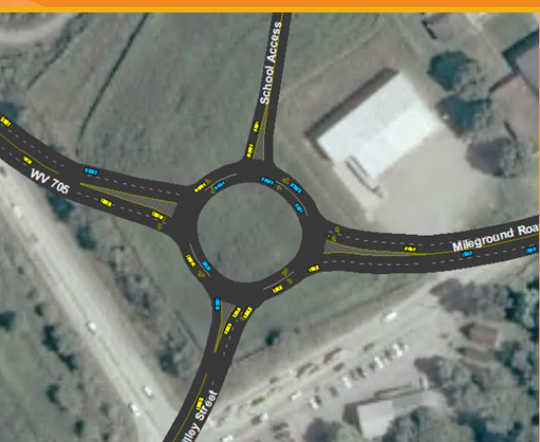
Mileground Road Traffic Analysis
Final Report



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West Virginia Department
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Division of Highways

Submitted by:

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ENGINEERING INFRASTRUCTURE SOLUTIONS

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Executive Summary

The Mileground Road Traffic Analysis arose from the WV 705 Connector project. The WV 705 Connector is a part of a plan to relieve traffic congestion, improve safety, and provide better accessibility in the greater Morgantown area, particularly within the corridor connecting downtown and the West Virginia University (WVU) campus to Interstate 68 to the east.

The original WV 705 Connector is part of the *2030 Transportation Plan* of the Morgantown Monogalia Metropolitan Planning Organization (MPO) and was intended to be a four-lane median-divided arterial street connecting CR 857 with WV 705 near Stewartstown Road.

Recent development in the project corridor has resulted in elimination of the original WV 705 Connector project due to drastically increasing right-of-way costs. Thus, the *2030 Transportation Plan* must be amended.

As part of the Plan amendment process, the focus has been shifted to making improvements to WV 705 and Mileground Road (US 119) for the section from Stewartstown Road (CR 67) to the intersection with CR 857 (Cheat Lake Road/Point Marion Road) at Easton. Two basic options have been considered:

- The Five-Lane alternative would upgrade Mileground Road to a five-lane facility with a continuous center two-way left-turn lane and signalized intersections; and
- The Four-Lane alternative would upgrade Mileground Road to a four-lane median-divided facility with roundabouts at major intersections.

In response to concerns about impacts to businesses along Mileground Road, a compromise or Hybrid alternative was developed that would minimize these impacts. The Hybrid alternative would consist of two lanes in the eastbound (outbound) direction, one lane in the westbound (inbound) direction, and a continuous center two-way left-turn lane.

Additionally, a No Widening alternative was evaluated for comparison. The No Widening alternative does not add lanes to the central portion of Mileground Road but does include improvements at either end. At the west end, WV 705 would be re-aligned so that it becomes a through movement with Mileground Road, with Willey Street becoming the third leg of a T-intersection.

The fundamental assumption was that upgrading the existing Mileground Road facility will improve traffic congestion and safety in the corridor and will provide the MPO with a recommended alternative to the original WV 705 Connector in amending the 2030 Transportation Plan.

The study demonstrated that the No Build or Do Nothing option is not a good option. Traffic is expected to increase within the corridor due to growth in the area and resulting congestion can be expected to worsen accordingly. The construction of a proposed new elementary school just north of the armory building potentially could add another signalized intersection to WV 705 if no other improvements were made; even with improvements, additional traffic associated with the school is anticipated.

Under the No Widening alternative, improvements to Mileground Road *will* be made in the form of re-aligning the WV 705/Mileground Road and Mileground Road/Cheat Road/Point Marion Road intersections so that the primary movement becomes a through movement. This change would make those two intersections operate more efficiently and thus delay would be reduced, but little benefit along the Mileground Road section itself would be realized.

The Four-Lane alternative with roundabouts at major intersection would add capacity and reduce congestion. The mountable raised median would eliminate left turns and make all driveways right-in/right-out access points; left turns would be accommodated at U-turns through the downstream roundabout. The mountable median still would accommodate emergency vehicles. This alternative offers improved safety compared to the existing three-lane cross-section and there would be smoother flow along Mileground Road, but there could be an associated negative perception by local businesses and patrons because of the elimination of left turns. For this alternative, a roundabout at Mileground Road/Cheat Road/Point Marion Road is not recommended due to safety concerns associated with approach grades that are steeper than recommended guidelines. Finally, the Four-Lane alternative would have significant right-of-way acquisition requirements.

The Five-Lane alternative also performed well with respect to reducing congestion, but right-of-way acquisition would be most significant among the options that were considered. As traffic volumes grow in the future, the Five-Lane alternative would be expected to result in higher vehicular conflicts and crashes when compared to the existing three-lane section.

The Hybrid alternative would not require as much right-of-way as the Four-Lane or Five-Lane alternatives as only one lane would be added in the outbound direction. While this option does provide reduced congestion for the P.M. peak period, which was deemed to be the most heavily congestion period during a typical day, it provides very little benefit during the A.M. peak as no lanes would be added in the inbound direction.

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Introduction

The Mileground Road Traffic Analysis arose from the WV 705 Connector project. The WV 705 Connector is a part of a plan to relieve traffic congestion, improve safety, and provide better accessibility in the greater Morgantown area, particularly within the corridor connecting downtown and the West Virginia University (WVU) campus to Interstate 68 to the east.

The original WV 705 Connector is part of the *2030 Transportation Plan* of the Morgantown Monogalia Metropolitan Planning Organization (MPO) and was intended to be a four-lane median-divided arterial street connecting CR 857 with WV 705 near Stewartstown Road. A map showing the original WV 705 Connector and the general study area is shown in **Figure 1**.

Approximately 40 options and alternatives have been evaluated up to this point. However, recent development in the project corridor has resulted in elimination of the original WV 705 Connector project due to drastically increasing right-of-way costs. Thus, the *2030 Transportation Plan* must be amended.

As part of the Plan amendment process, the focus has been shifted to making improvements to WV 705 and Mileground Road (US 119) for the section from Stewartstown Road (CR 67) to the intersection with CR 857 (Cheat Lake Road/Point Marion Road) at Easton. Two basic options have been considered:

- The Five-Lane alternative would upgrade Mileground Road to a five-lane facility with a continuous center two-way left-turn lane and signalized intersections; and
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The fundamental assumption was that upgrading the existing Mileground Road facility will improve traffic congestion and safety in the corridor and will provide the MPO with a recommended alternative to the original WV 705 Connector in amending the 2030 Transportation Plan.

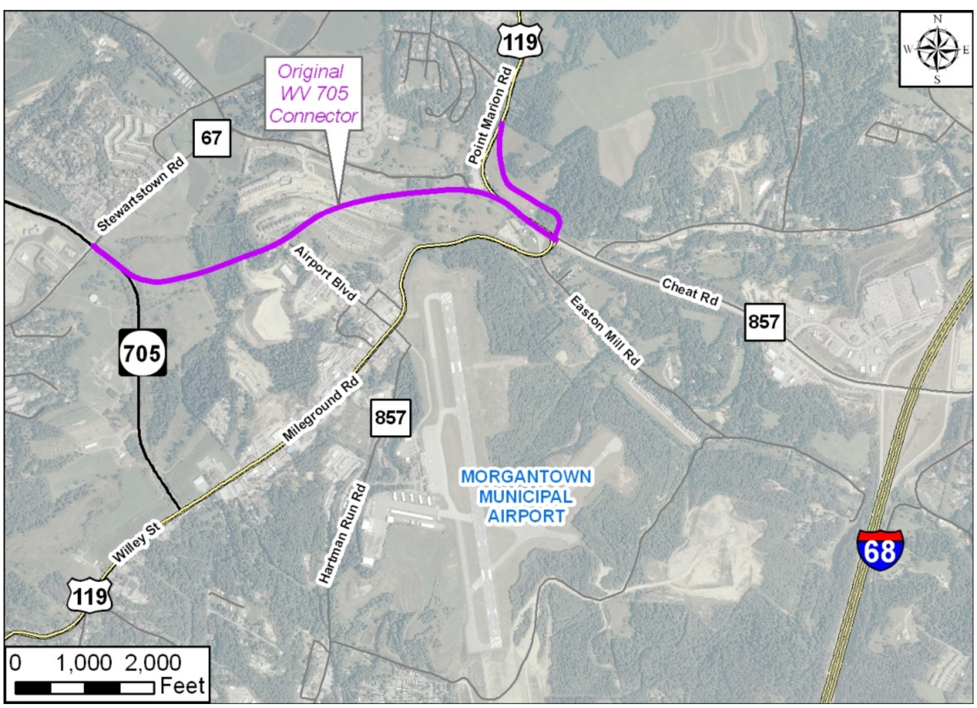

Figure 1. Study Area

Existing Conditions

Mileground Road is functionally classified as an Urban Minor Arterial. In addition to providing a connection between downtown Morgantown and the WVU campus with I-68, it also provides access to a number of area businesses. Mileground Road from Cheat Road/Point Marion Road to WV 705 is designated as US 119 and is part of the National Highway System. Toward the east end of the corridor, it provides access to the Morgantown Municipal Airport.

Mileground Road has one through travel lane in each direction. The section from WV 705 to Airport Boulevard is a three-lane section with a continuous center left-turn lane. Access to numerous businesses along the corridor is provided directly from Mileground Road, as seen in **Figure 2.**

Figure 2. Three-Lane Section with Left-Turn Lane

The section from Airport Boulevard to Cheat Road/Point Marion Road also has three lanes, but is undivided and has a second through traffic lane in the westbound or inbound direction. This section traverses a steep uphill grade in the westbound direction and the second lane serves as a climbing lane. A photograph of this section is shown in **Figure 3**.

Figure 3. Three-Lane Section with Climbing Lane

WV 705 from Stewartstown Road to Mileground Road also is functionally classified as an Urban Minor Arterial. It has one through lane in each direction and the roadway section expands at the approaches to Mileground Road and Stewartstown Road to include turn lanes. Posted speed limits are 40 mph for Mileground Road and 50 mph for WV 705. However, during peak traffic periods, these speeds are generally unattainable due to heavy congestion.

Existing average daily traffic (ADT) volumes are presented in **Figure 4**. Volumes are consistent along Mileground Road and WV 705, ranging from 20,000 to 23,000 vehicles per day. The consistency reinforces the premise that the majority of vehicles traveling along Mileground Road and WV 705 are passing through the area, at least during peak periods.

