



Captain Johnston Blakely Elementary School

Traffic Impact Study

October 2017

Updated from January 2017 Study

prepared to:
City of Bainbridge Island

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1. Introduction

This study documents the immediate and long-range traffic conditions associated with Bainbridge Island School District's proposal to replace Captain Johnston Blakely Elementary School. This study updates the January 2017 traffic impact analysis, based on recent revisions to the proposed campus plan.

The purpose of this report is to identify potentially significant traffic impacts generated by the Project and, where appropriate, outline programmatic and/or physical improvements to reduce or eliminate potential adverse impacts.

This report generally follows a scope of work provided by Bainbridge Island staff.

i. **Existing Campus Description**

Captain Johnston Blakely Elementary School is located at 4704 Blakely Ave. The school is at the southeast corner of Blakely Ave and Baker Hill Road at land parcel number 03240-2-2004-2005.

A vicinity map highlighting the school's location is provided as Figure 1.



Figure 1: Vicinity Map

Current enrollment is 350 students and there are 44 total full-time and part-time teachers and staff. Class hours are generally between 7:50 AM and 2:20 PM, and teachers and staff generally arrive around 7:00 AM and depart by 3:30 PM.

Morning school bus drop-offs are from 7:30 AM to 7:45 AM. Afterschool school bus pick-ups arrive between 2:10 PM and 2:20 PM, and depart by 2:30 PM.

The campus includes two one-way accesses off Blakely Ave. A north driveway is configured for outbound-only traffic and is roughly 75 feet south from Baker Hill Road. A south driveway is configured for inbound-only traffic and is roughly 475 feet south of Baker Hill Road.

ii. **Proposed Campus Description**

Bainbridge Island School District is proposing to replace the existing school with an expanded and modernized elementary school campus at its current location. The new campus is forecast to serve 450 students by 2019 and has capacity to serve up to 600 students in the long-term.

The north driveway will be relocated to become the east leg of Baker Hill Road. The new east leg is proposed with a right-turn lane for vehicles exiting the site to the north and a shared through-left turn lane. The existing utility pole will be incorporated into the design of the east leg-driveway and the pole will bisect the right and shared through-left turn lanes.

The north driveway will provide access to the major parking lot which will be oriented for one-way counterclockwise traffic circulation. The lot includes 48 angled parking spaces and a student drop-off and pick-up area. There are 19, 20-foot long, parallel parking spaces that make up the major student drop-off and pick-up area.

The existing south driveway will be retained, and its service area will be reconfigured for school buses and for some staff parking (five spaces). The bus area will include drop-off and pick-up and bus parking.

A conceptual site plan is included as **Figure 2**.

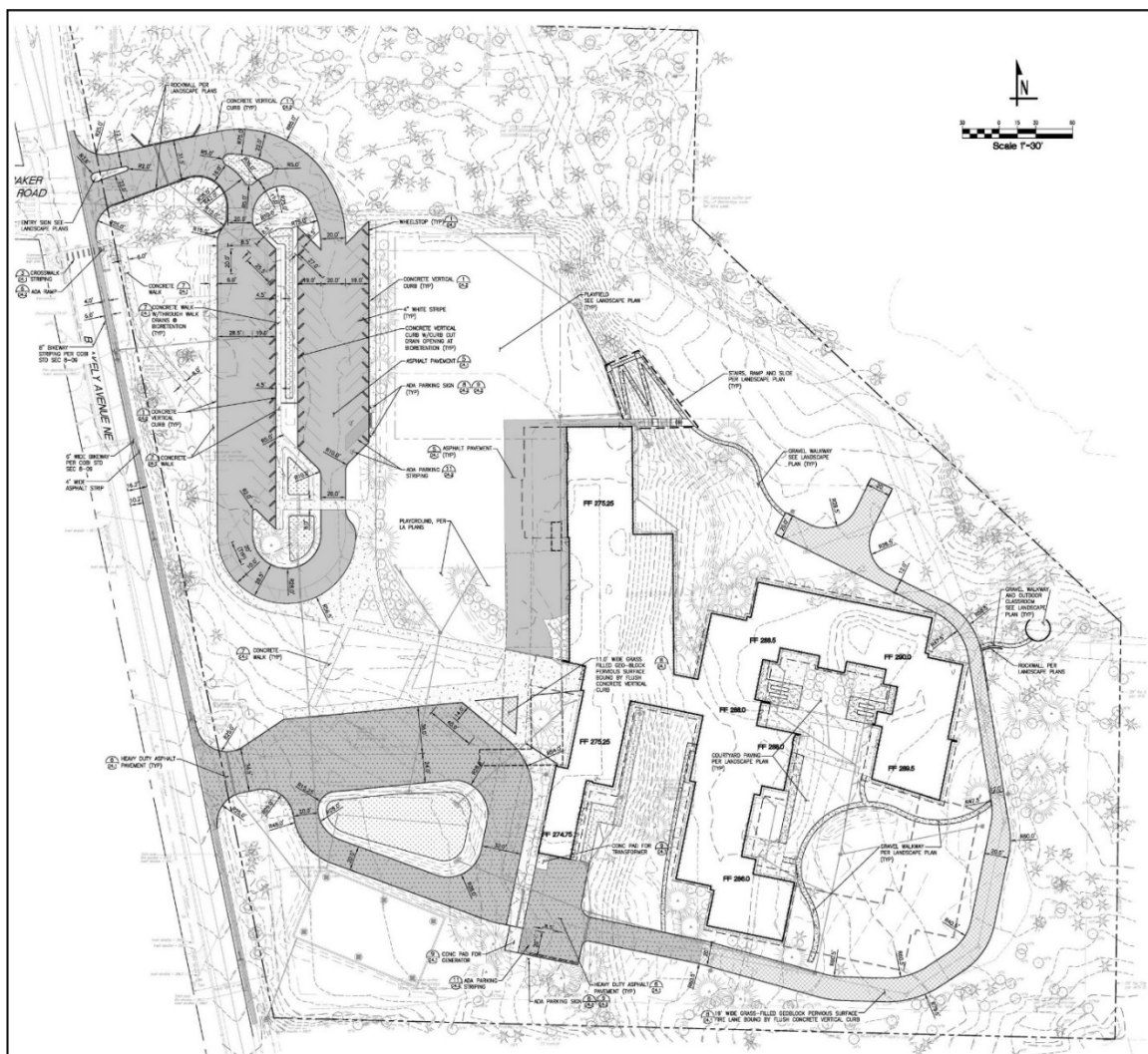


Figure 2: Conceptual Site Plan

The school replacement is anticipated to be complete and operational by 2019.

2. Trip Generation, Distribution and Assignment

i. Existing Elementary School Trips

Traffic volumes were collected at the existing campus driveways on Thursday, December 1, 2016. Table 1 summarizes the finding for the existing campus (350 student) and compares the current trip generation rates to national data compiled by the Institute of Transportation Engineers.

Table 1: Existing Elementary School Trip Generation

Students: 350	AM Peak (7-8 AM)			Afterschool Peak (2-3 PM)			PM Peak (4-5 PM)		
	Total	In	Out	Total	In	Out	Total	In	Out
December 1, 2016 Trips	186	146	40	98	39	59	23	8	15
December 1, 2016 Rate ¹	0.53	78%	22%	0.28	40%	60%	0.07	35%	65%
Relationship to ITE Rates ²	0.45	55%	45%	0.15	49%	51%	0.28	45%	55%

1. Rate based on driveway counts and an existing student body of 350 students

2. Institute of Transportation Engineers (ITE) trip generation rates for Land Use 520; "Elementary School"

ii. Future Trip Generation

The future campus is expected to grow to 450 students by 2019 (intermediate growth) and has a capacity for 600 students.

Trip generation for the future campus is based on the existing trip generation collected for the 350-student campus. Table 2 summarizes the trip generation forecasts for the campus expansion.

Table 2: Future Elementary School Trip Generation

Students: 350	AM Peak (7-8 AM)			Afterschool Peak (2-3 PM)			PM Peak (4-5 PM)		
	Total	In	Out	Total	In	Out	Total	In	Out
Existing Trip Rate	0.53	78%	22%	0.28	40%	60%	0.07	35%	65%
Future (450 students) ¹	239	186	53	126	50	76	32	11	21
Capacity (600 students) ²	318	248	70	168	67	101	42	15	27

1. Anticipated student enrollment by 2019 (near-term)

2. Enrollment at full-capacity

New trips are the difference between the trips generated by the increased student population. Existing school trips are those already on the local road network. New trips are summarized in Table 3 for the proposed year 2019 school expansion and expansion of the campus to full capacity.

Table 3: Trip Generation; New Trips Generated

Students: 350	AM Peak (7-8 AM)			Afterschool Peak (2-3 PM)			PM Peak (4-5 PM)		
	Total	In	Out	Total	In	Out	Total	In	Out
Existing (350 students)	146	40	186	39	59	98	8	15	23
Future (450 students)	42	11	53	11	17	28	3	6	9
Capacity (600 students)	104	28	132	28	42	70	7	12	19

3. Trip Distribution and Assignment

The City of Bainbridge Island staff identified the following three study intersections and the site accesses for existing and future traffic operations analyses:

- (1) Baker Hill Road and Blakely Ave
- (2) Baker Hill Road and Pleasant Beach Drive
- (3) Blakely Ave and Bucklin Hill Road

Peak hour trip distribution was based on information from the City of Bainbridge's Traffic model and review of the existing turning movement volumes collected at Baker Hill Road and Blakely Ave, Baker Hill Road and Pleasant Beach Drive, and Blakely Ave and Bucklin Hill Road and the existing school accesses.

From the site plan, the existing north driveway will be relocated to Baker Hill Road, and Baker Hill Road and Blakely Ave will become a four-legged intersection. The site access will be stop sign controlled and no turn restrictions are proposed. The intersection will serve as the primary site access for non-school bus student drop-off and pick-up and parking.

The existing south driveway will be reconfigured for school buses and for some staff parking (five spaces). The south parking lot includes parking for eight school buses to drop-off and pick-up students. It is anticipated that the buses will arrive during the morning peak (7-8 AM) and depart during the afterschool peak (2-3 PM), and the staff will arrive prior to the morning peak and depart during the PM peak hour (4-5 PM).

Figure 3 illustrates the assignment of the net increase of school trips with the 450-student year 2019 enrollment projection, for the 7-8 AM, 2-3 PM and 4-5 PM peak hour periods.

Figure 4 illustrates the assignment of the net increase of school trips with the 600-student enrollment at full capacity, for the 7-8 AM, 2-3 PM and 4-5 PM peak hour periods.

