Fermi 2
6400 North Dixie Hwy., Newport, MI 48166

Detroit Edison

10 CFR 50 Appendix E

December 20, 2012
NRC-12-0086

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Reference: Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

Subject: Fermi 2 Evacuation Time Estimate Report

Pursuant to 10 CFR Part 50, Appendix E.IV.4, The Detroit Edison Company, the current licensee for Fermi 2, is transmitting an Evacuation Time Estimate (ETE) analysis for Fermi 2. The analysis was prepared using 2010 data from the U.S. Census Bureau. The Enclosure to this letter provides the ETE Report.

No commitments are being made in this letter.

Should you have any questions or require additional information, please contact Mr. Zackary W. Rad of my staff at (734) 586-5076.

Sincerely,

Zackary W. Rad
Manager, Nuclear Licensing

Enclosure

cc: NRC Project Manager
NRC Resident Office
Reactor Projects Chief, Branch 4, Region III
Regional Administrator, Region III
Supervisor, Electric Operators,
Michigan Public Service Commission

Enclosure to
NRC-12-0086

Fermi 2 NRC Docket No. 50-341
Operating License No. NPF-43

Fermi 2 Evacuation Time Estimate Report

Project Name: Fermi 2 2010 Evacuation Time Estimate Report

Department: Radiological Emergency Response and Preparedness

Product: Fermi Nuclear Power Plant Development of Evacuation Time Estimates

Project Closure Report Version Control

Version	Date	Author	Change Description
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1. REPORT APPROVALS

Technical Review By GE Garber / 12·11·12
Principal Technical Specialist Date

Approved By N Avrakotos, / 12-11-12
Manager, RERP Date

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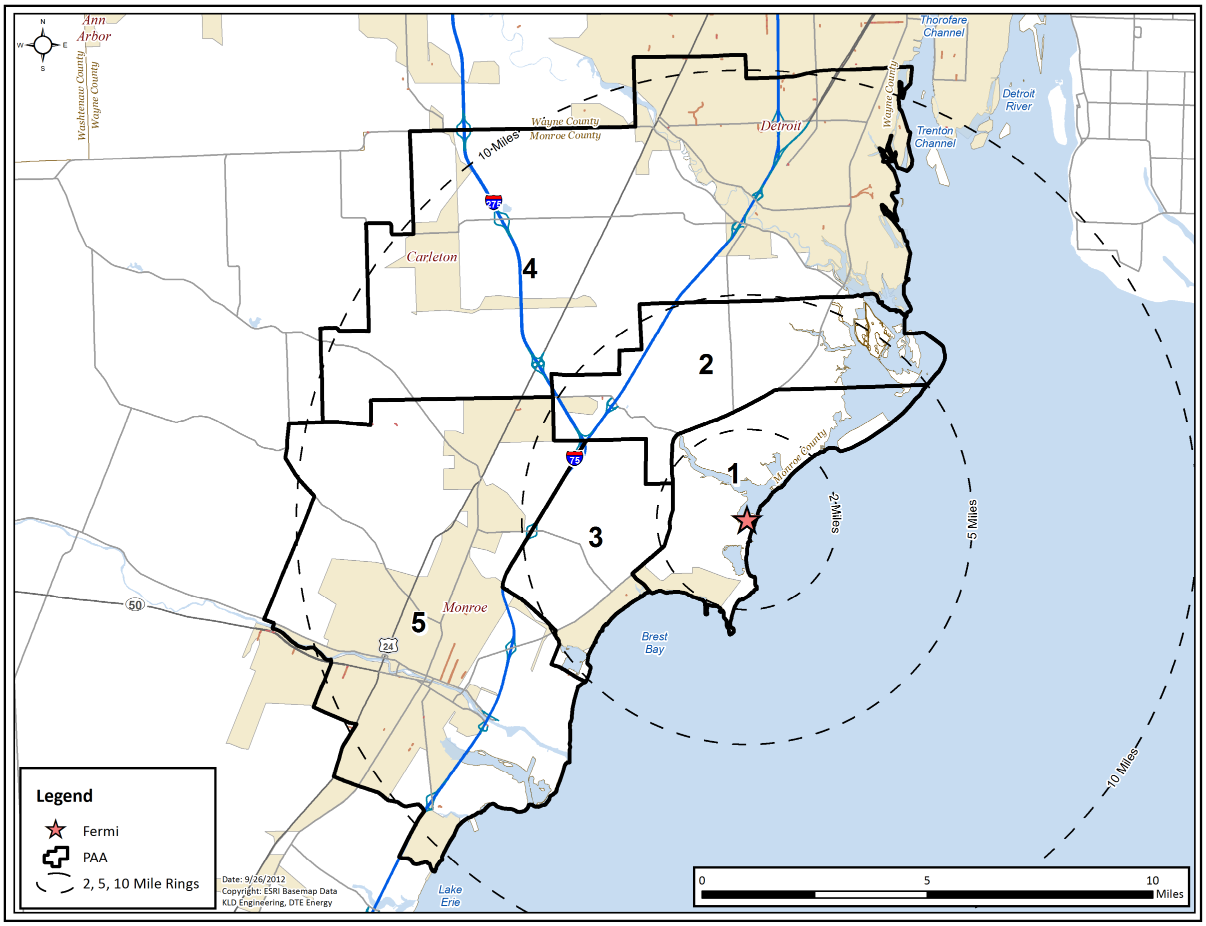
Fermi Nuclear Power Plant

Development of Evacuation Time Estimates



Work performed for DTE Energy, by:

KLD Engineering, P.C.
43 Corporate Drive
Hauppauge, NY 11788
mailto:kweinisch@kldcompanies.com

December 2012 **Final Report, Rev. 1** **KLD TR – 532**

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EXECUTIVE SUMMARY

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the Fermi Nuclear Power Plant (FNPP) located in Monroe County, MI. ETE are part of the required planning basis and provide DTE Energy and State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, guidance is provided by documents published by Federal Governmental agencies. Most important of these are:

- Criteria for Development of Evacuation Time Estimate Studies, NUREG/CR-7002, November 2011.
- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG-0654/FEMA-REP-1, Rev. 1, November 1980.
- Development of Evacuation Time Estimates for Nuclear Power Plants, NUREG/CR-6863, January 2005.
- 10CFR50, Appendix E – "Emergency Planning and Preparedness for Production and Utilization Facilities"

Overview of Project Activities

This project began in February, 2012 and extended over a period of 9 months. The major activities performed are briefly described in chronological sequence:

- Attended "kick-off" meetings with DTE Energy personnel and emergency management personnel representing state and county governments.
- Accessed U.S. Census Bureau data files for the year 2010. Studied Geographical Information Systems (GIS) maps of the area in the vicinity of the FNPP, then conducted a detailed field survey of the highway network.
- Synthesized this information to create an analysis network representing the highway system topology and capacities within the Emergency Planning Zone (EPZ), plus a Shadow Region covering the region between the EPZ boundary and approximately 15 miles radially from the plant.
- Designed and sponsored a telephone survey of residents within the EPZ to gather focused data needed for this ETE study that were not contained within the census database. The survey instrument was reviewed and modified by the licensee and offsite response organization (ORO) personnel prior to the survey.
- Data collection forms (provided to the OROs at the kickoff meeting) were returned with data pertaining to employment, transients, and special facilities in each county. Telephone calls to specific facilities supplemented the data provided.

- The traffic demand and trip-generation rates of evacuating vehicles were estimated from the gathered data. The trip generation rates reflected the estimated mobilization time (i.e., the time required by evacuees to prepare for the evacuation trip) computed using the results of the telephone survey of EPZ residents.
- Following federal guidelines, the EPZ is subdivided into 5 Protective Action Areas (PAA). These PAA are then grouped within circular areas or "keyhole" configurations (circles plus radial sectors) that define a total of 10 Evacuation Regions.
- The time-varying external circumstances are represented as Evacuation Scenarios, each described in terms of the following factors: (1) Season (Summer, Winter); (2) Day of Week (Midweek, Weekend); (3) Time of Day (Midday, Evening); and (4) Weather (Good, Rain, Snow). One special event scenario involving the River Raisin Jazz Festival was considered. One roadway impact scenario was considered wherein a single lane was closed on Interstate 75 southbound for the duration of the evacuation.
- Staged evacuation was considered for those regions wherein the 2 mile radius and sectors downwind to 5 miles were evacuated.
- As per NUREG/CR-7002, the Planning Basis for the calculation of ETE is:
  - A rapidly escalating accident at the FNPP that quickly assumes the status of General Emergency such that the Advisory to Evacuate is virtually coincident with the siren alert, and no early protective actions have been implemented.
  - While an unlikely accident scenario, this planning basis will yield ETE, measured as the elapsed time from the Advisory to Evacuate until the stated percentage of the population exits the impacted Region, that represent "upper bound" estimates. This conservative Planning Basis is applicable for all initiating events.
- If the emergency occurs while schools are in session, the ETE study assumes that the children will be evacuated by bus directly to reception centers or host schools located outside the EPZ. Parents, relatives, and neighbors are advised to not pick up their children at school prior to the arrival of the buses dispatched for that purpose. The ETE for schoolchildren are calculated separately.
- Evacuees who do not have access to a private vehicle will either ride-share with relatives, friends or neighbors, or be evacuated by buses provided as specified in the county evacuation plans. Those in special facilities will likewise be evacuated with public transit, as needed: bus, van, or ambulance, as required. Separate ETE are calculated for the transit-dependent evacuees, for homebound special needs population, and for those evacuated from special facilities.

<u>Computation of ETE</u>

A total of 140 ETE were computed for the evacuation of the general public. Each ETE quantifies the aggregate evacuation time estimated for the population within one of the 10 Evacuation Regions to evacuate from that Region, under the circumstances defined for one of the 14

Evacuation Scenarios (10 x 14 = 140). Separate ETE are calculated for transit-dependent evacuees, including schoolchildren for applicable scenarios.

Except for Region R03, which is the evacuation of the entire EPZ, only a portion of the people within the EPZ would be advised to evacuate. That is, the Advisory to Evacuate applies only to those people occupying the specified impacted region. It is assumed that 100 percent of the people within the impacted region will evacuate in response to this Advisory. The people occupying the remainder of the EPZ outside the impacted region may be advised to take shelter.

The computation of ETE assumes that 20% of the population within the EPZ but outside the impacted region, will elect to "voluntarily" evacuate. In addition, 20% of the population in the Shadow Region will also elect to evacuate. These voluntary evacuees could impede those who are evacuating from within the impacted region. The impedance that could be caused by voluntary evacuees is considered in the computation of ETE for the impacted region.

Staged evacuation is considered wherein those people within the 2-mile region evacuate immediately, while those beyond 2 miles, but within the EPZ, shelter-in-place. Once 90% of the 2-mile region is evacuated, those people beyond 2 miles begin to evacuate. As per federal guidance, 20% of people beyond 2 miles will evacuate (non-compliance) even though they are advised to shelter-in-place.

The computational procedure is outlined as follows:

- A link-node representation of the highway network is coded. Each link represents a unidirectional length of highway; each node usually represents an intersection or merge point. The capacity of each link is estimated based on the field survey observations and on established traffic engineering procedures.
- The evacuation trips are generated at locations called "zonal centroids" located within the EPZ and Shadow Region. The trip generation rates vary over time reflecting the mobilization process, and from one location (centroid) to another depending on population density and on whether a centroid is within, or outside, the impacted area.
- The evacuation model computes the routing patterns for evacuating vehicles that are compliant with federal guidelines (outbound relative to the location of the plant), then simulate the traffic flow movements over space and time. This simulation process estimates the rate that traffic flow exits the impacted region.

The ETE statistics provide the elapsed times for 90 percent and 100 percent, respectively, of the population within the impacted region, to evacuate from within the impacted region. These statistics are presented in tabular and graphical formats. The 90^{th} percentile ETE have been identified as the values that should be considered when making protective action decisions because the 100^{th} percentile ETE are prolonged by those relatively few people who take longer to mobilize. This is referred to as the "evacuation tail" in Section 4.0 of NUREG/CR-7002.

The use of a public outreach (information) program to emphasize the need for evacuees to minimize the time needed to prepare to evacuate (secure the home, assemble needed clothes, medicines, etc.) should also be considered.

Traffic Management

This study references the comprehensive traffic management plans provided by Monroe and Wayne Counties, and identifies critical intersections.

Selected Results

A compilation of selected information is presented on the following pages in the form of Figures and Tables extracted from the body of the report; these are described below.

- Figure 6-1 displays a map of the FNPP EPZ showing the layout of the 5 PAA that comprise, in aggregate, the EPZ.
- Table 3-1 presents the estimates of permanent resident population in each PAA based on the 2010 Census data.
- Table 6-1 defines each of the 10 Evacuation Regions in terms of their respective groups of PAA.
- Table 6-2 lists the Evacuation Scenarios.
- Tables 7-1 and Table 7-2 are compilations of ETE. These data are the times needed to clear the indicated regions of 90 and 100 percent of the population occupying these regions, respectively. These computed ETE include consideration of mobilization time and of estimated voluntary evacuations from other regions within the EPZ and from the Shadow Region.
- Tables 7-3 and Table 7-4 present ETE for the 2-mile region for un-staged and staged evacuations for the 90th and 100th percentiles, respectively.
- Table 8-7 presents ETE for the schoolchildren in good weather.
- Table 8-11 presents ETE for the transit-dependent population in good weather.
- Figure H-7 presents an example of an Evacuation Region (Region R07) to be evacuated under the circumstances defined in Table 6-1. Maps of all regions are provided in Appendix H.

Conclusions

- General population ETE were computed for 140 unique cases – a combination of 10 unique Evacuation Regions and 14 unique Evacuation Scenarios. Table 7-1 and Table 7-2 document these ETE for the 90th and 100th percentiles. These ETE range from 1:35 (hr:min) to 2:40 at the 90th percentile.
- Inspection of Table 7-1 and Table 7-2 indicates that the ETE for the 100th percentile are significantly longer than those for the 90th percentile. This is the result of the long trip generation "tail". As these stragglers mobilize, the aggregate rate of egress slows since many vehicles have already left the EPZ. Towards the end of the process, relatively few evacuation routes service the remaining demand. See Figures 7-9 through 7-22.
- Inspection of Table 7-3 and Table 7-4 indicates that a staged evacuation provides no

benefits to evacuees from within the 2 mile region and unnecessarily delays the evacuation of those beyond 2 miles (compare Regions R02, R04 and R05 with Regions R08 through R10, respectively, in Tables 7-1 and 7-2). See Section 7.6 for additional discussion.

- Comparison of Scenarios 3 (summer, weekend, midday, good weather) and 13 (summer, weekend, midday, special event) in Table 7-1 indicates that the special event does not materially affect the ETE with increases of only 5 minutes at the 90th percentile. The special event has no impact on the 100th percentile ETE. See Section 7.5 for additional discussion.
- Comparison of Scenarios 1 and 14 in Table 7-1 indicates that the roadway closure – a single lane southbound on Interstate-75 from the interchange with I-275 (Exit 20) to the end of the EPZ at Laplaisance Rd (before Exit 9) – does not have a material impact on 90th percentile ETE, with increases of only up to 5 minutes for an evacuation of the entire EPZ (Region R03). The roadway impact scenario has no impact on the 100th percentile ETE. See Section 7.5 for additional discussion.
- The city of Monroe is the most congested area during an evacuation. All congestion within the EPZ clears by 2 hours and 30 minutes after the Advisory to Evacuate. See Section 7.3 and Figures 7-3 through 7-8.
- Separate ETE were computed for schools, medical facilities, transit-dependent persons, homebound special needs persons and correctional facilities. The average single-wave ETE for schools and correctional facilities are within a similar range as the general population ETE at the 90th percentile. The average single-wave ETE for transit-dependents, medical facilities, and homebound special needs exceed the general population ETE at the 90th percentile. See Section 8.
- Table 8-5 indicates that there are sufficient transportation resources available to evacuate the transit-dependent population within the EPZ in a single wave. See Sections 8.4 and 8.5.
- The general population ETE at the 90th percentile is insensitive to reductions in the base trip generation time of 4 hours due to the traffic congestion within the EPZ. The 100th percentile ETE, however, mirrors trip generation time. See Table M-1.
- The general population ETE is relatively insensitive to the voluntary evacuation of vehicles in the Shadow Region (tripling the shadow evacuation percentage only increases 90th percentile ETE by 5 minutes). See Table M-2.
- A population increase of 55% results in ETE changes which meet the criteria for updating ETE between decennial Censuses. See Section M.3.

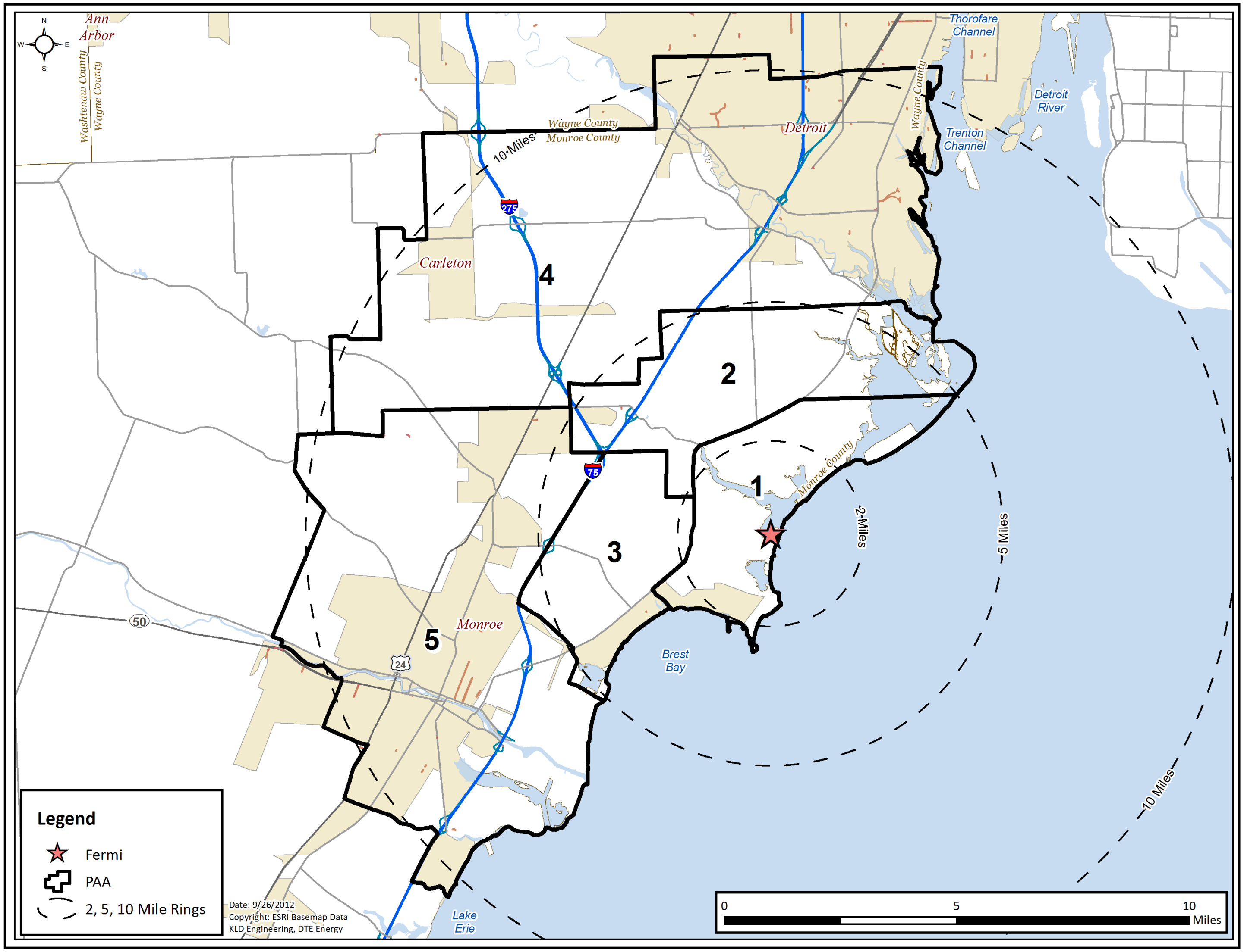


Figure 6-1. FNPP EPZ Subareas

Table 3-1. EPZ Permanent Resident Population

PAA	2000 Population	2010 Population
1	3,723	3,429
2	2,576	4,746
3	5,628	5,434
4	33,723	38,810
5	47,049	45,406
TOTAL	**92,699**	**97,825**
EPZ Population Growth:		**5.53%**

Table 6-1. Description of Evacuation Regions

Basic Regions						
		PAA				
Region	Description	1	2	3	4	5
R01	2-Mile Region	x				
R02	5-Mile Region	x	x	x		
R03	Full EPZ	x	x	x	x	x
Evacuate 2-Mile Region and Downwind to 5 Miles						
		PAA				
Region	Wind Direction From:	1	2	3	4	5
	W,WNW,NW,NNW,N,NNE	Refer to Region R01				
R04	NE,ENE,E	x		x		
	ESE,SE	Refer to Region R02				
R05	SSE,S,SSW,SW,WSW	x	x			
Evacuate 5-Mile Region and Downwind to the EPZ Boundary						
		PAA				
Region	Wind Direction From:	1	2	3	4	5
	WSW,W,WNW,NW,NNW,N	Refer to Region R02				
R06	NNE,NE,ENE	x	x	x		x
	E,ESE,SE	Refer to Region R03				
R07	SSE,S,SSW,SW	x	x	x	x	
Staged Evacuation - 2-Mile Region Evacuates, then Evacuate Downwind to 5 Miles						
		PAA				
Region	Wind Direction From:	1	2	3	4	5
R08	No Wind	x	x	x		
	W,WNW,NW,NNW,N,NNE	Refer to Region R01				
R09	NE,ENE,E	x		x		
	ESE,SE	Refer to Region R02				
R10	SSE,S,SSW,SW,WSW	x	x			
Key						
PAA(s) Evacuate	PAA(s) Shelter-in-Place	Shelter-in-Place until 90% ETE for R01, then Evacuate				

Table 6-2. Evacuation Scenario Definitions

Scenario	Season[1]	Day of Week	Time of Day	Weather	Special
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Midweek	Midday	Snow	None
9	Winter	Weekend	Midday	Good	None
10	Winter	Weekend	Midday	Rain	None
11	Winter	Weekend	Midday	Snow	None
12	Winter	Midweek, Weekend	Evening	Good	None
13	Summer	Weekend	Midday	Good	River Raisin Jazz Festival
14	Summer	Midweek	Midday	Good	Roadway Impact – Lane Closure on I-75 SB

[1] Winter means that school is in session (also applies to spring and autumn). Summer means that school is not in session.

Table 7-1. Time to Clear the Indicated Area of *90* Percent of the Affected Population

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R02	2:00	2:00	1:55	1:55	1:50	2:00	2:00	2:10	1:55	2:00	2:05	1:50	1:55	2:00
R03	2:10	2:15	2:00	2:05	1:50	2:05	2:10	2:35	1:55	2:00	2:20	1:50	2:05	2:15
2-Mile Region and Keyhole to 5 Miles														
R04	2:00	2:00	1:55	2:00	1:55	2:00	2:00	2:10	2:00	2:00	2:05	1:55	1:55	2:00
R05	2:00	2:00	2:00	2:00	1:55	2:00	2:00	2:05	2:00	2:00	2:05	1:55	2:00	2:00
5-Mile Region and Keyhole to EPZ Boundary														
R06	2:00	2:05	1:55	1:55	1:50	2:00	2:05	2:15	1:55	1:55	2:10	1:50	1:55	2:00
R07	2:05	2:05	1:55	2:00	1:50	2:05	2:05	2:20	2:00	2:00	2:10	1:50	1:55	2:05
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles														
R08	2:10	2:10	2:10	2:10	2:10	2:10	2:10	2:40	2:10	2:10	2:35	2:10	2:10	2:10
R09	2:10	2:10	2:10	2:10	2:10	2:10	2:10	2:40	2:10	2:10	2:35	2:10	2:10	2:10
R10	2:05	2:05	2:05	2:05	2:05	2:05	2:05	2:25	2:05	2:05	2:25	2:05	2:05	2:05

Table 7-2. Time to Clear the Indicated Area of *100* Percent of the Affected Population

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R02	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R03	4:10	4:10	4:10	4:10	4:10	4:10	4:10	4:40	4:10	4:10	4:40	4:10	4:10	4:10
2-Mile Region and Keyhole to 5 Miles														
R04	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R05	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
5-Mile Region and Keyhole to EPZ Boundary														
R06	4:10	4:10	4:10	4:10	4:10	4:10	4:10	4:40	4:10	4:10	4:40	4:10	4:10	4:10
R07	4:10	4:10	4:10	4:10	4:10	4:10	4:10	4:40	4:10	4:10	4:40	4:10	4:10	4:10
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles														
R08	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R09	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R10	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05

Table 7-3. Time to Clear 90 Percent of the 2-Mile Region

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Evening	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Unstaged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R01	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R02	1:55	2:00	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R04	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R05	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
Staged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R08	2:00	2:05	2:00	2:00	2:00	2:00	2:05	2:35	2:00	2:00	2:30	2:00	2:00	2:00
R09	2:00	2:00	1:55	1:55	1:55	2:00	2:00	2:30	1:55	1:55	2:30	1:55	1:55	2:00
R10	2:00	2:05	2:00	2:00	2:00	2:00	2:00	2:35	2:00	2:00	2:30	2:00	2:00	2:00

Table 7-4. Time to Clear 100 Percent of the 2-Mile Region

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Evening	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Unstaged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R01	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R02	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R04	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R05	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
Staged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R08	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R09	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R10	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00

Table 8-7. School Evacuation Time Estimates – Good Weather

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
MONROE COUNTY SCHOOLS									
Airport Senior High School	15	15	2.4	50.0	3	**0:35**	17.0	26	**1:00**
Carleton Country Day	30	15	1.3	50.0	2	**0:50**	17.0	26	**1:15**
Custer Elementary School #1	45	15	4.0	15.2	16	**1:20**	13.9	21	**1:40**
Custer Elementary School #2	45	15	4.0	15.2	16	**1:20**	13.9	21	**1:40**
Eyler Elementary School	45	15	2.3	45.0	3	**1:05**	17.2	26	**1:30**
Hollywood Elementary School	45	15	5.9	42.6	8	**1:10**	14.3	21	**1:30**
Holy Ghost Lutheran School	45	15	5.0	33.1	9	**1:10**	13.5	20	**1:30**
Hurd Elementary School	90	15	5.8	54.2	6	**1:55**	7.4	11	**2:05**
Jefferson High School	15	15	7.9	49.8	10	**0:40**	7.4	11	**0:55**
Jefferson Middle School	15	15	7.6	49.8	9	**0:40**	7.4	11	**0:50**
Lutheran High School South	30	15	6.3	48.4	8	**0:55**	6.0	9	**1:05**
Manor Elementary School	45	15	3.7	27.3	8	**1:10**	15.1	23	**1:35**
Monroe Middle School	45	15	2.7	5.4	30	**1:30**	14.3	21	**1:55**
Monroe Senior High School	45	15	3.1	26.7	7	**1:10**	18.4	28	**1:35**
Neidermeier Elementary School	45	15	7.7	43.7	11	**1:15**	16.8	25	**1:40**
North Elementary School	45	15	12.6	55.0	14	**1:15**	7.4	11	**1:25**
Orchard Center High School	45	15	4.7	32.9	9	**1:10**	7.3	11	**1:20**
Pathway Christian Academy/ Daycare	90	15	7.4	46.8	9	**1:55**	8.0	12	**2:10**
Raisinville Elementary School	45	15	2.9	33.1	5	**1:05**	18.4	28	**1:35**
Ritter Elementary School	45	15	6.9	41.1	10	**1:10**	17.3	26	**1:40**
Riverside Elementary School	45	15	6.1	43.1	8	**1:10**	14.9	22	**1:30**
Sodt Elementary School	45	15	9.2	35.6	16	**1:20**	7.4	11	**1:30**
St. Charles School	45	15	11.1	36.4	18	**1:20**	5.9	9	**1:30**
St. John's School	45	15	2.8	5.7	29	**1:30**	6.4	10	**1:40**
St. Mary's Catholic Center High School	45	15	5.5	43.1	8	**1:10**	6.3	9	**1:20**

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
St. Mary's Parish School	45	15	5.5	42.5	8	**1:10**	6.3	9	**1:20**
St. Michael's School	45	15	5.6	30.4	11	**1:15**	6.8	10	**1:25**
St. Patrick School	45	15	1.5	50.0	2	**1:05**	16.5	25	**1:30**
Sterling Elementary School	30	15	2.6	50.0	3	**0:50**	16.8	25	**1:15**
Trinity Lutheran School	45	15	2.7	5.6	29	**1:30**	6.3	9	**1:40**
Wager Junior High School	15	15	2.3	50.0	3	**0:35**	17.6	26	**1:00**
Waterloo Elementary School	45	15	3.0	28.4	6	**1:10**	18.7	28	**1:35**
Zion Lutheran School	45	15	4.0	40.4	6	**1:10**	19.7	30	**1:40**
WAYNE COUNTY SCHOOLS									
Chapman Elementary School	90	15	3.5	55.0	4	**1:50**	10.7	16	**2:05**
David Oren Hunter Elementary School	90	15	1.7	33.4	3	**1:50**	10.7	16	**2:05**
Downriver High School	90	15	5.4	50.5	6	**1:55**	13.6	20	**2:15**
Ethel C. Bobcean Elementary School	90	15	3.5	53.0	4	**1:50**	8.7	13	**2:05**
Flat Rock / Gibraltar Head Start	90	15	3.7	53.0	4	**1:50**	8.7	13	**2:05**
Flat Rock Community High School	90	15	3.6	53.0	4	**1:50**	11.3	17	**2:10**
Hellen C. Shumate Junior High School	90	15	3.5	50.0	4	**1:50**	13.5	20	**2:10**
John M. Barnes Elementary	90	15	4.9	47.9	6	**1:55**	8.7	13	**2:05**
Oscar A. Carlson High School	90	15	3.5	50.0	4	**1:50**	13.5	20	**2:10**
Parsons Elementary School	90	15	3.2	47.6	4	**1:50**	13.5	20	**2:10**
Simpson Middle School	90	15	4.9	47.9	6	**1:55**	8.7	13	**2:05**
St. Mary's Rockwood Elementary School	90	15	3.2	44.6	4	**1:50**	10.7	16	**2:05**
Summit Academy/Summit Early Childhood Center	90	15	2.4	54.3	3	**1:50**	10.7	16	**2:05**
					Maximum for EPZ:	**1:55**		**Maximum:**	**2:15**
					Average for EPZ:	**1:25**		**Average:**	**1:40**

Table 8-11. Transit-Dependent Evacuation Time Estimates – Good Weather

Route Number	Bus Number	One-Wave						Two-Wave							
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
1	1 & 2	90	12.5	30.7	24	30	**2:25**	6.2	9	5	10	48	30	**4:10**
	3 & 4	95	12.5	31.4	24	30	**2:30**	6.2	9	5	10	48	30	**4:15**
	5 & 6	100	12.5	31.8	24	30	**2:35**	6.2	9	5	10	48	30	**4:20**
	7 & 8	105	12.5	32.0	23	30	**2:40**	6.2	9	5	10	48	30	**4:25**
	9 & 10	110	12.5	32.8	23	30	**2:45**	6.2	9	5	10	48	30	**4:30**
	11 & 12	115	12.5	34.2	22	30	**2:50**	6.2	9	5	10	48	30	**4:35**
	13 & 14	120	12.5	35.3	21	30	**2:55**	6.2	9	5	10	48	30	**4:40**
	15 & 16	125	12.5	36.4	21	30	**3:00**	6.2	9	5	10	47	30	**4:45**
2	1 & 2	90	8.9	31.1	17	30	**2:20**	6.1	9	5	10	36	30	**3:55**
	3 & 4	95	8.9	29.3	18	30	**2:25**	6.1	9	5	10	36	30	**4:00**
	5 & 6	100	8.9	28.5	19	30	**2:30**	6.1	9	5	10	36	30	**4:05**
	7 & 8	105	8.9	28.0	19	30	**2:35**	6.1	9	5	10	36	30	**4:10**
	9 & 10	110	8.9	27.9	19	30	**2:40**	6.1	9	5	10	36	30	**4:15**
	11 & 12	115	8.9	29.8	18	30	**2:45**	6.1	9	5	10	36	30	**4:20**
	13 & 14	120	8.9	32.4	16	30	**2:50**	6.1	9	5	10	36	30	**4:25**
3	1 & 2	90	9.1	10.9	50	30	**2:50**	12.4	19	5	10	47	30	**4:45**
	3 & 4	95	9.1	11.4	48	30	**2:55**	12.4	19	5	10	47	30	**4:50**
	5 & 6	100	9.1	12.2	45	30	**2:55**	12.4	19	5	10	47	30	**4:50**
	7 & 8	105	9.1	13.2	41	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	9 & 10	110	9.1	14.4	38	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	11 & 12	115	9.1	15.8	35	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	13 & 14	120	9.1	20.4	27	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	15	125	9.1	22.9	24	30	**3:00**	12.4	19	5	10	47	30	**4:55**
4	1 & 2	90	9.4	13.6	42	30	**2:45**	12.2	18	5	10	47	30	**4:40**
	3 & 4	95	9.4	13.9	41	30	**2:50**	12.2	18	5	10	47	30	**4:45**
	5 & 6	100	9.4	14.4	39	30	**2:50**	12.2	18	5	10	47	30	**4:45**
	7 & 8	105	9.4	16.2	35	30	**2:50**	12.2	18	5	10	47	30	**4:45**
	9 & 10	110	9.4	17.1	33	30	**2:55**	12.2	18	5	10	47	30	**4:50**
	11 & 12	115	9.4	19.3	29	30	**2:55**	12.2	18	5	10	47	30	**4:50**
	13 & 14	120	9.4	20.8	27	30	**3:00**	12.2	18	5	10	46	30	**4:50**

Route Number	Bus Number	One-Wave						Two-Wave						
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
5	1 & 2	90	7.3	41.4	11	30	**2:15**	18.2	27	5	10	48	30	**4:20**
	3 & 4	95	7.3	41.2	11	30	**2:20**	18.2	27	5	10	48	30	**4:25**
	5 & 6	100	7.3	41.7	10	30	**2:20**	18.2	27	5	10	48	30	**4:25**
	7 & 8	105	7.3	41.7	11	30	**2:30**	18.2	27	5	10	48	30	**4:35**
	9 & 10	110	7.3	41.9	10	30	**2:30**	18.2	27	5	10	48	30	**4:35**
	11	115	7.3	40.7	11	30	**2:40**	18.2	27	5	10	48	30	**4:45**
	12	120	7.3	41.2	11	30	**2:45**	18.2	27	5	10	48	30	**4:50**
6	1 & 2	90	10.2	42.8	14	30	**2:15**	12.2	18	5	10	47	30	**4:10**
	3 & 4	95	10.2	42.4	14	30	**2:20**	12.2	18	5	10	47	30	**4:15**
	5 & 6	100	10.2	42.3	14	30	**2:25**	12.2	18	5	10	47	30	**4:20**
	7 & 8	105	10.2	42.8	14	30	**2:30**	12.2	18	5	10	47	30	**4:25**
	9 & 10	110	10.2	43.2	14	30	**2:35**	12.2	18	5	10	47	30	**4:30**
	11	115	10.2	43.6	14	30	**2:40**	12.2	18	5	10	47	30	**4:35**
	12	120	10.2	44.0	14	30	**2:45**	12.2	18	5	10	47	30	**4:40**
7	1 & 2	90	5.9	23.3	15	30	**2:15**	8.7	13	5	10	31	30	**3:45**
	3 & 4	95	5.9	24.5	14	30	**2:20**	8.7	13	5	10	31	30	**3:50**
	5 & 6	100	5.9	25.2	14	30	**2:25**	8.7	13	5	10	31	30	**3:55**
	7 & 8	105	5.9	28.1	13	30	**2:30**	8.7	13	5	10	31	30	**4:00**
	9 & 10	110	5.9	31.6	11	30	**2:35**	8.7	13	5	10	31	30	**4:05**
	11	115	5.9	33.8	10	30	**2:35**	8.7	13	5	10	31	30	**4:05**
	12	120	5.9	34.4	10	30	**2:40**	8.7	13	5	10	31	30	**4:10**
						Maximum ETE:	**3:00**						**Maximum ETE:**	**4:55**
						Average ETE:	**2:40**						**Average ETE:**	**4:30**

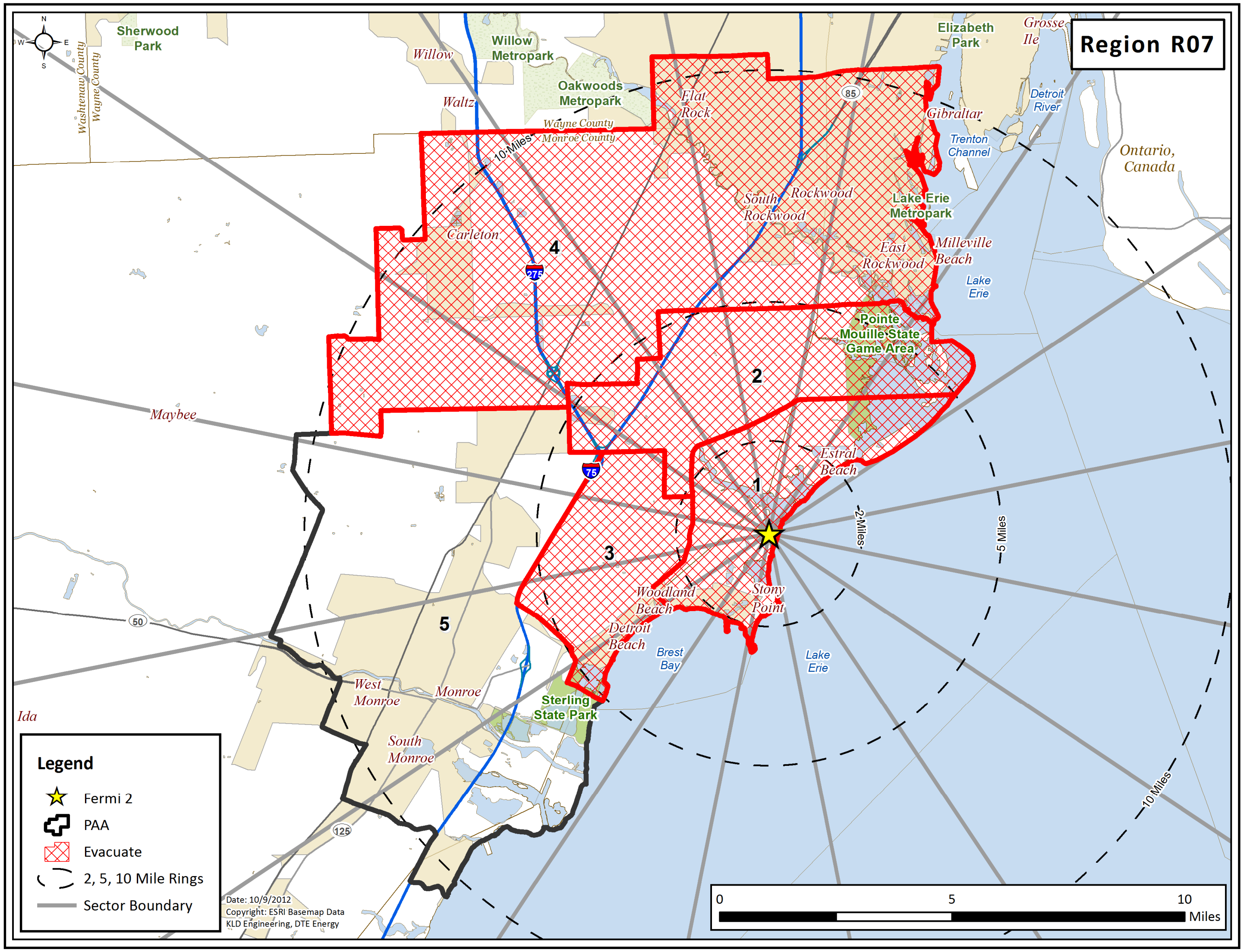


Figure H-7. Region R07

1 INTRODUCTION

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the Fermi Nuclear Power Plant (FNPP), located in Monroe County, MI. ETE provide State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, guidance is provided by documents published by Federal Governmental agencies. Most important of these are:

- Criteria for Development of Evacuation Time Estimate Studies, NUREG/CR-7002, November 2011.
- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/FEMA REP 1, Rev. 1, November 1980.
- Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones, NUREG/CR 1745, November 1980.
- Development of Evacuation Time Estimates for Nuclear Power Plants, NUREG/CR-6863, January 2005.

The work effort reported herein was supported and guided by local stakeholders who contributed suggestions, critiques, and the local knowledge base required. Table 1-1 presents a summary of stakeholders and interactions.

Table 1-1. Stakeholder Interaction

Stakeholder	Nature of Stakeholder Interaction
DTE Energy	Meetings to define data requirements and set up contacts with local government agencies
County Emergency Management Departments	Provide means for data collection and obtaining county emergency plans
MSP/EMHSD	Obtain existing traffic management plans and state emergency plans

1.1 Overview of the ETE Process

The following outline presents a brief description of the work effort in chronological sequence:

1. Information Gathering:
    a. Defined the scope of work in discussions with representatives from DTE Energy.
    b. Attended meetings with emergency planners from Monroe County EMW and Wayne County HSEM to identify issues to be addressed and resources available.

c. Conducted a detailed field survey of the highway system and of area traffic conditions within the Emergency Planning Zone (EPZ) and Shadow Region.

d. Obtained demographic data from the 2010 census, county emergency management departments.

e. Conducted a random sample telephone survey of EPZ residents.

f. Conducted a data collection effort to identify and describe schools, special facilities, major employers, transportation providers, and other important information.

2. Estimated distributions of Trip Generation times representing the time required by various population groups (permanent residents, employees, and transients) to prepare (mobilize) for the evacuation trip. These estimates are primarily based upon the random sample telephone survey.

3. Defined Evacuation Scenarios. These scenarios reflect the variation in demand, in trip generation distribution and in highway capacities, associated with different seasons, day of week, time of day and weather conditions.

4. Reviewed the existing traffic management plan to be implemented by local and state police in the event of an incident at the plant. Traffic control is applied at specified Traffic Control Points (TCP) located within the EPZ.

5. Used existing Protective Action Areas (PAA) to define evacuation regions. The EPZ is partitioned into 5 PAA along jurisdictional and geographic boundaries. "Regions" are groups of contiguous PAA for which ETE are calculated. The configurations of these Regions reflect wind direction and the radial extent of the impacted area. Each Region, other than those that approximate circular areas, approximates a "key-hole section" within the EPZ as recommended by NUREG/CR-7002.

6. Estimated demand for transit services for persons at "Special Facilities" and for transit-dependent persons at home.

7. Prepared the input streams for the DYNEV II system.

    a. Estimated the evacuation traffic demand, based on the available information derived from Census data, and from data provided by local and state agencies, DTE Energy and from the telephone survey.

    b. Applied the procedures specified in the 2010 Highway Capacity Manual (HCM[1]) to the data acquired during the field survey, to estimate the capacity of all highway segments comprising the evacuation routes.

    c. Developed the link-node representation of the evacuation network, which is used as the basis for the computer analysis that calculates the ETE.

[1] Highway Capacity Manual (HCM 2010), Transportation Research Board, National Research Council, 2010.

d. Calculated the evacuating traffic demand for each Region and for each Scenario.

e. Specified selected candidate destinations for each “origin” (location of each “source” where evacuation trips are generated over the mobilization time) to support evacuation travel consistent with outbound movement relative to the location of the FNPP.

8. Executed the DYNEV II model to determine optimal evacuation routing and compute ETE for all residents, transients and employees (“general population”) with access to private vehicles. Generated a complete set of ETE for all specified Regions and Scenarios.
9. Documented ETE in formats in accordance with NUREG/CR-7002.
10. Calculated the ETE for all transit activities including those for special facilities (schools, medical facilities, etc.), for the transit-dependent population and for homebound special needs population.

1.2 The Fermi Nuclear Power Plant Location

The FNPP is located along the western shore of Lake Erie in Frenchtown Charter Township, Monroe County, Michigan. The site is approximately 25 miles northeast of Toledo, OH and 25 miles southwest of Detroit, MI. The Emergency Planning Zone (EPZ) consists of parts of Monroe and Wayne Counties in Michigan. Figure 1-1 displays the area surrounding the FNPP. This map identifies the communities in the area and the major roads.

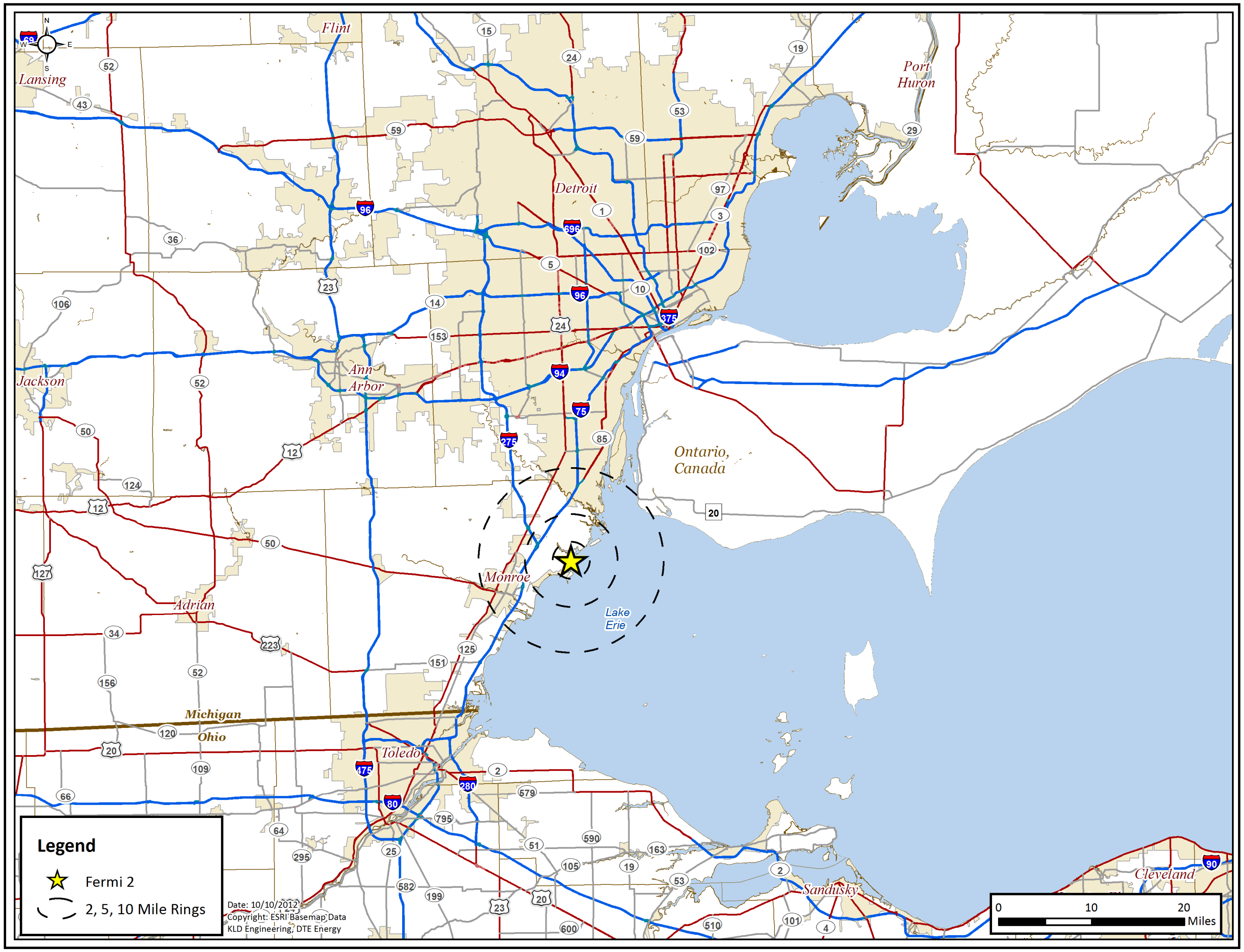


Figure 1-1. FNPP Location

1.3 Preliminary Activities

These activities are described below.

<u>Field Surveys of the Highway Network</u>

KLD personnel drove the entire highway system within the EPZ and the Shadow Region which consists of the area between the EPZ boundary and approximately 15 miles radially from the plant. The characteristics of each section of highway were recorded. These characteristics are shown in Table 1-2:

Table 1-2. Highway Characteristics

- Number of lanes
- Lane width
- Shoulder type & width
- Interchange geometries
- Lane channelization & queuing capacity (including turn bays/lanes)
- Geometrics: curves, grades (>4%)
- Posted speed
- Actual free speed
- Abutting land use
- Control devices
- Intersection configuration (including roundabouts where applicable)
- Traffic signal type
- Unusual characteristics: Narrow bridges, sharp curves, poor pavement, flood warning signs, inadequate delineations, toll booths, etc.

Video and audio recording equipment were used to capture a permanent record of the highway infrastructure. No attempt was made to meticulously measure such attributes as lane width and shoulder width; estimates of these measures based on visual observation and recorded images were considered appropriate for the purpose of estimating the capacity of highway sections. For example, Exhibit 15-7 in the HCM indicates that a reduction in lane width from 12 feet (the “base” value) to 10 feet can reduce free flow speed (FFS) by 1.1 mph – not a material difference – for two-lane highways. Exhibit 15-30 in the HCM shows little sensitivity for the estimates of Service Volumes at Level of Service (LOS) E (near capacity), with respect to FFS, for two-lane highways.

The data from the audio and video recordings were used to create detailed geographical information systems (GIS) shapefiles and databases of the roadway characteristics and of the traffic control devices observed during the road survey; this information was referenced while preparing the input stream for the DYNEV II System.

As documented on page 15-5 of the HCM 2010, the capacity of a two-lane highway is 1700 passenger cars per hour in one direction. For freeway sections, a value of 2250 vehicles per hour per lane is assigned, as per Exhibit 11-17 of the HCM 2010. The road survey has identified several segments which are characterized by adverse geometrics on two-lane highways which are reflected in reduced values for both capacity and speed. These estimates are consistent with the service volumes for LOS E presented in HCM Exhibit 15-30. These links may be identified by reviewing Appendix K. Link capacity is an input to DYNEV II which computes the ETE. Further discussion of roadway capacity is provided in Section 4 of this report.

Traffic signals are either pre-timed (signal timings are fixed over time and do not change with the traffic volume on competing approaches), or are actuated (signal timings vary over time based on the changing traffic volumes on competing approaches). Actuated signals require detectors to provide the traffic data used by the signal controller to adjust the signal timings. These detectors are typically magnetic loops in the roadway, or video cameras mounted on the signal masts and pointed toward the intersection approaches. If detectors were observed on the approaches to a signalized intersection during the road survey, detailed signal timings were not collected as the timings vary with traffic volume. TCPs at locations which have control devices are represented as actuated signals in the DYNEV II system.

If no detectors were observed, the signal control at the intersection was considered pre-timed, and detailed signal timings were gathered for several signal cycles. These signal timings were input to the DYNEV II system used to compute ETE, as per NUREG/CR-7002 guidance.

Figure 1-2 presents the link-node analysis network that was constructed to model the evacuation roadway network in the EPZ and Shadow Region. The directional arrows on the links and the node numbers have been removed from Figure 1-2 to clarify the figure. The detailed figures provided in Appendix K depict the analysis network with directional arrows shown and node numbers provided. The observations made during the field survey were used to calibrate the analysis network.

Telephone Survey

A telephone survey was undertaken to gather information needed for the evacuation study. Appendix F presents the survey instrument, the procedures used and tabulations of data compiled from the survey returns.

These data were utilized to develop estimates of vehicle occupancy to estimate the number of evacuating vehicles during an evacuation and to estimate elements of the mobilization process. This database was also referenced to estimate the number of transit-dependent residents.

Computing the Evacuation Time Estimates

The overall study procedure is outlined in Appendix D. Demographic data were obtained from several sources, as detailed later in this report. These data were analyzed and converted into vehicle demand data. The vehicle demand was loaded onto appropriate "source" links of the analysis network using GIS mapping software. The DYNEV II system was then used to compute ETE for all Regions and Scenarios.

Analytical Tools

The DYNEV II System that was employed for this study is comprised of several integrated computer models. One of these is the DYNEV (DYnamic Network EVacuation) macroscopic simulation model, a new version of the IDYNEV model that was developed by KLD under contract with the Federal Emergency Management Agency (FEMA).

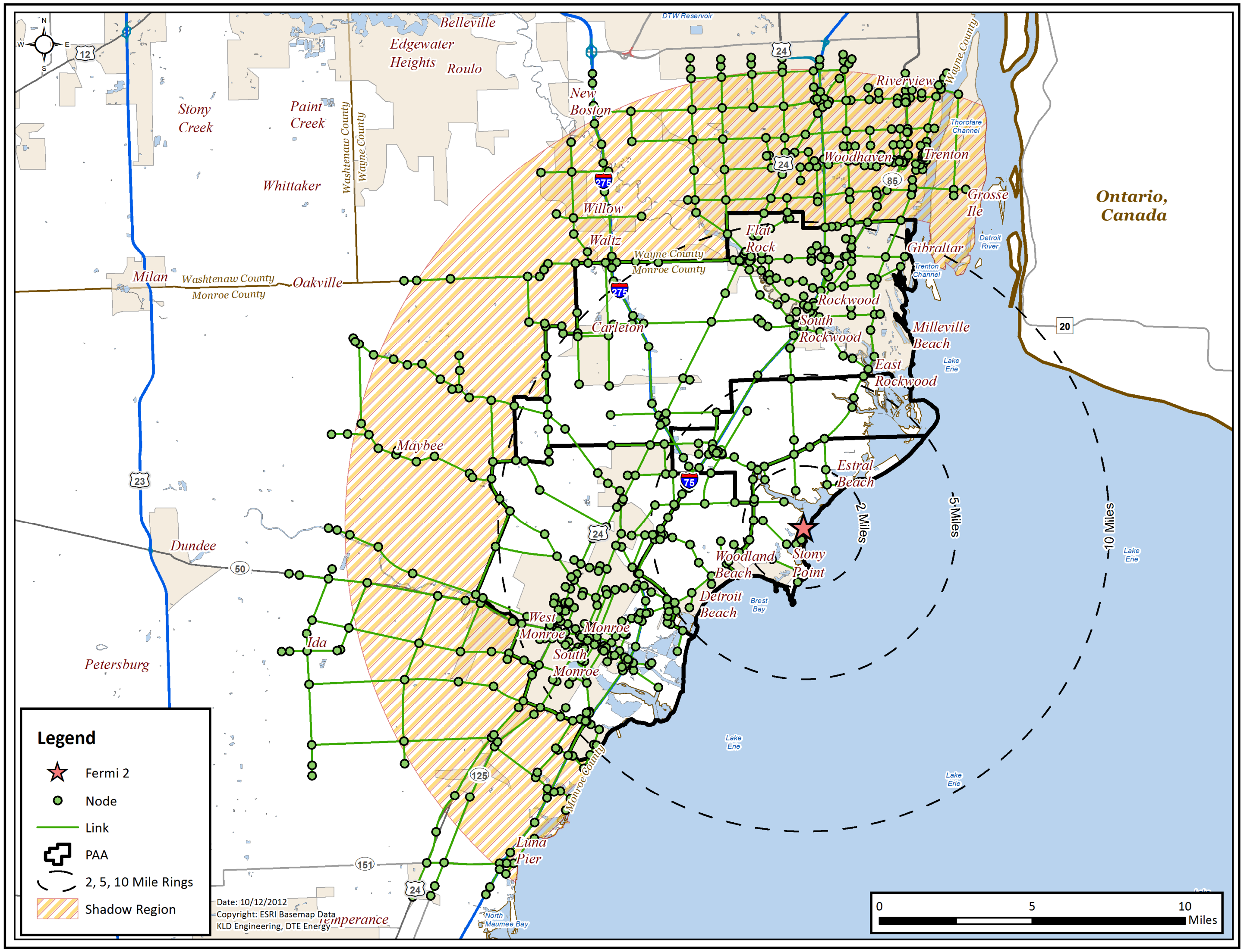


Figure 1-2. FNPP Link-Node Analysis Network

DYNEV II consists of four sub-models:

- A macroscopic traffic simulation model (for details, see Appendix C).
- A Trip Distribution (TD), model that assigns a set of candidate destination (D) nodes for each "origin" (O) located within the analysis network, where evacuation trips are "generated" over time. This establishes a set of O-D tables.
- A Dynamic Traffic Assignment (DTA), model which assigns trips to paths of travel (routes) which satisfy the O-D tables, over time. The TD and DTA models are integrated to form the DTRAD (Dynamic Traffic Assignment and Distribution) model, as described in Appendix B.
- A Myopic Traffic Diversion model which diverts traffic to avoid intense, local congestion, if possible.

Another software product developed by KLD, named UNITES (UNIfied Transportation Engineering System) was used to expedite data entry and to automate the production of output tables.

The dynamics of traffic flow over the network are graphically animated using the software product, EVAN (EVacuation ANimator), developed by KLD. EVAN is GIS based, and displays statistics such as LOS, vehicles discharged, average speed, and percent of vehicles evacuated, output by the DYNEV II System. The use of a GIS framework enables the user to zoom in on areas of congestion and query road name, town name and other geographical information.

The procedure for applying the DYNEV II System within the framework of developing ETE is outlined in Appendix D. Appendix A is a glossary of terms.

For the reader interested in an evaluation of the original model, I-DYNEV, the following references are suggested:

- NUREG/CR-4873 – Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code
- NUREG/CR-4874 – The Sensitivity of Evacuation Time Estimates to Changes in Input Parameters for the I-DYNEV Computer Code

The evacuation analysis procedures are based upon the need to:

- Route traffic along paths of travel that will expedite their travel from their respective points of origin to points outside the EPZ.
- Restrict movement toward the plant to the extent practicable, and disperse traffic demand so as to avoid focusing demand on a limited number of highways.
- Move traffic in directions that are generally outbound, relative to the location of the FNPP.

DYNEV II provides a detailed description of traffic operations on the evacuation network. This description enables the analyst to identify bottlenecks and to develop countermeasures that are designed to represent the behavioral responses of evacuees. The effects of these countermeasures may then be tested with the model.

1.4 Comparison with Prior ETE Study

Table 1-3 presents a comparison of the present ETE study with the 2008 study. The major factors contributing to the differences between the ETE values obtained in this study and those of the previous study can be summarized as follows:

- A decrease in permanent resident population.
- The model used in the previous study used highway capacities based upon the 2000 HCM. The current study uses an updated model reflecting increased highway capacities based upon the 2010 HCM.
- The previous study modeled all traffic signals as pretimed signals with fixed signal timings. NUREG/CR-7002 requires the ETE to consider actuated signals in the traffic simulation model where they exist in the real word. Actuated signals allocate green time based on the volume at each approach and will vary throughout the simulation. This adaptive intersection control has improved capacity at critical intersections along congested corridors, thus decreasing ETE.

Table 1-3. ETE Study Comparisons

Topic	Previous ETE Study	Current ETE Study
Resident Population Basis	2000 US Census Data; Population = 103,343	ArcGIS Software using 2010 US Census blocks; area ratio method used. Population = 97,825
Resident Population Vehicle Occupancy	2.72 persons/household, 1.24 evacuating vehicles/household yielding: 2.19 persons/vehicle	2.72 persons/household, 1.24 evacuating vehicles/household yielding: 2.19 persons/vehicle
Employee Population	Employees treated as separate population group. Employee estimates based on information provided by the counties, by Internet searches, and by direct phone calls to major employers. 1.02 employees/vehicle based on phone survey results. Employees = 5,047	Employees treated as separate population group. Employee estimates based on information provided by the counties, by Internet searches, and by direct phone calls to major employers. 1.01 employees/vehicle based on phone survey results. Employees = 4,797

Topic	Previous ETE Study	Current ETE Study
Transit-Dependent Population	Estimates based upon U.S. Census data and the results of the telephone survey. A total of 1,253 people who do not have access to a vehicle, requiring 42 buses to evacuate. Included are 153 homebound special needs persons needed special transportation to evacuate (100 required a bus, 40 required a wheelchair-accessible vehicle, and 13 required an ambulance).	Estimates based upon U.S. Census data and the results of the telephone survey. A total of 2,834 people who do not have access to a vehicle, requiring 95 buses to evacuate. An additional 334 homebound special needs persons needed special transportation to evacuate (219 required a bus, 103 required a wheelchair-accessible vehicle, and 12 required an ambulance).
Transient Population	Transient estimates based upon information provided about transient attractions in EPZ, supplemented by observations of the facilities during the road survey and from aerial photography. Transients = 13,458	Transient estimates based upon information provided about transient attractions in EPZ, supplemented by observations of the facilities during the road survey and from aerial photography. Transients = 13,537
Special Facilities Population	Special facility population based on information provided by each county within the EPZ. Medical Facility Census = 950 Buses Required = 9 Wheelchair Buses Required = 27 Ambulances Required = 31 Correctional Facility Census = 343 Buses Required = 12	Special facility population based on information provided by each county within the EPZ. Medical Facility Census = 950 Buses Required = 31 Wheelchair Vans Required = 34 Ambulances Required = 21 Correctional Facility Census = 343 Buses Required = 12
School Population	School population based on information provided by each county within the EPZ. School enrollment = 20,398 Buses Required = 383	School population based on information provided by each county within the EPZ. School enrollment = 19,173 Buses required = 361
Voluntary evacuation from within EPZ in areas outside region to be evacuated	50 percent of population within the circular portion of the region; 35 percent, in annular ring between the circle and the EPZ boundary.	20 percent of the population within the EPZ, but not within the Evacuation Region (see Figure 2-1)
Shadow Evacuation	30% of people outside of the EPZ within the Shadow Region	20% of people outside of the EPZ within the Shadow Region (see Figure 7-2)
Network Size	828 links; 615 nodes	1,000 links; 705 nodes

Topic	Previous ETE Study	Current ETE Study
Roadway Geometric Data	Field surveys conducted in 2008. Road capacities based on 2000 HCM.	Field surveys conducted in February 2012. Roads and intersections were video archived. Road capacities based on 2010 HCM.
School Evacuation	Direct evacuation to designated Reception Center/Host School.	Direct evacuation to designated Reception Center/Host School.
Ridesharing	50 percent of transit-dependent persons will evacuate with a neighbor or friend.	50 percent of transit-dependent persons will evacuate with a neighbor or friend.
Trip Generation for Evacuation	Based on residential telephone survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 30 and 240 minutes. Residents without commuters returning leave between 15 and 180 minutes. Employees and transients leave between 15 and 120 minutes. All times measured from the Advisory to Evacuate.	Based on residential telephone survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 30 and 240 minutes. Residents without commuters returning leave between 15 and 180 minutes. Employees and transients leave between 15 and 105 minutes. All times measured from the Advisory to Evacuate.
Weather	Normal, Rain, or Snow. The capacity and free flow speed of all links in the network are reduced by 10% in the event of rain and 20% for snow.	Normal, Rain, or Snow. The capacity and free flow speed of all links in the network are reduced by 10% in the event of rain and 20% for snow.
Modeling	IDYNEV System	DYNEV II System – Version 4.0.11.0
Special Events	Two considered: River Raisin Jazz Festival and Construction of a new unit at the Fermi Nuclear Power Plant site during refueling of the operational unit.	River Raising Jazz Festival. Special event population = 6,667
Evacuation Cases	7 Regions and 14 Scenarios producing 98 unique cases.	10 Regions (central sector wind direction and each adjacent sector technique used) and 14 Scenarios producing 140 unique cases.
Evacuation Time Estimates Reporting	ETE reported for 50th, 90th 95th and 100th percentile population. Results presented by Region and Scenario.	ETE reported for 90th and 100th percentile population. Results presented by Region and Scenario.

Topic	Previous ETE Study	Current ETE Study
Evacuation Time Estimates for the entire EPZ, 90th percentile	Winter Weekday Midday, Good Weather: 2:50 Summer Weekend, Midday, Good Weather: 2:45	Winter Weekday Midday, Good Weather: 2:05 Summer Weekend, Midday, Good Weather: 2:00

2 STUDY ESTIMATES AND ASSUMPTIONS

This section presents the estimates and assumptions utilized in the development of the evacuation time estimates.

2.1 Data Estimates

1. Population estimates are based upon Census 2010 data.
2. Estimates of employees who reside outside the EPZ and commute to work within the EPZ are based upon employment data obtained from county emergency management offices, direct phone calls to major employers, and from the previous ETE report.
3. Population estimates at special facilities are based on available data from county emergency management offices and from phone calls to specific facilities.
4. Roadway capacity estimates are based on field surveys and the application of the Highway Capacity Manual 2010.
5. Population mobilization times are based on a statistical analysis of data acquired from a random sample telephone survey of EPZ residents (see Section 5 and Appendix F).
6. The relationship between resident population and evacuating vehicles is developed from the telephone survey. Average values of 2.72 persons per household and 1.24 evacuating vehicles per household are used. The relationship between persons and vehicles for transients and employees is as follows:
    a. Employees: 1.01 employees per vehicle (telephone survey results) for all major employers.
    b. Parks: Vehicle occupancy varies is 2.3 persons per vehicle based on data provided by Sterling State Park.
    c. Special Events: Assumed transients attending the River Raisin Jazz Festival show travel as families/households in a single vehicle, and used the average household size of 2.72 persons to estimate the number of vehicles.

2.2 Study Methodological Assumptions

1. ETE are presented for the evacuation of the 90th and 100th percentiles of population for each Region and for each Scenario. The percentile ETE is defined as the elapsed time from the Advisory to Evacuate issued to a specific Region of the EPZ, to the time that Region is clear of the indicated percentile of evacuees. A Region is defined as a group of PAA that is issued an Advisory to Evacuate. A scenario is a combination of circumstances, including time of day, day of week, season, and weather conditions.
2. The ETE are computed and presented in tabular format and graphically, in a format compliant with NUREG/CR-7002.
3. Evacuation movements (paths of travel) are generally outbound relative to the plant to the extent permitted by the highway network. All major evacuation routes are used in the analysis.
4. Regions are defined by the underlying "keyhole" or circular configurations as specified in Section 1.4 of NUREG/CR-7002. These Regions, as defined, display irregular boundaries reflecting the geography of the PAA included within these underlying configurations.
5. As indicated in Figure 2-2 of NUREG/CR-7002, 100% of people within the impacted "keyhole" evacuate. 20% of those people within the EPZ, not within the impacted keyhole, will voluntarily evacuate. 20% of those people within the Shadow Region will voluntarily evacuate. See Figure 2-1 for a graphical representation of these evacuation percentages. Sensitivity studies explore the effect on ETE of increasing the percentage of voluntary evacuees in the Shadow Region (see Appendix M).
6. A total of 14 "Scenarios" representing different temporal variations (season, time of day, day of week) and weather conditions are considered. These Scenarios are outlined in Table 2-1.
7. Scenario 14 considers the closure of a single lane southbound on Interstate-75 from the interchange with I-275 (Exit 20) to the end of the EPZ at Laplaisance Rd (before Exit 9).
8. The models of the I-DYNEV System were recognized as state of the art by the Atomic Safety & Licensing Board (ASLB) in past hearings. (Sources: Atomic Safety & Licensing Board Hearings on Seabrook and Shoreham; Urbanik[1]). The models have continuously been refined and extended since those hearings and were independently validated by a consultant retained by the NRC. The new DYNEV II model incorporates the latest technology in traffic simulation and in dynamic traffic assignment.

[1] Urbanik, T., et. al. Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code, NUREG/CR-4873, Nuclear Regulatory Commission, June, 1988.

Table 2-1. Evacuation Scenario Definitions

Scenario	Season[2]	Day of Week	Time of Day	Weather	Special
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Midweek	Midday	Snow	None
9	Winter	Weekend	Midday	Good	None
10	Winter	Weekend	Midday	Rain	None
11	Winter	Weekend	Midday	Snow	None
12	Winter	Midweek, Weekend	Evening	Good	None
13	Summer	Weekend	Midday	Good	River Raisin Jazz Festival
14	Summer	Midweek	Midday	Good	Roadway Impact – Lane Closure on I-75 SB

[2] Winter assumes that school is in session (also applies to spring and autumn). Summer assumes that school is not in session.

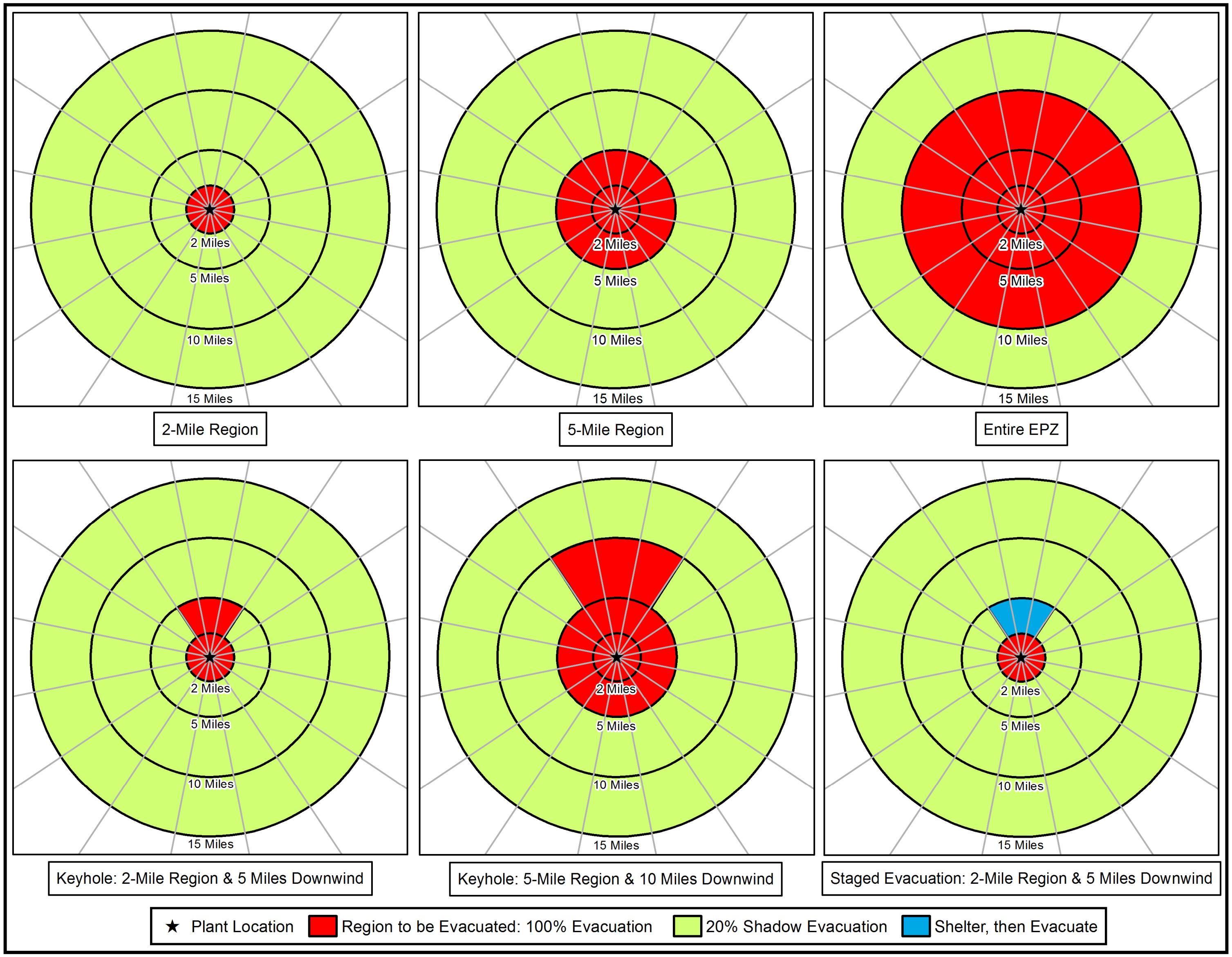


Figure 2-1. Voluntary Evacuation Methodology

2.3 Study Assumptions

1. The Planning Basis Assumption for the calculation of ETE is a rapidly escalating accident that requires evacuation, and includes the following:
    a. Advisory to Evacuate is announced coincident with the siren notification.
    b. Mobilization of the general population will commence within 15 minutes after siren notification.
    c. ETE are measured relative to the Advisory to Evacuate.
2. It is assumed that everyone within the group of PAA forming a Region that is issued an Advisory to Evacuate will, in fact, respond and evacuate in general accord with the planned routes.
3. 62 percent of the households in the EPZ have at least 1 commuter; 55 percent of those households with commuters will await the return of a commuter before beginning their evacuation trip, based on the telephone survey results. Therefore 34 percent (62% x 55% = 34%) of EPZ households will await the return of a commuter, prior to beginning their evacuation trip.
4. The ETE will also include consideration of "through" (External-External) trips during the time that such traffic is permitted to enter the evacuated Region. "Normal" traffic flow is assumed to be present within the EPZ at the start of the emergency.
5. Access Control Points (ACP) will be staffed within approximately 120 minutes following the siren notifications, to divert traffic attempting to enter the EPZ. Earlier activation of ACP locations could delay returning commuters. It is assumed that no through traffic will enter the EPZ after this 120 minute time period.
6. Traffic Control Points (TCP) within the EPZ will be staffed over time, beginning at the Advisory to Evacuate. Their number and location will depend on the Region to be evacuated and resources available. The objectives of these TCP are:
    a. Facilitate the movements of all (mostly evacuating) vehicles at the location.
    b. Discourage inadvertent vehicle movements towards the plant.
    c. Provide assurance and guidance to any traveler who is unsure of the appropriate actions or routing.
    d. Act as local surveillance and communications center.
    e. Provide information to the emergency operations center (EOC) as needed, based on direct observation or on information provided by travelers.

    In calculating ETE, it is assumed that evacuees will drive safely, travel in directions identified in the plan, and obey all control devices and traffic guides.

7. Buses will be used to transport those without access to private vehicles:
   a. If schools are in session, transport (buses) will evacuate students directly to the designated host schools.
   b. It is assumed parents will pick up children at day care centers prior to evacuation.
   c. Buses, wheelchair vans and ambulances will evacuate patients at medical facilities and at any senior facilities within the EPZ, as needed.
   d. Transit-dependent general population will be evacuated to Reception Centers.
   e. Schoolchildren, if school is in session, are given priority in assigning transit vehicles.
   f. Bus mobilization time is considered in ETE calculations.
   g. Analysis of the number of required round-trips ("waves") of evacuating transit vehicles is presented.
   h. Transport of transit-dependent evacuees from reception centers to congregate care centers is not considered in this study.
8. Provisions are made for evacuating the transit-dependent portion of the general population to reception centers by bus, based on the assumption that some of these people will ride-share with family, neighbors, and friends, thus reducing the demand for buses. We assume that the percentage of people who rideshare is 50 percent. This assumption is based upon reported experience for other emergencies[3], and on guidance in Section 2.2 of NUREG/CR-7002.
9. Two types of adverse weather scenarios are considered. Rain may occur for either winter or summer scenarios; snow occurs in winter scenarios only. It is assumed that the rain or snow begins earlier or at about the same time the evacuation advisory is issued. No weather-related reduction in the number of transients who may be present in the EPZ is assumed. It is assumed that roads are passable and that the appropriate agencies are plowing the roads as they would normally when snowing.

   Adverse weather scenarios affect roadway capacity and the free flow highway speeds. The factors applied for the ETE study are based on recent research on the effects of weather on roadway operations[4]; the factors are shown in Table 2-2.

[3] Institute for Environmental Studies, University of Toronto, THE MISSISSAUGA EVACUATION FINAL REPORT, June 1981. The report indicates that 6,600 people of a transit-dependent population of 8,600 people shared rides with other residents; a ride share rate of 76% (Page 5-10).

[4] Agarwal, M. et. Al. Impacts of Weather on Urban Freeway Traffic Flow Characteristics and Facility Capacity, Proceedings of the 2005 Mid-Continent Transportation Research Symposium, August, 2005. The results of this paper are included as Exhibit 10-15 in the HCM 2010.

10. School buses used to transport students are assumed to transport 70 students per bus for elementary schools and 50 students per bus for middle and high schools, based on discussions with county offices of emergency management. Transit buses used to transport the transit-dependent general population are assumed to transport 30 people per bus.

Table 2-2. Model Adjustment for Adverse Weather

Scenario	Highway Capacity*	Free Flow Speed*	Mobilization Time for General Population
Rain	90%	90%	No Effect
Snow	80%	80%	Clear driveway before leaving home (See Figure F-12)
*Adverse weather capacity and speed values are given as a percentage of good weather conditions. Roads are assumed to be passable.			

3 DEMAND ESTIMATION

The estimates of demand, expressed in terms of people and vehicles, constitute a critical element in developing an evacuation plan. These estimates consist of three components:

1. An estimate of population within the EPZ, stratified into groups (resident, employee, transient).
2. An estimate, for each population group, of mean occupancy per evacuating vehicle. This estimate is used to determine the number of evacuating vehicles.
3. An estimate of potential double-counting of vehicles.

Appendix E presents much of the source material for the population estimates. Our primary source of population data, the 2010 Census, however, is not adequate for directly estimating some transient groups.

Throughout the year, vacationers and tourists enter the EPZ. These non-residents may dwell within the EPZ for a short period (e.g. a few days or one or two weeks), or may enter and leave within one day. Estimates of the size of these population components must be obtained, so that the associated number of evacuating vehicles can be ascertained.

The potential for double-counting people and vehicles must be addressed. For example:

- A resident who works and shops within the EPZ could be counted as a resident, again as an employee and once again as a shopper.
- A visitor who stays at a hotel and spends time at a park, then goes shopping could be counted three times.

Furthermore, the number of vehicles at a location depends on time of day. For example, motel parking lots may be full at dawn and empty at noon. Similarly, parking lots at area parks, which are full at noon, may be almost empty at dawn. Estimating counts of vehicles by simply adding up the capacities of different types of parking facilities will tend to overestimate the number of transients and can lead to ETE that are too conservative.

Analysis of the population characteristics of the Fermi EPZ indicates the need to identify three distinct groups:

- Permanent residents - people who are year round residents of the EPZ.
- Transients - people who reside outside of the EPZ who enter the area for a specific purpose (shopping, recreation) and then leave the area.
- Employees - people who reside outside of the EPZ and commute to businesses within the EPZ on a daily basis.

Estimates of the population and number of evacuating vehicles for each of the population groups are presented for each PAA and by polar coordinate representation (population rose). The Fermi EPZ is subdivided into 5 PAAs. The EPZ is shown in Figure 3-1.

3.1 Permanent Residents

The primary source for estimating permanent population is the latest U.S. Census data. The average household size (2.72 persons/household – See Figure F-1) and the number of evacuating vehicles per household (1.24 vehicles/household – See Figure F-7) were adapted from the telephone survey results.

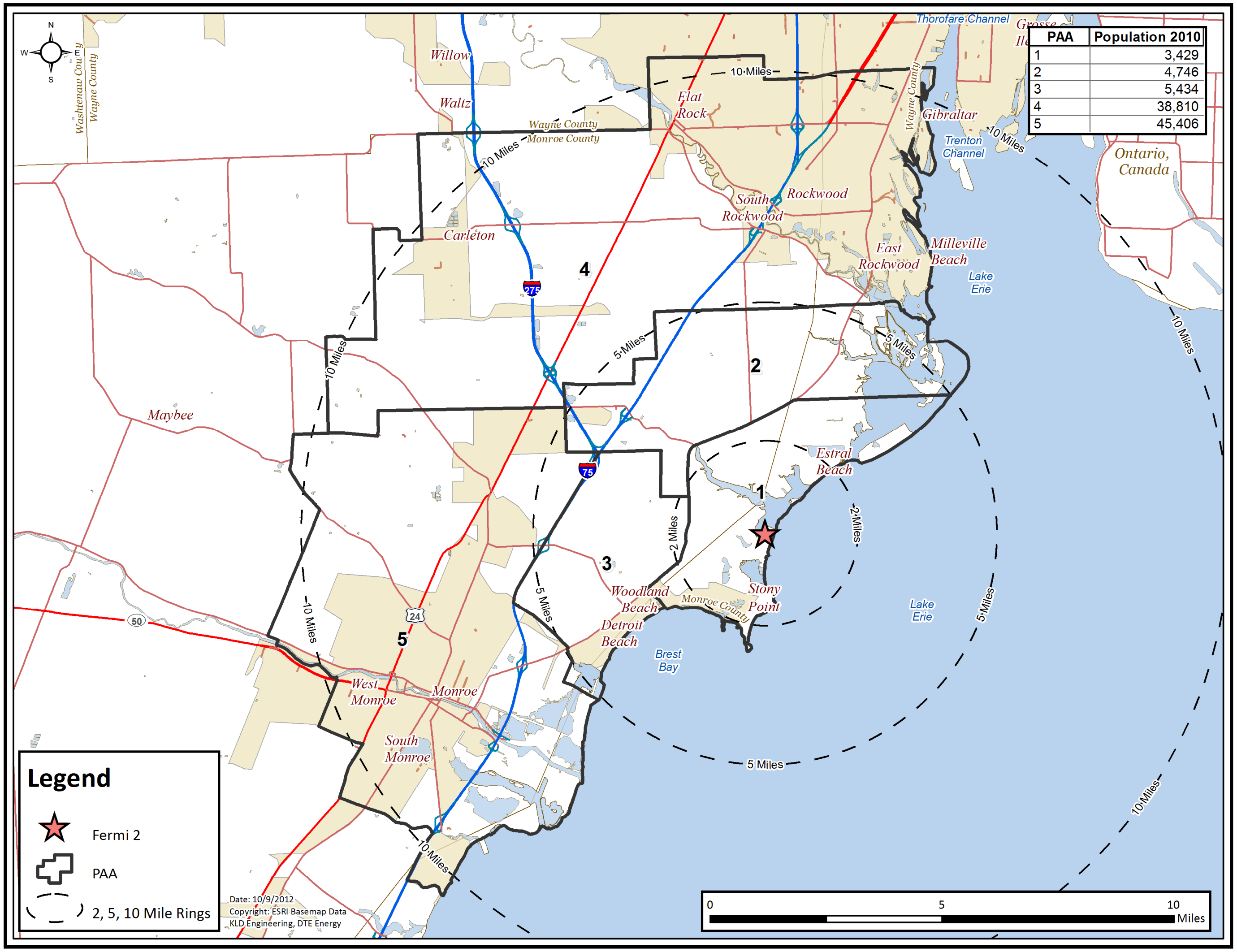
Population estimates are based upon Census 2010 data. The estimates are created by cutting the census block polygons by the PAA and EPZ boundaries. A ratio of the original area of each census block and the updated area (after cutting) is multiplied by the total block population to estimate what the population is within the EPZ. This methodology assumes that the population is evenly distributed across a census block. Table 3-1 provides the permanent resident population within the EPZ, by PAA based on this methodology.

The year 2010 permanent resident population is divided by the average household size and then multiplied by the average number of evacuating vehicles per household in order to estimate number of vehicles. Permanent resident population and vehicle estimates are presented in Table 3-2. Figure 3-2 and Figure 3-3 present the permanent resident population and permanent resident vehicle estimates by sector and distance from Fermi. This "rose" was constructed using GIS software.

It can be argued that this estimate of permanent residents overstates, somewhat, the number of evacuating vehicles, especially during the summer. It is certainly reasonable to assert that some portion of the population would be on vacation during the summer and would travel elsewhere. A rough estimate of this reduction can be obtained as follows:

- Assume 50 percent of all households vacation for a two-week period over the summer.
- Assume these vacations, in aggregate, are uniformly dispersed over 10 weeks, i.e. 10 percent of the population is on vacation during each two-week interval.
- Assume half of these vacationers leave the area.

On this basis, the permanent resident population would be reduced by 5 percent in the summer and by a lesser amount in the off-season. Given the uncertainty in this estimate, we elected to apply no reductions in permanent resident population for the summer scenarios to account for residents who may be out of the area.



PAA	Population 2010
1	3,429
2	4,746
3	5,434
4	38,810
5	45,406

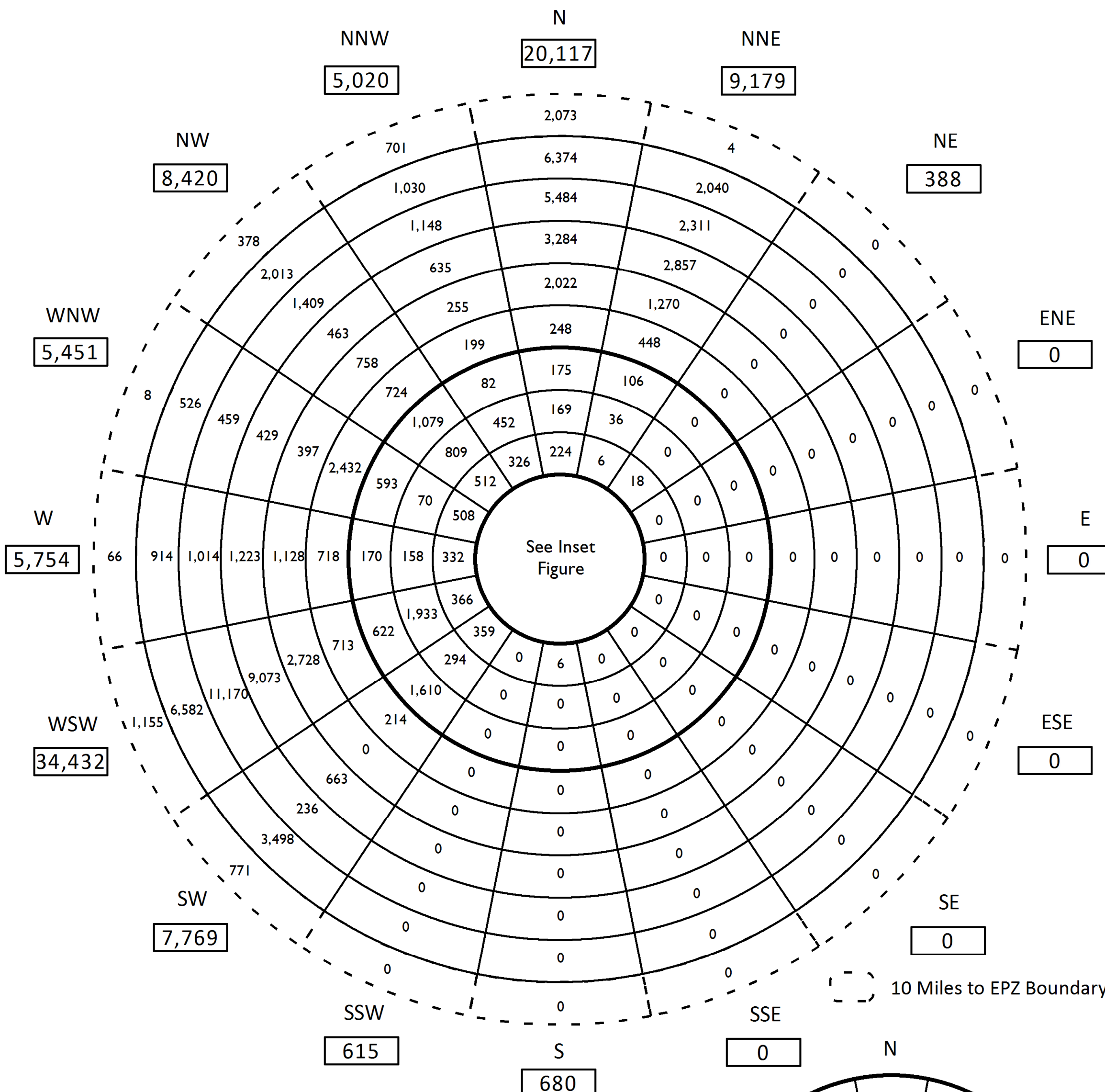
Figure 3-1. Fermi EPZ

Table 3-1. EPZ Permanent Resident Population

PAA	2000 Population	2010 Population
1	3,723	3,429
2	2,576	4,746
3	5,628	5,434
4	33,723	38,810
5	47,049	45,406
TOTAL	**92,699**	**97,825**
EPZ Population Growth:		**5.53%**

Table 3-2. Permanent Resident Population and Vehicles by PAA

PAA	2010 Population	2010 Resident Vehicles
1	3,429	1,561
2	4,746	2,160
3	5,434	2,471
4	38,810	17,679
5	45,406	20,682
TOTAL	**97,825**	**44,553**



Resident Population

Miles	Subtotal by Ring	Cumulative Total
0 - 1	67	67
1 - 2	2,498	2,565
2 - 3	2,657	5,222
3 - 4	3,921	9,143
4 - 5	4,437	13,580
5 - 6	5,696	19,276
6 - 7	8,558	27,834
7 - 8	18,627	46,461
8 - 9	23,231	69,692
9 - 10	22,977	92,669
10 - EPZ	5,156	97,825
	Total:	97,825

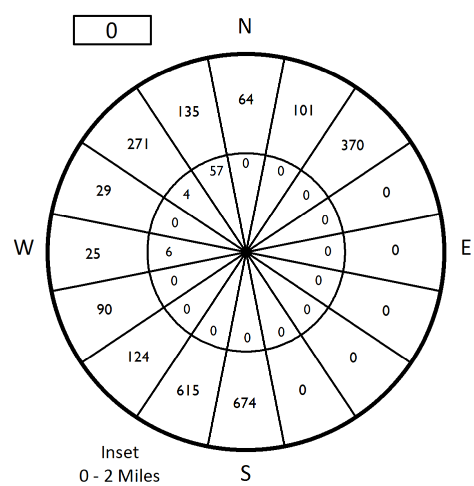
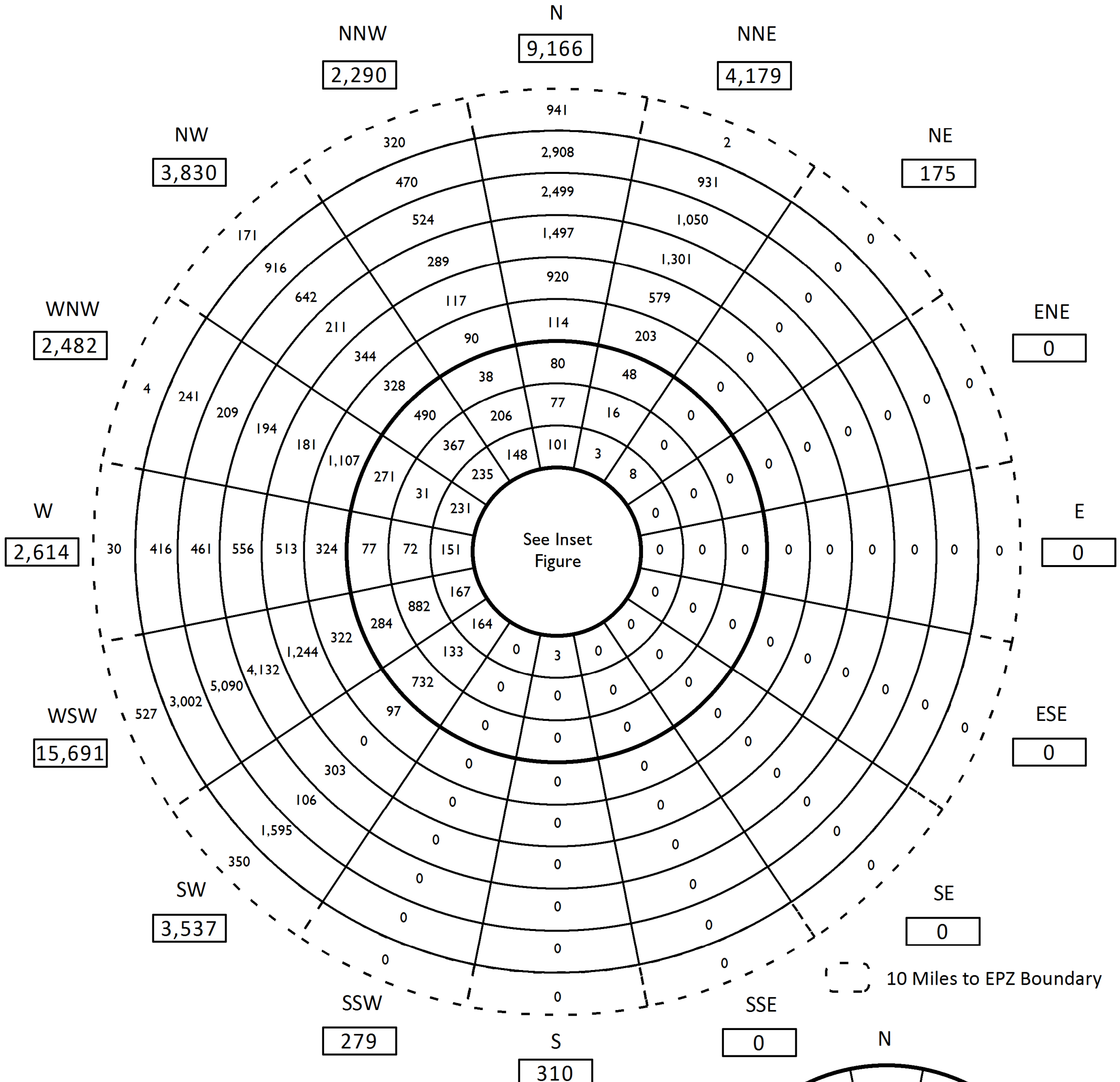


Figure 3-2. Permanent Resident Population by Sector



Resident Vehicles

Miles	Subtotal by Ring	Cumulative Total
0 - 1	31	31
1 - 2	1,136	1,167
2 - 3	1,211	2,378
3 - 4	1,784	4,162
4 - 5	2,020	6,182
5 - 6	2,585	8,767
6 - 7	3,898	12,665
7 - 8	8,483	21,148
8 - 9	10,581	31,729
9 - 10	10,479	42,208
10 - EPZ	2,345	44,553
	Total:	44,553

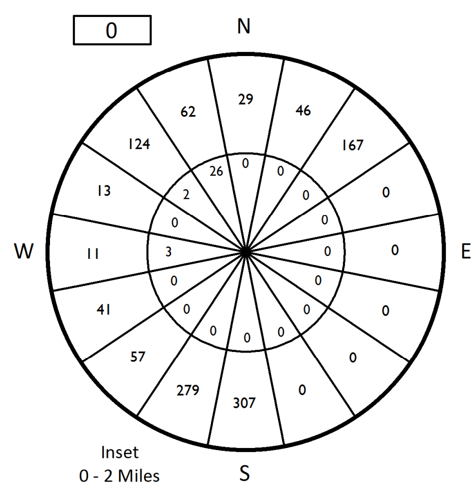


Figure 3-3. Permanent Resident Vehicles by Sector

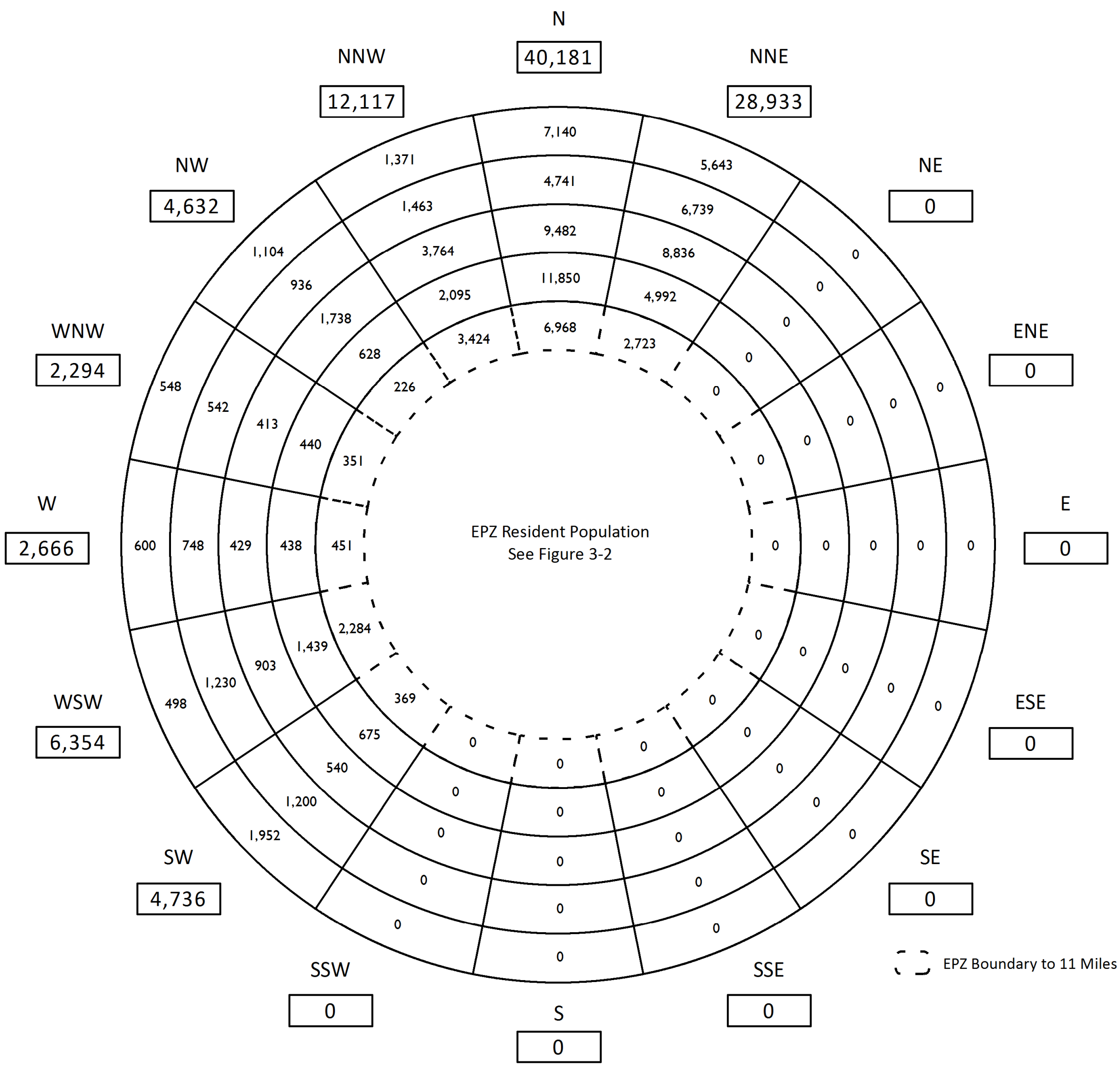
3.2 Shadow Population

A portion of the population living outside the evacuation area extending to 15 miles radially from the FNPP (in the Shadow Region) may elect to evacuate without having been instructed to do so. Based upon NUREG/CR-7002 guidance, it is assumed that 20 percent of the permanent resident population, based on U.S. Census Bureau data, in this Shadow Region will elect to evacuate.

Shadow population characteristics (household size, evacuating vehicles per household, mobilization time) are assumed to be the same as that for the EPZ permanent resident population. Table 3-3, Figure 3-4, and Figure 3-5 present estimates of the shadow population and vehicles, by sector.

Table 3-3. Shadow Population and Vehicles by Sector

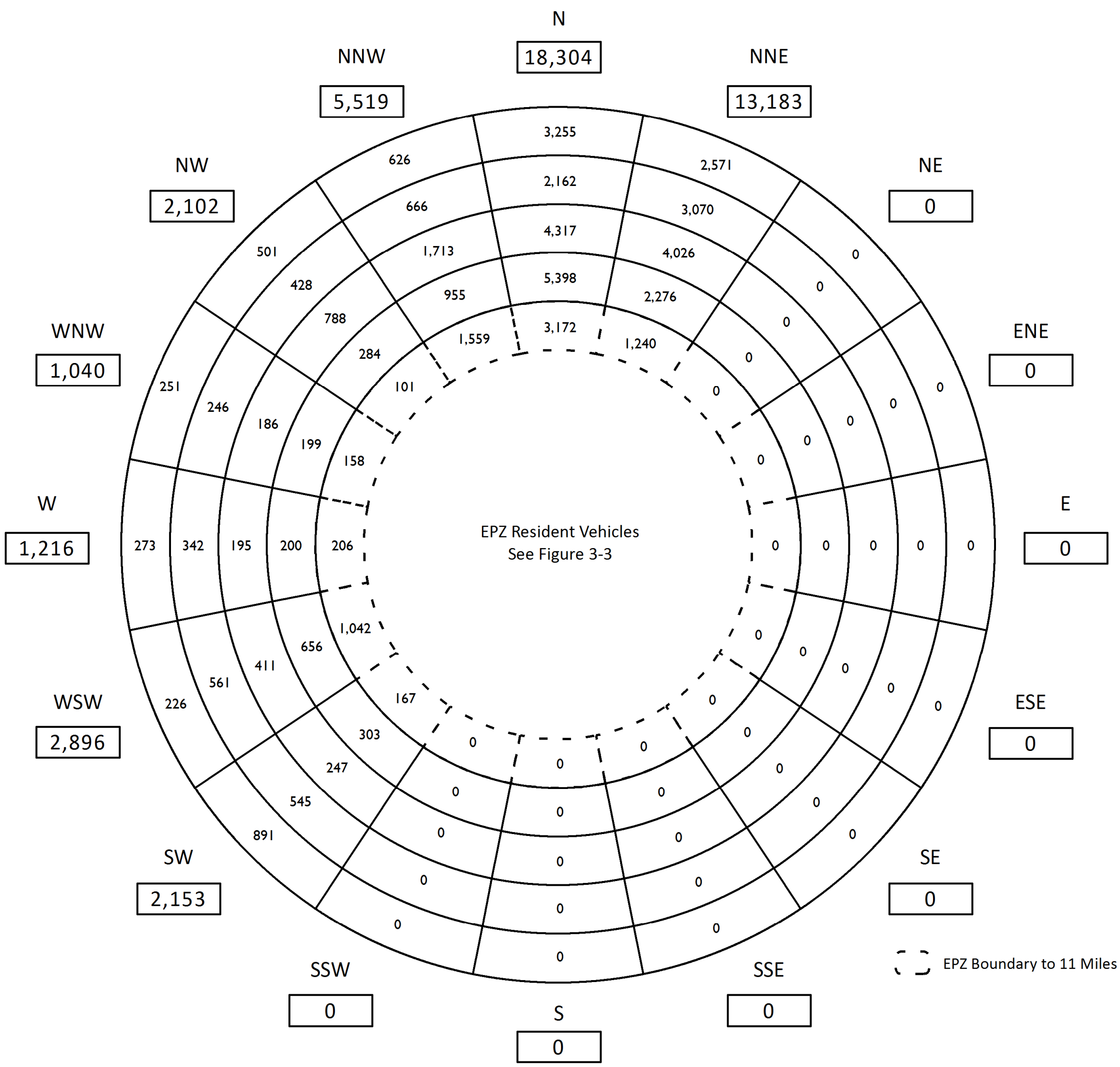
PAA	Population	Evacuating Vehicles
N	40,181	18,304
NNE	28,933	13,183
NE	0	0
ENE	0	0
E	0	0
ESE	0	0
SE	0	0
SSE	0	0
S	0	0
SSW	0	0
SW	4,736	2,153
WSW	6,354	2,896
W	2,666	1,216
WNW	2,294	1,040
NW	4,632	2,102
NNW	12,117	5,519
TOTAL	**101,913**	**46,413**



Shadow Population

Miles	Subtotal by Ring	Cumulative Total
EPZ - 11	16,796	16,796
11 - 12	22,557	39,353
12 - 13	26,105	65,458
13 - 14	17,599	83,057
14 - 15	18,856	101,913
	Total:	101,913

Figure 3-4. Shadow Population by Sector



Shadow Vehicles

Miles	Subtotal by Ring	Cumulative Total
EPZ - 11	7,645	7,645
11 - 12	10,271	17,916
12 - 13	11,883	29,799
13 - 14	8,020	37,819
14 - 15	8,594	46,413
	Total:	46,413

Figure 3-5. Shadow Vehicles by Sector

3.3 Transient Population

Transient population groups are defined as those people (who are not permanent residents, nor commuting employees) who enter the EPZ for a specific purpose (shopping, recreation). Transients may spend less than one day or stay overnight at lodging facilities. The FNPP EPZ has a number of areas and facilities that attract transients, including:

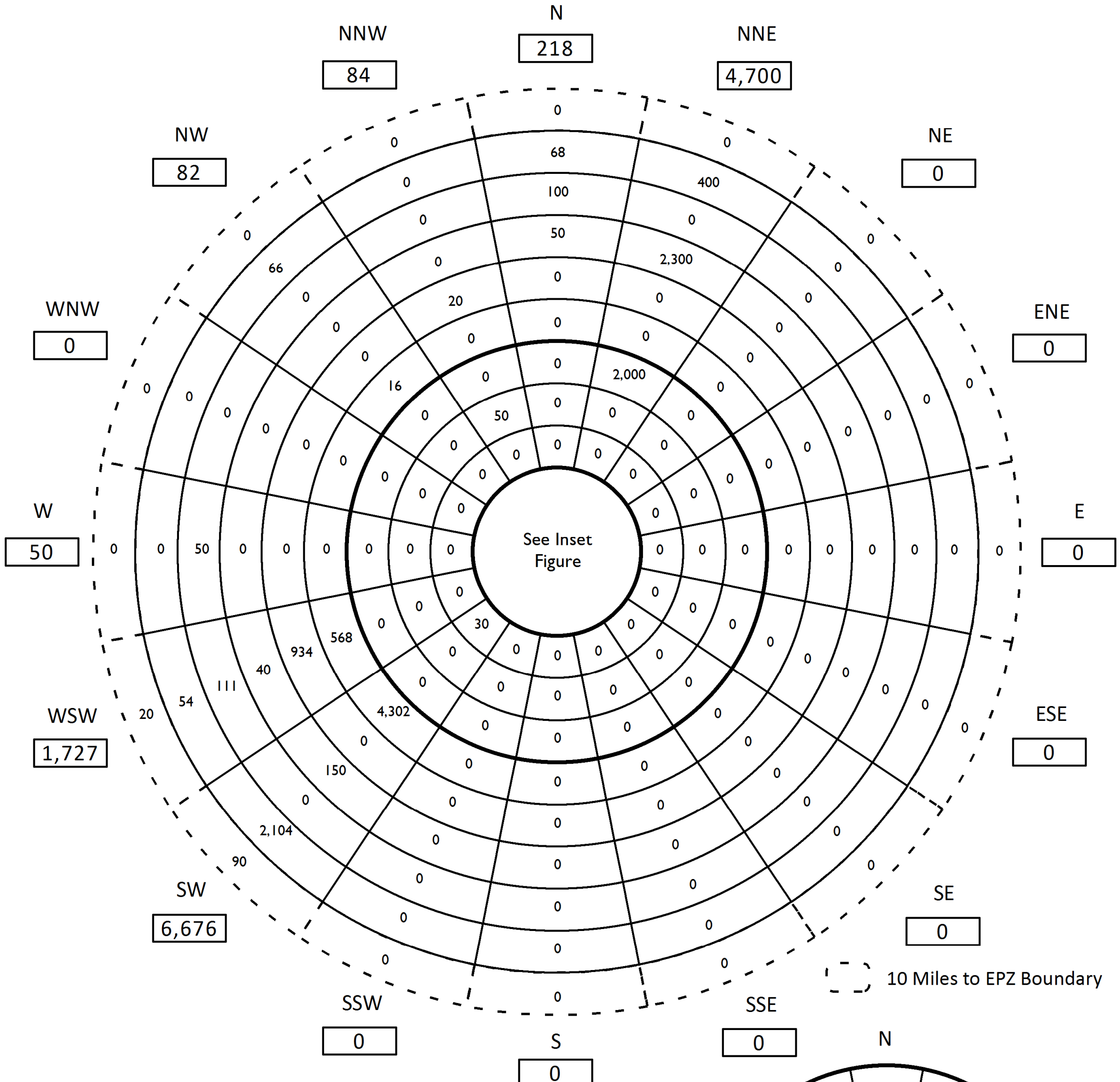
- Lodging Facilities - 1,651 transients in 825 vehicles
- Marinas – 1,784 transients in 912 vehicles
- Golf Courses – 300 transients in 50 vehicles
- Parks – 8,602 transients in 3,807 vehicles
- Retail – 1,200 transients in 600 vehicles

The data for these facilities was provided by the counties, obtained by telephone calls placed to the facilities, or estimated based on similar facilities. Golf courses did not provide any information, therefore it is conservatively estimated that at most 50 non-EPZ residents would be golfing during peak times and that the vehicle occupancy rate is one person per vehicle. Appendix E summarizes the transient data that was estimated for the EPZ. Table E-4 presents the number of transients visiting recreational areas, while Table E-5 presents the number of transients at lodging facilities within the EPZ.

