Route 11/460

CORRIDOR STUDY

November 2013

Prepared For:

VDOT

Prepared By:

Kimley-Horn and Associates, Inc.

Route 11/460 Corridor Study

Roanoke County, Montgomery County, and the Town of Christiansburg, Virginia

November 2013

Route 11/460:

I-81 Interchange (Exit 118) to Technology Drive

Prepared for:

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1. INTRODUCTION

1.1 Background

Virginia Department of Transportation (VDOT) in conjunction with Roanoke County, Montgomery County, and Town of Christiansburg identified the need to develop a corridor study for Route 11/460. This report, the Route 11/460 Corridor Study, documents the findings of the project team and presents the following information: data collection and inventory summaries; existing conditions analyses; future conditions analyses; development/analysis of the proposed improvements; and the final recommendations with the plan of action for the corridor. The Route 11/460 Corridor Study serves as a technical document which identifies future conditions and potential projects. The study will focus primarily on operations, access management, and safety. Capacity and congestion issues occur when traffic is diverted from I-81 during incidents; however, this study will focus on typical weekday operations. Although the recommendations made herein do not directly address mitigating congestion during I-81 incidents, the recommendations are intended to improve everyday traffic operations on the Route 11/460 corridor which positively impacts incident traffic.

1.2 Purpose

The purpose of this study is to examine the existing and future conditions along an approximately 17 mile long section of Route 11/460 in Roanoke County, Montgomery County, and the Town of Christiansburg, Virginia. The study identifies potential transportation improvement solutions along the corridor as well as assists VDOT, Roanoke County, Montgomery County, Town of Christiansburg, Roanoke Valley Area Metropolitan Planning Organization (RVAMPO), Roanoke Valley-Alleghany Regional Commission (RVARC), New River Valley Planning District Commission (NRVPDC), and New River Valley Metropolitan Planning Organization (NRVMPO) staff in their discussions with property owners and developers as they convey future plans and projects for the corridor. The study will ultimately be used as a planning tool by the above mentioned entities to manage growth and assess transportation network impacts created by regional influences internally and externally to the study corridor. The study links the issues of surrounding traffic demand, land use along the corridor, and the roadway network together, allowing the local planning agencies to make informed land use and economic development decisions. The study also provides an assessment of the level of improvements necessary and helps identify the need for funding to support future anticipated growth along the corridor by both public and private funding streams. The study will describe the future vision for the corridor, supported by improvements to ensure the vision is achieved. Specifically, the intended outcomes of the study were to:

- Determine the safety and integrity of existing transportation infrastructure, including vehicular, bicycle, and pedestrian infrastructure
- Establish a long-term vision for the corridor
- Provide consensus-based future recommended improvements with prioritization and phasing

1.3 Study Area

The limits of the Route 11/460 corridor study are from the I-81 interchange (Exit 118) in the Town of Christiansburg, through Montgomery County, to the intersection with Technology Drive in Roanoke County. The section of Route 11/460 in the study area is approximately 17 miles long and extends through the villages of Shawsville and Elliston, the communities of Christiansburg and Glenvar, and through both Roanoke and Montgomery Counties. In the study area, Route 11/460 is also referred to as Roanoke Road, Lee Highway, and West Main Street. Although the general orientation of Route 11/460 in the study corridor is northeast/southwest, for the purposes of this study, the corridor was considered to have an east/west alignment throughout the study area.

The following eight intersections along Route 11/460 were identified and analyzed. These intersections are referred to herein as the "study area intersections" and are all unsignalized.

1. Route 11/460 at Alleghany Spring Road (Route 637)
2. Route 11/460 at North Fork Road (Route 603)
3. Route 11/460 at Gardner Street (Route 626)
4. Route 11/460 at Campbell Drive (Route 671)
5. Route 11/460 at Western Virginia Water Authority Water Treatment Plant Entrance
6. Route 11/460 at Western Virginia Water Authority Water Treatment Plant Entrance
7. Route 11/460 at West River Road (Route 639)
8. Route 11/460 at Dixie Caverns Entrance
9. Route 11/460 at Dow Hollow Road (Route 647)

The study area boundary is shown in **Figure 1.1**. More detailed study area maps are provided in **Figure 1.2** through **Figure 1.8**.

1.4 Project Team Members

The Route 11/460 corridor study project team includes the following members:

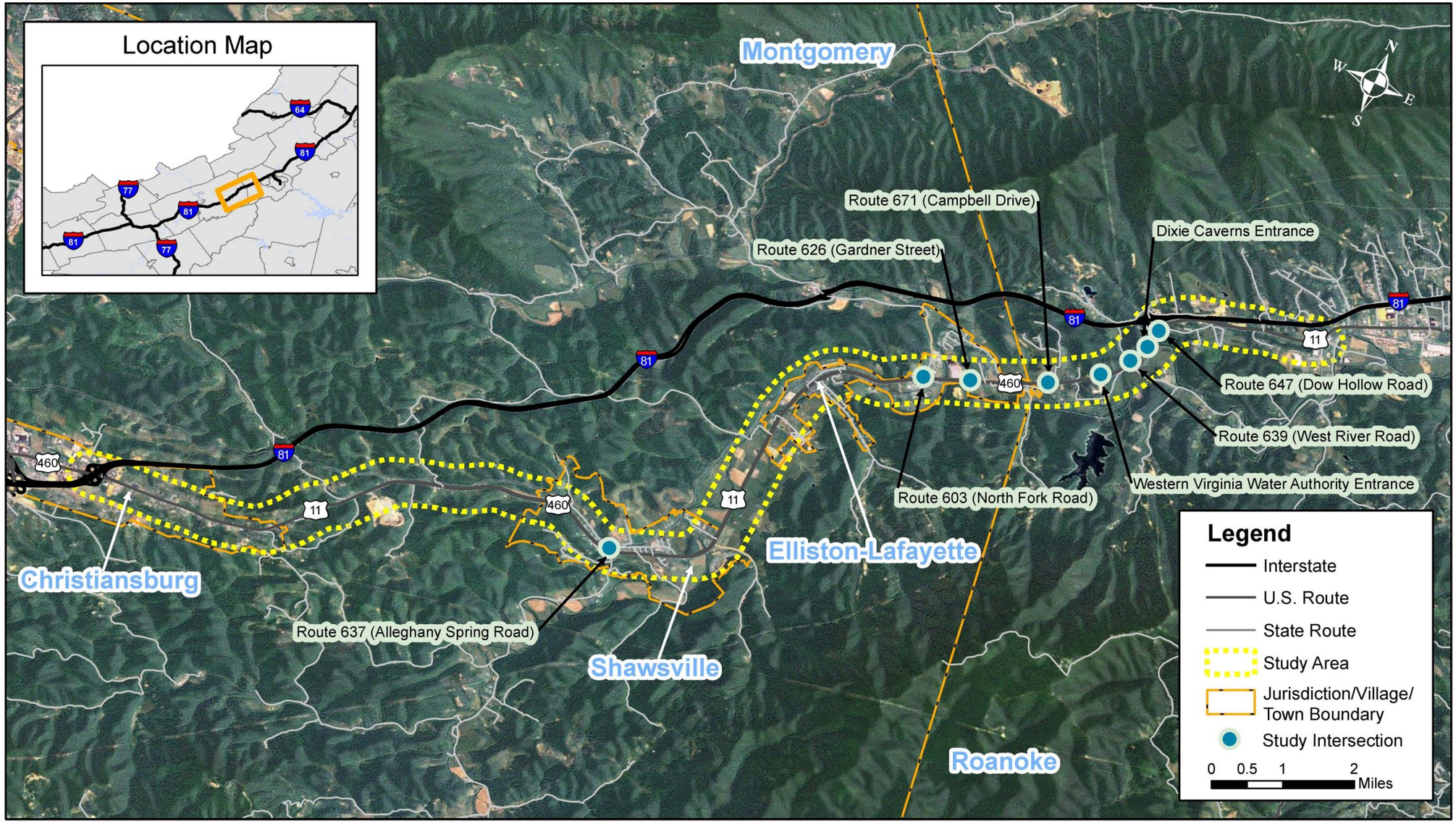
- VDOT
- Roanoke County
- Montgomery County
- Town of Christiansburg
- RVAMPO
- RVARC
- NRVPDC
- NRVMPO
- Kimley-Horn and Associates

These individuals are referred to herein as the "Study Team".

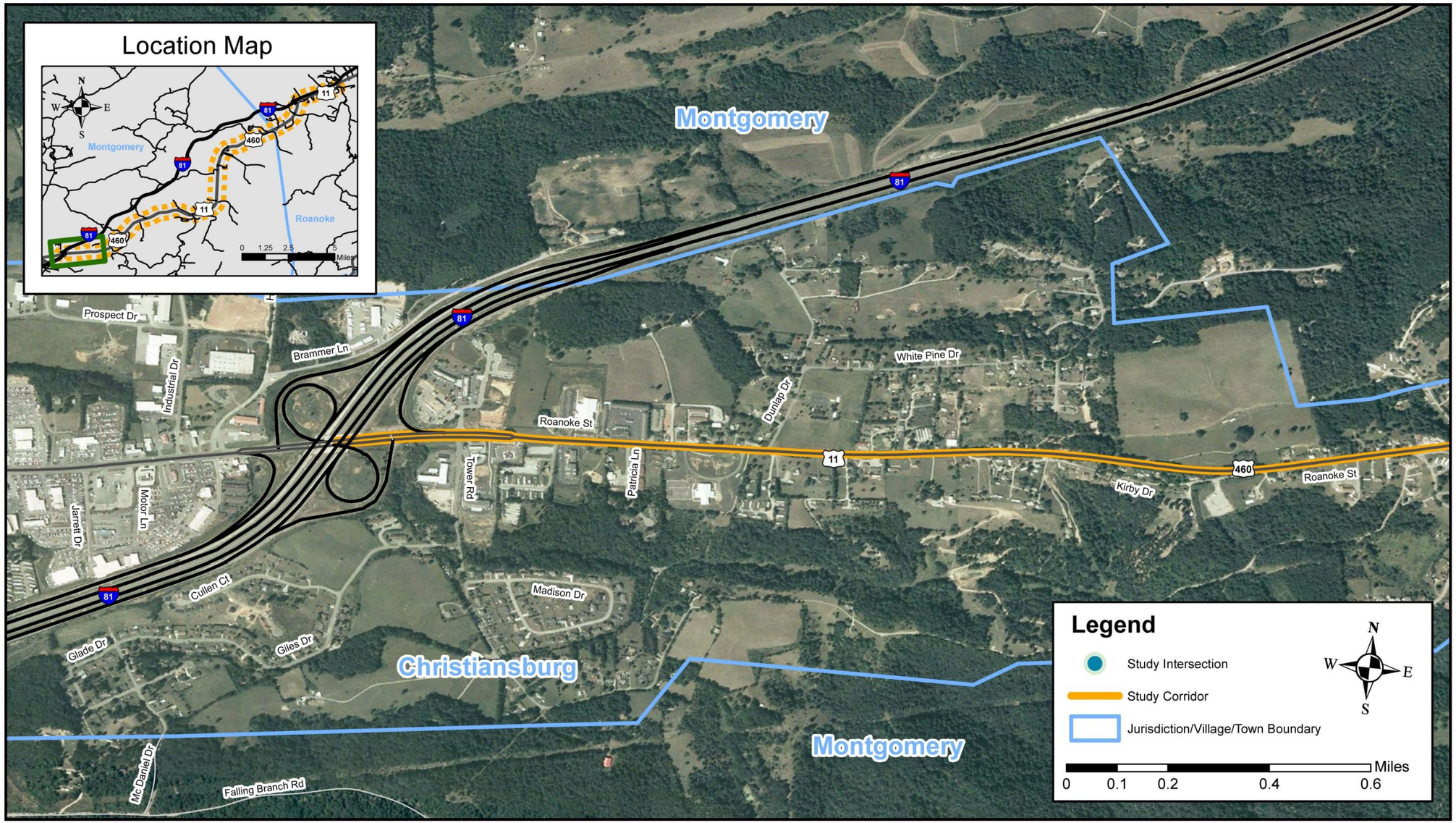
1.5 Public Involvement

An important component of the Route 11/460 Corridor Study planning process was the involvement of and feedback from the public. Over the duration of the study, two citizen information meetings were held. Most important to the success of the planning effort was the involvement of diverse segments of the population. A variety of stakeholders, including residents, property owners, business owners, employees, and commuters in the Route 11/460 study area, participated in these workshops. The objectives of the citizen information meetings were twofold. The first objective was to inform and educate the public about the study, its objectives, and its outcomes. The second objective was to encourage and gather input and feedback in a formal setting from the public regarding the issues to be studied, the recommend improvements considered, and the future vision for the corridor. Techniques used to educate and obtain input from the public at the citizen information meetings included presentations, questionnaires, comment stations, and mapping exercises.

A summary of the public involvement process along with the results of the citizen information meetings are included in Chapter 7 of this report.

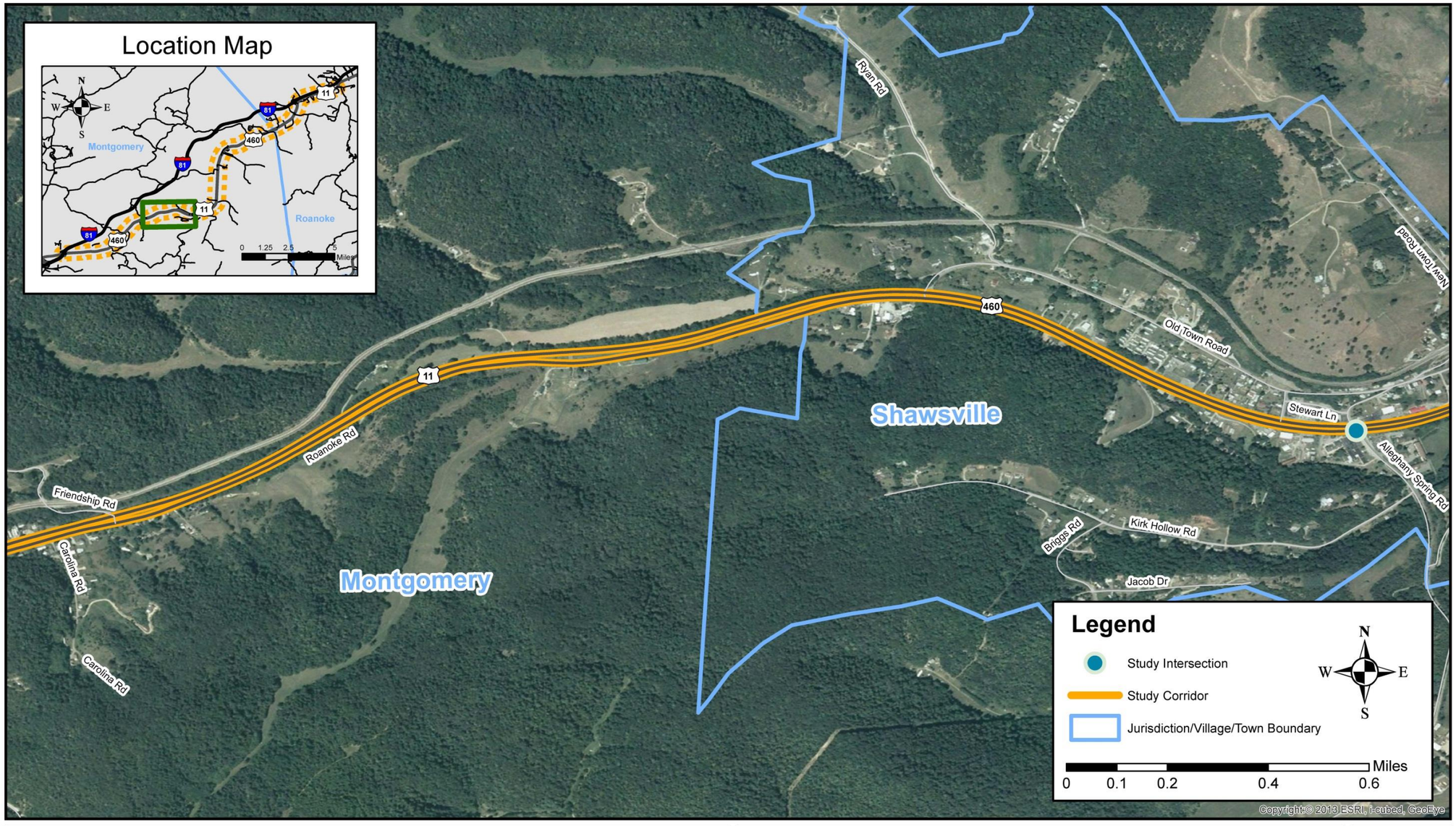


Route 11/460 Corridor Study	Study Area Map	Figure 1.1

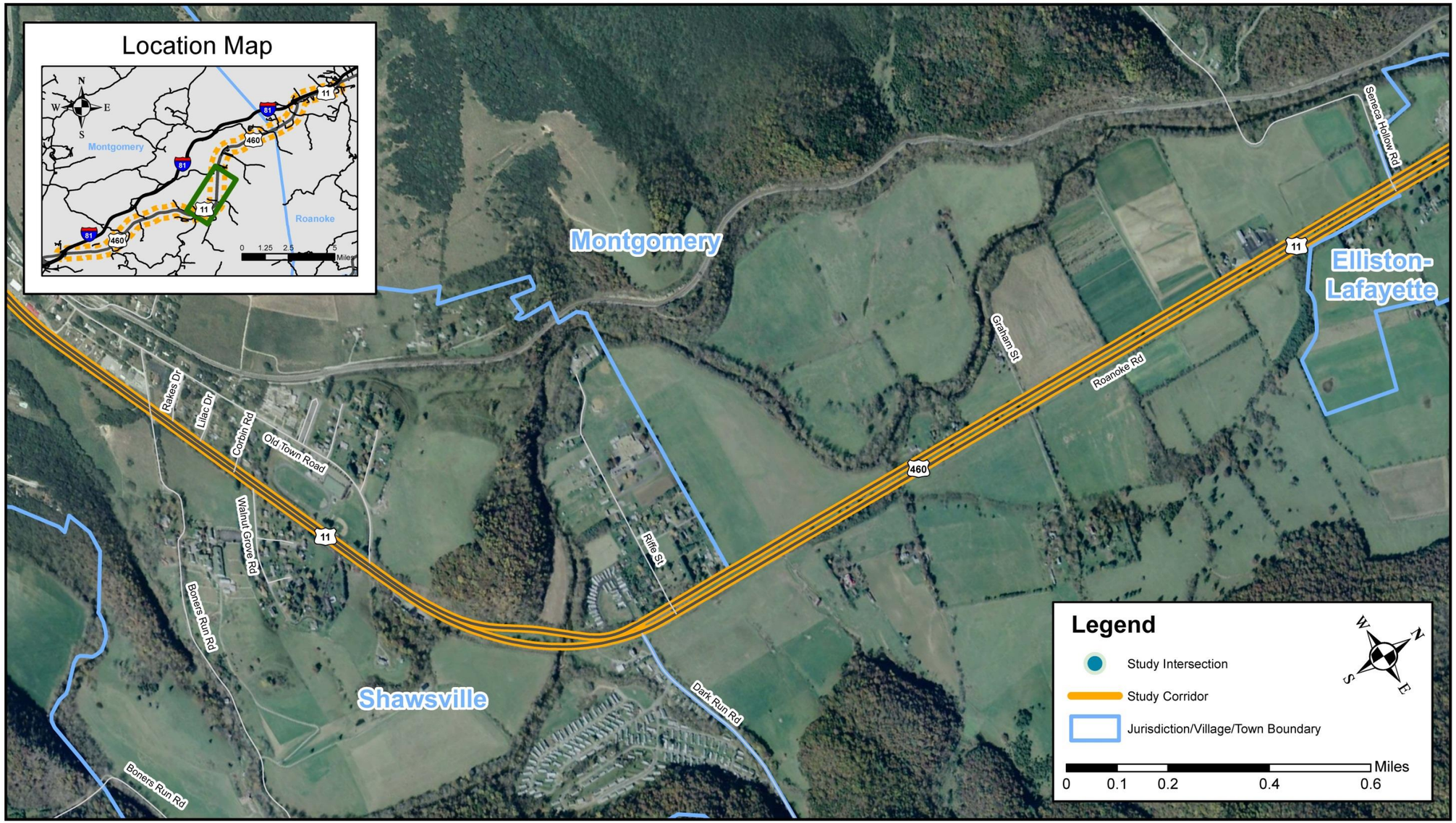


Route 11/460 Corridor Study	Corridor Location Map	Figure 1.2

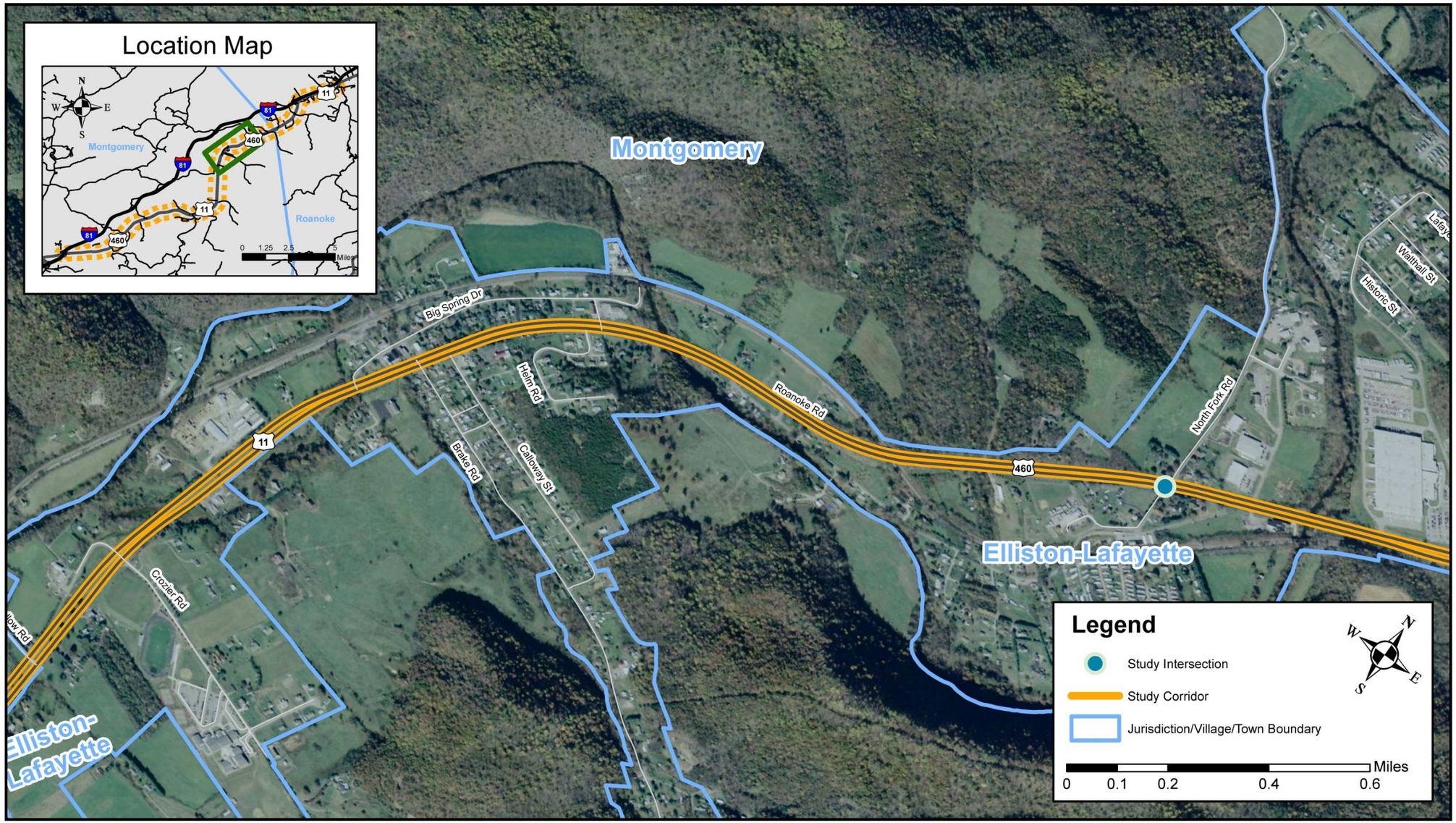
Route 11/460 Corridor Study	Corridor Location Map	Figure 1.3



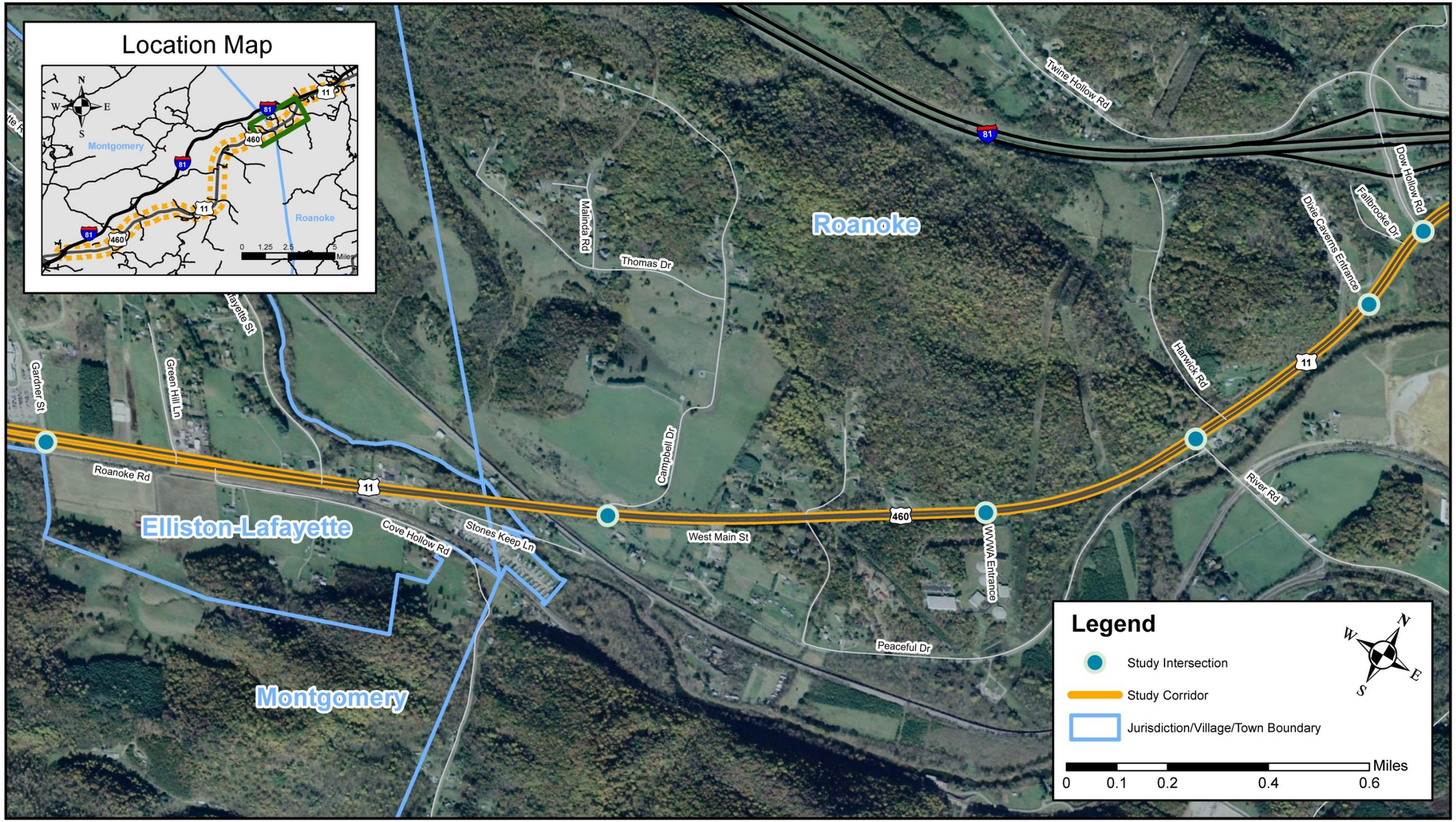
Route 11/460 Corridor Study	Corridor Location Map	Figure 1.4



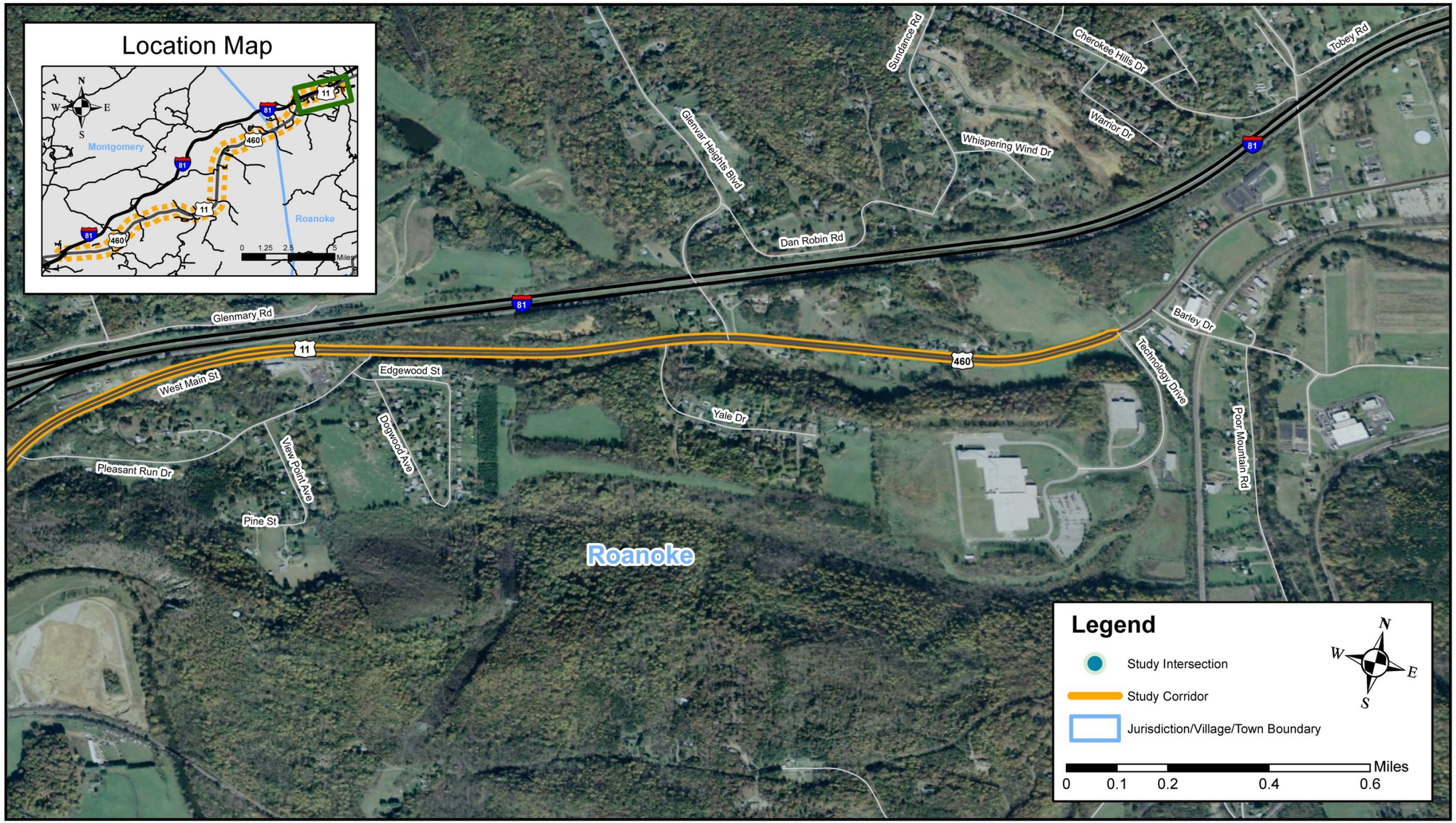
Route 11/460 Corridor Study	Corridor Location Map	Figure 1.5



Route 11/460 Corridor Study	Corridor Location Map	Figure 1.6



Route 11/460 Corridor Study	Corridor Location Map	Figure 1.7



Route 11/460 Corridor Study	Corridor Location Map	Figure 1.8

2. DATA COLLECTION AND INVENTORY

An inventory of existing roadway conditions was prepared along the study corridor and at the study area intersections based on a field review conducted on October 1 and October 2, 2012. Traffic, crash, and Geographic Information System (GIS) data was provided by VDOT, Roanoke County, and Montgomery County and utilized to document existing conditions.

2.1 General Description of the Corridor

The study corridor extends through the jurisdictions of Roanoke County, Montgomery County, and the Town of Christiansburg and is oriented in a general northeast/southwest direction. For the purposes of this study, the corridor was considered to have an east/west alignment throughout the study area. Throughout the study area, the functional classification of Route 11/460 varies. The majority of the study corridor is classified as a Rural Major Collector within Roanoke County and Montgomery County. However, the western most portion of the study corridor, within the jurisdictional limits of the Town of Christiansburg, is classified as an Urban Minor Arterial while the eastern most portion of the study corridor, east of West River Road, is classified as an Urban Collector according to VDOT's Montgomery County and Roanoke County 2005 Functional Classification maps.

VDOT is currently conducting a statewide review of the Functional Classification system. It has been proposed that Route 11/460 be upgraded to a Minor Arterial classification for the entire length of the study corridor. The Functional Classification review will not be completed until after the completion of the Route 11/460 Corridor Study.

All intersections and access points along the Route 11/460 study corridor are unsignalized with the exception of Crozier Road, which is the only signalized intersection within the study corridor. At several intersections along the corridor, exclusive, left and/or right turn lanes exist. Pedestrian facilities are relatively minimal to non-existent along the study corridor.

2.1.1 Roadway Sections

Observations from field reconnaissance of existing physical and operational conditions for the Route 11/460 corridor revealed that the roadway section varies throughout the study corridor, ranging from three to five lanes wide and containing both divided and undivided segments. Spot field measurements indicate lane width varying from 10 feet to 13 feet and paved shoulder width varying from zero feet to three feet. The roadway sections along the study corridor are further described in the following sections and outlined on **Figure 2.1** through **Figure 2.7**. The roadway section callouts (i.e. A1, A2, B1, B2, etc.) in the sections below refer to **Figure 2.1** through **Figure 2.7.**

Interstate 81 to Sisson & Ryan Quarry Entrance (~3.5 miles)

This section of Route 11/460 is a three-lane, undivided roadway (i.e. no median barrier preventing left-turning vehicles). Between I-81 and Dunlap Drive (Route 618) there is one travel lane in each direction and a center two-way left-turn lane (Photograph 2.1 – Section A1). The segment from Dunlap Drive to Mt Pleasant Road (Route 639) has two travel lanes in the eastbound direction and one travel lane in the westbound direction (Photograph 2.2 – Section A2). From Mt Pleasant Road to just west of Woodland Drive, the roadway again has one travel lane in each direction and a center two-way left-turn lane (Photograph 2.3 – Section A3). The section of roadway from just west of Woodland Drive to the Sisson & Ryan Quarry has one travel lane in the eastbound direction and two travel lanes in the westbound direction (Photograph 2.4 – Section A4).

Photograph 2.1 – Typical roadway section between I-81 and Dunlap Drive (Section A1, Eastbound Direction)

Photograph 2.2 – Typical roadway section between Dunlap Drive and Mt Pleasant Road (Section A2, Westbound Direction)

Photograph 2.3 – Typical roadway section between Mt Pleasant Road and Woodlawn Drive (Section A3, Eastbound Direction)

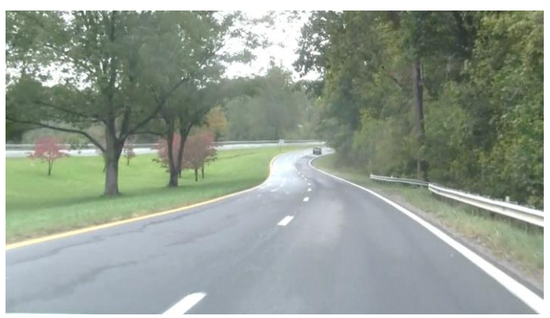
Photograph 2.4 – Typical roadway section between Woodlawn Drive and the Sisson & Ryan Rock Quarry (Section A4, Westbound Direction)

Sisson & Ryan Quarry Entrance to West River Road (Route 639) (~11.0 miles)

This section of Route 11/460 is a four-lane, divided roadway with a median barrier restricting left-turning vehicles except at designated median breaks. Between the entrance to the Sisson & Ryan Quarry and Crown Road (Route 795), the two eastbound travel lanes are separated from the two westbound travel lanes by guardrail (Photograph 2.5 – Section B1). From Crown Road to just east of Lafayette Street (Route 626), the two lanes in each direction are separated by a variable-width grass median (Photograph 2.6 and Photograph 2.7 – Section B2). The roadway segment just east of Lafayette Street to West River Road is again divided by guardrail (Photograph 2.8 – Section B3).

Photograph 2.5 – Typical roadway section between the Sisson and Ryan Rock Quarry and Crown Road (Section B1, Westbound Direction)

Photograph 2.6 – Typical roadway section near Alleghany Spring Road (Section B2, Eastbound Direction)



Photograph 2.7 – Typical roadway section near Dark Run Road (Section B2, Eastbound Direction)

Photograph 2.8 – Typical roadway section between Lafayette Street and West River Road (Section B3, Westbound Direction)

West River Road to Pleasant Run Drive (Route 796) (~1.3 miles)

This section of Route 11/460 is a five-lane, divided roadway between West River Road and the eastern most Pleasant Run Drive intersection with Route 11/460. Within this section there are two travel lanes in each direction and a center two-way left turn lane (Photograph 2.9 – Section C1). This section does not have a median barrier restricting left-turning vehicles.

Photograph 2.9 – Typical roadway section between West River Road and Pleasant Run Drive (Eastbound Direction)

Pleasant Run Drive to Technology Drive (~1.2 miles)

The section of Route 11/460 from the eastern most Pleasant Run Drive intersection to Vintage Lane is a four-lane, divided roadway with a median barrier restricting left-turning vehicles except at designated median breaks. The two eastbound lanes are separated from the two westbound lanes by guardrail (Photograph 2.10 – Section D1). At the eastern end of the study corridor, there is a three-lane, divided roadway segment that is approximately one quarter mile long between Vintage Lane and Technology Drive. In this section, one eastbound travel lane is separated from the two westbound travel lanes by guardrail (Photograph 2.11 – Section D2).

