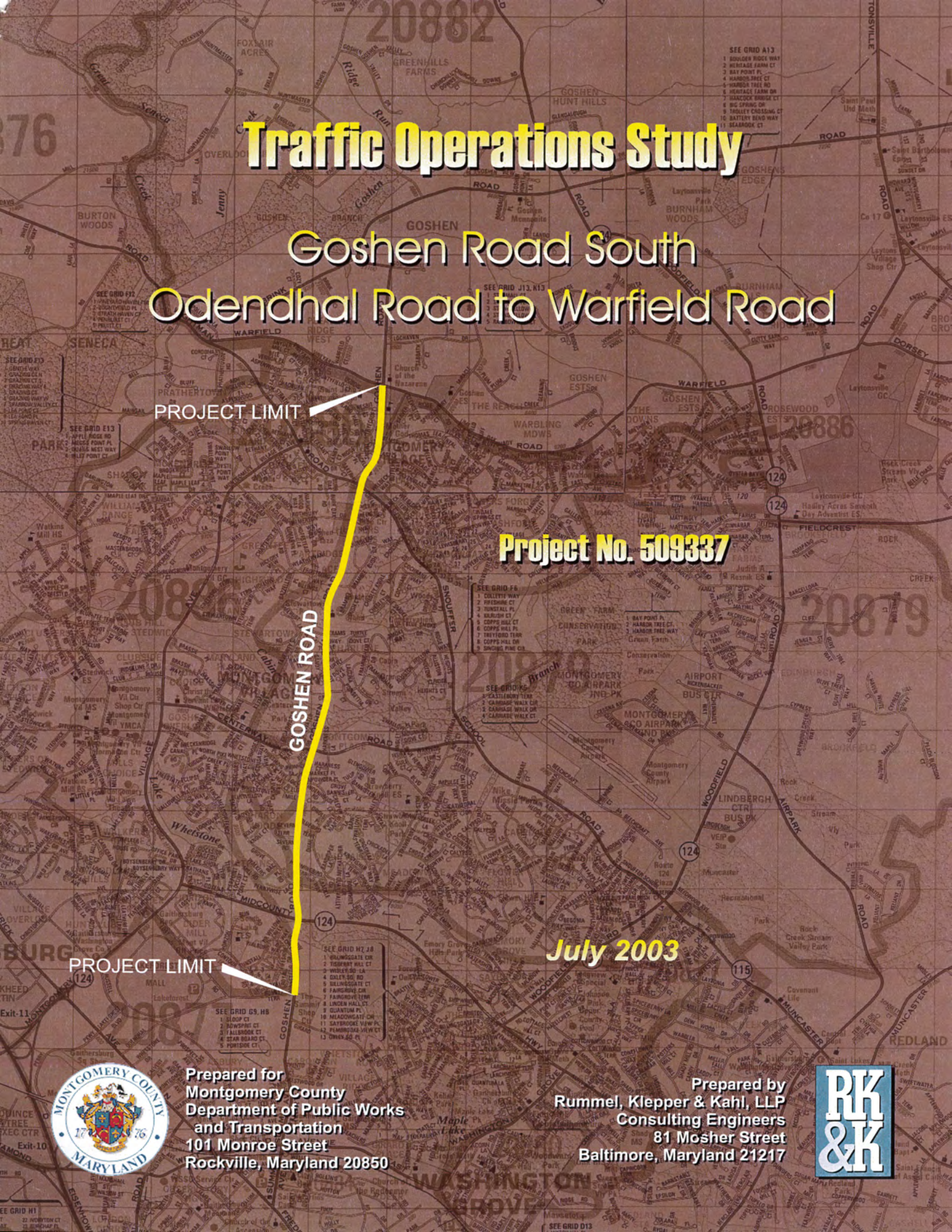
# Traffic Operations Study

## Goshen Road South
## Odendhal Road to Warfield Road




**Project No. 509337**

***July 2003***

**Prepared for**
**Montgomery County**
**Department of Public Works**
**and Transportation**
**101 Monroe Street**
**Rockville, Maryland 20850**

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# SUMMARY

**Description**

The purpose of this traffic study is to evaluate traffic operations related to the proposed widening of Goshen Road from Odendhal Avenue to Warfield Road in Montgomery County, Maryland. This study was requested by the Montgomery County Department of Public Works and Transportation (DPW&T). Data collected for use in this study includes existing (year 2002) vehicular turning movement volumes, mainline Goshen Road traffic volumes, vehicle classification data, 85$^{th}$ percentile non-peak hour speeds, existing intersection lane configurations, travel times, peak hour link speeds, and corridor-wide accident history for 1999 through 2001. Goshen Road travel forecasts for the 2015 and 2025 design years were provided by the Maryland-National Capital Park and Planning Commission (M-NCPPC).

The accident history of the Goshen Road corridor between Odendhal Avenue and Warfield Road during the most recent three year period for which data was available (January 1999 through December 2001) indicates that the rate of collisions that have occurred along Goshen Road during this period is approximately twice the statewide average rate for similar roadways. It is likely that the roadway improvements included in the improvement and widening alternatives will help to decrease accident rates on this portion of roadway. Such improvements include, leveling the vertical alignment and straightening horizontal curves to improve sight distances; the construction of a median and left turn lanes to provide a safe storage space for left turning vehicles; and the addition of bike lanes, sidewalks, crosswalks and lighting to increase pedestrians and cyclists safety.

This study includes evaluation of existing conditions and analyses of a no-build alternative and several build alternatives for the years 2015 and 2025. The build alternatives for Goshen Road include making spot capacity improvements to the existing two-lane roadway, or widening from the current two lanes to either a four lane or six lane roadway. This study includes capacity analyses of each of the 18 intersections along the Goshen Road corridor using traffic volumes for the existing year (2002) and design years 2015 and 2025. Intersection capacity analyses were conducted using the Critical Lane Method and Synchro software at signalized intersections, and the Highway Capacity Software v4.1b at unsignalized intersections (excluding the Six Lane alternatives). Table S-1 summarizes the results of the intersection capacity analyses for each alternative and design year in terms of Level of Service (LOS) and Control Delay in seconds per vehicle. Synchro was also used to perform arterial capacity analyses for the corridor.

**Existing Conditions (2002)**

The results of the intersection capacity analyses indicate that one signalized (Midcounty Highway) and nine unsignalized intersections operate at unacceptable conditions (CLV > 1,500) during either the AM or PM peak hours under existing conditions. The results of the arterial capacity analyses indicate that in general, travel times in the northbound direction are higher during the PM peak hour (approximately 9 minutes) and travel times in the southbound direction are slightly higher during the AM peak hour (approximately 8.5 minutes).

**2015**

The results of the intersection capacity analyses indicate that 16 of the 18 intersections are expected to have unacceptable operating conditions (CLV > 1,500) during either the AM or PM peak hours by 2015 if no widening or other intersection improvements are made. If spot capacity improvements were made by 2015 without providing additional lanes along the entire length of Goshen Road, 10 unsignalized intersections would still operate at unacceptable conditions. Possible left turn restrictions or signalization (if warranted) may be implemented at these intersections in the future to obtain acceptable levels of service. If Goshen Road were widened to four or six lanes by 2015, only three (3) of the currently unsignalized intersections would operate at unacceptable conditions.

The results of the arterial capacity analyses indicate that if no widening or intersection improvements occur by 2015, the travel times during the peak hours in the peak directions will increase by approximately 20-28 percent (~ 2 minutes) compared to existing conditions. The results indicate that the spot improvement alternative and both of the widening alternatives would improve these travel times. The travel times for the Four Lane and Six Lane alternatives would be shorter than existing conditions.

**2025**

If Goshen Road is not widened or otherwise improved by 2025, all 18 intersections are projected to have unacceptable operating conditions by that time. If spot capacity improvements are made by 2025 without providing additional lanes along the entire length of Goshen Road, 11 unsignalized intersections would still operate at unacceptable conditions. Possible left turn restrictions or signalization (if warranted) may be implemented at these intersections in the future to obtain acceptable levels of service. If Goshen Road were widened to four or six lanes by 2025, only three (3) of the currently unsignalized intersections would operate at unacceptable conditions.

The results of the arterial capacity analyses indicate that if no widening or intersection improvements occur by 2025, the travel times during the peak hours in the peak directions will increase by approximately 78 percent (~7 minutes) compared to existing conditions. The results indicate that the spot improvement alternative and both of the widening alternatives would improve these travel times. The travel times for the Four Lane and Six Lane alternatives would be shorter than existing conditions.

Traffic forecasts from M-NCPPC show that the volume along a four lane Goshen Road in 2025 will be higher if no other planned roadway improvements are built in the surrounding policy area. Year 2050 projections utilizing the master plan build-out roadway network show some traffic growth along the southern portion of Goshen Road, but not enough to warrant constructing six (6) continuous lanes.

Goshen Road Corridor Study
Montgomery County DPW&T

RK&K Engineers, LLP
July 2003

## Table S-1
## Alternatives Summary Table
## LOS, Control Delay (sec/veh) & CLV

| Goshen Road Intersections | | 2002 Existing | | | | | | 2015 No Build | | | | | | 2015 Two Lanes - Improved [4] | | | | | | 2015 Four Lanes [4] | | | | | | 2015 Six Lanes [4] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [5] | CLV [5] |
| **AM Peak** | Control | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Odendhal Avenue | | A 6 | A 7 | C 22 | - | A 10 | 888 | B 13 | A 7 | C 30 | - | B 12 | 1,145 | A 3 | A 4 | C 25 | - | A 7 | 1,075 | A 3 | A 2 | C 24 | - | A 6 | 880 | A 3 | A 2 | C 22 | - | A 7 | 900 |
| 2 Willow Creek Drive | | B 11 | - | D 34 | - | D 34 | 1,440 | E 45 | - | F >999 | - | F >999 | 3,000 [3] | F 52 | - | F 193 | - | F 193 | 3,000 [3] Possible R-in, R-out | B 12 | - | C 23 | - | C 23 | 1,270 | - | - | - | - | ★ | ★ |
| 3 Midcounty Highway (MD 124) | | C 20 | D 48 | F 208 | E 78 | F 109 | 1,504 | C 21 | F 114 | F 150 | E 80 | F 109 | 1,911 | C 21 | D 51 | E 60 | D 44 | D 49 | 1,345 | B 14 | D 49 | D 48 | D 45 | D 44 | 1,249 | B 18 | D 37 | E 63 | D 53 | D 47 | 1,195 |
| 4 Emory Grove Road | | B 14 | C 32 | C 20 | E 63 | D 36 | 1,264 | A 3 | F 95 | C 21 | F 131 | F 81 | 1,658 | A 9 | A 7 | C 23 | D 45 | B 15 | 1,035 | B 12 | A 5 | C 28 | D 44 | B 15 | 1,089 | B 13 | A 6 | C 23 | D 43 | B 15 | 895 |
| 5 Severn Road | | B 11 | - | D 28 | - | D 28 | 1,357 | B 14 | - | F 544 | - | F 544 | 3,000 [3] | B 14 | - | E 47 | - | E 47 | 1,567 Possible R-out | B 15 | - | D 30 | - | D 30 | 1,374 | - | - | - | - | ★ | ★ |
| 6 Lindenhouse Road | | - | A 8 | - | F 74 | F 74 | 1,839 | - | A 8 | - | F >999 | F >999 | 3,000 [3] | - | A 8 | - | F 874 | F 874 | 3,000 [3] Possible R-out | - | A 9 | - | C 15 | C 15 | 1,153 | - | - | - | - | ★ | ★ |
| 7 Centerway Road | | B 11 | C 30 | C 33 | D 43 | C 30 | 1,274 | A 7 | D 47 | E 64 | D 54 | D 44 | 1,645 | A 6 | B 13 | C 29 | D 39 | B 18 | 1,067 | B 12 | C 22 | C 31 | D 37 | C 24 | 1,225 | B 13 | C 24 | C 26 | C 33 | C 24 | 1,094 |
| 8 Rock Elm Way | | - | A 8 | - | D 26 | D 26 | 1,321 | - | A 8 | - | F 51 | F 51 | 1,808 | - | A 8 | - | C 23 | C 23 | 1,275 Possible R-in, R-out | - | A 9 | - | C 16 | C 16 | 1,168 | - | - | - | - | ★ | ★ |
| 9 Framingham Drive | | - | A 8 | - | E 42 | E 42 | 1,518 | - | A 8 | - | F 472 | F 472 | 3,000 [3] | - | A 8 | - | F 56 | F 56 | 1,858 Possible Signal | - | A 9 | - | C 24 | C 24 | 1,281 | - | - | - | - | ★ | ★ |
| 10 Turtle Dove Terrace / Sandy Lake Drive | | A 10 | A 8 | C 23 | D 33 | D 33 | 1,422 | B 12 | A 8 | F 64 | F 176 | F 176 | 2,564 | B 12 | A 8 | D 32 | E 41 | E 41 | 1,512 Possible R-out | B 12 | A 9 | C 23 | C 21 | C 23 | 1,263 | - | - | - | - | ★ | ★ |
| 11 Stewartown Road / Trams Way | | A 10 | A 8 | C 21 | D 31 | D 31 | 1,386 | B 12 | A 8 | F 103 | F 112 | F 112 | 2,217 | B 12 | A 8 | E 39 | E 40 | E 40 | 1,501 Possible signal | B 13 | A 9 | C 27 | C 25 | C 27 | 1,302 | - | - | - | - | ★ | ★ |
| 12 Bramble Bush Drive | | - | A 8 | - | C 23 | C 23 | 1,270 | - | A 8 | - | F 64 | F 64 | 1,740 | - | A 8 | - | D 26 | D 26 | 1,320 | - | A 9 | - | B 15 | B 15 | 1,138 | - | - | - | - | ★ | ★ |
| 13 Rothbury Drive / Green Run Way | | A 9 | A 8 | C 20 | C 18 | C 20 | 1,219 | B 12 | A 8 | F 155 | F 85 | F 155 | 2,648 | B 11 | A 8 | E 37 | F 377 | F 377 | 3,000 [3] Possible Signal | B 12 | A 8 | D 23 | C 20 | C 20 | 1,422 Possible Signal | - | - | - | - | ★ | ★ |
| 14 Goshen Crossing | | A 9 | - | C 18 | - | C 18 | 1,195 | B 12 | - | F 82 | - | F 82 | 1,924 | B 13 | - | D 31 | - | D 31 | 1,396 Possible R-in, R-out | B 12 | - | C 23 | - | C 23 | 1,266 Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 Snouffer School Road / Wigthman Road | | A 9 | B 14 | B 18 | C 27 | B 17 | 963 | B 16 | C 25 | B 15 | C 27 | C 21 | 1,413 | B 16 | C 27 | D 42 | C 34 | C 31 | 1,100 | B 17 | C 27 | D 44 | C 31 | C 31 | 1,393 | C 28 | C 27 | D 36 | C 24 | C 29 | 1,200 |
| 16 East Village Avenue | | A 4 | A 8 | - | B 17 | A 9 | 854 | A 4 | B 11 | - | C 20 | B 10 | 1,173 | A 8 | A 8 | - | C 20 | B 11 | 1,075 | A 7 | A 4 | - | B 15 | A 8 | 805 | A 7 | A 9 | - | B 14 | A 9 | 672 |
| 17 Mother of God School | | A 9 | A 8 | B 12 | F 164 | F 164 | 2,738 | A 9 | A 9 | B 15 | F >999 | F >999 | 3,000 [3] | A 9 | A 9 | B 15 | F 434 | F 434 | 3,000 [3] Possible R-out | B 10 | A 10 | B 12 | F 193 | F 193 | 3000 [3] Possible R-out | - | - | - | - | ★ | ★ |
| 18 Warfield Road | | C 16 | D 26 | B 12 | B 14 | C 19 | 1,212 | E 49 | F 205 | B 14 | C 17 | F 117 | 2,270 | E 48 | F 205 | B 14 | C 17 | F 117 | 2,270 Possible Signal | A 5 | B 13 | D 45 | D 39 | B 18 | 833 Signalized | A 3 | B 13 | D 44 | D 39 | B 17 | 743 Signalized |
| **PM Peak** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Odendhal Avenue | | D 40 | B 20 | D 49 | - | D 36 | 1,449 | E 70 | C 21 | F 86 | - | E 59 | 1,700 | C 28 | C 21 | C 33 | - | C 27 | 1,384 | B 16 | C 21 | D 36 | - | C 24 | 1,322 | B 18 | C 23 | D 36 | - | C 25 | 1,327 |
| 2 Willow Creek Drive | | B 11 | - | F 158 | - | F 158 | 2,682 | B 11 | - | F 525 | - | F 525 | 3,000 [3] | B 11 | - | E 45 | - | E 45 | 1,552 Possible R-in, R-out | B 12 | - | D 30 | - | D 30 | 1,375 | - | - | - | - | ★ | ★ |
| 3 Midcounty Highway (MD 124) | | F 110 | D 38 | E 67 | E 98 | F 83 | 1,604 | F 94 | D 46 | F 88 | F 115 | F 91 | 1,830 | C 24 | C 28 | D 45 | D 41 | D 35 | 1,366 | C 25 | C 32 | D 38 | D 45 | D 35 | 1,481 | D 45 | C 26 | D 53 | E 65 | D 50 | 1,419 |
| 4 Emory Grove Road | | A 6 | A 7 | C 30 | D 44 | B 12 | 1,244 | D 54 | A 3 | C 30 | D 52 | D 38 | 1,834 | A 5 | A 6 | C 29 | D 43 | A 10 | 1,179 | A 8 | A 5 | C 33 | D 42 | B 11 | 1,111 | A 5 | A 5 | C 33 | D 38 | A 9 | 918 |
| 5 Severn Road | | A 9 | - | F 53 | - | F 53 | 1,632 | A 9 | - | F 146 | - | F 146 | 2,560 | A 9 | - | D 25 | - | D 25 | 1,302 Possible R-out | A 10 | - | E 38 | - | E 38 | 1,480 | - | - | - | - | ★ | ★ |
| 6 Lindenhouse Road | | - | B 10 | - | D 31 | D 31 | 1,402 | - | B 13 | - | F 95 | F 95 | 2,046 | - | B 13 | - | D 29 | D 29 | 1,362 Possible R-out | - | B 15 | - | D 27 | D 27 | 1,335 | - | - | - | - | ★ | ★ |
| 7 Centerway Road | | B 14 | D 39 | C 30 | C 30 | C 26 | 1,256 | C 29 | E 75 | D 52 | D 41 | D 45 | 1,603 | A 6 | B 11 | C 31 | D 36 | B 16 | 1,063 | B 17 | B 16 | D 45 | D 43 | C 27 | 1,312 | C 21 | C 24 | D 36 | D 39 | C 27 | 1,190 |
| 8 Rock Elm Way | | - | A 10 | - | C 23 | C 23 | 1,275 | - | B 12 | - | E 45 | E 45 | 1,545 | - | C 15 | - | D 29 | D 29 | 1,357 Possible R-in, R-out | - | B 12 | - | C 18 | C 18 | 1,189 | - | - | - | - | ★ | ★ |
| 9 Framingham Drive | | - | B 10 | - | E 41 | E 41 | 1,505 | - | B 13 | - | F 193 | F 193 | 3,000 [3] | - | B 13 | - | D 31 | D 31 | 1,384 Possible Signal | - | C 15 | - | D 35 | D 35 | 1,443 | - | - | - | - | ★ | ★ |
| 10 Turtle Dove Terrace / Sandy Lake Drive | | A 9 | A 10 | D 33 | E 43 | E 43 | 1,531 | A 9 | B 12 | F 131 | F 218 | F 218 | 3,000 [3] | A 9 | B 12 | D 31 | E 40 | E 40 | 1,500 Possible R-out | A 10 | B 14 | C 22 | E 38 | E 38 | 1,483 | - | - | - | - | ★ | ★ |
| 11 Stewartown Road / Trams Way | | A 9 | A 9 | C 20 | D 35 | D 35 | 1,443 | A 9 | B 11 | F 75 | F 85 | F 85 | 1,945 | A 9 | B 11 | C 23 | D 31 | D 31 | 1,389 Possible Signal | A 9 | B 12 | C 18 | E 40 | E 40 | 1,496 | - | - | - | - | ★ | ★ |
| 12 Bramble Bush Drive | | - | A 9 | - | D 30 | D 30 | 1,377 | - | B 11 | - | F 98 | F 98 | 2,080 | - | B 11 | - | D 29 | D 29 | 1,354 | - | B 13 | - | D 26 | D 26 | 1,315 | - | - | - | - | ★ | ★ |
| 13 Rothbury Drive / Green Run Way | | A 9 | A 9 | F 255 | E 38 | F 255 | 3,000 [3] | B 10 | B 10 | F >999 | F 462 | F >999 | 3,000 [3] | B 10 | B 10 | F 191 | F 53 | F 191 | 3,000 [3] Possible Signal | B 11 | B 11 | F 575 | F 55 | F 575 | 3,000 [3] Possible Signal | - | - | - | - | ★ | ★ |
| 14 Goshen Crossing | | B 10 | - | F 459 | - | F 459 | 3,000 [3] | B 12 | - | F >999 | - | F >999 | 3,000 [3] | B 12 | - | F 954 | - | F 954 | 3,000 [3] Possible R-in, R-out | B 13 | - | F 761 | - | F 761 | 3,000 [3] Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 Snouffer School Road / Wigthman Road | | B 19 | B 16 | D 51 | E 75 | D 43 | 1,333 | D 39 | D 45 | F 99 | F 83 | E 67 | 1,386 | D 54 | D 40 | D 47 | D 43 | D 47 | 1,253 | D 39 | C 25 | D 46 | D 39 | D 39 | 1,424 | D 50 | C 34 | D 51 | D 48 | D 48 | 1,466 |
| 16 East Village Avenue | | A 5 | A 5 | - | B 18 | A 6 | 936 | A 9 | A 9 | - | C 31 | B 11 | 1,325 | A 7 | A 7 | - | D 38 | B 10 | 1,113 | A 7 | A 3 | - | B 19 | A 8 | 984 | B 14 | A 7 | - | B 16 | B 13 | 1,030 |
| 17 Mother of God School | | A 8 | A 9 | B 11 | C 19 | C 19 | 1,203 | A 8 | B 11 | C 20 | D 33 | D 33 | 1,417 | A 8 | B 11 | B 15 | C 23 | C 23 | 1,272 Possible R-out | A 8 | B 12 | B 15 | C 21 | C 21 | 1,245 Possible R-out | - | - | - | - | ★ | ★ |
| 18 Warfield Road | | F 164 | B 13 | B 13 | B 14 | F 104 | 2,140 | F 697 | D 32 | C 20 | C 23 | F 424 | 3,000 [3] | F 697 | D 32 | C 20 | C 23 | F 424 | 3,000 [3] Possible Signal | A 8 | C 23 | D 46 | C 31 | B 18 | 1,066 Signalized | A 6 | B 15 | D 44 | C 30 | B 15 | 909 Signalized |

| Goshen Road Intersections | | 2025 No Build | | | | | | 2025 Two Lanes - Improved [4] | | | | | | 2025 Four Lanes [4] | | | | | | 2025 Six Lanes [5] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [6] | CLV [6] |
| **AM Peak** | Control | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Odendhal Avenue | | A 8 | A 9 | C 26 | - | B 11 | 1,170 | A 3 | A 6 | C 27 | - | A 8 | 1,100 | A 3 | A 2 | C 28 | - | A 6 | 900 | A 3 | A 3 | C 22 | - | A 7 | 895 |
| 2 Willow Creek Drive | | F >999 | - | F >999 | - | F >999 | 3,000 [3] | E 37 | - | F 159 | - | F 159 | 2,592 Possible R-in, R-out | B 11 | - | C 17 | - | C 17 | 1,173 | - | - | - | - | ★ | ★ |
| 3 Midcounty Highway (MD 124) | | B 14 | F 110 | F 140 | E 65 | F 98 | 1,953 | C 22 | D 52 | E 66 | D 47 | D 51 | 1,355 | B 12 | D 36 | D 48 | D 47 | D 38 | 1,305 | B 18 | D 37 | D 50 | D 50 | D 41 | 1,141 |
| 4 Emory Grove Road | | A 9 | F 108 | C 25 | F 128 | F 86 | 1,725 | B 16 | A 6 | C 25 | D 45 | B 15 | 1,070 | B 11 | A 5 | C 26 | D 45 | B 14 | 1,084 | A 3 | A 5 | C 22 | D 43 | B 12 | 887 |
| 5 Severn Road | | B 14 | - | F 136 | - | F 136 | 2,458 | B 14 | - | E 43 | - | E 43 | 1,525 Possible R-out | B 15 | - | D 30 | - | D 30 | 1,378 | - | - | - | - | ★ | ★ |
| 6 Lindenhouse Road | | A 9 | - | - | F >999 | F >999 | 3,000 [3] | - | A 9 | - | F >999 | F >999 | 3,000 [3] Possible R-out | - | A 9 | - | C 15 | C 15 | 1,152 | - | - | - | - | ★ | ★ |
| 7 Centerway Road | | A 9 | E 75 | E 74 | E 59 | E 59 | 1,770 | A 8 | B 17 | C 27 | D 38 | C 20 | 1,167 | B 12 | C 23 | C 31 | D 37 | C 25 | 1,243 | B 13 | C 24 | C 26 | C 33 | C 24 | 1,120 |
| 8 Rock Elm Way | | - | F 285 | - | F >999 | F >999 | 3,000 [3] | - | F 285 | - | B 13 | F 285 | 3,000 [3] Possible R-in, R-out | - | A 9 | - | C 16 | C 16 | 1,168 | - | - | - | - | ★ | ★ |
| 9 Framingham Drive | | - | A 9 | - | F 795 | F 795 | 3,000 [3] | - | A 9 | - | F 75 | F 75 | 1,869 Possible Signal | - | A 9 | - | C 24 | C 24 | 1,281 | - | - | - | - | ★ | ★ |
| 10 Turtle Dove Terrace / Sandy Lake Drive | | B 12 | A 9 | F 117 | F 404 | F 404 | 3,000 [3] | B 12 | A 9 | D 32 | E 44 | E 44 | 1,642 Possible R-out | B 12 | A 9 | C 23 | C 21 | C 23 | 1,263 | - | - | - | - | ★ | ★ |
| 11 Stewartown Road / Trams Way | | B 12 | A 9 | F 205 | F 245 | F 245 | 3,000 [3] | B 12 | A 9 | D 34 | F 51 | F 51 | 1,814 Possible Signal | B 13 | A 9 | D 27 | D 25 | D 27 | 1,323 | - | - | - | - | ★ | ★ |
| 12 Bramble Bush Drive | | - | A 9 | - | F 104 | F 104 | 2,143 | - | A 9 | - | E 40 | E 40 | 1,496 | - | A 9 | - | C 16 | C 16 | 1,158 | - | - | - | - | ★ | ★ |
| 13 Rothbury Drive / Green Run Way | | B 12 | A 9 | F 271 | F 119 | F 271 | 3,000 [3] | B 12 | A 8 | E 44 | F >999 | F >999 | 3,000 [3] Possible Signal | B 12 | A 8 | D 33 | C 20 | D 33 | 1,425 Possible Signal | - | - | - | - | ★ | ★ |
| 14 Goshen Crossing | | B 12 | - | F 167 | - | F 167 | 2,770 | B 14 | - | C 25 | - | C 25 | 1,294 Possible R-in, R-out | B 12 | - | C 20 | - | C 20 | 1,230 Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 Snouffer School Road / Wigthman Road | | B 16 | B 19 | C 28 | F 83 | C 32 | 1,543 | B 16 | C 28 | D 46 | C 32 | C 32 | 1,197 | B 18 | C 26 | D 44 | C 31 | C 31 | 1,390 | B 15 | C 27 | D 36 | C 24 | C 27 | 1,169 |
| 16 East Village Avenue | | A 3 | B 15 | - | C 31 | B 14 | 1,363 | A 4 | B 11 | - | C 34 | B 13 | 1,230 | A 7 | A 8 | - | B 15 | A 8 | 802 | B 12 | A 5 | - | B 14 | A 9 | 658 |
| 17 Mother of God School | | A 3 | B 10 | C 17 | F >999 | F >999 | 3,000 [3] | B 10 | A 10 | C 17 | F 415 | F 415 | 3,000 [3] Possible R-out | B 10 | A 10 | B 12 | F 193 | F 193 | 3,000 [3] Possible R-out | - | - | - | - | ★ | ★ |
| 18 Warfield Road | | F 183 | F 512 | C 21 | D 33 | F 295 | 3,000 [3] | F 183 | F 512 | C 21 | D 33 | F 295 | 3,000 [3] Possible Signal | A 4 | B 17 | D 45 | D 38 | B 19 | 835 Signalized | B 10 | B 16 | D 43 | D 39 | C 21 | 719 Signalized |
| **PM Peak** | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Odendhal Avenue | | F 121 | D 50 | F 89 | - | F 88 | 1,805 | C 30 | C 24 | D 37 | - | C 30 | 1,447 | B 13 | B 19 | C 34 | - | C 21 | 1,245 | C 31 | B 14 | C 35 | - | C 26 | 1,315 |
| 2 Willow Creek Drive | | B 12 | - | F >999 | - | F >999 | 3,000 [3] | B 12 | - | F 58 | - | F 58 | 1,681 Possible R-in, R-out | B 11 | - | D 26 | - | D 26 | 1,311 | - | - | - | - | ★ | ★ |
| 3 Midcounty Highway (MD 124) | | F 90 | C 32 | F 90 | F 116 | F 87 | 1,903 | C 23 | C 30 | D 48 | D 43 | D 35 | 1,415 | C 22 | C 32 | C 34 | D 41 | C 32 | 1,380 | C 27 | C 26 | D 35 | D 48 | C 35 | 1,371 |
| 4 Emory Grove Road | | E 79 | A 6 | C 30 | F 131 | E 63 | 1,822 | B 10 | B 11 | C 30 | E 55 | B 15 | 1,278 | A 7 | A 4 | C 30 | D 44 | A 10 | 1,087 | A 10 | A 5 | C 32 | D 40 | B 12 | 900 |
| 5 Severn Road | | A 10 | - | F 86 | - | F 86 | 1,956 | A 10 | - | C 24 | - | C 24 | 1,281 Possible R-out | A 10 | - | C 26 | - | C 26 | 1,309 | - | - | - | - | ★ | ★ |
| 6 Lindenhouse Road | | - | B 14 | - | F 158 | F 158 | 2,680 | - | B 14 | - | D 34 | D 34 | 1,438 Possible R-out | - | B 14 | - | D 27 | D 27 | 1,333 | - | - | - | - | ★ | ★ |
| 7 Centerway Road | | F 114 | F 116 | D 55 | C 32 | F 91 | 1,860 | B 13 | B 17 | C 32 | C 32 | B 20 | 1,244 | B 16 | B 19 | D 45 | D 42 | C 27 | 1,333 | C 21 | C 27 | D 39 | D 39 | C 29 | 1,215 |
| 8 Rock Elm Way | | - | B 13 | - | F 63 | F 63 | 1,729 | - | B 13 | - | D 30 | D 30 | 1,375 Possible R-in, R-out | - | B 11 | - | C 16 | C 16 | 1,159 | - | - | - | - | ★ | ★ |
| 9 Framingham Drive | | - | B 15 | - | F 519 | F 519 | 3,000 [3] | - | B 15 | - | E 43 | E 43 | 1,527 Possible Signal | - | C 15 | - | D 35 | D 35 | 1,447 | - | - | - | - | ★ | ★ |
| 10 Turtle Dove Terrace / Sandy Lake Drive | | A 10 | B 13 | F 515 | F 479 | F 515 | 3,000 [3] | A 10 | B 13 | E 50 | E 46 | E 50 | 1,596 Possible R-out | A 10 | B 14 | C 22 | E 39 | E 39 | 1,487 | - | - | - | - | ★ | ★ |
| 11 Stewartown Road / Trams Way | | A 9 | B 12 | F 260 | F 140 | F 260 | 3,000 [3] | A 9 | B 12 | D 27 | E 37 | E 37 | 1,473 Possible Signal | A 9 | B 12 | C 18 | E 40 | E 40 | 1,496 | - | - | - | - | ★ | ★ |
| 12 Bramble Bush Drive | | - | B 12 | - | F 237 | F 237 | 3,000 [3] | - | B 12 | - | E 38 | E 38 | 1,482 | - | B 13 | - | D 26 | D 26 | 1,317 | - | - | - | - | ★ | ★ |
| 13 Rothbury Drive / Green Run Way | | B 10 | B 11 | F >999 | F >999 | F >999 | 3,000 [3] | B 10 | B 11 | F >999 | F >999 | F >999 | 3,000 [3] Possible Signal | B 11 | B 12 | F 575 | F 55 | F 575 | 3,000 [3] Possible Signal | - | - | - | - | ★ | ★ |
| 14 Goshen Crossing | | B 13 | - | F >999 | - | F >999 | 3,000 [3] | B 13 | - | F >999 | - | F >999 | 3,000 [3] Possible R-in, R-out | B 13 | - | F 448 | - | F 448 | 3,000 [3] Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 Snouffer School Road / Wigthman Road | | F 91 | D 55 | F 130 | F 99 | F 97 | 2,015 | D 40 | C 29 | D 51 | D 47 | D 43 | 1,418 | D 39 | C 27 | D 46 | D 39 | D 39 | 1,436 | D 39 | C 26 | D 46 | D 39 | D 39 | 1,435 |
| 16 East Village Avenue | | E 61 | F 287 | - | B 18 | F 102 | 1,545 | A 9 | A 7 | - | D 38 | B 12 | 1,251 | A 7 | A 3 | - | B 17 | A 7 | 990 | B 13 | A 9 | - | B 16 | B 13 | 1,002 |
| 17 Mother of God School | | A 8 | B 12 | C 23 | F 53 | F 53 | 1,631 | A 8 | B 12 | C 15 | D 28 | D 28 | 1,342 Possible R-out | A 8 | B 12 | B 15 | C 21 | C 21 | 1,245 Possible R-out | - | - | - | - | ★ | ★ |
| 18 Warfield Road | | F >999 | F 88 | D 34 | E 41 | F 705 | 3,000 [3] | F >999 | F 88 | D 34 | E 41 | F 705 | 3,000 [3] Possible Signal | A 9 | C 23 | D 46 | C 31 | B 18 | 1,069 Signalized | A 7 | B 14 | D 44 | C 32 | B 15 | 879 Signalized |

