Traffic Impact Study

The Greens South at Willowsford

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Loudoun County, Virginia

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INTRODUCTION AND SUMMARY

Purpose of Report and Study Objectives

The following report presents the findings of a traffic impact analysis for the proposed Greens South at Willowsford residential development located in Loudoun County, Virginia. The site is located south of Braddock Road (Route 705) and west of Lightridge Farm Road (Route 705). The site is comprised of an assemblage of properties totaling approximately 737 acres in size and is zoned as TR-3 (*Transitional Residential-3*). The proposed plan calls for a rezoning on the property to TR-1 (*Transitional Residential-1*) to accommodate 802 single-family detached residential units. The proposed development is anticipated to be complete in 2020.

The following tasks were completed as part of this study:

- A scoping meeting was held on November 7, 2012 with representatives from Loudoun County, which included discussions about the parameters of the study and relevant background information. Correspondence with the Virginia Department of Transportation (VDOT) staff about the scoping letter was done via email. A copy of the signed scoping letter confirming the parameters and assumptions used in the traffic impact study is included in Appendix A.
- Field reconnaissance in the vicinity of the site was performed to collect information related to existing traffic controls, roadway geometry, and traffic flow characteristics.
- In order to determine the weekday peak hour turning movement traffic volumes, traffic counts were conducted on Wednesday, November 7, 2012; Thursday, November 15, 2012; and Tuesday, November 27, 2012, during the AM and PM commuter peak periods.
- Future traffic conditions were estimated based on regional growth, approved developments in the area and the proposed development plan.
- Regional growth was based on historical ADT volumes published by VDOT and was consistent with other traffic studies in the area. The approved background developments in the vicinity of the proposed development were included in the analysis per discussions held at the scoping meeting with VDOT and OTS staff.
- Traffic volumes for the proposed Greens South at Willowsford development were generated using the methodology outlined in the Institute of Transportation Engineers' (ITE) Trip Generation, 9th Edition publication.
- Intersection capacity analyses were performed for existing conditions (2012), future conditions without development (2020), and future conditions with development (2020) during weekday morning and afternoon commuter peak hour traffic conditions at the intersections located within the study area.

Sources of data for this study include Institute of Transportation Engineers (ITE), Wells & Associates, Urban, Loudoun County's Office of Transportation Services, the Virginia Department of Transportation (VDOT), and the office files and field reconnaissance efforts by Gorove/Slade Associates, Inc.

EXECUTIVE SUMMARY

Site Location and Study Area

The proposed Greens South at Willowsford development is located in Loudoun County, Virginia. The proposed residential site is located south of Braddock Road (Route 705) and west of Lightridge Farm Road (Route 705). The site is comprised of an assemblage of properties totaling approximately 737 acres in size. **Figure 1** shows the site location.

Description of the Proposed Development

Willowsford Greens, LLC is proposing a rezoning on the property to TR-1 (*Transitional Residential-1*) to accommodate 802 single-family detached residential units. The site is currently vacant and could allow for 245 single-family detached residential units under the current zoning. The proposed development is anticipated to be complete by 2020. The site will be accessed via Grassland Grove Drive, which currently connects to Braddock Road. Grassland Grove Drive is planned to be extended to connect with the future Northstar Boulevard extension, which will provide another access point to the site through Northstar Boulevard.

Principal Findings, Conclusions, and Recommendations

The analysis presented in this report supports the following major conclusions:

- **Existing (2012) Conditions:**
  - The following intersections operate at unacceptable level of service under existing conditions:
    - Braddock Road and Summerall Drive/Supreme Drive (AM and PM Peak Hour)
    - John Mosby Highway (US Route 59) and Lenah Road/Lenah Farm Lane (AM and PM Peak Hour)
- **Future Conditions without Development (2020):**
  - The following planned transportation improvements in the vicinity of the site were assumed to be in place by 2020:

    - **Trailhead Drive Extension**: As part of the Grove at Willowsford development, Trailhead Drive is planned to be extended from its current termination just north of Braddock Road to Lenah Road. This extension is included in Loudoun County's Countywide Transportation Plan (CTP) and is labeled as Lenah Loop Road. It is planned to have a two-lane undivided section and is anticipated to be complete by 2020.

    - **Northstar Boulevard Extension**: As part of the Kirkpatrick West development (ZMAP 2002-0001), Northstar Boulevard (SR 659 Relocated) is planned to be extended as a two-lane undivided road from Braddock Road to the southern site entrance of Kirkpatrick West. South of the site driveway, Northstar Boulevard will transition back into the existing Lightridge Farm Drive section.
  - The traffic generated by the following approved background developments were incorporated:
    - Greenfield Crossing
    - Stone Ridge
    - Seven Hills
    - Elementary School along Goshen (LCPS)
    - The Grove at Willowsford
    - CD Smith

- Kirkpatrick West
- Marrwood
- Westport
- By-right residential at the Greens at Willowsford Site
- Elementary School on Willowsford Site

o In addition to the background developments that were incorporated, an inherent growth rate of 1% on US Route 50 was applied to the existing volumes to evaluate future without development (2020) traffic volumes.

o The following intersections have movements with unacceptable level of service:

- Braddock Road and Northstar Boulevard (AM and PM Peak Hour)
- Braddock Road and Summerall Drive/Supreme Drive (AM and PM Peak Hour)
- John Mosby Highway (Route 50) and Lenah Road/Lenah Farm Lane (AM and PM Peak Hour)

o The following mitigation measures are recommended under the future without development scenario:

- Install a traffic signal at the intersection of Braddock Road and Northstar Boulevard.
- Install a traffic signal at the intersection of Braddock Road and Summerall Drive/Supreme Drive.
- Install a traffic signal and install a westbound left turn bay at the intersection of John Mosby Highway (Route 50) and Lenah Road/Lenah Farm Road.

o With the recommended improvements in place, all of the intersections operate at acceptable levels of service under future conditions without development (2020).

▪ **Future Conditions with Development (2020):**

o The proposed plan calls for a rezoning on the property to accommodate 802 single-family detached residential units. The construction of the proposed development is anticipated to be complete by 2020.

o The proposed development will generate approximately 572 trips during weekday morning peak period, 685 trips during weekday afternoon peak period, and 7,131 trips during an entire weekday.

o The following improvements are proposed under the future with development (2020) scenario:

- Northstar Boulevard widened from a two-lane to a four-lane divided roadway from Braddock Road (Route 620) to just south of Grassland Grove Drive.
- Grassland Grove extended as a two-lane undivided road between just south of Braddock Road (Route 705) to the Northstar Boulevard extension.

o The following mitigation measures are recommended under the future with development scenario:

- Braddock Road and Trailhead Drive/Grassland Grove Drive:
  - Install a traffic signal.
- Northstar Boulevard and Grassland Grove Drive/Kirkpatrick West Driveway:
  - Add an eastbound left turn bay.
  - Add a northbound left turn bay.
  - Add a southbound right turn bay.

With the recommended improvements in place, all of the regional intersections and site entrances operate at acceptable levels of service under the future conditions with development (2020).

BACKGROUND INFORMATION: PROPOSED DEVELOPMENT (SITE AND NEARBY)

Non-Existent Transportation Improvements

The following planned and proposed roadway/transportation improvements in the vicinity of the site have been considered in the traffic study:

- **Planned**:
  - **Trailhead Drive Extension to Lenah Road**: As part of the Grove at Willowsford development, Trailhead Drive is planned to be extended from its current termination just north of Braddock Road to Lenah Road. This extension is included in Loudoun County's Countywide Transportation Plan (CTP) and is labeled as Lenah Loop Road. It is planned to have a two-lane undivided section and is anticipated to be complete by 2020.
  - **Northstar Boulevard Extension**: As part of the Kirkpatrick West development (ZMAP 2002-0001), Northstar Boulevard (SR 659 Relocated) is planned to be extended as a two-lane undivided road from Braddock Road to the southern site entrance of Kirkpatrick West. South of the site driveway, Northstar Boulevard will transition back into the existing Lightridge Farm Drive section.
  - **Tall Cedars Parkway Extension between Gum Spring Road and Riding Center Drive**: Loudoun County plans to extend Tall Cedars Parkway as a four-lane divided road between Gum Spring Road and Riding Center Drive. When this section is complete, Tall Cedars Parkway will run from US Route 50 in South Riding to Northstar Boulevard. This section is currently under design and is anticipated to be in place by 2020, consistent with the discussions held at the scoping meeting.
- **Proposed**:
  - **Northstar Boulevard Widening**: As part of the proposed site's improvements, Northstar Boulevard is planned to be widened from a two-lane to a four-lane divided section from Braddock Road to the future Grassland Grove Drive. Also, Lightridge Farm Drive was assumed to end at a cul-de-sac just west of future Northstar Boulevard. This improvement was incorporated in the analysis of the future conditions with development (2020).
  - **Grassland Grove Drive Extension**: As part of the proposed site's improvements, Grassland Grove Drive is planned to be extended as a two-lane undivided road from its current termination south of Braddock Road to the Northstar Boulevard extension. This extension is included in Loudoun County's Countywide Transportation Plan (CTP) as the southern portion of Lenah Loop Road. This improvement was incorporated in the analysis of the future conditions with development (2020).

Description of On-Site Development

Map of Site Location

The proposed development is located in Loudoun County, Virginia. The proposed residential site is located south of Braddock Road (Route 705) and west of Lightridge Farm Road (Route 705). The size of the property is approximately 737 acres. **Figure 1** shows the site location.

Description of the Parcel and Current Zoning

The site consists of an assemblage of parcels that are currently zoned as TR-3 (*Transitional Residential*). A parcel map of the site is shown in **Figure 2**.

General Terrain Features

The terrain of the site is generally flat.

Location within Jurisdiction and Region

The site is located within the Dulles Planning Subarea of Loudoun County.

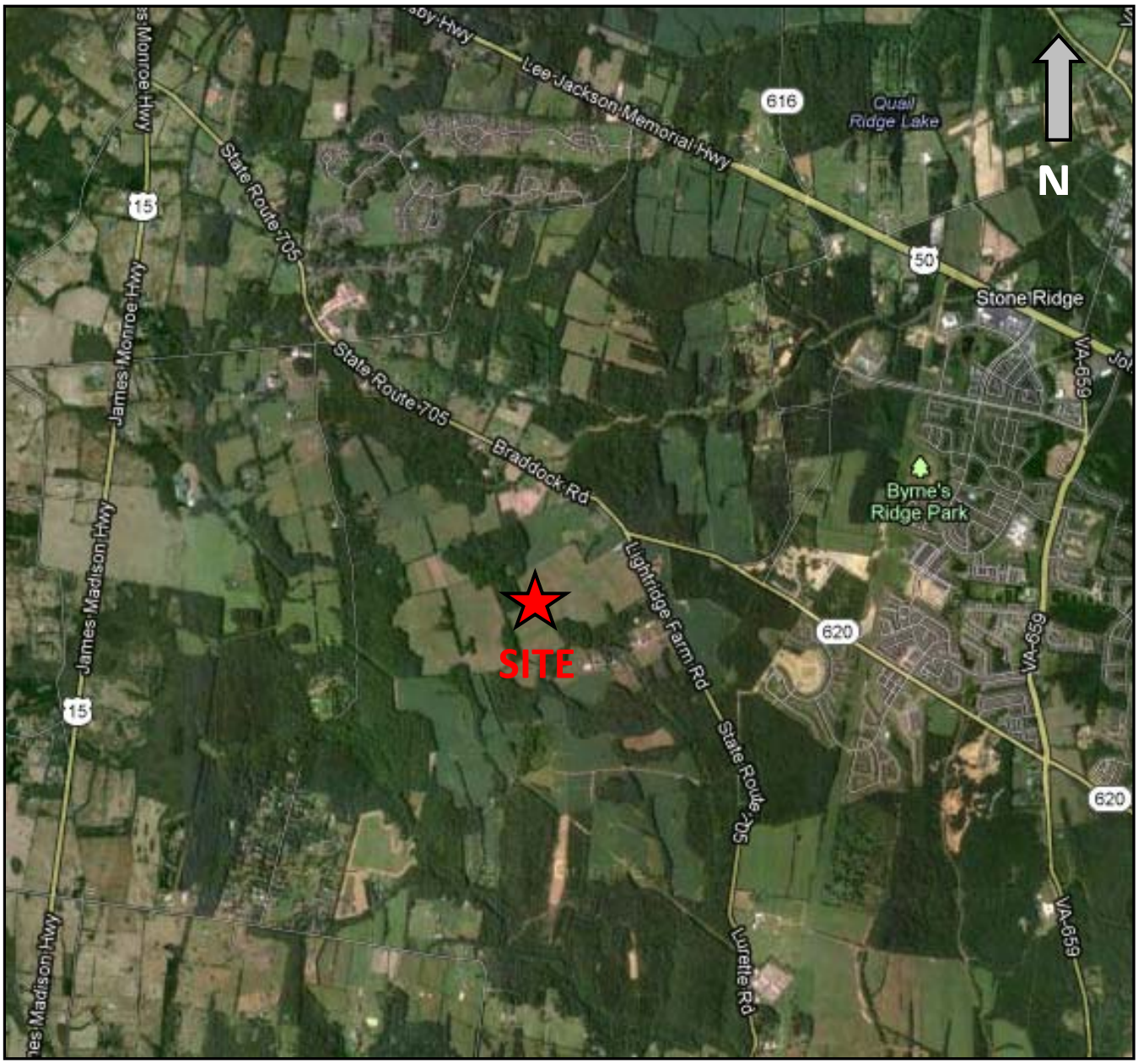


Figure 1: Area Map and Site Location

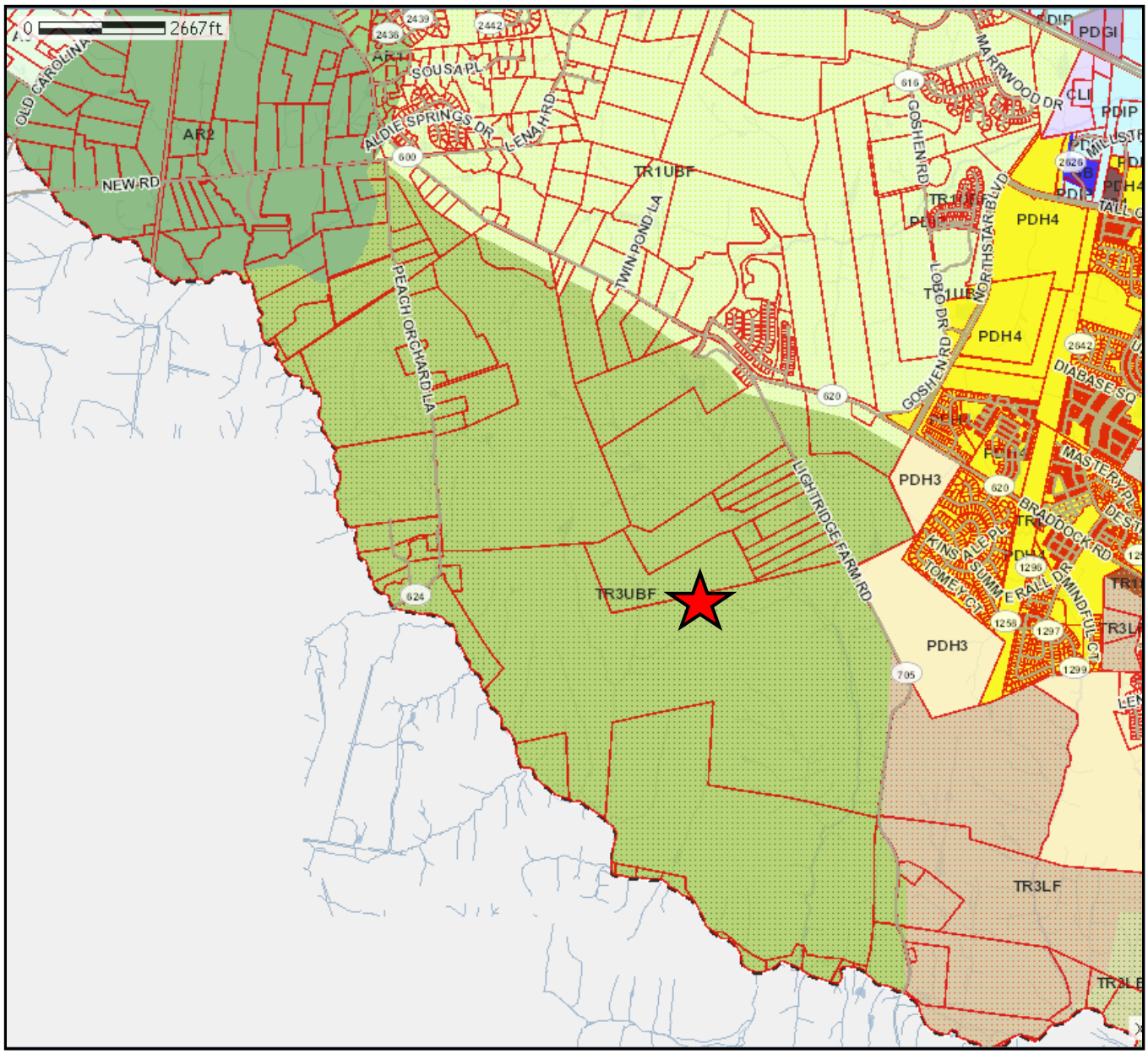


Figure 2: Site Parcel Map
(*Excerpt from Loudoun County Website*)

Description of Geometric Scope and Limits of the Study Area

The following intersections were identified for inclusion in this study:

1. Braddock Road and New Road/Lenah Road
2. Braddock Road and Grassland Grove Drive/Trailhead Drive
3. Braddock Road and Lightridge Farm Road
4. Braddock Road and Northstar Boulevard
5. Braddock Road and Summerall Drive/Supreme Drive
6. John Mosby Highway (US Route 50) and Lenah Road/Lenah Farm Lane
7. Northstar Boulevard Extended and Grassland Grove Drive/Kirkpatrick West Driveway (*Future Intersection*)
8. Site driveways

Existing and Proposed Site Uses

The site is comprised of an assemblage of properties totaling approximately 737 acres in size. The site is currently vacant and is zoned as TR-3 (*Transitional Residential-3*). The proposed plan calls for a rezoning on the property to accommodate 802 single-family detached residential units. The proposed development is anticipated to be complete in 2020. A concept plan is shown on **Figure 3**.

Nearby Uses

The proposed Greens South at Willowsford will be located south of Braddock Road and west of Lightridge Farm Road. Most of the surrounding parcels contain farmland and residential uses. East of the site exists residential neighborhoods.

Existing Roadway Network

A description of the major roadways within the immediate vicinity of the site is presented below:

Braddock Road (VA Route 705/VA Route 620) is an east-west two-lane undivided minor collector. Some sections of Braddock Road are unpaved in the vicinity of the site. The posted speed limit on this road is 35 mph within the vicinity of the proposed development and increases to 40 mph west of Lenah Road and 45 mph east of Northstar Boulevard.

Northstar Boulevard (VA Route 659 Relocated) is a two-lane undivided minor arterial with left and right turn lanes at all intersections. The north-south road currently extends from Tall Cedars Parkway to Braddock Road with a posted speed limit of 45 mph. According to Loudoun County's CTP, Northstar Boulevard is planned as a six-lane divided roadway under its ultimate conditions and is planned to be extended north to connect to US Route 50 and extended south to the Prince William County line. For the purposes of this study, the widening of the existing segment and the northern extension to US Route 50 were not assumed to be in place by 2020. The southern extension as a two-lane undivided roadway from Braddock Road to future Grassland Grove Drive was assumed to be in place for the future with conditions (2020) analysis as a site related improvement.

John Mosby Highway (US Route 50) varies from a two to four lane minor arterial in the vicinity of the proposed site. At the study intersection of Route 50 and Lenah Road, Route 50 is a two-lane undivided section with a posted speed limit of 50 mph. East of the study intersection, Route 50 transitions to a four-lane divided section with a posted speed limit of 55 mph.

