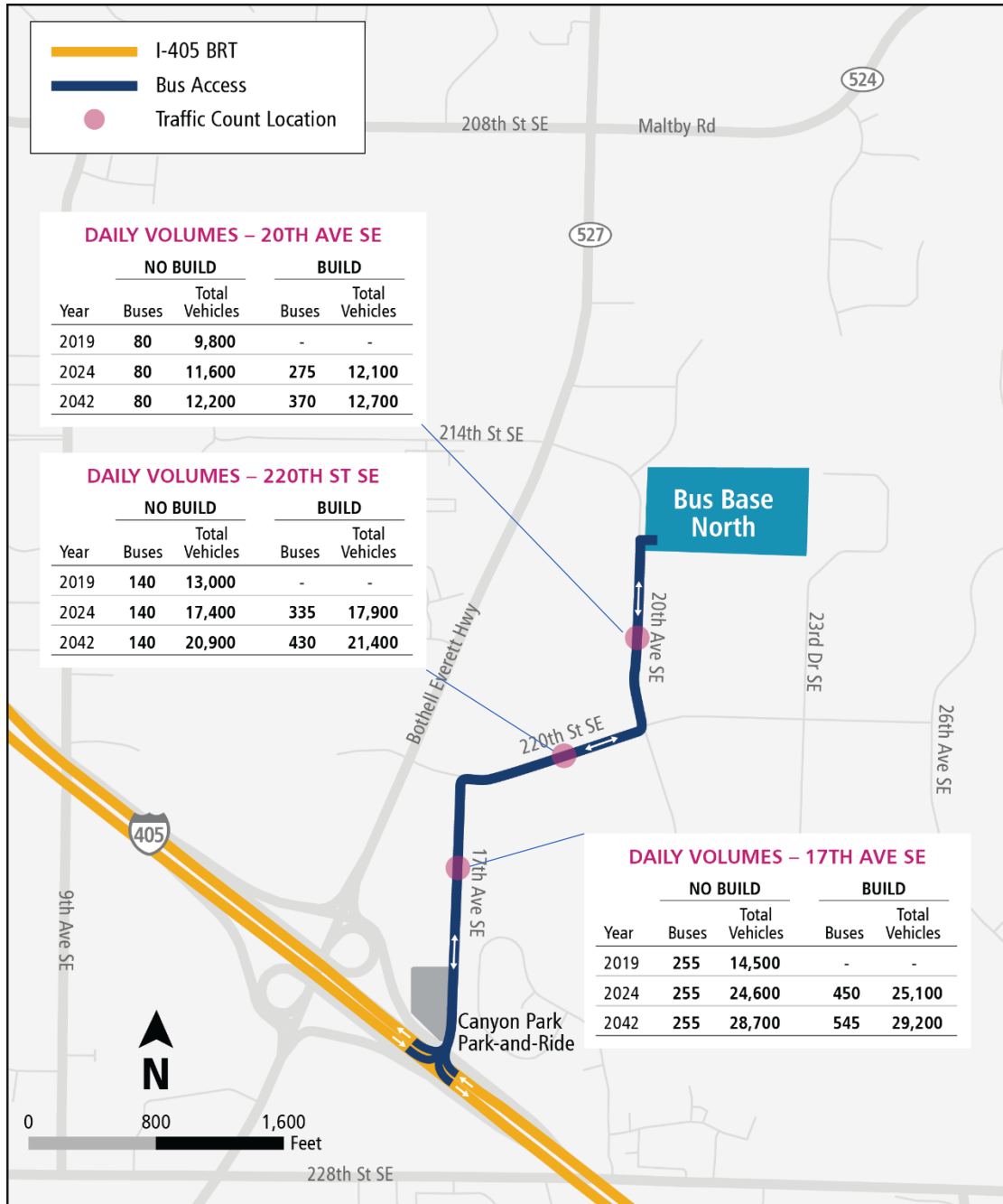


Figure 6-1 Estimated daily volumes for primary affected roadway segments

6.9 Summary of potential impacts

Because of the relatively low volume of trips generated by Bus Base North in comparison to existing and future traffic in the study area in the No Build condition, the use of the proposed Bus Base North facility is not anticipated to adversely impact the transportation system in terms of traffic operations, safety, parking, transit, freight, or multimodal mobility.