NOTE: LOS & delay at signalized intersections are from Synchro version 5
LOS & delay at unsignalized intersections are from HCS 2000 version 4.1b

[1] Operations for worst minor approach at unsignalized intersections (TWSC) are shown in overall intersection operation column
[2] CLV value for unsignalized intersections is based on equivalent delay from HCS (1,500 CLV = 40.0 sec/veh)
[3] Maximum CLV for unsignalized intersections was capped at 3,000
[4] Build Alternatives were analyzed with two stage gap acceptance, assuming storage in median for one vehicle turning left from minor approach.
[5] Unsignalized intersections on six lane roadways can not be analyzed with HCS/HCM due to the "limitations of the research" in the HCM

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# I. Introduction

The purpose of this traffic study is to examine traffic operations related to the potential widening of Goshen Road from Odendhal Avenue to Warfield Road in Montgomery County, Maryland. This portion of Goshen Road is a two (2) lane undivided roadway (one lane per direction) that is currently classified in the Gaithersburg and Vicinity Master Plan as a major highway. There are currently a total of six (6) signalized intersections and 12 unsignalized intersections within the corridor. Please refer to Figure 1: Goshen Road Corridor Map for their locations. Condition diagrams for each intersection showing existing intersection configurations can be found on pages 3-11. Condition diagrams for signalized intersections are shown first with one intersection per page, followed by condition diagrams for unsignalized intersections, which are shown four intersections per page.

Three analysis years (2002, 2015, 2025) were selected for the study. Traffic volumes were projected for the two future design years based on calibrated output from the Maryland-National Capital Park and Planning Commission (M-NCPPC) regional transportation model. The existing roadway conditions (two lanes) were analyzed using volumes for all three design years and the two widening options (4 lanes and 6 lanes) were analyzed using projected traffic volumes for 2015 and 2025. Additionally, the two future design years (2015 and 2025) were also analyzed with a two-lane corridor but with minor TSM improvements including signalization of key intersections and restricting left turns at other intersections. Therefore, a total of nine (9) alternatives were analyzed for this study. Table 1 summarizes the alternatives by type of improvement and design year.

**Goshen Road Corridor Study** **RK&K Engineers, LLP**
**Montgomery County DPW&T** **July 2003**

**Table 1**
**Summary of Roadway Improvement Alternatives**

| Design Year | No Build (Two Lanes) | Two Lanes with Improvements | Four Lane | Six Lane |
|---|---|---|---|---|
| 2002 | 🗐 | | | |
| 2015 | 🗐 | 🗐 | 🗐 | 🗐 |
| 2025 | 🗐 | 🗐 | 🗐 | 🗐 |

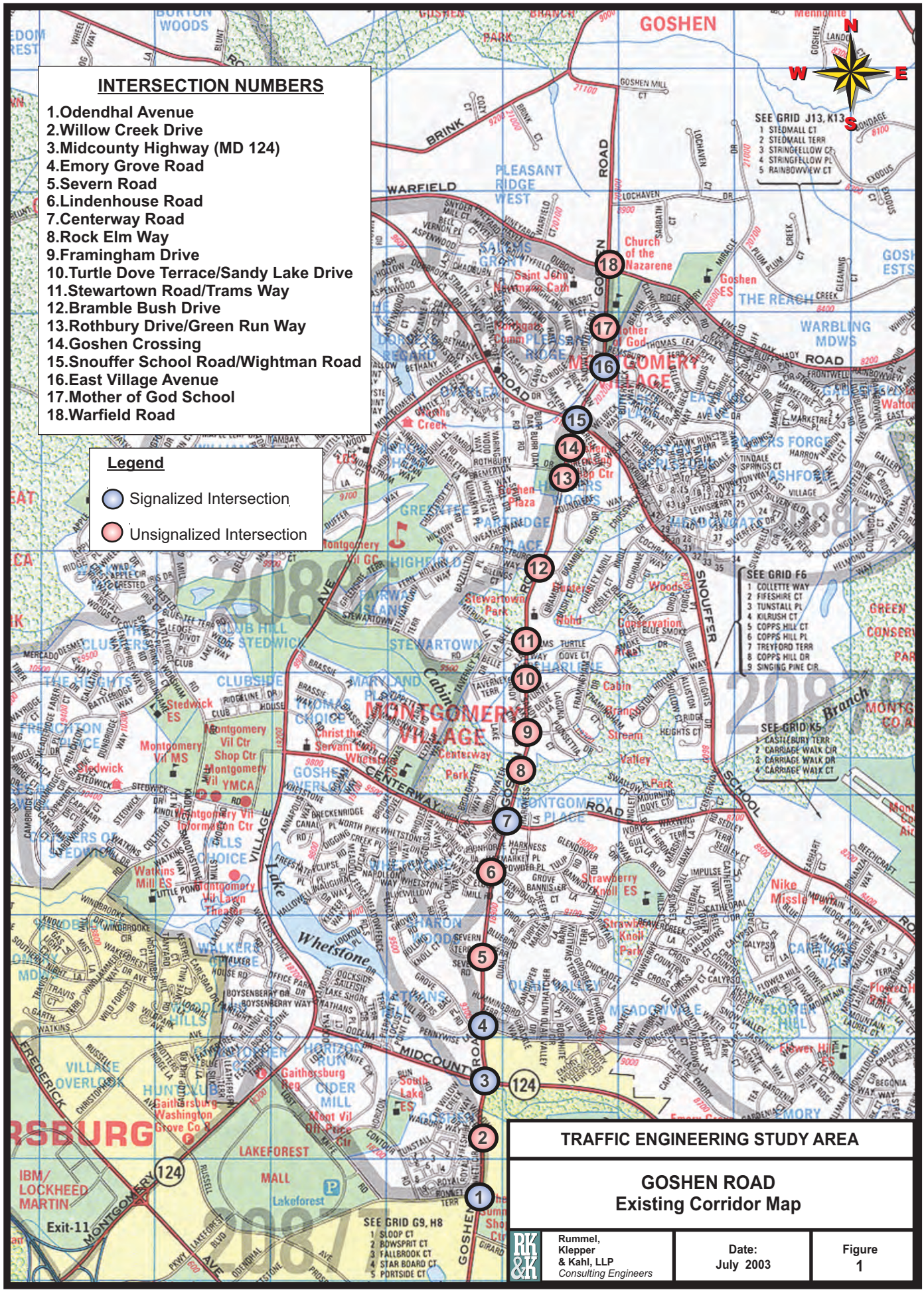

INTERSECTION NUMBERS
1.Odendhal Avenue
2.Willow Creek Drive
3.Midcounty Highway (MD 124)
4.Emory Grove Road
5.Severn Road
6.Lindenhouse Road
7.Centerway Road
8.Rock Elm Way
9.Framingham Drive
10.Turtle Dove Terrace/Sandy Lake Drive
11.Stewartown Road/Trams Way
12.Bramble Bush Drive
13.Rothbury Drive/Green Run Way
14.Goshen Crossing
15.Snouffer School Road/Wightman Road
16.East Village Avenue
17.Mother of God School
18.Warfield Road
Legend
Signalized Intersection
Unsignalized Intersection
N
W
E
S
GOSHEN
WARFIELD
ROAD
SNOUFFER
SCHOOL
MIDCOUNTY
ROAD
Whetstone
Lake
Branch
SEE GRID J13, K13
1 STEDMALL CT
2 STEDMALL TERR
3 STRINGFELLOW CT
4 STRINGFELLOW PL
5 RAINBOWVIEW CT
SEE GRID F6
1 COLLETTE WAY
2 FIFESHIRE CT
3 TUNSTALL PL
4 KILRUSH CT
5 COPPS HILL CT
6 COPPS HILL PL
7 TREYFORD TERR
8 COPPS HILL DR
9 SINGING PINE CIR
SEE GRID K5
1 CASTLEBURY TERR
2 CARRIAGE WALK CIR
3 CARRIAGE WALK DR
4 CARRIAGE WALK CT
SEE GRID G9, H8
1 SLOOP CT
2 BOWSPRIT CT
3 FALLBROOK CT
4 STAR BOARD CT
5 PORTSIDE CT
Church of the Nazarene
Saint John Neumann Cath
Mother of God
Goshen ES
Montgomery Vil MS
Montgomery Vil YMCA
Montgomery Vil Shop Ctr
Montgomery Vil Info Ctr
Montgomery Vil Lawn Theater
Stedwick ES
Watkins Mill ES
Strawberry Knoll ES
Gaithersburg Reg
Gaithersburg Washington Grove Co
Lakeforest Mall
IBM/ LOCKHEED MARTIN
Exit-11
124
TRAFFIC ENGINEERING STUDY AREA
GOSHEN ROAD
Existing Corridor Map
Rummel, Klepper & Kahl, LLP
Consulting Engineers
Date: July 2003
Figure 1