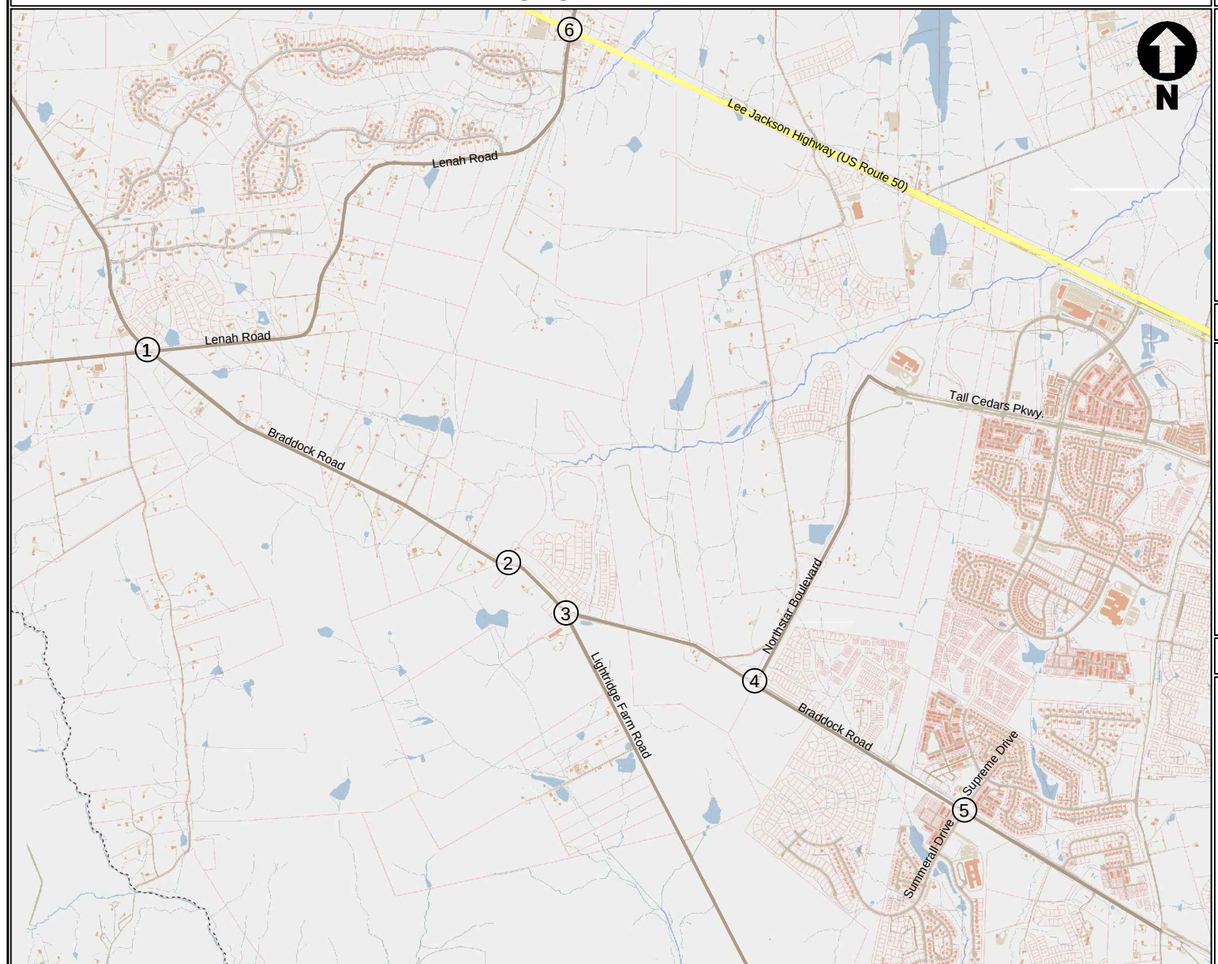
Lenah Road (VA Route 600) is a two-lane undivided local roadway extending between US Route 50 to Braddock Road. Most portions are unpaved. The posted speed limit is 25 mph in the vicinity of the site. According to Loudoun County's CTP, the road is planned to be widened to a four-lane undivided section between Route 50 and Tall Cedars Parkway at its ultimate condition. Portions of the future Lenah Loop Road will follow the alignment of the existing Lenah Road. For the purposes of this study, the widening of Lenah Road near Route 50 was not assumed to be in place by 2020.

Lightridge Farm Road (VA Route 705) is a two-lane unpaved local road that runs north to south between Braddock Road and the Prince William County line. The posted speed limit on this road is 30 mph within the vicinity of the proposed development.

The existing lane configuration and traffic controls for the study intersections are shown on **Figure 4**.

Figure 3: Concept Plan

STUDY AREA



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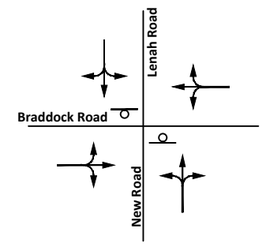

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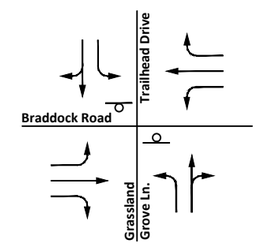

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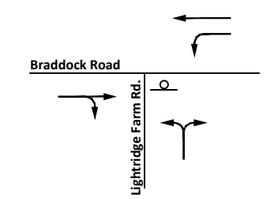

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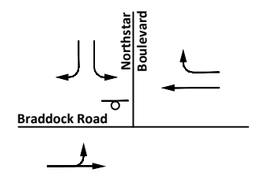

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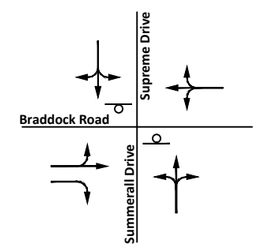

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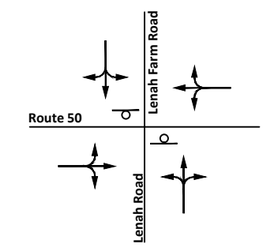


INTERSECTION #7

FOR FUTURE USE

INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND

INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 4
Existing Conditions (2012)
Lane Use & Traffic Control Devices

ANALYSIS OF EXISTING CONDITIONS (2012)

Existing Traffic Volumes

In order to determine the weekday peak hour turning movement traffic volumes, traffic counts were conducted on Wednesday, November 7, 2012, Thursday, November 15, 2012 and Tuesday, November 27, 2012 from 6:00 AM to 9:00 AM and from 4:00 PM to 7:00 PM. Analysis of the existing traffic data determined the following peak hours:

- AM Peak Hour: 7:00 AM to 8:00 AM
- PM Peak Hour: 4:45 PM to 5:45 PM

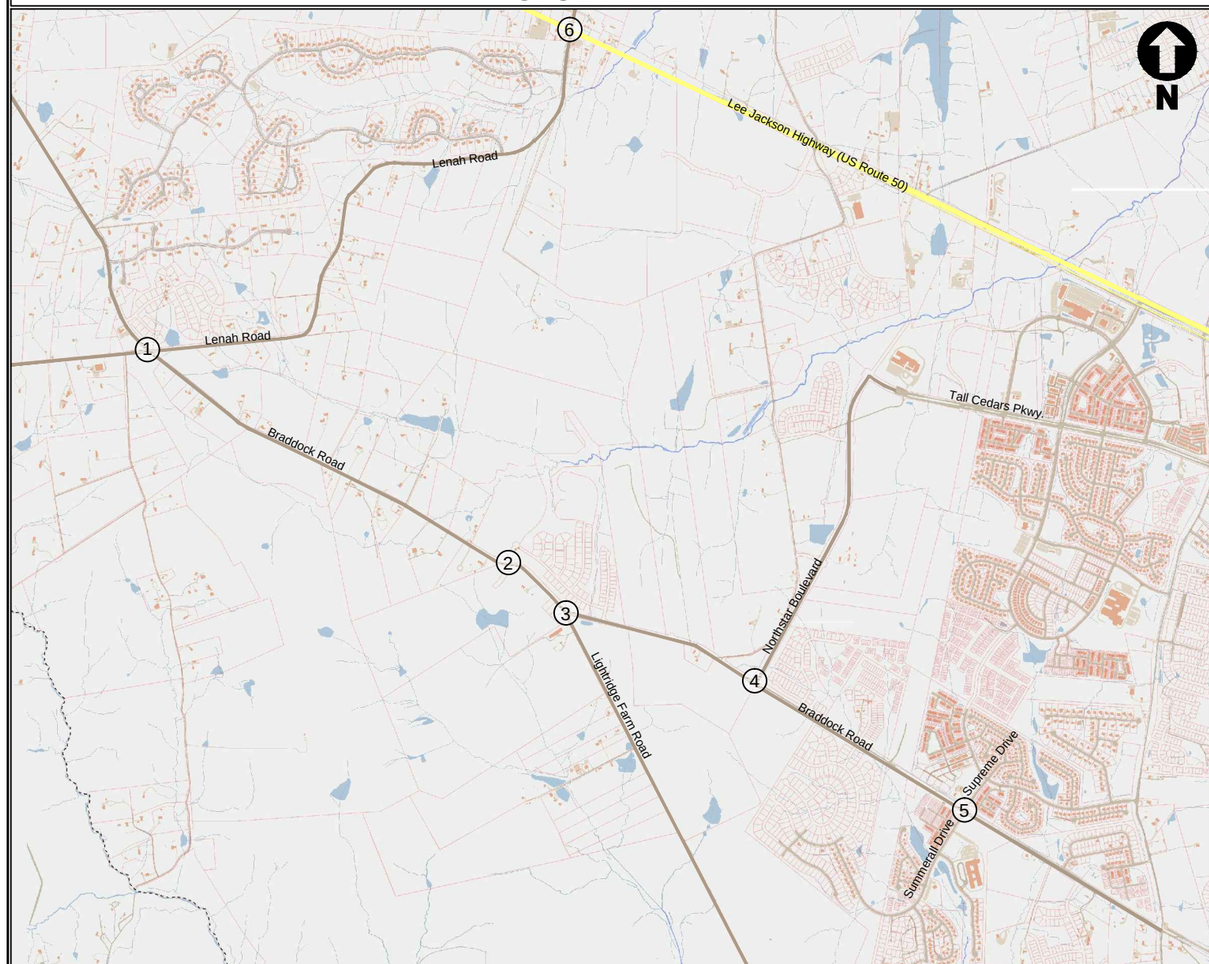
The existing morning and afternoon peak hour traffic volumes for the intersections contained within the study area are shown in **Figure 5**. The estimated average daily traffic data for different roadways are also shown in the same graphic. The existing turning movement counts are included in the Technical Appendix B.

Hazardous Locations

The following roadways in the vicinity of the proposed site have segments that are unpaved:

- Braddock Road is unpaved for approximately a 0.5-mile segment between Lenah Road and Trailhead Drive and is unpaved for approximately a 0.3-mile segment between Lightridge Farm Road and Goshen Road.
- Lenah Road is unpaved from Braddock Road to approximately 1.5 miles north of Braddock Road then turns into a paved road for approximately 0.5 miles north to US Route 50.
- Lenah Farm Lane is unpaved north of US Route 50.

STUDY AREA



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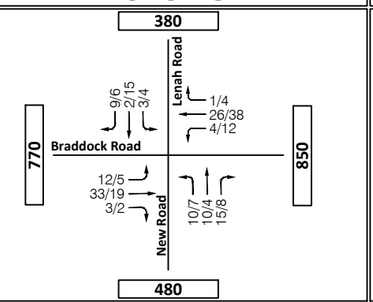

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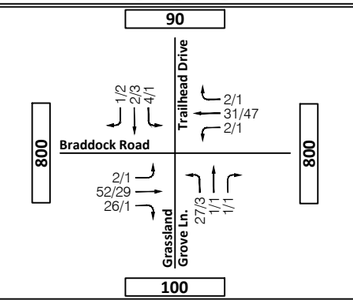

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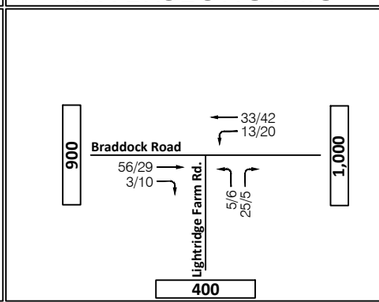

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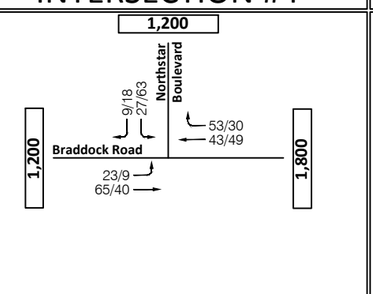

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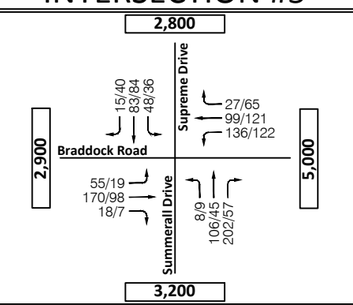

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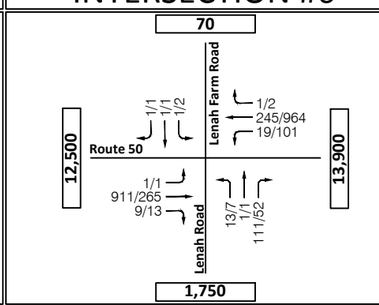


INTERSECTION #7

FOR FUTURE USE

INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND

INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 5
Existing Conditions (2012)
Peak Hour Traffic Volumes

Existing Conditions Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday morning and afternoon commuter peak hours, under the existing conditions. Intersection capacity analyses were performed using *Synchro version 7* based on the Highway Capacity Manual (HCM 2000) data and methodology. Existing peak hour factors by movement calculated from field count data were used.

The results of the intersection capacity analyses for the existing conditions are summarized in **Table 1**. The description of the different LOS and delay and the detailed analysis worksheets for the existing conditions are included in the Technical Appendix C and D respectively.

Table 1: Existing Conditions (2012) Intersection Capacity Analysis

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
1	***Braddock Rd & New Rd/Lenah Rd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	2	A	1.6
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	1	A	2
	Northbound Approach	**A**	**9.5**	**A**	**9.5**
	Northbound Left/Thru/Right	A	9.5	A	9.5
	Southbound Approach	**A**	**9.2**	**A**	**9.7**
	Southbound Left/Thru/Right	A	9.2	A	9.7
2	***Braddock Rd & Grassland Grove Dr/ Trailhead Dr***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	7.4	A	7.4
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	7.4	A	7.3
	Northbound Approach	**A**	**9.6**	**A**	**9.3**
	Northbound Left	A	9.7	A	9.4
	Northbound Thru/Right	A	8.9	A	9.2
	Southbound Approach	**A**	**9.7**	**A**	**9.4**
	Southbound Left	A	9.5	A	9.3
	Southbound Thru/Right	A	9.8	A	9.4
3	***Braddock Rd & Lightridge Farm Rd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	7.4	A	7.4
	Northbound Approach	**A**	**9.1**	**A**	**9.1**
	Northbound Left/Right	A	9.1	A	9.1

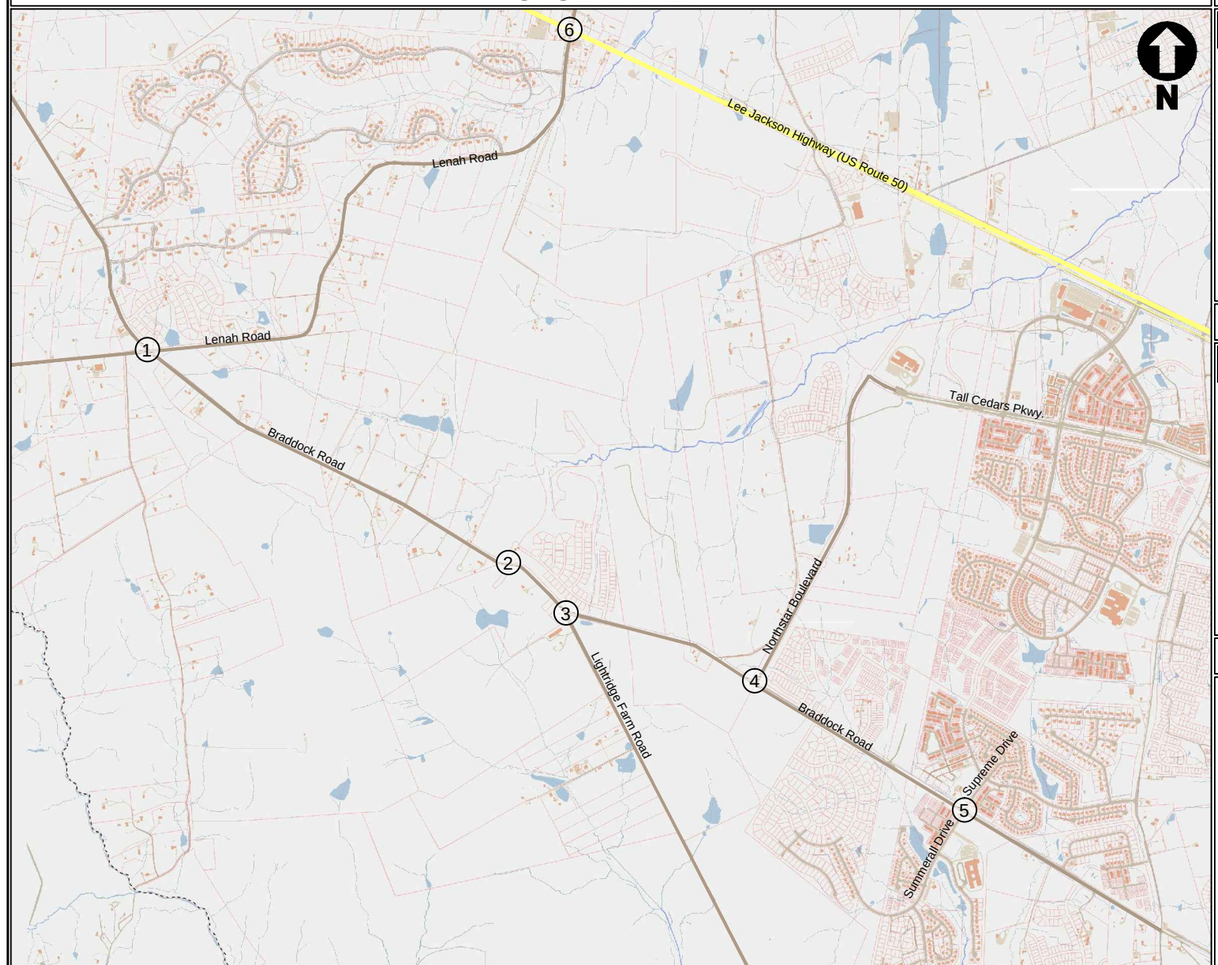
No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
4	***Braddock Rd & Northstar Blvd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	1.8	A	1.2
	Westbound Approach	N/A	N/A	N/A	N/A
	Southbound Approach	**A**	**9.5**	**A**	**9.6**
	Southbound Left	A	9.9	A	9.9
	Southbound Right	A	8.6	A	8.8
5	***Braddock Rd & Summerall Dr/Supreme Dr***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	2.2	A	1.8
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	5	A	3.4
	Northbound Approach	**F**	**148.7**	**C**	**18.7**
	Northbound Left/Thru/Right	F	148.7	C	18.7
	Southbound Approach	**F**	*****	**E**	**35.3**
	Southbound Left/Thru/Right	F	*	E	35.3
6	***John Mosby Hwy (US Rt. 50) & Lenah Rd/Lenah Farm Ln***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	0	A	0.1
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	1.8	A	2.9
	Northbound Approach	**F**	**69.4**	**C**	**22.0**
	Northbound Left/Thru/Right	F	69.4	C	22.0
	Southbound Approach	**F**	**57.1**	**F**	**62.0**
	Southbound Left/Thru/Right	F	57.1	F	62.0

According to Loudoun County's level of service (LOS) criteria, it is desirable to achieve a level of service (LOS) D or better for each approach at an intersection. **Table 1** shows that the following intersections have approaches that operate under unacceptable levels of service under the existing conditions:

- Braddock Road and Summerall Drive/Supreme Drive (AM and PM Peak Hour)
- John Mosby Highway (US Route 50) and Lenah Road/Lenah Farm Lane (AM and PM Peak Hour)

The results of the intersection capacity analyses for the existing conditions (2012) are shown in **Figure 6**.

