

January 26, 2017

Mr. Leon Hughes, AICP
Spotsylvania County
9019 Old Battlefield Boulevard
Suite 320
Spotsylvania, Virginia 22553
Phone: (540) 507-7220

Reference: River Road Residential – Traffic Impact Analysis

Dear Mr. Hughes,

Ramey Kemp & Associates, Inc. (RKA) has performed a Traffic Impact Analysis (TIA) for this proposed neighborhood, which consists of 39 single-family lots on the north side of Route 618 (River Road) between Route 620 (Spotswood Furnace Road) and Musket Ridge Lane. If approved, the neighborhood is expected to be built-out by 2018. Figure 1 shows the site location and study intersections.

The purpose of this letter report is to provide the following:

- Trip generation calculations
- Evaluation of turn lane warrants for the proposed connection to River Road
- Capacity analysis of the study intersections
- Sight distance study for the proposed connection to River Road
- Collision data analysis

Trip Generation

The trip generation potential of the neighborhood during a typical weekday, AM peak hour and PM peak hour was estimated using the methodologies published by the Institute of Transportation Engineers (ITE) *Trip Generation Manual – 9th Edition*. Table 1 summarizes the trip generation calculations.

Table 1
ITE Trip Generation – 9th Edition – Weekday

| Land Use (ITE Land Use Code) | Size | Weekday Daily Traffic (vpd) | | AM Peak Hour (vph) | | PM Peak Hour (vph) | |
|---------------------------------|----------|-----------------------------------|------|-----------------------|------|-----------------------|------|
| | | Enter | Exit | Enter | Exit | Enter | Exit |
| Single-Family Homes (210) | 39 homes | 221 | 221 | 9 | 28 | 28 | 17 |

Existing Roadway Conditions

Route 618 (River Road) is a two-lane minor collector with an average daily traffic (ADT) volume of approximately 2,400 vehicles per day, and a posted speed limit of 35 mph west of Spotswood Furnace Road. River Road has an ADT of 2,900 vehicles per day and a posted speed limit of 40 mph east of Spotswood Furnace Road.

Route 620 (Spotswood Furnace Road) is a two-lane local collector with an ADT volume of approximately 2,800 vehicles per day, and a posted speed limit of 35 mph.

Existing Traffic Volumes

The AM peak hour (7:00 to 9:00 AM) and PM peak hour (4:00 to 6:00 PM) turning movement counts were conducted by Technical Traffic Services, LLC at the following intersection during the week of November 28:

- Spotswood Furnace Road at River Road

Figure 2 shows the existing 2016 traffic volumes and the count data is enclosed.

Background Traffic Growth

The existing peak hour traffic volumes were grown by an annual rate of 2.0% for two years to estimate the 2018 no-build traffic volumes. The no-build (2018) traffic volumes are shown in Figure 2.

Site Traffic Distribution

The following site traffic distribution was applied based on a review of the existing traffic volumes, the adjacent roadway network, and engineering judgment:

- 40% to / from the east on River Road
- 40% to / from the south on Spotswood Furnace Road
- 20% to / from the west on River Road

Figure 3 shows the site trip distribution and site trip assignment. Figure 4 shows the projected build (2018) AM and PM peak hour traffic volumes.

VDOT Turn Lane Warrant Analysis

The projected build-out AM and PM peak hour traffic volumes at the proposed driveway were compared to the turn lane warrants in the Virginia Department of Transportation (VDOT) *Access Management Design Standards for Entrances and Intersections*:

- An eastbound left-turn lane on River Road is not warranted
- A westbound right-turn lane or taper on River Road is not warranted

Figure 4 shows the recommended lanes. The turn lane warrant diagrams are enclosed for reference.

Intersection Spacing Standards

VDOT requires at least 335 feet of separation between full-movement intersections on two-lane Minor Collector roadways posted 35 mph. The proposed neighborhood driveway on River Road is approximately 575 feet east of Trench Court, which exceeds VDOT's minimum intersection spacing standards.

Traffic Capacity Analysis

Traffic capacity analysis was performed using Synchro 9.1, which is a comprehensive software package that allows the user to model signalized and unsignalized intersections to determine levels-of-service based on the thresholds specified in the 2010 Highway Capacity Manual (HCM).

Table 2 summarizes the capacity analysis results for the unsignalized intersection of River Road at Spotswood Furnace Road, and all of the Synchro outputs are enclosed for reference.

Table 2
Level-of-Service Summary
Spotswood Furnace Road at River Road (Unsignalized – 4-way stop)

| CONDITION | LANE GROUP | AM PEAK HOUR | | | PM PEAK HOUR | | |
|----------------------------------|------------|--------------|------------|---------------------|--------------|------------|---------------------|
| | | Lane LOS | Queue (ft) | Overall LOS (Delay) | Lane LOS | Queue (ft) | Overall LOS (Delay) |
| Existing 2016 Traffic Conditions | EBL/T/R | B | 55 | A (9.6 sec) | A | 8 | A (9.2 sec) |
| | WBL/T/R | A | 8 | | A | 45 | |
| | NBL/T/R | A | 8 | | A | 8 | |
| | SBL/T/R | A | 5 | | A | 0 | |
| No-Build 2018 Traffic Conditions | EBL/T/R | B | 60 | A (9.8 sec) | A | 8 | A (9.3 sec) |
| | WBL/T/R | A | 8 | | A | 48 | |
| | NBL/T/R | A | 10 | | A | 8 | |
| | SBL/T/R | A | 5 | | A | 0 | |
| Build 2018 Traffic Conditions | EBL/T/R | B | 68 | B (10.3 sec) | A | 10 | A (9.6 sec) |
| | WBL/T/R | A | 10 | | B | 53 | |
| | NBL/T/R | A | 10 | | A | 10 | |
| | SBL/T/R | A | 5 | | A | 0 | |

The capacity analysis indicates that the intersection currently operates at LOS A during the AM and PM peak hours. Under no-build conditions, the intersection is expected to continue to operate at LOS A during the AM and PM peak hours. Under build conditions, the intersection is expected to operate at LOS B during the AM peak hour and LOS A during the PM peak hour.

No improvements are warranted or recommended at this intersection.

Table 3 summarizes the capacity analysis results for the proposed unsignalized intersection of River Road at Neighborhood Driveway, and all of the Synchro outputs are enclosed for reference.

Table 3
Level-of-Service Summary
River Road at Neighborhood Driveway (Unsignalized)

| CONDITION | LANE GROUP | AM PEAK HOUR | | | PM PEAK HOUR | | |
|-------------------------------|--------------------|--------------|------------|---------------------|--------------|------------|---------------------|
| | | Lane LOS | Queue (ft) | Overall LOS (Delay) | Lane LOS | Queue (ft) | Overall LOS (Delay) |
| Build 2018 Traffic Conditions | EBL/T ² | A | 0 | N/A ³ | A | 0 | N/A ³ |
| | WBT/R | - | - | | - | - | |
| | SBL/R ¹ | B | 3 | | B | 3 | |

1. Level of service for minor approach
2. Level of service for major street left-turn movement
3. HCM methodology does not provide lane group or overall LOS, delay, and queue lengths for major street through movements or right turns at unsignalized intersections.

The capacity analysis indicates that the minor street left-turn movement is projected to operate with short delays (less than 25 seconds) during the AM and PM peak hours at build-out of the neighborhood, and the queue lengths are expected to be one vehicle or less. No improvements are warranted or recommended at this intersection.

Sight Distance Evaluation

The sight distance for drivers exiting the proposed neighborhood driveway were measured in the field. Table 4 summarizes the sight distance requirements for driveways on two-lane roadways according to the VDOT Road Design Manual. Table 4 also summarizes the sight distance requirements according to *A Policy on Geometric Design of Highways and Streets*, which is published by the American Association of State Highway and Transportation Officials (AASHTO).