**Figure 2. Condition Diagram for Odendhal Avenue Intersection**

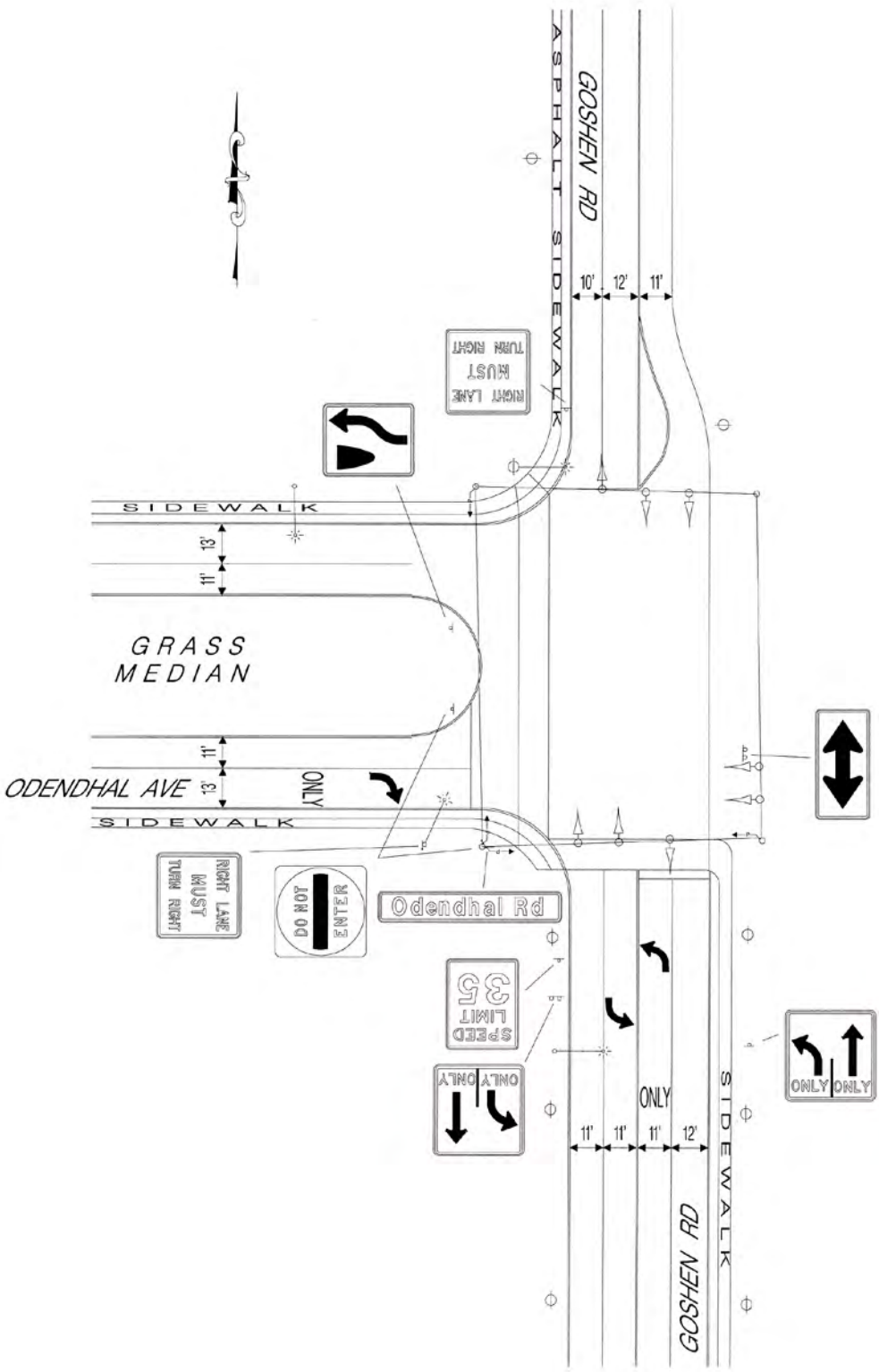


**Figure 3. Condition Diagram for Midcounty Highway Intersection**

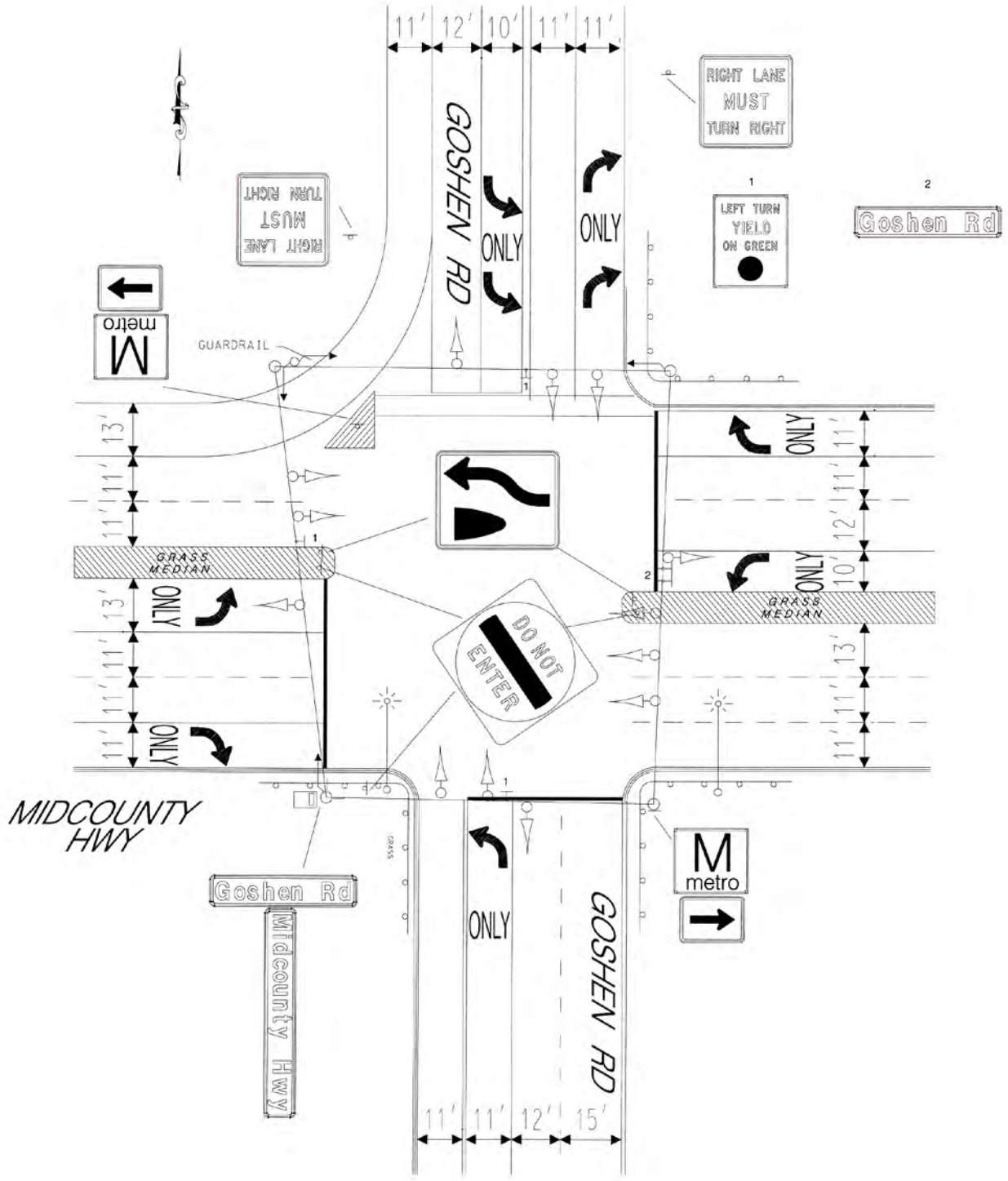


**Figure 4. Condition Diagram for Emory Grove Road Intersection**

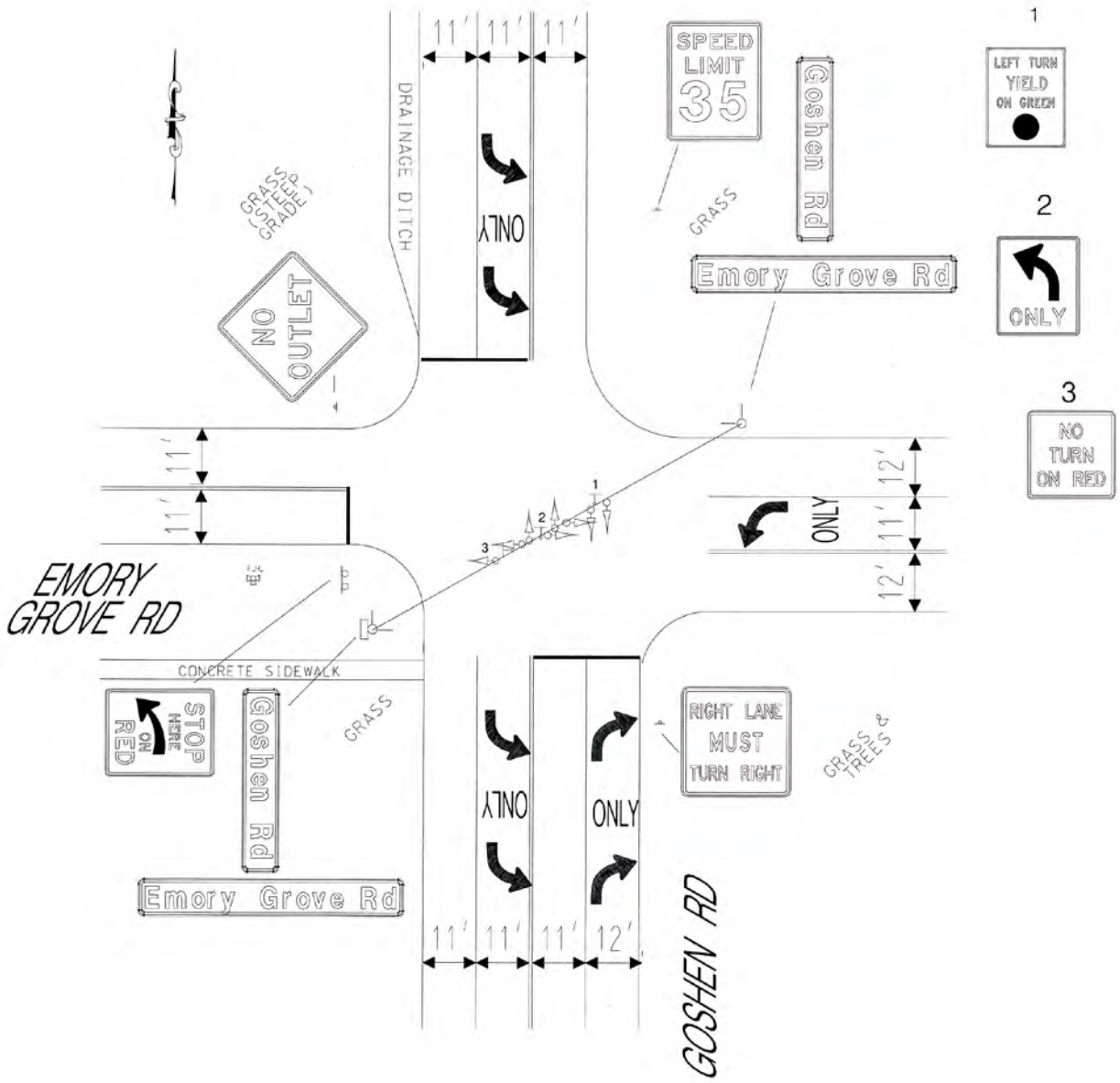


**Figure 5. Condition Diagram for Centerway Road Intersection**

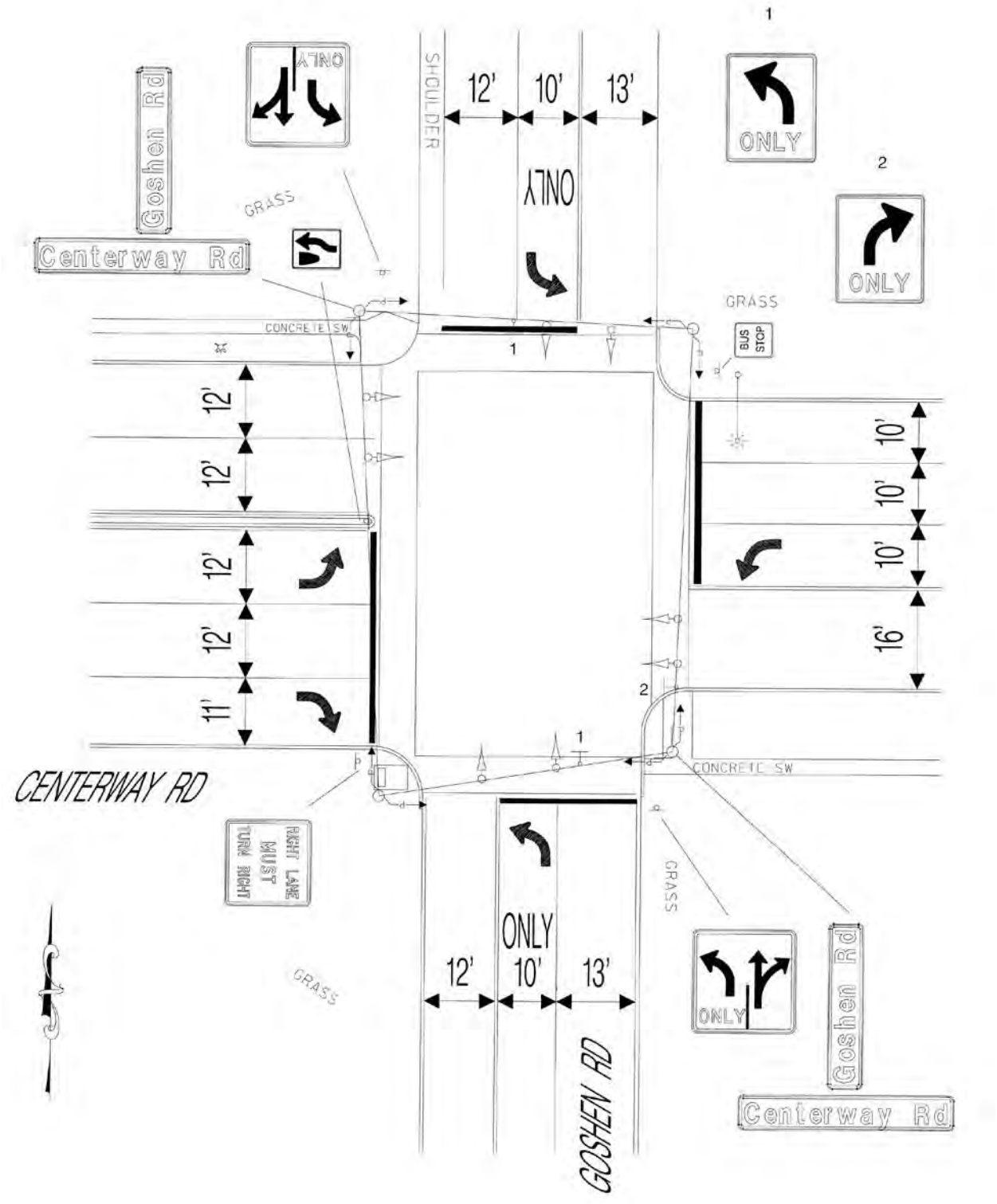


**Figure 6. Condition Diagram for Snouffer School Road – Wightman Road Intersection**

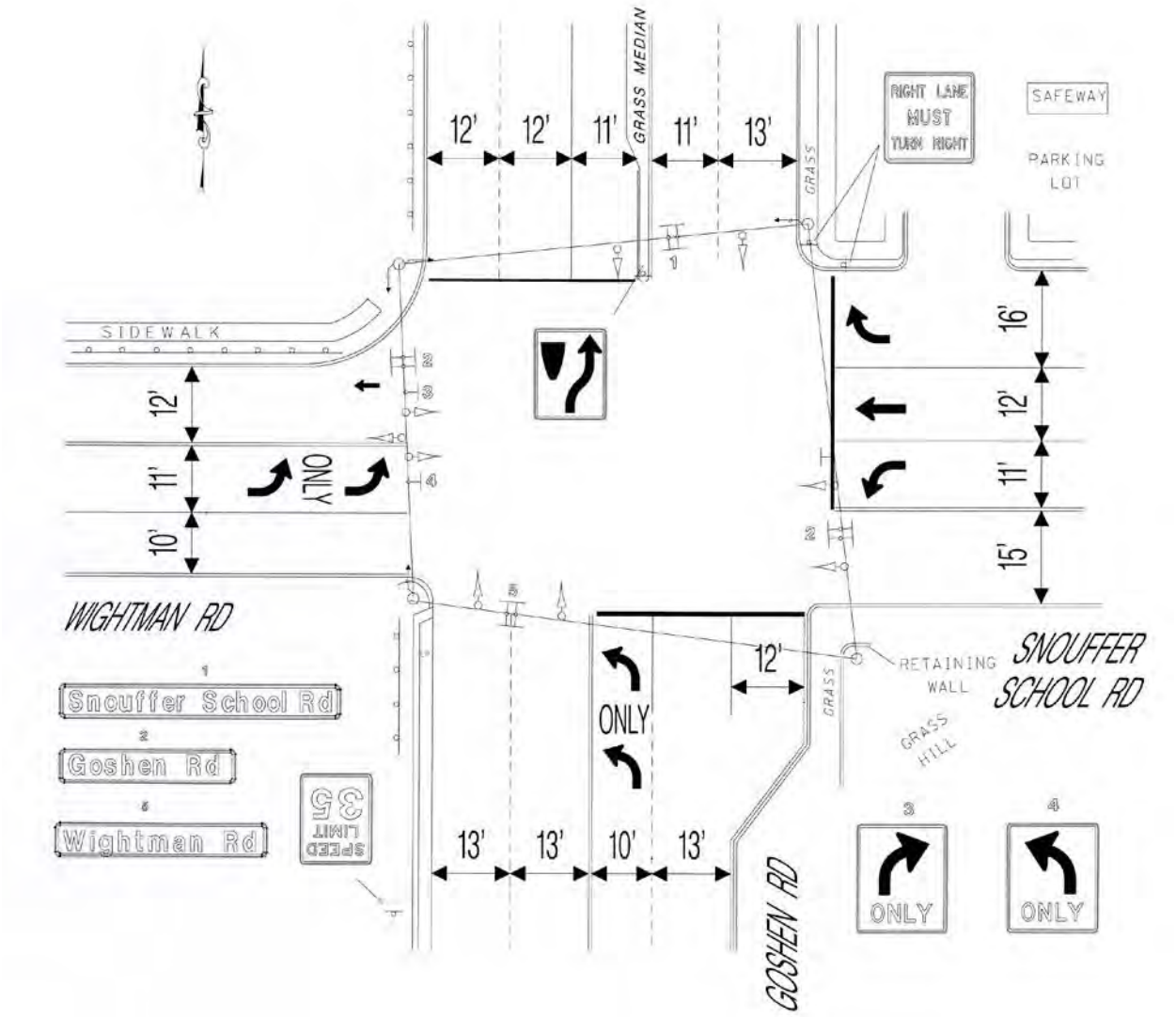


**Figure 7. Condition Diagram for East Village Avenue Intersection**

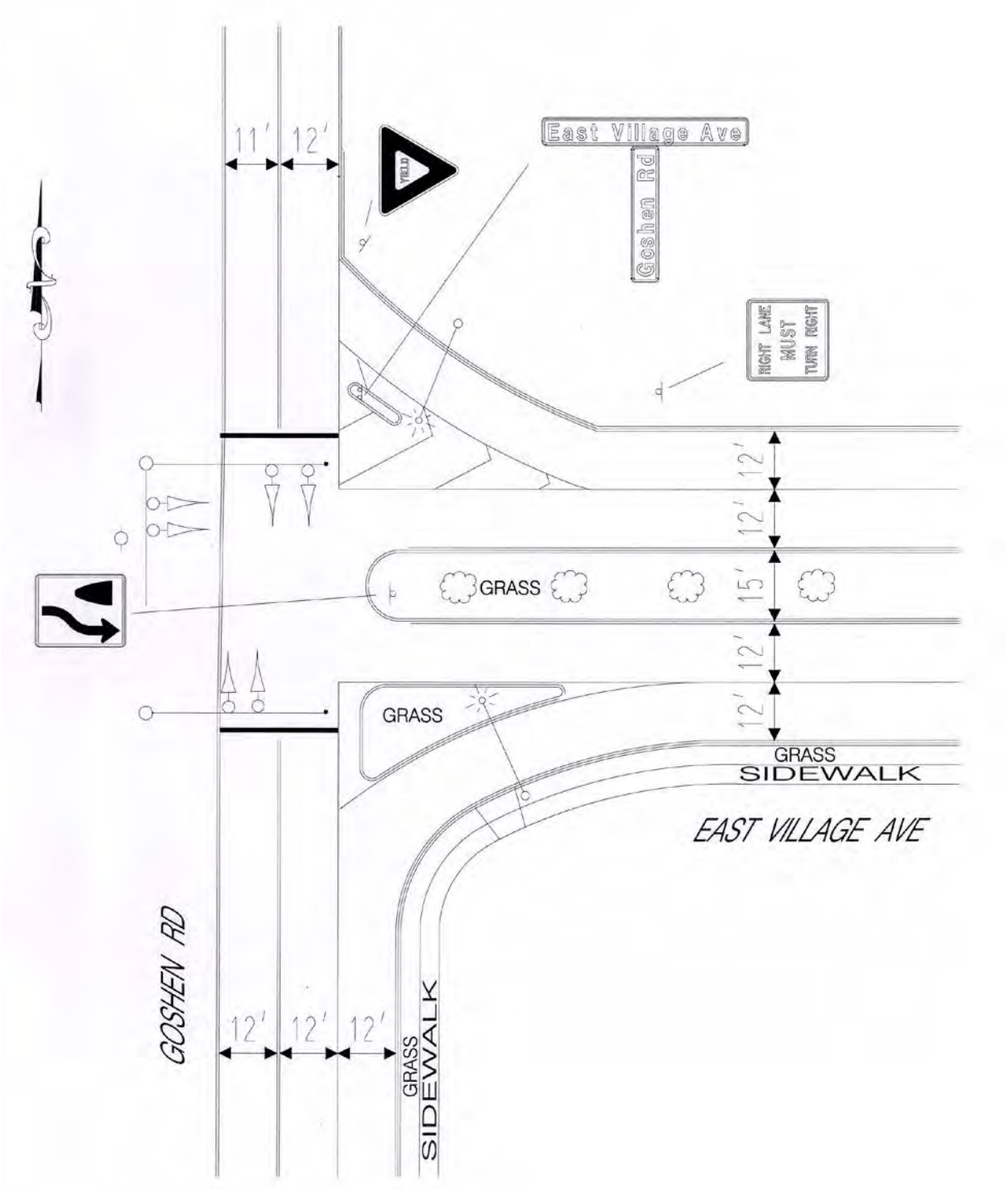


**Figure 8. Condition Diagram for Willow Creek Drive Intersection**

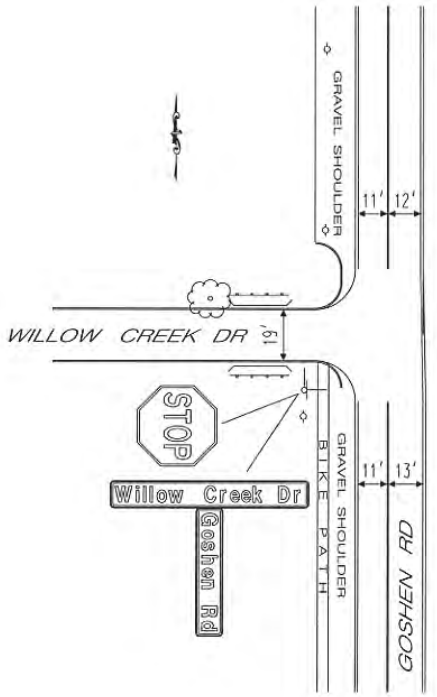



**Figure 9. Condition Diagram for Severn Road Intersection**

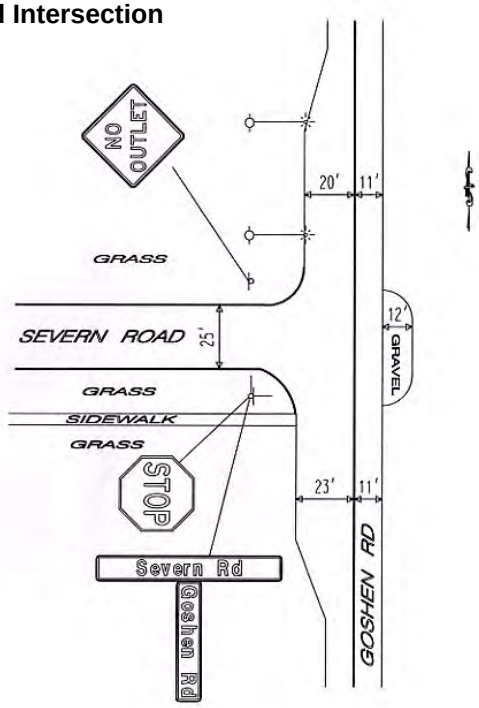



**Figure 10. Condition Diagram for Lindenhouse Road Intersection**

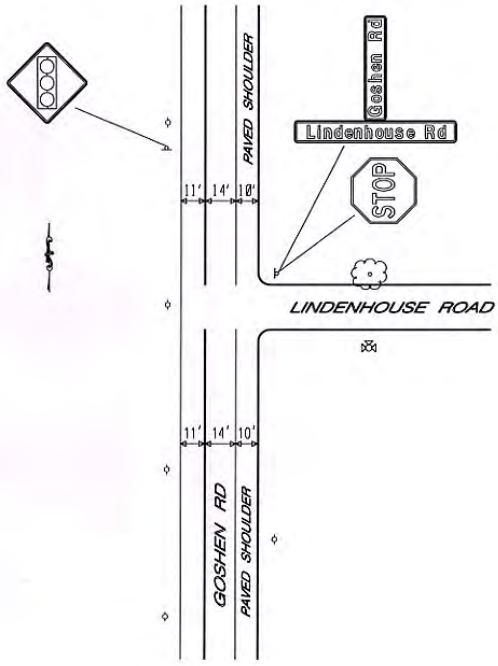



**Figure 11. Condition Diagram for Rock Elm Way Intersection**

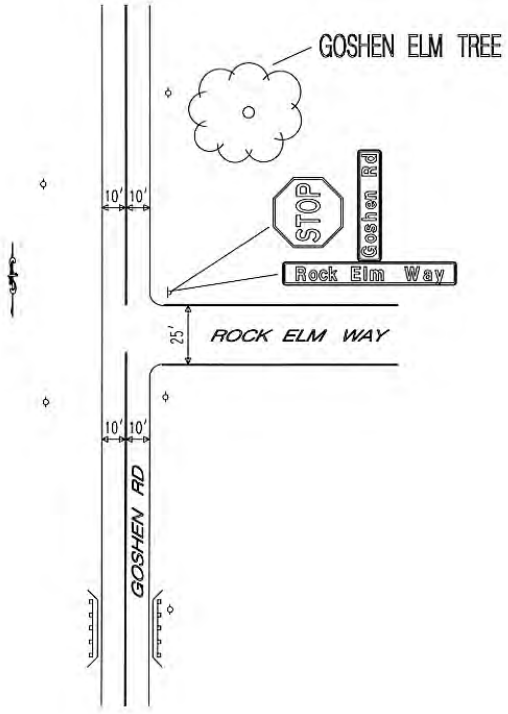


**Figure 12. Condition Diagram for Framingham Drive Intersection**

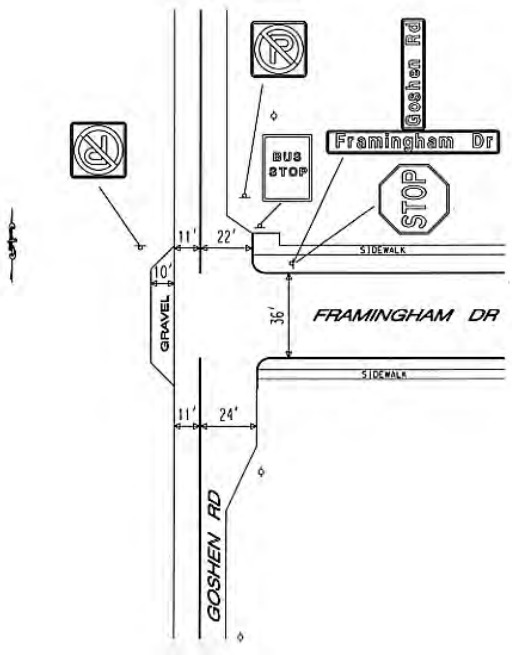



**Figure 13. Condition Diagram for Turtle Dove Terrace – Sandy Lake Drive Intersection**

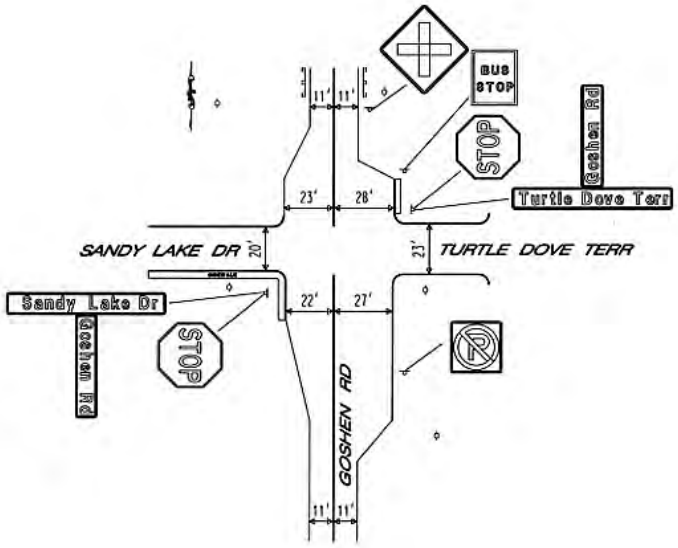



**Figure 14. Condition Diagram for Stewartown Road – Trams Way Intersection**

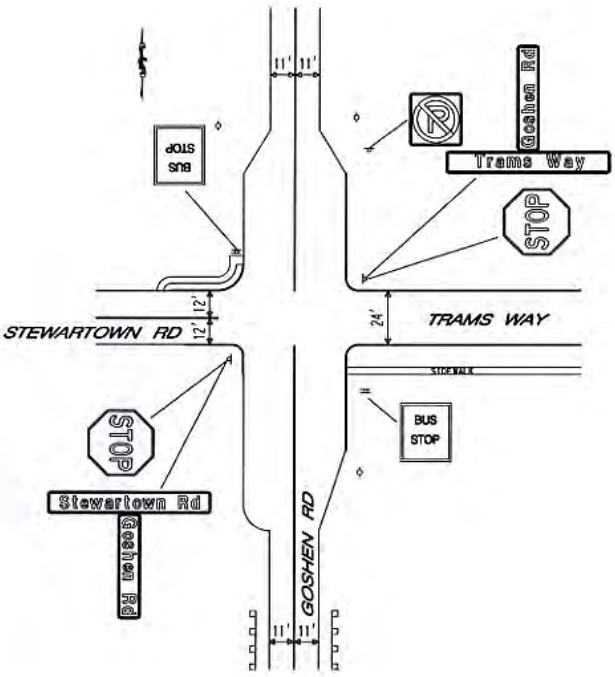



**Figure 15. Condition Diagram for Bramble Bush Drive Intersection**

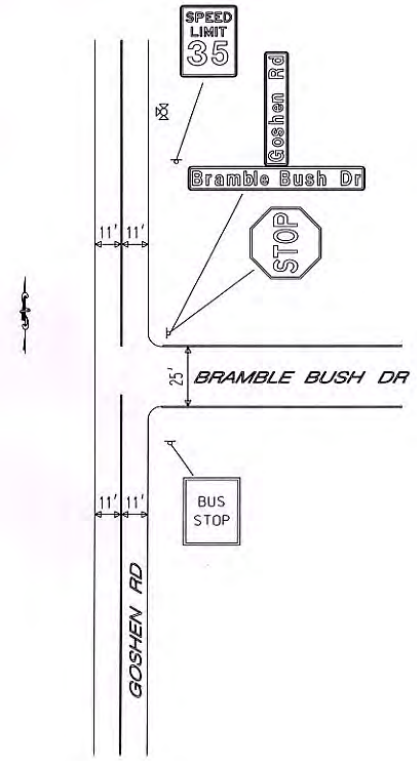


**Figure 16. Condition Diagram for Rothbury Drive – Green Run Way Intersection**

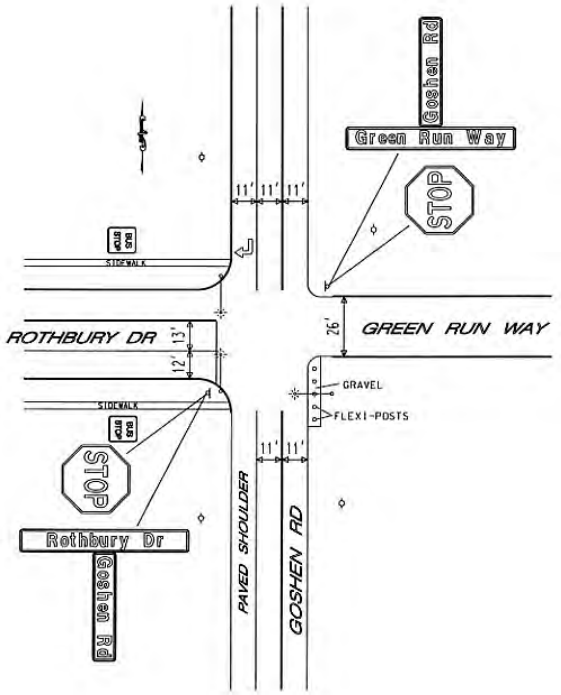



**Figure 17. Condition Diagram for Goshen Crossing Intersection**

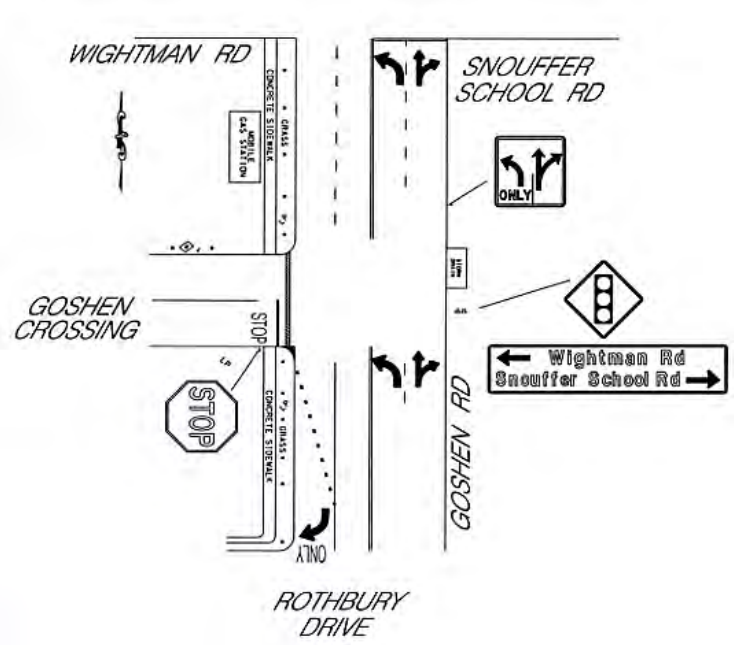
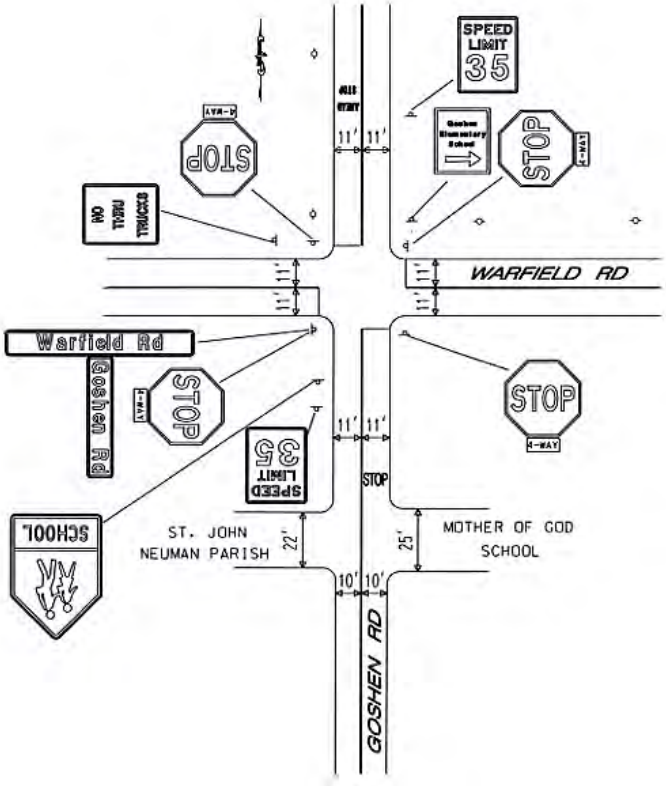



**Figure 18. Condition Diagram for Mother of God School and Warfield Road Intersections**



# II. Existing Conditions

## A. Existing Traffic Volumes

RK&K collected traffic and roadway characteristic data at various points along the Goshen Road study corridor to determine existing traffic operations. The traffic data collection included manual turning movement counts conducted at the 18 intersections within the corridor plus automatic tube counts placed at three locations along the corridor. Details of the turning movement counts and the tube counts are described below.

**2002 Seasonally Adjusted Intersection Turning Movement Counts**

RK&K conducted turning movement counts during the AM and PM peak hours at the 18 intersections. The AM peak hour along this corridor was found to be 7:30 – 8:30 AM and the PM peak hour was found to be 5:15 PM – 6:15 PM. The turning movement volumes were counted over a period of two weeks starting on 2/5/02 and ending on 2/14/02. Table 2 lists the intersecting road names, the intersection type, and dates of counts in order from the southern end to the northern end of the corridor. The raw count data for each location are included in Appendix A.

These turning movement volumes were seasonally adjusted for the month and day when which they were counted. While the majority of the corridor has rural characteristics with no curb and gutter, it is located in the northern suburbs of Gaithersburg, Maryland. Therefore the seasonal adjustment factor for the corridor was calculated as the average of the "Rural-Other" classification factor and the "Urban-Other" classification factor from the 2000 edition of the Maryland State Highway Administration publication, *Traffic Trends.*

The turning movement volumes were then further adjusted so that the traffic volume leaving one intersection would balance with the traffic volume entering the adjacent intersection. In general, most intersections were relatively close to balancing with exception of the intersection of Goshen Road at Midcounty Highway. The volumes counted at this intersection were approximately 30 percent higher than the volumes counted at the two adjacent intersections. Therefore, before the balancing process was started, the volumes entering the Midcounty Highway intersection were reduced by approximately 150 vehicles. After this reduction, the traffic volumes were reasonably balanced throughout the corridor, and only minor adjustments were made to the remaining intersections to achieve a completely balanced corridor.

Traffic volumes along Goshen Road were found to be approximately 25% higher in the PM peak. Traffic also tends to be higher in the southbound direction during the AM peak and higher in the northbound direction during the PM peak. In general, the highest volumes on Goshen Road are concentrated toward the two ends of the study area; south of Centerway Road and north of Snouffer School Road.

**Goshen Road Corridor Study** **RK&K Engineers, LLP**
**Montgomery County DPW&T** **July 2003**

**Table 2**
**Intersection Turning Movement Count Locations**

| Intersecting Road Name | Intersection Type | Count Date |
|---|---|---|
| 1. Odendhal Avenue | Signalized | 2/5/2002 |
| 2. Willow Creek Drive | TWSC | 2/6/2002 |
| 3. Midcounty Highway (MD 124) | Signalized | 2/5/2002 |
| 4. Emory Grove Road | Signalized | 2/6/2002 |
| 5. Severn Road | TWSC | 2/12/2002 |
| 6. Lindenhouse Road | TWSC | 2/6/2002 |
| 7. Centerway Road | Signalized | 2/6/2002 |
| 8. Rock Elm Way | TWSC | 2/12/2002 |
| 9. Framingham Drive | TWSC | 2/12/2002 |
| 10. Turtle Dove Terrace / Sandy Lake Drive | TWSC | 2/12/2002 |
| 11. Stewartown Road / Trams Way | TWSC | 2/12/2002 |
| 12. Bramble Bush Drive | TWSC | 2/13/2002 |
| 13. Rothbury Drive / Green Run Way | TWSC | 2/13/2002 |
| 14. Goshen Crossing | TWSC | 2/13/2002 |
| 15. Snouffer School Road / Wightman Road | Signalized | 2/13/2002 |
| 16. East Village Avenue | Signalized* | 2/14/2002 |
| 17. Mother of God School | TWSC | 2/14/2002 |
| 18. Warfield Road | AWSC | 2/14/2002 |

* East Village Avenue Intersection was TWSC at the time of the 2/14/2002 count.
NOTE: TWSC = Two Way Stop Controlled
AWSC = All Way Stop Controlled

**2002 Seasonally Adjusted Mainline Volume Counts**

RK&K placed automatic tube counters for a period of 48 hours on May 13-14, 2002 and July 16-17, 2002 to collect daily traffic volumes, 85$^{th}$ percentile speeds, and heavy vehicle percentages along the Goshen Road corridor. Appendix A contains the raw count data for each location. The tubes were placed at three (3) locations along the corridor. Please refer to Figure 19.

Location 1: 0.2 miles north of Midcounty Highway
Location 2: 0.2 miles north of Centerway Road
Location 3: 0.2 miles north of Snouffer School Road

Tables 3 and 4 summarize the results of the May count and July counts respectively. The data were collected twice because the volumes from the first collection in May did not match well with the intersection turning movement count volumes collected in February. A comparison of the May and July data revealed that the data from Location 1 (Midcounty Highway) during the May counts is not valid most likely due to faulty equipment (a malfunctioning road tube). The July data from Location 1 matched much

better with the turning movement count data and the data from Locations 2 and 3 appear to be reasonably consistent with the data collected in May; therefore, the July data was used for this study.

The mainline volumes were seasonally adjusted and are representative of average annual daily traffic (AADT), given in vehicles per day (vpd). The July data show the 85th percentile speeds during non-peak periods to be near 50 mph in both directions at each of the three tube count locations; even though the speed limit is posted at 35 miles per hour. Figure 19 also shows the 85th percentile speed measured at each location along with the locations of the posted speed limit signs.