Photograph 2.10 – Typical roadway section between Pleasant Run Drive and Vintage Lane (Section D1, Westbound Direction)

Photograph 2.11 – Typical roadway section between Vintage Lane and Technology Drive (Section D2, Eastbound Direction)

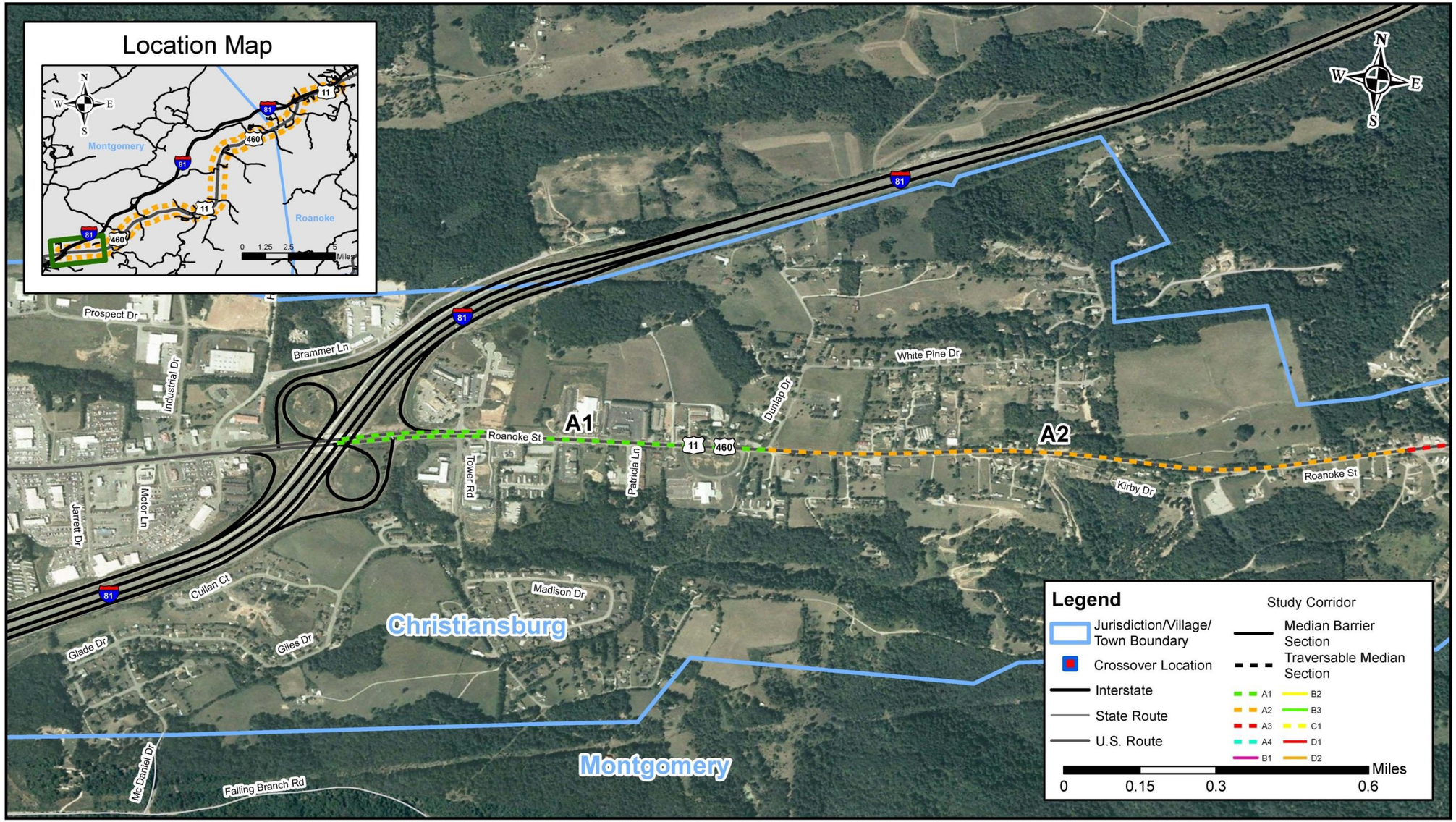
2.1.2 Crossovers

Within the 17-mile long study area, approximately 12 miles of the corridor has a median barrier that restricts left-turning vehicles. Within the 12-mile median barrier section, Route 11/460 has 66 crossovers resulting in an average crossover spacing of less than 1,000 feet. The locations of these crossovers are shown on **Figure 2.1** through **Figure 2.7**. For reference, the crossovers were assigned numbers, with the western-most crossover assigned number 1 and the eastern-most crossover assigned number 66.

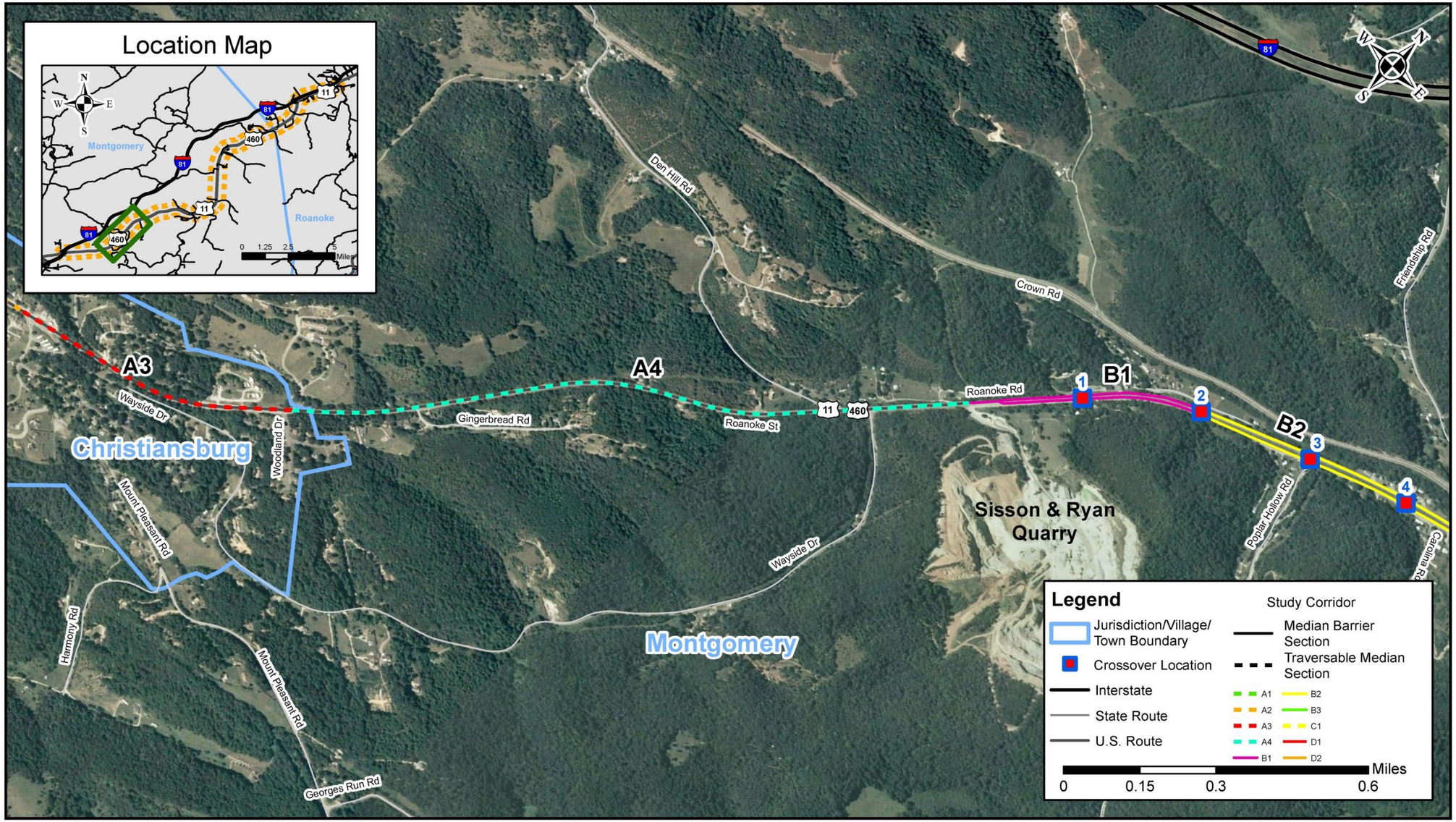
The distance between successive crossovers ranges from approximately 160 feet between crossovers 37 and 38 and between crossovers 61 and 62 to approximately 7,020 feet between crossovers 58 and 59. The distances between adjacent crossovers along the study corridor are summarized in **Table 2.1**.

Table 2.1 – Crossover Spacing

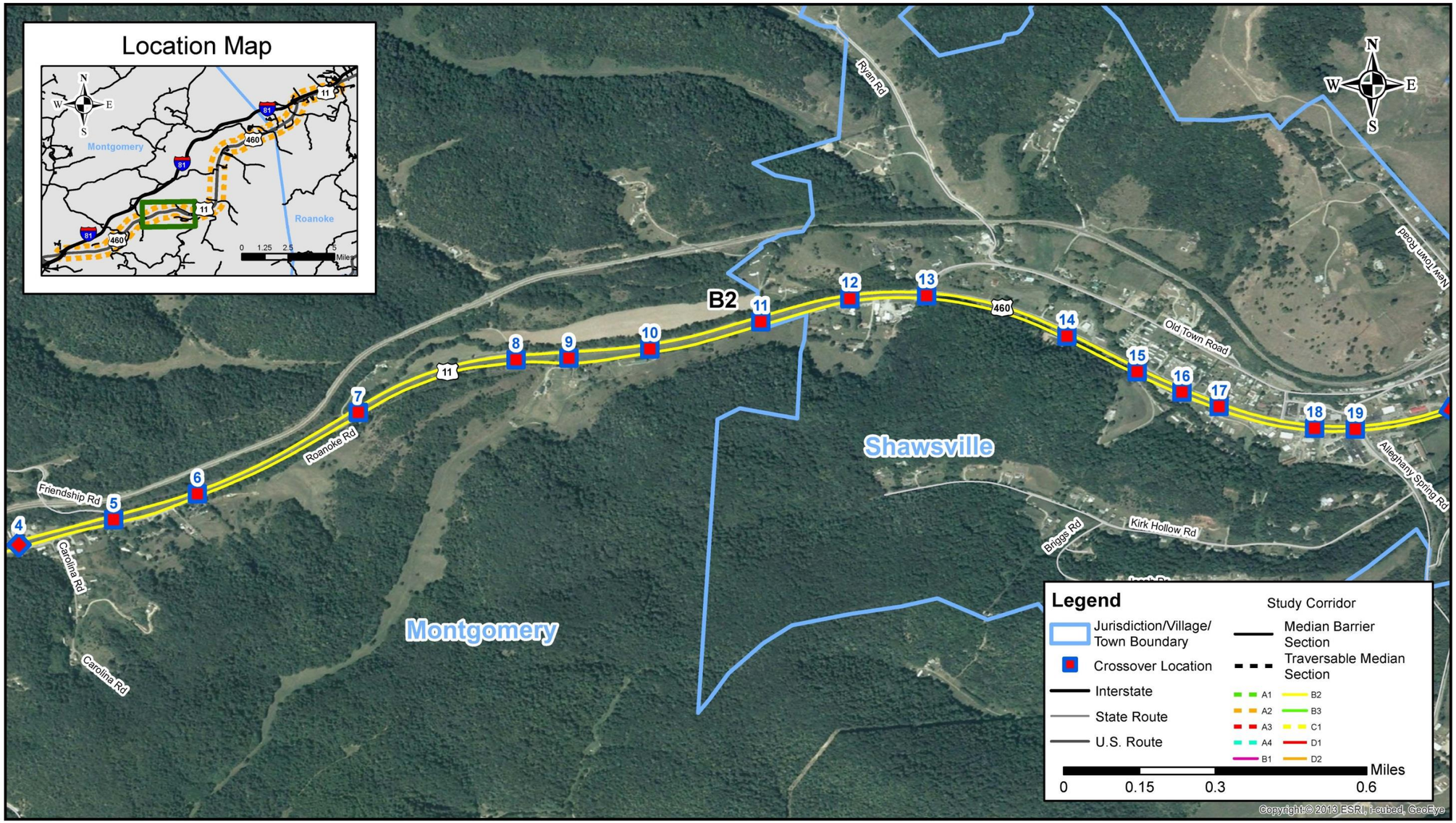
Crossover #	Cross Street (if available)	Distance to Adjacent Crossover to the East (ft)
1		1,100
2		1,020
3	Poplar Hollow Rd	910
4		840
5	Friendship Rd	750
6		1,590
7		1,440
8		440
9		690
10		980
11	Sparrow Rd	780
12		640
13	Old Town Rd	1,250
14		690
15		430
16		350
17	Trump Ln	840
18		344
19	Alleghany Spring Rd	830
20		1,050
21	Boners Run Rd	910
22	Corbin Rd	780
23	Pair-O-Docs Ln	640
24	Old Town Rd	2,760
25	Dark Run Rd	410
26	Riffe St	1,260
27		2,110
28		870
29	Graham St	1,720
30		1,060
31		1,320
32		320
33	Seneca Hollow Rd	1,420
34	Crozier Rd	1,300
35		1,670
36	Big Spring Dr	500
37		160
38	Brake Rd	310
39	Calloway St	770
40		700
41	Big Spring Dr	1,690
42		1,850
43		1,620
44	North Fork Rd	760
45	Enterprise Dr	1,880
46	Gardner St	1,160
47	Green Hill Ln	870
48	Apgar Dr	410
49	Lafayette Rd	640
50		350
51	Stones Keep Ln	1,570
52	Campbell Dr	870
53	Marshall Dr	840
54	Peaceful Dr	730
55		890
56	WVWA	950
57		1,210
58	West River Rd	7,020
59	Pleasant Run Dr	1,200
60		1,310
61	Yale Dr	160
62		360
63	Glenvar Heights Blvd	1,320
64		350
65		630
66	Vintage Ln	-



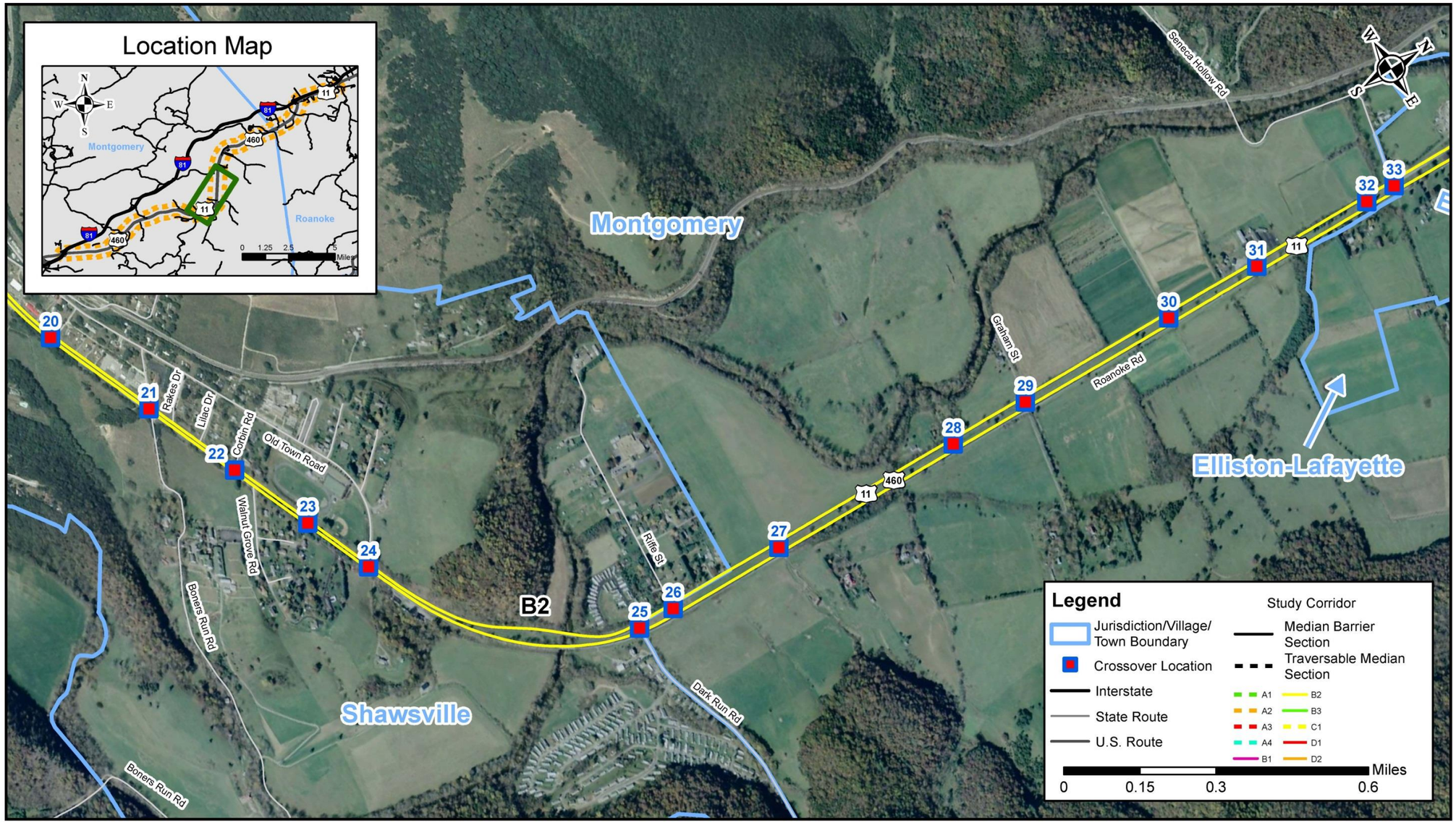
Route 11/460 Corridor Study	Crossover Location Map	Figure 2.1



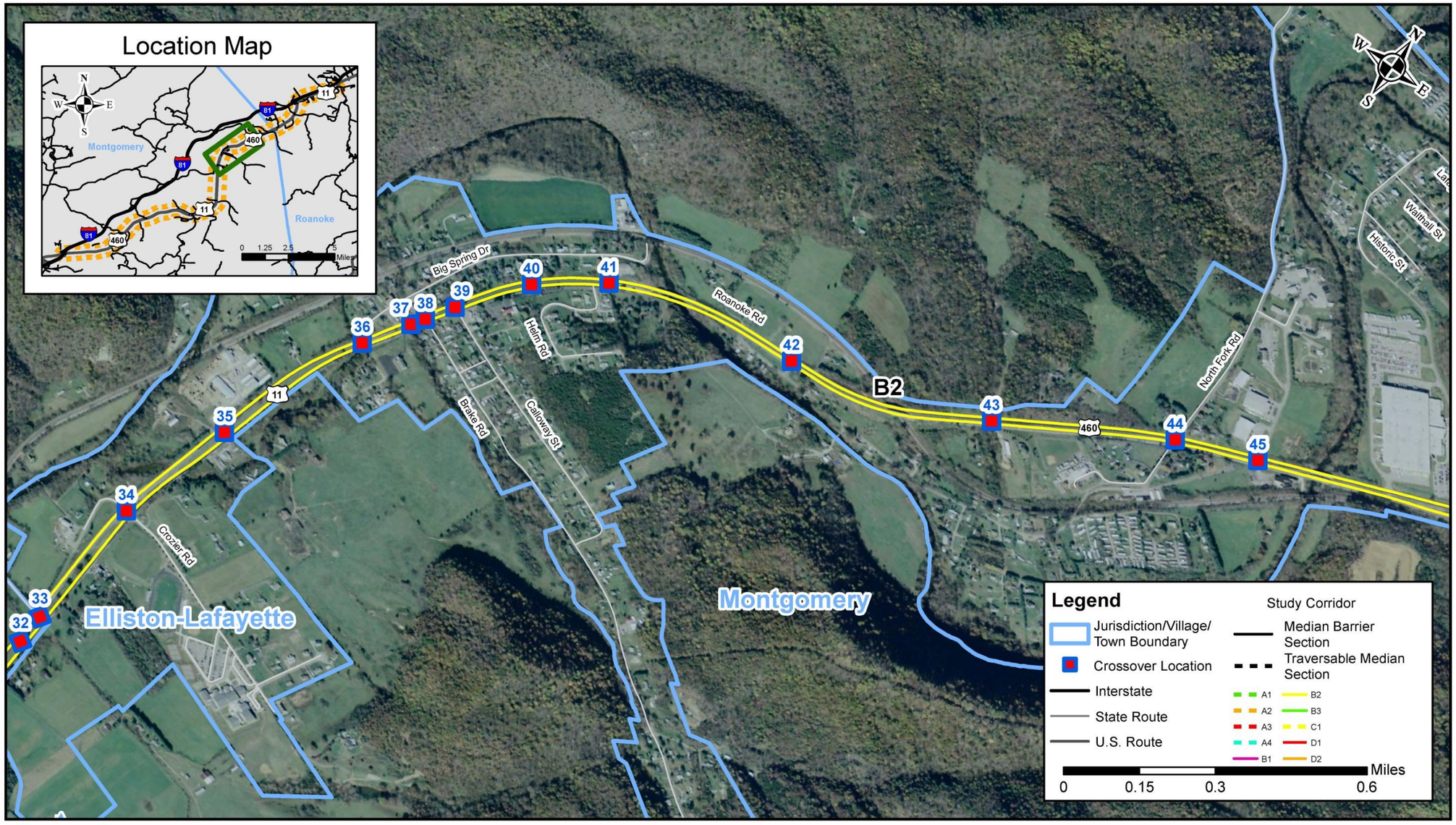
Route 11/460 Corridor Study	Crossover Location Map	Figure 2.2



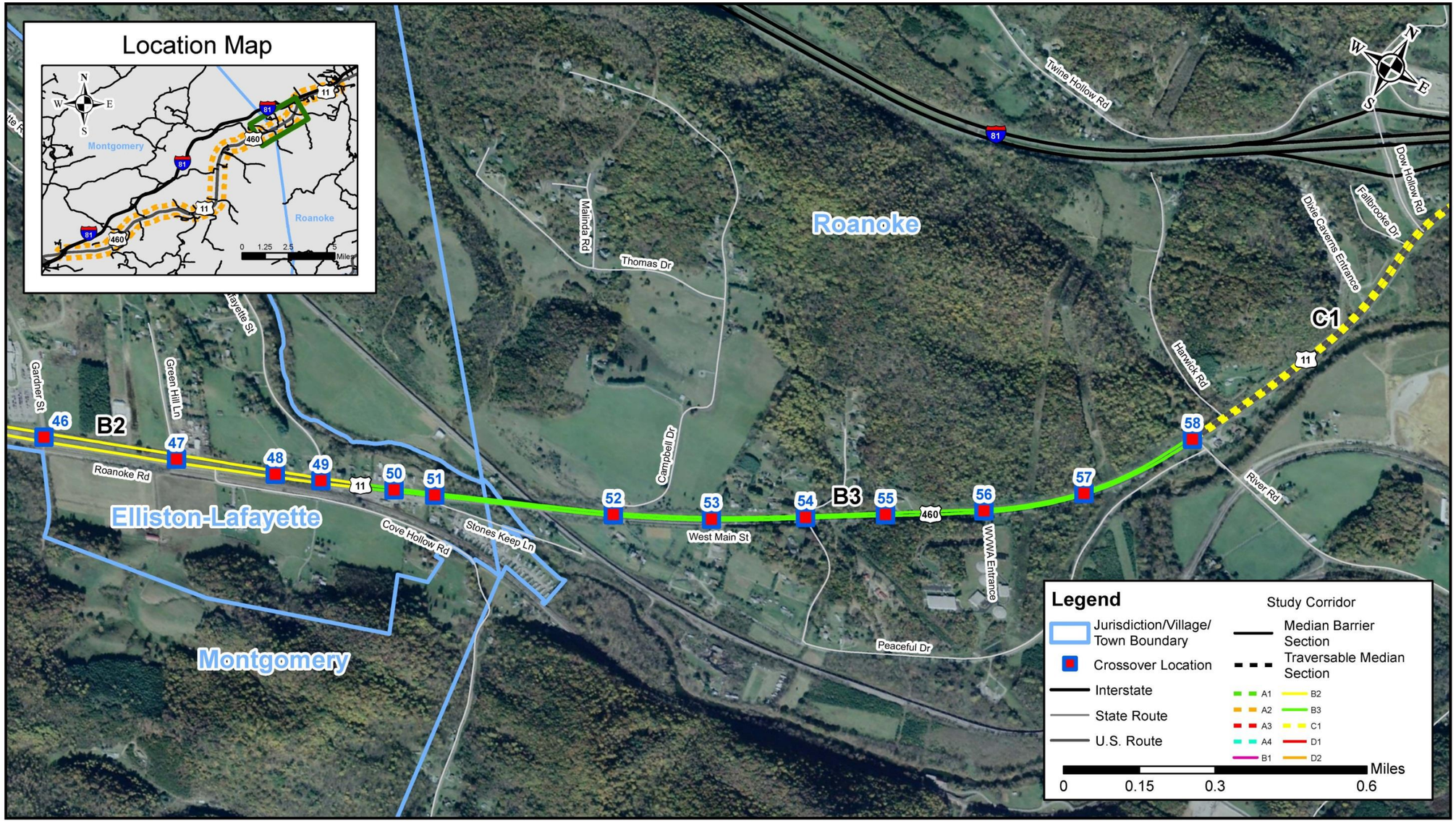
Route 11/460 Corridor Study	Crossover Location Map	Figure 2.3



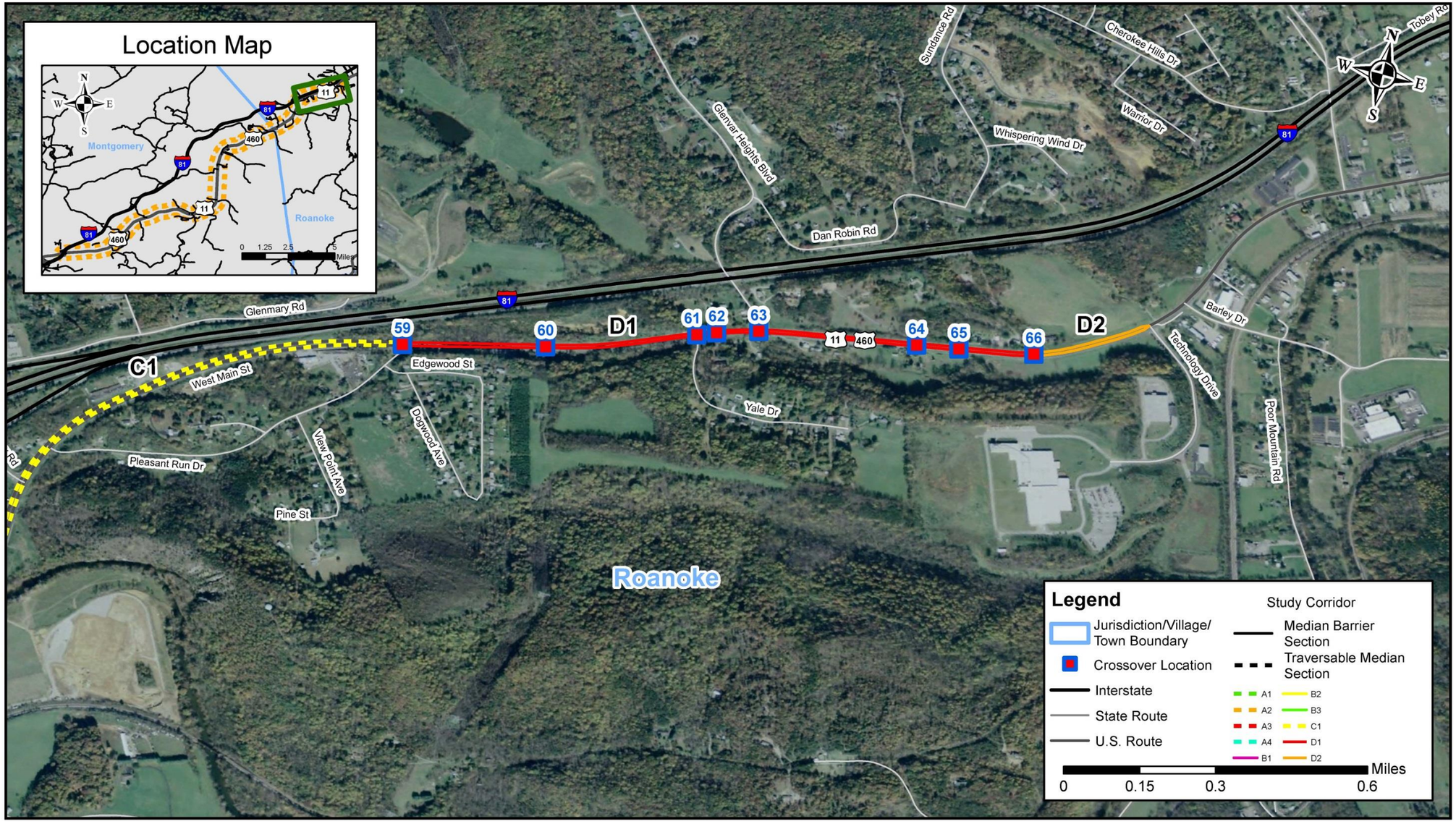
Route 11/460 Corridor Study	Crossover Location Map	Figure 2.4



Route 11/460 Corridor Study	Crossover Location Map	Figure 2.5



Route 11/460 Corridor Study	Crossover Location Map	Figure 2.6



Route 11/460 Corridor Study	Crossover Location Map	Figure 2.7

2.1.3 Corridor Speed

The speed limit ranges from 45 MPH to 60 MPH within the study corridor. **Table 2.2** provides further details on the speed limit changes. There are two school zones with speed limits of 35 MPH when flashing for Shawsville Elementary and Eastern Montgomery Elementary.

Table 2.2 – Study Corridor Speed Limits

From	To	Speed Limit (MPH)
Western Limit of Study Corridor	Patricia Lane	45
Patricia Lane	Sisson & Ryan Quarry Entrance	55
Sisson & Ryan Quarry Entrance	Old Town Road (western intersection with Route 11/460)	60
Old Town Road (western intersection with Route 11/460)	Pair-O-Docs Lane	45
Pair-O-Docs Lane	Riffe Street	55
Riffe Street	Barnett Road	60
Barnett Road	Eastern Limit of Study Corridor	55

Spot speeds were collected along Route 11/460 at the intersection with Friendship Road (Route 636) on October 2, 2012 for the 15-minute period from 4:15 PM to 4:30 PM. At this location the posted speed limit is 60 MPH in both the eastbound and westbound directions. In the eastbound direction, the average speed was 58 MPH and the 85th percentile speed was 62 MPH. In the westbound direction, the average speed was 60 MPH and the 85th percentile speed was 65 MPH. Refer to the **Appendix** for the complete spot speed data.

2.2 Physical Environment

A comprehensive review of available data pertaining to the existing and planned physical environment along the Route 11/460 corridor was conducted; where possible, the data was obtained in ESRI-compatible format. The obtained published and electronic data and reports were used to document existing and planned conditions in the study area. This review included the following information which was provided by VDOT, Roanoke County, and Montgomery County:

1. Digital aerial photography
2. GIS data
   - VDOT GIS data included roads, jurisdiction boundaries, and bodies of water.
   - Roanoke County GIS data included streets, property lines, zoning boundaries, railroad tracks, watercourses, subdivisions, and buildings
   - Montgomery County GIS data included property lines, zoning boundaries, and comprehensive plan lane use.
3. Local transportation planning studies
4. Median crossover locations

Zoning and parcel information is included in **Figure 2.8** through **Figure 2.14**. A zoning classification key for each jurisdiction is provided in **Table 2.3**.

Along Route 11/460 the predominant land use is agricultural. There are concentrated areas of residential and commercial properties within Christiansburg, Shawsville, Elliston, and Glenvar. In addition, Shawsville Elementary, Shawsville Middle, Eastern Montgomery Elementary, and Eastern Montgomery High Schools are all located along the study corridor.

2.3 Supplemental Field Data Collection

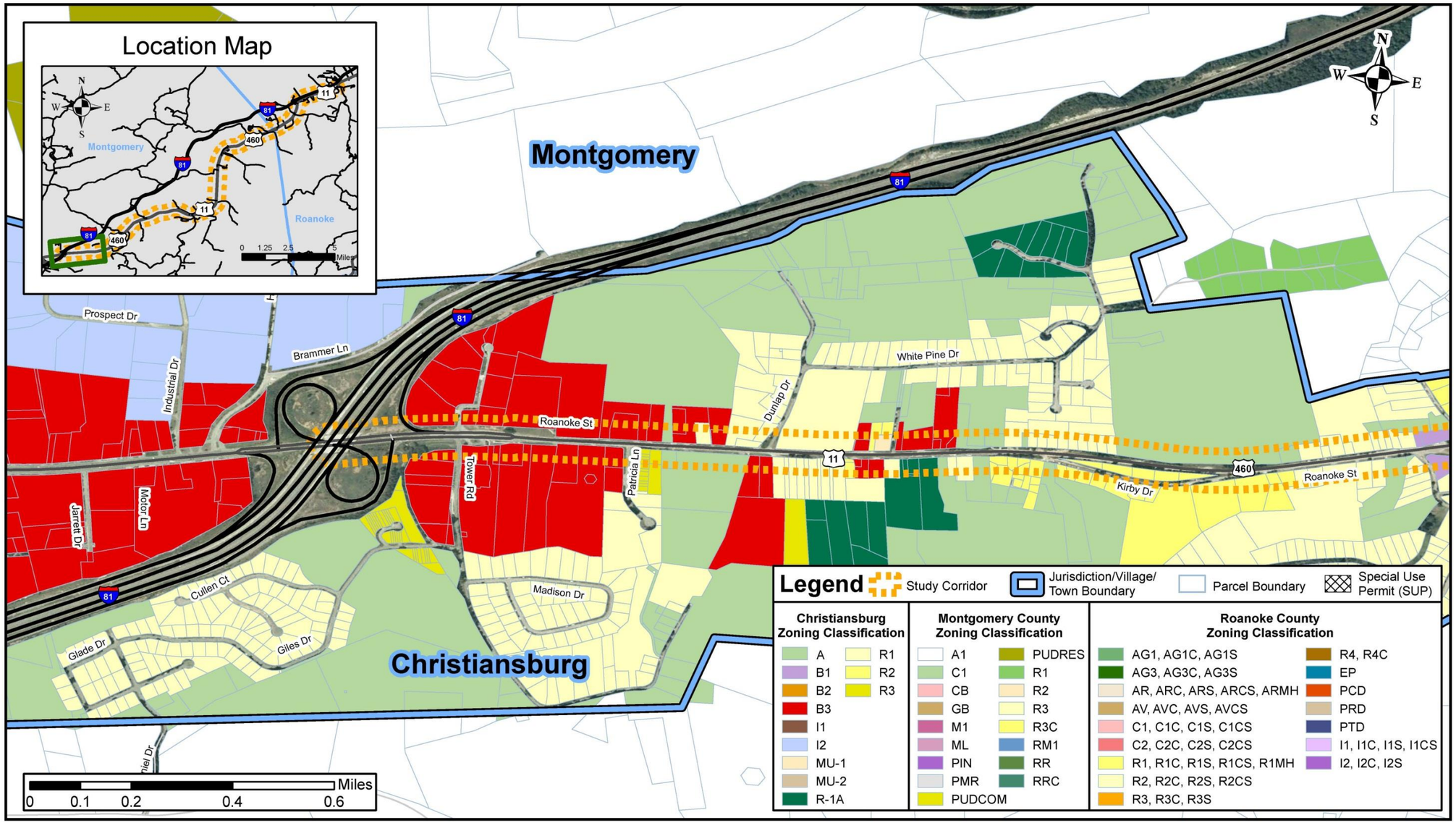
A field inventory of the corridor was conducted in October 2012 to augment and verify some of the aforementioned data. This review was limited to visual verification of the following information:

- Intersection traffic control and roadway geometry (including signs)
- Street cross section (number of lanes, lane width, edge treatment, median treatment, presence of turn lanes, surface)
- Sidewalks, bikeways, medians, and crosswalks
- Bridges
- Curb and gutter/shoulder treatment
- Turn lanes (length and location)
- Lighting
- Guardrail
- Current land use and development
- Business names

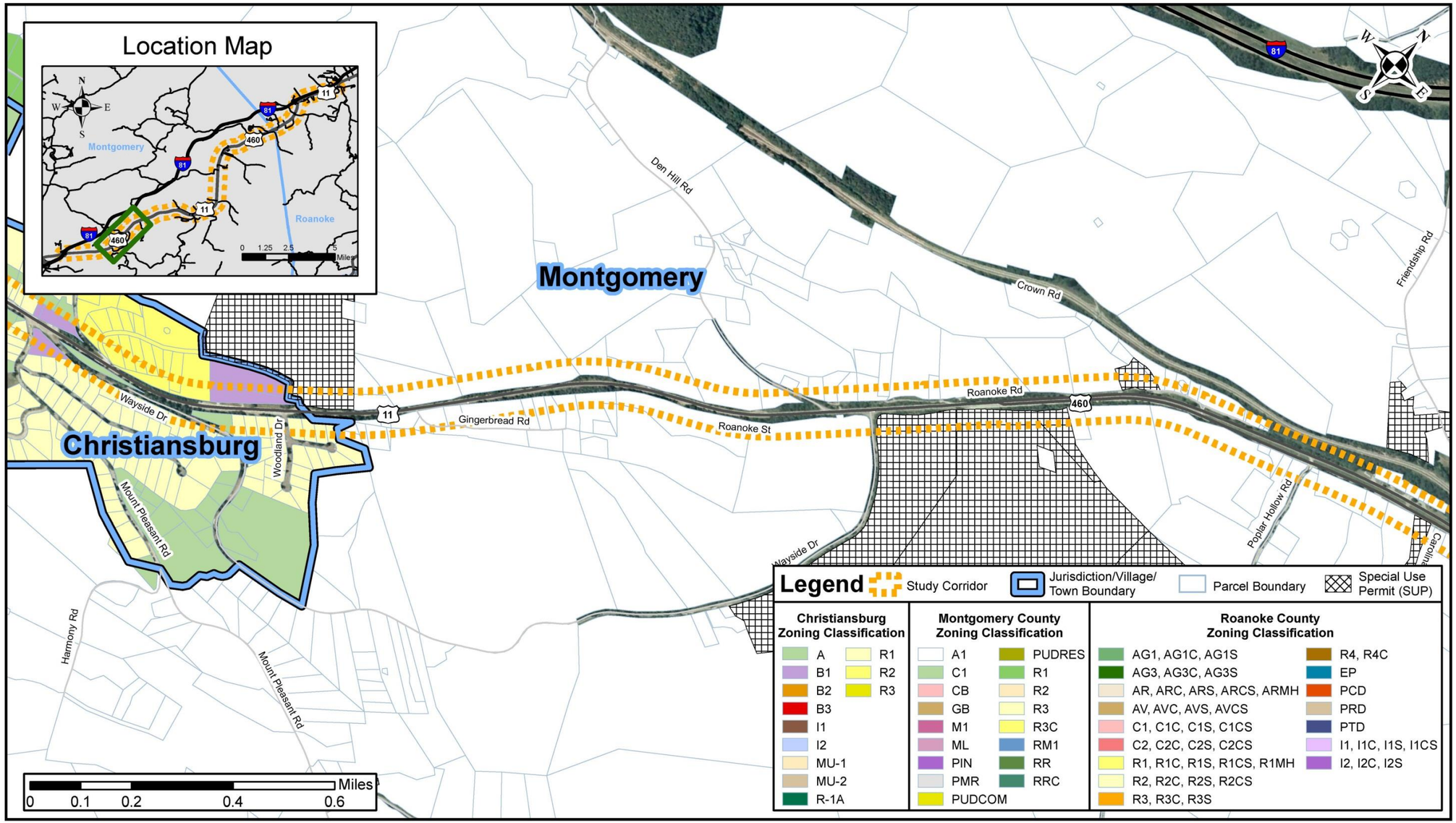
During the field inventory, visual observations were noted regarding the operations of automobile, pedestrian and bicycle traffic. Field data related to cross-sections and roadway geometry at the study area intersections is summarized in the **Appendix**.