Table 4
Sight Distance Requirements
(From Exhibits 9-55 and 9-58 in the 2004 AASHTO Green Book)

| Design Speed | Turn | VDOT Minimum Sight Distance | AASHTO Minimum Sight Distance | Actual Sight Distance |
|--------------------|-------|-----------------------------|-------------------------------|-----------------------|
| River Road: 40 mph | Left | 390 feet | 445 feet | 550 feet |
| | Right | 390 feet | 385 feet | 700 feet |

At the proposed driveway location on River Road, drivers exiting the site are able to see approximately 550 feet to the west, and 700 feet to the east, which exceeds both the VDOT Road Design Manual and the AASHTO minimum sight distance requirements in both directions.

Enclosed for reference are photos taken at the proposed driveway location looking in both directions.

Collision Data Analysis

Collision data was collected from the Virginia Department of Motor Vehicles (DMV) from January 1, 2013 to December 31, 2015 within 500 feet of the intersection of Spotswood Furnace Road at River Road. In the past three years, there have been only 5 reported collisions within 500 feet of the study intersection, with zero fatalities, and 3 collisions that resulted in an injury. The collision data does not indicate an unusual collision pattern that requires mitigation.

Recommendations

Both study intersections are projected to operate acceptably at build-out of the proposed neighborhood and no off-site roadway improvements are warranted or recommended.

We appreciate your attention to this matter. Please contact me at (804) 217-8560 if you have any questions about this report.

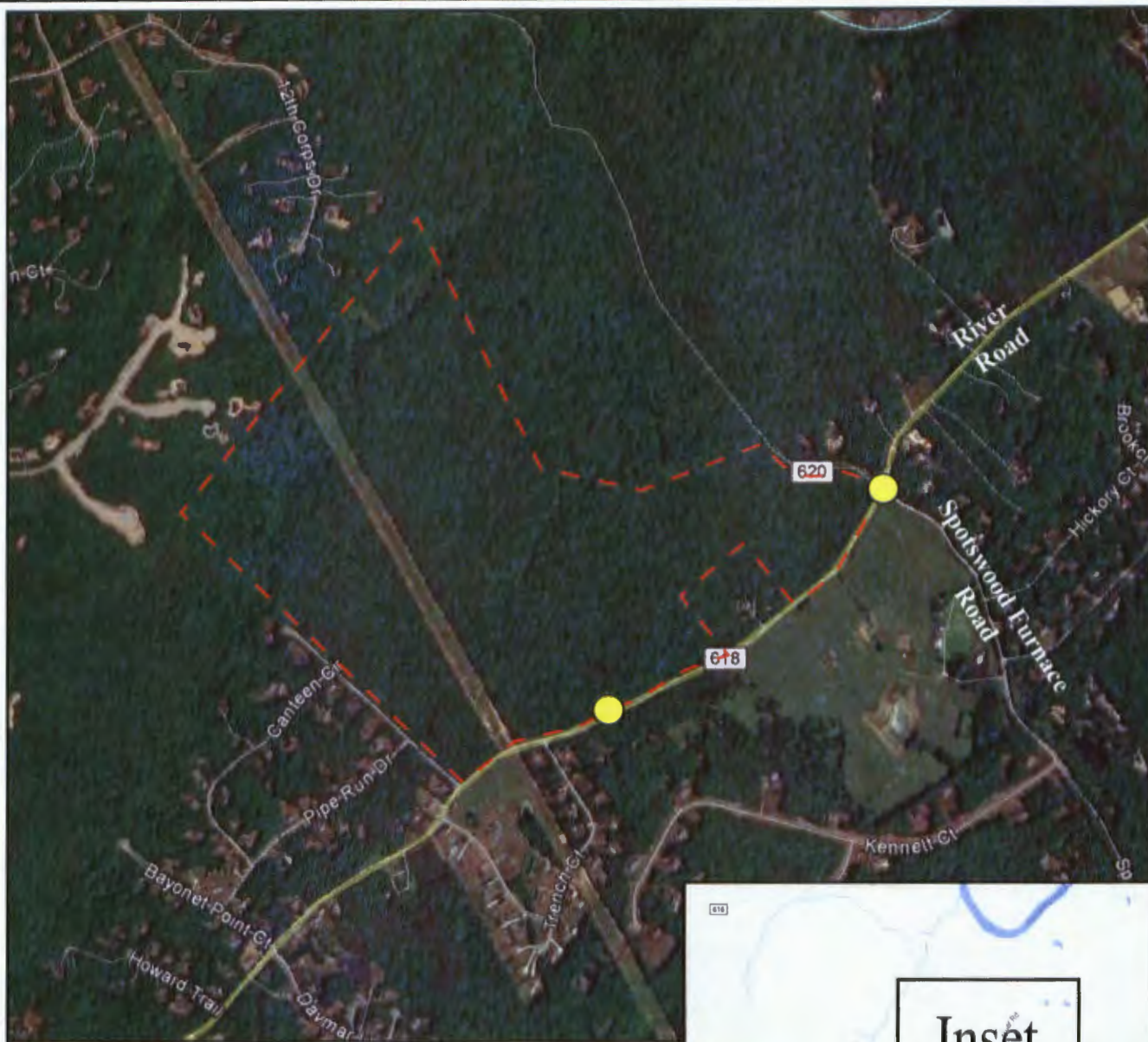
Sincerely yours,
Ramey Kemp & Associates, Inc.



Carl Hultgren, P.E., PTOE
Regional Manager

Enclosures: Figures, VDOT turn lane warrant diagrams, Sight distance photos, Collision data, Synchro output

Copy to: Mr. John Rayl
Mr. Justin Franklin, P.E., Fairbanks & Franklin



Inset

LEGEND



Study Intersection



Site Boundary



Overview



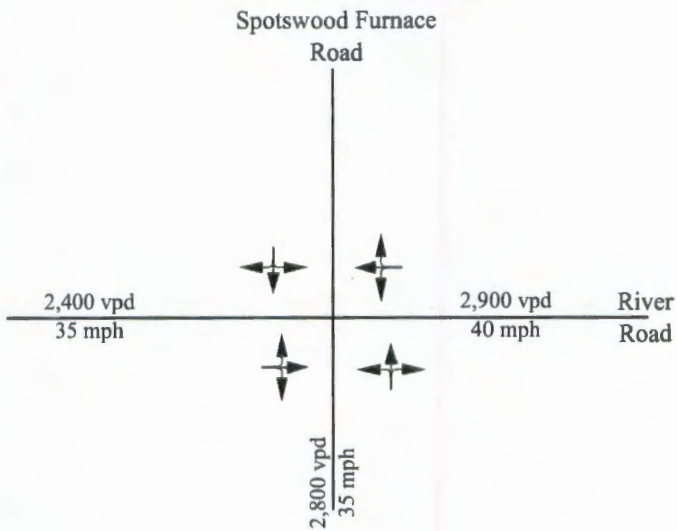
River Road Residential
Spotsylvania County, Virginia