**Goshen Road Corridor Study** **RK&K Engineers, LLP**
**Montgomery County DPW&T** **July 2003**

**Table 3**
**May 13, 2002 Volume Count Summary**

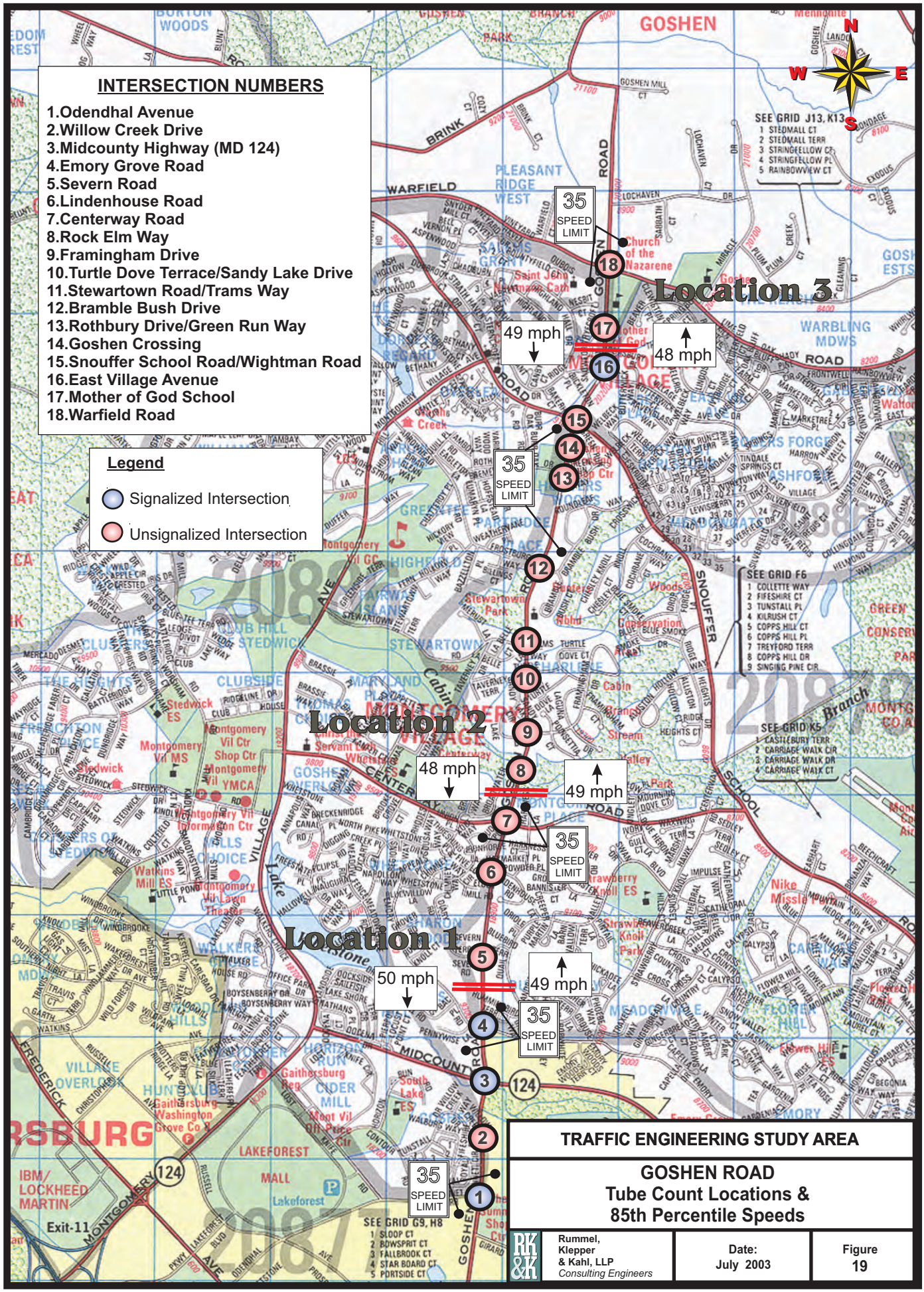
| | Location 1 (Midcounty) | Location 2 (Centerway) | Location 3 (Snouffer Sch.) |
|---|---|---|---|
| ADT | 13,946 | 14,450 | 10,213 |
| DHV (% of ADT) | 9.3% (PM) | 8.5% (PM) | 9.1% (PM) |
| Directional Distribution of DHV | 72/28 NB/SB | 62/38 NB/SB | 67/33 NB/SB |
| 85th % Speed (mph) | 47 NB 38 SB | 49 NB 49 SB | 47 NB 45 SB |
| Truck Percentage (% of ADT) | 7.2% | 2.7% | 2.5% |
| (Medium Trucks) | (25%) | (90%) | (90%) |
| (Heavy Trucks) | (75%) | (10%) | (10%) |

NOT APPLICABLE

**Goshen Road Corridor Study** **RK&K Engineers, LLP**
**Montgomery County DPW&T** **July 2003**

**Table 4**
**July 16, 2002 Volume Count Summary**

| | Location 1 (Midcounty) | Location 2 (Centerway) | Location 3 (Snouffer School) |
|---|---|---|---|
| ADT | 15,876 | 14,282 | 9,085 |
| DHV (% of ADT) | 9.2% (PM) | 9.0% (PM) | 9.7% (PM) |
| Directional Distribution of DHV | 65/35 NB/SB | 63/37 NB/SB | 70/30 NB/SB |
| 85th % Speed (mph) | 49 NB 50 SB | 49 NB 48 SB | 48 NB 49 SB |
| Truck Percentage (% of ADT) | 1.4% | 1.0% | 1.4% |
| (Medium Trucks) | (90%) | (85%) | (90%) |
| (Heavy Trucks) | (10%) | (15%) | (10%) |




TRAFFIC ENGINEERING STUDY AREA

GOSHEN ROAD
Tube Count Locations &
85th Percentile Speeds

Rummel, Klepper & Kahl, LLP
*Consulting Engineers*

Date: July 2003

Figure 19

## B. Existing Intersection Capacity Analyses

Capacity analyses were performed for each intersection using the 2002 seasonally adjusted and balanced turning movement volumes for the AM and PM peak hours. Existing signal timings for the six signalized intersections were obtained from the Montgomery County DPW&T. Operations at each intersection was measured in two ways:

1. **Delay / Level of Service (LOS)**
   - *Signalized Intersections* - Synchro Traffic Signal Coordination Software, Version 5 was used to determine approach and intersection delay.
   - *Unsignalized Intersections* - The 2000 Highway Capacity Software, version 4.1b (HCS) was used to determine approach delay.

2. **Capacity**
   - *Signalized Intersections* - The Critical Lane Volume (CLV) method was used to determine if the intersection is operating under, near, at, or over capacity.
   - *Unsignalized Intersections* – Movement delay on worst approach of unsignalized intersection was converted to CLV equivalent (see explanation below).

Synchro 5 was used to analyze delay and level of service (LOS) at the signalized intersections because of its ability to model and optimize traffic on signalized arterials. The software program uses methodologies from the *2000 Highway Capacity Manual.* Signalized intersection capacity is measured in terms of delay per vehicle. Level of service (LOS) A (delay $\leq$ 10 seconds/vehicle) represents the best possible operating conditions, whereas LOS F (delay > 80 seconds/vehicle) represents congested conditions, corresponding with traffic that has reached or exceeded available capacity. The HCM levels of service criteria for signalized intersections are shown in Table 5.

The Highway Capacity Software, version 4.1b (HCS) for unsignalized intersections was used to analyze the unsignalized intersections. The HCS software is based entirely on the capacity analysis methodology of the *2000 Highway Capacity Manual.* Unsignalized intersection capacity is also measured in terms of LOS and delay, primarily for vehicles on the stop-controlled approaches and vehicles turning left from the major street approaches. The LOS thresholds for unsignalized intersections are a bit lower than those for signalized intersections. Here, LOS A represents delay $\leq$ 10 seconds/vehicle and LOS F represents delay > 50 seconds/vehicle. The software output for all of the capacity analyses are provided in Volume II - Appendices. The HCM levels of service criteria for unsignalized intersections are also shown in Table 5.

The Critical Lane Volume (CLV) method was used to analyze signalized intersections to evaluate intersection operation in terms of capacity. Montgomery County has set forth a maximum CLV of 1,500 or less for the Montgomery Village/Airpark policy area in the 2003 Annual Growth Policy in order to comply with the adequate public facilities ordinance and growth capacity ceilings. **In this report, any intersection that operates with a CLV greater than 1,500 is considered to operate at unacceptable conditions.** The CLV method is a planning tool used to evaluate signalized intersection operations based on a CLV value, which is the maximum number of vehicles passing through the intersection per lane in an hour. The methodology is based on alternating signal green time between approaches and therefore cannot accurately estimate operations at unsignalized intersections. For this report, an equivalent CLV value was estimated at unsignalized intersection so that the maximum CLV criterion for the Montgomery Village/Airpark policy area may also be used to evaluate the unsignalized intersections along the corridor. The CLV values at unsignalized intersections were estimated from the movement delay (from HCS) of the worst operating approach using the level of service thresholds for CLV used by the Maryland State Highway Administration. These level of service thresholds are shown in Table 5. Note that approach delay is capped in the HCS at 999.9 sec/veh; likewise the CLV equivalent for unsignalized intersections was capped at 3,000 vehicles.

Goshen Road Corridor Study RK&K Engineers, LLP
Montgomery County DPW&T July 2003

Table 5
**Level of Service Criteria**

| **Level of Service** | **Critical Lane Volume** CLV (veh/hr/lane) | **HCM --** ***Signalized*** Control Delay (sec/veh) | **HCM --*Unsignalized*** Control Delay (sec/veh) |
|---|---|---|---|
| A | 1,000 or less | 10 or less | 10 or less |
| B | 1,000 – 1,150 | 10 - 20 | 10 – 15 |
| C | 1,150 – 1,300 | 20 - 35 | 15 – 25 |
| D | 1,300 – 1,450 | 35 - 55 | 25 – 35 |
| E | 1,450 – 1,600 | 55 - 80 | 35 – 50 |
| F | 1,600 or more | 80 or more | 50 or more |

Table 6 summarizes levels of service and control delay by approach and for each overall intersection with critical lane volume. At unsignalized intersections, the overall intersection operation is that of the worst operating approach.

Roadways located to the east of Goshen Road that meet at unsignalized T-intersections operate worse during the AM peak because the primary movement is to make a left into heavy southbound traffic. Likewise, roadways located to the west of Goshen Road that meet at unsignalized T-intersections operate worse during the PM peak because the primary movement is to make a left into heavy northbound traffic. Both signalized and unsignalized intersections with four approaches tend to operate worse during the PM because of the overall higher volumes during the PM peak. Figure 20 shows the lane configurations and critical lane values at each intersection during existing conditions.

The following intersections were found to have an approach that operates at unacceptable conditions under existing conditions. The intersections are listed in order from the southern end to the northern end of the corridor.

1. Willow Creek Drive *CLV = 1,440 (2,682)*

Willow Creek Drive is a local road located at an unsignalized T-intersection at the southern end of the Goshen Road corridor between the signalized intersections at Odendhal Avenue to the south and Midcounty Highway to the north. Vehicles on Willow Creek Drive have access to the signalized intersection at Odendhal Avenue via an alternate route. The volumes on the road are low (29 vehicles during the AM peak and 14 vehicles during the PM peak), and the approach operates at level of service D during the AM peak and F during the PM peak.

2. Midcounty Highway *CLV = 1,504 (1,604)*

Midcounty Highway (MD 124) is a four lane arterial where it intersects Goshen Road. During the AM peak, the volumes along Midcounty Highway are approximately 20 percent higher than on Goshen Road and approximately 25 percent higher during the PM peak. Overall, the intersection operates at a level of service F during the AM and PM peak hours. During the AM peak hour, the highest delay is experienced primarily by the vehicles on Midcounty Highway. However, during the PM peak hour, the northbound approach on Goshen Road also experiences high delay.

3. Severn Road *CLV = 1,357 (1,632)*

Severn Road is a local road located at an unsignalized T-intersection just north of the Emory Grove intersection. Severn Road serves a small residential development and provides the only access for those residents. The volumes on the road are low (15 vehicles during the AM peak and 14 vehicles during the PM peak). The approach operates at level of service D during the AM peak and F during the PM peak

4. Lindenhouse Road *CLV = 1,839 (1,402)*

Lindenhouse Road is a local road terminating at an unsignalized T-intersection on the southern section of the Goshen Road corridor just south of the signalized intersection at Centerway Road. Vehicles on Lindenhouse Road have access to the signalized intersection at Centerway Road via an alternate route. The volumes on the road are higher during the AM peak with most vehicles turning left into southbound traffic (43 vehicles turning left during the AM peak). The approach operates at LOS F during the AM peak and LOS D during the PM peak.

5. Framingham Drive *CLV = 1,518 (1,505)*

Framingham Drive is a local road terminating at an unsignalized T-intersection in the middle section of the Goshen Road corridor. Framingham Drive serves several residential communities and connects to Turtle Dove Terrace. The volumes at the Framingham Drive intersection are relatively higher than at the other local roads along the corridor (90 vehicles during the AM peak and 48 vehicles during the PM peak). The approach operates at level of service E during both peak hours.

6. Turtle Dove Terrace / Sandy Lake Drive *CLV = 1,422 (1,531)*

The intersection is a four leg, two-way stop controlled intersection that serves residential developments to the east and west of Goshen Road. Residents on Turtle Dove Terrace have access to Goshen Road via Framingham Drive, but residents on Sandy Lake Drive do not have other access to Goshen Road. The volumes on both approaches are 84 vehicles during the AM peak and 51 vehicles during the PM peak. The intersection operates at LOS D during the AM peak and LOS E during eh PM peak.

7. Rothbury Drive/Green Run Way *CLV = 1,219 (3,000)*

This unsignalized intersection is located near the middle of the Goshen Road study corridor, just south of the Goshen Crossing shopping center's main entrance/exit. Traffic can also access this shopping center via Rothbury Drive. Green Run Way provides access to residential development and connects to Bramble Bush Drive to the south. Both of the minor street approaches operate at level of service C during the AM peak; however, the eastbound approach (Rothbury Drive) operates at level of service F and the westbound approach (Green Run Way) operates at level of service E during the PM peak.

8. Goshen Crossing *CLV = 1,195 (3,000)*

The entry to the Goshen Crossing shopping center intersects Goshen Road at an unsignalized T-intersection. The heavy movement is vehicles turning left into northbound traffic during the PM peak (197 vehicles turning left during the PM peak). This approach operates at level of service C during the AM peak and F during the PM peak.

9. Mother of God School *CLV = 2,738 (1,203)*

The entry to the Mother of God School to the east and the entry of the Saint John Newmann Catholic Church to the west meet at an unsignalized intersection along Goshen Road. The westbound approach from the Mother of God School operates at level of service F during the AM peak and C during the PM peak. During the AM peak, there are approximately 139 vehicles leaving the Mother of God School, 88 of which turn left into the heavy southbound traffic on Goshen Road.

10. Warfield Road *CLV = 1,212 (2,140)*

The Warfield Road intersection is a four-way stop controlled intersection at the northern end of the Goshen Road corridor. The intersection operates overall at a level of service C during the AM peak and F during the PM peak. The heaviest movement is the northbound through during the PM peak (564 vehicles). This approach operates at level of service F during the PM peak.

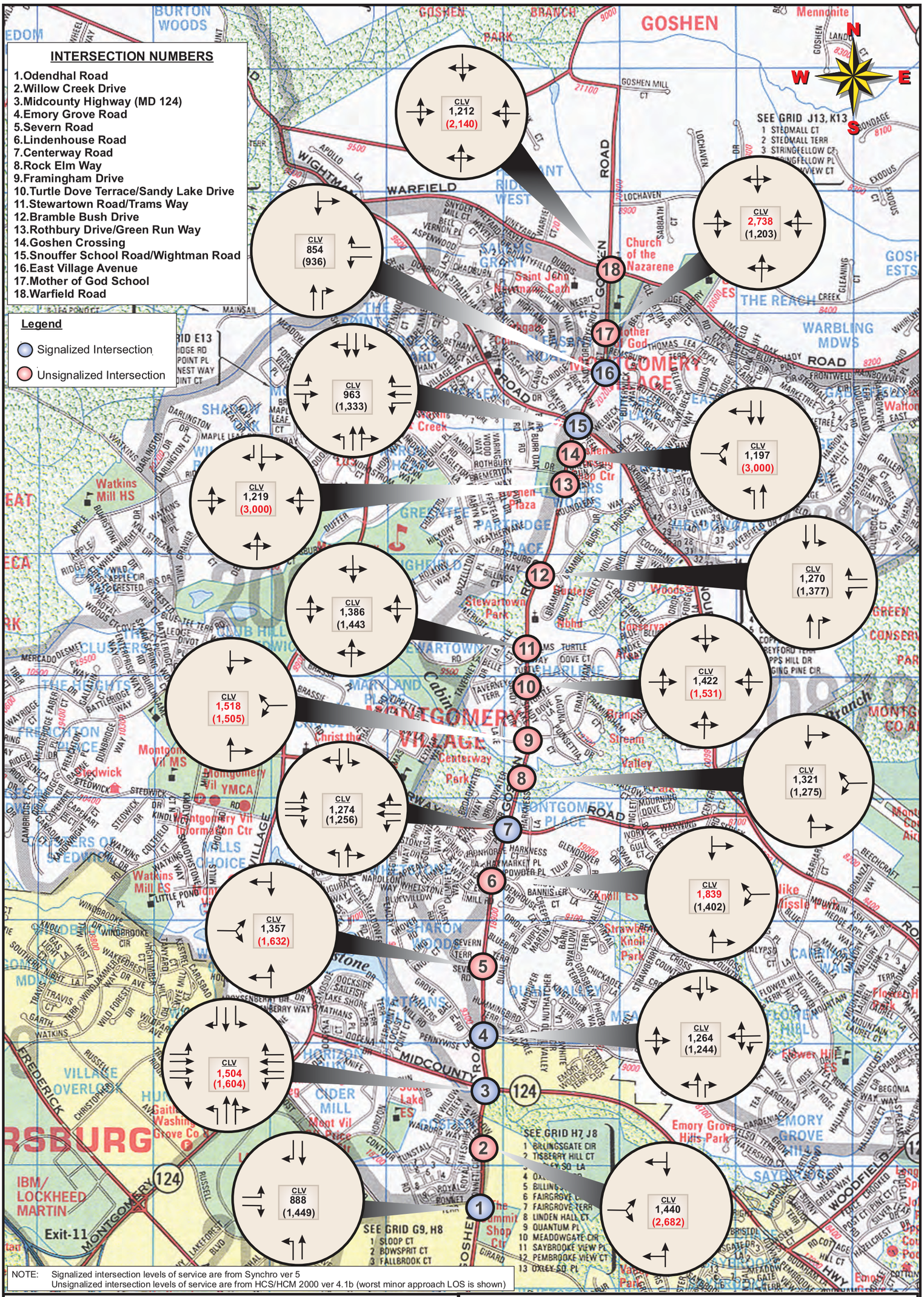
Goshen Road Corridor Study
Montgomery County DPW&T

RK&K Engineers, LLP
July 2003

**Table 6**
**Existing Conditions Summary Table - LOS and Control Delay (sec/veh)**

| Goshen Road Intersections | | 2002 Existing | | | | | |
|---|---|---|---|---|---|---|---|
| | | NB | SB | EB | WB | Overall [1] | CLV [2] |
| **AM Peak** | Control | | | | | | |
| 1 Odendhal Avenue | | A 6 | A 7 | C 22 | - | A 10 | 888 |
| 2 Willow Creek Drive | STOP | B 11 | - | D 34 | - | D 34 | 1,440 |
| 3 Midcounty Highway (MD 124) | | C 20 | D 48 | F 208 | E 78 | F 109 | 1,504 |
| 4 Emory Grove Road | | B 14 | C 32 | C 20 | E 63 | D 36 | 1,264 |
| 5 Severn Road | STOP | B 11 | - | D 28 | - | D 28 | 1,357 |
| 6 Lindenhouse Road | STOP | - | A 8 | - | F 74 | F 74 | 1,839 |
| 7 Centerway Road | | B 11 | C 30 | C 33 | D 43 | C 30 | 1,274 |
| 8 Rock Elm Way | STOP | - | A 8 | - | D 26 | D 26 | 1,321 |
| 9 Framingham Drive | STOP | - | A 8 | - | E 42 | E 42 | 1,518 |
| 10 Turtle Dove Terrace / Sandy Lake Drive | STOP | A 10 | A 8 | C 23 | D 33 | D 33 | 1,422 |
| 11 Stewartown Road / Trams Way | STOP | A 10 | A 8 | C 21 | D 31 | D 31 | 1,386 |
| 12 Bramble Bush Drive | STOP | - | A 8 | - | C 23 | C 23 | 1,270 |
| 13 Rothbury Drive / Green Run Way | STOP | A 9 | A 8 | C 20 | C 18 | C 20 | 1,219 |
| 14 Goshen Crossing | STOP | A 9 | - | C 18 | - | C 18 | 1,195 |
| 15 Snouffer School Road / Wigthman Road | | A 9 | B 14 | B 18 | C 27 | B 17 | 963 |
| 16 East Village Avenue | | A 4 | A 8 | - | B 17 | A 9 | 854 |
| 17 Mother of God School | STOP | A 9 | A 8 | B 12 | F 164 | F 164 | 2,738 |
| 18 Warfield Road | STOP | C 16 | D 26 | B 12 | B 14 | C 19 | 1,212 |
| **PM Peak** | | | | | | | |
| 1 Odendhal Avenue | | D 40 | B 20 | D 49 | - | D 36 | 1,449 |
| 2 Willow Creek Drive | STOP | B 11 | - | F 158 | - | F 158 | 2,682 |
| 3 Midcounty Highway (MD 124) | | F 110 | D 38 | E 67 | F 98 | F 83 | 1,604 |
| 4 Emory Grove Road | | A 6 | A 7 | C 30 | D 44 | B 12 | 1,244 |
| 5 Severn Road | STOP | A 9 | - | F 53 | - | F 53 | 1,632 |
| 6 Lindenhouse Road | STOP | - | B 10 | - | D 31 | D 31 | 1,402 |
| 7 Centerway Road | | B 14 | D 39 | C 30 | C 30 | C 26 | 1,256 |
| 8 Rock Elm Way | STOP | - | A 10 | - | C 23 | C 23 | 1,275 |
| 9 Framingham Drive | STOP | - | B 10 | - | E 41 | E 41 | 1,505 |
| 10 Turtle Dove Terrace / Sandy Lake Drive | STOP | A 9 | A 10 | D 33 | E 43 | E 43 | 1,531 |
| 11 Stewartown Road / Trams Way | STOP | A 9 | A 9 | C 20 | D 35 | D 35 | 1,443 |
| 12 Bramble Bush Drive | STOP | - | A 9 | - | D 30 | D 30 | 1,377 |
| 13 Rothbury Drive / Green Run Way | STOP | A 9 | A 9 | F 255 | E 38 | F 255 | 3,000 [3] |
| 14 Goshen Crossing | STOP | B 10 | - | F 459 | - | F 459 | 3,000 [3] |
| 15 Snouffer School Road / Wigthman Road | | B 19 | B 16 | D 51 | E 75 | D 43 | 1,333 |
| 16 East Village Avenue | | A 5 | A 5 | - | B 18 | A 6 | 936 |
| 17 Mother of God School | STOP | A 8 | A 9 | B 11 | C 19 | C 19 | 1,203 |
| 18 Warfield Road | STOP | F 164 | B 13 | B 13 | B 14 | F 104 | 2,140 |

NOTE: LOS & delay at signalized intersections are from Synchro version 5
LOS & delay at unsignalized intersections are from HCS 2000 version 4.1b
[1] Operations for worst minor approach at unsignalized intersections (TWSC) are shown in overall intersection operation column
[2] CLV value for unsignalized intersections is based on equivalent delay from HCS (1,500 CLV = 40.0 sec/veh)
[3] Maximum CLV for unsignalized intersections was capped at 3,000


INTERSECTION NUMBERS
1.Odendhal Road
2.Willow Creek Drive
3.Midcounty Highway (MD 124)
4.Emory Grove Road
5.Severn Road
6.Lindenhouse Road
7.Centerway Road
8.Rock Elm Way
9.Framingham Drive
10.Turtle Dove Terrace/Sandy Lake Drive
11.Stewartown Road/Trams Way
12.Bramble Bush Drive
13.Rothbury Drive/Green Run Way
14.Goshen Crossing
15.Snouffer School Road/Wightman Road
16.East Village Avenue
17.Mother of God School
18.Warfield Road
Legend
Signalized Intersection
Unsignalized Intersection
CLV 1,212 (2,140)
CLV 854 (936)
CLV 2,738 (1,203)
CLV 963 (1,333)
CLV 1,219 (3,000)
CLV 1,197 (3,000)
CLV 1,386 (1,443)
CLV 1,270 (1,377)
CLV 1,518 (1,505)
CLV 1,422 (1,531)
CLV 1,274 (1,256)
CLV 1,321 (1,275)
CLV 1,357 (1,632)
CLV 1,839 (1,402)
CLV 1,504 (1,604)
CLV 1,264 (1,244)
CLV 888 (1,449)
CLV 1,440 (2,682)
SEE GRID J13, K13
SEE GRID H7, J8
SEE GRID G9, H8
NOTE: Signalized intersection levels of service are from Synchro ver 5
Unsignalized intersection levels of service are from HCS/HCM 2000 ver 4.1b (worst minor approach LOS is shown)
Key Map of Montgomery County
STUDY SITE
TRAFFIC ENGINEERING STUDY AREA
GOSHEN ROAD
Existing Levels of Service
Rummel, Klepper & Kahl, LLP
Consulting Engineers
Date: July 2003
Figure 20

## C. Existing Arterial Capacity Analyses

Goshen Road provides mobility to/from the employment areas in Washington D.C., Gaithersburg, Rockville, and the I-270 Corridor as well as access to residential communities and several shopping areas along the corridor. The amount of access provided by Goshen Road is assessed by the operation of individual intersections along the corridor, while the degree of mobility is assessed mainly by the travel speeds of through vehicles. In general, the mobility of a roadway is inversely related to the access of a roadway. As such, roadways that provide good access may not provide good mobility and roadways that provide good mobility may not provide good access. By studying the arterial levels of service in addition to the intersection levels of service, it is possible to determine the impacts, if any, that improving access along Goshen Road may have on mobility and vice versa.

Synchro provides an arterial level of service for each roadway segment between signalized intersections and an average level of service for the whole corridor in each direction of travel. The arterial level of service is based on two parameters: the average speed of through vehicles and the arterial class of the roadway. The Synchro methodology for determining arterial capacity is illustrated in Figure 21. (Note: If the demand exceeds capacity at any point along the roadway, average travel speed might not be a good measure of the arterial level of service).

**Figure 21: Synchro Arterial Capacity Analysis Methodology**

| RUNNING TIME | |
|---|---|
| **Link Distance** | **Running Time** |
| > 0.5 mile | Distance / Flow Speed |
| ≤ 0.5 mile | 1994 HCM Table 11-4 |

**SIGNAL DELAY** = 1.3 * Stopped Delay for through lane group from signalized intersection analysis

**TRAVEL TIME** = Running Time + Signal Delay

**AVERAGE TRAVEL SPEED** = Link Distance / Travel Time

| ARTERIAL CLASS | | |
|---|---|---|
| **Class** | **Average Travel Speed (mph)** | **Link Distance (ft)** |
| V | 1 to 29 | any |
| IV | 30 to35 | < 2,000 |
| III | 30 to 35 | ≥ 2,000 |
| II | 36 to 45 | any |
| I | above 45 | any |

| ARTERIAL LOS | | | | |
|---|---|---|---|---|
| **Arterial Class** | **I** | **II** | **III** | **IV** |
| **LOS** | **Average Travel Speed (mph)** | | | |
| A | >42 | >35 | >30 | >25 |
| B | 34-42 | 28-35 | 24-30 | 19-25 |
| C | 27-34 | 22-28 | 18-24 | 13-19 |
| D | 21-27 | 17-22 | 14-18 | 9-13 |
| E | 16-21 | 13-17 | 10-14 | 7-9 |
| F | ≤16 | ≤13 | ≤10 | ≤7 |

Existing travel times were measured along Goshen Road on January 8, 2003 by recording stopped time at signalized intersections and the running time between signalized intersections. Four runs in each direction were conducted during the AM and PM peak hours. Travel times in the northbound direction began when entering the Odendhal Avenue queue just south of the intersection and continued until passing through the Warfield Road intersection. Travel times in the southbound direction began when entering the Warfield Road queue just north of the intersection and continued until passing through the Odendhal Avenue intersection. The average travel times and travel speeds were calculated for each segment. The average travel speeds from the field were then input as the theoretical flow speed for each link in Synchro, see Table 7. These field measured travel times were then compared to the estimated travel times calculated by Synchro based on an hour of simulated traffic flow assuming existing volumes and existing conditions.

