



**Anne Arundel County
Transportation Facility Planning Study
Stevenson Road / Quarterfield Road
Contract No. H539626
Final Report (Technical Memo 4)**

Prepared for:

Anne Arundel County Department of Public Works

Prepared by:

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A stylized, blue-toned illustration of a cityscape at the bottom of the page. It includes buildings, a bridge, a water tower, trees, and cars on a road.

**RISE TO THE
CHALLENGE**

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1. INTRODUCTION

The Anne Arundel County Department of Public Works (DPW) requested KCI Technologies Inc. (KCI) to provide Architect / Engineer (A/E) Services to perform a study focusing on Stevenson Road from Quarterfield Road to New Cut Road, and Quarterfield Road from Janet Dale Lane to Donaldson Avenue. Several issues have been identified, including multimodal operations, safety, accessibility, and mobility; particularly, for access to nearby public schools.

Growth from development has resulted in increased travel demand along these corridors. The corridors provide access to multiple County public schools and connections to I-97 and MD 3 Business, with primarily residential developments in the area. Safe access is needed to Quarterfield Elementary School, which opened in Fall 2023 and the new Severn Run High School, which opened in Fall 2024. Measures are needed to manage speeds on these roadways and to improve pedestrian safety, as these corridors contain minimal pedestrian facilities and lack bicycle facilities. Recently, sidewalks were installed along eastbound Stevenson Road between Crest Hill Road and New Cut Road, and along southbound New Cut Road (MD 3 Business) between Stevenson Road and south of Grover Road.

There was a County Safe Routes to School study that proposed improvements for student walking and bicycle safety, mobility, and accessibility to and from the Quarterfield Elementary School. The study, which was an accessibility study, has been completed. The County is currently developing a plan to implement the recommendations from that study.

This report provides three plan views of proposed alternatives that incorporate typical sections designed to improve safety and accessibility for pedestrians, cyclists, and school students. Other improvement options included in the alternatives are intersection concepts, signal warrant analyses, sight distance evaluations, pedestrian crossing improvements, traffic calming measures, signing and pavement marking updates, and Stormwater Management (SWM) facility options.

This report recommends that the Alternative 2 typical section be considered for detailed design and construction as part of a future capital project along both the Stevenson Road and Quarterfield Road corridors. In addition, it is recommended that a single-lane roundabout be designed for the Quarterfield Road at MD 174 (Quarterfield Road/Donaldson Avenue) intersection, and that the Quarterfield Road at Stevenson Road intersection be converted to an All-Way Stop Condition. Other improvements such as improving sight lines at the Stevenson Road and Quarterfield Road intersection and relocating the existing three speed humps on Stevenson Road are all part of the Task 4 report recommendations for a future capital project. These recommendations are based on review comments received on the Task 3 alternatives report, feedback received at the stakeholder meetings, and input obtained at the Public Meeting for this study. Further details regarding the recommended improvements can be found in **Section 7** of this report.

Relevant information that was included in the **Task 1-Existing Conditions** report (**Appendix A** to this report) and the **Task 2-Tech Memo #2 – Purpose and Need Statement** (**Appendix B** to this report) is also provided to support the alternatives developed for the project.

1.1 Project Background

The need for a formal, comprehensive study came about for many reasons. First, there is a future Middle school planned on the site of the current Center of Applied Technology North (“CAT North”) in the next couple years. In addition, there are other school developments planned in the area. The Stevenson Road /Quarterfield Road study is looking at the overall corridor benefits for school transportation that might impact school children and their parents that walk or bike to and from the local schools as well as others who may choose those travel modes for recreational purposes.

Anne Arundel County has received numerous requests from residents to improve the sidewalk network within the area. There are various gaps and deficiencies that they're looking to address. While this study is not meant to only address school-specific needs, they are one of the driving forces behind evaluating these corridors as a whole. Some of the improvements previously discussed, have been implemented, including the recent opening of Severn Run High School at Stevenson Road and New Cut Road, as well as a variety of other smaller improvements such as sidewalks and drainage and stormwater management.

However, there are minimal to no pedestrian and bicycle facilities to accommodate all these multimodal uses. Anne Arundel County has recently completed a safe routes to school study specific to Quarterfield Elementary School. That study recommended various infrastructure improvements to help students that walk and bike to and from the school. The County recognizes there is some overlap with that study with this comprehensive feasibility study.

The County's Safe Routes to School (SRTS) Phase 1 was completed in 2022 and included an accessibility study at Quarterfield Elementary School, which covered all roads in the school walk zone plus some roads immediately beyond it. The goal was to develop recommendations to improve safety for students walking and biking to/from school and finding opportunities to expand the walk zone. In general, the County's transportation master plan (*Move Anne Arundel!*) prioritize walkable communities and SRTS initiatives. The Stevenson Road and Quarterfield Road corridors are key to the success of the community and provide the primary accesses for school transportation.

1.2 Project Area

The project is located in the town of Severn, Maryland in Anne Arundel County. See **Figure 1** for an aerial view of the study area. The study area covers Stevenson Road from Quarterfield Road to MD 3 Business (New Cut Road) and Quarterfield Road from Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road). The section of Stevenson Road between Old Stevenson Road and MD 3 Business (New Cut Road) is maintained by SHA and is designated as MD 997E. The remaining section of Stevenson Road from Quarterfield Road to Old Stevenson Road is maintained by Anne Arundel County. Likewise, the entire section of Quarterfield Road within the study limits is maintained by Anne Arundel County.

The land uses within the study area are predominantly residential, but there are four schools with direct access to either Stevenson Road or Quarterfield Road. These schools are:

- Quarterfield Elementary School
- Center for Applied Technology-North (CAT-North)
- Archbishop Spalding High School (Private)
- Severn Run High School



Figure 1: Study Area

2. EXISTING CONDITIONS OVERVIEW

The **Task 1-Existing Conditions** report provided a summary of the following existing conditions:

- Existing Roadway Conditions and Site Observations
- Existing Traffic Count Data and Operational Results
- Existing Crash Data Summary
- Existing Pedestrian Level of Comfort
- Existing Bicycle Level of Traffic Stress

Below are the key findings from the **Task 1-Existing Conditions** report that guided the development of the proposed condition alternatives.

2.1 Existing Roadway Conditions Overview

Table 1 provides a summary of the major roadway components, functional classifications and posted speed limits for the study corridors. For the purposes of this study, the State and County -maintained sections of Stevenson Road are considered to run in an east-west direction. Also, Quarterfield Road is considered to run in a north-south direction.

Table 1: Existing Roadway Summary

Roadway	Study Limits	Functional Classification*	Posted Speed Limit
MD 997E (Stevenson Road)	Stevenson Road (CO 1337) to MD 3 Business (New Cut Road)	Urban Major Collector	30 MPH
Stevenson Road (CO 1337)	Quarterfield Road to Old Stevenson Road	Collector	35 MPH / 30 MPH
Quarterfield Road (CO 907)	Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road)	Minor Arterial	35 MPH

*- Sources: SHA Highway Location Reference and AA County Road Functional Classifications

MD 997E (Stevenson Road) - Stevenson Road (CO 1337) to MD 3 Business (New Cut Road)

The State-maintained section of Stevenson Road (MD 997E) from Stevenson Road (CO 1337) to New Cut Road (MD 3 Business) is classified as an urban major collector with a posted speed limit of 30 MPH. There are no traffic calming measures in this section of Stevenson Road.

This section has two travel lanes, which widen to four lanes starting east of Old Stevenson Road to route traffic to and from New Cut Road. The eastbound and westbound lanes are approximately 13 feet wide, east of Crest Hill Road. The lane widths reduce to approximately 11 feet approaching the intersection with New Cut Road. This roadway is a closed section with a westbound shoulder width ranging between 0 to 6.5 feet and an eastbound shoulder width between 0 to 10.5 feet. There are no marked on-street bicycle facilities in this section of Stevenson Road.

A separate project was also constructed along this section of Stevenson Road. The Stevenson Road Sidewalk project installed 875 feet of concrete sidewalk along eastbound Stevenson Road between Crest Hill Road and New Cut Road. Construction also included new curb and gutter, new storm drain inlets and drainage pipes, an upgraded driveway at the Calvary Baptist Church entrance, a bio-swale along westbound Stevenson Road, and pavement resurfacing.

There was also a sidewalk project along New Cut Road that installed 1,400 feet of concrete sidewalk along southbound New Cut Road from south of Grover Road to Stevenson Road (MD 997E). This project also included ADA ramp and driveway improvements, curb and gutter, and future pedestrian crossings that will serve the Severn Run High School across New Cut Road.

Stevenson Road (CO 1337) - Quarterfield Road (CO 907) to Old Stevenson Road

The County-maintained section of Stevenson Road (CO 1337) from Quarterfield Road (CO 907) to MD 997E (Stevenson Road) is classified as a collector roadway with a posted speed limit of 35 MPH between Quarterfield Road and the CAT-North Entrance and reduces to 30 MPH between the CAT-North Entrance and Old Stevenson Road.

This segment of Stevenson Road has a mix of open and closed sections. There are two travel lanes along this entire section of Stevenson Road. The westbound lane is approximately 12.5 feet wide, and the eastbound lane is approximately 10.5 feet wide from Quarterfield Road to McNelin Way. The lanes are 11 feet wide between McNelin Way and Grasons Court. Between Grasons Court and Spaulding Circle, the westbound lane width increases to approximately 14 feet, and the eastbound lane width increases to approximately 16 feet. The roadway contains varying shoulder widths. The shoulder width along westbound Stevenson Road varies between 0 and three feet, while the shoulder width along eastbound Stevenson Road varies between 0 and 5.5 feet. There are also three existing speed humps on Stevenson Road between the CAT-North Entrance and Crest Hill Road.

The sidewalk on both sides of Stevenson Road is four feet wide, west of Crest Hill Road. There are gaps in the sidewalk along both eastbound and westbound Stevenson Road. There are some existing sidewalk ramps on the north side of Stevenson Road and along eastbound Stevenson Road but no associated signed or marked crossings across Stevenson Road. None of the side streets in this section (Theresa Rose Lane, Wildflower Drive, McNelin Way, Grasons Court, Spaulding Way, and Spaulding Circle) have marked crosswalks or stop lines across the side road approaches. In addition, there are no bicycle facilities on this portion of Stevenson Road.

Quarterfield Road (CO 907) - Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road)
Quarterfield Road (CO 907), between Janet Dale Lane and MD 174 (Donaldson Avenue/Quarterfield Road) is classified as a Minor Arterial roadway, and has a posted speed limit of 35 MPH. There are no traffic calming measures in this section of the roadway.

This portion of the roadway has both open and closed sections. In general, there are two travel lanes along the section that widen to three lanes to accommodate turning movements to and from MD 174 (Donaldson Avenue/Quarterfield Road). The lane widths are 11 feet. At the Quarterfield Road/Donaldson Avenue intersection, the southbound lane is 18 feet wide, the northbound left-turn lane is 12 feet wide, and the northbound right turn lane is 23 feet wide. This portion of the roadway contains a southbound shoulder that varies from 0 to six-foot wide, and a northbound shoulder that varies from 0 to five-foot wide.

There is an existing sidewalk along the east side of Quarterfield Road near Janet Dale Lane and Perry Lane. This sidewalk is four feet wide and is separated from the road by a 5 foot wide grass buffer. A short section of sidewalk also exists on the west side, north of Janet Dale Lane. This sidewalk is four feet wide and is separated from the road by a 6 foot wide grass buffer.

The sidewalk on the east side of the road resumes near the entrance to Quarterfield Elementary School and continues to MD 174. This sidewalk is four feet wide. There is a four foot wide sidewalk on the west side of the road that begins at Chad Avenue and continues to MD 174. Gaps in the sidewalk exist along the west side of Quarterfield Road and along the east side of the road. None of the side streets within the study limits (Janet Dale Lane, Stevens Road, Perry Lane, Quarterfield Elementary School entrance, Myers Drive, Myers Court, or Chad Avenue) have stop lines or crosswalk pavement markings. Likewise, there are no crosswalks at the Quarterfield Road/MD 174 intersection. Finally, there are no bicycle facilities in this section of the roadway.

Figure 2 illustrates the existing lane configuration diagram at the intersections along the Stevenson Road and Quarterfield Road corridors. **Figure 3** shows the existing sidewalk

coverage along the Stevenson Road and Quarterfield Road corridors. The information shown in the figure was sourced from Anne Arundel County’s Open GIS Data (<https://opendata.aacounty.org/datasets/>) and the field investigations.

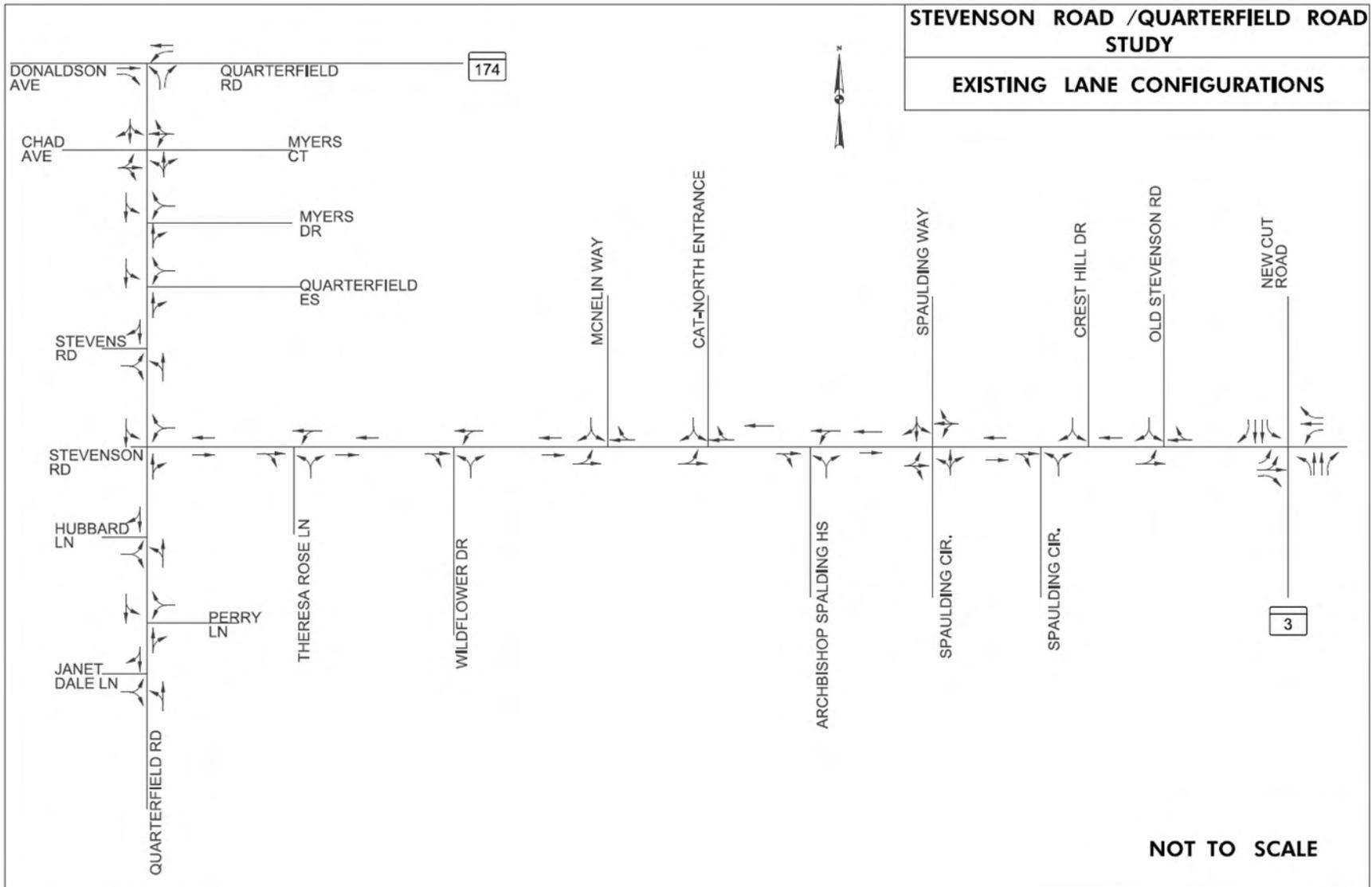


Figure 2: Existing Lane Configurations

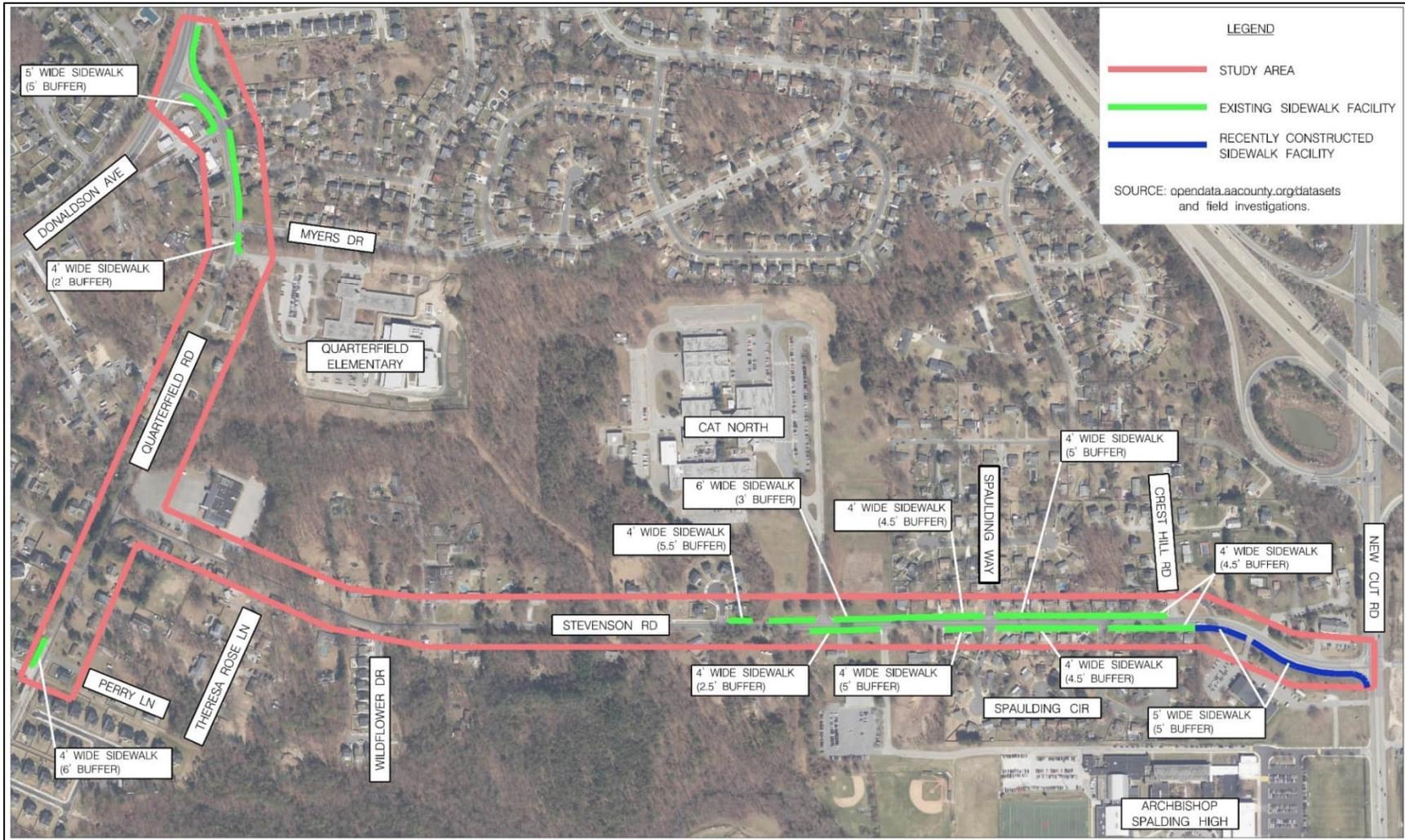


Figure 3: Existing Pedestrian Facilities

2.2 Existing Pedestrian Level of Comfort Overview

A Pedestrian Level of Comfort (PLOC) analysis was conducted for this study to identify locations in the existing sidewalk network that are uncomfortable due to inadequate width or gaps in the network as well as at pedestrian crossings. The Montgomery County PLOC approach was used since Anne Arundel County does not currently have their own methodology. The methodology was inspired by the Bicycle Level of Traffic Stress (LTS) analysis conducted for the Montgomery County Bicycle Master Plan.

The PLOC analysis assigns numerical values to the comfort levels to provide quantitative results based on the qualitative measures. The comfort scale is as follows:

- 1 = Very comfortable
- 1.5 = Comfortable
- 2 = Somewhat comfortable
- 2.5 = Somewhat uncomfortable
- 3 = Uncomfortable
- 3.5 = Very Uncomfortable
- 4 = Undesirable

Sidewalks

Please note that there are three segments within the study area with notable gaps in the existing sidewalks network or have limited sidewalk coverage that may contribute to a lower PLOC rating. These segments are:

- Stevenson Road (CO 1337), from Theresa Rose Lane to Wildflower Drive (south side)
- Stevenson Road (CO 1337), from Grasons Court to CAT-North Entrance (north side)
- Stevenson Road (CO 1337), from CAT-North to Spaulding Way/Spaulding Circle (south side)

In general, the Stevenson Road and Quarterfield Road corridors have PLOC ratings of either 3 (Uncomfortable) or 4 (Undesirable) based on the available width of existing sidewalks, available buffer widths, posted speed limits and lack of any on-street parking or bicycle lanes.

Results of the PLOC analysis for existing sidewalks (pathways) along the Stevenson and Quarterfield Road corridors are summarized in the **Task 1-Existing Conditions** report for various segments along the Quarterfield Road corridor as well as the County and State-maintained portions of Stevenson Road.

Crossings

The locations selected for the PLOC evaluation needed to have two receiving ramps to accommodate pedestrian crossing movement. Please note that there are no existing marked crosswalks at intersections or midblock locations along either the Stevenson Road or Quarterfield Road corridors within the study limits.

In general, the existing crossings for the Stevenson Road and Quarterfield Road corridors have **PLOC ratings of either 2 (Somewhat Comfortable) or 4 (Undesirable)** based on the approach posted speed limit, approach traffic control and the number of lanes a pedestrian must cross.

Results of the PLOC analysis for existing crossings along the Stevenson Road and Quarterfield Road corridors are summarized in the **Task 1-Existing Conditions** report.

2.3 Existing Bicycle Level of Traffic Stress Overview

The Maryland Department of Transportation (MDOT) has transitioned from using the Bicycle Level of Comfort (BLOC) to the Level of Traffic Stress (LTS) methodology for measuring the “bikeability” of a roadway network. This transition was done in coordination with the implementation of MDOT SHA’s Context Driven Design Guidelines and other national and departmental initiatives. SHA prefers to use LTS over BLOC as LTS requires fewer variables to calculate including:

- Presence and type of bicycle facility
- Speed Limit
- Number of Through Lanes
- Traffic Volumes

The traditional Level of Traffic Stress (LTS) rating scale, using a scale of “1” (protected bikeways or side paths suitable for all users) to “4” (no bike facility or bike lane on major roadway suitable for only strong and fearless riders) is a measure for assessing the quality of the roadway network for its comfort with various bicycle users. The lower the LTS score (i.e., 1 or 2), the more inviting the bicycle facility is for more audiences. LTS rating for a roadway are dependent on the specific number of through lanes, the effective annual average daily traffic (AADT), and prevailing speed. Please note that the LTS scale ratings “0” and “5” are not applicable to the existing conditions in the study area. An LTS rating of “0” is associated with off-road facilities such as rails-to-trails or shared-use paths, while an LTS rating of “5” indicates that bicycle access is prohibited.

Overall, the County and State-maintained sections of Stevenson Road and the section of Quarterfield Road would qualify as having **LTS ratings of 4** since all roads have one lane per direction of travel, have ADTs that exceed 3,000 vpd, and have prevailing speeds that are 30 MPH or higher for existing conditions.

More details on the Bicycle LTS analysis are provided in the **Task 1-Existing Conditions** report.

3. PURPOSE AND NEED OVERVIEW

The purpose of this project is to identify existing geometric deficiencies, reduce crash potential, improve pedestrian and bicycle compatibility, and evaluate alternatives to address deficiencies for all travel modes while minimizing impacts on the natural and built environment.

Improvements to the Stevenson Road and Quarterfield Road corridors are needed to address the following factors:

- Provide continuous pedestrian and bicycle facilities that meet current AASHTO and ADA design guidelines.
- Promote Complete Streets and Vision Zero principles to accommodate all modes of travel.
- Advance the initiatives identified in the *Quarterfield Elementary School Safe Routes to School Accessibility Study: Existing Conditions and Recommendations* (August 17, 2023).
- Support the future access and mobility needs of the residential properties and local schools along these corridors, including the replacement of the Old Mill Middle School North at the CAT-North location.
- Identify implementable recommendations in both directions along the Stevenson Road and Quarterfield Road corridors for all travel modes.

The project is needed to provide safe access to the new Severn Run High School (opened in Fall 2024) and the Quarterfield Elementary School (new building constructed to replace old in Fall 2023). Measures are needed to manage vehicular travel speeds and increased demand from development growth on the Stevenson Road and Quarterfield Road corridors.

Bicyclists are permitted to share the road with motor vehicles, and the County Code allows bicycles to ride on existing sidewalks. However, the Stevenson Road and Quarterfield Road corridors lack continuous sidewalk networks and do not have any signed or dedicated bicycle facilities. There is an ongoing County Safe Routes to School project associated with the Quarterfield Elementary School that proposes various pedestrian and bicycle improvements to enhance safety, mobility, and accessibility to the school.

KCI reviewed various Anne Arundel County programs and documents including *Move Anne Arundel!*, *Walk & Roll Anne Arundel!*, the County's Complete Streets Program, the Safe Routes to School (SRTS) program, Vision Zero plan, and various Traffic Impact Studies (TIS) for schools to see if any have been implemented or are relevant to the study area. Please refer to the Task 1 – Existing Conditions report for a summary of document reviewed for this study.

To support the needs of the project, *Move Anne Arundel!* (the County's Transportation Master Plan) indicated that 17 schools were recommended to implement various Safe Routes to School programs bicycle and pedestrian investments, including Quarterfield Elementary School. Specifically, there were recommendations to expand the walk zone by improving crossing conditions at Quarterfield Road and MD 174 (Donaldson Avenue / Quarterfield Road) as well as other related improvements that fall outside the limits of the Stevenson Road / Quarterfield Road study area. Please note that there is no funded project currently in place to implement the SRTS recommendations.

Walk & Roll Anne Arundel!, which is the County's updated pedestrian and bicycle master plan, recommended a separated bicycle lane on Stevenson Road, between Quarterfield Road and MD 3 Business (New Cut Road).

The *Quarterfield Elementary School Safe Routes to School Accessibility Study: Existing Conditions and Recommendations* report identified specific improvements needed along the Stevenson Road and Quarterfield Road corridors. Those included:

- A signed bike route for MD 174 (Donaldson Avenue / Quarterfield Road). The limits of the bike route were not identified in the SRTS report.
- Sidewalk and speed management improvements for
 - Stevenson Road from Quarterfield Road to CAT-North, and
 - Quarterfield Road from west of Janet Dale Lane to Myers Drive.
- School zone signing improvements for Quarterfield Road from west of Stevens Road to Chad Avenue.

More details on the Purpose and Need are provided in **Task 2-Tech Memo #2 – Purpose and Need Statement (Appendix B)** to this report).

4. ALTERNATIVES CONSIDERED FOR THE STUDY

Based on the information gathered during Task 1 and 2, proposed improvement alternatives were developed for each roadway segment within the study area to support the Purpose and Need Statement. The Task 3 report looked at corridor-wide and spot-specific alternatives that included options for roadway typical sections, intersection improvements, school zone designations, minor traffic calming and safety measures, and Stormwater Management (SWM) implementation. The proposed typical sections and intersection improvements considered the existing operating conditions for all users as well as the Future (2050) No Build traffic conditions. The typical sections were developed using guidance from *Walk & Roll Anne Arunde!!* and other relevant County resources.

These alternatives considered access and mobility for existing schools in the area as well as the development of the new Old Mill North Middle School on the CAT-North campus on Stevenson Road.

4.1 Roadway Typical Sections

Table 2 provides a summary of the three typical sections developed for each roadway within the study corridor used for each of the alternatives as shown in the Task 3 report.

Table 2: Proposed Typical Sections Summary

	Motorist Lanes	Bicycle Lanes	Curb & Gutter	Grass Buffer	Sidewalk	Shared Use Path
ALTERNATIVE 1						
Quarterfield Rd	11'	5'	Yes	3'	6' (Both)	None
Stevenson Rd	11'	5'	Yes	3'	6' (Both)	None
ALTERNATIVE 2						
Quarterfield Rd	11'	None	Yes	3'	6' (SB)	11' (NB)
Stevenson Rd	11'	None	Yes	3'	6' (EB)	11' (WB)
ALTERNATIVE 3						
Quarterfield Rd	14'	Shared	Yes	3'	6' (Both)	None
Stevenson Rd	14'	Shared	Yes	3'	6' (Both)	None

Alternative 1 Typical Section

Along both Quarterfield Road and Stevenson Road, Alternative 1 proposes 11 foot travel lanes along with 5 foot on-street bicycle lanes. Curb and gutter would be placed along the travel lanes. This alternative proposes 3 foot grass buffers and 6 foot concrete sidewalks on both sides. There are no shared use paths included along Quarterfield Road for Alternative 1.

This alternative provides optimal sidewalk connectivity and does not reduce the existing width of the roadway. A visual representation of the Alternative 1 typical section for both Quarterfield Road and Stevenson Road can be found below in **Figure 4**.



Figure 4: Alternative 1 Typical Section

Alternative 2 Typical Section

Along both Quarterfield Road and Stevenson Road, Alternative 2 proposes 11 foot travel lanes and does not provide on-street bicycle lanes. Curb and gutter would be placed along the travel lanes, and in some areas the existing roadway width would be reduced. Along southbound Quarterfield Road, a 3 foot grass buffer and a 6 foot concrete sidewalk is proposed. Along northbound Quarterfield Road, a 3 foot grass buffer and an 11 foot Shared Use Path (SUP) is proposed.

This alternative provides optimal safety for both pedestrians and cyclists, as there are no on-roadway cyclist facilities proposed, and all pedestrian facilities will be horizontally and vertically offset from existing roadway grade. A visual representation of the Alternative 2 typical section for both Quarterfield Road and Stevenson Road can be found below in **Figure 5**.



Figure 5: Alternative 2 Typical Section

Alternative 3 Typical Section

Along Quarterfield Road and Stevenson Road, Alternative 3 proposes 14 foot travel lanes that are to be used by both motorists and cyclists. Curb and gutter would be placed along the travel lanes, and in some areas the existing roadway width would be reduced. Alternative 3 proposes 3 foot grass buffers and 6 foot concrete sidewalks on both sides of Quarterfield Road. There are no shared use paths included along Quarterfield Road for Alternative 3.

This alternative has the smallest footprint and would require the least amount of right-of-way acquisition. A visual representation of the Alternative 3 typical section for both Quarterfield Road and Stevenson Road can be found below in **Figure 6**.

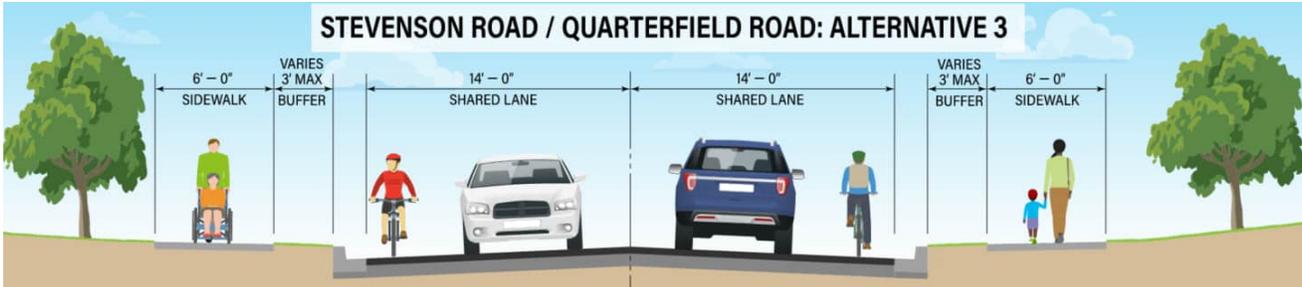


Figure 6: Alternative 3 Typical Section

4.2 Initial Intersection Improvements Concepts

Geometric, safety, and functionality improvements were considered at all intersections within the project corridor. The following three intersections were identified as candidates for potential improvements:

- Quarterfield Road at Donaldson Avenue
- Quarterfield Road at Stevenson Road
- Stevenson Road at the Entrance to CAT-North

Future improvements for the intersection of Stevenson Road (MD 997A) and New Cut Road were also considered. However, this intersection has been recently modified to provide improved geometrics and pedestrian improvements as part of a separate project associated with the Severn Run High School and was thus, alternatives at this intersection were excluded for this study. SHA is currently in the process of reviewing signal modifications that include installation of a marked crosswalk across the south leg of New Cut Road. Details for these updates are not yet available.

Below is a summary of the proposed improvement alternatives at each of the three intersections identified for potential improvements.

Quarterfield Road at MD 174 (Donaldson Avenue)

Roundabout Option

Based on the findings from the traffic analyses outlined in this report, the Quarterfield Road at MD 174 (Quarterfield Road/Donaldson Avenue) intersection was identified as a candidate for a single-lane roundabout. The initial roundabout design included bypass lanes for turning right onto

southbound Quarterfield Road and turning right onto eastbound Donaldson Avenue. The design criteria and methodology used for sizing and choosing the type of roundabout followed the guidelines outlined in the *Maryland State Highway Administration (SHA) Roundabout Design Guidelines*, the *National Cooperative Highway Research Program (NCHRP) Research Report 1043 – Guide for Roundabouts (2023)*, and *A Policy on Geometric Design of Highways and Streets (AASHTO), 7th Edition (Green Book)*. **Table 3** outlines the design criteria selected for this roundabout.

Table 3: Quarterfield Road at MD 174 (Donaldson Avenue) – Roundabout Design Criteria

Design Vehicle	WB-50
Design Speed	25 mph
Inscribed Diameter	140 feet
Entry Width	14-18 feet
Circulatory Width	(14-16.8) - (18- 21.6) feet
Truck Apron	3 - 15 feet
Buffer	6 feet

For a visual representation of the roundabout alternative at this intersection, see **Figure 7** below, or **Appendix C – Proposed Alternatives Displays**.

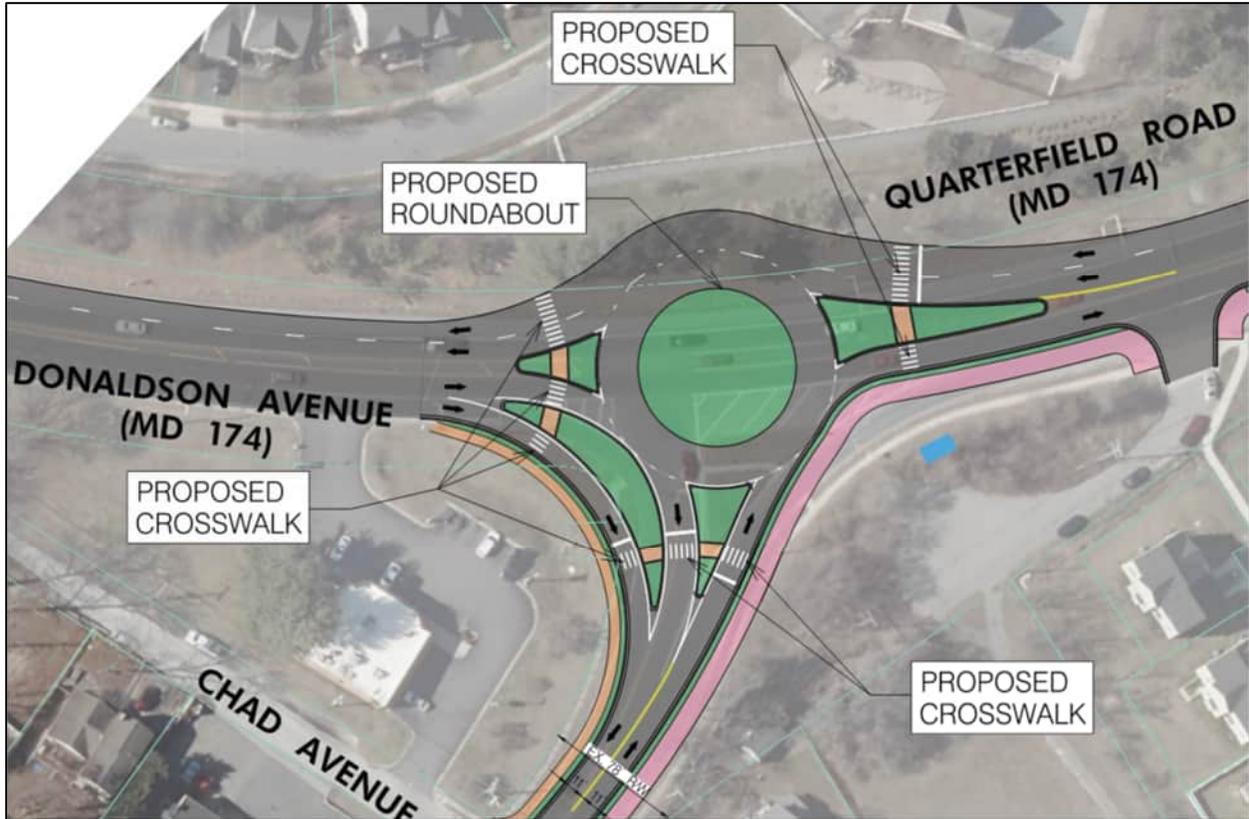


Figure 7: Quarterfield Rd at MD 174 (Donaldson Ave/Quarterfield Rd) – Roundabout Layout

Signalized Intersection Option

Based on the findings from the traffic analyses outlined in this report, the Quarterfield Road at MD 174 (Donaldson Avenue / Quarterfield Road) intersection was identified as a candidate for a signalized intersection. See section **5.2 – Traffic Signal Warrant Analysis** for more information regarding the guidelines followed, methodology used, observed results, and analysis performed to develop this option.

For a visual representation of the signalized intersection alternative at this intersection, see **Figure 8** below, or **Appendix C**.

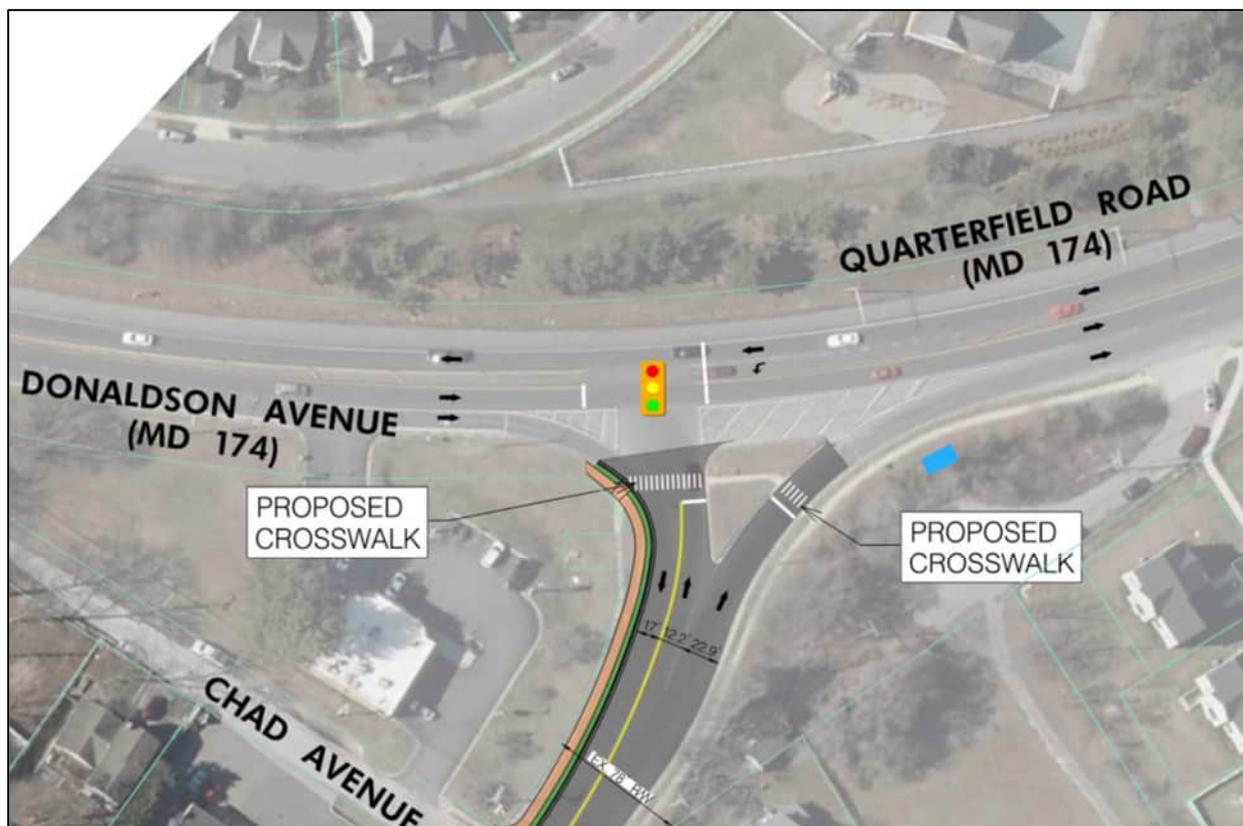


Figure 8: Quarterfield Rd at MD 174 (Donaldson Ave/Quarterfield Rd) – Signalized Intersection Layout

Quarterfield Road at Stevenson Road

All-Way Stop Controlled Option

Based on the findings from the traffic analyses outlined in this report, the Quarterfield Road at Stevenson Road intersection was identified as a candidate to potentially convert to an all-way stop controlled condition. See section **5.1 – Multi-Way Stop Warrant Analysis** for more information regarding the guidelines followed, methodology used, observed results, and analysis performed to develop this option.

For a visual representation of the all-way stop controlled intersection alternative at this intersection, see **Figure 9** below, or **Appendix C**.

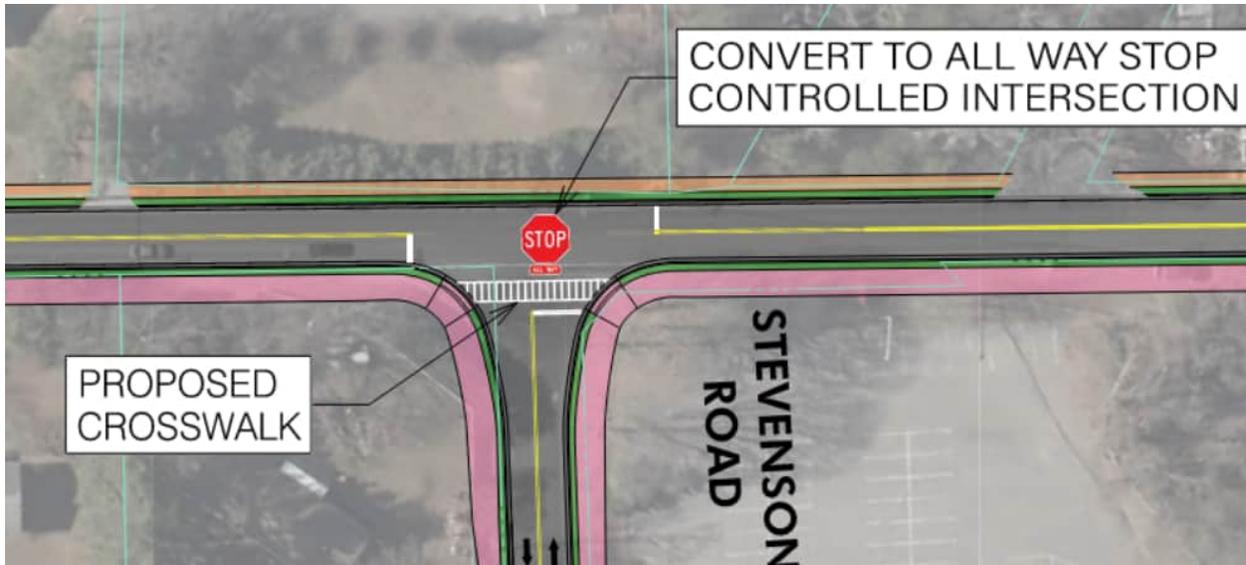


Figure 9: Quarterfield Road at Stevenson Road – All-Way Stop Controlled Layout

Roundabout Option

Based on the findings from the traffic analyses outlined in this report, the Quarterfield Road at Stevenson Road intersection was identified as a candidate for a single-lane roundabout. The design criteria and methodology used for sizing and choosing the type of roundabout followed the guidelines outlined in the *Maryland State Highway Administration (SHA) Roundabout Design Guidelines*, the *National Cooperative Highway Research Program (NCHRP) Research Report 1043 – Guide for Roundabouts (2023)*, and *A Policy on Geometric Design of Highways and Streets (AASHTO), 7th Edition (Green Book)*.

Roundabouts were designed to accommodate the WB-50 design vehicle. A smaller diameter roundabout to accommodate a smaller design vehicle could be analyzed as part of future capital projects to potentially reduce cost and footprint.

Table 4 outlines the design criteria selected for this roundabout.

Table 4: Quarterfield Road at Stevenson Road – Roundabout Design Criteria

Design Vehicle	WB-50
Design Speed	25 mph
Inscribed Diameter	120 feet
Entry Width	14-18 feet
Circulatory Width	(14-16.8) - (18- 21.6) feet
Truck Apron	3 - 15 feet
Buffer	6 feet

For a visual representation of the roundabout alternative at this intersection, see **Figure 10** below, or **Appendix C**.



Figure 10: Quarterfield Road at Stevenson Road – Roundabout Layout

Sight Distance Evaluation

While performing initial field investigations, it was noted that the Intersection Sight Distance (ISD) at the Stevenson Road at Quarterfield Road intersection may be substandard. A formal sight distance evaluation was performed in the field on August 18, 2025. A summary of the design criteria used and the results of the field investigations can be found below.

ISD requirements were established using policy and guidelines provided in Chapter 9.5.3.2 of *A Policy on Geometric Design of Highways and Streets (AASHTO), 7th Edition (Green Book)*. The two cases evaluated were Case B1 – Left turns from a stop controlled minor road, and Case B2 – Right turns from a stop controlled minor road. The design speed of the major road (Quarterfield Road) is 35 MPH. No time gap adjustments were needed for steep grades or additional lanes.

An ISD for Case B1 was selected from **Table 5**, sourced from page 9-46 of the *Green Book*.

Table 5: Design Intersection Sight Distance—Case B1, Left Turn from Stop

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)
15	80	165.4	170
20	115	220.5	225
25	155	275.6	280
30	200	330.8	335
35	250	385.9	390
40	305	441.0	445
45	360	496.1	500
50	425	551.3	555
55	495	606.4	610
60	570	661.5	665
65	645	716.6	720
70	730	771.8	775
75	820	826.9	830
80	910	882.0	885

An ISD for Case B2 was selected from **Table 6**, sourced from page 9-48 of the *Green Book*.

Table 6: Design Intersection Sight Distance—Case B2, Right Turn from Stop

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Intersection Sight Distance for Passenger Cars	
		Calculated (ft)	Design (ft)
15	80	143.3	145
20	115	191.1	195
25	155	238.9	240
30	200	286.7	290
35	250	334.4	335
40	305	382.2	385
45	360	430.0	430
50	425	477.8	480
55	495	525.5	530
60	570	573.3	575
65	645	621.1	625
70	730	668.9	670
75	820	716.6	720
80	910	764.4	765

The design ISD for Case B2, Right Turn from Stop was smaller than the design ISD for Case B1, Left Turn from Stop. As such, the design ISD for Case B1 was used for both departure sight triangles.

For a visual representation of the sight distance evaluation and departure sight triangles, please refer to **Appendix D**.

During the field investigations, intersection sight distance measurements were taken in both directions along Quarterfield Road. A summary of the ISD measurements for Cases B1 and B2 can be found below in **Tables 7 and 8**, respectively.

Table 7: Intersection Sight Distance — Case B1, Left Turn from Stop – Field Measurements

WESTBOUND STEVENSON ROAD AT QUARTERFIELD - INTERSECTION SIGHT DISTANCE EVALUATION FOR PASSENGER CAR EYE HEIGHT (42" (3.5')) on WB Stevenson Approach OBJECT HEIGHT (42" (3.5')) ALONG QUARTERFIELD ROAD					
A	B		C1		
APPROACH	SETBACK DISTANCE FROM WHITE EDGE LINE ON STEVENSON ROAD (FT.)	Speed	CASE B1, Left Turn from Stop - FROM STEVENSON APPROACH (FT.)	REQUIRED SIGHT DISTANCE AVAILABLE (Y/N)	FIELD MEASURED SIGHT DISTANCE (FT.)
WB STEVENSON	14.5	40 MPH	445	Y	488
		35 MPH	390	Y	
		30 MPH	335	Y	
		25 MPH	280	Y	
	8	40 MPH	445	Y	557
		35 MPH	390	Y	
		30 MPH	335	Y	
		25 MPH	280	Y	

**NOTE: Quarterfield Road Design Speed (40 MPH); Posted Speed (35 MPH)

Table 8: Intersection Sight Distance — Case B2, Right Turn from Stop – Field Measurements

WESTBOUND STEVENSON ROAD AT QUARTERFIELD - INTERSECTION SIGHT DISTANCE EVALUATION FOR PASSENGER CAR EYE HEIGHT (42" (3.5')) on WB Stevenson Approach OBJECT HEIGHT (42" (3.5')) ALONG QUARTERFIELD ROAD					
A	B		C2		
APPROACH	SETBACK DISTANCE FROM WHITE EDGE LINE ON STEVENSON ROAD (FT.)	Speed	CASE B2, Right Turn from Stop - FROM STEVENSON APPROACH (FT.)	REQUIRED SIGHT DISTANCE AVAILABLE (Y/N)	FIELD MEASURED SIGHT DISTANCE (FT.)
WB STEVENSON	14.5	40 MPH	385	N	335
		35 MPH	335	Y	
		30 MPH	290	Y	
		25 MPH	240	Y	
	8	40 MPH	385	Y	438
		35 MPH	335	Y	
		30 MPH	290	Y	
		25 MPH	240	Y	

**NOTE: Quarterfield Road Design Speed (40 MPH); Posted Speed (35 MPH)

As noted in the field measurements, the existing intersection satisfies ISD criteria for Case B1 (Left-Turn from Stop). However, for Case B2 (Right-Turn from Stop), a sight triangle length of 335' was measured, which does not meet the required length of 385' for the roadway design speed (40 MPH). The existing guide sign indicating "CENTER OF APPLIED TECHNOLOGY NORTH (RIGHT ARROW)" located along northbound Quarterfield Road, just south of the Quarterfield Road at Stevenson Road intersection was blocking sight lines when looking south.

For recommendations to improve the existing sight distance at this intersection, refer to **Section 7.2** of this report.

Stevenson Road at Entrance to CAT-North

Raised Crosswalk

There are three existing speed humps located on Stevenson Road between Crest Hill Road and the entrance to CAT-North, spaced approximately 500 to 600 feet apart. Anne Arundel County currently utilizes a 'Flat Top Speed Hump' as a traffic calming measure on various County roads. The Speed Hump provides a 6 foot long transition with up to a three inch raised flat top hump for 10 linear feet, followed by a 6 foot long transition back down to existing road grade. The dimensions shown in this detail would also apply to a raised crosswalk.

A raised crosswalk was considered at this location to both expand the limits of the existing speed humps along Stevenson Road as well as to establish a school zone for both the future Middle School (to replace CAT-North) and Archbishop Spalding High School. The raised crosswalk is proposed for the west leg of the Stevenson Road at Entrance to CAT-North intersection.

An additional Flat Top Speed Hump was also proposed just west of Grasons Court, which would provide four speed humps, and one raised crosswalk along the Stevenson Road corridor. The speed humps and raised crosswalk would work in conjunction with the posted 30 MPH speed limit from approximately Grasons Court to Crest Hill Road to provide a safer environment for all users.

For a visual representation of the raised crosswalk and other speed humps details along Stevenson Road, please refer to **Appendix E**.

4.3 Additional Improvements

Additional improvements were also considered in conjunction with the proposed design alternatives. These additional improvements will provide increased visibility, accessibility, and safety throughout the project corridor. Some additional improvements considered for this study are listed below:

- Marked Crosswalks and Stop Lines at all major intersections along both Quarterfield Road and Stevenson Road. This will provide improved visibility for all users, and safer crossings for pedestrians and cyclists. These improvements support previous recommendations made in the *Safe Routes to School Study*.
- Wider (8-inch) pavement markings for edge lines. This will increase visibility of traveled lanes and provide a clearer delineation between motorist lanes and bicycle lanes.

- Signing updates/improvements to account for School Zones (including Quarterfield Elementary School, Future Middle School to replace CAT-North, and Archbishop Spalding High School). The school zone signing will be updated in coordination with the speed camera program.

4.4 Stormwater Management (SWM) Analysis

A desktop level evaluation of potential Stormwater Management (SWM) facility locations within the project corridor was performed. The corridor was analyzed from aerial and street level views to identify low points, locations of potential drainage concerns, and available parcels and green space. Some constraints when selecting potential SWM facility locations were the presence of underground utilities, limited available right-of-way, and how the facility would mesh with the associated pedestrian and roadway improvements. Implementing linear facilities such as grass swales and bioswales were also considered during this exercise.

The SWM options, including locations and types of facilities, are outlined below and depicted in **Figures 11, 12, 13, 14, and 15**:



Figure 11: SWM Facility Options – Stevenson Road Near New Cut Road

1. Potential Outfall location within the available right-of-way. Located in the northwest corner of the Stevenson Road at Old Stevenson Road intersection.
2. Potential Grass Swale/Bioswale location. Located in the southwest corner of the Stevenson Road at New Cut Road intersection.



Figure 12: SWM Facility Options – Stevenson Road Near Entrance to CAT-North

3. Potential Bio-Retention Pond location. Located in the parcel just west of the entrance to CAT-North.
4. Potential Bio-Retention Pond location. Located in the parcel just east of the entrance to CAT-North.
5. Retrofit the existing County-owned pond. Located in the parcel just east of the entrance to CAT-North.



Figure 13: SWM Facility Options – Stevenson Road Near Grasons Court

6. Potential Outfall location within available right-of-way. Located along WB Stevenson Road, west of the property at 829 Stevenson Road.



Figure 14: SWM Facility Options – Quarterfield Road at Donaldson Avenue

7. Potential Grass Swale/Bioswale location within the available right-of-way. Located in the NE corner of the Quarterfield Road at Donaldson Avenue intersection.



Figure 15: SWM Facility Options – Stevenson Road at Quarterfield Road

8. Potential other facility located in County-owned parcel at the low point along northbound Quarterfield Road.

4.5 Cost Comparison and Right-of-Way Estimates

Concept Level Cost Estimates and Right-of-Way acreage estimates for each alternative were developed for comparative analysis and to help with selecting a recommended alternative. High level quantities were calculated for each alternative, and a construction cost was estimated utilizing the latest comparable costs from the latest *State Highway Administration (SHA) Price Index*.

Quantities calculated for corridor wide improvements included pavement section quantities, pavement markings, concrete sidewalk, asphalt SUP, curb and gutter, and landscaping. Several other items were not quantified at this stage, but were estimated using an assumed percentage of the total construction cost, including preliminary items, earthwork, survey, utility relocations, right-of-way acquisition, etc. See **Table 9** below for a high-level comparison of construction costs and right-of-way impacts for each alternative.

Table 9: Planning Level Alternatives Cost and Right-of-Way Matrix

Alternative	Construction Cost	R/W Impacts (Ac)
1	\$ 6,300,000	13.54
2	\$ 5,500,000	6.04
3	\$ 6,000,000	11.79

5. ALTERNATIVES ANALYSES

Various operational and safety analyses were performed for the alternatives proposed for the Stevenson Road and Quarterfield Road study. The operational analysis focuses on warrants required for either multi-way stop conditions or signal control, as well as all-way stop control, signal, and roundabout intersection analysis. The safety analysis evaluates predictive crashes based on future conditions and assesses pedestrian and bicycle comfort levels for each proposed alternative.

5.1 Multi-Way Stop Warrant Analysis

An all-way stop control (AWSC) warrant analysis was evaluated for the Stevenson Road at Quarterfield Road intersection under existing traffic volumes. This intersection currently has stop control on the Stevenson Road approach only, while the Quarterfield Road approaches operate under free flow conditions.

According to the Maryland Manual on Traffic Control Devices (MdMUTCD), multi-way stop control can be useful as a safety measure at intersections if certain traffic conditions exist. Safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.

The multi-way stop analysis is based on four warrants that are specified in Section 2B.07 of the 2011 Edition of the Maryland Manual on Uniform Traffic Control Devices (MdMUTCD). The four multi-way stop control warrants are:

- Warrant A, Traffic Control Signals
- Warrant B, Crash Experience
- Warrant C, Minimum Volumes
 - C.1, Eight-Hour Vehicular Volumes
 - C.2, Eight-Hour Vehicular, Pedestrian, and Bicycle Volumes
 - C.3, Major-Street Speed
- Warrant D, 80% of Warrants B, C.1, and C.2.

A description of each of the warrants and results for the study intersection are provided below:

- Warrant A, Traffic Control Signals – Where traffic signals are justified, the multi-way stop may be used as an interim measure that can be installed quickly to control traffic while arrangements are made for installation of the traffic control signal. As indicated in **this report, a traffic signal is not warranted at the intersection of Stevenson Road and Quarterfield Road, and therefore Warrant A is not met.**
- Warrant B, Crash Experience – Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. **Based on the crash data provided by SHA, a total of six crashes were reported over a five-year period at the intersection. The highest number of reported crashes in any given year during that time was three. Therefore, Warrant B is not met.**
- Warrant C, Minimum Volumes
 - C.1, Eight-Hour Vehicular Volumes – The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day. **Nine of the 13 hours of vehicular volume on the major street approaches are equal to or greater than 300 vehicles per hour. Since the number of hours meets or exceeds the eight hour requirement, criteria C.1 for Warrant C is met.**
 - C.2, Eight-Hour Vehicular, Pedestrian, and Bicycle Volumes – The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour. **Four of the 13 hours of vehicular volume on the minor street approach are equal to or greater than 200 vehicles per hour. Since the number of hours does not meet or exceed the eight hour requirement and the highest existing peak hour does not have a delay of at least 30 seconds vehicle, criteria C.2 of Warrant C is not met.**
 - C.3, Major-Street Speed – If the 85th percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2. **The 85th percentile speed for Quarterfield Road is 39 MPH, which is below the requirement for this warrant to be considered. However, the traffic volumes reported on the major and minor street approaches do meet the required 210 and 140 vehicles per hour for the same eight hours. Given that the volumes do meet the 70% threshold,**

consideration may be given to how close (39 MPH) the speed study results are to the 40 MPH threshold. It is possible that future volume and speed data collections could yield higher speed results. However, for the purposes of this study, all elements of criteria C.3 are not met, and therefore, the overall Warrant C is not met.

- Warrant D, 80% of Warrants B, C.1, and C.2. – Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition. **To satisfy Criteria B, C.1, and C.2 to 80 percent of the minimum values (4 crashes within a 12-month period, 240 vehicles per hour on the major street approaches, and 160 vehicles per hour on the minor street approaches) would be required. Twelve of the 13 hours of vehicular volume on the major street approaches are equal to or greater than 240 vehicles per hour. However, only four of the 13 hours of vehicular volume on the minor street approach are equal to or greater than 160 vehicles per hour, and 80% of Warrant B would still not equate to enough reported crashes. Therefore, Warrant D is not met.**

Table 10 summarizes the results of the multi-way stop control warrant at the Stevenson Road and Quarterfield Road intersection.

Table 10: Summary of Multi-Way Stop Control Warrants (Stevenson/Quarterfield)

MULTI-WAY STOP CONTROL WARRANT	SATISFIED (YES/NO)
A: Traffic Control Signals	NO
B: Crash Experience	NO
C: Minimum Volumes	NO
- C.1: Eight-hour Vehicular Volumes	YES
- C.2: Eight-hour Vehicular, Pedestrian, and Bicycle Volumes	NO
- C.3: Major Street Speed	NO
D: 80% of Warrants B, C.1, and C.2	NO

For the study intersection, only criteria C.1 of Warrant C for multi-way stop control is satisfied, but since criteria C.2 and C.3 are not met, Warrant C is not met. Based on the traffic volumes and crash data, no other warrants for a multi-way stop control are met at the intersection of Stevenson Road and Quarterfield Road.

It should be noted that the MdMUTCD also identifies other criteria that may be considered in an engineering study, including:

- The need to control left-turn conflicts.
- The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes.
- Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and

D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.

Due to the current intersection sight distance limitations and need to promote pedestrian and bicycle traffic on these corridors, a multi-way stop control should still be considered prior to 2050 future conditions at this intersection as part of the Alternative 2 recommendation. The latest edition of the MUTCD (2023) also has a warrant associated with sight distance requirements. In addition, SHA plans to publish a new MdMUTCD in 2026. Although not officially adopted in Maryland yet, the new MUTCD may be utilized in a future study to confirm a multi-way stop condition at Stevenson Road and Quarterfield Road. Please note that a change to multi-way stop control could introduce some delays to school buses and emergency service vehicles that travel along Quarterfield Road. **Table 11** provides a summary of the all way stop control results for Stevenson Road at Quarterfield Road.

Table 11: Summary of Study Intersection Traffic Results (2050 Build Alternative – All Way Stop Control)

Intersection	Traffic Control All Way Stop Control (Proposed)	2050 Build	
		LOS / Delay (sec/veh)	
		AM	PM
Stevenson Rd at Quarterfield Rd	EB Approach	C / 15.7	B / 11.9
	WB Approach	C / 17.9	B / 14.4
	NB Approach	B / 13.8	B / 13.5
	Overall	C / 16.0	B / 13.5

Delay values measured in seconds/vehicle (sec/veh)

Refer to **Appendix F** for a summary of the traffic volumes used for the multi-way stop control warrants and **Appendix G** for the HCS All Way Stop Control analysis.

5.2 Traffic Signal Warrant Analysis

Traffic Signal Warrant Analysis (TSWA) were performed for the following two intersections:

- Existing two-way stop-controlled (TWSC) intersection of MD 174 (Donaldson Avenue/Quarterfield Road) at Quarterfield Road using the count data obtained on September 17, 2024.
- Existing two-way stop-controlled (TWSC) intersection of Stevenson Road at Quarterfield Road using the count data obtained on September 17, 2024.

The signal warrant analysis is based on nine warrants that are specified in the 2011 Edition of the Maryland Manual on Uniform Traffic Control Devices (MdMUTCD). The nine signal warrants are:

- Warrant 1, Eight-Hour Vehicular Volume.
- Warrant 2, Four-Hour Vehicular Volume.
- Warrant 3, Peak Hour.
- Warrant 4, Pedestrian Volume.
- Warrant 5, School Crossing.
- Warrant 6, Coordinated Signal System.
- Warrant 7, Crash Experience.
- Warrant 8, Roadway Network.

- Warrant 9, Intersection Near a Grade Crossing.

The largest 12-hour volume total (7:00 AM to 7:00 PM) of the 13-hour counts performed on September 17, 2024 was used for the warrant analyses. The traffic signal warrant analysis was conducted using the Highway Capacity Software (HCS7) Warrants program. The HCS7 Warrants worksheets for MD 174 (Donaldson Avenue/Quarterfield Road) at Quarterfield Road and Stevenson Road at Quarterfield Road may be found in **Appendix H** and **Appendix I**, respectively.

The description of the signal warrants from the 2011 MdMUTCD and the results of the warrant analysis are provided below.

Warrant 1, Eight-Hour Vehicular Volume

According to the 2011 MdMUTCD, the Minimum Vehicular Volume, Condition A, is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal. For two lanes or more on a major street approach, and one lane on the minor street approaches, the mainline volume must be greater than 600 vehicles per hour at the same time that the minor street approach volume is 150 or greater for each of any eight hours of an average day. The Interruption of Continuous Traffic, Condition B, is intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delays or conflict in entering or crossing the major street. It is intended that Warrant 1 be treated as a single warrant.

If Condition A is satisfied, then the criteria for Warrant 1 are satisfied and Condition B and the combination of Conditions A and B are not needed. Similarly, if Condition B is satisfied, then the criteria for Warrant 1 are satisfied and the combination of Conditions A and B is not needed. Eight hours are required to satisfy this volume warrant.

MD 174 at Quarterfield Road

At this intersection, all 12 hours evaluated were satisfied for Condition A. Likewise, Condition B – Interruption of Continuous Traffic, was met for all 12 hours. Therefore, Warrant 1 was satisfied.

Stevenson Road at Quarterfield Road

At this intersection, only two of the 12 hours evaluated had a sufficient volume for Condition A so this condition is not satisfied. Likewise, Condition B – Interruption of Continuous Traffic, was not met for any of the 12 hours. Therefore, Warrant 1 was not satisfied.

