Upper Township Form Based Code

Route 9 (MP 23.2 to MP 29.2)
Upper Township
Cape May County, NJ

Traffic Analysis Report

Prepared for:
Upper Township

By
Urban Engineers

November, 2012

Executive Summary

A comprehensive traffic analysis was performed to assess the traffic impacts associated with the Marmora Village Center redevelopment. As part of the access modification application, the proposed two-lane desired typical section (DTS) was analyzed and compared to the existing four-lane DTS. The first scenario is the proposed two-lane DTS on Route 9, which includes left-turn lanes at intersections and a network grid roadway system that provides many route choices for drivers to navigate the Marmora Village Center. The second scenario includes a four-lane Route 9 with left-turn lanes at intersections, but without the proposed network grid roadway system.

To analyze the network grid in Scenario 1, the dynamic traffic assignment (DTA) module in the microscopic simulation program VISSIM was used. Using the DTA module, traffic assignment is completed dynamically over time by an iterative process where vehicles determine a routes “cost” using travel time. As the iterations progress the routes with high costs, or travel times, become less attractive to drivers and are thus used minimally or eliminated completely. The idea is that the DTA module mimics what happens in real-life as drivers use alternative routes as one route becomes more congested to an alternative route.

The traffic analysis was based on an anticipated non-seasonal weekday with the existing roadway volumes and proposed traffic associated with the Marmora Village Center. Based on existing traffic volumes, and net trips generated, the PM peak hour was designated as the controlling peak and selected for analysis. The ITE Trip Generation 8th Edition manual was used to estimate trips generated from the anticipated land uses, which estimated that 2642 total net trips (1287 entering and 1355 exiting) would be generated as a result of the new development during the PM peak hour. The estimated trip generation took into account internal trip capture percentage of 17 based on NCHRP Report 684 methodology.

The traffic simulation analysis indicated that both scenarios operate well at LOS C or better for all signalized intersections, and both could accommodate future traffic volumes with complete build-out of the Marmora Village Center. The network-wide results show that average and total delay time are within 5% for both scenarios, and average number of stops per vehicle is comparable with a slight increase for Scenario 1 with the network grid. The results also showed that there were no intersections or approaches projected to operate at LOS F with the exception of a one minor approach at an un-signalized intersection in Scenario 2. Regardless of the Route 9 cross-section and roadway network grid options, the Roosevelt Blvd/GSP NB Ramps intersection should be further investigated due to the large number of eastbound left-turning vehicles accessing the GSP NB on-ramp.

From a traffic analysis perspective, Upper Township’s application to reduce the desirable typical section (DTS) from four-lane to two-lane would not result in adverse traffic operations when compared to a four-lane Route 9 scenario with the caveat that the supporting network grid roadway system needs to be implemented over time as development occurs.

Table of Contents

List of Figures

List of Tables

List of Appendices

1. Introduction

Upper Township is proposing a redevelopment strategy in the form of Marmora Village Center for a 2-mile stretch of Route 9, which includes transforming Route 9 into a traditional main street and creating a network grid roadway system to increase vehicular and pedestrian connectivity. To create the main street feel on Route 9, Upper Township is applying for an access classification change to the desirable typical section (DTS) for Route 9 between milepost 23.2 and 29.2 from a four-lane section to a two-lane section.

The Marmora Village Center has redevelopment potential of over 1.6 million square feet and 1,300 residential units, which will generate a significant amount of vehicular trips added to Route 9 and the surrounding roadway network. The purpose of the traffic analysis is to determine the amount of vehicle trips generated in the project area under full development and determine the impact to Route 9 under the following scenarios:

Scenario 1: Route 9 with a two-lane section and left turn lanes, and network grid, and

Scenario 2: Route 9 with a four-lane section and left turn lanes with no network grid.

2. Study Methodology

From a traffic operations perspective, the main challenge of the analyzing and comparing these two scenarios is determining the benefits and limitations of each scenario. The two scenarios are essentially a comparison of grid roadway network (Scenario 1) to a wider primary road (Scenario 2). ***Figure 1*** shows the land use map developed for Marmora Village Center including the extensive network grid roadway system (Scenario 1). The challenge this extensive grid presents is the almost infinite number of route choices drivers have to get from one point to another.