Peak hour intersection turning movement counts were collected by the West Virginia Department of Transportation during June and July in 2010. Counts were collected at the following intersections:

- Mileground Road/Cheat Road/Point Marion Road
- Mileground Road/Easton Mill Road
- Mileground Road/Airport Boulevard/Hartman Run Road
- Mileground Road/Tramore Lane
- Mileground Road/WV 705
- WV 705/Stewartstown Road

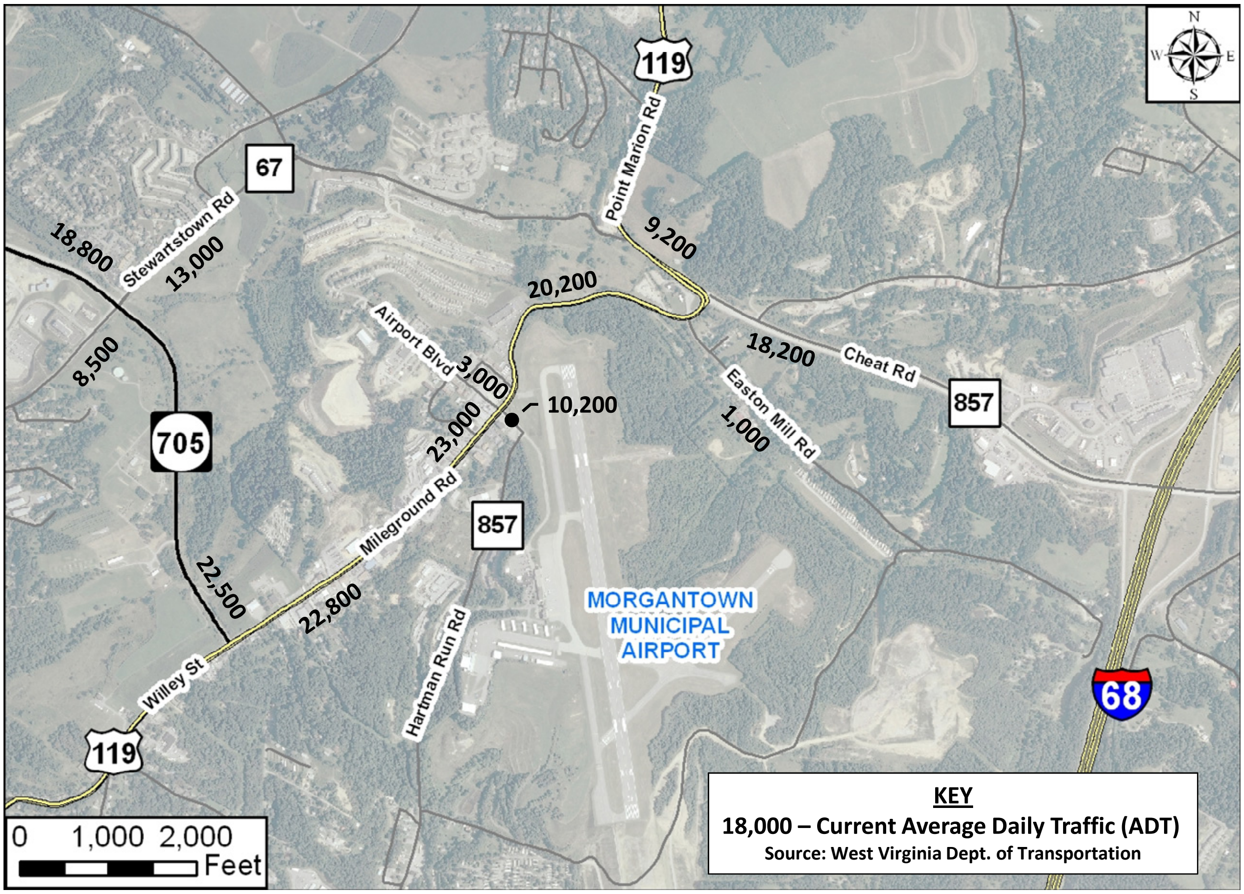

Figure 4. Existing Average Daily Traffic (ADT)

The turning movement counts were collected during weekday morning and afternoon peak traffic periods. The counts were collected during the morning peak period from 7:00 A.M. until 9:00 A.M. and during the afternoon peak period from 2:00 P.M. until 6:00 P.M. The highest 60-minute periods generally occur from 7:30 A.M. to 8:30 A.M. and from 4:30 P.M. to 5:30 P.M.; however, traffic levels during the P.M. peak period remain fairly constant from about 3:00 P.M. through 6:00 P.M. For the morning peak, the maximum hourly flow rates (in vehicles per hour) for those intersections listed previously are presented in **Figure 5**. Maximum hourly flow rates for the afternoon peak period are shown in **Figure 6**.

A traffic simulation model was developed to assess existing traffic conditions and to compare alternative improvement schemes. A further, detailed discussion of the model development is provided in the following section. The model was used to estimate average vehicular delays at signalized intersections during the A.M. and P.M. peak periods. These delays are summarized in **Table 1**.

Table 1. Existing Average Intersection Delays

Signalized Intersection	Ave. Delay (sec/veh)	
	AM Peak	PM Peak
WV 705/Stewartstown Road	29.8	149.4
Mileground Road/WV 705	60.6	68.8
Mileground Road/Airport Blvd./Hartman Run Rd.	27.0	84.2
Mileground Road/Cheat Rd./Point Marion Rd.	48.1	109.1

Source: Mileground Road Traffic Simulation Model

The results reflect the heavy congestion, particularly in the afternoon peak period, at all of the signalized intersections.