Table 3-4 presents transient population and transient vehicle estimates by PAA. Figure 3-6 and Figure 3-7 present these data by sector and distance from the plant.

Table 3-4. Summary of Transients and Transient Vehicles

PAA	Transients	Transient Vehicles
1	44	22
2	2,050	920
3	0	0
4	3,020	1,410
5	8,423	4,092
TOTAL	**13,537**	**6,444**



Transients

Miles	Subtotal by Ring	Cumulative Total
0 - 1	0	0
1 - 2	14	14
2 - 3	30	44
3 - 4	50	94
4 - 5	2,000	2,094
5 - 6	4,886	6,980
6 - 7	954	7,934
7 - 8	2,540	10,474
8 - 9	261	10,735
9 - 10	2,692	13,427
10 - EPZ	110	13,537
	Total:	13,537

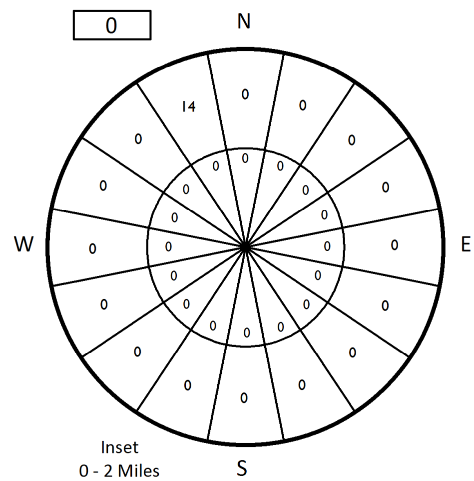
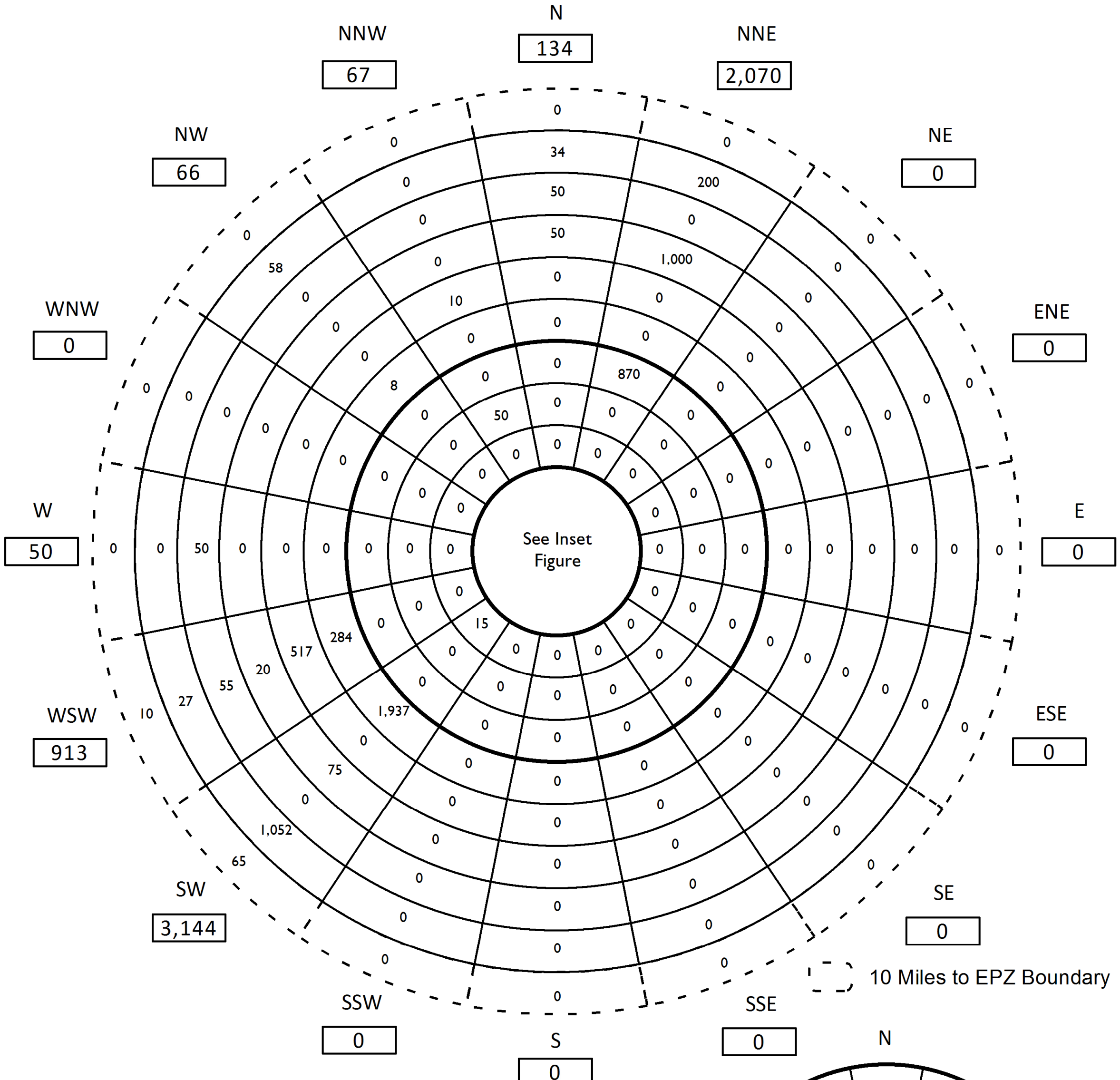


Figure 3-6. Transient Population by Sector



Transient Vehicles

Miles	Subtotal by Ring	Cumulative Total
0 - 1	0	0
1 - 2	7	7
2 - 3	15	22
3 - 4	50	72
4 - 5	870	942
5 - 6	2,229	3,171
6 - 7	527	3,698
7 - 8	1,145	4,843
8 - 9	155	4,998
9 - 10	1,371	6,369
10 - EPZ	75	6,444
	Total:	6,444

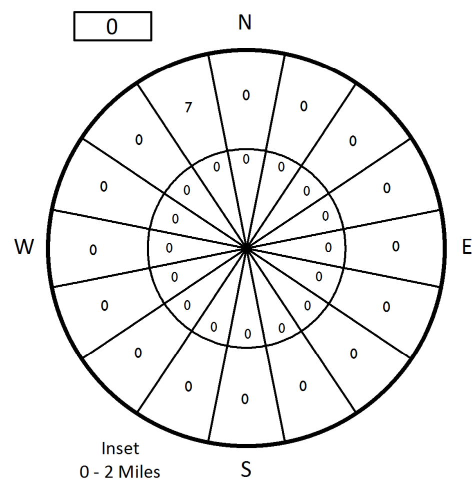


Figure 3-7. Transient Vehicles by Sector

3.4 Employees

Employees who work within the EPZ fall into two categories:

- Those who live and work in the EPZ
- Those who live outside of the EPZ and commute to jobs within the EPZ.

Those of the first category are already counted as part of the permanent resident population. To avoid double counting, we focus only on those employees commuting from outside the EPZ who will evacuate along with the permanent resident population.

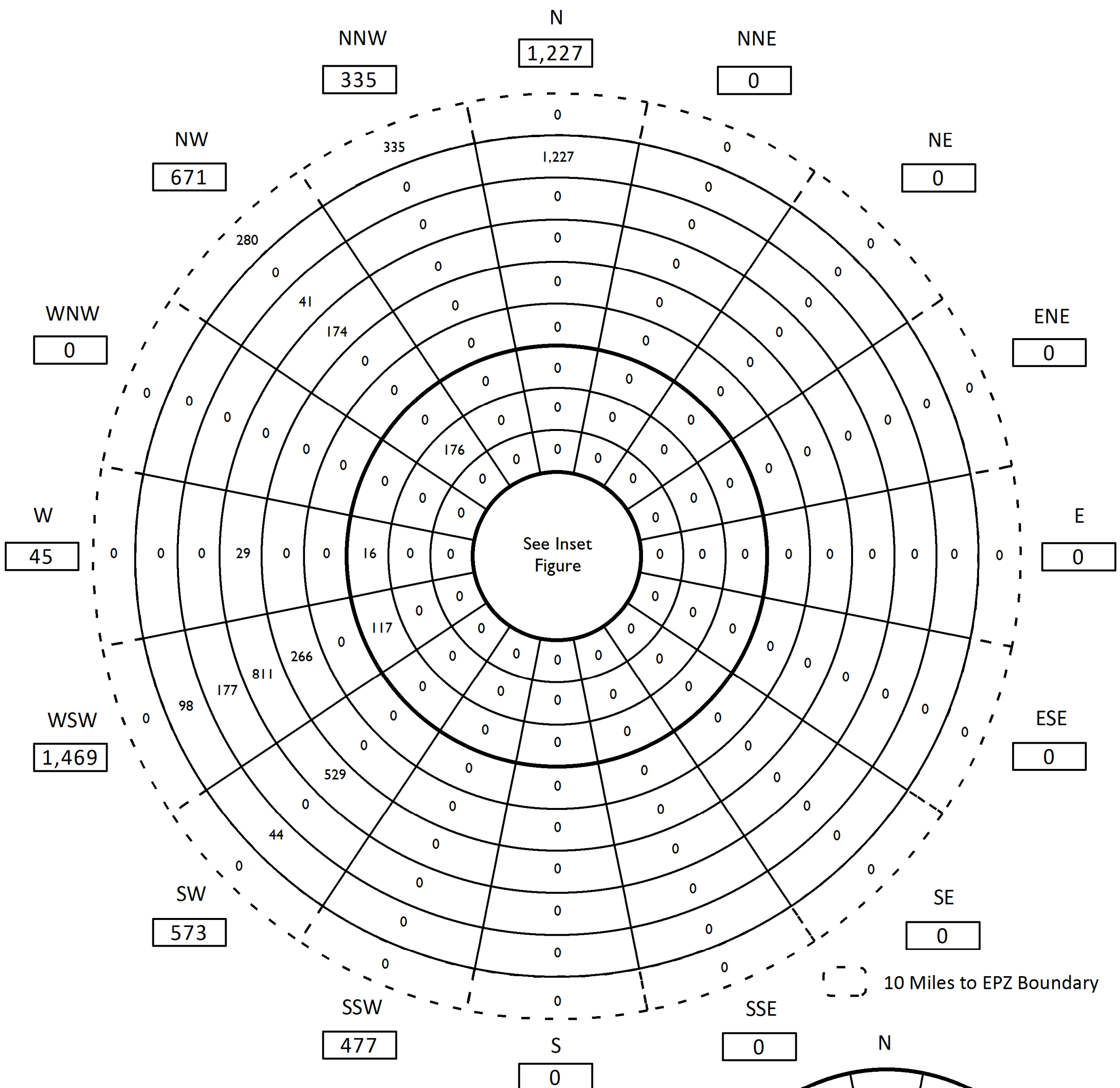
Data provided by Monroe and Wayne counties were used to estimate the number of employees commuting into the EPZ for those employers who did not provide data.

In Table E-3, the Employees (Max Shift) is multiplied by the percent Non-EPZ factor to determine the number of employees who are not residents of the EPZ. A vehicle occupancy of 1.01 employees per vehicle obtained from the telephone survey (see Figure F-6) was used to determine the number of evacuating employee vehicles for all major employers.

Table 3-5 presents non-EPZ Resident employee and vehicle estimates by PAA. Figure 3-8 and Figure 3-9 present these data by sector.

Table 3-5. Summary of Non-EPZ Resident Employees and Employee Vehicles

PAA	Employees	Employee Vehicles
1	477	472
2	176	174
3	133	132
4	2,057	2,038
5	1,954	1,935
TOTAL	**4,797**	**4,751**



Employees

Miles	Subtotal by Ring	Cumulative Total
0 - 1	477	477
1 - 2	0	477
2 - 3	0	477
3 - 4	176	653
4 - 5	133	786
5 - 6	0	786
6 - 7	266	1,052
7 - 8	1,543	2,595
8 - 9	218	2,813
9 - 10	1,369	4,182
10 - EPZ	615	4,797
	Total:	4,797

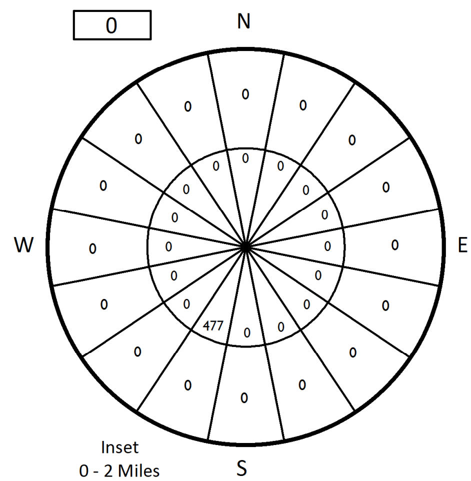
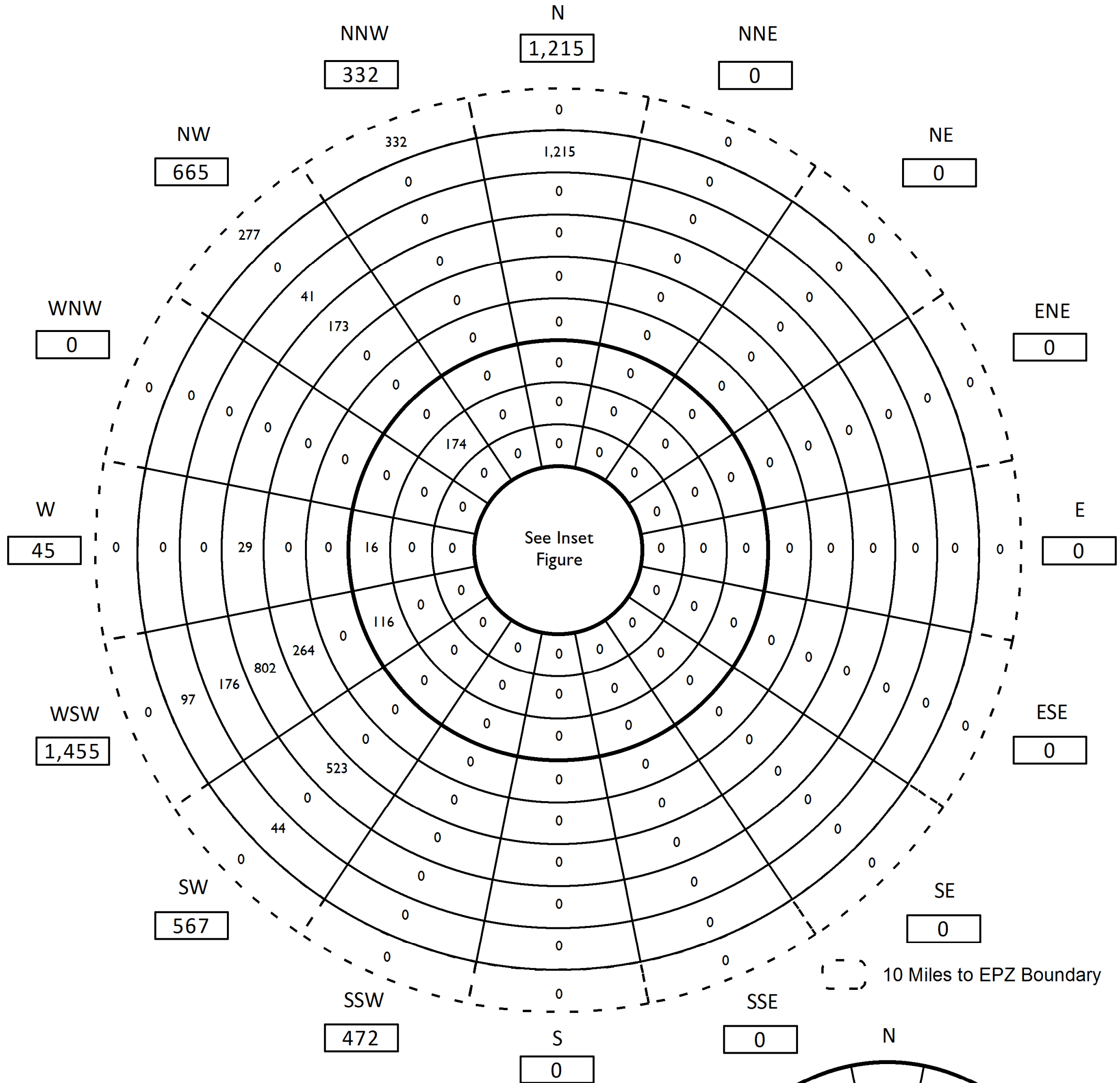


Figure 3-8. Employee Population by Sector



Employee Vehicles

Miles	Subtotal by Ring	Cumulative Total
0 - 1	472	472
1 - 2	0	472
2 - 3	0	472
3 - 4	174	646
4 - 5	132	778
5 - 6	0	778
6 - 7	264	1,042
7 - 8	1,527	2,569
8 - 9	217	2,786
9 - 10	1,356	4,142
10 - EPZ	609	4,751
	Total:	4,751

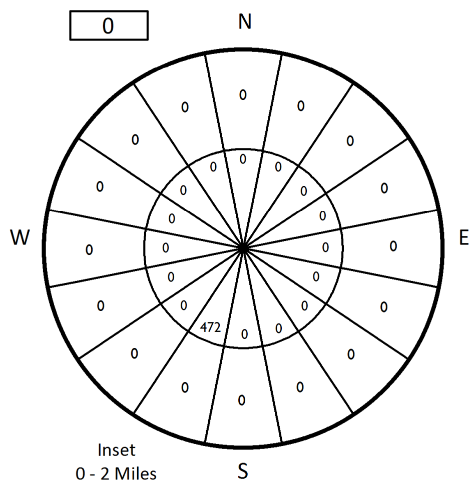


Figure 3-9. Employee Vehicles by Sector

3.5 Medical Facilities

Data were provided by the counties for each of the medical facilities within the EPZ. Table E-2 in Appendix E summarizes the data gathered. Section 8 details the evacuation of medical facilities and their patients. The number and type of evacuating vehicles that need to be provided depend on the patients' state of health. It is estimated that buses can transport up to 30 people; wheelchair vans, up to 4 people; and ambulances, up to 2 people.

3.6 Total Demand in Addition to Permanent Population

Vehicles will be traveling through the EPZ (external-external trips) at the time of an accident. After the Advisory to Evacuate is announced, these through-travelers will also evacuate. These through vehicles are assumed to travel on the major routes traversing the EPZ – I-75 and I-275. It is assumed that this traffic will continue to enter the EPZ during the first 120 minutes following the Advisory to Evacuate.

Average Annual Daily Traffic (AADT) data was obtained from Federal Highway Administration to estimate the number of vehicles per hour on the aforementioned routes. The AADT was multiplied by the K-Factor, which is the proportion of the AADT on a roadway segment or link during the design hour, resulting in the design hour volume (DHV). The design hour is usually the 30th highest hourly traffic volume of the year, measured in vehicles per hour (vph). The DHV is then multiplied by the D-Factor, which is the proportion of the DHV occurring in the peak direction of travel (also known as the directional split). The resulting values are the directional design hourly volumes (DDHV), and are presented in Table 3-6, for each of the routes considered. The DDHV is then multiplied by 2 hours (access control points – ACP – are assumed to be activated at 120 minutes after the advisory to evacuate) to estimate the total number of external vehicles loaded on the analysis network. As indicated, there are 10,452 vehicles entering the EPZ as external-external trips prior to the activation of the ACP and the diversion of this traffic. This number is reduced by 60% for evening scenarios (Scenarios 5 and 12) as discussed in Section 6.

3.7 Special Event

One special event (Scenario 13) is considered for the ETE study – the River Raisin Jazz Festival. The event occurs on a weekend in mid-August in St. Mary's Park in the City of Monroe. Data were obtained from Monroe County indicated that the maximum attendance at a given event is 10,000 and that two-thirds of the people would be coming to the event from out of the area. It is assumed that most attendees at this even would travel as a family, so the average household size of 2.72 was used to estimate vehicle occupancy. These estimations result in an additional 6,667 transients traveling in 2,451 vehicles for this scenario.

Public transportation is not provided for this event and was not considered in the special event analysis.

Table 3-6. FNPP EPZ External Traffic

Upstream Node	Downstream Node	Road Name	Direction	HPMS[1] AADT	K-Factor[2]	D-Factor[2]	Hourly Volume	External Traffic
8454	454	I-75	NB	49,344	0.107	0.33	1,742	3,484
8240	140	I-75	SB	49,344	0.107	0.33	1,742	3,484
8030	30	I-275	SB	49,344	0.107	0.33	1,742	3,484
							TOTAL:	**10,452**

[1]Highway Performance Monitoring System (HPMS), Federal Highway Administration (FHWA), Washington, D.C., 2012
[2]HCM 2010

3.8 Summary of Demand

A summary of population and vehicle demand is provided in Table 3-7 and Table 3-8, respectively. This summary includes all population groups described in this section. Additional population groups – transit-dependent, special facility and school population – are described in greater detail in Section 8. A total of 159,842 people and 76,536 vehicles are considered in this study.

Table 3-7. Summary of Population Demand

PAA	Residents	Transit-Dependent	Transients	Employees	Special Facilities	Schools	Shadow Population	External Traffic	Total
1	3,429	0	44	477	0	425	0	0	4,375
2	4,746	0	2,050	176	0	500	0	0	7,472
3	5,434	0	0	133	0	1,484	0	0	7,051
4	38,810	1,074	3,020	2,057	11	9,063	0	0	54,035
5	45,406	1,760	8,423	1,954	1,282	7,701	0	0	66,526
Shadow	0	0	0	0	0	0	20,383	0	20,383
Total	**97,825**	**2,834**	**13,537**	**4,797**	**1,293**	**19,173**	**20,383**	**0**	**159,842**

NOTE: Shadow Population has been reduced to 20%. Refer to Figure 2-1 for additional information.
NOTE: Special Facilities include both medical facilities and correctional facilities.

Table 3-8. Summary of Vehicle Demand

PAA	Residents	Transit-Dependent	Transients	Employees	Special Facilities	Schools	Shadow Population	External Traffic	Total
1	1,561	0	22	472	0	14	0	0	2,069
2	2,160	0	920	174	0	18	0	0	3,272
3	2,471	0	0	132	0	58	0	0	2,661
4	17,679	72	1,410	2,038	4	338	0	0	21,540
5	20,682	118	4,092	1,935	129	294	0	0	27,259
Shadow	0	0	0	0	0	0	9,283	10,452	19,735
Total	**44,553**	**190**	**6,444**	**4,751**	**141**	**722**	**9,283**	**10,452**	**76,536**

NOTE: Shadow Population has been reduced to 20%. Refer to Figure 2-1 for additional information.
NOTE: Buses represented as two passenger vehicles. Refer to Section 8 for additional information.
NOTE: Special Facilities include both medical facilities and correctional facilities.

4 ESTIMATION OF HIGHWAY CAPACITY

The ability of the road network to service vehicle demand is a major factor in determining how rapidly an evacuation can be completed. The capacity of a road is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane of roadway during a given time period under prevailing roadway, traffic and control conditions, as stated in the 2010 Highway Capacity Manual (HCM 2010).

In discussing capacity, different operating conditions have been assigned alphabetical designations, A through F, to reflect the range of traffic operational characteristics. These designations have been termed "Levels of Service" (LOS). For example, LOS A connotes free-flow and high-speed operating conditions; LOS F represents a forced flow condition. LOS E describes traffic operating at or near capacity.

Another concept, closely associated with capacity, is "Service Volume" (SV). Service volume is defined as "The maximum hourly rate at which vehicles, bicycles or persons reasonably can be expected to traverse a point or uniform section of a roadway during an hour under specific assumed conditions while maintaining a designated level of service." This definition is similar to that for capacity. The major distinction is that values of SV vary from one LOS to another, while capacity is the service volume at the upper bound of LOS E, only.

This distinction is illustrated in Exhibit 11-17 of the HCM 2010. As indicated there, the SV varies with Free Flow Speed (FFS), and LOS. The SV is calculated by the DYNEV II simulation model, based on the specified link attributes, FFS, capacity, control device and traffic demand.

Other factors also influence capacity. These include, but are not limited to:

- Lane width
- Shoulder width
- Pavement condition
- Horizontal and vertical alignment (curvature and grade)
- Percent truck traffic
- Control device (and timing, if it is a signal)
- Weather conditions (rain, snow, fog, wind speed, ice)

These factors are considered during the road survey and in the capacity estimation process; some factors have greater influence on capacity than others. For example, lane and shoulder width have only a limited influence on Base Free Flow Speed (BFFS[1]) according to Exhibit 15-7 of the HCM. Consequently, lane and shoulder widths at the narrowest points were observed during the road survey and these observations were recorded, but no detailed measurements of lane or shoulder width were taken. Horizontal and vertical alignment can influence both FFS and capacity. The estimated FFS were measured using the survey vehicle's speedometer and observing local traffic, under free flow conditions. Capacity is estimated from the procedures of

[1] A very rough estimate of BFFS might be taken as the posted speed limit plus 10 mph (HCM 2010 Page 15-15)

the 2010 HCM. For example, HCM Exhibit 7-1(b) shows the sensitivity of Service Volume at the upper bound of LOS D to grade (capacity is the Service Volume at the upper bound of LOS E).

As discussed in Section 2.3, it is necessary to adjust capacity figures to represent the prevailing conditions during inclement weather. Based on limited empirical data, weather conditions such as rain reduce the values of free speed and of highway capacity by approximately 10 percent. Over the last decade new studies have been made on the effects of rain on traffic capacity. These studies indicate a range of effects between 5 and 20 percent depending on wind speed and precipitation rates. As indicated in Section 2.3, we employ a reduction in free speed and in highway capacity of 10 percent and 20 percent for rain and snow, respectively.

Since congestion arising from evacuation may be significant, estimates of roadway capacity must be determined with great care. Because of its importance, a brief discussion of the major factors that influence highway capacity is presented in this section.

Rural highways generally consist of: (1) one or more uniform sections with limited access (driveways, parking areas) characterized by "uninterrupted" flow; and (2) approaches to at-grade intersections where flow can be "interrupted" by a control device or by turning or crossing traffic at the intersection. Due to these differences, separate estimates of capacity must be made for each section. Often, the approach to the intersection is widened by the addition of one or more lanes (turn pockets or turn bays), to compensate for the lower capacity of the approach due to the factors there that can interrupt the flow of traffic. These additional lanes are recorded during the field survey and later entered as input to the DYNEV II system.

4.1 Capacity Estimations on Approaches to Intersections

At-grade intersections are apt to become the first bottleneck locations under local heavy traffic volume conditions. This characteristic reflects the need to allocate access time to the respective competing traffic streams by exerting some form of control. During evacuation, control at critical intersections will often be provided by traffic control personnel assigned for that purpose, whose directions may supersede traffic control devices. The existing traffic management plans documented in the county emergency plans are extensive and were adopted without change.

The per-lane capacity of an approach to a signalized intersection can be expressed (simplistically) in the following form:

$$Q_{cap,m} = \left(\frac{3600}{h_m}\right) \times \left(\frac{G-L}{C}\right)_m = \left(\frac{3600}{h_m}\right) \times P_m$$

where:

$Q_{cap,m}$ = Capacity of a single lane of traffic on an approach, which executes

		movement, *m*, upon entering the intersection; vehicles per hour (vph)
h_m	=	Mean queue discharge headway of vehicles on this lane that are executing movement, *m*; seconds per vehicle
G	=	Mean duration of GREEN time servicing vehicles that are executing movement, *m*, for each signal cycle; seconds
L	=	Mean "lost time" for each signal phase servicing movement, *m*; seconds
C	=	Duration of each signal cycle; seconds
P_m	=	Proportion of GREEN time allocated for vehicles executing movement, *m*, from this lane. This value is specified as part of the control treatment.
m	=	The movement executed by vehicles after they enter the intersection: through, left-turn, right-turn, and diagonal.

The turn-movement-specific mean discharge headway h_m, depends in a complex way upon many factors: roadway geometrics, turn percentages, the extent of conflicting traffic streams, the control treatment, and others. A primary factor is the value of "saturation queue discharge headway", h_{sat}, which applies to through vehicles that are not impeded by other conflicting traffic streams. This value, itself, depends upon many factors including motorist behavior. Formally, we can write,

$$h_m = f_m(h_{sat}, F_1, F_2, \dots)$$

where:

h_{sat}	=	Saturation discharge headway for through vehicles; seconds per vehicle
F_1,F_2	=	The various known factors influencing h_m
$f_m(\ )$	=	Complex function relating h_m to the known (or estimated) values of h_{sat}, F_1, F_2, …

The estimation of h_m for specified values of h_{sat}, F_1, F_2, … is undertaken within the DYNEV II simulation model by a mathematical model[2]. The resulting values for h_m always satisfy the condition:

$$h_m \geq h_{sat}$$

[2] Lieberman, E., "Determining Lateral Deployment of Traffic on an Approach to an Intersection", McShane, W. & Lieberman, E., "Service Rates of Mixed Traffic on the far Left Lane of an Approach". Both papers appear in Transportation Research Record 772, 1980. Lieberman, E., Xin, W., “Macroscopic Traffic Modeling For Large-Scale Evacuation Planning”, presented at the TRB 2012 Annual Meeting, January 22-26, 2012

That is, the turn-movement-specific discharge headways are always greater than, or equal to the saturation discharge headway for through vehicles. These headways (or its inverse equivalent, "saturation flow rate"), may be determined by observation or using the procedures of the HCM 2010.

The above discussion is necessarily brief given the scope of this ETE report and the complexity of the subject of intersection capacity. In fact, Chapters 18, 19 and 20 in the HCM 2010 address this topic. The factors, F_1, F_2,…, influencing saturation flow rate are identified in equation (18-5) of the HCM 2010.

The traffic signals within the EPZ and Shadow Region are modeled using representative phasing plans and phase durations obtained as part of the field data collection. Traffic responsive signal installations allow the proportion of green time allocated (P_m) for each approach to each intersection to be determined by the expected traffic volumes on each approach during evacuation circumstances. The amount of green time (G) allocated is subject to maximum and minimum phase duration constraints; 2 seconds of yellow time are indicated for each signal phase and 1 second of all-red time is assigned between signal phases, typically. If a signal is pre-timed, the yellow and all-red times observed during the road survey are used. A lost time (L) of 2.0 seconds is used for each signal phase in the analysis.

4.2 Capacity Estimation along Sections of Highway

The capacity of highway sections -- as distinct from approaches to intersections -- is a function of roadway geometrics, traffic composition (e.g. percent heavy trucks and buses in the traffic stream) and, of course, motorist behavior. There is a fundamental relationship which relates service volume (i.e. the number of vehicles serviced within a uniform highway section in a given time period) to traffic density. The top curve in Figure 4-1 illustrates this relationship.

As indicated, there are two flow regimes: (1) Free Flow (left side of curve); and (2) Forced Flow (right side). In the Free Flow regime, the traffic demand is fully serviced; the service volume increases as demand volume and density increase, until the service volume attains its maximum value, which is the capacity of the highway section. As traffic demand and the resulting highway density increase beyond this "critical" value, the rate at which traffic can be serviced (i.e. the service volume) can actually decline below capacity ("capacity drop"). Therefore, in order to realistically represent traffic performance during congested conditions (i.e. when demand exceeds capacity), it is necessary to estimate the service volume, V_F, under congested conditions.

The value of V_F can be expressed as:

$$V_F = R \times Capacity$$

where:

R = Reduction factor which is less than unity

We have employed a value of R=0.90. The advisability of such a capacity reduction factor is based upon empirical studies that identified a fall-off in the service flow rate when congestion occurs at “bottlenecks” or “choke points” on a freeway system. Zhang and Levinson[3] describe a research program that collected data from a computer-based surveillance system (loop detectors) installed on the Interstate Highway System, at 27 active bottlenecks in the twin cities metro area in Minnesota over a 7-week period. When flow breakdown occurs, queues are formed which discharge at lower flow rates than the maximum capacity prior to observed breakdown. These queue discharge flow (QDF) rates vary from one location to the next and also vary by day of week and time of day based upon local circumstances. The cited reference presents a mean QDF of 2,016 passenger cars per hour per lane (pcphpl). This figure compares with the nominal capacity estimate of 2,250 pcphpl estimated for the ETE and indicated in Appendix K for freeway links. The ratio of these two numbers is 0.896 which translates into a capacity reduction factor of 0.90.

Since the principal objective of evacuation time estimate analyses is to develop a “realistic” estimate of evacuation times, use of the representative value for this capacity reduction factor (R=0.90) is justified. This factor is applied only when flow breaks down, as determined by the simulation model.

Rural roads, like freeways, are classified as “uninterrupted flow” facilities. (This is in contrast with urban street systems which have closely spaced signalized intersections and are classified as “interrupted flow” facilities.) As such, traffic flow along rural roads is subject to the same effects as freeways in the event traffic demand exceeds the nominal capacity, resulting in queuing and lower QDF rates. As a practical matter, rural roads rarely break down at locations away from intersections. Any breakdowns on rural roads are generally experienced at intersections where other model logic applies, or at lane drops which reduce capacity there. Therefore, the application of a factor of 0.90 is appropriate on rural roads, but rarely, if ever, activated.

The estimated value of capacity is based primarily upon the type of facility and on roadway geometrics. Sections of roadway with adverse geometrics are characterized by lower free-flow speeds and lane capacity. Exhibit 15-30 in the Highway Capacity Manual was referenced to estimate saturation flow rates. The impact of narrow lanes and shoulders on free-flow speed and on capacity is not material, particularly when flow is predominantly in one direction as is the case during an evacuation.

The procedure used here was to estimate "section" capacity, V_E, based on observations made traveling over each section of the evacuation network, based on the posted speed limits and travel behavior of other motorists and by reference to the 2010 HCM. The DYNEV II simulation model determines for each highway section, represented as a network link, whether its capacity would be limited by the "section-specific" service volume, V_E, or by the intersection-specific capacity. For each link, the model selects the lower value of capacity.

[3] Lei Zhang and David Levinson, “Some Properties of Flows at Freeway Bottlenecks,” Transportation Research Record 1883, 2004.

4.3 Application to the FNPP Study Area

As part of the development of the link-node analysis network for the study area, an estimate of roadway capacity is required. The source material for the capacity estimates presented herein is contained in:

2010 Highway Capacity Manual (HCM)
Transportation Research Board
National Research Council
Washington, D.C.

The highway system in the study area consists primarily of three categories of roads and, of course, intersections:

- Two-Lane roads: Local, State
- Multi-Lane Highways (at-grade)
- Freeways

Each of these classifications will be discussed.

4.3.1 Two-Lane Roads

Ref: HCM Chapter 15

Two lane roads comprise the majority of highways within the EPZ. The per-lane capacity of a two-lane highway is estimated at 1700 passenger cars per hour (pc/h). This estimate is essentially independent of the directional distribution of traffic volume except that, for extended distances, the two-way capacity will not exceed 3200 pc/h. The HCM procedures then estimate Level of Service (LOS) and Average Travel Speed. The DYNEV II simulation model accepts the specified value of capacity as input and computes average speed based on the time-varying demand: capacity relations.

Based on the field survey and on expected traffic operations associated with evacuation scenarios:

- Most sections of two-lane roads within the EPZ are classified as "Class I", with "level terrain"; some are "rolling terrain".
- "Class II" highways are mostly those within urban and suburban centers.

4.3.2 Multi-Lane Highway

Ref: HCM Chapter 14

Exhibit 14-2 of the HCM 2010 presents a set of curves that indicate a per-lane capacity ranging from approximately 1900 to 2200 pc/h, for free-speeds of 45 to 60 mph, respectively. Based on observation, the multi-lane highways outside of urban areas within the EPZ service traffic with free-speeds in this range. The actual time-varying speeds computed by the simulation model reflect the demand: capacity relationship and the impact of control at intersections. A conservative estimate of per-lane capacity of 1900 pc/h is adopted for this study for multi-lane highways outside of urban areas, as shown in Appendix K.

4.3.3 Freeways

Ref: HCM Chapters 10, 11, 12, 13

Chapter 10 of the HCM 2010 describes a procedure for integrating the results obtained in Chapters 11, 12 and 13, which compute capacity and LOS for freeway components. Chapter 10 also presents a discussion of simulation models. The DYNEV II simulation model automatically performs this integration process.

Chapter 11 of the HCM 2010 presents procedures for estimating capacity and LOS for “Basic Freeway Segments". Exhibit 11-17 of the HCM 2010 presents capacity vs. free speed estimates, which are provided below.

Free Speed (mph):	55	60	65	70+
Per-Lane Capacity (pc/h):	2250	2300	2350	2400

The inputs to the simulation model are highway geometrics, free-speeds and capacity based on field observations. The simulation logic calculates actual time-varying speeds based on demand: capacity relationships. A conservative estimate of per-lane capacity of 2250 pc/h is adopted for this study for freeways, as shown in Appendix K.

Chapter 12 of the HCM 2010 presents procedures for estimating capacity, speed, density and LOS for freeway weaving sections. The simulation model contains logic that relates speed to demand volume: capacity ratio. The value of capacity obtained from the computational procedures detailed in Chapter 12 depends on the "Type" and geometrics of the weaving segment and on the "Volume Ratio" (ratio of weaving volume to total volume).

Chapter 13 of the HCM 2010 presents procedures for estimating capacities of ramps and of "merge" areas. There are three significant factors to the determination of capacity of a ramp-freeway junction: The capacity of the freeway immediately downstream of an on-ramp or immediately upstream of an off-ramp; the capacity of the ramp roadway; and the maximum flow rate entering the ramp influence area. In most cases, the freeway capacity is the controlling factor. Values of this merge area capacity are presented in Exhibit 13-8 of the HCM 2010, and depend on the number of freeway lanes and on the freeway free speed. Ramp capacity is presented in Exhibit 13-10 and is a function of the ramp free flow speed. The DYNEV II simulation model logic simulates the merging operations of the ramp and freeway traffic in accord with the procedures in Chapter 13 of the HCM 2010. If congestion results from an excess of demand relative to capacity, then the model allocates service appropriately to the two entering traffic streams and produces LOS F conditions (The HCM does not address LOS F explicitly).

4.3.4 Intersections

Ref: HCM Chapters 18, 19, 20, 21

Procedures for estimating capacity and LOS for approaches to intersections are presented in Chapter 18 (signalized intersections), Chapters 19, 20 (un-signalized intersections) and Chapter 21 (roundabouts). The complexity of these computations is indicated by the aggregate length of these chapters. The DYNEV II simulation logic is likewise complex.

The simulation model explicitly models intersections: Stop/yield controlled intersections (both 2-way and all-way) and traffic signal controlled intersections. Where intersections are controlled by fixed time controllers, traffic signal timings are set to reflect average (non-evacuation) traffic conditions. Actuated traffic signal settings respond to the time-varying demands of evacuation traffic to adjust the relative capacities of the competing intersection approaches.

The model is also capable of modeling the presence of manned traffic control. At specific locations where it is advisable or where existing plans call for overriding existing traffic control to implement manned control, the model will use actuated signal timings that reflect the presence of traffic guides. At locations where a special traffic control strategy (continuous left-turns, contra-flow lanes) is used, the strategy is modeled explicitly. Where applicable, the location and type of traffic control for nodes in the evacuation network are noted in Appendix K. The characteristics of the ten highest volume signalized intersections are detailed in Appendix J.

4.4 Simulation and Capacity Estimation

Chapter 6 of the HCM is entitled, "HCM and Alternative Analysis Tools." The chapter discusses the use of alternative tools such as simulation modeling to evaluate the operational performance of highway networks. Among the reasons cited in Chapter 6 to consider using simulation as an alternative analysis tool is:

> *"The system under study involves a group of different facilities or travel modes with mutual interactions invoking several procedural chapters of the HCM. Alternative tools are able to analyze these facilities as a single system."*

This statement succinctly describes the analyses required to determine traffic operations across an area encompassing an EPZ operating under evacuation conditions. The model utilized for this study, DYNEV II, is further described in Appendix C. It is essential to recognize that simulation models do not replicate the methodology and procedures of the HCM – they *replace* these procedures by describing the complex interactions of traffic flow and computing Measures of Effectiveness (MOE) detailing the operational performance of traffic over time and by location. The DYNEV II simulation model includes some HCM 2010 procedures only for the purpose of estimating capacity.

All simulation models must be calibrated properly with field observations that quantify the performance parameters applicable to the analysis network. Two of the most important of these are: (1) Free flow speed (FFS); and (2) saturation headway, h_{sat}. The first of these is estimated by direct observation during the road survey; the second is estimated using the concepts of the HCM 2010, as described earlier. These parameters are listed in Appendix K, for each network link.

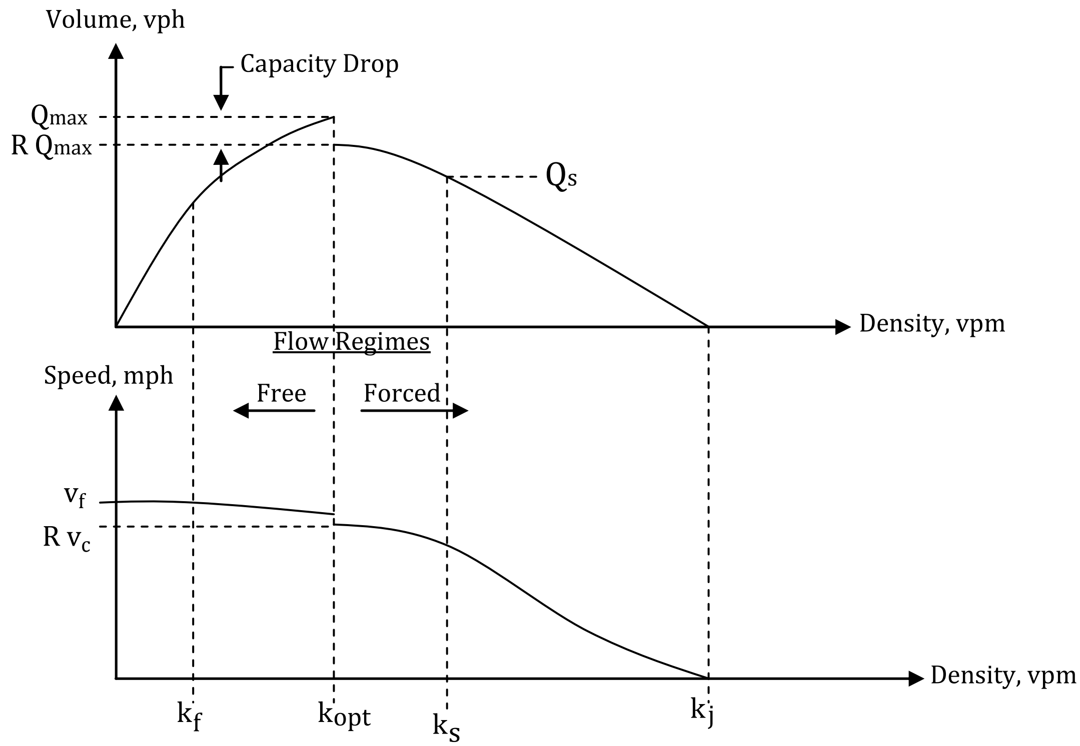


Figure 4-1. Fundamental Diagrams

5 ESTIMATION OF TRIP GENERATION TIME

Federal Government guidelines (see NUREG CR-7002) specify that the planner estimate the distributions of elapsed times associated with mobilization activities undertaken by the public to prepare for the evacuation trip. The elapsed time associated with each activity is represented as a statistical distribution reflecting differences between members of the public. The quantification of these activity-based distributions relies largely on the results of the telephone survey. We define the sum of these distributions of elapsed times as the Trip Generation Time Distribution.

5.1 Background

In general, an accident at a nuclear power plant is characterized by the following Emergency Classification Levels (see Appendix 1 of NUREG 0654 for details):

1. Unusual Event
2. Alert
3. Site Area Emergency
4. General Emergency

At each level, the Federal guidelines specify a set of Actions to be undertaken by the Licensee, and by State and Local offsite authorities. As a Planning Basis, we will adopt a conservative posture, in accordance with Section 1.2 of NUREG/CR-7002, that a rapidly escalating accident will be considered in calculating the Trip Generation Time. We will assume:

1. The Advisory to Evacuate will be announced coincident with the siren notification.
2. Mobilization of the general population will commence within 15 minutes after the siren notification.
3. ETE are measured relative to the Advisory to Evacuate.

We emphasize that the adoption of this planning basis is not a representation that these events will occur within the indicated time frame. Rather, these assumptions are necessary in order to:

1. Establish a temporal framework for estimating the Trip Generation distribution in the format recommended in Section 2.13 of NUREG/CR-6863.
2. Identify temporal points of reference that uniquely define "Clear Time" and ETE.

It is likely that a longer time will elapse between the various classes of an emergency.

For example, suppose one hour elapses from the siren alert to the Advisory to Evacuate. In this case, it is reasonable to expect some degree of spontaneous evacuation by the public during this one-hour period. As a result, the population within the EPZ will be lower when the Advisory to Evacuate is announced, than at the time of the siren alert. In addition, many will engage in preparation activities to evacuate, in anticipation that an Advisory will be broadcast. Thus, the time needed to complete the mobilization activities and the number of people remaining to evacuate the EPZ after the Advisory to Evacuate, will both be somewhat less than the estimates presented in this report. Consequently, the ETE presented in this report are higher than the actual evacuation time, if this hypothetical situation were to take place.

The notification process consists of two events:

1. Transmitting information using the alert notification systems available within the EPZ (e.g. sirens, tone alerts, EAS broadcasts, loud speakers).
2. Receiving and correctly interpreting the information that is transmitted.

The population within the EPZ is dispersed over an area of approximately 157 square miles and is engaged in a wide variety of activities. It must be anticipated that some time will elapse between the transmission and receipt of the information advising the public of an accident.

The amount of elapsed time will vary from one individual to the next depending on where that person is, what that person is doing, and related factors. Furthermore, some persons who will be directly involved with the evacuation process may be outside the EPZ at the time the emergency is declared. These people may be commuters, shoppers and other travelers who reside within the EPZ and who will return to join the other household members upon receiving notification of an emergency.

As indicated in Section 2.13 of NUREG/CR-6863, the estimated elapsed times for the receipt of notification can be expressed as a distribution reflecting the different notification times for different people within, and outside, the EPZ. By using time distributions, it is also possible to distinguish between different population groups and different day-of-week and time-of-day scenarios, so that accurate ETE may be computed.

For example, people at home or at work within the EPZ will be notified by siren, and/or tone alert and/or radio (if available). Those well outside the EPZ will be notified by telephone, radio, TV and word-of-mouth, with potentially longer time lags. Furthermore, the spatial distribution of the EPZ population will differ with time of day - families will be united in the evenings, but dispersed during the day. In this respect, weekends will differ from weekdays.

As indicated in Section 4.1 of NUREG/CR-7002, the information required to compute trip generation times is typically obtained from a telephone survey of EPZ residents. Such a survey was conducted in support of the 2008 ETE study. Appendix F presents the survey sampling plan, survey instrument, and raw survey results. It is important to note that the shape and duration of the evacuation trip mobilization distribution is important at sites where traffic congestion is not expected to cause the evacuation time estimate to extend in time well beyond the trip generation period. The remaining discussion will focus on the application of the trip generation data obtained from the telephone survey to the development of the ETE documented in this report.

5.2 Fundamental Considerations

The environment leading up to the time that people begin their evacuation trips consists of a sequence of events and activities. Each event (other than the first) occurs at an instant in time and is the outcome of an activity.

Activities are undertaken over a period of time. Activities may be in "series" (i.e. to undertake an activity implies the completion of all preceding events) or may be in parallel (two or more activities may take place over the same period of time). Activities conducted in series are functionally dependent on the completion of prior activities; activities conducted in parallel are functionally independent of one another. The relevant events associated with the public's preparation for evacuation are:

Event Number	Event Description
1	Notification
2	Awareness of Situation
3	Depart Work
4	Arrive Home
5	Depart on Evacuation Trip

Associated with each sequence of events are one or more activities, as outlined below:

Table 5-1. Event Sequence for Evacuation Activities

Event Sequence	Activity	Distribution
1 → 2	Receive Notification	1
2 → 3	Prepare to Leave Work	2
2,3 → 4	Travel Home	3
2,4 → 5	Prepare to Leave to Evacuate	4
N/A	Snow Clearance	5

These relationships are shown graphically in Figure 5-1.

- An Event is a 'state' that exists at a point in time (e.g., depart work, arrive home)
- An Activity is a 'process' that takes place over some elapsed time (e.g., prepare to leave work, travel home)

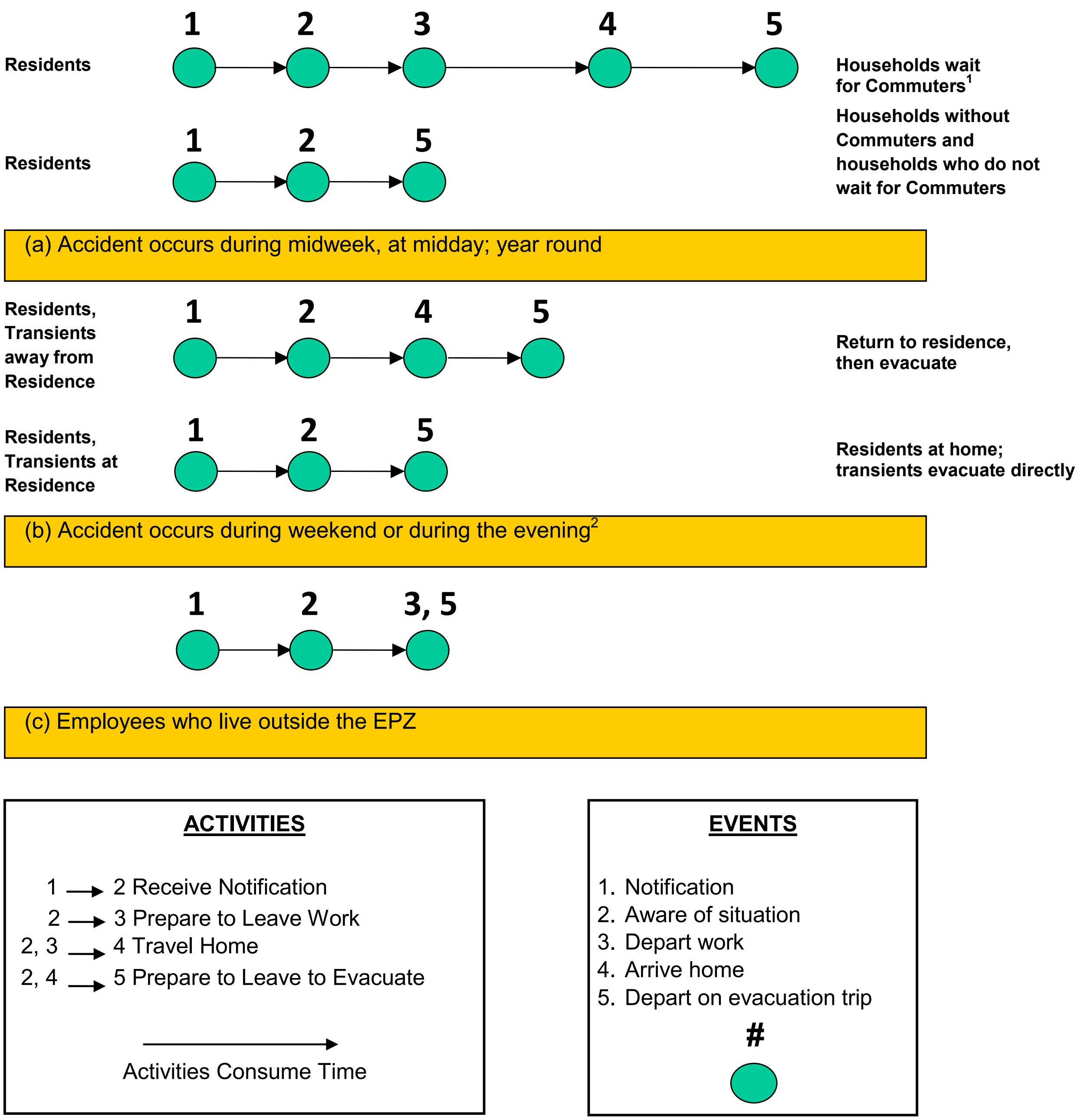
As such, a completed Activity changes the 'state' of an individual (e.g. the activity, 'travel home' changes the state from 'depart work' to 'arrive home'). Therefore, an Activity can be described as an 'Event Sequence'; the elapsed times to perform an event sequence vary from one person to the next and are described as statistical distributions on the following pages.

An employee who lives outside the EPZ will follow sequence (c) of Figure 5-1. A household within the EPZ that has one or more commuters at work, and will await their return before beginning the evacuation trip will follow the first sequence of Figure 5-1(a). A household within the EPZ that has no commuters at work, or that will not await the return of any commuters, will follow the second sequence of Figure 5-1(a), regardless of day of week or time of day.

Households with no commuters on weekends or in the evening/night-time, will follow the applicable sequence in Figure 5-1(b). Transients will always follow one of the sequences of Figure 5-1(b). Some transients away from their residence could elect to evacuate immediately without returning to the residence, as indicated in the second sequence.

It is seen from Figure 5-1, that the Trip Generation time (i.e. the total elapsed time from Event 1 to Event 5) depends on the scenario and will vary from one household to the next. Furthermore, Event 5 depends, in a complicated way, on the time distributions of all activities preceding that event. That is, to estimate the time distribution of Event 5, we must obtain estimates of the time distributions of all preceding events. For this study, we adopt the conservative posture that all activities will occur in sequence.

In some cases, assuming certain events occur strictly sequential (for instance, commuter returning home before beginning preparation to leave, or removing snow only after the preparation to leave) can result in rather *conservative* (that is, longer) estimates of mobilization times. It is reasonable to expect that at least some parts of these events will overlap for many households, but that assumption is not made in this study.



[1] Applies for evening and weekends also if commuters are at work.
[2] Applies throughout the year for transients.

Figure 5-1. Events and Activities Preceding the Evacuation Trip

5.3 Estimated Time Distributions of Activities Preceding Event 5

The time distribution of an event is obtained by "summing" the time distributions of all prior contributing activities. (This "summing" process is quite different than an algebraic sum since it is performed on distributions – not scalar numbers).

Time Distribution No. 1, Notification Process: Activity 1 → 2

In accordance with the 2012 Federal Emergency Management Agency (FEMA) Radiological Emergency Preparedness Program Manual, 100% of the population is notified within 45 minutes. It is assumed (based on the presence of sirens within the EPZ) that 87 percent of those within the EPZ will be aware of the accident within 30 minutes with the remainder notified within the following 15 minutes. The notification distribution is given below:

Table 5-2. Time Distribution for Notifying the Public

Elapsed Time (Minutes)	Percent of Population Notified
0	0%
5	7%
10	13%
15	27%
20	47%
25	66%
30	87%
35	92%
40	97%
45	100%

Distribution No. 2, Prepare to Leave Work: Activity 2 → 3

It is reasonable to expect that the vast majority of business enterprises within the EPZ will elect to shut down following notification and most employees would leave work quickly. Commuters, who work outside the EPZ could, in all probability, also leave quickly since facilities outside the EPZ would remain open and other personnel would remain. Personnel or farmers responsible for equipment/livestock would require additional time to secure their facility. The distribution of Activity 2 → 3 shown in Table 5-3 reflects data obtained by the telephone survey. This distribution is plotted in Figure 5-2.

Table 5-3. Time Distribution for Employees to Prepare to Leave Work

Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work	Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work
0	0%	40	86%
5	12%	45	94%
10	29%	50	96%
15	45%	55	96%
20	58%	60	99%
25	66%	75	99%
30	77%	90	100%
35	82%		

NOTE: The survey data was normalized to distribute the "Don't know" response. That is, the sample was reduced in size to include only those households who responded to this question. The underlying assumption is that the distribution of this activity for the "Don't know" responders, if the event takes place, would be the same as those responders who provided estimates.

Distribution No. 3, Travel Home: Activity 3 $\rightarrow$ 4

These data are provided directly by those households which responded to the telephone survey. This distribution is plotted in Figure 5-2 and listed in Table 5-4.

Table 5-4. Time Distribution for Commuters to Travel Home

Elapsed Time (Minutes)	Cumulative Percent Returning Home	Elapsed Time (Minutes)	Cumulative Percent Returning Home
0	0	40	86%
5	11%	45	94%
10	29%	50	95%
15	41%	55	95%
20	54%	60	99%
25	62%	75	99%
30	74%	90	100%
35	80%		

NOTE: The survey data was normalized to distribute the "Don't know" response

Distribution No. 4, Prepare to Leave Home: Activity 2, 4 → 5

These data are provided directly by those households which responded to the telephone survey. This distribution is plotted in Figure 5-2 and listed in Table 5-5.

Table 5-5. Time Distribution for Population to Prepare to Evacuate

Elapsed Time (Minutes)	Cumulative Percent Ready to Evacuate
0	0%
15	33%
30	71%
45	77%
60	89%
75	96%
90	97%
105	97%
120	98%
135	100%

NOTE: The survey data was normalized to distribute the "Don't know" response

Distribution No. 5, Snow Clearance Time Distribution

Inclement weather scenarios involving snowfall must address the time lags associated with snow clearance. It is assumed that snow equipment is mobilized and deployed during the snowfall to maintain passable roads. The general consensus is that the snow-plowing efforts are generally successful for all but the most extreme blizzards when the rate of snow accumulation exceeds that of snow clearance over a period of many hours.

Consequently, it is reasonable to assume that the highway system will remain passable – albeit at a lower capacity – under the vast majority of snow conditions. Nevertheless, for the vehicles to gain access to the highway system, it may be necessary for driveways and employee parking lots to be cleared to the extent needed to permit vehicles to gain access to the roadways. These clearance activities take time; this time must be incorporated into the trip generation time distributions. These data are provided by those households which responded to the telephone survey. This distribution is plotted in Figure 5-2 and listed in Table 5-6.

Table 5-6. Time Distribution for Population to Clear 6"-8" of Snow

Elapsed Time (Minutes)	Cumulative Percent Completing Snow Removal
0	0%
15	49%
30	82%
45	86%
60	93%
75	97%
90	98%
105	98%
120	99%
135	100%

NOTE: The survey data was normalized to distribute the "Don't know" response

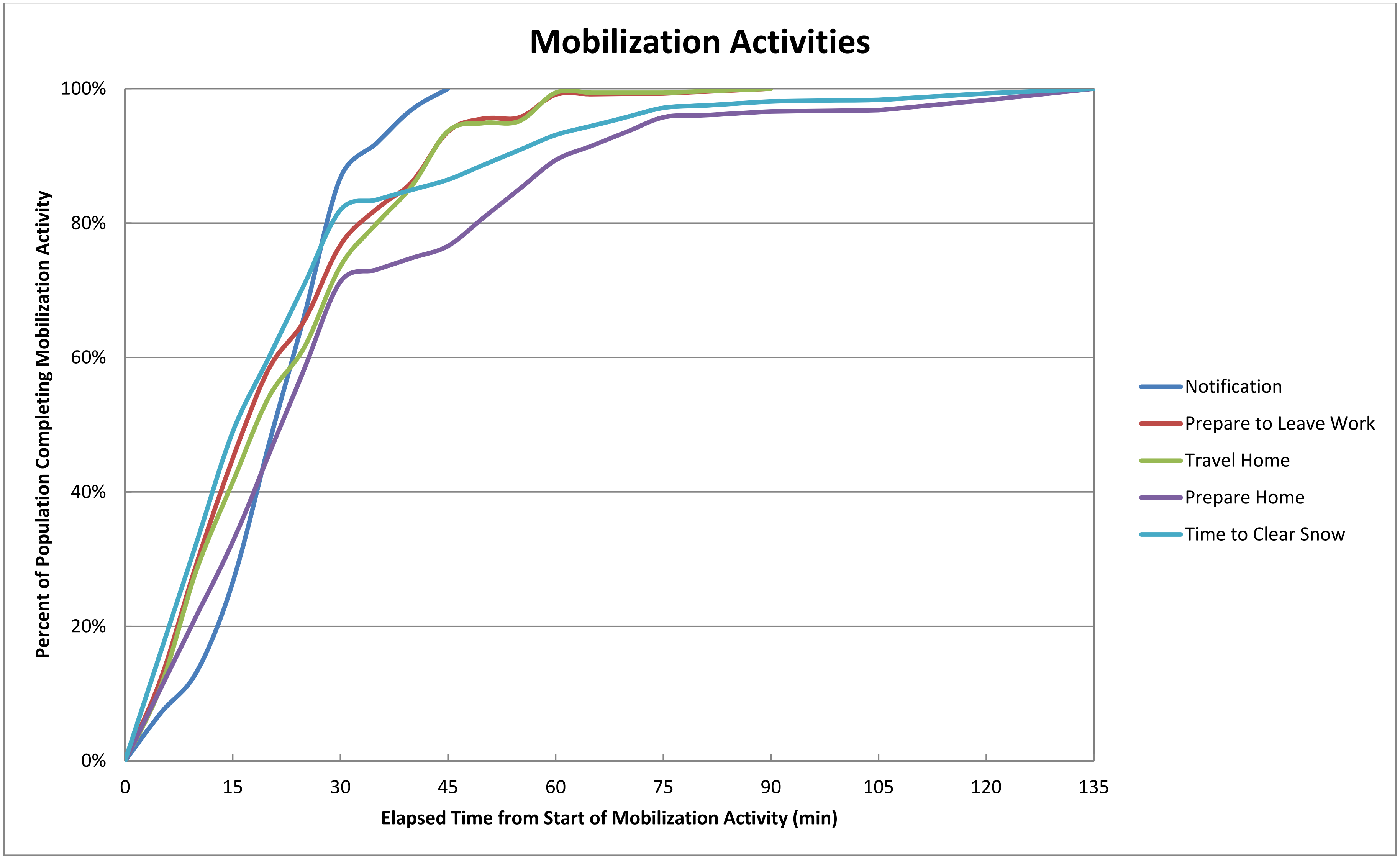


Figure 5-2. Evacuation Mobilization Activities

5.4 Calculation of Trip Generation Time Distribution

The time distributions for each of the mobilization activities presented herein must be combined to form the appropriate Trip Generation Distributions. As discussed above, this study assumes that the stated events take place in sequence such that all preceding events must be completed before the current event can occur. For example, if a household awaits the return of a commuter, the work-to-home trip (Activity 3 $\rightarrow$ 4) must precede Activity 4 $\rightarrow$ 5.

To calculate the time distribution of an event that is dependent on two sequential activities, it is necessary to "sum" the distributions associated with these prior activities. The distribution summing algorithm is applied repeatedly as shown to form the required distribution. As an outcome of this procedure, new time distributions are formed; we assign "letter" designations to these intermediate distributions to describe the procedure. Table 5-7 presents the summing procedure to arrive at each designated distribution.

Table 5-7. Mapping Distributions to Events

Apply "Summing" Algorithm To:	Distribution Obtained	Event Defined
Distributions 1 and 2	Distribution A	Event 3
Distributions A and 3	Distribution B	Event 4
Distributions B and 4	Distribution C	Event 5
Distributions 1 and 4	Distribution D	Event 5
Distributions C and 5	Distribution E	Event 5
Distributions D and 5	Distribution F	Event 5

Table 5-8 presents a description of each of the final trip generation distributions achieved after the summing process is completed.

Table 5-8. Description of the Distributions

Distribution	Description
A	Time distribution of commuters departing place of work (Event 3). Also applies to employees who work within the EPZ who live outside, and to Transients within the EPZ.
B	Time distribution of commuters arriving home (Event 4).
C	Time distribution of residents with commuters who return home, leaving home to begin the evacuation trip (Event 5).
D	Time distribution of residents without commuters returning home, leaving home to begin the evacuation trip (Event 5).
E	Time distribution of residents with commuters who return home, leaving home to begin the evacuation trip, after snow clearance activities (Event 5).
F	Time distribution of residents with no commuters returning home, leaving to begin the evacuation trip, after snow clearance activities (Event 5).

5.4.1 Statistical Outliers

As already mentioned, some portion of the survey respondents answer “don’t know” to some questions or choose to not respond to a question. The mobilization activity distributions are based upon actual responses. But, it is the nature of surveys that a few numeric responses are inconsistent with the overall pattern of results. An example would be a case in which for 500 responses, almost all of them estimate less than two hours for a given answer, but 3 say “four hours” and 4 say “six or more hours”.

These “outliers” must be considered: are they valid responses, or so atypical that they should be dropped from the sample?

In assessing outliers, there are three alternates to consider:

1) Some responses with very long times may be valid, but reflect the reality that the respondent really needs to be classified in a different population subgroup, based upon special needs;

2) Other responses may be unrealistic (6 hours to return home from commuting distance, or 2 days to prepare the home for departure);

3) Some high values are representative and plausible, and one must not cut them as part of the consideration of outliers.

The issue of course is how to make the decision that a given response or set of responses are to be considered “outliers” for the component mobilization activities, using a method that objectively quantifies the process.

There is considerable statistical literature on the identification and treatment of outliers singly or in groups, much of which assumes the data is normally distributed and some of which uses nonparametric methods to avoid that assumption. The literature cites that limited work has been done directly on outliers in sample survey responses.

In establishing the overall mobilization time/trip generation distributions, the following principles are used:

1) It is recognized that the overall trip generation distributions are conservative estimates, because they assume a household will do the mobilization activities sequentially, with no overlap of activities;

2) The individual mobilization activities (prepare to leave work, travel home, prepare home, clear snow) are reviewed for outliers, and then the overall trip generation distributions are created (see Figure 5-1, Table 5-7, Table 5-8);

3) Outliers can be eliminated either because the response reflects a special population (e.g. special needs, transit dependent) or lack of realism, because the purpose is to estimate trip generation patterns for personal vehicles;

4) To eliminate outliers,
    a) the mean and standard deviation of the specific activity are estimated from the responses,
    b) the median of the same data is estimated, with its position relative to the mean noted,
    c) the histogram of the data is inspected, and
    d) all values greater than 3.5 standard deviations are flagged for attention, taking special note of whether there are gaps (categories with zero entries) in the histogram display.

   In general, only flagged values more than 4 standard deviations from the mean are allowed to be considered outliers, with gaps in the histogram expected.

   When flagged values are classified as outliers and dropped, steps “a” to “d” are repeated.

5) As a practical matter, even with outliers eliminated by the above, the resultant histogram, viewed as a cumulative distribution, is not a normal distribution. A typical situation that results is shown below in Figure 5-3.

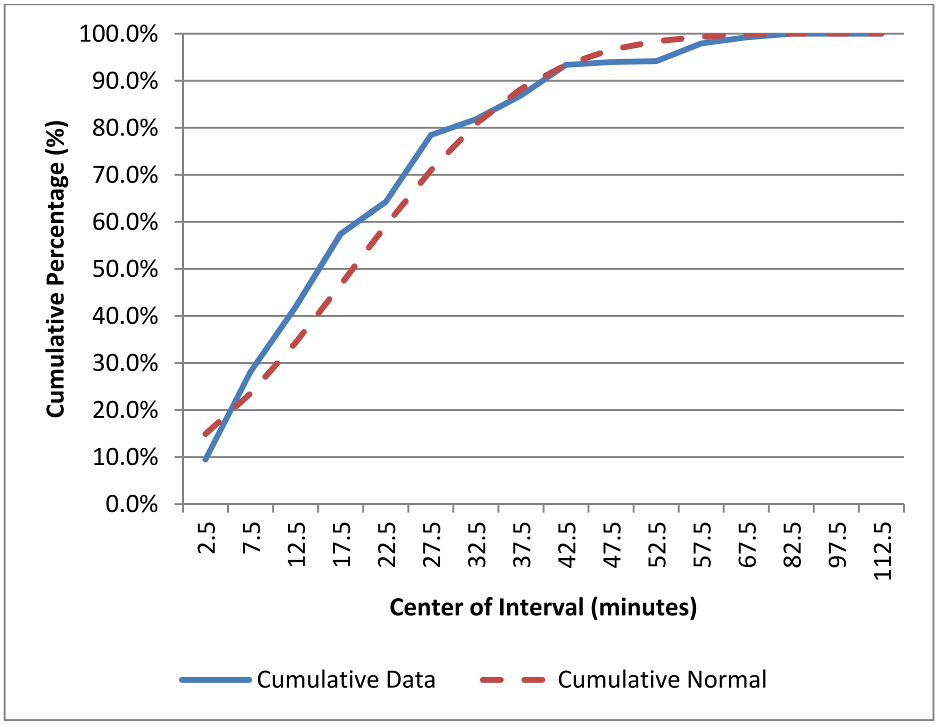


Figure 5-3. Comparison of Data Distribution and Normal Distribution

6) In particular, the cumulative distribution differs from the normal distribution in two key aspects, both very important in loading a network to estimate evacuation times:

   - Most of the real data is to the left of the "normal" curve above, indicating that the network loads faster for the first 80-85% of the vehicles, potentially causing more (and earlier) congestion than otherwise modeled;
   - The last 10-15% of the real data "tails off" slower than the comparable "normal" curve, indicating that there is significant traffic still loading at later times.

   Because these two features are important to preserve, it is the histogram of the data that is used to describe the mobilization activities, <u>not</u> a "normal" curve fit to the data. One could consider other distributions, but using the shape of the *actual* data curve is unambiguous and preserves these important features;

7) With the mobilization activities each modeled according to Steps 1-6, including preserving the features cited in Step 6, the overall (or total) mobilization times are constructed.

This is done by using the data sets and distributions under different scenarios (e.g. commuter returning, no commuter returning, no snow or snow in each). In general, these are additive, using weighting based upon the probability distributions of each element; Figure 5-4 presents the combined trip generation distributions designated A, C, D, E and F. These distributions are presented on the same time scale. (As discussed earlier, the use of strictly additive activities is a conservative approach, because it makes all activities sequential – preparation for departure follows the return of the commuter; snow clearance follows the preparation for departure, and so forth. In practice, it is reasonable that some of these activities are done in parallel, at least to some extent – for instance, preparation to depart begins by a household member at home while the commuter is still on the road.)

The mobilization distributions that result are used in their tabular/graphical form as direct inputs to later computations that lead to the ETE.

The DYNEV II simulation model is designed to accept varying rates of vehicle trip generation for each origin centroid, expressed in the form of histograms. These histograms, which represent Distributions A, C, D, E and F, properly displaced with respect to one another, are tabulated in Table 5-9 (Distribution B, Arrive Home, omitted for clarity).

The final time period (15) is 600 minutes long. This time period is added to allow the analysis network to clear, in the event congestion persists beyond the trip generation period. Note that there are no trips generated during this final time period.

5.4.2 Staged Evacuation Trip Generation

As defined in NUREG/CR-7002, staged evacuation consists of the following:

1. PAA comprising the 2 mile region are advised to evacuate immediately
2. PAA comprising regions extending from 2 to 5 miles downwind are advised to shelter in-place while the 2-mile region is cleared
3. As vehicles evacuate the 2 mile region, sheltered people from 2 to 5 miles downwind continue preparation for evacuation
4. The population sheltering in the 2 to 5 mile region are advised to begin evacuating when approximately 90% of those originally within the 2 mile region evacuate across the 2 mile region boundary
5. Non-compliance with the shelter recommendation is the same as the shadow evacuation percentage of 20%

<u>Assumptions</u>

1. The EPZ population in PAA beyond 5 miles will react as does the population in the 2 to 5 mile region; that is they will first shelter, then evacuate after the 90th percentile ETE for the 2 mile region
2. The population in the shadow region beyond the EPZ boundary, extending to 15 miles radially from the plant, will react as they do for all non-staged evacuation scenarios. That is 20% of these households will elect to evacuate with no shelter delay.
3. The transient population will not be expected to stage their evacuation because of the limited sheltering options available to people who may be at parks, on a beach, or at other venues. Also, notifying the transient population of a staged evacuation would prove difficult.
4. Employees will also be assumed to evacuate without first sheltering.

<u>Procedure</u>

1. Trip generation for population groups in the 2 mile region will be as computed based upon the results of the telephone survey and analysis.
2. Trip generation for the population subject to staged evacuation will be formulated as follows:
    a. Identify the 90th percentile evacuation time for the PAA comprising the 2-mile region. This value, T_{Scen}^*, is obtained from simulation results. It will become the time at which the region being sheltered will be told to evacuate for each scenario.
    b. The resultant trip generation curves for staging are then formed as follows:
        i. The non-shelter trip generation curve is followed until a maximum of 20% of the total trips are generated (to account for shelter non-compliance).
        ii. No additional trips are generated until time T_{Scen}^*

iii. Following time T_{Scen}^*, the balance of trips are generated:
    1. by stepping up and then following the non-shelter trip generation curve (if T_{Scen}^* is $\leq$ max trip generation time) or
    2. by stepping up to 100% (if T_{Scen}^* is > max trip generation time)

c. Note: This procedure implies that there may be different staged trip generation distributions for different scenarios. NUREG/CR-7002 uses the statement "approximately 90th percentile" as the time to end staging and begin evacuating. The value of T_{Scen}^* is 1:45 for non-snow scenarios and 2:15 for snow scenarios.

3. Staged trip generation distributions are created for the following population groups:
    a. Residents with returning commuters
    b. Residents without returning commuters
    c. Residents with returning commuters and snow conditions
    d. Residents without returning commuters and snow conditions

Figure 5-5 presents the staged trip generation distributions for both residents with and without returning commuters; the 90th percentile two-mile evacuation time is 105 minutes for good weather and 135 minutes for snow scenarios. At the 90th percentile evacuation time, 20% of the population (who normally would have completed their mobilization activities for an un-staged evacuation) advised to shelter has nevertheless departed the area. These people do not comply with the shelter advisory. Also included on the plot are the trip generation distributions for these groups as applied to the regions advised to evacuate immediately.

Since the 90th percentile evacuation time occurs before the end of the trip generation time, after the sheltered region is advised to evacuate, the shelter trip generation distribution rises to meet the balance of the non-staged trip generation distribution. Following time T_{Scen}^*, the balance of staged evacuation trips that are ready to depart are released within 15 minutes. After T_{Scen}^*+15, the remainder of evacuation trips are generated in accordance with the unstaged trip generation distribution.

Table 5-10 provides the trip generation histograms for staged evacuation.

5.4.3 Trip Generation for Waterways and Recreational Areas

Annex G of the Monroe County Emergency Management Plan states that the Monroe County Health Department, Environmental Health Division and the Director of Environmental Health are responsible to perform search and rescue including Lake Erie support with the Marine Patrol. It is assumed that this alerting and the time it takes for boaters to return to marinas are within the mobilization time of the transients within the EPZ (90 minutes).

Table 5-9. Trip Generation Histograms for the EPZ Population for Unstaged Evacuation

Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period					
		Employees (Distribution A)	Transients (Distribution A)	Residents with Commuters (Distribution C)	Residents Without Commuters (Distribution D)	Residents With Commuters Snow (Distribution E)	Residents Without Commuters Snow (Distribution F)
1	15	3%	3%	0%	2%	0%	0%
2	15	20%	20%	0%	16%	0%	3%
3	15	34%	34%	2%	30%	0%	13%
4	15	25%	25%	8%	23%	2%	22%
5	15	12%	12%	16%	12%	7%	19%
6	15	5%	5%	18%	8%	12%	15%
7	15	1%	1%	18%	5%	15%	10%
8	15	0%	0%	14%	1%	16%	7%
9	15	0%	0%	10%	1%	14%	4%
10	15	0%	0%	6%	1%	11%	2%
11	30	0%	0%	5%	1%	13%	4%
12	30	0%	0%	2%	0%	6%	1%
13	30	0%	0%	1%	0%	3%	0%
14	30	0%	0%	0%	0%	1%	0%
15	600	0%	0%	0%	0%	0%	0%

NOTE:

- Shadow vehicles are loaded onto the analysis network (Figure 1-2) using Distributions C and E for good weather and snow, respectively.
- Special event vehicles are loaded using Distribution A.

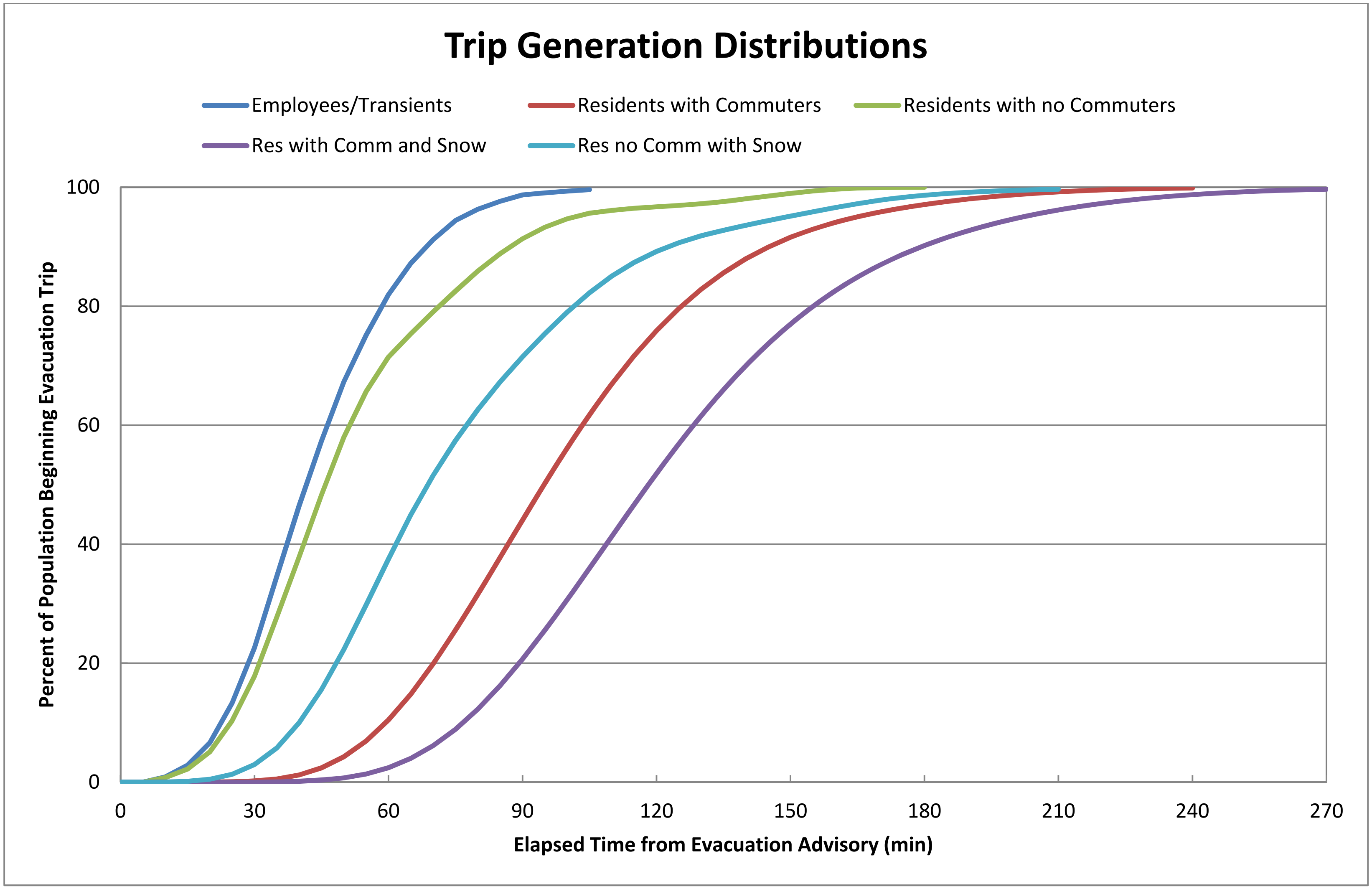


Figure 5-4. Comparison of Trip Generation Distributions

Table 5-10. Trip Generation Histograms for the EPZ Population for Staged Evacuation

Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period*			
		Residents with Commuters (Distribution C)	Residents Without Commuters (Distribution D)	Residents With Commuters Snow (Distribution E)	Residents Without Commuters Snow (Distribution F)
1	15	0%	0%	0%	0%
2	15	0%	4%	0%	1%
3	15	0%	6%	0%	2%
4	15	2%	4%	0%	5%
5	15	3%	3%	2%	3%
6	15	4%	1%	2%	3%
7	15	3%	1%	3%	2%
8	15	64%	78%	3%	2%
9	15	10%	1%	3%	1%
10	15	6%	1%	64%	76%
11	30	5%	1%	13%	4%
12	30	2%	0%	6%	1%
13	30	1%	0%	3%	0%
14	30	0%	0%	1%	0%
15	600	0%	0%	0%	0%

*Trip Generation for Employees and Transients (see Table 5-9) is the same for Unstaged and Staged Evacuation.

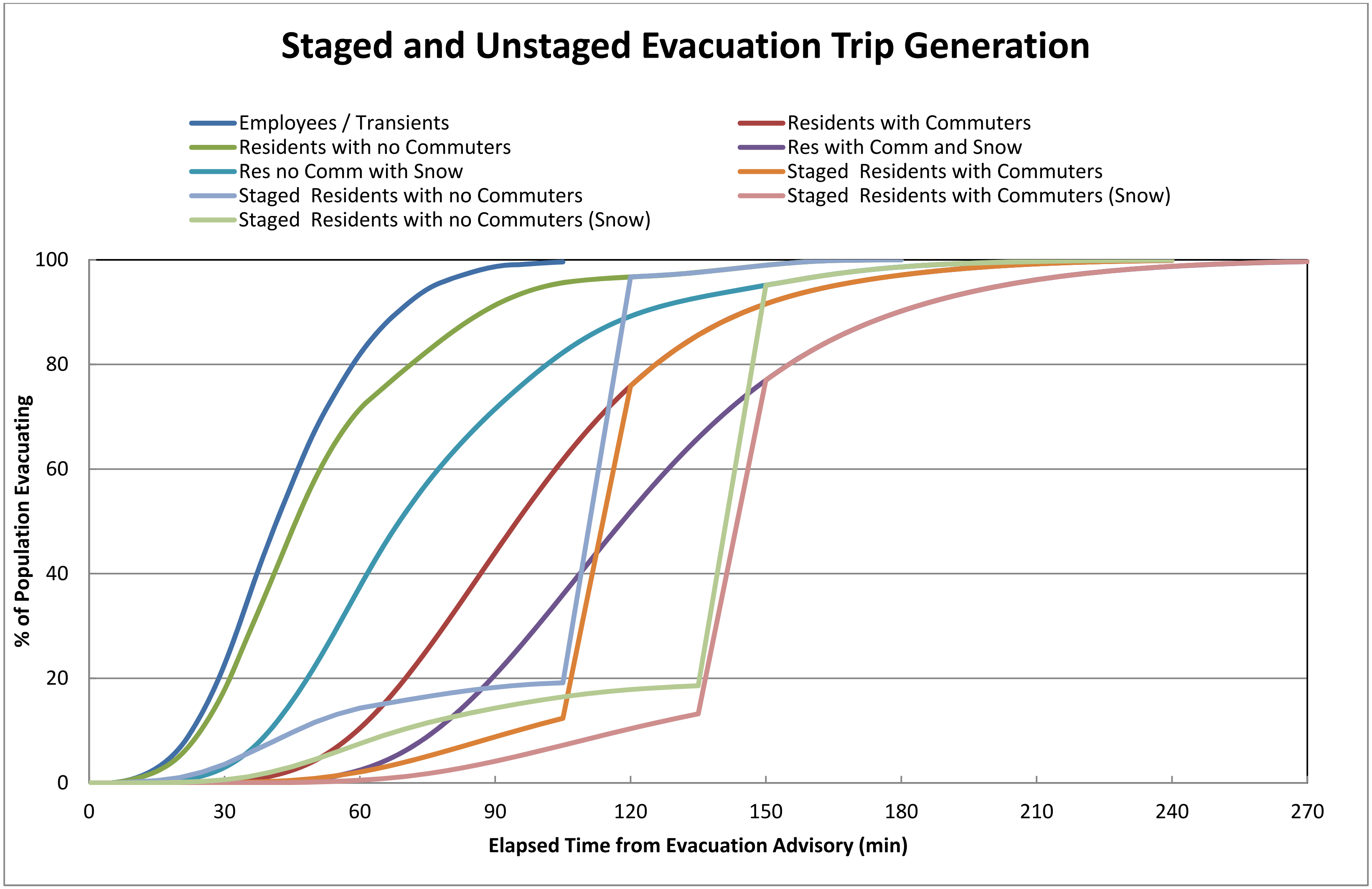


Figure 5-5. Comparison of Staged and Unstaged Trip Generation Distributions in the 2 to 5 Mile Region – Winter Midweek and Winter Weekend

6 DEMAND ESTIMATION FOR EVACUATION SCENARIOS

An evacuation "case" defines a combination of Evacuation Region and Evacuation Scenario. The definitions of "Region" and "Scenario" are as follows:

Region A grouping of contiguous evacuating PAA that forms either a "keyhole" sector-based area, or a circular area within the EPZ, that must be evacuated in response to a radiological emergency.

Scenario A combination of circumstances, including time of day, day of week, season, and weather conditions. Scenarios define the number of people in each of the affected population groups and their respective mobilization time distributions.

A total of 10 Regions were defined which encompass all the groupings of PAA considered. These Regions are defined in Table 6-1. The PAA configurations are identified in Figure 6-1. Each keyhole sector-based area consists of a central circle centered at the power plant, and three adjoining sectors, each with a central angle of 22.5 degrees, as per NUREG/CR-7002 guidance. The central sector coincides with the wind direction. These sectors extend to 5 miles from the plant (Regions R04 and R05) or to the EPZ boundary (Regions R06 and R07). Regions R01, R02 and R03 represent evacuations of circular areas with radii of 2, 5 and 10 miles, respectively. Regions R08 through R10 are identical to Regions R02, R04 and R05, respectively; however, those PAA between 2 miles and 5 miles are staged until 90% of the 2-mile region (Region R01) has evacuated.

A total of 14 Scenarios were evaluated for all Regions. Thus, there are a total of 10 x 14 = 140 evacuation cases. Table 6-2 is a description of all Scenarios.

Each combination of region and scenario implies a specific population to be evacuated. Table 6-3 presents the percentage of each population group estimated to evacuate for each scenario. Table 6-4 presents the vehicle counts for each scenario for an evacuation of Region R03 – the entire EPZ.

The vehicle estimates presented in Section 3 are peak values. These peak values are adjusted depending on the scenario and region being considered, using scenario and region specific percentages, such that the average population is considered for each evacuation case. The scenario percentages are presented in Table 6-3, while the regional percentages are provided in Table H-1. The percentages presented in Table 6-3 were determined as follows:

The number of residents with commuters during the week (when workforce is at its peak) is equal to the product of 62% (the number of households with at least one commuter) and 55% (the number of households with a commuter that would await the return of the commuter prior to evacuating). See assumption 3 in Section 2.3. It is estimated for weekend and evening scenarios that 10% of households with returning commuters will have a commuter at work during those times.

Employment is assumed to be at its peak during the winter, midweek, midday scenarios.

Employment is reduced slightly (96%) for summer, midweek, midday scenarios. This is based on the estimation that 50% of the employees commuting into the EPZ will be on vacation for a week during the approximate 12 weeks of summer. It is further estimated that those taking vacation will be uniformly dispersed throughout the summer with approximately 4% of employees vacationing each week. It is further estimated that only 10% of the employees are working in the evenings and during the weekends.

Transient activity is estimated to be at its peak during summer weekends and less (40%) during the week. As shown in Appendix E, there are a number of lodging facilities offering overnight accommodations in the EPZ; thus, transient activity during evening hours is 25% for summer and 10% for winter. Transient activity on winter weekends is estimated to be 25%.

As noted in the shadow footnote to Table 6-3, the shadow percentages are computed using a base of 20% (see assumption 5 in Section 2.2); to include the employees within the shadow region who may choose to evacuate, the voluntary evacuation is multiplied by a scenario-specific proportion of employees to permanent residents in the shadow region. For example, using the values provided in Table 6-4 for Scenario 1, the shadow percentage is computed as follows:

$$20\% \times \left(1 + \frac{4{,}561}{15{,}215 + 29{,}38}\right) = 22\%$$

One special event – River Raisin Jazz Festival – was considered as Scenario 13. Thus, the special event traffic is 100% evacuated for Scenario 13, and 0% for all other scenarios.

It is estimated that summer school enrollment is approximately 10% of enrollment during the regular school year for summer, midweek, midday scenarios. School is not in session during weekends and evenings, thus no buses for school children are needed under those circumstances. As discussed in Section 7, schools are in session during the winter season, midweek, midday and 100% of buses will be needed under those circumstances. Transit buses for the transit-dependent population are set to 100% for all scenarios as it is assumed that the transit-dependent population is present in the EPZ for all scenarios.

External traffic is estimated to be reduced by 60% during evening scenarios and is 100% for all other scenarios.

Table 6-1. Description of Evacuation Regions

Basic Regions						
		PAA				
Region	**Description**	**1**	**2**	**3**	**4**	**5**
R01	2-Mile Region	x				
R02	5-Mile Region	x	x	x		
R03	Full EPZ	x	x	x	x	x
Evacuate 2-Mile Region and Downwind to 5 Miles						
		PAA				
Region	**Wind Direction From:**	**1**	**2**	**3**	**4**	**5**
	W,WNW,NW,NNW,N,NNE	**Refer to Region R01**				
R04	NE,ENE,E	x		x		
	ESE,SE	**Refer to Region R02**				
R05	SSE,S,SSW,SW,WSW	x	x			
Evacuate 5-Mile Region and Downwind to the EPZ Boundary						
		PAA				
Region	**Wind Direction From:**	**1**	**2**	**3**	**4**	**5**
	WSW,W,WNW,NW,NNW,N	**Refer to Region R02**				
R06	NNE,NE,ENE	x	x	x		x
	E,ESE,SE	**Refer to Region R03**				
R07	SSE,S,SSW,SW	x	x	x	x	
Staged Evacuation - 2-Mile Region Evacuates, then Evacuate Downwind to 5 Miles						
		PAA				
Region	**Wind Direction From:**	**1**	**2**	**3**	**4**	**5**
R08	No Wind	x	x	x		
	W,WNW,NW,NNW,N,NNE	**Refer to Region R01**				
R09	NE,ENE,E	x		x		
	ESE,SE	**Refer to Region R02**				
R10	SSE,S,SSW,SW,WSW	x	x			
Key						
PAA(s) Evacuate	PAA(s) Shelter-in-Place	Shelter-in-Place until 90% ETE for R01, then Evacuate				

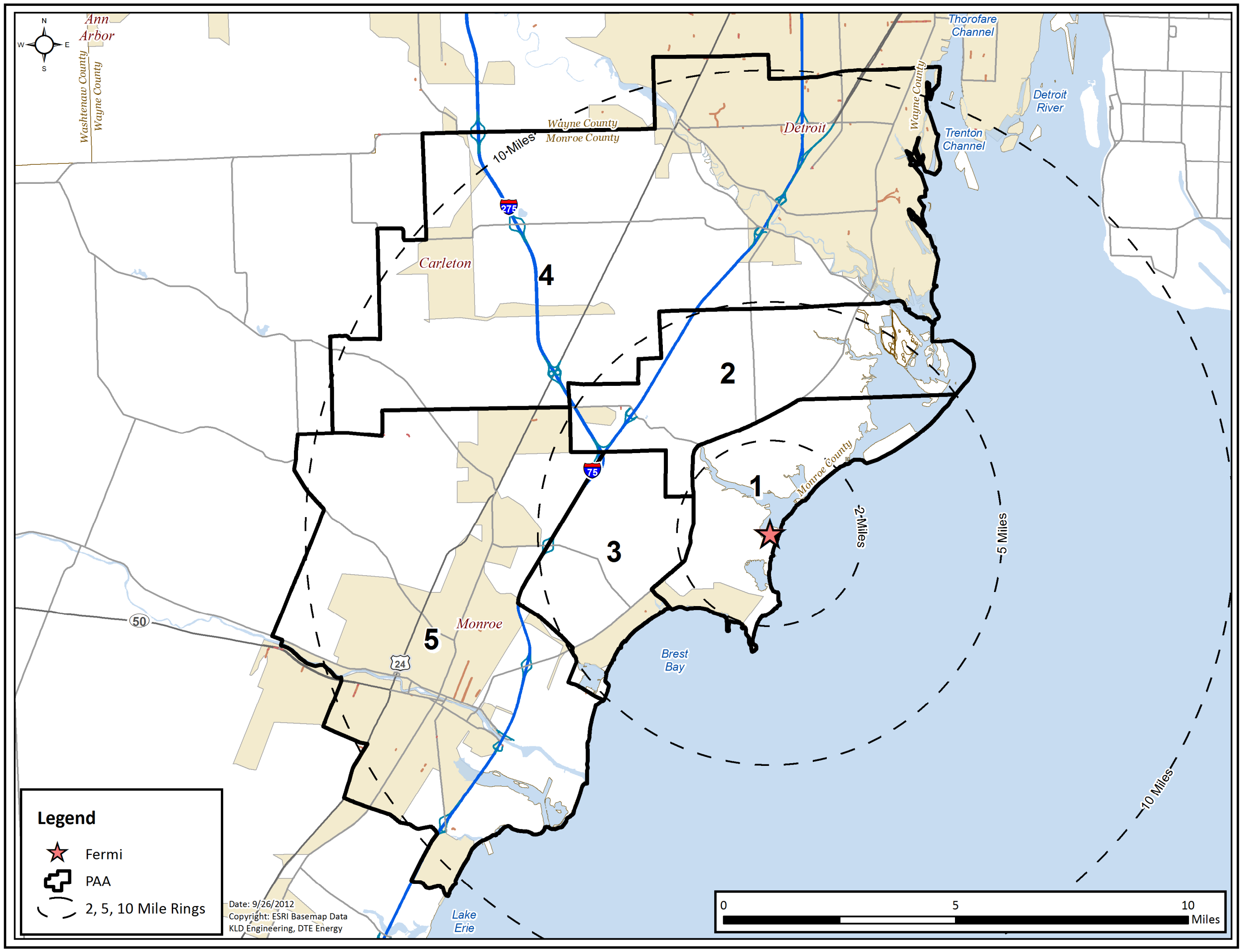


Figure 6-1. Fermi EPZ PAAs

Table 6-2. Evacuation Scenario Definitions

Scenario	Season[1]	Day of Week	Time of Day	Weather	Special
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Midweek	Midday	Snow	None
9	Winter	Weekend	Midday	Good	None
10	Winter	Weekend	Midday	Rain	None
11	Winter	Weekend	Midday	Snow	None
12	Winter	Midweek, Weekend	Evening	Good	None
13	Summer	Weekend	Midday	Good	River Raisin Jazz Festival
14	Summer	Midweek	Midday	Good	Roadway Impact – Lane Closure on I-75 SB

[1] Winter means that school is in session (also applies to spring and autumn). Summer means that school is not in session.

Table 6-3. Percent of Population Groups Evacuating for Various Scenarios

Scenario	Households With Returning Commuters	Households Without Returning Commuters	Employees	Transients	Shadow	Special Events	School Buses	Transit Buses	External Through Traffic
1	34%	66%	96%	40%	22%	0%	10%	100%	100%
2	34%	66%	96%	40%	22%	0%	10%	100%	100%
3	3%	97%	10%	100%	20%	0%	0%	100%	100%
4	3%	97%	10%	100%	20%	0%	0%	100%	100%
5	3%	97%	10%	25%	20%	0%	0%	100%	40%
6	34%	66%	100%	15%	22%	0%	100%	100%	100%
7	34%	66%	100%	15%	22%	0%	100%	100%	100%
8	34%	66%	100%	15%	22%	0%	100%	100%	100%
9	3%	97%	10%	25%	20%	0%	0%	100%	100%
10	3%	97%	10%	25%	20%	0%	0%	100%	100%
11	3%	97%	10%	25%	20%	0%	0%	100%	100%
12	3%	97%	10%	10%	20%	0%	0%	100%	40%
13	3%	97%	10%	100%	20%	100%	0%	100%	100%
14	34%	66%	96%	40%	22%	0%	10%	100%	100%

Resident Households with Commuters ....Households of EPZ residents who await the return of commuters prior to beginning the evacuation trip.
Resident Households with No Commuters ..Households of EPZ residents who do not have commuters or will not await the return of commuters prior to beginning the evacuation trip.
Employees..EPZ employees who live outside the EPZ
Transients ....People who are in the EPZ at the time of an accident for recreational or other (non-employment) purposes.
Shadow..Residents and employees in the shadow region (outside of the EPZ) who will spontaneously decide to relocate during the evacuation. The basis for the values shown is a 20% relocation of shadow residents along with a proportional percentage of shadow employees.
Special Events ....Additional vehicles in the EPZ due to the identified special event.
School and Transit Buses ....Vehicle-equivalents present on the road during evacuation servicing schools and transit-dependent people (1 bus is equivalent to 2 passenger vehicles).
External Through Traffic ....Traffic on interstates/freeways and major arterial roads at the start of the evacuation. This traffic is stopped by access control approximately 2 hours after the evacuation begins.

Table 6-4. Vehicle Estimates by Scenario

Scenario	Households With Returning Commuters	Households Without Returning Commuters	Employees	Transients	Shadow	Special Events	School Buses	Transit Buses	External Through Traffic	Total Scenario Vehicles
1	15,215	29,338	4,561	2,578	10,233	-	72	190	10,452	72,639
2	15,215	29,338	4,561	2,578	10,233	-	72	190	10,452	72,639
3	1,522	43,031	475	6,444	9,382	-	-	190	10,452	71,496
4	1,522	43,031	475	6,444	9,382	-	-	190	10,452	71,496
5	1,522	43,031	475	1,611	9,382	-	-	190	4,181	60,392
6	15,215	29,338	4,751	967	10,272	-	722	190	10,452	71,907
7	15,215	29,338	4,751	967	10,272	-	722	190	10,452	71,907
8	15,215	29,338	4,751	967	10,272	-	722	190	10,452	71,907
9	1,522	43,031	475	1,611	9,382	-	-	190	10,452	66,663
10	1,522	43,031	475	1,611	9,382	-	-	190	10,452	66,663
11	1,522	43,031	475	1,611	9,382	-	-	190	10,452	66,663
12	1,522	43,031	475	644	9,382	-	-	190	4,181	59,425
13	1,522	43,031	475	6,444	9,382	2,451	-	190	10,452	73,947
14	15,215	29,338	4,561	2,578	10,233	-	72	190	10,452	72,639

Note: Vehicle estimates are for an evacuation of the entire EPZ (Region R03)

7 GENERAL POPULATION EVACUATION TIME ESTIMATES (ETE)

This section presents the ETE results of the computer analyses using the DYNEV II System described in Appendices B, C and D. These results cover 10 regions within the FNPP EPZ and the 14 Evacuation Scenarios discussed in Section 6.

The ETE for all Evacuation Cases are presented in Table 7-1 and Table 7-2. These tables present the estimated times to clear the indicated population percentages from the Evacuation Regions for all Evacuation Scenarios. The ETE of the 2-mile region in both staged and un-staged regions are presented in Table 7-3 and Table 7-4. Table 7-5 defines the evacuation regions considered. The tabulated values of ETE are obtained from the DYNEV II System outputs which are generated at 5-minute intervals.

7.1 Voluntary Evacuation and Shadow Evacuation

"Voluntary evacuees" are people within the EPZ in PAA for which an Advisory to Evacuate has not been issued, yet who elect to evacuate. "Shadow evacuation" is the voluntary outward movement of some people from the Shadow Region (outside the EPZ) for whom no protective action recommendation has been issued. Both voluntary and shadow evacuations are assumed to take place over the same time frame as the evacuation from within the impacted Evacuation Region.