Site Location and Study
Intersections

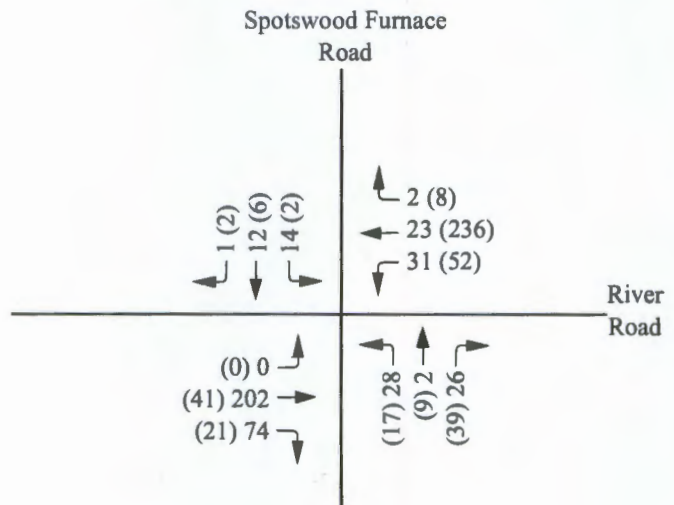
Scale: Not to Scale

Figure 1

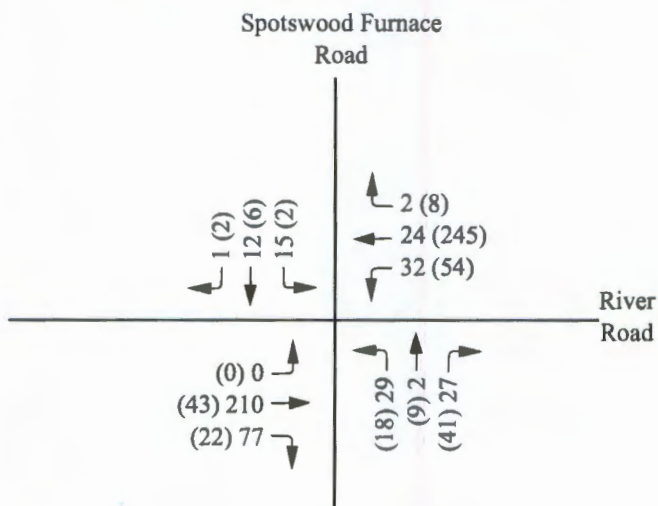
Existing Lane Configuration



Existing (2016) Traffic Volumes



No-Build (2018) Traffic Volumes



LEGEND

→ Existing Lane
X (Y) AM (PM) Peak Hour



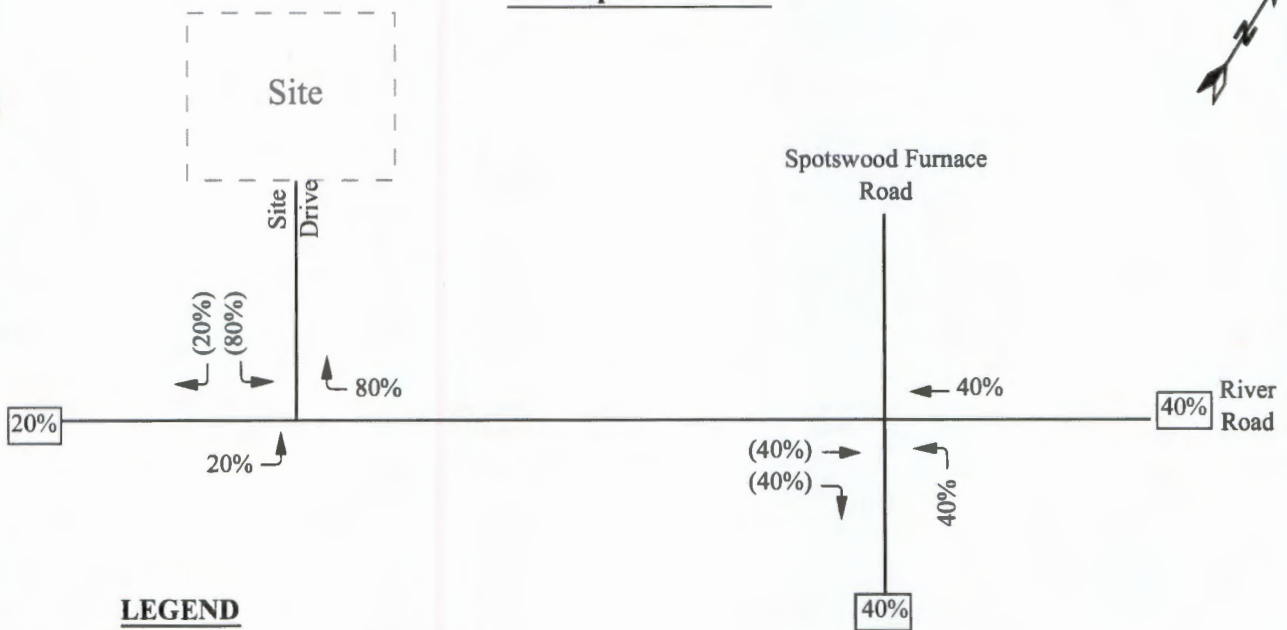
River Road Residential
Spotsylvania County, Virginia

Existing Lane Configuration,
Existing (2016) Traffic Volumes,
No-Build (2018) Traffic Volumes

