



# PROJECT PIPELINE

## S Military Highway and Bainbridge Boulevard

HR-23-08

Final Report





# Project Pipeline – Hampton Roads

## HR-23-08 S Military Highway and Bainbridge Boulevard

June 2024

Prepared for



Prepared by



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- Appendix E – Concept Development
- Appendix F – Preferred Alternative

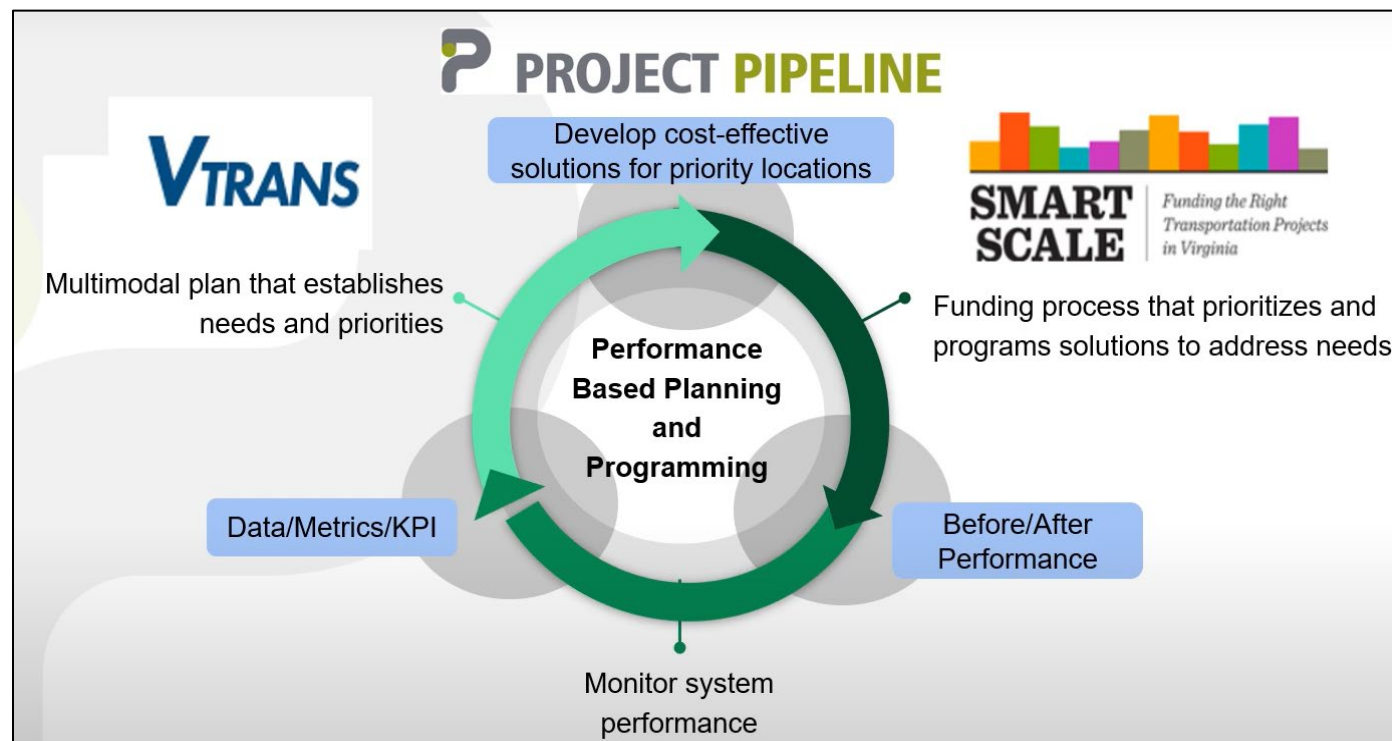
# 1 Needs Evaluation & Diagnosis

## 1.1 Introduction

Multimodal Project Pipeline (Project Pipeline) is a performance-based planning program to identify cost-effective solutions to multimodal transportation needs in Virginia. Through this planning process, projects and solutions may be considered for funding through programs, including SMART SCALE, revenue sharing, interstate funding, and others. Visit the Project Pipeline webpage for additional information: [vaprojectpipeline.org](http://vaprojectpipeline.org).

This study is titled HR-23-08 - US 460/US 13 (S Military Highway) at Bainbridge Boulevard and will be referred to as “the Study,” in this report. This study focuses on concepts targeting identified needs including congestion mitigation, safety improvement, pedestrian and bicycle infrastructure along the study area, and transit access. The objectives of Project Pipeline are shown in Figure 1.

Figure 1: Project Pipeline Objectives

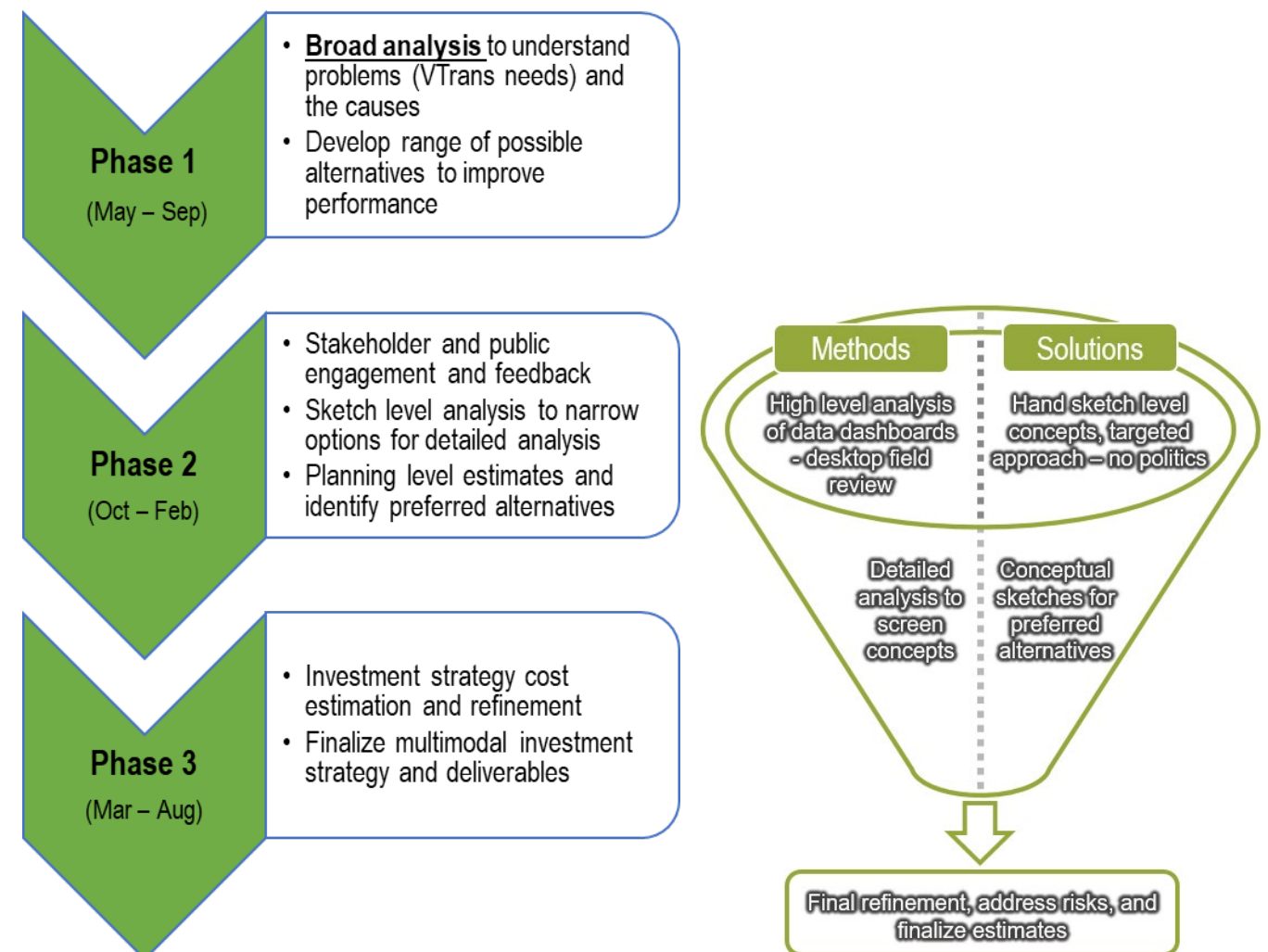


## 1.2 Methodology

The Project Pipeline study process consists of three phases, further detailed in Figure 2.

- **Phase 1:** Problem Diagnosis and Alternative Brainstorming
- **Phase 2:** Alternative Evaluation and Sketch-Level Analysis
- **Phase 3:** Investment Strategy and Cost Estimate

Figure 2: Study Phase Methods and Solution



## 1.3 Study Background

A study work group (SWG) was formed for this Study to capture input from local stakeholders and shape the development of potential improvements. The SWG provided local and institutional knowledge of the area; reviewed study methodologies; provided input on key assumptions; and reviewed and approved proposed improvements developed through the study process. The SWG included members representing the following organizations:

- Virginia Department of Transportation (VDOT)
- Office of Intermodal Planning and Investment (OIPI)
- City of Chesapeake
- Hampton Roads Transportation Planning Organization (HRTPO)
- Department of Rail and Public Transportation (DRPT)
- Kimley-Horn

The study area extends along S Military Highway and Bainbridge Boulevard and contains their respective on- and off-ramps. The study area limits along S Military Highway extend between the Gilmerton Bridge and the I-464/S Military Highway on- and off-ramps and total approximately eight tenths of a mile in length. The study area limits along Bainbridge Boulevard begin at the intersection of Smith Douglas Road and Bainbridge Boulevard and extend north until it reaches the intersection of Reunion Street and Bainbridge Boulevard and total approximately a half mile in length. The extents of the study area are shown in **Figure 3**. Bainbridge Boulevard is a two-lane roadway with a 35 MPH posted speed limit within the study area. Bainbridge Boulevard is classified as an “Minor Arterial”. S Military Highway is a four-lane median divided arterial with a posted 50 MPH speed limit traveling westbound and a 45 MPH posted speed limit traveling eastbound within the study area. Note that the City of Chesapeake’s online speed limit map shows the entire corridor as a 50 MPH speed limit. S Military Highway is classified as an “Other Principal Arterial”.

The study area is located geographically central within the City of Chesapeake, Virginia but located generally in the southern large, urbanized area of the region according to VDOT’s Classification Map. The study area generally has an industrialized land use along both S Military Highway and Bainbridge Boulevard, with an isolated residential land use along Bainbridge Boulevard in the northwest area of the study area. Both S Military Highway and Bainbridge Boulevard serve as important transportation corridors for the City of Chesapeake and the surrounding region. They accommodate a wide array of users with varying trip purposes. S Military Highway connects to I-464 just east of the study area and to the west carries traffic to US 17 and I-64 approximately three miles west of the study area. Bainbridge Boulevard acts as a north-south arterial with southbound trips going through industrial

areas before terminating at US 17 and the northbound trips traverse through residential areas before terminating at South Main Street in Norfolk.

To the west of the study area, the Gilmerton Bridge is a vertical lift four-lane bridge over the southern branch of the Elizabeth River. The bridge opens on average between 10-12 times a day, between April and November, with approximately 55 percent of those openings occurring between 8:00 am and 4:00 pm. The bridge opens on demand for marine traffic except during the morning and afternoon weekday peak periods (6:30 – 8:30 am and 3:30 – 5:30 pm), when prior notice is required.

Two railroads run perpendicularly through the study area and intersect approximately 250 feet south of the railroad crossing on S Military Highway. The Norfolk Southern Railroad runs east and west, parallel to S Military Highway on the west side of the study area, then uses the middle level of the Triple Decker Bridge to deviate away from S Military Highway on the east side of the study area in the northeast direction. The Norfolk & Portsmouth Railroad travels north and south through the study area and intersects S Military Highway between the Gilmerton Bridge and the S Military Highway westbound on-ramp from southbound Bainbridge Boulevard. This rail line ends just south of the study area in an industrial development and is therefore not used frequently. On average, the Norfolk & Portsmouth Railroad crossing on S Military Highway is used twice per week and there have been no reported blocked crossings.

The Triple Decker Bridge Rehabilitation project is currently under construction within the study area and is funded through the VDOT State of Good Repair (SGR) program. The goal of this project is to extend the service life of the bridge and avoid implementation of a weight restriction on the S Military Highway bridge. Construction for the Triple Decker Bridge Rehabilitation started in November 2022 and is scheduled to be completed in March 2025. There is a temporary ramp closure on the eastbound S Military Highway exit to northbound Bainbridge Boulevard because of this project.

Two 700-foot-long disconnected sidewalk segments on both sides of Bainbridge Boulevard under the Triple Decker Bridge, were the only bicycle and pedestrian facilities identified within the study area. Two Hampton Roads Transit (HRT) bus stops (#1864 and #1847) associated with Route 58 are located within the study area at the Bainbridge Boulevard and Reunion Street intersection. Two more Route 58 stops (#1863 and #5988) are located just south of the study area south of the Bainbridge Boulevard and Smith Douglas Road intersection. None of these bus stops have pedestrian facility connections or bus pad infrastructure.

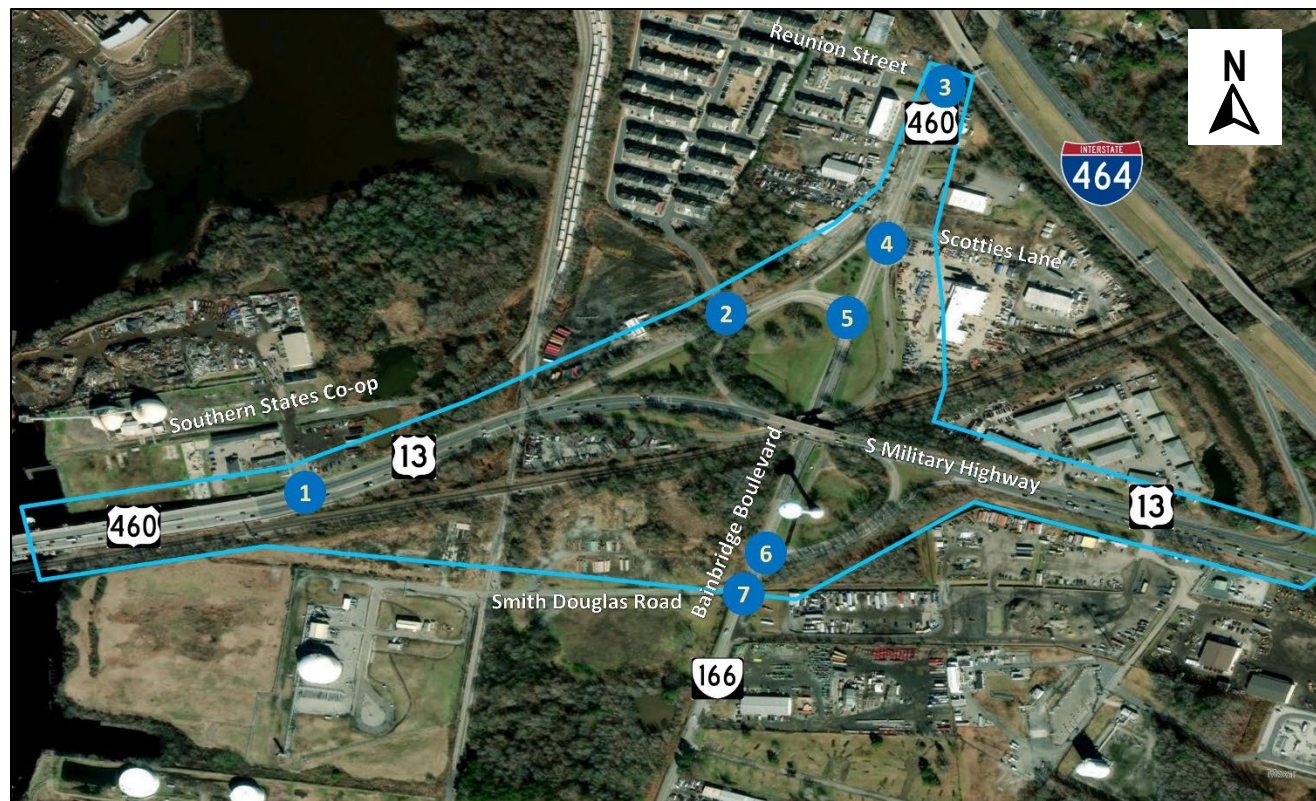
Data was collected at the following intersections, also shown in **Figure 3**.

1. Southern States Co-Op and S Military Highway
2. Whitfield Lane and WB S Military Highway
3. Reunion Street and Bainbridge Boulevard

4. Scotties Lane and Bainbridge Boulevard
5. Bainbridge Boulevard and WB S Military Highway On/Off Ramp
6. Bainbridge Boulevard and EB S Military Highway On/Off Ramps
7. Smith Douglas Road and Bainbridge Boulevard

Data was collected for the transportation analysis in the study area including intersection turning movement counts, pedestrian and bicycle counts, and transit ridership data within the study area. This data is discussed further in the report.

Figure 3: Study Area Data Collection Points



A framework document was developed at the onset of the study to outline the study needs, methods, and assumptions. The signed framework document is provided in **Appendix A**.

## 1.4 VTrans Needs

Project Pipeline focuses on identifying solutions to address the identified VTrans Mid-Term needs with a performance-based planning approach. The VTrans Mid-Term needs were identified from a data-informed process to guide Virginia's transportation future. The VTrans needs within the study area are outlined in **Table 1**.

Table 1: VTrans Needs Identified in the Study Area

VTrans 2019 Mid-Term Need	Priority
Bicycle Access	High
Capacity Preservation	None
Congestion Mitigation	Low
IEDA (UDA) Access	None
Pedestrian Access	None
Safety Improvement	High
Pedestrian Safety Improvement	Low
Reliability	Low
Rail On-time Performance	None
Transit Access	Very High
Transit Access for Equity Emphasis Areas	Low
Transportation Demand Management	Very High

The S Military Highway corridor, between Gilmerton Bridge and the I-464/S Military Highway on- and off-ramps was identified as a Project Pipeline study location due to the presence of overlapping VTrans needs, as outlined in **Table 1**. Kimley-Horn undertook the following steps to confirm and expand on the VTrans needs identified in the study area:

- Reviewed the Project Pipeline data dashboard and VTrans needs to identify issues and trends in the study area
- Conducted a field review of the study area to observe issues and document existing conditions
- Collected traffic counts at the study area intersections and tube counts along the study area corridors and ramps
- Reviewed relevant studies and plans near the study area to inform the alternative development
- Conducted detailed Existing Conditions and No-Build Conditions traffic operation analyses using Synchro and HCS
- Evaluated high-level concepts
- Reviewed existing transit, bicycle, and pedestrian facilities and user data



## 1.5 High-Level Needs Diagnosis

The data dashboard was developed by OIPI and VDOT to centralize data collection and leverage big data sources to streamline VTrans needs and diagnosis problems across all Project Pipeline studies as well as identifying the core issues and patterns identified in the framework document.

The data dashboard contains performance measures including VDOT crash data, travel time index data, infrastructure data, and average speed data for each study area. The results of this analysis are summarized in the Phase 1 summary sheets in **Appendix B**. StreetLight data was also obtained to better understand the major travel patterns to, from, and through the study area.

The study team reviewed the dashboard performance measures in addition to other sources to validate the presence of VTrans needs and identify where improvements in the study area would be most effective. The study team confirmed the VTrans needs for Transportation Demand Management, transit access, bicycle access, and safety improvements. Although it is not noted as a VTrans Need, pedestrian access should also be considered as a need and could be addressed concurrently with the bicycle access.

### 1.5.1 Operations and Access Needs

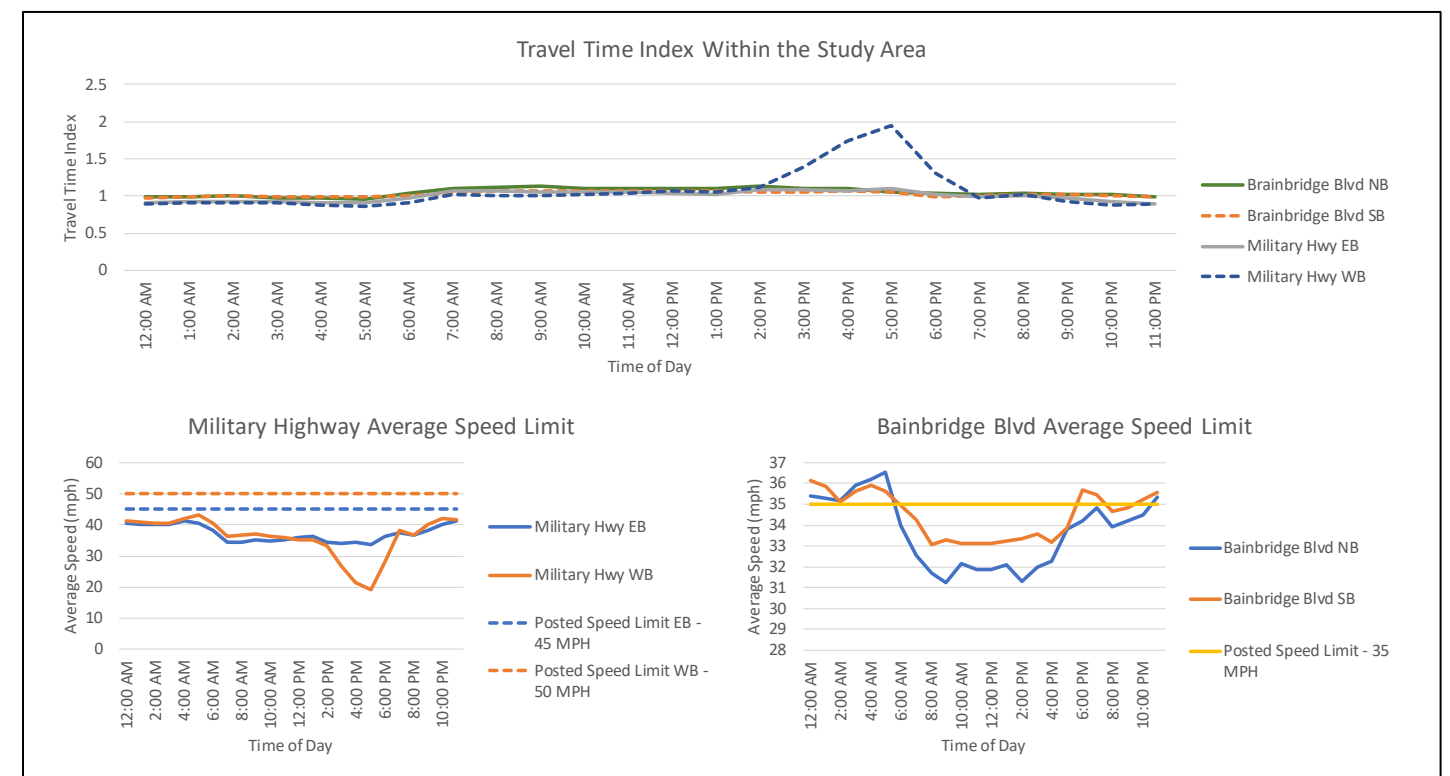
The study area has a high bicycle VTrans need as shown in **Table 2**, based on its lack of existing infrastructure despite planned facilities in the local CTP. The City of Chesapeake’s 2050 Trails Plan proposes a Class I multi-use path along S Military Highway and a Class II on-road facility along Bainbridge Boulevard to facilitate bicyclist travel throughout the corridor. S Military Highway scored as a top 1 percent Pedestrian Safety Action Plan (PSAP) priority corridor based on 2012-2016 data. This ranking is based on pedestrian safety factors consisting of crash history, proximity to a park, population density, AADT, posted speed limit, and number of lanes.

Congestion Mitigation was identified as a low priority need for the study area in VTrans. The Gilmerton Bridge, west of the study area, was observed to contribute to congestion on westbound S Military Highway when opened during peak hour travel. However, congestion soon dissipated once the bridge was closed. To the east of the study area, a sequence of traffic lights was observed to cause moderate backups that extend into the study area along eastbound S Military Highway. Additionally, the Norfolk & Portsmouth railroad crossing between the Gilmerton Bridge and Bainbridge Boulevard on S Military Highway, was seen contributing to congestion as some drivers slow down to cross the railroad. Dense traffic flow was seen throughout the peak hour regardless of the Gilmerton Bridge, railroad crossing, and traffic lights in the study area. See **Figure 4** for travel time and average speed data within the study area and **Figure 5** for a summary diagram of existing conditions.

Table 2: VTrans Operations and Access Needs in the Study Area

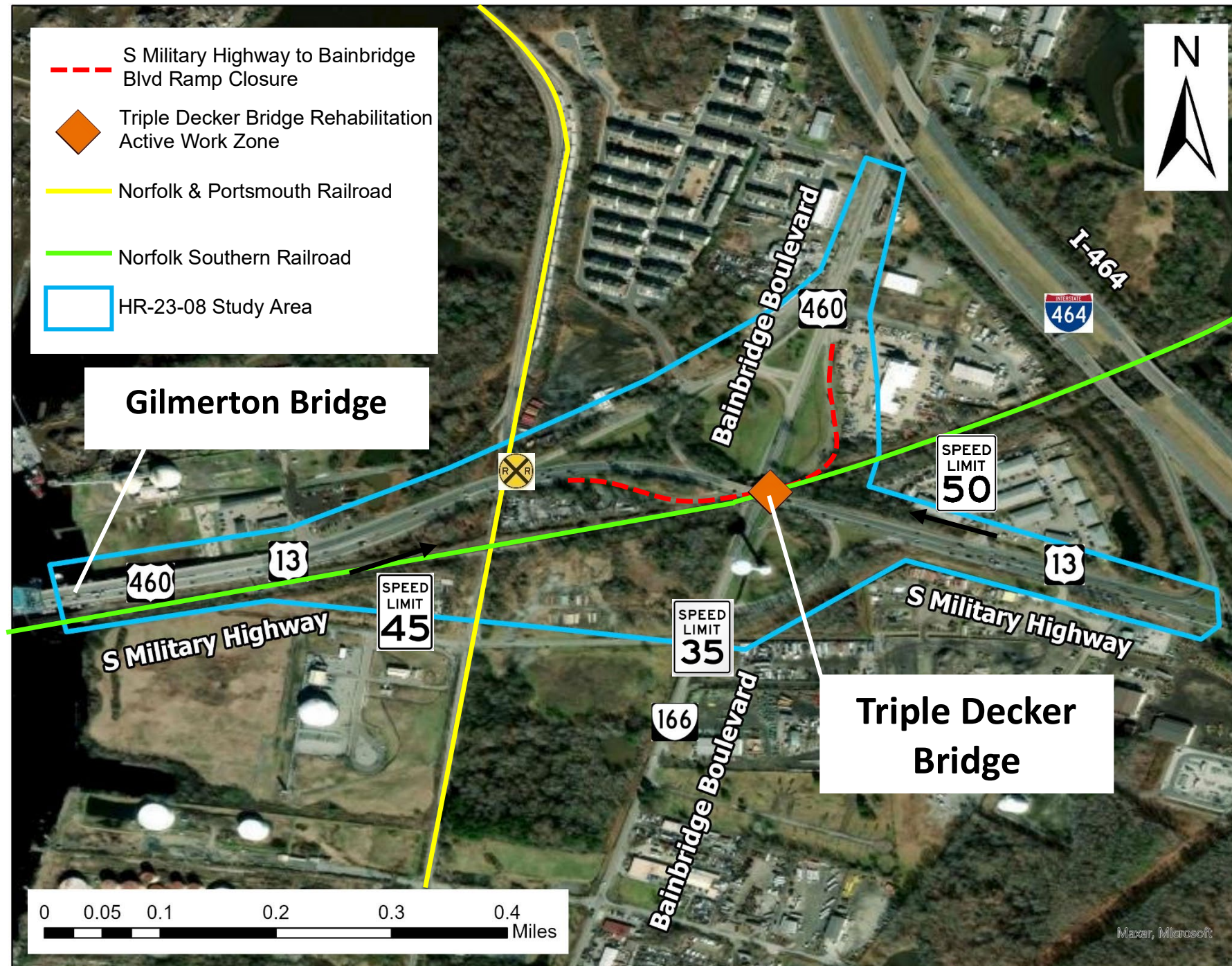
Operations and Access Needs				
Congestion Mitigation (RN)	Capacity Preservation (RN)	Bicycle Access (RN)	Pedestrian Access (RN)	IEDA (UDA) Access
Low	No Need	High	No Need	No Need

Figure 4: High-Level Operations Needs Summary



The remaining Operations and Access needs categories (pedestrian access, IEDA/UDA access, and capacity preservation) within the study area were identified as having no priority. Due to the industrial nature of the study area, and lack of adjacent facilities to connect to, no priority for pedestrian access is appropriate. Industrial and Economic Development Areas (IEDA) and Urban Development Areas (UDA) are locally designated growth and development areas. This study is not located within or adjacent to any UDA or IEDA designated areas or any sites certified by the Virginia Economic Development Partnership (VEDP).

Figure 5: Project Study Area



### 1.5.2 Safety and Reliability Needs

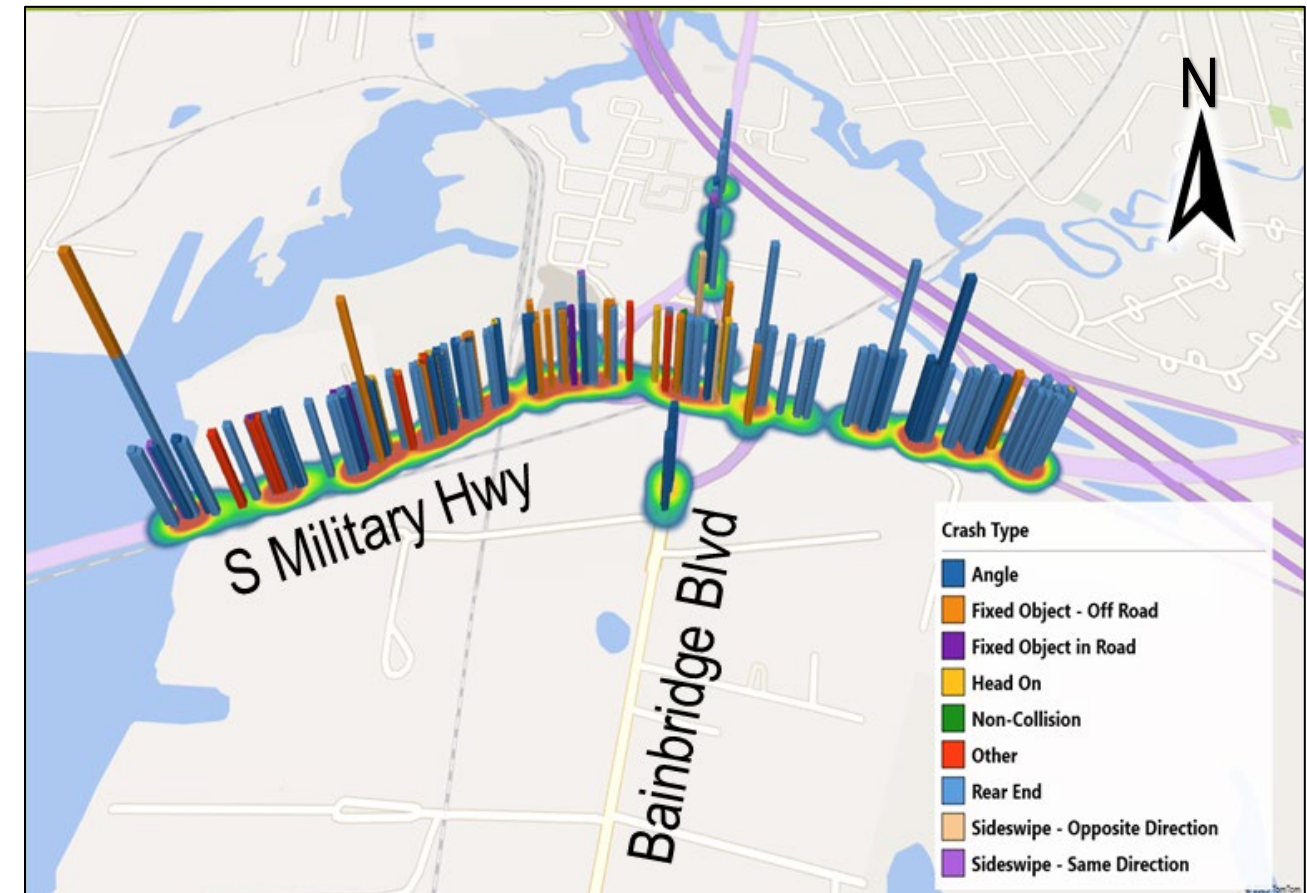
The study area has been identified as a high priority for safety improvements. A high frequency of crashes throughout the study area made safety improvements both a Statewide and a Construction District High priority (see Table 3). A concentration of crashes along S Military Highway can be seen below in Figure 6, with the most common crash type being rear ends (50 percent), which is consistent with congestion that may be caused by the opening of the Gilmerton Bridge, the Norfolk & Portsmouth railroad crossings, and the traffic lights east of the study area, or generally high volumes along the corridor. Crash severity throughout the study area was primarily classified as property damage only (PDO), which contained 56 percent of the total crashes. The number of crashes per year throughout the study area is consistent during the five-year period, ranging from 28 crashes in 2021 and 2022 to 33 crashes in 2020.