Although some of the study area intersections are expected to exceed the City of Bothell peak-hour operational standard of LOS E in the 2042 future horizon year in the No Build condition, there is no change in projected corridor level-of-service or intersection vehicle delay when estimated traffic from the Bus Base North is added to future No Build condition.

Sound Transit buses traveling between Bus Base North and I-405 may adversely affect pavement conditions on some Canyon Park Business Center roadways, including increased wear on the roadway and pavement markings. Sound Transit will coordinate with the Canyon Park Business Center throughout the development of the Bus Base North to continue to assess these potential effects.

7 INDIRECT AND CUMULATIVE IMPACTS

The analysis of future traffic impacts (delay, LOS, safety, etc.) in Section 6 is a cumulative analysis based on the results of traffic modeling that incorporates past, present, and approved future actions as well as projected regional growth. When other large-scale transportation projects in the area are accounted for, the effects of the Bus Base North site generation and changes to intersection/arterial LOS are expected to be even less adverse as defined by documented thresholds. It is anticipated that for most of the duration of construction, daily truck volumes would remain at medium to low volumes (Sound Transit, 2019), depending on the deliveries of materials and sequencing of construction activities, which is not anticipated to affect intersection or arterial LOS.

Overall, the WSDOT ETL direct access ramp is projected to add approximately 1,400 vehicles per hour (both directions) in the AM peak period and 1,800 vehicles (both directions) in the PM peak hour. In comparison, with less than 50 vehicles generated per peak period, the BBN project would have minimal impact on traffic operations. Intersection LOS is expected to degrade in the future from existing conditions based on more intensive land uses and the WSDOT ETL Expansion project's direct access ramp. However, intersection and SR 527 corridor LOS would not further degrade between the Bus Base North No Build and Build conditions.

8 POTENTIAL MITIGATION

Based on the analysis results and findings of this Bus Base North study, no mitigation is required to address project impacts related to traffic operations, safety, parking, or overall mobility. Sound Transit will continue to coordinate with the Canyon Park Business Center throughout the development of the Bus Base North project regarding potential effects to business district roadways.

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Appendix A

I-405 BRT Traffic Analysis Methodology and Assumptions Technical Memorandum

1



Bus Rapid Transit

I-405 corridor

2

Technical Memorandum: Operational Assumptions and Analysis – Draft

3

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6

June 2018

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Revision History

1

Version	Title	Date	Notes, As Required
0	Technical Memorandum: Operational Assumptions and Analysis – Draft	6/1/2018	First draft for ST review

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Acronyms and Abbreviations

1

BRT	bus rapid transit
ETL	Express Toll Lanes
GP	General Purpose
Project	I-405 Bus Rapid Transit Project
ST3	Sound Transit 3 Plan
WSDOT	Washington State Department of Transportation

2

1 INTRODUCTION

The I-405 Bus Rapid Transit (BRT) and Bus Operations & Maintenance Facility project (Project) will provide frequent and reliable bus service connecting Lynnwood to Bellevue to Burien with intermediate stops, primarily on I-405.

This report will briefly describe the key methods and assumptions for the Project alignment and determining its operational characteristics.

2 BRT ALIGNMENT

The Project alignment consists of two or three operating routes that would serve 11 BRT stations.

2.1 Operating Routes

The Sound Transit 3 (ST3) representative project included two BRT lines extending north and south from the Bellevue Transit Center along I-405.

In addition to the representative project, several different operating schemes are being evaluated, including some potential interaction with the SR 522/NE 145th BRT project. Evaluation of these alternative operating plans will consider travel times, reliability, impacts to origin and destination markets, and capital and operating costs.