Scale: Not to Scale

Figure 2

Site Trip Distribution



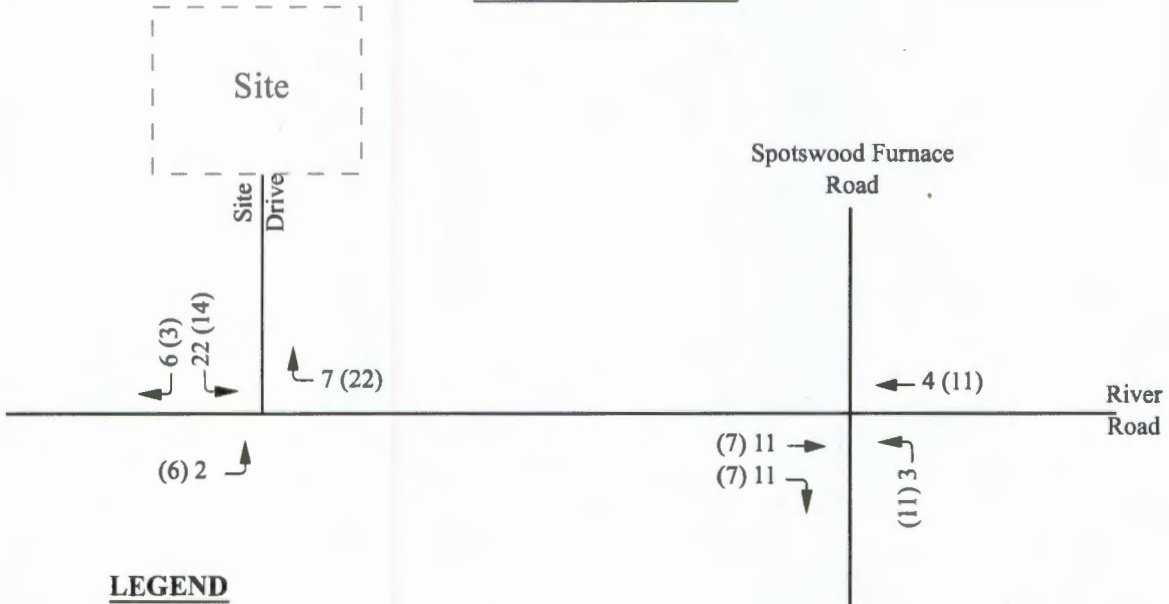
LEGEND

XX%

Regional Trip Distribution

X% (Y%) Entering (Exiting) Trip Distribution

Site Trip Assignment



LEGEND

X (Y) AM (PM) Peak Hour Traffic



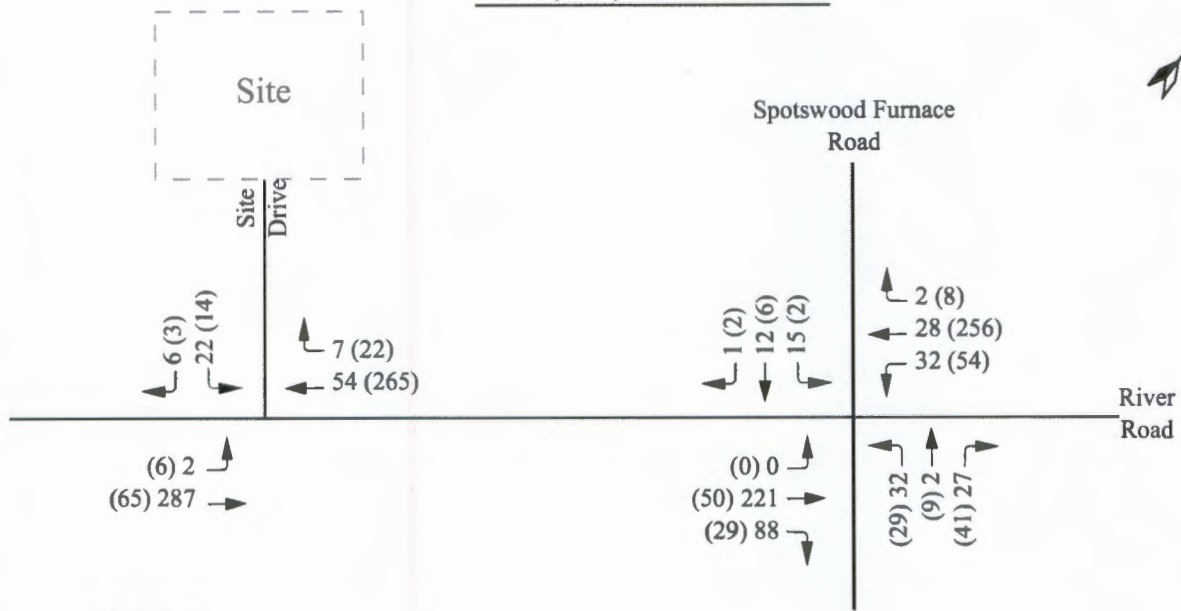
River Road Residential
Spotsylvania County, Virginia

Site Trip Distribution and
Assignment

Scale: Not to Scale

Figure 3

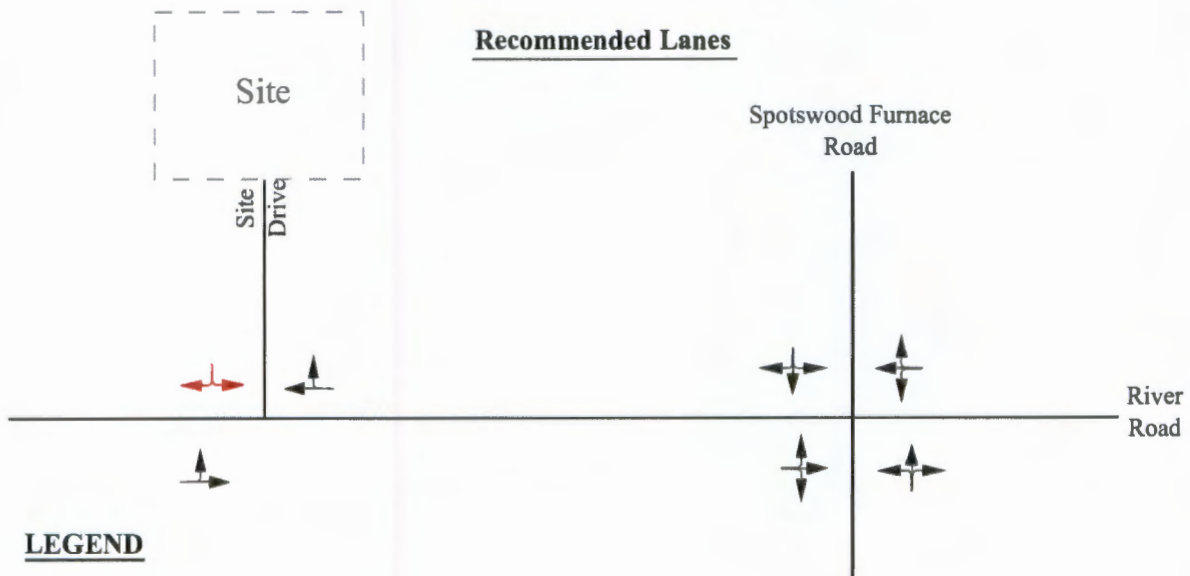
Build (2018) Traffic Volumes



LEGEND

X (Y) AM (PM) Peak Hour

Recommended Lanes



LEGEND

- Existing Lane
- Recommended Lane
- X' Storage (In Feet)