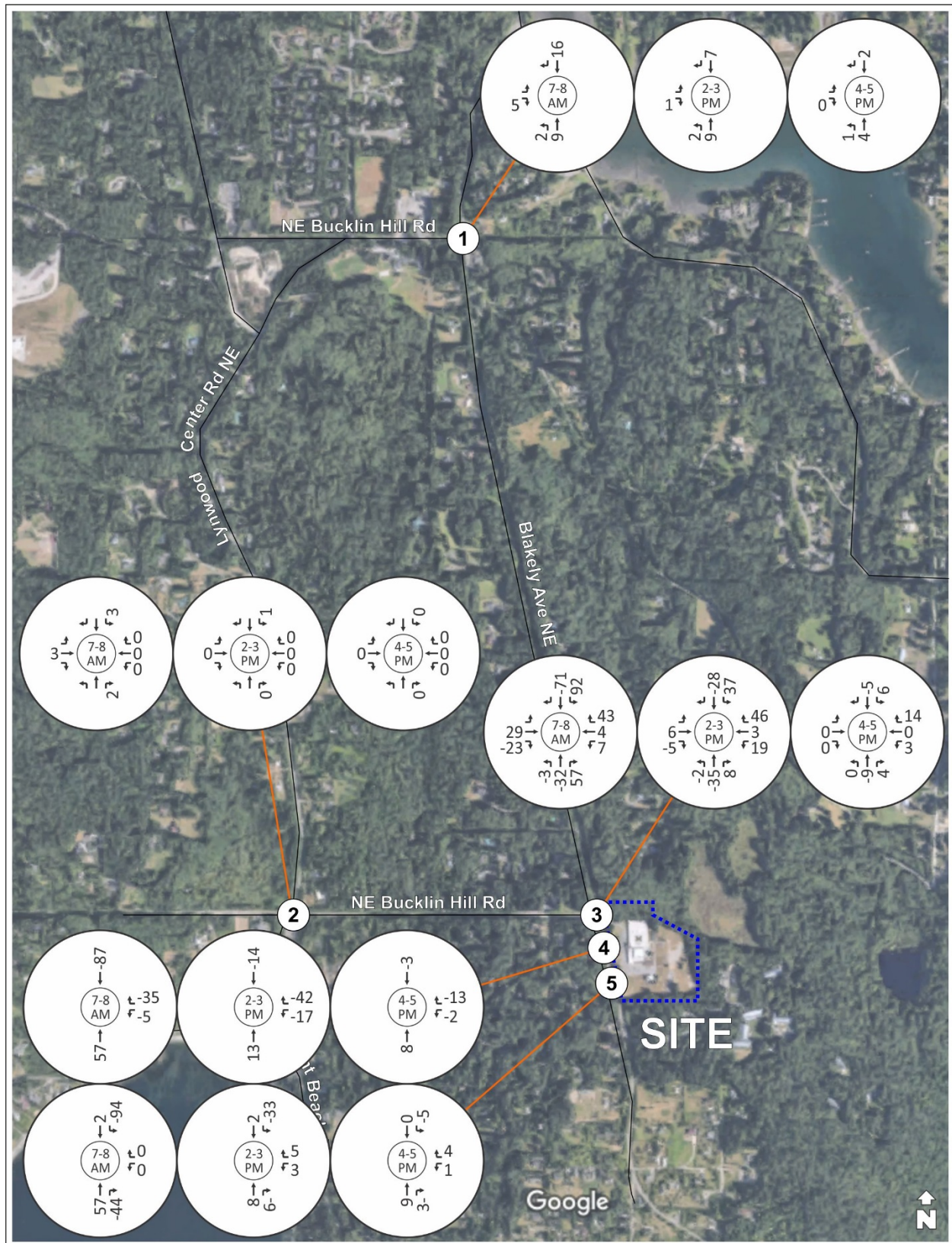


Figure 3: 450-Student Campus New Trip Assignment

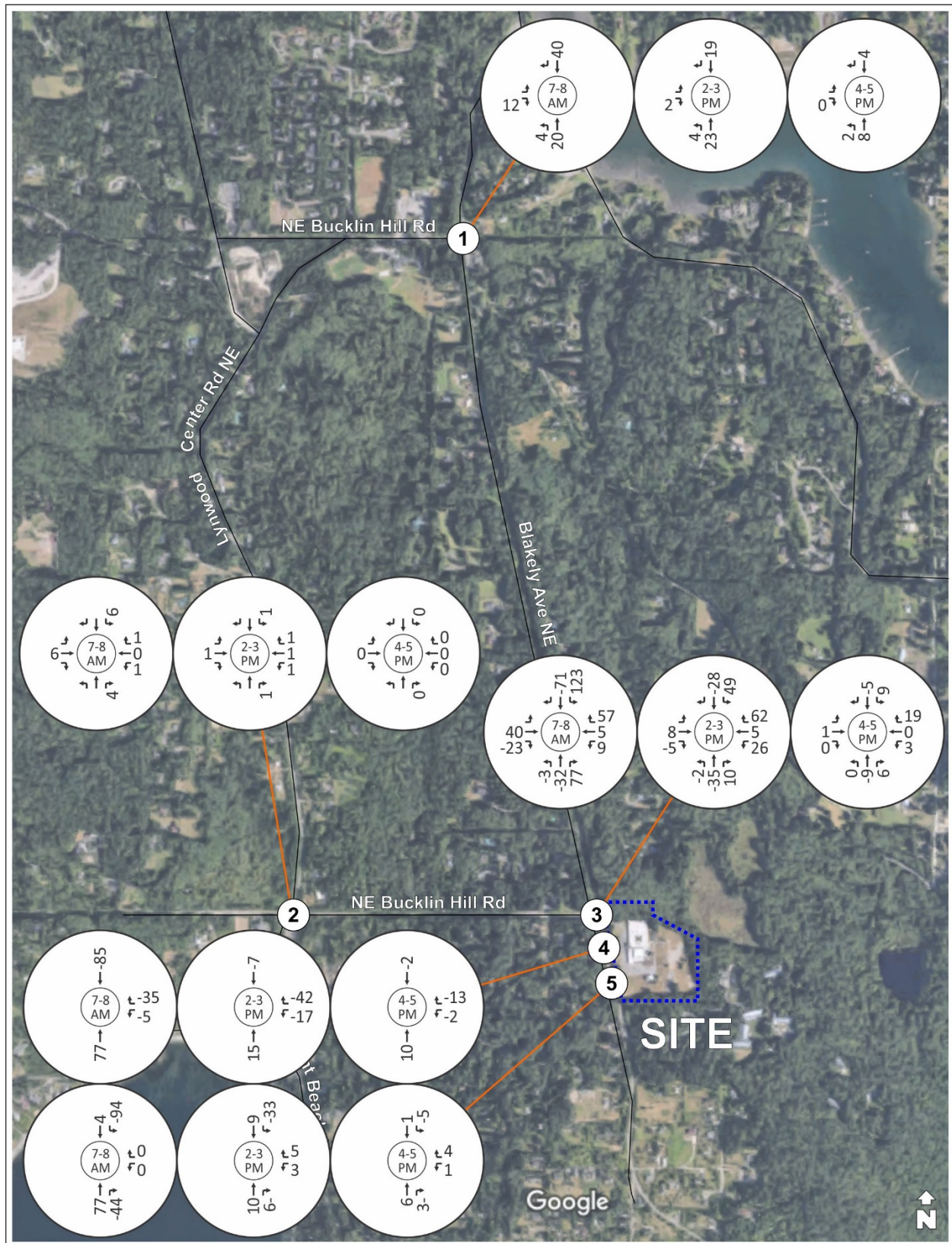


Figure 4: 600-Student Campus New Trip Assignment

4. Existing Conditions

This section describes the existing traffic conditions which will serve as a baseline to compare against future immediate and long-range traffic conditions without and with the Project.

i. Road Network and Study Intersections

Major roadways within the study area are described below:

- Blakely Ave is a north-south road classified as a secondary arterial. Blakely Ave has one travel lane in each direction. Near the school the posted speed limit is 30 mph. “School Ahead” signs are posted at near the edge of the school property facing northbound and southbound traffic. For about 150 feet on either side of school property, the shoulder sections on each side of the road are paved and marked with bicycle lane symbols. A “Share the Road” sign is posted near the south edge of the school property facing NB traffic. The rest of the road within the study area has shoulders that are mostly gravel. There is no curb, gutter, sidewalk, or shared use path on either side of the road in the immediate vicinity.
- Baker Hill Road is an east-west road classified as a secondary arterial. Baker Hill Road has one travel lane in each direction. Near the school the posted speed limit is 30 mph.

ii. Traffic Conditions

Existing intersection volumes were collected at the study intersection on Thursday, December 1, 2016 by Traffic Count Consultants, Inc. from 7 to 9 AM and from 2 to 6 PM. The peak hour turning movement volumes evaluated for traffic operations were selected to coincide with the peak hour traffic volumes generated by the school; thus, the morning peak hour was from 7 to 8 AM, corresponding the start of school, the afternoon peak hour was from 2 to 3 PM and the PM peak hour was from 4 to 5 PM.

Figure 5 illustrates the existing traffic volumes for these three peak hour periods.

iii. Transit and Non-Motorized

Kitsap Transit route #97 provides weekday morning and afternoon service along Blakely Ave and Baker Hill Road. The nearest public transit stop is on Pleasant Beach Road south of Baker Hill Road, to the west of the school. The road shoulder fronting the school is paved, there is not curb, gutter or sidewalk.

The school is served by School District buses that load and unload on campus.

iv. Level of Service

Level of service (LOS) is a measure of an intersection’s ability to serve the entering traffic flow.

For this study, the Synchro computer program, was used to compute LOS and delay using 2010 Highway Capacity Manual methodology.

The City of Bainbridge Island intersection LOS threshold is based on road classification and location in the city. The study intersections are in the “Sub-Urban Zone” and the LOS threshold is “C”.

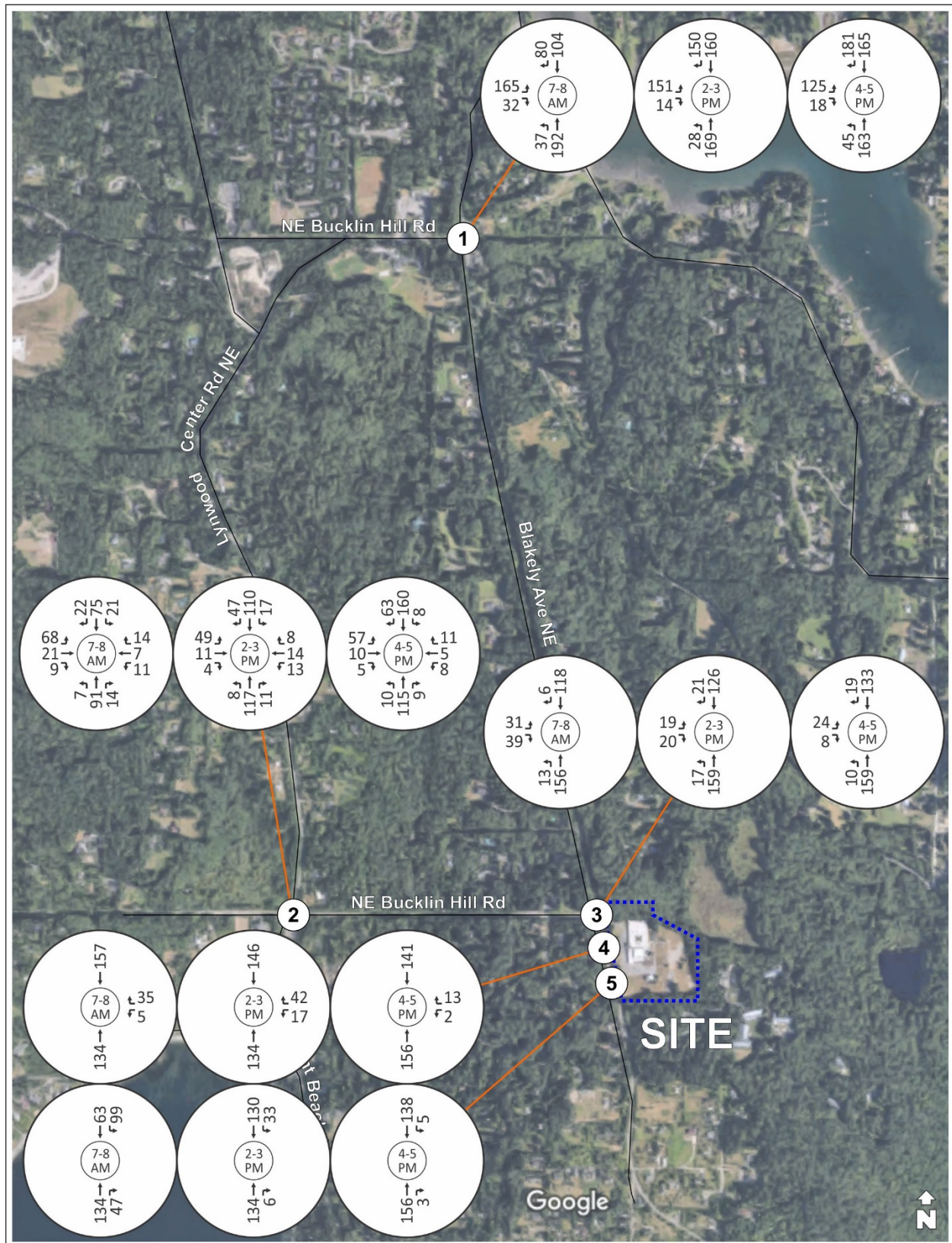


Figure 5: 2016 Existing Traffic Volumes

The peak hour factor (PHF) is used in LOS analyses to account for the traffic demand fluctuations during the peak hour. A PHF equal to 1.0 demonstrates that the flow of traffic through the hour is constant. The existing PHF's were retained through future conditions and are not adjusted for increased congestion and traffic through the study intersections.