STUDY AREA



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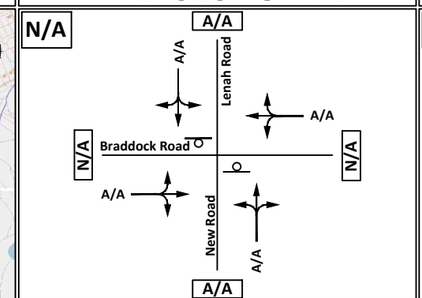

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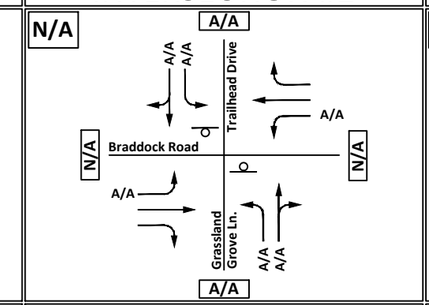

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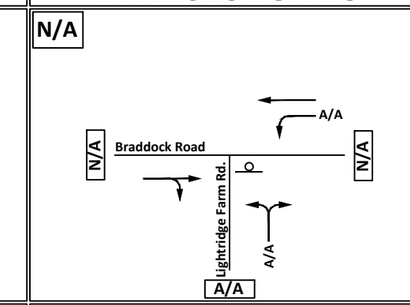

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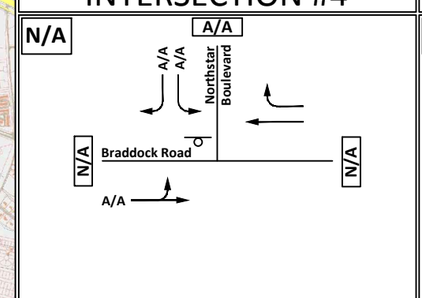

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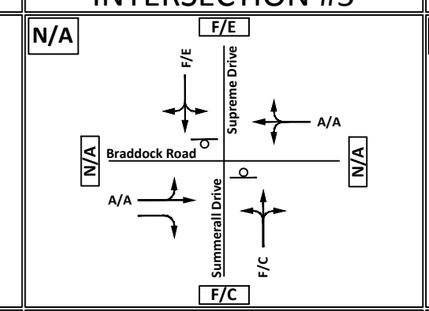

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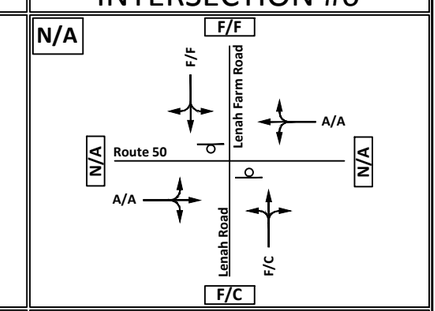


INTERSECTION #7

FOR FUTURE USE

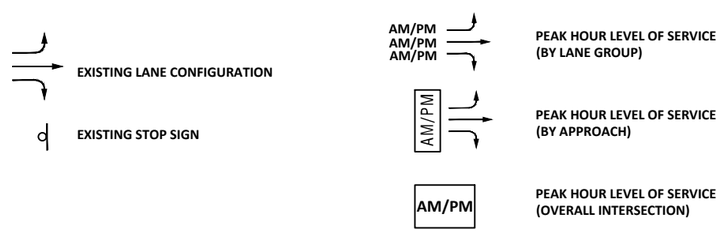
INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND



INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 6
Existing Conditions (2012)
Peak Hour Levels of Service & Recommended Improvements

ANALYSIS OF FUTURE CONDITIONS WITHOUT DEVELOPMENT (2020)

Planned Roadway/Transportation Improvements

The following planned roadway/transportation improvements in the vicinity of the site for the 2020 traffic conditions were considered in traffic study:

- **Trailhead Drive Extension**: As part of the Grove at Willowsford development, Trailhead Drive is planned to be extended from its current termination just north of Braddock Road to Lenah Road. This extension is included in Loudoun County's Countywide Transportation Plan (CTP) and is labeled as Lenah Loop Road. It is planned to have a two-lane undivided section and is anticipated to be complete by 2020.

Due to the extension of Trailhead Drive, some of the existing traffic on Lenah Road will use Trailhead Drive to access areas north of Braddock Road and US Route 50. It was assumed that 30% of the existing traffic entering/exiting Lenah Road from/to Braddock Road will be rerouted to Trailhead Drive. The rerouted trips from the Trailhead Drive extension are shown in **Figure 7**.

- **Northstar Boulevard Extension**: As part of the Kirkpatrick West development (ZMAP 2002-0001), Northstar Boulevard (SR 659 Relocated) is planned to be extended as a two-lane undivided road from Braddock Road to the southern site entrance of Kirkpatrick West. South of the site driveway, Northstar Boulevard will transition back into the existing Lightridge Farm Drive section.

Due to the extension of Northstar Boulevard, most of the existing traffic on Lightridge Farm Drive will use the new section of Northstar Boulevard to access Braddock Road. It was assumed that 75% of the existing traffic entering/exiting Lightridge Farm Drive from/to Braddock Road will be rerouted to the new extension of Northstar Boulevard south of Braddock Road. The rerouted trips due to the Northstar Boulevard extension are shown in **Figure 8**.

- **Tall Cedars Parkway Extension**: Loudoun County plans to extend Tall Cedars Parkway as a four-lane divided road between Gum Spring Road and Riding Center Drive. When this section is complete, Tall Cedars Parkway will run from US Route 50 in South Riding to Northstar Boulevard. This section is currently under design and is anticipated to be in place by 2020, consistent with the discussions held at the scoping meeting. This improvement was assumed for the future analysis but does not directly have an impact on the study area.

Future Conditions without Development (2020) Traffic Volumes

The following approved background developments were identified at the scoping meeting and were included in the background conditions (2020):

- Greenfield Crossing[1]
  - 40 Single-family attached units
  - 10 Single-family detached units
- Stone Ridge[1]
  - 156 Single-family attached units
  - 192 Single-family detached units
  - 302 Multifamily units

- Seven Hills[1]
    - 263 Single-family attached units
    - 583 Single-family detached units
    - 212 Multifamily units
- Elementary School along Goshen Road (LCPS)
    - 875 students Elementary School
- The Grove at Willowsford[1]
    - 628 Single-family detached units
- CD Smith
    - 214 Single-family attached units
    - 153 Single-family detached units
    - 88 Multifamily units
- Kirkpatrick West
    - 66 Single-family attached units
    - 173 Single-family detached units
    - 134 Multifamily units
    - 105 kSF Retail
- Marrwood
    - 65 Single-family detached units
- Westport (Lenah Mill) [1]
    - 433 Single-family detached units
- By-right residential at the Greens at Willowsford[2]
    - 444 Single-family detached units
- Elementary School on Willowsford Site[3]
    - 875 Student Elementary School

[1] These developments are in the process of being constructed. The dwelling units listed above represent an estimate of the remaining units anticipated to be built by 2020.

[2] The by-right residential at the Greens at Willowsford represents the by-right development adjacent to the proposed site that is not included in the rezoning application.

[3] This represents a future elementary school on the proposed site. The school is not part of the rezoning application, but it is anticipated that a portion of the proposed site will be allocated for a future public use site. In order to be conservative and account for the trips generated by the potential public use site, an elementary school was incorporated in the background traffic volumes.

The trips generated by the approved background developments are included in Appendix E. A map showing the location of the background developments is provided in **Figure 9**. No inherent growth was applied to Braddock Road because a significant portion of the trips from the background developments will use Braddock Road. The background developments will increase the existing volumes on Braddock Road by approximately 19% per year from 2012 to 2020. **Table 2** shows the inherent growth calculations on Braddock Road and the projected growth used in the study.

In addition to the background developments, an inherent growth rate of 1% per year was applied to the existing volumes on the through movements of US Route 50 to evaluate future without development (2020) traffic volumes. The inherent growth was evaluated based on historical traffic growth provided by VDOT as well as other studies in the area. **Table 3** shows the inherent growth calculations on Route 50 and the projected growth used in the study.

Figure 9 shows the background growth volumes and includes the trips from all of the background developments plus the inherent growth. **Figure 11** shows the future conditions without development (2020) traffic volumes.

Table 2: Inherent Growth – Braddock Road

Braddock Road Traffic Projections								
			Volumes*			Annual Growth		
			2007	2009	2012	2007-2012	2009-2012	Average
Actual Trend	AM	West of Lenah Road	51	-	93	12.8%	-	12.8%
		From Lenah Road to Northstar Boulevard	46	-	97	16.1%	-	16.1%
		From Northstar Boulevard to Gum Spring Road	-	444	682		15.4%	15.4%
							Average AM	**14.7%**
	PM	West of Lenah Road	94	-	77	-3.9%	-	-3.9%
		From Lenah Road to Northstar Boulevard	65	-	87	6.0%	-	6.0%
		From Northstar Boulevard to Gum Spring Road	-	279	499		21.4%	21.4%
							Average PM	**7.8%**
							Average AM and PM	**11.3%**
			2012	2020 Projected				2012-2020
Projected Trend	AM	West of Lenah Road	93	346				17.8%
		From Lenah Road to Northstar Boulevard	97	688				27.7%
		From Northstar Boulevard to Gum Spring Road	682	1208				7.4%
							Average AM	**17.7%**
	PM	West of Lenah Road	77	302				18.6%
		From Lenah Road to Northstar Boulevard	87	619				27.8%
		From Northstar Boulevard to Gum Spring Road	499	1244				12.1%
							Average PM	**19.5%**
							Average AM and PM	**18.6%**

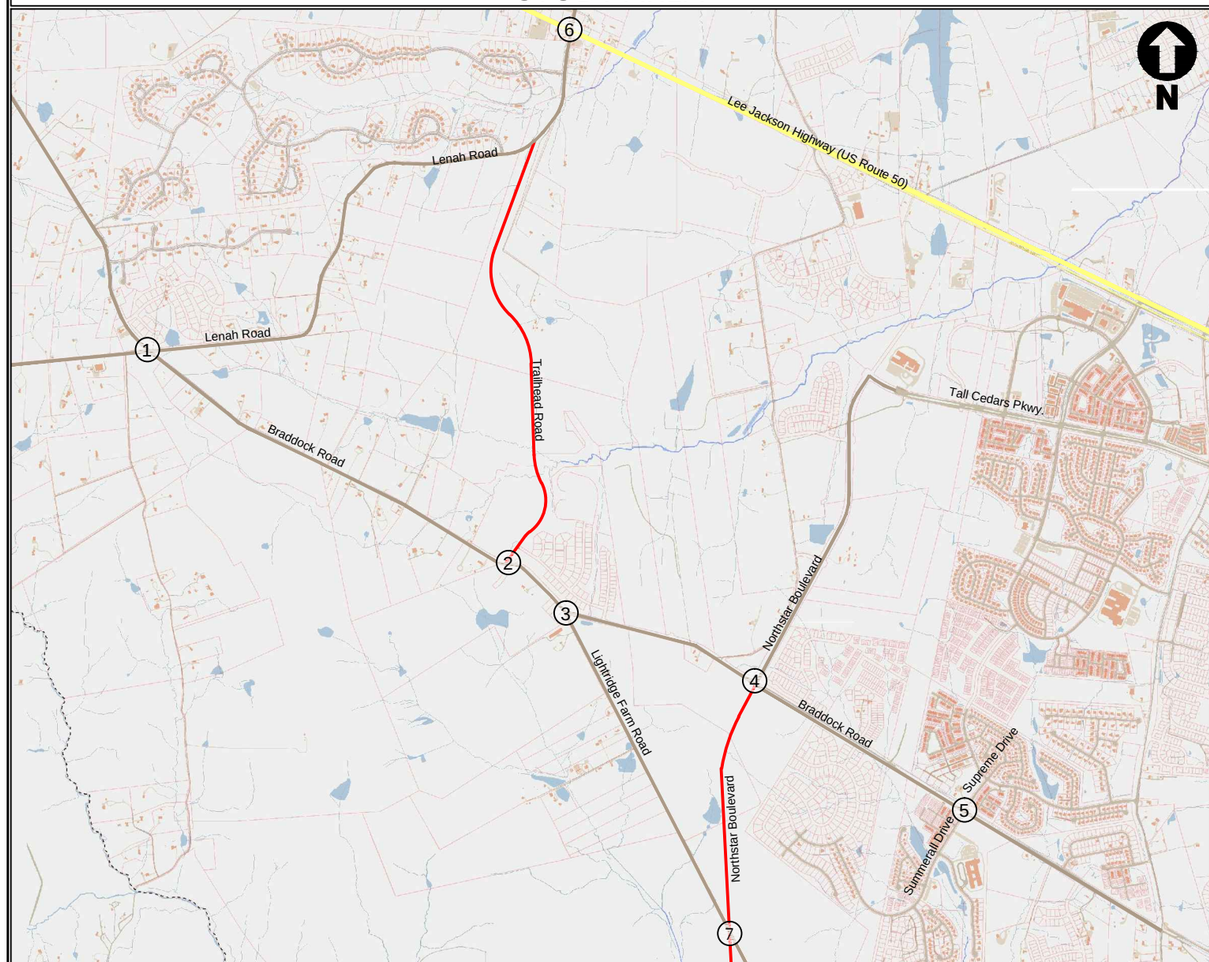
**Note: The actual trend volumes were taken from historical traffic counts performed by Gorove/Slade Associates.*

Table 3: Inherent Growth – John Mosby Highway (Route 50)

Route 50 Traffic Projections								
			Volumes			Annual Growth		
			2007	2009	2012	2007-2009	2009-2012	**Average**
Actual Trend	AM	East of Lenah Road	1326	1333	1287	0.3%	-1.2%	**-0.5%**
	PM	East of Lenah Road	1256	1366	1386	4.3%	0.5%	**2.4%**
							Average AM and PM	**1.0%**
			2012	2020 Projected				**2012-2020**
Projected Trend	AM	East of Lenah Road	1287	1835				4.5%
	PM	East of Lenah Road	1386	2031				4.9%
							Average AM and PM	**4.7%**

**Note: The actual trend volumes were taken from historical traffic counts performed by Gorove/Slade Associates*

STUDY AREA



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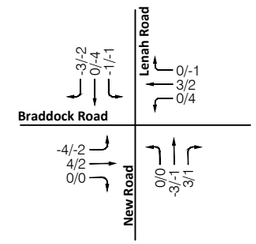

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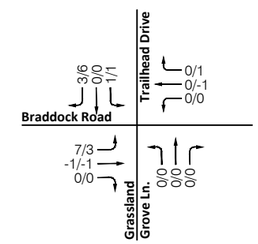

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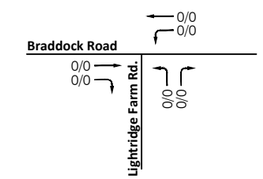

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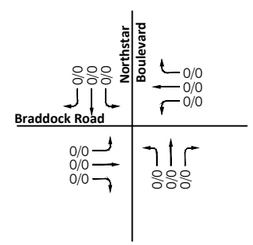

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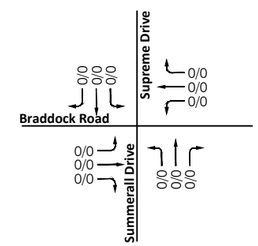

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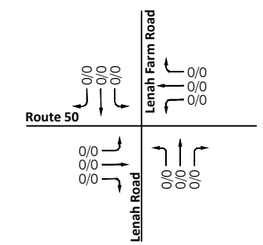

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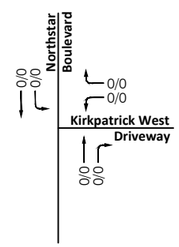


INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND

PEAK HOUR TRAFFIC VOLUMES

PLANNED ROADWAY IMPROVEMENTS (2020)

INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

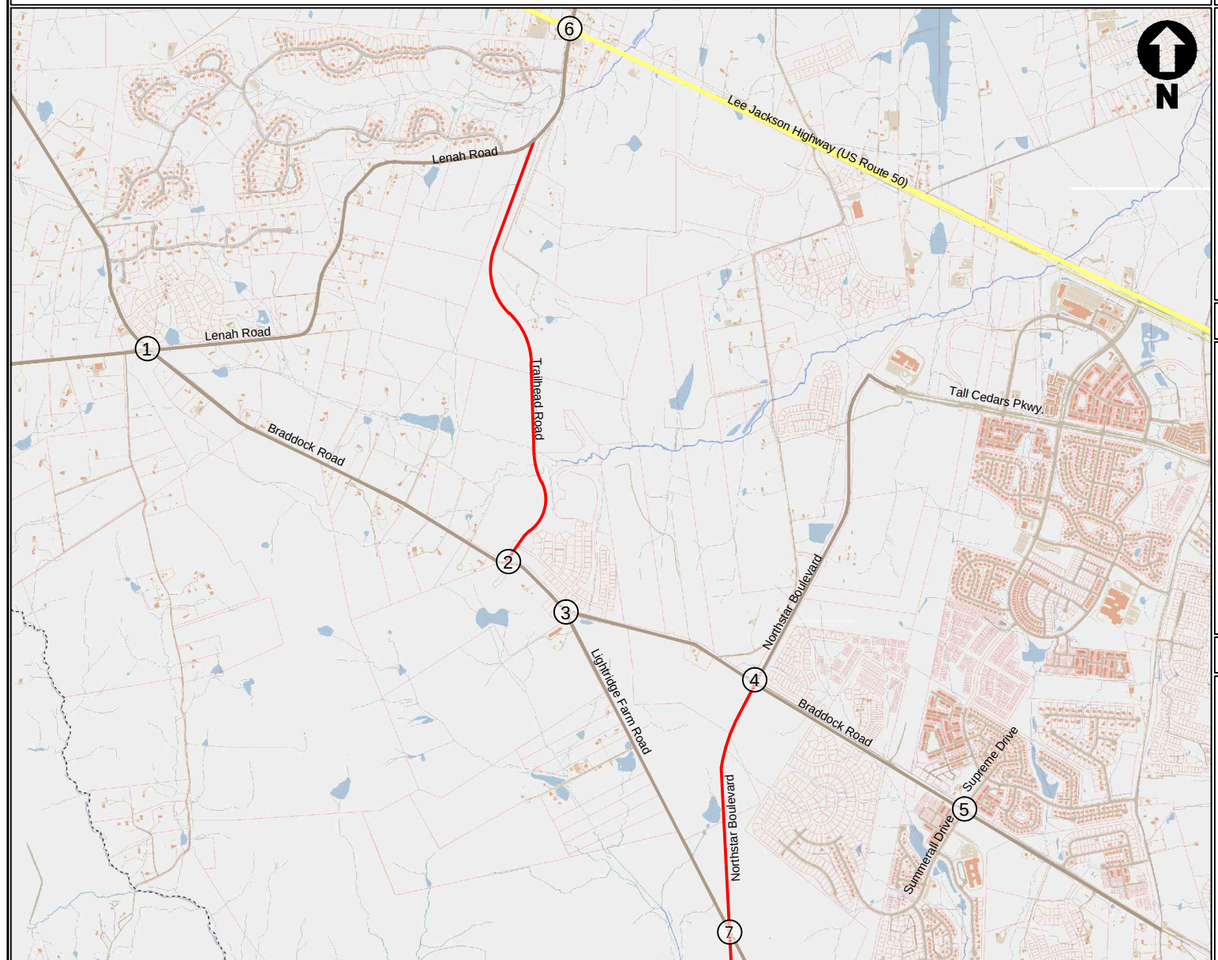
FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 7
Future Conditions without Development (2020)
Existing Rerouted Traffic Volumes Due to Trailhead Drive Extension

STUDY AREA



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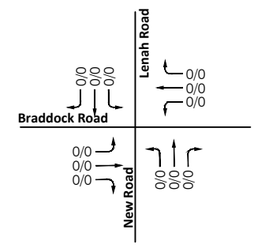

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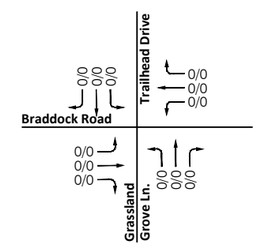

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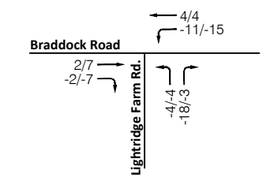