River Road Residential
Spotsylvania County, Virginia

Build (2018) Volumes and
Recommended Lanes

Scale: Not to Scale

Figure 4

Eastbound Left-turn lane on
River Road at Proposed Site Driveway

F-78

WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAY

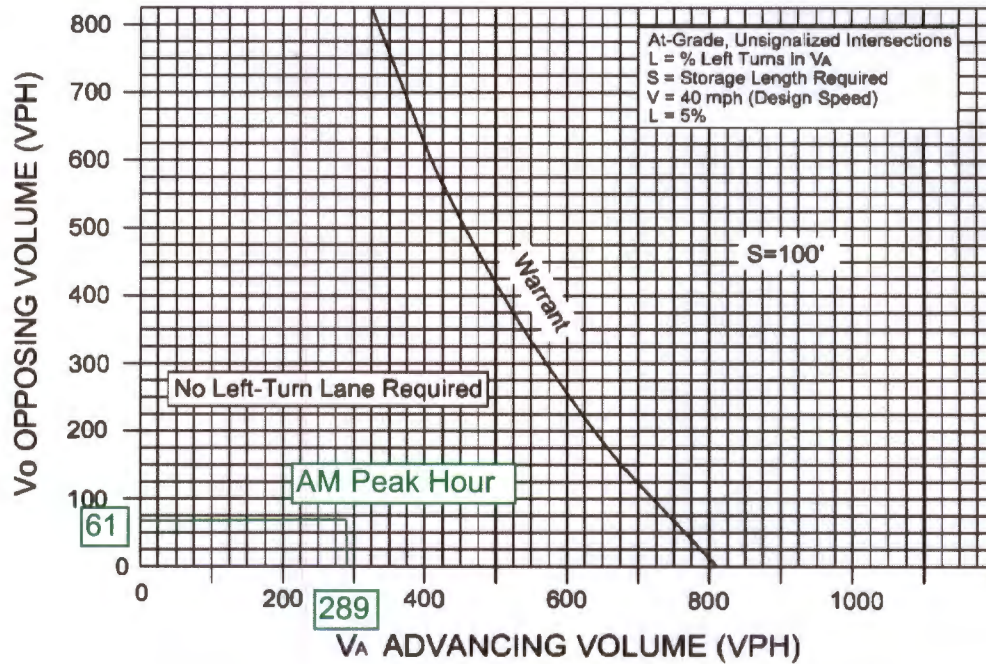


FIGURE 3-5

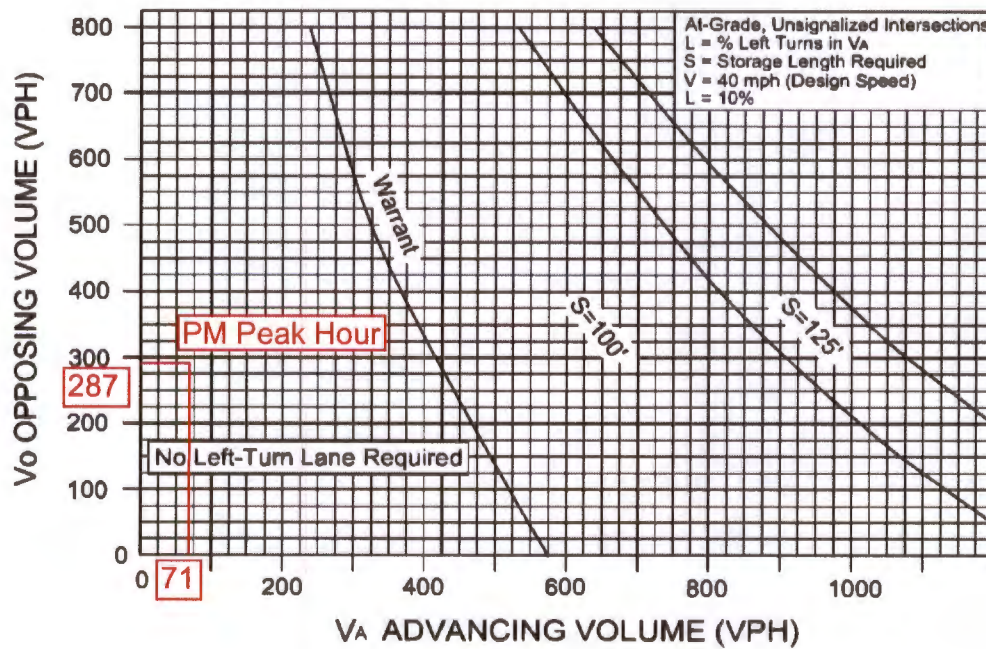
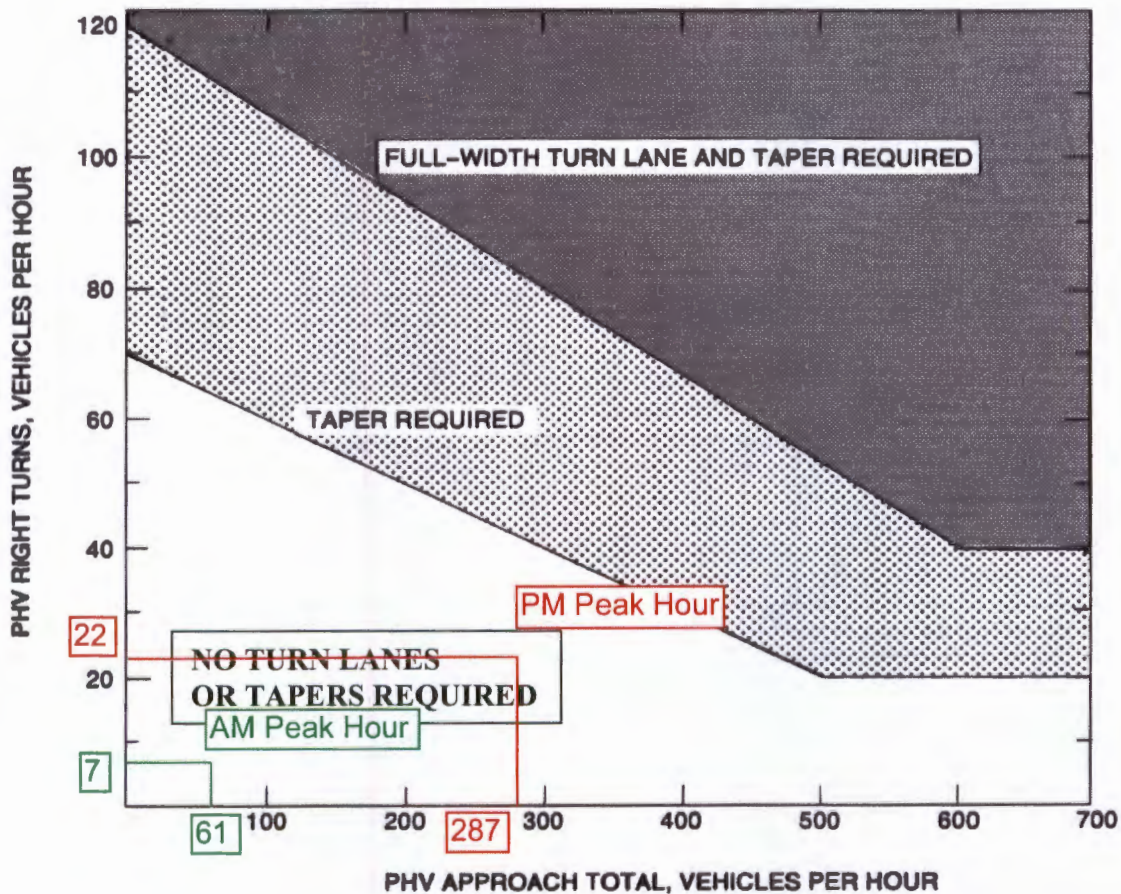


FIGURE 3-6



Appropriate Radius required at all Intersections and Entrances (Commercial or Private).

LEGEND

PHV - Peak Hour Volume (also Design Hourly Volume equivalent)

Adjustment for Right Turns

For posted speeds at or under 45 mph, PHV right turns > 40, and PHV total < 300.

Adjusted right turns = PHV Right Turns - 20

If PHV is not known use formula: $PHV = ADT \times K \times D$

K = the percent of AADT occurring in the peak hour

D = the percent of traffic in the peak direction of flow

Note: An average of 11% for K x D will suffice.

When right turn facilities are warranted, see Figure 3-1 for design criteria.*

FIGURE 3-26 WARRANTS FOR RIGHT TURN TREATMENT (2-LANE HIGHWAY)



Exhibit 1 – Looking west on River Road at proposed driveway location



Exhibit 2 – Looking east on River Road at proposed driveway location

2015 Crash Data

Select a Year: [2015](#) [2014](#) [2013](#)

☒ Fatal ☐ Injury ☐ Property Damage

[View Larger Map](#)



Click the map to identify a specific location, as you zoom in using your mouse-wheel, individual crash locations will become available.

Click a crash location indicator to see the crash summary.

To view injury and property damage crashes use the [View Larger Map](#) link and include the layers in the upper left hand control panel

2014 Crash Data

Select a Year: [2015](#) [2014](#) [2013](#)

☒ Fatal ☐ Injury ☐ Property Damage

[View Larger Map](#)



Click the map to identify a specific location, as you zoom in using your mouse-wheel, individual crash locations will become available.
Click a crash location indicator to see the crash summary.
To view injury and property damage crashes use the [View Larger Map](#) link and include the layers in the upper left hand control panel

2013 Crash Data

Select a Year: [2015](#) [2014](#) [2013](#)

☒ Fatal ☐ Injury ☐ Property Damage

[View Larger Map](#)



Click the map to identify a specific location, as you zoom in using your mouse-wheel, individual crash locations will become available.

Click a crash location indicator to see the crash summary.




To view injury and property damage crashes use the View Larger Map link and include the layers in the upper left hand control panel

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Existing 2016 Conditions
Timing Plan: AM Peak Hour

Intersection

Intersection Delay, s/veh 9.6
Intersection LOS A

| Movement | EBU | EBL | EBT | EBR | WBU | WBL | WBT | WBR | NBU | NBL | NBT | NBR |
|---------------------|------|------|---|------|------|------|---|------|------|------|---|------|
| Lane Configurations | | |  | | | |  | | | |  | |
| Traffic Vol, veh/h | 0 | 1 | 202 | 74 | 0 | 31 | 23 | 2 | 0 | 28 | 2 | 26 |
| Future Vol, veh/h | 0 | 1 | 202 | 74 | 0 | 31 | 23 | 2 | 0 | 28 | 2 | 26 |
| Peak Hour Factor | 0.92 | 0.74 | 0.74 | 0.74 | 0.92 | 0.74 | 0.74 | 0.74 | 0.92 | 0.74 | 0.74 | 0.74 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 1 | 273 | 100 | 0 | 42 | 31 | 3 | 0 | 38 | 3 | 35 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB |
|----------------------------|------|-----|-----|
| Opposing Approach | WB | EB | SB |
| Opposing Lanes | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB |
| Conflicting Lanes Left | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB |
| Conflicting Lanes Right | 1 | 1 | 1 |
| HCM Control Delay | 10.3 | 8.2 | 8.4 |
| HCM LOS | B | A | A |


| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|------------------------|-------|-------|-------|-------|
| Vol Left, % | 50% | 0% | 55% | 52% |
| Vol Thru, % | 4% | 73% | 41% | 44% |
| Vol Right, % | 46% | 27% | 4% | 4% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 56 | 277 | 56 | 27 |
| LT Vol | 28 | 1 | 31 | 14 |
| Through Vol | 2 | 202 | 23 | 12 |
| RT Vol | 26 | 74 | 2 | 1 |
| Lane Flow Rate | 76 | 374 | 76 | 36 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 0.101 | 0.43 | 0.098 | 0.052 |
| Departure Headway (Hd) | 4.788 | 4.14 | 4.682 | 5.102 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 748 | 872 | 766 | 702 |
| Service Time | 2.817 | 2.159 | 2.709 | 3.134 |
| HCM Lane V/C Ratio | 0.102 | 0.429 | 0.099 | 0.051 |
| HCM Control Delay | 8.4 | 10.3 | 8.2 | 8.4 |
| HCM Lane LOS | A | B | A | A |
| HCM 95th-tile Q | 0.3 | 2.2 | 0.3 | 0.2 |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Existing 2016 Conditions
Timing Plan: AM Peak Hour