For reference, the description of the two operating routes in the representative project is provided below:

- North Route: Bellevue Transit Center to Lynnwood Transit Center. This route would operate in the express toll lanes (ETLs) from Bellevue to north of Totem Lake, transitioning to a mix of general-purpose (GP) traffic and bus-only shoulders.
- South Route: Bellevue Transit Center to Burien Transit Center. This route would operate in the ETLs from Bellevue south to near South Renton, then operating primarily in mixed traffic to Tukwila International Boulevard Station, and then in new bus-only lanes along SR 518 to Burien.

2.2 Station Locations

The following I-405 BRT stations were identified in the ST3 representative project:

- Lynnwood City Center
- Canyon Park
- NE 195th
- Brickyard

- 1 • Totem Lake/Kingsgate
- 2 • NE 85th
- 3 • Bellevue Transit Center
- 4 • NE 44th
- 5 • South Renton Transit Center
- 6 • Tukwila International Blvd
- 7 • Burien Transit Center

8 The preferred placement of each station and the routing to and from each station will be
9 evaluated and determined by station-area teams. These evaluations will include impacts on
10 reliability, travel time, ease of transfers, impacts to through-traveling riders, and consistency with
11 the ST3 plan, among other factors.

12 3 OPERATIONAL CHARACTERISTICS

13 Several of the operational characteristics of I-405 BRT service (e.g., headways, span of service,
14 and travel times) are described in this section. Assumptions about these items determine needs
15 for layover spaces and service hours.

16 3.1 Headways

17 The ST3 representative project assumes headways of 10 minutes during peak periods and 15
18 minutes the remainder of the day and on weekends.

19 Additionally, these routes could employ active management of service in the following ways that
20 could affect headways:

- 21 • Actively manage spacing between buses when congestion is higher or lower than normal.
22 Instead of operating on a rigid, time-based schedule during peak periods, a headway-based
23 schedule would be used to keep buses evenly spaced during variable operating conditions.
- 24 • Provide “gap buses” that can enter service when delays occur or headways become highly
25 uneven. This can help maintain headways, with the added benefit of being able to adapt
26 service during incidents (e.g., crashes) more effectively. However, the use of gap buses
27 uses service hours and fleet that could otherwise provide in-service buses, so the tradeoffs
28 of using gap buses would need to be evaluated.

29 The peak periods where 10-minute service would be provided could be different for the various
30 operating routes to accommodate regional variations when the peak commute occurs. The
31 existing route ridership profiles north and south of downtown Bellevue will be reviewed to
32 determine recommended time periods for peak-period headways.

3.2 Span of Service

The I-405 BRT span of service is expected to be similar to Link light rail, though the actual number of hours per day was not explicitly noted in the ST3 representative project. The number of hours assumed for estimating the I-405 BRT operating costs in the ST3 plan for the representative project is shown in **Table 1**.

Table 1 Span of Service for I-405 BRT and Link Light Rail

	I-405 BRT	Link Light Rail
Weekdays	19 hours	20 hours
Saturdays	19 hours	19 hours
Sundays	17 hours	18 hours

Evaluation of potential first- and last-train connections will be performed to determine the importance of these connections. Additionally, if these connections would expand the span of service, consideration to longer headways in early-morning and late-night hours could be considered.

3.3 Travel Times

The travel times for I-405 BRT will be estimated using a variety of tools, depending on what models exist or can easily be developed for subareas of the corridor. These tools include a travel demand model, Vissim simulation modeling of the I-405 corridor, Synchro intersection delay modeling, and observed existing travel times. The emphasis of the travel-time development will be for the first full year of BRT operations, 2025, though some evaluation will occur for 2042 to identify potential challenges in the years after service begins.

