Southeastern Collector Study

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Town of Berryville
Clarke County

Southeastern Collector Study

Contents

Executive Summary

Overview

The Town of Berryville and Clarke County, VA have long envisioned a Southeastern Collector to encourage expansion of the Clarke County Business Park. To determine how to best incorporate the existing roadway network, connect across the Norfolk Southern Rail Line and finance the collector, the Town of Berryville and Clarke County commissioned the *Southeastern Collector Transportation Study*.

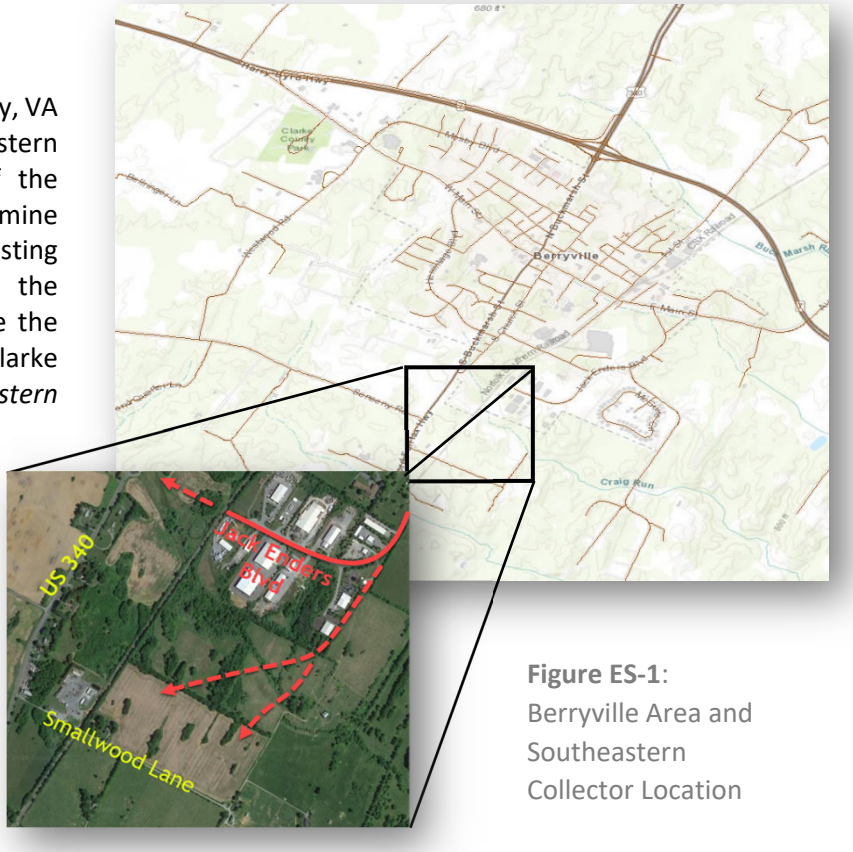


Figure ES-1: Berryville Area and Southeastern Collector Location

Four concepts for the Southeastern Collector were developed by Town and County Staff. There are three general alternatives to extend Jack Enders Boulevard and the Business Park. The fourth concept is a combination of two other concepts. The four concepts are below:

1. Concept A. Extend Jack Enders Boulevard over NS railroad to US 340.
2. Concept B. Extend Jack Enders Boulevard to Smallwood Lane and improve Smallwood Lane to US 340.
3. Concept C. Extend Jack Enders Boulevard to US 340 and into Southern Potential Growth Area. This Concept is a combination of Concept A and D.
4. Concept D. New Road in Southern Potential Growth Area without a connection to Smallwood Lane.

See exhibits in appendix.

Feasibility of New At-Grade Norfolk Southern Crossing

Although the Clarke County Business Park site plan shows an extension of Jack Enders Boulevard, the approval for a new-at-grade crossing is beyond the Town or County's control. As such, one of the objectives of this study is to determine the feasibility of a new crossing, and specifically of Concept A.

The feasibility of a new at-grade crossing depends on the answers to two key questions:

1) What would be necessary to obtain approval from Norfolk Southern for a new crossing?
2) Is the Jack Enders Boulevard extension the most optimal location for a new collector in the southeastern growth area?

Multiple conversations were held with Norfolk Southern staff. New, at grade crossings are not only highly discouraged, but also discouraged by Virginia State Statute[1]. Two hypothetical scenarios were discussed with Norfolk Southern Staff to gage the feasibility of a new crossing. First, what if the Town closed two or more existing at grade crossings? Second, would Norfolk Southern be amenable if the Town created a new siding and rail related commercial area?

The Norfolk Southern staff were not amenable to these hypothetical scenarios. Norfolk Southern Staff cited Virginia State Statute, and current efforts to eliminate at grade crossings. Furthermore, the proposed location of the new at grade crossing for Concept A is located on a curve and has sight distance limitations for southbound trains and would be disruptive to local residents. Although Norfolk Southern staff were careful not to formally reject the proposed at grade crossing, they were very clear that it was not a realistic a concept[2].

To obtain approval of a new at grade crossing, Norfolk Southern requires a Concept Package be submitted[3]. Subsequent plans are normally reviewed by Norfolk Southern at the requester's expense. It is likely that the Town would need to enter into a Preliminary Engineering Agreement with Norfolk Southern and provide compensation to Norfolk Southern to continue applying the new at grade crossing.

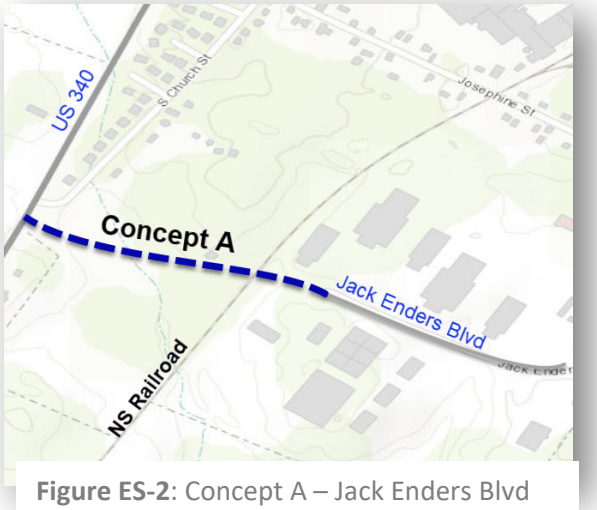


Figure ES-2: Concept A – Jack Enders Blvd Extended with new NS Railroad crossing.

The coordination with Norfolk Southern, research and analysis concluded:

1. The location of the new crossing for Concept A is not acceptable to Norfolk Southern. Even extraordinary efforts by the Town and County will be insufficient to overcome the general aversion to new at grade crossings, and especially in the proposed location.
2. The Town and County do not have existing crossings that can be eliminated to continue a dialog with Norfolk Southern. Nor does the Town and County have plans for major investment in a rail facility to make the new crossing part of a larger package.
3. To further pursue the new crossing for Concept A will require developing a Concept Package, and possibly enter into a Preliminary Engineering agreement with Norfolk Southern, and incur the expense of Norfolk Southern engineering reviews.
4. The location of Concept A is not superior to the other options. Concepts B and D create more developable property than Concept A. Concepts B and D have less wetland impacts than Concept A. Concept A's only advantage is lower construction cost.

[1] Va. Code Ann. § 56-363 (1996).
[2] Teleconference held June 19, 2019. Attendees from Norfolk Southern: Mr. Roger Bennett (NS Corp) and Mr. Scott Overbey (NS Corp).
[3] Norfolk Southern Railway Company, Public Projects Manual, Rev 2; Section 4 page 3.

As such, the Study Team recommended that the Town and County discontinue consideration of Concept A as the proposed Southeastern Collector. Concept C is a combination of Concept A and Concept D; as such this concept is also eliminated.

Final Concepts Selected for Study

Concept B and Concept D were selected for further study. Within both concepts are two variations, resulting in four Concepts, shown in Figure ES-2 with a typical road profile in Figure ES-4. The northern Terminus is shown in Figure ES-5

1. Concept B1- Extend Jack Enders Boulevard into the Smallwood Property, perpendicular to Craig's Run and onto Smallwood Lane. Upgrade Smallwood Lane and Smallwood Lane's existing at grade crossing of Norfolk Southern RR.
2. Concept B2 – Similar to B1, however the roadway will run further east to take advantage of existing Smallwood Lane.
3. Concept D1 – Identical to B1, without the connection to Smallwood Lane. This alternative will not provide a crossing of Norfolk Southern for the expanded Business Park.
4. Concept D2 - Identical to B2, without the connection to Smallwood Lane. This alternative will not provide a crossing of Norfolk Southern for the expanded Business Park

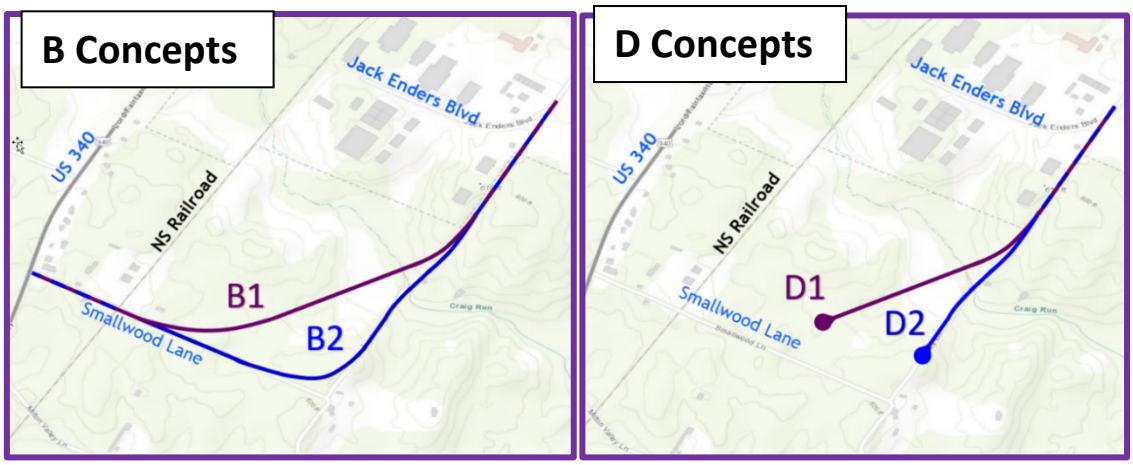


Figure ES-3: Concepts for Southeastern Collector

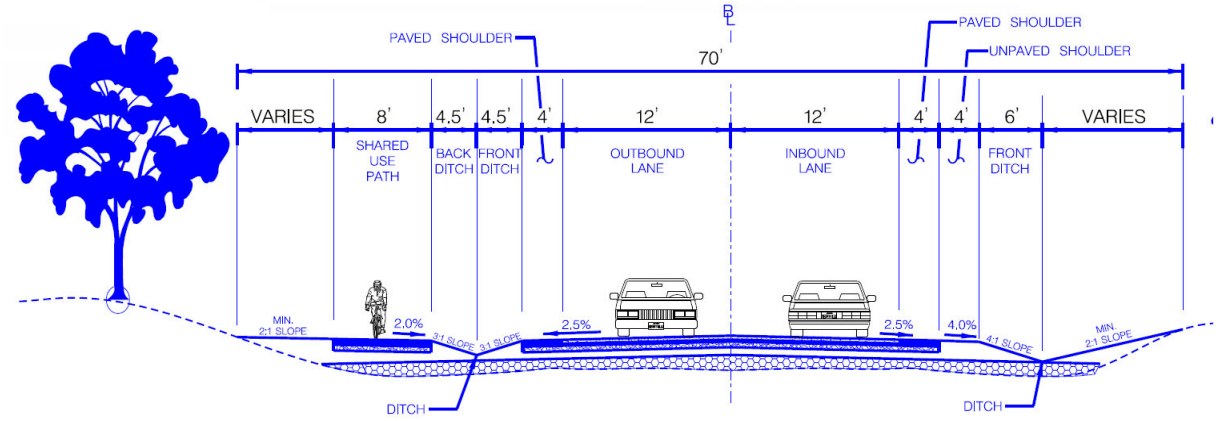


Figure ES-4: Typical Section of Southeastern Collector.

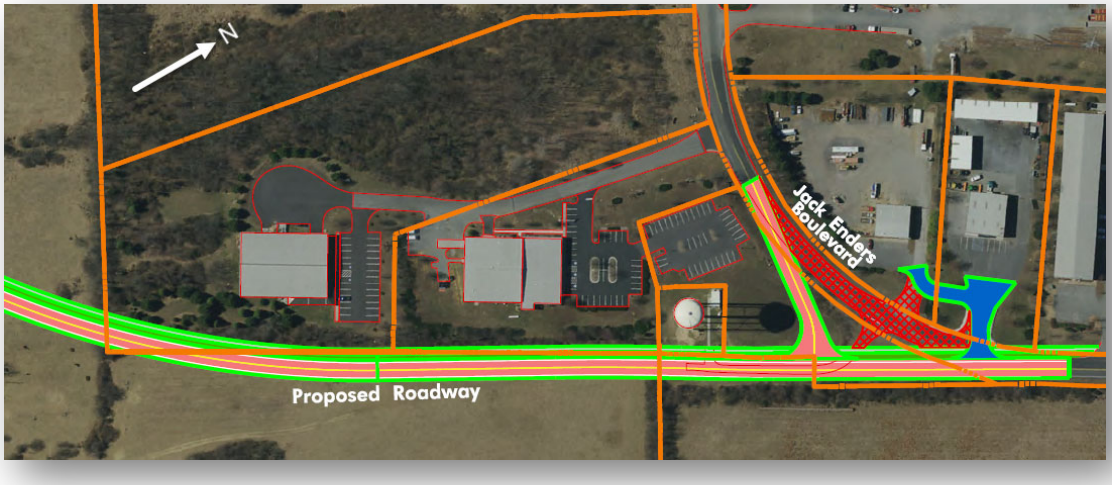


Figure ES-5: Southern Collector Northern Terminus

Changes in Travel Patterns

A microsimulation model of the Town was used to determine the changes in traffic patterns and changes in Level of Service at key intersections. The Land Use and Traffic Analysis found the following:

- The development associated with the Collector roadway is projected to be 500,000 square feet (SF) of light industrial. This development is projected to generate 340 vph *from* the area and 110 vph *to* the area (PM peak hour).
- The downtown Berryville Main Street Intersections are projected to have modest increases in traffic volume and intersection delay.
- Additional traffic from Concept D is expected to use local streets to avoid the center of Berryville. With Concept D nearly 200 vehicles during the PM peak hour are projected to divert away from the intersection of US 340 and Main Street.
- Concept B creates a route to bypass downtown Berryville. The model projects 130 vph to use Concept B as a bypass under normal conditions (PM peak hour).
- The traffic at the Jack Enders Boulevard / Main Street intersection will increase by 494 vph, over 60%, with Concept D. Current total volume is 812 vph.
- With Concept D additional capacity is needed at Jack Enders Boulevard and Main Street. A new signalized intersection with a dedicated westbound left turn lane and eastbound right turn lane will be necessary.
- Initially the negative impacts from Concept D will be manageable. A new signal at Jack Enders Boulevard will not be necessary until development is well underway.
- Traffic on Smallwood Lane will increase from 10 vph to 533 vph with Concept B. This will create the need for improvements to US 340 and, eventually, a new signal.

Environmental Impacts

Natural Environment – Both Concepts are largely located in farmland, as such impacts to habitat, forests, and endangered species are estimated to be minimal. The impacts will be limited to Craig's Run, an intermittent stream which is surrounded by wetlands, and a freshwater forested wetland.

The B1 and D1 Concepts have the least impacts to wetlands. They were developed to have a clean, direct perpendicular crossing of Craig's Run. Nonetheless the B2 and D2 Concepts are still estimated to impact only 1 acre of wetlands.

Historical Resources – The Concepts are not located near any state or federal registered historic properties. There are three structures impacted by Concepts B2 and D2 along Lindey Lane. These structures were determined by Clarke County to have some historic significance.

Project Costs

Table ES-1 summarizes the cost of each Concept. Concept D1 and D2 are less costly by virtue of terminating before Smallwood Lane.

Table ES-1 Comparative Costs ($ thousands)

	B1	B2	D1	D2
Construction Cost				
Mainline	$8,130	$7,950	$5,280	$4,820
Intersection Improvements	$560	$560	$430	$430
New Traffic Signals	$600	$600	$540	$540
At Grade Railroad Crossing	$160	$160	$0	$0
Subtotal Construction Cost[4]	**$9,460**	**$9,280**	**$6,250**	**$5,790**
ROW Cost	**$100**	**$100**	**$60**	**$70**
Total Cost	**$9,560**	**$9,380**	**$6,310**	**$5,870**

[4] Construction cost per mile: B1 - $9,080; B2 - $8,670; D1 - $10,310; D2 - $10,200

Summary – Advantages and Disadvantages of Each Concept

Concept B1 – This Concept is the most expensive but provides the most benefit. The alignment splits the Smallwood Property providing a central roadway for the new business park. The additional connection to US 340 aids the flow of traffic from the new and existing business park.

The alignment also minimizes the impact to Craig's Run and surrounding wetlands. However, it is the costliest Concept with an estimated cost of $9.6 Million

Concept B2 – This Concept is a variation of B1 and uses existing Lindey Lane. Compared with B1 it is located on the edge of the Smallwood Property, and has a less direct crossing of Craig's Run and increased environmental impacts. However, this Concept has the same traffic benefits as B1 and a slightly lower cost of $9.4 Million.

Concept D1 – This Concept follows the B1 alignment; however, it does not provide a new connection to US 340. As such it results in additional traffic through downtown Berryville and will require an upgrade to the intersection of Jack Enders Boulevard and East Main Street. The cost is lower than either of the "B" Concepts at $6.3 Million.

Concept D2 – As with B2 this Concept is on the edge of the Smallwood Property and will not be a central roadway for the new business park. It also has a less direct crossing of Craig's Run, which increases the environmental impacts to Craig's Run. However, this Concept has the lowest cost of $5.9 Million.

Table ES-2 Summary of Costs and Benefits

	B1	B2	D1	D2
Land Use	Bisects Smallwood Property	Eastern Edge of Smallwood Property not optimal	Bisects Smallwood Property	Eastern Edge of Smallwood Property not optimal
Environmental	Minimal impact to Craig's Run	Not as environmentally preferred crossing of Craig's run	Minimal impact to Craig's Run	Not as environmentally preferred crossing of Craig's run
Traffic Flow	Improves traffic flow throughout	Improves traffic flow throughout	Large increase on Jack Enders Boulevard, traffic diversions onto Berryville streets	Large increase on Jack Enders Boulevard, traffic diversions onto Berryville streets
Implementation	More $$, includes new connection at US 340.	More $$, includes new connection at US 340.	Can be expanded after initial phase.	Can be expanded after initial phase
Total Cost	**$9,560**	**$9,380**	**$6,310**	**$5,870**

Conclusions, Implementation and Recommendations

Concept B1 best meet the needs of the Town and County. The Concept provides an upgraded crossing of the Norfolk Southern Railroad, improved traffic flow in and around Berryville and best promotes future development in the Southern Growth Area. The estimated cost is $9.6 Million. A variety of funding sources are appropriate for this project as listed in table ES-3.

Planning, funding and building the new roadway will require a multi-pronged and multi-phased approach.

First, the Southern Growth Area, primarily on the Smallwood property, will need to be planned. With a vision of how this property will be redeveloped the Town and County can add this vision to the Comprehensive Plan and update the zoning. These initial planning steps will allow the roadway to compete for Smart SCALE funding and open the potential for grants and investment from private developers.

Table ES-3 Funding Sources

Transportation Funds	**Brief description**
Smart SCALE	Primary source for roadway funding. Smart SCALE Prioritizes projects for use of transportation State and Federal funds.
Revenue Sharing	VDOT program, provides a 50% match for qualifying projects. Other funds can be used for 50% match
Public Private Partnerships	The Public Private Transportation Act enables local governments to partner with private entities to build roadways.
State Grant Funder	
Community Development Block Grant	Based upon demographics and community need
FEMA flood protection policies and regional planning	Flood education, policy enforcement, construction standard updates, ordinance review
VDOT SRTS	Safe routes to schools, walking trails, bike trails
Go Virginia, Growth and Opportunity	Tech sector partnerships to develop economy in rural areas
Federal Grant Program	
USDA/NRCS Watershed Protection grants	For water quality, water supply protection, habitat
US Forest Service Land and Water Conservation Fund	Purchase land for permanent protection
TIGER/Build grants	Public transportation program 20% for urban areas
Redismart, department of Energy	For smart grid design implementation
INFRA program	Transportation that promotes economic vitality, accountability along freight highway

Second, the Town and County need to actively pursue funds from State and Federal grants and investment from developers. An extension of Jack Enders Boulevard into the Smallwood Property, like Concept D1, will encourage some initial development on the Property. With this initial development it will be easier to attract other users or developers to the property. The site will be able to generate revenue and provide the funds to finish the Collector with either Smart SCALE or Revenue Sharing.

With a marketable vision the site and roadway will be a candidate for a Virginia Public Private Partnership (P3). This program will allow the Town and County to contract the development of the site. A private entity will assume much of the funding and risk, and in turn receive either future revenues or profits from the site.

Smart SCALE is the dominant program for allocating State and Federal transportation funds. In rural areas, the largest source of points is Economic Development. The Southern Growth Area will need to be planned for the Southeastern Collector to gain Economic Development points. Without Smart SCALE, the Town and County can also receive a 50% match using the Revenue Sharing program. With Concept B1, the Town and County will need to raise $ 4.8 Million (one half of $9.6 M). Other grants and private money can be used for this match.

Concept B1 could be implemented in four phases:

I. Extend Jack Enders Boulevard into the Smallwood property to stimulate initial development.
II. As development progresses, improve the Jack Enders Boulevard / Main Street Intersection.
III. As development approaches 75% of buildout, extend the Connector to US 340.
IV. When traffic warrants, add a signal at the intersection of Smallwood Lane and US 340.

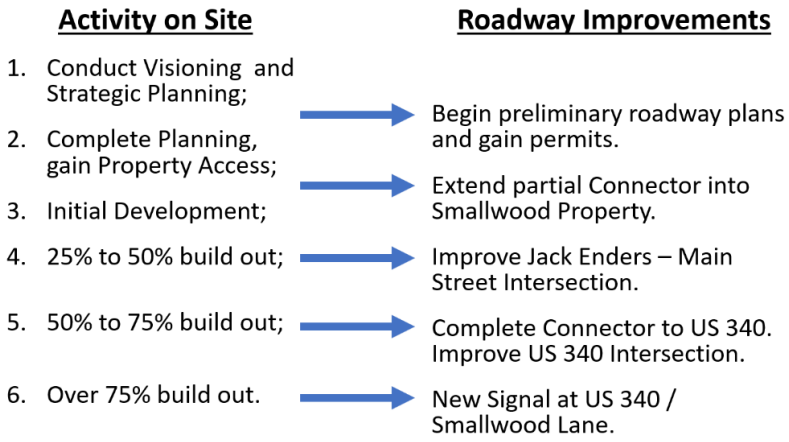


Figure ES-6: Timing of Connector Construction

The timing of the phases will depend on the type of development and corresponding number of trips generated. When development reaches 25% of full buildout approximately 125 thousand SF of development will have occurred. For a typical industrial park this will create an additional 870 new daily trips and 107 new peak hour trips. This typical scenario is not likely to trigger the need for roadway improvements, however if the new development has greater than typical trip generation or a high number of trucks then roadway improvements may be necessary.

When the development reaches 50% of buildout and 250 thousand SF of development, improvements to Jack Enders Boulevard will be necessary. At this point it will also be necessary to gain environmental approvals and begin design of the Connector. By 75% of buildout and 375 thousand SF of development it will be time to complete the Connector to US 340. The final improvement is a signal at US 340 and Smallwood Lane. This improvement should be implemented when conditions warrant, likely after 75% development.

The Southeastern Collector and the accompanying development will create many benefits for the Town and County. We recommend that the Town and County select Concept B1 and begin the visioning and planning for the associated development.

1. Existing Conditions

1.1 Background

The Town of Berryville and Clarke County, Virginia have long envisioned a Southeastern Collector to encourage development and provide connectivity. To determine how to best incorporate the existing roadways, connect across the Norfolk Southern Rail Line and to finance the collector the Town and County commissioned the Southeastern Collector Transportation Study.

The Town of Berryville Area Plan proposes to expand the existing Business Park along Jack Enders Boulevard into an area designated as the Southern Potential Future Growth Area. To support development a connection between Buckmarsh Street (US 340) and Main Street (VA Business 7) is necessary.

The default location for the Southeastern Collector has been along Jack Enders Boulevard, and across the Norfolk Southern railroad on a new at-grade railroad crossing. This connection will provide the needed connection from US 340 to VA Route 7 Business, serve the existing businesses along Jack Enders Boulevard and further open the Southern Potentail Growth Area across the Norfolk Southern rail line.

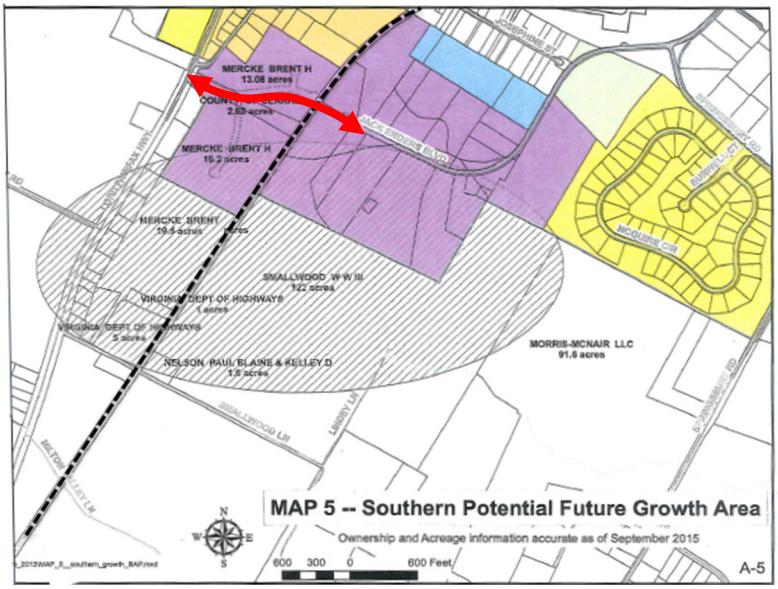


Figure 1.1 Southern Potential Growth Area. Will a Southeastern Collector be effective without a new or improved crossing of the railroad? *Source of map: 2015 Berryville Area Plan*

However, new at grade rail crossings are discouraged by Virginia Statute[5], and are not generally approved by Norfolk Southern without closing at least one existing at-grade crossing in the vicinity and without the addition of a rail terminal or siding.

Other additions to the Jack Enders Boulevard - Clarke County Business Park area could be made to the south into the Smallwood property. The Town and County identified four concepts:

[5] § 56-363. Crossing of a railroad or public highway by another railroad; crossing of a railroad by a public highway. This statute states that crossings "shall, wherever reasonably practicable, pass above or below the existing facility".

Concept A – Extend Jack Enders Boulevard from current terminus west across Norfolk Southern Railroad with new at-grade crossing to connection point near the intersection of South Church Street and US 340.

Concept B – Extend Jack Enders Boulevard to Smallwood Lane then west to US 340.

Concept C – Extend Jack Enders Boulevard to US 340 as in Concept A and extend Jack Enders Boulevard south into the Smallwood property.

Concept D – Extend Jack Enders Boulevard south (as in Concept C) without a new connection across NS Rail Line.

The Town and County further established the following goals for the Study[6]:

- Identify the feasibility and cost of each concept including total cost of developing a new at-grade crossing (Concepts A and C) or improving an existing at-grade rail crossing (Concept B).
- Determine any required improvements along the corridor to maintain acceptable Levels of Service (LOS) including but not limited to the need for new signalized intersections, turn lanes, crosswalks, and drainage improvements.
- Project how implementation of each Concept will impact traffic patterns along all corridors to be examined. This would help to determine the amount and nature of current traffic that would use Jack Enders Boulevard as a bypass to avoid downtown Berryville.

The purpose of this Section is to establish the safety, traffic, environmental, land use and business conditions in the Berryville area. These conditions will be the basis for further defining the Collector concepts and determining their benefits, costs and impacts.

1.2 Existing Traffic Conditions

Berryville is in the center of Clarke County, VA at the intersection of VA Route 7 and US Route 340. Both corridors are long-standing transportation corridors that were known in the 18th century as the Winchester Turnpike and Charles Town Road, respectively. Although the major highway Interstate corridors in this region are I-66 and I-81, both VA Route 7 and US Route 340 provide supplementary service.

Traffic conditions in the Town of Berryville are governed by Main Street (VA 7 Business) and US Route 340. Other than external traffic on VA Route 7, the bulk of Town trips pass on either Main Street or US Route 340. The Town's system of collector roadways (identified as Jack Enders Boulevard, Mosby Boulevard, Hermitage Boulevard, and Fairfax Street) depend on Main Street and US Route 340 to function with acceptable levels of service.

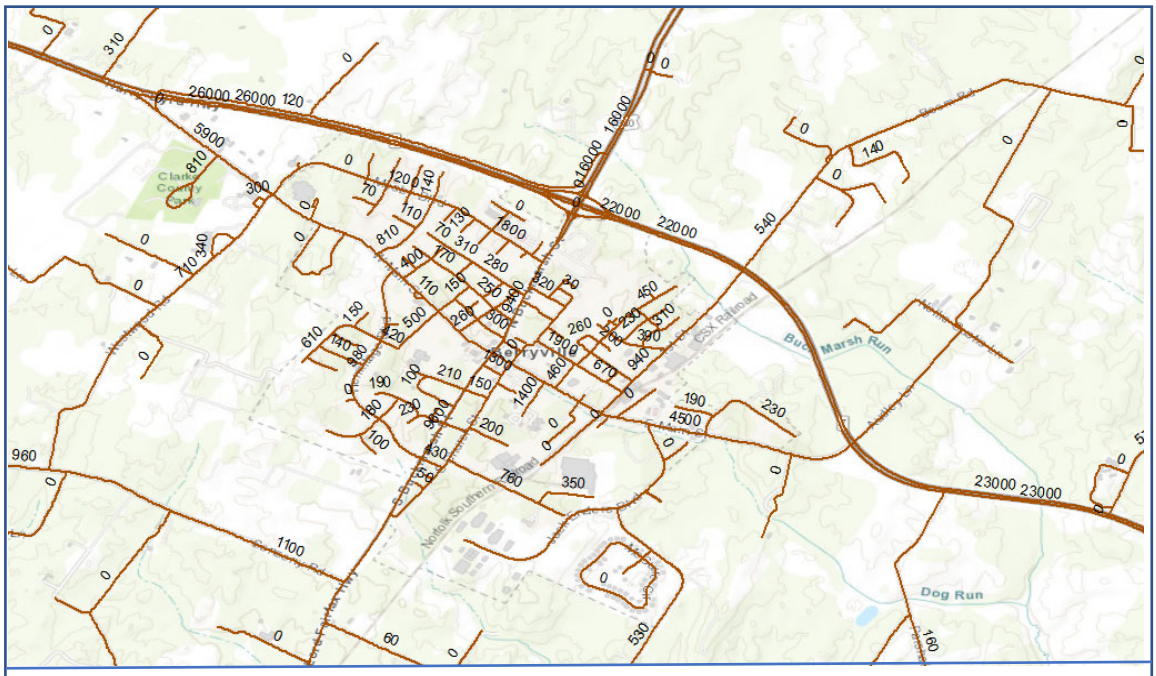
In Town, both roadways are urban roadways with frequent driveways, on-street parking and limited roadway width. Main Street serves local uses and helps create the historic small town feel that is valued by residents and visitors. It is not consistent with the setting for these roadways to pass large volumes of traffic. As such, capacity and traffic flow can be easily disrupted by large trucks or even minor incidents.

[6] Berryville Town Council & Clark County Board of Supervisors Joint Meeting 11 December 2018, Attachment 1 Scope of Transportation Study, page 3.

Traffic Volumes and Levels of Service

Traffic conditions are generally acceptable in the Town. Figure 1.2 shows Average Annual Daily Traffic from the VDOT database[7]; Figure 1.3 shows turning movements for the Town's key intersection at US 340 and Main Street. On the following page, Table 1.1 shows the calculated LOS based on traffic counts taken at the three intersections shown.

Figure 1.2 shows that the Route 7 traffic is separate from Berryville Town traffic. The large volumes on Route 7 have a high Directional "D" value, indicating that the traffic is predominantly eastbound in the morning and westbound in the evening. The other roadways in Figure 1.2 have modest "D" values and lower volumes. Some roadways have existing limitations. For instance, through trucks are prohibited on Route 7 Business (Main Street). US 340 has moderate truck traffic and north-south truck traffic through Town is unavoidable. US 340 in Berryville has 8% truck traffic[8]. There are also restrictions of Mosby and Hemitage.



Location	Average Annual Daily Traffic	Directional "D" Value	Peak Hour Factor "K"
Route 7	26,000 – 22,000	.70 - .79	.09
Main Street, Route 7 Business	5,900 – 4,500	.55 - .68	.10
US 340	9,600 – 16,000	.59 - .55	.09
South Church Street	3,300	.52	.10
Jack Enders Boulevard	3,000	.56	.12

Figure 1.2 Average Daily Traffic Volumes and Key Traffic Characteristics

[7] VDOT, 2018 Daily Traffic Volume Estimates, Special Locality Report 168 Berryville.
[8] Ibid.