Table 4 summarizes the existing intersection LOS, and shows that the study intersections operate at LOS C or better and satisfy the City's standard.

Table 4: 2016 Intersection LOS

Intersection	AM Peak (7-8 AM)			Afterschool (3-4 PM)			PM Peak (4-5 PM)		
	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
2016 Existing School									
Blakely/Bucklin Hill	EB L	C	24.7	EB L	C	17.3	EB L	C	16.5
Pleasant Beach/Baker Hill	EB	B	13.5	EB	B	12.7	EB	B	13.5
Blakely/Baker Hill	EB	B	12	EB	B	10.4	EB	B	10.7
Blakely/N School Driveway	WB	B	10.5	WB	B	10.1	WB	A	9.5
Blakely/S School Driveway	SB	A	8.2	SB	A	7.6	SB	A	7.6

1. Movement (EB = eastbound; WB = westbound; L = dedicated left turn; R = dedicated right turn; LT = shared left-through)
2. Delay measured in seconds of delay for the worst controlled approach

It is noted that the eastbound left turn movement at Blakely Ave and Bucklin Hill Road, operates at LOS C, and is approaching LOS D in the 7-8 AM period. The "C" to "D" delay threshold is 25 seconds.

v. Safety

Crash statistics, between 2011 and 2015, within the study area were provided by WSDOT and are summarized in Table 5.

Table 5: Collision History 2011-2015

Location	Reported Collisions					
	2011	2012	2013	2014	2015	Avg.
Blakely Ave at Bucklin Hill Road	1	0	0	1	0	0.4
Blakely Ave at Baker Hill Road	0	0	0	0	0	0.0
Baker Hill Road at Pleasant Beach Drive	0	1	0	1	0	0.4
Blakely Ave south of school	0	1	1	0	0	0.4
Baker Hill Road: Pleasant Beach Drive to Blakely Ave	1	0	0	0	0	0.2

Between 2011 and 2015 there seven crashes reported in the study area, none of which resulted in a fatality. Of the seven crashes only two were reported as resulting in a "possible" injury.

The crash types are summarized below:

- Three were classified as "entering at angle", where one vehicle collides with another vehicle turning through an intersection.
- One involved a vehicle driving over an embankment.
- One involved a vehicle colliding with a mailbox and the driver was cited as being impaired.
- One involved a rear end collision, whereby the vehicles involved were following too closely.
- One involved a vehicle making an improper turn and colliding with a parked vehicle in a driveway, just south of the elementary school.

The collisions reports are not of a frequency, consistent type or involve obvious road deficiencies to warrant more detailed investigation.

5. Future Year 2019 Year of Opening Conditions

This section of this report evaluates future year 2019 conditions without and with the school. Future conditions include local and regional traffic growth related to new trips generated within the study area, planned transportation improvements, and projected school-generated trips.

Year 2019 corresponds to the anticipated year of opening for the new school.

i. Future Traffic Conditions

Between now and 2019 traffic volume growth includes general regional traffic growth, local traffic growth, the latter related to new development activity, and new school generated trips.

a. Without-New School

A 1% annual growth rate was applied to the existing turning movement volumes to forecast future conditions without the expanded school. This is generally consistent with the growth projections from the City of Bainbridge Island's Comprehensive Plan. This accounts for regional traffic growth and local traffic growth related to new development activity.

Figure 6 illustrates the future year 2019 without-new school traffic volumes.

b. With-New School

Year 2019 with-new school traffic volumes were forecast by adding the future growth associated with the school-generated trips (see Figures 3 and 4) to the without-new school traffic volumes (Figure 6).

Figure 7 illustrates the future year 2019 traffic volumes with a 450-student new school, representing traffic conditions with the anticipated near-term growth.

Figure 8 illustrates the future year 2019 traffic volumes with a 600-student new school, representing traffic conditions with the school at full-capacity.

ii. Level of Service

Table 6 summarizes the future intersection LOS, and shows that the increases in student enrollment are forecast to incrementally increase delay at the study intersections and at the new site accesses.

In year 2019, the study intersections operate at LOS C or better and satisfy the City's standard, except Blakely Ave and Bucklin Hill Road and Blakely Ave and Baker Hill Road, in the 7-8 AM period.

During the 7-8 AM period at Blakely Ave and Bucklin Hill Road:

- Without expansion of the existing school, the eastbound approach from Bucklin Hill Road operates at LOS C and the left turn movement operates at LOS D with 26 seconds of delay, which is a 2 second increase in delay from year 2016 existing conditions.
- With an enrollment of 450 students, the eastbound approach from Bucklin Hill Road drops to LOS D and the left turn movement operates at LOS D with 30 seconds (+4 seconds) of delay.
- With full capacity (600 students), the eastbound approach from Bucklin Hill Road also drops to LOS E and the left turn movement drops to LOS F with 51 seconds (+21 seconds) of delay.

During the 7-8 AM period at Blakely Ave and Baker Hill Road and with school expansion to full capacity (600 students), the eastbound approach from Baker Hill Road is forecast to operate at LOS E, with 39 seconds of delay. Delay increases by 17 seconds with full capacity compared to the near-term expansion of 450 students. In the near-term, the eastbound approach operates at LOS C.