Goshen Road Corridor Study — RK&K Engineers, LLP
Montgomery County DPW&T — July 2003

Table 7
**Peak Hour Link Speeds (mph)**

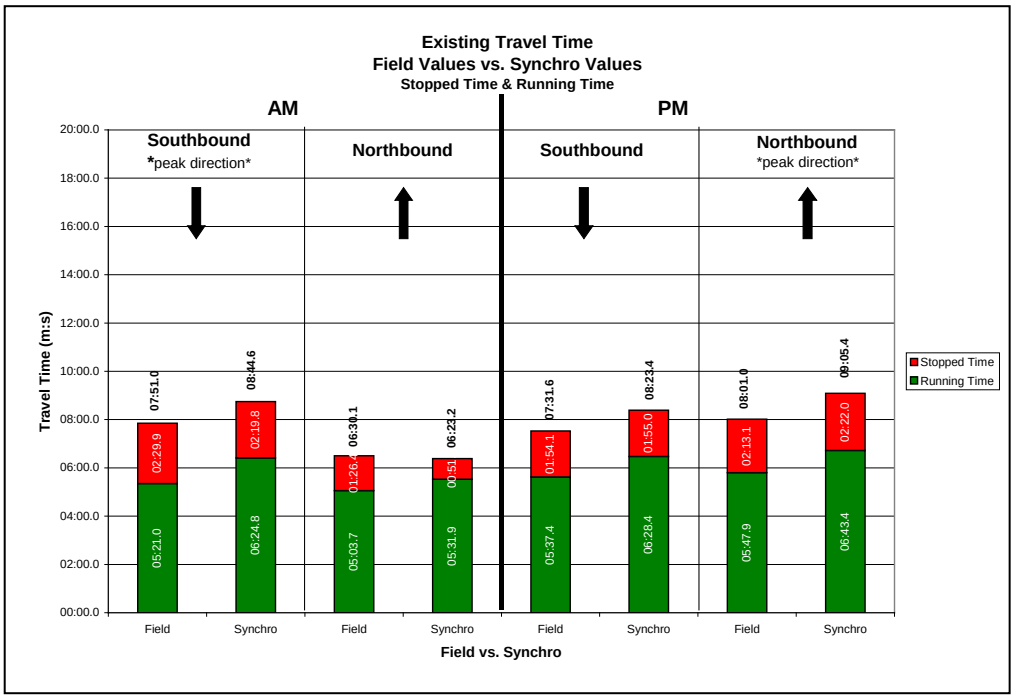
| Northbound | | AM | PM* | Southbound | | AM* | PM |
|---|---|---|---|---|---|---|---|
| between | Odendhal Ave<br>Midcounty Rd | 37 | 35 | between | Warfield Rd<br>Snouffer School Rd | 24 | 27 |
| between | Midcounty Rd<br>Emory Grove Rd | 28 | 30 | between | Snouffer School Rd<br>Centerway Rd | 38 | 36 |
| between | Emory Grove Rd<br>Centerway Rd | 39 | 32 | between | Centerway Rd<br>Emory Grove Rd | 36 | 32 |
| between | Centerway Rd<br>Snouffer School Rd | 38 | 32 | between | Emory Grove Rd<br>Midcounty Rd | 27 | 24 |
| between | Snouffer School Rd<br>Warfield Rd | 27 | 36 | between | Midcounty Rd<br>Odendhal Ave | 33 | 33 |

* Peak direction

It should be noted that the delay reported by Synchro is control delay, which includes the time to decelerate, time stopped and time to accelerate. In order to compare the control delay from Synchro with the actual stopped delay in the field, all the control delay from the Synchro output was converted into a stopped delay by dividing it by 1.3, which is a standard practice in the HCM. The difference between the control delay and calculated stopped delay was then added to the segment running time. The converted Synchro stopped times and running times are included in the appendices of this report. Figure 22 summarizes the comparison between the field measured travel times and the Synchro results during the AM and PM peak hours.

The results of the AM peak hour are shown on the left side of Figure 22 and the results of the PM peak are shown on the right side. The total travel time for the entire corridor (sum of the running time and stopped time) in each direction is shown at the top of each bar on the chart. The portion of the travel time that was spent stopped at signalized intersections is shown in red (stopped time); while the portion of time spent traveling between intersections is shown in green (running time).

**Figure 22: Existing Field Travel Times vs. Synchro Travel Times**




In general, the Synchro results for travel time are similar and slightly higher than those recorded in the field. The travel time for the northbound direction during the AM peak hour was the only travel time for which Synchro calculated a lower travel than the field, but the difference in times was less than 2 percent. The Synchro results for total travel time in the southbound direction during the AM peak hour was approximately 9 percent (55.0 s) greater than the field measured travel times. The Synchro results for total travel time in the northbound direction during the PM peak hour was approximately 13 percent (65.0 s) greater than the field measured travel times. The proportions of travel time attributed to stopped time verses running time were very similar when comparing Synchro's calculated time to those measured in the field. In general, the Synchro times were consistent with, but a bit more conservative than those in the field.

## D. Recent Accident History

The most recent accident data available for this corridor covers the period between January 1999 to December 2001. This data was provided by the Maryland State Highway Administration's Traffic Safety and Analysis Division. The accident data show that the accident rates for injury, property damage, and total accidents were significantly higher than the comparative statewide accident rates for roadways with similar characteristics as Goshen Road. The accident rates for opposite direction, rear end, left turn, angle, pedestrian, and fixed object collisions were also significantly higher than the statewide accident rates (see Table 7). The study and statewide rates shown in Table 8 are in terms of accidents per 100-million vehicle-miles traveled along Goshen Road and similar roadways throughout Maryland, respectively.

| Goshen Road Corridor Study | | | | | RK&K Engineers, LLP July 2003 | |
|---|---|---|---|---|---|---|
| **Table 8** | | | | | | |
| **Accident Study Worksheet and Rate Comparison** | | | | | | |
| **Collision Type** | **1999** | **2000** | **2001** | **Total** | **Study Rate** | **Statewide Rate** |
| **Fatal** | 0 | 0 | 0 | 0 | 0.0 | 1.9 |
| **Injury** | 13 | 15 | 22 | 50 | 119.5 | 63.1 |
| **Property Damage** | 16 | 21 | 15 | 52 | 124.3 | 54.3 |
| **Total Accidents** | 29 | 36 | 37 | 102 | 243.8 | 119.3 |
| **Opposite Direction** | 3 | 3 | 3 | 9 | 21.5 | 8.1 |
| **Rear End** | 12 | 15 | 7 | 34 | 81.3 | 33.5 |
| **Sideswipe** | 0 | 0 | 0 | 0 | 0.0 | 0.4 |
| **Left Turn** | 2 | 1 | 9 | 12 | 28.7 | 18.1 |
| **Angle** | 3 | 7 | 6 | 16 | 38.3 | 25.0 |
| **Pedestrian** | 0 | 2 | 4 | 6 | 14.3 | 2.7 |
| **Parked Vehicle** | 0 | 0 | 0 | 0 | 0.0 | 2.3 |
| **Fixed Object** | 6 | 2 | 5 | 13 | 31.1 | 12.3 |
| **Other** | 3 | 6 | 3 | 12 | 28.7 | 6.9 |
| **Truck Related** | 1 | 1 | 1 | 3 | 7.2 | 10.0 |
| **Nighttime** | 14 | 13 | 7 | 34 | 33% | 32% |
| **Wet Surface** | 13 | 13 | 5 | 31 | 30% | 28% |
| **Alcohol Related** | 2 | 1 | 2 | 5 | 4% | 8% |

Notes:
1) Study Rates and Statewide Rates shown above are Accidents per 100 Million Vehicle-Miles Traveled
2) Red Values Represent Study Rates that are Significantly Higher than the Statewide Rates

The following trends were revealed by the accident data:

- There were 102 total accidents along Goshen Road between Odendhal Avenue and Warfield Road during the three year period, with 60 of the accidents being intersection related.
- Approximately one third (33%) of the accidents throughout the corridor were rear end collisions.
- Approximately 25% of the total accidents occurred in the vicinity of the Midcounty Highway and Emory Grove Road intersections.
- Approximately one third of the collisions occurred at night, and one third of the accidents occurred on wet pavement.
- Nearly half of the reported collisions resulted in injuries. The remaining half was property damage only collisions. There were no fatal collisions reported along Goshen Road during the 3-year study period.
- Twelve (12) collisions were reported during the AM peak period (6:00 AM to 9:00 AM); 27 collisions were reported during the PM peak period (3:00 PM to 6:00 PM). See Figure 23 on the following page.
- Seventy percent (70%) of the total accidents occurred during the PM hours between Noon and Midnight.
- August, November and December each had the highest number of reported collisions per month compared to the remaining nine (9) months of the year (covering the entire 3-year study period). See Figure 24 on the following page.
- The study corridor accident rates for injury, property damage only, opposite direction, rear end, pedestrian, and fixed object collisions were more than twice the statewide rates. The study rate for pedestrian collisions was more the five (5) times the statewide rate. See Figure 25 on the following page.

It is likely that the roadway improvements included in the improvement and widening alternatives will help to decrease accident rates on this portion of roadway. Such improvements include:

- The leveling of vertical alignment and straightening of horizontal curves to improve sight distances.

- The construction of left turn lanes to provide a safe storage space for vehicles turning left from Goshen Road.
- The construction of a median to provide a buffer between northbound and southbound traffic and also to provide a safe storage space for vehicles turning left from the minor streets.
- The construction of bike lanes, sidewalks and crosswalks to provide a safe travel way for pedestrians and cyclists.
- The addition of lighting along the entire length of the project area will improve visibility of pedestrians and fixed objects.

**Figure 23: Reported Accidents along Goshen Road by Time of Day**

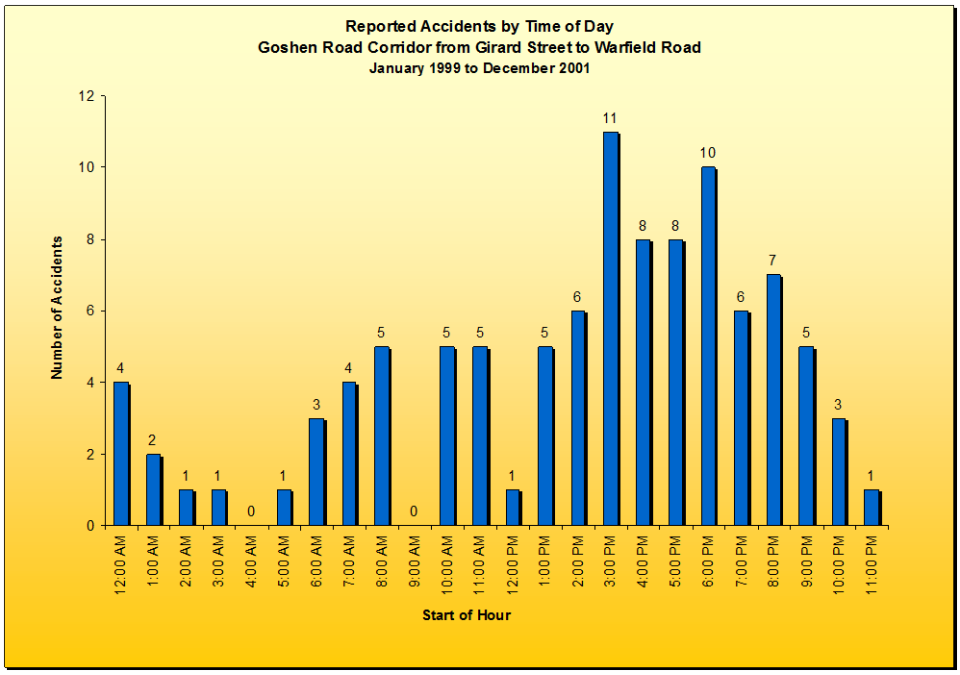


**Figure 24: Reported Accidents along Goshen Road by Month of Occurrence**

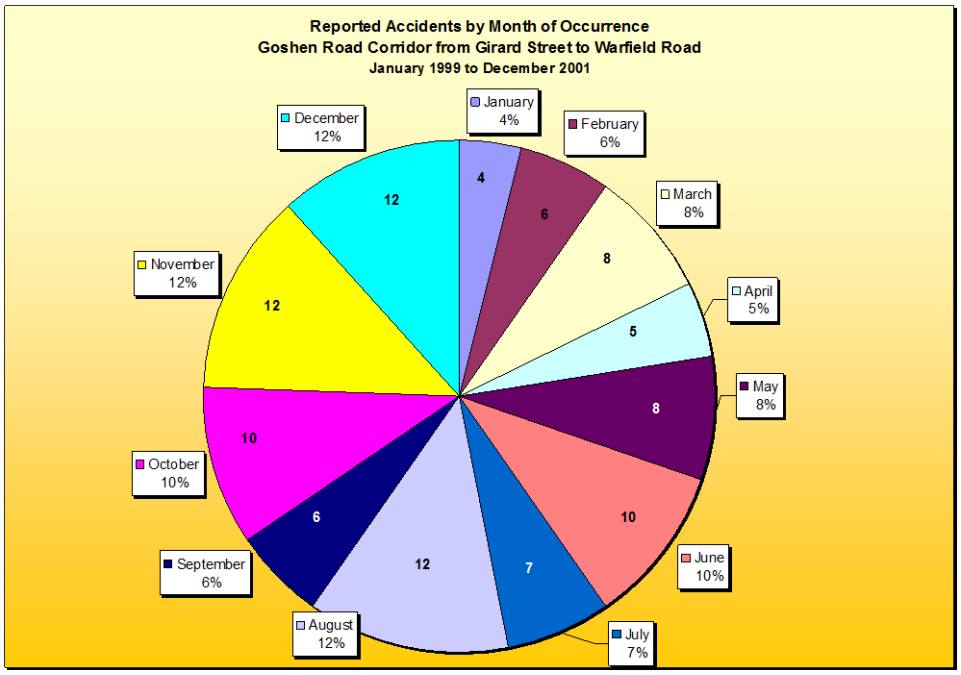
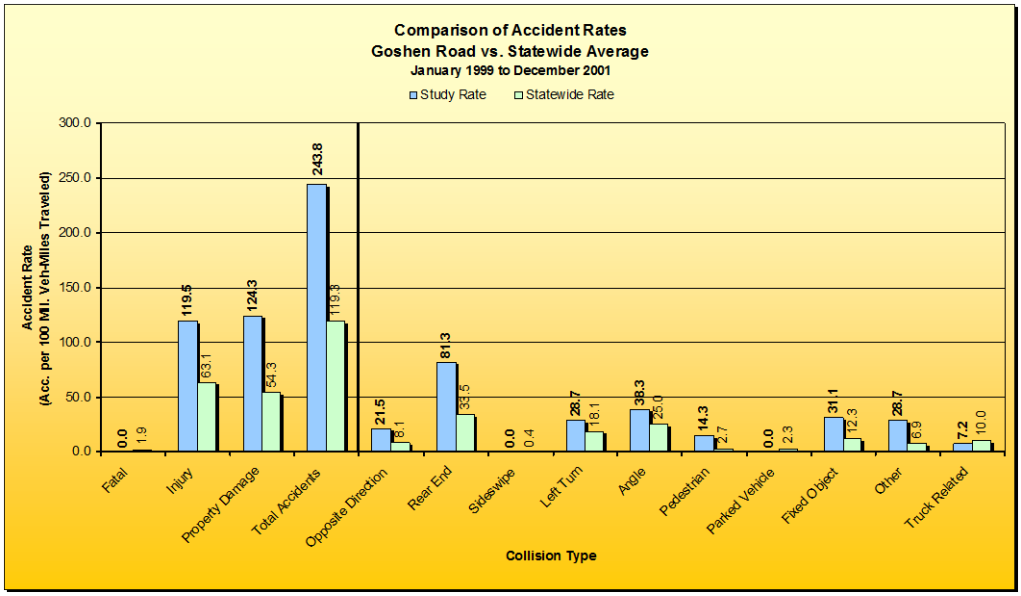



**Figure 25: Comparison of Accident Rates: Goshen Road vs. Statewide Average**



## III. Travel Forecasting Methodology

Turning movement volumes along Goshen Road for Year 2015 and 2025 were developed for the No Build (Two Lane), Four Lane, and Six Lane alternatives. The Maryland-National Capital Park and Planning Commission (M-NCPPC) provided PM peak hour travel forecasts for roadway link segments along Goshen Road and several parallel routes for 2015 and 2025. The M-NCPPC model also generated traffic volumes for the base forecasting modeling year (1998).

RK&K calibrated the PM peak hour link volumes provided by the M-NCPPC model using the screenline refinement procedure set forth in NCHRP Report No. 255. As part of this procedure, RK&K obtained actual traffic count data from 1998 for Goshen Road and the parallel routes that were included in the MNCPPC model. The screenline refinement procedure was used to calibrate the link volumes along Goshen Road for all six alternatives: 2015 No Build (Two Lanes), 2015 Four Lane, 2015 Six Lane, 2025 No Build (Two Lanes), 2025 Four Lane, and 2025 Six Lane. The result was a set of refined bi-directional PM peak hour link volumes.

The refined link volumes were then used to develop turning movement volumes at each of the 18 intersections along Goshen Road within the project limits for each of the six alternatives. The procedure used to develop these turning movements is discussed in "A Model of Turning Movement Propensity," Transportation Research Record No. 1287, pp. 195-204, 1990, and was implemented using the TMOVES software. This procedure estimates future turning movement volumes based on existing link volumes, existing turning movement volumes, and future link volumes (the link volumes from the screenline refinement procedure).

Using the projected turning movement volumes, the through volumes along Goshen Road were balanced, with any traffic volume increases or decreases being distributed along mainline Goshen Road. Traffic volumes turning onto and off of minor residential streets and cul-de-sacs intersecting Goshen Road typically were held constant for the future year projections due to the limited potential for growth along these streets.

Since the M-NCPPC model, which provided the basis for the projected traffic volumes for all six alternatives, only generates PM peak hour link volumes, RK&K developed AM peak hour turning movement volumes along the Goshen Road corridor based on the existing temporal and directional distribution trends. For example, the existing AM peak hour volumes along Goshen Road are slightly lower than the existing PM peak hour volumes. This trend was applied to the 2015 and 2025 peak hour volumes.

Table 9 shows estimated ADT volumes for each design year based on balanced PM peak link volumes at the three locations were data was collected during the tube counts (see Figure 19). As shown in the table, the traffic along Goshen Road tends to increase as the design year increases (2002, 2015, 2025) and as the capacity of the road increases (two lanes, four lanes, six lanes).

**Goshen Road Corridor Study** **RK&K Engineers, LLP**
**Montgomery County DPW&T** **July 2003**

**Table 9**
**Estimated ADT Comparison**

| | Existing | 2015 | | | 2025 | | |
|---|---|---|---|---|---|---|---|
| | 2002 | 2 Lanes | 4 Lanes | 6 Lanes | 2 Lanes | 4 Lanes | 6 Lanes |
| **Location 1 (Midcounty)** | 17,740 | 23,210 | 26,300 | 27,120 | 26,140 | 26,470 | 27,340 |
| **Location 2 (Centerway)** | 16,230 | 21,890 | 25,110 | 26,110 | 24,720 | 25,170 | 26,110 |
| **Location 3 (Snouffer Sch.)** | 10,650 | 15,720 | 18,920 | 19,740 | 18,560 | 18,970 | 19,790 |

## IV. Analysis of Year 2015 Alternatives

Each intersection along Goshen Road was analyzed with Synchro using the projected year 2015 traffic volumes for four (4) alternatives: No Build (Two Lanes), Two Lanes with Improvements (including signalization of key intersections and restricting left turns at other intersections), Four Lane, and Six Lane. Table 10 summarizes the intersection levels of service for each of these 2015 alternatives. The results of the capacity analyses for each intersection under each 2015 alternative are summarized below.

### A. 2015 No Build Alternative

The existing lane configurations and optimized signal timings were used for the analysis of the No Build condition. Under the 2015 No Build condition, four of the six signalized intersections and all of the unsignalized intersections would operate at unacceptable conditions due to the higher volumes along Goshen Road. The delay at the intersections of Willow Creek Drive, Lindenhouse Road, Rothbury Drive, Goshen Crossing and Mother of God School, would experience delays that exceed the range of the Highway Capacity Software (> 999.9 seconds). Figure 26 shows the lane configurations and CLV values at each intersection during the 2015 No Build alternative. The following is a discussion of the expected operations at the signalized intersections along the corridor.

1. Odendhal Avenue *CLV = 1,145 (1,700)*

In 2015, the intersection of Odendhal Avenue would operate at LOS B during the AM peak and LOS E during the PM peak. This intersection currently operates at LOS A during the AM peak and LOS D during the PM peak under existing conditions. The projected 2015 traffic volumes on all three approaches of this intersection are slightly higher than the existing volumes, which contribute to the minor decrease in operational performance during the PM peak hour.

2. Midcounty Highway *CLV = 1,911 (1,830)*

In 2015, the Midcounty Highway intersection would continue to operate at LOS F during peak hours with similar intersection delay as compared to the existing (2002) conditions.

3. Emory Grove Road *CLV = 1,658 (1,634)*

The overall AM peak hour LOS at this intersection would decline from LOS D under existing conditions to LOS F in 2015 due to the substantial projected increase in southbound through traffic along Goshen Road. During the PM peak hour, the level of service would decline from LOS B to LOS D.

4. Centerway Road *CLV = 1,645 (1,603)*

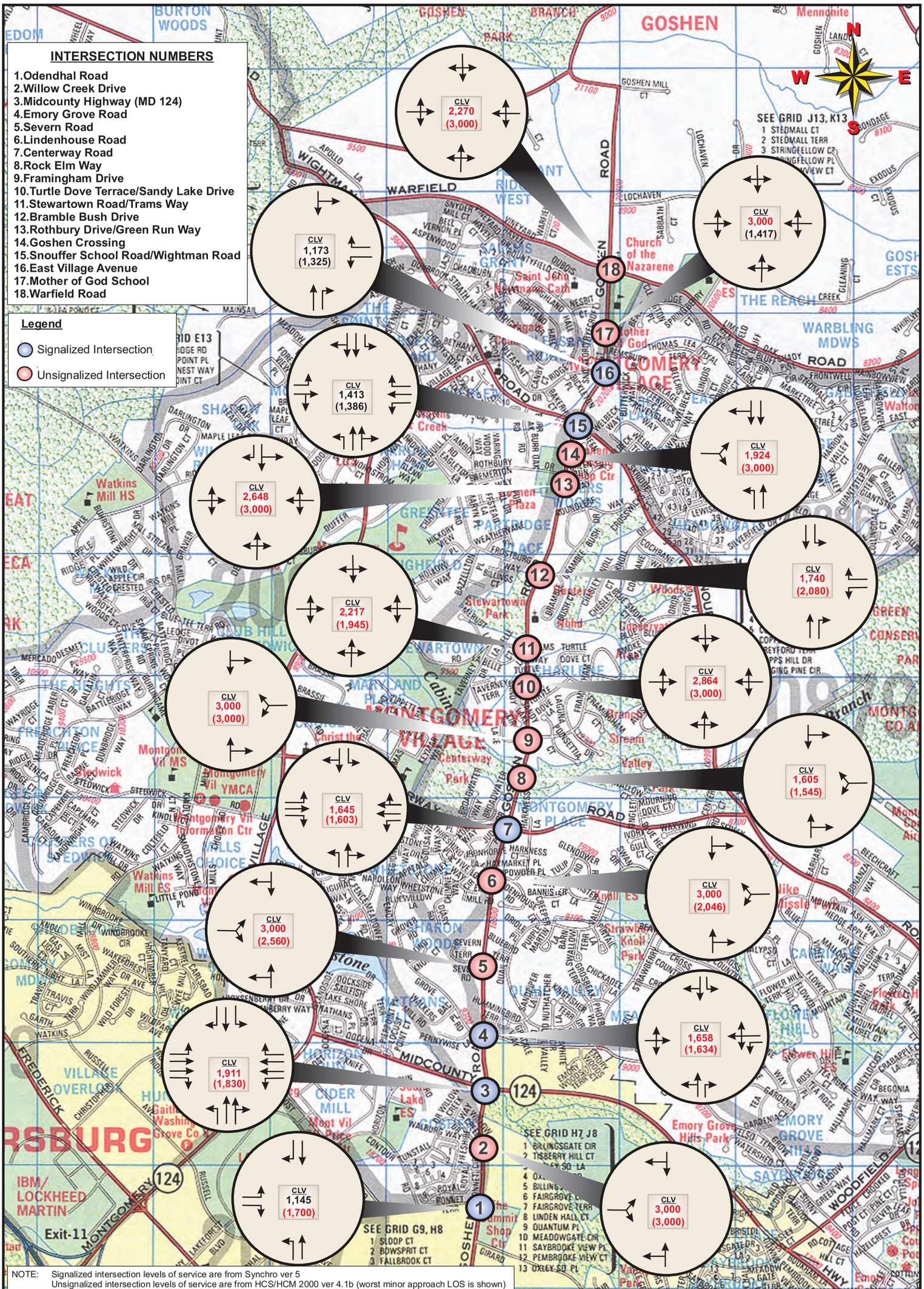
The overall AM and PM levels of service at this intersection would drop from an existing LOS C during both peak hours to a projected LOS D during both peak hours. The eastbound approach along Centerway Road would operate at LOS E during the AM peak hour and the southbound approach along Goshen Road would operate at LOS F during the PM peak. The decreased levels of service on these approaches are mainly due to the projected increase in traffic volumes along Goshen Road.

5. Snouffer School Road *CLV = 1,413 (1,386)*

The eastbound and westbound approaches of Snouffer School Road would operate at LOS F during the PM peak in 2015 due to the relatively high volumes that are protected on the minor approaches. This intersection is projected to operate at LOS C during the AM peak hour and LOS E during the PM peak hour. Under current 2002 conditions, this intersection operates at LOS B in the AM peak hour and LOS D in the PM peak hour.

6. East Village Avenue *CLV = 1,173 (1,325)*

Under 2015 No Build conditions, the intersection of East Village Avenue would operate at LOS B during the AM and PM peak hours. When compared to the existing operating conditions of LOS A, this appears to be an insignificant change.


INTERSECTION NUMBERS
1.Odendhal Road
2.Willow Creek Drive
3.Midcounty Highway (MD 124)
4.Emory Grove Road
5.Severn Road
6.Lindenhouse Road
7.Centerway Road
8.Rock Elm Way
9.Framingham Drive
10.Turtle Dove Terrace/Sandy Lake Drive
11.Stewartown Road/Trams Way
12.Bramble Bush Drive
13.Rothbury Drive/Green Run Way
14.Goshen Crossing
15.Snouffer School Road/Wightman Road
16.East Village Avenue
17.Mother of God School
18.Warfield Road
Legend
Signalized Intersection
Unsignalized Intersection
CLV 2,270 (3,000)
CLV 1,173 (1,325)
CLV 3,000 (1,417)
CLV 1,413 (1,386)
CLV 1,924 (3,000)
CLV 2,648 (3,000)
CLV 1,740 (2,080)
CLV 2,217 (1,945)
CLV 2,864 (3,000)
CLV 3,000 (3,000)
CLV 1,605 (1,545)
CLV 1,645 (1,603)
CLV 3,000 (2,046)
CLV 3,000 (2,560)
CLV 1,658 (1,634)
CLV 1,911 (1,830)
CLV 1,145 (1,700)
CLV 3,000 (3,000)
SEE GRID J13, K13
SEE GRID H7, J8
SEE GRID G9, H8
NOTE: Signalized intersection levels of service are from Synchro ver 5
Unsignalized intersection levels of service are from HCS/HCM 2000 ver 4.1b (worst minor approach LOS is shown)
Key Map of Montgomery County
STUDY SITE
TRAFFIC ENGINEERING STUDY AREA
GOSHEN ROAD
2015 No Build Levels of Service
Rummel, Klepper & Kahl, LLP
Consulting Engineers
Date: July 2003
Figure 26

## B. 2015 Two Lanes with Improvements Alternative

This alternative assumes that no additional through lanes will be constructed along the *entire* length of Goshen Road, but that spot capacity improvements will be made at certain intersections throughout the corridor in order to achieve a CLV of 1,500 or less in design years 2015 and 2025 (these improvements are shown in red on the level of service graphics).

By the year 2015, all of the unsignalized intersections would operate at unacceptable conditions. Ten of these intersections would continue to operate at unacceptable conditions even geometric improvements. The improvements that were applied included separate left turn lanes on minor approaches and the construction of a median on Goshen Road to allow for left turn bays on Goshen Road and allow a two-stage gap acceptance for left turns from the minor approaches. The following is a list of intersections that would continue to operate at unacceptable conditions with a possible improvement to allow for acceptable operations in the future.

1. Willow Creek Drive - Possibly restrict left turns from Goshen Road and from Willow Creek Drive.
2. Severn Road - Possibly restrict left turns from Severn Road.
3. Lindenhouse Road - Possibly restrict left turns from Lindenhouse Road.
4. Framingham Drive - Possibly install a signal if signal warrants are met.
5. Turtle Dove Terrace / Sandy Lake Drive - Possibly restrict left turns from Turtle Dove Terrace.
6. Stewartown Road / Trams Way - Possibly restrict left turns from Trams Way or possibly install signal if warrants are met.
7. Rothbury Drive / Green Run Way – Possibly install signal if warrants are met.
8. Goshen Crossing – Possibly restrict left turns from Goshen Road and from Goshen Crossing.
9. Mother of God School – Possibly restrict left turns from the Mother of God School and provide alternate access onto Warfield Road.
10. Warfield Road – Possibly install signal if warrants are met.

To obtain a CLV of 1,500 or less, modifications would be needed at the following intersections:

- **Odendhal Avenue** - A second eastbound left-turn lane would be added.
- **Midcounty Highway** - The intersection would need to be modified significantly by adding a third northbound through lane with an exclusive right turn lane, a second southbound through lane and a second westbound left-turn lane.
- **Emory Grove Road** - A second through lane would be added to the northbound and southbound approaches along with an exclusive northbound left turn lane.
- **Centerway Road** - A second through lane would be added to the northbound and southbound approaches.
- **Snouffer School Road/Wightman Road** - A third northbound through lane with an exclusive right would be added along with a second through lane on the eastbound approach. A second westbound through lane would be added. Protected left turn phases would be added to all approaches at this intersection.