Intersection

Intersection Delay, s/veh
Intersection LOS

| Movement | SBU | SBL | SBT | SBR |
|---------------------|------|------|---|------|
| Lane Configurations | | |  | |
| Traffic Vol, veh/h | 0 | 14 | 12 | 1 |
| Future Vol, veh/h | 0 | 14 | 12 | 1 |
| Peak Hour Factor | 0.92 | 0.74 | 0.74 | 0.74 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 19 | 16 | 1 |
| Number of Lanes | 0 | 0 | 1 | 0 |




| | |
|----------------------------|-----|
| Approach | SB |
| Opposing Approach | NB |
| Opposing Lanes | 1 |
| Conflicting Approach Left | WB |
| Conflicting Lanes Left | 1 |
| Conflicting Approach Right | EB |
| Conflicting Lanes Right | 1 |
| HCM Control Delay | 8.4 |
| HCM LOS | A |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Existing 2016 Conditions
Timing Plan: PM Peak Hour

Intersection

Intersection Delay, s/veh 9.2
Intersection LOS A

| Movement | EBU | EBL | EBT | EBR | WBU | WBL | WBT | WBR | NBU | NBL | NBT | NBR |
|---------------------|------|------|---|------|------|------|---|------|------|------|---|------|
| Lane Configurations | | |  | | | |  | | | |  | |
| Traffic Vol, veh/h | 0 | 1 | 41 | 21 | 0 | 52 | 236 | 8 | 0 | 17 | 9 | 39 |
| Future Vol, veh/h | 0 | 1 | 41 | 21 | 0 | 52 | 236 | 8 | 0 | 17 | 9 | 39 |
| Peak Hour Factor | 0.92 | 0.90 | 0.90 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 1 | 46 | 23 | 0 | 58 | 262 | 9 | 0 | 19 | 10 | 43 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB |
|----------------------------|-----|-----|----|
| Opposing Approach | WB | EB | SB |
| Opposing Lanes | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB |
| Conflicting Lanes Left | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB |
| Conflicting Lanes Right | 1 | 1 | 1 |
| HCM Control Delay | 7.7 | 9.8 | 8 |
| HCM LOS | A | A | A |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|------------------------|-------|-------|-------|-------|
| Vol Left, % | 26% | 2% | 18% | 20% |
| Vol Thru, % | 14% | 65% | 80% | 60% |
| Vol Right, % | 60% | 33% | 3% | 20% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 65 | 63 | 296 | 10 |
| LT Vol | 17 | 1 | 52 | 2 |
| Through Vol | 9 | 41 | 236 | 6 |
| RT Vol | 39 | 21 | 8 | 2 |
| Lane Flow Rate | 72 | 70 | 329 | 11 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 0.091 | 0.083 | 0.379 | 0.015 |
| Departure Headway (Hd) | 4.518 | 4.266 | 4.151 | 4.825 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 797 | 843 | 855 | 745 |
| Service Time | 2.524 | 2.277 | 2.233 | 2.834 |
| HCM Lane V/C Ratio | 0.09 | 0.083 | 0.385 | 0.015 |
| HCM Control Delay | 8 | 7.7 | 9.8 | 7.9 |
| HCM Lane LOS | A | A | A | A |
| HCM 95th-tile Q | 0.3 | 0.3 | 1.8 | 0 |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Existing 2016 Conditions
Timing Plan: PM Peak Hour

Intersection

Intersection Delay, s/veh

Intersection LOS




| Movement | SBU | SBL | SBT | SBR |
|----------------------------|------|------|------|------|
| Lane Configurations | | | + | |
| Traffic Vol, veh/h | 0 | 2 | 6 | 2 |
| Future Vol, veh/h | 0 | 2 | 6 | 2 |
| Peak Hour Factor | 0.92 | 0.90 | 0.90 | 0.90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 2 | 7 | 2 |
| Number of Lanes | 0 | 0 | 1 | 0 |
| Approach | SB | | | |
| Opposing Approach | NB | | | |
| Opposing Lanes | 1 | | | |
| Conflicting Approach Left | WB | | | |
| Conflicting Lanes Left | 1 | | | |
| Conflicting Approach Right | EB | | | |
| Conflicting Lanes Right | 1 | | | |
| HCM Control Delay | 7.9 | | | |
| HCM LOS | A | | | |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

No-Build 2018 Conditions
Timing Plan: AM Peak Hour

Intersection

Intersection Delay, s/veh 9.8
Intersection LOS A

| Movement | EBU | EBL | EBT | EBR | WBU | WBL | WBT | WBR | NBU | NBL | NBT | NBR |
|---------------------|------|------|---|------|------|------|---|------|------|------|---|------|
| Lane Configurations | | |  | | | |  | | | |  | |
| Traffic Vol, veh/h | 0 | 1 | 210 | 77 | 0 | 32 | 24 | 2 | 0 | 29 | 2 | 27 |
| Future Vol, veh/h | 0 | 1 | 210 | 77 | 0 | 32 | 24 | 2 | 0 | 29 | 2 | 27 |
| Peak Hour Factor | 0.92 | 0.74 | 0.74 | 0.74 | 0.92 | 0.74 | 0.74 | 0.74 | 0.92 | 0.74 | 0.74 | 0.74 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 1 | 284 | 104 | 0 | 43 | 32 | 3 | 0 | 39 | 3 | 36 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB |
|----------------------------|------|-----|-----|
| Opposing Approach | WB | EB | SB |
| Opposing Lanes | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB |
| Conflicting Lanes Left | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB |
| Conflicting Lanes Right | 1 | 1 | 1 |
| HCM Control Delay | 10.5 | 8.3 | 8.4 |
| HCM LOS | B | A | A |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|------------------------|-------|-------|-------|-------|
| Vol Left, % | 50% | 0% | 55% | 54% |
| Vol Thru, % | 3% | 73% | 41% | 43% |
| Vol Right, % | 47% | 27% | 3% | 4% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 58 | 288 | 58 | 28 |
| LT Vol | 29 | 1 | 32 | 15 |
| Through Vol | 2 | 210 | 24 | 12 |
| RT Vol | 27 | 77 | 2 | 1 |
| Lane Flow Rate | 78 | 389 | 78 | 38 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 0.105 | 0.449 | 0.103 | 0.054 |
| Departure Headway (Hd) | 4.83 | 4.156 | 4.712 | 5.152 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 741 | 868 | 761 | 694 |
| Service Time | 2.864 | 2.175 | 2.74 | 3.188 |
| HCM Lane V/C Ratio | 0.105 | 0.448 | 0.102 | 0.055 |
| HCM Control Delay | 8.4 | 10.5 | 8.3 | 8.5 |
| HCM Lane LOS | A | B | A | A |
| HCM 95th-ile Q | 0.4 | 2.4 | 0.3 | 0.2 |