Figure 6 shows the total number of crashes reported in the 5-year period between 2018 and 2022 based on crash types within the study area. The crash analysis showed that the greatest number of crashes occurred along S Military Highway, with the most common crash type appearing to be angled crashes. More details on the crash analysis are discussed further in the chapter.

Table 3: VTrans Safety and Reliability Needs in the Study Area

Safety and Reliability Needs			
Reliability (RN)	Construction District Safety Improvement	Statewide Safety Improvement	Pedestrian Safety Improvement
Low	High	High	Low

Figure 6: Crash Data Heat Map of the Study Area (2018-2022)



### 1.5.3 Transit and Transportation Demand Management Needs

Transit Access and Transportation Demand Management were identified as very high VTrans priority needs in the study area as shown in Table 4. Two Hampton Roads Transit (HRT) bus stops (#1864 and #1847) associated with Route 58 are located within the study area at the Bainbridge Boulevard and Reunion Street intersection as shown in Figure 7. Two more Route 58 stops (#1863 and #5988) are located just south of the study area south of the Bainbridge Boulevard and Smith Douglas Road intersection. None of these bus stops have pedestrian facility connections or bus pad infrastructure. Though the HRT Route 57 bus operates along S Military Highway, there is no access to public transportation on S Military Highway in the study area. The nearest Park & Ride is seven miles north of the study area, limiting commuter access to the busses in the region. In the 2019 calendar year, Route 57 had 405 daily riders and Route 58 had 175 daily riders. Improvements in this study area should consider increased access to these transportation alternatives.

Figure 7: HRT Bus Route Through the Study Area

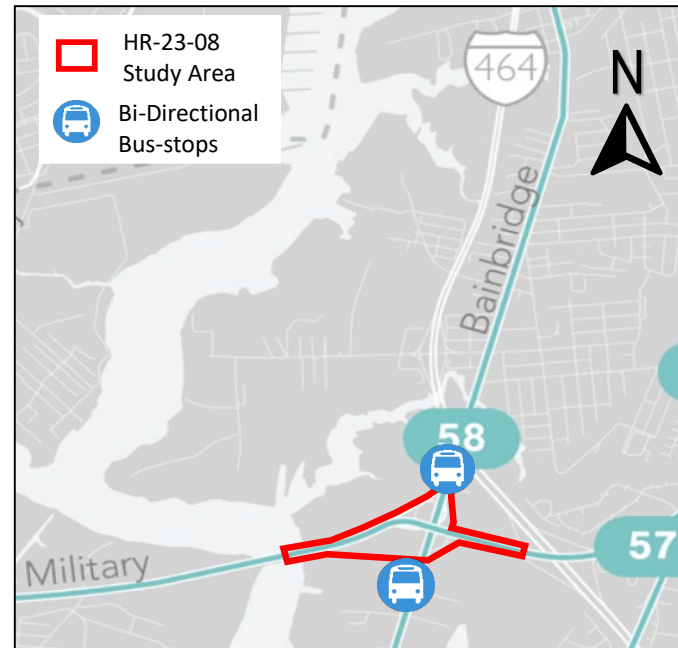


Table 4: VTrans Transit and Transportation Demand Management Needs

Transit and Transportation Demand Management Needs				
Rail On-time Performance (COSS)	Transportation Demand Management (CoSS)	Transportation Demand Management (RN)	Transit Access for Equity Emphasis Areas (RN)	Transit Access (RN)
No Need	Low	Very High	Low	Very High

### 1.5.4 Environmental Justice

The Screening Tool for Equity Analysis for Projects (STEAP) was used to analyze demographics in a 0.3-mile buffer radius from the study area. The analysis showed that the study area predominately consists of African Americans and Caucasians, making up 47 percent and 40 percent of the study area respectively. The household income data for the study area shows that 34 percent of households make over 75,000 dollars per year, however 53 percent of households make less than 50,000 dollars per year and 11 percent of households make less than 15,000 dollars per year. Thirteen percent of the population near the study area is in poverty, composed of five percent Caucasian and six percent African American individuals. Eighty-two percent of the study area was identified as English speakers, 18 percent non-English speakers, with five percent no English at all. Other notable demographics were

that 20 percent of the population was considered disabled and 10 percent of the population were veterans.

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### 1.5.6 Environmental Screening Analysis

The study team prepared an environmental screening analysis (see Figure 8), which examined various geospatial datasets relevant to the study area. The datasets for the analyses included the National Wetland Inventory data, FEMA flood zones, and cultural resource assessments performed by the Department of Historic Resources (DHR) for both archeological and architectural resources. Historic resources were identified along the Norfolk Southern train track and at the Triple Decker Bridge within the study area, however these resources have been determined to be not eligible for listing on the National Register of Historic Places (NRHP) or have been removed. Therefore, these sites would not be subject to Section 106 or Section 4(f) regulations. Approximately six potential hazardous sites were identified from the Department of Environmental Quality, with multiple registered petroleum tank facilities located within and immediately adjacent to the study area. Closed petroleum release cases were identified in the northern portion of the study area. The full findings for this environmental screening analysis and the full environmental justice and environmental screening analysis table can be found in Appendix C.

## 1.6 Detailed Needs Validation

The study team performed additional traffic operations and safety analyses to further quantify the existing and anticipated needs within the study area. Results from these analyses were used as a baseline when comparing the conditions of proposed improvements to the existing and anticipated no-build conditions.

### 1.6.1 Existing Conditions Traffic Operations and Safety Analysis

Multiple safety concerns were observed during the site visit to the study area. Primary concerns include missing or damaged signs along both roadways, minimal drainage inlets leading to standing water on Bainbridge Boulevard and faded pavement markings caused by deterioration of the roadway on Bainbridge Boulevard. The study team conducted a multifaceted analysis of the existing conditions of the study area, which included reviewing previous studies, conducting a safety analysis, conducting a preliminary field review, analyzing traffic operations using Synchro and HCS, and reviewing pedestrian, bicycle, and transit activity. The results of the existing conditions analysis were presented to the Study Work Group during a Technical Team Workshop on July 28, 2023. The presentation is provided in **Appendix C**.

#### Relevant Studies, Plans, and Projects

The Triple Decker Bridge Rehabilitation project is currently under construction within the study area and is funded through the VDOT State of Good Repair (SGR) program. The goal of this project is to extend the service life of the bridge and avoid implementation of a weight restriction on the S Military Highway bridge. Construction for the Triple Decker Bridge Rehabilitation started in November 2022 and is scheduled to be completed in March 2025. There is a temporary ramp closure on the eastbound S Military Highway exit to northbound Bainbridge Boulevard because of this project.

In 2014, the Gilmerton Bridge project replaced the previously existing bascule bridge with a vertical lift bridge. The scope of the project required construction to maintain vehicular and maritime traffic during the extent of the project and cost \$134 million. The new bridge reduced congestion in the study area

because of the heightened bridge which allowed for fewer openings and had wider lanes than the previous bridge.

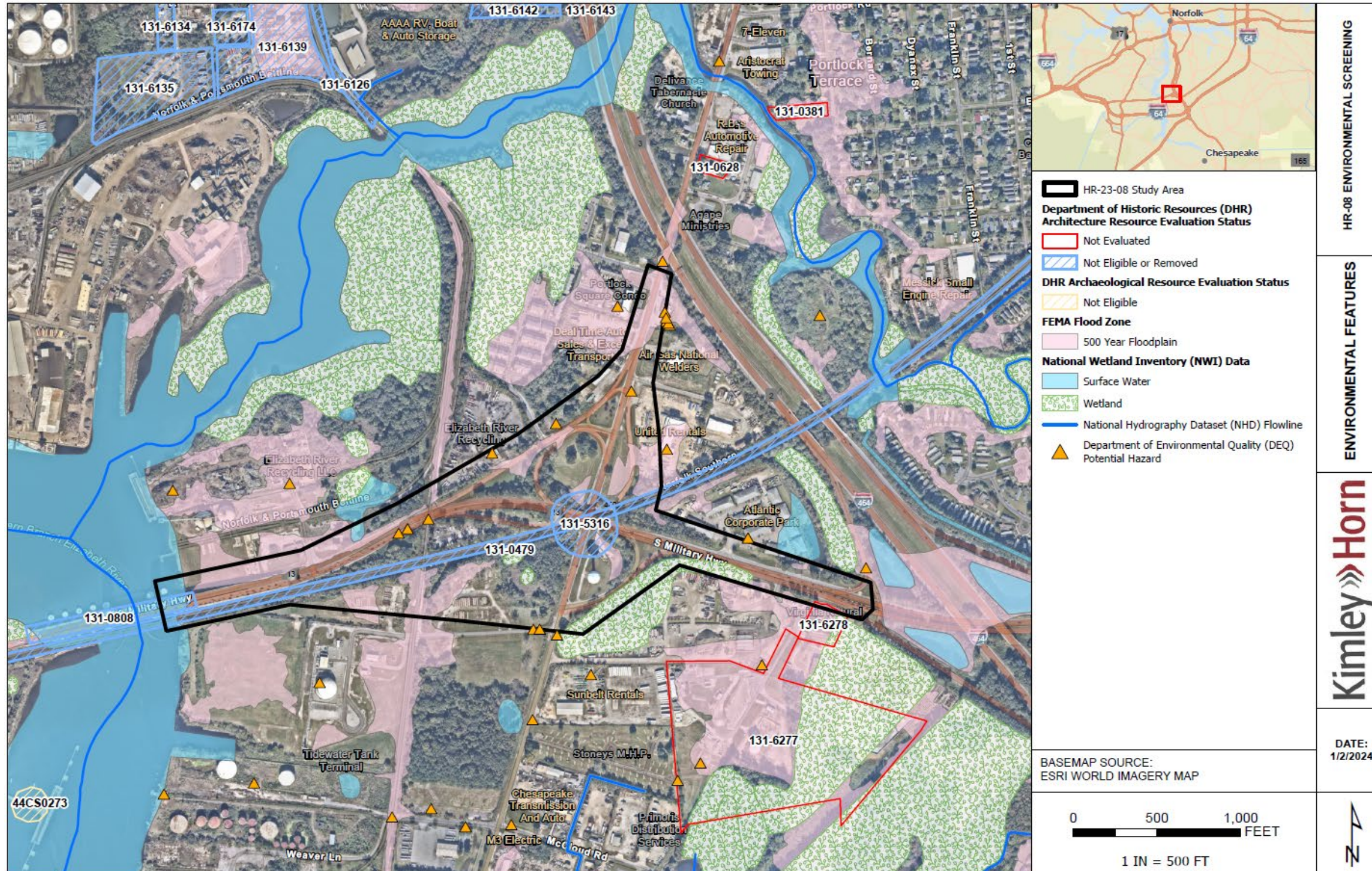
The 2026 City of Chesapeake Comprehensive Plan and Hampton Roads Planning District Commission outline the need to expand S Military Highway to six lanes in the study area and industrial portions of the roadway, and to four lanes in the western corridor beyond the study area. However, the City of Chesapeake Master Transportation Plan proposes the expansion of S Military Highway to an 8-lane arterial and Bainbridge Boulevard (south of S Military Highway) to a 4-lane arterial based on this 2050 long-range and not fiscally constrained plan.

Within the study area, the at grade railroad crossing on S Military Highway was reported by DRPT to have on average two rail crossings per week as of 2019. Also, there were no blocked crossings reported for S Military Highway. The existing crossing is reported to include at-grade crossing advance warning signs (W10-1), low ground clearance sign (W10-5), along with railroad crossing symbols and stop lines for pavement markings.

#### Safety Analysis

A safety analysis was conducted using crash data from the VDOT Crash Database over a five-year period (January 1, 2018 – December 31, 2022). In total, 150 crashes were reported in the study area with one fatality, 65 injury crashes, and 84 PDO crashes. Bainbridge Boulevard was found to have 186 crashes per 100 MVMT and S Military Highway was found to have 242 crashes per 100 MVMT. Additionally, VDOT's 2016-2020 Top Potential Safety Improvement (PSI) Segments and Intersections data lists S Military Highway as a priority need segment for safety improvement. VDOT also lists S Military Highway within the study area as a statewide top 1% priority Pedestrian Safety Action Plan priority corridor and Bainbridge Boulevard between Reunion Street and Scotties Lane as a statewide top 5% corridor. The frequency of crashes in the study area, and eight (8) identified key locations within the study area, by severity and crash type are shown in **Table 5** and **Table 6**, respectively. **Appendix C** includes a detailed crash summary of eight identified key locations or segments within the study area.

Figure 8: Environmental Screening Analysis



*Bainbridge Boulevard and Scotties Lane/Eastbound S Military Highway Off-Ramp*

Five crashes were recorded in this section of the study area, and all involved a vehicle coming from the eastbound S Military Highway off-ramp entering northbound Bainbridge Boulevard. Poor pavement markings are present on the ramp, potentially causing confusion for yield conditions. Additionally, northbound Bainbridge Boulevard traffic must turn right across the ramp entrance to access United Rentals.

*Bainbridge Boulevard and Eastbound S Military Highway Ramps/Smith Douglas Road*

Four angle crashes were recorded in this section of the study area. Three of the crashes involve a vehicle coming from the eastbound S Military Highway off-ramp, mistiming traffic on Bainbridge Boulevard, and resulting in a collision. The other crash involved a vehicle traveling southbound on Bainbridge Boulevard, turning left on to the eastbound S Military Highway on-ramp, and striking a vehicle traveling northbound on Bainbridge Boulevard.

*Eastbound S Military Highway at Southbound I-464 On-Ramp*

This section of the study area includes 11 rear end crashes and six angle crashes. The 10 rear end crashes are associated with traffic on eastbound S Military Highway yielding to vehicles making a westbound left from S Military Highway onto the ramp to southbound I-464 or vehicles stopping at the traffic light just east of the study area. The seven angle crashes are associated with vehicles traveling on westbound S Military Highway colliding with vehicles traveling on eastbound S Military Highway while making a left into the lot just before the exit to I-464.

*Eastbound S Military Highway at the Ramp to Bainbridge Boulevard Northbound*

The majority of the crashes in this section of the study area were rear ends caused by vehicles stopping for the railroad crossing or by vehicles stopping for an emergency vehicle. Two crashes in this section involved vehicles hitting the median, causing the crash, but no crashes appeared to be related to the exit ramp.

*Westbound and Eastbound S Military Highway Railroad Crossings*

This section of S Military Highway was analyzed several hundred feet upstream of the railroad crossing to determine if a significant number of crashes were related to the railroad. Of the 21 crashes in this area, only four were related to the railroad crossing, three of which were rear ends, and one was a head on collision from losing control after driving over the railroad tracks. The remaining crashes in this area resulted in minor injuries and property damage only. 11 crashes in this area were reported to be rear-end crashes while the second highest (five) was due to a fixed object on the road.

*Westbound S Military Highway*

Most crashes on westbound S Military Highway consisted of rear ends, angle crashes, and fixed object crashes. Slightly less than half (20) of the crashes were noted to include drivers following too closely. A slight grouping of crashes can be observed near the curve in S Military Highway just west of the railroad crossing.

*Eastbound S Military Highway*

Most crashes on eastbound S Military Highway consisted of rear ends, angle crashes, and fixed object crashes. Approximately one half (33) of these crashes were noted to include drivers following too closely. A slight grouping of crashes can be observed near the curve in S Military Highway on both sides of the railroad crossing. Eastbound S Military Highway also had the only fatal crash within the study area where a vehicle ran off the road, swerved back on, then was hit by an oncoming vehicle.

*Southbound Bainbridge Boulevard to Westbound S Military Highway Ramp Merge Area*

Fifteen crashes were observed in this section of the study area. Of the 15 crashes, 10 were property damage only and five were visible injury crashes. No trends in contributing factors were found for the crash history in this section.

**Table 5: Frequency of Crashes within the Study Area by Crash Severity**

Area of Interest	K	A	B	C	PDO	Total
Bainbridge Boulevard and Scotties Lane/eastbound S Military Highway off-ramp intersection	0	0	1	0	4	5
Bainbridge Boulevard and eastbound S Military Highway ramps/Smith Douglas Road intersection	0	0	1	1	2	4
Eastbound S Military Highway at the ramp to I-464 southbound	0	0	4	0	13	17
Eastbound S Military Highway at the ramp to Bainbridge Boulevard northbound	0	0	3	1	3	7
S Military Highway westbound and eastbound railroad crossings	0	3	9	1	8	21
S Military Highway Westbound	0	5	18	0	35	58
S Military Highway Eastbound	1	5	25	1	37	69
Southbound Bainbridge Boulevard to westbound S Military Highway ramp merge area	0	0	5	0	10	15
<b>Total*</b>	<b>1</b>	<b>10</b>	<b>53</b>	<b>2</b>	<b>84</b>	<b>150</b>

\*Areas of interest have overlapping data. The total does not equal the sum of the areas of interest.

**Table 6: Frequency of Crashes within the Study Area by Crash Type**

Area of Interest	Rear End	Angle	Fixed Object – Off Road	Sideswipe	Head On	Other	Total
Bainbridge Boulevard and Scotties Lane/ eastbound S Military Highway off-ramp intersection	2	2	0	1	0	0	5
Bainbridge Boulevard and eastbound S Military Highway ramps/Smith Douglas Road intersection	0	4	0	0	0	0	4
Eastbound S Military Highway at the ramp to I-464 southbound	11	6	0	0	0	0	17
Eastbound S Military Highway at the ramp to Bainbridge Boulevard northbound	4	1	1	0	0	1	7
S Military Highway westbound and eastbound railroad crossings	11	2	5	0	1	2	21
S Military Highway westbound	27	9	6	2	6	8	58
S Military Highway eastbound	37	16	9	1	1	5	69
Southbound Bainbridge Boulevard to westbound S Military Highway ramp merge area	3	4	3	1	3	1	15
<b>Total*</b>	<b>77</b>	<b>28</b>	<b>19</b>	<b>6</b>	<b>7</b>	<b>13</b>	<b>150</b>

\*Areas of interest have overlapping data. The total does not equal the sum of the areas of interest.

**Traffic Data**

Twelve-hour vehicular turning movement, pedestrian, and bicycle count data were collected at the study intersections on Wednesday, May 24, 2023, and 48-hour tube counts were collected on Tuesday, May 30, and Wednesday, May 31, 2023, on the arterials. Ramp tube counts were collected on Wednesday, May 31, 2023 and Thursday, June 1, 2023, with a recount on Wednesday, June 14, 2023 and Thursday, June 15, 2023 for the westbound S Military Highway off-ramp to Bainbridge Boulevard as shown in **Figure 9**.

**Figure 9: Bainbridge Boulevard at Eastbound S Military Highway On-/Off-Ramps**



The AM and PM peak hours were determined to be 7:15 - 8:15 AM and 4:00 - 5:00 PM. The existing traffic volumes are summarized in **Figure 10** and the heavy vehicle percentages and peak hour factors are summarized in **Figure 11**.

Existing intersection lane configurations and speed limits on corridors within the study area are shown in **Figure 12**.



Figure 10: Existing AM and PM Peak Hour Traffic Volumes

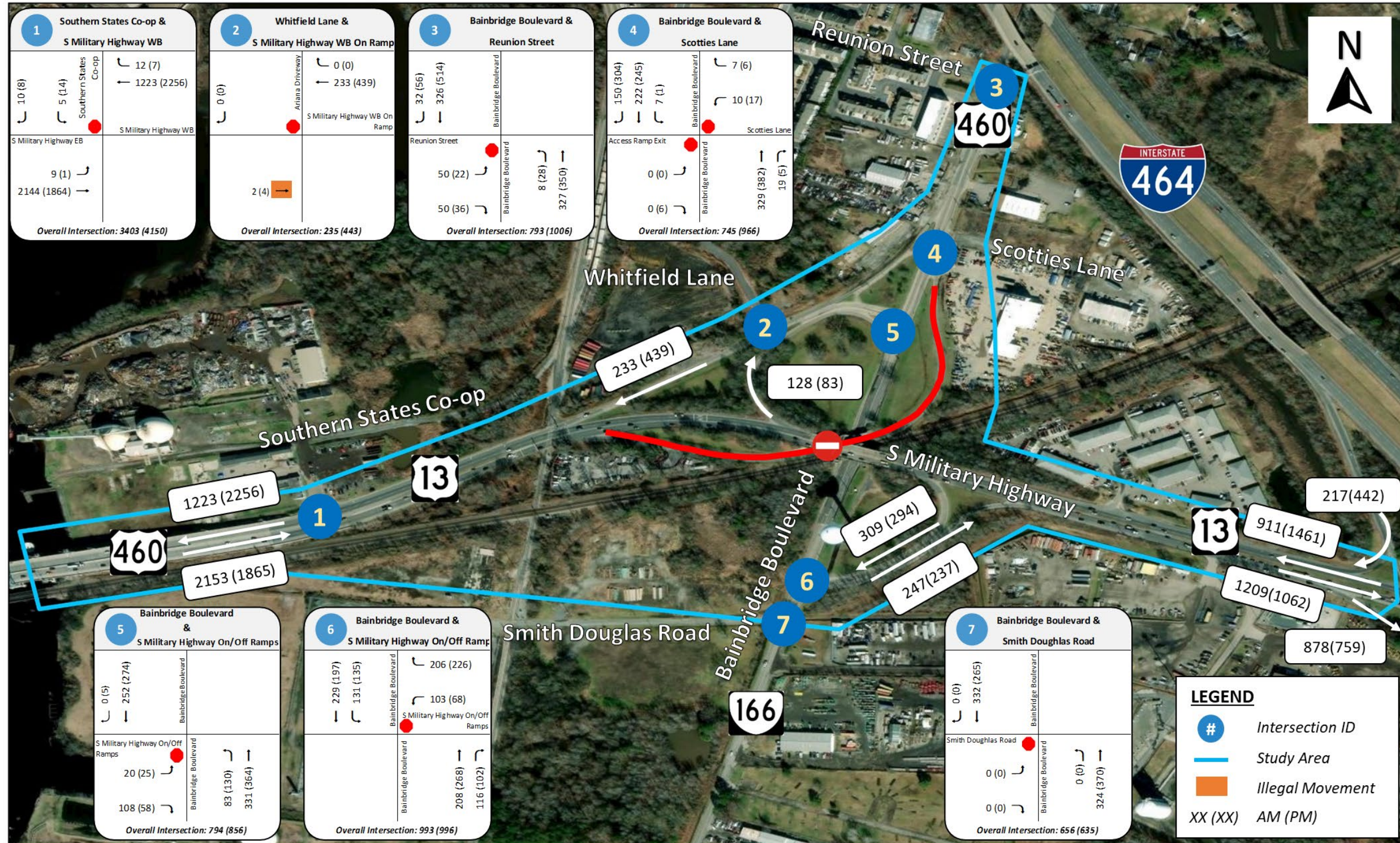


Figure 11: Existing AM and PM Heavy Vehicle percentage and Peak Hour Factor

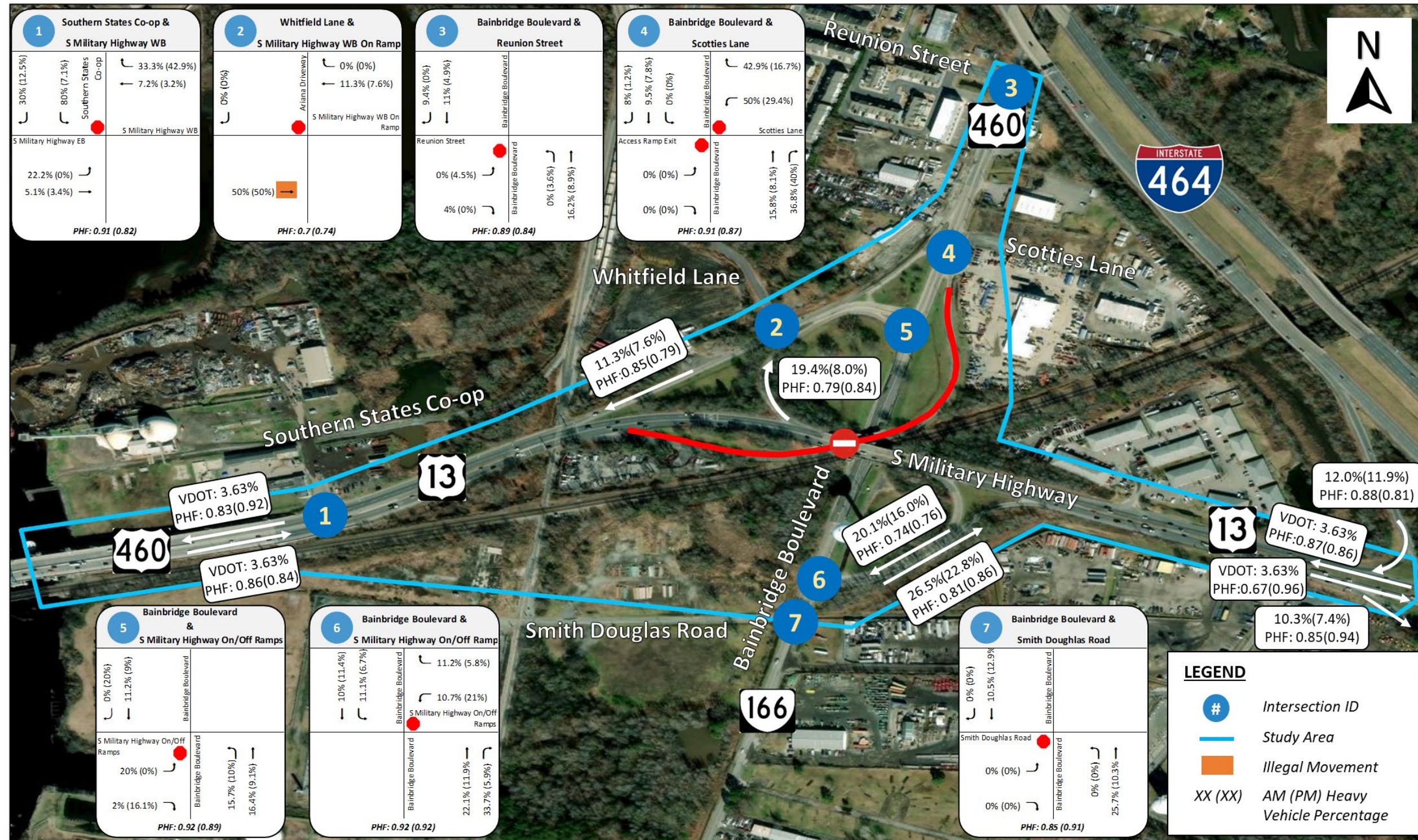
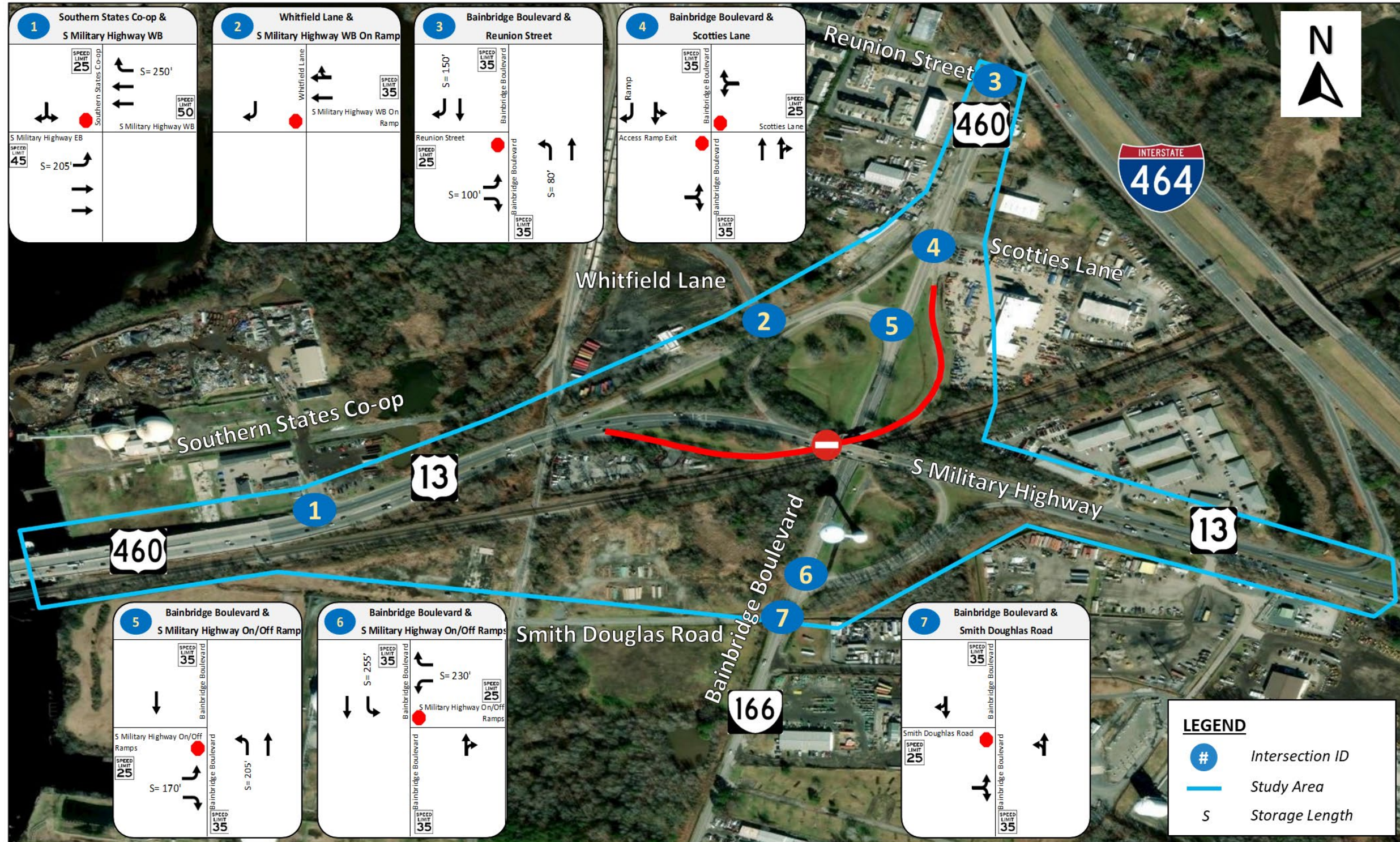
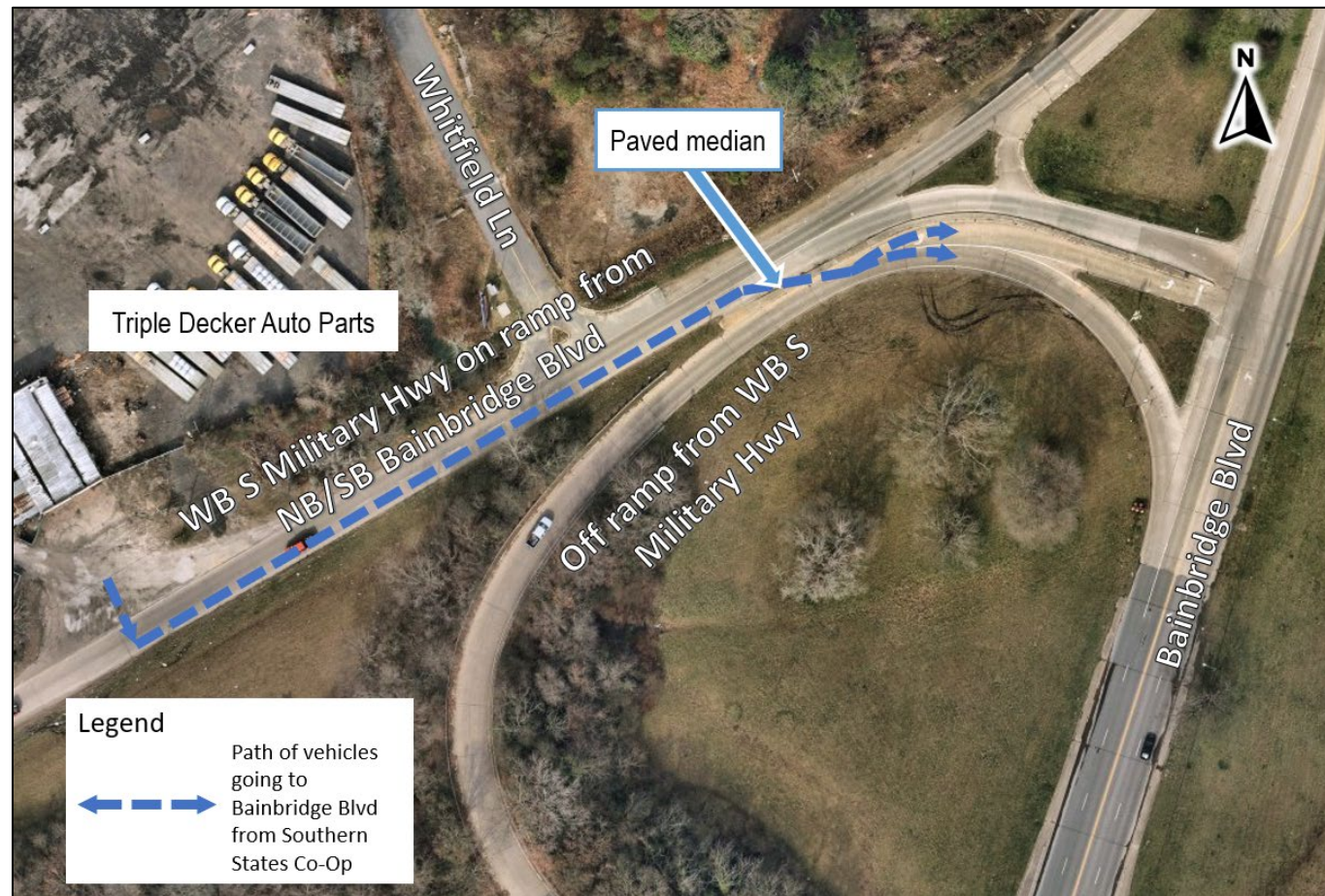


Figure 12: Existing Lane Configuration and Speed Limit



At the Whitfield Lane and S Military Highway westbound off-ramp intersection, drivers were counted traveling in the opposite direction of traffic (see **Figure 13**). Vehicles exiting the Triple Decker Auto Parts driveway to the west of Whitfield Lane were observed making an illegal left turn and would then cross over the median to access Bainbridge Boulevard from the eastbound S Military Highway on/off-ramp (intersection five). There were more vehicles in the PM peak hour traveling in the illegal traffic direction than in the AM peak hour.