- **East Village Avenue -** A second northbound through lane would be added.

The expected traffic operations and levels of service under this alternative were compared to those under the 2015 No Build alternative. Figure 27 shows the lane configurations and CLV values at each intersection during the 2015 Two-Lane Improved alternative. Other significant findings from the comparison are discussed below:

1. Odendhal Avenue *CLV = 1,075 (1,384)*

Under the Two Lanes with Improvements alternative, the overall AM peak hour level of service at this intersection would remain within the very good range (LOS A) with minimal delay. The overall PM peak hour level of service would improve significantly over the No Build alternative (from LOS E to LOS C), with the overall intersection delay being reduced by more than 30 seconds per vehicle.

2. Midcounty Highway *CLV = 1,345 (1,366)*

The modifications proposed for the Midcounty Highway intersection would improve traffic operations at this location from LOS F for both peak hours under the No Build alternative to LOS D during both peak hours. However, as noted previously, the improvements needed to reach a CLV less than 1,500 are extensive.

3. Emory Grove Road *CLV = 1,035 (1,179)*

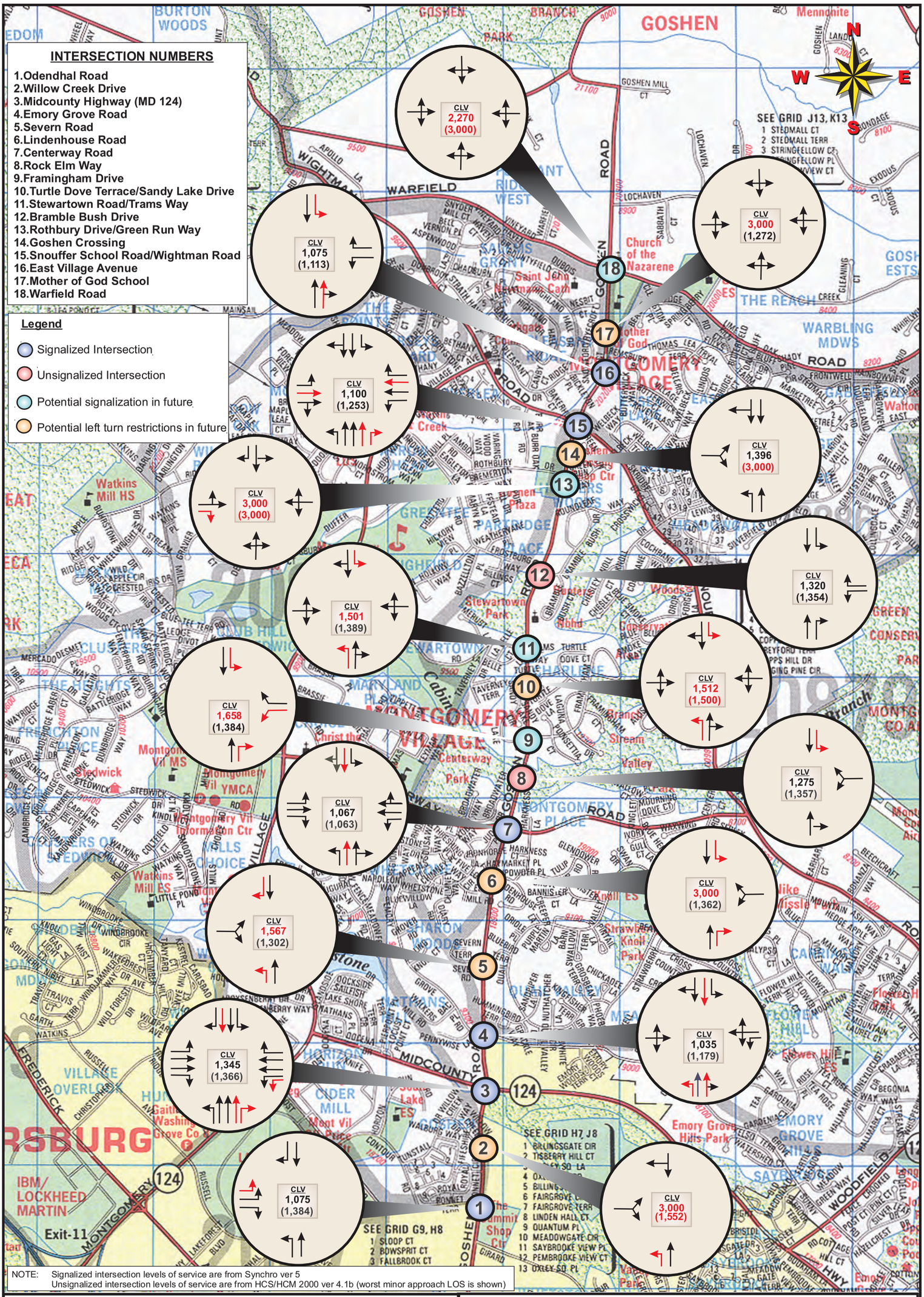
The improvements suggested under this alternative for the Emory Grove Road intersection would result in very good operation (LOS A/B) during both peak hours. These levels of service are much improved over the corresponding No Build levels, which were LOS F during the AM peak hour and LOS D during the PM peak. With the improvements, all four intersection approaches would operate at LOS D or better during the peak hours.

4. Centerway Road *CLV = 1,067 (1,063)*

Under the No Build alternative, this intersection was projected to operate at LOS D during both the AM and PM peak hours in 2015, but at LOS E/F in 2025. With the changes proposed under the Two Lanes with Improvements alternative, traffic operations would improve to LOS B during the AM and PM peak hours, with reductions in overall intersection delay of approximately 25 seconds per vehicle. The eastbound and westbound approaches along Centerway Road would continue to experience worse operating conditions than the Goshen Road approaches; however, all approaches would operate at LOS D or better during the peak hours.

5. Snouffer School Road/Wightman Road *CLV = 1,100 (1,253)*

The PM peak hour level of service at this intersection would improve from LOS E under the No Build alternative to LOS D with the proposed intersection modifications under this alternative. The AM peak hour level of service would remain unchanged at LOS C.




Key Map of Montgomery County

STUDY SITE

# TRAFFIC ENGINEERING STUDY AREA

## GOSHEN ROAD
## 2015 Two-Lane Improved Levels of Service

Rummel, Klepper & Kahl, LLP
*Consulting Engineers*

Date: July 2003

Figure 27

## C. 2015 Four Lane Alternative

To address the relatively high traffic control device-related delays at the unsignalized intersections and the large percentage of intersection related accidents and rear end collisions throughout the corridor, this improvement alternative assumes that Goshen Road would be widened to a four-lane divided roadway with a median area wide enough to accommodate exclusive left turn lanes on Goshen Road and median storage for one left turning vehicle from a minor street at unsignalized intersections. The AM and PM peak hour Synchro networks from the Two Lane with Improvements alternative were altered to reflect the lane changes incorporated into the Four Lane alternative (shown in red on Figure 28).

The intersection at Warfield Road was assumed to be signalized (currently four-way stop controlled) during the Four Lane and Six Lane alternatives. The intersection was assumed to be signalized because, if Goshen Road were expanded to four or six lanes, an all-way stop controlled intersection would not be desirable. In addition, the intersection would likely meet Warrant 8 - Roadway Network, of the 2000 edition of the Manual on Uniform Traffic Control Devices (MUTCD).

Significant improvements would occur at the unsignalized intersections due to the two-stage gap acceptance allowed by the median. With a two-stage gap acceptance, passenger cars are allowed to wait in the median prior to completing the second stage of their turns (thereby reducing minor street delay). There are three unsignalized intersections that would continue to operate at unacceptable conditions during the Four Lane alternative. These intersections are at Rothbury Drive / Green Run Way, Goshen Crossing, and Mother of God School. The same improvement options recommended for these intersections during the Two Lane with Improvements would continue to allow for acceptable operations during the Four Lane Alternative.

To obtain a CLV of 1,500 or less, modifications would be needed at the following intersections (shown in red on Figure 28):

- An additional through lane would be added to Goshen Road in each direction throughout the study corridor.
- Exclusive left turn lanes would be added to Goshen Road at each intersection.
- **Midcounty Highway** - A second left turn lane would be added to the southbound approach along with a third eastbound through lane.
- **Centerway Road** –Protected left turn phases would be added to all of the approaches at the intersection.
- **Snouffer School Road / Wightman Road** – The exclusive northbound right turn lane would be turned into a shared right turn lane.

Figure 28 shows the lane configurations and CLV values at each intersection during the 2015 Four-Lane alternative. The following is a discussion of the significant findings from the analysis of the signalized intersections. All comparisons are between the 2015 Four Lane alternative and 2015 Two Lanes with Improvements alternative.

1. Odendhal Avenue *CLV = 880 (1,322)*

A comparison of the projected traffic operations at this intersection under the Two Lanes with Improvements and the Four Lane alternatives shows that there would not be any significant change in delay or level of service during either the AM or PM peak hours.

2. Midcounty Highway *CLV = 1,249 (1,353)*

The overall level of service at this intersection would be LOS D during both the AM and PM peak hours under both alternatives. The highest amounts of delay would be along Midcounty Highway.

3. Emory Grove Road *CLV = 1,089 (1,111)*

The Emory Grove Road intersection would continue to operate at LOS B during both the AM peak hours. Westbound Emory Grove Road would experience the most delay and worst levels of service (LOS D) of all four approaches during both the AM and PM peak hours.

4. Centerway Road *CLV = 1,225 (1,312)*

The Centerway intersection would operate at LOS C during both peak hours. This intersection was projected to operate at LOS B during both the AM and PM peak hours under the Two Lanes with Improvements alternative. The decreased level of service during the Four Lane alternative is primarily due to higher volumes at the intersection.

5. Snouffer School Road/Wightman Road *CLV = 1,393 (1,424)*

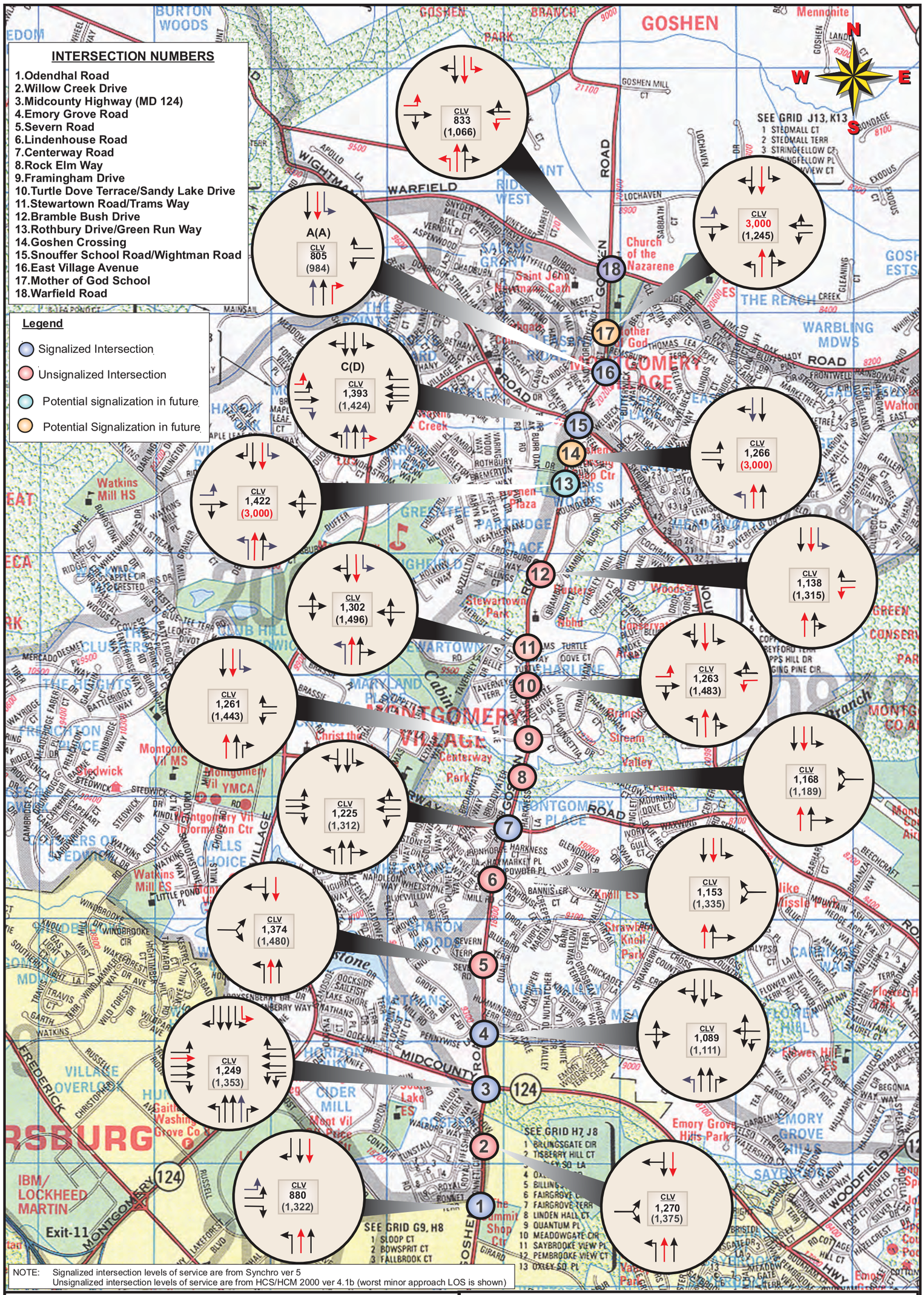
With four lanes along Goshen Road, the overall level of service at this intersection would be LOS C during the AM peak hour and LOS D during the PM peak hour. The intersection operates at similarly to the Two Lane with Improvements alternative.

6. East Village Avenue *CLV = 805 (984)*

With four lanes along Goshen Road, this intersection would continue to operate at very good levels of service (LOS A) during the AM and PM peak hours.

7. Warfield Road *CLV = 833 (1,066)*

The Warfield intersection would operate at LOS B during both peak hours with the addition of a traffic signal. During the Two-Lane with Improvements alternative the intersection would be controlled with an all-way stop and was projected to operate at LOS F during both peak hours.




Key Map of Montgomery County

STUDY SITE

# TRAFFIC ENGINEERING STUDY AREA

## GOSHEN ROAD
## 2015 Four-Lane Levels of Service

Rummel, Klepper & Kahl, LLP
*Consulting Engineers*

Date: July 2003

Figure 28

## D. 2015 Six Lane Alternative

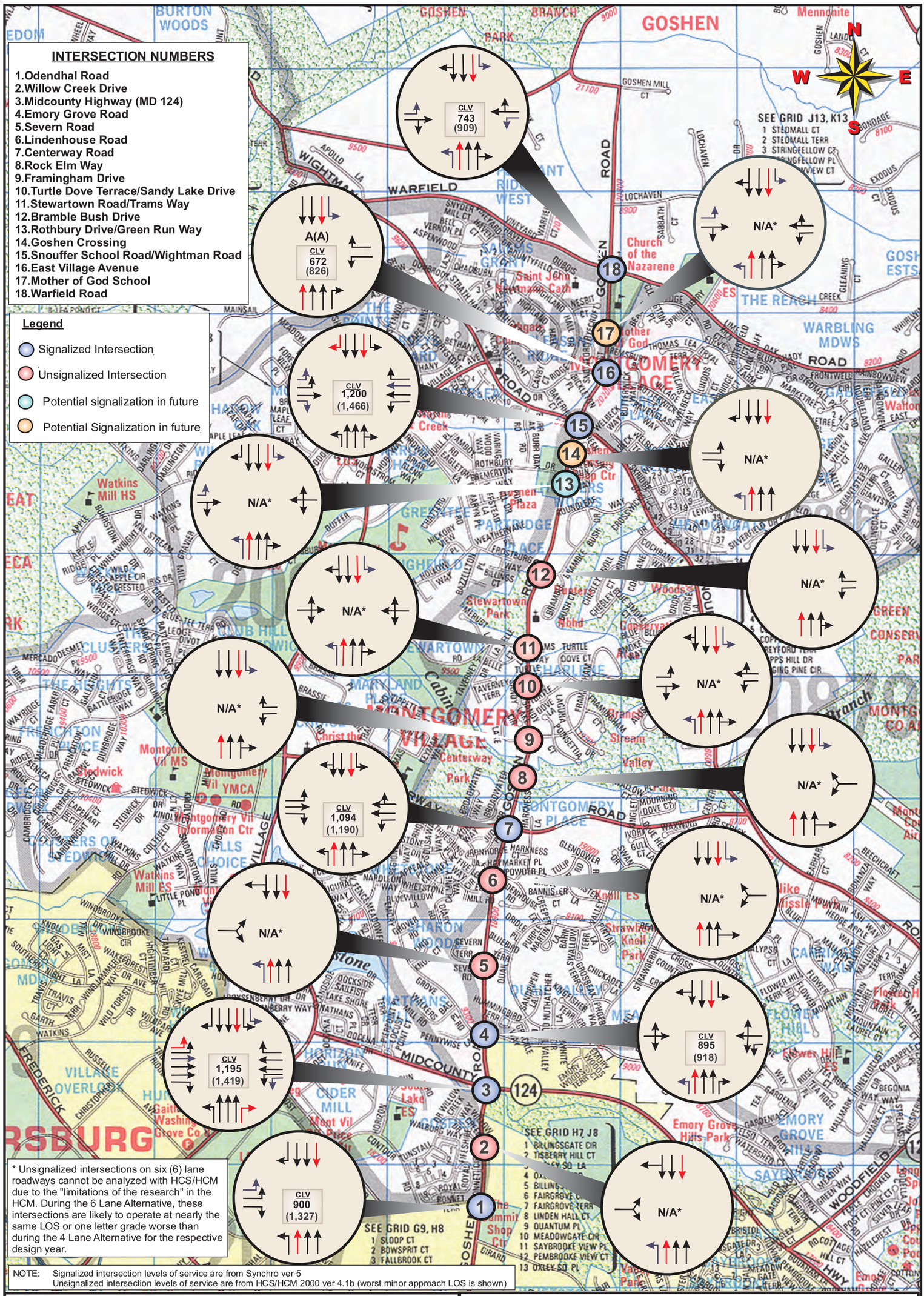
As with the Four Lane alternative, Goshen Road was assumed to be a divided roadway under the Six Lane alternative. The unsignalized intersections could not be analyzed using the HCS under this Six Lane alternative due to the limitations of the HCM methodology, which stipulates that each major-street approach can have a maximum of two (2) through lanes and one (1) exclusive right and/or left turn lane. Therefore, it was assumed that these intersections would likely operate at approximately the same level of service or slightly worse than with the Four Lane alternative. This assumption was based on the following factors:

- With six lanes on Goshen Road, vehicles turning left from the minor streets would have to cross more lanes on the mainline to complete their turns.
- Although the six lane alternative would increase the capacity along Goshen Road, the likelihood of obtaining an acceptable gap across all three lanes simultaneously in one direction might be similar to or worse than under the Four Lane alternative, depending on the degree of platooning among mainline through vehicles.

Figure 29 shows the lane configurations and CLV values at the signalized intersection during the 2015 Six Lane alternative. The following changes were made to the Four Lane Synchro networks to be used in the analysis of the Six Lane alternative (shown in red in Figure 29):

- An additional through lane would be added to Goshen Road in each direction throughout the study corridor.
- **Midcounty Highway** - An exclusive right turn lane would be added to the northbound approach.
- **Snouffer School Road/Wightman Road** - An exclusive right turn lane would be added to the southbound approach.

The analysis results indicate that the addition of the third through lane on Goshen Road would have limited effects on operations at the signalized intersections along the corridor, with little change in levels of service when compared to the Four Lane alternative. Only the intersection at Emory Grove Road would experience a level of service improvement under this alternative (compared to the Four Lane alternative): LOS B to LOS A during the PM peak hour.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14.Goshen Crossing
15.Snouffer School Road/Wightman Road
16.East Village Avenue
17.Mother of God School
18.Warfield Road
Legend
Signalized Intersection
Unsignalized Intersection
Potential signalization in future
Potential Signalization in future
CLV 743 (909)
A(A) CLV 672 (826)
CLV 1,200 (1,466)
N/A*
CLV 1,094 (1,190)
CLV 1,195 (1,419)
CLV 900 (1,327)
CLV 895 (918)
SEE GRID J13, K13
SEE GRID H7, J8
SEE GRID G9, H8
* Unsignalized intersections on six (6) lane roadways cannot be analyzed with HCS/HCM due to the "limitations of the research" in the HCM. During the 6 Lane Alternative, these intersections are likely to operate at nearly the same LOS or one letter grade worse than during the 4 Lane Alternative for the respective design year.
NOTE: Signalized intersection levels of service are from Synchro ver 5
Unsignalized intersection levels of service are from HCS/HCM 2000 ver 4.1b (worst minor approach LOS is shown)
Key Map of Montgomery County
STUDY SITE
TRAFFIC ENGINEERING STUDY AREA
GOSHEN ROAD
2015 Six-Lane Levels of Service
Rummel, Klepper & Kahl, LLP
Consulting Engineers
Date: July 2003
Figure 29

**Goshen Road Corridor Study**
**Montgomery County DPW&T**

**RK&K Engineers, LLP**
**July 2003**

## Table 10
## 2015 Alternatives Summary Table - LOS and Control Delay (sec/veh)

| Goshen Road Intersections | 2015 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No Build | | | | | | Two Lanes - Improved [4] | | | | | | Four Lanes [4] | | | | | | Six Lanes [4] | | | | | |
| | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] |
| **AM Peak** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Odendhal Avenue | B 13 | A 7 | C 30 | - | B 12 | 1,145 | A 3 | A 4 | C 25 | - | A 7 | 1,075 | A 3 | A 2 | C 24 | - | A 6 | 880 | A 3 | A 2 | C 22 | - | A 7 | 900 |
| 2 Willow Creek Drive | E 45 | - | F >999 | - | F >999 | 3,000 [3] | F 52 | - | F 193 | - | F 193 | 3,000 [3] Possible R-in, R-out | B 12 | - | C 23 | - | C 23 | 1,270 | - | - | - | - | ★ | ★ |
| 3 Midcounty Highway (MD 124) | C 21 | F 114 | F 150 | E 80 | F 106 | 1,911 | C 21 | D 51 | E 60 | D 44 | D 49 | 1,345 | B 14 | D 49 | D 48 | D 45 | D 44 | 1,249 | B 18 | D 37 | E 63 | D 53 | D 47 | 1,195 |
| 4 Emory Grove Road | A 3 | F 95 | C 21 | F 131 | F 81 | 1,638 | A 9 | A 7 | C 23 | D 45 | B 15 | 1,035 | B 12 | A 5 | C 28 | D 44 | B 15 | 1,089 | B 13 | A 6 | C 23 | D 43 | B 15 | 895 |
| 5 Severn Road | B 14 | - | F 544 | - | F 544 | 3,000 [3] | B 14 | - | E 47 | - | E 47 | 1,567 Possible R-out | B 15 | - | D 30 | - | D 30 | 1,374 | - | - | - | - | ★ | ★ |
| 6 Lindenhouse Road | - | A 8 | - | F >999 | F >999 | 3,000 [3] | - | A 8 | - | F 874 | F 874 | 3,000 [3] Possible R-out | - | A 9 | - | C 15 | C 15 | 1,153 | - | - | - | - | ★ | ★ |
| 7 Centerway Road | A 7 | D 47 | E 64 | D 54 | D 44 | 1,645 | A 6 | B 13 | C 29 | D 39 | B 18 | 1,067 | B 12 | C 22 | C 31 | D 37 | C 24 | 1,225 | B 13 | C 24 | C 26 | C 33 | C 24 | 1,094 |
| 8 Rock Elm Way | - | A 8 | - | F 51 | F 51 | 1,609 | - | A 8 | - | C 23 | C 23 | 1,275 Possible R-in, R-out | - | A 9 | - | C 16 | C 16 | 1,168 | - | - | - | - | ★ | ★ |
| 9 Framingham Drive | - | A 8 | - | F 472 | F 472 | 3,000 [3] | - | A 8 | - | F 56 | F 56 | 1,658 Possible Signal | - | A 9 | - | C 24 | C 24 | 1,281 | - | - | - | - | ★ | ★ |
| 10 Turtle Dove Terrace / Sandy Lake Drive | B 12 | A 8 | F 64 | F 176 | F 176 | 2,864 | B 12 | A 8 | D 32 | E 41 | E 41 | 1,512 Possible R-out | B 12 | A 9 | C 23 | C 21 | C 23 | 1,263 | - | - | - | - | ★ | ★ |
| 11 Stewartown Road / Trams Way | B 12 | A 8 | F 103 | F 112 | F 112 | 2,217 | B 12 | A 8 | E 39 | E 40 | E 40 | 1,501 Possible signal | B 13 | A 9 | C 27 | C 25 | C 27 | 1,302 | - | - | - | - | ★ | ★ |
| 12 Bramble Bush Drive | - | A 8 | - | F 64 | F 64 | 1,740 | - | A 8 | - | D 26 | D 26 | 1,320 | - | A 9 | - | B 15 | B 15 | 1,138 | - | - | - | - | ★ | ★ |
| 13 Rothbury Drive / Green Run Way | B 12 | A 8 | F 155 | F 85 | F 155 | 2,648 | B 11 | A 8 | E 37 | F 377 | F 377 | 3,000 [3] Possible Signal | B 12 | A 8 | D 23 | C 20 | C 20 | 1,422 Possible Signal | - | - | - | - | ★ | ★ |
| 14 Goshen Crossing | B 12 | - | F 82 | - | F 82 | 1,824 | B 13 | - | D 31 | - | D 31 | 1,396 Possible R-in, R-out | B 12 | - | C 23 | - | C 23 | 1,266 Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 Snouffer School Road / Wigthman Road | B 16 | C 25 | B 15 | C 27 | C 21 | 1,413 | B 16 | C 27 | D 42 | C 34 | C 31 | 1,100 | B 17 | C 27 | D 44 | C 31 | C 31 | 1,393 | C 28 | C 27 | D 36 | C 24 | C 29 | 1,200 |
| 16 East Village Avenue | A 4 | B 11 | - | C 20 | B 10 | 1,173 | A 8 | A 8 | - | C 20 | B 11 | 1,075 | A 7 | A 4 | - | B 15 | A 8 | 805 | A 7 | A 9 | - | B 14 | A 9 | 672 |
| 17 Mother of God School | A 9 | A 9 | B 15 | F >999 | F >999 | 3,000 [3] | A 9 | A 9 | B 15 | F 434 | F 434 | 3,000 [3] Possible R-out | B 10 | A 10 | B 12 | F 193 | F 193 | 3000 [3] Possible R-out | - | - | - | - | ★ | ★ |
| 18 Warfield Road | E 49 | F 205 | B 14 | C 17 | F 117 | 2,270 | E 48 | F 205 | B 14 | C 17 | F 117 | 2,270 Possible Signal | A 5 | B 13 | D 45 | D 39 | B 18 | 833 Signalized | A 3 | B 13 | D 44 | D 39 | B 17 | 743 Signalized |
| **PM Peak** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Odendhal Avenue | E 70 | C 21 | F 86 | - | E 59 | 1,709 | C 28 | C 21 | C 33 | - | C 27 | 1,384 | B 16 | C 21 | D 36 | - | C 24 | 1,322 | B 18 | C 23 | D 36 | - | C 25 | 1,327 |
| 2 Willow Creek Drive | B 11 | - | F 525 | - | F 525 | 3,000 [3] | B 11 | - | E 45 | - | E 45 | 1,552 Possible R-in, R-out | B 12 | - | D 30 | - | D 30 | 1,375 | - | - | - | - | ★ | ★ |
| 3 Midcounty Highway (MD 124) | F 94 | D 46 | F 88 | F 115 | F 91 | 1,830 | C 24 | C 28 | D 45 | D 41 | D 35 | 1,366 | C 25 | C 32 | D 38 | D 45 | D 35 | 1,481 | D 45 | C 26 | D 53 | E 65 | D 50 | 1,419 |
| 4 Emory Grove Road | D 54 | A 3 | C 30 | D 52 | D 38 | 1,634 | A 5 | A 6 | C 29 | D 43 | A 10 | 1,179 | A 8 | A 5 | C 33 | D 42 | B 11 | 1,111 | A 5 | A 5 | C 33 | D 38 | A 9 | 918 |
| 5 Severn Road | A 9 | - | F 146 | - | F 146 | 2,566 | A 9 | - | D 25 | - | D 25 | 1,302 Possible R-out | A 10 | - | E 38 | - | E 38 | 1,480 | - | - | - | - | ★ | ★ |
| 6 Lindenhouse Road | - | B 13 | - | F 95 | F 95 | 2,046 | - | B 13 | - | D 29 | D 29 | 1,362 Possible R-out | - | B 15 | - | D 27 | D 27 | 1,335 | - | - | - | - | ★ | ★ |
| 7 Centerway Road | C 29 | E 75 | D 52 | D 41 | D 45 | 1,803 | A 6 | B 11 | C 31 | D 36 | B 16 | 1,063 | B 17 | B 16 | D 45 | D 43 | C 27 | 1,312 | C 21 | C 24 | D 36 | D 39 | C 27 | 1,190 |
| 8 Rock Elm Way | - | B 12 | - | E 45 | E 45 | 1,545 | - | C 15 | - | D 29 | D 29 | 1,357 Possible R-in, R-out | - | B 12 | - | C 18 | C 18 | 1,189 | - | - | - | - | ★ | ★ |
| 9 Framingham Drive | - | B 13 | - | F 193 | F 193 | 3,000 [3] | - | B 13 | - | D 31 | D 31 | 1,384 Possible Signal | - | C 15 | - | D 35 | D 35 | 1,443 | - | - | - | - | ★ | ★ |
| 10 Turtle Dove Terrace / Sandy Lake Drive | A 9 | B 12 | F 131 | F 218 | F 218 | 3,000 [3] | A 9 | B 12 | D 31 | E 40 | E 40 | 1,500 Possible R-out | A 10 | B 14 | C 22 | E 38 | E 38 | 1,483 | - | - | - | - | ★ | ★ |
| 11 Stewartown Road / Trams Way | A 9 | B 11 | F 75 | F 85 | F 85 | 1,945 | A 9 | B 11 | C 23 | D 31 | D 31 | 1,389 Possible Signal | A 9 | B 12 | C 18 | E 40 | E 40 | 1,496 | - | - | - | - | ★ | ★ |
| 12 Bramble Bush Drive | - | B 11 | - | F 98 | F 98 | 2,080 | - | B 11 | - | D 29 | D 29 | 1,354 | - | B 13 | - | D 26 | D 26 | 1,315 | - | - | - | - | ★ | ★ |
| 13 Rothbury Drive / Green Run Way | B 10 | B 10 | F >999 | F 462 | F >999 | 3,000 [3] | B 10 | B 10 | F 191 | F 53 | F 191 | 3,000 [3] Possible Signal | B 11 | B 11 | F 575 | F 55 | F 575 | 3,000 [3] Possible Signal | - | - | - | - | ★ | ★ |
| 14 Goshen Crossing | B 12 | - | F >999 | - | F >999 | 3,000 [3] | B 12 | - | F 954 | - | F 954 | 3,000 [3] Possible R-in, R-out | B 13 | - | F 761 | - | F 761 | 3,000 [3] Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 Snouffer School Road / Wigthman Road | D 39 | D 45 | F 99 | F 83 | E 67 | 1,386 | D 54 | D 40 | D 47 | D 43 | D 47 | 1,253 | D 39 | C 25 | D 46 | D 39 | D 39 | 1,424 | D 50 | C 34 | D 51 | D 48 | D 48 | 1,466 |
| 16 East Village Avenue | A 9 | A 9 | - | C 31 | B 11 | 1,325 | A 7 | A 7 | - | D 38 | B 10 | 1,113 | A 7 | A 3 | - | B 19 | A 8 | 984 | B 14 | A 7 | - | B 16 | B 13 | 1,090 |
| 17 Mother of God School | A 8 | B 11 | C 20 | D 33 | D 33 | 1,417 | A 8 | B 11 | B 15 | C 23 | C 23 | 1,272 Possible R-out | A 8 | B 12 | B 15 | C 21 | C 21 | 1,245 Possible R-out | - | - | - | - | ★ | ★ |
| 18 Warfield Road | F 597 | D 32 | C 20 | C 23 | F 424 | 3,000 [3] | F 597 | D 32 | C 20 | C 23 | F 424 | 3,000 [3] Possible Signal | A 9 | C 23 | D 46 | C 31 | B 18 | 1,066 Signalized | A 6 | B 15 | D 44 | C 30 | B 15 | 909 Signalized |