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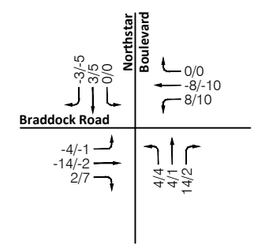

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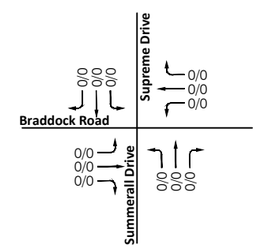

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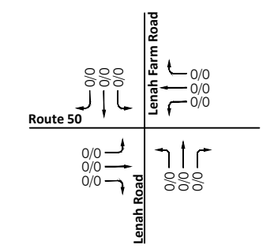

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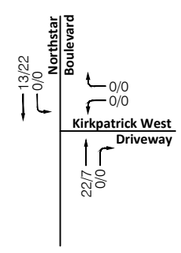


INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND

PEAK HOUR TRAFFIC VOLUMES

PLANNED ROADWAY IMPROVEMENTS (2020)

INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

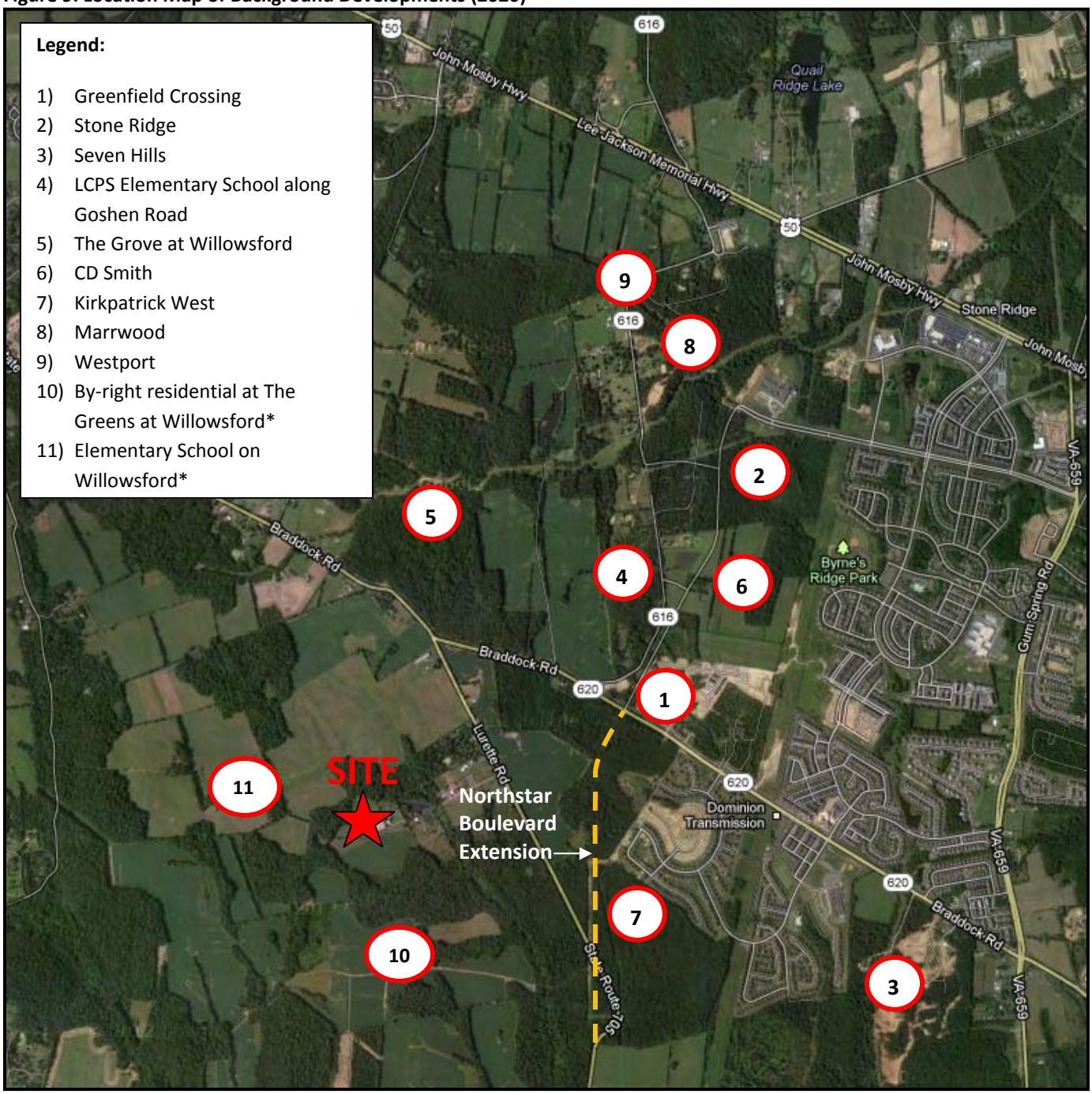
FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

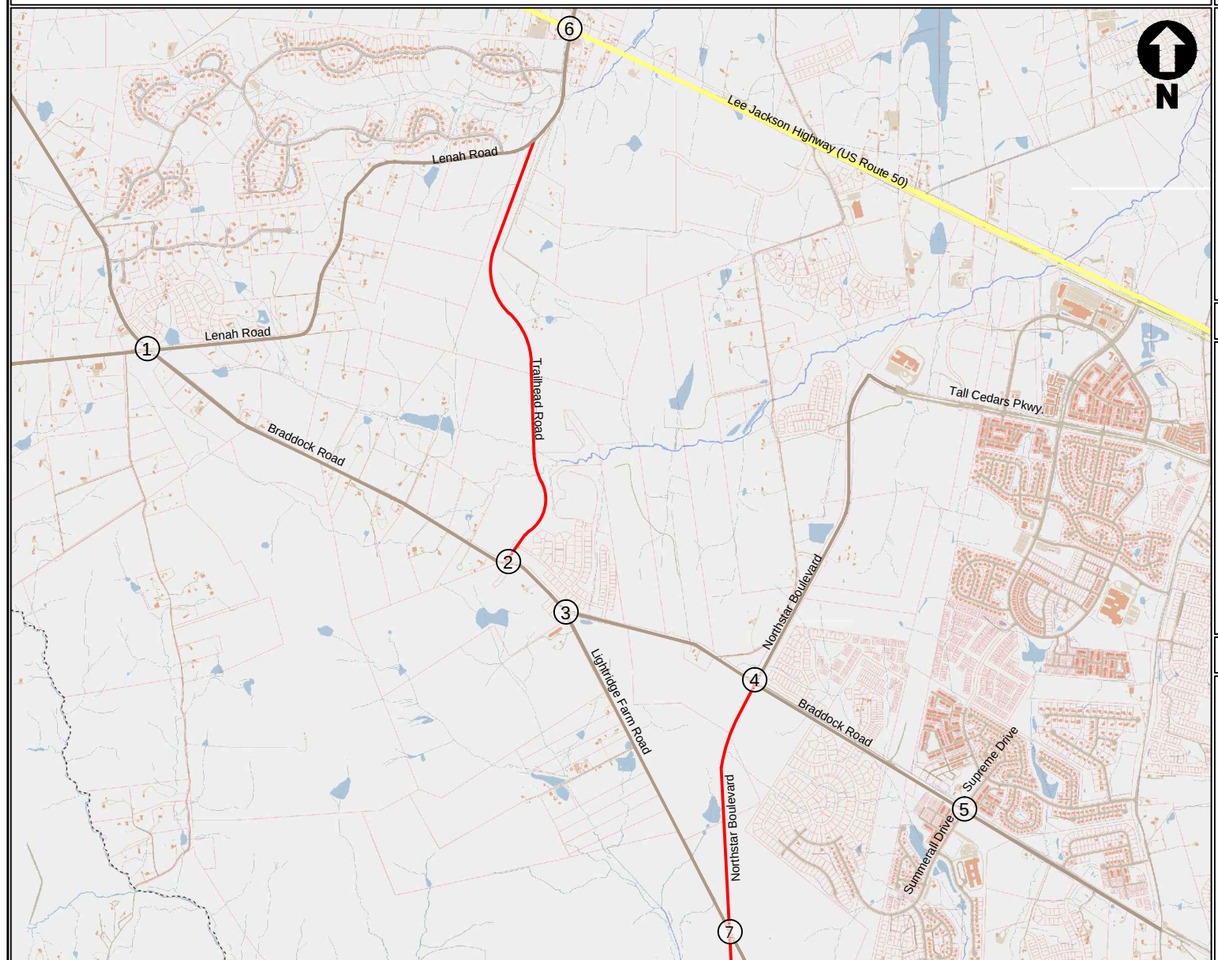
Figure 8
Future Conditions without Development (2020)
Existing Rerouted Traffic Volumes Due to Northstar Boulevard Extension

Figure 9: Location Map of Background Developments (2020)



** Note: The trips were assumed along the regional roadway network; however, the entrances serving these uses will be located along roads proposed with the proposed development in place. Therefore, to be conservative, it was assumed that the sites will be accessed via the Braddock Road/Grassland Grove Drive intersection and off Northstar Boulevard extended.*

STUDY AREA



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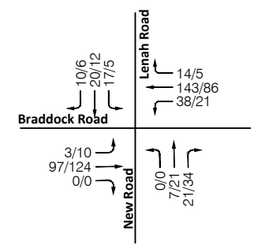

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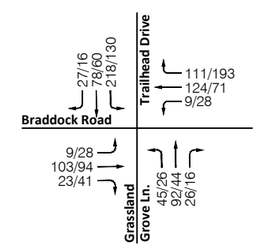

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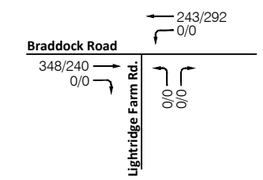

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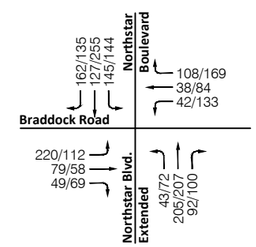

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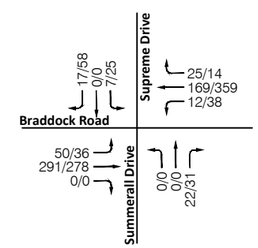

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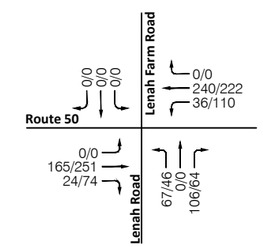

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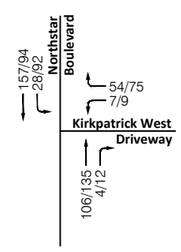


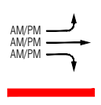
INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND



PEAK HOUR TRAFFIC VOLUMES

PLANNED ROADWAY IMPROVEMENTS (2020)

INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

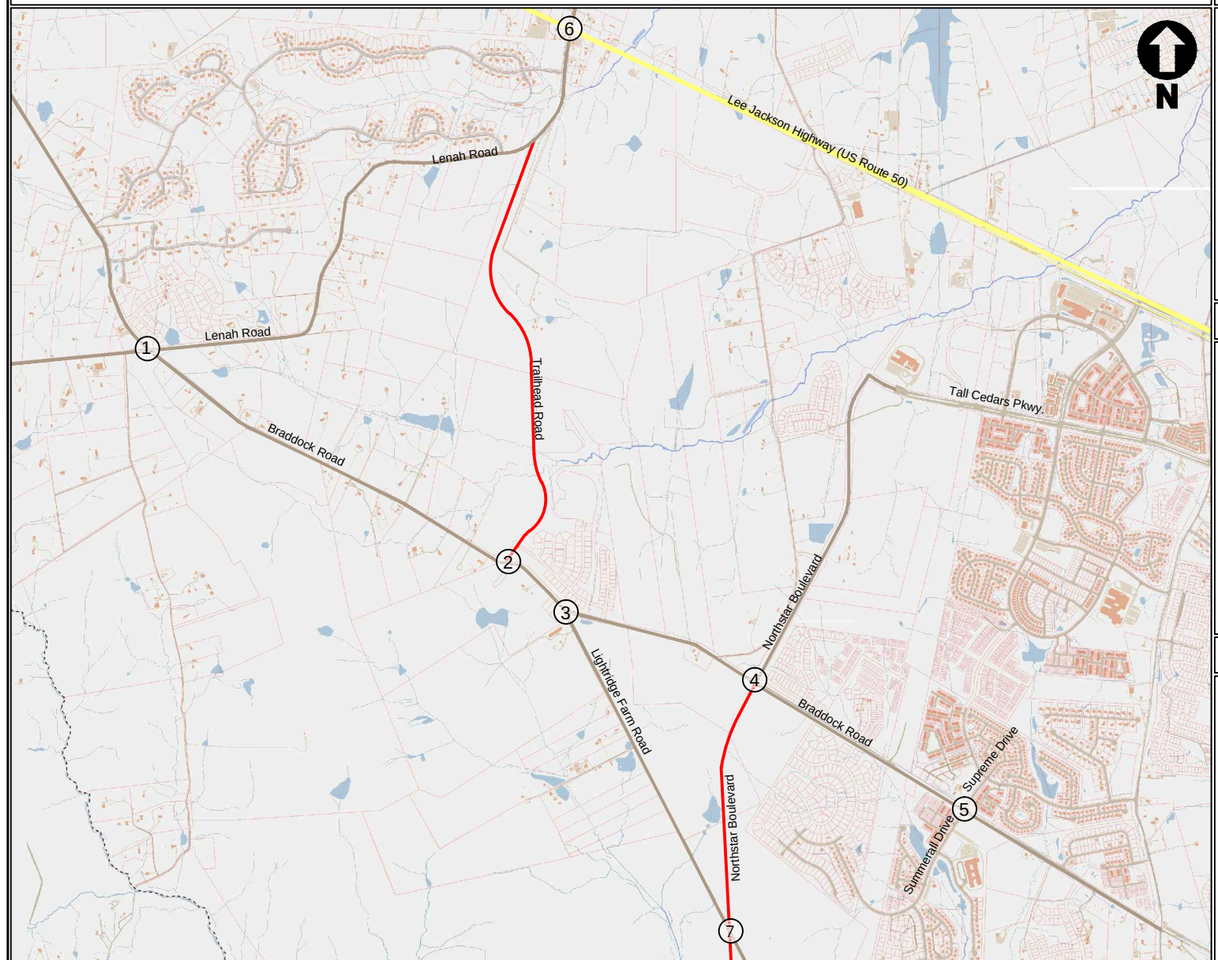
FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 10
Future Conditions without Development (2020)
Background Development Site Trips Plus Growth

STUDY AREA



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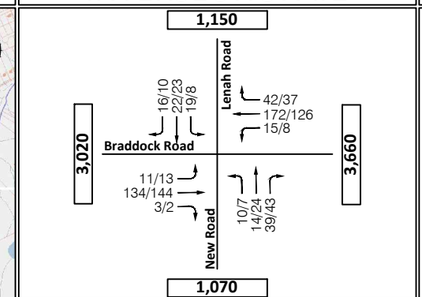

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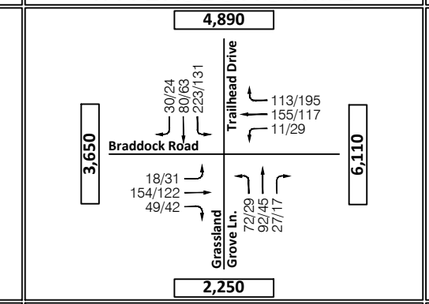

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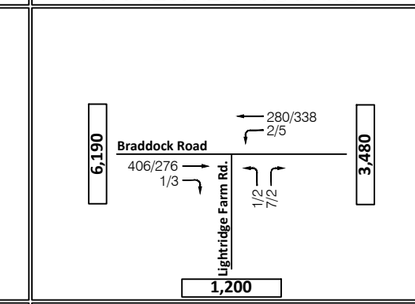

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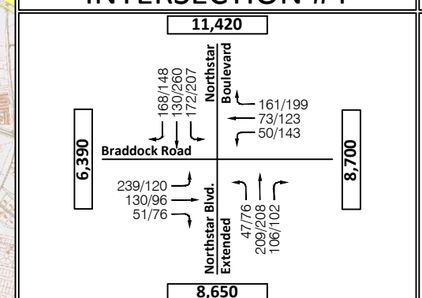

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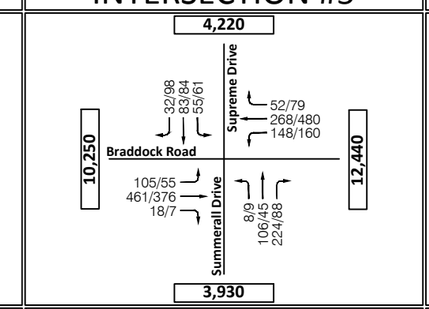

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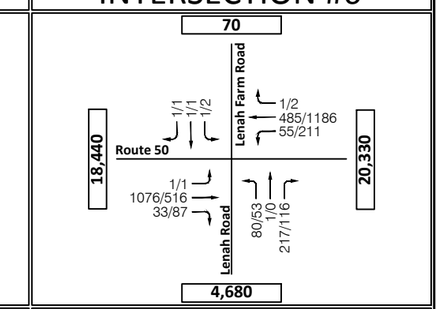

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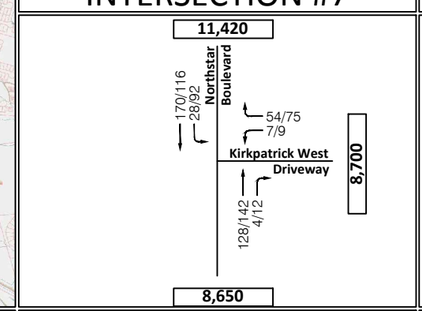


INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND

AM/PM
AM/PM
AM/PM — PEAK HOUR TRAFFIC VOLUMES

X,XXX — AVERAGE DAILY TRAFFIC VOLUME

PLANNED ROADWAY IMPROVEMENTS (2020)

INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 11
Future Conditions without Development (2020)
Peak Hour Traffic Volumes

Future Conditions without Development (2020) Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday morning and weekday afternoon commuter peak hours, under the future conditions without development for 2020. Intersection capacity analyses were performed using *Synchro version 7* based on the Highway Capacity Manual (HCM 2000) data and methodology. As discussed at the scoping meeting, a peak hour factor of 0.92 was used for all movements.

The results of the intersection capacity analyses for the future conditions without development are summarized in **Table 4**. The description of the different LOS and delay and the detailed analysis worksheets for the future conditions without development are included in Technical Appendix C and Technical Appendix F.