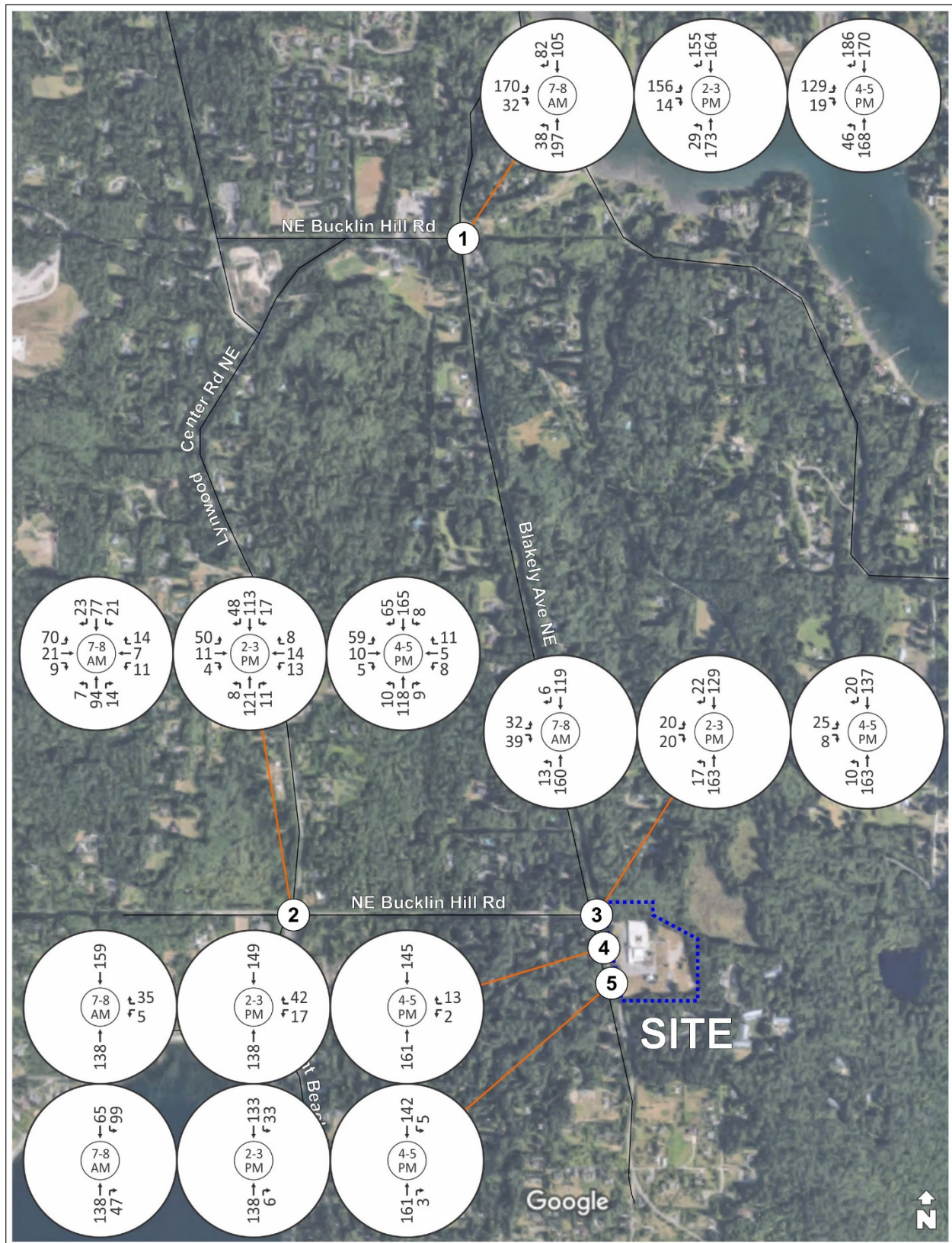


Figure 6: 2019 Without-New School Volumes

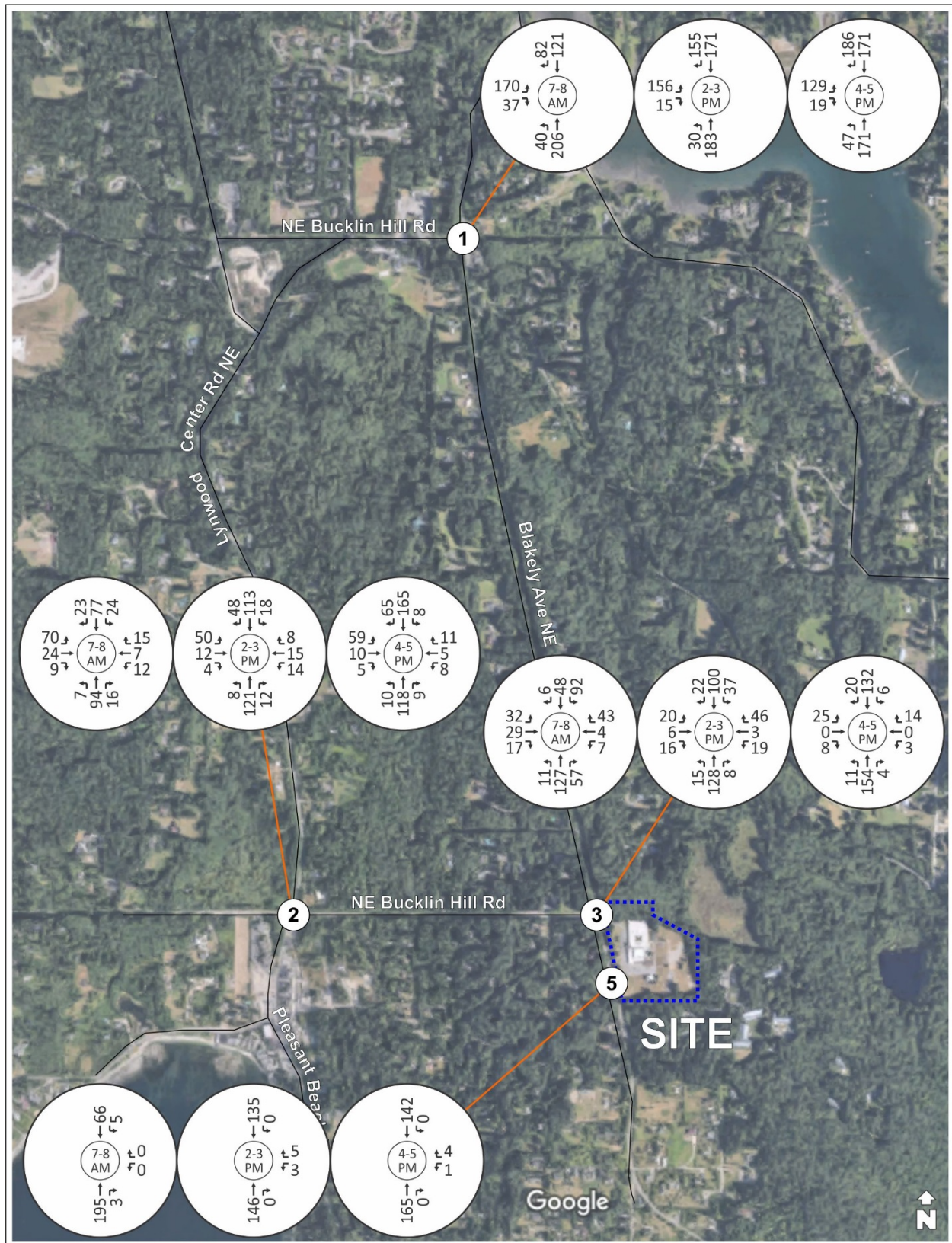


Figure 7: 2019 With-New School (450 students) Volumes

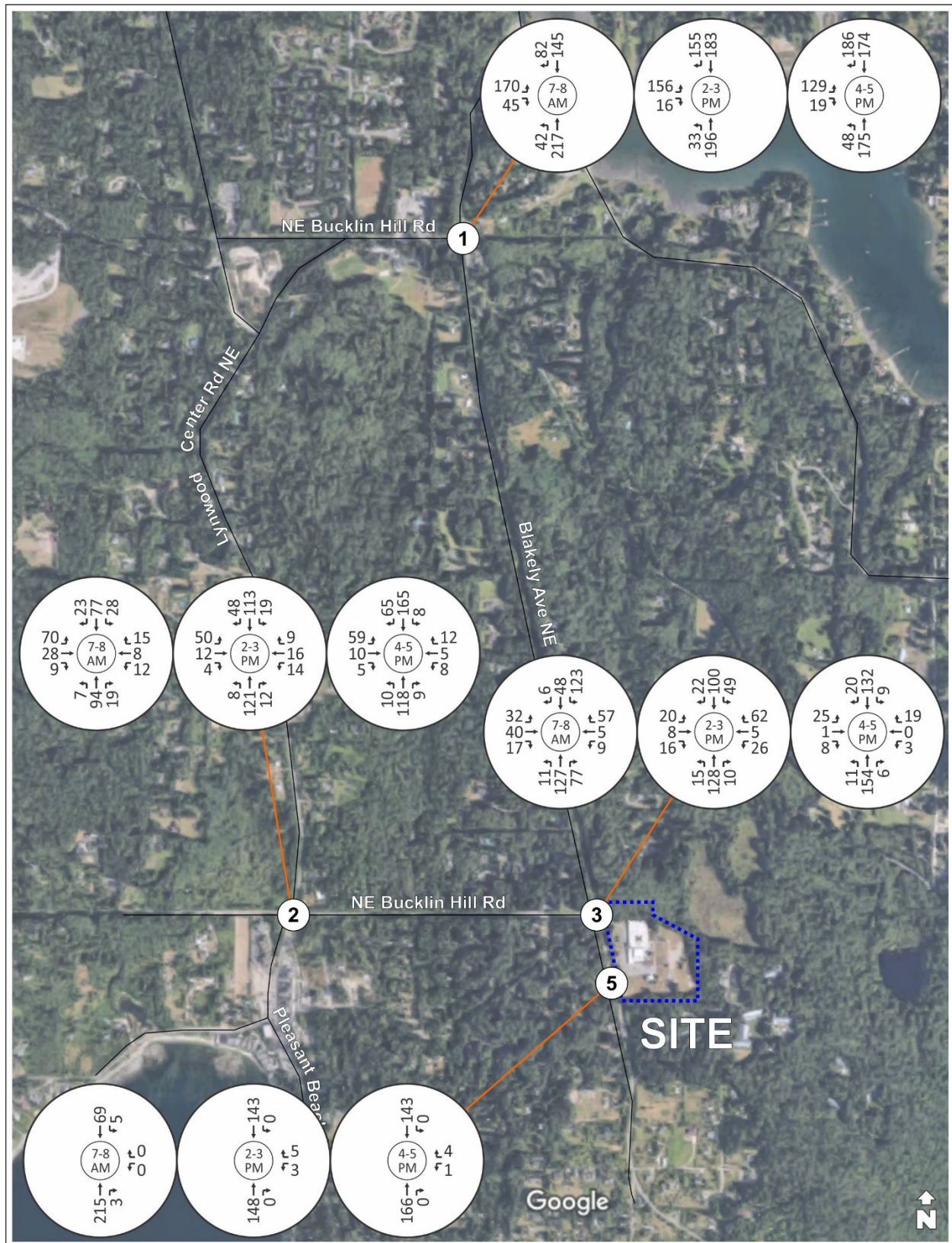


Figure 8: 2019 With-New School (600 students) Volumes

Table 6: 2019 Intersection LOS

Intersection	AM Peak (7-8 AM)			Afterschool (3-4 PM)			PM Peak (4-5 PM)		
2019 With Existing School	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
Blakely/Bucklin Hill	EB L	D	26.4	EB L	C	18.1	EB L	C	17.2
Pleasant Beach/Baker Hill	EB	B	13.7	EB	B	12.8	EB	B	13.7
Blakely/Baker Hill	EB	B	12.1	EB	B	10.5	EB	B	10.8
Blakely/N School Driveway	WB	B	10.6	WB	B	10.2	WB	A	9.5
Blakely/S School Driveway	SB	A	8.2	SB	A	7.6	SB	A	7.6
2019 With 450 students (Near-Term)	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
Blakely/Bucklin Hill	EB L	D	29.9	EB L	C	18.8	EB L	C	17.4
Baker Hill/Pleasant Beach	EB	B	14	EB	B	13	EB	B	13.7
Blakely/Baker Hill/N School Driveway	EB	C	22.5	EB	B	11.9	EB	B	11.4
	WB LT	C	18	WB LT	B	12.9	WB LT	B	11.6
Blakely/Baker Hill/S School Driveway	SB	A	7.9	WB	A	9.7	WB	A	9.7
2019 With 600 students (Capacity)	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
Blakely/Bucklin Hill	EB L	E	50.8	EB L	C	20.1	EB L	C	17.6
Baker Hill/Pleasant Beach	EB	B	14.5	EB	B	13	EB	B	13.8
Blakely/Baker Hill/N School Driveway	EB	E	39.2	EB	B	12.5	EB	B	11.6
	WB LT	C	24.3	WB LT	B	13.8	WB LT	B	11.7
Blakely/Baker Hill/S School Driveway	SB	A	8	WB	A	9.8	WB	A	9.7

3. Movement (EB = eastbound; WB = westbound; L = dedicated left turn; R = dedicated right turn; LT = shared left-through)

4. Delay measured in seconds of delay for the worst controlled approach

iii. Mitigation Analysis

a. Blakely Ave and Bucklin Hill Road (7-8 AM)

The eastbound left turn movement is forecast to operate at LOS D without expansion of the existing school and with the near-term expansion of school's enrollment to 450 students, and at LOS E with full expansion of the school's enrollment to 600 students. The following summarizes the mitigation analysis:

- Do nothing
- Add turn lanes
- Add stop signs on all approaches (all-way stop control)
- Construct a mini-roundabout

Do Nothing

Since the LOS D/E impacts occurs in the morning, and not in the afternoon, the morning delay experienced by drivers at this intersection is "normal" and expected. Mitigation for one time-period may result in other unanticipated impacts.

Southbound Right Turn Lane

Turn lanes or pockets would require additional right-of-way. The WSDOT Design Manual was used to justify turn lane warrants for future conditions with the near-term and full-capacity expansions.

Figure 9 includes right turn lane analysis and shows that a southbound right turn pocket or taper may be considered based on future 7-8 AM volumes. With a southbound right turn pocket, the eastbound left could operate at LOS C and meet the City's standard, without school expansion.

A southbound right turn pocket will not improve the eastbound left turn delay enough with the school expansion; and thus, would does not support elementary school traffic from 7-8 AM.

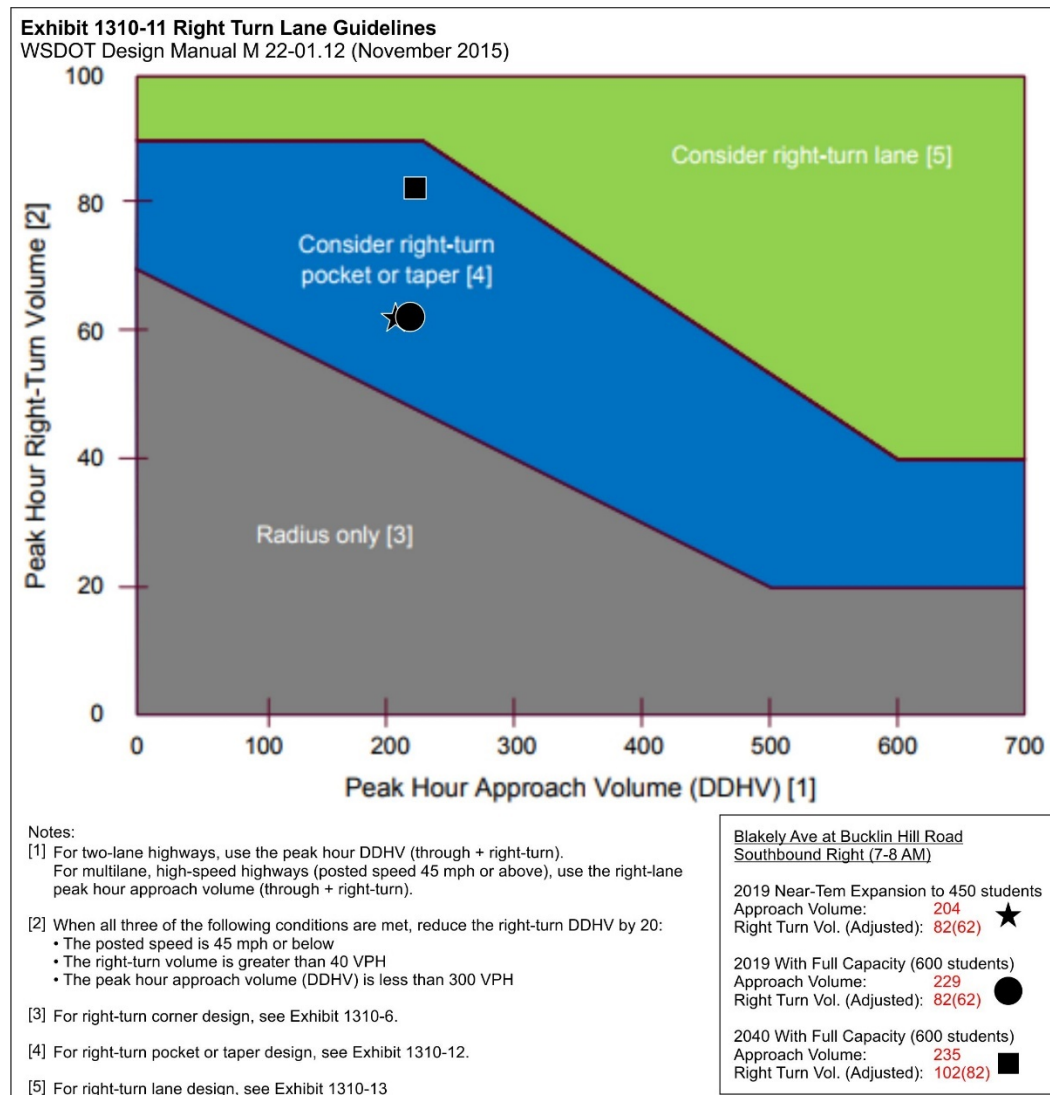


Figure 9: Right Turn Lane Warrant Blakely Ave and Bucklin Hill Road 7-8 AM Volumes

All-Way Stop Control

All-way stop control does not require a “warrant” analysis. Adding stop signs to Blakely Ave at Bucklin Hill Road would increase travel times on Blakely Ave, due to traffic being required to stop on all legs of the intersection. With stop signs on Blakely Ave, traffic from Bucklin Hill Road be able enter or cross Blakely Ave with the cross traffic stopped.