At the request of Anne Arundel County, it was determined that because the 85th percentile speed along Quarterfield Road was so close to 40 MPH, and likely exceeds 40 MPH, that the traffic volumes in the 70 percent columns in Table 4C-1 of the MdMUTCD may be used in place of the 100 percent columns for conditions A and B to evaluate Warrant 1, Eight Hour Vehicular Volumes for the Stevenson Road at Quarterfield Road intersection. Please refer to **Figure 16** for a copy of Table 4C-1 from the MdMUTCD.

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% ^a	80% ^b	70% ^c	56% ^d	100% ^a	80% ^b	70% ^c	56% ^d
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% ^a	80% ^b	70% ^c	56% ^d	100% ^a	80% ^b	70% ^c	56% ^d
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

^a Basic minimum hourly volume
^b Used for combination of Conditions A and B after adequate trial of other remedial measures
^c May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000
^d May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

Figure 16: Table 4C-1 (from MdMUTCD) for Warrant 1

When evaluating using the 70 percent volumes criteria, seven of the 12 hours evaluated had a sufficient volume for Condition A so this condition is still not satisfied. Likewise, Condition B – Interruption of Continuous Traffic, only met for two of the 12 hours. Therefore, Warrant 1 was still not satisfied.

Warrant 2, Four-Hour Vehicular Volume

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal. According to the MdMUTCD, the need for a traffic signal shall be considered if, for each of any four hours of an average day, the values representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor street approach (one direction only) all fall above the applicable curve in Figure 4C-1 for the existing combination of approach lanes.

MD 174 at Quarterfield Road

For the study intersection, all 12 hours evaluated were satisfied for Warrant 2. Therefore, Warrant 2 was satisfied.

Stevenson Road at Quarterfield Road

For the study intersection, none of the 12 hours were met for Warrant 2. Therefore, Warrant 2 is not satisfied. These values are summarized and calculated using the HCS Warrants software and are plotted, as shown in **Figure 17**.

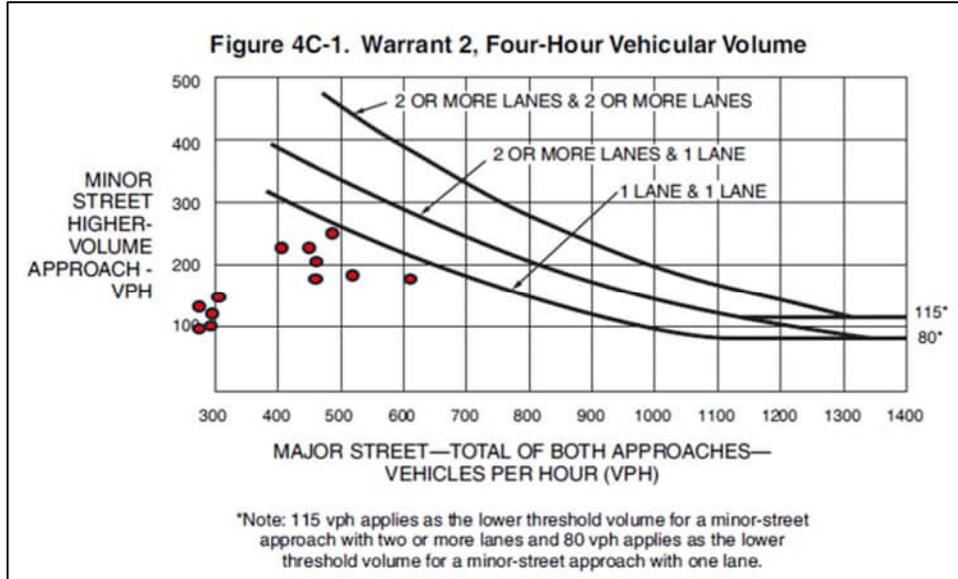


Figure 17: Figure 4C-1 (from MdMUTCD) for Warrant 2

Since it was determined that the 85th percentile speed along Quarterfield Road was so close to 40 MPH, and likely exceeds 40 MPH, that the traffic volumes in the 70 percent columns in Figure 4C-2 of the MdMUTCD may be used in place of Figure 4C-1 to evaluate Warrant 2, Four Hour Vehicular Volumes for the Stevenson Road at Quarterfield Road intersection. Please refer to **Figure 18** for the plotted points on Figure 4C-2 from the MdMUTCD.

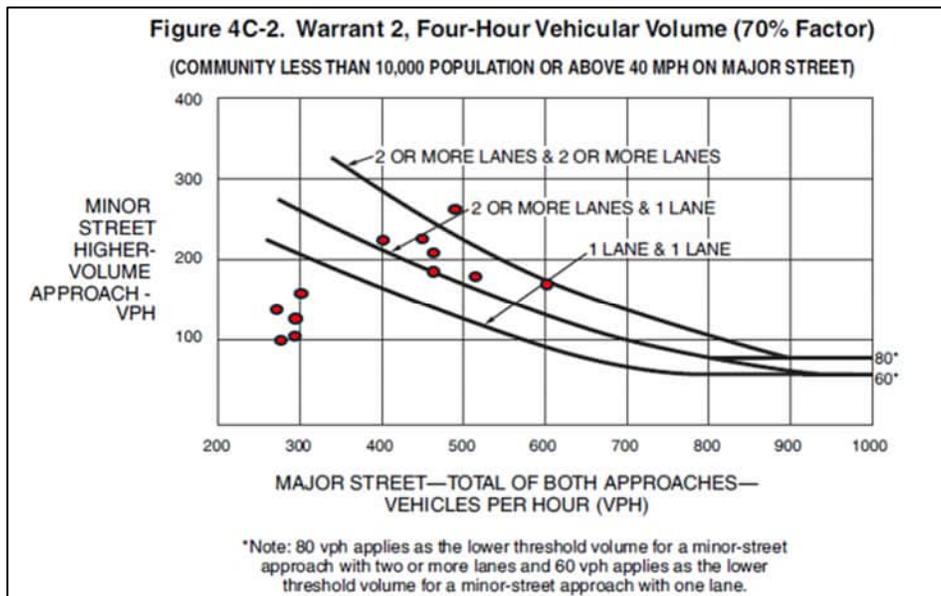


Figure 18: Figure 4C-2 (from MdMUTCD) for Warrant 2

When evaluating using the 70 percent volumes criteria, seven of the 12 hours evaluated had a sufficient volume for Condition B so this condition is satisfied. Therefore, Warrant 2 was satisfied.

Warrant 3, Peak Hour

The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of one hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

According to the MdMUTCD, the need for a traffic signal shall be considered if an engineering study finds that the criteria in either of the following two categories are met:

Warrant 3A (All three conditions exist for the same one hour; any four consecutive 15-minute periods of an average day)

- The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds 4 vehicle-hours for a one-lane approach or 5 vehicle-hours for a two-lane approach.
- The volume on the same minor street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes; and
- The total entering volume serviced during the hour equals 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.

MD 174 at Quarterfield Road

Warrant 3A was not evaluated for the existing volumes since stopped time delay data was not collected at the study intersection. Therefore, Warrant 3A is not satisfied for the purposes of this study.

Stevenson Road at Quarterfield Road

Warrant 3A was not evaluated for the projected volumes since it is not possible to measure stopped delay values on projected volumes. Therefore, Warrant 3A is not satisfied for the purposes of this study.

Warrant 3B

- The values representing the vehicles per hour on the major street (total or both approaches) and the corresponding vehicles per hour on the higher-volume minor street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 of the MdMUTCD for the existing combination of approach lanes.

MD 174 at Quarterfield Road

For the study intersection, all 12 hours meet the requirements of Warrant 3B. Therefore, Warrant 3B is satisfied. Since 3B is satisfied, Warrant 3 (overall) is satisfied.

Stevenson Road at Quarterfield Road

For the intersection, no hour meets the requirements of Warrant 3B. Therefore, Warrant 3B was not satisfied. Since 3B is not satisfied, Warrant 3 (overall) is not satisfied. These values are summarized and calculated using the HCS Warrants software and plotted as shown in **Figure 19**.

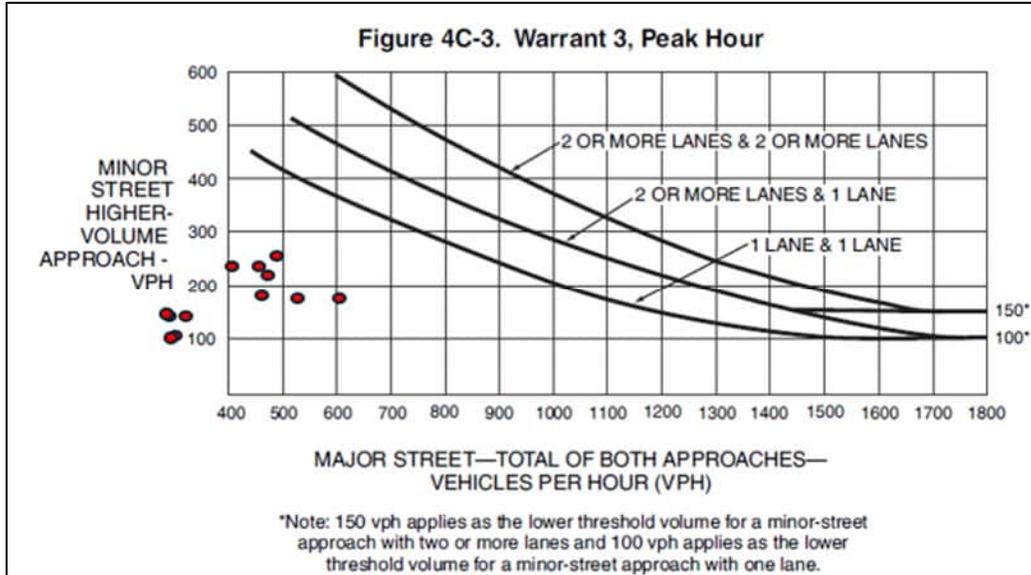


Figure 19: Figure 4C-3 (from MdMUTCD) for Warrant 3

Similar to the reevaluations made for Warrants 1 and 2 because of the 85th percentile speed along Quarterfield Road, Warrant 3 was also reevaluated using Figure 4C-4 in place of Figure 4C-3 in the MdMUTCD for Warrant 3, Peak Hour (70% Factor) for the Stevenson Road at Quarterfield Road intersection. Please refer to **Figure 20** for the plotted points on Figure 4C-4 from the MdMUTCD.

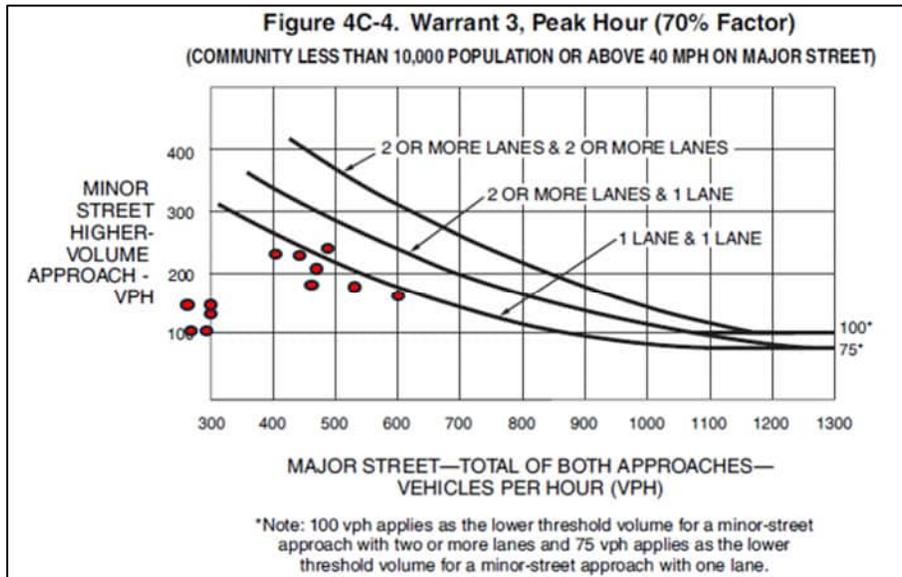


Figure 20: Figure 4C-4 (from MdMUTCD) for Warrant 3

When evaluating using the 70 percent volumes criteria, one hour was met for of Warrant 3B. Therefore, Warrant 3B was satisfied. Since 3B is satisfied, Warrant 3 (overall) is satisfied.

Warrant 4, Pedestrian Volume

The Pedestrian Volume signal warrant is intended for application where the traffic volume on a major street is so heavy that pedestrians experience excessive delay in crossing the major street. The need for a traffic control signal at an intersection or a midblock crossing shall be considered if the following conditions are met:

- A. The pedestrian volume crossing the major street at an intersection or midblock location during an average day is 100 or more for each of any four hours or 190 or more during any one hour; and
- B. There are fewer than 60 gaps per hour in the traffic stream of adequate length to allow pedestrians to cross during the same period when the pedestrian volume criterion is satisfied. Where there is a divided street having a median of sufficient width for pedestrians to wait, the requirements applies separately to each direction of traffic.

The criteria for the pedestrian volume crossing the major roadway may be reduced by as much as 50 percent if the average crossing speed of pedestrians is less than four feet per second. A traffic control signal may not be needed at the study location if adjacent coordinated traffic control signals consistently provide gaps of adequate length for pedestrians to cross the street, even if the rate of gap occurrence is less than one per minute.

MD 174 at Quarterfield Road

Field observations along with intersection turning movement count data revealed that the pedestrian volume crossing MD 174 is very small, and therefore, this warrant does not apply.

Stevenson Road at Quarterfield Road

Field observations along with intersection turning movement count data revealed that the pedestrian volume crossing Quarterfield Road is very small, and therefore, this warrant does not apply.

Warrant 5, School Crossing

The School Crossing signal warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal.

Neither study intersection is located within a designated school zone, and therefore, this warrant is not satisfied for either intersection.

Warrant 6, Coordinated Signal System

Progressive movement in a coordinated signal system sometimes necessitates installing traffic control signals at intersections where they would not otherwise be needed to maintain proper platooning of vehicles.

Neither intersection is part of a coordinated corridor, so Warrant 6 is not met for either intersection.

Warrant 7, Crash Experience

The Crash Experience signal warrant conditions are intended for application where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal.

The study intersections do not meet this warrant because there were less than five reported crashes in any 12-month period.

Warrant 8, Roadway Network

Installing a traffic control signal at some intersections might be justified to encourage concentration and organization of traffic flow on a roadway network. This warrant is not applicable for either of the study intersections.

Warrant 9, Intersection Near a Grade Crossing

According to the MdMUTCD, the Intersection Near a Grade Crossing signal warrant is intended for use at a location where none of the conditions described in the other eight warrants are met, but the proximity to an intersection from a railroad track grade crossing on an approach controlled by a Yield or Stop sign is the main reason for considering a traffic signal. This warrant is not applicable for either of the study intersections.

Table 12 summarizes the results of the traffic signal warrant analysis for the intersections of MD 174 at Quarterfield Road and Stevenson Road at Quarterfield Road.

Table 12: Summary of Traffic Signal Warrants Analysis Results

	MD 174 AT QUARTERFIELD RD¹	STEVENSON RD AT QUARTERFIELD RD²	STEVENSON RD AT QUARTERFIELD RD² (70 PERCENT VOLUMES)
SIGNAL WARRANT NO.	SATISFIED (YES/NO)	SATISFIED (YES/NO)	SATISFIED (YES/NO)
1-A: Eight-Hour Vehicular Volume Minimum Vehicular Volume	YES	NO	NO
1-B: Eight-Hour Vehicular Volume Interruption of Continuous Traffic	YES	NO	NO
2: Four-Hour Vehicular Volume	YES	NO	YES
3-A: Peak Hour Conditions	NO	NO	NO
3-B: Peak Hour Vehicular Volumes	YES	NO	YES
4: Pedestrian Volume	NO	NO	NO
5: School Crossing	NO	NO	NO
6: Coordinated Signal System	NO	NO	NO
7: Crash Experience	NO	NO	NO
8: Roadway Network	NO	NO	NO
9: Intersection Near Grade Crossing	NO	NO	NO

1 – Warrant Analysis for MD 174 at Quarterfield Rd provided in Appendix I

2 – Warrant Analysis for Stevenson Rd at Quarterfield Rd provided in Appendix H

By evaluating the 70 percent volumes for Warrant 1 in Table 4C-1, and by plotting the data points on the MdMUTCD figures for Warrants 2 and 3 for 70% volume conditions (see below) confirms how close the points are to the thresholds under each condition. As shown, it was found that Warrant 2 is clearly met for the 70 percent condition.

The current MdMUTCD and new FHWA MUTCD (2023) both include language for incorporating other site-specific factors as appropriate for justifying traffic signals. The language on signal needs studies in the new FHWA MUTCD changes almost all standard statements to guidance, providing more flexibility, which assists with considering changes to traffic controls at these intersections. With the presence of multiple schools in the area, a future middle school planned to replace the CAT-North school, pedestrian/bicycle facilities, and warrants met with the 85th percentile speeds exceeding 40 MPH and the population of the surrounding community, installing a future traffic signal at the Stevenson Road and Quarterfield Road intersection should be considered.

Capacity analysis for the study intersections was performed using the Highway Capacity Manual (HCM) methodologies to analyze the weekday AM and PM peak hours. The Synchro traffic software was used to analyze the signalized and unsignalized intersections.

Table 13 summarizes the delay ranges (seconds/vehicle) that correspond to the level of service (LOS) for two-way (side street) stop-controlled intersections and signalized intersections. In general, the Anne Arundel County Traffic Impact Study Guidelines state that a LOS of "D" is acceptable for intersections and roadway segments.

Table 13: Intersection Levels of Service and Delay Thresholds

LOS	Delay Threshold (sec/veh)	
	Two-Way (Side Street) Stop*	Signal
A	0 - 10	0 - 10
B	10 - 15	10 - 20
C	15 - 25	20 - 35
D	25 - 35	35 - 55
E	35 - 50	55 - 80
F	> 50	> 80

Source: Highway Capacity Manual

**Applies to only the worst of the stop-controlled approaches*

The Highway Capacity Manual (HCM) Signalized and Unsignalized Intersection analysis results comparing the 2050 No Build conditions and 2050 Build conditions are shown in **Table 14** for the study intersections. Please note that the 2050 No Build Condition for the Stevenson Road at Quarterfield Road intersection assumes that an all-way stop condition is in place.

Table 14: Summary of Study Intersection Traffic Results (2050 Build Alternative - Signal)

Intersection	Approach	2050 No Build		2050 Build	
		LOS / Delay (sec/veh)		LOS / Delay (sec/veh)	
		Stop Control (Existing)		Signal (Proposed)	
		AM	PM	AM	PM
Quarterfield Rd / MD 174 (Donaldson Ave / Quarterfield Rd)	WB	A / 3.2	A / 3.1	B / 17.1	B / 19.4
	EB	---	---	D / 38.8	D / 44.9
	NB	F / 133.3	F / 338.7	B / 17.7	C / 29.1
	Overall	N/A	N/A	C / 25.0	C / 30.3
Stevenson Rd / Quarterfield Rd*	WB	B / 13.8	B / 13.8	A / 9.8	A / 6.8
	NB	C / 15.7	B / 11.9	B / 8.3	A / 8.8
	SB	C / 17.9	B / 14.4	D / 51.5	C / 31.7
	Overall	C / 16.0	B / 13.5	C / 24.5	B / 16.3

Delay values measured in seconds/vehicle (sec/veh)

*The 2050 No Build Condition for Stevenson Rd at Quarterfield Rd is assumed to be AWSC.

The 95th percentile queue analysis results from Synchro for key turning movements at the MD 174/Quarterfield Road and Stevenson Road/Quarterfield Road intersections comparing the 2050 No Build conditions and Build conditions with a signal are shown in **Table 15**.

Table 15: Summary of Study Intersection 95th Percentile Queues (2050 No Build vs. Build)

Intersection	Key Movement	Existing Storage Length (ft)	2050 No Build Conditions* 95th % Queue (ft)		2050 Build Conditions 95th % Queue (ft)	
			Stop Control		Signal	
			AM	PM	AM	PM
MD 174 at Quarterfield Rd	WB MD 174 Left-Turn*	150	35	25	198	251
	NB Quarterfield Left-Turn*	200	223	173	64	69
	NB Quarterfield Right-Turn*	200	205	63	138	88
Stevenson Rd / Quarterfield Rd	WB Stevenson Left/Right Turn*	700	63	70	93	77
	NB Quarterfield Thru/Right*	720	100	53	111	71
	SB Quarterfield Thru/Left*	1150	113	78	290	178

* - Synchro provides 95th queue by # of vehicles for stop-controlled intersections. Queue calculation: # of Vehicles x 25 ft/vehicle

*The 2050 No Build Condition for Stevenson Rd at Quarterfield Rd is assumed to be AWSC.

Queuing along the westbound MD 174 left-turn lane may exceed the available storage length for this movement. If a signal is proposed, further analysis is recommended to determine the appropriate storage length for the westbound MD 174 left-turn to accommodate future queues with a traffic signal control.

There were no apparent queuing issues at the Stevenson Road and Quarterfield Road intersections under 2050 No Build (All Way Stop Control) or 2050 Build (Signal Control) conditions.

Refer to **Appendix J** for the Synchro reports for 2050 Build Conditions for a signal at the MD 174 and Quarterfield Road intersection and at the Stevenson Road and Quarterfield Road intersection.

5.3 Roundabout Traffic Analysis

In addition to the multi-way stop control and signal warrant analysis, roundabouts were evaluated at the Stevenson Road at Quarterfield Road and the MD 174 (Donaldson Avenue / Quarterfield Road) at Quarterfield Road intersections. The SIDRA software program was used to analyze single-lane roundabouts at both intersections.

For the Stevenson Road at Quarterfield Road intersection, a single-lane roundabout configuration was evaluated. **Figure 21** illustrates the initial roundabout configuration evaluated for this intersection.

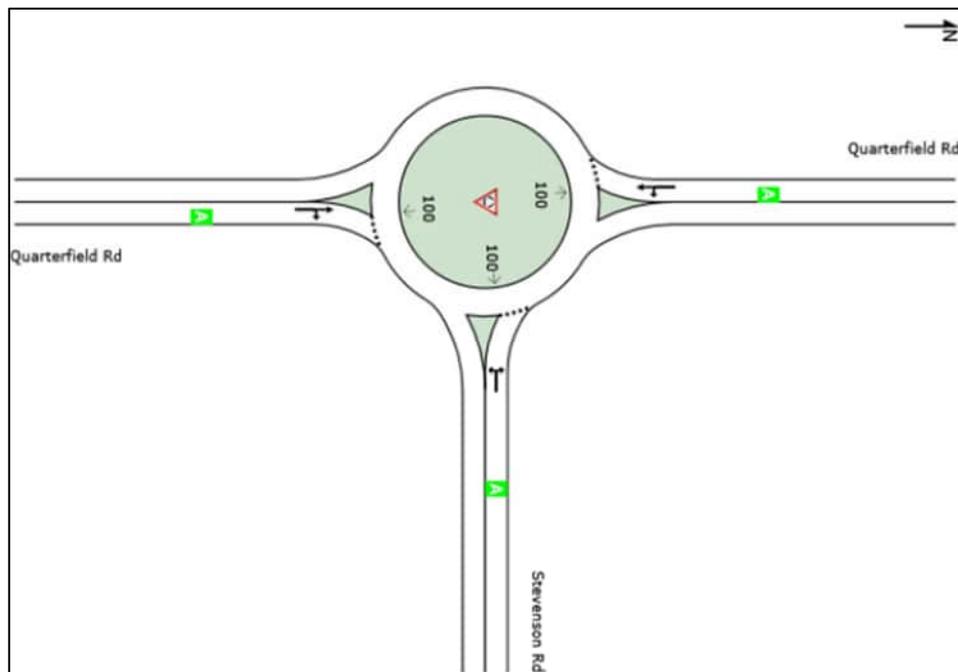


Figure 21: Single-Lane Roundabout – Stevenson at Quarterfield

Capacity analysis for the study intersections was performed using the Highway Capacity Manual (HCM) methodologies to analyze the weekday AM and PM peak hours under 2050 Build Conditions. The SIDRA traffic software was used to analyze the signalized and unsignalized intersections.

The SIDRA single-lane roundabout analysis results comparing the 2050 Build conditions are shown in **Table 16** for the Stevenson Road at Quarterfield Road study intersection.

Table 16: Summary of SIDRA Roundabout Analysis (2050 Build Conditions) – Quarterfield at MD 174

INTERSECTION	APPROACH	SINGLE-LANE ROUNDABOUT	
		AM Delay* (LOS)	PM Delay* (LOS)
Stevenson Rd at Quarterfield Rd	NB Quarterfield	8.4 (A)	5.4 (A)
	SB Quarterfield	6.3 (A)	6.1 (A)
	WB Stevenson	6.1 (A)	6.0 (A)
	OVERALL	7.0 (A)	5.9 (A)

* - sec/veh

For the MD 174 at Quarterfield Road intersection, the initial roundabout configuration evaluated consisted of maintaining the right-turn movements along eastbound MD 174 and northbound Quarterfield Road as bypass lanes to the roundabout, which is similar the existing two-way stop controlled intersection design. **Figure 22** illustrates the initial roundabout configuration evaluated for this intersection.

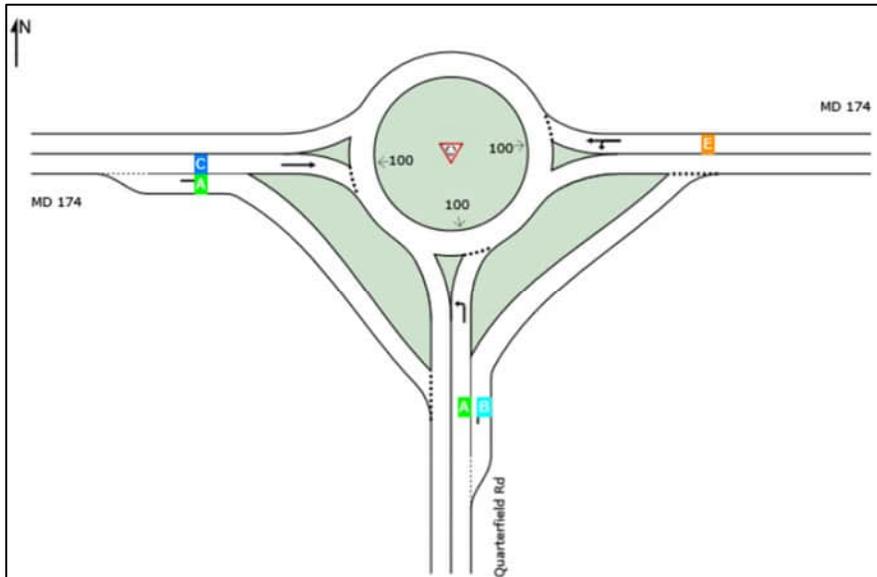


Figure 22: Single-Lane Roundabout (Initial Design) – Quarterfield at MD 174

This initial design included eastbound MD 174 and northbound Quarterfield Road right-turn bypass lanes to replicate the separate right-turn lanes under existing conditions. However, the westbound MD 174 approach is expected to operate at a LOS “E” during the PM peak period and generate a significant queue length with this design. As a result, the roundabout was reevaluated with a bypass lane for the westbound MD 174 through movement to improve the approach and overall intersection operations. This would require the roundabout to provide two circulating lanes to accommodate the westbound through movement. **Figure 23** illustrates the revised configuration for this intersection.

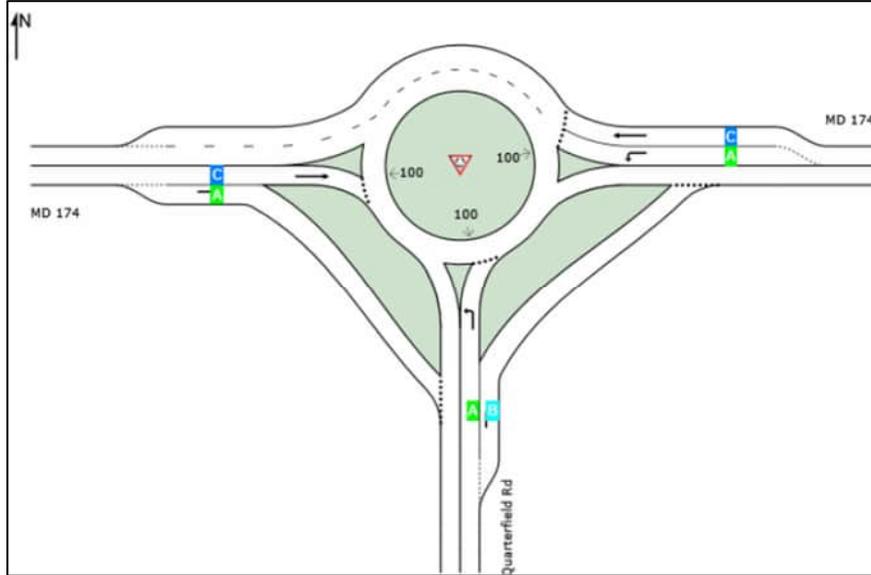


Figure 23: Single-Lane Roundabout (Revised Design) – Quarterfield at MD 174

Capacity analysis for the study intersections was performed using the Highway Capacity Manual (HCM) methodologies to analyze the weekday AM and PM peak hours under 2050 Build Conditions. The SIDRA traffic software was used to analyze the signalized and unsignalized intersections.

The SIDRA single-lane roundabout analysis results comparing the 2050 Build conditions are shown in **Table 17** for the MD 174 at Quarterfield Road study intersection with and without a westbound MD 174 through bypass lane.

Table 17: Summary of SIDRA Roundabout Analysis (2050 Build Conditions) – Quarterfield at MD 174

INTERSECTION	APPROACH	SINGLE-LANE ROUNDABOUT		SINGLE-LANE ROUNDABOUT	
		INITIAL DESIGN (WITHOUT WB MD 174 BYPASS LANE) -FIGURE 16-		REVISED DESIGN (WITH WB MD 174 BYPASS LANE) -FIGURE 17-	
		AM Delay* (LOS)	PM Delay* (LOS)	AM Delay* (LOS)	PM Delay* (LOS)
MD 174 (Donaldson Ave / Quarterfield Rd) at Quarterfield Rd	EB MD 174	10.1 (C)	21.3 (C)	7.5 (A)	21.3 (C)
	WB MD 174	18.4 (C)	35.0 (E)	11.5 (B)	15.8 (C)
	NB Quarterfield	11.1 (B)	10.1 (B)	10.1 (B)	10.1 (B)
	OVERALL	14.0 (B)	26.6 (D)	10.9 (B)	17.4 (C)

* - sec/veh

Refer to **Appendix K** for the SIDRA reports for 2050 Build Conditions for roundabouts at the Stevenson Road / Quarterfield Road and MD 174 / Quarterfield Road intersections.

5.4 Posted Speed Limit Evaluations

To support the project's purpose and need, speed limit evaluations were performed using the Federal Highway Administration's (FHWA) USLIMITS2 tool along the following roadway segments:

- Quarterfield Road, from Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road)
- Stevenson Road, from Quarterfield Road to the CAT-North Entrance.
- Stevenson Road, from Archbishop Spauling HS Entrance to Crest Hill Road

To address the purpose and need, the study aims to provide continuous pedestrian and bicycle facilities, promote complete streets and Vision Zero principles for all modes of travel, and support access and mobility needs for local schools and residents alike.

The FHWA USLIMITS2 tool is a web-based tool designed to help practitioners with conducting an engineering study for setting reasonable, safe, and consistent speed limits for specific segments of roads.

The USLIMITS2 tool was developed based on research through the **National Cooperative Highway Research Program (NCHRP) Project 3-67**. USLIMITS2 considers all major factors used by practitioners to make engineering judgment in determining an appropriate speed limit. This includes operating speed (50th and 85th percentile), annual average daily traffic, roadway characteristics and geometric conditions, level of development in the area around the road, crash and injury rates, presence of on-street parking, and extent of ped/bike activity, as well as several others depending on the road type.

USLIMITS2 is applicable to all types of roads; however, it is not applicable to school zones, construction zones, or roads with variable speed limits that are raised or lowered based on weather, traffic conditions, or other factors. Engineering experience and knowledge should be used in collecting the required information and when interpreting the results. Please note that this tool does not constitute a standard, specification, or regulation.

Quarterfield Road, from Janet Dale Lane to MD 174

Quarterfield Road has a posted speed limit of 35 MPH. There is a section on this roadway (east of Stevenson Road) near the Quarterfield Elementary School that is signed as a School Zone. However, there are no advisory speeds, time of day speed reductions, or other changes to the posted speed limit through the school zone. There is an automated speed enforcement camera near the school entrance, but there are no associated regulatory or advisory speed limits associated with the camera.

The USLIMITS2 tool recommends that the posted speed limit should remain 35 MPH under existing and future (2050) traffic conditions. However, the speed limit results for existing conditions also indicate that a comprehensive crash study should be undertaken to identify engineering and traffic control deficiencies and appropriate corrective actions. The speed limit should only be reduced as a last measure after all other treatments have either been tried or ruled out. Crash data was not available for evaluating the 2050 conditions. Crash data should be evaluated periodically along this corridor and updated for future assessments. If the road will

undergo design modifications, changes to the speed limit may be justified. It should be noted that automated speed cameras are not considered in the USLIMITS2 data inputs.

Stevenson Road, from Quarterfield Road to the CAT-North Entrance

This section of Stevenson Road has a posted speed limit of 35 MPH. There is an End School Zone along eastbound Stevenson Road located approximately 250 feet east of the CAT-North Entrance and past the Archbishop Spalding High School intersection. However, there is no corresponding End School Zone sign along westbound Stevenson Road. Therefore, it is unclear whether there is an established School Zone for either the CAT-North facility or Archbishop Spalding High School. Please note that there are also no advisory speeds, time of day speed reductions, or other changes to the posted speed limit along this section of Stevenson Road.

The USLIMITS2 tool recommends that the posted speed limit should be 40 MPH under existing and future (2050) traffic conditions. However, since it is assumed that pedestrian and bicycle activity will be prominent in future conditions, consideration should be given to implementing engineering measures to reduce speeds before changing the recommended speed limit.

Stevenson Road, from Archbishop Spalding HS Entrance to the Crest Hill Road

This section of Stevenson Road has a posted speed limit of 30 MPH with advisory speed plaques for 15 MPH located at two of the three speed humps. Please note that there are time of day speed reductions, or other speed reduction signs associated with schools along this section of Stevenson Road.

The USLIMITS2 tool recommends that the posted speed limit should be 25 MPH under existing and future (2050) traffic conditions. It should be noted that traffic calming measures such as speed humps are not considered in the USLIMITS2 data inputs. Since it is assumed that pedestrian and bicycle activity will be prominent in future conditions, consideration should be given to implementing engineering measures to reduce speeds before changing the recommended speed limit.

Please refer to **Appendix L** for the USLIMITS2 reports for existing and future (2050) conditions assessment of posted speed limits along Quarterfield Road between Janet Dale Lane and MD 174, along Stevenson Road between Quarterfield Road and the CAT-North Entrance, and Stevenson Road between Archbishop Spalding HS Entrance and Crest Hill Road.

5.5 Highway Safety Manual - Predictive Safety Analysis

Predictive Crash Analysis using the Highway Safety Manual

In addition to qualitative analyses that evaluates the historical crash data, predictive crash analysis methodologies outlined in the Highway Safety Manual (HSM) were used to provide a high-level, quantitative-based analysis for the corridor-wide alternatives and spot improvements in the future. While the predictive methods in the HSM cannot be used to determine the actual safety performance of typical section changes such as adding bicycle lanes, sidewalks or shared-use paths, the results of the predictive analysis can be used for relative comparison purposes for the 2050 No Build and Build conditions.

The Urban and Suburban Arterial Analysis spreadsheets (which are based on the analysis outlined in Chapter 12 of the HSM) were used for the predicted crash analysis for the Quarterfield Road and Stevenson Road corridors. The standard HSM spreadsheet tool used to evaluate suburban and urban arterials is limited to evaluating up to a five-lane roadway typical section.

Most inputs for the various segments were obtained using Google aerial mapping and available orthophotos for the project. More detailed inputs were estimated using these tools in combination with Streetview and available photos taken from site visits.

Quarterfield Road and Stevenson Road Corridors – Urban Arterial Predictive Crash Analysis

The 2050 No Build and Build conditions for both Quarterfield Road and Stevenson Road consist of one roadway segment and two intersections along each corridor. Quarterfield Road is evaluated between Janet Dale Lane and MD 174 (Segment 1) and includes the intersections at Stevenson Road (Intersection 1) and MD 174 (Intersection 2).

For the intersections, the inputs for both spreadsheet tools require information about AADT for the major and minor roadway, presence of intersection lighting, if the intersection is signal-controlled or not, if red-light cameras are present, the maximum number of lanes crossed by pedestrians, number of bus stops, schools, and alcohol establishments within 1,000 feet of the intersection. If the intersection is signal-controlled, information about left-turn signal phasing, approaches with left-turn lanes, and right-turn prohibitions are also present. For these corridors, there are no existing bus stops or alcohol establishments nearby, but the local schools are identified.

For the intersections, the inputs for both spreadsheet tools require information about AADT for the major and minor roadway, presence of intersection lighting, if the intersection is signal-controlled or not, if red-light cameras are present, the maximum number of lanes crossed by pedestrians, number of bus stops, schools, and alcohol establishments within 1,000 feet of the intersection. If the intersection is signal-controlled, information about left-turn signal phasing, approaches with left-turn lanes, and right-turn prohibitions are also present. For these corridors, there are no existing bus stops or alcohol establishments nearby, but the local schools are identified.

Table 18 summarizes the predictive analysis results along Quarterfield Road and Stevenson Road using the HSM spreadsheets for urban and suburban arterials. The table provides the predicted crash totals per segment and per intersection per year for 2050 No Build conditions for each given segment or intersection. In addition, the table summarizes the predictive crash results for a proposed signal at the Quarterfield Road and MD 174 intersection under 2050 Build Conditions. The HSM tools cannot evaluate roundabouts at this time.

Table 18: Predictive Annual Crashes (2050 No Build and Build) – Quarterfield and Stevenson

Locations	Site ID	Predicted Average Crash Frequency (crashes per year)		
		N ^{Predicted} (TOTAL) ¹	N ^{Predicted} (FI) ²	N ^{Predicted} (PDO) ³
Quarterfield Rd, Janet Dale Ln to MD 174	Segment 1	0.94	0.28	0.66
Quarterfield Rd at Stevenson Rd	Intersection 1	1.50	0.49	1.01
Quarterfield Rd at MD 174	Intersection 2	1.11	0.36	0.75
Stevenson Rd, Quarterfield to CAT-North	Segment 1	1.27	0.38	0.90
Stevenson Rd at CAT-North	Intersection 1	0.68	0.27	0.41
Stevenson Rd, CAT-North to MD 3 Bus	Segment 2	0.72	0.24	0.48
Stevenson Rd at MD 3 Business	Intersection 2	2.70	0.93	1.77
TOTALS (2050 NO BUILD)		9	3	6
Quarterfield Rd at MD 174 2050 Build - Proposed Signal	Intersection 2	1.20	0.44	0.76
TOTALS (2050 BUILD)		9	3	6

NOTE: Results based on HSM Chapter 12 Arterials – Ch. 12 HSM Tool. Values were rounded to the nearest hundredth. Totals for both corridors were rounded to the nearest whole number.

Values

1 – Total of all Fatal/Injury and Property Damage Only Crashes

2 – FI (Fatal/Injury-Related Crashes)

3 – PDO (Property Damage Only)

Table 18 indicates that the total predicted annual crashes along Quarterfield Road, 2050 No Build conditions would result in approximately four total crashes per year. Of this total, approximately one of these crashes would be fatal or injury-related (FI) and approximately three crashes would be PDO-type crashes. Likewise, the predicted annual crashes along Stevenson Road, 2050 No Build conditions would result in approximately five total crashes per year. Of this total, approximately two of these crashes would be fatal or injury-related (FI) and approximately three crashes would be PDO-type crashes. Overall, it is estimated that a total of nine crashes per year in 2050 may occur across the Quarterfield Road and Stevenson Road corridors and the specified intersections, with three of those crashes possibly resulting in either fatalities or injuries and six resulting in property-damage only.

Refer to **Appendix M** for the HSM Spreadsheets.

5.6 Crash Modification Factors Review

The predictive methods for safety analysis available in the HSM and HSM spreadsheet tools are limited to specific roadway and intersection control types. To supplement the Highway Safety Manual Predictive analysis, crash modification factors (CMFs) were used to estimate safety benefits for corridor-wide, intersection, and various other improvement alternatives considered for the Stevenson Road and Quarterfield Road study. A CMF is used to compute the expected number of crashes after implementing a countermeasure on a road or intersection.

A CMF provides a quantitative estimate of the effectiveness of a countermeasure. This allows a CMF user to:

- Identify the most cost-effective strategy when considering various countermeasures. CMFs can indicate which countermeasure will have the greatest impact on reducing crash risk and quantify the benefits for each alternative under consideration.
- Identify the most cost-effective locations for using safety funding. CMFs can assist in determining where to deploy countermeasures that yield the greatest crash savings, which is the estimated reduction in crashes expected from a specific roadway safety improvement.
- Compare the results of new analyses to existing CMFs. CMFs can assist researchers by giving a context to newly produced CMFs to check for reasonableness in the results.
- Check validity of assumptions in cost-benefit analyses. CMFs provide a basis for conducting cost-benefit analysis to determine if a proposed project is worth undertaking.

CMFs with a value less than 1.0 indicate an expected decrease in crashes. CMFs greater than 1.0 indicate an expected increase in crashes.

The CMF Clearinghouse, available at <https://cmfclearinghouse.fhwa.dot.gov/>, offers transportation professionals a central, Web-based repository of CMFs, as well as additional information and resources related to using and developing CMFs. CMFs are developed based on research and are periodically updated, including development of new CMFs.

The following countermeasures were researched based on the initial recommendations considered using the CMF Clearinghouse for the Stevenson Road / Quarterfield Road Study to supplement the HSM Predictive Analysis:

- All Way Stop Control
- Signalized Intersections
- Roundabouts
- Speed Humps and Raised Pedestrian Crosswalks

In addition to using engineering judgment, various filter options available in the CMF Clearinghouse such as star quality ratings, roadway type, area type, and intersection type were selected to identify those countermeasures that most closely represented the improvements proposed for Stevenson Road and Quarterfield Road study were identified.

All Way Stop Control

A total of six CMFs were identified that convert minor-road stop control to all-way stop control, as would be proposed at the Quarterfield Road and Stevenson Road intersection. The average CMF for those studies was 0.86. This estimates that by converting a minor-road stop control to all-way stop control may reduce crashes by about 14 percent. Please note that two of the CMFs are greater than 1.0, which may indicate that certain crashes such as rear-end collisions could increase with all-way stop control.

Traffic Signals

A total of 10 CMFs were identified installing a traffic signal, as would be proposed at the Quarterfield Road and MD 174 intersection. The average CMF for those studies was 0.80. This estimates that installing a traffic signal may reduce crashes by about 20 percent. Please note that two of the CMFs are greater than 1.0, which may indicate that certain crashes such as rear-end collisions could increase with signal control.

Roundabouts

A total of five CMFs were identified that convert a 3-leg or 4-leg intersection to a roundabout, as would be proposed at the Quarterfield / Stevenson and Quarterfield Road / MD 174 intersections. The average CMF for those studies was 0.42. This estimates that installing a roundabout may reduce crashes by about 58 percent. Please note that the CMFs none of the applicable CMFs are greater than 1.0, which would indicate that crash reduction is probable.

Speed Humps / Raised Crosswalks

A total of six CMFs were identified that install speed humps and/or a raised crosswalk, as would be proposed across Stevenson Road at the CAT-North intersection, and to the west of CAT-North. The average CMF for those studies was 0.72. This would estimate that by converting a minor-road stop control to all-way stop control may reduce crashes by about 28 percent. Please note that one of the CMFs is greater than 1.0, which is associated with a study outside of the United States. The study with the CMF greater than 1.0 implies that vehicle-bicycle crashes may worsen with the installation of these traffic calming measures.

Refer to **Appendix N** for the CMF summaries for each of these countermeasures.

5.7 Build Conditions Pedestrian Level of Comfort Assessment

As with the existing conditions, a Pedestrian Level of Comfort (PLOC) analysis was conducted for this study for the three corridor alternatives to evaluate the proposed conditions for pedestrians. The Montgomery County PLOC approach was used since Anne Arundel County does not currently have their own methodology.

Results of the PLOC analysis for the proposed sidewalks or shared use paths (pathways) along the Stevenson and Quarterfield Road corridors are summarized in **Tables 19, 20, and 21**. The table evaluates various segments along the Quarterfield Road corridor, as well as the County-maintained and State-maintained portions of Stevenson Road. The table identifies the posted speed limit for each segment, proposed sidewalk and/or shared use path widths on either side of the roadways, the presence of on-road buffers such as a designated parking lane (DPL) or separated bike lane (SBL), available buffer widths (grass or other) between the roadway and sidewalk or path, and the associated PLOC score. According to the Manual on Uniform Traffic Control Devices (MUTCD), a separated bike lane is an exclusive facility for bicyclists that is located within or directly adjacent to the roadway and that is physically separated from motor vehicle traffic with a vertical element.

Table 19 summarizes the PLOC analysis for Alternative 3 and how it compares to the existing conditions PLOC results.

Table 19: Alternative 1 - PLOC Analysis Results for Stevenson and Quarterfield Road Corridors

NON-URBAN SETTING – ALTERNATIVE 1 VS. EXISTING									
Roadway	Segments	Posted Speed Limit	Side of Road	Sidewalk Width (ft)	Buffer Type	Buffer Width (ft)	ALT 1 PLOC	Existing PLOC	
Quarterfield Road (CO 907)	Janet Dale Ln to Perry Ln	35	West	6	No DPL or SBL	3	2	3	
			East	6	No DPL or SBL	3	2	3	
	Perry Lane to Stevenson		West	6	No DPL or SBL	3	2	4	
			East	6	No DPL or SBL	3	2	4	
	Stevenson to QES		West	6	No DPL or SBL	3	2	4	
			East	6	No DPL or SBL	3	2	4	
	QES to Myers Dr		West	6	No DPL or SBL	3	2	4	
			East	6	No DPL or SBL	3	2	3	
	Myers Dr to Chad Ave/Myers Ct		West	6	No DPL or SBL	3	2	4	
			East	6	No DPL or SBL	3	2	3	
Chad Ave/Myers Ct to MD 174	West	6	No DPL or SBL	3	2	3			
	East	6	No DPL or SBL	3	2	3			
Stevenson Road (CO 1337)	Quarterfield Rd to Theresa Rose	35	North	6	No DPL or SBL	3	2	4	
			South	6	No DPL or SBL	3	2	4	
	Theresa Rose to Wildflower		North	6	No DPL or SBL	3	2	4	
			South	6	No DPL or SBL	3	2	4	
	Wildflower to Grasons Ct		North	6	No DPL or SBL	3	2	3	
			South	6	No DPL or SBL	3	2	4	
	Grasons to CAT-North		North	6	No DPL or SBL	3	2	3	
			South	6	No DPL or SBL	3	2	4	
	CAT-North to Spaulding Way		30	North	6	No DPL or SBL	3	1	3
				South	6	No DPL or SBL	3	1	3
Spaulding Way to Crest Hill	North	6		No DPL or SBL	3	1	3		
	South	6		No DPL or SBL	3	1	3		
Stevenson Road (MD 997E)	Crest Hill to Old Stevenson	30		North	6	N/A	3	2	4
				South	6	No DPL or SBL	3	3	3
	Old Stevenson to MD 3 Business			North	6	N/A	3	3	4
				South	6	No DPL or SBL	3	3	3

Alternative 1 appears to provide improved PLOC ratings ranging from 1 (Very Comfortable) to 3 (Uncomfortable) along the corridors when compared to existing conditions. The existing Stevenson Road and Quarterfield Road corridors have PLOC ratings of either 3 (Uncomfortable) or 4 (Undesirable) based on the available width of existing sidewalks, available buffer widths, posted speed limits and lack of any on-street parking or bicycle lanes under existing conditions.

Table 20 summarizes the PLOC analysis for Alternative 2 and how it compares to the existing conditions PLOC results.

Table 20: Alternative 2 - PLOC Analysis Results for Stevenson and Quarterfield Road Corridors

NON-URBAN SETTING – ALTERNATIVE 2* VS. EXISTING									
Roadway	Segments	Posted Speed Limit	Side of Road	Sidewalk Width (ft)*	Buffer Type	Buffer Width (ft)	ALT 2 PLOC	Existing PLOC	
Quarterfield Road (CO 907)	Janet Dale Ln to Perry Ln	35	West	5	No DPL or SBL	3	3	3	
			East	11	No DPL or SBL	3	3	3	
	Perry Lane to Stevenson		West	5	No DPL or SBL	3	3	4	
			East	11	No DPL or SBL	3	3	4	
	Stevenson to QES		West	5	No DPL or SBL	3	3	4	
			East	11	No DPL or SBL	3	3	4	
	QES to Myers Dr		West	5	No DPL or SBL	3	3	4	
			East	11	No DPL or SBL	3	3	3	
	Myers Dr to Chad Ave/Myers Ct		West	5	No DPL or SBL	3	3	4	
			East	11	No DPL or SBL	3	3	3	
Chad Ave/Myers Ct to MD 174	West	5	No DPL or SBL	3	3	3			
	East	11	No DPL or SBL	3	3	3			
Stevenson Road (CO 1337)	Quarterfield Rd to Theresa Rose	35	North	11	No DPL or SBL	3	3	4	
			South	5	No DPL or SBL	3	3	4	
	Theresa Rose to Wildflower		North	11	No DPL or SBL	3	3	4	
			South	5	No DPL or SBL	3	3	4	
	Wildflower to Grasons Ct		North	11	No DPL or SBL	3	3	3	
			South	5	No DPL or SBL	3	3	4	
	Grasons to CAT-North		North	11	No DPL or SBL	3	3	3	
			South	5	No DPL or SBL	3	3	4	
	CAT-North to Spaulding Way		30	North	11	No DPL or SBL	3	3	3
				South	5	No DPL or SBL	3	3	3
Spaulding Way to Crest Hill	North	11		No DPL or SBL	3	3	3		
	South	5		No DPL or SBL	3	3	3		
Stevenson Road (MD 997E)	Crest Hill to Old Stevenson	30	North	11	No DPL or SBL	3	3	4	
			South	5	No DPL or SBL	3	3	3	
	Old Stevenson to MD 3 Business		North	5	N/A	3	4	4	
			South	5	No DPL or SBL	3	3	3	

*- The sidewalk widths for the Alternative 2 PLOC analysis have been updated to reflect the Recommended Alternative.

Alternative 2 appears to provide some improved PLOC ratings of 3 (Uncomfortable) along the Quarterfield Road and Stevenson Road corridors with posted speeds of 35 MPH compared to existing conditions. The existing Stevenson Road and Quarterfield Road corridors have PLOC

ratings of either 3 (Uncomfortable) or 4 (Undesirable) in these sections based on the available width of existing sidewalks, available buffer widths, posted speed limits and lack of any on-street parking or bicycle lanes under existing conditions.

Table 21 summarizes the PLOC analysis for Alternative 3 and how it compares to the existing conditions PLOC results.

Table 21: Alternative 3 - PLOC Analysis Results for Stevenson and Quarterfield Road Corridors

NON-URBAN SETTING – ALTERNATIVE 3 VS. EXISTING									
Roadway	Segments	Posted Speed Limit	Side of Road	Sidewalk Width (ft)	Buffer Type	Buffer Width (ft)	ALT 3 PLOC	Existing PLOC	
Quarterfield Road (CO 907)	Janet Dale Ln to Perry Ln	35	West	6	No DPL or SBL	3	3	3	
			East	6	No DPL or SBL	3	3	3	
	Perry Lane to Stevenson		West	6	No DPL or SBL	3	3	4	
			East	6	No DPL or SBL	3	3	4	
	Stevenson to QES		West	6	No DPL or SBL	3	3	4	
			East	6	No DPL or SBL	3	3	4	
	QES to Myers Dr		West	6	No DPL or SBL	3	3	4	
			East	6	No DPL or SBL	3	3	3	
	Myers Dr to Chad Ave/Myers Ct		West	6	No DPL or SBL	3	3	4	
			East	6	No DPL or SBL	3	3	3	
Chad Ave/Myers Ct to MD 174	West	6	No DPL or SBL	3	3	3			
	East	6	No DPL or SBL	3	3	3			
Stevenson Road (CO 1337)	Quarterfield Rd to Theresa Rose	35	North	6	No DPL or SBL	3	3	4	
			South	6	No DPL or SBL	3	3	4	
	Theresa Rose to Wildflower		North	6	No DPL or SBL	3	3	4	
			South	6	No DPL or SBL	3	3	4	
	Wildflower to Grasons Ct		North	6	No DPL or SBL	3	3	3	
			South	6	No DPL or SBL	3	3	4	
	Grasons to CAT-North		North	6	No DPL or SBL	3	3	3	
			South	6	No DPL or SBL	3	3	4	
	CAT-North to Spaulding Way		30	North	6	No DPL or SBL	3	3	3
				South	6	No DPL or SBL	3	3	3
Spaulding Way to Crest Hill	North	6		No DPL or SBL	3	3	3		
	South	6		No DPL or SBL	3	3	3		
Stevenson Road (MD 997E)	Crest Hill to Old Stevenson	30		North	6	No DPL or SBL	3	3	4
				South	6	No DPL or SBL	3	3	3
	Old Stevenson to MD 3 Business			North	6	N/A	3	4	4
				South	6	No DPL or SBL	3	3	3

Alternative 3 also appears to provide some improved PLOC ratings of 3 (Uncomfortable) along the Quarterfield Road and Stevenson Road corridors with posted speeds of 35 MPH when compared to existing conditions. The existing Stevenson Road and Quarterfield Road corridors have PLOC ratings of either 3 (Uncomfortable) or 4 (Undesirable) in these sections based on the available width of existing sidewalks, available buffer widths, posted speed limits and lack of any on-street parking or bicycle lanes under existing conditions.

5.8 Build Conditions Bicycle Level of Traffic Stress Assessment

As with the existing conditions, Level of Traffic Stress (LTS) for measuring the “bikeability” of a roadway network was assessed for the three proposed corridor alternatives. The traditional Level of Traffic Stress (LTS) (scale “1” to “4”) is a measure for assessing the quality of the roadway network for its comfort with various bicycle users. The lower the LTS score, the more inviting the bicycle facility is for more audiences. **Table 22** summarizes the general LTS ratings.

Table 22: Bicycle Level of Traffic Stress Ratings

LTS	Target Audience	Bicycle Facility Types
0	All ages and abilities	Rail-trails, shared-use paths
1	Almost everyone	Protected bikeways, sidepaths
2	Interested but concerned	Bike lanes, bike boulevards
3	Enthused and confident	Bike lanes, shared lanes, shoulders
4	Strong and fearless	No bike facility or bike lane on a major roadway
5	Bicycle Access Prohibited	Bicycle access is prohibited by managing roadway agency

Source: MDOT LTS Methodology

Table 23 categorizes the corresponding LTS rating for a roadway with a specific number of through lanes, the effective annual average daily traffic (AADT), and prevailing speed. Referring to the 2050 ADT values (**Appendix B**) and 85th percentile (prevailing) speed data (**Appendix B**), both the County and State maintained sections of Stevenson Road and the section of Quarterfield Road would qualify as having a range of **LTS ratings** based on the proposed bicycle facilities for each alternative.

Table 23: Bicycle LTS with Mixed Traffic Criteria

Number of Lanes	Effective ADT	Prevailing Speed						
		<20mph	25mph	30mph	35mph	40mph	45mph	50+mph
Unlaned 2-way street (No centerline)	0-750	1	1	2	2	3	3	3
	751-1500	1	1	2	3	3	3	4
	1501-3000	2	2	2	3	4	4	4
	3000+	2	3	3	3	4	4	4
1 thru lane per direction (1-way, 1 lane street or 2-way street with centerline)	0-750	1	1	2	2	3	3	3
	751-1500	2	2	2	3	3	3	4
	1501-3000	2	3	3	3	4	4	4
	3000+	3	3	3	4	4	4	4
2 thru lanes per direction	0-8000	3	3	3	3	4	4	4
	8001+	3	3	4	4	4	4	4
3+ thru lanes per direction	Any	3	3	4	4	4	4	4

Effective ADT = ADT for two-way roads. Effective ADT – 1.5' ADT for one-way roads

Source: MDOT LTS Methodology

For Alternative 1, the proposed on-street bicycle lanes in both directions of travel along Quarterfield Road would improve the **LTS ratings** to a **3** according to **Table 24**, based on having one through lane per direction and prevailing speeds of 39 MPH (posted speed limit is 35 MPH).

Adding proposed on-street bicycle lanes in both directions of travel along Stevenson Road would also improve the **LTS ratings** to a **3** according to **Table 24**, based on having one through lane per direction and a prevailing speed of 43 MPH between Wildflower Drive and the CAT-North Entrance (posted speed limit is 35 MPH).

Adding proposed on-street bicycle lanes in both directions of travel along Stevenson Road would improve the **LTS ratings** to a **2 or 3** according to **Table 24**, based on having one through lane per direction and a prevailing speed of 32 MPH between Spaulding Circle and Crest Hill Road (posted speed limit is 30 MPH).

Table 24: Level of Traffic Stress Ratings with Standard Bike Lanes

Standard Bike Lanes							
Number of Lanes	Vertical Separation	≤25mph	30mph	35mph	40mph	45mph	50+mph
1-thru lane per direction or unlaned	No	1	2	3	3	4	4
2 thru lanes per direction	No	2	3	3	3	4	4
3+ thru lanes per direction	No	3	3	4	4	4	4

Source: MDOT LTS Methodology

For Alternative 2, the proposed shared use path would yield a LTS rating of 0 for bicyclists not on the roadway, as indicated by the facility type in **Table 22**. For bicyclists who prefer to ride in the

travel lanes, the **LTS ratings** would be at a **3 or 4**, based on the roadway characteristics, presence of a vertical separation, and prevailing speeds ranging from 30 MPH to 45 MPH for these roadways, as indicated in **Table 23** for Mixed Traffic Criteria.

For Alternative 3, the proposed 14 foot wide travel lanes would yield an **LTS rating** of a **3 or 4**, based on the roadway characteristics, presence of a vertical separation and prevailing speeds ranging between 30 MPH and 45 MPH as indicated in **Table 23** for Mixed Traffic Criteria.

6. PUBLIC MEETING AND STAKEHOLDER SUMMARY

The project team has held two virtual meetings with community leaders via Google Meet. The first stakeholder meeting was held on October 15, 2024, and was focused on introducing the project, providing the stakeholders with the background and goals, and going over the project status and findings to date. Stakeholders expressed some concerns with the walkability of the corridor, stating that some people may not be walking or biking because they currently don't feel safe using the corridor in its existing condition. Others noted excessive driver speeds along Stevenson Road, west of the CAT-North entrance, and that existing signing is underwhelming and ineffective.

The second stakeholder meeting was held on April 21, 2025, and focused on the discussion of the existing conditions, site observations, and traffic data. Draft recommendations were also presented at this meeting. Stakeholders expressed an interest in options that included a shared use path for pedestrians and cyclists to share.

A public meeting was held on September 3, 2025, at the Rippling Woods Elementary School to summarize the existing conditions, present the preliminary recommendations proposed for the corridor, and solicit feedback from the community. Display boards showed the entirety of the study area, with the recommendations for the corridor overlaid on the existing aerial imagery. Typical sections and general information boards were also displayed on boards. Approximately 20-25 residents attended the public meeting, engaged in discussion about the project, and provided their thoughts and ideas.

Some specific takeaways from the public meeting include:

- Residents generally felt overwhelmed with the number of schools and amount of school traffic in the corridor. They fear more traffic will come once the CAT-North technical school is replaced with the Middle School.
- Many residents spoke favorably about a potential roundabout at the Quarterfield Road at Stevenson Road intersection.
- Some were in favor of a roundabout at the Quarterfield Road and Donaldson Avenue intersection but did not seem as supportive as one at Quarterfield and Stevenson.
- There was generally positive feedback for adding sidewalks and/or a SUP within the corridor, but some were skeptical of proposing facilities on both sides of the roadway due to property impacts.
- Sidewalk connectivity was a major priority for the community.

Comments and feedback received from Stakeholders and the community during this study have been compiled into an anonymized matrix, which is provided in **Appendix O**.

7. ALTERNATIVE RECOMMENDATION

As mentioned, the alternatives and improvement options outlined in this report were presented to project stakeholders and the community at various times throughout the study. Public comments and feedback were documented at all stages to help with the selection of a recommended alternative.

These alternatives were reevaluated and analyzed to determine the optimal alternative suitable for this corridor based on public and stakeholder feedback, anticipated cost, constructability, functionality, and other factors and summarized in the Task 3 report. After reviewing all feedback and comparing alternatives, the study team recommends **Alternative 2** for the corridor-wide typical section improvements along with various supporting intersection improvements as outlined in this report. Some refinements to the typical section and other related improvement recommendations associated with Alternative 2 are described below.

7.1 Corridor Typical Section Recommendation

The recommended Alternative 2 typical section for both Stevenson Road and Quarterfield Road provides 11 foot travel lanes with the option of an open section, or installation of curb and gutter. In some areas, there is potential for the existing roadway width to be reduced.

Along southbound Quarterfield Road, a 3 foot grass buffer and a 5 foot concrete sidewalk is proposed. Along northbound Quarterfield Road, a 3 foot grass buffer and an 11 foot Shared Use Path (SUP) is proposed.

Along eastbound Stevenson Road, a 3 foot grass buffer and a 5 foot concrete sidewalk is proposed. Along westbound Stevenson Road, a 3 foot grass buffer and an 11 foot Shared Use Path (SUP) is proposed.

Six-foot wide sidewalks were previously proposed as part of all the alternatives and based on the *Walk & Roll Arundel!* guide. Once it was determined that Alternative 2 was the preferred option for these corridors, the sidewalk widths were revised to 5 foot to better align with current County requirements and minimize impacts to adjacent properties along these corridors, while still addressing the Purpose and Need of the project.

Although the width of the shared-use path was not changed as part of this recommendation, the 11 foot SUP may be reduced to 10 feet during design of a future capital project to minimize impacts and cost, and to match the width of existing SUP facilities located near the study area.

A visual representation of the Updated Alternative 2 typical section for both Quarterfield Road and Stevenson Road can be found below in **Figure 24**.

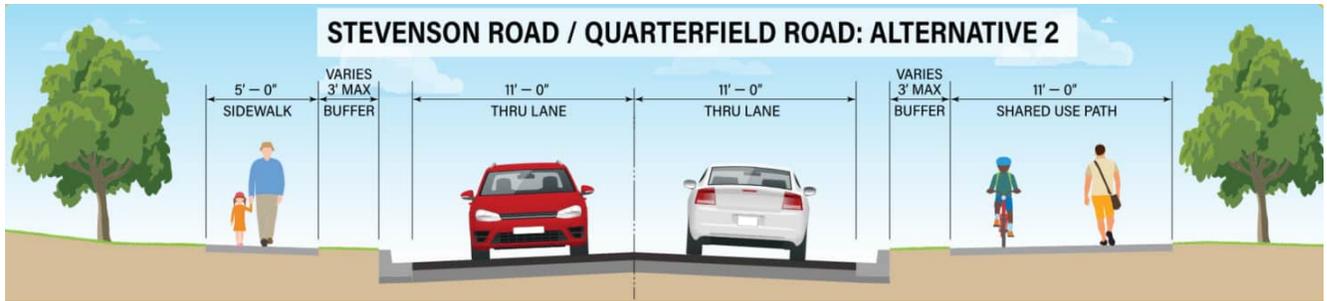


Figure 24: Updated Alternative 2 Typical Section

This alternative provides optimal safety for both pedestrians and cyclists, as there are no on-roadway cyclist facilities proposed, and all pedestrian facilities will be horizontally offset from vehicular traffic.

7.2 Intersection Recommendations

The two intersections that were analyzed for potential improvements are the Stevenson Road at Quarterfield Road intersection, and the Quarterfield Road at Donaldson Avenue (MD 174) intersection. Additionally, the Stevenson Road (MD 997E) at New Cut Road (MD 3 Business) intersection have some recommended improvements that work in conjunction with Alternative 2.

Stevenson Road at Quarterfield Road intersection

With the presence of multiple schools in the area, a future middle school planned to replace the CAT-North school, pedestrian/bicycle facilities, the 85th percentile speeds meeting or exceeding 40 MPH, and the sight distance deficiencies, converting the Stevenson Road and Quarterfield Road intersection to an all-way stop control is recommended as a near-term improvement. This is recommended as a short-term measure to address existing deficiencies until a signal is installed in conjunction with the sidewalks/paths and other improvements associated with Alternative 2.

The single-lane roundabout considered for this location appears to create significant impacts to adjacent properties for the size necessary to accommodate a single-lane roundabout. A signalized intersection may be warranted at this location but signal warrants with updated traffic volumes and speed data should be reevaluated with the detailed design and implementation of Alternative 2.