NOTE: LOS & delay at signalized intersections are from Synchro version 5
LOS & delay at unsignalized intersections are from HCS 2000 version 4.1b

[1] Operations for worst minor approach at unsignalized intersections (TWSC) are shown in overall intersection operation column
[2] CLV value for unsignalized intersections is based on equivalent delay from HCS (1,500 CLV = 40.0 sec/veh)
[3] Maximum CLV for unsignalized intersections was capped at 3,000
[4] Build Alternatives were analyzed with two stage gap acceptance, assuming storage in median for one vehicle turning left from minor approach.
[5] Unsignalized intersections on six lane roadways can not be analyzed with HCS/HCM due to the "limitations of the research" in the HCM

## E. 2015 Arterial Capacity Analyses

Figures 30 and 31 show the results of the 2015 arterial analyses for the AM and PM peak hours respectively. The running time, stopped time and total travel time are shown for the Existing (2002), 2015 No Build, 2015 Two Lane with Improvements, 2015 Four Lane, and 2015 Six Lane alternatives. In general, the running times during the Existing, No Build, Two Lane with Improvements alternatives should be relatively the same because the same links speeds were assumed throughout those alternatives. Conversely, the stopped time should change for each scenario due to capacity changes at each intersection. The running times for the Four Lane and Six Lane alternatives should decrease because faster link speeds were assumed during those alternatives. The basis for this assumption is that the geometric improvements included in these alternatives, such as increasing the radius of horizontal curves, flattening vertical curves, providing left turn lanes, and adding through lanes may facilitate higher speeds. As such, the link speeds were assumed to be 5 miles per hour higher than the existing link speeds during the Four Lane alternative and 10 miles per hour higher during the Six Lane alternative.

The signal timings used during the 2015 No Build alternative were optimized during the analyses; so some of the stopped times for the 2015 No Build alternatives may be less than the Existing (2002) stopped times, which were based on actual timings.

The results indicate that travel times in the peak direction of travel during each peak hour, (i.e., the southbound direction during the AM peak hour and the northbound direction in the PM peak hour) during the 2015 No Build alternative increase. The travel time in the southbound direction during the AM peak hour would increase by approximately 28 percent (2.5 minutes) compared to Existing (2002) conditions. The travel time in the northbound direction during the PM peak would increase by approximately 20 percent (2 minutes) as compared to Existing (2002) conditions.

Travel times for each of the build alternatives decrease consecutively in each direction during both peak hours. The decreased travel time is a result of reduced intersection delay (proportional to the additional capacity for each of alternative), plus the reduced running times/faster link speeds (Four Lane and Six Lane alternatives). The Synchro results indicated that the travel times for the Four Lane and Six Lane alternatives in 2015 are expected to be less than during the existing conditions.

**Figure 30: Summary of Travel Times for 2015 Alternatives (AM Peak)**

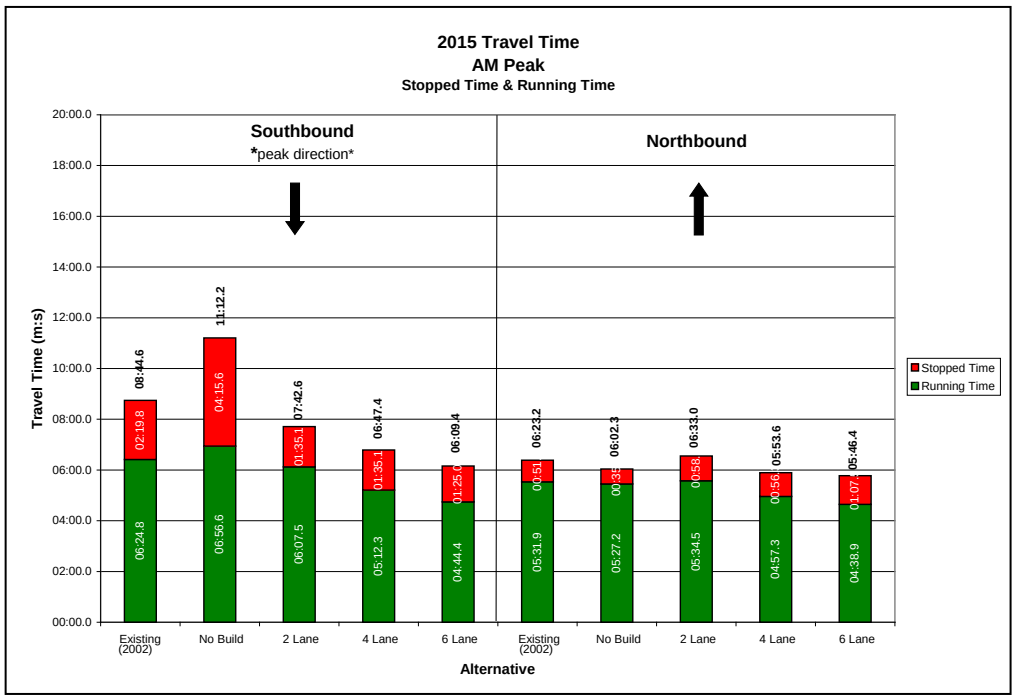
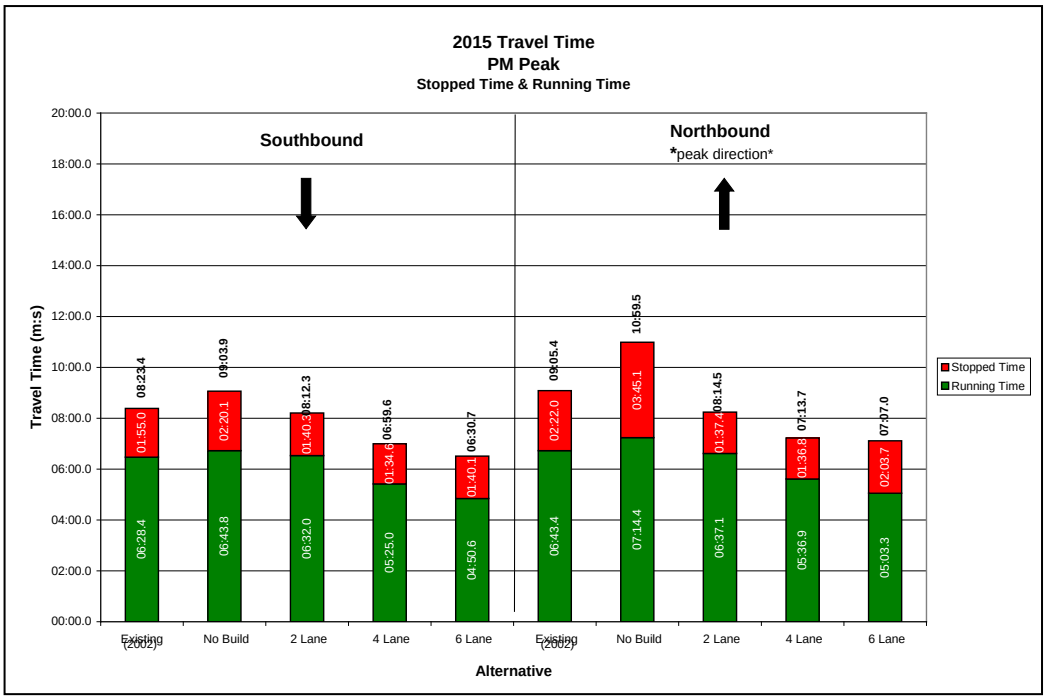



**Figure 31: Summary of Travel Times for 2015 Alternatives (PM Peak)**



# V. Analysis of Year 2025 Alternatives

Each intersection along Goshen Road was analyzed with Synchro using the projected year 2025 traffic volumes for four alternatives: No Build (Two Lanes), Two Lanes with Improvements (including signalization of key intersections and restricting left turns at other intersections), Four Lane, and Six Lane. Table 11 summarizes the intersection levels of service for each of these 2025 alternatives. The results of the capacity analyses for each intersection and each 2025 alternative are summarized below.

## A. 2025 No Build Alternative

The existing lane configurations and optimized signal timings were used for the analysis of the 2025 No Build condition. Under the 2025 No Build condition, all 18 intersections along the Goshen Road corridor are expected to operate at unacceptable conditions due to the higher volumes along Goshen Road. Figure 32 shows the lane configurations and CLV values at each intersection during the 2025 No Build alternative. The analysis results were similar to those for the 2015 No Build alternative, with the following exceptions:

1. Odendhal Avenue *CLV = 1,170 (1,805)*

   At this intersection, the AM peak hour level of service would remain the same as in 2015 (LOS B). However, during the PM peak hour in 2025, this intersection would operate at LOS F, down from LOS E under the 2015 No Build alternative.

2. Centerway Road *CLV = 1,770 (1,860)*

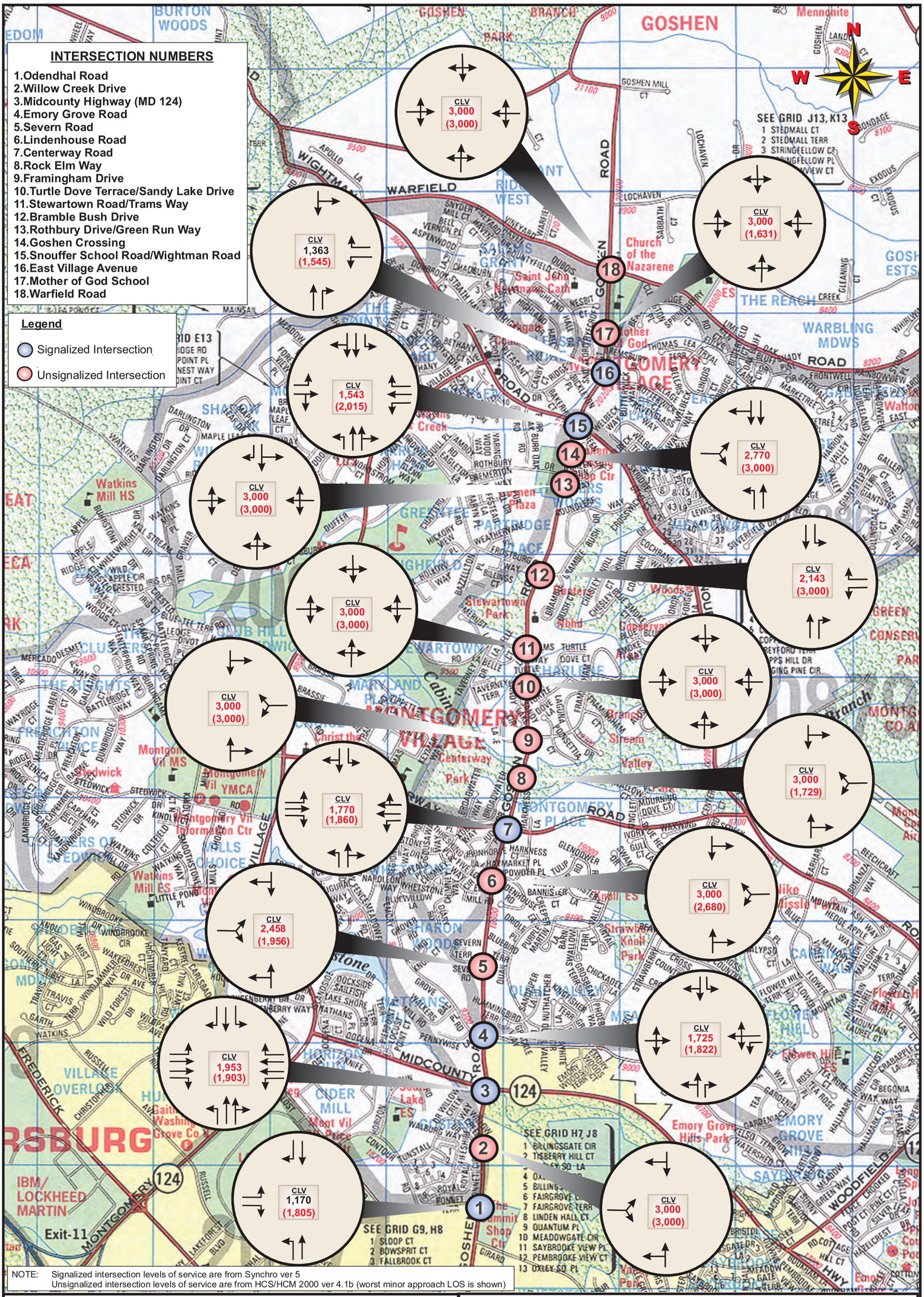
   The level of service at this intersection would decrease from LOS D to LOS E during the AM peak and LOS F during the PM peak under the 2025 No Build alternative. The most significant increase in delay would occur along the northbound Goshen Road approach during the PM peak hour (from 29 sec/veh to 114 sec/veh).

3. Snouffer School Road/Wightman Road *CLV = 1,543 (2,015)*

   The AM peak hour level of service would remain at LOS C in 2025 while the PM peak hour level of service would drop from LOS E to LOS F in 2025.

4. East Village Avenue *CLV = 1,363 (1,545)*

   The PM peak hour level of service would decrease from LOS B under the 2015 No Build alternative to LOS F under the 2025 No Build alternative. This decline can most likely be attributed to the increased traffic volume along northbound Goshen Road combined with the presence of only a shared through/left-turn lane along southbound Goshen Road. A more detailed analysis reveals that the northbound and southbound approach levels of service would drop from LOS B to LOS E/F in 2025, with an increase in southbound delay of almost five (5) minutes per vehicle.




Key Map of Montgomery County

STUDY SITE

# TRAFFIC ENGINEERING STUDY AREA

## GOSHEN ROAD
## 2025 No Build Levels of Service

Rummel, Klepper & Kahl, LLP
*Consulting Engineers*

Date: July 2003

Figure 32

## B. 2025 Two Lanes with Improvements Alternative

As in 2015, this alternative assumes that no additional through lanes will be constructed along the *entire* length of Goshen Road, but that spot capacity improvements will be made at certain intersections throughout the corridor. The same modifications that were proposed under the 2015 Two Lanes with Improvements alternative were used in the analysis of this alternative for 2025 (see section IV-B of this report for a detailed listing of the intersection improvements).

By 2025, all of the unsignalized intersections would operate at unacceptable conditions if no improvements were made to Goshen Road. Eleven of these intersections would continue to operate at unacceptable conditions even geometric improvements. These intersections include the ten intersections predicted to operate at unacceptable operations in 2015 for the Two Lane with Improvement alternative, as well as the Rock Elm Way intersection. One possible improvement to reach acceptable operation at this intersection in the future would be to restrict left turns from Goshen Road and from Rock Elm Way.

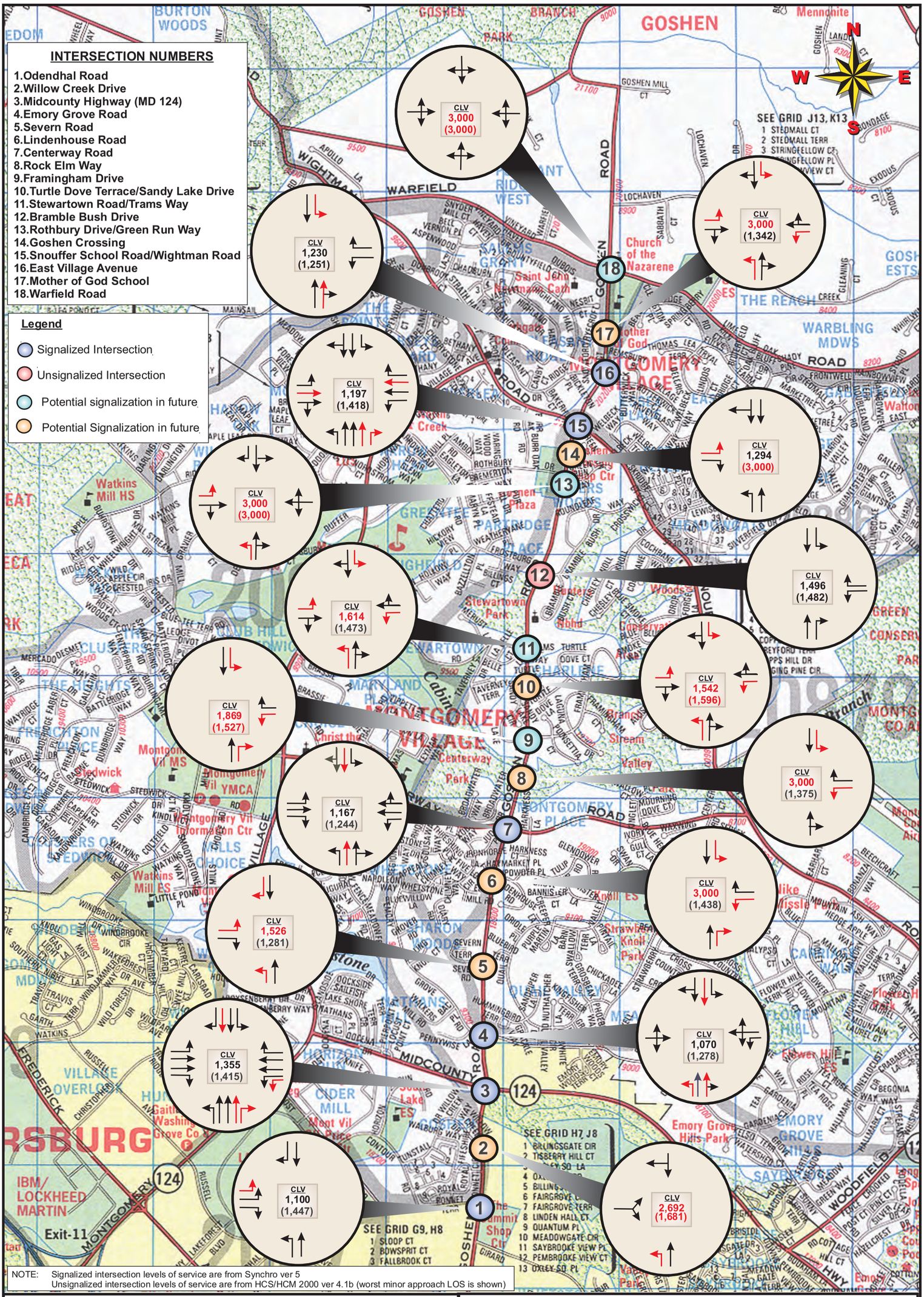
Figure 33 shows the lane configurations and CLV values at each intersection during the 2025 Two-Lane Improved alternative. The remaining intersections would operate at CLV 1,500 or less under this alternative during both the AM and PM peak hours. The results of the capacity analyses showed that there would be no significant changes in levels of service at any of the 18 intersections along Goshen Road when compared to the 2015 Two Lanes with Improvements alternative.

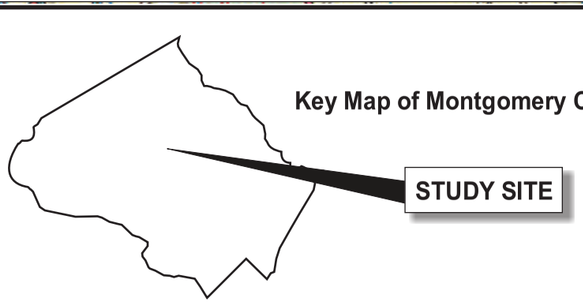
## C. 2025 Four Lane Alternative

The analysis of the 2025 Four Lane alternative was performed using the same lane configurations that were used for the 2015 Four Lane alternative. Figure 34 shows the lane configurations and CLV values at each intersection during the 2015 Four-Lane alternative. The Synchro analysis results for 2025 indicate that there would be similar or only slightly better traffic operations at each signalized intersection along Goshen Road when compared to the 2025 Two Lanes with Improvements alternative. All of the signalized intersections would continue to operate at CLV 1,500 or less during both the AM and PM peak hours.

However, compared to the 2025 Two Lanes with Improvements alternative, significant improvements in traffic operations would be realized at the unsignalized intersections during the AM and PM peak hours using 2025 volumes with four lanes. These improved levels of service are the result of the two-stage gap acceptance process made available to left-turning vehicles by the wide median proposed along Goshen Road, which would allow passenger cars to wait in the median prior to completing the second stage of their turns (thereby reducing minor street delay). The same three intersections that would operate at unacceptable conditions in 2015 would continue to operate unacceptably in 2025 under the Four Lane alternative (Rothbury Drive / Green Run Way, Goshen Crossing, and Mother of God School).

A brief evaluation of the 2025 projected PM peak hour volumes along a four lane Goshen Road with no additional roadway improvements in the Montgomery Village/Airpark policy area was performed. The evaluation of this data confirms that traffic volumes along a four lane Goshen Road in 2025 will be noticeably higher without the planned improvements to other roads in this policy area than they would be if all of the planned policy area roadway improvements are constructed. A plot showing the unadjusted PM peak hour link volumes for this special case is provided in Appendix J.



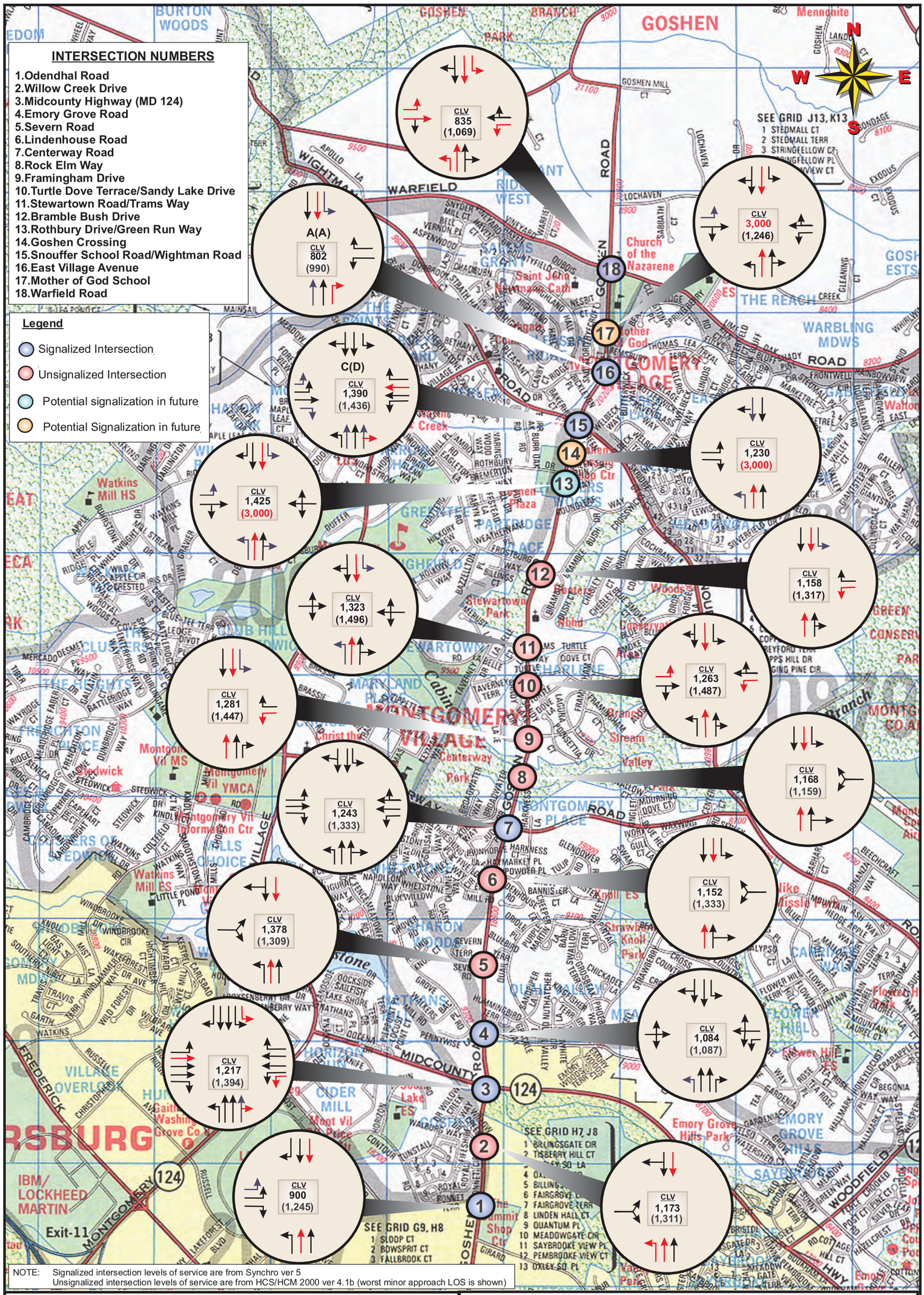

# TRAFFIC ENGINEERING STUDY AREA

## GOSHEN ROAD
## 2025 Two-Lane Improved Levels of Service

Rummel, Klepper & Kahl, LLP
*Consulting Engineers*

Date: July 2003

Figure 33




Key Map of Montgomery County

STUDY SITE

# TRAFFIC ENGINEERING STUDY AREA

## GOSHEN ROAD
## 2025 Four-Lane Levels of Service

Rummel, Klepper & Kahl, LLP
*Consulting Engineers*

Date: July 2003

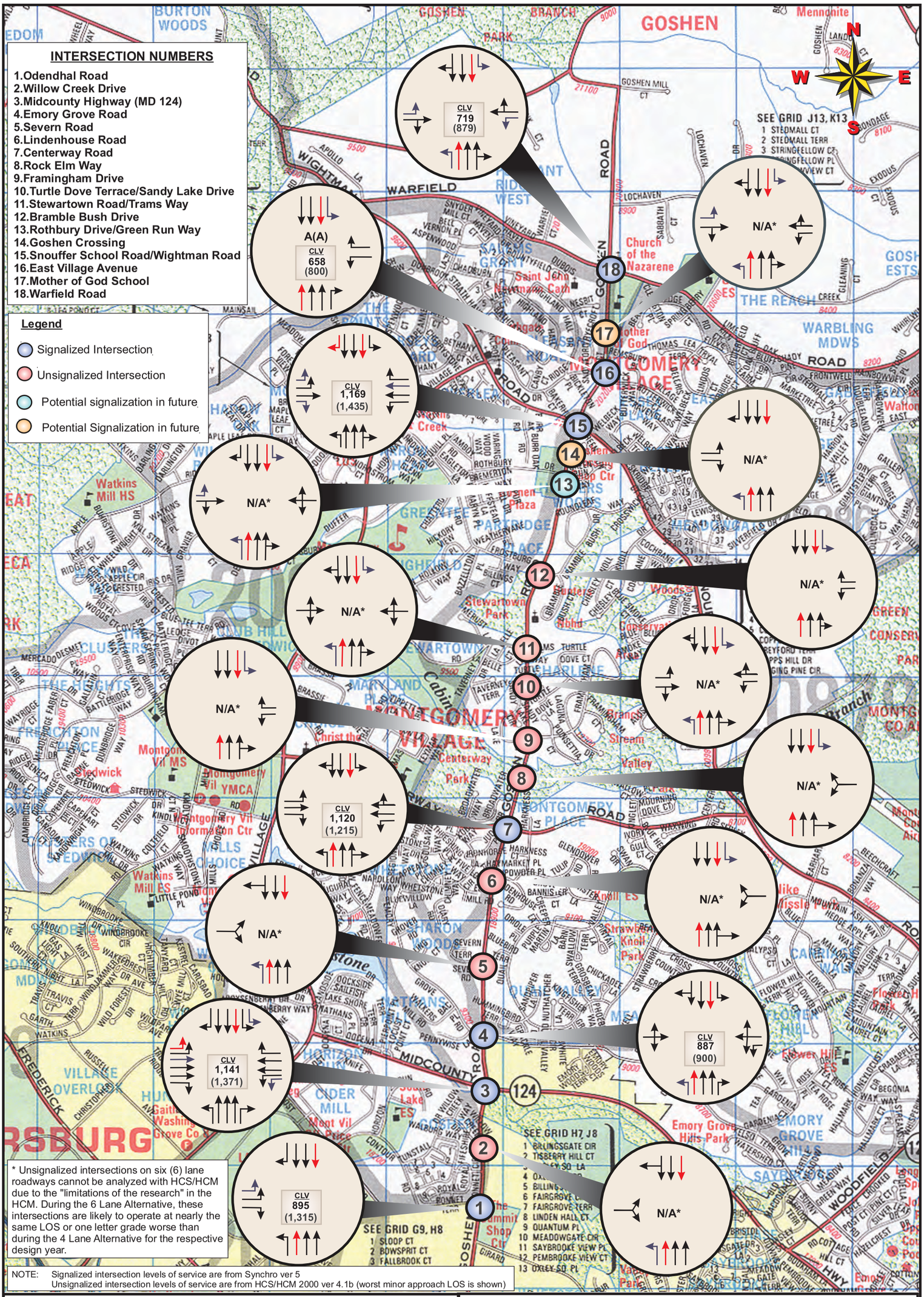
Figure 34

## D. 2025 Six Lane Alternative

The analysis of the 2025 Six Lane alternative was performed using the same lane configurations that were used for the 2015 Six Lane alternative. Figure 35 shows the lane configurations and CLV values at the signalized intersection during the 2015 Six Lane alternative. As with the Four Lane alternative, the Synchro analysis results for 2025 indicate that there would be similar or slightly improved traffic operations at each signalized intersection along Goshen Road when compared to the 2025 Two Lanes with Improvements alternative. Again, the unsignalized intersections could not be analyzed using the HCS under this Six Lane alternative due to the limitations of the HCM methodology which stipulates that each major-street approach can have a maximum of two (2) through lanes and one (1) exclusive right and/or left turn lane. Therefore, it was assumed that these intersections would likely operate at approximately the same LOS or slightly worse than with the Four Lane alternative. This assumption was based on the following factors:

- With six lanes on Goshen Road, vehicles turning left from the minor streets would have to cross more lanes on the mainline to complete their turns.
- Although the six lane alternative would increase the capacity along Goshen Road, the likelihood of obtaining an acceptable gap across all three lanes simultaneously in one direction might be similar to or worse than under the Four Lane alternative, depending on the degree of platooning among mainline through vehicles.

A brief evaluation of the 2050 projected PM peak hour volumes along a **four lane** Goshen Road was performed. The master plan build-out roadway network was used by M-NCPPC to develop these volumes. The 2050 traffic volumes were compared to the volumes for the 2025 four lane Goshen Road alternative. This comparison indicated that traffic volumes along Goshen Road would increase between Odendhal Avenue and Centerway, and would remain relatively unchanged from Centerway north to Warfield Road. Although the projected traffic volume along the southern portion of Goshen Road would be higher in 2050 than in 2025, this growth will not require six (6) continuous lanes for acceptable traffic operations. A plot showing the unadjusted PM peak hour link volumes for this special case is provided in Appendix K.


INTERSECTION NUMBERS
1.Odendhal Road
2.Willow Creek Drive
3.Midcounty Highway (MD 124)
4.Emory Grove Road
5.Severn Road
6.Lindenhouse Road
7.Centerway Road
8.Rock Elm Way
9.Framingham Drive
10.Turtle Dove Terrace/Sandy Lake Drive
11.Stewartown Road/Trams Way
12.Bramble Bush Drive
13.Rothbury Drive/Green Run Way
14.Goshen Crossing
15.Snouffer School Road/Wightman Road
16.East Village Avenue
17.Mother of God School
18.Warfield Road
Legend
Signalized Intersection
Unsignalized Intersection
Potential signalization in future
Potential Signalization in future
CLV 719 (879)
A(A) CLV 658 (800)
CLV 1,169 (1,435)
N/A*
CLV 1,120 (1,215)
CLV 1,141 (1,371)
CLV 895 (1,315)
CLV 887 (900)
SEE GRID J13, K13
SEE GRID H7, J8
SEE GRID G9, H8
* Unsignalized intersections on six (6) lane roadways cannot be analyzed with HCS/HCM due to the "limitations of the research" in the HCM. During the 6 Lane Alternative, these intersections are likely to operate at nearly the same LOS or one letter grade worse than during the 4 Lane Alternative for the respective design year.
NOTE: Signalized intersection levels of service are from Synchro ver 5
Unsignalized intersection levels of service are from HCS/HCM 2000 ver 4.1b (worst minor approach LOS is shown)
Key Map of Montgomery County
STUDY SITE
TRAFFIC ENGINEERING STUDY AREA
GOSHEN ROAD
2025 Six-Lane Levels of Service
Rummel, Klepper & Kahl, LLP
Consulting Engineers
Date: July 2003
Figure 35

**Goshen Road Corridor Study**
**Montgomery County DPW&T**

**RK&K Engineers, LLP**
**July 2003**

## Table 11
## 2025 Alternatives Summary Table - LOS and Control Delay (sec/veh)

| | Goshen Road Intersections | 2025 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No Build | | | | | | Two Lanes - Improved [4] | | | | | | Four Lanes [4] | | | | | | Six Lanes [5] | | | | | |
| | | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [1] | CLV [2] | NB | SB | EB | WB | Overall [5] | CLV [2] |
| | **AM Peak** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Odendhal Avenue | A 8 | A 9 | C 26 | - | B 11 | 1,170 | A 3 | A 6 | C 27 | - | A 8 | 1,100 | A 3 | A 2 | C 28 | - | A 6 | 900 | A 3 | A 3 | C 22 | - | A 7 | 895 |
| 2 | Willow Creek Drive | F >999 | - | F >999 | - | F >999 | 3,000 [3] | E 37 | - | F 159 | - | F 159 | 2,892 Possible R-in, R-out | B 11 | - | C 17 | - | C 17 | 1,173 | - | - | - | - | ★ | ★ |
| 3 | Midcounty Highway (MD 124) | B 14 | F 110 | F 140 | E 65 | F 98 | 1,953 | C 22 | D 52 | E 66 | D 47 | D 51 | 1,355 | B 12 | D 36 | D 48 | D 47 | D 38 | 1,305 | B 18 | D 37 | D 50 | D 50 | D 41 | 1,141 |
| 4 | Emory Grove Road | A 9 | F 108 | C 25 | F 128 | F 86 | 1,725 | B 18 | A 6 | C 25 | D 45 | B 15 | 1,070 | B 11 | A 5 | C 26 | D 45 | B 14 | 1,084 | A 3 | A 5 | C 22 | D 43 | B 12 | 887 |
| 5 | Severn Road | B 14 | - | F 136 | - | F 136 | 2,458 | B 14 | - | E 43 | - | E 43 | 1,525 Possible R-out | B 15 | - | D 30 | - | D 30 | 1,378 | - | - | - | - | ★ | ★ |
| 6 | Lindenhouse Road | A 9 | - | - | F >999 | F >999 | 3,000 [3] | - | A 9 | - | F >999 | F >999 | 3,000 [3] Possible R-out | - | A 9 | - | C 15 | C 15 | 1,152 | - | - | - | - | ★ | ★ |
| 7 | Centerway Road | A 9 | E 75 | E 74 | E 59 | E 59 | 1,770 | A 8 | B 17 | C 27 | D 38 | C 20 | 1,167 | B 12 | C 23 | C 31 | D 37 | C 25 | 1,243 | B 13 | C 24 | C 26 | C 33 | C 24 | 1,120 |
| 8 | Rock Elm Way | - | F 285 | - | F >999 | F >999 | 3,000 [3] | - | F 285 | - | B 13 | F 285 | 3,000 [3] Possible R-in, R-out | - | A 9 | - | C 16 | C 16 | 1,168 | - | - | - | - | ★ | ★ |
| 9 | Framingham Drive | - | A 9 | - | F 795 | F 795 | 3,000 [3] | - | A 9 | - | F 75 | F 75 | 1,869 Possible Signal | - | A 9 | - | C 24 | C 24 | 1,281 | - | - | - | - | ★ | ★ |
| 10 | Turtle Dove Terrace / Sandy Lake Drive | B 12 | A 9 | F 117 | F 404 | F 404 | 3,000 [3] | B 12 | A 9 | D 32 | E 44 | E 44 | 1,542 Possible R-out | B 12 | A 9 | C 23 | C 21 | C 23 | 1,263 | - | - | - | - | ★ | ★ |
| 11 | Stewartown Road / Trams Way | B 12 | A 9 | F 205 | F 245 | F 245 | 3,000 [3] | B 12 | A 9 | D 34 | F 51 | F 51 | 1,614 Possible Signal | B 13 | A 9 | D 27 | D 25 | D 27 | 1,323 | - | - | - | - | ★ | ★ |
| 12 | Bramble Bush Drive | - | A 9 | - | F 104 | F 104 | 2,143 | - | A 9 | - | E 40 | E 40 | 1,496 | - | A 9 | - | C 16 | C 16 | 1,158 | - | - | - | - | ★ | ★ |
| 13 | Rothbury Drive / Green Run Way | B 12 | A 9 | F 271 | F 119 | F 271 | 3,000 [3] | B 12 | A 8 | E 44 | F >999 | F >999 | 3,000 [3] Possible Signal | B 12 | A 8 | D 33 | C 20 | D 33 | 1,425 Possible Signal | - | - | - | - | ★ | ★ |
| 14 | Goshen Crossing | B 12 | - | F 167 | - | F 167 | 2,776 | B 14 | - | C 25 | - | C 25 | 1,294 Possible R-in, R-out | B 12 | - | C 20 | - | C 20 | 1,230 Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 | Snouffer School Road / Wigthman Road | B 16 | B 19 | C 28 | F 83 | C 32 | 1,543 | B 16 | C 28 | D 46 | C 32 | C 32 | 1,197 | B 18 | C 26 | D 44 | C 31 | C 31 | 1,390 | B 15 | C 27 | D 36 | C 24 | C 27 | 1,169 |
| 16 | East Village Avenue | A 3 | B 15 | - | C 31 | B 14 | 1,383 | A 4 | B 11 | - | C 34 | B 13 | 1,230 | A 7 | A 8 | - | B 15 | A 8 | 802 | B 12 | A 5 | - | B 14 | A 9 | 658 |
| 17 | Mother of God School | B 10 | A 10 | C 17 | F >999 | F >999 | 3,000 [3] | B 10 | A 10 | C 17 | F 415 | F 415 | 3,000 [3] Possible R-out | B 10 | A 10 | B 12 | F 193 | F 193 | 3,000 [3] Possible R-out | - | - | - | - | ★ | ★ |
| 18 | Warfield Road | F 183 | F 512 | C 21 | D 33 | F 295 | 3,000 [3] | F 183 | F 512 | C 21 | D 33 | F 295 | 3,000 [3] Possible Signal | A 4 | B 17 | D 45 | D 38 | B 19 | 835 Signalized | B 10 | B 16 | D 43 | D 39 | C 21 | 719 Signalized |
| | **PM Peak** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Odendhal Avenue | F 121 | D 50 | F 89 | - | F 88 | 1,805 | C 30 | C 24 | D 37 | - | C 30 | 1,447 | B 13 | B 19 | C 34 | - | C 21 | 1,245 | C 31 | B 14 | C 35 | - | C 26 | 1,315 |
| 2 | Willow Creek Drive | B 12 | - | F >999 | - | F >999 | 3,000 [3] | B 12 | - | F 58 | - | F 58 | 1,581 Possible R-in, R-out | B 11 | - | D 26 | - | D 26 | 1,311 | - | - | - | - | ★ | ★ |
| 3 | Midcounty Highway (MD 124) | F 90 | C 32 | F 90 | F 116 | F 97 | 1,903 | C 23 | C 30 | D 48 | D 43 | D 35 | 1,415 | C 22 | C 32 | C 34 | D 41 | C 32 | 1,380 | C 27 | C 26 | D 35 | D 48 | C 35 | 1,371 |
| 4 | Emory Grove Road | E 79 | A 6 | C 30 | F 131 | E 63 | 1,822 | B 10 | B 11 | C 30 | E 55 | B 15 | 1,278 | A 7 | A 4 | C 30 | D 44 | A 10 | 1,087 | A 10 | A 5 | C 32 | D 40 | B 12 | 900 |
| 5 | Severn Road | A 10 | - | F 86 | - | F 86 | 1,956 | A 10 | - | C 24 | - | C 24 | 1,281 Possible R-out | A 10 | - | C 26 | - | C 26 | 1,309 | - | - | - | - | ★ | ★ |
| 6 | Lindenhouse Road | - | B 14 | - | F 158 | F 158 | 2,580 | - | B 14 | - | D 34 | D 34 | 1,438 Possible R-out | - | B 14 | - | D 27 | D 27 | 1,333 | - | - | - | - | ★ | ★ |
| 7 | Centerway Road | F 114 | F 116 | D 55 | C 32 | F 91 | 1,860 | B 13 | B 17 | C 32 | C 32 | B 20 | 1,244 | B 16 | B 19 | D 45 | D 42 | C 27 | 1,333 | C 21 | C 27 | D 39 | D 39 | C 29 | 1,215 |
| 8 | Rock Elm Way | - | B 13 | - | F 63 | F 63 | 1,729 | - | B 13 | - | D 30 | D 30 | 1,375 Possible R-in, R-out | - | B 11 | - | C 16 | C 16 | 1,159 | - | - | - | - | ★ | ★ |
| 9 | Framingham Drive | - | B 15 | - | F 519 | F 519 | 3,000 [3] | - | B 15 | - | E 43 | E 43 | 1,527 Possible Signal | - | C 15 | - | D 35 | D 35 | 1,447 | - | - | - | - | ★ | ★ |
| 10 | Turtle Dove Terrace / Sandy Lake Drive | A 10 | B 13 | F 515 | F 479 | F 515 | 3,000 [3] | A 10 | B 13 | E 50 | E 46 | E 50 | 1,596 Possible R-out | A 10 | B 14 | C 22 | E 39 | E 39 | 1,487 | - | - | - | - | ★ | ★ |
| 11 | Stewartown Road / Trams Way | A 9 | B 12 | F 260 | F 140 | F 266 | 3,000 [3] | A 9 | B 12 | D 27 | E 37 | E 37 | 1,473 Possible Signal | A 9 | B 12 | C 18 | E 40 | E 40 | 1,496 | - | - | - | - | ★ | ★ |
| 12 | Bramble Bush Drive | - | B 12 | - | F 237 | F 237 | 3,000 [3] | - | B 12 | - | E 38 | E 38 | 1,482 | - | B 13 | - | D 26 | D 26 | 1,317 | - | - | - | - | ★ | ★ |
| 13 | Rothbury Drive / Green Run Way | B 10 | B 11 | F >999 | F >999 | F >999 | 3,000 [3] | B 10 | B 11 | F >999 | F >999 | F >999 | 3,000 [3] Possible Signal | B 11 | B 12 | F 575 | F 55 | F 575 | 3,000 [3] Possible Signal | - | - | - | - | ★ | ★ |
| 14 | Goshen Crossing | B 13 | - | F >999 | - | F >999 | 3,000 [3] | B 13 | - | F >999 | - | F >999 | 3,000 [3] Possible R-in, R-out | B 13 | - | F 448 | - | F 448 | 3,000 [3] Possible R-in, R-out | - | - | - | - | ★ | ★ |
| 15 | Snouffer School Road / Wigthman Road | F 91 | D 55 | F 130 | F 99 | F 97 | 3,015 | D 40 | C 29 | D 51 | D 47 | D 43 | 1,418 | D 39 | C 27 | D 46 | D 39 | D 39 | 1,436 | D 39 | C 26 | D 46 | D 39 | D 39 | 1,435 |
| 16 | East Village Avenue | E 61 | F 287 | - | B 18 | F 102 | 1,545 | A 9 | A 7 | - | D 38 | B 12 | 1,251 | A 7 | A 3 | - | B 17 | A 7 | 990 | B 13 | A 9 | - | B 16 | B 13 | 1,002 |
| 17 | Mother of God School | A 8 | B 12 | C 23 | F 53 | F 53 | 1,531 | A 8 | B 12 | C 15 | D 28 | D 28 | 1,342 Possible R-out | A 8 | B 12 | B 15 | C 21 | C 21 | 1,245 Possible R-out | - | - | - | - | ★ | ★ |
| 18 | Warfield Road | F >999 | F 88 | D 34 | E 41 | F 705 | 3,000 [3] | F >999 | F 88 | D 34 | E 41 | F 705 | 3,000 [3] Possible Signal | A 9 | C 23 | D 46 | C 31 | B 18 | 1,069 Signalized | A 7 | B 14 | D 44 | C 32 | B 15 | 879 Signalized |

NOTE: LOS & delay at signalized intersections are from Synchro version 5
LOS & delay at unsignalized intersections are from HCS 2000 version 4.1b

[1] Operations for worst minor approach at unsignalized intersections (TWSC) are shown in overall intersection operation column
[2] CLV value for unsignalized intersections is based on equivalent delay from HCS (1,500 CLV = 40.0 sec/veh)
[3] Maximum CLV for unsignalized intersections was capped at 3,000
[4] Build Alternatives were analyzed with two stage gap acceptance, assuming storage in median for one vehicle turning left from minor approach.
[5] Unsignalized intersections on six lane roadways can not be analyzed with HCS/HCM due to the "limitations of the research" in the HCM

## E. 2025 Arterial Capacity Analyses

The results from the 2025 arterial capacity analyses for the AM and PM peak hours are summarized in Figures 36 and 37 respectively. The 2025 No Build alternative indicate increases in travel times in both directions during both peak hours as compared to the 2015 No Build alternative. The largest increase in travel time is during the PM peak hour. The travel time in both directions would increase by approximately 78 percent (7 minutes).

The travel times during the Two Lane with Improvements alternative decrease for both directions in both peak hours when compared to the 2025 No Build alternative, especially during the PM peak. The travel time in the northbound direction during the PM peak would decrease by approximately 7.5 minutes and by 5.5 minutes in the southbound direction.

The travel times for the Four Lane and Six Lane alternatives continue to decrease in each direction during both peak hours. This decrease is mainly due to the reduced running times/faster link speeds. The Synchro results indicate that the travel times for the Four Lane and Six Lane alternatives in 2025 are expected to be less than during the existing conditions. Travel times during these alternatives would be less than travel times during existing conditions (2002).

**Figure 36: Summary of Travel Times for 2025 Alternatives (AM Peak)**

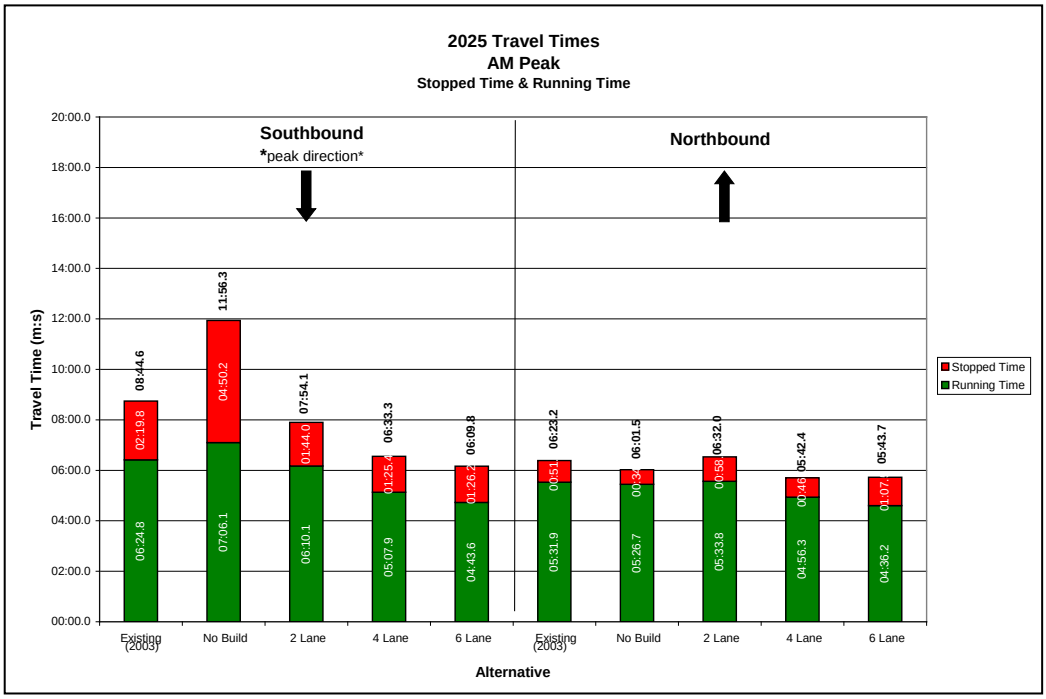
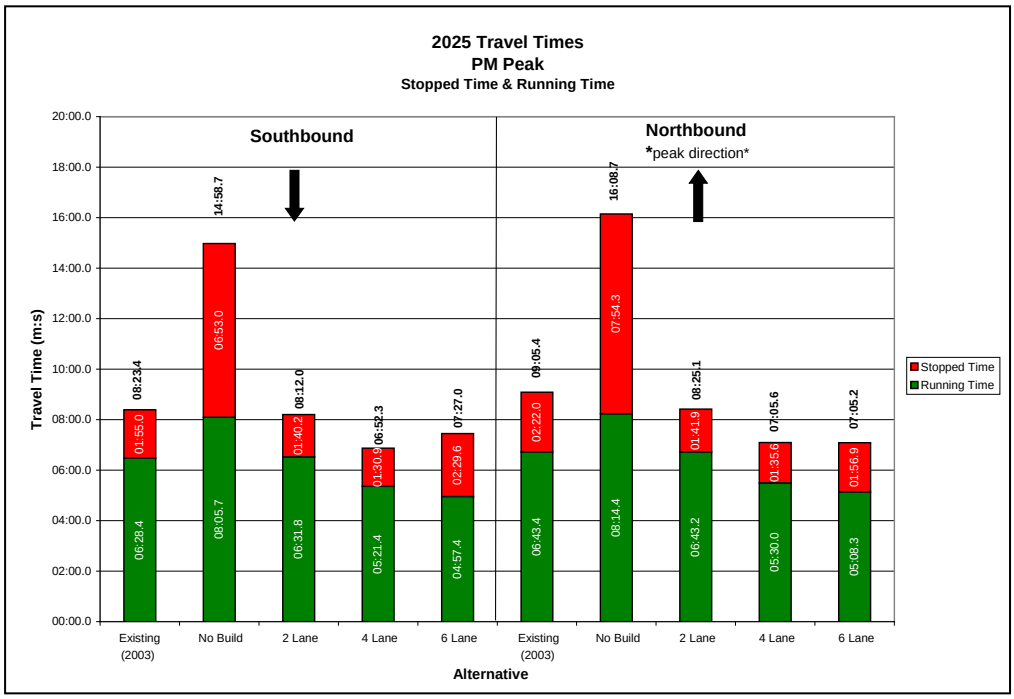



**Figure 37: Summary of Travel Times for 2025 Alternatives (PM Peak)**



## VI. Conclusion

The build alternatives for Goshen Road include making spot capacity improvements to the existing two-lane roadway, or widening from the current two lanes to either a four lane or six lane roadway. The no-build alternative was also evaluated for 2002, 2015, and 2025. This study includes intersection capacity analyses of each of the 18 intersections along the Goshen Road corridor as well as arterial capacity analyses using traffic volumes for the existing year (2002) and design years 2015 and 2025. Capacity analyses were conducted using the Critical Lane Method at signalized intersections, Highway Capacity Software v4.1b at unsignalized intersections (excluding the Six Lane alternatives), and Synchro software for all intersections. The Synchro software was also used for the arterial capacity analyses.

The accident history of the Goshen Road corridor between Odendhal Avenue and Warfield Road during the most recent three year period for which data was available (January 1999 through December 2001) indicates that the rate of collisions that have occurred along Goshen Road during this period is approximately twice the statewide average rate for similar roadways. It is likely that the roadway improvements included in the improvement and widening alternatives will help to decrease accident rates on this portion of roadway. Such improvements include, leveling the vertical alignment and straightening horizontal curves to improve sight distances; the construction of a median and left turn lanes to provide a safe storage space for left turning vehicles; and the addition of bike lanes, sidewalks, crosswalks and lighting to increase pedestrians and cyclists safety.

**Existing Condition (2002)**
The results of the intersection capacity analyses indicate that one signalized (Midcounty Highway) and six unsignalized intersections operate at unacceptable conditions (CLV > 1,500) during either the AM or PM peak hours under existing conditions. The results of the arterial capacity analyses indicate that in general, travel times in the northbound direction are higher during the PM peak hour (approximately 9 minutes) and travel times in the southbound direction are slightly higher during the AM peak hour (approximately 8.75 minutes).

**2015**
The results of the intersection capacity analyses indicate that 16 of the 18 intersections are expected to have unacceptable operating conditions (CLV > 1,500) during either the AM or PM peak hours by 2015 if no widening or other intersection improvements are made. If spot capacity improvements were made by 2015 without providing additional lanes along the entire length of Goshen Road, 10 unsignalized intersections would still operate at unacceptable conditions. Possible left turn restrictions or signalization (if warranted) may be implemented at these intersections in the future to obtain acceptable levels of service. If Goshen Road were widened to four or six lanes by 2015, only three (3) of the currently unsignalized intersections would operate at unacceptable conditions.

The results of the arterial capacity analyses indicate that if no widening or intersection improvements occur by 2015, the travel times during the peak hours in the peak directions will increase by approximately 20-28 percent (~ 2 minutes) compared to existing conditions. The results indicate that the spot improvement alternative and both of the widening alternatives would improve these travel times. The travel times for the Four Lane and Six Lane alternatives would be shorter than existing conditions.

**2025**
If Goshen Road is not widened or otherwise improved by 2025, all 18 intersections are projected to have unacceptable operating conditions by that time. If spot capacity improvements are made by 2025 without providing additional lanes along the entire length of Goshen Road, 11 unsignalized intersections would still operate at unacceptable conditions. Possible left turn restrictions or signalization (if warranted) may be implemented at these intersections in the future to obtain acceptable levels of service. If Goshen Road were widened to four or six lanes by 2025, only three (3) of the currently unsignalized intersections would operate at unacceptable conditions.

The results of the arterial capacity analyses indicate that if no widening or intersection improvements occur by 2025, the travel times during the peak hours in the peak directions will increase by approximately 78 percent (~7 minutes) compared to existing conditions. The results indicate that the spot improvement alternative and both of the widening alternatives would improve these travel times. The travel times for the Four Lane and Six Lane alternatives would be shorter than existing conditions.

Traffic forecasts from M-NCPPC show that the volume along a four lane Goshen Road in 2025 will be higher if no other planned roadway improvements are built in the surrounding policy area. Year 2050 projections utilizing the master plan build-out roadway network show some traffic growth along the southern portion of Goshen Road, but not enough to warrant constructing six (6) continuous lanes.