

DRAFT

TRANSPORTATION TECHNICAL REPORT

for

Sartori Elementary School

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August 26, 2016

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1. INTRODUCTION

This report presents the transportation impact analysis for the proposed new Sartori Elementary School planned at 315 Garden Avenue N in Renton. It includes a description of existing and proposed conditions in the site vicinity, projected trip generation and distribution pattern, operational analysis where site-generated traffic would access the street system, and an assessment of the project’s impacts to transit service and non-motorized facilities. The study area for this analysis was defined by City of Renton (City) review staff.¹ All other elements of the analysis presented in this report follow the City’s *Traffic Impact Analysis Policy Guidelines for New Development*.² In addition to the analysis required in the policy guidelines, this report provides additional analysis of site access operations, queueing, special event conditions, and construction-related transportation impacts.

1.1. Project Description

The site consists of 14 parcels bounded by N 4th Street on the north, Park Avenue N on the west, Garden Avenue N on the east, and N 3rd Street on the south. The site location and vicinity are shown on Figure 1. Some uses at the site have already been vacated and/or demolished. However, at the time of this analysis some other uses were still occupied and operating. Table 1 presents a summary of the site’s existing uses, based on King County Assessor data.³

Table 1. Existing Site Uses

Types of Uses	Size / Number of Units
Public School (Sartori Education Center)	39,284 sf
Residential units	11 units ^a
Office (converted single family residence)	1,720 sf
Commercial (includes retail, supermarket, restaurant, drive-thru espresso stand)	7,100 sf ^b

sf = square feet

- a. Includes nine single family residences plus one duplex.*
- b. Includes two buildings at 314 Park Avenue N consisting of a 6,390 sf supermarket / deli and fast-food restaurant; and a separate 96-sf espresso stand. It also includes 614-sf of the single-family residence building at 350 Park Avenue N, which was permitted as a retail dog grooming business.*

The existing school has on-site parking with about 83 striped stalls; the supermarket/restaurant site has a large paved area with about 17 marked spaces and additional unmarked pavement (review of historic aerials indicated that up to 46 spaces have been striped on this site). Most of the single family residences have driveways and/or garages that serve on-site parking. The overall site has numerous curb cuts that provide access to the various parcels. There are six curb cuts along N 3rd Street, one on N 4th Street, and five on Park Avenue N. There are no curb cuts on Garden Avenue N.

The project would remove all existing structures and parking on the site and construct a new elementary school with approximately 79,000 square feet (sf) and capacity for up to 650 students (kindergarten through 5th grade). The proposed site plan is shown on Figure 2. The new school is proposed to include about 83 parking spaces in two surface lots (north and south). Visitors and staff would access the south lot from a driveway on N 3rd Avenue; additional staff parking and family-vehicle load/unload would be directed to the north lot with access from N 4th Street. School buses are proposed to load and unload curbside on the west side of Garden Avenue N.

¹ Email communication: I. Fitz-James, Renton Department of Community & Economic Development, Aug. 1, 2016.

² City of Renton, Rev. January 2016.

³ King County Assessor website data, accessed, August 10, 2016.



Figure 1
Site Location and Vicinity

2. BACKGROUND CONDITIONS

2.1. Roadway Network

2.1.1. Existing Network

The City designates streets as principal arterials, minor arterials, collectors, and local access streets depending upon the street's function in the roadway network.⁴ The key roadways in the vicinity of the project site are described below.

Garden Avenue N is a two-way, north-south roadway that provides connection between Bronson Way N to the south and N Park Drive to the north. North of N 4th Street, the roadway is a three- to four-lane Minor Arterial. South of N 4th Street, it is a two-lane local access street with on-street parking on both sides. It has a posted speed limit of 25 mph. In the vicinity of the site the roadway has curbs, gutters, and sidewalks on both sides. Its intersections with N 3rd Street and N 4th Street are signalized with crosswalks on all sides. On-street parking is permitted on both sides; however, parking is prohibited on the west side adjacent to the school site during school hours, and on the east side is limited to two hours during weekday and Saturday daytime hours.

Park Avenue N is a four-lane Principal Arterial that provides north-south connection between Bronson Way N to the south and N Park Drive to the north. Adjacent to the project site, it has two travel lanes in each direction. The roadway has a posted speed limit of 30 miles per hour (mph) and curbs, gutters, and sidewalks on both sides. Its intersections with N 3rd and N 4th Streets are signalized with crosswalks on all sides. On-street parking is not permitted on either side of the roadway.

N 3rd Street is a three/four-lane Principal Arterial that provides one-way eastbound access between Logan Avenue N on the west to Sunset Boulevard N on the east. Near the project site, the roadway has three eastbound travel lanes and a posted speed limit of 25 mph. It has curbs, gutters, and sidewalks on both sides. On-street parking is not permitted on either side of the roadway.

N 4th Street is a four-lane Principal Arterial that provides one-way westbound connection between Houser Way N to the east and Logan Avenue N to the west. The eastern portion of the arterial is designated as Factory Place N and oriented northwest before bending west and becoming N 4th Street at Factory Avenue N, about two blocks east of the site. The roadway has a posted speed limit of 30 mph and has curbs, gutters, and sidewalks on both sides. On-street parking is not permitted on either side of the roadway.

Regional access to the site vicinity is provided via Interstate-405 (I-405), State Route (SR) 169, and SR 167. I-405 and SR 169 can be accessed at the Sunset/Bronson Way interchange about 0.4 miles southeast of the project site. SR 167 and I-405 can be accessed at the Rainier Avenue S interchange about 2 miles southwest.

2.1.2. Planned Transportation Projects in Site Vicinity

The City of Renton's adopted 2016-2021 Six-Year Transportation Improvement Program (TIP)⁵ and Draft 2017-2022 TIP⁶ were reviewed to determine if any proposed projects would affect study-area roadways. Neither TIP included any projects that would affect the capacity or operations at the study area

⁴ City of Renton, Arterial Streets, Revised on August 4, 2014, Resolution 4222.

⁵ City of Renton, Adopted June 15, 2015.

⁶ City of Renton, Presented to Council August 1, 2016.

intersections by year 2018 when the proposed Sartori Elementary School project is expected to be complete and occupied. Therefore, the existing roadway network was assumed for analysis of 2018 conditions.

The *Renton Trails and Bicycle Master Plan*⁷ includes recommended bicycle lanes along N 3rd Street, N 4th Street, and Garden Avenue N. However, these routes are not currently identified as funded projects, so were not assumed to be complete for analysis of 2018 conditions.

2.2. Traffic Volumes

The following sections document the existing and forecast background traffic within the project site vicinity during morning and afternoon peak periods when school traffic generation would be highest, and during the commuter PM peak hour (typically the highest volume hour between 4:00 and 6:00 P.M.) when background traffic on city streets is typically highest. The study area for analysis required by the City includes the following four intersections located at the site corners:

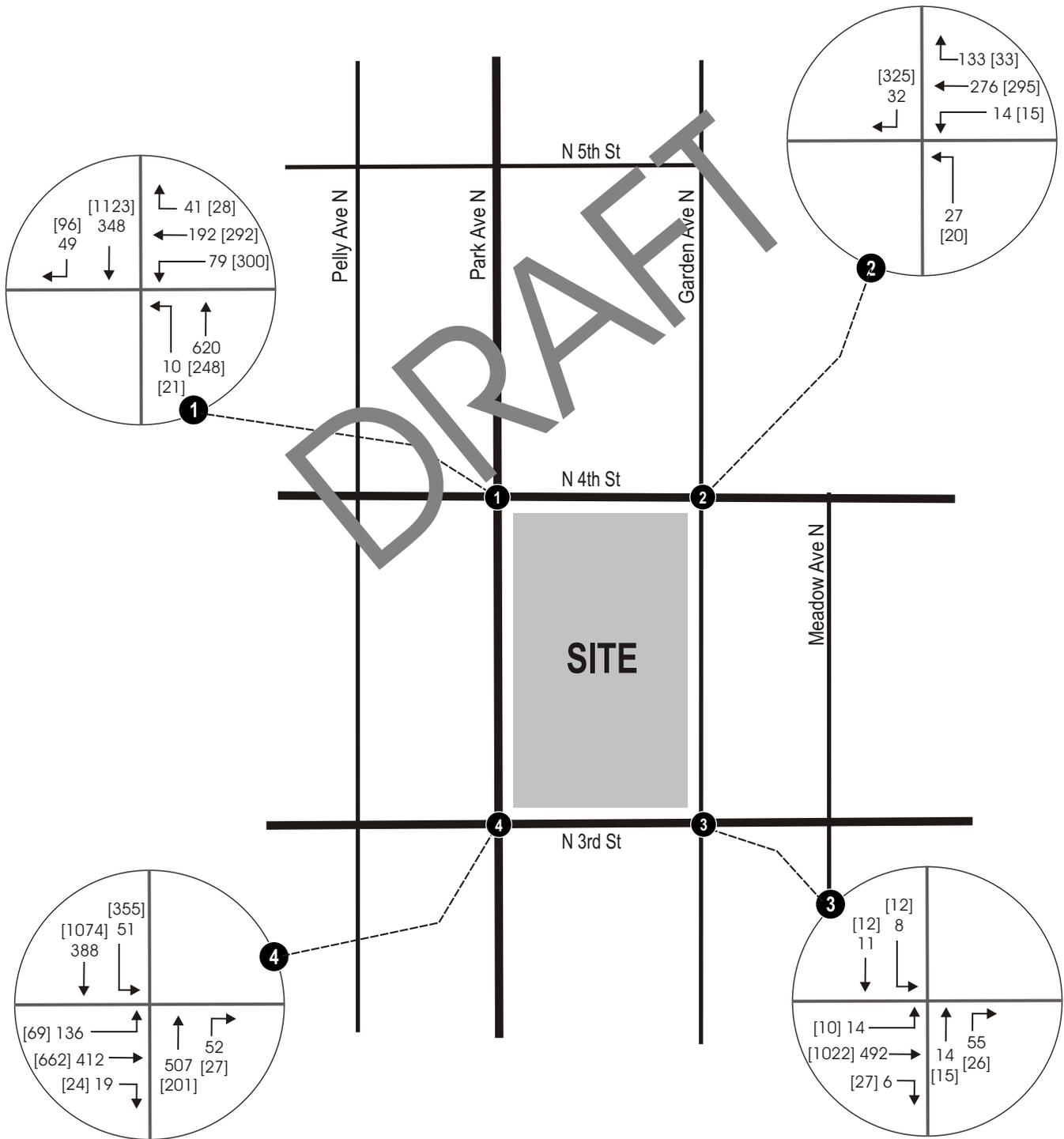
- N 4th Street / Park Avenue N
- N 4th Street / Garden Avenue N
- N 3rd Street / Park Avenue N
- N 3rd Street / Garden Avenue N

2.2.1. Existing Traffic Volumes

Vehicle turning movement counts were conducted at the four study-area intersections on Thursday, May 19, 2016, by Idax Data Solutions. The morning counts were performed from 7:00 to 10:00 A.M.; the afternoon counts were performed from 2:00 to 6:00 P.M. The peak volumes at these four intersections varied by location with the morning peak hours beginning at 7:00, 7:15, or 7:30 A.M. and afternoon peaks beginning at 2:30, 4:00, or 4:15 P.M. This variation in peak hours can be explained by the combination of one-way streets that affect commuting patterns combined with the site's proximity to Boeing, which has an early shift end in the afternoon. It is acknowledged that the Logan Avenue Reconstruction project (about ¼-mile west of the site) was still being completed at the time of these counts with Park Avenue N being used as a detour route. Therefore, the existing volumes counted on Park Avenue N are likely higher than typical conditions without the detour.

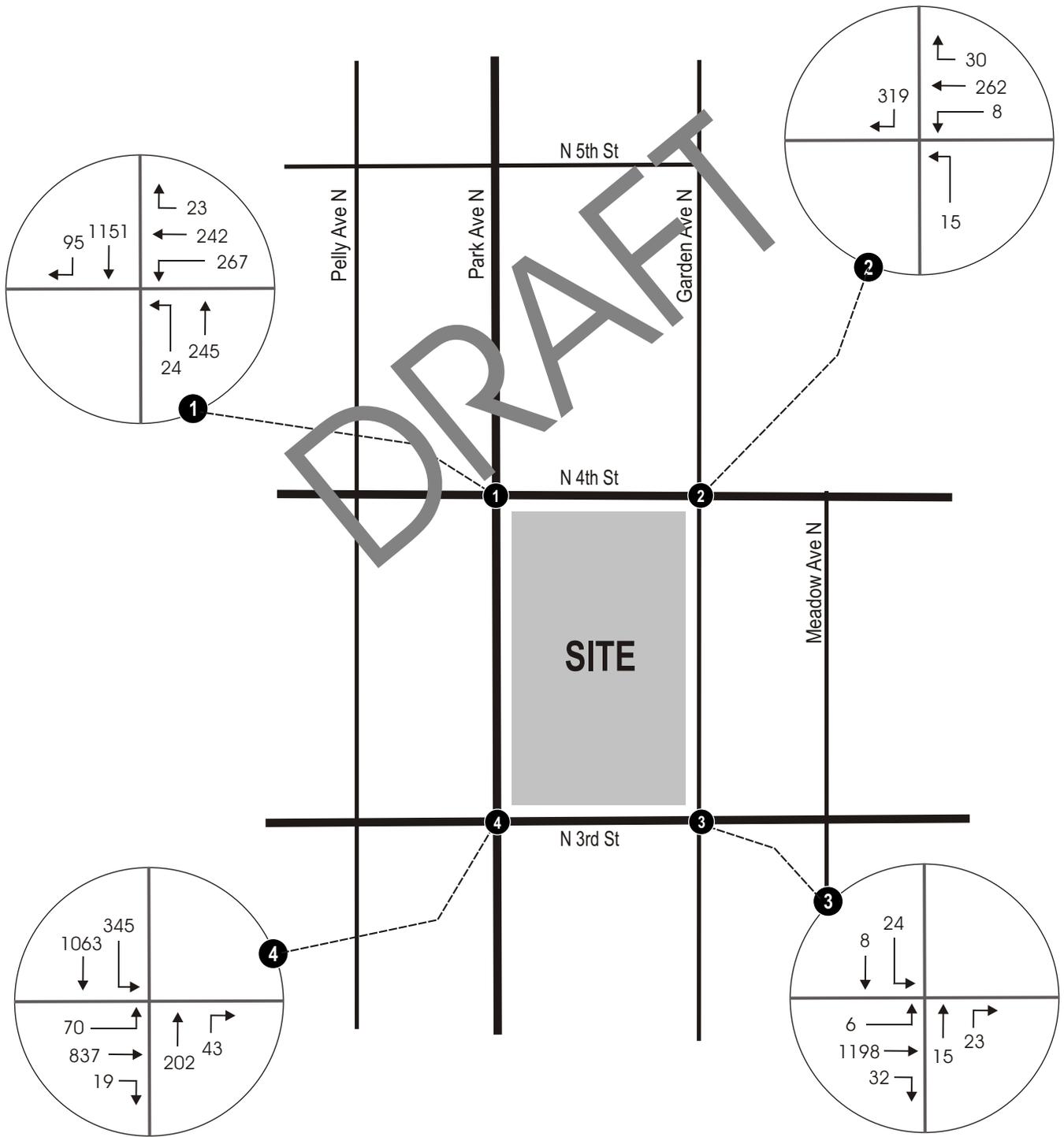
The proposed Sartori Elementary School is proposed as a choice school that would draw an estimated 30% of its enrollment from the local area around the school and the remaining enrollment from the entire district (discussed in more detail in *Section 3.2.3. Trip Distribution and Assignment*). In order to provide district-wide bus transportation to and from this site, the new Sartori Elementary would require later start and dismissal times, with the school day expected to begin at 9:00 A.M. and end at 3:40 P.M. The peak hours for school traffic are expected to occur from 8:15 to 9:15 A.M. and from 3:15 to 4:15 P.M. Conditions were analyzed for these hours, as well as the commuter PM peak hour. The existing turning movement volumes during the morning and afternoon peak hours and are shown on Figure 3; the commuter PM peak hour volumes are shown on Figure 4.

⁷ City of Renton, Adopted May 11, 2009.



KEY:

← XX [XX] AM Peak [Afternoon Peak] Volumes



2.2.2. Forecast 2018 Background Traffic Volumes

Traffic forecasts were developed for future 2018 conditions, which is the year the project is planned to be completed and occupied. To determine appropriate rates for background traffic growth, historical traffic counts were reviewed. A comparison of PM peak hour volumes at the N 4th Street/Park Avenue N intersection from 2007 to 2016 found that total entering traffic has increased by about 2.2% per year.⁸ However, the 2016 volumes also reflected the Logan Avenue detour traffic which likely resulted in inflated values. Review of Washington State Department of Transportation (WSDOT) traffic data for SR 900 (Sunset Way) at the I-405 interchange found daily volumes increased by about 2.3% annually from 2012 to 2015.⁹ Renton Transportation Operations staff¹⁰ indicated the City review of available data found that volumes have generally either declined or remained relatively stable (with annual growth of 0.5% or less) in the vicinity of the project. City staff noted that recent growth is likely somewhat higher due to the continued economic recovery. Overall, the count comparisons indicated that traffic volume growth has been variable depending on the location and peak period.

Review of City online sources¹¹ indicated no major development projects (pipeline development projects) currently planned in the study area that would add traffic to the study area intersections. City planning staff¹² were also contacted to determine if there are any planned or permitted development projects (known as pipeline development projects) in the vicinity that are expected to add traffic to the study area roadways. City staff did not respond with any information about major development projects that would add traffic to the study-area intersections.

Based on these reviews, a 2.5% compound annual growth rate was applied to all existing peak hour traffic volumes to forecast 2018 without-project volumes. Since existing count volumes from 2016 were likely inflated due to the Logan Avenue construction and detour routing that was in place at the time, this growth assumption reflects a conservatively high worst-case for projecting 2018 volumes. The resulting 2018 “without project” volumes during morning and afternoon peak hours are shown on Figure 5; the 2018 “without project” commuter PM peak hour volumes are shown on Figure 6.

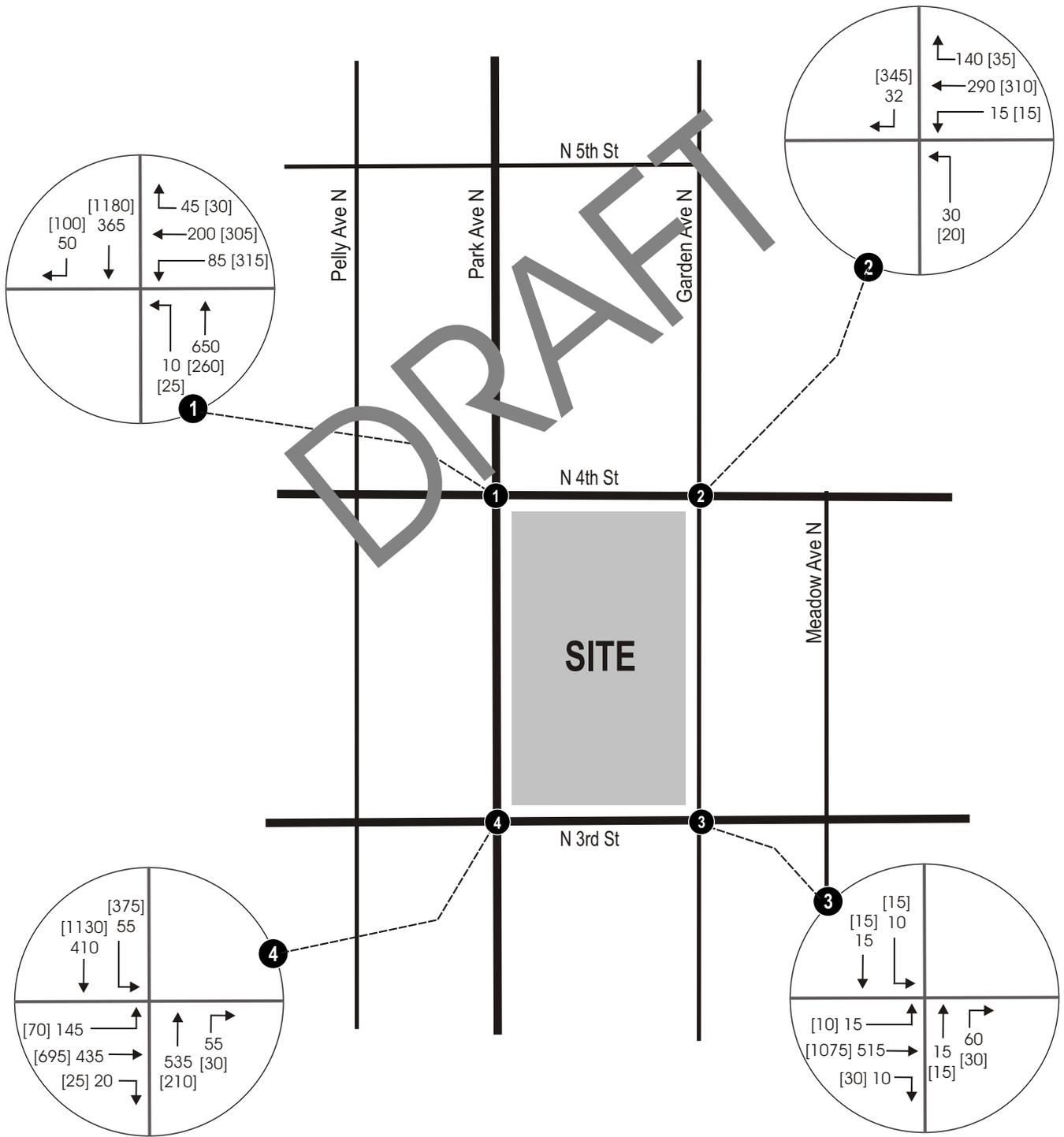
⁸ Renton School District Transportation Center – Traffic Impact Analysis, The Transpo Group, Inc., July 20, 2007.

⁹ 2015 Annual Traffic Report, WSDOT.

¹⁰ Personal communication, R. Mar, PE, PTOE, Transportation Operations, City of Renton, August 11, 2016.

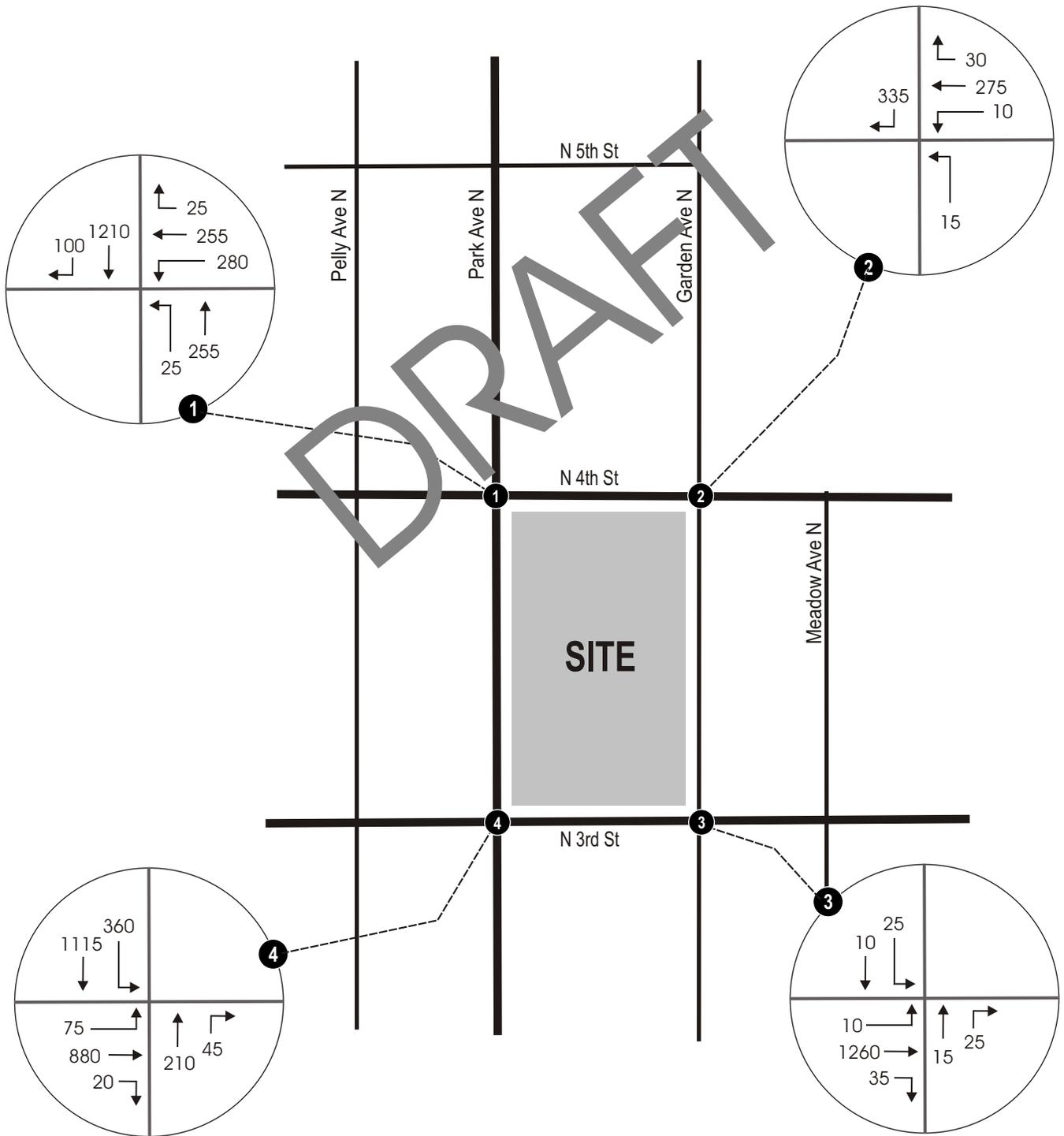
¹¹ City of Renton, COR Maps GIS application, Accessed August 2016.

