Transportation Assessment

Kenmore MS, Carlin Springs ES, & New ES

Arlington County, Virginia

DRAFT

August 3, 2012

Prepared for:
Arlington Public Schools

GOROVE / SLADE
Transportation Planners and Engineers

Prepared by:

GOROVE / SLADE
Transportation Planners and Engineers

1140 Connecticut Avenue, NW
Suite 600
Washington, DC 20036
Tel: 202.296.8625
Fax: 202.785.1276

3914 Centreville Road
Suite 330
Chantilly, VA 20151
Tel: 703.787.9595
Fax: 703.787.9905

7001 Heritage Village Plaza
Suite 220
Gainesville, VA 20155
Tel: 703.787.9595
Fax: 703.787.9905

www.goroveslade.com

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

This report presents the findings of a transportation assessment for Kenmore Middle School and Carlin Springs Elementary School in Arlington County, Virginia. The purpose of this assessment is to:

1. Review the existing transportation conditions at Kenmore Middle School & Carlin Springs Elementary School;
2. Assess the impacts of future planned expansions of Kenmore Middle School, Carlin Springs Elementary School, and the nearby Campbell Elementary School on the surrounding roadway network; and
3. Assess the impacts of placing a new elementary school on the site, adjacent to the Kenmore and Carlin Springs schools.

This report was assembled early in the process of planning of the existing schools' expansion and new elementary school construction. It purposely contains information for the design team to incorporate into the designs. Typically, traffic analyses occur after a site has been designed and are reactionary in nature. APS' desire was to perform analyses early in the process to help inform how to minimize traffic and parking impacts can be minimized.

Existing Conditions - Kenmore Middle School and Carlin Springs Elementary School

The report reviews existing school access, including traffic and parking demand, pick-up/drop-off activity, bus loading and unloading, and pedestrian and bicycling facilities. Details are included in the report, with findings of note from the traffic and parking counts including:

- The schools in the area (Kenmore Middle School, Carlin Springs Elementary School, and Campbell Elementary School), all generate a significant amount of trips during their morning peak arrival time. Their morning traffic generation is much higher than national averages, and is likely due to a high amount of pick-up/drop-off activity as well as the limitations of the pedestrian environment surrounding the schools.
- The schools' afternoon traffic generation, during the highest concentration of departures, occurs hours before the commuter peak of traffic, and is significantly smaller than the traffic generated during the morning. This is likely due to how the departures of students are spread-out by after school activities, and how students are more likely to carpool in the afternoon compared to the morning.
- Kenmore Middle School generates a significantly higher amount of trips than the two elementary schools.
- Parking demand was easily accommodated on site, based on parking counts, observations and conversations with school staff.

A review of student and employees access to school noted several concerns, which are detailed in the report, and which includes a list of potential solutions:

- Passenger Car Pick-up/Drop-off Layout and Congestion: Carlin Springs Elementary School – Potential solutions include signing and marking improvements and the use of additional staff to manage traffic flow. Long-term solutions include targeted alterations to the parking lot.
- Bus Turning at Route 50 and Manchester Street - Potential solutions included working with Arlington County's Department of Environmental Services (DES) to explore geometrical changes to this intersection to improve operations. APS can also request additional enforcement of cars blocking the box at this location. Long-term solutions include changing the existing access points and roadway circulation within the school site.

- Poor Pedestrian Facilities along Carlin Springs Road – Potential solutions include working with DES to study potential improvements to Carlin Springs Road. Operational issues observed at traffic signal crossings can be addressed in the long term.

- Jaywalking generated by placement of Kenmore MS school door relative to crosswalks on Carlin Springs Road – Potential solutions include working with DES to study if a potential crossing of Carlin Springs Road at this location would be possible. Several solutions are available for mid-block pedestrian crossings, and a solution that works for the school without generating detrimental impacts to Carlin Spring Road traffic may be possible. In the short term, County or APS staff could be placed at this intersection to deter student jaywalking.

- Congestion exiting Kenmore Middle School – Potential solutions include working with DES to examine whether changes to signal timings could help alleviate delays. This may not be possible it the morning, but a specific signal timing change implemented between 2:00 and 3:00 pm at this intersection on school days, could help alleviate these delays while not having a detrimental impact to Carlin Springs Road because it would occur prior to the evening commuter rush. Constructing a separate right- and left-turn lane along the school approach or moving the existing crosswalk to the other side of the intersection could also help alleviate the existing congestion.

- General congestion along Carlin Springs Road – Potential solutions include instituting earlier start times for the schools and reducing demand through the use of Transportation Demand Management (TDM) programs. A more long-term solution would be to spread-out the location of arrivals and departures through adding more school driveways.

Potential Impacts from Existing School Growth and New Elementary School

The growth of existing schools and the new elementary school have the potential to generate traffic impacts internal to the school sites and external on the surrounding roadways. The goal of this report is to determine how to minimize these potential impacts. Based on the existing conditions analysis, the most impact to surrounding roadways would be generated by the additional traffic generated during the morning peak of school arrivals. A significant amount of new pick-up/drop-off activity is projected for the schools. The impact in the afternoon peak time of school departures does not have the same potential impact because it occurs much earlier than the commuter traffic peak, and because student departures are more spread out in the afternoon, with a much lower concentration of vehicles.

In addition to external impacts, negative impacts on the school sites could occur from the additional pick-up/drop-offs and bus traffic generated. Also, the new trips have the potential to generate significant congestion at school driveways.

Findings from Impact Analysis

Impact analyses were preformed in order to develop recommendations on how the new school's site design should be configured to minimize transportation impacts. The impact analyses were performed for several scenarios, which incorporated the strategies of: (1) staggering and altering school start times, and (2) changing access patterns and creating new driveways.

Conclusions reached after completing the impact analyses included the following:

- Staggering start times leads to a much greater reduction in impacts to external roadway traffic than the various access schemes that explored new driveway locations.
    - Successfully minimizing impacts of the schools is dependent on staggering start times.

- For a significant reduction in impacts, the new elementary school start times should be 20 to 30 minutes earlier or later than Kenmore Middle School.
- An even greater reduction in impacts occurs when start times are shifted earlier, to avoid the commuter traffic peak. The least amount of congestion in all scenarios evaluated in the report was one where the start time of the Middle School was moved 30 minutes earlier than it is now (Kenmore MS generates the most traffic). Starting class this early in the morning may not be practical though.

- Analyses of the different access schemes, where new driveway locations were tested, showed that changing school access could have a positive benefit to internal school traffic. Different access schemes for the schools did not show significant benefits to commuter traffic on external roadways.
  - The two scenarios where access is not combined with the existing 3rd Street/Carlin Springs driveway show lower driveway delay entering and exiting the schools.
  - Schemes were access was shared between the new schools and existing schools can provide opportunities to improve access for the existing schools.

With the evaluation completed, the following recommendations were made for the site design of the campus containing the existing schools and the new elementary school:

- School start times should be staggered; the elementary school start times should be 20 to 30 minutes earlier or later than Kenmore Middle School.
- Access to the new ES parking and pick-up/drop-off facilities should not occur at the intersection of Carlin Springs Road and 3rd Street. A new driveway should be constructed, and it should not be located on Carlin Springs Road. Sharing access with Carlin Springs MS is a good alternative that provides the opportunity to alter the Carlin Springs main parking lot to better accommodate passenger car pick-up/drop-off.
- Bus access to the new school can be provided from the access road leading to the intersection of Carlin Springs Road and 3rd Street, connected to the Kenmore Middle School bus facility. This would allow for an expanded facility to be provided with sufficient queuing space for both schools, and flexible bus routing so that buses can enter and exit from either Manchester Street or Carlin Springs Road.
- A separate left and right turn lane should be constructed at the intersection of Carlin Springs Road and 3rd Street, exiting the school. This improvement can be combined with altering the access to the Kenmore MS parking lot, moving it farther from the intersection and improving the geometry of the turns into and out of the lot.
- If quality walking paths are provided and walking distances kept to a minimum, sharing parking between the schools could result in a low amount (approximately 25) of new parking spaces required as part of new school construction.
- A Transportation Demand Management (TDM) plan should be developed in conjunction with the County's DES to help reduce overall trip generation at the schools.

Next Steps

The following list contains the next steps to be taken to move forward on this project.

- Improving access to Kenmore Middle School and Carlin Springs ES

- Perform a travel survey of students and parents to learn more about school transportation use and concerns;
- Examine crash data at nearby intersections to help provide more information on pedestrian and vehicular safety; and
- Discuss potential solutions with school staff, community and Arlington County Department of Environmental Services staff:

- Planning and designing a new elementary school on the site
  - Scope and complete a full Transportation Impact Study in coordination with Arlington County Department of Environmental Services staff;
  - Work with design team to implement recommendations contained within this report; and
  - Design the access and circulation of the new school in a manner that best fits with the characteristics of the surrounding transportation network.

INTRODUCTION

This report presents the findings of a transportation assessment for Kenmore Middle School (MS) and Carlin Springs Elementary School (ES) in Arlington County, Virginia. The purpose of this assessment is to:

1. Review the existing transportation conditions at Kenmore Middle School & Carlin Springs Elementary School;
2. Assess the impacts of future planned expansions of Kenmore Middle School, Carlin Springs Elementary School, and the adjacent Campbell Elementary School on the surrounding roadway network; and
3. Assess the impact of placing a new elementary school on the site, adjacent to the Kenmore and Carlin Springs schools.

With this in mind, the report is split into three sections; the first evaluates existing conditions at Kenmore Middle School and Carlin Springs Elementary School, including student/employee access, capacity of nearby intersections, and parking demand. It ends with a summary of existing concerns and potential solutions. The second section of this report reviews potential impacts of the planned expansions of Kenmore MS, Carlin Springs ES, and the adjacent Campbell ES. This section also evaluates the potential impacts of a new elementary school on the site, including traffic and parking demands. The third section introduces and evaluates different conceptual layouts of the Kenmore MS, Carlin Springs ES, and New School site. Recommendations are based on knowledge gained from these analyses.

This report was assembled early in the process of design of the existing school expansion and new elementary school construction. It purposely contains information for the architects to incorporate into their designs. Typically, traffic analyses occur after a site has been designed and are reactionary in nature. APS' desire was to perform analyses early in the process to help provide the design team information on how to minimize traffic and parking impacts.

Kenmore Middle School, located at 200 S. Carlin Springs Road, has a student population of 731 (as of November 2011). Enrollment is expected to grow in the future, up to 1,054 students in 2017. The school is currently approved to expand to as many as 1,300 students. Carlin Springs Elementary School, located at 5995 S. 5th Road, has a student population of 580 (as of November 2011). Enrollment is expected to grow in the future, up to 658 students in 2017. The new elementary school is planned to open around 2017. It will be a choice school, serving the entire County, with an enrollment of approximately 600 students. Campbell Elementary School, located at 737 S. Carlin Springs Road, has a student population of 435 (as of November 2011). Enrollment is expected to grow in the future, up to 518 students in 2017.

Figure 1 shows the location of Kenmore Middle School, Carlin Springs Elementary School, the adjacent Campbell Elementary School, and the existing school boundaries.

EXISTING CONDITIONS AT KENMORE MS & CARLIN SPRINGS ES

This section of the report reviews how students, parents, and employees access Kenmore Middle School and Carlin Springs Elementary School, examines capacity at nearby intersections, summarizes concerns resulting from the review, and presents potential conclusions.

The review of existing conditions is based on the following:

- Interviews with school staff, during a meeting from May 11, 2012;
- Data collected during May 2012, including traffic data at nearby intersections, school driveways, and counts of parking demand on and off street; and
- Site visits and observations in May and June 2012, including a field review of transportation conditions.

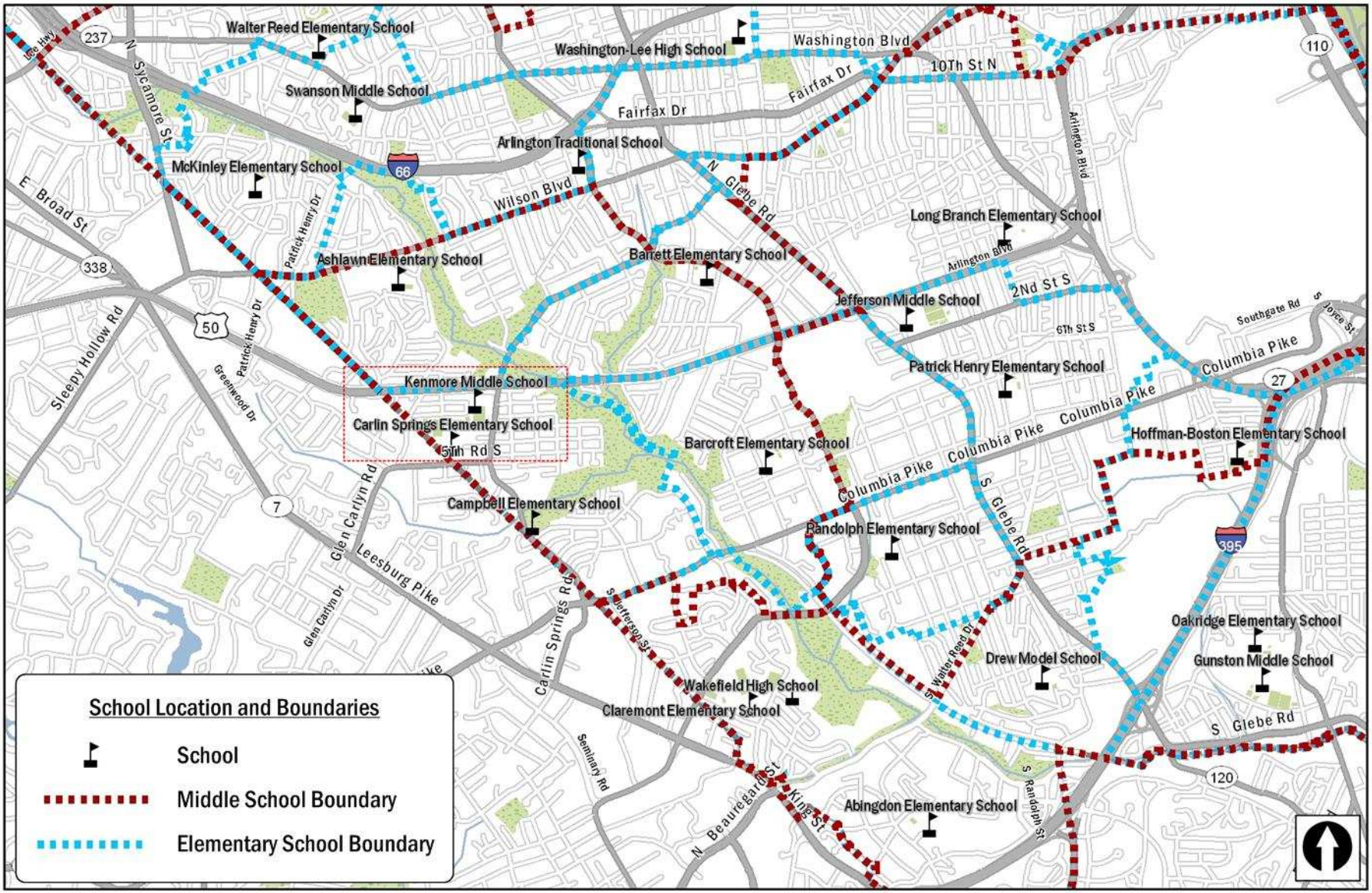


Figure 1: School Location and Boundaries

This evaluation used the Safe Routes to School (SRTS) program for guidance, notably in its review of pedestrian and cycling conditions, and during the field review. SRTS programs are sustained efforts by parents, schools, community leaders, and local, state, and federal governments to improve the health and well-being of children by enabling and encouraging them to walk and bicycle to school[1].

SRTS programs use a variety of education, engineering, and enforcement strategies that help make routes safer for children to walk and bicycle to school and encouragement strategies to entice more children to walk and bike. They have grown popular in recent years in response to problems created by a growing reliance on motor vehicles for student transportation, an expanding built environment, as well as the development and availability of federal and state funding for SRTS programs. SRTS principles guide the decisions that local professionals and members of the school community make as they begin to address issues that will improve the built environment for children to safely walk and bicycle to school.

Student Access

Students travel to and from school in three major ways: (1) school bus, (2) passenger car pick-up/drop-off, and (3) walking and cycling. At Kenmore Middle School, homeroom begins at 7:50 am, and students start arriving around 7:30 am. The last bell of the day is at 2:24 pm. Many students do not leave at this time and stay for after school programs and activities. School staff estimates that 50% of students leave after last bell, and the rest remain on site for after-school activities and programs.

At Carlin Springs Elementary School, first bell is at 8:00 am. Extra care services begin at 7:00 am, with many students participating. Arrivals begin at 7:10 am, with buses arriving between 7:15 to 7:40 am. The last bell is at 2:41 pm, with many students, but not all, departing at that time. School staff estimates that 60% of students leave after the last bell, and the rest remain on site for after-school activities and programs.

For both schools, the concentration of arriving traffic is greater in the morning than in the afternoon. The following sections describe how students get to and from school via bus, pick-up/drop-off, and walking and cycling.

School Bus

At Kenmore Middle School, buses use a dedicated facility to the west of the school accessed from the Arlington Boulevard local road, as shown in Figure 2. This facility is blocked off from the adjacent street during times of bus activity. Around 10 to 12 buses are used, and they currently can all fit within the existing bus facility. The pedestrian path from the loading/unloading zone to the school is direct and does not require students to cross traffic.

Due to the one-way streets, buses must enter from Manchester Street. School staff noted that many bus routes require a left turn from Route 50 onto Manchester Street followed by an immediate left onto the local lanes of Arlington Boulevard. This movement is often blocked by vehicles waiting at the traffic signal, which can generate delays to buses arriving at the school.

At Carlin Springs Elementary School, buses use a dedicated facility to the north of the school accessed via Carlin Springs Road at 3rd Street, as shown in Figure 2. Employee parking is also located in the bus area, but visitor traffic including student pick-up and drop-off is prohibited in this area. Around seven to eight buses are used, and they currently can all fit within the exiting bus facility. The pedestrian path from the loading/unloading zone to the school is direct and does not require students to cross traffic.

[1] http://www.saferoutesinfo.org

Passenger Car Pick-up/Drop-off

At Kenmore Middle School, passenger car pick-up and drop-off occurs in two areas: a primary location is provided within the main parking lot south of the school and a secondary location is provided just north of the school. Each pick-up/drop-off area is depicted on Figure 2. The primary drop-off area mostly works well, with a few minor issues. Although it occurs within a parking lot, the main pick-up/drop-off area is separated from the parking lot circulation system and aisles. Also, cars pull up and discharge passengers on the right side, and there is sufficient room for vehicles to pass if they pick-up or drop-off their student before cars in front of them. Concerns include the sharp right turn into the parking lot, which can be difficult for cars to execute without encroaching into the path of vehicles also trying to exit. During the morning and afternoon when pick-up/drop-off activity is high, there are a lot of simultaneous entries and exits that generate congestion at the parking lot access point. In addition, in the afternoon, queues develop from cars leaving the lot and trying to access Carlin Springs Road at 3rd Street. Delay at the signal at the intersection of the site drive with Carlin Springs Road and 3rd Street causes outbound traffic to back up into the site.

The northern, secondary pick-up/drop-off location is accessed from Carlin Springs Road and, during site observations, was used significantly less. Generally, the layout of the area works well, although school staff noted problems in the past with drivers going the wrong way (the facility is one-way from Carlin Springs to the Arlington Boulevard local lanes) and cars waiting in non-designated areas. In order for cars to pick-up and drop-off passengers on the right side they need to pass the facility and loop back. Some drivers are not aware of this and two-way traffic can sometimes occur. Recent signing improvements have been made to the facility, and it has yet to be seen whether these issues still remain.

At Carlin Springs Elementary School, the pick-up/drop-off location is within the main parking lot. Generally, it works well, but concerns were noted by school staff and observed on field visits. The pick-up/drop-off occurs within a main parking drive aisle, and oftentimes insufficient space is provided for cars to pass other cars waiting. This leads to frustrated drivers; employees will prefer to park in the lot north of the school, and drivers picking up or dropping off students will make illegal maneuvers in attempt to pass other cars waiting. During times of heavy activity, such as the morning, the queue from student drop-offs can reach 5th Road, which in turn can back up vehicles turning left and right into the school on 5th Road. The large amount of vehicles entering and exiting the lot simultaneously in the morning can also lead to a situation where vehicle paths overlap at the site driveway. The congestion generated at the driveway exacerbates the delays generated by queues at the pick-up/drop-off facility.

Walking & Cycling

During the field visits, a significant number of students were observed walking to and from Kenmore Middle School. Carlin Springs Elementary School offers busing to all students and does not have a 'no busing' zone in close distance to the school like other APS schools. This is due to the problematic facilities (including narrow sidewalks with obstructions) and intimidating pedestrian environment (high vehicular volumes and speeds adjacent to sidewalks) on walking routes to and from the school.

No students were observed bicycling to or from either school, and based on discussions with school staff, bicycling is not common. There is not a significant amount of bicycle facilities near the schools; current facilities are shown on Figure 3. It is likely that the lack of dedicated bike lanes near the school and the intimidating speeds and traffic on the automobile dominant designed roadways of 5th Road and Carlin Springs Road lead to a minimal amount of bicycling.

A field review noted many pedestrian issues and concerns near the schools. A summary of pedestrian facilities and conditions is contained in Figure 4. A detailed field review of conditions is attached to this report. The field review consisted of walking pedestrian routes within a quarter-mile radius of the school.

Within this area, most streets have sidewalks on both sides. A few blocks only have sidewalks on one side of the street, and others have no sidewalks at all. Most of these streets are in the residential neighborhood to the east of the school across Carlin Springs Road. Within the residential streets, the sidewalks are generally of sufficient width and of high enough quality to handle pedestrian traffic. Although similar in width to Carlin Springs Road, the low traffic volume and low-speed nature of these streets allow narrower sidewalk widths on residential streets to provide an adequate and comfortable pedestrian environment.

On arterial streets, such as Carlin Springs Road and 5th Road, the pedestrian environment ranges from adequate to poor. Sidewalks do exist on these roadways and on both sides of the street. At all signalized intersections, crossings are provided, and marked crosswalks are provided at all intersections along the arterial. However, limited crossings are provided to cross Carlin Springs Road. Several intersections along the arterial either do not have any crosswalks across Carlin Springs Road or only provide a single crosswalk along one side, instead of one on each side of the intersection. Most blocks along these roads also provide a landscaped buffer between the sidewalk and the roadway to help separate pedestrians from moving traffic.

Along Carlin Springs Road and 5th Road, concerns noted in the field review were numerous.

- Sidewalk width ranged from three to four feet along most blocks. This did not appear adequate to handle pedestrian demand. The narrowness of the sidewalks also helped create an intimidating environment on Carlin Springs Road, which has a high amount of vehicular traffic moving at high speeds.
- Significant amounts of obstructions in the sidewalks were noted, effectively reducing the width of the facility. Most of these obstructions were utility poles and traffic signal poles. This was observed to be worse at some intersection corners, where traffic poles severely restricted the effective width of the sidewalk (to a point where pedestrians in wheelchairs would not be able to use the sidewalk).
- Several marked crosswalks did not have curb ramps.
- Most signalized intersections had significant issues with pedestrian crossings. Where pedestrian actuation buttons were present, it was confusing which crossing they controlled, and some were not labeled at all. At several intersections, pushing the buttons did not lead to a walk sign on either crosswalk at the corner, even after waiting for several signal cycles. Some pedestrian heads at the traffic signals at the Route 50 ramps were not functional. A significant number of crosswalks in the study area never received a walk signal during the field review.
- In the morning, the traffic queued along Carlin Springs Road consistently blocked and covered marked crosswalks.

Specific to the schools, the location of the school front doors are not aligned with the external roadways accommodation of pedestrians. At Kenmore Middle School, the front door leads pedestrians to Carlin Springs Road where no crossing is present and the closest ones are hundreds of feet away to the north and south. Significant jaywalking was observed at this point where many students were observed crossing the street in gaps of traffic to/from the school. A common destination appeared to be the 7-Eleven Store across the street. The same condition occurs at Carlin Springs Elementary School, where the school driveway and path to the front door occurs far from a pedestrian crossing of 5th Road. However, no major issues were observed in the field visit, likely because students are not required to walk to school.