The ETE for the FNPP EPZ addresses the issue of voluntary evacuees in the manner shown in Figure 7-1. Within the EPZ, 20 percent of people located in PAA outside of the evacuation region who are not advised to evacuate, are assumed to elect to evacuate. Similarly, it is assumed that 20 percent of those people in the Shadow Region will choose to leave the area.

Figure 7-2 presents the area identified as the Shadow Region. This region extends radially from the plant to cover a region between the EPZ boundary and approximately 15 miles. The population and number of evacuating vehicles in the Shadow Region were estimated using the same methodology that was used for permanent residents within the EPZ (see Section 3.1). As discussed in Section 3.2, it is estimated that a total of 101,913 people reside in the Shadow Region; 20 percent of them would evacuate. See Table 6-4 for the number of evacuating vehicles from the Shadow Region.

Traffic generated within this Shadow Region, traveling away from the FNPP location, has the potential for impeding evacuating vehicles from within the Evacuation Region. All ETE calculations include this shadow traffic movement.

7.2 Staged Evacuation

As defined in NUREG/CR-7002, staged evacuation consists of the following:

1. PAA comprising the 2 mile region are advised to evacuate immediately.
2. PAA comprising regions extending from 2 to 5 miles downwind are advised to shelter in-place while the two mile region is cleared.

3. As vehicles evacuate the 2 mile region, people from 2 to 5 miles downwind continue preparation for evacuation while they shelter.
4. The population sheltering in the 2 to 5 mile region is advised to evacuate when approximately 90% of the 2 mile region evacuating traffic crosses the 2 mile region boundary.
5. Non-compliance with the shelter recommendation is the same as the shadow evacuation percentage of 20%.

See Section 5.4.2 for additional information on staged evacuation.

7.3 Patterns of Traffic Congestion during Evacuation

Figure 7-3 through Figure 7-8 illustrate the patterns of traffic congestion that arise for the case when the entire EPZ (Region R03) is advised to evacuate during the winter, midweek, midday period under good weather conditions (Scenario 6).

Traffic congestion, as the term is used here, is defined as Level of Service (LOS) F. LOS F is defined as follows (HCM 2010, page 5-5):

> The HCM uses LOS F to define operations that have either broken down (i.e., demand exceeds capacity) or have exceeded a specified service measure value, or combination of service measure values, that most users would consider unsatisfactory. However, particularly for planning applications where different alternatives may be compared, analysts may be interested in knowing just how bad the LOS F condition is. Several measures are available to describe individually, or in combination, the severity of a LOS F condition:
>
> • *Demand-to-capacity ratios* describe the extent to which capacity is exceeded during the analysis period (e.g., by 1%, 15%, etc.);
>
> • *Duration of LOS F* describes how long the condition persists (e.g., 15 min, 1 h, 3 h); and
>
> • *Spatial extent measures* describe the areas affected by LOS F conditions. These include measures such as the back of queue, and the identification of the specific intersection approaches or system elements experiencing LOS F conditions.

All highway "links" which experience LOS F are delineated in these figures by a thick red line; all others are lightly indicated. Congestion develops rapidly around concentrations of population and traffic bottlenecks. Figure 7-3 displays the developing congestion within the population center of the City of Monroe to the southwest of FNPP, just 30 minutes after the Advisory to Evacuate (ATE). Throughout the entirety of the evacuation, congestion never develops within the 2-mile region.

At one hour after the ATE, Figure 7-4 displays fully-developed congestion within Monroe. I-75 SB south of Monroe is also now experiencing congestion (LOS F). I-75 is servicing both evacuees as well as through traffic, as ACPs have yet to be established. Congestion is now beginning to develop in Wayne County along Fort St and Jefferson Ave in Gibraltar.

At one hour and thirty minutes, as shown in Figure 7-5, congestion begins to subside in Monroe and in Wayne County. Congestion (LOS F) persists along the main evacuation routes out of the city of Monroe – Custer Rd, SR-50, US-24/S Telegraph Rd, S Dixie Hwy, and Laplaisance Rd. Congestion has been slowly building along Oakville Waltz Rd westbound at the intersection with Sumpter Rd. This intersection is controlled by an all-way stop sign which is creating a queue of evacuating vehicles.

At two hours, as shown in Figure 7-6, congestion has almost completely subsided within the city of Monroe and in Wayne County. Congestion still persists in the shadow along those evacuation routes exiting the city of Monroe.

At two hours and thirty minutes, as shown in Figure 7-7, the EPZ is clear of congestion. Note that congestion within the EPZ clears well in advance of the completion of trip generation time for permanent residents, which is four hours. Congestion still persists within the shadow along SR-50. The congestion along Oakville Waltz Rd persists, however this congestion has never developed to the point where it penetrates the EPZ boundary.

Over the next thirty minutes, at three hours after the ATE, all remnants of congestion within the shadow area have dissipated, as shown in Figure 7-8.

7.4 Evacuation Rates

Evacuation is a continuous process, as implied by Figure 7-9 through Figure 7-22. These figures indicate the rate at which traffic flows out of the indicated areas for the case of an evacuation of the full EPZ (Region R03) under the indicated conditions. One figure is presented for each scenario considered.

As indicated in Figure 7-9, there is typically a long "tail" to these distributions. Vehicles begin to evacuate an area slowly at first, as people respond to the ATE at different rates. Then traffic demand builds rapidly (slopes of curves increase). When the system becomes congested, traffic exits the EPZ at rates somewhat below capacity until some evacuation routes have cleared. As more routes clear, the aggregate rate of egress slows since many vehicles have already left the EPZ. Towards the end of the process, relatively few evacuation routes service the remaining demand.

This decline in aggregate flow rate, towards the end of the process, is characterized by these curves flattening and gradually becoming horizontal. Ideally, it would be desirable to fully saturate all evacuation routes equally so that all will service traffic near capacity levels and all will clear at the same time. For this ideal situation, all curves would retain the same slope until the end – thus minimizing evacuation time. In reality, this ideal is generally unattainable reflecting the spatial variation in population density, mobilization rates and in highway capacity over the EPZ.

7.5 Evacuation Time Estimate (ETE) Results

Table 7-1 and Table 7-2 present the ETE values for all 10 Evacuation Regions and all 14 Evacuation Scenarios. Table 7-3 and Table 7-4 present the ETE values for the 2-Mile region for both staged and un-staged keyhole regions downwind to 5 miles. The tables are organized as follows:

Table	Contents
7-1	ETE represents the elapsed time required for 90 percent of the population within a Region, to evacuate from that Region. All Scenarios are considered, as well as Staged Evacuation scenarios.
7-2	ETE represents the elapsed time required for 100 percent of the population within a Region, to evacuate from that Region. All Scenarios are considered, as well as Staged Evacuation scenarios.
7-3	ETE represents the elapsed time required for 90 percent of the population within the 2-mile Region, to evacuate from that Region with both Concurrent and Staged Evacuations.
7-4	ETE represents the elapsed time required for 100 percent of the population within the 2-mile Region, to evacuate from that Region with both Concurrent and Staged Evacuations.

The animation snapshots described above reflect the ETE statistics for the concurrent (un-staged) evacuation scenarios and regions, which are displayed in Figure 7-3 through Figure 7-8. While congestion exists within the EPZ, it clears prior to when 90% of the general population has mobilized to evacuate; this is reflected in the ETE statistics:

- The 90th percentile ETE for Region R01 (2-mile area) ranges from 1:35 to 1:55 (higher during snow scenarios). As shown in Figure 5-4, 90 percent of residents without commuters mobilize in about 1 hour and 30 minutes and 90 percent of residents with commuters mobilize in about 2 hours and 25 minutes. The 90th percentile ETE is slightly less than the mobilization time for Region R01 during weekday scenarios, primarily because approximately 25% of evacuees from Region R01 are employees at FNPP, who mobilize quickly. Figure 5-4 indicates that 90 percent of employees mobilize in about 70 minutes.
- The 90th percentile ETE for all other regions are approximately 10 minutes longer, on average (higher during snow scenarios).

The 100th percentile ETE for all regions and for all scenarios are the same values as the mobilization times. This fact implies that the congestion within the EPZ dissipates prior to the end of mobilization, as is displayed in Figure 7-7.

Comparison of Scenarios 3 and 13 in Table 7-1 indicates that the Special Event – River Raisin Jazz Festival – has little impact on the ETE for the 90th percentile, with increases of only up to 5 minutes for the evacuation of the entire EPZ (Region R03). As discussed in Section 7.3, congestion within the downtown area of the city of Monroe clears by two hours after the ATE, and as discussed above, the 90th percentile ETE is dictated by the mobilization activities of the general population and not congestion. Therefore, there exists ample reserve capacity along evacuation routes out of Monroe to evacuate the 2,451 additional vehicles present for the special event, without materially impacting the ETE at the 90th percentile. The special event also has no impact on ETE at the 100th percentile, as indicated in Table 7-2.

Comparison of Scenarios 1 and 14 in Table 7-1 indicates that the roadway closure – a single lane southbound on Interstate-75 from the interchange with I-275 (Exit 20) to the end of the EPZ at Laplaisance Rd (before Exit 9) – does not have a material impact on 90th percentile ETE, with increases of only up to 5 minutes for an evacuation of the entire EPZ (Region R03). As discussed in Section 7.3, congestion (LOS F) never fully develops along I-75 SB within the EPZ. While I-75 SB is reduced from three lanes to two lanes, capacity is only reduced by a third, leaving ample capacity to evacuate the population without materially impacting the ETE at the 90th percentile. The roadway closure also has no impact on ETE at the 100th percentile, as indicated in Table 7-2.

7.6 Staged Evacuation Results

Table 7-3 and Table 7-4 present a comparison of the ETE compiled for the concurrent (un-staged) and staged evacuation studies. Note that Regions R08 through R10 are the same geographic areas as Regions R02, R04 and R05, respectively.

To determine whether the staged evacuation strategy is worthy of consideration, one must show that the ETE for the 2-mile region can be reduced without significantly affecting the region between 2 miles and 5 miles. In all cases, as shown in these tables, the ETE for the 2-mile region increases when a staged evacuation is implemented. The reason for this is that some evacuees from within the 5-mile area need to travel into the 2-mile region to evacuate, primarily those neighborhoods along N Dixie Hwy. Consequently, since these residents are staged, their delay in evacuation directly increases the 90th percentile ETE for the 2-mile region. Comparing Regions R02, R04, and R05 with Region R01 in Table 7-3 indicates that those evacuees from within the 2-mile region are never impacted by those evacuees beyond 2-miles. Therefore, staging the evacuation to sharply reduce congestion within the 5-mile area provides no benefits to evacuees from within the 2-mile region and unnecessarily delays the evacuation of those beyond 2 miles.

While failing to provide assistance to evacuees from within 2 miles of the FNPP, staging produces a negative impact on the ETE for those evacuating from within the 5-mile area. A comparison of ETE between Regions, R08 and R02; R09 and R04; and R10 and R06; reveals that staging retards the 90th percentile ETE for those in the 2 to 5-mile area by up to 30 minutes (see Table 7-1) and has no impact on the 100th percentile ETE (see Table 7-2). This extending of ETE is due to the delay in beginning the evacuation trip experienced by those who shelter before evacuating.

In summary, the staged evacuation protective action strategy provides no benefits and adversely impacts many evacuees located beyond 2 miles from the FNPP.

7.7 Guidance on Using ETE Tables

The user first determines the percentile of population for which the ETE is sought (The NRC guidance calls for the 90th percentile). The applicable value of ETE within the chosen Table may then be identified using the following procedure:

1. Identify the applicable **Scenario**:
   - Season
     - Summer
     - Winter (also Autumn and Spring)
   - Day of Week
     - Midweek
     - Weekend
   - Time of Day
     - Midday
     - Evening
   - Weather Condition
     - Good Weather
     - Rain
     - Snow
   - Special Event
     - River Raisin Jazz Festival
     - Road Closure (one lane on I-75 SB is closed)
   - Evacuation Staging
     - No, Staged Evacuation is not considered
     - Yes, Staged Evacuation is considered

While these Scenarios are designed, in aggregate, to represent conditions throughout the year, some further clarification is warranted:

- The conditions of a summer evening (either midweek or weekend) and rain are not explicitly identified in the Tables. For these conditions, Scenarios (2) and (4) apply.
- The conditions of a winter evening (either midweek or weekend) and rain are not explicitly identified in the Tables. For these conditions, Scenarios (7) and (10) for rain apply.
- The conditions of a winter evening (either midweek or weekend) and snow are not explicitly identified in the Tables. For these conditions, Scenarios (8) and (11) for snow apply.
- The seasons are defined as follows:
  - Summer assumes that public schools are not in session.
  - Winter (includes Spring and Autumn) considers that public schools are in session.

- Time of Day: Midday implies the time over which most commuters are at work or are travelling to/from work.

2. With the desired percentile ETE and Scenario identified, now identify the **Evacuation Region**:
   - Determine the projected azimuth direction of the plume (coincident with the wind direction). This direction is expressed in terms of compass orientation: from N, NNE, NE, …
   - Determine the distance that the Evacuation Region will extend from the nuclear power plant. The applicable distances and their associated candidate Regions are given below:
     - 2 Miles (Region R01)
     - To 5 Miles (Region R02, R04 and R05)
     - To EPZ Boundary (Regions R06 and R07)
   - Enter Table 7-5 and identify the applicable group of candidate Regions based on the distance that the selected Region extends from the FNPP. Select the Evacuation Region identifier in that row, based on the azimuth direction of the plume, from the first column of the Table.
3. Determine the **ETE Table** based on the **percentile** selected. Then, for the **Scenario** identified in Step 1 and the **Region** identified in Step 2, proceed as follows:
   - The columns of Table 7-1 are labeled with the Scenario numbers. Identify the proper column in the selected Table using the Scenario number defined in Step 1.
   - Identify the row in this table that provides ETE values for the Region identified in Step 2.
   - The unique data cell defined by the column and row so determined contains the desired value of ETE expressed in Hours:Minutes.

Example

It is desired to identify the ETE for the following conditions:

- Sunday, August 10th at 4:00 AM.
- It is raining.
- Wind direction is from the northeast (NE).
- Wind speed is such that the distance to be evacuated is judged to be a 5-mile radius and downwind to 10 miles (to EPZ boundary).
- The desired ETE is that value needed to evacuate 90 percent of the population from within the impacted Region.
- A staged evacuation is not desired.

Table 7-1 is applicable because the 90th percentile ETE is desired. Proceed as follows:

1. Identify the Scenario as summer, weekend, evening and raining. Entering Table 7-1, it is seen that there is no match for these descriptors. However, the clarification given above assigns this combination of circumstances to Scenario 4.
2. Enter Table 7-5 and locate the Region described as "Evacuate 5-Mile Radius and Downwind to the EPZ Boundary" for wind direction from the NE (toward the SW) and read Region R06 in the first column of that row.
3. Enter Table 7-1 to locate the data cell containing the value of ETE for Scenario 4 and Region R06. This data cell is in column (4) and in the row for Region R06; it contains the ETE value of **1:55**.

Table 7-1. Time to Clear the Indicated Area of _90_ Percent of the Affected Population

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R02	2:00	2:00	1:55	1:55	1:50	2:00	2:00	2:10	1:55	2:00	2:05	1:50	1:55	2:00
R03	2:10	2:15	2:00	2:05	1:50	2:05	2:10	2:35	1:55	2:00	2:20	1:50	2:05	2:15
2-Mile Region and Keyhole to 5 Miles														
R04	2:00	2:00	1:55	2:00	1:55	2:00	2:00	2:10	2:00	2:00	2:05	1:55	1:55	2:00
R05	2:00	2:00	2:00	2:00	1:55	2:00	2:00	2:05	2:00	2:00	2:05	1:55	2:00	2:00
5-Mile Region and Keyhole to EPZ Boundary														
R06	2:00	2:05	1:55	1:55	1:50	2:00	2:05	2:15	1:55	1:55	2:10	1:50	1:55	2:00
R07	2:05	2:05	1:55	2:00	1:50	2:05	2:05	2:20	2:00	2:00	2:10	1:50	1:55	2:05
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles														
R08	2:10	2:10	2:10	2:10	2:10	2:10	2:10	2:40	2:10	2:10	2:35	2:10	2:10	2:10
R09	2:10	2:10	2:10	2:10	2:10	2:10	2:10	2:40	2:10	2:10	2:35	2:10	2:10	2:10
R10	2:05	2:05	2:05	2:05	2:05	2:05	2:05	2:25	2:05	2:05	2:25	2:05	2:05	2:05

Table 7-2. Time to Clear the Indicated Area of *100* Percent of the Affected Population

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R02	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R03	4:10	4:10	4:10	4:10	4:10	4:10	4:10	4:40	4:10	4:10	4:40	4:10	4:10	4:10
2-Mile Region and Keyhole to 5 Miles														
R04	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R05	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
5-Mile Region and Keyhole to EPZ Boundary														
R06	4:10	4:10	4:10	4:10	4:10	4:10	4:10	4:40	4:10	4:10	4:40	4:10	4:10	4:10
R07	4:10	4:10	4:10	4:10	4:10	4:10	4:10	4:40	4:10	4:10	4:40	4:10	4:10	4:10
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles														
R08	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R09	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05
R10	4:05	4:05	4:05	4:05	4:05	4:05	4:05	4:35	4:05	4:05	4:35	4:05	4:05	4:05

Table 7-3. Time to Clear *90* Percent of the 2-Mile Area within the Indicated Region

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Evening	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Unstaged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R01	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R02	1:55	2:00	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R04	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
R05	1:55	1:55	1:35	1:35	1:35	1:55	1:55	2:30	1:35	1:35	2:10	1:35	1:35	1:55
Staged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R08	2:00	2:05	2:00	2:00	2:00	2:00	2:05	2:35	2:00	2:00	2:30	2:00	2:00	2:00
R09	2:00	2:00	1:55	1:55	1:55	2:00	2:00	2:30	1:55	1:55	2:30	1:55	1:55	2:00
R10	2:00	2:05	2:00	2:00	2:00	2:00	2:00	2:35	2:00	2:00	2:30	2:00	2:00	2:00

Table 7-4. Time to Clear *100* Percent of the 2-Mile Area within the Indicated Region

	Summer		Summer		Summer	Winter			Winter			Winter	Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Weekend			Midweek Weekend	Weekend	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region	Midday		Midday		Evening	Midday			Midday			Evening	Evening	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Special Event	Roadway Impact
Unstaged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R01	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R02	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R04	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R05	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
Staged Evacuation - 2-Mile Region and Keyhole to 5-Miles														
R08	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R09	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00
R10	4:00	4:00	4:00	4:00	4:00	4:00	4:00	4:30	4:00	4:00	4:30	4:00	4:00	4:00

Table 7-5. Description of Evacuation Regions

Basic Regions						
		PAA				
Region	Description	1	2	3	4	5
R01	2-Mile Region	x				
R02	5-Mile Region	x	x	x		
R03	Full EPZ	x	x	x	x	x
Evacuate 2-Mile Region and Downwind to 5 Miles						
		PAA				
Region	Wind Direction From:	1	2	3	4	5
	W,WNW,NW,NNW,N,NNE	Refer to Region R01				
R04	NE,ENE,E	x		x		
	ESE,SE	Refer to Region R02				
R05	SSE,S,SSW,SW,WSW	x	x			
Evacuate 5-Mile Region and Downwind to the EPZ Boundary						
		PAA				
Region	Wind Direction From:	1	2	3	4	5
	WSW,W,WNW,NW,NNW,N	Refer to Region R02				
R06	NNE,NE,ENE	x	x	x		x
	E,ESE,SE	Refer to Region R03				
R07	SSE,S,SSW,SW	x	x	x	x	
Staged Evacuation - 2-Mile Region Evacuates, then Evacuate Downwind to 5 Miles						
		PAA				
Region	Wind Direction From:	1	2	3	4	5
R08	No Wind	x	x	x		
	W,WNW,NW,NNW,N,NNE	Refer to Region R01				
R09	NE,ENE,E	x		x		
	ESE,SE	Refer to Region R02				
R10	SSE,S,SSW,SW,WSW	x	x			
Key						
PAA(s) Evacuate	PAA(s) Shelter-in-Place	Shelter-in-Place until 90% ETE for R01, then Evacuate				

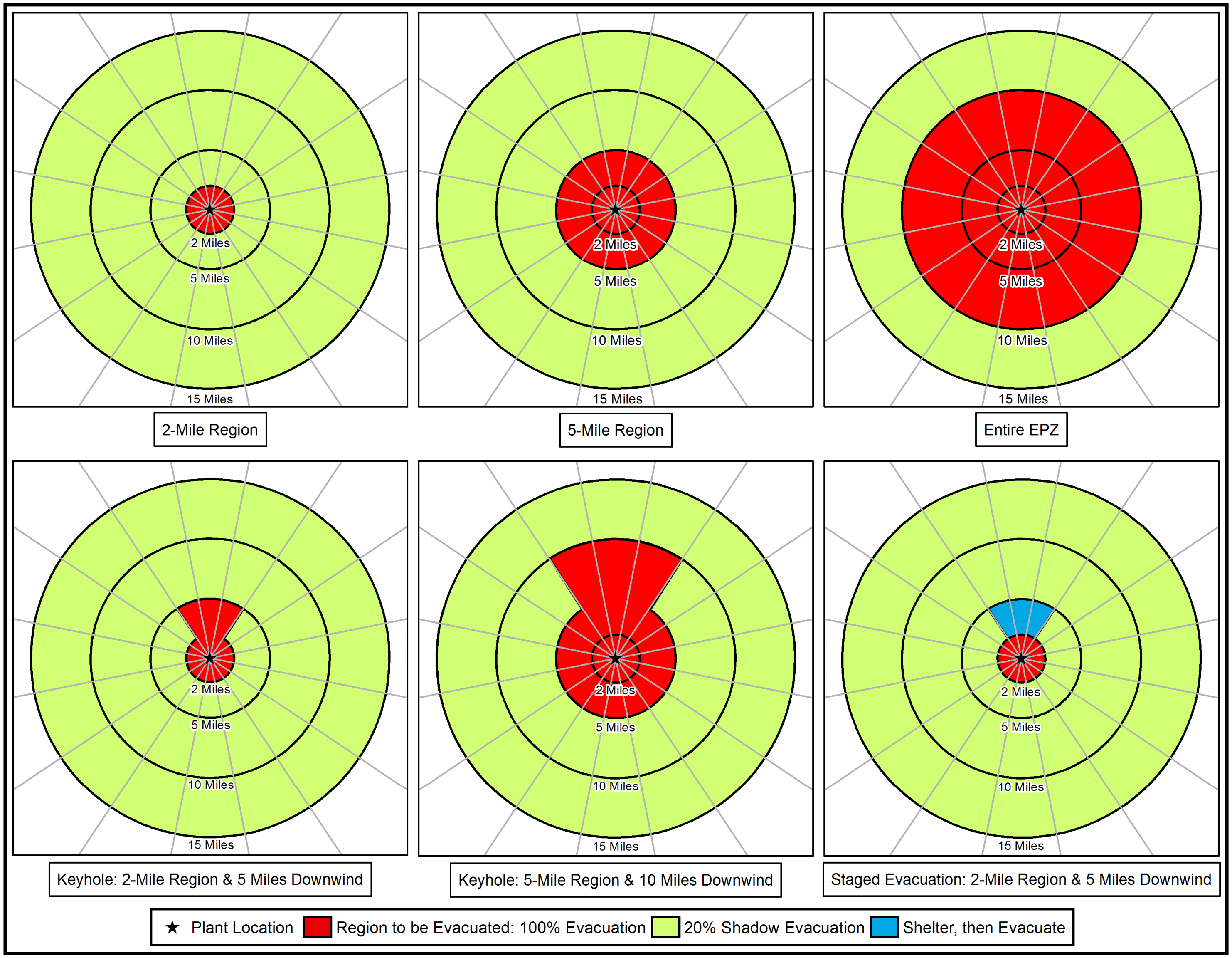


Figure 7-1. Voluntary Evacuation Methodology

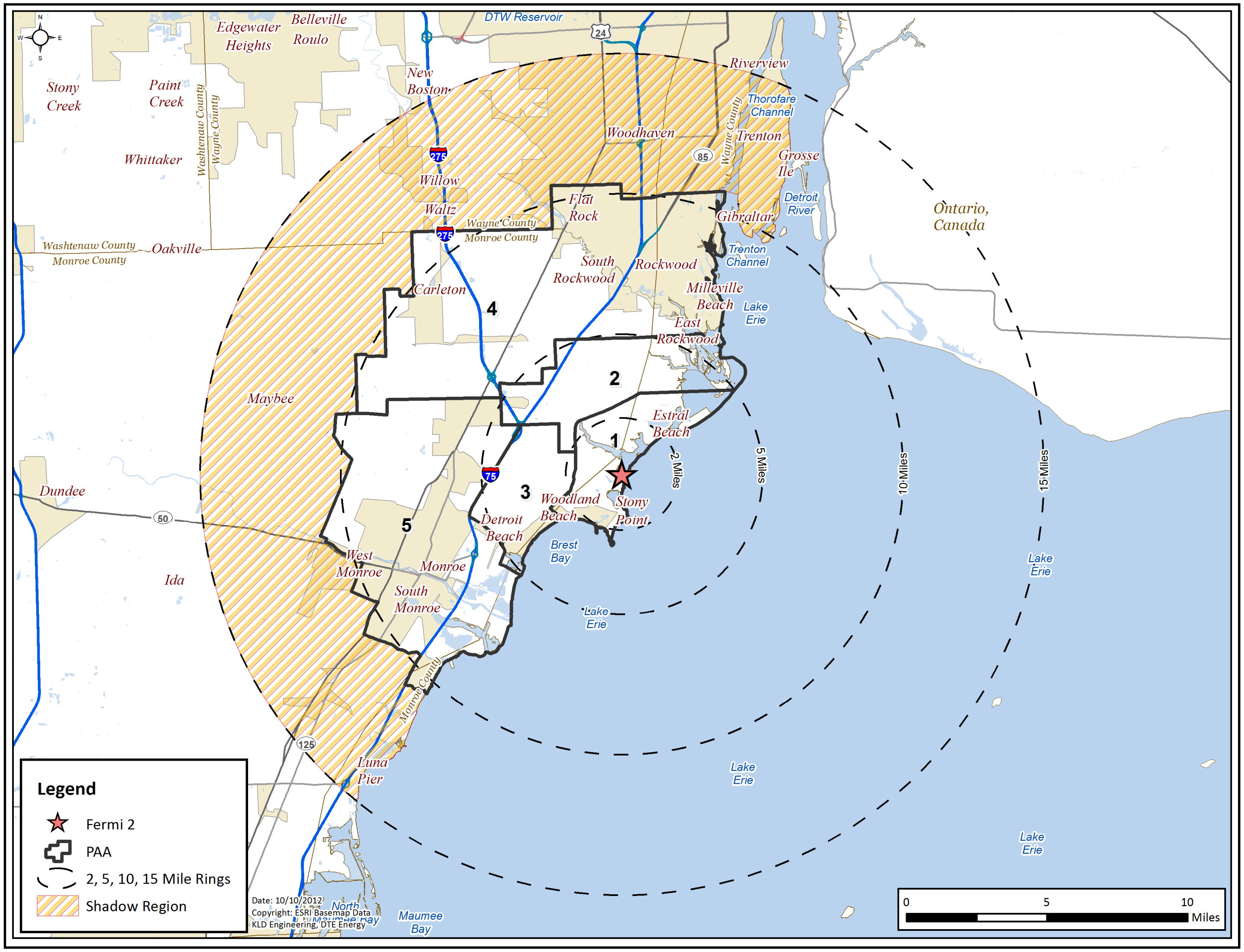


Figure 7-2. FNPP Shadow Region

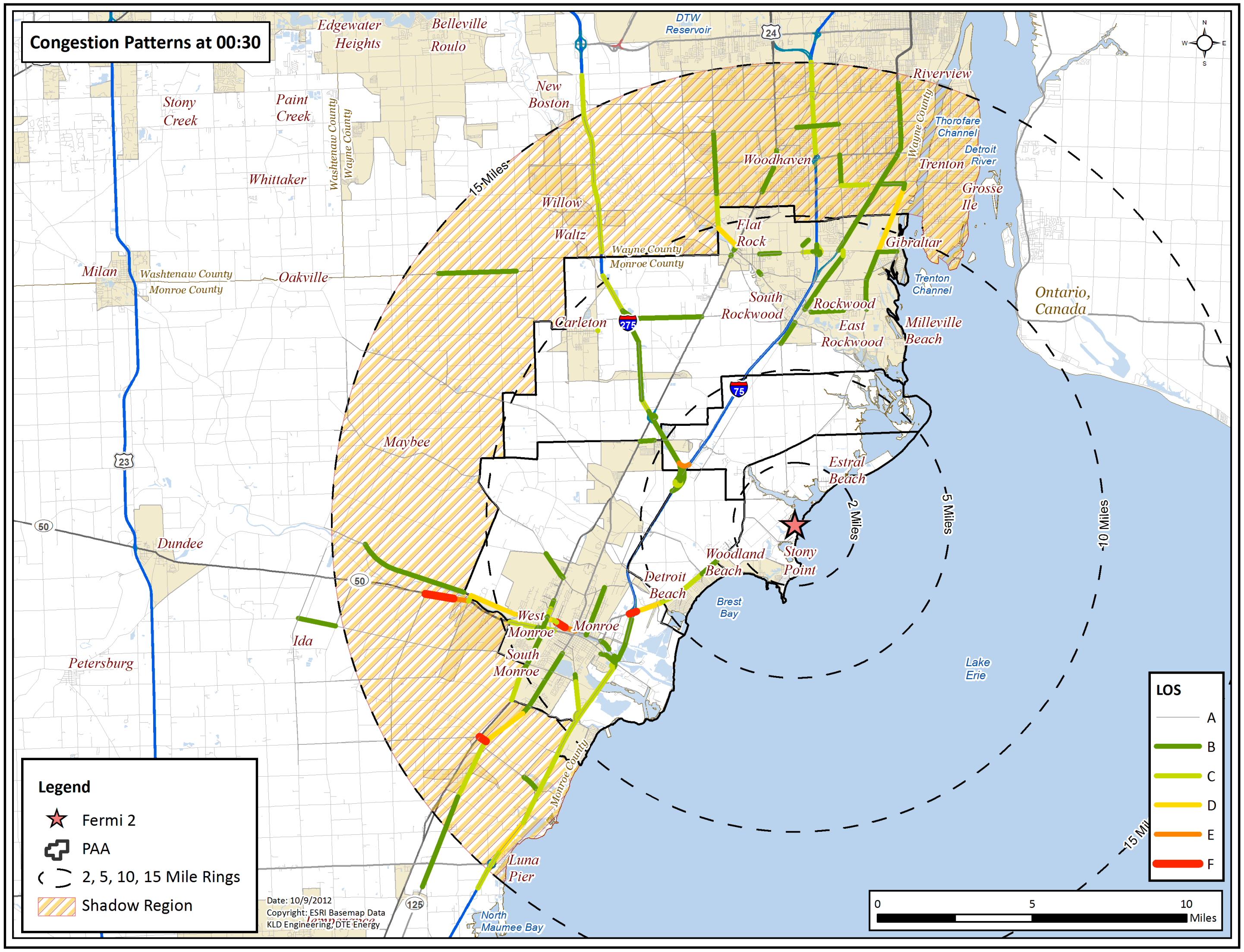


Figure 7-3. Congestion Patterns at 30 Minutes after the Advisory to Evacuate

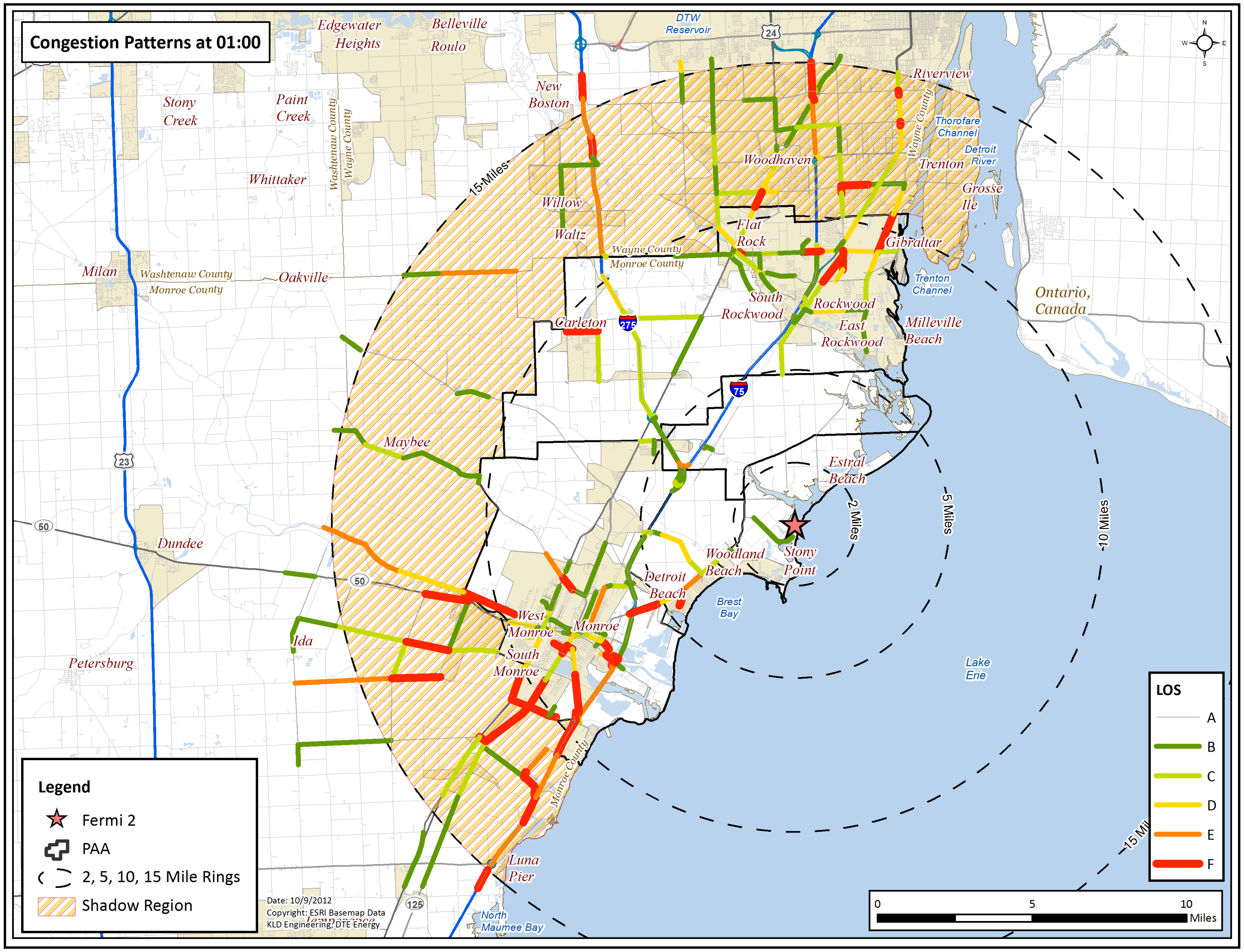


Figure 7-4. Congestion Patterns at 1 Hour after the Advisory to Evacuate

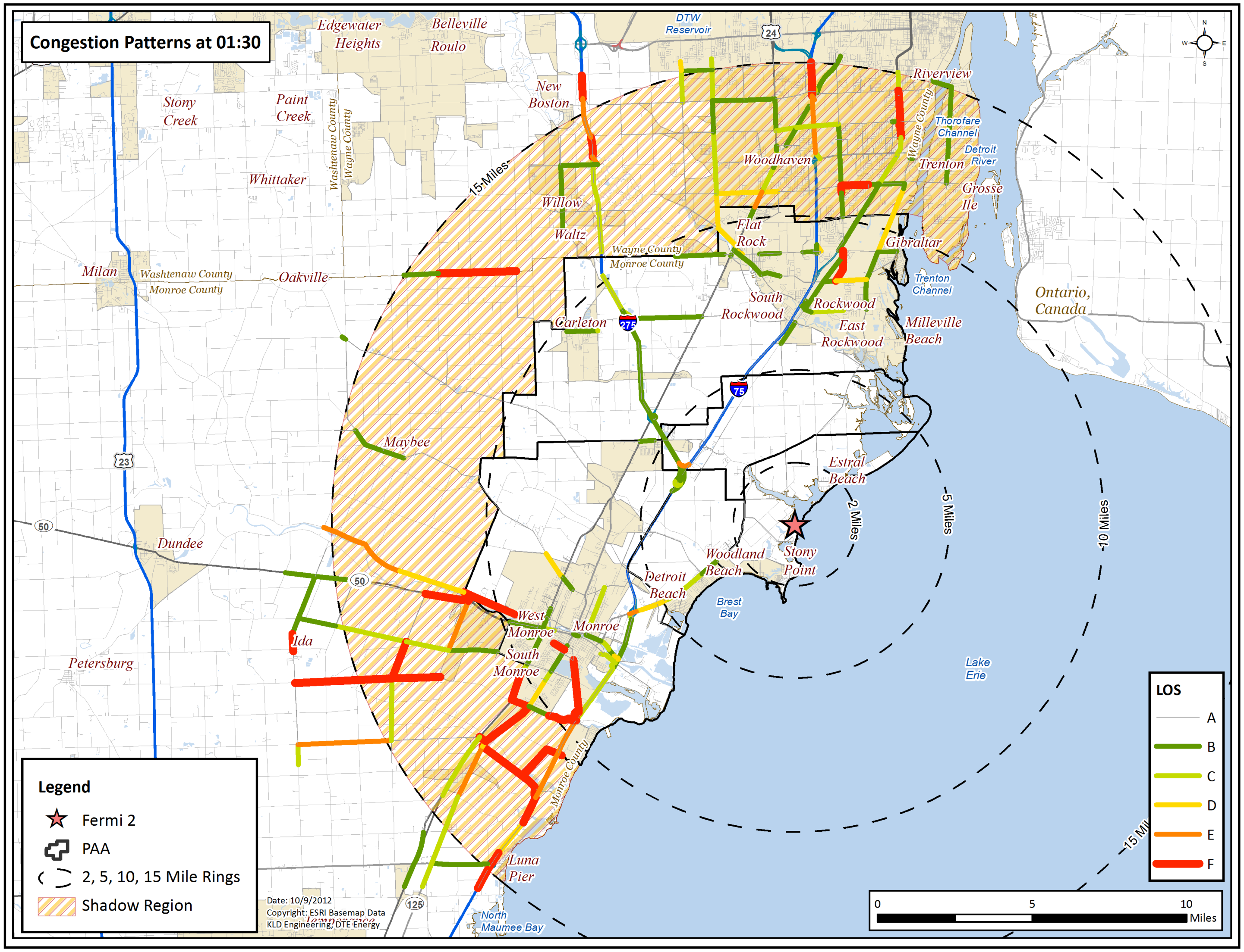


Figure 7-5. Congestion Patterns at 1 Hour, 30 Minutes after the Advisory to Evacuate

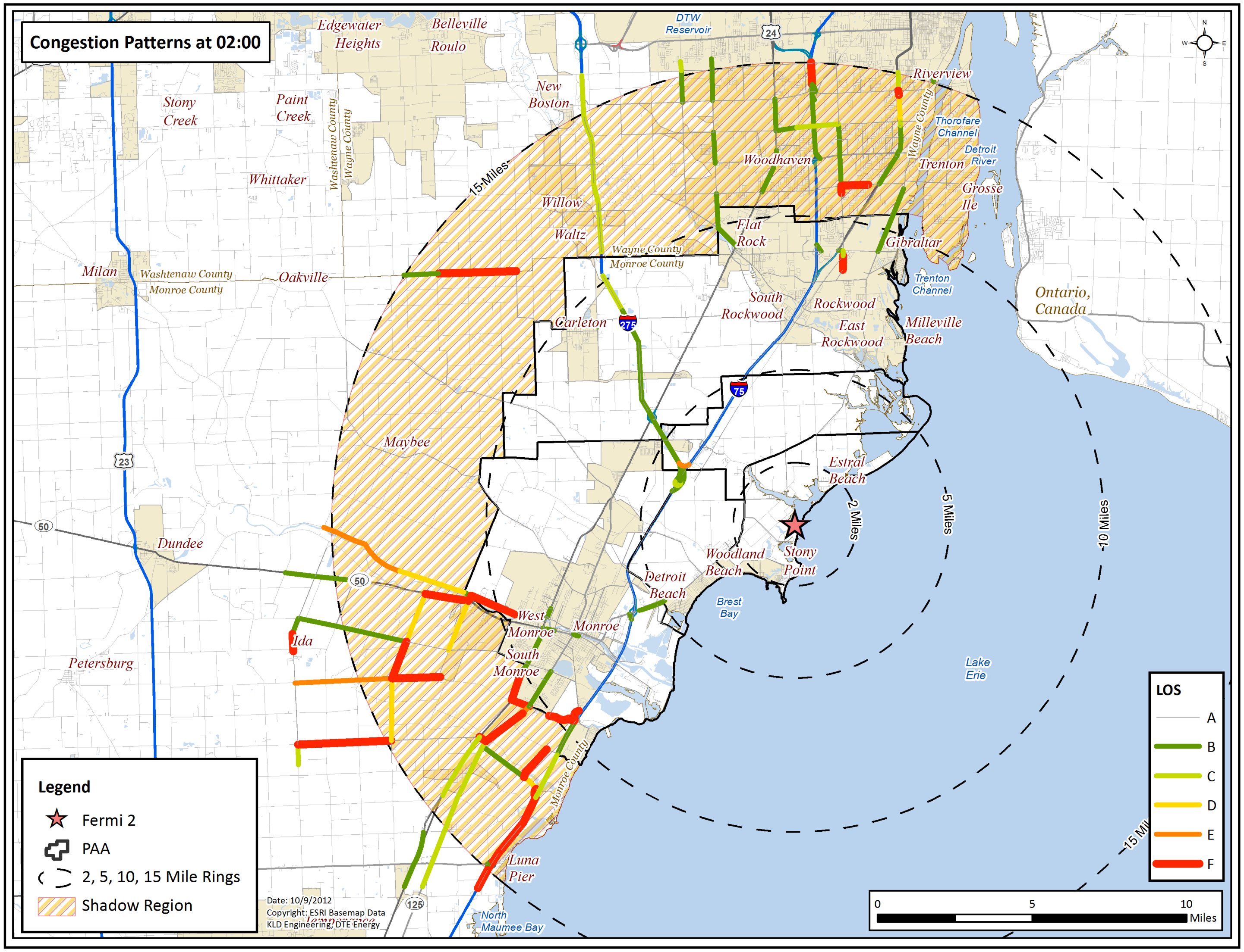


Figure 7-6. Congestion Patterns at 2 Hours after the Advisory to Evacuate

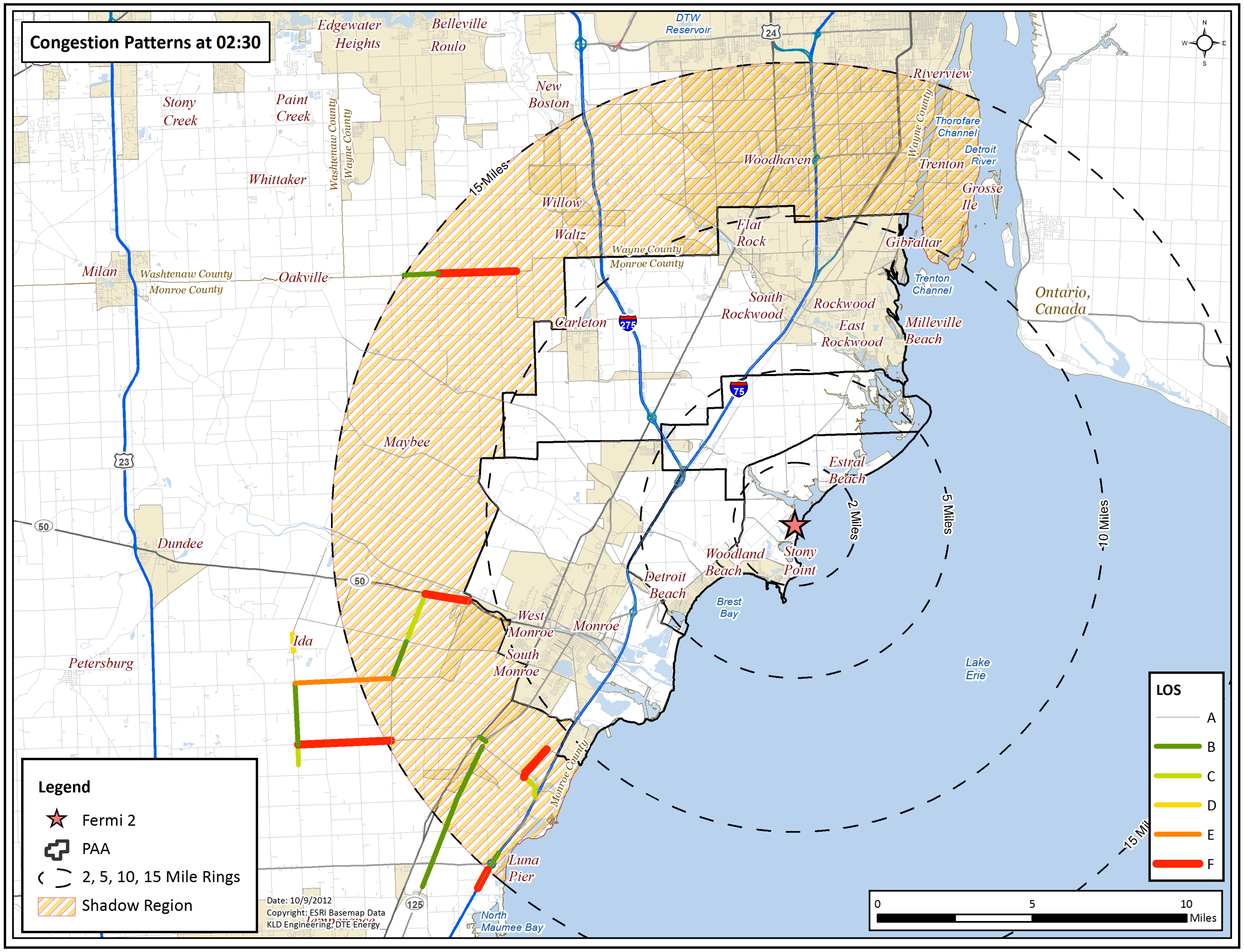


Figure 7-7. Congestion Patterns at 2 Hours, 30 Minutes after the Advisory to Evacuate

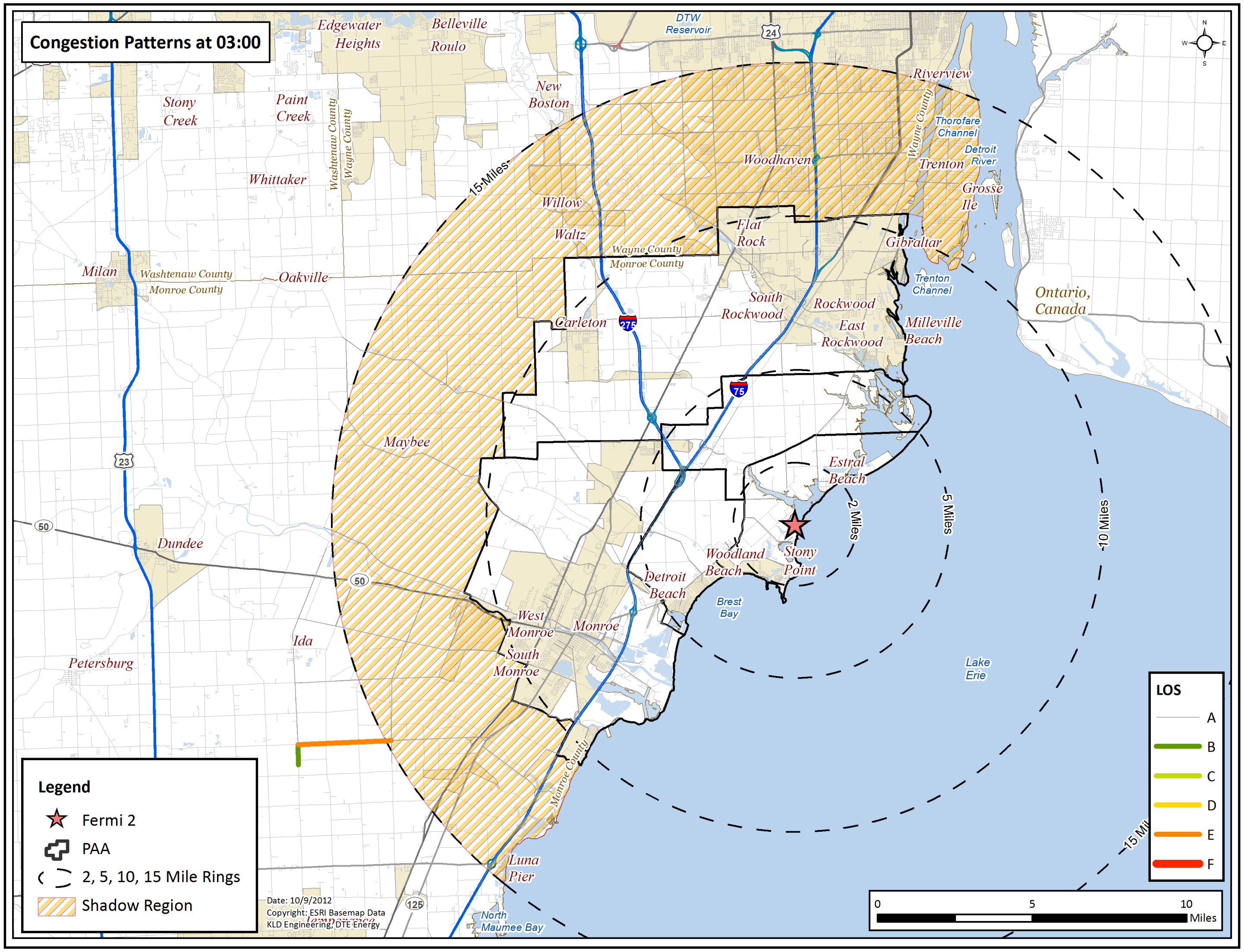


Figure 7-8. Congestion Patterns at 3 Hours after the Advisory to Evacuate

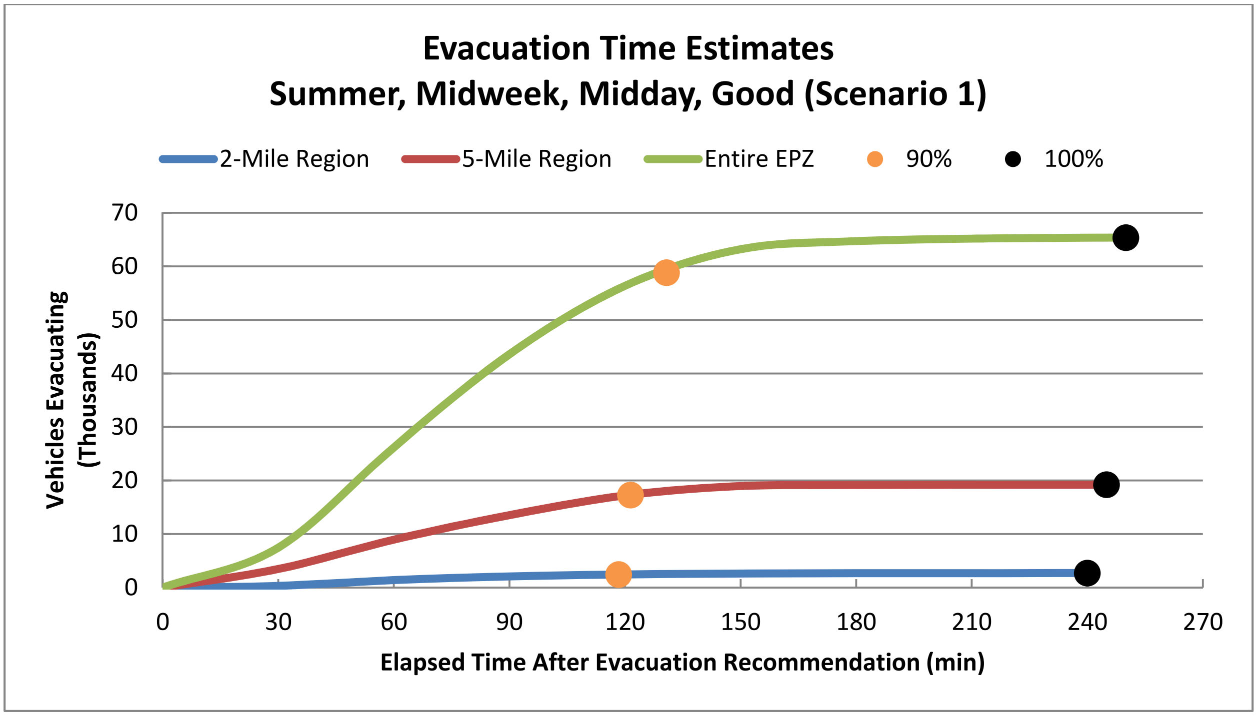


Figure 7-9. Evacuation Time Estimates - Scenario 1 for Region R03

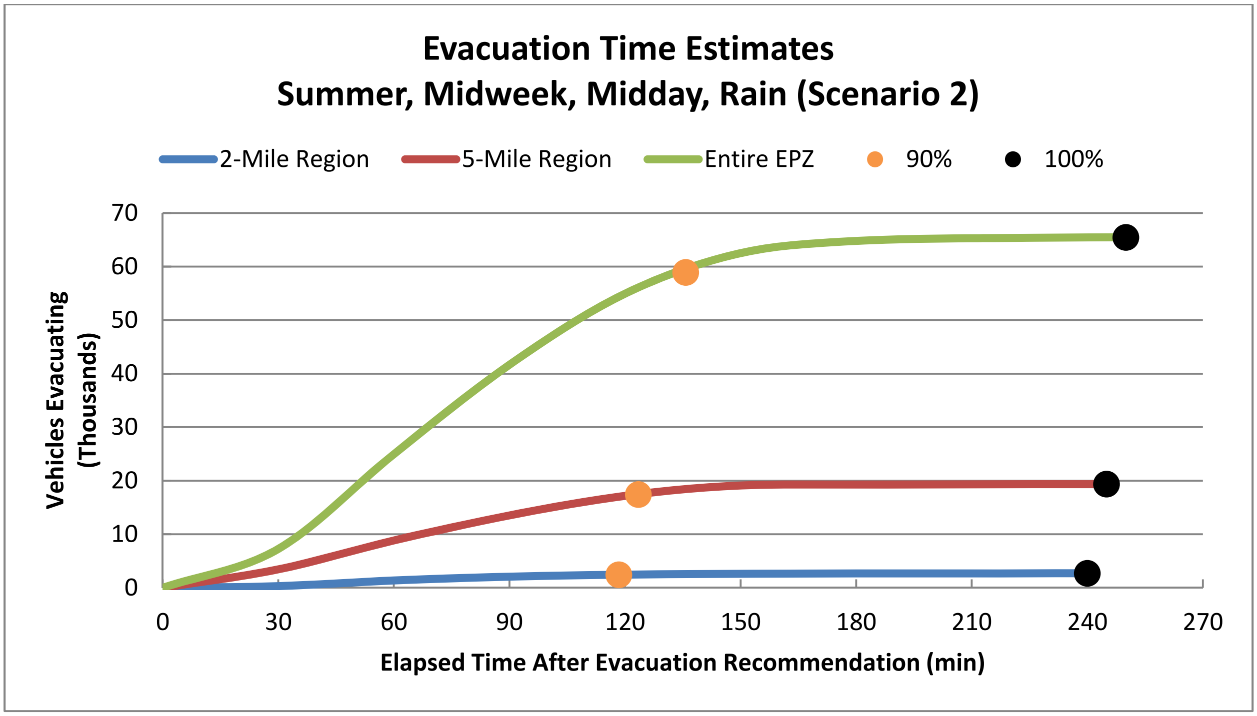


Figure 7-10. Evacuation Time Estimates - Scenario 2 for Region R03

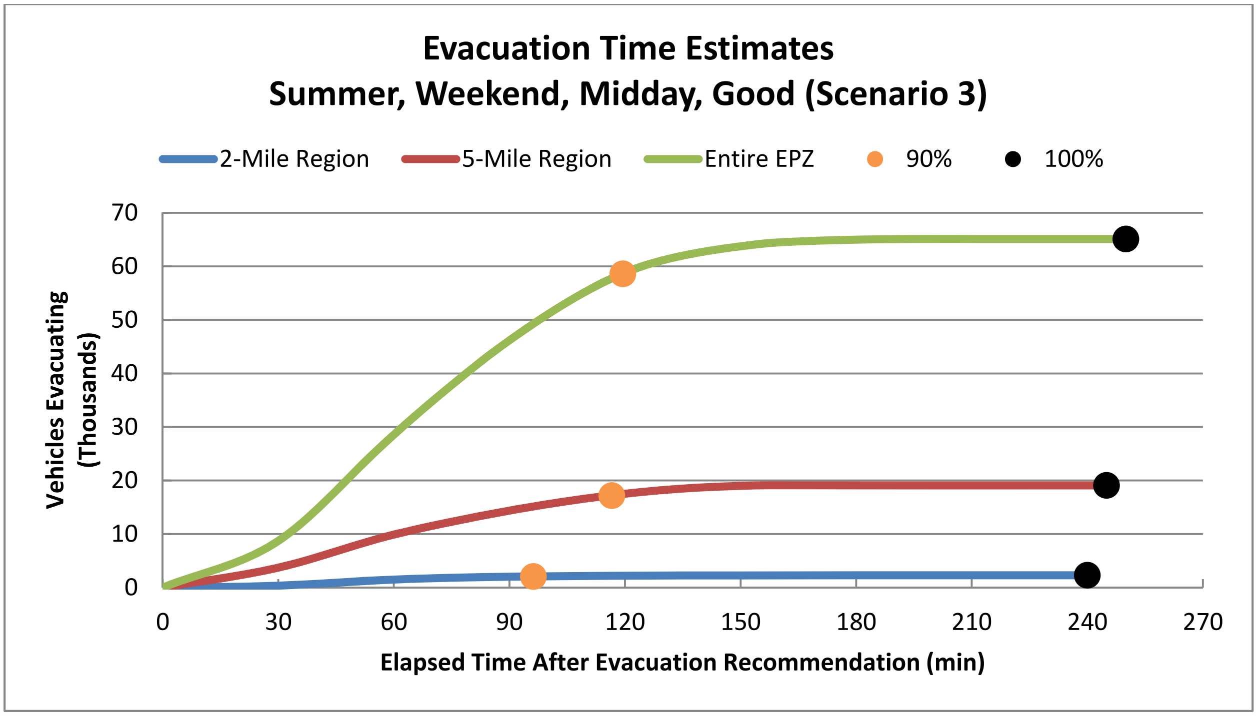


Figure 7-11. Evacuation Time Estimates - Scenario 3 for Region R03

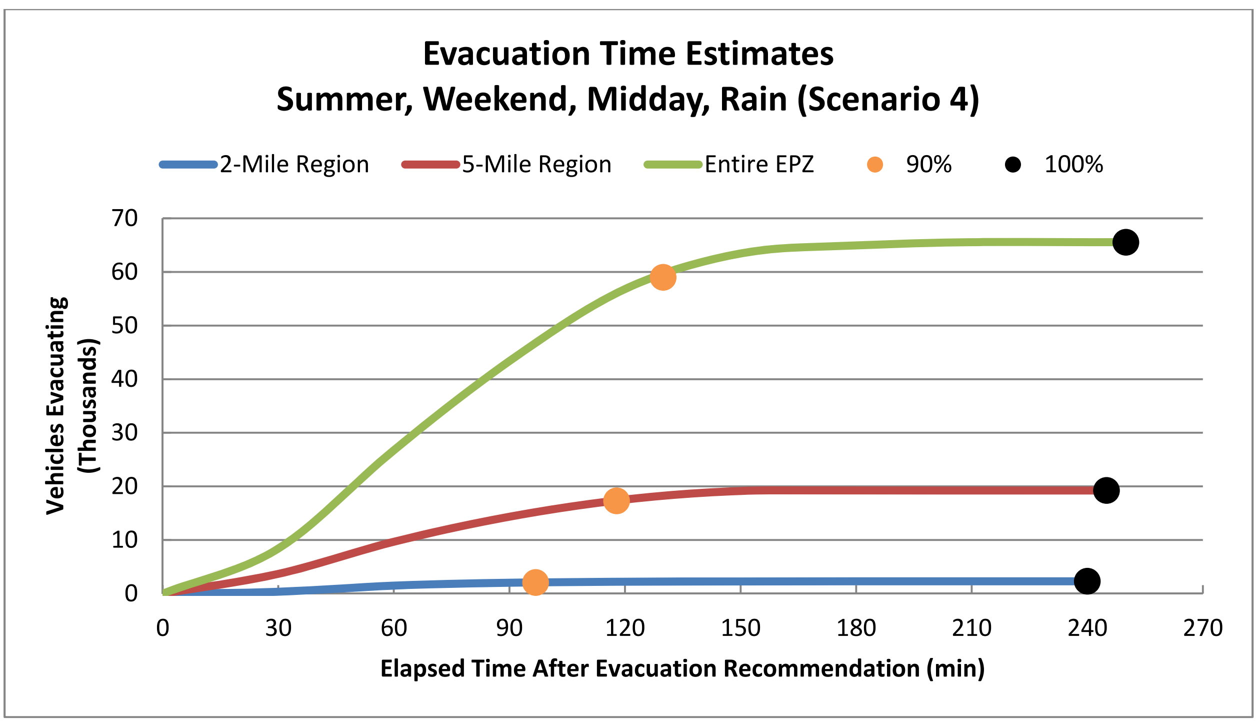


Figure 7-12. Evacuation Time Estimates - Scenario 4 for Region R03

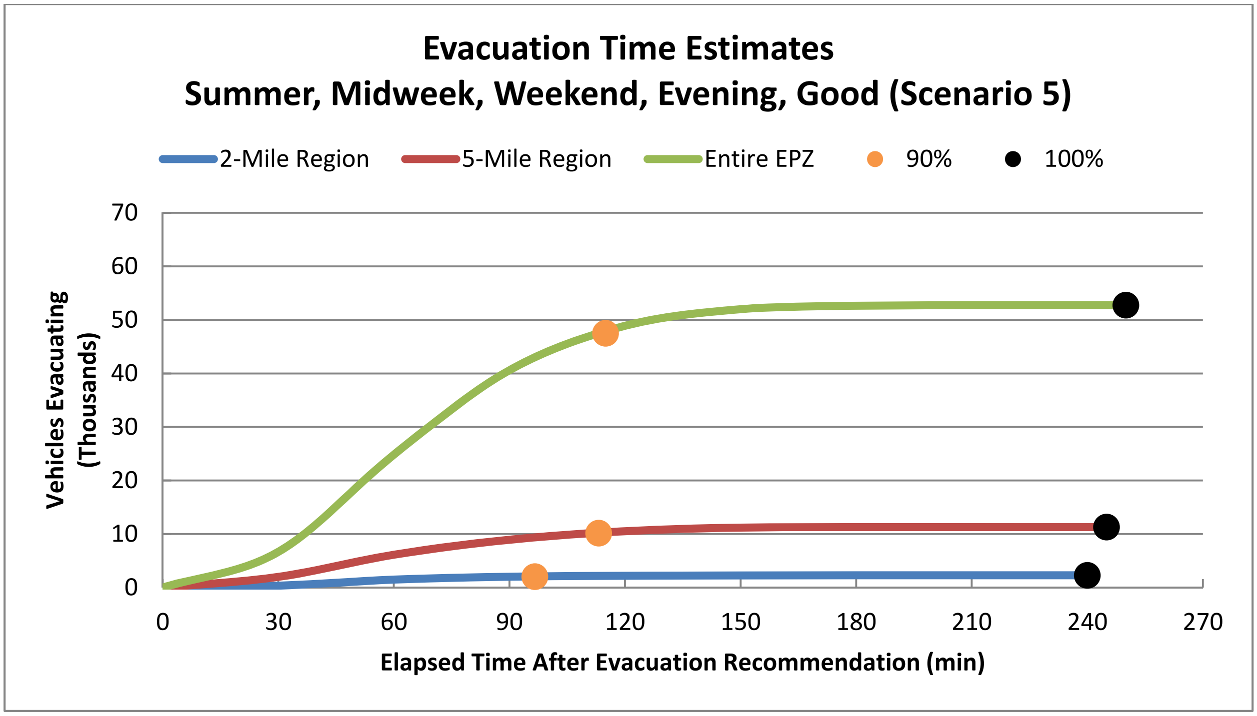


Figure 7-13. Evacuation Time Estimates - Scenario 5 for Region R03

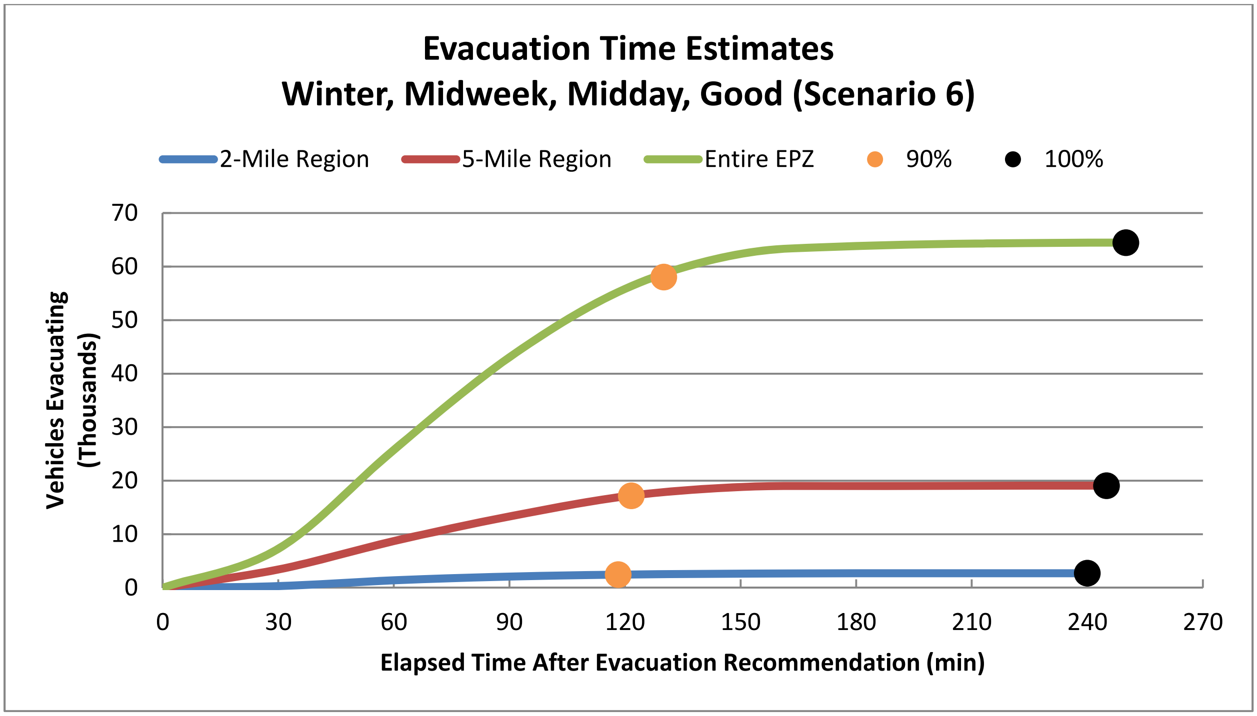


Figure 7-14. Evacuation Time Estimates - Scenario 6 for Region R03

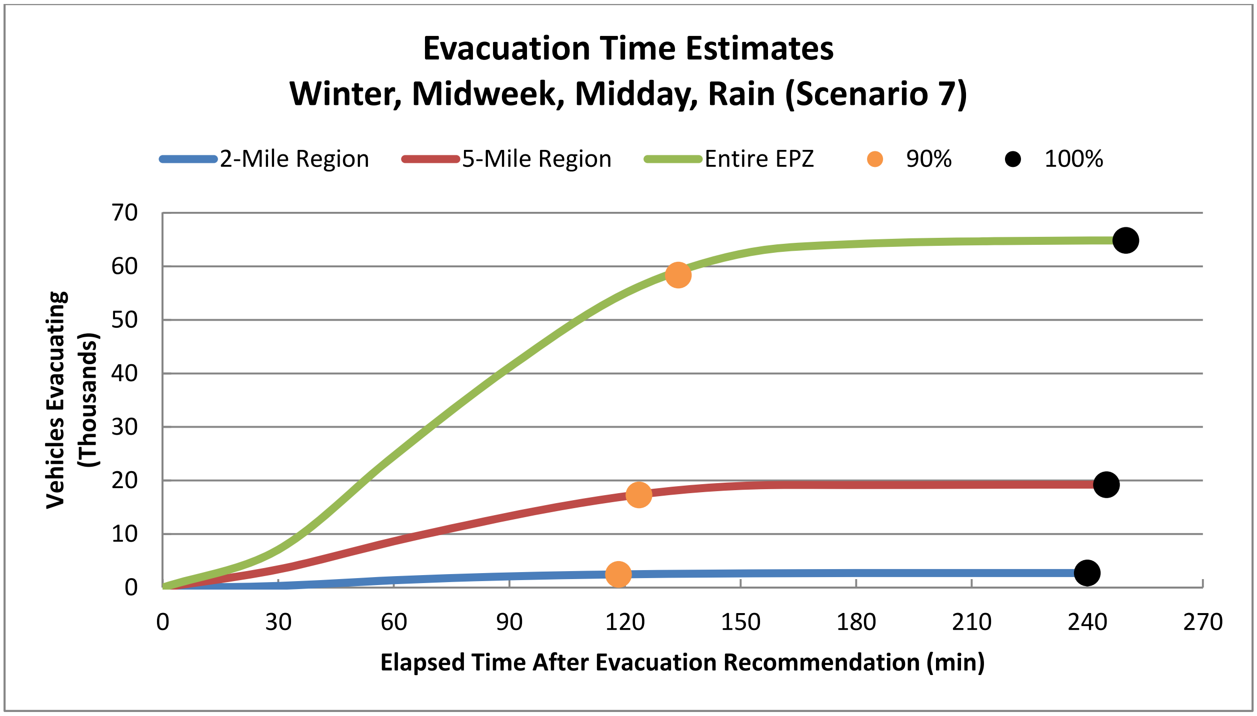


Figure 7-15. Evacuation Time Estimates - Scenario 7 for Region R03

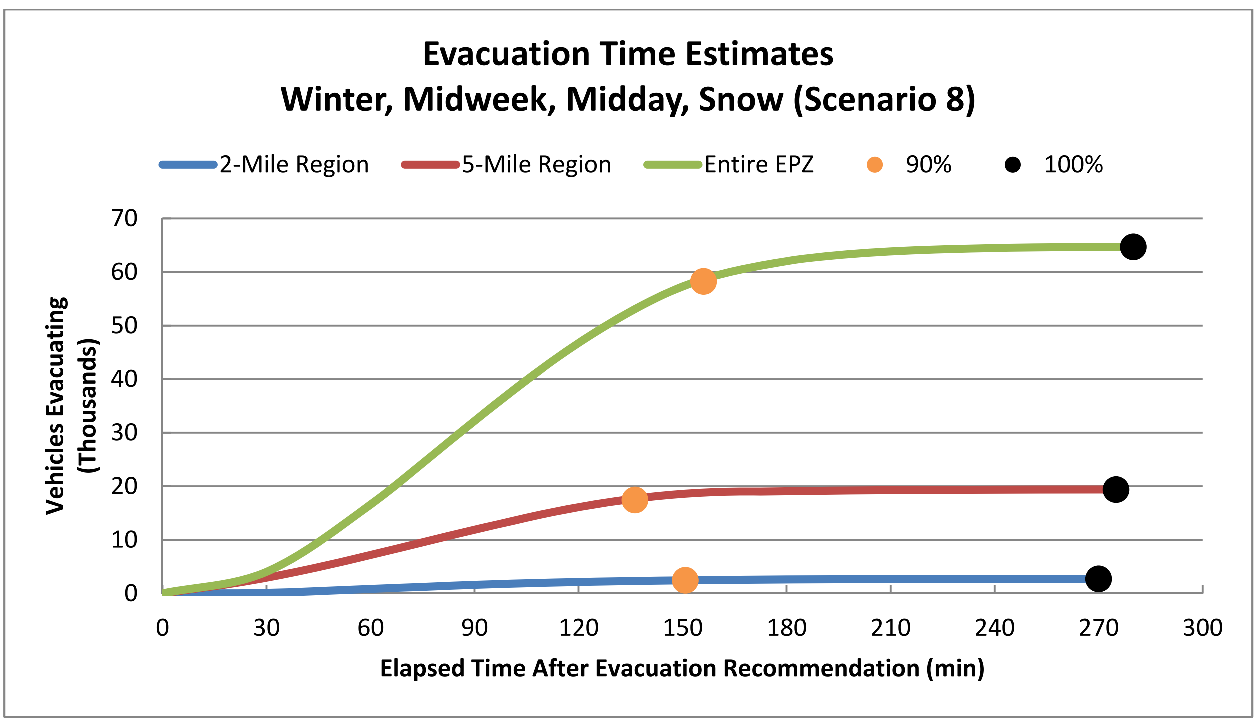


Figure 7-16. Evacuation Time Estimates - Scenario 8 for Region R03

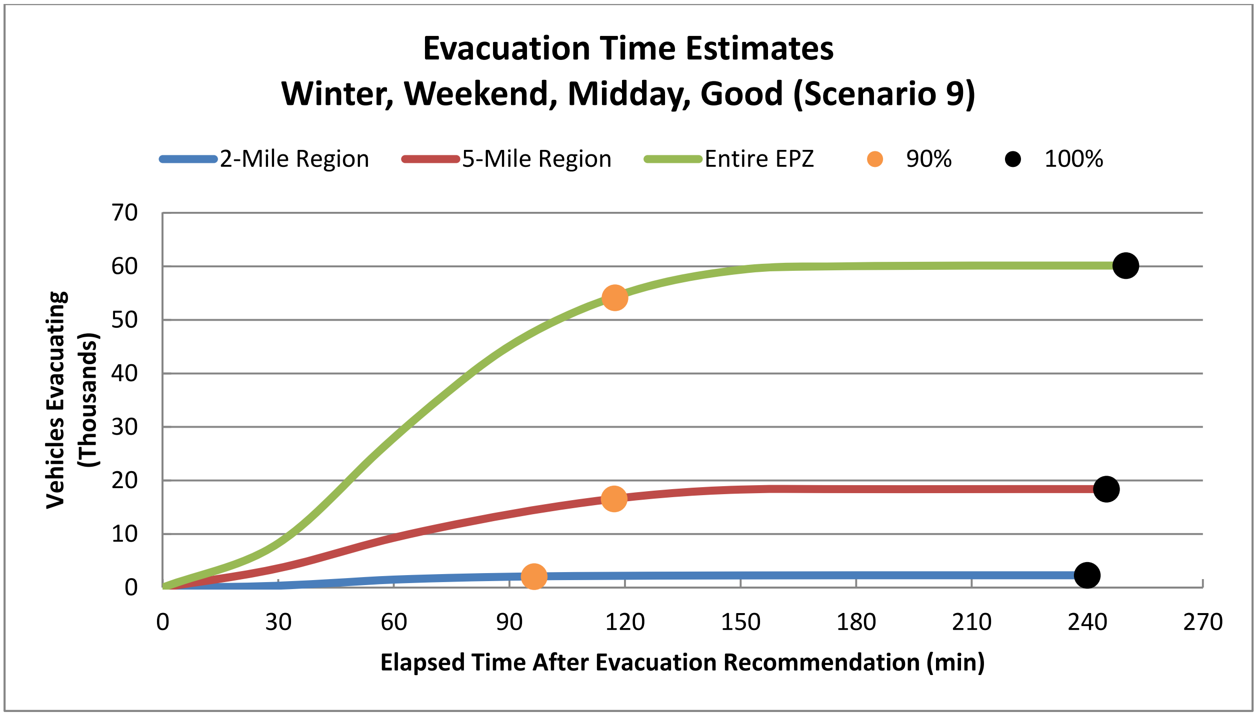


Figure 7-17. Evacuation Time Estimates - Scenario 9 for Region R03

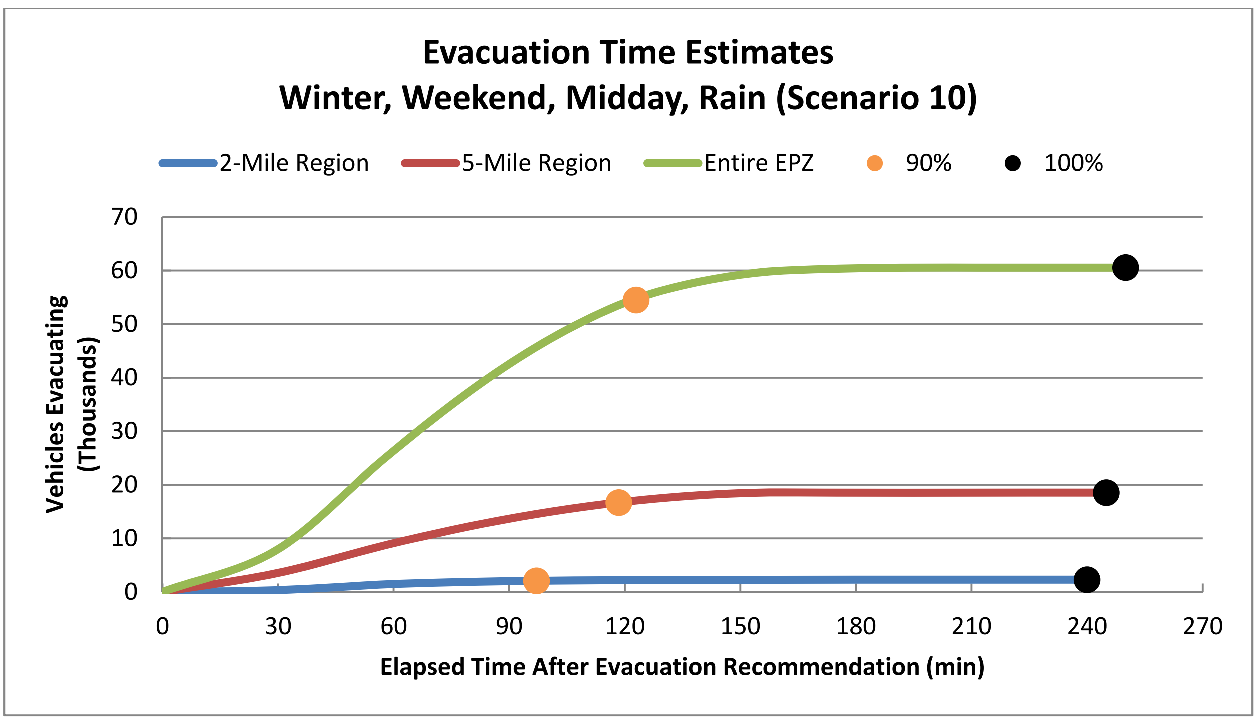


Figure 7-18. Evacuation Time Estimates - Scenario 10 for Region R03

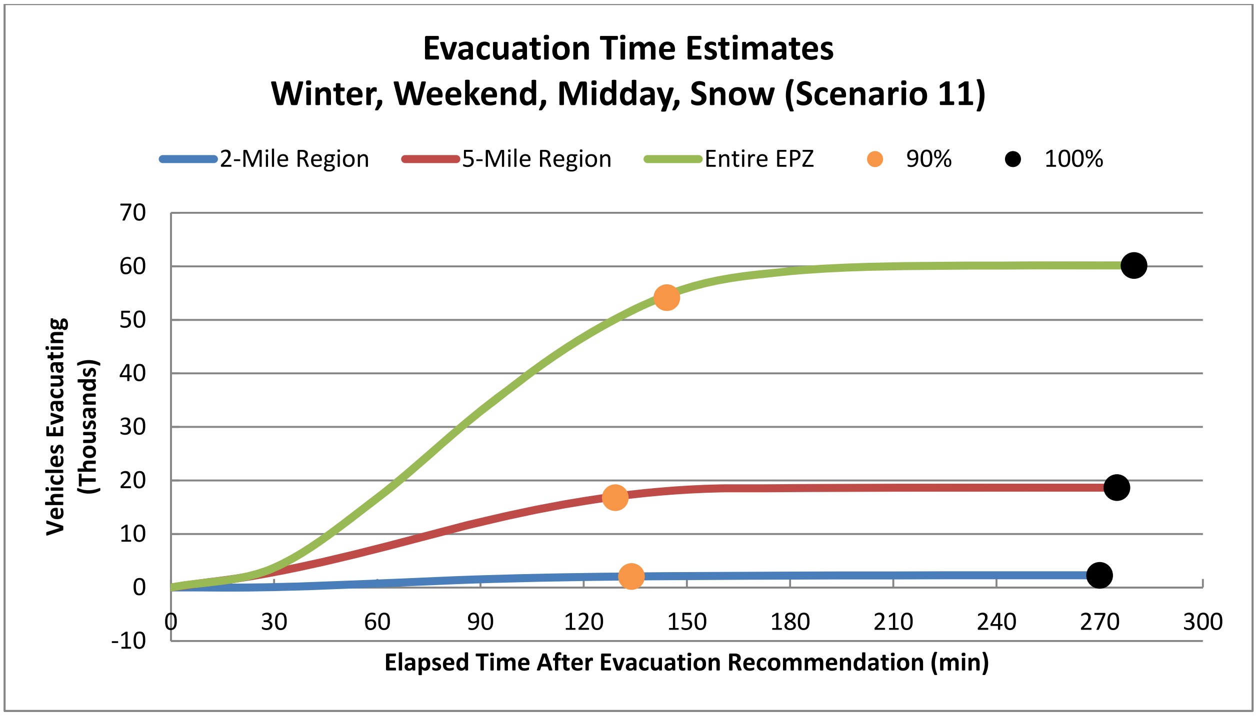


Figure 7-19. Evacuation Time Estimates - Scenario 11 for Region R03

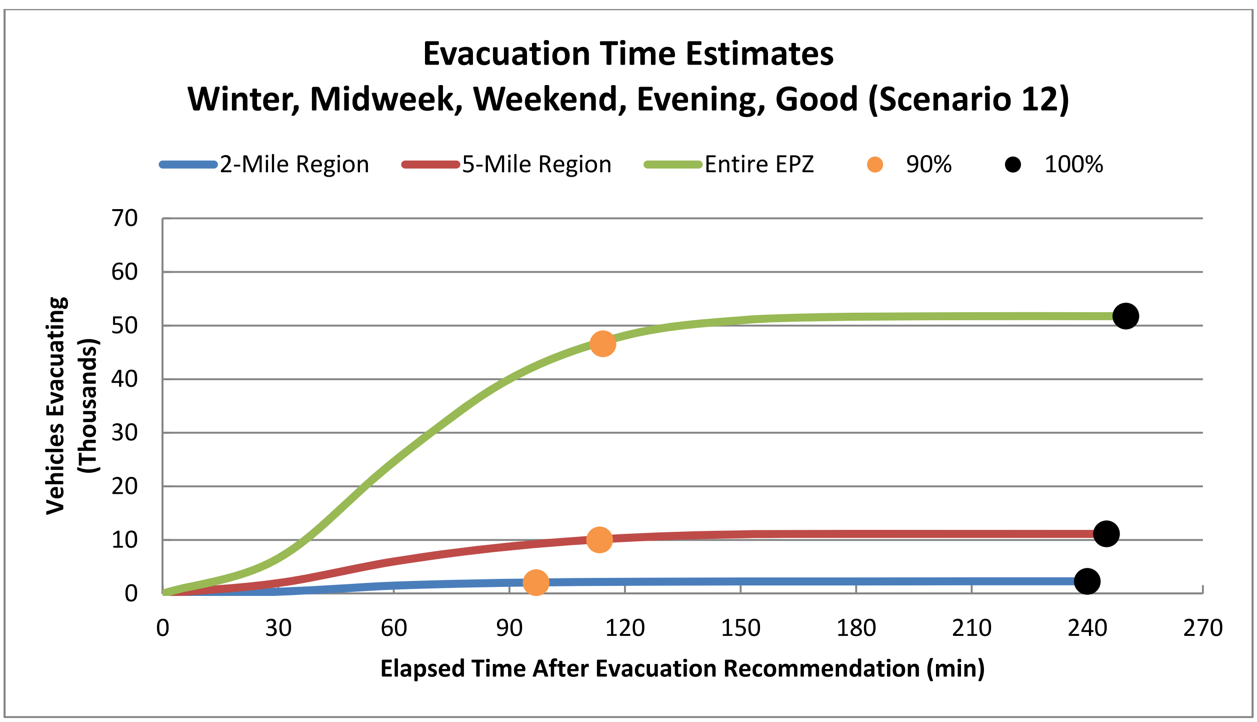


Figure 7-20. Evacuation Time Estimates - Scenario 12 for Region R03

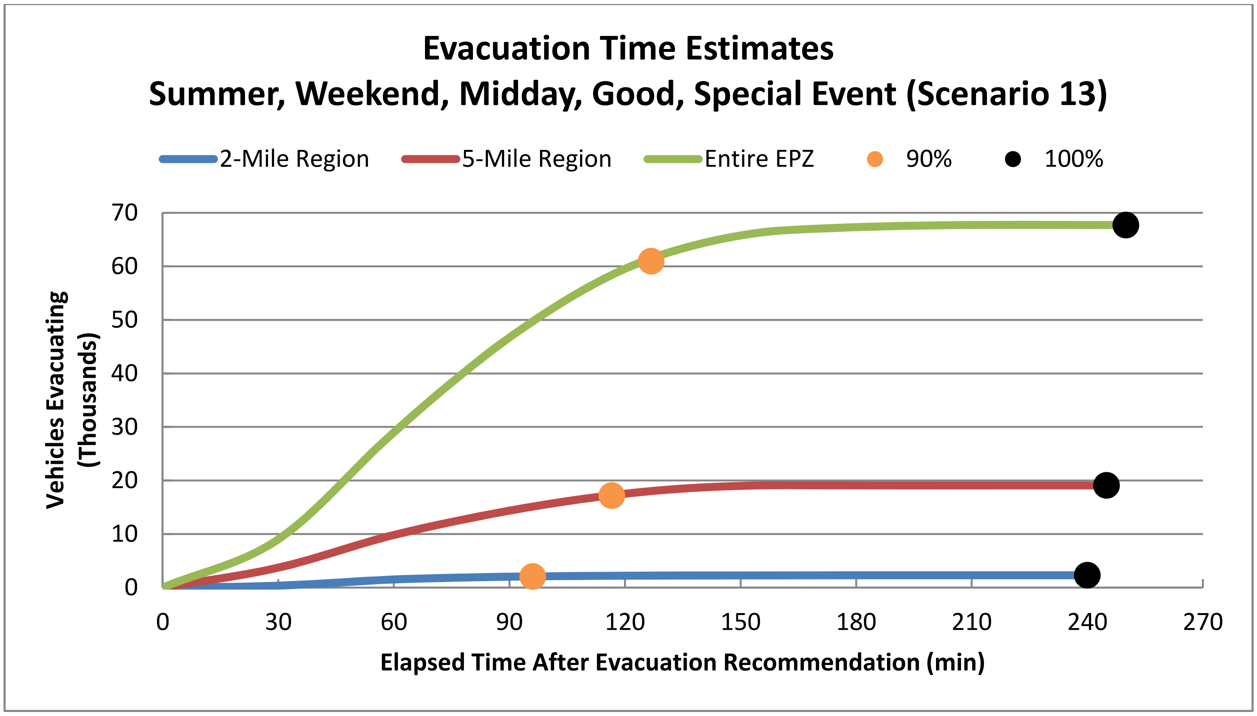


Figure 7-21. Evacuation Time Estimates - Scenario 13 for Region R03

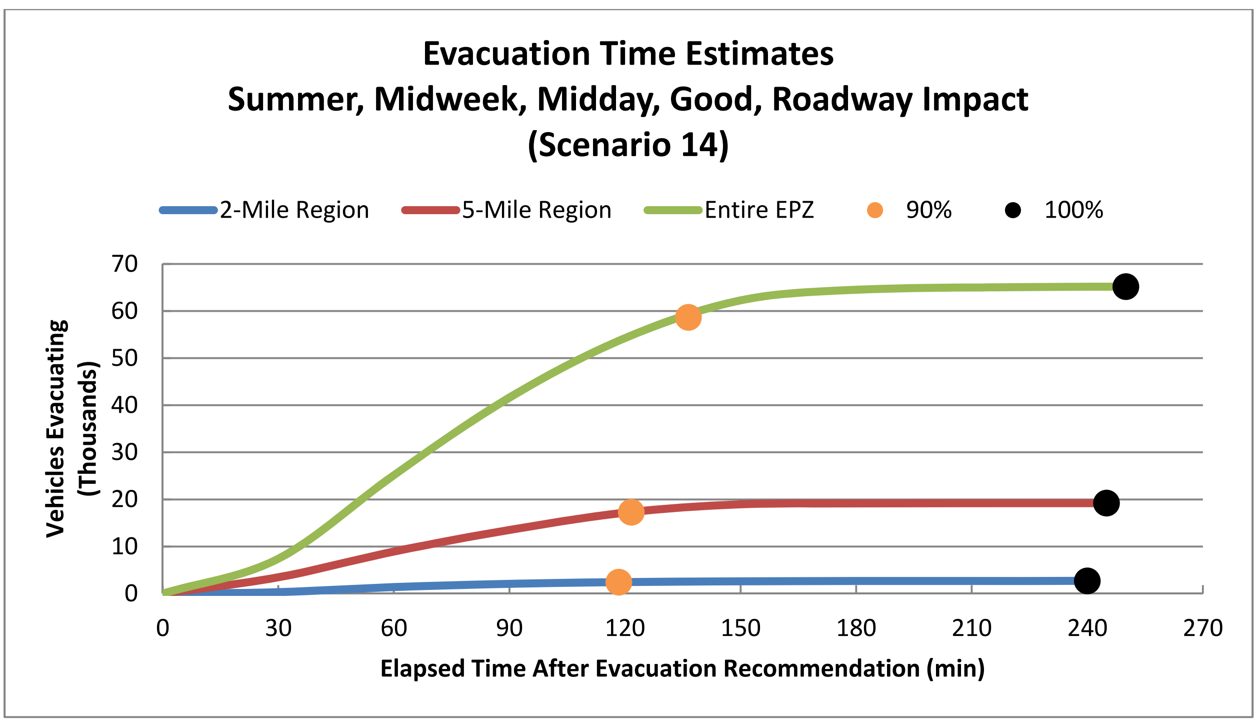


Figure 7-22. Evacuation Time Estimates - Scenario 14 for Region R03

8 TRANSIT-DEPENDENT AND SPECIAL FACILITY EVACUATION TIME ESTIMATES

This section details the analyses applied and the results obtained in the form of evacuation time estimates for transit vehicles. The demand for transit service reflects the needs of three population groups: (1) residents with no vehicles available; (2) residents of special facilities such as schools, medical facilities, and correctional facilities; and (3) homebound special needs population.

These transit vehicles mix with the general evacuation traffic that is comprised mostly of "passenger cars" (pc's). The presence of each transit vehicle in the evacuating traffic stream is represented within the modeling paradigm described in Appendix D as equivalent to two pc's. This equivalence factor represents the longer size and more sluggish operating characteristics of a transit vehicle, relative to those of a pc.

Transit vehicles must be mobilized in preparation for their respective evacuation missions. Specifically:

- Bus drivers must be alerted
- They must travel to the bus depot
- They must be briefed there and assigned to a route or facility

These activities consume time. Based on discussion with the offsite agencies, it is estimated that bus mobilization time will average approximately 90 minutes extending from the Advisory to Evacuate to the time when buses first arrive at the facility to be evacuated, unless specific facility data is provided.

During this mobilization period, other mobilization activities are taking place. One of these is the action taken by parents, neighbors, relatives and friends to pick up children from school prior to the arrival of buses, so that they may join their families. Virtually all studies of evacuations have concluded that this "bonding" process of uniting families is universally prevalent during emergencies and should be anticipated in the planning process. The current public information disseminated to residents of the Fermi EPZ indicates that schoolchildren will be evacuated to host schools where they can be picked up by parents. As discussed in Section 2, this study assumes a fast breaking general emergency. Therefore, children are evacuated to host schools. Picking up children at school could add to traffic congestion at the schools, delaying the departure of the buses evacuating schoolchildren, which may have to return in a subsequent "wave" to the EPZ to evacuate the transit-dependent population. This report provides estimates of buses under the assumption that no children will be picked up by their parents (in accordance with NUREG/CR-7002), to present an upper bound estimate of buses required. It is assumed that children at day-care centers are picked up by parents or guardians and that the time to perform this activity is included in the trip generation times discussed in Section 5.

The procedure for computing transit-dependent ETE is to:

- Estimate demand for transit service

- Estimate time to perform all transit functions
- Estimate route travel times to the EPZ boundary and to the reception centers

8.1 Transit Dependent People Demand Estimate

The telephone survey (see Appendix F) results were used to estimate the portion of the population requiring transit service:

- Those persons in households that do not have a vehicle available.
- Those persons in households that do have vehicle(s) that would not be available at the time the evacuation is advised.

In the latter group, the vehicle(s) may be used by a commuter(s) who does not return (or is not expected to return) home to evacuate the household.

Table 8-1 presents estimates of transit-dependent people. Note:

- Estimates of persons requiring transit vehicles include schoolchildren. For those evacuation scenarios where children are at school when an evacuation is ordered, separate transportation is provided for the schoolchildren. The actual need for transit vehicles by residents is thereby less than the given estimates. However, estimates of transit vehicles are not reduced when schools are in session.
- It is reasonable and appropriate to consider that many transit-dependent persons will evacuate by ride-sharing with neighbors, friends or family. For example, nearly 80 percent of those who evacuated from Mississauga, Ontario who did not use their own cars, shared a ride with neighbors or friends. Other documents report that approximately 70 percent of transit dependent persons were evacuated via ride sharing. **We will adopt a conservative estimate that 50 percent of transit dependent persons will ride share, in accordance with NUREG/CR-7002.**

The estimated number of bus trips needed to service transit-dependent persons is based on an estimate of average bus occupancy of 30 persons at the conclusion of the bus run. Transit vehicle seating capacities typically equal or exceed 60 children on average (roughly equivalent to 40 adults). If transit vehicle evacuees are two thirds adults and one third children, then the number of "adult seats" taken by 30 persons is 20 + (2/3 x10) = 27. On this basis, the average load factor anticipated is (27/40) x 100 = 68 percent. Thus, if the actual demand for service exceeds the estimates of Table 8-1 by 50 percent, the demand for service can still be accommodated by the available bus seating capacity.

$$\left[20 + \left(\frac{2}{3} \times 10\right)\right] \div 40 \times 1.5 = 1.00$$

Table 8-1 indicates that transportation must be provided for 2,834 people. Therefore, a total of **95 bus runs** are required to transport this population to reception centers.

To illustrate this estimation procedure, we calculate the number of persons, P, requiring public transit or ride-share, and the number of buses, B, required for the Fermi EPZ:

$$P = No. of\ HH\ \times \sum_{i=0}^{n} \{(\%\ HH\ with\ i\ vehicles) \times [(Average\ HH\ Size) - i]\} \times A^i C^i$$

Where,

A = Percent of households with commuters

C = Percent of households who will not await the return of a commuter

$$P = 35{,}965 \times [0.042 \times 1.57 + 0.246 \times (1.87 - 1) \times 0.62 \times 0.45 + 0.494 \times (2.83 - 2) \times (0.62 \times 0.45)^2] = 5{,}667$$

$$B = (0.5 \times P) \div 30 = 95$$

These calculations are explained as follows:

- All members (1.57 avg.) of households (HH) with no vehicles (4.2%) will evacuate by public transit or ride-share. The term 35,965 (number of households) x 0.042 x 1.57, accounts for these people.
- The members of HH with 1 vehicle away (24.6%), who are at home, equal (1.87-1). The number of HH where the commuter will not return home is equal to (35,965 x 0.246 x 0.62 x 0.45), as 62% of EPZ households have a commuter, 45% of which would not return home in the event of an emergency. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms.
- The members of HH with 2 vehicles that are away (49.4%), who are at home, equal (2.83 – 2). The number of HH where neither commuter will return home is equal to 35,965 x 0.494 x $(0.62 \times 0.45)^2$. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms (the last term is squared to represent the probability that neither commuter will return).
- Households with 3 or more vehicles are assumed to have no need for transit vehicles.
- The total number of persons requiring public transit is the sum of such people in HH with no vehicles, or with 1 or 2 vehicles that are away from home.

The estimate of transit-dependent population in Table 8-1 far exceeds the number of registered transit-dependent persons in the EPZ as provided by the counties (discussed below in Section 8.5). This is consistent with the findings of NUREG/CR-6953, Volume 2, in that a large majority of the transit-dependent population within the EPZs of U.S. nuclear plants does not register with their local emergency response agency.

8.2 School Population – Transit Demand

Table 8-2 presents the school population and transportation requirements for the direct evacuation of all schools within the EPZ for the 2011-2012 school year. This information was provided by the local county emergency management agencies. The column in Table 8-2 entitled "Buses Required" specifies the number of buses required for each school under the following set of assumptions and estimates:

- No students will be picked up by their parents prior to the arrival of the buses.
- While many high school students commute to school using private automobiles (as discussed in Section 2.4 of NUREG/CR-7002), the estimate of buses required for school evacuation do not consider the use of these private vehicles.
- Bus capacity, expressed in students per bus, is set to 70 for primary schools and 50 for middle and high schools.
- Those staff members who do not accompany the students will evacuate in their private vehicles.
- No allowance is made for student absenteeism, typically 3 percent daily.

It is recommended that the counties in the EPZ introduce procedures whereby the schools are contacted prior to the dispatch of buses from the depot, to ascertain the current estimate of students to be evacuated. In this way, the number of buses dispatched to the schools will reflect the actual number needed. The need for buses would be reduced by any high school students who have evacuated using private automobiles (if permitted by school authorities). Those buses originally allocated to evacuate schoolchildren that are not needed due to children being picked up by their parents, can be gainfully assigned to service other facilities or those persons who do not have access to private vehicles or to ride-sharing.

Table 8-3 presents a list of the host schools for each school district in the EPZ. Students will be transported to these host schools where they will be subsequently retrieved by their respective families.

8.3 Medical Facility Demand

Table 8-4 presents the census of medical facilities in the EPZ. 950 people have been identified as living in, or being treated in, these facilities. The capacity and current census for each facility were provided by the county emergency management agencies. This data includes the number of ambulatory, wheelchair-bound and bedridden patients at each facility.

The transportation requirements for the medical facility population are also presented in Table 8-4. The number of ambulance runs is determined by assuming that 2 patients can be accommodated per ambulance trip; the number of wheelchair van runs assumes 4 wheelchair-bound patients per trip and the number of bus runs estimated assumes 30 ambulatory patients per trip.

8.4 Evacuation Time Estimates for Transit Dependent People

EPZ bus resources are assigned to evacuating schoolchildren (if school is in session at the time of the ATE) as the first priority in the event of an emergency. In the event that the allocation of buses dispatched from the depots to the various facilities and to the bus routes is somewhat "inefficient", or if there is a shortfall of available drivers, then there may be a need for some buses to return to the EPZ from the reception center after completing their first evacuation trip, to complete a "second wave" of providing transport service to evacuees. For this reason, the ETE for the transit-dependent population will be calculated for both a one wave transit evacuation and for two waves. Of course, if the impacted Evacuation Region is other than R03 (the entire EPZ), then there will likely be ample transit resources relative to demand in the impacted Region and this discussion of a second wave would likely not apply.

When school evacuation needs are satisfied, subsequent assignments of buses to service the transit-dependent should be sensitive to their mobilization time. Clearly, the buses should be dispatched after people have completed their mobilization activities and are in a position to board the buses when they arrive at the pick-up points.

Evacuation Time Estimates for transit trips were developed using both good weather and adverse weather conditions. Figure 8-1 presents the chronology of events relevant to transit operations. The elapsed time for each activity will now be discussed with reference to Figure 8-1.

Activity: Mobilize Drivers (A→B→C)

Mobilization is the elapsed time from the Advisory to Evacuate until the time the buses arrive at the facility to be evacuated. For many schools, the mobilization time for buses was provided by the county. For those schools which did not provide information, it is assumed that for a rapidly escalating radiological emergency with no observable indication before the fact, school bus drivers would likely require 90 minutes to be contacted, to travel to the depot, be briefed, and to travel to the transit-dependent facilities. Mobilization time is slightly longer in adverse weather – 100 minutes when raining, 110 minutes when snowing.

Activity: Board Passengers (C→D)

Based on discussions with offsite agencies, a loading time of 15 minutes (20 minutes for rain and 25 minutes for snow) for school buses is used.

For multiple stops along a pick-up route (transit-dependent bus routes) estimation of travel time must allow for the delay associated with stopping and starting at each pick-up point. The time, t, required for a bus to decelerate at a rate, "a", expressed in ft/sec/sec, from a speed, "v", expressed in ft/sec, to a stop, is t = v/a. Assuming the same acceleration rate and final speed following the stop yields a total time, T, to service boarding passengers:

$$T = t + B + t = B + 2t = B + \frac{2v}{a},$$

Where B = Dwell time to service passengers. The total distance, "s" in feet, travelled during the deceleration and acceleration activities is: $s = v^2/a$. If the bus had not stopped to service passengers, but had continued to travel at speed, v, then its travel time over the distance, s, would be: s/v = v/a. Then the total delay (i.e. pickup time, P) to service passengers is:

$$P = T - \frac{v}{a} = B + \frac{v}{a}$$

Assigning reasonable estimates:

- B = 50 seconds: a generous value for a single passenger, carrying personal items, to board per stop
- v = 25 mph = 37 ft/sec
- a = 4 ft/sec/sec, a moderate average rate

Then, P ≈ 1 minute per stop. Allowing 30 minutes pick-up time per bus run implies 30 stops per run, for good weather. It is assumed that bus acceleration and speed will be less in rain; total loading time is 40 minutes per bus in rain, 50 minutes in snow.

Activity: Travel to EPZ Boundary (D→E)

School Evacuation

Transportation resources available were provided by the EPZ county emergency management agencies and are summarized in Table 8-5. Also included in the table are the number of buses needed to evacuate schools, medical facilities, transit-dependent population, homebound special needs (discussed below in Section 8.5) and correctional facilities (discussed below in Section 8.6). These numbers indicate there are sufficient resources available to evacuate the transit dependent population in a single wave.

The buses servicing the schools are ready to begin their evacuation trips at 15 minutes (loading time) after mobilization time. The UNITES software discussed in Section 1.3 was used to define bus routes along the most likely path from a school being evacuated to the EPZ boundary, traveling toward the appropriate host school. This is done in UNITES by interactively selecting the series of nodes from the school to the EPZ boundary. Each bus route is given an identification number and is written to the DYNEV II input stream. DYNEV computes the route length and outputs the average speed for each 5 minute interval, for each bus route. The specified bus routes are documented in Table 8-6 (refer to the maps of the link-node analysis network in Appendix K for node locations). Data provided by DYNEV during the appropriate timeframe depending on the mobilization and loading times (i.e., 100 to 105 minutes after the advisory to evacuate for good weather) were used to compute the average speed for each route, as follows:

$$Average\ Speed\ \left(\frac{mi.}{hr}\right)$$

$$= \left[\frac{\sum_{i=1}^{n} length\ of\ link\ i\ (mi)}{\sum_{i=1}^{n}\left\{Delay\ on\ link\ i\ (min.) + \frac{length\ of\ link\ i\ (mi.)}{current\ speed\ on\ link\ i\ \left(\frac{mi.}{hr.}\right)} \times \frac{60\ min.}{1\ hr.}\right\}}\right] \times \frac{60\ min.}{1\ hr.}$$

The average speed computed (using this methodology) for the buses servicing each of the schools in the EPZ is shown in Table 8-7 through Table 8-9 for school evacuation, and in Table 8-11 through Table 8-13 for the transit vehicles evacuating transit-dependent persons, which are discussed later. The travel time to the EPZ boundary was computed for each bus using the computed average speed and the distance to the EPZ boundary along the most likely route out of the EPZ. The travel time from the EPZ boundary to the host school was computed assuming an average speed of 40 mph, 35 mph, and 30 mph for good weather, rain and snow, respectively. Speeds were reduced in Table 8-7 through Table 8-9 and in Table 8-11 through Table 8-13 to 55 mph (50 mph for rain – 10% decrease – and 45 mph for snow – 20% decrease) for those calculated bus speeds which exceed 55 mph, as the school bus speed limit for state routes in Michigan is 55 mph.