¹² V. Grover, Transportation Planning & Programming, and B. Bannwarth, Development Engineering Mngr. City of Renton, August 2016



KEY:

← XX [XX] AM Peak [Afternoon Peak] Volumes



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2.3. Traffic Operations

Traffic operations analyses were performed for the study-area intersections. Traffic operations are evaluated using levels of service (LOS) with six letter designations, “A” through “F.” LOS A is the best and represents the best traffic operation with little or no delay to motorists. LOS F is the worst and indicates poor traffic operations with long delays. The level of service definitions and thresholds are provided in Appendix A. The City’s adopted minimum operational standard for arterial and collector intersections is LOS D (with some limited exceptions that do not apply to the study area intersections).¹³

Levels of service were determined using procedures in the *Highway Capacity Manual*.¹⁴ Delay calculations rely on complex equations that consider a number of variables. For example, delay at signalized intersections is determined based on a complex combination of variables including: the quality of progression, cycle length, green ratio, and a volume-to-capacity ratio for the lane group or approach in question. Delay at unsignalized intersections is determined for vehicles that must stop or yield for oncoming traffic. That delay is related to the availability of gaps in the main street's traffic flow and the ability of a driver to enter or pass through those gaps. All level of service calculations were performed using the *Synchro 9.1* traffic operations analysis software. The software models reflect current intersection geometries and levels of service were reported using the *Synchro* module for signalized intersections. Signal timings and geometric conditions were field verified.

Table 2 summarizes levels of service for existing (2016) and 2018 “without project” conditions for the morning, afternoon, and commuter PM peak hours. As shown, all four signalized intersections currently operate at LOS C or better and are forecast to remain at those levels in 2018 without the project.

Table 2. Level of Service – Existing (2016) and 2018-Without-Project Conditions

Signalized Intersection	Morning Peak Hour (8:15 to 9:15 A.M.)				Afternoon Peak Hour (3:15 to 4:15 P.M.)				PM Peak Hour (4:00 to 5:00 P.M.)			
	Existing (2016)		2018 w/o Project		Existing (2016)		2018 w/o Project		Existing (2016)		2018 w/o Project	
	LOS ¹	Delay ²	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
N 4 th St / Park Ave	B	16.3	B	16.6	C	24.3	C	25.3	C	24.8	C	26.1
N 4 th St / Garden Ave N	A	6.9	A	6.9	A	4.7	A	4.8	A	4.3	A	4.4
N 3 rd St / Garden Ave N	C	20.7	C	20.8	A	8.9	A	9.6	B	11.6	B	12.2
N 3 rd St / Park Ave	C	24.6	C	27.2	B	15.1	B	15.4	B	16.7	B	17.3

Source: Heffron Transportation, August 2016.

1. LOS = Level of service.
2. Delay = Average seconds of delay per vehicle.

¹³ City of Renton Comprehensive Plan – Transportation Element, Adopted June 22, 2015.

¹⁴ Transportation Research Board, 2010.

2.4. Parking

2.4.1. On-Site Parking

As described previously, the existing school use includes on-site parking with about 83 striped stalls; the supermarket/restaurant site has a large paved area with about 17 marked spaces and additional unmarked pavement that can be used for parking. Most of the single family residences have driveways and/or garages that serve on-site parking.

2.4.2. On-Street Parking

In the vicinity of the project site, on-street parking occurs along both sides of Garden Avenue N (between N 2nd and 4th Streets), Meadow Avenue N (one block to the east), and Pelly Avenue N (one block to the west). However, some of the on-street parking is subject to restrictions.

On the west side of Garden Avenue N adjacent to the project site, parking is prohibited from 6:00 A.M. to 4:00 P.M. on school days. On the east side, parking is restricted to two hours from 8:00 A.M. to 6:00 P.M. on weekdays and Saturdays.” On both sides of Pelly Avenue N, parking is restricted to two hours from 8:00 A.M. to 6:00 P.M. on weekdays. Parking is unrestricted on Meadow Avenue N between N 3rd and 4th Streets, and on Garden, Pelly, and Meadow Avenues N to the south between N 2nd and N 3rd Streets.

Field counts indicate a weekday on-street parking capacity of about 185 vehicles along these roadway segments. Parking counts conducted in August 2016 (when schools were out for summer) indicated a mid-morning demand of 63 vehicles (approximately 34% utilization) and a mid-afternoon demand of 75 vehicles (approximately 40% utilization).

2.5. Traffic Safety

Collision data for the study area intersections and roadway segments adjacent to the site were obtained from WSDOT. These data, reflecting the period between January 1, 2013 to July 15, 2016 (just over 3.5 years), were examined to determine if there are any unusual traffic safety conditions that could impact or be impacted by the proposed project. The collision data are summarized in Table 3.

The highest number of collisions over this period was reported at the N 4th Street/Park Avenue N intersection. The data indicate that 16 of 33 reported were right-angle collisions; of these, 11 had contributing causes listed as ‘inattention’ and ‘disregard stop and go light.’ A similar patterns of angle collisions occurred at the N 3rd Street/Park Avenue N intersection with 15 angle collisions out of the 24 total reported and 11 with contributing causes listed as ‘inattention’ and ‘disregard stop and go light.’

At the N 4th Street/Park Avenue N intersection, there were 10 left-turn collisions and two side-swipe collisions that all involved vehicles making improper left turns (e.g. from an inside through lane) from westbound N 4th Street to southbound Park Avenue N. It is noted that there are no overhead signs or pavement markings along N 4th Street approaching Park Avenue N indicating the lane channelization for left turns, which could result in some driver confusion. For comparison, there are overhead signs on the N 3rd Street approach to Park Avenue N indicating left-turn channelization.

One collision reported in 2013 at the N 3rd Street/Garden Avenue N intersection involved a school bus. The collision involved a passenger vehicle making an improper left turn and no reported injuries.

There were only two collisions reported along the roadway segments, along N 3rd Street just east of Park Avenue N, during the 3.5-year time period. None of the intersection or roadway segment collisions involved fatalities.

Table 3. Collision Summary (January 1, 2013 through July 15, 2016)

Intersection	Rear-End	Side-Swipe	Left Turn	Right Angle	Ped / Cycle	Other ^a	Total for 3.5 Years	Average/Year
N 4 th St / Park Ave N	2	2	13	16	0	0	33	9.4
N 4 th St / Garden Ave N	1	1	2	0	0	1	5	1.4
N 3 rd St / Park Ave N	0	3	5	15	1	0	24	6.9
N 3 rd St / Garden Ave N	1	0	2	0	1	0	4	1.1
Roadway Segment	Rear-End	Side-Swipe	Left Turn	Right Angle	Ped / Cycle	Other ^a	Total for 3.5 Years	Average/Year
N 4 th St – between Park Ave N and Garden Ave N	0	0	0	0	0	0	0	0.0
N 3 rd St – between Park Ave N and Garden Ave N	0	1	1	0	0	0	2	0.6
Park Ave N – between N 4 th St and N 3 rd St	0	0	0	0	0	0	0	0.0
Garden Ave N – between N 4 th St and N 3 rd St	0	0	0	0	0	0	0	0.0

Source: Washington State Department of Transportation, August 2016.

a. "Other" collision involved vehicle striking an object.

2.6. Transit Facilities and Service

King County Metro Transit (Metro) provides bus service directly to the project site with one stop located on Park Avenue N at N 3rd Street and two stops on Park Avenue N at N 4th Street. The stops are served by the following three routes.

Route 167 provides peak period service between the University District and the South Renton Park-and-Ride. It operates on weekdays with four northbound trips in the morning between 6:00 and about 8:00 A.M. and five southbound trips in the afternoon between about 2:40 and 5:00 P.M.

Route 240 provides service seven-days per week between the Renton and Bellevue Transit Centers with stops in the Wilburton, Eastgate, Newcastle, Renton Highlands, and Renton Boeing areas. Weekday service is provided from about 5:00 A.M. to about midnight with 30-minute headways (the time between consecutive buses).

Route 342 provides peak period service between the Shoreline Park-and-Ride and the Renton Transit Center with stops in the Kenmore, Bothell, Totem Lake, Bellevue, and Renton Boeing areas. It operates on weekdays with three northbound trips in the morning between 5:30 and about 7:00 A.M. and three southbound trips in the afternoon between about 3:15 and 5:15 P.M.

About 0.35-mile to the west, Metro's RapidRide F Line operates along Logan Avenue N with stops located south of N 4th Street. The F Line provides service between the Burien Transit Center and the

Landing in Renton (about a half-mile north of the site) with stops at the Tukwila International Boulevard Station, Southcenter, and the Renton Transit Center.

About ¼-mile to the north, Sound Transit's ST Express Bus Service Routes 560 and 566 serve stops on both sides of Park Avenue N at N 6th Street. Route 560 provides daily two-way service between West Seattle and Bellevue with stops in Burien, SeaTac, and Renton; Route 566 provides weekday two-way service between Overlake and Kent with stops in Auburn, Renton, and Bellevue.

2.7. Non-Motorized Transportation Facilities

As described in the *Roadway Network* section, the study area roadways have sidewalks on both sides. There are marked crosswalks with pedestrian signals at all four study-area intersections. All legs of the Park Avenue N intersections with N 3rd and N 4th Streets have pedestrian actuation buttons; at the Garden Avenue N intersections with N 3rd and 4th Street, only the N 3rd Street crossings have pedestrian actuation buttons.

The *Renton Trails and Bicycle Master Plan* includes recommended bicycle lane routes along N 3rd Street, N 4th Street, and Garden Avenue N. However, these improvements are not included in either the currently adopted or draft six-year transportation improvement programs.

3. PROJECT IMPACTS

This section describes the conditions that would exist with the proposed new Sartori Elementary School. Vehicle trip estimates were prepared using standard published rates and added to the forecast 2018-without-project traffic volume forecasts. Level of service analyses were performed to determine the proposed project's impact on traffic operations in the study area. Potential impacts to site access, queuing, transit, safety, non-motorized facilities, and parking were evaluated. In addition, analysis of special event conditions and construction were examined. The following sections describe the methodology used to determine the proposed project's impacts.

3.1. Roadway Network

The City would require frontage improvements and right-of-way dedications along all four sides of the site as part of project development, described as follows.

Park Avenue N – New curb at its existing location with an 8-foot wide planter and a new 12-foot wide sidewalk, requiring right-of-way dedication of about 12 feet to the back of the sidewalk.

N 3rd Street – New curb at its existing location with an 8-foot wide planter and a new 8-foot wide sidewalk, requiring right-of-way dedication of about 4.5 feet to the back of the sidewalk.

N 4th Street – New curb at its existing location with an 8-foot wide planter and a new 8-foot wide sidewalk, requiring right-of-way dedication of between 8.0 and 8.5 feet to the back of the sidewalk.

Garden Avenue N – New curb and curb bulbs at corners of 3rd and 4th Avenue with an 8-foot wide bus parking lane and a 10-foot sidewalk behind the curb. A right-of-way dedication of about 9 feet to the back of the sidewalk is required to provide these improvements.

All intersections – New curb returns with radii of 35 feet would be required at all corners. Two perpendicular curb ramps would be required at each corner.

Along Garden Avenue N, the proposed on-street load/unload zone is expected to be restricted to school buses only during morning arrival and afternoon dismissal periods, but could be available for general parking during other times of the day. The project would eliminate all existing site access driveways along Park Avenue N. Along N 3rd Street, all existing access driveways would be removed and a single two-way access driveway would be constructed about midway between Park and Garden Avenues N. Along N 4th Street, the existing access driveway would be removed and two one-way access driveways would be constructed to serve the family-vehicle load/unload loop and on-site parking (see Figure 2). No other changes to the roadway network are proposed.

3.2. Traffic Volumes

3.2.1. Proposed Project Trip Generation

The proposed Sartori Elementary School is expected to generate new trips on the surrounding transportation network. Vehicle trip generation estimates for the new school were determined using the standard rates published in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual*.¹⁵ Rates published for Elementary School (Land Use 520) were applied. This reference includes rates based on building floor area, number of students, and number of staff. In order to represent potential worst-case conditions, the rates based on building area, which produce the highest estimates, were applied to the proposed project. The vehicle trips projected to be generated by the proposed project are summarized in Table 4. As shown, the project is anticipated to generate 1,220 vehicle trips per day (610

¹⁵ ITE, 9th Edition, 2012.

in, 610 out), including 415 trips during the morning peak hour, 250 trips during the afternoon peak hour, and 100 trips during the commuter PM peak hour.

Table 4. Estimated Vehicle Trips Generated by the Proposed Project

Proposed Land Use	ITE Land Use Code	Size (sf)	Daily Trips	Morning Peak Hour ¹			Afternoon Peak Hour ²			Commuter PM Peak Hour ³		
				In	Out	Total	In	Out	Total	In	Out	Total
Elementary School	520	79,000	1,220	235	180	415	110	140	250	45	55	100

Source: Heffron Transportation, Inc., August 2016, using rates in Trip Generation Manual (ITE, 9th Edition, 2012).

1. The morning peak hour for the proposed school is expected to occur from 8:15 to 9:15 A.M. based on planned start time of 9:00 A.M.
2. The afternoon peak hour for the proposed school is expected to occur from 3:15 to 4:15 P.M. based on planned dismissal time of 3:40 P.M.
3. The commuter PM peak hour of the adjacent roadways varies based on location, but typically occurs during one hour between 4:00 and 6:00 P.M. The trip generation reported is the highest one-hour total during this period.

3.2.2. Trip Generation of Existing Uses and Net Change with Project

The project would remove the existing uses on the site. Typically, traffic impact analyses account for the removal of existing uses to determine the net increase in traffic associated with a new development. In those cases, traffic from existing uses to be removed would be subtracted before the new development's traffic is added. However, since some of the buildings on the site were vacant at the time that traffic counts were taken at study area intersection, no vehicle trip credit for the removal of these uses was applied to the 2018 "with project" traffic volume forecasts or operational analysis. The estimate of traffic generation by existing uses and the net changes expected due to the project are provided as a matter of disclosure and can be used in determining mitigation requirements and impact fees. Trip generation estimates for the existing uses were developed from rates and equations published in the Trip Generation Manual, as listed in Table 5.

Table 5. Trip Generation Rates Applied to Existing Uses

Existing Land Use	ITE Land Use Code	Size	ITE Trip Generation Rates ¹			
			Daily	Morning Peak	Afternoon Peak	Commuter PM Peak
Elementary School	520	39,284 sf	15.43 / ksf	5.20 / ksf	3.11 / ksf	1.21 / ksf
Single-Family Homes	210	9 du	9.52 / du	0.75 / du	n/a ²	1.00 / du
Duplex (Apartment)	220	2 du	6.65 / du	0.51 / du	n/a ²	0.62 / du
Office (converted SFR)	710	1,720 sf	11.03 / ksf	1.56 / ksf	n/a ²	1.49 / ksf
Supermarket (including restaurant ³)	850	6,486 sf	42.70 / ksf	0.96 / ksf	2.90 / ksf ⁴	3.71 / ksf
Specialty Retail (dog groomer)	826	614 sf	44.32 / ksf	1.95 / ksf ⁴	2.90 / ksf ⁴	2.71 / ksf

sf = square feet; du = dwelling units; ksf = 1,000 square feet of building area.

1. Source: Institute of Transportation Engineers (ITE) Trip Generation, 9th Edition, 2012. Rates listed in terms of trips generated per 1,000 square feet (ksf) or per dwelling unit (du).
2. n/a = Trip rates are generally not published for the afternoon peak hour when elementary schools typically are dismissed. These uses would not be expected to generate noticeable trips during this time.
3. The supermarket rate was applied to entire retail building, which includes a fast-food Mexican restaurant. This rate reflects a conservatively low estimate of trips for this existing use.
4. Morning and afternoon trip rate estimates based on hourly variation data published for Shopping Centers (Land Use 820), which indicate that at retail centers, between 5% and 9% of total weekday daily trips occur each hour from 8 to 10 A.M. and 2 to 4 P.M.

The resulting trip generation estimates for the site’s existing uses is presented in Table 6. This table also shows the estimated trip generation for the proposed new school and the net change due to the project. As shown, when considering the site’s existing uses, the project is estimated to generate about 200 fewer trips per day, and about 26 fewer trips during the commuter PM peak hour. The new school is estimated to generate net increases of 176 morning peak hour trips and 93 afternoon peak hour trips. These figures are reasonable and expected since school traffic tends to be focused mostly during the morning arrival time and afternoon dismissal, and the project would construct a school that is roughly double the size of the existing school on the site.

Table 6. Estimated Vehicle Trips Generated by Existing Uses and Net Change With Project

Proposed Land Use	ITE Land Use Code	Size	Daily Trips	Morning Peak Hour ^a			Afternoon Peak Hour ^b			Commuter PM Peak Hour ^c		
				In	Out	Total	In	Out	Total	In	Out	Total
Elementary School	520	39,284 sf	610	115	90	205	55	70	125	25	25	50
Single-Family Houses	210	9 du	90	2	5	7	0	0	0 ^d	6	3	9
Duplex (Apartment)	220	2 du	10	0	1	1	0	0	0 ^d	1	0	1
Office	710	1,720 sf	20	3	0	3	0	0	0 ^d	0	3	3
Supermarket	850	6,486 sf	660	14	8	22	15	15	30	31	30	61
Specialty Retail	826	614 sf	30	1	0	1	1	1	2	1	1	2
Total Existing Uses			1,420	135	104	239	71	86	157	64	62	126
Proposed School			1,220	235	180	415	110	140	250	45	55	100
Total Net Change			-200	100	76	176	39	54	93	-19	-7	-26

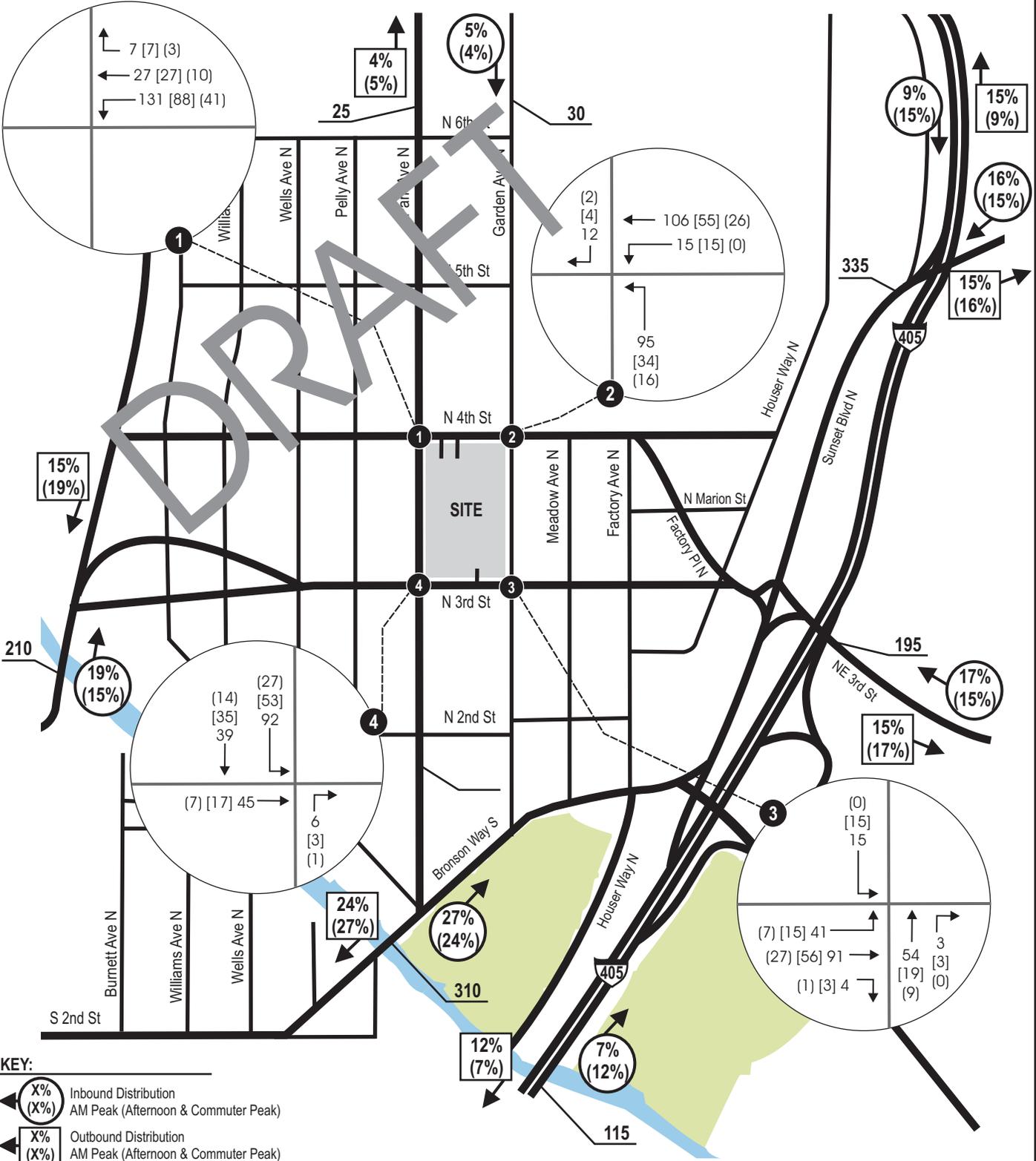
Source: Heffron Transportation, Inc., August 2016, using rates in Trip Generation Manual (ITE, 9th Edition, 2012).

- a. The morning peak hour for the proposed school is expected to occur from 8:15 to 9:15 A.M. based on planned start time of 9:00 A.M.
- b. The afternoon peak hour for the proposed school is expected to occur from 3:15 to 4:15 P.M. based on planned dismissal time of 3:40 P.M.
- c. The commuter PM peak hour of the adjacent roadways varies based on location, but typically occurs during one hour between 4:00 and 6:00 P.M. The trip generation reported is the highest one hour total during this period.
- d. Rates are not provided for the afternoon peak hour when school dismissal is expected to occur.

3.2.3. Trip Distribution and Assignment

As described previously, the proposed Sartori Elementary School is planned as a choice school that would draw an estimated 30% of its enrollment from the local area around the school and the remaining enrollment from the entire district. In order to develop trip distribution patterns for school traffic, current enrollment data and attendance boundaries of existing elementary schools within the district were examined to approximate student population density and related residential origins and destinations. Travel routes were developed using Google Maps predictive travel times to determine likely travel routes to and from the project site. For conditions when there are multiple viable travel routes, project trips were proportionally assigned to each route to match the travel patterns observed in existing turning movement counts from intersections around the site. These analyses assume the same distribution percentages for both inbound and outbound trips because the majority of drivers would use the same routes around the project site to reach their workplaces, residences, and commercial destinations.