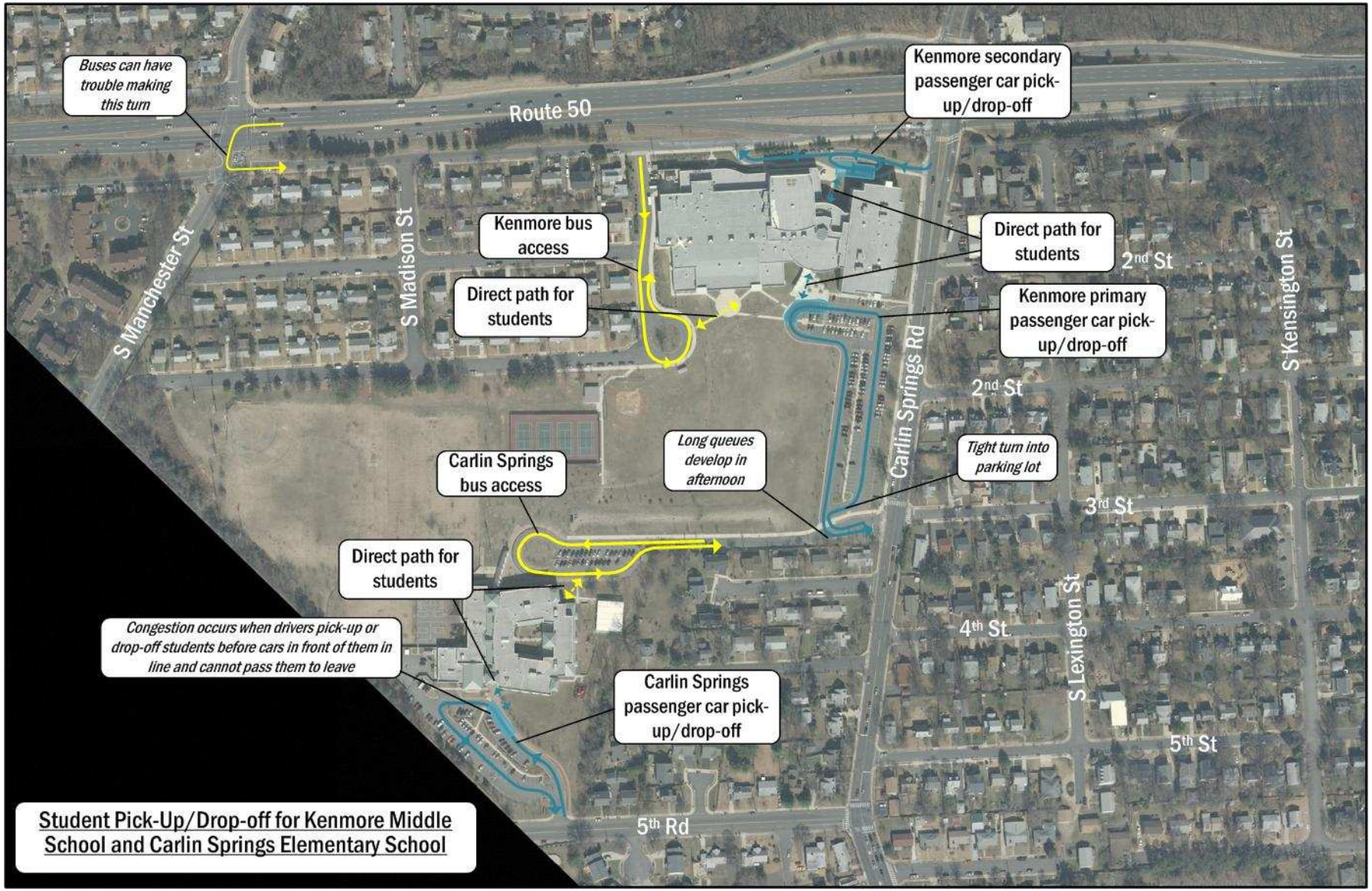


Figure 2: Student Pick-up/Drop-off for Kenmore MS and Carlin Springs ES

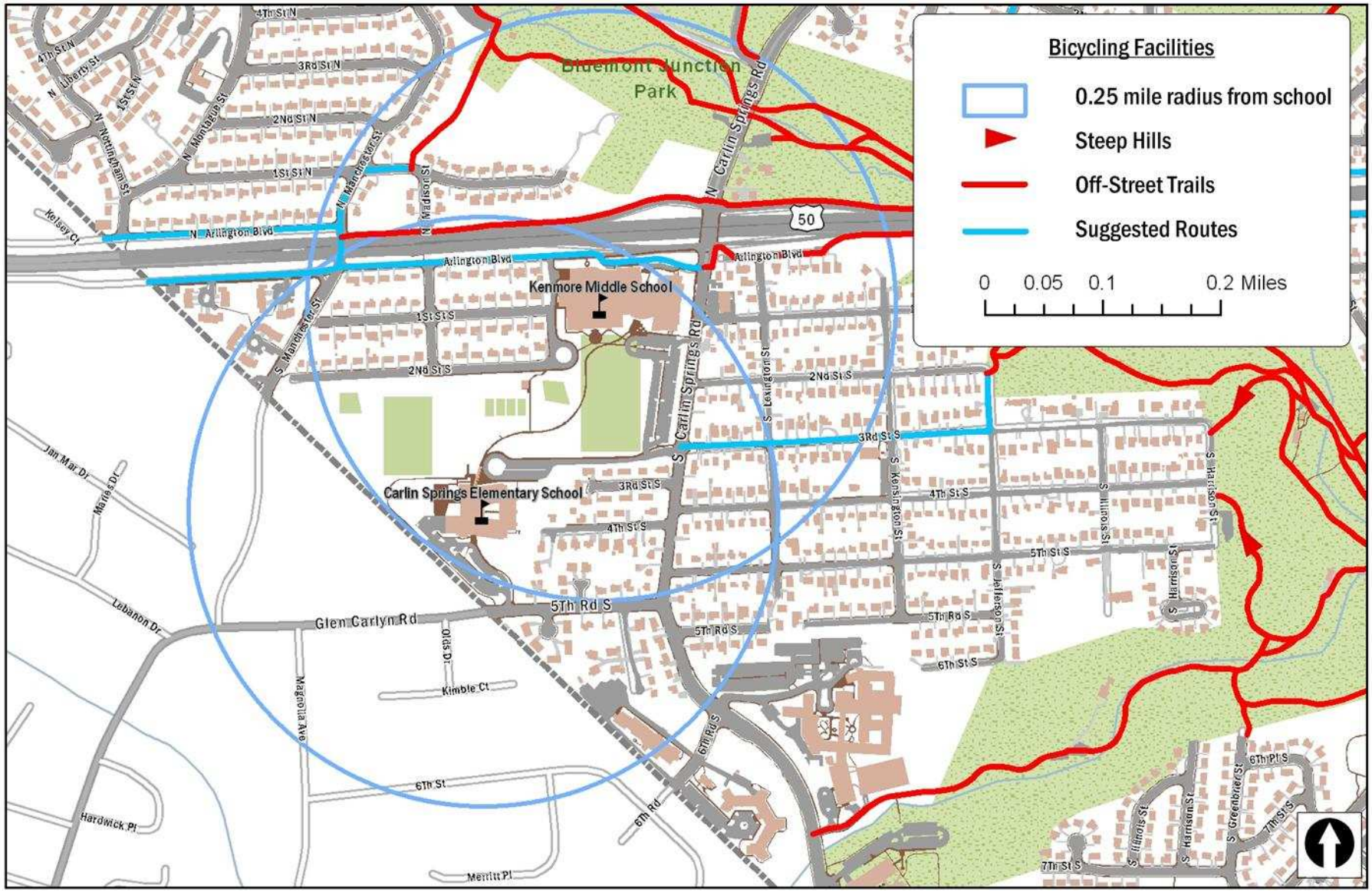


Figure 3: Bicycling Facilities near Kenmore MS and Carlin Springs ES

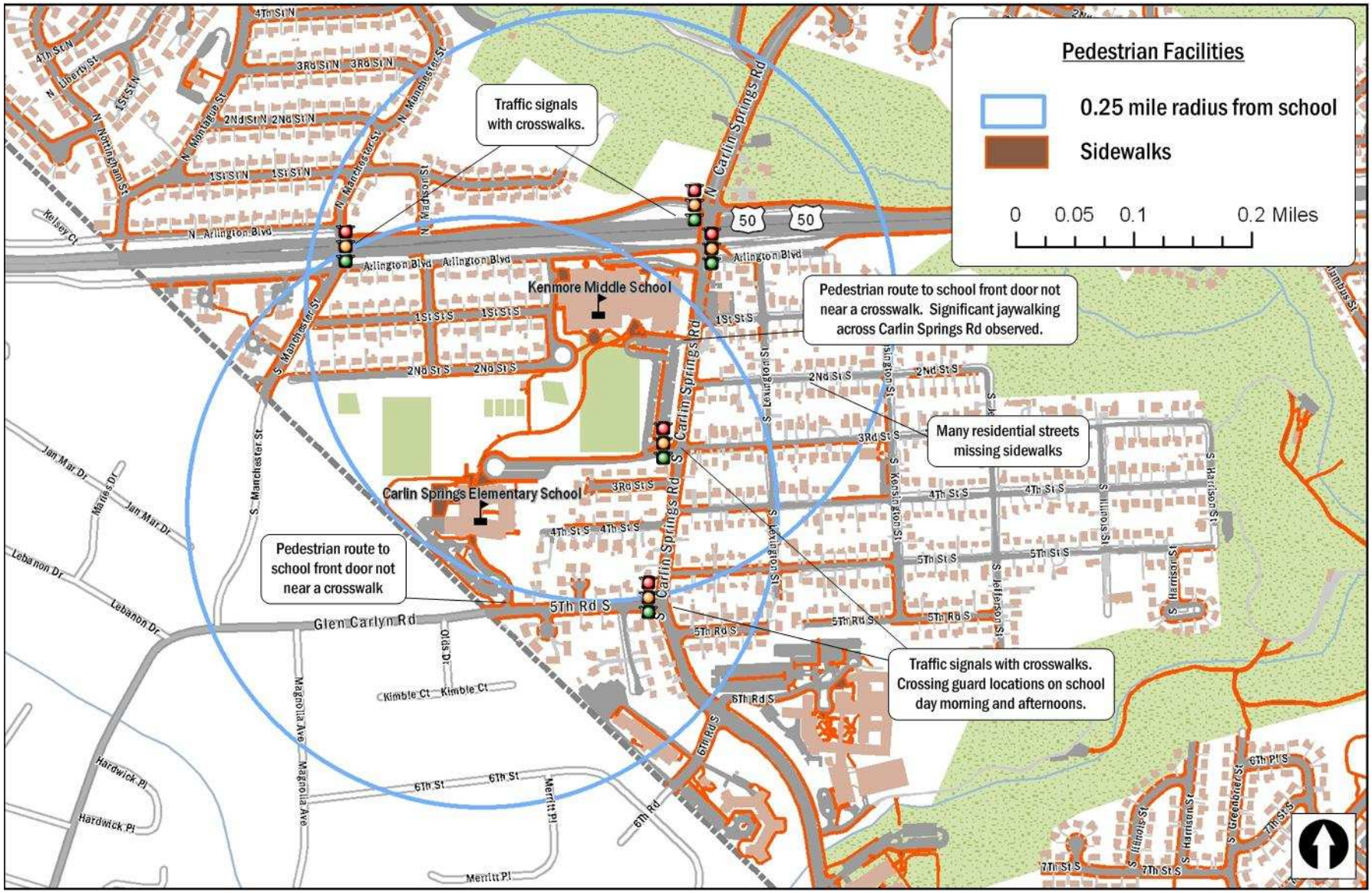


Figure 4: Pedestrian Facilities near Kenmore MS and Carlin Springs ES

Employee Access

The majority of employees drive and park in school parking lots. Figure 5 identifies parking facilities at the school. Kenmore Middle School has 166 parking spaces, the majority of which are in the main parking lot south of the school. Carlin Springs Elementary School has 132 parking spaces on two lots on either side of the school. Between both schools is a pervious grass paved parking lot used for the recreation fields and overflow school parking, which contains approximately 84 parking spaces. Some Carlin Springs employees use this lot as they prefer parking on the north side of the school, and the regular lot on north side fills up on a typical day.

Some employees take advantage of transit service in the area. ART 75 travels along Carlin Springs Road and stops close by the school, as do Metrobus routes 25A and 25B. Metrobus 4A, 4B, and 4H run along Arlington Boulevard, with an eastbound stop directly adjacent to the school. Figure 6 shows the existing transit service near the schools.

Employees that walk or bike to work encounter the same quality facilities and concerns that students do as described above. School staff noted that employees walking or biking to work is minimal.

Transportation Demand

Traffic Volumes

As part of this assessment, traffic counts were conducted at the school driveways to determine the peak traffic generated by the school in amount, concentration, and time. These counts were conducted on Thursday, May 19, 2012 between the hours of 7:00 to 9:30 AM and 2:00 to 4:30 PM, chosen because they correspond to the first and last bell times at Kenmore MS, Carlin Springs ES, and the adjacent Campbell ES.

The data collected provided the following information:

- Kenmore Middle School
  - The peak hour of morning traffic generated by the school was 7:00 to 8:00 AM, with school traffic highly concentrated in the half-hour between 7:15 and 7:45 AM. The total amount of vehicles entering and exiting the school from 7:00 to 8:00 AM was 602, with 407 of those between 7:15 and 7:45 AM.
  - The peak hour of afternoon traffic generated by the school was 2:15 to 3:15 PM, with school traffic highly concentrated in the half-hour between 2:15 and 2:45 PM. The total amount of vehicles entering and exiting the school from 2:15 to 3:15 PM was 244, with 165 of those between 2:15 and 2:45 PM.
- Carlin Springs Elementary School
  - The peak hour of morning traffic generated by the school was 7:00 to 8:00 AM, with school traffic highly concentrated in the half-hour between 7:30 and 8:00 AM. The total amount of vehicles entering and exiting the school from 7:00 to 8:00 AM was 381, with 237 of those between 7:30 and 8:00 AM.
  - The peak hour of afternoon traffic generated by the school was 2:30 to 3:30 PM, with school traffic concentrated in the half-hour between 2:30 and 3:00 PM. The total amount of vehicles entering and exiting the school from 2:30 to 3:30 PM was 86, with 53 of those between 2:30 and 3:00 PM.

- Campbell Elementary School
  - The peak hour of morning traffic generated by the school was 7:15 to 8:15 AM, with school traffic highly concentrated in the half-hour between 7:30 and 8:00 AM. The total amount of vehicles entering and exiting the school from 7:15 to 8:15 AM was 311, with 205 of those between 7:30 and 8:00 AM.
  - The peak hour of afternoon traffic generated by the school was 2:15 to 3:15 PM, with school traffic concentrated in the half-hour between 2:30 and 3:00 PM. The total amount of vehicles entering and exiting the school from 2:30 to 3:30 PM was 167, with 105 of those between 2:30 and 3:00 PM.
- Morning traffic generated by the three schools is much greater and more concentrated than traffic generated in the evening. This is likely because afternoon programs and activities at the school spread out student departures.

The count data was used to assemble the charts contained in Figure 7 and Figure 8. The purpose of these charts is to graphically show the concentration of school traffic to also compare the school traffic in relation to commuter traffic. In these charts, commuter traffic is represented by the number of vehicles that entered and exited the study area during the time the school counts were conducted. The charts demonstrate how much higher the morning school traffic peak is compared to the afternoon school traffic peak, and how the afternoon departures are much more spread out. In addition, it shows how the morning school peak occurs during the morning commuter period, while the afternoon school peak occurs before commuter traffic has entered its peak period.

ITE Trip Generation

This report also compared the measured trip generation of the existing schools with industry standards for elementary & middle school trip generation. Transportation Planners traditionally use the Institute of Transportation Engineers' (ITE) *Trip Generation*, 8th Edition to calculate projected traffic demand for a new development or project. The manual is used to estimate the number of trips entering and exiting a site at a given time (frequently the morning and afternoon peak hours and a typical weekday). ITE rates are typically functions based on the type of development and square footage, number of dwelling units, or other standard measurable size variable. The rates do not consider the location of the development, the cost of transportation, and many other important factors; they are often estimated based on observations of existing development.

Trip Generation defines elementary schools are those that typically serve students attending kindergarten through the fifth of sixth grade. They are usually located in residential communities and typically provide bus service to students beyond a specified distance to the school. Middle schools/junior high schools are those that serve students who have completed elementary school and have not yet entered high school. The weekday morning peak hour of the schools typically coincide with the peak hour of the adjacent street traffic; the weekday afternoon peak hour of the schools varies between 2:00 and 4:00 PM.

Table 1 shows a comparison between the existing trips generated by the schools and the trip rates given by ITE.

Table 1: Trip Generation Comparison

School	Size (Students)	Existing Trips		ITE *Trip Generation*	
		AM Peak	*PM Peak*	*AM Peak*	*PM Peak*
Kenmore Middle School	741	602	244	400	230
Carlin Springs Elementary School	580	381	86	261	162
Campbell Elementary School	435	311	167	196	122

As shown in Table 1, the trip generation comparison shows:

- ITE *Trip Generation* shows a higher trip generation during the morning peak period than the afternoon peak period. This is also reflected in the existing trips counted for the three schools.
- All three schools generate a higher number of existing morning peak hour trips than predicted by *Trip Generation*. This is likely due to the high volume of drop-off activity at the schools, as well as the restrictions on walking to school due to the surrounding pedestrian environment.
- Kenmore Middle School and Campbell Elementary School generate a slightly higher number of existing trips during the afternoon peak period than predicted by *Trip Generation*. However, Carlin Springs Elementary School generates approximately half of the number of trips predicted by *Trip Generation*. This is likely due to the number of students engaging in after-school activities.

Parking Supply

As stated previously, Kenmore Middle School has a totally parking supply of 159 spaces, the majority of which are in the main parking lot south of the school. Carlin Springs Elementary School has a total supply of 131 parking spaces on two lots on either side of the school, as well as a grass paved parking lot used for the recreation fields and overflow school parking, which contains approximately 84 parking spaces.

According to the Arlington County Zoning Ordinance (AZCO), elementary school and junior high (middle) schools must provide one parking space per twenty (20) students of design capacity[1]. This equates to an existing minimum parking supply of 49 spaces at Kenmore MS and 29 spaces at Carlin Springs ES. Both Kenmore MS and Carlin Springs ES provide a parking supply greater than what is required by the AZCO based on the student design capacity.

Additionally, the AZCO requires that one parking space must be provided for each ten (10) seats in an auditorium or other facility for public assembly. If no fixed seating arrangement is specified, the requirement is one parking space per fifty (50) square feet of floor area. This equates to a minimum parking supply of 309 spaces at Kenmore MS and 97 spaces at Carlin Springs ES. Based on these criteria, Carlin Springs provides adequate parking supply, with an excess of 34 parking spaces. However, Kenmore MS has a parking shortage of approximately 150 spaces. Part of this shortage can be accommodated in the grass parking lot, which contains approximately 84 parking spaces.

Currently, Kenmore MS and Carlin Springs ES have an agreement not to schedule events on the same date due to their close proximity. Due to this agreement, all of the lots on the site are shared between the two schools during events. Thus, all of the Carlin Springs parking lots can be used to satisfy the demand generated by events held at Kenmore MS.

[1] Arlington County Zoning Ordinance, *Section 33: Automobile Parking, Standing and Loading Space*, page 8 of 11; April 27, 2010

Figure 5: On-site Parking Facilities for Kenmore MS and Carlin Springs ES

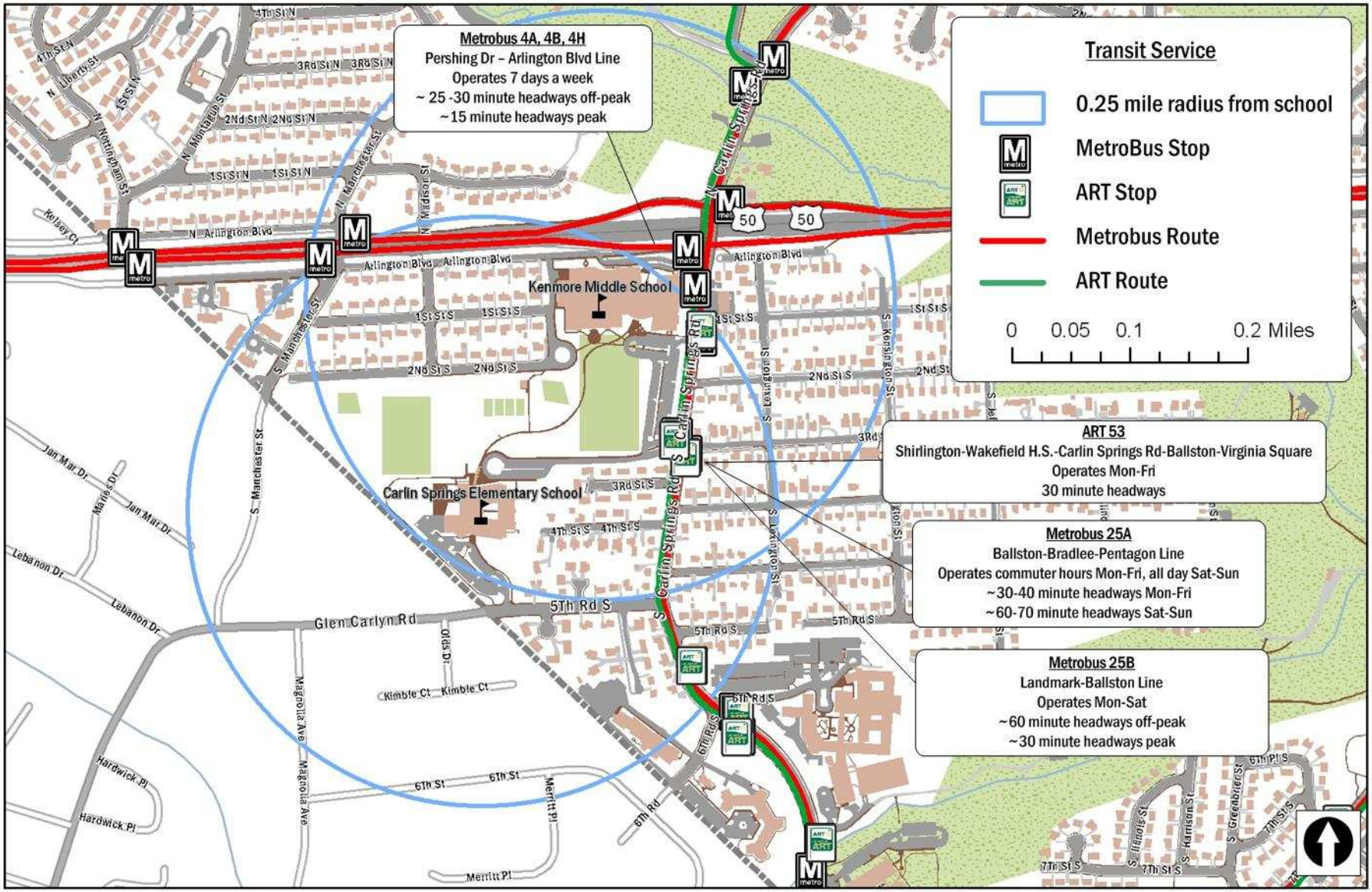


Figure 6: Transit Service near Kenmore MS and Carlin Springs ES

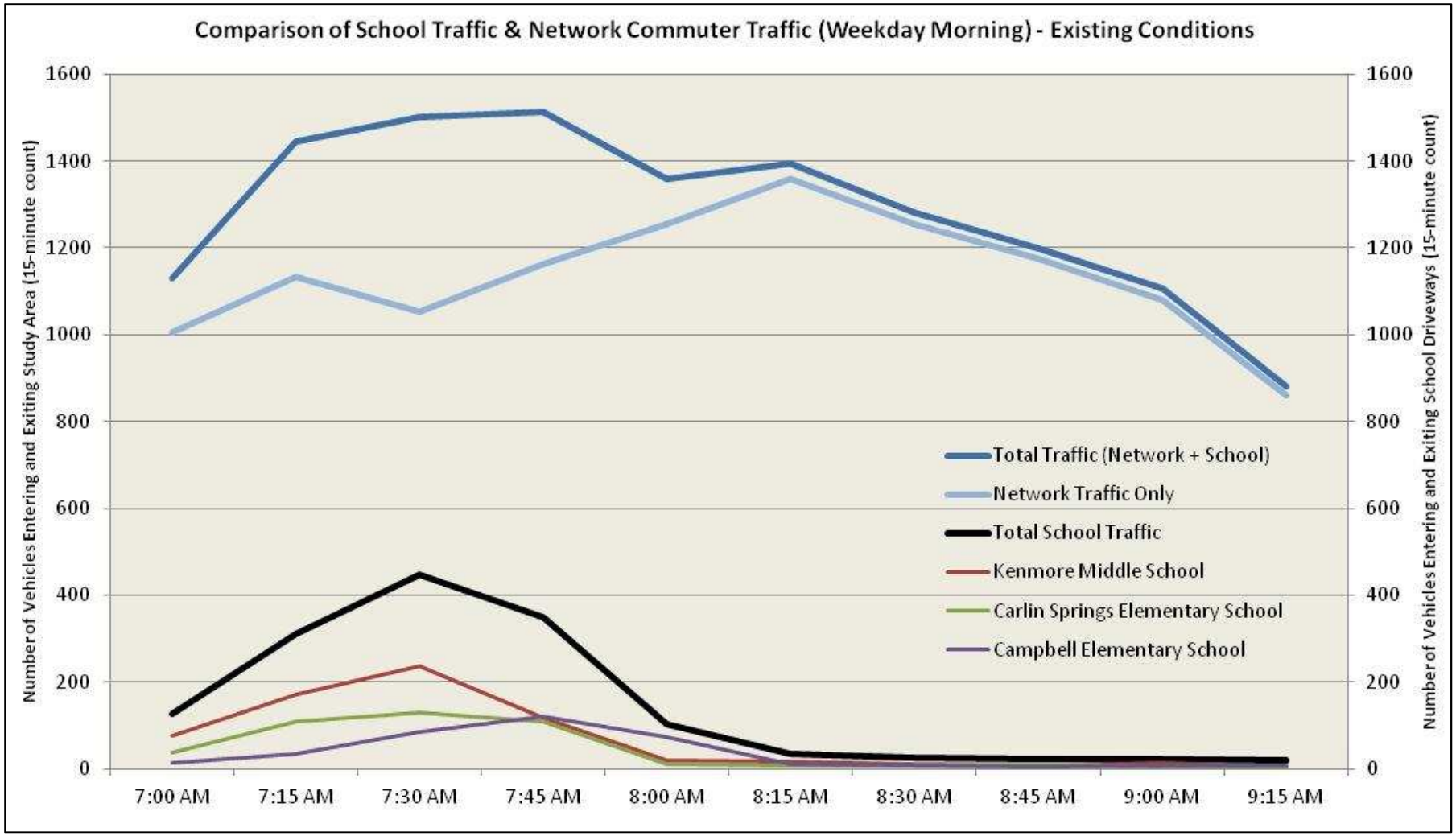


Figure 7: Comparison of School Generated and Commuter Traffic (Weekday Morning)

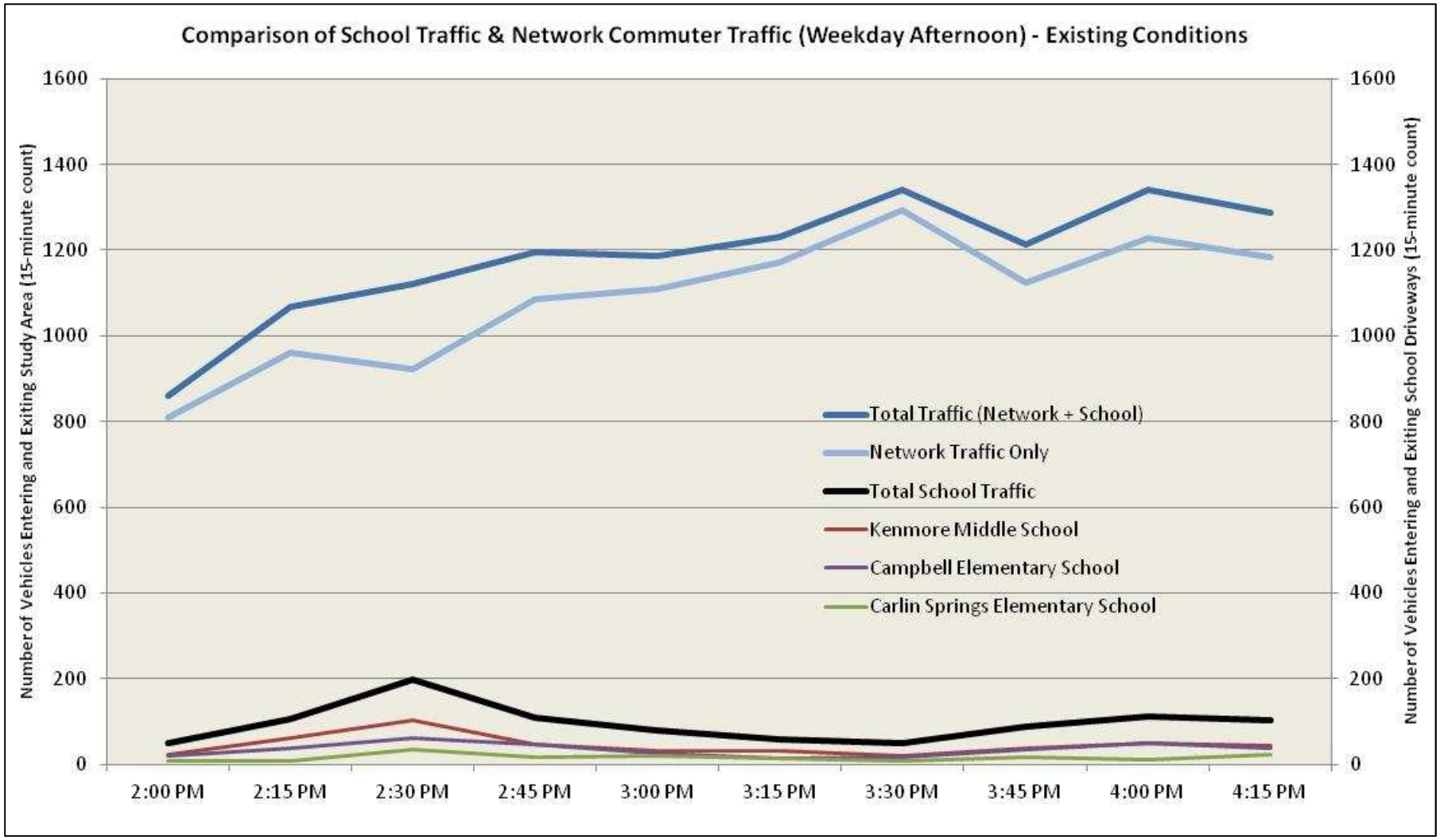


Figure 8: Comparison of School Generated and Commuter Traffic (Weekday Afternoon)

Parking Demand

In addition to measuring traffic demand generated by the school, this assessment also conducted counts of parking demand. The parking demand counts included counts within school lots and counts of on-street parking demand. The purpose of the counts was to determine how well the existing lots handle parking demand and to determine if the school parking demand uses nearby on-street parking. Parking counts were conducted on two days, Thursday, May 17, 2012 and Saturday, May 19, 2012, from 11 AM to 8 PM.