Table 8-7 (good weather), Table 8-8 (rain) and Table 8-9 (snow) present the following evacuation time estimates (rounded up to the nearest 5 minutes) for schools in the EPZ: (1) The elapsed time from the Advisory to Evacuate until the bus exits the EPZ; and (2) The elapsed time until the bus reaches the host school. The evacuation time out of the EPZ can be computed as the sum of times associated with Activities A→B→C, C→D, and D→E (For example: 15 min. + 15 + 3 = 0:35 for Airport Senior High School, with good weather rounded up to the nearest 5 minutes). The evacuation time to the host school is determined by adding the time associated with Activity E→F (discussed below), to this EPZ evacuation time.

Evacuation of Transit-Dependent Population

The buses dispatched from the depots to service the transit-dependent evacuees will be scheduled so that they arrive at their respective routes after their passengers have completed their mobilization. As shown in Figure 5-4 (Residents with no Commuters), 90 percent of the evacuees will complete their mobilization when the buses will begin their routes, approximately 90 minutes after the Advisory to Evacuate. The routes were designed to cover the more urban areas where the transit-dependent population is likely to reside (see Table 8-10). The start of service on these routes is separated by 5 minute headways, as shown in Table 8-11 through Table 8-13. The use of bus headways ensures that those people who take longer to mobilize will be picked up. Mobilization time is 10 minutes longer in rain to account for slower travel speeds and reduced roadway capacity.

Those buses servicing the transit-dependent evacuees will first travel along their pick-up routes, then proceed out of the EPZ. The county emergency plans do not define bus routes to service these pick-up locations. The 7 bus routes shown graphically in Figure 8-2 and described in Table 8-10 were designed as part of this study to service the major routes through each population center. It is assumed that residents will walk to and congregate at these pre-designated pick-up locations, and that they can arrive at the stops within the 90 minute bus mobilization time (good weather).

As previously discussed, a pickup time of 30 minutes (good weather) is estimated for 30 individual stops to pick up passengers, with an average of one minute of delay associated with each stop. A longer pickup time of 40 minutes and 50 minutes are used for rain and snow, respectively.

The travel distance along the respective pick-up routes within the EPZ is estimated using the UNITES software. Bus travel times within the EPZ are computed using average speeds computed by DYNEV, using the aforementioned methodology that was used for school evacuation.

Table 8-11 through Table 8-13 present the transit-dependent population evacuation time estimates for each bus route calculated using the above procedures for good weather, rain and snow, respectively.

For example, the ETE for the bus numbers 1 & 2 servicing Route 1 is computed as 90 + 24 + 30 = 2:25 for good weather (rounded up to nearest 5 minutes). Here, 24 minutes is the time to travel 12.5 miles at 30.7 mph, the average speed output by the model for this route starting at 90 minutes. The ETE for a second wave (discussed below) is presented in the event there is a shortfall of available buses or bus drivers, as previously discussed.

<u>Activity: Travel to Reception Centers (E→F)</u>

The distances from the EPZ boundary to the reception centers are measured using GIS software along the most likely route from the EPZ exit point to the reception center. The reception centers are mapped in Figure 10-1. For a one-wave evacuation, this travel time outside the EPZ does not contribute to the ETE. For a two-wave evacuation, the ETE for buses must be considered separately, since it could exceed the ETE for the general population. Assumed bus speeds of 40 mph, 35 mph, and 30 mph for good weather, rain, and snow, respectively, will be applied for this activity for buses servicing the transit-dependent population.

<u>Activity: Passengers Leave Bus (F→G)</u>

A bus can empty within 5 minutes. The driver takes a 10 minute break.

<u>Activity: Bus Returns to Route for Second Wave Evacuation (G→C)</u>

The buses assigned to return to the EPZ to perform a “second wave” evacuation of transit-dependent evacuees will be those that have already evacuated transit-dependent people who mobilized more quickly. The first wave of transit-dependent people depart the bus, and the bus then returns to the EPZ, travels to its route and proceeds to pick up more transit-dependent evacuees along the route. The travel time back to the EPZ is equal to the travel time to the reception center.

The second-wave ETE for the bus numbers 1 & 2 route servicing Route 1 is computed as follows for good weather:

- Bus arrives at reception center at 2:34 in good weather (2:25 to exit EPZ + 9 minute travel time to reception center).
- Bus discharges passengers (5 minutes) and driver takes a 10-minute rest: 15 minutes.
- Bus returns to EPZ and completes second route: 9 minutes (equal to travel time to reception center) + 19 minutes (12.5 miles @ 40 mph) + 20 minutes (12.5 miles @ 37 mph)= 48 minutes
- Bus completes pick-ups along route: 30 minutes.
- Bus exits EPZ at time 2:25 + 0:09 + 0:15 + 0:48 + 0:30 = 4:10 (rounded to nearest 5 minutes) after the Advisory to Evacuate.

The ETE for the completion of the second wave for all transit-dependent bus routes are provided in Table 8-11 through Table 8-13. The average ETE for a two-wave evacuation of transit-dependent people exceeds the ETE for the general population at the 90th percentile.

The relocation of transit-dependent evacuees from the reception centers to congregate care centers, if the counties decide to do so, is not considered in this study.

Evacuation of Medical Facilities

The evacuation of these facilities is similar to school evacuation except:

- Buses are assigned on the basis of 30 patients to allow for staff to accompany the patients. Wheelchair buses can accommodate 15 patients, and ambulances can accommodate 2 patients.
- Loading times of 1 minute, 5 minutes, and 15 minutes per patient are assumed for ambulatory patients, wheelchair bound patients, and bedridden patients, respectively.

Table 8-4 indicates that 31 bus runs, 34 wheelchair van runs and 21 ambulance runs are needed to service all of the medical facilities in the EPZ. According to Table 8-5, the counties can collectively provide 1,812 buses, 14 short buses, 119 wheelchair vans and 129 ambulances. Thus, there are sufficient resources to evacuate the ambulatory and wheelchair bound persons from the medical facilities in a single wave

As is done for the schools, it is estimated that mobilization time averages 90 minutes. Specially trained medical support staff (working their regular shift) will be on site to assist in the evacuation of patients. Additional staff (if needed) could be mobilized over this same 90 minute timeframe.

Table 8-14 through Table 8-16 summarize the ETE for medical facilities within the EPZ for good weather, rain, and snow. Average speeds output by the model for Scenario 6 (Scenario 7 for rain and Scenario 8 for snow) Region 3, capped at 55 mph (50 mph for rain and 45 mph for snow), are used to compute travel time to EPZ boundary. The travel time to the EPZ boundary is computed by dividing the distance to the EPZ boundary by the average travel speed. The ETE is the sum of the mobilization time, total passenger loading time, and travel time out of the EPZ. Concurrent loading on multiple buses, wheelchair buses/vans, and ambulances at capacity is assumed such that the maximum loading times for buses, wheelchair buses and ambulances are 30, 75 and 30 minutes, respectively. All ETE are rounded to the nearest 5 minutes. For example, the calculation of ETE for the ALCC with 6 ambulatory residents during good weather is:

ETE: 90 + 6 x 1 + 9 = 105 min. or 1:45

It is assumed that medical facility population is directly evacuated to appropriate host medical facilities. Relocation of this population to permanent facilities and/or passing through the reception center before arriving at the host facility are not considered in this analysis.

8.5 Special Needs Population

The county emergency management agencies have separate registrations for homebound special needs persons. Based on data provided by Wayne County, the special needs population within the EPZ resides in Marybrook Residence, which is accounted for under medical facilities. Based on data provided by the Monroe County, there are an estimated 334 homebound special needs people, 219 that require a bus, 103 that require a wheelchair accessible vehicle, and 12 that require an ambulance to evacuate.

<u>ETE for Homebound Special Needs Persons</u>

Table 8-17 summarizes the ETE for homebound special needs people. The table is categorized by type of vehicle required and then broken down by weather condition. The table takes into consideration the deployment of multiple vehicles to reduce the number of stops per vehicle. It is conservatively assumed that ambulatory and wheelchair bound special needs households are spaced 3 miles apart and bedridden households are spaced 5 miles apart. Van and bus speeds approximate 20 mph between households and ambulance speeds approximate 30 mph in good weather (10% slower in rain, 20% slower in snow). Mobilization times of 90 minutes were used (100 minutes for rain, and 110 minutes for snow). The last HH is assumed to be 5 miles from the EPZ boundary, and the network-wide average speed, capped at 55 mph (50 mph for rain and 40 mph for snow), after the last pickup is used to compute travel time. ETE is computed by summing mobilization time, loading time at first household, travel to subsequent households, loading time at subsequent households, and travel time to EPZ boundary. All ETE are rounded to the nearest 5 minutes.

For example, assuming no more than one special needs person per HH implies that 219 ambulatory households need to be serviced. While only 8 buses are needed from a capacity perspective, if 32 buses are deployed to service these special needs HH, then each would require about 7 stops. The following outlines the ETE calculations:

1. Assume 32 buses are deployed, each with about 7 stops, to service a total of 219 HH.
2. The ETE is calculated as follows:

a. Buses arrive at the first pickup location: 90 minutes
b. Load HH members at first pickup: 5 minutes
c. Travel to subsequent pickup locations: 6 @ 9 minutes = 54 minutes
d. Load HH members at subsequent pickup locations: 6 @ 5 minutes = 30 minutes
e. Travel to EPZ boundary: 9 minutes (5 miles @ 34.4 mph).

ETE: 90 + 5 + 54 + 30 + 9 = 3:10 rounded to the nearest 5 minutes

8.6 Correctional Facilities

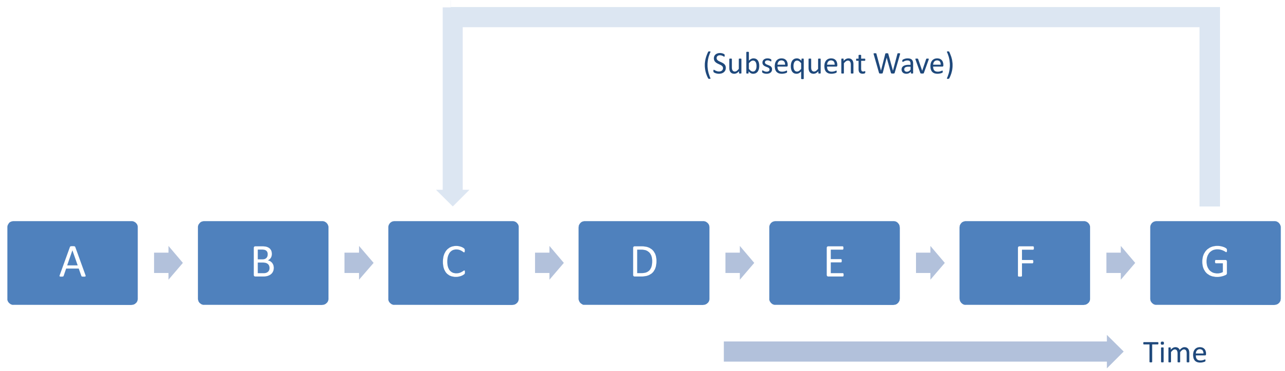
There are two correctional facilities within the Fermi 2 EPZ – Monroe City Jail Facility #1 and Facility #2 – as indicated in Table E-7. Based on discussions with the Monroe County Sheriff Department, school buses provided by the Monroe County School System would be used to transport prisoners from these facilities. As indicated in Table E-7, there are 343 inmates at these facilities. Assuming a bus capacity of 30 inmates, 12 buses would be needed. Mobilization time of buses would be 30 minutes to 1 hour, according to the sheriff's department. Monroe County has verbal agreements with Lucas County, Washtenaw County, Lenawee County and Wayne County to house these displaced inmates in the event of an evacuation. The following jails are located within these counties:

- Mound Correctional Facility in Wayne County, Michigan
- Ryan Correctional Facility in Wayne County, Michigan
- Gus Harrison Correctional Facility in Lenawee County, Michigan
- Huron Valley Complex in Washtenaw County, Michigan
- Toledo Correctional Institution in Lucas County, Ohio

It is assumed that loading time is 1 minute per passenger to account for additional security measures that will be taken, for a total loading time of 30 minutes per bus.

The ETE for the inmates at the Monroe City Jail is computed as follows:

- Mobilization time is 60 minutes.
- Loading time is 30 minutes.
- Lucas County is located to the south of the City of Monroe; Lenawee County is located to the west; Washtenaw is located to the northwest; and Wayne County is located to the north. Therefore, evacuation to any of these counties would require leaving the EPZ southbound to avoid traveling closer to the plant.
- Facility #1 would evacuate southbound on State Highway 125 to depart the EPZ – a 2.5 mile route.
- Facility #2 would evacuate southbound on Laplaisance Rd. to access Interstate-75 southbound and depart the EPZ – a 2.5 mile route. The average network speed output by DYNEV of 30.3 mph is used for buses evacuating these facilities to account for congestion within the City of Monroe.
- Travel time to the EPZ boundary is 5 minutes (2.5 miles @ 30.3 mph).
- ETE = 60 + 30 + 5 = 95 minutes or 1:35



Event	
A	Advisory to Evacuate
B	Bus Dispatched from Depot
C	Bus Arrives at Facility/Pick-up Route
D	Bus Departs for Reception Center
E	Bus Exits Region
F	Bus Arrives at Reception Center/Host Facility
G	Bus Available for “Second Wave” Evacuation Service
Activity	
A→B	Driver Mobilization
B→C	Travel to Facility or to Pick-up Route
C→D	Passengers Board the Bus
D→E	Bus Travels Towards Region Boundary
E→F	Bus Travels Towards Reception Center Outside the EPZ
F→G	Passengers Leave Bus; Driver Takes a Break

Figure 8-1. Chronology of Transit Evacuation Operations

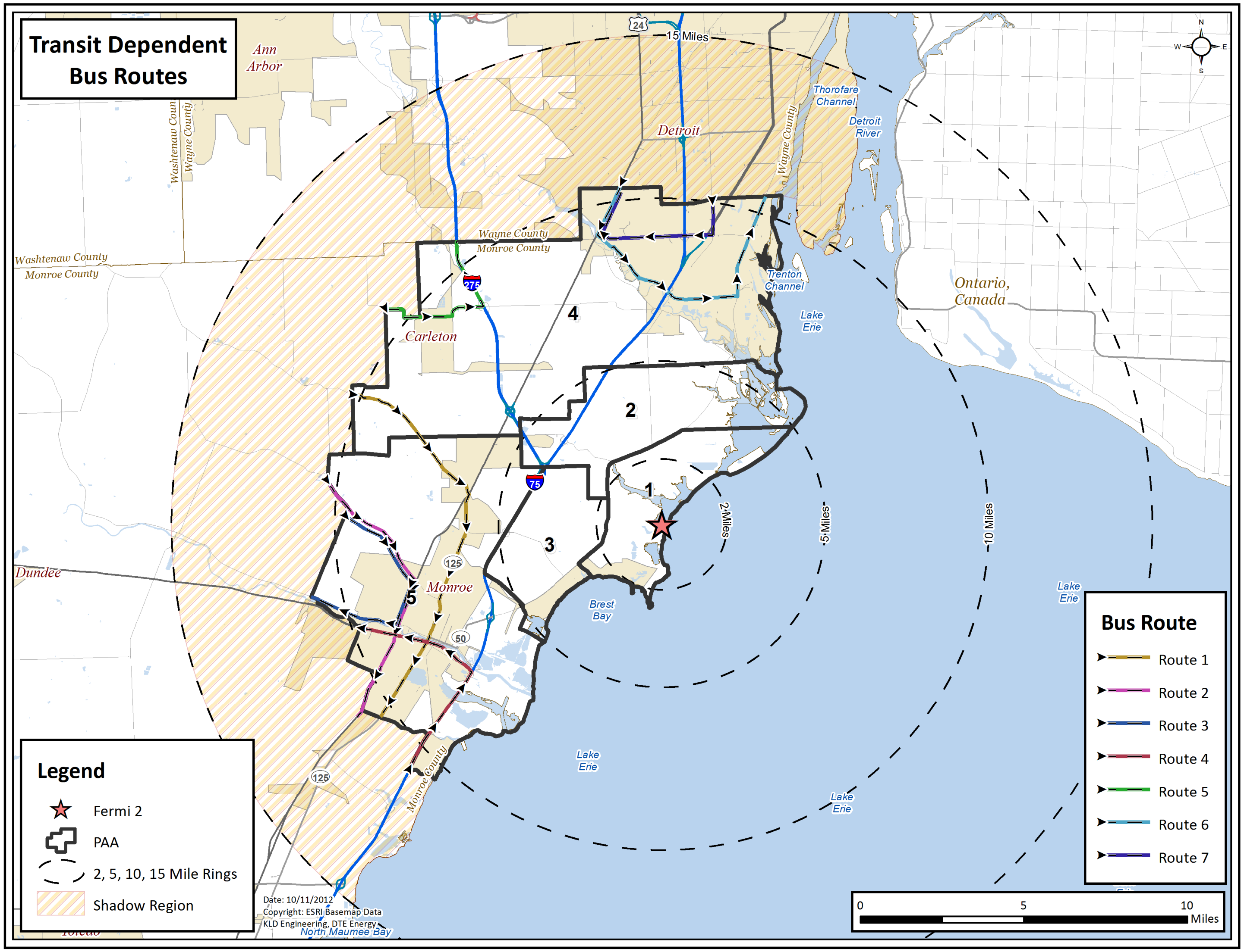


Figure 8-2. Transit-Dependent Bus Routes

Table 8-1. Transit-Dependent Population Estimates

2010 EPZ Population	Survey Average HH Size with Indicated No. of Vehicles			Estimated No. of Households	Survey Percent HH with Indicated No. of Vehicles			Survey Percent HH with Commuters	Survey Percent HH with Non-Returning Commuters	Total People Requiring Transport	Estimated Ridesharing Percentage	People Requiring Public Transit	Percent Population Requiring Public Transit
	0	1	2		0	1	2						
97,825	1.57	1.87	2.83	35,965	4.2%	24.6%	49.4%	62%	45%	5,667	50%	2,834	2.9%

Table 8-2. School Population Demand Estimates

PAA	School Name	District	Enrollment	Buses Required
1	North Elementary School	Jefferson	425	7
2	Neidermeier Elementary School	Airport	306	5
2	St. Charles School	Private	194	4
3	Jefferson High School	Jefferson	775	16
3	Jefferson Middle School	Jefferson	365	8
3	Sodt Elementary School	Jefferson	344	5
4	Airport Senior High School	Airport	1,050	21
4	Carleton Country Day*	Airport	114	3
4	Chapman Elementary School	Gibraltar	503	8
4	David Oren Hunter Elementary School	Gibraltar	422	7
4	Downriver High School	Gibraltar	62	2
4	Ethel C. Bobcean Elementary School	Flat Rock	483	7
4	Eyler Elementary School	Airport	300	5
4	Flat Rock / Gibraltar Head Start*	Gibraltar	175	3
4	Flat Rock Community High School	Flat Rock	568	12
4	Hellen C. Shumate Junior High School	Gibraltar	895	18
4	John M. Barnes Elementary	Flat Rock	429	7
4	Oscar A. Carlson High School	Gibraltar	1,074	22
4	Parsons Elementary School	Gibraltar	447	7
4	Ritter Elementary School	Airport	300	5
4	Simpson Middle School	Flat Rock	431	9
4	St. Mary's Rockwood Elementary School*	Gibraltar	220	4
4	St. Patrick School*	Airport	134	3
4	Sterling Elementary School	Airport	313	5
4	Summit Academy/Summit Early Childhood Center	Flat Rock	403	6
4	Wager Junior High School	Airport	740	15
5	Custer Elementary School #1	Monroe	650	10
5	Custer Elementary School #2	Monroe	294	5
5	Hollywood Elementary School	Monroe	237	4
5	Holy Ghost Lutheran School*	Monroe	100	2
5	Hurd Elementary School	Jefferson	420	6
5	Lutheran High School South*	Airport	36	1
5	Manor Elementary School	Monroe	406	6
5	Monroe Middle School	Monroe	941	19
5	Monroe Senior High School	Monroe	2,130	43
5	Orchard Center High School	Monroe	175	4
5	Pathway Christian Academy/ Daycare	Monroe	138	3

PAA	School Name	District	Enrollment	Buses Required
5	Raisinville Elementary School	Monroe	425	7
5	Riverside Elementary School	Monroe	162	3
5	St. John's School*	Monroe	211	5
5	St. Mary's Catholic Center High School*	Monroe	411	9
5	St. Mary's Parish School*	Monroe	248	5
5	St. Michael's School*	Monroe	185	4
5	Trinity Lutheran School*	Monroe	220	5
5	Waterloo Elementary School	Monroe	250	4
5	Zion Lutheran School	Monroe	62	2
		TOTAL:	**19,173**	**361**

*Denotes Private School which will evacuate with the schools of the public school district listed

Table 8-3. Host Schools

School District	Host School
MONROE COUNTY	
Jefferson (Monroe)	Mason Senior High, Erie, MI
St. Charles (Newport)	St. Stephen School, New Boston, MI
Airport (Carleton)	Milan Senior High, Milan, MI
Monroe (Monroe)	Bedford Senior High, Temperance, MI
WAYNE COUNTY	
Gibraltar	Harry. S. Truman High School, Taylor, MI
Flat Rock	

Table 8-4. Medical Facility Transit Demand

PAA	Facility Name	Municipality	Cap-acity	Current Census	Ambu-latory	Wheel-chair Bound	Bed-ridden	Bus Runs	Wheel-chair Van Runs	Ambulance
MONROE COUNTY MEDICAL FACILITIES										
5	ALCC	Monroe	21	12	6	6	0	1	2	0
5	Alterra	Monroe	20	15	15	0	0	1	0	0
5	IHM Motherhouse	Monroe	210	192	177	13	2	6	4	1
5	Lutheran Home	Monroe	115	115	106	8	1	4	2	1
5	Maplewood Manor	Monroe	120	110	101	8	1	4	2	1
5	Medilodge II	Monroe	103	92	85	6	1	3	2	1
5	Mercy Memorial Hospital	Monroe	168	168	69	69	30	3	18	15
5	Mercy Memorial Nursing Center	Monroe	70	60	59	0	1	2	0	1
5	Tendercare of Monroe	Monroe	192	175	161	12	2	6	3	1
		Monroe County Subtotal:	***1,019***	***939***	***779***	***122***	***38***	***30***	***33***	***21***
WAYNE COUNTY MEDICAL FACILITIES										
4	Marybrook Residence	Flat Rock	12	11	10	1	0	1	1	0
		Wayne County Subtotal:	***12***	***11***	***10***	***1***	***0***	***1***	***1***	***0***
		TOTAL:	**1,031**	**950**	**789**	**123**	**38**	**31**	**34**	**21**

Table 8-5. Summary of Transportation Resources

Transportation Resource	Buses	Short Bus	Wheelchair Vans	Ambulances
Resources Available				
Airport School District	36		4	
Jefferson School District	21		4	
Monroe School District	315	14		
Gibraltar School District	30			
Flat Rock School District	14			
Bedford Schools			5	
Manson Schools			2	
Dundee Schools			2	
Summerfield Schools			3	
Whiteford Schools			10	
Ida Schools			2	
East Side Med Star			6	
Community			13	
Concord			16	
HealthLink			5	
HVA			6	
Rapid Response			8	
Medic one			9	
Superior			6	
Universal (Macomb)			10	
Star EMS			3	
ProMedica			5	
Monroe County				69
Wayne County	1,396			60
TOTAL:	**1,812**	**14**	**119**	**129**
Resources Needed				
Schools (Table 8-2):	361			
Medical Facilities (Table 8-4):	31		34	21
Transit-Dependent Population (Table 8-10):	95			
Homebound Special Needs (Section 8.5):	32		26	6
Correctional Facilities (Section 8.6):	12			
TOTAL TRANSPORTATION NEEDS:	**531**	**0**	**60**	**27**

Table 8-6. Bus Route Descriptions

Bus Route Number	Description	Nodes Traversed from Route Start to EPZ Boundary
1	Transit route 1	58, 107, 319, 106, 105, 7, 104, 79, 78, 732, 101, 785, 100, 99, 98, 97, 133
2	Transit route 2	525, 660, 60, 61, 62, 258, 775, 64, 75, 74, 135, 73, 840, 832, 498
3	Transit route 3	528, 526, 618, 617, 616, 632, 508
4	Transit route 4	211, 184, 181, 325, 78, 324, 76, 215, 64, 65, 66, 841, 67
5	Transit Route 5	535, 583, 582, 237, 580, 234, 584, 232, 231, 271, 457, 829, 270
6	Transit route 6	545, 40, 641, 547, 42, 171, 656
7	Transit route 7	47, 649, 49, 50, 51, 347, 350, 115, 116, 659, 117
8	North Elementary School	444, 441, 278, 280, 279, 23, 24, 296, 297, 451, 452, 298, 453, 300, 209, 302, 305, 761, 307
9	Neidermeier Elementary School	226, 109, 534
10	St. Charles School	36, 462, 35, 800, 760, 34, 33, 737, 32, 162, 85, 736, 84, 298, 453, 300, 209, 302, 305, 761, 307
11	Jefferson High School	35, 800, 760, 34, 33, 737, 32, 162, 85, 736, 84, 298, 453, 300, 209, 302, 305, 761, 307
12	Sodt Elementary School	34, 33, 737, 32, 162, 85, 736, 84, 298, 453, 300, 209, 302, 305, 761, 307
13	Airport Senior High School	109, 534
15	Eyler Elementary School	341, 830, 243
16	Ritter Elementary School	342, 56, 231
22	Custer Elementary School #1	514, 734, 513, 700, 701, 217, 304, 305, 761, 307
25	Holy Ghost Lutheran School	508, 67, 841, 66, 65, 64, 75, 74, 135, 73
26	Hurd Elementary School	33, 737, 32, 162, 85, 736, 84, 298, 453, 300, 209, 302, 305, 761, 307
28	Lutheran High School South	332, 108, 335, 222, 223, 226, 109, 534
29	Manor Elementary School	204, 527, 258, 775, 64, 75, 74, 135, 73
30	Monroe Middle School	101, 519, 177, 182, 520, 217, 304, 305, 761, 307
31	Monroe Senior High	505, 500, 74, 135, 73
32	Orchard Center High School	210, 175, 569, 301, 303, 302, 305, 761, 307
33	Pathway Christian Academy/ Daycare	60, 531, 105, 7, 104, 79, 80, 190, 81, 63, 299, 759, 300, 209, 302, 305, 761, 307
34	Raisinville Elementary School	508, 67, 841, 66, 65, 64, 75, 74, 135, 73
35	Riverside Elementary School	79, 80, 190, 81, 63, 299, 759, 300, 209, 302, 305, 761, 307
37	St. John's School	78, 732, 101, 519, 177, 182, 520, 217, 304, 305, 761, 307

Bus Route Number	Description	Nodes Traversed from Route Start to EPZ Boundary
38	St. Mary's Catholic Center High School	79, 80, 190, 81, 63, 299, 759, 300, 209, 302, 305, 761, 307
39	St. Mary's Parish School	104, 79, 80, 190, 81, 63, 299, 759, 300, 209, 302, 305, 761, 307
40	St. Michael's School	211, 569, 301, 303, 302, 305, 761, 307
41	Trinity Lutheran School	325, 796, 730, 731, 519, 177, 182, 520, 217, 304, 305, 761, 307
42	Waterloo Elementary School	66, 65, 64, 75, 74, 135, 73
43	Zion Lutheran School	113, 105, 7, 104, 79, 80, 190, 81, 63, 299, 759, 300, 209, 302, 305, 761, 307
44	Chapman Elementary School	169, 817, 292, 447, 293, 448, 604, 290, 288, 842, 287
45	David Oren Hunter Elementary School	602, 552, 208
46	Downriver High School	549, 40, 545, 546, 170, 292, 447, 293, 448, 604, 290, 288, 842, 287
47	Ethel C. Bobcean Elementary School	49, 649, 47, 683, 289, 291, 290, 288, 842, 287
50	Hellen C. Shumate Junior High School	547, 42, 43, 160, 159, 252, 288, 842, 287
51	John M. Barnes Elementary	374, 49, 649, 47, 683, 289, 291, 290, 288, 842, 287
53	Parsons Elementary School	387, 42, 43, 160, 159, 252, 288, 842, 287
55	St. mary's rockwood elementary school	170, 292, 447, 293, 448, 604, 290, 288, 842, 287
56	Summit Academy/Summit Early Childhood Center	649, 47, 683, 289, 291, 290, 288, 842, 287
57	ALCC	319, 106, 105, 531, 60, 660, 525, 68, 69, 630, 70
58	Alterra	529, 62, 258, 775, 64, 65, 66, 841, 67
59	IHM Motherhouse	322, 323, 618, 617, 616, 632, 508, 67
60	Lutheran Home	105, 7, 104, 79, 322, 323, 618, 617, 616, 632, 508, 67
61	Maplewood Manor	319, 107, 58, 108, 335, 222, 223, 226, 109, 534
62	Medilodge II	527, 258, 775, 64, 65, 66, 841, 67
63	Mercy Memorial Hospital	113, 320, 80, 79, 322, 323, 618, 617, 616, 632, 508, 67
64	Mercy Memorial Nursing Center	105, 531, 60, 660, 525, 68, 69, 630, 70
65	Tendercare of Monroe	61, 62, 258, 775, 64, 65, 66, 841, 67
66	Marybrook Residence	649, 47, 683, 289, 252, 288, 842, 287

Table 8-7. School Evacuation Time Estimates - Good Weather

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
MONROE COUNTY SCHOOLS									
Airport Senior High School	15	15	2.4	50.0	3	**0:35**	17.0	26	**1:00**
Carleton Country Day	30	15	1.3	50.0	2	**0:50**	17.0	26	**1:15**
Custer Elementary School #1	45	15	4.0	15.2	16	**1:20**	13.9	21	**1:40**
Custer Elementary School #2	45	15	4.0	15.2	16	**1:20**	13.9	21	**1:40**
Eyler Elementary School	45	15	2.3	45.0	3	**1:05**	17.2	26	**1:30**
Hollywood Elementary School	45	15	5.9	42.6	8	**1:10**	14.3	21	**1:30**
Holy Ghost Lutheran School	45	15	5.0	33.1	9	**1:10**	13.5	20	**1:30**
Hurd Elementary School	90	15	5.8	54.2	6	**1:55**	7.4	11	**2:05**
Jefferson High School	15	15	7.9	49.8	10	**0:40**	7.4	11	**0:55**
Jefferson Middle School	15	15	7.6	49.8	9	**0:40**	7.4	11	**0:50**
Lutheran High School South	30	15	6.3	48.4	8	**0:55**	6.0	9	**1:05**
Manor Elementary School	45	15	3.7	27.3	8	**1:10**	15.1	23	**1:35**
Monroe Middle School	45	15	2.7	5.4	30	**1:30**	14.3	21	**1:55**
Monroe Senior High School	45	15	3.1	26.7	7	**1:10**	18.4	28	**1:35**
Neidermeier Elementary School	45	15	7.7	43.7	11	**1:15**	16.8	25	**1:40**
North Elementary School	45	15	12.6	55.0	14	**1:15**	7.4	11	**1:25**
Orchard Center High School	45	15	4.7	32.9	9	**1:10**	7.3	11	**1:20**
Pathway Christian Academy/ Daycare	90	15	7.4	46.8	9	**1:55**	8.0	12	**2:10**
Raisinville Elementary School	45	15	2.9	33.1	5	**1:05**	18.4	28	**1:35**
Ritter Elementary School	45	15	6.9	41.1	10	**1:10**	17.3	26	**1:40**
Riverside Elementary School	45	15	6.1	43.1	8	**1:10**	14.9	22	**1:30**
Sodt Elementary School	45	15	9.2	35.6	16	**1:20**	7.4	11	**1:30**
St. Charles School	45	15	11.1	36.4	18	**1:20**	5.9	9	**1:30**
St. John's School	45	15	2.8	5.7	29	**1:30**	6.4	10	**1:40**
St. Mary's Catholic Center High School	45	15	5.5	43.1	8	**1:10**	6.3	9	**1:20**

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
St. Mary's Parish School	45	15	5.5	42.5	8	**1:10**	6.3	9	**1:20**
St. Michael's School	45	15	5.6	30.4	11	**1:15**	6.8	10	**1:25**
St. Patrick School	45	15	1.5	50.0	2	**1:05**	16.5	25	**1:30**
Sterling Elementary School	30	15	2.6	50.0	3	**0:50**	16.8	25	**1:15**
Trinity Lutheran School	45	15	2.7	5.6	29	**1:30**	6.3	9	**1:40**
Wager Junior High School	15	15	2.3	50.0	3	**0:35**	17.6	26	**1:00**
Waterloo Elementary School	45	15	3.0	28.4	6	**1:10**	18.7	28	**1:35**
Zion Lutheran School	45	15	4.0	40.4	6	**1:10**	19.7	30	**1:40**
WAYNE COUNTY SCHOOLS									
Chapman Elementary School	90	15	3.5	55.0	4	**1:50**	10.7	16	**2:05**
David Oren Hunter Elementary School	90	15	1.7	33.4	3	**1:50**	10.7	16	**2:05**
Downriver High School	90	15	5.4	50.5	6	**1:55**	13.6	20	**2:15**
Ethel C. Bobcean Elementary School	90	15	3.5	53.0	4	**1:50**	8.7	13	**2:05**
Flat Rock / Gibraltar Head Start	90	15	3.7	53.0	4	**1:50**	8.7	13	**2:05**
Flat Rock Community High School	90	15	3.6	53.0	4	**1:50**	11.3	17	**2:10**
Hellen C. Shumate Junior High School	90	15	3.5	50.0	4	**1:50**	13.5	20	**2:10**
John M. Barnes Elementary	90	15	4.9	47.9	6	**1:55**	8.7	13	**2:05**
Oscar A. Carlson High School	90	15	3.5	50.0	4	**1:50**	13.5	20	**2:10**
Parsons Elementary School	90	15	3.2	47.6	4	**1:50**	13.5	20	**2:10**
Simpson Middle School	90	15	4.9	47.9	6	**1:55**	8.7	13	**2:05**
St. Mary's Rockwood Elementary School	90	15	3.2	44.6	4	**1:50**	10.7	16	**2:05**
Summit Academy/Summit Early Childhood Center	90	15	2.4	54.3	3	**1:50**	10.7	16	**2:05**
					Maximum for EPZ:	**1:55**		**Maximum:**	**2:15**
					Average for EPZ:	**1:25**		**Average:**	**1:40**

Table 8-8. School Evacuation Time Estimates - Rain

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
A COUNTY SCHOOLS									
Airport Senior High School	25	20	2.4	45.0	3	**0:50**	17.0	29	**1:20**
Carleton Country Day	40	20	1.3	45.0	2	**1:05**	17.0	29	**1:35**
Custer Elementary School #1	55	20	4.0	12.9	19	**1:35**	13.9	24	**2:00**
Custer Elementary School #2	55	20	4.0	12.9	19	**1:35**	13.9	24	**2:00**
Eyler Elementary School	55	20	2.3	40.8	3	**1:20**	17.2	29	**1:50**
Hollywood Elementary School	55	20	5.9	30.7	12	**1:30**	14.3	25	**1:55**
Holy Ghost Lutheran School	55	20	5.0	20.5	15	**1:30**	13.5	23	**1:55**
Hurd Elementary School	100	20	5.8	36.2	10	**2:10**	7.4	13	**2:25**
Jefferson High School	25	20	7.9	26.8	18	**1:05**	7.4	13	**1:20**
Jefferson Middle School	25	20	7.6	26.8	17	**1:05**	7.4	13	**1:15**
Lutheran High School South	40	20	6.3	43.1	9	**1:10**	6.0	10	**1:20**
Manor Elementary School	55	20	3.7	15.6	14	**1:30**	15.1	26	**1:55**
Monroe Middle School	55	20	2.7	4.1	40	**1:55**	14.3	25	**2:20**
Monroe Senior High School	55	20	3.1	13.3	14	**1:30**	18.4	32	**2:05**
Neidermeier Elementary School	55	20	7.7	39.5	12	**1:30**	16.8	29	**2:00**
North Elementary School	55	20	12.6	50.0	15	**1:30**	7.4	13	**1:45**
Orchard Center High School	55	20	4.7	22.7	12	**1:30**	7.3	13	**1:40**
Pathway Christian Academy/ Daycare	100	20	7.4	33.2	13	**2:15**	8.0	14	**2:30**
Raisinville Elementary School	55	20	2.9	19.8	9	**1:25**	18.4	32	**2:00**
Ritter Elementary School	55	20	6.9	37.4	11	**1:30**	17.3	30	**2:00**
Riverside Elementary School	55	20	6.1	29.6	12	**1:30**	14.9	26	**1:55**
Sodt Elementary School	55	20	9.2	32.4	17	**1:35**	7.4	13	**1:45**
St. Charles School	55	20	11.1	34.5	19	**1:35**	5.9	10	**1:45**
St. John's School	55	20	2.8	4.3	39	**1:55**	6.4	11	**2:05**
St. Mary's Catholic Center High School	55	20	5.5	29.6	11	**1:30**	6.3	11	**1:40**

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
St. Mary's Parish School	55	20	5.5	29.5	11	**1:30**	6.3	11	**1:40**
St. Michael's School	55	20	5.6	20.4	16	**1:35**	6.8	12	**1:45**
St. Patrick School	55	20	1.5	45.0	2	**1:20**	16.5	28	**1:45**
Sterling Elementary School	40	20	2.6	45.0	3	**1:05**	16.8	29	**1:35**
Trinity Lutheran School	55	20	2.7	4.3	38	**1:55**	6.3	11	**2:05**
Wager Junior High School	25	20	2.3	45.0	3	**0:50**	17.6	30	**1:20**
Waterloo Elementary School	55	20	3.0	16.3	11	**1:30**	18.7	32	**2:00**
Zion Lutheran School	55	20	4.0	29.6	8	**1:25**	19.7	34	**2:00**
WAYNE COUNTY SCHOOLS									
Average for EPZ:	100	20	3.5	33.9	6	**2:10**	10.7	18	**2:25**
David Oren Hunter Elementary School	100	20	1.7	46.7	2	**2:05**	10.7	18	**2:20**
Downriver High School	100	20	5.4	47.1	7	**2:10**	13.6	23	**2:30**
Ethel C. Bobcean Elementary School	100	20	3.5	47.3	4	**2:05**	8.7	15	**2:20**
Flat Rock / Gibraltar Head Start	100	20	3.7	47.3	5	**2:05**	8.7	15	**2:20**
Flat Rock Community High School	100	20	3.6	46.9	5	**2:05**	11.3	19	**2:25**
Hellen C. Shumate Junior High School	100	20	3.5	44.0	5	**2:05**	13.5	23	**2:30**
John M. Barnes Elementary	100	20	4.9	46.3	6	**2:10**	8.7	15	**2:25**
Oscar A. Carlson High School	100	20	3.5	43.9	5	**2:05**	13.5	23	**2:30**
Parsons Elementary School	100	20	3.2	44.0	4	**2:05**	13.5	23	**2:30**
Simpson Middle School	100	20	4.9	39.5	7	**2:10**	8.7	15	**2:25**
St. Mary's Rockwood Elementary School	100	20	3.2	48.3	4	**2:05**	10.7	18	**2:25**
Summit Academy/Summit Early Childhood Center	100	20	2.4	50.0	3	**2:05**	10.7	18	**2:25**
					Maximum for EPZ:	**2:15**		**Maximum:**	**2:30**
					Average for EPZ:	**1:40**		**Average:**	**2:00**

Table 8-9. School Evacuation Time Estimates - Snow

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
A COUNTY SCHOOLS									
Airport Senior High School	35	25	2.4	40.0	4	**1:05**	17.0	34	**1:40**
Carleton Country Day	50	25	1.3	40.0	2	**1:20**	17.0	34	**1:55**
Custer Elementary School #1	65	25	4.0	12.4	19	**1:50**	13.9	28	**2:20**
Custer Elementary School #2	65	25	4.0	12.4	19	**1:50**	13.9	28	**2:20**
Eyler Elementary School	65	25	2.3	36.0	4	**1:35**	17.2	34	**2:10**
Hollywood Elementary School	65	25	5.9	35.1	10	**1:40**	14.3	29	**2:10**
Holy Ghost Lutheran School	65	25	5.0	24.7	12	**1:45**	13.5	27	**2:10**
Hurd Elementary School	110	25	5.8	45.0	8	**2:25**	7.4	15	**2:40**
Jefferson High School	35	25	7.9	26.5	18	**1:20**	7.4	15	**1:35**
Jefferson Middle School	35	25	7.6	26.5	17	**1:20**	7.4	15	**1:35**
Lutheran High School South	50	25	6.3	38.9	10	**1:25**	6.0	12	**1:40**
Manor Elementary School	65	25	3.7	20.2	11	**1:45**	15.1	30	**2:15**
Monroe Middle School	65	25	2.7	4.2	38	**2:10**	14.3	29	**2:40**
Monroe Senior High School	65	25	3.1	19.5	10	**1:40**	18.4	37	**2:20**
Neidermeier Elementary School	65	25	7.7	35.3	13	**1:45**	16.8	34	**2:20**
North Elementary School	65	25	12.6	45.0	17	**1:50**	7.4	15	**2:05**
Orchard Center High School	65	25	4.7	39.3	7	**1:40**	7.3	15	**1:55**
Pathway Christian Academy/ Daycare	110	25	7.4	37.4	12	**2:30**	8.0	16	**2:45**
Raisinville Elementary School	65	25	2.9	24.6	7	**1:40**	18.4	37	**2:15**
Ritter Elementary School	65	25	6.9	32.4	13	**1:45**	17.3	35	**2:20**
Riverside Elementary School	65	25	6.1	35.2	10	**1:40**	14.9	30	**2:10**
Sodt Elementary School	65	25	9.2	29.0	19	**1:50**	7.4	15	**2:05**
St. Charles School	65	25	11.1	30.4	22	**1:55**	5.9	12	**2:05**
St. John's School	65	25	2.8	4.5	37	**2:10**	6.4	13	**2:20**
St. Mary's Catholic Center High School	65	25	5.5	35.0	9	**1:40**	6.3	13	**1:55**

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To EPZ Bdry (mi)	Average Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bdry to H.S. (mi.)	Travel Time from EPZ Bdry to H.S. (min)	ETE to H.S. (hr:min)
St. Mary's Parish School	65	25	5.5	34.6	10	**1:40**	6.3	13	**1:55**
St. Michael's School	65	25	5.6	35.9	9	**1:40**	6.8	14	**1:55**
St. Patrick School	65	25	1.5	40.0	2	**1:35**	16.5	33	**2:05**
Sterling Elementary School	50	25	2.6	40.0	4	**1:20**	16.8	34	**1:55**
Trinity Lutheran School	65	25	2.7	4.1	39	**2:10**	6.3	13	**2:25**
Wager Junior High School	35	25	2.3	40.0	3	**1:05**	17.6	35	**1:40**
Waterloo Elementary School	65	25	3.0	20.7	9	**1:40**	18.7	37	**2:20**
WAYNE COUNTY SCHOOLS									
Chapman Elementary School	110	25	3.5	30.3	7	**2:25**	10.7	21	**2:45**
David Oren Hunter Elementary School	110	25	1.7	40.8	3	**2:20**	10.7	21	**2:40**
Downriver High School	110	25	5.4	41.7	8	**2:25**	13.6	27	**2:50**
Ethel C. Bobcean Elementary School	110	25	3.5	42.2	5	**2:20**	8.7	17	**2:40**
Flat Rock / Gibraltar Head Start	110	25	3.7	41.7	5	**2:20**	8.7	17	**2:40**
Flat Rock Community High School	110	25	3.6	40.7	5	**2:20**	11.3	23	**2:45**
Hellen C. Shumate Junior High School	110	25	3.5	38.6	5	**2:20**	13.5	27	**2:50**
John M. Barnes Elementary	110	25	4.9	40.7	7	**2:25**	8.7	17	**2:40**
Oscar A. Carlson High School	110	25	3.5	38.5	5	**2:20**	13.5	27	**2:50**
Parsons Elementary School	110	25	3.2	39.0	5	**2:20**	13.5	27	**2:50**
Simpson Middle School	110	25	4.9	34.9	8	**2:25**	8.7	17	**2:40**
St. Mary's Rockwood Elementary School	110	25	3.2	43.2	4	**2:20**	10.7	21	**2:40**
Summit Academy/Summit Early Childhood Center	110	25	2.4	45.0	3	**2:20**	10.7	21	**2:40**
					Maximum for EPZ:	**2:30**		**Maximum:**	**2:50**
					Average for EPZ:	**1:55**		**Average:**	**2:20**

Table 8-10. Summary of Transit-Dependent Bus Routes

Route	No. of Buses	Route Description	Length (mi.)
1	16	Eastbound on Stoney Creek Rd to Michigan Highway 125. South on Michigan Highway 125 through Monroe and out of the EPZ.	12.5
2	14	Eastbound on Bluebush Rd to US Highway 24. South on US Highway 24 through Monroe and out of the EPZ.	8.9
3	15	Eastbound on Bluebush Rd to US Highway 24. South on US Highway 24 to North Custer Rd. West on North Custer Rd through Monroe and out of the EPZ.	9.1
4	14	Northbound on Interstate 75. Exit for Front Street. West on Front Street through Monroe and out of the EPZ.	9.4
5	12	Westbound through Carleton on Ash Street to I-275 northbound.	7.3
6	12	Southbound on US Highway 24 to East Huron River Dr. East on East Huron River Dr to Jefferson Ave. North on Jefferson Ave out of the EPZ.	10.2
7	12	Southbound on Allen Road to Gibraltar Rd. West on Gibraltar Rd to US Highway 24. North on US Highway 24 out of the EPZ.	5.9
Total:	**95**		

Table 8-11. Transit-Dependent Evacuation Time Estimates - Good Weather

Route Number	Bus Number	One-Wave							Two-Wave					
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
1	1 & 2	90	12.5	30.7	24	30	**2:25**	6.2	9	5	10	48	30	**4:10**
	3 & 4	95	12.5	31.4	24	30	**2:30**	6.2	9	5	10	48	30	**4:15**
	5 & 6	100	12.5	31.8	24	30	**2:35**	6.2	9	5	10	48	30	**4:20**
	7 & 8	105	12.5	32.0	23	30	**2:40**	6.2	9	5	10	48	30	**4:25**
	9 & 10	110	12.5	32.8	23	30	**2:45**	6.2	9	5	10	48	30	**4:30**
	11 & 12	115	12.5	34.2	22	30	**2:50**	6.2	9	5	10	48	30	**4:35**
	13 & 14	120	12.5	35.3	21	30	**2:55**	6.2	9	5	10	48	30	**4:40**
	15 & 16	125	12.5	36.4	21	30	**3:00**	6.2	9	5	10	47	30	**4:45**
2	1 & 2	90	8.9	31.1	17	30	**2:20**	6.1	9	5	10	36	30	**3:55**
	3 & 4	95	8.9	29.3	18	30	**2:25**	6.1	9	5	10	36	30	**4:00**
	5 & 6	100	8.9	28.5	19	30	**2:30**	6.1	9	5	10	36	30	**4:05**
	7 & 8	105	8.9	28.0	19	30	**2:35**	6.1	9	5	10	36	30	**4:10**
	9 & 10	110	8.9	27.9	19	30	**2:40**	6.1	9	5	10	36	30	**4:15**
	11 & 12	115	8.9	29.8	18	30	**2:45**	6.1	9	5	10	36	30	**4:20**
	13 & 14	120	8.9	32.4	16	30	**2:50**	6.1	9	5	10	36	30	**4:25**
3	1 & 2	90	9.1	10.9	50	30	**2:50**	12.4	19	5	10	47	30	**4:45**
	3 & 4	95	9.1	11.4	48	30	**2:55**	12.4	19	5	10	47	30	**4:50**
	5 & 6	100	9.1	12.2	45	30	**2:55**	12.4	19	5	10	47	30	**4:50**
	7 & 8	105	9.1	13.2	41	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	9 & 10	110	9.1	14.4	38	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	11 & 12	115	9.1	15.8	35	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	13 & 14	120	9.1	20.4	27	30	**3:00**	12.4	19	5	10	47	30	**4:55**
	15	125	9.1	22.9	24	30	**3:00**	12.4	19	5	10	47	30	**4:55**
4	1 & 2	90	9.4	13.6	42	30	**2:45**	12.2	18	5	10	47	30	**4:40**
	3 & 4	95	9.4	13.9	41	30	**2:50**	12.2	18	5	10	47	30	**4:45**
	5 & 6	100	9.4	14.4	39	30	**2:50**	12.2	18	5	10	47	30	**4:45**
	7 & 8	105	9.4	16.2	35	30	**2:50**	12.2	18	5	10	47	30	**4:45**
	9 & 10	110	9.4	17.1	33	30	**2:55**	12.2	18	5	10	47	30	**4:50**
	11 & 12	115	9.4	19.3	29	30	**2:55**	12.2	18	5	10	47	30	**4:50**
	13 & 14	120	9.4	20.8	27	30	**3:00**	12.2	18	5	10	46	30	**4:50**

Route Number	Bus Number	One-Wave							Two-Wave						
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
5	1 & 2	90	7.3	41.4	11	30	**2:15**	18.2	27	5	10	48	30	**4:20**
	3 & 4	95	7.3	41.2	11	30	**2:20**	18.2	27	5	10	48	30	**4:25**
	5 & 6	100	7.3	41.7	10	30	**2:20**	18.2	27	5	10	48	30	**4:25**
	7 & 8	105	7.3	41.7	11	30	**2:30**	18.2	27	5	10	48	30	**4:35**
	9 & 10	110	7.3	41.9	10	30	**2:30**	18.2	27	5	10	48	30	**4:35**
	11	115	7.3	40.7	11	30	**2:40**	18.2	27	5	10	48	30	**4:45**
	12	120	7.3	41.2	11	30	**2:45**	18.2	27	5	10	48	30	**4:50**
6	1 & 2	90	10.2	42.8	14	30	**2:15**	12.2	18	5	10	47	30	**4:10**
	3 & 4	95	10.2	42.4	14	30	**2:20**	12.2	18	5	10	47	30	**4:15**
	5 & 6	100	10.2	42.3	14	30	**2:25**	12.2	18	5	10	47	30	**4:20**
	7 & 8	105	10.2	42.8	14	30	**2:30**	12.2	18	5	10	47	30	**4:25**
	9 & 10	110	10.2	43.2	14	30	**2:35**	12.2	18	5	10	47	30	**4:30**
	11	115	10.2	43.6	14	30	**2:40**	12.2	18	5	10	47	30	**4:35**
	12	120	10.2	44.0	14	30	**2:45**	12.2	18	5	10	47	30	**4:40**
7	1 & 2	90	5.9	23.3	15	30	**2:15**	8.7	13	5	10	31	30	**3:45**
	3 & 4	95	5.9	24.5	14	30	**2:20**	8.7	13	5	10	31	30	**3:50**
	5 & 6	100	5.9	25.2	14	30	**2:25**	8.7	13	5	10	31	30	**3:55**
	7 & 8	105	5.9	28.1	13	30	**2:30**	8.7	13	5	10	31	30	**4:00**
	9 & 10	110	5.9	31.6	11	30	**2:35**	8.7	13	5	10	31	30	**4:05**
	11	115	5.9	33.8	10	30	**2:35**	8.7	13	5	10	31	30	**4:05**
	12	120	5.9	34.4	10	30	**2:40**	8.7	13	5	10	31	30	**4:10**
						Maximum ETE:	**3:00**						**Maximum ETE:**	**4:55**
						Average ETE:	**2:40**						**Average ETE:**	**4:30**

Table 8-12. Transit-Dependent Evacuation Time Estimates - Rain

Route Number	Bus Number	One-Wave						Two-Wave						
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
1	1 & 2	100	12.5	50.0	15	40	**2:35**	6.2	11	5	10	44	40	**4:25**
	3 & 4	105	12.5	50.0	15	40	**2:40**	6.2	11	5	10	44	40	**4:30**
	5 & 6	110	12.5	50.0	15	40	**2:45**	6.2	11	5	10	44	40	**4:35**
	7 & 8	115	12.5	50.0	15	40	**2:50**	6.2	11	5	10	44	40	**4:40**
	9 & 10	120	12.5	50.0	15	40	**2:55**	6.2	11	5	10	44	40	**4:45**
	11 & 12	125	12.5	50.0	15	40	**3:00**	6.2	11	5	10	44	40	**4:50**
	13 & 14	130	12.5	50.0	15	40	**3:05**	6.2	11	5	10	44	40	**4:55**
	15 & 16	135	12.5	50.0	15	40	**3:10**	6.2	11	5	10	44	40	**5:00**
2	1 & 2	100	8.9	50.0	11	40	**2:35**	6.1	10	5	10	34	40	**4:15**
	3 & 4	105	8.9	50.0	11	40	**2:40**	6.1	10	5	10	34	40	**4:20**
	5 & 6	110	8.9	50.0	11	40	**2:45**	6.1	10	5	10	34	40	**4:25**
	7 & 8	115	8.9	50.0	11	40	**2:50**	6.1	10	5	10	34	40	**4:30**
	9 & 10	120	8.9	50.0	11	40	**2:55**	6.1	10	5	10	34	40	**4:35**
	11 & 12	125	8.9	50.0	11	40	**3:00**	6.1	10	5	10	34	40	**4:40**
	13 & 14	130	8.9	50.0	11	40	**3:05**	6.1	10	5	10	34	40	**4:45**
3	1 & 2	100	9.1	50.0	11	40	**2:35**	12.4	21	5	10	46	40	**4:40**
	3 & 4	105	9.1	50.0	11	40	**2:40**	12.4	21	5	10	46	40	**4:45**
	5 & 6	110	9.1	50.0	11	40	**2:45**	12.4	21	5	10	46	40	**4:50**
	7 & 8	115	9.1	50.0	11	40	**2:50**	12.4	21	5	10	46	40	**4:55**
	9 & 10	120	9.1	50.0	11	40	**2:55**	12.4	21	5	10	46	40	**5:00**
	11 & 12	125	9.1	50.0	11	40	**3:00**	12.4	21	5	10	46	40	**5:05**
	13 & 14	130	9.1	50.0	11	40	**3:05**	12.4	21	5	10	46	40	**5:10**
	15	135	9.1	50.0	11	40	**3:10**	12.4	21	5	10	46	40	**5:15**
4	1 & 2	100	9.4	50.0	11	40	**2:35**	12.2	21	5	10	46	40	**4:40**
	3 & 4	105	9.4	50.0	11	40	**2:40**	12.2	21	5	10	46	40	**4:45**
	5 & 6	110	9.4	50.0	11	40	**2:45**	12.2	21	5	10	46	40	**4:50**
	7 & 8	115	9.4	50.0	11	40	**2:50**	12.2	21	5	10	46	40	**4:55**
	9 & 10	120	9.4	50.0	11	40	**2:55**	12.2	21	5	10	46	40	**5:00**
	11 & 12	125	9.4	50.0	11	40	**3:00**	12.2	21	5	10	46	40	**5:05**
	13 & 14	130	9.4	50.0	11	40	**3:05**	12.2	21	5	10	46	40	**5:10**

Route Number	Bus Number	One-Wave						Two-Wave						
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
5	1 & 2	100	7.3	50.0	9	40	**2:30**	18.2	31	5	10	51	40	**4:50**
	3 & 4	105	7.3	50.0	9	40	**2:35**	18.2	31	5	10	51	40	**4:55**
	5 & 6	110	7.3	50.0	9	40	**2:40**	18.2	31	5	10	51	40	**5:00**
	7 & 8	115	7.3	50.0	9	40	**2:45**	18.2	31	5	10	51	40	**5:05**
	9 & 10	120	7.3	50.0	9	40	**2:50**	18.2	31	5	10	51	40	**5:10**
	11	125	7.3	50.0	9	40	**2:55**	18.2	31	5	10	51	40	**5:15**
	12	130	7.3	50.0	9	40	**3:00**	18.2	31	5	10	51	40	**5:20**
6	1 & 2	100	10.2	50.0	12	40	**2:35**	12.2	21	5	10	48	40	**4:40**
	3 & 4	105	10.2	50.0	12	40	**2:40**	12.2	21	5	10	48	40	**4:45**
	5 & 6	110	10.2	50.0	12	40	**2:45**	12.2	21	5	10	48	40	**4:50**
	7 & 8	115	10.2	50.0	12	40	**2:50**	12.2	21	5	10	48	40	**4:55**
	9 & 10	120	10.2	50.0	12	40	**2:55**	12.2	21	5	10	48	40	**5:00**
	11	125	10.2	50.0	12	40	**3:00**	12.2	21	5	10	48	40	**5:05**
	12	130	10.2	50.0	12	40	**3:05**	12.2	21	5	10	48	40	**5:10**
7	1 & 2	100	5.9	50.0	7	40	**2:30**	8.7	15	5	10	31	40	**4:15**
	3 & 4	105	5.9	50.0	7	40	**2:35**	8.7	15	5	10	31	40	**4:20**
	5 & 6	110	5.9	50.0	7	40	**2:40**	8.7	15	5	10	31	40	**4:25**
	7 & 8	115	5.9	50.0	7	40	**2:45**	8.7	15	5	10	31	40	**4:30**
	9 & 10	120	5.9	50.0	7	40	**2:50**	8.7	15	5	10	31	40	**4:35**
	11	125	5.9	50.0	7	40	**2:55**	8.7	15	5	10	31	40	**4:40**
	12	130	5.9	50.0	7	40	**3:00**	8.7	15	5	10	31	40	**4:45**
						Maximum ETE:	**3:10**						**Maximum ETE:**	**5:20**
						Average ETE:	**2:50**						**Average ETE:**	**4:50**

Table 8-13. Transit Dependent Evacuation Time Estimates - Snow

Route Number	Bus Number	One-Wave						Two-Wave							
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
1	1 & 2	110	12.5	45.0	17	50	**3:00**	6.2	12	5	10	48	50	**5:10**
	3 & 4	115	12.5	45.0	17	50	**3:05**	6.2	12	5	10	48	50	**5:15**
	5 & 6	120	12.5	45.0	17	50	**3:10**	6.2	12	5	10	48	50	**5:20**
	7 & 8	125	12.5	45.0	17	50	**3:15**	6.2	12	5	10	48	50	**5:25**
	9 & 10	130	12.5	45.0	17	50	**3:20**	6.2	12	5	10	48	50	**5:30**
	11 & 12	135	12.5	45.0	17	50	**3:25**	6.2	12	5	10	48	50	**5:35**
	13 & 14	140	12.5	45.0	17	50	**3:30**	6.2	12	5	10	48	50	**5:40**
	15 & 16	145	12.5	45.0	17	50	**3:35**	6.2	12	5	10	48	50	**5:45**
2	1 & 2	110	8.9	45.0	12	50	**2:55**	6.1	12	5	10	37	50	**4:50**
	3 & 4	115	8.9	45.0	12	50	**3:00**	6.1	12	5	10	37	50	**4:55**
	5 & 6	120	8.9	45.0	12	50	**3:05**	6.1	12	5	10	37	50	**5:00**
	7 & 8	125	8.9	45.0	12	50	**3:10**	6.1	12	5	10	37	50	**5:05**
	9 & 10	130	8.9	45.0	12	50	**3:15**	6.1	12	5	10	37	50	**5:10**
	11 & 12	135	8.9	45.0	12	50	**3:20**	6.1	12	5	10	37	50	**5:15**
	13 & 14	140	8.9	45.0	12	50	**3:25**	6.1	12	5	10	37	50	**5:20**
3	1 & 2	110	9.1	45.0	12	50	**2:55**	12.4	25	5	10	51	50	**5:20**
	3 & 4	115	9.1	45.0	12	50	**3:00**	12.4	25	5	10	51	50	**5:25**
	5 & 6	120	9.1	45.0	12	50	**3:05**	12.4	25	5	10	51	50	**5:30**
	7 & 8	125	9.1	45.0	12	50	**3:10**	12.4	25	5	10	51	50	**5:35**
	9 & 10	130	9.1	45.0	12	50	**3:15**	12.4	25	5	10	51	50	**5:40**
	11 & 12	135	9.1	45.0	12	50	**3:20**	12.4	25	5	10	51	50	**5:45**
	13 & 14	140	9.1	45.0	12	50	**3:25**	12.4	25	5	10	51	50	**5:50**
	15	145	9.1	45.0	12	50	**3:30**	12.4	25	5	10	51	50	**5:55**
4	1 & 2	110	9.4	45.0	13	50	**2:55**	12.2	24	5	10	51	50	**5:20**
	3 & 4	115	9.4	45.0	13	50	**3:00**	12.2	24	5	10	51	50	**5:25**
	5 & 6	120	9.4	45.0	13	50	**3:05**	12.2	24	5	10	51	50	**5:30**
	7 & 8	125	9.4	45.0	13	50	**3:10**	12.2	24	5	10	51	50	**5:35**
	9 & 10	130	9.4	45.0	13	50	**3:15**	12.2	24	5	10	51	50	**5:40**
	11 & 12	135	9.4	45.0	13	50	**3:20**	12.2	24	5	10	51	50	**5:45**
	13 & 14	140	9.4	45.0	13	50	**3:25**	12.2	24	5	10	51	50	**5:50**

Route Number	Bus Number	One-Wave						Two-Wave						
		Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	Distance to R. C. (miles)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
5	1 & 2	110	7.3	45.0	10	50	**2:50**	18.2	36	5	10	57	50	**5:30**
	3 & 4	115	7.3	45.0	10	50	**2:55**	18.2	36	5	10	57	50	**5:35**
	5 & 6	120	7.3	45.0	10	50	**3:00**	18.2	36	5	10	57	50	**5:40**
	7 & 8	125	7.3	45.0	10	50	**3:05**	18.2	36	5	10	57	50	**5:45**
	9 & 10	130	7.3	45.0	10	50	**3:10**	18.2	36	5	10	57	50	**5:50**
	11	135	7.3	45.0	10	50	**3:15**	18.2	36	5	10	57	50	**5:55**
	12	140	7.3	45.0	10	50	**3:20**	18.2	36	5	10	57	50	**6:00**
6	1 & 2	110	10.2	45.0	14	50	**2:55**	12.2	24	5	10	53	50	**5:20**
	3 & 4	115	10.2	45.0	14	50	**3:00**	12.2	24	5	10	53	50	**5:25**
	5 & 6	120	10.2	45.0	14	50	**3:05**	12.2	24	5	10	53	50	**5:30**
	7 & 8	125	10.2	45.0	14	50	**3:10**	12.2	24	5	10	53	50	**5:35**
	9 & 10	130	10.2	45.0	14	50	**3:15**	12.2	24	5	10	53	50	**5:40**
	11	135	10.2	45.0	14	50	**3:20**	12.2	24	5	10	53	50	**5:45**
	12	140	10.2	45.0	14	50	**3:25**	12.2	24	5	10	53	50	**5:50**
7	1 & 2	110	5.9	45.0	8	50	**2:50**	8.7	17	5	10	34	50	**4:50**
	3 & 4	115	5.9	45.0	8	50	**2:55**	8.7	17	5	10	34	50	**4:55**
	5 & 6	120	5.9	45.0	8	50	**3:00**	8.7	17	5	10	34	50	**5:00**
	7 & 8	125	5.9	45.0	8	50	**3:05**	8.7	17	5	10	34	50	**5:05**
	9 & 10	130	5.9	45.0	8	50	**3:10**	8.7	17	5	10	34	50	**5:10**
	11	135	5.9	45.0	8	50	**3:15**	8.7	17	5	10	34	50	**5:15**
	12	140	5.9	45.0	8	50	**3:20**	8.7	17	5	10	34	50	**5:20**
						Maximum ETE:	**3:35**						**Maximum ETE:**	**6:00**
						Average ETE:	**3:10**						**Average ETE:**	**5:30**

Table 8-14. Special Facility Evacuation Time Estimates - Good Weather

Medical Facility	Patient	Mobilization (min)	Loading Rate (min per person)	People	Total Loading Time (min)	Dist. To EPZ Bdry (mi)	Travel Time to EPZ Boundary (min)	ETE (hr:min)
ALCC	Ambulatory	90	1	6	6	7.2	9	**1:45**
	Wheelchair bound	90	5	6	30	7.2	9	**2:10**
Alterra	Ambulatory	90	1	15	15	11.2	40	**2:25**
IHM Motherhouse	Ambulatory	90	1	177	30	8.2	33	**2:35**
	Wheelchair bound	90	5	13	65	8.2	14	**2:50**
	Bedridden	90	15	2	30	8.2	33	**2:35**
Lutheran Home	Ambulatory	90	1	106	30	5.3	24	**2:25**
	Wheelchair bound	90	5	8	40	5.3	18	**2:30**
	Bedridden	90	15	1	15	5.3	32	**2:20**
Maplewood Manor	Ambulatory	90	1	101	30	7.0	9	**2:10**
	Wheelchair bound	90	5	8	40	7.0	9	**2:20**
	Bedridden	90	15	1	15	7.0	9	**1:55**
Marybrook Residence	Ambulatory	90	1	10	10	4.6	6	**1:50**
	Wheelchair bound	90	5	1	5	4.6	6	**1:45**
Medilodge II	Ambulatory	90	1	85	30	3.4	14	**2:15**
	Wheelchair bound	90	5	6	30	3.4	14	**2:15**
	Bedridden	90	15	1	15	3.4	22	**2:10**
Mercy Memorial Hospital	Ambulatory	90	1	69	30	5.4	24	**2:25**
	Wheelchair bound	90	5	69	75	5.4	9	**2:55**
	Bedridden	90	15	30	30	5.4	24	**2:25**
Mercy Memorial Nursing Center	Ambulatory	90	1	59	30	5.4	7	**2:10**
	Bedridden	90	15	1	15	5.4	7	**1:55**
Tendercare of Monroe	Ambulatory	90	1	161	30	4.1	12	**2:15**
	Wheelchair bound	90	5	12	60	4.1	6	**2:40**
	Bedridden	90	15	2	30	4.1	12	**2:15**
							Maximum ETE:	**2:55**
							Average ETE:	**2:20**

Table 8-15. Medical Facility Evacuation Time Estimates - Rain

Medical Facility	Patient	Mobilization (min)	Loading Rate (min per person)	People	Total Loading Time (min)	Dist. To EPZ Bdry (mi)	Travel Time to EPZ Boundary (min)	ETE (hr:min)
ALCC	Ambulatory	100	1	6	6	7.2	10	**2:00**
	Wheelchair bound	100	5	6	30	7.2	10	**2:20**
Alterra	Ambulatory	100	1	15	15	11.2	43	**2:40**
ALCC	Ambulatory	100	1	177	30	8.2	12	**2:25**
	Wheelchair bound	100	5	13	65	8.2	11	**3:00**
	Bedridden	100	15	2	30	8.2	12	**2:25**
Lutheran Home	Ambulatory	100	1	106	30	5.3	24	**2:35**
	Wheelchair bound	100	5	8	40	5.3	19	**2:40**
	Bedridden	100	15	1	15	5.3	37	**2:35**
Maplewood Manor	Ambulatory	100	1	101	30	7.0	10	**2:20**
	Wheelchair bound	100	5	8	40	7.0	10	**2:30**
	Bedridden	100	15	1	15	7.0	10	**2:05**
Marybrook Residence	Ambulatory	100	1	10	10	4.6	6	**2:00**
	Wheelchair bound	100	5	1	5	4.6	6	**1:55**
Medilodge II	Ambulatory	100	1	85	30	3.4	16	**2:30**
	Wheelchair bound	100	5	6	30	3.4	16	**2:30**
	Bedridden	100	15	1	15	3.4	25	**2:20**
Mercy Memorial Hospital	Ambulatory	100	1	69	30	5.4	24	**2:35**
	Wheelchair bound	100	5	69	75	5.4	10	**3:05**
	Bedridden	100	15	30	30	5.4	24	**2:35**
Mercy Memorial Nursing Center	Ambulatory	100	1	59	30	5.4	8	**2:20**
	Bedridden	100	15	1	15	5.4	8	**2:05**
Tendercare of Monroe	Ambulatory	100	1	161	30	4.1	17	**2:30**
	Wheelchair bound	100	5	12	60	4.1	7	**2:50**
	Bedridden	100	15	2	30	4.1	17	**2:30**
							Maximum ETE:	**3:05**
							Average ETE:	**2:30**

Table 8-16. Medical Facility Evacuation Time Estimates - Snow

Medical Facility	Patient	Mobilization (min)	Loading Rate (min per person)	People	Total Loading Time (min)	Dist. To EPZ Bdry (mi)	Travel Time to EPZ Boundary (min)	ETE (hr:min)
ALCC	Ambulatory	110	1	6	6	7.2	12	**2:10**
	Wheelchair bound	110	5	6	30	7.2	12	**2:35**
Alterra	Ambulatory	110	1	15	15	11.2	48	**2:55**
ALCC	Ambulatory	110	1	177	30	8.2	13	**2:35**
	Wheelchair bound	110	5	13	65	8.2	13	**3:10**
	Bedridden	110	15	2	30	8.2	13	**2:35**
Lutheran Home	Ambulatory	110	1	106	30	5.3	25	**2:45**
	Wheelchair bound	110	5	8	40	5.3	19	**2:50**
	Bedridden	110	15	1	15	5.3	34	**2:40**
Maplewood Manor	Ambulatory	110	1	101	30	7.0	11	**2:35**
	Wheelchair bound	110	5	8	40	7.0	11	**2:45**
	Bedridden	110	15	1	15	7.0	11	**2:20**
Marybrook Residence	Ambulatory	110	1	10	10	4.6	7	**2:10**
	Wheelchair bound	110	5	1	5	4.6	7	**2:05**
Medilodge II	Ambulatory	110	1	85	30	3.4	20	**2:40**
	Wheelchair bound	110	5	6	30	3.4	20	**2:40**
	Bedridden	110	15	1	15	3.4	26	**2:35**
Mercy Memorial Hospital	Ambulatory	110	1	69	30	5.4	25	**2:45**
	Wheelchair bound	110	5	69	75	5.4	12	**3:20**
	Bedridden	110	15	30	30	5.4	25	**2:45**
Mercy Memorial Nursing Center	Ambulatory	110	1	59	30	5.4	9	**2:30**
	Bedridden	110	15	1	15	5.4	9	**2:15**
Tendercare of Monroe	Ambulatory	110	1	161	30	4.1	19	**2:40**
	Wheelchair bound	110	5	12	60	4.1	10	**3:00**
	Bedridden	110	15	2	30	4.1	19	**2:40**
							Maximum ETE:	**3:20**
							Average ETE:	**2:40**

Table 8-17. Homebound Special Needs Population Evacuation Time Estimates

Vehicle Type	People Requiring Vehicle	Vehicles deployed	Stops	Weather Conditions	Mobilization Time (min)	Loading Time at 1st Stop (min)	Travel to Subsequent Stops (min)	Total Loading Time at Subsequent Stops (min)	Travel Time to EPZ Boundary (min)	ETE (hr:min)
Buses	219	32	7	Good	90	5	0	30	9	**3:10**
				Rain	100		0		11	**3:30**
				Snow	110		0		11	**3:45**
Wheelchair Vans	103	26	4	Good	90	5	27	15	9	**2:30**
				Rain	100		30		11	**2:45**
				Snow	110		33		11	**2:55**
Ambulances	12	6	2	Good	90	15	10	15	9	**2:20**
				Rain	100		11		11	**2:35**
				Snow	110		13		11	**2:45**
									Maximum ETE:	**3:45**
									Average ETE:	**2:55**

9 TRAFFIC MANAGEMENT STRATEGY

This section discusses the suggested traffic control and management strategy that is designed to expedite the movement of evacuating traffic. The resources required to implement this strategy include:

- Personnel with the capabilities of performing the planned control functions of traffic guides (preferably, not necessarily, law enforcement officers).
- Traffic Control Devices to assist these personnel in the performance of their tasks. These devices should comply with the guidance of the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration (FHWA) of the U.S.D.O.T. All state and most county transportation agencies have access to the MUTCD, which is available on-line: http://mutcd.fhwa.dot.gov which provides access to the official PDF version.
- A plan that defines all locations, provides necessary details and is documented in a format that is readily understood by those assigned to perform traffic control.

The functions to be performed in the field are:

1. <u>Facilitate</u> evacuating traffic movements that safely expedite travel out of the EPZ.
2. <u>Discourage</u> traffic movements that move evacuating vehicles in a direction which takes them significantly closer to the power plant, or which interferes with the efficient flow of other evacuees.

The terms "facilitate" and "discourage" rather than "enforce" and "prohibit" to indicate the need for flexibility in performing the traffic control function. There are always legitimate reasons for a driver to prefer a direction other than that indicated. For example:

- A driver may be traveling home from work or from another location, to join other family members prior to evacuating.
- An evacuating driver may be travelling to pick up a relative, or other evacuees.
- The driver may be an emergency worker en route to perform an important activity.

The implementation of a plan <u>must</u> also be flexible enough for the application of sound judgment by the traffic guide.

The traffic management plan is the outcome of the following process:

1. The existing TCPs and ACPs identified by the offsite agencies in their existing emergency plans serve as the basis of the traffic management plan, as per NUREG/CR-7002.
2. Computer analysis of the evacuation traffic flow environment.

    This analysis identifies the best routing and those critical intersections that experience pronounced congestion. Any critical intersections that are not identified in the existing offsite plans are suggested as additional TCPs and ACPs
3. Computer analysis of the evacuation traffic flow environment (see Figures 7-3 through 7-8). As discussed in Section 7.3, congestion within the EPZ is clear by 2 hours after the ATE. Based on the limited traffic congestion within the EPZ, no additional TCPs are identified as a result of this study. The existing traffic management plans are adequate.

The use of Intelligent Transportation Systems (ITS) technologies can reduce manpower and equipment needs, while still facilitating the evacuation process. Dynamic Message Signs (DMS) can be placed within the EPZ to provide information to travelers regarding traffic conditions, route selection, and reception center information. DMS can also be placed outside of the EPZ to warn motorists to avoid using routes that may conflict with the flow of evacuees away from the power plant. Highway Advisory Radio (HAR) can be used to broadcast information to evacuees en route through their vehicle stereo systems. Automated Traveler Information Systems (ATIS) can also be used to provide evacuees with information. Internet websites can provide traffic and evacuation route information before the evacuee begins their trip, while on board navigation systems (GPS units), cell phones, and pagers can be used to provide information en route. These are only several examples of how ITS technologies can benefit the evacuation process. Consideration should be given that ITS technologies be used to facilitate the evacuation process, and any additional signage placed should consider evacuation needs.

The ETE analysis treated all controlled intersections that are existing TCP locations in the offsite agency plans as being controlled by actuated signals.

Chapters 2N and 5G, and Part 6 of the 2009 MUTCD are particularly relevant and should be reviewed during emergency response training.

The ETE calculations reflect the assumption that all “external-external” trips are interdicted and diverted after 2 hours have elapsed from the ATE.

All transit vehicles and other responders entering the EPZ to support the evacuation are assumed to be unhindered by personnel manning ACPs and TCPs.

Study Assumptions 5 and 6 in Section 2.3 discuss ACP and TCP staffing schedules and operations.

10 EVACUATION ROUTES

Evacuation routes are comprised of two distinct components:

- Routing from a PAA being evacuated to the boundary of the Evacuation Region and thence out of the EPZ.
- Routing of transit-dependent evacuees from the EPZ boundary to reception centers.

Evacuees will select routes within the EPZ in such a way as to minimize their exposure to risk. This expectation is met by the DYNEV II model routing traffic away from the location of the plant, to the extent practicable. The DTRAD model satisfies this behavior by routing traffic so as to balance traffic demand relative to the available highway capacity to the extent possible. See Appendices B through D for further discussion.

The routing of transit-dependent evacuees from the EPZ boundary to reception centers is designed to minimize the amount of travel outside the EPZ, from the points where these routes cross the EPZ boundary.

Figure 10-1 presents a map showing the general population reception centers and host schools for evacuees. The major evacuation routes for the EPZ are presented in Figure 10-2.

It is assumed that all school evacuees will be taken to the appropriate host school and subsequently picked up by parents or guardians. Transit-dependent evacuees are transported to the nearest reception center for each county. This study does not consider the transport of evacuees from reception centers to congregate care centers, if the counties do make the decision to relocate evacuees.

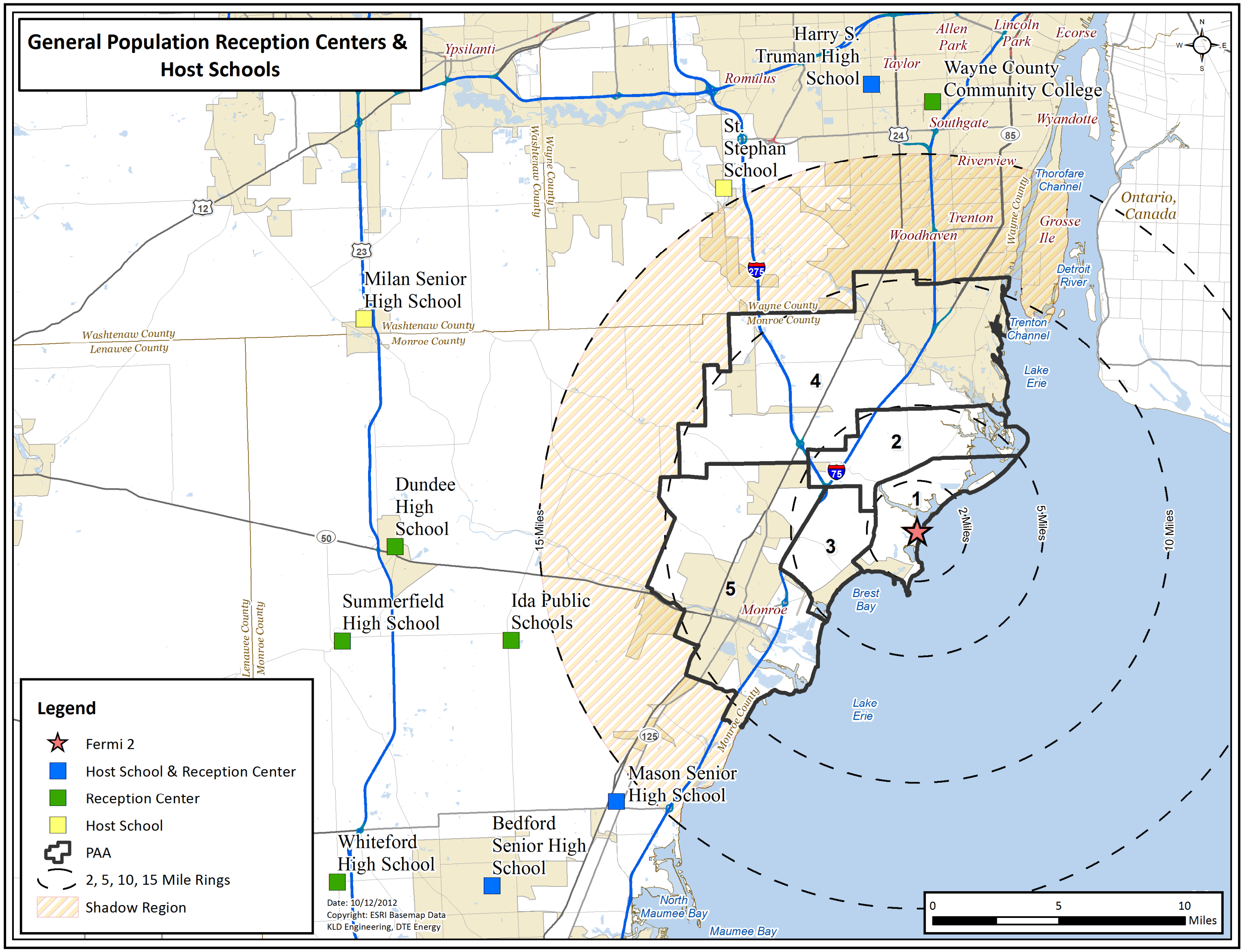


Figure 10-1. General Population Reception Centers and Host Schools

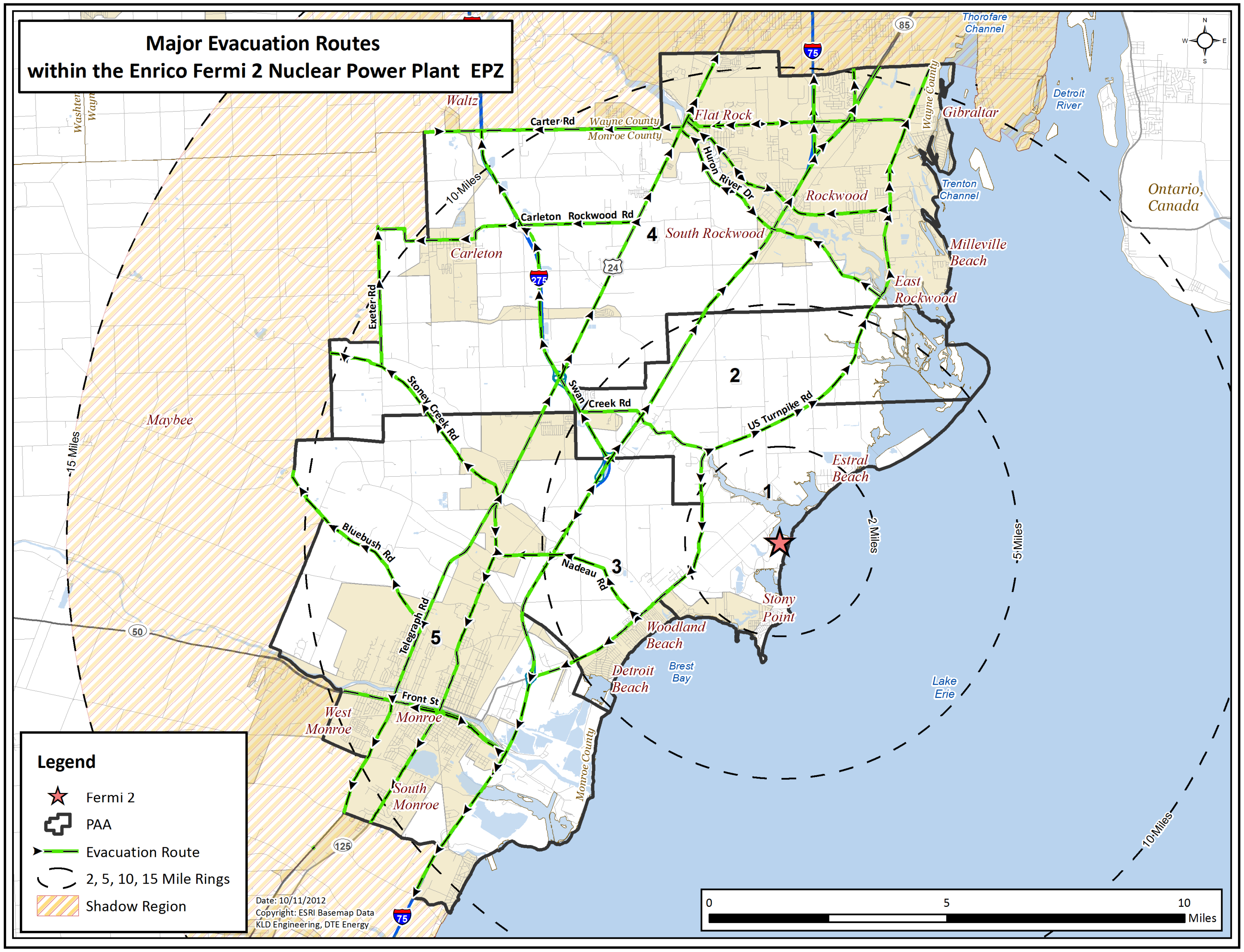


Figure 10-2. Evacuation Route Map

11 SURVEILLANCE OF EVACUATION OPERATIONS

There is a need for surveillance of traffic operations during the evacuation. There is also a need to clear any blockage of roadways arising from accidents or vehicle disablement. Surveillance can take several forms.

1. Traffic control personnel, located at Traffic Control and Access Control points, provide fixed-point surveillance.
2. Ground patrols may be undertaken along well-defined paths to ensure coverage of those highways that serve as major evacuation routes.
3. Aerial surveillance of evacuation operations may also be conducted using helicopter or fixed-wing aircraft, if available.
4. Cellular phone calls (if cellular coverage exists) from motorists may also provide direct field reports of road blockages.

These concurrent surveillance procedures are designed to provide coverage of the entire EPZ as well as the area around its periphery. It is the responsibility of the counties to support an emergency response system that can receive messages from the field and be in a position to respond to any reported problems in a timely manner. This coverage should quickly identify, and expedite the response to any blockage caused by a disabled vehicle.

Tow Vehicles

In a low-speed traffic environment, any vehicle disablement is likely to arise due to a low-speed collision, mechanical failure or the exhaustion of its fuel supply. In any case, the disabled vehicle can be pushed onto the shoulder, thereby restoring traffic flow. Past experience in other emergencies indicates that evacuees who are leaving an area often perform activities such as pushing a disabled vehicle to the side of the road without prompting.

While the need for tow vehicles is expected to be low under the circumstances described above, it is still prudent to be prepared for such a need. Consideration should be given that tow trucks with a supply of gasoline be deployed at strategic locations within, or just outside, the EPZ. These locations should be selected so that:

- They permit access to key, heavily loaded, evacuation routes.
- Responding tow trucks would most likely travel counter-flow relative to evacuating traffic.

Consideration should also be given that the state and local emergency management agencies encourage gas stations to remain open during the evacuation.

12 CONFIRMATION TIME

It is necessary to confirm that the evacuation process is effective in the sense that the public is complying with the Advisory to Evacuate. Numerous options are available in an emergency to confirm that all persons in a designated evacuation area that desire to evacuate have done so. These options range from surveying a statistically random sample of 0.8% of the landline phones in the area to a full door-to-door validation. Each method has its unique advantages combined with its shortcomings.

To provide a bounding time estimate a complete door-to-door confirmation is assumed. The following parameters are used in order to estimate the confirmation time:

- According to the telephone survey (Figure F-1), the average household size in the EPZ is 2.63 people. Based on an EPZ population of 97,825 (Table 3-1), there are approximately 37,200 households in the EPZ.
- 10 emergency vehicles patrol the EPZ after the estimated time to evacuate 100% of the EPZ population (about 4 hours, See Table 7-2) to confirm evacuation.
- Emergency vehicles will make announcements using the vehicle's public address system informing residents to call 911 if they are still at home and have not yet evacuated.
- Door to door distance within the EPZ is approximately 150 feet.
- Average speed of police car during patrol is 5 mph.

Based on the number of households in the EPZ and the parameters above, the time to complete door-to-door confirmation is computed as follows:

37,200 households x 150 ft ÷ 5,280 ft/mile ÷ 5 mi/hr ÷ 10 vehicles = 21.1 hr

If additional patrol vehicles are available or if only a portion of the EPZ is in the evacuation region, this time would be reduced.

It is necessary to confirm that the evacuation process is effective in the sense that the public is complying with the Advisory to Evacuate. In accordance with the county plans and procedures, evacuation confirmation activities to assure that all of the population has been notified will be conducted on the basis of either the monitoring of traffic flow from the EPZ or interviews of evacuees at established reception centers. In accordance with established procedures for Monroe County, additional door-to-door confirmation may be performed as a backup.

Not all evacuees will go to reception centers, as many evacuees will elect to evacuate to a lodging facility or the home of a friend/family member outside of the EPZ. In fact, page III-92 of the FEMA Radiological Emergency Planning (REP) manual indicates that reception centers should have the capacity to monitor 20% of the EPZ population within 12 hours. Thus, confirmation of evacuation based on data compiled at reception centers/congregate care facilities is not feasible as approximately 80% of evacuees will not go to a congregate care facility.

Based on the amount of time and effort needed to complete door-to-door confirmation, an alternative or complementary approach is suggested. The suggested procedure employs a stratified random sample and a telephone survey. The size of the sample is dependent on the expected number of households that do not comply with the Advisory to Evacuate. It is reasonable to assume for the purpose of estimating sample size that at least 80 percent of the population within the EPZ will comply with the Advisory to Evacuate. On this basis, an analysis could be undertaken (see Table 12-1) to yield an estimated sample size of approximately 300.

The confirmation process should start at about 2-1/2 hours after the Advisory to Evacuate, which is when 90 percent of evacuees have completed their mobilization activities. At this time, virtually all evacuees will have departed on their respective trips and the local telephone system will be largely free of traffic.

As indicated in Table 12-1, approximately 7-1/2 person hours are needed to complete the telephone survey. If six people are assigned to this task, each dialing a different set of telephone exchanges (e.g., each person can be assigned a different set of Protective Action Areas), then the confirmation process will extend over a time frame of about 75 minutes. Thus, the confirmation should be completed before the evacuated area is cleared. Of course, fewer people would be needed for this survey if the Evacuation Region were only a portion of the EPZ. Use of modern automated computer controlled dialing equipment can significantly reduce the manpower requirements and the time required to undertake this type of confirmation survey.

Should the number of telephone responses (i.e., people still at home) exceed 20 percent, then the telephone survey should be repeated after an hour's interval until the confirmation process is completed.

If this method is indeed used by Monroe and Wayne Counties, it is recommended that a list of telephone numbers within the EPZ be available in their EOC at all times. Such a list could be purchased from vendors and could be periodically updated. As indicated above, the confirmation process should not begin until 2 ½ hours after the Advisory to Evacuate, to ensure that most households have had enough time to mobilize and to start their evacuation travel. This timeframe will enable telephone operators to arrive at their workplace, access the call list and prepare to make the necessary phone calls.

Table 12-1. Estimated Number of Telephone Calls Required for Confirmation of Evacuation

Problem Definition

Estimate number of phone calls, n, needed to ascertain the proportion, F of households that have not evacuated.

Reference: Burstein, H., Attribute Sampling, McGraw Hill, 1971

Given:

- No. of households plus other facilities, N, within the EPZ (est.) = 37,500
- Est. proportion, F, of households that will not evacuate = 0.20
- Allowable error margin, e: 0.05
- Confidence level, α: 0.95 (implies A = 1.96)

Applying Table 10 of cited reference,

$$p = F + e = 0.25;\ \ q = 1 - p = 0.75$$

$$n = \frac{A^2 pq + e}{e^2} = 308$$

Finite population correction:

$$n_F = \frac{nN}{n + N - 1} = 305$$

Thus, some 300 telephone calls will confirm that approximately 20 percent of the population has not evacuated. If only 10 percent of the population does not comply with the Advisory to Evacuate, then the required sample size, n_F = 216.

Est. Person Hours to complete 300 telephone calls

Assume:

- Time to dial using touch tone (random selection of listed numbers): 30 seconds
- Time for 6 rings (no answer): 36 seconds
- Time for 4 rings plus short conversation: 60 sec.
- Interval between calls: 20 sec.

Person Hours:

$$\frac{300[30 + 0.8(36) + 0.2(60) + 20]}{3600} = 7.6$$

13 RECOMMENDATIONS

The following recommendations are offered:

1. Examination of the general population ETE in Section 7 shows that the ETE for 100 percent of the population is generally 1 to 2 ½ hours longer than for 90 percent of the population. Specifically, the additional time needed for the last 10 percent of the population to evacuate can be as much as double the time needed to evacuate 90 percent of the population. This non-linearity reflects the fact that these relatively few stragglers require significantly more time to mobilize (i.e. prepare for the evacuation trip) than their neighbors. This leads to two recommendations:
    a. The public outreach (information) program should emphasize the need for evacuees to minimize the time needed to prepare to evacuate (secure the home, assemble needed clothes, medicines, etc.).
    b. The decision makers should reference Table 7-1 which list the time needed to evacuate 90 percent of the population, when preparing recommended protective actions, as per NUREG/CR-7002 guidance.
2. Staged evacuation is not beneficial due to the low population within the 2 and 5-mile regions of the plant and the limited traffic congestion within these regions.
3. A lane closure on I-75 SB from the interchange with I-275 (Exit 20) to the end of the EPZ at Laplaisance Rd (before Exit 9) does not have a material impact on the 90th or 100th percentile ETE. Sufficient reserve highway capacity mitigates the impacts of the capacity reduction considered.
4. Counties should implement procedures whereby schools are contacted prior to dispatch of buses from the depots to get an accurate count of students needing transportation and the number of buses required (See Section 8).
5. Intelligent Transportation Systems (ITS) such as Dynamic Message Signs (DMS), Highway Advisory Radio (HAR), Automated Traveler Information Systems (ATIS), etc. should be used to facilitate the evacuation process (See Section 9). The placement of additional signage should consider evacuation needs.
6. Counties/State should establish strategic locations to position tow trucks provided with gasoline containers in the event of a disabled vehicle during the evacuation process (see Section 11) and should encourage gas stations to remain open during the evacuation.

APPENDIX A

Glossary of Traffic Engineering Terms

A. GLOSSARY OF TRAFFIC ENGINEERING TERMS

Table A-1. Glossary of Traffic Engineering Terms

Term	Definition
Analysis Network	A graphical representation of the geometric topology of a physical roadway system, which is comprised of directional links and nodes.
Link	A network link represents a specific, one-directional section of roadway. A link has both physical (length, number of lanes, topology, etc.) and operational (turn movement percentages, service rate, free-flow speed) characteristics.
Measures of Effectiveness	Statistics describing traffic operations on a roadway network.
Node	A network node generally represents an intersection of network links. A node has control characteristics, i.e., the allocation of service time to each approach link.
Origin	A location attached to a network link, within the EPZ or Shadow Region, where trips are generated at a specified rate in vehicles per hour (vph). These trips enter the roadway system to travel to their respective destinations.
Prevailing Roadway and Traffic Conditions	Relates to the physical features of the roadway, the nature (e.g., composition) of traffic on the roadway and the ambient conditions (weather, visibility, pavement conditions, etc.).
Service Rate	Maximum rate at which vehicles, executing a specific turn maneuver, can be discharged from a section of roadway at the prevailing conditions, expressed in vehicles per second (vps) or vehicles per hour (vph).
Service Volume	Maximum number of vehicles which can pass over a section of roadway in one direction during a specified time period with operating conditions at a specified Level of Service (The Service Volume at the upper bound of Level of Service, E, equals Capacity). Service Volume is usually expressed as vehicles per hour (vph).
Signal Cycle Length	The total elapsed time to display all signal indications, in sequence. The cycle length is expressed in seconds.
Signal Interval	A single combination of signal indications. The interval duration is expressed in seconds. A signal phase is comprised of a sequence of signal intervals, usually green, yellow, red.

Term	Definition
Signal Phase	A set of signal indications (and intervals) which services a particular combination of traffic movements on selected approaches to the intersection. The phase duration is expressed in seconds.
Traffic (Trip) Assignment	A process of assigning traffic to paths of travel in such a way as to satisfy all trip objectives (i.e., the desire of each vehicle to travel from a specified origin in the network to a specified destination) and to optimize some stated objective or combination of objectives. In general, the objective is stated in terms of minimizing a generalized "cost". For example, "cost" may be expressed in terms of travel time.
Traffic Density	The number of vehicles that occupy one lane of a roadway section of specified length at a point in time, expressed as vehicles per mile (vpm).
Traffic (Trip) Distribution	A process for determining the destinations of all traffic generated at the origins. The result often takes the form of a Trip Table, which is a matrix of origin-destination traffic volumes.
Traffic Simulation	A computer model designed to replicate the real-world operation of vehicles on a roadway network, so as to provide statistics describing traffic performance. These statistics are called Measures of Effectiveness.
Traffic Volume	The number of vehicles that pass over a section of roadway in one direction, expressed in vehicles per hour (vph). Where applicable, traffic volume may be stratified by turn movement.
Travel Mode	Distinguishes between private auto, bus, rail, pedestrian and air travel modes.
Trip Table or Origin-Destination Matrix	A rectangular matrix or table, whose entries contain the number of trips generated at each specified origin, during a specified time period, that are attracted to (and travel toward) each of its specified destinations. These values are expressed in vehicles per hour (vph) or in vehicles.
Turning Capacity	The capacity associated with that component of the traffic stream which executes a specified turn maneuver from an approach at an intersection.

APPENDIX B

DTRAD: Dynamic Traffic Assignment and Distribution Model

B. DYNAMIC TRAFFIC ASSIGNMENT AND DISTRIBUTION MODEL

This section describes the integrated dynamic trip assignment and distribution model named DTRAD (Dynamic Traffic Assignment and Distribution) that is expressly designed for use in analyzing evacuation scenarios. DTRAD employs logit-based path-choice principles and is one of the models of the DYNEVII System. The DTRAD module implements path-based *Dynamic Traffic Assignment* (DTA) so that time dependent Origin-Destination (OD) trips are "assigned" to routes over the network based on prevailing traffic conditions.

To apply the DYNEV II System, the analyst must specify the highway network, link capacity information, the time-varying volume of traffic generated at all origin centroids and, optionally, a set of accessible candidate destination nodes on the periphery of the EPZ for selected origins. DTRAD calculates the optimal dynamic trip distribution (i.e., trip destinations) and the optimal dynamic trip assignment (i.e., trip routing) of the traffic generated at each origin node traveling to its set of candidate destination nodes, so as to minimize evacuee travel "cost."

Overview of Integrated Distribution and Assignment Model

The underlying premise is that the selection of destinations and routes is intrinsically coupled in an evacuation scenario. That is, people in vehicles seek to travel out of an area of potential risk as rapidly as possible by selecting the "best" routes. The model is designed to identify these "best" routes in a manner that realistically distributes vehicles from origins to destinations and routes them over the highway network, in a consistent and optimal manner, reflecting evacuee behavior.

For each origin, a set of "candidate destination nodes" is selected by the software logic and by the analyst to reflect the desire by evacuees to travel away from the power plant and to access major highways. The specific destination nodes within this set that are selected by travelers and the selection of the connecting paths of travel, are both determined by DTRAD. This determination is made by a logit-based path choice model in DTRAD, so as to minimize the trip "cost", as discussed later.

The traffic loading on the network and the consequent operational traffic environment of the network (density, speed, throughput on each link) vary over time as the evacuation takes place. The DTRAD model, which is interfaced with the DYNEV simulation model, executes a succession of "sessions" wherein it computes the optimal routing and selection of destination nodes for the conditions that exist at that time.

Interfacing the DYNEV Simulation Model with DTRAD

The DYNEV II system reflects NRC guidance that evacuees will seek to travel in a general direction away from the location of the hazardous event. An algorithm was developed to support the DTRAD model in dynamically varying the Trip Table (O-D matrix) over time from one DTRAD session to the next. Another algorithm executes a "mapping" from the specified "geometric" network (link-node analysis network) that represents the physical highway system, to a "path" network that represents the vehicle [turn] movements. DTRAD computations are performed on the "path" network: DYNEV simulation model, on the "geometric" network.

DTRAD Description

DTRAD is the DTA module for the DYNEV II System.

When the road network under study is large, multiple routing options are usually available between trip origins and destinations. The problem of loading traffic demands and propagating them over the network links is called Network Loading and is addressed by DYNEVII using macroscopic traffic simulation modeling. Traffic assignment deals with computing the distribution of the traffic over the road network for given O-D demands and is a model of the route choice of the drivers. Travel demand changes significantly over time, and the road network may have time dependent characteristics, e.g., time-varying signal timing or reduced road capacity because of lane closure, or traffic congestion. To consider these time dependencies, DTA procedures are required.

The DTRAD DTA module represents the dynamic route choice behavior of drivers, using the specification of dynamic origin-destination matrices as flow input. Drivers choose their routes through the network based on the travel cost they experience (as determined by the simulation model). This allows traffic to be distributed over the network according to the time-dependent conditions. The modeling principles of D-TRAD include:

- It is assumed that drivers not only select the best route (i.e., lowest cost path) but some also select less attractive routes. The algorithm implemented by DTRAD archives several "efficient" routes for each O-D pair from which the drivers choose.
- The choice of one route out of a set of possible routes is an outcome of "discrete choice modeling". Given a set of routes and their generalized costs, the percentages of drivers that choose each route is computed. The most prevalent model for discrete choice modeling is the logit model. DTRAD uses a variant of Path-Size-Logit model (PSL). PSL overcomes the drawback of the traditional multinomial logit model by incorporating an additional deterministic path size correction term to address path overlapping in the random utility expression.
- DTRAD executes the TA algorithm on an abstract network representation called "the path network" which is built from the actual physical link-node analysis network. This execution continues until a stable situation is reached: the volumes and travel times on the edges of the path network do not change significantly from one iteration to the next. The criteria for this convergence are defined by the user.
- Travel "cost" plays a crucial role in route choice. In DTRAD, path cost is a linear summation of the generalized cost of each link that comprises the path. The generalized cost for a link, a, is expressed as

  $$c_a = \alpha t_a + \beta l_a + \gamma s_a ,$$

  where c_a is the generalized cost for link a, and α , β, and γ are cost coefficients for link travel time, distance, and supplemental cost, respectively. Distance and supplemental costs are defined as invariant properties of the network model, while travel time is a dynamic property dictated by prevailing traffic conditions. The DYNEV simulation model computes travel times on all edges in the network and DTRAD uses that information to constantly update the costs of paths. The route choice decision model in the next simulation iteration uses these updated values to adjust the route choice behavior. This way, traffic demands are dynamically re-assigned based on time dependent conditions. The interaction between the DTRAD traffic assignment and DYNEV II simulation models is depicted in Figure B-1. Each round of interaction is called a Traffic Assignment Session (TA session). A TA session is composed of multiple iterations, marked as loop B in the figure.

- The supplemental cost is based on the "survival distribution" (a variation of the exponential distribution).The Inverse Survival Function is a "cost" term in DTRAD to represent the potential risk of travel toward the plant:

  $s_a = - \beta \ln (p), 0 \leq p \leq l ; \beta > 0$

  $p = \frac{d_n}{d_0}$

  d_n = Distance of node, n, from the plant
  d_0 =Distance from the plant where there is zero risk
  β = Scaling factor

The value of d_o = 15 miles, the outer distance of the shadow region. Note that the supplemental cost, $s_{a,}$ of link, a, is (high, low), if its downstream node, n, is (near, far from) the power plant.

Network Equilibrium

In 1952, John Wardrop wrote:

> *Under equilibrium conditions traffic arranges itself in congested networks in such a way that no individual trip-maker can reduce his path costs by switching routes.*

The above statement describes the "User Equilibrium" definition, also called the "Selfish Driver Equilibrium". It is a hypothesis that represents a [hopeful] condition that evolves over time as drivers search out alternative routes to identify those routes that minimize their respective "costs". It has been found that this "equilibrium" objective to minimize costs is largely realized by most drivers who routinely take the same trip over the same network at the same time (i.e., commuters). Effectively, such drivers "learn" which routes are best for them over time. Thus, the traffic environment "settles down" to a near-equilibrium state.

Clearly, since an emergency evacuation is a sudden, unique event, it does not constitute a long-term learning experience which can achieve an equilibrium state. Consequently, DTRAD was not designed as an equilibrium solution, but to represent drivers in a new and unfamiliar situation, who respond in a flexible manner to real-time information (either broadcast or observed) in such a way as to minimize their respective costs of travel.