School bus trips were assigned separately based on anticipated routing guidance provided by the Renton School District’s Transportation staff. The resulting total project trip distribution patterns and assignments for the daily, morning, afternoon, and commuter PM peak hours are shown on Figure 7.



- KEY:**
- ◀ X% Inbound Distribution
 - ◌ (X%) AM Peak (Afternoon & Commuter Peak)
 - ▶ X% Outbound Distribution
 - ◌ (X%) AM Peak (Afternoon & Commuter Peak)
 - ← XX [XX] (XX) AM Peak [Afternoon Peak] (Commuter PM Peak) Trips
 - XXX Daily Trips

3.2.1. Forecast With-Project Traffic Volumes

To estimate 2018 traffic volumes with the proposed project, the project trips were added to the 2018 without-project volumes. Forecast 2018 with-project volumes for morning and afternoon peak hours are shown on Figure 8, and shown on Figure 9 for the PM peak hour.

3.3. Traffic Operations

Intersection levels of service for future with-project conditions were determined using the same methodology described previously for existing and future without-project conditions. The new Sartori Elementary School is expected to generate new pedestrian and bicycle trips between the site and surrounding residential properties. These added trips would increase the number of pedestrian crossings at the study area intersections. The potential increases in pedestrian crossing activity and the peaking characteristics of school traffic (with school drop-off and pick-up activity primarily expected to occur during about 20 minutes within the peak hours) have all been accounted for in the operations analyses of the study area intersections.

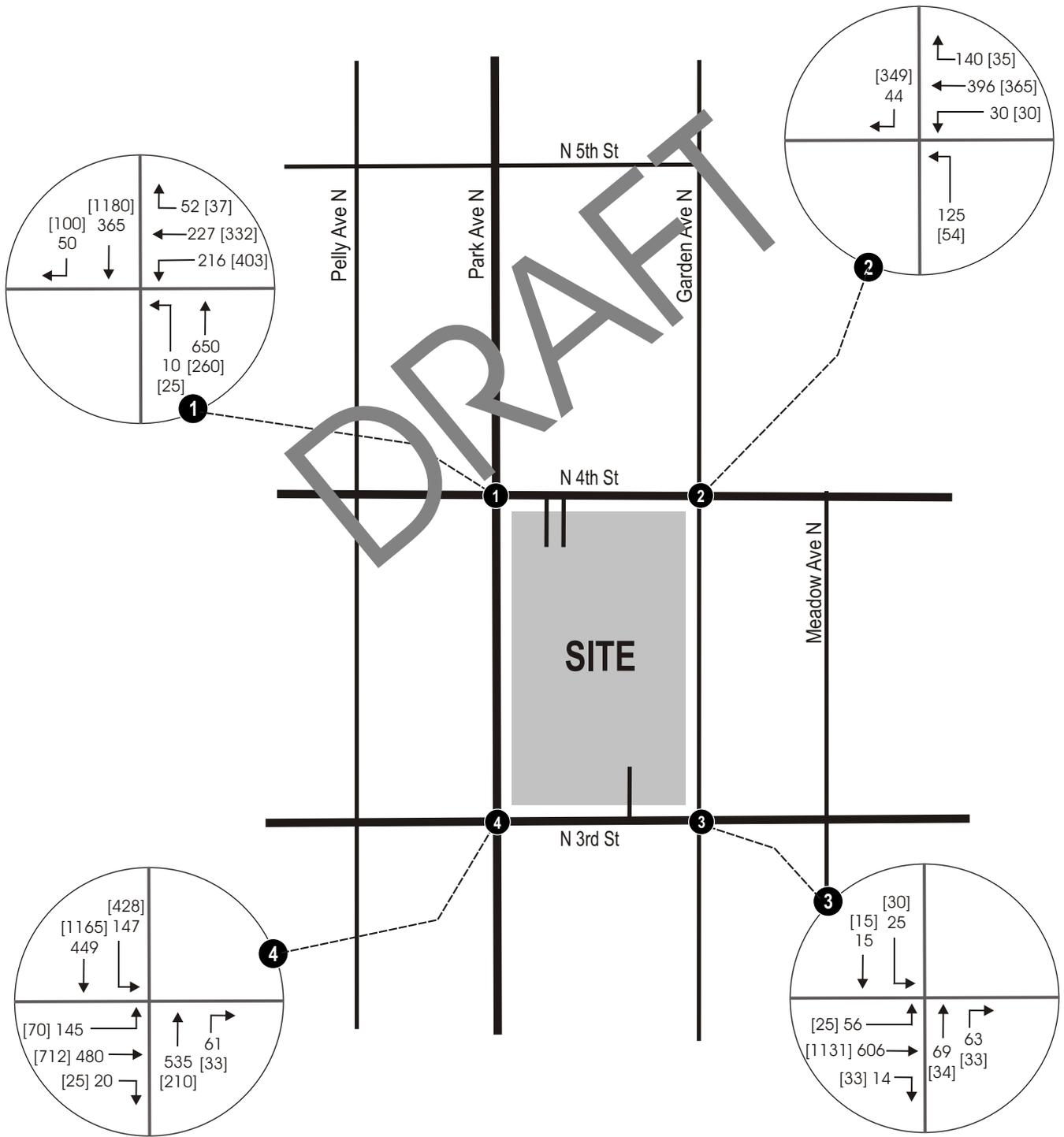
Table 7 summarizes forecast 2018 levels of service without and with the proposed project for the morning, afternoon, and PM peak hours. As shown, the school project is expected to add some delay to most locations; however, all four signalized study-area intersections are expected to continue operating at the same levels—LOS C or better—with the proposed Sartori Elementary School project. The projected increases in average delay due to the project are estimated to range from 0.1 to 2.4 seconds per vehicle. One location is forecast to experience a slight decline in overall average delay, due to higher volumes on movements with very low delay. Based on these results, the project is expected to have a negligible impact to traffic operations at study area intersections.

Table 7. Level of Service – 2018 Conditions Without and With Project

Signalized Intersection	2018 Morning Peak Hour (8:15 to 9:15 A.M.)		2018 Afternoon Peak Hour (3:15 to 4:15 P.M.)		2018 PM Peak Hour (4:00 to 5:00 P.M.)					
	Without Project		With Project		Without Project		With Project			
	LOS ¹	Delay ²	LOS	Delay	LOS	Delay	LOS	Delay		
N 4 th St / Park Ave	B	16.6	B	18.0	C	25.3	C	26.2	C	26.3
N 4 th St / Garden Ave N	A	6.9	A	9.3	A	4.8	A	6.6	A	5.0
N 3 rd St / Garden Ave N	C	20.8	C	20.3	A	9.6	B	10.5	B	12.3
N 3 rd St / Park Ave	C	27.2	C	28.6	B	15.4	B	16.4	B	17.6

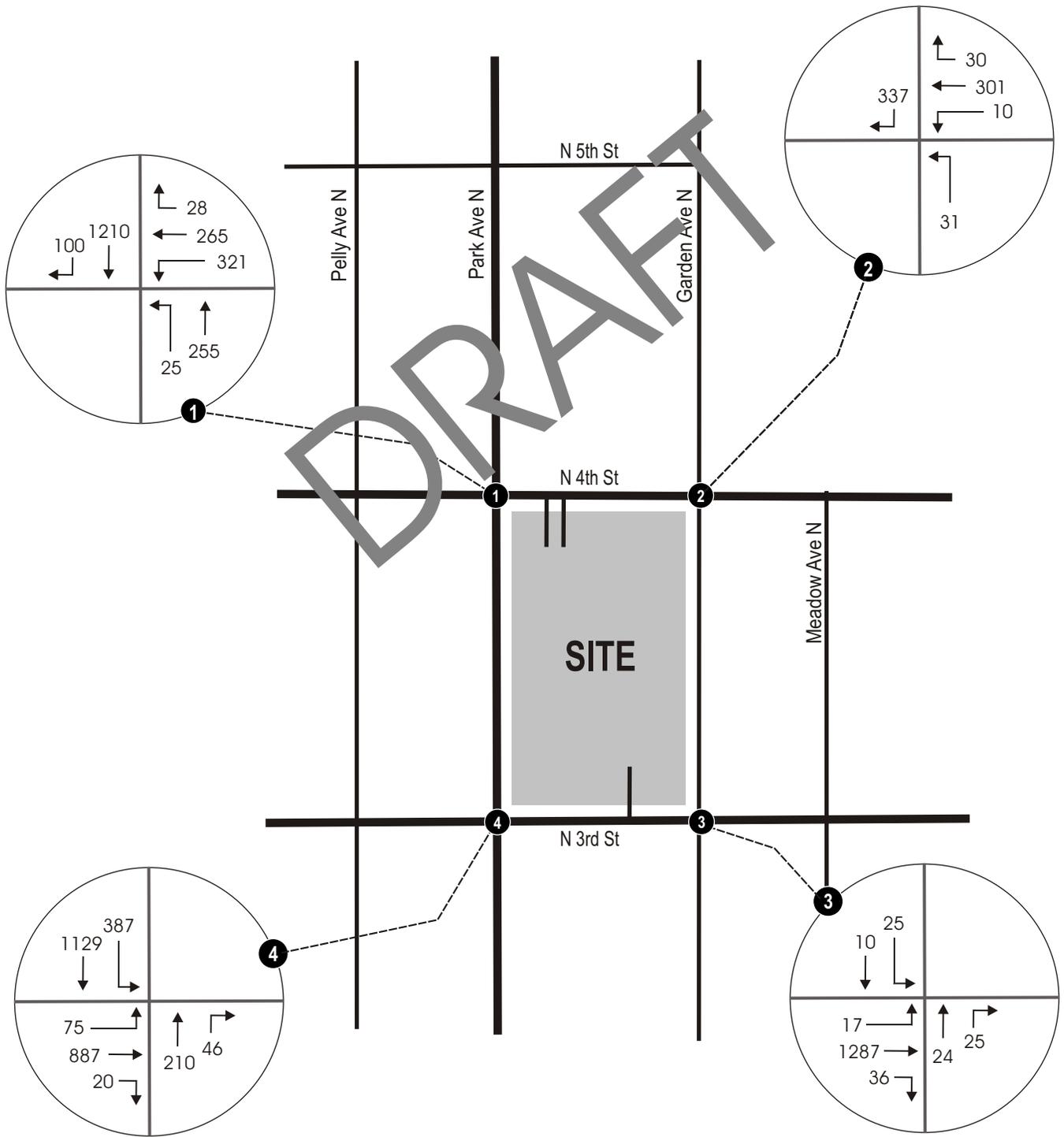
Source: Heffron Transportation, August 2016.

1. LOS = Level of service.
2. Delay = Average seconds of delay per vehicle.



KEY:

← XX [XX] AM Peak [Afternoon Peak] Volumes



DRAFT

3.4. Site Access

The project would provide access in two locations. The family-vehicle drop-off/pick-up loop and a portion of staff parking (about 53 spaces) would be located at the north end of the site and would be served by two one-way access driveways on N 4th Street—inbound at the eastern driveway and outbound at the western driveway. This access configuration, combined with the clockwise circulation pattern proposed, maximizes the amount of desirable on-site queue area for family vehicles and eliminates conflicting left-turn movements that would exist with a traditional two-way driveway on a one-way street such as N 4th Street. The south parking lot (about 30 spaces for staff and visitors) as well as the service and loading area would be accessed from a single driveway on N 3rd Street. Operations analyses of the proposed access driveways indicate that all movements would operate at LOS B or better during all times of the day. School bus load/unload would occur on the west side of Garden Avenue N, adjacent to the school site.

3.5. On-Site Vehicle Queueing

The on-site family-vehicle load/unload loop would provide space for about 30 vehicles to wait/queue at one time. During the afternoon dismissal period, an additional 15 to 20 parking spaces within the north parking lot are likely to be available for family-vehicle load/unload activity bringing the total north lot queuing capacity to between 45 and 50 vehicles. In the mornings, school drop-off activities usually occur with limited queues or delay. This is because arrivals tend to be spread out over the 20 to 30 minutes before school start time. During this period, family drivers generally arrive, drop off students, and then immediately leave the site. In the afternoons, many family drivers arrive early and wait in the queue lane(s) or parking spaces for the students to be dismissed, and longer vehicle queues can develop.

The morning arrival queue can be modeled directly using Poisson arrival methodologies for a multi-channel service system (i.e., the number of drop-off spaces that can be used simultaneously). Assumptions documented from queuing data collection at Bellevue School District schools were used for this analysis.¹⁶ This includes the assumption that it takes about 15 seconds for students to exit a vehicle while at the drop-off location space and the entire morning arrival time for a school occurs within 20 minutes. This equates to a service rate for each drop-off space of 4 vehicles per minute (80 vehicles in 20 minutes or a rate of 240 vehicles per hour). For the proposed Sartori Elementary School, the estimated morning arrival volume is 225 vehicles (as presented in the *Trip Generation* section); however, this value includes school buses (expected to be 14) and staff arrivals (estimated at about 50). The total number of family-vehicle arrivals during the morning peak hour is estimated at 161 (to account for the compressed 20 minute arrival period, the arrival rate for the model is three times this level or 483 vehicles per hour).

Students could be dropped off along much of the queue lane shown on the site plan (see Figure 2), which allows for more than 14 spaces to be used at one time in the main family-vehicle drop-off/pick-up location. However, to provide an analysis of potential worst-case conditions, a range of four to eight spaces was evaluated to estimate both the average and 95th-percentile queues for the drop-off area closest to the building. Table 8 shows the estimated queues for the assumed drop-off spaces at the proposed school during the morning arrival. As shown, the estimated morning arrival queue is expected to be accommodated on-site and is not expected to exceed the available load/unload zone capacity. The queue model calculation results are included in Appendix C.

¹⁶ Gibson Traffic Consultants, Enatai Elementary School Traffic Impact Analysis, August 2014.

Table 8. Estimated Morning Arrival Vehicle Queues

Vehicles Served Simultaneously	Average Queue	95 th Percentile Queue	Exceeds On-Site Vehicle Capacity?
4 vehicles	2 vehicles	5 vehicles	No
5	2	4	No
6	2	4	No
7	2	4	No
8	2	4	No

Source: *Heffron Transportation, Inc., August 2016, using service rate assumptions based on observations included in the Enatal Elementary School Traffic Impact Analysis, (Gibson Traffic Consultants, August 2014).*

Although the queue analysis and estimation model is reasonable for application to morning arrival queues, the afternoon queueing conditions are different. Family drivers arrive prior to school dismissal during a time when no vehicles are being loaded (or serviced). This causes vehicle queues to develop prior to the student dismissal. In addition, students arrive at their family vehicles at different rates, so the service times per vehicle are different than during morning arrival. To estimate on-site vehicle queues during afternoon school dismissal, data collected on March 15 and October 15, 2015, at the Bellevue School District’s Cherry Crest Elementary School were considered. The Bellevue school enrolls about 570 students with 50 staff members and school parking lot has about 82 spaces. Therefore, conditions are quite similar to that of the proposed Sartori Elementary School. During both afternoon observation periods, the parking lot was nearly full. Cherry Crest Elementary School is dismissed at 2:25 P.M.; during the October observation, there were 22 vehicles in the queue at 2:26 P.M. The longest standing vehicle queue observed was 30 vehicles. The queue had completely dissipated by 2:37 P.M. It should be noted that even though there was space on site for additional vehicles in the queue lane; 25 to 30 family-vehicles were parked on the adjacent streets and were assumed to be associated with the school dismissal activity. These vehicles had left by 2:38 P.M. Overall, the afternoon peak queues dissipated within about 15 minutes after school dismissal.

As described previously, the proposed Sartori Elementary School would accommodate up to 650 students and 60 staff members. Based on the queue observations at Cherry Crest Elementary and adjusting for the higher potential enrollment, the afternoon queue is estimated at up to 68 vehicles. As mentioned, the proposed north load/unload loop and excess parking is estimated to accommodate 45 to 50 vehicles. If the estimated queue of 68 vehicles occurs, the excess demand (18 to 23 vehicles) is likely to occur elsewhere including in the proposed visitor lot on the south side of the school and some on-street along the east side of Garden Avenue N. It should be noted that since Sartori Elementary would be a choice school drawing from the entire District, more students may rely on bus transportation, since it may be less convenient for many family drivers to make trips across the District during the afternoon. In contrast, observations at neighborhood schools that draw from a smaller area (such as the Bellevue elementary observed) often have higher numbers of family drivers willing to make short trips to pick up students in the afternoon. As a result, the estimated queues may be conservatively high. However, if afternoon queues fill the north lot and load/unload area, access management measures could be implemented to prevent those queues from adversely impacting traffic flow on N 4th Street.

It is acknowledged that some fluctuation in volumes and queuing activities are common as they can be affected by weather, special events, and unfamiliarity with drop-off/pick-up procedures at the beginning of each school year. It is noted that family drivers with younger students are more likely to park their vehicles and walk their children to and from the school.

3.6. Parking

3.6.1. School Day Parking

School-day parking at elementary schools is primarily driven by staffing levels and family-volunteer activity. Parking demand rates for elementary schools based on staffing levels have been developed using counts conducted at several Seattle elementary schools in 2013 and 2014 for recent modernizations and/or replacement projects; these data reflect peak school-day parking demand rates that range from 1.06 to 1.23 vehicles per employee. ITE's *Parking Generation*¹⁷ does not include data for elementary schools based on staffing levels (the data provided are based on enrollment levels and are unclear if they reflect conditions during morning arrival, afternoon dismissal, or special events). *Parking Generation* does include an employee-based rate for middle schools of 1.22-vehicles-per-employee, which is consistent with observations by Heffron Transportation. Therefore, a midday parking demand rate of 1.23 vehicles per employee was applied. This rate accounts for employees and family volunteers or other visitors who may be on-site midday.

The District estimates that Sartori Elementary School could have up to 60 employees with the school at full capacity. Using the parking rate described above, the new school is projected to have a midday peak parking demand of about 74 vehicles, which is likely to occur during late morning when all teachers, administrative staff, kitchen staff, and volunteers are typically on site. Afternoon demand is often somewhat lower, as part-time and food-service staff often leave after lunch. The proposed on-site parking supply of 83 spaces is expected to accommodate typical midday peak parking demand.

3.6.2. Evening Event Parking

Sartori Elementary School would have common spaces and a gymnasium that could be used for events at the school. The school is expected to host evening events periodically throughout the school year that could use these spaces. The types of events typically held at schools include the following.

- **Large School Events** – Typically occur about once per month or once every other month. The largest events occur two or three times per year and usually include: Back to School Night; Curriculum Night Open House, and a concert or talent show. Some of the larger events have staggered arrivals and not all attendees are on site at once, while others have fixed start and end times and all attendees are on site simultaneously.
- **PTA (or other) Meetings** – There are commonly five or six smaller PTA events that occur each year. Typically, attendance ranges from about 30 to 100 people. .
- **Community Use** – The site may be scheduled for use by community groups (e.g. Cub Scouts, Boy Scouts, Brownies, etc.) or recreational sports on the playfield. However, it is noted that the playfield will be smaller than those at most elementary schools and may not support organized athletics. Community-use events usually have smaller attendance levels of 10 to 50 people, but may occur more frequently.

For evening events, the on-site parking supply of 83 spaces would be available. Room for another 17 parked vehicles would exist in the family-vehicle load/unload zone, bringing the on-site total to 100 spaces. The on-street school-bus load/unload zone could also be used for event parking and could accommodate about 28 more cars. The Renton School District Transportation facility is located across N 4th Street directly north of the site. That facility has 98 parking spaces that are within about 400-foot walking distance to the Sartori Elementary School site and could also be used to accommodate parking overflow during larger evening events.

¹⁷ ITE, 4th Edition, 2010.

For larger evening events, there are typically between 3.0 and 3.5 persons attending for each parked vehicle. This rate accounts for higher levels of carpooling (families and students in a single vehicle) as well as drop-off activity that does not generate parked vehicles. At these rates, the on-site parking supply combined with the adjacent on-street supply and the overflow parking at the Transportation facility (totaling 226 spaces) could accommodate events with attendance of between 675 and 790 persons without requiring use of nearby on-street parking. It is noted however that some event attendees may choose to park on-street nearby for convenience. If event parking demand exceeds these levels or if larger attendance levels are expected, it may be necessary to modify the event to reduce total peak demand. For example, curriculum night could be separated into two nights based on grade levels.

3.7. Traffic Safety

The project is not expected to result in any significant adverse safety impacts. However, as noted in the analysis of collision data, there were several collisions that involved vehicles making improper left-turns from westbound N 4th Street to southbound Park Avenue N. With the introduction of the two one-way school access driveways on N 4th Street and additional trips along N 4th Street, it may be beneficial to install lane channelization markings (painted arrows) and/or street signs on N 4th Street approaching Park Avenue N that better inform drivers that the outside lanes are for turns and the inside lanes are for through traffic only.

The school would result in increased traffic and pedestrian traffic activity around the site. The proposal should also include establishment of school crossings and school-zone speed limits during peak arrival and dismissal times. The District should work with the City to define and implement school speed zones around the site, including installation of signage. The project is not expected to result in any significant adverse safety impacts.

3.8. Transit Facilities & Service

Some transit trips may be generated by the teachers or staff at the site. The nearest transit stops are currently located directly in front of the school site on Park Avenue N at the N 3rd Street and N 4th Street intersections. School bus transportation would be provided to those students living beyond the 1-mile walk area for the school. The project is not expected to result in adverse impacts to transit.

3.9. Non-Motorized Transportation Facilities

The new Sartori Elementary School is expected to generate additional pedestrian and bicycle trips within the site vicinity. The District should also coordinate with the City and Renton Police Department (RPD) to re-establish and enforce school-zone speed limits near the site. Prior to school opening, the District should review and identify walk routes, crosswalk locations, and crossing guard locations.

3.10. Short-term Impacts from Construction

Construction at the site is planned to start in late spring 2017; the school is planned to be ready for occupancy by fall of 2018. The construction effort would include limited earthwork that would consist of excavation that would remove and export about 2,000 cubic yards (cy) of material from the site and import about 4,500 cy of fill to the site.¹⁸ Half of this earthwork activity is anticipated to occur during a several month period at the beginning of the project; the remainder would likely be spread out over several months near the end of the project. Assuming an average of 20-cubic yards per truck

¹⁸ AHBL, Earthwork quantities estimates, August 2016.

(truck/trailer combination), the earthwork would generate about 165 truckloads (165 trucks in and 165 trucks out) during the two periods at the beginning and end of the project. Assuming these earthwork periods are condensed to about two months each, this would correspond to about eight truck trips per day (four in, four out) and one or fewer truck trips per hour on a typical eight-hour work day. This volume of truck traffic may be noticeable residents living adjacent to the site, but is not expected to result in significant impacts to traffic operations in the site vicinity.

The construction of the project would also generate employee and equipment trips to and from the site. Construction work shifts for schools are usually from 7:00 A.M. to 3:30 P.M., with workers arriving between 6:30 and 6:45 A.M. and leaving between 3:30 and 4:00 P.M. The number of workers at the project site at any one time would vary depending upon the construction element being implemented. Parking for construction personnel may be provided within the site, but some construction workers may also park on-street along the site frontage of Garden Avenue N.

4. MITIGATION

4.1. Transportation Impact Fees

The City of Renton collects transportation impact fees and has outlined fee rates for a variety of uses. The City's 2016 *Development Fees* schedule does not include a specific rate for elementary schools (a fee rate of \$2.00 per square foot is listed for high schools), but indicates that fees for uses not listed are determined "per current ITE Manual." For uses not listed, Renton Municipal Code (RMC) allows for an independent transportation mitigation fee calculation as stated in RMC 4-1-190.H.1:

If, in the judgment of the Administrator, none of the fee categories or fee amounts set forth in the City's Fee Schedule published and on file with the City Clerk accurately describes or captures the impacts of a new development on public facilities, the Department may conduct independent fee calculations and the Administrator may impose alternative fees on a specific development based on those calculations.