In addition to school activities, the recreation fields also produce parking demand. On the days of the counts, the fields were reserved for the following uses (times can overlap due to multiple fields on site):

- Thursday, May 17, 2012
  - ASBR Baseball, 6:00 to 8:00 PM
  - ASA Soccer, 8:00 to 10:00 PM
  - ASA Soccer, 5:00 to 6:00 PM
  - Arlington Youth Lacrosse, 6:00 to 7:30 PM
  - ASA Soccer, 7:30 to 9:45 PM
- Saturday, May 19, 2012
  - ASBR Baseball, 10:00 AM to 12:00 PM

School Parking Lots

A summary of the parking data collected at the school lots is presented in Figure 9.

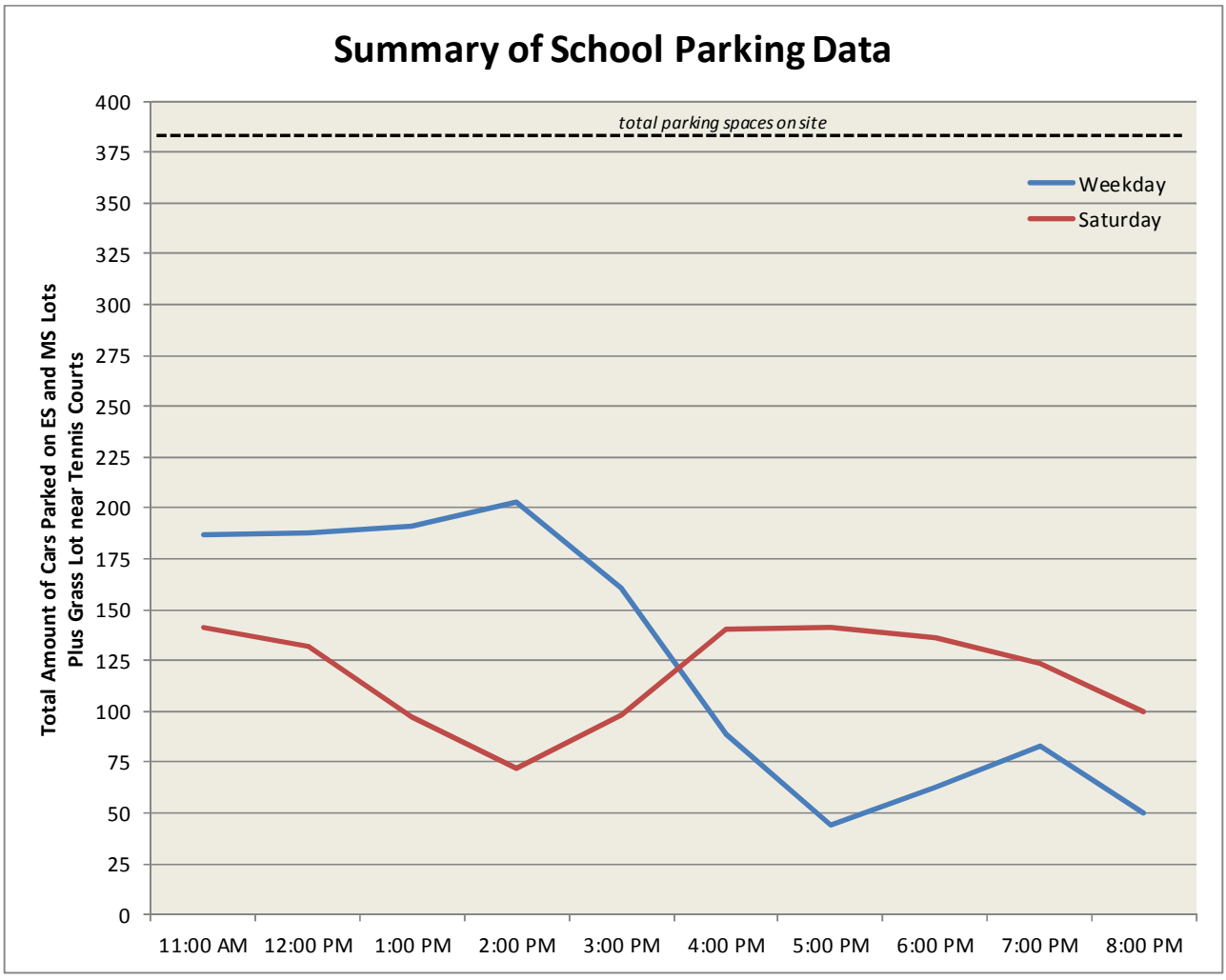
The weekday parking data matches discussions with school staff and observations, showing that the parking on-site easily handles demand generated from the schools. Including the recreation field lot as part of the parking supply, the peak parking demand was 53% of the total supply.

The Saturday data shows that all demand was also easily accommodated on site, with demand peaking at 37% of the total supply. Some demand generated during the day and evening was likely from use of the recreation fields. Clear pathways exist between the schools and the fields, which makes the school lots attractive to field users.

On-Street Parking

In addition to the counts of parking demand on school lots, a count of on-street parking inventory was performed. The extent of the counts was selected to represent a reasonable walking distance to both the schools and the recreation fields. Figure 10 and Figure 11 contain the results of these counts.

The weekday on-street counts showed a minimal amount of on-street parking during the day and a few blocks getting full at night. The Saturday counts showed that most blocks had significant occupancy, with a few more full than others. The patterns of occupancy by block appear to be connected to whether homes on that block had driveways or not. The few blocks with higher on-street parking demand did not have homes with driveways. The on-street counts appear to show that the school and recreational fields have no impact, or minimal impact to on-street parking, and any impact that may have does not generate any concerns or problems.



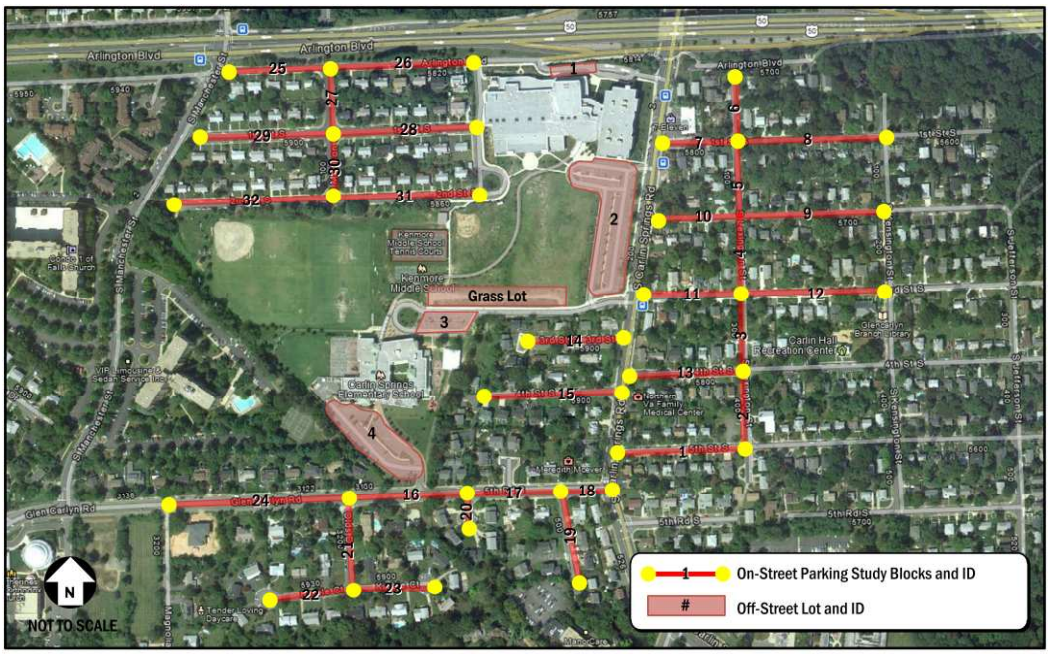
Thursday, May 17, 2012

Time	Kenmore MS		Carlin Springs ES		Total	
11:00 AM	93	*56%*	94	*53%*	187	*49%*
12:00 PM	96	*58%*	92	*52%*	188	*49%*
1:00 PM	101	*61%*	90	*51%*	191	*50%*
2:00 PM	109	*66%*	94	*53%*	203	*53%*
3:00 PM	85	*51%*	76	*43%*	161	*42%*
4:00 PM	56	*34%*	33	*19%*	89	*23%*
5:00 PM	24	*14%*	20	*11%*	44	*12%*
6:00 PM	25	*15%*	38	*21%*	63	*16%*
7:00 PM	33	*20%*	50	*28%*	83	*22%*
8:00 PM	39	*23%*	11	*6%*	50	*13%*

Saturday, May 19, 2012

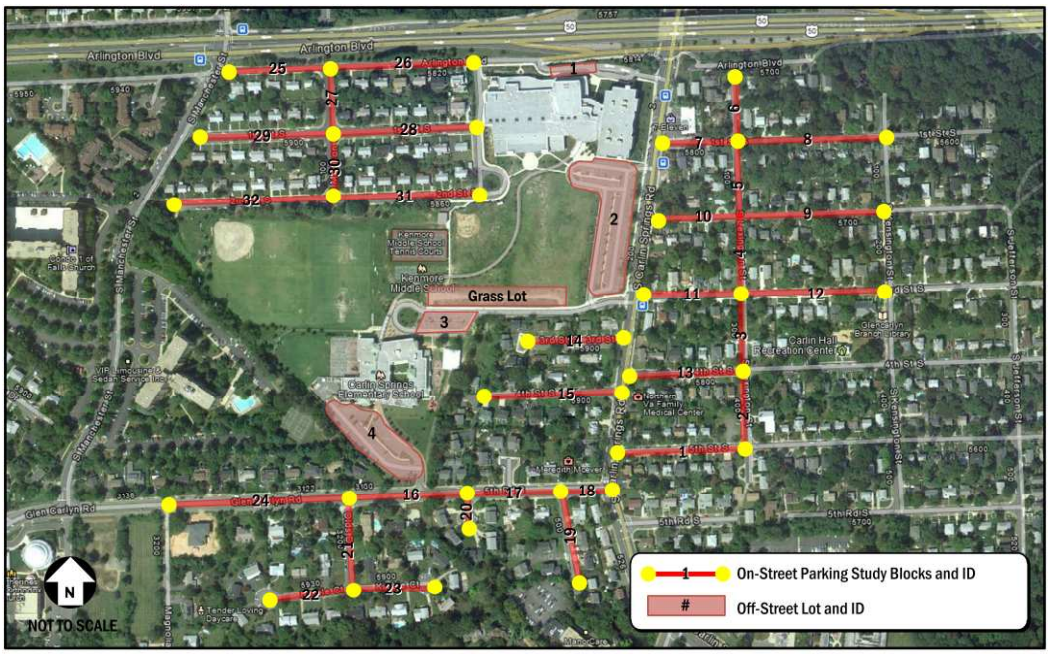
Time	Kenmore MS		Carlin Springs ES		Total	
11:00 AM	116	*70%*	25	*14%*	141	*37%*
12:00 PM	101	*61%*	31	*17%*	132	*35%*
1:00 PM	72	*43%*	25	*14%*	97	*25%*
2:00 PM	46	*28%*	26	*15%*	72	*19%*
3:00 PM	66	*40%*	32	*18%*	98	*26%*
4:00 PM	105	*63%*	35	*20%*	140	*37%*
5:00 PM	131	*79%*	10	*6%*	141	*37%*
6:00 PM	130	*78%*	6	*3%*	136	*36%*
7:00 PM	106	*64%*	17	*10%*	123	*32%*
8:00 PM	80	*48%*	20	*11%*	100	*26%*

Figure 9: Summary of School Parking Data



ID	Street	From	To	No. of Spaces	Thursday (5-17-12) Occupancy										ID
					11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	
1	5th St	Carlin Springs Rd	Lexington St	25	4	4	4	3	4	4	4	8	8	6	1
2	Lexington St	5th St	4th St	21	2	3	1	1	2	3	2	3	2	2	2
3	Lexington St	4th St	3rd St	20	0	0	0	0	0	1	1	1	1	1	3
4	Lexington St	3rd St	2nd St	18	4	4	2	2	2	5	2	3	1	1	4
5	Lexington St	2nd St	1st St	17	5	5	5	4	3	3	3	3	3	4	5
6	Lexington St	1st St	Arlington Blvd	17	3	4	2	0	1	1	2	2	2	3	6
7	1st St	Carlin Springs Rd	Lexington St	14	2	1	2	3	1	0	0	0	1	0	7
8	1st St	Lexington St	Kensington St	31	6	6	6	5	3	4	6	5	10	9	8
9	2nd St	Kensington St	Lexington St	31	1	2	0	1	1	2	1	1	3	2	9
10	2nd St	Lexington St	Carlin Springs Rd	20	4	2	3	3	3	3	3	3	4	4	10
11	3rd St	Carlin Springs Rd	Lexington St	18	3	3	3	3	4	4	3	3	5	4	11
12	3rd St	Kensington St	Kensington St	31	6	7	8	5	7	6	5	4	6	8	12
13	4th St	Lexington St	Kensington St	20	8	8	7	6	5	5	7	5	7	6	13
14	3rd St	Carlin Springs Rd	End	21	8	10	8	8	6	8	8	16	12	13	14
15	4th St	Carlin Springs Rd	End	17	8	6	6	7	6	7	9	10	15	14	15
16	5th Rd	Olds Dr	Larrimore St	33	6	6	6	4	3	3	5	5	6	4	16
17	5th Rd	Larrimore St	Lancaster St	22	2	2	2	2	2	3	3	3	2	0	17
18	5th Rd	Lancaster St	Carlin Springs Rd	5	0	0	0	0	1	0	0	0	0	0	18
19	Lancaster St	5th St	End	12	6	6	6	5	6	4	3	6	8	8	19
20	Larrimore St	5th St	End	8	2	2	2	8	2	2	2	2	2	1	20
21	Olds Dr	Glen Carlyn Rd	Kimble Ct	25	1	1	1	0	1	1	1	2	5	6	21
22	Kimble Ct	Olds Dr	End (West)	23	0	3	2	2	1	1	1	2	2	3	22
23	Kimble Ct	Olds Dr	End (East)	20	2	4	8	6	6	8	10	8	10	9	23
24	Glen Carlyn Rd	Olds Dr	Magnolia Ave	48	8	8	7	11	10	12	9	9	10	11	24
25	Arlington Blvd	Manchester St	Madison St	10	2	2	2	2	2	3	3	6	6	6	25
26	Arlington Blvd	Madison St	School Drwy	39	9	9	8	8	7	7	5	8	6	6	26
27	Madison St	Arlington Blvd	1st St East	18	2	3	3	5	4	3	2	2	1	1	27
28	1st St	Madison St	School Drwy	34	8	7	9	10	9	9	9	12	10	11	28
29	1st St	Madison St	End	34	11	8	5	11	10	14	12	15	13	14	29
30	Madison St	1st St	2nd St	18	2	2	2	2	2	2	2	2	4	4	30
31	2nd St	Madison St	School Drwy	39	8	8	7	8	4	4	5	6	5	8	31
32	2nd St	Madison St	End	50	5	4	5	4	5	5	6	30	28	13	32
			Total	**759**	**138**	**140**	**132**	**139**	**123**	**137**	**134**	**185**	**198**	**182**	
			Shading Key:		**<25%**		**25-50%**		**50-75%**		**75-100%**				

Figure 10: On-Street Parking Count Results (Thursday, May 17, 2012)



ID	Street	From	To	No. of Spaces	Saturday (5-19-12) Occupancy										ID
					11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	
1	5th St	Carlin Springs Rd	Lexington St	25	5	5	5	5	7	6	7	7	9	9	1
2	Lexington St	5th St	4th St	21	1	1	1	1	1	1	2	1	2	1	2
3	Lexington St	4th St	3rd St	20	2	1	1	1	1	1	2	2	2	1	3
4	Lexington St	3rd St	2nd St	18	3	2	1	2	1	2	2	2	3	2	4
5	Lexington St	2nd St	1st St	17	4	5	5	5	5	3	4	4	4	4	5
6	Lexington St	1st St	Arlington Blvd	17	1	1	3	3	1	2	2	1	1	1	6
7	1st St	Carlin Springs Rd	Lexington St	14	2	1	2	2	1	0	1	0	0	0	7
8	1st St	Lexington St	Kensington St	31	9	10	6	8	6	9	8	11	10	13	8
9	2nd St	Kensington St	Lexington St	31	4	6	5	5	4	4	4	3	4	4	9
10	2nd St	Lexington St	Carlin Springs Rd	20	7	5	4	4	5	5	5	4	5	3	10
11	3rd St	Carlin Springs Rd	Lexington St	18	9	9	7	6	6	7	7	7	7	7	11
12	3rd St	Kensington St	Kensington St	31	8	8	8	6	4	6	5	6	6	5	12
13	4th St	Lexington St	Kensington St	20	7	10	10	10	8	7	9	9	11	12	13
14	3rd St	Carlin Springs Rd	End	21	12	12	12	10	14	13	12	13	13	13	14
15	4th St	Carlin Springs Rd	End	17	10	11	10	10	9	10	12	13	12	12	15
16	5th Rd	Olds Dr	Larrimore St	33	4	5	7	7	7	7	8	7	6	6	16
17	5th Rd	Larrimore St	Lancaster St	22	2	1	0	0	0	0	1	2	2	1	17
18	5th Rd	Lancaster St	Carlin Springs Rd	5	0	0	0	0	0	0	0	0	0	0	18
19	Lancaster St	5th St	End	12	9	8	10	10	9	9	8	9	7	8	19
20	Larrimore St	5th St	End	8	4	3	3	1	1	3	4	3	2	2	20
21	Olds Dr	Glen Carlyn Rd	Kimble Ct	25	3	4	4	4	4	2	2	1	1	1	21
22	Kimble Ct	Olds Dr	End (West)	23	3	3	3	4	3	3	3	2	2	2	22
23	Kimble Ct	Olds Dr	End (East)	20	9	7	5	7	9	8	9	10	9	9	23
24	Glen Carlyn Rd	Olds Dr	Magnolia Ave	48	9	7	11	14	12	16	15	9	13	16	24
25	Arlington Blvd	Manchester St	Madison St	10	4	4	5	5	5	6	7	6	7	7	25
26	Arlington Blvd	Madison St	School Drwy	39	8	7	7	9	7	9	9	9	10	8	26
27	Madison St	Arlington Blvd	1st St East	18	3	3	4	3	3	3	4	4	4	3	27
28	1st St	Madison St	School Drwy	34	11	11	11	9	9	9	13	13	19	19	28
29	1st St	Madison St	End	34	13	14	15	14	13	15	16	15	16	12	29
30	Madison St	1st St	2nd St	18	1	1	1	2	2	2	2	2	2	2	30
31	2nd St	Madison St	School Drwy	39	15	14	12	6	10	4	3	3	5	4	31
32	2nd St	Madison St	End	50	5	5	5	5	8	8	8	8	9	7	32
			Total	**759**	**187**	**184**	**183**	**178**	**175**	**180**	**194**	**186**	**203**	**194**	
			Shading Key:		**<25%**		**25-50%**		**50-75%**		**75-100%**				

Figure 11: On-Street Parking Count Results (Saturday, May 19, 2012)

Traffic Capacity at Nearby Intersections

As part of this Transportation Assessment, traffic capacity at nearby intersections was examined to determine if any traffic concerns exist currently, and to help provide background information for determining if the growth at Kenmore MS, Carlin Springs ES, and the adjacent Campbell ES and the decision to place an elementary school adjacent to the schools would generate any capacity issues. Details of the capacity analyses are attached to this report. This section summarizes the existing traffic capacity. Later sections of this report examine potential future scenarios.

The study area intersections were set to those intersections closest to the school driveways along Carlin Springs Road and 5th Road and major intersections on approach and departure routes to the schools. In order to perform intersection capacity analyses, Gorove/Slade conducted turning movement counts of vehicular traffic between 7:00 and 9:30 AM and 2:00 and 4:30 PM on Thursday, May 19, 2012. The traffic capacity analyses were performed for the peak half-hour of highest traffic generated by the school in the morning and afternoon, and thus the count times were based on the first and last bell times at the schools. In addition, the analyses are based on information provided by Arlington County for their traffic network, including signal timings and offsets. Gorove/Slade conducted field visits to record observations and geometrical information. Figure 12 contains a map of the study area intersections, and a summary of Level of Service (LOS) results for each intersection. LOS is a measure of congestion ranging from LOS A (least congested) to LOS F (most congested). LOS is one of the most common terms used to describe how "good" or how "bad" traffic is, or is projected to be. The LOS grades are based on a calculation of the average delay drivers experience travelling through an intersection.

For signalized intersections, the LOS grades shown on Figure 12 are for the overall intersection (based on the average delay for all drivers passing through). LOS for a signalized intersection is based on the volume of vehicles traveling through the intersection, the capacity of the intersection (number and width of lanes, signal timing, etc.), and the average delay experienced by a driver at the intersection.

At a signalized intersection, LOS A, B, and C are the most favorable for vehicles, indicating that most vehicles arrive at the intersection during the green phase and do not have to stop at the intersection. LOS A, B, and C are frequently seen on roadways with favorable signal timings or low traffic volumes. LOS D indicates that the intersection experiences a noticeable amount of delay. This delay is seen by vehicles arriving during the red phase or sitting through a full signal cycle before being able to continue to the next intersection. LOS E indicates that the intersection has reached its theoretical capacity. Intersections that operate under LOS E typically have poor progression along a corridor (stopping at multiple red lights along a single stretch of roadway) and high traffic volumes. LOS F describes intersections that operate under conditions that are typically viewed as “unacceptable” to most drivers. This level of delay is typically seen when the volume on the roadway exceeds the capacity of the intersection, either due to the roadway configuration or signal timing and progression.

At signalized intersections, LOS grades of E or better are typically desired during peak times. Since LOS E is often used to denote when an intersection reaches its theoretical capacity, the most efficient use of a roadway may occur when all the movements at an intersection operate under LOS E. A well-designed intersection does not necessarily operate at LOS A at all times. Instead, the busiest intersections should reach LOS E during the highest times of use to ensure efficient use of public facilities. In practice, the most desirable LOS grades depend on location, time, and context.

The unsignalized intersections within the study area are all 2-way stop controlled intersections, which means that the main roadway flows through the intersection without stopping while the cross-street is controlled by stop signs. Since the main roadway does not have a stop sign, through traffic and right turns are assumed to be able to pass through the intersection without any delay. The only vehicles on the main roadway that theoretically experience delay are those executing left turns

because they must yield to through traffic. However, the vehicles on the cross-street, which are controlled by a stop sign, will experience delay and are given a corresponding LOS grade based on the level of delay. The LOS grade given to the stop-controlled cross-street is based on the volume of conflicting traffic (vehicles on the main roadway and vehicles on the opposite approach at a four-way intersection), the capacity of the approach (number and width of lanes), and the size and frequency of acceptable gaps in the main street traffic to complete a turn from the cross-street. In Figure 12, the intersection capacity is depicted through the largest delay to the cross-street traffic.

At an unsignalized intersection, LOS A on the cross-street indicates that there is very little conflicting traffic and vehicles are only briefly paused at the stop sign before continuing. LOS B, C, D, and E correspond to an increase in delay experienced by a driver waiting at a stop sign. LOS F describes an intersection that operates under conditions that are typically viewed as "unacceptable" to most drivers. LOS F typically exists when there are insufficient gaps for cross-street traffic to enter the intersection. While an unsignalized intersection may operate under LOS F conditions, the delay may not result in long queues and may only reflect a significant amount of wait-time experienced by a small volume of vehicles. A signal may not be warranted at an intersection operating at LOS F if the traffic volumes are low on the cross-street. The LOS F will likely just result in adjustments to driver behavior, either changing their travel routes, if available, or increasing their threshold for risk (decreasing the length of gap between vehicles they deem necessary to enter the intersection).

The existing capacity analysis shows the following:

- School morning and afternoon peak half-hours show most intersections operate at LOS C or better. Exceptions include:
    - Overall LOS F at Carlin Springs Road at the intersection of 3rd Street with the northbound movement generating the delays.
    - Although the overall intersection does not operate at LOS F, the north and southbound Manchester Street at Arlington Boulevard approaches operate with an LOS F in the morning school peak hour.
- At the Carlin Springs Road and 3rd Street intersection, northbound traffic on Carlin Springs Road is approximately double that of the southbound traffic. During school peaks, the eastbound movement is utilizing the maximum green time available. This causes a greater gap between consecutive green times for the north and southbound movements which result in longer queues. Because there is such a large difference between the north and southbound traffic volumes, the northbound queues cannot completely dissipate even though most of the southbound traffic is able to move through the intersection.
- Field visits showed northbound traffic on Carlin Springs Road backing up from the Arlington Boulevard eastbound ramps over 3,000' south, however capacity analysis shows that the intersection at the eastbound ramps operates at an LOS C. Potential causes include:
    - Congestion backing up from Arlington Boulevard due to a short merge lane. This intersection has a shared through/right turn lane in the northbound direction. If traffic backs up along the ramp, the right lane may be blocked to vehicles that are trying to go through the intersection.
    - Congestion stemming from Carlin Springs Road and 3rd Street intersection. It is possible that the intersection of Carlin Springs Road and the Arlington Boulevard eastbound ramps only backs up to 3rd Street (approximately 1000') and that the rest of the backup is caused by the failing northbound movement at Carlin Springs Road and 3rd Street.