An example of data to be used includes existing automobile travel times in the northern half of the I-405 corridor where ETLs are already in operation, shown in **Table 2**. The ETLs provide a large travel-time savings in the peak direction during the peak period relative to GP lanes.

Table 2 Observed Travel Times in I-405 North Corridor, Fall 2017

Between		AM Peak Period				PM Peak Period			
		Northbound		Southbound		Northbound		Southbound	
		GP	ETL	GP	ETL	GP	ETL	GP	ETL
I-5	SR 527	3.4	3.4	12.0	8.9	5.0	3.5	3.9	3.5
SR 527	NE 195th St.	2.2	2.2	10.7	5.9	3.3	2.4	2.7	2.2
NE 195th St.	NE 160th St.	2.1	2.1	6.5	2.6	3.5	2.4	2.3	2.1
NE 160th St.	NE 128th St.	1.8	1.8	3.8	2.6	3.4	1.8	1.8	1.8
NE 128th St.	N 85th St.	2.5	2.5	5.6	3.0	4.9	2.7	2.5	2.5
N 85th St.	NE 6th St.	4.1	4.1	6.2	4.1	11.7	5.0	8.5	4.5

3.3.1 Reliability

In addition to the improved travel times, ETLs provide greater reliability than GP lanes. The reliability data of the existing travel in the I-405 north corridor will be used to determine likely variability across days in the south corridor in the future. Note that two ETLs will be provided by WSDOT between Bellevue and SR 167, so existing south corridor reliability is likely to not be an issue when BRT service begins.

In determining the fleet sizing and schedules for operations, a worse-than-typical day should be considered in order to provide reliable service on most days. The extent to which Sound Transit would like to accommodate congested days needs to be decided; for example, the route could be scheduled to meet headway goals on a chosen percentage of peak-period trips.

3.4 Layover Needs

Layover needs will depend on the choices set by operating routes, travel times, and targeted reliability.

The station-area evaluations for Lynnwood City Center, Bellevue Transit Center, Burien Transit Center, and potentially NE 195th (near UW Bothell) will identify locations at or near each station that can provide two to three layover spaces for each operating route. Note that while the likely discontinuation of ST Express routes 535 and 560 will free a few layover locations in Lynnwood and Bellevue, additional layover capacity will be needed.

3.5 Service Hours

Service hours will be determined based on assumed operating routes, headways, and span of service, taking in consideration more detailed travel time estimates and the targets for reliability as noted above.

4 TRANSIT INTERGRATION

Many riders of I-405 BRT will be transferring to and from other services. Station designs should accommodate the expected transfers. The extent to which transfers are expected at a given station will be determined using the ridership forecasting model and an analysis of existing and expected future origins and destinations for riders.

4.1 Sound Transit

4.1.1 SR 522/NE 145th BRT

As part of the ongoing operating route analysis, the connection between the I-405 BRT and SR 522/NE 145th BRT services will be determined. While not in the ST3 representative project for SR 522/NE 145th BRT, it will be desirable to have that route connect directly to the I-405 BRT service at UW Bothell.

1 **4.1.2 Link Light Rail**

2 I-405 BRT will connect to Link light rail service at three locations:

- 3 • Lynnwood City Center Station
4 • Bellevue Transit Center
5 • Tukwila International Blvd Station

6 Transfers are expected between I-405 BRT and Link light rail at these three locations, including
7 at Tukwila International Boulevard Station where existing ST Express Route 560 riders to Sea-
8 Tac Airport will need to transfer to reach the airport.

9 **4.2 King County Metro**

10 The Project will have connections to existing local bus service and future integration
11 opportunities at every station. Based on the King County *Metro Connects, Long-Range Plan*
12 (2017), the frequency, and number of express and local transit services will increase. For the
13 evaluation of station areas and transit integration, the year 2025 *Metro Connects Plan* is to be
14 assumed, which includes the Project, SR 522/NE 145th BRT, and Link light rail extensions to
15 Lynnwood, Redmond, and Federal Way as part of the transit network. The year 2040 *Metro*
16 *Connects Plan* is a long-range plan and includes some unfunded capital project and service
17 hours.