Based on data presented in Table 8 of the City of Renton's *Rate Study for Impact Fees*¹⁹ the transportation impact fee rate for the High School land use category is calculated as follows:

High School ITE PM Peak Hour Trip Rate	×	% New Trips	×	Trip Length Factor	=	Net New Trips	Rate Per Unit Based on \$7,517.08 per trip
0.97 trips / 1,000 sf		80%		1.00		0.78 per 1,000 sf	\$5.83 per sf

However, the adopted fee rate for high school uses in 2016 is roughly 34% of the total calculated rate- (\$2.00 ÷ \$5.83 = 34.3%). If this same methodology is applied to the published trip generation rate for elementary schools (ITE Land Use 520), the fee rate would be calculated as follows:

Elementary School PM Peak Hour Trip Rate	×	% New Trips	×	Trip Length Factor	=	Net New Trips	Rate Per Unit Based on \$7,517.08 per trip
1.21 trips / 1,000 sf		80%		1.00		0.97 per 1,000 sf	\$7.28 per sf

The calculated fee rate for 2016 would then be about **\$2.496** per square foot (34.3% × \$7.28). Based on this independent fee rate and the proposed school size that could be up to 79,000 square feet, the transportation impact fee for project would be **\$197,184**.

However, as described previously, the project would remove the existing uses from the site and the City allows for credit against the fee for removed uses. The estimated credit for the uses that would be removed is presented in Table 9. As shown, credit for remove of all existing uses totals just over \$216,000, more than the fee for the new school. Therefore, there should be no net fee due for the proposed school project. It should be noted that transportation impact fees are due and payable before the building permit is issued by the City based on the fee rates in effect at that time.

¹⁹ Henderson Young & Company, August 26, 2011.

Table 9. Transportation Impact Fee Credit Estimate for Existing Site Uses to be Removed

Types of Uses	Size / # of Units	Fee Rate ^a	Fee Credit Amount
Public School (Sartori Education Center)	39,284 sf	\$2.496 / sf ^b	(\$98,050)
Single Family Homes	9 units	\$2,951.17 / dwelling	(\$26,561)
Duplex (assume apartment rate) ^c	2 units	\$1,923.83 / dwelling	(\$3,848)
Office (converted single family residence)	1,720 sf	\$5.10 / sf	(\$8,772)
Supermarket / Restaurant / Drive-Thru Espresso	6,486 sf ^d	\$11.83 / sf ^e	(\$76,729)
Retail (dog groomer)	614 sf ^f	\$3.33 / sf ^g	(\$2,045)
Total Credit			(\$216,005)
Fee for New School			\$197,184
Total Fee Due			\$0

Source: Heffron Transportation, Inc., August 2016.

- a. Unless otherwise noted, rates from City of Renton's 2016 Development Fees, Revised August, 2016.
- b. Elementary School rate developed by Heffron Transportation based on current ITE Trip Generation Manual and City of Renton Impact Fee Rate Study methodology.
- c. No rate published for "duplex," so, fee rate for Apartment was applied.
- d. Includes two buildings at 314 Park Avenue N consisting of a 6,390 sf Market & Deli and fast-food restaurant; and a separate 96-sf espresso stand.
- e. Size of restaurant is not provided by King County Assessor, so credit estimated for all uses with lower supermarket rate.
- f. A portion (614-sf) of the single-family residence building at 350 Park Avenue N was permitted as a retail dog grooming business.
- g. Neither the City's fee rate schedule nor the ITE Manual include rates for a dog groomer. Therefore, the shopping center rate (typically applied for general retail uses) was applied.

4.2. Right-of-Way Dedications

In order to comply with street frontage and curb-return radii requirements outlined by the City, the project would dedicate right-of-way along the street frontages of all four sides of the project site. These would include about 12 feet along Park Avenue N, about 4.5 feet along N 3rd Street, 8.0 to 8.5 feet along N 4th Street, and about 9 feet along Garden Avenue N. In total, the right-of-way dedications are estimated at 17,524 sf (or roughly 0.4 acre).

4.3. Roadway Network Improvements

4.3.1. Frontage Improvements

The City will require frontage improvements along all four sides of the site. The following describes the requirements for each roadway fronting the site.

Park Avenue N – New curb at its existing location with an 8-foot wide planter and a new 12-foot wide sidewalk.

N 3rd Street – New curb at its existing location with an 8-foot wide planter and a new 8-foot wide sidewalk.

N 4th Street – New curb at its existing location with an 8-foot wide planter and a new 8-foot wide sidewalk.

Garden Avenue N – New curb and curb bulbs at corners of 3rd and 4th Avenue with an 8-foot wide bus parking lane and a 10-foot sidewalk behind the curb. The proposed on-street load/unload zone is expected to be restricted to school buses only during morning arrival and afternoon dismissal periods, but could be available for general parking during other times of the day.

All intersections – New curb returns with radii of 35 feet at all corners with two perpendicular curb ramps at each corner.

4.3.2. Roadway Markings & Signage

As described in *Section 3.7 Traffic Safety*, it may be beneficial to install lane channelization markings (painted arrows) and/or street signs on N 4th Street approaching Park Avenue N to better inform drivers that the outside lanes are for turns and the inside lanes are for through traffic only.

The District should coordinate with the City to confirm the locations, extent, and signage of the school-bus load/unload zone along the west side of Garden Avenue N. The District should also coordinate with the City to review walk routes and determine if any changes should be made to crosswalk locations, signage, or pavement markings. Part of this effort would be to define and implement school zone speed limits according to City standards.

4.4. Operational Measures

The following operational measures are recommended for implementation prior to school opening and are expected to be updated as conditions warrant.

Transportation Management Plan (TMP) – Prior to the school opening, the District and school principal should establish a Transportation Management Plan (TMP) to educate families about the access load/unload procedures for the site layout. The effort should communicate to families and staff the constrained site conditions and limited ability to accommodate family vehicles. It should encourage school bus ridership, carpooling, and supervised walking (such as walking school buses). The plan should define clear procedures and travel routes for family vehicles and instruct family drivers not to block or partially block travel lanes with queued or waiting vehicles. The plan should also address evening event conditions by identifying appropriate parking locations for attendees, directing attendees or staff to the remote off-site parking (at the District's Transportation facility), and or adjusting the schedule or size of events to better accommodate demand with the available parking supply.

Speed Enforcement – The District should coordinate with the City to ensure that school zone speed limits are signed and enforced, and that crossing guard locations are identified and staffed.

Event Communication Plan – The District and school administration should develop a neighborhood communication plan to inform nearby neighbors of events each year. The plan should be updated annually (or as events are scheduled) and should provide information about the dates, times, and rough magnitude of attendance. The communication would be intended to allow neighbors to plan for the occasional increase in on-street parking demand that would occur with large events.

Construction Management Plan (CMP) – The District should require the selected contractor to develop a construction management plan (CMP) that addresses traffic and pedestrian control during school construction. It should define truck routes, lane closures, walkway closures, and parking disruptions, as necessary. To the extent possible, the CMP should direct trucks to arterials and away from residential streets to avoid unnecessary conflicts with resident and pedestrian activity. The CMP may also include measures to keep adjacent streets clean on a daily basis at the truck exit points (such as street sweeping or on-site truck wheel cleaning) to reduce tracking dirt offsite. The CMP should identify parking locations for the construction staff; to the extent possible, construction employee parking should be contained on-site.

APPENDIX A

Level of Service Definitions

Levels of service (LOS) are qualitative descriptions of traffic operating conditions. These levels of service are designated with letters ranging from LOS A, which is indicative of good operating conditions with little or no delay, to LOS F, which is indicative of stop-and-go conditions with frequent and lengthy delays. Levels of service for this analysis were developed using procedures presented in the *Highway Capacity Manual* (Transportation Research Board, 2010).

Level of service for signalized intersections is defined in terms of delay. Delay can be a cause of driver discomfort, frustration, inefficient fuel consumption, and lost travel time. Specifically, level of service criteria are stated in terms of the average delay per vehicle in seconds. Delay is a complex measure and is dependent on a number of variables including: the quality of progression, cycle length, green ratio, and a volume-to-capacity ratio for the lane group or approach in question. Table A-1 shows the level of service criteria for signalized intersections from the *Highway Capacity Manual*.

Table A-1. Level of Service Criteria

Level of Service	Average Delay Per Vehicle	General Description
A	Less than 10.0 Seconds	Free flow
B	10.1 to 20.0 seconds	Stable flow (slight delays)
C	20.1 to 35.0 seconds	Stable flow (acceptable delays)
D	35.1 to 55.0 seconds	Approaching unstable flow (tolerable delay—occasionally wait through more than one signal cycle before proceeding.
E	55.1 to 80.0 seconds	Unstable flow (approaching intolerable delay)
F	Greater than 80.0 seconds	Forced flow (jammed)

Source: Transportation Research Board, *Highway Capacity Manual*, 2010.

For unsignalized two-way-stop-controlled, all-way-stop-controlled, and roundabout intersections, level of service is based on the average delay per vehicle. The level of service for a two-way, stop-controlled intersection is determined by the computed or measured control delay and is defined for each minor movement. Delay is related to the availability of gaps in the main street's traffic flow, and the ability of a driver to enter or pass through those gaps. The delay at an all-way, stop-sign (AWSC) controlled intersection is based on saturation headways, departure headways, and service times. Delay at roundabouts is based on entry flow rates and flow rate capacity. Table A-2 shows the level of service criteria for unsignalized intersections from the *Highway Capacity Manual*.

Table A-2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Delay (seconds per vehicle)
A	Less than 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	Greater than 50.0

Source: Transportation Research Board, *Highway Capacity Manual*, 2010.

APPENDIX B

Level of Service Calculation Sheets

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Existing (2016) Morning Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑	↑		↑↑			↑↑	
Traffic Volume (vph)	0	0	0	79	192	41	10	620	0	0	348	49
Future Volume (vph)	0	0	0	79	192	41	10	620	0	0	348	49
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99		1.00			1.00	0.982
Frt						0.850						
Flt Protected					0.986			0.999				
Satd. Flow (prot)	0	0	0	0	4825	1524	0	3468	0	0	3339	0
Flt Permitted					0.986			0.950				
Satd. Flow (perm)	0	0	0	0	4822	1501	0	3298	0	0	3339	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						89					23	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		281			438			671			521	
Travel Time (s)		6.4			10.0			15.3			11.8	
Confl. Peds. (#/hr)	3		2	2		3	1		1	1		1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	0%	0%	6%	6%	6%	4%	4%	4%	6%	6%	6%
Adj. Flow (vph)	0	0	0	88	213	46	11	689	0	0	387	54
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	301	46	0	700	0	0	441	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				30.0	30.0	30.0	12.0	50.0			38.0	
Total Split (s)				30.0	30.0	30.0	12.0	50.0			38.0	
Total Split (%)				37.5%	37.5%	37.5%	15.0%	62.5%			47.5%	
Maximum Green (s)				24.5	24.5	24.5	8.0	44.5			32.5	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				7.5	7.5	7.5		32.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effct Green (s)					24.5	24.5		44.5			32.5	
Actuated g/C Ratio					0.31	0.31		0.56			0.41	
v/c Ratio					0.20	0.09		0.38			0.32	
Control Delay					17.5	6.7		16.5			16.1	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					17.5	6.7		16.5			16.1	
LOS					B	A		B			B	
Approach Delay					16.1			16.5			16.1	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Existing (2016) Morning Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS					B			B				B
Queue Length 50th (ft)					43	1		134				72
Queue Length 95th (ft)					65	23		m168				107
Internal Link Dist (ft)		201			358			591				441
Turn Bay Length (ft)												
Base Capacity (vph)					1476	521		1848				1370
Starvation Cap Reductn					0	0		0				0
Spillback Cap Reductn					0	0		0				0
Storage Cap Reductn					0	0		0				0
Reduced v/c Ratio					0.20	0.09		0.38				0.32

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 62.5 (78%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.38
 Intersection Signal Delay: 16.3
 Intersection Capacity Utilization 66.7%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Existing (2016) Morning Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	14	276	133	27	0	0	0	0	32
Future Volume (vph)	0	0	0	14	276	133	27	0	0	0	0	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98						
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4706	1468	1433	0	0	0	0	1550
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4706	1437	1433	0	0	0	0	1550
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						160						507
Link Speed (mph)		30			30			30				30
Link Distance (ft)		438			463			670				531
Travel Time (s)		10.0			10.5			15.2				12.1
Confl. Peds. (#/hr)	1		1	1		1						
Confl. Bikes (#/hr)						1						
Peak Hour Factor	0.83	0.25	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	0%	0%	0%	10%	10%	10%	26%	26%	26%	6%	6%	6%
Adj. Flow (vph)	0	0	0	17	333	160	33	0	0	0	0	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	350	160	33	0	0	0	0	39
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				50.0	50.0	50.0	25.5					25.5
Total Split (s)				50.0	50.0	50.0	30.0					30.0
Total Split (%)				62.5%	62.5%	62.5%	37.5%					37.5%
Maximum Green (s)				45.0	45.0	45.0	25.5					25.5
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				33.0	33.0	33.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					45.0	45.0	25.5					25.5
Actuated g/C Ratio					0.56	0.56	0.32					0.32
v/c Ratio					0.13	0.18	0.07					0.05
Control Delay					8.4	2.0	21.4					0.1
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					8.4	2.0	21.4					0.1
LOS					A	A	C					A
Approach Delay					6.4			21.4			0.1	
Approach LOS					A			C			A	
Queue Length 50th (ft)					27	0	14					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Existing (2016) Morning Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					37	19	29					0
Internal Link Dist (ft)		358			383			590			451	
Turn Bay Length (ft)												
Base Capacity (vph)					2647	878	456					839
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.13	0.18	0.07					0.05

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.18
 Intersection Signal Delay: 6.9
 Intersection Capacity Utilization 55.4%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service B

Splits and Phases: 2: Garden Ave N & N 4th St



RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Existing (2016) Morning Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  										
Traffic Volume (vph)	14	492	6	0	0	0	0	14	55	8	11	0
Future Volume (vph)	14	492	6	0	0	0	0	14	55	8	11	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00										
Frt		0.998						0.892				
Flt Protected		0.999									0.980	
Satd. Flow (prot)	0	4832	0	0	0	0	0	1599	0	0	1411	0
Flt Permitted		0.999									0.915	
Satd. Flow (perm)	0	4831	0	0	0	0	0	1599	0	0	1317	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		4						71				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			190			467			670	
Travel Time (s)		10.0			4.3			10.6			15.2	
Confl. Peds. (#/hr)	6		2	2		6						
Peak Hour Factor	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Heavy Vehicles (%)	7%	7%	7%	0%	0%	0%	6%	6%	6%	32%	32%	32%
Adj. Flow (vph)	18	631	8	0	0	0	0	18	71	10	14	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	657	0	0	0	0	0	89	0	0	24	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	53.0	53.0						27.0		27.0	27.0	
Total Split (s)	53.0	53.0						27.0		27.0	27.0	
Total Split (%)	66.3%	66.3%						33.8%		33.8%	33.8%	
Maximum Green (s)	48.0	48.0						22.5		22.5	22.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		5.0						4.5		4.5	4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	36.0	36.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						15.5		15.5	15.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		48.0						22.5		22.5	22.5	
Actuated g/C Ratio		0.60						0.28		0.28	0.28	
v/c Ratio		0.23						0.18		0.06	0.06	
Control Delay		22.2						9.0		25.5	25.5	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		22.2						9.0		25.5	25.5	
LOS		C						A		C	C	
Approach Delay		22.2						9.0		25.5	25.5	
Approach LOS		C						A		C	C	
Queue Length 50th (ft)		104						7		11	11	
Queue Length 95th (ft)		117						30		28	28	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Existing (2016) Morning Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		359			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		2900						500			370	
Starvation Cap Reductn		0						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.23						0.18			0.06	

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.23
 Intersection Signal Delay: 20.7
 Intersection Capacity Utilization 55.6%
 Analysis Period (min) 15

Intersection LOS: C
 ICU Level of Service B

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Existing (2016) Morning Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	136	412	19	0	0	0	0	507	52	51	388	0
Future Volume (vph)	136	412	19	0	0	0	0	507	52	51	388	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		1.00		
Frt		0.995						0.987				
Flt Protected		0.988								0.950		
Satd. Flow (prot)	0	4853	0	0	0	0	0	1767	0	1703	3406	0
Flt Permitted		0.988								0.146		
Satd. Flow (perm)	0	4849	0	0	0	0	0	1767	0	262	3406	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6						8				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		309			439			474				671
Travel Time (s)		7.0			10.0			10.8				15.3
Confl. Peds. (#/hr)	2		5	5		2	2		4	4		2
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	5%	5%	5%	0%	0%	0%	6%	6%	6%	6%	6%	6%
Adj. Flow (vph)	156	474	22	0	0	0	0	583	60	59	446	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	652	0	0	0	0	0	643	0	59	446	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	27.0	27.0						39.0		14.0	53.0	
Total Split (s)	27.0	27.0						39.0		14.0	53.0	
Total Split (%)	33.8%	33.8%						48.8%		17.5%	66.3%	
Maximum Green (s)	21.0	21.0						33.0		10.0	47.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	9.0	9.0						23.0			37.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		21.0						33.0		49.0	47.0	
Actuated g/C Ratio		0.26						0.41		0.61	0.59	
v/c Ratio		0.51						0.88		0.17	0.22	
Control Delay		26.6						37.0		8.6	6.2	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		26.6						37.0		8.6	6.2	
LOS		C						D		A	A	
Approach Delay		26.6						37.0			6.5	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Existing (2016) Morning Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Approach LOS		C							D			A		
Queue Length 50th (ft)		100							284			8	36	
Queue Length 95th (ft)		130							#460			20	48	
Internal Link Dist (ft)		229						359		394			591	
Turn Bay Length (ft)												100		
Base Capacity (vph)		1277							733			340	2001	
Starvation Cap Reductn		0							0			0	0	
Spillback Cap Reductn		0							0			0	0	
Storage Cap Reductn		0							0			0	0	
Reduced v/c Ratio		0.51							0.88			0.17	0.22	

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 66 (83%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 24.6
 Intersection Capacity Utilization 66.7%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 Without-Project - Morning Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	85	200	45	10	650	0	0	365	50
Future Volume (vph)	0	0	0	85	200	45	10	650	0	0	365	50
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99		1.00			1.00	0.982
Flt Protected					0.985			0.999				
Satd. Flow (prot)	0	0	0	0	4820	1524	0	3468	0	0	3339	0
Flt Permitted					0.985			0.950				
Satd. Flow (perm)	0	0	0	0	4817	1501	0	3298	0	0	3339	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						89					23	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		289			438			671			576	
Travel Time (s)		6.6			10.0			15.3			13.1	
Confl. Peds. (#/hr)	3		2	2		3	1		1	1		1
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	0%	0%	6%	6%	6%	4%	4%	4%	6%	6%	6%
Adj. Flow (vph)	0	0	0	94	222	50	11	722	0	0	406	56
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	316	50	0	733	0	0	462	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				30.0	30.0	30.0	12.0	50.0			38.0	
Total Split (s)				30.0	30.0	30.0	12.0	50.0			38.0	
Total Split (%)				37.5%	37.5%	37.5%	15.0%	62.5%			47.5%	
Maximum Green (s)				24.5	24.5	24.5	8.0	44.5			32.5	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				7.5	7.5	7.5		32.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					24.5	24.5		44.5			32.5	
Actuated g/C Ratio					0.31	0.31		0.56			0.41	
v/c Ratio					0.21	0.10		0.40			0.34	
Control Delay					17.7	6.9		17.0			16.3	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					17.7	6.9		17.0			16.3	
LOS					B	A		B			B	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 Without-Project - Morning Peak Hour
Lanes, Volumes, Timings

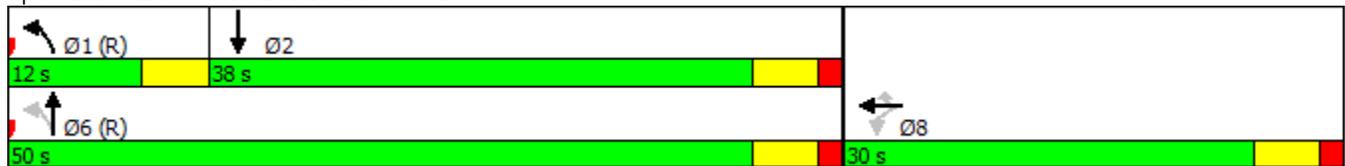
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					16.2			17.0			16.3	
Approach LOS					B			B			B	
Queue Length 50th (ft)					46	1		145			76	
Queue Length 95th (ft)					68	25		m169			112	
Internal Link Dist (ft)		209			358			591			496	
Turn Bay Length (ft)												
Base Capacity (vph)					1475	521		1848			1370	
Starvation Cap Reductn					0	0		0			0	
Spillback Cap Reductn					0	0		0			0	
Storage Cap Reductn					0	0		0			0	
Reduced v/c Ratio					0.21	0.10		0.40			0.34	

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 62.5 (78%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.40
 Intersection Signal Delay: 16.6
 Intersection Capacity Utilization 66.7%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 Without-Project - Morning Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	15	290	140	30	0	0	0	0	32
Future Volume (vph)	0	0	0	15	290	140	30	0	0	0	0	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98						
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4706	1468	1433	0	0	0	0	1550
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4706	1436	1433	0	0	0	0	1550
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						169						489
Link Speed (mph)		30			30			30				30
Link Distance (ft)		438			463			670				574
Travel Time (s)		10.0			10.5			15.2				13.0
Confl. Peds. (#/hr)	1		1	1		1						
Confl. Bikes (#/hr)						2						
Peak Hour Factor	0.83	0.25	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	0%	0%	0%	10%	10%	10%	26%	26%	26%	6%	6%	6%
Adj. Flow (vph)	0	0	0	18	349	169	36	0	0	0	0	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	367	169	36	0	0	0	0	39
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				50.0	50.0	50.0	25.5					25.5
Total Split (s)				50.0	50.0	50.0	30.0					30.0
Total Split (%)				62.5%	62.5%	62.5%	37.5%					37.5%
Maximum Green (s)				45.0	45.0	45.0	25.5					25.5
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				33.0	33.0	33.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					45.0	45.0	25.5					25.5
Actuated g/C Ratio					0.56	0.56	0.32					0.32
v/c Ratio					0.14	0.19	0.08					0.05
Control Delay					8.5	2.0	21.2					0.1
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					8.5	2.0	21.2					0.1
LOS					A	A	C					A
Approach Delay					6.4			21.2			0.1	
Approach LOS					A			C			A	
Queue Length 50th (ft)					29	0	15					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Forecast 2018 Without-Project - Morning Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					39	19	31					0
Internal Link Dist (ft)		358			383			590			494	
Turn Bay Length (ft)												
Base Capacity (vph)					2647	881	456					827
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.14	0.19	0.08					0.05

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.19
 Intersection Signal Delay: 6.9
 Intersection Capacity Utilization 55.4%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service B

Splits and Phases: 2: Garden Ave N & N 4th St



RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Forecast 2018 Without-Project - Morning Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	515	10	0	0	0	0	15	60	10	15	0
Future Volume (vph)	15	515	10	0	0	0	0	15	60	10	15	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.99				
Frt		0.997						0.892				
Flt Protected		0.999									0.980	
Satd. Flow (prot)	0	4826	0	0	0	0	0	1582	0	0	1411	0
Flt Permitted		0.999									0.908	
Satd. Flow (perm)	0	4826	0	0	0	0	0	1582	0	0	1307	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6						77				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			190			619			670	
Travel Time (s)		10.0			4.3			14.1			15.2	
Confl. Peds. (#/hr)	6		2	2		6						
Confl. Bikes (#/hr)									1			1
Peak Hour Factor	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Heavy Vehicles (%)	7%	7%	7%	0%	0%	0%	6%	6%	6%	32%	32%	32%
Adj. Flow (vph)	19	660	13	0	0	0	0	19	77	13	19	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	692	0	0	0	0	0	96	0	0	32	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	53.0	53.0						27.0		27.0	27.0	
Total Split (s)	53.0	53.0						27.0		27.0	27.0	
Total Split (%)	66.3%	66.3%						33.8%		33.8%	33.8%	
Maximum Green (s)	48.0	48.0						22.5		22.5	22.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	36.0	36.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						15.5		15.5	15.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		48.0						22.5			22.5	
Actuated g/C Ratio		0.60						0.28			0.28	
v/c Ratio		0.24						0.19			0.09	
Control Delay		22.2						8.9			25.0	
Queue Delay		0.0						0.0			0.0	
Total Delay		22.2						8.9			25.0	
LOS		C						A			C	
Approach Delay		22.2						8.9			25.0	
Approach LOS		C						A			C	
Queue Length 50th (ft)		110						7			14	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Forecast 2018 Without-Project - Morning Peak Hour
 Lanes, Volumes, Timings