The addition of all-way stop control would improve the eastbound LOS to C and the overall intersection would operate well at LOS B with expansion of the school to up to 600 students.

Mini-Roundabout

Mini-roundabouts are generally applicable at the junctions of two-lane roads, when road-way speeds are 35 mph or less, and when the total entering volume from all approaches is less than 1,600 vehicles per hour. Transit activity would need to be considered with a mini-roundabout design.

Compared to an all-way stop, the mini-roundabout has less impact on travel times on the corridor, when design properly. Unlike a typical roundabout, such as at High School Road and Madison Ave, a mini-

roundabout is designed with a smaller footprint (50 to 80 feet inscribed diameters) and may fit within the existing travel-way without needing to acquire additional right-of-way.

As a mini-roundabout the intersection operates LOS A and satisfies the City's LOS standards.

Signal control warrants were not reviewed with this analysis. It does not appear that the vehicle volumes through the intersection will support a traffic signal.

Table 7 compares the mitigation options for Blakely Ave and Bucklin Hill Road.

Table 7: 2019 Intersection LOS Blakely/Bucklin Hill Mitigation AM Peak (7-8 AM)

2019 With Existing School	AM Peak (7-8 AM)					
	Mvmt. ¹	LOS	Delay ²	Trips ³	Volume ⁴	Share ⁵
Do Nothing	EB L	D	26.4			
Southbound Right	EB L	C	22.3			
All-Way Stop	Avg.	B	13.6			
2019 With 450 students (Near-Term)	AM Peak (7-8 AM)					
	Mvmt. ¹	LOS	Delay ²	Trips ³	Volume ⁴	Share ⁵
Do Nothing	EB L	D	29.9			
All-Way Stop	Avg.	B	14.4	31	661	4.7%
Mini-Roundabout	EB	A	9.4			
2019 With 600 students (Capacity)	AM Peak (7-8 AM)					
	Mvmt. ¹	LOS	Delay ²	Trips ³	Volume ⁴	Share ⁵
Do Nothing	EB L	E	50.8			
All-Way Stop	Avg.	C	15.6	76	707	10.8%
Mini-Roundabout	EB	A	9.5			

1. Movement (EB = eastbound; L = dedicated left turn; R = dedicated right turn); Avg. = Average for Intersection
2. Delay measured in seconds of delay for the worst controlled approach
3. New school-generated trips
4. 2019 Volume
5. Proportionate Share = Trips ÷ 2019 Volume

Either an all-way stop or mini-roundabout would allow the intersection to function within the City's LOS standards in year 2019 with expansion of the school to up to 600 students.

b. Blakely Ave and Baker Hill Road and North (Primary) School Driveway (7-8 AM)

The School District's near-term proposal to increase the enrollment to 450 students supports the City's LOS standards at the Blakely Ave and Baker Hill Road intersection.

The eastbound left turn movement is forecast to operate at LOS E with full expansion of the school's enrollment to 600 students. It is unlikely the school will reach its student capacity (600 students) by 2019. And thus, no mitigation is required in the near-term, since the LOS E impacts are only identified in the 7-8 AM period with the school at full capacity.

More detailed analyses of site access considerations are reviewed in Section 7 of this report.

iv. Safety

As stated earlier in this document, the crash history did not show any significant concerns in the study area. Furthermore, recent crash reports, did not shows crashes in the study area in 2015.

6. Future Year 2040 Conditions

This section documents long range traffic conditions in year 2040 without and with the Project. The long-range horizon year analysis is intended to assist with the City of Bainbridge Island's Comprehensive Planning. While this long-range analysis is included in this Traffic Impact Study, any incremental school expansion impact and associated mitigation will be proportionated to the impacts of all traffic growth in the study area.

As indicated earlier in this report, the new school is proposed to accommodate a capacity of 600 students. To document the potential impacts of the school, school traffic with the school at full capacity was evaluated for the 2040 conditions only.

i. Traffic Conditions

A 1% annual growth rate was applied to the existing traffic volumes to forecast future traffic growth between now and year 2040 to account for regional traffic growth and local traffic growth.

Figure 10 illustrates the year 2040 without-new school peak hour traffic volumes. Figure 11 illustrates the year 2040 with a new school at full capacity (600 students).

ii. Level of Service

Table 8 summarizes the future without and with new school intersection LOS. Copies of the intersection capacity reports are included in the Appendix.

For the year 2040 LOS analysis the PHF were not changed. This assumes that existing traffic flows remain the same and that increased congestion due to growth between 2016 and 2040 does not occur. This is a conservative approach to evaluating future conditions.

Table 8: 2040 Intersection LOS

Intersection	AM Peak (7-8 AM)			Afterschool (2-3 PM)			PM Peak (4-5 PM)		
2040 with Existing School	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
Blakely/Bucklin Hill	EB L	F	62.0	EB L	D	26.6	EB L	D	25.7
Pleasant Beach/Baker Hill	EB	B	16.5	EB	B	15	EB	B	16.7
Blakely/Baker Hill	EB	B	14.4	EB	B	11.1	EB	B	11.6
Blakely/N School Driveway	WB	B	11.1	WB	B	10.6	WB	A	9.8
Blakely/S School Driveway	SB	A	8.4	SB	A	7.7	SB	A	7.7
2040 with 600 students (Capacity)	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
Blakely/Bucklin Hill	EB L	F	104.3	EB L	D	31.4	EB L	D	26.4
Baker Hill/Pleasant Beach	EB	C	17.8	EB	C	15.1	EB	C	16.7
Blakely/Baker Hill/N School Driveway	EB	F	62.9	EB	B	13.7	EB	B	12.6
	WB LT	D	28	WB LT	B	15.3	WB LT	B	12.7
Blakely/Baker Hill/S School Driveway	SB	A	8.8	WB	B	10.1	WB	B	10.1

1. Movement (EB = eastbound; WB = westbound; L = dedicated left turn; R = dedicated right turn; LT = shared left-through)

2. Delay measured in seconds of delay for the worst controlled approach

In year 2040 with increased enrollment all study intersections are forecast to operate at LOS C or better, except Blakely Ave and Bucklin Hill Road, in the 7-8 AM, 2-3 PM and 4-5 PM periods, and Blakely Ave and Baker Hill Road, in the 7-8 AM period.