Table 4: Future Conditions without Development (2020) Intersection Capacity Analysis

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
1	***Braddock Rd & New Rd/Lenah Rd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	0.6	A	0.7
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	1.6	A	1.8
	Northbound Approach	**B**	**11.1**	**B**	**11.1**
	Northbound Left/Thru/Right	B	11.1	B	11.1
	Southbound Approach	**B**	**12.8**	**B**	**12.0**
	Southbound Left/Thru/Right	B	12.8	B	12.0
2	***Braddock Rd & Grassland Grove Dr/ Trailhead Dr***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	7.9	A	8.0
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	7.7	A	7.6
	Northbound Approach	**C**	**15.1**	**B**	**14.0**
	Northbound Left	C	15.9	B	14.0
	Northbound Thru/Right	B	14.6	B	14.0
	Southbound Approach	**C**	**23.2**	**B**	**15.0**
	Southbound Left	D	28.1	C	16.5
	Southbound Thru/Right	B	13.2	B	12.7
3	***Braddock Rd & Lightridge Farm Rd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	8.2	A	7.9
	Northbound Approach	**B**	**11.4**	**B**	**11.8**
	Northbound Left/Right	B	11.4	B	11.8

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
4	***Braddock Rd & Northstar Blvd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left/Thru/Right	A	5.6	A	4.0
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left/Thru	A	3.3	A	4.7
	Northbound Approach	**F**	**652.1**	**F**	*****
	Northbound Left/Thru/Right	F	652.1	F	*
	Southbound Approach	**F**	*****	**F**	*****
	Southbound Left	F	*	F	*
	Southbound Right	E	49.5	F	249.7
4	***Mitigation - Install traffic signal***				
	Overall Intersection (Signalized)	**C**	**30.7**	**C**	**24.9**
	Eastbound Approach	**C**	**32.6**	**C**	**31.5**
	Eastbound Left/Thru/Right	C	32.6	C	31.5
	Westbound Approach	**D**	**40.2**	**B**	**18.2**
	Westbound Left/Thru	C	27.6	C	23.9
	Westbound Right	D	49.9	B	10.5
	Northbound Approach	**C**	**29.4**	**C**	**33.0**
	Northbound Left/Thru/Right	C	29.4	C	33.0
	Southbound Approach	**C**	**24.2**	**C**	**21.7**
	Southbound Left	C	28.5	C	21.7
	Southbound Thru/Right	C	21.7	C	21.7
5	***Braddock Rd & Summerall Dr/Supreme Dr***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	2.4	A	1.8
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	4.1	A	3.5
	Northbound Approach	**F**	**427.0**	**F**	**244.0**
	Northbound Left/Thru/Right	F	427.0	F	244.0
	Southbound Approach	**F**	*****	**F**	**865.0**
	Southbound Left/Thru/Right	F	*	F	865.0
5	***Mitigation - Install traffic signal***				
	Overall Intersection (Signalized)	**C**	**25.6**	**C**	**28.5**
	Eastbound Approach	**B**	**13.6**	**B**	**17.4**
	Eastbound Left/Thru	B	13.7	B	17.5
	Eastbound Right	A	8.7	B	12.0
	Westbound Approach	**C**	**22.4**	**C**	**27.6**
	Westbound Left/Thru/Right	C	22.4	C	27.6
	Northbound Approach	**D**	**42.8**	**D**	**36.6**
	Northbound Left/Thru/Right	D	42.8	D	36.6
	Southbound Approach	**D**	**41.5**	**D**	**46.5**
	Southbound Left/Thru/Right	D	41.5	D	46.5

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
6	***John Mosby Hwy (US Rt. 50) & Lenah Rd/Lenah Farm Ln***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	0.0	A	0.1
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	2.8	B	10.1
	Northbound Approach	**F**	**842.7**	**F**	*****
	Northbound Left/Thru/Right	F	842.7	F	*
	Southbound Approach	**F**	*****	**F**	**244.6**
	Southbound Left/Thru/Right	F	*	F	244.6
6	***Mitigation - Install traffic control signal; Add westbound left turn bay***				
	Overall Intersection (Signalized)	**D**	**36.4**	**C**	**23.7**
	Eastbound Approach	**D**	**46.9**	**A**	**8.9**
	Eastbound Left/Thru/Right	D	46.9	A	8.9
	Westbound Approach	**B**	**11.4**	**C**	**27.6**
	Westbound Left	B	11.2	A	9.1
	Westbound Thru/Right	B	11.4	C	30.9
	Northbound Approach	**D**	**42.4**	**D**	**44.1**
	Northbound Left/Thru/Right	D	42.4	D	44.1
	Southbound Approach	**C**	**30.9**	**D**	**37.7**
	Southbound Left/Thru/Right	C	30.9	D	37.7
7	***Kirkpatrick Farms Driveway & Northstar Blvd Extended***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Westbound Approach	**A**	**9.6**	**A**	**10.0**
	Westbound Left/Right	A	9.6	A	10.0
	Northbound Approach	**N/A**	**N/A**	**N/A**	**N/A**
	Southbound Approach	**N/A**	**N/A**	**N/A**	**N/A**
	Southbound Left/Thru	A	1.2	A	3.8

As mentioned earlier, according to the Loudoun County level of service (LOS) criteria, it is desirable to achieve a level of service (LOS) D or better for each approach at an intersection. As shown in **Table 4**, all the study intersections operate at acceptable levels of service under future conditions without development (2020), except for the following intersections:

- Braddock Road and Northstar Boulevard (AM Peak Hour)
- Braddock Road and Summerall Drive/Supreme Drive (AM and PM Peak Hour)
- John Mosby Highway (Route 50) and Lenah Road/Lenah Farm Lane (AM and PM Peak Hour)

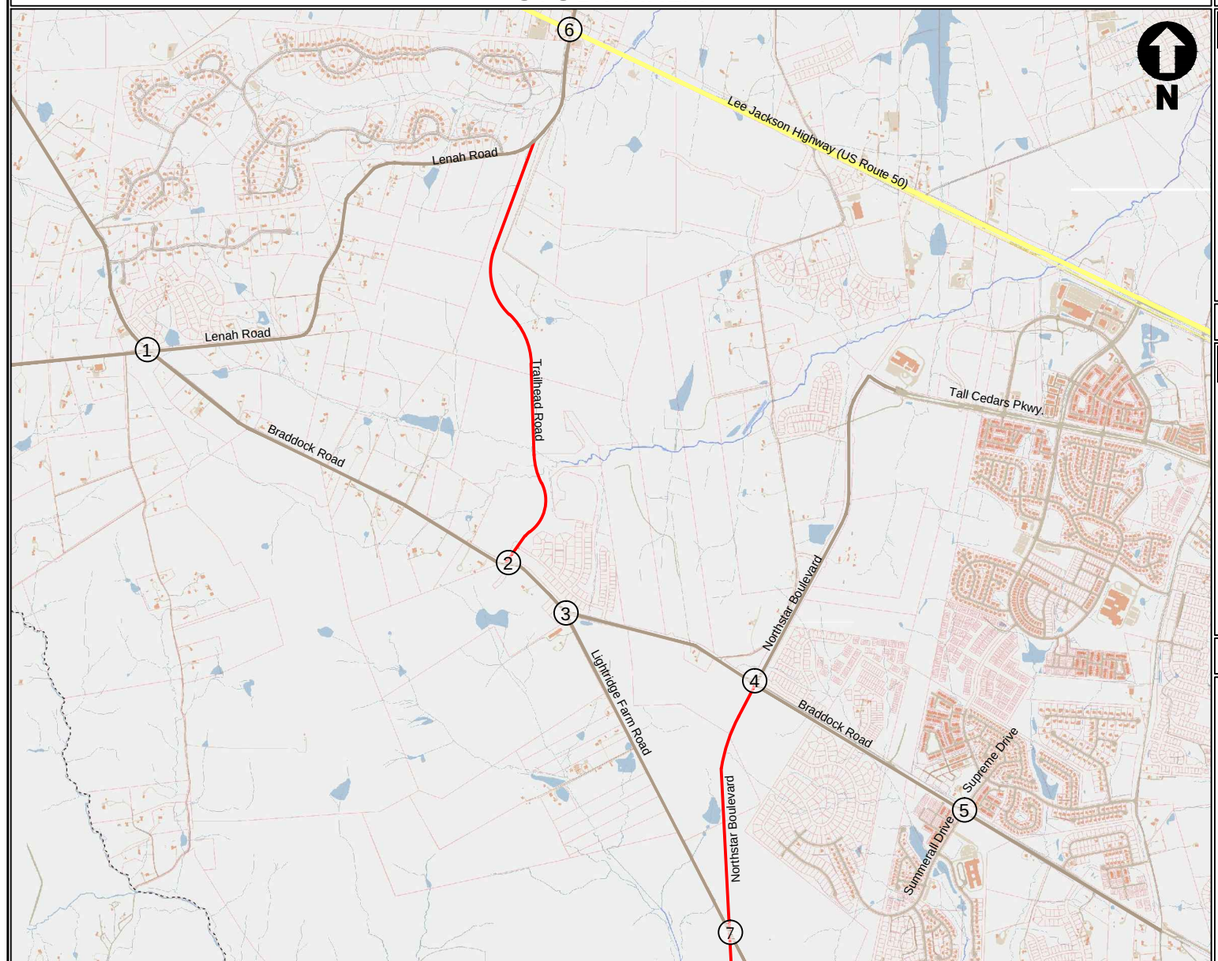
The following mitigation measures are recommended under the future conditions without development scenario:

- Braddock Road and Northstar Boulevard
  - Install a traffic signal.
- Braddock Road and Summerall Drive/Supreme Drive
  - Install a traffic signal.
- John Mosby Highway (Route 50) and Lenah Road/Lenah Farm Road
  - Install a traffic signal.
  - Add a westbound left turn bay.

With the recommended improvements in place, all of the intersections operate at acceptable levels of service under future conditions without development (2020).

The results of the intersection capacity analyses are shown graphically **Figure 12**.

STUDY AREA



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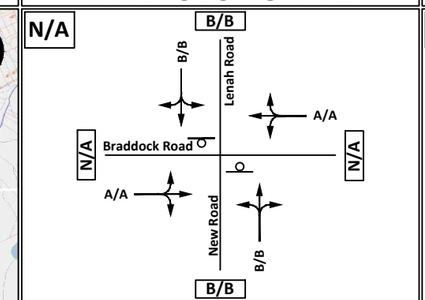

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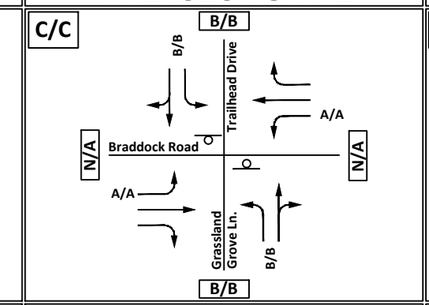

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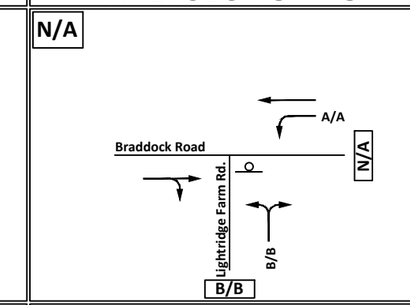

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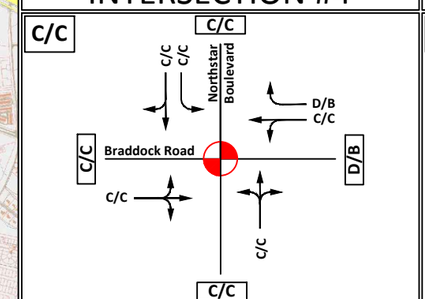

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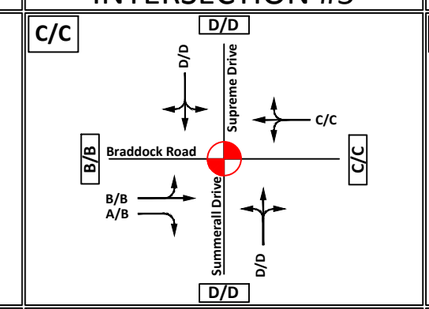

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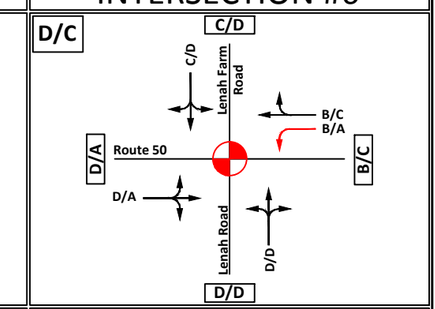

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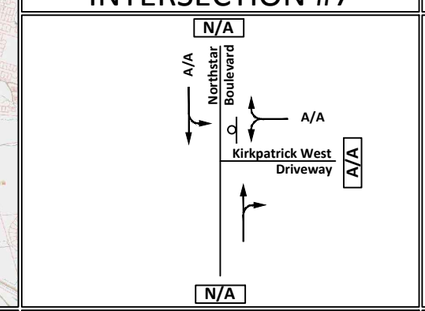


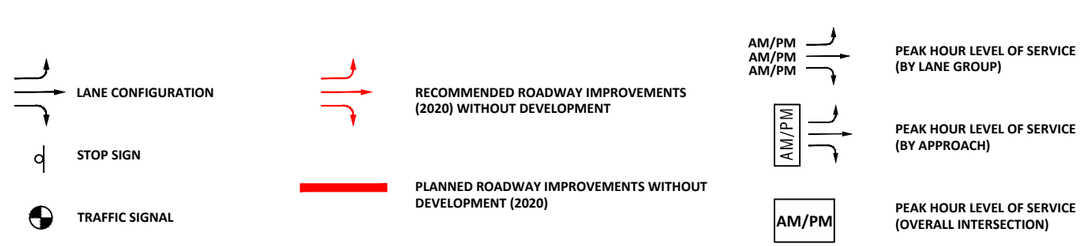
INTERSECTION #8

FOR FUTURE USE

INTERSECTION #9

FOR FUTURE USE

LEGEND



INTERSECTION #10

FOR FUTURE USE

INTERSECTION #11

FOR FUTURE USE

INTERSECTION #12

FOR FUTURE USE

Figure 12
Future Conditions without Development (2020)
Peak Hour Levels of Service & Recommended Improvements

TRIP GENERATION AND SITE TRAFFIC (2020)

Site Description

The site is located south of Braddock Road (Route 705) and west of Lightridge Farm Road (Route 705). The applicant is proposing to rezone the property to TR-1 (*Transitional Residential-1*) to accommodate 802 single-family detached residential units. The site is currently vacant and is approximately 737 acres in size. It is currently is zoned as TR-3 (*Transitional Residential-3*) and could allow for 245 single-family detached units. The proposed development is anticipated to be complete by 2020.

Site Access

The site will be accessed via future Grassland Grove Drive (also known as Lenah Loop Road) which currently connects to Braddock Road. Grassland Grove Drive is planned to be extended to connect with the future Northstar Boulevard extension. This will provide another access point to the site through Northstar Boulevard. There are four (4) roundabout intersections planned along the Grassland Grove Drive extension to provide access to site driveways.

Site Generated Volumes

In order to calculate the trips generated by the approved use and the proposed development, ITE's Trip Generation, 9th Edition was used to determine the trips into and out of the study site for the weekday morning and afternoon peak hours. **Table 5** shows the trip generation calculations (2020) for the approved and proposed uses.

Table 5: Trip Generation (2020) – Proposed Use and Existing Use

Land Use	ITE Code	Size	Units	------ Weekday ------						
				AM Peak Hour			*PM Peak Hour*			*Weekday*
				In	Out	Total	In	Out	Total	Total
Proposed Use										
Single Family Detached	210	802	DU	143	429	572	432	253	685	7,131
Approved Use										
Single Family Detached	210	245	DU	46	136	182	149	87	236	2,396
Comparison (Proposed - Approved)				**97**	**293**	**390**	**283**	**166**	**449**	**4,735**

As shown in **Table 5**, the proposed development will generate approximately 572 trips during weekday morning peak period, 685 trips during weekday afternoon peak period, and 7,131 trips during an entire weekday. As compared to the approved use, the proposed development will generate 390 more trips during the weekday morning peak period, 449 more trips during the weekday afternoon peak period, and 4,735 more weekday daily trips.

Direction of Approach and Future Conditions (2020) Volumes

The direction of approach for the proposed trips was evaluated based on the existing travel pattern, location of employment within the region, and general engineering judgment.

The direction of approach for traffic generated by the proposed development is shown in **Table 6**.

Table 6: Direction of Approach (2020)

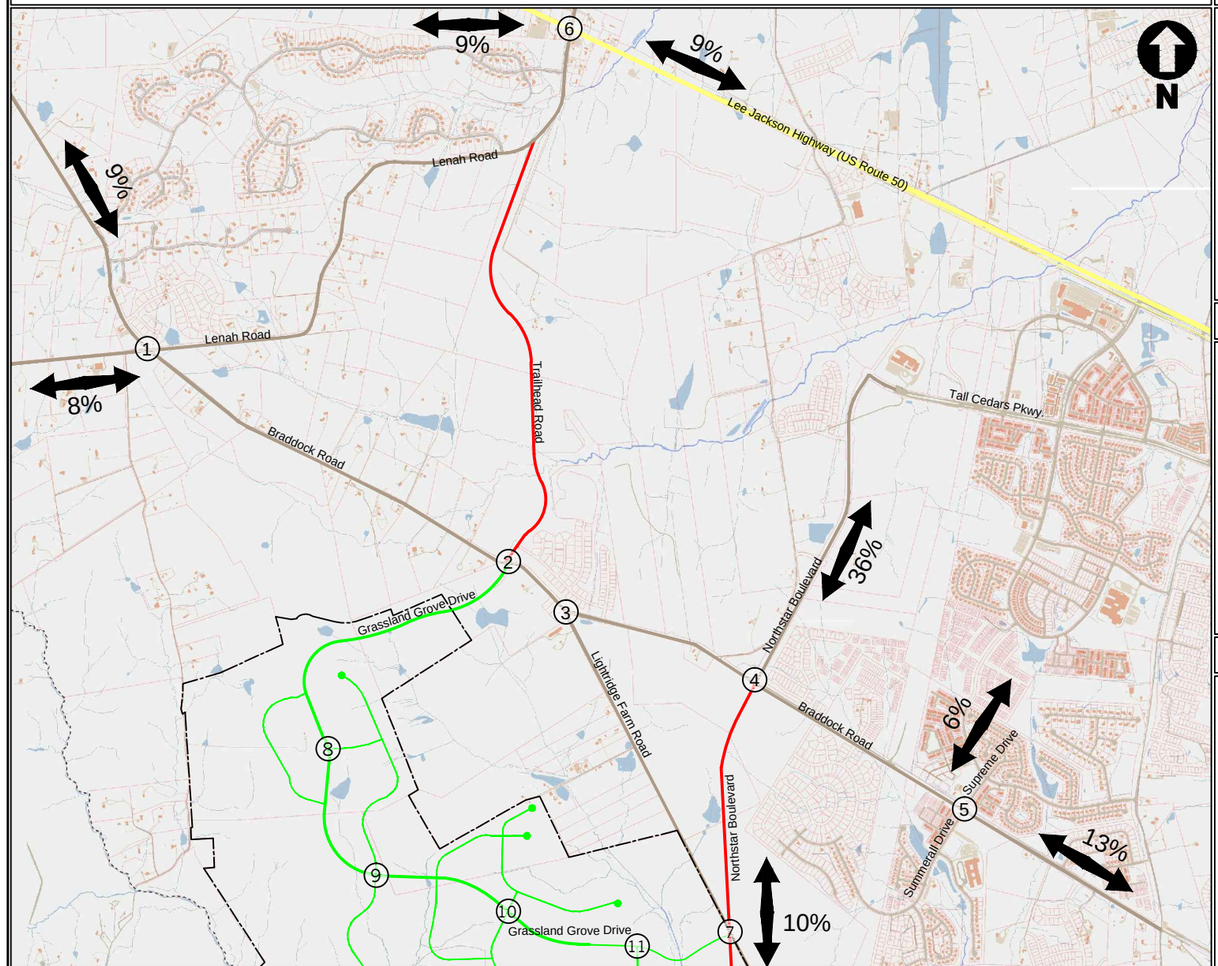
Road Name and Direction	Direction of Approach
To and from the west along John Mosby Highway (Route 50)	9%
To and from the east along John Mosby Highway (Route 50)	9%
To and from the west along Braddock Road, west of Lenah Road	9%
To and from the west along New Road	8%
To and from the south along future Northstar Boulevard	10%
To and from the north along Northstar Boulevard	36%
To and from the north along Supreme Drive	6%
To and from the east along Braddock Road, east of Supreme Drive	13%
Total	**100%**

Note: It should be noted that the distributions above are altered slightly from those in the scoping document. The changes are reflective of a review of travel time estimates within the study area, specifically, the routing to and from the site and points northeast via a comparison of the Northstar Boulevard route and the Supreme Drive route.

The inbound and outbound trips calculated for the weekday morning, and weekday afternoon commuter peak hours were routed based on the distribution provided above.

The site traffic assignment and distribution assumptions for both peak hours are illustrated in **Figure 13**.