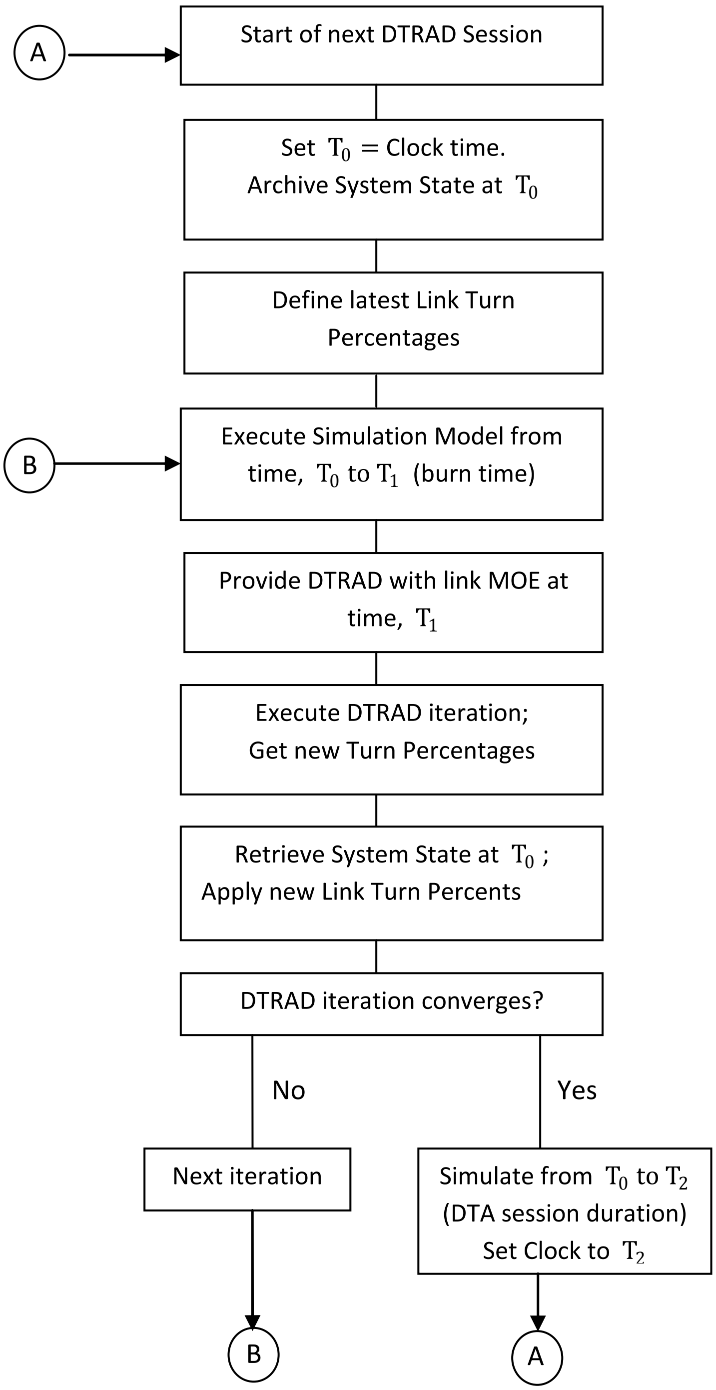


Figure B-1. Flow Diagram of Simulation-DTRAD Interface

APPENDIX C

DYNEV Traffic Simulation Model

C. DYNEV TRAFFIC SIMULATION MODEL

The DYNEV traffic simulation model is a *macroscopic* model that describes the operations of traffic flow in terms of aggregate variables: vehicles, flow rate, mean speed, volume, density, queue length, *on each link*, for each turn movement, during each Time Interval (simulation time step). The model generates trips from "sources" and from Entry Links and introduces them onto the analysis network at rates specified by the analyst based on the mobilization time distributions. The model simulates the movements of all vehicles on all network links over time until the network is empty. At intervals, the model outputs Measures of Effectiveness (MOE) such as those listed in Table C-1.

Model Features Include:

- Explicit consideration is taken of the variation in density over the time step; an iterative procedure is employed to calculate an average density over the simulation time step for the purpose of computing a mean speed for moving vehicles.
- Multiple turn movements can be serviced on one link; a separate algorithm is used to estimate the number of (fractional) lanes assigned to the vehicles performing each turn movement, based, in part, on the turn percentages provided by the DTRAD model.
- At any point in time, traffic flow on a link is subdivided into two classifications: queued and moving vehicles. The number of vehicles in each classification is computed. Vehicle spillback, stratified by turn movement for each network link, is explicitly considered and quantified. The propagation of stopping waves from link to link is computed within each time step of the simulation. There is no "vertical stacking" of queues on a link.
- Any link can accommodate "source flow" from zones via side streets and parking facilities that are not explicitly represented. This flow represents the evacuating trips that are generated at the source.
- The relation between the number of vehicles occupying the link and its storage capacity is monitored every time step for every link and for every turn movement. If the available storage capacity on a link is exceeded by the demand for service, then the simulator applies a "metering" rate to the entering traffic from both the upstream feeders and source node to ensure that the available storage capacity is not exceeded.
- A "path network" that represents the specified traffic movements from each network link is constructed by the model; this path network is utilized by the DTRAD model.
- A two-way interface with DTRAD: (1) provides link travel times; (2) receives data that translates into link turn percentages.
- Provides MOE to animation software, EVAN
- Calculates ETE statistics

All traffic simulation models are data-intensive. Table C-2 outlines the necessary input data elements.

To provide an efficient framework for defining these specifications, the physical highway environment is represented as a network. The unidirectional links of the network represent roadway sections: rural, multi-lane, urban streets or freeways. The nodes of the network generally represent intersections or points along a section where a geometric property changes (e.g. a lane drop, change in grade or free flow speed).

Figure C-1 is an example of a small network representation. The freeway is defined by the sequence of links, (20,21), (21,22), and (22,23). Links (8001, 19) and (3, 8011) are Entry and Exit links, respectively. An arterial extends from node 3 to node 19 and is partially subsumed within a grid network. Note that links (21,22) and (17,19) are grade-separated.

Table C-1. Selected Measures of Effectiveness Output by DYNEV II

Measure	Units	Applies To
Vehicles Discharged	Vehicles	Link, Network, Exit Link
Speed	Miles/Hours (mph)	Link, Network
Density	Vehicles/Mile/Lane	Link
Level of Service	LOS	Link
Content	Vehicles	Network
Travel Time	Vehicle-hours	Network
Evacuated Vehicles	Vehicles	Network, Exit Link
Trip Travel Time	Vehicle-minutes/trip	Network
Capacity Utilization	Percent	Exit Link
Attraction	Percent of total evacuating vehicles	Exit Link
Max Queue	Vehicles	Node, Approach
Time of Max Queue	Hours:minutes	Node, Approach
Route Statistics	Length (mi); Mean Speed (mph); Travel Time (min)	Route
Mean Travel Time	Minutes	Evacuation Trips; Network

Table C-2. Input Requirements for the DYNEV II Model

HIGHWAY NETWORK

- Links defined by upstream and downstream node numbers
- Link lengths
- Number of lanes (up to 9) and channelization
- Turn bays (1 to 3 lanes)
- Destination (exit) nodes
- Network topology defined in terms of downstream nodes for each receiving link
- Node Coordinates (X,Y)
- Nuclear Power Plant Coordinates (X,Y)

GENERATED TRAFFIC VOLUMES

- On all entry links and source nodes (origins), by Time Period

TRAFFIC CONTROL SPECIFICATIONS

- Traffic signals: link-specific, turn movement specific
- Signal control treated as fixed time or actuated
- Location of traffic control points (these are represented as actuated signals)
- Stop and Yield signs
- Right-turn-on-red (RTOR)
- Route diversion specifications
- Turn restrictions
- Lane control (e.g. lane closure, movement-specific)

DRIVER'S AND OPERATIONAL CHARACTERISTICS

- Driver's (vehicle-specific) response mechanisms: free-flow speed, discharge headway
- Bus route designation.

DYNAMIC TRAFFIC ASSIGNMENT

- Candidate destination nodes for each origin (optional)
- Duration of DTA sessions
- Duration of simulation "burn time"
- Desired number of destination nodes per origin

INCIDENTS

- Identify and Schedule of closed lanes
- Identify and Schedule of closed links

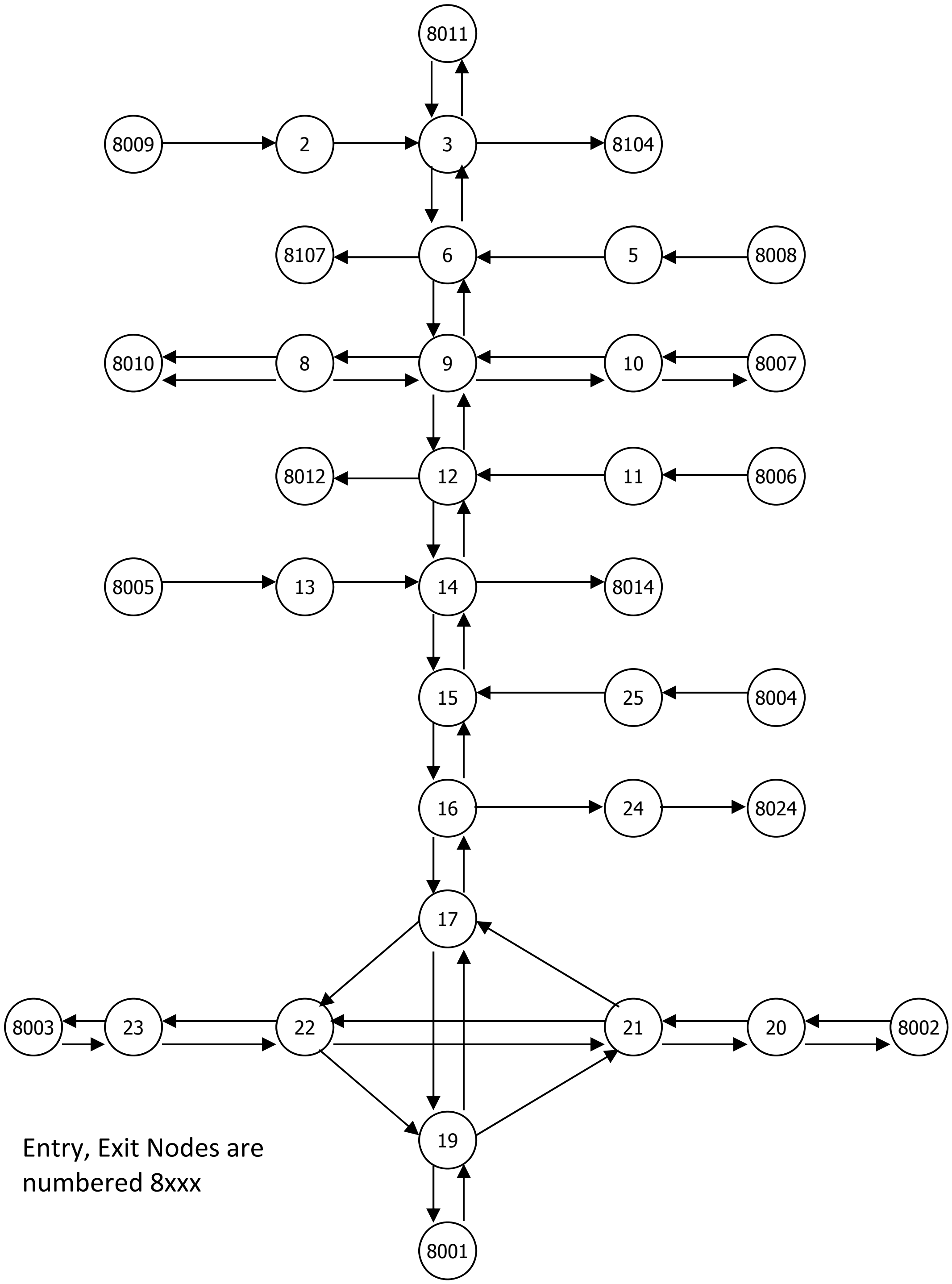


Figure C-1. Representative Analysis Network

C.1 Methodology

C.1.1 The Fundamental Diagram

It is necessary to define the fundamental diagram describing flow-density and speed-density relationships. Rather than "settling for" a triangular representation, a more realistic representation that includes a "capacity drop", (I-R)$Q_{max,}$ at the critical density when flow conditions enter the forced flow regime, is developed and calibrated for each link. This representation, shown in Figure C-2, asserts a constant free speed up to a density, k_f, and then a linear reduction in speed in the range, $k_f \leq k \leq k_c = 45 \text{ vpm}$, the density at capacity. In the flow-density plane, a quadratic relationship is prescribed in the range, $k_c < k \leq k_s = 95 \text{ vpm}$ which roughly represents the "stop-and-go" condition of severe congestion. The value of flow rate, Q_s, corresponding to k_s, is approximated at $0.7\, RQ_{max}$. A linear relationship between k_s and k_j completes the diagram shown in Figure C-2. Table C-3 is a glossary of terms.

The fundamental diagram is applied to moving traffic on every link. The specified calibration values for each link are: (1) Free speed, v_f ; (2) Capacity, Q_{max} ; (3) Critical density, $k_c = 45 \text{ vpm}$; (4) Capacity Drop Factor, R = 0.9 ; (5) Jam density, k_j . Then, $v_c = \frac{Q_{max}}{k_c}$, $k_f = k_c - \frac{(V_f - V_c)\, k_c^2}{Q_{max}}$. Setting $\bar{k} = k - k_c$, then $Q = RQ_{max} - \frac{RQ_{max}}{8333} \bar{k}^2$ for $0 \leq \bar{k} \leq \bar{k}_s = 50$. It can be shown that $Q = (0.98 - 0.0056\, \bar{k})\, RQ_{max}$ for $\bar{k}_s \leq \bar{k} \leq \bar{k}_j$, where $\bar{k}_s = 50$ and $\bar{k}_j = 175$.

C.1.2 The Simulation Model

The simulation model solves a sequence of "unit problems". Each unit problem computes the movement of traffic on a link, for each specified turn movement, over a specified time interval (TI) which serves as the simulation time step for all links. Figure C-3 is a representation of the unit problem in the time-distance plane. Table C-3 is a glossary of terms that are referenced in the following description of the unit problem procedure.

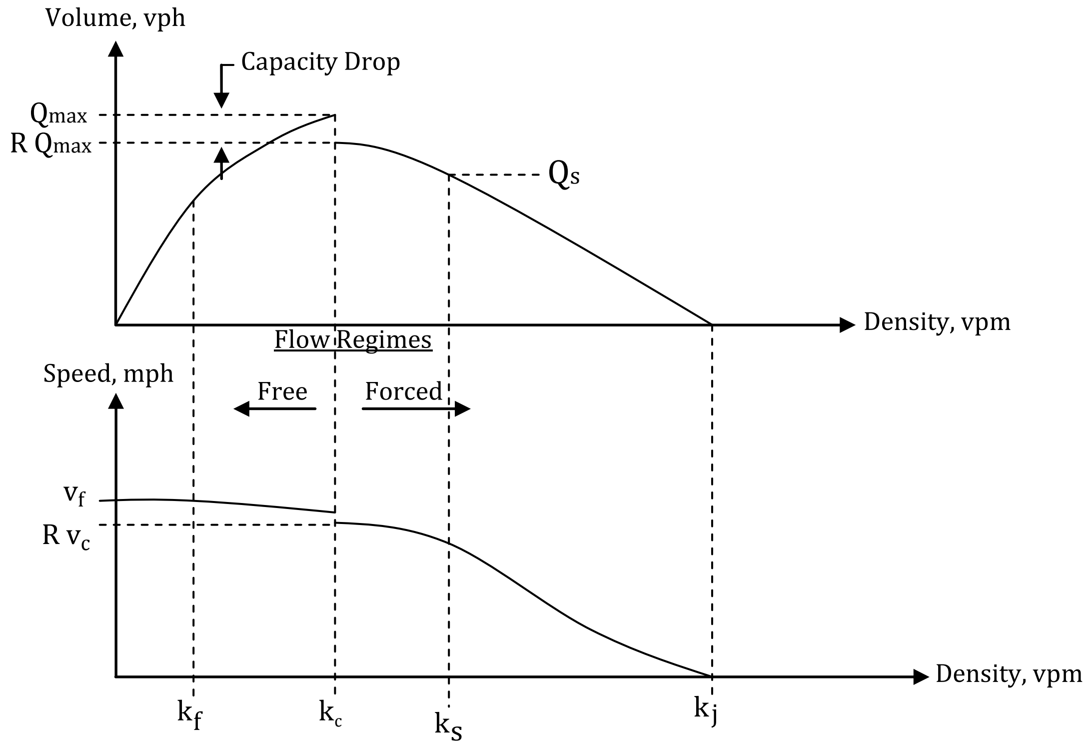


Figure C-2. Fundamental Diagrams

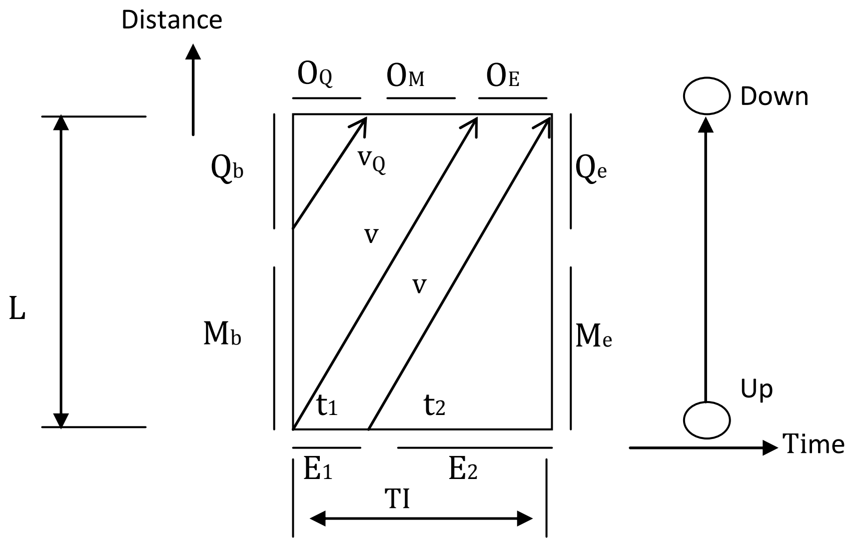


Figure C-3. A UNIT Problem Configuration with $t_1 > 0$

Table C-3. Glossary

Cap	The maximum number of vehicles, of a particular movement, that can discharge from a link within a time interval.
E	The number of vehicles, of a particular movement, that enter the link over the time interval. The portion, E_{TI}, can reach the stop-bar within the TI.
G/C	The green time: cycle time ratio that services the vehicles of a particular turn movement on a link.
h	The mean queue discharge headway, seconds.
k	Density in vehicles per lane per mile.
$\bar{k}$	The average density of <u>moving</u> vehicles of a particular movement over a TI, on a link.
L	The length of the link in feet.
L_b , L_e	The queue length in feet of a particular movement, at the [beginning, end] of a time interval.
LN	The number of lanes, expressed as a floating point number, allocated to service a particular movement on a link.
L_v	The mean effective length of a queued vehicle including the vehicle spacing, feet.
M	Metering factor (Multiplier): 1.
M_b , M_e	The number of moving vehicles on the link, of a particular movement, that are moving at the [beginning, end] of the time interval. These vehicles are assumed to be of equal spacing, over the length of link upstream of the queue.
O	The total number of vehicles of a particular movement that are discharged from a link over a time interval.
O_Q , O_M , O_E	The components of the vehicles of a particular movement that are discharged from a link within a time interval: vehicles that were Queued at the beginning of the TI; vehicles that were Moving within the link at the beginning of the TI; vehicles that Entered the link during the TI.
P_x	The percentage, expressed as a fraction, of the total flow on the link that executes a particular turn movement, x.

Q_b , Q_e	The number of queued vehicles on the link, of a particular turn movement, at the [beginning, end] of the time interval.
Q_{max}	The maximum flow rate that can be serviced by a link for a particular movement in the absence of a control device. It is specified by the analyst as an estimate of link capacity, based upon a field survey, with reference to the HCM.
R	The factor that is applied to the capacity of a link to represent the "capacity drop" when the flow condition moves into the forced flow regime. The lower capacity at that point is equal to RQ_{max} .
RCap	The remaining capacity available to service vehicles of a particular movement after that queue has been completely serviced, within a time interval, expressed as vehicles.
S_x	Service rate for movement x, vehicles per hour (vph).
t_1	Vehicles of a particular turn movement that enter a link over the first t_1 seconds of a time interval, can reach the stop-bar (in the absence of a queue down-stream) within the same time interval.
TI	The time interval, in seconds, which is used as the simulation time step.
v	The mean speed of travel, in feet per second (fps) or miles per hour (mph), of moving vehicles on the link.
v_Q	The mean speed of the last vehicle in a queue that discharges from the link within the TI. This speed differs from the mean speed of moving vehicles, v.
W	The width of the intersection in feet. This is the difference between the link length which extends from stop-bar to stop-bar and the block length.

The formulation and the associated logic presented below are designed to solve the unit problem for each sweep over the network (discussed below), for each turn movement serviced on each link that comprises the evacuation network, and for each TI over the duration of the evacuation.

Given $= Q_b, M_b, L, TI, E_0, LN, G/C, h, L_v, R_0, L_c, E, M$
Compute $= O, Q_e, M_e$
Define $O = O_Q + O_M + O_E$; $E = E_1 + E_2$

1. For the first sweep, s = 1, of this TI, get initial estimates of mean density, k_0, the R – factor, R_0 and entering traffic, E_0, using the values computed for the final sweep of the prior TI. For each subsequent sweep, $s > 1$, calculate $E = \sum_i P_i\ O_i + S$ where P_i, O_i are the relevant turn percentages from feeder link, i , and its total outflow (possibly metered) over this TI; S is the total source flow (possibly metered) during the current TI.
   Set iteration counter, n = 0, $k = k_0$, and $E = E_0$.

2. Calculate $v(k)$ such that $k \leq 130$ using the analytical representations of the fundamental diagram.
   Calculate $\text{Cap} = \frac{Q_{max}(TI)}{3600}\left(G/C\right) LN$, in vehicles, this value may be reduced due to metering
   Set $R = 1.0$ if $G/C < 1$ or if $k \leq k_c$; Set $R = 0.9$ only if $G/C = 1$ and $k > k_c$
   Calculate queue length, $L_b = Q_b \frac{L_v}{LN}$

3. Calculate $t_1 = TI - \frac{L}{V}$. If $t_1 \prec 0$, set $t_1 = E_1 = O_E = 0$; Else, $E_1 = E \frac{t_1}{TI}$.

4. Then $E_2 = E - E_1$; $t_2 = TI - t_1$

5. If $Q_b \geq \text{Cap}$, then
   $O_Q = \text{Cap}, O_M = O_E = 0$
   If $t_1 > 0$, then
   $Q'_e = Q_b + M_b + E_1 - \text{Cap}$
   Else
   $Q'_e = Q_b - \text{Cap}$
   End if
   Calculate Q_e and M_e using Algorithm A (below)

6. Else $(Q_b \prec \text{Cap})$
   $O_Q = Q_b$, $\text{RCap} = \text{Cap} - O_Q$

7. If $M_b \leq \text{RCap}$, then

8. If $t_1 > 0$, $O_M = M_b$, $O_E = \min\left(RCap - M_b, \frac{t_1\ Cap}{TI}\right) \geq 0$

$Q'_e = E_1 - O_E$

If $Q'_e > 0$, then

Calculate Q_e, M_e with Algorithm A

Else

$Q_e = 0$, $M_e = E_2$

End if

Else $(t_1 = 0)$

$O_M = \left(\frac{v(TI) - L_b}{L - L_b}\right) M_b$ and $O_E = 0$

$M_e = M_b - O_M + E$; $Q_e = 0$

End if

9. Else $(M_b > RCap)$

$O_E = 0$

If $t_1 > 0$, then

$O_M = RCap$, $Q'_e = M_b - O_M + E_1$

Calculate Q_e and M_e using Algorithm A

10. Else $(t_1 = 0)$

$M_d = \left[\left(\frac{v(TI) - L_b}{L - L_b}\right) M_b\right]$

If $M_d > RCap$, *then*

$O_M = RCap$

$Q'_e = M_d - O_M$

Apply Algorithm A to calculate Q_e and M_e

Else

$O_M = M_d$

$M_e = M_b - O_M + E$ and $Q_e = 0$

End if

End if

End if

End if

11. Calculate a new estimate of average density, $\bar{k}_n = \frac{1}{4}[k_b + 2\ k_m + k_e]$,

where k_b = density at the beginning of the TI

k_e = density at the end of the TI

k_m = density at the mid-point of the TI

All values of density apply only to the moving vehicles.

If $|\bar{k}_n - \bar{k}_{n-1}| > \in$ and $n < N$

where N = max number of iterations, and ϵ is a convergence criterion, then

12. set $n = n + 1$, and return to step 2 to perform iteration, n, using $k = \bar{k}_n$.
End if

Computation of unit problem is now complete. Check for excessive inflow causing spillback.

13. If $Q_e + M_e > \frac{(L-W)\,LN}{L_v}$, then

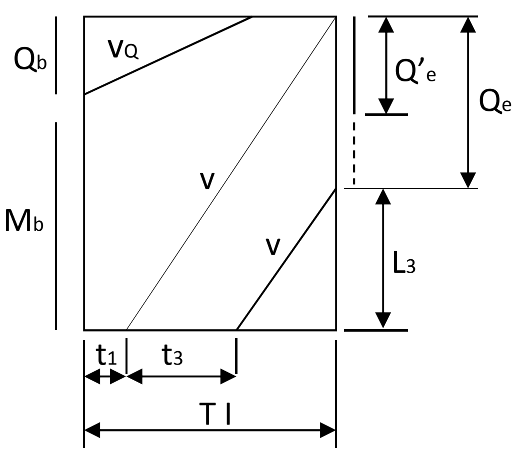
The number of excess vehicles that cause spillback is: $SB = Q_e + M_e - \frac{(L-W) \cdot LN}{L_v}$, where W is the width of the upstream intersection. To prevent spillback, meter the outflow from the feeder approaches and from the source flow, S, during this TI by the amount, SB. That is, set

$$M = 1 - \frac{SB}{(E + S)} \geq 0 \text{ , where M is the metering factor (over all movements).}$$

This metering factor is assigned appropriately to all feeder links and to the source flow, to be applied during the next network sweep, discussed later.

Algorithm A

This analysis addresses the flow environment over a TI during which moving vehicles can join a standing or discharging queue. For the case shown, $Q_b \leq Cap$, with $t_1 > 0$ and a queue of length, Q'_e , formed by that portion of M_b and E that reaches the stop-bar within the TI, but could not discharge due to inadequate capacity. That is, $Q_b + M_b + E_1 > Cap$. This queue length, $Q'_e = Q_b + M_b + E_1 - Cap$ can be extended to Q_e by traffic entering the approach during the current TI, traveling at speed, v, and reaching the rear of the queue within the TI. A portion of the entering vehicles, $E_3 = E\,\frac{t_3}{TI}$, will likely join the queue. This analysis calculates t_3 , Q_e and M_e for the input values of L, TI, v, E, t, L_v, LN, Q'_e .



When $t_1 > 0$ and $Q_b \leq Cap$:

Define: $L'_e = Q'_e \frac{L_v}{LN}$. From the sketch, $L_3 = v(TI - t_1 - t_3) = L - (Q'_e + E_3)\frac{L_v}{LN}$.

Substituting $E_3 = \frac{t_3}{TI}\,E$ yields: $-vt_3 + \frac{t_3}{TI}\,E\,\frac{L_v}{LN} = L - v(TI - t_1) - L'_e$. Recognizing that the first two terms on the right hand side cancel, solve for t_3 to obtain:

$$t_3 = \frac{L'_e}{\left[v - \frac{E}{TI}\frac{L_v}{LN}\right]} \qquad \text{such that} \quad 0 \le t_3 \le TI - t_1$$

If the denominator, $\left[v - \frac{E}{TI}\frac{L_v}{LN}\right] \le 0$, set $t_3 = TI - t_1$.

$$\text{Then, } Q_e = Q'_e + E\,\frac{t_3}{TI} \quad , \qquad M_e = E\left(1 - \frac{t_1 + t_3}{TI}\right)$$

The complete Algorithm A considers all flow scenarios; space limitation precludes its inclusion, here.

C.1.3 Lane Assignment

The "unit problem" is solved for each turn movement on each link. Therefore it is necessary to calculate a value, LN_x , of allocated lanes for each movement, x. If in fact all lanes are specified by, say, arrows painted on the pavement, either as full lanes or as lanes within a turn bay, then the problem is fully defined. If however there remain un-channelized lanes on a link, then an analysis is undertaken to subdivide the number of these physical lanes into turn movement specific virtual lanes, LN_x.

C.2 Implementation

C.2.1 Computational Procedure

The computational procedure for this model is shown in the form of a flow diagram as Figure C-4. As discussed earlier, the simulation model processes traffic flow for each link independently over TI that the analyst specifies; it is usually 60 seconds or longer. The first step is to execute an algorithm to define the sequence in which the network links are processed so that as many links as possible are processed after their feeder links are processed, within the same network sweep. Since a general network will have many closed loops, it is not possible to guarantee that every link processed will have all of its feeder links processed earlier.

The processing then continues as a succession of time steps of duration, TI, until the simulation is completed. Within each time step, the processing performs a series of "sweeps" over all network links; this is necessary to ensure that the traffic flow is synchronous over the entire network. Specifically, the sweep ensures continuity of flow among all the network links; in the context of this model, this means that the values of E, M, and S are all defined for each link such that they represent the synchronous movement of traffic from each link to all of its outbound links. These sweeps also serve to compute the metering rates that control spillback.

Within each sweep, processing solves the "unit problem" for each turn movement on each link. With the turn movement percentages for each link provided by the DTRAD model, an algorithm allocates the number of lanes to each movement serviced on each link. The timing at a signal, if any, applied at the downstream end of the link, is expressed as a G/C ratio, the signal timing needed to define this ratio is an input requirement for the model. The model also has the capability of representing, with macroscopic fidelity, the actions of actuated signals responding to the time-varying competing demands on the approaches to the intersection.

The solution of the unit problem yields the values of the number of vehicles, O, that discharge from the link over the time interval and the number of vehicles that remain on the link at the end of the time interval as stratified by queued and moving vehicles: $\mathrm{Q_e}$ and $\mathrm{M_e}$. The procedure considers each movement separately (multi-piping). After all network links are processed for a given network sweep, the updated consistent values of entering flows, E; metering rates, M; and source flows, S are defined so as to satisfy the “no spillback” condition. The procedure then performs the unit problem solutions for all network links during the following sweep.

Experience has shown that the system converges (i.e. the values of E, M and S “settle down” for all network links) in just two sweeps if the network is entirely under-saturated or in four sweeps in the presence of extensive congestion with link spillback. (The initial sweep over each link uses the final values of E and M, of the prior TI). At the completion of the final sweep for a TI, the procedure computes and stores all measures of effectiveness for each link and turn movement for output purposes. It then prepares for the following time interval by defining the values of $\mathrm{Q_b}$ and $\mathrm{M_b}$ for the start of the next TI as being those values of $\mathrm{Q_e}$ and $\mathrm{M_e}$ at the end of the prior TI. In this manner, the simulation model processes the traffic flow over time until the end of the run. Note that there is no space-discretization other than the specification of network links.

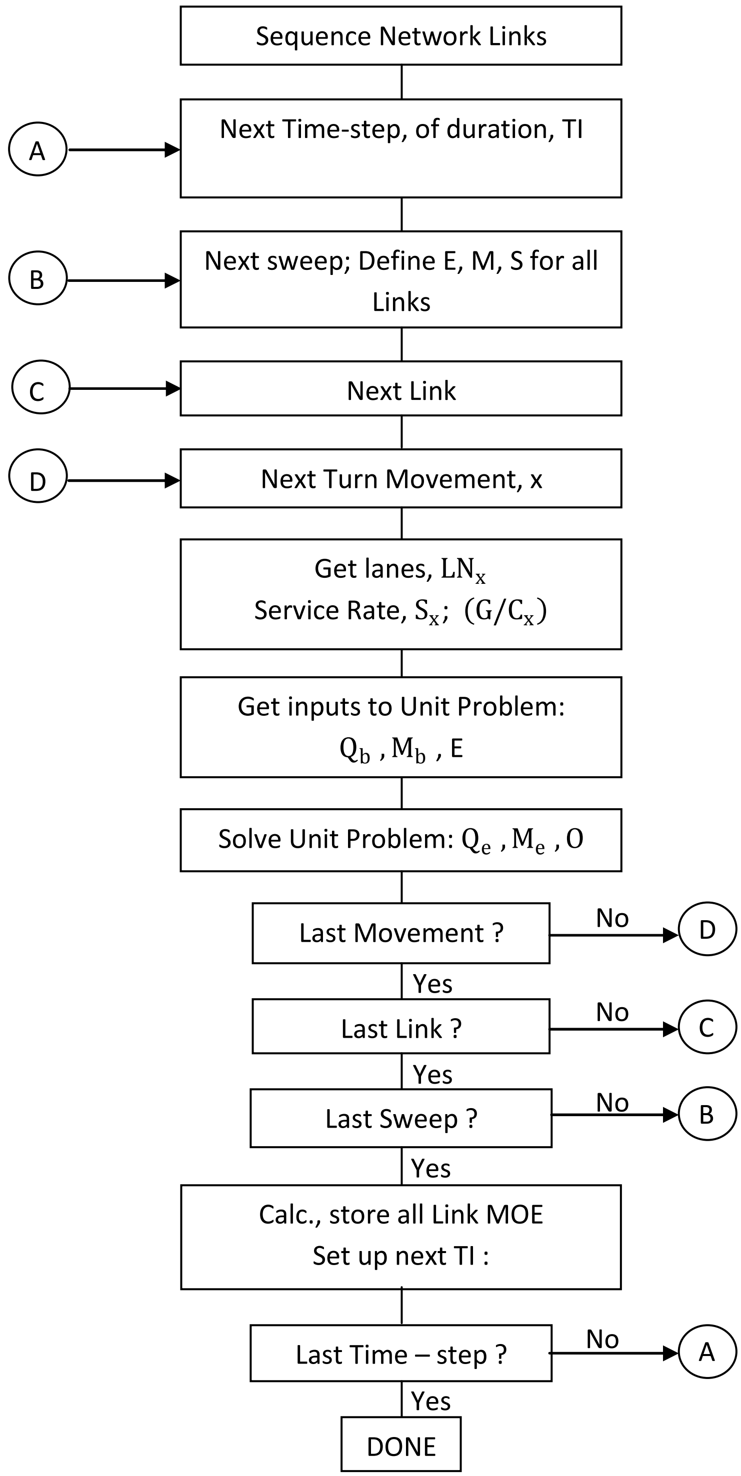


Figure C-4. Flow of Simulation Processing (See Glossary: Table C-3)

C.2.2 Interfacing with Dynamic Traffic Assignment (DTRAD)

The **DYNEV II** system reflects NRC guidance that evacuees will seek to travel in a general direction away from the location of the hazardous event. Thus, an algorithm was developed to identify an appropriate set of destination nodes for each origin based on its location and on the expected direction of travel. This algorithm also supports the DTRAD model in dynamically varying the Trip Table (O-D matrix) over time from one DTRAD session to the next.

Figure B-1 depicts the interaction of the simulation model with the DTRAD model in the **DYNEV II** system. As indicated, **DYNEV II** performs a succession of DTRAD "sessions"; each such session computes the turn link percentages for each link that remain constant for the session duration, $[T_0, T_2]$, specified by the analyst. The end product is the assignment of traffic volumes from each origin to paths connecting it with its destinations in such a way as to minimize the network-wide cost function. The output of the DTRAD model is a set of updated link turn percentages which represent this assignment of traffic.

As indicated in Figure B-1, the simulation model supports the DTRAD session by providing it with operational link MOE that are needed by the path choice model and included in the DTRAD cost function. These MOE represent the operational state of the network at a time, $T_1 \leq T_2$, which lies within the session duration, $[T_0, T_2]$. This "burn time", $T_1 - T_0$, is selected by the analyst. For each DTRAD iteration, the simulation model computes the change in network operations over this burn time using the latest set of link turn percentages computed by the DTRAD model. Upon convergence of the DTRAD iterative procedure, the simulation model accepts the latest turn percentages provided by the DTA model, returns to the origin time, T_0, and executes until it arrives at the end of the DTRAD session duration at time, T_2. At this time the next DTA session is launched and the whole process repeats until the end of the **DYNEV II** run.

Additional details are presented in Appendix B.

APPENDIX D

Detailed Description of Study Procedure

D. DETAILED DESCRIPTION OF STUDY PROCEDURE

This appendix describes the activities that were performed to compute Evacuation Time Estimates. The individual steps of this effort are represented as a flow diagram in Figure D-1. Each numbered step in the description that follows corresponds to the numbered element in the flow diagram.

Step 1

The first activity was to obtain EPZ boundary information and create a GIS base map. The base map extends beyond the Shadow Region which extends approximately 15 miles (radially) from the power plant location. The base map incorporates the local roadway topology, a suitable topographic background and the EPZ boundary.

Step 2

2010 Census block information was obtained in GIS format. This information was used to estimate the resident population within the EPZ and Shadow Region and to define the spatial distribution and demographic characteristics of the population within the study area. Employee data were estimated from county emergency managers, internet searches and from phone calls to major employers. Transient data were obtained from county emergency management agencies, from phone calls to transient attractions and estimations based on similar facilities. Information concerning schools, medical and other types of special facilities within the EPZ was obtained from county and municipal sources.

Step 3

A kickoff meeting was conducted with major stakeholders (state and county emergency managers, on-site and off-site utility emergency managers). The purpose of the kickoff meeting was to present an overview of the work effort, identify key agency personnel, and indicate the data requirements for the study. Specific requests for information were presented to county emergency managers. Unique features of the study area were discussed to identify the local concerns that should be addressed by the ETE study.

Step 4

Next, a physical survey of the roadway system in the study area was conducted to determine the geometric properties of the highway sections, the channelization of lanes on each section of roadway, whether there are any turn restrictions or special treatment of traffic at intersections, the type and functioning of traffic control devices, gathering signal timings for pre-timed traffic signals, and to make the necessary observations needed to estimate realistic values of roadway capacity.

Step 5

A telephone survey of households within the EPZ was conducted to identify household dynamics, trip generation characteristics, and evacuation-related demographic information of the EPZ population. This information was used to determine important study factors including the average number of evacuating vehicles used by each household, and the time required to perform pre-evacuation mobilization activities.

Step 6

A computerized representation of the physical roadway system, called a link-node analysis network, was developed using the UNITES software developed by KLD. Once the geometry of the network was completed, the network was calibrated using the information gathered during the road survey (Step 4). Estimates of highway capacity for each link and other link-specific characteristics were introduced to the network description. Traffic signal timings were input accordingly. The link-node analysis network was imported into a GIS map. 2010 Census data were overlaid in the map, and origin centroids where trips would be generated during the evacuation process were assigned to appropriate links.

Step 7

The EPZ is subdivided into 5 PAAs. Based on wind direction and speed, Regions (groupings of PAA) that may be advised to evacuate, were developed.

The need for evacuation can occur over a range of time-of-day, day-of-week, seasonal and weather-related conditions. Scenarios were developed to capture the variation in evacuation demand, highway capacity and mobilization time, for different time of day, day of the week, time of year, and weather conditions.

Step 8

The input stream for the DYNEV II model, which integrates the dynamic traffic assignment and distribution model, DTRAD, with the evacuation simulation model, was created for a prototype evacuation case – the evacuation of the entire EPZ for a representative scenario.

Step 9

After creating this input stream, the DYNEV II System was executed on the prototype evacuation case to compute evacuating traffic routing patterns consistent with the appropriate NRC guidelines. DYNEV II contains an extensive suite of data diagnostics which check the completeness and consistency of the input data specified. The analyst reviews all warning and error messages produced by the model and then corrects the database to create an input stream that properly executes to completion.

The model assigns destinations to all origin centroids consistent with a (general) radial evacuation of the EPZ and Shadow Region. The analyst may optionally supplement and/or replace these model-assigned destinations, based on professional judgment, after studying the topology of the analysis highway network. The model produces link and network-wide measures of effectiveness as well as estimates of evacuation time.

Step 10

The results generated by the prototype evacuation case are critically examined. The examination includes observing the animated graphics (using the EVAN software which operates on data produced by DYNEV II) and reviewing the statistics output by the model. This is a labor-intensive activity, requiring the direct participation of skilled engineers who possess the necessary practical experience to interpret the results and to determine the causes of any problems reflected in the results.

Essentially, the approach is to identify those bottlenecks in the network that represent locations where congested conditions are pronounced and to identify the cause of this congestion. This cause can take many forms, either as excess demand due to high rates of trip generation, improper routing, a shortfall of capacity, or as a quantitative flaw in the way the physical system was represented in the input stream. This examination leads to one of two conclusions:

- The results are satisfactory; or
- The input stream must be modified accordingly.

This decision requires, of course, the application of the user's judgment and experience based upon the results obtained in previous applications of the model and a comparison of the results of the latest prototype evacuation case iteration with the previous ones. If the results are satisfactory in the opinion of the user, then the process continues with Step 13. Otherwise, proceed to Step 11.

Step 11

There are many "treatments" available to the user in resolving apparent problems. These treatments range from decisions to reroute the traffic by assigning additional evacuation destinations for one or more sources, imposing turn restrictions where they can produce significant improvements in capacity, changing the control treatment at critical intersections so as to provide improved service for one or more movements, or in prescribing specific treatments for channelizing the flow so as to expedite the movement of traffic along major roadway systems. Such "treatments" take the form of modifications to the original prototype evacuation case input stream. All treatments are designed to improve the representation of evacuation behavior.

Step 12

As noted above, the changes to the input stream must be implemented to reflect the modifications undertaken in Step 11. At the completion of this activity, the process returns to Step 9 where the DYNEV II System is again executed.

Step 13

Evacuation of transit-dependent evacuees and special facilities are included in the evacuation analysis. Fixed routing for transit buses and for school buses, ambulances, and other transit vehicles are introduced into the final prototype evacuation case data set. DYNEV II generates route-specific speeds over time for use in the estimation of evacuation times for the transit dependent and special facility population groups.

Step 14

The prototype evacuation case was used as the basis for generating all region and scenario-specific evacuation cases to be simulated. This process was automated through the UNITES user interface. For each specific case, the population to be evacuated, the trip generation distributions, the highway capacity and speeds, and other factors are adjusted to produce a customized case-specific data set.

Step 15

All evacuation cases are executed using the DYNEV II System to compute ETE. Once results were available, quality control procedures were used to assure the results were consistent, dynamic routing was reasonable, and traffic congestion/bottlenecks were addressed properly.

Step 16

Once vehicular evacuation results are accepted, average travel speeds for transit and special facility routes were used to compute evacuation time estimates for transit-dependent permanent residents, schools, hospitals, and other special facilities.

Step 17

The simulation results are analyzed, tabulated and graphed. The results were then documented, as required by NUREG/CR-7002.

Step 18

Following the completion of documentation activities, the ETE criteria checklist (see Appendix N) was completed. An appropriate report reference is provided for each criterion provided in the checklist.

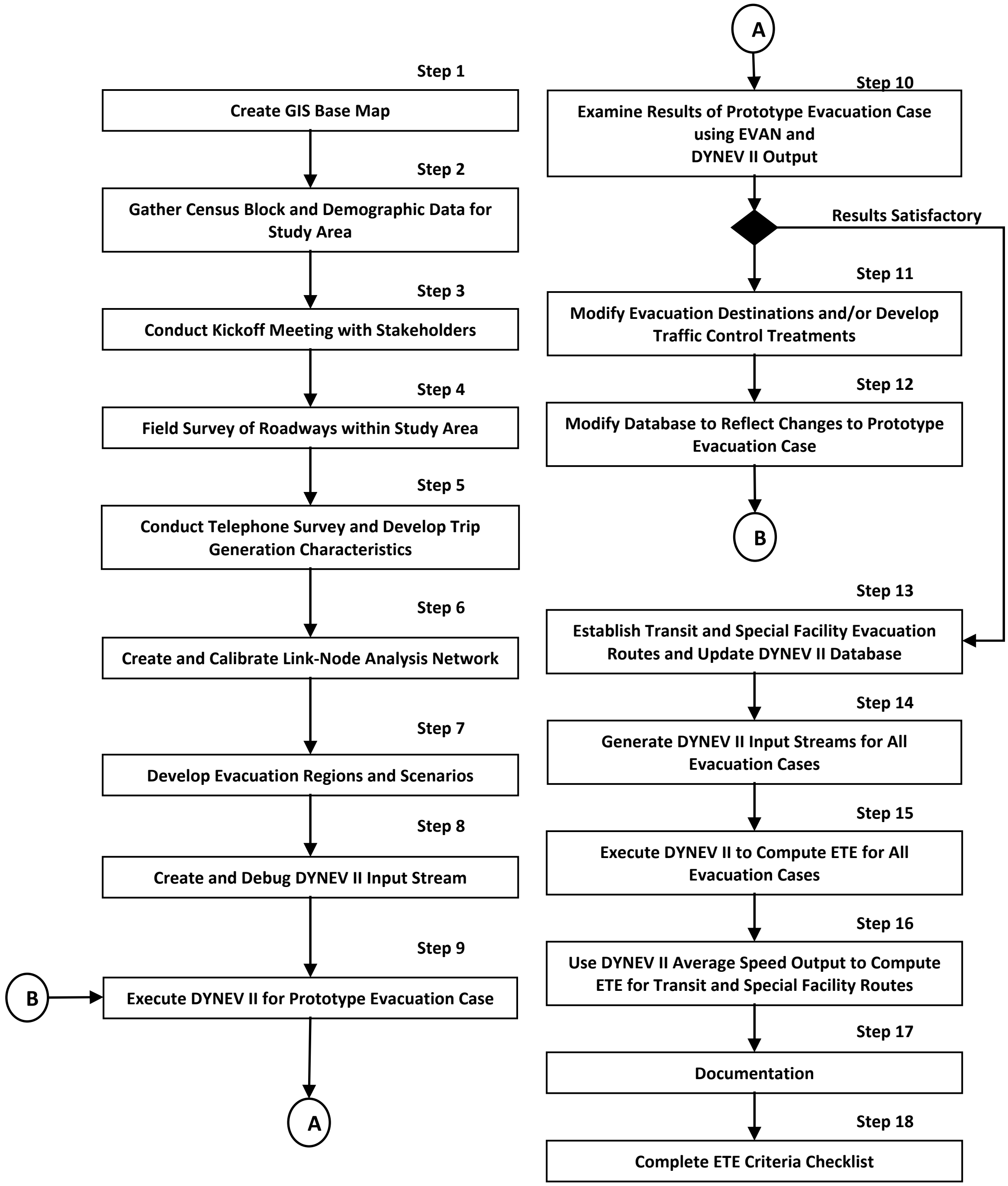


Figure D-1. Flow Diagram of Activities

APPENDIX E

Special Facility Data

E. SPECIAL FACILITY DATA

The following tables list population information, as of September 2012, for special facilities, transient attractions and major employers that are located within the Fermi EPZ. Special facilities are defined as schools, hospitals and other medical care facilities, and correctional facilities. Transient population data is included in the tables for recreational areas and lodging facilities. Employment data is included in the tables for major employers. Each table is grouped by county. The location of the facility is defined by its straight-line distance (miles) and direction (magnetic bearing) from the center point of the plant. Maps of each school, medical facility, recreational area, lodging facility, and major employer are also provided.

Table E-1. Schools within the EPZ

PAA	Distance (miles)	Dire-ction	School Name	Street Address	Municipality	Phone	Enroll-ment	Staff
MONROE COUNTY								
1	2.3	NNW	North Elementary School	8271 North Dixie Highway	Newport	(734) 586-6784	425	23
2	3.5	NW	Neidermeier Elementary School	8400 S. Newport Rd.	S. Rockwood	(734) 654-2121	306	16
2	2.6	NW	St. Charles School	8125 Swan Creek	Monroe	(734) 586-2531	194	10
3	2.9	WSW	Jefferson High School	5707 Williams Rd.	Monroe	(734) 289-5555	775	45
3	3.0	WSW	Jefferson Middle School	5201 N. Stony Creek Rd.	Monroe	(734) 289-5565	365	21
3	3.6	WSW	Sodt Elementary School	2888 Nadeau Rd.	Monroe	(734) 586-6784	344	20
4	8.1	NW	Airport Senior High School	11330 Grafton Rd.	Carleton	(734) 654-6208	1,050	55
4	9.7	NW	Carleton Country Day School	12707 Maxwell Rd	Carleton	(734) 654-8424	114	11
4	8.4	NW	Eyler Elementary School	1335 Carleton-S. Rockwood Rd.	Carleton	(734) 654-2121	300	19
4	6.6	N	Ritter Elementary School	5650 Carleton-S. Rockwood Rd.	S. Rockwood	(734) 379-5335	300	18
4	9.1	WNW	St. Patrick School	2970 West Labo Rd.	Carleton	(734) 654-2522	134	13
4	8.1	NW	Sterling Elementary School	160 Fessner Rd.	Carleton	(734) 654-6846	313	17
4	8.0	NW	Wager Junior High School	11200 Grafton Rd.	Carleton	(734) 654-2522	740	44
5	10.6	WSW	Custer Elementary School #1	5003 West Albain Rd.	Monroe	(734) 265-4300	650	48
5	10.7	WSW	Custer Elementary School #2	5001 West Albain Rd.	Monroe	(734) 265-4300	294	10
5	7.0	WSW	Hollywood Elementary School	1135 Riverview Avenue	Monroe	(734) 265-4500	237	21
5	8.9	W	Holy Ghost Lutheran School	3563 Heiss Rd.	Monroe	(734) 242-0509	100	10
5	5.1	WSW	Hurd Elementary School	1960 E. Hurd Rd	Monroe	(734) 289-5580	420	50
5	5.7	WNW	Lutheran High School South	8210 North Telegraph Rd.	Monroe	(734) 586-8832	36	6
5	8.6	WSW	Manor Elementary School	1731 West Lorain St.	Monroe	(734) 265-4700	406	36
5	8.3	WSW	Monroe Middle School	503 Washington St.	Monroe	(734) 265-4000	941	59
5	9.9	WSW	Monroe Senior High School	901 Herr Rd.	Monroe	(734) 265-3400	2,130	118
5	7.7	SW	Orchard Center High School	1750 Oak St.	Monroe	(734) 265-3700	175	15
5	7.6	WSW	Pathway Christian Academy/ Daycare	1199 Stewart Rd.	Monroe	(734) 241-1002	138	22
5	9.7	W	Raisinville Elementary School	2300 North Raisinville Rd.	Monroe	(734) 265-4800	425	25
5	8.4	WSW	Riverside Elementary School	77 North Roessler St.	Monroe	(734) 265-4900	162	9
5	8.3	WSW	St. John's School	521 South Monroe St.	Monroe	(734) 421-1670	211	16

PAA	Distance (miles)	Dire-ction	School Name	Street Address	Municipality	Phone	Enroll-ment	Staff
5	8.0	WSW	St. Mary's Catholic Center High School	108 West Elm Avenue	Monroe	(734) 241-0663	411	33
5	7.9	WSW	St. Mary's Parish School	151 North Monroe St.	Monroe	(734) 421-3377	248	14
5	8.3	WSW	St. Michael's School	510 West Front St.	Monroe	(734) 241-3923	185	14
5	8.1	WSW	Trinity Lutheran School	315 Scott St.	Monroe	(734) 241-1160	220	12
5	9.3	WSW	Waterloo Elementary School	1933 South Custer Rd.	Monroe	(734) 265-5100	250	14
5	6.9	WSW	Zion Lutheran School	186 Cole Rd.	Monroe	(734) 242-1378	62	5
						Monroe County Subtotals:	*13,061*	*849*
				WAYNE COUNTY				
4	7.6	N	Chapman Elementary School	31500 Olmstead Rd	Rockwood	(734) 379-3766	503	53
4	9.4	N	David Oren Hunter Elementary School	21320 Roche Rd	Brownstown	(734) 676-9550	422	68
4	7.3	NNE	Downriver High School	33211 McCann Rd	Rockwood	(734) 379-4704	62	12
4	9.2	N	Ethel C. Bobcean Elementary School	28300 Evergreen St	Flat Rock	(734) 782-3005	483	60
4	9.0	N	Flat Rock / Gibraltar Head Start	28639 Division St	Flat Rock	(734) 379-6810	175	0
4	9.3	N	Flat Rock Community High School	28100 Aspen Dr	Flat Rock	(734) 782-1270	568	49
4	8.6	NNE	Hellen C. Shumate Junior High School	30550 W Jefferson Ave	Gibraltar	(734) 379-7600	895	56
4	8.3	N	John M. Barnes Elementary School	24925 Meadows Dr	Flat Rock	(734) 782-2113	429	35
4	8.5	NNE	Oscar A. Carlson High School	30550 W Jefferson Ave	Gibraltar	(734) 379-7100	1,074	67
4	9.3	NNE	Parsons Elementary School	14473 Middle Gibraltar Rd	Gibraltar	(734) 676-9550	447	53
4	8.4	N	Simpson Middle School	24900 Meadows Dr	Flat Rock	(734) 782-2453	431	33
4	7.1	N	St. Mary's Rockwood Elementary School	32447 Church St	Rockwood	(734) 379-9285	220	15
4	8.4	N	Summit Academy/Summit Early Childhood Center	30100 Omstead Rd	Flat Rock	(734) 379-6810	403	60
						Wayne County Subtotals:	*6,112*	*561*
						TOTAL:	**19,173**	**1,410**

Table E-2. Medical Facilities within the EPZ

PAA	Distance (miles)	Dire-ction	Facility Name	Street Address	Municipality	Phone	Capacity	Current Census	Ambul-atory Patients	Wheel-chair Patients	Bed-ridden Patients
MONROE COUNTY											
5	7.5	W	ALCC	2590 N Monroe St	Monroe	(734) 243-4000	21	12	6	6	0
5	8.8	WSW	Alterra	1605 Fredericks Dr	Monroe	(734) 241-5700	20	15	15	0	0
5	8.5	WSW	IHM Motherhouse	610 W Elm Ave	Monroe	(734) 777-3482	210	192	177	13	2
5	8.2	WSW	Lutheran Home	1236 S Monroe St	Monroe	(734) 241-9533	115	115	106	8	1
5	8.3	W	Maplewood Manor	3250 N Monroe St	Monroe	(734) 243-5100	120	110	101	8	1
5	8.0	WSW	Medilodge II	481 Village Green Ln	Monroe	(734) 242-6282	103	92	85	6	1
5	6.5	WSW	Mercy Memorial Hospital	718 N Macomb St	Monroe	(734) 240-8400	168	168	69	69	30
5	7.2	WSW	Mercy Memorial Nursing Center	700 Stewart Rd	Monroe	(734) 240-1888	70	60	59	0	1
5	6.1	WSW	Tendercare of Monroe	1215 N Telegraph Rd	Monroe	(734) 242-4848	192	175	161	12	2
						Monroe County Subtotals:	*1,019*	*939*	*779*	*122*	*38*
WAYNE COUNTY											
4	2.6	N	Marybrook Residence	23201 Gibraltar Rd	Flat Rock	(734) 782-0015	12	11	10	1	0
						Wayne County Subtotals:	*12*	*11*	*10*	*1*	*0*
						TOTAL:	**1,031**	**950**	**789**	**123**	**38**

Table E-3. Major Employers within the EPZ

PAA	Distance (miles)	Dire-ction	Facility Name	Street Address	Municipality	Phone	Employees (max shift)	% Non-EPZ	Employees (Non EPZ)
MONROE COUNTY									
1	7.0	SSW	Fermi II NuclearPower Plant	6400 N Dixie Hwy	Newport	(734) 586-5300	867	55%	477
2	4.5	NW	Meijer Distribution Center	8857 Swan Creek Rd	Newport	(734) 586-7100	450	39%	176
3	8.2	WSW	Jefferson Public Schools	2400 N Dixie Hwy	Monroe	(734) 289-5550	300	39%	117
3	9.3	W	TWB Company LLC	1600 Nadeau Rd	Monroe	(734) 289-6400	40	40%	16
4	8.0	NW	Airport Community Schools	11270 Grafton Rd	Carleton	(734) 654-2414	80	51%	41
4	7.2	NW	Detroit Auto Action	600 Will Carleton Rd	Carleton	(734) 654-7100	400	70%	280
4	7.5	NW	Four Star Greenhouse	1015 Indian Trail Rd	Carleton	(734) 654-6420	320	39%	125
4	6.7	NW	Four Star Greenhouse	1199 E Sigler Rd	Carleton	(734) 654-6420	125	39%	49
4	8.0	NNW	Guardian Industries	14600 Romine Rd	Carleton	(734) 654-6264	185	80%	148
4	9.4	NNW	Guardian Science & Technology Center	14511 Romine Rd	Carleton	(734) 654-1111	130	90%	117
4	9.6	NNW	KC Transportation	888 Will Carleton Rd	Carleton	(734) 654-4600	100	70%	70
5	7.5	WSW	Bay Corrugated	1655 W 7th St	Monroe	(734) 243-5400	250	39%	98
5	7.9	WSW	County of Monroe	125 E. 2nd St	Monroe	(734) 240-7046	200	50%	100
5	6.6	SW	Detroit Stoker	1510 E 1st St	Monroe	(734) 241-9500	160	39%	62
5	10.3	WSW	Frenchtown Square Mall	2121 N Monroe St	Monroe	(734) 242-9150	455	25%	114
5	3.7	WSW	La-Z-Boy Incorporated	1284 N Telegraph Rd	Monroe	(734) 242-1444	480	40%	192
5	10.4	SW	MACSTEEL	3000 E Front St	Monroe	(734) 243-2446	148	60%	89
5	7.2	WSW	Meijer (Frenchtown Store)	1700 N Telegraph Rd	Monroe	(734) 384-8001	156	39%	61
5	8.1	WSW	Mercy Memorial Hospital System	725 N Monroe St	Monroe	(734) 240-8940	1,200	39%	468
5	10.3	WSW	Monroe Backyard Products	1000 Ternes Dr.	Monroe	(734) 242-6900	70	39%	27
5	4.5	WSW	Monroe Bank & Trust	10 Washington St	Monroe	(734) 241-3431	100	80%	80
5	7.0	SW	Monroe Factory Shops	14500 Laplaisance Road	Monroe	(734) 735-0894	113	39%	44
5	6.9	SW	Monroe Power Plant	3500 E Front St	Monroe	(734) 384-2201	687	55%	378

PAA	Distance (miles)	Dire-ction	Facility Name	Street Address	Municipality	Phone	Employees (max shift)	% Non-EPZ	Employees (Non EPZ)
5	7.6	WSW	Monroe Public Schools	1275 N Macomb St	Monroe	(734) 265-3000	40	25%	10
5	9.2	WSW	Monroe Publishing Company	20 W 1st St	Monroe	(734) 242-1100	125	39%	49
5	7.2	WSW	National Galvanizing	1500 Telb St	Monroe	(734) 243-1882	100	39%	39
5	10.3	WSW	Pioneer Metal Finishing	525 Ternes Dr	Monroe	(734) 384-1323	130	39%	51
5	8.1	WSW	Sisters, Servants of the Immaculate Heart of Mary	610 W Elm Ave	Monroe	(734) 241-3660	186	15%	28
5	6.4	WSW	SYGMA Network	660 Detroit Ave	Monroe	(734) 241-2890	70	50%	35
5	6.7	W	Wal-Mart	2155 N Telegraph Rd	Monroe	(734) 242-2280	75	39%	29
						Monroe County Subtotals:	*7,742*	-	*3,570*
WAYNE COUNTY									
4	3.3	N	Auto Alliance International	1 International Drive	Flat Rock	(734) 782-7800	3,145	39%	1,227
						Wayne County Subtotals:	*3,145*	-	*1,227*
						TOTAL:	**10,887**	**-**	**4,797**

Table E-4. Parks/Recreational Attractions within the EPZ

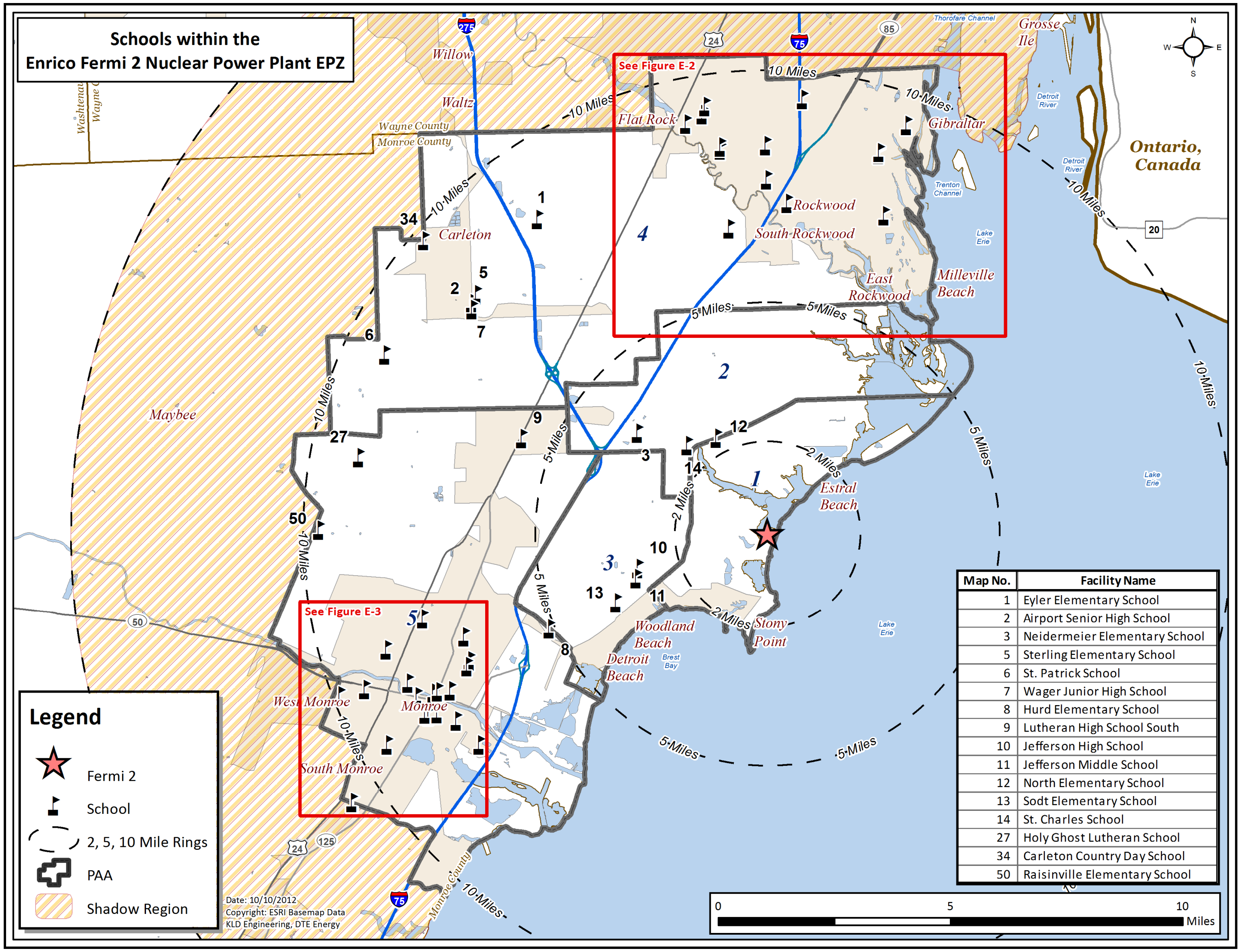
PAA	Distance (miles)	Dire-ction	Facility Name	Street Address	Municipality	Phone	Transients	Vehicles
MONROE COUNTY								
1	10.4	SW	Brest Bay Marina	4088 Brest Rd	Newport	(734) 289-1234	30	15
1	9.5	NNW	Swan Yacht Basin	5898 Trombley Rd	Newport	(734) 586-2762	14	7
2	8.7	NNW	Lilac Brothers Golf Course	9090 Armstrong Rd	New Port	(734) 586-7555	50	50
2	7.9	NNE	Point Mouillee State Game Area	37205 Point Mouille Rd	Brownstown	(734) 379-9692	2,000	870
4	6.4	NW	Carleton Glen Golf Club	13470 Grafton Road	Carlton	(734) 654-6201	50	50
4	6.1	N	Wesburn Golf & Country Club	5617 S Huron River Dr	S Rockwood	(734) 379-3555	50	50
5	9.5	SW	Charlie's Boat & Bait	13468 Laplaisance Rd	Monroe	(734) 241-1545	40	40
5	10.4	SW	Erie Party Shoppe & Docks	6838 Laplaisance Rd	Monroe	(734) 242-2833	1,000	500
5	6.2	WSW	Frenchtown Square Mall	2121 N Monroe St	Monroe	(734) 242-9150	400	200
5	9.6	SW	Harbor Marina	13950 Bridge St	Monroe	(734) 241-2833	50	25
5	9.3	SW	Miller Boat Marina	6838 Laplaisance Rd	Monroe	(734) 242-7734	50	25
5	5.5	SW	Monroe Factory Shops	14500 Laplaisance Rd	Monroe	(734) 735-0894	800	400
5	6.7	WSW	Monroe Golf & Country Club	611 Cole Rd	Monroe	(734) 241-6531	50	50
5	8.7	WSW	Raisin River Country Club	1500 N Dixie Hwy	Monroe	(734) 289-3700	50	50
5	6.8	SW	Riverfront Marina	1560 E Elm Ave	Monroe	(734) 242-0737	150	75
5	8.1	W	Sandy Creek Golf Course	3177 Heiss Rd	Monroe	(734) 242-7200	50	50
5	4.6	SW	Sterling State Park	2800 State Park Rd	Monroe	(734) 289-2715	4,302	1,937
5	7.3	SW	Trout's Yacht Basin	7970 Bolles Harbor Dr	Monroe	(734) 242-5545	50	25
						Monroe County Subtotals:	*9,186*	*4,419*
WAYNE COUNTY								
4	6.9	NNE	Humbug Marina, Inc.	13400 Middle Gibraltar Rd	Rockwood	(734) 676-6633	400	200
4	7.4	NNE	Lake Erie Metro Park	32481 W Jefferson	Brownstown	(734) 379-5020	2,300	1,000
4	5.5	NNE	Lake Erie Metropark Golf Course	14786 Lee Rd	Brownstown	(734) 379-0048	Included with the park	
4	9.1	NNE	Lake Erie Metropark Harbor of Refuge	14786 Lee Road	Brownstown	(734) 379-0048	Included with the park	
						Wayne County Subtotals:	*2,700*	*1,200*
						TOTAL:	**11,886**	**5,619**

Table E-5. Lodging Facilities within the EPZ

PAA	Distance (miles)	Dire-ction	Facility Name	Street Address	Municipality	Phone	Transients	Vehicles
MONROE COUNTY								
4	9.2	NNW	Eva's Motel	11920 Telegraph Rd	Carleton	(734) 654-9143	20	10
4	9.6	NW	Carlton Hotel	927 Monroe St	Carleton	(734) 654-6910	16	8
4	7.8	NW	Glee Motel	10195 Telegraph Rd	Carleton	(734) 586-8100	16	8
5	6.6	SW	Baymont Inn & Suites Monroe	14774 Laplaisance Rd	Monroe	(248) 931-7694	100	50
5	5.7	WSW	Best Value Inn	1885 Welcome Way	Monroe	(734) 289-1080	178	89
5	9.6	WSW	Best Western	1900 Welcome Way	Monroe	(734) 289-2330	192	96
5	9.1	SW	Comfort Inn	6500 East Albain Rd	Monroe	(734) 384-1500	104	52
5	8.1	WSW	Del Rio Suites & Hotel	215 E Elm St	Monroe	(734) 242-9400	40	20
5	6.2	WSW	Hampton Inn Monroe	1565 North Dixie Hwy	Monroe	(734) 289-5700	118	59
5	8.4	WSW	Hollywood Motel	1028 N Telegraph Rd	Monroe	(734) 241-7333	20	10
5	8.1	WSW	Hotel Sterling	109 W Front St	Monroe	(734) 242-6212	79	39
5	5.8	WSW	Knights Inn	1250 N Dixie Hwy	Monroe	(734) 243-0597	176	88
5	9.6	WSW	Monroe Motel	15339 S Telegraph Rd	Monroe	(734) 241-6443	20	10
5	9.3	WSW	Motel Seven	15390 S Dixie Hwy	Monroe	(734) 384-1100	54	27
5	5.7	WSW	Quality Inn & Suites	1225 N Dixie Hwy	Monroe	(734) 242-0555	258	129
5	10.2	WSW	Sunset Motel	450 N Telegraph Rd	Monroe	(734) 242-3448	12	6
5	5.9	WSW	Travel Inn Suites & Spas	1440 N Dixie Hwy	Monroe	(734) 289-2000	80	40
						Monroe County Subtotals:	*1,483*	*741*
WAYNE COUNTY								
4	10.0	N	Best Motel	27527 Telegraph Rd	Flat Rock	(734) 782-9399	38	19
4	0.4	N	Poplar Motel	26831 Telegraph Rd	Flat Rock	(734) 782-3716	14	7
4	8.8	N	Ram's Motel	27541 Telegraph Rd	Flat Rock	(734) 783-2933	16	8
4	7.1	N	Sleep Inn	29101 Commerce Dr	Flat Rock	(734) 782-9898	100	50
						Wayne County Subtotals:	*168*	*84*
						TOTAL:	**1,651**	**825**

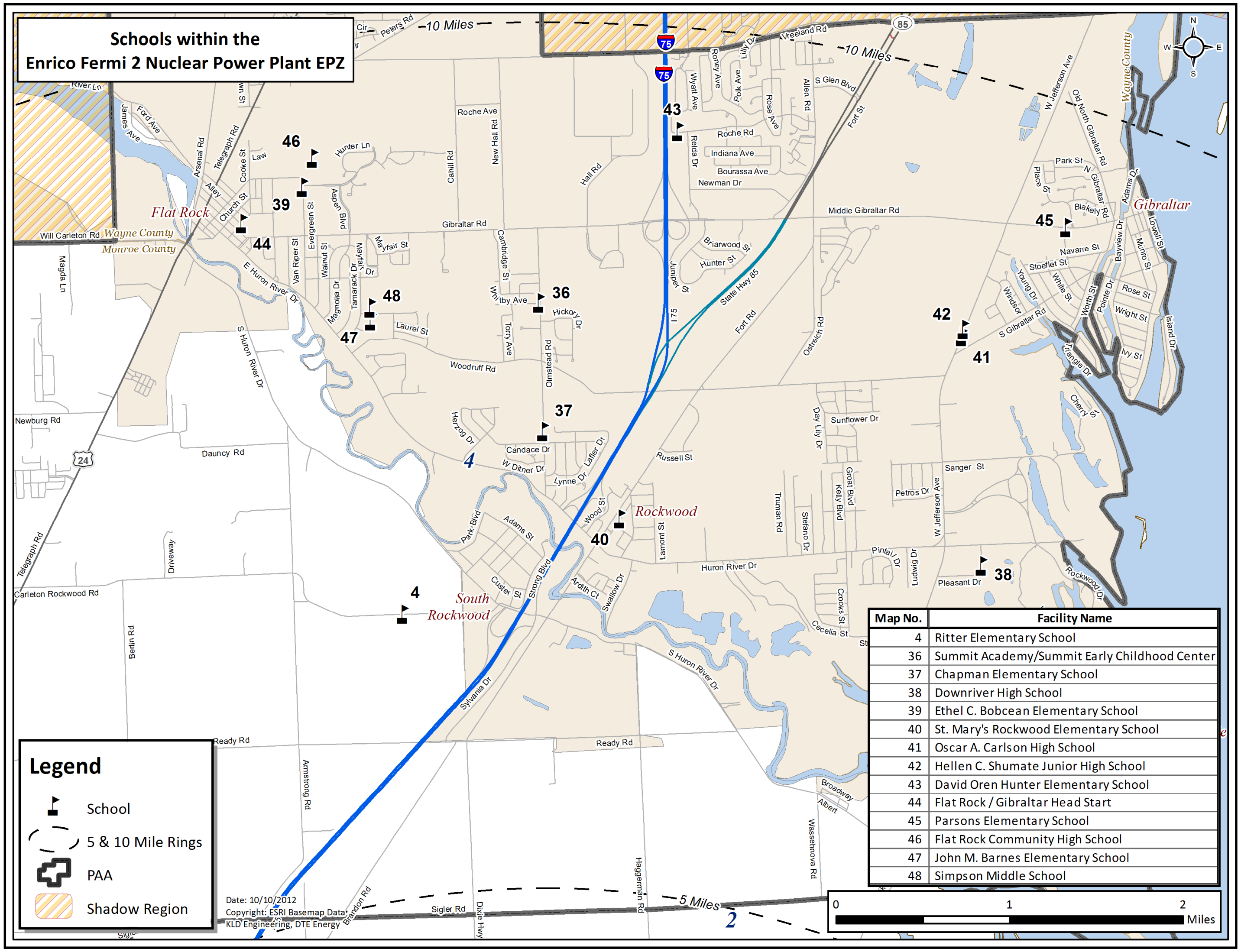
Table E-6. Correctional Facilities within the EPZ

PAA	Distance (miles)	Dire-ction	Facility Name	Street Address	Municipality	Phone	Staff	Census
MONROE COUNTY								
5	7.9	WSW	Monroe County Jail - Facility #1	100 E 2nd St	Monroe	(743) 240-7400	37	183
5	8.5	SW	Monroe County Jail - Facility #2	7000 E Dunbar Rd	Monroe	(743) 240-7400	37	160
						Monroe County Subtotal:	*74*	*343*
						TOTAL:	**74**	**343**



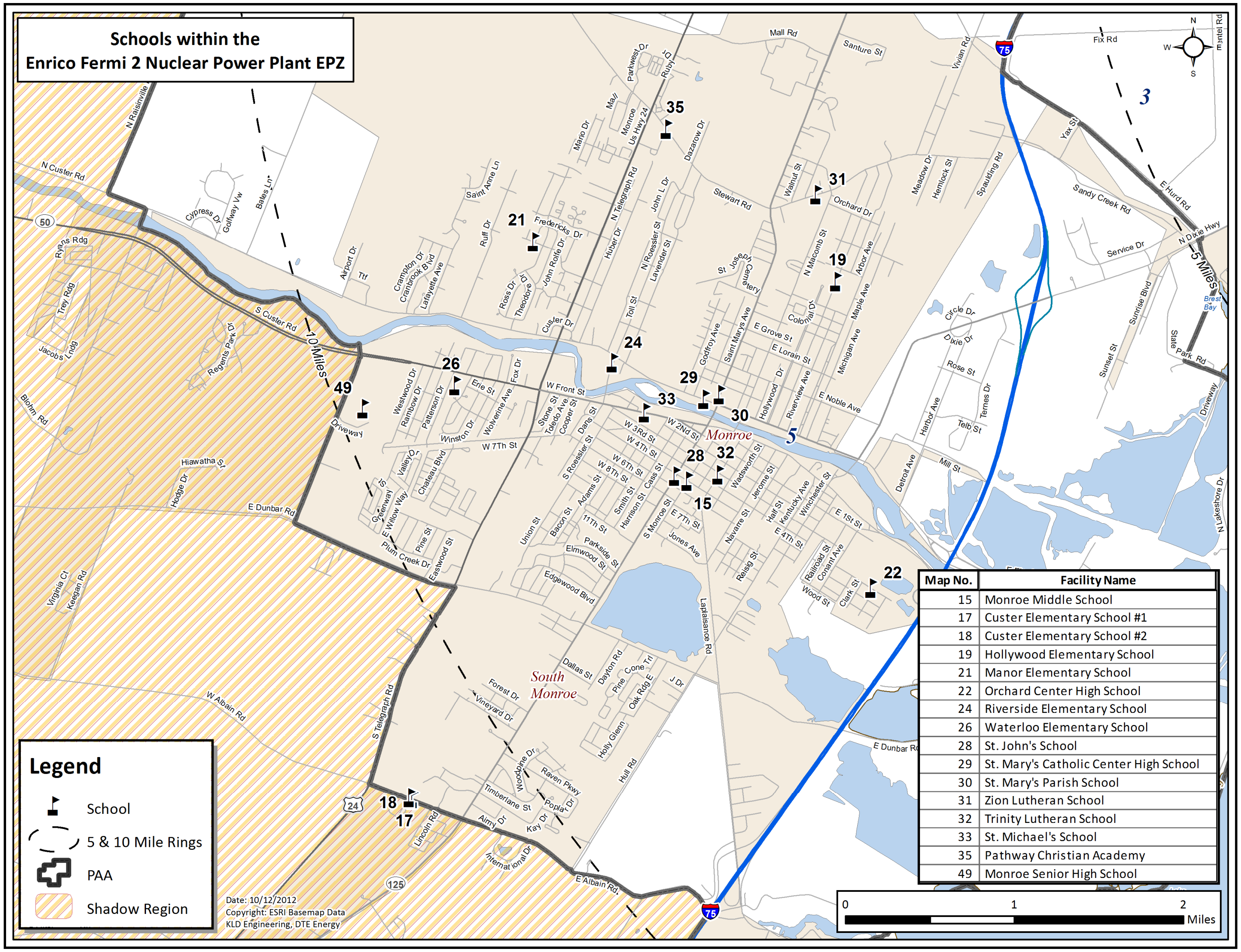
Map No.	Facility Name
1	Eyler Elementary School
2	Airport Senior High School
3	Neidermeier Elementary School
5	Sterling Elementary School
6	St. Patrick School
7	Wager Junior High School
8	Hurd Elementary School
9	Lutheran High School South
10	Jefferson High School
11	Jefferson Middle School
12	North Elementary School
13	Sodt Elementary School
14	St. Charles School
27	Holy Ghost Lutheran School
34	Carleton Country Day School
50	Raisinville Elementary School

Figure E-1. Schools within the EPZ (1 of 3)



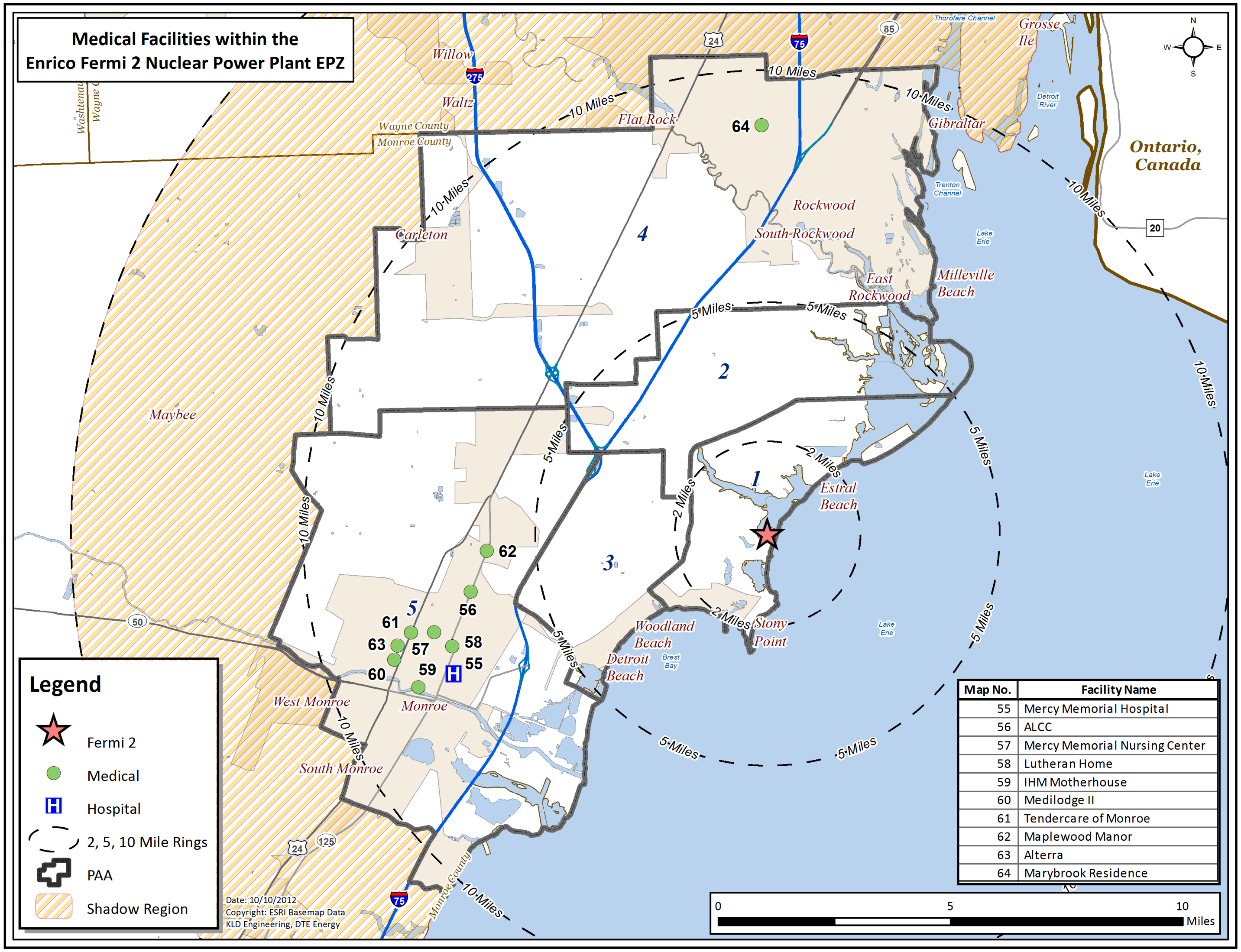
Map No.	Facility Name
4	Ritter Elementary School
36	Summit Academy/Summit Early Childhood Center
37	Chapman Elementary School
38	Downriver High School
39	Ethel C. Bobcean Elementary School
40	St. Mary's Rockwood Elementary School
41	Oscar A. Carlson High School
42	Hellen C. Shumate Junior High School
43	David Oren Hunter Elementary School
44	Flat Rock / Gibraltar Head Start
45	Parsons Elementary School
46	Flat Rock Community High School
47	John M. Barnes Elementary School
48	Simpson Middle School

Figure E-2. Schools within the EPZ (2 of 3)



Map No.	Facility Name
15	Monroe Middle School
17	Custer Elementary School #1
18	Custer Elementary School #2
19	Hollywood Elementary School
21	Manor Elementary School
22	Orchard Center High School
24	Riverside Elementary School
26	Waterloo Elementary School
28	St. John's School
29	St. Mary's Catholic Center High School
30	St. Mary's Parish School
31	Zion Lutheran School
32	Trinity Lutheran School
33	St. Michael's School
35	Pathway Christian Academy
49	Monroe Senior High School

Figure E-3. Schools within the EPZ (3 of 3)



Map No.	Facility Name
55	Mercy Memorial Hospital
56	ALCC
57	Mercy Memorial Nursing Center
58	Lutheran Home
59	IHM Motherhouse
60	Medilodge II
61	Tendercare of Monroe
62	Maplewood Manor
63	Alterra
64	Marybrook Residence

Figure E-4. Medical Faciities within the EPZ

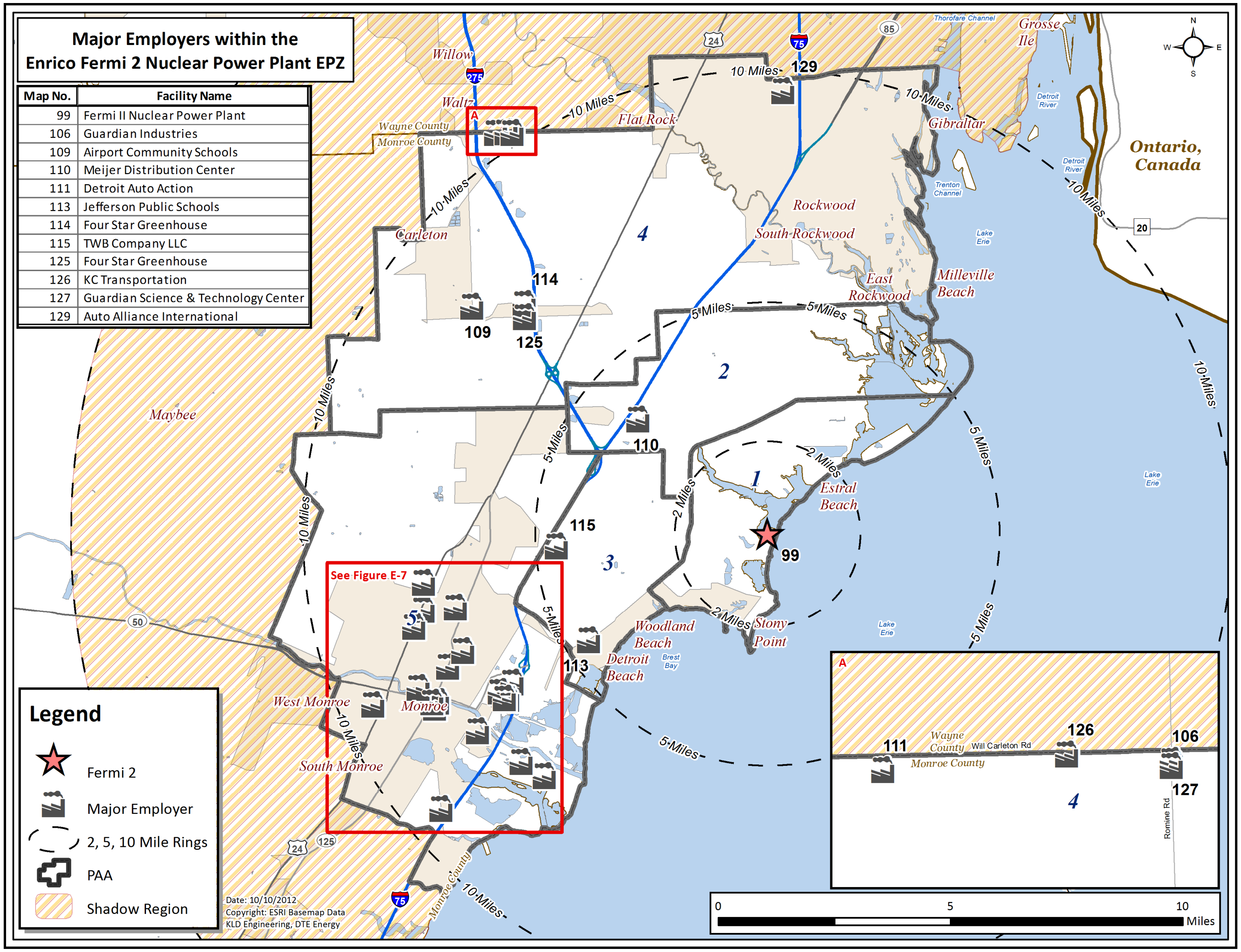
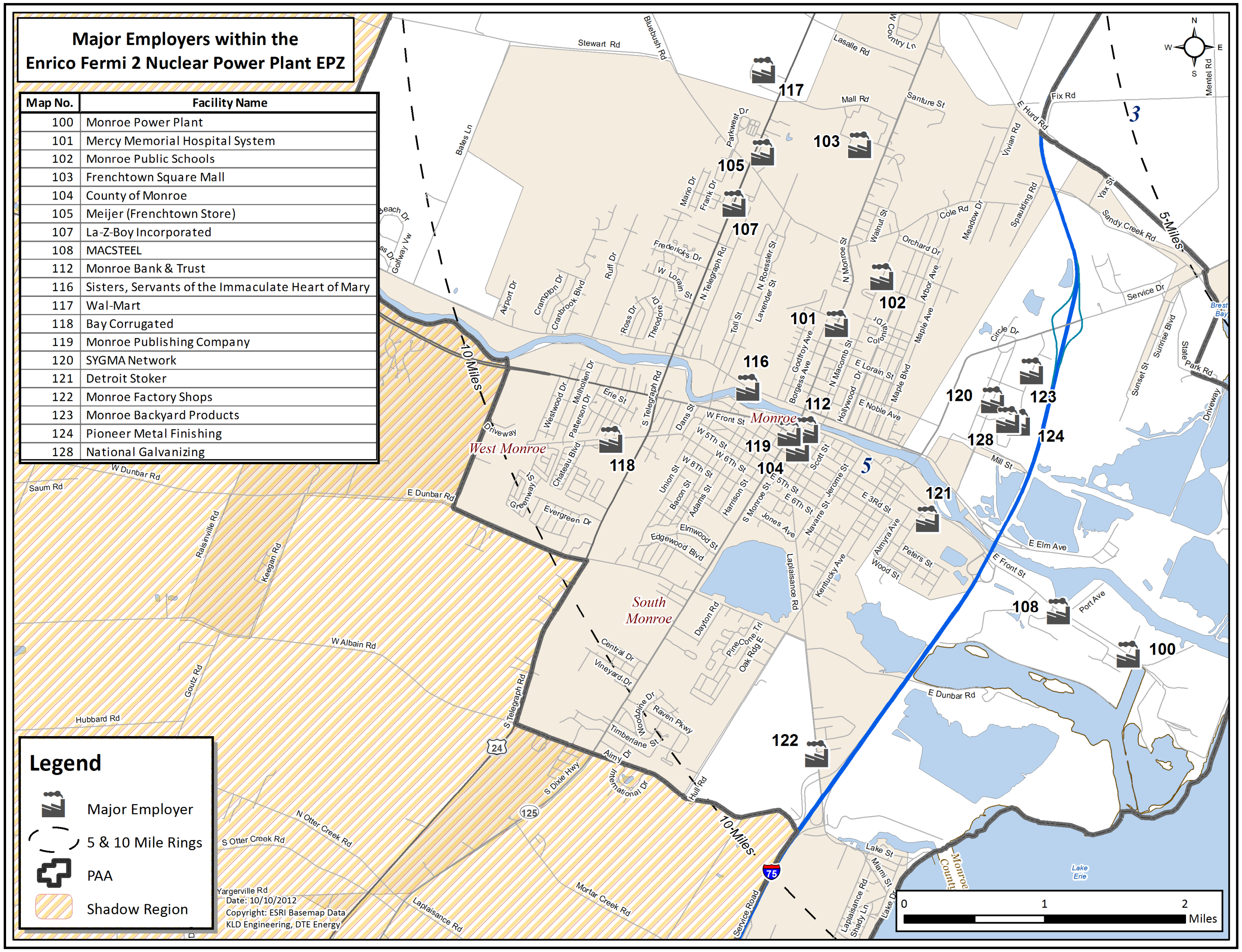


Figure E-5. Major Employers within the EPZ (1 of 2)



Map No.	Facility Name
100	Monroe Power Plant
101	Mercy Memorial Hospital System
102	Monroe Public Schools
103	Frenchtown Square Mall
104	County of Monroe
105	Meijer (Frenchtown Store)
107	La-Z-Boy Incorporated
108	MACSTEEL
112	Monroe Bank & Trust
116	Sisters, Servants of the Immaculate Heart of Mary
117	Wal-Mart
118	Bay Corrugated
119	Monroe Publishing Company
120	SYGMA Network
121	Detroit Stoker
122	Monroe Factory Shops
123	Monroe Backyard Products
124	Pioneer Metal Finishing
128	National Galvanizing

Figure E-6. Major Employers within the EPZ (2 of 2)

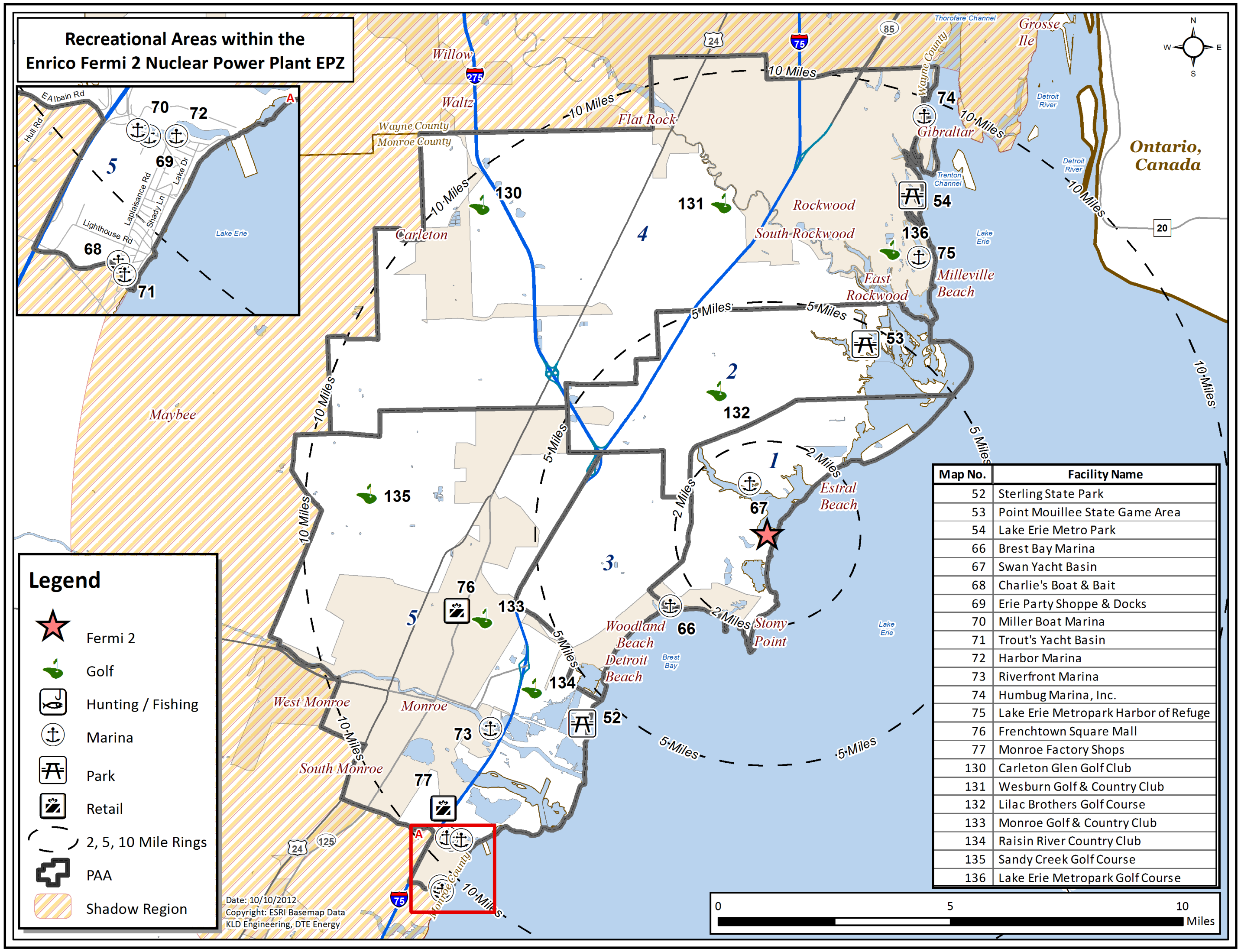


Figure E-7. Recreational Areas within the EPZ

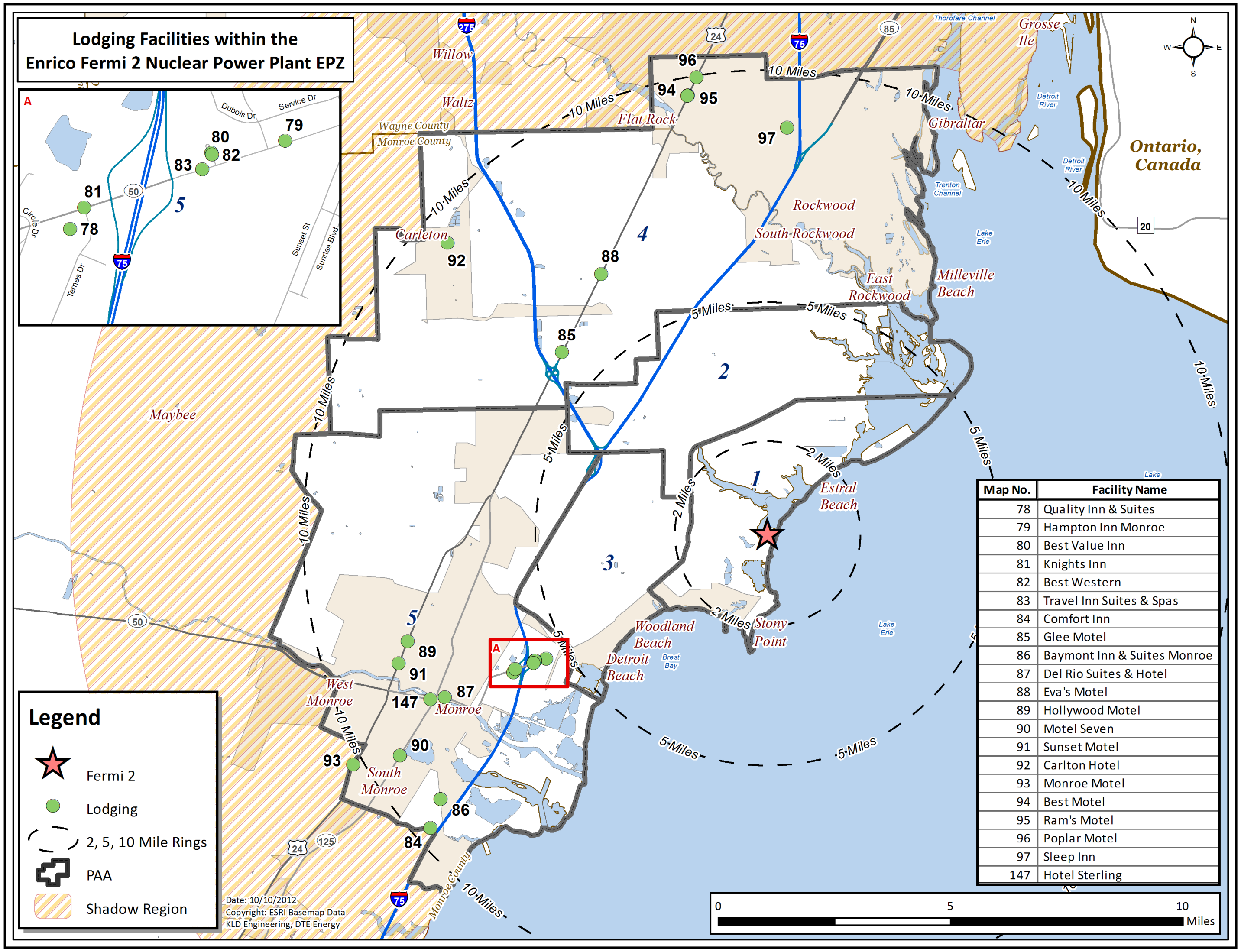


Figure E-8. Lodging Facilities within the EPZ

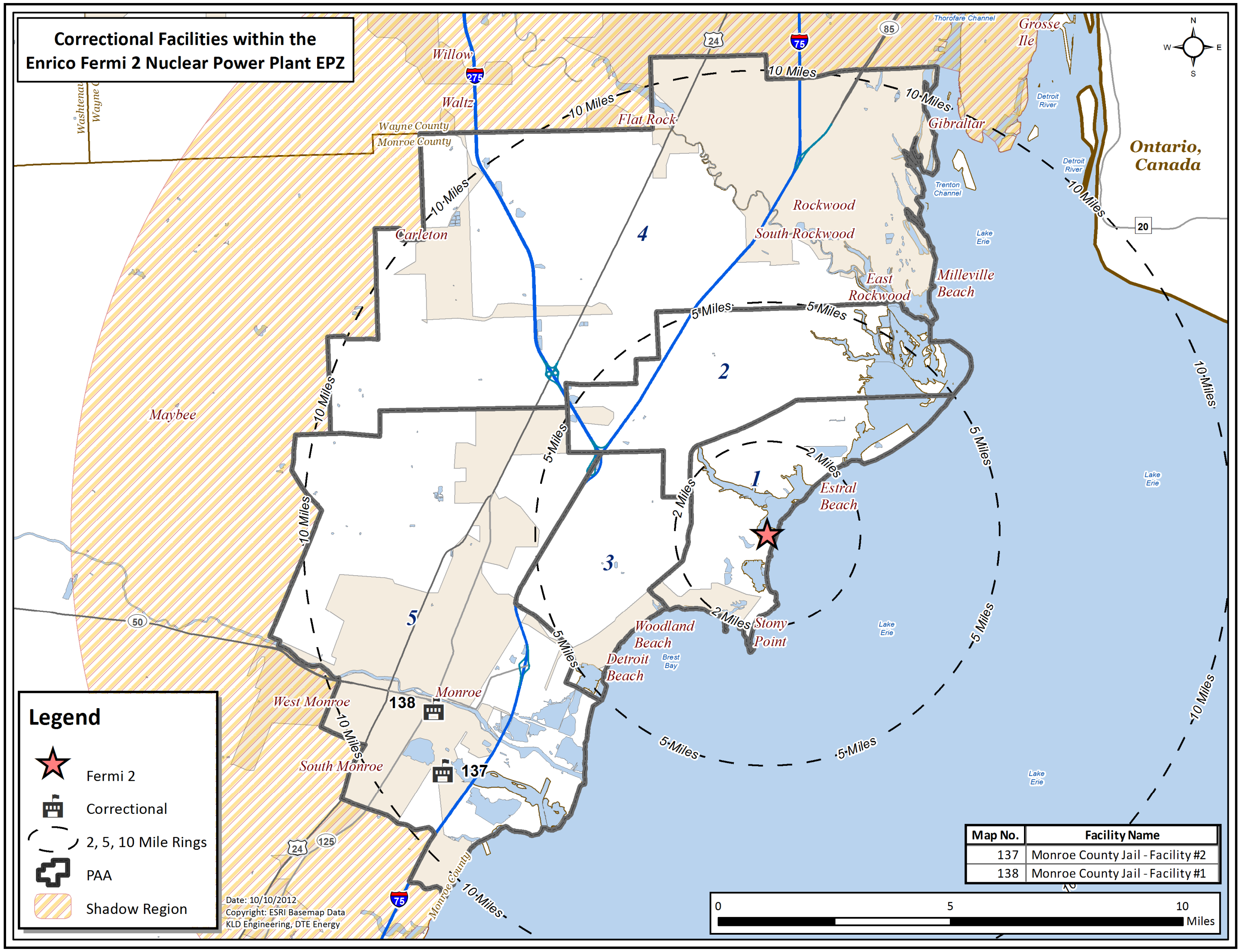


Figure E-9. Correctional Facilities within the EPZ

APPENDIX F

Telephone Survey

F. TELEPHONE SURVEY

F.1 Introduction

The development of evacuation time estimates for the Fermi EPZ requires the identification of travel patterns, car ownership and household size of the population within the EPZ. Demographic information can be obtained from Census data. The use of this data has several limitations when applied to emergency planning. First, the Census data do not encompass the range of information needed to identify the time required for preliminary activities (mobilization) that must be undertaken prior to evacuating the area. Secondly, Census data do not contain attitudinal responses needed from the population of the EPZ and consequently may not accurately represent the anticipated behavioral characteristics of the evacuating populace.

These concerns are addressed by conducting a telephone survey of a representative sample of the EPZ population. The survey is designed to elicit information from the public concerning family demographics and estimates of response times to well defined events. The design of the survey includes a limited number of questions of the form "What would you do if …?" and other questions regarding activities with which the respondent is familiar ("How long does it take you to …?")

F.2 Survey Instrument and Sampling Plan

Attachment A presents the final survey instrument used in this study. A draft of the instrument was submitted to stakeholders for comment. Comments were received and the survey instrument was modified accordingly, prior to conducting the survey.

Following the completion of the instrument, a sampling plan was developed. A sample size of approximately 550 **completed** survey forms yields results with a sampling error of ±4.17% at the 95% confidence level. The sample must be drawn from the EPZ population. Consequently, a list of zip codes in the EPZ was developed using GIS software. This list is shown in Table F-1. Along with each zip code, an estimate of the population and number of households in each area was determined by overlaying Census data and the EPZ boundary, again using GIS software. The proportional number of desired completed survey interviews for each area was identified, as shown in Table F-1. Note that the average household size computed in Table F-1 was an estimate for sampling purposes and was not used in the ETE study.

The completed survey adhered to the sampling plan.