Table 2.3 – Zoning Classification Key

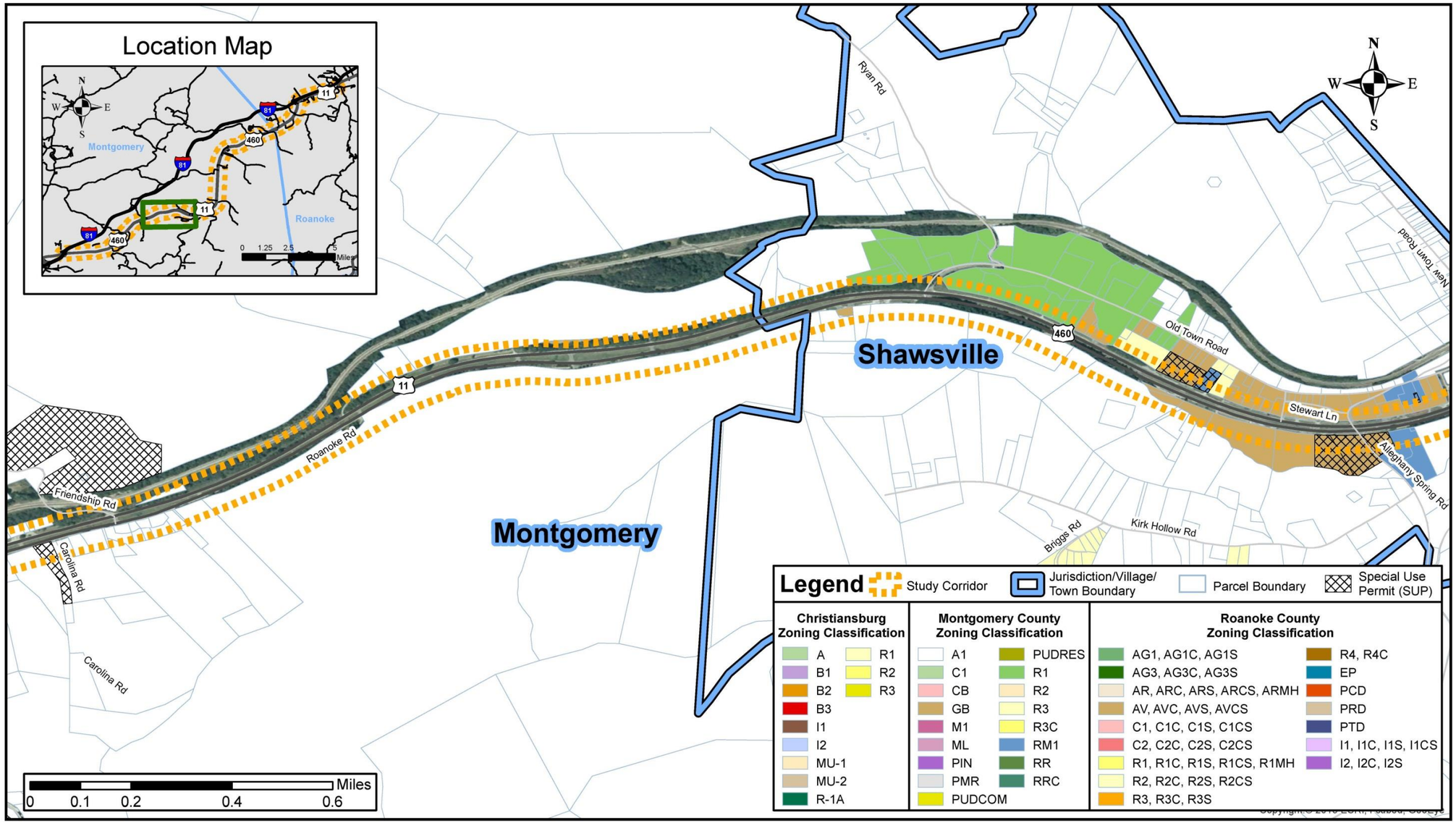
ZONE	DESCRIPTION
Town of Christiansburg	
A	Agricultural
B1	Limited Business
B2	Central Business
B3	General Business
I1	Limited Industrial
I2	General Industrial
MU-1	Mixed Use: Residential-Limited Business
MU-2	Mixed Use: Residential-Limited, Business-Limited Industrial
R-1A	Rural Residential
R1	Single Family Residential
R2	Two-Family Residential
R3	Multi-Family Residential
Montgomery County	
A1	Agricultural
C1	Conservation
CB	Community Business
GB	General Business
M1	Manufacturing
ML	Manufacturing Light
PIN	Planned Industrial
PMR	Planned Mobile Home Residential
PUDCOM	Planned Unit Development Commercial
PUDRES	Planned Unit Development Residential
R1	Residential
R2	Residential
R3	Residential
R3C	Residential (Compact)
RM1	Multi-Family Residential
RR	Rural Residential
RRC	Rural Residential (Compact)
Roanoke County	
AG1	Agricultural/Rural Low Density
AG3	Agricultural/Rural Preserve
AR	Agricultural/Residential
AV	Agricultural/Village Center
C1	Office
C2	General Commercial
R1	Low Density Residential
R2	Medium Density Residential
R3	Medium Density Multi-Family Residential
R4	High Density Multi-Family Residential
EP	Explore Park
PCD	Planned Commercial Development
PRD	Planned Residential Development
PTD	Planned Technology Development
I1	Low Intensity Industrial
I2	High Intensity Industrial



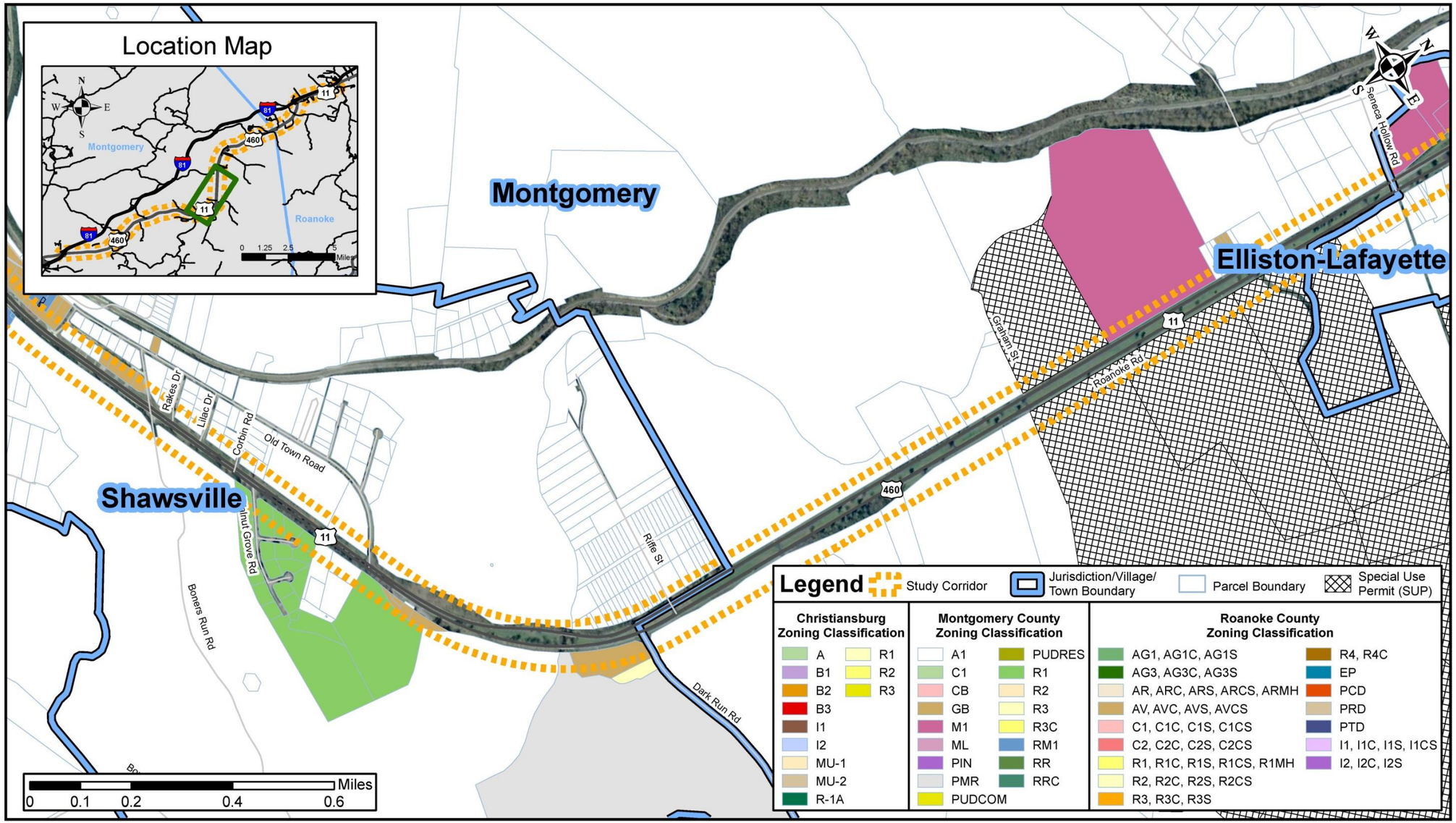
Route 11/460 Corridor Study	Existing Zoning Map	Figure 2.8



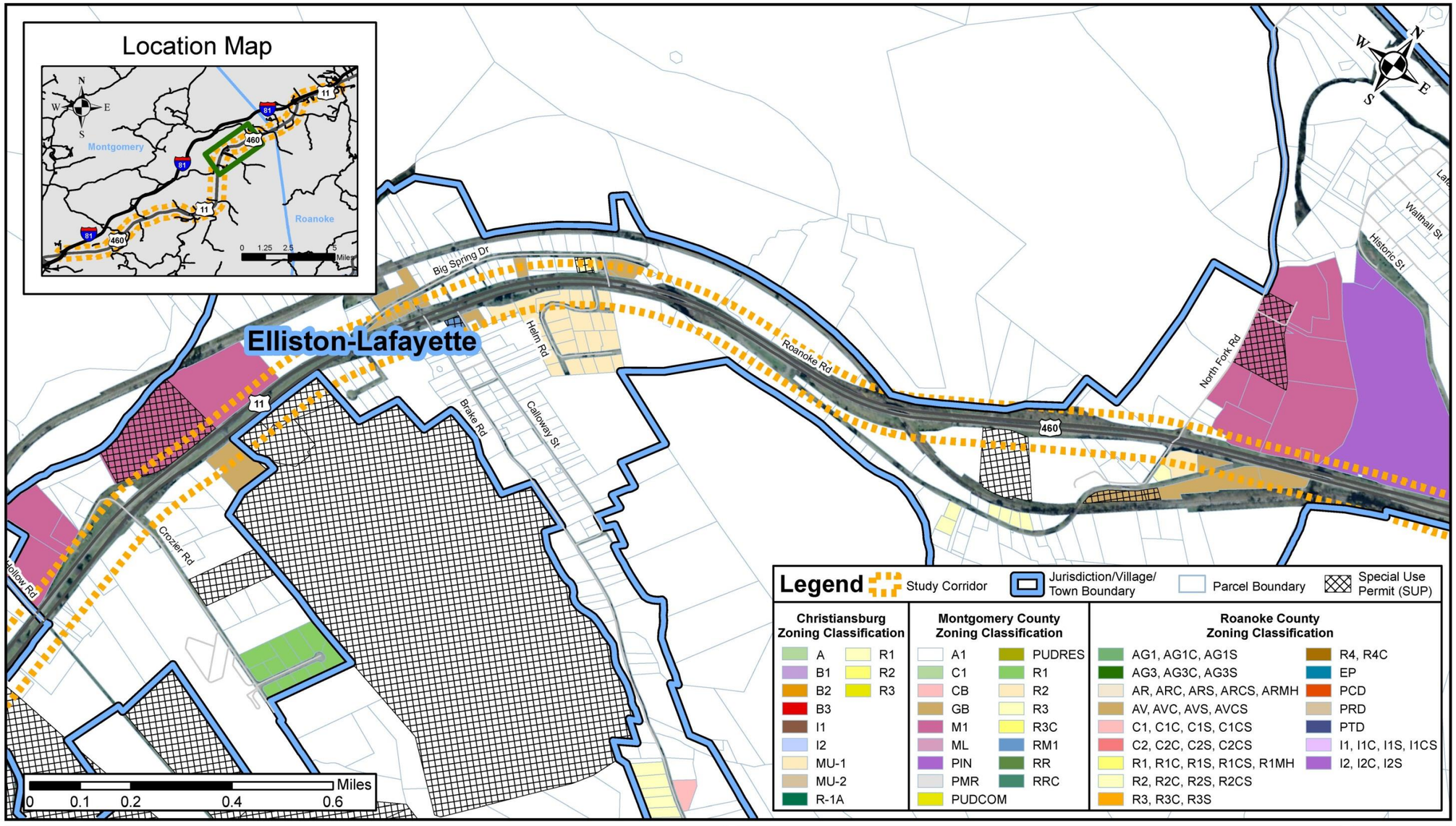
Route 11/460 Corridor Study	Existing Zoning Map	Figure 2.9



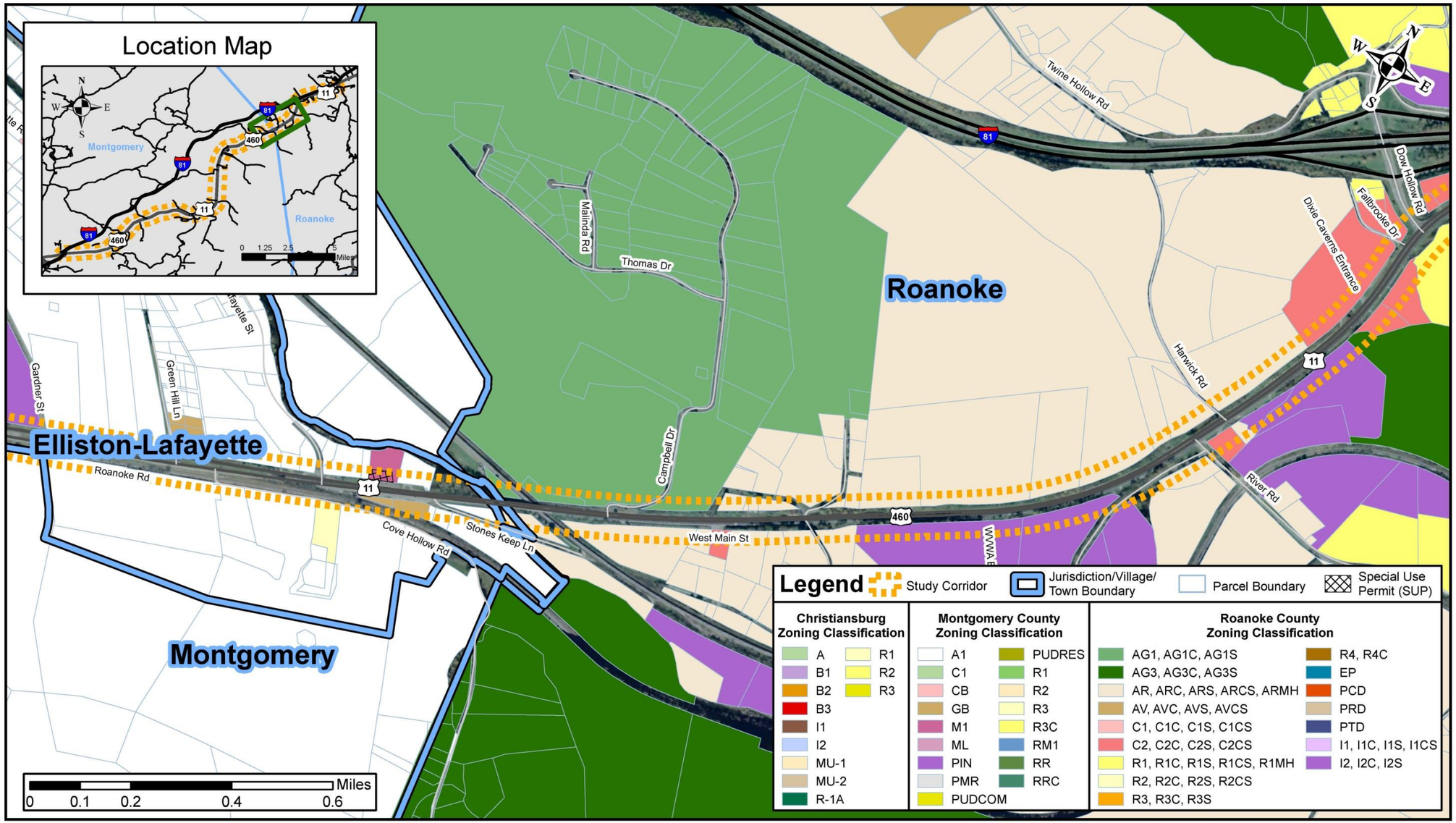
Route 11/460 Corridor Study	Existing Zoning Map	Figure 2.10



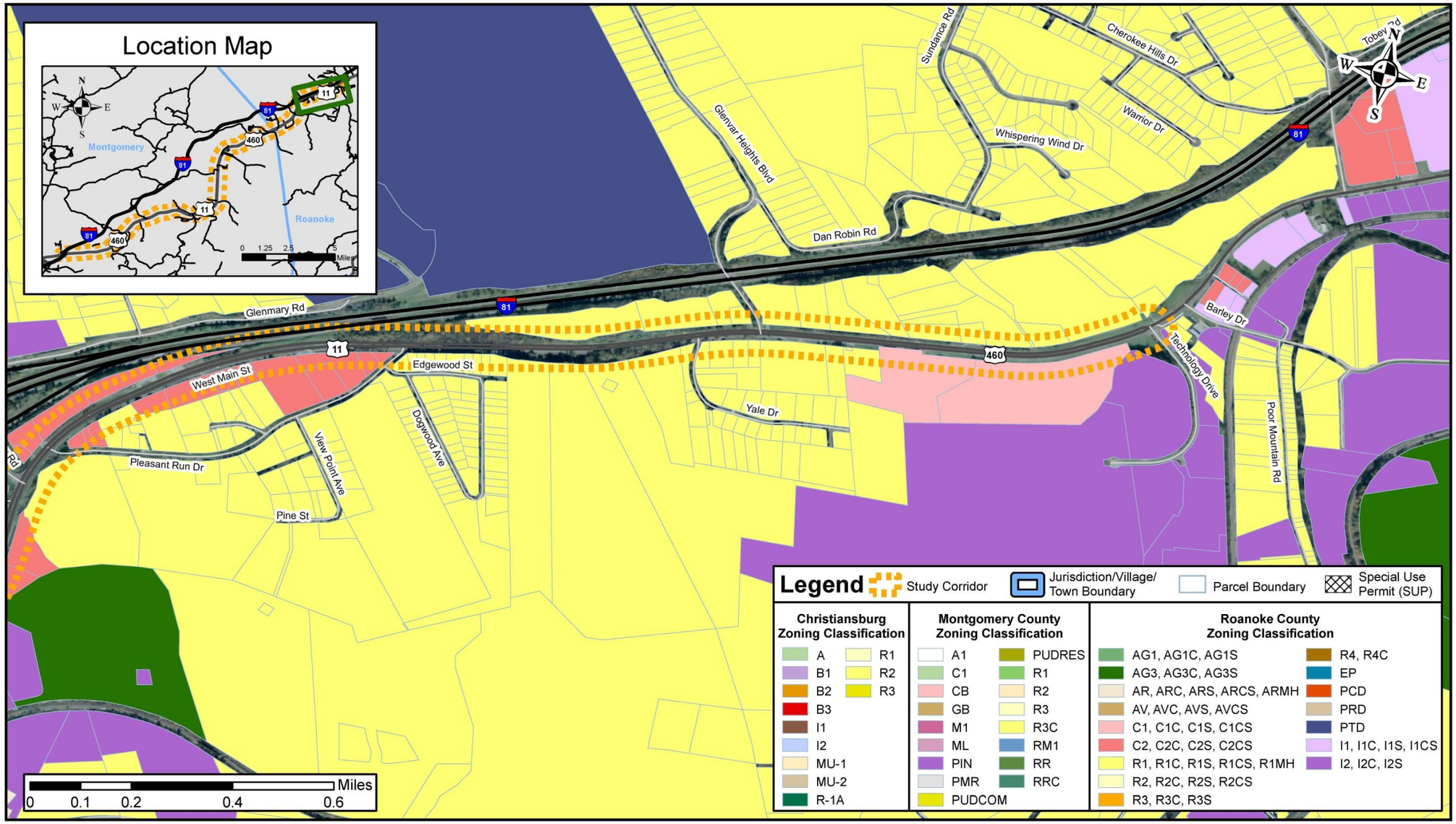
Route 11/460 Corridor Study	Existing Zoning Map	Figure 2.11



Route 11/460 Corridor Study	Existing Zoning Map	Figure 2.12



Route 11/460 Corridor Study	Existing Zoning Map	Figure 2.13



Route 11/460 Corridor Study

Existing Zoning Map

Figure 2.14

2.4 Other Relevant Planning Efforts

Several relevant planning efforts were previously completed within the vicinity of the study corridor. A brief summary of these efforts and how they relate to the Route 11/460 corridor study are offered below.

2.4.1 Shawsville Village Plan

The Shawsville Village Plan – Montgomery County (2025) was adopted on June 11, 2007. The purpose of this plan is to guide development in the village while maintaining the village's distinct identity. Shawsville has a rural character, small town feel and is located near the intersection of Route 11/460 and Alleghany Spring Road in Montgomery County, Virginia. Shawsville encompasses approximately two square miles. Based on a household survey and community visioning session conducted in 2007, the residents within Shawsville would like to improve transportation safety, access/availability to public transportation, and pedestrian/bike/golf cart connections to public facilities. The plan assumes Shawsville will continue to grow over the next 25 years in line with Montgomery County at just over 1% per year annually. Smart Way bus added a trial service to Shawsville in 2007 linking the Roanoke Valley and the New River Valley. The service was terminated in 2008 as a result high cost and low ridership.

The plan developed several policies to guide the actions of Montgomery County, State Agencies, the Town of Blacksburg, and private landowners to preserve Shawsville in accordance with the vision of the plan. Policies applicable to the Route 11/460 corridor and transportation in general are included in the Appendix and have been taken into account throughout the development of this plan.

2.4.2 Elliston & Lafayette Village Plan

The Elliston & Lafayette Village Plan – Montgomery County (2025) was adopted on June 25, 2007. The purpose of this plan is to guide development in the village while maintaining the village's distinct identity. The Villages of Elliston and Lafayette have a rural character, are pedestrian oriented communities, and are located approximately four miles east of Shawsville in Montgomery County, Virginia. Elliston and Lafayette are rich in historic resources which are viewed as community assets. The two villages are separated by the South Fork of the Roanoke River. Through the public input process conducted in 2004, citizens within the Elliston & Lafayette areas identified the need for an improved transportation system, including an interconnected road network, and the provision of alternative and mass transit opportunities and facilities. The citizens also developed the following four goals:

1. Maintain and enhance rural and small town character of the Elliston and Lafayette area;
2. Strengthen existing businesses and provide opportunities for new business and industrial development;
3. Establish strong transportation connections within and around Elliston and Lafayette; and
4. Develop a diverse and attractive housing stock to meet the needs of all Elliston and Lafayette residents, both now and in the future.

The plan developed several policies to guide the actions of the appropriate planning agencies to preserve Elliston and Lafayette in accordance with the vision of the plan. Policies applicable to the Route 11/460 corridor, and transportation in general, are included in the Appendix and have been taken into account throughout the development of this corridor study.

2.4.3 Lafayette Route 11/460 Corridor Plan

The Lafayette Route 11/460 Corridor Plan was completed on March 12, 2012 and was prepared by Renaissance Planning Group for Montgomery County, Virginia. The Route 11/460 Corridor Plan builds on the Elliston and Lafayette Village Plan to clarify the corridor design and transportation planning principles intended for the corridor through these villages. The goal of the plan was to develop an updated long-range vision and conceptual plan for the corridor. Through the public involvement process, the property owners and local officials identified the following three key issues: supporting economic development opportunities; improving safety of Route 460 for all users; and maintaining or enhancing the scenic quality of the corridor. The plan focuses on Route 11/460 from the Roanoke County line to the intersection with the Norfolk Southern Railroad. The plan analyzed and refined the then current land use plans within the study area and projected an approximately 10,000 vehicle per day increase on Route 11/460 in the next 20 to 30 years. Within the land use recommendations was the general theme to integrate pedestrian improvements/circulation, provide external connections to a broader trail network and greenway system, and landscape open space and street trees. The plan recommends shared bicycle and pedestrian facilities within a buffered trail system as opposed to alongside Route 11/460. The plan's specific Route 11/460 recommendations for each corridor segment are included in the Appendix and have been taken into account throughout the development of this corridor study.

2.4.4 Shawsville Area Route 11/460 Corridor Study

The Shawsville Area Route 11/460 Corridor Study was completed July 2012 and was prepared by the New River Valley Planning District Commission for the Montgomery County Planning Department. The study evaluates performance and safety concerns within the Shawsville Village area. The study mainly focused on applying VDOT access management standards and AASHTO's minimum sight distance requirements to the existing intersections and access points on Route 11/460 within the study area. The plan recommends developing a local blueprint which includes access management principals, speed limit and sight distance issues, potential safety and capacity needs, alternative transportation choices, hazard mitigation techniques, integration of transportation and future land use planning, and pin-pointing potential improvements. According to the study, only 40% of the entrances and crossovers in the Shawsville area meet VDOTs current Access Management Regulations. The study provides detailed recommendations to all crossovers and access points located within the study corridor. The plan recommends closing eight of the 16 existing crossovers on Route 11/460. These recommendations have been incorporated into Chapter 5. The plan also suggests that nearly 60% of the access points on Route 11/460 do not provide good intersection sight distance. The plan offers the following potential improvements to the corridor:

1. Reduce the number of open-median crossings
2. Reduce the number of entrances
3. Create access between parcels and joining entrances
4. Add turn lanes at open medians and local roadways
5. Perform a signal determination at Route 11/460 and Alleghany Spring Road
6. Remove vegetation growth that limits proper sight distance at intersections
7. Install advanced warning signs/devices to alert motorists of flood prone areas
8. Reduce the speed limit in an attempt to provide benefit to Partial Access Entrances; would not improve sight distance

The study's specific Route 11/460 crossover recommendations are included in the Appendix and have been taken into account throughout the development of this corridor study.

2.4.5 Glenvar Community Plan

The Glenvar Community Plan was adopted on January 24, 2012. The purpose of this plan is to guide development in the community while maintaining the community's distinct identity. In particular, development issues related to the West Main Street (Route 11/460) widening project and the proposed intermodal facility in Montgomery County were studied. The study area is located within Roanoke County and has a western limit of the Montgomery County line and an eastern limit of the City of Salem. Responses to a 2010 community survey indicated that issues important to community members included maintaining the community feel of the area, traffic, appearance of Route 11/460, and safe options for alternative modes of transportation. Survey responses also revealed that the top five transportation improvements believed to be needed in the Glenvar area are bike lanes, improving/widening existing roads, greenways, sidewalks, and community identification signs.

At the core of the Glenvar Community Plan was the following vision statement: "The Glenvar area strives to be a visually appealing, healthy and sustainable community that encourages a mix of land uses in a manner that is consistent with the community's rural character." The eight goals listed below were developed based on the overall vision of the community:

1. Ensure that public services and facilities will adequately serve the needs of residents and businesses within the Glenvar Community and that such services and facilities are adaptable to future growth.
2. Develop a safe, efficient transportation system that provides a range of transportation choices and reinforces the livability of neighborhoods.
3. Provide a mix of environmentally-sensitive commercial and industrial uses at approximate locations in the Glenvar Community that meet the needs of current and future residents.
4. Provide a diverse, affordable and sustainable housing mix for varied population, while preserving the natural resources and rural character of the community.
5. Conserve and appropriately use the Glenvar Community's natural resources in a manner that ensures their long-term viability and recreational, natural, scenic and economic value.
6. Preserve, enhance and promote the unique, historic and cultural richness of the Glenvar Community.
7. Maintain a healthy, safe and sustainable community that ensures opportunities for multi-generational community to live, work, recreate and raise a family.
8. Develop a comprehensive system of public and private parks, trails and open spaces that meet the needs of all age groups within the Glenvar Community.

The Glenvar Community Plan provided recommendations for the Route 11/460 corridor and are included in the Appendix. These recommendations have been taken into account throughout the development of this corridor study.

2.4.6 Route 603 (North Fork Road) – Elliston/Ironto Connector

The Route 603 (North Fork Road) – Elliston/Ironto Connector is a VDOT Six-Year Improvement Program (SYIP) project to improve safety and capacity (UPC 92558). The reconstruction project includes two 12-foot travel lanes with 5-foot paved shoulders, 3-foot unpaved shoulders, and retaining walls. This project will enhance the Route 11/460 connection to Interstate 81 (Exit 128). The project is estimated to cost approximately $20 million with a current advertisement date of 2014. The VDOT SYIP project details are included in the Appendix.

In VDOT's operational analysis of the Route 603 corridor, dated November 10, 2009, the Route 11/460 and North Fork Road intersection was analyzed taking into account anticipated traffic volume growth as a result of the proposed intermodal facility. The results of the study indicate the Route 11/460 and North Fork Road intersection will operate adequately under existing and design year (2033) conditions. The existing turn lane lengths were determined to be adequate. Should Route 603 be relocated to the intersection of the industrial park entrance, the intersection is projected to operate adequately and the existing turn lanes will remain adequate.

2.4.7 Proposed Roanoke Regional Intermodal Facility

The Roanoke Regional Intermodal Facility is a project proposed as part of the Heartland Corridor Initiative, a freight rail improvement project in Virginia, West Virginia, and Ohio. Norfolk Southern is constructing the Heartland Corridor with support from Federal Highway Administration, Eastern Federal Lands Division (FHWA-EFLHD), the Commonwealth of Virginia, the state of West Virginia, and the state of Ohio. The Heartland Corridor Initiative projects include infrastructure improvements such as increased tunnel clearances and intermodal facilities in all three states. These projects are designed to increase capacity along the Heartland Corridor and decrease the shipping time between Hampton Roads and Chicago by 1.5 days.

The proposed location for the Roanoke Regional Intermodal Facility is in Montgomery County near the Roanoke County line. This location is approximately three miles from I-81 Exit 132, which provides truck access to the interstate. The construction of the Roanoke Regional Intermodal Facility is projected to have a positive economic impact on the Roanoke region by attracting new businesses to the region and creating jobs.

Based on discussions at the Route 11/460 Study Kick-Off Meeting on October 1, 2012, the Roanoke Regional Intermodal Facility project has stalled. For the purposes of this study it is assumed that the Roanoke Regional Intermodal Facility is not in place. Should the facility be constructed, it should adhere to the vision of this study. The construction of the Roanoke Regional Intermodal Facility can result in a significant change in character within the local area. The ancillary impacts of the intermodal facility should be addressed through the normal County and VDOT processes.

2.4.8 Village Transportation Links Plan

The Village Transportation Links Plan: Final Report – Montgomery County, was adopted on June 25, 2007. The purpose of this plan is to develop a comprehensive Bicycle, Pedestrian, and Greenways Master Plan for each village identified in the Montgomery County Comprehensive Plan. The goals of the plan include: connecting activities/spaces within villages, strengthening a sense of place in each village, improving connections to schools, connecting to regional trails, resources, and intermodal facilities, and leveraging public/private funding opportunities. Specific goals and recommendations associated with Shawsville and Elliston and Lafayette are provided below.

Shawsville

The plan points out the focal points of Shawsville including the Shawsville Elementary and Middle Schools and the Meadowbrook Center. The main recommendation made within the Shawsville area is connecting residential areas to the Meadowbrook Library/YMCA. The plan provides the following items to accomplish this recommendation:

1. Construct parallel system to Route 11/460 connecting historic residential areas and schools to the library by creating a multi-use trail and sidewalks along Old Town Road.
2. Constructing sidewalks to residential areas not located within village core.
3. Add paved shoulders to Route 11/460 to provide safer direct access to regional destinations.

The plan also recommends a traffic signal at the Route 11/460 and Alleghany Spring Road intersection to provide pedestrians a safe crossing of Route 11/460.

Elliston/Lafayette

The plan points out the two villages are largely defined by their environmental features, the South and North Fork of Roanoke River and the Pedlar Hills Natural Area. The plan suggests these features provide an opportunity to connect the two villages through a river or greenway trail. The main recommendation made within these two villages is to harness the natural and historic features. The plan provides the following items to accomplish this recommendation:

1. Create a parallel system of historic road alignments and greenway facilities to link villages without crossing Route 11/460.
2. Provide paved shoulders and sidewalks along Route 11/460 to provide safer direct access between key destinations.
3. Provide “share the road” signs on low volume residential roads.

Excerpts from the Village Transportation Links Plan are included in the Appendix and include specific recommendations to Shawsville and Elliston/Lafayette which have been taken into account throughout the development of this corridor study.

3. EXISTING CONDITIONS (2012)

A thorough understanding of the 2012 existing conditions (referred to herein as "Existing Conditions") in the Route 11/460 corridor required that detailed field observations be completed in the early stages of the project, prior to completing the analyses. The existing conditions analyses were developed using the data collection discussed in the previous chapter of this report, as well as visual observations of the operational characteristics. This chapter of the report describes the analysis of the existing traffic conditions, transit conditions and pedestrian/bicycle conditions within the corridor. The intent of the quantitative and qualitative analyses was to provide a starting point for improvements with more of an emphasis placed on future conditions analysis and mitigation strategies.

3.1 2012 Traffic Volumes

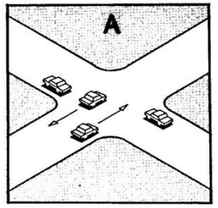
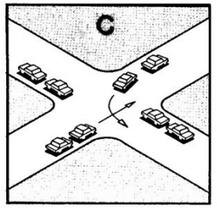
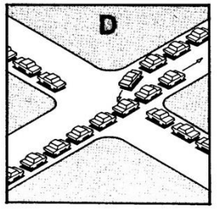
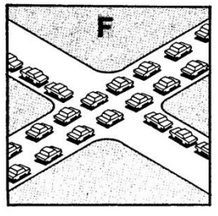
Collection of existing Turning Movement Count (TMC) data was conducted between the hours of 6:00 AM to 8:00 AM and 3:00 PM to 6:00 PM on Tuesday, June 5th and Wednesday, June 6th, 2012 at the eight study area intersections. The 2012 AM and PM peak hour volumes at the study area intersections are summarized in **Figure 3.1** and **Figure 3.2**. The AM and PM peak hours of each study area intersection are also displayed on the figures. Complete TMC data is included in the **Appendix**. Based on the 2011 VDOT published traffic volume data, the approximate annual average daily traffic (AADT) volume on Route 11/460 is as follows:

- 8,000 vehicles per day (VPD) between Tower Road and the Town of Christiansburg/Montgomery County line (Town of Christiansburg)
- Ranges between 7,000 VPD and 7,800 VPD between the Town of Christiansburg/Montgomery County line and the Montgomery/Roanoke County line (Montgomery County)
- Ranges between 8,500 VPD to 10,000 VPD from Montgomery/Roanoke County line to Daugherty Road (Roanoke County)

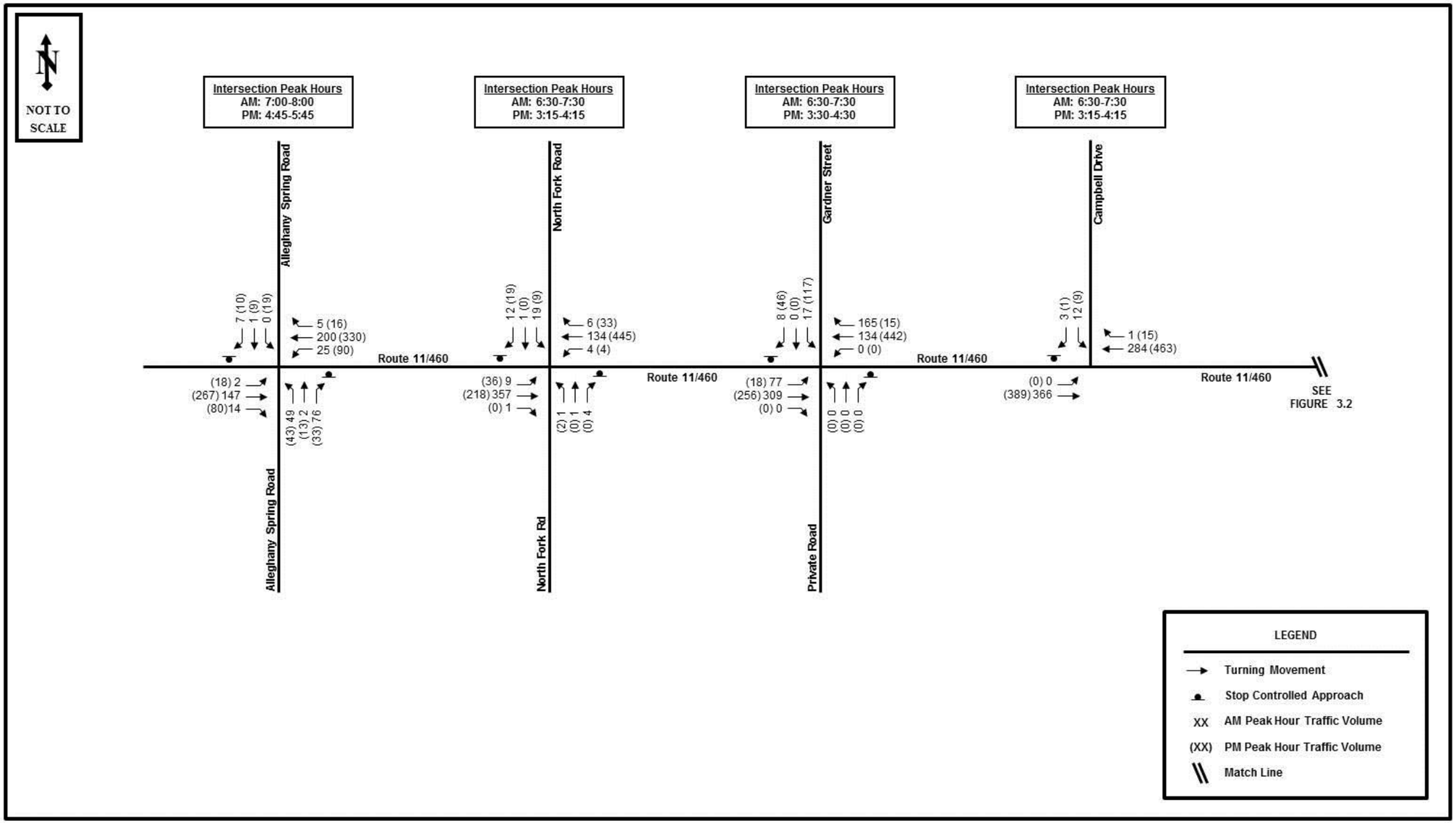
3.2 Level of Service

Capacity analyses allow traffic engineers to assess the operational conditions and identify the impacts of traffic on the surrounding roadway network. The Transportation Research Board's (TRB) *Highway Capacity Manual* (HCM) methodologies govern the methodology for evaluating capacity and the quality of service provided to road users traveling through a roadway network. There are six letter grades of Levels of Service (LOS) ranging from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. **Table 3.1** shows in detail how each of these levels of service are interpreted.

Table 3.1 – Level of Service Definitions

LOS	Roadway Segments or Controlled Access Highways	Intersections	
A	Free flow, low traffic density	No vehicle waits longer than one signal indication	
B	Delay is not unreasonable, stable traffic flow	On a rare occasion, motorists wait through more than one signal indication	
C	Stable condtion, movements somewhat restricted due to higher volumes, but not objectionable for motorists	Intermittently, drivers wait through more than one signal indication and occasionally backups may develop behind left turning vehicles, traffic flow still stable and acceptable.	
D	Movements more restricted queues and delays may occur during short peaks, but lower demands occur often enough to permit clearing, thus preventing excessive backups.	Delay at intersections may become extensive with some, especially left-turning vehicles waiting two or more signal indications, but enough cycles with lower demand occur to permit periodic clearance, thus preventing excessive backups.	
E	Actual capacity of the roadway involves delay to all motorists due to congestion.	Very long queues may create lengthy delays especially for left turning vehicles.	
F	Forced flow with demand volumes greater than capacity resulting in complete congestion. Volumes drop to zero in extreme cases.	Backups from locations down-stream restrict or prevent movement of vehicles out of approach, creating a storage area during part or all of an hour.	