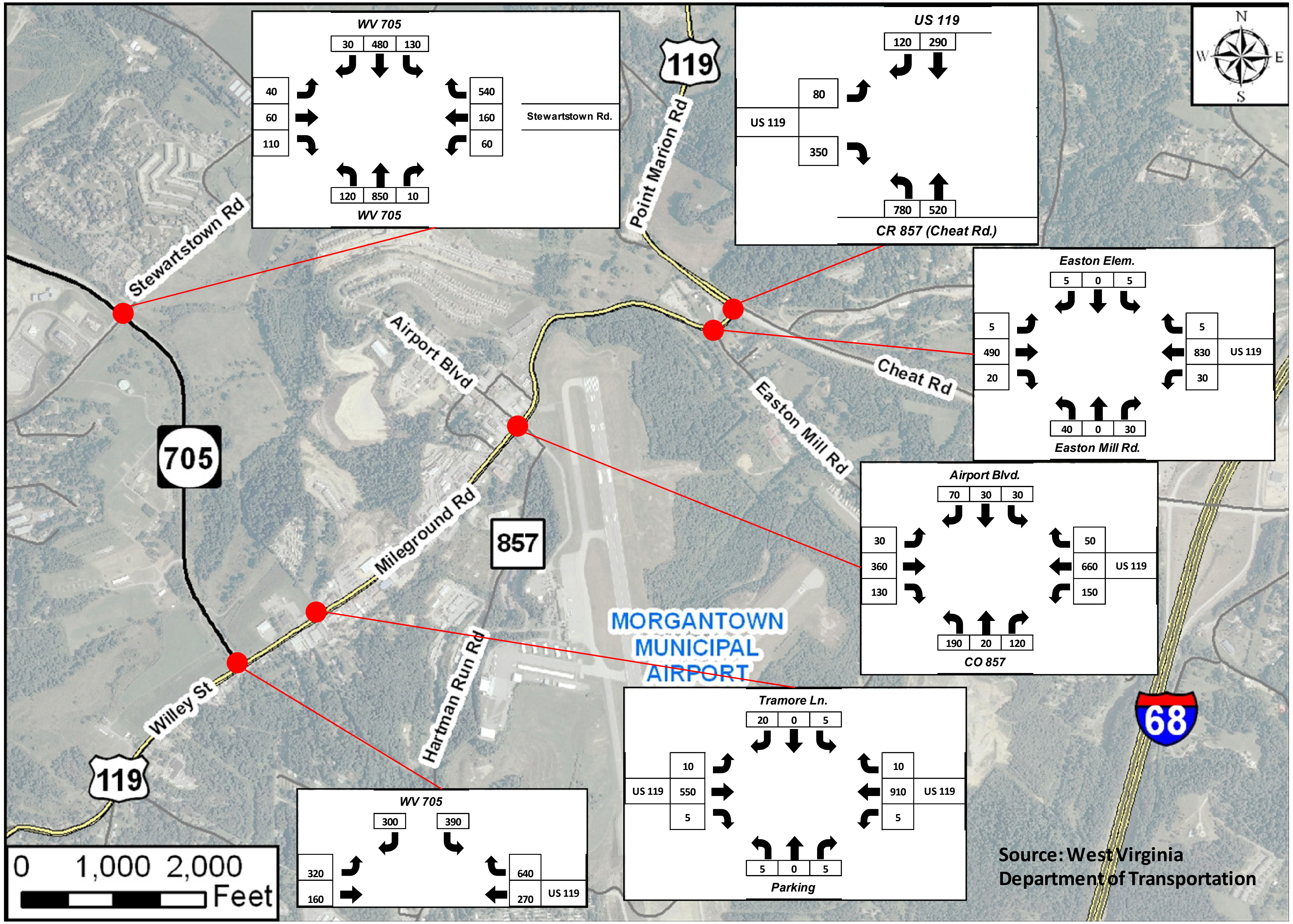

Figure 5. Existing A.M. Peak Intersection Turning Movement Volumes

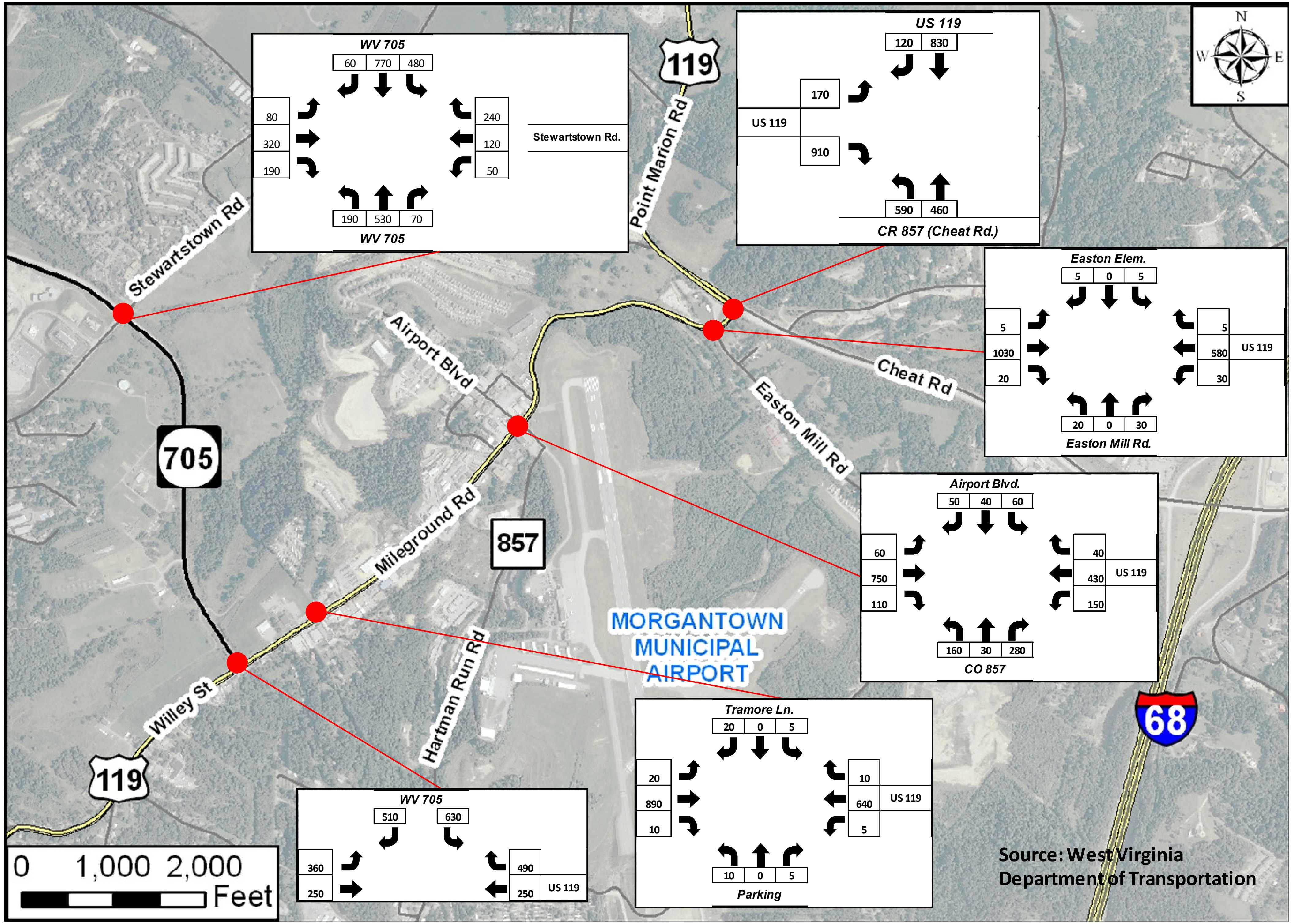

Figure 6. Existing A.M. Peak Intersection Turning Movement Volumes

While the inclination may be to correlate the average intersection delays as reported in Table 1 with level of service as a means of qualifying the intersection conditions, it should be pointed out that a direct correlation cannot be made when a simulation model is used. Level of Service (LOS), as defined in the *2000 Highway Capacity Manual*[1] (HCM), is a qualitative measure used to describe traffic conditions, ranging from LOS A (best) to LOS F (worst). For signalized intersections, level of service is stratified according to average control delay; that is, delay incurred as a result of the traffic control (signal).

While microscopic traffic simulation models such as that used in the Mileground Road Traffic Analysis also compute intersection delay attributable to signal control, the delay is computed differently than in the HCM method upon which level of service is based. Thus, it is an incorrect application of the HCM to correlate average intersection delay as computed by a traffic simulation model with the stratification of level of service by average control delay as presented in the HCM. With that caveat, the conclusion still can be drawn that the signalized intersections along Mileground Road and WV 705 between Cheat Road/Point Marion Road and Stewartstown Road operate at or over capacity and experience considerable congestion during peak traffic periods, particularly during the afternoon peak.

A separate HCM methodology exists for evaluating urban streets at a facility level; that is, urban streets are analyzed as a whole and include both signalized intersections and the street segments between them. Levels of service for urban street sections are based on average travel speed, which includes both the running time between intersections and the delay time incurred at signals. Unlike the signalized intersection method, simulation model output for average speeds can be compared directly with the LOS stratification scale from the HCM, based on the urban street classification. The LOS scale for urban streets from the 2000 HCM is shown in **Table 2**. Estimated existing weekday A.M. and P.M. peak period average travel speeds and corresponding levels of service are shown in **Table 3**.

Table 2. Urban Street Levels of Service by Class

Urban Street Class	I	II	III	IV
Range of free-flow speeds (FFS)	55 to 45 mi/h	45 to 35 mi/h	35 to 30 mi/h	35 to 25 mi/h
Typical FFS	50 mi/h	40 mi/h	35 mi/h	30 mi/h
LOS	Average Travel Speed (mi/h)			
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

Source: 2000 Highway Capacity Manual, Exhibit 15-2

The results help to quantify the existing traffic conditions on Mileground Road and on WV 705, particularly during the afternoon peak period when stop-and-go traffic conditions are commonplace.

Table 3. Existing Urban Street Section Levels of Service

Urban Street Section	From	To	Urban Street Class	A.M. Peak Inbound Ave. Speed	A.M. Peak Inbound LOS	A.M. Peak Outbound Ave. Speed	A.M. Peak Outbound LOS	P.M. Peak Inbound Ave. Speed	P.M. Peak Inbound LOS	P.M. Peak Outbound Ave. Speed	P.M. Peak Outbound LOS
Mileground Road	WV 705	Airport Blvd.	II	16.7	E	28.0	B/C	25.5	C	9.1	F
Mileground Road	Airport Blvd.	Cheat Road	II	28.2	B/C	30.2	B/C	28.7	B/C	7.8	F
WV 705	Stewartstown Rd.	Mileground Rd.	I	30.0	C	34.8	A/B	22.4	D	28.4	A

[1] *Highway Capacity Manual*, Transportation Research Board, National Research Council, Washington, D.C., 2000.

Traffic Simulation Model

A microscopic traffic simulation model was the primary tool used in this analysis for evaluating existing traffic conditions and for comparing projected future conditions associated with Mileground Road improvement alternatives. "Microscopic" means that individual vehicles are simulated as they move through the roadway network and mathematical models are used to simulate driver interactions associated with car following, acceleration/deceleration, and gap acceptance when entering a conflicting traffic stream.

The TransModeler® Traffic Simulation Software, Version 2.6, by Caliper Corporation, was used to perform the analysis. In addition to providing 2-D and 3-D animations of simulated conditions, TransModeler provides detailed performance measures that were used in the comparison and evaluation of alternatives. A screen capture of the existing network simulation is shown in **Figure 7**.

Base year models were developed to simulate existing traffic conditions during the weekday A.M. and P.M. peak periods; that is, for the peak 60-minute traffic conditions that occur between 7:00 a.m. and 9:00 a.m. and between 2:00 p.m. and 6:00 p.m. Three calibration parameters were used: intersection volumes, average travel speeds, and maximum queue lengths.

For those six intersections where turning movement counts were collected, turning movement output from the model runs was compared to the field data. The calibration objective was to minimize the difference between the two and the Percent Root Mean Square Error (%RMSE) statistic was used to do this, where the statistic is defined as:

$$\%RMSE = \frac{\sqrt{\sum_j (Model - Count)^2 / (Number\ of\ Counts)}}{(\sum_j (Count_j / Number\ of Counts)} \ x\ 100$$

where *j* represents each individual network link.

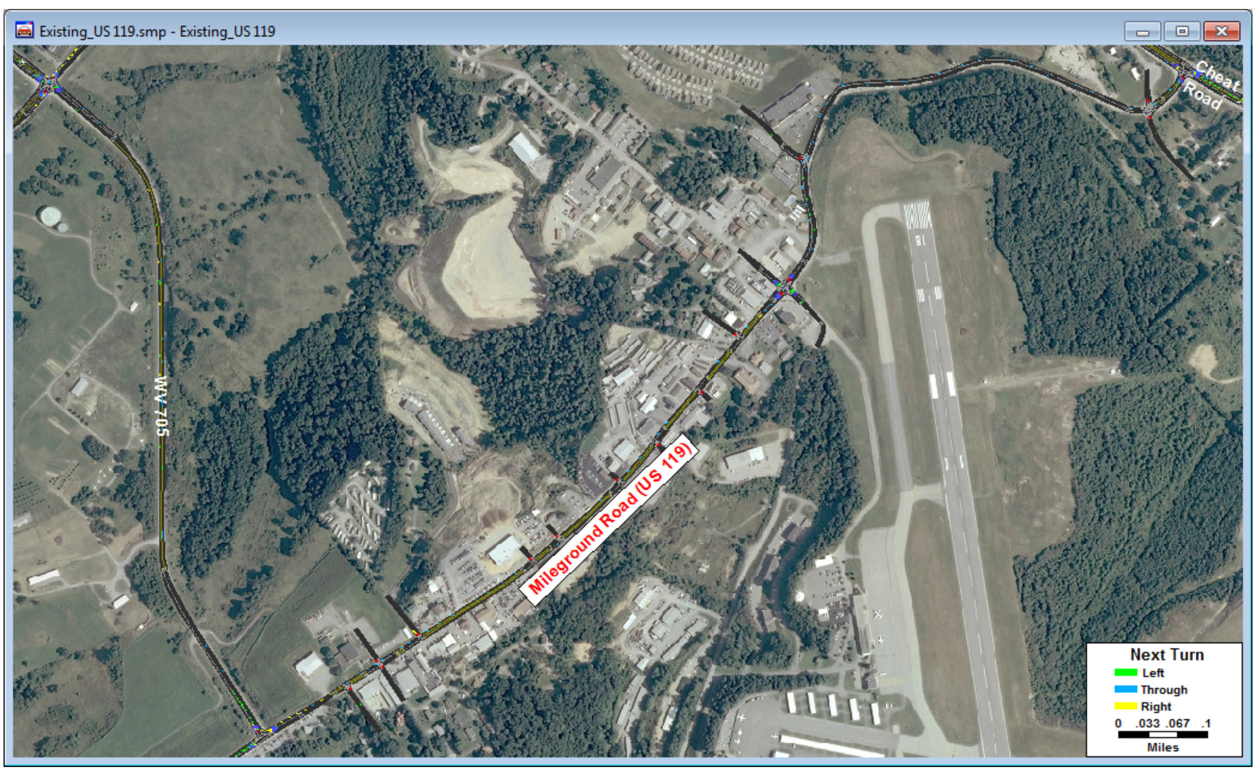

Figure 7. TransModeler Existing Conditions Traffic Simulation

The "Model" parameter in the equation was the average turning movement volume computed over 10 model runs. Because TransModeler reflects the random variation that occurs in day-to-day traffic, multiple simulation runs were made and average values were compared.

For travel demand models, a %RMSE value of 30 percent or less is considered to be acceptable and indicates a reasonably calibrated model. For traffic simulation models, a %RMSE of 30 percent would indicate that the amount of variability within the model is too high and something lower is desirable (although there isn't an industry-wide goal for simulation models). For the Mileground Road A.M. and P.M. existing condition simulation models the following %RMSE results were obtained when comparing model-projected intersection turning movements with actual counts:

A.M. Peak 7.5% RMSE
P.M. Peak 6.8% RMSE

The %RMSE computational results are provided in the Appendix in **Table A-1** for the A.M. peak and **Table A-2** for the P.M. peak. The results show that the overall the volume calibration results are considered to be acceptable.

Existing average travel speeds for Mileground Road and WV 705 were presented previously in Table 3. Actual travel time data were not collected for this study due to the aggressive schedule. However, the model results compared favorably with observed in-vehicle travel speeds during peak period field reviews that were performed.

A final calibration check was performed. Existing peak period queues were compared with observed queues in the field at four intersections:

- WV 705/Stewartstown Road
- Mileground Road/WV 705
- Mileground Road/Airport Boulevard/Hartman Run Road
- Mileground Road/Cheat Road/Point Marion Road

For each period, ten model runs were performed and average maximum queues were computed. In TransModeler, queues are measured in each lane on a network segment link from the downstream end (i.e. at the stop bar) to as far upstream as the queue extends. The head of a lane queue is always at the downstream end of a segment and never moves. Thus, if a vehicle is not stopped at the downstream end of a segment at the time a queue measurement is taken, no queue will be recorded, even if a queue exists but the head of the queue has moved upstream. As a result, maximum queues in TransModeler may appear to be a little shorter than observed queues, but this is because of the definition that is used by the software.