Table F-1. Fermi Telephone Survey Sampling Plan

Zip Code	Population within EPZ (2000)	Households	Required Sample
48117	7,333	2,683	42
48134	8,958	3,430	54
48145	112	35	0
48161	20,502	8,042	126
48162	27,406	10,634	166
48166	10,468	3,677	57
48173	10,247	3,968	62
48179	3,067	1,100	17
48183	4,606	1,661	26
Total	**92,699**	**35,230**	**550**
		Average Household Size:	**2.63**

The survey discussed herein was performed in 2007 for the preparation of a COLA licensing effort. The EPZ population has increased by about 5.5 percent (5,126 people) between the 2000 and 2010 Census (see Section 3.1). In the intervening period, the nature of the EPZ has not changed. Consequently, the use of 2007 telephone survey results can be justified on this basis.

F.3 Survey Results

The results of the survey fall into two categories. First, the household demographics of the area can be identified. Demographic information includes such factors as household size, automobile ownership, and automobile availability. The distributions of the time to perform certain pre-evacuation activities are the second category of survey results. These data are processed to develop the trip generation distributions used in the evacuation modeling effort, as discussed in Section 5.

A review of the survey instrument reveals that several questions have a "don't know" (DK) or "refused" entry for a response. It is accepted practice in conducting surveys of this type to accept the answers of a respondent who offers a DK response for a few questions or who refuses to answer a few questions. To address the issue of occasional DK/refused responses from a large sample, the practice is to assume that the distribution of these responses is the same as the underlying distribution of the positive responses. In effect, the DK/refused responses are ignored and the distributions are based upon the positive data that is acquired.

F.3.1 Household Demographic Results

Household Size

Figure F-1 presents the distribution of household size within the EPZ. The average household contains 2.72 people. The estimated household size (2.63 persons) used to determine the survey sample (Table F-1) was drawn from Census data. The close agreement between the average household size obtained from the survey and from the Census is an indication of the reliability of the survey.

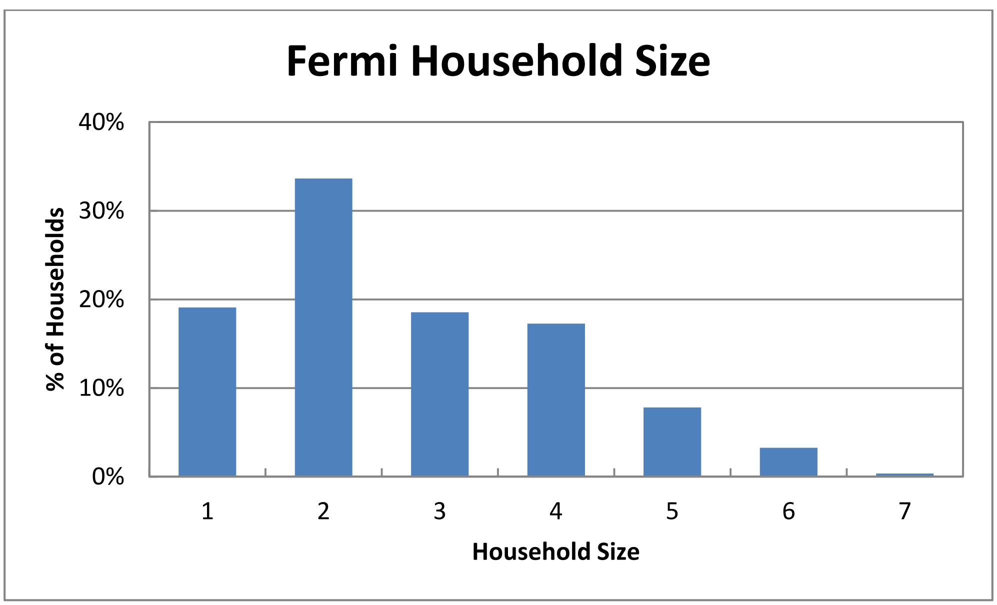


Figure F-1. Household Size in the EPZ

Automobile Ownership

The average number of automobiles available per household in the EPZ is 1.99. It should be noted that approximately 4.2 percent of households do not have access to an automobile. The distribution of automobile ownership is presented in Figure F-2. Figure F-3 and Figure F-4 present the automobile availability by household size. Note that the majority of households without access to a car are single person households. As expected, nearly all households of 2 or more people have access to at least one vehicle.

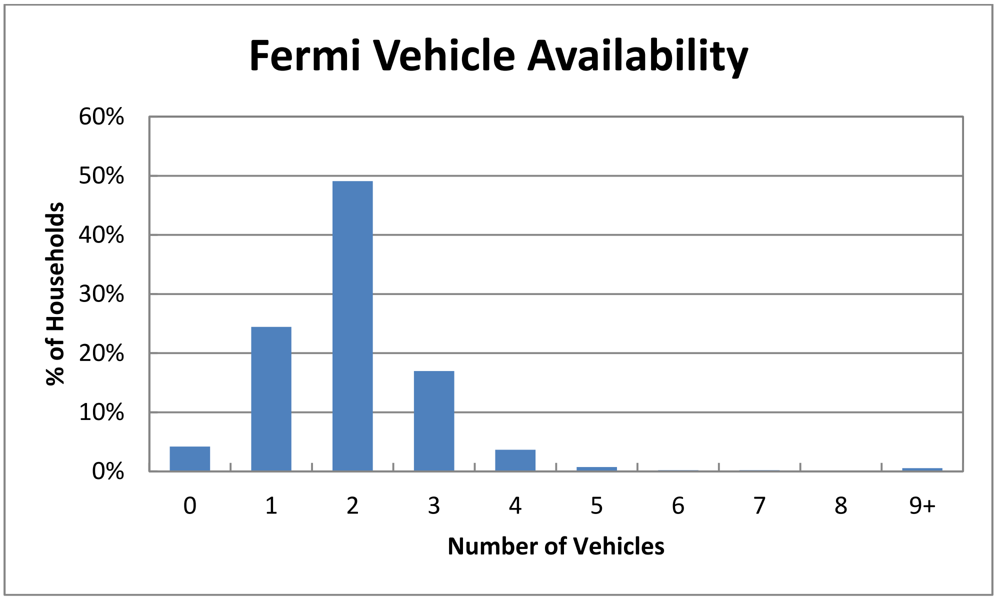


Figure F-2. Household Vehicle Availability

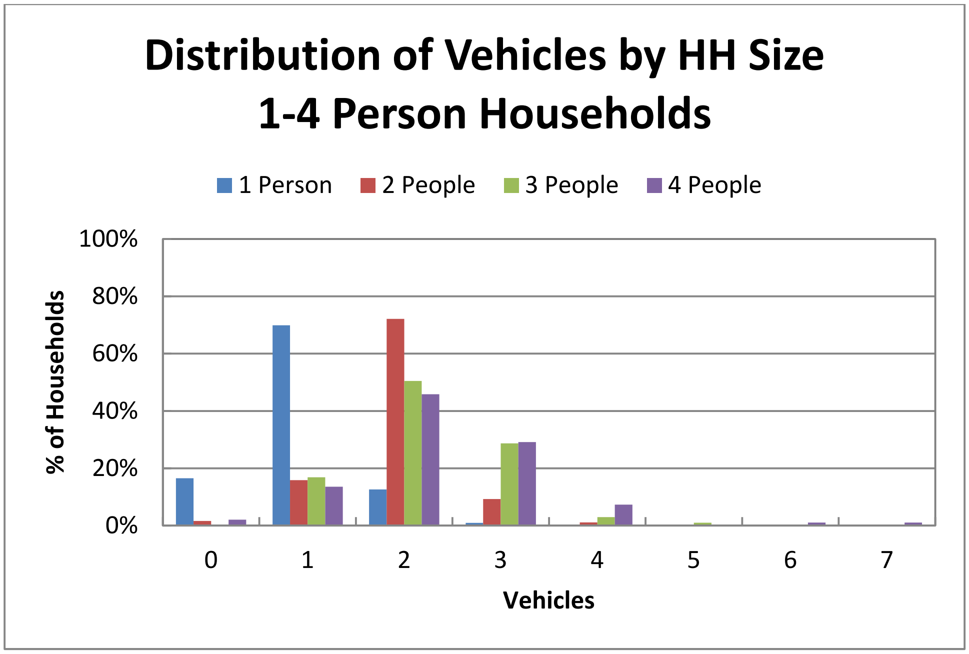


Figure F-3. Vehicle Availability - 1 to 5 Person Households

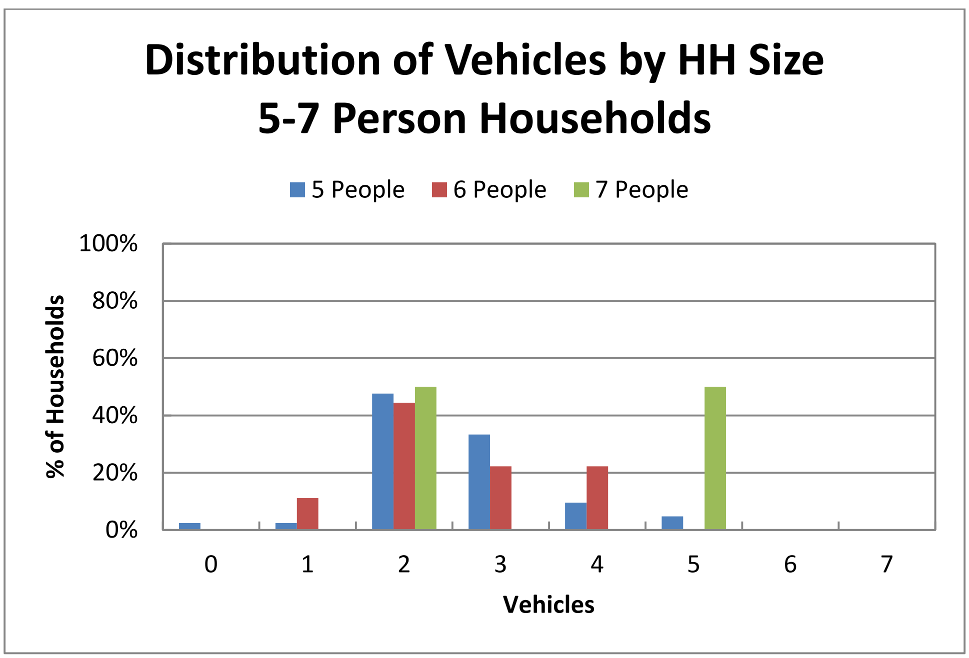


Figure F-4. Vehicle Availability - 6 to 9+ Person Households

Commuters

Figure F-5 presents the distribution of the number of commuters in each household. Commuters are defined as household members who travel to work or college on a daily basis. The data shows an average of 1.05 commuters in each household in the EPZ, and 62% of households have at least one commuter.

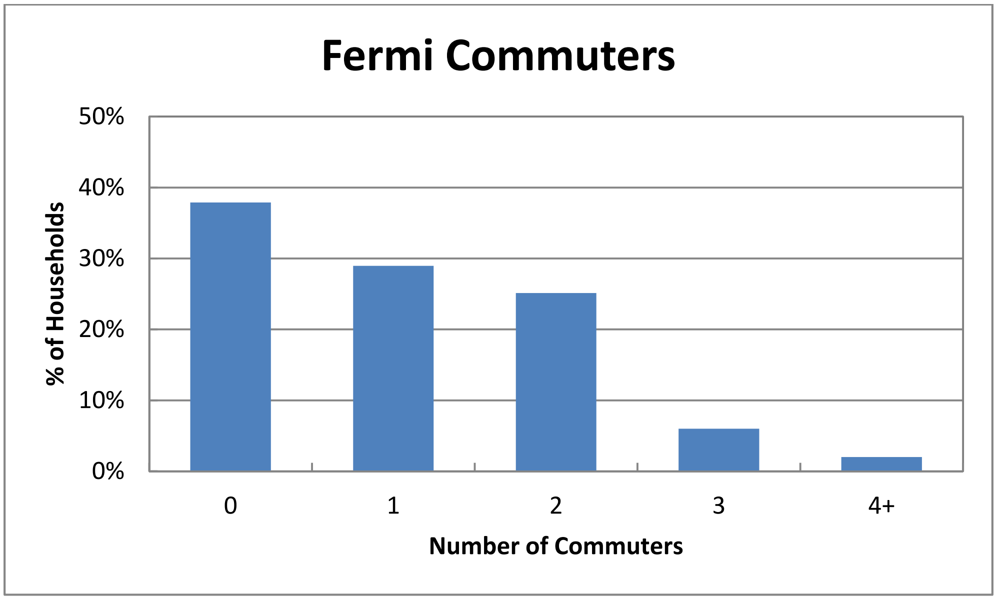


Figure F-5. Commuters in Households in the EPZ

Commuter Travel Modes

Figure F-6 presents the mode of travel that commuters use on a daily basis. The vast majority of commuters use their private automobiles to travel to work. The data shows an average of 1.01 employees per vehicle, assuming 2 people per vehicle – on average – for carpools.

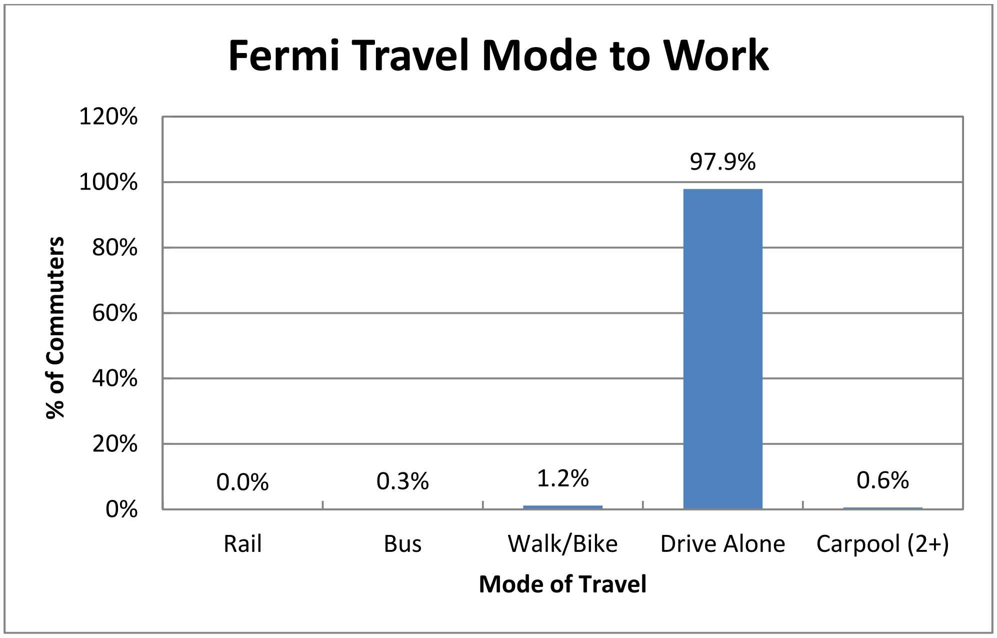


Figure F-6. Modes of Travel in the EPZ

F.3.2 Evacuation Response

Several questions were asked to gauge the population's response to an emergency. These are now discussed:

"How many of the vehicles would your household use during an evacuation?" The response is shown in Figure F-7. On average, evacuating households would use 1.24 vehicles.

"Would your family await the return of other family members prior to evacuating the area?" Of the survey participants who responded, 55 percent said they would await the return of other family members before evacuating and 45 percent indicated that they would not await the return of other family members.

"If you had a household pet, would you take your pet with you if you were asked to evacuate the area?" Based on the responses to the survey, 70 percent of households have a family pet. Of the households with pets, 79 percent of them indicated that they would take their pets with them, as shown in Figure F-8.

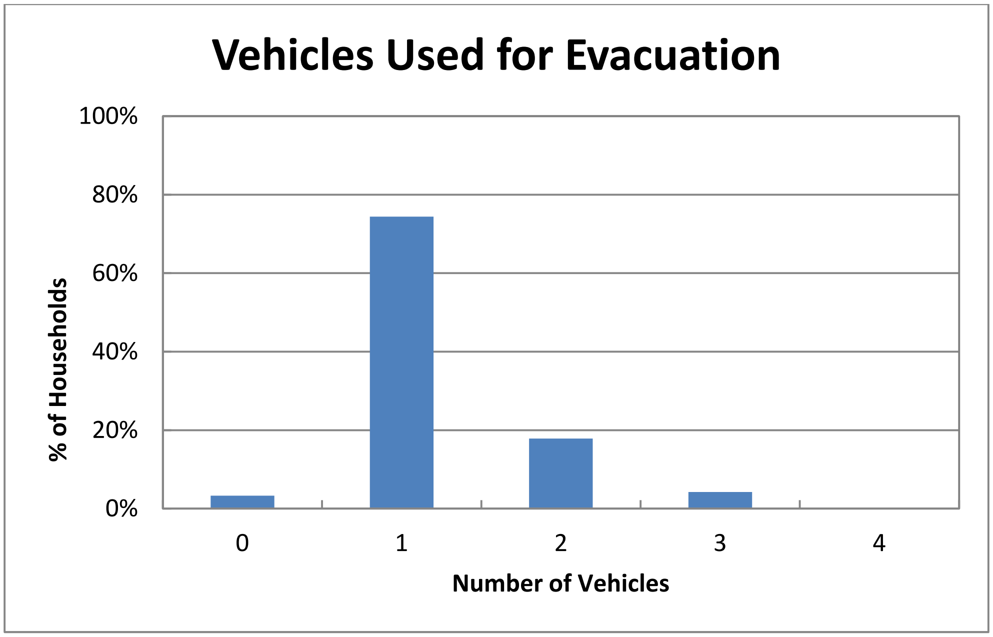


Figure F-7. Number of Vehicles Used for Evacuation

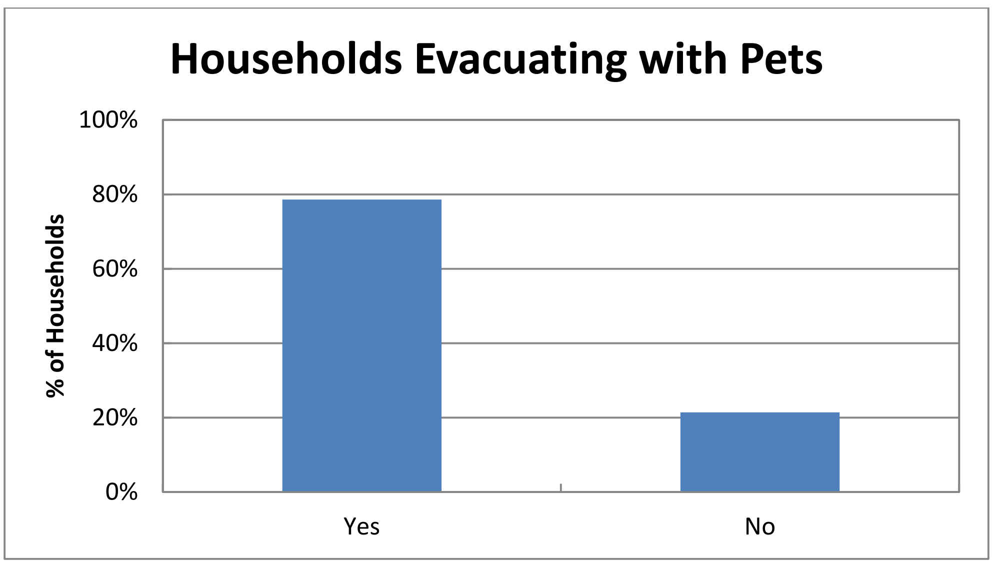


Figure F-8. Households Evacuating with Pets

F.3.3 Time Distribution Results

The survey asked several questions about the amount of time it takes to perform certain pre-evacuation activities. These activities involve actions taken by residents during the course of their day-to-day lives. Thus, the answers fall within the realm of the responder's experience.

The mobilization distributions provided below are the result of having applied the analysis described in Section 5.4.1 on the component activities of the mobilization.

"How long does it take the commuter to complete preparation for leaving work?" Figure F-9 presents the cumulative distribution; in all cases, the activity is completed by about 90 minutes. Ninety-four percent can leave within 45 minutes.

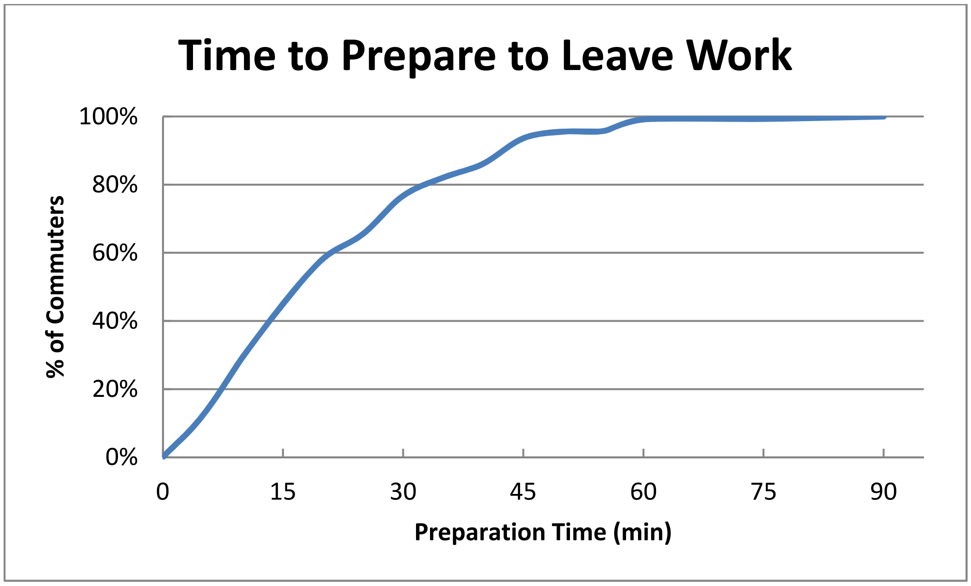


Figure F-9. Time Required to Prepare to Leave Work/School

"How long would it take the commuter to travel home?" Figure F-10 presents the work to home travel time for the EPZ. Ninety-four percent of commuters can arrive home within 45 minutes of leaving work; all within 90 minutes.

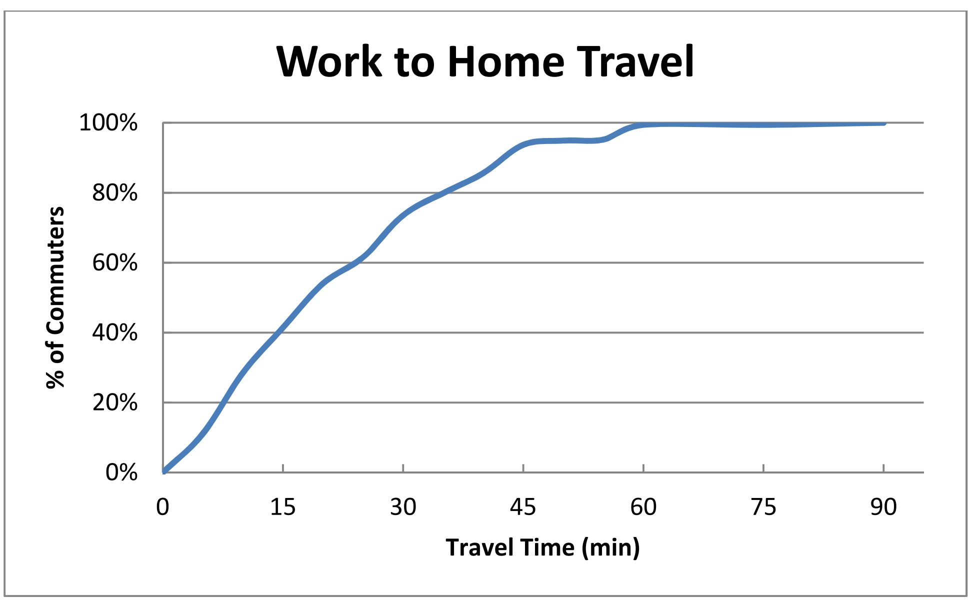


Figure F-10. Work to Home Travel Time

"How long would it take the family to pack clothing, secure the house, and load the car?" Figure F-11 presents the time required to prepare for leaving on an evacuation trip. In many ways this activity mimics a family's preparation for a short holiday or weekend away from home. Hence, the responses represent the experience of the responder in performing similar activities.

The distribution shown in Figure F-11 has a long "tail." About 96 percent of households can be ready to leave home within 75 minutes; the remaining households require up to an additional hour.

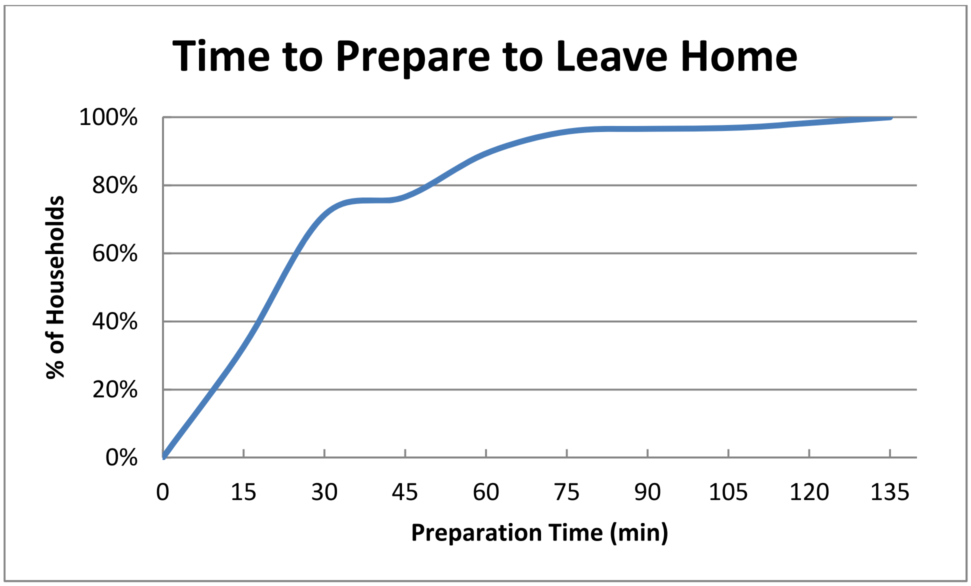


Figure F-11. Time to Prepare Home for Evacuation

"How long would it take you to clear 6 to 8 inches of snow from your driveway?" During adverse, snowy weather conditions, an additional activity must be performed before residents can depart on the evacuation trip. Although snow scenarios assume that the roads and highways have been plowed and are passable (albeit at lower speeds and capacities), it may be necessary to clear a private driveway prior to leaving the home so that the vehicle can access the street. Figure F-12 presents the time distribution for removing 6 to 8 inches of snow from a driveway. The time distribution for clearing the driveway has a long tail; about 93 percent of driveways are passable within 60 minutes. The last driveway is cleared 135 minutes after the start of this activity.

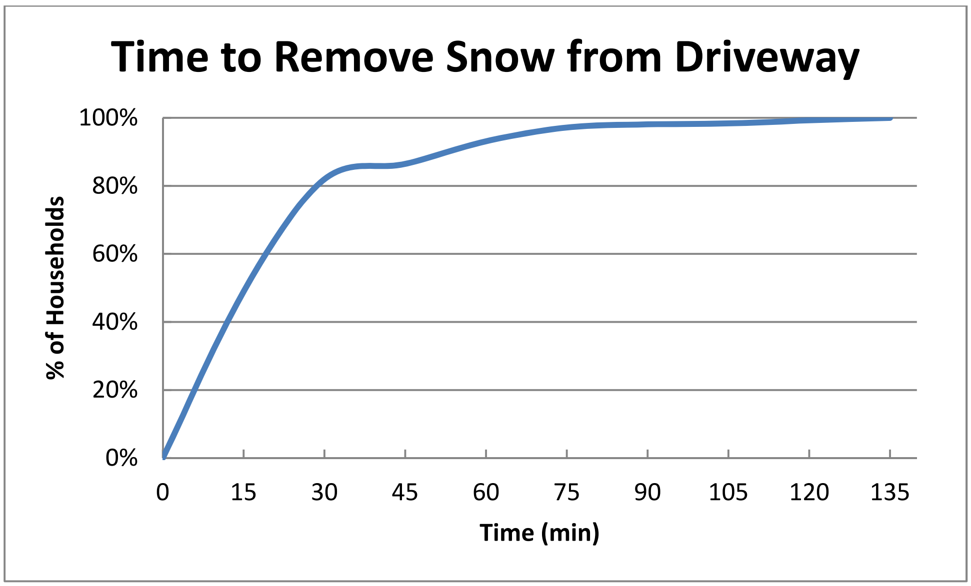


Figure F-12. Time to Clear Driveway of 6"-8" of Snow

F.4 Conclusions

The telephone survey provides valuable, relevant data associated with the EPZ population, which have been used to quantify demographics specific to the EPZ, and "mobilization time" which can influence evacuation time estimates.

ATTACHMENT A

Telephone Survey Instrument

Survey Instrument

Hello, my name is _______________ and I'm working	**COL.1**	Unused
on a survey being made for [insert marketing firm	**COL.2**	Unused
name] designed to identify local travel patterns	**COL.3**	Unused
in your area. The survey will be used for		
emergency plans in response to hazards that		
are not weather-related. The information obtained		
will be used in a traffic engineering study and in	**COL.4**	Unused
connection with an update of the county's	**COL.5**	Unused
emergency response plans. Your participation in this		
survey will greatly enhance the county's emergency		
preparedness program.	Sex	**COL. 8**
		1 Male
		2 Female

INTERVIEWER: ASK TO SPEAK TO THE HEAD OF HOUSEHOLD OR THE SPOUSE OF THE HEAD OF HOUSEHOLD. (Terminate call if not a residence)

DO NOT ASK:

1A. Record area code. To Be Determined

COL. 9-11

1B. Record exchange number. To Be Determined

COL. 12-14

---

2. What is your home Zip Code **Col. 15-19**

3. In total, how many cars, or other vehicles are usually available to the household? (DO NOT READ ANSWERS.) **COL.20**
1 ONE
2 TWO
3 THREE

4	FOUR
5	FIVE
6	SIX
7	SEVEN
8	EIGHT
9	NINE OR MORE
0	ZERO (NONE)
X	REFUSED

---

4. How many people usually live in this household? (DO NOT READ ANSWERS.)

COL.21		**COL.22**	
1	ONE	0	TEN
2	TWO	1	ELEVEN
3	THREE	2	TWELVE
4	FOUR	3	THIRTEEN
5	FIVE	4	FOURTEEN
6	SIX	5	FIFTEEN
7	SEVEN	6	SIXTEEN
8	EIGHT	7	SEVENTEEN
9	NINE	8	EIGHTEEN
		9	NINETEEN OR MORE
		X	REFUSED

---

5. How many children living in this household go to local public, private, or parochial schools? (DO NOT READ ANSWERS.)

COL.23	
0	ZERO
1	ONE
2	TWO
3	THREE
4	FOUR
5	FIVE
6	SIX
7	SEVEN
8	EIGHT
9	NINE OR MORE
X	REFUSED

---

6. How many people in the household commute to a job, or to college, at least 4 times a week?

COL.24		SKIP TO
0	ZERO	Q. 12
1	ONE	Q. 7
2	TWO	Q. 7
3	THREE	Q. 7

4	FOUR OR MORE	Q. 7
5	DON'T KNOW/REFUSED	Q. 12

INTERVIEWER: For each person identified in Question 6, ask Questions 7, 8, 9, and 10.

7. Thinking about commuter #1, how does that person usually travel to work or college? (REPEAT QUESTION FOR EACH COMMUTER.)

	Commuter #1 **COL.25**	Commuter #2 **COL.26**	Commuter #3 **COL.27**	Commuter #4 **COL.28**
Rail	1	1	1	1
Bus	2	2	2	2
Walk/Bicycle	3	3	3	3
Driver Car/Van	4	4	4	4
Park & Ride (Car/Rail, Xpress_bus)	5	5	5	5
Driver Carpool-2 or more people	6	6	6	6
Passenger Carpool-2 or more people	7	7	7	7
Taxi	8	8	8	8
Refused	9	9	9	9

---

8. What is the name of the city, town or community in which Commuter #1 works or attends school? (REPEAT QUESTION FOR EACH COMMUTER.) (FILL IN ANSWER.)

COMMUTER #1			COMMUTER #2			COMMUTER #3			COMMUTER #4		
City/Town		State	City/Town		State	City/Town		State	City/Town		State
COL.29	**COL.30**	**COL.31**	**COL.32**	**COL.33**	**COL.34**	**COL.35**	**COL.36**	**COL.37**	**COL.38**	**COL.39**	**COL.40**
0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5

6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9

9. How long would it take Commuter #1 to travel home from work or college?
(REPEAT QUESTION FOR EACH COMMUTER.) (DO NOT READ ANSWERS.)

COMMUTER #1

COL.41	**COL.42**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #2

COL.43	**COL.44**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #3

COL.45	**COL.46**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES –
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR
7 31-35 MINUTES	
8 36-40 MINUTES	
9 41-45 MINUTES	

COMMUTER #4

COL.47	**COL.48**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR
7 31-35 MINUTES	
8 36-40 MINUTES	
9 41-45 MINUTES	

	31 MINUTES AND 1 HOUR 45 MINUTES		31 MINUTES AND 1 HOUR 45 MINUTES
	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS		7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
	8 OVER 2 HOURS (SPECIFY _____)		8 OVER 2 HOURS (SPECIFY _____)
	9		9
	0		0
	X DON'T KNOW/REFUSED		X DON'T KNOW/REFUSED

10. Approximately how long does it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home? (REPEAT QUESTION FOR EACH COMMUTER.)

(DO NOT READ ANSWERS.)

COMMUTER #1		COMMUTER #2	
COL. 49	**COL.50**	**COL.51**	**COL. 52**
1 5 MINUTES OR LESS	1 46-50 MINUTES	1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES	2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR	3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES	4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES		5 21-25 MINUTES	
6 26-30 MINUTES		6 26-30 MINUTES	
7 31-35 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES	7 31-35 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
8 36-40 MINUTES		8 36-40 MINUTES	
9 41-45 MINUTES		9 41-45 MINUTES	
	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES		6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS		7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
	8 OVER 2 HOURS (SPECIFY _____)		8 OVER 2 HOURS (SPECIFY _____)
	9		9
	0		0
	X DON'T KNOW/REFUSED		X DON'T KNOW/REFUSED

COMMUTER #3		COMMUTER #4	
COL. 53	**COL. 54**	**COL. 55**	**COL. 56**
1 5 MINUTES OR LESS	1 46-50 MINUTES	1 5 MINUTES OR LESS	1 46-50 MINUTES

2 6-10 MINUTES	2 51-55 MINUTES	2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR	3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES –	4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES	5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES	6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS	7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)	8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9	9 41-45 MINUTES	9
	0		0
	X DON'T KNOW/REFUSED		X DON'T KNOW/REFUSED

---

11. When the commuters are away from home, is there a vehicle at home that is available for evacuation during any emergency?

Col. 57

1 Yes
2 No
3 Don’t Know/Refused

12. Would you await the return of family members prior to evacuating the area?

Col. 58

1 Yes
2 No
3 Don’t Know/Refused

---

13. How many of the vehicles that are usually available to the household would your family use during an evacuation?

(DO NOT READ ANSWERS.)

COL.59

1 ONE
2 TWO

3 THREE
4 FOUR
5 FIVE
6 SIX
7 SEVEN
8 EIGHT
9 NINE OR MORE
0 ZERO (NONE)
X REFUSED

14. How long would it take the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area? (DO NOT READ ANSWERS.)

COL.60

1 LESS THAN 15 MINUTES
2 15-30 MINUTES
3 31-45 MINUTES
4 46 MINUTES - 1 HOUR
5 1 HOUR TO 1 HOUR 15 MINUTES
6 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
7 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
8 1 HOUR 46 MINUTES TO 2 HOURS
9 2 HOURS TO 2 HOURS 15 MINUTES
0 2 HOURS 16 MINUTES TO 2 HOURS 30 MINUTES
X 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES
Y 2 HOURS 46 MINUTES TO 3 HOURS

COL.61

1 3 HOURS TO 3 HOURS 15 MINUTES
2 3 HOURS 16 MINUTES TO 3 HOURS 30 MINUTES
3 3 HOURS 31 MINUTES TO 3 HOURS 45 MINUTES
4 3 HOURS 46 MINUTES TO 4 HOURS
5 4 HOURS TO 4 HOURS 15 MINUTES
6 4 HOURS 16 MINUTES TO 4 HOURS 30 MINUTES
7 4 HOURS 31 MINUTES TO 4 HOURS 45 MINUTES
8 4 HOURS 46 MINUTES TO 5 HOURS
9 5 HOURS TO 5 HOURS 15 MINUTES
0 5 HOURS 16 MINUTES TO 5 HOURS 30 MINUTES
X 5 HOURS 31 MINUTES TO 5 HOURS 45 MINUTES
Y 5 HOURS 46 MINUTES TO 6 HOURS

COL.62

1 DON'T KNOW

15. How long would it take you to clear 6-8" of snow to move the car from the driveway or curb to begin the evacuation trip? Assume the roads are passable.

(DO NOT READ RESPONSES.)

COL.63

1 LESS THAN 15 MINUTES
2 15-30 MINUTES
3 31-45 MINUTES
4 46 MINUTES - 1 HOUR
5 1 HOUR TO 1 HOUR 15 MINUTES
6 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
7 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
8 1 HOUR 46 MINUTES TO 2 HOURS

COL.64

1 MORE THAN 3 HOURS
2 DON'T KNOW

9 2 HOURS TO 2 HOURS 15 MINUTES

0 2 HOURS 16 MINUTES TO 2 HOURS 30 MINUTES

X 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES

Y 2 HOURS 46 MINUTES TO 3 HOURS

---

16. Would you take household pets with you if you were asked to evacuate the area?

Col. 65

1 Yes

2 No

3 Don't Know/Refused

County	EMA Phone
Monroe	(734)240-3135
Wayne	(734)942-5289

Thank you very much. ___________________________

(TELEPHONE NUMBER CALLED)

If requested:

For Additional information

Contact your County Emergency Management Office

APPENDIX G

Traffic Management Plan

G. TRAFFIC MANAGEMENT PLAN

NUREG/CR-7002 indicates that the existing TCPs and ACPs identified by the offsite agencies should be used in the evacuation simulation modeling. The traffic and access control plans for the EPZ were provided by each county.

These plans were reviewed and the TCP and ACPs were modeled accordingly.

G.1 Traffic and Access Control Points

As discussed in Section 9, traffic and access control points at intersections (which are controlled) are modeled as actuated signals. Figure G-1 displays TCPs and ACPs that were included in the county emergency plans. If an intersection has a pre-timed signal, stop, or yield control, and the intersection is identified as a traffic or access control point, the control type was changed to an actuated signal in the DYNEV II system. Table K-2 provides the control type and node number for those nodes which are controlled. If the existing control was changed due to the point being a TCP or ACP, the control type is indicated as "Traffic Control Point" in Table K-2.

It is assumed that ACPs will be established within 2 hours of the advisory to evacuate to discourage through travelers from using major through routes which traverse the EPZ. As discussed in Section 3.7, external traffic was considered on the interstates which traverse the EPZ – I-75 and I-275 – in this analysis. The generation of these external trips ceased at 2 hours after the advisory to evacuate in the simulation.

It is recommended that ACPs on these interstates be given top priority in assigning manpower and equipment as they are the major routes traversing the EPZ, which will typically carry the highest volume of through traffic.

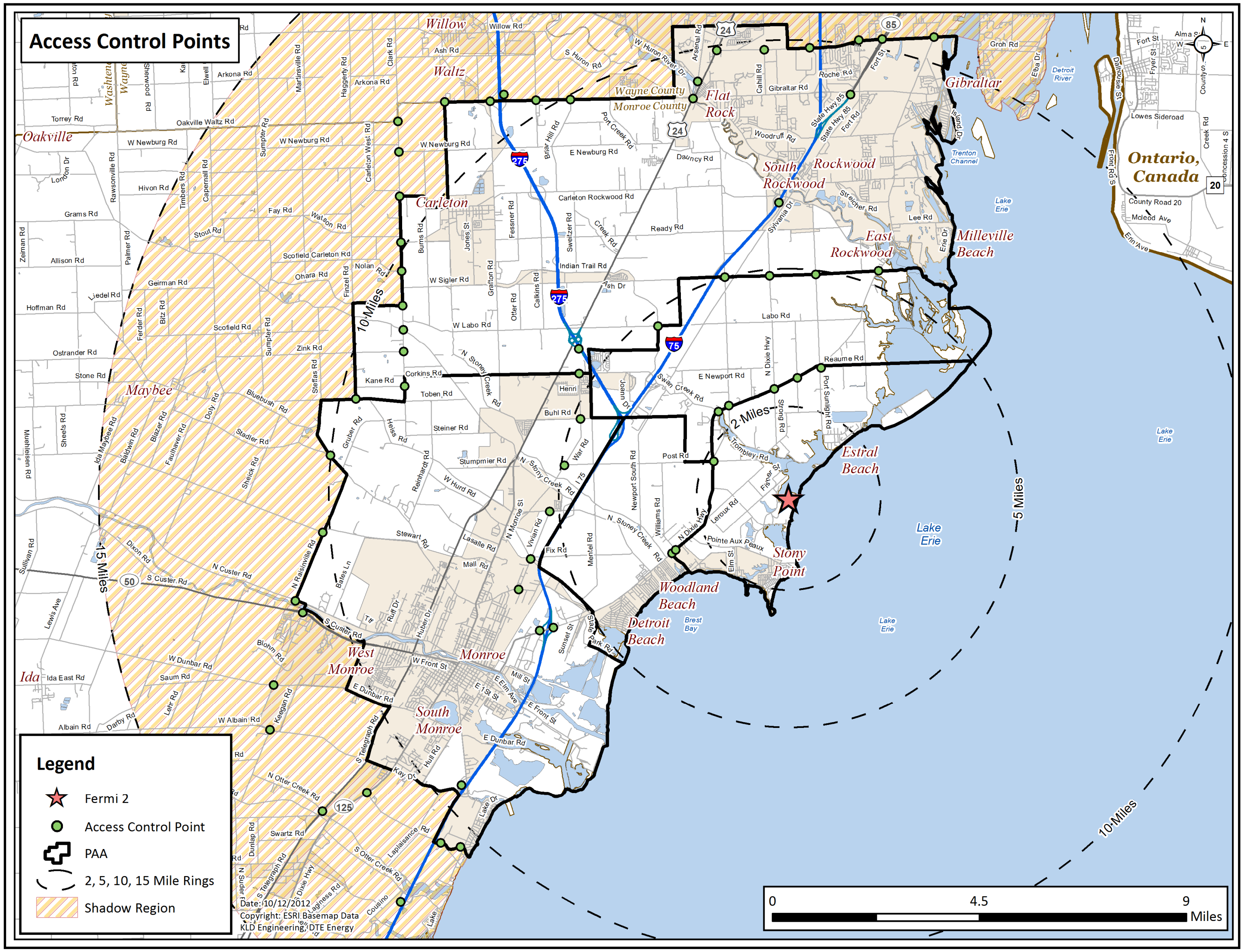


Figure G-1. Access Control Points for the FNPP EPZ

APPENDIX H

Evacuation Regions

H. EVACUATION REGIONS

This appendix presents the evacuation percentages for each Evacuation Region (Table H-1) and maps of all Evacuation Regions. The percentages presented in Table H-1 are based on the methodology discussed in assumption 5 of Section 2.2 and shown in Figure 2-1.

Note the baseline ETE study assumes 20 percent of households will not comply with the shelter advisory, as per Section 2.5.2 of NUREG/CR-7002.

Table H-1. Percent of PAA Population Evacuating for Each Region

Basic Regions						
		PAA				
Region	**Description**	**1**	**2**	**3**	**4**	**5**
R01	2-Mile Region	**100%**	**20%**	**20%**	**20%**	**20%**
R02	5-Mile Region	**100%**	**100%**	**100%**	**20%**	**20%**
R03	Full EPZ	**100%**	**100%**	**100%**	**100%**	**100%**
Evacuate 2-Mile Region and Downwind to 5 Miles						
		PAA				
Region	**Wind Direction From:**	**1**	**2**	**3**	**4**	**5**
N/A	W,WNW,NW,NNW,N,NNE	**Refer to Region R01**				
R04	NE,ENE,E	**100%**	**20%**	**100%**	**20%**	**20%**
N/A	ESE,SE	**Refer to Region R02**				
R05	SSE,S,SSW,SW,WSW	**100%**	**100%**	**20%**	**20%**	**20%**
Evacuate 5-Mile Region and Downwind to the EPZ Boundary						
		PAA				
Region	**Wind Direction From:**	**1**	**2**	**3**	**4**	**5**
N/A	WSW,W,WNW,NW,NNW,N	**Refer to Region R02**				
R06	NNE,NE,ENE	**100%**	**100%**	**100%**	**20%**	**100%**
N/A	E,ESE,SE	**Refer to Region R03**				
R07	SSE,S,SSW,SW	**100%**	**100%**	**100%**	**100%**	**20%**
Staged Evacuation - 2-Mile Region Evacuates, then Evacuate Downwind to 5 Miles						
		PAA				
Region	**Wind Direction From:**	**1**	**2**	**3**	**4**	**5**
R08	No Wind	**100%**	**100%**	**100%**	**20%**	**20%**
N/A	W,WNW,NW,NNW,N,NNE	**Refer to Region R01**				
R09	NE,ENE,E	**100%**	**20%**	**100%**	**20%**	**20%**
N/A	ESE,SE	**Refer to Region R02**				
R10	SSE,S,SSW,SW,WSW	**100%**	**100%**	**20%**	**20%**	**20%**
Key						
PAA(s) Evacuate	PAA(s) Shelter-in-Place	Shelter-in-Place until 90% ETE for R01, then Evacuate				

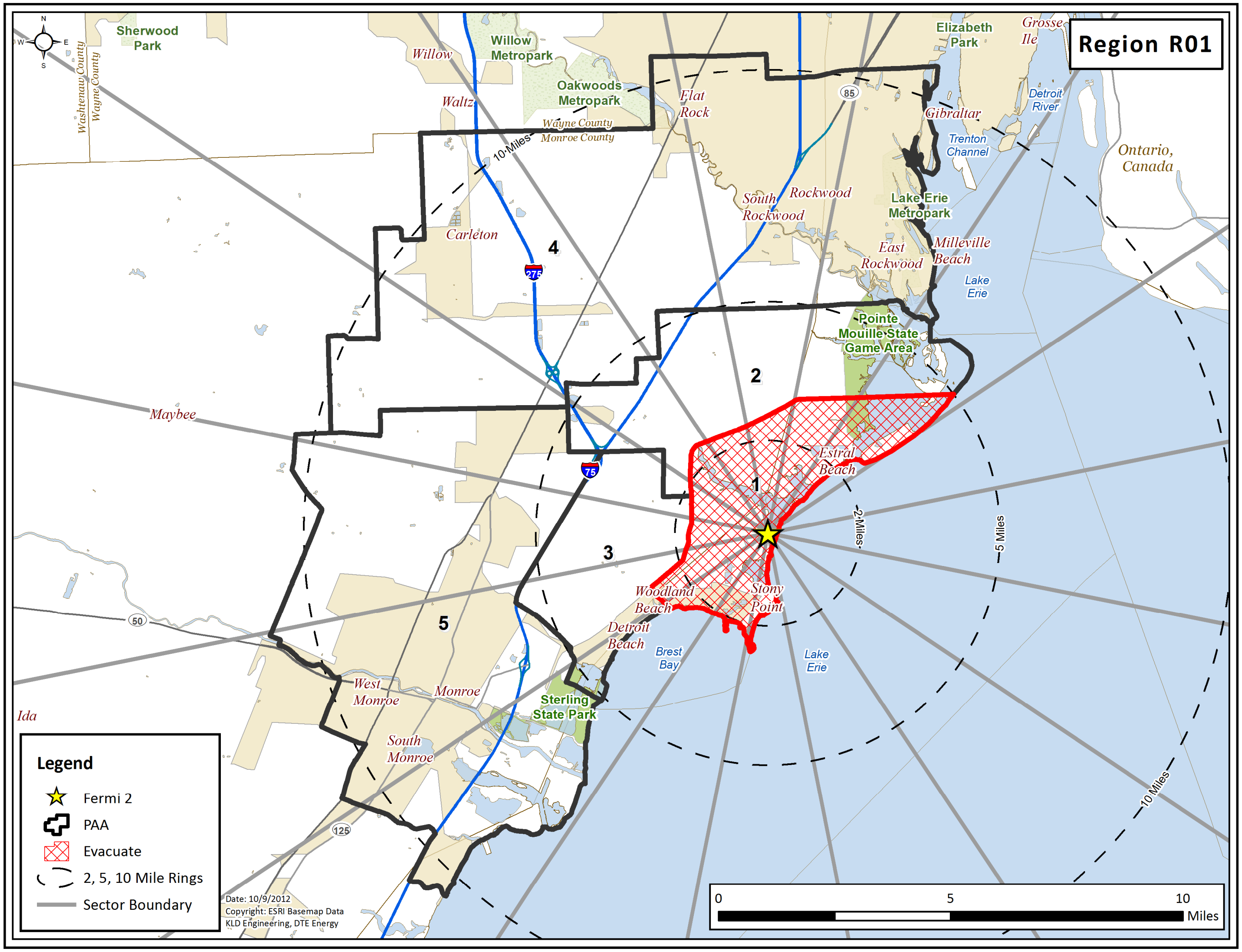


Figure H-1. Region R01

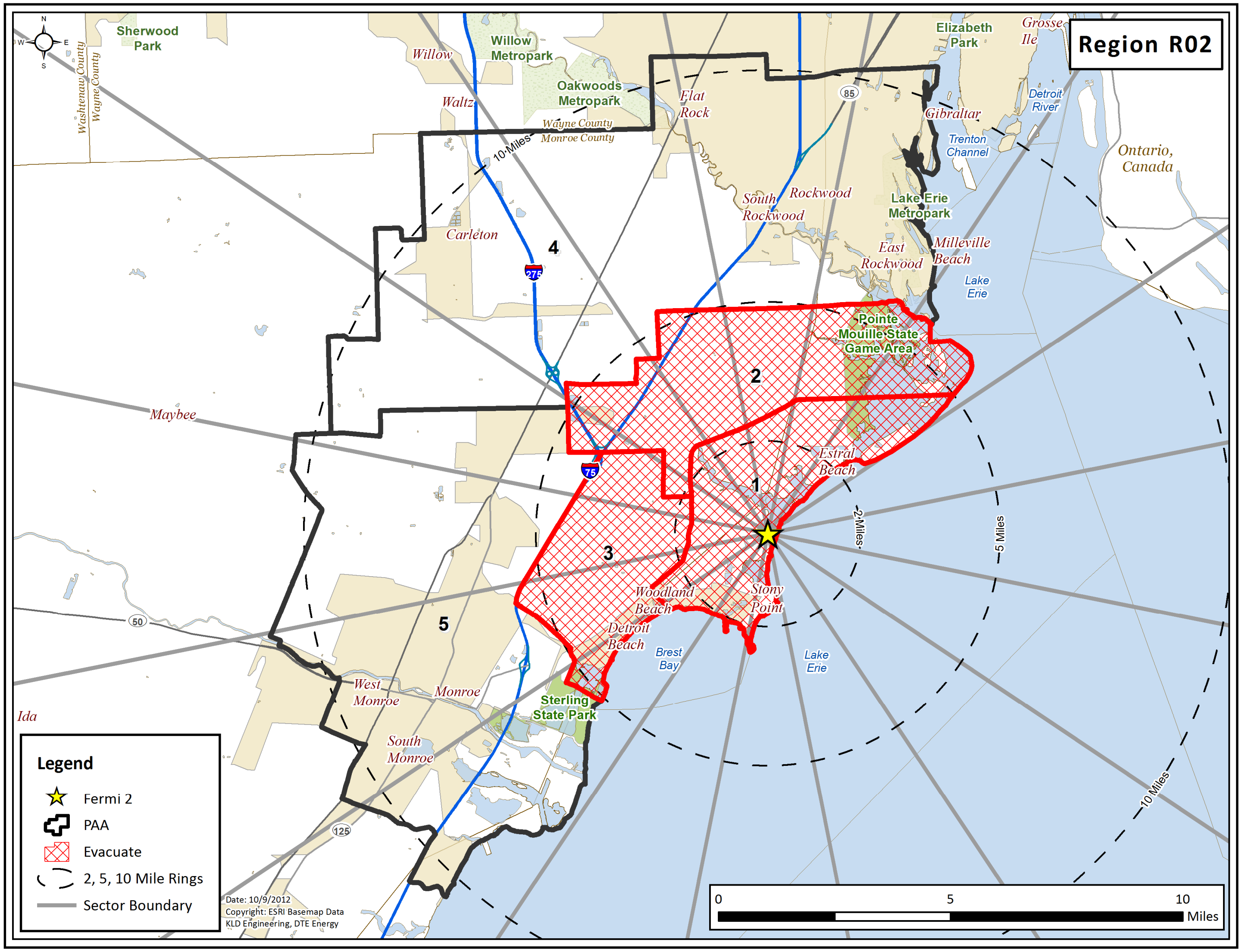


Figure H-2. Region R02

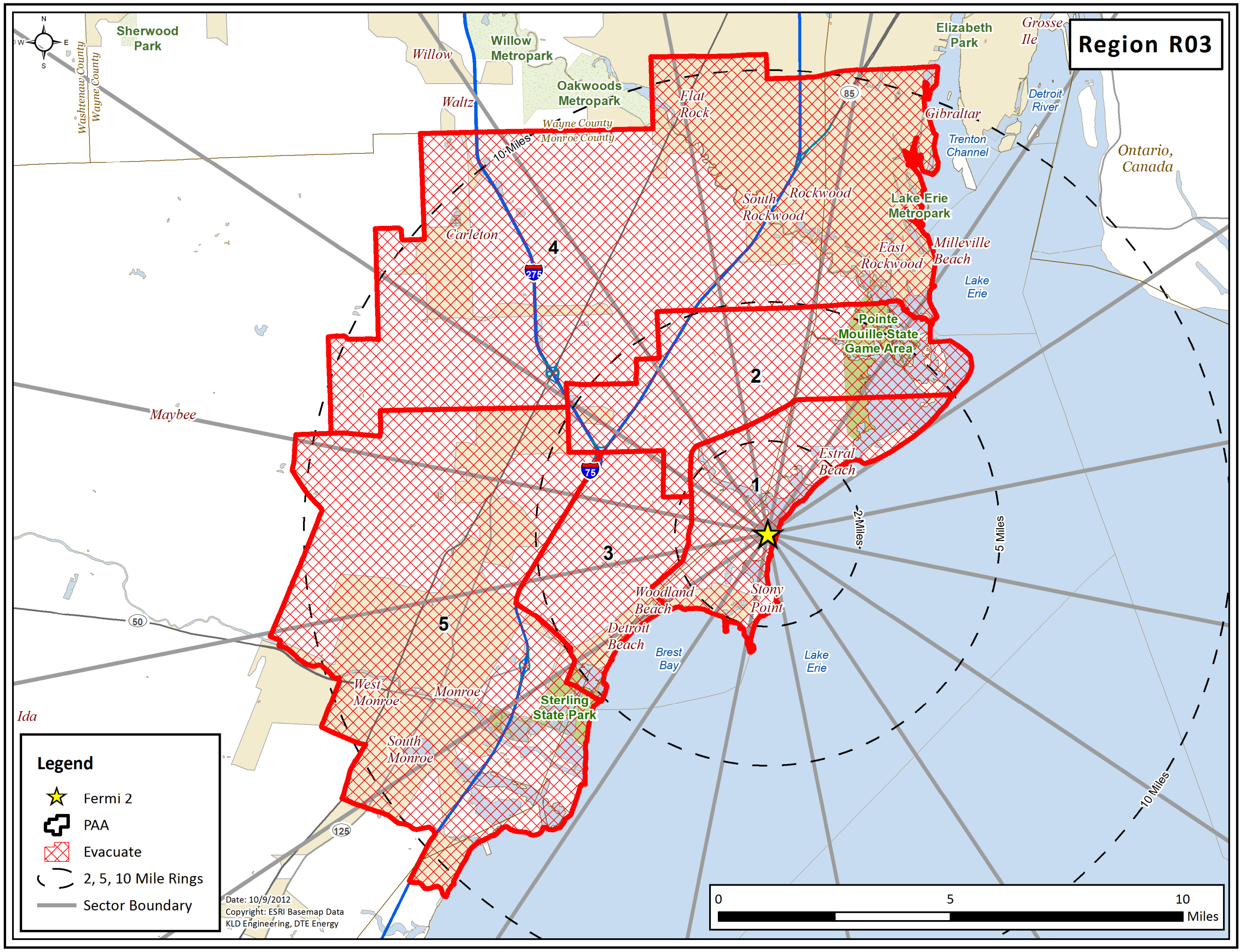


Figure H-3. Region R03

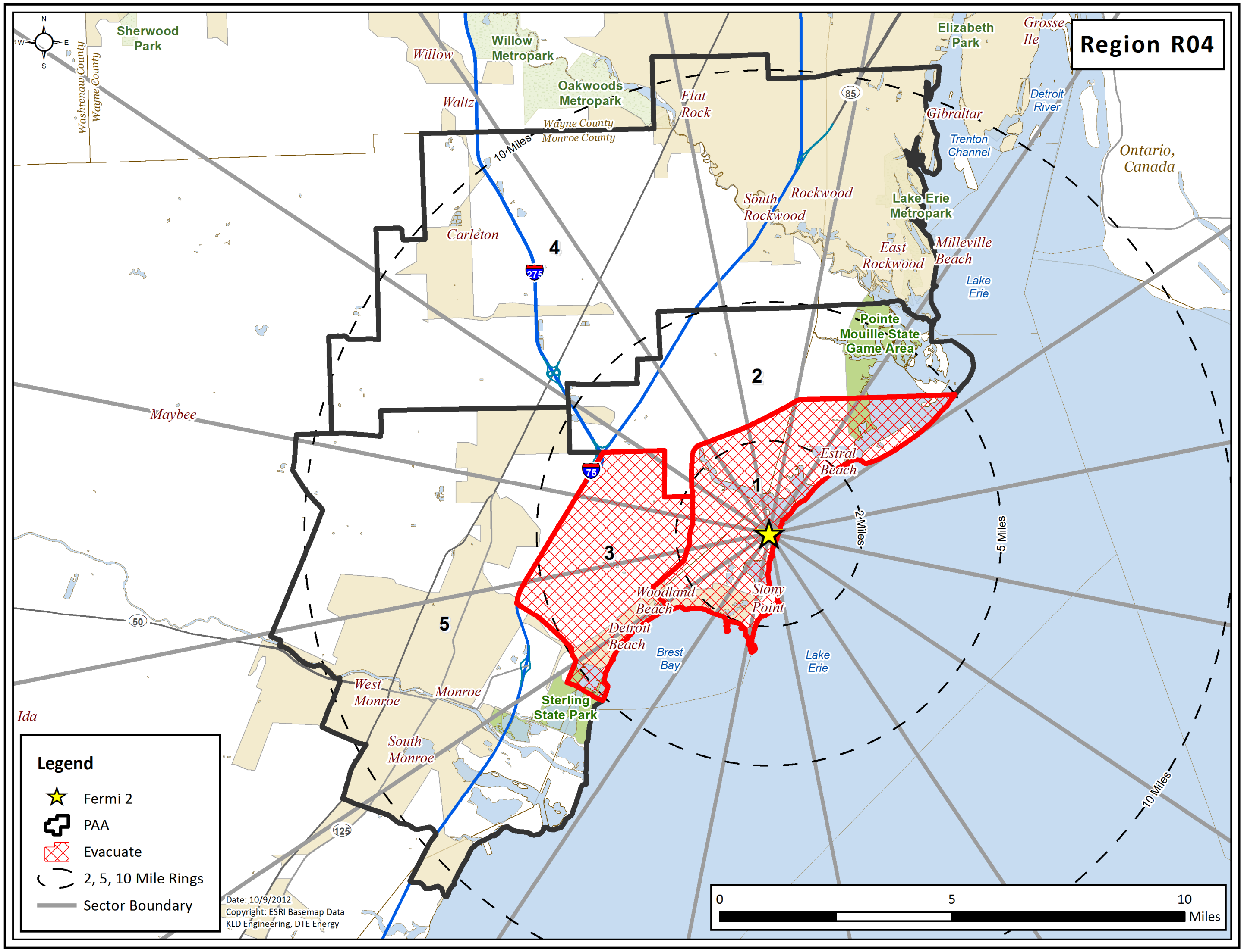


Figure H-4. Region R04

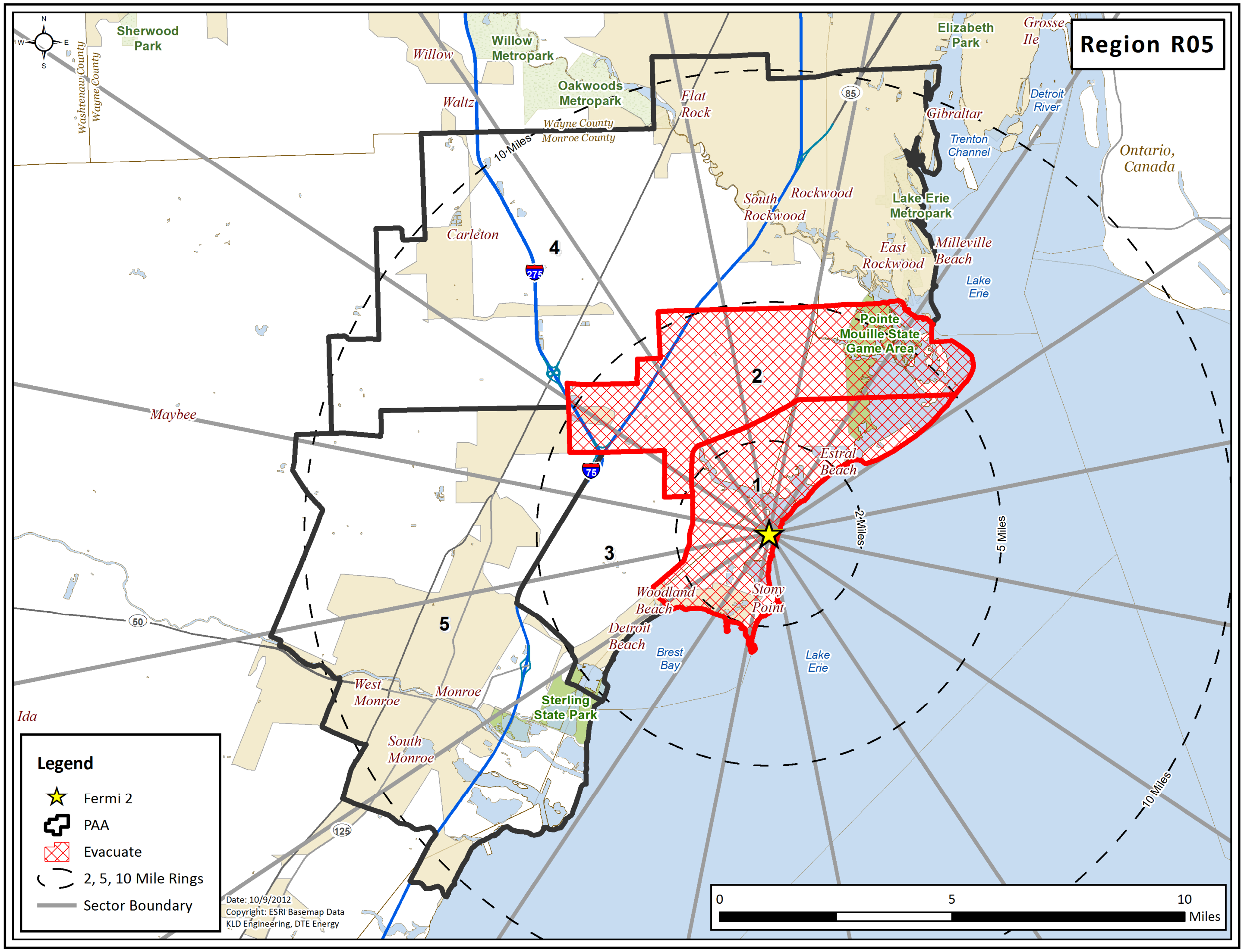


Figure H-5. Region R05

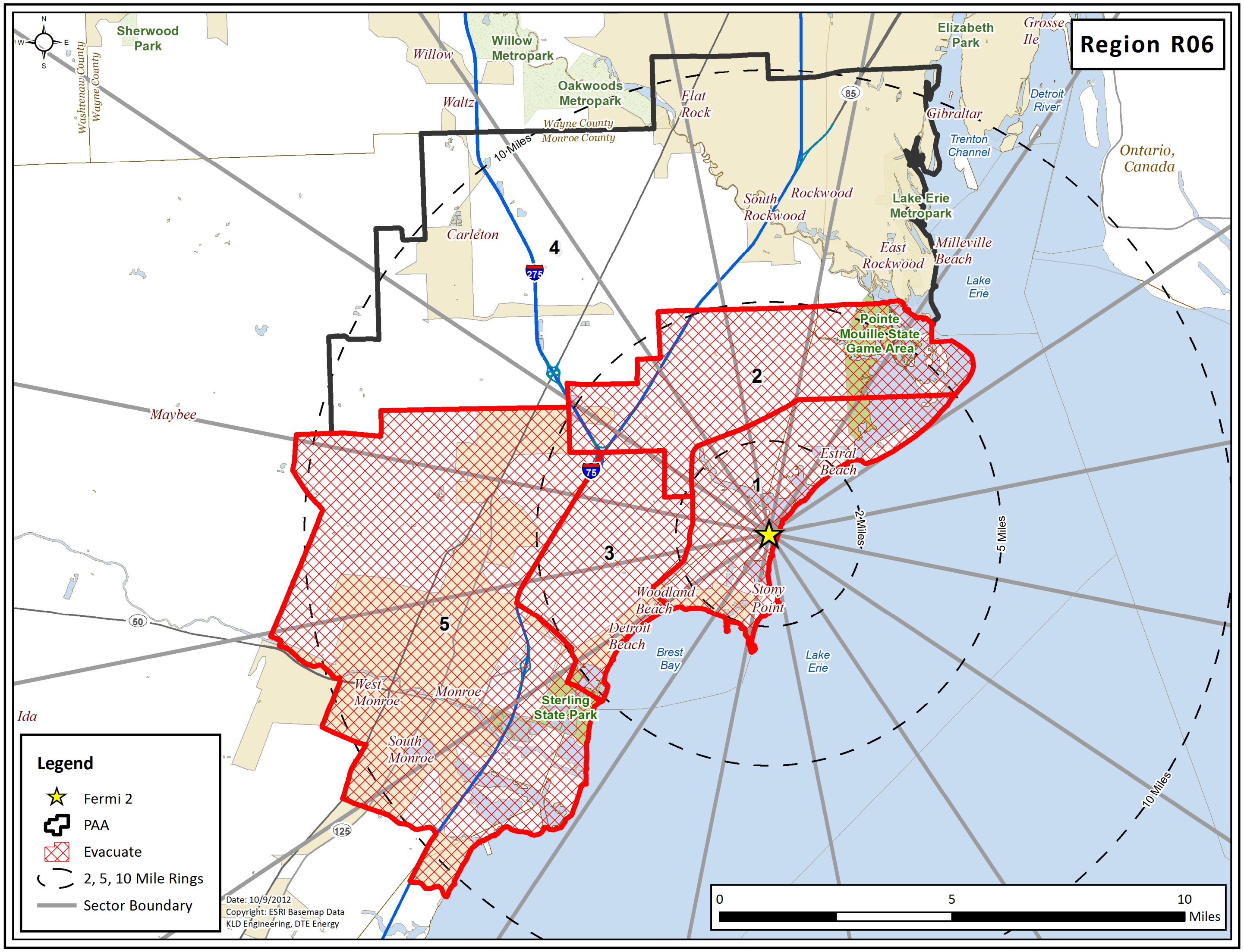


Figure H-6. Region R06

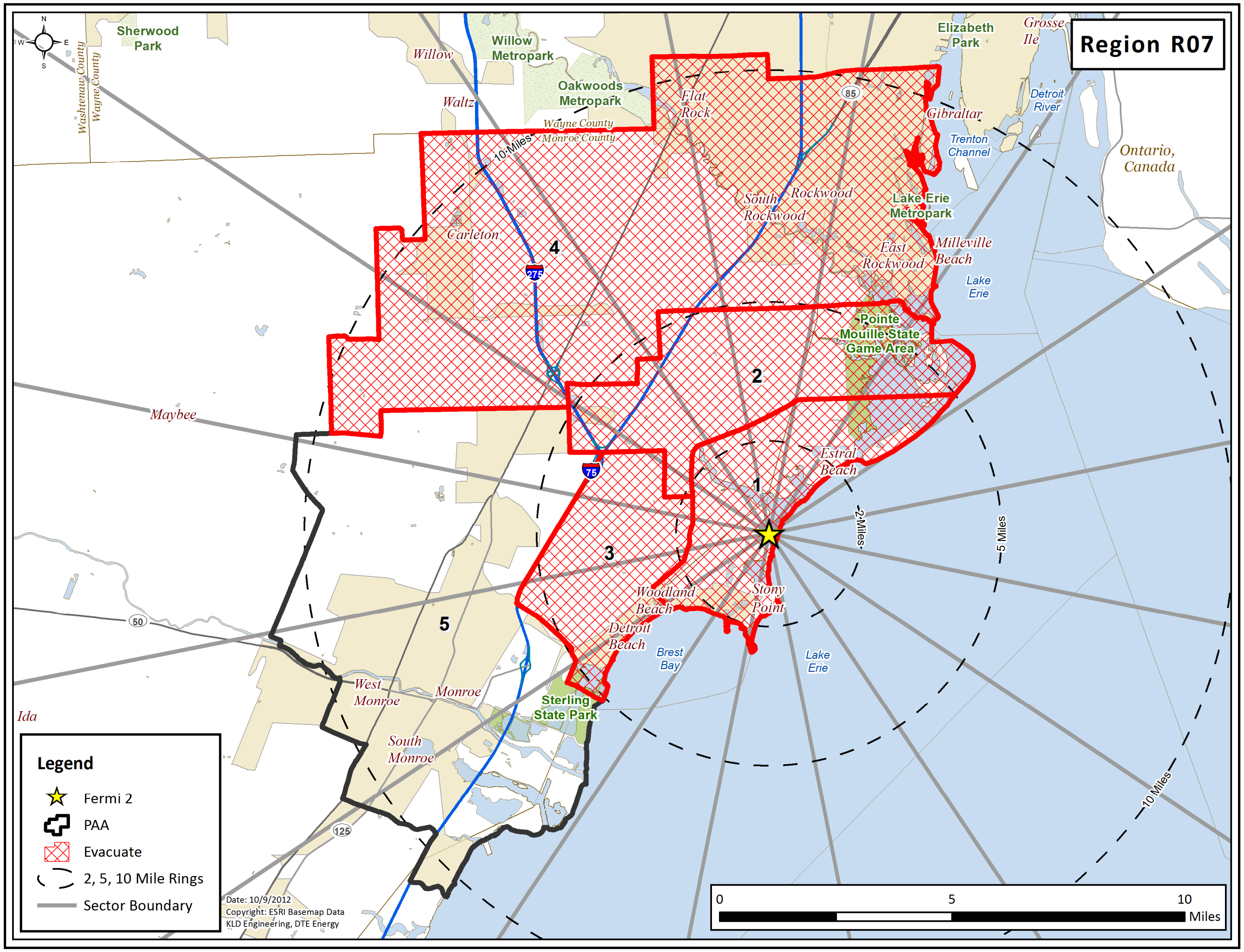


Figure H-7. Region R07

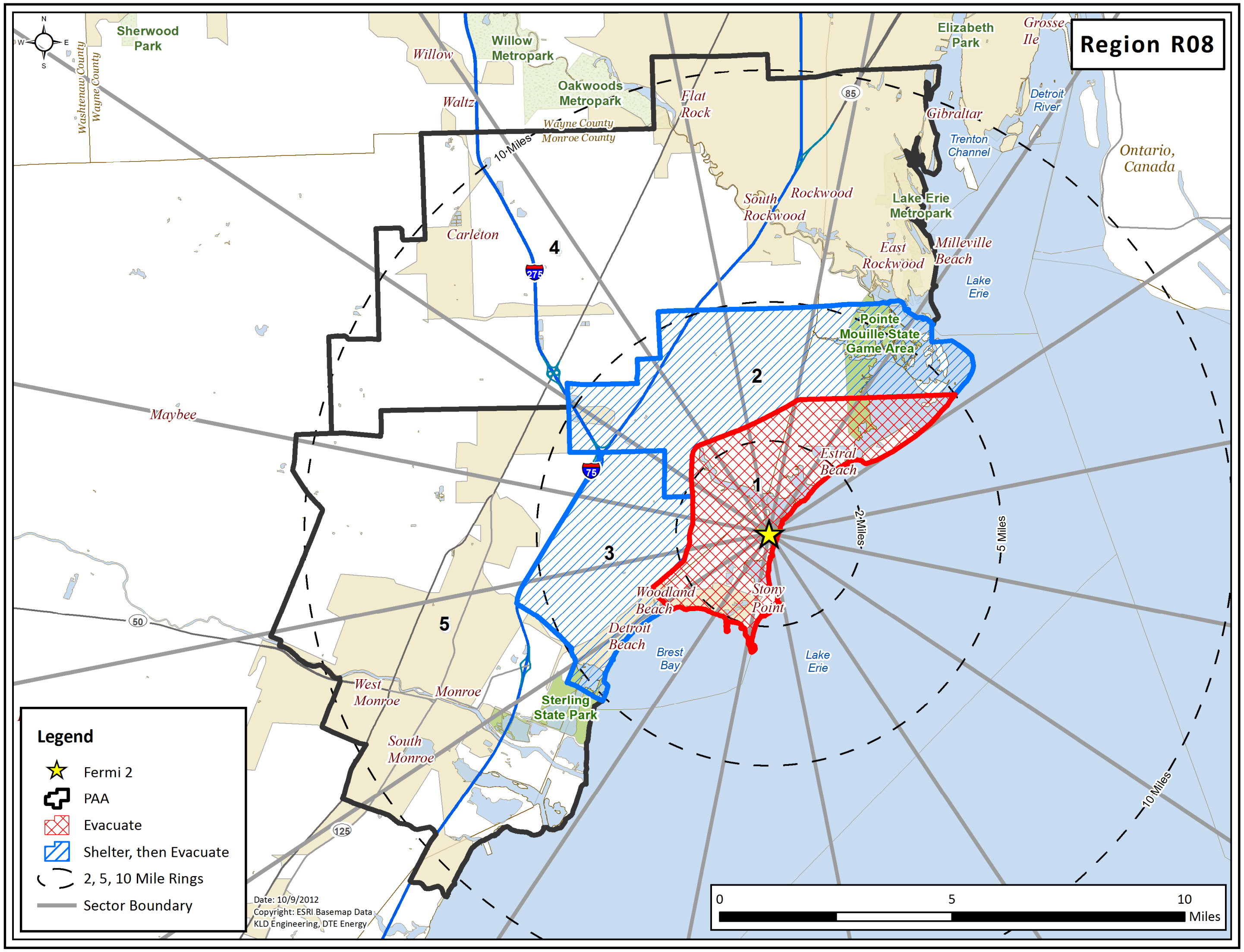


Figure H-8. Region R08

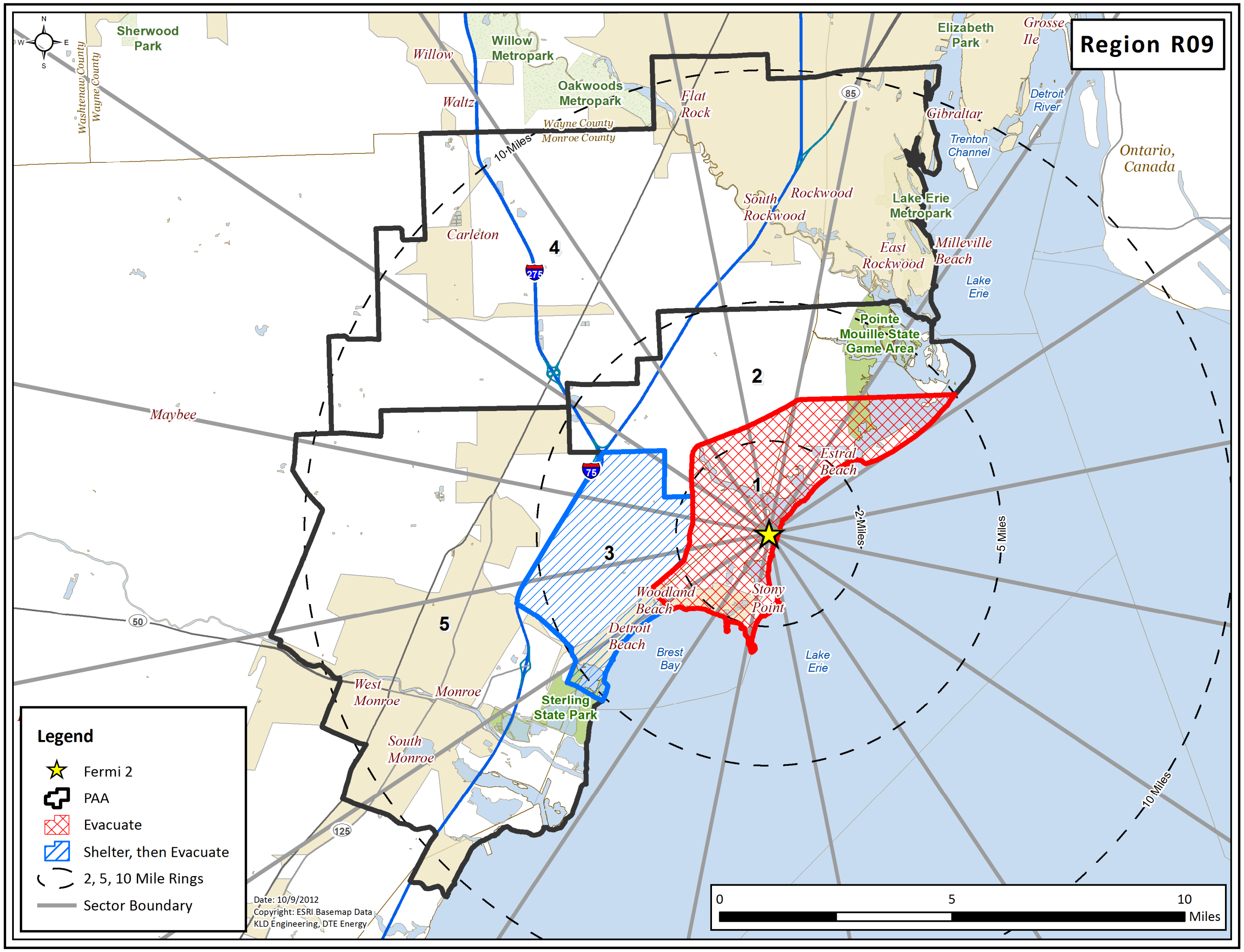


Figure H-9. Region R09

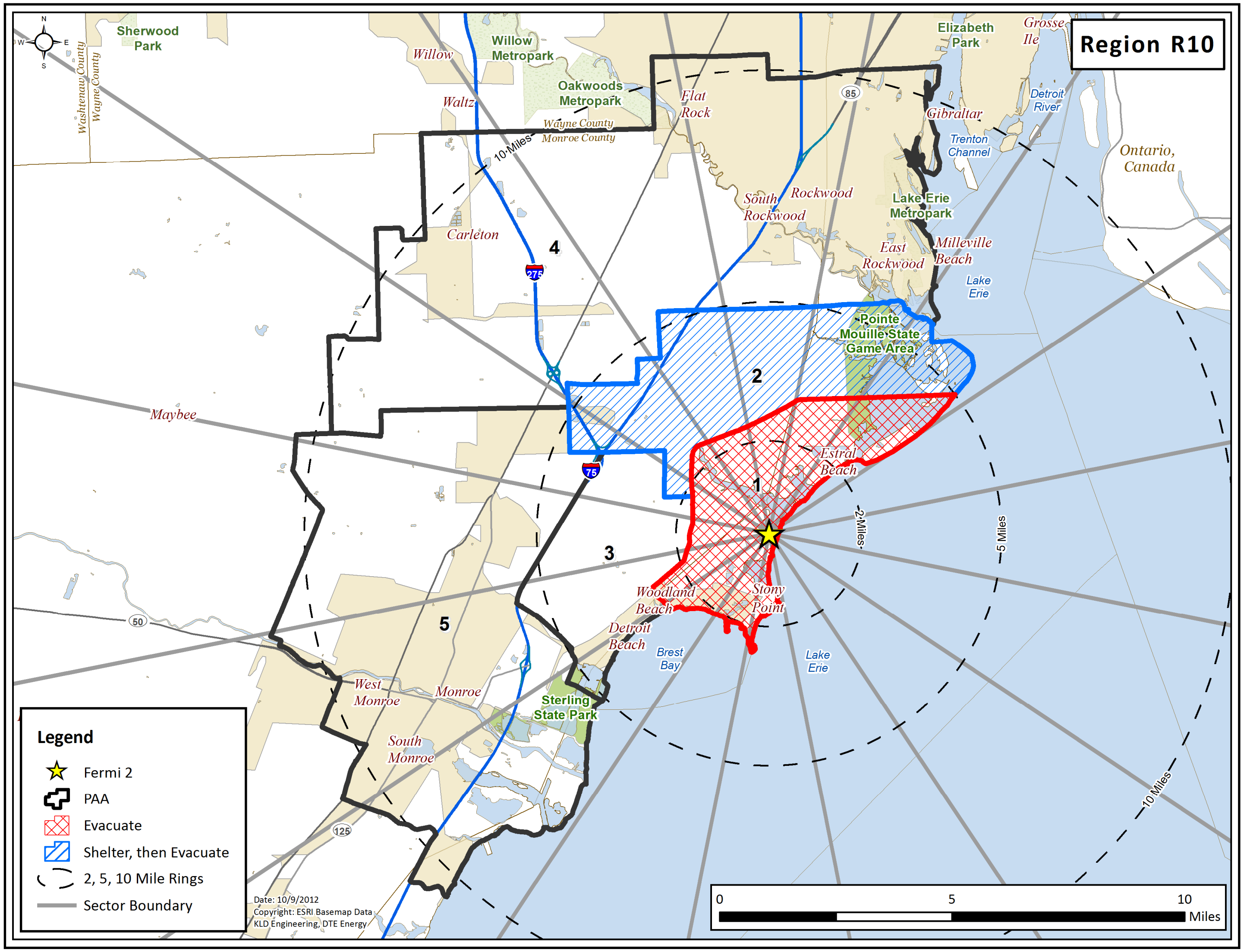


Figure H-10. Region R10

APPENDIX J

Representative Inputs to and Outputs from the DYNEV II System

J. REPRESENTATIVE INPUTS TO AND OUTPUTS FROM THE DYNEV II SYSTEM

This appendix presents data input to and output from the DYNEV II System. Table J-1 provides the volume and queues for the ten highest volume signalized intersections in the study area. Refer to Table K-2 and the figures in Appendix K for a map showing the geographic location of each intersection.

Table J-2 provides source (vehicle loading) and destination information for several roadway segments (links) in the analysis network. Refer to Table K-1 and the figures in Appendix K for a map showing the geographic location of each link.

Table J-3 provides network–wide statistics (average travel time, average speed and number of vehicles) for an evacuation of the entire EPZ (Region R03) for each scenario. As expected, Scenario 13 (Special Event) has a slower network-wide average travel speed and higher network-wide average travel time than Scenario 3 (Summer, Weekend, Midday, Good Weather). Scenario 14 (Roadway Impact) has a slower network-wide average travel speed and higher network-wide average travel time than Scenario 1 (Summer, Midweek, Midday, Good Weather).

Table J-4 provides statistics (average speed and travel time) for the major evacuation routes – I-275, I-75, N Dixie Hwy, and US-24 – for an evacuation of the entire EPZ (Region R03) under Scenario 1 conditions. As discussed in Section 7.3 and shown in Figures 7-3 through 7-8, congestion persists for the first two hours of the evacuation. As such, the average speeds are comparably slower (and travel times longer) during these first two hours compared with the last two hours of the evacuation.

Table J-5 provides the number of vehicles discharged and the cumulative percent of total vehicles discharged for each link exiting the analysis network, for an evacuation of the entire EPZ (Region R03) under Scenario 1 conditions. Refer to Table K-1 and the figures in Appendix K for a map showing the geographic location of each link.

Figure J-1 through Figure J-14 plot the trip generation time versus the ETE for each of the 14 Scenarios considered. The distance between the trip generation and ETE curves is the travel time. Plots of trip generation versus ETE are indicative of the level of traffic congestion during evacuation. For low population density sites, the curves are close together, indicating short travel times and minimal traffic congestion. For higher population density sites, the curves are farther apart indicating longer travel times and the presence of traffic congestion. As seen in Figure J-1 through Figure J-14, the curves are spatially separated as a result of the traffic congestion in the EPZ, which was discussed in detail in Section 7.3.

Table J-1. Characteristics of the Ten Highest Volume Signalized Intersections

Node	Location	Intersection Control	Approach (Up Node)	Total Volume (Veh)	Max. Turn Queue (Veh)
392	SR-85 & Van horn Rd	A	395	3,725	0
			172	2,606	0
			TOTAL	6,331	-
152	SR-85 & Sibley Rd	A	424	5,916	144
			87	21	0
			199	249	3
			TOTAL	6,186	-
793	SR-85 & Left Turns from Williamsbur Dr	A	151	6,147	0
			794	0	0
			TOTAL	6,147	-
154	SR-85 & King Rd	A	419	5,493	96
			421	161	0
			202	450	5
			TOTAL	6,104	-
424	SR-85 & Left Turns from Sibley Rd	A	610	249	1
			154	5,665	82
			TOTAL	5,914	-
97	SR-125 & W Albain Rd	A	73	754	29
			514	663	36
			98	4,327	222
			TOTAL	5,744	-
73	US-24 & W Albain Rd	A	135	4,328	136
			97	1,333	172
			TOTAL	5,661	-
419	SR-85 & Left Turns from King Rd	A	155	5,040	93
			611	450	11
			TOTAL	5,490	-
156	SR-85 & West Rd	A	398	4,841	6
			179	163	0
			714	72	0
			TOTAL	5,076	-
118	US-24 & West Rd	A	364	4,231	0
			168	43	0
			166	778	0
			TOTAL	5,052	-

Table J-2. Sample Simulation Model Input

Link Number	Vehicles Entering Network on this Link	Directional Preference	Destination Nodes	Destination Capacity
2	541	S	8089	3,810
			8437	5,715
			8240	6,750
901	143	W	8454	6,750
			8773	1,698
			8631	1,698
504	130	N	8240	6,750
			8055	3,810
			8629	3,810
781	1,168	N	8240	6,750
			8055	3,810
			8629	3,810
163	67	W	8454	6,750
			8773	1,698
			8631	1,698
467	204	W	8030	6,750
			8678	1,698
944	99	W	8216	1,698
			8541	1,698
			8773	1,698
261	21	N	8089	3,810
			8437	5,715
586	57	SW	8497	1,698
			8510	1,698
			8454	6,750
773	45	NW	8678	1,698

Table J-3. Selected Model Outputs for the Evacuation of the Entire EPZ (Region R03)

Scenario	1	2	3	4	5	6	7
Network-Wide Average Travel Time (Min/Veh-Mi)	1.8	2.2	2.2	2.6	2.1	1.7	2.1
Network-Wide Average Speed (mph)	32.9	27.2	27.6	22.7	28.9	34.5	28.2
Total Vehicles Exiting Network	76,019	76,149	75,015	75,544	62,367	75,103	75,531
Scenario	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Network-Wide Average Travel Time (Min/Veh-Mi)	2.1	1.9	2.3	2.3	2.0	2.4	2.0
Network-Wide Average Speed (mph)	28.5	31.7	26.3	26.5	29.4	25.1	30.6
Total Vehicles Exiting Network	75,169	69,989	70,474	69,730	61,363	77,668	75,801

Table J-4. Average Speed (mph) and Travel Time (min) for Major Evacuation Routes (Region R03, Scenario 1)

		Elapsed Time (hours)							
		1		2		3		4	
Route	Length (miles)	Speed (mph)	Travel Time (min)	Speed	Travel Time	Speed	Travel Time	Speed	Travel Time
I-275 NB	7.5	66.9	6.7	71.5	6.3	74.5	6.0	74.5	6.0
I-75 NB	9.2	72.1	7.6	73.6	7.5	73.7	7.5	73.7	7.5
I-75 SB	9.7	60.6	9.6	67.6	8.6	67.9	8.5	67.9	8.5
N Dixie Hwy NB	11.9	30.3	23.6	47.8	15.0	48.5	14.8	50.0	14.3
N Dixie Hwy SB	6.5	25.9	15.1	40.2	9.7	38.9	10.0	41.7	9.3
US-24 NB	10.4	46.1	13.6	44.9	14.0	45.5	13.8	46.9	13.3
US-24 SB	7.4	36.0	12.3	36.1	12.3	40.8	10.9	41.4	10.7

Table J-5. Simulation Model Outputs at Network Exit Links for Region R03, Scenario 1

Network Exit Link	Elapsed Time (hours)			
	1	2	3	4
	Cumulative Vehicles Discharged by the Indicated Time Interval			
	Cumulative Percent of Vehicles Discharged During by the Indicated Time Interval			
0	0	0	0	0
	0%	0%	0%	0%
106	363	1,122	1,524	1,568
	2%	2%	2%	2%
137	192	926	1,182	1,218
	1%	2%	2%	2%
214	417	1,734	2,954	3,038
	2%	3%	4%	4%
215	350	1,300	2,298	2,605
	2%	2%	3%	3%
222	479	1,240	1,762	1,795
	2%	2%	2%	2%
337	558	1,689	2,487	2,579
	3%	3%	3%	3%
360	4,335	10,866	12,971	13,088
	21%	19%	17%	17%
390	4,245	10,897	12,933	13,183
	20%	19%	17%	17%
441	4,795	11,067	15,577	15,768
	23%	19%	21%	21%
639	220	571	655	669
	1%	1%	1%	1%
770	354	992	1,173	1,198
	2%	2%	2%	2%
849	542	1,831	2,174	2,208
	3%	3%	3%	3%
850	113	536	682	695
	1%	1%	1%	1%
854	372	1,221	1,527	1,564
	2%	2%	2%	2%
856	314	1,176	1,459	1,485
	2%	2%	2%	2%
858	491	1,785	2,208	2,253
	2%	3%	3%	3%

Network Exit Link	Elapsed Time (hours)			
	1	2	3	4
	Cumulative Vehicles Discharged by the Indicated Time Interval			
	Cumulative Percent of Vehicles Discharged During by the Indicated Time Interval			
860	4	38	51	53
	0%	0%	0%	0%
879	485	1,331	1,949	1,992
	2%	2%	3%	3%
890	657	2,233	2,866	2,888
	3%	4%	4%	4%
914	1,526	4,742	6,018	6,150
	7%	8%	8%	8%

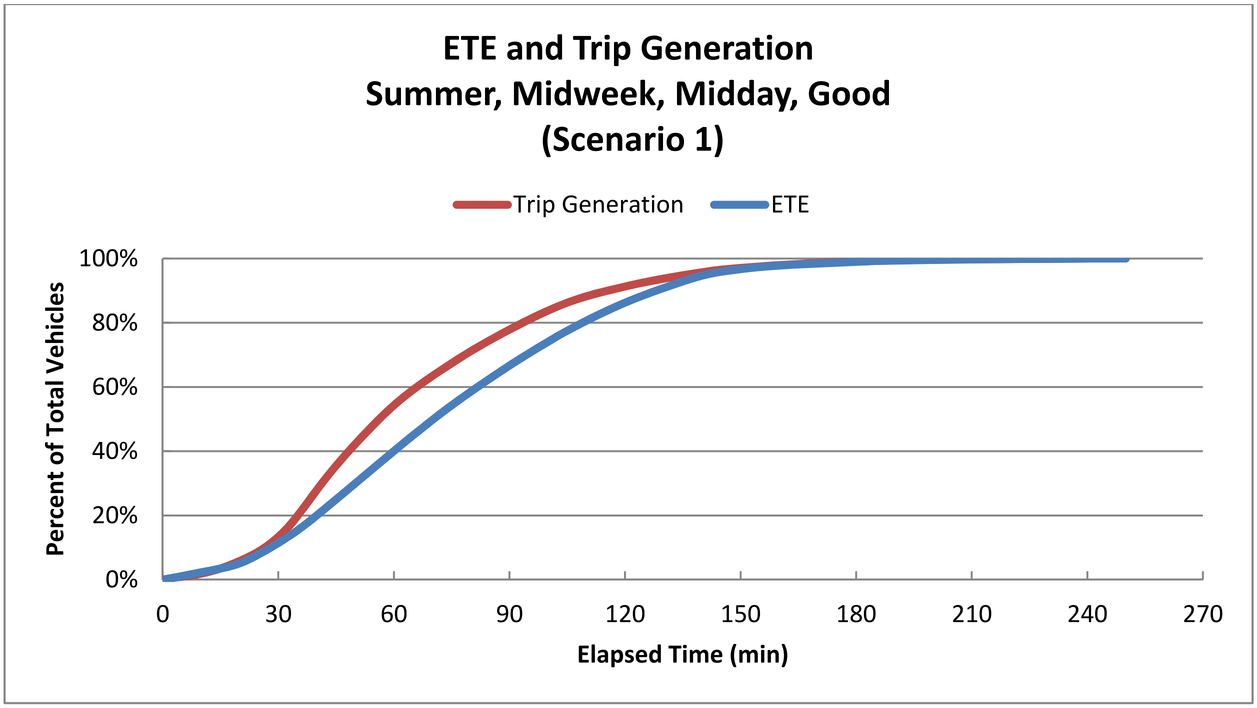


Figure J-1. ETE and Trip Generation: Summer, Midweek, Midday, Good Weather (Scenario 1)

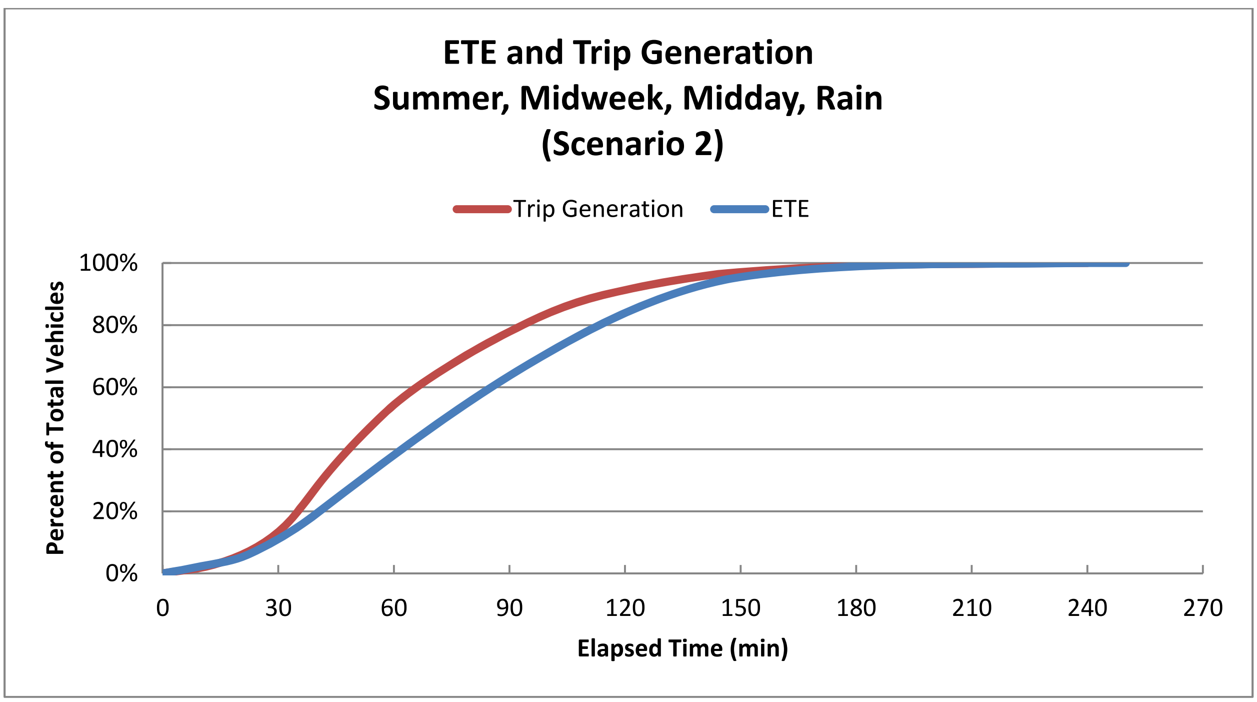


Figure J-2. ETE and Trip Generation: Summer, Midweek, Midday, Rain (Scenario 2)

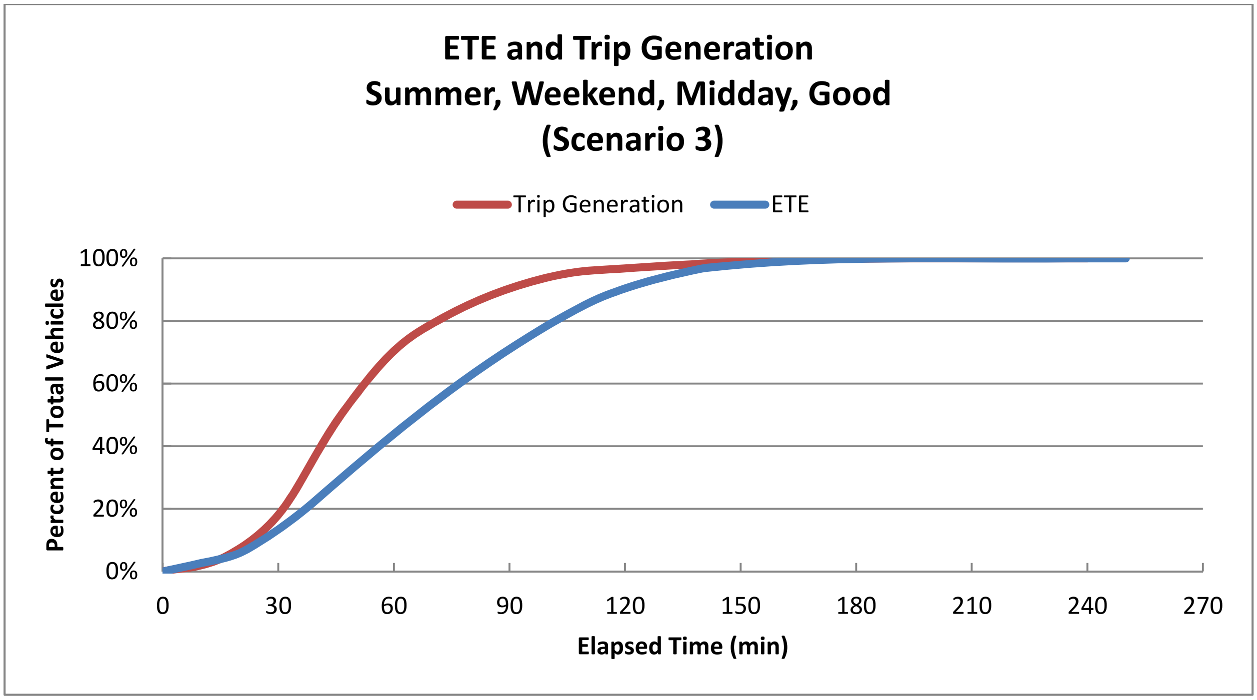


Figure J-3. ETE and Trip Generation: Summer, Weekend, Midday, Good Weather (Scenario 3)

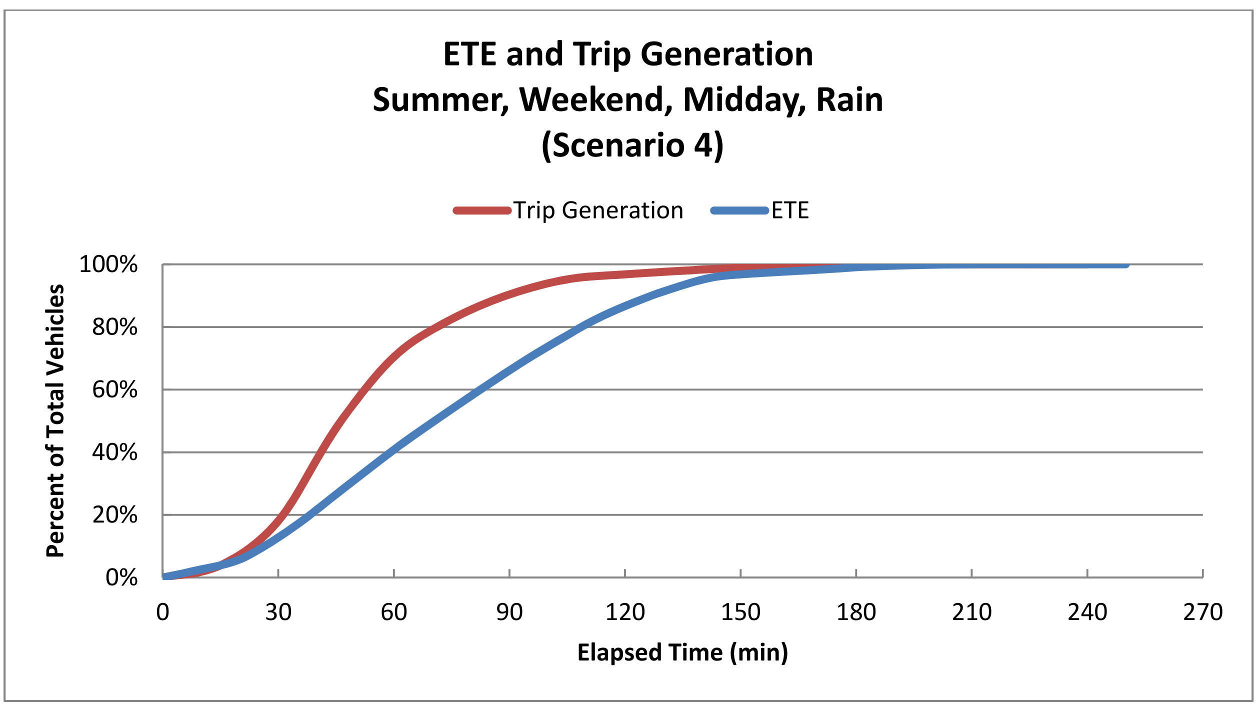


Figure J-4. ETE and Trip Generation: Summer, Weekend, Midday, Rain (Scenario 4)

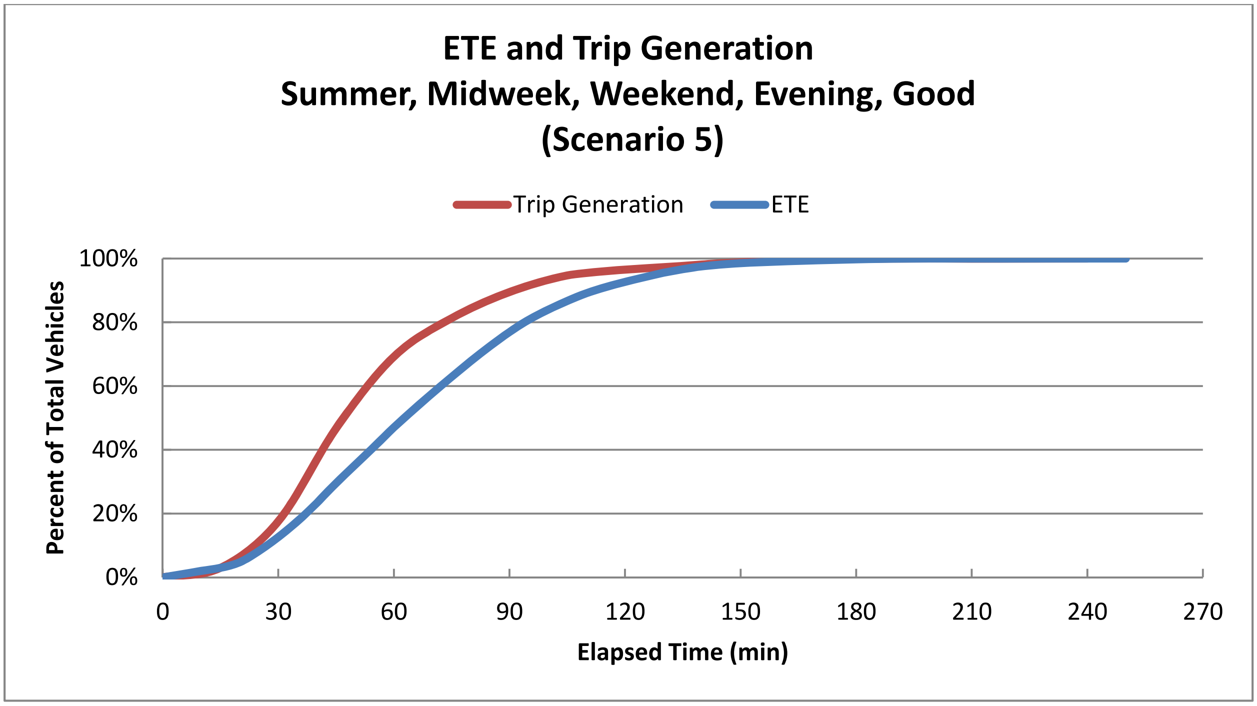


Figure J-5. ETE and Trip Generation: Summer, Midweek, Weekend, Evening, Good Weather (Scenario 5)