**Figure 13: Path of Wrong Way Vehicles from Triple Decker Auto Parts**



**Field Review Observations**

A preliminary field review was conducted on June 8, 2023, to verify existing conditions, confirm traffic control devices and lane configurations, and observe peak hour traffic conditions and driver behavior.

The study team made the following observations during the field review:

- Along S Military Highway, a decrease in speed was observed for vehicles in both the eastbound and westbound directions when approaching the curvature on the west side of the study area.
- Two crashes were observed during the field visit, with a rear-end crash by the railroad crossing on S Military Highway and another rear-end crash at the intersection of Bainbridge Boulevard and the westbound S Military Highway On/Off Ramp.
- Bainbridge Boulevard at Reunion Street
  - Residential neighborhood along Reunion Street
  - Includes two bus stops in both directions along Bainbridge Boulevard
    - Does not include bus passenger shelter nor pedestrian facility along either side of Bainbridge Boulevard as shown in **Figure 14**
  - Witnessed two pedestrians cross Bainbridge Boulevard, no crosswalks at this intersection
  - Narrow (10 foot) left turn lane on eastbound approach
  - Narrow (9.5 foot) merge lane heading southbound Bainbridge Boulevard

**Figure 14: Pedestrian Facility Along Bainbridge Boulevard with No Nearby Connections**



- Bainbridge Boulevard at Scotties Lane/Access Ramp
  - Witnessed one rear-end crash
  - United Rentals Driveway is located immediately at the (currently closed) off-ramp and Bainbridge Boulevard. This would require drivers exiting the ramp to yield to drivers traveling along Bainbridge Boulevard and drivers exiting the driveway
  - Witnessed one pedestrian on Bainbridge Boulevard
  - Poor pavement conditions
- Bainbridge Boulevard at Westbound S Military Highway off Ramp
  - One near-miss crash was observed when a driver exiting westbound S Military Highway onto southbound Bainbridge Boulevard failed to yield the right-of-way to oncoming traffic while a southbound Bainbridge vehicle driver was merging to the rightmost lane
- Bainbridge Boulevard at Eastbound S Military On/Off Ramps
  - Faded pavement markings
  - Insufficient turning radii for heavy vehicles turning right off the ramp
  - Vehicles coming off the ramp to make a left travel beyond the faded stop bar, leading to close calls to vehicles turning northbound left onto the ramp
  - Damaged stop sign
  - Foliage blocking signs along Bainbridge Boulevard
- Bainbridge Boulevard at Smith Douglas Road
  - The land use along Smith Douglas Road is comprised of vacant land and industrial facilities
- S Military Highway at Southern States Co-Op
  - Difficult to make a left out of Southern States Co-Op Driveway onto eastbound S Military Highway
  - Drivers on S Military Highway were observed going over the posted speed limit
  - Rear-end crash witnessed east of the of the intersection, vehicles were heading westbound prior to the railroad crossing
- S Military Highway at Atlantic Corporate Park
  - Misplaced median observed in S Military Highway
  - No right turn lane present along S Military Highway onto Atlantic Corporate Park driveway
  - 50 MPH posted speed limit sign heading in the westbound direction along S Military Highway
- S Military Highway at Jrs Contracting
  - Witnessed U-turn eastbound S Military Highway
  - Notable debris on roadway

- S Military at Southbound I-464 On/Off Ramps
  - Signalized intersection
  - There were no notable operational and safety concerns observed during the field visit at this ramp diverge point

### Operations Measures of Effectiveness

Synchro 11 and Highway Capacity Software (HCS) 7 were used to evaluate the existing traffic operations conditions. Synchro is a deterministic tool primarily used for analyzing traffic flow, traffic signal progression, and traffic signal timing optimization. Additionally, Synchro may be used to analyze arterials, signalized intersections, and unsignalized intersections. For this study, Synchro was used to analyze the unsignalized intersections along Bainbridge Boulevard. Vehicular delay/level of service (LOS), and 95<sup>th</sup> percentile queue lengths were used as measures of effectiveness (MOE) for the locations analyzed in Synchro.

The intersection Level of Service (LOS) is a qualitative measure that describes a driver’s perception of the operating conditions. LOS ratings range from A to F with LOS A indicating little or no congestion and LOS F indicating severe congestion, unstable traffic flow, and/or stop-and-go conditions. **Table 7** summarizes the LOS corresponding to the delay at unsignalized and signalized intersections as specified in the HCM. For unsignalized intersections, control delay, and the resulting LOS, is calculated by determining the number of available gaps in the conflicting traffic stream. The LOS analysis is performed for individual movements and not for the overall intersection because the traffic on the mainline is not affected by the traffic on the side street. The HCM defines queue length as “the distance between the upstream and downstream ends of the queue.” The 95<sup>th</sup> percentile queue length is the queue length that has only a 5 percent probability of being exceeded during a given analysis period.

Table 7: LOS and Delay

Level of Service	Control Delay (seconds/vehicle)	
	Signalized Intersection	Unsignalized Intersection
A	≤ 10.0	≤ 10.0
B	> 10.0 to 20.0	> 10.0 to 15.0
C	> 20.0 to 35.0	> 15.0 to 25.0
D	> 35.0 to 55.0	> 25.0 to 35.0
E	> 55.0 to 80.0	> 35.0 to 50.0
F	≥ 80.0	≥ 50.0

HCS is a deterministic tool based on methodologies outlined in the Highway Capacity Manual (HCM). HCS may be used to analyze urban street facilities, urban street segments, signalized intersections, unsignalized intersections (two-way and all-way), freeway facilities, basic freeway segments, merging and diverging segments, weaving segments, collector-distributor facilities, multilane highways, and two-lane highways. For this study, HCS was used to analyze the operations along S Military Highway, including the merging, weaving, diverging, and basic freeway segments. Volume to capacity (v/c) ratio, space mean speed, and travel time were used as MOEs for these segments analyzed in HCS. The HCM defines v/c ratio as “the ratio of the flow rate to capacity for a system element.” A facility with a v/c ratio over 1.0 is considered over capacity and performing at unacceptable levels of operation. Space mean speed is measured in miles per hour (MPH) and defined as “an average speed based on the average travel time of vehicles to traverse a length of roadway.” Travel time is “the average time spent by vehicles traversing a highway segment, including control delay,” and is measured in seconds.

### Existing Conditions Traffic Analysis

Existing conditions at all intersections and freeway segments were modeled based on the existing roadway geometry and traffic volumes shown in **Figure 10** and **Figure 12**. Inputs and analysis methodologies were consistent with the guidance in *VDOT Traffic Operations and Safety Analysis Manual* (TOSAM), Version 2.0.

### Synchro Analysis

A traffic operations analysis was conducted to evaluate the performance of four intersections on Bainbridge Boulevard under existing AM and PM peak hour conditions and one intersection on S Military Highway. Existing conditions were modeled using Synchro 11. Five unsignalized intersections were analyzed and all the movements were determined to be operating at a LOS C or better on Bainbridge Boulevard. S Military Highway and Southern States Co-Op intersection is showing LOS F for the southbound movement which is stop controlled. Synchro results are less reliable if a movement is oversaturated (i.e., level of service is F or v/c is greater than 1) so the magnitude of delay may be overestimated. It also may be that drivers are less conservative than assumed in the Synchro analysis, and that drivers are accepting smaller and less safe gaps in traffic to make turning movements. **Table 8** shows the Synchro analysis results both for AM and PM peak hours.

- The highest delay occurred in the PM for the eastbound left movement at the Reunion Street and Bainbridge Boulevard intersection, which was 23 seconds.
- All movements were observed to be performing at an LOS C or better with all Bainbridge Boulevard movements operating at an LOS A, in both the AM and PM peak hours.
- No notable difference was observed in the AM and PM operations.

### HCS Analysis

A traffic operations analysis was conducted to evaluate the performance of the S Military Highway under existing AM and PM peak hour conditions. Existing conditions were modeled using HCS 7. S Military Highway was divided into four segments in the eastbound and five segments in the westbound directions for the purpose of this analysis. Two assumptions have been made for this analysis. First, free-flow speed (FFS) is equal to the speed limit plus 7 MPH based on TOSAM guidance. Second, for the weave segment in the eastbound direction, a 100/0 split is used for the ramp to freeway/ramp to ramp volumes meaning that all volume from on-ramp is going to the freeway not to the next off-ramp. **Table 9** and **Table 10** show the HCS analysis results for both the AM and PM peak hours in the eastbound and westbound directions.

- The highest density was in the AM peak hour in the eastbound direction in the downstream section of Gilmerton Bridge. This section operates at LOS D.
- Segments of eastbound S Military Highway east of Bainbridge Boulevard were observed to have increased density in the AM peak hour as compared to the same segment in the PM peak hour. Likewise, in the westbound direction, these segments increased in density during the PM peak hour as compared to the AM peak hour.
- All segments of S Military Highway were observed to operate at a LOS C or better, with the following exceptions in the eastbound direction in the AM peak hour:
  - The westernmost segment downstream of Gilmerton Bridge operates at LOS D
  - The overall eastbound facility along S Military Highway operates at LOS D in the AM peak hour.

### Existing Conditions Conclusions

Synchro and HCS results show that there are no notable operational deficiencies on Bainbridge Boulevard and S Military Highway, which is consistent with the lack of a VTrans-identified priority needs for congestion improvements in the study area.

Table 8: Synchro Analysis Result for 2023 Existing Conditions Peak Hour Control Delay and LOS

Intersection Number and Description	Type of Control	Lane Group	Northbound				Southbound				Eastbound				Westbound			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1 S Military Hwy and Southern States Co-Op	Unsignalized	Left	†	†	†	†	406	F	5824	F	12.2	B	24.5	C	†	†	†	†
		Through	†	†	†	†	†	†	†	†	0	A	0	A	0.0	A	0.0	A
		Right	†	†	†	†	406.0	F	5824.0	F	†	†	†	†	0.0	A	0.0	A
		Approach	†	†	†	†	406.0	F	5824.0	F	0.1	A	0	A	0.0	A	0.0	A
3 Bainbridge Boulevard and Reunion Street	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Reunion Street												
		Left	8.1	A	9.1	A	†	†	†	†	16.2	C	23.2	C	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	0.0	A	0.0	A	10.8	B	12.9	B	†	†	†	†
Approach	0.2	A	0.7	A	0.0	A	0.0	A	13.5	B	16.8	C	†	†	†	†		
4 Bainbridge Boulevard and Smith Douglas Road	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Driveway												
		Left	†	†	†	†	8.1	A	8.2	A	0.0	A	0.0	A	14.5	B	16.7	C
		Through	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	0.0	A	9.8	A	14.5	B	16.7	C
Approach	0.0	A	0.0	A	0.2	A	0.0	A	0.0	A	9.8	A	14.5	B	16.7	C		
5 Bainbridge Boulevard and S Military Highway WB Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		S Military Highway SB Ramps												
		Left	8.2	A	8.4	A	†	†	†	†	17.3	C	21.3	C	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	10.5	B	10.6	B	†	†	†	†
Approach	1.6	A	2.2	A	0.0	A	0.0	A	11.6	B	13.8	B	†	†	†	†		
6 Bainbridge Boulevard and S Military Highway EB On/Off Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		S Military Highway EB On/Off Ramps												
		Left	†	†	†	†	8.1	A	8.3	A	†	†	†	†	20.0	C	19.7	C
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†				
		Right	0.0	A	0.0	A	†	†	†	†	†	†	†	†	11.2	B	12.1	B
Approach	0.0	A	0.0	A	3.0	A	3.4	A	†	†	†	†	14.1	B	13.9	B		

† SYNCHRO does not provide level of service or delay for movements with no conflicting volumes

Table 9: HCS Analysis Result for 2023 Existing Conditions Peak Hour Speed, Density and LOS along S Military Highway (Eastbound)

Eastbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (MPH)	Density (pc/mi/ln)	LOS	Speed (MPH)	Density (pc/mi/ln)	LOS
Downstream of Gilmerton Bridge	Basic	48.3	26.8	D	48.3	24	C
Off-Ramp to Bainbridge Boulevard	Diverge	47.3	26.5	C	47.3	24.5	C
Between Off-Ramp to and On-Ramp from Bainbridge Boulevard	Basic	43.6	25.4	C	43.6	22.4	C
Between On-Ramp from Bainbridge Boulevard and Off-Ramp to I-464	Weaving	38	26.4	C	40.9	17.1	B
<b>Overall Facility</b>		<b>42.6</b>	<b>26.6</b>	<b>D</b>	<b>44.7</b>	<b>20.3</b>	<b>C</b>

Table 10: Analysis Result for 2023 Existing Conditions Peak Hour Speed, Density and LOS along S Military Highway (Westbound)

Westbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (MPH)	Density (pc/mi/ln)	LOS	Speed (MPH)	Density (pc/mi/ln)	LOS
On-Ramp from I-464	Merge	52.6	12.9	B	52.2	22.7	C
Off-Ramp to Bainbridge Boulevard	Diverge	50.3	13.4	B	50.4	22.7	C
Between Off-Ramp to Bainbridge Boulevard and On-Ramp from Bainbridge Boulevard	Basic	53.9	10.8	A	53.9	19.9	C
On-Ramp from Bainbridge Boulevard	Merge	52.6	14.8	B	52.1	25.5	C
Upstream of Gilmerton Bridge	Basic	55.2	14	B	55.2	23.1	C
<b>Overall Facility</b>		<b>54</b>	<b>13.7</b>	<b>B</b>	<b>53.8</b>	<b>23.2</b>	<b>C</b>



## 1.6.2 Transit Propensity and Transit Potential Analysis

Transit access was identified as a high priority in VTrans for the study area. Currently, the east-west HRT Route 57 goes from Robert Hall to Airline Boulevard with a frequency of 60 minutes and runs from 6 AM to 7:30 PM Monday through Saturday. Planned improvements on Route 57 include an alignment change, which will occur beyond the study area; along with weekday services to begin at 5 AM. Route 57 has a total of 25 daily trips, with no service on Sundays. The north-south HRT Route 58 goes from Seaboard Avenue to TCC Chesapeake Campus through the study area along Bainbridge Boulevard. Route 58 has a total of 27 daily trips with no service on Sundays. There are no planned improvements. Both routes are being considered to have Sunday ridership added beyond 2033.

The study area was analyzed using StreetLight data to gain a better understanding of the directional travel demand for potential implementation of transit and TDM improvements. The analysis used a 0.5-mile buffer of the study area to identify the origin-destination data for trips starting, ending, or traversing the study area.

The first StreetLight analysis involved vehicles that would be starting their trips from outside of the study area and would end their trips inside the study area (referred to as a Zone in the analysis). For vehicular traffic entering the study area in the AM peak period, the analysis showed there were higher volumes (more than 200 trips) ending in the study area from the western segment along S Military Highway (see **Figure 15**), which this would mean that there were more vehicles traveling eastbound on S Military Highway with trips ending in the study area. The PM peak period showed there was a higher vehicular volume (more than 300 trips) ending in the study from the eastern segment, where vehicles traveling westbound on S Military Highway with trip ends within the study area (see **Figure 16**). These are potential trips that could be served by the existing Route 57 service if a bus stop were located in the study area.

The second StreetLight analysis involved vehicles that would begin inside the study area and would end outside of the study area, which would help identify which direction drivers are traveling during both peak periods (see **Figure 17**). For vehicles exiting the study area in the AM peak period, the analysis showed there was an even trip distribution in both directions on S Military Highway, and in both directions on I-464 (more than 200 trips in each direction). During the PM peak period, the analysis showed a higher number of vehicles (more than 300 trips) headed westbound on S Military Highway across the river (see **Figure 18**). This data would also support the need for a stop along Route 57 in the study area.

Figure 15: StreetLight Data – Trips Entering the Study Area in the AM Peak

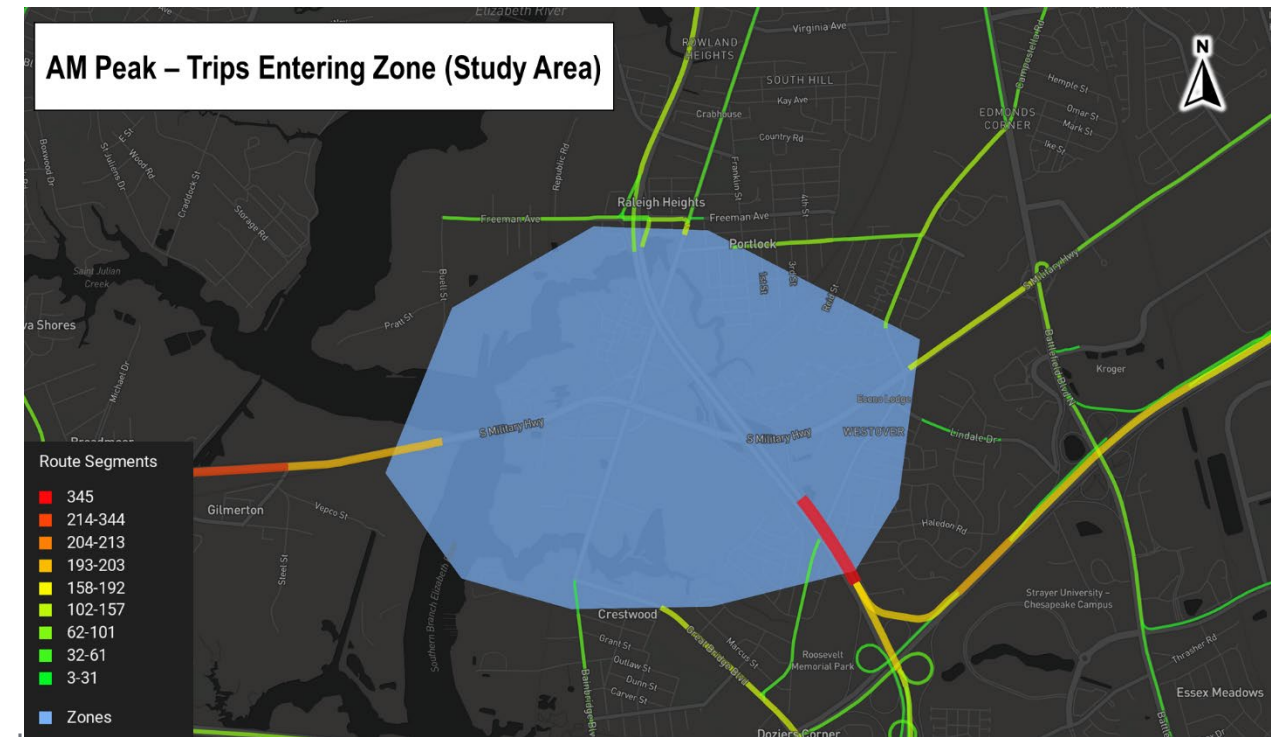


Figure 16: StreetLight Data – Trips Entering the Study Area in the PM Peak

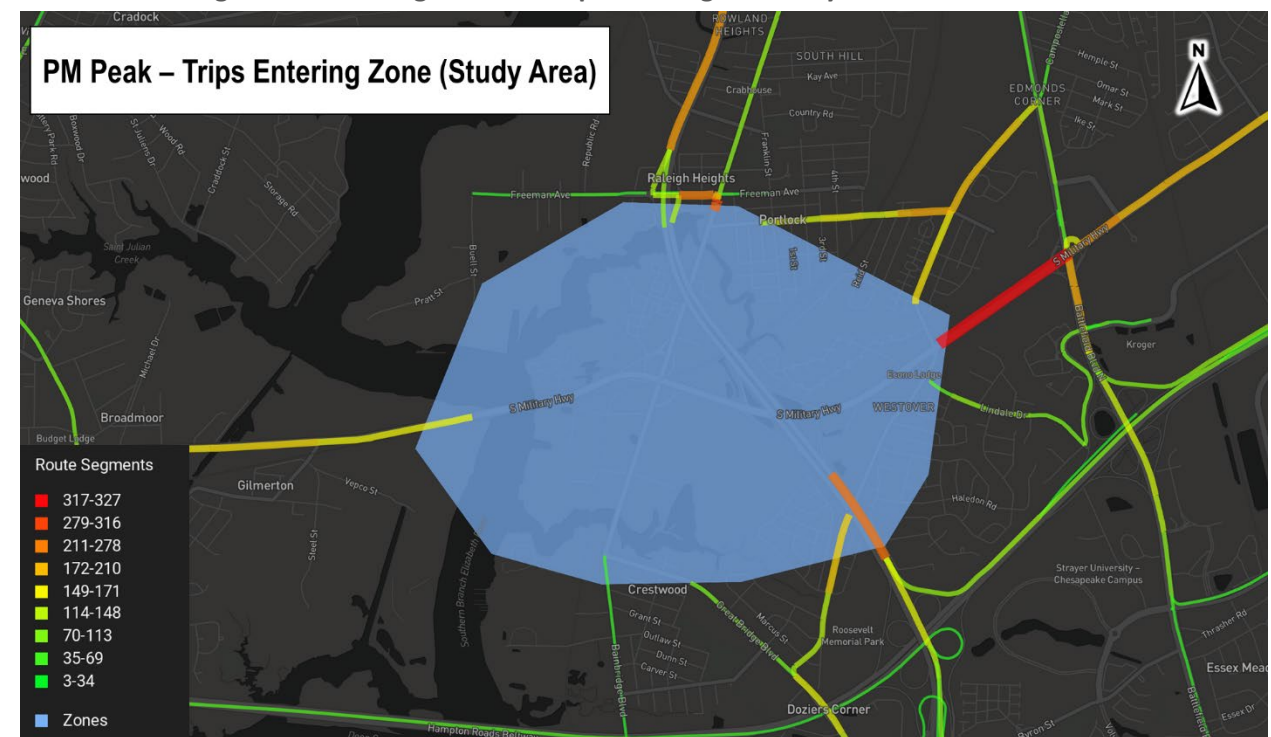


Figure 17: StreetLight Data – Trips Exiting the Study Area in the AM Peak

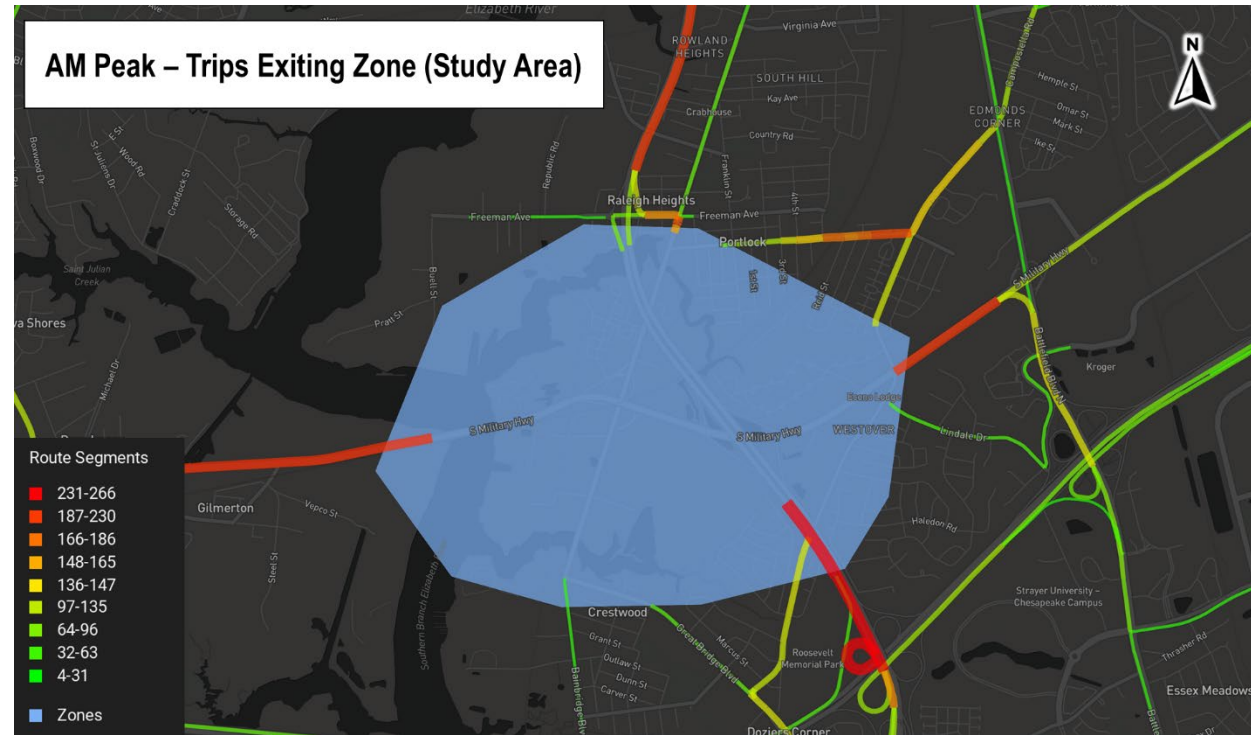
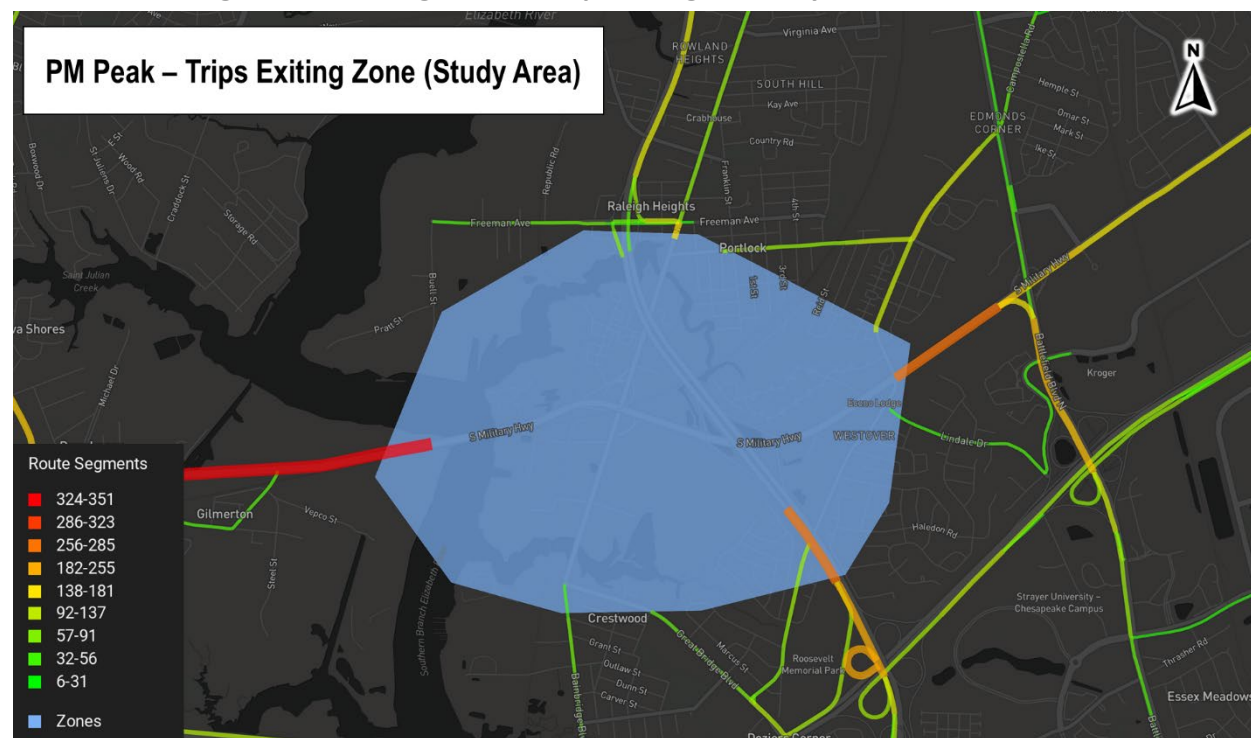


Figure 18: StreetLight Data – Trips Exiting the Study Area in the PM Peak



The final StreetLight analysis completed evaluated the patterns and volumes of trips traveling through the study area during the AM and PM peak hours. These trips do not end nor begin in the study area. As shown in **Figure 19** and **Figure 20**, there was a high trip volume in both peak periods traversing the study area along I-464. This data indicates that there would be a high propensity for a Park & Ride, carpool, or commuter lot within the study area based on its location and traffic patterns as a crossroads for the region.