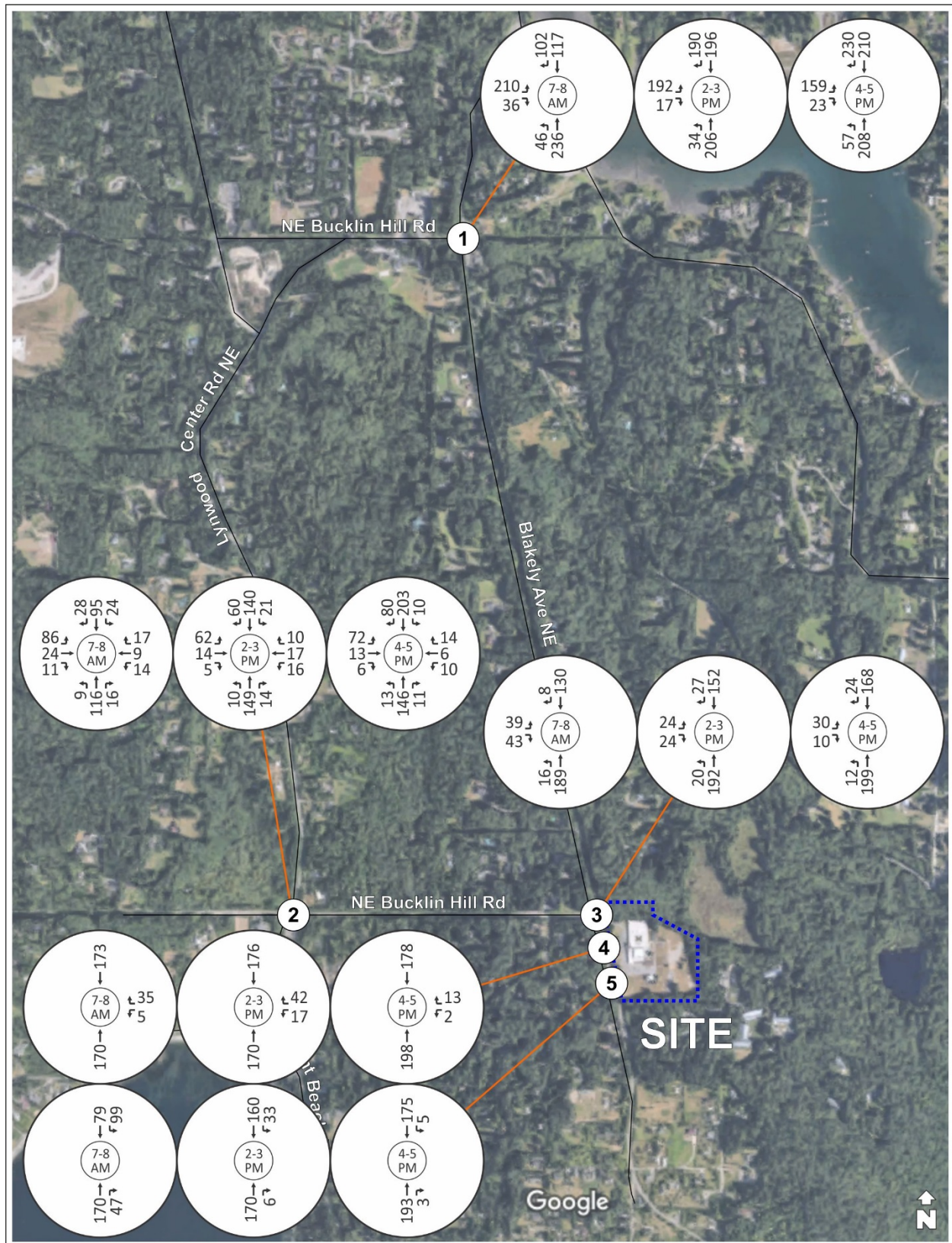


Figure 10: 2040 Without-New School Volumes

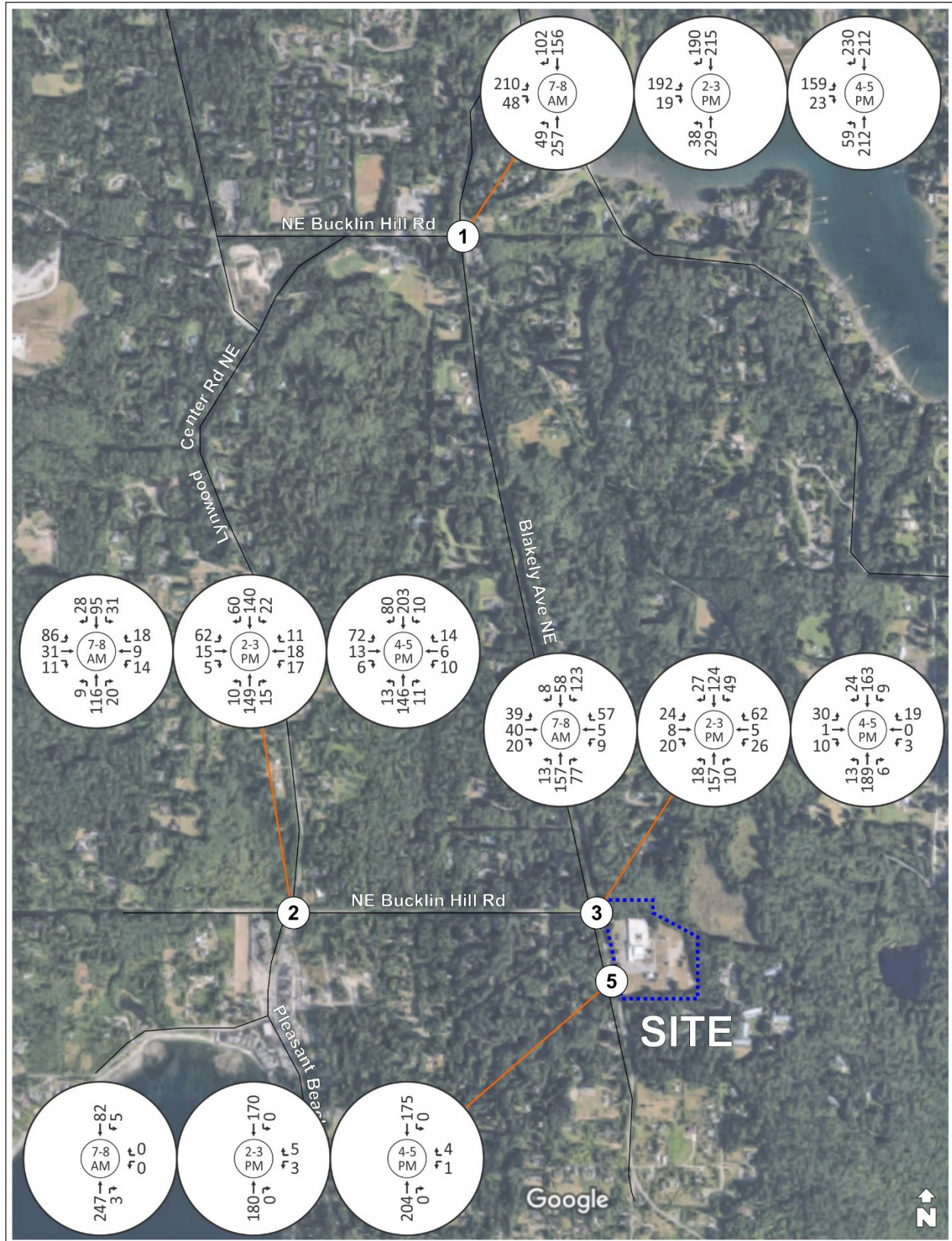


Figure 11: 2040 With-New School Full Capacity (600-students) Volumes

iii. Mitigation Analysis

a. Blakely Ave and Bucklin Hill Road

- During the 7-8 AM period, without and with expansion of the existing school, the eastbound left turn movement operates at LOS F. Eastbound left turn delay increases by 42 seconds between without and with expansion conditions.
- During the 2-3 PM period, without and with expansion of the existing school, the eastbound left turn movement operates at LOS D. Eastbound left turn delay increases by 5 seconds between without and with expansion conditions.
- During the 4-5 PM period, without and with expansion of the existing school, the eastbound left turn movement operates at LOS D. Eastbound left turn delay increases by 1 second between without and with expansion conditions.

Southbound Right Turn Lane

Figure 12 includes right turn lane analysis. A southbound right turn lane is not warranted and a right turn pocket or taper may be considered based on future 7-8 AM volumes. A southbound right turn lane is warranted based on the future 2-3 PM and 4-5 PM volumes.

A southbound right turn pocket lane from Baker Ave to Bucklin Hill Road does not resolve the LOS deficiencies for the eastbound left turn movement during the 7-8 AM period.

All-Way Stop Control

The addition of all-way stop control would improve the eastbound LOS to C and the overall intersection would operate well at LOS B with expansion of the school to up to 600 students.

Mini-Roundabout

As a mini-roundabout the intersection's eastbound approach improves to LOS B or better and satisfies the City's LOS standards.

Table 9 compares the mitigation options for Blakely Ave and Bucklin Hill Road and shows that either an all-way stop or mini-roundabout would allow the intersection to function within the City's LOS standards in year 2019 with expansion of the school to up to 600 students.

Table 9: 2040 Intersection LOS Blakely Ave and Bucklin Hill Road Mitigation

2040 with Existing School	Mvmt. ¹	AM Peak (7-8 AM)			Afterschool (2-3 PM)			PM Peak (4-5 PM)		
		LOS	Delay ²	Share ³	LOS	Delay ²	Share ³	LOS	Delay ²	Share ³
Do Nothing	EB L	F	62.0		D	26.6		D	25.7	
Southbound Right	EB L	E	44.0		C	20.0		C	19.5	
All-Way Stop	Avg.	C	18.8		C	16.0		B	14.6	
Mini-Roundabout	EB	A	9.3		B	10.0		A	9.6	
2040 with 600 students (Capacity)	Mvmt. ¹	AM Peak (7-8 AM)			Afterschool (2-3 PM)			PM Peak (4-5 PM)		
		LOS	Delay ²	Share ³	LOS	Delay ²	Share ³	LOS	Delay ²	Share ³
Do Nothing	EB L	F	104.3		D	31.4		D	26.4	
Southbound Right	EB L	F	70.8		C	22.8		C	20.0	
All-Way Stop	Avg.	C	22.8	9.2%	C	17.7	5.4%	B	14.8	1.5%
Mini-Roundabout	EB	A	9.5		B	10.1		A	9.6	

1. Movement (EB = eastbound; L = dedicated left turn; R = dedicated right turn); Avg. = Average for Intersection
2. Delay measured in seconds of delay for the worst controlled approach
3. Proportionate Share = New school-generation trips ÷ 2019 Volume

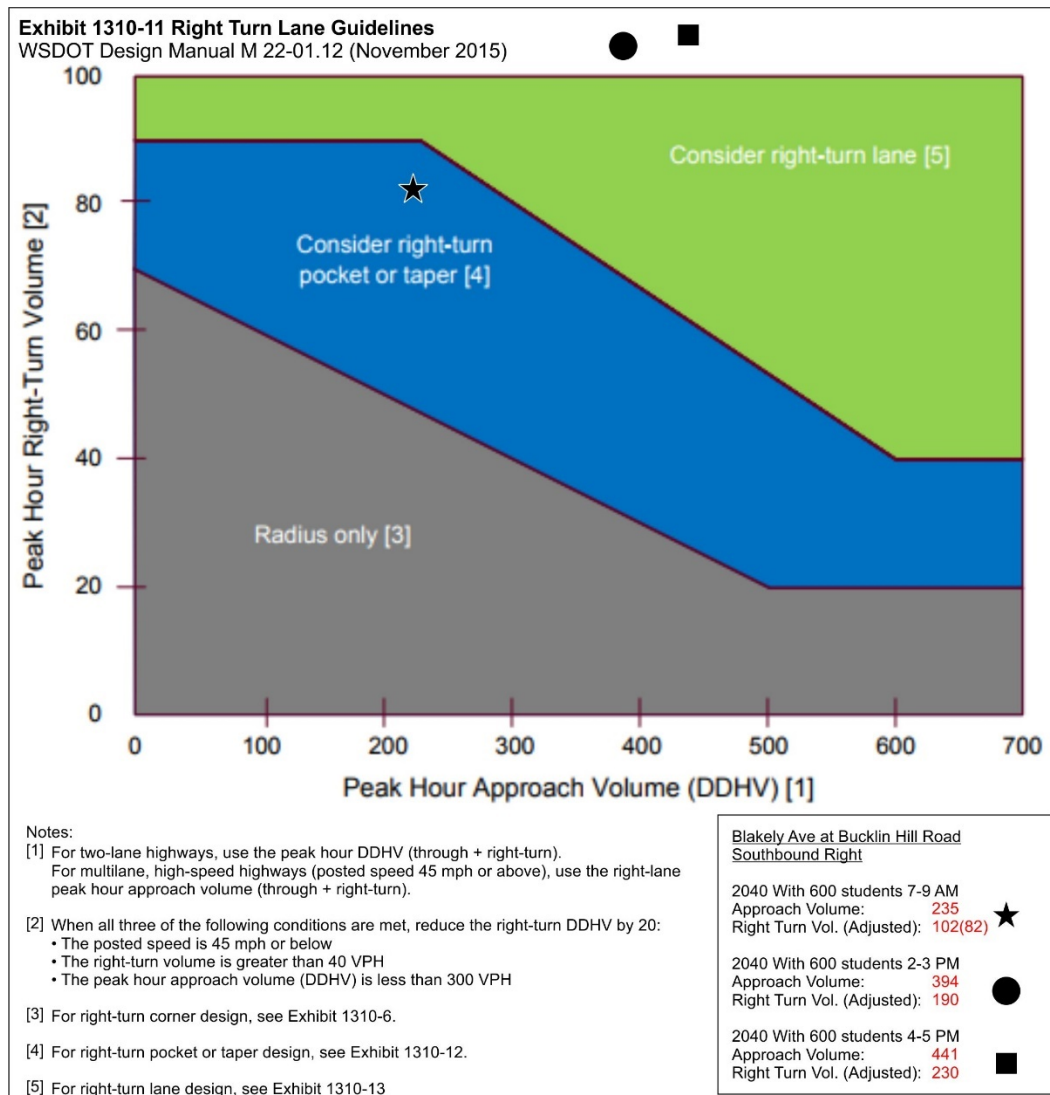


Figure 12: Right Turn Lane Warrant Blakely Ave and Bucklin Hill Road Year 2040 Volumes

b. Blakely Ave and Baker Hill Road and North (Primary) School Driveway (7-8 AM)

During the 7-8 AM period at Blakely Ave and Baker Hill Road and with school expansion to full capacity (600 students), the eastbound approach from Baker Hill Road is forecast to operate at LOS F, with 63 seconds of delay, and the westbound shared left-through movement is forecast to operate at LOS D, with 28 seconds of delay.

The School District's near-term proposal to increase the enrollment to 450 students supports the City's LOS standards at the Blakely Ave and Baker Hill Road intersection.

The eastbound left turn movement is forecast to operate at LOS E with full expansion of the school's enrollment to 600 students. It is unlikely the school will reach its student capacity (600 students) by 2019. And thus, no mitigation is required in the near-term, since the LOS E impacts are only identified in the 7-8 AM period with the school at full capacity.

More detailed analyses of site access considerations are reviewed in Section 7 of this report.

7. Site Access

This section focuses on considerations for design of the school's driveways. Specifically, the new primary school access, at Baker Hill Road, was reviewed for right turn and left turn lane warrants and all-way stop sign control.

i. Northbound Right Turn Lane

Figure 13 includes right turn lane analysis. Future volumes with the school at full capacity (600 students), suggest that a right turn pocket or taper lane may be considered.