To analyze the network grid, the dynamic traffic assignment (DTA) module in the microscopic simulation program VISSIM (v5.40), developed by PTV America, was used. The DTA module is designed to model route choice behavior of drivers as opposed to static routes, which are defined routes from point A to B using a specific route and the drivers having no choice which way to go from their origin to their destination. Using the DTA module, traffic assignment is completed dynamically over time by an iterative process where vehicles determine a routes "cost" using travel time. As the iterations progress the routes with high costs, or travel times, become less attractive to drivers and are thus used minimally or eliminated completely. The idea is that the DTA module mimics what happens in real-life as drivers use alternative routes as one route becomes more congested to an alternative route.

The traditional method for analyzing intersections, or corridors, is to develop turning movement counts at each intersection and determine the capacity, average delay, and Level of Service (LOS) for each movement or approach. This process would be modeled by the static routing method described above. DTA analysis using VISSIM does not require turning movement counts, but rather origin and destination matrices. Origins and destinations (O/D) are placed throughout the network and routes are selected dynamically using simulated cost as described above. Vehicles can take a number of routes depending on the amount of delay each route possesses.

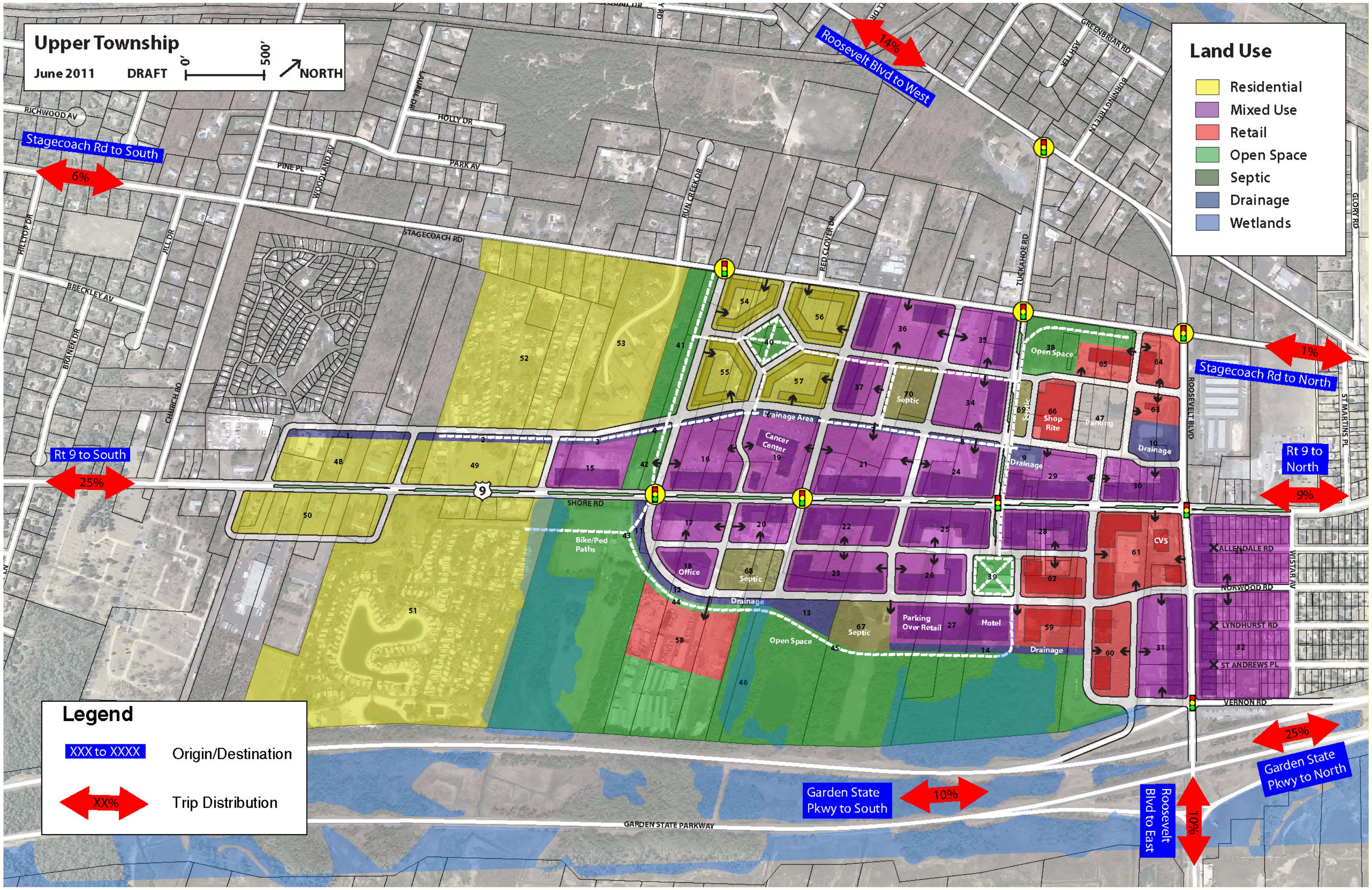


Figure 1: Marmora Village Center Land Use Map

Note: High resolution PDF in Appendix A

Dynamic Traffic Assignment Example:

The shortest route between two points is taken by most drivers on the first iteration; therefore, significant delay occurs at the signalized intersections along the shortest path. The second iteration drivers branch out to longer distance routes, but with less congestion and delay. As the iterations continue, drivers will help determine the costs of each route and the routes with the lowest costs will be more attractive. When the vehicles have learned the network and are all generally taking the lowest cost routes (i.e., multiple routes from one point to another have the similar costs) the model has converged.