STUDY AREA



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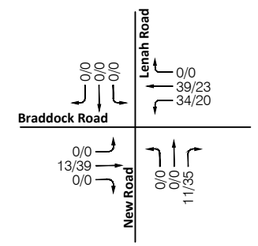

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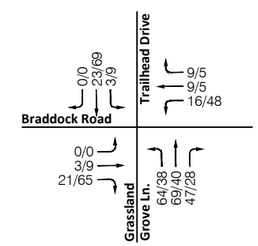

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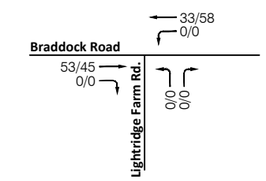

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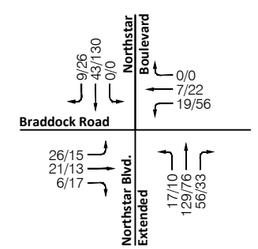

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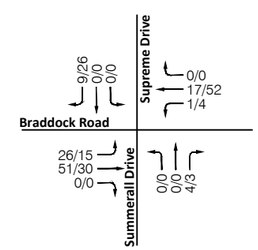

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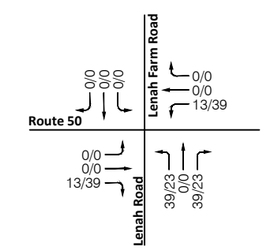

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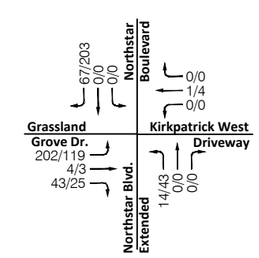

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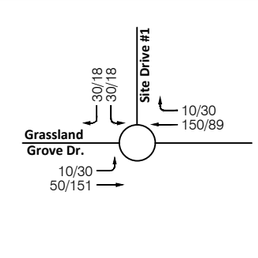

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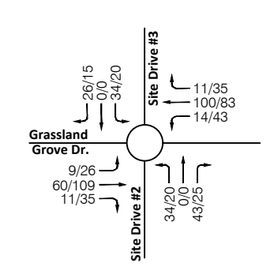


LEGEND

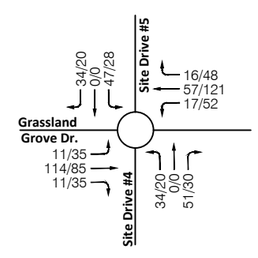
AM/PM
AM/PM
AM/PM — PEAK HOUR TRAFFIC VOLUMES

PLANNED NETWORK (2020) WITHOUT DEVELOPMENT

PROPOSED ROADWAY NETWORK (2020) WITH DEVELOPMENT

X% — DIRECTION OF APPROACH

INTERSECTION #10



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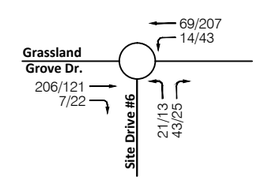


INTERSECTION #12

FOR FUTURE USE

Figure 13
Site Generated Trips and Direction of Approach (2020)
Peak Hour Traffic Volumes

ANALYSIS OF FUTURE CONDITIONS WITH DEVELOPMENT (2020)

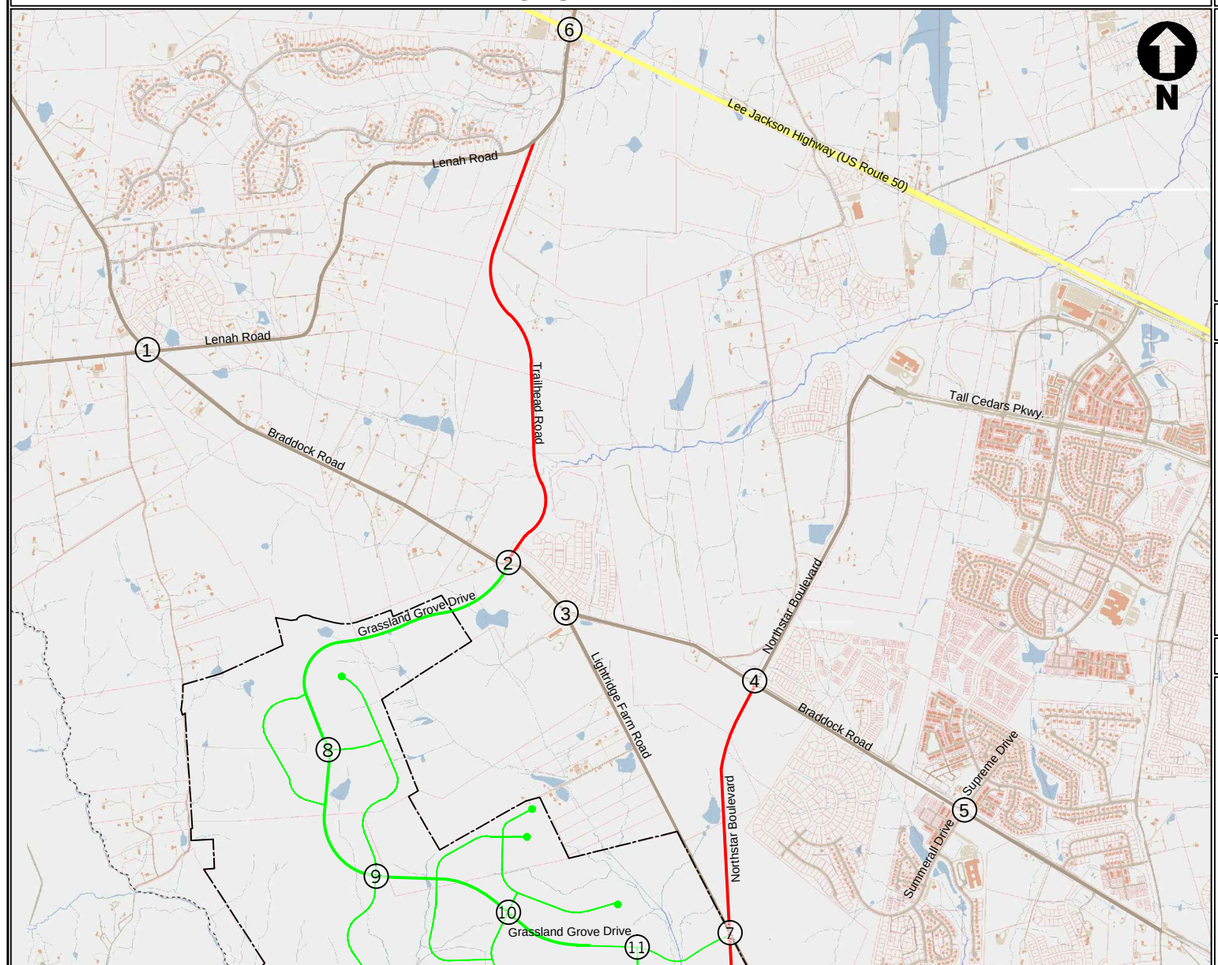
Future Conditions with Development (2020) Traffic Volumes

In order to provide better access to the proposed site, Grassland Grove Drive (also known as Lenah Loop Road in the CTP) is planned to be extended. Grassland Grove Drive currently terminates just south of Braddock Road. It is planned to be extended as a two-lane undivided road and will traverse through the proposed development. This road is included in Loudoun County's CTP as a two-lane undivided minor collector with a design speed of 40 mph. Four (4) roundabout intersections are proposed along Grassland Grove Drive at the site driveways. The roundabouts are analyzed as part of the future conditions with development. As a site improvement, Northstar Boulevard will be widened from a two lane to a four-lane divided roadway from Braddock Road to Grassland Grove Drive. South of Grassland Grove Drive, the Northstar Boulevard extension will tie into the existing two-lane section of Lightridge Farm Road.

Due to the proposed Grassland Grove Drive extension described above, some of the planned background development trips will be rerouted to the new roadway through Northstar Boulevard. Specifically, the by-right Greens at Willowsford residential development and the elementary school on the Willowsford Site will use the new Grassland Grove Drive connection to access the site through Northstar Boulevard.

The total rerouted trips are shown in **Figure 14**. The future without development volumes were added to the site trips and the rerouted trips to establish the future with development volumes, as shown on **Figure 15**.

STUDY AREA



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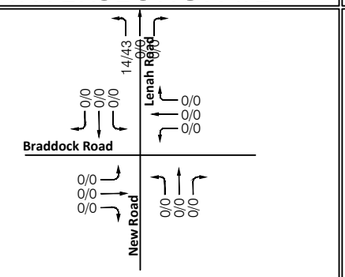

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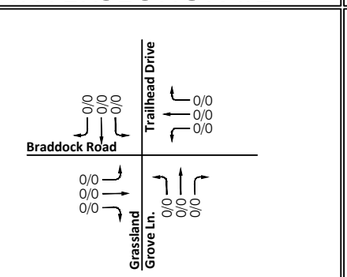

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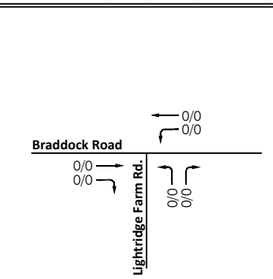

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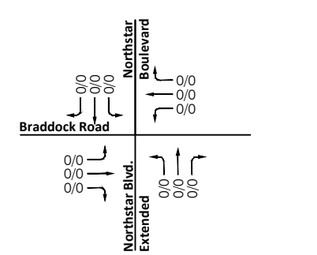

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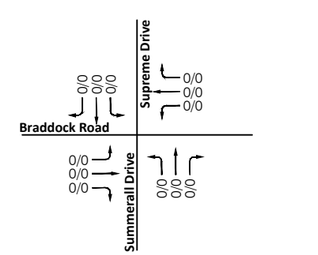

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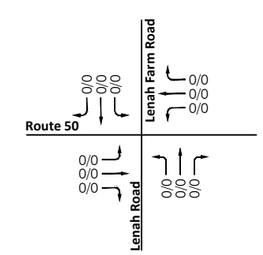

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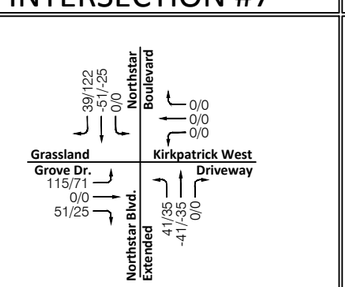

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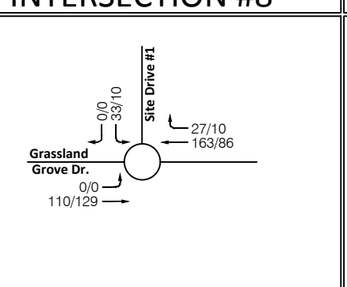

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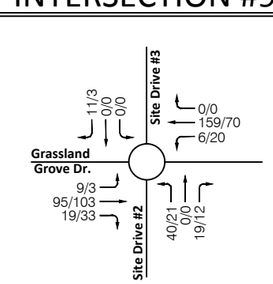


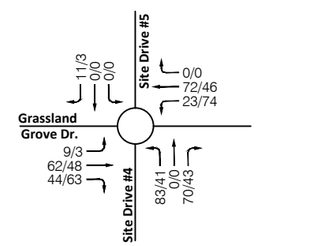
LEGEND

PEAK HOUR TRAFFIC VOLUMES

PROPOSED ROADWAY NETWORK (2020) WITHOUT DEVELOPMENT

PROPOSED ROADWAY NETWORK (2020) WITH DEVELOPMENT

INTERSECTION #10



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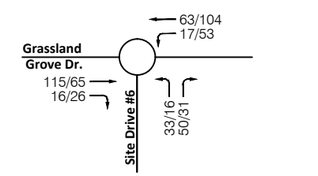
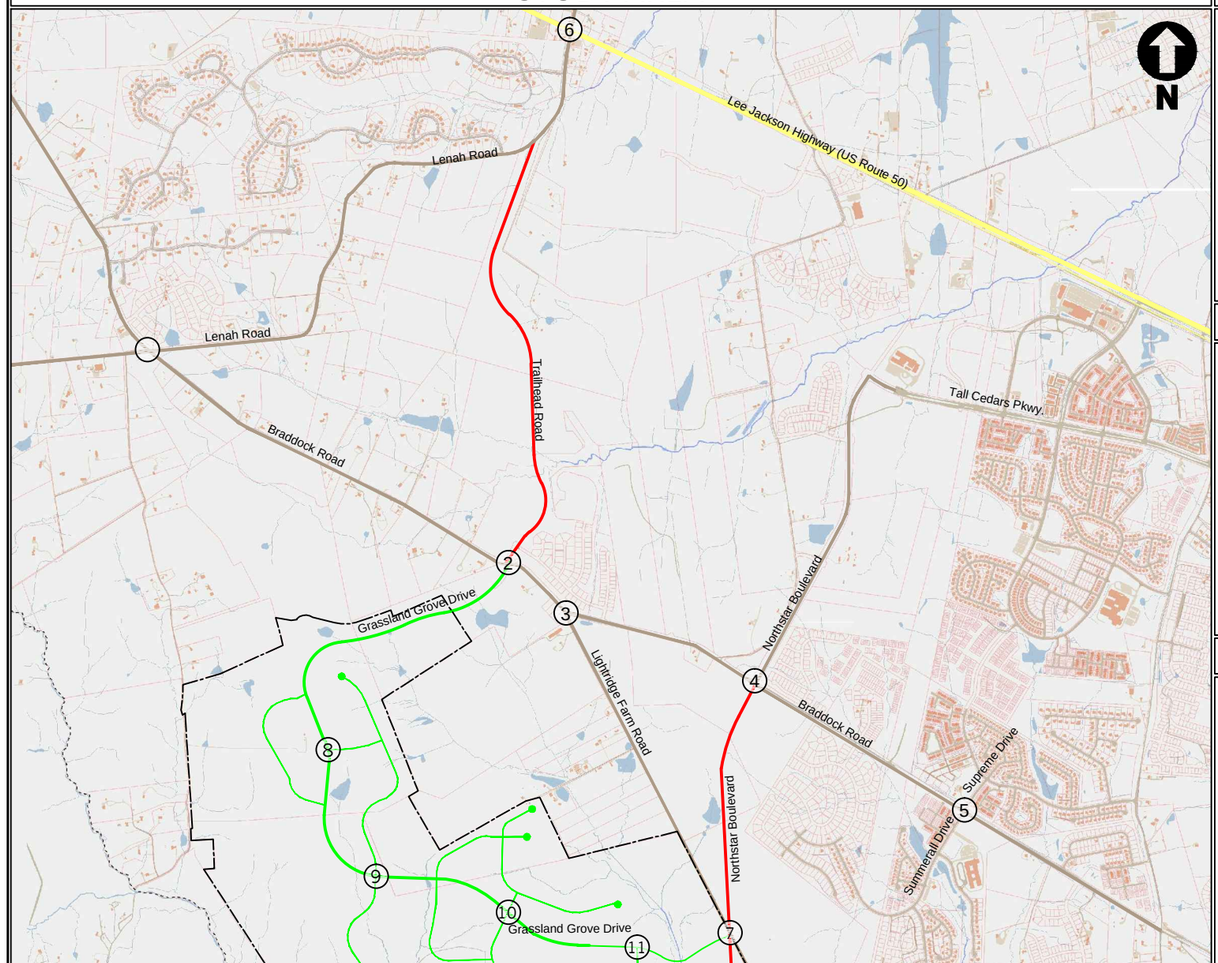


INTERSECTION #12

FOR FUTURE USE

Figure 14
Rerouted Background Development Trips
Due to Grassland Grove Drive Extension (2020)

STUDY AREA



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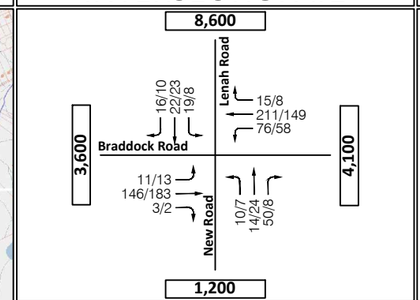

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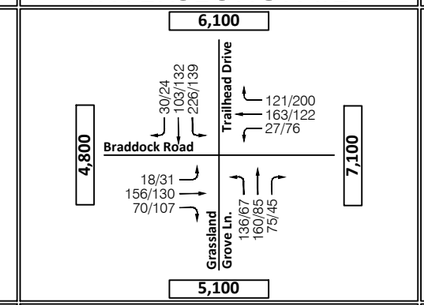

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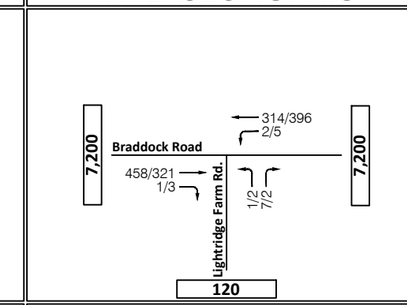

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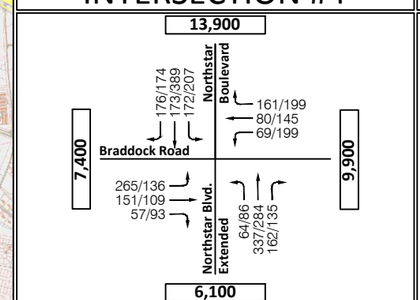

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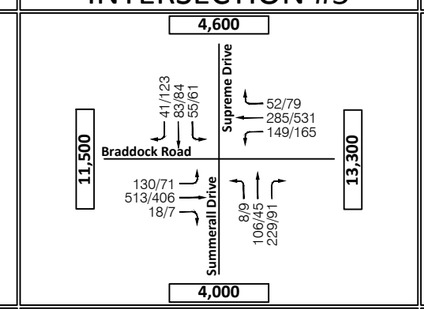

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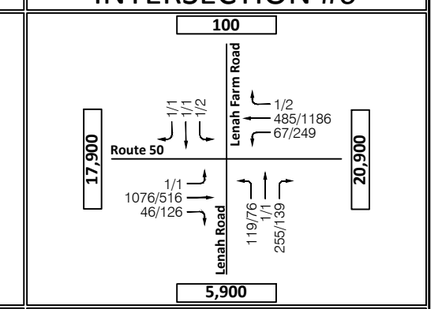

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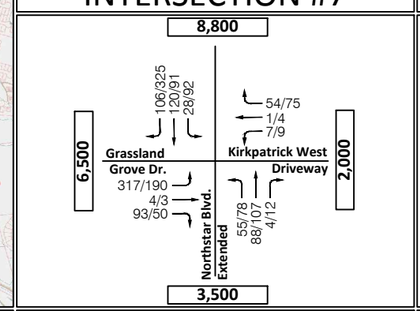

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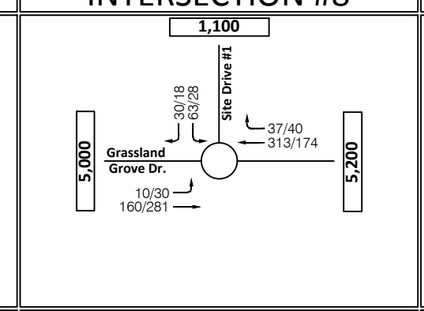

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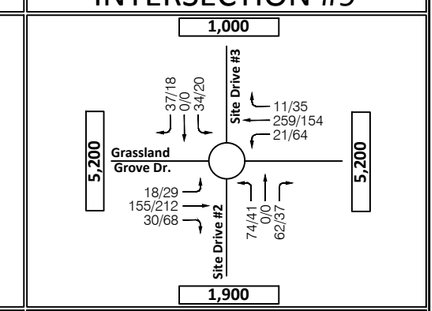

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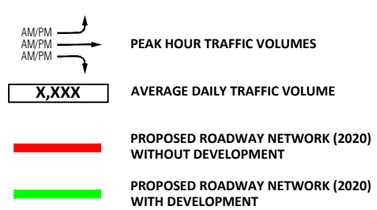

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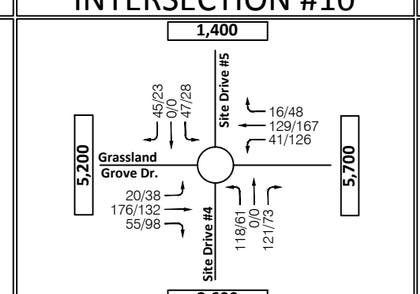

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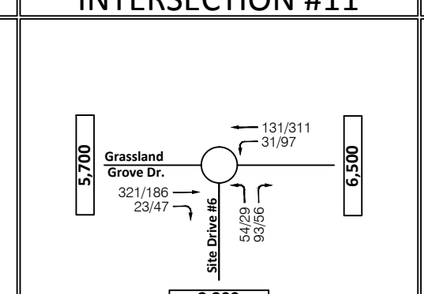


INTERSECTION #12

FOR FUTURE USE

Figure 15
Future Conditions with Development (2020)
Peak Hour Traffic Volumes

Future Conditions with Development (2020) Capacity Analysis

Capacity analyses were performed at the intersections contained within the study area during the weekday morning peak hours and weekday afternoon commuter peak hours, under the future conditions with development. Intersection capacity analyses were performed using *Synchro version 7* based on the Highway Capacity Manual (HCM 2000) data and methodology. Roundabout capacity analyses were performed at the four roundabouts using *Sidra version 5.1* based on the Highway Capacity Manual (HCM 2010). As discussed at the scoping meeting, a peak hour factor of 0.92 was used for all movements.