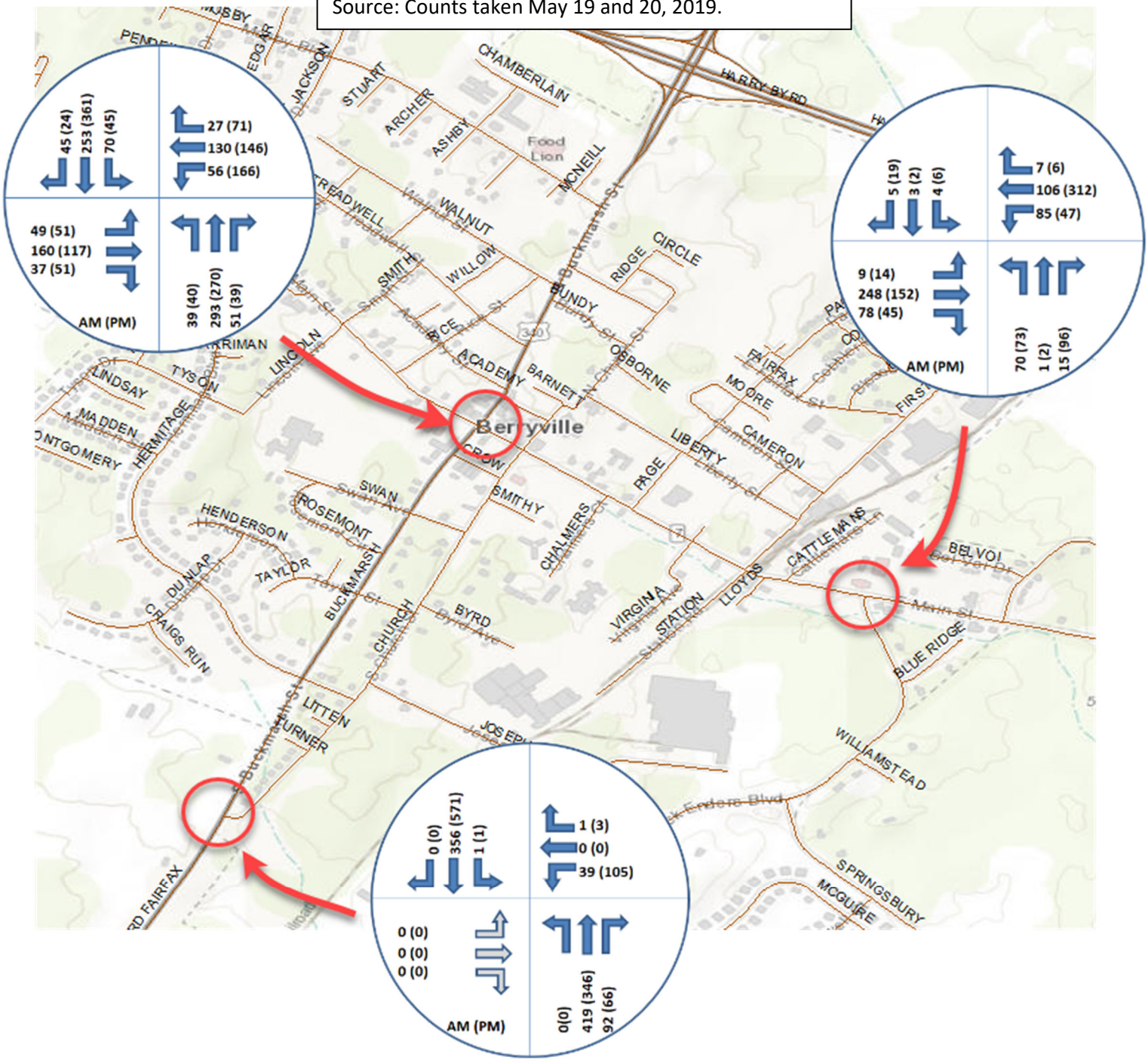
Traffic Counts were conducted on May 21, 2019 for three intersections. Key traffic characteristics are shown in Table 1.1. Figure 1.3 shows turning movement counts by movement.

Table 1.1: Intersection Turning Movement County Summary		
Intersection	**Peak Period AM / PM**	**Total Intersection Volume**
Main Street at Jack Enders Blvd	7:00 – 8:00 AM 3:30 – 4:15 PM	731 AM 775 PM
US 340 at Main Street	7:15 – 8:15 AM 4:15 – 5:15 PM	1,210 AM 1,381 PM
US 340 at Church Street	7:15 – 8:15 AM 4:15 – 5:15 PM	1,009 AM 1,092 PM

Town traffic is largely local traffic with a destination or origin in the Town or immediate area. The exception is external traffic that is passing through the Town on US 340. The largest movement at the intersection of US 340 and Main Street is the US 340 through (i.e. north-south) traffic. North-south volumes at Main Street are 50% greater than east-west volumes, as such it is likely that 1/4 to 1/3 of the north-south peak hour traffic through the center of town is through traffic. (See Figure 1.2 and Table 1.2.)

Table 1. 2: Intersection Volumes and LOS by Approach				
Intersection	**Approach**	**Volume AM (PM)**	**Delay Sec**	**LOS**
US 340 – Main Street				
	Northbound	383 (349)	22.4 / (21.0)	C (C)
	Southbound	368 (430)	18.8 / (23.9)	B (C)
	Eastbound	246 (219)	28.3 / (28.5)	C (C)
	Westbound	213 (383)	25.5 / (27.8)	C (C)
Main Street – Jack Enders Blvd				
	Northbound	186 (171)	13.6 / (13.6)	B / (B)
	Southbound	12 (27)	14.0 / (14.2)	B / (B)
	Eastbound	335 (212)	0.2 / (0.5)	A / (A)
	Westbound	198 (365)	3.5 / (1.0)	A / (A)
US 340 – Church Street				
	Northbound	611 (412)	0.0 / (0.0)	NA
	Southbound	357 (572)	0.0 / (0.0)	NA
	Westbound	40 (108)	19.5 / (29.6)	C / (D)

Figure 1.3: Traffic Volumes at Study Intersections.
Source: Counts taken May 19 and 20, 2019.



Crash History

Vehicular crashes in Berryville are typical for the roadways and volume in the Town. Analysis of 122 crashes over 3 years on US 340 and Main Street (RT 7 Business) and Jack Enders Boulevard reveal that most crashes are at intersections or driveways. In addition, non-injury crashes (i.e. Property Damage Only) dominate.

Berryville crashes are less severe than area crashes in general. This is likely due to higher speeds on rural roadways outside the built-up towns and cities. As shown in table 1.3, Berryville injury crashes on primary routes consist of only 9% of total crashes, as compared to 35% for Clarke County and 31% for the greater Northern Shenandoah Valley Area.

Table 1.3: Three-year (2016-2018) Crash Percentages on Primary Routes[9]

Crash Type	Berryville Area	Clarke County	NSVRC Area.
Fatality	0 / 0%	7 / 1%	51 / 1%
Injury A	1 / 1%	46 / 8%	250 / 5%
Injury B	5 / 7%	128 / 22%	1,176 / 22%
Injury C	1 / 1%	17 / 3%	149 / 3%
Property Damage Only (PDO)	68 / 91%	373 / 65%	3,678 / 69%
Total	**75 / 100%**	**571 / 100%**	**5,304 / 100%**

Note: All comparisons with Clarke County and Northern Shenandoah Valley Regional Commission (NSVRC) area are for crashes on Primary Routes. The NSVRC area consists of the Counties of Clarke, Frederick, Shenandoah, Warren and Page and the towns and cities located within these areas.
Injury A – Evacuation for medical treatment, Injury B – Injury treated on site. Injury C – Complaint, no visible injury.

Of the crashes analyzed, 70% of the crashes can be described into 4 types. The top two crash types in the area were 1) failure to obey a signal or properly yield the right-of-way at an intersection, and 2) rear-end in heavy traffic. Other types of rear-end and maneuvers in or out of driveways were the next most prevalent types of crashes. Below is a breakdown of the crashes analyzed:

- Failure to Obey Signal or Yield Right-of-Way at Intersection: 27 (22%)
- Rear End in Heavy Traffic: 19 (22%)
- Rear End at Signal or Other Location: 16 (13%)
- Turn In/Out of Driveway: 16 (13%)
- Deer Crashes: 7 (6%)
- Parking Related: 5 (4%)
- Run off Road (Not Asleep): 5 (4%)
- Fell Asleep at Wheel: 4 (3%)
- Other (13%)

[9] VDOT, Crash Analysis Tool. VDOT receives crash data via DMV TREDS System.

The following segments and intersections had the largest numbers of crashes; therefore, trends could be drawn for these specific locations:

Table 1.4: Summary of Crashes[10]

Segment Description	Total Crashes	Severity	Primary Trend	Notable Crashes
Main Street @ US 340	7	6 PDO, 1 Injury	Rear ends (57%)	Truck turning right from EB Main to SB Buckmarsh struck pole. Distracted Truck Rear ended vehicle at light.
Main Street @ N. Church St	12	11 PDO, 1 Injury	Parking related (25%)	Pedestrian hit by left turn while in crosswalk.
Main Street between N. Church and Route 7	9	7 PDO, 2 Injury	Parking related (33%); driver fell asleep (33%)	Confused driver turned left onto railroad tracks and got stuck.
Main Street @ Jack Enders Blvd	3	3 PDO	Turning vehicle accidents (100%)	Right turning truck from Jack Enders Boulevard clipped vehicle in left turn lane.
Main Street @ Route 7	14	14 PDO	Rear ends due to heavy traffic (57%)	Most crashes are a result of rear ends in heavy traffic.
Rt. 7 Between US 340 and Parshall Rd	25	16 PDO, 5 Injury, 4 Serious Injury	Rear ends due to heavy traffic (40%)	Most crashes are a result of rear ends in heavy traffic.

Truck Involved Crash Trends: In total across the studies roadway segments, there were 15 (12%) large truck related crashes of the 122 crashes analyzed. Truck traffic is less than 9% on all the roadways. On US 340 from Main Street to RT 7 (Harry Byrd Highway) 7 of the 33 crashes (21%) of the crashes involved heavy trucks.

Rail Crossing Crashes: There was one rail crossing involved crash. The crash did not involve the train. The crash was due to driver confusion for mistaking the tracks as a road. The vehicle turned from west bound E. Main St. south onto the tracks that cross E. Main St., lodging the vehicle on top of the tracks. The vehicle was stuck and needed to be towed off the tracks. There were no other rail-related vehicle crashes reported over the period of 2016-2018.

[10] VDOT, Crash Analysis Tool. VDOT receives crash data via DMV TREDS System.

1.3. Natural and Historic Resources

Natural Resources

Berryville is located in the Shenandoah Valley in the Great Appalachian Valley. The area is punctuated by rolling hills, valleys and streams. The area is largely Karst topography, which is characterized by underground drainage systems due to the solubility of the underlying limestone.

In the study area, the most prominent feature affecting the location of a future roadway and development is Craig's Run. This stream if surrounded by wetlands, and a freshwater forested wetland. Craig's Run is listed on the EPA 303d list for impaired waters in Virginia for E-coli from NPS agricultural runoff. The wetlands fall under section 404 of the Clean Water Act requiring delineation and permitting for any impacts.

Forestland in the area will also have to be identified and quantified for its natural resource value. The Karst geology is prone to sinkholes and seeps, making it an unpredictable region to build upon, though not impossible. The soil region is the Northern Mountains and Piedmont of the Eastern Mountains and Piedmont and this study area is dominated by Poplimento-Webbtown soils.

According to the Department of the Interior, several potential threatened/endangered species may exist in the study area including: *Myotis sodalis* (Indiana bat), *Myotis septentrionalis* (Northern Long-eared bat), and *Antrolana lira* (Crustacean or unpigmented troglobite). There may also be a *Bartramia longicauda*, (Upland sandpiper) in the region though no sightings have been identified since 2014. All these resources will require further study prior to any development activity.

A map showing area Natural Resources is in Figure 1.4.

Historic Resources

Historic resources in the area include the Josephine City Historic District which includes Josephine Street, the Josephine Community Museum and the Milton Valley Cemetery. This district is listed in the National Registry, and the Virginia Cultural Heritage Listing and Virginia Department of Historic Resources. These areas are shown in Figure 1.4.

Resources in Figure 1.4 marked with stars (clusters of local historic structures) are not officially protected; however, they are locally significant remnants of local history.

Conclusions:

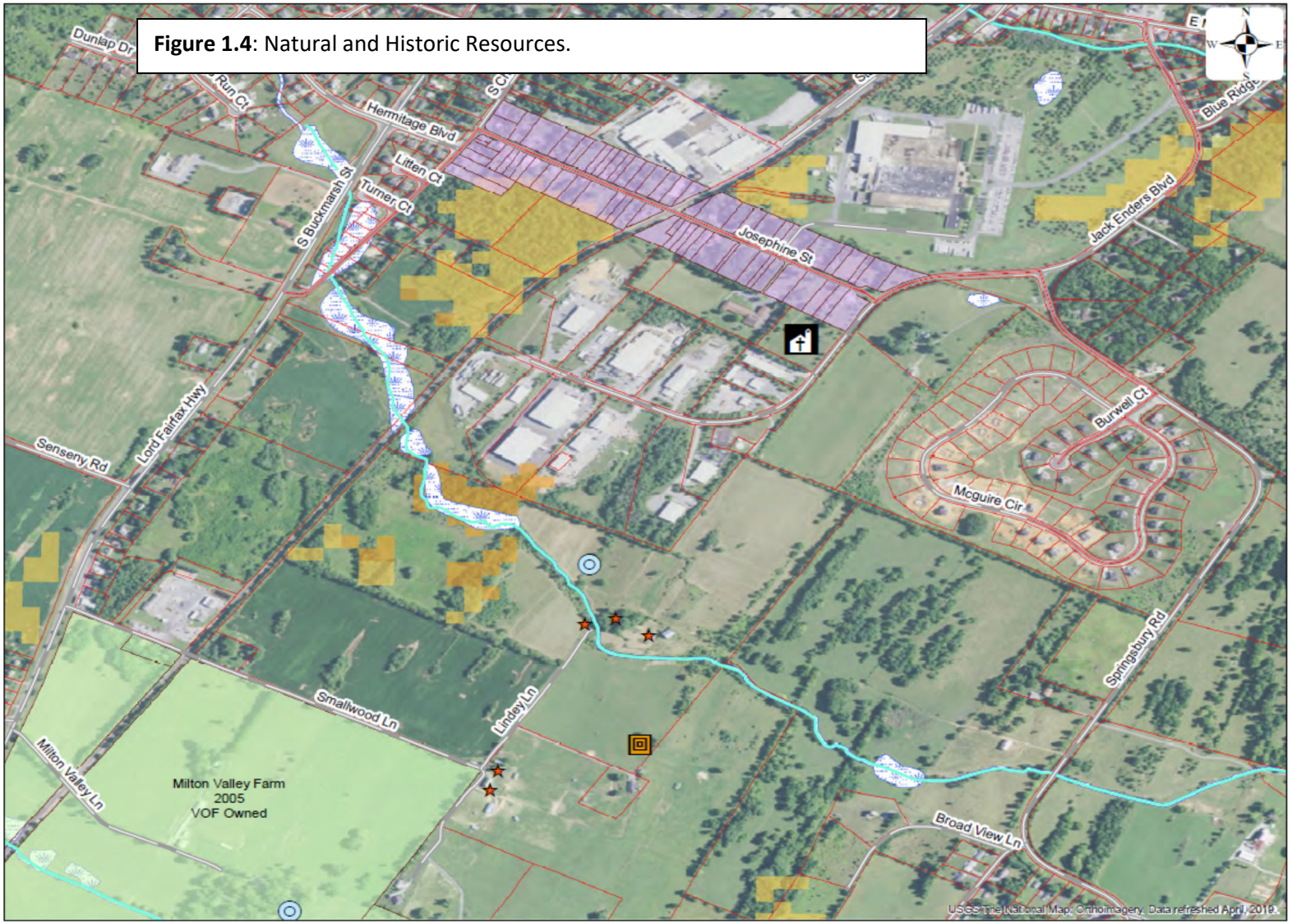
- Crossing of Craig's Run will require wetland/forest study and Army Corps permits after jurisdictional determination by Virginia Department of Environmental Quality
- Forest cover areas will require further study
- All alternatives will require a Section 7 review for the bat and the crustacean (this is normal for construction in this area)
- Milton Valley Farm is a permanent easement that prohibits disturbance and may also require a scenic buffer.

Natural Resources Investigated in Study Area

ADC National Map Grid
Big Tree National registration site
Cornell lab of ornithology, https://www.allaboutbirds.org/guide/Upland_Sandpiper/maps-sightings
DEQ, Virginia Department of Environmental Quality
DCR, Virginia Department of Conservation and Recreation
FEMA flood maps
Geology review
Municipal Water/Sewer District map
Municipal Zoning map
National Park Service site maps
National Wetland Map
Regional contour maps
Soil Region summary
Shenandoah River PCB TMDL data (VA DEQ Valley Regional Office)
State Forest Cover map
Sub Watershed, Dog Run, Craig Run, 303D list of impaired waters
USDA/NRCS Soil survey
US Department of the Interior, IPAC, USFWS Species search
Virginia Outdoors Fund regional identification of Conservation Easements
Watershed HUC data EPA, Potomac Shenandoah Watershed

Cultural Structure Review in Study Area
Clarke County Conservation Easement Map
Clarke County Government Historic District Driving and Walking Tour Map
Clarke County Historical Association
Clarke County survey of structures (discussion with County Point of Contact)
Historic topo graphic maps
Josephine School Community Museum
National Trust for Historic Preservation
Scenic Byway setback area
Virginia Department of Historic Resources

Figure 1.4: Natural and Historic Resources.



Primary Soil Group:
Poplimento
Karst Geology

-Potential T/E species habitat in caves
-Potential sinkholes
-Springs
-Historic Structures
-Conservation Easements
-Cemetery - Milton Valley

1.4 Land Use

Clarke County is a scenic rural County that seeks to focus growth that will preserve its rural character. Future commercial, retail, subdivision residential and industrial growth is planned to occur in the Town of Berryville. Similarly, Berryville is known as an historic small Town with a quaint downtown. The Town's land use plan seeks to maintain this character and provide for a multitude of land uses through careful planning and execution. As stated in the 2015 Berryville Area Plan:

> "The overriding purpose of the Plan is to encourage development of a safe, healthy, and distinctive living environment while maintaining the unique historical ambience of the community. Preservation and conservation issues dominate the underlying themes to be presented in the comprehensive planning program." [11]

The Clarke County Business Park is currently the home to Berryville and the County's light industrial development. Most of the non-service major employers in Clarke County are located in the County Business Park. Among the top 10 private sector employer's[12] four - Berryville Graphics, American Woodmark, Caldwell & Santmyer and Cochran's Lumber and Millwork - are located on Jack Enders Boulevard.

The Clarke County Business Park is designated by the 2015 Berryville Area Plan to developed as Light Industrial or Research at a 0.3 Floor Area Ratio (FAR)[13]. The 2015 Plan does not represent a change, it has long been the intent of the County and Town to develop this area as light industrial or research.

The Berryville Area Plan Land Uses (2015) map is in Figure 1.5.

Clarke County and Berryville seek to maintain the rural setting and small-town nature of Berryville while providing new sources of employment and tax revenues. Expanding and controlling light industrial development to the Clarke County Business Park area will help achieve this goal

[11] Berryville Area Development Authority, 2015 Berryville Area Plan, page III-1.
[12] Ibid, page I-5.
[13] Ibid, page A-9 Table 12, Future Land Use Table and Projected Development Yields

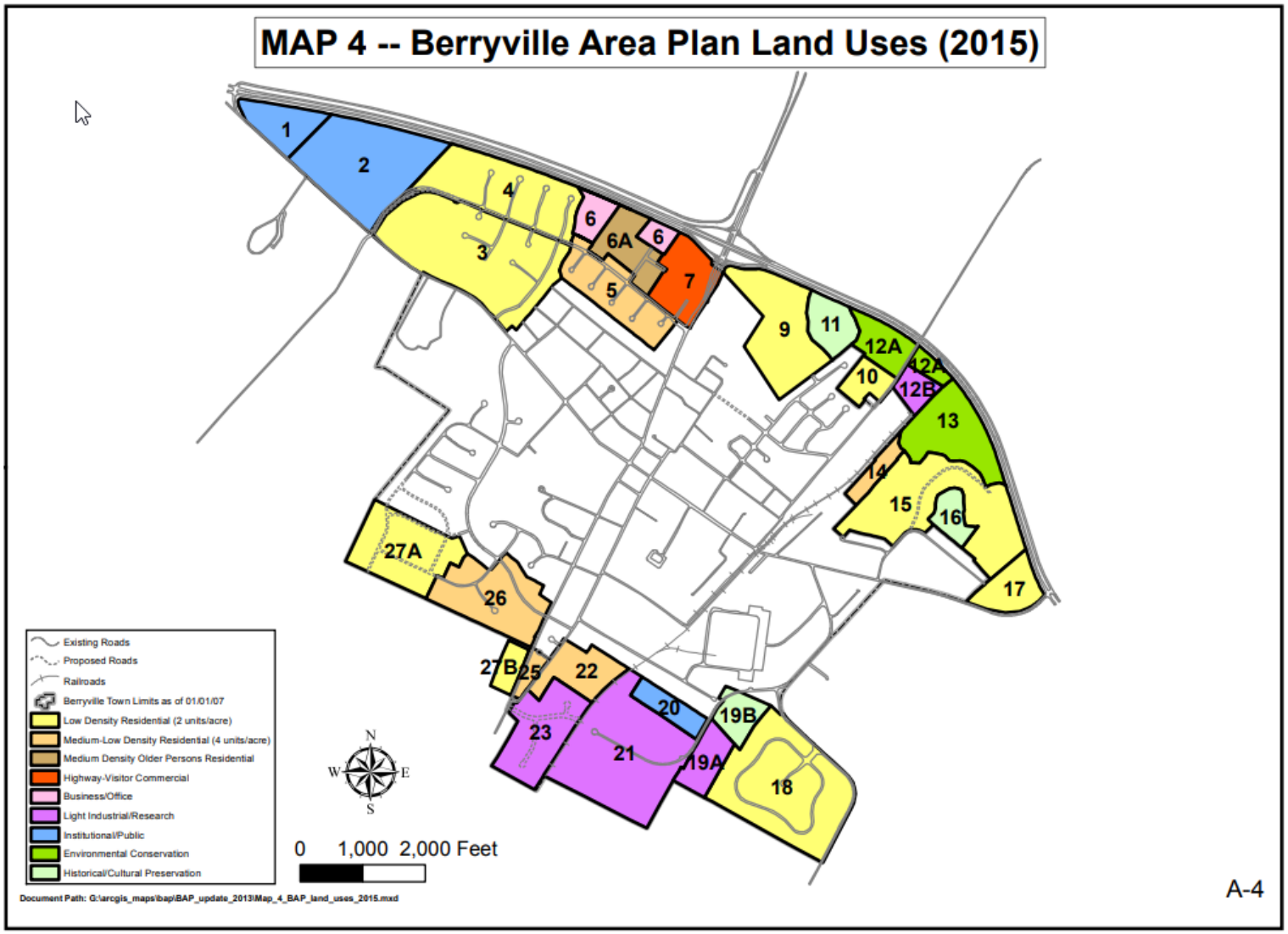


Figure 1.5 Berryville Area Plan Land Uses (2015) map. *Source: 2015 Berryville Area Plan*

2. Concept Alternatives

2.1 Concept Definition

Four Concepts for the Southeastern Collector were developed by Town and County Staff. These four Concepts do not inhibit the development of additional concepts, rather they define a general definition of all the possible alternatives for a Southeastern Collector roadway.

There are three general alternatives to extend Jack Enders Boulevard and expand the Business Park. A fourth alternative is a combination alternative. These alternatives, formally referred to as Concepts are below:

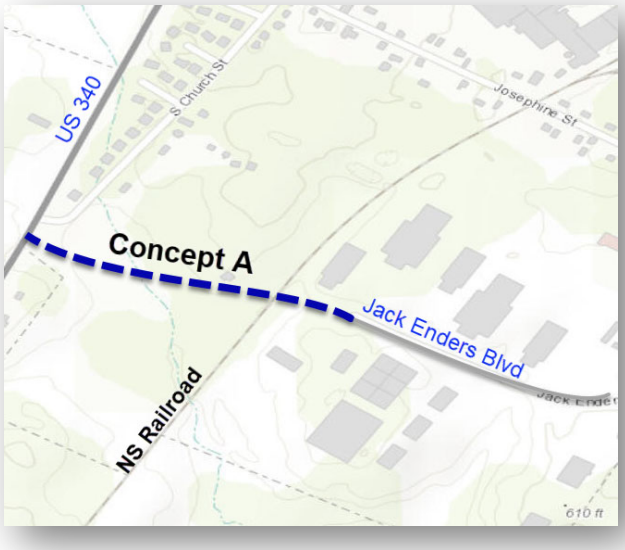
1. Concept A. Extend Jack Enders Boulevard over Norfolk Southern (NS) railroad to US 340.
2. Concept B. Extend Jack Enders to Smallwood Lane and improve Smallwood Lane to US 340.
3. Concept C. Extend Jack Enders Boulevard to US 340 and into Southern Potential Growth Area. This Concept is a combination of Concept A and D.
4. Concept D. New Road in Southern Potential Growth Area without a connection to Smallwood Lane.

Within each Concept there are several different alternatives. These alternatives were analyzed and those that provided distinct advantages and impacts were carried forward for further analysis. The result of this preliminary screening was one (1) Concept A, and C alternatives and two (2) Concept B and D alternatives.

Feasibility of New At-Grade Norfolk Southern Crossing

Although the Clarke County Business Park site plan shows an extension of Jack Enders Boulevard, the approval for a new-at-grade crossing is beyond the Town or County's control. As such, one of the objectives of this study is to determine the feasibility of a new crossing, and specifically of Concept A. The feasibility of a new at-grade crossing depends on the answer to two key questions:

1) What would be necessary to obtain approval from Norfolk Southern for a new crossing?
2) Is the Jack Enders Boulevard extension the most optimal location for a new collector in the southeastern growth area?



Multiple conversations were held with Norfolk Southern staff (see conversation summary below). New, at grade crossings are not only highly discouraged by Norfolk Southern, but also by Virginia State Statute[14]. Two hypothetical scenarios were discussed with Norfolk Southern Staff to gage the feasibility of a new crossing. First, what if the Town closed two or more existing at grade crossings? Second, would Norfolk Southern be amenable if the Town created a new siding and rail related commercial area.

The Norfolk Southern staff were not amenable to these hypothetical scenarios. Norfolk Southern Staff cited Virginia State Statues, and current efforts to eliminate at grade crossings.

Furthermore, the proposed location of the new at grade crossing for Concept A is located on a curve and has sight distance limitations for southbound trains. Although Norfolk Southern staff were careful not to formally reject the proposed at grade crossing, they were very clear that it was not a realistic a concept[15].

Multiple Conversations with Norfolk Southern and Rail Personnel were conducted:

- On April 3, 2019 Mr. David Metcalf spoke with Scott Overbey, the Public Projects coordinator for Norfolk Southern (NS). The purpose of this conversation was to determine what the Town and County would need to do to gain approval from NS for a new at grade crossing. Mr. Overbey stated that the Town and County would need to follow the procedure in the Public Projects Manual. The Public Projects Manual calls for preliminary design, normally performed by NS at the community's expense.
- On May 16, 2019 Mr. David Metcalf spoke with Scott Overbey, the Public Projects coordinator for Norfolk Southern (NS). This conversation was a follow-up to the previous conversation to determine what could be done to obtain a decision from NS without submitting the engineering design and study. Mr. Overbey suggested that if the Town could develop a commercial rail terminal, then this development may justify an additional at grade crossing.
- On May 16, 2019 Mr. Metcalf spoke with Debra Haislip, State Rail Program Manager at Virginia Department of Transportation. Ms. Haislip stated that VDOT is working with NS and others to eliminate at-grade crossings, and that VDOT would aid with roadway project development if approved by NS.
- On May 23, 2019 Mr. David Metcalf spoke with Scott Overbey, the Public Projects coordinator for NS with the director for commercial development. The purpose of this conversation to determine if Berryville would be attractive to have rail related development. The NS personnel stated that a specific proposal would be necessary to determine if NS would provide rail infrastructure to support rail related development.
- On June 19, 2019 a teleconference was held with Mr. Roger Bennett (NS Corp) and Mr. Scott Overbey (NS Corp) and Christy Dunkle, Keith Dalton, David Ash, Brandon Stidham from Town and County. NS personnel highlighted additional issues with the proposed location of the new at grade crossing. Mr. Bennett suggested the town submit a Concept Package to NS for consideration.

[14] Va. Code Ann. § 56-363 (1996).

[15] Teleconference held June 19, 2019. Attendees from Norfolk Southern: Mr. Roger Bennett (NS Corp) and Mr. Scott Overbey (NS Corp).

To obtain approval of a new at grade crossing, Norfolk Southern normally requires a Concept Package be submitted[16]. The review of this package, and subsequent plans are normally reviewed by Norfolk Southern at the requesters expense. It is likely that the Town would need to enter into a Preliminary Engineering agreement with Norfolk Southern and provide compensation to Norfolk Southern to continue applying the new at grade crossing.

The coordination with Norfolk Southern, research and analysis concluded:

1. The location of the new crossing for Concept A is not acceptable to Norfolk Southern. Even extraordinary efforts by the Town and County will be insufficient to overcome the general aversion to new at grade crossings, and especially to the proposed location.
2. The Town and County do not have existing crossings that can be eliminated to continue a dialog with Norfolk Southern. Nor does the Town and County have plans for major investment in a rail facility to make the new crossing part of a larger package.
3. To further pursue the new crossing for Concept A will require developing a Concept Package, and possibly enter into a Preliminary Engineering agreement with Norfolk Southern, and incur the expense of Norfolk Southern engineering reviews.
4. The location of Concept A is not superior to the other options. Concepts B and D create more developable property than Concept A. Concepts B and D have less wetland impacts than Concept A. Concept A's only advantage is lower construction cost.

As such, the Study Team recommended that the Town and County discontinue consideration of Concept A as the proposed Southeastern Collector. Concept C is a combination of Concept A and Concept D; as such this concept is also eliminated.

Final Concepts Selected for Study

Concept B and Concept D were selected for further study. Within both concepts there are two variations, resulting in four Concepts, shown on the following page in Figure 2.1:

1. Concept B1- Extend Jack Enders Boulevard into Smallwood Property, perpendicular to Craig's Run and onto Smallwood Lane. Upgrade Smallwood Lane and Smallwood Lane existing at grade crossing of Norfolk Southern RR.
2. Concept B2 – Similar to B1; however, the roadway will run further east to take advantage of existing Smallwood Lane.
3. Concept D1 – Identical to B1, without the connection to Smallwood Lane. This alternative will not provide a crossing of Norfolk Southern for the expanded Business Park.
4. Concept D2 - Identical to B2, without the connection to Smallwood Lane. This alternative will not provide a crossing of Norfolk Southern for the expanded Business Park.

[16] Norfolk Southern Railway Company, Public Projects Manual, Rev 2; Section 4 page 3.

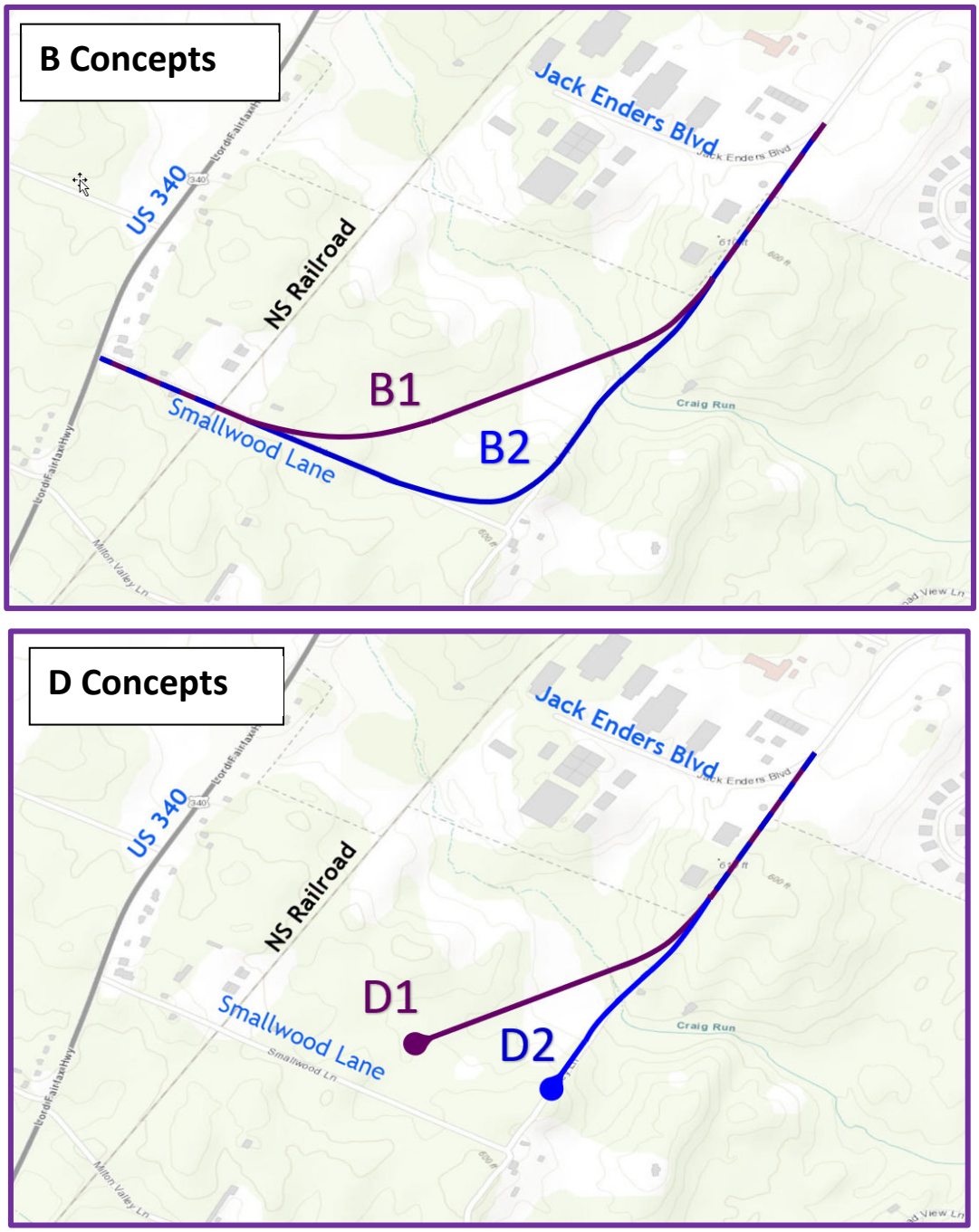


Figure 2.1: Concepts for Southeastern Collector

Characteristics of the Concepts

The proposed collector is planned as a rural collector. The design criteria for this roadway specifies 12 foot lanes, 4 foot paved shoulders and superelevation[17]. The design speed in rolling terrain is 50 mph. Although the design speed does not specify the posted speed limit, it does lead to geometric criteria that accommodate that speed. A summary of criteria for the rural collector:

- Design speed (rolling terrain): 50 mph
- Minimum width of lane: 12 feet
- Minimum width of graded shoulders: 8 feet; with 4' paved.
- Minimum radius: 760 feet.

Existing Jack Enders Boulevard (shown to right) generally meets these criteria, with the exception of paved shoulders. Although it is desirable that the typical section of the existing Jack Enders Boulevard match the new section, it is not required. Furthermore, it is possible that a design exception could be obtained for the proposed roadway. However, for planning and cost estimating purposes, the criteria and typical section for fully compliant rural section are assumed.

Figure 2.2 shows the typical Section of the proposed collector. The assumed ROW is 70 feet with a 13-foot separation between the edge of pavement and the shared use path. At the RR crossing the shoulders are reduced and the ditches are eliminated, as such the required width is 32 feet.