To determine the O/D matrices, traffic volume flows through the project area were determined using existing volumes and volumes generated from the Marmora Village Center development. Existing volumes on the existing roadway network were determined using previous traffic impact study (TIS) reports, NJDOT traffic count data, and automatic traffic recorder (ATR) data. Vehicle trip generation for the Marmora Village Center was completed and trips were distributed to origin points throughout the project area. The combination of the existing volumes and net trips generated from the development made up the O/D matrices used for the DTA process in VISSIM. The VISSIM program generates measures of effectiveness (MOE) for each intersection such as average vehicle delay, average and maximum queuing, and travel time, and also network-wide MOE such as stops per vehicle and total network delay.

3. Existing Traffic Volumes

Prior to determining the trips generated from the development, the existing traffic volumes on the existing roadway network need to be accounted for in the Base condition. The following two completed TIS reports were used to help develop the existing volumes:

- Marmora Shop Rite Traffic Impact Study, October 2004
- CVS Pharmacy Traffic Engineering Assessment and Air Quality Analysis, January 2010

The traffic assessment for the Marmora Village Center is based on non-seasonal, weekday traffic volumes. Automatic traffic recorder (ATR) data was available from various sources including NJDOT traffic count website and previously completed studies. The historic ATR data available ranged from 2008 to 2010 and was used to verify the “blended” turning movement counts from the 2004 and 2010 TIS reports. ***Figure 2*** contains the existing turning movement count figure.

As previously stated, when describing VISSIMs’ DTA module, the program requires an O/D matrix and not static turning movement count routes. The existing turning movement count in ***Figure 2*** shows trip distribution percentages on the perimeter of the network, and these percentages were used as a general guide to develop the O/D matrix for existing traffic volumes.