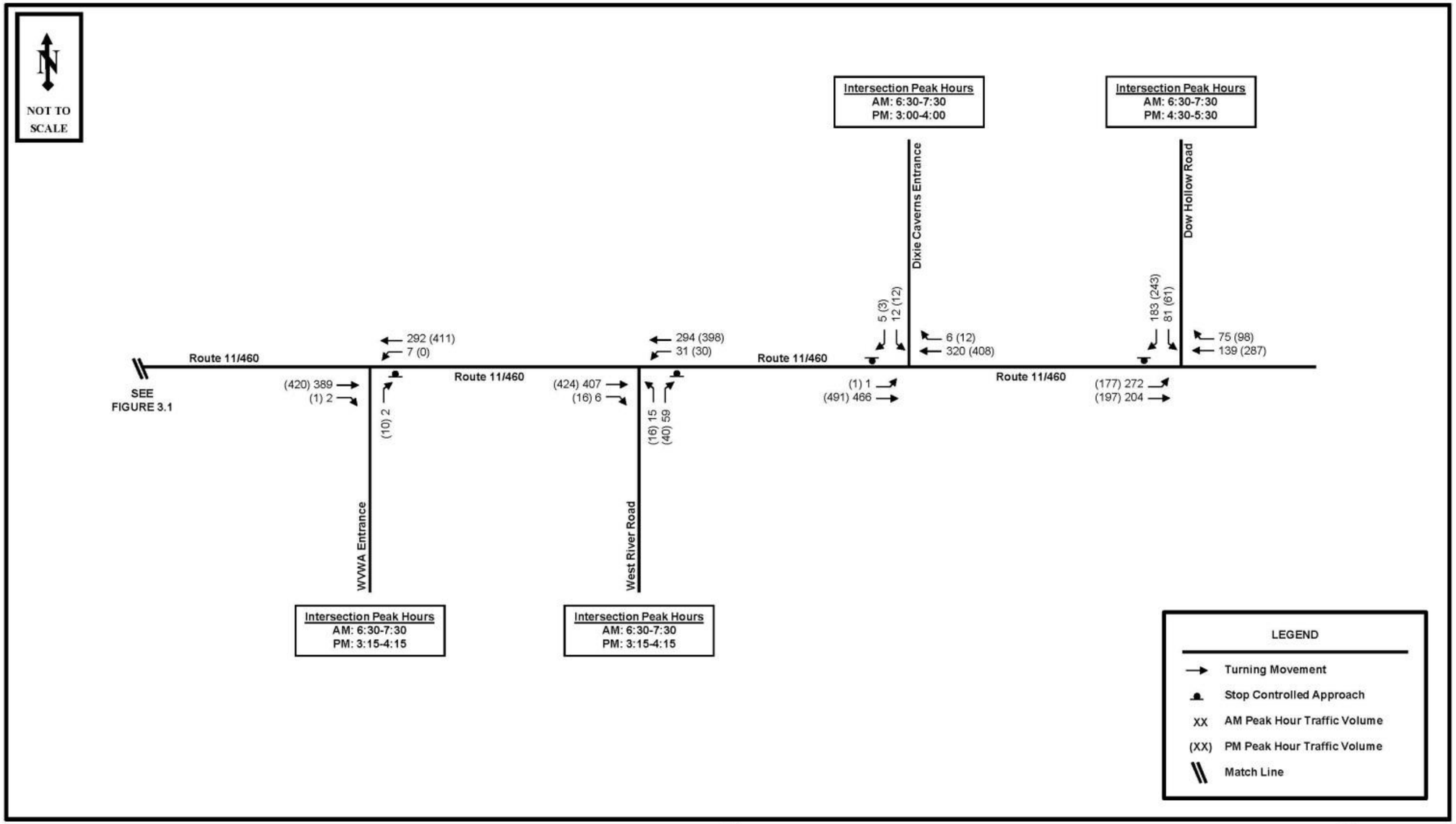
Source: A Policy on Design of Urban Highways and Arterial Streets – AASHTO, 1973 based upon material published in Highway Capacity Manual, National Academy of Sciences, 1965



Route 11/460 Corridor Study

Existing (2012) Traffic Volumes (1 of 2)

Figure 3.1



Route 11/460 Corridor Study | Existing (2012) Traffic Volumes (2 of 2) | Figure 3.2

3.2.1 Intersection Level of Service

Intersection level of service is defined in terms of delay, a measure of driver discomfort, frustration, fuel consumption, and lost travel time. **Table 3.2** summarizes the delay associated with each LOS category.

Table 3.2 – Signalized and Unsignalized Intersection Level of Service Criteria

LOS	Intersection Delay (sec/veh)	
	Signalized	Unsignalized
A	0 - 10	0 - 10
B	>10 - 20	>10 - 15
C	>20 - 35	>15 - 25
D	>35 - 55	>25 – 35
E	>55 - 80	>35 – 50
F	>80	>50

Source: Transportation Research Board, Highway Capacity Manual 2000

The eight study area intersections, all unsignalized, were anlyzed using SYNCHRO Version 7 based on methodologies in the HCM 2000. Intersection TMC data was used in conjunction with existing geometric data to determine the existing LOS. For the analysis, the following assumptions were made:

- 12- foot lane widths
- No bus stops
- No conflicting pedestrian or bicycle traffic
- Heavy vehicle percentages from TMC data with the following adjustments:
  - Minimum 2% heavy vehicle percentage for all approaches
  - Maximum 10% heavy vehicle percentage for low volume (less than 10 vehicles per hour) approaches
- Peak hour factor (PHF) from TMC data with the following adjustments:
  - Minimum Peak Hour Factor (PHF) of 0.85 for all approaches

Table 3.3 through **Table 3.10** summarize the delay and associated approach LOS for each of the study area intersections. For movements without conflicting volumes, such as the major street's through and right turn movements at a two-way stop-controlled intersection, an associated delay or LOS is not reported by SYNCHRO. **Figure 3.3** and **Figure 3.4** show the LOS of each individual lane group as well as the overall approach LOS for all study area intersections. The corresponding SYNCHRO output sheets are included in the Appendix.

As shown in **Figure 3.3** and **Figure 3.4**, all of the study area intersection lane groups and overall approaches operate at a LOS B or better during the AM peak hour and at a LOS C or better during the PM peak hour. In addition, mainline Route 11/460 (lane group and overall approaches) operates at LOS A during the AM and PM peak hours at all study area intersections. LOS A through LOS D are generally considered satisfactory based on standard traffic engineering practice.

Table 3.3 – Route 11/460 at Alleghany Spring Road Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and Alleghany Spring Road			
AM	Eastbound - Route 11/460	0.1	A
	Westbound - Route 11/460	0.8	A
	Northbound - Alleghany Spring Road	11.1	B
	Southbound - Alleghany Spring Road	9.5	A
PM	Eastbound - Route 11/460	0.4	A
	Westbound - Route 11/460	1.7	A
	Northbound - Alleghany Spring Road	19.0	C
	Southbound - Alleghany Spring Road	20.2	C

Table 3.4 – Route 11/460 at North Fork Road Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and North Fork Road			
AM	Eastbound - Route 11/460	0.2	A
	Westbound - Route 11/460	0.2	A
	Northbound - North Fork Road	10.9	B
	Southbound - North Fork Road	11.0	B
PM	Eastbound - Route 11/460	1.2	A
	Westbound - Route 11/460	0.1	A
	Northbound - North Fork Road	15.7	C
	Southbound - North Fork Road	12.8	B

Table 3.5 – Route 11/460 at Gardner Street Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and Gardner Street			
AM	Eastbound - Route 11/460	1.6	A
	Westbound - Route 11/460	0.0	A
	Northbound - Gardner Street	0.0	A
	Southbound - Gardner Street	12.4	B
PM	Eastbound - Route 11/460	0.6	A
	Westbound - Route 11/460	0.0	A
	Northbound - Gardner Street	0.0	A
	Southbound - Gardner Street	20.9	C

Table 3.6 – Route 11/460 at Campbell Drive Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and Campbell Drive			
AM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Campbell Drive	12.3	B
PM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Campbell Drive	15.7	C

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

Table 3.7 – Route 11/460 at Western Virginia Water Authority Entrance Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and WVWA Entrance			
AM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.2	A
	Northbound - WVWA Entrance	9.7	A
PM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.0	A
	Northbound - WVWA Entrance	9.9	A

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

Table 3.8 – Route 11/460 at West River Road Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and West River Road			
AM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.8	A
	Northbound - West River Road	10.9	B
PM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.6	A
	Northbound - West River Road	11.1	B

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

Table 3.9 – Route 11/460 at Dixie Caverns Entrance Existing Approach LOS Summary

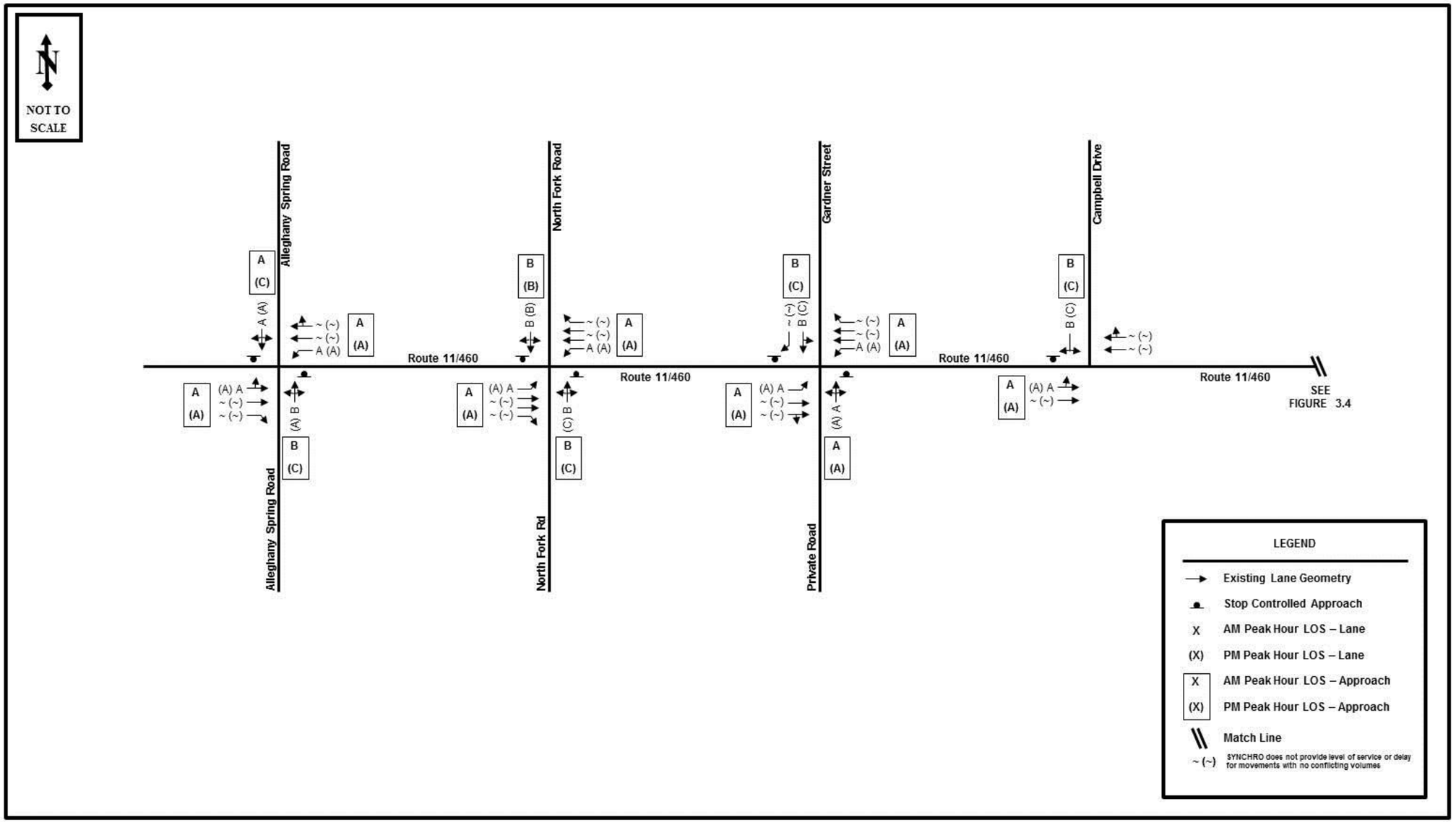
Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and Dixie Caverns Entrance			
AM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Dixie Caverns Entrance	10.8	B
PM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Dixie Caverns Entrance	11.7	B

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

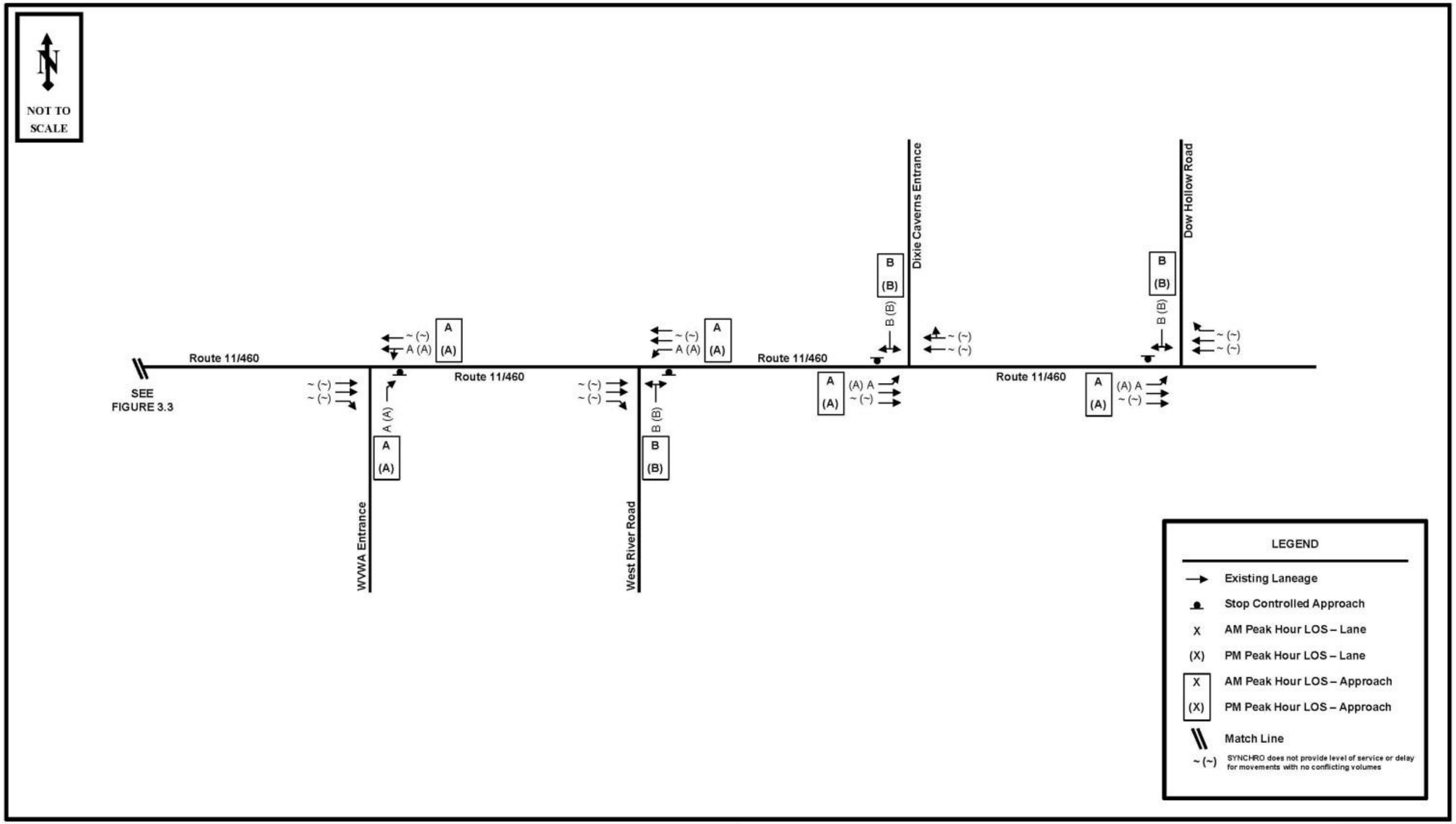
Table 3.10 – Route 11/460 at Dow Hollow Road Existing Approach LOS Summary

Peak Hour	Approach	Delay (sec/veh)	LOS
Intersection: Route 11/460 and Dow Hollow Road			
AM	Eastbound - Route 11/460	5.0	A
	Westbound - Route 11/460	†	†
	Southbound - Dow Hollow Road	14.3	B
PM	Eastbound - Route 11/460	4.2	A
	Westbound - Route 11/460	†	†
	Southbound - Dow Hollow Road	11.7	B

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



Route 11/460 Corridor Study | Existing (2012) Intersection LOS (1 of 2) | Figure 3.3



Route 11/460 Corridor Study	Existing (2012) Intersection LOS (2 of 2)	Figure 3.4

3.2.2 Arterial Link Levels of Service

For multilane highways, LOS is defined by the HCM in terms of free-flow speed (miles per hour) and density (passenger cars per mile per lane). LOS ranges from A to F, where LOS A indicates a condition of little or no congestion and LOS F indicates a condition of severe congestion, unstable traffic flow, and stop-and-go conditions. LOS A through LOS D are generally considered satisfactory based on standard traffic engineering practice. **Table 3.11** summarizes the density and free-flow speed associated with each LOS.

Table 3.11 – HCM Multilane Arterial LOS Criteria

LOS	Free Flow Speed (mi/h)	Density (pc/mi/ln)
A	All	>0-11
B	All	>11-18
C	All	>18-26
D	All	>26-35
E	60	>35-40
	55	>35-41
	50	>35-43
	45	>35-45
F	Demand Exceeds Capacity	
	60	>40
	55	>41
	50	>43
	45	>45

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

The following three locations along the Route 11/460 study corridor were analyzed for arterial LOS:

1. West of Alleghany Spring Road
2. West of North Fork Road
3. East of Dow Hollow Road

Highway Capacity Software (HCS) 2010, a traffic analysis tool based on the theory of the HCM, was used to analyze multi-lane arterial LOS at the three identified locations along the study corridor. Inputs to HCS came from data collected during the field review and TMC data. In addition, a rolling terrain was assumed for all three locations. **Table 3.12** summarizes the Existing Conditions arterial link LOS. Arterial analysis for Route 11/460 indicates that the corridor operates at LOS A at all of the analyzed segment locations. The corridor carries approximately 7,000 to 10,000 VPD, which is well below the standard threshold for a typical four-lane, divided roadway.

Table 3.12 – Existing Arterial Level of Service

Travel Direction	Time of Day	Average Travel Speed (mi/h)	Density (pc/mi/h)	LOS
West of Alleghany Spring Road				
Eastbound	AM	50	2.1	A
	PM	50	4.3	A
Westbound	AM	50	3.1	A
	PM	50	4.4	A
West of North Fork Road				
Eastbound	AM	55	3.8	A
	PM	55	2.9	A
Westbound	AM	55	1.5	A
	PM	55	5.1	A
East of Dow Hollow Road				
Eastbound	AM	60	3.1	A
	PM	60	2.4	A
Westbound	AM	60	2.4	A
	PM	60	3.6	A

3.3 Queue Lengths

Queue lengths, or the distance at which stopped vehicles accumulate at an intersection, were calculated. Queue length is another performance indicator of the intersection's operational characteristics. Large or lengthy queues may be indicative of capacity or operational issues such as needed turn lanes. Understanding possible causes of large queue lengths helps in the identification of potential solutions. A 95th percentile queuing analysis was completed for the study area intersections under both AM and PM peak hour existing conditions. SYNCHRO plus SimTraffic Version 7 was used to perform a 60-minute simulation for the analyses. The 95th percentile queue length, measured in feet, represents the queue length with a five percent probability of being exceeded during the analysis time period. A summary of the 95th percentile queue lengths for each of the study area intersection's lane groups is presented in **Table 3.13** through **Table 3.20**. For movements without conflicting volumes, no queue length is reported by SimTraffic. Based on the Existing Conditions queuing analysis, no queue lengths exceed any existing turn lane storage length at the study area intersections. The maximum queue within the study area is the southbound left-turn on Dow Hollow Road which is 110 feet during the AM peak hour (or about a five vehicle queue). The supporting SimTraffic output sheets are included in the **Appendix**.

Table 3.13 – Route 11/460 at Alleghany Spring Road Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Alleghany Spring Road		
EBLT	~	~
EBT	~	~
EBR	~	~
WBL	19	36
WBT	~	~
WBTR	~	~
NBLTR	54	56
SBLTR	18	36

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.14 – Route 11/460 at North Fork Road Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and North Fork Road		
EBL	~	1
EBT	~	~
EBR	~	~
WBL	~	~
WBT	~	~
WBR	~	~
NBLTR	8	4
SBLTR	37	27

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.15 – Route 11/460 at Gardner Street Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Gardner Street		
EBL	35	15
EBT	~	~
EBTR	~	~
WBL	~	~
WBT	~	~
WBR	15	~
NBLTR	~	~
SBLT	27	59
SBR	20	39

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.16 – Route 11/460 at Campbell Drive Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Campbell Drive		
EBTL	~	~
EBT	~	~
WBT	~	~
WBTR	~	~
SBLR	33	17

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.17 – Route 11/460 at Western Virginia Water Authority Entrance Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and WVWA Entrance		
EBT	~	~
EBR	~	~
WBLT	18	~
WBT	~	~
NBL	~	~
NBR	7	18

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.18 – Route 11/460 at West River Road Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and West River Road		
EBT	~	~
EBR	~	~
WBL	25	20
WBT	~	~
NBLR	47	46

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.19 – Route 11/460 at Dixie Caverns Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Dixie Caverns Entrance		
EBL	~	~
EBT	~	~
WBT	~	~
WBTR	~	~
SBLR	16	12

~SYNCHRO does not report Queue Length on movements with no conflict.

Table 3.20 – Route 11/460 at Dow Hollow Road Existing 95th Percentile Queue Lengths

Lane Group	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Dow Hollow Road		
EBL	65	69
EBT	~	~
WBT	~	~
WBR	11	18
SBL	110	52
SBR	58	65

~SYNCHRO does not report Queue Length on movements with no conflict.

3.4 Crash Analysis

Crash analysis for the study corridor was conducted using the latest three years of available crash data. Crash reports dating from January 1, 2009 to December 31, 2011 were obtained from VDOT. Over the three year time period, 212 total crashes were reported within the study area. **Table 3.21** summarizes the study corridor crashes and the following sections further describe corridor crash trends and segment specific crash data.

Table 3.21 – Corridor Crash Summary

Year	Number of Crashes		
	Eastbound	Westbound	Total
2009	36	21	**57**
2010	35	34	**69**
2011	35	51	**86**
Total	**106**	**106**	**212**

3.4.1 Corridor-Wide Crash Trends

Crash Type

The most predominant crash types in the study corridor are angle, deer, and fixed object – off road crashes. A summary of the corridor crashes by type is provided in **Table 3.22.**

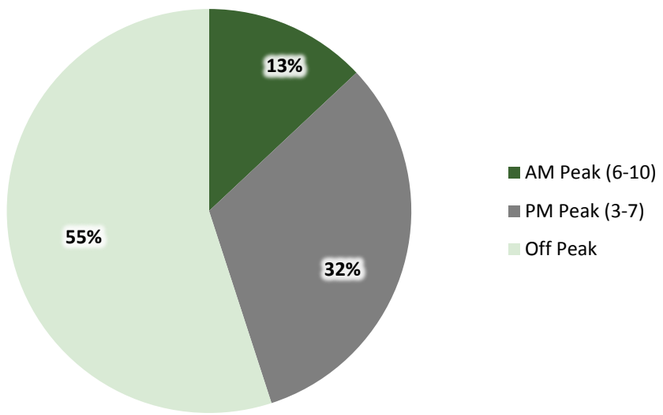
Table 3.22 – Crash Summary: Type of Crash

Crash Type	Number of Crashes		
	Eastbound	Westbound	Total
Angle	32	29	**61**
Deer	22	22	**44**
Fixed Object - Off Road	18	17	**35**
Rear End	13	13	**26**
Sideswipe - Same Direction	7	5	**12**
Head On	2	7	**9**
Non-Collision	3	3	**6**
Other Animal	3	3	**6**
Fixed Object - In Road	2	3	**5**
Other	3	1	**4**
Backed Into	0	2	**2**
Train	1	0	**1**
Pedestrian	0	1	**1**

Time of Day

Within the limits of the study corridor, approximately half of the crashes occurred during the AM peak period (6-10 AM) and PM peak period (3-7 PM). The majority of the peak period crashes (approximately 72 percent of peak hour crashes) occurred during the PM peak period. A summary of the corridor crashes by time of day is provided in **Figure 3.5**.

Figure 3.5 – Crash Summary: Time of Day



Severity

Within the limits of the study corridor, fatal (4) and injury (65) crashes accounted for approximately one third of the reported crashes. The remaining two thirds of the crashes were property damage only (PDO). A summary of crashes by severity is shown in **Table 3.23.**

Table 3.23 – Corridor Crash Summary: Severity

Severity	Number of Crashes		
	Eastbound	Westbound	Total
Fatality	2	2	**4**
Injury	36	29	**65**
Property Damage Only	68	75	**143**

There were four fatal crashes reported along the study corridor. Two of the fatal crashes occurred in the westbound direction and two fatal crashes occurred in the eastbound direction of Route 11/460. One of the fatal crashes involved a pedestrian and was located on eastbound Route 11/460.

The fatal pedestrian crash on eastbound Route 11/460 occurred in 2009 at 8:23 AM approximately 0.8 miles east of the Mt Pleasant Road intersection (or just east of the Gingerbread Road intersection). The crash type was a fixed object – off road. The driver struck the guardrail before colliding with the pedestrian. The crash occurred in rain, on a wet roadway surface, and in daylight. One vehicle was involved in the crash. The second fatal crash on eastbound Route 11/460 occurred in 2010 at 3:20 PM at the intersection of Dark Run Road and was an angle crash.

One of the westbound Route 11/460 fatal crashes occurred in 2009 at 9:19 PM approximately 0.15 miles west of the intersection of the Glenvar Heights Boulevard and was a fixed object – off road crash. The second westbound Route 11/460 fatal crash occurred in 2011 at 8:27 PM at the intersection of Peaceful Drive and was a fixed object – off road crash.

3.4.2 Study Area Intersection Crashes

At each of the eight study area intersections, collision diagrams were prepared to document crashes occurring between January 1, 2009 and December 31, 2011. The following list provides the total number of crashes that occurred at each study area intersection during the three year period. The collision diagrams containing detailed crash information can be found in the Appendix.

- Route 11/460 at Alleghany Spring Road – 6 total crashes with the following recurring crash patterns and safety issues:
  - Four crashes (66%) were angle crashes, three involving vehicles crossing through the median opening and one involving a vehicle exiting the southbound approach. One of these crashes resulted in an injury. The width of the grass median at this intersection is approximately 20 feet. In addition, there is currently no eastbound Route 11/460 left-turn lane at this intersection to move turning vehicles out of the main travel lanes.
- Route 11/460 at North Fork Road – 2 total crashes
  - Based on a review of the two crashes, no recurring crash patterns or safety issues were identified.
- Route 11/460 at Gardner Street – 5 total crashes with the following recurring crash patterns and safety issues:
  - Two crashes (40%) were angle crashes involving southbound vehicles turning off of Gardner Street.
  - Two crashes (40%) were animal in roadway crashes. One of these crashes resulted in an injury.
- Route 11/460 at Campbell Drive – 4 total crashes with the following recurring crash patterns and safety issues:
  - Three crashes (75%) were fixed object crashes. All three crashes involved an eastbound traveling vehicle striking the center guardrail. One of these crashes resulted in an injury.
- Route 11/460 at Western Virginia Water Authority Water Treatment Plant Entrance – 0 total crashes
- Route 11/460 at West River Road – 4 total crashes with the following recurring crash patterns and safety issues:
  - Two crashes (50%) were angle crashes involving vehicles turning into/out of West River Road. There is a Citgo in the southeast corner of the intersection with an entrance along Route 11/460 in close proximity to West River Road. The close proximity of the Citgo entrance and West River Road can lead to confusion with drivers being unaware which point vehicles are turning into.
  - At the intersection of West River Road the cross-section of Route 11/460 changes from a four-lane grass median/guardrail divided roadway (to the west) to a four-lane two-way left turn lane divided roadway (to the east). The area in between the end of the guardrail and the start of the two-way left turn lane is not wide enough to allow a vehicle to make a two-stage left-turn from West River Road.
- Route 11/460 at Dixie Caverns Entrance – 1 total crashes
  - Based on a review of the crash, no recurring crash patterns or safety issues were identified.
- Route 11/460 at Dow Hollow Road – 19 total crashes with the following recurring crash patterns and safety issues:
  - Eight crashes (42%) were angle crashes involving vehicles turning to/from Dow Hollow Road. Three of these crashes resulted in an injury. Angle collisions are typically more severe in nature, which holds true at this intersection with three injury crashes. There is also limited sight distance at this intersection due to overgrown vegetation.
  - Three crashes (16%) were rear-end crashes on the southbound approach.

The collision diagrams containing detailed crash information can be found in the in the **Appendix**.

3.4.3 Crash Hot Spots

Crash activity by half-mile segments of roadway, or crash density, in the eastbound and westbound directions of the Route 11/460 study corridor is shown in **Figure 3.6** and **Figure 3.7**. A critical crash density, defined as the average crash density plus two standard deviations, was determined for both the eastbound and westbound directions. In the eastbound direction of the study corridor the critical crash density was 8.08 crashes per half-mile and in the westbound direction the critical crash density was 6.99 crashes per half-mile. Segments with more crashes than the critical crash density were considered to be crash "hot spots." Five hot spots were identified along the study corridor, two in the eastbound direction and three in the westbound direction. Maps with mile marker information are provided in the Appendix.

Hot Spot 1 – Route 11/460 Eastbound (Mile Marker 121.2-121.7)

The first eastbound hot spot is located on the western end of the study corridor in the Town of Christiansburg. The half-mile segment runs from the northbound I-81 off-ramp onto eastbound Route 11/460 to about a tenth of a mile west of Dunlap Drive. There were ten reported crashes over the three year analysis period in this half-mile segment. The ten reported crashes are summarized in the following list:

- Crash Type
  - Seven angle, two rear end, one sideswipe – same direction.
- Severity
  - Six crashes were injury with the remaining four crashes being property damage only.
- Location
  - Two of the crashes (including one injury crash) were located at the intersection of the northbound I-81 off-ramp with Route 11/460.
  - Three of the crashes (including two injury crashes) were located at the intersection of Route 11/460 with Tower Road/Hampton Boulevard NE.

- Three of the crashes (including two injury crashes) were located where Route 11/460 drops from two lanes to one lane in the eastbound direction.
- Two of the crashes (including one injury crash) were located within 200 feet of the intersection of Route 11/460 with Patricia Lane SE.

- Year and Time of Day
  - Five crashes occurred in 2009, two crashes in 2010, and three crashes in 2011.
  - Three crashes occurred during the PM peak period.

Hot Spot 2 – Route 11/460 Eastbound (Mile Marker 128.7-129.2)

The second eastbound hot spot is located near Riffe Street (east of Shawsville). The segment extends approximately a quarter-mile west of Riffe Street to a quarter-mile east of Riffe Street. There were nine reported crashes over the three year analysis period in this half-mile segment. The nine reported crashes are summarized in the following list:

- Crash Type
  - Four angle, two deer, one sideswipe – same direction, one fixed object – off road, one non-collision.
- Severity
  - One crash was fatal, two crashes were injury and the remaining six crashes were property damage only.
- Location
  - Five of the crashes (including the fatal crash and both injury crashes) were located at the intersection of Route 11/460 with Dark Run Road.
  - This hot spot is located within an existing school zone.
- Year and Time of Day
  - Four crashes occurred in 2009, three crashes in 2010, and two crashes in 2011.
  - One crash occurred during the AM peak period and four crashes occurred during the PM peak period.

Hot Spot 3 – Route 11/460 Westbound (Mile Marker 121.2-121.7)

The first westbound hot spot is located on the western end of the study corridor in the Town of Christiansburg. The half-mile segment runs from approximately a tenth of a mile west of Dunlap Drive to the northbound I-81 on-ramp. This hot spot has identical limits as Hot Spot 1 in the eastbound direction. There were seven reported crashes over the three year analysis period in this half-mile segment. The seven reported crashes are summarized below:

- Crash Type
  - Four angle, two rear end, one backed into.
- Severity
  - Four crashes were injury and the remaining three crashes were property damage only.
- Location
  - Three of the crashes (all of which were injury crashes) were located within 150 feet of the intersection of Route 11/460 with Tower Road/Hampton Boulevard NE.
  - Two of the crashes were located within 150 feet of the intersection of Route 11/460 with Patricia Lane SE.
- Year and Time of Day
  - Four crashes occurred in 2009, three crashes in 2010, and zero crashes in 2011.
  - Two crashes occurred during the PM peak period.

Hot Spot 4 – Route 11/460 Westbound (Mile Marker 130.2-130.7)

The second westbound hot spot is located near Barnett Road, between the Eastern Montgomery Elementary School and the Eastern Montgomery High School. The segment extends from approximately a tenth of a mile east of Barnett Road to four tenths of a mile west of Barnett Road. There were seven reported crashes over the three year analysis period in this half-mile segment. The seven reported crashes are summarized below:

- Crash Type
  - Three deer, one rear end, one sideswipe – same direction, one fixed object – off road, and one head on.
- Severity
  - Two crashes were injury and the remaining five crashes were property damage only.
- Location
  - Three of the crashes (including one of the injury crashes) were located at the intersection of Route 11/460 with Barnett Road/Seneca Hollow Road.
  - This hot spot is located within an existing school zone.
- Year and Time of Day
  - One crash occurred in 2009, one crash in 2010, and five crashes in 2011.
  - One crash occurred during the AM peak period.

Hot Spot 5 – Route 11/460 Westbound (Mile Marker 135.7-136.2)

The third westbound hot spot is located near Dow Hollow Road. The segment extends from approximately a quarter-mile east of Dow Hollow Road to a quarter-mile west of Dow Hollow Road. There were seven reported crashes over the three year analysis period in this half-mile segment. The seven reported crashes are summarized below:

- Crash Type
  - Five angle, one rear end, one animal in roadway.
- Severity
  - All seven crashes were property damage only.
- Year and Time of Day
  - Zero crashes occurred in 2009, one crash in 2010, and six crashes in 2011.
  - Two crashes occurred during the PM peak period.

See Section 3.4.2 for additional information regarding the crashes that occurred at the Route 11/460 and Dow Hollow Road intersection. Since this hot spot only includes crashes occurring along westbound Route 11/460, the number of crashes occurring in the hot spot is less than the total number of crashes at the intersection.

3.5 Other Crash Locations

Crash activity was analyzed through the Shawsville and Elliston/Lafayette areas to determine if any recurring crash patterns were present.

- Shawsville – 29 total crashes (combined eastbound and westbound):
  - Crash type: twelve angle, five sideswipe – same direction, four fixed object – off road, four deer, one rear end, one head on, one non-collision, one pedestrian
  - Severity: one fatal, seven injury (one of which was a pedestrian injury), twenty-one PDO

  Angle crashes accounted for 41% of the crashes within Shawsville. Angle collisions are common in areas with a high density of access points. Angle collisions are typically more severe in nature, which holds true at through this section with a total of seven injuries (24%) and one fatality.
- Elliston/Lafayette – 46 total crashes (combined eastbound and westbound):
  - Crash type: fifteen deer, twelve angle, five fixed object-off road, four rear end, three head on, three other animal, two ”other”, one fixed object in road, and one non-collision
  - Severity: fourteen Injury (one of which was a pedestrian injury), and thirty-two PDO

  Deer crashes accounted for 33% and angle crashes accounted for 26% of the crashes within Elliston/Lafayette. Thirty percent of the crashes within this area resulted in an injury.

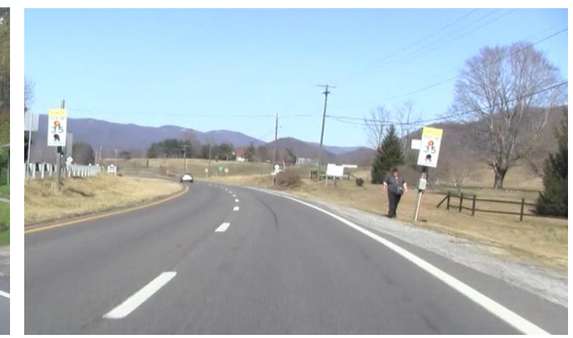
3.6 Transit

No regular/fixed-route transit service currently exists in the study area; therefore, an existing conditions analysis of transit operations was not performed as part of this study. Demand-Response transit service is available within the Town of Christiansburg corporate limits through Blacksburg Transit, but this covers only a miniscule piece of the 11/460 corridor included in this study. Ride Solutions also currently serves the Roanoke and New River Valleys. This agency provides free services that promote transportation demand management (TDM) alternatives by helping individuals and businesses identify commuting options to work and school.

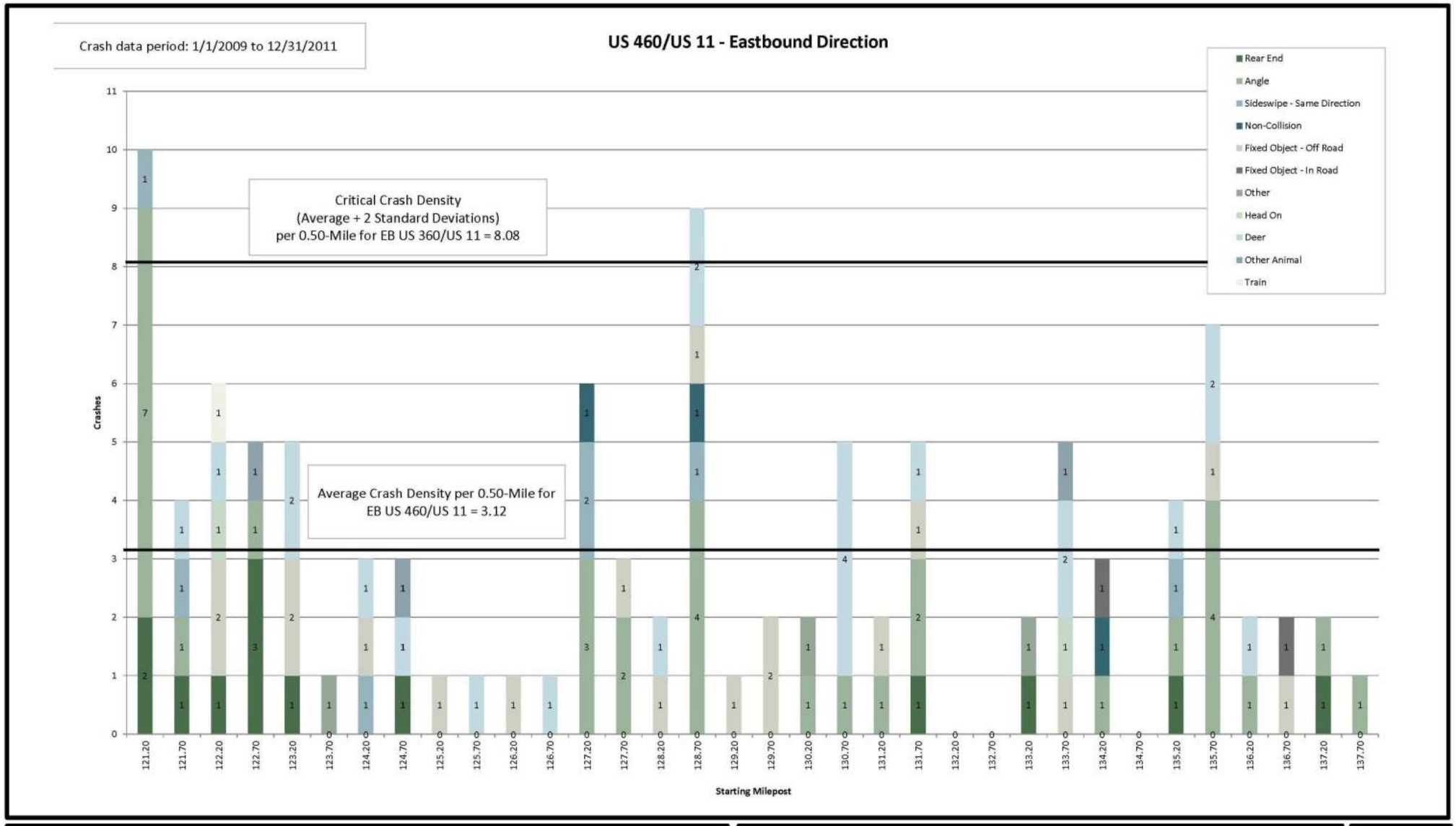
3.7 Bicycles and Pedestrians

No bicycle or pedestrian accommodations currently exist in the study area. Minimal bicycle and pedestrian traffic was observed on Route 11/460 during the field review (Photograph 3.1 and Photograph 3.2). There were no patterns of bicycle or pedestrian traffic being predominant. The facility serves almost exclusively motorized vehicles.