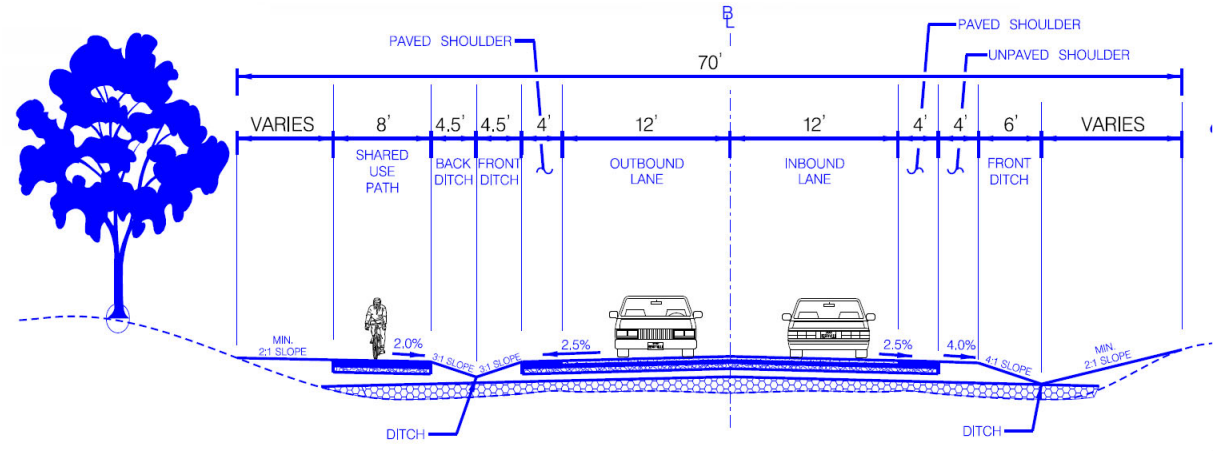


Figure 2.2: Typical Section of Southeastern Collector

[17] Superelevation is banking of a roadway on curves and is not found on low volume or residential roadways.

The Concepts will extend Jack Enders Blvd and create a new intersection with the last portion of Jack Enders Blvd. This new intersection is the same for all of the Concepts and is shown in the extract below and in Figure 2.5 on the following page. Additional Concept Plans are in Appendix D.

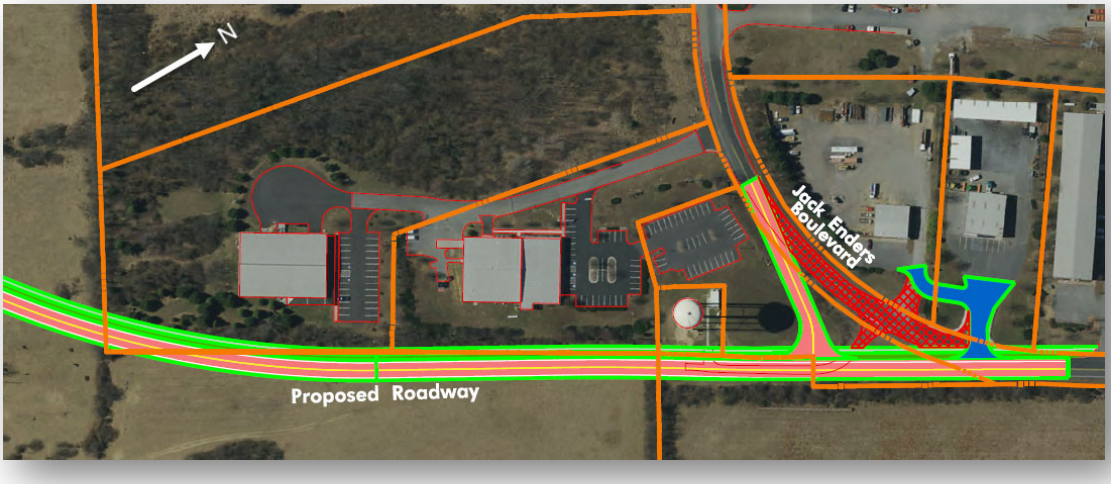


Figure 2.3: Northern terminus of Concept D1

Concept B1 and Concept B2 will create an expanded intersection at US 340 and Smallwood Lane. This expanded intersection will require northbound deceleration and acceleration lanes. North of this intersection US 340 widens to a three-lane section. This three-lane section will be carried further south to allow for a dedicated southbound left turn lane onto Smallwood Lane. These improvements are shown in Figure 2.5 and in the extract below.

The expanded intersection at US 340 and Smallwood Lane will generally fit within the US 340 Right-of-Way (ROW). The ROW of the businesses just to the north of Smallwood Lane are currently using VDOT ROW for signs and access, some of this area will be used for the expanded intersection.

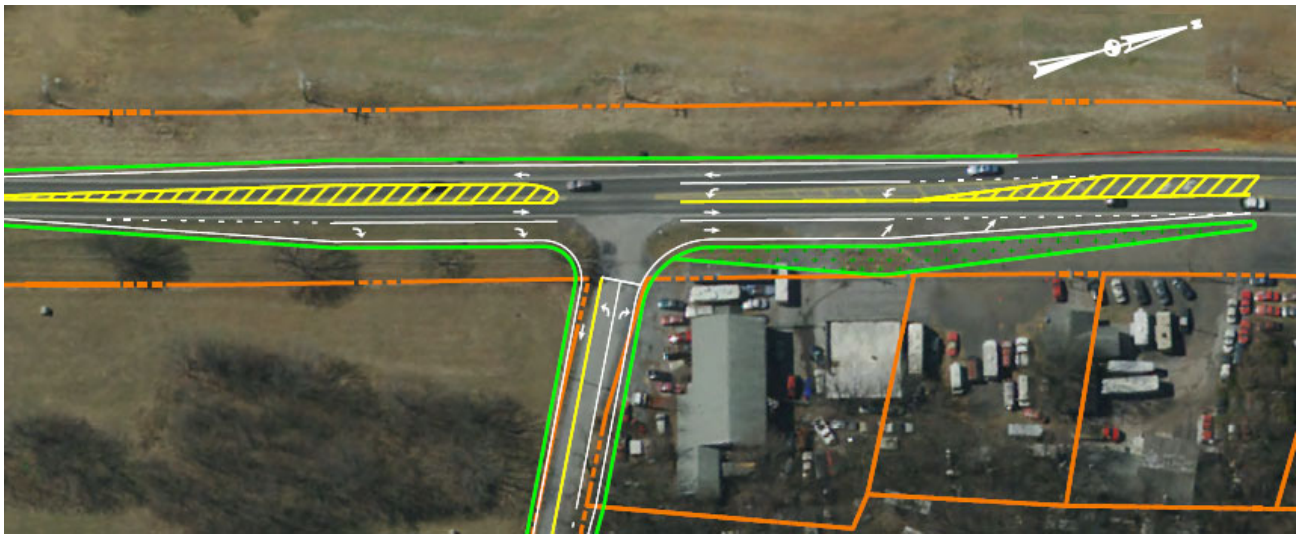
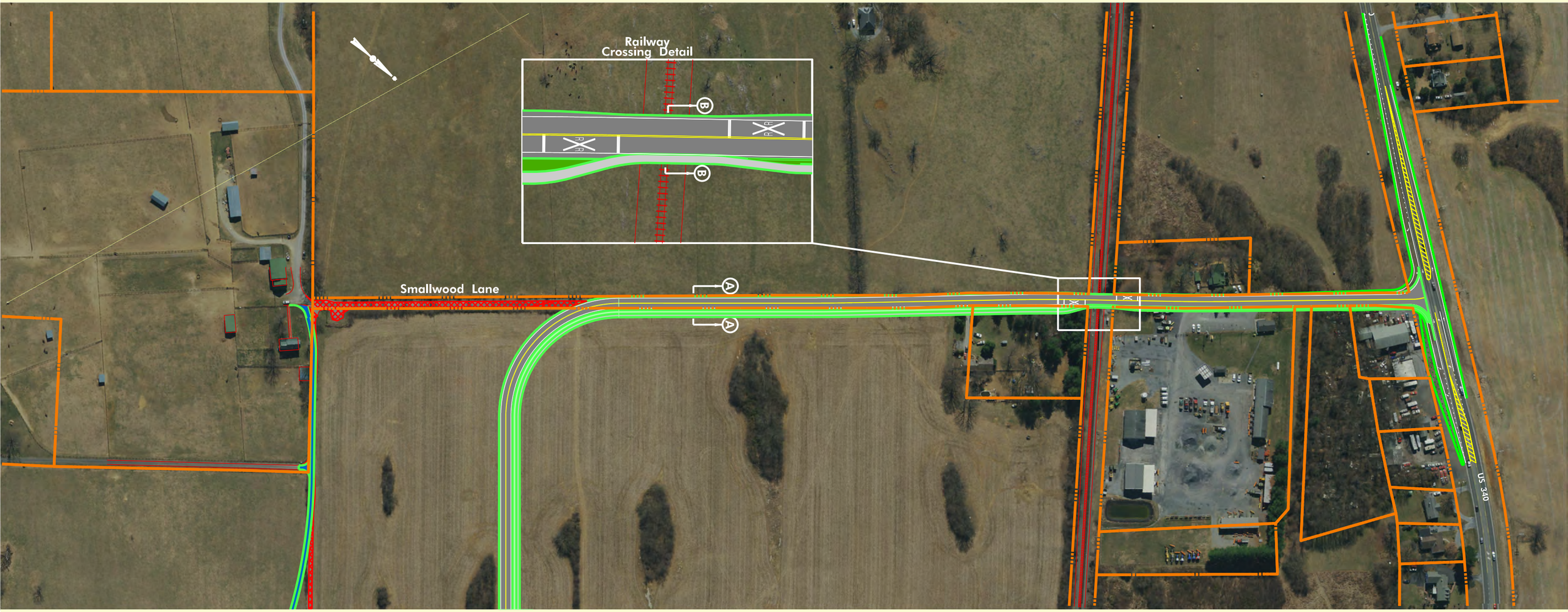


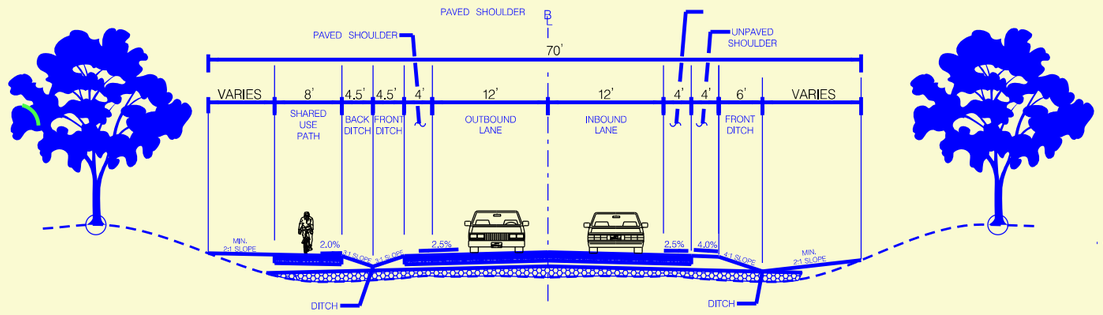
Figure 2.4: Southern terminus of Concept B1 and B2

Berryville Roadway Improvements
CONCEPT B1 - PART 1

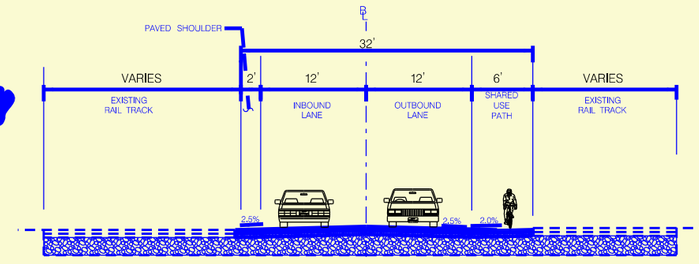


LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL



PROPOSED TYPICAL SECTION AA – RURAL COLLECTOR

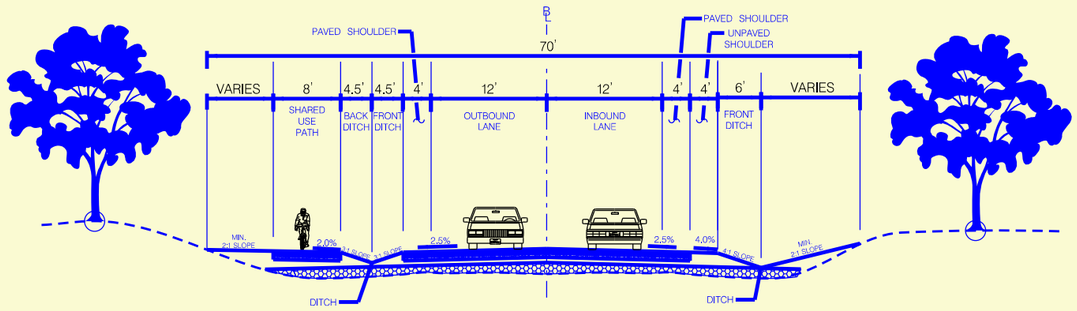


PROPOSED TYPICAL SECTION BB – RURAL COLLECTOR

Berryville Roadway Improvements
CONCEPT B1 - PART 2

LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL



PROPOSED TYPICAL SECTION – RURAL COLLECTOR

3. Concept Analysis

3.1 Methodology

To determine which of the four concepts best meets the needs of the Town of Berryville and Clarke County, VA a quantitative and qualitative analysis was conducted. This analysis determined the relative costs, benefits and impacts of each concept and this section explains the results in the following subsections:

- **Land Use** – the amount of property made available by the Concept and ability of each alternative to promote development.
- **Traffic Service** – the ability of alternative to improve overall circulation, reduce trucks in downtown Berryville. Change in traffic volumes at key intersections and a general evaluation of new traffic patterns.
- **Natural Environment** – Impacts to wetlands, forested areas, streams, flora and fauna and animals.
- **Historical Resources** – Impacts to historic buildings, areas and sites. Federal, State and Local sites are considered.
- **Community Impacts** – Impacts to neighborhoods and community facilities are estimated.
- **Costs** – Construction and ROW costs are determined.

3.2 Land Use

This benefit is evaluated for:

a) How much property is made available for development by the improvement?
b) How likely is the development to occur relative to the other Concept alternatives?

The Clarke County Business Park is zoned BP Business Park and regulated under Section 612 of the Town of Berryville Zoning Ordinance. This designation allows for a maximum allowable density of 0.35 acres of developable land. This means that for every acre of developable land on the property, 0.35 acres can be built on. However, it is unlikely that every parcel will be developed to the maximum allowable density. A separate analysis was conducted to determine the future development.

The analysis assumed that future development has the same characteristics as the existing Business Park. Fourteen parcels of light industrial services were identified with an existing total rooftop area of about 301,000 Square Feet. The parcels cover a total land area of about 65 acres, with an estimated 44 acres of developable land. This translates to about 4,600 square feet of building per acre of developable land, or a ratio of 0.16 acre/acre.

The Business Park (BP) designation allows many types of uses including heavy industrial production such as Textile Product Mills and Heavy Construction. It also allows light industrial, which generates smaller consumer goods. The analysis assumes light industrial.

Concept Alternative B1, and B2. All the alternatives take advantage of the Smallwood Property between the existing Commercial Park and Smallwood Lane. The B1 alternative could also take

advantage of the properties to the south of Smallwood Lane, however that property – Milton Family Farm - is in an agricultural easement.

Alternative B2 is located east of B1 and could take advantage of the property to the east. This extension would likely be after the full buildout of the Smallwood Property.

An estimated 500,000 square feet are made available by each of the alternatives. The precise yield will depend on the development patterns and feeder road system. Figure 3.1 shows a scenario that will create 500,000 square feet of developable property.

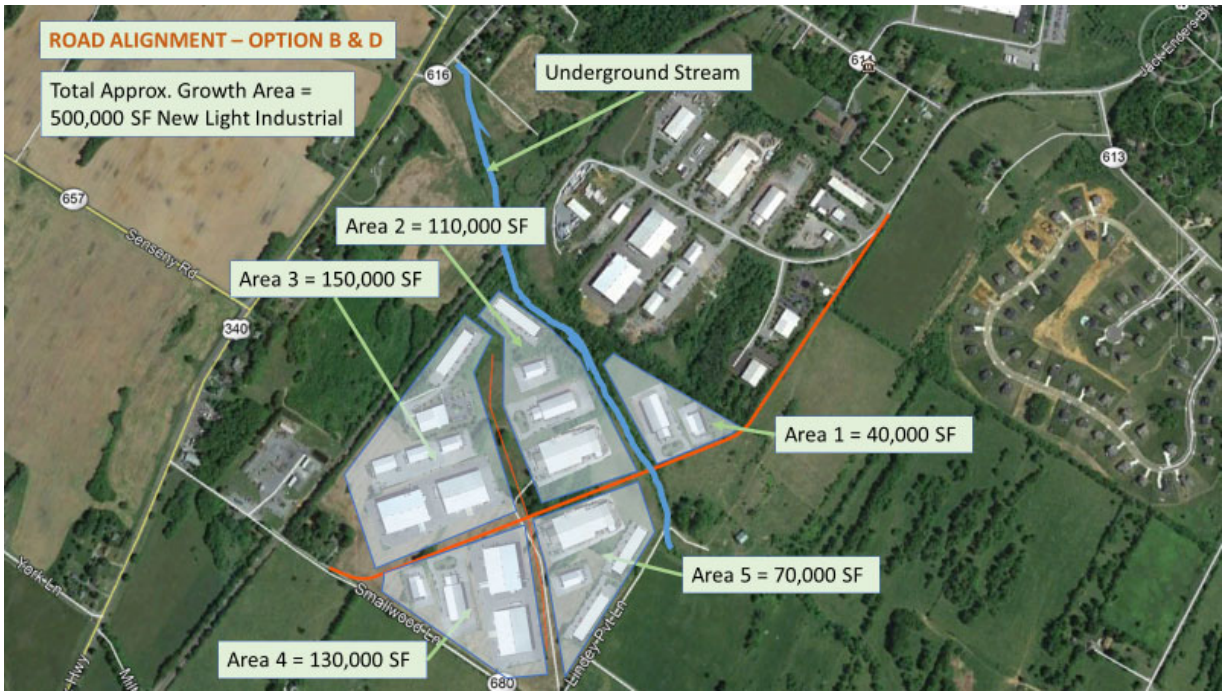


Figure 3.1: Theoretical Build-out of Smallwood Property.

Concept Alternatives D1 and D2. Similar to B1 and B2 the D Concepts can take advantage of the Smallwood property. As with the B Concepts, D2 is better positioned for a future buildout to the east. However, the improved accessibility of the new connection to US 340 will make the Smallwood Property more attractive. A summary of the analysis:

Table 3.1 Summary of Land Use Benefits

	Concept B1	Concept B2	Concept D1	Concept D2
New SF Commercial / Light Industrial Land Use	500k SF	500k SF	500k SF	500k SF
Future Expansion to East	Possible	Better	Possible	Better
Attractiveness to Development	Better, Good connection to US 340	Better, Good connection to US 340	Possible	Possible

3.3 Traffic Service

3.3.1 Overview. Each Concept is assumed to bring light industrial development of approximately 500,000 Square Feet. The B1 and B2 Concepts provide new access to US 340. These concepts also provide a de facto bypass of Berryville along Jack Enders Boulevard extended. This additional development and the new connection will change traffic patterns in Berryville. The analysis was conducted to:

- Determine what improvements are needed, if any, at Jack Enders Boulevard and East Main Street for each Concept.
- Determine what upgrades to the intersection of US 340 and Smallwood Lane will be necessary with the B1 and B2 Concepts.
- Determine the general changes in traffic in downtown Berryville from each of the Concepts.

To answer these questions, the microsimulation AIMSUN was used to model the Town's road-network. Three intersections were analyzed with SNYCHRO to determine changes in Level of Service (LOS) along US 340 and Main Street. The three study intersections are:

- East Main Street and Jack Enders Boulevard,
- Main Street and US 340,
- US 340 and Church Street.

In addition, the intersection of US 340 and Smallwood Lane was analyzed for future conditions with Concept B1 and B2.

3.3.2 Traffic Methodology. Traffic projections in Berryville are challenging. There are many alternative routes for traffic to use – traffic can use Rt 7 to bypass Main Street or traffic can divert (i.e. "cut through") to local roadways to avoid downtown. Furthermore, traffic is dynamic. When an intersection becomes congested, traffic will divert away from that intersection until the intersection becomes less congested.

To meet these challenges and to show the changes in traffic flow an AIMSUN microsimulation of the Town was created.:

- The entire Town road network was downloaded and processed.
- Traffic was assigned using a 16 X 16 PM peak hour Origin Destination Matrix. The OD Matrix consisted of 5 external nodes and 11 internal Transportation Analysis Zones (TAZ).
- Trip generation from the11 different internal TAZs were estimated from an inventory of buildings in the TAZ (Appendix A-4)
- Average Daily Traffic (ADT) from the VDOT database and Turning Movement Counts taken for the study at the three study intersections were used to calibrate and validate the model.

The process to develop the road network, to create the 16 X 16 Origin Destination Matrix and to validate the model are explained further in Appendix A: Traffic Analysis Methodology.

The analysis focuses on the three study intersections; however, general trends throughout the network as predicted by the model were observed as well.

3.3.3 Changes in Traffic Patterns. The analysis determined the following for Concept B and Concept D at the three study intersections. The figures shown are the changes in intersection volumes when compared with existing traffic.

Changes in traffic with Concept B at Jack Enders Boulevard and East Main Street:

- The additional 500,000 square feet of light industrial was estimated to generate 450 new trips. Of these 340 new trips are *from* the development and 110 new trips *to* the development during the PM peak hour.
- Eastbound Traffic to Jack Enders Boulevard decreased, despite these new trips. This is due to traffic accessing Jack Enders Boulevard from the new connection from Smallwood Lane.
- The traffic impacts from the new development are largely mitigated with the new connection with US 340. The total volumes at the Jack Enders Boulevard / Main Street intersection increase slightly.

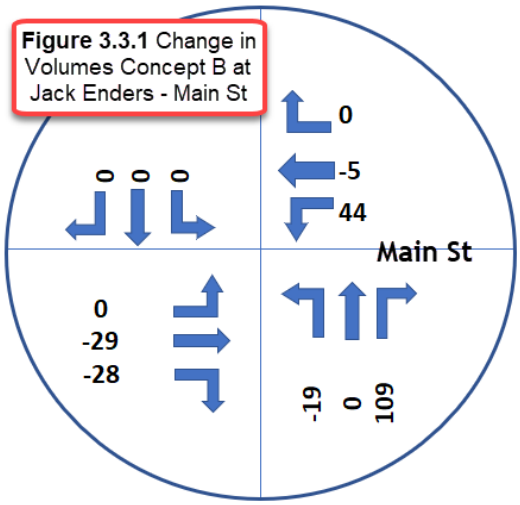


Figure 3.3.1 Change in Volumes Concept B at Jack Enders - Main St

Changes in traffic with Concept D at Jack Enders Boulevard and East Main Street.

- Nearly all of the 450 peak hour trips will pass through this intersection.
- Without another access point, traffic on Jack Enders Boulevard more than doubles; from 301 vhp to 775 vph.
- As shown in Figure 3.3.2, the increase in left turns out of Jack Enders Boulevard increased by 156 vehicles per hour, and left turns onto Jack Enders Boulevard increased by 20 vph. These increases will warrant a new signal at this intersection.

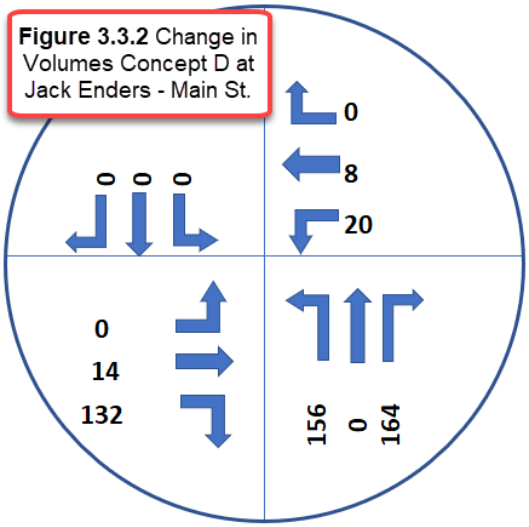


Figure 3.3.2 Change in Volumes Concept D at Jack Enders - Main St.

Changes in traffic with Concept B at Main Street and US 340

- New traffic, to and from the south result in slight changes in traffic patterns through the intersection. Some of the decreases are due to traffic using Concept B to bypass the Town.
- Overall, the intersection volumes increase by 67 vph.
- Some of the decreases (shown as negative numbers) are traffic diverted to smaller downtown streets.

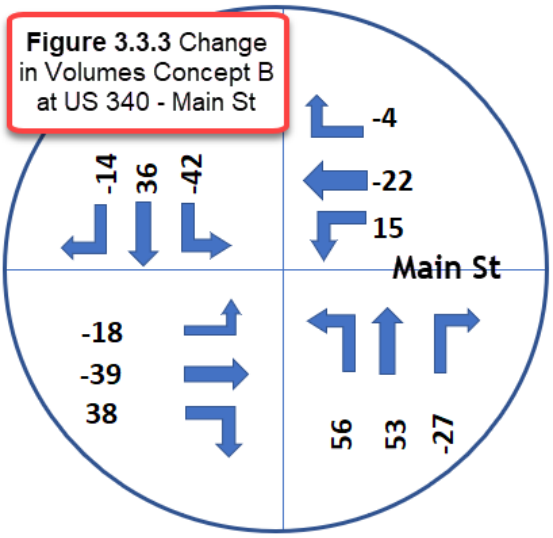


Figure 3.3.3 Change in Volumes Concept B at US 340 - Main St

Changes in traffic with Concept D at Main Street and US 340:

- The overall intersection volumes increase by 196 vph. Without traffic diverting to smaller downtown streets, this increase would be significantly greater.
- Nearly 200 vph are diverted to local roadways to avoid the US 340 – Main Street intersection. The mircro-simulation projected increases in the roadways shown in Table 3.2 on the following page.

Changes in traffic with Concept B at US 340 and Church Street:

- The increase northbound of 90 vph is due to development traffic using the new connection to reach destinations to the north and west. This increase is also seen in the increase in left turns and through traffic at the Main Street intersection.
- The increase southbound of 37 vph is due to traffic traveling to the new development.

Changes in traffic with Concept D at US 340 and Church Street:

- Overall, traffic volumes are little changed from existing conditions.
- Additional traffic is traveling from the north or south, to or from the new development via US 340 and Main Street.

Projected traffic volumes are shown on the following page in Figure 3.4. The intersection of US 340 and Smallwood Lane, with Concept B has the projected traffic volumes shown in Figure 3.5.

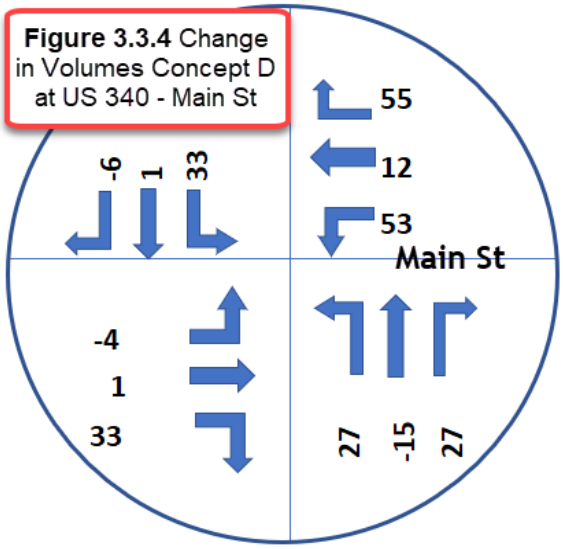


Figure 3.3.4 Change in Volumes Concept D at US 340 - Main St

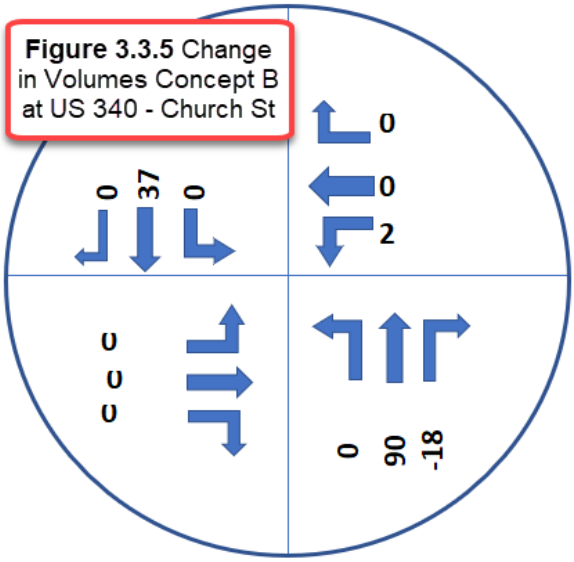


Figure 3.3.5 Change in Volumes Concept B at US 340 - Church St

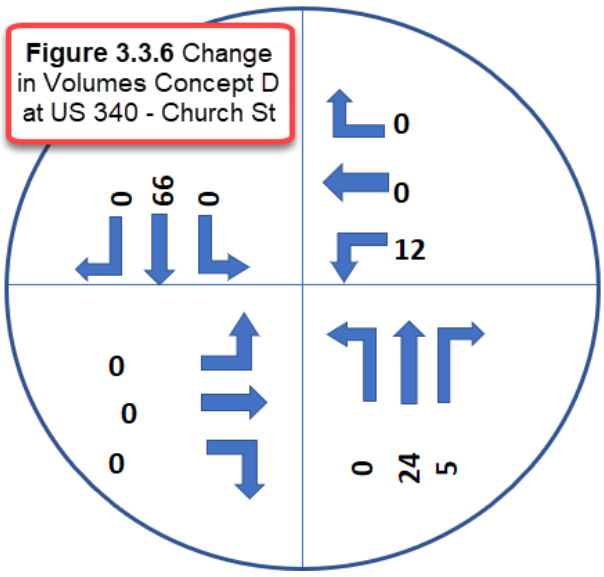
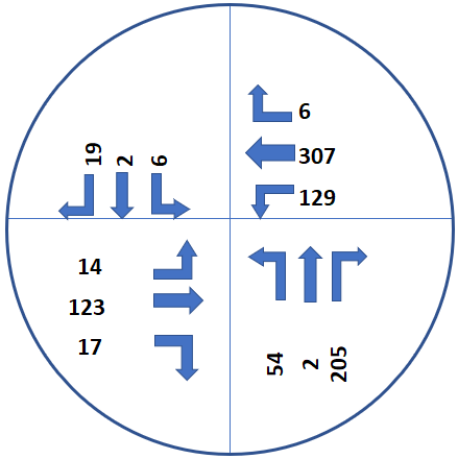


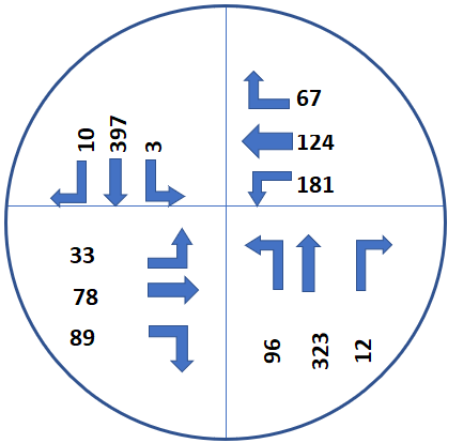
Figure 3.3.6 Change in Volumes Concept D at US 340 - Church St

Jack Enders Boulevard / Main Street

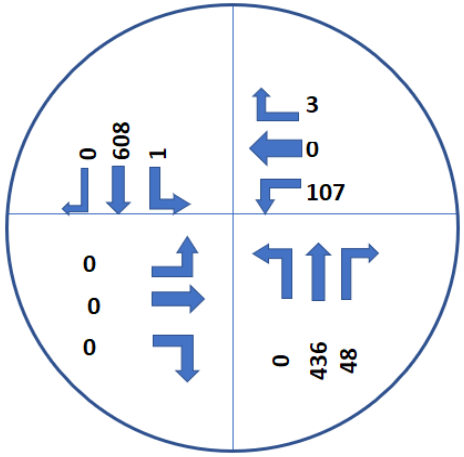


US 340 / Main Street

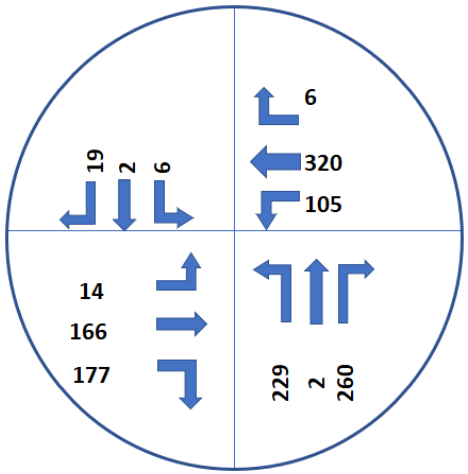
CONCEPT B

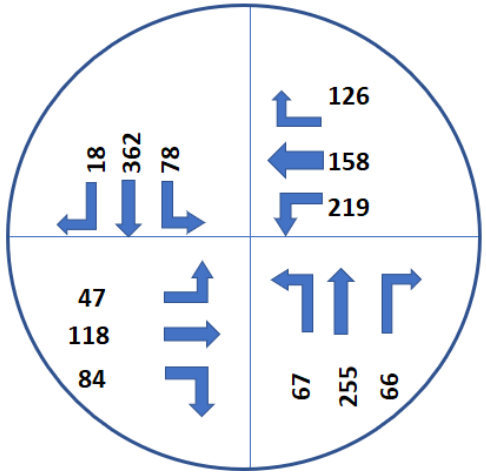


US 340 / Church Street



CONCEPT D





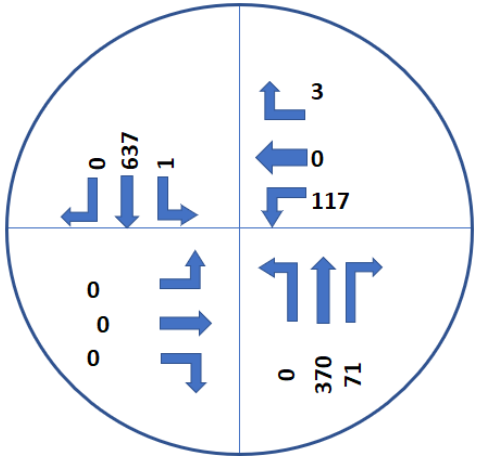


Figure 3.4: Projected Traffic Volumes at Study Intersections.

3.3.4 Changes in Traffic Patterns. As a result of the improved connectivity, Concept B projects only minor changes throughout the Berryville roadway network. Table 3.2 shows that despite the addition of 450 new trips from the new development, the only significant increases are at the new, southern connection with US 340.

With Concept D, nearly 1/3 of the increased traffic volume are projected to use local streets to avoid the downtown area and the US 340 – Main Street Intersection. The microsimulation projects traffic to use the town grid, but most significantly North Church Street, Bundy Street, Academy Street, Liberty Street and Page Street. Nearly 200 vehicles during the PM peak hour are projected to divert away from the intersection of US 340 and Main Street.

Concept D also exposes pedestrians and some residents to greater traffic. Along East Main Street there are residences, pedestrians and no sidewalks. The additional business park traffic will expose pedestrians to more truck traffic. Closer to the center of Town the diverted "cut through" traffic will expose residents to external traffic.