Figure 19: StreetLight Data – Trips Through the Study Area in the AM Peak

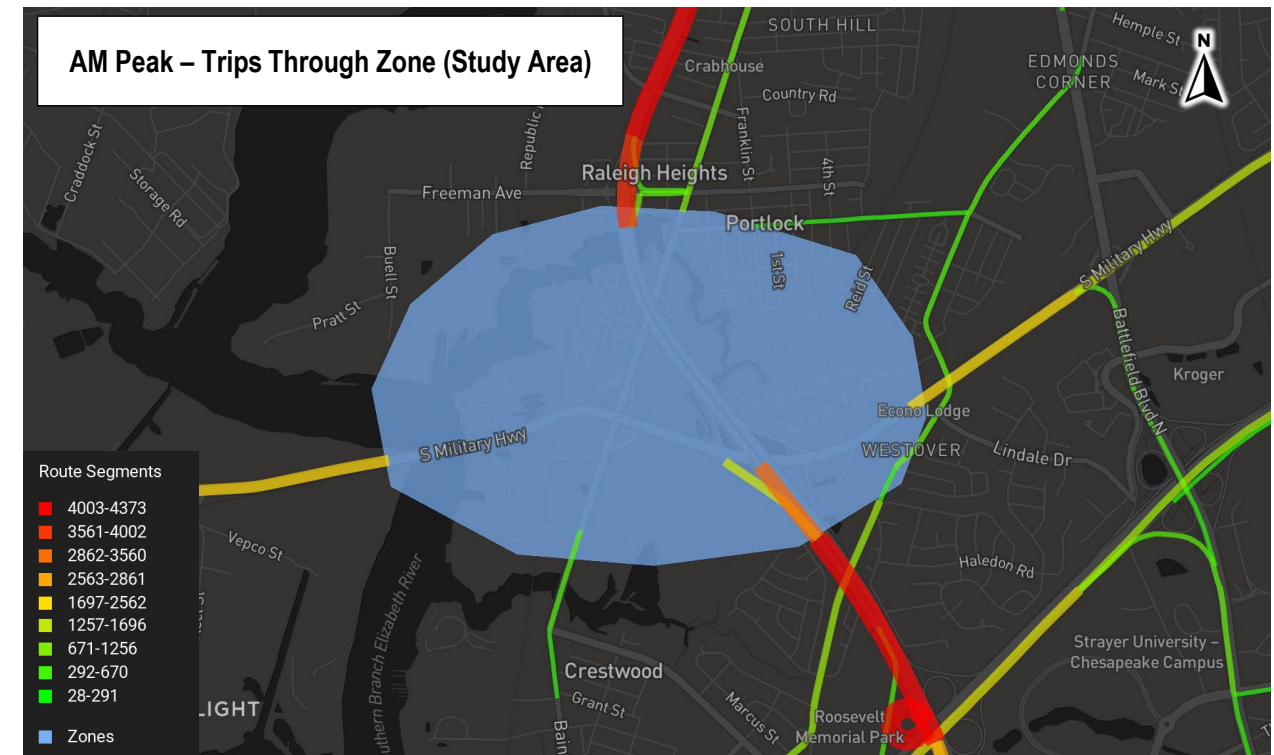
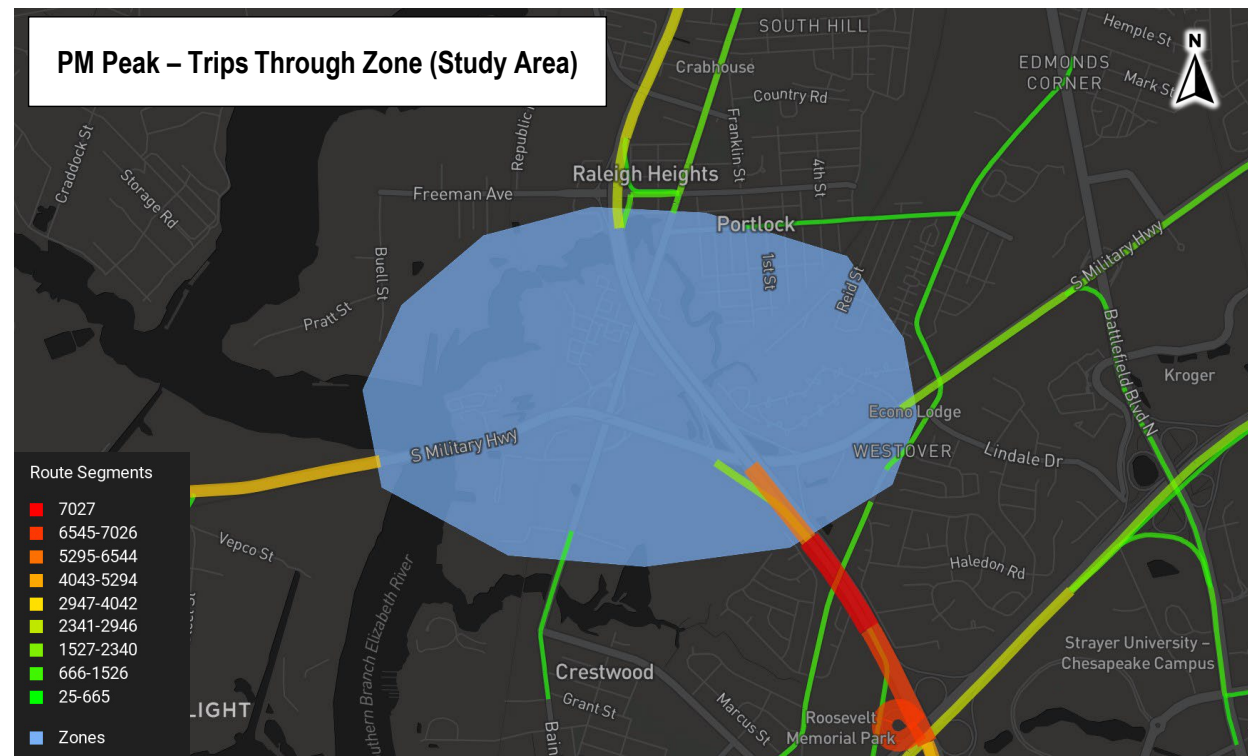


Figure 20: StreetLight Data – Trips Through the Study Area in the PM Peak



- Merging is difficult
- Lack of turn lanes
- A lot of sudden stopping and rear-end crashes

### 1.6.4 No-Build Conditions Analysis

Traffic volumes were projected for 2045 traffic conditions so that future traffic conditions in the study area could be evaluated by the study team to be used to evaluate long-term advantages of the proposed improvements identified in this study and improvements related to other projects. To estimate future 2045 traffic volumes, traffic growth rates applied to current traffic volumes were gathered from the following sources:

- **Hampton Roads Regional Travel Demand Model (TDM)**  
Outputs from the Hampton Roads Regional TDM, which included base year data from 2022 and future year data for 2045, were adjusted using NCHRP 765 methodologies that incorporate project-specific and VDOT project traffic count data to calibrate future volume projections. Using the adjusted future year (2045) TDM output and existing available count data, linear traffic growth rates for the study area were developed.
- **Historical traffic count data**  
Historical traffic count data were sourced primarily from official VDOT historical AADTs. Significant development and regression trends between years were identified, outliers were removed, and a linear regression analysis was performed to produce linear traffic growth rates for segments throughout the study area. The 2013 Gilmerton bridge construction activities west of the study area on S Military Highway were considered.
- **Socioeconomic data**  
Population and employment data from traffic analysis zones (TAZ) in the 2022-2045 Hampton Roads Regional TDM were reviewed and compared to the linear traffic growth rates developed from the TDM.

**Figure 21** and **Table 11** present recommended linear traffic growth rates and computed traffic growth rates using historic traffic volumes and the HRTPO TDM. An annual traffic growth rate of 1% was applied on Bainbridge Boulevard north of S Military Highway and 2% south of S Military Highway. An annual traffic growth rate of 0.5% was applied on S Military Highway east of Bainbridge Boulevard and 1% west of Bainbridge Boulevard. Traffic growth rates development was presented in a stakeholder meeting on September 14, 2023 and approved by VDOT on January 24, 2024. The full presentation is included in **Appendix D**.

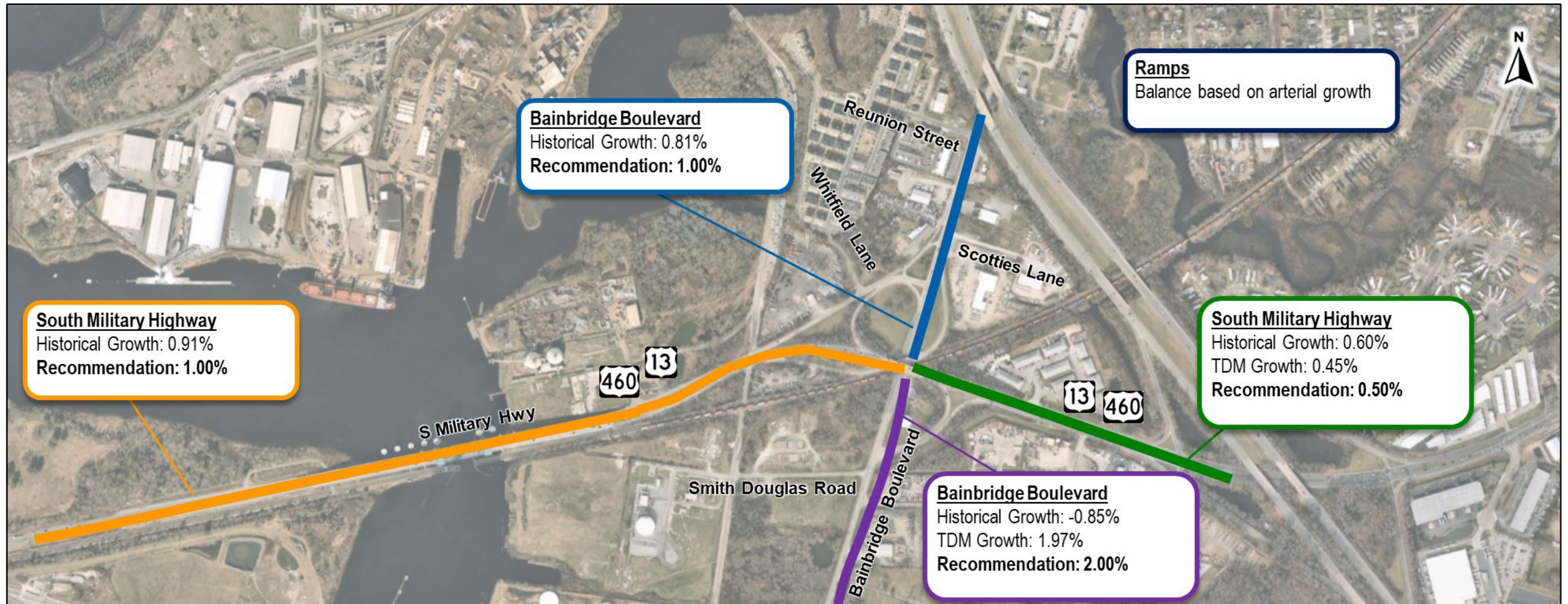
### 1.6.3 Phase 1 Public Outreach

The Phase 1 Public Input survey was held from August 24, 2023, to September 11, 2023, to collect feedback on existing traffic, safety, transit, and bicycle and pedestrian issues within the study area. The online survey included 267 participants with 331 comments. Participants ranked reducing traffic congestion and corridor safety/intersection safety as the two most important issues in the study area. Speeding/aggressive driving and lack of sidewalks/missing sidewalks were identified as the greatest safety issues. Detailed results from the Phase 1 public outreach efforts can be found in **Appendix C**.

Common themes among written comments included the following:

- Area is unfit and dangerous for pedestrian walking or bicycle travel. However, people walk alongside the roads because there is no alternative walking or bicycle route.
- Degraded/uneven street surface (especially Bainbridge Boulevard). Lane markings are not visible, and area could use a clean up
- Poor road conditions
- Gilmerton Bridge needs a lift schedule
- Major flooding under the Triple Decker Bridge

Figure 21: Study Area Recommended Growth Rate



**Table 11: Linear Traffic Growth Rate Development Summary**

ID	Segment	Historical Linear Growth Rate	Projected TDM Linear Growth Rate	Recommended Linear Growth Rate
1	Bainbridge Blvd. north of S Military Hwy	0.81 %	<i>Value not used due to TDM exceeding validation threshold</i>	1.0%
2	S Military Hwy. east of Bainbridge Blvd.	0.60%	0.45%	0.5%
3	Bainbridge Blvd. south of S Military Hwy	-0.85%	1.97%	2.0%
4	S Military Hwy. west of Bainbridge Blvd.	0.91%	<i>Value not used due to TDM exceeding validation threshold</i>	1.0%

development of light industrial facilities. Though, there are no publicly announced plans for either of these developments to occur.

- Bainbridge Boulevard south of Military Highway is planned be widened to four lanes to Dominion Boulevard, according to the Chesapeake 2050 Master Transportation Plan. However, there are no formal plans for that improvement to occur. Based on the preliminary results of this study, they improvement may not be warranted.

### Synchro Analysis

Traffic operational analyses were conducted to evaluate the overall performance of the study intersections under No-Build (2045) AM and PM peak hour conditions. The AM and PM 2045 traffic volumes are shown in **Figure 22**. The intent of No-Build conditions analyses was to provide a general understanding of the baseline future traffic conditions as a starting point for developing improvements alternatives. No-Build conditions were modeled using Synchro 11 for the entire study area. The results of the No-Build analyses are shown in **Table 12**.

The existing conditions Synchro models were used as a basis for developing the No-Build models for the AM and PM peak hour conditions. The models were updated with the projected 2045 No-Build traffic volumes and reopening of the eastbound S Military Highway to northbound Bainbridge Boulevard flyover ramp following completion of construction. With the reopening of this ramp, all traffic currently making the westbound right turn from the eastbound S Military Highway off ramp was shifted to the flyover ramp. No-Build inputs and analysis methodologies were applied consistently in accordance with the TOSAM.

The following information summarizes the traffic development findings.

- Given the relatively low existing traffic volumes on Bainbridge Boulevard, the 2% linear traffic growth rate between 2022 and 2045 represents a low increase. For example, at one intersection in this segment, it would result in a 160 vehicle increase for the northbound approach during the peak hour. Comparatively, a 1% increase at the same location would be an 80-vehicle increase, which is only an 80-vehicle difference in the approach volume.
- Following a review of the TAZ data for the TDM model, it was noted the TAZs to the south of the interchange projected a 23% increase in employees (by place of work) while the TAZ to the north projected no employee growth. Likewise, the TAZs to the south projected a 23% increase in the number of households while the TAZs to the north projected an increase in the number households from 18 to 214 (1,000%). However, the main townhome neighborhood in the study area and in this TAZ was completed and fully open between 2017 and 2022, so much of that traffic growth should not be considered.
- There are some similarities between this socioeconomic growth and the land use plan growth in Chesapeake 2035. There is one small area designated as high density residential to the south of the interchange which has not yet been developed. There are also areas for further

Figure 22: No-Build 2045 AM and PM Peak Hour Traffic Volumes

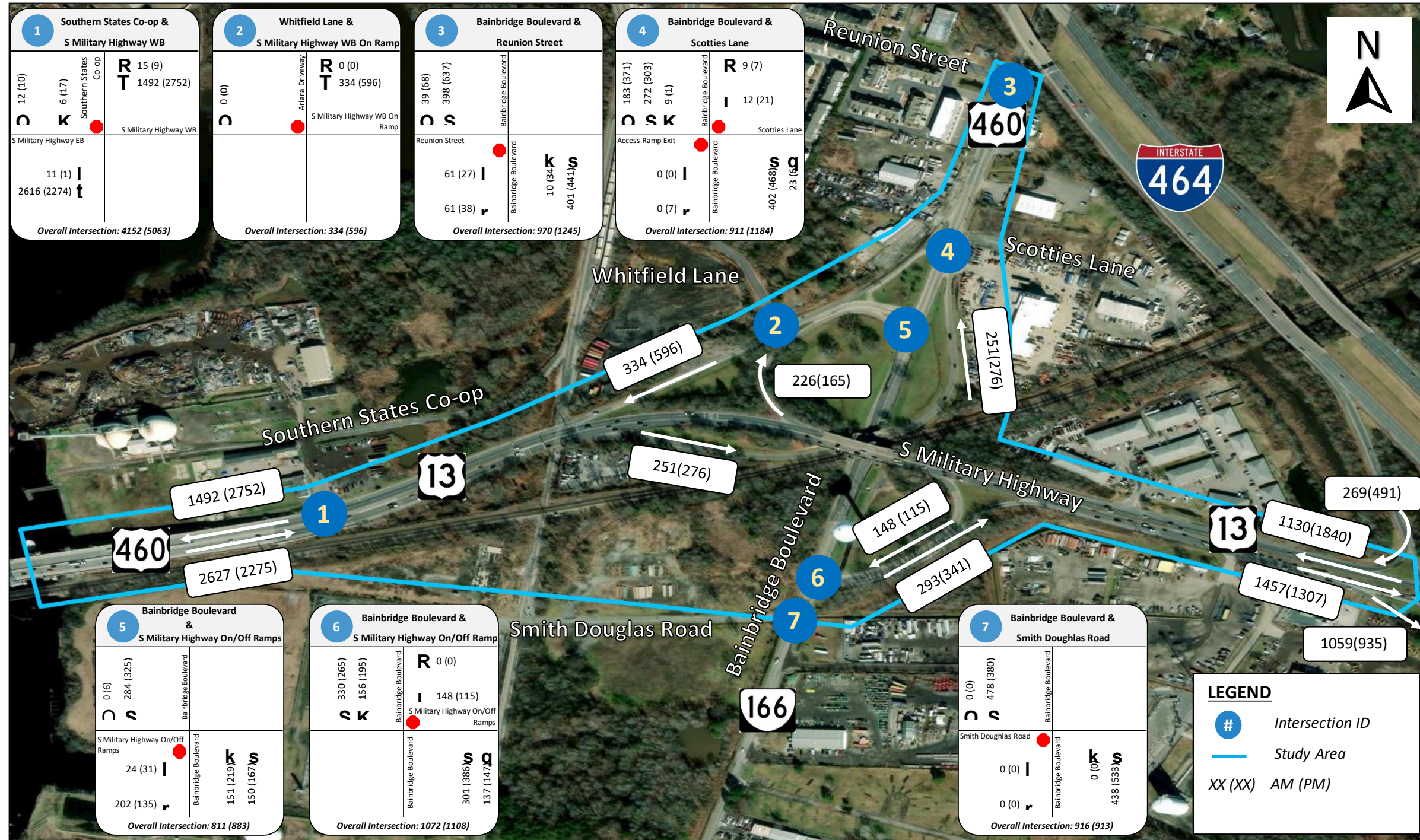


Table 12: Synchro Analysis Result for 2045 No-Build Conditions Peak Hour Control Delay and LOS

Intersection Number and Description	Type of Control	Lane Group	Northbound				Southbound				Eastbound				Westbound			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1 S Military Hwy and Southern States Co-op	Unsignalized	Left	†	†	†	†	2181	F	9502	F	17.0	C	36.1	E	†	†	†	†
		Through	†	†	†	†	†	†	†	†	0	A	0	A	0.0	A	0.0	A
		Right	†	†	†	†	2181.0	F	9502.0	F	†	†	†	†	0.0	A	0.0	A
		Approach	†	†	†	†	2181.0	F	9502.0	F	0.1	A	0	A	0.0	A	0.0	A
3 Bainbridge Boulevard and Reunion Street	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Reunion Street												
		Left	8.3	A	9.5	A	†	†	†	†	19.7	C	28.7	D	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	0.0	A	0.0	A	11.6	B	13.9	B	†	†	†	†
Approach	0.2	A	0.7	A	0.0	A	0.0	A	15.7	C	20	C	†	†	†	†		
4 Bainbridge Boulevard and Scotties Lane	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Driveway				Scotties Lane								
		Left	†	†	†	†	8.3	A	8.4	A	0.0	A	10.1	B	16.7	C	19.6	C
		Through	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	10.1	B	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	0.0	A	10.1	B	16.7	C	19.6	C
Approach	0.0	A	0.0	A	0.3	A	0.0	A	0.0	A	10.1	B	16.7	C	19.6	C		
5 Bainbridge Boulevard and US 13 WB Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 SB Ramps												
		Left	8.6	A	8.9	A	†	†	†	†	18.3	C	23.9	C	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	11.9	B	12.0	B	†	†	†	†
Approach	4.3	A	5.1	A	0.0	A	0.0	A	12.6	B	14.2	B	†	†	†	†		
6 Bainbridge Boulevard and US 13 EB On/Off Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 EB On/Off Ramps												
		Left	†	†	†	†	8.5	A	9.0	A	†	†	†	†	46.0	E	54.4	F
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†				
		Right	0.0	A	0.0	A	†	†	†	†	†	†	†	†	†			
Approach	0.0	A	0.0	A	2.7	A	3.8	A	†	†	†	†	46.0	E	54.4	F		

† SYNCHRO does not provide level of service or delay for movements with no conflicting volumes

The following trends were observed under No-Build conditions.

### AM and PM Peak Hours

- All movements were observed to be performing at an LOS C or better except the:
  - Southbound approach at the S Military Highway and Southern States Co-Op intersection (LOS F in AM and PM peak hours). Synchro results are less reliable if a movement is oversaturated (i.e., level of service is F or v/c is greater than 1) so the magnitude of delay may be overestimated. It also may be that drivers are less conservative than assumed in the Synchro analysis, and that drivers are accepting smaller and less safe gaps in traffic to make turning movements.
  - Eastbound left in the PM peak hour at the Bainbridge Boulevard and Reunion Street intersection (LOS D)
  - Westbound approach at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps (LOS E in the AM peak hour and LOS F in the PM peak hour)
- These results represent a large enough increase in traffic volumes at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps intersection to decrease operations from acceptable to unacceptable delay levels in both the AM and PM peak hours with no background improvements.

### **HCS Analysis**

The No-Build 2045 AM and PM peak hour HCS models were created based on the existing conditions models including the re-opening of the off ramp from eastbound S Military Highway to northbound Bainbridge Boulevard. In the No-Build 2045 scenario, there are five segments both the eastbound and westbound directions. The same assumptions from the existing models were applied to the No-Build 2045 models. **Table 13** and **Table 14** show the HCS analysis results for both the AM and PM peak hours in the eastbound and westbound directions.

The following trends were observed under No-Build conditions.

### AM and PM Peak Hours

- The highest density was in the AM peak hour in the eastbound direction upstream of the S Military Highway eastbound off ramp. The density is projected to be 31 pc/mi/ln and operate at a LOS D.
- Segments of eastbound S Military Highway east of Bainbridge Boulevard were observed to have increased density in the AM peak hour as compared to the same segment in the PM peak hour. Likewise, in the westbound direction, segment density increased during the PM peak hour compared to the AM peak hour.

- All S Military Highway segments were projected to operate at a LOS D or better.

### **No-Build Conditions Conclusions**

Synchro and HCS results show that there are no notable operational deficiencies on Bainbridge Boulevard and S Military Highway, except on the westbound approach at the Bainbridge Boulevard and S Military Highway on/off ramps intersection which are projected to operate at LOS E in the No-Build 2045 AM peak hour and LOS F in the No-Build 2045 PM peak hour and at the southbound approach and eastbound left movement at the S Military Highway and Southern States Co-Op intersection is projected to operate at LOS F (AM and PM peak hours) and LOS E (PM peak hour only), respectively. All other movements will be at LOS D or better based on the results of the Synchro analysis. Based on HCS analyses, all freeway segments are projected to operate at a LOS D or better in the No-Build 2045 AM and PM peak hours.

Since the Southern States Co-Op intersection is a business driveway with minimal volumes, improvements to the intersection were not proposed to be considered a need as part of this study. The westbound S Military Highway off-ramp intersection on Bainbridge Boulevard is anticipated to fail in 2045 due to the relatively large forecasted growth at that location in the TDM. Given that the existing conditions were not determined to have a safety or operations concern of note, and the historic growth at this location has been flat over the last twenty years, the SWG decided to proceed in the alternatives analysis phase without proposing intersection improvements at this location, such as addition of a signal. However, during the build operations analysis sensitivity tests would be conducted to determine if a signal would be warranted in 2045, if installation of a signal would result in acceptable operations in 2045, and whether proposed safety and multimodal improvements at the intersection would result in acceptable operations in an interim 2032 analysis year, assuming the same annual growth rate used in the 2045 forecasts.

The HCS analyses reveal minor adverse changes in speed and density, however all segments are projected to remain within the level of acceptable operations.



Table 13: HCS Analysis Result for 2045 No-Build Conditions Peak Hour Speed, Density, and LOS along S Military Highway (Eastbound)

Eastbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (MPH)	Density (pc/mi/ln)	LOS	Speed (MPH)	Density (pc/mi/ln)	LOS
Downstream of Gilmerton Bridge	Basic	47.8	30.9	D	47.8	27.0	D
Off-Ramp to Bainbridge Blvd NB	Diverge	47.4	31.1	D	47.4	27.2	C
Off-Ramp to Bainbridge Blvd	Diverge	47.6	28.1	C	47.6	23.8	C
Between Off-Ramp to and On-Ramp from Bainbridge Blvd	Basic	43.1	29.0	D	43.1	24.8	C
Between On-Ramp from Bainbridge Blvd and Off-Ramp to I-464	Weaving	37.5	26.5	C	38.8	22.0	C
Overall Facility		43.3	28.6	D	43.9	24.3	C

Table 14: HCS Analysis Result for 2045 No Build Conditions Peak Hour Speed, Density, and LOS along S Military Highway (Westbound)

Westbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (MPH)	Density (pc/mi/ln)	LOS	Speed (MPH)	Density (pc/mi/ln)	LOS
On-Ramp from I-464	Merge	52.5	15.2	B	51.9	25.7	C
Off-Ramp to Bainbridge Blvd	Diverge	50.2	15.7	B	50.3	26.1	C
Between Off-Ramp to Bainbridge Blvd and On-Ramp from Bainbridge Blvd	Basic	53.9	12.0	B	53.9	22.1	C
On-Ramp from Bainbridge Blvd	Merge	52.6	16.4	B	51.6	30.4	C
Upstream of Gilmerton Bridge	Basic	55.2	15.4	B	55.2	28.2	D
Overall Facility		53.9	15.3	B	53.7	27.6	D

## 2 Alternatives Development & Refinement

The study team developed alternative concepts along S Military Highway and Bainbridge Boulevard to enhance multimodal access and address safety and geometric deficiencies in the study area.

The study team screened concepts based on anticipated safety and multimodal access benefits, constructability, estimated costs, and input from the SWG. A SWG meeting was held on July 28, 2023 to review the identified needs and brainstorm potential improvement concepts. The meeting materials are in **Appendix E**. The improvement concepts that were selected to be advanced to Phase 2 for further evaluation are described in the following section of the report.

### 2.1 Phase 1 Alternative Development

The study team developed preliminary concepts in parallel with the high-level needs diagnosis efforts documented in **Section 1.5**. The proposed Phase 1 concepts were developed to meet the following criteria:

- Provide transit access in the study area
- Enhance travel demand management opportunities
- Mitigate safety issues for all users along S Military Highway and Bainbridge Boulevard
- Enhance bicycle and pedestrian access throughout the study area

The following sections of the report describe the process used to develop Phase 1 concepts encompassing various needs categories.

#### 2.1.1 Concepts Addressing Transit Access and TDM

Concepts addressing transit access and transportation demand management (TDM) include:

- Adding a Park & Ride facility off the Bainbridge Boulevard to S Military Highway access ramp and the southern portion of the study area. This concept would increase the number of transit users and provide a carpooling option in the study area.
- Adding a bus stop in the study area on S Military Highway on the Hampton Roads Transit Route 57 would provide transit access for employees at Atlantic Corporate Park. There are currently no bus stops within the study area along S Military Highway. Adding a bus stop near Atlantic Corporate Park with a bus pad and shelter may increase ridership on this route.

- Adding a bus pad and shelter at the Hampton Roads Transit Route 58 stop on Reunion Street would provide transit users a safer and more attractive waiting area. A sidewalk connection to the adjacent neighborhood should also be considered.

#### 2.1.2 Concepts Addressing Operations and Access

Concepts addressing operations and access include:

- Providing a two-way travel roadway for vehicles on the access ramp from Bainbridge Boulevard to westbound S Military Highway to enhance vehicular access exiting Triple Decker Auto Parts to access Bainbridge Boulevard.
- Increasing the turning radius for heavy vehicles using the eastbound S Military Highway to northbound Bainbridge Boulevard off-ramp (southern loop ramp) would improve operations by accommodating the frequent number of heavy vehicles making this movement, reduce the need for additional maintenance activities, and reduce the risk of heavy vehicle collision with signage or vehicles.
- Removing the emergency-only access on Whitfield Lane would provide the residents at the Portlock Square community more direct access to S Military Highway.

#### 2.1.3 Concepts Addressing Safety

Concepts addressing safety include:

- Improving sight distance along the horizontal curve on S Military Highway through vegetation trimming to enhance safety along the horizontal curve by increasing sight distance, which could decrease the risk of rear-end crashes.
- Reviewing the posted speed limit on S Military Highway and reducing the posted speed limit to 45 MPH. The existing posted speed limit is different in both directions: 45 MPH in the eastbound direction and 50 MPH in the westbound direction. Reducing the westbound speed limit to be consistent with the eastbound direction could increase safety on S Military Highway.
- Adding curve chevrons along S Military Highway would provide enhanced conspicuity for drivers when approaching horizontal curves to improve safety.
- Adding a dynamic message sign (DMS) would provide advanced warning to drivers of queuing ahead due to the Gilmerton Bridge being raised, impacts of the railroad crossing, or peak hour traffic congestion. The sign could increase driver awareness on S Military Highway. The DMS could also be used for other regional traffic alerts and driver instructions if placed just east of the I-464 interchange.

## 2.1.4 Concepts Addressing Pedestrian and Bicycle Safety

Concepts addressing pedestrian and bicycle access include:

- Adding a shared-use path along Bainbridge Boulevard to provide a separate facility for pedestrian and bicyclists.
- Adding a crosswalk along the approaches to the Bainbridge Boulevard and Reunion Street intersection to provide a safer pedestrian access to the Hampton Roads Transit Route 58 stop.

## 2.1.5 Phase 1 Alternatives Summary

The study team discussed two additional concepts with the SWG during the brainstorming and potential concepts meeting, but were not advanced to Phase 2:


- **Railroad Grade Separation:** This concept would help with the reduction of rear-end crashes due to vehicles stopping for the Norfolk & Portsmouth Belt Line Railroad trains, but it was discussed within the study team that with this concept would be too high of a potential cost with only an estimated two rail crossings per week, as noted in **Chapter 1**.
- **Proposal of a multi-use path along S Military Highway and across the Gilmerton Bridge** was discussed but not advanced due to high speeds on the adjacent roadway, the minimal pedestrian trip generators within the corridor, and the lack of a connection to another facility east or west of the study area.

**Table 15** includes a refined list of the concepts considered in Phase 1 and the associated needs addressed. A summary of needs addressed with each corresponding concept developed during Phase 1 is shown in **Figure 23** showing the preliminary concepts categorized by the needs addressed by the concept.


**Table 15: Phase 1 Concepts and Anticipated Needs Addressed**

Need	Concept	Need	Concept
Transit Access/TDM Need	Park & Ride facility	Safety Need	Improve sight distance
	Bus stop on S Military Highway		Review posted speed limit
	Bus pad at existing stop		Add curve chevron signs
Operations and Access Need	Two-way travel on access ramp		Drawbridge/rail crossing/queue advance warning signs
	Increase turn radius for heavy vehicles	Pedestrian and Bicycle Need	Bicycle/pedestrian facility
	Remove emergency only access from Whitfield Lane		Crosswalk improvements


Figure 23: Phase 1 Scoping-Level Improvement Concepts

**Transit Access/TDM Improvements** 


1 Park and Ride facility  
 2 Add bus stop on S Military Highway  
3 Bus pad at existing stop

**Operations Improvements** 

1 2-way travel on access ramp  
2 Increase turn radius for buses  
3 Remove emergency only from Whitfield Lane

**Safety Improvements** 

1 Improve sight distance  
2 Review posted speed limit  
3 Curve chevrons  
4 Drawbridge/rail crossing/queue advance warning

**Pedestrian and Bicycle Improvements** 

— — — — Bicycle/Pedestrian Facility     
 - - - - - Crosswalk



## 2.2 Phase 2 Concepts Analysis and Refinement

A SWG meeting was held on January 9, 2024 to share the draft concept sketches and gather feedback on the alternatives. An additional SWG meeting was held on February 7, 2024 to review the revised concepts and share the concept screening results before public outreach. During the concept screening results meeting, the study team discussed each concept based on potential impacts to safety, traffic operations, cost, and right-of-way impacts. Both presentations, along with the detailed concept benefits, are included in **Appendix E**.