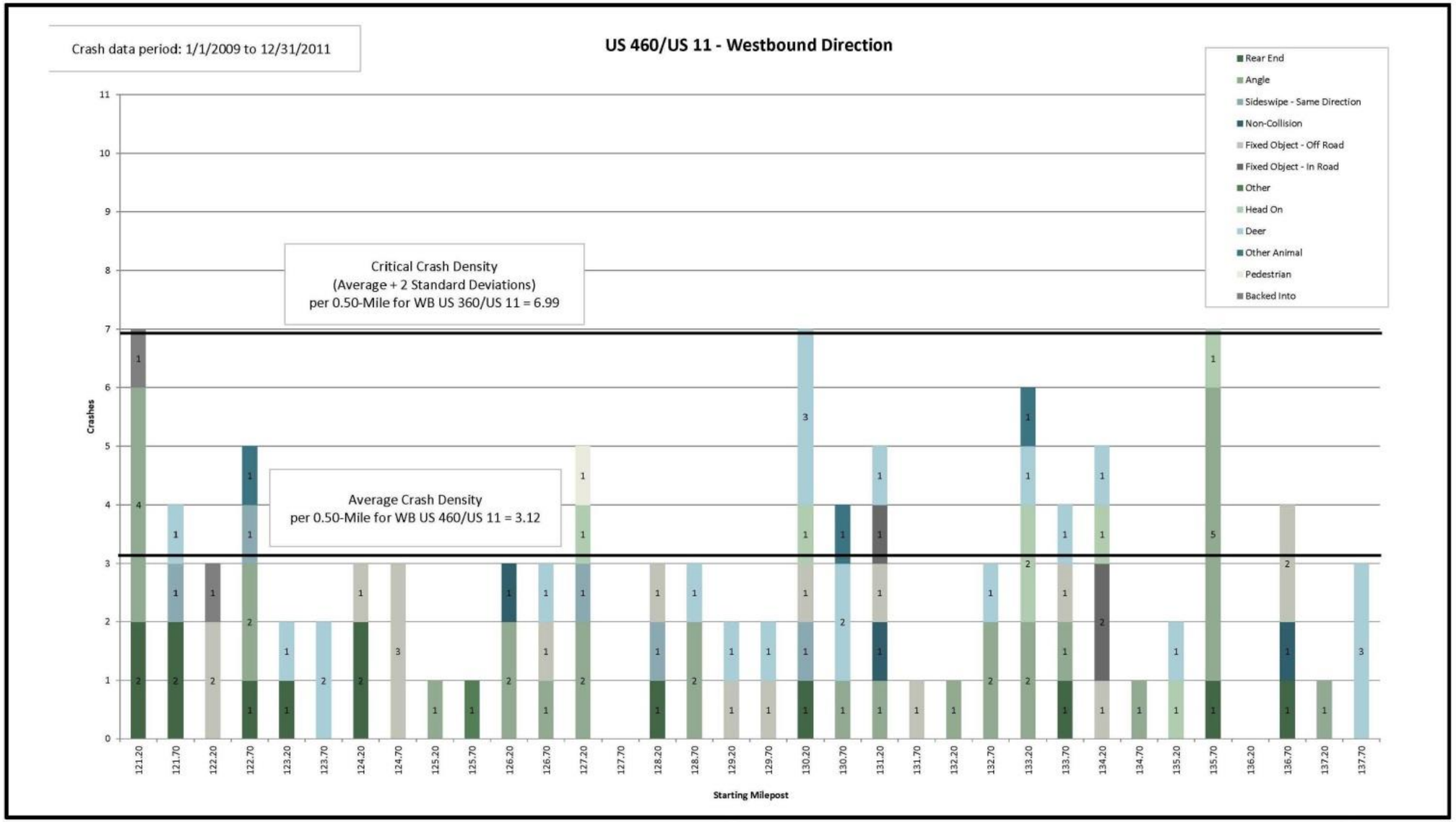
Photograph 3.1 – Biker observed on Route 11/460 by Den Hill Road (Route 641)



Photograph 3.2 – Pedestrian observed on Route 11/460 by Dark Run Road (Route 633)



Route 11/460 Corridor Study	Eastbound Route 11/460 Crash Histogram	Figure 3.6



Route 11/460 Corridor Study	Westbound Route 11/460 Crash Histogram	Figure 3.7

4. FUTURE CONDITIONS

The Route 11/460 Corridor Study included the collection of existing roadway geometry, existing intersection geometry, traffic volume data (existing and future), crash data, and public input. This information was examined to analyze future conditions and develop recommended improvements. The recommended short-, mid-, and long-term multimodal improvements identified in the following chapter of this study are intended to provide the Project Team with a long-term vision for the corridor that can be supported on a regional basis. The study will assist these agencies in continuing to manage planned growth along the corridor, quantify the associated transportation impacts, update existing area plans (i.e., Shawsville Village Plan, Elliston & Lafayette Village Plan, etc.), and strategically implement the necessary improvements along and adjacent to the Route 11/460 corridor. This chapter provides a summary of two future analyses scenarios, one taking into account no roadway improvements (Future 2035 Baseline) and one taking into account recommended roadway improvements (Future 2035 Proposed), each being analyzed with projected 2035 traffic volumes. The two analysis scenarios were conducted to establish a baseline condition to compare with the Route 11/460 roadway improvement recommendations (presented in Chapter 5).

4.1 Future Traffic Growth Rate

When planning ahead to address the future needs of a transportation network, it is important to project the level of traffic that is anticipated during the horizon planning years. Historical traffic growth trends (as identified in VDOT's Statewide Planning System (SPS)), traffic from planned and/or approved development(s), and population growth rates as extracted from studies performed in the vicinity of the study area all play key roles in the development of traffic volume projections. The purpose of developing annualized traffic growth is to accurately project the increase in traffic volumes due to usage increases and non-specific growth throughout the area. For example, an increase in socio-economic activity generally equates to an increase in the use of transportation facilities, which results in more vehicles (e.g., personal vehicles, commercial vehicles, trucks and/or transit vehicles) on the surrounding roadway network.

The annualized growth rates were then applied to existing traffic volumes to develop future traffic volume projections that were generally consistent with existing traffic patterns while taking into account anticipated future traffic conditions. The traffic volume projection effort and the associated future conditions analysis provide the basis for determining necessary future corridor and intersection improvements. This section of the report outlines the process and methodology used to develop future traffic volume projections within the Route 11/460 corridor study area.

4.2 Growth Rate Methodology

Various traffic-related data resources were referenced and compared to develop annualized growth rates for future traffic projections. For this study, the following resources were used.

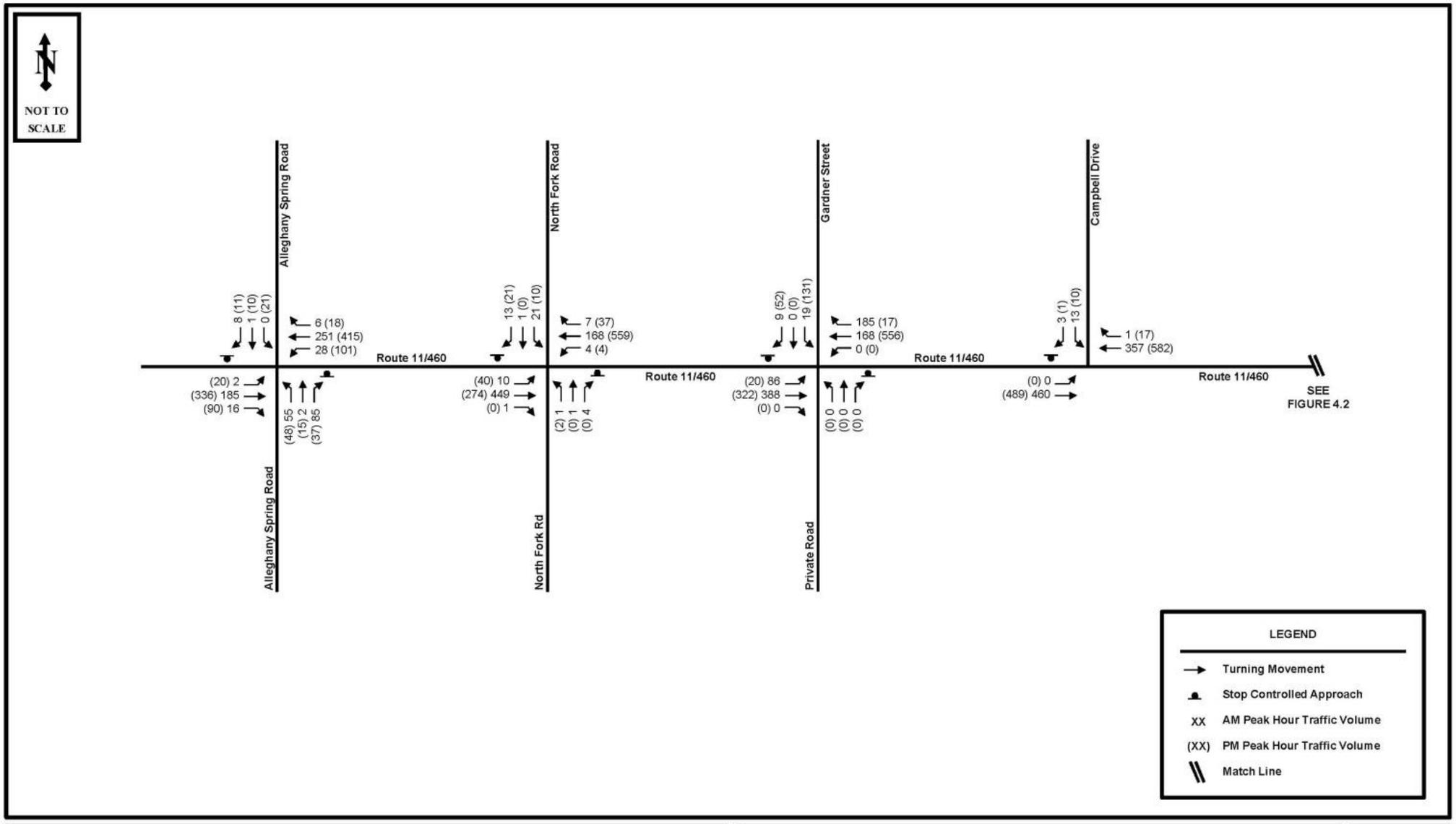
- Historic traffic volumes as obtained from VDOT's Statewide Planning System (SPS)
    - Based on a review of historic traffic volumes, the Route 11/460 corridor has grown at approximately 1.6 to 2.0% over the last 20 years. However, over the last couple years the traffic growth on Route 11/460 has been relatively flat, likely due in part to the economy.
- Projected traffic and population growth rates as identified in the following studies:
    - Shawsville Village Plan – the Shawsville Village Plan anticipates the population growth over the next 25 years will continue at slightly more than 1%.
    - Lafayette Route 11/460 Corridor Plan – the Lafayette Route 11/460 Corridor Plan anticipates the ADT along Route 11/460 in the Lafayette area will grow from 8,100 vehicles per day (VPD) in 2009 to 16,000 VPD in 2033. This increase in ADT correlates to approximately a 2.9% traffic growth rate.

Based on a review of the traffic related data resources identified above, discussions with the Project Team, and engineering judgment, an annualized growth rate of 1.0% was selected for mainline Route 11/460. An annualized growth rate of 0.5% was selected for the side streets at each study area intersection as the side streets are anticipated to develop (build out) at a slower rate than mainline Route 11/460 which provides a connection between Christiansburg and Roanoke. These growth rates provide a conservative approach to developing future traffic volume projections.

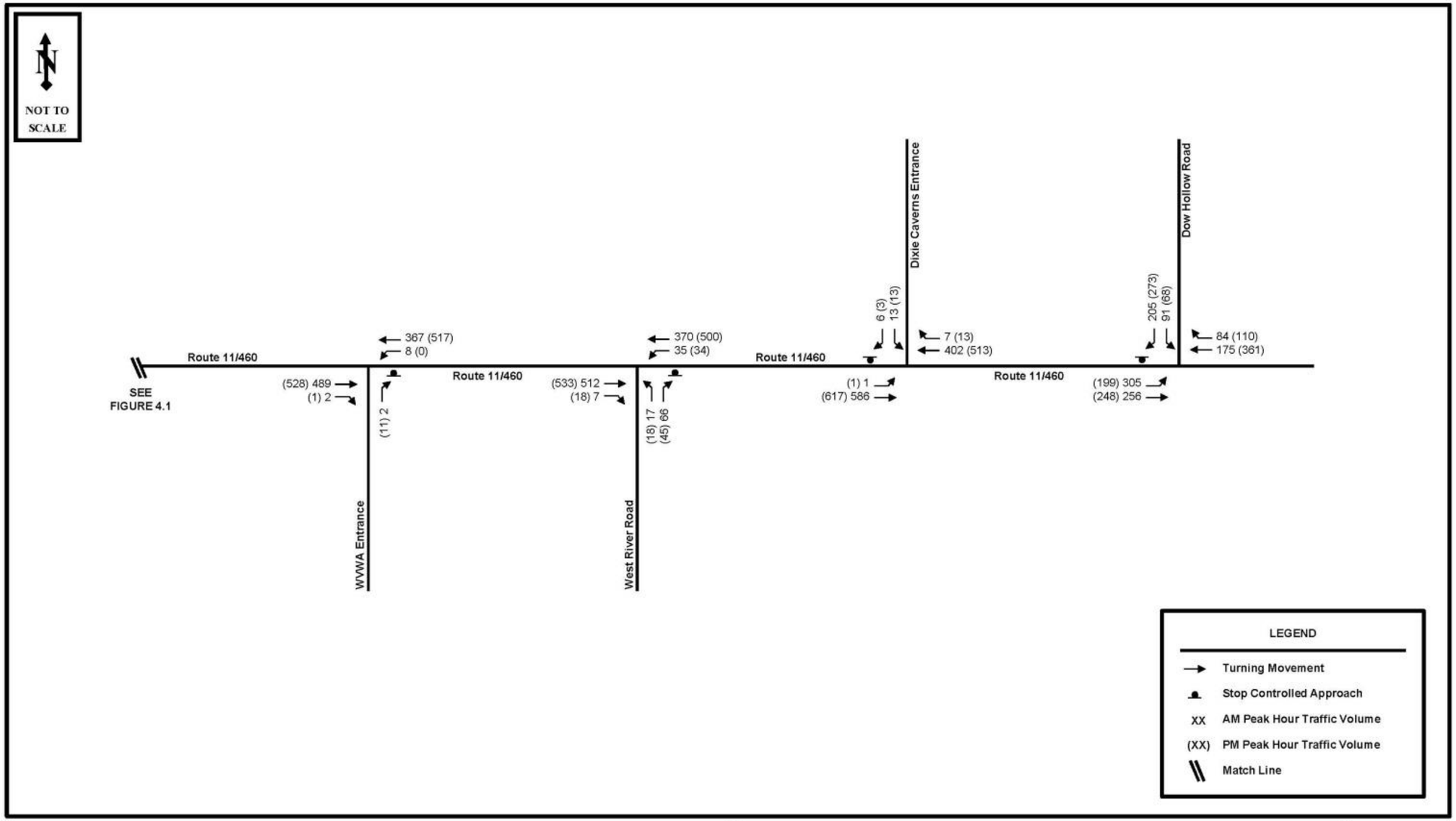
4.3 Future Traffic Volume Calculation

The growth rates developed were applied to Existing 2012 turning movement traffic volumes to develop future traffic volumes projections for detailed analysis of the study corridor. Mainline Route 11/460 through traffic volumes (eastbound and westbound) were grown at 1.0% compounded annually for 23 years to develop 2035 future traffic volumes. A 1.0% growth rate compounded annually results in a total increase of approximately 26% over the defined 23 year period (2012 to 2035). Side street turning movement volumes to/from Route 11/460 were grown at 0.5% compounded annually for 23 years to develop 2035 future traffic volumes. A 0.5% growth rate compounded annually results in a total increase of approximately 12% over the defined 23 year period (2012 to 2035). Projected future 2035 AM and PM peak hour volumes at the study area intersections are summarized in **Figure 4.1** and **Figure 4.2**. Future AADT volumes were projected based on the 2011 VDOT published traffic volume data using a 1% growth rate compounded annually as identified above. Future 2035 Route 11/460 AADT volumes are projected to be as follows:

- 10,200 vehicles per day (VPD) between Tower Road and the Town of Christiansburg/Montgomery County line (Town of Christiansburg)
- Range between 8,900 VPD and 9,900 VPD between the Town of Christiansburg/Montgomery County line and the Montgomery/Roanoke County line (Montgomery County)
- Range between 10,800 VPD to 12,700 VPD from Montgomery/Roanoke County line to Daugherty Road (Roanoke County)



Route 11/460 Corridor Study	Future 2035 Traffic Volumes (1 of 2)	Figure 4.1



Route 11/460 Corridor Study | Future 2035 Traffic Volumes (2 of 2) | Figure 4.2

4.4 Future Roadway Network

4.4.1 Future 2035 Baseline Conditions

To evaluate 2035 Baseline traffic conditions, future 2035 traffic volumes were used along with existing roadway geometric conditions. Based on a review of the planning documents identified in Section 2.4, no planned or programmed roadway improvements were identified at the study area intersections. As a result, existing roadway geometric conditions were used to analyze future 2035 Baseline traffic conditions.

4.4.2 Future 2035 Proposed Conditions

To evaluate 2035 Proposed traffic conditions, future 2035 traffic volumes were used along with proposed roadway improvements. The 2035 Proposed roadway conditions include the roadway recommendations made as a result of this corridor study, which include an eastbound Route 11/460 left-turn lane at the Alleghany Spring Road intersection, lengthened right and left-turn lanes where warranted throughout the study corridor and traffic signals at the intersections of Alleghany Spring Road and Dow Hollow Road with Route 11/460. The proposed turn lane improvements included in the 2035 Proposed network are identified in Section 4.4 and the proposed traffic signals are identified in Section 4.4.4.

4.4.3 Turn Lane Warrant Analysis

Right and left-turn lane warrant analyses were performed at the study area intersections under 2012 and 2035 traffic volume conditions in accordance with warrant requirements contained in the VDOT Road Design Manual (see Appendix). The results of the turn lane warrant analyses are summarized in Table 4.1. Under 2035 traffic volume conditions, the following turn lanes meet the warrant threshold:

- Route 11/460 at Alleghany Spring Road
  - Eastbound Right-Turn Lane
  - Eastbound Left-Turn Lane
  - Westbound Left-Turn Lane
- Route 11/460 at North Fork Road
  - Westbound Right-Turn Taper
  - Eastbound Left-Turn Lane
- Route 11/460 at Gardner Street
  - Westbound Right-Turn Lane
  - Eastbound Left-Turn Lane
- Route 11/460 at West River Road
  - Westbound Left-Turn Lane
- Route 11/460 at Dow Hollow Road
  - Westbound Right-Turn Lane
  - Eastbound Left-Turn Lane

With the exception of an eastbound left-turn lane at the intersection of Route 11/460 with Alleghany Spring Road, all of the above turn lanes are present under the 2012 existing conditions. However, several of these existing turn lanes do not meet the required storage and taper lengths. The required turn lane dimensions as well as the 2012 existing turn lane dimensions are presented in Table 4.1. In addition to installing an eastbound left-turn lane at the intersection of Route 11/460 with Alleghany Spring Road, the following turn lanes need to be lengthened in order to meet the storage and taper lengths required under 2035 traffic conditions:

- Route 11/460 Eastbound Right-Turn Lane at Alleghany Spring Road
  - Extend from 125 feet of storage and 150 feet of taper to 200 feet of storage and 200 feet of taper
- Route 11/460 Westbound Left-Turn Lane at Alleghany Spring Road
  - Extend from 75 feet of storage and 75 feet of taper to 200 feet of storage and 200 feet of taper
- Route 11/460 Westbound Right-Turn Lane at Gardner Street
  - Extend from 225 feet of storage and 75 feet of taper to 225 feet of storage and 175 feet of taper
- Route 11/460 Eastbound Left-Turn Lane at Gardner Street
  - Extend from 150 feet of storage and 200 feet of taper to 200 feet of storage and 200 feet of taper
- Route 11/460 Westbound Right-Turn Lane at Dow Hollow Road
  - Extend from 125 feet of storage and 125 feet of taper to 200 feet of storage and 200 feet of taper
- Route 11/460 Eastbound Left-Turn Lane at Dow Hollow Road
  - Extend from 250 feet of storage and 50 feet of taper to 250 feet of storage and 200 feet of taper

The need for side street turn lanes was based on the 2035 Baseline capacity analysis contained in Section 4.5. Based on a review of this information, no side street turn lanes were identified at the study area intersections.

Turn lane warrant worksheets are included in the **Appendix**.

Table 4.1 – Turn Lane Warrant Analysis Summary

Turn Lane Warrant Analysis Summary						
Intersection with Route 11/460	Direction	2012		2035		Existing Turn Lane Dimensions
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	
Alleghany Spring Road	EB Right-Turn	Not Met	Met – Full (200' x 200')	Not Met	Met – Full (200' x 200')	125' x 150'
	WB Right-Turn	Not Met	Not Met	Not Met	Not Met	-
	EB Left-Turn	Not Met	Met – Full (200' x 200')	Not Met	Met – Full (200' x 200')	-
	WB Left-Turn	Met – Full (200' x 200')	Met – Full (200' x 200')	Met – Full (200' x 200')	Met – Full (200' x 200')	75' x 75'
North Fork Road	EB Right-Turn	Not Met	Not Met	Not Met	Not Met	225' x 125'
	WB Right-Turn	Not Met	Met – Taper (200')	Not Met	Met – Taper (200')	325' x 125'
	EB Left-Turn	Not Met	Met – Full (200' x 200')	Not Met	Met – Full (200' x 200')	300' x 200'
	WB Left-Turn	Not Met	Not Met	Not Met	Not Met	275' x 200'
Gardner Street	EB Right-Turn	Not Met	Not Met	Not Met	Not Met	-
	WB Right-Turn	Met – Taper (200')	Met – Full (200' x 200')	Met – Taper (200')	Met – Full (200' x 200')	225' x 75'
	EB Left-Turn	Met – Full (200' x 200')	Not Met	Met – Full (200' x 200')	Met – Full (200' x 200')	150' x 200'
	WB Left-Turn	Not Met	Not Met	Not Met	Not Met	150' x 200'
Campbell Drive	WB Right-Turn	Not Met	Not Met	Not Met	Not Met	-
	EB Left-Turn	Not Met	Not Met	Not Met	Not Met	-
WVWA Entrance	EB Right-Turn	Not Met	Not Met	Not Met	Not Met	150' x 50'
	WB Left-Turn	Not Met	Not Met	Not Met	Not Met	-
West River Road	EB Right-Turn	Not Met	Not Met	Not Met	Not Met	50' x 25'
	WB Left-Turn	Met – Full (200' x 200')	Met – Full (200' x 200')	Met – Full (200' x 200')	Met – Full (200' x 200')	400' x 25'
Dixie Caverns Entrance	WB Right-Turn	Not Met	Not Met	Not Met	Not Met	-
	EB Left-Turn	Not Met	Not Met	Not Met	Not Met	400' x 25'
Dow Hollow Road	WB Right-Turn	Met – Taper (200')	Met – Full (200' x 200')	Met – Taper (200')	Met – Full (200' x 200')	125' x 125'
	EB Left-Turn	Met – Full (200' x 200')	Met – Full (200' x 200')	Met – Full (250' x 200')	Met – Full (200' x 200')	250' x 50'

*200' x 200' = 200 feet of storage and 200 feet of taper length

4.4.4 Traffic Signal Warrant Analysis

Traffic signal warrant analyses were performed under 2035 traffic volume conditions at the following study area intersections:

- Route 11/460 at Alleghany Spring Road
- Route 11/460 at North Fork Road
- Route 11/460 at Dow Hollow Road

All traffic signal warrants were performed based on the Manual of Uniform Traffic Control Devices (MUTCD, 2009 edition). For each of the three intersections listed above, Warrant 1 (Eight-Hour Vehicular Volume), Warrant 2 (Four-Hour Vehicular Volume) and Warrant 3 (Peak Hour) were analyzed. The results of the signal warrant analyses are outlined in **Table 4.2**.

Table 4.2 – Traffic Signal Warrant Analysis Summary

Intersection with Route 11/460	Warrant 1 (8-Hour Vehicular Volume Warrant)	Warrant 2 (4-Hour Vehicular Volume Warrant)	Warrant 3 (Peak Hour Warrant)
Alleghany Spring Road	**Not Met** (7 of 8 hours satisfied)	**Not Met** (3 of 4 hours satisfied)	**Not Met** (0 of 1 hour satisfied)
North Fork Road	**Not Met** (0 of 8 hours satisfied)	**Not Met** (0 of 4 hours satisfied)	**Not Met** (0 of 1 hour satisfied)
Dow Hollow Road	**Not Met** (0 of 8 hours satisfied)	**Met** (4 of 4 hours satisfied)	**Not Met** (0 of 1 hour satisfied)

The only traffic signal warrant that was satisfied under the projected 2035 traffic volume conditions was Warrant 2 at the intersection of Route 11/460 and Dow Hollow Road. The Route 11/460 intersection with Alleghany Spring Road was close to meeting both Warrant 1 and Warrant 2. Under projected 2035 traffic volume conditions, the intersection of Route 11/460 with Alleghany Spring Road satisfied seven of eight hours for Warrant 1 and three of four hours for Warrant 2.

Based on the results of the traffic signal warrant analysis, the 2035 Proposed conditions analyzed traffic signals at the intersections of Alleghany Spring Road and Dow Hollow Road with Route 11/460.

4.5 Future 2035 Baseline and Proposed Conditions – Levels of Service

Intersection capacity analyses, consistent with the HCM and methodology described in Chapter 3, were performed for the AM and PM peak hours at the following study area intersections:

- Route 11/460 at Alleghany Spring Road
- Route 11/460 at North Fork Road
- Route 11/460 at Gardner Street
- Route 11/460 at Campbell Drive
- Route 11/460 at Western Virginia Water Authority Water Treatment Plant Entrance
- Route 11/460 at West River Road
- Route 11/460 at Dixie Caverns Entrance
- Route 11/460 at Dow Hollow Road

Analyses were performed for Existing 2012, Future 2035 Baseline, and Future 2035 Proposed scenarios. The Future 2035 Baseline conditions represent no changes to the roadway network when compared to existing conditions. Future 2035 Proposed conditions represents proposed changes to the roadway network as identified in Section 4.4. The methodologies used to analyze Existing 2012 conditions (as presented in Chapter 3) were used to analyze Future 2035 Baseline and Future 2035 Proposed conditions.

Table 4.3 through **Table 4.10 s**ummarize the delay and associated approach LOS for each of the study area intersections. At intersections where traffic signals are proposed under Future 2035 Proposed conditions, additional columns are presented in the tables showing the delay and associated LOS for the Future 2035 Proposed conditions. For intersections where no traffic signals are proposed under Future 2035 Proposed condition, only Future 2035 Baseline results are shown since the results did not change under Future 2035 Proposed condtions. For movements without conflicting volumes, such as the major street's through and right turn movements at a two-way, stop-controlled intersection, an assocaited delay or LOS is not reported by SYNCHRO. In addition, for intersections without traffic signals, an overall intersection delay or LOS is not reported by SYNCHRO. **Figure 4.3** and **Figure 4.4** show the LOS of each individual lane group as well as the overall approach LOS for all study area intersections. The corresponding SYNCHRO output sheets are included in the **Appendix**.

Under Future 2035 Baseline conditions, as shown in **Figure 4.3** and **Figure 4.4**, all of the study area intersection lane groups and overall approaches operate at a LOS D or better during the AM and PM peak hours with the exception of Gardner Street. The southbound sidestreet approach at Gardner Street operates at an overall approach LOS E during the PM peak hour with approximately 36.4 seconds of delay per vehicle. Mainline Route 11/460 (lane group and overall approaches) operates at a LOS A during the AM and PM peak hours at all study area intersections under Future 2035 Baseline conditions. LOS A through LOS D are generally considered satisfactory based on standard traffic enginnering practice. When compared to Existing 2012 conditions, Gardner Street degradates two LOS categories from LOS C to LOS E during the PM peak hour with an increased delay of 15.5 seconds per vehicle. With no change in roadway geometry, this decrease in LOS is a result of traffic volume growth. As a result of traffic volume growth, side street, stop-controlled vehicles have more difficultly finding enough gaps of suitable size to allow the side street demand to safely cross through traffic on Route 11/460.

Under Future 2035 Proposed conditions, the lengthing of the turn lanes identified in Section 4.4 does not result in any change in LOS from the 2035 Baseline conditions, but does offer a safety benefit. Left-turn lanes provide a protected location for turning vehicles to wait for a gap in opposing traffic. Reducing the potential for rear-end crashes, left-turn lanes also encourage drivers to wait for an adequate gap in opposing traffic. According to VDOT's Highway Safety Improvement Program (HSIP), the Highway Safety Program (HSP) Proposed Safety Improvements form identifies the associated safety benefit for different improvement types through the use of Crash Reduction Factors (CRF). As defined by the Federal Highway Administration, a CRF "is the percentage crash reduction that might be expected after implementing a given countermeasure at a specific site." Based on VDOT's Proposed Safety Improvements form, the addition of a left-turn lane can expect a 43% reduction in all rear-end, left-turn, and overturn crashes while the addition of a right-turn lane can expect a 21% reduction in all rear-end and right-turn crashes.

Under Future 2035 Proposed condition, the installation of traffic signals along the Route 11/460 study corridor at Alleghany Spring Road and Dow Hollow Road results in all approaches at Alleghany Spring Road and Dow Hollow Road operating at LOS C or better. When compared to Future 2035 Baseline condtions, mainline Route 11/460 (lane group and overall approaches) degrade from a LOS A to a LOS B for both the eastbound and westbound approaches at the Alleghany Spring Road intersection and for the westbound approach at the Dow Hollow Road intersection. At the Alleghany Spring Road intersection, during the AM peak hour the southbound approach degrades from a LOS A to a LOS C under the Future 2035 Proposed condtion, but the northbound and southbound approaches improve from LOS D to LOS C under the Future 2035 Proposed condition. In addition, at the Dow Hollow Road intersection, the southbound left-turn lane improves from LOS D during the AM peak hour and LOS C during the PM peak hour under Future 2035 Baseline condtions to LOS B during both the AM and PM peak hours under Future 2035 Proposed condtions. This results on the southbound approach at Dow Hollow Road imrpove from LOS C under Future 2035 Baseline condtions to LOS B under Future 2035 Proposed condtions.

Table 4.3 – Route 11/460 at Alleghany Spring Road Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline		Future 2035 Proposed	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
Intersection: Route 11/460 and Alleghany Spring Road					
AM	Eastbound - Route 11/460	0.1	A	12.0	B
	Westbound - Route 11/460	0.8	A	12.2	B
	Northbound - Alleghany Spring Road	12.1	B	18.7	B
	Southbound - Alleghany Spring Road	9.8	A	23.0	C
	Overall Intersection	**N/A**	**N/A**	**13.7**	**B**
PM	Eastbound - Route 11/460	0.4	A	12.8	B
	Westbound - Route 11/460	1.6	A	11.3	B
	Northbound - Alleghany Spring Road	27.1	D	23.9	C
	Southbound - Alleghany Spring Road	27.7	D	31.5	C
	Overall Intersection	**N/A**	**N/A**	**13.8**	**B**

Table 4.4 – Route 11/460 at North Fork Road Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline	
		Delay (sec/veh)	LOS
Intersection: Route 11/460 and North Fork Road			
AM	Eastbound - Route 11/460	0.2	A
	Westbound - Route 11/460	0.2	A
	Northbound - North Fork Road	11.8	B
	Southbound - North Fork Road	11.9	B
PM	Eastbound - Route 11/460	1.2	A
	Westbound - Route 11/460	0.1	A
	Northbound - North Fork Road	18.8	C
	Southbound - North Fork Road	15.0	B

Table 4.5 – Route 11/460 at Gardner Street Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline	
		Delay (sec/veh)	LOS
Intersection: Route 11/460 and Gardner Street			
AM	Eastbound - Route 11/460	1.5	A
	Westbound - Route 11/460	0.0	A
	Northbound - Private Road	0.0	A
	Southbound - Gardner Street	13.9	B
PM	Eastbound - Route 11/460	0.5	A
	Westbound - Route 11/460	0.0	A
	Northbound - Private Road	0.0	A
	Southbound - Gardner Street	36.4	E

Table 4.6 – Route 11/460 at Campbell Drive Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline	
		Delay (sec/veh)	LOS
Intersection: Route 11/460 and Campbell Drive			
AM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Campbell Drive	14.0	B
PM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Campbell Drive	19.5	C

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

Table 4.7 – Route 11/460 at WVWA Entrance Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline Delay (sec/veh)	Future 2035 Baseline LOS
Intersection: Route 11/460 and WVWA Entrance			
AM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.2	A
	Northbound - WVWA Entrance	10.1	B
PM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.0	A
	Northbound - WVWA Entrance	10.4	B

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

Table 4.8 – Route 11/460 at West River Road Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline Delay (sec/veh)	Future 2035 Baseline LOS
Intersection: Route 11/460 and West River Road			
AM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.8	A
	Northbound - West River Road	11.8	B
PM	Eastbound - Route 11/460	†	†
	Westbound - Route 11/460	0.6	A
	Northbound - West River Road	12.1	B

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

Table 4.9 – Route 11/460 at Dixie Caverns Entrance Future 2035 LOS Summary

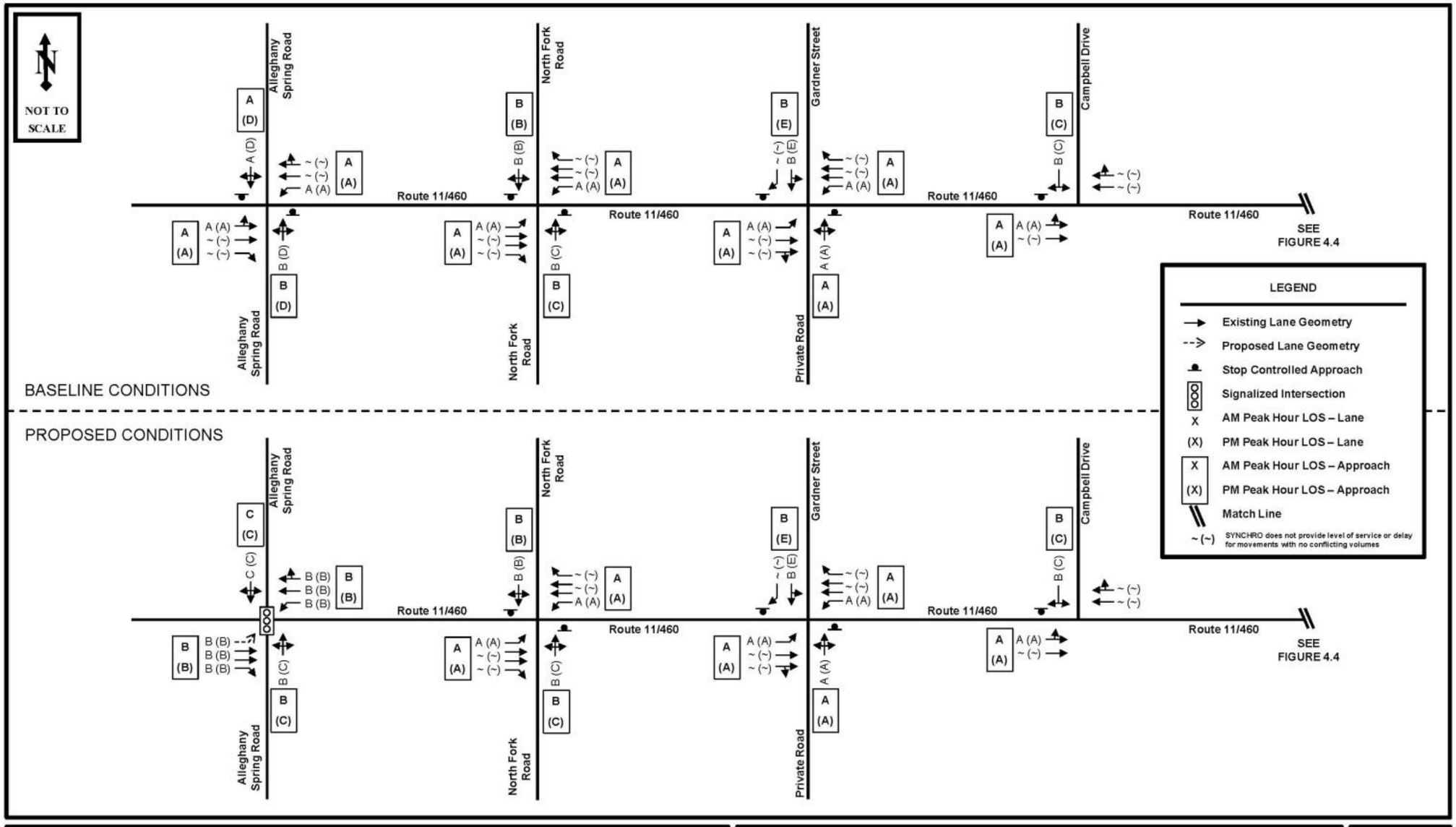
Peak Hour	Approach	Future 2035 Baseline Delay (sec/veh)	Future 2035 Baseline LOS
Intersection: Route 11/460 and Dixie Caverns Entrance			
AM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Dixie Caverns Entrance	11.6	B
PM	Eastbound - Route 11/460	0.0	A
	Westbound - Route 11/460	†	†
	Southbound - Dixie Caverns Entrance	12.9	B

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

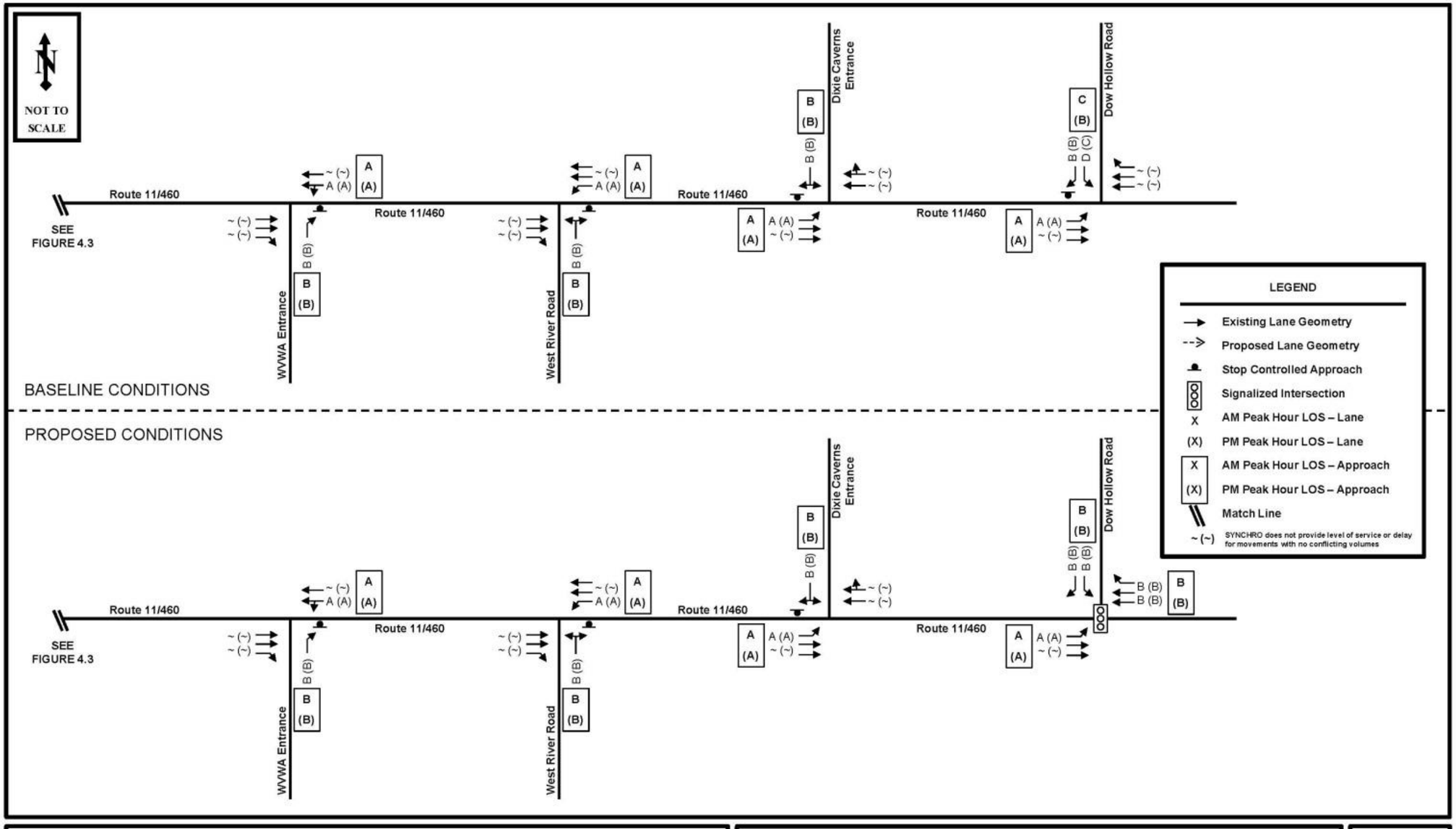
Table 4.10 – Route 11/460 at Dow Hollow Road Future 2035 LOS Summary

Peak Hour	Approach	Future 2035 Baseline Delay (sec/veh)	Future 2035 Baseline LOS	Future 2035 Proposed Delay (sec/veh)	Future 2035 Proposed LOS
Intersection: Route 11/460 and Dow Hollow Road					
AM	Eastbound - Route 11/460	5.0	A	6.0	A
	Westbound - Route 11/460	†	†	18.2	B
	Southbound - Dow Hollow Road	17.4	C	17.8	B
	Overall Intersection	**N/A**	**N/A**	**12.0**	**B**
PM	Eastbound - Route 11/460	4.2	A	5.6	A
	Westbound - Route 11/460	†	†	14.4	B
	Southbound - Dow Hollow Road	12.9	B	16.0	B
	Overall Intersection	**N/A**	**N/A**	**11.7**	**B**

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



Route 11/460 Corridor Study	Future 2035 Baseline and Proposed Intersection LOS (1 of 2)	Figure 4.3



Route 11/460 Corridor Study

Future 2035 Baseline and Proposed Intersection LOS (2 of 2)

Figure 4.4

4.5.1 Future 2035 Baseline and Proposed Arterial Link Levels of Service

Future 2035 arterial link analyses were conducted at the following three locations analyzed under Existing 2012 conditions:

1. West of Alleghany Spring Road
2. West of North Fork Road
3. East of Dow Hollow Road

The methodologies used to analyze Existing 2012 conditions were used to analyze future 2035 conditions. Under Future 2035 Proposed conditions, the increased shoulder width does not impact the multilane HCS analysis. The shoulder width is not an input in the multilane HCS module; however, lateral clearance is an input. Under the Existing and Future 2035 Baseline conditions, the lateral clearance was set to six feet which is the maximum allowed in the software. Therefore, the Future 2035 Proposed condition results are identical to the Future 2035 Baseline condition results. The arterial link LOS during the AM and PM peak hours are summarized in **Table 4.11**. Under Future 2035 Baseline and Proposed conditions, arterial analysis for Route 11/460 indicates that the corridor operates at a LOS A at all of the analyzed segment locations.