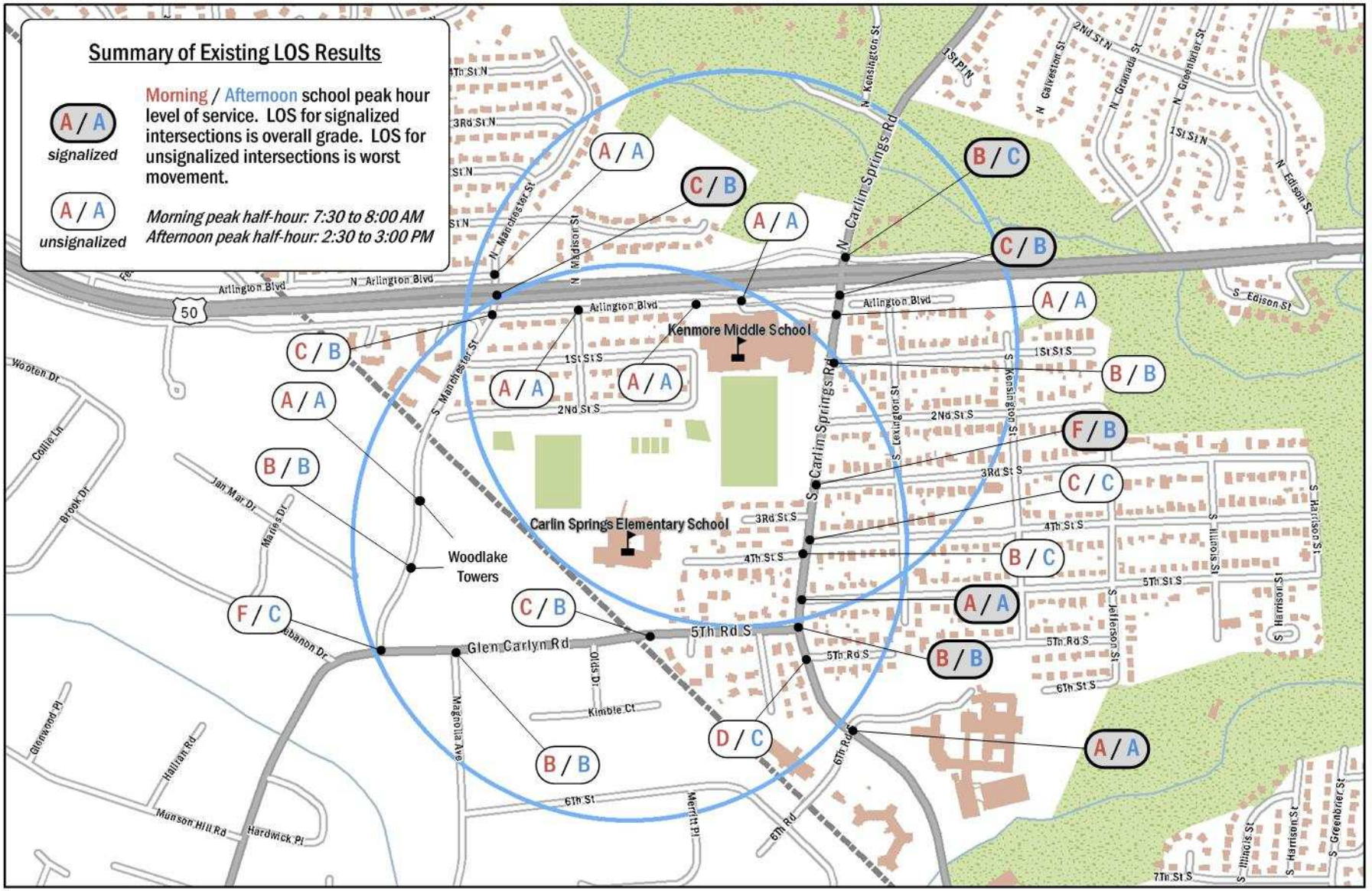


Figure 12: Summary of Existing LOS Results

POTENTIAL IMPACT OF EXPANSIONS AND NEW ELEMENTARY SCHOOL

As stated previously, Kenmore Middle School has an existing student population of 731 (as of November 2011). Enrollment is expected to grow in the future, up to 1,054 students in 2017. The school is currently approved to expand to as many as 1,300 students. Carlin Springs Elementary School has an existing student population of 580 (as of November 2011). Enrollment is expected to grow in the future, up to 658 students in 2017. The adjacent Campbell Elementary School has an existing population of 435 (as of November 2011). Enroll is expected to grow in the future, up to 518 students in 2017. A new elementary school located adjacent to Kenmore MS and Carlin Springs ES is planned to open around 2017. It will be a choice school serving the entire County, with an enrollment of approximately 600 students.

Traffic Demand

Expansion of Kenmore MS, Carlin Springs ES, and Campbell ES

In order to determine the impact of the future growth at the schools on the roadway network, the existing trip generation was examined for Kenmore Middle School, Carlin Springs Elementary School, and the adjacent Campbell Elementary School. Although an analysis of Campbell ES facilities is not included in this report, the school is included in the traffic demand due to its proximity to the Kenmore and Carlin Springs schools. Campbell ES is located less than one half-mile from Carlin Springs ES, so the trips generated by the school influence the roadway network adjacent to Kenmore MS, Carlin Springs ES, and the new ES.

Table 2: Existing and Future Populations

School	Population by Year	
	Existing (2011)	*Future (2017)*
Kenmore Middle School	741	1,051
Carlin Springs Elementary School	580	658
Campbell Elementary School	435	518

In order to determine the existing traffic demand of the schools, the traffic volumes entering and exiting the school driveways during the morning and afternoon peak were summed. As stated previously, Gorove/Slade conducted turning movement counts of vehicular traffic between 7:00 and 9:30 AM and 2:00 and 4:30 PM on Thursday, May 19, 2012. These counts included traffic volumes at all of the site driveways for Kenmore MS, Carlin Spring ES, and Campbell ES. Traffic volumes were counted and summed in 15-minute intervals for each of the peak periods. Traffic volumes were also collected at the intersections closest to the school driveways along Carlin Springs Road and 5th Road and major intersections on approach and departure routes to the schools. Figure 7 and Figure 8, shown previously, depict the existing traffic volumes at the schools compared to the total traffic volumes on the surrounding roadway network.

Future traffic demand was estimated based on the existing traffic demand shown in Figure 7 and Figure 8, increased by a growth factor based on the ratio of the future student population to the existing population at each of the schools. Figure 13 and Figure 14 show the existing and projected future traffic demand for Kenmore MS, Carlin Springs ES, and Campbell MS, as well as the total traffic demand for all three schools.

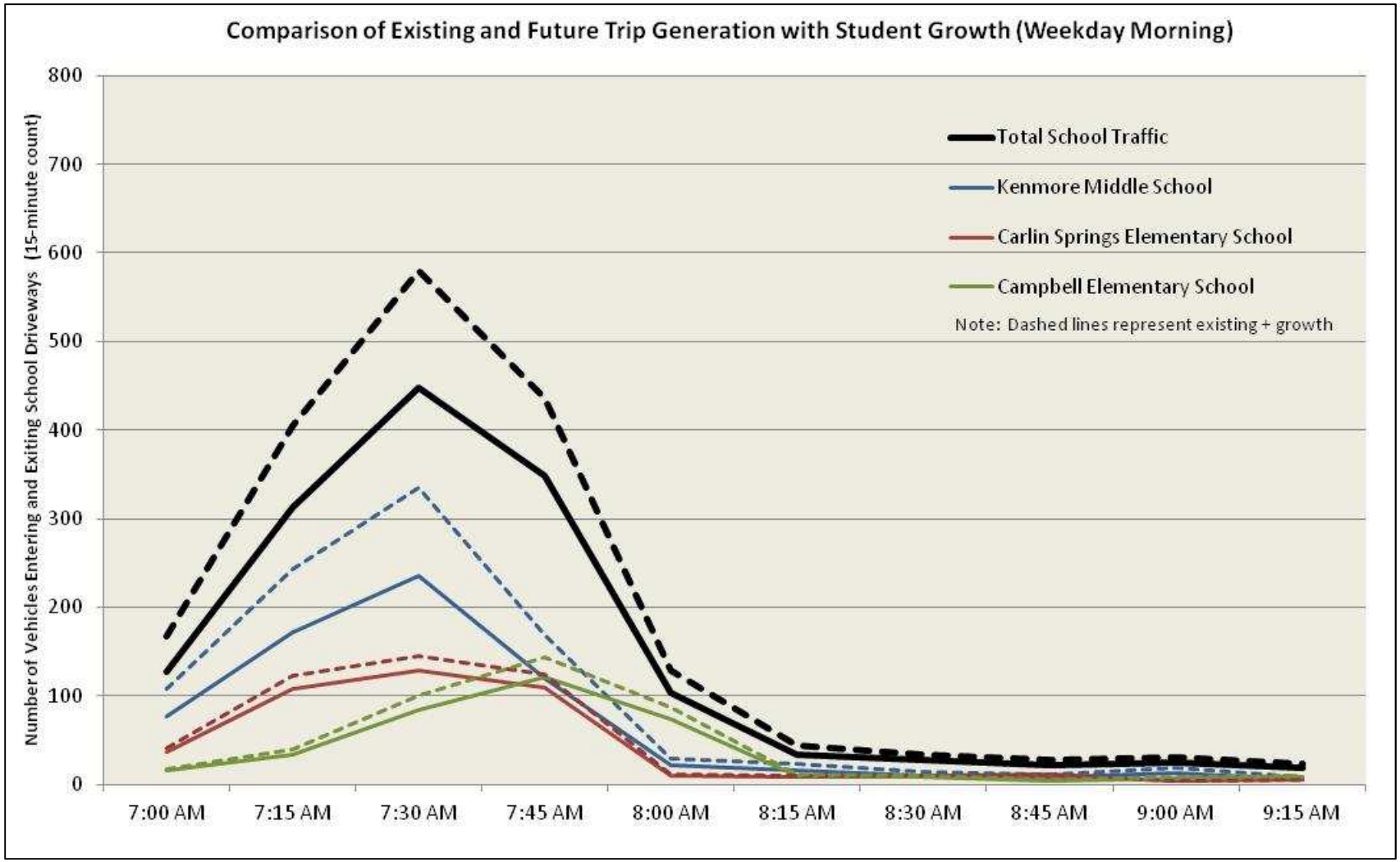


Figure 13: Comparison of Existing and Projected Future Traffic Demand with Growth (Weekday Morning)

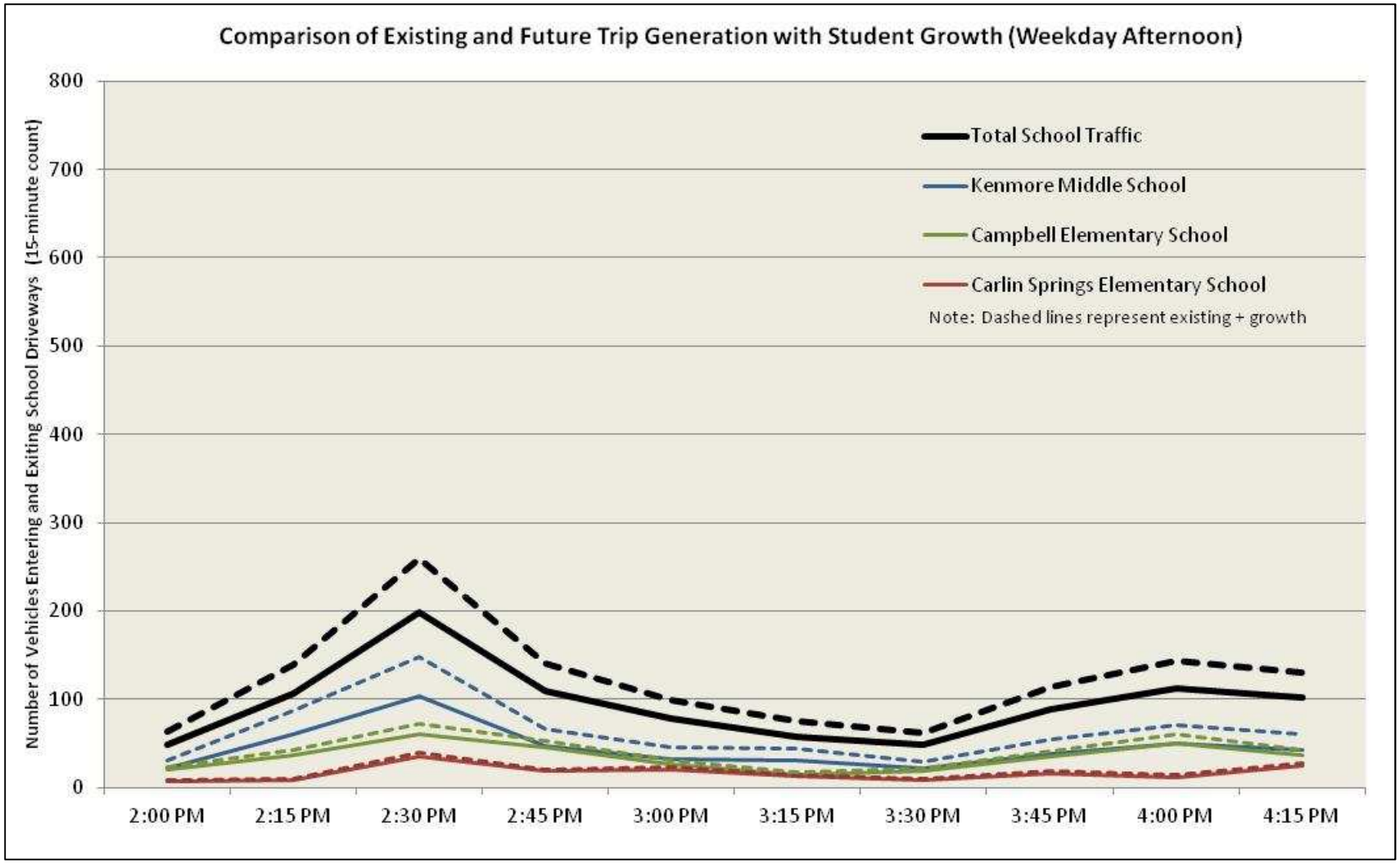


Figure 14: Comparison of Existing and Projected Future Traffic Demand with Growth (Weekday Afternoon)

As shown in Figure 13 and Figure 14:

- Kenmore MS generates more trips than both Carlin Springs ES and Campbell ES
- During the morning peak period, Carlin Springs ES and Kenmore MS peak at the same time (7:30-7:45 AM). Campbell ES peaks approximately 15 minutes later (7:45 AM).
- During the afternoon peak period, all three schools peak at the same time (2:30-2:45 PM).
- The addition of the growth at the three schools yields an increase in the total morning peak hour trips of approximately 29.5% during the morning peak (7:30-7:45 AM). During the afternoon peak (2:30-2:45 PM), the increase is approximately 30.2%.
- The most significant growth is shown at Kenmore MS, whose growth yields an increase in trips of approximately 41.9% during the morning peak (7:30-7:45 AM) and approximately 42.3% during the afternoon peak (2:30-2:45 PM).

Construction of New ES

The amount of traffic that a new elementary school would generate was projected based on data from the library of Gorove/Slade on other elementary schools. The new ES is projected to generate approximately 409 trips during the morning peak hour and approximately 150 trips during the afternoon peak hour. It is likely that a new elementary school would mimic the transportation patterns of the existing schools on site, notably the times of peak activity and how morning traffic is much higher than afternoon traffic.

Figure 15 and Figure 16 show the future traffic demand generated by the new ES and the total traffic demand for all four schools, assuming the same school times as Carlin Springs ES and Campbell ES. The new school generates trips that would increase the total school trip peak approximately 25.5% during the morning peak (7:30-7:45 AM) and approximately 17.8% during the afternoon peak (2:30-2:45 PM)

Comparing this amount of trip generation to the existing capacity analyses and LOS results indicates that, combined with the expansions at the existing schools, a new school has the potential to exacerbate the existing issues observed along Carlin Springs Road in the morning. The impacts on the evening would be limited because of the lower amount of trips generated and how the school peak occurs before the commuter peak.

Possible ways to minimize the traffic impacts from the new school match the ones listed prior for alleviating the existing issues:

- The schools could move their class start time earlier in the morning to further separate them from the morning commuter peak.
- The schools could stagger their start times to reduce the overall demand they have on traffic at any one time. It may prove beneficial for the new elementary school to have different bell times than Carlin Springs Elementary School and Campbell Elementary School, which both begin at 8:00 AM.
- Overall school impact could be reduced through the use of Transportation Demand Management (TDM) programs to try to reduce the amount of cars that drive to school. Pedestrian improvements combined with Safe Routes to School programs could increase the amount of students that walk to school, decreasing the amount of pick-ups and drop-offs. Incentives for employees to take transit, walk/bike to work, and carpool could also reduce vehicular demand slightly and improve conditions.

- As part of the school construction, additional driveway locations accessing the site should be added to spread out traffic demand over several locations. More driveways along Carlin Springs Road could spread out traffic enough to allow for more traffic signal green time to switch to Carlin Springs Road through traffic. An even more beneficial impact could be generated by adding another access to another street. A logical place to add another access point would be from Manchester Street, possible through a new intersection near where 2nd Street once connected with Manchester Street. Consideration should be given to locating the new school driveways from 2nd Street. Ideally the parking lots could be shared among all schools or at least between the new school and Kenmore Middle School, which could be linked so that drivers would have the option of using multiple driveways. Thus, they could alter their access routes to and from school to align with the least congested routes, creating the most efficient use the local roads. Any sort of connection would have to be designed to minimize cut-through activity from non-school related traffic.

The next section of this report details the scenarios that minimize the traffic impacts of the proposed new school and evaluates them to reach overall conclusions.

Parking Demand

Future parking demand was predicted based on the population growth of Kenmore MS and Carlin Springs ES, as shown previously in Table 2. The existing demand in the school parking lots, as shown previously in Figure 9, was increased by a growth factor based on the ratio of the future student population to the existing population at each of the schools.

Based on the population growth and the existing parking demand, Figure 17 shows the future parking demand off-street. The future parking demand peaks at 69% of the total supply during a typical weekday, including the recreation field. On a Saturday, the future parking demand peaks at 52% of the total supply, including the recreation fields. Of note, Figure 17 shows the Saturday parking demand at Kenmore MS equaling 112% and 111% during the 5:00 PM and 6:00 PM hours, respectively. It is expected that any demand that exceeds 100% will use other parking spaces on-site, including those available at Carlin Springs ES in the paved and the grass parking lot. During these hours, the parking demand at the Carlin Springs ES parking lots are 6% and 4%, respectively, leading to excess supply available to satisfy the demand at the Kenmore MS parking lots. Overall, including all available parking lots, the parking demand will equal 52% and 50% of the total supply off-street.

The new elementary school will likely have parking demand that resembles the existing Carlin Springs Elementary School. As shown previously on Figure 9, based on field observations and data collected by Gorove Slade, the existing Carlin Springs ES currently has a peak parking demand of 94 parking spaces. Since this school has 580 students, parking demand at the new school should have a similar demand with a slight increase. Based on a population of 600 students, the peak parking demand of the new elementary school should be approximately 97 parking spaces. Ideally, a parking lot has 10% additional supply over demand to account for circulation, so the new school will likely have a parking need of 107 spaces.

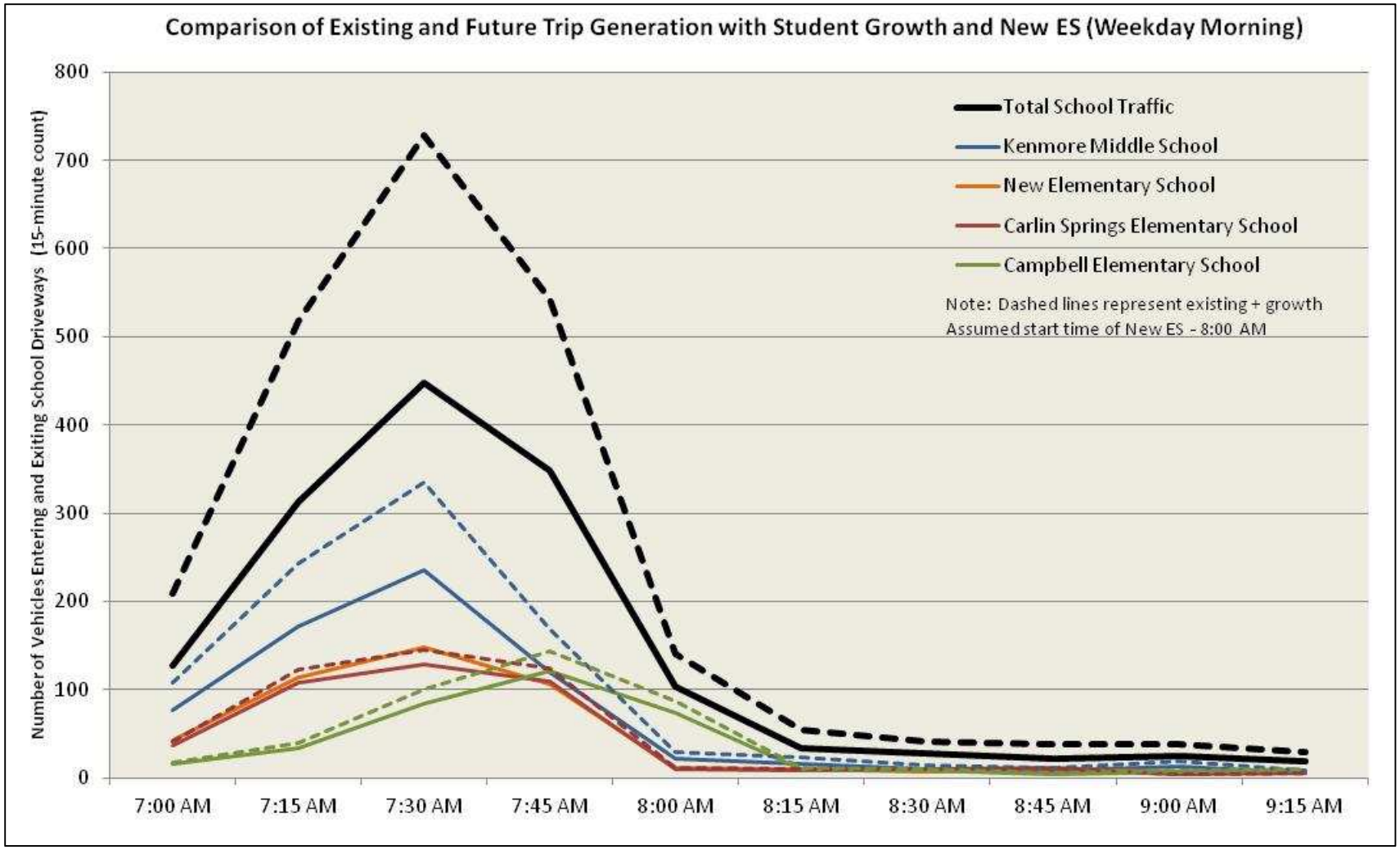


Figure 15: Comparison of Existing and Projected Future Traffic Demand with Growth and New ES (Weekday Morning)

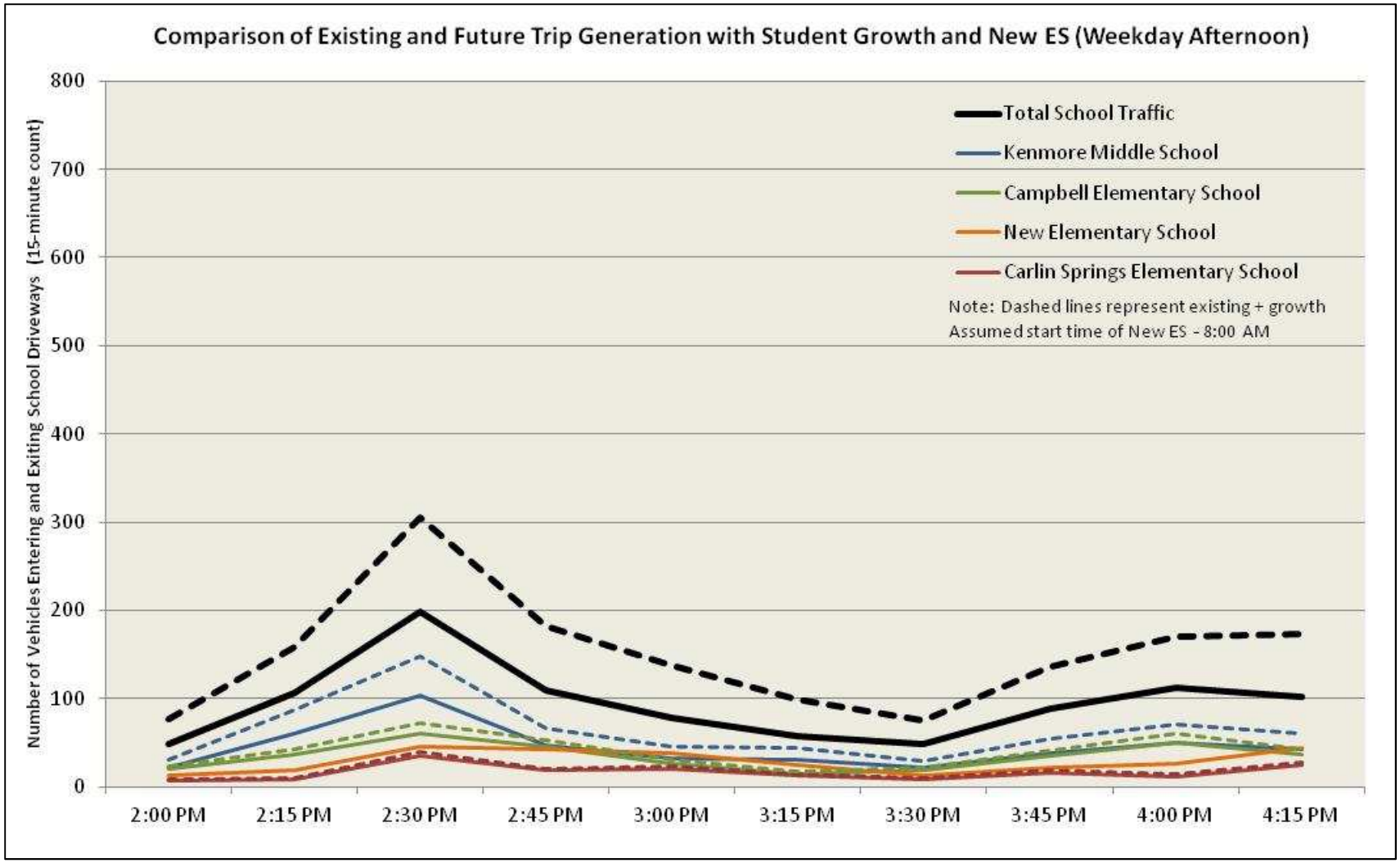


Figure 16: Comparison of Existing and Projected Future Traffic Demand with Growth and New ES (Weekday Afternoon)

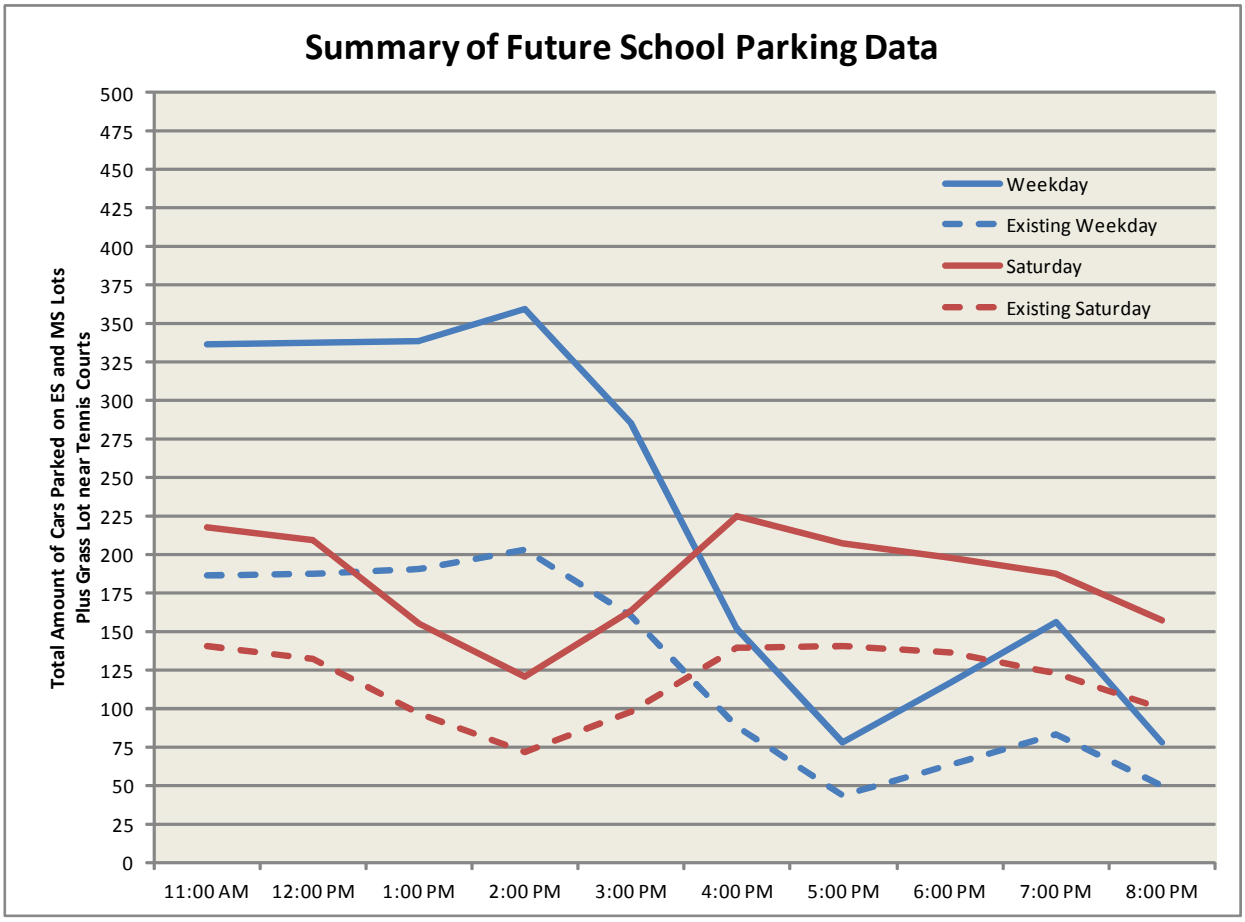
Table 3 shows the existing and future parking demand generated by the three schools, as well as the proposed parking supply. The table defines the target goals to provide guidance for the design of the site. The parking supply constructed on-site should satisfy both the demand goals and the parking minimums defined in the Arlington County Zoning Ordinance (AZCO), as shown in Table 3. The new school should also agree to not schedule events on the same days as events held as Kenmore MS and Carlin Springs ES in order to share the parking supply at the three schools. Additionally, if the expansion of the existing schools increases the design capacity and/or assembly space, the parking minimums should be re-examined to ensure that there is adequate parking provided on site to satisfy the AZCO guidelines.