A summary of existing peak period average maximum queue lengths is shown in **Table 4**. The reported peak period average maximum queues were consistent, albeit it slightly shorter, than those observed in the field.

Table 4. Average Maximum Queue Lengths

Direction	Approach	Ave. Max. Queue (ft.)	
		A.M. Peak	P.M. Peak
NB (Inbound)	WV 705 at Stewartstown Rd.	300	1,500
SB (Outbound)	WV 705 at Mileground Rd.	400	870
WB (Inbound)	Mileground Rd. at WV 705	730	320
EB (Outbound)	Mileground Rd. at Airport Blvd.	400	900
WB (Inbound)	Mileground Rd. at Airport Blvd.	400	350
EB (Outbound)	Mileground Rd. at Cheat Rd.	200	470
NB (Inbound)	Cheat Rd. at Mileground Rd.	1,000	1,100

Design Alternatives

Once the original WV 705 Connector project was deemed infeasible, the focus within the corridor shifted to improvement alternatives for Mileground Road. Two primary alternatives were identified originally:

- A Five-Lane section from WV 705 to Airport Boulevard/Hartman Run Road with two lanes in each direction plus a continuous center two-way left-turn lane and signalized intersections at existing locations; and
- A Four-Lane, median-divided section with a mountable median and roundabouts at WV 705, Airport Boulevard/Hartman Run Road and Cheat Road/Point Marion Road.

A typical cross-section of the Five-Lane alternative is shown in **Figure 8** and the Four-Lane median-divided alternative is shown in **Figure 9**.

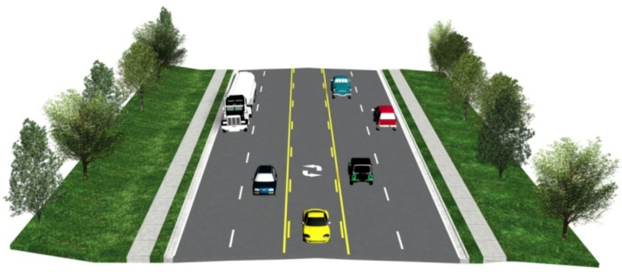

Figure 8. Five-Lane Alternative Typical Cross-Section

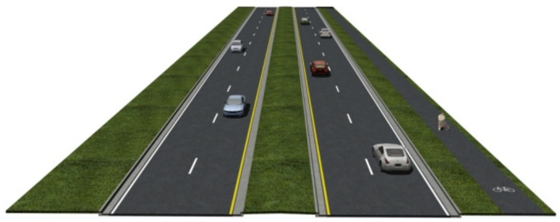

Figure 9. Four-Lane Median-Divided Alternative Typical Cross-Section

The Five-Lane and the Four-Lane alternatives would have similar right-of-way requirements and in both cases additional right-of-way would be required. In response to concerns about impacts to businesses along Mileground Road, a compromise or Hybrid alternative was developed that would minimize these impacts. The Hybrid alternative would consist of two lanes in the eastbound (outbound) direction, one lane in the westbound (inbound) direction, and a continuous center two-way left-turn lane. A screen capture from the traffic simulation model for the Hybrid alternative is shown in **Figure 10**. This option would minimize right-of-way impacts as it would require only one additional lane, but the benefits also would be limited primarily to the P.M. peak period, when the outbound directional flow is heaviest.

Figure 10. Hybrid Alternative Simulation

Finally, a No Widening alternative was evaluated for comparison. The No Widening alternative does not add lanes to the central portion of Mileground Road but does include improvements at either end. At the west end, WV 705 would be re-aligned so that it becomes a through movement with Mileground Road, with Willey Street becoming the third leg of a T-intersection, as shown in **Figure 11**.

Figure 11. Conceptual WV 705 Re-alignment with Mileground Road

At the east end, Milegound Ground and Cheat Road would be re-aligned to form a through movement, with Point Marion Road and Easton Hill Road becoming intersecting cross-streets, as shown in **Figure 12**.

Figure 12. Conceptual Cheat Road Re-alignment with Mileground Road

The improvements by the West Virginia Department of Transportation (WVDOT) will have significant impacts on reducing congestion at two major choke points along the Mileground Road corridor by converting heavy left-turning movements (Cheat Road-to-Mileground Road in the A.M. peak and WV 705-to-Mileground Road in the P.M. peak) to through movements. However, congestion along much of Mileground Road will remain and worsen under a No Widening alternative as no additional through capacity is being provided.

Planned Elementary School

Another factor in the development of traffic projections and evaluation of alternatives for Mileground Road is the inclusion of a proposed new elementary school to be located at the corner of Mileground Road and WV 705. The school will serve approximately 450 students and will be created through the consolidation of Woodburn Elementary School, located west of the study area, and Easton Elementary, located at the corner of Mileground Road and Point Marion Road. The Monongalia County Board of Education had been considering several sites and in October 2010 voted to enter into negotiations with WVU on the purchase of the property shown as Parcel "E" in **Figure 13**.

Figure 13. New School Site (Parcel "E")

Primary access to the school would be provided via a fourth leg of the reconstructed intersection of WV 705 and Mileground Road, which was presented in the previous section of this report (see Figure 11). As a traditional four-legged signalized intersection, if the Five-Lane alternative were implemented, the school access drive would align as an intersecting cross-street with a re-aligned Willey Street. If the Four-Lane alternative were to be implemented, the school access drive would constitute the fourth leg of a roundabout intersection.

Secondary access to the school off Mileground Road near the armory access or Tramore Lane was assumed, but traffic conditions along Mileground Road and/or the selected improvement alternative could limit this access to right-in/right-out only.

Projections for new vehicle trips to be added to the Mileground Road corridor as a result of the new school were developed using the Institute of Transportation

Engineers *Trip Generation, 8th Edition*[2] manual. The average number of trip ends, where an entering and exiting trip each constitute a trip end, was estimated based on the assumed 450 students. School buses, faculty and staff trip ends, and parent drop-offs/pick-ups are all factored into the estimation. A summary of the projected trip ends using methods from Trip Generation is presented in **Table 5** below. It should be pointed out that these estimates are conservative – estimates were "rounded up" to be more reflective of an average "busy day" associated with school traffic.

Table 5. Proposed New School Trip Generation

	Total	Enter	Exit
Daily	600	300	300
A.M Peak	260	140	120
P.M. Peak	170	80	90

Source: Institute of Transportation Engineers *Trip Generation*, 8th Edition

Overall, assuming all of the school traffic was comprised of "new" trips added to the Mileground Road corridor, the additional school traffic would comprise about three percent of the total traffic (current daily traffic volumes on Mileground Road and WV 705 are about 23,000 vehicles per day). On a daily basis, this is a small percentage. During peak traffic periods, the contribution of school traffic, albeit small, is more noticeable because traffic conditions on Mileground Road and WV 705 are congested already.

Evaluation of Alternatives

The traffic simulation model developed for this study was the primary analysis tool used in evaluating the design alternatives. Performance measures obtained from the model either were compared directly among the alternatives or were used in computing other variables that were compared.

Analysis Scenarios

Several analysis scenarios were created for the purpose of evaluating and comparing the Mileground Corridor alternatives. Two critical time periods on a "typical" day were compared – the average weekday morning and afternoon peak periods or "rush hours." On Mileground Road, these periods typically occur from 7:00 A.M. until about 9:00 A.M. and from around 2:30 P.M. until about 6:00 P.M. Although there are other times (noon, for example) when Mileground Road traffic conditions are congested, these morning and afternoon peaks represent a regularly occurring worst case. Traffic counts for the base year models were collected during the summer of 2010, but these counts were multiplied by an adjustment factor derived from historical data to account for traffic conditions when local schools and WVU are in session.

In addition to current or existing year traffic conditions that were simulated, hypothetical future year traffic conditions were simulated and alternatives were evaluated based on these simulated future conditions. The Morgantown Travel Model maintained by the Morgantown Monongalia Metropolitan Planning Organization (MPO) was used to develop growth factors that were applied to existing traffic volumes in order to estimate future travel demand. The MPO model includes a forecast year of 2030 and growth factors were applied to create hypothetical year 2030 A.M. and P.M. peak period model scenarios. Projected year 2030 intersection movements are provided in **Figures A-1** and **A-2**, respectively, in the Appendix.

Several alternatives and modifications of alternatives for improving Mileground Road were evaluated and compared. These were also compared with two existing conditions scenarios: 1) existing conditions as they are today; and 2) existing or current year conditions with the addition of traffic from the proposed new school located at Mileground Road and WV 705.

Variations of the Five-Lane and Four-Lane alternatives included roundabouts at various intersections. A list and description of alternatives is provided in **Table 6**. Conceptual diagrams are presented in **Figure 14**.

[2] *Trip Generation, 8th Edition*, Institute of Transportation Engineers, Washington, D.C., 2008.

Table 6. Alternative Analysis Scenarios

Scenario	Description
Existing	Year 2010 conditions based on existing traffic data and roadway network
Existing with School	Year 2010 traffic conditions with additional traffic that would be generated with the construction of proposed new school at the WV 705/Mileground Road intersection
No Widening	Projected Year 2030 traffic conditions with no widening along Mileground Road but with re-alignment at: 1) WV 705/Mileground Road and 2) Mileground Road/Cheat Road/Point Marion Road
Hybrid*	Projected Year 2030 traffic conditions with a second through lane added in the eastbound (outbound) direction of Mileground Road from WV 705 to Airport Boulevard/Hartman Run Road
5L(A)*	Projected Year 2030 traffic conditions for a Five-Lane section of Mileground Road and signalized intersections at: 1) WV 705/Mileground Road; 2) Mileground Road/ Airport Boulevard/Hartman Run Road; and 3) Mileground Road/ Cheat Road/Point Marion Road
5L(B)*	Projected Year 2030 traffic conditions for a Five-Lane section of Mileground Road, with a roundabout at WV 705/Mileground Road and signalized intersections at: 1) Mileground Road/ Airport Boulevard/Hartman Run Road; and 2) Mileground Road/ Cheat Road/Point Marion Road
4L(A)*	Projected Year 2030 traffic conditions for a Four-Lane Median-Divided-Lane section of Mileground Road with roundabouts at: 1) WV 705/Mileground Road; 2) Mileground Road/ Airport Boulevard/Hartman Run Road; and 3) Mileground Road/ Cheat Road/Point Marion Road
4L(B)*	Projected Year 2030 traffic conditions for a Four-Lane Median-Divided-Lane section of Mileground Road with roundabouts at: 1) WV 705/Mileground Road and 2) Mileground Road/ Airport Boulevard/Hartman Run Road; and a signalized intersection at Mileground Road/ Cheat Road/Point Marion Road
4L(C)*	Projected Year 2030 traffic conditions for a Four-Lane Median-Divided-Lane section of Mileground Road with a roundabouts at WV 705/Mileground Road and signalized intersections at: 1) Mileground Road/ Airport Boulevard/Hartman Run Road; and 2) Mileground Road/ Cheat Road/Point Marion Road
*All of these alternatives include adding a through lane to eastbound (outbound) Mileground Road from Airport Boulevard/Hartman Run Road to Cheat Road/Point Marion Road, making this a four-lane undivided roadway section.	