In addition to changing the traffic control to an all-way stop control in the near term, other minor improvements are recommended as part of Alternative 2. These improvements include:

- Sight distance improvements, such as vegetation clearing for sight distance and improved sign visibility.
- Relocating the existing guide sign indicating “CENTER OF APPLIED TECHNOLOGY NORTH (RIGHT ARROW)” slightly further south of the intersection to provide better sight lines for a stopped vehicle turning onto Quarterfield Road.
- Reset the stop line pavement marking on Stevenson Road to be offset four feet from the eastbound travel lane along Quarterfield Road.

- Install Side Road (W2-2) Intersection warning signs with supplemental “Stevenson Road” street name plaques along both directions of Quarterfield Road in advance of the intersection.

Quarterfield Road at Donaldson Avenue/Quarterfield Road (MD 174) intersection

The recommendation is to construct a single-lane roundabout with bypass lanes along the eastbound and westbound MD 174 approaches at the Quarterfield Road and MD 174 intersection. Following some comments on the number of approach lanes needed on Quarterfield Road, additional SIDRA analysis determined that a right-turn bypass lane along northbound Quarterfield Road is not needed for operations.

The roundabout design and analysis was revised to no longer have a northbound Quarterfield Road right-turn bypass lane to reduce the overall size of the intersection, while also reducing impacts to right-of-way. By eliminating the need for a right-turn bypass lane on Quarterfield Road, safety should improve for pedestrians and bicycles crossing this leg of the intersection.

The updated SIDRA single-lane roundabout analysis results comparing the 2050 Build conditions are shown in **Table 25** for the MD 174 at Quarterfield Road study intersection with a westbound MD 174 through bypass lane, and without a northbound Quarterfield Road right-turn bypass lane as the recommended design. The results of the initial roundabout analysis are provided in the table for comparison purposes, with the updated SIDRA analysis provided in **Appendix P**. An illustration of the recommended design is shown in **Figure 25**.

Table 25: Summary of SIDRA Roundabout Analysis (2050 Build Conditions) – Quarterfield at MD 174

INTERSECTION	APPROACH	SINGLE-LANE ROUNDABOUT		RECOMMENDED SINGLE-LANE ROUNDABOUT	
		INITIAL DESIGN (WITHOUT WB MD 174 BYPASS LANE)		REVISED DESIGN (WITH WB MD 174 BYPASS LANE)	
		AM Delay* (LOS)	PM Delay* (LOS)	AM Delay* (LOS)	PM Delay* (LOS)
MD 174 (Donaldson Ave / Quarterfield Rd) at Quarterfield Rd	EB MD 174	10.1 (C)	21.3 (C)	10.1 (B)	21.3 (C)
	WB MD 174	18.4 (C)	35.0 (E)	11.5 (B)	15.8 (C)
	NB Quarterfield	11.1 (B)	10.1 (B)	20.2 (C)	17.1 (C)
	OVERALL	14.0 (B)	26.6 (D)	12.9 (B)	18.2 (C)

* - sec/veh

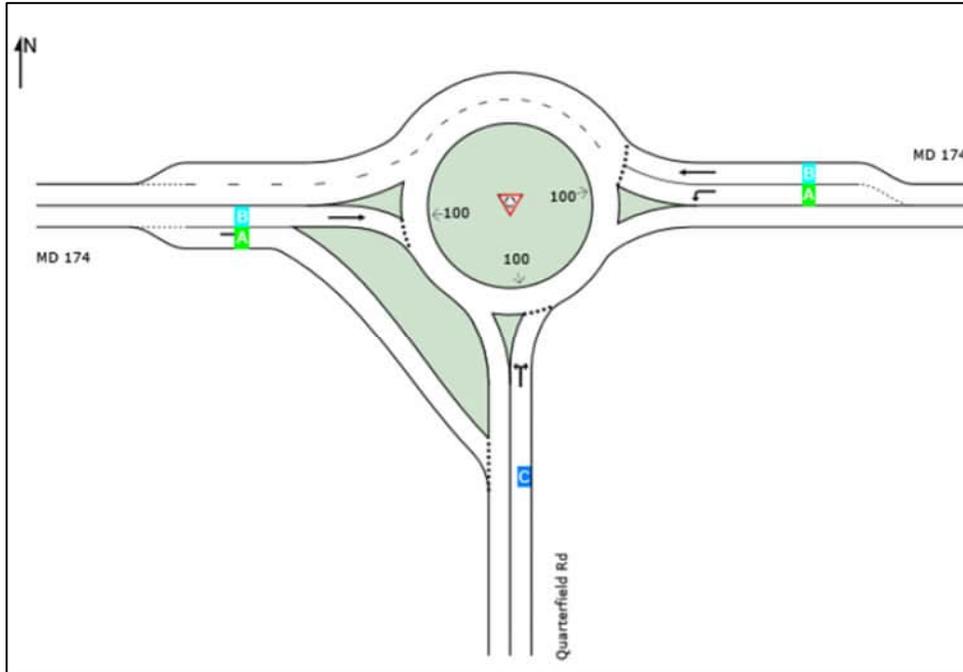


Figure 25: Single-Lane Roundabout (Recommended Design) – Quarterfield at MD 174

Stevenson Road at New Cut Road (MD 3 Business) intersection

The SUP along westbound Stevenson Road will stub out at the SHA right-of-way line and can be connected to adjacent pedestrian facilities as part of a future project. The only recommended improvement at this intersection is to provide a continental style crosswalk across the west leg of this intersection.

There is a proposed continental style crosswalk across the south leg of this intersection that will be installed by SHA at a future date. This crosswalk is shown and labeled on the updated Alternative 2 display.

Anne Arundel County and SHA will coordinate the installation of crosswalks for the other 2 legs of this intersection as part of a future study.

There are other minor intersection improvements that could be compatible with Alternative 2, including but not limited to curb bump outs, lane width reduction, and adjustments to corner radii. These minor intersection improvements are not shown on the alternative displays but could be considered during a future design project.

7.3 Additional Improvement Recommendations

Removal of existing speed humps and construction of three new speed humps along Stevenson Road between CAT-North and Crest Hill Road

There are three existing speed humps located on Stevenson Road between Crest Hill Road and the entrance to CAT-North, spaced approximately 500 to 600 feet apart. Anne Arundel County

currently utilizes a ‘Flat Top Speed Hump’ as a traffic calming measure on various County roads. The Speed Hump provides a 6 foot long transition with up to a three inch raised flat top hump for 10 linear feet, followed by a 6 foot long transition back down to existing road grade. The dimensions shown in this detail would also apply to a *Raised Crosswalk*.

A Raised Crosswalk is recommended at the west leg of Stevenson Road at the CAT-North Entrance to work in conjunction with a school zone for both the future Middle School (to replace CAT-North) and Archbishop Spalding High School. The location of the proposed raised crosswalk is shown in **Figure 26**. This would be an uncontrolled crosswalk that would likely require a school crossing guard and School Crossing signs along both directions of Stevenson Road, per the MdMUTCD.

In addition, two new Flat Top Speed Humps will be placed as shown in **Figure 26**. One will be placed just west of the Stevenson Road at Spaulding Circle/Spaulding Way intersection, and also one just to the west of the Stevenson Road at Crest Hill Road intersection. Previously, a fourth speed hump was also proposed just west of Grasons Court, which would provide four speed humps, and one raised crosswalk along the Stevenson Road corridor. However, this new speed hump will not be part of the recommended improvements at this time because it does not appear to be following the Anne Arundel County Neighborhood Traffic Control Guidelines.



Figure 26: Recommended Raised Crosswalk and Speed Humps (Stevenson Road)

Establishment of one School Zone along Stevenson Road to encompass the CAT-North/Future Middle School and Archbishop Spalding High School.

The school zone signing would follow the requirements provided in Chapter 7 of the MdMUTCD. Specifically, at the beginning of the school zone, a pentagonal, fluorescent yellow-green SCHOOL (S1-1) sign marks the start. This sign should be placed between 150 feet (minimum) and 750 feet (maximum) prior to the CAT-North Entrance along eastbound Stevenson Road. Likewise, a SCHOOL (S1-1) sign should be placed between 150 feet (minimum) and 750 feet (maximum) prior to the Archbishop Spalding High School Entrance along westbound Stevenson Road. If a FINES DOUBLE (S4-4(1)) sign is used in association with the school zone, they would be set beneath a Speed Limit (R2-1) sign and be placed approximately 200 feet after the SCHOOL (S1-1) signs for Stevenson Road, as shown in Figure 7B-3a of the MdMUTCD if the school zone will not have a speed limit reduction. For this improvement recommendation, new speed limit signs should be installed, or existing Speed Limit signs may be relocated to establish the School Zone. The end of the School Zone should have an END SCHOOL ZONE (S5-2) sign that marks the end of the designated area in both directions along Stevenson Road. These signs are typically set at

the same distance from the school entrance as the SCHOOL (S1-1) signs, as indicated in Figure 7B-3a of the MdMUTCD. (shown here as **Figure 27**).

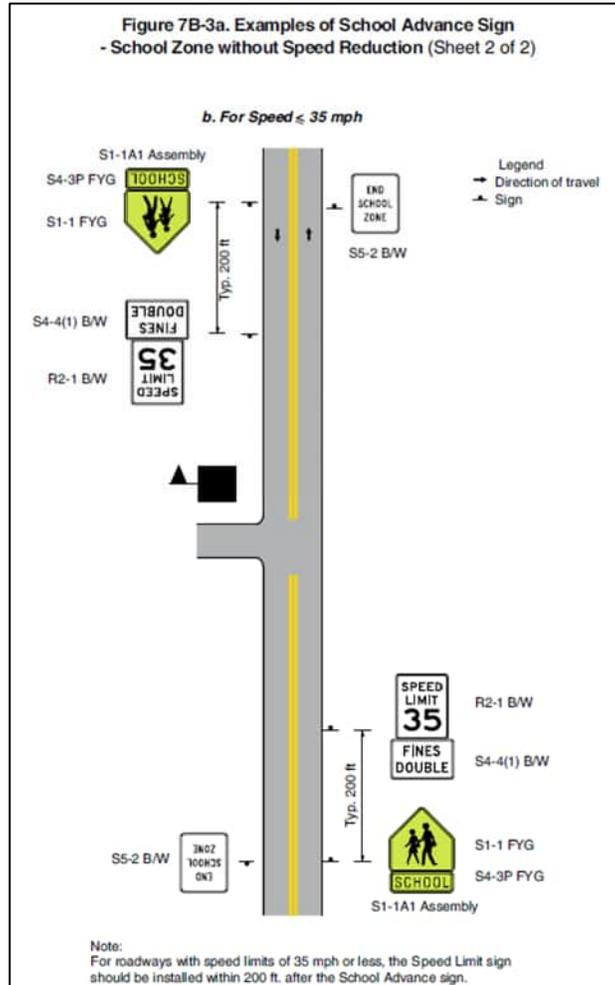


Figure 27: School Zone Signing (Speed Limit 35 MPH or Less)

Signing and Pavement Marking Recommendations

- Marked Crosswalks and Stop Lines at all major intersections along both Quarterfield Road and Stevenson Road. This will provide improved visibility for all users, and safer crossings for pedestrians and cyclists. These improvements support previous recommendations made in the *Safe Routes to School Study*.
- Wider (8-inch) pavement markings for edge lines along both Stevenson Road and Quarterfield Road. This will increase visibility of traveled lanes and provide a clearer delineation between motorist lanes and bicycle lanes.
- Signing updates/improvements to account for School Zones (including Quarterfield Elementary School, Future Middle School to replace CAT-North, and Archbishop Spalding

High School). The school zone signing along Quarterfield Road for the Quarterfield Elementary School will be updated in coordination with the speed camera program. In addition, all school signs along Quarterfield Road and Stevenson Road should be updated to the fluorescent yellow-green color and have End School Zone signs installed in both directions travel.

8. COST ESTIMATE SUMMARY

Concept Level Cost Estimates and Right-of-Way acreage estimates for each alternative were developed for comparative analysis and to help with selecting a recommended alternative. High level quantities were calculated for each alternative, and a planning level construction cost was estimated utilizing the latest comparable costs from the latest *State Highway Administration (SHA) Price Index*.

Quantities calculated for corridor-wide improvements included pavement section quantities, pavement markings, concrete sidewalk, asphalt SUP, curb and gutter, and landscaping. Several other items were not quantified at this stage, but were estimated using an assumed percentage of the total construction cost, including preliminary items, earthwork, survey, utility relocations, right-of-way acquisition, etc.

As shown in **Table 9** and below, Alternative 2 has the lowest estimated cost of the three alternatives:

- Alternative 1 \$6,300,000
- Alternative 2 \$5,500,000
- Alternative 3 \$6,000,000

Additionally, the proposed improvements in Alternative 2 impact the least amount of private right-of-way:

- Alternative 1 13.54 acres
- Alternative 2 6.04 acres
- Alternative 3 11.79 acres

An approximate standalone cost for the roundabout option at the Quarterfield Road at Donaldson Avenue (MD 174) intersection was estimated at \$1,300,000. This cost was not included in any of the Alternative cost estimates.

An approximate standalone cost for the traffic signal option at the Quarterfield Road at Donaldson Avenue (MD 174) intersection was estimated at \$250,000. This cost was not included in any of the Alternative cost estimates.

An approximate standalone cost for the installation of concrete sidewalk along northbound Quarterfield Road between Janet Dale Lane and Derby Farm Road was estimated at \$110,000. This cost was not included in any of the Alternative cost estimates.

For itemized versions of the high-level cost estimates and right-of-way estimates for the three alternatives, refer to **Appendix Q**.

This study identified several improvements that could be implemented along Stevenson Road between New Cut Road and Quarterfield Road, and along Quarterfield Road between Janet Dale Lane and Donaldson Avenue. Some of these improvements can be implemented in the near term, which is assumed can be completed within one year. Other improvements will require additional studies and engineering design to proceed. It is anticipated that mid-term improvements may take anywhere from one year to three years to implement. Long-term improvements may take more than three years to implement. All are dependent on funding availability, and coordination with others such as State Highway Administration.

Near-term improvements include:

- Installation of All-Way Stop Control conditions at the Stevenson Road and Quarterfield Road intersection.
- Sight distance and safety improvements at the Stevenson Road and Quarterfield Road intersection, including vegetation trimming, installation of warning signs, existing sign relocations and resetting of the stop line.
- Installing marked crosswalks and stop lines at all major intersections along both Quarterfield Road and Stevenson Road.
- Signing updates and related improvements to account for School Zones.

Mid-term improvement recommendations include:

- Roadway resurfacing and restriping.
- Reconstructing the three existing speed humps on Stevenson Road to be adequately spaced out and providing a raised crosswalk at the CAT-North entrance.
- Installing five-foot sidewalks along eastbound Stevenson Road and southbound Quarterfield Road to fill the gaps in existing sidewalk network.
- Installing 11 foot shared use paths along westbound Stevenson Road and northbound Quarterfield Road.

Long-term improvements include:

- Installing a roundabout at the Quarterfield Road and Donaldson Avenue (MD 174) intersection.

9. CONCLUSION AND NEXT STEPS

The report presents a comprehensive study of the Stevenson Road and Quarterfield Road corridors in Severn, Maryland, evaluating multimodal safety, accessibility, and mobility needs driven by recent and upcoming school developments, residential growth, and increased travel demand. The study addresses deficiencies in pedestrian and bicycle infrastructure, incorporates findings from the County's Safe Routes to School initiatives, and develops improvement alternatives that include typical sections, intersection concepts, traffic calming, sight-distance enhancements, and stormwater management options. Based on stakeholder feedback and previous task reports, the study recommends advancing Alternative 2 for detailed design along both corridors, constructing a single-lane roundabout at Quarterfield Road/MD 174, converting the Stevenson Road/Quarterfield Road intersection to an all-way stop controlled condition,

improving sight lines at key intersections, and relocating existing speed humps as part of future capital project efforts.

The Existing Conditions assessment for the Stevenson Road and Quarterfield Road corridors documents roadway characteristics, traffic operations, pedestrian and bicycle conditions, and safety issues that inform the development of future improvement alternatives. The corridors consist of a mix of State- and County-maintained segments with varying lane widths, inconsistent shoulders, and limited traffic calming, while both pedestrian and bicycle facilities are largely inadequate, with numerous sidewalk gaps, missing crosswalks, and no dedicated bike infrastructure. Pedestrian Level of Comfort (PLOC) ratings are predominantly “Uncomfortable” or “Undesirable” due to narrow or missing sidewalks, minimal buffers, and higher vehicle speeds, while Bicycle Level of Traffic Stress (LTS) scores rate the entire corridor as Level 4, indicating conditions suitable only for highly experienced riders. Recent isolated improvements such as new sidewalks near New Cut Road and along Stevenson Road have not addressed broader connectivity issues, and the crash (safety), operational, and field-observed data reinforce the need for comprehensive multimodal upgrades along these school-impacted corridors.

The Purpose and Need identifies the critical transportation deficiencies along the Stevenson Road and Quarterfield Road corridors, emphasizing the need to improve safety, manage growing travel demand, and provide continuous, ADA-compliant pedestrian and bicycle facilities that support all users, including students accessing nearby schools. The study aims to address geometric issues, reduce crash potential, and incorporate Complete Streets and Vision Zero principles while aligning with recommendations from the County’s Safe Routes to School initiatives and long-term planning documents such as Move Anne Arundel! and Walk & Roll Anne Arundel!. Improvements are essential to serve the existing and future schools, while mitigating speed concerns and filling multimodal gaps caused by a lack of sidewalks and dedicated bicycle facilities. The document outlines the need for implementable, context-sensitive upgrades that enhance connectivity, mobility, and safety for all travel modes throughout the study area.

Near-term improvement recommendations include:

- Installation of All-Way Stop Control conditions at the Stevenson Road and Quarterfield Road intersection.
- Sight distance and safety improvements at the Stevenson Road and Quarterfield Road intersection, including vegetation trimming, installation of warning signs, existing sign relocations and resetting of the stop line.
- Installing marked crosswalks and stop lines at all major side streets along both Quarterfield Road and Stevenson Road.
- Signing updates / improvements to account for School Zones.

Mid-term improvement recommendations include:

- Roadway resurfacing and restriping.
- Reconstructing the three existing speed humps on Stevenson Road to be adequately spaced out and providing a raised crosswalk at the CAT-North entrance.
- Installing five-foot sidewalks along eastbound Stevenson Road and southbound Quarterfield Road to fill the gaps in existing sidewalk network.
- Installing 11 foot shared use paths along westbound Stevenson Road and northbound Quarterfield Road.

Long-term improvement recommendations include:

- Installing a roundabout at the Quarterfield Road and Donaldson Avenue / Quarterfield Road (MD 174) intersection.

The near-, mid-, and long-term improvements recommended in this report could be implemented as part of one, or many capital improvement projects following the completion of the County's *Safe Routes to School* study.



Anne Arundel County

Transportation Facility Planning Study

Stevenson Road / Quarterfield Road

Contract No. H539626

Final Report (Technical Memo 4)

APPENDICES

**RISE TO THE
CHALLENGE**



Appendix A

Task 1 – Existing Conditions Report



Anne Arundel County
Transportation Facility Planning Study
Stevenson Road / Quarterfield Road
Contract No. H539626
Existing Conditions Report (TASK 1)

Prepared for:

Anne Arundel County Department of Public Works

Prepared by:

KCI Technologies Inc.

November 2024

Revised: December 2024

**RISE TO THE
CHALLENGE**

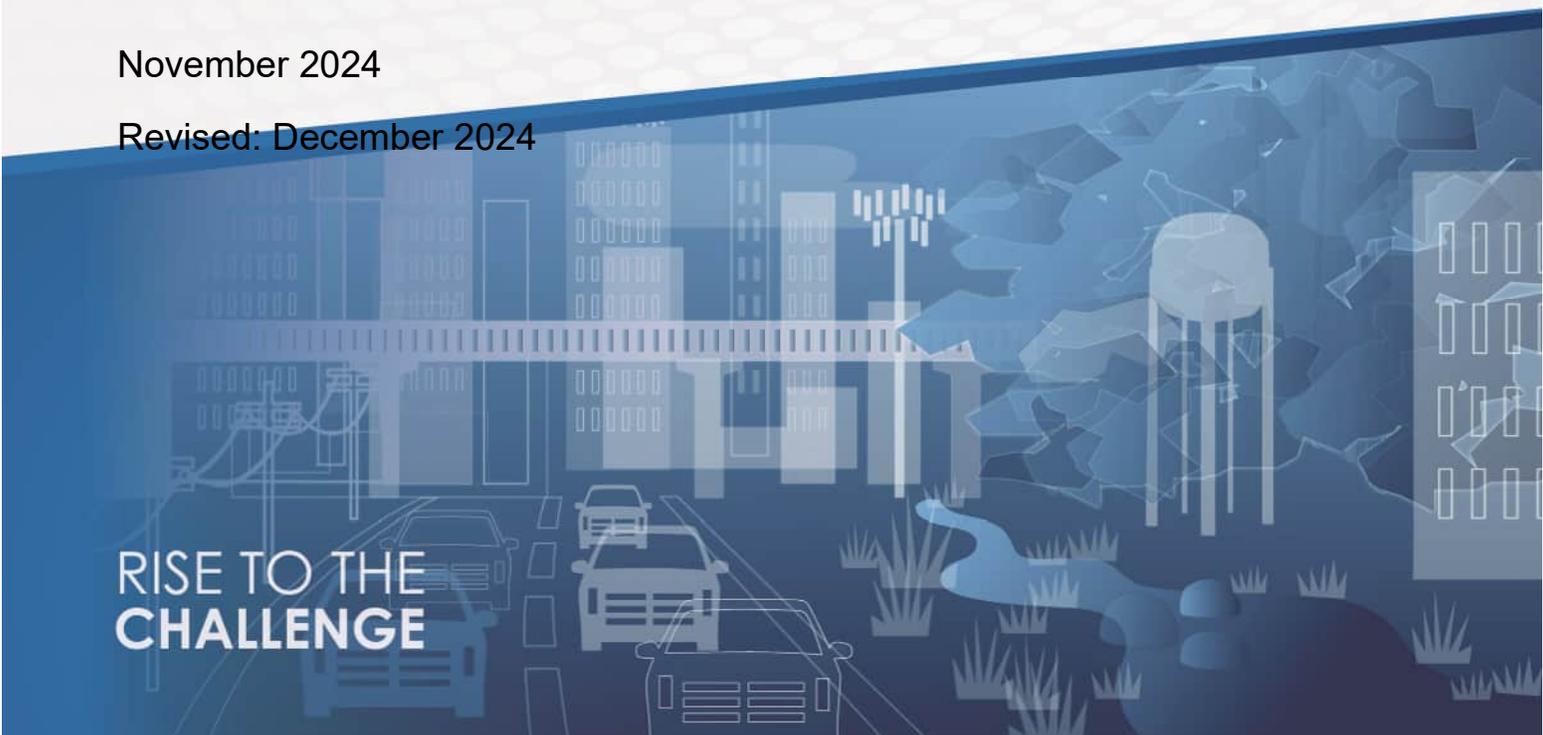


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1. INTRODUCTION

The Anne Arundel County Department of Public Works (DPW) requested KCI Technologies Inc. (KCI) to provide Architect / Engineer (A/E) Services to perform a study focusing on Stevenson Road from Quarterfield Road to New Cut Road, and Quarterfield Road from Janet Dale Lane to Donaldson Avenue. Several issues have been identified, including multimodal operations, safety, accessibility, and mobility, particularly for access to nearby public schools.

Growth from development has resulted in increased travel demand along these corridors. The corridors provide access to multiple County public schools and connections to I-97 and MD 3 Business, with primarily residential developments in the area. Safe access is needed to Quarterfield Elementary School, which opened in Fall 2023 and the new Severn Run High School, which opened in Fall 2024. Measures are needed to manage speeds on these roadways and to improve pedestrian safety, as these corridors contain minimal pedestrian facilities and lack bicycle facilities. Sidewalk was recently installed along eastbound Stevenson Road between Crest Hill Road and New Cut Road, and along southbound New Cut Road (MD 3 Business) between Stevenson Road and south of Grover Road.

There was a County Safe Routes to School study that proposed improvements for student walking and bicycle safety, mobility, and accessibility to and from the Quarterfield Elementary School. The study, which was an accessibility study, has been completed. The County is currently developing a plan to implement the recommendations from that study.

The purpose of this study is to identify existing geometric deficiencies, reduce crash potential, improve pedestrian and bicycle compatibility, and evaluate alternatives to address deficiencies while minimizing impacts to the natural and built environment. The project should promote Complete Streets and Vision Zero principles. The final product will include implementable recommendations for improvements in both directions along the corridors for travel by all modes.

This report provides a summary of the existing conditions and data that have been collected so far for the project. The information will be used to develop various recommendations and build improvements to improve safety for all users and all modes of travel.

1.1 Project Background

The need for a formal, comprehensive study came about for a reasons. First, there is a future Middle school planned on the site of the current Center of Applied Technology North (“CAT North”) in the next couple years. In addition, there are other school developments planned in the area. The Stevenson Road /Quarterfield Road study is looking at the overall corridor benefits for school transportation. That might deal with children and parents walking to and from the schools that bicycle in the area and from the schools are just recreationally and then vehicular improvements at the key intersections.

Anne Arundel County has received numerous requests from residents to improve the sidewalk network within the area. There are various gaps and deficiencies that they're looking to address. While this study is not meant to only address school-specific needs, they are one of the driving

forces behind evaluating these corridors as a whole. Some of the improvements previously discussed, have been implemented, including the recent opening of Severn Run High School at Stevenson Road and New Cut Road, as well as a variety of other smaller improvements such as sidewalks and drainage and stormwater management.

Unfortunately, there are minimal to no pedestrian and bicycle facilities to accommodate all these multimodal uses. Anne Arundel County has recently completed a safe routes to school study specific to Quarterfield Elementary School. That study recommended various infrastructure improvements to help students that walk and bike to and from the school. The County recognizes there is some overlap with that study with this comprehensive feasibility study.

The County's Safe Routes to School (SRTS) Phase 1 was completed in 2022 and included an accessibility study at Quarterfield Elementary School, which covered all roads in the school walk zone plus some roads immediately beyond it. The goal was to develop recommendations to improve safety for students walking and biking to/from school and finding opportunities to expand the walk zone. In general, the County's transportation master plan (*Move Anne Arundel!*) prioritize walkable communities and SRTS initiatives.

The Stevenson Road and Quarterfield Road corridors are key to the success of the community. These roads provide the primary accesses for school transportation. While accessibility was considered through the Safe Routes to School study, it was only a high-level assessment. The Stevenson Road / Quarterfield Road study will be an in-depth feasibility study.

1.2 Project Area

The project is in the town of Severn, Maryland in Anne Arundel County. See **Figure 1** for an aerial view of the study area. The land uses within the study area are predominantly residential, but there are four schools direct access to either Stevenson Road or Quarterfield Road. These schools are:

- Quarterfield Elementary School
- Center for Applied Technology-North (CAT-North)
- Archbishop Spalding High School (Private)
- Severn Run High School



Figure 1: Study Area

The study area covers Stevenson Road from Quarterfield Road to MD 3 Business (New Cut Road) and Quarterfield Road from Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road). The section of Stevenson Road between Old Stevenson Road and MD 3 Business (New Cut Road) is maintained by SHA and is designated as MD 997E. The remaining section of Stevenson Road from Quarterfield Road to Old Stevenson Road is maintained by Anne Arundel County. Likewise, the entire section of Quarterfield Road within the study limits is maintained by Anne Arundel County.

The section of Quarterfield Road, south of Janet Dale Lane is not included in the study limits because it's already being considered for future sidewalk installations under other county initiatives. Future improvements in that section of Quarterfield Road may be combined with any recommended improvements from this study for construction.

2. EXISTING GUIDELINES AND STUDIES REVIEW

KCI reviewed various documents including *Move Anne Arundel!*, *Walk & Roll Anne Arundel!*, the County's Complete Streets Program, the Safe Routes to School (SRTS) program, Vision Zero, and Traffic Impact Studies (TIS) completed for schools, to see if any programs, initiatives or improvements have been implemented or are relevant to the study area. Below is a brief synopsis of those reviews.

2.1 Move Anne Arundel!

Move Anne Arundel! is Anne Arundel County’s Transportation Master Plan. In 2009, Anne Arundel County adopted its General Development Plan (GDP) to guide land use, transportation, environmental, and social infrastructure investments. The 2009 GDP recommended that specific issues be studied and consolidated into a Transportation Functional Master Plan, and rebranded the plan as *Move Anne Arundel!* This plan is a comprehensive framework for transportation policies, strategies, and implementation projects to serve as the basis for the County’s next General Development Plan.

One of the investment priorities within the County master plan is to make communities more walkable. A good measure to determine the walkability of a community is whether parents will let their child walk to school or in a group when the school is located less than one mile from their home. As part of the *Move Anne Arundel!* Plan, 17 elementary schools across the County are recommended to implement various Safe Routes to School programs such as new sidewalk connections, highly visible signing, education, and enforcement activities.

Within the *Move Anne Arundel!* plan, there were recommended bicycle and pedestrian investments identified for Quarterfield Elementary School. Specifically, there were recommendations to expand the walk zone by improving crossing conditions at Quarterfield Road and MD 174 (Donaldson Avenue/Quarterfield Road) as well as other related improvements that fall outside the limits of the Stevenson Road / Quarterfield Road study area.

2.2 Walk & Roll Anne Arundel!

Walk & Roll Anne Arundel! is Anne Arundel County’s updated pedestrian and bicycle master plan. The document (dated January 2023) seeks to identify improvements to these transportation conditions. Anne Arundel County leaders, residents, and stakeholders can use *Walk & Roll Anne Arundel!* to advance active transportation infrastructure. The recommendations in the plan should enable more people to walk and bicycle safely, comfortably, and efficiently.

The following specific recommendation was identified for the Stevenson Road / Quarterfield Road study area in the *Walk & Roll Anne Arundel!* plan:

- Separated bicycle lane on Stevenson Road from Quarterfield Road to MD 3 Business (New Cut Road)
 - The study notes that construction of a separated bicycle lane would improve connectivity to employment centers and schools but may require right-of-way acquisition.

2.3 Anne Arundel County Complete Streets Policy

The Anne Arundel County Complete Streets Policy intends to improve safety and transportation options for all users throughout the County. Once implemented, improvements must account for the mobility needs of all users and travel modes in a context sensitive manner, while providing appropriate facilities for each user for the specific circumstances. The Complete Streets Policy strives to achieve the most efficient use of the existing roadways to meet changing demographics.

The literature review did not identify any previous studies or specific applications of the Complete Streets policies for the Stevenson Road or Quarterfield Road corridors.

2.4 Safe Routes to School

Quarterfield Elementary School is located on Quarterfield Road with access just south of Myers Drive, near the intersection with MD 174 (Donaldson Avenue). The school has grades Pre K through 5 and has 436 students with a capacity to accommodate 463. About 40 percent of the students are registered for bus transportation.

The Quarterfield Elementary School Safe Routes to School Accessibility Study: Existing Conditions and Recommendations (August 17, 2023) was reviewed to determine if any improvements are proposed in the Stevenson Road / Quarterfield Road study area. This report summarized existing conditions and recommendations for added infrastructure, education, or encouragement programs to increase the number of children that could safely walk or ride bikes to school.

Specific Safe Routes to School (SRTS) study recommendations that fall within the Stevenson Road and Quarterfield Road corridors included:

- A signed bike route (i.e., included in the County Master Plan) for MD 174 (Donaldson Avenue/Quarterfield Road). Please note that the limits of the bike lanes were not described in the SRTS report.
- Sidewalk and speed management improvements along Stevenson Road from Quarterfield Road to CAT-North.
- Sidewalk and speed management improvements along Quarterfield Road from west of Janet Dale Lane to Myers Drive.
- Speed management and school zone signing improvements along Quarterfield Road from west of Stevens Road to Chad Avenue.

2.5 Vision Zero

The Anne Arundel County Vision Zero plan (enacted in May 2022) will set targets for infrastructure-related crashes on County roads separately from those on State roads. However, State and local agencies will partner to affect change on all roadways in Anne Arundel County and collaborate with State Strategic Highway Safety Program (SHSP) teams as appropriate in the implementation plan. As part of the County Vision Zero plan, the six “E’s” of traffic safety include:

- Engagement,
- Enforcement,
- Engineering,
- Emergency Medical Services (EMS),
- Equity, and
- Evaluation.

In addition, four emphasis areas were identified to address fatal crashes on County roads as defined in the County Vision Zero Plan include:

- **Infrastructure Related** – associated with run off the road, intersection-related, and work zone collisions
- **Human Behavior** – associated with impaired driving, speeding, and distracted driving
- **Vulnerable Road Users** – associated with pedestrians, bicyclists, and motorcyclists involved in crashes
- **Road User Types** – associated with younger drivers (ages 16-20), older drivers (ages 65 or more), and children who walk.

The literature review did not identify any previous studies or specific Vision Zero applications for the Stevenson Road or Quarterfield Road corridors.

2.6 Automated Traffic Enforcement Speed Program

Anne Arundel County is implementing an automated speed camera program to improve public safety on their roadways. The Anne Arundel County Automated Traffic Enforcement Speed Program uses Portable Camera Units (PCUs) to monitor and enforce speed limits. The goal of the program is to increase roadway safety and reduce traffic-related fatalities and serious injuries in the county. This ensures the safety of all roadway users, including students, older adults, and community members.

In accordance with state law, the speed cameras in school zones will operate from 6:00 AM until 8:00 PM Monday through Friday to help reduce speeds and create safer driving habits around County schools. Any speed cameras placed in residential areas will operate 24 hours a day, 7 days a week.

Signing will be installed to notify drivers of the new speed cameras. The system will only issue warnings for the first 15 days at each designated location. After the 15-day warning period, the cameras will begin to issue citations with a \$40 fine for motorists traveling 12 mph or more over the posted speed limit.

2.7 TIS and Development Reviews

A cursory review was conducted for the following reports to support the Stevenson Road / Quarterfield Road study:

- Old Mill West High School Traffic Impact Study (January 2020) – now referred to as Severn Run High School.
- Old Mill Middle School North Replacement – Design Development Submission (March 2024)

Old Mill West High School Traffic Impact Study (January 2020)

A traffic impact study for the recently constructed Severn Run High School (previously named Old Mill West High School) was prepared in January 2020 and reviewed in support of the Stevenson Road /Quarterfield Road study. The new high school is located to the east of MD 3 Business (New

Cut Road) with one of its two access points along MD 3 Business located across from Stevenson Road.

The school's current enrollment is 1,627 students. Approximately 320 students walk to school.

Old Mill Middle School North Replacement – Design Development Submission (March 2024)

The existing Old Mill Middle School North (OMMSN) is located at 610 Patriot Lane in Millersville, Maryland. The school occupies approximately 160,000 SF of a larger building which is also home to Old Mill Middle School South and Old Mill High School. The replacement of this middle school is the result of an approved master plan of the Old Mill school complex, completed in the fall of 2016.

The site for the new replacement school will be located on the eastern portion of the CAT (Center of Applied Technology) North Campus located at 800 Stevenson Road within the Stevenson Road / Quarterfield Road study limits. The new middle school will include twenty-seven (27) grade level classrooms for Math, English, and Social Studies, nine (9) science labs, one (1) AVID classroom, three (3) special education classrooms, one (1) magnet program space, and various other classrooms. The new site layout will include a bus loop, parent drop-off lane, parking lot, multipurpose fields, softball fields, tennis courts, and basketball courts. The existing Old Mill Middle School North will remain occupied during new construction and will then be demolished as part of the implementation of the 2016 Old Mill Complex master plan. The new middle school design will accommodate approximately 1,220 students. Access to the new middle school will remain from Stevenson Road as shown in the proposed layout in **Figure 2**. This illustration was obtained from the Design Development Submission.



Figure 2: Proposed Old Mill North Middle School (Source: Design Development Submission)

3. EXISTING CONDITIONS

This report provides a summary of the following existing conditions

- Existing Roadway Conditions and Site Observations
- Existing Traffic Count Data and Operational Results
- Existing Crash Data Summary
- Existing Pedestrian Level of Comfort
- Existing Bicycle Level of Traffic Stress

A site visit was conducted on September 19, 2024. Traffic patterns, and driver behavior were observed along the corridors and at the study intersections during the peak and non-peak periods. During the non-peak hours, existing conditions and measurements were obtained for roadway widths, lane configurations, presence of existing on-street parking and bus stops, roadway, and intersection lighting, posted speed limits, and cursory sight distance checks.

3.1 Existing Roadway Conditions and Site Observations

The following is a summary of the existing roadway conditions for Stevenson Road and Quarterfield Road, along with relevant observations taken during the September 19 site visit. Please refer to **Appendix A** for the base roadway plans with stationing, baseline, and labels for the side streets and other features.

Refer to **Table 1** for a summary of the major roadway components, functional classifications and posted speed limits.

Table 1: Existing Roadway Summary

Roadway	Study Limits	Functional Classification*	Posted Speed Limit
MD 997E (Stevenson Road)	Stevenson Road (CO 1337) to MD 3 Business (New Cut Road)	Urban Major Collector	30 MPH
Stevenson Road (CO 1337)	Quarterfield Road to Old Stevenson Road	Collector	35 MPH
Quarterfield Road (CO 907)	Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road)	Minor Arterial	35 MPH

*- Sources: SHA Highway Location Reference and AA County Road Functional Classifications

MD 997E (Stevenson Road) from Stevenson Road (CO 1337) to MD 3 Business (New Cut Road)

The State-maintained section of Stevenson Road (MD 997E) from Stevenson Road (CO 1337) to New Cut Road (MD 3 Business) is classified as an urban major collector with a posted speed limit of 30 MPH. For the purposes of this study, this section of Stevenson Road is considered to run in an east-west direction. The right-of-way width is approximately 110 feet. There are no traffic calming measures in this section of the Stevenson Road corridor. See **Figure 3** for a view of Stevenson Road looking west from New Cut Road.



Figure 3: MD 997E (Stevenson Road) looking west. Markings shown are temporary per the ongoing construction.

This section of Stevenson Road has two travel lanes, which widen to four lanes starting at approximate STA. 154+50 (between Old Stevenson Road and New Cut Road) to direct traffic on and off New Cut Road. This roadway section is classified as a closed section with a westbound shoulder varying between 0 to 6.5 feet and an eastbound shoulder varying between 0 to 10.5 feet. There are no areas designated for on-street parking. Please see **Table 2** for the locations of the open and closed sections.

Table 2: Existing Roadway Sections – MD 997E (Stevenson Rd)

Open Section		Closed Section	
Left (STA.)	Right (STA.)	Left (STA.)	Right (STA.)
147+50 – 152+50		152+50 - end	147+50 - end

There are two projects that were recently constructed along this corridor: the Stevenson Road Sidewalk Project and the New Cut Road Sidewalk Project. The Stevenson Road Sidewalk Project proposed to install 875 linear feet of concrete sidewalk along eastbound Stevenson Road between Crest Hill Road, and New Cut Road. This project includes additional improvements including placement of curb and gutter, construction of new storm drain inlets and drainage pipes, an upgraded driveway at the entrance to the Calvary Baptist Church, a bio-swale along westbound Stevenson Road, and pavement resurfacing. This project completed construction in the Fall of 2024. The New Cut Road Sidewalk Project proposed to install 1,400 linear feet of concrete sidewalk along southbound New Cut Road (MD 3 Business) from south of Grover Road to Stevenson Road (MD 997E). This project includes ADA ramp improvements, driveway improvements, placement of curb and gutter, and pedestrian crossings that will serve the Severn Run High School across New Cut Road. This project also proposed a bio-retention basin in the southwest corner of the New Cut Road/Stevenson Road intersection. This project was expected to complete construction in the summer/fall of 2024.

During the site visit, the team used engineering judgement to assess the corridor for potential sight distance concerns due to the horizontal and/or vertical geometry of the roadway. There were no areas that appeared to have less than sufficient sight distance with regards to roadway geometry. Sight distance triangles were not developed during the field investigations and sight distance calculations were not performed. **Figures 4 and 5** below show the driver sight lines along Stevenson Road near Old Stevenson Rd.



Figure 4: Driver sight line near Old Stevenson Road) looking west



Figure 5: Driver sight line near Calvary Church Entrance looking east

Along eastbound Stevenson Rd there is existing 47-inch wide sidewalk between STA. 147+00 and STA. 148+25 and a five-foot wide sidewalk from STA. 148+25 to New Cut Road. There is an existing ADA ramp with no crosswalk in the southwest quadrant of Stevenson Road and New Cut Road (see **Figure 6**). The ramp is too far away from the intersection to use as a crossing for New Cut Road, so it will need to be removed or relocated.



Figure 6: ADA Ramp in SW Quadrant of Stevenson/New Cut

There are no bicycle facilities in this section of Stevenson Road. However, there was a cyclist traveling in the roadway from Stevenson Road to southbound New Cut Road during the site visit observations. In addition, there are no transit bus stops in this corridor.

Stevenson Road (CO 1337) from Quarterfield Road (CO 907) to MD 997E (Stevenson Road)

The County-maintained section of Stevenson Road (CO 1337) from Quarterfield Road (CO 907) to MD 997E (Stevenson Road) is classified as a collector with a posted speed limit of 35 MPH. For the purposes of this study, this section of Stevenson Road is considered to run in an east-west direction. Right-of-way widths vary along this section of Stevenson Road. The right-of-way width is approximately 30 feet between Quarterfield Road and STA. 120+40, 60 feet from STA. 120+40 to 129+15, and varies from 40 feet to 60 feet between STA. 129+15 and Crest Hill Road.

There are curve warning signs with supplemental 25 MPH advisory signs around STA. 106+00 and STA. 116+00. Additionally, there is a school warning sign along westbound Stevenson Road at STA. 138+80 and another school warning sign near the entrance to Archbishop Spalding High School. An End School Zone sign was located along eastbound Stevenson Road just after the entrance to Archbishop Spalding High School. However, an End School Zone sign was not identified along westbound Stevenson Road. There are also speed humps (see **Figure 7**) at Stations 135+25, 140+50, and 147+50. Field observers felt that there were several vehicles traveling above the posted speed limit in this section of Stevenson Road.



Figure 7: Speed Hump along Stevenson Road

There is a mix of open and closed sections along this corridor. Please see **Table 3** for the locations of the open and closed sections. There are two travel lanes along this entire section of Stevenson Road. The westbound lane is roughly 12.5' wide and the eastbound is roughly 10.5' wide from Quarterfield Rd to McNelin Way. The lanes are 11 feet wide between McNelin Way and Grasons Ct. Between Grasons Ct and Spaulding Circle, the westbound travel lane widens to roughly 14' wide and the eastbound lane widens to roughly 16' wide. These widths stay consistent until you approach New Cut Rd, where they begin to widen. The lanes are 16.5 feet wide at STA. 132+50. This portion of the roadway contains varying shoulder widths. The shoulder width along westbound Stevenson Road varies between 0 and 3 feet, while the shoulder width along eastbound Stevenson Road varies between 0 and 5.5 feet. The shoulders are not wide enough

for on-street parking. Additionally, there are multiple “No Parking Anytime signs” along the corridor. There were no sight line issues observed along this section of the corridor.

Table 3: Existing Roadway Sections – Stevenson Road (CO 1337)

Open Section		Closed Section	
Left (STA.)	Right (STA.)	Left (STA.)	Right (STA.)
125+25 – 128+75	111+00 – 121+50	100+00 – 125+25	100+00 – 111+00
129+50 – 147+50	131+00 - 147+50	128+75 – 129+50	121+50 – 131+00

The sidewalk on the north side of the road is four feet wide between Crest Hill Road and STA. 125+00, where it ends. The sidewalk on the south side of the road is also four feet wide between STA. 143+75 and STA. 131+25, where it ends. It is approximately 47 inches wide between Crest Hill Road and STA. 143+75. There are gaps in the sidewalk near STA. 113+50 to 131+25 along eastbound Stevenson Road and STA. 128+75 to STA. 129+50 along westbound Stevenson Road. There are sidewalk ramps near STA. 125+50, 128+75 , and 129+50 on the north side of Stevenson Road and near STA. 132+75 along eastbound Stevenson Road for a midblock crossing. However, there are no crosswalk markings and no sidewalk to continue to along the south side of Stevenson Road. **Figure 8** shows one of the midblock crossing ramps, east of Grasons Court. Theresa Rose Lane, Wildflower Drive, McNelin Way, Grasons Court, Spaulding Way, and Spaulding Circle all did not have any crosswalks or stop line pavement markings across the side road approaches. In addition, there are no bicycle facilities on this portion of the roadway.



Figure 8: Ramp without marked midblock crossing along Stevenson Road

There were no transit bus stops noted along the corridor during the field visit. School bus activity was observed between approximately 11:20 AM and 11:30 AM for the Center for Applied Technology. This caused an increase in traffic along the corridor. In addition to the school buses, some students drove themselves which further increased traffic along the corridor during the time that the school let out.

Quarterfield Road (CO 907), between Janet Dale Lane and MD 174 (Donaldson Avenue/Quarterfield Road)

Quarterfield Road (CO 907), between Janet Dale Lane and MD 174 (Donaldson Avenue/Quarterfield Road) is classified as a Minor Arterial roadway, and has a posted speed limit of 35 MPH. The right-of-way width varies in this corridor. The average right-of-way width is 30 feet from the beginning of the corridor to STA. 324+50, and 50 feet from STA. 325+50 to 329+25, ROW at the intersection with MD 174 (Donaldson Avenue/Quarterfield Road) is 31' wide on the eastbound side, and includes the wooded area and Old Sector Quarterfield Rd on the westbound side. There are no traffic calming measures in this section of the roadway.

This portion of the roadway has both open and closed sections. Please see **Table 4** for the locations of the open and closed sections. There are two lanes along the section, with three lanes starting around STA. 330+50 to accommodate turning movements to and from MD 174 (Donaldson Avenue/Quarterfield Road). The lane widths through this section up to the Quarterfield Road/Donaldson Avenue intersection are 11 feet. At the Quarterfield Road/Donaldson Avenue intersection, the southbound lane is 18 feet wide, the northbound left-turn lane is 12 feet wide, and the northbound right turn lane is 23 feet wide. This portion of the roadway contains a southbound shoulder that varies from 0 to 6 feet wide, and a northbound shoulder that varies from 0 to 5 feet wide. There are no areas designated for on-street parking.

Table 4: Existing Roadway Sections – Quarterfield Road (CO 907)

Open Section		Closed Section	
Left (STA.)	Right (STA.)	Left (STA.)	Right (STA.)
304+50 to 329+00	303+75 to 323+00	303+00 to 304+50	303+00 to 303+75
		329+00 to end	323+00 to end

During the site visit, the team used engineering judgement to assess the corridor for potential sight distance concerns due to the horizontal and/or vertical geometry of the roadway. There were no areas that appeared to have less than sufficient sight distance with regards to roadway geometry. Sight distance triangles were not developed during the field investigations and sight distance calculations were not performed. Figures 9, 10 and 11 below show the driver sight lines along Quarterfield Rd.



Figure 9: Driver sight line, northbound Quarterfield approaching Quarterfield ES



Figure 10: Driver sight line, northbound Quarterfield approaching Janet Dale Lane



Figure 11: Driver sight line, southbound Quarterfield approaching Chad Avenue

There is an existing sidewalk along the east side of Quarterfield Road near Janet Dale Lane and Perry Lane. This sidewalk is four feet wide and is separated from the road by a five foot wide buffer. A short section of sidewalk also exists on the west side, north of Janet Dale Lane. This sidewalk is four feet wide and is separated from the road by a six foot wide buffer.

The sidewalk on the east side of the road resumes near the entrance to Quarterfield Elementary School and continues to MD 174. This sidewalk is four feet wide. The four foot wide sidewalk on the west side of the road begins at Chad Avenue and also continues to MD 174. Gaps in the sidewalk were noted from STA. 304+50 to STA. 329+00 along the west side of Quarterfield Road and STA. 303+75 to STA. 323+00 along the east side of the road. None of the side streets within the study limits (Janet Dale Lane, Stevens Road, Perry Lane, Quarterfield Elementary School entrance, Myers Drive, Myers Court, or Chad Avenue) have stop lines or crosswalk pavement markings. There were also no crosswalks at the Quarterfield Road/MD 174 intersection. There are no bicycle facilities in this section of the roadway. Additionally, there is guardrail in poor condition at the southeast quadrant of Stevenson Road and Quarterfield Road intersection (see **Figure 12**).



Figure 12: Existing Guardrail (SE Quadrant of Stevenson/Quarterfield)

School warning signs are provided along both directions of Quarterfield Road in advance of the Quarterfield Elementary School entrance to indicate the beginning of the school zone. There are also End School Zone signs located along northbound Quarterfield Road, east of Myers Court and along southbound Quarterfield Road, west of the Quarterfield Elementary School entrance.

School buses were observed entering and exiting the Quarterfield Elementary School entrance around 2:30 PM. Between the buses and increased number of vehicles due to parent's picking up their students from school, traffic backed up on both eastbound and westbound Quarterfield Road. U-turns were observed on Quarterfield Road to then access Stevenson Road and find alternative access to MD 174. These observations coincided with heavy traffic congestion on Quarterfield Rd.

Anne Arundel County currently have a Portable Camera Unit (Speed Camera) installed along northbound Quarterfield Road near the Quarterfield Elementary School entrance. The camera was installed on October 3, 2024, which occurred after the initial site visit.

As part of the County's Automated Traffic Enforcement Speed program, there will be 40 cameras installed. The County currently have only 21 sites permitted. At this time, the other schools in the study area (Severn Run High School and Archbishop Spalding High School) have not yet been surveyed for future cameras.

As part of the September 19, 2024 site visit, lane configurations were confirmed for the intersections along the Stevenson Road and Quarterfield Road corridors. Refer to **Figure 13** for the existing lane configuration diagram.

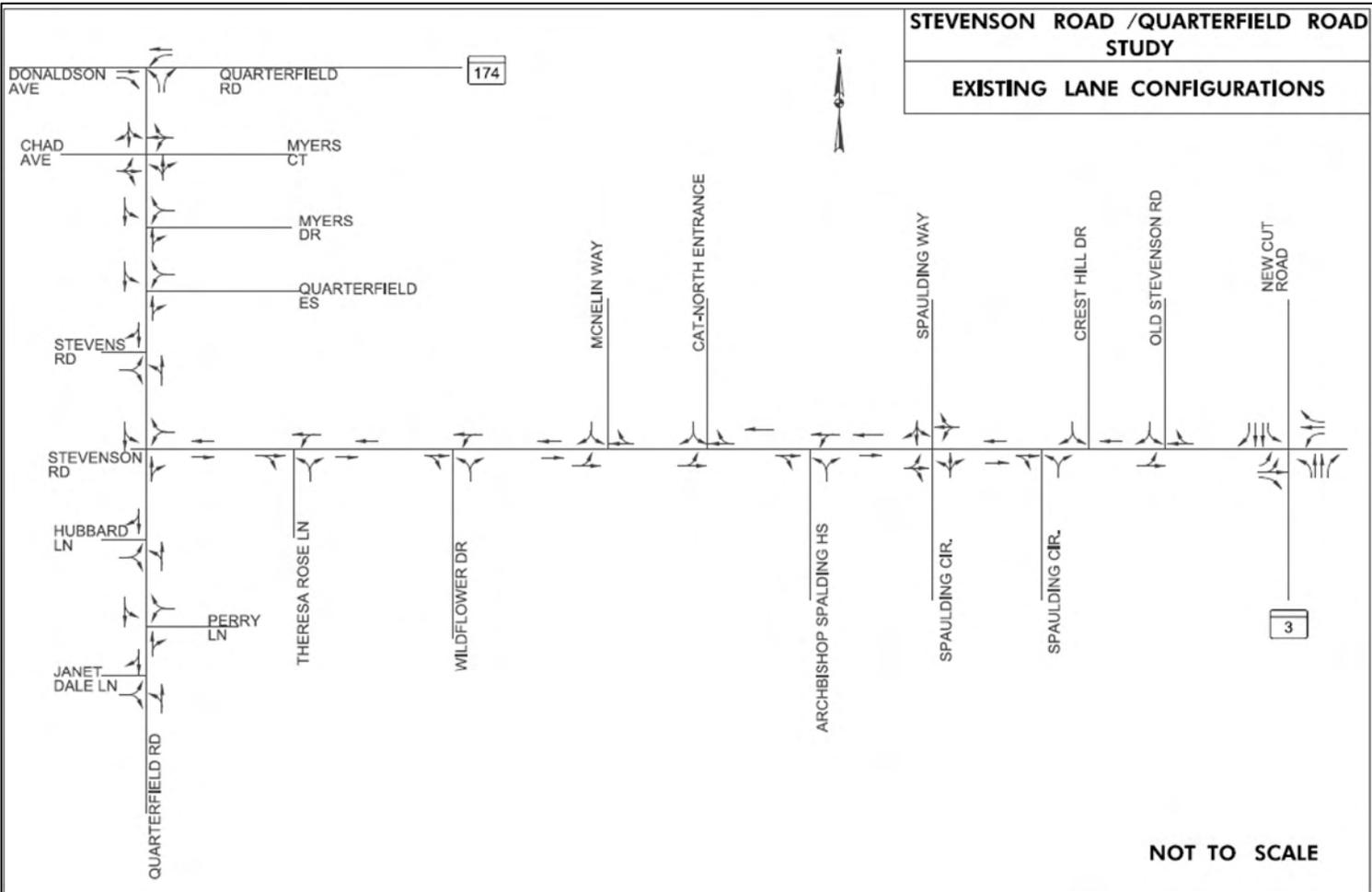


Figure 13: Existing Lane Configurations

3.2 Existing Traffic Count Data

SHA provided the latest signal plans for the MD 3 Business at MD 997E (Stevenson Road) and Severn Run High School intersection to allow the project team to confirm signal phasing and lane configurations. A copy of the signal plan may be found in **Appendix B**

Except for the MD 997E (Stevenson Road) at MD 3 Business (New Cut Road) intersection, all intersections have two-way stop control (TWSC) with stop control for the side street approaches and free flow traffic along the mainline approaches. MD 997E (Stevenson Road) at MD 3 Business (New Cut Road) is signal controlled on all four approaches.

Seven-day, 168-hour traffic volume, vehicle classification and speed data were also collected during the week of September 16, 2024 at the following three locations:

- Quarterfield Road, between Stevenson Road and Myers Drive
- Stevenson Road, between Wildflower Drive and the driveway for the Center of Applied Technology Driveway
- Stevenson Road, between Spaulding Circle and Crest Hill Road

Weekday 13-hour turning movement counts (TMCs) were obtained at six (6) intersections between the hours of 6:00 AM and 7:00 PM during the week of September 16, 2024 when schools were in session. The TMC data includes vehicular, pedestrian and bicycle traffic at the following intersections.

- Stevenson Road at Quarterfield Road
- Stevenson Road at MD 3 Business (New Cut Road)
- Quarterfield Road at Janet Dale Lane
- Quarterfield Road at MD 174 (Donaldson Avenue/Quarterfield Road)
- Quarterfield Road at Myers Drive
- Quarterfield Road at Quarterfield Elementary School Driveway

A summary of the weekday peak hour volumes may be found in **Figure 14**. Refer to **Appendix C** for a summary of the traffic count information obtained for this study.

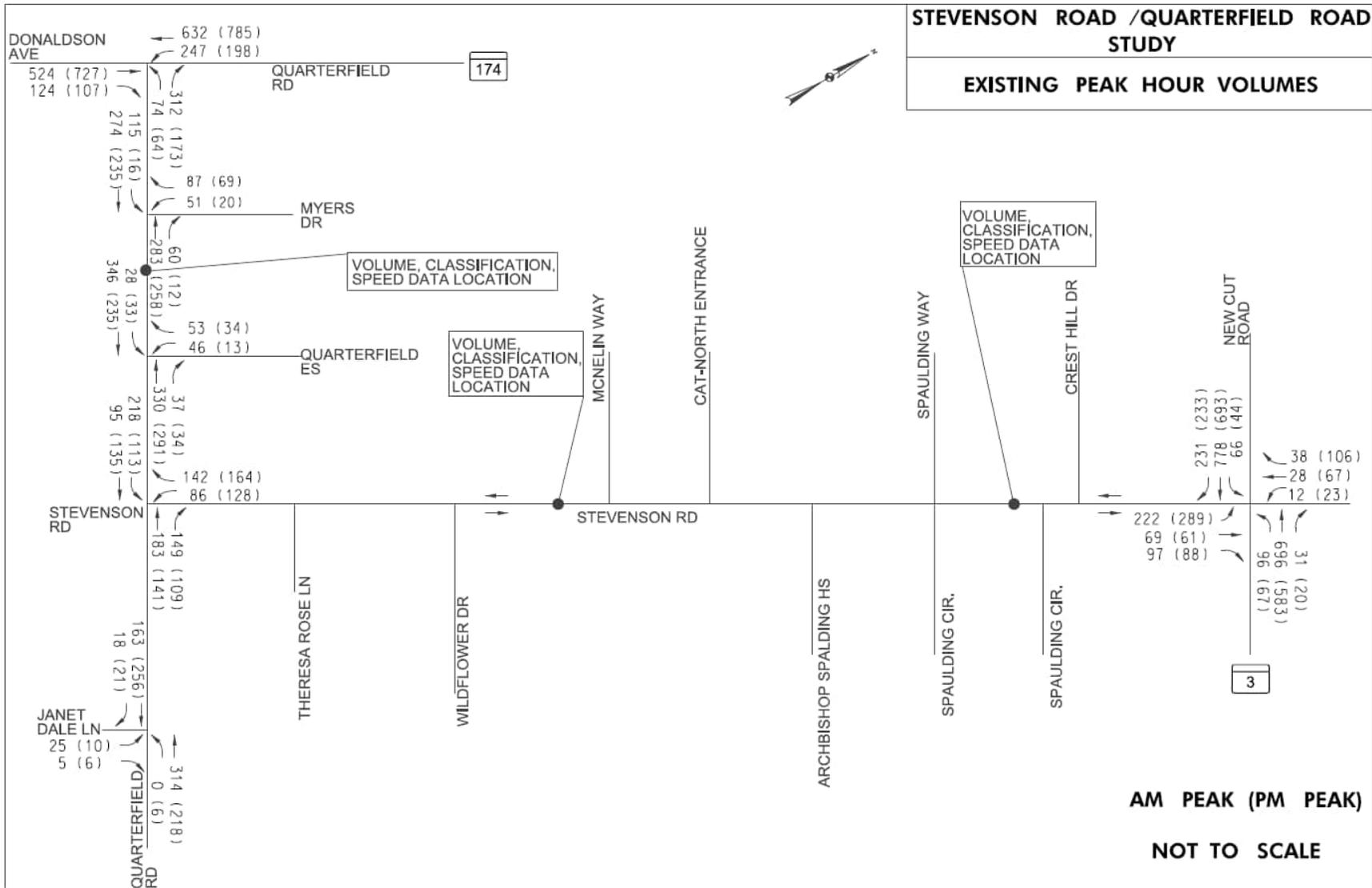


Figure 14: Existing Peak Hour Traffic Volumes

3.3 Existing Speed Data

The speed data collected at these locations included the 15th percentile, 50th percentile, 85th percentile, and 95th percentile speed statistics. In addition, the mean (average), 10 MPH pace, number and percentage of vehicles in the pace, and number and percentage above the posted speed limits were summarized for the seven-day period. The 10 MPH pace is the 10 MPH range encompassing the greatest percentage of all the measured speeds in a spot speed study. **Table 5** summarizes the speed data for each roadway segment including the percentage of vehicles traveling over the posted speed limit and the percentage of vehicles in the 10 MPH pace range.

Table 5: Average Daily Traffic and Speed Summary

Segment	ADT (vpd)	Posted Speed Limit (MPH)	85 th -Percentile Speed (MPH)	Mean (Average) Speed (MPH)	Vehicles over Posted Speed (%)	Vehicles in 10 MPH Pace (%)
Quarterfield	6350	35	39	35	42%	71%
Stevenson – Wildflower to CAT-N	4500	35	43	39	75%	65%
Stevenson – Spaulding to Crest Hill	5400	30	32	27	23%	71%

For Quarterfield Road between Stevenson Road and Myers Drive, the posted speed limit is 35 MPH, and the 10 MPH pace range is 31-40 MPH. For Stevenson Road between Wildflower Drive and CAT-North, the posted speed limit is 35 MPH, and the 10 MPH pace range is 36-45 MPH. For Stevenson Road between Spaulding Circle and Crest Hill Road, the posted speed limit is 30 MPH, and the 10 MPH pace range is 21-30 MPH.

Refer to **Appendix C** for a summary of the traffic count information obtained for this study.

3.4 Crash Data Summary

The project team obtained crash data from SHA for the following roadway segments and intersections for the five-year period from January 1, 2019 to December 31, 2023:

ROADWAY SEGMENTS

- MD 997E (Stevenson Road), from Old Stevenson Road to MD 3 Business (New Cut Road),
- Stevenson Road (CO 1337), from Quarterfield Road to Old Stevenson Road, and
- Quarterfield Road (CO 907), from Janet Dale Lane to MD 174 (Donaldson Avenue/Quarterfield Road).

INTESECTIONS

- MD 997E (Stevenson Road) at MD 3 Business (New Cut Road),
- Stevenson Road (CO 1337) at Center of Applied Technology-North,
- Stevenson Road (CO 1337) at Quarterfield Road (CO 907),
- Quarterfield Road (CO 907) at Janet Dale Lane,

- Quarterfield Road (CO 907) at Quarterfield Road Elementary School,
- Quarterfield Road (CO 907) at Myers Drive, and
- Quarterfield Road (CO 907) at MD 174 (Donaldson Avenue/Quarterfield Road).

SHA noted that the 2023 data should be considered preliminary.

Table 6 provides a summary of the reported crashes for each roadway segment and key intersection by year.

Table 6: Crash Summary by Year

Segment	Total	2019	2020	2021	2022	2023
MD 997E	6	1	2	1	2	0
Stevenson (County)	4	0	1	2	1	0
Quarterfield	23	4	7	4	1	7
Intersection	Total	2019	2020	2021	2022	2023
Stevenson / New Cut	12	1	2	2	5	2
Stevenson / CAT-N	0	0	0	0	0	0
Stevenson / Quarterfield	6	0	3	1	0	2
Quarterfield / Janet Dale	0	0	0	0	0	0
Quarterfield / QES	0	0	0	0	0	0
Quarterfield / Myers	0	0	0	0	0	0
Quarterfield / Donaldson	11	1	1	2	4	3
Total	62	7	16	12	13	14

A total of 62 crashes were reported across the three roadway segments and seven study intersections. Among the three roadway segments, the section of Quarterfield Road from Janet Dale Lane and MD 174 had the most crashes (23 crashes). Of the seven study intersections, Stevenson Road at MD 3 Business (New Cut Road) and Quarterfield Road at MD 174 (Donaldson Avenue/Quarterfield Road) had about the same number of reported crashes; 12 and 11, respectively. No crashes were reported at Stevenson/CAT North, Quarterfield Road/Janet Dale Lane, Quarterfield Road/Quarterfield Elementary School, or Quarterfield Road/Myers Drive intersections. On average, about 12 crashes were reported annually within the study limits with the fewest crashes occurring in 2019 (7 crashes) and the most reported crashes occurring in 2020 (16 crashes).

Table 7 provides a summary of the crash severity for each roadway segment and key intersection.

Table 7: Crash Severity Summary

Segment	Total	Fatal	Injury	PDO
MD 997E	6	0	2	4
Stevenson (County)	4	0	0	4
Quarterfield	23	0	10	13
Intersection	Total	Fatal	Injury	PDO
Stevenson / New Cut	12	0	3	9
Stevenson / CAT-N	0	0	0	0
Stevenson / Quarterfield	6	0	3	3
Quarterfield / Janet Dale	0	0	0	0
Quarterfield / QES	0	0	0	0
Quarterfield / Myers	0	0	0	0
Quarterfield / Donaldson	11	--	4	7
Total	62	0	22	40

There were no fatalities among the 62 reported crashes between January 1, 2019 and December 31, 2023. However, approximately 35% of all reported crashes were injury-related. Injury crashes were most prevalent (10 of 22 injury crashes) along Quarterfield Road between Janet Dale Lane and MD 174 (Donaldson Avenue/Quarterfield Road). The remaining reported crashes within the study limits were categorized as property-damage only (PDO).

Table 8 provides a summary of the collision types for each roadway segment and key intersection.

Table 8: Crash Collision Type Summary

Segment	Total	Pedestrian	Angle	Left Turn	Rear End	Fixed Object	Sideswipe	Other
MD 997E	6	0	0	0	4	0	2	0
Stevenson (County)	4	0	0	0	1	1	1	1
Quarterfield	23	3	7	0	4	5	0	4
Intersection	Total	Pedestrian	Angle	Left Turn	Rear End	Fixed Object	Sideswipe	Other
Stevenson / New Cut	12	0	0	5	6	0	1	0
Stevenson / CAT-N	0	0	0	0	0	0	0	0
Stevenson / Quarterfield	6	2	2	0	0	0	0	2
Quarterfield / Janet Dale	0	0	0	0	0	0	0	0
Quarterfield / QES	0	0	0	0	0	0	0	0
Quarterfield / Myers	0	0	0	0	0	0	0	0
Quarterfield / Donaldson	11	0	6	0	5	0	0	0
Total (% of Total)	62	5 (8%)	15 (24%)	5 (8%)	20 (32%)	6 (10%)	4 (7%)	7 (11%)

Approximately one-third (33 percent) of all reported crashes occurring on these roadway segments and intersections were rear-end type collisions. Rear end collisions accounted for half of the reported crashes at the Stevenson Road and MD 3 Business (New Cut Road) intersection. This crash type may be attributed to the signal control at this intersection, as well as heavier traffic volumes on MD 3 Business. Likewise, half of all reported crashes at the Quarterfield Road and MD 174 (Donaldson Avenue/Quarterfield Road). While not signal-controlled, this intersection also involves a State-maintained route carrying more traffic volume than the intersecting County roadway.