### 2.2.1 Study Area Concept Analysis

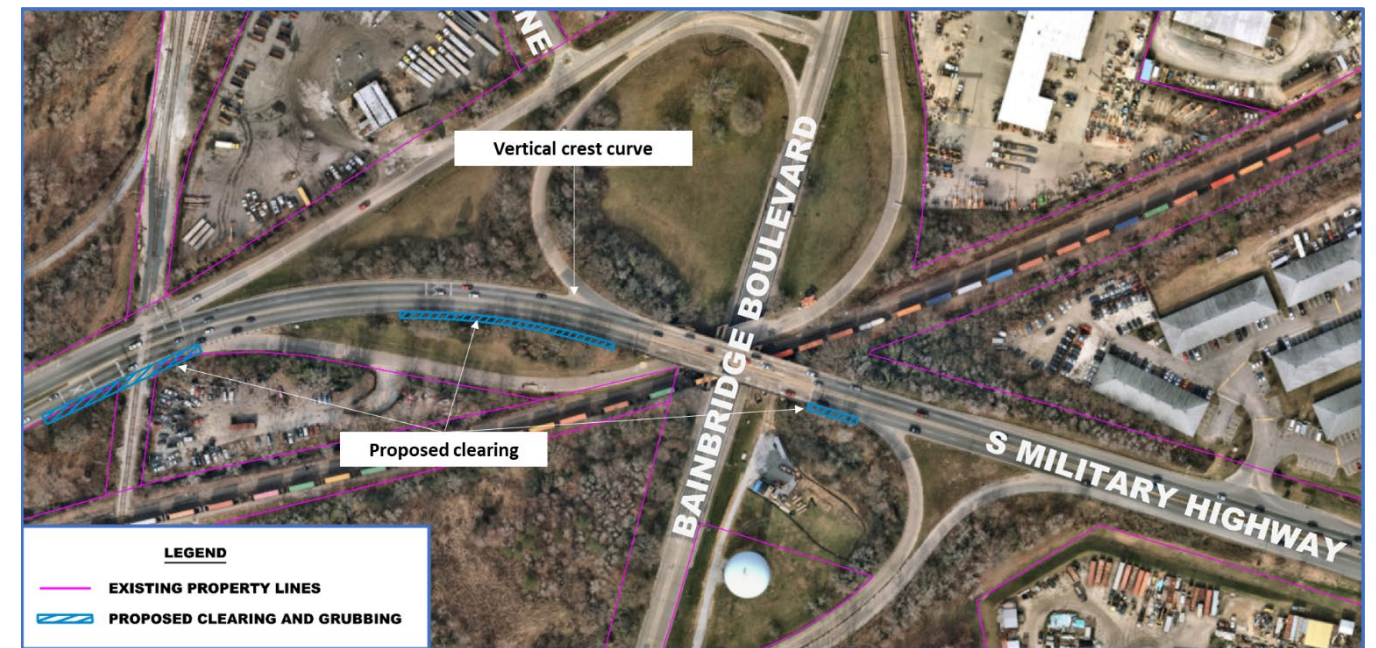
The improvement concepts were grouped into categories including safety improvements, transit/TDM improvements, and bike/pedestrian improvements. The following report sections include the documentation of the detailed descriptions for each analyzed concept.

### 2.2.2 Safety Improvement Concepts

#### Sight Distance Improvements on S Military Highway

This concept would provide clearing and grubbing along S Military Highway to improve safety by enhancing sight distance for vehicles approaching the horizontal curve, which could also provide traffic flow benefits as drivers would have more sight distance. This concept would need to be combined with another concept for state funding application since it is considered a maintenance activity. **Figure 24** presents a concept sketch of the proposed alternative.

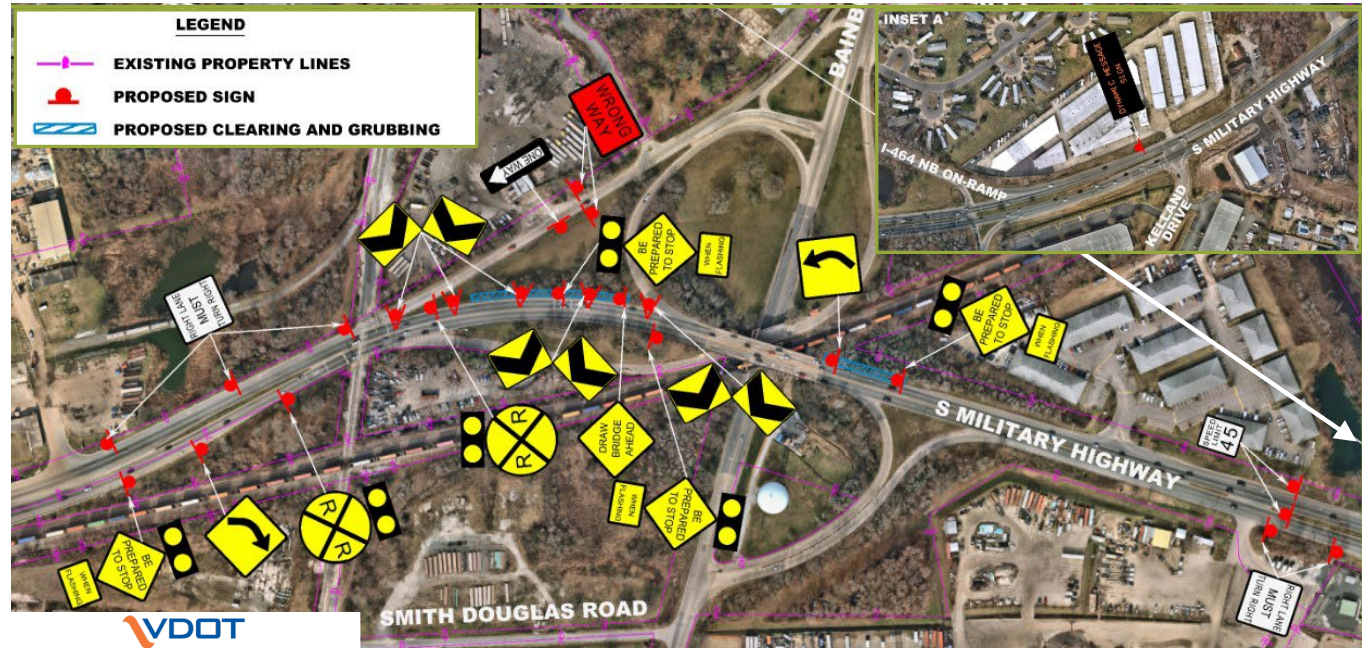
Figure 24: Phase 2 Concept - Sight Distance Improvements on S Military Highway



### Signage Improvements on S Military Highway

This concept would include additional signage on S Military Highway, including queue ahead, wrong way, and horizontal curve ahead signs. These signs would provide increased driver expectancy when approaching the horizontal curves. The proposed installation of a digital message sign (DMS) east of the study area would provide a warning to drivers when there is a train crossing or when the Gilmerton Bridge is raised to provide alternative routing suggestions. The sign could also be used to alert drivers of traffic conditions on I-464. Finally, a reduction in the current westbound posted speed limit of 50 MPH within the study area to 45 MPH was proposed to be consistent with westbound segments upstream and downstream of the study area and with the posted speed limit in the eastbound direction. This reduction in posted speed would help to reduce speeds on horizontal and vertical curves and be more consistent with observed speeds in the corridor. Based on a preliminary speed data review available using INRIX following guidance in IIM-TE 365 (Speed Limit Change Process), it is anticipated that this proposed reduction in speed limit would be acceptable. **Figure 25** shows a concept sketch of the alternative. This concept was submitted in a previous SMART SCALE application combined with an RCUT at the 2506 S Military Highway driveway but did not score high enough to receive funding.

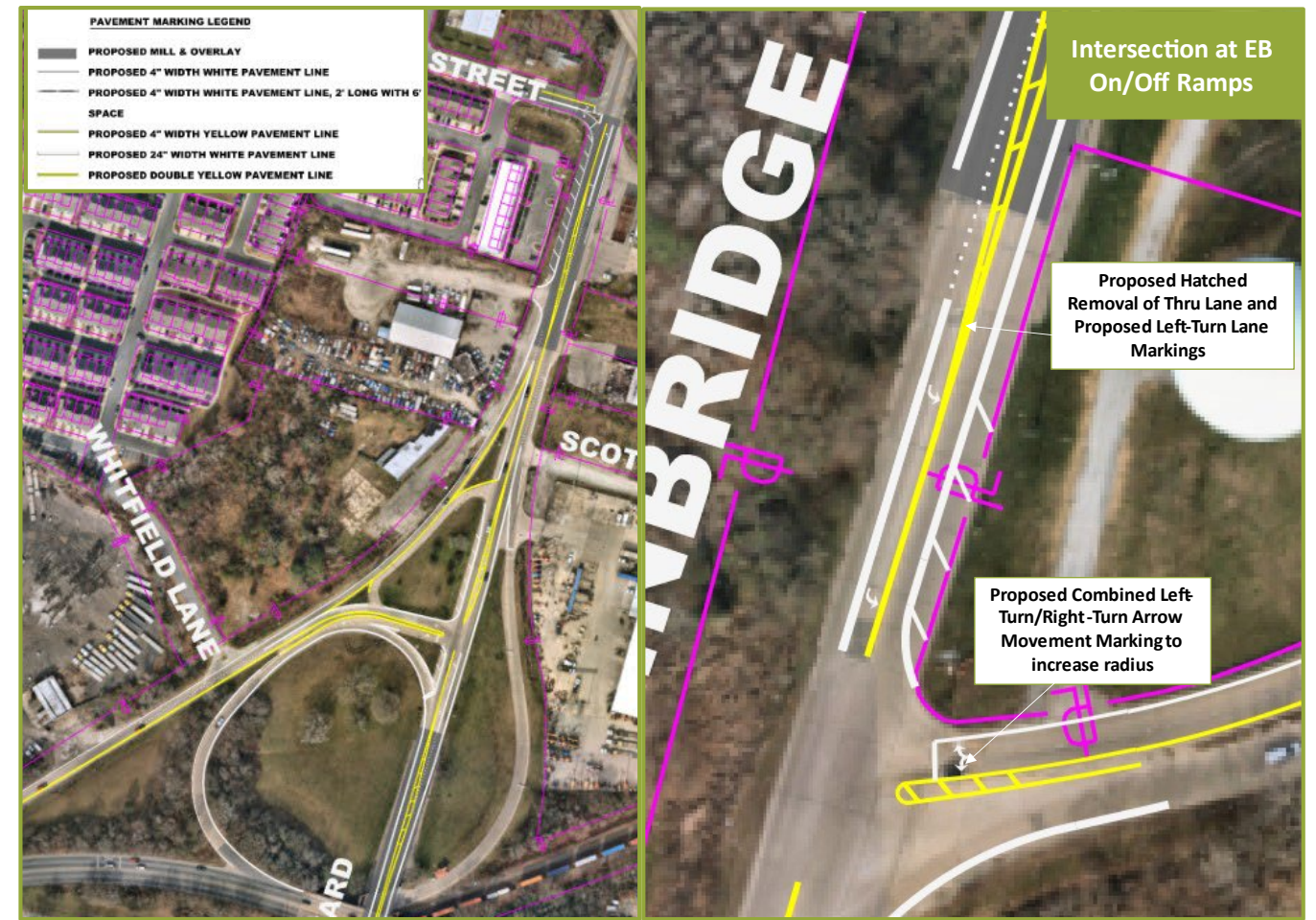
Figure 25: Phase 2 Concept - Signage Improvements on S Military Highway



### Pavement Marking Improvements Along Bainbridge Boulevard

This concept would upgrade pavement markings along Bainbridge Boulevard to improve conspicuity of the lane markings and improve lane continuity through the corridor by converting the innermost lane in both directions, which is a left-turn drop lane, to be a dedicated left-turn lane with storage. The eastbound S Military Highway to Bainbridge Boulevard ramp would also be modified to be a single lane for vehicles to turn northbound or southbound on Bainbridge Boulevard, which would provide heavy vehicles a larger turning radius and potentially reduce the risk of heavy vehicles colliding with signage or other vehicles. Finally, the pavement markings at the intersection of the westbound S Military Highway off-ramp and southbound Bainbridge Boulevard and Reunion Street and southbound Bainbridge Boulevard are proposed to be modified to remove the acceleration lanes and more clearly define which movements have the right-of-way. Retroreflective material with contrast pavement markings on concrete should be considered. **Figure 26** shows a concept sketch of the alternative.

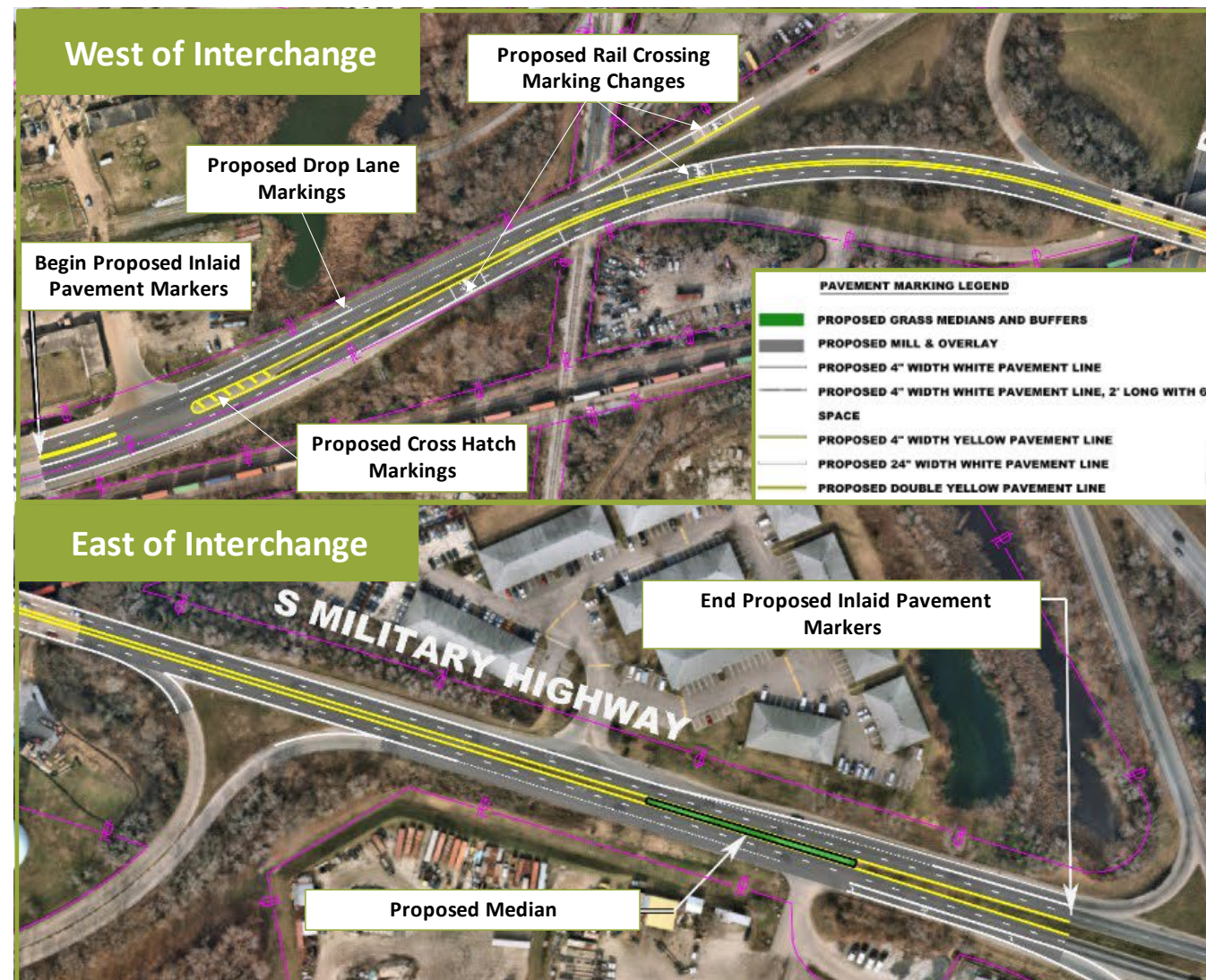
Figure 26: Phase 2 Concept - Pavement Marking Improvements Along Bainbridge Boulevard



### Pavement Marking Improvements Along S Military Highway

This concept would replace existing pavement markings with new retroreflective pavement markings, install inlaid pavement markers on the centerline, lane line, and outside lane marking, and close the median openings between Bainbridge Boulevard and I-464. This change in the median would revise access to and from the driveways along this segment to become right-in/right-out access only. Additionally, rail crossing marking changes would be applied west S Military Highway interchange, providing improved safety by reducing the risk of rear-end collisions from motorists reducing their speed to cross the at-grade railroad. **Figure 27** presents a concept sketch of the alternative.

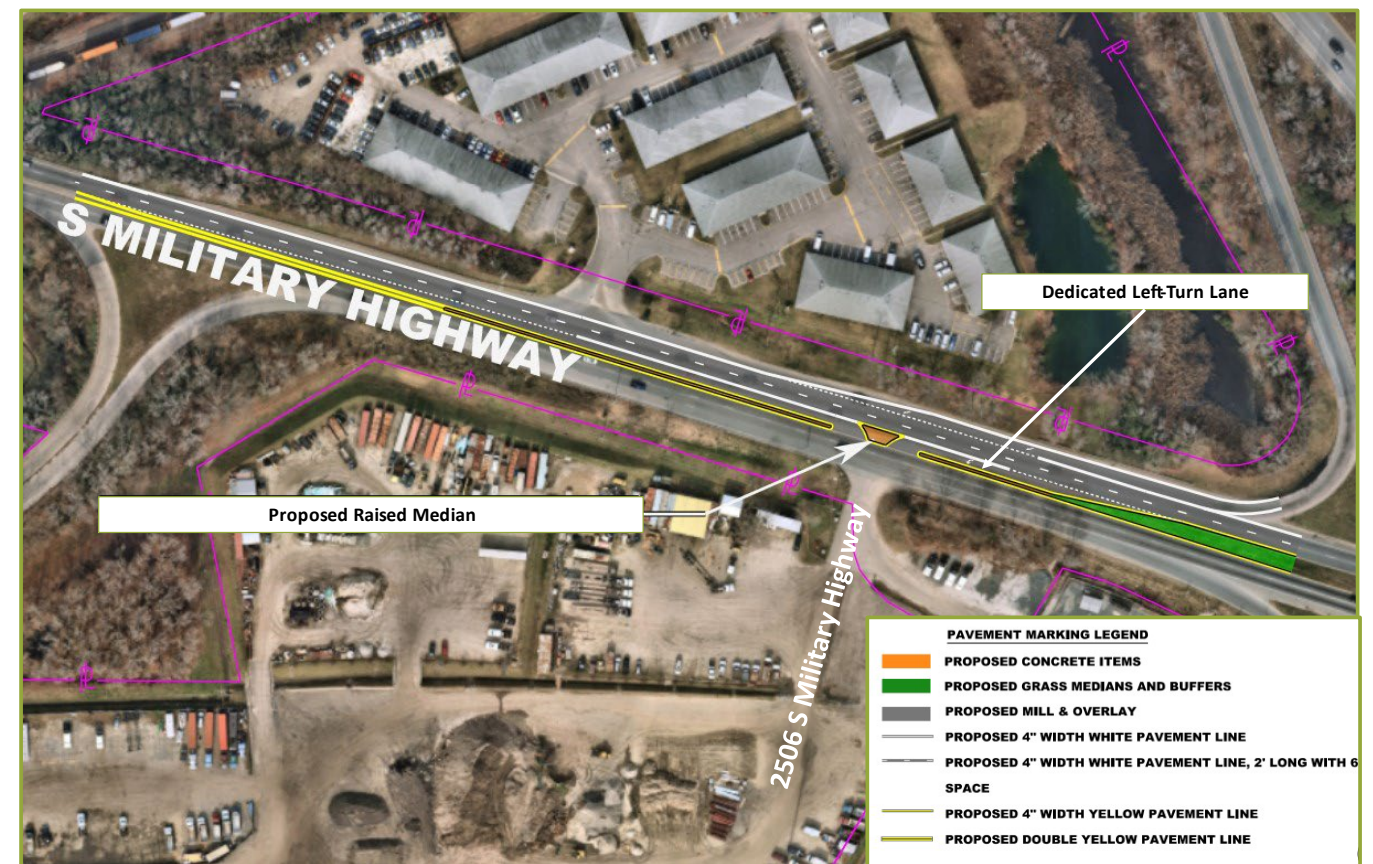
Figure 27: Phase 2 Concept - Pavement Marking Improvements Along S Military Highway



### South Military Highway Continuous-T

This concept would modify the median configuration along S Military Highway between Bainbridge Boulevard and I-464 to provide a westbound left-turn lane into the commercial driveway at 2506 S Military Highway properties and a westbound acceleration lane for vehicles turning left out of this driveway. This concept would help improve safety and operations on S Military Highway by eliminating the need for left-turn vehicles to block the eastbound inside through lane and providing acceleration for vehicles to merge into westbound traffic. **Figure 28** presents a concept sketch of the alternative.

Figure 28: Phase 2 Concept - S Military Highway Continuous-T



### S Military Highway RCUT

This concept would include the installation of a restricted crossing U-turn (RCUT) intersection on S Military Highway at the commercial driveway at 2506 S Military Highway. This intersection configuration would redirect the left turns exiting the driveway at 2506 S Military Highway to right turns that then U-turn east of I-464 at the traffic signal for northbound I-464 ramps, where a U-turn bulb-out is proposed, to travel on westbound S Military Highway. **Figure 29** presents a concept sketch of the alternative. This concept was submitted in a previous SMART SCALE application, combined with signing improvements, but did not score high enough to receive funding.

Figure 29: Phase 2 Concept - S Military Highway R-Cut



### Eastbound S Military Highway to Northbound Bainbridge Boulevard Ramp Closure

This concept would permanently close the off-ramp from eastbound S Military Highway to northbound Bainbridge Boulevard to through traffic so it can only be accessible to emergency vehicles. The ramp is currently closed during the rehabilitation of the Triple Decker Bridge which carries the ramp over Bainbridge Boulevard. This improvement would enhance safety by reducing the risk for rear-end collisions on the S Military Highway horizontal curve and improving access management at Bainbridge Boulevard merge point. **Figure 30** presents a concept sketch of the alternative.

Figure 30: Phase 2 Concept - Eastbound S Military Highway to Northbound Bainbridge Boulevard Ramp Closure



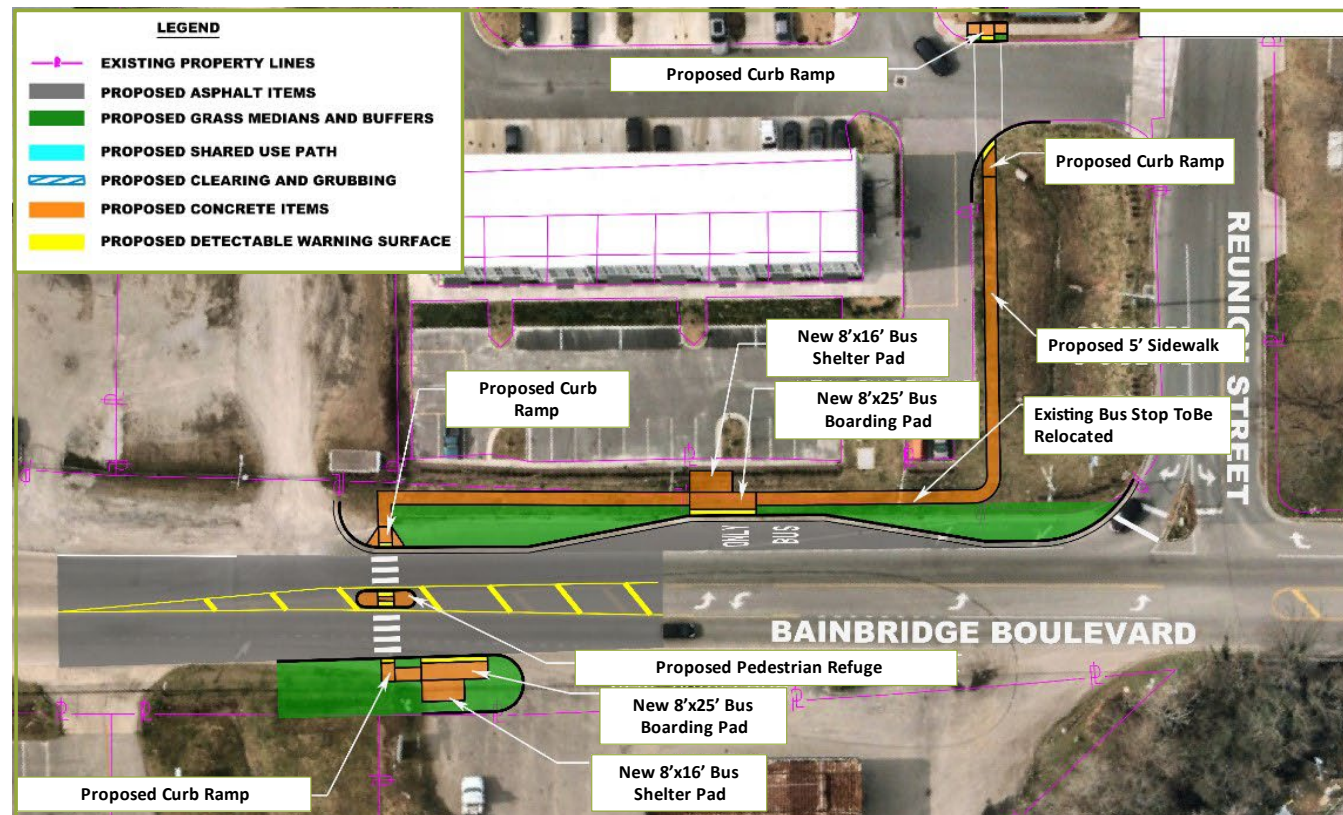


Transit/TDM Improvements

Bus Stop Improvement Along Bainbridge Boulevard

This concept would add a five-foot sidewalk to connect the existing bus stops near Reunion Street to the Portlock Square neighborhood, add a marked crosswalk with a pedestrian refuge island, and add a bus pull-off lane in the southbound direction with a shelter and boarding pad at both bus stops. Based on IIM-TE-384.1 (Pedestrian Crossing Accommodations at Unsignalized Locations), a pedestrian refuge island or a rectangular rapid flashing beacon (RRFB) for a roadway with a posted speed limit of 35 MPH is recommended. Therefore, the study team proposed a refuge island and an RRFB on Bainbridge Boulevard, which would reduce the crossing distance for pedestrians at this unsignalized crossing location and provide traffic calming benefits. Figure 31 presents a concept sketch of the alternative. A sidewalk along Reunion Street was considered, but it was instead proposed within the Portlock Square community due to utility conflicts.

Figure 31: Phase 2 Concept - Bus Stop Improvements on Bainbridge Boulevard



Bus Stop Improvements Along S Military Highway

This concept would add eastbound and westbound bus stops for existing Route 57 that travels through the study area on Military Highway but does not currently stop within or near the study area. A five-foot sidewalk and a crosswalk were proposed to connect the westbound bus stop near the Atlantic Corporate Park to the proposed eastbound bus stop at the signalized I-464 southbound ramps intersection. Hampton Roads Transit indicated they would not support adding a stop along this segment of S Military Highway, therefore, the SWG decided to not advance this concept. Figure 32 presents a concept sketch of the alternative.

Figure 32: Phase 2 Concept - Bus Stop Improvements Along S Military Highway



### Park & Ride and Ramp Access Improvements

This concept would add a park & ride/commuter lot with approximately 300 parking spaces and a bus loop for bus Routes 57 and 58 that would be adjacent to the parking lot to keep parking and bus movements separated. The bus loop would include a boarding pad, shelter, and a slip ramp to provide buses using Route 57 direct access to the westbound S Military Highway on-ramp. The park & ride lot could be used for transit or carpooling users. Public outreach and education would need to be considered to increase ridership. Current estimates from HRT indicate that approximately 1-2% of trips may switch to transit services if provided with an option. Based on an analysis of StreetLight data, it was estimated that an additional 70 - 140 users could switch to bus or carpool modes, in addition to the existing approximate 250 riders who use Routes 57 and 58 if this Park & Ride were implemented. **Figure 33** presents a concept sketch of the alternative.

### Park & Ride (Southern Option)

This concept would add a park & ride/commuter lot with approximately 1,300 parking spaces and a bus loop for bus Routes 57 and 58. The bus loop would include a boarding pad and bus shelter to keep bus movements separated from parking movements. Current estimates from HRT indicate that approximately 1-2% of trips may switch to transit services if provided an option. Based on an analysis of StreetLight data, it was estimated that an additional 70 - 140 users could switch to bus or carpool modes, in addition to the existing approximate 250 riders who use Routes 57 and 58 if this Park & Ride were implemented. Given the park & ride lot is estimated to be underutilized *the SWG decided to not advance this concept*. **Figure 34** presents a concept sketch of the alternative.

Figure 33: Phase 2 Concept - Park & Ride and Ramp Access Improvements

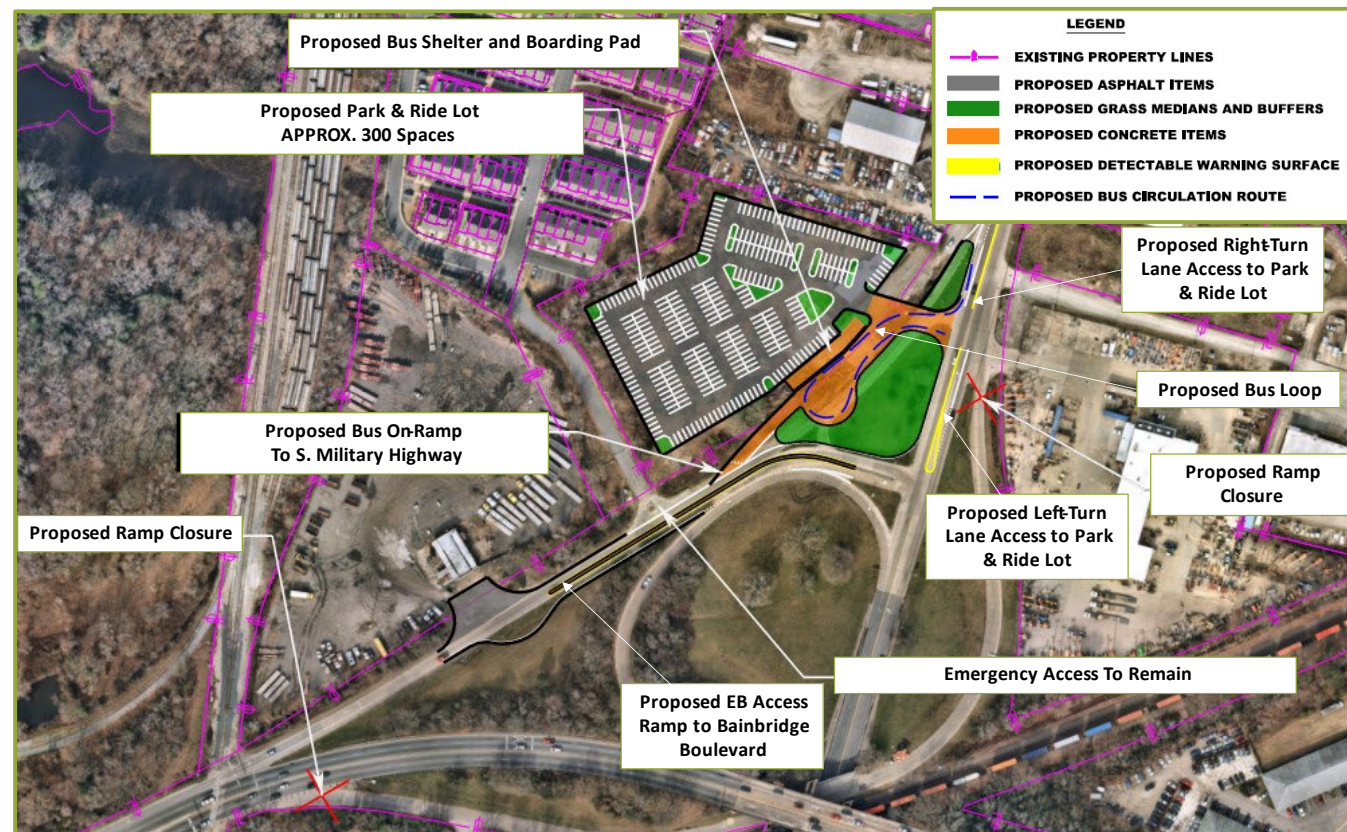
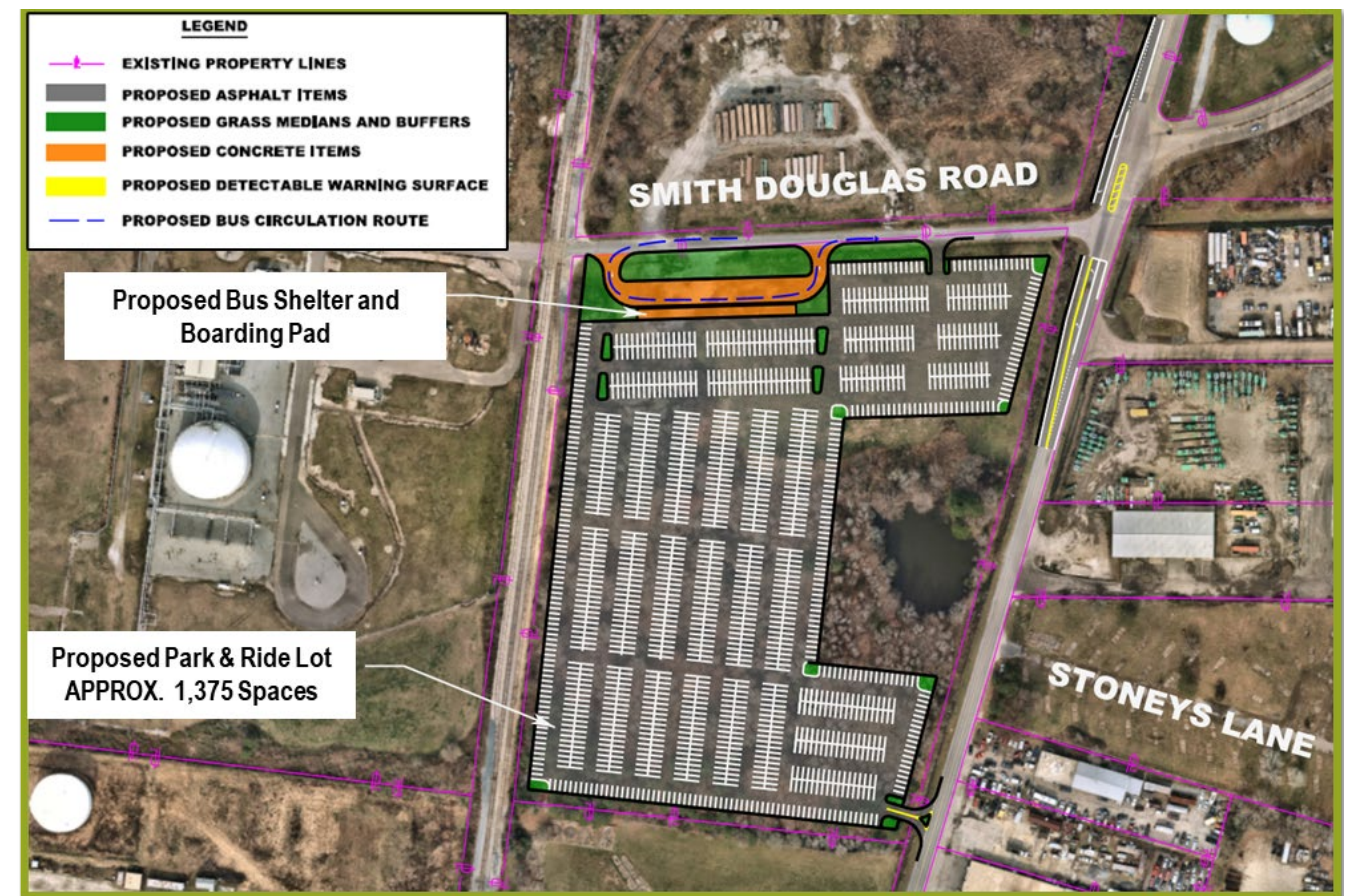


Figure 34: Phase 2 Concept - Park & Ride (Southern Option)



*Bike/Pedestrian Access Improvement Concepts*

**Whitfield Lane Shared-Use Path**

This concept would include a ten-foot shared-use path with an eight-foot buffer along Whitfield Lane connecting the Portlock Square neighborhood to the bus stop on Bainbridge Boulevard. Along portions of the access ramp, a five-foot buffer waiver may be required to minimize utility relocations. This concept would also include a new bus shelter, boarding pad, and commercial driveways for existing businesses along the shared-use path. This concept would provide improved safety and accessibility for pedestrians, bicyclists, and transit users. **Figure 35** presents a concept sketch of the alternative.