Table 4.11 – Future 2035 Baseline and Proposed Conditions Arterial Level of Service

Travel Direction	Time of Day	Average Travel Speed (mi/h)	Density (pc/mi/h)	LOS
West of Alleghany Spring Road				
Eastbound	AM	50	2.6	A
	PM	50	5.2	A
Westbound	AM	50	3.8	A
	PM	50	5.5	A
West of North Fork Road				
Eastbound	AM	55	4.8	A
	PM	55	3.6	A
Westbound	AM	55	1.9	A
	PM	55	6.4	A
East of Dow Hollow Road				
Eastbound	AM	60	3.8	A
	PM	60	2.9	A
Westbound	AM	60	2.9	A
	PM	60	4.4	A

4.6 Queue Lengths

Queue lengths, or the distance at which stopped vehicles accumulate at an intersection, were calculated. Queue length is another performance indicator of the intersection's operational characteristics. Large or lengthy queues may be indicative of capacity or operational issues, which help in the identification of potential solutions. A 95th percentile queuing analysis was completed for the study area intersections under both Future 2035 Baseline and Future 2035 Proposed AM and PM peak hour conditions. There was no significant change in queue lengths for unsignalized intersections in the Future 2035 Proposed conditions and, as a result, Future 2035 Proposed queue lengths are only presented for the signalized intersections (Alleghany Spring Road and Dow Hollow Road). SYNCHRO plus SimTraffic Version 7 was used to perform the analyses. The 95th percentile queue length, measured in feet, represents the queue length with a five percent probability of being exceeded during the analysis time period. A summary of the 95th percentile queue lengths for each of the study area intersection lane groups is presented in **Table 4.12** through **Table 4.19**. For movements without conflicting volumes, no queue length is reported by SimTraffic. Under Future 2035 Proposed conditions, 95th percentile queue lengths were compared with proposed turn lane storage lengths to determine if sufficient capacity is provided. Based on the Future 2035 Baseline 95th percentile queue lengths, queues do not exceed 200 feet (or approximately 8 vehicles) at any of the study area intersections and queues do not exceed the storage capacity of the existing or proposed turn lanes.

The supporting SimTraffic output sheets are included in the **Appendix**.

Table 4.12 – Route 11/460 at Alleghany Spring Road Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline 95th Percentile Queue Length (Ft)		Lane Group	Future 2035 Proposed 95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour		AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Alleghany Spring Road					
EBLT	~	~	EBL	1	4
EBT	~	~	EBT	10	42
EBR	~	~	EBR	*	2
WBL	21	50	WBL	14	67
WBT	~	~	WBT	14	50
WBTR	~	~	WBTR	21	94
NBLTR	56	69	NBLTR	87	72
SBLTR	24	36	SBLTR	15	50

~ SimTraffic does not report Queue Length on movements with no conflict.

* Queue Length not reported by SimTraffic.

Table 4.13 – Route 11/460 at North Fork Road Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline	
	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and North Fork Road		
EBL	~	~
EBT	~	~
EBR	~	~
WBL	~	~
WBT	~	~
WBR	~	~
NBLTR	11	7
SBLTR	31	23

~SimTraffic does not report Queue Length on movements with no conflict.

Table 4.14 – Route 11/460 at Gardner Street Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline	
	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Gardner Street		
EBL	31	17
EBT	~	~
EBTR	~	~
WBL	~	~
WBT	~	~
WBR	6	~
NBLTR	~	~
SBLT	28	74
SBR	23	34

~SimTraffic does not report Queue Length on movements with no conflict.

Table 4.15 – Route 11/460 at Campbell Drive Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline	
	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Campbell Drive		
EBTL	~	~
EBT	~	~
WBT	~	~
WBTR	~	~
SBLR	31	28

~SimTraffic does not report Queue Length on movements with no conflict.

Table 4.16 – Route 11/460 at WVWA Entrance Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline	
	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and WVWA Entrance		
EBT	~	~
EBR	~	~
WBLT	21	~
WBT	~	~
NBL	~	~
NBR	6	18

~SimTraffic does not report Queue Length on movements with no conflict.

Table 4.17 – Route 11/460 at West River Road Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline	
	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and West River Road		
EBT	~	~
EBR	~	~
WBL	34	29
WBT	~	~
NBLR	60	53

~SimTraffic does not report Queue Length on movements with no conflict.

Table 4.18 – Route 11/460 at Dixie Caverns Entrance Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline	
	95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Dixie Caverns Entrance		
EBL	8	~
EBT	~	~
WBT	~	~
WBTR	~	~
SBLR	22	16

~SimTraffic does not report Queue Length on movements with no conflict.

Table 4.19 – Route 11/460 at Dow Hollow Road Future 2035 95th Percentile Queue Lengths

Lane Group	Future 2035 Baseline		Lane Group	Future 2035 Proposed	
	95th Percentile Queue Length (Ft)			95th Percentile Queue Length (Ft)	
	AM Peak Hour	PM Peak Hour		AM Peak Hour	PM Peak Hour
Intersection: Route 11/460 and Dow Hollow Road					
EBL	113	103	EBL	179	112
EBT	~	~	EBT	60	55
WBT	~	~	WBT	71	106
WBR	25	29	WBR	57	55
SBL	101	87	SBL	96	66
SBR	83	66	SBR	72	71

~SimTraffic does not report Queue Length on movements with no conflict.

5. RECOMMENDATIONS

Based on the results of the Future 2035 Baseline and Proposed conditions, field observations, review of input received from the public involvement process, alignment with project goals, and feedback from the Project Team members, recommendations for transportation improvements throughout the study corridor were developed. The recommendations were developed to accommodate anticipated growth in pedestrian, bicycle, and automobile traffic volumes expected in the study area by 2035. The recommendations can be implemented in phases in conjunction with growth and funding availability. Therefore, the recommendations were categorized as short-, mid-, and long-term improvements to assist VDOT, Roanoke County, Montgomery County, Town of Christiansburg, RVAMPO, RVARC, NRVPDC, and NRVMPO in the phasing and programming of these improvements.

Short-term recommendations are projects that can be completed within a year, typically at minimal expense and little to no right-of-way impacts. Mid-term recommendations could require preliminary engineering or design, right-of-way acquisition, and/or minor disturbance to operations (i.e. roadway and/or maintenance of traffic plans). These mid-term improvements would come with a higher price tag and could take between one and five+ years to implement. Long-term recommendations are the most expensive improvements and could require extensive design, right-of-way acquisition, utility relocation, and permitting. These long-term improvements could take between five and twenty+ years to plan, design, approve, and construct. With limited right-of-way along the Route 11/460 study corridor and the likely impacts associated with each proposed recommendation, the timeframe for implementation can be longer than typically expected. The recommendations documented herein are not listed in any particular priority order. The short-, mid-, and long-term labels were used to categorize improvements were based on scale, cost, and timeframe for implementation. **Figure 5.4** through **Figure 5.10** show the approximate location of each proposed short-, mid-, and long-term recommendation. A summary table containing all recommendations along with planning level costs is included in Chapter 6.

5.1 Short-Term Improvements

5.1.1 Sight Distance

- **S1.** Cut back vegetation to improve sight distance at Dow Hollow Road.
  - Trim back vegetation on southwest corner to improve sight distance (Photograph 5.1 and Photograph 5.2).

Photograph 5.1 – Sight Distance Right on Dow Hollow Road (Looking West)

Photograph 5.2 – Route 11/460 and Dow Hollow Road Intersection Sight Distance Improvements

5.1.2 Signing and Striping

- **S2.** Dow Hollow Road and Route 11/460 Intersection
  - Southbound Dow Hollow Road approach: route signs currently provided for Route 460 West / Route 11 South (Photograph 5.3). Route signs should be added to designate Route 460 East /Route 11 North. In addition, route signs should be provided on the south side of the intersection to direct vehicles on the southbound Dow Hollow Road approach (Photograph 5.4).
  - "STOP" (R1-1) sign provided on southbound Dow Hollow Road approach is mounted behind a larger "KEEP RIGHT" (R4-7) sign (Photograph 5.5 and Photograph 5.6). This obscures the octagon shape used to identify a stop sign. A 36 inch x 36 inch "STOP" (R1-1) sign and a 24 inch x 30 inch "KEEP RIGHT" (R4-7) sign should be installed.
  - Provide the following striping improvements/modifications (see **Figure 5.1**):
    - Provide bump out striping to create a westbound right-turn lane on Route 11/460 immediately west of Dow Hollow Road to serve Fallbrooke Drive.
    - Stripe a "pork chop" on the westbound approach to channelize the westbound right-turn lane. The existing right-turn lane is approximately 29' feet wide, this improvement will help positively guide right turning vehicles.
    - The westbound acceleration lane on the west side of Fallbrooke Drive should be striped out as a result of the upstream striping improvements.
  - Remove I-81 signs on the southbound Dow Hollow Road approach. Vehicles traveling southbound would have already passed the I-81 interchange with Dow Hollow Road.

Photograph 5.3 – Dow Hollow Rd Southbound Approach – Route 460 West / Route 11 South Signed, No Signing for Route 460 East / Route 11 North

Photograph 5.4 – Dow Hollow Rd Southbound Approach – No Route Signs Provides on Far Side of Intersection

Photograph 5.5 – Dow Hollow Rd Southbound Approach – Stop Sign Mounted Behind Larger Sign

Photograph 5.6 – Keep Right Sign Mounted on North Side of Intersection – Obscures the Co-located Stop Sign

Figure 5.1 – Route 11/460 and Dow Hollow Road Intersection Striping Improvements

- **S3.** In advance of the left-lane drop on westbound Route 11/460 (at Woodland Drive) near the Town of Christiansburg, one "LEFT LANE ENDS 1000 FT" sign and one "LEFT LANE ENDS 500 FEET" sign is provided. These signs should be replaced with the "LEFT LANE ENDS" (W9-1) "1000 FEET" and "500 FEET" distance plaques (W16-2P) to match the lane drop on eastbound Route 11/460 near Mt Pleasant Road (Photograph 5.7). A "LANE ENDS" (W4-2) sign should also be added at the merge point, as provided in the eastbound direction (Photograph 5.8).

Photograph 5.7 – "LEFT LANE ENDS" Sign

Photograph 5.8 – "LANE ENDS" Sign

- **S4.** Not Used
- **S5.** Install a "CURVE" (W1-2) sign along westbound Route 11/460 in advance of Kirby Drive. Without a curve warning sign, westbound vehicles have the potential to mistake Kirby Drive as the through movement creating a head-on conflict with eastbound Route 11/460 vehicles.

Photograph 5.9 – Route 11/460 Westbound Approach to Kirby Drive

W1-2

- **S6.** Object markers are currently provided on one side of a narrow road section along the following sections of Route 11/460. A second object marker should be added to the following three bridges to provide object markers on both sides of each narrow road section.
  - Eastbound between Friendship Road and Sparrow Road (Photograph 5.10)
  - Eastbound between Old Town Road and Dark Run Road (Photograph 5.11)
  - Eastbound located east of Big Spring Drive (US Post Office) (Photograph 5.12)

Photograph 5.10 – Narrow Road Section on Eastbound Route 11/460 Between Friendship Road and Sparrow Road

Photograph 5.11 – Narrow Road Section on Eastbound Route 11/460 Between Old Town Road and Dark Run road

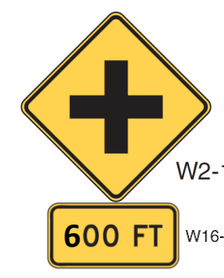
Photograph 5.12 – Narrow Road Section on Eastbound Route 11/460 East of Big Spring Road (US Post Office)

- **S7.** Four out of date "REDUCED SPEED LIMIT AHEAD" signs should be replaced with the updated version (W3-5). Two signs are located on westbound Route 11/460 east of Old Town Road (Photograph 5.13) and two signs are located on eastbound Route 11/460 east of Sparrow Road.

Photograph 5.13 – Route 11/460 Westbound – Reduced Speed Limit Signs East of Old Town Road

W3-5

- **S8.** Add a "600 FEET" distance plaque (W16-2P) to the two existing "CROSS ROAD" (W2-1) signs in advance of Alleghany Spring Road. One sign is located on eastbound Route 11/460 and the other on the westbound side. This recommendation will inform the driver of the approximate location of the Alleghany Spring Road intersection. A second identical sign should be added to the median in each direction to dual indicate these warning signs.



W2-1

W16-2aP

- **S9.** Three non-standard "TRUCKS KEEP RIGHT DO NOT PASS" signs and one "TRUCKERS STEEP GRADE USE RIGHT LANE" sign present on westbound Route 11/460, west of Poplar Hollow Road, within three lane section (Photograph 5.14 and Photograph 5.15). A standard "HILL" (W7-1) sign and "TRUCKS USE RIGHT LANE" (R4-5) sign should be used.

Photograph 5.14 – "TRUCKS KEEP RIGHT DO NOT PASS" Sign

Photograph 5.15 – "TRUCKERS STEEP GRADE USE RIGHT LANE" Sign

W7-1

R4-5

- **S10.** Replace leaning "WATCH FOR TURNING VEHICLES" sign on eastbound Route 11/460 west of Kirby Drive (Photograph 5.16).

- **S11.** Replace leaning "DIVIDED HIGHWAY" and "KEEP RIGHT" sign on eastbound Route 11/460 west of Pleasant Run Road (Photograph 5.17).

Photograph 5.16 – Leaning "WATCH FOR TURNING VEHICLES" sign

Photograph 5.17 – Leaning "DIVIDED HIGHWAY" and "KEEP RIGHT" sign

- **S12.** All "SCHOOL BUS STOP AHEAD" signs should be upgraded to the current S3-1 version with a fluorescent yellow-green background. All school warning signs should have a fluorescent yellow-green background.

S3-1

- **S13.** Replace "SCHOOL" plaque with a fluorescent yellow-green background on the School Speed Limit sign located on eastbound Route 11/460 west of Dark Run Road.

Photograph 5.18 – "SCHOOL SPEED LIMIT" Sign Located on Eastbound Route 11/460 West of Dark Run Road

- **S14.** Replace the existing "WATCH FOR TURNING VEHICLES" and "INTERSECTION WARNING" (W2-7R) signs on the westbound Route 11/460 approach to West River Road and trim back vegetation to make signs visible. The existing signs have become faded and are difficult to read (Photograph 5.19).

Photograph 5.19 – Route 11/460 Approach to West River Road – Faded Advanced Warning Signs

- **S15.** Not Used

5.1.3 Lighting

- **S16.** Provide lighting at study area intersections and through the Villages of Shawsville and Elliston if power is readily available and lighting is not already present. See the Mid-Term Recommendations if power is not readily available.

5.1.4 Access Management

The first two access management recommendations are listed as short-term because of the immediate need, but should continue to be considered as the Route 11/460 corridor develops into the future. The third access management recommendation should be pursued should the subject site be redeveloped or undergo a major renovation.

- **S17.** Continually improve access/reduce number of driveways as redevelopment occurs. Photograph 5.20 shows an example of two closely spaced intersections along the Route 11/460 corridor.
- **S18.** Positively define access by reducing wide throat widths at existing access points. Photograph 5.21 shows an example of existing wipe down access on the Route 11/460 corridor.

Photograph 5.20 – Access Management at West River Road/Gas Station Access

Photograph 5.21 – Example of Access Along the Route 11/460 Corridor with a Wide Throat/Wipe Down Entrance

- **S19.** Route 11/460 and West River Road Intersection.
  - Relocate/remove the existing gas station entrance on the south side of Route 11/460 to West River Road, south of Route 11/460, see **Figure 5.2**. The current configuration can become confusing to drivers to determine which access vehicles are turning to/from.

Figure 5.2 – Route 11/460 and West River Road Access Management

5.1.5 Other

- **S20.** Replace the damaged guardrail on the northwest corner of the Route 11/460 and Dow Hollow Road intersection (Photograph 5.22).

Photograph 5.22 – Damaged Guardrail on Northwest Corner of Route 11/460 and Dow Hollow Road Intersection

5.2 Mid-Term Recommendations

5.2.1 Traffic Signal Control:

- **M1.** A traffic signal warrant analysis should be performed at the following locations:
  - Alleghany Spring Road
    - Based on projected 2035 traffic volumes, the subject intersection meets seven hours of the eight hours required to meet Warrant 1 and meets three hours of the four hours required to meet Warrant 2.
  - Dow Hollow Road
    - Based on projected 2035 traffic volumes, the subject intersection meets Warrant 2 requirements; however, meets zero hours of the eight hours required to meet Warrant 1.

  A traffic signal should be considered at the locations where warrants are met. If traffic signal warrants are not met at the time of study, the subject intersections should be monitored to determine if/when additional traffic control is warranted.

5.2.2 Roadway Improvements:

- **M2.** With the exception of the eastbound left-turn lane at the intersection of Route 11/460 with Alleghany Spring Road, all of the warranted turn lanes are present under existing conditions. However, several of the existing turn lanes do not meet the required storage and taper lengths. Per the VDOT Road Design Manual, all turn lanes along the subject corridor should have 200 feet of storage and 200 feet of taper with the exception of the eastbound left-turn lane at the Dow Hollow Road intersection, which requires 250 feet of storage. In cases where the existing storage length is greater than 200 feet, it is recommended to maintain the storage length and increase the taper length to create a total 400 foot turn lane length (storage + taper). The "extra" storage length could be striped back to a 200 foot taper, should VDOT choose to do so. In addition to meeting the VDOT Road Design Manual, turn lanes offer a safety benefit to the corridor. The following turn lane improvements are recommended at the study area intersections, additional turn lane recommendations at crossover locations are included in Section 5.2.3:

  - Route 11/460 Eastbound Left-Turn Lane at Alleghany Spring Road
    - Construct new turn lane with 200 feet of storage and 200 feet of taper
  - Route 11/460 Eastbound Right-Turn Lane at Alleghany Spring Road
    - Extend from 125 feet of storage and 150 feet of taper to 200 feet of storage and 200 feet of taper
  - Route 11/460 Westbound Left-Turn Lane at Alleghany Spring Road
    - Extend from 75 feet of storage and 75 feet of taper to 200 feet of storage and 200 feet of taper
  - Route 11/460 Westbound Right-Turn Lane at Gardner Street
    - Extend from 225 feet of storage and 75 feet of taper to 225 feet of storage and 175 feet of taper
  - Route 11/460 Eastbound Left-Turn Lane at Gardner Street
    - Extend from 150 feet of storage and 200 feet of taper to 200 feet of storage and 200 feet of taper
  - Route 11/460 Westbound Right-Turn Lane at Dow Hollow Road
    - Extend from 125 feet of storage and 125 feet of taper to 200 feet of storage and 200 feet of taper
  - Route 11/460 Eastbound Left-Turn Lane at Dow Hollow Road
    - Extend from 250 feet of storage and 50 feet of taper to 250 feet of storage and 200 feet of taper

5.2.3 Median Crossovers:

- **M3.** As identified in Section 2.1.2, 66 crossovers are located within the 12-mile median barrier section of the corridor. Based on a review of each crossover location, the following recommendations are made to maintain, close, relocate, or modify the existing crossovers or propose new crossover locations. The crossover recommendations within Shawsville (crossover #11 through crossover #26) were taken from the Shawsville Area Route 11/460 Corridor Study. Access management was identified as a recommendation in the Lafayette Route 11/460 Corridor Plan; however, specific crossover recommendations through Elliston (crossover #35 through crossover #45) were not identified as to which to maintain, close, relocate, or modify. Therefore, crossover recommendations within Elliston were developed herein. Left-turn lanes are recommended at each crossover location to be maintained. Although all left-turn lanes recommended do not directly serve a side street, with the closure of several medians, vehicles will be required to make U-turn movements at the crossovers to remain. The recommended left-turn lanes at each crossover are based on safety. Traffic volumes were not collected to compare with VDOT turn lane warrants to justify the turn lanes.

Photograph 5.23 – Crossover #5 Southbound Approach

Table 5.1 – Crossover Spacing

Crossover #	Cross Street (if available)	Distance to Adjacent Crossover to the East (ft)	Recommendation	Additional Improvements
1		1,100	Close	N/A
2		1,020	Maintain	Construct EBL; WBL provided
3	Poplar Hollow Rd	910	Maintain	Construct EBL & WBL
4		840	Close	N/A
5	Friendship Rd	750	Maintain	Construct EBL &WBL, improve SB approach (Photograph 5.23)
6		1,590	Close	N/A
7		1,440	Close	N/A
8		440	Close	N/A
9		690	Maintain	Construct EBL & WBL
10		980	Close	N/A
11	Sparrow Rd	780	Maintain	Construct EBL & WBL
12		640	Close	N/A
13	Old Town Rd	1,250	Maintain	Construct EBL, WBL, & WBR
14		690	Maintain	Construct EBL & WBL
15		430	Close	N/A
16		350	Close	N/A
17	Trump Ln	840	Close	N/A
18		344	Close	N/A
19	Alleghany Spring Rd	830	Maintain	Construct EBL, EBR, WBL, & WBR
20		1,050	Maintain	Construct EBL
21	Boners Run Rd	910	Maintain	Construct EBL, WBL, & WBR
22	Corbin Rd	780	Close	N/A
23	Pair-O-Docs Ln	640	Maintain	None
24	Old Town Rd	2,760	Maintain	Construct EBL, WBL, & WBR
~	*	-	New Crossover	Construct EBL & WBL
25	Dark Run Rd	410	Close	N/A
26	Riffe St	1,260	Maintain	Construct EBL, WBL, & WBR
27		2,110	Maintain	Construct EBL & WBL
28		870	Close	N/A
29	Graham St	1,720	Maintain	Construct EBL & WBL
30		1,060	Close	N/A
31		1,320	Maintain	Construct EBL (EBR & WBL provided)
32		320	Close	N/A
33	Seneca Hollow Rd	1,420	Maintain	None, EBL & WBL provided
34	Crozier Rd	1,300	Maintain	None, signal provided
35		1,670	Maintain	Construct EBL (WBL provided)
36	Big Spring Dr	500	Modify	Convert to RIRO+LI, construct EBL
37		160	Close	N/A
38	Brake Rd	310	Modify	Convert to RIRO+LI, construct WBL
39	Calloway St	770	Maintain	Construct EBL & WBL
40		700	Close	N/A
41	Big Spring Dr	1,690	Maintain	Construct EBL & WBL
42		1,850	Maintain	None, EBL & WBL provided
43		1,620	Maintain	None, EBL & WBL provided
44	North Fork Rd	760	Maintain	None, EBL & WBL provided
45	Enterprise Dr	1,880	Maintain	None, EBL & WBL provided
46	Gardner St	1,160	Maintain	None, EBL & WBL provided
47	Green Hill Ln	870	Maintain	Construct EBL & WBL
48	Apgar Dr	410	Close	N/A
49	Lafayette Rd	640	Maintain	Construct EBL & WBL
50		350	Relocate	Shift west and construct EBL
51	Stones Keep Ln	1,570	Maintain	Construct WBL*
52	Campbell Dr	870	Maintain	Construct EBL*
53	Marshall Dr	840	Maintain	Construct EBL & WBL*
54	Peaceful Dr	730	Maintain	Construct EBL & WBL*
55		890	Close	N/A
56	WVWA	950	Maintain	Construct WBL*
57		1,210	Close	N/A
58	West River Rd	7,020	Maintain	None (WBL provided)
59	Pleasant Run Dr	1,200	Maintain	Construct WBL*
60		1,310	Close	N/A
61	Yale Dr	160	Close	N/A
62		360	Close	N/A
63	Glenvar Heights Blvd	1,320	Maintain	Construct EBL & WBL*
64		350	Close	N/A
65		630	Close	N/A
66	Vintage Ln	-	Modify	Convert to RIRO+LI+U-turn, construct EBL*

EBL=Eastbound Left-Turn Lane, WBL=Westbound Left-Turn Lane

RIRO+LI = Right-In/Right-Out + Left-In Only

*From Crossover #51 at Stones Keep Lane to Crossover #66 at Vintage Lane, the existing median does not appear to have room to retrofit left-turn lanes on Route 11/460. Construction of turn lanes could require reconstruction of the subject intersection. A second alternative along this 4 mile section of Route 11/460 is to close all existing crossover locations and provide an adequate U-turn location on each end of the subject segment. In order to provide the two U-turn locations, Route 11/460 would need to be widened in two locations, as opposed to widening at the eight proposed locations where crossovers are recommended to be maintained.

5.2.4 Guardrail:

- **M4.** Upgrade the existing non-standard guardrail end treatments at the following locations. The existing end treatments can become a safety hazard at the following locations.
  - Westbound Route 11/460
    - Between Yale Drive and Pleasant Run Road (Photograph 5.24)
    - West of Dixie Caverns Entrance (Photograph 5.25)
    - West of WVWA Entrance (Photograph 5.26)
    - East of Green Hill Lane (Photograph 5.27)
  - Eastbound Route 11/460
    - East of the Sisson & Ryan Quarry (Photograph 5.28)
    - East of Alleghany Spring Road (Photograph 5.29)
    - East of Old Town Road (or Hale's Restaurant) (Photograph 5.30)
    - East of Dark Run Road (Photograph 5.31)
    - Between Dark Run Road and Graham Street (Photograph 5.32)
    - East of Crosier Road (Photograph 5.33)
    - Between Big Spring Drive and the bridge over the railroad tracks (Photograph 5.34)
    - East of Dow Hollow Road (Photograph 5.35)

Photograph 5.24 – Out of Compliance Guardrail End Treatment

Photograph 5.25 – Out of Compliance Guardrail End Treatment

Photograph 5.26 – Out of Compliance Guardrail End Treatment

Photograph 5.27 – Out of Compliance Guardrail End Treatment

Photograph 5.28 – Out of Compliance Guardrail End Treatment

Photograph 5.29 – Out of Compliance Guardrail End Treatment

Photograph 5.30 – Out of Compliance Guardrail End Treatment

Photograph 5.31 – Out of Compliance Guardrail End Treatment

Photograph 5.32 – Out of Compliance Guardrail End Treatment

Photograph 5.33 – Out of Compliance Guardrail End Treatment

Photograph 5.34 – Out of Compliance Guardrail End Treatment

Photograph 5.35 – Out of Compliance Guardrail End Treatment

- **M5.** Conduct routine maintenance to maintain a flush shoulder with Route 11/460 edges of pavement. Pavement-edge drop-offs along the corridor should not be more than two inches. Pavement-edge drop-offs can make it difficult for drivers to maintain steady control of their vehicles. Photograph 5.36 shows an example of a pavement-edge drop-off along the Route 11/460 corridor.

Photograph 5.36 – Edge Drop Off Along Route 11/460

5.2.5 Lighting:

- **M6.** Provide lighting at study area intersections and through the Villages of Shawsville and Elliston where power is not readily available.

5.2.6 Signing:

- **M7.** Upgrade all signs to meet current MUTCD standards.

5.2.7 Parking:

- **M8.** Provide a Park and Ride lot near the I-81/Dow Hollow Road (Exit 132) interchange
  - Per VDOT's website, there are no Park and Ride lots located within the study limits. However, there are two nearby Park and Ride lots in the vicinity of the study corridor. One is located at the intersection of Falling Branch Road and White Oak Lane in Christiansburg. This lot provides 55 parking spaces, two handicap spaces, and bus service (via Christiansburg's Go Anywhere Transit, Smart Way, and MegaBus), but does not provide lighting or an emergency phone service. The second lot is located at Exit 128 on I-81 at the intersection of Pedlar Road and North Fork Road in Montgomery County. This lot provides 40 parking spaces, one handicap space, and lighting, but does not provide bus service or a phone. A location should be identified to construct a Park and Ride lot near the Route 11/460 and Dow Hollow Road intersection. This lot should be provided to promote carpooling and provide for a potential future transit stop location. A parking demand study should be performed to determine the number of parking spaces to provide at the proposed Park and Ride lot.

5.2.8 Other:

- **M9.** Perform a speed study through Shawsville and Elliston. Angle crashes accounted for 41% of the crashes within Shawsville. Angle collisions are common in areas with a high density of access points and are typically more severe in nature. Deer crashes accounted for 33% and angle crashes accounted for 26% of the crashes within Elliston/Lafayette. Thirty percent of the crashes within the Elliston/Lafayette area resulted in an injury. A reduction in speed limit can help reduce the number of overall crashes and the severity of those that do occur.

- **M10.** Develop an incident management plan to evaluate how I-81 traffic is routed to Route 11/460 versus how emergency vehicles are routed to I-81. When I-81 is rerouted to Route 11/460 during incidents, Route 11/460 can become congested. Emergency vehicles can become stuck along the congested corridor and can become delayed arriving to the scene. The incident management plan should evaluate the impacts of the improved North Fork Road access should the intermodal facility come to fruition.

- **M11.** Construct a bicycle lane, sidewalk, and/or paved multi-use path, where feasible, within Shawsville and Elliston. Within Shawsville, pedestrian accommodations should be added to the Route 11/460 and Alleghany Spring Road intersection (i.e. pavement crosswalks, pedestrian actuated signal, pedestrian heads if traffic signal becomes warranted).

5.3 Long-Term Recommendations

5.3.1 Roadway Improvements:

- **L1.** Along the entire study corridor, widen the Route 11/460 travel lanes to 12 feet with accompanied shoulder widths ranging from ten feet to thirteen feet (total graded and paved). This recommendation should be coordinated with other projects and development along the Route 11/460 corridor.

  Within the four-lane divided sections of the study corridor, widen the shoulders to ten feet (total graded and paved) with the following paved and graded widths (13 feet should be provided in areas with guardrail):

  - Right shoulder: eight feet paved and two feet gravel
  - Left shoulder: four feet paved and six feet gravel

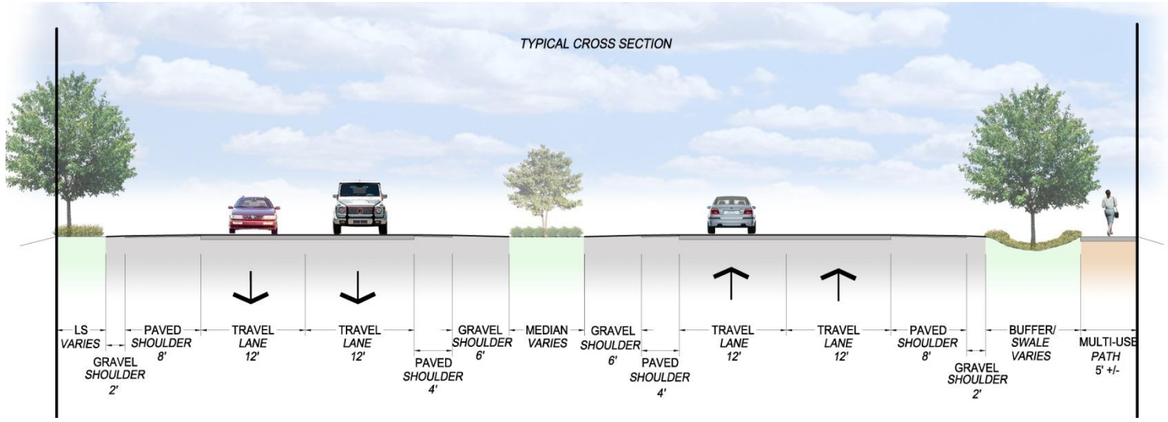
  The existing Route 11/460 divided cross section is shown in Photograph 5.37 and Photograph 5.38, the proposed Route 11/460 cross section is shown in **Figure 5.3**.

  Within the undivided sections of the study corridor, widen both sides of Route 11/460 ranging from 10 feet to 13 feet (total graded and paved). For sections that do not require guardrail, the proposed shoulder should include eight feet total paved shoulder with rumble strips and two feet of gravel shoulder. Where guardrail exists or is warranted, thirteen feet (total graded and paved) should be provided).

Photograph 5.37 – Route 11/460 Existing Cross Section

Photograph 5.38 – Route 11/460 Existing Cross Section

Figure 5.3 – Route 11/460 Proposed Cross Section



- **L2.** As identified in Section 2.4.6, VDOT is planning to improve North Fork Road (VDOT Project UPC 92558). The Route 603 (North Fork Road) – Elliston/Ironto Connector is a VDOT Six-Year Improvement Program (SYIP) project to improve safety and capacity. The reconstruction project includes two 12-foot travel lanes with 5-foot paved shoulders, 3-foot unpaved shoulders, and retaining walls. This project will enhance the Route 11/460 connection to Interstate 81 (Exit 128). Although this improvement will not directly impact the Route 11/460 corridor, the North Fork Road access to I-81 will be improved and become an attractive route to/from I-81. This improvement can potentially result in reduced traffic volumes on Route 11/460 as vehicles utilize North Fork Road (Exit 128) to get to/from I-81 as opposed to traveling to Exit 118 or Exit 132 via Route 11/460.
- **L3.** Clear zones are areas that are designed to be free of fixed objects or hazards (i.e. trees, sign supports, utility poles, light poles, etc) and available for safe recovery for out of control or errant vehicles. Based on a visual review of the corridor, the clear zone should be improved along the entire corridor.

5.3.2 Intersection Reconstruction/Sight Distance

- **L4.** Reduce the vertical curve grade west of the WVWA Entrance.
  - Sight distance left is approximately 550 feet (Photograph 5.39 and Photograph 5.40). This location does not meet the required intersection sight distance of 560 feet per the VDOT Road Design Manual. Based on a review of the latest three years of crash data, this intersection did not have any crashes, therefore, does not have a recurring crash pattern related to the sight distance restriction.

Photograph 5.39 – WVWA Northbound Approach – Sight Distance Left

Photograph 5.40 – Vertical Curve Crest at WVWA Entrance

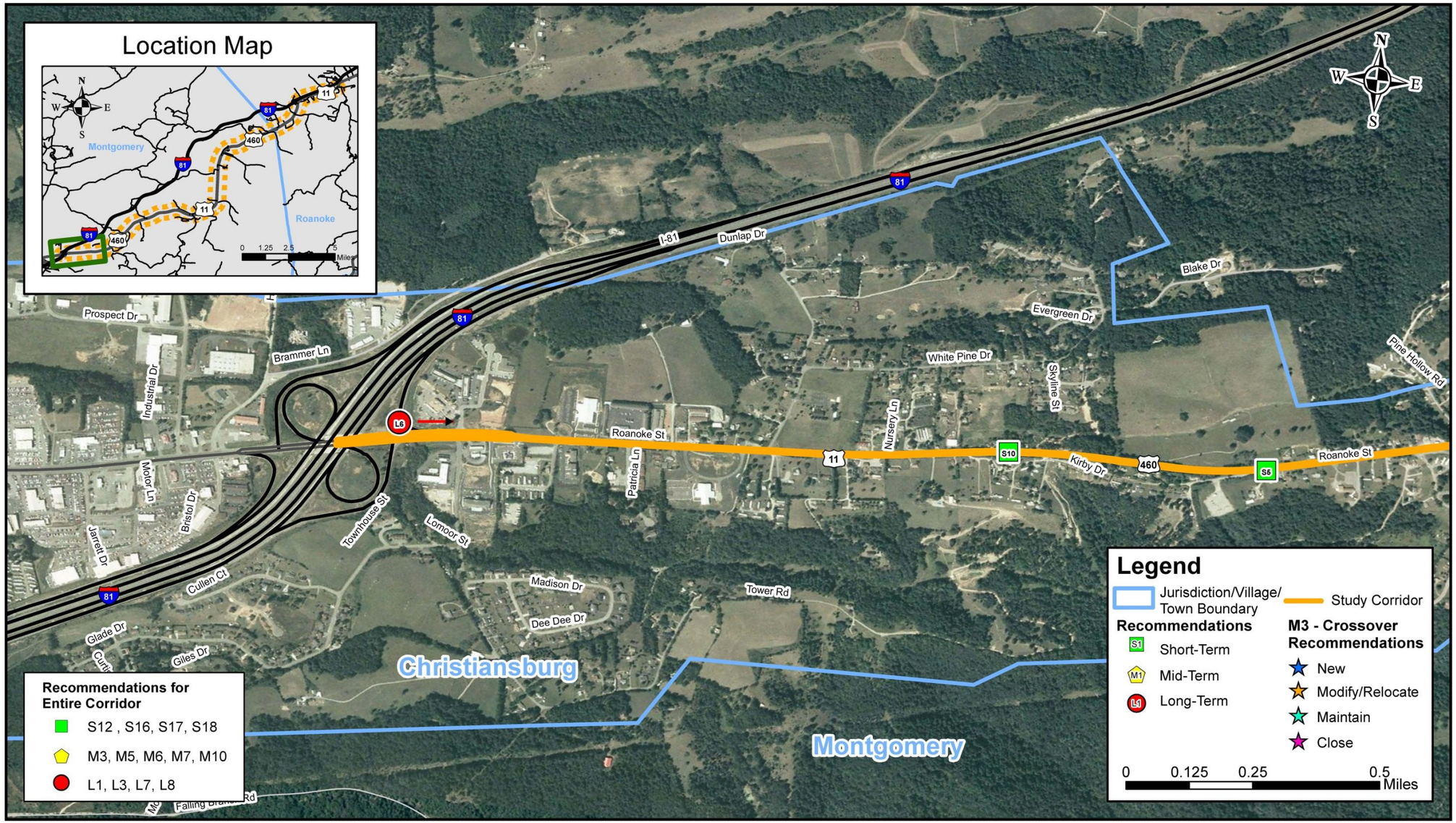
- **L5.** Add eastbound left-turn lane on Route 11/460 at Den Hill Road
  - Under the existing condition, signing is provided to restrict eastbound left-turn movements. An eastbound left-turn lane should be provided to allow vehicles to turn left at Den Hill Road. Based on a review of the latest three years of available crash data, the subject intersection had four crashes. Two crashes were rear-ends, one resulting in an injury, as vehicles stop in the single eastbound through lane to make a left-turn despite the signing restriction.