Angle and Other (Undefined) collisions make up just over one-third (35 percent) of the reported crashes. All 15 reported angle-type crashes occurred along Quarterfield Road or along intersections associated with Quarterfield Road (specifically at Stevenson Road or MD 174) within the study limits.

A copy of the crash data provided by SHA for this project is available in **Appendix D**.

3.5 Existing Pedestrian Level of Comfort

A Pedestrian Level of Comfort (PLOC) analysis was developed by the Montgomery County Planning Department and used on this study to identify locations in the existing sidewalk network that are uncomfortable due to inadequate width or gaps in the network and pedestrian crossings. The Montgomery County PLOC approach was inspired by the Bicycle Level of Traffic Stress (LTS) analysis conducted for the Montgomery County Bicycle Master Plan. Anne Arundel County does not currently have their own methodology, so it was agreed to apply the Montgomery County analysis for this study.

Using the Montgomery County Planning analysis, PLOC scores identify qualitative ratings ranging from High-Quality to Unacceptable for existing sidewalks and pedestrian crossings. These ratings are defined below:

- **High-Quality:** This walking environment enables parents to walk with young children with a moderate level of supervision.
- **Acceptable:** This walking environment is comfortable for families, but parents would hold the hands of young children.
- **Unacceptable:** This walking environment is uncomfortable, and most adults will only walk if they have no other option.

The PLOC analysis assign a numerical value to comfort levels in an effort provide quantitative results based on the qualitative measures. The comfort scale is as follows:

- 1 = Very comfortable
- 1.5 = Comfortable
- 2 = Somewhat comfortable
- 2.5 = Somewhat uncomfortable
- 3 = Uncomfortable
- 3.5 = Very Uncomfortable
- 4 = Undesirable

Sidewalks and crossings are scored based on a “weakest link” approach in which the comfort of a segment in the network is governed by its most uncomfortable characteristic. Sidewalk and street crossings are evaluated using different methodologies. Sidewalk scoring considers the following inputs:

Adjacent Planned Land Uses

- Urban

- Mixed-use or high-density land use zones
- Within ½ mile of rail or 1/4-mile from bus rapid transit stations
- Suburban

Sidewalk Width

- Less than 3.5 feet
- 3.5 feet to less than 5 feet
- 5 feet to less than 8 feet
- 8 feet or more

Posted Speed Limit

- Less than 25 MPH
- 25 MPH
- 30 MPH
- 35 MPH
- Greater than/equal to 40 MPH

Sidewalk Buffer Width

- 0 feet to less than 2 feet
- 2 feet to less than 5 feet
- 5 feet to less than 8 feet
- Greater than/equal to 8 feet

On-Street Buffer Separation

- Designated Parking Lane (DPL)
- Separated Bike Lane (SBL) – one or two.

A copy of the relevant information for the Montgomery County Planning Methodology may be found in **Appendix E**.

Sidewalks

The Stevenson Road / Quarterfield Road study area is considered “non-urban” (i.e., suburban). PLOC scoring for these attributes are defined in **Table 9** from the Montgomery County Planning PLOC Methodology.

Table 9: PLOC Scoring for Non-Urban Sidewalks (Pathways)

	PATHWAY WIDTH	POSTED SPEED LIMIT	PATHWAY BUFFER WIDTH / ON-STREET SEPARATION											
			0 ft to <2 ft			2 to <5 ft			5 to <8 ft			≥8 ft		
			No DPL or SBL	DPL or 1SBL	2SBL or DPL & SBL	No DPL or SBL	DPL or 1SBL	2SBL or DPL & SBL	No DPL or SBL	DPL or 1SBL	2SBL or DPL & SBL	No DPL or SBL	DPL or 1SBL	2SBL or DPL & SBL
NON-URBAN	No walkway		Use "No Pathway" Table											
	Less than 5ft	< 25 mph	2	2	1	2	1	1	2	1	1	1	1	1
		25 mph	2/3*	2	1	2	1	1	2	1	1	1	1	1
		30 mph	4	3	1	3	2	1	2	1	1	1	1	1
		35 mph	4	3	2	3	2	2	3	2	1	2	1	1
		≥ 40 mph	4	4	3	4	3	2	3	2	2	2	1	1
	≥5 to 8 ft	< 25 mph	2	2	1	2	1	1	2	1	1	1	1	1
		25 mph	2/3*	2	1	2	1	1	2	1	1	1	1	1
		30 mph	4	3	1	3	2	1	2	1	1	1	1	1
		35 mph	4	3	2	3	2	2	3	2	1	2	1	1
		≥ 40 mph	4	4	3	4	3	2	3	2	2	2	1	1
	≥8 ft	< 25 mph	2	1	1	2	1	1	1	1	1	1	1	1
		25 mph	2	2	1	2	1	1	1	1	1	1	1	1
		30 mph	4	3	1	3	2	1	2	1	1	1	1	1
		35 mph	4	3	2	3	2	2	3	2	1	1/2^	1	1
		≥ 40 mph	4	4	3	4	3	2	3	2	2	1/2^	1	1

Source: Montgomery County Planning Pedestrian Plan (March 2022)

Streets with no sidewalks receive special consideration because they cannot be scored based on path width or buffer. The most important considerations on these streets are posted speed, amount of vehicle traffic, land use and parking presence. **Table 10** is taken from the Montgomery County Planning PLOC Methodology. It uses roadway functional class as a substitute for vehicle traffic volumes, since traffic volume data are not available on all County-type roads.

Table 10: PLOC Scoring for Roadways with No Sidewalks (Pathways)

CONTEXT	MASTER PLAN OF HIGHWAYS AND TRANSITWAYS (MPOHT) FUNCTIONAL CLASSIFICATION	PARKING ALLOWED	POSTED SPEED LIMIT				
			< 25 mph	25 mph	30 mph	35 mph	≥ 40 mph
URBAN	Any	No / Yes	4	4	4	4	4
NON-URBAN	Less than Primary Residential	No	2	3	4	4	4
		Yes	2	3	4	4	4
	Primary Residential or Greater	No	2	4	4	4	4
		Yes	3	4	4	4	4

Source: Montgomery County Planning Pedestrian Plan (March 2022)

Results of the PLOC analysis for existing sidewalks (pathways) along the Stevenson and Quarterfield Road corridors are summarized in **Table 11**. The table evaluates various segments along the Quarterfield Road corridor as well as the County-maintained and State-maintained portions of Stevenson Road. The table identifies the posted speed limit for each segment, existing sidewalk widths on either side of the roadway (if applicable), the presence of on-road buffers such

as a designated parking lane (DPL) or separated bike lane (SBL), available buffer width (grass or other), and the associated PLOC score.

Please note that there are three segments with notable gaps in the existing sidewalks network or limited sidewalk coverage that may contribute to a lower PLOC rating. These segments are:

- Stevenson Road (CO 1337), from Theresa Rose Lane to Wildflower Drive (south side)
- Stevenson Road (CO 1337), from Grasons Court to CAT-North Entrance (north side)
- Stevenson Road (CO 1337), from CAT-North to Spaulding Way/Spaulding Circle (south side)

Table 11: Existing PLOC Analysis Results for Stevenson and Quarterfield Road Corridors

NON-URBAN SETTING								
Roadway	Segments	Posted Speed Limit	Side of Road	Sidewalk Width (ft)	Buffer Type	Buffer Width (ft)	PLOC	
Quarterfield Road (CO 907)	Janet Dale Ln to Perry Ln	35	West	4	No DPL or SBL	6	3	
			East	4	No DPL or SBL	5	3	
	Perry Lane to Stevenson		West	N/A	No DPL or SBL	N/A	4	
			East	N/A	No DPL or SBL	N/A	4	
	Stevenson to QES		West	N/A	No DPL or SBL	N/A	4	
			East	N/A	No DPL or SBL	N/A	4	
	QES to Myers Dr		West	N/A	No DPL or SBL	N/A	4	
			East	4	No DPL or SBL	2	3	
	Myers Dr to Chad Ave/Myers Ct		West	N/A	No DPL or SBL	N/A	4	
			East	4	No DPL or SBL	4	3	
	Chad Ave/Myers Ct to MD 174		West	4	No DPL or SBL	5	3	
			East	4	No DPL or SBL	5	3	
Stevenson Road (CO 1337)	Quarterfield Rd to Theresa Rose	35	North	N/A	No DPL or SBL	N/A	4	
			South	N/A	No DPL or SBL	N/A	4	
	Theresa Rose to Wildflower		North	N/A	No DPL or SBL	N/A	4	
			South*	N/A	No DPL or SBL	N/A	4	
	Wildflower to Grasons Ct		North	4	No DPL or SBL	5.5	3	
			South	N/A	No DPL or SBL	N/A	4	
	Grasons to CAT-North		North*	4	No DPL or SBL	5.5	3	
			South	N/A	No DPL or SBL	N/A	4	
	CAT-North to Spaulding Way		30	North	6	No DPL or SBL	3	3
				South*	4	No DPL or SBL	2.5	3
Spaulding Way to Crest Hill	North	4		No DPL or SBL	4	3		
	South	4		No DPL or SBL	4	3		
Stevenson Road (MD 997E)	Crest Hill to Old Stevenson	30	North	N/A	No DPL or SBL	N/A	4	
			South	5	No DPL or SBL	2.5	3	
	Old Stevenson to MD 3 Business		North	N/A	No DPL or SBL	N/A	4	
			South	5	No DPL or SBL	2.5	3	

*-denotes a segment with a gap in the sidewalk or limited sidewalk available.

In general, the Stevenson Road and Quarterfield Road corridors have PLOC ratings of either 3 (Uncomfortable) or 4 (Undesirable) based on the available width of existing sidewalks, available buffer widths, posted speed limits and lack of any on-street parking or bicycle lanes.

Crossings

The information in **Table 12** is taken from the Montgomery County Planning PLOC Methodology. The following variables are considered for either signalized crossings or stop-controlled crossings: number of lanes, median type, crosswalk type and posted speed limit. In these cases, the posted speed limit on the road that pedestrians will cross is the posted speed limit used for the PLOC crossing score.

Table 12: PLOC Scoring for Controlled (Signal or Stop-Controlled) Crossings

# OF LANES	MEDIAN TYPE	CROSSWALK TYPE	POSTED SPEED LIMIT				
			< 25 mph	25 mph	30 mph	35 mph	>= 40
1 to 3	Raised Refuge Island	High Visibility	1	1	1	2	2
		Marked	1	1	2	2	2
		Unmarked	1	1	3	3	4
	Raised/Hardened Centerline	High Visibility	1	1	2	2	3
		Marked	1	1	2	2	3
		Unmarked	1	2	3	4	4
	Painted/None	High Visibility	1	1	2	3	3
		Marked	1	1	2	3	3
		Unmarked	1	2	3	4	4

Source: Montgomery County Planning Pedestrian Plan (March 2022)

*-Crossings evaluated only if they have two receiving ramps

Results of the PLOC analysis for existing crossings along the Stevenson and Quarterfield Road corridors are summarized in **Table 13**. These locations were evaluated because they have two receiving ramps to accommodate pedestrian crossing movement. Please note that there are no existing marked crosswalks at intersections or midblock locations along either the Stevenson Road or Quarterfield Road corridors. This includes the pedestrian crossing across the northbound Quarterfield Road right-turn to MD 174 have crosswalk pavement markings.

The northbound Quarterfield Road channelized right-turn to MD 174 is considered an uncontrolled crossing for pedestrians. All other existing pedestrian crossings evaluated for this study occur across side roads with stop control for the approaching vehicles. None of the stop-controlled crossing locations or the pedestrian crossing across the northbound Quarterfield Road right-turn to MD 174 have any median for pedestrian refuge areas.

Table 13: PLOC Scoring for Controlled (Signal or Stop-Controlled) Crossings

Intersection	Crossing Approach*	Approach Posted Speed Limit	Approach Traffic Control	# of Lanes Crossed	Median Type	Crosswalk Type	PLOC
Quarterfield Road at Janet Dale Lane	Eastbound Janet Dale Ln	25	Stop	2	None	Unmarked	2
Quarterfield Road at Myers Drive	Westbound Myers Dr	25	Stop	2	None	Unmarked	2
Quarterfield Road at Myers Court	Westbound Myers Ct	25	Stop	2	None	Unmarked	2
Quarterfield Road at MD 174	Northbound Quarterfield Rd	35	Stop	2	None	Unmarked	4
	Northbound Quarterfield Rd (Channelized Right Turn)	35	Free	1	None	Unmarked	4
Stevenson at Wildflower	Northbound Wildflower	25	Stop	2	None	Unmarked	2
Stevenson at Grasons Ct	Southbound Grasons Ct	25	Stop	2	None	Unmarked	2
Stevenson at Spaulding Circle/Spaulding Way	Northbound Spaulding Cir	25	Stop	2	None	Unmarked	2
	Southbound Spaulding Way	25	Stop	2	None	Unmarked	2
Stevenson at Spaulding Circle	Northbound Spaulding Cir	25	Stop	2	None	Unmarked	2

In general, the Stevenson Road and Quarterfield Road corridors have PLOC ratings of either 2 (Somewhat Comfortable) or 4 (Undesirable) for existing crossings based on the approach posted speed limit, approach traffic control and the number of lanes a pedestrian must cross. Based on the Montgomery County PLOC methodology, the pedestrian crossing locations at Quarterfield Road and MD 174 receive the highest PLOC scores of all the existing locations evaluated for this study.

The existing pedestrian facilities within the corridor are highlighted in Figure 15 below. The information shown in the figure was sourced from Anne Arundel County’s Open GIS Data (<https://opendata.aacounty.org/datasets/>) and the field investigations performed on September 19, 2024.

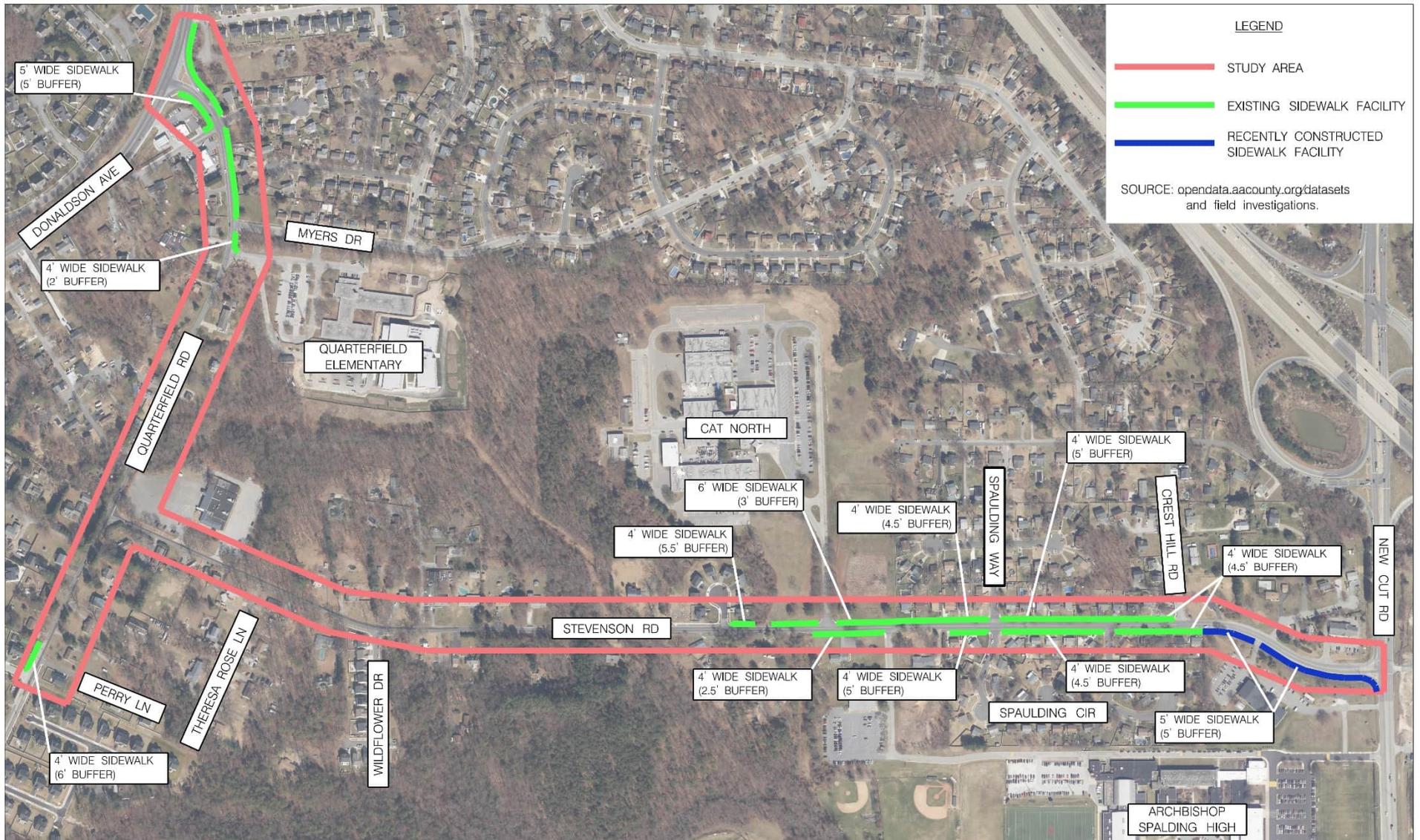


Figure 15: Existing Pedestrian Facilities

3.6 Existing Bicycle Level of Traffic Stress

The Maryland Department of Transportation has transitioned from using the Bicycle Level of Comfort (BLOC) to using the Level of Traffic Stress (LTS) for measuring the “bikeability” of a roadway network. This transition was done in coordination with the implementation of MDOT SHA’s Context Driven Design Guidelines and other national and departmental initiatives. LTS is preferred over BLOC as LTS requires fewer variables to calculate including:

- Presence and type of bicycle facility
- Speed Limit
- Number of Through Lanes/Traffic Volume

The traditional Level of Traffic Stress (LTS) (scale “1” to “4”) is a measure for assessing the quality of the roadway network for its comfort with various bicycle users. The lower the LTS score, the more inviting the bicycle facility is for more audiences. **Table 14** summarizes the various LTS ratings.

Table 14: Bicycle Level of Traffic Stress Ratings

LTS	Target Audience	Bicycle Facility Types
0	All ages and abilities	Rail-trails, shared-use paths
1	Almost everyone	Protected bikeways, sidepaths
2	Interested but concerned	Bike lanes, bike boulevards
3	Enthused and confident	Bike lanes, shared lanes, shoulders
4	Strong and fearless	No bike facility or bike lane on a major roadway
5	Bicycle Access Prohibited	Bicycle access is prohibited by managing roadway agency

Source: MDOT LTS Methodology

Table 15 categorizes the corresponding LTS rating for a roadway with a specific number of through lanes, the effective annual average daily traffic (AADT), and prevailing speed.

Referring to the ADT values and 85th percentile speed data found in **Table 5**, both County and State maintained sections of Stevenson Road and the section of Quarterfield Road would qualify as having a **LTS rating of 4** for since all have one through lane per direction, have ADTs that exceed 3,000 vpd and have prevailing speeds that are 30 MPH or higher for existing conditions.

Table 15: Bicycle LTS with Mixed Traffic Criteria

Number of Lanes	Effective ADT	Prevailing Speed						
		<20mph	25mph	30mph	35mph	40mph	45mph	50+mph
Unlaned 2-way street (No centerline)	0-750	1	1	2	2	3	3	3
	751-1500	1	1	2	3	3	3	4
	1501-3000	2	2	2	3	4	4	4
	3000+	2	3	3	3	4	4	4
1 thru lane per direction (1-way, 1 lane street or 2-way street with centerline)	0-750	1	1	2	2	3	3	3
	751-1500	2	2	2	3	3	3	4
	1501-3000	2	3	3	3	4	4	4
	3000+	3	3	3	4	4	4	4
2 thru lanes per direction	0-8000	3	3	3	3	4	4	4
	8001+	3	3	4	4	4	4	4
3+ thru lanes per direction	Any	3	3	4	4	4	4	4

Effective ADT = ADT for two-way roads. Effective ADT – 1.5x ADT for one-way roads

Source: MDOT LTS Methodology

4. EXISTING CONDITIONS TRAFFIC ANALYSIS

Capacity analysis for the study intersections was performed using the Highway Capacity Manual (HCM) methodologies to analyze the weekday AM and PM peak hours. The Synchro traffic software was used to analyze the signalized and unsignalized intersections.

Table 16 summarizes the delay ranges (seconds/vehicle) that correspond to the level of service (LOS) for two-way (side street) stop-controlled intersections and signalized intersections. In general, the Anne Arundel County Traffic Impact Study Guidelines state that a LOS of "D" is acceptable for intersections and roadway segments

Table 16: Intersection Levels of Service and Delay Thresholds

LOS	Delay Threshold (sec/veh)	
	Two-Way (Side Street) Stop*	Signal
A	0 - 10	0 - 10
B	10 - 15	10 - 20
C	15 - 25	20 - 35
D	25 - 35	35 - 55
E	35 - 50	55 - 80
F	> 50	> 80

Source: Highway Capacity Manual

*Applies to only the worst of the stop-controlled approaches

The Highway Capacity Manual (HCM) Signalized and Unsignalized Intersection analysis results for existing conditions are shown in **Table 17** for the study intersections.

Table 17: Existing Study Intersections – Summary of Traffic Results

Intersection	Traffic Control	LOS	
		AM	PM
Stevenson Road / MD 3 BUS (New Cut Road)	Signal	B	B
Stevenson Road / Quarterfield Road	Side Street Stop	C	C
Quarterfield Road / Janet Dale Lane	Side Street Stop	B	B
Quarterfield Road / Quarterfield ES	Side Street Stop	A	A
Quarterfield Road / Myers Drive	Side Street Stop	C	A
Quarterfield Road / MD 174 (Donaldson Avenue/Quarterfield Road)	Side Street Stop	F	F

The results show that all approaches and the study intersections operate at acceptable levels of service (LOS) in both the AM and PM peak hours, except for the Quarterfield Road at MD 174 (Donaldson Avenue/Quarterfield Road) intersection. The stop-controlled approach along the County-maintained portion of Quarterfield Road experiences delay that result in LOS of “F” in both the AM and PM peak periods.

Refer to **Appendix F** for the Synchro analysis reports for the study intersections under existing conditions.

5. EQUITY AND VULNERABLE POPULATIONS ANALYSIS

The Anne Arundel County Department of Public Works (DPW) requested KCI to identify vulnerable populations surrounding the study limits. This information will be used to assist in incorporating equity considerations into the study improvements to better serve the travel needs of vulnerable populations.

The goal of the equity and vulnerable populations analysis is to identify where there are vulnerable populations and determine the specific demographics of those areas identified as having vulnerable populations.

The data used for this analysis includes the following two resources:

- U.S. Department of Transportation (DOT) resources Equitable Transportation Communities (ETC) Explorer
- Federal Highway’s Administration Screening Tool for Equity Analysis of Projects (STEAP)
- Baltimore Metropolitan Council (BMC) resources to identify vulnerable populations and incorporate equity considerations into improvement development.

To analyze the data from the above resources, a one-mile buffer was placed around the study limits. Areas of vulnerable populations that are within or touching the one-mile buffer area were analyzed.

5.1 Baltimore Metropolitan Council Vulnerable Population Index

The Baltimore Metropolitan Council (BMC) Vulnerable Population Index (VPI) is used to identify vulnerable people and grounds around the study area. According to the BMC, the following seven individual population groups are identified as vulnerable:

1. Low-Income Population (below 200% of poverty level)
2. Non-Hispanic Minority Population
3. Hispanic or Latino Population (all races)
4. Population with Limited English Proficiency (LEP)
5. Population with Disabilities
6. Elderly Population (age 75 and up)
7. Households with No Car

The VPI is calculated by evaluating census tract-level demographic data. If a vulnerable population group is over the regional mean (listed below) they are divided into two equally sized intervals. Census tracts in the lower interval are given a score of 1 and block groups in the upper interval are given a score of 2. The scores are totaled for each census tract resulting in the VPI. In general, a lower VPI indicates a less vulnerable area, while a higher VPI indicates a more vulnerable area.

1. Percent of population Low Income (population with income below 200% of the poverty level) threshold: **21.4%**
2. Percent of population that is a non-Hispanic (not White and not Hispanic) Minority Population threshold: **38.3%**
3. Percent of population that is Hispanic or Latino (all races) threshold: **6.0%**
4. Population with Limited English Proficiency (population over 5 years old that speaks English “not well” or “not at all”) threshold: **1.8%**
5. Percent of Population with Disabilities threshold: **11.8%**
6. Elderly Population (Age 75 or older) threshold: **6.4%**
7. Percent of Households that do not have a car threshold: **10.5%**

Figure 16 illustrates all ten census tracts with three census tracts receiving a VPI of 4 or greater.

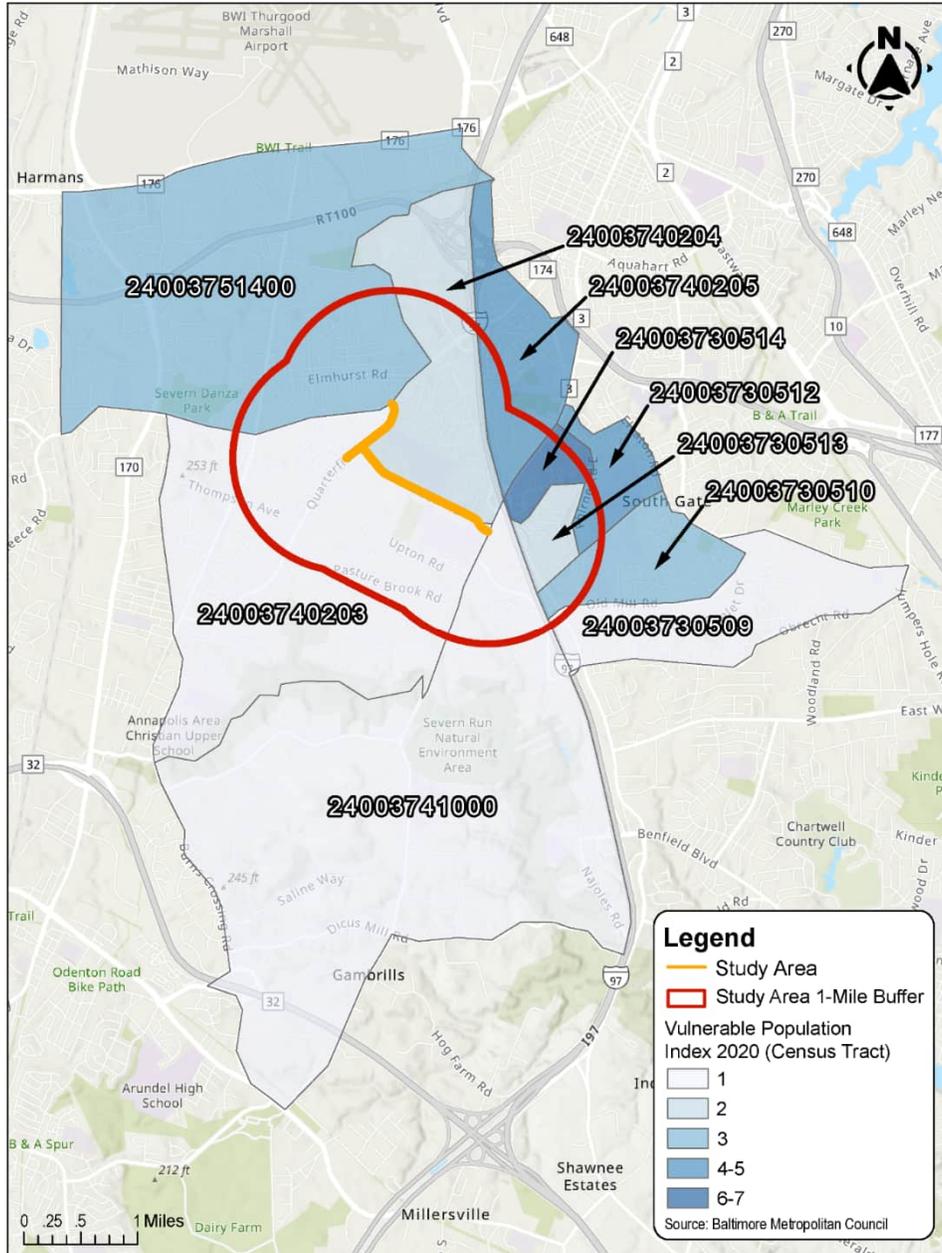


Figure16: BMC Vulnerable Population Index 2020 Map

According to the VPI, all ten census tracts that are within or touching the one-mile buffer area contain at least one vulnerable population group over the regional mean (see **Table 18**).

Table 18: Vulnerable Population Group Results per the BMC

Vulnerable Population Group	Census Tracts (last six digits)									
	730509	730510	730512	730513	730514	740203	740204	740205	741000	751400
Vulnerable Population Index	1	3	5	2	7	1	2	4	1	3
Percent of population Low Income (population with income below 200% of the poverty level)	11.0%	7.4%	19.5%	20.0%	41.9%	8.0%	14.6%	25.0%	13.0%	13.8%
Percent of population that is a non-Hispanic (not White and not Hispanic) Minority Population	19.4%	47.5%	58.5%	47.8%	53.6%	27.8%	26.1%	23.2%	16.1%	36.6%
Percent of population that is Hispanic or Latino (all races)	9.5%	2.0%	9.1%	1.2%	13.3%	4.1%	9.4%	17.7%	6.6%	2.1%
Population with Limited English Proficiency (population over 5 years old that speaks English “not well” or “not at all”)	0.4%	1.9%	4.7%	0.8%	2.5%	1.9%	0.3%	2.5%	0.6%	1.9%
Percent of Population with Disabilities	9.2%	12.3%	14.6%	18.3%	17.7%	9.7%	12.2%	16.6%	7.9%	12.1%
Percent of population that is age 75 or older	3.3%	4.5%	1.1%	2.8%	7.6%	3.0%	2.6%	5.1%	5.9%	10.7%
Percent of households that do not have a car	2.1%	4.1%	15.6%	2.1%	23.4%	0.7%	6.9%	3.6%	3.5%	4.1%
VULNERABLE POPULATION INDEX	1	3	5	2	7	1	2	4	1	3

Note: Cells highlighted orange indicate that the vulnerable population group is over the regional mean.

6. PUBLIC OUTREACH

The project team held a meeting on October 15, 2024 with community leaders to introduce the project, discuss initial project activities, and review the project schedule and next steps. Some of the topics discussed at the meeting with community leaders included:

- Additional Site Visits – County staff noted that there will be additional field observations performed at various times and days to provide a more comprehensive look at the existing conditions in the corridor.
- Some community leaders noted that these corridors have different types of bicycle riders at different times of the day. For example, some bicyclists have been seen riding to work well before sunrise.
- Commuters may be out on these roads between 5:00 AM and 6:00 AM riding their bikes. People may not be walking / biking throughout the day because they currently don't feel as safe once the vehicular traffic volumes increase.

- The consensus is that people want to feel safe before they go out to walk, run, or ride a bicycle. Facilities such as shared use paths can provide a greater sense of safety for many people.
- Managing travel speeds with physical changes to the roadway can be challenging.
 - Based on the available speed data, there seems to be an increase in driver speeds along Stevenson Road between CAT-North and Quarterfield Road. This part of the corridor does not contain speed humps. There may be some opportunity to provide physical improvements to this section of the roadway.
 - However, speed humps sometimes receive negative feedback from freight drivers, emergency vehicle drivers and school bus drivers so all users should be considered before physical changes are made to a roadway.

7. TASK 1 RECOMMENDATIONS AND NEXT STEPS

The next steps in the project are to develop a 2050 travel demand forecast using the latest model from the Baltimore Metropolitan Council (BMC), as modified in the most recent studies that use the most recently adopted version of the Regional Cooperative Forecast from the BMC's Baltimore Regional Transportation Board (BRTB). The model will account for other planned transportation improvements in the model forecasting analysis, including *Move Anne Arundell*, Walk and Roll Anne Arundel, and other study recommendations from the County and SHA. Coordination meetings may be held with Anne Arundel County, SHA, and the BMC to develop the travel forecasting model and future traffic for this project.

The 2050 forecasted traffic data will be used to evaluate Future No-Build traffic operations along the corridors and at the study intersections. The 2050 No-Build traffic will be analyzed for the typical weekday AM and PM peak periods. Additional peak periods such as the weekday midday peak or a peak hour associated with school traffic may also be evaluated. Traffic software programs such as Synchro/SimTraffic will be used to evaluate traffic operations along the corridors and at the study intersections for 2050 No-Build conditions.

In conjunction with the 2050 Traffic Forecasts, an initial Purpose and Need Statement will be prepared to support any recommended alternatives for inclusion in the County's Capital Improvement Program.

The purpose and need document will encompass:

- Existing traffic operational, safety, accessibility, and mobility performance for all modes.
- Forecasted (2050) operations under no build conditions.
- Potential changes in crash risk due to traffic growth and land use changes.
- Secondary research findings about known resources in the area.
- Changes in socio-economic data from the recent cooperative forecast.
- Other pertinent information necessary for project recommendations.

The 2050 No Build conditions analysis and Purpose and Need statement will be included in the next report submittal for this project.

Appendix B

Task 2 – Tech Memo #3 / Purpose and Need Statement



Anne Arundel County

Transportation Facility Planning Study

Stevenson Road / Quarterfield Road

Contract No. H539626

**Purpose & Need Statement / Future No Build
Conditions Analysis (Task 2 Report)**

Prepared for:

Anne Arundel County Department of Public Works

Prepared by:

KCI Technologies Inc.

March 2025

Revised: May 2025

**RISE TO THE
CHALLENGE**



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1. INTRODUCTION

The Anne Arundel County Department of Public Works (DPW) requested KCI Technologies Inc. (KCI) to provide Architect / Engineer (A/E) Services to perform a study focusing on Stevenson Road from Quarterfield Road to New Cut Road, and Quarterfield Road from Janet Dale Lane to Donaldson Avenue. Several issues have been identified, including multimodal operations, safety, accessibility, and mobility; particularly, for access to nearby public schools.

Growth from development has resulted in increased travel demand along these corridors. The corridors provide access to multiple County public schools and connections to I-97 and MD 3 Business, with primarily residential developments in the area. Safe access is needed to the Quarterfield Elementary School, where a new building was constructed to replace the existing school in Fall 2023, and the new Severn Run High School, which opened in Fall 2024. Measures are needed to manage speeds on these roadways and to improve pedestrian safety, as these corridors contain minimal pedestrian facilities and lack bicycle facilities. Recently, sidewalks were installed along eastbound Stevenson Road between Crest Hill Road and New Cut Road, and along southbound New Cut Road (MD 3 Business) between Stevenson Road and south of Grover Road.

There was a County Safe Routes to School study that proposed improvements for student walking and bicycle safety, mobility, and accessibility to and from the Quarterfield Elementary School. The study, which was an accessibility study, has been completed. The County is currently developing a plan to implement the recommendations from that study.

This report provides the Purpose and Need for the project, describes the application of the Baltimore Metropolitan Council (BMC) regional model to establish future (2050) No Build traffic volumes, and summarizes the operational analysis of the projected future peak hour volumes at the study intersections. Relevant information that was included in the **Task 1-Existing Conditions** report (**Appendix A** to this report) is also provided to support the Purpose and Need for the project.

1.1 Project Background

The need for a formal, comprehensive study came about for many reasons. First, there is a future Middle school planned on the site of the current Center of Applied Technology North (“CAT North”) in the next couple years. In addition, there are other school developments planned in the area. The Stevenson Road /Quarterfield Road study is looking at the overall corridor benefits for school transportation that might impact school children and their parents that walk or bike to and from the local schools as well as others who may choose those travel modes for recreational purposes.

Anne Arundel County has received numerous requests from residents to improve the sidewalk network within the area. There are various gaps and deficiencies that they're looking to address. While this study is not meant to only address school-specific needs, they are one of the driving forces behind evaluating these corridors as a whole. Some of the improvements previously discussed, have been implemented, including the recent opening of Severn Run High School at Stevenson Road and New Cut Road, as well as a variety of other smaller improvements such as sidewalks and drainage and stormwater management.

However, there are minimal to no pedestrian and bicycle facilities to accommodate all these multimodal uses. Anne Arundel County has recently completed a safe routes to school study specific to Quarterfield Elementary School. That study recommended various infrastructure improvements to help students that walk and bike to and from the school. The County recognizes there is some overlap with that study with this comprehensive feasibility study.

The County's Safe Routes to School (SRTS) Phase 1 was completed in 2022 and included an accessibility study at Quarterfield Elementary School, which covered all roads in the school walk zone plus some roads immediately beyond it. The goal was to develop recommendations to improve safety for students walking and biking to/from school and finding opportunities to expand the walk zone. In general, the County's transportation master plan (*Move Anne Arundel!*) prioritize walkable communities and SRTS initiatives. The Stevenson Road and Quarterfield Road corridors are key to the success of the community and provide the primary accesses for school transportation.

1.2 Project Area

The project is located in the town of Severn, Maryland in Anne Arundel County. See **Figure 1** for an aerial view of the study area. The study area covers Stevenson Road from Quarterfield Road to MD 3 Business (New Cut Road) and Quarterfield Road from Janet Dale Lane to MD 174 (Donaldson Avenue / Quarterfield Road). The section of Stevenson Road between Old Stevenson Road and MD 3 Business (New Cut Road) is maintained by SHA and is designated as MD 997E. The remaining section of Stevenson Road from Quarterfield Road to Old Stevenson Road is maintained by Anne Arundel County. Likewise, the entire section of Quarterfield Road within the study limits is maintained by Anne Arundel County.

The land uses within the study area are predominantly residential, but there are four schools with direct access to either Stevenson Road or Quarterfield Road. These schools are:

- Quarterfield Elementary School
- Center for Applied Technology-North (CAT-North)
- Archbishop Spalding High School (Private)
- Severn Run High School



Figure 1: Study Area

2. PROJECT PURPOSE AND NEED

The purpose of this project is to identify existing geometric deficiencies, reduce crash potential, improve pedestrian and bicycle compatibility, and evaluate alternatives to address deficiencies for all travel modes while minimizing impacts on the natural and built environment.

Improvements to the Stevenson Road and Quarterfield Road corridors are needed to address the following factors:

- Provide continuous pedestrian and bicycle facilities that meet current AASHTO and ADA design guidelines.
- Promote Complete Streets and Vision Zero principles to accommodate all modes of travel.
- Advance the initiatives identified in the *Quarterfield Elementary School Safe Routes to School Accessibility Study: Existing Conditions and Recommendations* (August 17, 2023).
- Support the future access and mobility needs of the residential properties and local schools along these corridors, including the replacement of the Old Mill Middle School North at the CAT-North location.
- Identify implementable recommendations in both directions along the Stevenson Road and Quarterfield Road corridors for all travel modes.

The project is needed to provide safe access to the new Severn Run High School (opened in Fall 2024) and the Quarterfield Elementary School (new building constructed to replace old in Fall 2023). Measures are needed to manage vehicular travel speeds and increased demand from development growth on the Stevenson Road and Quarterfield Road corridors.

Bicyclists are permitted to share the road with motor vehicles, and the County Code allows bicycles to ride on existing sidewalks. However, the Stevenson Road and Quarterfield Road corridors lack continuous sidewalk networks and do not have any signed or dedicated bicycle facilities. There is an ongoing County Safe Routes to School project associated with the Quarterfield Elementary School that proposes various pedestrian and bicycle improvements to enhance safety, mobility, and accessibility to the school.

KCI reviewed various Anne Arundel County programs and documents including *Move Anne Arundel!*, *Walk & Roll Anne Arundel!*, the County's Complete Streets Program, the Safe Routes to School (SRTS) program, Vision Zero plan, and various Traffic Impact Studies (TIS) for schools to see if any have been implemented or are relevant to the study area. Please refer to the Task 1 – Existing Conditions report for a summary of document reviewed for this study.

To support the needs of the project, *Move Anne Arundel!* (the County's Transportation Master Plan) indicated that 17 schools were recommended to implement various Safe Routes to School programs bicycle and pedestrian investments, including Quarterfield Elementary School. Specifically, there were recommendations to expand the walk zone by improving crossing conditions at Quarterfield Road and MD 174 (Donaldson Avenue / Quarterfield Road) as well as other related improvements that fall outside the limits of the Stevenson Road / Quarterfield Road study area. Please note that there is no funded project currently in place to implement the SRTS recommendations.

Walk & Roll Anne Arundel!, which is the County's updated pedestrian and bicycle master plan, recommended a separated bicycle lane on Stevenson Road, between Quarterfield Road and MD 3 Business (New Cut Road).

The *Quarterfield Elementary School Safe Routes to School Accessibility Study: Existing Conditions and Recommendations* report identified specific improvements needed along the Stevenson Road and Quarterfield Road corridors. Those included:

- A signed bike route for MD 174 (Donaldson Avenue / Quarterfield Road). The limits of the bike route were not identified in the SRTS report.
- Sidewalk and speed management improvements for
 - Stevenson Road from Quarterfield Road to CAT-North, and
 - Quarterfield Road from west of Janet Dale Lane to Myers Drive.
- School zone signing improvements for Quarterfield Road from west of Stevens Road to Chad Avenue.

3. EXISTING CONDITIONS OVERVIEW

The **Task 1-Existing Conditions** report provided a summary of the following existing conditions

- Existing Roadway Conditions and Site Observations
- Existing Traffic Count Data and Operational Results
- Existing Crash Data Summary
- Existing Pedestrian Level of Comfort
- Existing Bicycle Level of Traffic Stress

Below are the key findings from the **Task 1-Existing Conditions** report that support the purpose and need for this project.

3.1 Existing Roadway Conditions Overview

Table 1 provides a summary of the major roadway components, functional classifications and posted speed limits for the study corridors. For the purposes of this study, the State and County -maintained sections of Stevenson Road are considered to run in an east-west direction. Also, Quarterfield Road is considered to run in a north-south direction.

Table 1: Existing Roadway Summary

Roadway	Study Limits	Functional Classification*	Posted Speed Limit
MD 997E (Stevenson Road)	Stevenson Road (CO 1337) to MD 3 Business (New Cut Road)	Urban Major Collector	30 MPH
Stevenson Road (CO 1337)	Quarterfield Road to Old Stevenson Road	Collector	35 MPH / 30 MPH **
Quarterfield Road (CO 907)	Janet Dale Lane to MD 174 (Donaldson Avenue / Quarterfield Road)	Minor Arterial	35 MPH

*- Sources: SHA Highway Location Reference and AA County Road Functional Classifications

** - 35 MPH from Quarterfield Road to CAT-North; 30 MPH from CAT-North to Old Stevenson Road

MD 997E (Stevenson Road) from Stevenson Road (CO 1337) to MD 3 Business (New Cut Road)

The State-maintained section of Stevenson Road (MD 997E) from Stevenson Road (CO 1337) to New Cut Road (MD 3 Business) is classified as an urban major collector with a posted speed limit of 30 MPH. There are no traffic calming measures in this section of Stevenson Road.

This section has two travel lanes, which widen to four lanes starting east of Old Stevenson Road to route traffic to and from New Cut Road. The eastbound and westbound lanes are approximately 13 feet wide, east of Crest Hill Road. The lane widths reduce to approximately 11 feet approaching the intersection with New Cut Road. This roadway is a closed section with a westbound shoulder width ranging between 0 to 6.5 feet and an eastbound shoulder width between 0 to 10.5 feet. There are no marked bicycle facilities in this section of Stevenson Road.

A separate project was also constructed along this section of Stevenson Road. The Stevenson Road Sidewalk project installed 875 linear feet of concrete sidewalk along eastbound Stevenson Road between Crest Hill Road and New Cut Road. This project also included construction of new curb and gutter, new storm drain inlets and drainage pipes, an upgraded driveway at the entrance to the Calvary Baptist Church, a bio-swale along westbound Stevenson Road, and pavement resurfacing.

There was also a sidewalk project along New Cut Road that installed 1,400 linear feet of concrete sidewalk along southbound New Cut Road from south of Grover Road to Stevenson Road (MD 997E). This project also included ADA ramp improvements, driveway improvements, curb and gutter, and future pedestrian crossings that will serve the Severn Run High School across New Cut Road.

Stevenson Road (CO 1337) from Quarterfield Road (CO 907) to Old Stevenson Road

The County-maintained section of Stevenson Road (CO 1337) from Quarterfield Road (CO 907) to MD 997E (Stevenson Road) is classified as a collector roadway with a posted speed limit of 35 MPH between Quarterfield Road and the CAT-North Entrance and reduces to 30 MPH between the CAT-North Entrance and Old Stevenson Road.

This segment of Stevenson Road has a mix of open and closed sections. There are two travel lanes along this entire section of Stevenson Road. The westbound lane is approximately 12.5 feet wide, and the eastbound lane is approximately 10.5 feet wide from Quarterfield Road to McNelin Way. The lanes are 11 feet wide between McNelin Way and Grasons Court. Between Grasons Court and Spaulding Circle, the westbound lane width increases to approximately 14 feet and the eastbound lane width increases to approximately 16 feet. The roadway contains varying shoulder widths. The shoulder width along westbound Stevenson Road varies between zero and three feet, while the shoulder width along eastbound Stevenson Road varies between zero and 5.5 feet. There are also three existing speed humps on Stevenson Road between the CAT-North Entrance and Crest Hill Road.

The sidewalk on both sides of Stevenson Road is four feet wide, west of Crest Hill Road. There are gaps in the sidewalk along both eastbound and westbound Stevenson Road. There are existing sidewalk ramps on the north side of Stevenson Road and along eastbound Stevenson Road but no associated signed or marked crossings across Stevenson Road. None of the side streets in this section (Theresa Rose Lane, Wildflower Drive, McNelin Way, Grasons Court, Spaulding Way, and Spaulding Circle) have marked crosswalks or stop lines across the side road approaches. In addition, there are no bicycle facilities on this portion of Stevenson Road.

Quarterfield Road (CO 907), between Janet Dale Lane and MD 174 (Donaldson Avenue / Quarterfield Road)

Quarterfield Road (CO 907), between Janet Dale Lane and MD 174 (Donaldson Avenue / Quarterfield Road) is classified as a Minor Arterial roadway, and has a posted speed limit of 35 MPH. There are no traffic calming measures in this section of the roadway.

This portion of the roadway has both open and closed sections. In general, there are two travel lanes along the section that widen to three lanes to accommodate turning movements to and from MD 174 (Donaldson Avenue / Quarterfield Road). The lane widths are 11 feet. At the Quarterfield Road/Donaldson Avenue intersection, the southbound lane is 18 feet wide, the northbound left-turn lane is 12 feet wide, and the northbound right turn lane is 23 feet wide. This portion of the roadway contains a southbound shoulder that varies from zero to six-feet wide, and a northbound shoulder that varies from zero to five-feet wide.

There is an existing sidewalk along the east side of Quarterfield Road near Janet Dale Lane and Perry Lane. This sidewalk is four feet wide and is separated from the road by a five-foot wide grass buffer. A short section of sidewalk also exists on the west side, north of Janet Dale Lane. This sidewalk is four feet wide and is separated from the road by a six-foot wide grass buffer.

The sidewalk on the east side of the road resumes near the entrance to Quarterfield Elementary School and continues to MD 174. This sidewalk is four feet wide. There is a four foot wide sidewalk on the west side of the road that begins at Chad Avenue and continues to MD 174. Gaps in the sidewalk exist along the west side of Quarterfield Road and along the east side of the road. None of the side streets within the study limits (Janet Dale Lane, Stevens Road, Perry Lane, Quarterfield Elementary School entrance, Myers Drive, Myers Court, or Chad Avenue) have stop lines or crosswalk pavement markings. Likewise, there are no crosswalks at the Quarterfield Road/MD 174 intersection. Finally, there are no bicycle facilities in this section of the roadway.

Figure 2 illustrates the existing lane configuration diagram at the intersections along the Stevenson Road and Quarterfield Road corridors. **Figure 3** shows the existing sidewalk coverage along the Stevenson Road and Quarterfield Road corridors. The information shown in the figure was sourced from Anne Arundel County's Open GIS Data (<https://opendata.aacounty.org/datasets/>) and the field investigations.

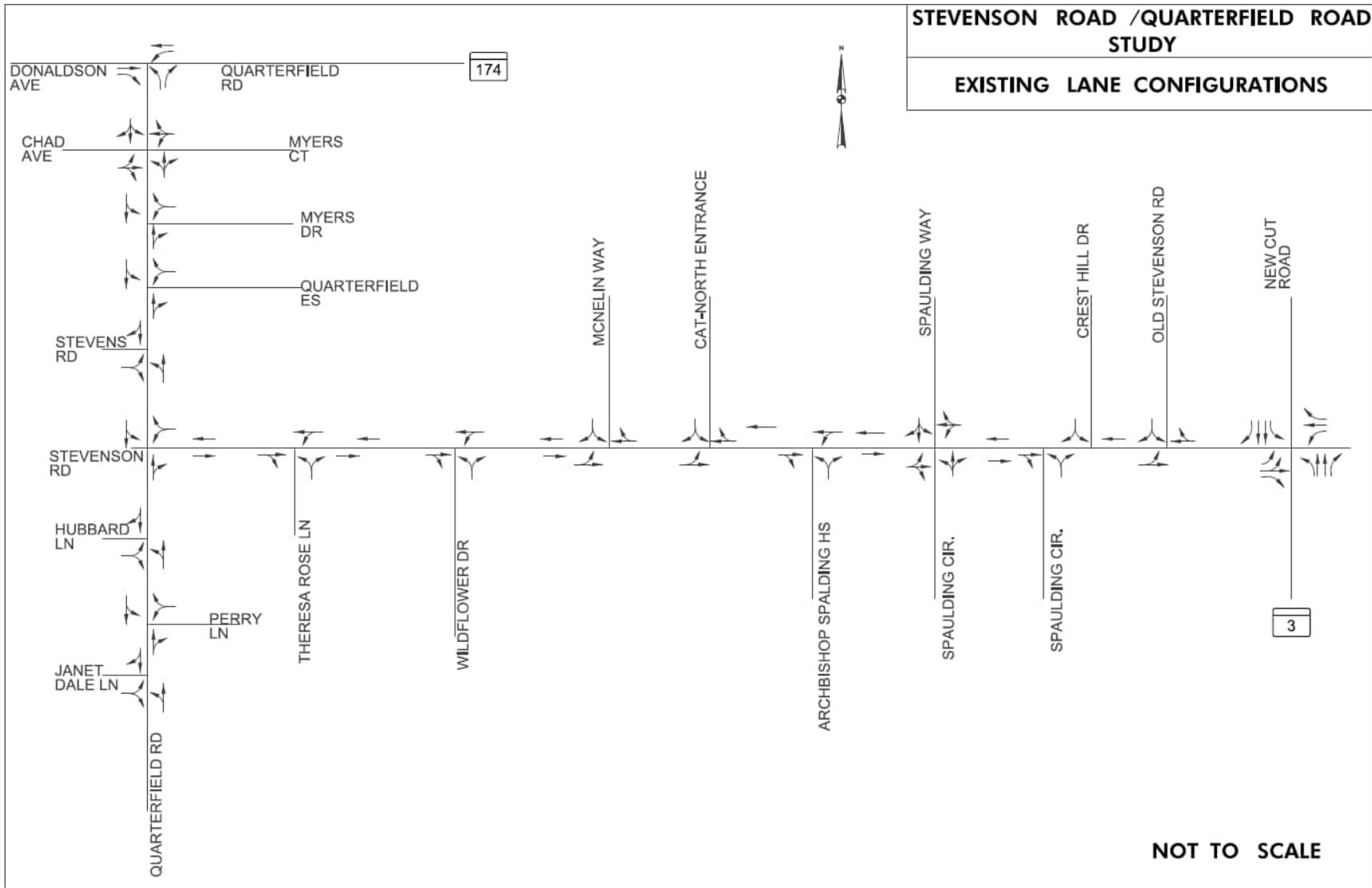


Figure 2: Existing Lane Configurations

3.2 Existing Traffic Count Data Overview

Seven-day, 168-hour traffic volume, vehicle classification and speed data were collected during the week of September 16, 2024 at the following three locations:

- Quarterfield Road, between Stevenson Road and Myers Drive
- Stevenson Road, between Wildflower Drive and the driveway for the Center of Applied Technology Driveway
- Stevenson Road, between Spaulding Circle and Crest Hill Road

13-hour weekday turning movement counts (TMCs) were also collected at six (6) intersections between the hours of 6:00 AM and 7:00 PM during the week of September 16, 2024 when schools were in session. The TMC data includes vehicle, pedestrian, and bicycle traffic at the following intersections.

- Stevenson Road at Quarterfield Road
- Stevenson Road at MD 3 Business (New Cut Road)
- Quarterfield Road at Janet Dale Lane
- Quarterfield Road at MD 174 (Donaldson Avenue / Quarterfield Road)
- Quarterfield Road at Myers Drive
- Quarterfield Road at Quarterfield Elementary School Driveway

A summary of the existing (2024) weekday peak hour volumes is provided in **Figure 4**. Refer to the **Task 1-Existing Conditions** report appendices for a summary of the traffic count information obtained for this study.

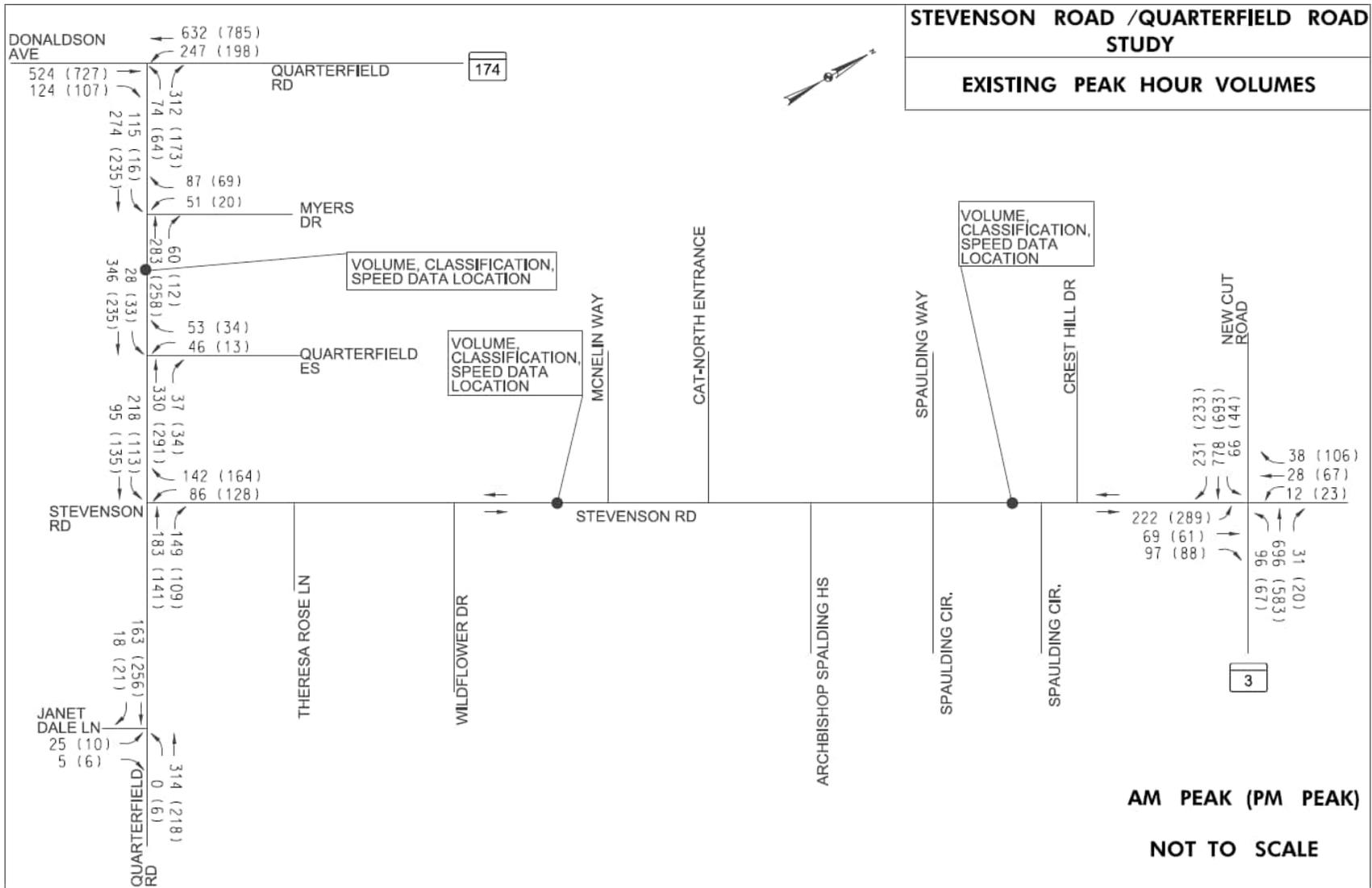


Figure 4: Existing Peak Hour Traffic Volumes

3.3 Existing Speed Data Overview

The speed data collected for the study included the 15th percentile, 50th percentile, 85th percentile, and 95th percentile speed statistics. In addition, the mean (average), 10 MPH pace, number, and percentage of vehicles in the pace, and number and percentage above the posted speed limits were summarized for the seven-day period. The 10 MPH pace is the 10 MPH range encompassing the greatest percentage of all the measured speeds in a spot speed study. **Table 2** summarizes the speed data for each roadway segment including the percentage of vehicles traveling over the posted speed limit.

Table 2: Average Daily Traffic and Speed Summary

Segment	ADT (vpd)	Speed Limit (MPH)	85 th -Percentile Speed (MPH)	Average Speed (MPH)	% of Vehicles Over Speed Limit			
					Total	1-5 MPH	6-10 MPH	>10 MPH
Quarterfield	6,350	35	39	35	42%	31%	9%	2%
Stevenson – Wildflower to CAT-N	4,500	35	43	39	75%	40%	25%	10%
Stevenson – Spaulding to Crest Hill	5,400	30	32	27	23%	19%	3%	1%

Quarterfield Road between Stevenson Road and Myers Drive has a posted speed limit is 35 MPH and a 10 MPH pace range is 31-40 MPH. Stevenson Road, between Wildflower Drive and CAT-North, has a posted speed limit is 35 MPH, and the 10 MPH pace range is 36-45 MPH. Approximately 75% of all vehicles were traveling over the posted speed limit and the 85th Percentile speed was 43 MPH, which is 8 MPH over the posted speed limit. For the section of Stevenson Road between Spaulding Circle and Crest Hill Road, the posted speed limit is 30 MPH, and the 10 MPH pace range is 21-30 MPH. This section has less than 25% of all vehicles traveling over the posted speed limit and an 85th Percentile speed of 32 MPH, which is two miles per hour over the posted speed limit. Vehicle speeds in this section may be closer to the posted speed due to the existing speed humps.

Refer to the **Task 1-Existing Conditions** report appendices for a summary of the traffic count information obtained for this study.

3.4 Crash Data Overview

Crash data was obtained from SHA for the following three roadway segments and seven intersections for the five-year period from January 1, 2019 to December 31, 2023:

ROADWAY SEGMENTS

- MD 997E (Stevenson Road), from Old Stevenson Road to MD 3 Business (New Cut Road),
- Stevenson Road (CO 1337), from Quarterfield Road to Old Stevenson Road, and

- Quarterfield Road (CO 907), from Janet Dale Lane to MD 174 (Donaldson Avenue / Quarterfield Road).

INTERSECTIONS

- MD 997E (Stevenson Road) at MD 3 Business (New Cut Road),
- Stevenson Road (CO 1337) at the Center of Applied Technology-North,
- Stevenson Road (CO 1337) at Quarterfield Road (CO 907),
- Quarterfield Road (CO 907) at Janet Dale Lane,
- Quarterfield Road (CO 907) at Quarterfield Elementary School,
- Quarterfield Road (CO 907) at Myers Drive, and
- Quarterfield Road (CO 907) at MD 174 (Donaldson Avenue / Quarterfield Road).

Table 3 provides a summary of the reported crashes for each roadway segment and key intersection by year.

Table 3: Crash Summary by Year

Segment	Total	2019	2020	2021	2022	2023
MD 997E	6	1	2	1	2	0
Stevenson (County)	4	0	1	2	1	0
Quarterfield	23	4	7	4	1	7
Intersection	Total	2019	2020	2021	2022	2023
Stevenson / New Cut	12	1	2	2	5	2
Stevenson / CAT-N	0	0	0	0	0	0
Stevenson / Quarterfield	6	0	3	1	0	2
Quarterfield / Janet Dale	0	0	0	0	0	0
Quarterfield / QES	0	0	0	0	0	0
Quarterfield / Myers	0	0	0	0	0	0
Quarterfield / Donaldson	11	1	1	2	4	3
Total Crashes	62	7	16	12	13	14

Sixty-two (62) crashes were reported across the three roadway segments and seven specified intersections. The section of Quarterfield Road from Janet Dale Lane and MD 174 had the most crashes (23 crashes) of the three roadway segments. Of the seven intersections, Stevenson Road at MD 3 Business (New Cut Road) and Quarterfield Road at MD 174 (Donaldson Avenue / Quarterfield Road) had about the same number of reported crashes; 12 and 11, respectively. Stevenson Road at Quarterfield Road had six reported crashes.

Table 4 provides a summary of the crash severity for each roadway segment and key intersection.

Table 4: Crash Severity Summary

Segment	Total	Fatal	Injury	PDO
MD 997E	6	0	2	4
Stevenson (County)	4	0	0	4
Quarterfield	23	0	10	13
Intersection	Total	Fatal	Injury	PDO
Stevenson / New Cut	12	0	3	9
Stevenson / CAT-N	0	0	0	0
Stevenson / Quarterfield	6	0	3	3
Quarterfield / Janet Dale	0	0	0	0
Quarterfield / QES	0	0	0	0
Quarterfield / Myers	0	0	0	0
Quarterfield / Donaldson	11	--	4	7
Total	62	0	22	40

No fatalities occurred among the 62 reported crashes over this five-year period. However, approximately 35% of all reported crashes were injury-related. The number of injury crashes were similar to the property-damage only (PDO) crashes reported along Quarterfield Road between Janet Dale Lane and MD 174 (Donaldson Avenue / Quarterfield Road).

Table 5 provides a summary of the collision types for each roadway segment and key intersection.

Table 5: Crash Collision Type Summary

Segment	Total	Pedestrian/ Bicycle	Angle	Left Turn	Rear End	Fixed Object	Sideswipe	Other
MD 997E	6	0	0	0	4	0	2	0
Stevenson (County)	4	0	0	0	1	1	1	1
Quarterfield	23	3	7	0	4	5	0	4
Intersection	Total	Pedestrian/ Bicycle	Angle	Left Turn	Rear End	Fixed Object	Sideswipe	Other
Stevenson / New Cut	12	0	0	5	6	0	1	0
Stevenson / CAT-N	0	0	0	0	0	0	0	0
Stevenson / Quarterfield	6	2	2	0	0	0	0	2
Quarterfield / Janet Dale	0	0	0	0	0	0	0	0
Quarterfield / QES	0	0	0	0	0	0	0	0
Quarterfield / Myers	0	0	0	0	0	0	0	0
Quarterfield / Donaldson	11	0	6	0	5	0	0	0
Total (% of Total)	62	5 (8%)	15 (24%)	5 (8%)	20 (32%)	6 (10%)	4 (7%)	7 (11%)

Approximately one-third (33 percent) of all reported crashes occurring on these roadway segments and intersections were rear-end type collisions. Rear end collisions accounted for half of the reported crashes at the Stevenson Road and MD 3 Business (New Cut Road) intersection. Likewise, half of all reported crashes at the Quarterfield Road and MD 174 (Donaldson Avenue/Quarterfield Road) intersection were rear-end type collisions.

Angle and Other (Undefined) collisions account for approximately one-third (35 percent) of the reported crashes. All 15 reported angle-type crashes occurred along Quarterfield Road or along intersections associated with Quarterfield Road (specifically at Stevenson Road or MD 174).

Five pedestrian/bicycle crashes were reported, with three occurring along the Quarterfield Road corridor and two occurring at the Stevenson Road and Quarterfield Road intersection. Consideration for pedestrian and bicycle improvements along Quarterfield Road may improve safety.

A copy of the crash data for this project is available in the **Task 1-Existing Conditions** report appendices.

3.5 Existing Pedestrian Level of Comfort Overview

A Pedestrian Level of Comfort (PLOC) analysis was conducted for this study to identify locations in the existing sidewalk network that are uncomfortable due to inadequate width or gaps in the network as well as at pedestrian crossings. The Montgomery County PLOC approach was used since Anne Arundel County does not currently have their own methodology. The methodology was inspired by the Bicycle Level of Traffic Stress (LTS) analysis conducted for the Montgomery County Bicycle Master Plan.