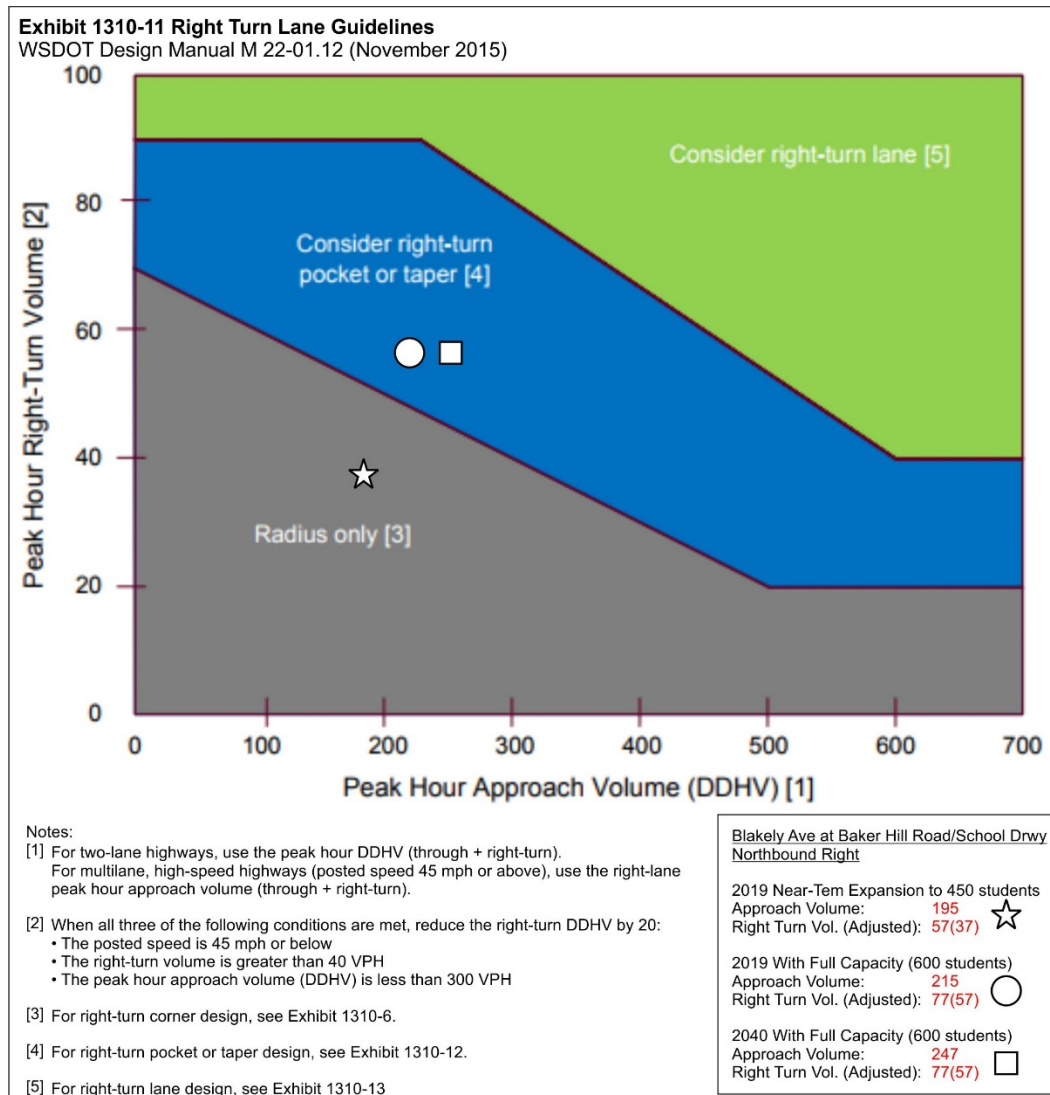


Figure 13: Right Turn Lane Warrant Blakely Ave and Baker Hill Road

The northbound right turn volume is less than 80 vehicles during the 7-8 AM peak hour and is significantly lower during the afterschool peak hours. The addition of a right turn pocket would provide a stacking area off Blakely Ave for vehicles making a right into the school's campus. A turn pocket would require widening the travel-way on Blakey Ave, and this would increase the walking distance for pedestrians crossing the roadway.

At this time, a right-turn pocket is not recommended, this condition is similar to existing conditions.

ii. Southbound Left Turn Lane Analysis

Figure 14 includes left turn lane analysis. It should be noted that Blakely Ave has a 30-mph posted speed limit, and the speed limit is further reduced near the school; thus, the left turn analysis may be conservative.

At full student capacity (600 students), the design hour volumes on Blakely Ave at Baker Hill Road suggest additional left turn lane analysis.

Currently, Blakely Ave includes a landscaped median located about 100 feet north of the Baker Hill Road intersection and the area between the landscaped median and Baker Hill Road could be modified to support a southbound left turn lane for inbound traffic into the school. The left turn lane will require some widening on of Baker Hill Road.

A vehicle queue analysis was prepared using the SimTraffic computer program, which is compatible with Syncho, to model southbound queues with a dedicated left turn lane at Baker Hill Road. Years 2019 and 2040 7-8 AM peak hour conditions with a school enrollment of 600 students show that the 95th-percentile southbound left turn queue is less than 75 feet.

100-feet is the typical minimum recommendation for left turn storage. This typical dimension may require modifications to the existing landscaped median. The City should consider an alternative storage lane length based on additional queuing analysis.

There are eight school buses and five staff parking spaces accessible off the south driveway. The volumes do not suggest the need for a left turn lane at the south access.

Table 10 compares AM, afterschool and PM conditions without and with a southbound left turn on Blakely Ave at Baker Hill Road.

iii. All-Way Stop Control and Mini-Roundabout Analyses

A left turn lane is not required with all-way stop control or a mini-roundabout.

Table 10 compares AM, afterschool and PM conditions without and with all-way stop sign control or a mini-roundabout at Blakely Ave and Baker Hill Road.

Table 10: 2040 Intersection LOS Blakely Ave/Baker Hill/School Driveway Mitigation

2040 with 600 students (Capacity)	AM Peak (7 to 8 AM)			Afterschool (2 to 3 PM)			PM Peak (4 to 6 PM)		
	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²	Mvmt. ¹	LOS	Delay ²
Do Nothing	EB	F	62.9	EB	B	13.7	EB	B	12.6
	WB LT	D	28.0	WB LT	C	15.3	WB LT	B	12.7
Southbound Left	EB	F	60.9	EB	B	13.7	EB	B	12.6
	WB LT	D	27.7	WB LT	C	15.2	WB LT	B	12.7
All-Way Stop	Avg.	B	14.2	Avg.	A	9.8	Avg.	A	9.0
Mini-Roundabout	NB	A	7.8	EB	A	7.6	EB	A	8.7

1. Movement (EB = eastbound; L = dedicated left turn; R = dedicated right turn); Avg. = Average for Intersection
2. Delay measured in seconds of delay for the worst controlled approach
3. Proportionate Share = New school-generation trips ÷ 2019 Volume

A southbound left turn lane does not noticeably improve the intersection's control delay from Baker Hill Road or from the school driveway. Overall, with the left turn lane, southbound travel times on Blakely Ave will improve as through vehicles will not need to wait for a left turning vehicle at the intersection. It is reasonable that during school hours, with children present, stopping behind turning vehicles is advisable, since it will reduce speeds and increase safety for students.

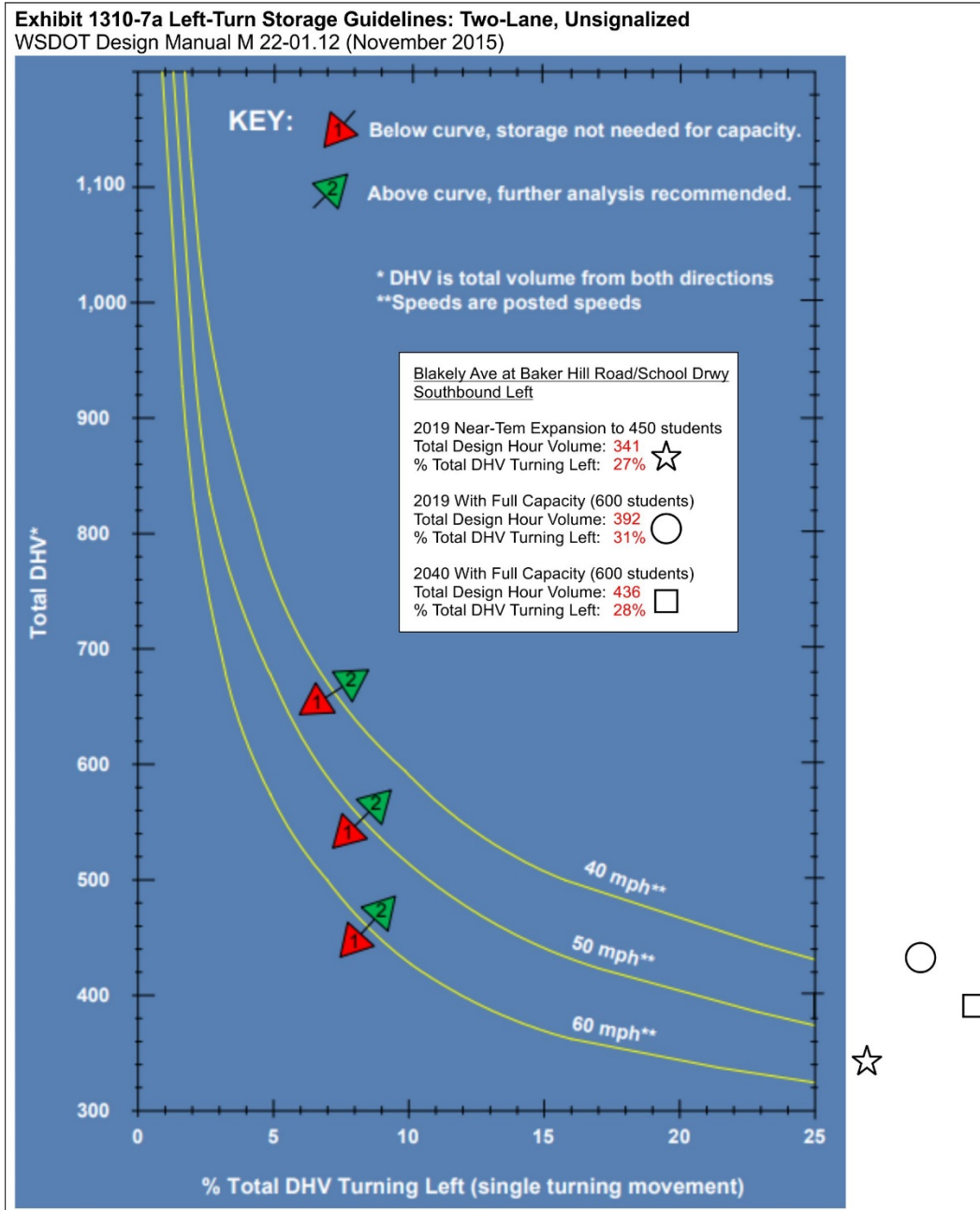


Figure 14: Left Turn Lane Warrant Blakely Ave and Baker Hill Road

Adding stop signs to all intersection approaches improves the LOS from “F” to “B” in the 7-8 AM period. An all-way stop would increase travel times on Blakely Ave, due to traffic being required to stop at the intersection. The all-way stop does not require any widening to the existing travel way on Blakely Ave.

A mini-roundabout improves the LOS from “F” to “A” in the 7-8 AM period. The mini-roundabout would have less of an impact on travel times on Blakely Ave, due to traffic being required to yield at the intersection. The mini-roundabout may require some modification to existing travel way on Blakely Ave and would also need to be designed to support school buses and other large vehicles.

8. Access Design

The Applicant's engineer is recommended to provide design support that both new driveways can effectively accommodate respective design vehicles.

During a meeting with City staff and the Applicant, on March 30, 2017, staff indicated that they were comfortable with the proposed design of the primary access, which is bisected by an existing utility pole. As stated above, the Applicant's engineer is recommended to supply design support to show that this median in the driveway can work with the appropriate design vehicles.

i. **Sight Distance**

The AASHTO Green Book documents stopping sight distance (SSD) and intersection, or entering, sight distance (ESD) guidelines. AASHTO recommends the accesses meet 305 feet of SSD and 445 feet of ESD.