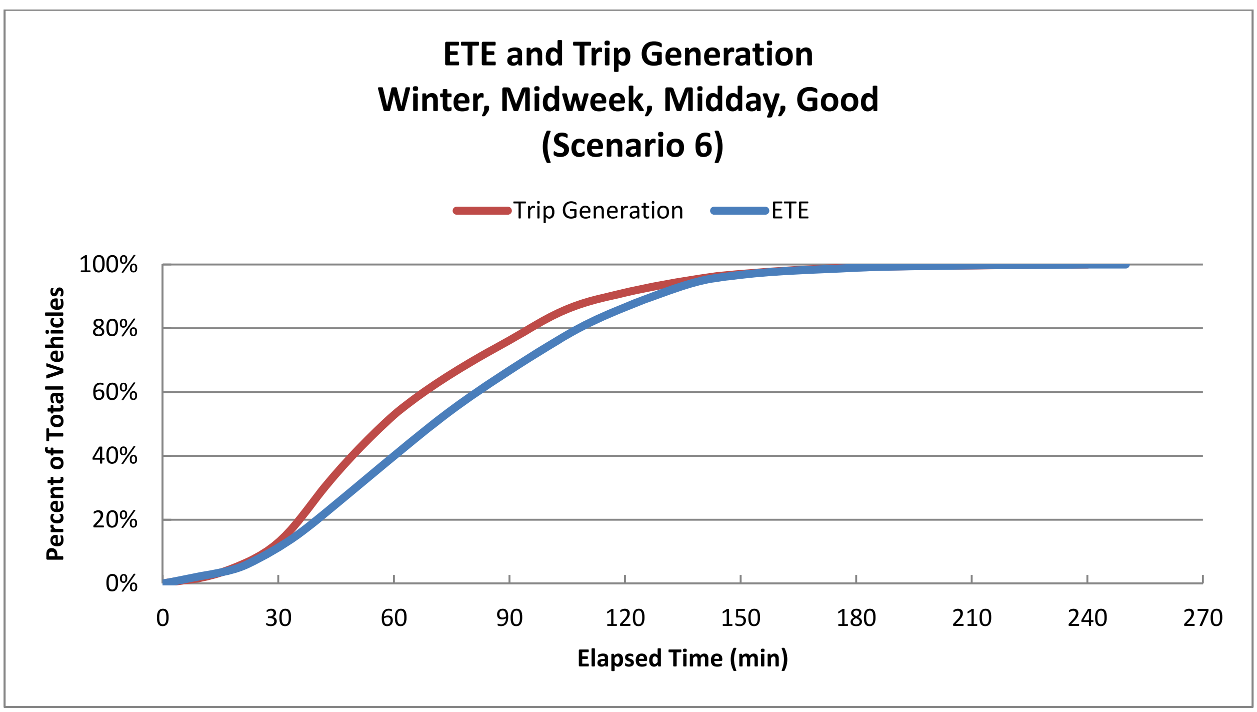


Figure J-6. ETE and Trip Generation: Winter, Midweek, Midday, Good Weather (Scenario 6)

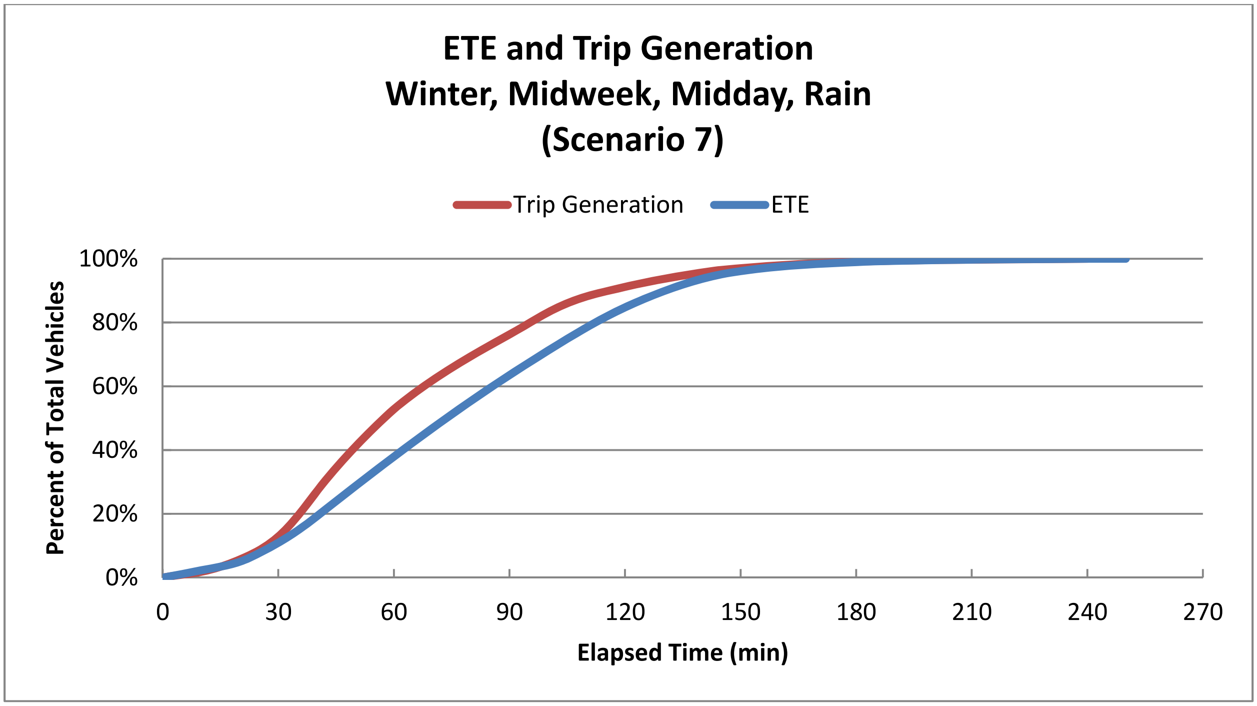


Figure J-7. ETE and Trip Generation: Winter, Midweek, Midday, Rain (Scenario 7)

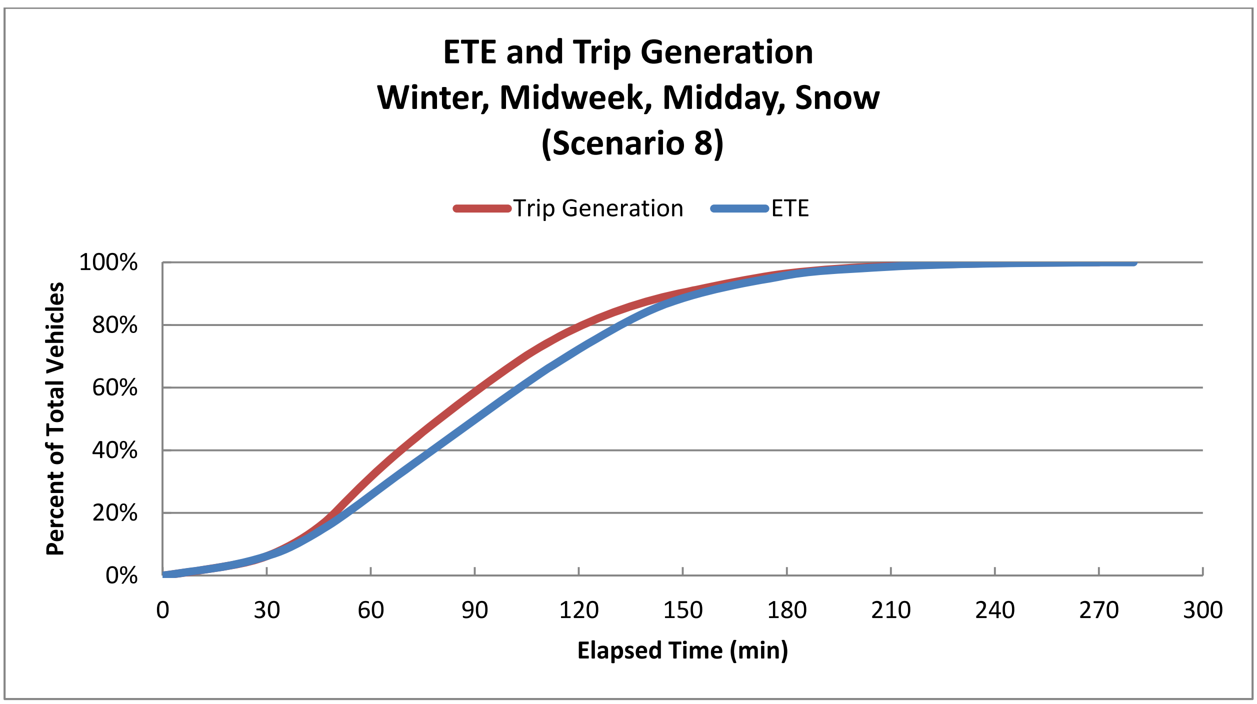


Figure J-8. ETE and Trip Generation: Winter, Midweek, Midday, Snow (Scenario 8)

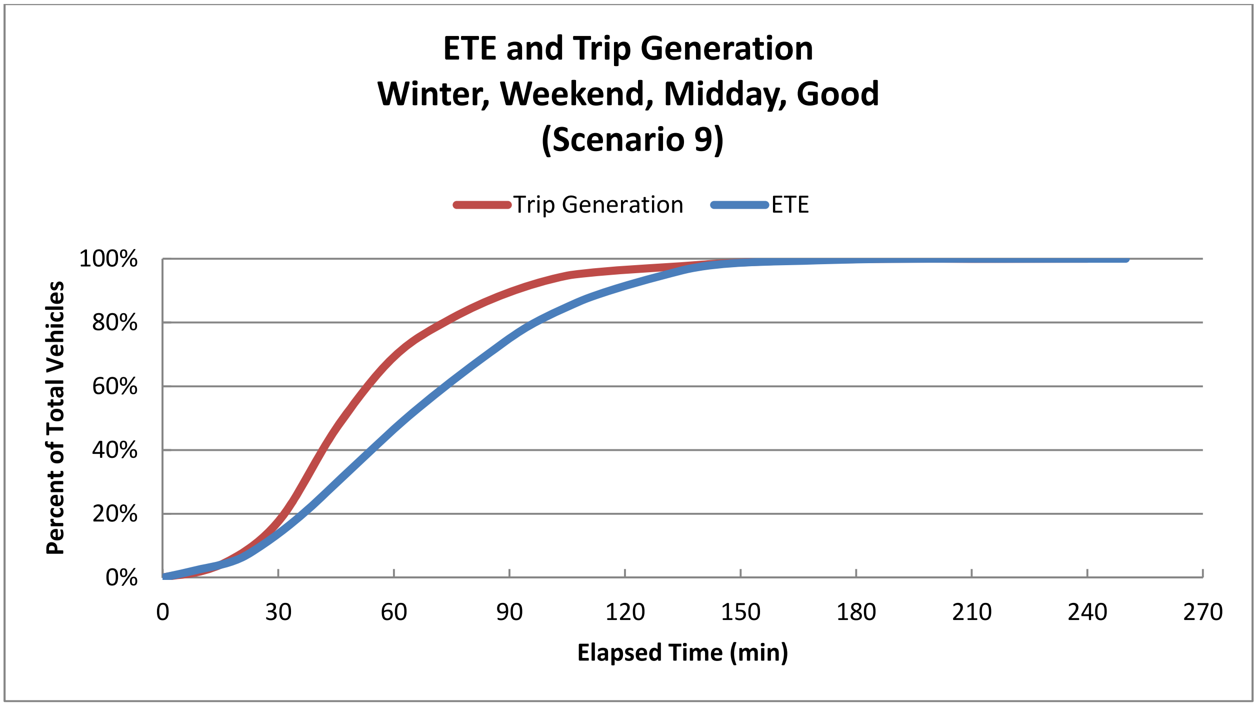


Figure J-9. ETE and Trip Generation: Winter, Weekend, Midday, Good Weather (Scenario 9)

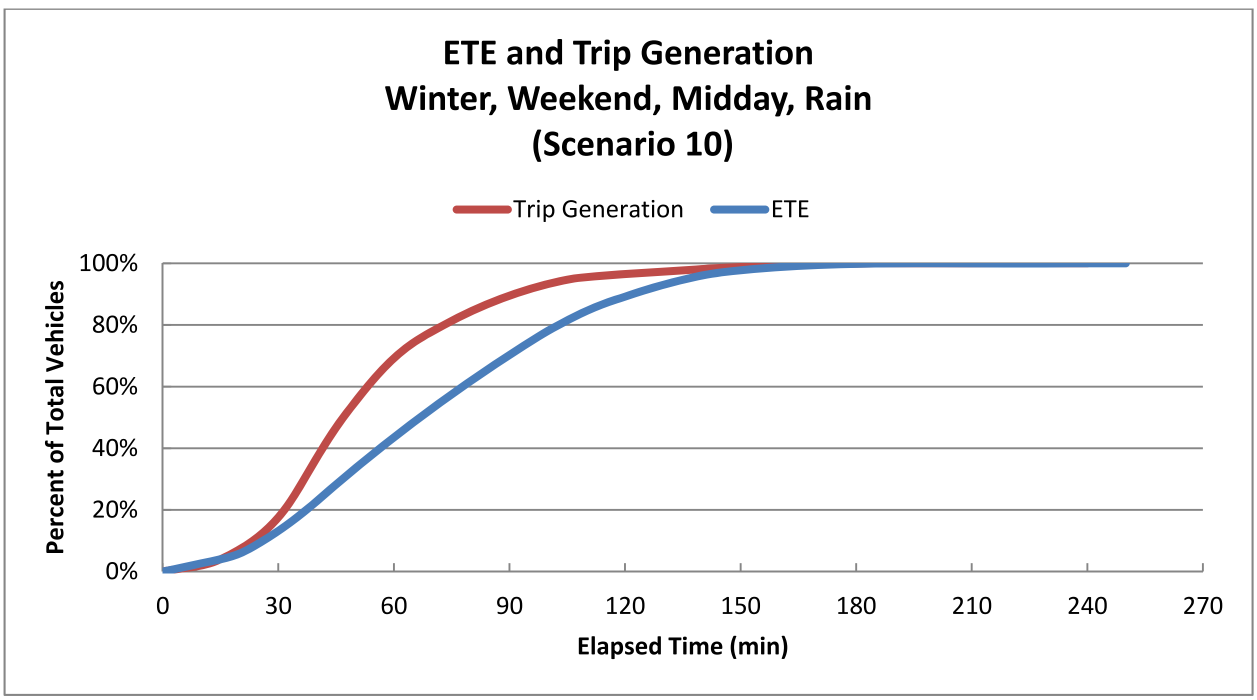


Figure J-10. ETE and Trip Generation: Winter, Weekend, Midday, Rain (Scenario 10)

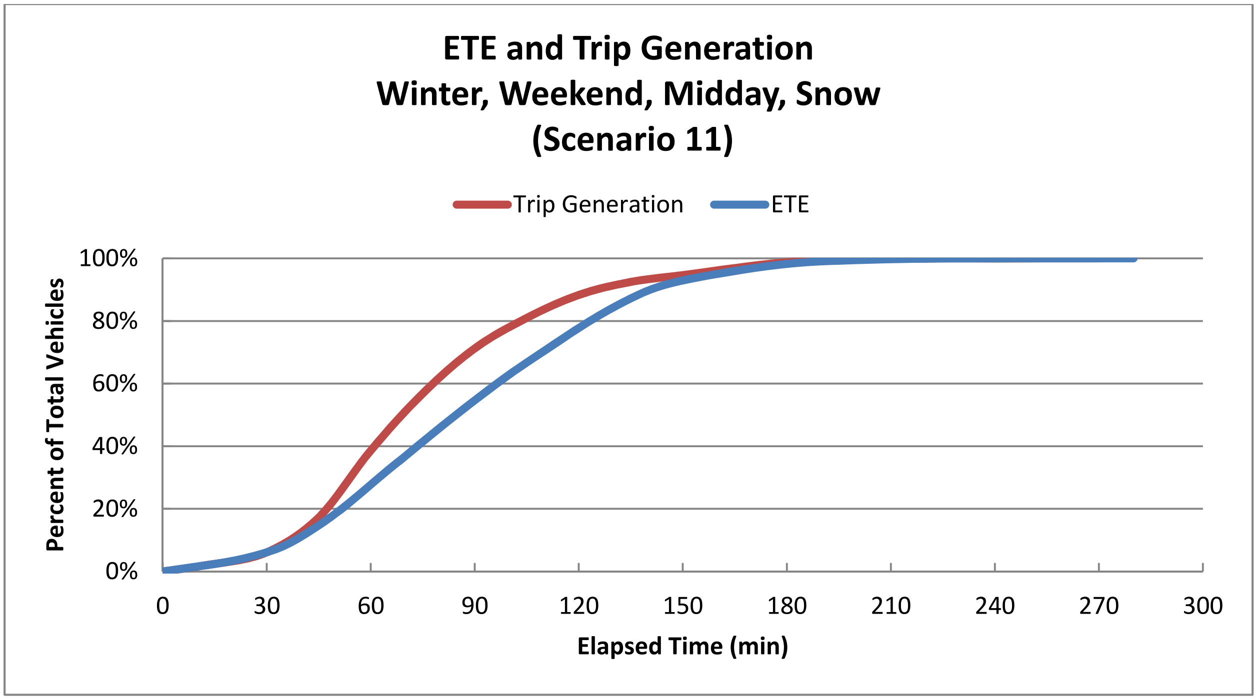


Figure J-11. ETE and Trip Generation: Winter, Weekend, Midday, Snow (Scenario 11)

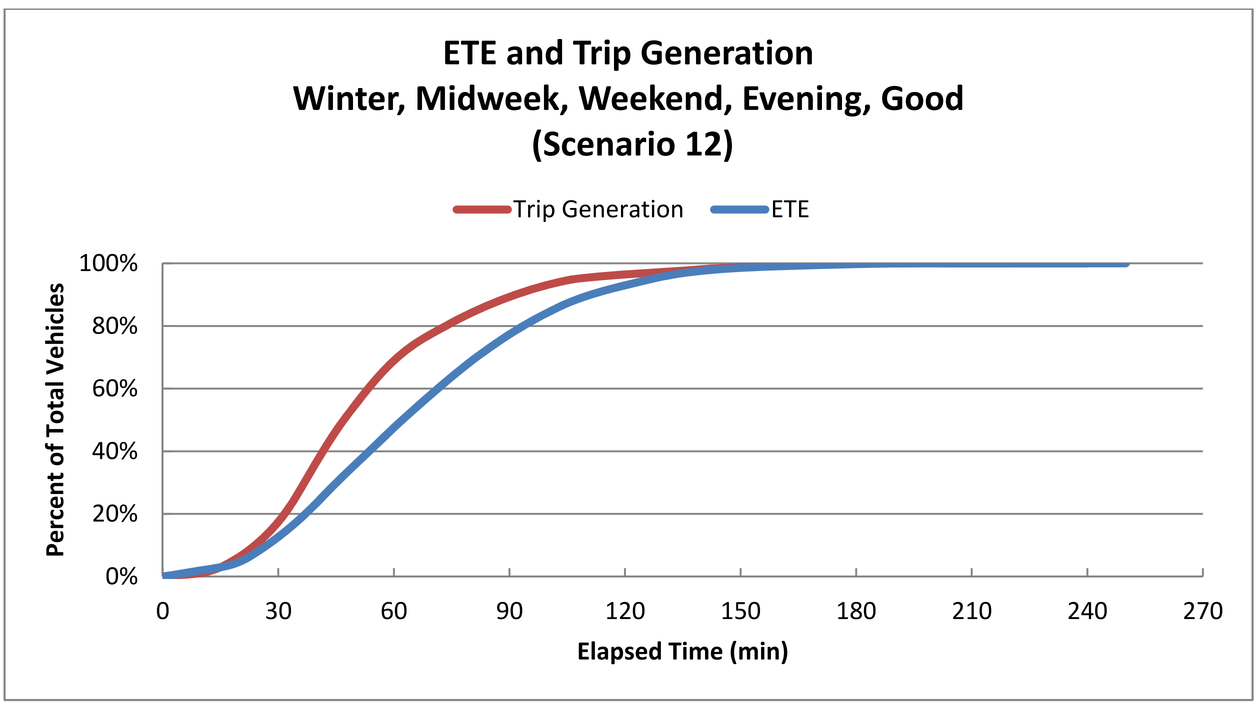


Figure J-12. ETE and Trip Generation: Winter, Midweek, Weekend, Evening, Good Weather (Scenario 12)

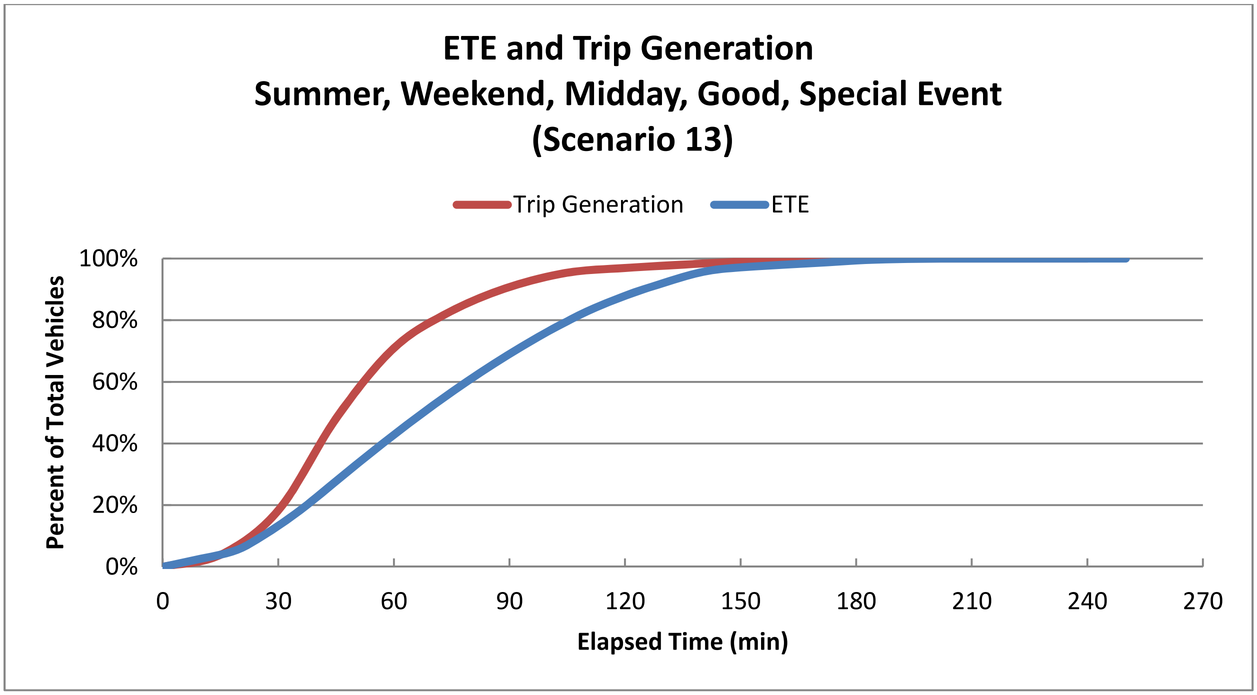


Figure J-13. ETE and Trip Generation: Summer, Weekend, Midday, Good Weather, Special Event (Scenario 13)

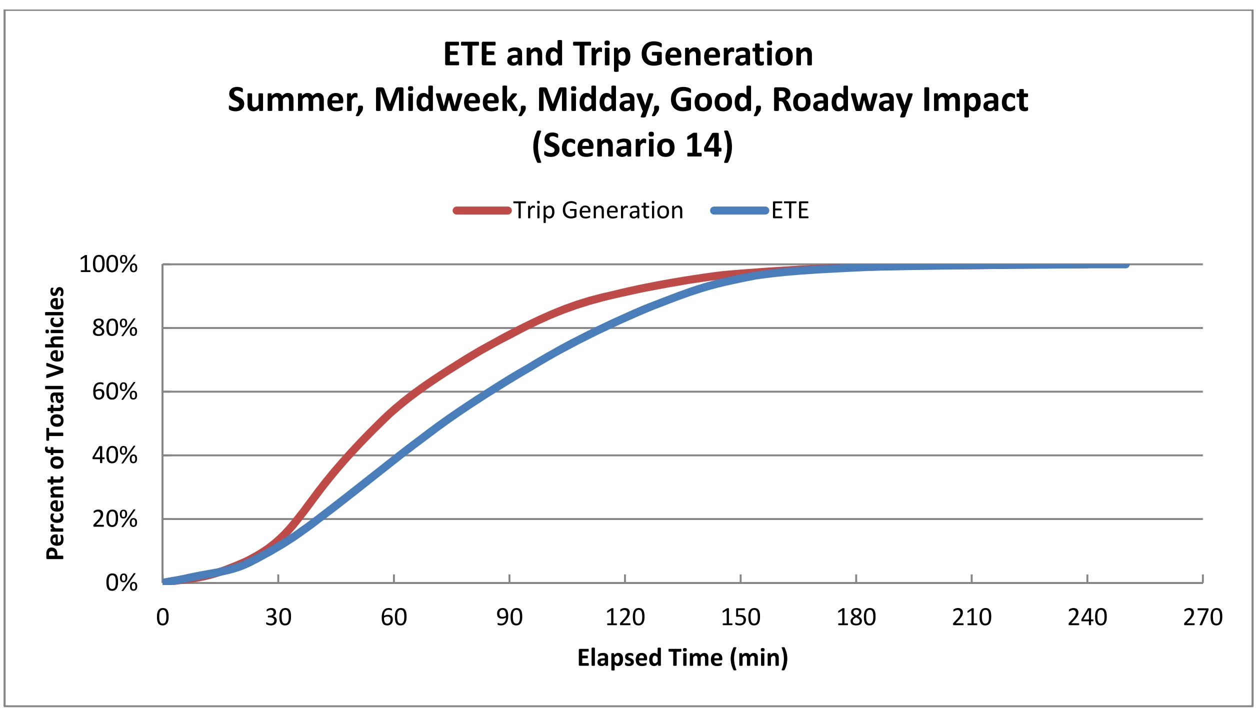


Figure J-14. ETE and Trip Generation: Summer, Midweek, Midday, Good Weather, Roadway Impact (Scenario 14)

APPENDIX K

Evacuation Roadway Network

K. EVACUATION ROADWAY NETWORK

As discussed in Section 1.3, a link-node analysis network was constructed to model the roadway network within the study area. Figure K-1 provides an overview of the link-node analysis network. The figure has been divided up into 46 more detailed figures (Figure K-2 through Figure K-23) which show each of the links and nodes in the network.

The analysis network was calibrated using the observations made during the field survey conducted in January 2012. Table K-1 lists the characteristics of each roadway section modeled in the ETE analysis. Each link is identified by its road name and the upstream and downstream node numbers. The geographic location of each link can be observed by referencing the grid map number provided in Table K-1. The roadway type identified in Table K-1 is based on the following criteria:

- Freeway: limited access highway, 2 or more lanes in each direction, high free flow speeds
- Freeway ramp: ramp on to or off of a limited access highway
- Major arterial: 3 or more lanes in each direction
- Minor arterial: 2 or more lanes in each direction
- Collector: single lane in each direction
- Local roadways: single lane in each direction, local roads with low free flow speeds

The term, "No. of Lanes" in Table K-1 identifies the number of lanes that extend throughout the length of the link. Many links have additional lanes on the immediate approach to an intersection (turn pockets); these have been recorded and entered into the input stream for the DYNEV II System.

As discussed in Section 1.3, lane width and shoulder width were not physically measured during the road survey. Rather, estimates of these measures were based on visual observations and recorded images.

Table K-2 identifies each node in the network that is controlled and the type of control (stop sign, yield sign, pre-timed signal, actuated signal, traffic control point) at that node. Uncontrolled nodes are not included in Table K-2. The location of each node can be observed by referencing the grid map number provided.