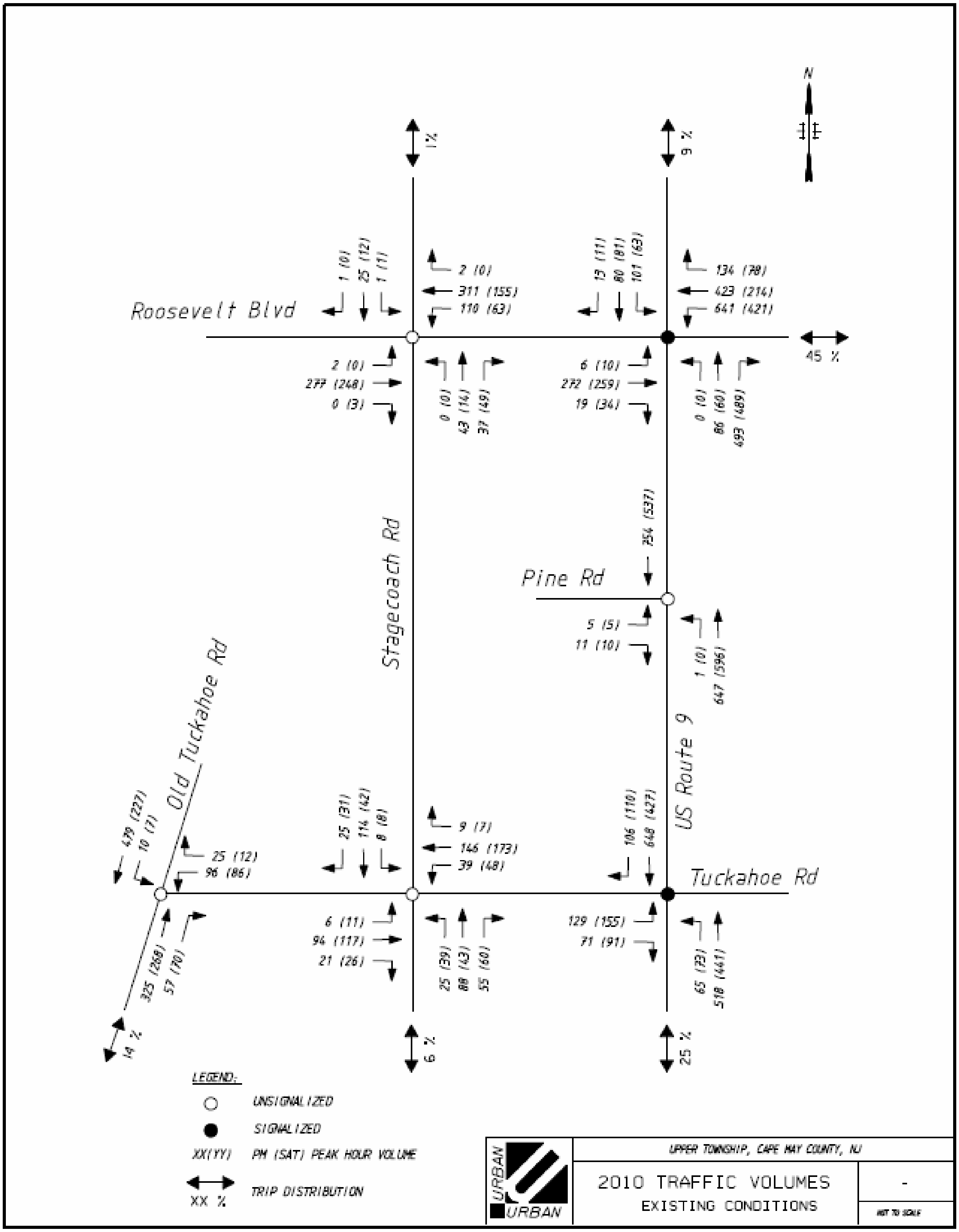


Figure 2: Existing Turning Movement Count Figure

4. Trip Generation and Distribution

To develop the traffic volumes that were included in the VISSIM model, trip generation was completed for the Marmora Village Center. The overall process was to determine the amount of new trips generated from parcels that would be developed, account for internal trip capture between the sites due to walkability, pedestrian friendly design and town center design, and distribute the remaining trips in and out of the network. ***Figure 3*** shows a flow diagram of the trip generation and distribution process.