River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

No-Build 2018 Conditions
Timing Plan: AM Peak Hour

Intersection

Intersection Delay, s/veh

Intersection LOS

| Movement | SBU | SBL | SBT | SBR |
|---------------------|------|------|---|------|
| Lane Configurations | | |  | |
| Traffic Vol, veh/h | 0 | 15 | 12 | 1 |
| Future Vol, veh/h | 0 | 15 | 12 | 1 |
| Peak Hour Factor | 0.92 | 0.74 | 0.74 | 0.74 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 20 | 16 | 1 |
| Number of Lanes | 0 | 0 | 1 | 0 |




| | |
|----------------------------|-----|
| Approach | SB |
| Opposing Approach | NB |
| Opposing Lanes | 1 |
| Conflicting Approach Left | WB |
| Conflicting Lanes Left | 1 |
| Conflicting Approach Right | EB |
| Conflicting Lanes Right | 1 |
| HCM Control Delay | 8.5 |
| HCM LOS | A |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

No-Build 2018 Conditions
Timing Plan: PM Peak Hour

Intersection

Intersection Delay, s/veh 9.3
Intersection LOS A

| Movement | EBU | EBL | EBT | EBR | WBU | WBL | WBT | WBR | NBU | NBL | NBT | NBR |
|---------------------|------|------|---|------|------|------|---|------|------|------|---|------|
| Lane Configurations | | |  | | | |  | | | |  | |
| Traffic Vol, veh/h | 0 | 1 | 43 | 22 | 0 | 54 | 245 | 8 | 0 | 18 | 9 | 41 |
| Future Vol, veh/h | 0 | 1 | 43 | 22 | 0 | 54 | 245 | 8 | 0 | 18 | 9 | 41 |
| Peak Hour Factor | 0.92 | 0.90 | 0.90 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 1 | 48 | 24 | 0 | 60 | 272 | 9 | 0 | 20 | 10 | 46 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB |
|----------------------------|-----|----|----|
| Opposing Approach | WB | EB | SB |
| Opposing Lanes | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB |
| Conflicting Lanes Left | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB |
| Conflicting Lanes Right | 1 | 1 | 1 |
| HCM Control Delay | 7.7 | 10 | 8 |
| HCM LOS | A | A | A |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|------------------------|-------|-------|-------|-------|
| Vol Left, % | 26% | 2% | 18% | 20% |
| Vol Thru, % | 13% | 65% | 80% | 60% |
| Vol Right, % | 60% | 33% | 3% | 20% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 68 | 66 | 307 | 10 |
| LT Vol | 18 | 1 | 54 | 2 |
| Through Vol | 9 | 43 | 245 | 6 |
| RT Vol | 41 | 22 | 8 | 2 |
| Lane Flow Rate | 76 | 73 | 341 | 11 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 0.096 | 0.087 | 0.394 | 0.015 |
| Departure Headway (Hd) | 4.554 | 4.288 | 4.16 | 4.867 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 791 | 838 | 853 | 738 |
| Service Time | 2.558 | 2.3 | 2.247 | 2.876 |
| HCM Lane V/C Ratio | 0.096 | 0.087 | 0.4 | 0.015 |
| HCM Control Delay | 8 | 7.7 | 10 | 8 |
| HCM Lane LOS | A | A | A | A |
| HCM 95th-tile Q | 0.3 | 0.3 | 1.9 | 0 |


River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

No-Build 2018 Conditions
Timing Plan: PM Peak Hour

Intersection

Intersection Delay, s/veh

Intersection LOS

| Movement | SBU | SBL | SBT | SBR |
|---------------------|------|------|---|------|
| Lane Configurations | | |  | |
| Traffic Vol, veh/h | 0 | 2 | 6 | 2 |
| Future Vol, veh/h | 0 | 2 | 6 | 2 |
| Peak Hour Factor | 0.92 | 0.90 | 0.90 | 0.90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 2 | 7 | 2 |
| Number of Lanes | 0 | 0 | 1 | 0 |

Approach




| | |
|----------------------------|----|
| | SB |
| Opposing Approach | NB |
| Opposing Lanes | 1 |
| Conflicting Approach Left | WB |
| Conflicting Lanes Left | 1 |
| Conflicting Approach Right | EB |
| Conflicting Lanes Right | 1 |
| HCM Control Delay | 8 |
| HCM LOS | A |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Build 2018 Conditions
Timing Plan: AM Peak Hour

Intersection

Intersection Delay, s/veh 10.3
Intersection LOS B

| Movement | EBU | EBL | EBT | EBR | WBU | WBL | WBT | WBR | NBU | NBL | NBT | NBR |
|---------------------|------|------|---|------|------|------|--|------|------|------|---|------|
| Lane Configurations | | |  | | | |  | | | |  | |
| Traffic Vol, veh/h | 0 | 1 | 221 | 88 | 0 | 32 | 28 | 2 | 0 | 32 | 2 | 27 |
| Future Vol, veh/h | 0 | 1 | 221 | 88 | 0 | 32 | 28 | 2 | 0 | 32 | 2 | 27 |
| Peak Hour Factor | 0.92 | 0.74 | 0.74 | 0.74 | 0.92 | 0.74 | 0.74 | 0.74 | 0.92 | 0.74 | 0.74 | 0.74 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 1 | 299 | 119 | 0 | 43 | 38 | 3 | 0 | 43 | 3 | 36 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB |
|----------------------------|------|-----|-----|
| Opposing Approach | WB | EB | SB |
| Opposing Lanes | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB |
| Conflicting Lanes Left | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB |
| Conflicting Lanes Right | 1 | 1 | 1 |
| HCM Control Delay | 11.1 | 8.4 | 8.6 |
| HCM LOS | B | A | A |


| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|------------------------|-------|-------|-------|-------|
| Vol Left, % | 52% | 0% | 52% | 54% |
| Vol Thru, % | 3% | 71% | 45% | 43% |
| Vol Right, % | 44% | 28% | 3% | 4% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 61 | 310 | 62 | 28 |
| LT Vol | 32 | 1 | 32 | 15 |
| Through Vol | 2 | 221 | 28 | 12 |
| RT Vol | 27 | 88 | 2 | 1 |
| Lane Flow Rate | 82 | 419 | 84 | 38 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 0.113 | 0.485 | 0.111 | 0.055 |
| Departure Headway (Hd) | 4.925 | 4.168 | 4.753 | 5.237 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 726 | 867 | 753 | 682 |
| Service Time | 2.966 | 2.19 | 2.786 | 3.281 |
| HCM Lane V/C Ratio | 0.113 | 0.483 | 0.112 | 0.056 |
| HCM Control Delay | 8.6 | 11.1 | 8.4 | 8.6 |
| HCM Lane LOS | A | B | A | A |
| HCM 95th-ile Q | 0.4 | 2.7 | 0.4 | 0.2 |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Build 2018 Conditions
Timing Plan: AM Peak Hour

Intersection

Intersection Delay, s/veh
Intersection LOS

| Movement | SBU | SBL | SBT | SBR |
|----------------------------|------|------|---|------|
| Lane Configurations | | |  | |
| Traffic Vol, veh/h | 0 | 15 | 12 | 1 |
| Future Vol, veh/h | 0 | 15 | 12 | 1 |
| Peak Hour Factor | 0.92 | 0.74 | 0.74 | 0.74 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 20 | 16 | 1 |
| Number of Lanes | 0 | 0 | 1 | 0 |
| Approach | SB | | | |
| Opposing Approach | NB | | | |
| Opposing Lanes | 1 | | | |
| Conflicting Approach Left | WB | | | |
| Conflicting Lanes Left | 1 | | | |
| Conflicting Approach Right | EB | | | |
| Conflicting Lanes Right | 1 | | | |
| HCM Control Delay | 8.6 | | | |
| HCM LOS | A | | | |