18 **4.3 Community Transit**

19 Connections to existing and planned Community Transit bus services will be available on the
20 northern BRT operating routes including at Lynnwood City Center Station, Canyon Park Station,
21 and the UW Bothell campus. It is assumed that the Swift Green Line at Canyon Park and Swift
22 Orange Line at Lynnwood will be in operation and that transfers between Sound Transit BRT
23 lines and Swift lines will be accommodated.

24 **5 REFERENCES**

25 King County Metro. 2017. *Metro Connects, Long-Range Plan*. Available at:
26 <http://www.kcmetrovision.org/view-plan/>.

soundtransit.org/i405brt

brt@soundtransit.org
206-398-5470



Appendix B

Peak Hour Trip Distribution

Appendix B

Peak Hour Trip Distribution

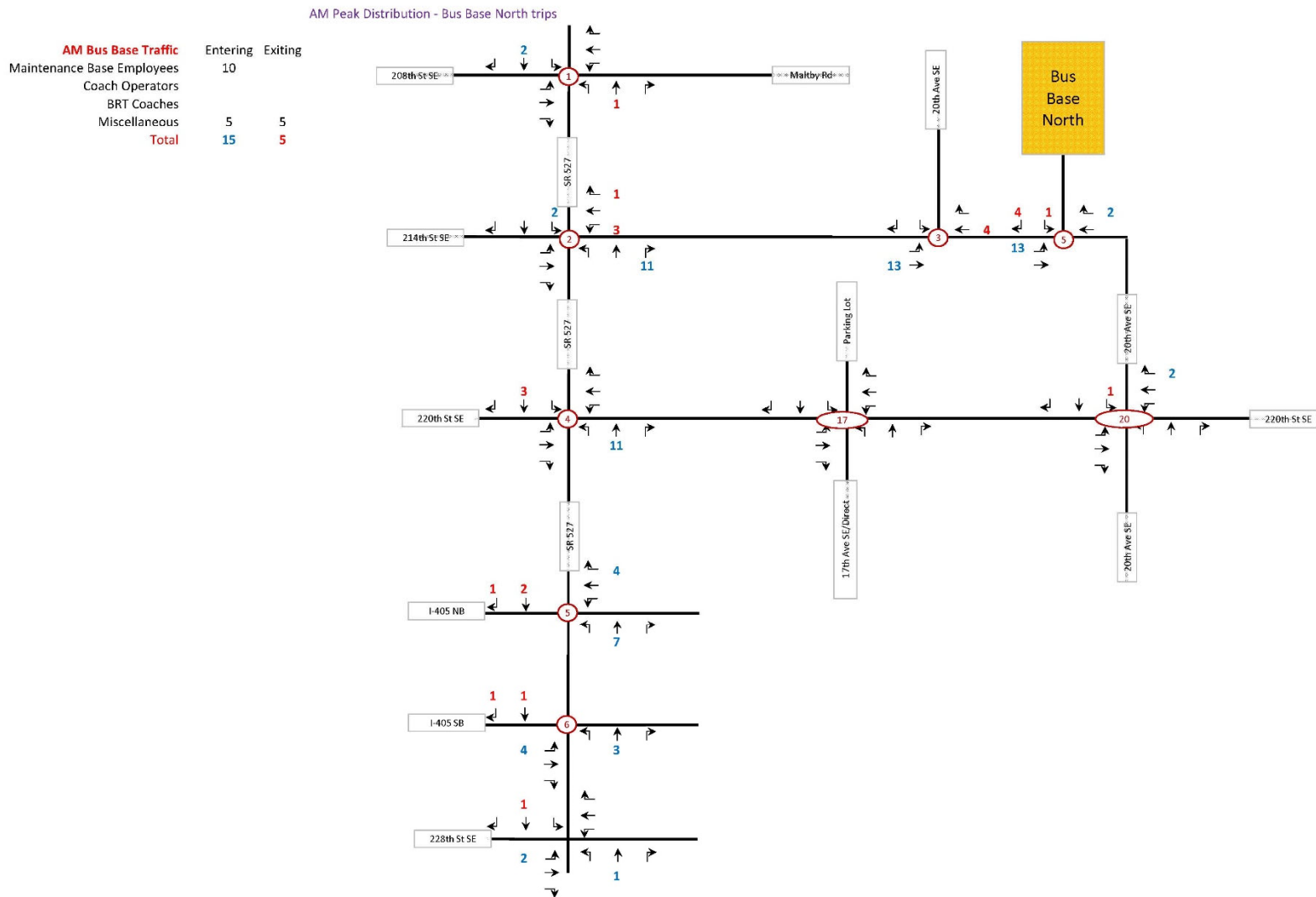


Figure B-1 Bus Base North a.m. Peak Hour Trip Distribution

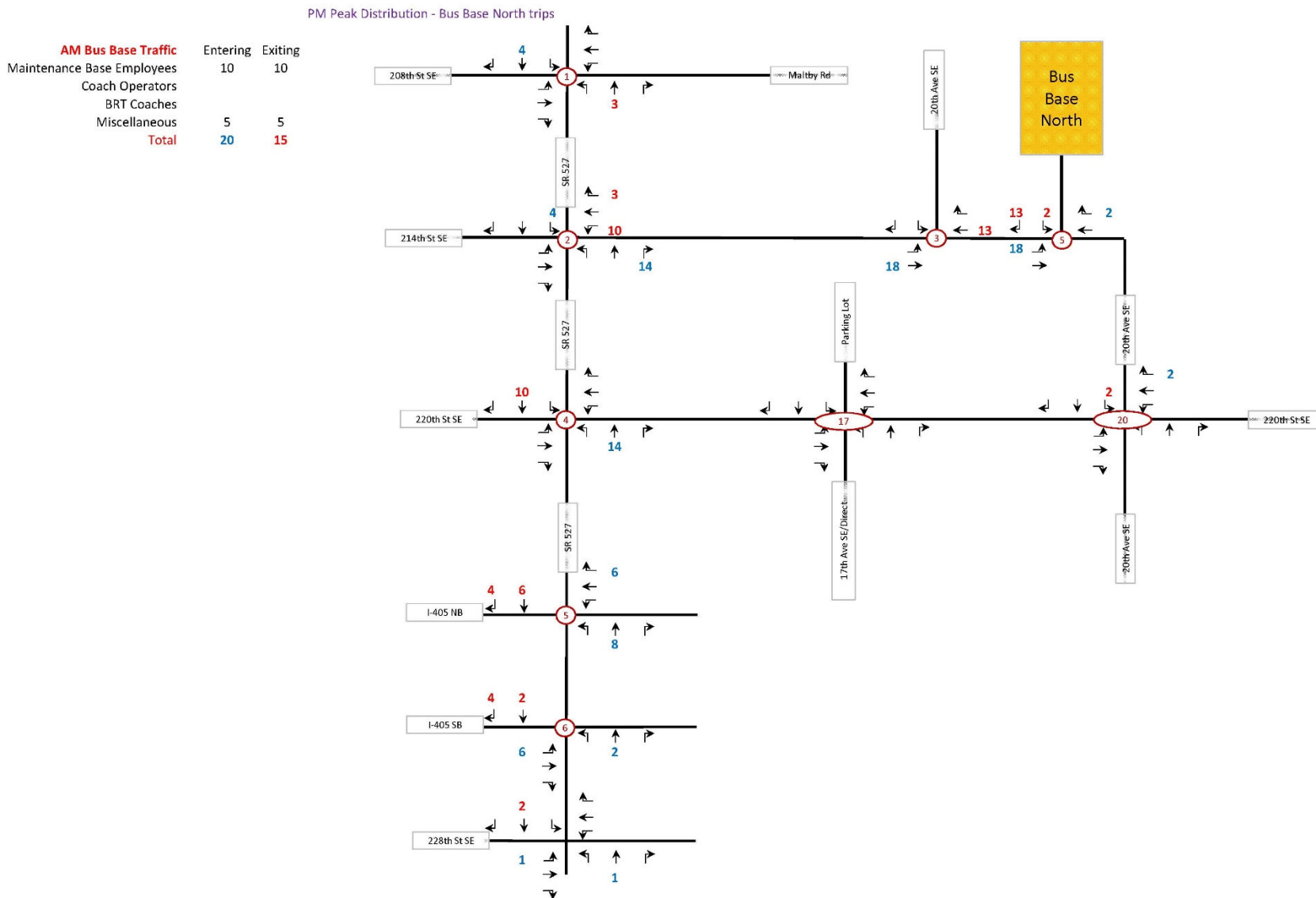


Figure B-2 Bus Base North p.m. Peak Hour Trip Distribution

Appendix C

Detailed Crash History