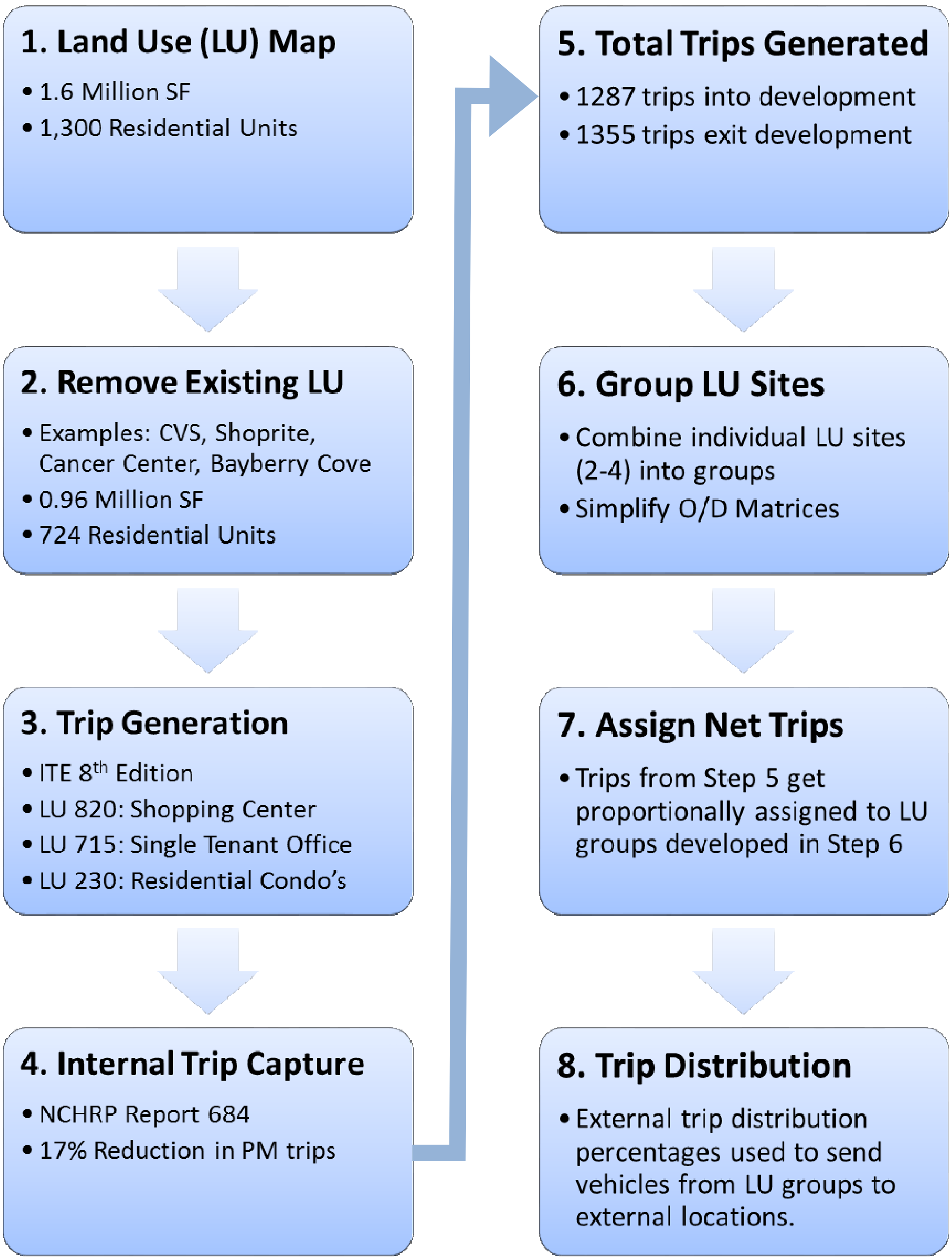


Figure 3: Trip Generation and Distribution Flow Diagram

1. Land Use (LU) Map

The Marmora Village Center LU map is shown in ***Figure 1*** and includes a total of over 1.6 million square feet of developable area and 1,300 residential units.

2. Remove Existing LU

The LU map contains sites including complete redevelopment, partial redevelopment, and existing sites that are recently developed and are not anticipated to change under the Marmora Village Center redevelopment plan (or if they do they would be anticipated to generate a similar number of trips). Some of these existing sites include Shoprite, CVS, Plaza 9 strip mall, Econo Lodge hotel, Cancer Center, Wawa, and Bayberry Cove residential development. After removal of these sites, and partial credit where applicable, the net developable area is 0.96 million square feet and 724 residential units. ***Appendix A*** includes a table indicating the sites that were removed from the trip generation calculations.

3. Trip Generation

The Institute for Transportation Engineers (ITE) Trip Generation Manual, 8^{th} Edition, was used for trip generation estimates for the developable area. The land use codes (LUC) selected for Marmora Village Center mixed-use development include the following:

- LUC 820 (Shopping Centers) for retail,
- LUC 715 (Single Tenant Office) for office, and
- LUC 230 (Residential Condominiums/Townhouses) for residential.