Table 3: Parking Demand Comparison

School	Existing (2011)			Future (2017)		
	Parking Demand[1]	*Zoning Req.*[2]	*Parking Supply*	*Parking Demand*[1]	*Zoning Req.*[2]	*Recommended Parking Supply*[3]
Kenmore Middle School	109	49/309	159	155	49/309	171
Carlin Springs Elementary School	94	29/97	215[4]	107	29/97	120
New Elementary School	--	--	--	97	30/102	107
Total	**203**	**78/406**	**374**	**359**	**108/508**	**398**

1 – Demand based on observations and data collected by Gorove/Slade, future demand based on existing demand plus population growth
2 – Zoning requirements as stated in the Arlington County Zoning Ordinance. Zoning requirements shown based on student design capacity and public assembly space (students/assembly space).
3 – Recommended supply is equal to projected demand plus 10%
4 – Includes grass lot

As shown in Table 3, the recommended future parking supply of 398 spaces is only 24 spaces more than the current parking supply. Thus, if quality walking paths are provided and walking distances kept to a minimum, sharing parking between the schools could result in a low amount of new parking spaces required as part of new school construction. When designing the new school facilities, this should be taken into account, as well as meeting the AZCO minimums. The design should balance the zoning and practical parking needs, while also keeping the amount of new parking constructed at a minimum to preserve as many playing fields on site as possible.



Thursday, May 17, 2012

Time	Kenmore MS		Carlin Springs ES		New ES		Total	
11:00 AM	132	*80%*	107	*60%*	98	89%	337	*68%*
12:00 PM	137	*83%*	105	*59%*	96	87%	338	*69%*
1:00 PM	144	*87%*	102	*57%*	93	85%	339	*69%*
2:00 PM	155	*93%*	107	*60%*	98	89%	360	*73%*
3:00 PM	121	*73%*	86	*48%*	78	71%	285	*58%*
4:00 PM	80	*48%*	38	*21%*	35	32%	153	*31%*
5:00 PM	34	*20%*	23	*13%*	21	19%	78	*16%*
6:00 PM	35	*21%*	43	*24%*	39	36%	117	*24%*
7:00 PM	47	*28%*	57	*32%*	52	47%	156	*32%*
8:00 PM	55	*33%*	12	*7%*	11	10%	78	*16%*

Saturday, May 19, 2012

Time	Kenmore MS		Carlin Springs ES		New ES		Total	
11:00 AM	164	*99%*	28	*16%*	26	23%	218	*44%*
12:00 PM	143	*86%*	35	*20%*	32	29%	210	*43%*
1:00 PM	102	*61%*	28	*16%*	26	23%	156	*32%*
2:00 PM	65	*39%*	29	*16%*	26	24%	120	*24%*
3:00 PM	93	*56%*	37	*21%*	34	31%	164	*33%*
4:00 PM	149	*90%*	40	*22%*	36	33%	225	*46%*
5:00 PM	186	*112%*	11	*6%*	10	9%	207	*42%*
6:00 PM	185	*111%*	7	*4%*	6	6%	198	*40%*
7:00 PM	151	*91%*	19	*11%*	17	16%	187	*38%*
8:00 PM	113	*68%*	23	*13%*	21	19%	157	*32%*

Figure 17: Summary of Future School Parking Demand

SUMMARY OF CONCERNS & POTENTIAL SOLUTIONS

The following contains recommendations to mitigate concerns from the review of the existing facilities, as well as the future growth at Kenmore Middle School and Carlin Springs ES:

- *Bus Loading/Unloading*

  Bus loading/unloading will likely remain in the same locations at Kenmore MS and Carling Springs ES after the expansions. In order to improve bus access, APS can work with Arlington County's Department of Environmental Services (DES) to explore geometrical changes to the intersection of Route 50 and Manchester Street. As stated previously, buses currently enter Kenmore Middle School from Manchester Street, and must turn left at this intersection, followed by an immediate left on to the local lanes of Arlington Boulevard. This movement is often blocked by vehicles waiting at the traffic signal, which can generate delays to buses arriving at the school. APS can also request additional enforcement of cars blocking the box at this location.

  If these solutions do not work, a secondary access point for the Kenmore MS could be constructed to connect to 5th Road or Carlin Springs Road. If a secondary access point is constructed, care should be taken when locating the vehicular access points for the buses, since they require larger turn radii and generally more room compared to other vehicles. This can create large gaps in sidewalks for pedestrians, and encourage high speeds in passenger cars. Ideally buses and passenger cars would have separate access points so as not to encourage cars making high speed turns in and out of school driveways.

- *Passenger Car Pick-up/Drop-off*

  Passenger car pick-up/drop-off will likely remain in the same locations at Kenmore MS and Carling Springs ES after the expansions. However, due to the existing congestion at the Carlin Springs ES pick-up/drop-off area, signing and marking improvements can be installed in the lot in an attempt to get drivers to organize better and gain more efficiency in the short-term and to mitigate the impacts of the future expansion. This could include signs and markings telling drivers to pull up to the front and not drop-off students at the back of the queue. Additionally, more staff can be engaged to manage and help reduce congestion.

  If short-term solutions do not work at Carling Springs ES, long-term solutions could include targeted changes to the parking lot, including introducing a second location to turn around, widening the parking aisle to allow for cars to pass one another, or reconstructing the lot to include a longer pick-up/drop-off area. If other improvements are constructed, APS should ensure that passenger car pick-up/drop-off occurs within its own separate area; when located in a parking lot it should not take place within a drive aisle. Students should be discharged on the right side of the vehicle and have a direct path to the school. Additionally, some short-term parking spaces could be constructed near the pick-up/drop-off area for drivers waiting to pick-up their students in the afternoon.

  In addition to the existing congestion at Carlin Springs ES, the secondary pick-up/drop-off area at Kenmore Middle School has experienced problems in the past with drivers going the wrong way, ignoring other rules, and generating congestion that may be exacerbated by the future expansion. In the short-term, signing and marking improvements can be installed in an attempt to get drivers to organize better and gain more efficiency. Additionally, more staff can be engaged to help reduce congestion. Placing one or two school staff in the pick-up/drop-off area could also enable it to function well.

  If short-term solutions do not work, the pick-up/drop-off area can also be closed, moving all activity to the primary pick-up/drop-off area south of the School. However, if all activity is moved to the primary pick-up/drop-off area

south of the School, improvements may be necessary along the driveway and at the parking lot entrance in order to mitigate the impact of the expansion.

- *Parking*

  As stated previously, the future off-street parking demand is expected to increase to approximately 69% of the total supply during a typical weekday. On a Saturday, the future parking demand peaks at 52% of the total supply. Based on the demand, Kenmore MS and Carlin Springs ES are expected to provide a surplus of parking off-site. Additionally, no on-street impacts are expected.

  However, it was noted that, in the existing conditions, traffic exiting Kenmore MS onto Carlin Springs Road can back up along the access road with long delays, blocking the parking lot driveway. This existing delay will be exacerbated in the future due to the school expansions and construction of the new elementary school. In order to mitigate the impact of the expansions and to alleviate the existing congestions, APS can work with DES to examine whether changes to signal timings could help alleviate delays. This may not be possible it the morning, but a specific signal timing change implemented between 2:00 and 3:00 pm at this intersection on school days, could help alleviate these delays while not having a detrimental impact to Carlin Springs Road because it would occur prior to the evening commuter rush. Constructing a separate right- and left-turn lane along the school approach or moving the existing crosswalk to the other side of the intersection could also help alleviate the existing congestion and mitigate impacts to the site due to the expansion of the schools.

- *Transportation Demand Management*

  Transportation Demand Management (TDM) programs at the existing schools on site are very limited. TDM programs are initiatives to reduce vehicular traffic through promoting non-auto modes such as walking, bicycling, and transit. The growth at Kenmore MS and Carlin Springs along with the construction of a new ES would be a good impetus for pushing TDM programs at all of the schools. At minimum, bicycle racks for employees and students should be incorporated into the existing site design. The racks should be secure and covered. Initiatives for employees to use the nearby transit service should also be explored. The County already has programs for its employees and can help assemble a TDM plan.

- *Pedestrian Facilities*

  As stated previously, poor pedestrian facilities currently exist adjacent to both Kenmore MS and Carlin Springs ES. This includes narrow sidewalks, sidewalk obstructions, lack of curb ramps at marked crosswalks, broken or missing pedestrian actuation buttons at signalized crosswalks, and traffic queues along Carlin Springs Road blocking marked crosswalks. These issues will be exacerbated in the future with the expansion at the schools. To mitigate the impact and improve the existing facilities, APS will work with Arlington County's Department of Environmental Services (DES) to study potential improvements to Carlin Springs Road. In the short term, the operational issues observed at traffic signal crossings should be addressed. Significant time and money would be needed to implement infrastructure improvements to sidewalks and intersections, so careful study with all roadway users and stakeholders within the corridor would be needed before implementing solutions. If additional paths to and from the school are constructed, they should be direct and not overlap parking lots and loading/unloading areas. When they do, they should have a dedicated and highly marked path with sidewalks. Upgrades to pedestrian facilities in the surrounding area may be needed to encourage students to walk to and from school. APS and the County should coordinate efforts to review potential improvements.

In addition to poor pedestrian facilities, jaywalking was also noted in the existing conditions between Kenmore Middle School and a 7-Eleven Store located across the street. Students were observed crossing the street in between gaps of traffic to and from the school, across Carlin Springs Road. In addition to examining issues corridor-wide, APS can work with DES to study if a potential crossing of Carlin Springs Road at this location would be possible. Several solutions are available for mid-block pedestrian crossings, and a solution that works for the school without generating detrimental impacts to Carlin Spring Road traffic may be possible. In the short term, County or APS staff could be placed at this intersection to deter student jaywalking.

- *Roadway Network*

  As noted previously, the existing roadway network surrounding Kenmore MS and Carlin Springs ES experiences congestion during the morning peak hour, which can delay school access and negatively affect student and employee arrival times. This congestion will be exacerbated by the expansion of Kenmore MS and Carlin Springs ES, as well as the construction of the new ES. In order to mitigate the impact of the expansions and to alleviate the existing delays on Carlin Springs Road, the start time for the school could be pushed earlier. This would further separate the school traffic from the commuter traffic in the morning, and lessen the impact commuter delays have on the school.

  A more long-term solution would be to spread-out the location of arrivals and departures through adding more school driveways. Currently, a large portion of traffic from the schools uses the driveway opposite 3rd St on Carlin Springs Road. Additional driveway locations along Carlin Springs Road may spread out traffic enough to allow for more traffic signal green time to switch to Carlin Springs Road through traffic. More beneficial impact could be generated by adding an access point to the school parking lots and pick-up/drop-off areas from another street. The most logical place to add another access point would be from Manchester Street, possible though opening the intersection of Manchester Street and 2nd Street.

The following contains recommendations for the site design of the new elementary school adjacent to Kenmore MS and Carlin Springs ES:

- *Bus Loading/Unloading*

  Bus loading/unloading should occur separately from other activity, and students should have a clear space to walk between the loading/unloading area and the school. Care should be taken when locating the vehicular access points for the buses, since they require larger turn radii and generally more room compared to other vehicles. This can create large gaps in sidewalks for pedestrians, and encourage high speeds in passenger cars. Ideally buses and passenger cars would have separate access points so as not to encourage cars making high speed turns in and out of school driveways. Based on comparisons with other schools, it is likely that the school will have eight to ten buses at peak times, and the bus area should be designed to hold at least that many buses.

- *Passenger Car Pick-up/Drop-off*

  Passenger car pick-up/drop-off should occur within its own separate area; when located in a parking lot it should not take place within a drive aisle. Students should be discharged on the right side of the vehicle and have a direct path to the school. It can be useful to have some short-term parking spaces near the pick-up/drop-off area for drivers waiting to pick-up their students in the afternoon.

  Because the existing schools generate a significant amount of pick-up/drop-off activity, the access pattern for the new school should avoid conflicting with them.

- *Parking*

  The recommended future parking supply is only slightly more than the current parking supply. Thus, if quality walking paths are provided and walking distances kept to a minimum, sharing parking between the schools could result in a low amount of new parking spaces required as part of new school construction. When designing the new school facilities, this should be taken into account, as well as meeting the AZCO minimums. The design should balance the zoning and practical parking needs, while also keeping the amount of new parking constructed at a minimum to preserve as many playing fields on site as possible.

  Kenmore MS and Carlin Springs ES have an agreement to schedule events at separate times. The new elementary school should join this arrangement.

- *Pedestrian Facilities*

  Paths to and from the school, from all directions, should be direct and not overlap parking lots and loading/unloading areas. When they do, they should have a dedicated and highly marked path with sidewalks. Upgrades to pedestrian facilities in the surrounding area may be needed to encourage students to walk to and from school. APS and the County should coordinate efforts to review potential improvements.

- *Transportation Demand Management*

  Transportation Demand Management (TDM) programs at the existing schools on site are very limited. TDM programs are initiatives to reduce vehicular traffic through promoting non-auto modes such as walking, bicycling, and transit. A new elementary school would be a good impetus for pushing TDM programs at both schools. At minimum, bicycle racks for employees and students should be incorporated into the new school design. The racks should be secure and covered. Initiatives for employees to use the nearby transit service should also be explored. The County already has programs for its employees and can help assemble a TDM plan.

COMPARISON OF ALTERNATIVES

Mitigation Strategies

As stated above, there are several possible ways to minimize the impact of the new elementary school and the expansions of Kenmore Middle School, Carlin Springs Elementary School, and Campbell Elementary School. This includes staggering the school start-times, implementing Transportation Demand Management (TDM) programs, and constructing additional driveways to access the site. This section examines staggering and access strategies in further detail, including developing potential scenarios to test in order to help develop recommendations.

Staggering Strategies

As stated previously, the existing morning peak of Kenmore MS, Carlin Springs ES, and Campbell ES lines up close to the peak for traffic on the surrounding roadways. The impact of the existing schools is seen at the school driveways, which experience significant delay during both the morning and afternoon peak periods. This existing delay and congestion can be exacerbated in the future with the growth of the schools and the construction of a new elementary school on the site.

In order to lessen the impact on the peak hour, the start times for the schools could be moved to earlier times to both de-conflict with the peak of the surrounding roadway network and to spread out the peak hours of each of the schools throughout the morning peak period. In addition to staggering the start times for the existing schools, the start-time for the new school should be determined based on spreading out the impact of the schools to the peak hours.

Both of these mitigations – staggering the existing start times and choosing the start-time for the new school – are included in the alternatives analyzed.

Access Strategies

The impact of the schools on the surrounding roadway network could also be lessened by spreading out the trips generated by the schools to several driveways. This involves both rerouting existing trips to other driveways (both existing and newly constructed) and choosing the access point for the new school. Several access strategies were examined, and many variations exist among these strategies, but the following three alternatives were chosen for further analysis:

- Alternative A, as shown on Figure 18, includes constructing the new school between the two existing schools to share facilities. The existing bus loop for Kenmore MS would be extended to also provide bus-access for the new school. A pick-up/drop-off loop would be constructed off the existing access from Carlin Springs Road, which would also provide access to the parking lot.
- Alternative B, as shown on Figure 19, also includes constructing the new school between the two existing schools to share facilities. The existing bus loop for Kenmore MS would be extended to also provide bus-access for the new elementary school. However, a new roadway could be constructed off the existing Carlin Springs ES access from 5th Road, which would provide a reconstructed pick-up/drop-off area for Carlin Springs and pick-up/drop-off and parking access for the new school.
- Alternative C, as shown in Figure 20, includes constructing the new school between the two existing schools to share facilities. The existing bus loop for Kenmore MS would be reconstructed to provide bus-access for the new school, as well as allowing buses for Kenmore MS to access the bus loop from Carlin Springs Road. A new access point would be constructed on Manchester Street near 2nd Street to provide pick-up/drop-off and parking access for the new elementary school.

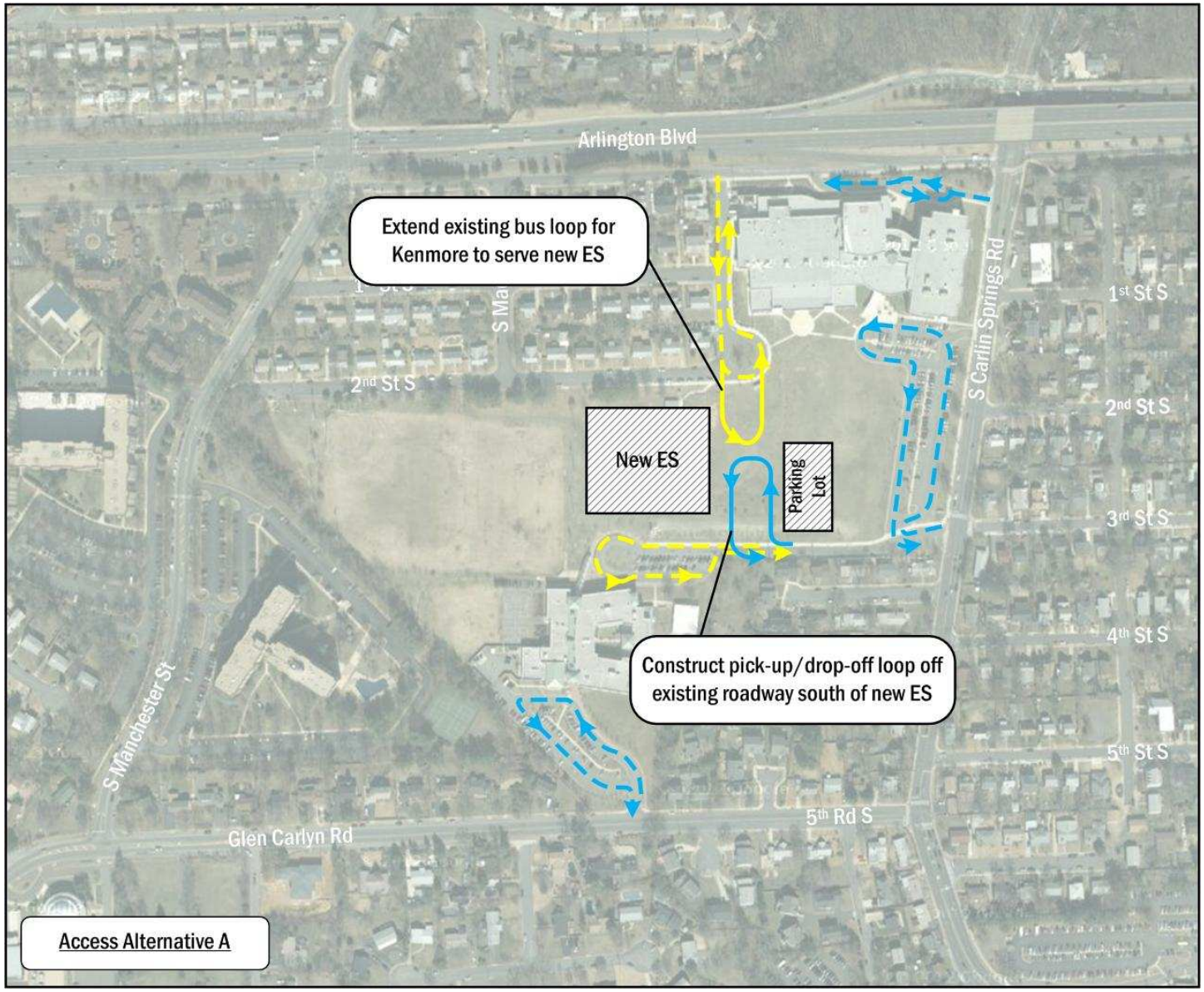


Figure 18: Access Alternative A

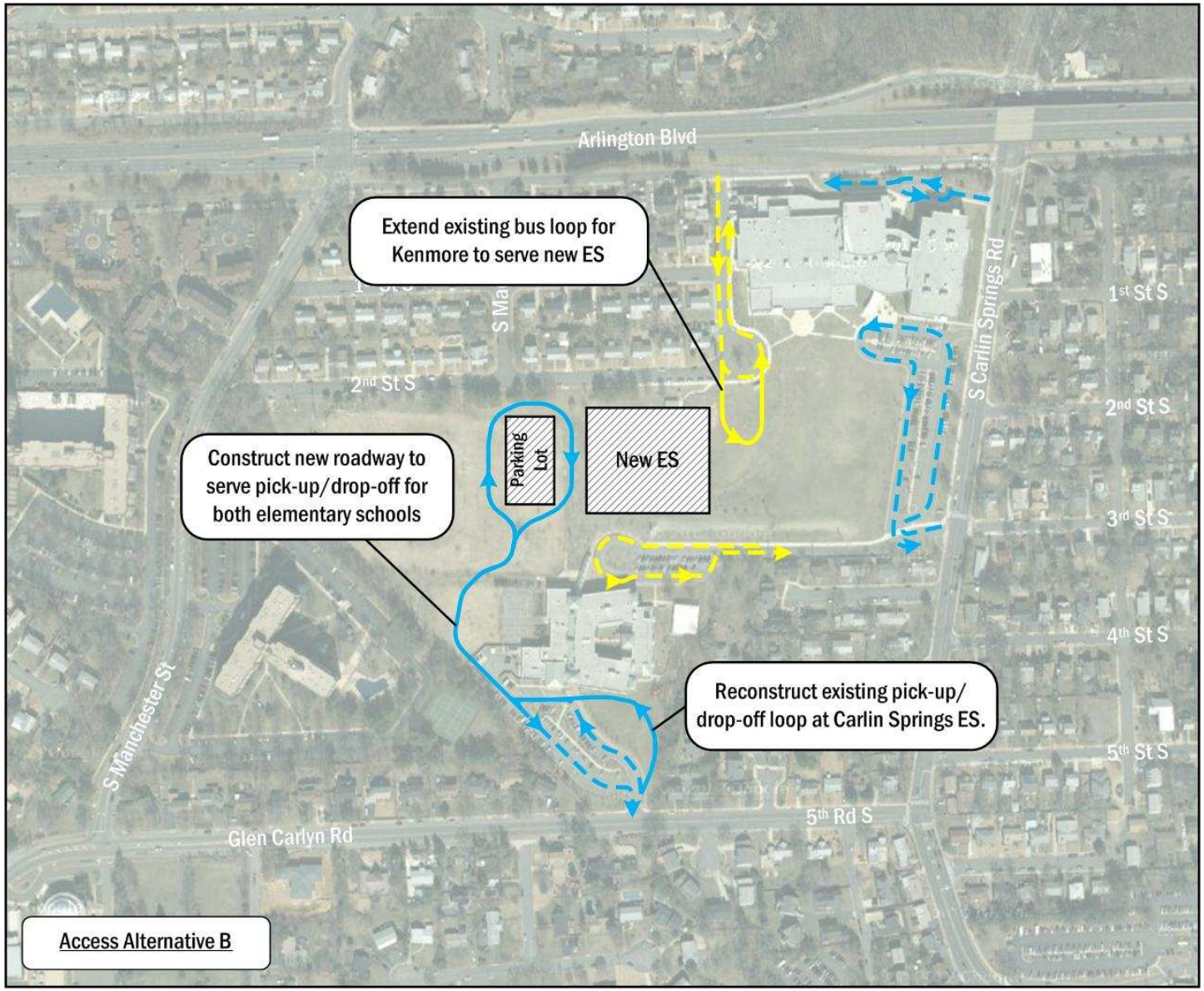


Figure 19: Access Alternative B

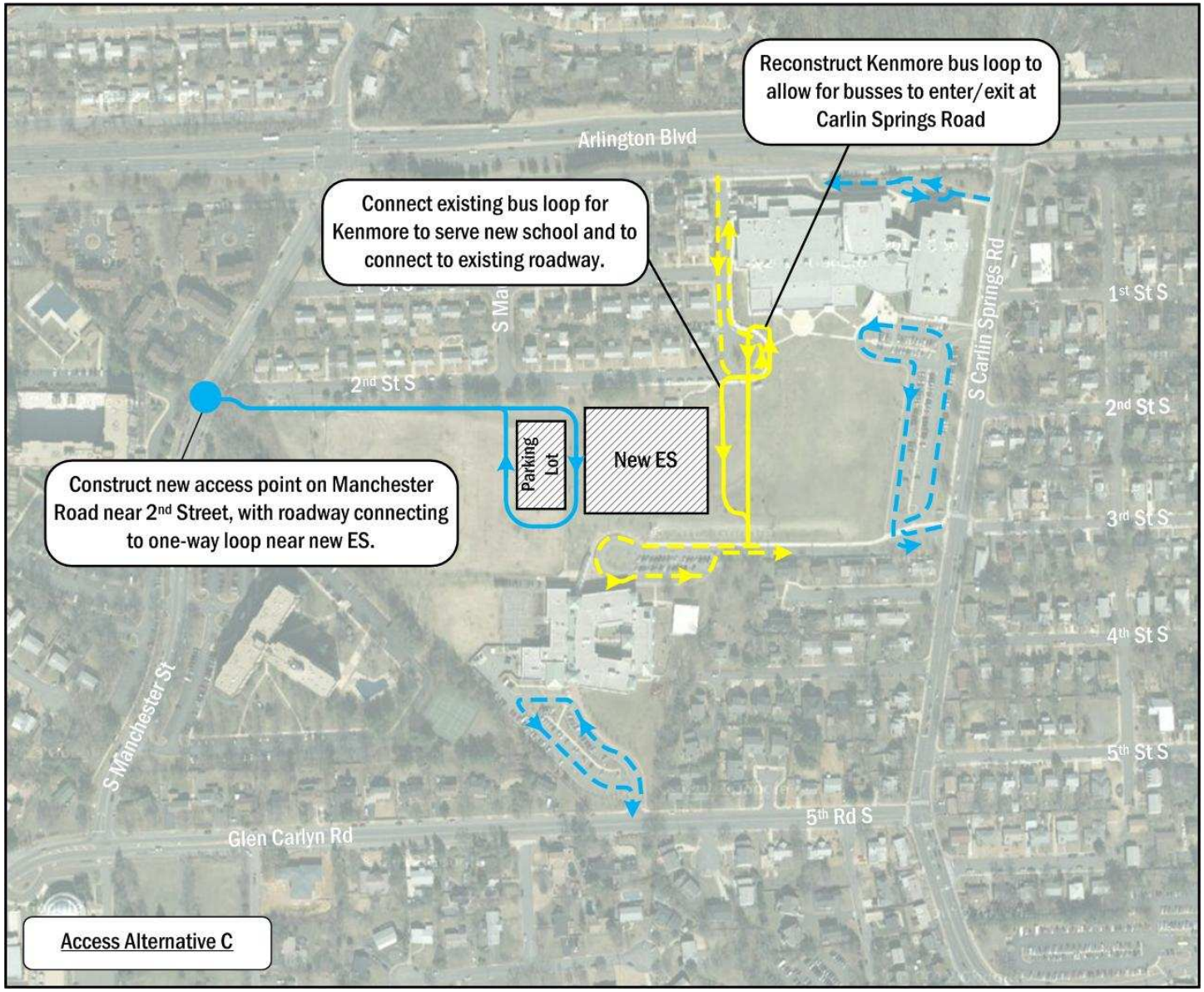


Figure 20: Access Alternative C

Analysis Scenarios

With these strategies in mind, five scenarios were analyzed to help determine the relative merits of the strategies and develop conclusions and recommendations:

- Scenario #1 – Existing Conditions
- Scenario #2 – Growth of Existing Schools
- Scenario #3 – Growth of Existing Schools + New Elementary School
  - Access Alternative A
  - Access Alternative B
  - Access Alternative C
- Scenario #4 – Staggering School Start-Times (Option 1)
  - Access Alternative A
  - Access Alternative B
  - Access Alternative C
- Scenario #5 – Staggering School Start-Times (Option 2)
  - Access Alternative A
  - Access Alternative B
  - Access Alternative C

The first two scenarios, which look at the existing conditions and projected future conditions with only growth at existing schools, are included for comparison purposes. The main evaluation takes place in the comparison of Scenarios 3, 4, and 5. Scenario 3 investigates the merits of the three access alternatives, without altering the school times of any of the existing schools (a start time for the new school is proposed that minimizes impacts). Scenario #4 and 5 examines staggering and shifting the start times of all four schools in a manner to minimize impacts, while the sub-alternatives compare the various access alternatives combined with the staggering strategies.