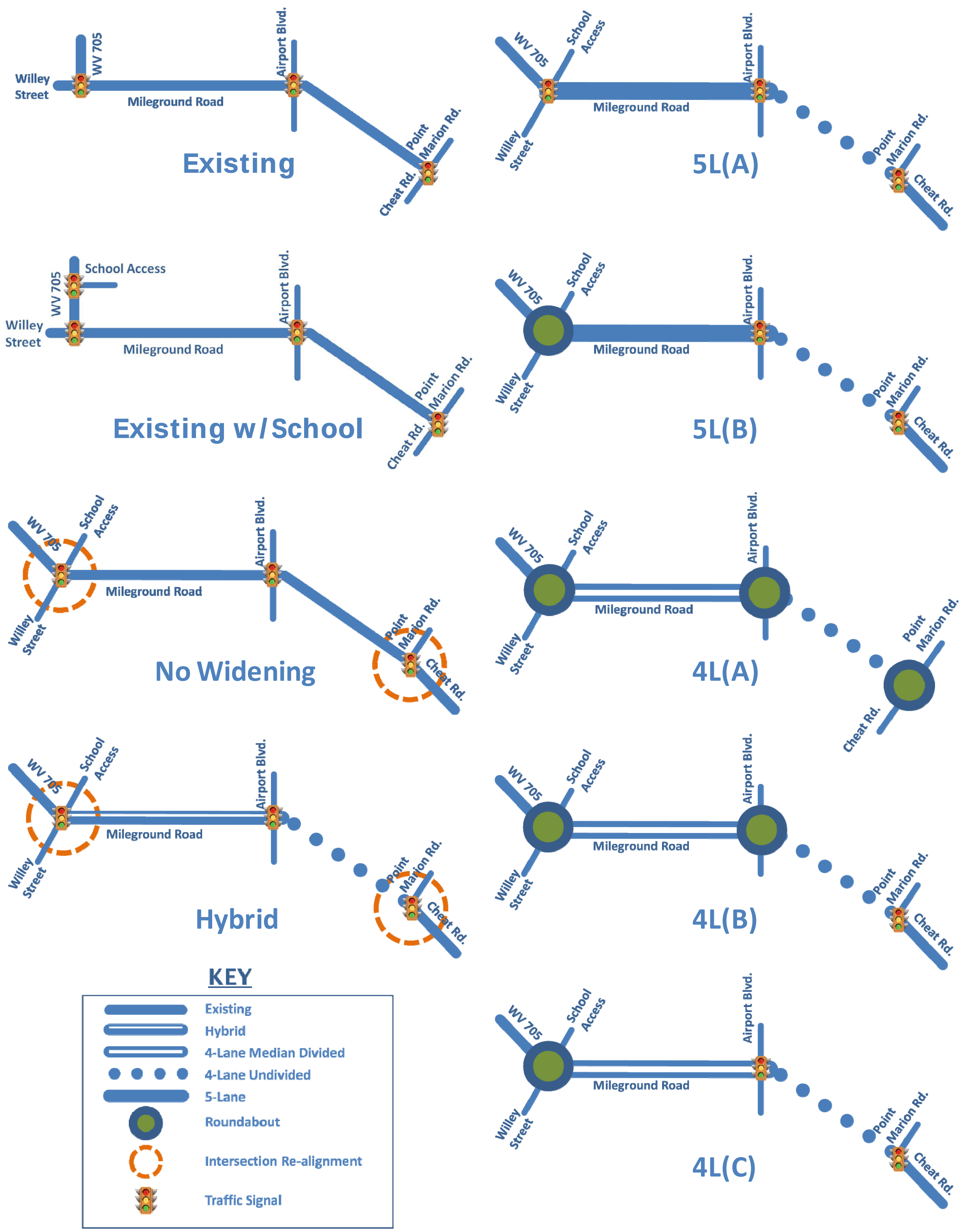

Figure 14. Evaluation Scenarios

Performance Measures

Performance measures are metrics or quantifiable parameters used to assess system performance. In the case of the Mileground Road Traffic Analysis, performance measures for each of the analysis scenarios were desired from the traffic simulation model. For this study, two types of performance measures were considered:

> **System-wide** – "Big picture" or area-wide performance measures that were used to assess the performance as a whole of the transportation system that was modeled.
>
> **Facility-specific** – Measures used to evaluate and compare specific elements of the transportation system, such as signalized intersections, roundabouts and street segments.

The system-wide and facility-specific performance measures are defined in **Table 7**. System-wide performance measures are summarized for the various analysis scenarios in **Table 8**.

Signalized intersection average vehicular delays are presented in **Table 9**. The results reflect the average of 10 simulation runs for each of the model scenarios. The average delay values shown represent weighted average delays for the entire intersection where individual lane group or turning movement delays are weighted according to the lane group or turning movement traffic volumes.

For the "Existing with School" scenario, it was assumed that access to the proposed new school would be provided via a direct connection to WV 705 which would include a signalized intersection. This assumption was made for comparison with other roadway improvement scenarios. Aside from the "Existing with School" scenario, the other alternative scenarios include some sort of improvement to the Mileground Road/WV 705 intersection which includes provision of access to the school as the fourth leg of this intersection. Thus, school contribution to intersection delays for all scenarios other than "Existing" and" Existing with School" are included in the average delay estimates for the Mileground Road/WV 705 intersection.

Average travel speeds along Mileground Road from WV 705 to Cheat Road are summarized in **Table 10**. Average travel speed is computed as the distance traveled over the section of interest divided by the total time, where total time includes running time plus time stopped at intersections. For those alternatives (4L(A) and 4L(B)) involving a roundabout at Mileground Road/Airport Boulevard, the average speed includes travel time through the roundabout. The average speeds reported do not include travel through the Mileground Road/WV 705 and Mileground Road/Cheat Road intersections; these define the endpoints of the segment in question.

The results show how the re-alignment of the Mileground Road/Cheat Road/Point Marion Road improves congestion in the outbound (eastbound) direction, particularly for the P.M. peak, where the heavy right-turn movement that exists today (eastbound Mileground Road-to-southbound Cheat Road) becomes a through movement. The benefit of this improvement is diminished under Alternative 4L(C) as the signalized intersection at Mileground Road/Airport Boulevard becomes a "choke point" for outbound vehicles in those alternatives where it is present.

Maximum queue lengths by approach were computed from the simulation model runs at the following intersections:

- WV 705/Stewartstown Road
- Mileground Road/WV 705
- Mileground Road/Airport Boulevard/Hartman Run Road
- Mileground Road/Cheat Road/Point Marion Road (this reconfigured intersection included the Easton Hill Road approach under the improvement scenarios)

Average maximum queue lengths by approach for 10 simulation model runs are shown in **Table 11**.

Table 7. Traffic Simulation Performance Measures

Performance Measure	Type	Description
Completed Trips	System-wide	The total number of vehicular trips that begin and end during the simulation period. Relatively, a higher number of completed trips implies a higher throughput of the modeled transportation network.
Vehicle-Miles Traveled (VMT)	System-wide	The sum total distance traveled by all vehicles that completed their trips during the analysis period. Relatively, a higher VMT implies a higher throughput of the modeled transportation network.
Vehicle-Hours Traveled (VHT)	System-wide	The sum total travel time experienced by all vehicles that completed their trips during the analysis period. Relatively, a higher VHT implies higher delays and lower throughput of the modeled transportation network.
Average Network Speed	System-wide	Travel speed averaged over all vehicles that completed their trips during the analysis period.
Total Network Delay	System-wide	The total difference between experienced travel time and free flow travel time, summed over all vehicles that completed their during the analysis period.
Average Network Delay	System-wide	The total difference between experienced travel time and free flow travel time, averaged over all vehicles that completed their during the analysis period.
Total Number of Stops	System-wide	The total number of stops experienced by all vehicles that completed their trips during the analysis period. Relatively, a higher number of total stops implies a more congested network.
Average Number of Stops	System-wide	The total number of stops experienced during a trip averaged over all vehicles that completed their trips during the analysis period.
Average Vehicular Delay	Facility-specific (Intersection)	Delay experienced at the intersection or on the intersection approach, averaged over all vehicles during the analysis period. Relatively, higher average vehicular delays imply a more congested intersection or approach leg.
Average Travel Speed	Facility-specific (Roadway Segment)	The travel speed of all vehicles on a roadway segment, averaged over all observations made during the analysis period. Relatively, lower average travel speeds imply a more congested roadway segment.
Maximum Queue Length	Facility-specific (Roadway Segment)	The maximum queue length on a per lane basis measured during the analysis period.

Table 8. Summary of System-Wide Performance Measures

	Scenario	Network Trip Statistics				Network Delays			
		Completed Trips	Vehicle-Miles Traveled (Miles)	Vehicle-Hours Traveled (Hours)	Avg. Speed (MPH)	Total Delay (Hours)	Avg. Delay (Sec/Mi)	Number of Stops (in 100's)	Avg. Number of Stops (Stops/Mi)
	AM Peak								
	Existing	4,350	4,530.0	214.0	21.2	125.2	107.4	96.0	2.3
	Existing with School	4,379	4,482.7	293.1	15.3	204.8	174.4	108.2	2.6
Year 2030	**No Widening**	5,329	5,063.0	551.1	9.2	454.5	384.4	242.5	5.0
	Hybrid	5,814	5,662.0	424.5	13.3	312.4	288.8	143.1	3.1
	5L(A)	6,028	6,108.9	426.2	14.3	305.9	327.6	120.8	2.7
	5L(B)	6,378	6,348.4	292.4	21.7	166.7	137.1	130.9	3.3
	4L(A)	6,433	6,934.5	300.2	23.1	161.5	137.6	117.0	2.4
	4L(B)	6,519	6,541.9	265.2	24.7	136.2	99.3	134.0	3.1
	4L(C)	6,110	6,296.2	318.1	19.8	193.5	150.2	186.0	4.3
	PM Peak								
	Existing	4,958	4,745.3	616.2	7.7	523.1	492.0	160.8	3.6
	Existing with School	4,819	4,479.5	716.8	6.2	628.8	583.8	165.7	3.7
Year 2030	**No Widening**	4,510	3,408.4	546.7	6.2	647.3	774.8	118.3	4.4
	Hybrid	6,139	5835	887	6.6	775.1	813.4	210.7	4.3
	5L(A)	6,375	5,957.1	764.3	7.8	656.6	663.5	229.7	5.1
	5L(B)	6,379	6,147.7	742.1	8.3	625.3	601.3	178.4	3.8
	4L(A)	6,858	6,862.4	628.0	10.9	489.3	431.5	346.0	5.7
	4L(B)	6,822	6,858.7	543.3	12.6	407.6	387.0	149.7	3.2
	4L(C)	6,496	6,227.8	556.3	11.2	432.5	421.7	178.2	3.4