Table C-1. Bus Base North Study Area Crashes - All Roads

Year	Serious Injury	Fatality	Fixed Object	Rear End	Sideswipe	Angle	Opposite	Same Direction	Other	Pedestrian/ Bike
2014	0	0	5	98	16	36	6	6	1	2
2015	2	1	4	116	21	21	5	4	0	3
2016	0	0	6	116	30	31	8	8	0	3
2017	5	0	7	114	21	26	7	5	0	4
2018	1	0	7	106	25	35	11	5	2	2
Total	8	1	29	550	113	149	37	28	3	14

Table C-2. 220th Street SE from SR 527 to 20th Avenue SE

Year	Serious Injury	Fatality	Fixed Object	Rear End	Sideswipe	Angle	Opposite	Same Direction	Other	Pedestrian/ Bike
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	1	0	0	0	0
2016	0	0	1	0	1	0	0	0	0	0
2017	0	0	0	0	1	1	0	0	0	0
2018	0	0	0	1	1	0	0	1	0	0
Total	0	0	1	1	3	2	0	1	0	0

Table C-3. SR 527 from 220th Street SE to 208th Street SE

Year	Serious Injury	Fatality	Fixed Object	Rear End	Sideswipe	Angle	Opposite	Same Direction	Other	Pedestrian/ Bike
2014	0	0	1	76	8	21	3	5	0	2
2015	1	0	2	90	8	12	5	4	0	1
2016	0	0	1	87	18	18	4	4	0	3
2017	5	0	5	79	15	15	6	3	0	2
2018	1	0	2	85	14	22	9	1	1	1
Total	7	0	11	417	63	88	27	17	1	9

Table C-4. 214th Street SE from SR 527 to 20th Avenue SE

Year	Serious Injury	Fatality	Fixed Object	Rear End	Sideswipe	Angle	Opposite	Same Direction	Other	Pedestrian/ Bike
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	1	0	0	0	0	0	0
2017	0	0	0	1	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	0	0	0	0

Table C-5. 20th Avenue SE from 214th Street SE to 220th Street SE

Year	Serious Injury	Fatality	Fixed Object	Rear End	Sideswipe	Angle	Opposite	Same Direction	Other	Pedestrian/ Bike
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	1	0	0	0	0
2016	0	0	1	0	0	0	0	0	0	0
2017	0	0	0	2	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	0
Total	0	0	1	2	0	1	0	0	0	0

Table C-6. 17th Avenue SE from the Canyon Park Park and Ride to 220th Street SE

Year	Serious Injury	Fatality	Fixed Object	Rear End	Sideswipe	Angle	Opposite	Same Direction	Other	Pedestrian/ Bike
2014	0	0	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	1	0	0	0	0
Total	0	0	0	0	0	1	0	0	0	0