**Figure 35: Phase 2 Concept - Whitfield Lane Shared-Use Path**

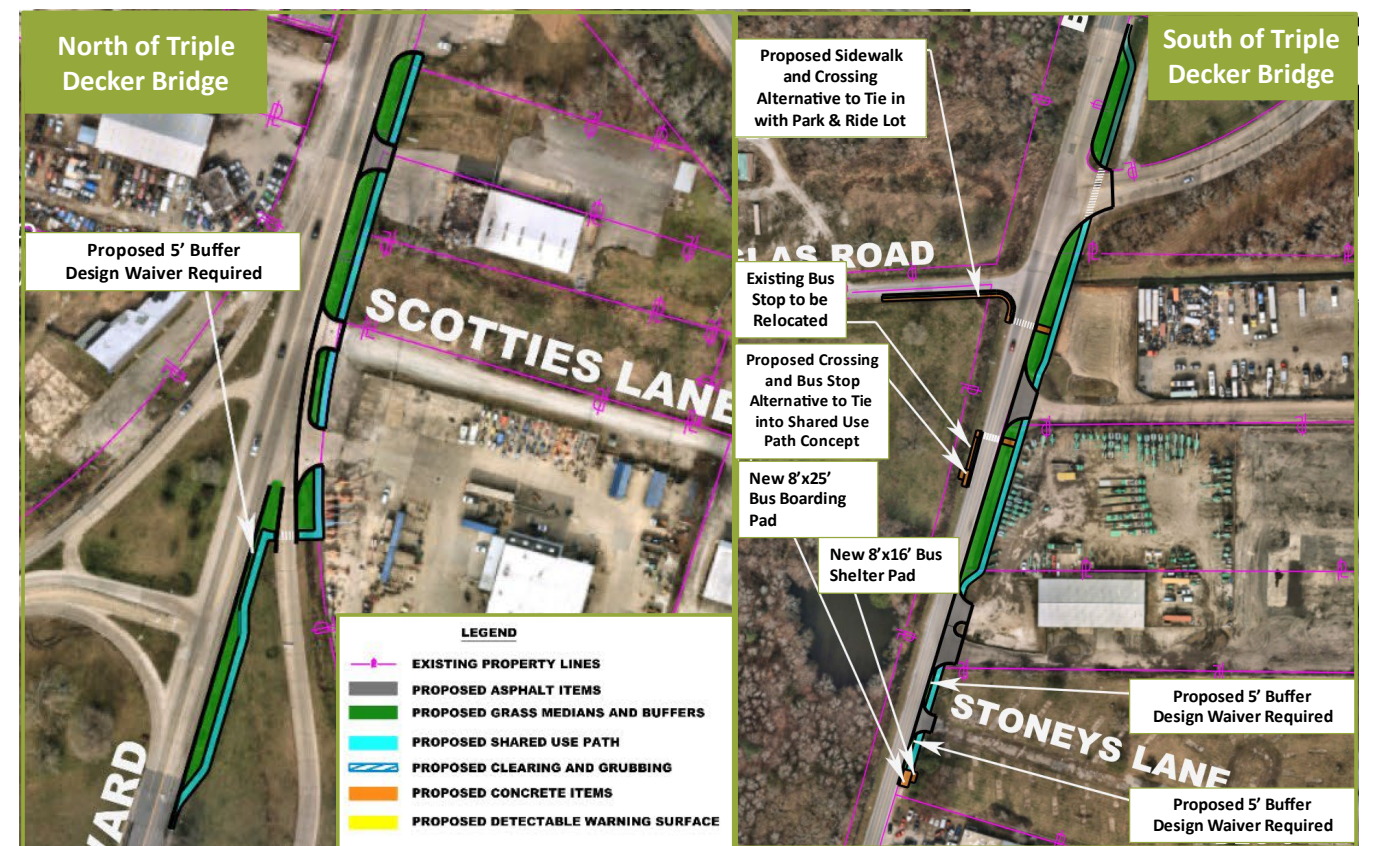


**Bainbridge Boulevard Shared-Use Path**

This concept would include a ten-foot wide shared-use path with an eight-foot buffer along the east side of Bainbridge Boulevard beginning at Stoneys Lane and ending at the Quest gas station near Reunion Street. Along portions of the corridor, a five-foot buffer waiver may be required to minimize utility relocations. This concept would update the existing bus stops to include an ADA-compliant bus boarding pad and shelter. A crossing south of the S Military Highway off-ramp would be proposed as an alternative to tie into the proposed park & ride lot or to the existing Stoneys Lane bus stop. This concept would provide improved safety and accessibility for pedestrians, bicyclists, and transit users.

**Figure 35** presents a concept sketch of the alternative.

**Figure 36: Phase 2 Concept - Bainbridge Boulevard Shared-Use Path**



### Anticipated Crash Reduction for Concepts

The study team reviewed crash modification factors (CMFs) to determine the potential safety benefits for each concept. CMFs were selected from the approved CMF list applied during the VDOT SMART SCALE safety scoring process, and where not available, the Virginia State Preferred CMF list or CMF Clearinghouse. The CMF resulting in the highest anticipated crash reduction was applied to fatal and injury crashes within the influence area of each intersection or roadway segment as applicable, as shown in **Table 16**. The CMF list has two appropriate CMFs for each improvement concept: one for all crash types and the other reserved for crashes involving a fatality and injury (F+I). Since the analysis approach focuses on F+I crashes, CMF (F+I) were applied for available concepts and CMF (All) were applied to obtain the crash reduction number for all other segments.

### 2.2.3 Phase 2 Concept Screening Summary

The primary goal of the Phase 2 concepts development was to prepare a refined set of concepts to present to the public to solicit feedback. The study team compared each concept across several metrics including safety, access management, right-of-way impacts, challenges and considerations, and cost to determine the refined concept list to present to the public, as shown in **Table 17**. Estimated costs were determined based on the VDOT one- to two-year statewide and district bid averages for major construction bid items and a comparison of recent projects of similar size and scope. More detailed itemized cost estimates will be prepared in Phase 3. Right-of-way impacts were determined based on potential concept conflicts to parcels in the study area using geospatial information. An order of magnitude of low, medium, or high was assigned to the relative impact of each concept. Qualitative benefits that were not reflected in the CMF scoring or synchro models were identified, and challenges, risks, and constraints were identified by the study team to be considered in the decision-making process and the design phases. Since the proposed improvements pertained to safety, multimodal, and access related strategies, operational performance was not used to compare the concepts. Systemic improvements, such as vegetation control and sign improvements, were not presented to the public as they were considered maintenance improvements and would be grouped with other concepts for state or federal funding applications.

Table 16: CMF and Crash Reduction for Concepts

Concept	CMF Name	CMF (All)	F+I CMF	Number of F+I Crashes	F+I Crash Reduction
<b>Sight Distance Improvements</b>	Increase stopping sight distance on crest vertical curve	0.7	0.76	15	4
<b>Signage Improvements on S Military Highway</b>	Upgrade railroad crossing signs to flashing lights	0.23		7	5
	Upgrade horizontal curve signage	0.82		12	3
		0.82	0.75	12	
	Change posted speed limit from X MPH to Y MPH	0.79		23	5
	Install changeable "queue ahead" warning signs	0.84		12	2
<b>Pavement Marking Improvements on Bainbridge Blvd</b>	Systemic signage and pavement marking improvements	0.917	0.899	3	0
<b>Pavement Marking Improvements on S Military Hwy</b>	Add raised pavement markers	0.87	0.87	55	7
	Add median or close median opening (convert to right-in/right-out)	0.4		5	3
<b>Continuous Green-T</b>	Median acceleration lane/green-T	0.85		5	1
<b>RCUT</b>	Convert two-way stop control to unsignalized RCUT	0.45		5	3
<b>Ramp Closure</b>		**		*	*
<b>Bus Stop Improvement along Bainbridge Blvd</b>	Presence of bus stops (bike crashes)	0.18		*	*
	Install RRFB	0.53			
	Add crosswalk	1			
<b>Bus Stop Improvements along S Military Hwy</b>	Presence of bus stops (bike crashes)	0.18			
	Add or upgrade sidewalk	0.12			
<b>Park &amp; Ride (Northern Option)</b>		**			
<b>Park &amp; Ride (Southern Option)</b>		**			
<b>Shared-Used Path along Whitfield Land</b>	Add shared-use path	0.75			
	Add shared-use path or mixed-use trail	0.12	(Pedestrians)		
		0.41	(Bicyclists)		
<b>Shared-Used Path along Bainbridge Blvd</b>	Add shared-use path	0.75			
	Add shared-use path or mixed-use trail	0.12	(Pedestrians)		
		0.41	(Bicyclists)		

\* No recent applicable historic crashes

\*\* No applicable CMF for the improvement exists

Table 17: Phase 2 Concept Screening Summary

Category	Concept	Estimated Cost	Crash Reduction	Access Management	ROW Impacts	Qualitative Benefits	Challenges and Considerations
Safety Improvement Concepts	Sight distance improvement along S Military Highway	< \$100K	4 crashes	None	Low	- Improved safety - Traffic flow benefits	- Concept combination
	Concept signage improvements along S Military Highway	\$500 K - \$700 K	15 crashes	None	Low	- Improved safety - DMS - Improved safety and operations	- Maintenance - ITS integration - I-464 Interchange
	Pavement marking improvements along Bainbridge Boulevard	\$300 K - \$400 K	< 1 crash	Low	None	- Improved safety - Improved operations - Improved resiliency	- Maintenance - Operations
	Pavement marking improvements along S Military Highway	\$800 K - \$1.1 M	10 crashes	Medium	Low	- Improved safety - Improved operations	- Maintenance - Property impacts
	S Military Highway continuous-T	\$600 K - \$700 K	1 crash	None	None	- Improved safety and operations access	- Safety - Operations
	RCUT on S Military Highway	\$900 K - \$1.5 M	3 crashes	Low	None	- Improved safety - Improved operations	- Design - Operations
	EB S Military Highway to NB Bainbridge Boulevard ramp closure	<\$100 K	N/A	Low	None	- Improved safety, operations, and access management	- Heavy vehicles
Transit/TDM Concepts	Bus Stop Improvement along Bainbridge Boulevard	\$200 K - \$300 K	<i>No recent bike/ped crashes documented</i>	Low	Low	- Improved access - Improved transit facilities and operations - Improved operations - Improved safety	- Design
	Bus stop improvements along S Military Highway	\$400 K - \$500 K	<i>No recent bike/ped crashes documented</i>	None	None	- Improved access - Improved transit facilities and operations - Improved safety	- Design - Ridership
	Park & Ride and ramp access improvements (Northern option)	\$6.2 M - \$8.0 M	N/A	Low	High	- Reduced traffic congestion - Increased transit utilization	- Public outreach and education - Bus design
	Park & Ride (Southern Option)	\$20.1 M - \$26.4 M	N/A	Low	High	- Reduced traffic congestion - Increased transit utilization	- Public outreach and education - Bus design
Bike and Pedestrian Access Improvement Concepts	Whitfield Lane shared-use path	\$1.4 M - \$1.7 M	<i>No recent bike/ped crashes documented</i>	None	Low	- Improved safety and accessibility	- Design
	Shared-use path along Bainbridge Boulevard	\$1.6 M - \$2.1 M	<i>No recent bike/ped crashes documented</i>	None	Medium	- Improved safety and accessibility	- Design

# 3 Public & Stakeholder Outreach & Feedback

The Project Pipeline process involved targeted outreach and stakeholder input for the alternative concepts in the study area. The study team developed concept sketches, prepared presentation materials, and created a public survey to meet the public engagement needs of this study. Systemic improvements, such as vegetation control and signage improvements, were not presented to the public as they were maintenance-related activities and would be consolidated with other concepts for potential future state or federal funding applications and would not warrant public input.

## 3.1 Stakeholder Coordination

Stakeholder engagement was a key component in the decision-making process to share study recommendations and receive feedback to consider factors other than just traffic operations. The stakeholders shared their regional and local knowledge about the study area and helped guide the study direction. The project stakeholders identified in **Section 1.3** were involved in all steps of the Project Pipeline Process and assisted in decision making with respect to which concepts advanced to the public engagement phase of the project.

## 3.2 Public Involvement

A PublicInput survey was available from March 6 to March 20, 2024 to collect feedback on potential improvements and concepts in the study corridor. The survey provided the SWG with an understanding of how the public viewed each concept before selecting preferred options. **Figure 37** summarizes the average ranking for each concept in the survey at S Military Highway and Bainbridge Boulevard after dividing those concepts into the two alternatives presented. A rating of 5.0 represents a strongly supported concept and a rating of 1.0 represents a strongly opposed concept.

The survey results revealed a clear trend of support for the bus stop improvement along Bainbridge Boulevard, which received the highest average rating of 4 out of 5, indicating strong support from respondents. Pavement markings along Bainbridge Boulevard (3.5 out of 5), pavement marking improvements along Bainbridge Boulevard (3.7 out of 5), Bainbridge Boulevard shared-use path (3.7 out of 5), and S Military Highway continuous green-T (3.7 out of 5) followed closely behind. Conversely, the Whitfield Lane shared-use path and park & ride and ramp access improvements

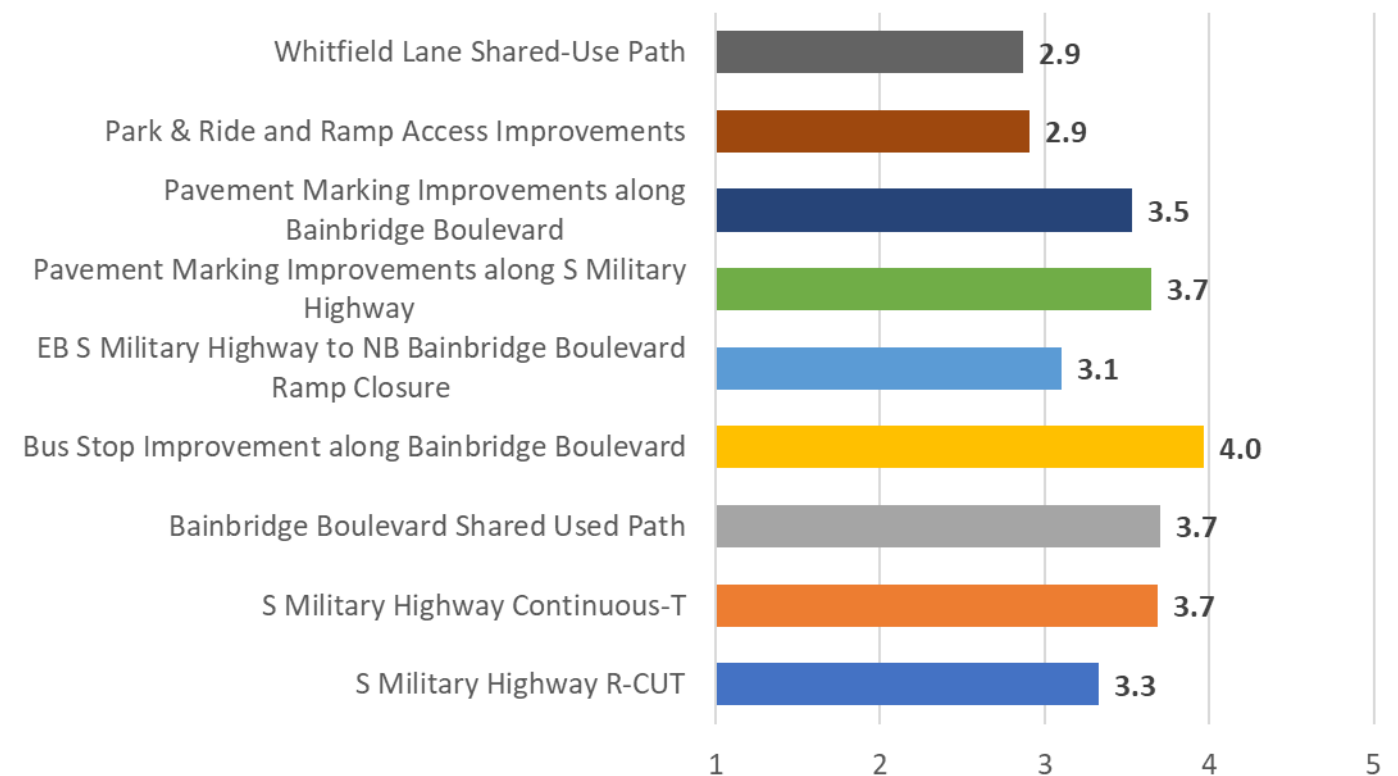
received a lower average rating of 2.9 out of 5, indicating a mostly neutral rating with a slight opposition to these concepts (i.e. neutral).

Participants were given an open comment section for each concept. Some of the most frequent topics included:

- Public concerns with pavement conditions on Bainbridge Boulevard
- Shared-use paths being useful in areas where they are needed, there are currently not many businesses and communities that support them
- Public concerns for park & ride lots utilization rates and maintenance requirements
- Public interest of a shared-use path along Whitfield Lane, but there is quicker access to the existing bus stop through Reunion Street. With the new bus stop location, a shared-use path on Whitfield Lane would be more appealing and direct

Kimley-Horn presented the PublicInput survey results to the study work group on March 20, 2024

**Figure 37: Public Engagement - Average Rating of Concepts**



## 4 Preferred Alternative & Investment Strategy

Phase 3 of the study included a detailed design, cost estimate, risk assessment, and further operations assessment of the selected preferred alternative.

### 4.1 Preferred Alternative Selection

During the SWG meeting on March 20, 2024, Kimley-Horn presented a set of concepts to advance to the development of a preferred alternative as outlined in **Section 2.2**. After reviewing the survey results and further discussing the concepts, the SWG decided to move forward with combining concepts into a single preferred alternative to be comprised of two different projects. Project 1 focused on multimodal safety and access improvements (see **Figure 38**) and Project 2 provided a park & ride/commuter lot (see **Figure 39**). The list of concepts under each project is shown in **Table 18**. **Appendix F** includes presentation materials from the Preferred Alternatives meeting. It also includes the Basis of Design document, which describes the project background and alternatives, design criteria, risks, cost estimates and other supporting materials.

Project 1 will enhance multimodal safety and access in the study area (see **Figure 40**, **Figure 41**, and **Figure 42** for the full concept design). This will be achieved through a multifaceted approach encompassing the following concept components evaluated in Phase 2:

- *Sight distance improvements along S Military Highway:* Clearing and grubbing along S Military Highway is proposed to improve stopping sight distance.
- *Signage improvements on S Military Highway:* Additional signage on S Military Highway, including a dynamic queue ahead, wrong way, railroad crossing warning signs with flashing beacons, and horizontal curve signs is proposed. Installation of a digital message sign (DMS) east of the study area is also proposed to provide a warning to drivers when there is a train crossing or the Gilmerton bridge is raised to provide alternate routing suggestions. Additionally, the DMS could alert drivers of I-464 traffic conditions. A reduction of the posted speed limit along S Military Highway to 45-mph is also proposed.
- *Pavement marking Improvements along Bainbridge Boulevard:* Replacement of all existing pavement markings with retroreflective material and contrast pavement markings on concrete are proposed, with modifications to existing striping geometrics as described here. Conversion of the innermost lane in both directions, which are left-turn drop lanes in the existing condition,

to each be a dedicated left-turn lane with storage is proposed. The eastbound S Military Highway to Bainbridge Boulevard ramp is also proposed to be modified to a shared left/right turn lane for vehicles to turn northbound or southbound on Bainbridge Boulevard which will provide a larger turning radius for heavy vehicles. Lastly, the pavement markings at the Reunion Street and Bainbridge Boulevard intersection would be modified to remove the acceleration lanes.

- *Pavement markings along S Military Highway:* Replacement of the existing pavement markings with new retroreflective pavement markings, installation of inlaid pavement markers on the centerline, lane line, and outside lane markings, and closure of the median openings between Bainbridge Boulevard and I-464 are proposed.
- *Eastbound S Military Highway to northbound Bainbridge Boulevard ramp closure:* The off-ramp from eastbound S Military Highway to northbound Bainbridge Boulevard is proposed to be permanently closed, making it only accessible to emergency vehicles. This would enhance safety by reducing the risk for rear-end collisions on eastbound S Military Highway where the existing exit ramp is located within a horizontal curve without a deceleration lane and by improving access management on Bainbridge Boulevard where the ramp merges into northbound traffic.
- *Bus stop improvement along Bainbridge Boulevard:* A five-foot sidewalk to connect the existing bus stop near Reunion Street to the Portlock Square neighborhood, a marked crosswalk with a pedestrian refuge island and rectangular rapid flashing beacons, a bus pull-off lane in the southbound direction, and a shelter and boarding pad at both bus stops are proposed.
- *Bainbridge Boulevard shared-use path:* A ten-foot wide shared-use path with an eight-foot buffer along the east side of Bainbridge Boulevard beginning at Stoneys Lane and ending at the Quest gas station near Reunion Street is proposed. Along portions of the corridor, a five-foot buffer waiver may be required to minimize utility relocations. The existing bus stops south of Smith Douglas Road would also be updated to include an ADA-compliant bus boarding pad and shelter. A marked high-visibility crosswalk is proposed to connect the northbound and southbound bus stops at this location as well.

Project 2 will enhance transit and ride share usage and pedestrian and bicycle access in the study area (see **Figure 43** for the full concept design). This will be achieved through the following components:

- *Park & Ride and ramp access improvements (northern option):* A park & ride/commuter lot with approximately 300 parking spaces and a bus loop for bus Routes 57 and 58 that would be adjacent to the parking lot to keep parking and bus movements separated is proposed. The bus



loop would include a boarding pad, shelter, and a slip ramp to provide buses using Route 57 direct access to the westbound S Military Highway on-ramp. The park & ride lot could be used for transit or carpooling users.

- *Whitfield Lane shared-use path*: A ten-foot shared-use path with an eight-foot buffer along Whitfield Lane connecting the Portlock Square neighborhood to the bus stop on Bainbridge Boulevard is proposed.

**Table 18: Phase 2 Consolidated Concepts into Projects 1 & 2**

<b>Preferred Alternative – Project 1</b>	Sight distance improvements
	Signage improvements along S Military Highway
	Pavement marking improvements along Bainbridge Boulevard
	Pavement marking improvements along S Military Highway
	Eastbound S Military Highway to northbound Bainbridge Boulevard ramp closure
	Bus stop improvement along Bainbridge Boulevard
<b>Preferred Alternative – Project 2</b>	Bainbridge Boulevard shared-use path
	Park & ride and ramp access improvements (northern option)
	Whitfield Lane shared-use path

by including a separate multi-use path for pedestrians and a bus stop off the arterial roadway, there have been no bicycle nor pedestrian crashes in the last five years in the vicinity of these improvements so the anticipated reduction in crashes is zero.

**Table 19: CMF and Crash Reduction Summary**

Alternative	F+I CMF	Five Year Crash Reduction (F+I)
Preferred Alternative – Project 1	Multiple CMF	25 - 30
Preferred Alternative – Project 2	0.12 and 0.41	*

\*No recent bike or pedestrian crashes documented

In addition to the applicable CMFs identified for Project 1 and Project 2, there are additional qualitative safety benefits provided with each concept.

Project 1 would provide improved safety by enhancing sight distance along S Military Highway, increasing driver expectancy when approaching the horizontal curve on S Military Highway, improving conspicuity of lane markings within the study area, improving lane continuity along Bainbridge Boulevard, reducing the risk of rear-end crashes along the horizontal curve on S Military Highway by removing the redundant exit ramp, improving access management along Bainbridge Boulevard where the current ramp merges with northbound traffic, and providing pedestrians and bicyclists a separate facility with safer access to existing bus stops.

Project 2 would assist in mitigating traffic congestion by constructing a park and ride facility, incentivizing commuters to utilize public transportation or carpooling. To further enhance safety and accessibility, a dedicated shared-use path would provide a separate facility for pedestrians and bicyclists traveling to and from the bus stop.

## 4.2 Safety Analysis for Alternatives

Since the two proposed projects comprising the preferred alternative are combinations of concepts, as shown in **Table 19** Error! Reference source not found., the previously described CMFs were merged to obtain the anticipated crash reduction for each project. Project 1 is expected to decrease crashes by 25 to 30 crashes. This range was established by considering the various CMFs for the concepts included in the project that have some related crash overlap. Though Project 2 would improve safety

Figure 38: Preferred Alternative Summary Sheet - Project 1

### Project Description

The improvements proposed at this location include:

- 1) Sight Distance Improvements along South Military Highway
- 2) Signage and DMS Improvements along South Military Highway
- 3) Pavement Marking Improvements along Bainbridge Boulevard
- 4) Pavement Marking Improvements along South Military Highway
- 5) Eastbound South Military Highway to Northbound Bainbridge Boulevard Ramp Closure
- 6) Bus Stop Improvement along Bainbridge Boulevard
- 7) Bainbridge Boulevard Shared Use Path

### Project Needs

The preferred alternative addresses VTrans needs relating to vehicular and pedestrian safety, congestion mitigation, bicycle access, transit access, and transportation demand management.

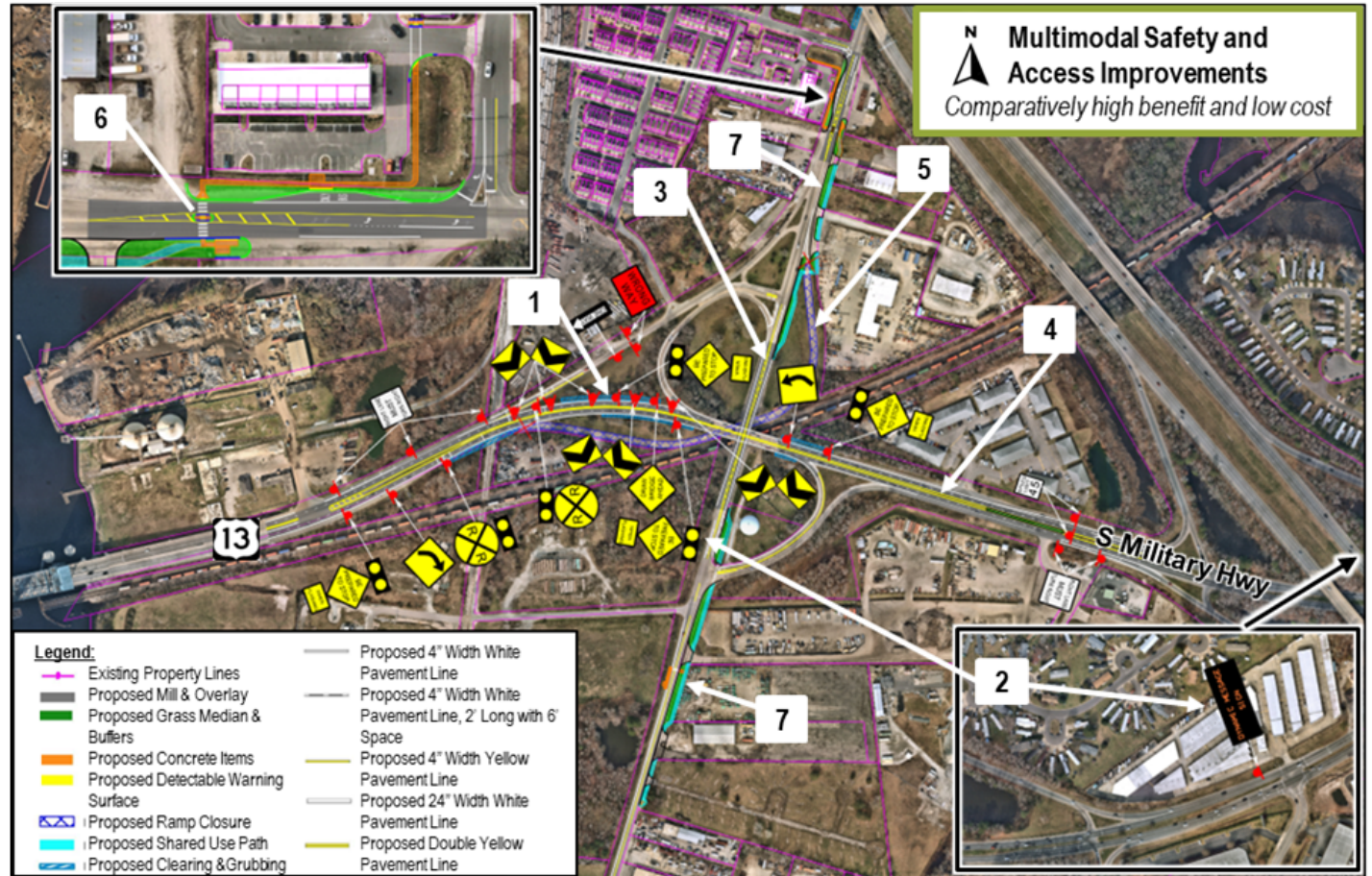
#### Needs and Priorities

Congestion Mitigation	Low	Pedestrian Safety Improvement	Low
Bicycle Access	High	Pedestrian Access	No Need
Reliability	Low	Transit Access	Low
Safety Improvement	High	Transportation Demand Mgmt.	Very High

### Project Benefits

The preferred alternative provides the following benefits:

- Enhanced safety with reduction of rear-end collisions along South Military Highway.
- Driver awareness and safety benefits through increased conspicuity for drivers along South Military Highway and Bainbridge Boulevard.
- Improves safety and connectivity by providing a separate facility for bicyclists and pedestrians.
- Improves transit facilities and operations by providing accessibility and comfort for transit users.