Table 9. Average Vehicular Delays at Intersections

	Scenario	WV 705 @ Stewartstown Rd.		Mileground Rd. @ School Access		Mileground Rd. @ WV 705		Mileground Rd. @ Airport Blvd.		Mileground Rd. @ Cheat Rd.	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
	Existing	29.8	149.4	N/A	N/A	60.6	68.8	27.0	84.2	48.1	109.1
	Existing with School	30.4	160.3	12.6	13.2	51.1	137.0	24.6	82.6	64.5	88.2
Year 2030	No Widening	54.5	235.0	*	*	160.5	174.7	87.8	177.5	27.2	118.3
	Hybrid	87.5	194.8	*	*	111.2	48.1	37.8	90.4	35.9	178.4
	5L(A)	109.6	202.0	*	*	40.1	35.4	22.7	25.6	56.0	160.2
	5L(B)	44.3	197.7	*	*	11.5	10.3	23.2	23.7	41.2	152.7
	4L(A)	49.1	167.0	*	*	27.3	35.4	21.9	36.2	14.9	94.1
	4L(B)	36.6	148.1	*	*	22.3	32.4	19.8	17.5	33.1	96.2
	4L(C)	38.3	166.1	*	*	35.3	31.5	23.2	32.8	62.0	113.7

** School access provided as the fourth leg of the Mileground Road/WV 705 intersection*

Table 10. Mileground Road Average Travel Speeds (in mph)

	Scenario	Outbound (Eastbound)		Inbound (Westbound)	
		AM	PM	AM	PM
	Existing	29.1	14.1	18.7	25.5
	Existing with School	28.7	8.4	21.5	26.4
Year 2030	No Widening	23.9	11.4	6.7	26.2
Year 2030	Hybrid	26.7	9.2	16.6	25.5
Year 2030	5L(A)	22.9	13.2	26.8	27.9
Year 2030	5L(B)	29.2	15.2	31.7	32.1
Year 2030	4L(A)	34.9	13.0	33.0	34.5
Year 2030	4L(B)	32.0	30.5	31.4	31.8
Year 2030	4L(C)	23.3	19.8	30.3	29.2

Note: Average travel speeds for the section of Mileground Road from WV 705 to Cheat Road

Table 11. Maximum Queue Lengths (in feet) by Approach

	Scenario	WV 705 @ Stewartstown Rd.				Mileground Rd. @ WV 705				Mileground Rd. @ Airport Blvd.				Mileground Rd. @ Cheat Rd.			
		NB	SB	EB	WB	NB	SB	EB	WB	NB	SB	EB	WB	NB	SB	EB	WB
AM Peak																	
	Existing	300	371	83	471	---	400	619	730	371	95	400	400	1000	250	200	---
	Existing with School	299	292	123	367	---	350	625	1005	258	91	361	386	1124	221	203	---
Year 2030	No Widening	354	965	156	675	904	208	616	524	449	223	469	731	224	316	397	158
Year 2030	Hybrid	1033	382	117	689	750	200	538	706	407	207	308	725	671	348	362	393
Year 2030	5L(A)	467	666	187	677	371	198	459	527	269	80	313	352	249	287	884	586
Year 2030	5L(B)	466	452	135	671	140	38	32	227	239	171	213	363	813	230	344	137
Year 2030	4L(A)	568	322	131	727	843	96	236	235	214	289	66	172	133	314	115	---
Year 2030	4L(B)	419	317	139	545	762	150	290	127	77	246	64	414	170	232	208	300
Year 2030	4L(C)	449	656	132	545	840	297	263	370	254	135	297	333	1043	302	819	310
PM Peak																	
	Existing	1500	1073	312	313	---	870	616	320	410	314	900	350	1100	1108	470	---
	Existing with School	432	1082	226	485	---	625	615	292	430	245	1054	353	1171	1093	245	---
Year 2030	No Widening	2000	1044	681	673	557	134	1628	500	412	341	1129	538	283	1202	1720	176
Year 2030	Hybrid	1056	1056	698	711	850	90	572	543	410	310	725	620	567	1211	2666	157
Year 2030	5L(A)	941	1048	685	672	565	110	506	329	367	139	327	342	1091	1211	2406	163
Year 2030	5L(B)	874	1079	681	676	223	36	60	78	306	208	293	239	715	1196	1899	174
Year 2030	4L(A)	1478	1043	680	707	876	70	281	121	360	251	168	104	112	580	1016	---
Year 2030	4L(B)	1136	1077	566	68	870	93	378	157	334	271	129	286	150	1192	369	300
Year 2030	4L(C)	1628	1050	677	677	858	149	344	295	330	166	416	375	235	1193	908	187

Travel Time Cost Analysis

As a final way to compare performance among the various scenarios, travel time costs were computed using simulation model output. As the models were developed to simulate current and hypothetical future weekday A.M. and P.M. peak traffic periods, a simplifying assumption was made that all drivers during these periods were commuters traveling along Mileground Road to and from work. The U.S. Bureau of Labor Statistics reported an average hourly wage of $18.70 for workers in Monongalia County in 2009. Assuming this to be an average value of time for a commuter trip along the study section of Mileground Road, average commuter trip costs were computed among the various scenarios in the inbound and outbound directions for the A.M. and P.M. peak traffic periods.

The average trip times along the study section and average commuter trip costs, or average trip values based on the average hourly wage, are summarized in **Table 12**. It should be pointed out that the average trip costs are *theoretical* costs computed for the sake of comparing alternatives. They are time-based only and do not include other factors such as vehicle operating costs (which the TransModeler software does not compute), maintenance and depreciation.

Comparison of Alternatives

This study facilitated a detailed operational evaluation of design alternatives for improvements to the Mileground. Performance measures from the traffic simulation model were summarized and used in the comparison. Additional factors such as safety, though not quantified, were included in the comparison as well.

The No Build or Do Nothing alternative was included as a baseline for comparison and to demonstrate that traffic congestion is anticipated to worsen if no improvements are considered. The No Widening alternative features improvements to two main bottlenecks – the WV 705/Mileground Road intersection and the Mileground Road/Cheat Road/Point Marion Road intersection – but does not include any improvement to the Mileground in between.

The Four-Lane and Five-Lane alternatives, including variations of each that deal with roundabout intersections, provide options for major capacity improvements through added lanes. The Hybrid alternative provides an option for adding capacity in the eastbound (outbound) direction only. Both the Four-Lane and Five-Lane alternatives incorporate the intersection re-alignments contained in the No Widening alternative.

A summary of advantage and disadvantages identified through the comparison is provided in **Table 13**.

Table 12. Summary of Average Commuter Trip Costs

Scenario		AM Peak				PM Peak			
		AM Peak Inbound		AM Peak Outbound		PM Peak Inbound		PM Peak Outbound	
		Trip Time	Ave. Cost	Trip Time	Ave. Cost	Trip Time	Ave. Cost	Trip Time	Ave. Cost
Existing		5.6	$ 1.76	5.8	$ 1.80	8.8	$ 2.75	11.2	$ 3.48
Existing with School		7.3	$ 2.29	8.1	$ 2.53	8.6	$ 2.69	16.8	$ 5.24
No Widening	Year 2030	14.5	$ 4.53	11.4	$ 3.56	13.2	$ 4.12	13.7	$ 4.27
Hybrid	Year 2030	9.0	$ 2.81	5.9	$ 1.83	8.9	$ 2.78	10.2	$ 3.18
5L(A)	Year 2030	4.2	$ 1.30	4.4	$ 1.38	6.4	$ 2.00	7.7	$ 2.41
5L(B)	Year 2030	4.3	$ 1.34	4.4	$ 1.36	5.9	$ 1.82	7.6	$ 2.38
4L(A)	Year 2030	4.2	$ 1.32	4.6	$ 1.43	6.7	$ 2.09	7.6	$ 2.38
4L(B)	Year 2030	4.3	$ 1.34	4.4	$ 1.37	6.4	$ 2.01	4.8	$ 1.51
4L(C)	Year 2030	4.3	$ 1.33	5.0	$ 1.54	7.0	$ 2.19	8.4	$ 2.60

Note: Trip time in minutes. Wages and costs were kept constant at a Year 2010 level to allow for direct comparison.

Table 13. Comparison of Alternatives Summary

Advantages	Disadvantages
No Action	
No actions are taken to improve congestion on Mileground Road. Access to the proposed new elementary school would be provided at a new signalized intersection with WV 705 about 700 - 800 feet north of Mileground Road.	
Advantages	**Disadvantages**
• Little to no cost • Minimal impacts to businesses along Mileground Road	• Worsening congestion as traffic volumes continue to grow in the corridor
No Widening	
The WV 705/Mileground Road and Mileground Road/Cheat Road/Point Marion Road intersections are re-aligned so that the predominant movement becomes a through movement. No additional through lanes are constructed along Mileground Road between these two intersections.	
Advantages	**Disadvantages**
• Localized congestion improvements at WV 705/Mileground Road and Mileground Road/Cheat Road/Point Marion Road intersections • Least costly of the "build" alternatives	• No congestion improvements along Mileground between these two intersections
4-Lane	
Widen Mileground Road to 4 lanes and construct a non-traversable median from WV 705 to Airport Blvd. The section from Airport Boulevard to Cheat Road is four-lane undivided. Variations of this alternative include roundabouts at WV 705, Airport Blvd. and/or Cheat Road. Access to the proposed new school is provided as the fourth leg to the roundabout at WV 705.	
Advantages	**Disadvantages**
• Adds capacity in both directions • Less "side friction" by eliminating mid-block left turns, thus smoother flow along Mileground Road between the roundabouts • All driveways right-in/ right-out • Crash experience lower than 5-Lane	• Right-of-way acquisition could be significant • Roundabouts could become bottlenecks • No left turns allowed; U-turns are made at roundabouts • Initial public perception can be negative • Concerns regarding business access
5-Lane	
Widen Mileground Road to 5 lanes from WV 705 to Airport Blvd. The section from Airport Boulevard to Cheat Road is four-lane undivided. Intersections with WV 705, Airport Blvd. and Cheat Road remain signalized. A variation of this alternative includes a roundabout at WV 705. The alternative includes the intersection re-alignments contained in the No Widening alternative. Access to the proposed new school is provided as the fourth leg to the intersection at WV 705.	
Advantages	**Disadvantages**
• Adds capacity in both directions • Reduction in congestion levels • All current access maintained • Center left-turn lane can be used for staging of left turns	• Requires the most right-of-way of all alternatives • Capacity issues at intersections may remain • Crash experience is expected to increase

Continued on next page

Hybrid	
Add one lane in the outbound (eastbound) direction of Mileground Road from WV 705 to Cheat Road. The alternative includes the intersection re-alignments contained in the No Widening alternative. The alternative includes the intersection re-alignments contained in the No Widening alternative.	
Advantages	**Disadvantages**
• Requires less right-of-way than 4-Lane and 5-Lane alternatives • Increased capacity in heaviest (outbound PM peak) direction • All existing access points maintained	• Limited effectiveness in addressing peak period congestion • No additional capacity in inbound direction • Crash experience likely to increase

Comparatively, the Four-Lane and Five-Lane alternatives provided similar performance. Both would improve congestion as capacity is increased through the addition of a travel lane in each direction. Under the Four-Lane alternative, all vehicles either slow or stop upon approaching the roundabouts, but not all vehicles would be required to stop at the signalized intersections under the Five-Lane alternative (depending upon what point during the cycle they arrived). At roundabouts, the simulation showed that delays on some of the minor approach legs could be quite significant (Airport Boulevard, for example) due to heavy peak flow along Mileground Road. At the WV 705/Mileground Road roundabout, the simulation showed that a bypass lane from outbound WV 705 to Willey Street would be needed to reduce heavy queues.