The PLOC analysis assigns numerical values to the comfort levels to provide quantitative results based on the qualitative measures. The comfort scale is as follows:

- 1 = Very comfortable
- 1.5 = Comfortable
- 2 = Somewhat comfortable
- 2.5 = Somewhat uncomfortable
- 3 = Uncomfortable
- 3.5 = Very Uncomfortable
- 4 = Undesirable

Sidewalks

Please note that there are three segments within the study area with notable gaps in the existing sidewalks network or have limited sidewalk coverage that may contribute to a lower PLOC rating. These segments are:

- Stevenson Road (CO 1337), from Theresa Rose Lane to Wildflower Drive (south side)
- Stevenson Road (CO 1337), from Grasons Court to CAT-North Entrance (north side)
- Stevenson Road (CO 1337), from CAT-North to Spaulding Way / Spaulding Circle (south side)

In general, the Stevenson Road and Quarterfield Road corridors have PLOC ratings of either 3 (Uncomfortable) or 4 (Undesirable) based on the available width of existing sidewalks, available buffer widths, posted speed limits and lack of any on-street parking or bicycle lanes.

Results of the PLOC analysis for existing sidewalks (pathways) along the Stevenson and Quarterfield Road corridors are summarized in the **Task 1-Existing Conditions** report for various segments along the Quarterfield Road corridor as well as the County and State-maintained portions of Stevenson Road.

Crossings

The locations selected for the PLOC evaluation needed to have two receiving ramps to accommodate pedestrian crossing movement. Please note that there are no existing marked crosswalks at intersections or midblock locations along either the Stevenson Road or Quarterfield Road corridors.

In general, the existing crossings for the Stevenson Road and Quarterfield Road corridors have **PLOC ratings of either 2 (Somewhat Comfortable) or 4 (Undesirable)** based on the approach posted speed limit, approach traffic control and the number of lanes a pedestrian must cross.

Results of the PLOC analysis for existing crossings along the Stevenson Road and Quarterfield Road corridors are summarized in the **Task 1-Existing Conditions** report.

3.6 Existing Bicycle Level of Traffic Stress Overview

The Maryland Department of Transportation (MDOT) uses the Level of Traffic Stress (LTS) methodology for measuring the “bikeability” of a roadway network. This methodology aligns with MDOT SHA’s Context Driven Design Guidelines and other national and departmental initiatives. LTS calculations require the following information:

- Presence and type of bicycle facility
- Speed Limit
- Number of Through Lanes/Traffic Volume

The traditional Level of Traffic Stress (LTS) rating scale, using a scale of “1” (protected bikeways or side paths suitable for all users) to “4” (no bike facility or bike lane on major roadway suitable for only strong and fearless riders) is a measure for assessing the quality of the roadway network for its comfort with various bicycle users. The lower the LTS score (i.e., 1 or 2), the more inviting the bicycle facility is for more audiences. LTS rating for a roadway are dependent on the specific number of through lanes, the effective annual average daily traffic (AADT), and prevailing speed. Please note that the LTS scale ratings “0” and “5” are not applicable to the existing conditions in the study area. An LTS rating of “0” is associated with off-road facilities such as rails-to-trails or shared-use paths, while an LTS rating of “5” indicates that bicycle access is prohibited.

Overall, the County and State-maintained sections of Stevenson Road and the section of Quarterfield Road would qualify as having **LTS ratings of 4** since all roads have one lane per direction of travel, have ADTs that exceed 3,000 vehicles per day (vpd), and have prevailing speeds that are 30 MPH or higher for existing conditions.

More details on the Bicycle LTS analysis are provided in the **Task 1-Existing Conditions** report.

4. TRAVEL DEMAND FORECASTING FOR 2050 CONDITIONS

The Baltimore Metropolitan Council (BMC) regional travel demand model was applied for the development of Future 2050 forecasted traffic. The BMC model is a regional model covering the entire Baltimore Metropolitan Council planning region, as well as Montgomery County, Prince George’s County, Frederick County in Maryland and Washington, D.C. As a regional model, the BMC model may not adequately represent the local traffic conditions, particularly in suburban or rural areas, where the road network is coarsely represented in the model. Therefore, refinements of the model were needed to enhance the reliability of the model for forecasting traffic in the study area.

A recently updated regional travel demand model (i.e., InSite B05 version) was provided by the BMC. The model input files for the 2025 and 2050 model runs were also provided, representing the current conditions and the 2050 long range plan conditions. These include the socio-economic data at traffic analysis zone (TAZ) level as well as the transportation network data. The model was installed on the study team’s workstation. After successful testing, the model was applied for travel demand analysis.

To support the analysis, the following data were collected and assembled in the study:

- Road segment traffic volume data collected from the Maryland DOT’s Traffic Monitoring System
- Existing (2024) traffic count data, as noted in Section 3.2 of this report.

The 2025 BMC model was examined for its reliability by comparing the model estimated daily traffic volumes against observed traffic volumes on selected road segments, as shown in **Table 6**. Please note that the BMC model is a regional model used to simulate regional travel patterns. It is not intended to precisely represent traffic volumes on local road segments. Nevertheless, **Table 6** indicates that the model is capable of estimating traffic volumes within a reasonable range of accuracy. The model underestimates traffic on local streets, which is understandable because local traffic that make short trips may not be adequately represented in the model.

Table 6: Comparison of Observed and Model Estimated Traffic Volumes

Road Segment	2023 AAWDT	2025 Model Estimated Daily Volume	Percent Difference
Stevenson Road E. of Quarterfield Road	4,040	3,565	-11.8%
Quarterfield Rd S. of Donaldson Avenue	6,420	5,711	-11.0%
Quarterfield Rd W. of I-97 Interchange	25,185	20,746	-17.6%
New Cut Road S. of Stevenson Road	14,045	16,152	15.0%
I-97 N. of MD-3	138,142	141,588	2.5%

AAWDT – Annual Average Weekday Traffic

Once the BMC model was validated for its reliability, the model was applied to the 2050 conditions, representing the socio-economic and network conditions as specified in the BMC’s long-range

plan. In this study, the model estimated traffic volumes were not directly used in predicting traffic volumes on individual road segments. Instead, the growth rates of traffic volumes from 2025 to 2050 were derived. The growth rates were then applied to the observed traffic volumes to generate the 2050 forecast traffic volumes.

Table 7 summarizes the growth of traffic volumes, by peak time period, on individual road segments. As shown in the table, traffic volumes will grow moderately, from 10% to 25%, for various road segments in the study area. Stevenson Road between Quarterfield Road and Archbishop Spalding High School is projected to have the highest daily traffic growth (about 25% growth) from 2025 to 2050.

Table 7: Projected Growth of Traffic Volumes by Time Period

Road Segment	AM Peak Period			PM Peak Period			Daily		
	2025	2050	% Growth	2025	2050	% Growth	2025	2050	% Growth
Quarterfield Road									
Queenstown Rd - Donaldson Ave	2,946	3,183	8.0%	2,078	2,397	15.4%	8,671	9,767	12.6%
Donaldson Ave. Myers Dr	2,244	2,638	17.6%	1,410	1,492	5.8%	5,710	6,620	15.9%
Myers Dr - Stevenson Rd	2,123	2,497	17.6%	1,201	1,367	13.8%	5,044	6,118	21.3%
Stevenson Rd - Janet Dale Ln	2,514	2,812	11.9%	1,520	1,800	18.4%	6,146	7,407	20.5%
Stevenson Road									
Quarterfield Rd - McNelin Way	1,414	1,703	20.4%	919	990	7.7%	3,566	4,409	23.6%
McNelin Way - Archbishop Cir	1,263	1,552	22.9%	752	825	9.7%	3,082	3,817	23.8%
Archbishop Cir - New Cut Rd	1,862	2,143	15.1%	1,726	1,860	7.8%	6,465	7,237	11.9%
New Cut Road									
I-97 SB Exit Ramp - Stevenson Rd	4,718	4,772	1.1%	5,962	6,074	1.9%	20,448	22,526	10.2%
Stevenson Rd - Archbishop Spalding HS	3,978	4,092	2.9%	4,668	5,154	10.4%	16,152	18,725	15.9%

Table 8 shows the derivation of the projected 2050 weekday daily volumes for the road segments on Stevenson Road and Quarterfield Road. The 2024 weekday counted volumes were obtained and extracted from the 7-day classified count data. The table indicates that the model-estimated growth rates for Stevenson Road from Spaulding Circle and Crest Hill Road and Quarterfield Road from Stevenson Road and Myers Drive vary significantly. This may be due to the impact of zone centroid connecting links. The growth rates of these two road segments were adjusted by taking the average of the two growth rates, as shown in the shaded cells in the table.

Table 8: Projected 2050 Weekday Daily Traffic Volumes

Road Segment	2024 Counted Avg. Weekday Vol.	2025 Model Est. Weekday Vol.	2050 Model Est. Weekday Vol.	Model Projected Growth from 2025 to 2050	Adjusted Growth from 2025 to 2050	Projected 2050 Weekday Vol.
Stevenson Rd between Spaulding Cir and Crest Hill Rd	4,915	3,083	3,817	23.8%	17.9%	5,828
Quarterfield Rd between Stevenson Rd and Myers Dr	5,893	6,464	7,235	11.9%	17.9%	6,988
Stevenson Rd between Wildflower Dr and Ctr for Applied Technologies Dwy	6,683	5,711	6,619	15.9%	15.9%	7,788

*shaded cells are the average of the model-projected growth rates from 2025 to 2050

The forecast 2050 turning movement volumes at major intersections in the project area were derived based on the observed turning movements in the base year and the projected traffic growth rates of road segments derived from the BMC regional model. For a particular intersection, the growth rates of entry traffic volumes and exit traffic volumes of various approach links were determined based on the projected directional traffic volumes from the BMC model. These projected growth rates were used to project the 2050 entry and exit volumes.

For an approach that was not explicitly coded in the BMC model, such as the westbound approach of Stevenson Road (i.e., Severn Run High School) at the intersection of Stevenson Road and New Cut Road, the growth factors of that approach are derived based on the ratio of total entry/exit volumes of the entire intersections between 2025 and 2050.

Also, the projected growth rates of an individual approach are constrained to be within the range of zero growth and no more than two times the growth rate of the total entry/exit volume at the intersection. This is to ensure that there will not be any unreasonable or extreme growth rates for individual approaches that would distort the factoring process of turning movement traffic volumes.

Given the 2050 projected (targeted) entry/exit volumes of various approaches at an intersection, a “Fratar process” can be applied to the 2025 observed turn movement volumes to project 2050 turning movement volumes. The “Fratar process” is a mathematical formula that estimates future trip distribution often used in travel demand forecasting. The forecasted (2050) turning movement volumes for the six intersections being studied in this study are illustrated in **Figure 5**.

In developing the future year turning movement volumes, it is assumed that future year volumes will not be lower than the base year volumes. If the forecast turning volumes are lower than the base year volumes, they will be set the same as the base year volumes.

Refer to **Appendix B** for the comprehensive technical memo summarizing the development of the 2050 traffic forecasts using the BMC regional model.

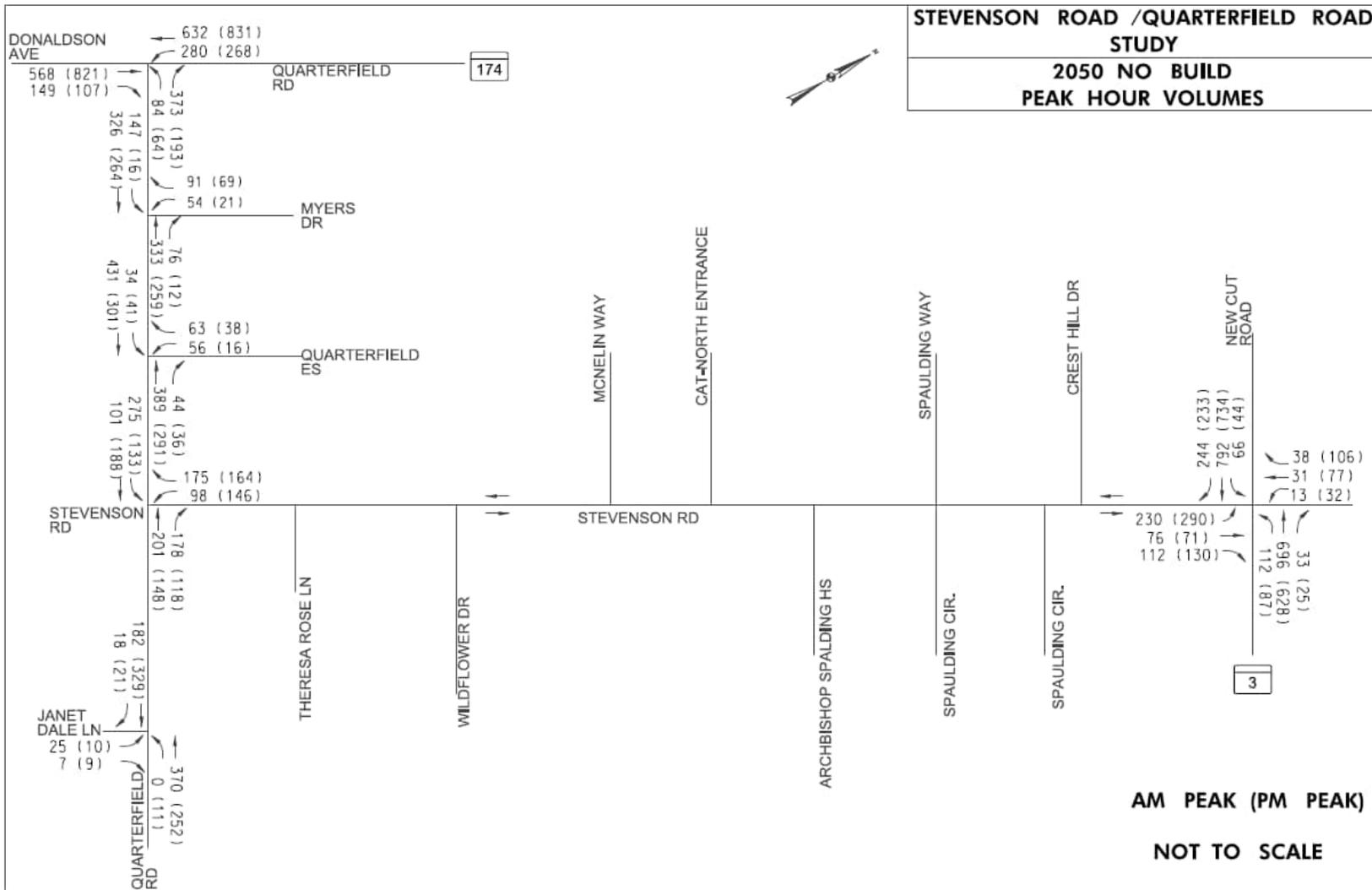


Figure 5: 2050 No Build Peak Hour Traffic Volumes

5.2050 FUTURE NO BUILD CONDITIONS

5.1 2050 Future No Build Traffic Analysis

The Future (2050) No Build capacity analysis for the study intersections was performed using the Highway Capacity Manual (HCM) methodologies to analyze the weekday AM and PM peak hours. The Synchro traffic software was used to analyze the signalized and unsignalized intersections.

Table 9 summarizes the delay ranges (seconds/vehicle) that correspond to the level of service (LOS) for two-way (side street) stop-controlled intersections and signalized intersections. In general, the Anne Arundel County Traffic Impact Study Guidelines state that a LOS of "D" is acceptable for intersections and roadway segments.

Table 9: Intersection Levels of Service and Delay Thresholds

LOS	Delay Threshold (sec/veh)	
	Two-Way (Side Street) Stop*	Signal
A	0 - 10	0 - 10
B	10 - 15	10 - 20
C	15 - 25	20 - 35
D	25 - 35	35 - 55
E	35 - 50	55 - 80
F	> 50	> 80

Source: Highway Capacity Manual

*Applies to only the worst of the stop-controlled approaches

The Highway Capacity Manual (HCM) Signalized and Unsignalized Intersection analysis results for the existing conditions and 2050 No Build conditions are shown in **Table 10** for the study intersections.

Table 10: Summary of Study Intersection Traffic Results (Existing vs. 2050 No Build)

Intersection	Traffic Control	Existing		2050 No Build	
		LOS / Delay (sec/veh)		LOS / Delay (sec/veh)	
		AM	PM	AM	PM
Stevenson Rd / MD 3 BUS (New Cut Rd)	Signal	B / 16.8	B / 18.9	B / 16.8	B / 19.6
Stevenson Rd / Quarterfield Rd	Side Street Stop	C / 23.0	C / 18.6	E / 49.7	D / 26.5
Quarterfield Rd / Janet Dale Ln	Side Street Stop	B / 12.0	B / 11.5	B / 12.6	B / 12.4
Quarterfield Rd / Quarterfield ES	Side Street Stop	C / 15.3	B / 11.7	C / 19.6	B / 12.3
Quarterfield Rd / Myers Dr	Side Street Stop	C / 16.8	B / 11.4	C / 22.5	B / 11.5
Quarterfield Rd / MD 174 (Donaldson Ave / Quarterfield Rd)	Side Street Stop	F / 76.5	F / 149.4	F / 133.3	F / 338.7

Delay values measured in seconds/vehicle (sec/veh)

The 2050 No Build results show that all approaches and the study intersections will operate at acceptable levels of service (LOS) in both the AM and PM peak hours, except for the Stevenson Road at Quarterfield Road and the Quarterfield Road at MD 174 (Donaldson Avenue / Quarterfield

Road) intersections. The stop-controlled approach along the County-maintained portion of Stevenson Road is projected to operate at a LOS of “E” during the future (2050) No Build AM peak period. This shows that the delays along Stevenson Road will increase beyond the acceptable LOS threshold when compared to the existing traffic conditions, which operate at a LOS of “C.” Likewise, the stop-controlled approach along the County-maintained portion of Quarterfield Road currently experience significant delay that result in a LOS of “F” during existing AM and PM peak periods and will continue to do so in the future (2050) No Build AM and PM peak periods at MD 174.

The 95th percentile queue analysis results from Synchro for key turning movements at the MD 3 Business/Stevenson Road and MD 174/Quarterfield Road intersections for the existing conditions and 2050 No Build conditions are shown in **Table 11**.

Table 11: Summary of Study Intersection 95th Percentile Queues (Existing vs. 2050 No Build)

Intersection	Key Movement	Existing Storage Length (ft)	Existing Conditions 95% Queue (ft)		2050 No Build Conditions 95% Queue (ft)	
			AM	PM		
MD 3 Business at Stevenson Rd	SB MD 3 Bus. Left-Turn	620	40	33	40	33
	SB MD 3 Bus. Right-Turn	620	48	50	48	49
	NB MD 3 Bus. Left-Turn	350	53	44	62	54
	EB Stevenson Right-Turn	150	18	14	29	40
MD 174 at Quarterfield Rd	WB MD 174 Left-Turn*	150	28	25	35	45
	NB Quarterfield Left-Turn*	200	163	173	223	220
	NB Quarterfield Right-Turn*	200	118	63	205	98

* - Synchro provides 95th queue by # of vehicles for stop-controlled intersections. Queue calculation: # of Vehicles x 25 ft/vehicle

Under 2050 Future No Build Conditions, there may be queuing that exceeds the available storage length along northbound Quarterfield Road at MD 174. It is expected that vehicles may queue on this approach past the Quarterfield Road at Chad Avenue/Myers Court intersection. Please note that Synchro does not generate a queue result for the eastbound right-turn movement along MD 174 at Quarterfield Road.

Refer to **Appendix C** for the Synchro analysis reports for the study intersections under 2050 No Build conditions. Refer to the **Task 1-Existing Conditions** report and appendices for the supporting traffic analysis for existing conditions.

5.2 Forecasted Safety and Operational Considerations

Section 3.4 of this report indicates that five reported crashes were related to pedestrians or bicycles along Quarterfield Road, with three occurring along the Quarterfield Road corridor and two occurring at the Stevenson Road/Quarterfield Road intersection. Consideration for pedestrian and bicycle improvements along Quarterfield Road may enhance safety in the future for residents and those that access Quarterfield Elementary School. Likewise, similar improvements may also benefit pedestrian and bicycle safety along Stevenson Road because of similar land uses and the presence of the other local schools. In addition, both corridors would appear to benefit from various pedestrian and bicycle-related improvements based on the results of the PLOC and LTS analyses. The regional model does not estimate future pedestrian and/or bicycle traffic demand.

Yet, existing deficiencies such as gaps in the sidewalk network, a lack of signed or marked bicycle facilities, and unmarked crossings suggest that improvements are needed to promote safety for these modes of travel in the future. In addition, the addition of the Severn Run HS and future Old Mill Middle School North replacement at the CAT-North site and recent housing developments may require the need for more pedestrian and bicycle safety improvements.

Section 3.3 of this report notes that there may be speeding issues along the Quarterfield Road corridor and the section of Stevenson Road from Quarterfield Road to CAT-North. This data indicates there is a need for roadway improvements such as changes to the roadway typical sections that could reduce vehicle speeds while promoting other travel modes such as walking and biking.

Section 5.1 of this report also suggests that the future peak hour traffic volumes may grow enough to affect the operations at key intersections such as Stevenson Road at Quarterfield Road and Quarterfield Road at MD 174. These traffic projections may justify the need for a change in traffic control to maintain safe and efficient travel through the corridors to access the residential neighborhoods and local schools.

The Baltimore Regional Transportation Board (BRTB) Cooperative Forecasting Group develops forecasts of spatial location and concentration of population, households, and employment over a 30-year period. The latest set of forecasts, named Round 10, was adopted by BRTB in 2022 and provides forecasts for 2020-2050. The Round 10 forecasts estimate that Anne Arundel County will surpass Baltimore City and Baltimore County in total jobs. This equates to a 33% increase in Anne Arundel County jobs between 2020 and 2030. Additionally, during the same period, the cooperative forecasts show Anne Arundel County with a 17% increase in population and an 18% increase in households.

The 2024 Anne Arundel Economic Development Corporation (AAEDC) *New and Expanding List* identified eighteen (18) new businesses in County Council District 2 (in the study area) from 2021 through 2024. In February 2025, Anne Arundel County announced a partnership investment of \$1.5 Million to support small businesses affected by the Key Bridge collapse and to support the Glen Burnie Place Based Investment Program. Additionally in February 2025, the AAEDC announced the “Glen Burnie Better Plaza”, a placemaking project that re-envision the Glen Burnie Town Center (about three miles north of the study area) as a community gathering space. These development investments may affect local businesses and residents of the study area.

6. NEXT STEPS

The next steps in the project are to develop typical sections and intersection concepts within the study area to support the Purpose and Need. The proposed typical sections and intersection improvements will consider the existing operating conditions for all users as well as the Future (2050) No Build traffic conditions. Near-term, mid-term, and long-term alternatives will consider access and mobility for existing schools in the area as well as the development of the new Old Mill North Middle School on the CAT-North campus on Stevenson Road. Based on the proposed typical sections and intersection improvements, it is anticipated that up to three (3) proposed alternatives will be prepared. The plans will account for a very high-level assessment of right-of-way needs to accommodate the proposed typical sections and intersection improvements.

Appendix C

Proposed Alternatives Displays

STEVENSON ROAD AND QUARTERFIELD ROAD CORRIDORS STUDY

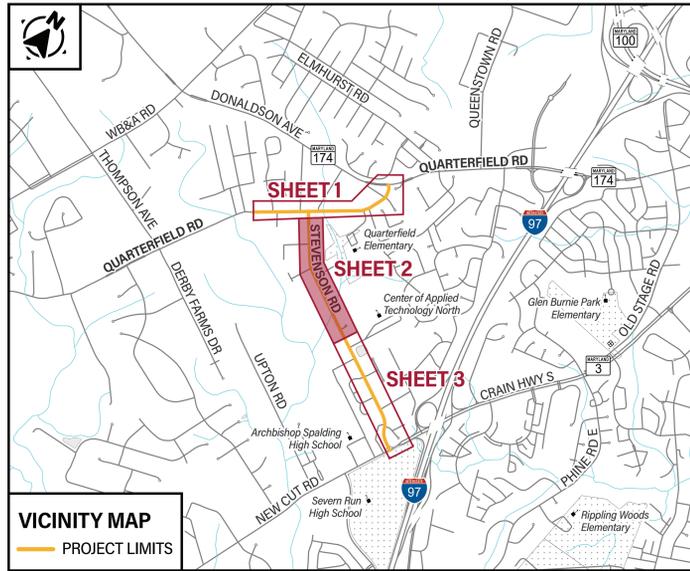
Alternative 2 - Stevenson Road



DPW & YOU
Making a difference, together

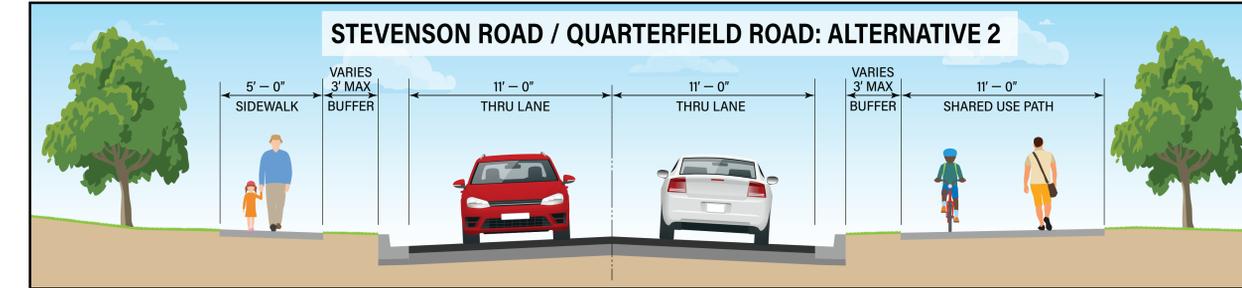
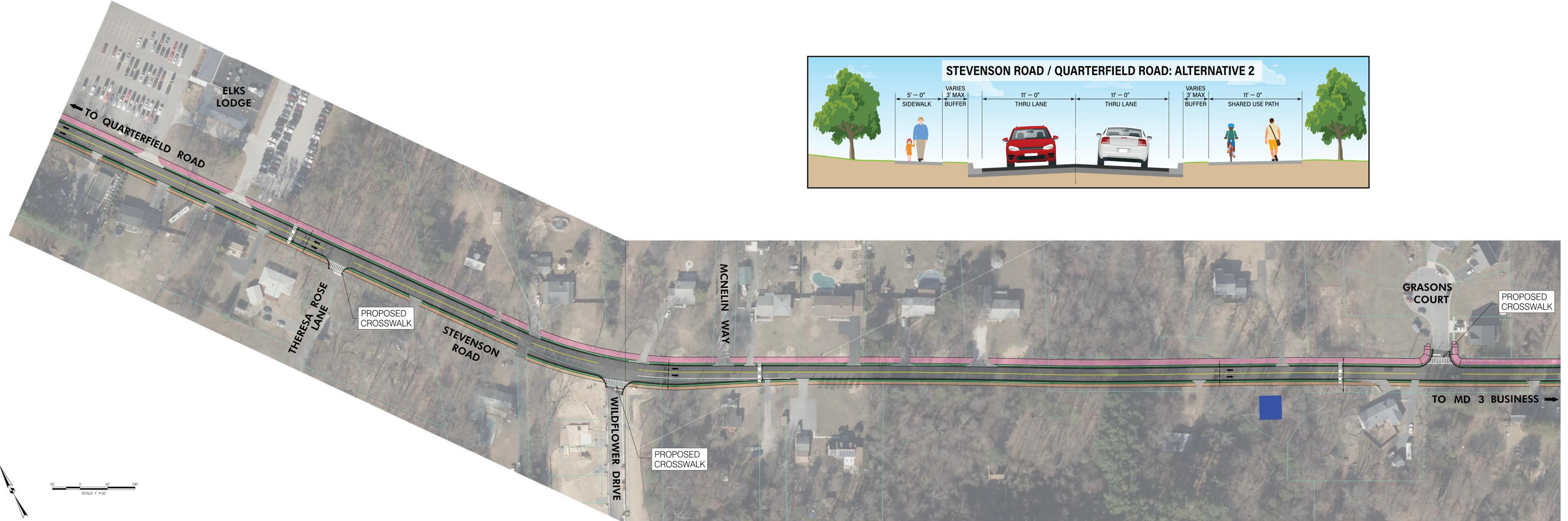


Bike and pedestrian accommodations are not specific to the intersection alternative shown on each board.



LEGEND

	PROPOSED GRASS / LANDSCAPING
	PROPOSED SIDEWALK
	PROPOSED SHARED USE PATH
	ASPHALT PAVEMENT
	PROPOSED GRASS SWALE / BIOSWALE
	PROPOSED STORMWATER MANAGEMENT FACILITY
	EXISTING RIGHT-OF-WAY LINE
	EXISTING PROPERTY LINE



STEVENSON ROAD AND QUARTERFIELD ROAD CORRIDORS STUDY

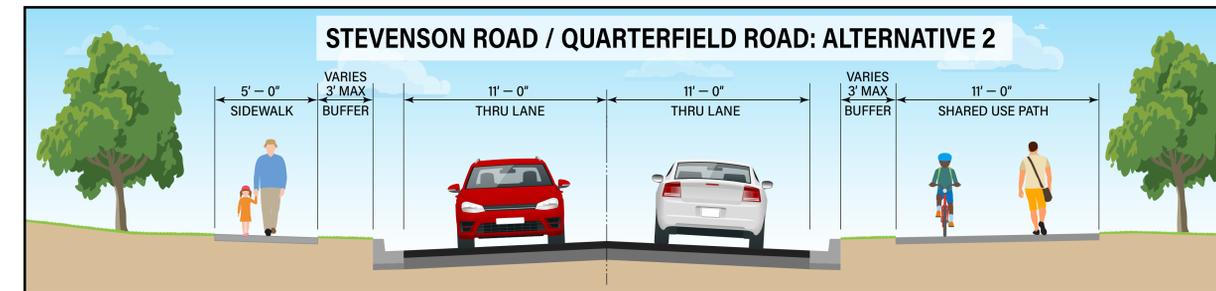
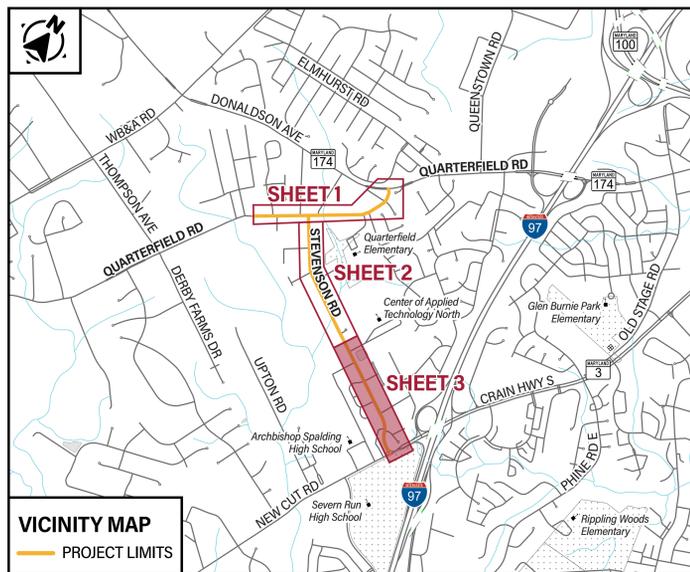
Alternative 2 - Stevenson Road



DPW & YOU
Making a difference, together

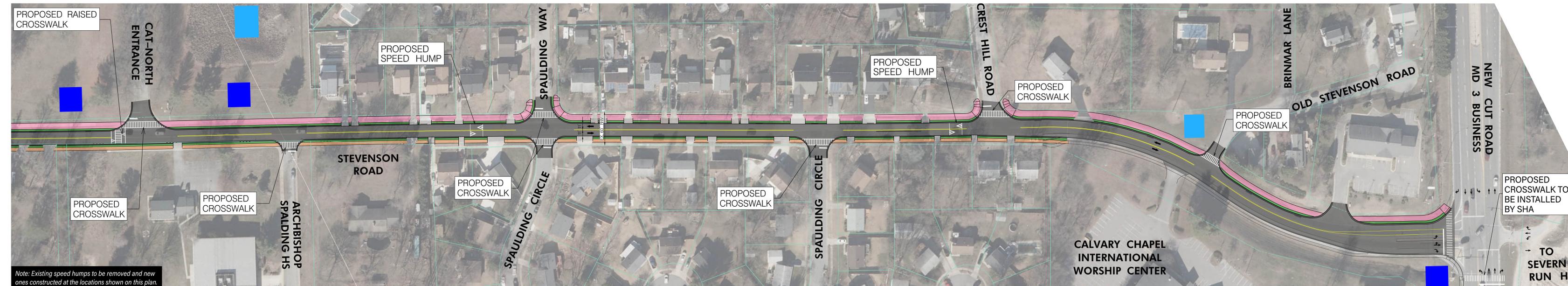


Bike and pedestrian accommodations are not specific to the intersection alternative shown on each board.



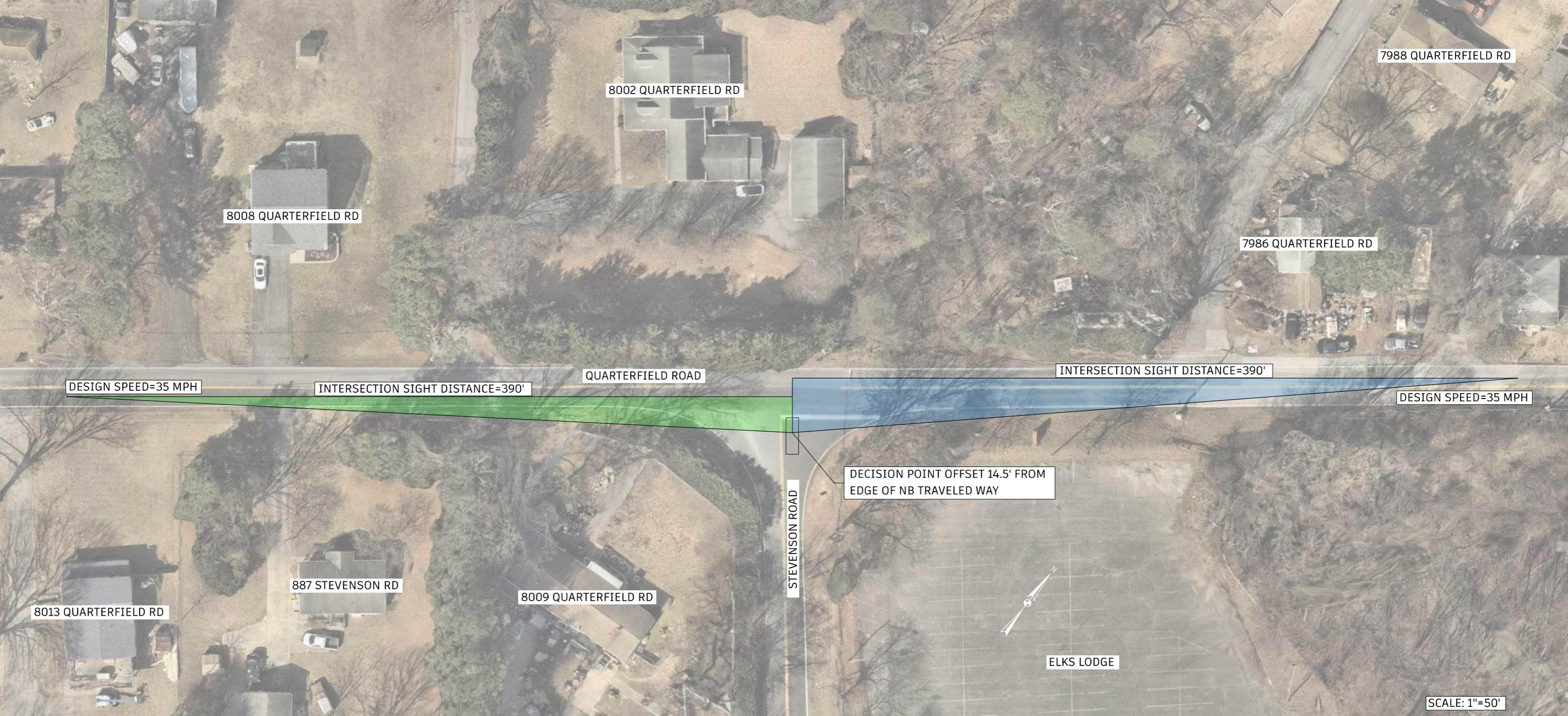
LEGEND

- PROPOSED GRASS / LANDSCAPING
- PROPOSED SIDEWALK
- PROPOSED SHARED USE PATH
- ASPHALT PAVEMENT
- PROPOSED GRASS SWALE / BIOSWALE
- PROPOSED STORMWATER MANAGEMENT FACILITY
- EXISTING RIGHT-OF-WAY LINE
- EXISTING PROPERTY LINE



Appendix D

Stevenson Road at Quarterfield Road – Intersection Sight Distance Display



7988 QUARTERFIELD RD

8002 QUARTERFIELD RD

8008 QUARTERFIELD RD

7986 QUARTERFIELD RD

QUARTERFIELD ROAD

INTERSECTION SIGHT DISTANCE=390'

DESIGN SPEED=35 MPH

INTERSECTION SIGHT DISTANCE=390'

DESIGN SPEED=35 MPH

DECISION POINT OFFSET 14.5' FROM
EDGE OF NB TRAVELED WAY

STEVENSON ROAD

887 STEVENSON RD

8009 QUARTERFIELD RD

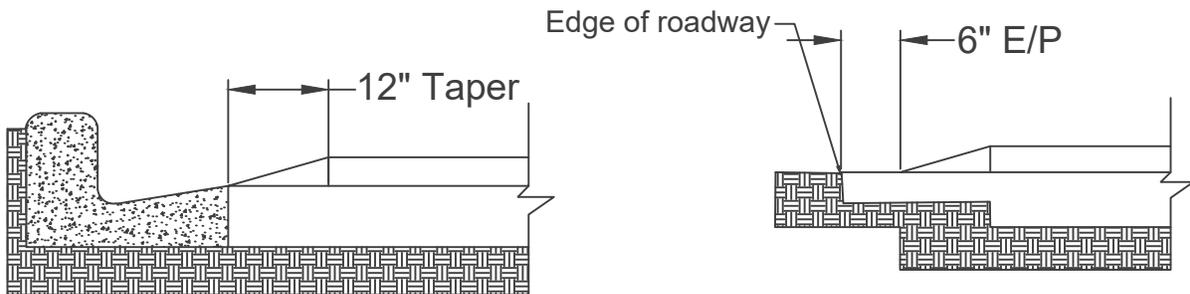
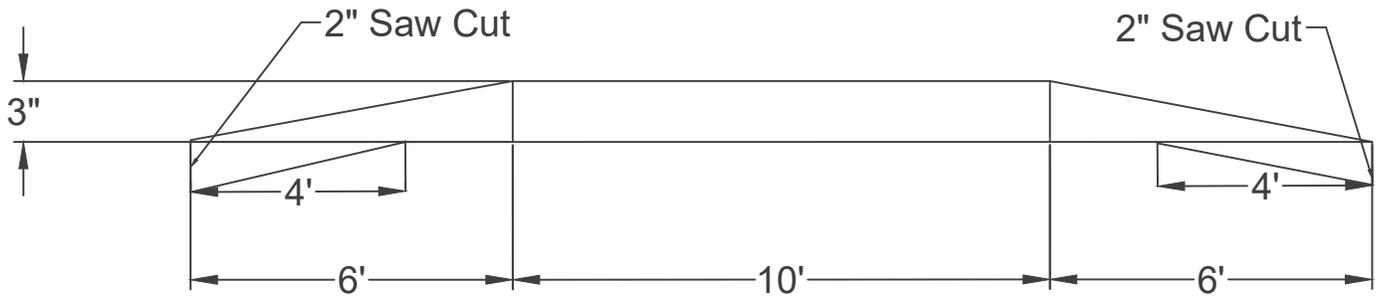
8013 QUARTERFIELD RD

ELKS LODGE

SCALE: 1"=50'

Appendix E

Flat Top Speed Hump Profile Detail



NOT TO SCALE

Traffic Engineering

FLAT TOP SPEED
HUMP PROFILE

Drawn By: NAF

Date: 4/22/22

Appendix F

Quarterfield Road at Stevenson Road – Multi-Way Stop Warrant Analysis

STEVENSON ROAD AT QUARTERFIELD ROAD

Multi-Way Stop Application and Warrants, Section 2B.07

Warrant C.1 and C.2

Averages 300 vehicles per hour for 8 hours on the Major Street

Averages 200 vehicles per hour for 8 hours on the Minor Street

Hour	Major		Minor		
0:00	0	FALSE	0:00	0	FALSE
1:00	0	FALSE	1:00	0	FALSE
2:00	0	FALSE	2:00	0	FALSE
3:00	0	FALSE	3:00	0	FALSE
4:00	0	FALSE	4:00	0	FALSE
5:00	0	FALSE	5:00	0	FALSE
6:00	192	FALSE	6:00	54	FALSE
7:00	602	X	7:00	175	FALSE
8:00	452	X	8:00	224	X
9:00	302	X	9:00	149	FALSE
10:00	287	FALSE	10:00	100	FALSE
11:00	300	X	11:00	117	FALSE
12:00	275	FALSE	12:00	133	FALSE
13:00	297	FALSE	13:00	102	FALSE
14:00	405	X	14:00	224	X
15:00	490	X	15:00	255	X
16:00	476	X	16:00	209	X
17:00	528	X	17:00	182	FALSE
18:00	465	X	18:00	186	FALSE
19:00	0	FALSE	19:00	0	FALSE
20:00	0	FALSE	20:00	0	FALSE
21:00	0	FALSE	21:00	0	FALSE
22:00	0	FALSE	22:00	0	FALSE
23:00	0	FALSE	23:00	0	FALSE
		9			4

STEVENSON ROAD AT QUARTERFIELD ROAD

Multi-Way Stop Application and Warrants, Section 2B.07

Warrant C3

70% of Warrants C1 and C2, if the 85th Percntile speed is greater than 40 MPH

Hour	Major		Minor		
0:00	0	FALSE	0:00	0	FALSE
1:00	0	FALSE	1:00	0	FALSE
2:00	0	FALSE	2:00	0	FALSE
3:00	0	FALSE	3:00	0	FALSE
4:00	0	FALSE	4:00	0	FALSE
5:00	0	FALSE	5:00	0	FALSE
6:00	192	FALSE	6:00	54	FALSE
7:00	602	X	7:00	175	X
8:00	452	X	8:00	224	X
9:00	302	X	9:00	149	X
10:00	287	X	10:00	100	FALSE
11:00	300	X	11:00	117	FALSE
12:00	275	X	12:00	133	FALSE
13:00	297	X	13:00	102	FALSE
14:00	405	X	14:00	224	X
15:00	490	X	15:00	255	X
16:00	476	X	16:00	209	X
17:00	528	X	17:00	182	X
18:00	465	X	18:00	186	X
19:00	0	FALSE	19:00	0	FALSE
20:00	0	FALSE	20:00	0	FALSE
21:00	0	FALSE	21:00	0	FALSE
22:00	0	FALSE	22:00	0	FALSE
23:00	0	FALSE	23:00	0	FALSE
		12			8

STEVENSON ROAD AT QUARTERFIELD ROAD

Multi-Way Stop Application and Warrants, Section 2B.07

Warrant D - 80% of Warrants B, C.1, and C.2

Major			Minor		
Hour					
0:00	0	FALSE	0:00	0	FALSE
1:00	0	FALSE	1:00	0	FALSE
2:00	0	FALSE	2:00	0	FALSE
3:00	0	FALSE	3:00	0	FALSE
4:00	0	FALSE	4:00	0	FALSE
5:00	0	FALSE	5:00	0	FALSE
6:00	192	FALSE	6:00	43.2	FALSE
7:00	602	X	7:00	140	FALSE
8:00	452	X	8:00	179.2	X
9:00	302	X	9:00	119.2	FALSE
10:00	287	X	10:00	80	FALSE
11:00	300	X	11:00	93.6	FALSE
12:00	275	X	12:00	106.4	FALSE
13:00	297	X	13:00	81.6	FALSE
14:00	405	X	14:00	179.2	X
15:00	490	X	15:00	204	X
16:00	476	X	16:00	167.2	X
17:00	528	X	17:00	145.6	FALSE
18:00	465	X	18:00	148.8	FALSE
19:00	0	FALSE	19:00	0	FALSE
20:00	0	FALSE	20:00	0	FALSE
21:00	0	FALSE	21:00	0	FALSE
22:00	0	FALSE	22:00	0	FALSE
23:00	0	FALSE	23:00	0	FALSE
		12			4

Appendix G

2050 Future Build Conditions – Synchro AWSC Analysis

Lanes, Volumes, Timings
40: Quarterfield Rd & Stevenson Rd

07/01/2025



Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	98	175	201	178	275	101
Future Volume (vph)	98	175	201	178	275	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.914		0.937			
Flt Protected	0.982					0.965
Satd. Flow (prot)	1656	0	1728	0	0	1780
Flt Permitted	0.982					0.965
Satd. Flow (perm)	1656	0	1728	0	0	1780
Link Speed (mph)	35		35			35
Link Distance (ft)	113		190			187
Travel Time (s)	2.2		3.7			3.6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	107	190	218	193	299	110
Shared Lane Traffic (%)						
Lane Group Flow (vph)	297	0	411	0	0	409
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Stop			Stop

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	68.2%
	ICU Level of Service C
Analysis Period (min)	15

Intersection	
Intersection Delay, s/veh	16
Intersection LOS	C

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Vol, veh/h	98	175	201	178	275	101
Future Vol, veh/h	98	175	201	178	275	101
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	107	190	218	193	299	110
Number of Lanes	1	0	1	0	0	1

Approach	NW	NE	SW
Opposing Approach		SW	NE
Opposing Lanes	0	1	1
Conflicting Approach Left	NE		NW
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SW	NW	
Conflicting Lanes Right	1	1	0
HCM Control Delay	13.8	15.7	17.9
HCM LOS	B	C	C

Lane	NELn1	NWLn1	SWLn1
Vol Left, %	0%	36%	73%
Vol Thru, %	53%	0%	27%
Vol Right, %	47%	64%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	379	273	376
LT Vol	0	98	275
Through Vol	201	0	101
RT Vol	178	175	0
Lane Flow Rate	412	297	409
Geometry Grp	1	1	1
Degree of Util (X)	0.595	0.471	0.635
Departure Headway (Hd)	5.2	5.72	5.594
Convergence, Y/N	Yes	Yes	Yes
Cap	692	629	646
Service Time	3.251	3.777	3.644
HCM Lane V/C Ratio	0.595	0.472	0.633
HCM Control Delay	15.7	13.8	17.9
HCM Lane LOS	C	B	C
HCM 95th-tile Q	4	2.5	4.5

Lanes, Volumes, Timings
40: Quarterfield Rd & Stevenson Rd

07/01/2025



Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	146	164	148	118	133	188
Future Volume (vph)	146	164	148	118	133	188
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.929		0.940			
Flt Protected	0.977					0.980
Satd. Flow (prot)	1674	0	1734	0	0	1808
Flt Permitted	0.977					0.980
Satd. Flow (perm)	1674	0	1734	0	0	1808
Link Speed (mph)	35		35			35
Link Distance (ft)	113		190			187
Travel Time (s)	2.2		3.7			3.6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	159	178	161	128	145	204
Shared Lane Traffic (%)						
Lane Group Flow (vph)	337	0	289	0	0	349
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Sign Control	Stop		Stop			Stop

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	60.4%
	ICU Level of Service B
Analysis Period (min)	15

Intersection	
Intersection Delay, s/veh	13.5
Intersection LOS	B

Movement	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Vol, veh/h	146	164	148	118	133	188
Future Vol, veh/h	146	164	148	118	133	188
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	159	178	161	128	145	204
Number of Lanes	1	0	1	0	0	1

Approach	NW	NE	SW
Opposing Approach		SW	NE
Opposing Lanes	0	1	1
Conflicting Approach Left	NE		NW
Conflicting Lanes Left	1	0	1
Conflicting Approach Right	SW	NW	
Conflicting Lanes Right	1	1	0
HCM Control Delay	13.8	11.9	14.4
HCM LOS	B	B	B

Lane	NELn1	NWLn1	SWLn1
Vol Left, %	0%	47%	41%
Vol Thru, %	56%	0%	59%
Vol Right, %	44%	53%	0%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	266	310	321
LT Vol	0	146	133
Through Vol	148	0	188
RT Vol	118	164	0
Lane Flow Rate	289	337	349
Geometry Grp	1	1	1
Degree of Util (X)	0.416	0.503	0.526
Departure Headway (Hd)	5.185	5.376	5.426
Convergence, Y/N	Yes	Yes	Yes
Cap	694	671	663
Service Time	3.224	3.415	3.463
HCM Lane V/C Ratio	0.416	0.502	0.526
HCM Control Delay	11.9	13.8	14.4
HCM Lane LOS	B	B	B
HCM 95th-tile Q	2.1	2.8	3.1

Appendix H

Traffic Signal Warrant Analysis: Quarterfield Road at Stevenson Road

HCS Warrants Report

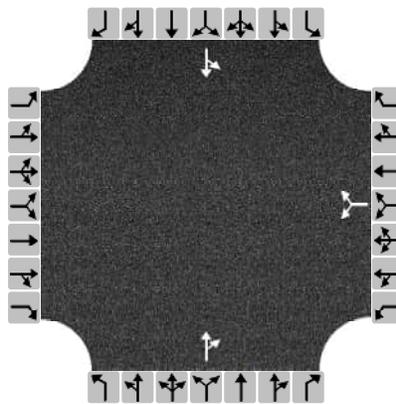
Project Information

Analyst	KCI Technologies	Date	3/31/2025
Agency		Analysis Year	2025
Jurisdiction		Time Period Analyzed	2024
Project Description	Stevenson Road at Quarterfield Road		

General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	1
Major Street Speed (mi/h)	35	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	0	0	0	0	0	0	1	0	0	1	0
Lane Usage					LR			TR			LT	
Vehicle Volumes Averages (veh/h)	0	0	0	81	0	89	0	125	74	93	113	0
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay Averages (s/veh)	0.0			0.0			0.0			0.0		
Delay Averages (veh-hrs)	0.0			0.0			0.0			0.0		

School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

Volume Summary														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (80%)	4A (100%)	4B (80%)
07 - 08	602	175	777	0	0	Yes	Yes	No	Yes	No	No	No	No	No
08 - 09	452	224	676	0	0	No	Yes	No	No	No	No	No	No	No
09 - 10	302	149	451	0	0	No	No	No	No	No	No	No	No	No
10 - 11	287	100	387	0	0	No	No	No	No	No	No	No	No	No
11 - 12	300	117	417	0	0	No	No	No	No	No	No	No	No	No
12 - 13	275	133	408	0	0	No	No	No	No	No	No	No	No	No
13 - 14	297	102	399	0	0	No	No	No	No	No	No	No	No	No
14 - 15	405	224	629	0	0	No	Yes	No	No	No	No	No	No	No
15 - 16	490	255	745	0	0	No	Yes	No	No	No	No	No	No	No
16 - 17	476	209	685	0	0	No	Yes	No	No	No	No	No	No	No
17 - 18	528	182	710	0	0	Yes	Yes	No	No	No	No	No	No	No
18 - 19	465	186	651	0	0	No	Yes	No	No	No	No	No	No	No
Total	4879	2056	6935	0	0	2	7	0	1	0	0	0	0	0

Warrants	
Warrant 1: Eight-Hour Vehicular Volume	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
Warrant 2: Four-Hour Vehicular Volume	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	
Warrant 3: Peak Hour	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	
Warrant 4: Pedestrian Volume	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
Warrant 5: School Crossing	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
Warrant 6: Coordinated Signal System	
Degree of Platooning (Predominant direction or both directions)	
Warrant 7: Crash Experience	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	
Warrant 8: Roadway Network	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
Warrant 9: Grade Crossing	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

HCS Warrants Report

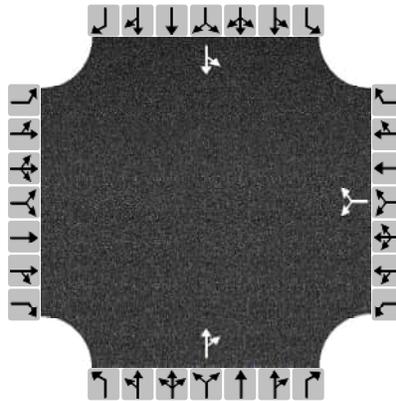
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General

Major Street Direction	North-South	Population < 10,000	Yes
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	1
Major Street Speed (mi/h)	41	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	0	0	0	0	0	0	1	0	0	1	0
Lane Usage					LR			TR			LT	
Vehicle Volumes Averages (veh/h)	0	0	0	81	0	89	0	125	74	93	113	0
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay Averages (s/veh)	0.0			0.0			0.0			0.0		
Delay Averages (veh-hrs)	0.0			0.0			0.0			0.0		

School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

Volume Summary														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (56%)	4A (70%)	4B (56%)
07 - 08	602	175	777	0	0	Yes	Yes	Yes	Yes	Yes	No	No	No	No
08 - 09	452	224	676	0	0	Yes	Yes	No	Yes	Yes	No	No	No	No
09 - 10	302	149	451	0	0	No	Yes	No	No	No	No	No	No	No
10 - 11	287	100	387	0	0	No	Yes	No	No	No	No	No	No	No
11 - 12	300	117	417	0	0	No	Yes	No	No	No	No	No	No	No
12 - 13	275	133	408	0	0	No	No	No	No	No	No	No	No	No
13 - 14	297	102	399	0	0	No	Yes	No	No	No	No	No	No	No
14 - 15	405	224	629	0	0	Yes	Yes	No	No	Yes	No	No	No	No
15 - 16	490	255	745	0	0	Yes	Yes	No	Yes	Yes	No	Yes	No	No
16 - 17	476	209	685	0	0	Yes	Yes	No	Yes	Yes	No	No	No	No
17 - 18	528	182	710	0	0	Yes	Yes	Yes	Yes	Yes	No	No	No	No
18 - 19	465	186	651	0	0	Yes	Yes	No	Yes	Yes	No	No	No	No
Total	4879	2056	6935	0	0	7	11	2	6	7	0	1	0	0

Warrants	
Warrant 1: Eight-Hour Vehicular Volume	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
Warrant 2: Four-Hour Vehicular Volume	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	✓
Warrant 3: Peak Hour	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	✓
Warrant 4: Pedestrian Volume	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
Warrant 5: School Crossing	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
Warrant 6: Coordinated Signal System	
Degree of Platooning (Predominant direction or both directions)	
Warrant 7: Crash Experience	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	✓
Warrant 8: Roadway Network	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
Warrant 9: Grade Crossing	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

Appendix I

Traffic Signal Warrant Analysis: Quarterfield Road at MD 174

HCS7 Warrants Report

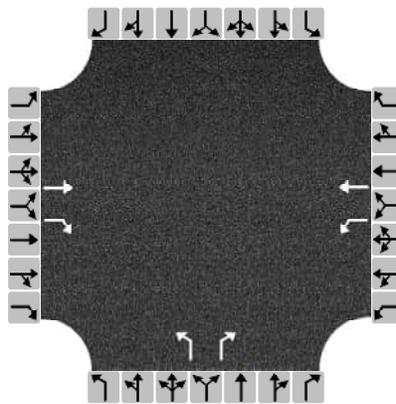
Project Information

Analyst	KCI Technologies	Date	4/1/2025
Agency		Analysis Year	2025
Jurisdiction		Time Period Analyzed	2024
Project Description	MD 174 at Quarterfield Road		

General

Major Street Direction	East-West	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	2
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	1150		

Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	0	1	1	1	1	0	1	0	1	0	0	0
Lane Usage		T	R	L	T		L		R			
Vehicle Volumes Averages (veh/h)	0	513	75	151	555	0	58	0	171	0	0	0
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	0
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)		Tractor-Trailer Trucks (%)	10

HCS7 Warrants Report

Volume Summary

Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (70%)	4A (70%)	4B (70%)
07 - 08	1448	364	1812	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
08 - 09	1317	280	1597	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
09 - 10	954	200	1154	2	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
10 - 11	971	178	1149	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
11 - 12	929	196	1125	4	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
12 - 13	1109	159	1268	6	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
13 - 14	1058	154	1212	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
14 - 15	1275	301	1576	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
15 - 16	1487	255	1742	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
16 - 17	1777	223	2000	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17 - 18	1809	233	2042	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
18 - 19	1414	213	1627	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Total	15548	2756	18304	12	0	12	12	12	12	12	0	12	0	0

Warrants

Warrant 1: Eight-Hour Vehicular Volume	✓
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	✓
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	✓
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	✓
Warrant 2: Four-Hour Vehicular Volume	✓
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	✓
Warrant 3: Peak Hour	✓
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	✓
Warrant 4: Pedestrian Volume	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
Warrant 5: School Crossing	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	✓
Warrant 6: Coordinated Signal System	
Degree of Platooning (Predominant direction or both directions)	
Warrant 7: Crash Experience	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	✓
Warrant 8: Roadway Network	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
Warrant 9: Grade Crossing	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

Appendix J

2050 Future Build Conditions – Synchro Signal Analysis

Lanes, Volumes, Timings
40: Quarterfield Rd & Stevenson Rd

01/19/2026



Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	98	175	201	178	275	101
Future Volume (vph)	98	175	201	178	275	101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.914		0.937			
Flt Protected	0.982					0.965
Satd. Flow (prot)	1656	0	1728	0	0	1780
Flt Permitted	0.982					0.470
Satd. Flow (perm)	1656	0	1728	0	0	867
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)	158		112			
Link Speed (mph)	35		35			35
Link Distance (ft)	113		190			187
Travel Time (s)	2.2		3.7			3.6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	107	190	218	193	299	110
Shared Lane Traffic (%)						
Lane Group Flow (vph)	297	0	411	0	0	409
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Number of Detectors	1		2		1	2
Detector Template	Left		Thru		Left	Thru
Leading Detector (ft)	20		100		20	100
Trailing Detector (ft)	0		0		0	0
Detector 1 Position(ft)	0		0		0	0
Detector 1 Size(ft)	20		6		20	6
Detector 1 Type	Cl+Ex		Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0		0.0	0.0
Detector 1 Queue (s)	0.0		0.0		0.0	0.0
Detector 1 Delay (s)	0.0		0.0		0.0	0.0
Detector 2 Position(ft)			94			94
Detector 2 Size(ft)			6			6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Prot		NA		Perm	NA
Protected Phases	2		4			8
Permitted Phases					8	
Detector Phase	2		4		8	8
Switch Phase						

Lanes, Volumes, Timings
 40: Quarterfield Rd & Stevenson Rd

01/19/2026

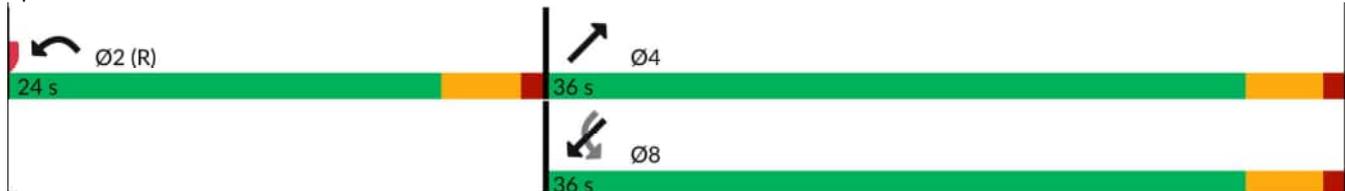


Lane Group	NWL	NWR	NET	NER	SWL	SWT
Minimum Initial (s)	5.0		5.0		5.0	5.0
Minimum Split (s)	22.5		22.5		22.5	22.5
Total Split (s)	24.0		36.0		36.0	36.0
Total Split (%)	40.0%		60.0%		60.0%	60.0%
Maximum Green (s)	19.5		31.5		31.5	31.5
Yellow Time (s)	3.5		3.5		3.5	3.5
All-Red Time (s)	1.0		1.0		1.0	1.0
Lost Time Adjust (s)	0.0		0.0			0.0
Total Lost Time (s)	4.5		4.5			4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	C-Max		None		None	None
Walk Time (s)	7.0		7.0		7.0	7.0
Flash Don't Walk (s)	11.0		11.0		11.0	11.0
Pedestrian Calls (#/hr)	0		0		0	0
Act Effect Green (s)	21.3		29.7			29.7
Actuated g/C Ratio	0.36		0.50			0.50
v/c Ratio	0.43		0.45			0.96
Control Delay (s/veh)	9.8		8.3			51.5
Queue Delay	0.0		0.0			0.0
Total Delay (s/veh)	9.8		8.3			51.5
LOS	A		A			D
Approach Delay (s/veh)	9.8		8.3			51.5
Approach LOS	A		A			D

Intersection Summary

Area Type: Other
 Cycle Length: 60
 Actuated Cycle Length: 60
 Offset: 0 (0%), Referenced to phase 2:NWL and 6:, Start of Green
 Natural Cycle: 60
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay (s/veh): 24.5
 Intersection LOS: C
 Intersection Capacity Utilization 69.4%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 40: Quarterfield Rd & Stevenson Rd



Queues

40: Quarterfield Rd & Stevenson Rd

01/19/2026



Lane Group	NWL	NET	SWT
Lane Group Flow (vph)	297	411	409
v/c Ratio	0.43	0.45	0.96
Control Delay (s/veh)	9.8	8.3	51.5
Queue Delay	0.0	0.0	0.0
Total Delay (s/veh)	9.8	8.3	51.5
Queue Length 50th (ft)	36	57	121
Queue Length 95th (ft)	93	111	#290
Internal Link Dist (ft)	33	110	107
Turn Bay Length (ft)			
Base Capacity (vph)	690	960	455
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.43	0.43	0.90

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Lanes, Volumes, Timings
40: Quarterfield Rd & Stevenson Rd

01/19/2026



Lane Group	NWL	NWR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	146	164	148	118	133	188
Future Volume (vph)	146	164	148	118	133	188
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.929		0.940			
Flt Protected	0.977					0.980
Satd. Flow (prot)	1674	0	1734	0	0	1808
Flt Permitted	0.977					0.678
Satd. Flow (perm)	1674	0	1734	0	0	1251
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)	149		106			
Link Speed (mph)	35		35			35
Link Distance (ft)	113		190			187
Travel Time (s)	2.2		3.7			3.6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	159	178	161	128	145	204
Shared Lane Traffic (%)						
Lane Group Flow (vph)	337	0	289	0	0	349
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		0			0
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Number of Detectors	1		2		1	2
Detector Template	Left		Thru		Left	Thru
Leading Detector (ft)	20		100		20	100
Trailing Detector (ft)	0		0		0	0
Detector 1 Position(ft)	0		0		0	0
Detector 1 Size(ft)	20		6		20	6
Detector 1 Type	Cl+Ex		Cl+Ex		Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0		0.0	0.0
Detector 1 Queue (s)	0.0		0.0		0.0	0.0
Detector 1 Delay (s)	0.0		0.0		0.0	0.0
Detector 2 Position(ft)			94			94
Detector 2 Size(ft)			6			6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Prot		NA		Perm	NA
Protected Phases	2		4			8
Permitted Phases					8	
Detector Phase	2		4		8	8
Switch Phase						

Lanes, Volumes, Timings
 40: Quarterfield Rd & Stevenson Rd

01/19/2026

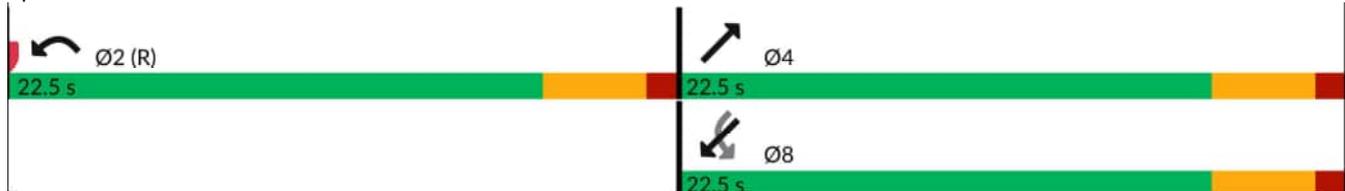


Lane Group	NWL	NWR	NET	NER	SWL	SWT
Minimum Initial (s)	5.0		5.0		5.0	5.0
Minimum Split (s)	22.5		22.5		22.5	22.5
Total Split (s)	22.5		22.5		22.5	22.5
Total Split (%)	50.0%		50.0%		50.0%	50.0%
Maximum Green (s)	18.0		18.0		18.0	18.0
Yellow Time (s)	3.5		3.5		3.5	3.5
All-Red Time (s)	1.0		1.0		1.0	1.0
Lost Time Adjust (s)	0.0		0.0			0.0
Total Lost Time (s)	4.5		4.5			4.5
Lead/Lag						
Lead-Lag Optimize?						
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Recall Mode	C-Max		None		None	None
Walk Time (s)	7.0		7.0		7.0	7.0
Flash Don't Walk (s)	11.0		11.0		11.0	11.0
Pedestrian Calls (#/hr)	0		0		0	0
Act Effct Green (s)	20.8		15.2			15.2
Actuated g/C Ratio	0.46		0.34			0.34
v/c Ratio	0.39		0.44			0.83
Control Delay (s/veh)	6.8		8.8			31.7
Queue Delay	0.0		0.0			0.0
Total Delay (s/veh)	6.8		8.8			31.7
LOS	A		A			C
Approach Delay (s/veh)	6.8		8.8			31.7
Approach LOS	A		A			C

Intersection Summary

Area Type: Other
 Cycle Length: 45
 Actuated Cycle Length: 45
 Offset: 0 (0%), Referenced to phase 2:NWL and 6:, Start of Green
 Natural Cycle: 45
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.83
 Intersection Signal Delay (s/veh): 16.3
 Intersection LOS: B
 Intersection Capacity Utilization 61.6%
 ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 40: Quarterfield Rd & Stevenson Rd



Queues

40: Quarterfield Rd & Stevenson Rd

01/19/2026



Lane Group	NWL	NET	SWT
Lane Group Flow (vph)	337	289	349
v/c Ratio	0.39	0.44	0.83
Control Delay (s/veh)	6.8	8.8	31.7
Queue Delay	0.0	0.0	0.0
Total Delay (s/veh)	6.8	8.8	31.7
Queue Length 50th (ft)	29	32	76
Queue Length 95th (ft)	77	71	#178
Internal Link Dist (ft)	33	110	107
Turn Bay Length (ft)			
Base Capacity (vph)	854	757	500
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.39	0.38	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Lanes, Volumes, Timings

21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025



Lane Group	NBL	NBR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	84	373	568	149	280	632
Future Volume (vph)	84	373	568	149	280	632
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	200		350	250	
Storage Lanes	1	1		1	1	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1752	1568	1863	1583	1770	1863
Flt Permitted	0.950				0.133	
Satd. Flow (perm)	1752	1568	1863	1583	248	1863
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		127		162		
Link Speed (mph)	35		45			45
Link Distance (ft)	321		556			334
Travel Time (s)	6.3		8.4			5.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Adj. Flow (vph)	91	405	617	162	304	687
Shared Lane Traffic (%)						
Lane Group Flow (vph)	91	405	617	162	304	687
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		12			12
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Number of Detectors	1	1	2	1	1	2
Detector Template	Left	Right	Thru	Right	Left	Thru
Leading Detector (ft)	20	20	100	20	20	100
Trailing Detector (ft)	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0
Detector 1 Size(ft)	20	20	6	20	20	6
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)			94			94
Detector 2 Size(ft)			6			6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Prot	pm+ov	NA	pm+ov	pm+pt	NA
Protected Phases	2	3	4	2	3	8

Lanes, Volumes, Timings

21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025

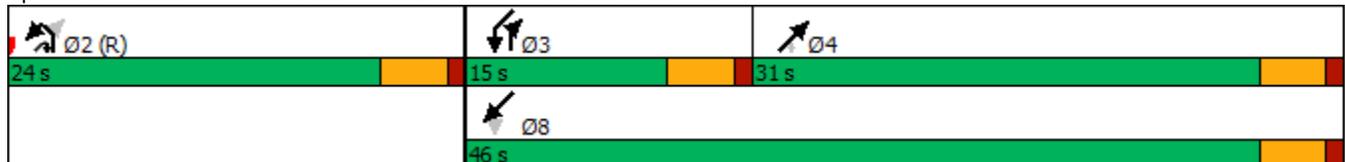


Lane Group	NBL	NBR	NET	NER	SWL	SWT
Permitted Phases		2		4	8	
Detector Phase	2	3	4	2	3	8
Switch Phase						
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	22.5	9.5	30.5	22.5	9.5	22.5
Total Split (s)	24.0	15.0	31.0	24.0	15.0	46.0
Total Split (%)	34.3%	21.4%	44.3%	34.3%	21.4%	65.7%
Maximum Green (s)	19.5	10.5	26.5	19.5	10.5	41.5
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	None	None	C-Max	None	None
Walk Time (s)	7.0		7.0	7.0		7.0
Flash Dont Walk (s)	11.0		11.0	11.0		11.0
Pedestrian Calls (#/hr)	0		0	0		0
Act Effct Green (s)	20.6	35.5	25.5	50.6	40.4	40.4
Actuated g/C Ratio	0.29	0.51	0.36	0.72	0.58	0.58
v/c Ratio	0.18	0.47	0.91	0.14	0.82	0.64
Control Delay	20.4	9.9	41.3	0.8	33.6	13.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.4	9.9	41.3	0.8	33.6	13.1
LOS	C	A	D	A	C	B
Approach Delay	11.8		32.9			19.4
Approach LOS	B		C			B

Intersection Summary

Area Type: Other
 Cycle Length: 70
 Actuated Cycle Length: 70
 Offset: 0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
 Natural Cycle: 70
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.91
 Intersection Signal Delay: 22.4
 Intersection LOS: C
 Intersection Capacity Utilization 61.3%
 ICU Level of Service B
 Analysis Period (min) 15

Splits and Phases: 21: Donaldson Ave/Quarterfield Rd & Stevenson Rd



Queues

21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025



Lane Group	NBL	NBR	NET	NER	SWL	SWT
Lane Group Flow (vph)	91	405	617	162	304	687
v/c Ratio	0.18	0.47	0.91	0.14	0.82	0.64
Control Delay	20.4	9.9	41.3	0.8	33.6	13.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.4	9.9	41.3	0.8	33.6	13.1
Queue Length 50th (ft)	30	70	241	0	72	170
Queue Length 95th (ft)	64	138	#428	12	#198	270
Internal Link Dist (ft)	241		476			254
Turn Bay Length (ft)		200		350	250	
Base Capacity (vph)	516	860	705	1189	371	1104
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.47	0.88	0.14	0.82	0.62

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
 21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025



Movement	NBL	NBR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (veh/h)	84	373	568	149	280	632
Future Volume (veh/h)	84	373	568	149	280	632
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1856	1856	1870	1870	1870	1870
Adj Flow Rate, veh/h	91	0	617	0	304	687
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	3	2	2	2	2
Cap, veh/h	565		668		367	1032
Arrive On Green	0.32	0.00	0.36	0.00	0.13	0.55
Sat Flow, veh/h	1767	1572	1870	1585	1781	1870
Grp Volume(v), veh/h	91	0	617	0	304	687
Grp Sat Flow(s),veh/h/ln	1767	1572	1870	1585	1781	1870
Q Serve(g_s), s	2.6	0.0	22.1	0.0	7.0	18.2
Cycle Q Clear(g_c), s	2.6	0.0	22.1	0.0	7.0	18.2
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	565		668		367	1032
V/C Ratio(X)	0.16		0.92		0.83	0.67
Avail Cap(c_a), veh/h	565		708		403	1109
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	17.1	0.0	21.6	0.0	14.9	11.1
Incr Delay (d2), s/veh	0.6	0.0	17.2	0.0	12.4	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	11.4	0.0	3.4	6.0
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	17.7	0.0	38.8	0.0	27.4	12.5
LnGrp LOS	B		D		C	B
Approach Vol, veh/h	91		617			991
Approach Delay, s/veh	17.7		38.8			17.1
Approach LOS	B		D			B
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		26.9	13.6	29.5		43.1
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s		19.5	10.5	26.5		41.5
Max Q Clear Time (g_c+I1), s		4.6	9.0	24.1		20.2
Green Ext Time (p_c), s		0.2	0.1	0.9		4.3
Intersection Summary						
HCM 6th Ctrl Delay			25.0			
HCM 6th LOS			C			
Notes						
Unsignalized Delay for [NER, NBR] is excluded from calculations of the approach delay and intersection delay.						