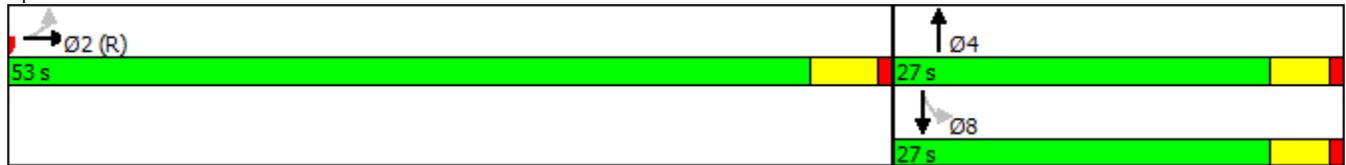
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		m124						31				32
Internal Link Dist (ft)		359			110			539				590
Turn Bay Length (ft)												
Base Capacity (vph)		2898						500				367
Starvation Cap Reductn		0						0				0
Spillback Cap Reductn		0						0				0
Storage Cap Reductn		0						0				0
Reduced v/c Ratio		0.24						0.19				0.09

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.24
 Intersection Signal Delay: 20.8
 Intersection Capacity Utilization 55.9%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service B

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 Without-Project - Morning Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  									 	
Traffic Volume (vph)	145	435	20	0	0	0	0	535	55	55	410	0
Future Volume (vph)	145	435	20	0	0	0	0	535	55	55	410	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		1.00		
Frt		0.995						0.987				
Flt Protected		0.988								0.950		
Satd. Flow (prot)	0	4853	0	0	0	0	0	1767	0	1703	3406	0
Flt Permitted		0.988								0.117		
Satd. Flow (perm)	0	4849	0	0	0	0	0	1767	0	210	3406	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6						8				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		297			439			618			671	
Travel Time (s)		6.8			10.0			14.0			15.3	
Confl. Peds. (#/hr)	2		5	5		2	2		4	4		2
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	5%	5%	5%	0%	0%	0%	6%	6%	6%	6%	6%	6%
Adj. Flow (vph)	167	500	23	0	0	0	0	615	63	63	471	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	690	0	0	0	0	0	678	0	63	471	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	27.0	27.0						39.0		14.0	53.0	
Total Split (s)	27.0	27.0						39.0		14.0	53.0	
Total Split (%)	33.8%	33.8%						48.8%		17.5%	66.3%	
Maximum Green (s)	21.0	21.0						33.0		10.0	47.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	9.0	9.0						23.0			37.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		21.0						33.0		49.0	47.0	
Actuated g/C Ratio		0.26						0.41		0.61	0.59	
v/c Ratio		0.54						0.92		0.20	0.24	
Control Delay		27.0						43.3		12.4	6.3	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		27.0						43.3		12.4	6.3	
LOS		C						D		B	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 Without-Project - Morning Peak Hour
Lanes, Volumes, Timings

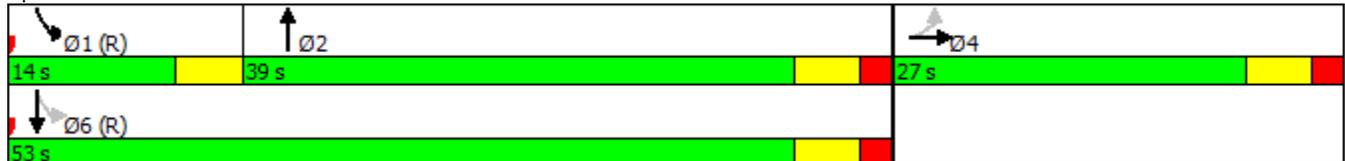
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		27.0						43.3				7.0
Approach LOS		C						D				A
Queue Length 50th (ft)		107						309		9		38
Queue Length 95th (ft)		138						#500		33		51
Internal Link Dist (ft)		217			359			538				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1277						733		315		2001
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.54						0.92		0.20		0.24

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 66 (83%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.92
 Intersection Signal Delay: 27.2
 Intersection Capacity Utilization 66.7%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
1: Park Ave N & N 4th St

Existing (2016) Afternoon Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑	↑		↑↑			↑↓	
Traffic Volume (vph)	0	0	0	300	292	28	21	248	0	0	1123	96
Future Volume (vph)	0	0	0	300	292	28	21	248	0	0	1123	96
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99		1.00			1.00	
Frt						0.850					0.988	
Flt Protected					0.975			0.996				
Satd. Flow (prot)	0	0	0	0	4958	1583	0	3360	0	0	3492	0
Flt Permitted					0.975			0.842				
Satd. Flow (perm)	0	0	0	0	4943	1561	0	2841	0	0	3492	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						71					12	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		284			438			671			531	
Travel Time (s)		6.5			10.0			15.3			12.1	
Confl. Peds. (#/hr)	2		6	6		2	5		1	1		5
Confl. Bikes (#/hr)									13			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	7%	7%	7%	2%	2%	2%
Adj. Flow (vph)	0	0	0	306	298	29	21	253	0	0	1146	98
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	604	29	0	274	0	0	1244	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (%)				35.5%	35.5%	35.5%	13.0%	64.5%			51.5%	
Maximum Green (s)				30.0	30.0	30.0	9.0	59.0			46.0	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				13.0	13.0	13.0		33.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					30.0	30.0		59.0			46.0	
Actuated g/C Ratio					0.30	0.30		0.59			0.46	
v/c Ratio					0.41	0.06		0.16			0.77	
Control Delay					26.1	1.9		13.3			26.4	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					26.1	1.9		13.3			26.4	
LOS					C	A		B			C	

RSD - Sartori Elementary
 1: Park Ave N & N 4th St

Existing (2016) Afternoon Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					25.0			13.3				26.4
Approach LOS					C			B				C
Queue Length 50th (ft)					113	0		42				335
Queue Length 95th (ft)					148	m8		77				422
Internal Link Dist (ft)		204			358			591				451
Turn Bay Length (ft)												
Base Capacity (vph)					1482	518		1715				1612
Starvation Cap Reductn					0	0		0				0
Spillback Cap Reductn					0	0		0				0
Storage Cap Reductn					0	0		0				0
Reduced v/c Ratio					0.41	0.06		0.16				0.77

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 61.5 (62%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.77
 Intersection Signal Delay: 24.3
 Intersection Capacity Utilization 72.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Existing (2016) Afternoon Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					  							
Traffic Volume (vph)	0	0	0	15	295	33	20	0	0	0	0	325
Future Volume (vph)	0	0	0	15	295	33	20	0	0	0	0	325
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98	1.00					0.99
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4793	1495	1504	0	0	0	0	1627
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4793	1463	1502	0	0	0	0	1605
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						35						571
Link Speed (mph)		30			30			30				30
Link Distance (ft)		438			463			670				527
Travel Time (s)		10.0			10.5			15.2				12.0
Confl. Peds. (#/hr)	2		2	2		2	1		1	1		1
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	8%	8%	8%	20%	20%	20%	1%	1%	1%
Adj. Flow (vph)	0	0	0	16	317	35	22	0	0	0	0	349
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	333	35	22	0	0	0	0	349
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				64.0	64.0	64.0	25.5					25.5
Total Split (s)				68.5	68.5	68.5	31.5					31.5
Total Split (%)				68.5%	68.5%	68.5%	31.5%					31.5%
Maximum Green (s)				63.5	63.5	63.5	27.0					27.0
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				47.0	47.0	47.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					63.5	63.5	27.0					27.0
Actuated g/C Ratio					0.64	0.64	0.27					0.27
v/c Ratio					0.11	0.04	0.05					0.41
Control Delay					7.3	2.5	21.8					1.5
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					7.3	2.5	21.8					1.5
LOS					A	A	C					A
Approach Delay					6.8			21.8			1.5	
Approach LOS					A			C			A	
Queue Length 50th (ft)					27	0	8					0
Queue Length 95th (ft)					39	11	20					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Existing (2016) Afternoon Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		358			383			590			447	
Turn Bay Length (ft)												
Base Capacity (vph)					3043	941	405					850
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.11	0.04	0.05					0.41

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.41
 Intersection Signal Delay: 4.7
 Intersection Capacity Utilization 84.4%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 2: Garden Ave N & N 4th St

 Ø2 (R)	 Ø4
68.5 s	31.5 s
	 Ø8
	31.5 s

RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Existing (2016) Afternoon Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  						 				
Traffic Volume (vph)	10	1022	27	0	0	0	0	15	26	12	12	0
Future Volume (vph)	10	1022	27	0	0	0	0	15	26	12	12	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.99			1.00	
Frt		0.996						0.915				
Flt Protected											0.976	
Satd. Flow (prot)	0	5062	0	0	0	0	0	1610	0	0	1717	0
Flt Permitted											0.892	
Satd. Flow (perm)	0	5062	0	0	0	0	0	1610	0	0	1568	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		9						29				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			190			467			670	
Travel Time (s)		10.0			4.3			10.6			15.2	
Confl. Peds. (#/hr)	8		1	1		8	1		1	1		1
Confl. Bikes (#/hr)									1			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	7%	7%	7%	8%	8%	8%
Adj. Flow (vph)	11	1136	30	0	0	0	0	17	29	13	13	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1177	0	0	0	0	0	46	0	0	26	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (%)	76.0%	76.0%						24.0%		24.0%	24.0%	
Maximum Green (s)	71.0	71.0						19.5		19.5	19.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	59.0	59.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						12.5		12.5	12.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		71.0						19.5		19.5	19.5	
Actuated g/C Ratio		0.71						0.20		0.20	0.20	
v/c Ratio		0.33						0.14		0.09	0.09	
Control Delay		7.7						18.4		39.7	39.7	
Queue Delay		0.2						0.0		0.0	0.0	
Total Delay		7.9						18.4		39.7	39.7	
LOS		A						B		D	D	
Approach Delay		7.9						18.4		39.7	39.7	
Approach LOS		A						B		D	D	
Queue Length 50th (ft)		92						9		16	16	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Existing (2016) Afternoon Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		143						40			42	
Internal Link Dist (ft)		359			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		3596						337			305	
Starvation Cap Reductn		1349						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.52						0.14			0.09	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.33
 Intersection Signal Delay: 8.9
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Existing (2016) Afternoon Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	69	662	24	0	0	0	0	201	27	355	1074	0
Future Volume (vph)	69	662	24	0	0	0	0	201	27	355	1074	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		1.00		
Frt		0.995						0.984				
Flt Protected		0.995								0.950		
Satd. Flow (prot)	0	4982	0	0	0	0	0	1743	0	1770	3539	0
Flt Permitted		0.995								0.538		
Satd. Flow (perm)	0	4979	0	0	0	0	0	1743	0	999	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5						9				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		422			439			474				671
Travel Time (s)		9.6			10.0			10.8				15.3
Confl. Peds. (#/hr)	3		12	12		3	4		5	5		4
Confl. Bikes (#/hr)									13			
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	3%	3%	3%	0%	0%	0%	7%	7%	7%	2%	2%	2%
Adj. Flow (vph)	71	682	25	0	0	0	0	207	28	366	1107	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	778	0	0	0	0	0	235	0	366	1107	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (%)	33.0%	33.0%						52.0%		15.0%	67.0%	
Maximum Green (s)	27.0	27.0						46.0		11.0	61.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	15.0	15.0						23.0			51.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		27.0						46.0		63.0	61.0	
Actuated g/C Ratio		0.27						0.46		0.63	0.61	
v/c Ratio		0.58						0.29		0.51	0.51	
Control Delay		33.4						17.4		5.1	5.2	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		33.4						17.4		5.1	5.2	
LOS		C						B		A	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Existing (2016) Afternoon Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		33.4						17.4				5.1
Approach LOS		C						B				A
Queue Length 50th (ft)		156						87		26		54
Queue Length 95th (ft)		198						140		m43		73
Internal Link Dist (ft)		342			359			394				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1347						806		714		2158
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.58						0.29		0.51		0.51

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 85 (85%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.58
 Intersection Signal Delay: 15.1
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 Without-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					  			 			 	
Traffic Volume (vph)	0	0	0	315	305	30	25	260	0	0	1180	100
Future Volume (vph)	0	0	0	315	305	30	25	260	0	0	1180	100
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99					1.00	
Frt						0.850					0.988	
Flt Protected					0.975			0.996				
Satd. Flow (prot)	0	0	0	0	4958	1583	0	3360	0	0	3492	0
Flt Permitted					0.975			0.784				
Satd. Flow (perm)	0	0	0	0	4943	1561	0	2645	0	0	3492	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						71					12	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		284			438			671			531	
Travel Time (s)		6.5			10.0			15.3			12.1	
Confl. Peds. (#/hr)	2		6	6		2	5		1	1		5
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	7%	7%	7%	2%	2%	2%
Adj. Flow (vph)	0	0	0	321	311	31	26	265	0	0	1204	102
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	632	31	0	291	0	0	1306	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (%)				35.5%	35.5%	35.5%	13.0%	64.5%			51.5%	
Maximum Green (s)				30.0	30.0	30.0	9.0	59.0			46.0	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				13.0	13.0	13.0		33.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					30.0	30.0		59.0			46.0	
Actuated g/C Ratio					0.30	0.30		0.59			0.46	
v/c Ratio					0.43	0.06		0.18			0.81	
Control Delay					26.3	2.0		13.8			28.0	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					26.3	2.0		13.8			28.0	
LOS					C	A		B			C	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 Without-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					25.2			13.8				28.0
Approach LOS					C			B				C
Queue Length 50th (ft)					119	0		46				362
Queue Length 95th (ft)					155	m8		83				455
Internal Link Dist (ft)		204			358			591				451
Turn Bay Length (ft)												
Base Capacity (vph)					1482	518		1614				1612
Starvation Cap Reductn					0	0		0				0
Spillback Cap Reductn					0	0		0				0
Storage Cap Reductn					0	0		0				0
Reduced v/c Ratio					0.43	0.06		0.18				0.81

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 61.5 (62%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 25.3
 Intersection Capacity Utilization 72.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 Without-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	15	310	35	20	0	0	0	0	345
Future Volume (vph)	0	0	0	15	310	35	20	0	0	0	0	345
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98	1.00					0.99
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4793	1495	1504	0	0	0	0	1627
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4793	1461	1502	0	0	0	0	1605
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						38						552
Link Speed (mph)		30			30			30				30
Link Distance (ft)		438			463			670				527
Travel Time (s)		10.0			10.5			15.2				12.0
Confl. Peds. (#/hr)	2		2	2		2	1		1	1		1
Confl. Bikes (#/hr)						2						
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	8%	8%	8%	20%	20%	20%	1%	1%	1%
Adj. Flow (vph)	0	0	0	16	333	38	22	0	0	0	0	371
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	349	38	22	0	0	0	0	371
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				64.0	64.0	64.0	25.5					25.5
Total Split (s)				68.5	68.5	68.5	31.5					31.5
Total Split (%)				68.5%	68.5%	68.5%	31.5%					31.5%
Maximum Green (s)				63.5	63.5	63.5	27.0					27.0
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				47.0	47.0	47.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					63.5	63.5	27.0					27.0
Actuated g/C Ratio					0.64	0.64	0.27					0.27
v/c Ratio					0.11	0.04	0.05					0.44
Control Delay					7.3	2.3	22.4					1.7
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					7.3	2.3	22.4					1.7
LOS					A	A	C					A
Approach Delay					6.8			22.4			1.7	
Approach LOS					A			C			A	
Queue Length 50th (ft)					29	0	8					0

RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 Without-Project - Afternoon Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					41	11	20					0
Internal Link Dist (ft)		358			383			590			447	
Turn Bay Length (ft)												
Base Capacity (vph)					3043	941	405					836
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.11	0.04	0.05					0.44

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.44
 Intersection Signal Delay: 4.8
 Intersection Capacity Utilization 85.6%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 2: Garden Ave N & N 4th St

 Ø2 (R) 68.5 s	 Ø4 31.5 s
	 Ø8 31.5 s

RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Forecast 2018 Without-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	1075	30	0	0	0	0	15	30	15	15	0
Future Volume (vph)	10	1075	30	0	0	0	0	15	30	15	15	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.99			1.00	
Frt		0.996						0.911				
Flt Protected											0.976	
Satd. Flow (prot)	0	5062	0	0	0	0	0	1602	0	0	1717	0
Flt Permitted											0.881	
Satd. Flow (perm)	0	5062	0	0	0	0	0	1602	0	0	1549	0
Right Turn on Red			Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		10						33				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			190			467			670	
Travel Time (s)		10.0			4.3			10.6			15.2	
Confl. Peds. (#/hr)	8		1	1		8	1		1	1		1
Confl. Bikes (#/hr)									1			1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	7%	7%	7%	8%	8%	8%
Adj. Flow (vph)	11	1194	33	0	0	0	0	17	33	17	17	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1238	0	0	0	0	0	50	0	0	34	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (%)	76.0%	76.0%						24.0%		24.0%	24.0%	
Maximum Green (s)	71.0	71.0						19.5		19.5	19.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	59.0	59.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						12.5		12.5	12.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		71.0						19.5		19.5	19.5	
Actuated g/C Ratio		0.71						0.20		0.20	0.20	
v/c Ratio		0.34						0.15		0.15	0.11	
Control Delay		8.2						17.7		17.7	38.9	
Queue Delay		0.2						0.0		0.0	0.0	
Total Delay		8.4						17.7		17.7	38.9	
LOS		A						B		B	D	
Approach Delay		8.4						17.7		17.7	38.9	
Approach LOS		A						B		B	D	
Queue Length 50th (ft)		103						9		9	20	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Forecast 2018 Without-Project - Afternoon Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		155						41			50	
Internal Link Dist (ft)		359			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		3596						338			302	
Starvation Cap Reductn		1347						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.55						0.15			0.11	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.34
 Intersection Signal Delay: 9.6
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 Without-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	695	25	0	0	0	0	210	30	375	1130	0
Future Volume (vph)	70	695	25	0	0	0	0	210	30	375	1130	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		1.00		
Frt		0.995						0.983				
Flt Protected		0.996								0.950		
Satd. Flow (prot)	0	4987	0	0	0	0	0	1742	0	1770	3539	0
Flt Permitted		0.996								0.526		
Satd. Flow (perm)	0	4984	0	0	0	0	0	1742	0	977	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5						10				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		422			439			474				671
Travel Time (s)		9.6			10.0			10.8				15.3
Confl. Peds. (#/hr)	3		12	12		3	4		5	5		4
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	3%	3%	3%	0%	0%	0%	7%	7%	7%	2%	2%	2%
Adj. Flow (vph)	72	716	26	0	0	0	0	216	31	387	1165	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	814	0	0	0	0	0	247	0	387	1165	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (%)	33.0%	33.0%						52.0%		15.0%	67.0%	
Maximum Green (s)	27.0	27.0						46.0		11.0	61.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	15.0	15.0						23.0			51.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		27.0						46.0		63.0	61.0	
Actuated g/C Ratio		0.27						0.46		0.63	0.61	
v/c Ratio		0.60						0.31		0.55	0.54	
Control Delay		33.9						17.5		5.5	5.4	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		33.9						17.5		5.5	5.4	
LOS		C						B		A	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 Without-Project - Afternoon Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		33.9						17.5				5.4
Approach LOS		C						B				A
Queue Length 50th (ft)		164						92		29		59
Queue Length 95th (ft)		208						148		m45		77
Internal Link Dist (ft)		342			359			394				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1349						806		702		2158
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.60						0.31		0.55		0.54

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 85 (85%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.60
 Intersection Signal Delay: 15.4
 Intersection Capacity Utilization 84.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
1: Park Ave N & N 4th St

Existing (2016) PM Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					  			 			 	
Traffic Volume (vph)	0	0	0	267	242	23	24	245	0	0	1151	95
Future Volume (vph)	0	0	0	267	242	23	24	245	0	0	1151	95
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99		1.00			1.00	0.989
Frt						0.850						
Flt Protected					0.974			0.996				
Satd. Flow (prot)	0	0	0	0	5002	1599	0	3299	0	0	3462	0
Flt Permitted					0.974			0.807				
Satd. Flow (perm)	0	0	0	0	4992	1575	0	2673	0	0	3462	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						71					11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		284			438			671			531	
Travel Time (s)		6.5			10.0			15.3			12.1	
Confl. Peds. (#/hr)	3		4	4		3	6		2	2		6
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	9%	9%	9%	3%	3%	3%
Adj. Flow (vph)	0	0	0	272	247	23	24	250	0	0	1174	97
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	519	23	0	274	0	0	1271	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (%)				35.5%	35.5%	35.5%	13.0%	64.5%			51.5%	
Maximum Green (s)				30.0	30.0	30.0	9.0	59.0			46.0	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				13.0	13.0	13.0		33.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effct Green (s)					30.0	30.0		59.0			46.0	
Actuated g/C Ratio					0.30	0.30		0.59			0.46	
v/c Ratio					0.35	0.04		0.17			0.80	
Control Delay					25.4	1.5		13.9			27.4	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					25.4	1.5		13.9			27.4	
LOS					C	A		B			C	
Approach Delay					24.4			13.9			27.4	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Existing (2016) PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS					C			B				C
Queue Length 50th (ft)					95	0		44				348
Queue Length 95th (ft)					127	m0		79				440
Internal Link Dist (ft)		204			358			591				451
Turn Bay Length (ft)												
Base Capacity (vph)					1497	522		1624				1598
Starvation Cap Reductn					0	0		0				0
Spillback Cap Reductn					0	0		0				0
Storage Cap Reductn					0	0		0				0
Reduced v/c Ratio					0.35	0.04		0.17				0.80

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 61.5 (62%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 24.8
 Intersection Capacity Utilization 72.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Existing (2016) PM Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	8	262	30	15	0	0	0	0	319
Future Volume (vph)	0	0	0	8	262	30	15	0	0	0	0	319
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98	1.00					0.99
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4622	1442	1421	0	0	0	0	1644
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4622	1411	1419	0	0	0	0	1621
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						32						613
Link Speed (mph)		30			30			30				30
Link Distance (ft)		438			463			670				527
Travel Time (s)		10.0			10.5			15.2				12.0
Confl. Peds. (#/hr)	2		2	2		2	1		1	1		1
Confl. Bikes (#/hr)			1									
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	12%	12%	12%	27%	27%	27%	0%	0%	0%
Adj. Flow (vph)	0	0	0	9	282	32	16	0	0	0	0	343
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	291	32	16	0	0	0	0	343
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				64.0	64.0	64.0	25.5					25.5
Total Split (s)				68.5	68.5	68.5	31.5					31.5
Total Split (%)				68.5%	68.5%	68.5%	31.5%					31.5%
Maximum Green (s)				63.5	63.5	63.5	27.0					27.0
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				47.0	47.0	47.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					63.5	63.5	27.0					27.0
Actuated g/C Ratio					0.64	0.64	0.27					0.27
v/c Ratio					0.10	0.04	0.04					0.39
Control Delay					7.2	2.5	20.6					1.3
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					7.2	2.5	20.6					1.3
LOS					A	A	C					A
Approach Delay					6.8			20.6			1.3	
Approach LOS					A			C			A	
Queue Length 50th (ft)					24	0	6					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Existing (2016) PM Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					35	10	m14					0
Internal Link Dist (ft)		358			383			590			447	
Turn Bay Length (ft)												
Base Capacity (vph)					2934	907	383					885
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.10	0.04	0.04					0.39

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.39
 Intersection Signal Delay: 4.3
 Intersection Capacity Utilization 84.0%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 2: Garden Ave N & N 4th St