The results of the intersection capacity analyses for the future conditions with development are summarized in **Table 7**. The description of the different LOS and delay are included in Appendix C. The detailed analysis worksheets for the future conditions with development (2020) scenario for the Synchro analyses and the Sidra analyses are included in Appendix G and Appendix H, respectively.

Table 7: Future Conditions with Development (2020) Capacity Analysis

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
1	***Braddock Rd & New Rd/Lenah Rd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	0.6	A	0.6
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	2.3	A	2.4
	Northbound Approach	**B**	**11.7**	**B**	**11.7**
	Northbound Left/Thru/Right	B	11.7	B	11.7
	Southbound Approach	**B**	**14.8**	**B**	**13.6**
	Southbound Left/Thru/Right	B	14.8	B	13.6
2	***Braddock Rd & Grassland Grove Dr/ Trailhead Dr***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Eastbound Left	A	7.9	A	8.1
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	7.8	A	7.9
	Northbound Approach	**C**	**21.0**	**C**	**20.2**
	Northbound Left	C	23.1	C	24.2
	Northbound Thru/Right	C	19.7	C	18.2
	Southbound Approach	**F**	**74.5**	**D**	**25.5**
	Southbound Left	F	109.5	D	31.4
	Southbound Thru/Right	C	15.2	C	20.2

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
2	***Mitigation - Install traffic control signal***				
	Overall Intersection (Signalized)	**C**	**32.9**	**C**	**26.7**
	Eastbound Approach	**B**	**17.2**	**B**	**11.3**
	Eastbound Left	B	14.6	A	9.2
	Eastbound Thru	B	17.9	B	11.8
	Eastbound Right	B	16.3	B	11.3
	Westbound Approach	**C**	**25.6**	**B**	**14.1**
	Westbound Left	C	20.3	A	9.0
	Westbound Thru	C	26.7	B	12.5
	Westbound Right	C	25.3	B	17.1
	Northbound Approach	**D**	**48.0**	**D**	**49.8**
	Northbound Left	C	34.3	D	42.1
	Northbound Thru/Right	E	55.9	D	53.8
	Southbound Approach	**C**	**34.4**	**D**	**42.3**
	Southbound Left	C	32.4	D	36.8
	Southbound Thru/Right	D	37.7	D	47.2
3	***Braddock Rd & Lightridge Farm Rd***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	N/A	N/A	N/A	N/A
	Westbound Approach	N/A	N/A	N/A	N/A
	Westbound Left	A	8.4	A	8.0
	Northbound Approach	**B**	**12.0**	**B**	**12.7**
	Northbound Left/Right	B	12.0	B	12.7
4	***Braddock Rd & Northstar Blvd***				
	Overall Intersection (Signalized)	**D**	**40.5**	**E**	**55.5**
	Eastbound Approach	**D**	**41.5**	**D**	**49.6**
	Eastbound Left/Thru/Right	D	41.5	D	49.6
	Westbound Approach	**D**	**37.5**	**C**	**23.9**
	Westbound Left/Thru	C	27.8	C	30.3
	Westbound Right	D	46.5	B	12.8
	Northbound Approach	**D**	**52.8**	**F**	**137.7**
	Northbound Left/Thru/Right	D	52.8	F	137.7
	Southbound Approach	**C**	**28.2**	**C**	**26.5**
	Southbound Left	D	38.4	C	26.0
	Southbound Thru/Right	C	23.1	C	26.7

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
4	***Mitigation - Widen Northstar Boulevard from 2 lanes to 4 lanes south of Braddock Road.***				
	Overall Intersection (Signalized)	**C**	**34.4**	**C**	**35.0**
	Eastbound Approach	**C**	**33.5**	**D**	**37.6**
	Eastbound Left/Thru/Right	C	33.5	D	37.6
	Westbound Approach	**B**	**20.0**	**C**	**24.7**
	Westbound Left/Thru	B	15.3	C	28.4
	Westbound Right	C	24.3	B	18.2
	Northbound Approach	**D**	**43.7**	**D**	**36.2**
	Northbound Left	C	22.7	C	27.2
	Northbound Thru/Right	D	46.5	D	38.0
	Southbound Approach	**C**	**33.5**	**D**	**40.3**
	Southbound Left	D	36.9	C	26.0
	Southbound Thru/Right	C	31.9	D	45.6
5	***Braddock Rd & Summerall Dr/Supreme Dr***				
	Overall Intersection (Signalized)	**C**	**32.7**	**D**	**37.4**
	Eastbound Approach	**B**	**19.1**	**B**	**17.3**
	Eastbound Left/Thru	B	19.3	B	17.4
	Eastbound Right	B	12.0	B	10.1
	Westbound Approach	**D**	**40.3**	**D**	**46.1**
	Westbound Left/Thru/Right	D	40.3	D	46.1
	Northbound Approach	**D**	**43.2**	**D**	**36.7**
	Northbound Left/Thru/Right	D	43.2	D	36.7
	Southbound Approach	**D**	**42.3**	**D**	**49.0**
	Southbound Left/Thru/Right	D	42.3	D	49.0
6	***John Mosby Hwy (US Rt. 50) & Lenah Rd/Lenah Farm Ln***				
	Overall Intersection (Signalized)	**D**	**40.5**	**C**	**24.6**
	Eastbound Approach	**D**	**50.2**	**A**	**9.4**
	Eastbound Left/Thru/Right	D	50.2	A	9.4
	Westbound Approach	**B**	**11.5**	**C**	**27.5**
	Westbound Left	B	12.4	B	11.3
	Westbound Thru/Right	B	11.4	C	30.9
	Northbound Approach	**D**	**54.5**	**D**	**50.0**
	Northbound Left/Thru/Right	D	54.5	D	50.0
	Southbound Approach	**C**	**30.9**	**D**	**37.7**
	Southbound Left/Thru/Right	C	30.9	D	37.7
7	***Grassland Grove Drive Extended / Kirkpatrick Farms Driveway & Northstar Blvd Extended***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	**F**	**63.0**	**F**	**97.8**
	Eastbound Left/Thru/Right	F	63.0	F	97.8
	Westbound Approach	**A**	**10.0**	**B**	**11.5**
	Westbound Left/Thru/Right	A	10.0	B	11.5
	Northbound Approach	**N/A**	**N/A**	**N/A**	**N/A**
	Northbound Left	A	3.2	A	3.8
	Southbound Approach	**N/A**	**N/A**	**N/A**	**N/A**
	Southbound Left	A	1.0	A	2.0

No.	Intersection (Movement)	AM Peak		PM Peak	
		LOS	Delay	LOS	Delay
7	***Mitigation - Install eastbound left turn bay, northbound left turn bay, southbound right turn bay; Widen Northstar Boulevard from 2 lanes to 4 lanes north of Grassland Grove Drive***				
	Overall Intersection (Unsignalized)	N/A	N/A	N/A	N/A
	Eastbound Approach	**D**	**26.7**	**D**	**32.0**
	Eastbound Left	D	32	E	38.3
	Eastbound Thru/Right	A	9.3	A	9.2
	Westbound Approach	**A**	**9.6**	**B**	**10.7**
	Westbound Left/Thru/Right	A	9.6	B	10.7
	Northbound Approach	**N/A**	**N/A**	**N/A**	**N/A**
	Northbound Left	A	7.9	A	8.5
	Southbound Approach	**N/A**	**N/A**	**N/A**	**N/A**
	Southbound Left/Thru	A	2.5	A	5.9
Roundabout analysis performed using Sidra 5.1					
8	***Grassland Grove Drive and Site Drive #1***				
	Single-Lane Roundabout #1	**A**	**6.3**	**A**	**6.0**
	Eastbound Approach	A	5.2	A	6.5
	Westbound Approach	A	6.9	A	5.4
	Southbound Approach	A	6.0	A	4.5
9	***Grassland Grove Drive and Site Drives #2 & #3***				
	Single-Lane Roundabout #2	**A**	**6.2**	**A**	**6.5**
	Eastbound Approach	A	5.5	A	7.1
	Westbound Approach	A	6.9	A	6.2
	Southbound Approach	A	5.8	A	4.9
	Northbound Approach	A	6.0	A	5.4
10	***Grassland Grove Drive and Site Drives #4 & #5***				
	Single-Lane Roundabout #3	**A**	**6.7**	**A**	**7.1**
	Eastbound Approach	A	6.4	A	7.3
	Westbound Approach	A	6.0	A	7.8
	Southbound Approach	A	5.8	A	5.7
	Northbound Approach	A	7.8	A	5.7
11	***Grassland Grove Drive and Site Drive #6***				
	Single-Lane Roundabout #4	**A**	**6.5**	**A**	**7.0**
	Eastbound Approach	A	7.0	A	6.2
	Westbound Approach	A	5.1	A	7.9
	Northbound Approach	A	7.0	A	5.0

As previously mentioned, it is desirable to achieve a level of service (LOS) D or better per approach at each intersection. **Table 7** shows that the regional intersections operate at acceptable levels of service under future conditions with development (2020), except for the following intersections:

- Braddock Road and Northstar Boulevard (PM Peak)
- Northstar Boulevard and Grassland Grove Drive/Kirkpatrick West Driveway (AM and PM Peak)

As previously mentioned, Northstar Boulevard is planned to be widened from two lanes to four lanes from Braddock Road to south of Grassland Grove Drive. South of Grassland Grove Drive, Northstar Boulevard will transition back into the existing two-lane section of Lightridge Farm Drive. In addition, the following improvements are recommended under the future conditions with development (2020) scenario:

- Braddock Road and Northstar Boulevard
  - The additional northbound lane along Northstar Boulevard will become a northbound left turn lane at Braddock Road.
- Northstar Boulevard and Grassland Grove Drive/Kirkpatrick West Driveway
  - Add an eastbound left turn bay.
  - Add a northbound left turn bay. (Please reference the turn lane warrant analysis section.)
  - Add a southbound right turn bay. (Please reference the turn lane warrant analysis section.)

With the recommended improvements in place, all of the regional intersections and all of the site entrances and roundabouts will operate at acceptable levels of service.

Site Traffic Contribution

Site traffic contribution computations were performed for four of the regional study intersections. The results are shown in **Table 8**.

Table 8: Site Traffic Contribution – Future Conditions with Development (2020)

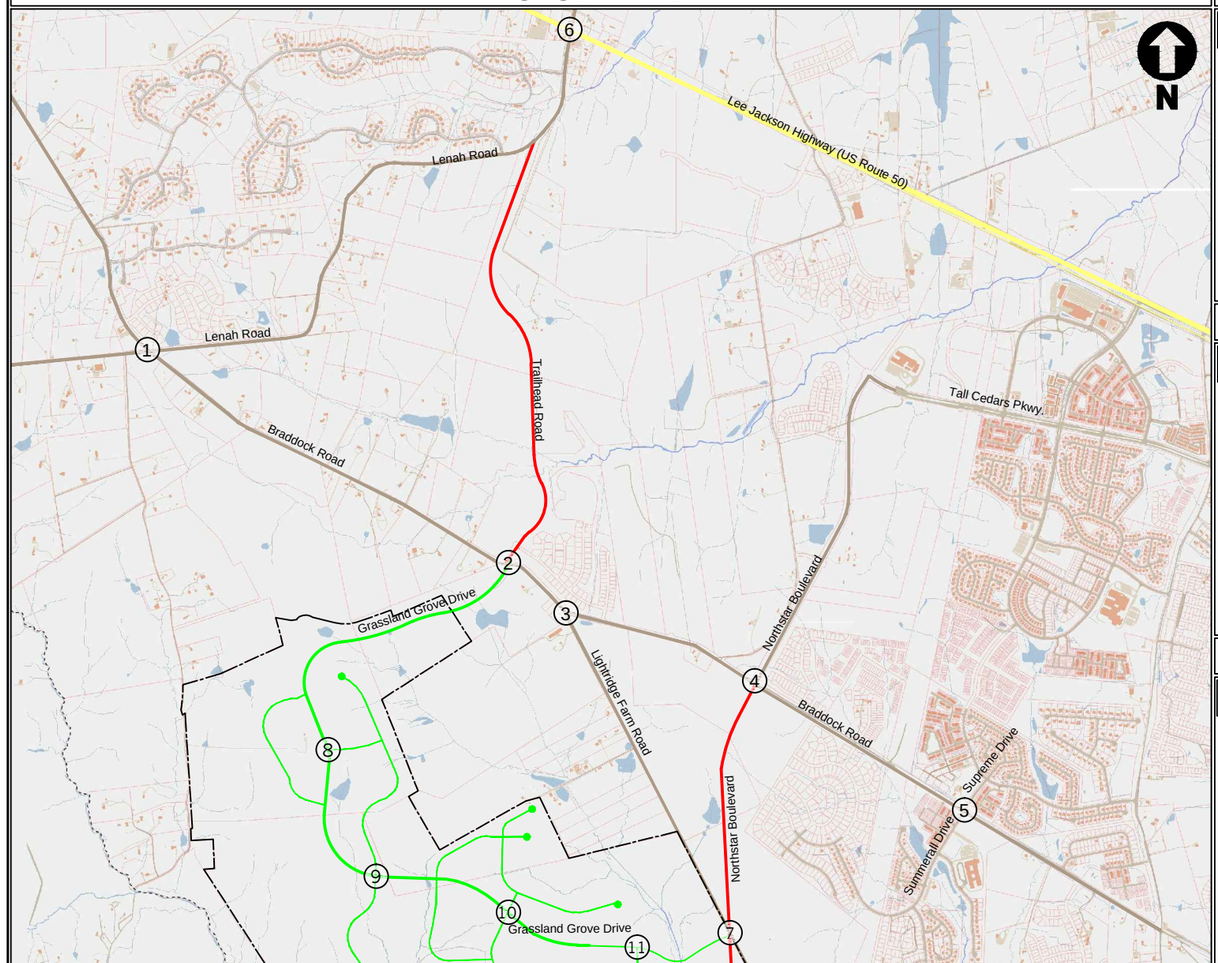
	Intersection	Peak Hour	Peak Hour Volumes (2020)		Site Volume Percent Contribution
			Site Volume	Total Intersection Volume	
(1)	Braddock Rd. and Grassland Grove Dr./Trailhead Dr.	AM	264	1285	20.5%
		PM	316	1158	27.3%
(2)	Braddock Rd. and Northstar Blvd.	AM	333	1867	17.8%
		PM	398	2156	18.5%
(3)	Braddock Rd. and Summerall Dr./Supreme Dr.	AM	108	1669	6.5%
		PM	130	1672	7.8%
(4)	Route 50 and Lenah Rd.	AM	104	2054	5.1%
		PM	124	2300	5.4%

The table above reveals the following:

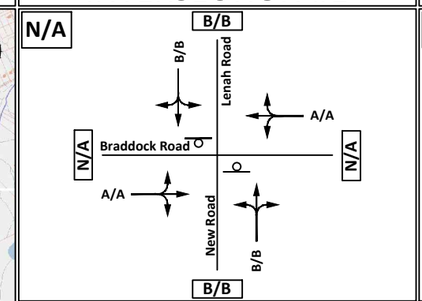
- The proposed development contributes approximately 17-27% to intersections in close vicinity to the site – (1) & (2)
- The proposed development contributes approximately 5-8% to regional intersections – (3) & (4)
- Hence, the impact from the proposed development is minimal on the local and regional roadway network.

The results of the intersection capacity analyses and the recommended improvements for future conditions with development (2020) are shown graphically in **Figure 16**.

STUDY AREA



INTERSECTION #1



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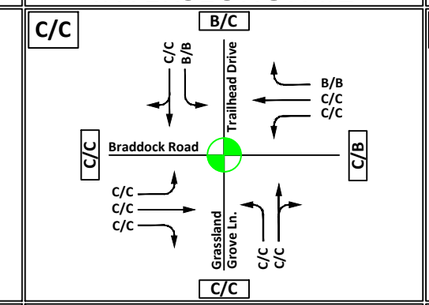

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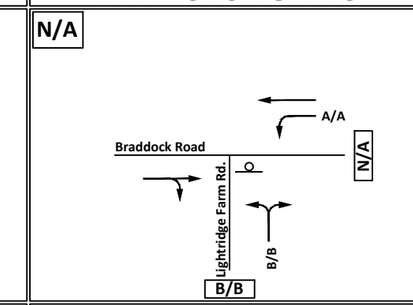

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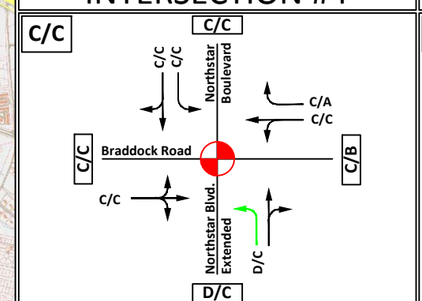

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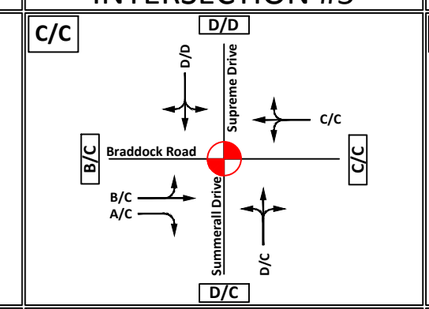

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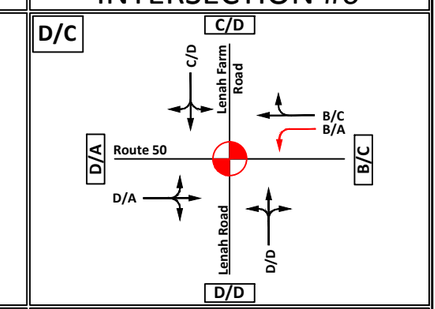

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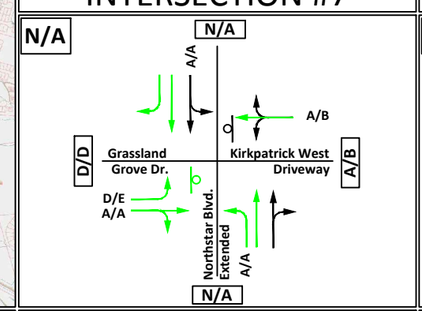

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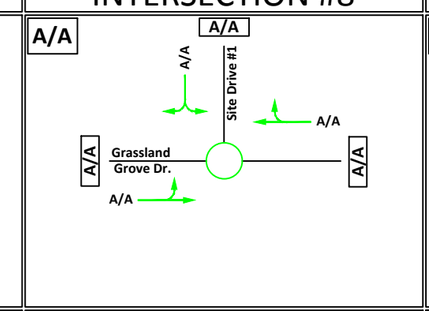

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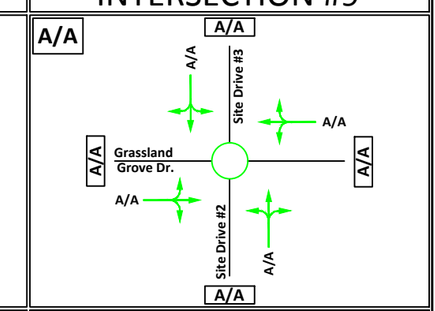
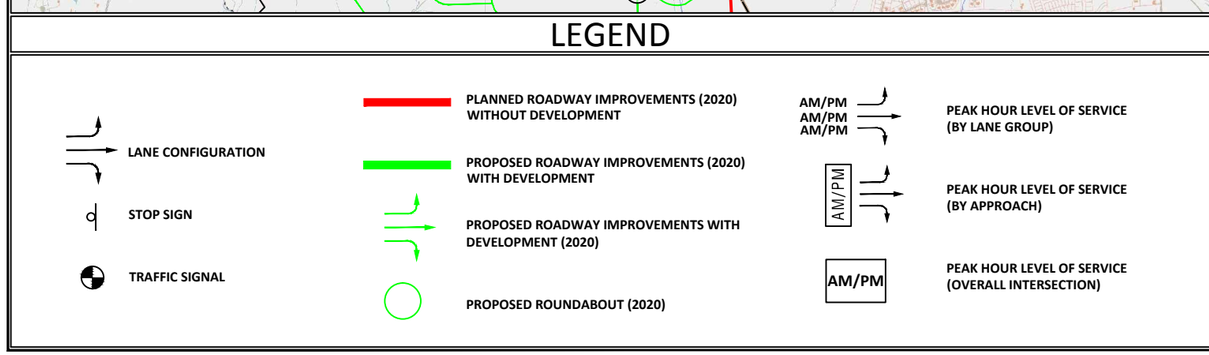


LEGEND



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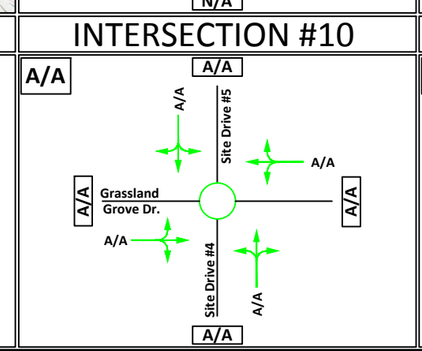

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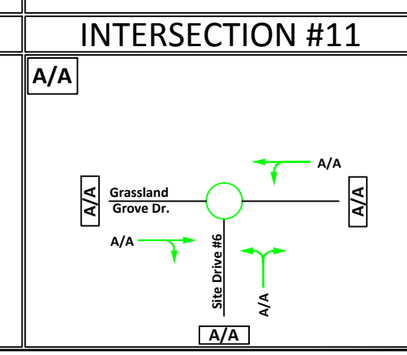

INTERSECTION #12

FOR FUTURE USE

Figure 16
Future Conditions with Development (2020)
Peak Hour Levels of Service & Recommended Improvements

QUEUING ANALYSIS

Queuing analyses were performed at the study intersections as requested at the scoping meeting. Queuing analyses were performed using *Synchro version 7* based on the Highway Capacity Manual (HCM 2000) data and methodology for the existing conditions (2012), future conditions without development (2020), and future conditions with development (2020). The queuing analysis for the proposed roundabouts in the future conditions with development (2020) were analyzed using *Sidra version 5.1*. The 95% and 50% queue results for the signalized intersections and the 95% queue results for the unsignalized intersections are presented in **Table 9** through **Table 11**. The queue results are expressed in feet and the detailed analysis worksheets are included in Appendix I.