Vegetation and landscaping along the site frontage and within the right-of-way should be trimmed and pruned to support the sightlines at the site accesses. Near the site, Blakely Ave is relatively straight and the grade increases gradually from south to north, but does not create a vertical sightline obstruction.

ii. **Maximum Vehicle Queue**

The 2010 TexITE Technical Paper Award, by Dustin W. Qualls, PE, PTOE Principal Traffic Engineers, Inc., entitled "*The Greening of Student Pick-Ups at School Dismissal*" reviewed observed vehicle queues during parent pick-up times at 55 elementary schools around the Houston, Texas, metropolitan area between 2007 and 2009.

Based on the data surveyed, a regression equation was developed to express the maximum queue length based on total enrollment:

$$Q = 0.05 \times S + 19$$

where:

Q = Maximum Queue Length (vehicles)

S = Total Enrollment (students)

The study also, provided a recommended "rule-of-thumb" for estimating the maximum queue as:

$$Q = 0.06 \times S$$

The regression equation and "rule-of-thumb" recommendation show that a 600-student elementary school will have a maximum queue between 36 and 49 vehicles.

iii. **Onsite Storage and Operations Recommendations**

Figure 15 highlights the primary parking lot. The current site plan shows 67 marked vehicle spaces in the primary lot including 48 angled parking spaces and 19 parallel spaces for student pick-up and drop off, and staff and teacher parking. There is approximately 725 linear feet in the drive-aisle for additional vehicle stacking, which is equivalent to about 36 vehicles.

Figure 16 highlights the south parking lot. The south driveway provide access for school bus parking and loading and unloading (up to 8 long-school buses) and staff parking for 5 vehicles.

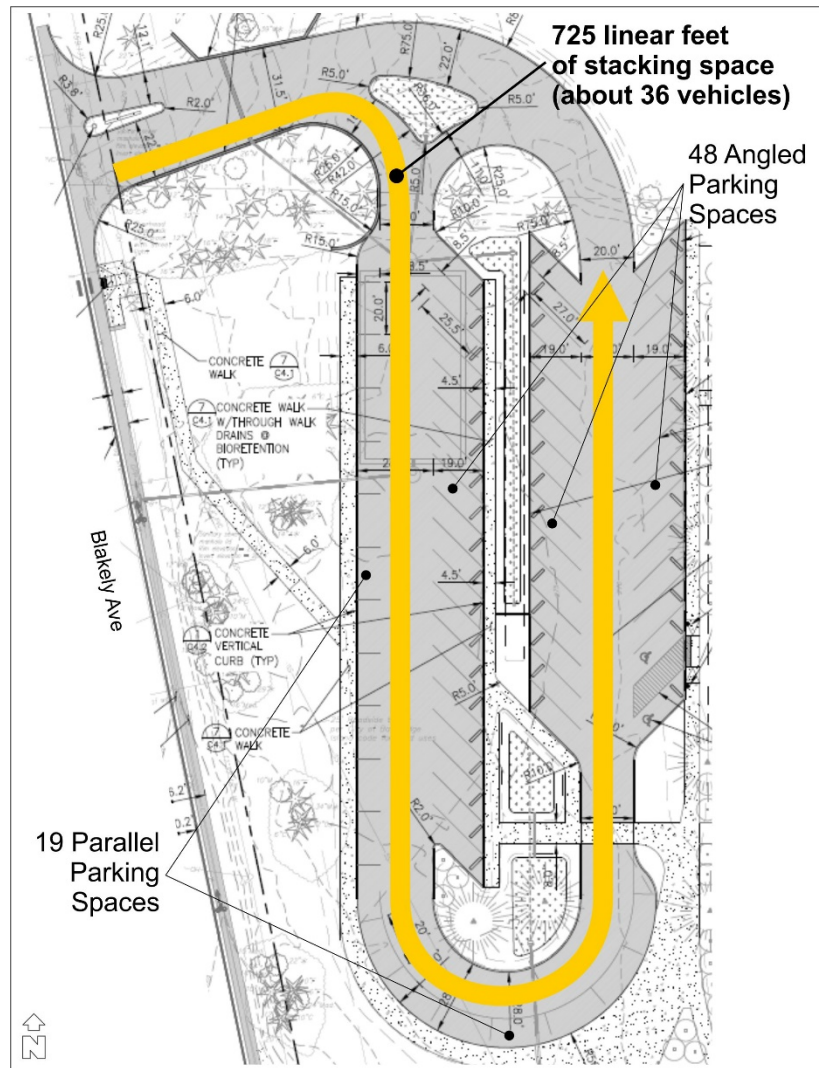


Figure 15: Primary Parking Lot Vehicle Stacking

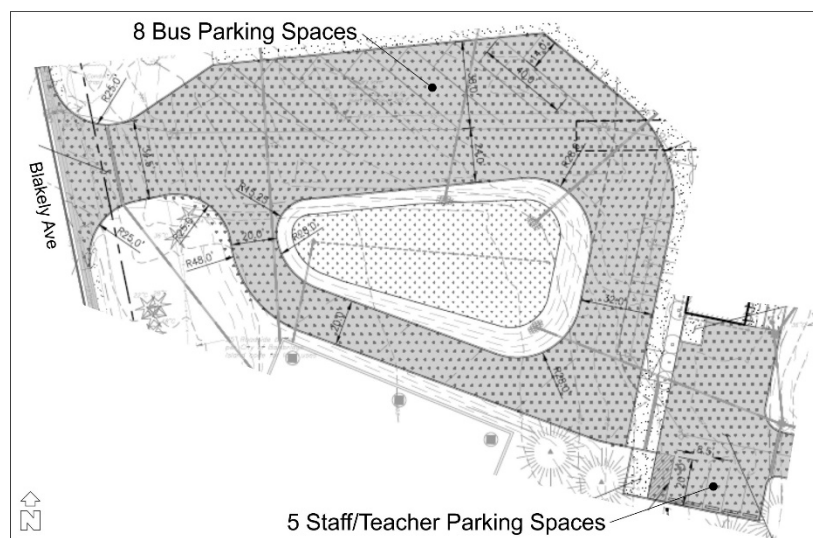


Figure 16: South Parking Lot Parking Area

Assuming that at maximum capacity the student-to-teacher ratio will equal the Washington State's average student-to-teacher ratio of 18:1, then with 600 students the elementary school is anticipated with 36 teachers. It is reasonable to assume that some teachers and staff will not need parking on the campus; thus, we assume at minimum 36 of the campus' 53 non-parallel parking spaces in both the primary and south parking lots will be occupied by school staff and teachers.

The remaining 17 parking spaces plus the 19 parallel spaces (36 spaces total) will be available afterschool for parents to park in to pick up students. This excludes the drive aisle area which could also be used to accommodate additional stacking onsite (up to 36 more vehicles).

Using the maximum queue recommendations from the Texas study, an elementary school with 600 students would need space onsite for between 36 and 49 vehicles to queue up waiting to pick up students.

We estimate about 36 marked parking spaces available for parent pickup after school and, if needed, additional stacking space in the drive aisle would allow up to 36 more vehicles to queue onsite. The onsite area available for vehicle queuing is reasonable to support the elementary school expansion.

It was not mentioned, if in the past there were significant queuing problems with the existing campus. The proposed primary parking area, does provide more storage capacity than the current campus layout, and should be able to accommodate more vehicle traffic.

School staff and teachers are recommended to assist with student pick-up and drop off to optimize circulation onsite.

9. Conclusions

i. Summary

Captain Johnston Blakely Elementary School is proposed to expand from 350 students to 450 students, by 2019, with the future campus' student capacity at 600 students.

With 450 students, the school is forecast to generate 53 new 7-8 AM peak hour trips; 28 new 2-3 PM afterschool peak hour trips; and 9 new 4-5 PM peak hour trips.

At full capacity (600 students), the school is forecast to generate 132 new 7-8 AM peak hour trips; 70 new 2-3 PM afterschool peak hour trips; and 19 new 4-5 PM peak hour trips.

In year 2019, at the time of near-term occupancy (450 students) the LOS at all study intersections operate at LOS C or better and satisfy the City of Bainbridge's LOS C standard, except Blakely Ave and Bucklin Hill Road. The intersection is forecast to operate at LOS D in the 7-8 AM period in 2019 without and with near-term occupancy.

In year 2019, at the time of full campus (600 students) the LOS at all study intersections operate at LOS C or better and satisfy the City of Bainbridge's LOS C standard, except Blakely Ave and Bucklin Hill Road and the site access at Blakely Ave and Baker Hill Road. Both intersection's forecast to operate at LOS E in the 7-8 AM period in 2019 with full occupancy. Full occupancy is not anticipated by 2040 and, thus near-term mitigation for a 600-student campus is unreasonable.

By year 2040, conditions at Blakely Ave and Bucklin Hill are forecast to drop to LOS F in the 7-8 AM period and to LOS D in the 2-3 PM and 3-4 PM periods without and with the school's expansion.

The maximum queue, related to parent pick-up, was forecast using data compiled for elementary schools in Texas. With a maximum enrollment of 600 students, the maximum queue is forecast between 36 and 49 vehicles onsite.

The proposed site plan has sufficient capacity to support the maximum queue forecasted.

ii. Mitigation

a. Frontage Improvements

Frontage improvements will be required per the City of Bainbridge Island Design and Construction Standards.

b. Offsite Intersection Improvements

Traffic impacts and associated mitigation for any development are based on the impact at time of stable occupancy under SEPA. While the cumulative impacts associated with longer term time horizons and traffic growth are evaluated in the TIA, the mitigation needs to remain related and roughly proportional to the project-generated portion of the traffic impact.

A "do nothing" conditions, southbound right-turn pocket, all-way stop sign control and a mini-roundabout were reviewed for their benefits to improve future 7-8 AM conditions at Blakely Ave and Bucklin Hill Road.

The "do nothing" analysis assumes, that the drivers are accustomed to the delays at Blakely Ave and Bucklin Hill Road and since the intersection operates sufficiently in 2019 in the afternoon analyses, mitigation may not be required.

The southbound right-turn pocket was justified, but did not effectively mitigate the eastbound left turn delay to LOS C or better.

All-way stop control, does not affect the existing right-of-way. With all-way stop control, the intersection LOS improves to “B” with the near-term expansion. All-way stop control will increase travel times on Blakely Ave with the stop sign applications.

The mini-roundabout showed fewer delay impacts, although design considerations may require minimal additional right-of-way and the design will need to effectively accommodate school bus, public transit and heavy vehicle traffic.

If sufficient right-of-way is available and there is sufficient support from the City and School District, then a mini roundabout is recommended to improve delays at this intersection.

c. Site Access Improvements

Northbound right turn lanes are not recommended for the site accesses. The staff and school bus volumes at the south access do not justify a right turn lane.

The primary access does generate enough traffic to warrant consideration of a right turn pocket or taper. However, to reduce the pedestrian crossing distance on Blakely Ave and to provide traffic calming for northbound vehicles, a right turn pocket is not recommended at the primary access.

A southbound left turn lane was reviewed. However, the southbound left turn lane does not noticeably improve intersection delay and would require additional right-of-way from Blakely Ave.

All-way stop sign control at the Blakely Ave, Baker Hill Road and primary school access intersection was found to reduce delays to conditions which satisfy the City’s LOS threshold in 2040 with the campus at full capacity (600 students).

A mini-roundabout was also reviewed, and it too shows delays satisfying the City’s LOS threshold in 2040 with the campus at full capacity (600 students).

At the site access, all-way stop control is recommended, to minimize any right-of-way constraints and to require approaching vehicles stop at the intersection to watch for school children.

In addition to the 2040 access control recommendations, the Applicant is recommended to provide supporting design information to show that the accesses are design appropriately and that the median bisecting the north driveway is reasonable.

d. Other Recommendations

School staff and teachers are recommended to assist with site circulation during student drop-off and pick-up times. Assistance may include, assisting drivers using the parking spaces and ushering students to queued-up vehicles.

In advance of school events, we recommend coordinating with neighbors to minimize impacts to their properties and so that they may plan accordingly.