The 450 vph new trips generated by the 500 thousand square feet of development results in increases in traffic throughout the town streets.

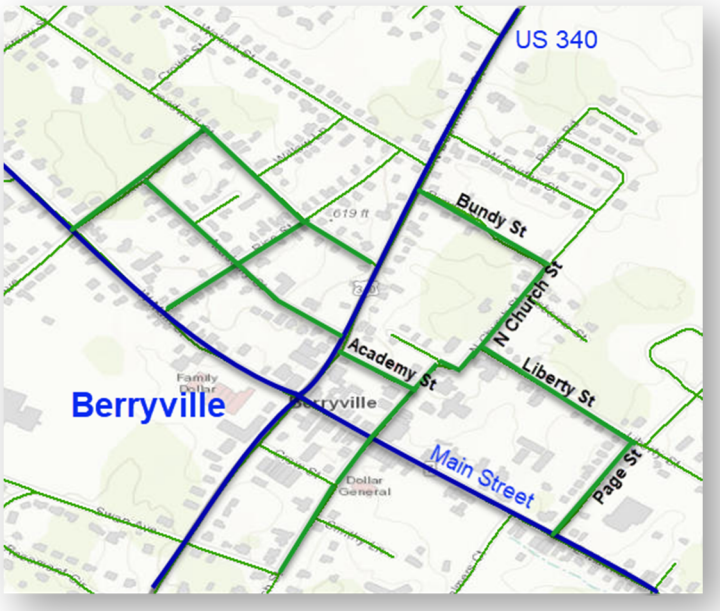


Figure 3.2: Concept D Diversion Routes Used (Shown in Green)

Table 3.3 shows the increases at the study intersections. The largest increases are at Jack Enders Boulevard and Main Street with Concept D and US 340 and Smallwood with Concept B.

Table 3.2 Change in Traffic From Concepts

Location	Existing vph	Change B	Change D
US 340 Main Street Intersection	1381	+32	+216
Main Street / Jack Enders Intersection	812	+72	+494
US 340 Church Street Intersection	1092	+111	+107
US 340 – Smallwood Lane	1040	+407	+62

3.3.5 Concept B Bypass Traffic on Collector. Some traffic is projected to use the Concept B Collector to bypass downtown Berryville. For example, the model projects 50 vph from south to north to bypass the Town. However, the Origin Destination table assigns 60 vph to travel form points south on US 340 to points east on Rt 7. As such, most of the traffic making this movement is assigned by the model to use the new collector roadway. In addition, there are destinations along and north of Main Street that could also be used by the bypass. The overall potential is 45 vph and the model assigns 15 vph (1/3) of these trips to the Collector.

The model used current stop control at the intersection of US 340 and Jack Enders Boulevard, and some congestion did occur at this location. This congestion, in part, discouraged more traffic from using the Southeastern collector as a bypass. The potential for a larger volume using the collector as bypass is shown in Table 3.3.

Table 3.3: Bypass Trips

From	To	Total Volume	Predicted to use the Collector as Bypass Route
Points South via US 340	Points east via Main Street/ RT 7	60 vph	50 vph
Points South via US 340	NE quadrant of Town (1st Street and Battlefield Dr)	45 vph	15 vph
Points east via Main Street/ RT 7	Points South via US 340	65 vph	50 vph
NE quadrant of Town (1st Street and Battlefield Dr)	Points South via US 340	62 vph	15 vph
Totals		**232 vph**	**130 vph**

3.3.6 US 340 - Smallwood Lane Intersection. Smallwood lane currently has very slight traffic, serving three residences, a business and the VDOT maintenance yard. With Concept B the combination of Smallwood Lane and Jack Enders Boulevard extended will serve a large area and provide a route to bypass downtown Berryville. This results in a new expanded intersection on US 340 and the likely need for a new signal at this intersection. The level of service of this intersection and the other study intersections is discussed in the next section.

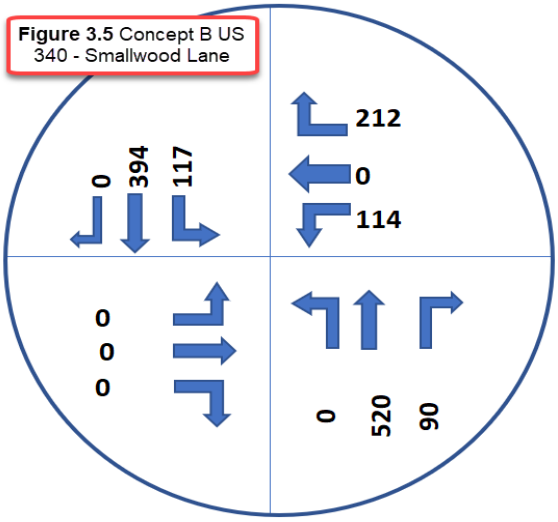


Figure 3.5 Concept B US 340 - Smallwood Lane

Using tables from the Manual of Uniform Traffic Control Devices (MUTCD) the volumes at the US 340 and Smallwood Lane intersection do not justify a new traffic signal. At full build; however, with heavy truck traffic, the highspeed through volumes, nearby railroad tracks and

the multipurpose trail along Concept B, a signal will provide an additional measure of control and safety to the intersection, and it may be required by VDOT when traffic volumes warrant it.

3.3.7 Concept B Smallwood Lane / Norfolk Southern Queue Analysis. The distance between Norfolk Southern Railroad tracks and US 340 is 770 feet. SYNCHRO was used to estimate the queues between US 340 and the Railroad tracks to confirm that traffic would not backup over the tracks (westbound traffic) or onto US 340 from the tracks (eastbound). For the eastbound queue, a five-minute wait for a passing train was assumed. The queue analysis showed enough roadway length, as shown in Table 3.4:

Table 3.4: Queue Lengths at US 340 and Smallwood Lane with Concept B

	EB with 5 Minute Stoppage	WB with normal signal operations
Maximum Queue	637 feet	230 feet
95% Queue	483 feet	125 feet
Average Queue	128 feet	84 feet

3.3.8 Projected changes in Level of Service. With only modest increases at most of the study intersections, the Level Of Service (LOS) of the three study intersections are little changed by the additional volume. The most significant change is at the intersection of Jack Enders and Main Street.

- **US 340-Main Street.** Only minor changes in LOS at this intersection was projected by the analysis. The LOS remains at LOS C for both Concept B and Concept D. Concept D has slightly more delay that Concept B.

  The microsimulation model routed trips away from this intersection during the simulation as congestion became greater. There were slower, but relatively uncongested local and residential streets that became more attractive. With the advance of route-finding applications, such as Waze or Google Maps, these diversions are realistic.

- **Jack Enders Boulevard/Main Street Improvements Needed**. With Concept B, the intersection of Jack Enders Boulevard and Main Street will not need to be signalized. However, a new westbound left turn lane is needed and was assumed in the analysis. With Concept D a new left turn lane, and a new traffic signal will be required. Unsignalized analysis showed excessive queues for the northbound movement.

  A signal is also assumed at US 340 and Smallwood Lane for Concept B; however this signal would not be necessary until full buildout of the Business Park.

- **US 340 at Church Street**. Volumes for both B and D increase on US 340 and the left turning vehicles from Church Street have difficulty gaining access to southbound US 340. However, there are several alternatives for traffic from Church Street to access US 340 South. With Hermitage Boulevard, Taylor Street or Swam Avenue also providing access to US 340 South, the left turn from Church Street is not expected to be problematic

Table 3.5 Changes in Level of Service.					
		Existing	Projected Concept B	Projected Concept D	
US 340 – Main Street		PM Delay Sec	PM Delay Sec	PM Delay Sec	
	Northbound	21.0/ C	16.2/B	24.8/C	
	Southbound	23.9/ C	25.0/C	27.6/C	
	Eastbound	28.5/ C	25.5/C	28.1/C	
	Westbound	27.8/ C	29.2/C	33.4/C	
		25.0/C	23.5/C	28.8/C	
Main Street – Jack Enders Boulevard					
	Northbound	**13.8/ B**	**12.9/B**	27.6/C	
	Southbound	**12.6/ B**	**14.8/B**	19.8/B	
	Eastbound	**0.5/ A**	**0.7/A**	32.0/C	
	Westbound	**1.0/ A**	**2.3/A**	26.5/C	
				28.3/C	
US 340 – Church Street					
	Northbound	**(0.0)**	**(0.0)**	**(0.0)**	
	Southbound	**(0.0)**	**(0.0)**	**(0.0)**	
	Westbound	**29.6/ D**	**39.6/E**	**40.0 / E**	
US 340 – Smallwood Lane					
	Northbound	NA	4.1/A	NA	
	Southbound	NA	4.1/A	NA	
	Westbound	NA	9.5/A	NA	
			5.3/A		
Notes: **Bold** indicates unsignalized analysis.					

3.3.9 Planning for Signalized Intersection Control

Intersections are converted from stop control to signalized control when safety, intersection delay or other operational condition justify the change. To assist traffic engineers with making this decision, the Manual for Uniform Traffic Control (MUTCD) has nine considerations, referred to as Warrants, that the traffic engineer analyzes. An example of Warrant 3 is on the following page.

MUTCD Traffic Signal Warrants

1. Warrant 1, Eight-Hour Vehicular Volume
2. Warrant 2, Four-Hour Vehicular Volume
3. Warrant 3, Peak Hour
4. Warrant 4, Pedestrian Volume
5. Warrant 5, School Crossing
6. Warrant 6, Coordinated Signal System
7. Warrant 7, Crash Experience
8. Warrant 8, Roadway Network
9. Warrant 9, Intersection Near a Grade Crossing

If one or more of these warrants are met, the addition of a signal may be justified. If none of the warrants are met, the signal is normally not justified. A signal may be put into place without meeting one of the nine Warrants, however there would need to be extenuating or unusual circumstances. VDOT discourages the addition of signals for anything other than safety or operational issues.

The VDOT will wait for traffic to build up to add a signal. Traffic projections may justify the new signal, but VDOT is not likely to place a signal based only on contingent projections. As such, at Jack Enders Boulevard and Main Street and at US 340 and Smallwood Lane, new signals will not be placed until the actual traffic justifies the signal. In such cases VDOT will require that the Southeastern Collector design incorporate the signal and include some of the signal infrastructure in the roadway project.

3.3.10 Phased Implementation of Development and Improvements. The proposed 500,000 square feet of new light industrial development is not likely to occur suddenly. It may not even be light industrial; Section 4: Implementation, discusses a need for the Town to seek all types of desirable development. The build up to 450 new peak hour trips, will take time to achieve.

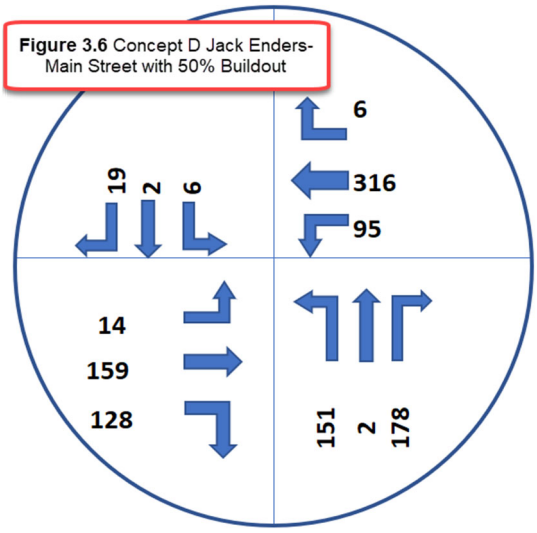


Figure 3.6 Concept D Jack Enders- Main Street with 50% Buildout

The negative traffic impacts of Concept D are apparent after full implementation. A key question is at what point will these negative impacts become apparent. To answer these questions, 50% of full buildout was evaluated. Figure 3.6 shows Jack Enders Boulevard – Main Street Volumes with 50% of full buildout.

With improvements to Jack Enders Boulevard a signal is not yet warranted. Figure 3.7 shows Warrant 3, Peak Hour. The green dot shows that under this warrant a signal does not meet the warrant with an additional turn lane on Main Street. Turn lanes would normally be added to the major street (Main Street) before installation of a new signal.

Concept D at 50% of full buildout:

- Need for Signal – No;
- Need for Left Turn WB Lane – Yes;
- Need for Right Turn EB Lane – Yes;
- Diverted Traffic in Berryville – approximately ½ of Full Buildout – 100 vph.

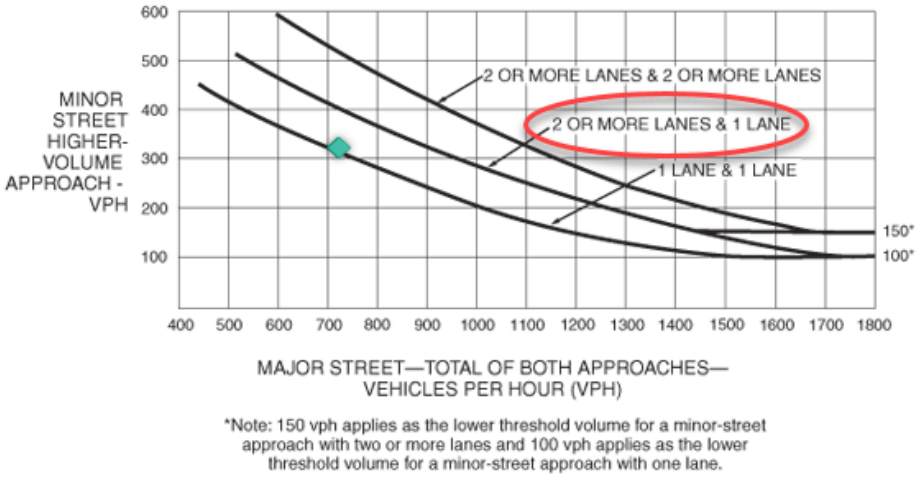


Figure 3.7: Warrant 3, peak hour with 50% of Buildout.

Concept B1 could be constructed in four phases. First, an extension from Jack Enders Boulevard into the Smallwood property would be built to support development. Next, as development progresses, improvements to the Jack Enders Boulevard / Main Street Intersection would be built. As development approaches 75% of buildout, the Connector will need to extend to US 340. Finally, a signal at the intersection of Smallwood Lane and US 340 will be necessary. This progression is shown in Figure 3.8.

Activity on Site		Roadway Improvements
1. Conduct Visioning and Strategic Planning;		
2. Complete Planning, gain Property Access;	→	Begin preliminary roadway plans and gain permits.
3. Initial Development;	→	Extend partial Connector into Smallwood Property.
4. 25% to 50% build out;	→	Improve Jack Enders – Main Street Intersection.
5. 50% to 75% build out;	→	Complete Connector to US 340. Improve US 340 Intersection.
6. Over 75% build out.	→	New Signal at US 340 / Smallwood Lane.

Figure 3.8: Timing of Connector Construction

The timing of the improvements in Figure 3.8 will depend on the type of development and corresponding number of trips generated. When development reaches 25% of full buildout approximately 125 thousand SF of development will have occurred. For a typical industrial park this will create an additional 870 new daily trips and 107 new peak hour trips. This typical scenario is not likely to trigger the need for roadway improvements, however if the new development has greater than typical trip generation or a high number of trucks then new roadway improvements may be necessary.

Traffic Analysis Summary

Findings

- The development associated with the Collector roadway is projected to be 500,000 Square Feet (SF) of light industrial. This development is projected to generate 340 vph *from* the area and 110 vph *to* the area (PM peak hour).
- The downtown Berryville Main Street Intersections are projected to have modest increases in traffic volume and intersection delay.
- Additional traffic from Concept D is expected to use local streets to avoid the center of Berryville. With Concept D nearly 200 vehicles during the PM peak hour are projected to divert away from the intersection of US 340 and Main Street.
- Concept B creates a route to bypass downtown Berryville. The model projects 130 vph to use Concept B as a bypass under normal conditions (PM peak hour).

- The traffic at the Jack Enders Boulevard / Main Street intersection will increase by 494 vph, over 60%, with Concept D. Current total volume is 812 vph.
- With Concept D additional capacity is needed at Jack Enders Boulevard and Main Street. A new signalized intersection with a dedicated westbound left turn lane and eastbound right turn lane will be necessary.
- Initially the negative impacts from Concept D will be manageable. A new signal at Jack Enders Boulevard will not be necessary until development is well underway.
- Traffic on Smallwood Lane will increase from 10 vph to 533 vph with Concept B. This will create the need for improvements to US 340 and, eventually, a new signal.

Traffic Conclusions. The improved connectivity provided by Concept B provides traffic benefits in Berryville. Without the additional connection development related traffic will divert to local streets and the Jack Enders Boulevard / Main Street intersection will require significant improvements.

3.4 Natural Environment

All the concepts are largely located in farmland, as such impacts to habitat, forests, and endangered species are estimated to be minimal. The impacts will be limited to Craig's Run, an intermittent stream which is surrounded by wetlands, and a freshwater forested wetland. Craig's Run is listed on the EPA 303d list for impaired waters in Virginia for E-coli from NPS agricultural runoff. The wetlands fall under section 404 of the Clean Water Act requiring delineation and permitting for any impacts.

The B1 and D1 Concepts have the least impacts to wetlands. They were developed to have a cleaner, more direct perpendicular crossing of Craig's Run that minimizes the area impacted. Nonetheless the B2 and D2 Concepts are still estimated to impact only 1 acre of wetlands.

Although none of the Concepts will have a major effect on Craig's Run, the impacts to wetlands and forestlands will need to be delineated and a Joint Permit Application to the Virginia Department of Environmental Quality will need to be conducted.

Impacts to Forestland is also minor. The B2 and D2 Concepts have less, but comparable, impacts to forests. A summary of impacts to wetlands and forest lands are in Table 4.2.

According to the Department of the Interior, several potential threatened/endangered species may exist in the study area including: *Myotis sodalis* (Indiana bat), *Myotis septentrionalis* (Northern Long-eared bat), and *Antrolana lira* (Crustacean or unpigmented troglobite). There may also be a *Bartramia longicauda*, (Upland sandpiper) in the region though no sightings have been identified since 2014. Although none of these species' habitat is expected to be adversely affected, a survey of the area will be necessary prior to design and construction of the new collector roadway.

The following protocol will need to be followed for all options.

- A Joint Permit application to the Department of Environmental Quality to determine jurisdiction of DEQ alone or The United States Army Corp of Engineers.
- Impacts to wetland and forestlands will need to be determined by delineations and analysis, ideally, this will assist in avoiding mitigation for any displacement

- Threatened and Endangered species review will be required by US Fish and Wildlife Service (Section 7 review)
- Karst geology considerations for surface limestone, underground seeps/springs and sinkholes.
- There will be additional DEQ permits for stormwater management and erosion and sediment control standards.
- A scenic buffer may be required by the conditions of the easement along Smallwood Lane.

Table 3.6 Summary of Natural Environment Impacts				
	Concept B1	Concept B2	Concept D1	Concept D2
Impacts to wetlands	.50* acres	1.0 acres	0.50* acres	1.0 acres
Impacts to Forests	1.79 acres	1.64 acres	1.79 acres	1.64 acres

*Impacts could be minimized depending upon strategy for construction implemented.

3.5 Historical Resources

Although the Berryville area is rich in historic structures, the Concepts only impact a cluster of buildings located along Lindey Lane. The Concepts will not have direct or indirect impacts to the Josephine City Historic District or the Milton Valley Cemetery.

The structures identified along Lindey Lane were listed on the Clarke County inventory of potentially historic facilities. They have not been protected through the Commonwealth of Virginia or the National Trust for Historic Preservation. It is unclear from discussion with the County or local historic professionals the historic value of these structures. Both Concept B2 and D2 will be near these structures. Further investigation may be required if options will displace them.

Table 3.7 Summary of Historic Resource Impacts				
	Concept B1	**Concept B2**	**Concept D1**	**Concept D2**
Historic Structures within 100 feet	none	3 County Designated	none	3 County Designated

3.6 Community Impacts

The impacts of the one-mile collector roadway through the undeveloped area are slight. Most of the community impacts are as a result of increases in traffic volumes and are identified in Section 3.3.

The most significant changes to Berryville and the surrounding area are due to the change in land use. The development of approximately 500,000 square feet of light industrial will change the appearance of the area just south and east of Berryville. However, as with the existing Business Park, the area can be easily secluded from rest of the town. The casual visitor to Berryville is probably unaware that the existing business Park, with 550,000 square feet of light industrial exists.

To further understand potential impacts to the Berryville area, an outreach program was conducted with key stakeholders. Berryville Graphics and representatives from Top of Virginia Chamber were interviewed. Full meeting notes are in Appendix A, a summary of each interview:

Berryville Graphics – Christy Dunkle and David Metcalf met with Gary Rannells and other Berryville Graphics Staff. The Berryville Graphics publishing operation takes deliveries and makes shipments generally to the west on Route 7. They have approximately 550 employees spread in 2 or 3 shifts, and they generally come from the north and west.

Mr. Rannells and other staff did not believe a new collector would hinder operations. There is the possibility that a new collector connection with US 340 will reduce the number of deliveries that mistakenly use Josephine Street.

Top of Virginia Regional Chamber. David Metcalf met with Cynthia Schneider of Top of Virginia Regional Chamber. Ms. Schneider did not place expansion of the business park as a high priority to support business in Berryville. However, if the new collector and expanded business park do not distract from the small-town charm of Berryville, then the existing visitor and tourist base would not be affected. She also believed that the limited bypass function the collector would perform would provide improvements to the existing network required and create community obligations.

There is ROW that needs to be purchased the entire length of each concept. These takings are not expected to impact the operations of any of the agricultural or businesses along the roadway. The ROW required by parcel is shown in Table 3.4 and in Appendix C: Construction and ROW costs.

State and Local governments in Virginia have the ability, via eminent domain, to acquire property from private landowners for transportation projects. The private landowner is entitled to fair compensation of their property plus damages. The Virginia Department of Transportation has a well-established process that involves an appraisal, negotiation and additional compensation for hardships created for the property owner.

Most of the private property needed is in the Smallwood property. At either terminus additional ROW is needed to provide for the 70-foot-wide typical section of the roadway. Property along the front or back of 14 parcels will be needed.

To the south of Smallwood Lane, the Milton Valley Farm is in a Forest-Agricultural Easement and is restricted from eminent domain takings. The ROW along Smallwood Lane is estimated to be 33 feet, as such the property needed to the north of Smallwood Lane is as much as 37 feet.

Concept B at the southern terminus requires an upgrade to the intersection. This upgrade will change the access to the auto sales / auto parts businesses to the north of Smallwood Lane. These businesses will have considerably more pass by-traffic and, if desired will be able to redevelop the properties.

The Collector with its associated development will add jobs, revenue and economic benefits to the area. It is not expected to have a negative impact on the Berryville community.

Table 3.8 Right of Way Required by Parcel (Square Feet)					
Parel	**Description**	**Concept B1**	**Concept B2**	**Concept D1**	**Concept D2**
I	NE corner US 340- Smallwood	2,883	2,883		
II	SE US 340 - Smallwood Lane	7,557	7,557		
III	North side of Smallwood Lane	2,103	2,103		
IV	South side of Smallwood Lane	7,404	7,404		
V	North side of Smallwood Lane	894	894		
VI	North side of Smallwood Lane	9,660	9,660		
VII	Residence just east of RR	11,770	11,770		
VIII	Milton Valley Farm Property	0	0		
IX	Smallwood Property	231,511	249,372	188,121	149,848
X	Pumpernickel Press	14,818	6,245	14,818	6,245
XI	Timberlake Cabinet	8,576	8,576	8,576	8,576
XII	Water tower	2,402	2,402	2,402	2,402
XIII	Along Jack Enders	10,998	10,998	10,998	10,998
XIV	West Side, Jack Enders	18,468	18,468	18,468	18,468
XV	West Side, Jack Enders	0	0	0	0
XVI	West Side, Jack Enders	1,030	1,030	1,030	1,030
XVII	West Side, Jack Enders	3,803	3,803	3,803	3,803

3.7 Costs

Construction costs for the Concepts is estimated based on quantities of major cost elements and a contingency of 35%. The costs per mile are consistent with recent highway projects.

Intersection improvements and new signals were estimated for Jack Enders Boulevard and Main Street (Concept D only) and US 340 and Smallwood Lane (Concept B only). Improvements at the Smallwood Lane at-grade rail crossing was assumed to be performed by Norfolk Southern Railroad, but not funded by Norfolk Southern Railroad. The estimated cost is for similar, active crossing examples.

ROW was estimated based on $10,000 / acre for Open Space (Smallwood Property) and $20,000 / acre for residential or business property. The additional ROW along Smallwood Lane was reduced at the Norfolk Southern Rail crossing. No major utility relocations are anticipated in the project.

Table 3.9 Comparative Costs ($ thousands)

	B1	B2	D1	D2
Construction Cost				
Mainline	$8,130	$7,950	$5,280	$4,820
Intersection Improvements	$560	$560	$430	$430
New Traffic Signals	$600	$600	$540	$540
At Grade Railroad Crossing	$160	$160	$0	$0
Subtotal Construction Cost	**$9,460**	**$9,280**	**$6,250**	**$5,790**
Total Length (feet)	*5,500*	*5,650*	*3,200*	*3,000*
Cost per mile	*$9,080*	*$8,670*	*$10,310*	*$10,200*
ROW Costs	**$100**	**$100**	**$60**	**$70**
Total Cost	**$9,560**	**$9,380**	**$6,310**	**$5,870**

Concept D is shorter and consequently less expense than Concept B. The difference between B1 and D2 is slightly more than $3.7 Million. Additional detail on the cost estimates are in Appendix C: Construction and ROW Cost Estimates.

3.8 Alternatives Analysis: Summary and Conclusions

Four Concepts were studied and developed. These Concepts are:

1. Concept A. Extend Jack Enders Boulevard over Norfolk Southern (NS) railroad to US 340.
2. Concept B. Extend Jack Enders Boulevard to Smallwood Lane and improve Smallwood Lane to US 340.
3. Concept C. Extend Jack Enders Boulevard to US 340 and into Southern Potential Growth Area. This Concept is a combination of Concept A and D.
4. Concept D. New Road in Southern Potential Growth Area without a connection to Smallwood Lane.

Concept A and Concept C require a new at grade crossing of the Norfolk Southern Railroad. This new crossing was determined to be not feasible based on coordination with Norfolk Southern and Town of Berryville and Clarke County Staff. The extensive measures and mitigation that would need to be taken to provide minor benefits made these Concepts not feasible.

Within Concept B and Concept D two variations were developed. Concept B1 and Concept D1 cross perpendicular to Craig's Run and are located near the center of the Smallwood property. Concept B2 and D2 use the existing Lindey Lane. The advantages and disadvantages of each concept is as follows:

Concept B1 – This Concept is the most costly but provides the most benefit. The alignment splits the Smallwood Property providing a central roadway for the new business park. The additional connection to US 340 aids the flow of traffic from the new and existing business park.

The alignment also minimizes the impact to Craig's Run and surrounding wetlands. However, it is the costliest Concept with an estimated cost of $9.6 Million

Concept B2 – This Concept is a variation of B1 and uses existing Lindey Lane. Compared with B1 it is located on the edge of the Smallwood Property, and has a less direct crossing of Craig's Run and increased environmental impacts. However, this Concept has the same traffic benefits as B1 and a slightly lower cost of $9.4 Million.

Concept D1 – This Concept follows the B1 alignment, however it does not provide a new connection to US 340. As such it results in additional traffic through downtown Berryville and will require an upgrade to the intersection of Jack Enders Boulevard and East Main Street. The cost is lower than either of the "B" Concepts at $6.3 Million.

Concept D2 – As with B2 this Concept is on the edge of the Smallwood Property and will not be a central roadway for the new business park. It also has a less direct crossing of Craig's Run, which increases the environmental impacts to Craig's Run. However, this Concept has the lowest cost of $5.9 Million.

Both Concept D1 and D2 impact traffic flow in Berryville. Without the connection to US 340 vehicles will increasingly use local roadways to avoid downtown Berryville.

Table 3.10 summarizes the benefits and impacts:

Table 3.10 Summary of Costs and Benefits				
	B1	**B2**	**D1**	**D2**
Land Use	Bisects Smallwood Lane Property	Eastern Edge of Smallwood Lane Property not optimal	Bisects Smallwood Lane Property	Eastern Edge of Smallwood Lane Property not optimal
Environmental	Minimal impact to Craig's Run	Not as environmentally preferred crossing of Craig's Run	Minimal impact to Craig's Run	Not as environmentally preferred crossing of Craig's Run
Traffic Flow	Improves traffic flow throughout	Improves traffic flow throughout	Large increase on Jack Enders Boulevard, traffic diversions onto Berryville streets	Large increase on Jack Enders Boulevard, traffic diversions onto Berryville streets
Implementation	More $$, includes new connection at US 340.	More $$, includes new connection at US 340.	Can be expanded after initial phase.	Can be expanded after initial phase
Total Cost	**$9,560**	**$9,380**	**$6,310**	**$5,870**

Concept B1 and B2 provide a connection to US 340 in the south which improves traffic flow for the business park and for traffic in the downtown area of Berryville. However, with the additional length B1 and B2 are more costly.

The new connection to US 340 is needed as the new business park gains momentum towards full build out. However, in the early phases of development the new connection to US 340 is not as necessary. Either Concept D1 or D2 will serve as an initial phase for Concept B1 or B2 with manageable impacts until the development is at least 50% complete.

The business park is likely to be on the Smallwood Property, and the Concept B1 / D1 best serves this property. It has the added benefit of minimizing impacts to Craig's Run and the properties along Lindey Lane.

Although Concept B1 best meets the needs of the Town and County, the roadway may be built in two phases. The first phase will be Concept D1. Once the area begins to attract business and light industry, the remainder of Concept B1 can be completed.

4.Implementation Plan

Funding Strategies

New Revenue from the business park can be expected to generate enough funds to capitalize the Southeastern Collector. However, timing is an issue. Without development plans it is difficult to attain grants, attract investors or gain proffers to design and build the roadway.

New public roadways in Virginia are generally funded by State and Federal sources via the Smart Scale prioritization process and the Revenue Sharing program. There are also a number of grants that are for related uses that could be applied towards the Southeastern Collector. This section identifies the steps the Town and County must take to define development, to be competitive with Smart Scale, and to obtain grants.

Smart Scale

Smart Scale[18] prioritizes transportation projects to use a wide range of State and Federal funds. The program ranks projects based on objective and quantifiable criteria. Jurisdictions throughout the Commonwealth submit projects that generally compete within their Virginia Department of Transportation (VDOT) District. There are six criteria, and the weighting of the criteria vary depending on the location of the project. For example, in more urban areas congestion mitigation score is weighted 45%; in rural areas this score is weighted 10%.

Berryville and Clarke County compete in the VDOT Staunton District using a rural weighting of the scores. This score is then divided by the cost of the project to determine the final score. The cost is the actual amount of funding needed. The weight of scores in each category for rural (Category D[19]):

- Safety 30%
- Congestion Mitigation 10%
- Accessibility 15%
- Land Use Not used
- Economic Development 35%
- Environmental Quality 10%

To be successful Berryville and Clarke County need to score well in either (or both) Safety and Economic Development. If the cost of the project is funded in part by another source, this will improve the score.

In the FY 2018 round, projects in Staunton District with scores over 2.18 were approved for funding[20]. However, in the FY 2020 Staunton District the lowest score approved is 4.31[21]. Both the scoring and

[18] Commonwealth Transportation Board, SMART SCALE Technical Guide, February 21, 2018.
[19] Ibid, page 36.
[20] Smartscale.org; Consensus scenario approved. May 17, 2017.
[21] Smartscale.org: FY 2020 Selected projects final (approved June 19, 2019) .

the approvals are relative, as such it is not possible to precisely predict points from round to round. However, what is necessary for the Southeastern Collector to be competitive can be determined from previous rounds and the scoring process.

Safety. The safety score is based in the estimated reduction in fatal and injury crashes. It is calculated for both the reduction in number of crashes and the reduction in crash rate. Berryville has a low number of crashes and a low crash rate; in the three years of 2016 to 2018 only 7 injury crashes were reported. As such, previous submissions have not been able to gain much of a score in this area.

Crashes are not entered into the State data base unless a police crash report is filed. It is possible that pedestrian or bike injuries are not reported, rather the injured person is taken immediately to seek treatment without the police crash report. In addition, the low number of crashes may also be a statistical abnormality and the number of crashes in 2019 may be closer to a true norm. An update of the Town and County crash record may help with the next Smart Scale submission.

The estimated decrease in crashes as a result of the project is estimated using Crash Modification Factors (CMF). CMFs vary by type of improvement. As such, the score may also be improved if the project includes proven safety features with large CMFs.

Economic Development. This score is one in which the Southeastern Collector can score well. Determining the Economic Development Score is complex and consists of three separate evaluations: Project Support for Economic Development (60%), Intermodal Access and Efficiency (20%) and Travel Time Reliability (20%).

Project Support for Economic Development rewards developments that are well along in site development. The table below shows factors used to scale the development square footage. For example, if the County / Town has the project referenced in Comprehensive Plan (it does), and a conceptual site plan approved for 220k SF, it would be given credit for 220k X 1.8 = 396k SF. Based on previous submissions, this amount of area would contribute 2.1 points to the total

Rating Description	Point Value
Transportation project referenced in local Comprehensive Plan…	0.5
Transportation project located in an area of economic distress* Up to:	0.5 (0.3)
Development project site plan status: Conceptual site plan submitted: Conceptual site plan approved: Detailed site plan submitted: Detailed site plan approved:	 0.5 1.0 2.0 4.0
Total Maximum	**5.0**
**Berryville has distress score of 59.6/200 = 0.3*	

Example Project Support for Economic Development Score Calculation:

1. Scaling Score: 1.8 (0.5 for Comp Plan, 0.3 for economic distress, 1.0 for approved plan)
2. Concept Site Plan Approved for 220k SF; 1.8 X 200k = 360k,
3. Expected normalized value = 3.96,
4. 60% of Economic Development Score and 35% of total Score: .83,
5. Divide by cost in $10 Million: .83 / $.4 = 2.1 points

Figure 4.1: Smart SCALE Economic Development Scoring and Example

(See Figure 4.1). This score will be higher if the conceptual plan is for more than 220k SF, and lower if more than $4 million in funding is needed.

Intermodal Access and Efficiency can provide points if the development includes freight terminals. Travel Time Reliability, as currently calculated, will not provide additional points.

The next Smartscale round will occur in 2021 for the FY 2022 round. Considerable project development does need to occur to support the Southeastern Collector application. First and foremost, the town of Berryville will need to work with area agencies to adapt the local planning documents. These include: Land use – comprehensive plan. Town/County annotation plans showed comprehensive plans and additions should the plans grow. The following items require engineering or considerable staff time to prepare, much of which can be performed well in advance.