### PublicInput Survey Summary

- The PublicInput survey ran between March 6 and March 20, 2024 (15 days)
- Survey included 301 participants and 385 comments
- Many respondents expressed concern with pavement conditions along Bainbridge Boulevard
- Many respondents were in favor with the pavement marking updates if drivers still have access to the businesses through the median opening
- Many respondents were in favor with closing the ramp from EB South Military Highway to NB Bainbridge Boulevard with some suggesting to remove the ramp completely.
- Many respondents noted that having a shared-use paths are only helpful in areas where it is needed. Respondent would add that there are not enough businesses and communities to support it

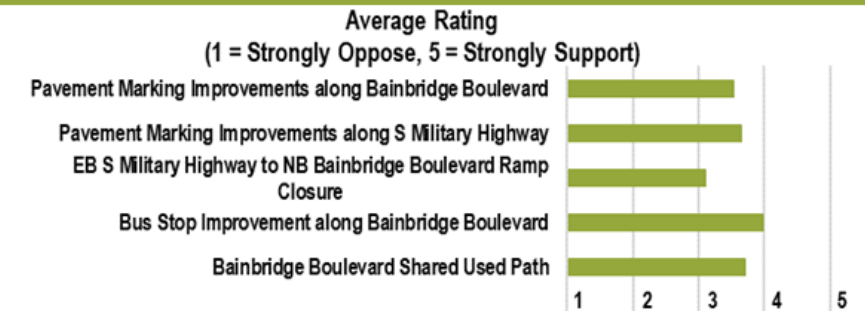


Figure 39: Preferred Alternative Summary Sheet - Project 2

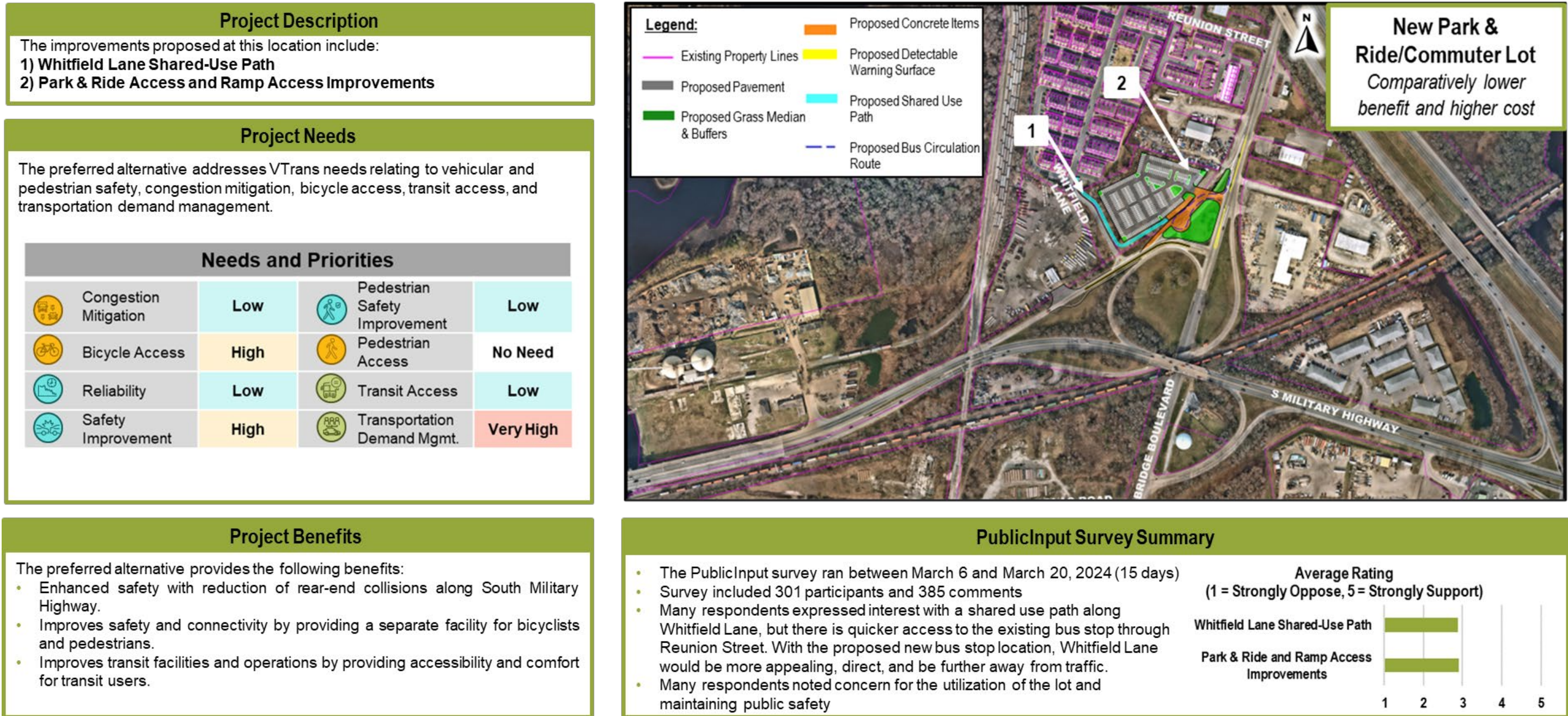


Figure 40: Project 1 - Multimodal Safety and Access Improvements (Sheet 1 of 3)

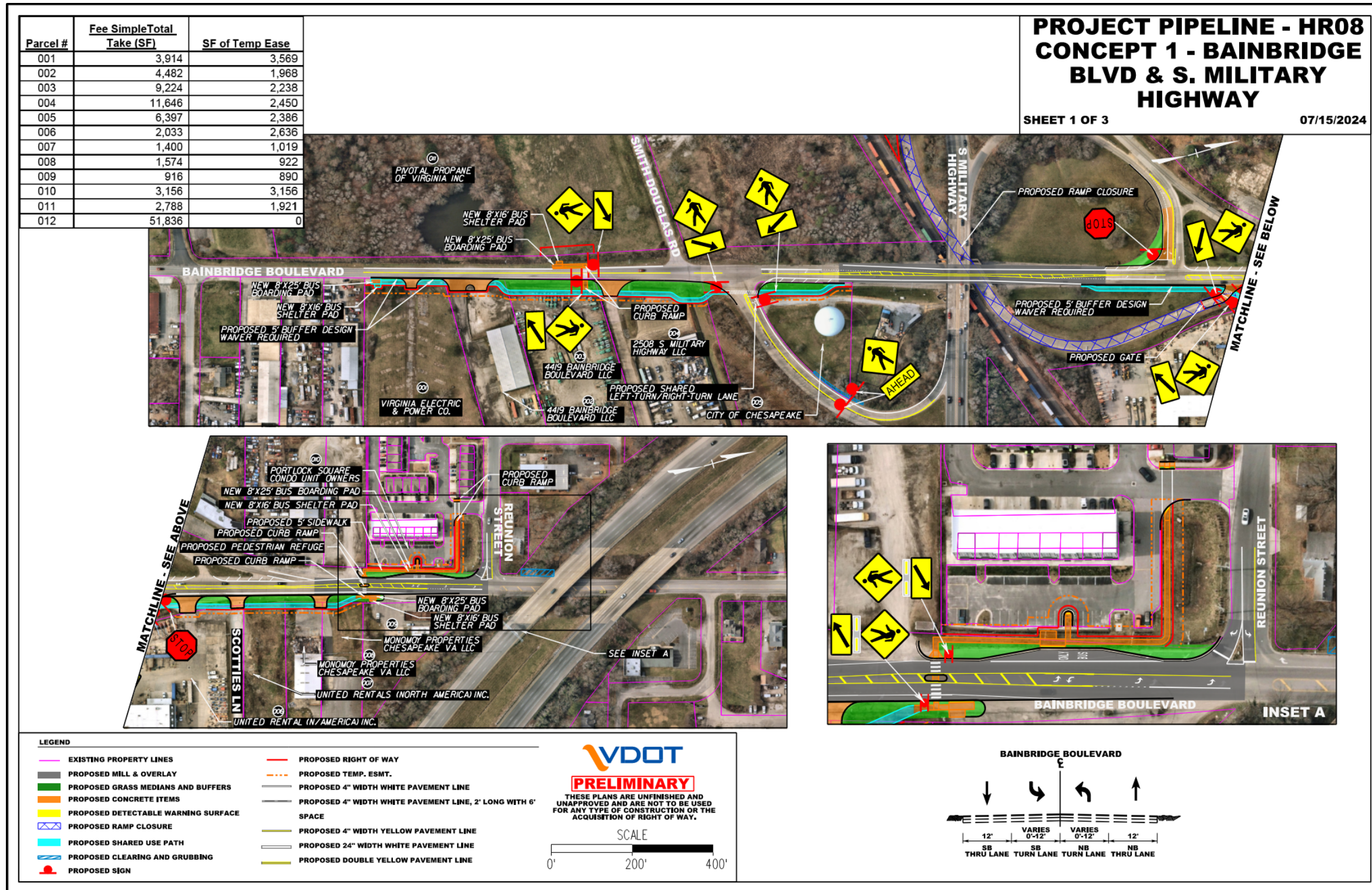


Figure 41: Project 1 - Multimodal Safety and Access Improvements (Sheet 2 of 3)

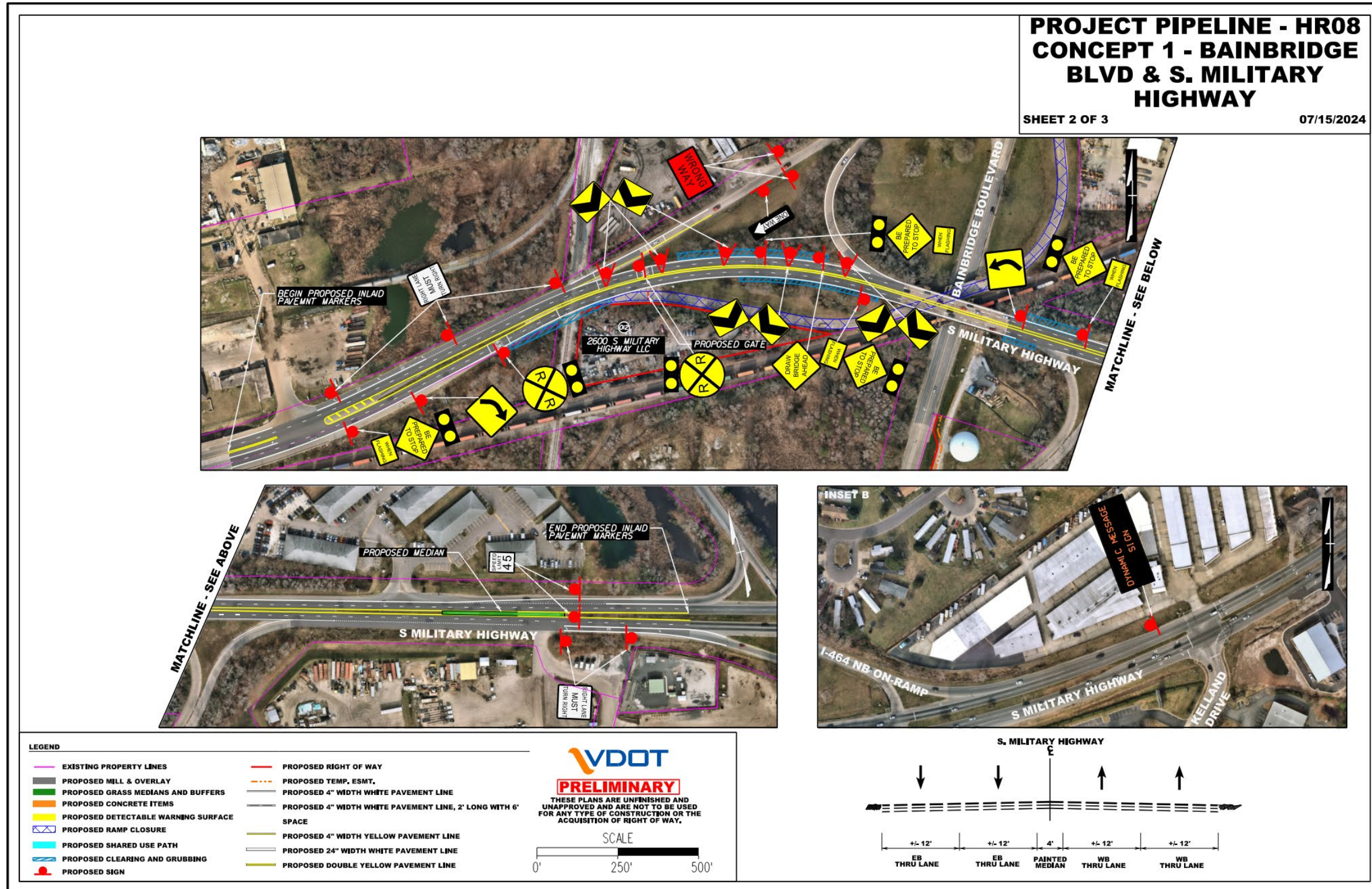


Figure 42: Project 1 - Multimodal Safety and Access Improvements (Sheet 3 of 3)

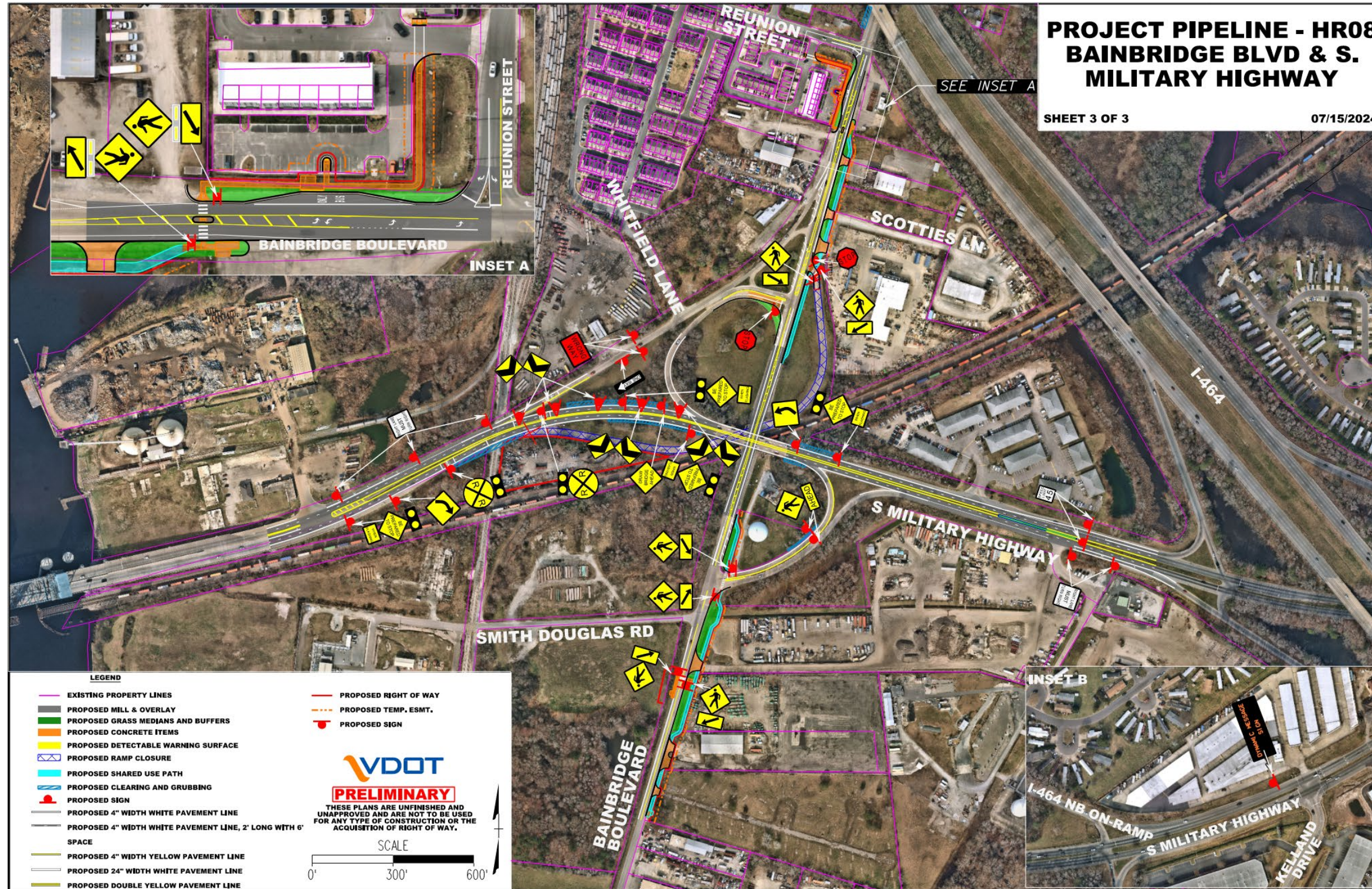
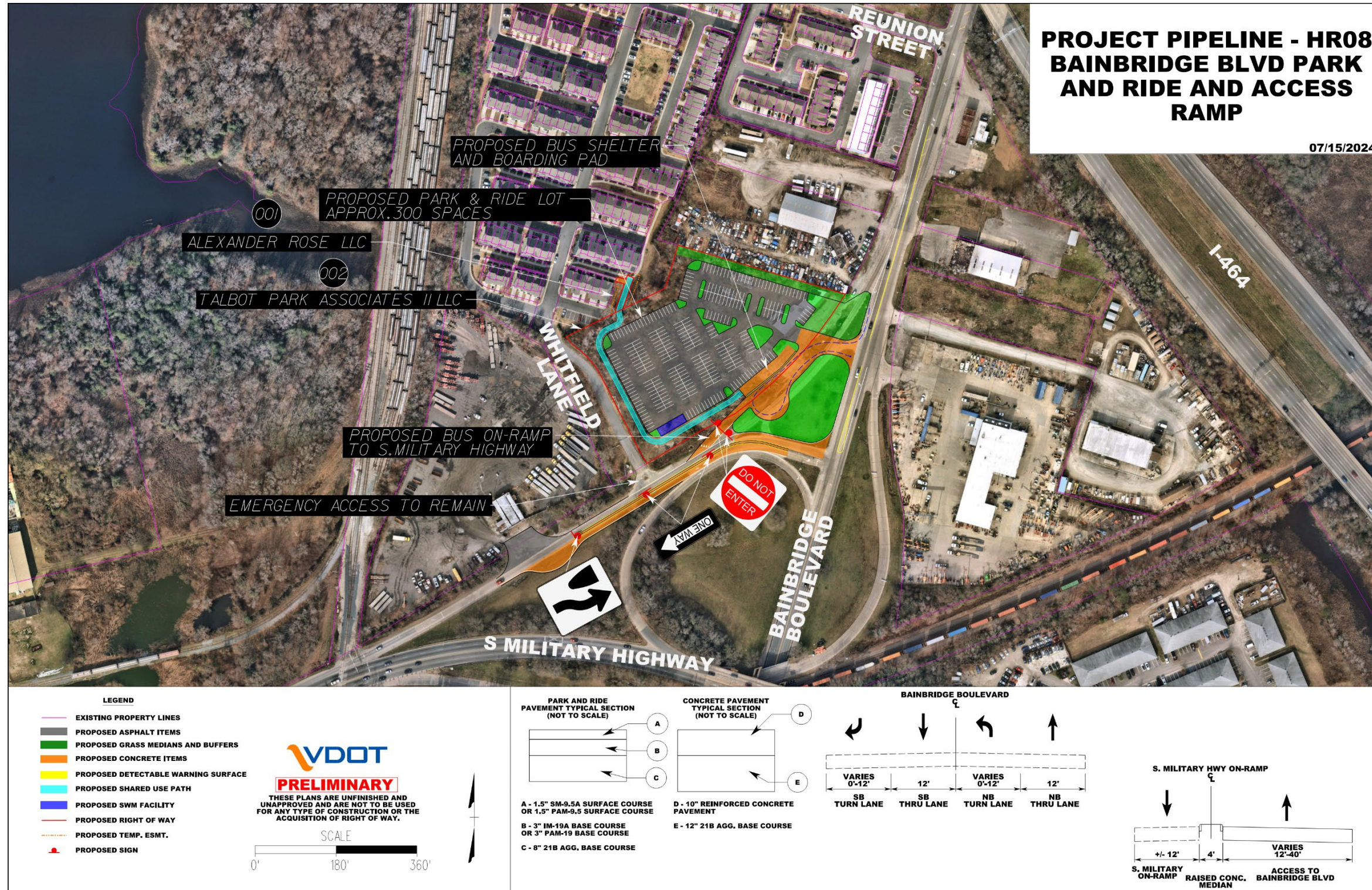


Figure 43: Project 2 - New Park & Ride/Commuter Lot



## 4.3 Operational Analysis for Alternatives

Once the preferred alternative was selected, the study team conducted Synchro and HCS analyses to refine the geometry of the preferred alternative and quantify the anticipated future traffic operations.

### 4.3.1 Synchro Analysis:

Traffic operational analyses were conducted to evaluate the overall performance of the study intersections under Build 2045 AM and PM peak hour conditions for both the Multimodal Safety & Access Improvement (Project 1) and Park & Ride (Project 2) concepts. As mentioned in **Section 1.6.4**, two additional sensitivity tests were done for Project 1 – the first with 2032 forecasted volumes with the proposed build configuration (stop control) and the second with 2045 forecasted volumes and a signalized intersection at the eastbound off ramp intersection with Bainbridge Boulevard. The AM and PM traffic volumes for all below scenarios are shown in Error! Reference source not found. through Error! Reference source not found. Build inputs and analysis methodologies were applied consistently in accordance with the TOSAM.

#### Scenario 1: Build 2045 Multimodal Safety and Access Improvement Concept (Project 1)

The Build 2045 Project 1 models were based on the No-Build 2045 models and included closure of the eastbound S Military Highway to northbound Bainbridge Boulevard flyover ramp as proposed in Project 1. With the closing of this ramp, all traffic making the eastbound to northbound movement would be shifted to the S Military Highway eastbound loop ramp to Bainbridge Boulevard as is occurring in the existing condition. The proposed laneage reconfigurations discussed above were also incorporated in the models. Build 2045 conditions were modeled using Synchro 11 for the entire study area. The results of the Build 2045 Project 1 analyses are shown in **Table 20**.

#### AM and PM Peak Hours

All movements were observed to be performing at an LOS C or better except for the following:

- Southbound approach (LOS F in AM and PM peak hours) and the eastbound left movement (LOS E in the PM peak hour) at the S Military Highway and Southern States Co-Op intersection. Synchro results are less reliable if a movement is oversaturated (i.e., level of service is F or v/c is greater than 1) so the magnitude of delay may be overestimated. It also may be that drivers are less conservative than assumed in the Synchro analysis, and that drivers are accepting of smaller and gaps in traffic to make turning movements. This delay did not increase from the no-build conditions analysis.

- Eastbound left turn in the PM peak hour at the Bainbridge Boulevard and Reunion Street intersection (LOS D); This delay did not increase from the no-build conditions analysis.
- Eastbound left turn in the PM peak hour at Bainbridge Boulevard and US 13 WB Ramps (LOS E); This delay increased from LOS C in the no-build condition.
- Westbound approach at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps intersection (LOS F in the AM and PM peak hours). This delay increased by approximately 100% as compared to the no-build conditions analysis.

To confirm that the proposed intersection configuration at the eastbound S Military Highway off-ramp and Bainbridge Boulevard intersection wouldn't adversely affect safety and operations on S Military Highway, the 95<sup>th</sup> percentile queue lengths were evaluated. The westbound approach at this intersection would have a 400-foot queue length (HCM 95th percentile). The stopping sight distance (SSD) for a 35-mph design speed ramp at a 3% downgrade is 257 feet. Together, these lengths sum to be approximately 650 feet which is less than the 700 feet available on the ramp. Therefore, it is not anticipated that the proposed build condition would adversely affect operations or safety on S Military Highway, despite the LOS F for the intersection approach.

When comparing the Build 2045 Project 1 conditions to No-Build 2045 conditions, the only notable changes in operations are limited to an increase in delay for the westbound approach at the S Military Highway eastbound on/off ramps and Bainbridge Boulevard intersection and the eastbound left for the westbound S Military Highway off-ramp. The operations are only being adversely affected to the point of being unacceptable at these two stop-controlled intersections. For the eastbound off-ramp and Bainbridge Boulevard intersection westbound approach, that is based on a 2% TDM growth rate despite historic growth being flat. This led the SWG to do a sensitivity analysis for an interim year 2032 to determine if the operations would be acceptable in a potential opening year. A second sensitivity analysis with Build 2045 volumes was also completed to verify whether or not a signal is expected to be warranted and function acceptably in the event that volumes increase at the rate forecasted by the TDM (2%). The results of these sensitivity analyses are shown below. Based on these results the SWG opted to maintain the stop control condition in the preferred alternative and SMART SCALE application.

#### Sensitivity Analysis 1: Build 2032 Multimodal Safety and Access Improvement

The Build 2032 Project 1 models were based on the Build 2045 Project 1 models. In order to determine whether or not the westbound approach at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps would operate with an acceptable delay level in an interim year, a sensitivity



test using Build 2032 volumes was conducted. The results of the Build 2032 Project 1 analyses are shown in **Table 21**.

### AM and PM Peak Hours

- All movements were observed to be performing at an LOS C or better except the:
  - Southbound approach (LOS F in the AM and PM peak hour) and eastbound left movement (LOS D in the PM peak hour) at the S Military Highway and Southern States Co-Op intersection. Synchro results are less reliable if a movement is oversaturated (i.e., level of service is F or v/c is greater than 1) so the magnitude of delay may be overestimated. It also may be that drivers are less conservative than assumed in the Synchro analysis,
  - Westbound approach at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps (LOS D in the AM peak hour and LOS D in the PM peak hour)
- These findings show that operation at the intersection of the Bainbridge Boulevard and eastbound on/off ramps of S Military Highway is anticipated to be acceptable in the Build 2032 conditions with the 2% annual growth.

### Sensitivity Analysis 2: Build 2045 Signalized Multimodal Safety and Access Improvement

The Build 2045 Signalized Project 1 models were based on the Build 2045 Project 1 models. In order to determine whether or not the westbound approach at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps would operate with an acceptable level of delay if a signal were to be installed at the intersection, a sensitivity analysis signalizing that intersection was completed. The results of the Build 2045 signalized Project 1 analyses are shown in **Table 22**. A signal warrant analysis for this intersection using 2045 volumes was completed and is summarized in **Table 28**. Warrant 1 (Combined Condition) and warrant 2 are met. Warrant 3 met the criteria, however, as stated in the MUTCD: “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”, therefore this warrant does not apply for this intersection. Warrants 4 through 9 are either not applicable, do not meet the threshold for consideration, or data were not obtained to perform the analysis. A full memorandum documenting the signal warrant analysis can be seen in **Appendix F**.

### AM and PM Peak Hours

- The results of this sensitivity analysis showed that a signal would effectively improve operations at the eastbound S Military Highway off-ramp intersection with Bainbridge Boulevard to an acceptable LOS (LOS C in AM and PM peak hours).
- Based on these results, the SWG decided to proceed with the stop control condition in the proposed preferred alternative and to monitor volumes and delay at this intersection. If volumes do increase to the point at which a signal is warranted, one could be installed.

### Scenario 2: Build 2045 Park & Ride Concept

The Build 2045 Project 2 models were based on the No-Build 2045 models and proposed geometric changes associated with the Project:

- Re-opening of the eastbound S Military Highway to northbound Bainbridge Boulevard flyover ramp which is currently closed for construction in the existing condition but was assumed open in the No-Build conditions analysis.
- Establishing a driveway entrance for the park and ride facility on the west side of Bainbridge Boulevard between Scotties Lane and the westbound S Military Highway on/off ramps.
- Removal of the southbound Bainbridge Boulevard slip ramp to westbound S Military Highway

The ITE Parking Generation Manual and the SMART SCALE Technical Guide were referenced to estimate the volume of traffic entering and leaving the Park & Ride lot in the AM and PM peak hours. There are 300 parking spaces at the proposed Park & Ride lot. Based on data from the Statewide Park & Ride Study, the congestion analysis assumes an average space utilization of 75% (225 daily users) for the proposed spaces with 32% of vehicles arriving and departing during peak hour. This level of usage was compared to the forecasted utilization based on HRT data and Streetlight data as discussed during the concept development phase and was determined to be consistent. The ITE Parking Generation Manual assumes 40% of vehicles arriving and departing during the AM and PM peak hours respectively. To be more conservative 40% was used for these analyses, so the arrival/departure of 90 (40% of 225) vehicles in the AM and PM peak hours respectively was used for this analysis. Additionally, it was assumed that 18 vehicles, or 20% of the 90 vehicles, would be carpool drivers that are entering and then immediately exiting the lot after picking up or dropping off passengers. The trips to and from the park and ride lot were all assumed to be conversions of existing trips through the network. Therefore, the volume entering the network in the AM peak hour was maintained, but the exiting volume during the AM peak hour was reduced by 72 (90-18) vehicles. The same assumption was used in the PM peak hour (72 less vehicles entering the network and the same

volume leaving the network in the PM peak hour). The trip distribution coming to and from the park and ride was based on the relative volumes entering and exiting the study area network.

The results of this scenario are shown in **Table 23**.

#### AM and PM Peak Hours

All movements were observed to be performing at an LOS D or better except the:

- Southbound approach (LOS F in AM and PM peak hours) and the eastbound left movement (LOS E in the PM peak hour) at the S Military Highway and Southern States Co-Op intersection. Synchro results are less reliable if a movement is oversaturated (i.e., level of service is F or v/c is greater than 1) so the magnitude of delay may be overestimated. It also may be that drivers are less conservative than assumed in the Synchro analysis, and that drivers are accepting of smaller and gaps in traffic to make turning movements. This delay did not increase from the no-build conditions analysis.
- Eastbound left turn in the PM peak hour at the Bainbridge Boulevard and Reunion Street intersection (LOS D); This delay did not increase from the no-build conditions analysis.
- Westbound approach at the Bainbridge Boulevard and Scotties Lane/Park and Ride entrance (LOS D in AM peak hour). This represents a slight increase in delay as compared to the no-build conditions.
- Eastbound left in the AM (LOS D) and PM (LOS E) peak hours at the Bainbridge Boulevard and westbound S Military Highway on/off ramp intersection.
- Westbound approach at the Bainbridge Boulevard and S Military Highway eastbound on/off ramps (LOS E in the AM peak hour and LOS F in the PM peak hour). This represents a marginal increase in delay as compared to the no-build conditions results.

When comparing the Build 2045 Project 2 conditions to No-Build 2045 conditions, the only notable change in operations is the LOS for the eastbound left-turn at the intersection of Bainbridge Boulevard and the westbound S Military Highway on/off-ramps. The overall approach however is still an acceptable LOS (LOS C).

### 4.3.2 HCS Analysis

#### Scenario 1: Build 2045 Multimodal Safety and Access Improvement Concept

The Build 2045 Project 1 AM and PM peak hour HCS models were created based on the No-Build 2045 conditions models and closing of the eastbound S Military Highway to northbound Bainbridge Boulevard flyover ramp as proposed in the Project 1 concept. In the Build 2045 Project 1 scenario, there are four segments in the eastbound and five segments on the westbound direction.

**Table 24** and

**Table 25** show the HCS analysis results for both the AM and PM peak hours in the eastbound and westbound directions.

The following trends were observed under Build 2045 Project 1 conditions.

#### AM and PM Peak Hours

- All S Military Highway segments were projected to operate at a LOS D or better.
- No notable changes as compared to the no-build conditions analysis were observed.

#### Scenario 2: Build 2045 Park & Ride Concept

The Build 2045 Project 2 models were based on the No-Build 2045 models and reopening of the eastbound S Military Highway to northbound Bainbridge Boulevard flyover ramp after the current construction activities are complete, and consistent with the no-build conditions. In the Build 2045 Project 2 scenario, there are five segments in the eastbound and five segments in the westbound direction.