When considering overall traffic flow along Mileground Road, the Four-Lane alternative provided the best results, primarily due to the raised median and elimination of left turns. Under this alternative, every driveway becomes a right-in/right-out access point, which reduces "side friction" and provides for smoother traffic flow along Mileground Road. Additionally, this alternative will be safer as it reduces the number of conflict points at each intersection and eliminates the most severe crash types – head-on and right-angle crashes. The down side is that drivers desiring to turn left into or out of a business will have to do so by driving through the roundabout and heading back in the other direction.

With regard to safety, there is a concern that a roundabout at Mileground Road/Cheat Road/Point Marion Road would result in increased crashes due to relatively steep downgrade approaches and potentially high speeds. This could be a particular problem on the northbound Cheat Road approach, where the downgrade is about 8 percent. The FHWA Roundabout Guide discourages roundabouts at such locations:

> "It is generally not desirable to locate roundabouts in locations where grades through the intersection are greater than four percent. The installation of roundabouts on roadways with grades lower than three percent is generally not problematic. …Care must be taken when designing roundabouts on steep grades. On approach roadways with grades steeper than -4 percent, it is more difficult for entering drivers to slow or stop on the approach."[3]

A roundabout at Mileground Road/Cheat Road/Point Marion Road could present both operational and safety problems and should be eliminated from consideration for this design alternative.

[3] *Roundabouts: An Informational Guide*, FHWA-RD-00-67, Federal Highway Administration, Washington, D.C., 2000, p. 167.

Other Factors to Consider

Other factors should be taken into account when considering improvements to Mileground Road. The WV 705/Stewartstown Road intersection will be a bottleneck under any scenario, as it is today. However, a new traffic signal system being installed for the Morgantown area, including WV 705 from downtown to the Mileground, will offer some relief. The Stewartstown Road intersection does have a metering effect on outbound traffic; thus, if improvements were made here, the downstream demand at the WV 705/Mileground Road intersection will be intensified somewhat (during the p.m. peak) as this bottleneck is reduced.

Recent development in the area, particularly multi-family residential development, has resulted in increased travel demand and heightened congestion along Mileground Road. As the WV 705 Connector project is no longer being considered, additional future development in this area will simply exacerbate the heavy congestion that exists currently if improvements are not made. Even without additional development, future traffic growth along Mileground Road is expected as Morgantown and the region grow.

This study assumed that future land use along Mileground Road would be consistent with current use. In other words, no new major traffic generators in the area were assumed.

Conclusions

The purpose of this study was to provide a detailed operational assessment of alternatives for improving Mileground Road as part of the process to amend the *2030 Transportation Plan* of the Morgantown Monogalia Metropolitan Planning Organization. The study provides information about the alternatives considered and anticipated traffic impacts in support of selecting a preferred alternative.

The study demonstrated that the No Build or Do Nothing option is not a viable option. Traffic is expected to increase within the corridor due to growth in the area and resulting congestion can be expected to worsen accordingly. The construction of a proposed new elementary school just north of the armory building would add another signalized intersection to WV 705 if no other improvements were made; even with improvements, additional traffic associated with the school is anticipated.

Under the No Widening alternative, improvements to Mileground Road *will* be made in the form of re-aligning the WV 705/Mileground Road and Mileground Road/Cheat Road/Point Marion Road intersections so that the primary movement becomes a through movement. This change would make those two intersections operate more efficiently and thus delay would be reduced, but little benefit along the Mileground Road section itself would be realized.

The Four-Lane alternative with roundabouts at major intersection would add capacity and reduce congestion. The raised median would eliminate left turns and make all driveways right-in/right-out access points; left turns would be accommodated as U-turns through the downstream roundabout. This alternative offers improved safety compared to the existing three-lane cross-section and there would be smoother flow along Mileground Road, but there could be an associated negative perception by local businesses and patrons because of the elimination of left turns. For this alternative, a roundabout at Mileground Road/Cheat Road/Point Marion Road is not recommended due to safety concerns associated with approach grades that are steeper than recommended guidelines. Finally, the Four-Lane alternative would have significant right-of-way acquisition requirements.

The Five-Lane alternative also performed well with respect to reducing congestion, but right-of-way acquisition would be most significant among the options that were considered. Additionally, vehicular conflicts and resulting crashes would be expected to increase when compared to the existing three-lane section and as traffic volumes grow.

The Hybrid alternative would not require as much right-of-way as the Four-Lane or Five-Lane alternatives as only one lane would be added in the outbound direction. While this option does provide reduced congestion for the P.M. peak period, which was deemed to be the most heavily congestion period during a typical day, it provides very little benefit during the A.M. peak as no lanes would be added in the inbound direction.

Appendix

Table A-1. Existing Simulation Model Turning Movement Calibration Results - A.M. Peak

Intersection	Approach Direction	Movement	Model	Count	Model - Count	(Model - Count)^2
Mileground Road at Cheat Road	NW	T	510.9	511	-0.1	0.01
Mileground Road at Cheat Road	NW	L	752.1	737	15.1	228.01
Mileground Road at Cheat Road	SE	R	156.2	162	-5.8	33.64
Mileground Road at Cheat Road	SE	T	238.7	252	-13.3	176.89
Mileground Road at Cheat Road	NE	L	109.8	122	-12.2	148.84
Mileground Road at Cheat Road	NE	R	374.8	356	18.8	353.44
Mileground Road at Airport Boulevard	SW	R	57.9	54	3.9	15.21
Mileground Road at Airport Boulevard	SW	T	721.2	727	-5.8	33.64
Mileground Road at Airport Boulevard	SW	L	160.1	170	-9.9	98.01
Mileground Road at Airport Boulevard	SE	L	34.1	42	-7.9	62.41
Mileground Road at Airport Boulevard	SE	R	66.1	68	-1.9	3.61
Mileground Road at Airport Boulevard	SE	T	23.6	18	5.6	31.36
Mileground Road at Airport Boulevard	NE	T	339.3	330	9.3	86.49
Mileground Road at Airport Boulevard	NE	L	35.3	35	0.3	0.09
Mileground Road at Airport Boulevard	NE	R	126.5	134	-7.5	56.25
Mileground Road at Airport Boulevard	NW	R	117.2	128	-10.8	116.64
Mileground Road at Airport Boulevard	NW	T	17.5	9	8.5	72.25
Mileground Road at Airport Boulevard	NW	L	192.2	171	21.2	449.44
Mileground Road at WV 705	SW	R	657.3	654	3.3	10.89
Mileground Road at WV 706	SW	T	239.3	241	-1.7	2.89
Mileground Road at WV 707	SE	L	342.9	345	-2.1	4.41
Mileground Road at WV 708	SE	R	308.2	294	14.2	201.64
Mileground Road at WV 709	NE	T	135.0	119	16.0	256.00
Mileground Road at WV 710	NE	L	335.3	335	0.3	0.09
Mileground Road at Easton Hill Road	SW	R	5.7	3	2.7	7.29
Mileground Road at Easton Hill Road	SW	T	878.3	880	-1.7	2.89
Mileground Road at Easton Hill Road	SW	L	33.6	30	3.6	12.96
Mileground Road at Easton Hill Road	S	L	3.6	6	-2.4	5.76
Mileground Road at Easton Hill Road	S	R	6.9	6	0.9	0.81
Mileground Road at Easton Hill Road	E	T	459.4	452	7.4	54.76
Mileground Road at Easton Hill Road	E	L	6.1	8	-1.9	3.61
Mileground Road at Easton Hill Road	E	R	24.7	26	-1.3	1.69
Mileground Road at Easton Hill Road	N	R	25.2	24	1.2	1.44
Mileground Road at Easton Hill Road	N	L	46.5	53	-6.5	42.25
WV 705 at Stewartstown Road	SW	R	565.3	589	-23.7	561.69
WV 705 at Stewartstown Road	SW	T	121.5	113	8.5	72.25
WV 705 at Stewartstown Road	SW	L	73.7	75	-1.3	1.69
WV 705 at Stewartstown Road	SE	L	138.6	139	-0.4	0.16
WV 705 at Stewartstown Road	SE	R	31.5	39	-7.5	56.25
WV 705 at Stewartstown Road	SE	T	460.7	453	7.7	59.29
WV 705 at Stewartstown Road	NE	T	44.4	43	1.4	1.96
WV 705 at Stewartstown Road	NE	L	46.9	38	8.9	79.21
WV 705 at Stewartstown Road	NE	R	117.9	109	8.9	79.21
WV 705 at Stewartstown Road	NW	R	20.8	17	3.8	14.44
WV 705 at Stewartstown Road	NW	T	843.6	815	28.6	817.96
WV 705 at Stewartstown Road	NW	L	139.9	149	-9.1	82.81
Mileground Road at Tramore Lane	SW	R	11.4	13	-1.6	2.56
Mileground Road at Tramore Lane	SW	T	937.9	930	7.9	62.41
Mileground Road at Tramore Lane	SE	R	16.5	17	-0.5	0.25
Mileground Road at Tramore Lane	SE	L	5.8	7	-1.2	1.44
Mileground Road at Tramore Lane	NE	L	9.3	9	0.3	0.09
Mileground Road at Tramore Lane	NE	T	489.3	472	17.3	299.29
			Sums	4590	46.9	2296.71
				Difference	1.0%	
			No. Counts (n)	52		
			%RMSE	**7.5%**		

$$\%RMSE = \frac{\sqrt{\sum_j (Model_j - Count_j)^2 / (Numberofcounts)}}{\left(\sum_j Count_j / Numberofcounts\right)} * 100$$

Table A-2. Existing Simulation Model Turning Movement Calibration Results - P.M. Peak