The LUC's were selected based on land use description, numbers of studies, average size of land use in surveyed sites, and R^2 value of trip generation equation. Total PM peak hour trips generated, prior to internal trip capture, is 1554 entering and 1628 exiting. ***Appendix A*** contains the trip generation table for AM and PM peak hours.

4. Internal Trip Capture

Internal trip capture is defined as trips made within a mixed-use development that are internalized or satisfied with both origin and destination within the development. The National Cooperative Highway Research Program (NCHRP) Report 684, Enhancing Internal Trip Capture Estimate for Mixed-Use Developments, provides an improved methodology to determine internal trip capture compared to the ITE method in the Trip Generation Handbook. Included with NCHRP Report 648 is a set of spreadsheets to calculate internal trip capture. It should be noted that in addition to the Report 684 internal trip capture equations, a conservative five percent trip credit was given for transit and two percent trip credit for non-motorized trips. The total internal trip capture rate for the PM peak hour was 17 percent. ***Appendix A*** contains the NCHRP Report 684 spreadsheets for internal capture.

5. Total Trips Generated

After accounting for internal trip capture the net PM peak hour trips generated by the developable land is 1287 entering and 1355 exiting. Based on existing traffic volumes, and net trips generated, the PM peak hour was designated as the controlling peak and selected for analysis. ***Appendix A*** contains AM and PM peak hour net trips generated.

6. Group LU Sites

The LU map (***Figure 1***) shows 70 individual sites. From an analysis standpoint it would be cumbersome to create O/D information for each individual site. To simplify the LU map, individual land use sites ranging from two to four sites were combined into one large site, which reduced the amount of sites to 19. **Appendix A** contains a modified version of the LU map with the grouped sites numbered one through nineteen.

7. Assign Net Trips

At this point the total net trips generated by the development have been calculated, and the LU sites have been grouped into 19 sites. The total net trips generated were then assigned to each site proportionally based on the square footage and residential units that each site contained. The trip generation analysis table in ***Appendix A*** contains the net trips assigned to each site. The result is that number of trips entering and exiting each site of the Marmora Village Center has been determined, but the external origins and destinations of these trips are still to be determined.

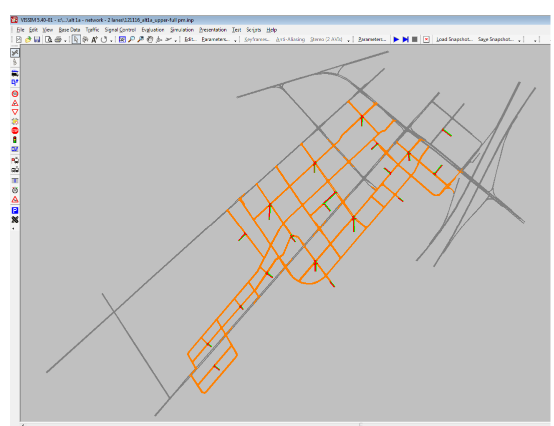
8. Trip Distribution

To determine the origins and destinations of the trips generated within the development, the trip distribution pattern from the existing traffic volume figure (***Figure 2***) was applied to the trips entering and exiting each site. This created two matrices:

- External → Internal   Trips entering the development from outside the network
- Internal → External   Trips exiting the development to outside the network

The combination of these two matrices and the existing traffic volume matrix made up the traffic volumes input into the VISSIM model.

5. Model Development



As previously stated the model chosen for this project was the microscopic simulation program VISSIM (v5.40). This model was selected for its ability to assign traffic dynamically over time by an iterative process of determining each available route “cost”, or travel time, and attracting more traffic to the lower cost routes. ***Section 2*** further describes the dynamic traffic assignment (DTA) module in VISSIM and how it functions within the program.

The modeled time period is non-summer PM peak hour with 100% build out based on the LU map (***Figure 1***) and includes the following two scenarios:

Scenario 1: Route 9 with a two-lane section and left turn lanes, and network grid, and

Scenario 2: Route 9 with a four-lane section and left turn lanes with no network grid.