 Ø2 (R) 68.5 s	 Ø4 31.5 s
	 Ø8 31.5 s

RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Existing (2016) PM Peak Hour
Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  						 				
Traffic Volume (vph)	6	1198	32	0	0	0	0	15	23	24	8	0
Future Volume (vph)	6	1198	32	0	0	0	0	15	23	24	8	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.99			1.00	
Frt		0.996						0.919				
Flt Protected											0.964	
Satd. Flow (prot)	0	5062	0	0	0	0	0	1729	0	0	1728	0
Flt Permitted											0.820	
Satd. Flow (perm)	0	5062	0	0	0	0	0	1729	0	0	1465	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10						24				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			190			467			670	
Travel Time (s)		10.0			4.3			10.6			15.2	
Confl. Peds. (#/hr)	9		2	2		9	2		3	3		2
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	0%	0%	0%	6%	6%	6%
Adj. Flow (vph)	6	1261	34	0	0	0	0	16	24	25	8	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1301	0	0	0	0	0	40	0	0	33	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (%)	76.0%	76.0%						24.0%		24.0%	24.0%	
Maximum Green (s)	71.0	71.0						19.5		19.5	19.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	59.0	59.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						12.5		12.5	12.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		71.0						19.5		19.5	19.5	
Actuated g/C Ratio		0.71						0.20		0.20	0.20	
v/c Ratio		0.36						0.11		0.12	0.12	
Control Delay		10.4						19.3		37.3	37.3	
Queue Delay		0.2						0.0		0.0	0.0	
Total Delay		10.7						19.3		37.3	37.3	
LOS		B						B		D	D	
Approach Delay		10.7						19.3		37.3	37.3	
Approach LOS		B						B		D	D	
Queue Length 50th (ft)		130						8		19	19	
Queue Length 95th (ft)		183						37		47	47	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Existing (2016) PM Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Internal Link Dist (ft)		359			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		3596						356			285	
Starvation Cap Reductn		1344						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.58						0.11			0.12	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.36
 Intersection Signal Delay: 11.6
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Existing (2016) PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	837	19	0	0	0	0	202	43	345	1063	0
Future Volume (vph)	70	837	19	0	0	0	0	202	43	345	1063	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		0.99		
Frt		0.997						0.976				
Flt Protected		0.996								0.950		
Satd. Flow (prot)	0	5048	0	0	0	0	0	1679	0	1770	3539	0
Flt Permitted		0.996								0.523		
Satd. Flow (perm)	0	5045	0	0	0	0	0	1679	0	968	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3						14				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		422			439			474			671	
Travel Time (s)		9.6			10.0			10.8			15.3	
Confl. Peds. (#/hr)	3		9	9		3	10		11	11		10
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	71	854	19	0	0	0	0	206	44	352	1085	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	944	0	0	0	0	0	250	0	352	1085	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (%)	33.0%	33.0%						52.0%		15.0%	67.0%	
Maximum Green (s)	27.0	27.0						46.0		11.0	61.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	15.0	15.0						23.0			51.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		27.0						46.0		63.0	61.0	
Actuated g/C Ratio		0.27						0.46		0.63	0.61	
v/c Ratio		0.69						0.32		0.50	0.50	
Control Delay		35.8						17.5		4.1	4.0	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		35.8						17.5		4.1	4.0	
LOS		D						B		A	A	
Approach Delay		35.8						17.5			4.0	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Existing (2016) PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach LOS		D						B				A
Queue Length 50th (ft)		197						92		17		42
Queue Length 95th (ft)		245						149		m31		58
Internal Link Dist (ft)		342			359			394				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1364						779		698		2158
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.69						0.32		0.50		0.50

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 85 (85%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 16.7
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 Without-Project - PM Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	280	255	25	25	255	0	0	1210	100
Future Volume (vph)	0	0	0	280	255	25	25	255	0	0	1210	100
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99					1.00	
Frt						0.850					0.989	
Flt Protected					0.974			0.995				
Satd. Flow (prot)	0	0	0	0	5002	1599	0	3295	0	0	3462	0
Flt Permitted					0.974			0.775				
Satd. Flow (perm)	0	0	0	0	4992	1575	0	2567	0	0	3462	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						71					11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		284			438			671			531	
Travel Time (s)		6.5			10.0			15.3			12.1	
Confl. Peds. (#/hr)	3		4	4		3	6		2	2		6
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	9%	9%	9%	3%	3%	3%
Adj. Flow (vph)	0	0	0	286	260	26	26	260	0	0	1235	102
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	546	26	0	286	0	0	1337	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (%)				35.5%	35.5%	35.5%	13.0%	64.5%			51.5%	
Maximum Green (s)				30.0	30.0	30.0	9.0	59.0			46.0	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				13.0	13.0	13.0		33.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					30.0	30.0		59.0			46.0	
Actuated g/C Ratio					0.30	0.30		0.59			0.46	
v/c Ratio					0.36	0.05		0.18			0.84	
Control Delay					25.6	1.7		14.1			29.4	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					25.6	1.7		14.1			29.4	
LOS					C	A		B			C	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 Without-Project - PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					24.5			14.1			29.4	
Approach LOS					C			B			C	
Queue Length 50th (ft)					100	0		47			378	
Queue Length 95th (ft)					133	m0		m82			476	
Internal Link Dist (ft)		204			358			591			451	
Turn Bay Length (ft)												
Base Capacity (vph)					1497	522		1569			1598	
Starvation Cap Reductn					0	0		0			0	
Spillback Cap Reductn					0	0		0			0	
Storage Cap Reductn					0	0		0			0	
Reduced v/c Ratio					0.36	0.05		0.18			0.84	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 61.5 (62%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.84
 Intersection Signal Delay: 26.1
 Intersection Capacity Utilization 72.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 Without-Project - PM Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	10	275	30	15	0	0	0	0	335
Future Volume (vph)	0	0	0	10	275	30	15	0	0	0	0	335
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98	1.00					0.99
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4622	1442	1421	0	0	0	0	1644
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4622	1409	1419	0	0	0	0	1621
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						32						596
Link Speed (mph)		30			30			30				30
Link Distance (ft)		438			463			670				527
Travel Time (s)		10.0			10.5			15.2				12.0
Confl. Peds. (#/hr)	2		2	2		2	1		1	1		1
Confl. Bikes (#/hr)						2						
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	12%	12%	12%	27%	27%	27%	0%	0%	0%
Adj. Flow (vph)	0	0	0	11	296	32	16	0	0	0	0	360
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	307	32	16	0	0	0	0	360
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				64.0	64.0	64.0	25.5					25.5
Total Split (s)				68.5	68.5	68.5	31.5					31.5
Total Split (%)				68.5%	68.5%	68.5%	31.5%					31.5%
Maximum Green (s)				63.5	63.5	63.5	27.0					27.0
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				47.0	47.0	47.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					63.5	63.5	27.0					27.0
Actuated g/C Ratio					0.64	0.64	0.27					0.27
v/c Ratio					0.10	0.04	0.04					0.41
Control Delay					7.2	2.5	22.2					1.4
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					7.2	2.5	22.2					1.4
LOS					A	A	C					A
Approach Delay					6.8			22.2			1.4	
Approach LOS					A			C			A	
Queue Length 50th (ft)					25	0	6					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Forecast 2018 Without-Project - PM Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					36	10	m16					0
Internal Link Dist (ft)		358			383			590			447	
Turn Bay Length (ft)												
Base Capacity (vph)					2934	906	383					872
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.10	0.04	0.04					0.41

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.41
 Intersection Signal Delay: 4.4
 Intersection Capacity Utilization 85.0%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 2: Garden Ave N & N 4th St

 Ø2 (R) 68.5 s	 Ø4 31.5 s
	 Ø8 31.5 s

RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Forecast 2018 Without-Project - PM Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  										
Traffic Volume (vph)	10	1260	35	0	0	0	0	15	25	25	10	0
Future Volume (vph)	10	1260	35	0	0	0	0	15	25	25	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.99			1.00	
Frt		0.996						0.916				
Flt Protected											0.966	
Satd. Flow (prot)	0	5062	0	0	0	0	0	1721	0	0	1732	0
Flt Permitted											0.827	
Satd. Flow (perm)	0	5062	0	0	0	0	0	1721	0	0	1478	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10						26				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		439			190			467			670	
Travel Time (s)		10.0			4.3			10.6			15.2	
Confl. Peds. (#/hr)	9		2	2		9	2		3	3		2
Confl. Bikes (#/hr)									1			1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	0%	0%	0%	6%	6%	6%
Adj. Flow (vph)	11	1326	37	0	0	0	0	16	26	26	11	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1374	0	0	0	0	0	42	0	0	37	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (%)	76.0%	76.0%						24.0%		24.0%	24.0%	
Maximum Green (s)	71.0	71.0						19.5		19.5	19.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	59.0	59.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						12.5		12.5	12.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		71.0						19.5			19.5	
Actuated g/C Ratio		0.71						0.20			0.20	
v/c Ratio		0.38						0.12			0.13	
Control Delay		11.1						18.7			37.7	
Queue Delay		0.3						0.0			0.0	
Total Delay		11.3						18.7			37.7	
LOS		B						B			D	
Approach Delay		11.3						18.7			37.7	
Approach LOS		B						B			D	
Queue Length 50th (ft)		146						8			21	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Forecast 2018 Without-Project - PM Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		200						37				51
Internal Link Dist (ft)		359			110			387				590
Turn Bay Length (ft)												
Base Capacity (vph)		3596						356				288
Starvation Cap Reductn		1342						0				0
Spillback Cap Reductn		0						0				0
Storage Cap Reductn		0						0				0
Reduced v/c Ratio		0.61						0.12				0.13

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.38
 Intersection Signal Delay: 12.2
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 Without-Project - PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	880	20	0	0	0	0	210	45	360	1115	0
Future Volume (vph)	75	880	20	0	0	0	0	210	45	360	1115	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		0.99		
Frt		0.997						0.976				
Flt Protected		0.996								0.950		
Satd. Flow (prot)	0	5048	0	0	0	0	0	1679	0	1770	3539	0
Flt Permitted		0.996								0.513		
Satd. Flow (perm)	0	5045	0	0	0	0	0	1679	0	950	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3						14				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		422			439			474				671
Travel Time (s)		9.6			10.0			10.8				15.3
Confl. Peds. (#/hr)	3		9	9		3	10		11	11		10
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	77	898	20	0	0	0	0	214	46	367	1138	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	995	0	0	0	0	0	260	0	367	1138	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (%)	33.0%	33.0%						52.0%		15.0%	67.0%	
Maximum Green (s)	27.0	27.0						46.0		11.0	61.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	15.0	15.0						23.0			51.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		27.0						46.0		63.0	61.0	
Actuated g/C Ratio		0.27						0.46		0.63	0.61	
v/c Ratio		0.73						0.33		0.53	0.53	
Control Delay		36.8						17.7		4.3	4.2	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		36.8						17.7		4.3	4.2	
LOS		D						B		A	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 Without-Project - PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		36.8						17.7				4.3
Approach LOS		D						B				A
Queue Length 50th (ft)		210						96		19		45
Queue Length 95th (ft)		260						155		m32		62
Internal Link Dist (ft)		342			359			394				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1364						779		688		2158
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.73						0.33		0.53		0.53

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 85 (85%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.73
 Intersection Signal Delay: 17.3
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 With-Project - Morning Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	216	227	52	10	650	0	0	365	50
Future Volume (vph)	0	0	0	216	227	52	10	650	0	0	365	50
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					0.99	0.96		1.00			1.00	
Frt						0.850					0.982	
Flt Protected					0.976			0.999				
Satd. Flow (prot)	0	0	0	0	4868	1553	0	3468	0	0	3332	0
Flt Permitted					0.976			0.950				
Satd. Flow (perm)	0	0	0	0	4810	1497	0	3297	0	0	3332	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						89					23	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		232			123			671			503	
Travel Time (s)		5.3			2.8			15.3			11.4	
Confl. Peds. (#/hr)	25		25	25		25	25		25	25		25
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	0%	0%	0%	4%	4%	4%	4%	4%	4%	6%	6%	6%
Adj. Flow (vph)	0	0	0	240	252	58	11	722	0	0	406	56
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	492	58	0	733	0	0	462	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				30.0	30.0	30.0	12.0	50.0			38.0	
Total Split (s)				30.0	30.0	30.0	12.0	50.0			38.0	
Total Split (%)				37.5%	37.5%	37.5%	15.0%	62.5%			47.5%	
Maximum Green (s)				24.5	24.5	24.5	8.0	44.5			32.5	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				7.5	7.5	7.5		32.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					24.5	24.5		44.5			32.5	
Actuated g/C Ratio					0.31	0.31		0.56			0.41	
v/c Ratio					0.33	0.11		0.40			0.34	
Control Delay					22.8	4.1		16.9			16.3	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					22.8	4.1		16.9			16.3	
LOS					C	A		B			B	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 With-Project - Morning Peak Hour
Lanes, Volumes, Timings

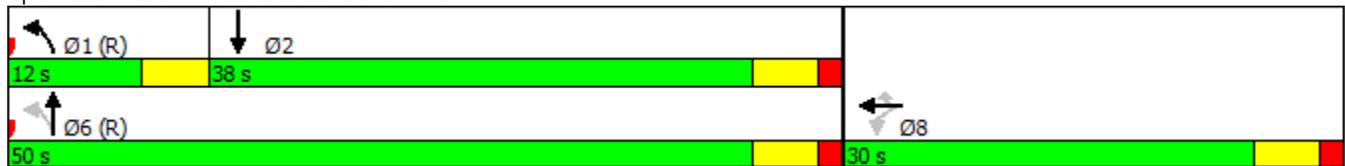
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					20.9			16.9			16.3	
Approach LOS					C			B			B	
Queue Length 50th (ft)					74	1		145			76	
Queue Length 95th (ft)					103	18		m167			112	
Internal Link Dist (ft)		152			43			591			423	
Turn Bay Length (ft)												
Base Capacity (vph)					1473	520		1847			1367	
Starvation Cap Reductn					0	0		0			0	
Spillback Cap Reductn					0	0		0			0	
Storage Cap Reductn					0	0		0			0	
Reduced v/c Ratio					0.33	0.11		0.40			0.34	

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 62.5 (78%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.40
 Intersection Signal Delay: 18.0
 Intersection Capacity Utilization 66.7%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 With-Project - Morning Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	30	396	140	125	0	0	0	0	44
Future Volume (vph)	0	0	0	30	396	140	125	0	0	0	0	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.97	0.98					0.97
Frt						0.850						0.865
Flt Protected					0.997		0.950					
Satd. Flow (prot)	0	0	0	0	4659	1455	1703	0	0	0	0	1580
Flt Permitted					0.997		0.950					
Satd. Flow (perm)	0	0	0	0	4655	1405	1674	0	0	0	0	1535
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						169						339
Link Speed (mph)		30			30			30				30
Link Distance (ft)		261			463			670				494
Travel Time (s)		5.9			10.5			15.2				11.2
Confl. Peds. (#/hr)	15		15	15		15	15		15	15		15
Confl. Bikes (#/hr)						2						
Peak Hour Factor	0.83	0.25	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles (%)	0%	0%	0%	11%	11%	11%	6%	6%	6%	4%	4%	4%
Adj. Flow (vph)	0	0	0	36	477	169	151	0	0	0	0	53
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	513	169	151	0	0	0	0	53
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				50.0	50.0	50.0	25.5					25.5
Total Split (s)				50.0	50.0	50.0	30.0					30.0
Total Split (%)				62.5%	62.5%	62.5%	37.5%					37.5%
Maximum Green (s)				45.0	45.0	45.0	25.5					25.5
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				33.0	33.0	33.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					45.0	45.0	25.5					25.5
Actuated g/C Ratio					0.56	0.56	0.32					0.32
v/c Ratio					0.20	0.20	0.28					0.07
Control Delay					8.8	2.0	22.2					0.2
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					8.8	2.0	22.2					0.2
LOS					A	A	C					A
Approach Delay					7.2			22.2			0.2	
Approach LOS					A			C			A	
Queue Length 50th (ft)					42	0	51					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Forecast 2018 With-Project - Morning Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					54	19	88					0
Internal Link Dist (ft)		181			383			590			414	
Turn Bay Length (ft)												
Base Capacity (vph)					2618	864	533					720
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.20	0.20	0.28					0.07

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.28
 Intersection Signal Delay: 9.3
 Intersection Capacity Utilization 65.5%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service C

Splits and Phases: 2: Garden Ave N & N 4th St



RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Forecast 2018 With-Project - Morning Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  										
Traffic Volume (vph)	56	606	14	0	0	0	0	69	63	25	15	0
Future Volume (vph)	56	606	14	0	0	0	0	69	63	25	15	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.98			0.99	
Frt		0.997						0.935				
Flt Protected		0.996									0.970	
Satd. Flow (prot)	0	4855	0	0	0	0	0	1645	0	0	1166	0
Flt Permitted		0.996									0.798	
Satd. Flow (perm)	0	4847	0	0	0	0	0	1645	0	0	947	0
Right Turn on Red			Yes						Yes			Yes
Satd. Flow (RTOR)		7						58				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		147			190			467			670	
Travel Time (s)		3.3			4.3			10.6			15.2	
Confl. Peds. (#/hr)	25		25	25			25	25		25	25	25
Confl. Bikes (#/hr)									1			1
Peak Hour Factor	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Heavy Vehicles (%)	6%	6%	6%	0%	0%	0%	6%	6%	6%	58%	58%	58%
Adj. Flow (vph)	72	777	18	0	0	0	0	88	81	32	19	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	867	0	0	0	0	0	169	0	0	51	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	53.0	53.0						27.0		27.0	27.0	
Total Split (s)	53.0	53.0						27.0		27.0	27.0	
Total Split (%)	66.3%	66.3%						33.8%		33.8%	33.8%	
Maximum Green (s)	48.0	48.0						22.5		22.5	22.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	36.0	36.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						15.5		15.5	15.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		48.0						22.5			22.5	
Actuated g/C Ratio		0.60						0.28			0.28	
v/c Ratio		0.30						0.34			0.19	
Control Delay		20.5						17.0			27.8	
Queue Delay		0.0						0.0			0.0	
Total Delay		20.5						17.0			27.8	
LOS		C						B			C	
Approach Delay		20.5						17.0			27.8	
Approach LOS		C						B			C	
Queue Length 50th (ft)		137						43			23	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Forecast 2018 With-Project - Morning Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		m153						75			49	
Internal Link Dist (ft)		67			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		2911						504			266	
Starvation Cap Reductn		0						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.30						0.34			0.19	

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.34
 Intersection Signal Delay: 20.3
 Intersection Capacity Utilization 70.9%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 With-Project - Morning Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	145	480	20	0	0	0	0	535	61	147	449	0
Future Volume (vph)	145	480	20	0	0	0	0	535	61	147	449	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		0.99						1.00		1.00		
Frt		0.995						0.986				
Flt Protected		0.989								0.950		
Satd. Flow (prot)	0	4855	0	0	0	0	0	1762	0	1703	3406	0
Flt Permitted		0.989								0.111		
Satd. Flow (perm)	0	4803	0	0	0	0	0	1762	0	198	3406	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		6						9				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		258			292			474				671
Travel Time (s)		5.9			6.6			10.8				15.3
Confl. Peds. (#/hr)	25		25	25		25	25		25	25		25
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Heavy Vehicles (%)	5%	5%	5%	0%	0%	0%	6%	6%	6%	6%	6%	6%
Adj. Flow (vph)	167	552	23	0	0	0	0	615	70	169	516	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	742	0	0	0	0	0	685	0	169	516	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	27.0	27.0						39.0		14.0	53.0	
Total Split (s)	27.0	27.0						39.0		14.0	53.0	
Total Split (%)	33.8%	33.8%						48.8%		17.5%	66.3%	
Maximum Green (s)	21.0	21.0						33.0		10.0	47.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	9.0	9.0						23.0			37.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		21.0						33.0		49.0	47.0	
Actuated g/C Ratio		0.26						0.41		0.61	0.59	
v/c Ratio		0.59						0.94		0.55	0.26	
Control Delay		27.7						45.0		26.9	8.5	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		27.7						45.0		26.9	8.5	
LOS		C						D		C	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

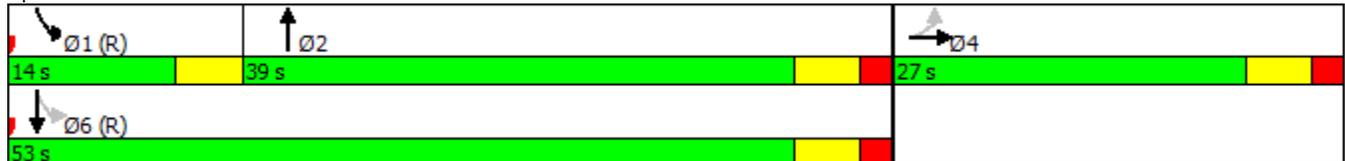
Forecast 2018 With-Project - Morning Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		27.7						45.0				13.0
Approach LOS		C						D				B
Queue Length 50th (ft)		117						315		55		64
Queue Length 95th (ft)		149						#508		112		84
Internal Link Dist (ft)		178			212			394				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1265						732		309		2001
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.59						0.94		0.55		0.26

Intersection Summary

Area Type: Other
 Cycle Length: 80
 Actuated Cycle Length: 80
 Offset: 66 (83%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 80
 Control Type: Pretimed
 Maximum v/c Ratio: 0.94
 Intersection Signal Delay: 28.6
 Intersection Capacity Utilization 71.1%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
5: N. Exit Driveway & N 4th St

Forecast 2018 With-Project - Morning Peak Hour
HCM Unsignalized Intersection Capacity Analysis

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations				↑↑↑↑	↘	
Traffic Volume (veh/h)	0	0	0	368	149	0
Future Volume (Veh/h)	0	0	0	368	149	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.40	0.40
Hourly flow rate (vph)	0	0	0	443	373	0
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)	123			315		
pX, platoon unblocked						
vC, conflicting volume			10		121	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			10		121	10
tC, single (s)			4.3		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.3		3.5	3.3
p0 queue free %			100		57	100
cM capacity (veh/h)			1545		861	1066
Direction, Lane #	WB 1	WB 2	WB 3	WB 4	NB 1	
Volume Total	111	111	111	111	373	
Volume Left	0	0	0	0	373	
Volume Right	0	0	0	0	0	
cSH	1700	1700	1700	1700	861	
Volume to Capacity	0.07	0.07	0.07	0.07	0.43	
Queue Length 95th (ft)	0	0	0	0	55	
Control Delay (s)	0.0	0.0	0.0	0.0	12.3	
Lane LOS					B	
Approach Delay (s)	0.0				12.3	
Approach LOS					B	
Intersection Summary						
Average Delay			5.6			
Intersection Capacity Utilization			20.3%		ICU Level of Service	A
Analysis Period (min)			15			

Intersection

Int Delay, s/veh	0.9					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔↑↑↑			↑	
Traffic Vol, veh/h	23	665	0	0	16	0
Future Vol, veh/h	23	665	0	0	16	0
Conflicting Peds, #/hr	10	0	0	10	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	1081229312	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	87	87	92	92	40	40
Heavy Vehicles, %	5	5	2	2	0	0
Mvmt Flow	26	764	0	0	40	0

Major/Minor	Major1		Minor2	
Conflicting Flow All	10	0	369	-
Stage 1	-	-	10	-
Stage 2	-	-	359	-
Critical Hdwy	5.4	-	5.7	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	6	-
Follow-up Hdwy	3.15	-	3.8	-
Pot Cap-1 Maneuver	1131	-	638	0
Stage 1	-	-	-	0
Stage 2	-	-	626	0
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1131	-	602	-
Mov Cap-2 Maneuver	-	-	602	-
Stage 1	-	-	-	-
Stage 2	-	-	596	-

Approach	EB	SB
HCM Control Delay, s	0.4	11.4
HCM LOS		B

Minor Lane/Major Mvmt	EBL	EBT	SBLn1
Capacity (veh/h)	1131	-	602
HCM Lane V/C Ratio	0.023	-	0.066
HCM Control Delay (s)	8.3	0.1	11.4
HCM Lane LOS	A	A	B
HCM 95th %tile Q(veh)	0.1	-	0.2