Table 9: Existing Conditions (2012) Queuing

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
1	***Braddock Rd & New Rd/Lenah Rd***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right	-	N/A	1	N/A	0
	Westbound Left/Thru/Right	-	N/A	0	N/A	1
	Northbound Left/Thru/Right	-	N/A	5	N/A	3
	Southbound Left/Thru/Right	-	N/A	2	N/A	4
2	***Braddock Rd & Grassland Grove Dr/ Trailhead Dr***					
	Overall Intersection (Unsignalized)					
	Eastbound Left	200	N/A	0	N/A	0
	Eastbound Thru	-	N/A	0	N/A	0
	Eastbound Right	200	N/A	0	N/A	0
	Westbound Left	200	N/A	0	N/A	0
	Westbound Thru	-	N/A	0	N/A	0
	Westbound Right	200	N/A	0	N/A	0
	Northbound Left	250	N/A	3	N/A	1
	Northbound Thru/Right	-	N/A	0	N/A	1
	Southbound Left	150	N/A	1	N/A	0
	Southbound Thru/Right	-	N/A	1	N/A	1
3	***Braddock Rd & Lightridge Farm Rd***					
	Overall Intersection (Unsignalized)					
	Eastbound Thru/Right	-	N/A	0	N/A	0
	Westbound Left	150	N/A	1	N/A	1
	Westbound Thru	-	N/A	0	N/A	0
	Northbound Left/Right	-	N/A	4	N/A	2
4	***Braddock Rd & Northstar Blvd***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru	-	N/A	1	N/A	1
	Westbound Thru	-	N/A	0	N/A	0
	Westbound Right	200	N/A	0	N/A	0
	Southbound Left	375	N/A	4	N/A	9
	Southbound Right	-	N/A	2	N/A	2

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
5	***Braddock Rd & Summerall Dr/Supreme Dr***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru	-	N/A	4	N/A	2
	Eastbound Right	200	N/A	0	N/A	0
	Westbound Left/Thru/Right	-	N/A	13	N/A	8
	Northbound Left/Thru/Right	-	N/A	447	N/A	45
	Southbound Left/Thru/Right	-	N/A	490	N/A	120
6	***John Mosby Hwy (US Rt. 50) & Lenah Rd/Lenah Farm Ln***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right	-	N/A	0	N/A	0
	Westbound Left/Thru/Right	-	N/A	5	N/A	9
	Northbound Left/Thru/Right	-	N/A	143	N/A	24
	Southbound Left/Thru/Right	-	N/A	4	N/A	12

As shown in **Table 9**, no intersections have movements where the peak hour queue length exceeds turn bay storage in the existing conditions.

Table 10: Future Conditions without Development (2020) Queuing

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
1	***Braddock Rd & New Rd/Lenah Rd***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right	-	N/A	1	N/A	1
	Westbound Left/Thru/Right	-	N/A	2	N/A	2
	Northbound Left/Thru/Right	-	N/A	9	N/A	10
	Southbound Left/Thru/Right	-	N/A	10	N/A	7
2	***Braddock Rd & Grassland Grove Dr/ Trailhead Dr***					
	Overall Intersection (Unsignalized)					
	Eastbound Left	200	N/A	1	N/A	2
	Eastbound Thru	-	N/A	0	N/A	0
	Eastbound Right	200	N/A	0	N/A	0
	Westbound Left	200	N/A	1	N/A	2
	Westbound Thru	-	N/A	0	N/A	0
	Westbound Right	200	N/A	0	N/A	0
	Northbound Left	250	N/A	17	N/A	6
	Northbound Thru/Right	-	N/A	25	N/A	13
	Southbound Left	150	N/A	100	N/A	33
	Southbound Thru/Right	-	N/A	20	N/A	15
3	***Braddock Rd & Lightridge Farm Rd***					
	Overall Intersection (Unsignalized)					
	Eastbound Thru/Right	-	N/A	0	N/A	0
	Westbound Left	150	N/A	0	N/A	0
	Westbound Thru	-	N/A	0	N/A	0
	Northbound Left/Right	-	N/A	1	N/A	1
4	***Braddock Rd & Northstar Blvd***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right	-	N/A	18	N/A	9
	Westbound Left/Thru	-	N/A	3	N/A	9
	Westbound Right	200	N/A	0	N/A	0
	Northbound Left/Thru/Right	-	N/A	812		*
	Southbound Left	375	N/A	*	N/A	*
	Southbound Right	-	N/A	200	N/A	600
4	***Mitigation - Install traffic signal***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru/Right	-	272	408	175	278
	Westbound Left/Thru	-	76	m105	117	m177
	Westbound Right	200	16	m50	0	m9
	Northbound Left/Thru/Right	-	223	329	255	379
	Southbound Left	375	84	133	97	149
	Southbound Thru/Right	-	121	193	204	296

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
5	***Braddock Rd & Summerall Dr/Supreme Dr***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru	-	N/A	8	N/A	5
	Eastbound Right	200	N/A	0	N/A	0
	Westbound Left/Thru/Right	-	N/A	14	N/A	13
	Northbound Left/Thru/Right	-	N/A	649	N/A	250
	Southbound Left/Thru/Right	-	N/A	*	N/A	620
5	***Mitigation - Install traffic control signal***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru	-	211	317	266	371
	Eastbound Right	200	0	m5	1	m3
	Westbound Left/Thru/Right	-	262	455	436	#781
	Northbound Left/Thru/Right	-	195	306	54	114
	Southbound Left/Thru/Right	-	114	192	163	258
6	***John Mosby Hwy (US Rt. 50) & Lenah Rd/Lenah Farm Ln***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right	-	N/A	0	N/A	0
	Westbound Left/Thru/Right	-	N/A	9	N/A	24
	Northbound Left/Thru/Right	-	N/A	739	N/A	*
	Southbound Left/Thru/Right	-	N/A	*	N/A	16
6	***Mitigation - Install traffic signal; Add westbound left turn bay***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru/Right	-	~863	#1236	193	273
	Westbound Left	250	18	43	62	112
	Westbound Thru/Right	-	184	257	789	#1255
	Northbound Left/Thru/Right	-	152	256	68	141
	Southbound Left/Thru/Right	-	1	9	2	12
7	***Kirkpatrick Farms Driveway & Northstar Blvd Extended***					
	Overall Intersection (Unsignalized)					
	Westbound Left/Right		N/A	6	N/A	9
	Northbound Thru/Right		N/A	0	N/A	0
	Southbound Left/Thru		N/A	2	N/A	6

m- Volume for the 95th percentile queue is metered by the upstream signal.
#- 95th percentile volume exceeds capacity; queue may be longer. Queue shown is maximum after two cycles.

As shown in **Table 10**, with the recommended improvements in place no intersections have movements where the peak hour queue length exceeds turn bay storage during the future conditions without development (2020).

Table 11: Future Conditions with Development (2020) Queuing

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
1	***Braddock Rd & New Rd/Lenah Rd***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right	-	N/A	1	N/A	1
	Westbound Left/Thru/Right	-	N/A	5	N/A	4
	Northbound Left/Thru/Right	-	N/A	11	N/A	16
	Southbound Left/Thru/Right	-	N/A	13	N/A	8
2	***Braddock Rd & Grassland Grove Dr/ Trailhead Dr***					
	Overall Intersection (Unsignalized)					
	Eastbound Left	200	N/A	1	N/A	2
	Eastbound Thru	-	N/A	0	N/A	0
	Eastbound Right	200	N/A	0	N/A	0
	Westbound Left	200	N/A	2	N/A	5
	Westbound Thru	-	N/A	0	N/A	0
	Westbound Right	200	N/A	0	N/A	0
	Northbound Left	250	N/A	52	N/A	28
	Northbound Thru/Right	-	N/A	73	N/A	37
	Southbound Left	150	N/A	250	N/A	73
	Southbound Thru/Right	-	N/A	30	N/A	51
2	***Mitigation - Install traffic control signal***					
	Overall Intersection (Signalized)					
	Eastbound Left	200	7	23	8	25
	Eastbound Thru	-	75	151	48	101
	Eastbound Right	200	0	34	0	32
	Westbound Left	200	16	m36	25	m46
	Westbound Thru	-	102	207	56	m87
	Westbound Right	200	8	49	19	m34
	Northbound Left	250	77	103	44	74
	Northbound Thru/Right	-	175	249	89	150
	Southbound Left	150	136	168	95	137
	Southbound Thru/Right	-	83	124	117	177
3	***Braddock Rd & Lightridge Farm Rd***					
	Overall Intersection (Unsignalized)					
	Eastbound Thru/Right	-	N/A	0	N/A	0
	Westbound Left	150	N/A	0	N/A	0
	Westbound Thru	-	N/A	0	N/A	0
	Northbound Left/Right	-	N/A	1	N/A	1

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
4	***Braddock Rd & Northstar Blvd***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru/Right	-	337	#547	240	#429
	Westbound Left/Thru	-	95	m112	213	m246
	Westbound Right	200	20	m34	3	m6
	Northbound Left/Thru/Right	-	434	#670	~502	#723
	Southbound Left	375	84	#135	98	150
	Southbound Thru/Right	-	163	248	333	469
4	***Mitigation - Widen Northstar Boulevard from 2 lanes to 4 lanes south of Braddock Road.***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru/Right	-	312	#542	240	#419
	Westbound Left/Thru	-	71	m83	237	m273
	Westbound Right	200	17	m21	11	m16
	Northbound Left	-	29	57	37	68
	Northbound Thru/Right	-	379	#581	297	429
	Southbound Left	375	84	#187	98	152
	Southbound Thru/Right	-	205	319	418	#630
5	***Braddock Rd & Summerall Dr/Supreme Dr***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru	-	302	m438	293	m372
	Eastbound Right	200	1	m4	1	m2
	Westbound Left/Thru/Right	-	331	#607	572	#912
	Northbound Left/Thru/Right	-	198	311	55	116
	Southbound Left/Thru/Right	-	120	201	181	285
6	***John Mosby Hwy (US Rt. 50) & Lenah Rd/Lenah Farm Ln***					
	Overall Intersection (Signalized)					
	Eastbound Left/Thru/Right	-	~932	#1260	212	300
	Westbound Left	250	23	53	83	153
	Westbound Thru/Right	-	184	257	789	#1255
	Northbound Left/Thru/Right	-	237	#406	117	208
	Southbound Left/Thru/Right	-	1	9	2	12
7	***Grassland Grove Drive Extended/Kirkpatrick West Drive & Northstar Blvd Extended***					
	Overall Intersection (Unsignalized)					
	Eastbound Left/Thru/Right		N/A	299	N/A	250
	Westbound Left/Thru/Right		N/A	7	N/A	13
	Northbound Left/Thru/Right		N/A	4	N/A	6
	Southbound Left/Thru/Right		N/A	2	N/A	6

No.	Intersection (Movement)	Bay/Link Length (feet)	AM Peak		PM Peak	
			50th Queue	95th Queue	50th Queue	95th Queue
7	***Mitigation - Install eastbound left turn bay, northbound left turn bay, southbound right turn lane; Widen Northstar Boulevard from 2 lanes to 4 lanes north of Grassland Grove Drive***					
	Overall Intersection (Unsignalized)					
	Eastbound Left	200	N/A	153	N/A	114
	Eastbound Thru/Right	-	N/A	9	N/A	5
	Westbound Left/Thru/Right	-	N/A	6	N/A	11
	Northbound Left	200	N/A	4	N/A	6
	Northbound Thru/Right	-	N/A	4	N/A	6
	Southbound Left/Thru	-	N/A	2	N/A	6
	Southbound Right	-	N/A	0	N/A	0
8	***Grassland Grove and Site Drive #1***					
	Single-Lane Roundabout					
	Eastbound Approach		N/A	18	N/A	38
	Westbound Approach		N/A	44	N/A	23
	Southbound Approach		N/A	12	N/A	5
9	***Grassland Grove and Site Drives #2 & #3***					
	Single-Lane Roundabout					
	Eastbound Approach		N/A	22	N/A	40
	Westbound Approach		N/A	37	N/A	30
	Northbound Approach		N/A	16	N/A	9
	Southbound Approach		N/A	9	N/A	4
10	***Grassland Grove and Site Drives #4 & #5***					
	Single-Lane Roundabout					
	Eastbound Approach		N/A	30	N/A	35
	Westbound Approach		N/A	22	N/A	47
	Northbound Approach		N/A	33	N/A	16
	Southbound Approach		N/A	11	N/A	7
11	***Grassland Grove and Site Drive #6***					
	Single-Lane Roundabout					
	Eastbound Approach		N/A	44	N/A	28
	Westbound Approach		N/A	17	N/A	58
	Northbound Approach		N/A	20	N/A	9

m- Volume for the 95th percentile queue is metered by the upstream signal.
#- 95th percentile volume exceeds capacity; queue may be longer. Queue shown is maximum after two cycles.

As shown in **Table 11**, with the recommended improvements in place, there are no intersections that have movements where the peak hour queue length exceeds turn bay storage length during the future conditions with development (2020).

TURN LANE WARRANTS

Turn lane warrant analyses were performed at the proposed site entrance along Northstar Boulevard extended. The VDOT Road Design Manual, Appendix F was referenced to determine if left turn lanes and/or right turn lanes are warranted at the site entrance. A summary of the turn lane warrant analysis is provided in the table below.

Table 12: Turn Lane Warrant Analysis

Intersection	Turn Lane	Turn Lane Warrant Met?
Northstar Boulevard at Grassland Grove Drive	Left	YES
	Right	YES

As shown in **Table 12**, a left turn lane and a right turn lane is warranted at the site entrance along the Northstar Boulevard extension. Therefore, a left turn lane is recommended along Northstar Boulevard at Grassland Grove Drive and a right turn lane is recommended along southbound Northstar Boulevard at Grassland Grove Drive.

CONCLUSIONS

This report presents the findings of a traffic impact analysis for the proposed Greens South at Willowsford to be located in Loudoun County, Virginia. The analysis presented in this report in this report supports the following major conclusions:

- **Existing (2012) Conditions:**
  - The following intersections operate at unacceptable levels of service under existing conditions:
    - Braddock Road and Summerall Drive/Supreme Drive (AM and PM Peak Hour)
    - John Mosby Highway (US Route 59) and Lenah Road/Lenah Farm Lane (AM and PM Peak Hour)
- **Future Conditions without Development (2020):**
  - The following planned transportation improvements in the vicinity of the site were assumed to be in place by 2020:

    - **Trailhead Drive Extension**: As part of the Grove at Willowsford development, Trailhead Drive is planned to be extended from its current termination just north of Braddock Road to Lenah Road. This extension is included in Loudoun County's Countywide Transportation Plan (CTP) and is labeled as Lenah Loop Road. It is planned to have a two-lane undivided section and is anticipated to be complete by 2020.

    - **Northstar Boulevard Extension**: As part of the Kirkpatrick West development (ZMAP 2002-0001), Northstar Boulevard (SR 659 Relocated) is planned to be extended as a two-lane undivided road from Braddock Road to the southern site entrance of Kirkpatrick West. South of the site driveway, Northstar Boulevard will transition back into the existing Lightridge Farm Drive section.
  - The traffic generated by the following approved background developments were incorporated:
    - Greenfield Crossing
    - Stone Ridge
    - Seven Hills
    - Elementary School along Goshen (LCPS)
    - The Grove at Willowsford
    - CD Smith
    - Kirkpatrick West
    - Marrwood
    - Westport
    - By-right residential at the Greens at Willowsford Site
    - Elementary School on Willowsford Site
  - In addition to the background developments that were incorporated, an inherent growth rate of 1% on US Route 50 was applied to the existing volumes to evaluate future without development (2020) traffic volumes.
  - The following intersections have movements with unacceptable levels of service:
    - Braddock Road and Northstar Boulevard (AM and PM Peak Hour)
    - Braddock Road and Summerall Drive/Supreme Drive (AM and PM Peak Hour)
    - John Mosby Highway (Route 50) and Lenah Road/Lenah Farm Lane (AM and PM Peak Hour)

- The following mitigation measures are recommended under the future without development scenario:
  - Install a traffic signal at the intersection of Braddock Road and Northstar Boulevard
  - Install a traffic signal at the intersection of Braddock Road and Summerall Drive/Supreme Drive
  - Install a traffic signal and install a westbound left turn bay at the intersection of John Mosby Highway (Route 50) and Lenah Road/Lenah Farm Road.
- With the recommended improvements in place, all of the intersections operate at acceptable levels of service under future conditions without development (2020).

- **Future Conditions with Development (2020):**
  - The proposed plan calls for a rezoning on the property to accommodate 802 single-family detached residential units. The construction of the proposed development is anticipated to be complete by 2020.
  - The proposed development will generate approximately 572 trips during weekday morning peak period, 685 trips during weekday afternoon peak period and 7,131 trips during an entire weekday.
  - The following improvements are proposed under the future conditions with development (2020) scenario:
    - Northstar Boulevard widened from a two-lane to a four-lane divided roadway from Braddock Road (Route 620) to just south of Grassland Grove Drive.
    - Grassland Grove extended as a two-lane undivided road between just south of Braddock Road (Route 705) to the Northstar Boulevard extension.
  - The following mitigation measures are recommended under the future conditions with development scenario:
    - Braddock Road and Trailhead Drive/Grassland Grove Drive:
      - Install a traffic signal.
    - Northstar Boulevard and Grassland Grove Drive/Kirkpatrick West Driveway:
      - Add an eastbound left turn bay.
      - Add a northbound left turn bay.
      - Add a southbound right turn bay.
  - With the recommended improvements in place, all of the regional intersections and site entrances operate at acceptable levels of service under the future conditions with development (2020).