River Road Residential - Spotsylvania County, VA
2: River Road & Site Driveway

Build 2018 Conditions
Timing Plan: AM Peak Hour

Intersection

Int Delay, s/veh 0.9

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|--------------------------|------|------|------|------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↓ | |
| Traffic Vol, veh/h | 2 | 287 | 54 | 7 | 22 | 6 |
| Future Vol, veh/h | 2 | 287 | 54 | 7 | 22 | 6 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 2 | 312 | 59 | 8 | 24 | 7 |

| Major/Minor | Major1 | Major2 | Minor2 |
|----------------------|---------|--------|-------------|
| Conflicting Flow All | 66 0 | - 0 | 378 62 |
| Stage 1 | - - | - - | 62 - |
| Stage 2 | - - | - - | 316 - |
| Critical Hdwy | 4.12 - | - - | 6.42 6.22 |
| Critical Hdwy Stg 1 | - - | - - | 5.42 - |
| Critical Hdwy Stg 2 | - - | - - | 5.42 - |
| Follow-up Hdwy | 2.218 - | - - | 3.518 3.318 |
| Pot Cap-1 Maneuver | 1536 - | - - | 624 1003 |
| Stage 1 | - - | - - | 961 - |
| Stage 2 | - - | - - | 739 - |
| Platoon blocked, % | - - | - - | - - |
| Mov Cap-1 Maneuver | 1536 - | - - | 623 1003 |
| Mov Cap-2 Maneuver | - - | - - | 623 - |
| Stage 1 | - - | - - | 961 - |
| Stage 2 | - - | - - | 738 - |

| Approach | EB | WB | SB |
|----------------------|-----|----|------|
| HCM Control Delay, s | 0.1 | 0 | 10.6 |
| HCM LOS | | | B |




| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|-----------------------|-------|-----|-----|-----|-------|
| Capacity (veh/h) | 1536 | - | - | - | 678 |
| HCM Lane V/C Ratio | 0.001 | - | - | - | 0.045 |
| HCM Control Delay (s) | 7.3 | 0 | - | - | 10.6 |
| HCM Lane LOS | A | A | - | - | B |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0.1 |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Build 2018 Conditions
Timing Plan: PM Peak Hour

Intersection

Intersection Delay, s/veh 9.6
Intersection LOS A

| Movement | EBU | EBL | EBT | EBR | WBU | WBL | WBT | WBR | NBU | NBL | NBT | NBR |
|---------------------|------|------|---|------|------|------|---|------|------|------|---|------|
| Lane Configurations | | |  | | | |  | | | |  | |
| Traffic Vol, veh/h | 0 | 1 | 50 | 29 | 0 | 54 | 256 | 8 | 0 | 29 | 9 | 41 |
| Future Vol, veh/h | 0 | 1 | 50 | 29 | 0 | 54 | 256 | 8 | 0 | 29 | 9 | 41 |
| Peak Hour Factor | 0.92 | 0.90 | 0.90 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 | 0.92 | 0.90 | 0.90 | 0.90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 1 | 56 | 32 | 0 | 60 | 284 | 9 | 0 | 32 | 10 | 46 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB |
|----------------------------|-----|------|-----|
| Opposing Approach | WB | EB | SB |
| Opposing Lanes | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB |
| Conflicting Lanes Left | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB |
| Conflicting Lanes Right | 1 | 1 | 1 |
| HCM Control Delay | 7.9 | 10.4 | 8.3 |
| HCM LOS | A | B | A |


| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|------------------------|-------|-------|-------|-------|
| Vol Left, % | 37% | 1% | 17% | 20% |
| Vol Thru, % | 11% | 62% | 81% | 60% |
| Vol Right, % | 52% | 36% | 3% | 20% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 79 | 80 | 318 | 10 |
| LT Vol | 29 | 1 | 54 | 2 |
| Through Vol | 9 | 50 | 256 | 6 |
| RT Vol | 41 | 29 | 8 | 2 |
| Lane Flow Rate | 88 | 89 | 353 | 11 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 0.114 | 0.107 | 0.422 | 0.015 |
| Departure Headway (Hd) | 4.69 | 4.324 | 4.3 | 4.953 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 765 | 830 | 841 | 722 |
| Service Time | 2.716 | 2.345 | 2.3 | 2.985 |
| HCM Lane V/C Ratio | 0.115 | 0.107 | 0.42 | 0.015 |
| HCM Control Delay | 8.3 | 7.9 | 10.4 | 8.1 |
| HCM Lane LOS | A | A | B | A |
| HCM 95th-tile Q | 0.4 | 0.4 | 2.1 | 0 |

River Road Residential - Spotsylvania County, VA
1: Spotswood Furnace Road & River Road

Build 2018 Conditions
Timing Plan: PM Peak Hour

Intersection

Intersection Delay, s/veh
Intersection LOS

| Movement | SBU | SBL | SBT | SBR |
|----------------------------|------|------|---|------|
| Lane Configurations | | |  | |
| Traffic Vol, veh/h | 0 | 2 | 6 | 2 |
| Future Vol, veh/h | 0 | 2 | 6 | 2 |
| Peak Hour Factor | 0.92 | 0.90 | 0.90 | 0.90 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 2 | 7 | 2 |
| Number of Lanes | 0 | 0 | 1 | 0 |
| Approach | SB | | | |
| Opposing Approach | NB | | | |
| Opposing Lanes | 1 | | | |
| Conflicting Approach Left | WB | | | |
| Conflicting Lanes Left | 1 | | | |
| Conflicting Approach Right | EB | | | |
| Conflicting Lanes Right | 1 | | | |
| HCM Control Delay | 8.1 | | | |
| HCM LOS | A | | | |

River Road Residential - Spotsylvania County, VA
2: River Road & Site Driveway

Build 2018 Conditions
Timing Plan: PM Peak Hour

Intersection

Int Delay, s/veh 0.6

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|--------------------------|------|------|------|------|------|------|
| Lane Configurations | | ↑ | ↑ | | ↑ | |
| Traffic Vol, veh/h | 6 | 65 | 265 | 22 | 14 | 3 |
| Future Vol, veh/h | 6 | 65 | 265 | 22 | 14 | 3 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | - | - | - | - | 0 | - |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 7 | 71 | 288 | 24 | 15 | 3 |

| Major/Minor | Major1 | Major2 | Minor2 |
|----------------------|---------|--------|-------------|
| Conflicting Flow All | 312 0 | - 0 | 384 300 |
| Stage 1 | - - | - - | 300 - |
| Stage 2 | - - | - - | 84 - |
| Critical Hdwy | 4.12 - | - - | 6.42 6.22 |
| Critical Hdwy Stg 1 | - - | - - | 5.42 - |
| Critical Hdwy Stg 2 | - - | - - | 5.42 - |
| Follow-up Hdwy | 2.218 - | - - | 3.518 3.318 |
| Pot Cap-1 Maneuver | 1248 - | - - | 619 740 |
| Stage 1 | - - | - - | 752 - |
| Stage 2 | - - | - - | 939 - |
| Platoon blocked, % | - - | - - | - - |
| Mov Cap-1 Maneuver | 1248 - | - - | 615 740 |
| Mov Cap-2 Maneuver | - - | - - | 615 - |
| Stage 1 | - - | - - | 752 - |
| Stage 2 | - - | - - | 933 - |

| Approach | EB | WB | SB |
|----------------------|-----|----|------|
| HCM Control Delay, s | 0.7 | 0 | 10.8 |
| HCM LOS | | | B |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 |
|-----------------------|-------|-----|-----|-----|-------|
| Capacity (veh/h) | 1248 | - | - | - | 634 |
| HCM Lane V/C Ratio | 0.005 | - | - | - | 0.029 |
| HCM Control Delay (s) | 7.9 | 0 | - | - | 10.8 |
| HCM Lane LOS | A | A | - | - | B |
| HCM 95th %tile Q(veh) | 0 | - | - | - | 0.1 |