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 With-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					  			 			 	
Traffic Volume (vph)	0	0	0	403	332	37	25	260	0	0	1180	100
Future Volume (vph)	0	0	0	403	332	37	25	260	0	0	1180	100
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					0.99	0.96					1.00	
Frt						0.850					0.988	
Flt Protected					0.973			0.996				
Satd. Flow (prot)	0	0	0	0	4948	1583	0	3360	0	0	3487	0
Flt Permitted					0.973			0.784				
Satd. Flow (perm)	0	0	0	0	4880	1526	0	2645	0	0	3487	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						71					12	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		232			123			671			503	
Travel Time (s)		5.3			2.8			15.3			11.4	
Confl. Peds. (#/hr)	25		25	25		25	25		25	25		25
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	7%	7%	7%	2%	2%	2%
Adj. Flow (vph)	0	0	0	411	339	38	26	265	0	0	1204	102
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	750	38	0	291	0	0	1306	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (%)				35.5%	35.5%	35.5%	13.0%	64.5%			51.5%	
Maximum Green (s)				30.0	30.0	30.0	9.0	59.0			46.0	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				13.0	13.0	13.0		33.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					30.0	30.0		59.0			46.0	
Actuated g/C Ratio					0.30	0.30		0.59			0.46	
v/c Ratio					0.51	0.07		0.18			0.81	
Control Delay					28.9	2.1		14.0			28.0	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					28.9	2.1		14.0			28.0	
LOS					C	A		B			C	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 With-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					27.6			14.0			28.0	
Approach LOS					C			B			C	
Queue Length 50th (ft)					147	0		47			362	
Queue Length 95th (ft)					189	m9		83			455	
Internal Link Dist (ft)		152			43			591			423	
Turn Bay Length (ft)												
Base Capacity (vph)					1464	507		1614			1610	
Starvation Cap Reductn					0	0		0			0	
Spillback Cap Reductn					0	0		0			0	
Storage Cap Reductn					0	0		0			0	
Reduced v/c Ratio					0.51	0.07		0.18			0.81	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 61.5 (62%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 26.2
 Intersection Capacity Utilization 76.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service D

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 With-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	30	365	35	54	0	0	0	0	349
Future Volume (vph)	0	0	0	30	365	35	54	0	0	0	0	349
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.97	0.99					0.97
Frt						0.850						0.865
Flt Protected					0.996		0.950					
Satd. Flow (prot)	0	0	0	0	4697	1468	1671	0	0	0	0	1627
Flt Permitted					0.996		0.950					
Satd. Flow (perm)	0	0	0	0	4692	1419	1659	0	0	0	0	1574
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						38						464
Link Speed (mph)		30			30			30				30
Link Distance (ft)		261			463			670				494
Travel Time (s)		5.9			10.5			15.2				11.2
Confl. Peds. (#/hr)	15		15	15		15	5		15	15		15
Confl. Bikes (#/hr)						2						
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	10%	10%	10%	8%	8%	8%	1%	1%	1%
Adj. Flow (vph)	0	0	0	32	392	38	58	0	0	0	0	375
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	424	38	58	0	0	0	0	375
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				64.0	64.0	64.0	25.5					25.5
Total Split (s)				68.5	68.5	68.5	31.5					31.5
Total Split (%)				68.5%	68.5%	68.5%	31.5%					31.5%
Maximum Green (s)				63.5	63.5	63.5	27.0					27.0
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				47.0	47.0	47.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					63.5	63.5	27.0					27.0
Actuated g/C Ratio					0.64	0.64	0.27					0.27
v/c Ratio					0.14	0.04	0.13					0.49
Control Delay					7.5	2.3	25.0					3.2
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					7.5	2.3	25.0					3.2
LOS					A	A	C					A
Approach Delay					7.0			25.0			3.2	
Approach LOS					A			C			A	
Queue Length 50th (ft)					36	0	21					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Forecast 2018 With-Project - Afternoon Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					49	11	47					22
Internal Link Dist (ft)		181			383			590			414	
Turn Bay Length (ft)												
Base Capacity (vph)					2979	914	447					763
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.14	0.04	0.13					0.49

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.49
 Intersection Signal Delay: 6.6
 Intersection Capacity Utilization 87.3%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 2: Garden Ave N & N 4th St

 Ø2 (R) 68.5 s	 Ø4 31.5 s
	 Ø8 31.5 s

RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Forecast 2018 With-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  						 				
Traffic Volume (vph)	25	1131	33	0	0	0	0	34	33	30	15	0
Future Volume (vph)	25	1131	33	0	0	0	0	34	33	30	15	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.97			0.98	
Frt		0.996						0.933				
Flt Protected		0.999									0.968	
Satd. Flow (prot)	0	5055	0	0	0	0	0	1586	0	0	1323	0
Flt Permitted		0.999									0.808	
Satd. Flow (perm)	0	5053	0	0	0	0	0	1586	0	0	1079	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10						37				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		147			190			467			670	
Travel Time (s)		3.3			4.3			10.6			15.2	
Confl. Peds. (#/hr)	25		25	25		25	25		25	25		25
Confl. Bikes (#/hr)									1			1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	9%	9%	9%	39%	39%	39%
Adj. Flow (vph)	28	1257	37	0	0	0	0	38	37	33	17	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1322	0	0	0	0	0	75	0	0	50	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (%)	76.0%	76.0%						24.0%		24.0%	24.0%	
Maximum Green (s)	71.0	71.0						19.5		19.5	19.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	59.0	59.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						12.5		12.5	12.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		71.0						19.5		19.5	19.5	
Actuated g/C Ratio		0.71						0.20		0.20	0.20	
v/c Ratio		0.37						0.22		0.24	0.24	
Control Delay		8.4						21.4		43.5	43.5	
Queue Delay		0.3						0.0		0.0	0.0	
Total Delay		8.6						21.4		43.5	43.5	
LOS		A						C		D	D	
Approach Delay		8.6						21.4		43.5	43.5	
Approach LOS		A						C		D	D	
Queue Length 50th (ft)		117						20			31	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Forecast 2018 With-Project - Afternoon Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		170						59			71	
Internal Link Dist (ft)		67			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		3590						339			210	
Starvation Cap Reductn		1339						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.59						0.22			0.24	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.37
 Intersection Signal Delay: 10.5
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 With-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	70	712	25	0	0	0	0	210	33	428	1165	0
Future Volume (vph)	70	712	25	0	0	0	0	210	33	428	1165	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		0.99						1.00		0.99		
Frt		0.995						0.982				
Flt Protected		0.996								0.950		
Satd. Flow (prot)	0	4985	0	0	0	0	0	1735	0	1770	3539	0
Flt Permitted		0.996								0.523		
Satd. Flow (perm)	0	4965	0	0	0	0	0	1735	0	960	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		5						10				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		305			292			474				671
Travel Time (s)		6.9			6.6			10.8				15.3
Confl. Peds. (#/hr)	25		25	25		25	25		25	25		25
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Heavy Vehicles (%)	3%	3%	3%	0%	0%	0%	7%	7%	7%	2%	2%	2%
Adj. Flow (vph)	72	734	26	0	0	0	0	216	34	441	1201	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	832	0	0	0	0	0	250	0	441	1201	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (%)	33.0%	33.0%						52.0%		15.0%	67.0%	
Maximum Green (s)	27.0	27.0						46.0		11.0	61.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	15.0	15.0						23.0			51.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		27.0						46.0		63.0	61.0	
Actuated g/C Ratio		0.27						0.46		0.63	0.61	
v/c Ratio		0.62						0.31		0.64	0.56	
Control Delay		34.2						17.6		7.9	7.1	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		34.2						17.6		7.9	7.1	
LOS		C						B		A	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 With-Project - Afternoon Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		34.2						17.6			7.3	
Approach LOS		C						B			A	
Queue Length 50th (ft)		169						93		46	80	
Queue Length 95th (ft)		213						149		m67	101	
Internal Link Dist (ft)		225			212			394			591	
Turn Bay Length (ft)										100		
Base Capacity (vph)		1344						803		693	2158	
Starvation Cap Reductn		0						0		0	0	
Spillback Cap Reductn		0						0		0	0	
Storage Cap Reductn		0						0		0	0	
Reduced v/c Ratio		0.62						0.31		0.64	0.56	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 85 (85%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.64
 Intersection Signal Delay: 16.4
 Intersection Capacity Utilization 87.0%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
5: N. Exit Driveway & N 4th St

Forecast 2018 With-Project - Afternoon Peak Hour
HCM Unsignalized Intersection Capacity Analysis

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations				↑↑↑↑	↘	
Traffic Volume (veh/h)	0	0	0	684	113	0
Future Volume (Veh/h)	0	0	0	684	113	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.93	0.93	0.40	0.40
Hourly flow rate (vph)	0	0	0	735	283	0
Pedestrians					10	
Lane Width (ft)					12.0	
Walking Speed (ft/s)					4.0	
Percent Blockage					1	
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)	123			315		
pX, platoon unblocked						
vC, conflicting volume				10	194	10
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				10	194	10
tC, single (s)				4.2	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.3	3.5	3.3
p0 queue free %				100	64	100
cM capacity (veh/h)				1566	776	1066
Direction, Lane #	WB 1	WB 2	WB 3	WB 4	NB 1	
Volume Total	184	184	184	184	283	
Volume Left	0	0	0	0	283	
Volume Right	0	0	0	0	0	
cSH	1700	1700	1700	1700	776	
Volume to Capacity	0.11	0.11	0.11	0.11	0.36	
Queue Length 95th (ft)	0	0	0	0	42	
Control Delay (s)	0.0	0.0	0.0	0.0	12.3	
Lane LOS					B	
Approach Delay (s)	0.0			12.3		
Approach LOS					B	
Intersection Summary						
Average Delay				3.4		
Intersection Capacity Utilization				22.8%		ICU Level of Service
Analysis Period (min)				15		A

Intersection

Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑			↑	
Traffic Vol, veh/h	11	1162	0	0	12	0
Future Vol, veh/h	11	1162	0	0	12	0
Conflicting Peds, #/hr	10	0	0	10	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	1081229312	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	97	97	92	92	40	40
Heavy Vehicles, %	3	3	2	2	0	0
Mvmt Flow	11	1198	0	0	30	0

Major/Minor	Major1		Minor2	
Conflicting Flow All	10	0	512	-
Stage 1	-	-	10	-
Stage 2	-	-	502	-
Critical Hdwy	5.36	-	5.7	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	6	-
Follow-up Hdwy	3.13	-	3.8	-
Pot Cap-1 Maneuver	1138	-	545	0
Stage 1	-	-	-	0
Stage 2	-	-	529	0
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	1138	-	520	-
Mov Cap-2 Maneuver	-	-	520	-
Stage 1	-	-	-	-
Stage 2	-	-	509	-

Approach	EB	SB
HCM Control Delay, s	0.2	12.3
HCM LOS		B

Minor Lane/Major Mvmt	EBL	EBT	SBLn1
Capacity (veh/h)	1138	-	520
HCM Lane V/C Ratio	0.01	-	0.058
HCM Control Delay (s)	8.2	0.1	12.3
HCM Lane LOS	A	A	B
HCM 95th %tile Q(veh)	0	-	0.2

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 With-Project - PM Peak Hour

Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	321	265	28	25	255	0	0	1210	100
Future Volume (vph)	0	0	0	321	265	28	25	255	0	0	1210	100
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	513		0	0		0
Storage Lanes	0		0	0		1	1		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	0.95	0.95	1.00	1.00	0.95	0.95
Ped Bike Factor					1.00	0.99					1.00	
Frt						0.850					0.989	
Flt Protected					0.973			0.995				
Satd. Flow (prot)	0	0	0	0	4997	1599	0	3295	0	0	3462	0
Flt Permitted					0.973			0.775				
Satd. Flow (perm)	0	0	0	0	4986	1575	0	2567	0	0	3462	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						71					11	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		232			123			671			503	
Travel Time (s)		5.3			2.8			15.3			11.4	
Confl. Peds. (#/hr)	3		4	4		3	6		2	2		6
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	9%	9%	9%	3%	3%	3%
Adj. Flow (vph)	0	0	0	328	270	29	26	260	0	0	1235	102
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	598	29	0	286	0	0	1337	0
Turn Type				Perm	NA	Perm	pm+pt	NA			NA	
Protected Phases					8		1	6			2	
Permitted Phases				8		8	6					
Minimum Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (s)				35.5	35.5	35.5	13.0	64.5			51.5	
Total Split (%)				35.5%	35.5%	35.5%	13.0%	64.5%			51.5%	
Maximum Green (s)				30.0	30.0	30.0	9.0	59.0			46.0	
Yellow Time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
All-Red Time (s)				1.5	1.5	1.5	0.0	1.5			1.5	
Lost Time Adjust (s)					0.0	0.0		0.0			0.0	
Total Lost Time (s)					5.5	5.5		5.5			5.5	
Lead/Lag							Lead				Lag	
Lead-Lag Optimize?							Yes				Yes	
Walk Time (s)				13.0	13.0	13.0		33.5			19.0	
Flash Dont Walk (s)				17.0	17.0	17.0		12.0			12.0	
Pedestrian Calls (#/hr)				0	0	0		0			0	
Act Effect Green (s)					30.0	30.0		59.0			46.0	
Actuated g/C Ratio					0.30	0.30		0.59			0.46	
v/c Ratio					0.40	0.06		0.18			0.84	
Control Delay					26.6	1.6		14.1			29.4	
Queue Delay					0.0	0.0		0.0			0.0	
Total Delay					26.6	1.6		14.1			29.4	
LOS					C	A		B			C	

RSD - Sartori Elementary
1: Park Ave N & N 4th St

Forecast 2018 With-Project - PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay					25.4			14.1			29.4	
Approach LOS					C			B			C	
Queue Length 50th (ft)					112	0		47			378	
Queue Length 95th (ft)					146	m0		m81			476	
Internal Link Dist (ft)		152			43			591			423	
Turn Bay Length (ft)												
Base Capacity (vph)					1495	522		1569			1598	
Starvation Cap Reductn					0	0		0			0	
Spillback Cap Reductn					0	0		0			0	
Storage Cap Reductn					0	0		0			0	
Reduced v/c Ratio					0.40	0.06		0.18			0.84	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 61.5 (62%), Referenced to phase 1:NBL and 6:NBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.84
 Intersection Signal Delay: 26.3
 Intersection Capacity Utilization 72.1%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 1: Park Ave N & N 4th St



RSD - Sartori Elementary
2: Garden Ave N & N 4th St

Forecast 2018 With-Project - PM Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	10	301	30	31	0	0	0	0	337
Future Volume (vph)	0	0	0	10	301	30	31	0	0	0	0	337
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor					1.00	0.98	1.00					0.99
Frt						0.850						0.865
Flt Protected					0.998		0.950					
Satd. Flow (prot)	0	0	0	0	4664	1455	1583	0	0	0	0	1644
Flt Permitted					0.998		0.950					
Satd. Flow (perm)	0	0	0	0	4663	1422	1581	0	0	0	0	1621
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						32						563
Link Speed (mph)		30			30			30				30
Link Distance (ft)		261			463			670				494
Travel Time (s)		5.9			10.5			15.2				11.2
Confl. Peds. (#/hr)	2		2	2		2	1		1	1		1
Confl. Bikes (#/hr)						2						
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Heavy Vehicles (%)	0%	0%	0%	11%	11%	11%	14%	14%	14%	0%	0%	0%
Adj. Flow (vph)	0	0	0	11	324	32	33	0	0	0	0	362
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	335	32	33	0	0	0	0	362
Turn Type				Perm	NA	Perm	Perm					Perm
Protected Phases					2							
Permitted Phases				2		2	8					4
Minimum Split (s)				64.0	64.0	64.0	25.5					25.5
Total Split (s)				68.5	68.5	68.5	31.5					31.5
Total Split (%)				68.5%	68.5%	68.5%	31.5%					31.5%
Maximum Green (s)				63.5	63.5	63.5	27.0					27.0
Yellow Time (s)				4.0	4.0	4.0	3.5					3.5
All-Red Time (s)				1.0	1.0	1.0	1.0					1.0
Lost Time Adjust (s)					0.0	0.0	0.0					0.0
Total Lost Time (s)					5.0	5.0	4.5					4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				47.0	47.0	47.0	7.0					7.0
Flash Dont Walk (s)				12.0	12.0	12.0	14.0					14.0
Pedestrian Calls (#/hr)				0	0	0	0					0
Act Effct Green (s)					63.5	63.5	27.0					27.0
Actuated g/C Ratio					0.64	0.64	0.27					0.27
v/c Ratio					0.11	0.04	0.08					0.43
Control Delay					7.3	2.5	22.0					1.6
Queue Delay					0.0	0.0	0.0					0.0
Total Delay					7.3	2.5	22.0					1.6
LOS					A	A	C					A
Approach Delay					6.9			22.0			1.6	
Approach LOS					A			C			A	
Queue Length 50th (ft)					27	0	12					0

RSD - Sartori Elementary
 2: Garden Ave N & N 4th St

Forecast 2018 With-Project - PM Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)					39	10	27					0
Internal Link Dist (ft)		181			383			590			414	
Turn Bay Length (ft)												
Base Capacity (vph)					2961	914	426					848
Starvation Cap Reductn					0	0	0					0
Spillback Cap Reductn					0	0	0					0
Storage Cap Reductn					0	0	0					0
Reduced v/c Ratio					0.11	0.04	0.08					0.43

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:WBTL and 6:, Start of Green
 Natural Cycle: 90
 Control Type: Pretimed
 Maximum v/c Ratio: 0.43
 Intersection Signal Delay: 5.0
 Intersection Capacity Utilization 85.1%
 Analysis Period (min) 15

Intersection LOS: A
 ICU Level of Service E

Splits and Phases: 2: Garden Ave N & N 4th St

 Ø2 (R)	 Ø4
68.5 s	31.5 s
	 Ø8
	31.5 s

RSD - Sartori Elementary
3: Garden Ave N & N 3rd St

Forecast 2018 With-Project - PM Peak Hour

Lanes, Volumes, Timings

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  						 				
Traffic Volume (vph)	17	1287	36	0	0	0	0	24	25	25	10	0
Future Volume (vph)	17	1287	36	0	0	0	0	24	25	25	10	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor		1.00						0.99			1.00	
Frt		0.996						0.931				
Flt Protected		0.999									0.966	
Satd. Flow (prot)	0	5057	0	0	0	0	0	1753	0	0	1732	0
Flt Permitted		0.999									0.823	
Satd. Flow (perm)	0	5057	0	0	0	0	0	1753	0	0	1471	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10						26				
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		147			190			467			670	
Travel Time (s)		3.3			4.3			10.6			15.2	
Confl. Peds. (#/hr)	9		2	2		9	2		3	3		2
Confl. Bikes (#/hr)									1			1
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	0%	0%	0%	6%	6%	6%
Adj. Flow (vph)	18	1355	38	0	0	0	0	25	26	26	11	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1411	0	0	0	0	0	51	0	0	37	0
Turn Type	Perm	NA						NA		Perm	NA	
Protected Phases		2						4			8	
Permitted Phases	2									8		
Minimum Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (s)	76.0	76.0						24.0		24.0	24.0	
Total Split (%)	76.0%	76.0%						24.0%		24.0%	24.0%	
Maximum Green (s)	71.0	71.0						19.5		19.5	19.5	
Yellow Time (s)	4.0	4.0						3.5		3.5	3.5	
All-Red Time (s)	1.0	1.0						1.0		1.0	1.0	
Lost Time Adjust (s)		0.0						0.0			0.0	
Total Lost Time (s)		5.0						4.5			4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	59.0	59.0						7.0		7.0	7.0	
Flash Dont Walk (s)	12.0	12.0						12.5		12.5	12.5	
Pedestrian Calls (#/hr)	0	0						0		0	0	
Act Effct Green (s)		71.0						19.5			19.5	
Actuated g/C Ratio		0.71						0.20			0.20	
v/c Ratio		0.39						0.14			0.13	
Control Delay		11.0						20.9			37.7	
Queue Delay		0.3						0.0			0.0	
Total Delay		11.3						20.9			37.7	
LOS		B						C			D	
Approach Delay		11.3						20.9			37.7	
Approach LOS		B						C			D	
Queue Length 50th (ft)		151						13			21	

RSD - Sartori Elementary
 3: Garden Ave N & N 3rd St

Forecast 2018 With-Project - PM Peak Hour
 Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		205						45			51	
Internal Link Dist (ft)		67			110			387			590	
Turn Bay Length (ft)												
Base Capacity (vph)		3593						362			286	
Starvation Cap Reductn		1336						0			0	
Spillback Cap Reductn		0						0			0	
Storage Cap Reductn		0						0			0	
Reduced v/c Ratio		0.63						0.14			0.13	

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 0 (0%), Referenced to phase 2:EBTL and 6:, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.39
 Intersection Signal Delay: 12.3
 Intersection Capacity Utilization 83.3%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 3: Garden Ave N & N 3rd St



RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 With-Project - PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	75	887	20	0	0	0	0	210	46	387	1129	0
Future Volume (vph)	75	887	20	0	0	0	0	210	46	387	1129	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	100		0
Storage Lanes	0		0	0		0	0		0	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.91	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Ped Bike Factor		1.00						1.00		0.99		
Frt		0.997						0.976				
Flt Protected		0.996								0.950		
Satd. Flow (prot)	0	5048	0	0	0	0	0	1679	0	1770	3539	0
Flt Permitted		0.996								0.512		
Satd. Flow (perm)	0	5045	0	0	0	0	0	1679	0	948	3539	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		3						15				
Link Speed (mph)		30			30			30				30
Link Distance (ft)		290			292			474				671
Travel Time (s)		6.6			6.6			10.8				15.3
Confl. Peds. (#/hr)	3		9	9		3	10		11	11		10
Confl. Bikes (#/hr)									2			
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	10%	10%	10%	2%	2%	2%
Adj. Flow (vph)	77	905	20	0	0	0	0	214	47	395	1152	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1002	0	0	0	0	0	261	0	395	1152	0
Turn Type	Perm	NA						NA		pm+pt	NA	
Protected Phases		4						2		1	6	
Permitted Phases	4									6		
Minimum Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (s)	33.0	33.0						52.0		15.0	67.0	
Total Split (%)	33.0%	33.0%						52.0%		15.0%	67.0%	
Maximum Green (s)	27.0	27.0						46.0		11.0	61.0	
Yellow Time (s)	4.0	4.0						4.0		4.0	4.0	
All-Red Time (s)	2.0	2.0						2.0		0.0	2.0	
Lost Time Adjust (s)		0.0						0.0		0.0	0.0	
Total Lost Time (s)		6.0						6.0		4.0	6.0	
Lead/Lag								Lag		Lead		
Lead-Lag Optimize?								Yes		Yes		
Walk Time (s)	15.0	15.0						23.0			51.0	
Flash Dont Walk (s)	12.0	12.0						10.0			10.0	
Pedestrian Calls (#/hr)	0	0						0			0	
Act Effct Green (s)		27.0						46.0		63.0	61.0	
Actuated g/C Ratio		0.27						0.46		0.63	0.61	
v/c Ratio		0.73						0.33		0.57	0.53	
Control Delay		36.9						17.7		5.3	5.0	
Queue Delay		0.0						0.0		0.0	0.0	
Total Delay		36.9						17.7		5.3	5.0	
LOS		D						B		A	A	

RSD - Sartori Elementary
4: Park Ave N & N 3rd St

Forecast 2018 With-Project - PM Peak Hour
Lanes, Volumes, Timings

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		36.9						17.7				5.1
Approach LOS		D						B				A
Queue Length 50th (ft)		212						96		26		54
Queue Length 95th (ft)		263						155		m41		73
Internal Link Dist (ft)		210			212			394				591
Turn Bay Length (ft)										100		
Base Capacity (vph)		1364						780		687		2158
Starvation Cap Reductn		0						0		0		0
Spillback Cap Reductn		0						0		0		0
Storage Cap Reductn		0						0		0		0
Reduced v/c Ratio		0.73						0.33		0.57		0.53

Intersection Summary

Area Type: Other
 Cycle Length: 100
 Actuated Cycle Length: 100
 Offset: 85 (85%), Referenced to phase 1:SBL and 6:SBTL, Start of Green
 Natural Cycle: 100
 Control Type: Pretimed
 Maximum v/c Ratio: 0.73
 Intersection Signal Delay: 17.6
 Intersection Capacity Utilization 84.8%
 Analysis Period (min) 15
 m Volume for 95th percentile queue is metered by upstream signal.

Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 4: Park Ave N & N 3rd St



RSD - Sartori Elementary
5: N. Exit Driveway & N 4th St

Forecast 2018 With-Project - PM Peak Hour
HCM Unsignalized Intersection Capacity Analysis

						
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations				↑↑↑↑	↘	
Traffic Volume (veh/h)	0	0	0	629	50	0
Future Volume (Veh/h)	0	0	0	629	50	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.93	0.93	0.93	0.93	0.50	0.50
Hourly flow rate (vph)	0	0	0	676	100	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)	123			315		
pX, platoon unblocked						
vC, conflicting volume				0	169	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol				0	169	0
tC, single (s)				4.2	6.8	6.9
tC, 2 stage (s)						
tF (s)				2.3	3.5	3.3
p0 queue free %				100	88	100
cM capacity (veh/h)				1586	811	1091
Direction, Lane #	WB 1	WB 2	WB 3	WB 4	NB 1	
Volume Total	169	169	169	169	100	
Volume Left	0	0	0	0	100	
Volume Right	0	0	0	0	0	
cSH	1700	1700	1700	1700	811	
Volume to Capacity	0.10	0.10	0.10	0.10	0.12	
Queue Length 95th (ft)	0	0	0	0	11	
Control Delay (s)	0.0	0.0	0.0	0.0	10.1	
Lane LOS					B	
Approach Delay (s)	0.0				10.1	
Approach LOS					B	
Intersection Summary						
Average Delay				1.3		
Intersection Capacity Utilization				19.1%		ICU Level of Service
Analysis Period (min)				15		A

Intersection

Int Delay, s/veh	0.1					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	←↑↑↑				↑	
Traffic Vol, veh/h	5	1315	0	0	5	0
Future Vol, veh/h	5	1315	0	0	5	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	1081229312	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	98	98	92	92	50	50
Heavy Vehicles, %	2	2	2	2	0	0
Mvmt Flow	5	1342	0	0	10	0

Major/Minor	Major1		Minor2	
Conflicting Flow All	0	0	547	-
Stage 1	-	-	0	-
Stage 2	-	-	547	-
Critical Hdwy	5.34	-	5.7	-
Critical Hdwy Stg 1	-	-	-	-
Critical Hdwy Stg 2	-	-	6	-
Follow-up Hdwy	3.12	-	3.8	-
Pot Cap-1 Maneuver	-	-	525	0
Stage 1	-	-	-	0
Stage 2	-	-	501	0
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	525	-
Mov Cap-2 Maneuver	-	-	525	-
Stage 1	-	-	-	-
Stage 2	-	-	501	-

Approach	EB	SB
HCM Control Delay, s		12
HCM LOS		B

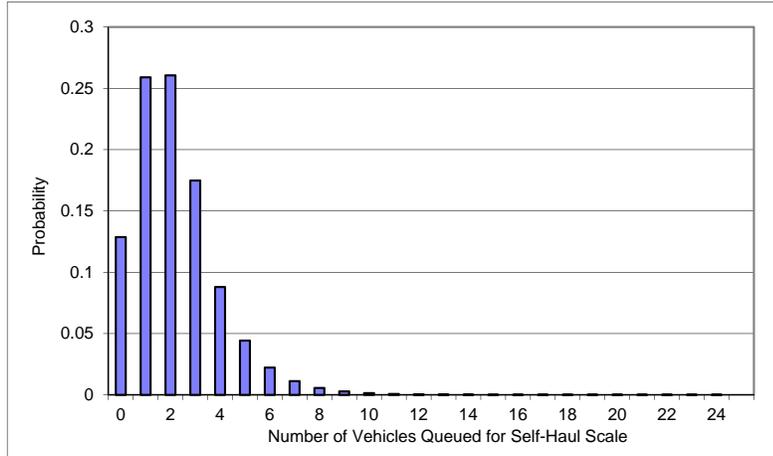
Minor Lane/Major Mvmt	EBL	EBT	SBLn1
Capacity (veh/h)	-	-	525
HCM Lane V/C Ratio	-	-	0.019
HCM Control Delay (s)	-	-	12
HCM Lane LOS	-	-	B
HCM 95th %tile Q(veh)	-	-	0.1

APPENDIX C

Queue Model Results

M/M/s Queuing Model for Renton School Disitrc't's Sartori Elementary Load/Unload Zone
Morning Peak Hour (Arrival)

Data		
$\lambda =$	483	(average arrival rate)
$\mu =$	240.0	(average service rate)
$s =$	4	(# servers)



where:

L = average number of vehicles queued at the load/unload zone at any one time

L_q = average number of vehicles in queue

W = average wait time at the load/unload zone (hours)

W_q = ave. wait time in queue (hours)

ρ = Load/Unload Zone utilization

P_0 = probability of 0 vehicles at the Load/Unload Zone

P_1 = probability of 1 vehicle at the Load/Unload Zone, etc.

2 =Average number of vehicles at the load/unload zone at any one time

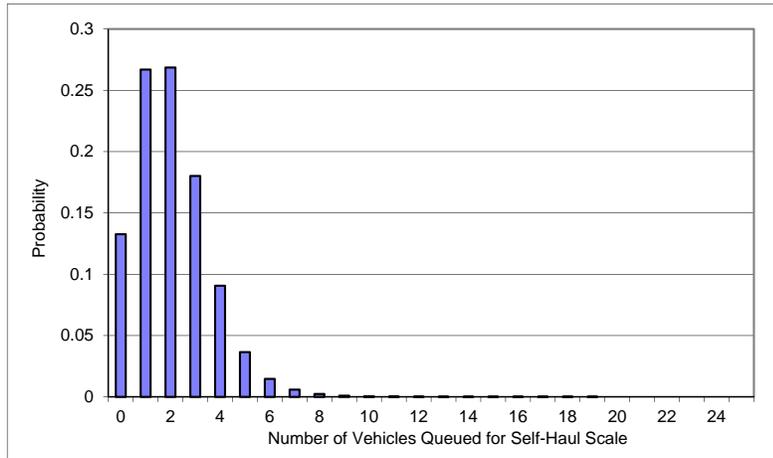
5 =Peak (95th-percentile) number of vehicles in load/unload zone at any one time

95.5% <= Closest probability to 95%

Results		
L =	2.191725961	
L_q =	0.179225961	
W =	0.005	Minutes
W_q =	0.000	0.3
ρ =	0.503125	0.0
		Prob < x vehicles
$P_0 =$	0.128672873	12.9% 0
$P_1 =$	0.258954157	38.8% 1
$P_2 =$	0.26057262	64.8% 2
$P_3 =$	0.174800799	82.3% 3
$P_4 =$	0.087946652	91.1% 4
$P_5 =$	0.044248159	95.5% 5
$P_6 =$	0.022262355	97.7% 6
$P_7 =$	0.011200747	98.9% 7
$P_8 =$	0.005635376	99.4% 8
$P_9 =$	0.002835299	99.7% 9
$P_{10} =$	0.00142651	99.9% 10
$P_{11} =$	0.000717713	99.9% 11
$P_{12} =$	0.000361099	100.0% 12
$P_{13} =$	0.000181678	100.0% 13
$P_{14} =$	9.14068E-05	100.0% 14
$P_{15} =$	4.5989E-05	100.0% 15
$P_{16} =$	2.31382E-05	100.0% 16
$P_{17} =$	1.16414E-05	100.0% 17
$P_{18} =$	5.85709E-06	100.0% 18
$P_{19} =$	2.94685E-06	100.0% 19
$P_{20} =$	1.48263E-06	100.0% 20
$P_{21} =$	7.4595E-07	100.0% 21
$P_{22} =$	3.75306E-07	100.0% 22
$P_{23} =$	1.88826E-07	100.0% 23
$P_{24} =$	9.5003E-08	100.0% 24
$P_{25} =$	4.77984E-08	100.0% 25
$P_{25} =$	2.40486E-08	100.0% 26
$P_{26} =$	1.20994E-08	100.0% 27
$P_{27} =$	6.08753E-09	100.0% 28
$P_{28} =$	3.06279E-09	100.0% 29
$P_{29} =$	1.54096E-09	100.0% 30
$P_{30} =$	7.75298E-10	100.0% 31
$P_{31} =$	3.90072E-10	100.0% 32
$P_{32} =$	1.96255E-10	100.0% 33
$P_{33} =$	9.87407E-11	100.0% 34
$P_{34} =$	4.96789E-11	100.0% 35
$P_{35} =$	2.49947E-11	100.0% 36
$P_{36} =$	1.25755E-11	100.0% 37
$P_{37} =$	6.32703E-12	100.0% 38
$P_{38} =$	3.18329E-12	100.0% 39
$P_{39} =$	1.60159E-12	100.0% 40
$P_{40} =$	8.058E-13	100.0% 41

M/M/s Queuing Model for Renton School Disitrc't's Sartori Elementary Load/Unload Zone
Morning Peak Hour (Arrival)

Data		
$\lambda =$	483	(average arrival rate)
$\mu =$	240.0	(average service rate)
$s =$	5	(# servers)



where:

L = average number of vehicles queued at the load/unload zone at any one time

L_q = average number of vehicles in queue

W = average wait time at the load/unload zone (hours)

W_q = ave. wait time in queue (hours)

ρ = Load/Unload Zone utilization

P_0 = probability of 0 vehicles at the Load/Unload Zone

P_1 = probability of 1 vehicle at the Load/Unload Zone, etc.

2 =Average number of vehicles at the load/unload zone at any one time

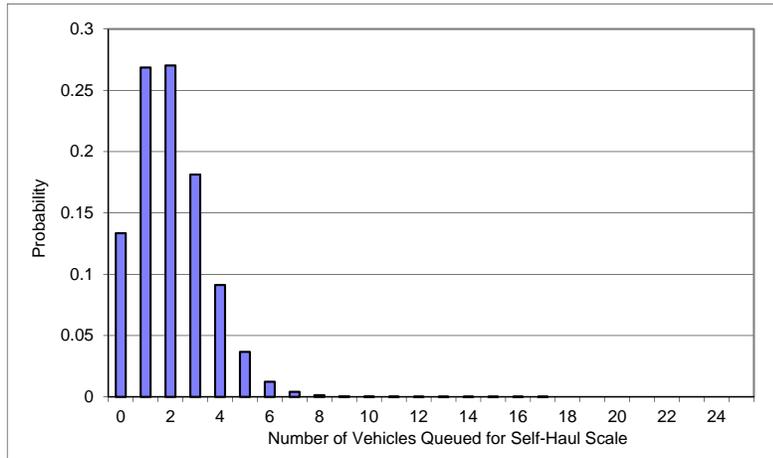
4 =Peak (95th-percentile) number of vehicles in load/unload zone at any one time

93.9% <= Closest probability to 95%

Results		
L =	2.053635596	
L_q =	0.041135596	
W =	0.004	Minutes
W_q =	0.000	0.3
ρ =	0.4025	0.0
		Prob < x vehicles
$P_0 =$	0.132626263	13.3% 0
$P_1 =$	0.266910354	40.0% 1
$P_2 =$	0.268578544	66.8% 2
$P_3 =$	0.18017144	84.8% 3
$P_4 =$	0.090648756	93.9% 4
$P_5 =$	0.036486124	97.5% 5
$P_6 =$	0.014685665	99.0% 6
$P_7 =$	0.00591098	99.6% 7
$P_8 =$	0.00237917	99.8% 8
$P_9 =$	0.000957616	99.9% 9
$P_{10} =$	0.00038544	100.0% 10
$P_{11} =$	0.00015514	100.0% 11
$P_{12} =$	6.24437E-05	100.0% 12
$P_{13} =$	2.51336E-05	100.0% 13
$P_{14} =$	1.01163E-05	100.0% 14
$P_{15} =$	4.0718E-06	100.0% 15
$P_{16} =$	1.6389E-06	100.0% 16
$P_{17} =$	6.59657E-07	100.0% 17
$P_{18} =$	2.65512E-07	100.0% 18
$P_{19} =$	1.06869E-07	100.0% 19
$P_{20} =$	4.30146E-08	100.0% 20
$P_{21} =$	1.73134E-08	100.0% 21
$P_{22} =$	6.96864E-09	100.0% 22
$P_{23} =$	2.80488E-09	100.0% 23
$P_{24} =$	1.12896E-09	100.0% 24
$P_{25} =$	4.54407E-10	100.0% 25
$P_{25} =$	1.82899E-10	100.0% 26
$P_{26} =$	7.36168E-11	100.0% 27
$P_{27} =$	2.96308E-11	100.0% 28
$P_{28} =$	1.19264E-11	100.0% 29
$P_{29} =$	4.80037E-12	100.0% 30
$P_{30} =$	1.93215E-12	100.0% 31
$P_{31} =$	7.7769E-13	100.0% 32
$P_{32} =$	3.1302E-13	100.0% 33
$P_{33} =$	1.25991E-13	100.0% 34
$P_{34} =$	5.07112E-14	100.0% 35
$P_{35} =$	2.04113E-14	100.0% 36
$P_{36} =$	8.21554E-15	100.0% 37
$P_{37} =$	3.30675E-15	100.0% 38
$P_{38} =$	1.33097E-15	100.0% 39
$P_{39} =$	5.35715E-16	100.0% 40
$P_{40} =$	2.15625E-16	100.0% 41

M/M/s Queuing Model for Renton School Disitrc't's Sartori Elementary Load/Unload Zone
Morning Peak Hour (Arrival)

Data		
$\lambda =$	483	(average arrival rate)
$\mu =$	240.0	(average service rate)
$s =$	6	(# servers)



where:

L = average number of vehicles queued at the load/unload zone at any one time

L_q = average number of vehicles in queue

W = average wait time at the load/unload zone (hours)

W_q = ave. wait time in queue (hours)

ρ = Load/Unload Zone utilization

P_0 = probability of 0 vehicles at the Load/Unload Zone

P_1 = probability of 1 vehicle at the Load/Unload Zone, etc.

2 =Average number of vehicles at the load/unload zone at any one time

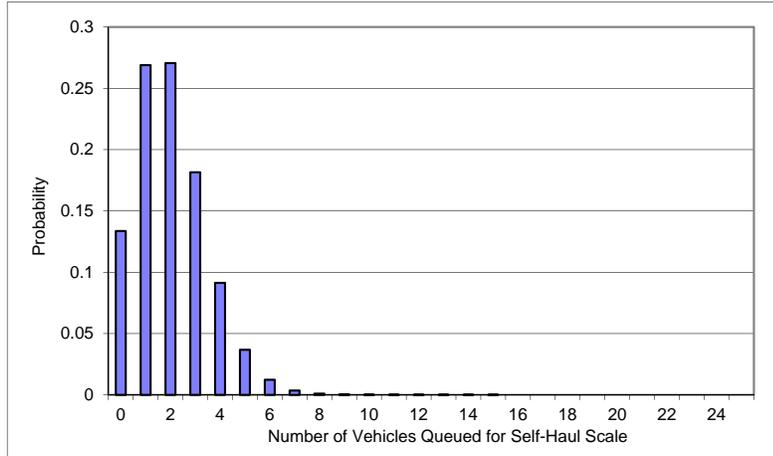
4 =Peak (95th-percentile) number of vehicles in load/unload zone at any one time

94.5% <= Closest probability to 95%

Results		
$L =$	2.021851545	
$L_q =$	0.009351545	
$W =$	0.004	Minutes
$W_q =$	0.000	0.3
		0.0
$\rho =$	0.335416667	
		Prob < x vehicles
$P_0 =$	0.133448827	13.3% 0
$P_1 =$	0.268565765	40.2% 1
$P_2 =$	0.270244301	67.2% 2
$P_3 =$	0.181288885	85.4% 3
$P_4 =$	0.09121097	94.5% 4
$P_5 =$	0.036712416	98.1% 5
$P_6 =$	0.012313956	99.4% 6
$P_7 =$	0.004130306	99.8% 7
$P_8 =$	0.001385374	99.9% 8
$P_9 =$	0.000464677	100.0% 9
$P_{10} =$	0.000155861	100.0% 10
$P_{11} =$	5.22782E-05	100.0% 11
$P_{12} =$	1.7535E-05	100.0% 12
$P_{13} =$	5.88153E-06	100.0% 13
$P_{14} =$	1.97276E-06	100.0% 14
$P_{15} =$	6.61697E-07	100.0% 15
$P_{16} =$	2.21944E-07	100.0% 16
$P_{17} =$	7.44438E-08	100.0% 17
$P_{18} =$	2.49697E-08	100.0% 18
$P_{19} =$	8.37525E-09	100.0% 19
$P_{20} =$	2.8092E-09	100.0% 20
$P_{21} =$	9.42252E-10	100.0% 21
$P_{22} =$	3.16047E-10	100.0% 22
$P_{23} =$	1.06007E-10	100.0% 23
$P_{24} =$	3.55567E-11	100.0% 24
$P_{25} =$	1.19263E-11	100.0% 25
$P_{25} =$	4.00028E-12	100.0% 26
$P_{26} =$	1.34176E-12	100.0% 27
$P_{27} =$	4.50049E-13	100.0% 28
$P_{28} =$	1.50954E-13	100.0% 29
$P_{29} =$	5.06324E-14	100.0% 30
$P_{30} =$	1.6983E-14	100.0% 31
$P_{31} =$	5.69637E-15	100.0% 32
$P_{32} =$	1.91066E-15	100.0% 33
$P_{33} =$	6.40866E-16	100.0% 34
$P_{34} =$	2.14957E-16	100.0% 35
$P_{35} =$	7.21002E-17	100.0% 36
$P_{36} =$	2.41836E-17	100.0% 37
$P_{37} =$	8.11159E-18	100.0% 38
$P_{38} =$	2.72076E-18	100.0% 39
$P_{39} =$	9.12589E-19	100.0% 40
$P_{40} =$	3.06098E-19	100.0% 41

M/M/s Queuing Model for Renton School Disitrc't's Sartori Elementary Load/Unload Zone
Morning Peak Hour (Arrival)

Data		
$\lambda =$	483	(average arrival rate)
$\mu =$	240.0	(average service rate)
$s =$	7	(# servers)



where:

L = average number of vehicles queued at the load/unload zone at any one time

L_q = average number of vehicles in queue

W = average wait time at the load/unload zone (hours)

W_q = ave. wait time in queue (hours)

ρ = Load/Unload Zone utilization

P_0 = probability of 0 vehicles at the Load/Unload Zone

P_1 = probability of 1 vehicle at the Load/Unload Zone, etc.

2 =Average number of vehicles at the load/unload zone at any one time

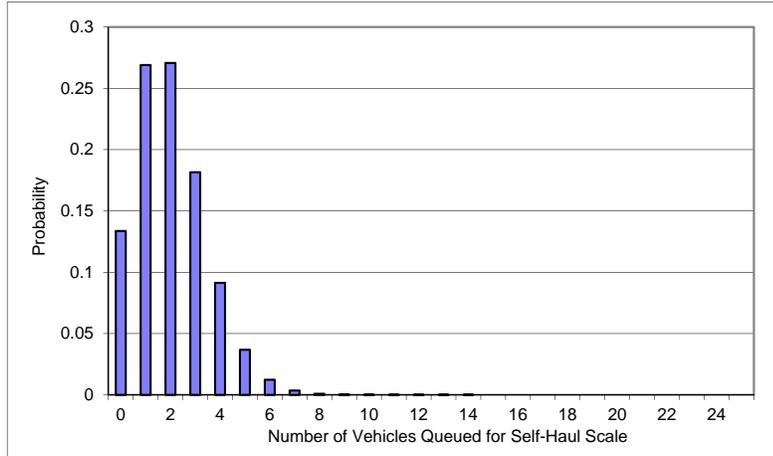
4 =Peak (95th-percentile) number of vehicles in load/unload zone at any one time

94.6% <= Closest probability to 95%

Results		
L =	2.014507452	
L_q =	0.002007452	
W =	0.004	Minutes
W_q =	0.000	0.3
ρ =	0.2875	0.0
		Prob < x vehicles
P_0 =	0.133615324	13.4% 0
P_1 =	0.26890084	40.3% 1
P_2 =	0.27058147	67.3% 2
P_3 =	0.181515069	85.5% 3
P_4 =	0.091324769	94.6% 4
P_5 =	0.03675822	98.3% 5
P_6 =	0.01232932	99.5% 6
P_7 =	0.003544679	99.9% 7
P_8 =	0.001019095	100.0% 8
P_9 =	0.00029299	100.0% 9
P_{10} =	8.42346E-05	100.0% 10
P_{11} =	2.42174E-05	100.0% 11
P_{12} =	6.96252E-06	100.0% 12
P_{13} =	2.00172E-06	100.0% 13
P_{14} =	5.75495E-07	100.0% 14
P_{15} =	1.65455E-07	100.0% 15
P_{16} =	4.75683E-08	100.0% 16
P_{17} =	1.36759E-08	100.0% 17
P_{18} =	3.93182E-09	100.0% 18
P_{19} =	1.1304E-09	100.0% 19
P_{20} =	3.24989E-10	100.0% 20
P_{21} =	9.34344E-11	100.0% 21
P_{22} =	2.68624E-11	100.0% 22
P_{23} =	7.72294E-12	100.0% 23
P_{24} =	2.22034E-12	100.0% 24
P_{25} =	6.38349E-13	100.0% 25
P_{25} =	1.83525E-13	100.0% 26
P_{26} =	5.27635E-14	100.0% 27
P_{27} =	1.51695E-14	100.0% 28
P_{28} =	4.36124E-15	100.0% 29
P_{29} =	1.25386E-15	100.0% 30
P_{30} =	3.60483E-16	100.0% 31
P_{31} =	1.03639E-16	100.0% 32
P_{32} =	2.97962E-17	100.0% 33
P_{33} =	8.56641E-18	100.0% 34
P_{34} =	2.46284E-18	100.0% 35
P_{35} =	7.08067E-19	100.0% 36
P_{36} =	2.03569E-19	100.0% 37
P_{37} =	5.85262E-20	100.0% 38
P_{38} =	1.68263E-20	100.0% 39
P_{39} =	4.83756E-21	100.0% 40
P_{40} =	1.3908E-21	100.0% 41

M/M/s Queuing Model for Renton School Disitrc't's Sartori Elementary Load/Unload Zone
Morning Peak Hour (Arrival)

Data		
$\lambda =$	483	(average arrival rate)
$\mu =$	240.0	(average service rate)
$s =$	8	(# servers)



where:

L = average number of vehicles queued at the load/unload zone at any one time

L_q = average number of vehicles in queue

W = average wait time at the load/unload zone (hours)

W_q = ave. wait time in queue (hours)

ρ = Load/Unload Zone utilization

P_0 = probability of 0 vehicles at the Load/Unload Zone

P_1 = probability of 1 vehicle at the Load/Unload Zone, etc.

2 =Average number of vehicles at the load/unload zone at any one time

4 =Peak (95th-percentile) number of vehicles in load/unload zone at any one time

94.6% <= Closest probability to 95%

Results		
L =	2.012900554	
L_q =	0.000400554	Minutes
W =	0.004	0.3
W_q =	0.000	0.0
ρ =	0.2515625	
		Prob < x vehicles
P_0 =	0.13364725	13.4% 0
P_1 =	0.268965091	40.3% 1
P_2 =	0.270646123	67.3% 2
P_3 =	0.181558441	85.5% 3
P_4 =	0.09134659	94.6% 4
P_5 =	0.036767003	98.3% 5
P_6 =	0.012332265	99.5% 6
P_7 =	0.003545526	99.9% 7
P_8 =	0.000891921	100.0% 8
P_9 =	0.000224374	100.0% 9
P_{10} =	5.64441E-05	100.0% 10
P_{11} =	1.41992E-05	100.0% 11
P_{12} =	3.57199E-06	100.0% 12
P_{13} =	8.98579E-07	100.0% 13
P_{14} =	2.26049E-07	100.0% 14
P_{15} =	5.68654E-08	100.0% 15
P_{16} =	1.43052E-08	100.0% 16
P_{17} =	3.59865E-09	100.0% 17
P_{18} =	9.05286E-10	100.0% 18
P_{19} =	2.27736E-10	100.0% 19
P_{20} =	5.72898E-11	100.0% 20
P_{21} =	1.4412E-11	100.0% 21
P_{22} =	3.62551E-12	100.0% 22
P_{23} =	9.12043E-13	100.0% 23
P_{24} =	2.29436E-13	100.0% 24
P_{25} =	5.77174E-14	100.0% 25
P_{25} =	1.45195E-14	100.0% 26
P_{26} =	3.65257E-15	100.0% 27
P_{27} =	9.1885E-16	100.0% 28
P_{28} =	2.31148E-16	100.0% 29
P_{29} =	5.81482E-17	100.0% 30
P_{30} =	1.46279E-17	100.0% 31
P_{31} =	3.67983E-18	100.0% 32
P_{32} =	9.25708E-19	100.0% 33
P_{33} =	2.32873E-19	100.0% 34
P_{34} =	5.85822E-20	100.0% 35
P_{35} =	1.47371E-20	100.0% 36
P_{36} =	3.7073E-21	100.0% 37
P_{37} =	9.32618E-22	100.0% 38
P_{38} =	2.34612E-22	100.0% 39
P_{39} =	5.90195E-23	100.0% 40
P_{40} =	1.48471E-23	100.0% 41