- Conceptual Plans
- Town and County Annexation Agreement
- Shared Comprehensive Plan
- Traffic Counts
- Cost Estimate
- Governing Body Resolution of support
- MPO Resolution of support
- Site Development Plan(s)
- Smart SCALE Application Portal

Smart SCALE Summary: The majority of points will come from the Safety and Economic Development categories. Safety will contribute points if additional injury crashes are recorded. Economic Development will provide points if there is an approved conceptual site plan. The level of effort for a Smart SCALE application is considerable, the Town and County should begin the longer lead time items well in advance.

Revenue Sharing

Revenue Sharing is a VDOT managed program that provides 50% funding from the State and requires a 50% local match. Projects apply on a biennial basis. New construction, reconstruction, and improvement projects are all eligible.

Projects need to be reviewed by the local VDOT Project Manager to confirm the eligibility of the project and to determine that the scope and estimate are accurate. This is done through the SMART Portal. Once this initial approval is provided, the detailed application can be submitted during the biennial application period.

After review by the VDOT Project Manager and Local Assistance Program personnel, and subject to the availability of funds, the project will receive a permanent UPC and will be submitted to the Commonwealth Transportation Board (CTB) for final approval.

The Southeastern Collector Roadway would need to be one of the Concept B alternatives to qualify for Revenue Sharing. **As such, Town and County would need to obtain over $4.3 million in local funds or roadway related grants to provide the local match.**

Revenue Sharing: New Roadways

*Revenue Sharing Program funds may be used to establish a new facility to be part of the system of state highways or part of the road system in the locality that is eligible to receive maintenance payments from VDOT pursuant to §33.2-319 of the Code of Virginia. In order for a new roadway to be eligible for Revenue Sharing Program funding, it must be a part of a locally adopted plan such as the locality's Comprehensive Plan and must be expected to divert sufficient traffic from existing public roads so that those roads will not need to be improved in the foreseeable future. Projects may also need to be included in the regional Constrained Long Range Plan in air quality non-attainment areas. Qualifying projects should provide an immediate benefit to the overall transportation network with a connection between two existing major public roads, based on current transportation needs. Projects that exclusively serve private developments or commercial establishments are not eligible. (*Source: VDOT, Revenue Sharing Program Guidelines, page 4).

Grant Funding – Developing the Vision

Although most transportation funding sources are allocated through Smart SCALE there are several related State and Federal sources that are not included in Smart SCALE that can be used to reduce the funding needed. However, to compete for these sources there needs to be a clear vision and strategy for the site.

The future development potential for the campus can be accomplished with regional input through public planning meetings and focused visioning sessions. This visioning should consider:

- What is a missing need for the region that this development could provide?
- What sort of development will enhance the community?
- What jobs are needed or desired?
- The impact to schools or other community assets?

Once the vision for the site is determined, the vision will need to be incorporated into the Comprehensive Plan and other regional plans. After inclusion in the plans funding can be applied for from a variety of sources (see table 4.1). The strongest grant applications will be for projects that provide benefits on a regional scale, economic promise, technology sector improvements, or features to enhance community livability.

In addition to grants that provide benefits on regional scale, there are sources that are focused on individual aspects of the development. Funding sources to protect wetland, waterway and forests would add funds for the site, and indirectly to the Southeastern Collector. Complimentary options may also include the addition of smart grid designs for the campus which would enhance funding opportunities through the **Redismart** program. This program is evolving through the Department of Energy.

Infrastructure program funding is available through the **INFRA** program, for transportation projects that promote economic vitality, innovative technology and accountability. Smaller projects associated with connections to the National Highway Freight Network, are the priority for this program.

All of these funding opportunities require the campus and road development to be in the comprehensive plan with a vision for the final development goals. The development of site as flex-space, hotel/conference center, medical center, community college or education complex, or as a hub business facility will determine the most appropriate course to follow to apply for grant funding.

Private Development

Often private developers who own a property will pay for roadways and traffic signals to support their proposed development. For the Southern Potential Future Growth area and the Southeastern Collector, a private developer may be persuaded to purchase the Smallwood property and build the collector provided the Comprehensive Plan, proper zoning and the roadway concept are complete.

In addition, Virginia's **Public Private Partnership (P3)** program allows the local government to request proposals and select the proposal that best delivers the vision. This tool is often used when the government wishes to privatize their property to benefit the community. This option is most realistic

for the development of the Smallwood property if the Town or County can gain ownership or a contract with the current owner.

Table 4.1 Potential Funding Sources	
State Grant Funder	Brief description
Community Development Block Grant	Based upon demographics and community need
FEMA flood protection policies and regional planning	Flood education, policy enforcement, construction standard updates, ordinance review
VDOT SRTS	Safe routes to schools, walking trails, bike trails
Go Virginia, Growth and Opportunity	Tech sector partnerships to develop economy in rural areas
Federal Grant Program	
USDA/NRCS Watershed Protection grants	For water quality, water supply protection, habitat
US Forest Service Land and Water Conservation Fund	Way to purchase land for permanent protection
TIGER/Build grants	Public transportation program 20% for urban areas
Redismart, department of Energy	For smart grid design implementation
INFRA program	Transportation that promotes economic vitality, accountability along freight highway

Summary - A Way Forward

This Study establishes the Southeastern Collector's traffic benefits, impacts and costs. This Study also provides the conceptual engineering needed for the Smart Scale and Revenue Sharing programs. However, to complete the Smart Scale application, a vision for the Southern Potential Future Growth area needs to be established. This vision will need to be shown in the approved Town and County Comprehensive plans and eventually a site plan will need to be developed.

The conceptual plan of the Southeastern Collector and the Comprehensive Plans will allow for additional grants to be obtained. Complimenting the development with other community needs such as clean water projects, forest development, technology innovations and walking/bike trails will allow for additional funding opportunities to match the major funding needed for the roadway.

Private developers can, at any time, hasten the process if they can be persuaded to implement the vision. This may be accomplished through a Public Private Partnership (P3). A large, comprehensive P3 will allow a single investor taking over the Smallwood Property and the construction of the roadway. The feasibility of this option is dependent on the marketability of the vision. If not feasible for a large P3, then a more conventional approach will be to build a portion of the roadway, and then induce development of individual parcels.

Phased construction of the Collector with incremental development will allow developers and the State and Federal sources to be used. In this regard, Concept D1 or D2 will serve as an initial phase for Concept B1 or B2.

A suggestion implementation plan:

Initial Planning, Smart SCALE Preparation

1. Develop a vision for the Southern Potential Future Growth area and update Comprehensive Plans.
2. Determine marketability of site development visions. Identify tenant types, and progress site plans.
3. Obtain Governing Bodies Resolution of support.
4. Submit for FY 2022 Smart Scale funding.

Obtain Grants and Support from Developers

5. Determine infrastructure requirements in addition to the Southeastern Collector.
6. Identify and apply for grants and other funding to support infrastructure requirements.
7. Determine feasibility of P3 to take over infrastructure and development. Develop and execute P3 arrangement if feasible.
8. Identify and market tenants and developers (if not P3).

Design, Gain Permits and Build

9. Design and gain permits for Southeastern Collector and other infrastructure.
10. Construct initial phases of Southeastern Collector via grants and initial developer(s).
11. Complete Southeastern Collector when the new business park is a legitimate growing enterprise.

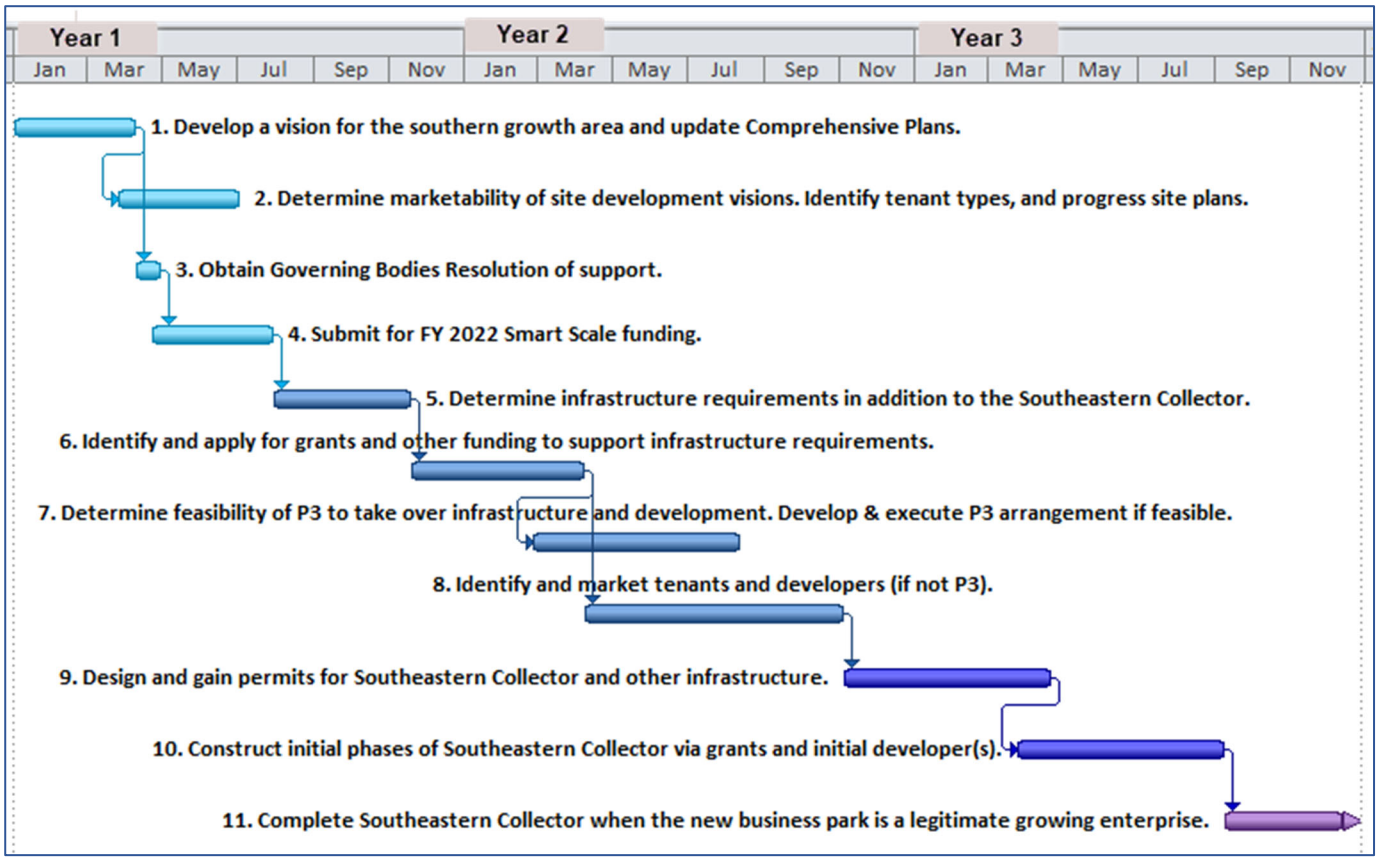
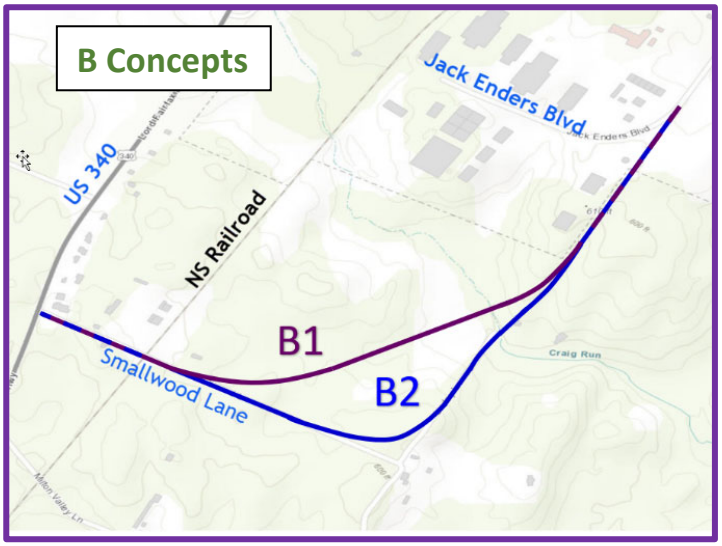


Figure 4.2: Three Year Implementation Schedule

5.Conclusions and Recommendations

After reviewing a wide range of alternatives, Concept B1 was determined to best meet the needs of the Town and County. The Concept provides an upgraded crossing of the Norfolk Southern Railroad, improved traffic flow in and around Berryville and best promotes future development in the Southern Potential Future Growth Area. The estimated cost is $9.6 Million.



A new at-grade crossing of the Norfolk Southern Railroad was considered and discussed at length with Norfolk Southern staff. This new crossing is simply not feasible and this Concept is deleted from further consideration.

Planning, funding and building the new roadway will require a multi-pronged and multi-phased approach.

First, the Southern Potential Future Growth Area, primarily on the Smallwood property, will need to be planned. With a vision of how this property will be redeveloped the Town and County can add this vision to the Comprehensive Plan and update the zoning. These initial planning steps will allow the roadway to compete for Smart SCALE funding and open the potential for grants and investment from private developers.

Second, the Town and County need to actively pursue funds from State and Federal Grants and investment from developers. An extension of Jack Enders Boulevard into the Smallwood Property, similar to Concept D1, will encourage some initial development on the Property. With this initial development it will be easier to attract other users or developers to the property. The site will be able to generate revenue and provide the funds to finish the Collector with either Smart SCALE or Revenue Sharing.

With a marketable vision the site and roadway will be a candidate for a Virginia Public Private Partnership (P3). This program will allow the Town and County to contract the development of the site. A private entity will assume much of the funding and risk, and in turn receive either future revenues or profits from the site.

Smart SCALE is the dominant program for allocating State and Federal transportation funds. The Southern Potential Future Growth Area will need to be planned for the Southeastern Collector to gain Economic Development points. Without Smart SCALE, the Town and County can also receive a 50% match using the Revenue Sharing program. With Concept B1, the Town and County will need to raise $4.8 Million (one half of $9.6 M). Other grants and private money can be used for this match.

In the previous Section, a three-year schedule is suggested. Depending on the vision and plan for the site, there are many ways the roadway and the accompanying development can proceed. Three years is optimistic as there are three years of worth of activities that need to take place.

Concept B1 could be implemented in four phases:

V. Extend Jack Enders Boulevard into the Smallwood property to stimulate initial development.
VI. As development progresses, improve the Jack Enders Boulevard / Main Street Intersection.
VII. As development approaches 75% of buildout, extend the Connector to US 340.
VIII. When traffic warrants, add a signal at the intersection of Smallwood Lane and US 340.

The timing of the improvements will depend on the type of development and corresponding number of trips generated. When development reaches 25% of full buildout approximately 125 thousand SF of development will have occurred. For a typical industrial park this will create an additional 870 new daily trips and 107 new peak hour trips. This typical scenario is not likely to trigger the need for roadway improvements, however if the new development has greater than typical trip generation or a high number of trucks then new roadway improvements may be necessary.

When the development reaches 50% of buildout and 250 thousand SF of development improvements to Jack Enders Boulevard will be necessary. At this point it will also be necessary to gain environmental approvals and begin design of the Connector. By 75% of buildout and 375 thousand SF of development it will be time to complete the Connector to US 340.

The final improvement is a signal at US 340 and Smallwood Lane. This improvement should be implemented when conditions warrant, likely after 75% development.

The Southeastern Collector and the accompanying development will create many benefits for the Town and County. We recommend that the Town and County select Concept B1 and begin the visioning and planning for the associated development.

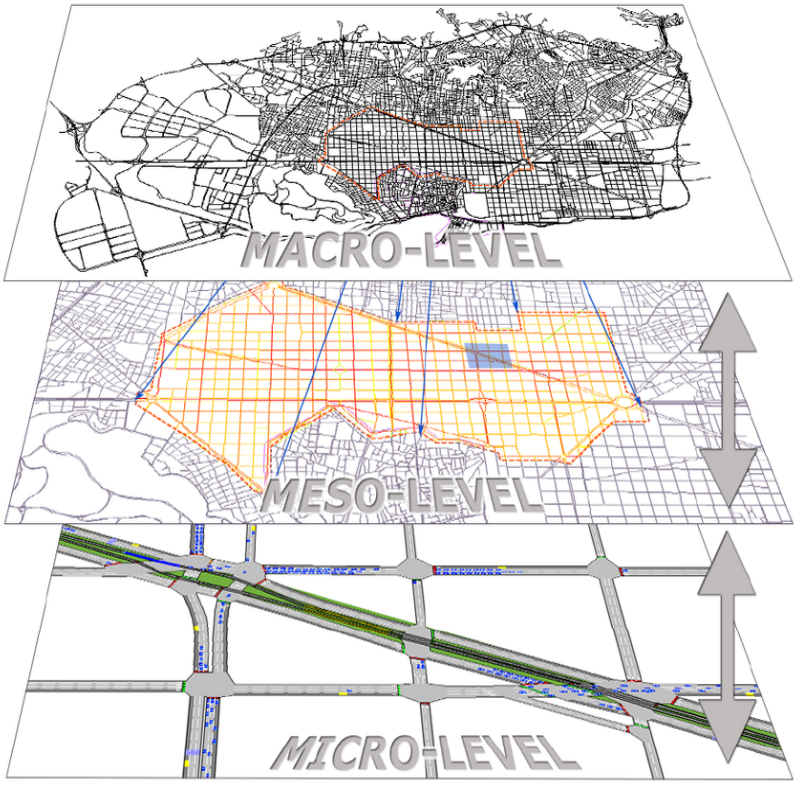
Appendix A:
Traffic Analysis Methodology

APPENDIX A: Traffic Analysis Methodology

The heart of the Southeastern Collector Transportation Study are the traffic projections and analysis of these projections. The projections and analysis are needed to determine the benefits and impacts of each of the Concepts. They need to determine:

- How much traffic will use each Concept, and how much external traffic will be diverted to each Concept?
- How will traffic patterns change, especially in downtown Berryville?
- How much traffic will use Concept B as a bypass of Berryville?
- What traffic control is necessary at new or expanded intersections:
  - Jack Enders Blvd and Main Street;
  - US 340 and Smallwood Lane;
  - US 340 and Concept A.
- What are the before and after LOS for the study intersections?

Projecting traffic in the Town of Berryville is challenging. There are many alternative routes for traffic to use – traffic can use Rt 7 to bypass Main Street or traffic can divert (ie "cut through") to local roadways to avoid downtown. Furthermore, traffic is dynamic. When an intersection becomes congested, traffic will divert away from that intersection until the intersection becomes less congested.



Three levels of Traffic Models:

Macro Level provide projections over a large area on principal roadways. Metropolitan Planning Organizations normally maintain Macro models.

Meso models are similar but in more detail and less coarse than the Macro Model.

Microsimulations seek to duplicate existing conditions. Each vehicle in a microsimulation is an independent program. Vehicles can be observed as they traverse the network.

Source of image: AIMSUN.com

As a result of the many route choices and dynamic nature of Berryville traffic, a dynamic traffic model was selected to model the traffic. A fully calibrated and validated microsimulation with dynamic route assignment of the Town would best perform this analysis. Such a microsimulation creates a detailed digital duplicate of the Town, however it a very time consuming and expensive approach.

Meso traffic models have many of the same benefits as the microsimulation, however they do not graphically show the flow of vehicles in the same manner as the microsimulation. A microsimulation that is at the same detail as the Meso Traffic Model will have the benefits of both. AIMSUN was selected to perform this analysis. AIMSUN can more easily provide a microsimulation model of the town and with modest calibration and validation efforts do so at the same accuracy as a Meso traffic model.

Highway Capacity Manual (HCM) Level of Service (LOS) analysis is the standard to determine how well a roadway will function. The LOS levels A through F are familiar and well accepted. To determine the LOS of the key intersections SYNCHRO was selected for its ease of use, ability to modify signal timing and phasing and ability to duplicate HCM analysis. The SYNCHRO results are in Appendix B: Traffic Counts and LOS Worksheets.

Traffic counts were taken at three intersections. In addition, VDOT AADT from the 2018 Daily Traffic Volume Estimates, Special Locality Report 168 Berryville was used to determine conditions at other locations in the network. All analysis was based on PM peak hour.

The following steps were taken to produce the AIMSUN model:

1. **Develop the road-network**. A full AMISUN model of Berryville was downloaded and processed. Links were updated, unnecessary links were eliminated and characteristics of links were modified to duplicate existing conditions.
2. **Create Transportation Analysis Zones**. Five external zones and 11 internal zones were created.
3. **Develop Origin (OD) – Destination Matrix**. The Five external OD locations and 11 internal areas were developed to create a 16 X 16 OD Matrix. This matrix identifies were traffic originates from (origin) and goes to (destination).
    a. For each external zone the existing traffic counts informed how many vehicles originate from the zone and how many pass into and through the model.
    b. For each internal zone the number and type of buildings and playing fields were used to estimate how many vehicles originate from the zone or leave the zone.
    c. Row and Column totals were calculated from a and b above. Local knowledge, engineering judgement were used to populate the remainder of the OD matrix. Iterative steps were required to balance the matrix.
4. **Calibrate and Validate Existing traffic.** The AIMSUN model was run with Dynamic Route Assignment (DRA). The model was adjusted to reflect realistic conditions and to approximate traffic counts at the key intersections. This is a very time consuming process and the required an understanding of how vehicles are likely to flow through and around Berryville.
5. **Determine Traffic Pattern Changes with Concepts.** The AIMSUN model was run with the new development traffic (TAZ 16) and new links. The change in traffic volumes was noted.

Improvements to the network were not assumed for the analysis. A background growth rate was not assumed as well. To clearly answer the key questions it was determined that the existing network, with the existing traffic as the base traffic would be best. Additional assumptions as to network improvements and background growth adds another variable to an already complex analysis.

On this and the following pages:

Figure A.1 – AIMSUN Network
Figure A.2 – Location of External and Internal TAZ
Figure A.3 – 16 X 16 PM Peak Hour OD Matrix

Figure A-1: AIMSUN Network

Figure A-2: Location of External and Internal TAZ

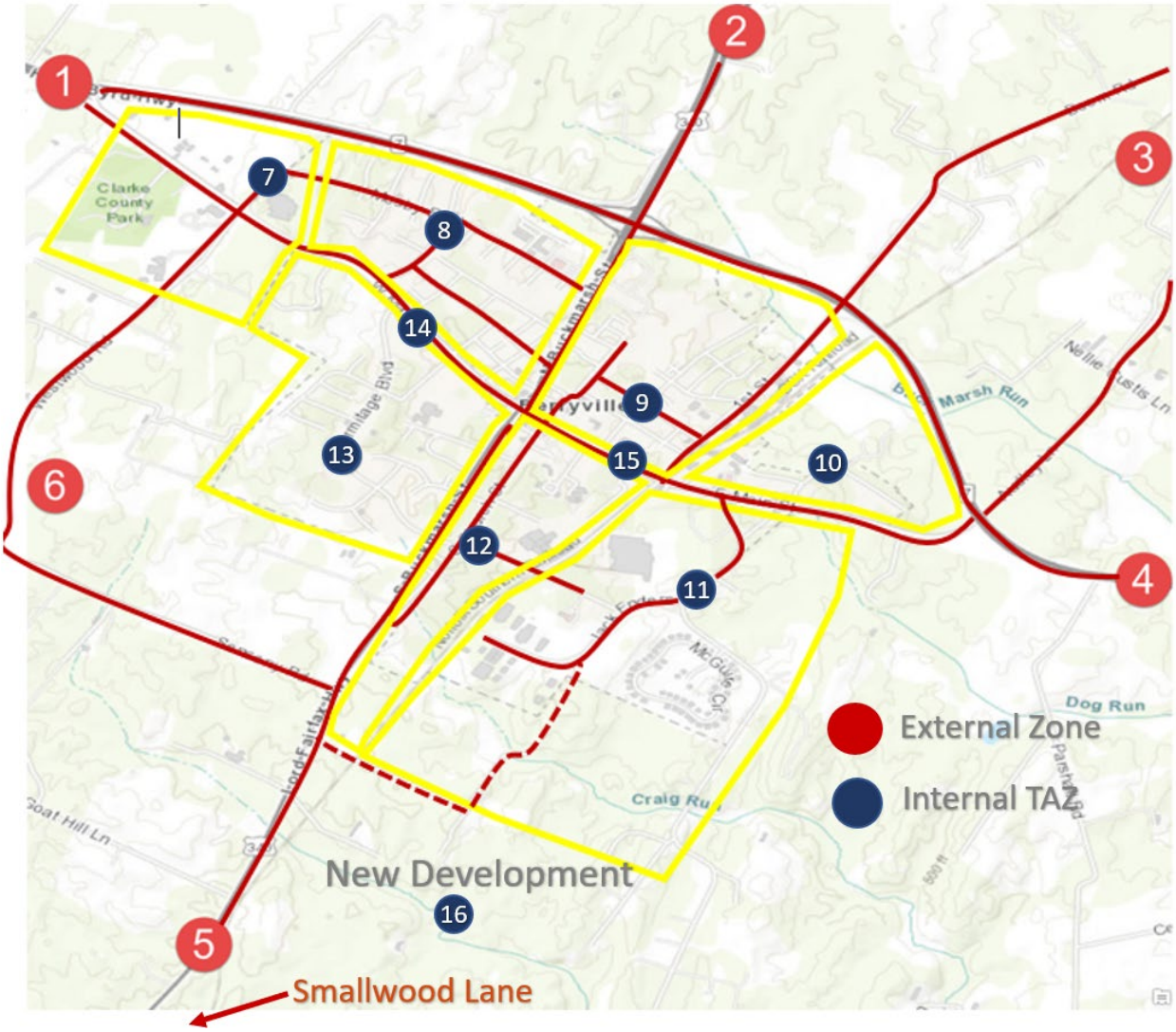


Figure A-3: 16 X 16 PM Peak Hour OD Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1		360	10	1890	55	20	15	70	20	15	40	10	15	35	25	15	2600
2	360		5	250	100	5	15	25	40	5	35	5	5	30	20	12	1440
3	5	5		10	5	2	5	5	5	2	5	2	2	15	5	3	50
4	1840	250	10		65	10	10	70	30	5	45	10	15	35	20	15	2300
5	75	120	10	60		80	15	40	15	10	35	66	10	30	15	13	576
6	15	20	10	15	30		10	5	15	5	5	5	5	25	10	3	100
7	30	25	5	10	15	15		25	30	10	5	10	20	8	5	3	190
8	60	20	5	60	10	5	22		10	5	5	5	5	12	7	3	220
9	80	100	15	60	40	25	25	20		10	5	15	20	20	20	3	515
10	25	20	3	7	7	3	3	3	3		3	5	5	20	10	2	85
11	40	45	5	70	35	10	5	10	5	5		5	5	10	10	4	280
12	35	10	3	5	30	5	15	3	3	3	3		3	10	5	3	115
13	40	10	3	5	30	5	15	5	10	3	5	4		10	5	4	130
14	35	30	15	35	30	25	8	12	20	20	10	10	10		20	5	220
15	35	20	5	20	15	10	5	7	20	10	10	5	5	20		5	100
16	50	55	5	80	45	15	6	11	8	8	8	8	8	15	15		340
Total	2600	1760	50	2300	384	100	140	300	365	60	260	150	205	140	80	90	

Appendix B: Traffic Counts and Level of Service Worksheets

Contents:

1. Traffic Counts
2. SYNCHRO Level of Service Worksheets

MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : Main Street @ Jack Enders Blvd
Site Code : 0006
Start Date : 5/21/2019
Page No : 1

Groups Printed- Unshifted

	Driveway From North				East Main St From East				Jack Enders Blvd From South				East Main St From West						
Start Time	Left	Thru	Right	U Turns	Left	Thru	Right	U Turns	Left	Thru	Right	U Turns	Left	Thru	Right	U Turns	Exclu. Total	Inclu. Total	Int. Total
06:30 AM	0	0	0	0	28	18	0	0	2	0	15	0	0	55	25	0	0	143	143
06:45 AM	0	0	1	0	34	17	0	0	4	0	11	0	3	70	45	1	1	185	186
Total	0	0	1	0	62	35	0	0	6	0	26	0	3	125	70	1	1	328	329
07:00 AM	1	0	0	0	20	28	0	0	15	0	34	0	0	43	27	0	0	168	168
07:15 AM	0	0	1	0	29	17	1	0	10	0	17	0	2	66	28	0	0	171	171
07:30 AM	0	2	1	0	12	25	2	0	27	0	47	1	3	65	12	0	1	196	197
07:45 AM	3	1	3	0	24	36	4	0	18	1	17	0	4	74	11	0	0	196	196
Total	4	3	5	0	85	106	7	0	70	1	115	1	9	248	78	0	1	731	732
08:00 AM	1	1	2	0	17	18	1	0	14	1	17	0	2	78	16	0	0	168	168
08:15 AM	1	2	3	0	8	17	3	0	3	0	20	0	3	53	12	0	0	125	125
08:30 AM	0	1	2	0	6	27	0	0	9	1	19	0	1	53	13	0	0	132	132
08:45 AM	0	1	2	0	4	29	0	0	8	0	10	0	2	39	10	0	0	105	105
Total	2	5	9	0	35	91	4	0	34	2	66	0	8	223	51	0	0	530	530
09:00 AM	0	1	0	0	11	26	1	0	5	0	13	1	0	33	10	0	1	100	101
09:15 AM	0	1	2	0	7	24	1	0	5	0	11	1	2	36	5	0	1	94	95
Total	0	2	2	0	18	50	2	0	10	0	24	2	2	69	15	0	2	194	196
03:30 PM	2	0	6	0	8	66	1	0	39	1	54	0	4	42	20	0	0	243	243
03:45 PM	1	1	3	0	9	79	3	0	11	1	16	0	3	37	8	0	0	172	172
Total	3	1	9	0	17	145	4	0	50	2	70	0	7	79	28	0	0	415	415
04:00 PM	2	0	8	0	19	77	2	0	11	0	17	0	4	37	8	0	0	185	185
04:15 PM	1	1	2	0	11	90	0	0	12	0	9	0	3	36	10	0	0	175	175
04:30 PM	3	0	4	0	14	74	4	0	22	0	21	0	3	42	5	0	0	192	192
04:45 PM	2	1	0	0	22	80	2	0	16	1	17	0	1	29	14	0	0	185	185
Total	8	2	14	0	66	321	8	0	61	1	64	0	11	144	37	0	0	737	737
05:00 PM	4	2	1	0	7	96	1	0	23	0	31	0	3	31	7	0	0	206	206
05:15 PM	0	0	1	0	9	76	0	0	11	0	12	0	1	29	11	0	0	150	150
05:30 PM	1	0	2	0	6	82	1	0	13	2	7	0	2	23	9	0	0	148	148
05:45 PM	1	1	4	0	12	96	3	0	8	1	4	0	1	28	2	0	0	161	161
Total	6	3	8	0	34	350	5	0	55	3	54	0	7	111	29	0	0	665	665
06:00 PM	1	1	2	0	8	64	0	0	7	0	7	0	1	25	7	0	0	123	123
06:15 PM	1	0	0	0	0	62	9	0	7	0	4	0	1	26	7	0	0	117	117
Grand Total	25	17	50	0	325	1224	39	0	300	9	430	3	49	1050	322	1	4	3840	3844
Apprch %	27.2	18.5	54.3		20.5	77.1	2.5		40.6	1.2	58.2		3.4	73.9	22.7				
Total %	0.7	0.4	1.3		8.5	31.9	1		7.8	0.2	11.2		1.3	27.3	8.4		0.1	99.9	

MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : Main Street @ Jack Enders Blvd
Site Code : 0006
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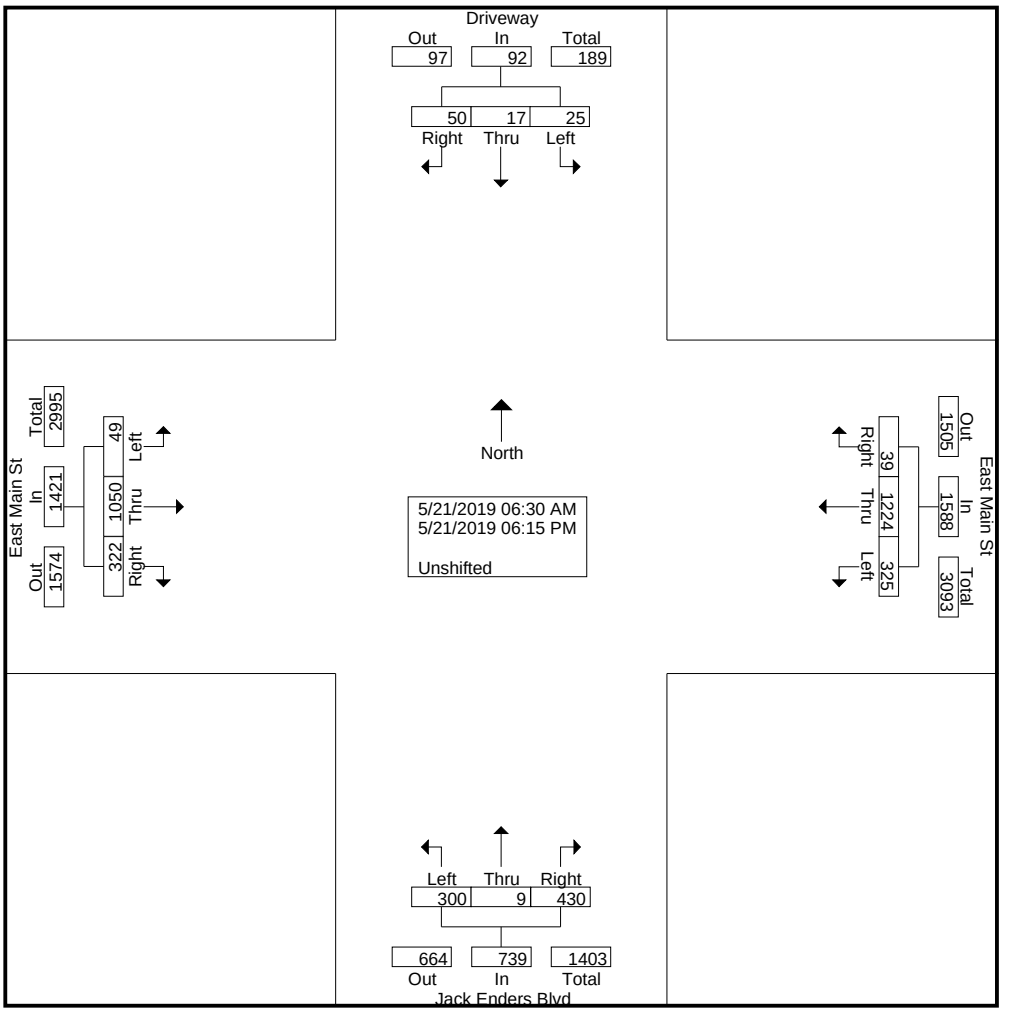
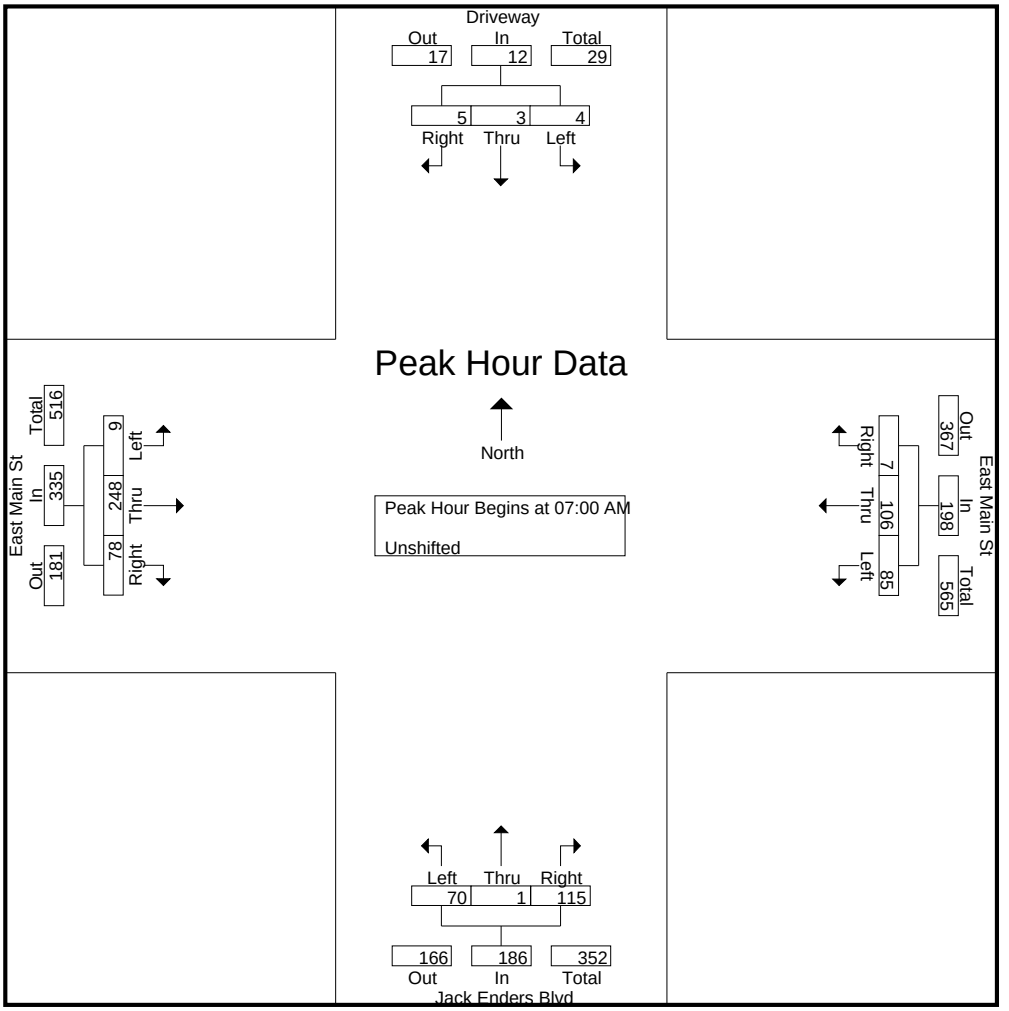


MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : Main Street @ Jack Enders Blvd
Site Code : 0006
Start Date : 5/21/2019
Page No : 3

	Driveway From North				East Main St From East				Jack Enders Blvd From South				East Main St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 09:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:00 AM																	
07:00 AM	1	0	0	1	20	28	0	48	15	0	34	49	0	43	27	70	168
07:15 AM	0	0	1	1	**29**	17	1	47	10	0	17	27	2	66	**28**	**96**	171
07:30 AM	0	**2**	1	3	12	25	2	39	**27**	0	**47**	**74**	3	65	12	80	**196**
07:45 AM	**3**	1	**3**	**7**	24	**36**	**4**	**64**	18	**1**	17	36	**4**	**74**	11	89	196
Total Volume	4	3	5	12	85	106	7	198	70	1	115	186	9	248	78	335	731
% App. Total	33.3	25	41.7		42.9	53.5	3.5		37.6	0.5	61.8		2.7	74	23.3		
PHF	.333	.375	.417	.429	.733	.736	.438	.773	.648	.250	.612	.628	.563	.838	.696	.872	.932



MCV Associates, Inc.
4605-C Pinecrest off Park Dr
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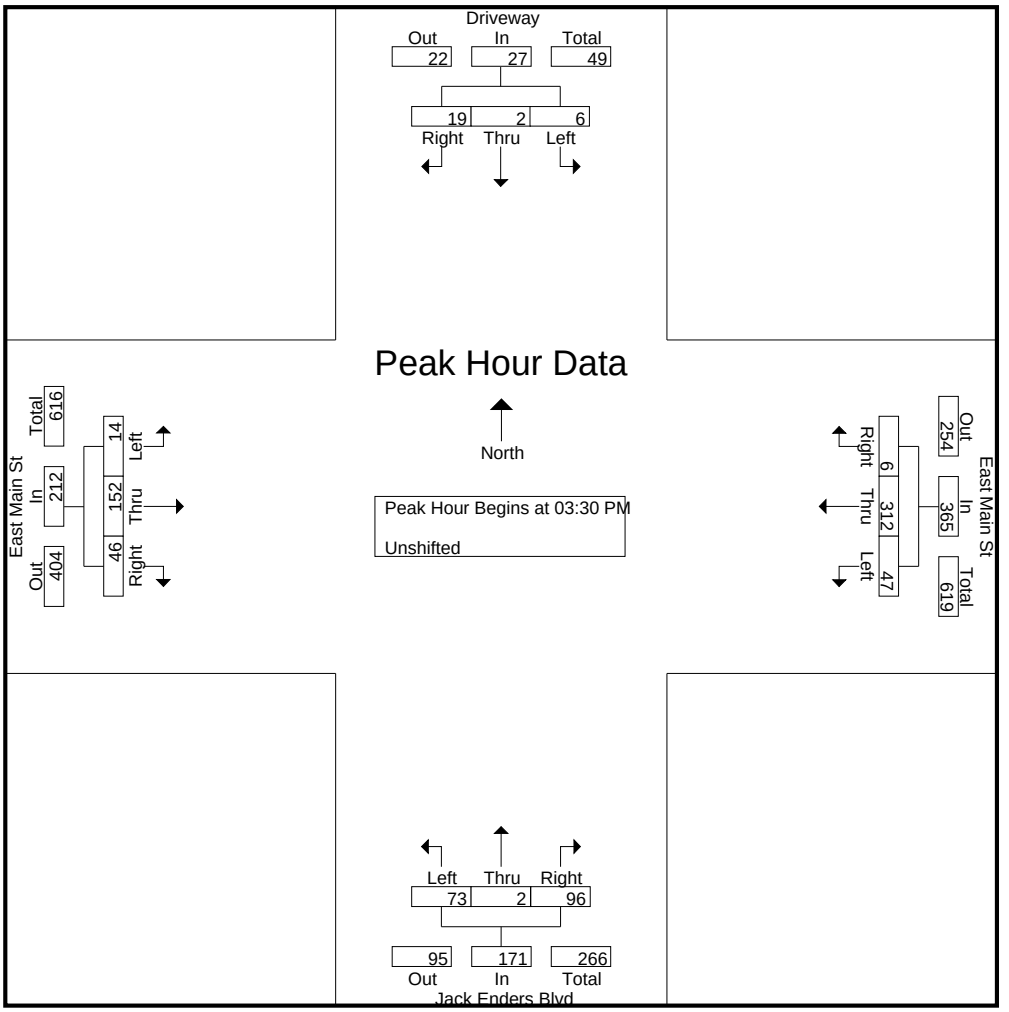
Phone: 703 914-4850

File Name : Main Street @ Jack Enders Blvd
Site Code : 0006
Start Date : 5/21/2019
Page No : 4

	Driveway From North				East Main St From East				Jack Enders Blvd From South				East Main St From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 06:15 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 03:30 PM																	
03:30 PM	**2**	0	6	8	8	66	1	75	**39**	**1**	**54**	**94**	**4**	**42**	**20**	**66**	**243**
03:45 PM	1	**1**	3	5	9	79	**3**	91	11	1	16	28	3	37	8	48	172
04:00 PM	2	0	**8**	**10**	**19**	77	2	98	11	0	17	28	4	37	8	49	185
04:15 PM	1	1	2	4	11	**90**	0	**101**	12	0	9	21	3	36	10	49	175
Total Volume	6	2	19	27	47	312	6	365	73	2	96	171	14	152	46	212	775
% App. Total	22.2	7.4	70.4		12.9	85.5	1.6		42.7	1.2	56.1		6.6	71.7	21.7		
PHF	.750	.500	.594	.675	.618	.867	.500	.903	.468	.500	.444	.455	.875	.905	.575	.803	.797



MCV Associates, Inc.
4605-C Pinecrest off Park Dr
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Phone: 703 914-4850

File Name : US 340 @ Main Street
Site Code : 0005
Start Date : 5/21/2019
Page No : 1

Groups Printed- Unshifted

	US 340 From North					Main Street From East					US 340 From South					Main Street From West							
Start Time	Left	Thru	Right	U Turns	App. Total	Left	Thru	Right	U Turns	App. Total	Left	Thru	Right	U Turns	App. Total	Left	Thru	Right	U Turns	App. Total	Exclu. Total	Inclu. Total	Int. Total
06:30 AM	18	42	2	0	62	10	4	3	0	17	2	57	2	0	61	12	23	3	0	38	0	178	178
06:45 AM	27	43	5	0	75	9	14	2	0	25	5	69	9	0	83	8	37	9	0	54	0	237	237
Total	45	85	7	0	137	19	18	5	0	42	7	126	11	0	144	20	60	12	0	92	0	415	415
07:00 AM	16	60	9	0	85	18	17	5	0	40	4	55	9	0	68	9	27	6	0	42	0	235	235
07:15 AM	15	58	4	0	77	11	17	2	0	30	5	73	15	0	93	4	30	9	0	43	0	243	243
07:30 AM	18	51	17	0	86	12	41	8	0	61	11	73	8	0	92	10	28	2	0	40	0	279	279
07:45 AM	21	60	17	0	98	15	39	7	0	61	13	75	15	0	103	20	41	10	0	71	0	333	333
Total	70	229	47	0	346	56	114	22	0	192	33	276	47	0	356	43	126	27	0	196	0	1090	1090
08:00 AM	16	84	7	0	107	18	33	10	0	61	10	72	13	0	95	15	61	16	0	92	0	355	355
08:15 AM	13	38	2	0	53	16	13	8	0	37	8	68	9	0	85	9	45	11	0	65	0	240	240
08:30 AM	13	47	4	0	64	15	15	12	0	42	2	67	9	0	78	8	29	14	0	51	0	235	235
08:45 AM	13	50	6	0	69	14	16	8	0	38	8	65	11	0	84	7	25	11	0	43	0	234	234
Total	55	219	19	0	293	63	77	38	0	178	28	272	42	0	342	39	160	52	0	251	0	1064	1064
09:00 AM	21	31	4	0	56	14	16	7	0	37	8	52	12	0	72	10	18	6	0	34	0	199	199
09:15 AM	12	31	8	0	51	15	22	14	0	51	8	63	11	0	82	11	26	9	0	46	0	230	230
Total	33	62	12	0	107	29	38	21	0	88	16	115	23	0	154	21	44	15	0	80	0	429	429
03:30 PM	17	87	6	0	110	26	25	22	0	73	9	75	8	0	92	16	35	16	0	67	0	342	342
03:45 PM	12	73	8	0	93	43	27	17	0	87	13	63	10	0	86	14	23	15	0	52	0	318	318
Total	29	160	14	0	203	69	52	39	0	160	22	138	18	0	178	30	58	31	0	119	0	660	660
04:00 PM	17	80	7	0	104	42	26	16	0	84	17	64	11	0	92	12	31	15	0	58	0	338	338
04:15 PM	11	95	1	0	107	44	27	22	0	93	13	64	12	0	89	16	29	17	0	62	0	351	351
04:30 PM	10	95	6	0	111	45	46	19	0	110	9	65	10	0	84	14	27	7	0	48	0	353	353
04:45 PM	17	96	11	0	124	33	33	14	0	80	10	65	5	0	80	13	25	12	0	50	0	334	334
Total	55	366	25	0	446	164	132	71	0	367	49	258	38	0	345	55	112	51	0	218	0	1376	1376
05:00 PM	7	75	6	0	88	44	40	16	0	100	8	76	12	0	96	8	36	15	0	59	0	343	343
05:15 PM	13	91	9	0	113	34	27	12	0	73	15	56	4	0	75	14	28	16	0	58	0	319	319
05:30 PM	12	89	5	0	106	26	37	10	0	73	10	74	12	0	96	10	24	8	0	42	0	317	317
05:45 PM	14	79	7	0	100	38	39	13	0	90	13	74	13	0	100	8	26	16	0	50	0	340	340
Total	46	334	27	0	407	142	143	51	0	336	46	280	41	0	367	40	114	55	0	209	0	1319	1319
06:00 PM	8	57	13	0	78	32	28	10	0	70	10	51	8	0	69	6	24	12	0	42	0	259	259
06:15 PM	6	57	7	0	70	23	23	8	0	54	10	51	13	0	74	7	18	14	0	39	0	237	237
Grand Total	347	1569	171	0	2087	597	625	265	0	1487	221	1567	241	0	2029	261	716	269	0	1246	0	6849	6849
Apprch %	16.6	75.2	8.2			40.1	42	17.8			10.9	77.2	11.9			20.9	57.5	21.6					
Total %	5.1	22.9	2.5		30.5	8.7	9.1	3.9		21.7	3.2	22.9	3.5		29.6	3.8	10.5	3.9		18.2	0	100	

MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : US 340 @ Main Street
Site Code : 0005
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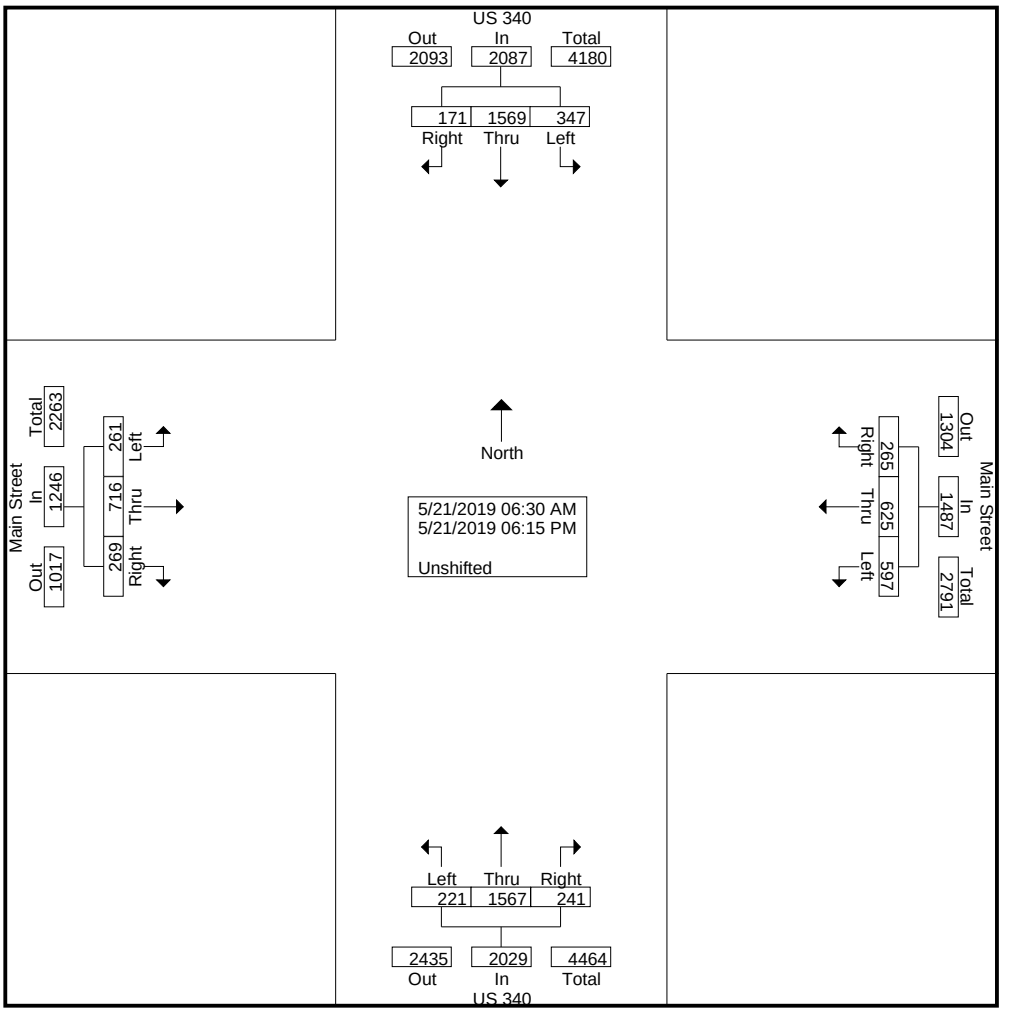

MCV Associates, Inc.
4605-C Pinecrest off Park Dr
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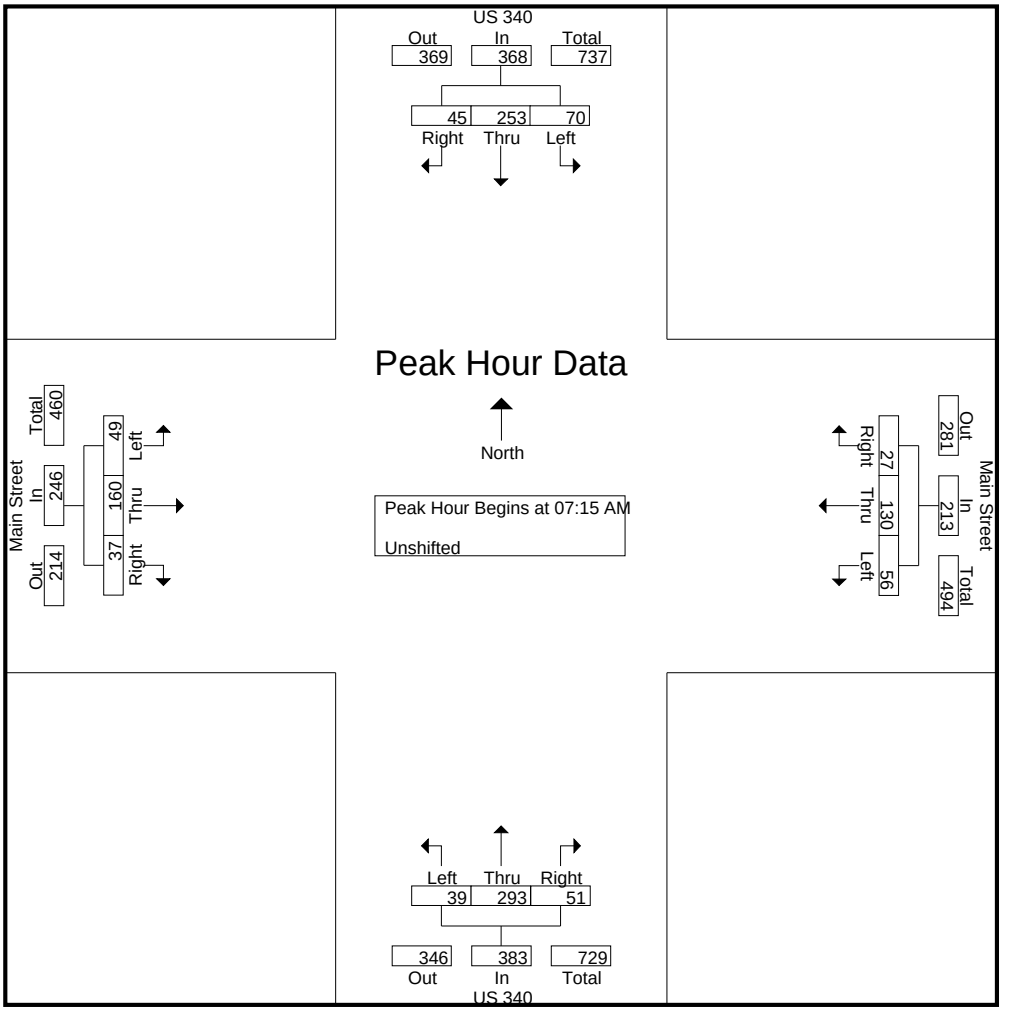
Phone: 703 914-4850

File Name : US 340 @ Main Street
Site Code : 0005
Start Date : 5/21/2019
Page No : 3

	US 340 From North				Main Street From East				US 340 From South				Main Street From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 09:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	15	58	4	77	11	17	2	30	5	73	**15**	93	4	30	9	43	243
07:30 AM	18	51	**17**	86	12	**41**	8	**61**	11	73	8	92	10	28	2	40	279
07:45 AM	**21**	60	17	98	15	39	7	61	**13**	**75**	15	**103**	**20**	41	10	71	333
08:00 AM	16	**84**	7	**107**	**18**	33	**10**	61	10	72	13	95	15	**61**	**16**	**92**	**355**
Total Volume	70	253	45	368	56	130	27	213	39	293	51	383	49	160	37	246	1210
% App. Total	19	68.8	12.2		26.3	61	12.7		10.2	76.5	13.3		19.9	65	15		
PHF	.833	.753	.662	.860	.778	.793	.675	.873	.750	.977	.850	.930	.613	.656	.578	.668	.852



MCV Associates, Inc.
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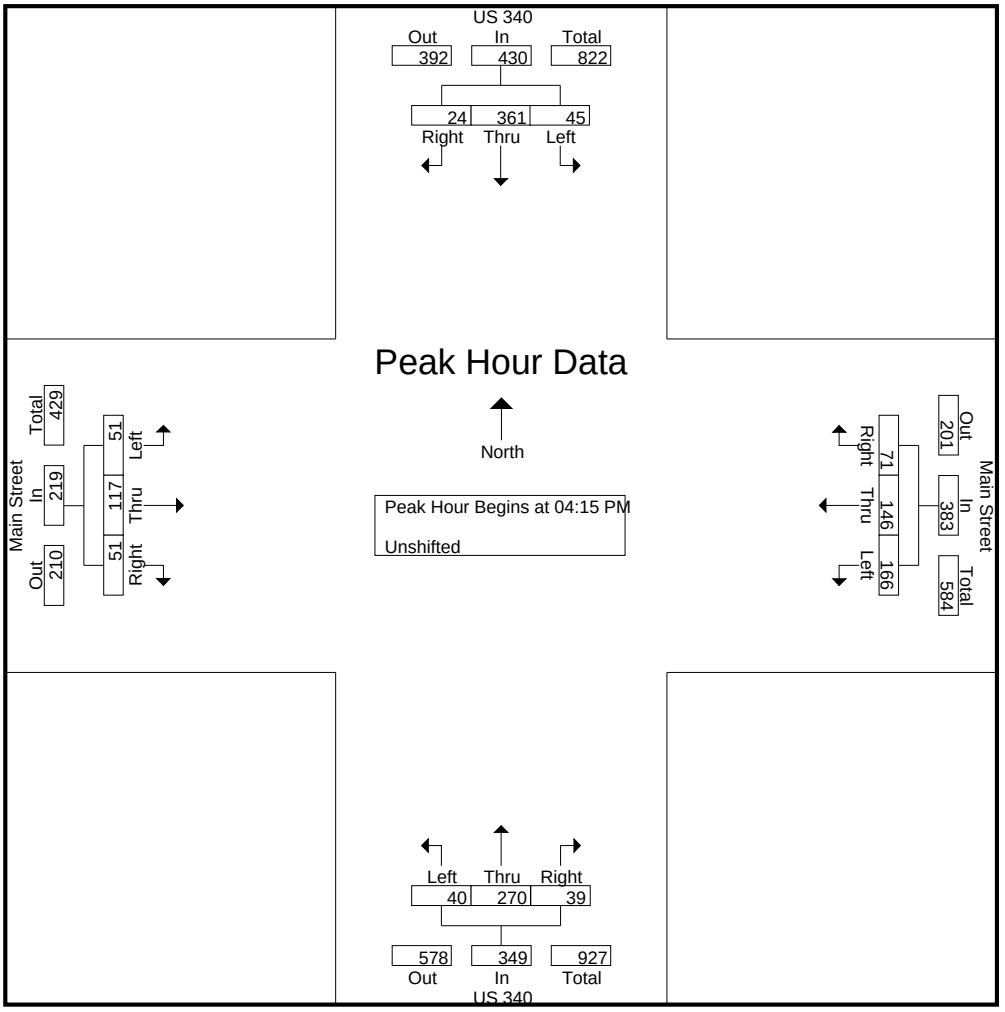
Phone: 703 914-4850

File Name : US 340 @ Main Street
Site Code : 0005
Start Date : 5/21/2019
Page No : 4

	US 340 From North				Main Street From East				US 340 From South				Main Street From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 06:15 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	11	95	1	107	44	27	**22**	93	**13**	64	**12**	89	**16**	29	**17**	**62**	351
04:30 PM	10	95	6	111	**45**	**46**	19	**110**	9	65	10	84	14	27	7	48	**353**
04:45 PM	**17**	**96**	**11**	**124**	33	33	14	80	10	65	5	80	13	25	12	50	334
05:00 PM	7	75	6	88	44	40	16	100	8	**76**	12	**96**	8	**36**	15	59	343
Total Volume	45	361	24	430	166	146	71	383	40	270	39	349	51	117	51	219	1381
% App. Total	10.5	84	5.6		43.3	38.1	18.5		11.5	77.4	11.2		23.3	53.4	23.3		
PHF	.662	.940	.545	.867	.922	.793	.807	.870	.769	.888	.813	.909	.797	.813	.750	.883	.978



MCV Associates, Inc.
4605-C Pinecrest off Park Dr
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Phone: 703 914-4850

File Name : US 340 @ South Church St
Site Code : 00003
Start Date : 5/21/2019
Page No : 1

Groups Printed- Unshifted

	US 340 From North				South church Street From East				US 340 From South				From West						
Start Time	Left	Thru	Right	U Turns	Left	Thru	Right	U Turns	Left	Thru	Right	U Turns	Left	Thru	Right	U Turns	Exclu. Total	Inclu. Total	Int. Total
06:30 AM	0	56	0	0	3	0	0	0	0	66	34	0	0	0	0	0	0	159	159
06:45 AM	1	56	0	0	8	0	0	0	0	79	54	0	0	0	0	0	0	198	198
Total	1	112	0	0	11	0	0	0	0	145	88	0	0	0	0	0	0	357	357
07:00 AM	1	94	0	0	15	0	0	0	0	75	43	0	0	0	0	0	0	228	228
07:15 AM	0	78	0	0	11	0	1	0	0	99	50	0	0	0	0	0	0	239	239
07:30 AM	0	76	0	0	13	0	0	0	0	105	49	0	0	0	0	0	0	243	243
07:45 AM	0	80	0	0	11	0	0	0	0	122	45	0	0	0	0	0	0	258	258
Total	1	328	0	0	50	0	1	0	0	401	187	0	0	0	0	0	0	968	968
08:00 AM	1	122	0	0	4	0	0	0	0	93	48	0	0	0	0	0	0	268	268
08:15 AM	0	62	0	0	9	0	0	0	0	91	36	0	0	0	0	0	0	198	198
08:30 AM	0	63	0	0	10	0	0	0	0	81	38	0	0	0	0	0	0	192	192
08:45 AM	0	61	0	0	9	0	0	0	0	80	31	0	0	0	0	0	0	181	181
Total	1	308	0	0	32	0	0	0	0	345	153	0	0	0	0	0	0	839	839
09:00 AM	0	55	0	0	7	0	0	0	0	67	28	0	0	0	0	0	0	157	157
09:15 AM	1	47	0	0	8	0	0	0	0	82	23	0	0	0	0	0	0	161	161
Total	1	102	0	0	15	0	0	0	0	149	51	0	0	0	0	0	0	318	318
03:30 PM	0	150	0	0	26	0	0	0	0	85	16	0	0	0	0	0	0	277	277
03:45 PM	1	122	0	0	17	0	2	0	0	89	27	0	0	0	0	0	0	258	258
Total	1	272	0	0	43	0	2	0	0	174	43	0	0	0	0	0	0	535	535
04:00 PM	0	135	0	0	20	0	1	0	0	74	22	0	0	0	0	0	0	252	252
04:15 PM	0	148	0	0	22	0	0	0	0	94	17	0	0	0	0	0	0	281	281
04:30 PM	1	147	0	0	31	0	0	0	0	71	23	0	0	0	0	0	0	273	273
04:45 PM	0	134	0	0	25	0	1	0	0	85	13	0	0	0	0	0	0	258	258
Total	1	564	0	0	98	0	2	0	0	324	75	0	0	0	0	0	0	1064	1064
05:00 PM	0	142	0	0	27	0	2	0	0	96	13	0	0	0	0	0	0	280	280
05:15 PM	0	138	0	0	20	0	0	0	0	80	19	0	0	0	0	0	0	257	257
05:30 PM	0	127	0	0	22	0	0	0	0	87	17	0	0	0	0	0	0	253	253
05:45 PM	0	120	0	0	32	0	0	0	0	96	14	0	0	0	0	0	0	262	262
Total	0	527	0	0	101	0	2	0	0	359	63	0	0	0	0	0	0	1052	1052
06:00 PM	0	95	0	0	15	0	1	0	0	79	21	0	0	0	0	0	0	211	211
06:15 PM	0	88	0	0	18	0	1	0	0	64	21	0	0	0	0	0	0	192	192
Grand Total	6	2396	0	0	383	0	9	0	0	2040	702	0	0	0	0	0	0	5536	5536
Apprch %	0.2	99.8	0		97.7	0	2.3		0	74.4	25.6		0	0	0				
Total %	0.1	43.3	0		6.9	0	0.2		0	36.8	12.7		0	0	0		0	100	

MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : US 340 @ South Church St
Site Code : 00003
Start Date : 5/21/2019
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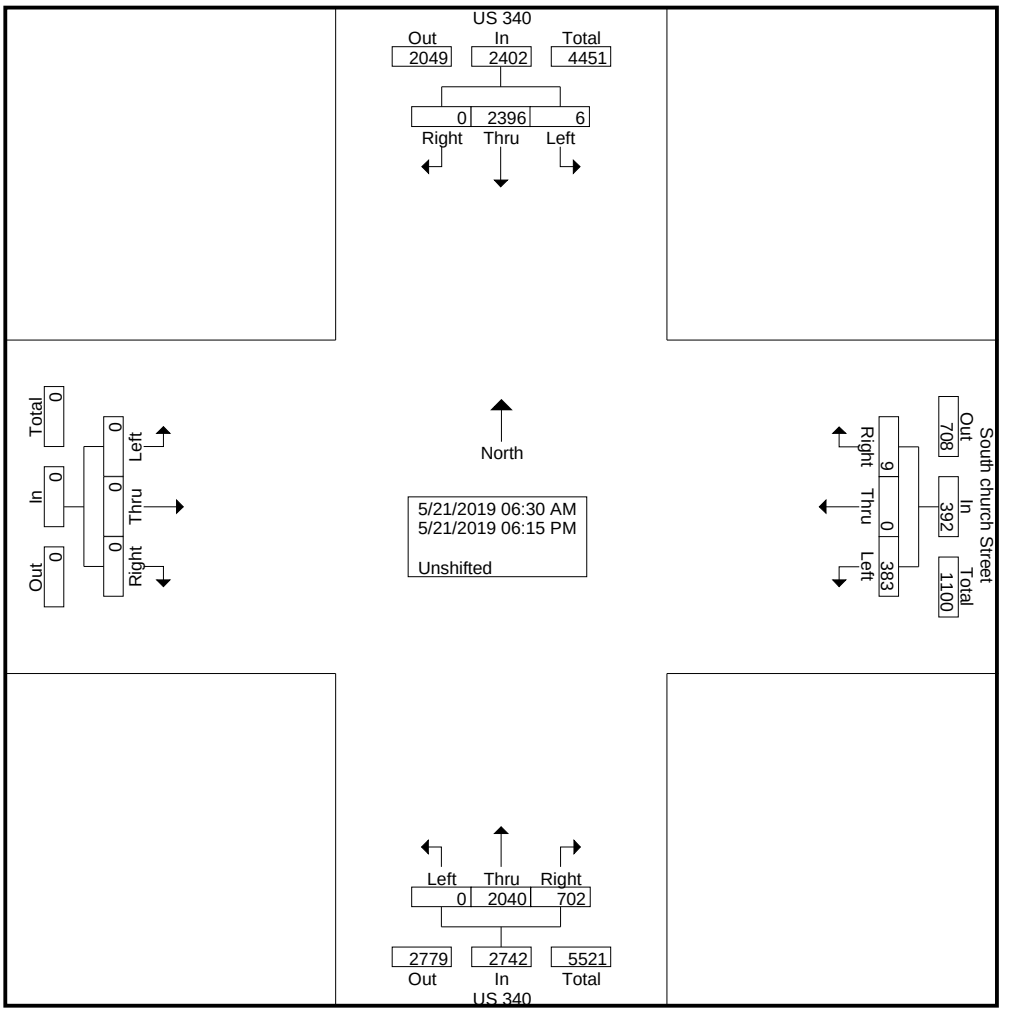
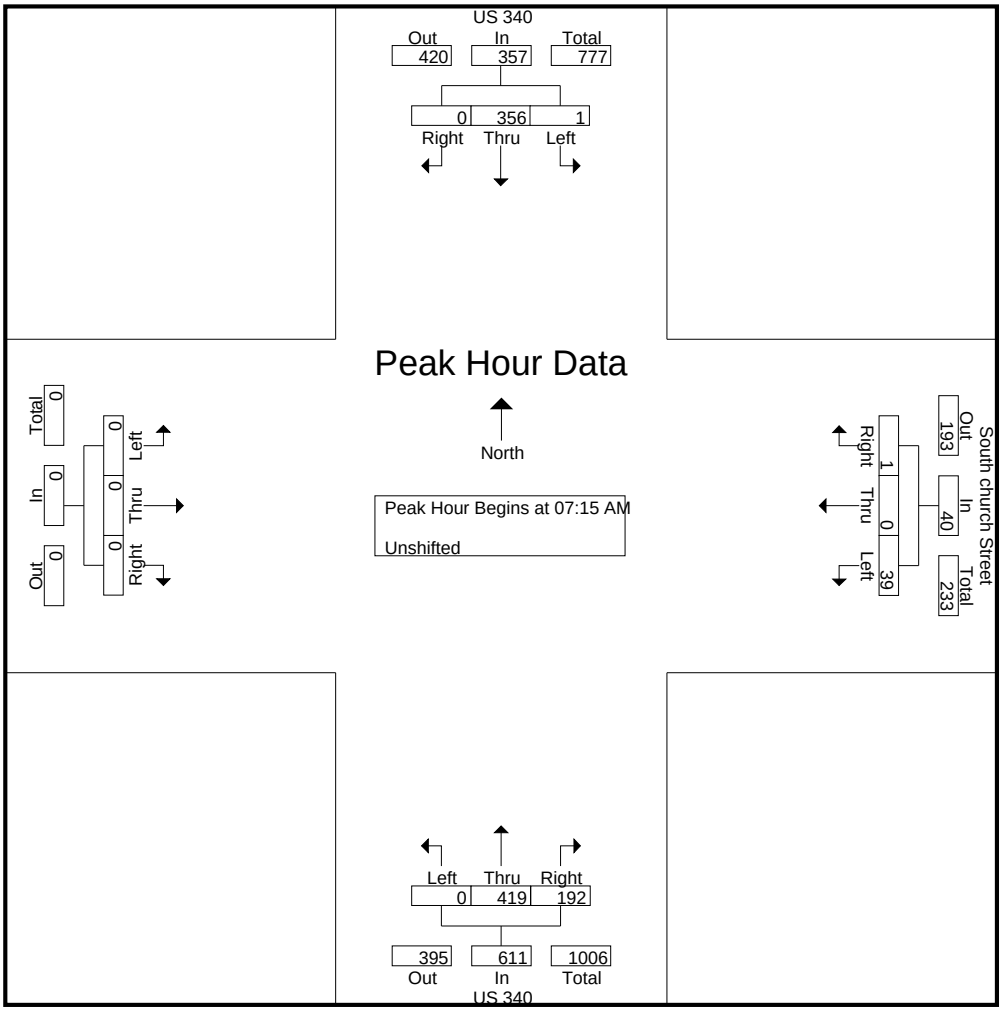


MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : US 340 @ South Church St
Site Code : 00003
Start Date : 5/21/2019
Page No : 3

	US 340 From North				South church Street From East				US 340 From South				From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:30 AM to 09:15 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:15 AM																	
07:15 AM	0	78	0	78	11	0	**1**	12	0	99	**50**	149	0	0	0	0	239
07:30 AM	0	76	0	76	**13**	0	0	**13**	0	105	49	154	0	0	0	0	243
07:45 AM	0	80	0	80	11	0	0	11	0	**122**	45	**167**	0	0	0	0	258
08:00 AM	**1**	**122**	0	**123**	4	0	0	4	0	93	48	141	0	0	0	0	**268**
Total Volume	1	356	0	357	39	0	1	40	0	419	192	611	0	0	0	0	1008
% App. Total	0.3	99.7	0		97.5	0	2.5		0	68.6	31.4		0	0	0		
PHF	.250	.730	.000	.726	.750	.000	.250	.769	.000	.859	.960	.915	.000	.000	.000	.000	.940

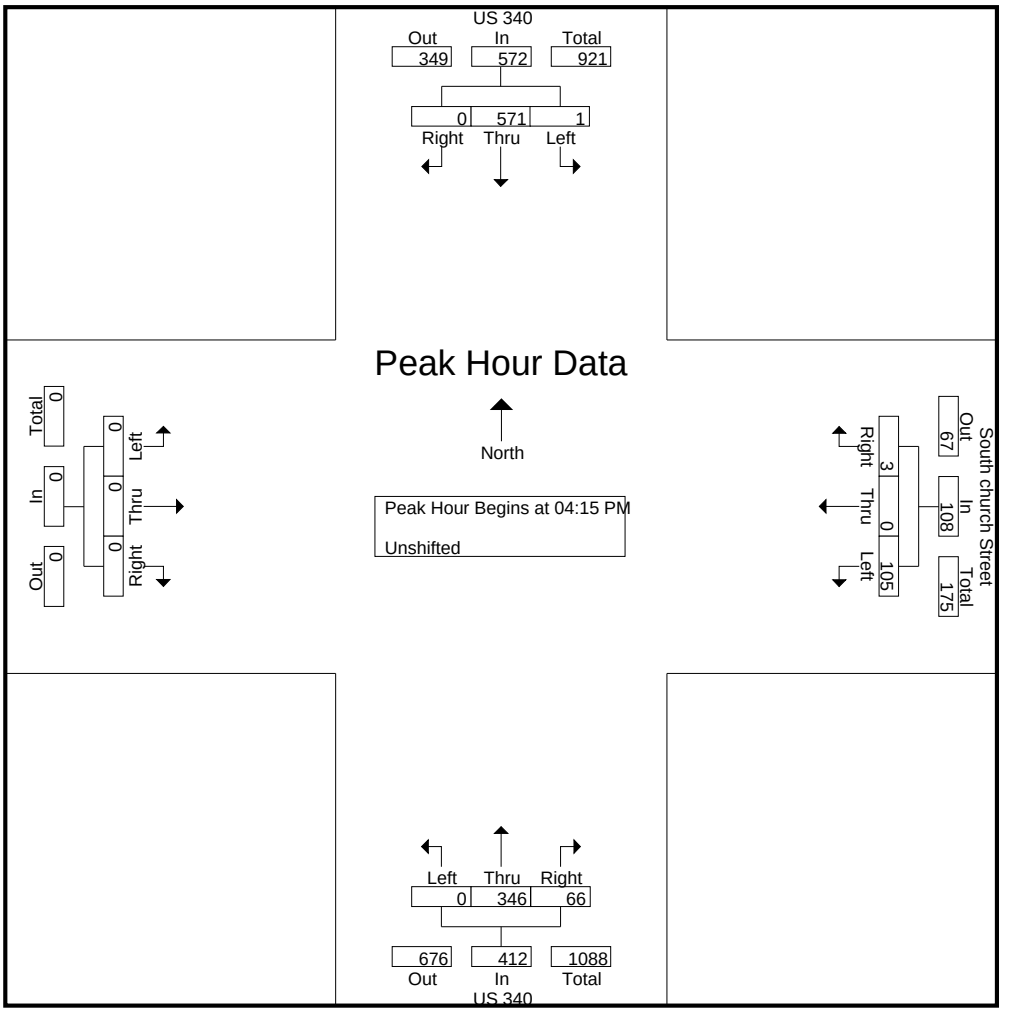


MCV Associates, Inc.
4605-C Pinecrest off Park Dr
Alexandria, VA - 22312

Phone: 703 914-4850

File Name : US 340 @ South Church St
Site Code : 00003
Start Date : 5/21/2019
Page No : 4

	US 340 From North				South church Street From East				US 340 From South				From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 03:30 PM to 06:15 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	**148**	0	**148**	22	0	0	22	0	94	17	**111**	0	0	0	0	**281**
04:30 PM	**1**	147	0	148	**31**	0	0	**31**	0	71	**23**	94	0	0	0	0	273
04:45 PM	0	134	0	134	25	0	1	26	0	85	13	98	0	0	0	0	258
05:00 PM	0	142	0	142	27	0	**2**	29	0	**96**	13	109	0	0	0	0	280
Total Volume	1	571	0	572	105	0	3	108	0	346	66	412	0	0	0	0	1092
% App. Total	0.2	99.8	0		97.2	0	2.8		0	84	16		0	0	0		
PHF	.250	.965	.000	.966	.847	.000	.375	.871	.000	.901	.717	.928	.000	.000	.000	.000	.972



HCM 6th Signalized Intersection Summary
9: US 340 & VA 7B/VA 7B (E Main Street)

07/30/2019

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	40	270	39	45	361	24	51	117	51	166	146	71
Future Volume (veh/h)	40	270	39	45	361	24	51	117	51	166	146	71
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	293	42	49	392	26	55	127	55	180	159	77
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	314	517	74	373	567	38	250	174	75	306	204	99
Arrive On Green	0.04	0.32	0.32	0.05	0.33	0.33	0.05	0.14	0.14	0.08	0.17	0.17
Sat Flow, veh/h	1781	1600	229	1781	1735	115	1781	1238	536	1781	1190	576
Grp Volume(v), veh/h	43	0	335	49	0	418	55	0	182	180	0	236
Grp Sat Flow(s),veh/h/ln	1781	0	1829	1781	0	1850	1781	0	1774	1781	0	1767
Q Serve(g_s), s	1.0	0.0	9.7	1.1	0.0	12.5	1.6	0.0	6.3	5.1	0.0	8.1
Cycle Q Clear(g_c), s	1.0	0.0	9.7	1.1	0.0	12.5	1.6	0.0	6.3	5.1	0.0	8.1
Prop In Lane	1.00		0.13	1.00		0.06	1.00		0.30	1.00		0.33
Lane Grp Cap(c), veh/h	314	0	591	373	0	605	250	0	249	306	0	303
V/C Ratio(X)	0.14	0.00	0.57	0.13	0.00	0.69	0.22	0.00	0.73	0.59	0.00	0.78
Avail Cap(c_a), veh/h	379	0	591	432	0	605	305	0	504	306	0	502
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	14.4	0.0	17.9	13.8	0.0	18.7	21.9	0.0	26.3	22.4	0.0	25.3
Incr Delay (d2), s/veh	0.2	0.0	3.9	0.2	0.0	6.4	0.4	0.0	4.1	2.9	0.0	4.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	4.4	0.4	0.0	6.0	0.7	0.0	2.8	2.4	0.0	3.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	14.6	0.0	21.8	14.0	0.0	25.0	22.4	0.0	30.4	25.4	0.0	29.6
LnGrp LOS	B	A	C	B	A	C	C	A	C	C	A	C
Approach Vol, veh/h		378			467			237			416	
Approach Delay, s/veh		21.0			23.9			28.5			27.8	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.7	27.4	11.4	15.2	9.5	27.6	9.4	17.2
Change Period (Y+Rc), s	* 6.8	* 6.8	* 6.3	* 6.3	* 6.8	* 6.8	* 6.3	* 6.3
Max Green Setting (Gmax), s	* 5	* 21	* 5.1	* 18	* 5	* 21	* 5.1	* 18
Max Q Clear Time (g_c+I1), s	3.1	11.7	7.1	8.3	3.0	14.5	3.6	10.1
Green Ext Time (p_c), s	0.0	1.3	0.0	0.6	0.0	1.3	0.0	0.8

Intersection Summary	
HCM 6th Ctrl Delay	25.0
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↰	↱		↔	
Traffic Vol, veh/h	14	152	46	47	312	6	73	2	96	6	2	19
Future Vol, veh/h	14	152	46	47	312	6	73	2	96	6	2	19
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	165	50	51	339	7	79	2	104	7	2	21

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	346	0	0	215	0	0	676	668	190	718	690	343
Stage 1	-	-	-	-	-	-	220	220	-	445	445	-
Stage 2	-	-	-	-	-	-	456	448	-	273	245	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1213	-	-	1355	-	-	367	379	852	344	368	700
Stage 1	-	-	-	-	-	-	782	721	-	592	575	-
Stage 2	-	-	-	-	-	-	584	573	-	733	703	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1213	-	-	1355	-	-	338	356	852	287	346	700
Mov Cap-2 Maneuver	-	-	-	-	-	-	338	356	-	287	346	-
Stage 1	-	-	-	-	-	-	771	711	-	584	548	-
Stage 2	-	-	-	-	-	-	538	546	-	632	693	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.5	1	13.8	12.6
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	338	852	1213	-	-	1355	-	-	502
HCM Lane V/C Ratio	0.241	0.122	0.013	-	-	0.038	-	-	0.058
HCM Control Delay (s)	19	9.8	8	0	-	7.8	0	-	12.6
HCM Lane LOS	C	A	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.9	0.4	0	-	-	0.1	-	-	0.2

Intersection	
Int Delay, s/veh	2.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	105	3	346	66	1	571
Future Vol, veh/h	105	3	346	66	1	571
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	114	3	376	72	1	621

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1035	412	0	0	448	0
Stage 1	412	-	-	-	-	-
Stage 2	623	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	257	640	-	-	1112	-
Stage 1	669	-	-	-	-	-
Stage 2	535	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	257	640	-	-	1112	-
Mov Cap-2 Maneuver	257	-	-	-	-	-
Stage 1	669	-	-	-	-	-
Stage 2	534	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	29.6	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	261	1112	-
HCM Lane V/C Ratio	-	-	0.45	0.001	-
HCM Control Delay (s)	-	-	29.6	8.2	0
HCM Lane LOS	-	-	D	A	A
HCM 95th %tile Q(veh)	-	-	2.2	0	-

Lanes, Volumes, Timings
9: US 340 & VA 7B/VA 7B (E Main Street)

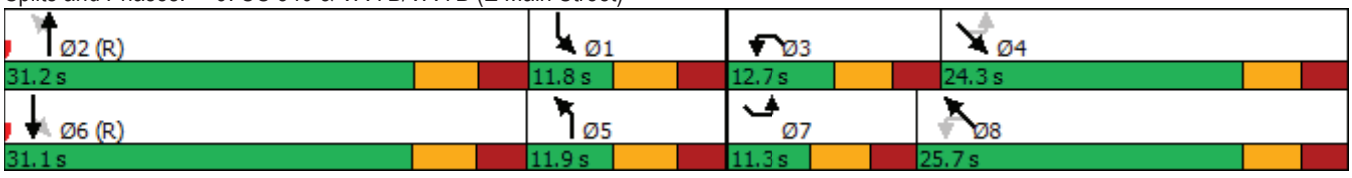
02/10/2020

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	96	323	12	3	397	10	33	78	89	181	124	67
Future Volume (vph)	96	323	12	3	397	10	33	78	89	181	124	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		0	100		0	0		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25			100			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.995			0.996			0.920			0.947	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1853	0	1770	1855	0	1770	1714	0	1770	1764	0
Flt Permitted	0.321			0.421			0.628			0.476		
Satd. Flow (perm)	598	1853	0	784	1855	0	1170	1714	0	887	1764	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		2			2			66			32	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		586			375			551			388	
Travel Time (s)		13.3			8.5			12.5			8.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	104	351	13	3	432	11	36	85	97	197	135	73
Shared Lane Traffic (%)												
Lane Group Flow (vph)	104	364	0	3	443	0	36	182	0	197	208	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane		Yes						Yes				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases	2			6			4			8		

Lane Group	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Detector Phase	5	2		1	6		7	4		3	8	
Switch Phase												
Minimum Initial (s)	5.0	8.0		5.0	8.0		5.0	8.0		5.0	8.0	
Minimum Split (s)	11.8	24.8		11.8	24.8		11.3	24.3		11.3	24.3	
Total Split (s)	11.9	31.2		11.8	31.1		11.3	24.3		12.7	25.7	
Total Split (%)	14.9%	39.0%		14.8%	38.9%		14.1%	30.4%		15.9%	32.1%	
Maximum Green (s)	5.1	24.4		5.0	24.3		5.0	18.0		6.4	19.4	
Yellow Time (s)	3.8	3.8		3.8	3.8		3.5	3.5		3.5	3.5	
All-Red Time (s)	3.0	3.0		3.0	3.0		2.8	2.8		2.8	2.8	
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Lost Time (s)	6.8	6.8		6.8	6.8		6.3	6.3		6.3	6.3	
Lead/Lag	Lag	Lead		Lag	Lead		Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	C-Max		None	C-Max		None	None		None	None	
Walk Time (s)		7.0			7.0			7.0			7.0	
Flash Dont Walk (s)		9.0			9.0			9.0			9.0	
Pedestrian Calls (#/hr)		0			0			0			0	
Act Effct Green (s)	41.5	39.5		37.3	32.3		17.1	12.0		22.1	18.3	
Actuated g/C Ratio	0.52	0.49		0.47	0.40		0.21	0.15		0.28	0.23	
v/c Ratio	0.27	0.40		0.01	0.59		0.12	0.58		0.62	0.49	
Control Delay	15.1	16.6		11.3	25.1		19.2	26.7		30.9	27.7	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	15.1	16.6		11.3	25.1		19.2	26.7		30.9	27.7	
LOS	B	B		B	C		B	C		C	C	
Approach Delay		16.2			25.0			25.5			29.2	
Approach LOS		B			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 80			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Natural Cycle: 75			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.62			
Intersection Signal Delay: 23.5		Intersection LOS: C	
Intersection Capacity Utilization 68.2%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 9: US 340 & VA 7B/VA 7B (E Main Street)



HCM 6th TWSC
3: Jack Enders Blvd & VA 7B

02/10/2020

Intersection	
Int Delay, s/veh	5.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	14	123	17	129	307	6	54	2	205	6	2	19
Future Vol, veh/h	14	123	17	129	307	6	54	2	205	6	2	19
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	200	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	134	18	140	334	7	59	2	223	7	2	21

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	341	0	0	152	0	0	802	794	143	904	800	338
Stage 1	-	-	-	-	-	-	173	173	-	618	618	-
Stage 2	-	-	-	-	-	-	629	621	-	286	182	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1218	-	-	1429	-	-	302	321	905	258	318	704
Stage 1	-	-	-	-	-	-	829	756	-	477	481	-
Stage 2	-	-	-	-	-	-	470	479	-	721	749	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1218	-	-	1429	-	-	267	286	905	177	283	704
Mov Cap-2 Maneuver	-	-	-	-	-	-	267	286	-	177	283	-
Stage 1	-	-	-	-	-	-	818	746	-	471	434	-
Stage 2	-	-	-	-	-	-	409	432	-	535	739	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.7	2.3	12.9	14.8
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	268	905	1218	-	-	1429	-	-	397
HCM Lane V/C Ratio	0.227	0.246	0.012	-	-	0.098	-	-	0.074
HCM Control Delay (s)	22.3	10.3	8	0	-	7.8	-	-	14.8
HCM Lane LOS	C	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0.9	1	0	-	-	0.3	-	-	0.2

HCM 6th TWSC
20: US 340 & South Church Street

02/10/2020

Intersection	
Int Delay, s/veh	3.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	107	3	436	48	1	608
Future Vol, veh/h	107	3	436	48	1	608
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	116	3	474	52	1	661

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1163	500	0	0	526	0
Stage 1	500	-	-	-	-	-
Stage 2	663	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	215	571	-	-	1041	-
Stage 1	609	-	-	-	-	-
Stage 2	512	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	215	571	-	-	1041	-
Mov Cap-2 Maneuver	215	-	-	-	-	-
Stage 1	609	-	-	-	-	-
Stage 2	511	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	39.6	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	219	1041	-
HCM Lane V/C Ratio	-	-	0.546	0.001	-
HCM Control Delay (s)	-	-	39.6	8.5	0
HCM Lane LOS	-	-	E	A	A
HCM 95th %tile Q(veh)	-	-	2.9	0	-

Intersection: 27: CSX Rail & Smallwood Lane

Movement	EB	WB	NB	SB
Directions Served	T	T	T	T
Maximum Queue (ft)	637	1021	15	17
Average Queue (ft)	128	203	3	3
95th Queue (ft)	483	769	16	19
Link Distance (ft)	701	1326	776	1042
Upstream Blk Time (%)	0			
Queuing Penalty (veh)	1			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

Zone wide Queuing Penalty: 1

HCM 6th Signalized Intersection Summary
9: US 340 & VA 7B/VA 7B (E Main Street)

02/10/2020

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (veh/h)	67	255	66	78	362	18	47	118	84	219	158	126
Future Volume (veh/h)	67	255	66	78	362	18	47	118	84	219	158	126
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	73	277	72	85	393	20	51	128	91	238	172	137
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	316	452	117	356	557	28	236	161	114	336	215	171
Arrive On Green	0.06	0.32	0.32	0.06	0.32	0.32	0.04	0.16	0.16	0.11	0.22	0.22
Sat Flow, veh/h	1781	1431	372	1781	1764	90	1781	1017	723	1781	964	768
Grp Volume(v), veh/h	73	0	349	85	0	413	51	0	219	238	0	309
Grp Sat Flow(s),veh/h/ln	1781	0	1803	1781	0	1854	1781	0	1740	1781	0	1732
Q Serve(g_s), s	0.0	0.0	11.9	0.0	0.0	14.2	1.7	0.0	8.8	7.9	0.0	12.2
Cycle Q Clear(g_c), s	0.0	0.0	11.9	0.0	0.0	14.2	1.7	0.0	8.8	7.9	0.0	12.2
Prop In Lane	1.00		0.21	1.00		0.05	1.00		0.42	1.00		0.44
Lane Grp Cap(c), veh/h	316	0	569	356	0	585	236	0	275	336	0	386
V/C Ratio(X)	0.23	0.00	0.61	0.24	0.00	0.71	0.22	0.00	0.80	0.71	0.00	0.80
Avail Cap(c_a), veh/h	338	0	569	378	0	585	282	0	432	336	0	497
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	26.6	0.0	21.1	24.8	0.0	21.9	24.2	0.0	29.4	23.2	0.0	26.7
Incr Delay (d2), s/veh	0.4	0.0	4.9	0.3	0.0	7.0	0.5	0.0	5.5	6.7	0.0	7.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	0.0	5.5	1.2	0.0	6.9	0.7	0.0	3.9	3.9	0.0	5.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.0	0.0	26.0	25.2	0.0	28.9	24.6	0.0	34.9	29.9	0.0	33.8
LnGrp LOS	C	A	C	C	A	C	C	A	C	C	A	C
Approach Vol, veh/h		422			498			270			547	
Approach Delay, s/veh		26.1			28.2			33.0			32.1	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.9	29.7	14.2	17.8	10.9	29.7	9.5	22.5
Change Period (Y+Rc), s	* 6.8	* 6.8	* 6.3	* 6.3	* 6.8	* 6.8	* 6.3	* 6.3
Max Green Setting (Gmax), s	* 5	* 23	* 7.9	* 18	* 5	* 23	* 5.1	* 21
Max Q Clear Time (g_c+I1), s	2.0	13.9	9.9	10.8	2.0	16.2	3.7	14.2
Green Ext Time (p_c), s	0.0	1.4	0.0	0.7	0.0	1.4	0.0	1.0

Intersection Summary	
HCM 6th Ctrl Delay	29.7
HCM 6th LOS	C

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	26.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	14	166	177	105	320	6	229	2	260	6	2	19
Future Vol, veh/h	14	166	177	105	320	6	229	2	260	6	2	19
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	150	-	-	200	-	0	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	180	192	114	348	7	249	2	283	7	2	21

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	355	0	0	372	0	0	897	889	276	1029	982	352
Stage 1	-	-	-	-	-	-	306	306	-	580	580	-
Stage 2	-	-	-	-	-	-	591	583	-	449	402	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1204	-	-	1186	-	-	261	282	763	212	249	692
Stage 1	-	-	-	-	-	-	704	662	-	500	500	-
Stage 2	-	-	-	-	-	-	493	499	-	589	600	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1204	-	-	1186	-	-	~ 230	251	763	121	222	692
Mov Cap-2 Maneuver	-	-	-	-	-	-	~ 230	251	-	121	222	-
Stage 1	-	-	-	-	-	-	693	651	-	492	452	-
Stage 2	-	-	-	-	-	-	430	451	-	364	590	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	2	68.4	17.6
HCM LOS			F	C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	230	763	1204	-	-	1186	-	-	314
HCM Lane V/C Ratio	1.092	0.37	0.013	-	-	0.096	-	-	0.093
HCM Control Delay (s)	131.4	12.5	8	0	-	8.4	-	-	17.6
HCM Lane LOS	F	B	A	A	-	A	-	-	C
HCM 95th %tile Q(veh)	11.1	1.7	0	-	-	0.3	-	-	0.3

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	166	177	105	320	6	229	2	260	6	2	19
Future Volume (veh/h)	14	166	177	105	320	6	229	2	260	6	2	19
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	15	180	192	114	348	7	249	2	283	7	2	21
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	60	214	217	247	499	10	483	4	433	99	28	298
Arrive On Green	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26	0.26
Sat Flow, veh/h	24	782	794	1010	1827	37	1768	14	1585	384	110	1151
Grp Volume(v), veh/h	387	0	0	114	0	355	251	0	283	30	0	0
Grp Sat Flow(s),veh/h/ln	1601	0	0	1010	0	1864	1782	0	1585	1644	0	0
Q Serve(g_s), s	4.4	0.0	0.0	0.4	0.0	11.9	8.3	0.0	11.0	1.0	0.0	0.0
Cycle Q Clear(g_c), s	16.3	0.0	0.0	16.7	0.0	11.9	8.3	0.0	11.0	1.0	0.0	0.0
Prop In Lane	0.04		0.50	1.00		0.02	0.99		1.00	0.23		0.70
Lane Grp Cap(c), veh/h	491	0	0	247	0	509	487	0	433	426	0	0
V/C Ratio(X)	0.79	0.00	0.00	0.46	0.00	0.70	0.52	0.00	0.65	0.07	0.00	0.00
Avail Cap(c_a), veh/h	504	0	0	255	0	523	487	0	433	426	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	24.0	0.0	0.0	24.7	0.0	22.7	21.3	0.0	22.3	19.4	0.0	0.0
Incr Delay (d2), s/veh	8.0	0.0	0.0	1.3	0.0	3.9	3.9	0.0	7.5	0.3	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.8	0.0	0.0	1.8	0.0	5.4	3.8	0.0	4.7	0.4	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.0	0.0	0.0	26.0	0.0	26.6	25.2	0.0	29.8	19.8	0.0	0.0
LnGrp LOS	C	A	A	C	A	C	C	A	C	B	A	A
Approach Vol, veh/h		387			469			534			30	
Approach Delay, s/veh		32.0			26.5			27.6			19.8	
Approach LOS		C			C			C			B	

Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		23.5		23.5		22.5		23.5				
Change Period (Y+Rc), s		4.5		4.5		4.5		4.5				
Max Green Setting (Gmax), s		19.0		19.5		18.0		19.5				
Max Q Clear Time (g_c+I1), s		13.0		18.3		3.0		18.7				
Green Ext Time (p_c), s		1.1		0.4		0.1		0.3				

Intersection Summary												
HCM 6th Ctrl Delay			28.3									
HCM 6th LOS			C									

Intersection	
Int Delay, s/veh	4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	117	3	370	71	1	637
Future Vol, veh/h	117	3	370	71	1	637
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	127	3	402	77	1	692

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1135	441	0	0	479	0
Stage 1	441	-	-	-	-	-
Stage 2	694	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	224	616	-	-	1083	-
Stage 1	648	-	-	-	-	-
Stage 2	496	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	224	616	-	-	1083	-
Mov Cap-2 Maneuver	224	-	-	-	-	-
Stage 1	648	-	-	-	-	-
Stage 2	495	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	40	0	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	228	1083	-
HCM Lane V/C Ratio	-	-	0.572	0.001	-
HCM Control Delay (s)	-	-	40	8.3	0
HCM Lane LOS	-	-	E	A	A
HCM 95th %tile Q(veh)	-	-	3.2	0	-

Appendix C:
Construction and ROW Costs

Appendix C: Summary Costs

Summary Costs				
	B1	**B2**	**D1**	**D2**
Construction Cost				
Mainline	$8,130	$7,950	$5,280	$4,820
Intersection Improvements	$560	$560	$430	$430
New Traffic Signals	$600	$600	$540	$540
At Grade Railroad Crossing	$160	$160	$0	$0
Subtotal: Construction Cost	**$9,460**	**$9,280**	**$6,250**	**$5,790**
Total Length (feet)	5,500	5,650	3,200	3,000
Cost per mile	$9,080	$8,670	$10,310	$10,200
ROW Costs				
ROW - Open Space (SF)	249,372	231,511	149,848	188,121
ROW - Residence or Business	93,794	102,366	51,523	60,095
Subtotal: ROW Cost $	**$100**	**$100**	**$60**	**$70**
Total Cost	**$9,560**	**$9,380**	**$6,310**	**$5,870**

Appendix: Cost Estimate

Concept Cost by Cost Element

Item			B1	B2	D1	D2
	Length in Feet		5,500	5,650	3,200	3,000
100	Mobilization	LS	$280,930	$274,360	$180,160	$163,480
111	Clearing and Grubbing	Acre	$34,520	$14,930	$27,990	$14,930
120	Regular Excavation	CY	$413,630	$178,870	$335,380	$178,870
505	Bedding Mat Agg 25	Ton	$651,850	$669,630	$379,260	$355,560
580	Underdrain UD 1	LF	$204,050	$209,620	$118,720	$111,300
1080	8" Pipe	LF	$165,000	$169,500	$96,000	$90,000
6751	Drop Inlet	EA	$78,200	$78,200	$78,200	$78,200
9056	Manhole	LF	$10,150	$10,150	$10,150	$10,150
10099	Aggr Mat 21 B	Ton	$997,460	$1,024,670	$580,340	$544,070
10611	Asphault Conc	Ton	$1,061,000	$1,089,930	$617,310	$578,730
10637	Asphault Surface	Ton	$1,352,050	$1,388,920	$786,650	$737,480
12600	Standard Curb Gut CG 6	LF	$7,500	$7,500	$7,500	$7,500
13294	Guardrail GR 8	LF	$11,290	$11,290	$11,290	$11,290
13345	GR 9 Terminal	EA	$14,470	$14,470	$14,470	$14,470
27013	Topsoil	CY	$50,930	$52,310	$29,630	$27,780
50108	Sign Panel	SF	$6,960	$6,960	$6,960	$6,960
54037	Typ A PVMT Line 8"	LF	$29,260	$30,060	$17,020	$15,960
54572	PVMT Symbol	EA	$2,290	$2,290	$2,290	$2,290
55188	Light Pole	EA	$24,000	$24,000	$24,000	$24,000
	E & S	LS	$104,000	$104,000	$60,000	$60,000
	Culvert	LS	$400,000	$400,000	$400,000	$400,000
	Utility Relocation	LS	$50,000	$50,000	$50,000	$50,000
	Subtotal		**$5,949,540**	**$5,811,660**	**$3,833,310**	**$3,483,000**
	RR Crossing	LS	$160,000	$160,000	$0	$0
	Signal	per leg	$600,000	$600,000	$540,000	$540,000
	US 340 OR Main Street Improvements		$564,580	$564,580	$434,240	$434,240
	Subtotal		**$7,274,120**	**$7,136,240**	**$4,807,560**	**$4,457,250**
	Contingency		$2,182,240	$2,140,870	$1,442,270	$1,337,170
	Total Construction		**$9,456,400**	**$9,277,100**	**$6,249,800**	**$5,794,400**

Appendix: Cost Details

Cost Elements

Item					B1			
					5,500			
100	Mobilization	LS	5%		280,930	L=	3700	
111	Clearing and Grubbing	Acre		$5,805.00	5.95	34,515	footprint of roadway on new location	
120	Regular Excavation	CY		$21.56	19,185.19	413,633	70' width X 2'deep X 71% of length	
505	Bedding Mat Agg 25	Ton		$50.00	13,037.04	651,852	8" X 48' footprint	$6,519 CY
580	Underdrain UD 1	LF		$18.55	11,000.00	204,050	2 X length	
1080	8" Pipe	LF		$300.00	550.00	165,000	10% of length	
6751	Drop Inlet	EA		$6,517.00	12.00	78,204	2 per 1000 feet	
9056	Manhole	LF		$846.00	12.00	10,152	2 per 1000 feet	
10099	Aggr Mat 21 B	Ton		$76.51	13,037.04	997,464	8" X 48' footprint	$6,518.52
10611	Asphault Conc	Ton		$102.80	10,320.99	1,060,998	8" X (8 + 30) X L	$5,160.49
10637	Asphault Surface	Ton		$131.00	10,320.99	1,352,049	2" X (8 + 30) X L	$5,160.49
12600	Standard Curb Gut CG 6	LF		$24.99	300.00	7,497	300 feet 300	
13294	Guardrail GR 8	LF		$22.58	500.00	11,290	500 feet	
13345	GR 9 Terminal	EA		$2,412.00	6.00	14,472	6 total	
27013	Topsoil	CY		$25.00	2,037.04	50,926	20 feet X 6" X L	
50108	Sign Panel	SF		$28.99	240.00	6,958	20 SF per sign	12
54037	Typ A PVMT Line 8"	LF		$1.33	22,000.00	29,260	4 X L	
54572	PVMT Symbol	EA		$286.00	8.00	2,288	8 total	
55188	Light Pole	EA		$4,000.00	6.00	24,000	6 Total	
	E & S	LS				104,000		
	Culvert	LS				400,000		
	Utility Relocation	LS				50,000		
	Subtotal					**5,949,537**		
	RR Crossing	LS				160,000		
	Signal	per leg		$200,000.00	3	600,000		
	US 340 Improvements					$564,581		
	Subtotal					$7,274,118		
	Contingency		30%			2,182,235		
						9,456,354		

Appendix: Cost Details

Cost Elements

Item					B2			
					5,650			
100	Mobilization	LS	5%		274,365	L=	1600	
111	Clearing and Grubbing	Acre	$5,805.00	2.57	14,926	footprint of roadway on new location		
120	Regular Excavation	CY	$21.56	8,296.30	178,868	70' width X 2'deep X 30% of length		
505	Bedding Mat Agg 25	Ton	$50.00	13,392.59	669,630	8" X 48' footprint	$6,696	CY
580	Underdrain UD 1	LF	$18.55	11,300.00	209,615	2 X length		
1080	8" Pipe	LF	$300.00	565.00	169,500	10% of length		
6751	Drop Inlet	EA	$6,517.00	12.00	78,204	2 per 1000 feet		
9056	Manhole	LF	$846.00	12.00	10,152	2 per 1000 feet		
10099	Aggr Mat 21 B	Ton	$76.51	13,392.59	1,024,667	8" X 48' footprint	$6,696.30	
10611	Asphault Conc	Ton	$102.80	10,602.47	1,089,934	8" X (8 + 30) X L	$5,301.23	
10637	Asphault Surface	Ton	$131.00	10,602.47	1,388,923	2" X (8 + 30) X L	$5,301.23	
12600	Standard Curb Gut CG 6	LF	$24.99	300.00	7,497	300 feet	300	
13294	Guardrail GR 8	LF	$22.58	500.00	11,290	500 feet		
13345	GR 9 Terminal	EA	$2,412.00	6.00	14,472	6 total		
27013	Topsoil	CY	$25.00	2,092.59	52,315	20 feet X 6" X L		
50108	Sign Panel	SF	$28.99	240.00	6,958	20 SF per sign	12	
54037	Typ A PVMT Line 8"	LF	$1.33	22,600.00	30,058	4 X L		
54572	PVMT Symbol	EA	$286.00	8.00	2,288	8 total		
55188	Light Pole	EA	$4,000.00	6.00	24,000	6 Total		
	E & S	LS			104,000			
	Culvert	LS			400,000			
	Utility Relocation	LS			50,000			
	Subtotal				**5,811,661**			
	RR Crossing	LS			160,000			
	Signal	per leg	$200,000.00	3	600,000			
	US 340 Improvements				$564,581			
	Subtotal				$7,136,242			
	Contingency		30%		2,140,873			
					9,277,114			