Photograph 5.41 – Eastbound Route 11/460 Approach to Den Hill Road – Left-Turn Sign Restriction

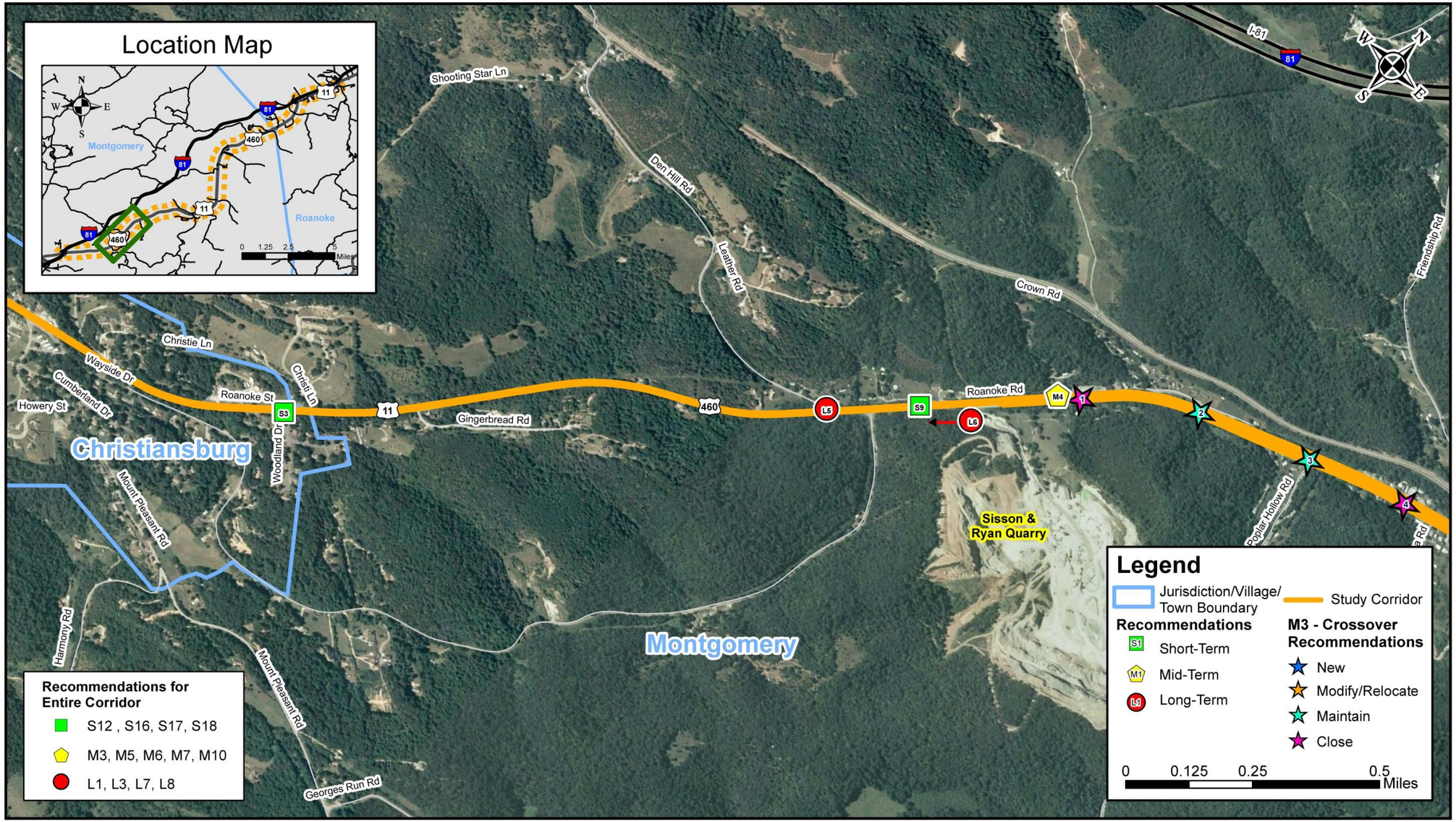
5.3.3 Other:

- **L6.** The existing three-lane section of Route 11/460 should be monitored for traffic growth and incremental improvements to determine if expansion to a four-lane facility is warranted. The Future 2035 Route 11/460 AADT volumes are projected to be approximately 10,000 VPD in the vicinity of the three-lane section. The projected 2035 AADT volume is within the range of what a typical three-lane road can accommodate.

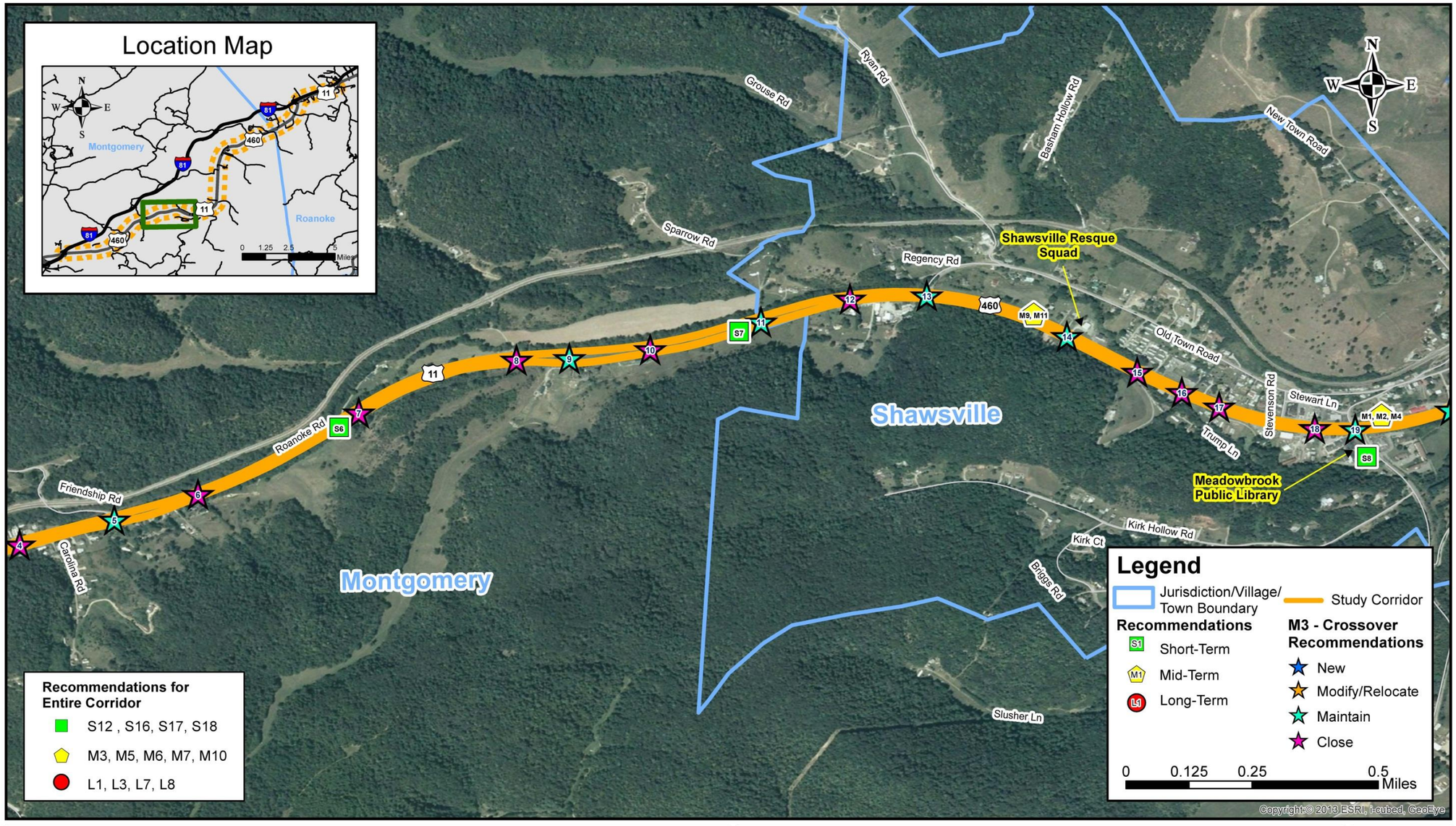
- **L7.** Following the North Fork Road improvements, ITS technologies should be considered to assist with I-81 incident management in order to direct traffic to the appropriate interchange with I-81.
- **L8.** Construct bicycle lane, sidewalk, and/or paved multi-use path, where feasible, along the Route 11/460 corridor and coordinate improvements with regional greenway plans. The focus of the bicycle and pedestrian improvements should be on connecting residential, commercial, and civic neighborhoods with each other and neighboring communities.



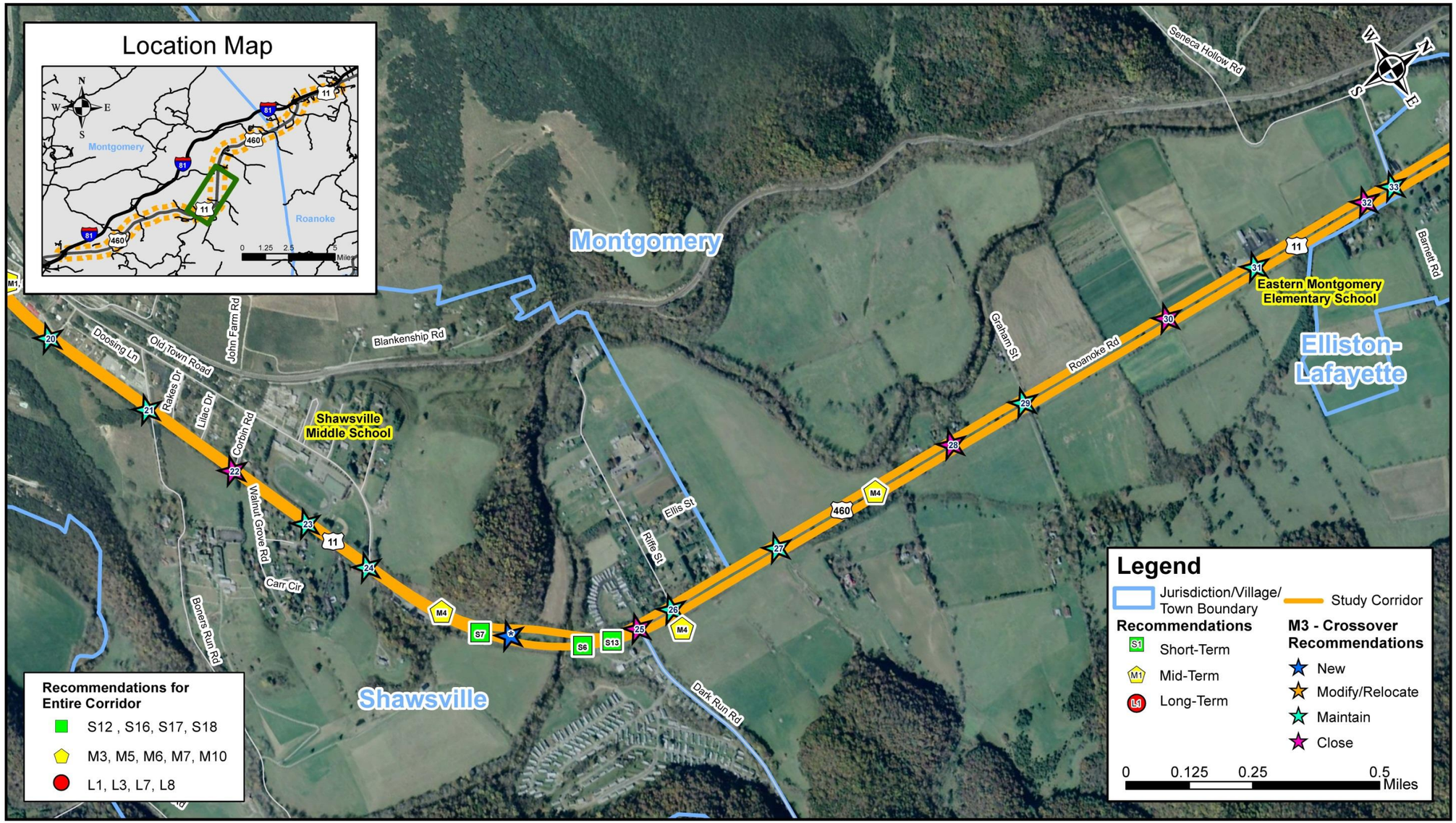
Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.4



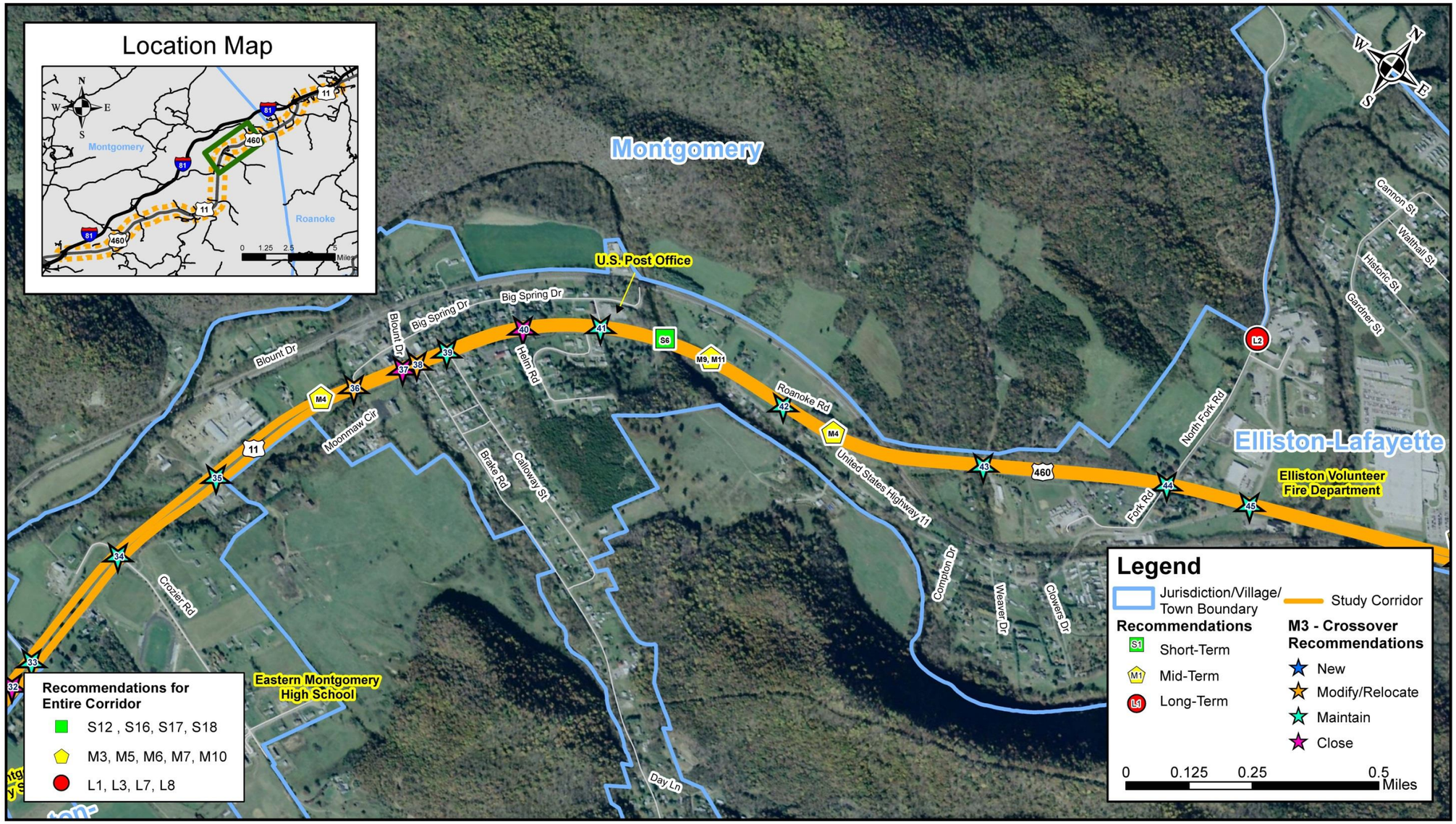
Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.5



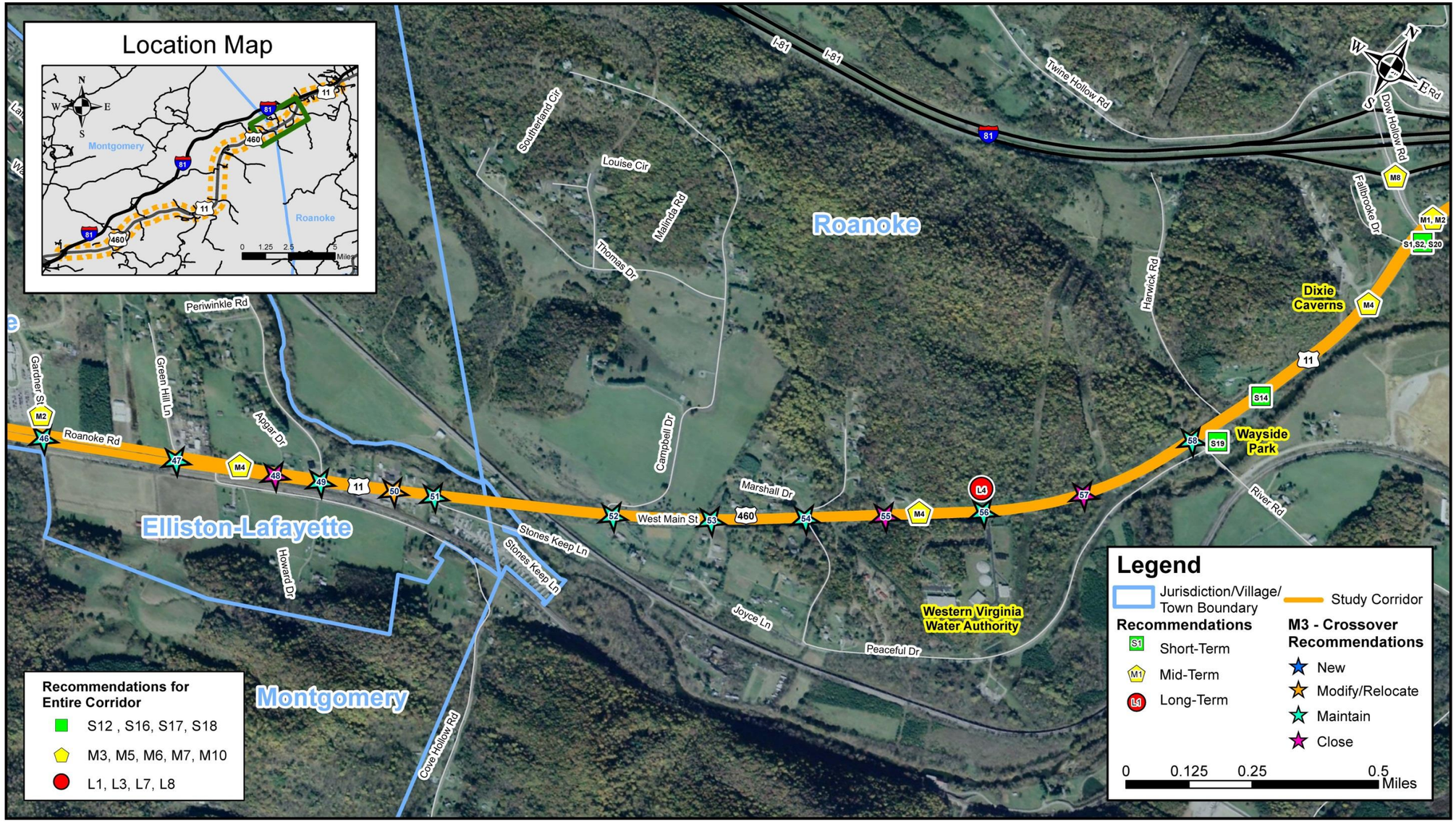
Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.6



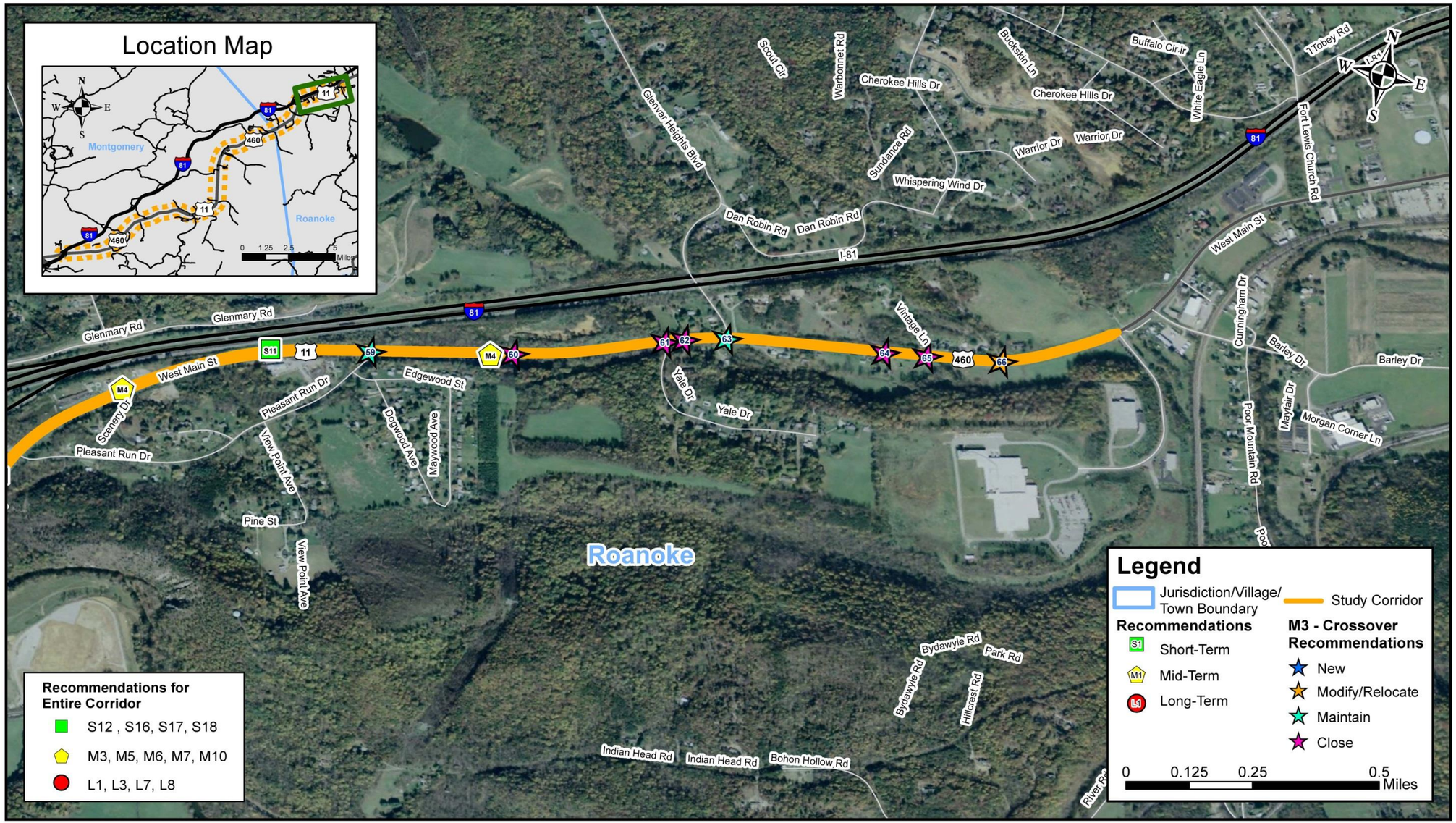
Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.7



Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.8



Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.9



Route 11/460 Corridor Study	Corridor Recommendations	Figure 5.10

6. PLANNING LEVEL COST ANALYSIS

6.1 Potential Funding Sources

There are a variety of potential funding sources, both private and public, that could potentially be used to further plan, design, and construct the improvements identified in Chapter 5. Some of these funding sources may apply only to specific improvements while others may apply to a broader range of improvements. The following represents some of the key potential funding sources.

- National Highway Performance Program (NHPP) for roadways and bridges
- Surface Transportation Program (STP) Funds and Regional Surface Transportation (RSTP) Funds for road improvements; and pedestrian, bicycle, and transit improvements
- Highway Safety Improvement Program (HSIP) Funds for spot or systemic safety improvements
- Transportation Alternatives (TA) Funds for roadway, pedestrian, bicycle, SRTS and transit improvements
- State maintenance funds –guardrail, signing, pavement overlays and other maintenance activities
- Revenue Sharing Funds for roadway improvements
- Economic Development Access (EDA) Funds for road improvements to provide adequate access for new or expanding establishments
- Primary Funds for roadway improvements
- Private Funds as development occurs along the Route 11/460 study corridor

Funding limits vary for each of the aforementioned funding sources. The improvements identified herein can be separated into smaller projects for funding purposes.

6.2 Planning Level Costs

Table 6.1 shows an associated timeframe for implementation (short, mid, long), an estimated planning level cost, and lead agency(s) for each proposed recommendation contained in Chapter 5. Right-of-way impacts associated with each proposed recommendation can significantly alter the timeframe for implementation and estimated planning level cost. The provided planning level costs are preliminary and not based on design.

Table 6.1 – Route 11/460 Proposed Recommendation Matrix

ID	Proposed Recommendation	Issue	Approximate Construction Costs (2013 Dollars)*	Lead Agency(s)
	Short-Term Recommendations (6-12 months)			
S1	Cut back vegetation at Dow Hollow Road to improve sight distance	Sight distance and meet VDOT standards	$2,000 - $4,000	VDOT
S2	Signing and striping improvements at Dow Hollow Rd/Route 11/460 intersection	Sight distance, traffic operations; driver confusion, and safety	$10,000 - $15,000	VDOT
S3	Upgrade and install additional signs for lane drop on westbound Route 11/460 near the Town of Christiansburg (west end of corridor)	Driver confusion and meet VDOT standards	$2,000 - $4,000	VDOT
S4	Not Used	N/A	N/A	N/A
S5	Install curve warning sign on westbound Route 11/460 in advance of Kirby Drive	Safety and driver confusion	$1,000 - $3,000	VDOT
S6	Install missing object markers at three narrow road locations along eastbound Route 11/460	Safety	$5,000 - $7,000	VDOT
S7	Upgrade four out of date reduced speed limit ahead signs	Meet VDOT standards	$3,000 - $4,000	VDOT
S8	Add distance plaque to cross road signs on eastbound and westbound Route 11/460 in advance of Alleghany Spring Road, install additional sign in median to dual indicate	Safety	$1,000 - $3,000	VDOT
S9	Replace “Trucks Keep Right Do Not Pass” signs on westbound Route 11/460 with updated signs	Meet VDOT standards	$2,000 - $4,000	VDOT
S10	Replace leaning “Watch For Turning Vehicles” sign on eastbound Route 11/460 west of Kirby Drive	Maintenance	$1,000 - $2,000	VDOT
S11	Replace leaning divided highway and “Keep Right” signs on eastbound Route 11/460 west of Pleasant Run Road	Maintenance	$1,000 - $2,000	VDOT
S12	Replace all school bus stop ahead signs to the current version	Meet VDOT standards	$2,000 - $4,000	VDOT
S13	Replace school plaque with current version on school speed limit sign on eastbound Route 11/460 west of Dark Run Road	Meet VDOT standards	$1,000 - $2,000	VDOT
S14	Replace the faded “Watch For Turning Vehicles” and intersection warning sign on westbound Route 11/460 approach to West River Road and trim back vegetation to improve visibility	Maintenance	$2,000 - $4,000	VDOT
S15	Not Used	N/A	N/A	N/A
S16	Provide lighting at study area intersections and through the Villages of Shawsville and Elliston if power is readily available	Safety	$1,000,000 - $2,000,000 (if power is available at all locations)	VDOT
S17	Continually improve access/reduce number of driveways as redevelopment occurs	Access management, safety, and meet VDOT standards	Performed through site development/redevelopment (private funds)	VDOT/Montgomery Co/Roanoke Co
S18	Positively define access by reducing wide throat widths at existing access points.	Access management, safety, and meet VDOT standards	$50,000 - $80,000 per access point	VDOT/Montgomery Co/Roanoke Co
S19	Relocate the existing gas station entrance on the south side of Route 11/460 to West River Road, south of Route 11/460 to improve intersection spacing	Access management, safety, and meet VDOT standards	Performed through site development/redevelopment (private funds)	VDOT/Roanoke Co
S20	Replace the damaged guardrail on the northwest corner of the Route 11/460 and Dow Hollow Road intersection	Maintenance	$5,000 - $7,000	VDOT

ID	Proposed Recommendation	Issue	Approximate Construction Costs (2013 Dollars)*	Lead Agency(s)
	Mid-Term Recommendations (1-5+ years)			
M1	Conduct traffic signal warrant analysis at Alleghany Spring Road and Dow Hollow Road, install traffic signal if justified	Traffic operations	$15,000 - $25,000 for traffic signal warrant analysis $200,000 - $300,000 for traffic signal	VDOT
M2	Construct/extend right- and left-turn lanes at identified locations	Traffic operations, safety, and crash reduction	$1,750,000 - $2,250,000 for Right- and Left-Turn Pair $1,400,000 - $1,800,000 for Left-Turn Lane	VDOT
M3	Maintain, close, relocate, and modify crossovers at identified locations	Traffic operations, safety, crash reduction, meet VDOT standards	$1,500,000 - $2,500,000 for new crossover $200,000 - $300,000 for modified crossover $40,000 - $60,000 to close crossover	VDOT
M4	Upgrade the existing non-standard guardrail end treatments at identified locations	Safety and meet VDOT standards	$5,000 - $7,000 per location	VDOT
M5	Conduct routine maintenance to maintain a flush shoulder with the Route 11/460 edges of pavement	Traffic operations, safety, and crash reduction	$50,000 - $75,000	VDOT
M6	Provide lighting at study area intersections and through the Villages of Shawsville and Elliston where power is not readily available	Safety	$4,000,000 - $6,000,000 (if power is not available at all locations)	VDOT
M7	Upgrade all signing to meet current MUTCD standards	Meet VDOT standards	$25,000 - $50,000	VDOT
M8	Provide Park and Ride lot at I-81 Exit 132	Provide additional Park and Ride location to promote carpooling and provide for potential future transit stop location	$10,000 - $15,000 per space	VDOT
M9	Perform a speed study through Shawsville and Elliston	Traffic operations and safety	$15,000 - $30,000	VDOT/Montgomery County
M10	Develop an incident management plan for I-81	Traffic operations and reduce emergency vehicle response time	$15,000 - $30,000	VDOT/Montgomery County
M11	Construct bicycle/pedestrian improvements within Shawsville and Elliston	Limited existing bicycle/pedestrian accommodations in the vicinity of villages	$3,000,000 - $4,000,000 for multi-use path $1,500,000 - $2,500,000 for bike lanes	VDOT/Montgomery County

ID	Proposed Recommendation	Issue	Approximate Construction Costs (2013 Dollars)*	Lead Agency(s)
	Long-Term Recommendations (5-20+ years)			
L1	Widen travel lanes to 12 feet with accompanied shoulder widths ranging from 10 to 13 feet and rumble strips along entire length of Route 11/460 study corridor	Traffic operations, safety, crash reduction, and meet VDOT standards	$30,000,000 - $40,000,000	VDOT
L2	Construct VDOT's planned project to improve North Fork Road (VDOT Project UPC 92558)	Traffic operations, safety, crash reduction, and meet VDOT standards	$20,000,000 (Funded)	VDOT
L3	Improve clear zone along Route 11/460	Safety	$75,000 - $100,000	VDOT
L4	Intersection reconstruction – WVWA Entrance • Reduce the vertical curve grade just west of WVWA Entrance	Sight distance, safety, and meet VDOT standard	$1,000,000 - $1,500,000	VDOT
L5	Intersection reconstruction – Den Hill Road • Construct eastbound left-turn lane	Safety and traffic operations	$1,400,000 - $1,800,000	VDOT
L6	Monitor traffic growth and incremental improvements to determine if expansion of existing 3-lane section to a 4-lane facility is warranted	Traffic operations	$150,000 - $250,000 for further study to determine needs of the corridor, develop alignments, etc.	VDOT
L7	Following the North Fork Road improvements, ITS technologies should be considered to assist with I-81 incident management in order to direct traffic to the appropriate interchange with I-81	Traffic operations and incident management	Varies based on ITS solutions	VDOT
L8	Construct bicycle lane, sidewalk, and/or paved multi-use path, where feasible, along the Route 11/460 corridor and coordinate improvements with regional greenway plans	Bicycle/Pedestrian	$5,000,000 - $8,000,000 for 5 ft sidewalk $15,000,000 - $25,000,000 for 10 ft shared use path off road $12,000,000 - $17,000,000 for bike lanes (4 ft pavement on both sides)	VDOT/Montgomery Co/Roanoke Co

*Approximate construction costs do not include PE, ROW, utility relocations, construction admin or inspection, etc. and are preliminary and not based on design

7. PUBLIC INVOLVEMENT

An important component of the Route 11/460 Corridor Study planning process was the involvement of the public. Over the duration of the study, two citizen workshops were held. A variety of stakeholders, including residents, property owners, business owners, employees, and commuters in the Route 11/460 study area, participated in these workshops. The objectives of the citizen workshops were the following:

- To inform and educate the public about the study, its objectives, and its outcomes.
- To encourage and gather input and feedback in a formal setting from the public regarding the issues to be studied, the recommend improvements considered, and the future vision for the corridor.

Techniques used to educate and obtain input from the public at the citizen information meetings included presentations, questionnaires, comment stations, and mapping exercises. The public involvement activities were established to allow the public to identify the following items:

- General corridor conditions
- Areas of congestion and safety concerns
- Desired locations for bicycle and pedestrian improvements
- Concerns for the future of the corridor
- Desired corridor improvements

Results from the public involvement process are included in the **Appendix**.

The following two citizen information meetings were conducted to obtain feedback and engage the public in the Route 11/460 planning process:

- Citizen Information Meeting #1: Project Introduction and Existing Conditions –January 22, 2013
    - Approximately 50 individuals attended the first meeting held at the Elliston Volunteer Fire Department in Montgomery County, Virginia.
    - The goal of this meeting was to gain public feedback on general corridor conditions, areas of congestion and safety concerns, desired locations for bicycle and pedestrian improvements, and concerns for the future of the corridor.
- Citizen Information Meeting #2: Review of Corridor Recommendations – April 10, 2013
    - Approximately 20 individuals attended the second meeting held at the Elliston Volunteer Fire Department in Montgomery County, Virginia.
    - The goal of this meeting was to inform the public of the proposed recommended improvements along the corridor, gain feedback on those recommended improvements, and identify additional improvements for the study corridor.

7.1 Summary of Public Feedback from Citizen Information Meeting #1

The first meeting was held in Montgomery County, Virginia at the Elliston Volunteer Fire Department on January 22, 2013, and was attended by approximately 50 individuals. This meeting was designed to introduce the project to the public, explain the study process, and collect comments and input from the public regarding existing conditions and areas for improvement. The public was offered several methods in which feedback could be provided, which included Aerial Boards, Question Boards, Questionnaire, and general conversation with project team members at the meeting. These methods are explained in detailed in the following sections.

7.1.1 Aerial Boards

At the workshop, display boards containing aerial maps of the study corridor were set up to allow the public to pinpoint locations of congestion and safety concerns, as well as locations of desired bicycle and pedestrian improvements. Meeting attendees were supplied with yellow and blue dots and asked to place yellow dots on the map in locations with perceived safety or congestion issues and the blue dots in locations of desired bicycle and pedestrian improvements. As shown in **Figure 7.1** and **Figure 7.2**, the results of this exercise were plotted on aerial maps using a geographic information system (GIS) spatial analyst tool (kernel density) to identify locations with a high density of dots.

The following areas were identified as main areas of congestion and safety concerns along the Route 11/460 study corridor:

- Den Hill Road/Wayside Drive
- Crown Road
- Alleghany Spring Road
- Walnut Grove Road
- Eastern Montgomery Elementary School
- North Fork Road
- Dow Hollow Road

The following areas were identified as desired bicycle and pedestrian improvement locations along the Route 11/460 study corridor.