For consistency, the same traffic volumes were applied to both scenarios. It could be argued the internal trip capture percentage should not be accounted for in Scenario 2 due to the lack of roadway network grid, but to keep the models consistent the same traffic volumes were used. The VISSIM DTA Model was developed using aerial photos for geometry, assumed 90 second cycle signals, speed limits, origin and destinations, and traffic volumes matrices. The DTA process and analysis is shown in ***Figure 4***.

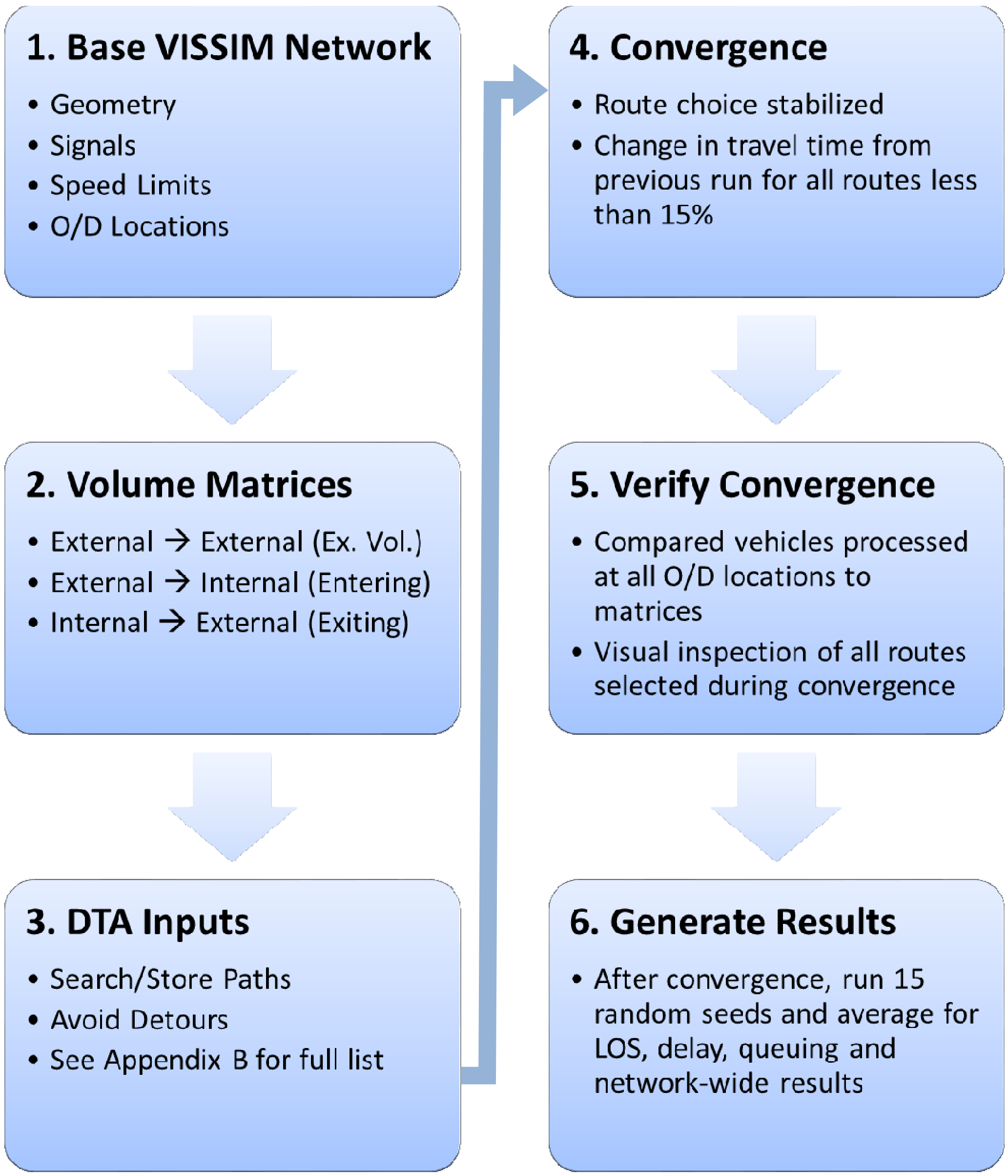


Figure 4: Dynamic Traffic Assignment Process

A more detailed DTA explanation is included in ***Appendix B***, including DTA inputs and convergence. Steps four through six were done separately for both scenarios as route choice and convergence was more simplified in Scenario 2 due to no network grid. It should be noted that, due to the location of development on the LU map, Scenario 2 has several new, full access, connections along Route 9 that allow isolated development sites access to the existing roadway network.