For the purposes of the traffic analysis component of the evaluation, only the morning peak period of school traffic was evaluated. This was done because the morning trip generation of the school is much higher than the afternoon, and the morning peak school time coincides with higher amount of commuter traffic compared to the afternoon. Thus, conclusions on traffic congestion are based on the worst case, the morning school peak period. Specifically, the time period analyzed was 7:30 am to 8:00 am. Traditionally, traffic analyses are performed over an hour-long period, but because the school traffic generation is so concentrated over a half hour, the smaller time period of analysis allows for more differentiation in results, and more clear conclusions, especially when examining the staggering strategies.

Table 4 summarizes the differences between alternatives.

Table 4: Summary of Scenarios Evaluated

Scenario	Access Scheme	School Start Times	Morning Peak Traffic Profile
1 – Existing	Existing	Kenmore MS: 7:50 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:00 AM	Figure 7
2 – Growth at existing schools only	Existing	Kenmore MS: 7:50 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:00 AM	Figure 21
3A– Growth plus new school	A: Figure 18	Kenmore MS: 7:50 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:00 AM New ES: 7:30 AM	Figure 22
3B – Growth plus new school	B: Figure 19	Kenmore MS: 7:50 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:00 AM New ES: 7:30 AM	Figure 22
3C – Growth plus new school	C: Figure 20	Kenmore MS: 7:50 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:00 AM New ES: 7:30 AM	Figure 22
4A – Staggering Start Times (Option 1)	A: Figure 18	Kenmore MS: 7:20 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:15 AM New ES: 7:30 AM	Figure 23
4B – Staggering Start Times (Option 1)	B: Figure 19	Kenmore MS: 7:20 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:15 AM New ES: 7:30 AM	Figure 23
4C – Staggering Start Times (Option 1)	C: Figure 20	Kenmore MS: 7:20 AM Carlin Springs ES: 8:00 AM Campbell ES: 8:15 AM New ES: 7:30 AM	Figure 23
5A – Staggering Start Times (Option 2)	A: Figure 18	Kenmore MS: 7:50 AM Carlin Springs ES: 7:30 AM Campbell ES: 7:30 AM New ES: 9:00 AM	Figure 24
5B – Staggering Start Times (Option 2)	B: Figure 19	Kenmore MS: 7:50 AM Carlin Springs ES: 7:30 AM Campbell ES: 7:30 AM New ES: 9:00 AM	Figure 24
5C – Staggering Start Times (Option 2)	C: Figure 20	Kenmore MS: 7:50 AM Carlin Springs ES: 7:30 AM Campbell ES: 7:30 AM New ES: 9:00 AM	Figure 24

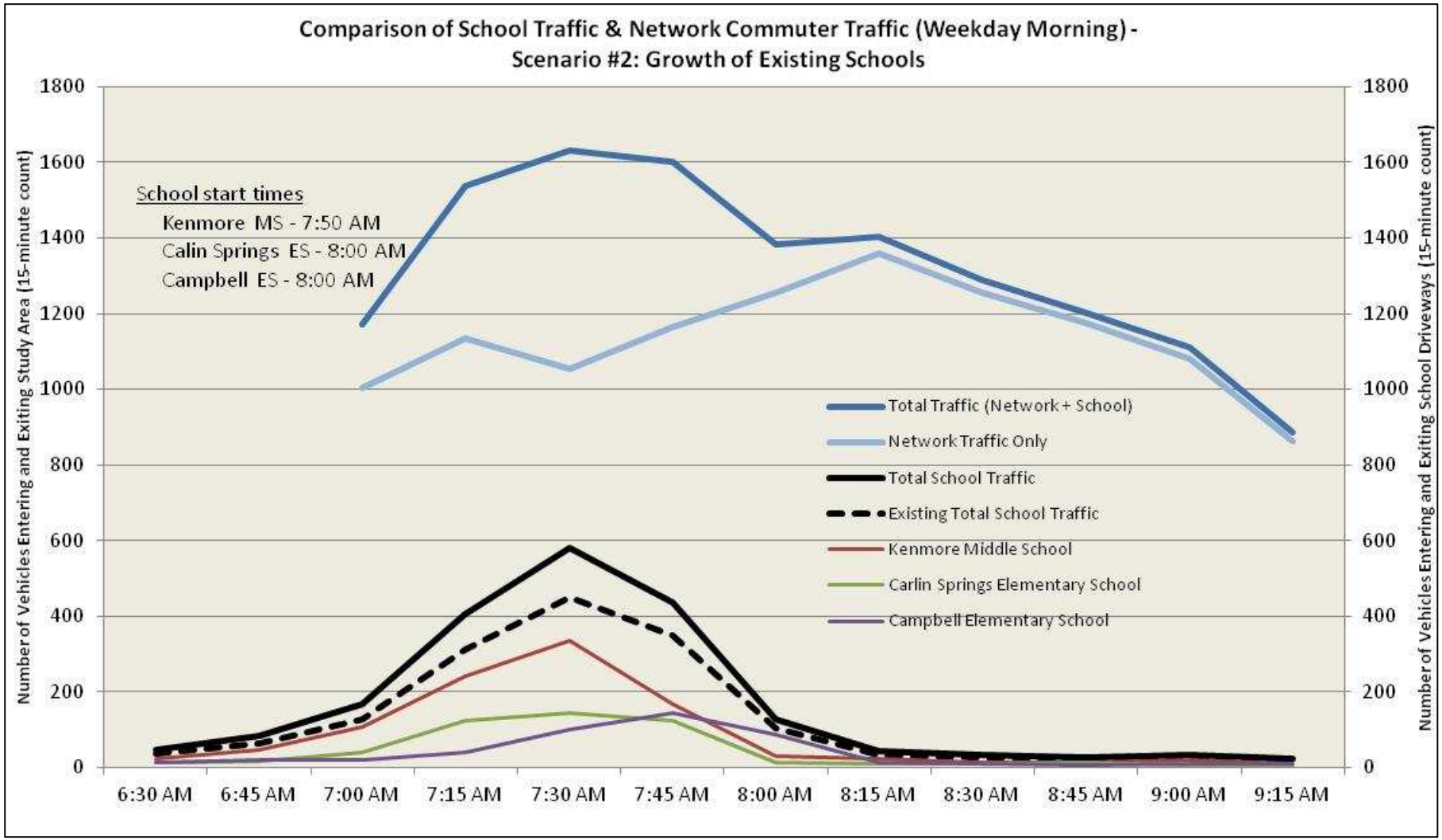


Figure 21: Scenario #2 – Comparison of School Generated and Commuter Traffic (Weekday Morning)

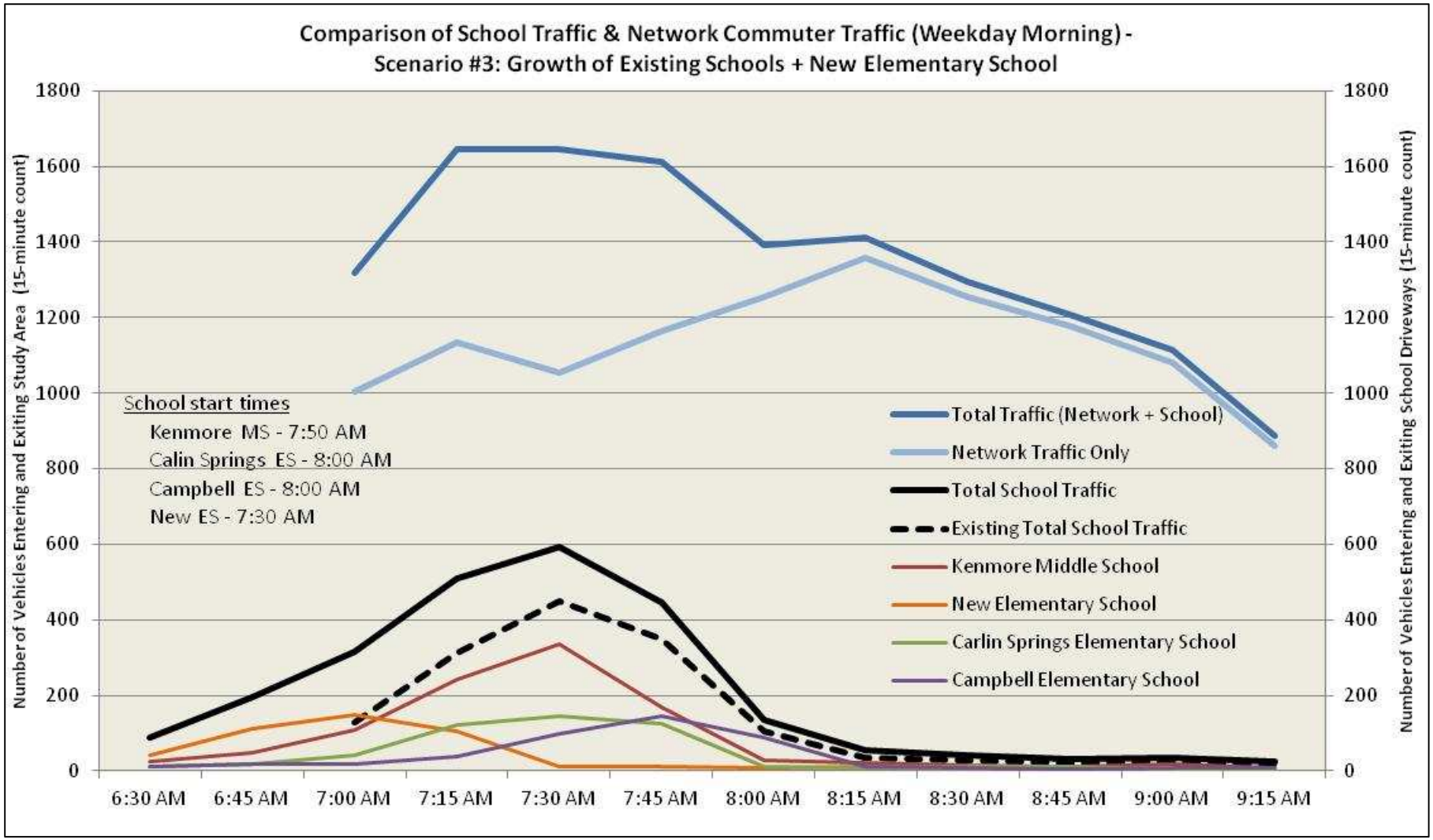


Figure 22: Scenario #3 – Comparison of School Generated and Commuter Traffic (Weekday Morning)

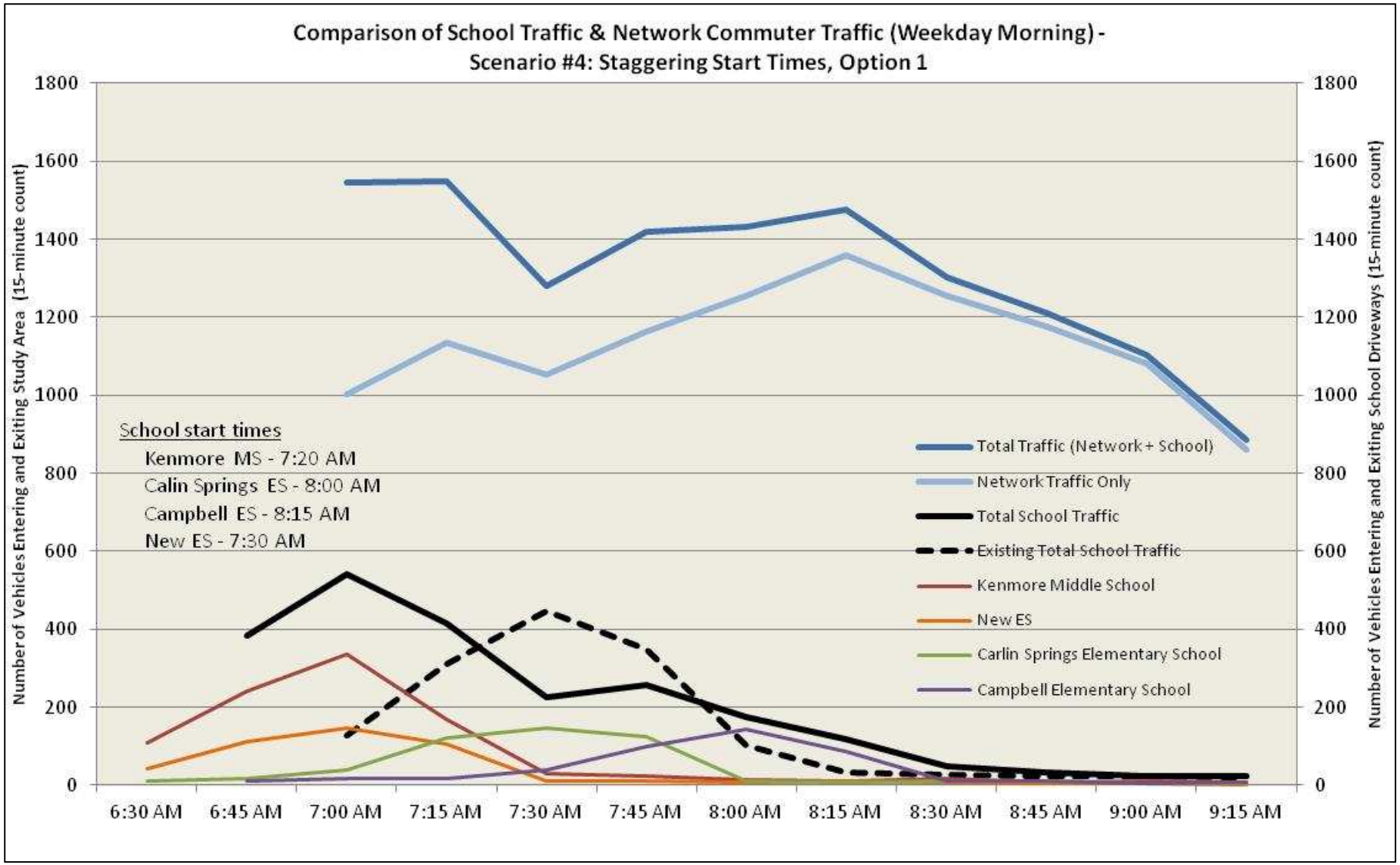


Figure 23: Scenario #4 – Comparison of School Generated and Commuter Traffic (Weekday Morning)

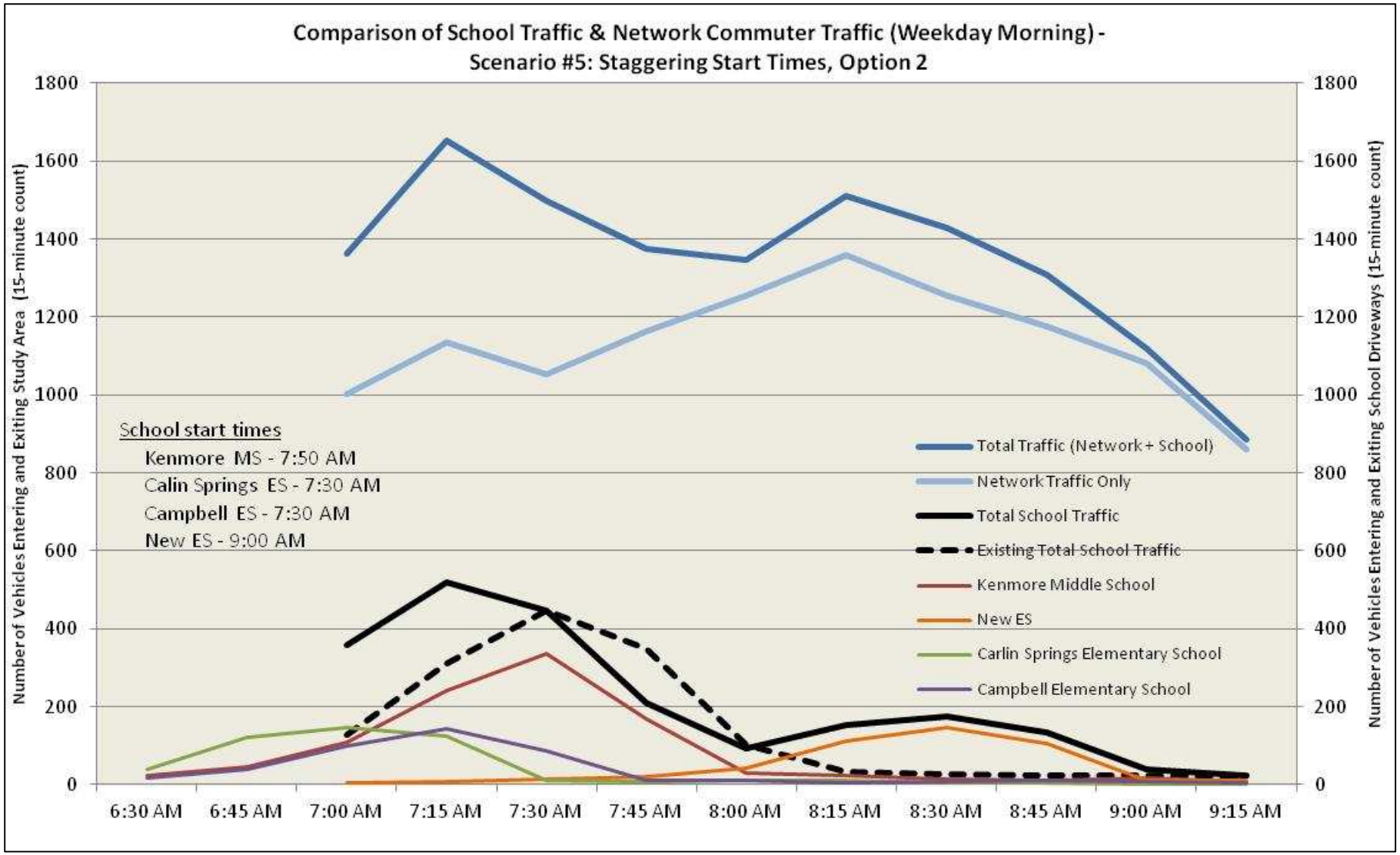


Figure 24: Scenario #5 - Comparison of School Generated and Commuter Traffic (Weekday Morning)

Evaluation and Recommendations

Several criteria were examined in order to evaluate the scenarios described above. The impacts to the following criteria were assessed:

- Parking – quality of access & accommodation of demand
- Bus access – quality of access & queuing
- Pick-up/drop-off – quality of access & queuing
- Pedestrian/bicycles – positive benefits of site design
- Internal roadway network – delays encountered entering or exiting school driveways
- External roadway network – delays generated to external traffic on surrounding roadways

The following section provides an overview of these criteria for each scenario. Afterwards, a table summarizing the relative difference between Scenarios 3 and 4 is presented.

Parking

All of the future scenarios will have the same impact on off-street parking because they will have similar parking demand, as outlined previously. As shown earlier in the report, the future parking demand generated by the growth of the existing schools, as well as the construction of the new school, will be adequately addressed on site. The existing parking supply at Carlin Springs Elementary School and Kenmore Middle School is adequate to satisfy the future parking demand. Additional spaces will need to be constructed for the new elementary school. Staggering the school start-times in Scenario #4 and 5 may have a slight impact on parking demand due to the shift of arrival and departure times. However, the peak parking demand should still be satisfied by the existing parking supply on site.

While the five analysis scenarios will have relatively similar parking demand, the parking access will be modified in Scenario #3, Scenario #4, and Scenario #5 as explained previously. The three Access Alternatives (a, b, and c) outline the parking lot access for the site. The following summarizes the impact of the Access Alternatives:

- *Scenario #3A, 4A, and 5A*
  In Alternative A, the parking access for Kenmore MS and Carlin Springs ES are not modified. However, a parking lot is constructed for the new ES, with access from the existing driveway on Carlin Springs Road. This will impact the operation of the driveway, as explained below, and lead to additional conflicts between vehicles and buses. Additionally, the construction of the parking lot and access may obstruct the existing grass paved lot.

- *Scenario #3B, 4B, and 5B*
  In Alternative B, the parking access for Kenmore MS and Carlin Springs ES are not modified. However, the pick-up/drop-off loop for Carlin Springs ES is reconstructed to address existing space constraints at the school. Access for the new school parking lot is provided from the existing driveway located on 5th Road. (Impacts to the driveway are outlined below.)

- *Scenario #3C, 4C, and 5C*
  In Alternative C, the parking access for Kenmore MS and Carlin Springs ES are not modified. A new parking access point is proposed for the elementary school, located on Manchester Street near 2nd Street.

Overall, the three future scenarios do not greatly differ on their impact to parking. The future demand is adequately handled by the parking supply. However, Access Alternative c best separates the parking access for the three schools by providing a new access point. It also allows for fewer conflicts between vehicles and buses due to the new access point.

Bus Access

The bus access will be impacted by the four future Scenarios outlined previously, as well as the three Access Alternatives. The following summarizes the impacts of each Scenario and Access Alternative:

- *Scenario #2*

  Scenario #2 will increase the volume of buses currently accessing the site due to the increase in student population at the existing schools. Currently, Carlin Springs ES is served by seven to eight buses. The existing bus facility is approximately 150 feet long (approximately four buses can queue at once), with an additional queuing space of approximately 250 feet. Based on the population growth, approximately one more bus will be needed. The queuing space is adequate to serve the increase in bus demand. Kenmore MS is currently served by approximately ten to twelve buses. The existing bus facility is approximately 150 feet long (approximately four buses can queue at once), with an additional queuing space of approximately 180 feet on the adjacent street. Based on the population growth, up to five additional buses may be needed. Since the existing queuing space provided is inadequate without blocking the roadway, the added buses will likely back up to Arlington Boulevard.

- *Scenario #3A, 4A, And 5A*

  Scenario #3A, 4A, and 5A will also increase the volume of buses currently accessing the Carlin Springs ES and Kenmore MS bus facilities. However, Access Alternative A includes extending the existing Kenmore MS bus loop to also serve the new ES. The loop would have approximately 250 feet to serve the new elementary school, which should a demand of approximately eight buses. Under this alternative, buses for both the new ES and the expanded Kenmore MS will likely spill back along the roadway, blocking access to 1st and 2nd Streets. In Scenario #3A, the new ES and Kenmore MS have start-times approximately 30 minutes apart, so they should be able to potentially share the bus facility. However, in Scenario #4A, the school times are staggered so that the new ES and Kenmore MS peak at approximately the same time. This may lead to conflicts since there is not adequate space to accommodate all of the buses. In Scenario #5A, Kenmore MS and the new ES have a significant separation in start time therefore there would not likely be any issues at the bus access. Additionally, Scenario #3A, 4A, and 5A do not solve the existing bus issue observed for Kenmore MS, whereas bus access is difficult from the school due to the turn the drivers must execute at the intersection of Manchester Street and the Arlington Boulevard local lanes.

- *Scenario #3B, 4B, and 5B*

  Scenario #3B, 4B, and 5B will also increase the volume of buses currently accessing the Carlin Springs ES and Kenmore MS bus facilities. However, Access Alternative B includes extending the existing Kenmore MS bus loop to also serve the new ES, similar to Access Alternative A. The conclusions above for Scenario #3A, 4A, and 5A are similar for Scenario #3B, 4B, and 5B. The buses for both the new ES and the expanded Kenmore MS will likely spill back along the roadway, blocking access to 1st and 2nd Streets. Additionally, the Scenarios do not solve the existing bus issue observed for Kenmore MS, whereas bus access is difficult from the school due to the turn the drivers must execute at the intersection of Manchester Street and the Arlington Boulevard local lanes.

- *Scenario #3C, 4C, and 5C*

  Scenario #3C, 4C, and 5C will also increase the volume of buses currently accessing the Carlin Springs ES and Kenmore MS bus facilities, similar to the other scenarios. However, these Scenarios include the reconstruction of the Kenmore bus loop, to be connected to a new bus loop for the elementary school. The Kenmore MS facilities would include the existing bus loop, redesigned to include additional queuing space. The facilities for both Kenmore MS and the new ES would be designed to serve as many buses as possible, with additional queuing space for waiting buses. Since these scenarios also include Kenmore MS and the new ES sharing bus facilities, Scenario #3C would allow for the schools to share the facilities. Scenario #4c may lead to conflicts between the schools if there is not adequate space to accommodate all of the buses. However, unlike the other scenarios, Scenario #3C, 4C, and 5C solve the existing turning problem observed for buses at the intersection of Manchester Street and the Arlington Boulevard local lanes. The new bus loop would allow for buses to enter the site from Carlin Springs Road, where turns are more favorable. However, this access would lead to an increase in conflicts between buses and vehicles utilizing the Kenmore MS pick-up/drop-off and those parking in the lots located off the Carlin Springs Road driveway.

Overall, Access Alternative C is the most favorable for buses due to the reconstruction of the Kenmore facilities to allow for bus access from Carlin Springs Road. While there will be an increase in bus and vehicle conflicts due to this alternative, it potentially increases the space provided for buses for both Kenmore MS and the new ES as well. Scenario #3 and #5 are also most favorable for the buses because it allows for Kenmore MS and the new ES to share the bus facilities due to a large enough separation between their start-times. If Scenario #4 is implemented, the new ES and Kenmore MS peak at approximately the same time, leading to potential conflicts between the buses for the two schools. Additional care should be given to the design of the bus facilities under this scenario to ensure that there is adequate queuing space for both schools.

Pick-Up and Drop-Off

The pick-up/drop-off facilities will be impacted by the four future Scenarios outlined previously, as well as the three Access Alternatives. The following summarizes the impacts of each Scenario and Access Alternative:

- *Scenario #2*

  Scenario #2 will increase the pick-up and drop-off activity at the existing site due to the increase in student population at Kenmore MS and Carlin Springs ES. This will likely exacerbate the existing issues outlined previously, including crowding at the Carlin Springs facility and congestion at the driveway for the Kenmore MS facility.