- I-81 Exit 118
- Sisson and Ryan Quarry
- Alleghany Spring Road
- Eastern Montgomery Elementary School

Figure 7.1 – Areas of Congestion and Safety Concerns (1 of 4)

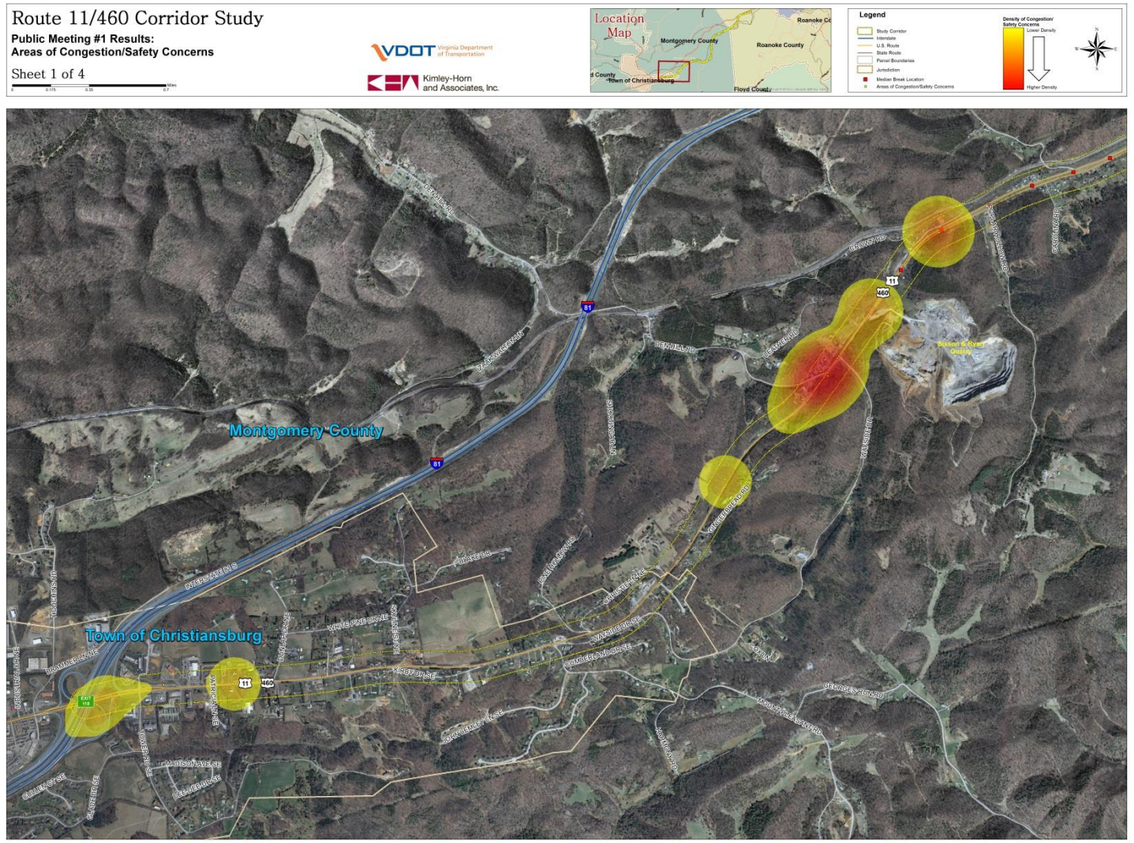


Figure 7.1 (cont.) – Areas of Congestion and Safety Concerns (2 of 4)

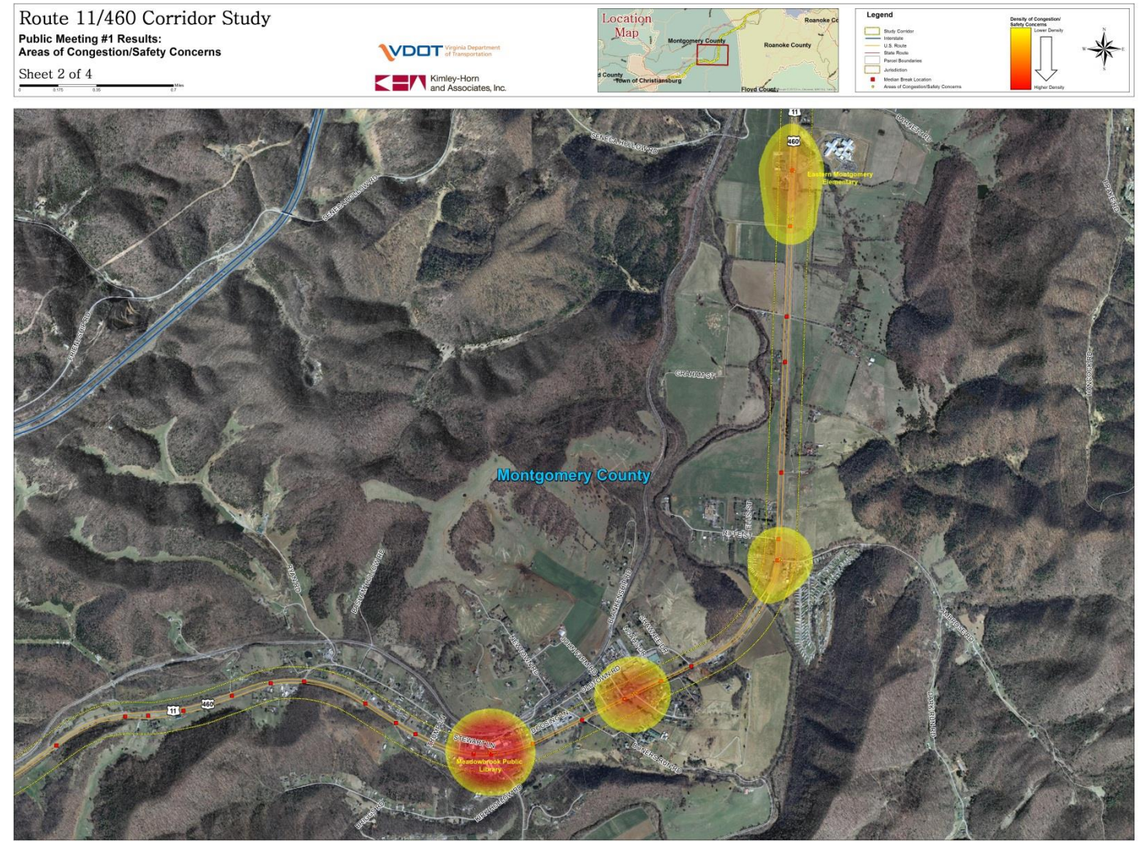


Figure 7.1 (cont.) – Areas of Congestion and Safety Concerns (3 of 4)

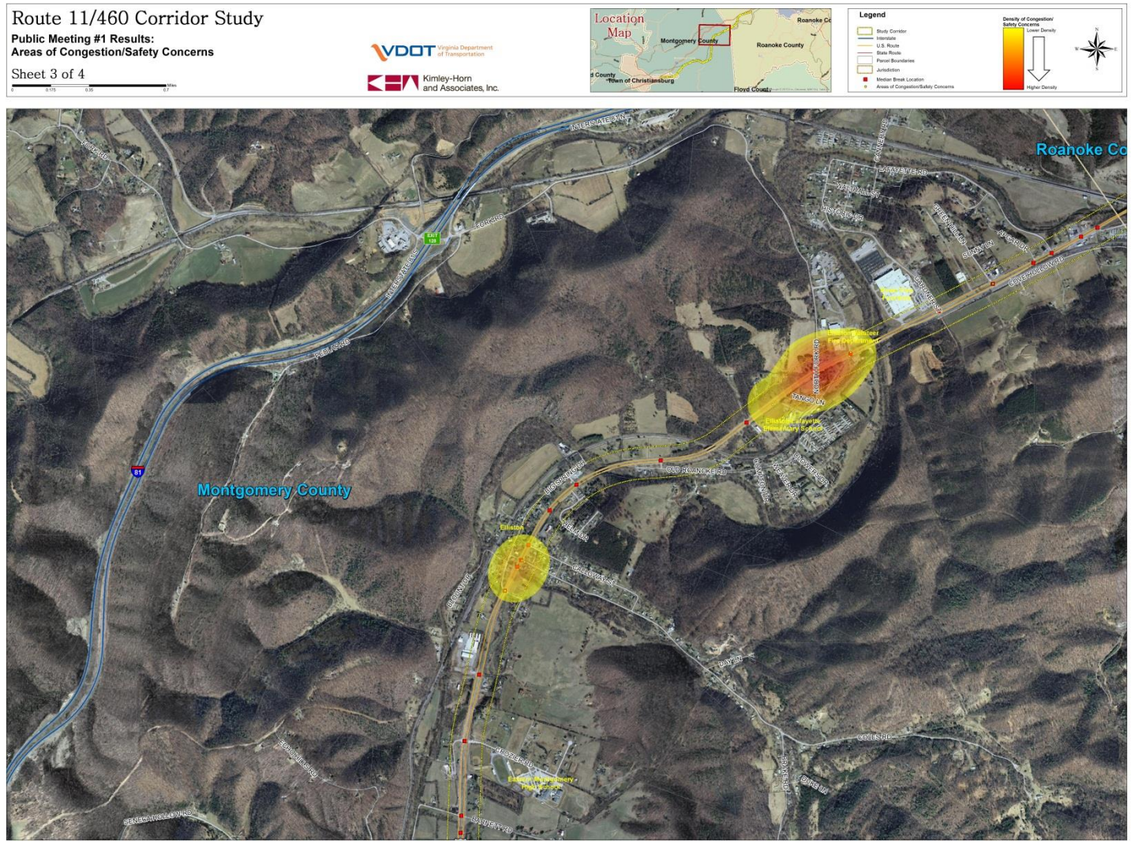


Figure 7.1 (cont.) – Areas of Congestion and Safety Concerns (4 of 4)

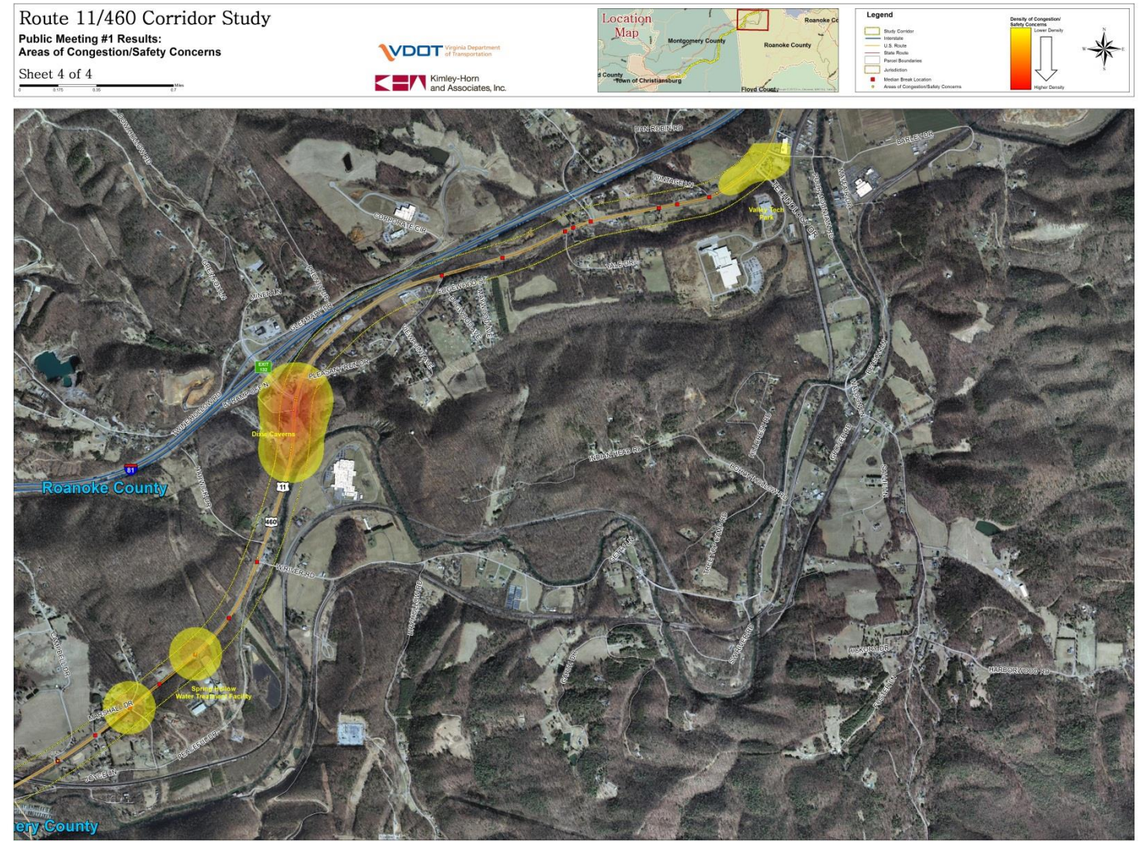


Figure 7.2 – Areas of Desired Bicycle and Pedestrian Improvements (1 of 4)

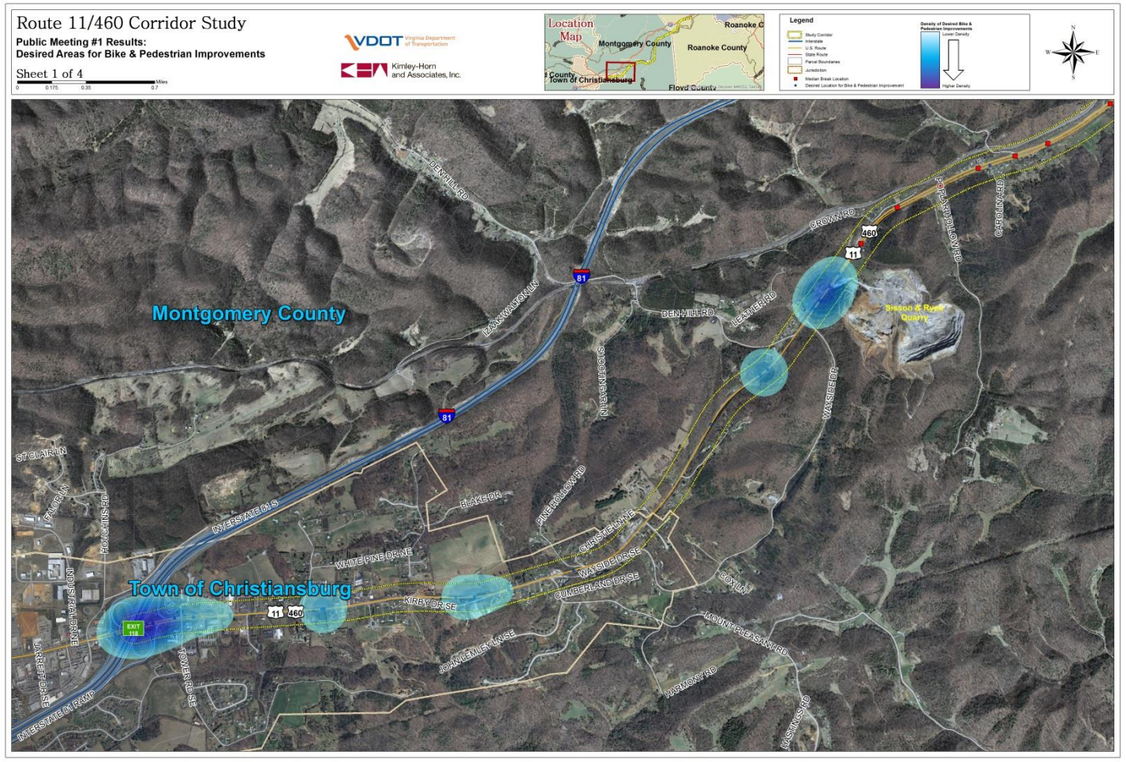


Figure 7.2 (cont.) – Areas of Desired Bicycle and Pedestrian Improvements (2 of 4)

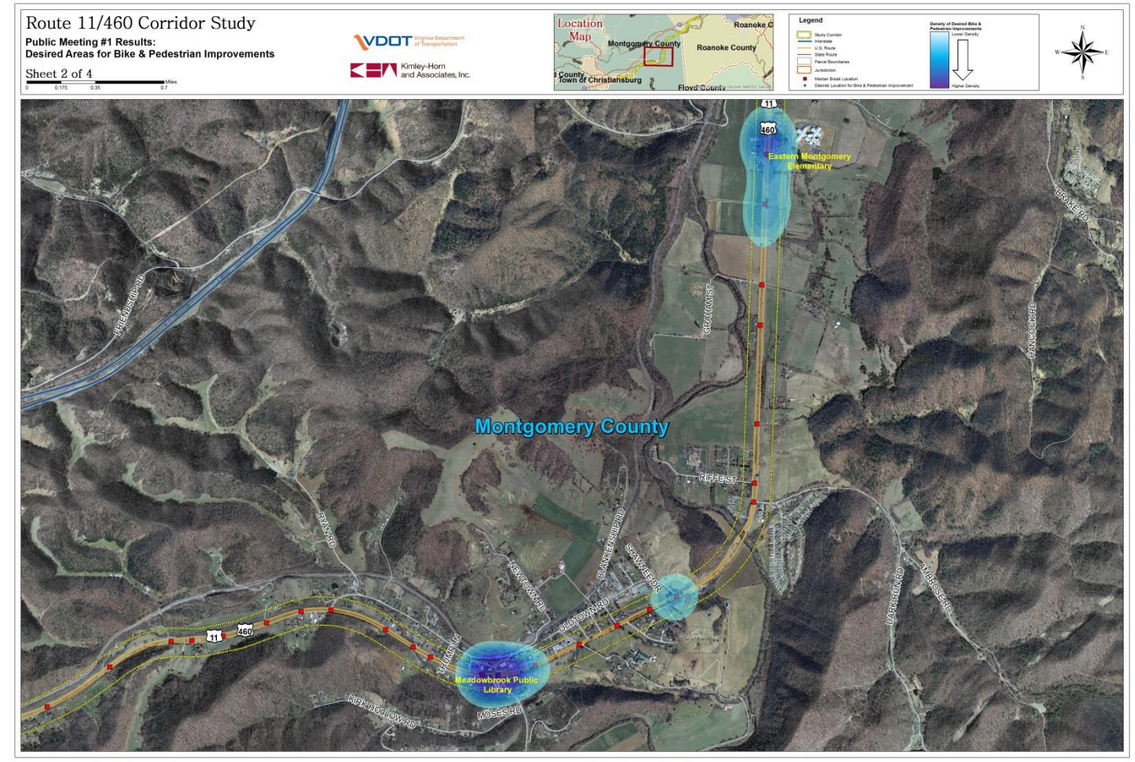


Figure 7.2 (cont.) – Areas of Desired Bicycle and Pedestrian Improvements (3 of 4)

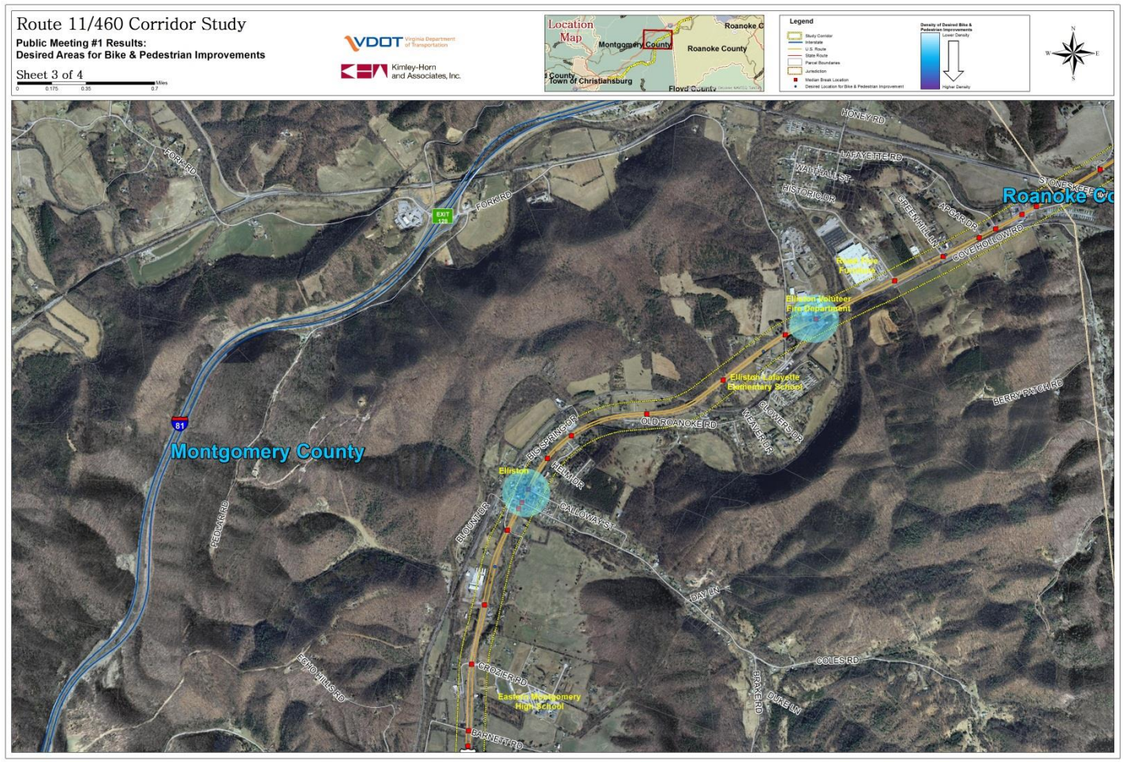
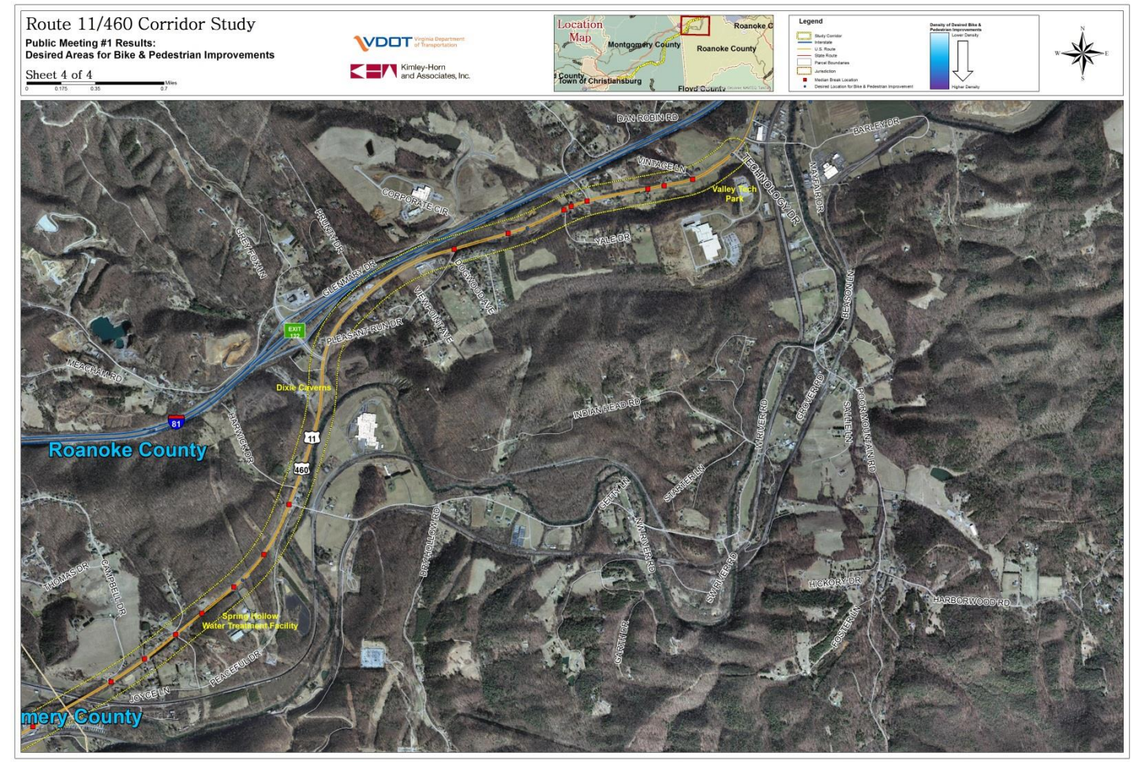


Figure 7.2 (cont.) – Areas of Desired Bicycle and Pedestrian Improvements (4 of 4)



7.1.2 Question Boards

In addition, display boards containing questions were used to obtain feedback on corridor-wide concerns. Meeting attendees were asked to answer the questions on sticky notes and place their responses on the display boards. The four questions are listed below along with a summary of the responses. All question board responses are provided in the **Appendix**.

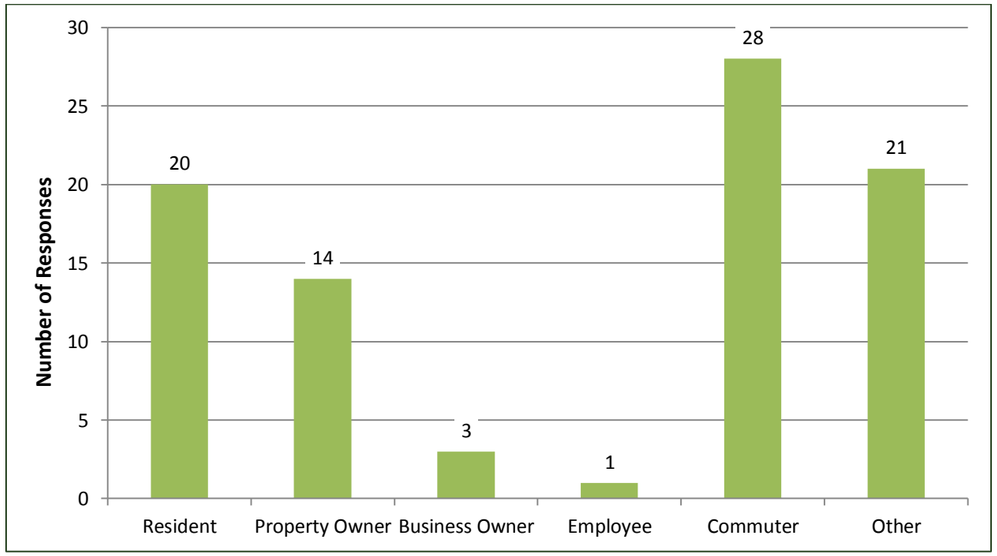
1. What is the primary traffic issue(s) on the corridor that concern you?
    - High traffic volumes when vehicles are detoured onto Route 11/460 from I-81
    - Lack of shoulders
    - Lack of turn lanes (Den Hill Road, Sisson & Ryan Quarry, Alleghany Spring Road, Newtown Road)
    - Lack of traffic signals (near schools, Alleghany Spring Road, Dow Hollow Road)
    - High speeds
    - Poor sight distance
    - Unsafe U-turns
    - Access for emergency vehicles at Elliston Fire Station and Shawsville Rescue Squad during congestion
    - Den Hill Road intersection improvements needed (grade, approach angle, sight distance)
2. If you could change some things along the corridor, what would it be in priority order?
    - Add turn lanes
    - Install, improve, and/or maintain shoulders
    - Reduce speed limit
    - Limit the number of access points
    - Limit truck/I-81 traffic
    - Forced traffic control/interruption at Elliston Fire Station and at Shawsville Rescue Squad during emergency events
    - Improve Den Hill Road intersection and allow entrance from both directions
3. What is your greatest concern for the future of the corridor?
    - Impacts to the corridor from the future Norfolk Southern intermodal facility
    - Too much development
    - High speeds and lack of patrol
    - Lack of maintenance
    - Truck/I-81 traffic
    - Alleghany Spring Road – traffic light or pedestrian crossing with flashing lights
4. Where and what type of pedestrian or bicycle improvements are needed in the corridor?
    - Connection to existing bicycle routes (i.e. Roanoke Valley, New River Valley, Roanoke River Greenway, Greenhill Park)
    - Striped bicycle lanes or wide shoulders
    - Share the road signs
    - Sidewalks near Alleghany Spring Road
    - Bike/River/Walkway for Lafayette, Elliston, and Shawsville

7.1.3 Questionnaire

Meeting attendees also received a questionnaire, a copy of which is included in the **Appendix**, with questions to answer about their experiences in the corridor with respect to traffic, safety, pedestrian issues, bicycle issues, and overall character of the corridor. Attendees were also encouraged to take extra copies of the questionnaire to community members who were unable to attend the meeting. Questionnaires could be dropped in a comment box provided at the meeting or mailed to the address provided on the form by February 19, 2013. Fifty questionnaire responses were received from the public. This survey should not be considered a random sample of the public opinion; therefore, no statistical significance can be concluded from the results. However, the survey does reflect opinions and responses from interested citizens in the area.

A summary of the interest of the respondents is shown in **Figure 7.3**. Individuals with multiple interests in the corridor were encouraged to select multiple categories. The largest number of individuals (28) classified themselves as commuters through the corridor, followed by other interest (21), and residents in the corridor (20).

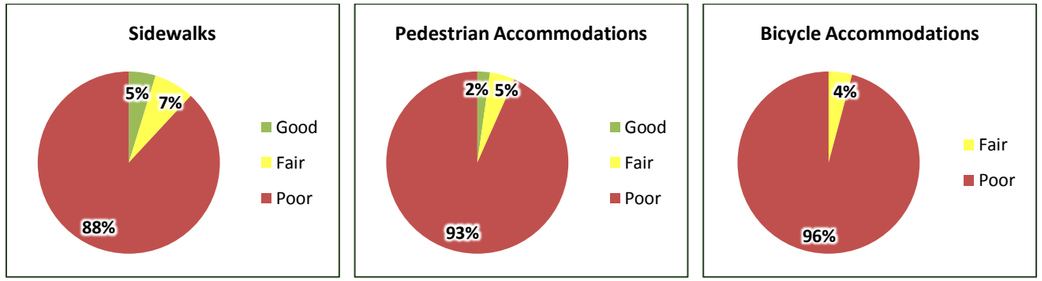
Figure 7.3 – Questionnaire Respondents Interest in the Corridor



Respondents were asked to categorize general corridor conditions, which included condition of streets, signage and wayfinding, lighting, sidewalks, access, traffic flow, pedestrian accommodations, bicycle accommodations, safety, landscaping, and overall appearance, as excellent, good, fair, or poor.

- Four categories were rated by 50% or more of respondents as either excellent or good. These categories with positive ratings were condition of streets (5% excellent, 66% good), signage and wayfinding (0% excellent, 65% good), traffic flow (10% excellent, 55% good), and overall appearance (5% excellent, 45% good).
- Three categories were rated by over 85% of respondents as poor. These categories were related to corridor use by pedestrians and bicyclists as shown in Figure 7.4. When asked what type of pedestrian facility respondents would prefer along the corridor, the largest number of individuals (37) responded with paved multi-use path, followed by sidewalks on both sides of the street (15) and improved crossover markings (14). When asked what type of bicycle facility respondents would prefer along the corridor, the largest number of individuals (37) responded with paved multi-use path, followed by striped bike lanes (29).

Figure 7.4 – Condition of Sidewalks, Pedestrian Accommodations, and Bicycle Accommodations



- As shown in **Figure 7.5**, corridor safety was rated as either poor or fair by 76% of individuals. Respondents indicated that the entire Route 11/460 corridor presents a safety concern to vehicular traffic. The safety concerns along Route 11/460 were given as drop-offs at the edge of pavement, high vehicle speeds, truck traffic, crossovers, lack of turn lanes, lack of shoulders, and poor sight distance. Respondents also indicated that the entire corridor presents a safety concern to pedestrian and bicycle traffic. Lack of sidewalks, lack of shoulders, narrow roads, high vehicle speeds, and no designated bike lanes were listed as reasons for this concern.

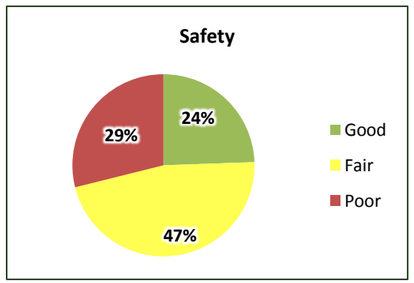


Figure 7.5 – Condition of Corridor Safety

Questionnaire respondents were also asked to indicate the type of improvement they wanted to see along the Route 11/460 corridor as well as their greatest concern for the future of the corridor. Individuals were permitted to select more than one improvement and/or concern when answering these questions. The results of these questions are shown in **Figure 7.6** and **Figure 7.7** respectively.

Figure 7.6 – Desired Improvements along the Corridor

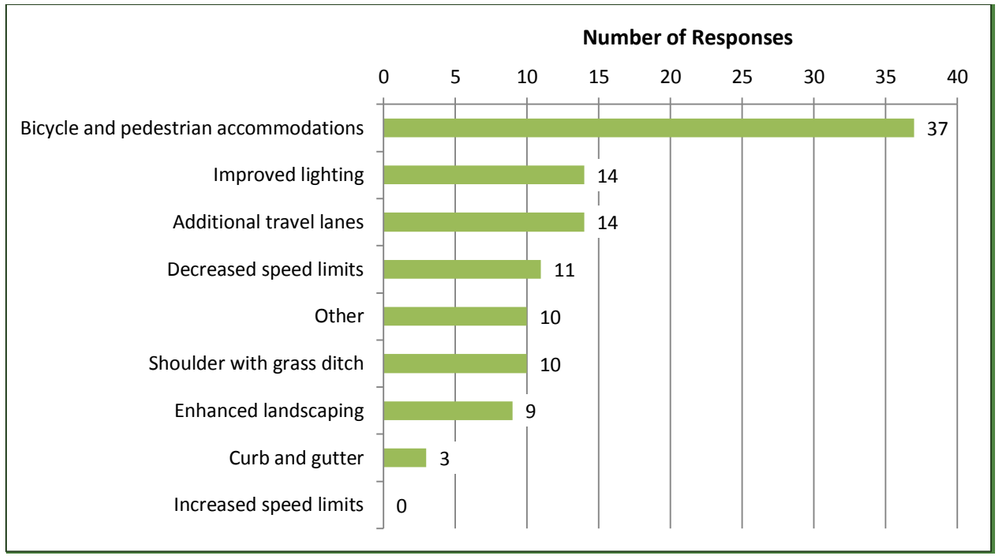
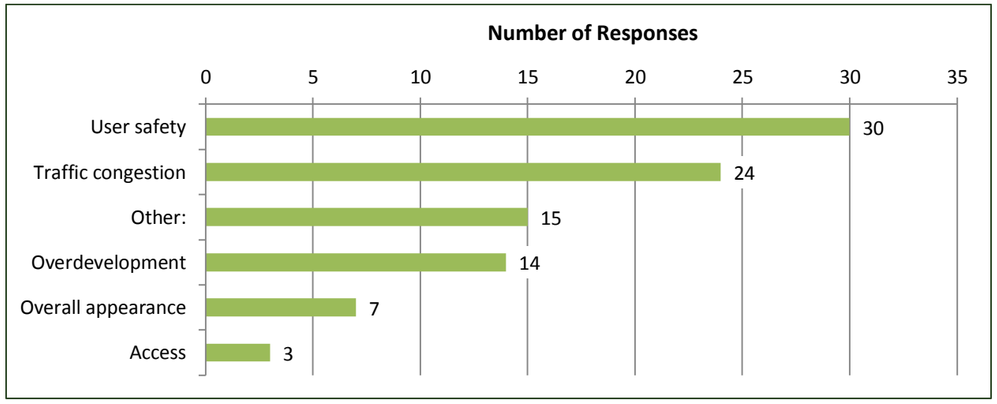


Figure 7.7 – Greatest Concern for the Future of the Corridor



Input from the questionnaires was carefully reviewed and analyzed. Information received helped the study team to validate empirical results with public feedback of operations and safety in the corridor. A summary of the results from each question in the questionnaire is provided in the **Appendix**.

7.2 Summary of Public Feedback from Citizen Information Meeting #2

The second meeting was held in Montgomery County, Virginia at Elliston Volunteer Fire Department on April 10, 2013, and was attended by approximately 20 individuals. This meeting was designed to review the results of the first meeting, explain the proposed short-, mid-, and long-term corridor recommendations, and to collect comments and input from the public on the proposed recommendations. The public was offered several methods in which feedback could be provided, which included a Questionnaire, Aerial Boards and general comments with project team members at the meeting. These methods are explained in detail in the following sections.

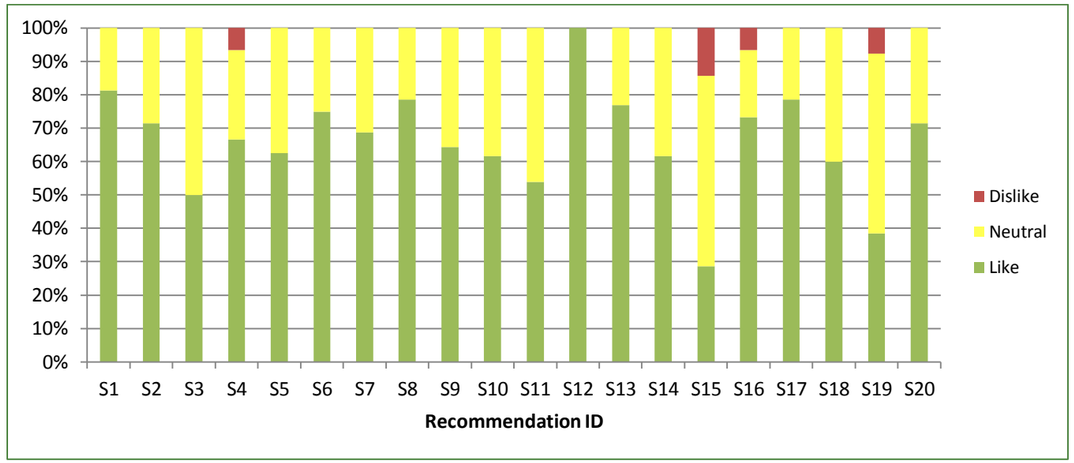
7.2.1 Questionnaire

Meeting attendees received a questionnaire, a copy of which is included in the **Appendix**, which listed each proposed short, mid, and long-term recommendation. For each recommendation, individuals were asked to select "like", "neutral", or "dislike" based on their opinion of the recommendation. In addition, space was provided on the questionnaire to provide any additional comments on each recommendation as well as additional recommendations. Questionnaires could be dropped in a comment box provided at the meeting.

Seventeen questionnaire responses were received from the public. This survey should not be considered a random sample of the public opinion; therefore, no statistical significance can be concluded from the results. However, the survey does reflect opinions and responses from interested citizens in the area. A summary of the questionnaire results is provided below and the complete results are provided in the **Appendix**.

The public opinion of the proposed short-term recommendations is shown in **Figure 7.8**. All of the short-term recommendations received a combination of "like" and "neutral" ratings by over 85% of the respondents. The proposed recommendation to replace all school bus stop ahead signs to the current version (S12) received a rating of "like" by 100% of respondents. The proposed short-term recommendation with the lowest percentage of "like" ratings (29%) and highest percentage of dislike ratings (14%) was the recommendation to consider removing the deer warning sign on eastbound 11/460 east of Glenvar Heights Boulevard (S15). As a result, the S15 recommendation has been removed from consideration.

Figure 7.8 – Public Opinion of Proposed Short-Term Recommendations



The public opinion of the proposed mid-term recommendations is shown in **Figure 7.9**. Six of the mid-term recommendations received zero "dislike" ratings. These recommendations were constructing turn lanes (M2), maintaining, closing, relocating, and modifying crossovers (M3), conducting routine shoulder maintenance (M5), providing lighting throughout the study corridor in locations where power is not readily available (M6), upgrading signs to comply with MUTCD standards (M7), and developing an incident management plan for I-81 (M10). Through conversation at the meeting, the recommendation to maintain, close, relocate, and modify crossovers (M3) was discussed, specifically the intersection of Route 11/460 and Walnut Grove Road. The subject intersection does not currently have a crossover and is a right-in/right-out access. A crossover is not recommended at this location and the existing crossover immediately west at Corbin Road is proposed to be closed. The nearby crossovers located at Old Town Road (to the east) and Boners Run Road (to the west) are proposed to be improved with eastbound and westbound left-turn lanes and should be used by vehicles destined to/from Walnut Grove Road and Corbin Road to make U-turns. The mid-term recommendation with the highest percentage of "dislike" ratings (25%) was to install traffic signals at Alleghany Spring Road and Dow Hollow Road if justified (M1).

Figure 7.9 – Public Opinion of Proposed Mid-Term Recommendations

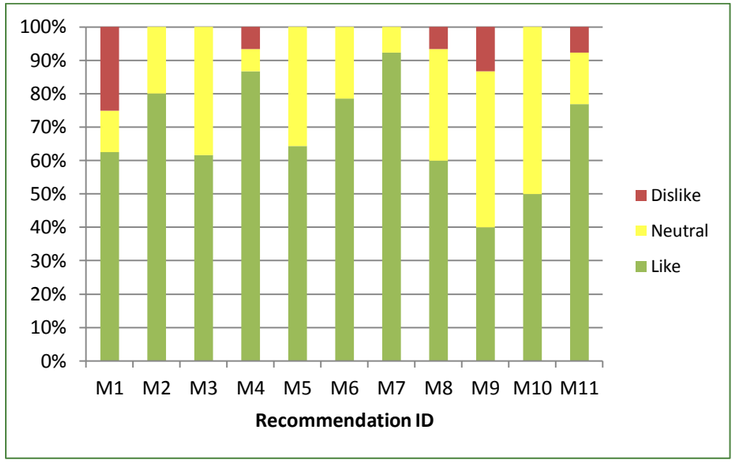
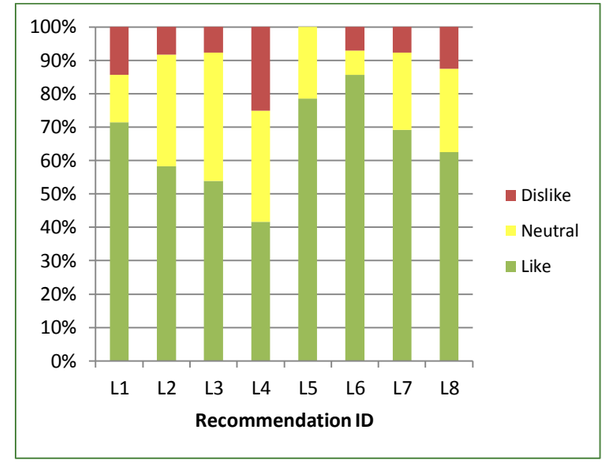


Figure 7.10 – Public Opinion of Proposed Long-Term Recommendations



The public opinion of the proposed long-term recommendations is shown in **Figure 7.10**. The proposed long-term recommendation with the highest percentage of "like" ratings (86%) was the recommendation to monitor traffic growth to determine if expansion of the existing 3-lane section to a 4-lane facility is justified (L6). Respondents commented that this recommendation is crucial especially on Christiansburg Mountain. One long-term recommendation received zero "dislike" ratings. This was the recommendation to reconstruct the Den Hill Road intersection (L5). The proposed long-term recommendation with the lowest percentage of "like" ratings (42%) and the highest percentage of "dislike" ratings (25%) was the recommendation to reconstruct the Western Virginia Water Authority (WVWA) entrance intersection (L4). Through conversation at the meeting, the installation of rumble strips included as part of L1 received negative feedback. The negative feedback was based on the noise created by rumble strips and that it takes away from the rural character of the corridor. However, due to the safety benefit provided by rumble strips, this recommendation was not modified.

7.2.2 Aerial Boards

At the workshop, boards containing aerial maps of the study corridor with the locations of the proposed short-, mid-, and long-term recommendations were displayed. Each aerial board contained a table which described the recommendations shown on that board. In addition, the recommendation labels on the aerial boards corresponded to the recommendation IDs on the questionnaire. Meeting attendees were encouraged to use the aerial boards to locate the proposed recommendations listed on the questionnaires. Meeting attendees were also supplied with sticky notes to provide comments on the proposed recommendations or additional recommendations. The sticky notes could be placed on the aerial boards at the location that corresponded to the comment. Comments provided on the sticky notes were combined with the questionnaire responses and are included in the Citizen Information Meeting #2 summary in the **Appendix**.

Roadway