**Table 26** and **Table 27** show the HCS analysis results for both the AM and PM peak hours in the eastbound and westbound directions.

The following trends were observed under Build 2045 Project 1 conditions.

#### AM and PM Peak Hours

- All S Military Highway segments were projected to operate at a LOS D or better.
- No notable changes as compared to the no-build conditions analysis were observed.

## Build Operation Analysis Summary

When comparing the Build 2045 Project 1 conditions to No-Build 2045 conditions, the only notable changes in operations are limited to an increase in delay for the westbound approach at the S Military Highway eastbound on/off ramps and Bainbridge Boulevard intersection and the eastbound left for the westbound S Military Highway off-ramp. The operations are only being adversely affected to the point of being unacceptable at these two stop-controlled intersections. For the eastbound off-ramp and Bainbridge Boulevard intersection westbound approach, that is based on a 2% TDM growth rate despite historic growth being flat. This led the SWG to do a sensitivity analysis for an interim year 2032 to determine if the operations would be acceptable in a potential opening year. A second sensitivity analysis with Build 2045 volumes was also completed to verify whether or not a signal is expected to be warranted and function acceptably in the event that volumes increase at the rate forecasted by the TDM (2%). Based on these results the SWG opted to maintain the stop control condition in the preferred alternative and SMART SCALE application.

When comparing the Build 2045 Project 2 conditions to No-Build 2045 conditions, the only notable change in operations is the LOS for the eastbound left-turn at the intersection of Bainbridge Boulevard and the westbound S Military Highway on/off-ramps. The overall approach however is still an acceptable LOS (LOS C).

**Appendix F** includes the full Synchro and HCS results from the Build analysis.

Figure 44: Build 2045 Multimodal and Safety Improvements (Project 1) AM and PM Peak Hour Traffic Volume

Build 2045 AM (7:15-8:15 AM) & PM (4:00-5:00 PM) Peak Hour Vehicle Volumes

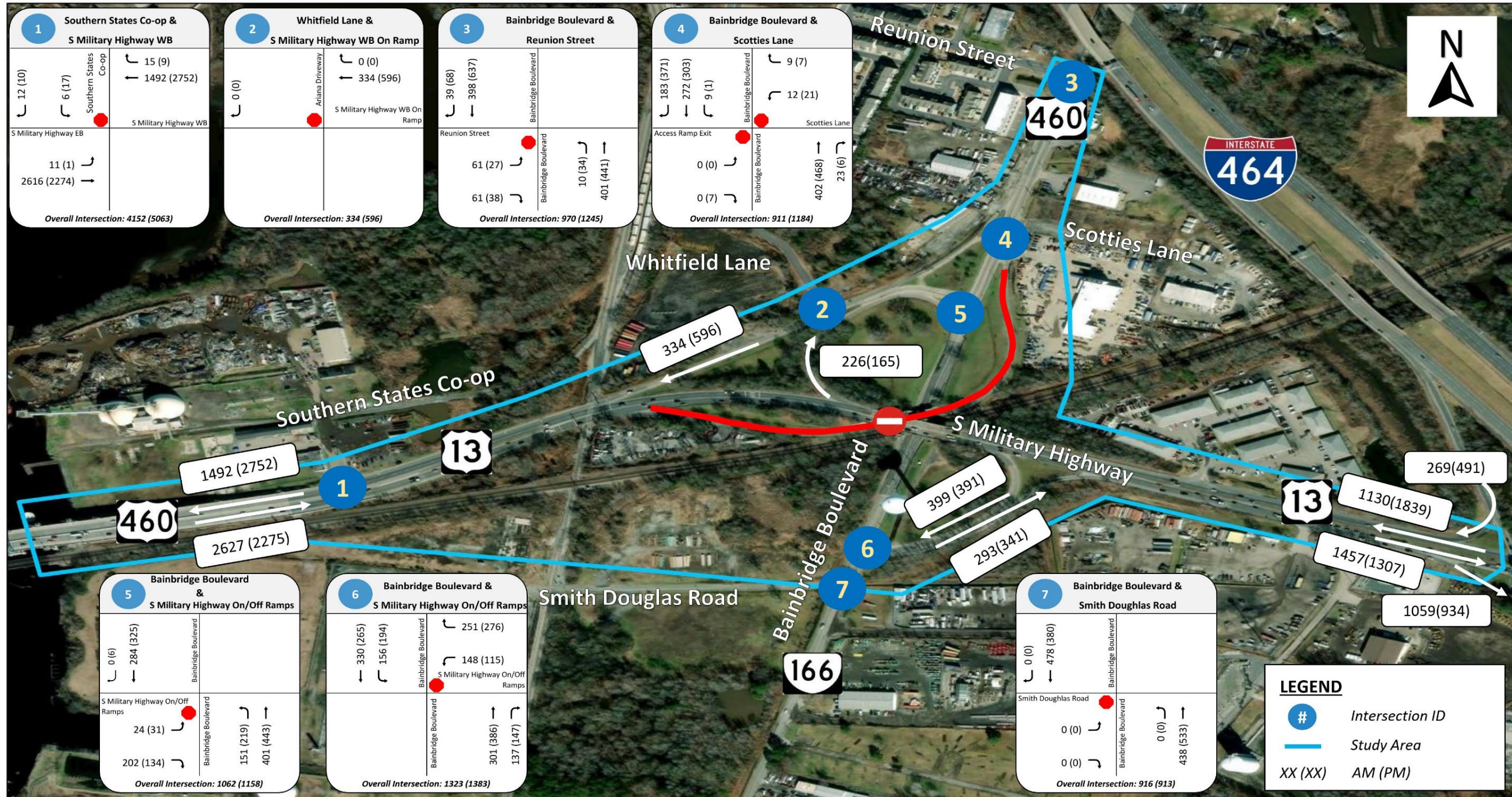


Figure 45: Build 2032 Multimodal and Safety Improvements (Project 1) AM and PM Peak Hour Traffic Volume

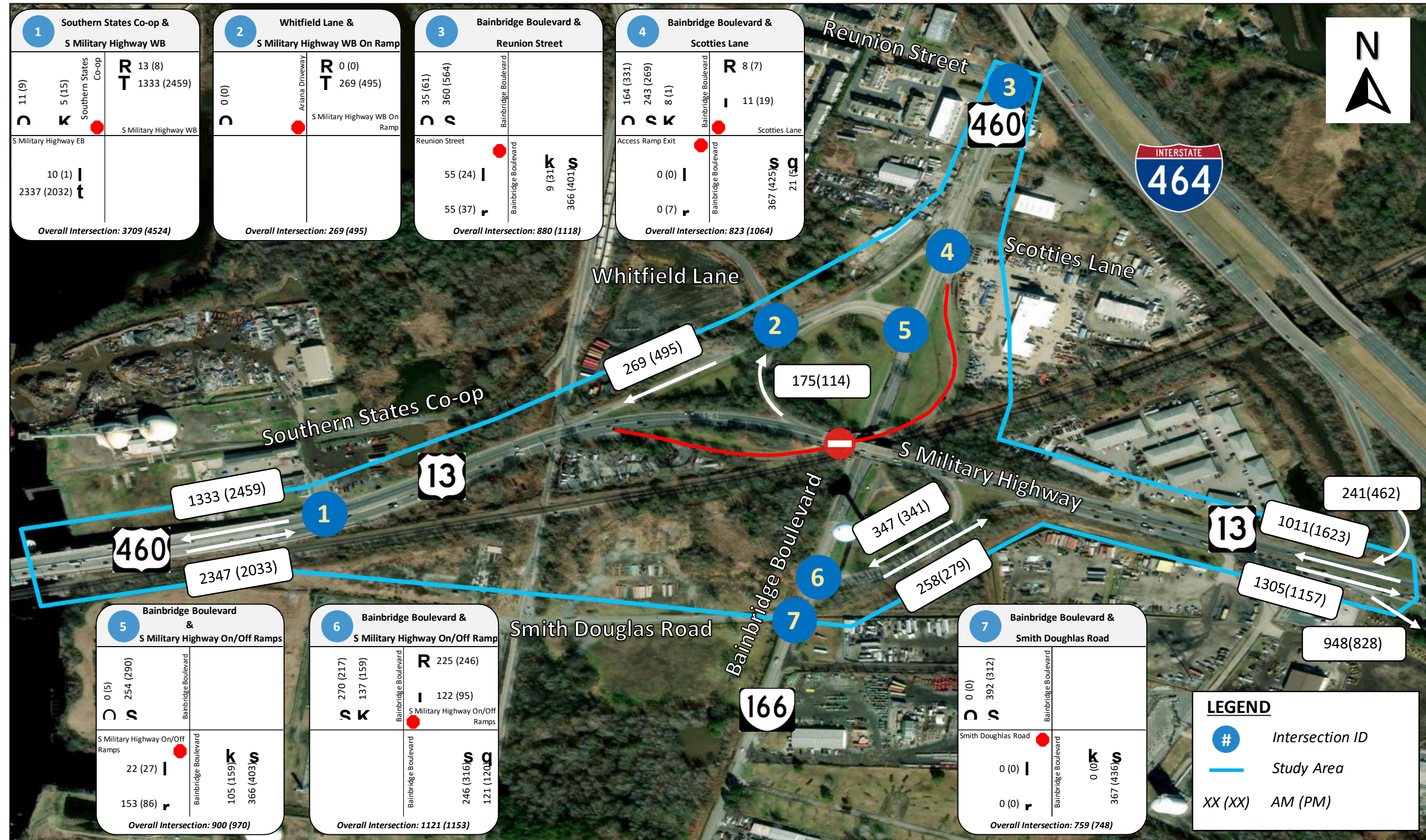


Figure 46: Build 2045 Park & Ride (Project 2) AM and PM Peak Hour Traffic Volume

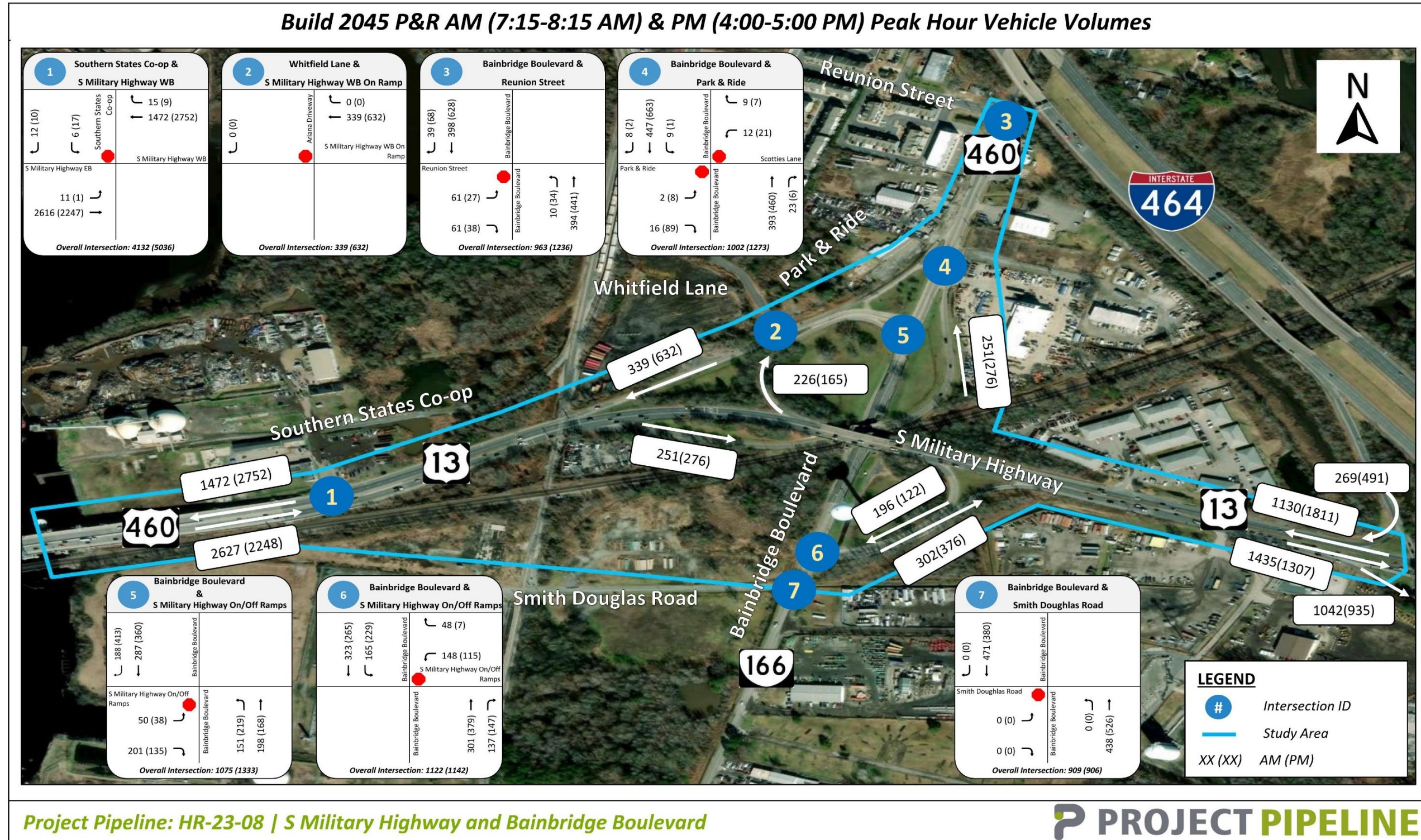


Table 20: Synchro Analysis Result for Build 2045 Multimodal and Safety Improvements (Project 1) Stop Controlled Conditions Peak Hour Control Delay and LOS

Intersection Number and Description	Type of Control	Lane Group	Northbound				Southbound				Eastbound				Westbound			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1 S Military Hwy and Southern States Co-op	Unsignalized	Left	†	†	†	†	2181	F	9502.4	F	17.0	C	36.1	E	†	†	†	†
		Through	†	†	†	†	†	†	†	†	0	A	0	A	0.0	A	0.0	A
		Right	†	†	†	†	2181.0	F	9502.4	F	†	†	†	†	0.0	A	0.0	A
		Approach	†	†	†	†	2181.0	F	9502.4	F	0.1	A	0	A	0.0	A	0.0	A
3 Bainbridge Boulevard and Reunion Street	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Reunion Street												
		Left	8.3	A	9.5	A	†	†	†	†	19.7	C	28.7	D	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	0.0	A	0.0	A	11.6	B	13.9	B	†	†	†	†
Approach	0.2	A	0.7	A	0.0	A	0.0	A	15.7	C	20.0	C	†	†	†	†		
4 Bainbridge Boulevard and Smith Douglas Road	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Driveway												
		Left	†	†	†	†	8.3	A	8.4	A	0.0	A	0.0	A	16.4	C	19.0	C
		Through	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	0.0	A	10.1	B	16.4	C	19.0	C
Approach	0.0	A	0.0	A	0.3	A	0.0	A	0.0	A	10.1	B	16.4	C	19.0	C		
5 Bainbridge Boulevard and US 13 WB Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 SB Ramps												
		Left	8.6	A	8.9	A	†	†	†	†	25.0	C	35.8	E	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	11.9	B	12.0	B	†	†	†	†
Approach	2.3	A	3.0	A	0.0	A	0.0	A	13.3	B	16.4	C	†	†	†	†		
6 Bainbridge Boulevard and US 13 EB On/Off Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 EB On/Off Ramps												
		Left	†	†	†	†	8.5	A	9.0	A	†	†	†	†	91.9	F	118.5	F
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	†	†	†	†	91.9	F	118.5	F
Approach	0.0	A	0.0	A	2.7	A	3.8	A	†	†	†	†	91.9	F	118.5	F		

† SYNCHRO does not provide level of service or delay for movements with no conflicting volumes

Table 21: Synchro Analysis Result for Build 2032 Multimodal and Safety Improvements (Project 1) Stop Controlled Conditions Peak Hour Control Delay and LOS

Intersection Number and Description	Type of Control	Lane Group	Northbound				Southbound				Eastbound				Westbound			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1 S Military Hwy and Southern States Co-op	Unsignalized	Left	†	†	†	†	636.5	F	3283.5	F	15.1	C	28.1	D	†	†	†	†
		Through	†	†	†	†	†	†	†	†	0.0	A	0.0	A	0.0	A	0.0	A
		Right	†	†	†	†	636.5	F	3283.5	F	†	†	†	†	0.0	A	0.0	A
		Approach	†	†	†	†	636.5	F	3283.5	F	0.1	A	0.0	A	0.0	A	0.0	A
3 Bainbridge Boulevard and Reunion Street	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Reunion Street												
		Left	8.2	A	9.1	A	†	†	†	†	17.4	C	23.8	C	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	0.0	A	0.0	A	11.1	B	12.9	B	†	†	†	†
Approach	0.2	A	0.7	A	0.0	A	0.0	A	14.3	B	17.2	C	†	†	†	†		
4 Bainbridge Boulevard and Smith Douglas Road	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Driveway												
		Left	†	†	†	†	8.2	A	8.3	A	0.0	A	0.0	A	15.2	C	16.9	C
		Through	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	0.0	A	9.8	A	15.2	C	16.9	C
Approach	0.0	A	0.0	A	0.3	A	0.0	A	0.0	A	9.8	A	15.2	C	16.9	C		
5 Bainbridge Boulevard and US 13 WB Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 SB Ramps												
		Left	8.3	A	8.5	A	†	†	†	†	19.4	C	24.4	C	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	11.0	B	11.0	B	†	†	†	†
Approach	1.8	A	2.4	A	0.0	A	0.0	A	12.1	B	14.2	B	†	†	†	†		
6 Bainbridge Boulevard and US 13 EB On/Off Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 EB On/Off Ramps												
		Left	†	†	†	†	8.3	A	8.5	A	†	†	†	†	31.3	D	34.0	D
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	†	†	†	†	31.3	D	34.0	D
Approach	0.0	A	0.0	A	2.8	A	3.6	A	†	†	†	†	31.3	D	34.0	D		

† SYNCHRO does not provide level of service or delay for movements with no conflicting volumes



Table 22: Synchro Analysis Result for Build Multimodal and Safety Improvements (Project 1) 2045 Signalized Conditions Peak Hour Control Delay and LOS

Intersection Number and Description	Type of Control	Lane Group	Northbound				Southbound				Eastbound				Westbound			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1 S Military Hwy and Southern States Co-op	Unsignalized	Left	†	†	†	†	2181.0	F	9502.4	F	17.0	C	36.1	E	†	†	†	†
		Through	†	†	†	†	†	†	†	†	0	A	0	A	0.0	A	0.0	A
		Right	†	†	†	†	2181.0	F	9502.4	F	†	†	†	†	0.0	A	0.0	A
		Approach	†	†	†	†	2181.0	F	9502.4	F	0.1	A	0	A	0.0	A	0.0	A
3 Bainbridge Boulevard and Reunion Street	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Reunion Street												
		Left	8.3	A	9.5	A	†	†	†	†	19.7	C	28.7	D	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	0.0	A	0.0	A	11.6	B	13.9	B	†	†	†	†
Approach	0.2	A	0.7	A	0.0	A	0.0	A	15.7	C	20.0	C	†	†	†	†		
4 Bainbridge Boulevard and Smith Douglas Road	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Driveway												
		Left	†	†	†	†	8.3	A	8.4	A	0.0	A	0.0	A	16.4	C	19.0	C
		Through	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	0.0	A	10.1	B	16.4	C	19.0	C
Approach	0.0	A	0.0	A	0.3	A	0.0	A	0.0	A	10.1	B	16.4	C	19.0	C		
5 Bainbridge Boulevard and US 13 WB Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 SB Ramps												
		Left	8.6	A	8.9	A	†	†	†	†	25.0	C	35.8	E	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	11.9	B	12.0	B	†	†	†	†
Approach	2.3	A	3.0	A	0.0	A	0.0	A	13.3	B	16.4	C	†	†	†	†		
6 Bainbridge Boulevard and US 13 EB On/Off Ramps	Signalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 EB On/Off Ramps												
		Left	†	†	†	†	10.8	B	13.4	B	†	†	†	†	21.6	C	24.4	C
		Through	9.4	A	10.9	B	10.8	B	13.4	B	†	†	†	†	†	†	†	†
		Right	9.4	A	10.9	B	†	†	†	†	†	†	†	†	21.6	C	24.4	C
Approach	9.4	A	10.9	B	10.8	B	13.4	B	†	†	†	†	21.6	C	24.4	C		

† SYNCHRO does not provide level of service or delay for movements with no conflicting volumes

Table 23: Synchro Analysis Result for Build 2045 Park & Ride (Project 2) Conditions Peak Hour Control Delay and LOS

Intersection Number and Description	Type of Control	Lane Group	Northbound				Southbound				Eastbound				Westbound			
			AM		PM		AM		PM		AM		PM		AM		PM	
			Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
1 S Military Hwy and Southern States Co-op	Unsignalized	Left	†	†	†	†	1348.2	F	9502.4	F	16.8	C	36.1	E	†	†	†	†
		Through	†	†	†	†	†	†	†	†	0	A	0	A	0.0	A	0.0	A
		Right	†	†	†	†	1348.2	F	9502.4	F	†	†	†	†	0.0	A	0.0	A
		Approach	†	†	†	†	1348.2	F	9502.4	F	0.1	A	0	A	0.0	A	0.0	A
3 Bainbridge Boulevard and Reunion Street	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Reunion Street												
		Left	8.3	A	9.5	A	†	†	†	†	19.5	C	28.2	D	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	0.0	A	0.0	A	11.6	B	13.7	B	†	†	†	†
Approach	0.2	A	0.7	A	0.0	A	0.0	A	15.6	C	19.7	C	†	†	†	†		
4 Bainbridge Boulevard and Scotties Lane/Park and Ride Entrance	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		Park & Ride Lot				Scotties Lane								
		Left	8.7	A	9.2	A	8.2	A	8.4	A	12.6	B	17.6	C	28.5	D	10.1	B
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	12.6	B	17.6	C	28.5	D	10.1	B
Approach	1.4	A	0.3	A	0.2	A	0.0	A	12.6	B	17.6	C	28.5	D	10.1	B		
5 Bainbridge Boulevard and US 13 WB Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 SB Ramps												
		Left	9.4	A	11.9	B	†	†	†	†	25.1	D	41.9	E	†	†	†	†
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	†	†	†	†	†	†	†	†	13.4	B	16.0	C	†	†	†	†
Approach	4.1	A	6.7	A	0.0	A	0.0	A	15.7	C	21.7	C	†	†	†	†		
6 Bainbridge Boulevard and US 13 EB On/Off Ramps	Unsignalized	Bainbridge Boulevard		Bainbridge Boulevard		US 13 EB On/Off Ramps												
		Left	†	†	†	†	10.5	B	9.1	A	†	†	†	†	48.1	E	72.3	F
		Through	0.0	A	0.0	A	0.0	A	0.0	A	†	†	†	†	†	†	†	†
		Right	0.0	A	0.0	A	†	†	†	†	†	†	†	†	10.5	B	10.6	B
Approach	0.0	A	0.0	A	2.9	A	4.2	A	†	†	†	†	38.9	E	68.8	F		

Table 24: HCS Analysis Result for Build 2045 Multimodal and Safety Improvements (Project 1) Conditions Peak Hour Speed, Density, and LOS along S Military Highway (Eastbound)

Eastbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (mph)	Density (pc/mi/ln)	LOS	Speed (mph)	Density (pc/mi/ln)	LOS
Downstream of Gilmerton Bridge	Basic	48.3	30.6	D	48.3	26.7	D
Between US-166 SB and US-13 EB Ramps	Diverge	47.2	31.3	D	47.3	27.3	C
Upstream of US-13 EB on Ramp	Basic	43.6	28.7	D	43.6	24.5	C
Off-Ramp to I-464	Weaving	37.5	26.5	C	38.8	22.0	C
Overall Facility		42.6	28.4	D	43.4	24.1	C

Table 25: HCS Analysis Result for Build 2045 Multimodal and Safety Improvements (Project 1) Conditions Peak Hour Speed, Density, and LOS along S Military Highway (Westbound)

Westbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (mph)	Density (pc/mi/ln)	LOS	Speed (mph)	Density (pc/mi/ln)	LOS
On-Ramp from I-464	Merge	49	14.3	B	48.6	27.5	C
Off-Ramp to US-166 SB	Diverge	47.5	16.6	B	47.6	27.6	C
Between US-166 SB and US-13 WB Ramps	Basic	49.5	13.1	B	49.5	24.3	C
On-Ramp from I-166	Merge	49.1	17.6	B	48.4	32.4	C
Downstream of Gilmerton Bridge	Basic	50.2	16.9	B	50.2	31.0	D
Overall Facility		49.6	16.6	B	49.5	30.0	D

Table 26: HCS Analysis Result for Build 2045 Park & Ride (Project 2) Conditions Peak Hour Speed, Density, and LOS along S Military Highway (Eastbound)

Eastbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (mph)	Density (pc/mi/ln)	LOS	Speed (mph)	Density (pc/mi/ln)	LOS
Downstream of Gilmerton Bridge	Basic	47.8	30.9	D	47.8	26.7	D
Upstream of US-13 EB off Ramp	Diverge	47.4	31.1	D	47.4	26.9	C
Between US-166 SB and US-13 EB off Ramp	Diverge	47.5	28.1	C	47.6	23.5	C
Upstream of US-13 EB on Ramp	Basic	43.1	28.4	D	43.1	24.4	C
Off-Ramp to I-464	Weaving	37.6	26.1	C	38.7	22.2	C
<b>Overall Facility</b>		<b>43.4</b>	<b>28.4</b>	<b>D</b>	<b>43.8</b>	<b>24.3</b>	<b>C</b>

Table 27: HCS Analysis Result for Build 2045 Park & Ride (Project 2) Conditions Peak Hour Speed, Density, and LOS along S Military Highway (Westbound)

Westbound		AM Peak Hour			PM Peak Hour		
Segment	Type	Speed (mph)	Density (pc/mi/ln)	LOS	Speed (mph)	Density (pc/mi/ln)	LOS
On-Ramp from I-464	Merge	52.5	15.2	B	52.0	25.4	C
Off-Ramp to US-166 SB	Diverge	50.1	15.7	B	50.3	25.8	C
Between US-166 SB and US-13 WB Ramps	Basic	53.8	11.7	B	53.9	21.7	C
On-Ramp from I-166	Merge	52.6	16.2	B	51.6	30.4	C
Downstream of Gilmerton Bridge	Basic	55.2	15.2	B	55.2	28.2	D
<b>Overall Facility</b>		<b>53.9</b>	<b>15.1</b>	<b>B</b>	<b>53.7</b>	<b>27.6</b>	<b>D</b>

Table 28: Signal Warrant Analysis – Build 2045 Volumes

City/County:	<b>Chesapeake</b>	85th-percentile speed on the major street exceeds 40 mph? (Y or N)	<b>N</b>
State:	<b>VA</b>	Isolated community with a population of less than 10,000? (Y or N)	<b>N</b>
Date:	<b>6/28/2024</b>	Apply 56% warrant to Warrant 1, Combination Warrant? (Y or N)	<b>N</b>
Major Street:	<b>Bainbridge Blvd</b>	Approach Lanes - Major? (1 or 2)	<b>1</b>
Minor Street:	<b>S Military Highway On/Off Ramps</b>	Approach Lanes - Minor? (1 or 2)	<b>1</b>

24-Hour Volume Summary	Major Street Total of Both Approaches	Minor Street Higher Volume Approach	Warrant 1, Condition A 100%		Warrant 1, Condition B 100%		Warrant 1, Combination Warrant				Warrant 2 100%	Warrant 3, Condition B 100%
			Major Street	Minor Street	Major Street	Minor Street	Major Street	Minor Street	Major Street	Minor Street	Figure 4C-1	Figure 4C-3
06:00 AM TO 07:00 AM	527	189	105%	126%	70%	252%	132%	158%	88%	315%	76%	47%
07:00 AM TO 08:00 AM	912	302	182%	201%	122%	403%	228%	252%	152%	503%	256%	126%
08:00 AM TO 09:00 AM	817	216	163%	144%	109%	288%	204%	180%	136%	360%	149%	78%
09:00 AM TO 10:00 AM	618	95	124%	63%	82%	127%	155%	79%	103%	158%	45%	27%
10:00 AM TO 11:00 AM	570	116	114%	77%	76%	155%	143%	97%	95%	193%	50%	31%
11:00 AM TO 12:00 PM	672	131	134%	87%	90%	175%	168%	109%	112%	218%	69%	39%
12:00 PM TO 01:00 PM	858	146	172%	97%	114%	195%	215%	122%	143%	243%	110%	56%
01:00 PM TO 02:00 PM	700	140	140%	93%	93%	187%	175%	117%	117%	233%	78%	43%
02:00 PM TO 03:00 PM	715	115	143%	77%	95%	153%	179%	96%	119%	192%	65%	36%
03:00 PM TO 04:00 PM	945	183	189%	122%	126%	244%	236%	153%	158%	305%	165%	81%
04:00 PM TO 05:00 PM	994	202	199%	135%	133%	269%	249%	168%	166%	337%	200%	99%
05:00 PM TO 06:00 PM	868	151	174%	101%	116%	201%	217%	126%	145%	252%	116%	59%
Source:	9,196	1,986	Threshold		Threshold		Threshold		Threshold		MUTCD Figure 4C-1 and 4C-2	MUTCD Figure 4C-3 and 4C-4
Created By:	MUTCD, 2009 Edition		500	150	750	75	400	120	600	60	Summary	Summary
	Kimley-Horn and Associates, Inc.		Summary		Summary		Summary		Summary		TOTAL	TOTAL
			TOTAL	6	TOTAL	6	TOTAL	9	TOTAL	10	6	1
			Met?	NO	Met?	NO	Met?	YES	Met?	YES	YES	YES

## 4.4 Planning-Level Sketch and Cost Estimates

Appendix F includes a planning-level sketch of the preferred alternative and a Basis of Design Memo detailing the established project design criteria, field review notes, risk assessment, and assumptions made during the design effort.

An engineer’s preliminary opinion of probable cost was created for construction costs, right of way acquisition costs, and utility relocation costs for the preferred alternative. These cost opinions established the project budget, in fiscal year (FY) 2024 dollars, as shown in Table 29. Appendix F also includes detailed cost estimates.

Table 29: Project 1 - Multimodal Improvements Cost Opinion

Phase Description	Budget (FY2024)
Preliminary Engineering	\$ 1,013,100
Right of Way and Utility Relocation	\$ 2,731,675
Construction	\$ 2,986,850
<b>Total Project Budget</b>	<b>\$ 6,731,625</b>

Table 30: Project 2 – Park & Ride Cost Opinion

Phase Description	Budget (FY2024)
Preliminary Engineering	\$ 1,646,600
Right of Way and Utility Relocation	\$ 3,474,700
Construction	\$ 7,797,200
<b>Total Project Budget</b>	<b>\$ 12,918,500</b>

## 4.5 Schedule Estimates

Schedule estimates were developed for the two alternatives. Table 31 summarizes the projected timeframes for the preliminary engineering (PE), right of way (RW), and construction (CN) phases. The schedule summary below applies to both Preferred Alternative 1 and Preferred Alternative 2. Please note that these phases have overlap, which results in a shorter schedule duration than if the phases were directly sequential.

Table 31: Schedule Estimates

Estimated Schedule by Phase (months)	PE	RW	CN	Total
Preferred Concept (all inclusive)	43	11	42	<b>75</b>

## 4.6 Project Risks

All projects have risks; however, some projects may have more significant risks than others due to technical complexity, funding, financing, and stakeholder acceptance. Risk management generally involves the process of anticipating what risks a project may face, mitigating them to the extent reasonably possible, and having a plan to react to them if and when they occur. This is recognized in VDOT guidance regarding the analysis of and mitigation of risks.

The following is a list the most notable potential issues that may affect project development, risks faced by the project, and risk mitigation strategies to be applied to manage and minimize risks throughout project development. Appendix F includes the risk analysis matrix with details on the risk assessment and mitigation strategy.

- Risk/Issue: Right-of-Way**  
 Right-of-way for businesses will be impacted, resulting in lost parking spaces and storage areas in the adjacent parcels. Both projects will require total takes, which may have increased costs during negotiations. Significant right-of-way impacts would increase project cost.
- Risk/Issue: Utilities**  
 The presence of many different utilities (power, underground fiber, gas, water and sanitary) along the Bainbridge corridor will likely have an impact to both schedule and costs.

## 4.7 Possible Funding Sources

The City of Chesapeake elected to submit the preferred alternative as two separate project applications for SMART SCALE funding. All remaining funding will come from the City of Chesapeake.