- *Scenario #3A, 4A, and 5A*

  Scenario #3A, 4A, and 5A will also increase the volume of pick-up and drop-off currently at the schools. These scenarios also add the pick-up/drop-off activity generated by the new ES. In Access Alternative A, the pick-up/drop-off facilities for Carlin Springs ES and Kenmore MS are not modified. The facility for the new ES is located off the existing driveway from Carlin Springs Road. In Scenario #3A and 5A, the new ES and Kenmore MS have start-times that do not conflict, so the pick-up/drop-off activity for the schools should not conflict. However, in Scenario #4A, the school times are staggered so that the new ES and Kenmore MS peak at approximately the same time. This may lead to conflicts between vehicles and congestion at the driveway. (Impacts to the driveway are outlined below.) Additionally, the increase in pick-up/drop-off activity generated by the new ES and the growth of

Kenmore MS may conflict with the existing bus facility for Carlin Springs ES, which is accessed via the same driveway along Carlin Springs Road.

- *Scenario #3B, 4B, and 5B*
  Scenario #3B, 4B, and 5B will also increase the volume of pick-up and drop-off currently at the schools and include the pick-up/drop-off activity generated by the new ES. However, in Access Alternative B, the existing pick-up/drop-off facilities for Carlin Springs ES are reconstructed in order to provide a longer queuing space due to existing issues at the school. The pick-up/drop-off facility for the new ES will share the driveway on 5th Road with Carlin Springs ES, but vehicles should not conflict in both scenarios due to the staggering of the school start-times by approximately 30 minutes or more. (Impacts to the driveway are outlined below.)

- *Scenario #3C, 4C, and 5C*
  Scenario #3C, 4C, and 5C will also increase the volume of pick-up and drop-off currently at the schools and include the pick-up/drop-off activity generated by the new ES. However, in Access Alternative C, a new access point is constructed along Manchester Street near 2nd Street, which will provide access to the pick-up/drop-off facilities for the new ES. This allows for all three schools to have separate pick-up/drop-off facilities. (Capacity of the new driveway is outlined below.)

Overall, Access Alternative B is most favorable for pick-up and drop-off activity due to the reconstruction of the existing Carlin Springs ES facilities. This alternative allows for a longer facility in order to improve existing congestion, as noted previously. While the two elementary schools must share the driveway located along 5th Road, the school start-times are staggered enough to prevent conflicts between vehicles accessing the site. Access alternative C is also favorable for the pick-up and drop-off activity because all three schools have their own facilities. However, this alternative does not improve any of the existing issues outlined previously.

Pedestrian/Bicycle

All of the future scenarios have the potential to increase the pedestrian and bicycle trips to the site. The growth of the existing Kenmore MS and Carlin Springs ES may lead to more students walking or biking from the surrounding neighborhood. Faculty and staff may also be encouraged to bike or walk to the schools due to the increase in Transportation Demand Management. The construction of the new ES may also lead to an increase in faculty and staff bike/walk trips. An increase in student bike/walk trips due to the construction of the new ES is not expected because it is a choice school and will likely not generate local bicycle/walking trips.

Growth of the existing schools and construction of the new school should not impact the existing pedestrian paths to and from the schools. Additionally, all of the scenarios include bus and pick-up/drop-off facilities that will be designed to provide clear space to walk between the loading/unloading area and the school. Design of new facilities could also include improvements to the existing pedestrian environment to encourage biking and walking to the school by both students and faculty/staff. The facility design, as well as the design of the new ES, should include bicycle facilities, such as bike racks, as explained previously.

Overall, the four future scenarios do not greatly differ on their impact to the bicycle and pedestrian environment.

Internal Roadway Network

As stated previously, the driveways and internal roadway network will be impacted by the four future Scenarios outlined previously, as well as the three Access Alternatives. Detailed capacity analyses of the driveways are attached to this report. The following summarizes the impacts of each Scenario and Access Alternative:

- *Scenario #2*
  The increase of traffic volumes due to the expansions of the existing schools in Scenario #2 does not show a significant impact on the driveways. The addition of traffic volumes due to the population increase at the schools exacerbates the existing areas of congestion, notably the school driveway on Carlin Springs Road. Additionally, a minor increase in delay is seen at the school driveway on 5th Road.

- *Scenario #3A, 3B, and 3C*
  Similar to Scenario #2, the increase of traffic volumes due to the expansions of the existing schools and the construction of the new school do not show a significant impact on the driveways. The addition of traffic volumes due to the population increase and the new school construction exacerbates the existing congestion at the school driveway on Carlin Springs Roadway and leads to a minor increase in delay at the school driveway on 5th Road. There are also no significant differences in capacity at the school driveways for the three Access Alternatives explained previously.

- *Scenario #4A, 4B, and 4C*
  The most significant impact on the driveways is seen in Scenario #4. Significant improvements in capacity are seen at the site driveway on Carlin Springs Road, improving the intersection to acceptable conditions. There are also no significant differences in capacity at the surrounding intersections for the three Access Alternatives explained previously.

- *Scenario #5A, 5B, and 5C*
  Scenario #5 shows another option for staggered start times of the school. This scenario does not yield the significant improvement to the site driveway on Carlin Springs Road that is seen in Scenario #4. The intersection continues to perform at an unacceptable level of service. There are also no significant differences in capacity at the school driveways for the three Access Alternatives.

Overall, Scenario #4 has the most favorable impact on the internal roadway network. This is seen in the improvement at the site driveway along Carlin Springs Road. Scenario #2, #3A/B/C, #5A/B/C do not show any significant impacts on the driveways, except for the increases in delay at the existing areas of congestion. Of these scenarios, Scenario #5 increases the delay the least because the start-times of the schools are staggered.

External Roadway Network

In addition to impact on the site driveways and internal roadway network, the growth of the existing schools and the construction of the new school will also have an impact on the surrounding roadway network. Table 5 shows the differences between network volumes and school traffic for each scenario in the morning and afternoon peak half-hours. The morning peak half-hour (7:30 to 8:00 AM) for the school coincides with high network volumes of the surrounding area. Therefore it is beneficial to decrease the percentage of school traffic traveling during that time period. Scenarios #1, 2, 3, and 5 show percentages above 25%, but, in Scenario #4, the amount of school traffic is decreased below that of the existing conditions. It should be noted that the percentage of school traffic is high for the afternoon peak half-hour (2:30 to 2:45

PM). However, the afternoon peak hour of the schools does not coincide with the afternoon peak hour of the adjacent street traffic due to the end-time of the schools. Therefore, the traffic volume on the surrounding roadway network is significantly lower than during the afternoon peak hour, leading to a much greater influence of school-related volumes.

Table 5: Comparison of Network Volumes

	Time	Network Volumes	School Traffic	% School Traffic
Scenario #1	7:30 - 7:45	1501	448	26.4%
	7:45 - 8:00	1513	349	
	2:30 - 2:45	436	199	36.4%
	2:45 - 3:00	413	110	
Scenario #2	7:30 - 7:45	1633	580	31.4%
	7:45 - 8:00	1601	437	
	2:30 - 2:45	377	259	42.6%
	2:45 - 3:00	562	141	
Scenario #3	7:30 - 7:45	1645	592	31.9%
	7:45 - 8:00	1611	447	
	2:30 - 2:45	542	305	47.4%
	2:45 - 3:00	486	183	
Scenario #4	7:30 - 7:45	1279	226	17.9%
	7:45 - 8:00	1420	256	
	2:30 - 2:45	539	302	47.1%
	2:45 - 3:00	482	179	
Scenario #5	7:30 - 7:45	1499	448	27.7%
	7:45 - 8:00	1374	349	
	2:30 - 2:45	489	258	41.6%
	2:45 - 3:00	425	122	

The increase in traffic volumes will also impact the capacity of the intersection in the study area. Detailed capacity analyses of the study area intersections are attached to this report. The following summarizes the impacts of each Scenario and Access Alternative:

- *Scenario #2*

  The increase of traffic volumes due to the expansions of the existing schools in Scenario #2 does not show a significant impact on the surrounding network. The addition of traffic volumes due to the population increase at the schools exacerbates the existing areas of congestion. Additionally, a few minor increases in delay are seen along approaches in the study area. However, no major impacts are noted in the capacity analysis.

- *Scenario #3A, 3B, and 3C*

  Similar to Scenario #2, the increase of traffic volumes due to the expansions of the existing schools and the construction of the new school do not show a significant impact on the surrounding network. The addition of traffic volumes due to the population increase and the new school construction exacerbates the existing areas of congestion. Additionally, a few minor increases in delay are seen along approaches in the study area. However,

no major impacts are noted in the capacity analysis. There are also no significant differences in capacity at the surrounding intersections for the three Access Alternatives explained previously.

- *Scenario #4A, 4B, and 4C*
  The most significant impact on the surrounding roadway network is seen in Scenario #4. Staggering the school start-times shifts the morning peak period of the school to slightly earlier than the peak hour of the surrounding roadway network, minimizing the impact of the school. Slight improvements in capacity are seen at several intersections, including those along Carlin Springs Road. There are also no significant differences in capacity at the surrounding intersections for the three Access Alternatives explained previously.

- *Scenario #5A, 5B, and 5C*
  Scenario #5 shows very similar levels of service as Scenario #4 within the external network. There are a few areas that show degradation in level of service over Scenario #4. Overall this scenario results in traffic demand most similar to that of the existing conditions. Existing problems remain however at most intersections the problems are not exacerbated. There are also no significant differences in capacity at the surrounding intersections for the three Access Alternatives explained previously.

Overall, Scenario #4 has the most favorable impact on the external roadway network. Scenario #5 is also very acceptable as it does not exacerbate many of the existing issues in the network, however it does not show improvements to the problems in the network. Scenario #2 and #3a/b/c do not show any significant impacts on the driveways, except for the increases in delay at the existing areas of congestion. However, Scenario #4 shows slight improvements at several intersections.

Recommendations

The evaluation of the scenarios led to the following general conclusions:

- Staggering start times leads to a much greater reduction in impacts to external roadway traffic than the various access schemes that explored new driveway locations. Through staggering start times, it is possible to minimize impacts in a manner that the weekday commuter peak hours are not more impacted by the schools than they are today.
- Although the three access alternatives examined did not show external impacts, they did show beneficial impacts to internal traffic. The two scenarios where access is not combined with the existing 3rd Street/Carlin Springs driveway show lower driveway delay entering and exiting the schools. In addition, the schemes where access was shared between the new schools and existing schools can provide opportunities to improve access for the existing schools.
- None of the scenarios evaluated was clearly superior to the others, and a preferred design would include elements from several of them.

Table 6: Summary of Relative Differences between Scenarios 3, 4 & 5

Scenario	Parking	Bus	Pick-up/Drop-off	Pedestrian /Bike	Internal Roads	External Roads
3A	Demand can be accommodated on site	Growth can generate potential for buses to back-up out of shared facility for Kenmore & New School		No significant difference between concepts.	More congestion at 3rd & Carlin Springs Rd (main entrance to Kenmore MS).	New traffic exacerbates existing problems.
3B		Growth can generate potential for buses to back-up out of shared facility for Kenmore & New School	Allows for improved facility at Carlin Springs ES.			
3C		Expanded facility could provide queuing room for Kenmore & New School buses. Kenmore would have access point from Carlin Springs and could route buses away from Arlington Blvd.	All facilities separated, minimizing conflicts between school populations.			
4A		Growth can generate potential for buses to back-up out of shared facility for Kenmore & New School. Close start times could make queues longer.	Kenmore/New School start times are close enough to create conflicts at driveway.		All driveways operate at acceptable conditions.	Schools comprise lower percentage of AM commuter peak hour than existing school traffic. Shifts school impacts to earlier in morning, providing slight improvements to AM commuter peak hour, but more congestion earlier (no single hour is worse than existing conditions).
4B		Growth can generate potential for buses to back-up out of shared facility for Kenmore & New School. Close start times could make queues longer.	Allows for improved facility at Carlin Springs ES.			
4C		Expanded facility could provide queuing room for Kenmore & New School buses. Kenmore would have access point from Carlin Springs and could route buses away from Arlington Blvd.	All facilities separated, minimizing conflicts between school populations.			
5A		Growth can generate potential for buses to back-up out of shared facility for Kenmore & New School. Close start times could make queues longer.			More congestion at 3rd & Carlin Springs Rd (main entrance to Kenmore MS).	New traffic exacerbates some existing problems. Schools comprise similar percentage of AM commuter peak hour as existing school traffic.
5B		Growth can generate potential for buses to back-up out of shared facility for Kenmore & New School. Close start times could make queues longer.	Allows for improved facility at Carlin Springs ES.			
5C		Expanded facility could provide queuing room for Kenmore & New School buses. Kenmore would have access point from Carlin Springs and could route buses away from Arlington Blvd.	All facilities separated, minimizing conflicts between school populations.			

With the evaluation completed, the following recommendations are made for the site design of the campus containing the existing schools and the new elementary school:

- School start times should be staggered similarly to how they are for Scenario #4 of Scenario #5. The main advantage of Scenario #4 is the opportunity to mitigate delay at the intersection of Kenmore School/Carlin Springs School Access at South Carlin Springs Road. At all other intersections Scenario #4 and 5 behave similarly.
- Access to the new ES parking and pick-up/drop-off facilities should not occur at the intersection of Carlin Springs Road and 3rd Street. Access Alternative b, where access is shared with Carlin Springs MS is a good alternative that provides the opportunity to alter the Carlin Springs main parking lot to better accommodate passenger car pick-up/drop-off.
- Bus access to the new school can be provided from the access road leading to the intersection of Carlin Springs Road and 3rd Street, connected to the Kenmore Middle School bus facility, as depicted in Access Alternative c. This would allow for an expanded facility to be provided with sufficient queuing space for both schools, and flexible bus routing so that buses can enter and exit from either Manchester Street or Carlin Springs Road.
- A separate left and right turn lane should be constructed at the intersection of Carlin Springs Road and 3rd Street, exiting the school. This improvement can be combined with altering the access to the Kenmore MS parking lot, moving it farther from the intersection and improving the geometry of the turns into and out of the lot.
- A Transportation Demand Management (TDM) plan should be developed in conjunction with the County's DES to help reduce overall trip generation at the existing schools and new ES.

The following list contains the next steps to be taken to move forward on this project.

- Improving access to Kenmore Middle School and Carlin Springs ES
  - Perform a travel survey of students and parents to learn more about school transportation use and concerns;
  - Examine crash data at nearby intersections to help provide more information on pedestrian and vehicular safety; and
  - Discuss potential solutions with school staff, community and Arlington County Department of Environmental Services staff:
- Planning and designing a new elementary school on the site
  - Scope and complete a full Transportation Impact Study in coordination with Arlington County Department of Environmental Services staff;
  - Work with design team to implement recommendations contained within this report; and
  - Design the access and circulation of the new school in a manner that best fits with the characteristics of the surrounding transportation network.

FIELD REVIEW: KENMORE MS / CARLIN SPRINGS ES

Observations taken in May/June 2012 and focused on school grounds and the area within an approximate 0.25 mile radius from the site within school boundaries.

Guidelines based on Safe Routes to School program documentation and the Federal Highway Administration's *Pedestrian Road Safety Audit.*

Guideline	Existing Condition
Pedestrian	
Sidewalks should be provided along the street. If no sidewalk is present, a walkable shoulder (e.g. wide enough to accommodate cyclists/ pedestrians) or alternative path/trail should exist. Sidewalks should be continuous and on both sides of the street.	This field review examined sidewalks within an approximate 0.25 mile radius from the school, within Arlington County. Within the area surveyed, the majority of roadways had sidewalks on both sides of the street. Some roadways only have sidewalks on one side of the street: • The south side of 2nd St between S Manchester St and S Madison St • The south side of 4th St west of Carlin Springs Rd • Portions of roads within the residential neighborhood east of Carlin Springs adjacent to Kenmore MS, such as the north side of 3rd St Some roadways have no sidewalks. These are located in the residential neighborhood east of Carlin Springs Rd adjacent to Kenmore MS, such as 1st and 2nd Streets

2nd Street looking towards Kenmore MS

Guideline	Existing Condition
Sidewalks should be wide enough to handle peak pedestrian traffic.	The predominant sidewalk width appears to be 3' to 4' throughout the field review area. Observations showed that peak volumes were not accommodated at all locations sidewalks, and that wider sidewalks on major pedestrian walking routes are needed to accommodate peak flows. The sidewalks adjacent to Kenmore MS are wide and accommodated peak pedestrian flows easily. Some curbs at signalized intersections appeared to have limited space for queuing (while waiting for walk signs.

Narrow sidewalks with obstructions and without buffer along Carlin Springs Rd

Sidewalk adjacent to Kenmore MS

Guideline	Existing Condition
	 *Limited curb space for queuing (for pedestrians waiting for a 'walk' signal)*
Sidewalks should have a buffer between them and moving traffic.	Some sidewalks in the field review area had buffers. When present, the buffers only provided minimal separated between pedestrians and moving vehicle traffic. The exception to this is 5th Rd, which had on-street parking lanes, which provide a larger buffer between pedestrians and moving traffic.  *On some blocks, small landscaped buffers exist along Carlin Springs Rd*

Guideline	Existing Condition
	 *5th Rd does not have landscaped buffers, but on-street parked cars provide separation from moving traffic (landscaped buffers are provided once the street changes to Glen Carlyn Rd east of Carlin Springs ES)*
Sidewalks should be well maintained and not in poor condition.	The majority of pedestrian facilities in the field review area were in good condition. In some cases, vegetation was covering sidewalks and tree roots had created an uneven surface, but these were minimal relative to the entire field review area.  *Tree roots causing sidewalk unevenness along Carlin Springs Rd*
Pedestrian paths and sidewalks should be clear of obstructions. Crossings should be clear of obstructions that could lead to pedestrians being difficult to see	Throughout the field review area, the placement of utility poles and traffic poles obstructed the sidewalks, reducing the effective width of the already narrow facilities.

Guideline	Existing Condition
while waiting to cross.	 *Signal pole obstructing sidewalk, reducing effective width*
Sidewalks and pedestrian pathways should not have steep grades. If stairs are provided, ramps should also be available. Curb ramps should be provided at crosswalks.	No grade issues were observed in the field review. Some significant grade changes occur to the south of the field review area along Carlin Springs Rd, but the grades were not observed to hinder pedestrian traffic and no stairs were provided. Several crosswalks on Carlin Springs Rd did not have curb ramps.

Guideline	Existing Condition

Crosswalk without curb ramp

Crosswalk without curb ramp (both sides)

Guideline	Existing Condition
School doors/gates should be appropriately located to provide convenient and direct access for pedestrians. Walking & cycling paths should have dedicated facilities on school grounds, so they do not overlap bus or passenger car pick-up/drop off areas. Paths through or around parking lots should have dedicated sidewalks and marked crossings.	At both schools, the passenger car pick-up/drop-off areas and the bus loading/unloading areas all have direct pedestrian access to the school. The doors of Kenmore MS had direct access for pedestrians from the north, south and from the parking lot. From the west, pedestrians either have to go around or through the bus loading/unloading loop. From the east, pedestrians have to use a signalized crossing of Carlin Springs road, the closest one to the north is approximately 400 feet away, the closest to the south is 475 feet away. Since the door of Kenmore MS does not align with a crossing of Carlin Springs Rd, jaywalking across the road near the door (the 7-11 appears to be a common destination) is frequent. The front door of Carlin Springs ES is only accessible from the north via a winding trail through the recreation fields that leads to the parking lot and does not provide a direct path. No connections are available to the west and east, and all pedestrians most funnel to 5th Rd to then access a direct path to the school. The path to the school connects with 5th Rd, far away from an available crossing place. The closest nearby crossing is at Carlin Springs Rd, approximately 650 away.
Pedestrians should easily be able to locate sidewalks, crossings and pedestrian facilities though either an intuitive design or wayfinding signage.	During the field review no issues with locating pathways and sidewalks were observed.
All nearby residential areas and transit stops should have high quality connections to the school. Non-connective roadway designs, such cul-de-sacs and dead-end roads should be avoided to allow for the most pedestrian/cyclist porosity on surrounding streets. Paths should be provided when roadways do not connect	All nearby residential areas within Arlington County had direct access to school, other than the issues with crossing Carlin Springs Rd and 5th Rd near the school doors noted above. The closet transit stops along Carlin Springs Rd are locates at 1st St and 3rd Rd. The southbound stops are both easily accessed. The northbound stops require crossing Carlin Springs Rd, and a crossing is only provided at 3rd Rd. Thus, there is no direct access to one of the transit stops serving Kenmore MS.
The number of driveways crossing a sidewalk should be kept to a minimum.	The majority of homes within the field review area have driveways, which cross sidewalks. The nature of the residential streets and the very low amount of traffic using these driveways significantly limits their negative impact to the pedestrian environment. On Carlin Springs Rd, the amount of driveways did not appear to be significant enough to negatively affect pedestrian conditions.
Sidewalks, paths and crosswalks should be adequately lit.	A lighting analysis was not performed as part of this field review.

Guideline	Existing Condition
Pedestrian travel zones should be clearly delineated from other modes of traffic through the use of striping, colored and/or textured pavement, signing, and other methods.	All sidewalks and paths were clearly marked within the area of field review. Along non-residential streets, such as Carlin Springs Rd, all crosswalks were easily identifiable. Some crosswalks had high visibility markings. On residential streets, most crosswalks are not marked. During the field visit this was not observed to be of concern, since travel speeds were low on these streets and crossings were not intimidating for pedestrians even without marked crosswalks.
Crosswalks should be sufficiently wide to accommodate peak demand	Where provided, crosswalks were observed to be wide enough to accommodate demand.
Pedestrians and cyclists should not conflict each other on common areas, such as trails and sidewalks.	Bicycle activity was minimal during the site visit, although most bicycles observed preferred to use the sidewalk compared to the street along Carlin Springs Rd. Thus led to conflicts between cyclists and pedestrians due to the narrow nature of the sidewalk.
Signs warning drivers to pedestrian activity should be used when appropriate.	A signing inventory was not performed as part of this field review, but warning signs were observed in the area.
Curb radii at intersections should not be overly wide as to encourage high speed turns and lengthen crosswalk distances. Channelized rights turns need to be designed in manner that minimizes conflicts with pedestrians.	At most intersections, curb radii appeared tight enough to keep turning speeds to a relatively slow speed. The intersection of 5th Rd and Carlin Springs Rd does have some wide curb radii and some turns were observed to occur at high speed, notably southbound right turns and northeast bound left turns.
Raised medians should be located to provide a safe waiting area (refuge) for pedestrians.	No medians are present in the field review area with the exception of the intersections of the Route 50 ramps with Carlin Springs Rd. At these intersections the medians incorporate refuges within the crosswalk.
Crossing guards should be employed where appropriate.	Crossing guards are stationed at the intersection of Carlin Springs Rd with 3rd St and 5th Rd.
Signalized crossings should provide enough time for pedestrians. Pedestrian heads and countdown timers should be used.	Within the field review area, traffic signals with pedestrian crossings are located on Carlin Springs Rd at its intersections with the Route 50 ramps, 3rd Rd, 5th Rd and 6th Rd. At each of these locations, crosswalks with pedestrian signal heads are provided. An exception is that intersection of Carlin Springs Rd with 3rd St does not have a east-west crosswalk across its southern half (one it provided on the northern side of the intersection). During the field visit, many of the pedestrian actuation buttons were confusing to use, as they were not

Guideline	Existing Condition
	marked for which crosswalk they controlled. In addition, some buttons appeared to not provide a 'walk' sign or have a function. This occurred at the intersection of Carlin Spring Rd with 6th Rd and Carlin Springs Rod with the Route 50 ramps. In some instances some crosswalks never received a walk signal even after pushing all buttons and waiting two or more cycles.
The speed of adjacent traffic should not be high enough to intimidate pedestrians and cyclists.	A speed study was not performed as part of this field review, during the site visits speeding did not appear to be an issue. Congestion along Carlin Springs Rd limited motorist speed.
Pick-up/Drop-off	
Pick-up/drop-off lanes should be separated from bus lanes to minimize confusion and conflicts	Bus loading/unloading is separate from passenger car pick-up/drop-off.
The bus loading/unloading area should have adequate storage so buses do not queue onto roadways or other space not designated for buses.	Bus queuing was not observed to be a problem.
Students should have sidewalks and direct access from the bus loading/unloading & the passenger car pick-up/drop-off areas to the school, without crossing parking lots and traffic lanes.	At both schools, the passenger car pick-up/drop-off areas and the bus loading/unloading areas all have direct pedestrian access to the school.
Passenger car pick-up/drop-off should occur on the right side of the vehicle so students do not have to enter the vehicular travel path.	Pick-up/drop-off occurs on the right side for both schools
Cars should not be double-parking or performing illegal turns in the designated pick-up/drop-off area.	In the Carlin Springs ES parking lot, some drivers drop-off their students ahead of the queue and attempt to turn around in the lot, which can generate congestion issues. Similar activity occurs in the afternoon, which had fewer cars picking up students compared to the morning, but since pick-ups do not occur in order, drivers are often trying to pass other cars still waiting for students. Observations at the Kenmore MS pick-up/drop-off area did not show similar problems. The design of the pick-up/drop-off area allows for cars to pass each other without difficulty. The secondary pick-up/drop-off facility on the north side of school was observed to have several drivers ignoring the rules, but as a significantly lower volume of drivers use this facility, no concerns were noted in the field.

Guideline	Existing Condition
Queuing for passenger cars should be adequate for cars waiting in the pick-up/drop-off area.	At Kenmore MS, queuing at the pick-up/drop-off areas was observed to be adequate as long as drivers followed instructions. At Carlin Springs ES, queuing of vehicles can sometimes back up onto 5th Rd, and generate issues with cars turning into and out of the school driveway.
Traffic Capacity & Operations	
The school zone should be identified with signs and pavement marking. School speed limit signs should be properly posted where appropriate.	A signing inventory was not performed as part of this field review, but speed limit signs were observed in the area.
Directional signs should be used to ensure traffic to/from the school uses the correct access points	Signing was not observed during the site visit. School staff sends instructions for school access to parents directly.
Driveways should not be too closely placed near intersections	School driveways are located with either at an intersection, or at a sufficient distance away from one as to not generate traffic issues. The entrance to the secondary pick-up/drop-off area on the north side of Kenmore MS is close to the intersection of Arlington Boulevard and Carlin Springs Rd, but it limited to right-in traffic only.
There should be sufficient gaps in traffic at unsignalized crossings for pedestrians to safely cross	No unsignalized crossings are provided in the field review area (outside of the residential neighborhoods).
Congestion along roadways and at intersections near the school should not be so severe to delay student and employee arrivals and departures.	In the morning, traffic northbound on Carlin Springs Rd was observed to be highly congested, interfering with student access via bus, drop-off and walking. During the afternoon, pick-up/drop-off activity encountered long queues while exiting the school onto Carlin Springs Rd. Buses traveling to Kenmore often turn left from Routes 50 to Manchester Road and then take an immediate left onto the Arlington Boulevard access road. This turn, which is difficult when no other vehicles are present, gets harder when cars line up at the intersection and don't stay positioned behind stop bars or block cross-streets.

Guideline	Existing Condition
Congestion and queuing in streets surrounding the school should not block crosswalk or pedestrian facility access.	In the morning, traffic was observed backing up over 3,000' from the intersection of Route 50 and Carlin Springs Rd, south along Carlin Springs Rd. This traffic often blocked east-west crosswalks along Carlin Springs Road.

Traffic queues covering crosswalk on Carlin Springs Rd

DETAILED IMPACTS REVIEW

This section details the vehicular trips generated in the study area along the vehicular access routes, defines the analysis assumptions, analyzes the vehicular impacts of the proposed development, and makes recommendations for improvements where needed.