Lanes, Volumes, Timings

21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025



Lane Group	NBL	NBR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (vph)	64	193	821	107	268	831
Future Volume (vph)	64	193	821	107	268	831
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	200		350	250	
Storage Lanes	1	1		1	1	
Taper Length (ft)	25				25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1752	1568	1863	1583	1770	1863
Flt Permitted	0.950				0.082	
Satd. Flow (perm)	1752	1568	1863	1583	153	1863
Right Turn on Red		Yes		Yes		
Satd. Flow (RTOR)		100		116		
Link Speed (mph)	35		45			45
Link Distance (ft)	321		556			334
Travel Time (s)	6.3		8.4			5.1
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Adj. Flow (vph)	70	210	892	116	291	903
Shared Lane Traffic (%)						
Lane Group Flow (vph)	70	210	892	116	291	903
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Right	Left	Left
Median Width(ft)	12		12			12
Link Offset(ft)	0		0			0
Crosswalk Width(ft)	16		16			16
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15	9		9	15	
Number of Detectors	1	1	2	1	1	2
Detector Template	Left	Right	Thru	Right	Left	Thru
Leading Detector (ft)	20	20	100	20	20	100
Trailing Detector (ft)	0	0	0	0	0	0
Detector 1 Position(ft)	0	0	0	0	0	0
Detector 1 Size(ft)	20	20	6	20	20	6
Detector 1 Type	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Detector 2 Position(ft)			94			94
Detector 2 Size(ft)			6			6
Detector 2 Type			Cl+Ex			Cl+Ex
Detector 2 Channel						
Detector 2 Extend (s)			0.0			0.0
Turn Type	Prot	pm+ov	NA	pm+ov	pm+pt	NA
Protected Phases	2	3	4	2	3	8

Lanes, Volumes, Timings

21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025

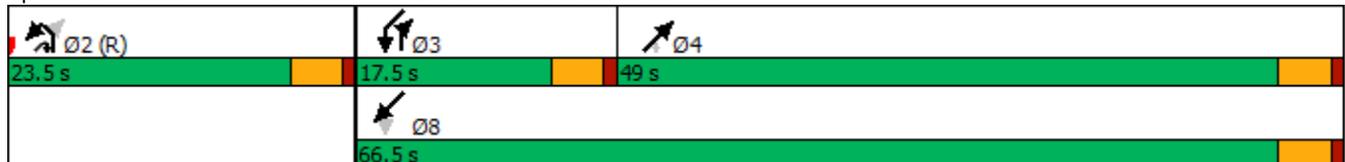


Lane Group	NBL	NBR	NET	NER	SWL	SWT
Permitted Phases		2		4	8	
Detector Phase	2	3	4	2	3	8
Switch Phase						
Minimum Initial (s)	5.0	12.0	5.0	5.0	12.0	5.0
Minimum Split (s)	22.5	17.5	22.5	22.5	17.5	22.5
Total Split (s)	23.5	17.5	49.0	23.5	17.5	66.5
Total Split (%)	26.1%	19.4%	54.4%	26.1%	19.4%	73.9%
Maximum Green (s)	19.0	13.0	44.5	19.0	13.0	62.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.5	4.5	4.5	4.5	4.5
Lead/Lag		Lead	Lag		Lead	
Lead-Lag Optimize?		Yes	Yes		Yes	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	None	None	C-Max	None	None
Walk Time (s)	7.0		7.0	7.0		7.0
Flash Dont Walk (s)	11.0		11.0	11.0		11.0
Pedestrian Calls (#/hr)	0		0	0		0
Act Effct Green (s)	19.5	36.8	44.2	68.2	61.5	61.5
Actuated g/C Ratio	0.22	0.41	0.49	0.76	0.68	0.68
v/c Ratio	0.19	0.30	0.97	0.09	0.87	0.71
Control Delay	30.8	10.6	48.1	0.7	48.1	12.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.8	10.6	48.1	0.7	48.1	12.5
LOS	C	B	D	A	D	B
Approach Delay	15.7		42.7			21.2
Approach LOS	B		D			C

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:NBL and 6:, Start of Green
Natural Cycle:	90
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	29.3
Intersection LOS:	C
Intersection Capacity Utilization:	73.5%
ICU Level of Service:	D
Analysis Period (min):	15

Splits and Phases: 21: Donaldson Ave/Quarterfield Rd & Stevenson Rd



Queues

21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025



Lane Group	NBL	NBR	NET	NER	SWL	SWT
Lane Group Flow (vph)	70	210	892	116	291	903
v/c Ratio	0.19	0.30	0.97	0.09	0.87	0.71
Control Delay	30.8	10.6	48.1	0.7	48.1	12.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.8	10.6	48.1	0.7	48.1	12.5
Queue Length 50th (ft)	33	39	469	0	109	268
Queue Length 95th (ft)	69	88	#744	11	#251	405
Internal Link Dist (ft)	241		476			254
Turn Bay Length (ft)		200		350	250	
Base Capacity (vph)	378	703	921	1227	337	1283
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.30	0.97	0.09	0.86	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
 21: Donaldson Ave/Quarterfield Rd & Stevenson Rd

07/01/2025



Movement	NBL	NBR	NET	NER	SWL	SWT
Lane Configurations						
Traffic Volume (veh/h)	64	193	821	107	268	831
Future Volume (veh/h)	64	193	821	107	268	831
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No		No			No
Adj Sat Flow, veh/h/ln	1856	1856	1870	1870	1870	1870
Adj Flow Rate, veh/h	70	0	892	0	291	903
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	3	3	2	2	2	2
Cap, veh/h	399		919		334	1261
Arrive On Green	0.23	0.00	0.49	0.00	0.13	0.67
Sat Flow, veh/h	1767	1572	1870	1585	1781	1870
Grp Volume(v), veh/h	70	0	892	0	291	903
Grp Sat Flow(s),veh/h/ln	1767	1572	1870	1585	1781	1870
Q Serve(g_s), s	2.9	0.0	41.8	0.0	9.4	27.4
Cycle Q Clear(g_c), s	2.9	0.0	41.8	0.0	9.4	27.4
Prop In Lane	1.00	1.00		1.00	1.00	
Lane Grp Cap(c), veh/h	399		919		334	1261
V/C Ratio(X)	0.18		0.97		0.87	0.72
Avail Cap(c_a), veh/h	399		925		354	1288
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	28.1	0.0	22.3	0.0	25.6	9.2
Incr Delay (d2), s/veh	1.0	0.0	22.7	0.0	19.5	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.0	21.4	0.0	7.6	8.7
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	29.1	0.0	44.9	0.0	45.2	11.1
LnGrp LOS	C		D		D	B
Approach Vol, veh/h	70		892			1194
Approach Delay, s/veh	29.1		44.9			19.4
Approach LOS	C		D			B
Timer - Assigned Phs		2	3	4		8
Phs Duration (G+Y+Rc), s		24.8	16.5	48.7		65.2
Change Period (Y+Rc), s		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s		19.0	13.0	44.5		62.0
Max Q Clear Time (g_c+I1), s		4.9	11.4	43.8		29.4
Green Ext Time (p_c), s		0.1	0.1	0.4		7.4

Intersection Summary

HCM 6th Ctrl Delay			30.3			
HCM 6th LOS			C			

Notes

Unsignalized Delay for [NER, NBR] is excluded from calculations of the approach delay and intersection delay.

Appendix K

2050 Future Build Conditions –SIDRA Roundabout Analysis

MOVEMENT SUMMARY

 Site: 101 [Stevenson at Quarterfield AM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h]	[HV %]	[Total veh/h]	[HV %]				[Veh. veh]	[Dist ft]				
South: Quarterfield Rd														
8	T1	201	3.0	218	3.0	0.421	8.4	LOS A	2.3	59.7	0.57	0.47	0.57	30.6
18	R2	178	3.0	193	3.0	0.421	8.4	LOS A	2.3	59.7	0.57	0.47	0.57	29.7
Approach		379	3.0	412	3.0	0.421	8.4	LOS A	2.3	59.7	0.57	0.47	0.57	30.2
East: Stevenson Rd														
1	L2	98	3.0	107	3.0	0.279	6.1	LOS A	1.4	35.8	0.43	0.31	0.43	30.9
16	R2	175	3.0	190	3.0	0.279	6.1	LOS A	1.4	35.8	0.43	0.31	0.43	29.9
Approach		273	3.0	297	3.0	0.279	6.1	LOS A	1.4	35.8	0.43	0.31	0.43	30.2
North: Quarterfield Rd														
7	L2	275	3.0	299	3.0	0.341	6.3	LOS A	1.9	49.7	0.33	0.18	0.33	30.1
4	T1	101	3.0	110	3.0	0.341	6.3	LOS A	1.9	49.7	0.33	0.18	0.33	29.9
Approach		376	3.0	409	3.0	0.341	6.3	LOS A	1.9	49.7	0.33	0.18	0.33	30.1
All Vehicles		1028	3.0	1117	3.0	0.421	7.0	LOS A	2.3	59.7	0.45	0.32	0.45	30.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
 LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

 Site: 101 [Stevenson at Quarterfield PM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h]	[HV %]	[Total veh/h]	[HV %]				[Veh. veh]	[Dist. ft]				
South: Quarterfield Rd														
8	T1	148	3.0	161	3.0	0.251	5.4	LOS A	1.3	32.4	0.35	0.21	0.35	31.9
18	R2	118	3.0	128	3.0	0.251	5.4	LOS A	1.3	32.4	0.35	0.21	0.35	31.0
Approach		266	3.0	289	3.0	0.251	5.4	LOS A	1.3	32.4	0.35	0.21	0.35	31.5
East: Stevenson Rd														
1	L2	146	3.0	159	3.0	0.298	6.0	LOS A	1.6	40.1	0.38	0.24	0.38	30.7
16	R2	164	3.0	178	3.0	0.298	6.0	LOS A	1.6	40.1	0.38	0.24	0.38	29.7
Approach		310	3.0	337	3.0	0.298	6.0	LOS A	1.6	40.1	0.38	0.24	0.38	30.1
North: Quarterfield Rd														
7	L2	133	3.0	145	3.0	0.308	6.1	LOS A	1.6	41.9	0.39	0.25	0.39	30.9
4	T1	188	3.0	204	3.0	0.308	6.1	LOS A	1.6	41.9	0.39	0.25	0.39	30.7
Approach		321	3.0	349	3.0	0.308	6.1	LOS A	1.6	41.9	0.39	0.25	0.39	30.8
All Vehicles		897	3.0	975	3.0	0.308	5.9	LOS A	1.6	41.9	0.37	0.23	0.37	30.8

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
 LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

Lane Level of Service

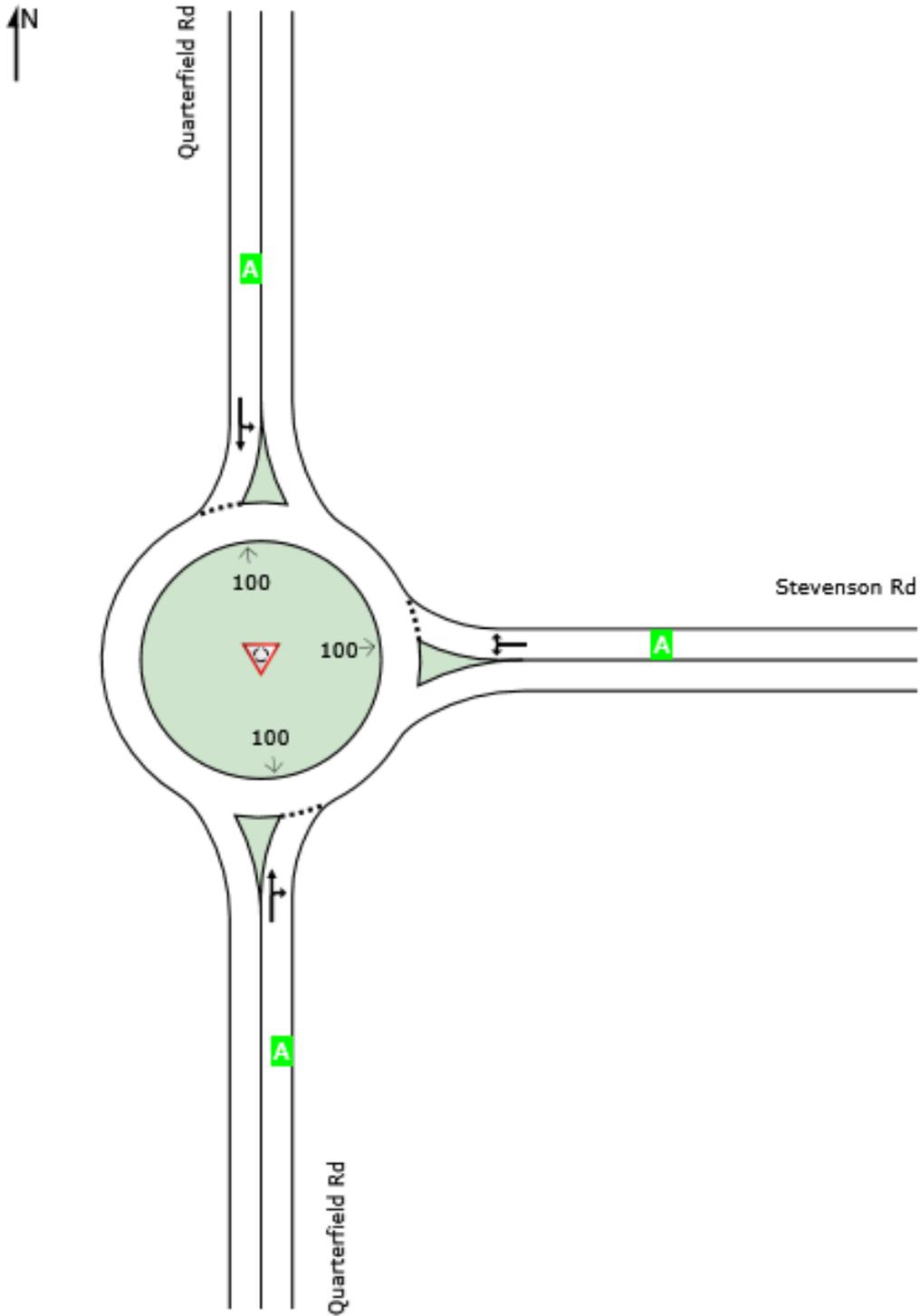
 Site: 101 [Stevenson at Quarterfield PM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

LANE LEVEL OF SERVICE

Lane Level of Service

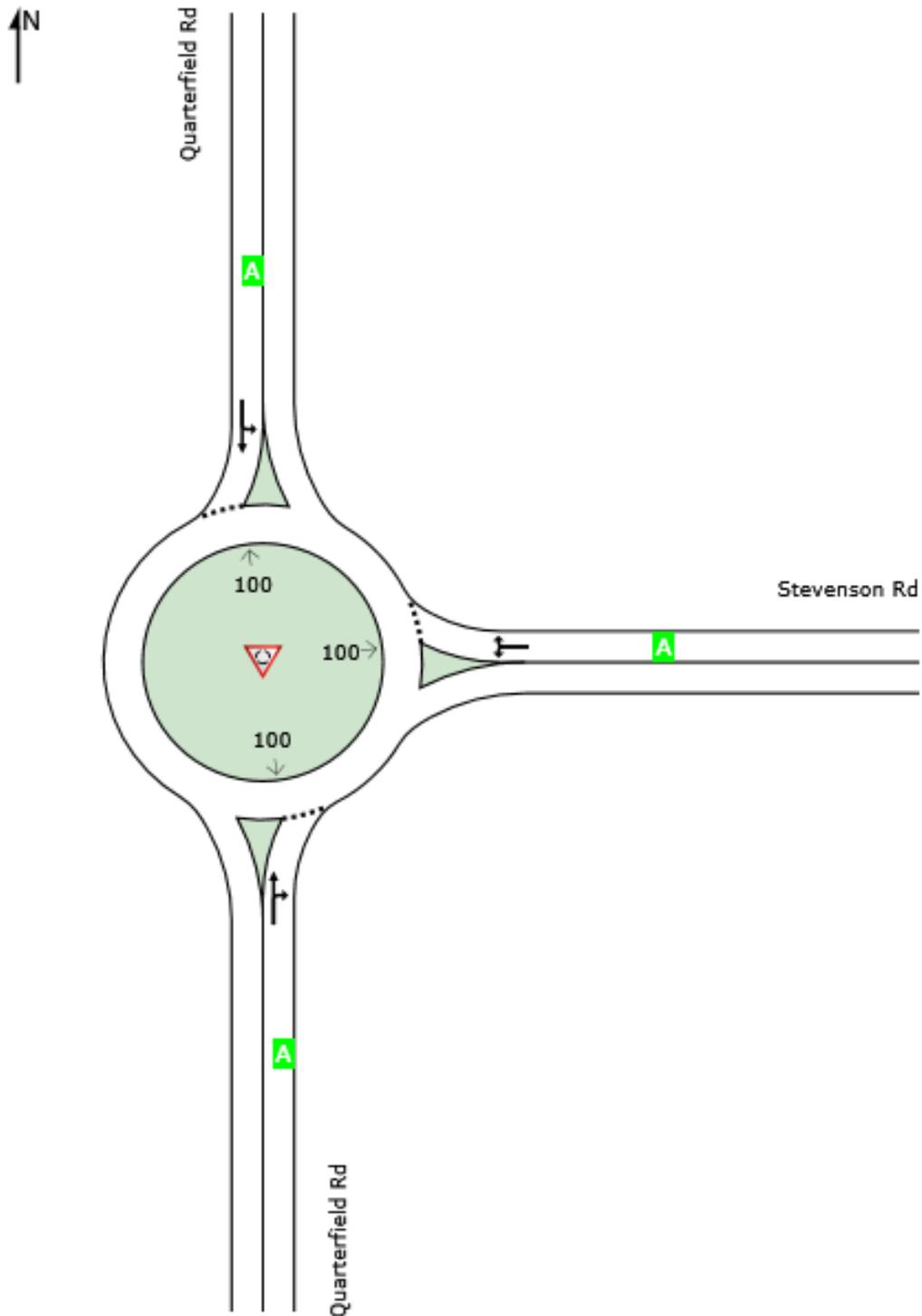
 Site: 101 [Stevenson at Quarterfield AM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	North	
LOS	A	A	A	A



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

MOVEMENT SUMMARY

Site: 101 [MD 174 at Quarterfield Road AM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] ft				
South: Quarterfield Rd														
3	L2	84	3.0	91	3.0	0.118	5.9	LOS A	0.4	11.2	0.55	0.51	0.55	29.7
18	R2	373	3.0	405	3.0	0.525	12.3	LOS B	3.6	91.0	0.72	0.86	1.09	28.2
Approach		457	3.0	497	3.0	0.525	11.1	LOS B	3.6	91.0	0.69	0.80	0.99	28.5
East: MD 174														
1	L2	280	3.0	304	3.0	0.814	18.4	LOS C	11.6	297.5	0.75	0.43	0.75	30.0
6	T1	632	3.0	687	3.0	0.814	18.4	LOS C	11.6	297.5	0.75	0.43	0.75	30.1
Approach		912	3.0	991	3.0	0.814	18.4	LOS C	11.6	297.5	0.75	0.43	0.75	30.0
West: MD 174														
2	T1	568	3.0	617	3.0	0.596	11.4	LOS B	5.8	149.2	0.65	0.67	0.91	34.0
12	R2	149	3.0	162	3.0	0.156	4.9	LOS A	0.6	16.3	0.42	0.31	0.42	36.5
Approach		717	3.0	779	3.0	0.596	10.1	LOS B	5.8	149.2	0.60	0.59	0.81	34.4
All Vehicles		2086	3.0	2267	3.0	0.814	14.0	LOS B	11.6	297.5	0.69	0.56	0.82	31.0

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
 LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [MD 174 at Quarterfield Road PM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] ft				
South: Quarterfield Rd														
3	L2	64	3.0	70	3.0	0.116	7.4	LOS A	0.4	10.5	0.62	0.62	0.62	29.1
18	R2	193	3.0	210	3.0	0.351	11.0	LOS B	1.5	39.1	0.69	0.74	0.84	28.7
Approach		257	3.0	279	3.0	0.351	10.1	LOS B	1.5	39.1	0.67	0.71	0.79	28.8
East: MD 174														
1	L2	268	3.0	291	3.0	0.959	35.0	LOS E	37.6	963.2	1.00	0.58	1.11	24.7
6	T1	831	3.0	903	3.0	0.959	35.0	LOS E	37.6	963.2	1.00	0.58	1.11	24.8
Approach		1099	3.0	1195	3.0	0.959	35.0	LOS E	37.6	963.2	1.00	0.58	1.11	24.8
West: MD 174														
2	T1	821	3.0	892	3.0	0.851	23.5	LOS C	23.8	608.9	0.97	1.35	2.17	28.8
12	R2	107	3.0	116	3.0	0.111	4.4	LOS A	0.4	11.2	0.39	0.28	0.39	36.8
Approach		928	3.0	1009	3.0	0.851	21.3	LOS C	23.8	608.9	0.91	1.23	1.97	29.5
All Vehicles		2284	3.0	2483	3.0	0.959	26.6	LOS D	37.6	963.2	0.92	0.86	1.42	26.9

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
 LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

Lane Level of Service

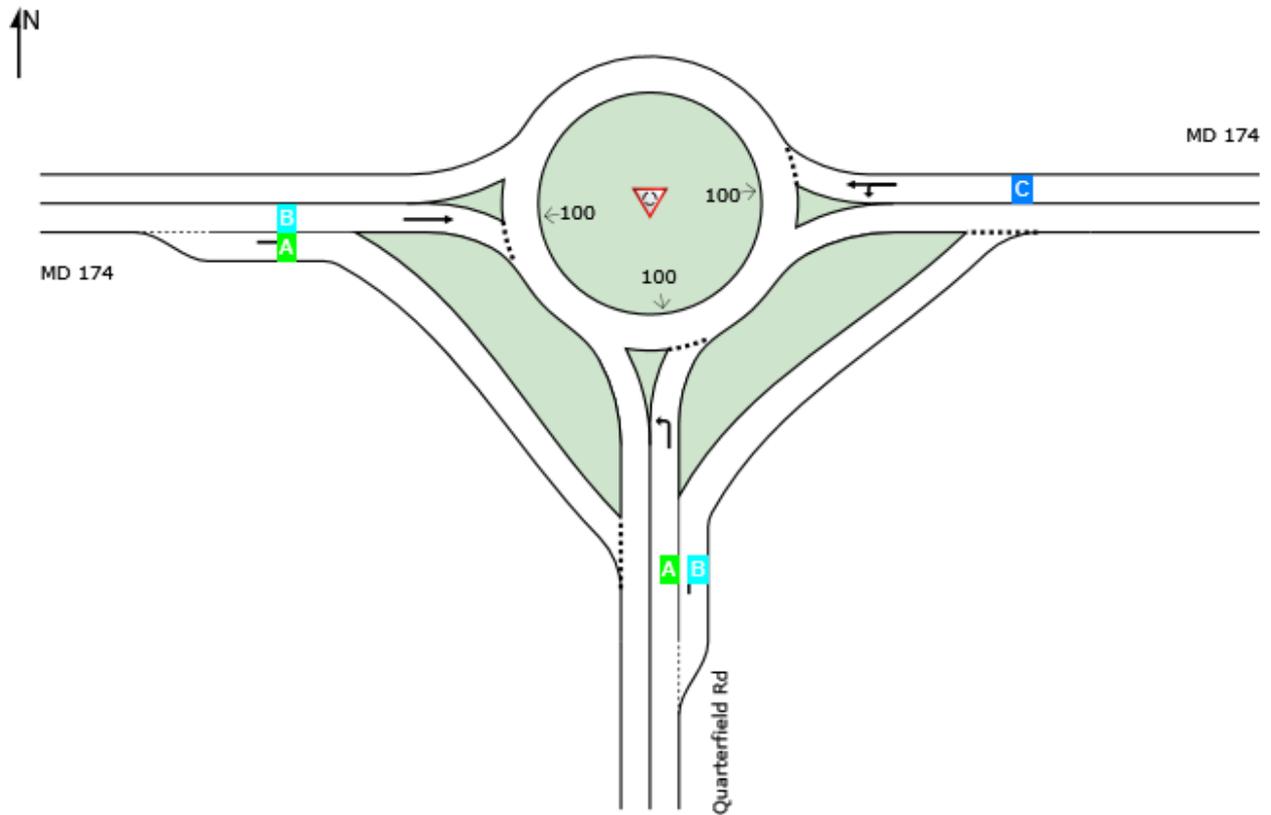
 Site: 101 [MD 174 at Quarterfield Road AM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	West	
LOS	B	C	B	B



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

LANE LEVEL OF SERVICE

Lane Level of Service

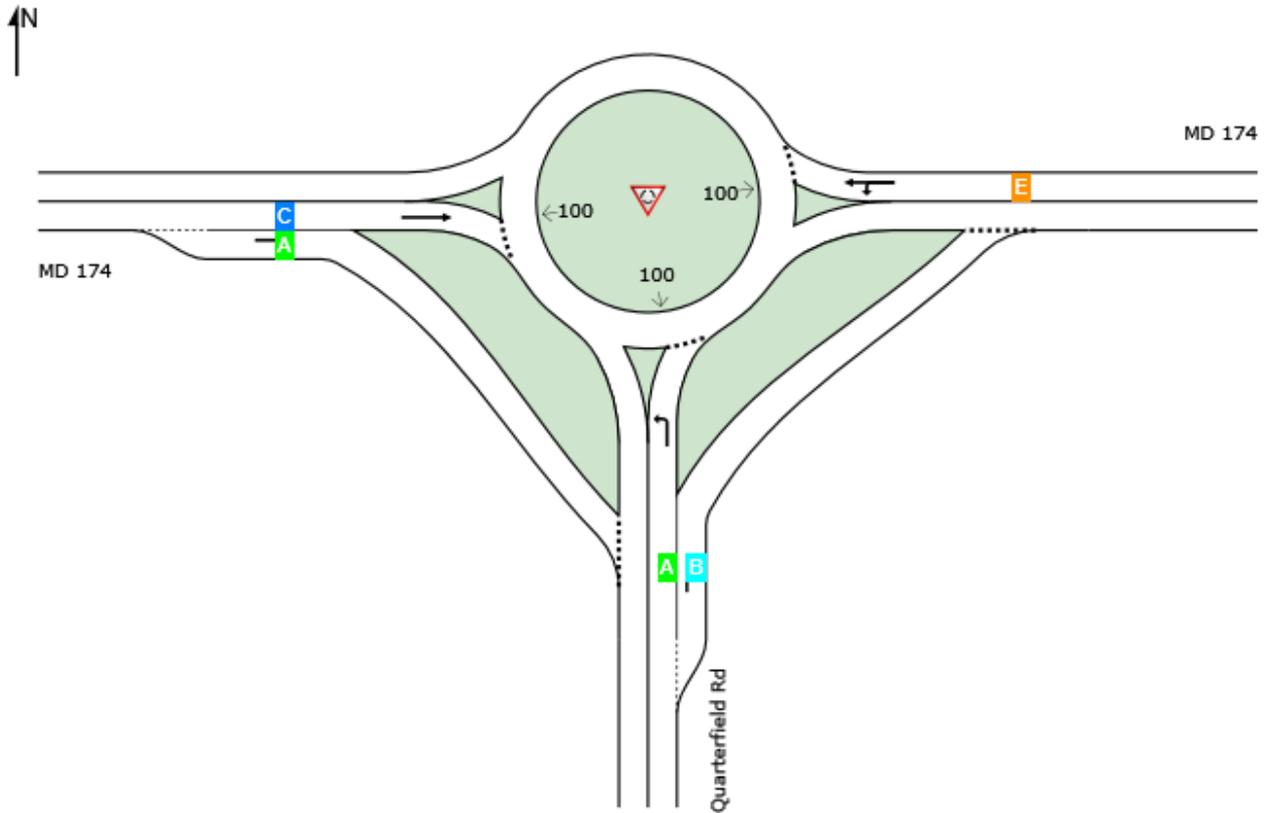
 Site: 101 [MD 174 at Quarterfield Road PM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	West	
LOS	B	E	C	D



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

MOVEMENT SUMMARY

Site: 101 [MD 174 at Quarterfield Road AM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] ft				
South: Quarterfield Rd														
3	L2	84	3.0	91	3.0	0.118	5.9	LOS A	0.4	11.2	0.55	0.51	0.55	29.7
18	R2	373	3.0	405	3.0	0.525	12.3	LOS B	3.6	91.0	0.72	0.86	1.09	28.2
Approach		457	3.0	497	3.0	0.525	11.1	LOS B	3.6	91.0	0.69	0.80	0.99	28.5
East: MD 174														
1	L2	280	3.0	304	3.0	0.240	4.9	LOS A	1.1	29.0	0.24	0.12	0.24	34.3
6	T1	632	3.0	687	3.0	0.543	14.4	LOS B	3.9	99.7	0.37	0.20	0.37	35.3
Approach		912	3.0	991	3.0	0.543	11.5	LOS B	3.9	99.7	0.33	0.18	0.33	35.0
West: MD 174														
2	T1	568	3.0	617	3.0	0.596	11.4	LOS B	5.8	149.2	0.65	0.67	0.91	34.0
12	R2	149	3.0	162	3.0	0.156	4.9	LOS A	0.6	16.3	0.42	0.31	0.42	36.5
Approach		717	3.0	779	3.0	0.596	10.1	LOS B	5.8	149.2	0.60	0.59	0.81	34.4
All Vehicles		2086	3.0	2267	3.0	0.596	10.9	LOS B	5.8	149.2	0.50	0.46	0.64	33.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
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 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [MD 174 at Quarterfield Road PM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] ft				
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18	R2	193	3.0	210	3.0	0.351	11.0	LOS B	1.5	39.1	0.69	0.74	0.84	28.7
Approach		257	3.0	279	3.0	0.351	10.1	LOS B	1.5	39.1	0.67	0.71	0.79	28.8
East: MD 174														
1	L2	268	3.0	291	3.0	0.226	4.7	LOS A	1.1	27.0	0.21	0.09	0.21	34.4
6	T1	831	3.0	903	3.0	0.699	19.4	LOS C	7.1	182.7	0.45	0.22	0.45	33.4
Approach		1099	3.0	1195	3.0	0.699	15.8	LOS C	7.1	182.7	0.39	0.19	0.39	33.7
West: MD 174														
2	T1	821	3.0	892	3.0	0.851	23.5	LOS C	23.8	608.9	0.97	1.35	2.17	28.8
12	R2	107	3.0	116	3.0	0.111	4.4	LOS A	0.4	11.2	0.39	0.28	0.39	36.8
Approach		928	3.0	1009	3.0	0.851	21.3	LOS C	23.8	608.9	0.91	1.23	1.97	29.5
All Vehicles		2284	3.0	2483	3.0	0.851	17.4	LOS C	23.8	608.9	0.63	0.67	1.08	31.3

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

Lane Level of Service

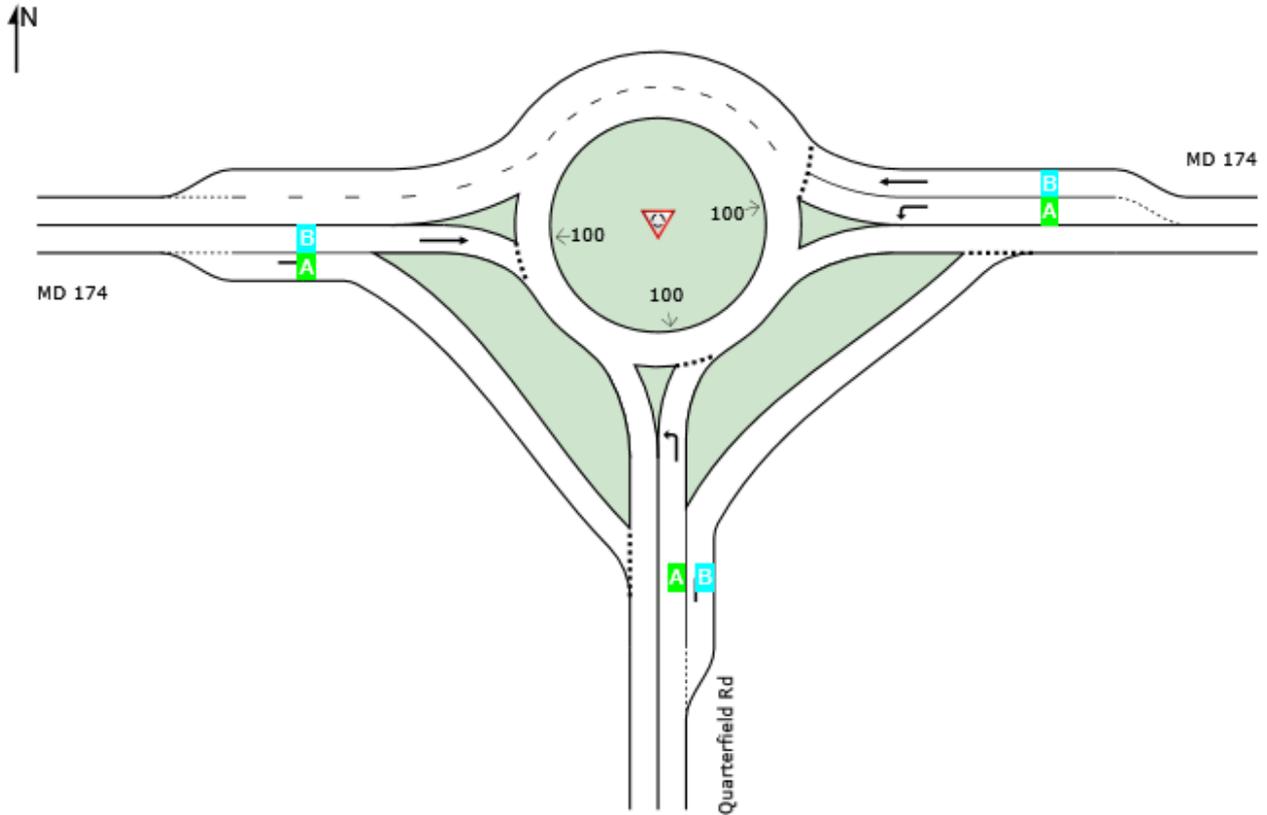
 Site: 101 [MD 174 at Quarterfield Road AM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	West	
LOS	B	B	B	B



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
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 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

LANE LEVEL OF SERVICE

Lane Level of Service

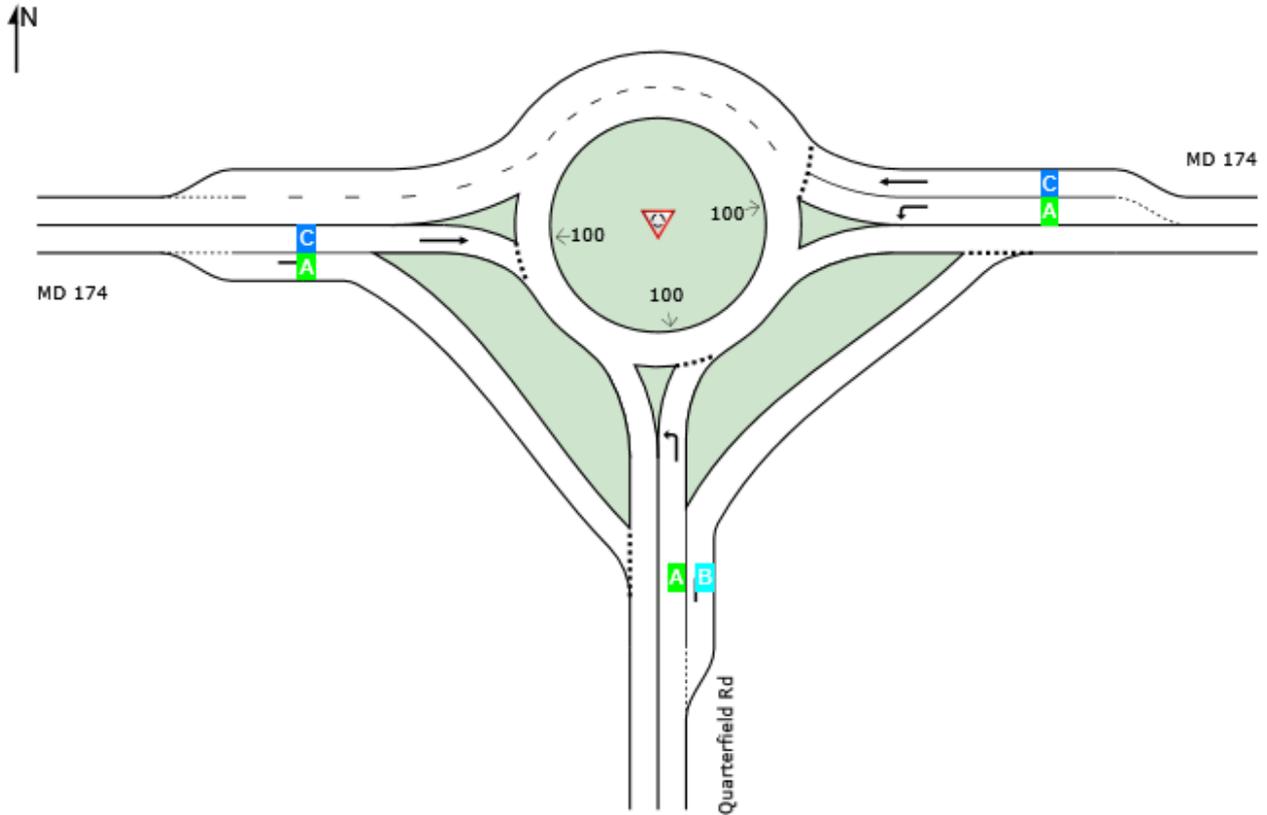
 Site: 101 [MD 174 at Quarterfield Road PM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	West	
LOS	B	C	C	C



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

Appendix L

FHWA USLIMITS2 Reports

USLIMITS2 Speed Zoning Report

Project Overview

Project Name: Quarterfield-1

Analyst: KCI

Date: 2025-06-27

Basic Project Information

Project Number: 221804667.16
Route Name: Quarterfield Road
From: Janet Dale Lane
To: MD 174 QuarterfieldDonaldson
State: Maryland
County: Anne Arundel County
City: Severn CDP
Route Type: Road Section in Developed Area
Route Status: Existing

Crash Data Information

Crash Data Years: 5.00
Crash AADT: 6350 veh/day
Total Number of Crashes: 40
Total Number of Injury Crashes: 17
Section Crash Rate: 639 per 100 MVM
Section Injury Crash Rate: 272 per 100 MVM
Crash Rate Average for Similar Roads: 235
Injury Rate Average for Similar Roads: 68

Roadway Information

Section Length: 0.54 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 35 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 21
Number of Signals: 0

Traffic Information

85th Percentile Speed: 39 mph
50th Percentile Speed: 35 mph
AADT: 6350 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: High

Project Description: Stevenson Road Quarterfield Road Feasibility Study

Recommended Speed Limit:



Note: The section crash rate of 639 per 100 MVM is above the critical rate (344). The injury crash rate for the section of 272 per 100 MVM is above the critical rate (130). A comprehensive crash study should be undertaken to identify engineering and traffic control deficiencies and appropriate corrective actions. The speed limit should only be reduced as a last measure after all other treatments have either been tried or ruled out.

Note: The road section is in an area with high pedestrian or bicycle activity. Consider implementing engineering measures to reduce speeds before lowering the recommended speed limit. See [Engineering Countermeasures for Speed Management](#) and [PedSafe](#) for more guidance.

Disclaimer: The U.S. Government assumes no liability for the use of the information contained in this report. This report does not constitute a standard, specification, or regulation.

How the Recommended Speed Limit was Determined

The questions and responses below, and the referenced page numbers, correspond to the flowcharts found in the [Decision Rules Flowchart document](#).

Terms Used in the Recommendation

- **Closest 85th:** This is the 5 mph increment that is closest to the 85th percentile speed (e.g., if the 85th percentile speed is 63 mph, the Closest 85th will be 65 mph).

- **Rounded-down 85th:** This is the 5 mph increment obtained by rounding down the 85th percentile to the nearest 5 mph increment (e.g., if the 85th percentile speed is 63 mph, the Rounded-down 85th will be 60 mph).
- **Closest 50th:** This is the 5 mph increment that is closest to the 50th percentile speed (e.g., if the 50th percentile speed is 58 mph, the Closest 50th will be 60 mph).
- **SL_1:** Speed limit determined using site characteristics (e.g., AADT, interchange spacing, roadside hazard rating, ped/bike activity, number of traffic signals, etc.).
- **SL_2:** Speed limit determined using crash data from the crash module.
- **SL:** Recommended Speed Limit.

The Recommended Speed Limit (SL) is the lower of the speed limit determined without crash data (SL_1) and the speed limit determined with crash data (SL_2).

Determine SL_1 Using Site Characteristics (pg. K-23)

Note: The number of signals per mile is being calculated as 0.00 signals per mile.

Note: The number of driveways per mile is being calculated as 38.89 driveways per mile.

Question 1: Are any of the following true: there are more than four signals per mile, pedestrian or bicyclist activity is high, parking activity is high, or there are more than 60 driveways per mile?

Results: Yes. There are 0.00 signals per mile, 38.89 driveways per mile, high pedestrian/bicyclist activity, and not high parking activity. **The SL_1 is set to the closest 50th percentile speed (35 mph).**

Question 2: Are crash data available?

Results: Yes, so use these data to determine SL_2.

Determine SL_2 Using Crash Data (pg. K-24)

Question 3: Is more than one year of crash data available?

Results: Yes, at least one year of crash data is available.

Note: The crash rate is calculated to be 639 crashes per 100M VMT, and the injury rate is calculated to be 272 crashes per 100M VMT.

Note: The critical crash rate is calculated as 344 crashes per 100M VMT.

Question 4: Is the crash rate (639 per 100M VMT) greater than the critical crash rate (344 crashes per 100M VMT)?

Results: Yes, the crash rate is greater than the critical crash rate. **The crash level is classified as high.**

Question 5: Is the injury crash rate (272 per 100M VMT) greater than the critical injury rate (130 crashes per 100M VMT)?

Results: Yes, so the injury crash rate is greater than the critical injury rate. **The injury crash level is classified as high.**

Question 6: Are either of the crash level (high) or injury crash level (high) classified as medium or high?

Results: Yes, but traffic control treatments can help reduce the crash/injury rate, **so the total crash level is classified as low.**

Question 7: Is the total crash level (low) classified as medium or high?

Results: No, so **SL_2 is set as the closest 85th speed (40 mph).**

Determine SL (pg. K-22)

Note: SL is set as the lower of SL_1 (35 mph) and SL_2 (40 mph). **The SL is set to 35 mph.**

Determine the Final Recommended Speed Limit (pg. K-28)

Question 8: Is the SL less than 20 mph or greater than 50 mph?

Results: The SL (35 mph) is between 20 mph and 50 mph. **The SL remains the same.**

Final Recommendation: The recommended speed limit is 35 mph.

Equations Used in the Crash Data Calculations

Exposure (M)

$$M = (\text{Section AADT} * 365 * \text{Section Length} * \text{Duration of Crash Data}) / (100000000)$$

$$M = (6350 * 365 * 0.54 * 5.00) / (100000000)$$

$$M = 0.0626$$

Crash Rate (Rc)

$$Rc = (\text{Section Crash Average} * 100000000) / (\text{Section AADT} * 365 * \text{Section Length})$$

$$Rc = (8.00 * 100000000) / (6350 * 365 * 0.54)$$

$$Rc = 639.19 \text{ crashes per 100 MVM}$$

Injury Rate (Ri)

$$Ri = (\text{Section Injury Crash Average} * 100000000) / (\text{Section AADT} * 365 * \text{Section Length})$$

$$Ri = (3.40 * 100000000) / (6350 * 365 * 0.54)$$

$$Ri = 271.66 \text{ injuries per 100 MVM}$$

Critical Crash Rate (Cc)

$$Cc = \text{Crash Average of Similar Sections} + 1.645 * (\text{Crash Average of Similar Sections} / \text{Exposure})^{(1/2)} + (1 / (2 * \text{Exposure}))$$

$$Cc = 235.03 + 1.645 * (235.03 / 0.0626)^{(1/2)} + (1 / (2 * 0.0626))$$

$$Cc = 343.83 \text{ crashes per 100 MVM}$$

Critical Injury Rate (Ic)

$$Ic = \text{Injury Crash Average of Similar Sections} + 1.645 * (\text{Injury Crash Average of Similar Sections} / \text{Exposure})^{(1/2)} + (1 / (2 * \text{Exposure}))$$

$$Ic = 67.63 + 1.645 * (67.63 / 0.0626)^{(1/2)} + (1 / (2 * 0.0626))$$

$$Ic = 129.70 \text{ injuries per 100 MVM}$$

USLIMITS2 Speed Zoning Report

Project Overview

Project Name: Quarterfield-2 2040

Analyst: KCI

Date: 2025-06-27

Basic Project Information

Project Number: 221804667.16
Route Name: Quarterfield Road
From: Janet Dale Lane
To: MD 174 QuarterfieldDonaldson
State: Maryland
County: Anne Arundel County
City: Severn CDP
Route Type: Road Section in Developed Area
Route Status: Existing

Roadway Information

Section Length: 0.54 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 35 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 21
Number of Signals: 0

Crash Data Information

Crash Data Years: 0
Crash AADT: N/A
Total Number of Crashes: N/A
Total Number of Injury Crashes: N/A

Traffic Information

85th Percentile Speed: 39 mph
50th Percentile Speed: 35 mph
AADT: 7000 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: High

Project Description: Stevenson Road Quarterfield Road Feasibility Study 2050 ADT

Recommended Speed Limit:



Note: Crash data were not entered for this project. A comprehensive crash study is a critical component of any traffic engineering study. We suggest that you repeat this process when crash data become available.

Note: The road section is in an area with high pedestrian or bicycle activity. Consider implementing engineering measures to reduce speeds before lowering the recommended speed limit. See [Engineering Countermeasures for Speed Management](#) and [PedSafe](#) for more guidance.

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How the Recommended Speed Limit was Determined

The questions and responses below, and the referenced page numbers, correspond to the flowcharts found in the [Decision Rules Flowchart document](#).

Terms Used in the Recommendation

- **Closest 85th:** This is the 5 mph increment that is closest to the 85th percentile speed (e.g., if the 85th percentile speed is 63 mph, the Closest 85th will be 65 mph).
- **Rounded-down 85th:** This is the 5 mph increment obtained by rounding down the 85th percentile to

the nearest 5 mph increment (e.g., if the 85th percentile speed is 63 mph, the Rounded-down 85th will be 60 mph).

- **Closest 50th:** This is the 5 mph increment that is closest to the 50th percentile speed (e.g., if the 50th percentile speed is 58 mph, the Closest 50th will be 60 mph).
- **SL_1:** Speed limit determined using site characteristics (e.g., AADT, interchange spacing, roadside hazard rating, ped/bike activity, number of traffic signals, etc.).
- **SL_2:** Speed limit determined using crash data from the crash module.
- **SL:** Recommended Speed Limit.

Determine SL_1 Using Site Characteristics (pg. K-23)

Note: The number of signals per mile is being calculated as 0.00 signals per mile.

Note: The number of driveways per mile is being calculated as 38.89 driveways per mile.

Question 1: Are any of the following true: there are more than four signals per mile, pedestrian or bicyclist activity is high, parking activity is high, or there are more than 60 driveways per mile?

Results: Yes. There are 0.00 signals per mile, 38.89 driveways per mile, high pedestrian/bicyclist activity, and not high parking activity. **The SL_1 is set to the closest 50th percentile speed (35 mph).**

Question 2: Are crash data available?

Results: No crash data are available. **The SL is being set equal to SL_1 (35 mph).**

Determine the Final Recommended Speed Limit (pg. K-28)

Question 3: Is the SL less than 20 mph or greater than 50 mph?

Results: The SL (35 mph) is between 20 mph and 50 mph. **The SL remains the same.**

Final Recommendation: The recommended speed limit is 35 mph.

USLIMITS2 Speed Zoning Report

Project Overview

Project Name: Stevenson-1

Analyst: KCI

Date: 2025-06-30

Basic Project Information

Project Number: 221804667.16
Route Name: Stevenson Road
From: Quarterfield Road
To: CAT-North Entrance
State: Maryland
County: Anne Arundel County
City: Severn CDP
Route Type: Road Section in Developed Area
Route Status: Existing

Crash Data Information

Crash Data Years: 5.00
Crash AADT: 4500 veh/day
Total Number of Crashes: 10
Total Number of Injury Crashes: 3
Section Crash Rate: 200 per 100 MVM
Section Injury Crash Rate: 60 per 100 MVM
Crash Rate Average for Similar Roads: 232
Injury Rate Average for Similar Roads: 66

Roadway Information

Section Length: 0.61 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 35 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 15
Number of Signals: 0

Traffic Information

85th Percentile Speed: 43 mph
50th Percentile Speed: 39 mph
AADT: 4500 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: High

Project Description: Stevenson Road and Quarterfield Road Feasibility Study

Recommended Speed Limit:



Note: The final recommended speed limit is higher than the 35 mph statutory speed limit for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

Note: The road section is in an area with high pedestrian or bicycle activity. Consider implementing engineering measures to reduce speeds before lowering the recommended speed limit. See [Engineering Countermeasures for Speed Management](#) and [PedSafe](#) for more guidance.

Disclaimer: The U.S. Government assumes no liability for the use of the information contained in this report. This report does not constitute a standard, specification, or regulation.

How the Recommended Speed Limit was Determined

The questions and responses below, and the referenced page numbers, correspond to the flowcharts found in the [Decision Rules Flowchart document](#).

Terms Used in the Recommendation

- **Closest 85th:** This is the 5 mph increment that is closest to the 85th percentile speed (e.g., if the 85th percentile speed is 63 mph, the Closest 85th will be 65 mph).

- **Rounded-down 85th:** This is the 5 mph increment obtained by rounding down the 85th percentile to the nearest 5 mph increment (e.g., if the 85th percentile speed is 63 mph, the Rounded-down 85th will be 60 mph).
- **Closest 50th:** This is the 5 mph increment that is closest to the 50th percentile speed (e.g., if the 50th percentile speed is 58 mph, the Closest 50th will be 60 mph).
- **SL_1:** Speed limit determined using site characteristics (e.g., AADT, interchange spacing, roadside hazard rating, ped/bike activity, number of traffic signals, etc.).
- **SL_2:** Speed limit determined using crash data from the crash module.
- **SL:** Recommended Speed Limit.

The Recommended Speed Limit (SL) is the lower of the speed limit determined without crash data (SL_1) and the speed limit determined with crash data (SL_2).

Determine SL_1 Using Site Characteristics (pg. K-23)

Note: The number of signals per mile is being calculated as 0.00 signals per mile.

Note: The number of driveways per mile is being calculated as 24.59 driveways per mile.

Question 1: Are any of the following true: there are more than four signals per mile, pedestrian or bicyclist activity is high, parking activity is high, or there are more than 60 driveways per mile?

Results: Yes. There are 0.00 signals per mile, 24.59 driveways per mile, high pedestrian/bicyclist activity, and not high parking activity. **The SL_1 is set to the closest 50th percentile speed (40 mph).**

Question 2: Are crash data available?

Results: Yes, so use these data to determine SL_2.

Determine SL_2 Using Crash Data (pg. K-24)

Question 3: Is more than one year of crash data available?

Results: Yes, at least one year of crash data is available.

Note: The crash rate is calculated to be 200 crashes per 100M VMT, and the injury rate is calculated to be 60 crashes per 100M VMT.

Note: The critical crash rate is calculated as 354 crashes per 100M VMT.

Question 4: Is the crash rate (200 per 100M VMT) greater than the critical crash rate (354 crashes per 100M VMT)?

Results: No, **so the crash level is classified as low.**

Question 5: Is the injury crash rate (60 per 100M VMT) greater than the critical injury rate (136 crashes per 100M VMT)?

Results: No, **so the injury crash level is classified as low.**

Question 6: Are either of the crash level (low) or injury crash level (low) classified as medium or high?

Results: No, **so the total crash level is classified low.**

Question 7: Is the total crash level (low) classified as medium or high?

Results: No, **so SL_2 is set as the closest 85th speed (45 mph).**

Determine SL (pg. K-22)

Note: SL is set as the lower of SL_1 (40 mph) and SL_2 (45 mph). **The SL is set to 40 mph.**

Determine the Final Recommended Speed Limit (pg. K-28)

Question 8: Is the SL less than 20 mph or greater than 50 mph?

Results: The SL (40 mph) is between 20 mph and 50 mph. **The SL remains the same.**

Final Recommendation: **The recommended speed limit is 40 mph.**

Equations Used in the Crash Data Calculations

Exposure (M)

$$M = (\text{Section AADT} * 365 * \text{Section Length} * \text{Duration of Crash Data}) / (100000000)$$

$$M = (4500 * 365 * 0.61 * 5.00) / (100000000)$$

$$M = 0.0501$$

Crash Rate (Rc)

$$Rc = (\text{Section Crash Average} * 100000000) / (\text{Section AADT} * 365 * \text{Section Length})$$

$$R_c = (2.00 * 100000000) / (4500 * 365 * 0.61)$$

R_c = 199.62 crashes per 100 MVM

Injury Rate (R_i)

$$R_i = (\text{Section Injury Crash Average} * 100000000) / (\text{Section AADT} * 365 * \text{Section Length})$$

$$R_i = (0.60 * 100000000) / (4500 * 365 * 0.61)$$

$$R_i = 59.88 \text{ injuries per 100 MVM}$$

Critical Crash Rate (C_c)

$$C_c = \text{Crash Average of Similar Sections} + 1.645 * (\text{Crash Average of Similar Sections} / \text{Exposure})^{(1/2)} + (1 / (2 * \text{Exposure}))$$

$$C_c = 231.80 + 1.645 * (231.80 / 0.0501)^{(1/2)} + (1 / (2 * 0.0501))$$

$$C_c = 353.68 \text{ crashes per 100 MVM}$$

Critical Injury Rate (I_c)

$$I_c = \text{Injury Crash Average of Similar Sections} + 1.645 * (\text{Injury Crash Average of Similar Sections} / \text{Exposure})^{(1/2)} + (1 / (2 * \text{Exposure}))$$

$$I_c = 66.27 + 1.645 * (66.27 / 0.0501)^{(1/2)} + (1 / (2 * 0.0501))$$

$$I_c = 136.08 \text{ injuries per 100 MVM}$$

USLIMITS2 Speed Zoning Report

Project Overview

Project Name: Stevenson-2 2050 ADT

Analyst: KCI

Date: 2025-06-27

Basic Project Information

Project Number: 221804667.16
Route Name: Stevenson Road
From: Quarterfield Road
To: CAT-North Entrance
State: Maryland
County: Anne Arundel County
City: Severn CDP
Route Type: Road Section in Developed Area
Route Status: Existing

Roadway Information

Section Length: 0.61 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 35 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 15
Number of Signals: 0

Crash Data Information

Crash Data Years: 0
Crash AADT: N/A
Total Number of Crashes: N/A
Total Number of Injury Crashes: N/A

Traffic Information

85th Percentile Speed: 43 mph
50th Percentile Speed: 39 mph
AADT: 7800 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: High

Project Description: Stevenson Road Quarterfield Road Feasibility Study - 2050 ADT

Recommended Speed Limit:



Note: The final recommended speed limit is higher than the 35 mph statutory speed limit for this type of road. An engineering study such as the one carried out with USLIMITS is usually required to set a speed limit above the statutory limit.

Note: Crash data were not entered for this project. A comprehensive crash study is a critical component of any traffic engineering study. We suggest that you repeat this process when crash data become available.

Note: The road section is in an area with high pedestrian or bicycle activity. Consider implementing engineering measures to reduce speeds before lowering the recommended speed limit. See [Engineering Countermeasures for Speed Management](#) and [PedSafe](#) for more guidance.

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USLIMITS2 Speed Zoning Report

Project Overview

Project Name: Stevenson-3

Analyst: KCI

Date: 2025-10-14

Basic Project Information

Project Number: 221804667.16
Route Name: Stevenson Road
From: Archbishop Spaulding HS
To: Crest Hill Road
State: Maryland
County: Anne Arundel County
City: Severn CDP
Route Type: Road Section in Developed Area
Route Status: Existing

Crash Data Information

Crash Data Years: 5.00
Crash AADT: 5400 veh/day
Total Number of Crashes: 3
Total Number of Injury Crashes: 0
Section Crash Rate: 122 per 100 MVM
Section Injury Crash Rate: 0 per 100 MVM
Crash Rate Average for Similar Roads: 235
Injury Rate Average for Similar Roads: 68

Roadway Information

Section Length: 0.25 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 30 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 24
Number of Signals: 0

Traffic Information

85th Percentile Speed: 32 mph
50th Percentile Speed: 27 mph
AADT: 5400 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: High

Project Description: Stevenson Road and Quarterfield Road Feasibility Study

Recommended Speed Limit:



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How the Recommended Speed Limit was Determined

The questions and responses below, and the referenced page numbers, correspond to the flowcharts found in the [Decision Rules Flowchart document](#).

Terms Used in the Recommendation

- **Closest 85th:** This is the 5 mph increment that is closest to the 85th percentile speed (e.g., if the 85th percentile speed is 63 mph, the Closest 85th will be 65 mph).
- **Rounded-down 85th:** This is the 5 mph increment obtained by rounding down the 85th percentile to the nearest 5 mph increment (e.g., if the 85th percentile speed is 63 mph, the Rounded-down 85th will be 60 mph).
- **Closest 50th:** This is the 5 mph increment that is closest to the 50th percentile speed (e.g., if the 50th percentile speed is 58 mph, the Closest 50th will be 60 mph).
- **SL_1:** Speed limit determined using site characteristics (e.g., AADT, interchange spacing, roadside hazard rating, ped/bike activity, number of traffic signals, etc.).
- **SL_2:** Speed limit determined using crash data from the crash module.

- **SL:** Recommended Speed Limit.