Intersection	Approach Direction	Movement	Model	Count	Model - Count	(Model - Count)^2
Mileground Road at Cheat Road	NW	T	550.9	460	90.9	8262.80
Mileground Road at Cheat Road	NW	L	421.6	590	-168.4	28358.56
Mileground Road at Cheat Road	SE	R	145.3	120	25.3	640.09
Mileground Road at Cheat Road	SE	T	776.9	830	-53.1	2819.61
Mileground Road at Cheat Road	NE	L	191.6	170	21.6	466.56
Mileground Road at Cheat Road	NE	R	844.3	910	-65.7	4316.49
Mileground Road at Airport Boulevard	SW	R	33.4	40	-6.6	43.56
Mileground Road at Airport Boulevard	SW	T	448.3	430	18.3	334.89
Mileground Road at Airport Boulevard	SW	L	114.2	150	-35.8	1281.64
Mileground Road at Airport Boulevard	SE	L	65.7	60	5.7	32.49
Mileground Road at Airport Boulevard	SE	R	47.8	50	-2.2	4.84
Mileground Road at Airport Boulevard	SE	T	27.5	40	-12.5	156.25
Mileground Road at Airport Boulevard	NE	T	699.4	750	-50.6	2560.36
Mileground Road at Airport Boulevard	NE	L	53.5	60	-6.5	42.25
Mileground Road at Airport Boulevard	NE	R	98.1	110	-11.9	141.61
Mileground Road at Airport Boulevard	NW	R	284.6	280	4.6	21.16
Mileground Road at Airport Boulevard	NW	T	23.0	30	-7.0	49.00
Mileground Road at Airport Boulevard	NW	L	157.0	160	-3.0	9.00
Mileground Road at WV 705	SW	R	451.6	490	-38.4	1474.56
Mileground Road at WV 706	SW	T	153.8	250	-96.2	9254.44
Mileground Road at WV 707	SE	L	625.2	630	-4.8	23.04
Mileground Road at WV 708	SE	R	399.8	510	-110.2	12144.05
Mileground Road at WV 709	NE	T	233.3	250	-16.7	278.89
Mileground Road at WV 710	NE	L	323.1	360	-36.9	1361.61
Mileground Road at Easton Hill Road	SW	T	559.3	580	-20.7	428.49
Mileground Road at Easton Hill Road	SW	L	22.3	30	-7.7	59.29
Mileground Road at Easton Hill Road	S	L	5.2	5	0.2	0.04
Mileground Road at Easton Hill Road	S	R	5.1	5	0.1	0.01
Mileground Road at Easton Hill Road	E	T	1006.9	1030	-23.1	533.61
Mileground Road at Easton Hill Road	E	L	3.7	5	-1.3	1.69
Mileground Road at Easton Hill Road	E	R	17.2	20	-2.8	7.84
Mileground Road at Easton Hill Road	N	R	30.7	30	0.7	0.49
Mileground Road at Easton Hill Road	N	L	22.8	20	2.8	7.84
WV 705 at Stewartstown Road	SW	R	257.1	240	17.1	292.41
WV 705 at Stewartstown Road	SW	T	92.3	120	-27.7	767.29
WV 705 at Stewartstown Road	SW	L	61.8	50	11.8	139.24
WV 705 at Stewartstown Road	SE	L	394.2	480	-85.8	7361.64
WV 705 at Stewartstown Road	SE	R	49.4	60	-10.6	112.36
WV 705 at Stewartstown Road	SE	T	745.1	770	-24.9	620.01
WV 705 at Stewartstown Road	NE	T	268.3	320	-51.7	2672.89
WV 705 at Stewartstown Road	NE	L	94.0	80	14.0	196.00
WV 705 at Stewartstown Road	NE	R	230.0	190	40.0	1600.00
WV 705 at Stewartstown Road	NW	R	71.0	70	1.0	1.00
WV 705 at Stewartstown Road	NW	T	504.4	530	-25.6	655.36
WV 705 at Stewartstown Road	NW	L	145.2	190	-44.8	2007.04
Mileground Road at Tramore Lane	SW	R	9.5	10	-0.5	0.25
Mileground Road at Tramore Lane	SW	T	610.9	640	-29.1	846.81
Mileground Road at Tramore Lane	SE	R	16.5	20	-3.5	12.25
Mileground Road at Tramore Lane	SE	L	5.5	5	0.5	0.25
Mileground Road at Tramore Lane	NE	L	13.9	20	-6.1	37.21
Mileground Road at Tramore Lane	NE	T	880.0	890	-10.0	100.00
			Sums	14140	-259.6	17973.48
				Difference	-1.8%	
			No. Counts (n)	51		
			%RMSE	**6.8%**		

$$\%RMSE = \frac{\sqrt{\sum_j (Model_j - Count_j)^2 / (Numberofcounts)}}{\left(\sum_j Count_j / Numberofcounts\right)} * 100$$

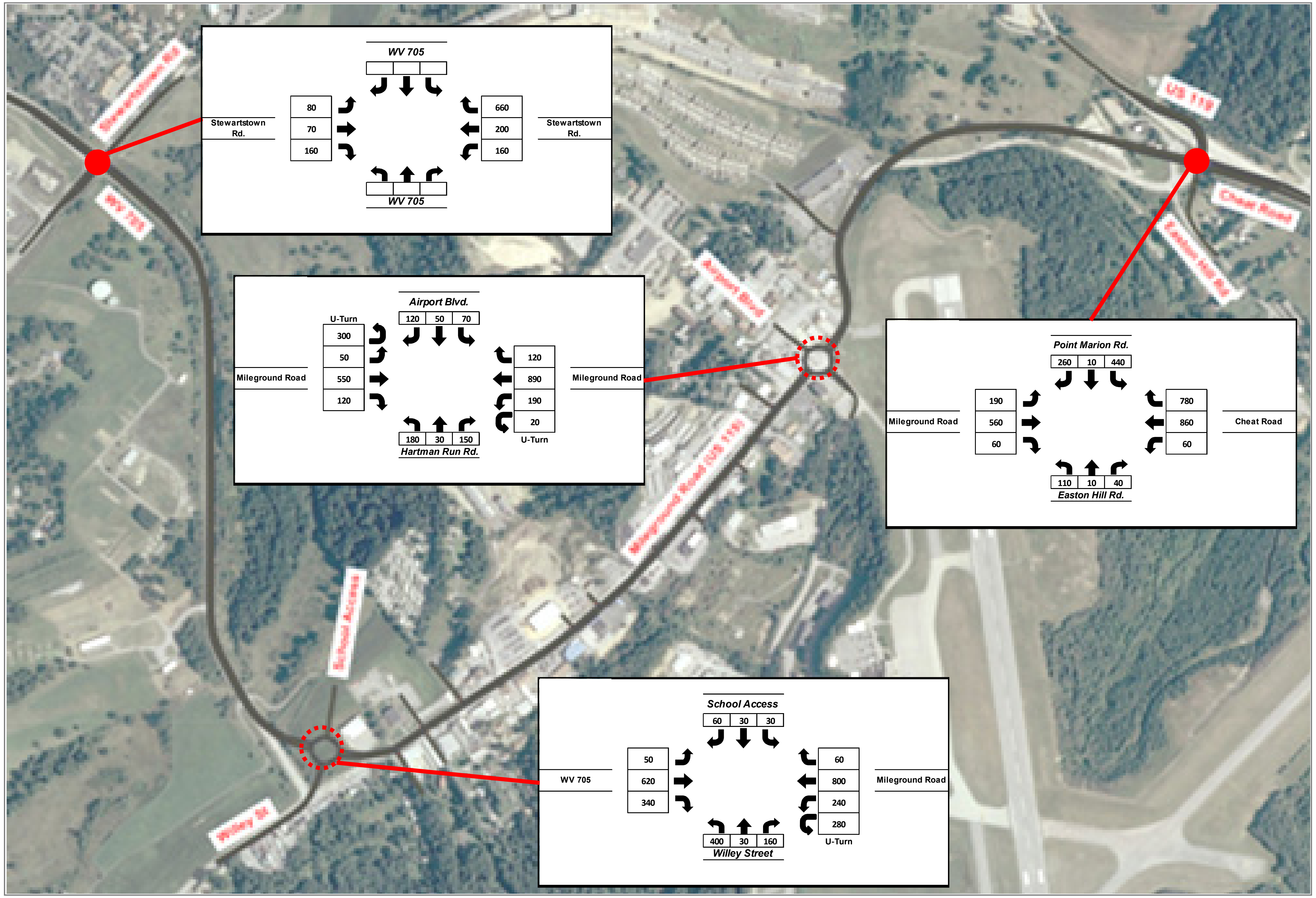

Figure A-1. Year 2030 A.M. Peak Traffic Projections

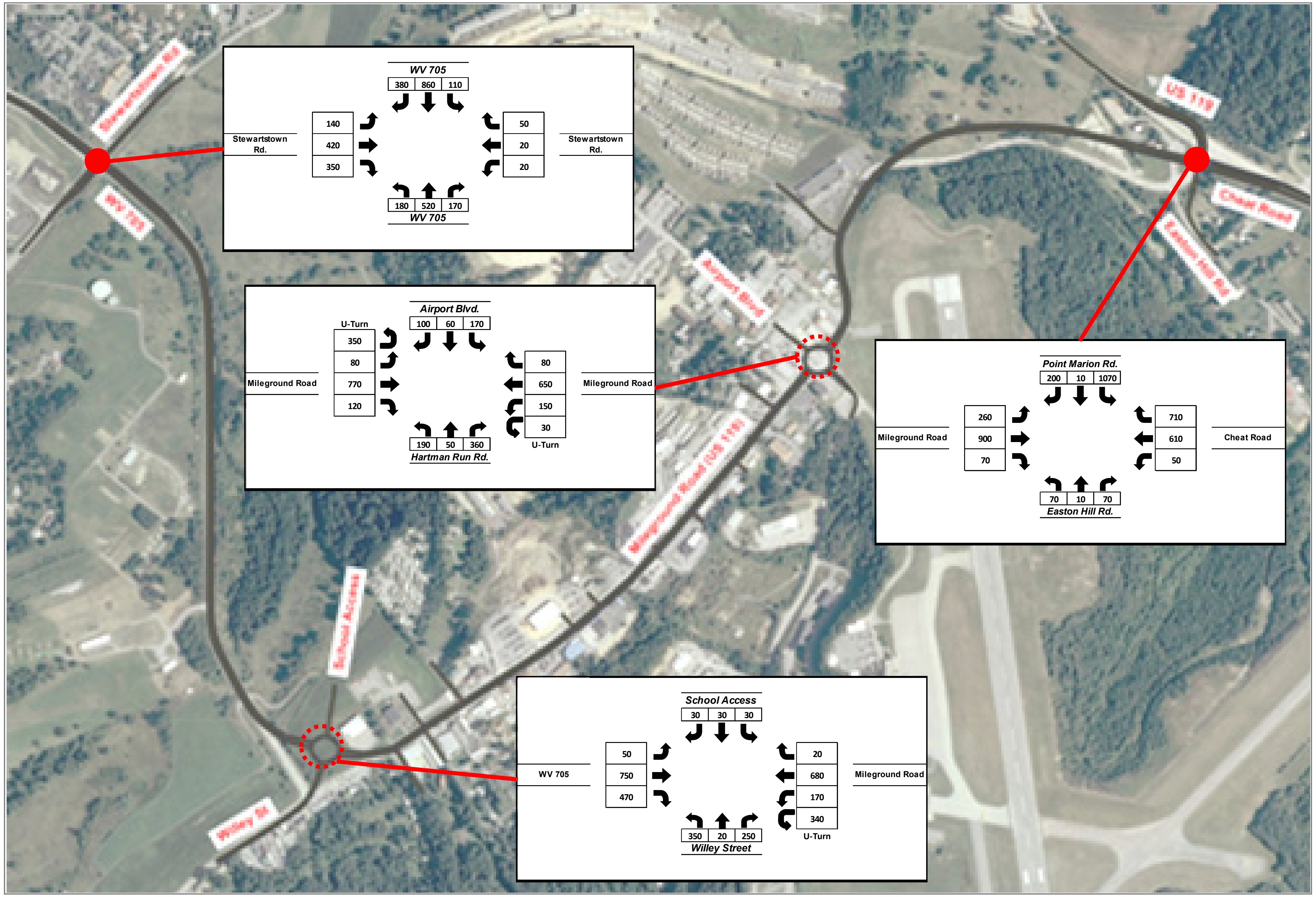

Figure A-2. Year 2030 P.M. Peak Traffic Projections

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