Scope of Analysis

The purpose of the study is to determine the impacts of the new elementary school and the existing schools' growth on the transportation network. All surrounding intersections and direct school access points were chosen for analysis as shown in Figure 25. Intersection capacity analyses were performed for the existing conditions at each intersection within the study area during the schools' morning and afternoon peak hours, as well as for future growth conditions with and without the new elementary school. Therefore, the selected study scenarios are as follows:

- Scenario #1 – 2012 Existing Conditions
- Scenario #2 – 2017 Future Conditions with Expansion of Existing Schools
- Scenario #3 – 2017 Future Conditions with New School and Expansion of Existing Schools
- Scenario #4 – 2017 Future Conditions with Staggered Start Times (Option 1)
- Scenario #5 – 2017 Future Conditions with Staggered Start Times (Option 2)

Scenarios #3, 4 and 5 are further broken down to include the access management strategies described previously. These include:

A. As shown previously in Figure 18, bus access and pick-up/drop off locations remain the same as existing for Kenmore MS and Carlin Springs ES. Bus access for new ES located off extended bus loop for Kenmore MS, with access from the Arlington Boulevard local lanes. Pick-up/drop-off area from new ES located south of bus loop, with access from Carlin Springs Road at the existing driveway.

B. As shown previously in Figure 19, bus access and pick-up/drop off locations remain the same as existing for Kenmore MS. Bus access for Carlin Springs ES will remain the same as existing, but the pick-up/drop-off loop will be reconstructed. Bus access for new ES located off extended bus loop for Kenmore MS, with access from the Arlington Boulevard local lanes. Pick-up/drop-off area from new ES located west of proposed school location, with access from 5th Road at the existing driveway.

C. As shown previously in Figure 20, pick-up/drop off locations remain the same as existing for Kenmore MS and Carlin Springs ES. Bus access for Carlin Springs will remain the same as existing. Bus access for the new ES will be located on the east side of the school, with access provided from Carlin Springs Road at the existing driveway. This will also include a reconstructed bus loop for Kenmore MS to provide access from Carlin Springs Road at the existing driveway. Pick-up/drop-off area for the new ES located west of the proposed school location, with a new access point constructed along Manchester Street near 2nd Street.

The capacity analyses consisted of a planning-level analysis in order to determine the potential impact of the growth and new school. Before the new school is constructed, a full Transportation Impact Study should be scoped and completed in coordination with Arlington County Department of Environmental Services staff.

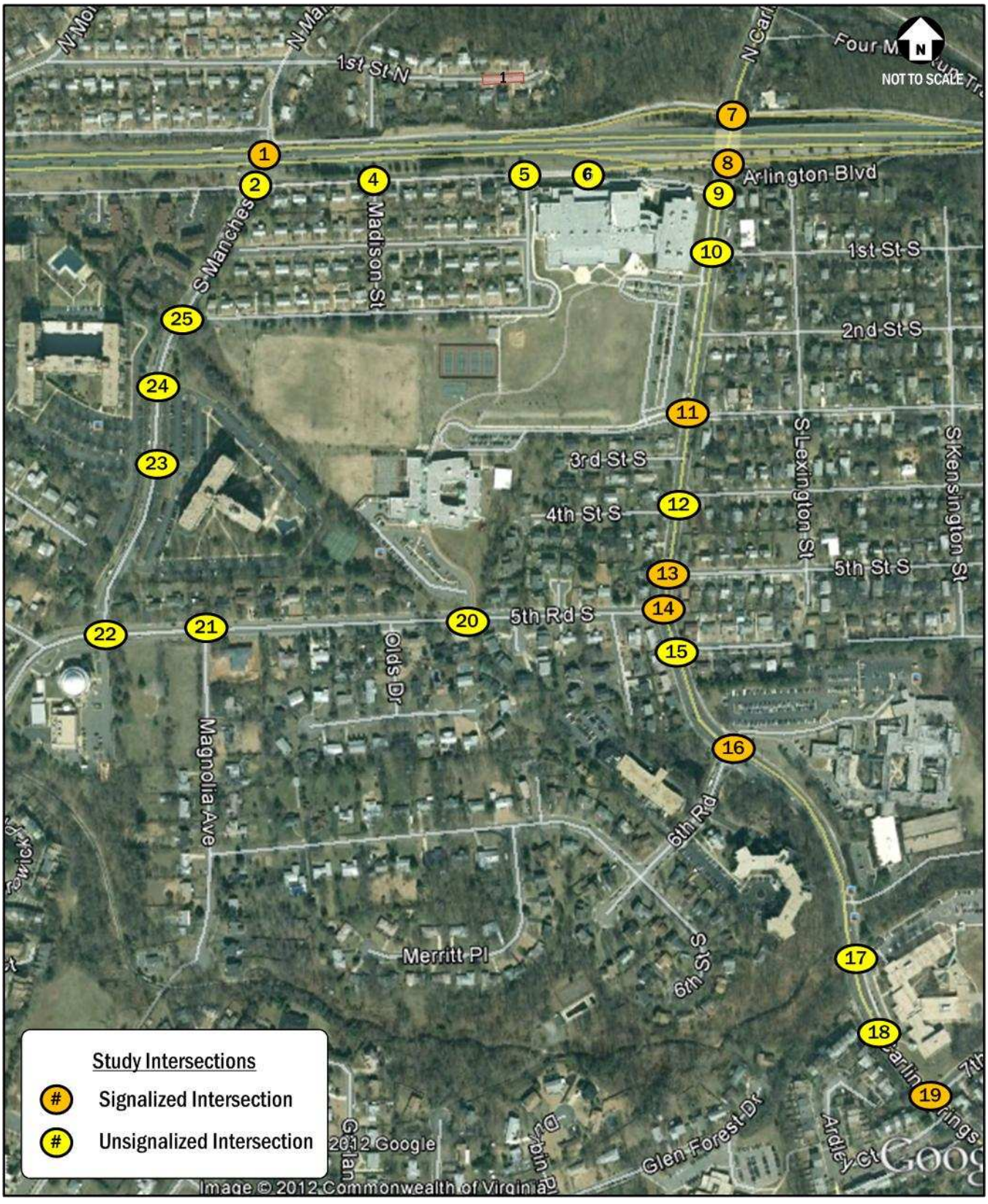


Figure 25: Study Intersections

The *Synchro, Version 7.0* software package was used to analyze the network based on the Highway Capacity Manual (HCM) methodology. The *Synchro* model was compiled using signal timings provided by Arlington County and with lane configurations and traffic volumes collected by Gorove/Slade. The following sections review the assumptions made for the technical analyses.

Traffic Volume Assumptions

The following section reviews the traffic volume assumptions made and methodologies used in the roadway capacity analyses. These assumptions are summarized in Table 7.

2012 Existing Conditions

The overall purpose of this study is to show what effect the proposed development will have on the transportation system in the study area. The existing conditions in and around the site are characterized in order to provide a foundation for assessing the transportation implications of the proposed development.

Arlington County and National standards require that traffic counts be conducted on a weekday, not including Monday or Friday, when traffic conditions can be described as "typical". This includes the consideration for adjacent uses, such as retail, special events, and recreation facilities and for major traffic generators.

In a full Transportation Impact Study, traffic counts are conducted on a "typical" day and are used to determine the morning and afternoon "peak hour" of traffic within the study area. According to the Highway Capacity Manual (HCM) methodologies, a one-hour analysis period is preferred. The "peak hour" represents the worst-case scenario, when the system traffic volumes are the highest. The use of a "typical" weekday morning and afternoon peak hours are used to ensure that conclusions regarding adverse impacts and their respective mitigation measures would apply to the vast majority of time roadways are used in the study area.

In order to ensure that the data collected contains the peak hour, traffic counts are taken for a period of several hours during the morning and afternoon peak periods. From these peak periods, a peak hour is derived for both the morning and the afternoon time periods. According to the Transportation Impact Analyses for Site Development Manual published by the Institute of Transportation Engineers (ITE), data is generally collected during the weekday morning (7:00 to 9:00 AM) and afternoon (4:00 to 6:00 PM) peak hours.

However, in this analysis, the peak hours for the schools were analyzed in order to determine the impact of the schools when their trip generation is the highest. Generally, the morning peak hour of the schools coincides with the morning peak commuter period. While the peak hours may not be exactly the same, they will likely overlap. However, the afternoon peak hour of the schools generally occurs before the afternoon peak commuter period. This is due to the dismissal time of the school occurring significantly before the commuter peak period. Therefore, for the purpose of this analysis of the school peak periods, the morning traffic count was performed from 7:00 to 9:30 AM and the afternoon traffic count was performed from 2:00 to 4:30 PM on Thursday, May 19, 2012.

The peak period counts are analyzed to determine the one hour during the morning and afternoon periods that contains the highest cumulative directional traffic demands. Generally a "peak hours" for the morning and afternoon are determined; however, based on the rapid stream of traffic generated by the start and end of a school day, "peak half-hours" were used in this analysis. The "peak half-hours" are determined by summing up the two fifteen-minute consecutive time periods in the study area that experience the highest cumulative traffic volumes. The hourly traffic volumes are

determined by extrapolating the volume of the peak half-hour to an hourly flow rate (doubling the half-hour peak traffic volumes to determine the hourly traffic volumes).

2017 Future Conditions with Existing Schools' Growth

All schools are anticipated to expand by the year 2017. Trip generation for the additional school population was calculated based on the existing trip generation for each school as shown below:

$$New\ Trips = Existing\ Trips\ x\ \frac{New\ Population}{Existing\ population}$$

The new trips were calculated for each 15 minute count interval and the trips for the "peak half-hour" were used in the analysis. The peak half-hour traffic volumes were doubled to determine the hourly traffic volumes.

These trips were then distributed and assigned to the network. The distribution was based upon the existing patterns of vehicles entering and exiting both the school access points as well as the overall network. This distribution was done for each school individually to ensure an accurate representation of the system as a whole.

The traffic volumes generated by the school population growth were added to the 2012 Existing network in order to establish the 2017 future conditions with the existing school growth only. No background growth or development was assumed for the purpose of this analysis. As stated previously, before the new school is constructed, a full Transportation Impact Study should be scoped and completed in coordination with Arlington County Department of Environmental Services staff. This study will include background growth due to inherent growth on the roadways, as well as background developments located in the study area.

2017 Future Conditions with New School and Existing Schools' Growth

The new elementary school is anticipated to be complete in 2017. Trip generation for the new school was determined based on an average of existing elementary schools' trip generation within the surrounding area obtained from the files of Gorove/Slade. In this scenario, three different access schemes were analyzed. In the first two schemes the new school is accessible via the existing accesses for Kenmore Middle School and/or Carlin Springs Elementary School. Trip distribution for these schemes was determined by following the entering and exiting patterns of the existing school traffic as well as the traffic patterns throughout the network. The third scheme involves the construction of a new access point along South Manchester Road near 2nd Street South. As there is no existing school traffic at this location, the distribution of entering and exiting trips was determined based on the traffic flow of South Manchester Road. The traffic was then distributed throughout the network based on overall traffic patterns.

The traffic volumes generated by the new school were added to the 2017 Future Conditions with Existing Schools' Growth in order to establish the 2017 future conditions with the addition of the new elementary school. Thus this scenario includes both the new traffic generated by the expansion of the existing schools and the traffic generated by the new elementary school.

2017 Future Conditions with Staggered Start Times (Option 1)

Staggering the start times of the four schools allows for the school traffic to be more evenly distributed throughout the network. As shown in Figure 23, shown previously, the peak of the school traffic is shifted earlier so that it is further away from the peak of the overall network.

The trips generated by each school were determined based on the original calculations of new trips for the second scenario. In that stage, the trips for each 15 minute interval were determined. These values were shifted to align with the new start time of each school. The trips entering and exiting each access point were then determined. For most access points the trip count decreased from the existing conditions. Therefore the amount of "new" trips was a negative number due to the peak hour of the school shifting to a time period outside of the analysis period. The trip distribution was performed in the same way as the previous scenarios, but instead of adding trips to the network, the trips were taken away from the network.

The traffic volumes generated by the staggered start times were taken away from the 2017 Future Conditions with Existing Schools' Growth volumes in order to establish the 2017 Future Conditions with Staggered Start Times. Thus this scenario includes both the new traffic generated by the expansion of the existing schools and the new traffic generated by the new elementary school with staggered start times, leading to an earlier overall school peak.

2017 Future Conditions with Staggered Start Times (Option 2)

As stated earlier, by staggering the start times of the schools, the school traffic can be more evenly distributed through the network. The trip generation was determined utilizing the same method as above in Option 1, using the new start times for each of the four schools, as shown in Figure 24. These start times yielded some higher and some lower volumes as compared to the existing conditions Again, the trip distribution was performed in the same way as previous scenarios, with trips added or subtracted appropriately to accurately model the traffic flow of the scenario.

The traffic volumes generated by the staggered start times were taken away from the 2017 Future Conditions with Existing Schools' Growth volumes in order to establish the 2017 Future Conditions with Staggered Start Times. Thus this scenario includes both the new traffic generated by the expansion of the existing schools and the new traffic generated by the new elementary school with staggered start times, leading to an earlier overall school peak.

Vehicular Analysis Results

Intersection capacity analyses were performed for the four outlined scenarios at the study intersections shown in Figure 25. Given that the school peak and network peak are very similar in the morning, it is important to minimize the impact in this condition. Therefore, only the AM "peak half-hour" was thoroughly analyzed as it is the controlling condition within the analysis. The school peak and network peak in the PM are far enough apart that changes in the school population and staggering of start times will create less of an overall impact.

Synchro, Version 7.0 was used to analyze the study intersections based on the Highway Capacity Manual (HCM) methodology. The results of the capacity analyses are expressed in level of service (LOS) for each approach. Levels of service (LOS) range from A to F. A brief description of each level of service for signalized and unsignalized intersections is provided below.

Table 7: Summary of Analysis Assumptions

2011 Existing Conditions
• Dates of data collection: Thursday, May 19, 2012 o Counts taken from 7:00 – 9:30 AM and 2:00 – 4:30 PM o Count sheets in Technical Appendix • System Peak: 7:00 – 8:00 AM, 2:15 – 3:15 PM • Half Hour Peak: 7:30 – 8:00 AM, 2:30 – 3:00 PM
2017 Future Conditions with Existing Schools' Growth
• Volumes added: o Expansion to existing schools population will occur by 2017 o Trips generated for each school individually based on population growth o No background growth or development assumed • Trip distribution based on existing traffic volumes and travel patterns at school access points and in the study area
2017 Future Conditions with New School and Existing Schools' Growth
• Volumes added: o Expansion to existing schools population will occur by 2017 o Completion of new school assumed to be complete by 2017 o Trips generated based on average of similar elementary schools in the area o No background growth or development assumed • Trip distribution for vehicles based on existing traffic volumes and travel patterns at school access points and in the study area.
2017 Future Conditions with Staggered Start Times (Option 1)
• Volumes added: o Expansion to existing schools population will occur by 2017 o Completion of new school assumed to be complete by 2017 o Trips generated shifted based on new coordination of start times • Trip distribution for vehicles based on existing traffic volumes and travel patterns at school access points and in the study area.
2017 Future Conditions with Staggered Start Times (Option 2)
• Volumes added: o Expansion to existing schools population will occur by 2017 o Completion of new school assumed to be completed by 2017 o Trips generated shifted based on new coordination of start times • Trip distribution for vehicles based on existing traffic volumes and travel patterns at school access points and in the study area.

For signalized intersections, LOS is based upon the traffic volume present in each lane on the roadway, the capacity of each lane at the intersection and the delay associated with each directional movement. The LOS criteria for signalized intersections are summarized in Table 8. Full LOS descriptions are included in the Technical Appendix.

Table 8: LOS Criteria for Signalized Intersections

LOS	Delay/vehicle (sec)	Progression Type	Comments
A	< 10	Favorable	
B	10.1 to 20	Good	
C	20.1 to 35	Fair	Generally considered the lower end of the range of the acceptable level of service in rural areas.
D	35.1 to 55	Unfavorable	Generally considered the lower end of the range of the acceptable level of service in urban areas.
E	55.1 to 80	Poor	Limit of acceptable conditions for the purpose of this analysis.
F	> 80	Poor	

At an unsignalized intersection, the major street through traffic and right turns are assumed to operate unimpeded and therefore receive no level of service rating. The level of service for the minor street is dependent on the volume and capacity of the available lanes. The level of service for the major street left turn traffic is dependent on the number and frequency of acceptable gaps in the major street traffic to make a conflicting turn. The level of service grade is provided for each conflicting movement at an unsignalized intersection and is based on the total average delay experienced by each vehicle. The delay includes the time it takes a vehicle to move from the back of a queue through the intersection. The unsignalized intersection levels of service are summarized in Table 9. Full LOS descriptions are included in the Technical Appendix.

Table 9: LOS Criteria for Unsignalized Intersections

LOS	Delay/vehicle (sec)	Comments
A	< 10	
B	10.1 to 15	
C	15.1 to 25	
D	25.1 to 35	
E	35.1 to 50	
F	> 50	LOS F may not always result in long queues but may result in adjustments to normal driver behavior

The LOS capacity analyses were based on: (1) the peak half-hour traffic volumes for the four scenarios; (2) the lane use and traffic controls in the existing network; and (3) the Highway Capacity Manual (HCM) methodologies (using *Synchro 7* software). Table 10 shows the results of the capacity analyses for the existing and growth conditions, as well as access-specific analyses of both scenarios involving the implementation of the new school. The LOS for each approach and the overall intersection is shown for the signalized intersections, and the LOS for each appropriate approach and movement is shown for the unsignalized intersections. The intersection ID numbers correspond with those shown in Figure 25.

The analysis results show the following:

- 2017 Future Conditions with Existing Schools' Growth
  - Decrease in overall LOS at:
    - Arlington Boulevard and South Manchester Street
    - South Carlin Springs Road and Campbell School North Access
  - Decrease in southbound LOS at Carlin Springs School Access at 5th Road South
  - Decrease in northbound LOS at Carlin Springs Road and Arlington Boulevard Eastbound Ramps
  - 90 second increase in overall delay at Kenmore School/Carlin Springs School Access and South Carlin Springs Road
- 2017 Future Conditions with New School and Existing Schools' Growth
  - All results given in 2017 Future Conditions with Existing Schools' Growth
  - Decrease in overall LOS at Carlin Springs Road and Arlington Boulevard Eastbound Ramps
- 2017 Future Conditions with Staggered Start Times (Option 1)
  - In comparison with 2017 Future Conditions with New School and Existing Schools' Growth:
    - Increase in overall LOS at:
    - Arlington Boulevard and South Manchester Street
    - Carlin Springs Road and Arlington Boulevard Eastbound Ramps
    - Kenmore School/Carlin Springs School Access and South Carlin Springs Road
    - South Carlin Springs Road and Campbell School North Access
    - Increase in southbound LOS at Carlin Springs School Access and 5th Road South
  - In comparison with existing conditions:
    - Increase in overall LOS at Kenmore School/Carlin Springs School Access and South Carlin Springs Road
- 2017 Future Conditions with Staggered Start Times (Option 2)
  - In comparison with 2017 Future Conditions with Staggered Start Times (Option 1)
    - Decrease in eastbound LOS at Carlin Springs Road at Arlington Boulevard Eastbound Ramps
    - Decrease in overall and northbound LOS at Kenmore School/Carlin Springs School Access and South Carlin Springs Road
  - Shows little significant difference in comparison with the existing conditions

Table 10: LOS Results, Morning Peak Half-Hour

ID	Intersection	Approach	LOS during AM peak half hour (7:30 - 8:00)										
			Scenario #1	Scenario #2	Scenario #3			Scenario #4			Scenario #5		
					A	B	C	A	B	C	A	B	C
1	Arlington Boulevard at South Manchester Street	**Overall**	C	D	D	D	D	C	C	C	C	C	C
		Eastbound	D	D	D	D	D	C	C	C	C	C	C
		Westbound	B	B	B	B	B	B	B	B	B	B	B
		Northbound	F	F	F	F	F	F	F	F	F	F	F
		Southbound	E	E	E	E	E	F	F	F	F	F	F
2	South Manchester Street at Arlington Boulevard Service Road	Eastbound	B	B	C	B	C	B	B	B	B	B	B
		Westbound	C	C	C	C	C	C	C	C	C	C	C
		Northbound Left	A	A	A	A	A	A	A	A	A	A	A
		Southbound Left	A	A	A	A	A	A	A	A	A	A	A
3	North Manchester Street at Arlington Boulevard Service Road	Eastbound	A	A	A	A	A	A	A	A	A	A	A
		Northbound Left	A	A	A	A	A	A	A	A	A	A	A
4	South Madison Street at Arlington Boulevard	Westbound Left	A	A	A	A	A	A	A	A	A	A	A
		Northbound	A	A	A	A	A	A	A	A	A	A	A
5	Kenmore School Service Access at Arlington Boulevard	Northbound	A	A	A	A	A	A	A	A	A	A	A
6	East Kenmore School Access at Arlington Boulevard	Northbound	A	A	A	A	A	A	A	A	A	A	A
7	Carlin Springs Road at Arlington Boulevard Westbound Ramps	**Overall**	B	B	B	B	B	B	B	B	B	B	B
		Westbound	D	D	D	D	D	D	D	D	D	D	D
		Northbound	A	A	A	A	A	A	A	A	A	A	A
		Southbound	B	C	C	C	C	B	B	B	C	C	C
8	Carlin Springs Road at Arlington Boulevard Eastbound Ramps	**Overall**	C	C	D	D	D	C	C	C	C	C	C
		Eastbound	E	E	E	E	E	D	D	D	E	E	E
		Northbound	C	D	D	D	D	C	C	C	C	C	C
		Southbound	A	A	A	A	A	A	A	A	A	A	A
9	Kenmore School Northmost Access at Carlin Springs Road	Northbound Left	A	B	B	B	B	A	A	A	A	A	A
10	South Carlin Springs Road at 1st Street South	Westbound	B	B	B	B	B	B	B	B	B	B	B
		Southbound Left	A	A	A	A	A	A	A	A	A	A	A

ID	Intersection	Approach	LOS during AM peak half hour (7:30 - 8:00)										
			Scenario #1	Scenario #2	Scenario #3			Scenario #4			Scenario #5		
					A	B	C	A	B	C	A	B	C
11	Kenmore School/Carlin Springs School Access at South Carlin Springs Road	**Overall**	F	F	F	F	F	C	A	A	F	F	F
		Eastbound	A	B	B	B	B	A	A	A	B	B	B
		Westbound	A	B	B	B	B	A	A	A	A	A	A
		Northbound	F	F	F	F	F	C	B	B	F	F	F
		Southbound	A	B	B	B	B	A	A	A	A	A	A
12	South Carlin Springs Road at 4th Street South	Eastbound	B	B	B	B	B	B	B	B	B	B	B
		Westbound	B	B	B	B	B	B	B	B	B	B	B
		Northbound Left	A	A	A	A	A	A	A	A	A	A	A
		Southbound Left	A	A	A	A	A	A	A	A	A	A	A
13	5th Street South at South Carlin Springs Road	**Overall**	A	A	A	A	A	A	A	A	A	A	A
		Westbound	E	E	E	E	E	E	E	E	E	E	E
		Northbound	A	A	A	A	A	A	A	A	A	A	A
		Southbound	B	B	B	B	B	B	B	B	B	B	B
14	5th Road South at South Carlin Springs Road	**Overall**	B	B	B	B	B	B	B	B	B	B	B
		Eastbound	D	D	D	D	D	D	D	D	D	D	D
		Northbound	B	B	B	B	B	B	B	B	B	B	B
		Southbound	A	A	A	A	A	A	A	A	A	A	A
15	South Carlin Springs Road at 5th Road South	Westbound	C	C	C	C	C	C	C	C	C	C	C
		Southbound Left	A	A	A	A	A	A	A	A	A	A	A
16	6th Road South at South Carlin Springs Road	**Overall**	A	A	A	A	A	A	A	A	A	A	A
		Eastbound	D	D	D	D	D	D	D	D	D	D	D
		Westbound	D	D	D	D	D	D	D	D	D	D	D
		Northbound	A	A	A	A	A	A	A	A	A	A	A
		Southbound	A	A	A	A	A	A	A	A	A	A	A
17	South Carlin Springs Road at Campbell School North Access	Westbound	C	F	F	F	F	C	C	C	B	B	B
		Southbound Left	C	D	D	D	D	C	C	C	C	C	C

ID	Intersection	Approach	LOS during AM peak half hour (7:30 - 8:00)										
			Scenario #1	Scenario #2	Scenario #3			Scenario #4			Scenario #5		
					A	B	C	A	B	C	A	B	C
18	South Carlin Springs Road at Campbell School South Access	Westbound	F	F	F	F	F	F	F	F	F	F	F
		Southbound Left	A	C	C	C	C	C	C	C	A	A	A
19	7th Road South/Ardley Court at Carlin Springs Road	**Overall**	B	B	B	B	B	B	B	B	B	B	B
		Eastbound	D	D	D	D	D	D	D	D	D	D	D
		Westbound	E	E	E	E	E	E	E	E	E	E	E
		Northbound	B	B	B	B	B	A	A	A	B	B	A
		Southbound	A	B	B	B	B	A	A	A	A	A	A
20	Carlin Springs School Access at 5th Road South	Eastbound Left	A	A	A	A	A	A	A	A	A	A	A
		Southbound	C	D	D	D	D	C	C	C	B	B	B
21	Glen Carlyn Road at Magnolia Avenue	Northbound	B	B	B	B	B	B	B	B	B	B	B
22	South Manchester Street/Temple Access at Glen Carlyn Road	Westbound	A	A	A	A	A	A	A	A	A	A	A
		Northbound	B	B	B	B	B	B	B	B	B	B	B
		Southbound	F	F	F	F	F	F	F	F	F	F	F
23	South Manchester Street at South Woodlake Towers Access	Eastbound	B	B	B	B	B	B	B	B	B	B	B
		Westbound	B	B	B	B	B	B	B	B	B	B	B
		Northbound Left	A	A	A	A	A	A	A	A	A	A	A
24	South Manchester Street at North Woodlake Towers Access	Westbound	B	B	B	B	B	B	B	B	B	B	B
		Southbound Left	A	A	A	A	A	A	A	A	A	A	A
25	Potential New Elementary School Access at South Manchester Street	Westbound	--	--	--	--	B	--	--	B	--	--	A
		Southbound Left	--	--	--	--	A	--	--	A	--	--	A

Potential Roadway Improvements

As outlined previously, there are some existing concerns regarding congestion at the school access points. Several possible improvements were investigated. These potential enhancements improve the operation of the school driveway, as well as ensure that the access points to the new school do not add to the existing concerns.

The main area of concern is the intersection of South Carlin Springs Road and 3rd Street South/School Access. In order to improve the existing issues two potential strategies were examined:

1. Creating separate right/left turn lanes at the school exit
2. Moving the crosswalk from the north to the south side of the intersection

These strategies were analyzed at both the morning and afternoon peak half-hour for the existing network. The levels of service and delay times for the existing conditions and both strategies are shown in Table 11.

Table 11: Impact of Potential Roadway Improvements at South Carlin Springs Road and 3rd Street South/School Access

Strategy	Time	Eastbound Approach	
		LOS	*Delay (sec)*
Existing	AM	A	9.9
	PM	F	102.4
Separate R/L Turn Lanes	AM	A	9.4
	PM	E	61.5
Change Crosswalk Location	AM	A	9.9
	PM	F	114.8

Strategy 1 results in an overall improvement for the eastbound approach as can be seen in the decrease in delay. However, Strategy 2 causes an increase in delay at the eastbound approach based on the larger amount of right than left turns. It can therefore be suggested that separating right and left turn movements at the school exit will create an improvement to the intersection. In conjunction with this solution, an alteration to the Kenmore Middle School entrance could be implemented to improve the traffic flow.