6. Model Results

Route convergence was completed for both scenarios, and then 15 random seeds were processed and averaged for measures of effectives (MOE) such as average delay per vehicles, Level of Service (LOS), average and maximum queuing, and network-wide MOEs including average delay per vehicle, average number of stops, total delay time and total travel time. LOS criteria for signalized and un-signalized intersections are based on the Highway Capacity Manual (HCM) 2010. ***Table 1*** shows LOS, average delay and network-wide results for the two scenarios.

Table 1: VISSIM Simulation Results

Int ID	Signalized Intersection	Delay (LOS)	
		Scenario 1	**Scenario 2**
1	Roosevelt Blvd & GSP NB	C (29)	C (29)
2	Roosevelt Blvd & GSP SB	C (31)	C (23)
3	Roosevelt Blvd & RT 9	C (23)	C (23)
4	Roosevelt Blvd & Stagecoach Rd	A (6)	A (5)
5	RT 9 & Tuckahoe Rd	B (12)	C (22)
6	Tuckahoe Rd & Stagecoach Rd	B (11)	B (13)
7	Roosevelt Blvd & Tuckahoe Rd	B (14)	B (14)
8	RT 9 & Cancer Center	A (9)	N/A
9	RT 9 & Norwood Rd	B (12)	B (10)
10	Stagecoach Rd & Norwood Rd	A (7)	N/A
Network-Wide Results			
Average Delay Per Vehicle (sec)		88	85
Average Number of Stops Per Vehicle		3.2	2.8
Total Delay Time (hr)		133	127

Scenario 2 had a lane configuration change from existing conditions for the westbound Roosevelt Blvd approach at Route 9. Due to the extremely high westbound left turn volume, the lane configuration was changed to a dedicated left turn lane, shared left-through lane, and a channelized right turn lane, which was changed from the existing approach lane configuration of a dedicated left turn lane, dedicated through lane, and channelized right turn lane. This dual left turn lane setup in Scenario 2 is operationally acceptable due to the four-lane section on Route 9, and due to the existing split phase setup there is no change in signal phasing.

The results in ***Table 1*** show that all signalized intersections within the project operate at LOS C or better in both scenarios. The network-wide results show that average and total delay time are within 5% for both scenarios, and average number of stops per vehicle is comparable with a slight increase for Scenario 1.

It should be noted that the eastbound left turn from Roosevelt Blvd to GSP NB On-Ramp is a large move at 820 vehicles and does experience queuing spillback past the left-turn pocket. This move requires a significant amount of protected green time to prevent spillback through the Roosevelt Blvd/GSP SB Ramps intersection. This issue exists in both Scneario 1 and 2, and is not impacted by changes to Route 9 or the addition of a network grid roadway system.

Overall the two scenarios had very comparable VISSIM simulation results showing that based on simulation results either scenario will operate well with the full buildout of the Marmora Village Center LU map (***Figure 1***). ***Appendix C*** contains full VISSIM simulation results for both scenarios including unsignalized intersections, vehicles processed, and network-wide results.

7. Conclusions

The traffic simulation analysis indicated that both scenarios operate well at LOS C or better for all signalized intersections, and both could accommodate future traffic volumes with complete build-out of the Marmora Village Center. The network-wide results show that average and total delay time are within 5% for both scenarios, and average number of stops per vehicle is comparable with a slight increase for Scenario 1 with the network grid. The results also showed that there were no intersections or approaches projected to operate at LOS F with the exception of a one minor approach at an un-signalized intersection in Scenario 2. Regardless of the Route 9 cross-section and roadway network grid options, the Roosevelt Blvd/GSP NB Ramps intersection should be further investigated due to the large number of eastbound left-turning vehicles accessing the GSP NB on-ramp.

From a traffic analysis perspective, Upper Township's application to reduce the desirable typical section (DTS) from four-lane to two-lane would not result in adverse traffic operations when compared to a four-lane Route 9 scenario with the caveat that the supporting grid, roadway network needs to be implemented over time as development occurs.