The Recommended Speed Limit (SL) is the lower of the speed limit determined without crash data (SL_1) and the speed limit determined with crash data (SL_2).

Determine SL_1 Using Site Characteristics (pg. K-23)

Note: The number of signals per mile is being calculated as 0.00 signals per mile.

Note: The number of driveways per mile is being calculated as 96.00 driveways per mile.

Question 1: Are any of the following true: there are more than four signals per mile, pedestrian or bicyclist activity is high, parking activity is high, or there are more than 60 driveways per mile?

Results: Yes. There are 0.00 signals per mile, 96.00 driveways per mile, high pedestrian/bicyclist activity, and not high parking activity. **The SL_1 is set to the closest 50th percentile speed (25 mph).**

Question 2: Are crash data available?

Results: Yes, so use these data to determine SL_2.

Determine SL_2 Using Crash Data (pg. K-24)

Question 3: Is more than one year of crash data available?

Results: Yes, at least one year of crash data is available.

Note: The crash rate is calculated to be 122 crashes per 100M VMT, and the injury rate is calculated to be 0 crashes per 100M VMT.

Note: The critical crash rate is calculated as 416 crashes per 100M VMT.

Question 4: Is the crash rate (122 per 100M VMT) greater than the critical crash rate (416 crashes per 100M VMT)?

Results: No, **so the crash level is classified as low.**

Question 5: Is the injury crash rate (0 per 100M VMT) greater than the critical injury rate (174 crashes per 100M VMT)?

Results: No, **so the injury crash level is classified as low.**

Question 6: Are either of the crash level (low) or injury crash level (low) classified as medium or high?

Results: No, **so the total crash level is classified low.**

Question 7: Is the total crash level (low) classified as medium or high?

Results: No, so **SL_2 is set as the closest 85th speed (30 mph).**

Determine SL (pg. K-22)

Note: SL is set as the lower of SL_1 (25 mph) and SL_2 (30 mph). **The SL is set to 25 mph.**

Determine the Final Recommended Speed Limit (pg. K-28)

Question 8: Is the SL less than 20 mph or greater than 50 mph?

Results: The SL (25 mph) is between 20 mph and 50 mph. **The SL remains the same.**

Final Recommendation: **The recommended speed limit is 25 mph.**

Equations Used in the Crash Data Calculations

Exposure (M)

$$M = (\text{Section AADT} * 365 * \text{Section Length} * \text{Duration of Crash Data}) / (100000000)$$

$$M = (5400 * 365 * 0.25 * 5.00) / (100000000)$$

$$M = 0.0246$$

Crash Rate (Rc)

$$Rc = (\text{Section Crash Average} * 100000000) / (\text{Section AADT} * 365 * \text{Section Length})$$

$$Rc = (0.60 * 100000000) / (5400 * 365 * 0.25)$$

$$Rc = 121.77 \text{ crashes per 100 MVM}$$

Injury Rate (Ri)

$$Ri = (\text{Section Injury Crash Average} * 100000000) / (\text{Section AADT} * 365 * \text{Section Length})$$

$$Ri = (0.00 * 100000000) / (5400 * 365 * 0.25)$$

$$Ri = 0.00 \text{ injuries per 100 MVM}$$

Critical Crash Rate (Cc)

$Cc = \text{Crash Average of Similar Sections} + 1.645 * (\text{Crash Average of Similar Sections} / \text{Exposure})^{(1/2)} + (1 / (2 * \text{Exposure}))$

$Cc = 235.03 + 1.645 * (235.03 / 0.0246)^{(1/2)} + (1 / (2 * 0.0246))$

Cc = 415.99 crashes per 100 MVM

Critical Injury Rate (Ic)

$Ic = \text{Injury Crash Average of Similar Sections} + 1.645 * (\text{Injury Crash Average of Similar Sections} / \text{Exposure})^{(1/2)} + (1 / (2 * \text{Exposure}))$

$Ic = 67.63 + 1.645 * (67.63 / 0.0246)^{(1/2)} + (1 / (2 * 0.0246))$

Ic = 174.11 injuries per 100 MVM

USLIMITS2 Speed Zoning Report

Project Overview

Project Name: Stevenson-4

Analyst: KCI

Date: 2025-10-14

Basic Project Information

Project Number: 221804667.16
Route Name: Stevenson Road
From: Archbishop Spaulding HS
To: Crest Hill Road
State: Maryland
County: Anne Arundel County
City: Severn CDP
Route Type: Road Section in Developed Area
Route Status: Existing

Crash Data Information

Crash Data Years: 0
Crash AADT: N/A
Total Number of Crashes: N/A
Total Number of Injury Crashes: N/A

Traffic Information

85th Percentile Speed: 32 mph
50th Percentile Speed: 27 mph
AADT: 5800 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: High

Roadway Information

Section Length: 0.25 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 30 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 24
Number of Signals: 0

Project Description: Stevenson Road and Quarterfield Road Feasibility Study - 2050 ADT

Recommended Speed Limit:



Note: Crash data were not entered for this project. A comprehensive crash study is a critical component of any traffic engineering study. We suggest that you repeat this process when crash data become available.

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How the Recommended Speed Limit was Determined

The questions and responses below, and the referenced page numbers, correspond to the flowcharts found in the [Decision Rules Flowchart document](#).

Terms Used in the Recommendation

- **Closest 85th:** This is the 5 mph increment that is closest to the 85th percentile speed (e.g., if the 85th percentile speed is 63 mph, the Closest 85th will be 65 mph).
- **Rounded-down 85th:** This is the 5 mph increment obtained by rounding down the 85th percentile to the nearest 5 mph increment (e.g., if the 85th percentile speed is 63 mph, the Rounded-down 85th will be 60 mph).
- **Closest 50th:** This is the 5 mph increment that is closest to the 50th percentile speed (e.g., if the 50th percentile speed is 58 mph, the Closest 50th will be 60 mph).

- **SL_1**: Speed limit determined using site characteristics (e.g., AADT, interchange spacing, roadside hazard rating, ped/bike activity, number of traffic signals, etc.).
- **SL_2**: Speed limit determined using crash data from the crash module.
- **SL**: Recommended Speed Limit.

Determine SL_1 Using Site Characteristics (pg. K-23)

Note: The number of signals per mile is being calculated as 0.00 signals per mile.

Note: The number of driveways per mile is being calculated as 96.00 driveways per mile.

Question 1: Are any of the following true: there are more than four signals per mile, pedestrian or bicyclist activity is high, parking activity is high, or there are more than 60 driveways per mile?

Results: Yes. There are 0.00 signals per mile, 96.00 driveways per mile, high pedestrian/bicyclist activity, and not high parking activity. **The SL_1 is set to the closest 50th percentile speed (25 mph).**

Question 2: Are crash data available?

Results: No crash data are available. **The SL is being set equal to SL_1 (25 mph).**

Determine the Final Recommended Speed Limit (pg. K-28)

Question 3: Is the SL less than 20 mph or greater than 50 mph?

Results: The SL (25 mph) is between 20 mph and 50 mph. **The SL remains the same.**

Final Recommendation: The recommended speed limit is 25 mph.

Appendix M

HSM Predictive Safety Analysis Results

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	JAB	Roadway	Quarterfield Road
Agency or Company	KCI	Roadway Section	Quarterfield, from Janet Dale Ln to MD 174
Date Performed	06/01/25	Jurisdiction	Anne Arundel County
		Analysis Year	2050
Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.54
AADT (veh/day)	AA _{MAX} = 32,600 (veh/day)	--	6,990
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		--	0
Median width (ft) - for divided only		--	Not Present
Lighting (present / not present)		Present	Present
Auto speed enforcement (present / not present)		Present	Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		--	0
Major industrial / institutional driveways (number)		1	1
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		5	5
Minor residential driveways (number)		10	10
Other driveways (number)		--	0
Speed Category		--	Posted Speed Greater than 30 mph
Roadside fixed object density (fixed objects / mi)		0	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		20	20
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
<i>CMF 1r</i>	<i>CMF 2r</i>	<i>CMF 3r</i>	<i>CMF 4r</i>	<i>CMF 5r</i>	<i>CMF comb</i>
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.93	0.95	0.88

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brmv}	Proportion of Total Crashes	Adjusted N _{brmv}	Combined CMFs	Calibration Factor, Cr	Predicted N _{brmv}
	a	b							
Total	-15.22	1.68	0.84	0.381	1.000	0.381	0.88	1.00	0.337
Fatal and Injury (FI)	-16.22	1.66	0.65	0.117	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.296	0.113	0.88	1.00	0.100
Property Damage Only (PDO)	-15.62	1.69	0.87	0.279	$(5)_{TOTAL} - (5)_{FI}$ 0.704	0.268	0.88	1.00	0.237

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brmv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brmv (PDO)} (crashes/year)	Predicted N _{brmv (TOTAL)} (crashes/year)
	from Table 12-4	(9) _{FI} from Worksheet 1C	from Table 12-4	(9) _{PDO} from Worksheet 1C	(9) _{TOTAL} from Worksheet 1C
Total	1.000	0.100	1.000	0.237	0.337
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Rear-end collision	0.730	0.073	0.778	0.185	0.258
Head-on collision	0.068	0.007	0.004	0.001	0.008
Angle collision	0.085	0.008	0.079	0.019	0.027
Sideswipe, same direction	0.015	0.001	0.031	0.007	0.009
Sideswipe, opposite direction	0.073	0.007	0.055	0.013	0.020
Other multiple-vehicle collision	0.029	0.003	0.053	0.013	0.015

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments									
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brsv}	Proportion of Total Crashes	Adjusted N _{brsv}	Combined CMFs (6) from Worksheet 1B	Calibration Factor, Cr	Predicted N _{brsv}
	from Table 12-5		from Table 12-5	from Equation 12-13		(4) _{TOTAL} *(5)			(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.323	1.000	0.323	0.88	1.00	0.286
Fatal and Injury (FI)	-3.96	0.23	0.50	0.079	(4) _{FI} /((4) _{FI} +(4) _{PDO}) 0.254	0.082	0.88	1.00	0.073
Property Damage Only (PDO)	-6.51	0.64	0.87	0.232	(5) _{TOTAL} -(5) _{FI} 0.746	0.241	0.88	1.00	0.214

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brsv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brsv (PDO)} (crashes/year)	Predicted N _{brsv (TOTAL)} (crashes/year)
	from Table 12-6	(9) _{FI} from Worksheet 1E	from Table 12-6	(9) _{PDO} from Worksheet 1E	(9) _{TOTAL} from Worksheet 1E
Total	1.000	0.073	1.000	0.214	0.286
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Collision with animal	0.026	0.002	0.066	0.014	0.016
Collision with fixed object	0.723	0.052	0.759	0.162	0.215
Collision with other object	0.010	0.001	0.013	0.003	0.004
Other single-vehicle collision	0.241	0.017	0.162	0.035	0.052

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	Number of driveways, n_j	Crashes per driveway per year, N_j	Coefficient for traffic adjustment, t	Initial N_{brdwy}	Overdispersion parameter, k
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	0	0.050	1.000	0.000	
Major industrial/institutional	1	0.172	1.000	0.080	
Minor industrial/institutional	0	0.023	1.000	0.000	
Major residential	5	0.083	1.000	0.193	
Minor residential	10	0.016	1.000	0.075	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.348	

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	Initial N_{brdwy}	Proportion of total crashes (f_{dwy})	Adjusted N_{brdwy}	Combined CMFs	Calibration factor, C_r	Predicted N_{brdwy}
	(5) _{TOTAL} from Worksheet 1G	from Table 12-7	(2) _{TOTAL} * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.348	1.000	0.348	0.88	1.00	0.308
Fatal and injury (FI)	--	0.323	0.112	0.88	1.00	0.100
Property damage only (PDO)	--	0.677	0.236	0.88	1.00	0.209

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{pedr}	Predicted N_{pedr}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8	(5)*(6)
Total	0.337	0.286	0.308	0.932	0.005	0.005
Fatal and injury (FI)	--	--	--	--	--	0.005

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-19

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{biker}	Predicted N_{biker}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9	(5)*(6)
Total	0.337	0.286	0.308	0.932	0.004	0.004
Fatal and injury (FI)	--	--	--	--	--	0.004

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-20

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.073	0.185	0.258
Head-on collisions (from Worksheet 1D)	0.007	0.001	0.008
Angle collisions (from Worksheet 1D)	0.008	0.019	0.027
Sideswipe, same direction (from Worksheet 1D)	0.001	0.007	0.009
Sideswipe, opposite direction (from Worksheet 1D)	0.007	0.013	0.020
Driveway-related collisions (from Worksheet 1H)	0.100	0.209	0.308
Other multiple-vehicle collision (from Worksheet 1D)	0.003	0.013	0.015
Subtotal	0.199	0.446	0.645
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.002	0.014	0.016
Collision with fixed object (from Worksheet 1F)	0.052	0.162	0.215
Collision with other object (from Worksheet 1F)	0.001	0.003	0.004
Other single-vehicle collision (from Worksheet 1F)	0.017	0.035	0.052
Collision with pedestrian (from Worksheet 1I)	0.005	0.000	0.005
Collision with bicycle (from Worksheet 1J)	0.004	0.000	0.004
Subtotal	0.081	0.214	0.295
Total	0.280	0.660	0.940

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	Predicted average crash frequency, $N_{\text{predicted rs}}$ (crashes/year)	Roadway segment length, L (mi)	Crash rate (crashes/mi/year)
	(Total) from Worksheet 1K		(2) / (3)
Total	0.94	0.54	1.7
Fatal and injury (FI)	0.28	0.54	0.5
Property damage only (PDO)	0.66	0.54	1.2

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections						
General Information			Location Information			
Analyst	JAB		Roadway	Quarterfield Road		
Agency or Company	KCI		Intersection	Quarterfield Road at Stevenson Road		
Date Performed	06/01/25		Jurisdiction	Anne Arundel County		
			Analysis Year	2050		
Input Data			Base Conditions	Site Conditions		
Intersection type (3ST, 3SG, 4ST, 4SG)			--	3ST		
AADT _{major} (veh/day)		AADT _{MAX} = 45,700 (veh/day)	--	6,990		
AADT _{minor} (veh/day)		AADT _{MAX} = 9,300 (veh/day)	--	7,790		
Intersection lighting (present/not present)			Present	Present		
Calibration factor, C _i			1.00	1.00		
Data for unsignalized intersections only:			--	--		
Number of major-road approaches with left-turn lanes (0,1,2)			0	0		
Number of major-road approaches with right-turn lanes (0,1,2)			0	0		
Data for signalized intersections only:			--	--		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0		
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0		
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			--	0		
Type of left-turn signal phasing for Leg #1			--	Not Applicable		
Type of left-turn signal phasing for Leg #2			--	Not Applicable		
Type of left-turn signal phasing for Leg #3			--	Not Applicable		
Type of left-turn signal phasing for Leg #4 (if applicable)			--	Not Applicable		
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0		
Intersection red light cameras (present/not present)			Not Present	Not Present		
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				1		
Maximum number of lanes crossed by a pedestrian (n _{lanesx})			2	2		
Number of bus stops within 300 m (1,000 ft) of the intersection			0	0		
Schools within 300 m (1,000 ft) of the intersection (present/not present)			Present	Present		
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0		

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF _{1i}	CMF _{2i}	CMF _{3i}	CMF _{4i}	CMF _{5i}	CMF _{6i}	CMF _{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	1.00	0.91	1.00	0.91

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bimv}	Proportion of Total Crashes	Adjusted N_{bimv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bimv}
	from Table 12-10			from Table 12-10	from Equation 12-21		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-13.36	1.11	0.41	0.80	1.150	1.000	1.150	0.91	1.00	1.046
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.349	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.296	0.341	0.91	1.00	0.310
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	0.829	$(5)_{TOTAL} - (5)_{FI}$ 0.704	0.810	0.91	1.00	0.736

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted $N_{bimv (FI)}$ (crashes/year)	Proportion of Collision Type _(PDO)	Predicted $N_{bimv (PDO)}$ (crashes/year)	Predicted $N_{bimv (TOTAL)}$ (crashes/year)
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.310	1.000	0.736	1.046
		$(2) * (3)_{FI}$		$(4) * (5)_{PDO}$	$(3) + (5)$
Rear-end collision	0.421	0.130	0.440	0.324	0.454
Head-on collision	0.045	0.014	0.023	0.017	0.031
Angle collision	0.343	0.106	0.262	0.193	0.299
Sideswipe	0.126	0.039	0.040	0.029	0.068
Other multiple-vehicle collision	0.065	0.020	0.235	0.173	0.193

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bisv}	Proportion of Total Crashes	Adjusted N_{bisv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bisv}
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.439	1.000	0.439	0.91	1.00	0.399
Fatal and Injury (FI)	--	--	--	--	0.136	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.315	0.138	0.91	1.00	0.126
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.296	$(5)_{TOTAL} - (5)_{FI}$ 0.685	0.301	0.91	1.00	0.273

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{bisv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{bisv (PDO)} (crashes/year)	Predicted N _{bisv (TOTAL)} (crashes/year)
	from Table 12-13	(9) _{FI} from Worksheet 2E	from Table 12-13	(9) _{PDO} from Worksheet 2E	(9) _{PDO} from Worksheet 2E
Total	1.000	0.126	1.000	0.273	0.399
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.001	0.001
Collision with animal	0.003	0.000	0.018	0.005	0.005
Collision with fixed object	0.762	0.096	0.834	0.228	0.324
Collision with other object	0.090	0.011	0.092	0.025	0.036
Other single-vehicle collision	0.039	0.005	0.023	0.006	0.011
Single-vehicle noncollision	0.105	0.013	0.030	0.008	0.021

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N _{bimv}	Predicted N _{bisv}	Predicted N _{bi}	f _{pedi}	Predicted N _{pedi}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16	(4)*(5)
Total	1.046	0.399	1.445	0.021	0.030
Fatal and injury (FI)	--	--	--	--	0.030

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-30

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections			
(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF _{1p}	CMF _{2p}	CMF _{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections										
(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	SPF Coefficients					Overdispersion Parameter, k	N _{pedbase}	Combined CMF	Calibration factor, C _i	Predicted N _{pedi}
	from Table 12-14									
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N_{bimv}	Predicted N_{bisv}	Predicted N_{bi}	f_{bikei}	Predicted N_{bikei}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17	(4)*(5)
Total	1.046	0.399	1.445	0.016	0.023
Fatal and injury (FI)	--	--	--	--	0.023

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-31

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.130	0.324	0.454
Head-on collisions (from Worksheet 2D)	0.014	0.017	0.031
Angle collisions (from Worksheet 2D)	0.106	0.193	0.299
Sideswipe (from Worksheet 2D)	0.039	0.029	0.068
Other multiple-vehicle collision (from Worksheet 2D)	0.020	0.173	0.193
Subtotal	0.310	0.736	1.046
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.001	0.001
Collision with animal (from Worksheet 2F)	0.000	0.005	0.005
Collision with fixed object (from Worksheet 2F)	0.096	0.228	0.324
Collision with other object (from Worksheet 2F)	0.011	0.025	0.036
Other single-vehicle collision (from Worksheet 2F)	0.005	0.006	0.011
Single-vehicle noncollision (from Worksheet 2F)	0.013	0.008	0.021
Collision with pedestrian (from Worksheet 2G or 2I)	0.030	0.000	0.030
Collision with bicycle (from Worksheet 2J)	0.023	0.000	0.023
Subtotal	0.179	0.273	0.453
Total	0.489	1.010	1.499

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	Predicted average crash frequency, $N_{predicted int}$ (crashes/year)
	(Total) from Worksheet 2K
Total	1.50
Fatal and injury (FI)	0.49
Property damage only (PDO)	1.01

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections						
General Information			Location Information			
Analyst	JAB		Roadway	Quarterfield Road		
Agency or Company	KCI		Intersection	Quarterfield Road at MD 174 (Donaldson/Quarterfield)		
Date Performed	06/01/25		Jurisdiction	Anne Arundel County		
			Analysis Year	2050		
Input Data			Base Conditions	Site Conditions		
Intersection type (3ST, 3SG, 4ST, 4SG)			--	3ST		
AADT _{major} (veh/day)	AADT _{MAX} = 45,700 (veh/day)		--	9,770		
AADT _{minor} (veh/day)	AADT _{MAX} = 9,300 (veh/day)		--	6,990		
Intersection lighting (present/not present)			Present	Present		
Calibration factor, C _i			1.00	1.00		
Data for unsignalized intersections only:			--	--		
Number of major-road approaches with left-turn lanes (0,1,2)			1	1		
Number of major-road approaches with right-turn lanes (0,1,2)			1	1		
Data for signalized intersections only:			--	--		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0		
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0		
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			--	0		
Type of left-turn signal phasing for Leg #1			--	Not Applicable		
Type of left-turn signal phasing for Leg #2			--	Not Applicable		
Type of left-turn signal phasing for Leg #3			--	Not Applicable		
Type of left-turn signal phasing for Leg #4 (if applicable)			--	Not Applicable		
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0		
Intersection red light cameras (present/not present)			Not Present	Not Present		
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				1		
Maximum number of lanes crossed by a pedestrian (n _{lanesx})			--	2		
Number of bus stops within 300 m (1,000 ft) of the intersection			0	0		
Schools within 300 m (1,000 ft) of the intersection (present/not present)			Present	Present		
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0		

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF _{1i}	CMF _{2i}	CMF _{3i}	CMF _{4i}	CMF _{5i}	CMF _{6i}	CMF _{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.67	1.00	0.86	1.00	0.91	1.00	0.52

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bimv}	Proportion of Total Crashes	Adjusted N_{bimv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bimv}
	from Table 12-10			from Table 12-10	from Equation 12-21		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-13.36	1.11	0.41	0.80	1.595	1.000	1.595	0.52	1.00	0.836
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.498	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.298	0.476	0.52	1.00	0.249
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	1.172	$(5)_{TOTAL} - (5)_{FI}$ 0.702	1.120	0.52	1.00	0.587

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted $N_{bimv (FI)}$ (crashes/year)	Proportion of Collision Type _(PDO)	Predicted $N_{bimv (PDO)}$ (crashes/year)	Predicted $N_{bimv (TOTAL)}$ (crashes/year)
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.249	1.000	0.587	0.836
		$(2) * (3)_{FI}$		$(4) * (5)_{PDO}$	$(3) + (5)$
Rear-end collision	0.421	0.105	0.440	0.258	0.363
Head-on collision	0.045	0.011	0.023	0.013	0.025
Angle collision	0.343	0.085	0.262	0.154	0.239
Sideswipe	0.126	0.031	0.040	0.023	0.055
Other multiple-vehicle collision	0.065	0.016	0.235	0.138	0.154

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bisv}	Proportion of Total Crashes	Adjusted N_{bisv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bisv}
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.438	1.000	0.438	0.52	1.00	0.230
Fatal and Injury (FI)	--	--	--	--	0.136	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.310	0.136	0.52	1.00	0.071
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.303	$(5)_{TOTAL} - (5)_{FI}$ 0.690	0.302	0.52	1.00	0.159

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{bisv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{bisv (PDO)} (crashes/year)	Predicted N _{bisv (TOTAL)} (crashes/year)
	from Table 12-13	(9) _{FI} from Worksheet 2E	from Table 12-13	(9) _{PDO} from Worksheet 2E	(9) _{PDO} from Worksheet 2E
Total	1.000	0.071	1.000	0.159	0.230
		(2) [*] (3) _{FI}		(4) [*] (5) _{PDO}	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.000	0.001
Collision with animal	0.003	0.000	0.018	0.003	0.003
Collision with fixed object	0.762	0.054	0.834	0.132	0.186
Collision with other object	0.090	0.006	0.092	0.015	0.021
Other single-vehicle collision	0.039	0.003	0.023	0.004	0.006
Single-vehicle noncollision	0.105	0.007	0.030	0.005	0.012

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections					
(1)	(2)	(3)	(4)	(5)	(7) [*]
Crash Severity Level	Predicted N _{bimv}	Predicted N _{bisv}	Predicted N _{bi}	f _{pedi}	Predicted N _{pedi}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16	(4) [*] (5)
Total	0.836	0.230	1.066	0.021	0.022
Fatal and injury (FI)	--	--	--	--	0.022

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-30

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections			
(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF _{1p}	CMF _{2p}	CMF _{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1) [*] (2) [*] (3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections										
(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	SPF Coefficients					Overdispersion Parameter, k	N _{pedbase}	Combined CMF	Calibration factor, C _i	Predicted N _{pedi}
	from Table 12-14									
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N_{bimv}	Predicted N_{bisv}	Predicted N_{bi}	f_{bikei}	Predicted N_{bikei}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17	(4)*(5)
Total	0.836	0.230	1.066	0.016	0.017
Fatal and injury (FI)	--	--	--	--	0.017

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-31

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.105	0.258	0.363
Head-on collisions (from Worksheet 2D)	0.011	0.013	0.025
Angle collisions (from Worksheet 2D)	0.085	0.154	0.239
Sideswipe (from Worksheet 2D)	0.031	0.023	0.055
Other multiple-vehicle collision (from Worksheet 2D)	0.016	0.138	0.154
Subtotal	0.249	0.587	0.836
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.001
Collision with animal (from Worksheet 2F)	0.000	0.003	0.003
Collision with fixed object (from Worksheet 2F)	0.054	0.132	0.186
Collision with other object (from Worksheet 2F)	0.006	0.015	0.021
Other single-vehicle collision (from Worksheet 2F)	0.003	0.004	0.006
Single-vehicle noncollision (from Worksheet 2F)	0.007	0.005	0.012
Collision with pedestrian (from Worksheet 2G or 2I)	0.022	0.000	0.022
Collision with bicycle (from Worksheet 2J)	0.017	0.000	0.017
Subtotal	0.111	0.159	0.269
Total	0.360	0.745	1.105

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	Predicted average crash frequency, $N_{predicted int}$ (crashes/year)
	(Total) from Worksheet 2K
Total	1.11
Fatal and injury (FI)	0.36
Property damage only (PDO)	0.75

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	JAB	Roadway	Quarterfield Road
Agency or Company	KCI	Roadway Section	Quarterfield, from Janet Dale Ln to MD 174
Date Performed	06/01/25	Jurisdiction	Anne Arundel County
		Analysis Year	2050
Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.54
AADT (veh/day)	AAADT _{MAX} = 32,600 (veh/day)	--	6,990
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		--	0
Median width (ft) - for divided only		--	Not Present
Lighting (present / not present)		Present	Present
Auto speed enforcement (present / not present)		Present	Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		--	0
Major industrial / institutional driveways (number)		1	1
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		5	5
Minor residential driveways (number)		10	10
Other driveways (number)		--	0
Speed Category		--	Posted Speed Greater than 30 mph
Roadside fixed object density (fixed objects / mi)		0	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		20	20
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
<i>CMF 1r</i>	<i>CMF 2r</i>	<i>CMF 3r</i>	<i>CMF 4r</i>	<i>CMF 5r</i>	<i>CMF comb</i>
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.93	0.95	0.88

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brmv}	Proportion of Total Crashes	Adjusted N _{brmv}	Combined CMFs	Calibration Factor, Cr	Predicted N _{brmv}
	a	b							
Total	-15.22	1.68	0.84	0.381	1.000	0.381	0.88	1.00	0.337
Fatal and Injury (FI)	-16.22	1.66	0.65	0.117	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.296	0.113	0.88	1.00	0.100
Property Damage Only (PDO)	-15.62	1.69	0.87	0.279	$(5)_{TOTAL} - (5)_{FI}$ 0.704	0.268	0.88	1.00	0.237

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments						
(1)	(2)		(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)		Predicted N _{brmv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brmv (PDO)} (crashes/year)	Predicted N _{brmv (TOTAL)} (crashes/year)
	from Table 12-4		(9) _{FI} from Worksheet 1C	from Table 12-4	(9) _{PDO} from Worksheet 1C	(9) _{TOTAL} from Worksheet 1C
Total	1.000		0.100	1.000	0.237	0.337
			(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Rear-end collision	0.730		0.073	0.778	0.185	0.258
Head-on collision	0.068		0.007	0.004	0.001	0.008
Angle collision	0.085		0.008	0.079	0.019	0.027
Sideswipe, same direction	0.015		0.001	0.031	0.007	0.009
Sideswipe, opposite direction	0.073		0.007	0.055	0.013	0.020
Other multiple-vehicle collision	0.029		0.003	0.053	0.013	0.015

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments									
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brsv}	Proportion of Total Crashes	Adjusted N _{brsv}	Combined CMFs (6) from Worksheet 1B	Calibration Factor, Cr	Predicted N _{brsv}
	from Table 12-5		from Table 12-5	from Equation 12-13		(4) _{TOTAL} *(5)			(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.323	1.000	0.323	0.88	1.00	0.286
Fatal and Injury (FI)	-3.96	0.23	0.50	0.079	(4) _{FI} /((4) _{FI} +(4) _{PDO}) 0.254	0.082	0.88	1.00	0.073
Property Damage Only (PDO)	-6.51	0.64	0.87	0.232	(5) _{TOTAL} -(5) _{FI} 0.746	0.241	0.88	1.00	0.214

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brsv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brsv (PDO)} (crashes/year)	Predicted N _{brsv (TOTAL)} (crashes/year)
	from Table 12-6	(9) _{FI} from Worksheet 1E	from Table 12-6	(9) _{PDO} from Worksheet 1E	(9) _{TOTAL} from Worksheet 1E
Total	1.000	0.073	1.000	0.214	0.286
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Collision with animal	0.026	0.002	0.066	0.014	0.016
Collision with fixed object	0.723	0.052	0.759	0.162	0.215
Collision with other object	0.010	0.001	0.013	0.003	0.004
Other single-vehicle collision	0.241	0.017	0.162	0.035	0.052

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	Number of driveways, n_j	Crashes per driveway per year, N_j	Coefficient for traffic adjustment, t	Initial N_{brdwy}	Overdispersion parameter, k
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	0	0.050	1.000	0.000	
Major industrial/institutional	1	0.172	1.000	0.080	
Minor industrial/institutional	0	0.023	1.000	0.000	
Major residential	5	0.083	1.000	0.193	
Minor residential	10	0.016	1.000	0.075	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.348	

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	Initial N_{brdwy}	Proportion of total crashes (f_{dwy})	Adjusted N_{brdwy}	Combined CMFs	Calibration factor, C_r	Predicted N_{brdwy}
	(5) _{TOTAL} from Worksheet 1G	from Table 12-7	(2) _{TOTAL} * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.348	1.000	0.348	0.88	1.00	0.308
Fatal and injury (FI)	--	0.323	0.112	0.88	1.00	0.100
Property damage only (PDO)	--	0.677	0.236	0.88	1.00	0.209

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{pedr}	Predicted N_{pedr}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8	(5)*(6)
Total	0.337	0.286	0.308	0.932	0.005	0.005
Fatal and injury (FI)	--	--	--	--	--	0.005

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-19

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{biker}	Predicted N_{biker}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9	(5)*(6)
Total	0.337	0.286	0.308	0.932	0.004	0.004
Fatal and injury (FI)	--	--	--	--	--	0.004

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-20

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.073	0.185	0.258
Head-on collisions (from Worksheet 1D)	0.007	0.001	0.008
Angle collisions (from Worksheet 1D)	0.008	0.019	0.027
Sideswipe, same direction (from Worksheet 1D)	0.001	0.007	0.009
Sideswipe, opposite direction (from Worksheet 1D)	0.007	0.013	0.020
Driveway-related collisions (from Worksheet 1H)	0.100	0.209	0.308
Other multiple-vehicle collision (from Worksheet 1D)	0.003	0.013	0.015
Subtotal	0.199	0.446	0.645
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.002	0.014	0.016
Collision with fixed object (from Worksheet 1F)	0.052	0.162	0.215
Collision with other object (from Worksheet 1F)	0.001	0.003	0.004
Other single-vehicle collision (from Worksheet 1F)	0.017	0.035	0.052
Collision with pedestrian (from Worksheet 1I)	0.005	0.000	0.005
Collision with bicycle (from Worksheet 1J)	0.004	0.000	0.004
Subtotal	0.081	0.214	0.295
Total	0.280	0.660	0.940

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	Predicted average crash frequency, $N_{\text{predicted rs}}$ (crashes/year)	Roadway segment length, L (mi)	Crash rate (crashes/mi/year)
	(Total) from Worksheet 1K		(2) / (3)
Total	0.94	0.54	1.7
Fatal and injury (FI)	0.28	0.54	0.5
Property damage only (PDO)	0.66	0.54	1.2

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections						
General Information			Location Information			
Analyst	JAB		Roadway	Quarterfield Road		
Agency or Company	KCI		Intersection	Quarterfield Road at Stevenson Road		
Date Performed	06/01/25		Jurisdiction	Anne Arundel County		
			Analysis Year	2050		
Input Data			Base Conditions	Site Conditions		
Intersection type (3ST, 3SG, 4ST, 4SG)			--	3ST		
AADT _{major} (veh/day)	AADT _{MAX} = 45,700 (veh/day)		--	6,990		
AADT _{minor} (veh/day)	AADT _{MAX} = 9,300 (veh/day)		--	7,790		
Intersection lighting (present/not present)			Present	Present		
Calibration factor, C _i			1.00	1.00		
Data for unsignalized intersections only:			--	--		
Number of major-road approaches with left-turn lanes (0,1,2)			0	0		
Number of major-road approaches with right-turn lanes (0,1,2)			0	0		
Data for signalized intersections only:			--	--		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0		
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0		
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			--	0		
Type of left-turn signal phasing for Leg #1			--	Not Applicable		
Type of left-turn signal phasing for Leg #2			--	Not Applicable		
Type of left-turn signal phasing for Leg #3			--	Not Applicable		
Type of left-turn signal phasing for Leg #4 (if applicable)			--	Not Applicable		
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0		
Intersection red light cameras (present/not present)			Not Present	Not Present		
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				0		
Maximum number of lanes crossed by a pedestrian (n _{lanesx})			2	2		
Number of bus stops within 300 m (1,000 ft) of the intersection			0	0		
Schools within 300 m (1,000 ft) of the intersection (present/not present)			Present	Present		
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0		

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF _{1i}	CMF _{2i}	CMF _{3i}	CMF _{4i}	CMF _{5i}	CMF _{6i}	CMF _{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	1.00	0.91	1.00	0.91

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bimv}	Proportion of Total Crashes	Adjusted N_{bimv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bimv}
	from Table 12-10			from Table 12-10	from Equation 12-21		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-13.36	1.11	0.41	0.80	1.150	1.000	1.150	0.91	1.00	1.046
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.349	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.296	0.341	0.91	1.00	0.310
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	0.829	$(5)_{TOTAL} - (5)_{FI}$ 0.704	0.810	0.91	1.00	0.736

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted $N_{bimv (FI)}$ (crashes/year)	Proportion of Collision Type _(PDO)	Predicted $N_{bimv (PDO)}$ (crashes/year)	Predicted $N_{bimv (TOTAL)}$ (crashes/year)
	from Table 12-11	(9) _{FI} from Worksheet 2C	from Table 12-11	(9) _{PDO} from Worksheet 2C	(9) _{PDO} from Worksheet 2C
Total	1.000	0.310	1.000	0.736	1.046
		(2) * (3) _{FI}		(4) * (5) _{PDO}	(3) + (5)
Rear-end collision	0.421	0.130	0.440	0.324	0.454
Head-on collision	0.045	0.014	0.023	0.017	0.031
Angle collision	0.343	0.106	0.262	0.193	0.299
Sideswipe	0.126	0.039	0.040	0.029	0.068
Other multiple-vehicle collision	0.065	0.020	0.235	0.173	0.193

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bisv}	Proportion of Total Crashes	Adjusted N_{bisv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bisv}
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.439	1.000	0.439	0.91	1.00	0.399
Fatal and Injury (FI)	--	--	--	--	0.136	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.315	0.138	0.91	1.00	0.126
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.296	$(5)_{TOTAL} - (5)_{FI}$ 0.685	0.301	0.91	1.00	0.273

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{bisv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{bisv (PDO)} (crashes/year)	Predicted N _{bisv (TOTAL)} (crashes/year)
	from Table 12-13	(9) _{FI} from Worksheet 2E	from Table 12-13	(9) _{PDO} from Worksheet 2E	(9) _{PDO} from Worksheet 2E
Total	1.000	0.126	1.000	0.273	0.399
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.001	0.001
Collision with animal	0.003	0.000	0.018	0.005	0.005
Collision with fixed object	0.762	0.096	0.834	0.228	0.324
Collision with other object	0.090	0.011	0.092	0.025	0.036
Other single-vehicle collision	0.039	0.005	0.023	0.006	0.011
Single-vehicle noncollision	0.105	0.013	0.030	0.008	0.021

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N _{bimv}	Predicted N _{bisv}	Predicted N _{bi}	f _{pedi}	Predicted N _{pedi}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16	(4)*(5)
Total	1.046	0.399	1.445	0.021	0.030
Fatal and injury (FI)	--	--	--	--	0.030

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-30

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections			
(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF _{1p}	CMF _{2p}	CMF _{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections										
(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	SPF Coefficients					Overdispersion Parameter, k	N _{pedbase}	Combined CMF	Calibration factor, C _i	Predicted N _{pedi}
	from Table 12-14									
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N_{bimv}	Predicted N_{bisv}	Predicted N_{bi}	f_{bikei}	Predicted N_{bikei}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17	(4)*(5)
Total	1.046	0.399	1.445	0.016	0.023
Fatal and injury (FI)	--	--	--	--	0.023

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-31

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.130	0.324	0.454
Head-on collisions (from Worksheet 2D)	0.014	0.017	0.031
Angle collisions (from Worksheet 2D)	0.106	0.193	0.299
Sideswipe (from Worksheet 2D)	0.039	0.029	0.068
Other multiple-vehicle collision (from Worksheet 2D)	0.020	0.173	0.193
Subtotal	0.310	0.736	1.046
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.001	0.001
Collision with animal (from Worksheet 2F)	0.000	0.005	0.005
Collision with fixed object (from Worksheet 2F)	0.096	0.228	0.324
Collision with other object (from Worksheet 2F)	0.011	0.025	0.036
Other single-vehicle collision (from Worksheet 2F)	0.005	0.006	0.011
Single-vehicle noncollision (from Worksheet 2F)	0.013	0.008	0.021
Collision with pedestrian (from Worksheet 2G or 2I)	0.030	0.000	0.030
Collision with bicycle (from Worksheet 2J)	0.023	0.000	0.023
Subtotal	0.179	0.273	0.453
Total	0.489	1.010	1.499

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	Predicted average crash frequency, $N_{predicted int}$ (crashes/year)
	(Total) from Worksheet 2K
Total	1.50
Fatal and injury (FI)	0.49
Property damage only (PDO)	1.01

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections						
General Information			Location Information			
Analyst	JAB		Roadway	Quarterfield Road		
Agency or Company	KCI		Intersection	Quarterfield Road at MD 174 (Donaldson/Quarterfield)		
Date Performed	06/01/25		Jurisdiction	Anne Arundel County		
			Analysis Year	2050		
Input Data			Base Conditions	Site Conditions		
Intersection type (3ST, 3SG, 4ST, 4SG)			--	3SG		
AADT _{major} (veh/day)	AADT _{MAX} = 58,100 (veh/day)		--	9,770		
AADT _{minor} (veh/day)	AADT _{MAX} = 16,400 (veh/day)		--	6,990		
Intersection lighting (present/not present)			Present	Present		
Calibration factor, C _i			1.00	1.00		
Data for unsignalized intersections only:			--	--		
Number of major-road approaches with left-turn lanes (0,1,2)			1	0		
Number of major-road approaches with right-turn lanes (0,1,2)			1	0		
Data for signalized intersections only:			--	--		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	2		
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	2		
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			--	1		
Type of left-turn signal phasing for Leg #1 (WB MD 174)			--	Protected / Permissive		
Type of left-turn signal phasing for Leg #2 (EB MD 174)			--	Not Applicable		
Type of left-turn signal phasing for Leg #3 (NB Quarterfield)			--	Protected		
Type of left-turn signal phasing for Leg #4 (if applicable)			--	Not Applicable		
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0		
Intersection red light cameras (present/not present)			Not Present	Not Present		
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				10		
Maximum number of lanes crossed by a pedestrian (n _{lanesx})			--	2		
Number of bus stops within 300 m (1,000 ft) of the intersection			0	0		
Schools within 300 m (1,000 ft) of the intersection (present/not present)			Present	Present		
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0		

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF _{1i}	CMF _{2i}	CMF _{3i}	CMF _{4i}	CMF _{5i}	CMF _{6i}	CMF _{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.86	0.99	0.92	1.00	0.91	1.00	0.71

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bimv}	Proportion of Total Crashes	Adjusted N_{bimv}	Combined CMFs	Calibration Factor, C_i	Predicted N_{bimv}
	from Table 12-10			from Table 12-10	from Equation 12-21		$(4)_{TOTAL} * (5)$	(7) from Worksheet 2B		$(6) * (7) * (8)$
	a	b	c							
Total	-12.13	1.11	0.26	0.33	1.447	1.000	1.447	0.71	1.00	1.034
Fatal and Injury (FI)	-11.58	1.02	0.17	0.30	0.494	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.356	0.515	0.71	1.00	0.368
Property Damage Only (PDO)	-13.24	1.14	0.30	0.36	0.895	$(5)_{TOTAL} - (5)_{FI}$ 0.644	0.932	0.71	1.00	0.666

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted $N_{bimv (FI)}$ (crashes/year)	Proportion of Collision Type _(PDO)	Predicted $N_{bimv (PDO)}$ (crashes/year)	Predicted $N_{bimv (TOTAL)}$ (crashes/year)
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.368	1.000	0.666	1.034
		$(2) * (3)_{FI}$		$(4) * (5)_{PDO}$	$(3) + (5)$
Rear-end collision	0.549	0.202	0.546	0.364	0.566
Head-on collision	0.038	0.014	0.020	0.013	0.027
Angle collision	0.280	0.103	0.204	0.136	0.239
Sideswipe	0.076	0.028	0.032	0.021	0.049
Other multiple-vehicle collision	0.057	0.021	0.198	0.132	0.153

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bisv}	Proportion of Total Crashes	Adjusted N_{bisv}	Combined CMFs	Calibration Factor, C_i	Predicted N_{bisv}
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		$(4)_{TOTAL} * (5)$	(7) from Worksheet 2B		$(6) * (7) * (8)$
	a	b	c							
Total	-9.02	0.42	0.40	0.36	0.198	1.000	0.198	0.71	1.00	0.141
Fatal and Injury (FI)	-9.75	0.27	0.51	0.24	0.064	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.325	0.064	0.71	1.00	0.046
Property Damage Only (PDO)	-9.08	0.45	0.33	0.53	0.132	$(5)_{TOTAL} - (5)_{FI}$ 0.675	0.133	0.71	1.00	0.095

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{bisv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{bisv (PDO)} (crashes/year)	Predicted N _{bisv (TOTAL)} (crashes/year)
	from Table 12-13	(9) _{FI} from Worksheet 2E	from Table 12-13	(9) _{PDO} from Worksheet 2E	(9) _{PDO} from Worksheet 2E
Total	1.000	0.046	1.000	0.095	0.141
		(2) [*] (3) _{FI}		(4) [*] (5) _{PDO}	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.001	0.000	0.003	0.000	0.000
Collision with fixed object	0.653	0.030	0.895	0.085	0.115
Collision with other object	0.091	0.004	0.069	0.007	0.011
Other single-vehicle collision	0.045	0.002	0.018	0.002	0.004
Single-vehicle noncollision	0.209	0.010	0.014	0.001	0.011

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections					
(1)	(2)	(3)	(4)	(5)	(7) [*]
Crash Severity Level	Predicted N _{bimv}	Predicted N _{bisv}	Predicted N _{bi}	f _{pedi}	Predicted N _{pedi}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16	(4) [*] (5)
Total	--	--	--	--	--
Fatal and injury (FI)	--	--	--	--	--

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-30

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections			
(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF _{1p}	CMF _{2p}	CMF _{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1) [*] (2) [*] (3)
1.00	1.35	1.00	1.35

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections										
(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	SPF Coefficients					Overdispersion Parameter, k	N _{pedbase}	Combined CMF	Calibration factor, C _i	Predicted N _{pedi}
	from Table 12-14									
	a	b	c	d	e					
Total	-6.60	0.05	0.24	0.41	0.09	0.52	0.006	1.35	1.00	0.008
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.008

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N_{bimv}	Predicted N_{bisv}	Predicted N_{bi}	f_{bikei}	Predicted N_{bikei}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17	(4)*(5)
Total	1.034	0.141	1.175	0.011	0.013
Fatal and injury (FI)	--	--	--	--	0.013

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-31

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.202	0.364	0.566
Head-on collisions (from Worksheet 2D)	0.014	0.013	0.027
Angle collisions (from Worksheet 2D)	0.103	0.136	0.239
Sideswipe (from Worksheet 2D)	0.028	0.021	0.049
Other multiple-vehicle collision (from Worksheet 2D)	0.021	0.132	0.153
Subtotal	0.368	0.666	1.034
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 2F)	0.030	0.085	0.115
Collision with other object (from Worksheet 2F)	0.004	0.007	0.011
Other single-vehicle collision (from Worksheet 2F)	0.002	0.002	0.004
Single-vehicle noncollision (from Worksheet 2F)	0.010	0.001	0.011
Collision with pedestrian (from Worksheet 2G or 2I)	0.008	0.000	0.008
Collision with bicycle (from Worksheet 2J)	0.013	0.000	0.013
Subtotal	0.067	0.095	0.163
Total	0.435	0.761	1.196

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	Predicted average crash frequency, $N_{predicted int}$ (crashes/year)
	(Total) from Worksheet 2K
Total	1.20
Fatal and injury (FI)	0.44
Property damage only (PDO)	0.76

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	JAB	Roadway	Stevenson Road
Agency or Company	KCI	Roadway Section	Stevenson, from Quarterfield to CAT-North
Date Performed	06/01/25	Jurisdiction	Anne Arundel County
		Analysis Year	2050
Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.6
AADT (veh/day)	AADT _{MAX} = 32,600 (veh/day)	--	7,790
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		--	0
Median width (ft) - for divided only		--	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		3	3
Major industrial / institutional driveways (number)		1	1
Minor industrial / institutional driveways (number)		--	0
Major residential driveways (number)		5	5
Minor residential driveways (number)		10	10
Other driveways (number)		--	0
Speed Category		--	Posted Speed Greater than 30 mph
Roadside fixed object density (fixed objects / mi)		10	10
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		20	20
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
<i>CMF 1r</i>	<i>CMF 2r</i>	<i>CMF 3r</i>	<i>CMF 4r</i>	<i>CMF 5r</i>	<i>CMF comb</i>
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.93	1.00	0.93

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brmv}	Proportion of Total Crashes	Adjusted N _{brmv}	Combined CMFs	Calibration Factor, Cr	Predicted N _{brmv}
	a	b							
Total	-15.22	1.68	0.84	0.508	1.000	0.508	0.93	1.00	0.473
Fatal and Injury (FI)	-16.22	1.66	0.65	0.156	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.296	0.150	0.93	1.00	0.140
Property Damage Only (PDO)	-15.62	1.69	0.87	0.373	$(5)_{TOTAL} - (5)_{FI}$ 0.704	0.358	0.93	1.00	0.333

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brmv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brmv (PDO)} (crashes/year)	Predicted N _{brmv (TOTAL)} (crashes/year)
	from Table 12-4	(9) _{FI} from Worksheet 1C	from Table 12-4	(9) _{PDO} from Worksheet 1C	(9) _{TOTAL} from Worksheet 1C
Total	1.000	0.140	1.000	0.333	0.473
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Rear-end collision	0.730	0.102	0.778	0.259	0.362
Head-on collision	0.068	0.010	0.004	0.001	0.011
Angle collision	0.085	0.012	0.079	0.026	0.038
Sideswipe, same direction	0.015	0.002	0.031	0.010	0.012
Sideswipe, opposite direction	0.073	0.010	0.055	0.018	0.029
Other multiple-vehicle collision	0.029	0.004	0.053	0.018	0.022

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments									
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brsv}	Proportion of Total Crashes	Adjusted N _{brsv}	Combined CMFs (6) from Worksheet 1B	Calibration Factor, Cr	Predicted N _{brsv}
	from Table 12-5		from Table 12-5	from Equation 12-13		(4) _{TOTAL} *(5)			(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.382	1.000	0.382	0.93	1.00	0.356
Fatal and Injury (FI)	-3.96	0.23	0.50	0.090	(4) _{FI} /((4) _{FI} +(4) _{PDO}) 0.245	0.094	0.93	1.00	0.087
Property Damage Only (PDO)	-6.51	0.64	0.87	0.276	(5) _{TOTAL} -(5) _{FI} 0.755	0.288	0.93	1.00	0.268

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brsv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brsv (PDO)} (crashes/year)	Predicted N _{brsv (TOTAL)} (crashes/year)
	from Table 12-6	(9) _{FI} from Worksheet 1E	from Table 12-6	(9) _{PDO} from Worksheet 1E	(9) _{TOTAL} from Worksheet 1E
Total	1.000	0.087	1.000	0.268	0.356
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Collision with animal	0.026	0.002	0.066	0.018	0.020
Collision with fixed object	0.723	0.063	0.759	0.204	0.267
Collision with other object	0.010	0.001	0.013	0.003	0.004
Other single-vehicle collision	0.241	0.021	0.162	0.043	0.065

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	Number of driveways, n_j	Crashes per driveway per year, N_i	Coefficient for traffic adjustment, t	Initial N_{brdwy}	Overdispersion parameter, k
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	3	0.050	1.000	0.078	
Major industrial/institutional	1	0.172	1.000	0.089	
Minor industrial/institutional	0	0.023	1.000	0.000	
Major residential	5	0.083	1.000	0.216	
Minor residential	10	0.016	1.000	0.083	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.466	

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	Initial N_{brdwy}	Proportion of total crashes (f_{dwy})	Adjusted N_{brdwy}	Combined CMFs	Calibration factor, C_r	Predicted N_{brdwy}
	(5) _{TOTAL} from Worksheet 1G	from Table 12-7	(2) _{TOTAL} * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.466	1.000	0.466	0.93	1.00	0.434
Fatal and injury (FI)	--	0.323	0.150	0.93	1.00	0.140
Property damage only (PDO)	--	0.677	0.315	0.93	1.00	0.294

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{pedr}	Predicted N_{pedr}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)		(5)*(6)
Total	0.473	0.356	0.434	1.263	0.005	0.006
Fatal and injury (FI)	--	--	--	--	--	0.006

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-19

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{biker}	Predicted N_{biker}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)		(5)*(6)
Total	0.473	0.356	0.434	1.263	0.004	0.005
Fatal and injury (FI)	--	--	--	--	--	0.005

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-20

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.102	0.259	0.362
Head-on collisions (from Worksheet 1D)	0.010	0.001	0.011
Angle collisions (from Worksheet 1D)	0.012	0.026	0.038
Sideswipe, same direction (from Worksheet 1D)	0.002	0.010	0.012
Sideswipe, opposite direction (from Worksheet 1D)	0.010	0.018	0.029
Driveway-related collisions (from Worksheet 1H)	0.140	0.294	0.434
Other multiple-vehicle collision (from Worksheet 1D)	0.004	0.018	0.022
Subtotal	0.280	0.627	0.907
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.002	0.018	0.020
Collision with fixed object (from Worksheet 1F)	0.063	0.204	0.267
Collision with other object (from Worksheet 1F)	0.001	0.003	0.004
Other single-vehicle collision (from Worksheet 1F)	0.021	0.043	0.065
Collision with pedestrian (from Worksheet 1I)	0.006	0.000	0.006
Collision with bicycle (from Worksheet 1J)	0.005	0.000	0.005
Subtotal	0.099	0.268	0.367
Total	0.379	0.896	1.274

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	Predicted average crash frequency, $N_{\text{predicted rs}}$ (crashes/year)	Roadway segment length, L (mi)	Crash rate (crashes/mi/year)
	(Total) from Worksheet 1K		(2) / (3)
Total	1.27	0.60	2.1
Fatal and injury (FI)	0.38	0.60	0.6
Property damage only (PDO)	0.90	0.60	1.5

Worksheet 1A -- General Information and Input Data for Urban and Suburban Roadway Segments

General Information		Location Information	
Analyst	JAB	Roadway	Stevenson Road
Agency or Company	KCI	Roadway Section	Stevenson, from CAT-North to MD 3 Business
Date Performed	06/01/25	Jurisdiction	Anne Arundel County
		Analysis Year	2050
Input Data		Base Conditions	Site Conditions
Roadway type (2U, 3T, 4U, 4D, ST)		--	2U
Length of segment, L (mi)		--	0.45
AADT (veh/day)	AADT _{MAX} = 32,600 (veh/day)	--	5,830
Type of on-street parking (none/parallel/angle)		None	None
Proportion of curb length with on-street parking		--	0
Median width (ft) - for divided only		--	Not Present
Lighting (present / not present)		Not Present	Present
Auto speed enforcement (present / not present)		Not Present	Not Present
Major commercial driveways (number)		--	0
Minor commercial driveways (number)		1	1
Major industrial / institutional driveways (number)		1	1
Minor industrial / institutional driveways (number)		1	1
Major residential driveways (number)		5	5
Minor residential driveways (number)		--	0
Other driveways (number)		--	0
Speed Category		--	Posted Speed 30 mph or Lower
Roadside fixed object density (fixed objects / mi)		0	0
Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		20	20
Calibration Factor, Cr		1.00	1.00

Worksheet 1B -- Crash Modification Factors for Urban and Suburban Roadway Segments

(1)	(2)	(3)	(4)	(5)	(6)
CMF for On-Street Parking	CMF for Roadside Fixed Objects	CMF for Median Width	CMF for Lighting	CMF for Automated Speed Enforcement	Combined CMF
<i>CMF 1r</i>	<i>CMF 2r</i>	<i>CMF 3r</i>	<i>CMF 4r</i>	<i>CMF 5r</i>	<i>CMF comb</i>
from Equation 12-32	from Equation 12-33	from Table 12-22	from Equation 12-34	from Section 12.7.1	(1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.93	1.00	0.93

Worksheet 1C -- Multiple-Vehicle Nondriveway Collisions by Severity Level for Urban and Suburban Roadway Segments

(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brmv}	Proportion of Total Crashes	Adjusted N _{brmv}	Combined CMFs	Calibration Factor, Cr	Predicted N _{brmv}
	a	b							
Total	-15.22	1.68	0.84	0.234	1.000	0.234	0.93	1.00	0.218
Fatal and Injury (FI)	-16.22	1.66	0.65	0.072	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.297	0.070	0.93	1.00	0.065
Property Damage Only (PDO)	-15.62	1.69	0.87	0.171	$(5)_{TOTAL} - (5)_{FI}$ 0.703	0.165	0.93	1.00	0.153

Worksheet 1D -- Multiple-Vehicle Nondriveway Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brmv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brmv (PDO)} (crashes/year)	Predicted N _{brmv (TOTAL)} (crashes/year)
	from Table 12-4	(9) _{FI} from Worksheet 1C	from Table 12-4	(9) _{PDO} from Worksheet 1C	(9) _{TOTAL} from Worksheet 1C
Total	1.000	0.065	1.000	0.153	0.218
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Rear-end collision	0.730	0.047	0.778	0.119	0.167
Head-on collision	0.068	0.004	0.004	0.001	0.005
Angle collision	0.085	0.006	0.079	0.012	0.018
Sideswipe, same direction	0.015	0.001	0.031	0.005	0.006
Sideswipe, opposite direction	0.073	0.005	0.055	0.008	0.013
Other multiple-vehicle collision	0.029	0.002	0.053	0.008	0.010

Worksheet 1E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Roadway Segments									
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients		Overdispersion Parameter, k	Initial N _{brsv}	Proportion of Total Crashes	Adjusted N _{brsv}	Combined CMFs (6) from Worksheet 1B	Calibration Factor, Cr	Predicted N _{brsv}
	from Table 12-5		from Table 12-5	from Equation 12-13		(4) _{TOTAL} *(5)			(6)*(7)*(8)
	a	b							
Total	-5.47	0.56	0.81	0.243	1.000	0.243	0.93	1.00	0.227
Fatal and Injury (FI)	-3.96	0.23	0.50	0.063	(4) _{FI} /((4) _{FI} +(4) _{PDO}) 0.268	0.065	0.93	1.00	0.061
Property Damage Only (PDO)	-6.51	0.64	0.87	0.172	(5) _{TOTAL} -(5) _{FI} 0.732	0.178	0.93	1.00	0.166

Worksheet 1F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{brsv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{brsv (PDO)} (crashes/year)	Predicted N _{brsv (TOTAL)} (crashes/year)
	from Table 12-6	(9) _{FI} from Worksheet 1E	from Table 12-6	(9) _{PDO} from Worksheet 1E	(9) _{TOTAL} from Worksheet 1E
Total	1.000	0.061	1.000	0.166	0.227
		(2)*(3) _{FI}		(4)*(5) _{PDO}	(3)+(5)
Collision with animal	0.026	0.002	0.066	0.011	0.013
Collision with fixed object	0.723	0.044	0.759	0.126	0.170
Collision with other object	0.010	0.001	0.013	0.002	0.003
Other single-vehicle collision	0.241	0.015	0.162	0.027	0.042

Worksheet 1G -- Multiple-Vehicle Driveway-Related Collisions by Driveway Type for Urban and Suburban Roadway Segments					
(1)	(2)	(3)	(4)	(5)	(6)
Driveway Type	Number of driveways, n_j	Crashes per driveway per year, N_j	Coefficient for traffic adjustment, t	Initial N_{brdwy}	Overdispersion parameter, k
		from Table 12-7	from Table 12-7	Equation 12-16 $n_j * N_j * (AADT/15,000)^t$	from Table 12-7
Major commercial	0	0.158	1.000	0.000	--
Minor commercial	1	0.050	1.000	0.019	
Major industrial/institutional	1	0.172	1.000	0.067	
Minor industrial/institutional	1	0.023	1.000	0.009	
Major residential	5	0.083	1.000	0.161	
Minor residential	0	0.016	1.000	0.000	
Other	0	0.025	1.000	0.000	
Total	--	--	--	0.257	

Worksheet 1H -- Multiple-Vehicle Driveway-Related Collisions by Severity Level for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Crash Severity Level	Initial N_{brdwy}	Proportion of total crashes (f_{dwy})	Adjusted N_{brdwy}	Combined CMFs	Calibration factor, C_r	Predicted N_{brdwy}
	(5) _{TOTAL} from Worksheet 1G	from Table 12-7	(2) _{TOTAL} * (3)	(6) from Worksheet 1B		(4)*(5)*(6)
Total	0.257	1.000	0.257	0.93	1.00	0.239
Fatal and injury (FI)	--	0.323	0.083	0.93	1.00	0.077
Property damage only (PDO)	--	0.677	0.174	0.93	1.00	0.162

Worksheet 1I -- Vehicle-Pedestrian Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{pedr}	Predicted N_{pedr}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-8	(5)*(6)
Total	0.218	0.227	0.239	0.684	0.036	0.025
Fatal and injury (FI)	--	--	--	--	--	0.025

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-19

Worksheet 1J -- Vehicle-Bicycle Collisions for Urban and Suburban Roadway Segments						
(1)	(2)	(3)	(4)	(5)	(6)	(8)*
Crash Severity Level	Predicted N_{brmv}	Predicted N_{brsv}	Predicted N_{brdwy}	Predicted N_{br}	f_{biker}	Predicted N_{biker}
	(9) from Worksheet 1C	(9) from Worksheet 1E	(7) from Worksheet 1H	(2)+(3)+(4)	from Table 12-9	(5)*(6)
Total	0.218	0.227	0.239	0.684	0.018	0.012
Fatal and injury (FI)	--	--	--	--	--	0.012

* Column 7 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-20

Worksheet 1K -- Crash Severity Distribution for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J	(5) from Worksheet 1D and 1F; and (7) from Worksheet 1H	(6) from Worksheet 1D and 1F; (7) from Worksheet 1H; and (8) from Worksheet 1I and 1J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 1D)	0.047	0.119	0.167
Head-on collisions (from Worksheet 1D)	0.004	0.001	0.005
Angle collisions (from Worksheet 1D)	0.006	0.012	0.018
Sideswipe, same direction (from Worksheet 1D)	0.001	0.005	0.006
Sideswipe, opposite direction (from Worksheet 1D)	0.005	0.008	0.013
Driveway-related collisions (from Worksheet 1H)	0.077	0.162	0.239
Other multiple-vehicle collision (from Worksheet 1D)	0.002	0.008	0.010
Subtotal	0.142	0.315	0.457
SINGLE-VEHICLE			
Collision with animal (from Worksheet 1F)	0.002	0.011	0.013
Collision with fixed object (from Worksheet 1F)	0.044	0.126	0.170
Collision with other object (from Worksheet 1F)	0.001	0.002	0.003
Other single-vehicle collision (from Worksheet 1F)	0.015	0.027	0.042
Collision with pedestrian (from Worksheet 1I)	0.025	0.000	0.025
Collision with bicycle (from Worksheet 1J)	0.012	0.000	0.012
Subtotal	0.098	0.166	0.264
Total	0.240	0.481	0.721

Worksheet 1L -- Summary Results for Urban and Suburban Roadway Segments			
(1)	(2)	(3)	(4)
Crash Severity Level	Predicted average crash frequency, $N_{\text{predicted rs}}$ (crashes/year)	Roadway segment length, L (mi)	Crash rate (crashes/mi/year)
	(Total) from Worksheet 1K		(2) / (3)
Total	0.72	0.45	1.6
Fatal and injury (FI)	0.24	0.45	0.5
Property damage only (PDO)	0.48	0.45	1.1

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections						
General Information			Location Information			
Analyst	JAB		Roadway	Stevenson Road		
Agency or Company	KCI		Intersection	Stevenson Road at CAT-North		
Date Performed	06/01/25		Jurisdiction	Anne Arundel County		
			Analysis Year	2050		
Input Data			Base Conditions	Site Conditions		
Intersection type (3ST, 3SG, 4ST, 4SG)			--	3ST		
AADT _{major} (veh/day)	AADT _{MAX} = 45,700 (veh/day)		--	7,790		
AADT _{minor} (veh/day)	AADT _{MAX} = 9,300 (veh/day)		--	1,000		
Intersection lighting (present/not present)			Present	Present		
Calibration factor, C _i			1.00	1.00		
Data for unsignalized intersections only:			--	--		
Number of major-road approaches with left-turn lanes (0,1,2)			--	0		
Number of major-road approaches with right-turn lanes (0,1,2)			--	0		
Data for signalized intersections only:			--	--		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			--	0		
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			--	0		
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			--	0		
Type of left-turn signal phasing for Leg #1 (SB CAT-North)			--	Not Applicable		
Type of left-turn signal phasing for Leg #2 (EB Stevenson)			--	Not Applicable		
Type of left-turn signal phasing for Leg #3 (WB Stevenson)			--	Not Applicable		
Type of left-turn signal phasing for Leg #4 (if applicable)			--	Not Applicable		
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0		
Intersection red light cameras (present/not present)			Not Present	Not Present		
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				0		
Maximum number of lanes crossed by a pedestrian (n _{lanesx})			2	2		
Number of bus stops within 300 m (1,000 ft) of the intersection			0	0		
Schools within 300 m (1,000 ft) of the intersection (present/not present)			Present	Present		
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0		

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF _{1i}	CMF _{2i}	CMF _{3i}	CMF _{4i}	CMF _{5i}	CMF _{6i}	CMF _{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
1.00	1.00	1.00	1.00	0.91	1.00	0.91

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bimv}	Proportion of Total Crashes	Adjusted N_{bimv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bimv}
	from Table 12-10			from Table 12-10	from Equation 12-21		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-13.36	1.11	0.41	0.80	0.559	1.000	0.559	0.91	1.00	0.508
Fatal and Injury (FI)	-14.01	1.16	0.30	0.69	0.214	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.392	0.219	0.91	1.00	0.199
Property Damage Only (PDO)	-15.38	1.20	0.51	0.77	0.331	$(5)_{TOTAL} - (5)_{FI}$ 0.608	0.340	0.91	1.00	0.309

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted $N_{bimv (FI)}$ (crashes/year)	Proportion of Collision Type _(PDO)	Predicted $N_{bimv (PDO)}$ (crashes/year)	Predicted $N_{bimv (TOTAL)}$ (crashes/year)
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.199	1.000	0.309	0.508
		$(2) * (3)_{FI}$		$(4) * (5)_{PDO}$	$(3) + (5)$
Rear-end collision	0.421	0.084	0.440	0.136	0.220
Head-on collision	0.045	0.009	0.023	0.007	0.016
Angle collision	0.343	0.068	0.262	0.081	0.149
Sideswipe	0.126	0.025	0.040	0.012	0.037
Other multiple-vehicle collision	0.065	0.013	0.235	0.073	0.086

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bisv}	Proportion of Total Crashes	Adjusted N_{bisv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bisv}
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-6.81	0.16	0.51	1.14	0.157	1.000	0.157	0.91	1.00	0.143
Fatal and Injury (FI)	--	--	--	--	0.049	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.331	0.052	0.91	1.00	0.047
Property Damage Only (PDO)	-8.36	0.25	0.55	1.29	0.098	$(5)_{TOTAL} - (5)_{FI}$ 0.669	0.105	0.91	1.00	0.095