Appendix: Cost Details

Cost Elements

Item					D1			
					3,200			
100	Mobilization	LS	5%		180,158	L=	3000	
111	Clearing and Grubbing	Acre	$5,805.00	4.82	27,986	footprint of roadway on new location		
120	Regular Excavation	CY	$21.56	15,555.56	335,378	70' width X 2'deep X 30% of length		
505	Bedding Mat Agg 25	Ton	$50.00	7,585.19	379,259	8" X 48' footprint	$3,793	CY
580	Underdrain UD 1	LF	$18.55	6,400.00	118,720	2 X length		
1080	8" Pipe	LF	$300.00	320.00	96,000	10% of length		
6751	Drop Inlet	EA	$6,517.00	12.00	78,204	2 per 1000 feet		
9056	Manhole	LF	$846.00	12.00	10,152	2 per 1000 feet		
10099	Aggr Mat 21 B	Ton	$76.51	7,585.19	580,343	8" X 48' footprint	$3,792.59	
10611	Asphault Conc	Ton	$102.80	6,004.94	617,308	8" X (8 + 30) X L	$3,002.47	
10637	Asphault Surface	Ton	$131.00	6,004.94	786,647	2" X (8 + 30) X L	$3,002.47	
12600	Standard Curb Gut CG 6	LF	$24.99	300.00	7,497	300 feet	300	
13294	Guardrail GR 8	LF	$22.58	500.00	11,290	500 feet		
13345	GR 9 Terminal	EA	$2,412.00	6.00	14,472	6 total		
27013	Topsoil	CY	$25.00	1,185.19	29,630	20 feet X 6" X L		
50108	Sign Panel	SF	$28.99	240.00	6,958	20 SF per sign	12	
54037	Typ A PVMT Line 8"	LF	$1.33	12,800.00	17,024	4 X L		
54572	PVMT Symbol	EA	$286.00	8.00	2,288	8 total		
55188	Light Pole	EA	$4,000.00	6.00	24,000	6 Total		
	E & S	LS			60,000			
	Culvert	LS			400,000			
	Utility Relocation	LS			50,000			
	Subtotal				**3,833,312**			
	RR Crossing	LS						
	Signal	per leg	$180,000.00	3	540,000			
	Main Street Improvements				$434,244			
	Subtotal				$4,807,555			
	Contingency		30%		1,442,267			
					6,249,822			

Appendix: Cost Details

Cost Elements

Item					D2			
					3,000			
100	Mobilization	LS	5%		163,476	L=	1600	
111	Clearing and Grubbing	Acre	$5,805.00	2.57	14,926	footprint of roadway on new location		
120	Regular Excavation	CY	$21.56	8,296.30	178,868	70' width X 2'deep X 30% of length		
505	Bedding Mat Agg 25	Ton	$50.00	7,111.11	355,556	8" X 48' footprint	$3,556	CY
580	Underdrain UD 1	LF	$18.55	6,000.00	111,300	2 X length		
1080	8" Pipe	LF	$300.00	300.00	90,000	10% of length		
6751	Drop Inlet	EA	$6,517.00	12.00	78,204	2 per 1000 feet		
9056	Manhole	LF	$846.00	12.00	10,152	2 per 1000 feet		
10099	Aggr Mat 21 B	Ton	$76.51	7,111.11	544,071	8" X 48' footprint	$3,555.56	
10611	Asphault Conc	Ton	$102.80	5,629.63	578,726	8" X (8 + 30) X L	$2,814.81	
10637	Asphault Surface	Ton	$131.00	5,629.63	737,481	2" X (8 + 30) X L	$2,814.81	
12600	Standard Curb Gut CG 6	LF	$24.99	300.00	7,497	300 feet	300	
13294	Guardrail GR 8	LF	$22.58	500.00	11,290	500 feet		
13345	GR 9 Terminal	EA	$2,412.00	6.00	14,472	6 total		
27013	Topsoil	CY	$25.00	1,111.11	27,778	20 feet X 6" X L		
50108	Sign Panel	SF	$28.99	240.00	6,958	20 SF per sign	12	
54037	Typ A PVMT Line 8"	LF	$1.33	12,000.00	15,960	4 X L		
54572	PVMT Symbol	EA	$286.00	8.00	2,288	8 total		
55188	Light Pole	EA	$4,000.00	6.00	24,000	6 Total		
	E & S	LS			60,000			
	Culvert	LS			400,000			
	Utility Relocation	LS			50,000			
	Subtotal				**3,483,003**			
	RR Crossing	LS						
	Signal	per leg	$180,000.00	3	540,000			
	Main Street Improvements				$434,244			
	Subtotal				$4,457,246			
	Contingency		30%		1,337,174			
					5,794,420			

Appendix: Cost Details B1 and B2

Cost of US 340 Improvements

100	Mobilization	LS	5%			23,313		
111	Clearing and Grubbing	Acre		$5,805.00	0.00	0		
120	Regular Excavation	CY		$21.56	1918.52	41,363	10% of Mainline B1	
505	Bedding Mat Agg 25	Ton		$50.00	586.42	29,321	4" X	293.2098765 CY
580	Underdrain UD 1	LF		$18.55	1800.00	33,390	2 X length	900
1080	8" Pipe	LF		$300.00	90.00	27,000	10% of length	10%
6751	Drop Inlet	EA		$6,517.00	2.00	13,034	2 per 1000 feet	
9056	Manhole	LF		$846.00	2.00	1,692	2 per 1000 feet	
10099	Aggr Mat 21 B	Ton		$76.51	586.42	44,867	4" X SF	293.2098765
10611	Asphault Conc	Ton		$102.80	586.42	60,284	4" X SF	293.2098765
10637	Asphault Surface	Ton		$131.00	1172.84	153,642	8" X SF	586.4197531
12600	Standard Curb Gut CG 6	LF		$24.99	200.00	4,998	200 feet	
13294	Guardrail GR 8	LF		$22.58	300.00	6,774	300 feet	
13345	GR 9 Terminal	EA		$2,412.00	4.00	9,648	4 total	
27013	Topsoil	CY		$25.00	333.33	8,333	20 feet X 6" X L	9000 SF
50108	Sign Panel	SF		$28.99	120.00	3,479	20 SF per sign	
54037	Typ A PVMT Line 8"	LF		$1.33	5400.00	7,182	6 X L	
54572	PVMT Symbol	EA		$286.00	10.00	2,860	10 total	
55188	Light Pole	EA		$4,000.00	2.00	8,000	2 Total	
	E & S	LS		10% of Main	$104,000.00	10,400		
	Utility Relocation	LS				20,000		
	MOT	Day		$50.00	$1,100.00	55,000		
	Subtotal					**564,581**		

Appendix: Cost Details D1 and D2

Cost Elements

Cost of Main Street Improvements

100	Mobilization	LS	5%			17,369		
111	Clearing and Grubbing	Acre		$5,805.00	0.00	0		
120	Regular Excavation	CY		$21.56	1555.56	33,538	10% of Mainline	
505	Bedding Mat Agg 25	Ton		$50.00	395.06	19,753	4" X	197.5308642 CY
580	Underdrain UD 1	LF		$18.55	1500.00	27,825	2 X length	750
1080	8" Pipe	LF		$300.00	75.00	22,500	10% of length	10%
6751	Drop Inlet	EA		$6,517.00	2.00	13,034	2 per 1000 feet	
9056	Manhole	LF		$846.00	2.00	1,692	2 per 1000 feet	
10099	Aggr Mat 21 B	Ton		$76.51	395.06	30,226	4" X SF	197.5308642
10611	Asphault Conc	Ton		$102.80	395.06	40,612	4" X SF	197.5308642
10637	Asphault Surface	Ton		$131.00	790.12	103,506	8" X SF	395.0617284
12600	Standard Curb Gut CG 6	LF		$24.99	200.00	4,998	200 feet	
13294	Guardrail GR 8	LF		$22.58	300.00	6,774	300 feet	
13345	GR 9 Terminal	EA		$2,412.00	4.00	9,648	4 total	
27013	Topsoil	CY		$25.00	277.78	6,944	20 feet X 6" X L	7500 SF
50108	Sign Panel	SF		$28.99	120.00	3,479	20 SF per sign	
54037	Typ A PVMT Line 8"	LF		$1.33	4500.00	5,985	6 X L	
54572	PVMT Symbol	EA		$286.00	10.00	2,860	10 total	
55188	Light Pole	EA		$4,000.00	2.00	8,000	2 Total	
	E & S	LS		10% of Main	$60,000.00	6,000		
	Utility Relocation	LS				20,000		
	MOT	Day		$45.00	$1,100.00	49,500		
	Subtotal					**434,244**		

Southeastern Collector Berryville
SUMMARY OF COSTS
ROW TAKES

Berryville - Right-of-way Take in SF

Number	Description	Concept B2	Concept B1	Concept D2	Concept D1
I	NE corner US 340- Smallwood	2,883	2,883		
II	SE US 340 - Smallwood Lane	7,557	7,557		
III	North side of Smallwood Lane	2,103	2,103		
IV	South side of Smallwood Lane	7,404	7,404		
V	North side of Smallwood Lane	894	894		
VI	North side of Smallwood Lane	9,660	9,660		
VII	Residence just east of RR	11,770	11,770		
VIII	Milton Valley Farm Property	0	0		
IX	Smallwood Property	249,372	231,511	149,848	188,121
X	Pumpernickle Press	6,245	14,818	6,245	14,818
XI	Timberlake Cabinet	8,576	8,576	8,576	8,576
XII	Water tower	2,402	2,402	2,402	2,402
XIII	Along Jack Enders	10,998	10,998	10,998	10,998
XIV	West Side, Jack Enders	18,468	18,468	18,468	18,468
XV	West Side, Jack Enders	0	0	0	0
XVI	West Side, Jack Enders	1,030	1,030	1,030	1,030
XVII	West Side, Jack Enders	3,803	3,803	3,803	3,803
	Total Less IX	93,794	102,366	51,523	60,095
	IX (Smallwood Property)	249,372	231,511	149,848	188,121
	ROW Cost	$100,312	$100,148	$58,056	$70,778

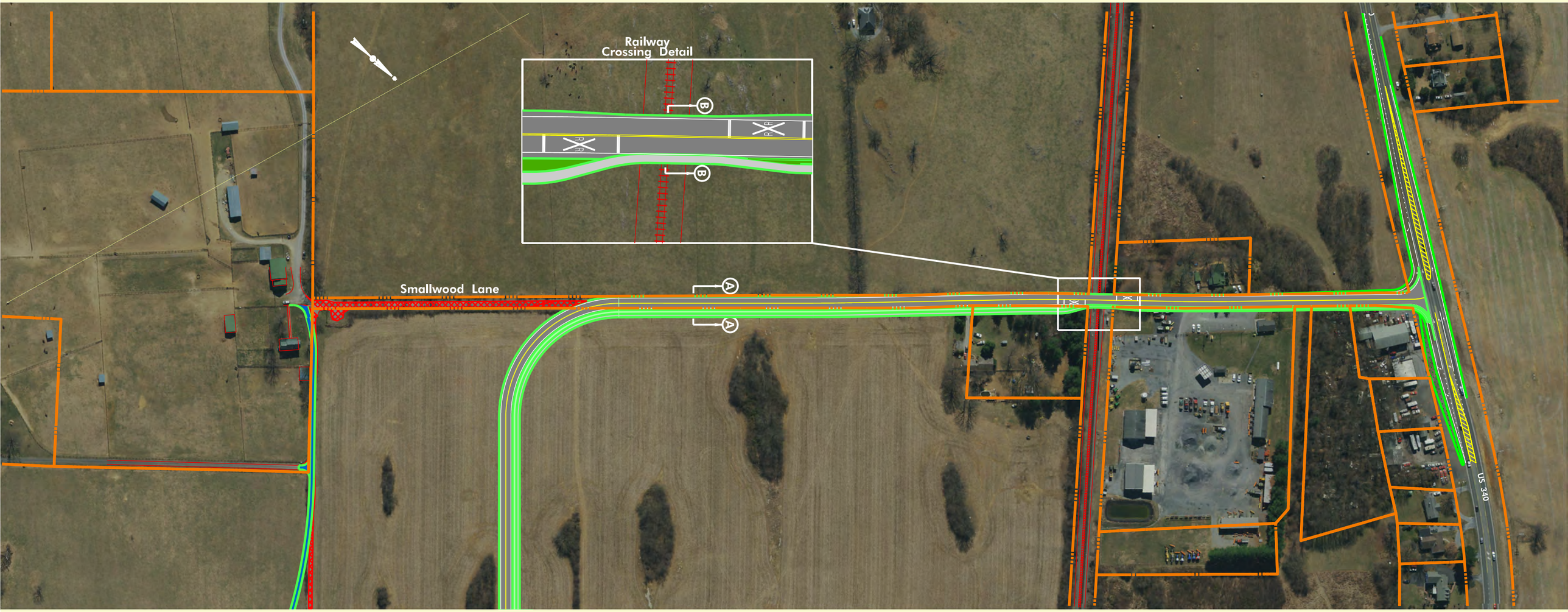
Estimated SF Costs

Open Space (Smallwood Property)	10,000	$ / acre
	0.230	$ / SF
Improved Residence or Business	20,000	$ / acre
	0.459	$ / SF

Appendix D: Conceptual Plans

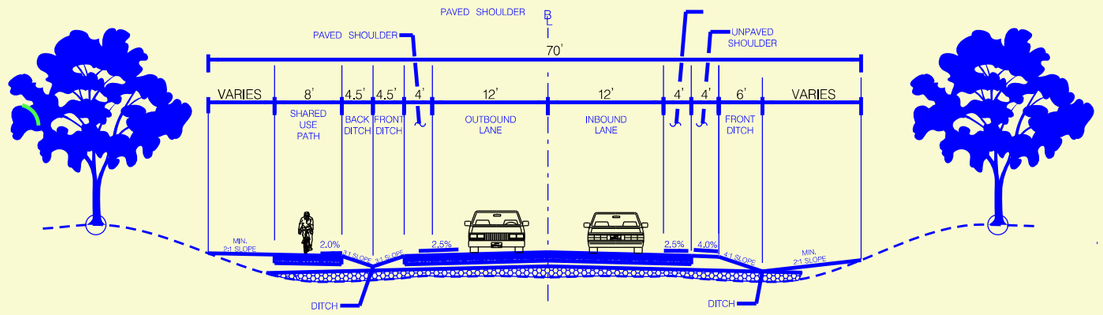
Contents:

Berryville Roadway Improvements
CONCEPT B1 - PART 1

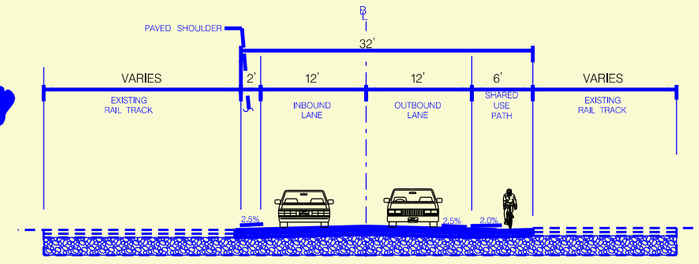


LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL



PROPOSED TYPICAL SECTION AA – RURAL COLLECTOR

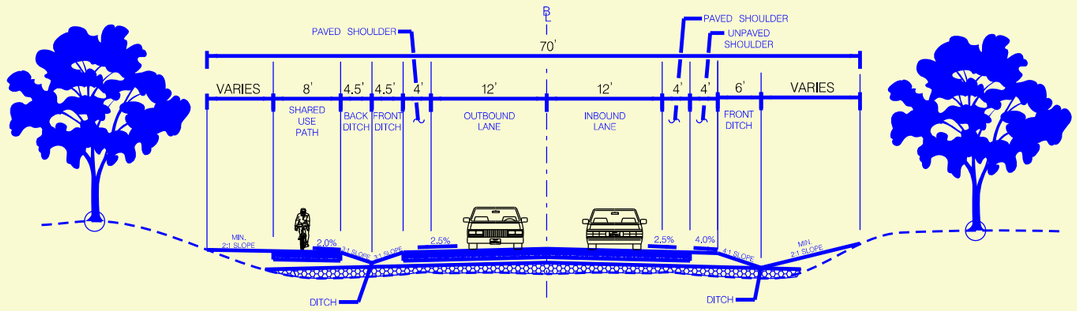


PROPOSED TYPICAL SECTION BB – RURAL COLLECTOR

Berryville Roadway Improvements
CONCEPT B1 - PART 2

LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL

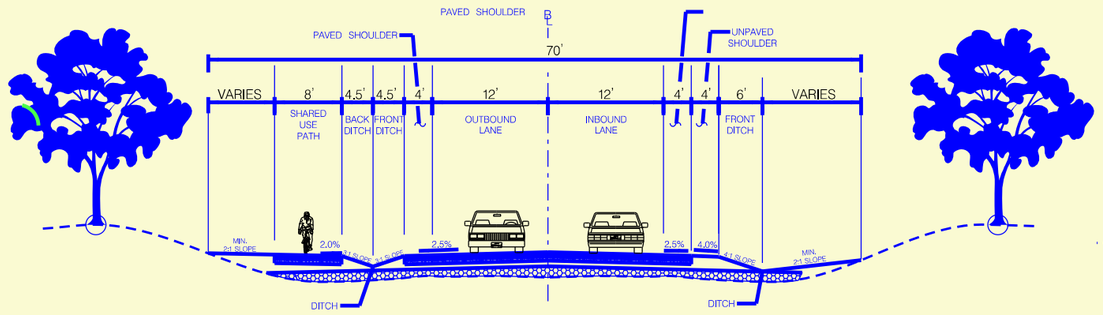


PROPOSED TYPICAL SECTION – RURAL COLLECTOR

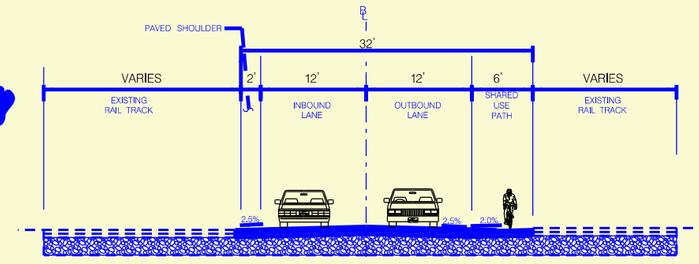
Berryville Roadway Improvements
CONCEPT B2 - PART 1

LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL



PROPOSED TYPICAL SECTION AA – RURAL COLLECTOR

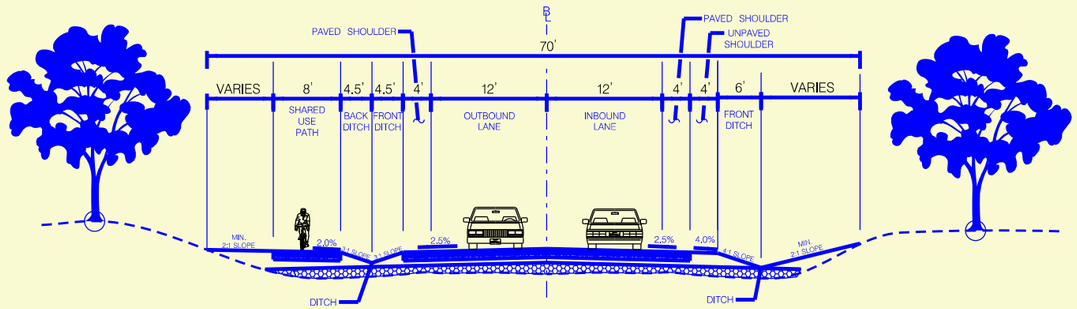


PROPOSED TYPICAL SECTION BB – RURAL COLLECTOR

Berryville Roadway Improvements
CONCEPT B2 - PART 2

LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL

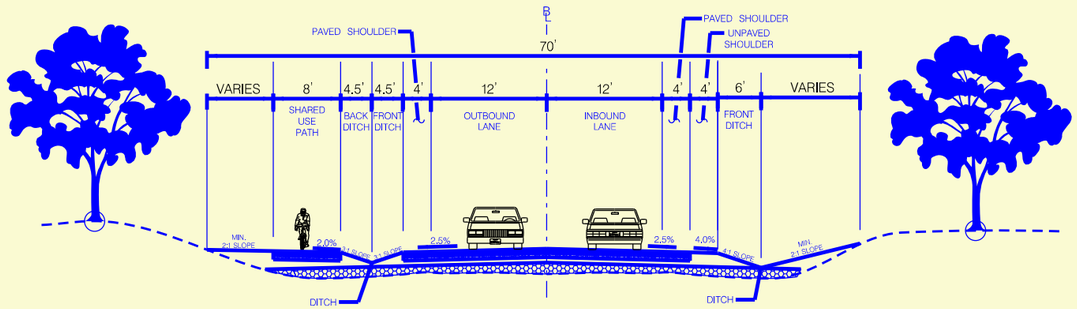


PROPOSED TYPICAL SECTION – RURAL COLLECTOR

Berryville Roadway Improvements
CONCEPT D1

LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL

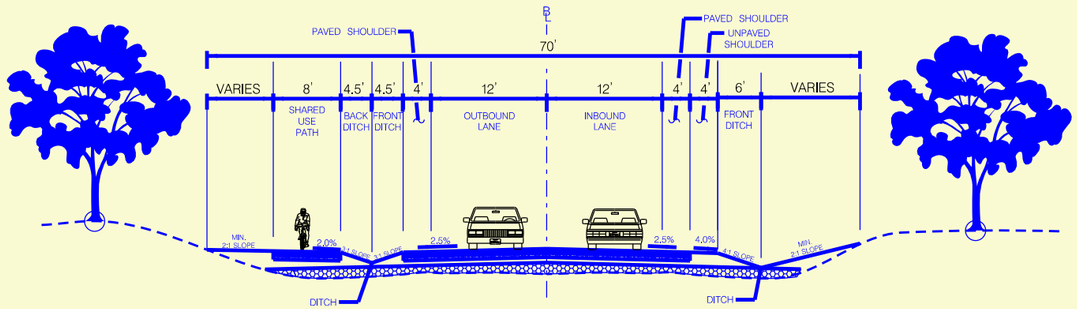


PROPOSED TYPICAL SECTION – RURAL COLLECTOR

Berryville Roadway Improvements
CONCEPT D2

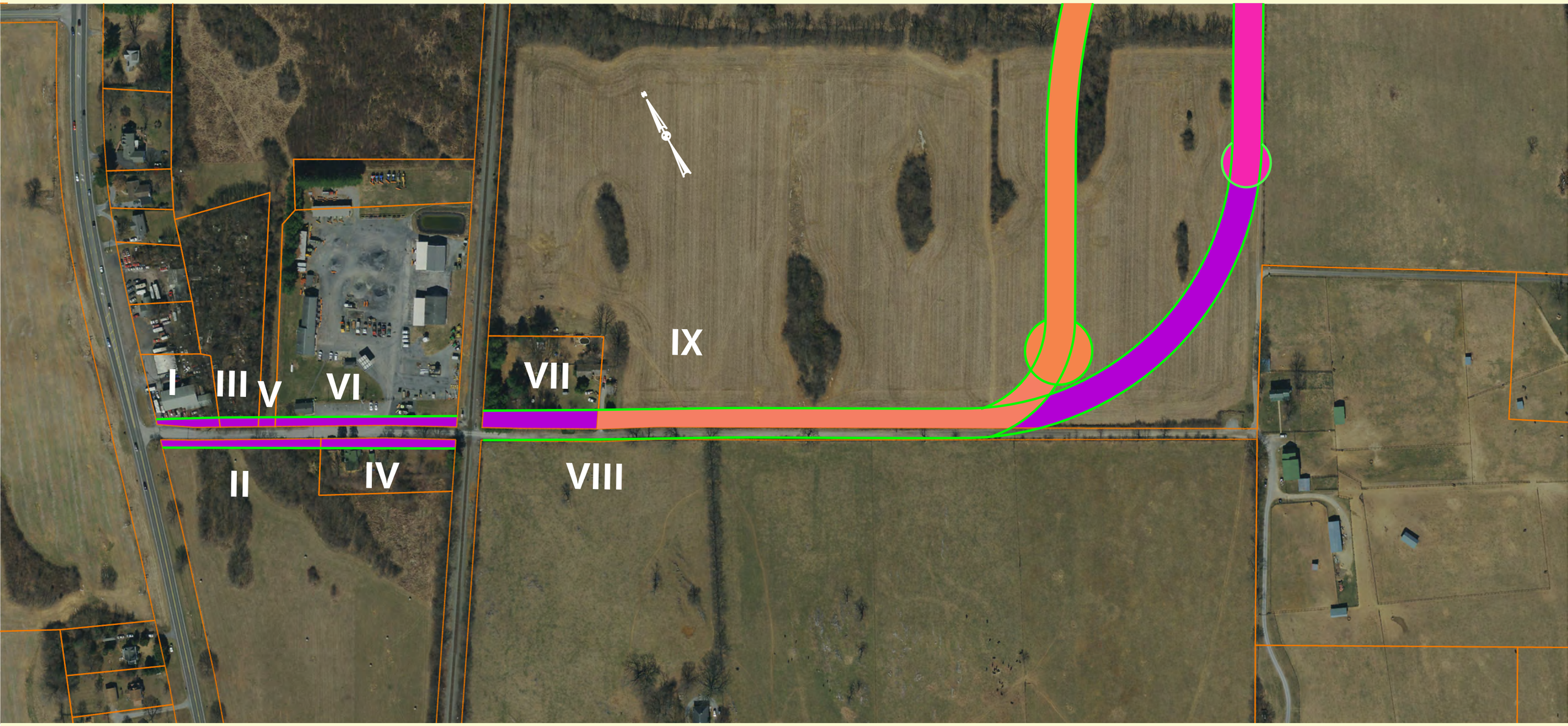
LEGEND:

- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL



PROPOSED TYPICAL SECTION – RURAL COLLECTOR

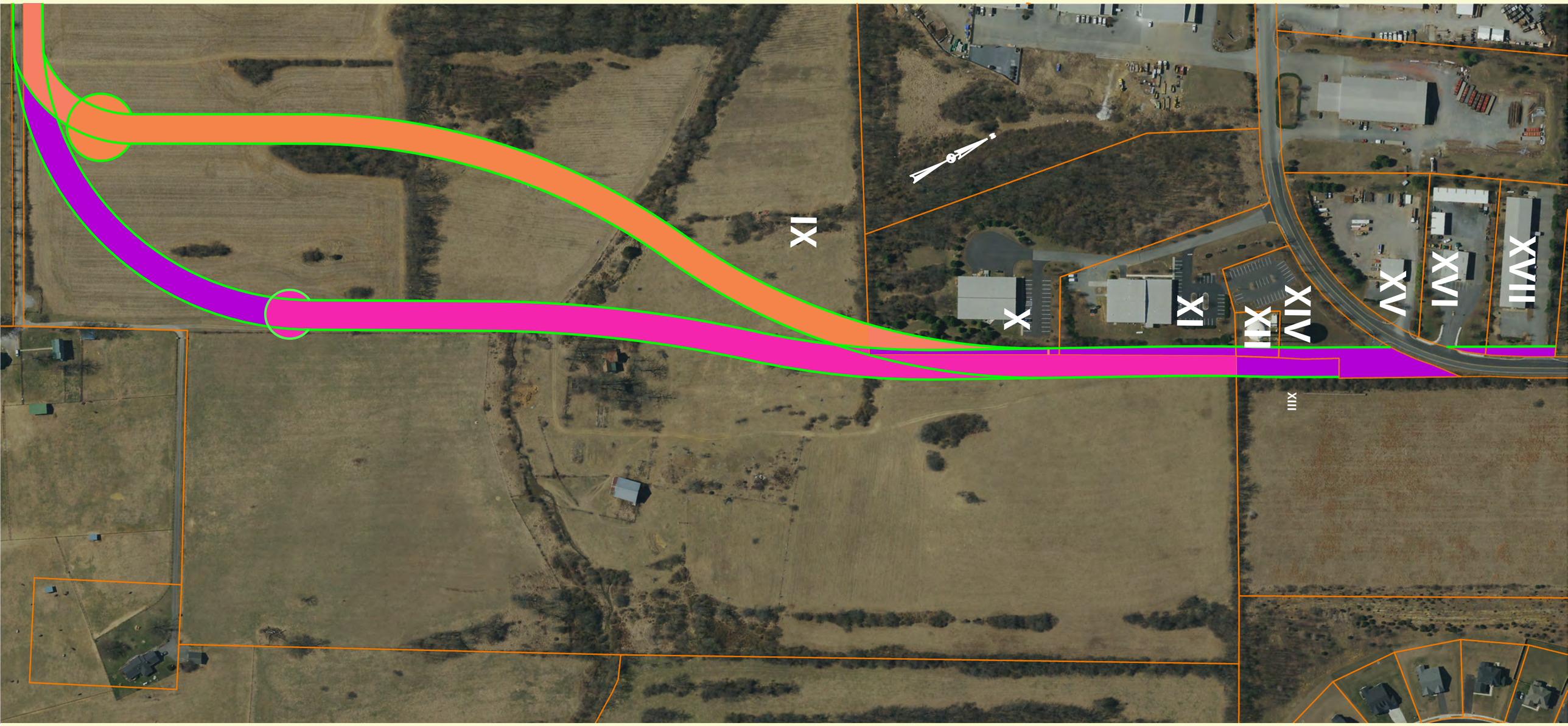
Berryville Roadway Improvements
RIGHT-OF-WAY TAKING - PART 1



LEGEND:

- CONCEPT B1 AND B2
- CONCEPT B1 AND B2
- CONCEPT D2
- CONCEPT D1

Berryville Roadway Improvements
RIGHT-OF-WAY TAKING - PART 2



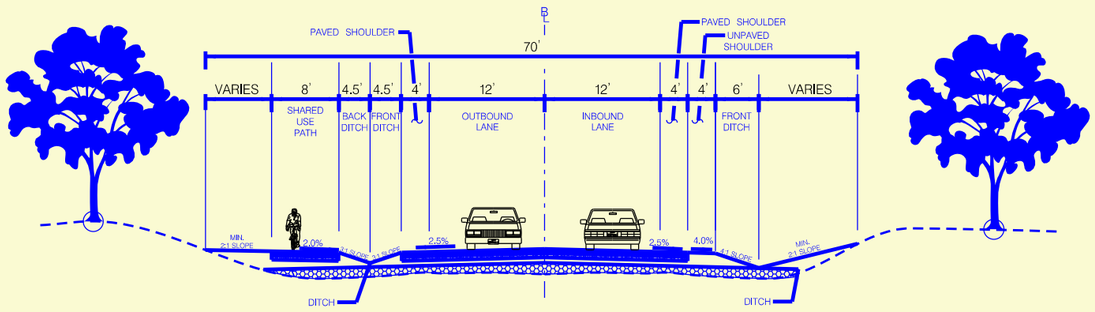
LEGEND:

- CONCEPT B1 AND B2
- CONCEPT B1 AND B2
- CONCEPT D2
- CONCEPT D1

Berryville Roadway Improvements
Alternate 1
CONCEPT B - NORTHERN TERMINIS

LEGEND:

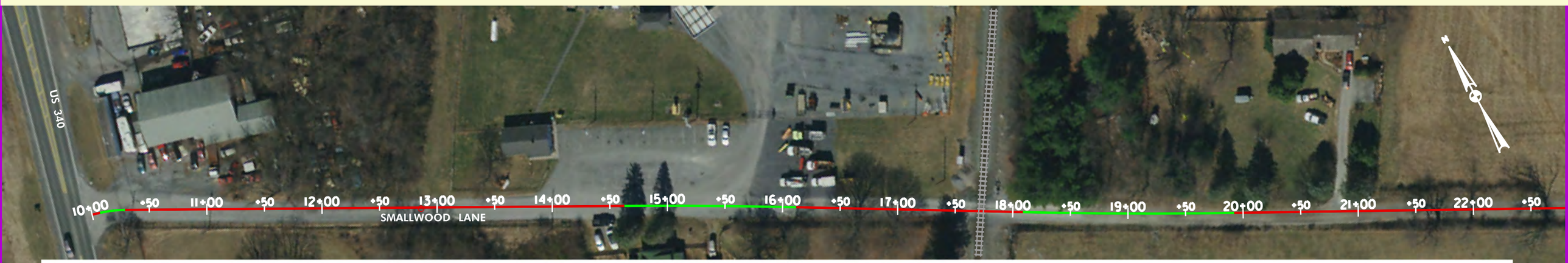
- PROPOSED ROADWAY
- GREEN SPACE/PROPOSED LANDSCAPED MEDIAN
- PROPOSED DRIVEWAY
- PROPOSED SHARED USE PATH
- PAVEMENT REMOVAL

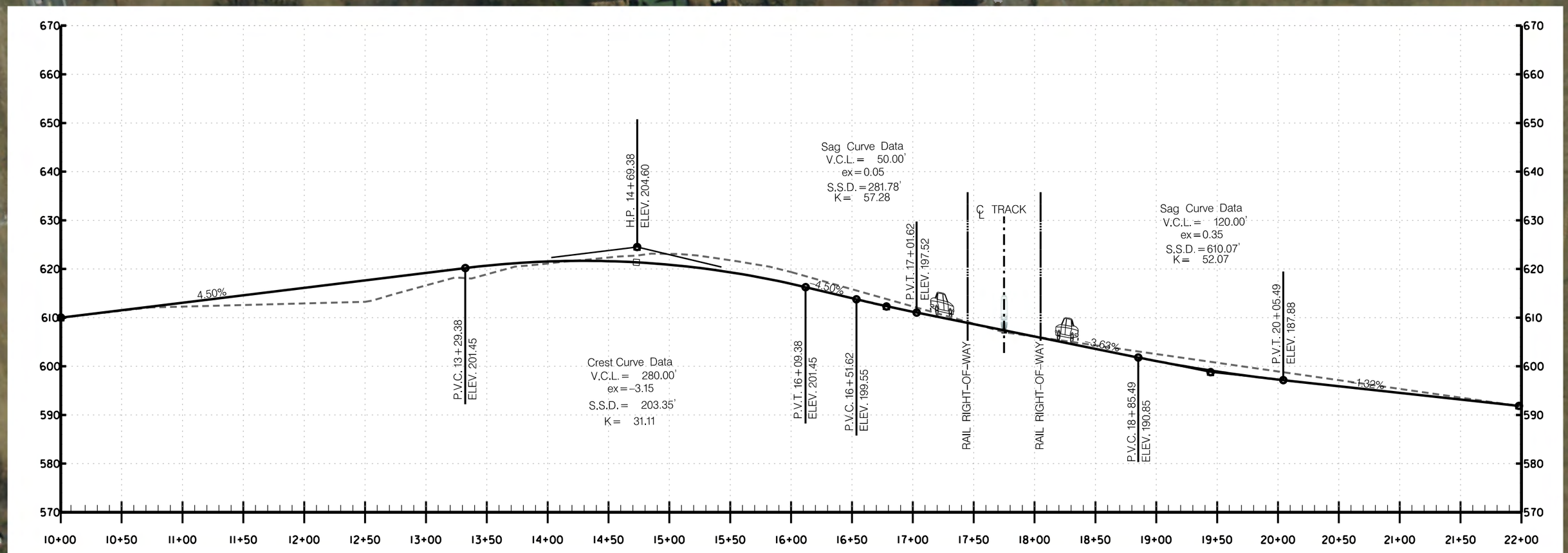


PROPOSED TYPICAL SECTION – RURAL COLLECTOR

50' 0 50' 100'
SCALE: 1" = 50'

Berryville Roadway Improvements
CONCEPT B - RAIL CROSSING PROFILE





Berryville Roadway Improvements
CONCEPT B - SOUTHERN TERMINIS