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{bisv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{bisv (PDO)} (crashes/year)	Predicted N _{bisv (TOTAL)} (crashes/year)
	from Table 12-13	(9) _{FI} from Worksheet 2E	from Table 12-13	(9) _{PDO} from Worksheet 2E	(9) _{PDO} from Worksheet 2E
Total	1.000	0.047	1.000	0.095	0.143
		(2) [*] (3) _{FI}		(4) [*] (5) _{PDO}	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.003	0.000	0.000
Collision with animal	0.003	0.000	0.018	0.002	0.002
Collision with fixed object	0.762	0.036	0.834	0.080	0.115
Collision with other object	0.090	0.004	0.092	0.009	0.013
Other single-vehicle collision	0.039	0.002	0.023	0.002	0.004
Single-vehicle noncollision	0.105	0.005	0.030	0.003	0.008

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections					
(1)	(2)	(3)	(4)	(5)	(7) [*]
Crash Severity Level	Predicted N _{bimv}	Predicted N _{bisv}	Predicted N _{bi}	f _{pedi}	Predicted N _{pedi}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16	(4) [*] (5)
Total	0.508	0.143	0.651	0.021	0.014
Fatal and injury (FI)	--	--	--	--	0.014

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-30

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections			
(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF _{1p}	CMF _{2p}	CMF _{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1) [*] (2) [*] (3)
--	--	--	--

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections										
(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	SPF Coefficients					Overdispersion Parameter, k	N _{pedbase}	Combined CMF	Calibration factor, C _i	Predicted N _{pedi}
	from Table 12-14									
	a	b	c	d	e					
Total	--	--	--	--	--	--	--	--	1.00	--
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	--

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N_{bimv}	Predicted N_{bisv}	Predicted N_{bi}	f_{bikei}	Predicted N_{bikei}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17	(4)*(5)
Total	0.508	0.143	0.651	0.016	0.010
Fatal and injury (FI)	--	--	--	--	0.010

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-31

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.084	0.136	0.220
Head-on collisions (from Worksheet 2D)	0.009	0.007	0.016
Angle collisions (from Worksheet 2D)	0.068	0.081	0.149
Sideswipe (from Worksheet 2D)	0.025	0.012	0.037
Other multiple-vehicle collision (from Worksheet 2D)	0.013	0.073	0.086
Subtotal	0.199	0.309	0.508
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.002	0.002
Collision with fixed object (from Worksheet 2F)	0.036	0.080	0.115
Collision with other object (from Worksheet 2F)	0.004	0.009	0.013
Other single-vehicle collision (from Worksheet 2F)	0.002	0.002	0.004
Single-vehicle noncollision (from Worksheet 2F)	0.005	0.003	0.008
Collision with pedestrian (from Worksheet 2G or 2I)	0.014	0.000	0.014
Collision with bicycle (from Worksheet 2J)	0.010	0.000	0.010
Subtotal	0.071	0.095	0.167
Total	0.271	0.405	0.675

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	Predicted average crash frequency, $N_{predicted int}$ (crashes/year)
	(Total) from Worksheet 2K
Total	0.68
Fatal and injury (FI)	0.27
Property damage only (PDO)	0.40

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections						
General Information			Location Information			
Analyst	JAB		Roadway	Stevenson Road		
Agency or Company	KCI		Intersection	Stevenson Road at MD 3 Bus (New Cut Rd)		
Date Performed	06/01/25		Jurisdiction	Anne Arundel County		
			Analysis Year	2050		
Input Data			Base Conditions	Site Conditions		
Intersection type (3ST, 3SG, 4ST, 4SG)			--	4SG		
AADT _{major} (veh/day)	AADT _{MAX} =	67,700 (veh/day)	--	22,530		
AADT _{minor} (veh/day)	AADT _{MAX} =	33,400 (veh/day)	--	5,830		
Intersection lighting (present/not present)			Present	Present		
Calibration factor, C _i			1.00	1.00		
Data for unsignalized intersections only:			--	--		
Number of major-road approaches with left-turn lanes (0,1,2)			--	0		
Number of major-road approaches with right-turn lanes (0,1,2)			--	0		
Data for signalized intersections only:			--	--		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			4	4		
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			4	4		
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			4	4		
Type of left-turn signal phasing for Leg #1 (NB MD 3 Bus)			Protected/Permissive	Protected / Permissive		
Type of left-turn signal phasing for Leg #2 (SB MD 3 Bus)			Protected/Permissive	Protected / Permissive		
Type of left-turn signal phasing for Leg #3 (EB Stevenson)			Protected	Protected		
Type of left-turn signal phasing for Leg #4 (if applicable) (WB High School Entrance)			Protected	Protected		
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0		
Intersection red light cameras (present/not present)			Not Present	Not Present		
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				20		
Maximum number of lanes crossed by a pedestrian (n _{lanesx})			6	6		
Number of bus stops within 300 m (1,000 ft) of the intersection			0	0		
Schools within 300 m (1,000 ft) of the intersection (present/not present)			Present	Present		
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0		

Worksheet 2B -- Crash Modification Factors for Urban and Suburban Arterial Intersections						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMF for Left-Turn Lanes	CMF for Left-Turn Signal Phasing	CMF for Right-Turn Lanes	CMF for Right Turn on Red	CMF for Lighting	CMF for Red Light Cameras	Combined CMF
CMF _{1i}	CMF _{2i}	CMF _{3i}	CMF _{4i}	CMF _{5i}	CMF _{6i}	CMF _{COMB}
from Table 12-24	from Table 12-25	from Table 12-26	from Equation 12-35	from Equation 12-36	from Equation 12-37	(1)*(2)*(3)*(4)*(5)*(6)
0.66	0.87	0.85	1.00	0.91	1.00	0.44

Worksheet 2C -- Multiple-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bimv}	Proportion of Total Crashes	Adjusted N_{bimv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bimv}
	from Table 12-10			from Table 12-10	from Equation 12-21		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-10.99	1.07	0.23	0.39	5.632	1.000	5.632	0.44	1.00	2.490
Fatal and Injury (FI)	-13.14	1.18	0.22	0.33	1.812	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.334	1.882	0.44	1.00	0.832
Property Damage Only (PDO)	-11.02	1.02	0.24	0.44	3.611	$(5)_{TOTAL} - (5)_{FI}$ 0.666	3.750	0.44	1.00	1.658

Worksheet 2D -- Multiple-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections

(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted $N_{bimv (FI)}$ (crashes/year)	Proportion of Collision Type (PDO)	Predicted $N_{bimv (PDO)}$ (crashes/year)	Predicted $N_{bimv (TOTAL)}$ (crashes/year)
	from Table 12-11	$(9)_{FI}$ from Worksheet 2C	from Table 12-11	$(9)_{PDO}$ from Worksheet 2C	$(9)_{PDO}$ from Worksheet 2C
Total	1.000	0.832	1.000	1.658	2.490
		$(2) * (3)_{FI}$		$(4) * (5)_{PDO}$	$(3) + (5)$
Rear-end collision	0.450	0.374	0.483	0.801	1.175
Head-on collision	0.049	0.041	0.030	0.050	0.091
Angle collision	0.347	0.289	0.244	0.405	0.693
Sideswipe	0.099	0.082	0.032	0.053	0.135
Other multiple-vehicle collision	0.055	0.046	0.211	0.350	0.396

Worksheet 2E -- Single-Vehicle Collisions by Severity Level for Urban and Suburban Arterial Intersections

(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crash Severity Level	SPF Coefficients			Overdispersion Parameter, k	Initial N_{bisv}	Proportion of Total Crashes	Adjusted N_{bisv}	Combined CMFs (7) from Worksheet 2B	Calibration Factor, C_i	Predicted N_{bisv}
	from Table 12-12			from Table 12-12	from Eqn. 12-24; (FI) from Eqn. 12-24 or 12-27		(4) _{TOTAL} * (5)			(6) * (7) * (8)
	a	b	c							
Total	-10.21	0.68	0.27	0.36	0.349	1.000	0.349	0.44	1.00	0.154
Fatal and Injury (FI)	-9.25	0.43	0.29	0.09	0.088	$(4)_{FI} / ((4)_{FI} + (4)_{PDO})$ 0.255	0.089	0.44	1.00	0.039
Property Damage Only (PDO)	-11.34	0.78	0.25	0.44	0.258	$(5)_{TOTAL} - (5)_{FI}$ 0.745	0.260	0.44	1.00	0.115

Worksheet 2F -- Single-Vehicle Collisions by Collision Type for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(6)
Collision Type	Proportion of Collision Type _(FI)	Predicted N _{bisv (FI)} (crashes/year)	Proportion of Collision Type _(PDO)	Predicted N _{bisv (PDO)} (crashes/year)	Predicted N _{bisv (TOTAL)} (crashes/year)
	from Table 12-13	(9) _{FI} from Worksheet 2E	from Table 12-13	(9) _{PDO} from Worksheet 2E	(9) _{PDO} from Worksheet 2E
Total	1.000	0.039	1.000	0.115	0.154
		(2)* _{(3)_{FI}}		(4)* _{(5)_{PDO}}	(3)+(5)
Collision with parked vehicle	0.001	0.000	0.001	0.000	0.000
Collision with animal	0.002	0.000	0.002	0.000	0.000
Collision with fixed object	0.744	0.029	0.870	0.100	0.129
Collision with other object	0.072	0.003	0.070	0.008	0.011
Other single-vehicle collision	0.040	0.002	0.023	0.003	0.004
Single-vehicle noncollision	0.141	0.006	0.034	0.004	0.009

Worksheet 2G -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Stop-Controlled Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N _{bimv}	Predicted N _{bisv}	Predicted N _{bi}	f _{pedi}	Predicted N _{pedi}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-16	(4)*(5)
Total	--	--	--	--	--
Fatal and injury (FI)	--	--	--	--	--

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-30

Worksheet 2H -- Crash Modification Factors for Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections			
(1)	(2)	(3)	(4)
CMF for Bus Stops	CMF for Schools	CMF for Alcohol Sales Establishments	Combined CMF
CMF _{1p}	CMF _{2p}	CMF _{3p}	
from Table 12-28	from Table 12-29	from Table 12-30	(1)*(2)*(3)
1.00	1.35	1.00	1.35

Worksheet 2I -- Vehicle-Pedestrian Collisions for Urban and Suburban Arterial Signalized Intersections										
(1)	(2)					(3)	(4)	(5)	(6)	(7)
Crash Severity Level	SPF Coefficients					Overdispersion Parameter, k	N _{pedbase}	Combined CMF	Calibration factor, C _i	Predicted N _{pedi}
	from Table 12-14									
	a	b	c	d	e					
Total	-9.53	0.40	0.26	0.45	0.04	0.24	0.015	1.35	1.00	0.020
Fatal and Injury (FI)	--	--	--	--	--	--	--	--	1.00	0.020

Worksheet 2J -- Vehicle-Bicycle Collisions for Urban and Suburban Arterial Intersections					
(1)	(2)	(3)	(4)	(5)	(7)*
Crash Severity Level	Predicted N_{bimv}	Predicted N_{bisv}	Predicted N_{bi}	f_{bikei}	Predicted N_{bikei}
	(9) from Worksheet 2C	(9) from Worksheet 2E	(2) + (3)	from Table 12-17	(4)*(5)
Total	2.490	0.154	2.644	0.015	0.040
Fatal and injury (FI)	--	--	--	--	0.040

* Column 6 has been removed due to redundant application of calibration factors and inconsistency with HSM Equation 12-31

Worksheet 2K -- Crash Severity Distribution for Urban and Suburban Arterial Intersections			
(1)	(2)	(3)	(4)
Collision type	Fatal and injury (FI)	Property damage only (PDO)	Total
	(3) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J	(5) from Worksheet 2D and 2F	(6) from Worksheet 2D and 2F; (7) from 2G or 2I and 2J
MULTIPLE-VEHICLE			
Rear-end collisions (from Worksheet 2D)	0.374	0.801	1.175
Head-on collisions (from Worksheet 2D)	0.041	0.050	0.091
Angle collisions (from Worksheet 2D)	0.289	0.405	0.693
Sideswipe (from Worksheet 2D)	0.082	0.053	0.135
Other multiple-vehicle collision (from Worksheet 2D)	0.046	0.350	0.396
Subtotal	0.832	1.658	2.490
SINGLE-VEHICLE			
Collision with parked vehicle (from Worksheet 2F)	0.000	0.000	0.000
Collision with animal (from Worksheet 2F)	0.000	0.000	0.000
Collision with fixed object (from Worksheet 2F)	0.029	0.100	0.129
Collision with other object (from Worksheet 2F)	0.003	0.008	0.011
Other single-vehicle collision (from Worksheet 2F)	0.002	0.003	0.004
Single-vehicle noncollision (from Worksheet 2F)	0.006	0.004	0.009
Collision with pedestrian (from Worksheet 2G or 2I)	0.020	0.000	0.020
Collision with bicycle (from Worksheet 2J)	0.040	0.000	0.040
Subtotal	0.099	0.115	0.214
Total	0.931	1.773	2.704

Worksheet 2L -- Summary Results for Urban and Suburban Arterial Intersections	
(1)	(2)
Crash severity level	Predicted average crash frequency, $N_{predicted int}$ (crashes/year)
	(Total) from Worksheet 2K
Total	2.70
Fatal and injury (FI)	0.93
Property damage only (PDO)	1.77

Appendix N

CMF Clearinghouse Summaries



CRASH MODIFICATION FACTORS CLEARINGHOUSE

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CMF COMPARISON

Below you will find comparisons for the CMFs you chose.

Please note that the rows **highlighted and bold/italic** contain the differences in the selected CMFs.

Countermeasure Name	Convert minor-road stop control to all-way stop control	Convert minor-road stop control to all-way stop control	Convert minor-road stop control to all-way stop control	Convert minor-road stop control to all-way stop control	Convert minor-road stop control to all-way stop control	Convert minor-road stop control to all-way stop control
CMF ID	<u>10525</u>	<u>10526</u>	<u>10527</u>	<u>10528</u>	<u>10529</u>	<u>10530</u>
CMF	1.08	1.99	0.78	0.56	0.4	0.32
Study Reference	<u>DENG ET AL., 2020</u>					
Unadjusted Standard Error AMF	0.5774	1	0.1461	0.1496	0.4554	0.4382
CMFunction						
Star Rating						
Rating Score Total	75	75	90	85	75	75
Crash Type	All	All	All	All	All	All
Crash Severity						
Crash Time of Day	Not specified					
Area Type	Not specified					
Road Division Type						
Road Type	<i>Major Collector</i>	<i>Major Collector</i>	<i>Major Collector</i>	<i>Major Collector</i>	<i>Minor Arterial</i>	<i>Minor Arterial</i>
Min Number of Lanes						
Max Number of Lanes						
Number of Lanes Direction						
Number of Lanes Comment						
Intersection Type	Roadway/roadway (not interchange related)					
Intersection Geometry	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg
Traffic Control	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled
Minimum Speed Limit						
Maximum Speed Limit						
Speed Unit						
Speed Limit Comment						
Study Type	1	1	1	1	1	1
Years From	2009	2009	2009	2009	2009	2009
Years To	2016	2016	2016	2016	2016	2016
Traffic Volume Unit						
Min Traffic Volume						
Max Traffic Volume						
Min Major Rd Volume						
Max Major Rd Volume						
Min Minor Rd Volume						
Max Minor Rd Volume						
Avg Traffic Volume						
Avg Major Rd Volume						
Avg Minor Rd Volume						
State of Origin	DC	DC	DC	DC	DC	DC
Municipality						

Country	<i>CMF for all crashes at intersections for collectors.</i>	<i>CMF for injury crashes at intersections for collectors.</i>	<i>CMF for all crashes at collectors intersecting with local roads.</i>	<i>CMF for injury crashes at collectors intersecting with local roads.</i>	<i>CMF for all crashes at collectors intersecting with minor arterials.</i>	<i>CMF for injury crashes at collectors intersecting with minor arterials.</i>
Comments						

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CMF COMPARISON

Below you will find comparisons for the CMFs you chose.

Please note that the rows **highlighted and bold/italic** contain the differences in the selected CMFs.

Countermeasure Name	Install a traffic signal	Install a traffic signal	Install a traffic signal			
CMF ID	<u>316</u>	<u>317</u>	<u>318</u>	<u>5531</u>	<u>5533</u>	<u>5534</u>
CMF	0.86	0.66	1.5	0.76	0.768	0.684
Study Reference	<u>MCGEE ET AL., 2003</u>	<u>MCGEE ET AL., 2003</u>	<u>MCGEE ET AL., 2003</u>	<u>WANG AND ABDEL-ATY, 2014</u>	<u>WANG AND ABDEL-ATY, 2014</u>	<u>WANG AND ABDEL-ATY, 2014</u>
Unadjusted Standard Error AMF	0.32	0.45	0.51	0.085	0.08	0.093
CMFunction						
Star Rating						
Rating Score Total	110	100	105	75	75	75
Crash Type	All	Angle	Rear end	All	All	All
Crash Severity	Fatal,Serious Injury,Minor Injury	Fatal,Serious Injury,Minor Injury	Fatal,Serious Injury,Minor Injury	All	All	Fatal,Serious injury,Minor injury
Crash Time of Day				Not specified	Not specified	Not specified
Area Type	Urban	Urban	Urban	Not specified	Not specified	Not specified
Road Division Type						
Road Type	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
Min Number of Lanes				2	2	2
Max Number of Lanes				4	4	4
Number of Lanes Direction						
Number of Lanes Comment						
Intersection Type	Roadway/roadway (not interchange related)	Roadway/roadway (not interchange related)	Roadway/roadway (not interchange related)			
Intersection Geometry	3-leg	3-leg	3-leg	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg
Traffic Control	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled
Minimum Speed Limit						
Maximum Speed Limit						
Speed Unit						
Speed Limit Comment						
Study Type	2	2	2	2	2	2
Years From				2004	2004	2004
Years To				2009	2009	2009
Traffic Volume Unit	Average Daily Traffic (ADT)	Average Daily Traffic (ADT)	Average Daily Traffic (ADT)	Annual Average Daily Traffic (AADT)	Annual Average Daily Traffic (AADT)	Annual Average Daily Traffic (AADT)
Min Traffic Volume						
Max Traffic Volume						
Min Major Rd Volume				25000	35000	35000
Max Major Rd Volume				35000		
Min Minor Rd Volume						
Max Minor Rd Volume						
Avg Traffic Volume						
Avg Major Rd Volume						
Avg Minor Rd Volume						
State of Origin				FL	FL	FL

Municipality							
Country							
Comments			<p><i>Countermeasure name has been slightly modified for consistency across Clearinghouse. The crash type was initially identified as "all" crashes for this CMF. This has been corrected to reflect Right-Angle crashes on January 7, 2021.</i></p>	<p><i>Countermeasure name has been slightly modified for consistency across Clearinghouse. The crash type was initially identified as "all" crashes for this CMF. This has been corrected to reflect Rear End crashes on January 7, 2021.</i></p>	<p><i>CMF applies to intersections with major road AADT 25,000-35,000</i></p>	<p><i>CMF applies to intersections with major road AADT >35,000</i></p>	<p><i>CMF applies to intersections with major road AADT >35,000</i></p>

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Please note that the rows **highlighted and bold/italic** contain the differences in the selected CMFs.

Countermeasure Name	Install a traffic signal	Install a traffic signal	Install a traffic signal	Install a traffic signal
CMF ID	<u>325</u>	<u>326</u>	<u>327</u>	<u>328</u>
CMF	0.56	0.23	0.4	1.58
Study Reference	<u>HARKEY ET AL., 2008</u>	<u>HARKEY ET AL., 2008</u>	<u>HARKEY ET AL., 2008</u>	<u>HARKEY ET AL., 2008</u>
Unadjusted Standard Error AMF		0.02	0.05	0.14
CMFunction				
Star Rating	★★★★★	★★★★★	★★★★★	★★★★★
Rating Score Total	145	145	145	145
Crash Type	All	Angle	Left turn	Rear end
Crash Severity	All	All	All	All
Crash Time of Day				
Area Type	Rural	Rural	Rural	Rural
Road Division Type				
Road Type	Not specified	Not Specified	Not Specified	Not specified
Min Number of Lanes				
Max Number of Lanes				
Number of Lanes Direction				
Number of Lanes Comment				
Intersection Type	Roadway/roadway (not interchange related)	Roadway/roadway (not interchange related)	Roadway/roadway (not interchange related)	Roadway/roadway (not interchange related)
Intersection Geometry	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg	3-leg,4-leg
Traffic Control	Stop-controlled	Stop-controlled	Stop-controlled	Stop-controlled
Minimum Speed Limit				
Maximum Speed Limit				
Speed Unit				
Speed Limit Comment				
Study Type	2	2	2	2
Years From				
Years To				
Traffic Volume Unit	Annual Average Daily Traffic (AADT)	Annual Average Daily Traffic (AADT)	Annual Average Daily Traffic (AADT)	
Min Traffic Volume				
Max Traffic Volume				
Min Major Rd Volume	3261	3261	3261	
Max Major Rd Volume	29926	29926	29926	
Min Minor Rd Volume	101	101	101	
Max Minor Rd Volume	10300	10300	10300	
Avg Traffic Volume				
Avg Major Rd Volume				
Avg Minor Rd Volume				
State of Origin				
Municipality				
Country				

Comments	<i>Countermeasure name has been slightly modified for consistency across Clearinghouse</i>	Countermeasure name changed to match HSM	Countermeasure name changed to match HSM	<i>Countermeasure name has been slightly modified for consistency across Clearinghouse</i>
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CMF COMPARISON

Below you will find comparisons for the CMFs you chose.
Please note that the rows **highlighted and bold/italic** contain the differences in the selected CMFs.

Countermeasure Name	Conversion of intersection to roundabout	Convert intersection to roundabout			
CMF ID	<u>10094</u>	<u>10095</u>	<u>10097</u>	<u>10098</u>	<u>11579</u>
CMF	0.439	0.433	0.313	0.309	0.601
Study Reference	<u><i>GBOLOGAH ET AL., 2019</i></u>	<u><i>WAGNER ET AL., 2023</i></u>			
Unadjusted Standard Error AMF					
CMFunction					
Star Rating					
Rating Score Total	85	85	85	85	75
Crash Type	All	All	All	All	All
Crash Severity					
Crash Time of Day	All	All	All	All	All
Area Type	All	All	All	All	All
Road Division Type	<i>Undivided</i>	<i>Undivided</i>	<i>Undivided</i>	<i>Undivided</i>	
Road Type	Not specified				
Min Number of Lanes	2				
Max Number of Lanes	2				
Number of Lanes Direction					
Number of Lanes Comment					
Intersection Type	Roadway/roadway (not interchange related)				
Intersection Geometry	<i>3-leg,4-leg</i>	<i>3-leg,4-leg</i>	<i>3-leg,4-leg</i>	<i>3-leg,4-leg</i>	<i>3-leg, 4-leg, More than 4 legs</i>
Traffic Control	<i>Not specified</i>	<i>Not specified</i>	<i>Not specified</i>	<i>Not specified</i>	
Minimum Speed Limit					
Maximum Speed Limit					
Speed Unit					
Speed Limit Comment					
Study Type	2	2	2	2	4
Years From	2007	2007	2007	2007	2015
Years To	2014	2014	2014	2014	2019
Traffic Volume Unit					Annual Average Daily Traffic (AADT)
Min Traffic Volume					
Max Traffic Volume					
Min Major Rd Volume					
Max Major Rd Volume					
Min Minor Rd Volume					
Max Minor Rd Volume					
Avg Traffic Volume					
Avg Major Rd Volume					
Avg Minor Rd Volume					
State of Origin	GA	GA	GA	GA	MN

Municipality					
Country	United States	United States	United States	United States	USA
Comments	<p><i>Applies to the conversion of a three or four-leg intersection to a single-lane or multilane roundabout. CMF analysis includes roundabout locations with less than four average observed crashes per year in before period as one sample, roundabout locations with just a single data-year of crashes in before or after period, and roundabout locations with zero observed crashes in the before period.</i></p>	<p><i>Applies to the conversion of a three or four-leg intersection to a single-lane or multilane roundabout. CMF analysis includes roundabout locations with less than four average observed crashes per year in before period as one sample, roundabout locations with just a single data-year of crashes in before or after period, and omits roundabout locations with zero observed crashes in the before period.</i></p>	<p><i>Applies to the conversion of a three or four-leg intersection to a single-lane or multilane roundabout. CMF analysis includes roundabout locations with less than four average observed crashes per year in before period as one sample, roundabout locations with just a single data-year of crashes in before or after period, and roundabout locations with zero observed crashes in the before period.</i></p>	<p><i>Applies to the conversion of a three or four-leg intersection to a single-lane or multilane roundabout. CMF analysis includes roundabout locations with less than four average observed crashes per year in before period as one sample, roundabout locations with just a single data-year of crashes in before or after period, and omits roundabout locations with zero observed crashes in the before period.</i></p>	<p><i>CMF is presented in Table 3.7 in the report.</i></p>

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CRASH MODIFICATION FACTORS CLEARINGHOUSE

ABOUT THE CLEARINGHOUSE | USING CMFs | DEVELOPING CMFs | ADDITIONAL RESOURCES

[Home](#) » [Compare CMFs](#)

CMF COMPARISON

Below you will find comparisons for the CMFs you chose.
Please note that the rows **highlighted and bold/italic** contain the differences in the selected CMFs.

Countermeasure Name	Install speed humps	Install speed humps	Install raised pedestrian crosswalks	Install raised pedestrian crosswalks	Install raised pedestrian crosswalks	Installation of a speed hump or other speed reducing measure for through motorized vehicles on the main road
CMF ID	<u>132</u>	<u>134</u>	<u>135</u>	<u>136</u>	<u>137</u>	<u>4043</u>
CMF	0.6	0.5	0.64	0.55	0.7	1.28
Study Reference	<u><i>ELVIK, R. AND VAA, T., 2004</i></u>	<u><i>SCHEPERS ET AL., 2011</i></u>				
Unadjusted Standard Error AMF						0.345
CMFunction						
Star Rating						
Rating Score Total	75	75	75	75	75	60
Crash Type	All	All	All	Vehicle/pedestrian	All	Vehicle/bicycle
Crash Severity	<i>Serious injury, Minor injury</i>	All				
Crash Time of Day						
Area Type	Urban and Suburban					
Road Division Type						All
Road Type	Local	Local	Local	Local	Local	All
Min Number of Lanes	2	2	2	2	2	
Max Number of Lanes	2	2	2	2	2	
Number of Lanes Direction						
Number of Lanes Comment						
Intersection Type						Roadway/roadway (not interchange related)
Intersection Geometry						
Traffic Control						
Minimum Speed Limit						
Maximum Speed Limit						
Speed Unit						
Speed Limit Comment						
Study Type	9	9	9	9	9	7
Years From						2005
Years To						2008
Traffic Volume Unit						Annual Average Daily Traffic (AADT)
Min Traffic Volume						
Max Traffic Volume						
Min Major Rd Volume						
Max Major Rd Volume						
Min Minor Rd Volume						
Max Minor Rd Volume						
Avg Traffic Volume						
Avg Major Rd Volume						7000

Avg Minor Rd Volume	
State of Origin	notusa
Municipality	
Country	Netherlands
Comments	

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Appendix O

Stakeholder and Public Comments Matrix

STEVENSON/QUARTERFIELD STUDY
STAKEHOLDER/PUBLIC COMMENTS MATRIX

General Study Comments	
1	No roundabouts on Quarterfield Rd nor Donaldson. Please add traffic lights. Please go with Alternative #2. We want a multiuse path that is off the road for safety so our daughter can ride her bike to school. Thank you.
2	We like the idea of putting roundabouts on Quarterfield at both proposed places. Also would love all the sidewalks for walking and biking, and making it possible for more kids to use them to get to school. Hopefully cutting down on the number of buses.
3	I was unable to attend the meeting about this proposed project, and am assuming that alternative #2 was selected. While I don't have a comment specific to the project, I'd like to voice my desire to have a sidewalk connecting all of the neighborhoods along Quarterfield Road. I live in the Colonial Park neighborhood which is not connected via sidewalk to either neighboring development. I risk my life, and that of my dogs, when trying to take an extended walk. There are often joggers, bicyclists, and walkers on Quarterfield Road. Having a sidewalk will connect neighborhoods and make for a safer pedestrian experience. I'll add that traffic calming humps are needed along Quarterfield road. There are many speeding down the road and near miss accidents at the corner of Colonial Park Drive and Quarterfield Road - a near-blind curve contributes to this issue. THANK YOU!!!
4	The roundabouts is my concern. The Donaldson/Quarterfield area needs a light vs a roundabout. The area is extremely busy and trying to cross is hard. I tried crossing Donaldson over to Quarterfield. I had to wait! The Stephenson/Quarterfield roundabout needs to have further review as I see property will have to be acquired for that to happen and I don't know if that property is private. Also you would think the Stop sign on Stephenson would atleast be at the corner or closer to Quarterfield. Maybe a roundabout would work there with pedestrian crossings. I do like the sidewalks on Quarterfield. It is needed since I live on Janet Dale and walked once to the 7-11 in the street and on people's lawns. Janet Dale Lane & Quarterfield Road: One side of Janet Dale have mailboxes on Quarterfield Rd that belong to no one. Those houses were replaced by a new development across the street. The other side of Janet Dale at Quarterfield, have trees that were planted to block the Evergreen Commons Pumping Station. The station is now gone. Will those trees remain as you have to drive pass the Stop sign on Janet Dale to see any oncoming traffic on Quarterfield.
5	I hope you are the right person to comment to because the letter and website says comments accepted until 09-14-25 but it is not clear who to comment to. I read some of the documents concerning Quarterfield Rd and Stevenson Rd area road improvements and AACO needs to stop building and look at the future as to where people will be living and some of these changes are coming about because of economic need. The MOVE project and 2009 GDP project and automated speed cameras all well in good on paper but be honest and real you only want to catch up to the money hungry PGCO and MOCO with the speed cameras, nothing has changed the people on ATVs still stop traffic on Quarterfield rd so they can all ride north together and no one wants their car hit by uninsured ATV so they stop. You want to make it more "walkable" and safe so people can ride their bike to work...really do you think someone who lives in one of those \$800,000 houses on Janet dale is WALKING to work, you don't buy that working at Walmart. They have good government jobs they cannot walk to from here. Do a study on that; go house to house and see how many people would use these bike lanes and walkways. We are surrounded in some areas of Quarterfield with sex offenders, homeless people and the mentally ill; it takes all kinds I know but consider how many people want their elders or children walking pass the homeless and sex offenders and mentally ill. AACO needs to wake up and see what is really going on out here instead of looking at papers and charts. Come out here and stand and look for awhile. AACO makes it good for "Certain" people and the rest of us pay the price of it in many ways. Such as the bus (69) that comes to Walmart that there never was a hearing for and because Walmart is so powerful there never will be and that bus brings the beggers out here to RT 97 and Quarterfield every day. I know this is nothing to do with your plan but just a comment about how one drop of the ball causes problems for "certain" people in the community. Whatever you have planned I hope that it is limited in the amount of land and trees that you have to disrupt. AACO loses more trees each year than any other county in Maryland and the greed for taxes from business and developers is unrelenting; it's like AACO is on "crack" they know it's wrong but they just keep doing it tearing down and allowing developers to lie and cheat the system and no one really comes out and sees with their own eyes how the traffic is moving and impacting the area and how the pedestrians are getting hit and the speeding continues because we have so many Virginia tags in the area and they could care less about your \$40.00 fine, they don't have to pay it because their is no repercussion if they don't. I have lived here for over 60 years and I hate the thought of moving but it is in my plan because the county's 20 year plan caused me to be rezoned and surrounded by commercial business. Like I said earlier they make it good for "certain" people.
6	Our community is Quarterfield Farms which intersects Quarterfield Rd via Quaterfield Farms Drive. Our neighborhood has a long stretch of sidewalk along QF Rd down to Darby Farms Rd. Overtime QF Rd has added communities with stretches of sidewalk, but there is no continuity. It's a patchwork of sidewalks interrupted by graveyards, patches of woods, etc. We would love to see the piecemeal sidewalks along QF Rd be connected to allow the hundreds of residents along QF Rd to walk/bike safely along QF Rd toward Stephenson and ultimately Route 174 which has sidewalks all the way down to retailers at Parke West. That would get a lot of folks out of their cars and we'd have a more pedestrian/bike friendly way to move around the area. Anything the county can do to provide more access would be awesome.

STEVENSON/QUARTERFIELD STUDY
 STAKEHOLDER/PUBLIC COMMENTS MATRIX

7	<p>We had originally asked for sidewalks from Quarterfield Elementary School along Quarterfield Rd all the way to WB&A. Much of the area is already complete and just need the sections to be joined. Can you please go back to the county to have the feasibility study extended?</p>
8	<p>I live on Stevenson road and have spent a bit of time in the last few days trying to understand what exactly the county is trying to change. The list I have compiled is not comprehensive but contains these items:</p> <ul style="list-style-type: none"> •Sidewalk construction for gaps, possible widening of sidewalks. •Bike lanes •Moving of Stop Sign •Fixing drainage •Changing Norcat into a middle school •Changing the intersection between Stevenson and New Cut <p>I have lived here since 2018 and can tell you what happens here from 12 am to 1159 pm and other events that a short term study will not tell you. I did read and go over the slides for the last study meeting. I do understand that your team came for a couple hours in September of last year during school hours to help understand what occurs during that time and you got a decently accurate picture.</p> <p>The sidewalks do need to be constructed. The new highschool has caused a lot more foot traffic that did not exist before, but, and this was not mentioned in your study notes, that foot traffic is predominately coming from Cresthill road, where the sidewalk ends before the street does and needs a lot more sidewalk beyond that. So, to stay on the New Cut rd side, the intersection was reconstructed to allow a lane to go straight into the school. The concrete section that was rebuilt there as a lane divider was poorly reconstructed. Any large vehicle that turns in has to get it exactly right or may end up damaging the vehicle. This also includes school buses. The little orange sign that sits on the end has already been run over twice and I suspect that is from the tractor trailers that occasionally come through. So, I highly recommend that this separator be reconstructed to allow more space for larger vehicles to safely pass through. There is a lot of traffic that goes through that section and ends up turning on Cresthill as a side note. Tax money doesn't really need to be spent on widening the sidewalks in areas that are already placed. It's a true waste of taxpayer dollars to replace sidewalks that work for the disabled already. Yes I am aware of the ADA law and as a disabled person, I can tell you it's a waste. Us disabled people aren't doing drag races in our wheelchairs, while the current 4 foot wide sidewalks work fine. The crosswalks, as noted in the last meeting, are not marked at all as mentioned before. This is a little outrageous in modern times. Also, there is no one that goes down the sidewalks in wheelchairs here. I only mention this so you guys don't have to wonder about it.</p> <p>Drainage. The drainage is a plus for the area it has been done in except the current work appears like it is going to create a hazard that did not exist before. The church parking lot above the drainage area had a slope that you could safely roll down without getting seriously injured. The current work appears to have created a cliff that could easily hurt someone if they fall down it, and considering it is next to a parking lot that high schoolers park in, that issue should be addressed before someone gets hurt. Also, the drainage has started collecting trash that was not collected in the grass before. I do not know if there is a solution for that being drawn up, but the residents here would appreciate it.</p>

STEVENSON/QUARTERFIELD STUDY
STAKEHOLDER/PUBLIC COMMENTS MATRIX

(Cont.)

Moving towards quarterfield, the traffic calming features. It was noted that the traffic calmers caused average speeds to drop while the skinnier section past the school entrance has a higher speed. These features somewhat work. At one point they really worked, but people were complaining that they couldn't speed and the features were reduced in size so much that they only work for people that want to slow down for them. To help further understand this frustration, two Porsches in particular have been observed going well over the speed of 41 mph over the features and it having almost no effect on the cars. The black one is estimated to have been going over 70 mph when going over the middle feature and it did not cause the vehicle to do anything except put some strain on the suspension. The traffic calming feature closest to quarterfield does not have an effect on any car. The only thing that slows cars at that feature is the gentleman that parks his truck in the road on top of the feature. So, we, the residents of Stevenson humbly request that you beef up the calmers to help slow things down a bit. Kids don't play in front yards here because of the amount of unsafe driving we see quite often. Oh, it has been requested by some residents that they be fixed to slow cars down more in the past as well. Fire trucks get through fine, and they would have less calls if they didn't have as many speeders making bull runs on Stevenson Rd.

Bike lanes. Bikes do come onto Stevenson during the warmer months. They ride in groups all through the area of Glenn Burnie and Severn. There was an older gentleman that rides his bike, but I haven't seen him since before the winter. I don't know if he was hit or just hasn't gotten back to riding again. The groups are generally around 20 deep and the bike lanes won't be wide enough for them. In fact, the lanes, although welcoming if well thought out, probably won't be utilized by residents either due to the proximity of unsafe driving. Kids and adults that live on Stevenson also ride bikes, but do so on the sidewalks to remain safe. The issue that many have raised is sidewalk, very small front yard, speeding cars, bike lane, and street parking. If the street is widened to allow a bike lane, and the sidewalks are widened, plus the road still maintains street parking (it absolutely should), what is the county going to pay for the severe loss of property value? This isn't the \$5,000 loss, it's the \$25,000 or more, loss from future values. Many residents are long term and what happens to their home value when the best part is taken to accomodate people who don't live on the road? These are legitimate concerns that have been brought up by people who live on Stevenson.

Nor Cat turning into a middle+B3 school. That one remains a question of why. The new high school has already caused a fair amount of anxiety and people are severely missing the farm that was there. Yes, I did read the report about overcrowding, but why put so many schools in one very close area? It isn't because of bus sharing like schools I have seen in other areas. So, what is the true reason for placing the schools in the areas they are in? I'm sure the engineers have seen that the new high school has already caused an uptick in accidents on New Cut rd. Those numbers are only going to continue to grow as time goes on. As witnessed with Quarterfield Elementary reconstruction, if the middle school is not well thought out by people who have lived with the headaches caused by poor design, the middle school could suffer the same fate. Hundreds of thousands or millions spent just to have to spend even more. Not to mention, what is going to be added so the residents can continue to enjoy the property? Many, and I mean many, residents use the current school property for numerous activities from bike riding, safely running or walking, teaching kids to drive safely, dog walking, and a number of other activities. A middle school should highly consider what it offers to residents in the area as well.

Also, how is the middle school going to affect home values? The high school did not add any money to value and has caused some residents to move as the traffic was already bad enough with Spaulding using the road. Many residents here are ready for the back entrance for Spaulding to be closed as it would alleviate us from quite a bit of the shenanigans that come from the teenagers ripping through the streets. That exhaust sounds great until your car is in the junk yard because you wrecked it, kind of stuff. Not to mention, it is safer for the buses when Spaulding traffic isn't on the road. I once watched a young person drive between the right side, where the kids get off the bus, and the curb to get past a stop bus as they weren't paying attention and almost hit it. Adding a middle school means more buses, and more possible accidents.

8

STEVENSON/QUARTERFIELD STUDY
STAKEHOLDER/PUBLIC COMMENTS MATRIX

8	<p>(Cont.) Something your study is likely to never see. Flooding. Stevenson road does flood. It doesn't do so regularly though. The water area past Grasons Ct and between the houses of 836 and 844 is where it floods. This is a low lying area and under heavy rain it floods several inches while flowing with some decent power. The draining that was mentioned before should help here. The road likely needs to be raised to allow for the water to flow safely under the roadway in these events. It gets flows that are wide enough that a crew cab long bed has all four tires in the water at one time. The speeding in this section is higher than what the study suggests as well. Cars have hit over 70 mph in this section several times. But, moving closer to quarterfield rd, we can talk about how this area needs sidewalks.</p> <p>Once you get to the intersection of Quarterfield and Stevenson you see the next biggest issue. Visibility. The previous report notes that the stop line is too far forward and that it should be moved back. Now, I understand that is probably a rule based though, but I struggle to see what that is going to do to make the intersection safer. People do not stop before stop signs in Maryland. They stop when they can clearly see the section of road they are trying to turn on. You can witness this at any time by visiting the intersection of Quarterfield and Donaldson Ave. You will promptly notice how most vehicles don't stop before the sign, and at peak times, don't stop at all when making the left hand turn. Taking those notes to Quarterfield and Stevenson, you can see where the visibility comes into play more than where a paint line is. The house/business on the left side of Stevenson should have the trees/bushes and fence moved back several feet from the street. The people turning left have to pull all the way forward, bumper almost into the intersection, to be able to see traffic coming from the left. Right hand turners have to pull even more forward to see past the cars on the left to see that traffic.</p> <p>People making a right hand turn onto Stevenson rd run into the occasional issue of having to slam on the brakes so they don't run into someone crossing the street into the yard business there. Or, slam into a vehicle backing into the property. I don't think this is addressable by the county as the business has been there a while, but it would be nice if it was moved, or made safer to limit the potential accidents, while having the business owner pay for the changes.</p> <p>Also, why is the county approving more buildings in areas that are prone to some kind of standing water? More housing? This area needs less housing. The infrastructure isn't here and it keeps changing the character of the area in a way that is not desirable.</p> <p>Please do not take any of this personally. These are issues that I have noticed, or people around the area have noticed.</p> <p>Also, please reach out to me with anything you feel should be addressed. The people on Stevenson rd are looking for answers and looking to work with the county to improve the area, but not at the cost of resident comfort. Spauldings game lights being on until 2 am shouldn't be a thing but they say that the county says they have to be. Let's not let stupidity like that ruin any more of Maryland.</p>
9	People generally felt overwhelmed with the # of schools and school traffic in the area. They fear more traffic will come once the CAT-North technical school is replaced with the Middle School.
10	Lots of traffic associated with people going back and forth to the shopping center with the WalMart too, near MD 174 and I-97 interchange.
11	<p>Along Quarterfield Road, citizens are aware of cars stacking along both directions of Quarterfield Road approaching Myers Drive and the Quarterfield Road entrance during the afternoon for pickup. This causes lots of issues with blocking the road for through traffic as it is just 2-lanes in the area with minimal shoulder and no designated areas for cars to wait to enter the school property.</p> <p>Specific to SB/WB Quarterfield Road, traffic coming from MD 174 will also stack up trying to turn left into either Myers Drive or Quarterfield ES entrance. Combined with NB/EB Quarterfield Road traffic waiting to turn into the school, it creates almost a one-lane, two-way traffic condition for vehicles trying to remain on Quarterfield Road.</p>
12	Some were in favor of a roundabout at Quarterfield and MD 174, but did not seem as supportive as one at Quarterfield and Stevenson.
13	Most people liked the general idea of adding sidewalks and/or a SUP. Just might not be doable to add both or have continuous sidewalk or path on both side of roadway due to likely property impacts. Did agree that trying to fill in the gaps in the walking network would help.
14	Most are not convinced that this will change people's habits or driving kids to school.
15	<p>Handful of residents who live on Janet Dale Lane:</p> <ul style="list-style-type: none"> oNoted a sight distance issue @ the Janet Dale Lane intersection with Quarterfield Road. There is a high-point on Quarterfield Road just east of this intersection limiting sight distance. oAlso noted there is speeding along Quarterfield Road. oThese residents prefer an alternative that includes a SUP.
16	<p>Resident (lives down Crest Hill Rd) concerned about increase in traffic volume. They often get stuck turning out of Crest Hill Rd onto Stevenson, waiting for a gap in traffic.</p> <p>Also concerned with speeding on Stevenson Rd, west of CAT-North</p>

STEVENSON/QUARTERFIELD STUDY
STAKEHOLDER/PUBLIC COMMENTS MATRIX

17	15-year resident noted that there are existing drainage issues. Front yards flood during storms. oAlso worried about utility impacts from the improvements. oNoted that they've seen children walking in the roadway shoulder. oNoted that there are already too many buses on Stevenson as-is
18	One resident noted that there is a large cluster of cyclists riding on Stevenson Road using the travel lane. This takes place often on Saturday mornings. oAlso noted that not many students walk to school these days.
19	Some residents noted concern over removing/relocating the speed hump at the entrance to Spalding High School.
20	A few people had concerns over the available right of way along Stevenson Road.
21	Full sidewalk connectivity seemed to be the most preferred improvement.
Comments Specific to Stevenson Road	
22	East of CAT-North, add Speed Cameras in Both Directions
23	East of Crest Hill, there is a grading issue on the property in the NE quadrant of Stevenson and Crest Hill. Please consider relocating SUP to south side of Stevenson.
24	Between Old Stevenson Road and MD 3 Bus, there are drainage ditches on the north side of Stevenson. Could pose a challenge to proposing SUP or sidewalk.
25	At MD 3 Bus and Stevenson intersection, a crosswalk may be in place on the south leg but the pedestrian signals are not in yet. Students use this leg to cross MD 3 Business.
26	Issue with snow removal and the divided left-turn area along SB MD 3 Business approaching the intersection.
27	Between Theresa Rose Lane and Wildflower Drive, the SUP will encroach onto property and exacerbate an existing drainage issue.
Comments Specific to Quarterfield @ Stevenson Intersection	
28	YES to all traffic circles!
29	No Roundabout. Put in a Traffic Light
30	Traffic Circle, YES. No traffic light
31	Like the roundabout for traffic calming and safety
32	Place sidewalk on the same side as school (Quarterfield ES)
Comments Specific to Quarterfield @ Donaldson (MD 174) Intersection	
33	Roundabout. No traffic light
34	Yes to roundabout. No traffic lights
35	No Roundabout.
36	Walking bridge over MD 174 (to the 7-Eleven). No at-grade crosswalk, it would be too dangerous.
37	Put in a traffic light.
38	Speed bumps.
39	If it is shown to operate adequately into the future as a single lane roundabout, I would support that. However, if it is required to be a multi-lane roundabout, I would prefer NOT to pursue the roundabout and would prefer to pursue a signal instead.
Comments Specific to Typical Section Alternatives	
40	ALT 2 seems like the safest option (is the least # of feet wide)
41	No shared lanes please. Raise the height of the speed humps.

Appendix P

Updated SIDRA Analysis for Quarterfield at MD 174

MOVEMENT SUMMARY

Site: 101 [MD 174 at Quarterfield Road AM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] ft				
South: Quarterfield Rd														
3	L2	84	3.0	91	3.0	0.709	20.2	LOS C	7.4	188.8	0.86	1.18	1.70	26.1
18	R2	373	3.0	405	3.0	0.709	20.2	LOS C	7.4	188.8	0.86	1.18	1.70	25.4
Approach		457	3.0	497	3.0	0.709	20.2	LOS C	7.4	188.8	0.86	1.18	1.70	25.5
East: MD 174														
1	L2	280	3.0	304	3.0	0.240	4.9	LOS A	1.1	29.0	0.24	0.12	0.24	34.3
6	T1	632	3.0	687	3.0	0.543	14.4	LOS B	3.9	99.7	0.37	0.20	0.37	35.3
Approach		912	3.0	991	3.0	0.543	11.5	LOS B	3.9	99.7	0.33	0.18	0.33	35.0
West: MD 174														
2	T1	568	3.0	617	3.0	0.596	11.4	LOS B	5.8	149.2	0.65	0.67	0.91	34.0
12	R2	149	3.0	162	3.0	0.156	4.9	LOS A	0.6	16.3	0.42	0.31	0.42	36.5
Approach		717	3.0	779	3.0	0.596	10.1	LOS B	5.8	149.2	0.60	0.59	0.81	34.4
All Vehicles		2086	3.0	2267	3.0	0.709	12.9	LOS B	7.4	188.8	0.54	0.54	0.80	32.2

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
 LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

Lane Level of Service

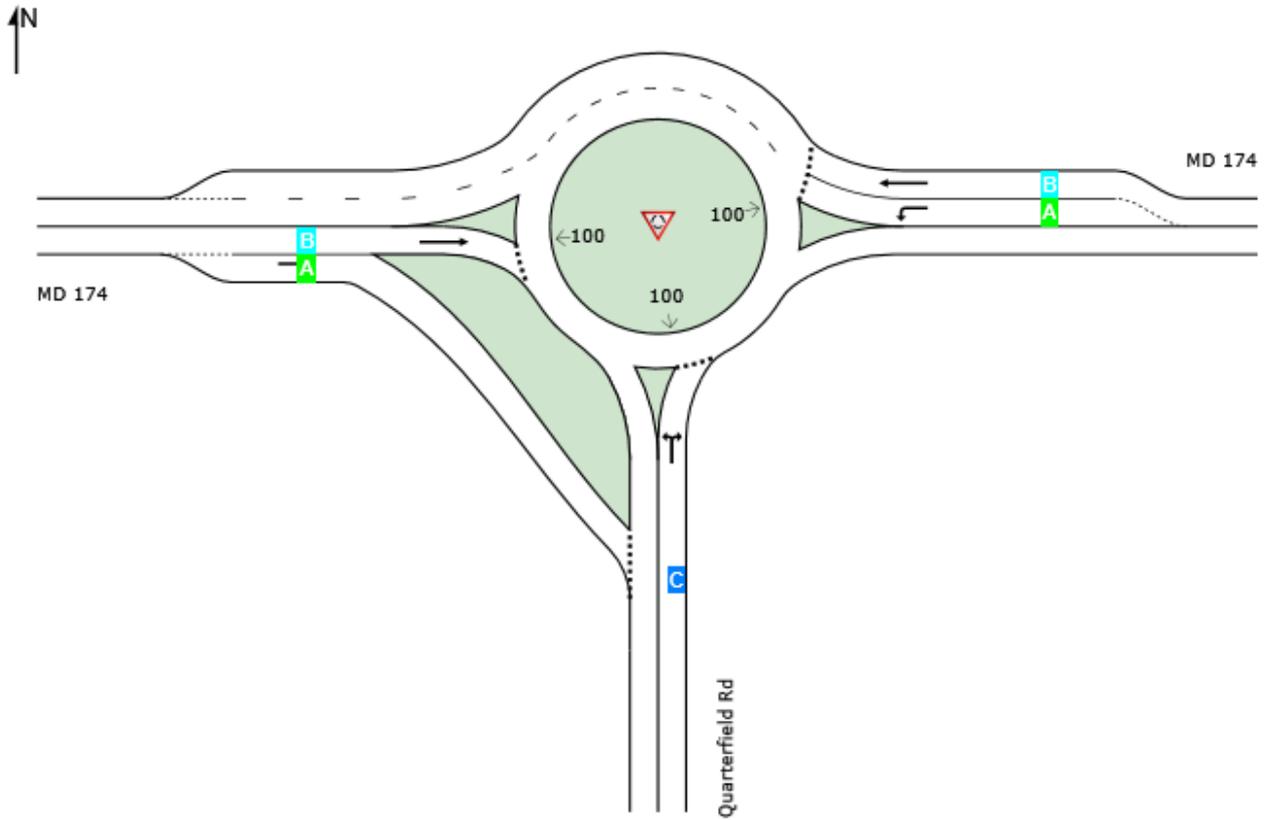
 Site: 101 [MD 174 at Quarterfield Road AM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	West	
LOS	C	B	B	B



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

MOVEMENT SUMMARY

Site: 101 [MD 174 at Quarterfield Road PM (Site Folder: General)]

New Site
 Site Category: (None)
 Roundabout

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV %	[Total veh/h	HV %				[Veh. veh	Dist] ft				
South: Quarterfield Rd														
3	L2	64	3.0	70	3.0	0.532	17.1	LOS C	3.1	79.8	0.79	0.94	1.25	27.0
18	R2	193	3.0	210	3.0	0.532	17.1	LOS C	3.1	79.8	0.79	0.94	1.25	26.2
Approach		257	3.0	279	3.0	0.532	17.1	LOS C	3.1	79.8	0.79	0.94	1.25	26.4
East: MD 174														
1	L2	268	3.0	291	3.0	0.226	4.7	LOS A	1.1	27.0	0.21	0.09	0.21	34.4
6	T1	831	3.0	903	3.0	0.699	19.4	LOS C	7.1	182.7	0.45	0.22	0.45	33.4
Approach		1099	3.0	1195	3.0	0.699	15.8	LOS C	7.1	182.7	0.39	0.19	0.39	33.7
West: MD 174														
2	T1	821	3.0	892	3.0	0.851	23.5	LOS C	23.8	608.9	0.97	1.35	2.17	28.8
12	R2	107	3.0	116	3.0	0.111	4.4	LOS A	0.4	11.2	0.39	0.28	0.39	36.8
Approach		928	3.0	1009	3.0	0.851	21.3	LOS C	23.8	608.9	0.91	1.23	1.97	29.5
All Vehicles		2284	3.0	2483	3.0	0.851	18.2	LOS C	23.8	608.9	0.64	0.70	1.13	31.0

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
 LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 6).
 Roundabout Capacity Model: US HCM 6.
 Delay Model: HCM Delay Formula (Geometric Delay is not included).
 Queue Model: HCM Queue Formula.
 Gap-Acceptance Capacity: Traditional M1.
 HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

Lane Level of Service

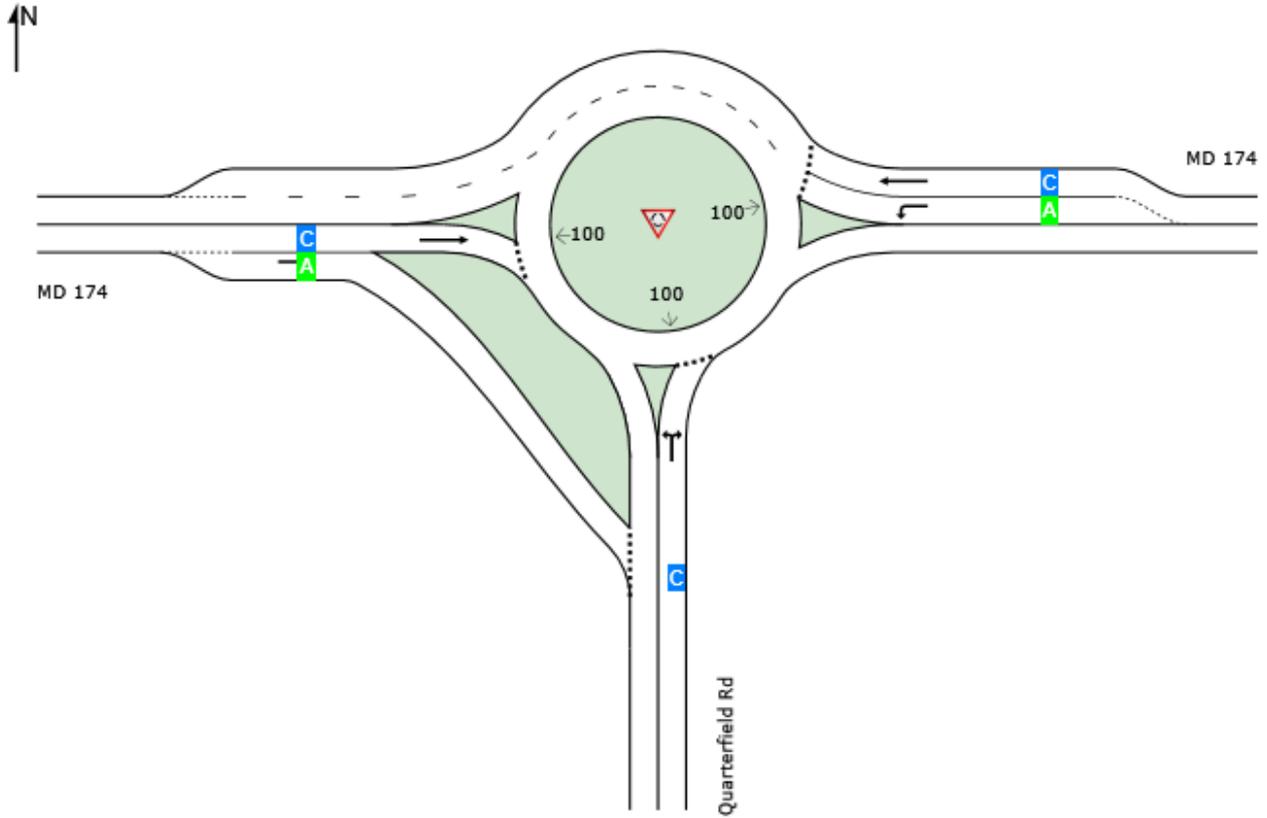
 Site: 101 [MD 174 at Quarterfield Road PM (Site Folder: General)]

New Site

Site Category: (None)

Roundabout

	Approaches			Intersection
	South	East	West	
LOS	C	C	C	C



Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
 Roundabout LOS Method: Same as Sign Control.
 Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
 LOS F will result if $v/c > 1$ irrespective of lane delay value (does not apply for approaches and intersection).
 Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
 Delay Model: HCM Delay Formula (Geometric Delay is not included).

Appendix Q

Planning Level Cost and Right-of-Way Estimates

STEVENSON / QUARTERFIELD TRAFFIC STUDY					
ALTERNATIVE 1 - PLANNING LEVEL QUANTITIES AND COST					
ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE	
PRELIMINARY ITEMS (25% OF CONSTRUCTION ITEMS)	LS	1	\$ 772,462.50	\$ 772,462.50	
EARTHWORK	LS	1	\$ 500,000.00	\$ 500,000.00	
ROADWAY RESURFACING	SF	216,000	\$ 2.50	\$ 540,000.00	
FULL DEPTH ROADWAY ASPHALT	SF	100,000	\$ 10.00	\$ 1,000,000.00	
CONCRETE SIDEWALK	SF	88,600	\$ 6.00	\$ 531,600.00	
DETECTABLE WARNING SURFACE	EA	60	\$ 45.00	\$ 2,700.00	
CURB AND GUTTER	LF	1,600	\$ 35.00	\$ 56,000.00	
PAVEMENT MARKINGS - SOLID WHITE	LF	16,600	\$ 1.00	\$ 16,600.00	
PAVEMENT MARKINGS - DOUBLE YELLOW	LF	15,000	\$ 1.00	\$ 15,000.00	
PAVEMENT MARKINGS - DASHED WHITE	LF	450	\$ 1.00	\$ 450.00	
PAVEMENT MARKINGS - CROSSWALK	LF	4,700	\$ 8.00	\$ 37,600.00	
PAVEMENT MARKINGS - STOP BAR	LF	300	\$ 18.00	\$ 5,400.00	
GRASS BUFFER LANDSCAPING	SF	40,300	\$ 5.00	\$ 201,500.00	
ROUNDBOUT CENTER LANDSCAPING	SF	32,000	\$ 5.00	\$ 160,000.00	
SPEED HUMP	EA	3	\$ 5,000.00	\$ 15,000.00	
RAISED CROSSWALK	EA	1	\$ 8,000.00	\$ 8,000.00	
CONSTRUCTION TOTAL				\$ 3,862,312.50	
SURVEY (10% OF CONSTRUCTION TOTAL)	LS	1	\$ 386,231.25	\$ 386,231.25	
UTILITY RELOCATIONS (15% OF CONSTRUCTION TOTAL)	LS	1	\$ 579,346.88	\$ 579,346.88	
SUBTOTAL				\$ 4,827,890.63	
CONTINGENCY (30%)				\$ 1,448,367.19	
TOTAL SAY				\$ 6,300,000.00	

This Estimate is to be used for planning purposes only. All costs of labor, materials, or equipment, and all percentages were estimated utilizing engineering experience, and comparable quantities/costs shown on recent SHA Bid Tabs. The Engineer does not guarantee that actual construction costs will not vary from what is shown in this estimate.

STEVENSON / QUARTERFIELD TRAFFIC STUDY					
ALTERNATIVE 1 - RIGHT OF WAY ESTIMATION					
Stevenson Road	277,668	SF	=	6.37	AC
Quarterfield Road	198,227	SF	=	4.55	AC
Roundabout @ Stevenson & Quarterfield Intersection	113,872	SF	=	2.61	AC
			TOTAL	13.54	AC

STEVENSON / QUARTERFIELD TRAFFIC STUDY					
ALTERNATIVE 2 - PLANNING LEVEL QUANTITIES AND COST					
ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE	
PRELIMINARY ITEMS (25% OF CONSTRUCTION ITEMS)	LS	1	\$ 665,087.50	\$	665,087.50
EARTHWORK	LS	1	\$ 350,000.00	\$	350,000.00
ROADWAY RESURFACING	SF	235,000	\$ 2.50	\$	587,500.00
CONCRETE SIDEWALK	SF	40,900	\$ 6.00	\$	245,400.00
ASPHALT SHARED USE PATH	SF	80,800	\$ 6.00	\$	484,800.00
DETECTABLE WARNING SURFACE	EA	60	\$ 45.00	\$	2,700.00
CURB AND GUTTER	LF	15,500	\$ 35.00	\$	542,500.00
PAVEMENT MARKINGS - SOLID WHITE	LF	8,500	\$ 1.00	\$	8,500.00
PAVEMENT MARKINGS - DOUBLE YELLOW	LF	15,000	\$ 1.00	\$	15,000.00
PAVEMENT MARKINGS - DASHED WHITE	LF	450	\$ 1.00	\$	450.00
PAVEMENT MARKINGS - CROSSWALK	LF	4,200	\$ 8.00	\$	33,600.00
PAVEMENT MARKINGS - STOP BAR	LF	300	\$ 18.00	\$	5,400.00
GRASS BUFFER LANDSCAPING	SF	40,300	\$ 5.00	\$	201,500.00
ROUNDBOUT CENTER LANDSCAPING	SF	32,000	\$ 5.00	\$	160,000.00
SPEED HUMP	EA	3	\$ 5,000.00	\$	15,000.00
RAISED CROSSWALK	EA	1	\$ 8,000.00	\$	8,000.00
CONSTRUCTION TOTAL				\$	3,325,437.50
SURVEY (10% OF CONSTRUCTION TOTAL)	LS	1	\$ 332,543.75	\$	332,543.75
UTILITY RELOCATIONS (15% OF CONSTRUCTION TOTAL)	LS	1	\$ 498,815.63	\$	498,815.63
SUBTOTAL				\$	4,156,796.88
CONTINGENCY (30%)				\$	1,247,039.06
TOTAL SAY				\$	5,500,000.00

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STEVENSON / QUARTERFIELD TRAFFIC STUDY					
ALTERNATIVE 2 - RIGHT OF WAY ESTIMATION					
Stevenson Road	60,035	SF	=	1.38	AC
Quarterfield Road	156,488	SF	=	3.59	AC
Roundabout @ Stevenson & Quarterfield Intersection	46,513	SF	=	1.07	AC
			TOTAL	6.04	AC

STEVENSON / QUARTERFIELD TRAFFIC STUDY					
ALTERNATIVE 3 - PLANNING LEVEL QUANTITIES AND COST					
ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE	
PRELIMINARY ITEMS (25% OF CONSTRUCTION ITEMS)	LS	1	\$ 737,012.50	\$ 737,012.50	
EARTHWORK	LS	1	\$ 425,000.00	\$ 425,000.00	
ROADWAY RESURFACING	SF	225,000	\$ 2.50	\$ 562,500.00	
FULL DEPTH ROADWAY ASPHALT	SF	55,000	\$ 10.00	\$ 550,000.00	
CONCRETE SIDEWALK	SF	88,600	\$ 6.00	\$ 531,600.00	
DETECTABLE WARNING SURFACE	EA	60	\$ 45.00	\$ 2,700.00	
CURB AND GUTTER	LF	15,000	\$ 35.00	\$ 525,000.00	
PAVEMENT MARKINGS - SOLID WHITE	LF	8,500	\$ 1.00	\$ 8,500.00	
PAVEMENT MARKINGS - DOUBLE YELLOW	LF	15,000	\$ 1.00	\$ 15,000.00	
PAVEMENT MARKINGS - DASHED WHITE	LF	250	\$ 1.00	\$ 250.00	
PAVEMENT MARKINGS - CROSSWALK	LF	4,700	\$ 8.00	\$ 37,600.00	
PAVEMENT MARKINGS - STOP BAR	LF	300	\$ 18.00	\$ 5,400.00	
GRASS BUFFER LANDSCAPING	SF	40,300	\$ 5.00	\$ 201,500.00	
ROUNDBOUT CENTER LANDSCAPING	SF	12,000	\$ 5.00	\$ 60,000.00	
SPEED HUMP	EA	3	\$ 5,000.00	\$ 15,000.00	
RAISED CROSSWALK	EA	1	\$ 8,000.00	\$ 8,000.00	
CONSTRUCTION TOTAL				\$ 3,685,062.50	
SURVEY (10% OF CONSTRUCTION TOTAL)	LS	1	\$ 368,506.25	\$ 368,506.25	
UTILITY RELOCATIONS (15% OF CONSTRUCTION TOTAL)	LS	1	\$ 552,759.38	\$ 552,759.38	
SUBTOTAL				\$ 4,606,328.13	
CONTINGENCY (30%)				\$ 1,381,898.44	
TOTAL SAY				\$ 6,000,000.00	

This Estimate is to be used for planning purposes only. All costs of labor, materials, or equipment, and all percentages were estimated utilizing engineering experience, and comparable quantities/costs shown on recent SHA Bid Tabs. The Engineer does not guarantee that actual construction costs will not vary from what is shown in this estimate.

STEVENSON / QUARTERFIELD TRAFFIC STUDY					
ALTERNATIVE 3 - RIGHT OF WAY ESTIMATION					
Stevenson Road	248,335	SF	=	5.70	AC
Quarterfield Road	162,764	SF	=	3.74	AC
Roundabout @ Stevenson & Quarterfield Intersection	102,556	SF	=	2.35	AC
			TOTAL	11.79	AC