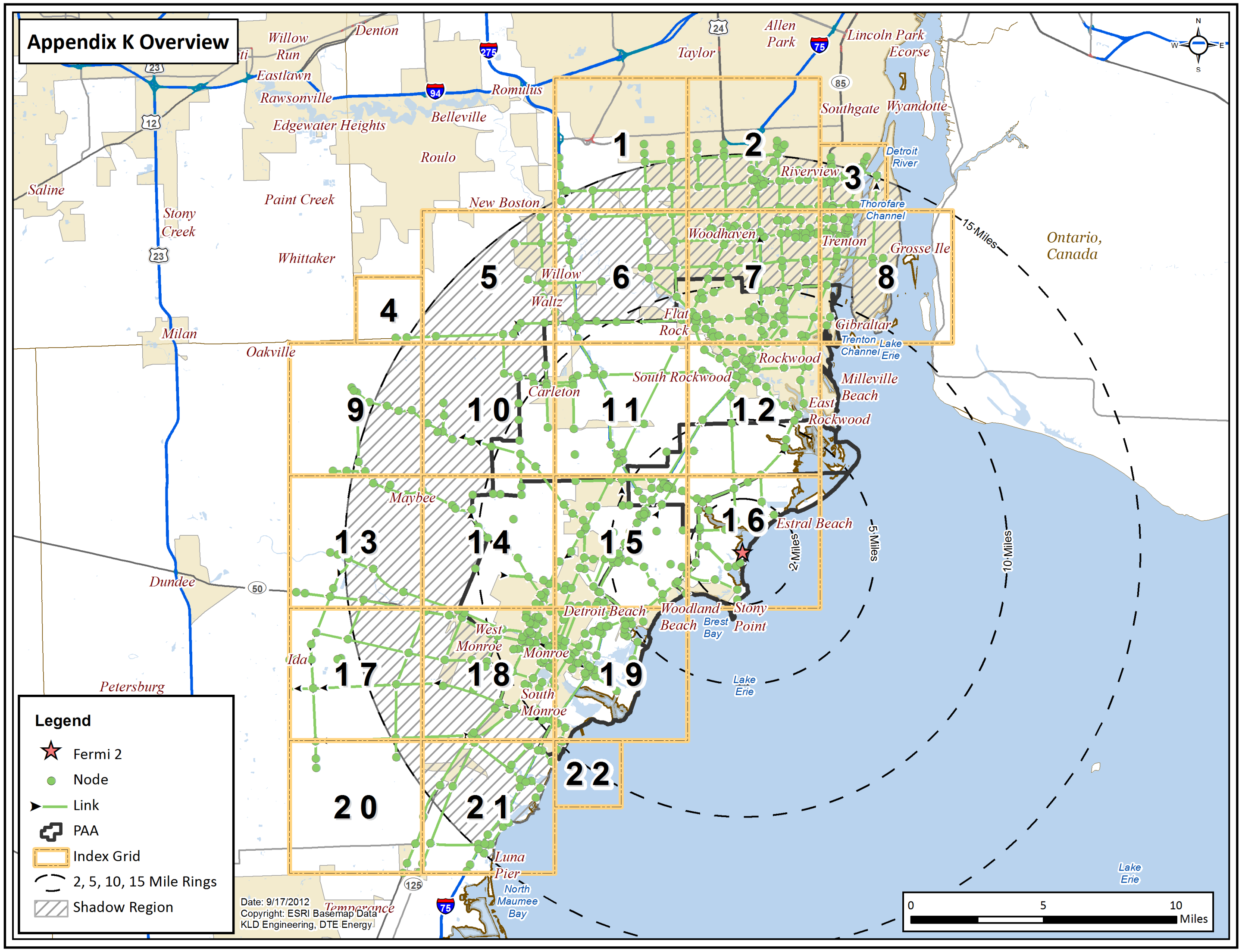


Figure K-1. FNPP Link-Node Analysis Network

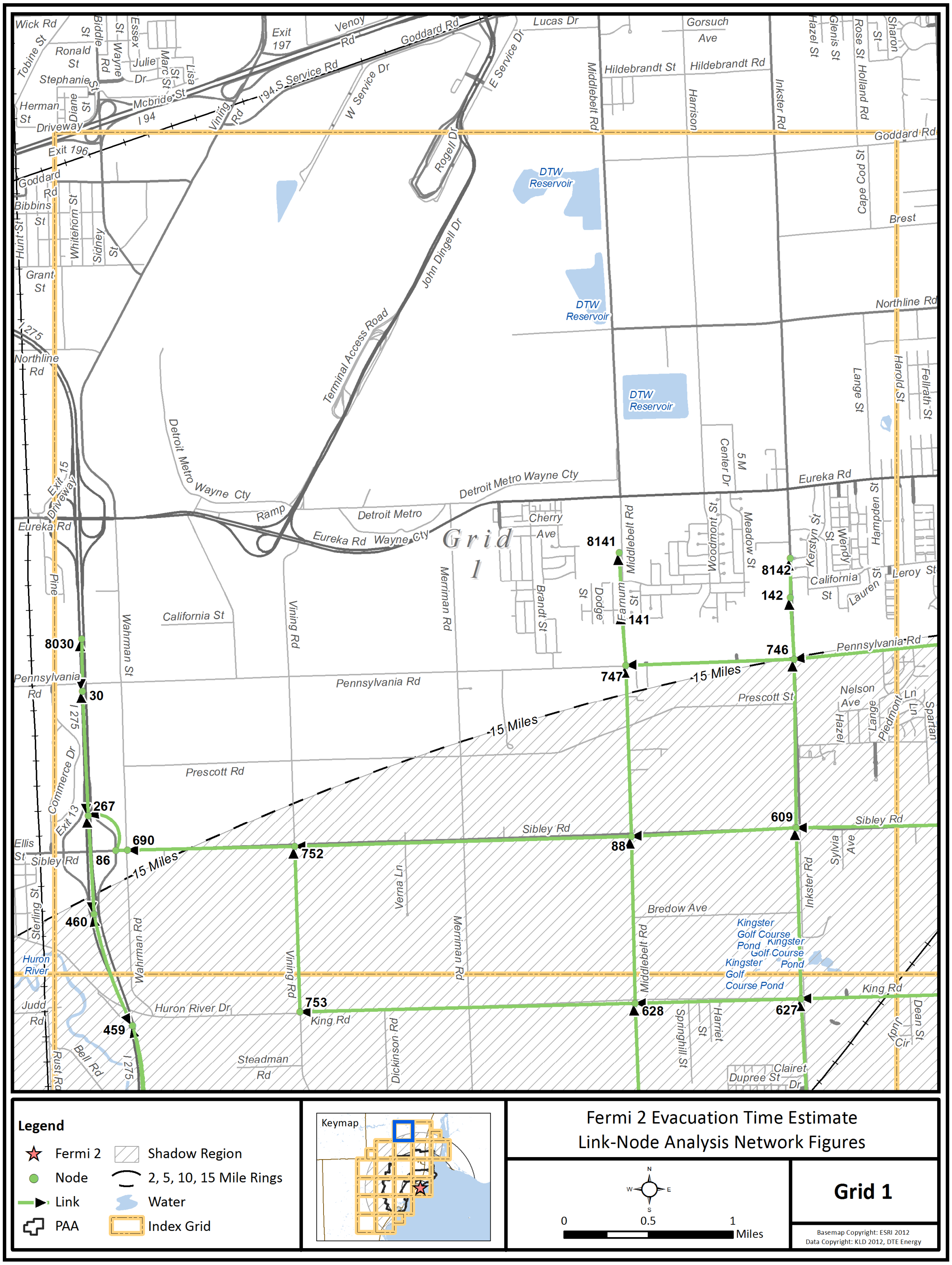


Figure K-2. Link-Node Analysis Network – Grid 1

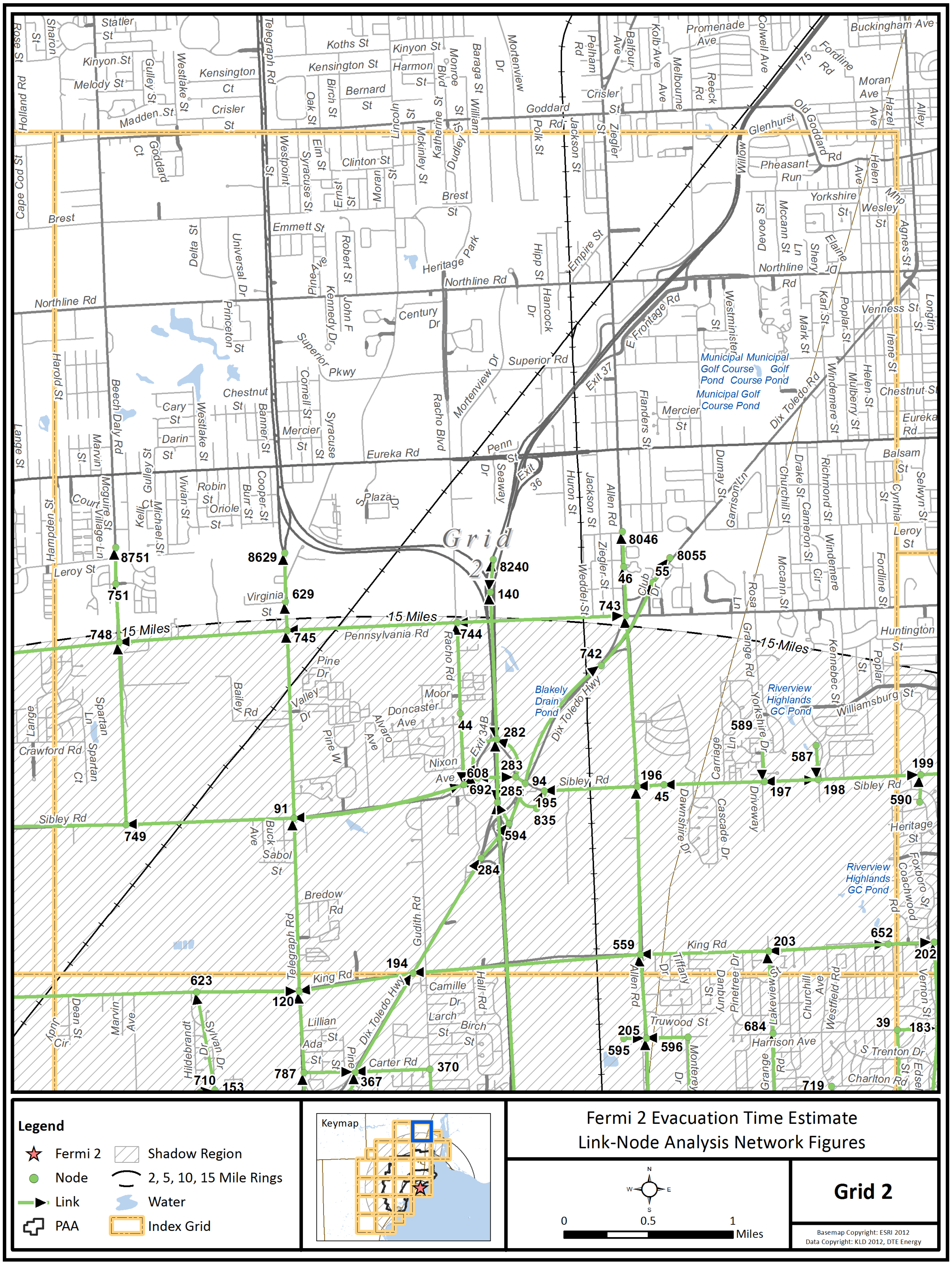


Figure K-3. Link-Node Analysis Network – Grid 2

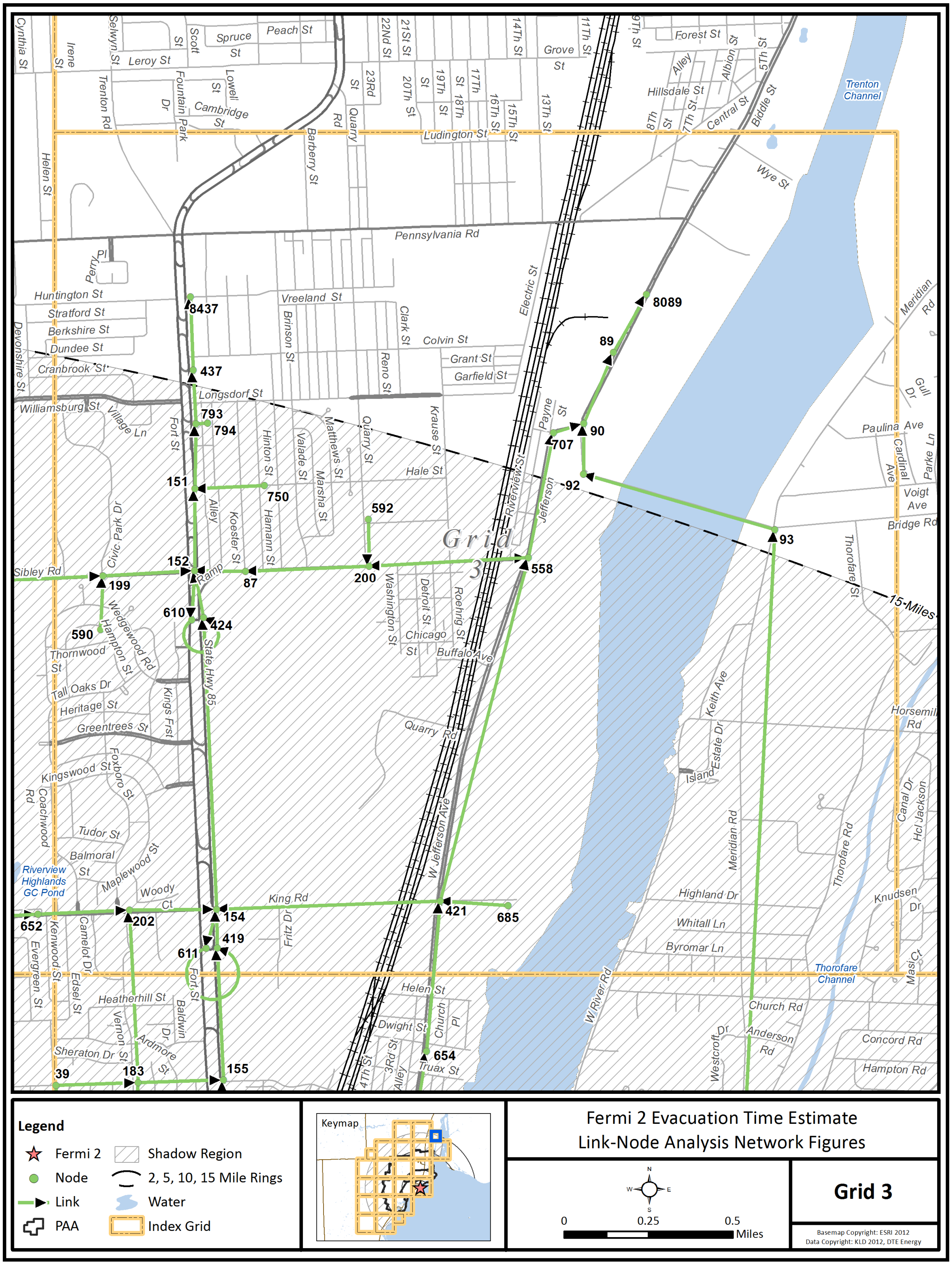


Figure K-4. Link-Node Analysis Network – Grid 3

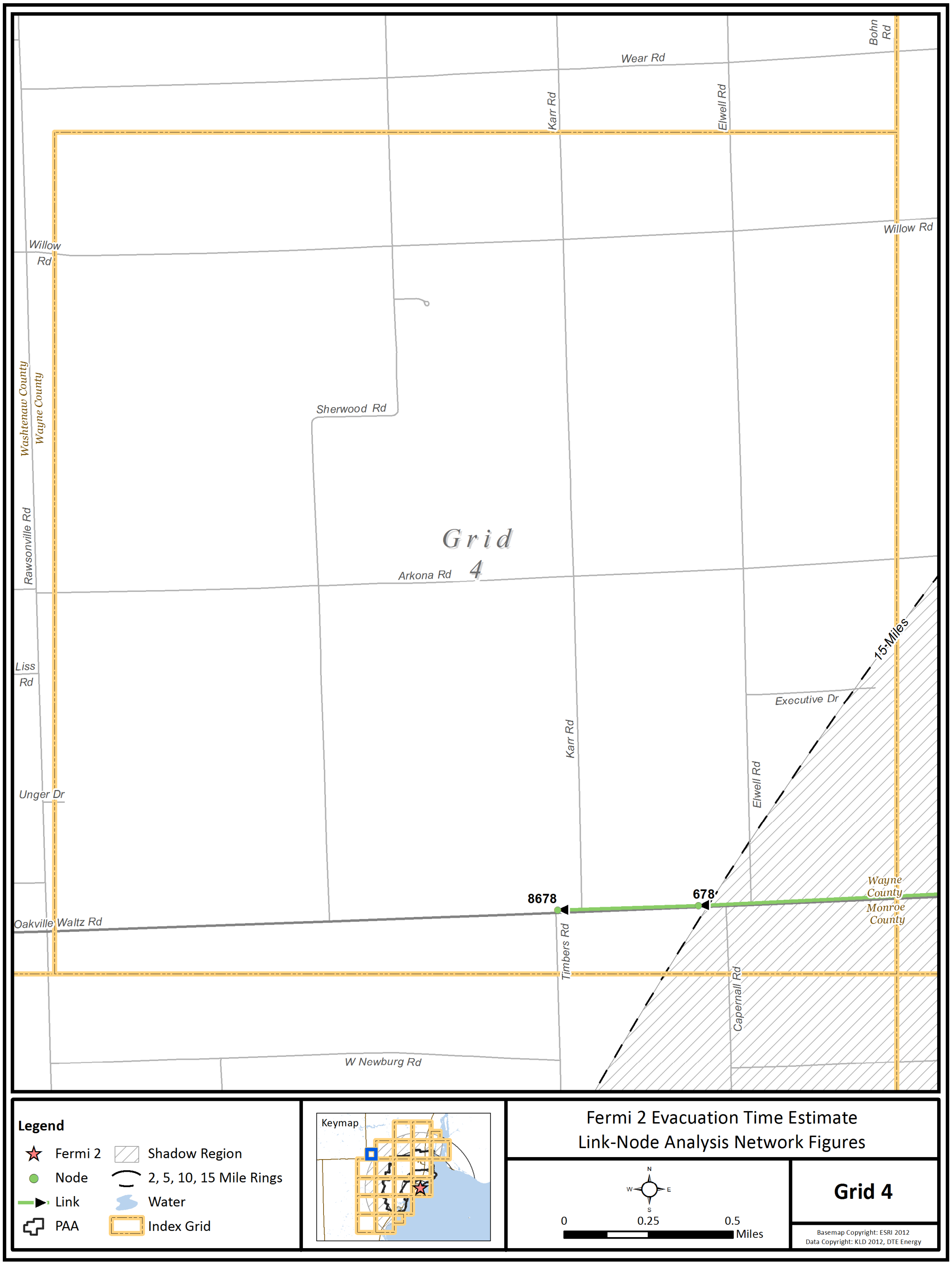


Figure K-5. Link-Node Analysis Network – Grid 4

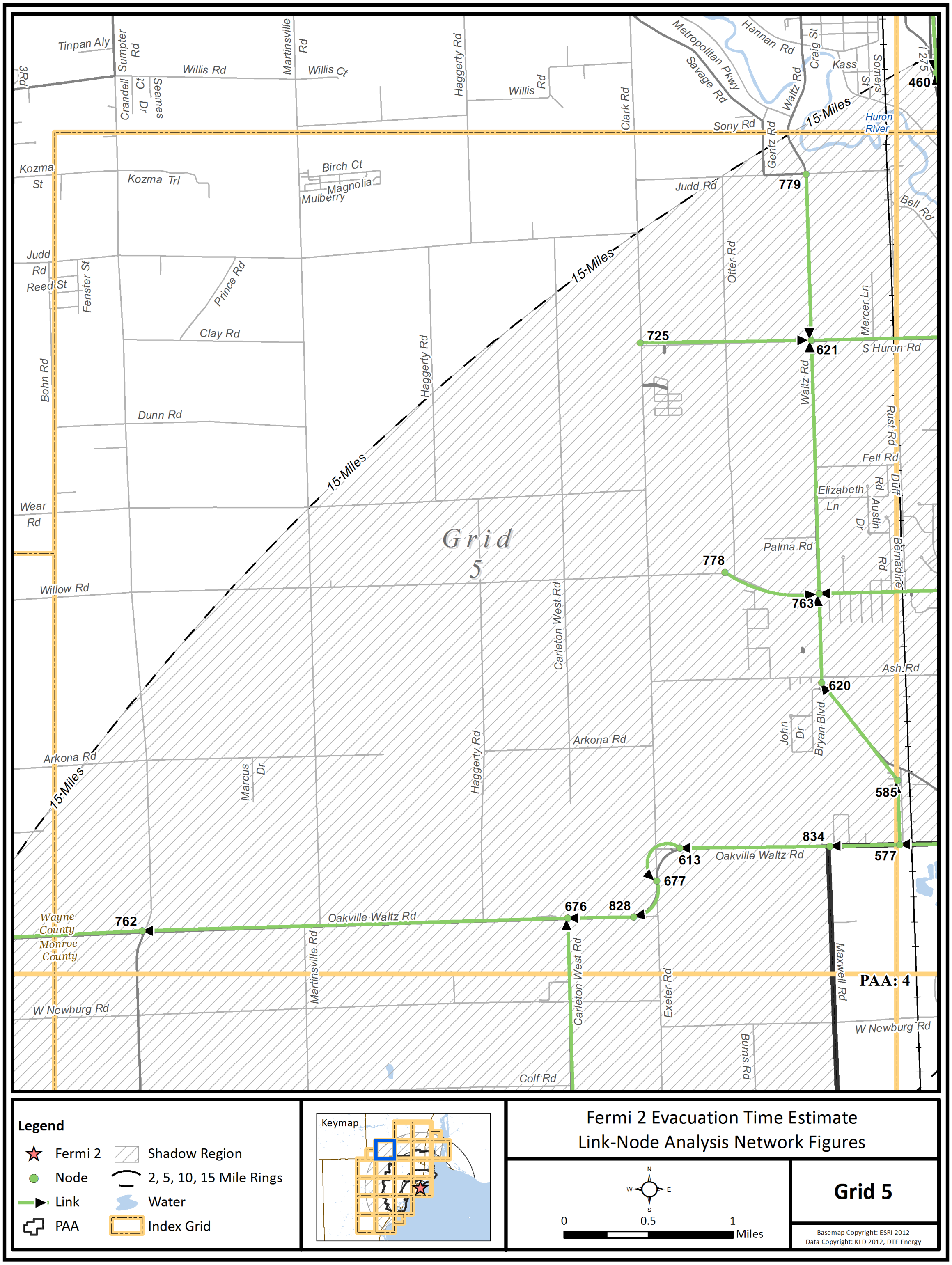


Figure K-6. Link-Node Analysis Network – Grid 5

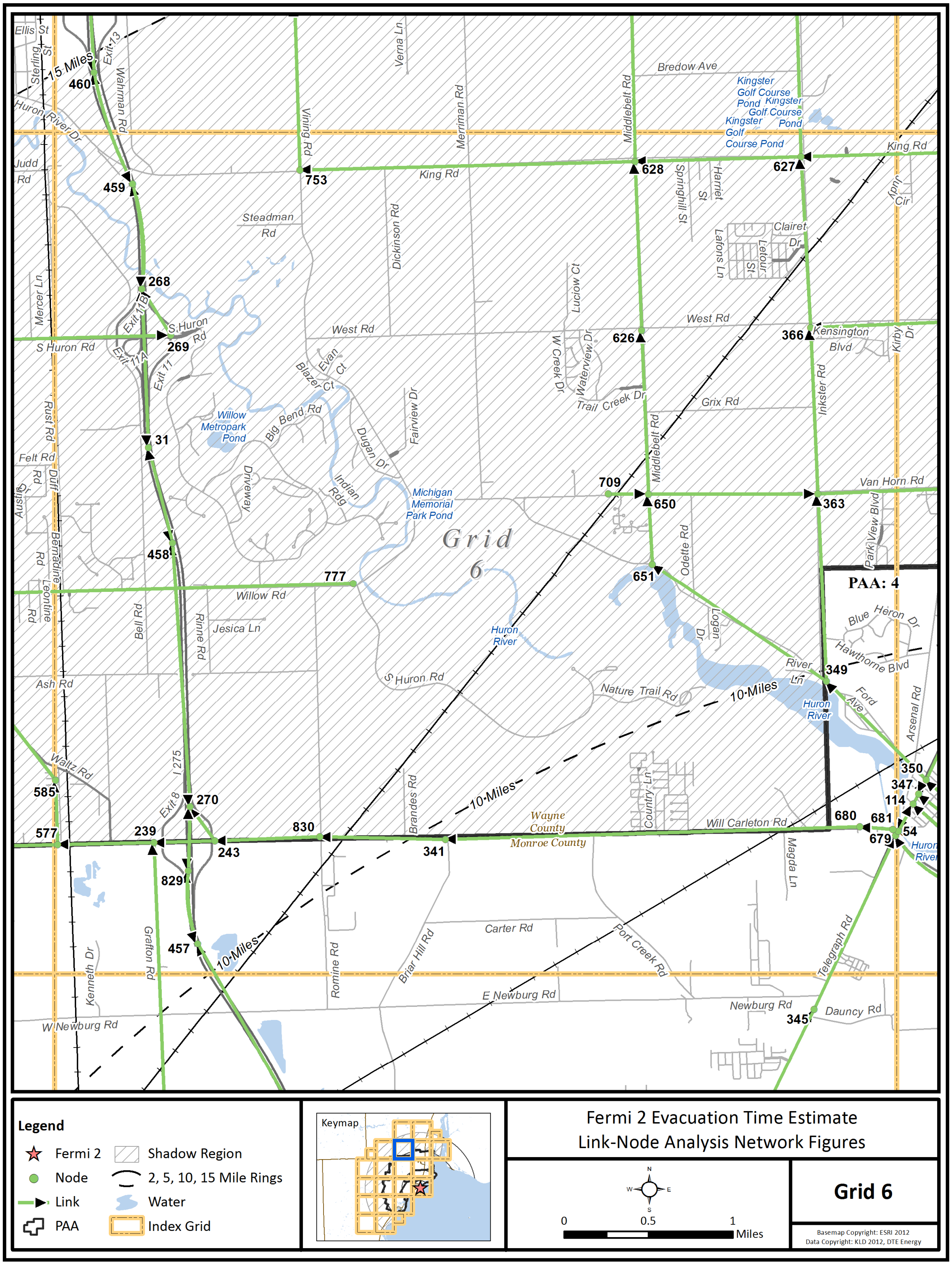


Figure K-7. Link-Node Analysis Network – Grid 6

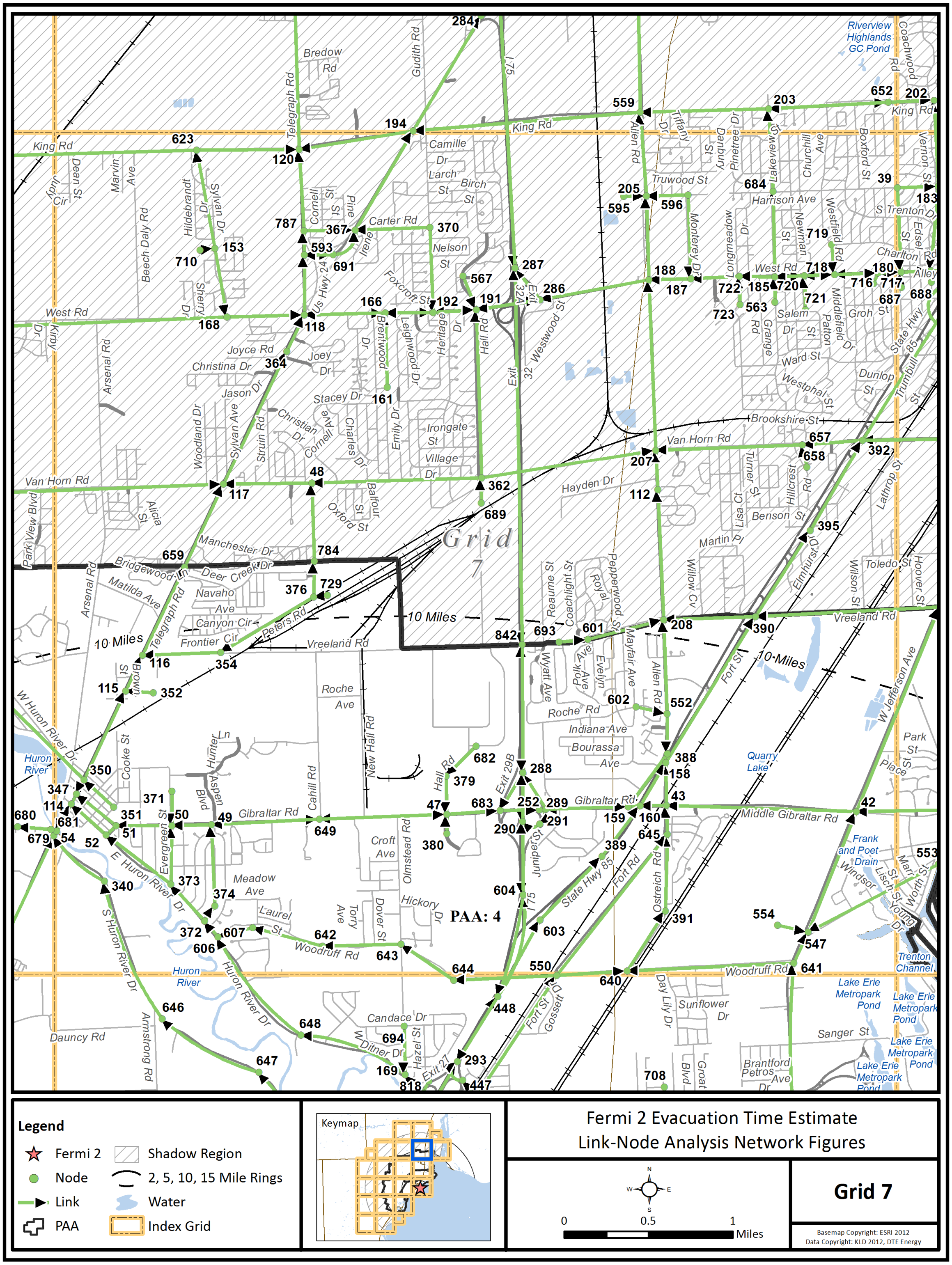


Figure K-8. Link-Node Analysis Network – Grid 7

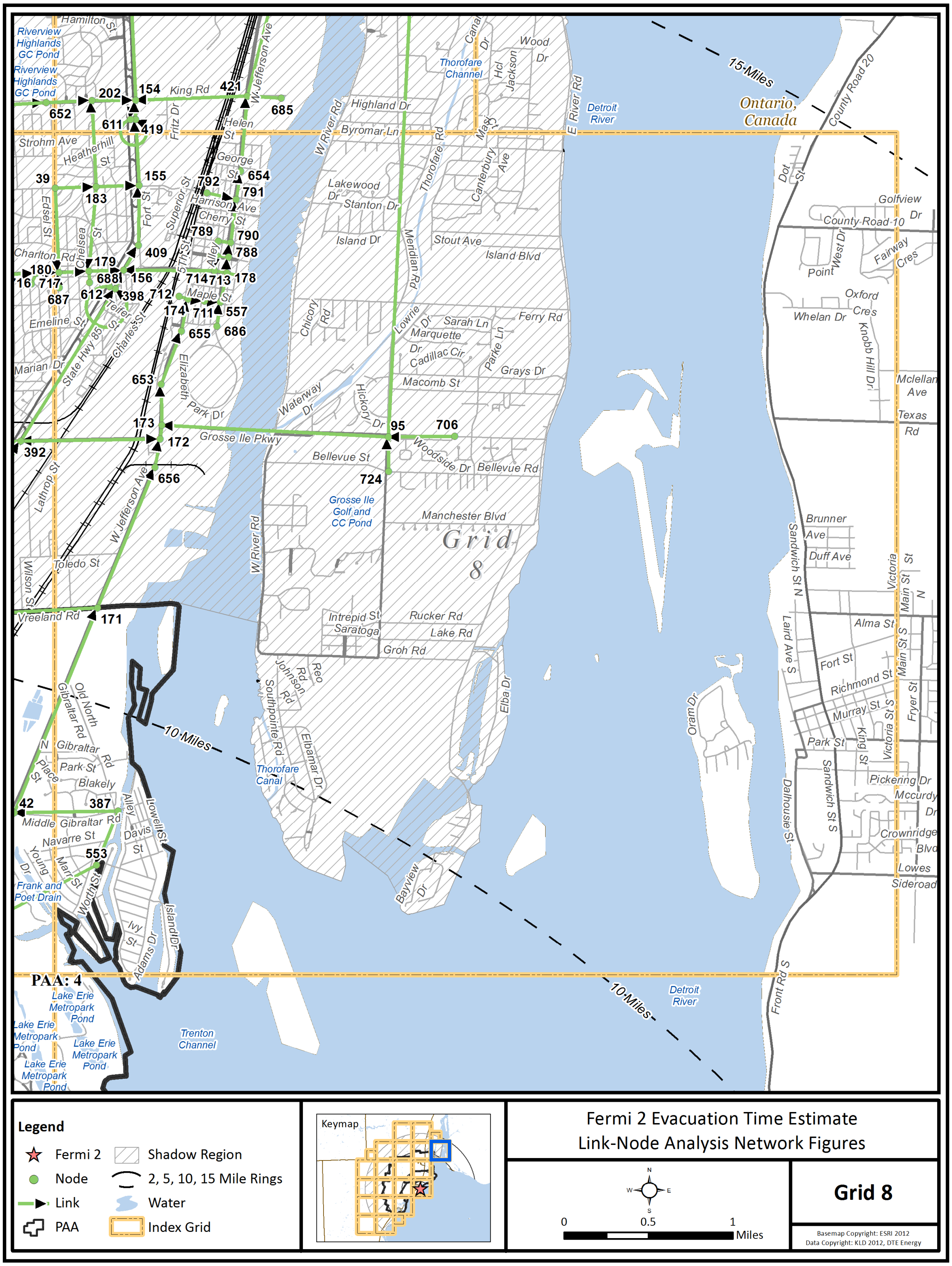


Figure K-9. Link-Node Analysis Network – Grid 8

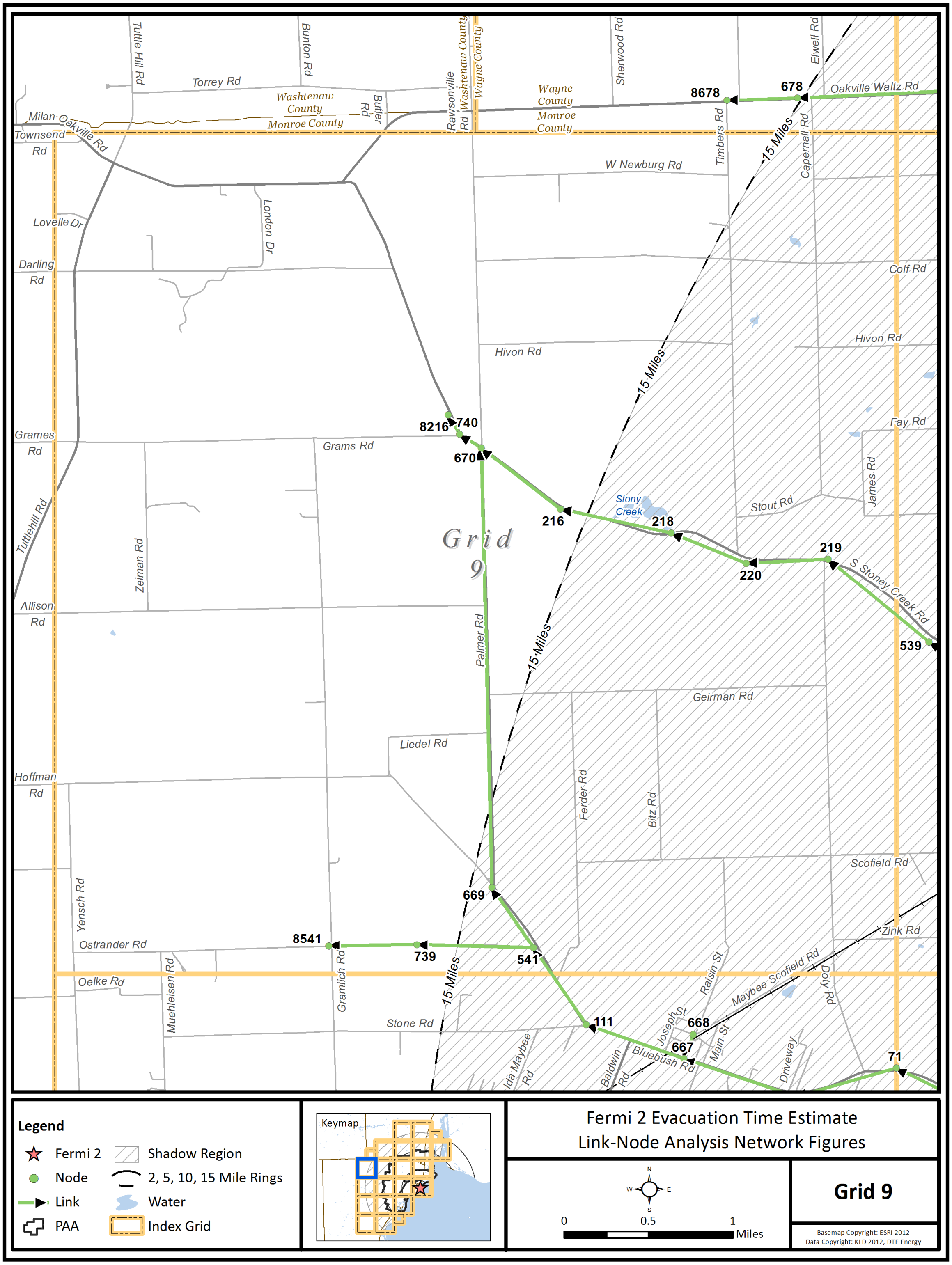


Figure K-10. Link-Node Analysis Network – Grid 9

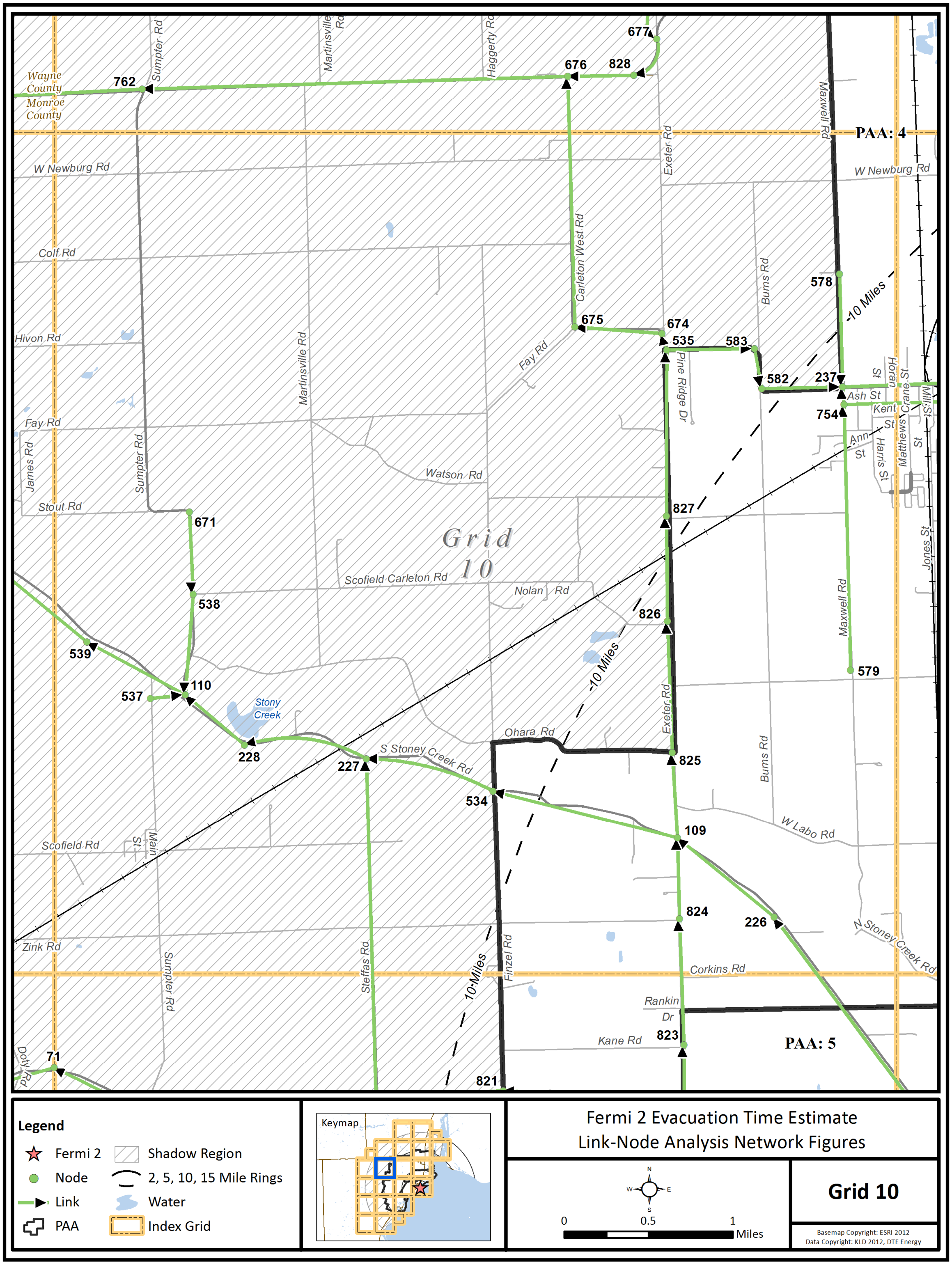


Figure K-11. Link-Node Analysis Network – Grid 10

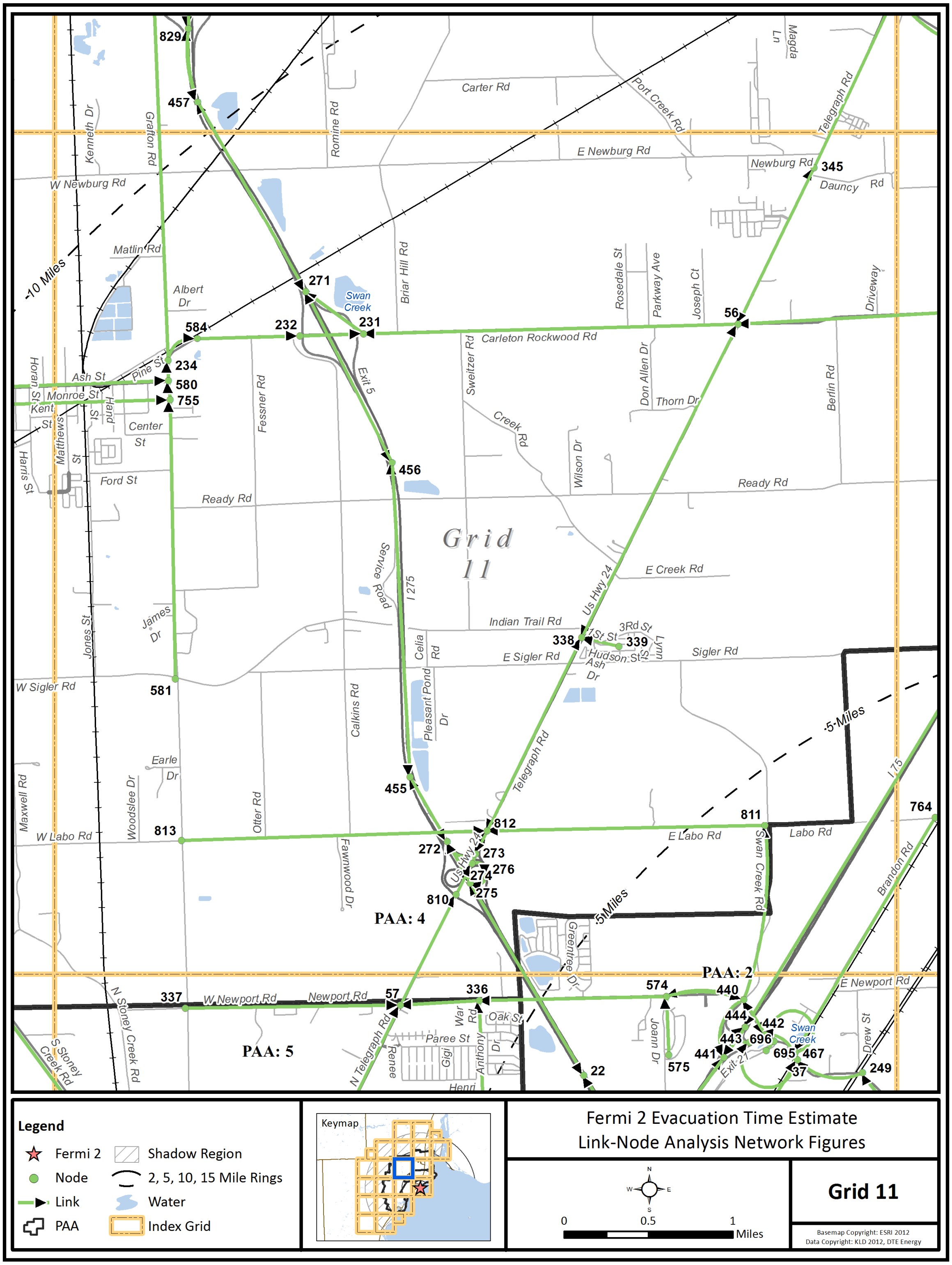


Figure K-12. Link-Node Analysis Network – Grid 11

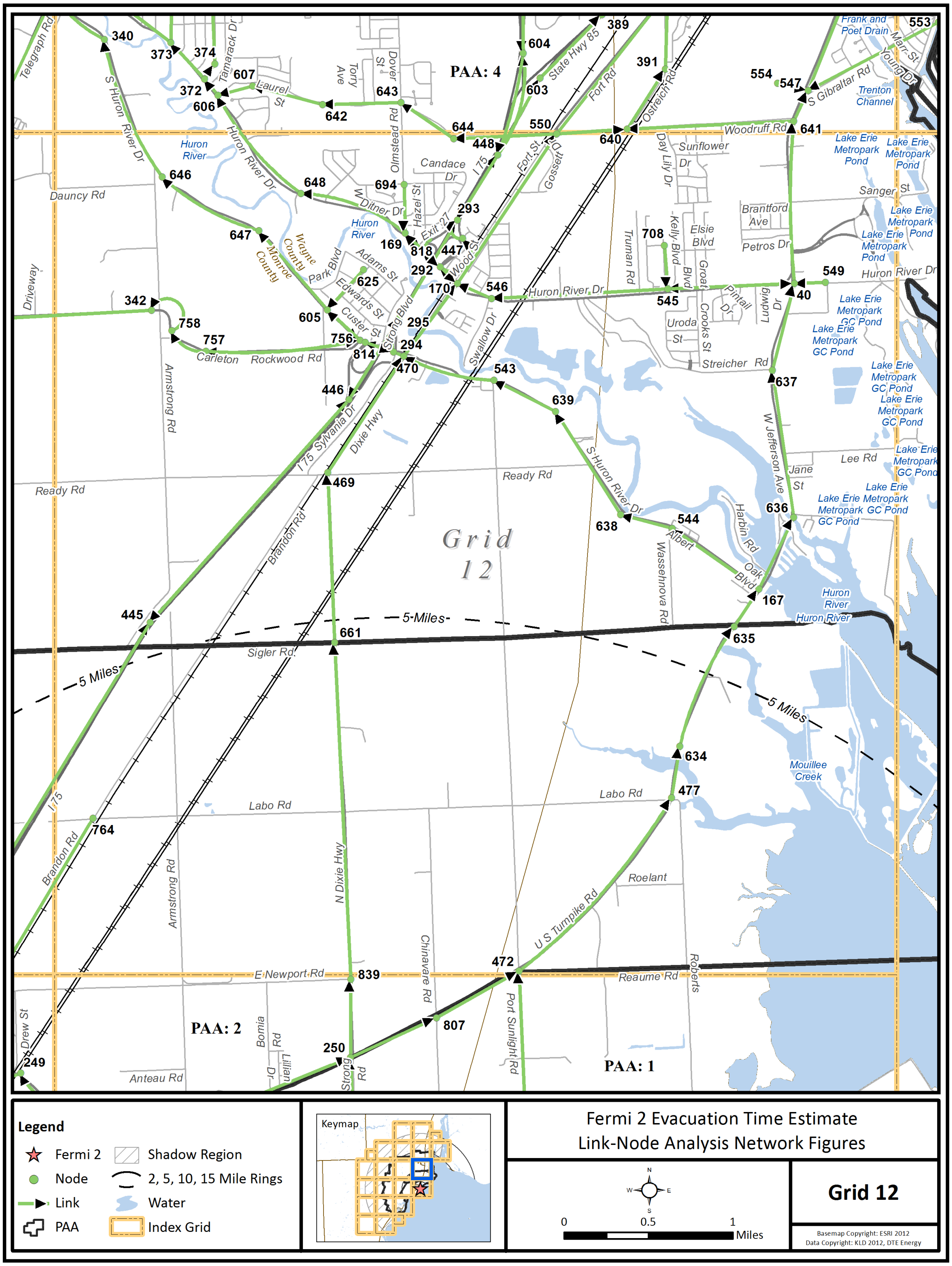


Figure K-13. Link-Node Analysis Network – Grid 12

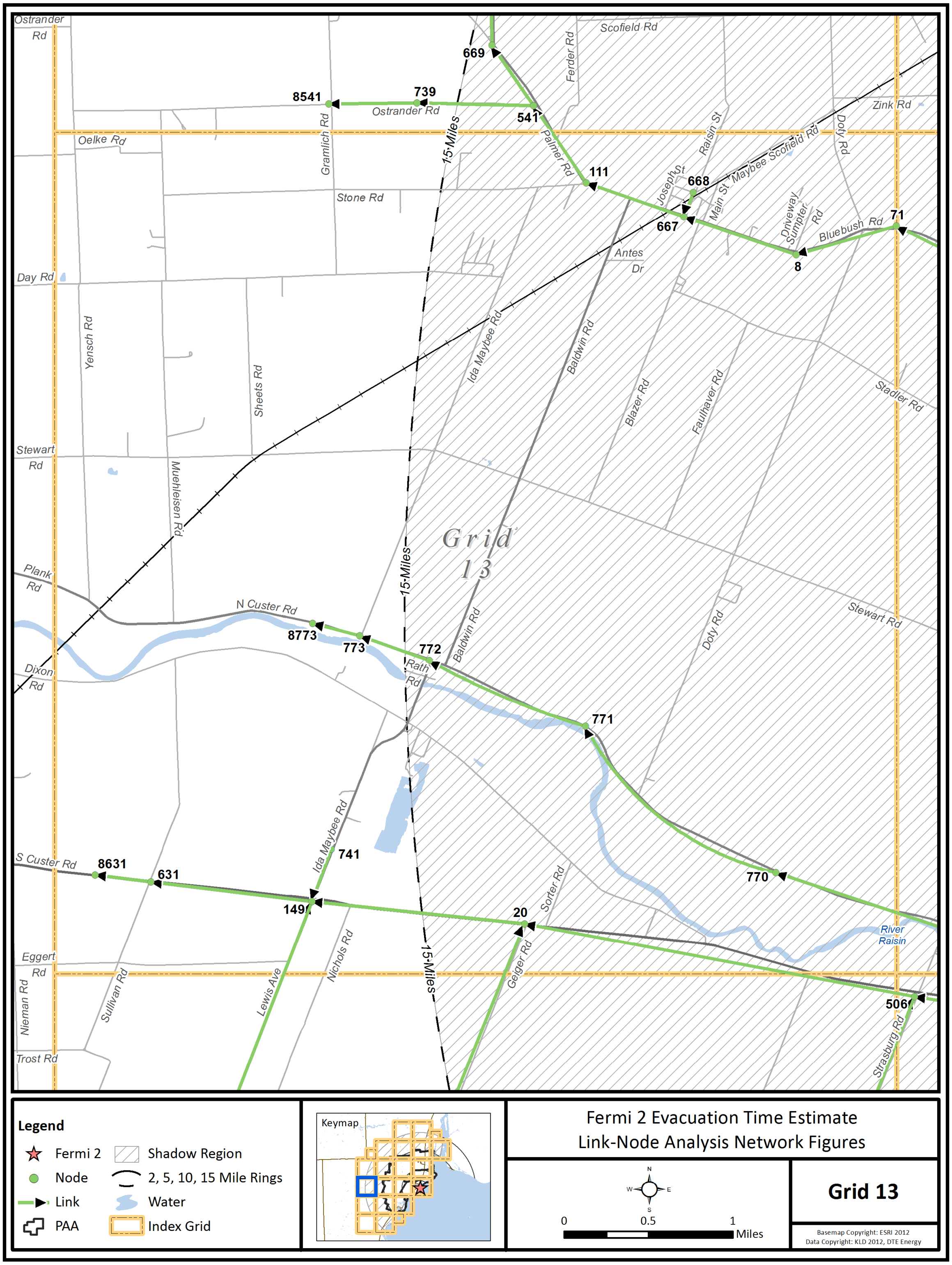


Figure K-14. Link-Node Analysis Network – Grid 13

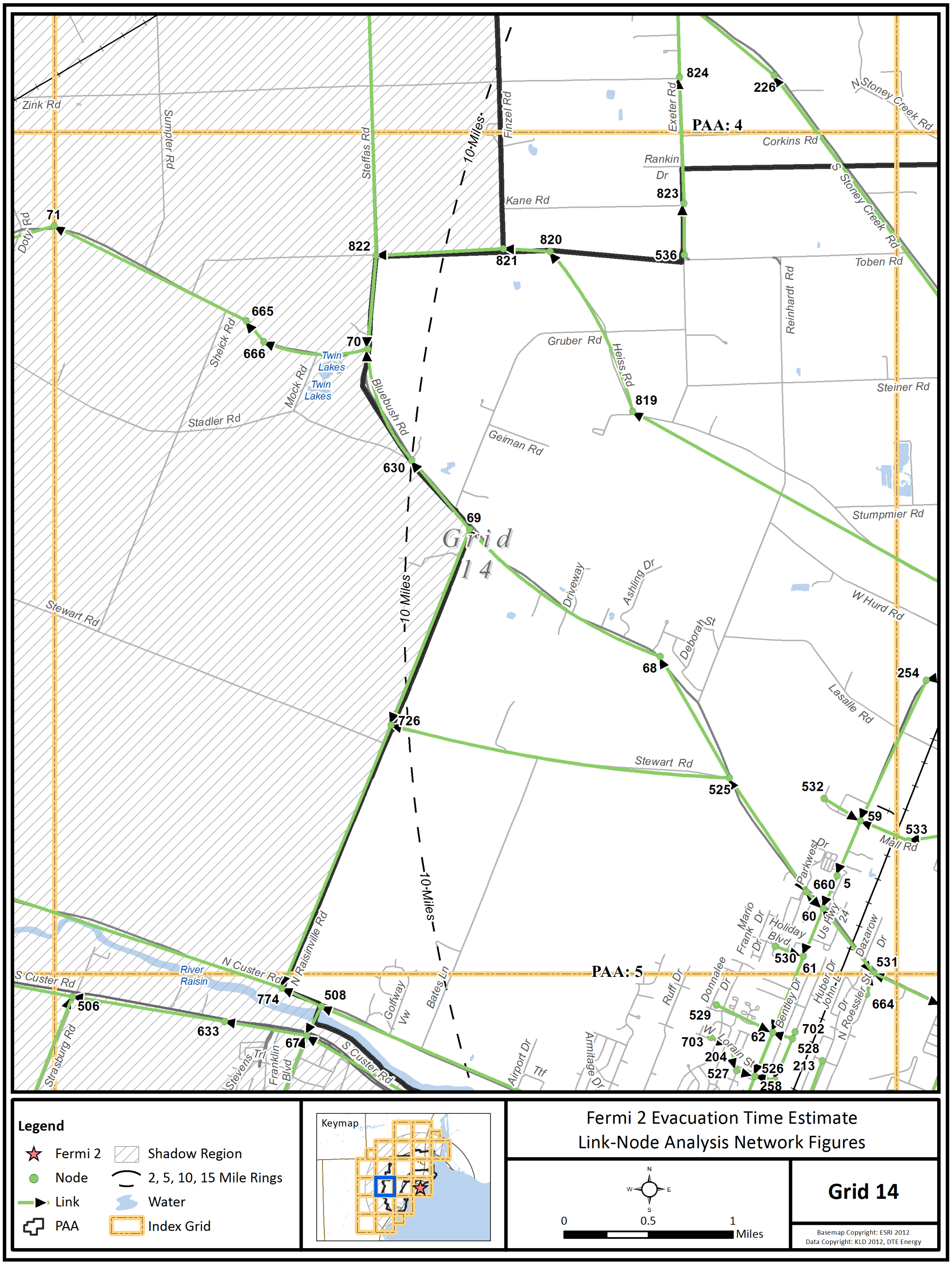


Figure K-15. Link-Node Analysis Network – Grid 14

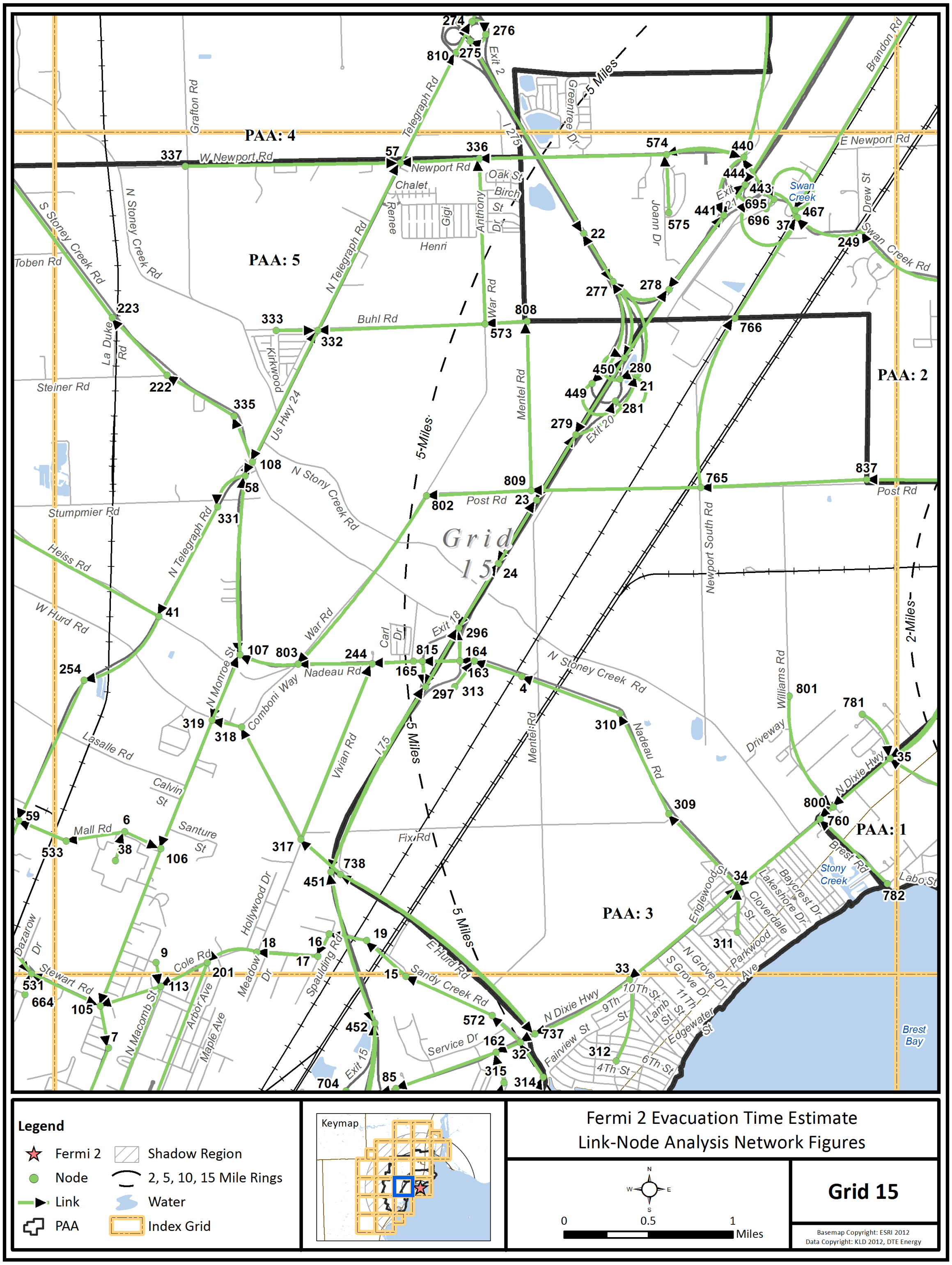


Figure K-16. Link-Node Analysis Network – Grid 15

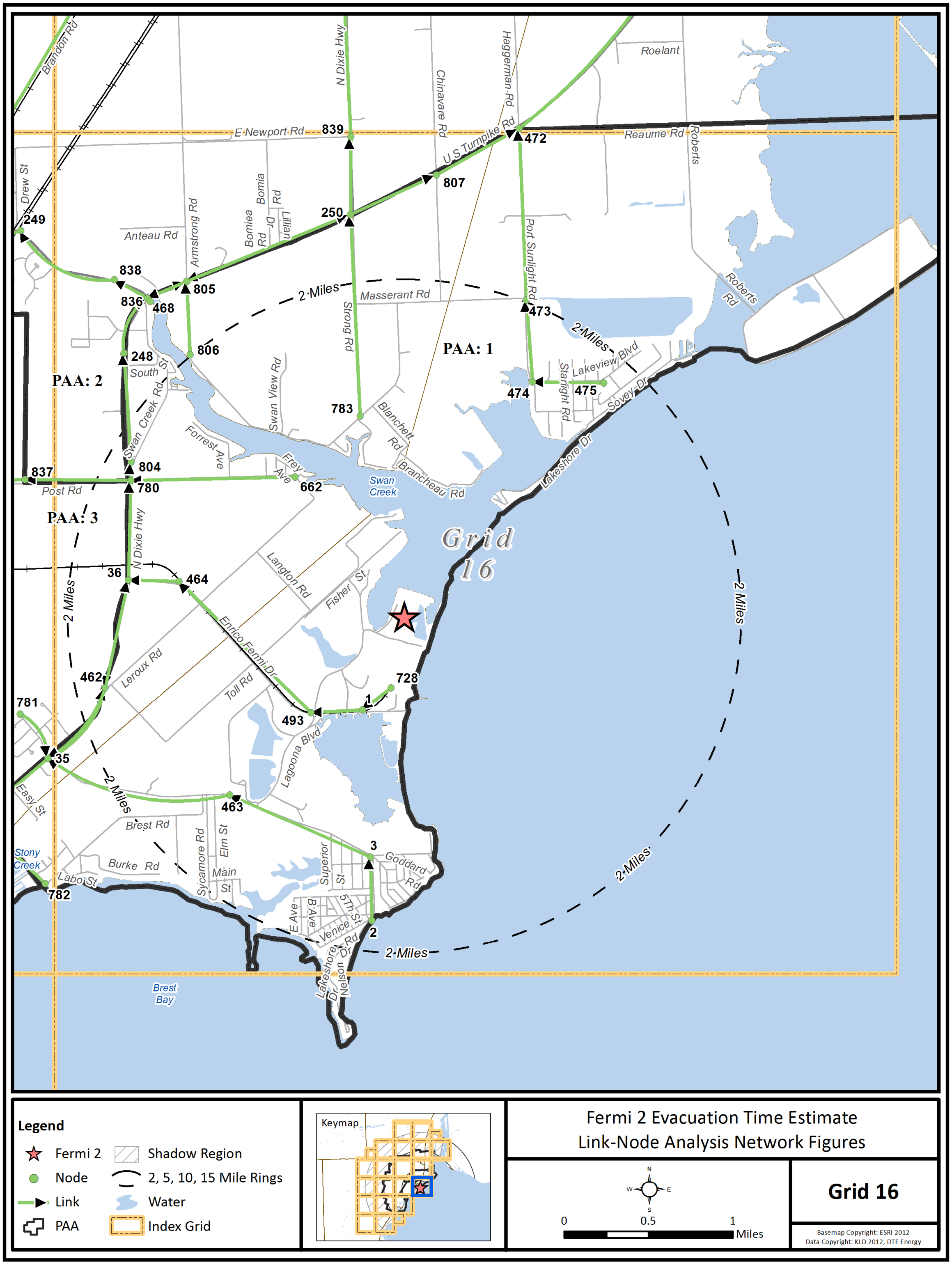


Figure K-17. Link-Node Analysis Network – Grid 16

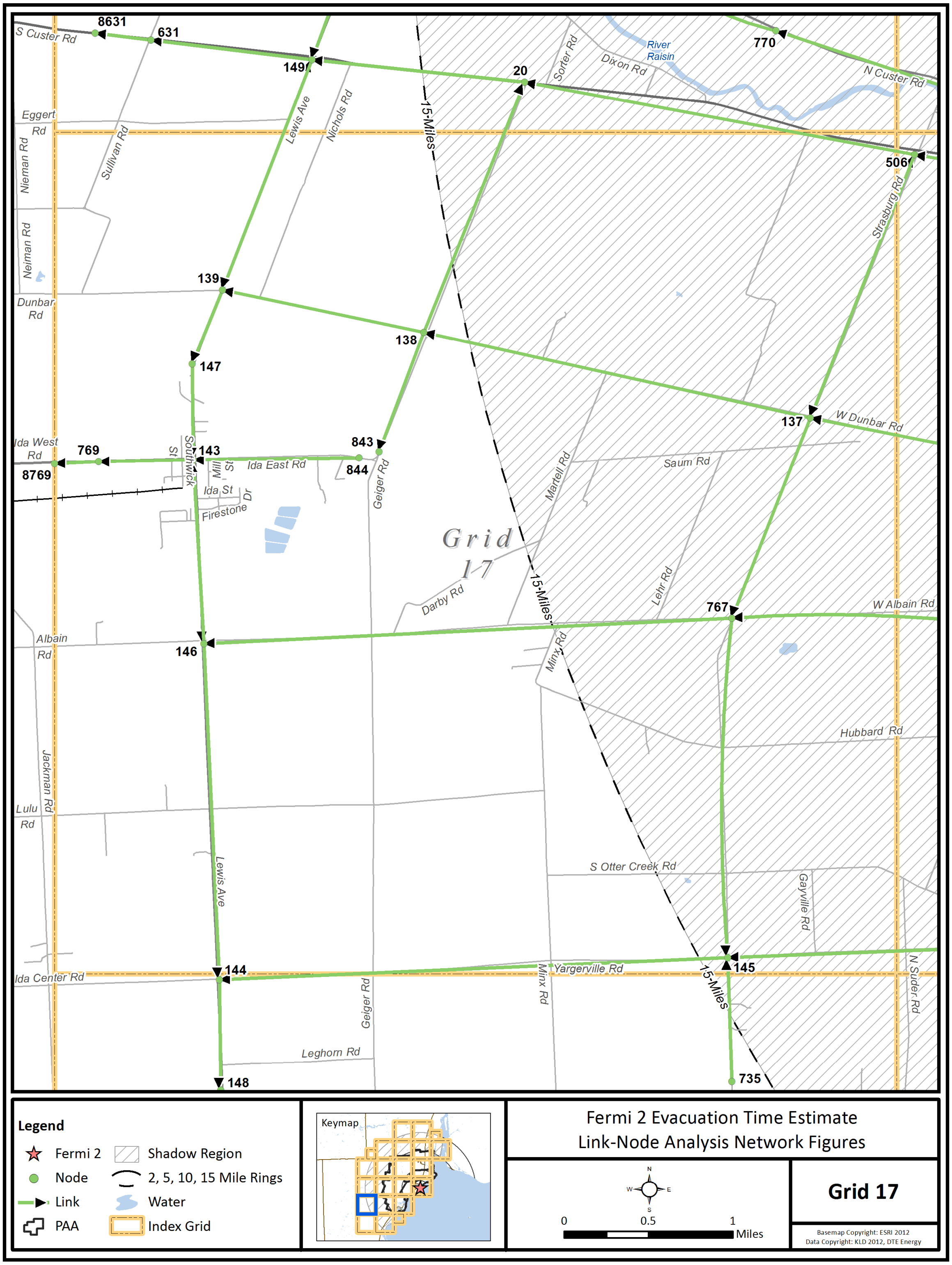


Figure K-18. Link-Node Analysis Network – Grid 17

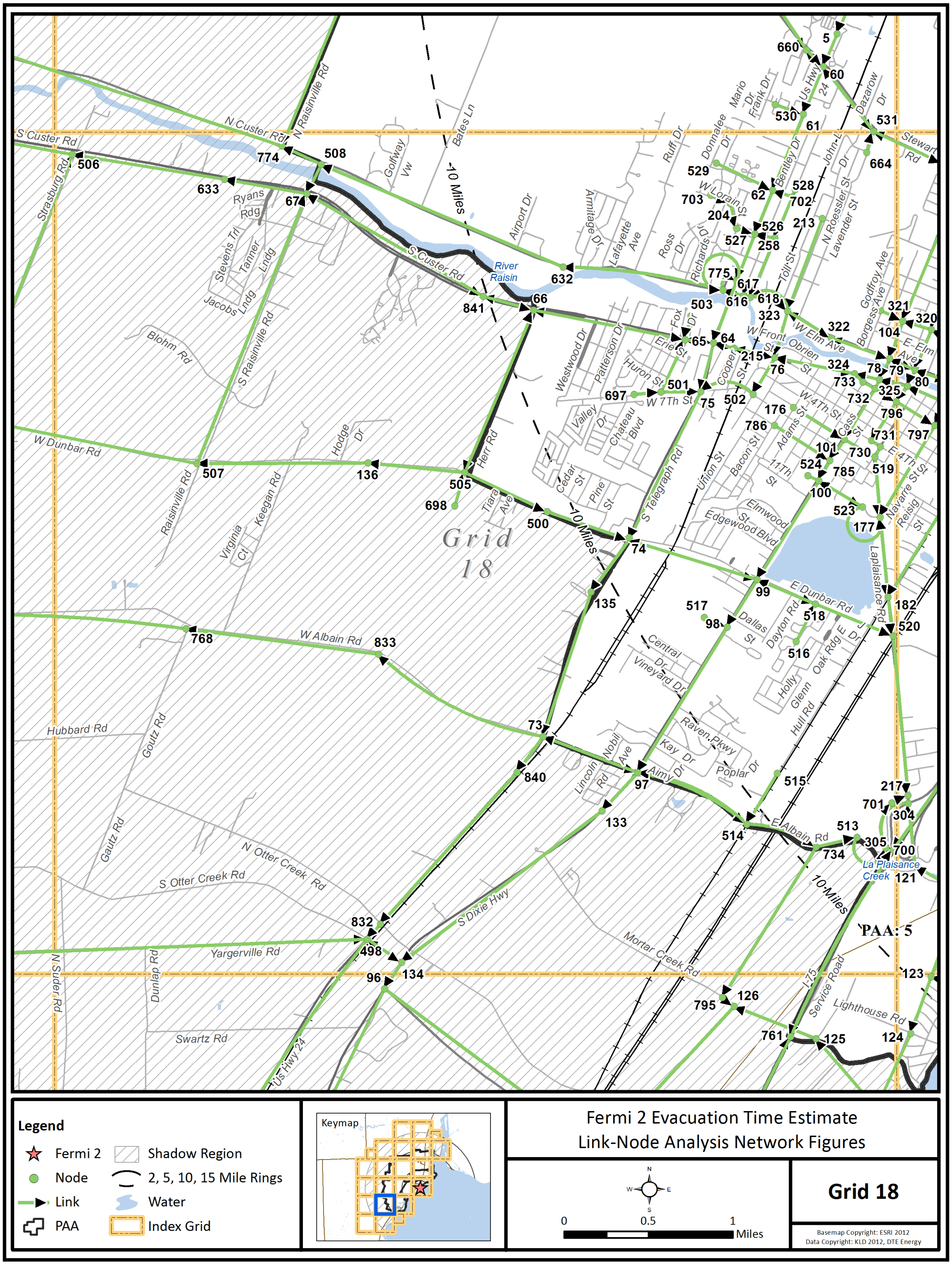


Figure K-19. Link-Node Analysis Network – Grid 18

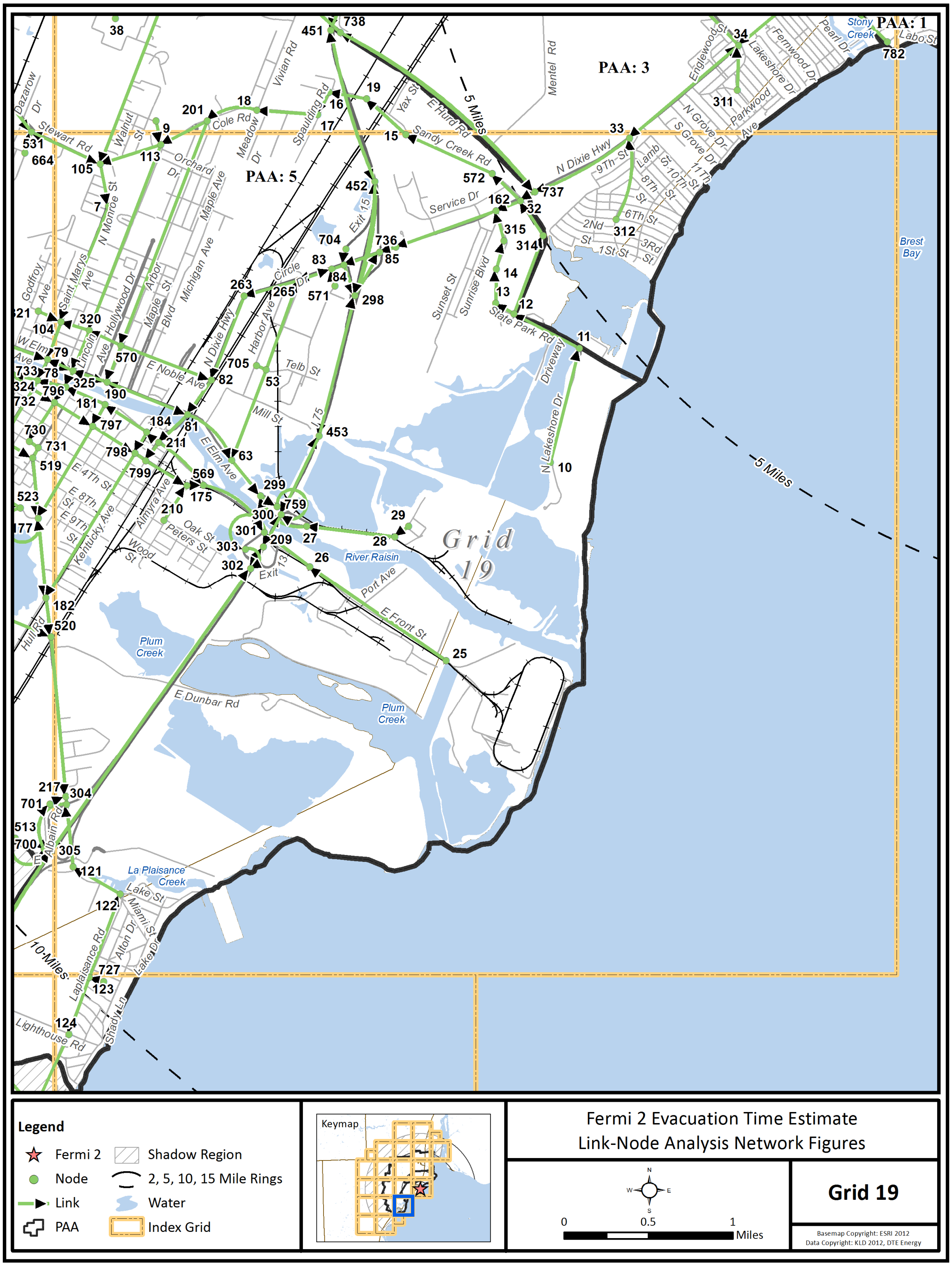


Figure K-20. Link-Node Analysis Network – Grid 19

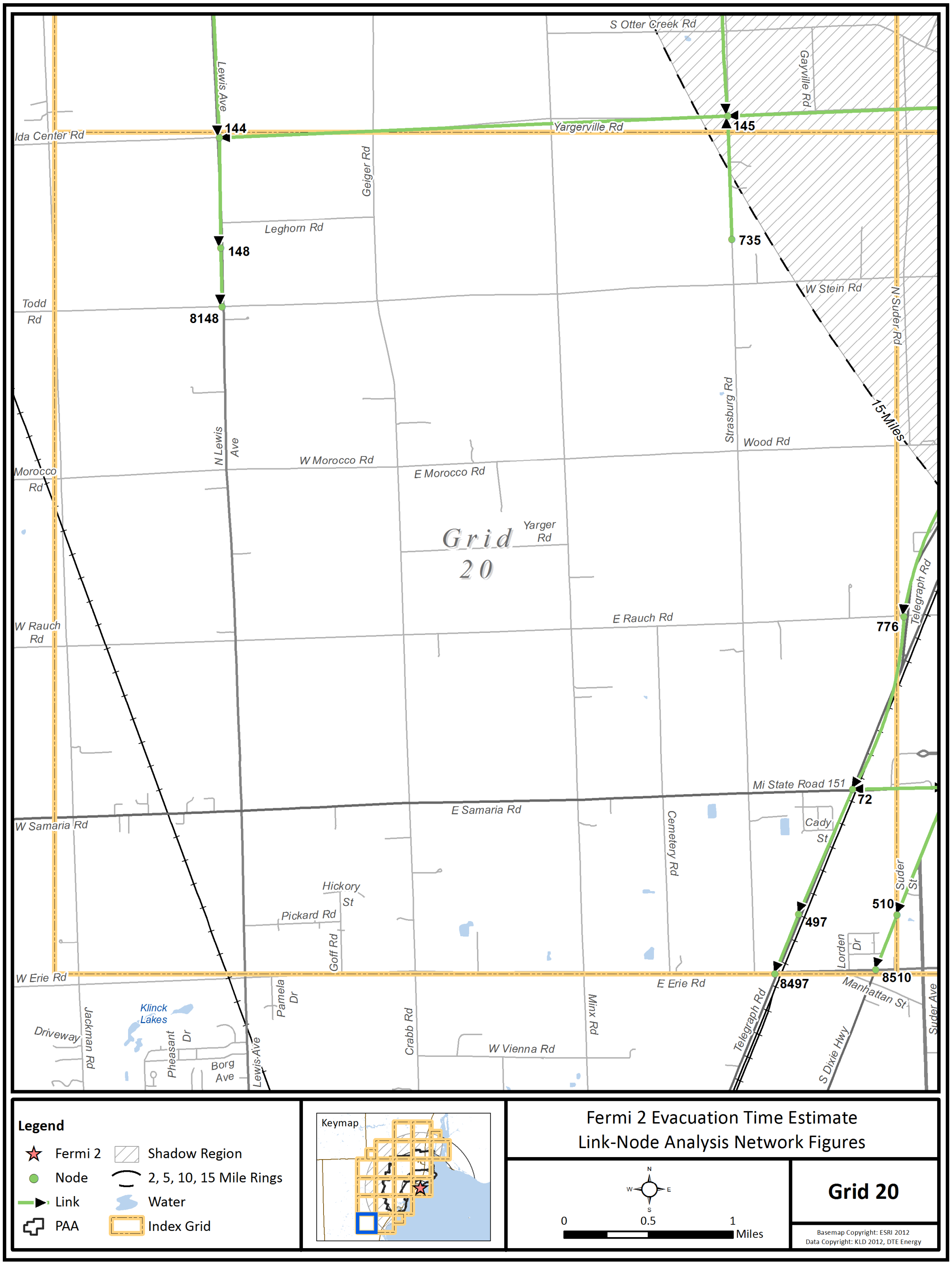


Figure K-21. Link-Node Analysis Network – Grid 20

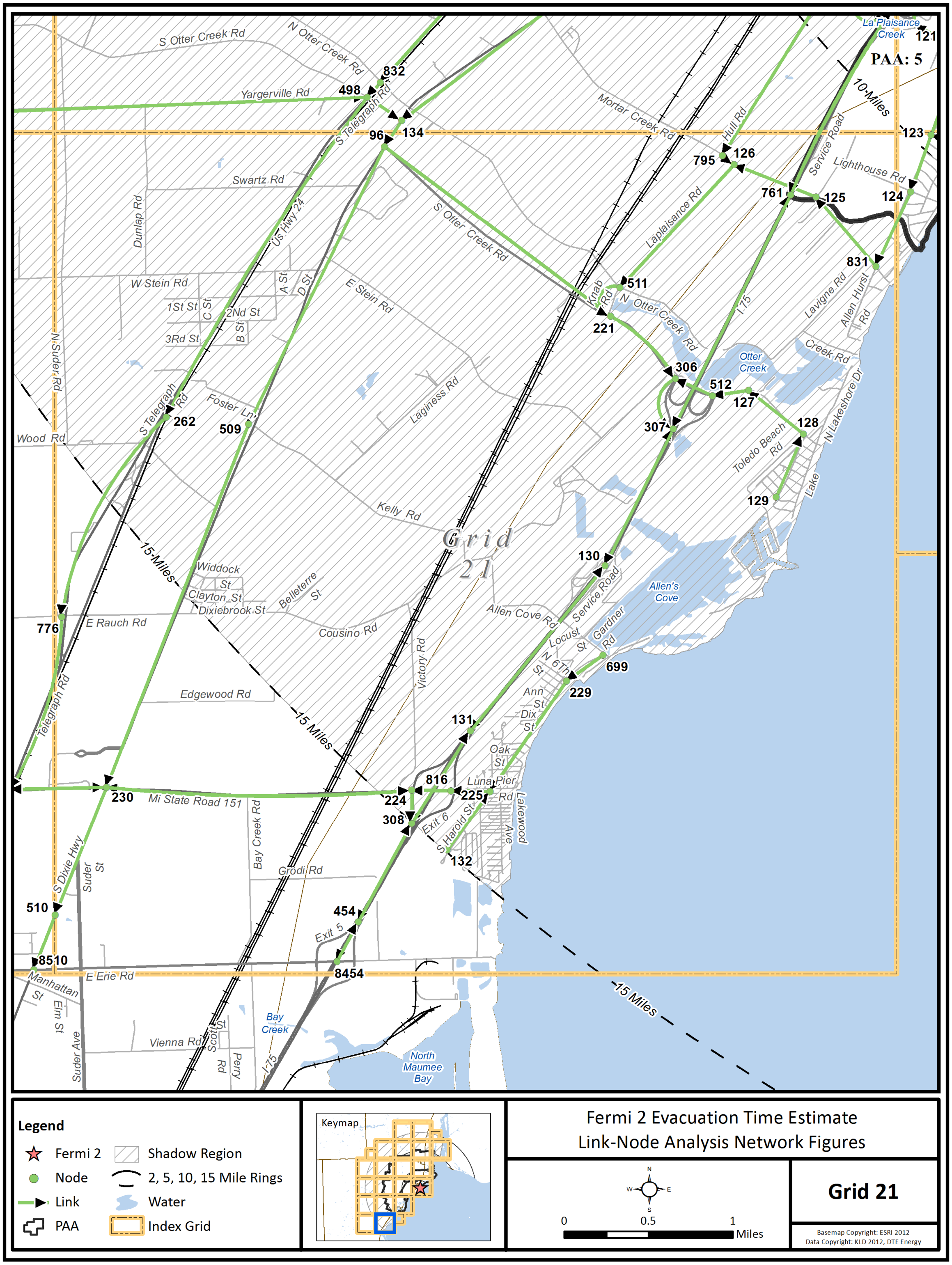


Figure K-22. Link-Node Analysis Network – Grid 21

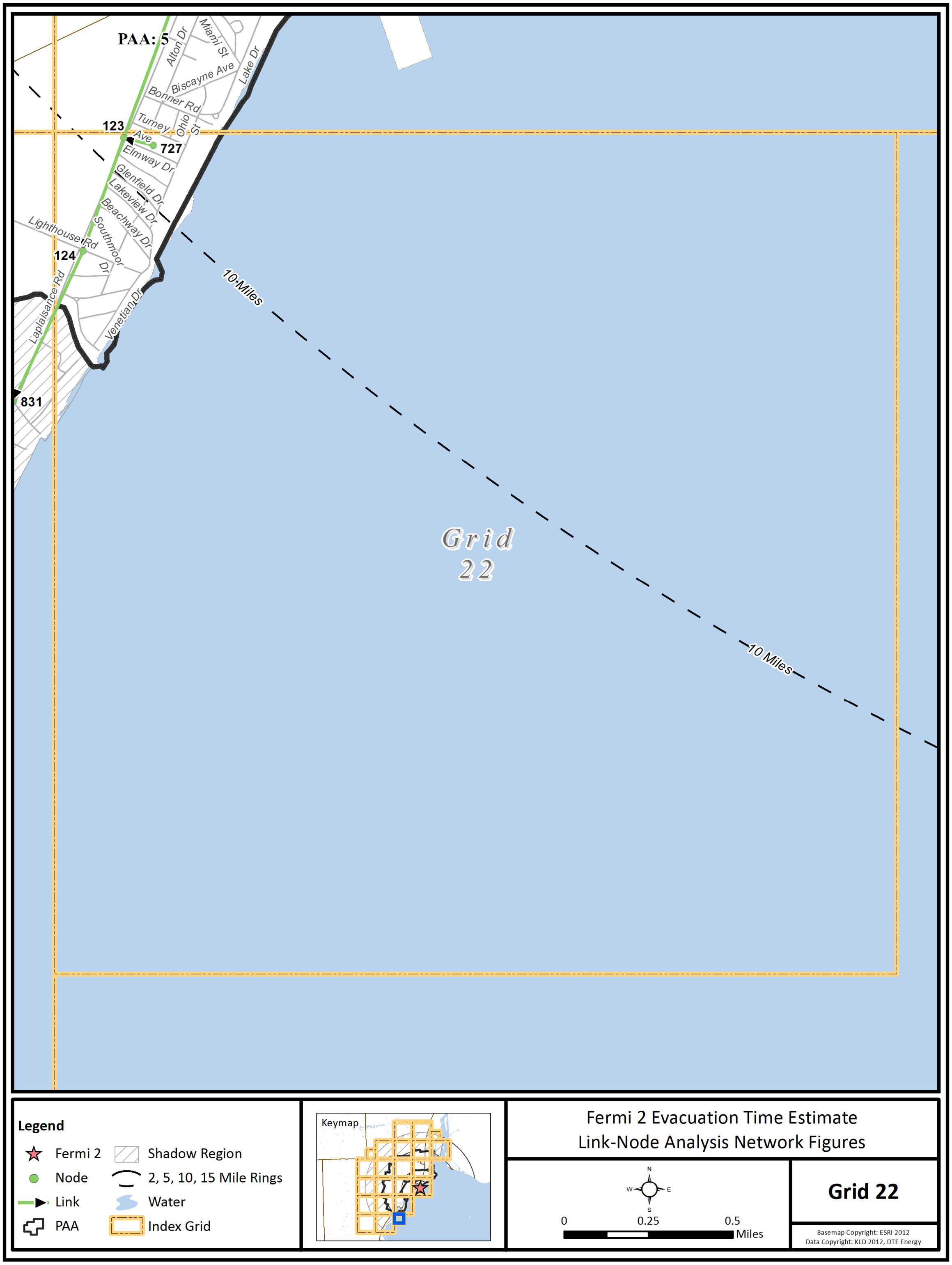


Figure K-23. Link-Node Analysis Network – Grid 22

Table K-1. Evacuation Roadway Network Characteristics

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1	1	493	FERMI DR	COLLECTOR	1618	1	12	4	1700	40	22
2	2	3	DEWEY RD	COLLECTOR	1983	1	12	4	1700	40	23
3	3	463	POINTE AUX PEAUX RD	COLLECTOR	4832	1	12	4	1700	40	22
4	4	163	NADEAU RD	MINOR ARTERIAL	1559	2	12	4	1750	50	22
5	5	60	US-24	MAJOR ARTERIAL	1111	2	12	4	1750	45	21
6	6	106	MALL RD	COLLECTOR	1256	1	12	4	1750	40	21
7	6	533	MALL RD	COLLECTOR	1853	1	12	4	1700	40	21
8	7	104	SR 125	MAJOR ARTERIAL	3908	2	12	4	1750	40	21
9	8	667	BLUE BUSH RD	MINOR ARTERIAL	3713	1	15	0	1350	30	15
10	9	113	BEECHWOOD ST	LOCAL ROADWAY	763	1	12	4	1750	40	21
11	10	11	N LAKESHORE DR	LOCAL ROADWAY	3689	1	12	4	1350	30	22
12	11	12	STATE PARK RD	LOCAL ROADWAY	2323	1	12	4	1350	30	22
13	12	13	STATE PARK RD	LOCAL ROADWAY	655	1	12	4	1350	30	22
14	12	314	SANDY CREEK RD	COLLECTOR	2616	1	12	4	1350	30	22
15	13	14	STATE PARK RD	LOCAL ROADWAY	1064	1	12	4	1350	30	22
16	14	315	STATE PARK RD	LOCAL ROADWAY	917	1	12	4	1350	30	22
17	15	19	SANDY CREEK RD	COLLECTOR	1664	1	12	4	1700	40	21
18	16	17	SANDY CREEK RD	COLLECTOR	791	1	12	4	1575	35	21
19	17	18	COLE RD	COLLECTOR	1914	1	12	4	1575	35	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
20	18	201	COLE RD	COLLECTOR	1600	1	12	4	1700	40	21
21	19	16	SANDY CREEK RD	COLLECTOR	1185	1	12	4	1575	35	21
22	20	149	SR 50	MAJOR ARTERIAL	6706	1	12	4	1700	60	19
23	21	277	I-75	FREEWAY	3138	2	12	4	2250	65	17
24	22	275	I-275	FREEWAY	6998	2	12	4	2250	75	17
25	22	277	I-275	FREEWAY	1771	3	12	4	2250	65	17
26	23	24	I-75	FREEWAY	2315	3	12	4	2250	65	17
27	23	279	I-75	FREEWAY	2395	5	12	4	2250	65	17
28	24	23	I-75	FREEWAY	2315	5	12	4	2250	65	17
29	24	296	I-75	FREEWAY	2370	3	12	4	2250	65	22
30	25	26	FRONT ST	COLLECTOR	5194	2	12	4	1900	45	26
31	26	301	FRONT ST	COLLECTOR	1782	2	12	4	1900	40	26
32	27	299	E ELM AVE	COLLECTOR	1824	2	12	4	1900	40	26
33	28	27	E ELM AVE	COLLECTOR	2783	2	12	4	1900	40	26
34	29	28	E ELM AVE	COLLECTOR	548	2	12	4	1900	40	26
35	30	267	I-275	FREEWAY	3909	3	12	4	2250	75	1
36	31	268	I-275	FREEWAY	4976	3	12	4	2250	75	5
37	31	458	I-275	FREEWAY	3087	3	12	4	2250	75	5
38	32	162	N DIXIE HWY	MAJOR ARTERIAL	836	1	12	4	1750	50	22
39	32	572	SANDY CREEK RD	COLLECTOR	1230	1	12	4	1700	40	22
40	33	34	N DIXIE HWY	MAJOR ARTERIAL	4484	1	12	4	1750	40	22
41	33	737	N DIXIE HWY	MAJOR ARTERIAL	3425	1	12	4	1750	50	22
42	34	33	N DIXIE HWY	MAJOR ARTERIAL	4484	1	12	4	1750	45	22
43	34	309	NADEAU RD	MINOR ARTERIAL	3177	1	12	4	1700	50	22
44	35	462	N DIXIE HWY	MAJOR ARTERIAL	2884	1	12	4	1700	50	22

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
45	35	800	N DIXIE HWY	MAJOR ARTERIAL	2342	1	12	4	1750	45	22
46	36	462	N DIXIE HWY	MAJOR ARTERIAL	3458	1	12	4	1700	50	22
47	36	780	N DIXIE HWY	MAJOR ARTERIAL	3120	1	12	4	1750	50	17
48	37	467	SWAN CREEK RD	MINOR ARTERIAL	252	1	12	4	1350	30	17
49	38	6	FRENCHTOWN SQUARE MALL	LOCAL ROADWAY	952	1	12	4	1350	30	21
50	39	180	EDSEL ST	COLLECTOR	2641	1	12	4	1750	35	7
51	39	183	HARRISON AVE	COLLECTOR	1287	1	12	4	1350	30	7
52	40	545	HURON RIVER DR	MAJOR ARTERIAL	3971	1	12	4	1700	50	13
53	40	641	W JEFFERSON AVE	MAJOR ARTERIAL	5090	1	12	4	1700	50	13
54	41	254	US-24	MAJOR ARTERIAL	3159	1	12	4	1700	60	21
55	41	819	HEISS RD	COLLECTOR	13211	1	12	2	1700	40	16
56	42	43	GIBRALTAR RD	MAJOR ARTERIAL	5958	1	12	4	1750	50	13
57	42	171	W JEFFERSON AVE	MAJOR ARTERIAL	6925	1	12	4	1700	50	7
58	43	158	FORT ST	MINOR ARTERIAL	1342	1	12	4	1700	40	13
59	43	160	GIBRALTAR RD	MAJOR ARTERIAL	822	2	12	4	1750	50	13
60	44	608	RANCHO	COLLECTOR	2226	1	12	4	1750	40	3
61	44	744	RANCHO	COLLECTOR	2849	2	12	4	1750	40	3
62	45	196	SIBLEY RD	MINOR ARTERIAL	840	2	12	4	1750	45	3
63	47	649	GIBRALTAR RD	MAJOR ARTERIAL	3985	2	12	4	1900	50	13
64	47	683	GIBRALTAR RD	MAJOR ARTERIAL	1682	2	12	4	1750	45	13
65	48	117	VAN HORN RD	MINOR ARTERIAL	2773	1	12	4	1750	40	6
66	49	50	GIBRALTAR RD	MAJOR ARTERIAL	1243	1	12	4	1750	40	12
67	49	649	GIBRALTAR RD	MAJOR ARTERIAL	3392	1	12	4	1700	45	12
68	50	51	GIBRALTAR RD	MAJOR ARTERIAL	1756	1	12	4	1575	35	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
69	51	52	W GARDEN BLVD	COLLECTOR	426	1	12	4	1125	25	12
70	51	347	GIBRALTAR RD	MAJOR ARTERIAL	1586	1	12	4	1575	35	12
71	52	51	GARDEN BLVD	COLLECTOR	426	1	12	4	1125	25	12
72	52	114	E HURON RIVER DR	COLLECTOR	1458	1	12	4	1750	35	12
73	53	63	DETROIT AVE	LOCAL ROADWAY	3037	1	12	4	1700	40	21
74	53	265	DETROIT AVE	LOCAL ROADWAY	2977	1	12	4	1700	40	21
75	54	679	US-24	MAJOR ARTERIAL	166	2	12	4	1750	35	12
76	56	231	CARLETON ROCKWOOD RD	COLLECTOR	11739	1	12	4	1700	50	12
77	56	338	US-24	MAJOR ARTERIAL	10983	2	12	4	1900	55	12
78	56	345	US-24	MAJOR ARTERIAL	5445	2	12	4	1900	55	12
79	57	810	US-24	MAJOR ARTERIAL	3881	2	12	4	1900	50	16
80	58	107	SR 125	MAJOR ARTERIAL	5624	2	12	4	1750	50	21
81	58	108	US-24	MAJOR ARTERIAL	489	2	12	4	1900	55	16
82	58	331	US-24	MAJOR ARTERIAL	1308	2	12	4	1900	50	16
83	59	5	US-24	MAJOR ARTERIAL	1879	1	12	4	1700	45	21
84	60	61	US-24	MAJOR ARTERIAL	1626	2	12	4	1750	45	21
85	60	531	STEWART RD	COLLECTOR	2571	2	12	4	1750	45	21
86	60	660	STEWART RD	COLLECTOR	744	1	12	4	1700	50	21
87	61	62	US-24	MAJOR ARTERIAL	2575	2	12	4	1750	45	21
88	62	258	US-24	MAJOR ARTERIAL	1476	2	12	4	1750	45	21
89	63	299	E ELM AVE	COLLECTOR	1429	2	12	4	1900	40	26
90	64	65	SR 50	MAJOR ARTERIAL	911	2	12	4	1750	35	21
91	64	75	US-24	MAJOR ARTERIAL	1580	2	12	4	1750	35	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
92	64	215	W FRONT ST	COLLECTOR	670	1	12	4	1700	40	21
93	65	64	SR 50	MAJOR ARTERIAL	911	1	12	4	1750	35	21
94	65	66	SR 50	MAJOR ARTERIAL	4838	2	12	4	1750	45	21
95	66	65	SR 50	MAJOR ARTERIAL	4838	2	12	4	1750	35	21
96	66	505	HERR RD	COLLECTOR	5530	1	12	4	1700	45	20
97	66	841	SR 50	MAJOR ARTERIAL	1624	2	12	4	1750	65	20
98	67	633	SR 50	MAJOR ARTERIAL	2618	2	12	4	1900	65	20
99	67	841	SR 50	MAJOR ARTERIAL	6411	2	12	4	1750	45	20
100	68	69	BLUE BUSH RD	MINOR ARTERIAL	7248	1	12	4	1700	55	20
101	69	630	BLUE BUSH RD	MINOR ARTERIAL	2820	1	12	4	1700	55	15
102	69	726	N RAISINVILLE RD	COLLECTOR	6622	1	12	2	1750	40	20
103	70	666	BLUE BUSH RD	MINOR ARTERIAL	3309	1	12	4	1700	50	15
104	71	8	BLUE BUSH RD	MINOR ARTERIAL	3263	1	12	4	1700	50	15
105	72	230	SR 151	MINOR ARTERIAL	3003	1	12	4	1750	45	29
106	72	497	US 24	MAJOR ARTERIAL	4273	1	12	4	1700	60	29
107	73	97	W ALBAIN RD	COLLECTOR	3179	1	12	4	1750	40	26
108	73	833	W ALBAIN RD	COLLECTOR	5828	1	12	4	1700	40	25
109	73	840	US 24	MAJOR ARTERIAL	1396	1	12	4	1700	50	25
110	74	99	E DUNBAR RD	COLLECTOR	4215	1	12	4	1750	40	26
111	74	135	US 24	MAJOR ARTERIAL	2014	2	12	4	1900	45	26
112	75	74	US 24	MAJOR ARTERIAL	5173	2	12	4	1750	45	26
113	76	215	SR 50	MAJOR ARTERIAL	1304	1	12	4	1350	30	21
114	76	324	W FRONT ST	COLLECTOR	2557	1	12	4	1700	35	21
115	76	502	S ROESSLER ST	COLLECTOR	1344	1	12	4	1575	35	21
116	78	324	SR 50	MAJOR ARTERIAL	798	1	12	4	1575	35	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
117	78	732	SR 125	MINOR ARTERIAL	317	2	12	4	1750	30	21
118	79	78	SR 125	MAJOR ARTERIAL	729	2	12	4	1750	35	21
119	79	80	E ELM AVE	COLLECTOR	864	1	12	4	1750	35	21
120	79	322	W ELM AVE	MINOR ARTERIAL	1943	1	12	4	1575	35	21
121	80	79	E ELM AVE	COLLECTOR	864	1	12	4	1750	35	21
122	80	190	E ELM AVE	COLLECTOR	1127	1	12	4	1750	35	21
123	80	325	S MACOMB ST	COLLECTOR	560	1	12	4	1750	35	21
124	81	63	E ELM AVE	COLLECTOR	2016	1	12	4	1700	40	21
125	81	190	E ELM AVE	COLLECTOR	2729	1	12	4	1750	35	21
126	81	211	N DIXIE HWY	MAJOR ARTERIAL	1265	1	12	4	1700	40	21
127	82	81	N DIXIE HWY	MAJOR ARTERIAL	1316	2	12	4	1750	40	21
128	83	84	N DIXIE HWY	MAJOR ARTERIAL	398	2	12	4	1750	45	21
129	83	265	N DIXIE HWY	MAJOR ARTERIAL	1114	2	12	4	1900	45	21
130	84	83	N DIXIE HWY	MAJOR ARTERIAL	398	1	12	4	1750	45	21
131	84	298	I-75 ON RAMP	FREEWAY RAMP	1029	1	12	4	1700	50	21
132	85	736	N DIXIE HWY	MAJOR ARTERIAL	537	2	12	4	1750	45	21
133	86	267	I-275 ON RAMP	FREEWAY RAMP	1442	1	12	4	1700	50	1
134	87	152	SIBLEY RD	MINOR ARTERIAL	801	2	12	4	1750	35	3
135	88	747	MIDDLEBELT RD	COLLECTOR	5369	1	12	4	1750	45	2
136	88	752	SIBLEY RD	MINOR ARTERIAL	10551	1	12	4	1700	50	1
137	90	89	W JEFFERSON AVE	MAJOR ARTERIAL	1200	2	12	4	1900	40	4
138	91	608	SIBLEY RD	MINOR ARTERIAL	5450	1	12	4	1750	50	3
139	91	745	US 24	MAJOR ARTERIAL	5885	2	12	4	1750	55	2
140	91	749	SIBLEY RD	MINOR ARTERIAL	5264	1	12	4	1700	50	2
141	92	90	BRIDGE RD	COLLECTOR	793	1	10	0	1750	35	4

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
142	93	92	BRIDGE RD	COLLECTOR	3126	1	10	0	1700	40	4
143	94	283	SIBLEY RD	MINOR ARTERIAL	358	2	12	4	1900	40	3
144	94	742	DIX TOLEDO HWY	MAJOR ARTERIAL	4465	2	12	4	1900	55	3
145	95	93	MERIDIAN RD	COLLECTOR	16524	1	12	4	1700	40	8
146	95	173	GROSSE ILE PKWY	COLLECTOR	7111	1	12	4	1750	40	8
147	96	221	S OTTER CREEK RD	COLLECTOR	8851	1	12	4	1700	50	25
148	96	509	SR 125	MINOR ARTERIAL	9688	1	12	4	1700	60	25
149	97	73	W ALBAIN RD	COLLECTOR	3179	1	12	4	1750	45	26
150	97	133	SR 125	MINOR ARTERIAL	1641	2	12	4	1900	45	26
151	97	514	W ALBAIN RD	COLLECTOR	3804	1	12	4	1700	40	26
152	98	97	SR 125	MINOR ARTERIAL	5355	2	12	4	1750	40	26
153	99	74	E DUNBAR RD	COLLECTOR	4215	1	12	4	1750	40	26
154	99	98	SR 125	MINOR ARTERIAL	1759	2	12	4	1750	45	26
155	99	518	E DUNBAR RD	COLLECTOR	1975	1	12	4	1700	40	26
156	100	99	SR 125	MINOR ARTERIAL	3655	2	12	4	1750	35	26
157	100	523	JONES AVE	COLLECTOR	1597	1	12	4	1575	35	26
158	101	519	E 6TH ST	COLLECTOR	1106	1	12	4	1750	35	21
159	101	785	SR 125	MINOR ARTERIAL	797	2	12	4	1900	35	21
160	104	79	SR 125	MAJOR ARTERIAL	1256	2	12	4	1750	35	21
161	105	7	SR 125	MAJOR ARTERIAL	1350	2	12	4	1900	45	21
162	105	531	STEWART RD	COLLECTOR	2385	2	12	4	1750	45	21
163	106	105	SR 125	MAJOR ARTERIAL	5276	2	12	4	1750	50	21
164	107	58	SR 125	MAJOR ARTERIAL	5623	2	12	4	1750	50	21
165	107	319	SR 125	MAJOR ARTERIAL	2233	2	12	4	1900	50	21
166	108	58	US-24	MAJOR ARTERIAL	489	3	12	4	1750	50	16

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
167	108	332	US-24	MAJOR ARTERIAL	4606	2	12	4	1900	55	16
168	108	335	S STONY CREEK RD	MINOR ARTERIAL	1544	1	12	2	1700	50	16
169	109	534	S STONY CREEK RD	MINOR ARTERIAL	5963	1	12	2	1700	50	16
170	109	825	EXETER RD	COLLECTOR	2677	1	12	2	1700	40	16
171	110	539	S STONY CREEK RD	MINOR ARTERIAL	3496	1	12	0	1700	55	15
172	111	541	PALMER RD	COLLECTOR	2919	1	12	4	1700	40	14
173	112	207	ALLEN RD	COLLECTOR	1248	2	12	4	1750	50	7
174	113	105	COLE RD	COLLECTOR	1995	2	12	4	1750	35	21
175	113	320	N MACOMB ST	COLLECTOR	6233	1	12	4	1750	35	21
176	114	347	US-24	MAJOR ARTERIAL	356	2	12	4	1900	35	12
177	114	679	US-24	MAJOR ARTERIAL	967	2	12	4	1750	35	12
178	115	116	US-24	MAJOR ARTERIAL	1230	2	12	4	1750	45	6
179	116	659	US-24	MAJOR ARTERIAL	3066	2	12	4	1900	45	6
180	117	364	US 24	MAJOR ARTERIAL	4616	2	12	4	1900	50	6
181	118	166	WEST RD	MINOR ARTERIAL	2534	1	12	4	1700	40	6
182	118	593	US 24	MAJOR ARTERIAL	1877	2	12	4	1750	40	6
183	120	91	US 24	MAJOR ARTERIAL	5435	2	12	4	1750	55	6
184	121	304	LAPLAISANCE RD	COLLECTOR	1977	1	12	4	1700	40	26
185	122	121	LAPLAISANCE RD	COLLECTOR	1703	1	12	4	1575	35	26
186	123	122	LAPLAISANCE RD	COLLECTOR	2794	1	12	4	1575	35	26
187	123	124	LAPLAISANCE RD	COLLECTOR	1890	1	12	4	1575	35	26
188	124	831	LAPLAISANCE RD	COLLECTOR	2590	1	12	4	1575	35	26
189	125	126	LAPLAISANCE RD	COLLECTOR	2768	1	12	4	1575	35	26
190	126	511	LAPLAISANCE RD	COLLECTOR	5254	1	12	4	1575	35	26
191	127	512	S OTTER CREEK RD	COLLECTOR	1141	1	12	4	1700	40	30

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
192	128	127	S OTTER CREEK RD	COLLECTOR	2197	1	12	4	1700	40	30
193	129	128	N SHORE BLVD	COLLECTOR	2144	1	12	4	1700	40	30
194	130	131	I-75	FREEWAY	6696	3	12	4	2250	70	29
195	130	307	I-75	FREEWAY	4788	3	12	4	2250	70	30
196	131	130	I-75	FREEWAY	6696	3	12	4	2250	70	29
197	131	308	I-75	FREEWAY	3420	3	12	4	2250	70	29
198	132	225	LAKEWOOD AVE	COLLECTOR	2275	1	12	4	1575	35	29
199	133	134	SR 125	MINOR ARTERIAL	7881	1	12	4	1700	60	25
200	134	96	SR 125	MINOR ARTERIAL	986	1	12	4	1700	60	25
201	134	498	S OTTER CREEK RD	COLLECTOR	1294	1	12	4	1350	30	25
202	135	73	US 24	MAJOR ARTERIAL	4774	1	12	4	1750	45	26
203	136	507	E DUNBAR RD	COLLECTOR	5363	1	12	4	1700	55	25
204	137	138	W DUNBAR RD	COLLECTOR	12413	1	12	4	1700	55	19
205	137	506	STRASBURG RD	COLLECTOR	8868	1	12	0	1700	50	20
206	137	767	STRASBURG RD	COLLECTOR	6750	1	12	4	1700	40	25
207	138	20	GEIGER RD	LOCAL ROADWAY	8457	1	12	4	1700	40	19
208	138	139	DUNBAR RD	COLLECTOR	6459	1	12	4	1700	40	19
209	139	147	LEWIS AVE	COLLECTOR	2507	1	12	4	1700	45	19
210	139	149	LEWIS AVE	COLLECTOR	7746	1	12	4	1700	45	19
211	140	282	I-75	FREEWAY	4619	3	12	4	2250	75	3
212	143	146	LEWIS AVE	COLLECTOR	5771	1	12	4	1700	40	24
213	144	148	LEWIS AVE	COLLECTOR	3468	1	12	4	1700	55	24
214	145	144	YARGERVILLE RD	COLLECTOR	15958	1	12	4	1700	45	24
215	145	498	YARGERVILLE RD	COLLECTOR	15115	1	12	4	1700	55	25

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
216	146	144	LEWIS AVE	COLLECTOR	10548	1	12	4	1700	55	24
218	147	143	LEWIS AVE	COLLECTOR	3015	1	12	4	1700	40	19
219	149	631	SR 50	MAJOR ARTERIAL	5082	1	12	4	1700	60	19
220	151	793	SR 85	MAJOR ARTERIAL	1018	3	12	4	1750	45	3
221	152	151	SR 85	MAJOR ARTERIAL	1283	3	12	4	1750	45	3
222	152	610	SR 85	MAJOR ARTERIAL	777	2	12	4	1900	40	3
223	153	168	SYIVAN AVE	COLLECTOR	2186	1	12	4	1350	30	6
224	153	623	SYIVAN AVE	COLLECTOR	3125	1	12	4	1350	30	6
225	154	424	SR 85	MAJOR ARTERIAL	4576	2	12	4	1750	55	7
226	154	611	SR 85	MAJOR ARTERIAL	632	2	12	4	1900	40	7
227	155	419	SR 85	MAJOR ARTERIAL	2070	2	12	4	1750	55	7
228	156	409	SR 85	MAJOR ARTERIAL	909	2	12	4	1900	55	7
229	156	612	SR 85	MAJOR ARTERIAL	685	2	12	4	1900	40	7
230	158	390	SR 85	MAJOR ARTERIAL	5365	2	12	4	1750	55	7
231	159	160	GIBRALTAR RD	MAJOR ARTERIAL	370	2	12	4	1750	50	13
232	159	252	GIBRALTAR RD	MAJOR ARTERIAL	2580	2	12	4	1750	45	13
233	160	158	SR 85	MAJOR ARTERIAL	1574	2	12	4	1900	55	13
234	160	159	GIBRALTAR RD	MAJOR ARTERIAL	370	2	12	4	1750	50	13
235	161	166	WESTWOOD DR	COLLECTOR	2339	1	12	4	1700	40	7
236	162	85	N DIXIE HWY	MAJOR ARTERIAL	3328	1	12	4	1700	45	21
237	163	164	NADEAU RD	MINOR ARTERIAL	456	2	12	4	1900	40	22
238	164	165	NADEAU RD	MINOR ARTERIAL	1176	1	12	4	1750	40	21
239	164	296	I-75 ON RAMP	FREEWAY RAMP	1037	1	12	4	1700	50	21
240	165	297	I-75 ON RAMP	FREEWAY RAMP	801	1	12	4	1700	50	21
241	165	815	NADEAU RD	MINOR ARTERIAL	284	1	12	4	1700	50	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
242	166	118	WEST RD	MINOR ARTERIAL	2534	1	12	4	1750	40	6
243	166	192	WEST RD	MINOR ARTERIAL	1507	2	12	4	1750	40	7
244	167	544	S HURON RIVER DR	MAJOR ARTERIAL	3315	1	12	4	1700	50	13
245	167	636	W JEFFERSON AVE	MAJOR ARTERIAL	2485	1	12	4	1700	50	13
246	168	118	WEST RD	MINOR ARTERIAL	2429	1	12	4	1750	40	6
247	168	366	WEST RD	MINOR ARTERIAL	8105	1	12	4	1750	40	6
248	169	648	HURON RIVER DR	MAJOR ARTERIAL	3521	1	12	4	1350	30	12
249	169	817	HURON RIVER DR	MAJOR ARTERIAL	786	2	12	4	1750	30	13
250	170	292	HURON RIVER DR	MAJOR ARTERIAL	743	2	12	4	1900	30	13
251	170	550	FORT ST	MINOR ARTERIAL	5623	1	12	4	1575	35	13
252	171	390	VREELAND RD	MINOR ARTERIAL	5779	1	12	4	1750	45	7
253	171	656	W JEFFERSON AVE	MAJOR ARTERIAL	4767	1	12	4	1700	50	7
254	172	173	W JEFFERSON AVE	MAJOR ARTERIAL	426	2	12	4	1750	55	7
255	172	392	VAN HORN RD	MINOR ARTERIAL	4375	2	12	4	1750	40	7
256	173	172	W JEFFERSON AVE	MAJOR ARTERIAL	426	2	12	4	1750	40	7
257	173	653	W JEFFERSON AVE	MAJOR ARTERIAL	1289	2	12	4	1900	40	7
258	174	711	W JEFFERSON AVE	MAJOR ARTERIAL	514	1	12	4	1350	30	7
259	175	569	CONANT AVE	LOCAL ROADWAY	511	1	12	4	1575	35	26
260	176	101	W 6TH ST	COLLECTOR	1887	1	12	4	1750	30	21
261	177	182	LAPLAISANCE RD	COLLECTOR	2516	1	12	4	1575	35	26
262	178	714	WEST RD	MINOR ARTERIAL	391	2	12	4	1750	35	7
263	178	788	W JEFFERSON AVE	MAJOR ARTERIAL	497	1	12	4	1700	45	7
264	179	156	WEST RD	MINOR ARTERIAL	1100	2	12	4	1750	35	7
265	180	179	WEST RD	MINOR ARTERIAL	933	2	12	4	1750	35	7

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
266	180	716	WEST RD	MINOR ARTERIAL	716	2	12	4	1750	35	7
267	181	325	FRONT ST	COLLECTOR	1354	1	12	4	1750	35	21
268	181	797	NAVARRE ST	LOCAL ROADWAY	780	1	12	4	1575	35	21
269	182	520	LAPLAISANCE RD	COLLECTOR	1227	1	12	4	1700	40	26
270	183	155	HARRISON AVE	COLLECTOR	1342	1	12	4	1750	40	7
271	183	179	CHELSEA ST	LOCAL ROADWAY	2653	1	12	4	1750	30	7
272	183	202	VERNON ST	LOCAL ROADWAY	2709	1	12	4	1750	30	7
273	184	181	FRONT ST	COLLECTOR	1561	1	12	4	1575	35	21
274	184	798	KENTUCKY AVE	LOCAL ROADWAY	741	1	12	4	1350	30	21
275	185	684	GRANGE RD	COLLECTOR	2675	1	12	4	1350	30	7
276	185	720	WEST RD	MINOR ARTERIAL	920	2	12	4	1750	35	7
277	185	722	WEST RD	MINOR ARTERIAL	1114	2	12	4	1750	35	7
278	187	188	WEST RD	MINOR ARTERIAL	1317	2	12	4	1750	35	7
279	188	205	ALLEN RD	COLLECTOR	2621	2	12	4	1750	50	7
280	188	286	WEST RD	MINOR ARTERIAL	3464	2	12	4	1900	40	7
281	190	80	E ELM AVE	COLLECTOR	1126	1	12	4	1750	35	21
282	190	81	E ELM AVE	COLLECTOR	2729	1	12	4	1750	30	21
283	191	192	WEST RD	MINOR ARTERIAL	1358	2	12	4	1750	40	7
284	191	286	WEST RD	MINOR ARTERIAL	2021	2	12	4	1900	40	7
285	192	166	WEST RD	MINOR ARTERIAL	1507	2	12	4	1900	40	7
286	192	191	WEST RD	MINOR ARTERIAL	1358	2	12	4	1750	40	7
287	194	120	KING RD	MINOR ARTERIAL	3617	1	12	4	1750	40	6

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
288	194	284	DIX TOLEDO HWY	MAJOR ARTERIAL	4186	2	12	4	1900	60	7
289	195	94	SIBLEY RD	MINOR ARTERIAL	646	2	12	4	1750	45	3
290	196	195	SIBLEY RD	MINOR ARTERIAL	2922	2	12	4	1750	45	3
291	196	743	ALLEN RD	COLLECTOR	5363	2	12	4	1750	50	3
292	197	45	SIBLEY RD	MINOR ARTERIAL	3147	1	12	4	1700	45	3
293	197	198	SIBLEY RD	MINOR ARTERIAL	1688	1	12	4	1750	35	3
294	198	197	SIBLEY RD	MINOR ARTERIAL	1688	1	12	4	1750	35	3
295	198	199	SIBLEY RD	MINOR ARTERIAL	3225	1	12	4	1750	35	3
296	199	152	SIBLEY RD	MINOR ARTERIAL	1432	2	12	4	1750	35	3
297	200	87	SIBLEY RD	MINOR ARTERIAL	1936	1	12	4	1575	35	3
298	200	558	SIBLEY RD	MINOR ARTERIAL	2502	1	12	4	1750	35	3
299	201	113	COLE RD	COLLECTOR	1625	1	12	4	1750	40	21
300	201	570	RIVERVIEW AVE	COLLECTOR	7546	1	12	4	1575	35	21
301	202	154	KING RD	MINOR ARTERIAL	1364	2	12	4	1750	40	7
302	203	559	KING RD	MINOR ARTERIAL	4032	1	12	4	1750	45	7
303	203	652	KING RD	MINOR ARTERIAL	3755	1	12	4	1700	45	7
304	204	527	W LORAIN ST	LOCAL ROADWAY	811	1	12	4	1350	30	21
305	205	559	ALLEN RD	COLLECTOR	2629	2	12	4	1750	50	7
306	207	188	ALLEN RD	COLLECTOR	5356	2	12	4	1750	50	7
307	208	112	ALLEN RD	COLLECTOR	4076	1	12	4	1700	50	7
308	209	300	I-75	FREEWAY	1157	4	12	4	2250	70	26
309	209	302	I-75	FREEWAY	793	3	12	4	2250	70	26
310	210	175	CONANT AVE	LOCAL ROADWAY	1311	1	12	4	1575	35	26

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
311	211	184	FRONT ST	COLLECTOR	496	1	12	4	1575	35	21
312	211	569	FRONT ST	COLLECTOR	1943	1	12	4	1575	35	26
313	211	799	WINCHESTER ST	COLLECTOR	700	1	12	4	1750	35	26
314	213	323	N ROESSLER ST	COLLECTOR	3099	1	12	4	1750	35	21
315	215	64	SR 50	MAJOR ARTERIAL	670	2	12	4	1750	35	21
316	215	76	W FRONT ST	COLLECTOR	1303	1	12	4	1750	35	21
317	216	670	S STONY CREEK RD	MINOR ARTERIAL	3138	1	12	0	1700	45	9
318	217	304	LAPLAISANCE RD	COLLECTOR	249	1	12	4	1700	40	26
319	218	216	S STONY CREEK RD	MINOR ARTERIAL	3555	1	12	2	1700	55	9
320	219	220	S STONY CREEK RD	MINOR ARTERIAL	2569	1	12	2	1700	55	10
321	220	218	S STONY CREEK RD	MINOR ARTERIAL	2530	1	12	2	1700	55	10
322	221	306	S OTTER CREEK RD	COLLECTOR	2843	1	12	4	1700	40	26
323	222	223	S STONY CREEK RD	MINOR ARTERIAL	2477	1	12	2	1700	50	16
324	223	226	S STONY CREEK RD	MINOR ARTERIAL	9482	1	12	2	1700	50	16
325	224	230	SR 151	MINOR ARTERIAL	9583	1	12	4	1750	50	29
326	224	308	I-75 ON RAMP	FREEWAY RAMP	1038	1	12	4	1700	50	29
327	225	816	SR 151	MINOR ARTERIAL	1233	1	12	4	1700	40	29
328	226	109	S STONY CREEK RD	MINOR ARTERIAL	3923	1	12	2	1750	40	16
329	227	228	S STONY CREEK RD	MINOR ARTERIAL	3900	1	12	2	1700	40	15
330	228	110	S STONY CREEK RD	MINOR ARTERIAL	2001	1	12	2	1700	50	15
331	229	225	HAROLD DR	COLLECTOR	4213	1	12	4	1575	35	29
332	230	72	SR 151	MINOR ARTERIAL	3003	1	12	4	1750	45	29
333	230	224	SR 151	MINOR ARTERIAL	9582	1	12	4	1700	40	29
334	230	510	SR 125	MINOR ARTERIAL	4319	1	12	4	1700	60	29
335	231	271	I-275 ON RAMP	FREEWAY RAMP	2237	1	12	4	1700	50	11

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
336	232	231	CARLETON ROCKWOOD RD	COLLECTOR	1997	1	12	4	1700	50	11
337	234	239	GRAFTON RD	COLLECTOR	11293	1	12	2	1750	45	11
338	234	584	CARLETON ROCKWOOD RD	COLLECTOR	1188	1	12	4	1575	35	11
339	237	580	ASH ST	COLLECTOR	5266	1	12	4	1350	30	11
340	239	577	OAKVILLE WALTZ RD	COLLECTOR	3017	1	12	2	1700	45	11
341	243	239	OAKVILLE WALTZ RD	COLLECTOR	1917	1	12	2	1750	45	11
342	243	270	I-275 ON RAMP	FREEWAY RAMP	1323	1	12	4	1700	50	11
343	244	803	NADEAU RD	MINOR ARTERIAL	2327	1	12	4	1700	50	21
344	248	468	N DIXIE HWY	MAJOR ARTERIAL	1914	1	12	4	1750	50	17
345	249	37	SWAN CREEK RD	MINOR ARTERIAL	2154	1	12	4	1700	50	17
346	250	805	N DIXIE HWY	MAJOR ARTERIAL	5543	1	12	4	1750	50	17
347	250	807	U.S. TURNPIKE RD	MAJOR ARTERIAL	2976	1	12	4	1700	55	18
348	250	839	DIXIE HWY	MINOR ARTERIAL	2444	1	12	4	1700	50	17
349	252	159	GIBRALTAR RD	MAJOR ARTERIAL	2580	2	12	4	1750	50	13
350	252	288	I-75 ON RAMP	FREEWAY RAMP	1362	1	12	4	1700	50	13
351	254	59	US-24	MAJOR ARTERIAL	4862	1	12	4	1750	45	21
352	258	775	US-24	MAJOR ARTERIAL	1567	2	12	4	1900	35	21
353	262	776	US 24	MAJOR ARTERIAL	7155	2	12	4	1900	60	29
354	263	82	N DIXIE HWY	MAJOR ARTERIAL	2820	2	12	4	1750	45	21
355	265	83	N DIXIE HWY	MAJOR ARTERIAL	1114	2	12	4	1750	45	21
356	265	263	N DIXIE HWY	MAJOR ARTERIAL	1764	2	12	4	1900	45	21
357	267	30	I-275	FREEWAY	3909	3	12	4	2250	75	1
358	267	460	I-275	FREEWAY	3103	3	12	4	2250	75	5
359	268	31	I-275	FREEWAY	4976	3	12	4	2250	75	5
360	268	459	I-275	FREEWAY	3315	3	12	4	2250	75	5

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
361	269	268	I-275 ON RAMP	FREEWAY RAMP	1710	1	12	4	1700	50	5
362	270	458	I-275	FREEWAY	8299	3	12	4	2250	75	5
363	270	829	I-275	FREEWAY	1999	3	12	4	2250	75	11
364	271	456	I-275	FREEWAY	6002	3	12	4	2250	75	11
365	271	457	I-275	FREEWAY	6849	3	12	4	2250	75	11
366	272	275	I-275	FREEWAY	1496	3	12	4	2250	75	16
367	272	455	I-275	FREEWAY	2333	3	12	4	2250	75	16
368	273	272	I-275 ON RAMP	FREEWAY RAMP	1030	1	12	4	1700	50	16
369	273	812	US-24	MAJOR ARTERIAL	813	2	12	4	1900	55	17
370	274	273	US-24	MAJOR ARTERIAL	327	2	12	4	1900	50	17
371	274	276	I-275 ON RAMP	FREEWAY RAMP	660	1	12	4	1350	30	17
372	275	22	I-275	FREEWAY	6998	2	12	4	2250	75	17
373	275	272	I-275	FREEWAY	1496	3	12	4	2250	75	16
374	276	275	I-275 ON RAMP	FREEWAY RAMP	632	1	12	4	1700	50	17
375	277	22	I-275	FREEWAY	1771	3	12	4	2250	65	17
376	277	280	I-75 ON RAMP	FREEWAY RAMP	2511	2	12	4	1900	50	17
377	277	449	I-275 Ramp to I-75 SB	FREEWAY RAMP	3448	1	12	4	1700	50	17
378	278	277	I-75 OFF RAMP	FREEWAY RAMP	1977	1	12	4	1700	50	17
379	278	280	I-75	FREEWAY	2569	3	12	4	2250	65	17
380	278	441	I-75	FREEWAY	2892	3	12	4	2250	75	17
381	279	21	I-75 NB Ramp to I-275	FREEWAY Ramp	2751	2	12	4	1900	60	17
382	279	23	I-75	FREEWAY	2395	4	12	4	2250	65	17
383	279	280	I-75	FREEWAY	2844	3	12	4	2250	65	17
384	280	278	I-75	FREEWAY	2569	3	12	4	2250	75	17
385	280	279	I-75	FREEWAY	2844	4	12	4	2250	65	17

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
386	281	450	I-75 ON RAMP	FREEWAY RAMP	744	1	12	4	1700	40	17
387	282	140	I-75	FREEWAY	4619	3	12	4	2250	75	3
388	282	285	I-75	FREEWAY	1967	3	12	4	2250	70	3
389	282	692	I-95 OFF RAMP	FREEWAY RAMP	1375	1	12	4	1750	50	3
390	283	94	SIBLEY RD	MINOR ARTERIAL	359	1	12	4	1750	40	3
391	283	282	I-95 ON RAMP	FREEWAY RAMP	1333	1	12	4	1700	50	3
392	283	692	SIBLEY RD	MINOR ARTERIAL	1197	2	12	4	1750	40	3
393	284	594	DIX TOLEDO HWY	MAJOR ARTERIAL	1392	3	12	4	1900	60	3
394	285	282	I-75	FREEWAY	1967	3	12	4	2250	75	3
395	285	287	I-75	FREEWAY	9665	3	12	4	2250	75	7
396	286	191	WEST RD	MINOR ARTERIAL	2021	2	12	4	1750	40	7
397	286	287	I-75 ON RAMP	FREEWAY RAMP	1264	1	12	4	1700	50	7
398	287	285	I-75	FREEWAY	9665	3	12	4	2250	75	7
399	287	842	I-75	FREEWAY	11814	3	12	4	2250	70	7
400	288	290	I-75	FREEWAY	1532	3	12	4	2250	70	13
401	288	683	I-75 OFF RAMP	FREEWAY RAMP	1390	1	12	4	1750	40	13
402	288	842	I-75	FREEWAY	4012	3	12	4	2250	75	7
403	289	252	GIBRALTAR RD	MAJOR ARTERIAL	206	2	12	4	1750	45	13
404	289	291	I-95 ON RAMP	FREEWAY RAMP	478	1	12	4	1575	30	13
405	290	288	I-75	FREEWAY	1532	3	12	4	2250	70	13
406	290	604	I-75	FREEWAY	2307	3	12	4	2250	70	13
407	291	290	I-95 ON RAMP	FREEWAY RAMP	713	1	12	4	1700	50	13
408	292	170	HURON RIVER DR	MAJOR ARTERIAL	743	2	12	4	1750	30	13
409	292	447	I-75 ON RAMP	FREEWAY RAMP	1184	1	12	4	1700	40	13
410	292	817	HURON RIVER DR	MAJOR ARTERIAL	751	2	12	4	1750	30	13

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
411	293	295	I-75	FREEWAY	3538	3	12	4	2250	75	13
412	293	448	I-75	FREEWAY	2396	4	12	4	2250	65	13
413	294	295	I-75 ON RAMP	FREEWAY RAMP	1116	1	12	4	1700	50	13
414	294	814	S HURON RIVER DR	MAJOR ARTERIAL	942	1	12	4	1700	40	13
415	295	293	I-75	FREEWAY	3538	3	12	4	2250	75	13
416	295	446	I-75	FREEWAY	3029	3	12	4	2250	75	13
417	296	24	I-75	FREEWAY	2370	4	12	4	2250	65	22
418	296	297	I-75	FREEWAY	2118	3	12	4	2250	65	21
419	297	296	I-75	FREEWAY	2118	3	12	4	2250	65	21
420	297	451	I-75	FREEWAY	6540	3	12	4	2250	65	21
421	298	452	I-75	FREEWAY	3644	3	12	4	2250	70	21
422	298	453	I-75	FREEWAY	4533	3	12	4	2250	70	21
423	298	736	I-75 OFF RAMP	FREEWAY RAMP	1573	1	12	4	1750	50	21
424	299	759	I-75 ON RAMP	FREEWAY RAMP	620	1	12	4	1700	40	26
425	300	209	I-75	FREEWAY	1157	4	12	4	2250	70	26
426	300	453	I-75	FREEWAY	2730	3	12	4	2250	70	26
427	301	303	I-75 ON RAMP	FREEWAY RAMP	816	1	12	4	1700	40	26
428	302	209	I-75	FREEWAY	793	3	12	4	2250	70	26
429	302	305	I-75	FREEWAY	10825	3	12	4	2250	70	26
430	303	302	I-75 ON RAMP	FREEWAY RAMP	641	1	12	4	1700	50	26
431	304	305	I-75 ON RAMP	FREEWAY RAMP	1645	1	12	4	1700	50	26
432	305	302	I-75	FREEWAY	10825	3	12	4	2250	70	26
433	305	761	I-75	FREEWAY	6700	3	12	4	2250	70	26
434	306	307	I-75 ON RAMP	FREEWAY RAMP	1635	1	12	4	1700	50	30
435	307	130	I-75	FREEWAY	4788	3	12	4	2250	70	30

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
436	307	761	I-75	FREEWAY	8210	3	12	4	2250	70	26
437	308	131	I-75	FREEWAY	3420	3	12	4	2250	70	29
438	308	454	I-75	FREEWAY	3516	3	12	4	2250	70	29
439	309	310	NADEAU RD	MINOR ARTERIAL	3503	1	12	4	1700	50	22
440	310	4	NADEAU RD	MINOR ARTERIAL	3294	1	12	4	1700	50	22
441	311	34	CLOVERDALE ST	LOCAL ROADWAY	1402	1	12	4	1750	30	22
442	312	33	GRAND BLVD	COLLECTOR	2605	1	12	4	1750	30	22
443	313	163	WOLVERINE DR	LOCAL ROADWAY	1010	1	12	4	1750	30	22
444	314	32	SANDY CREEK RD	COLLECTOR	1296	1	12	4	1750	30	22
445	315	162	STATE PARK RD	LOCAL ROADWAY	976	1	12	4	1750	30	22
446	317	244	VIVIAN RD	COLLECTOR	5941	1	12	4	1575	35	21
447	317	318	E HURD RD	COLLECTOR	3973	1	12	4	1700	45	21
448	318	319	E HURD RD	LOCAL ROADWAY	959	1	12	4	1575	35	21
449	319	106	SR 125	MAJOR ARTERIAL	4331	2	12	4	1750	50	21
450	319	107	SR 125	MAJOR ARTERIAL	2233	2	12	4	1750	50	21
451	320	80	N MACOMB ST	COLLECTOR	1361	1	12	4	1750	35	21
452	320	104	E NOBLE ST	COLLECTOR	932	1	12	4	1750	35	21
453	321	104	W NOBLE ST	COLLECTOR	779	1	12	4	1750	35	21
454	322	79	W ELM AVE	MINOR ARTERIAL	1944	1	12	4	1750	35	21
455	322	323	W ELM AVE	MINOR ARTERIAL	1608	1	12	4	1750	35	21
456	323	76	S MACOMB ST	COLLECTOR	1510	1	12	4	1575	35	21
457	323	322	W ELM AVE	MINOR ARTERIAL	1608	1	12	4	1575	35	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
458	323	618	W ELM AVE	MINOR ARTERIAL	1270	1	12	4	1700	40	21
459	324	76	SR 50	MAJOR ARTERIAL	2557	1	12	4	1575	35	21
460	324	733	E 1ST ST	COLLECTOR	360	1	12	4	1700	35	21
461	325	78	FRONT ST	COLLECTOR	905	1	12	4	1750	35	21
462	325	796	S MACOMB ST	COLLECTOR	602	1	12	4	1575	35	21
463	331	41	US-24	MAJOR ARTERIAL	3902	1	12	4	1700	60	21
464	332	57	US-24	MAJOR ARTERIAL	5851	2	12	4	1750	55	16
465	332	108	US-24	MAJOR ARTERIAL	4606	2	12	4	1900	55	16
466	333	332	BUHL RD	LOCAL ROADWAY	1310	1	12	4	1700	35	16
467	335	222	S STONY CREEK RD	MINOR ARTERIAL	2469	1	12	2	1700	50	16
468	336	57	NEWPORT RD	MINOR ARTERIAL	2472	1	12	4	1750	50	16
469	337	57	NEWPORT RD	COLLECTOR	6741	1	12	4	1750	50	16
470	338	56	US-24	MAJOR ARTERIAL	10983	2	12	4	1750	55	12
471	338	812	US-24	MAJOR ARTERIAL	6746	2	12	4	1900	50	17
472	339	338	1ST ST	LOCAL ROADWAY	1201	1	12	4	1700	30	12
473	340	54	S HURON RIVER DR	MAJOR ARTERIAL	2145	1	12	0	1750	35	12
474	341	830	WILL CARLETON RD	MINOR ARTERIAL	3936	1	12	4	1700	45	11
475	342	56	CARLETON ROCKWOOD RD	COLLECTOR	8025	1	12	4	1750	40	12
476	345	54	US-24	MAJOR ARTERIAL	6029	2	12	4	1750	45	12
477	345	56	US-24	MAJOR ARTERIAL	5446	2	12	4	1750	55	12
478	347	114	US-24	MAJOR ARTERIAL	356	2	12	4	1750	35	12
479	347	350	US-24	MAJOR ARTERIAL	506	2	12	4	1750	35	12
480	349	363	INKSTER RD	COLLECTOR	5886	1	12	4	1750	40	6

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
481	349	651	W HURON RIVER DR	MINOR ARTERIAL	6580	1	12	4	1700	40	6
482	350	115	US-24	MAJOR ARTERIAL	3075	2	12	4	1750	45	6
483	350	347	US-24	MAJOR ARTERIAL	506	2	12	4	1900	35	12
484	350	349	W HURON RIVER DR	MINOR ARTERIAL	4393	1	12	4	1700	40	6
485	351	350	YPSILANTI ST	LOCAL ROADWAY	1260	1	12	4	1750	35	12
486	352	115	LEONARD ST	LOCAL ROADWAY	864	1	12	4	1750	30	6
487	354	116	VREELAND RD	MAJOR ARTERIAL	2452	1	12	4	1750	35	6
488	362	48	VAN HORN RD	MINOR ARTERIAL	5321	1	12	4	1700	45	7
489	362	191	HALL RD	COLLECTOR	5297	2	12	4	1750	30	7
490	362	207	VAN HORN RD	MINOR ARTERIAL	5531	1	12	4	1750	40	7
491	363	117	VAN HORN RD	MINOR ARTERIAL	7773	1	12	4	1750	40	6
492	363	366	INKSTER RD	COLLECTOR	5226	1	12	4	1750	40	6
493	364	118	US 24	MAJOR ARTERIAL	1284	3	12	4	1750	50	6
494	366	627	INKSTER RD	COLLECTOR	5353	1	12	4	1750	40	6
495	367	194	DIX TOLEDO HWY	MAJOR ARTERIAL	3597	2	12	4	1750	60	7
496	370	192	GUDITH RD	COLLECTOR	2670	1	12	4	1750	30	7
497	370	367	CARTER RD	COLLECTOR	2352	1	12	4	1750	40	7
498	371	50	EVERGREEN ST	LOCAL ROADWAY	1081	1	12	4	1750	30	12
499	372	373	E HURON RIVER DR	COLLECTOR	1563	1	12	4	1575	35	12
500	372	374	ASPEN DR	LOCAL ROADWAY	573	1	12	4	1350	30	12
501	373	50	EVERGREEN ST	LOCAL ROADWAY	1840	1	12	4	1750	30	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
502	373	52	E HURON RIVER DR	COLLECTOR	2552	1	12	4	1575	35	12
503	374	49	ASPEN DR	LOCAL ROADWAY	2544	1	12	4	1750	30	12
504	376	354	PETERS RD	LOCAL ROADWAY	3395	1	12	4	1350	30	6
505	376	784	PETERS RD	LOCAL ROADWAY	1123	1	12	4	1575	35	6
506	379	47	GATEWAY DR	COLLECTOR	1198	2	12	4	1750	35	13
507	380	47	GATEWAY DR	LOCAL ROADWAY	601	1	12	4	1750	35	13
508	387	42	GIBRALTAR RD	MAJOR ARTERIAL	3254	1	12	4	1750	30	13
509	387	553	S GIBRALTAR RD	LOCAL ROADWAY	1834	1	12	4	1350	30	13
510	388	159	ALLEN RD	COLLECTOR	2060	1	12	4	1750	40	13
511	389	160	SR 85	MAJOR ARTERIAL	1988	2	12	4	1750	55	13
512	390	208	VREELAND RD	MINOR ARTERIAL	2876	1	12	4	1750	40	7
513	390	395	SR 85	MAJOR ARTERIAL	3204	2	12	4	1900	55	7
514	391	645	OSTREICH RD	COLLECTOR	2403	1	12	4	1700	45	13
515	392	172	VAN HORN RD	MINOR ARTERIAL	4375	2	12	4	1750	40	7
516	392	398	SR 85	MAJOR ARTERIAL	5622	2	12	4	1750	55	7
517	392	657	VAN HORN RD	MINOR ARTERIAL	1896	2	12	4	1750	40	7
518	395	392	SR 85	MAJOR ARTERIAL	3280	2	12	4	1750	55	7
519	398	156	SR 85	MAJOR ARTERIAL	633	2	12	4	1750	55	7
520	409	155	SR 85	MAJOR ARTERIAL	1871	2	12	4	1750	55	7
521	419	154	SR 85	MAJOR ARTERIAL	606	2	12	4	1750	55	7
522	421	154	KING RD	MINOR ARTERIAL	3508	2	12	4	1750	40	7

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
523	421	558	W JEFFERSON AVE	MAJOR ARTERIAL	5565	2	12	4	1750	45	8
524	424	152	SR 85	MAJOR ARTERIAL	754	2	12	4	1750	55	3
525	440	441	I-75 ON RAMP	FREEWAY RAMP	1966	1	12	4	1700	50	17
526	440	442	SWAN CREEK RD	MINOR ARTERIAL	1295	1	12	4	1575	35	17
527	440	574	SWAN CREEK RD	COLLECTOR	2451	1	12	2	1700	50	17
528	440	811	SWAN CREEK RD	COLLECTOR	5526	1	12	2	1700	40	17
529	441	278	I-75	FREEWAY	2892	4	12	4	2250	75	17
530	441	444	I-75	FREEWAY	1158	3	12	4	2250	75	17
531	442	440	SWAN CREEK RD	MINOR ARTERIAL	1295	1	12	4	1575	35	17
532	442	443	I-75 ON RAMP	FREEWAY RAMP	548	1	12	4	1350	30	17
533	443	444	I-75 ON RAMP	FREEWAY RAMP	521	1	12	4	1700	40	17
534	444	441	I-75	FREEWAY	1158	3	12	4	2250	75	17
535	444	445	I-75	FREEWAY	14884	3	12	4	2250	75	17
536	445	444	I-75	FREEWAY	14884	3	12	4	2250	75	17
537	445	446	I-75	FREEWAY	9364	3	12	4	2250	75	12
538	446	295	I-75	FREEWAY	3029	3	12	4	2250	75	13
539	446	445	I-75	FREEWAY	9364	3	12	4	2250	75	12
540	447	293	I-7 ON RAMP	FREEWAY RAMP	621	1	12	4	1700	50	13
541	448	293	I-75	FREEWAY	2396	3	12	4	2250	75	13
542	448	603	SR 85	MAJOR ARTERIAL	2748	1	12	4	1700	50	13
543	448	604	I-75	FREEWAY	3319	3	12	4	2250	70	13
544	449	281	I-75 ON RAMP	FREEWAY RAMP	1139	1	12	4	1700	40	17
545	450	280	I-75 ON RAMP	FREEWAY RAMP	678	1	12	4	1700	50	17
546	451	297	I-75	FREEWAY	6536	3	12	4	2250	65	21
547	451	452	I-75	FREEWAY	4947	3	12	4	2250	65	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
548	452	298	I-75	FREEWAY	3637	3	12	4	2250	70	21
549	452	451	I-75	FREEWAY	4946	3	12	4	2250	65	21
550	453	298	I-75	FREEWAY	4533	3	12	4	2250	70	21
551	453	300	I-75	FREEWAY	2730	3	12	4	2250	70	26
552	454	308	I-75	FREEWAY	3516	3	12	4	2250	70	29
553	455	272	I-275	FREEWAY	2333	3	12	4	2250	75	16
554	455	456	I-275	FREEWAY	9877	3	12	4	2250	75	11
555	456	271	I-275	FREEWAY	6002	3	12	4	2250	75	11
556	456	455	I-275	FREEWAY	9877	3	12	4	2250	75	11
557	457	271	I-275	FREEWAY	6849	3	12	4	2250	75	11
558	457	829	I-275	FREEWAY	2324	3	12	4	2250	75	11
559	458	31	I-275	FREEWAY	3087	3	12	4	2250	75	5
560	458	270	I-275	FREEWAY	8299	3	12	4	2250	75	5
561	459	268	I-275	FREEWAY	3311	3	12	4	2250	75	5
562	459	460	I-275	FREEWAY	3705	3	12	4	2250	75	5
563	460	267	I-275	FREEWAY	3103	3	12	4	2250	75	5
564	460	459	I-275	FREEWAY	3705	3	12	4	2250	75	5
565	462	35	N DIXIE HWY	MAJOR ARTERIAL	2875	1	12	4	1750	50	22
566	462	36	N DIXIE HWY	MAJOR ARTERIAL	3458	1	12	4	1750	40	22
567	463	35	POINTE AUX PEAUX RD	COLLECTOR	5940	1	12	4	1750	40	22
568	464	36	FERMI DR	COLLECTOR	1590	1	12	4	1750	50	22
569	467	695	SWAN CREEK RD	MINOR ARTERIAL	747	1	12	4	1750	30	17
570	468	805	N DIXIE HWY	MAJOR ARTERIAL	1343	1	12	4	1750	50	17
571	468	838	SWAN CREEK RD	MINOR ARTERIAL	1186	1	12	4	1700	50	17
572	469	470	DIXIE HWY	MINOR ARTERIAL	4351	1	12	4	1750	35	13

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
573	470	170	FORT ST	MINOR ARTERIAL	2832	1	12	4	1750	35	13
574	470	294	S HURON RIVER DR	MAJOR ARTERIAL	349	1	12	4	1350	30	13
575	472	477	U.S. TURNPIKE RD	MAJOR ARTERIAL	7270	1	12	4	1700	55	18
576	473	472	PORT SUNLIGHT RD	COLLECTOR	5384	1	12	4	1750	50	18
577	474	473	PORT SUNLIGHT RD	COLLECTOR	2578	1	12	4	1700	50	18
578	475	474	PORT SUNLIGHT RD	COLLECTOR	2233	1	12	4	1350	30	18
579	477	634	U.S. TURNPIKE RD	MAJOR ARTERIAL	1633	1	12	4	1700	55	18
580	493	464	FERMI DR	COLLECTOR	5835	1	12	4	1700	40	22
581	498	134	S OTTER CREEK RD	COLLECTOR	1294	1	12	4	1350	30	25
582	498	145	YARGERVILLE RD	COLLECTOR	15114	1	12	4	1700	55	25
583	498	262	US 24	MAJOR ARTERIAL	11863	1	12	4	1700	50	25
584	500	74	E DUNBAR RD	COLLECTOR	2705	1	12	4	1750	50	26
585	501	65	PATTERSON DR	LOCAL ROADWAY	1805	1	12	4	1750	35	21
586	501	75	W 7TH ST	LOCAL ROADWAY	1250	2	12	4	1750	35	21
587	502	75	W 7TH ST	LOCAL ROADWAY	1677	2	12	4	1750	35	21
588	503	65	BELLESTRI DR	LOCAL ROADWAY	764	1	12	4	1750	35	21
589	505	66	HERR RD	COLLECTOR	5530	1	12	4	1750	45	20
590	505	136	E DUNBAR RD	COLLECTOR	3045	1	12	4	1700	45	25
591	505	500	E DUNBAR RD	COLLECTOR	2868	1	12	4	1700	50	25
592	506	20	SR 50	MAJOR ARTERIAL	12434	1	12	4	1700	65	20
593	507	67	S RAISINVILLE RD	COLLECTOR	9137	1	12	4	1750	50	20
594	507	137	W DUNBAR RD	COLLECTOR	7313	1	12	4	1700	55	20

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
595	508	67	S RAISINVILLE RD	COLLECTOR	1018	1	12	4	1750	45	20
596	508	774	N CUSTER RD	MINOR ARTERIAL	1360	1	12	4	1750	45	20
597	509	230	SR 125	MINOR ARTERIAL	12218	1	12	4	1750	60	29
598	511	221	KNAB RD	LOCAL ROADWAY	947	1	12	4	1575	35	26
599	512	306	S OTTER CREEK RD	COLLECTOR	1288	1	12	4	1700	40	30
600	513	700	E ALBAIN RD	COLLECTOR	997	1	12	4	1700	40	26
601	514	97	W ALBAIN RD	COLLECTOR	3812	1	12	4	1750	40	26
602	514	734	E ALBAIN RD	COLLECTOR	2305	1	12	4	1350	30	26
603	515	514	HULL RD	LOCAL ROADWAY	1853	1	12	4	1700	40	26
604	516	518	PINE CONE TRAIL	LOCAL ROADWAY	1322	1	12	4	1575	35	26
605	517	98	SHOPPING PLAZA	LOCAL ROADWAY	783	1	12	4	1750	25	26
606	518	99	E DUNBAR RD	COLLECTOR	1975	1	12	4	1750	40	26
607	518	520	E DUNBAR RD	COLLECTOR	2631	1	12	4	1700	40	26
608	519	177	LAPLAISANCE RD	COLLECTOR	1892	1	12	4	1575	35	26
609	520	217	LAPLAISANCE RD	COLLECTOR	5022	1	12	4	1700	40	26
610	523	100	JONES AVE	COLLECTOR	1597	1	12	4	1750	35	26
611	523	177	JONES AVE	COLLECTOR	674	1	12	4	1575	35	26
612	524	100	KROGER SHOPPING PLAZA	LOCAL ROADWAY	373	1	12	4	1750	35	26
613	525	68	BLUE BUSH RD	MINOR ARTERIAL	4370	1	12	4	1700	55	21
614	525	660	STEWART RD	COLLECTOR	4323	1	12	4	1700	50	21
615	525	726	STEWART RD	COLLECTOR	10747	1	12	2	1750	40	20

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
616	526	258	W LORAIN ST	LOCAL ROADWAY	631	1	12	4	1750	30	21
617	526	618	HUBAR DR	LOCAL ROADWAY	2007	1	12	4	1350	30	21
618	527	258	W LORAIN ST	LOCAL ROADWAY	596	1	12	4	1750	30	21
619	528	62	FREDERICKS DR	LOCAL ROADWAY	646	1	12	4	1750	30	21
620	528	526	HUBAR DR	LOCAL ROADWAY	1406	1	12	4	1350	30	21
621	529	62	FREDERICKS DR	LOCAL ROADWAY	1970	1	12	4	1750	30	21
622	530	61	HOLIDAY BLVD	LOCAL ROADWAY	937	1	12	4	1750	30	21
623	531	60	STEWART RD	COLLECTOR	2571	2	12	4	1750	45	21
624	531	105	STEWART RD	COLLECTOR	2385	2	12	4	1750	45	21
625	532	59	MALL RD	COLLECTOR	1351	1	12	4	1750	30	21
626	533	59	MALL RD	COLLECTOR	1624	1	12	4	1750	35	21
627	534	227	S STONY CREEK RD	MINOR ARTERIAL	4118	1	12	2	1700	40	15
628	535	583	CARLETON WEST RD	COLLECTOR	2742	1	12	4	1700	40	11
629	535	674	CARLETON WEST RD	COLLECTOR	552	1	12	0	1700	40	11
630	536	823	EXETER RD	COLLECTOR	1636	1	12	4	1700	40	16
631	537	110	SUMPTER RD	LOCAL ROADWAY	1096	1	12	4	1700	40	15
632	538	110	SUMPTER RD	COLLECTOR	3148	1	12	4	1700	40	10
633	539	219	S STONY CREEK RD	MINOR ARTERIAL	4095	1	12	2	1700	55	10
634	541	669	PALMER RD	COLLECTOR	2306	1	12	4	1700	40	14

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
635	541	739	OSTRANDER RD	COLLECTOR	3665	1	12	4	1700	40	14
636	543	470	S HURON RIVER DR	MAJOR ARTERIAL	2934	1	12	4	1750	30	13
637	544	638	S HURON RIVER DR	MAJOR ARTERIAL	1669	1	12	4	1700	50	13
638	545	40	HURON RIVER DR	MAJOR ARTERIAL	3971	1	12	4	1700	40	13
639	545	546	HURON RIVER DR	MAJOR ARTERIAL	5539	1	12	4	1350	30	13
640	546	170	HURON RIVER DR	MAJOR ARTERIAL	1165	1	12	4	1750	30	13
641	547	42	W JEFFERSON AVE	MAJOR ARTERIAL	4071	1	12	4	1750	50	13
642	549	40	HURON RIVER DR	MAJOR ARTERIAL	970	1	12	4	1350	30	13
643	550	640	WOODRUFF RD	COLLECTOR	2215	1	12	4	1350	30	13
644	550	644	WOODRUFF RD	COLLECTOR	3225	1	12	4	1350	30	13
645	550	645	FORT ST	MINOR ARTERIAL	5628	1	12	4	1700	45	13
646	552	208	ALLEN RD	COLLECTOR	2951	1	12	4	1750	50	7
647	552	388	ALLEN RD	COLLECTOR	1255	1	12	4	1700	40	7
648	553	547	S GIBRALTAR RD	LOCAL ROADWAY	4602	1	12	4	1750	30	13
649	554	547	SCHOOL	LOCAL ROADWAY	988	1	12	4	1750	30	13
650	557	178	W JEFFERSON AVE	MAJOR ARTERIAL	934	1	12	4	1750	30	7
651	558	200	SIBLEY RD	MINOR ARTERIAL	2502	1	12	4	1750	35	3
652	558	707	W JEFFERSON AVE	MAJOR ARTERIAL	1993	2	12	4	1900	40	4
653	559	194	KING RD	MINOR ARTERIAL	7139	1	12	4	1750	40	7
654	559	196	ALLEN RD	COLLECTOR	5262	2	12	4	1750	50	7
655	563	185	GRANGE RD	COLLECTOR	792	1	12	4	1750	30	7
656	567	191	HALL RD	COLLECTOR	1127	1	12	4	1750	30	7
657	569	301	FRONT ST	COLLECTOR	2465	1	12	4	1900	45	26

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
658	570	82	E NOBLE ST	COLLECTOR	3044	1	12	2	1750	35	21
659	570	190	RIVERVIEW AVE	COLLECTOR	1222	1	12	4	1750	35	21
660	570	320	E NOBLE ST	COLLECTOR	1094	1	12	4	1750	35	21
661	571	83	TERNES DR	LOCAL ROADWAY	531	1	12	4	1750	30	21
662	572	15	SANDY CREEK RD	COLLECTOR	2976	1	12	4	1700	50	21
663	573	332	BUHL RD	COLLECTOR	5245	1	12	2	1700	40	16
664	573	336	WAR RD	COLLECTOR	5182	1	12	4	1750	40	17
665	574	336	NEWPORT RD	MINOR ARTERIAL	5873	1	12	4	1750	50	17
666	574	440	SWAN CREEK RD	MINOR ARTERIAL	2449	1	12	4	1700	50	17
667	575	574	JOANN ST	LOCAL ROADWAY	1835	1	12	4	1350	30	17
668	577	585	MINERAL SPRINGS RD	COLLECTOR	2011	1	12	4	1700	50	11
669	577	834	OAKVILLE WALTZ RD	COLLECTOR	2187	1	12	2	1700	50	11
670	578	237	MAXWELL RD	LOCAL ROADWAY	3533	1	12	4	1350	30	11
671	579	754	MAXWELL RD	LOCAL ROADWAY	8341	1	12	4	1575	35	11
672	580	234	GRAFTON RD	LOCAL ROADWAY	631	1	12	4	1350	30	11
673	581	755	GRAFTON RD	LOCAL ROADWAY	8751	1	12	4	1750	40	11
674	582	237	CARLETON WEST RD	COLLECTOR	2530	1	12	4	1350	30	11
675	583	582	CARLETON WEST RD	COLLECTOR	1275	1	12	4	1350	30	11
676	584	232	CARLETON ROCKWOOD RD	COLLECTOR	3223	1	12	4	1700	50	11
677	585	620	WALTZ RD	COLLECTOR	3886	1	12	4	1700	50	5

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
678	587	198	VALLEYVIEW ST	LOCAL ROADWAY	1071	1	12	4	1750	30	3
679	589	197	GRANGE RD	LOCAL ROADWAY	2015	1	12	4	1750	30	3
680	590	199	STONEWOOD RD	LOCAL ROADWAY	848	1	12	4	1750	30	3
681	592	200	QUARRY RD	LOCAL ROADWAY	738	1	12	4	1750	35	3
682	593	691	DIX TOLEDO HWY	MAJOR ARTERIAL	905	2	12	4	1900	60	6
683	593	787	US 24	MAJOR ARTERIAL	758	2	12	4	1750	55	6
684	594	94	DIX TOLEDO HWY	MAJOR ARTERIAL	1356	2	12	4	1750	55	3
685	594	285	I-75 ON RAMP	FREEWAY RAMP	763	1	12	4	1700	55	3
686	595	205	CARTER RD	LOCAL ROADWAY	721	1	12	4	1750	30	7
687	596	187	MONTEREY DR	LOCAL ROADWAY	2621	1	12	4	1750	30	7
688	596	205	CARTER RD	LOCAL ROADWAY	1304	1	12	4	1750	30	7
689	601	208	VREELAND RD	MINOR ARTERIAL	2457	1	12	4	1750	40	7
690	602	552	ROCHE RD	LOCAL ROADWAY	994	1	12	4	1575	35	7
691	603	389	SR 85	MAJOR ARTERIAL	2778	2	12	4	1900	50	13
692	604	290	I-75	FREEWAY	2307	3	12	4	2250	70	13
693	604	448	I-75	FREEWAY	3285	3	12	4	2250	65	13
694	605	647	S HURON RIVER DR	MAJOR ARTERIAL	3288	1	12	0	1700	40	12
695	605	756	S HURON RIVER DR	MAJOR ARTERIAL	1387	1	12	4	1700	40	12
696	606	372	E HURON RIVER DR	COLLECTOR	655	1	12	4	1575	35	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
697	607	606	WOODRUFF RD	COLLECTOR	1127	1	12	4	1350	30	12
698	608	91	SIBLEY RD	MAJOR ARTERIAL	5447	1	12	4	1750	50	3
699	608	692	SIBLEY RD	MINOR ARTERIAL	475	2	12	4	1750	40	3
700	609	88	SIBLEY RD	MINOR ARTERIAL	5180	1	12	4	1750	50	2
701	609	746	INKSTER RD	COLLECTOR	5283	1	12	4	1750	45	2
702	610	424	SR 85	MAJOR ARTERIAL	278	2	12	4	1750	20	3
703	611	419	SR 85	MAJOR ARTERIAL	211	2	12	4	1750	20	7
704	612	398	SR 85	MAJOR ARTERIAL	215	2	12	4	1750	25	7
705	613	677	OAKVILLE WALTZ RD	COLLECTOR	1362	1	12	2	1700	40	11
706	616	617	N CUSTER RD	MINOR ARTERIAL	670	1	12	4	1575	35	21
707	616	632	N CUSTER RD	MINOR ARTERIAL	5080	1	12	4	1575	35	21
708	616	775	CUSTER DR	COLLECTOR	553	1	12	4	1350	30	21
709	617	616	N CUSTER RD	MINOR ARTERIAL	670	1	12	4	1575	35	21
710	617	618	N CUSTER RD	MINOR ARTERIAL	213	1	12	4	1700	40	21
711	618	323	W ELM AVE	MINOR ARTERIAL	1265	1	12	4	1750	40	21
712	618	617	N CUSTER RD	MINOR ARTERIAL	213	1	12	4	1750	40	21
713	620	763	WALTZ RD	COLLECTOR	2784	1	12	4	1700	40	5
714	621	269	S HURON RD	COLLECTOR	6328	1	12	4	1700	45	5
715	623	120	KING RD	MINOR ARTERIAL	3219	1	12	4	1750	40	6
716	623	627	KING RD	MINOR ARTERIAL	7460	1	12	4	1750	40	6
717	625	605	GILDERSLEEVE ST	LOCAL ROADWAY	1693	1	12	4	1350	30	12
718	626	628	MIDDLEBELT RD	COLLECTOR	5297	1	12	4	1750	40	6
719	627	609	INKSTER RD	COLLECTOR	5366	1	12	4	1750	45	6
720	627	628	KING RD	COLLECTOR	5195	1	12	4	1700	40	6

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
721	628	88	MIDDLEBELT RD	COLLECTOR	5239	1	12	4	1750	45	6
722	628	753	KING RD	COLLECTOR	10514	1	12	4	1700	45	6
723	630	70	BLUE BUSH RD	MINOR ARTERIAL	3780	1	12	4	1700	45	15
724	632	508	N CUSTER RD	MINOR ARTERIAL	8234	1	12	4	1700	45	20
725	633	506	SR 50	MAJOR ARTERIAL	4830	1	12	4	1700	65	20
726	634	635	U.S. TURNPIKE RD	MAJOR ARTERIAL	4135	1	12	4	1700	55	18
727	635	167	U.S. TURNPIKE RD	MAJOR ARTERIAL	1414	1	12	4	1700	50	13
728	636	637	W JEFFERSON AVE	MAJOR ARTERIAL	4659	1	12	4	1700	50	13
729	637	40	W JEFFERSON AVE	MAJOR ARTERIAL	2483	1	12	4	1700	50	13
730	638	639	S HURON RIVER DR	MAJOR ARTERIAL	3823	1	12	4	1700	40	13
731	639	543	S HURON RIVER DR	MAJOR ARTERIAL	1774	1	12	4	1575	35	13
732	640	391	OSTREICH RD	COLLECTOR	2229	1	12	4	1700	40	13
733	641	547	W JEFFERSON AVE	MAJOR ARTERIAL	978	1	12	4	1750	50	13
734	641	640	WOODRUFF RD	COLLECTOR	5232	1	12	4	1700	45	13
735	642	607	WOODRUFF RD	COLLECTOR	2262	1	12	4	1350	30	12
736	643	642	WOODRUFF RD	COLLECTOR	2468	1	12	4	1350	30	12
737	644	643	WOODRUFF RD	COLLECTOR	2002	1	12	4	1350	30	13
738	645	43	FORT ST	MINOR ARTERIAL	908	1	12	4	1750	50	13
739	646	340	S HURON RIVER DR	MAJOR ARTERIAL	4705	1	12	0	1700	40	12
740	647	646	S HURON RIVER DR	MAJOR ARTERIAL	3483	1	12	0	1700	40	12
741	648	606	HURON RIVER DR	MAJOR ARTERIAL	4053	1	12	4	1350	30	12
742	649	47	GIBRALTAR RD	MAJOR ARTERIAL	3985	2	12	4	1750	35	13
743	649	49	GIBRALTAR RD	MAJOR ARTERIAL	3392	1	12	4	1750	45	12
744	650	363	VAN HORN RD	MINOR ARTERIAL	5302	1	12	4	1750	40	6
745	650	626	MIDDLEBELT RD	COLLECTOR	5144	1	12	4	1700	40	6

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
746	651	650	MIDDLEBELT RD	COLLECTOR	2201	1	12	4	1750	45	6
747	652	202	KING RD	MINOR ARTERIAL	1437	2	12	4	1750	45	7
748	652	203	KING RD	MINOR ARTERIAL	3755	1	12	4	1750	40	7
749	653	655	W JEFFERSON AVE	MAJOR ARTERIAL	1779	2	12	4	1900	40	7
750	654	421	W JEFFERSON AVE	MAJOR ARTERIAL	2363	2	12	4	1750	45	7
751	655	174	W JEFFERSON AVE	MAJOR ARTERIAL	1020	1	12	4	1750	30	7
752	656	172	W JEFFERSON AVE	MAJOR ARTERIAL	885	2	12	4	1750	50	7
753	657	207	VAN HORN RD	MINOR ARTERIAL	4603	1	12	4	1750	40	7
754	658	657	VALLEY RD	LOCAL ROADWAY	729	1	12	4	1750	30	7
755	659	117	US-24	MAJOR ARTERIAL	2867	2	12	4	1750	50	6
756	660	60	STEWART RD	COLLECTOR	744	2	12	4	1750	40	21
757	660	525	STEWART RD	COLLECTOR	4323	1	12	4	1700	50	21
758	661	469	DIXIE HWY	MINOR ARTERIAL	5327	1	12	4	1700	50	12
759	662	780	POST RD	COLLECTOR	5156	1	12	4	1750	40	17
760	664	531	LAVENDAR ST	LOCAL ROADWAY	690	1	12	4	1750	30	21
761	665	71	BLUE BUSH RD	MINOR ARTERIAL	6690	1	12	4	1700	50	15
762	666	665	BLUE BUSH RD	MINOR ARTERIAL	681	1	12	4	1700	40	15
763	667	111	BLUE BUSH RD	MINOR ARTERIAL	3247	1	15	0	1575	35	14
764	668	667	RAISIN ST	LOCAL ROADWAY	817	1	12	4	1575	35	15
765	669	670	PALMER RD	COLLECTOR	13778	1	12	0	1700	55	14
766	670	740	S STONY CREEK RD	MINOR ARTERIAL	805	1	12	2	1700	45	9
767	671	538	SUMPTER RD	COLLECTOR	2582	1	12	4	1700	40	10
768	674	675	CARLETON WEST RD	COLLECTOR	2738	1	12	0	1700	45	11

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
769	675	676	CARLETON WEST RD	COLLECTOR	7861	1	12	0	1700	45	11
770	676	762	OAKVILLE WALTZ RD	MINOR ARTERIAL	13340	1	12	4	1700	55	10
771	677	828	OAKVILLE WALTZ RD	COLLECTOR	1439	1	12	2	1700	40	11
772	679	114	US-24	MAJOR ARTERIAL	967	2	12	4	1750	35	12
773	679	681	WILL CARLETON RD	MINOR ARTERIAL	179	1	12	4	1700	40	12
774	680	341	WILL CARLETON RD	MINOR ARTERIAL	13000	1	12	4	1700	40	12
775	681	679	WILL CARLETON RD	MINOR ARTERIAL	179	1	12	4	1750	40	12
776	681	680	WILL CARLETON RD	MINOR ARTERIAL	1041	1	12	4	1700	40	12
777	682	379	GATEWAY DR	COLLECTOR	1340	2	12	4	1900	35	13
778	683	289	GIBRALTAR RD	MAJOR ARTERIAL	1235	2	12	4	1900	45	13
779	684	203	GRANGE RD	COLLECTOR	2589	1	12	4	1750	30	7
780	685	421	KING RD	LOCAL ROADWAY	1067	1	12	4	1750	25	7
781	686	557	ELIZABETH DR	LOCAL ROADWAY	771	1	12	4	1750	30	7
782	687	180	EDSEL ST	LOCAL ROADWAY	476	2	12	4	1750	30	7
783	688	179	ROSEWOOD ST	LOCAL ROADWAY	352	1	12	4	1750	30	7
784	689	362	HALL RD	COLLECTOR	789	1	12	4	1700	40	7
785	690	86	SIBLEY RD	MINOR ARTERIAL	372	2	12	4	1900	50	5
786	691	367	DIX TOLEDO HWY	MAJOR ARTERIAL	1032	2	12	4	1750	60	6
787	691	593	DIX TOLEDO HWY	MAJOR ARTERIAL	905	2	12	4	1750	60	6
788	692	283	SIBLEY RD	MINOR ARTERIAL	1165	2	12	4	1900	40	3
789	692	608	SIBLEY RD	MINOR ARTERIAL	444	2	12	4	1750	40	3
790	693	601	VREELAND RD	MINOR ARTERIAL	914	1	12	4	1700	40	7

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
791	694	169	OLMSTEAD RD	LOCAL ROADWAY	1519	1	12	4	1700	30	13
792	695	442	SWAN CREEK RD	MINOR ARTERIAL	351	1	12	4	1350	30	17
793	696	695	PARKING LOT	LOCAL ROADWAY	385	1	12	4	1750	30	17
794	697	501	W 7TH ST	LOCAL ROADWAY	844	1	12	4	1575	35	21
795	698	505	HERR RD	COLLECTOR	1091	1	12	4	1700	40	25
796	699	229	HAROLD DR	LOCAL ROADWAY	1399	1	12	4	1350	30	30
797	700	701	E ALBAIN RD	COLLECTOR	1460	1	12	4	1700	40	26
798	701	217	E ALBAIN RD	COLLECTOR	556	1	12	4	1700	40	26
799	702	528	HUBAR DR	LOCAL ROADWAY	238	1	12	4	1350	30	21
800	703	204	W LORAIN ST	LOCAL ROADWAY	654	1	12	4	1350	30	21
801	704	84	I-75 OFF RAMP	FREEWAY RAMP	490	1	12	4	1750	40	21
802	705	53	MILL ST	LOCAL ROADWAY	333	1	12	4	1700	40	21
803	706	95	GROSSE ILE PKWY	COLLECTOR	2067	1	12	4	1750	40	8
804	707	90	W JEFFERSON AVE	MAJOR ARTERIAL	302	2	12	4	1750	30	4
805	708	545	STEFANO CT	LOCAL ROADWAY	1370	1	12	4	1350	30	13
806	709	650	VAN HORN RD	MINOR ARTERIAL	1269	1	12	4	1750	45	6
807	710	153	MAHOGANY DR	LOCAL ROADWAY	464	1	12	4	1350	30	6
808	711	557	W JEFFERSON AVE	MAJOR ARTERIAL	505	1	12	4	1750	30	7

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
809	712	174	PARKING LOT	LOCAL ROADWAY	300	1	12	4	1750	30	7
810	713	178	WEST RD	LOCAL ROADWAY	367	1	12	4	1750	30	7
811	714	156	WEST RD	MINOR ARTERIAL	2845	2	12	4	1750	35	7
812	715	714	3RD ST	LOCAL ROADWAY	496	1	12	0	1750	30	7
813	715	788	ST JOSEPH AVE	COLLECTOR	379	1	12	4	1700	30	7
814	716	180	WEST RD	MINOR ARTERIAL	716	2	12	4	1750	35	7
815	716	718	WEST RD	MINOR ARTERIAL	1367	2	12	4	1750	35	7
816	717	716	BRIDGE ST	LOCAL ROADWAY	368	1	12	0	1750	30	7
817	718	716	WEST RD	MINOR ARTERIAL	1367	2	12	4	1750	35	7
818	718	720	WEST RD	MINOR ARTERIAL	953	2	12	4	1750	35	7
819	719	718	WESTFIELD RD	LOCAL ROADWAY	948	1	12	0	1750	30	7
820	720	185	WEST RD	MINOR ARTERIAL	920	2	12	4	1750	35	7
821	720	718	WEST RD	MINOR ARTERIAL	953	2	12	4	1750	35	7
822	721	720	MANNING ST	LOCAL ROADWAY	1070	1	12	0	1750	30	7
823	722	187	WEST RD	MINOR ARTERIAL	1528	2	12	4	1750	35	7
824	723	722	LONGMEADOW DR	LOCAL ROADWAY	888	1	12	0	1750	30	7
825	724	95	MERIDIAN RD	COLLECTOR	1079	1	12	4	1750	40	8
826	725	621	S HURON RD	COLLECTOR	5356	1	12	4	1750	35	5
827	726	774	N RAISINVILLE RD	COLLECTOR	8923	1	12	2	1750	40	20

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
828	727	123	BONNER RD	LOCAL ROADWAY	455	1	12	4	1700	45	26
829	728	1	FERMI DR	COLLECTOR	1143	1	12	4	1700	40	23
830	729	376	PETERS RD	LOCAL ROADWAY	419	1	12	4	1350	30	6
831	730	731	E 5TH ST	LOCAL ROADWAY	342	1	12	4	1350	30	21
832	731	519	SCOTT ST	LOCAL ROADWAY	370	1	12	4	1750	30	26
833	732	101	SR 125	MINOR ARTERIAL	1861	2	12	4	1750	30	21
834	732	796	E 1ST ST	COLLECTOR	792	1	12	4	1700	35	21
835	733	732	W 1ST ST	COLLECTOR	428	1	12	6	1750	35	21
836	734	513	E ALBAIN RD	COLLECTOR	1318	1	12	4	1350	30	26
837	734	795	HULL RD	COLLECTOR	5561	1	12	4	1700	40	26
838	735	145	STRASBURG RD	COLLECTOR	3881	1	12	4	1700	40	25
839	736	84	N DIXIE HWY	MAJOR ARTERIAL	1193	2	12	4	1750	45	21
840	737	32	N DIXIE HWY	MAJOR ARTERIAL	523	1	12	4	1750	50	22
841	737	738	E HURD RD	COLLECTOR	7917	1	12	4	1700	45	21
842	738	317	E HURD RD	COLLECTOR	1668	1	12	4	1700	45	21
843	738	737	E HURD RD	COLLECTOR	7912	1	12	4	1700	45	21
844	741	149	IDA MAYBEE RD	COLLECTOR	1747	1	12	4	1700	40	19
845	742	55	DIX TOLEDO HWY	MAJOR ARTERIAL	3060	2	12	4	1900	55	3
846	743	46	ALLEN RD	COLLECTOR	1536	2	12	4	1900	50	3
847	743	744	PENNSYLVANIA RD	COLLECTOR	5302	1	12	4	1750	40	3
848	744	743	PENNSYLVANIA RD	COLLECTOR	5302	1	12	4	1750	40	3
849	744	745	PENNSYLVANIA RD	COLLECTOR	5335	1	12	4	1750	40	3

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
850	745	629	US 24	MAJOR ARTERIAL	903	2	12	4	1900	55	2
851	745	748	PENNSYLVANIA RD	COLLECTOR	5286	1	12	4	1750	40	2
852	746	142	INKSTER RD	COLLECTOR	1940	1	12	4	1700	45	2
853	746	747	PENNSYLVANIA RD	COLLECTOR	5275	1	12	4	1750	40	2
854	747	141	MIDDLEBELT RD	COLLECTOR	1672	1	12	4	1700	45	2
855	748	746	PENNSYLVANIA RD	COLLECTOR	5264	1	12	4	1750	40	2
856	748	751	S BEECH DALY RD	COLLECTOR	1835	1	12	4	1700	40	2
857	749	609	SIBLEY RD	MINOR ARTERIAL	5392	1	12	4	1750	50	2
858	749	748	S BEECH DALY RD	COLLECTOR	5719	1	12	4	1750	30	2
859	750	151	HALE AVE	COLLECTOR	1088	1	12	4	1750	25	3
860	752	690	SIBLEY RD	MINOR ARTERIAL	5246	1	12	4	1700	50	5
861	753	752	VINING RD	COLLECTOR	5197	1	12	4	1700	45	5
862	754	237	MAXWELL RD	LOCAL ROADWAY	553	1	12	4	1350	30	11
863	754	755	MONROE ST	COLLECTOR	5277	1	12	4	1750	30	11
864	755	580	GRAFTON RD	LOCAL ROADWAY	600	1	12	4	1350	30	11
865	756	605	S HURON RIVER DR	MAJOR ARTERIAL	1387	1	12	4	1700	40	12
866	756	757	CARLETON ROCKWOOD RD	COLLECTOR	4852	1	12	4	1700	40	12
867	756	814	S HURON RIVER DR	MAJOR ARTERIAL	174	1	12	4	1700	40	12
868	757	756	CARLETON ROCKWOOD RD	COLLECTOR	4852	1	12	4	1700	40	12
869	757	758	CARLETON ROCKWOOD RD	COLLECTOR	1273	1	12	4	1575	35	12
870	758	342	CARLETON ROCKWOOD RD	COLLECTOR	1009	1	12	4	1700	30	12
871	759	300	I-75 ON RAMP	FREEWAY RAMP	290	1	12	4	1350	30	26
872	760	34	N DIXIE HWY	MAJOR ARTERIAL	3334	1	12	4	1750	45	22

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
873	761	305	I-75	FREEWAY	6699	3	12	4	2250	70	26
874	761	307	I-75	FREEWAY	8210	3	12	4	2250	70	26
875	762	678	OAKVILLE WALTZ RD	MINOR ARTERIAL	5868	1	12	4	1700	55	10
876	763	621	WALTZ RD	COLLECTOR	7956	1	12	4	1750	40	5
877	764	467	BRANDON RD	COLLECTOR	8569	1	12	4	1700	40	17
878	765	766	NEWPORT SOUTH RD	COLLECTOR	5512	1	12	4	1700	40	17
879	765	809	POST RD	COLLECTOR	5317	1	12	2	1700	45	17
880	766	37	NEWPORT SOUTH RD	COLLECTOR	3708	1	12	4	1700	40	17
881	767	145	STRASBURG RD	COLLECTOR	10668	1	12	4	1700	40	25
882	767	146	W ALBAIN RD	COLLECTOR	16568	1	12	4	1700	45	24
883	768	767	W ALBAIN RD	COLLECTOR	9302	1	12	4	1700	45	25
884	770	771	N CUSTER RD	MINOR ARTERIAL	7717	1	12	4	1700	45	20
885	771	772	N CUSTER RD	MINOR ARTERIAL	5322	1	12	4	1700	45	19
886	772	773	N CUSTER RD	MINOR ARTERIAL	2309	1	12	4	1700	45	19
887	774	770	N CUSTER RD	MINOR ARTERIAL	11489	1	12	4	1700	45	20
888	775	64	US-24	MAJOR ARTERIAL	2079	2	12	4	1750	35	21
889	775	616	CUSTER DR	COLLECTOR	552	1	12	4	1350	30	21
890	775	617	CUSTER DR	COLLECTOR	579	1	12	4	1750	30	21
891	776	72	US 24	MAJOR ARTERIAL	5674	1	12	4	1700	60	29
892	777	763	WILLOW RD	COLLECTOR	11792	1	12	4	1700	35	5
893	778	763	WILLOW RD	COLLECTOR	3061	1	12	4	1700	40	5
894	779	621	WALTZ RD	COLLECTOR	5200	1	12	4	1750	40	5
895	780	804	N DIXIE HWY	MAJOR ARTERIAL	584	1	12	4	1700	50	17
896	780	837	POST RD	COLLECTOR	3322	1	12	2	1700	45	17
897	781	35	MARSHALL FIELD DR	COLLECTOR	1661	1	12	4	1750	35	22

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
898	782	760	BREST RD	COLLECTOR	2921	1	12	4	1750	40	22
899	783	250	STRONG RD	COLLECTOR	6329	1	12	4	1750	35	17
900	784	48	PETERS RD	LOCAL ROADWAY	2454	1	12	4	1575	35	6
901	785	100	SR 125	MINOR ARTERIAL	721	2	12	4	1750	35	26
902	786	785	W 8TH ST	COLLECTOR	2053	1	12	4	1350	30	21
903	787	120	US 24	MAJOR ARTERIAL	2548	2	12	4	1750	55	6
904	787	367	CARTER RD	COLLECTOR	1608	1	12	4	1750	40	6
905	788	790	W JEFFERSON AVE	MAJOR ARTERIAL	458	1	12	4	1750	45	7
906	789	790	ELM ST	COLLECTOR	386	1	12	4	1750	30	7
907	790	791	W JEFFERSON AVE	MAJOR ARTERIAL	1366	1	12	4	1700	45	7
908	791	654	W JEFFERSON AVE	MAJOR ARTERIAL	895	1	12	4	1700	45	7
909	792	791	HARRISON AVE	COLLECTOR	940	1	12	4	1700	30	7
910	793	437	SR 85	MAJOR ARTERIAL	842	3	12	4	1900	45	3
911	794	793	DRIVEWAY	COLLECTOR	184	1	12	4	1750	25	3
912	795	126	MORTAR CREEK RD	COLLECTOR	459	1	12	4	1575	35	26
913	796	730	S MACOMB ST	COLLECTOR	1450	1	12	4	1575	35	21
914	796	797	E 1ST ST	COLLECTOR	1413	1	12	4	1700	35	21
915	797	177	NAVARRE ST	LOCAL ROADWAY	3357	1	12	4	1575	35	26
916	797	798	E 1ST ST	COLLECTOR	1569	1	12	4	1700	35	21
917	798	182	KENTUCKY AVE	LOCAL ROADWAY	5338	1	12	4	1350	30	26
918	798	799	E 1ST ST	COLLECTOR	418	1	12	4	1750	35	26
919	799	175	E 1ST ST	COLLECTOR	1502	1	12	4	1700	35	26
920	799	798	E 1ST ST	COLLECTOR	418	1	12	4	1700	35	26

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
921	800	760	N DIXIE HWY	MAJOR ARTERIAL	560	1	12	4	1750	45	22
922	801	800	WILLIAMS RD	COLLECTOR	3808	1	12	2	1750	35	22
923	802	803	WAR RD	COLLECTOR	6654	1	12	2	1700	45	21
924	803	107	NADEAU RD	MINOR ARTERIAL	1848	2	12	4	1750	50	21
925	804	248	N DIXIE HWY	MAJOR ARTERIAL	3406	1	12	4	1700	50	17
926	805	250	N DIXIE HWY	MAJOR ARTERIAL	5543	1	12	4	1750	50	17
927	805	468	N DIXIE HWY	MAJOR ARTERIAL	1343	1	12	4	1750	50	17
928	806	805	TROMBLEY RD	COLLECTOR	2306	1	12	2	1750	35	17
929	807	472	U.S. TURNPIKE RD	MAJOR ARTERIAL	2967	1	12	4	1750	55	18
930	808	573	BUHL RD	COLLECTOR	1319	1	12	2	1700	40	17
931	809	802	POST RD	COLLECTOR	3287	1	12	2	1700	45	17
932	809	808	MENTEL RD	COLLECTOR	5310	1	12	2	1700	40	17
933	810	274	US-24	MAJOR ARTERIAL	1087	2	12	4	1900	50	16
934	811	812	E LABO RD	COLLECTOR	8708	1	12	2	1700	40	17
935	812	273	US-24	MAJOR ARTERIAL	813	2	12	4	1900	50	17
936	812	338	US-24	MAJOR ARTERIAL	6746	2	12	4	1900	55	17
937	813	812	E LABO RD	COLLECTOR	9595	1	12	2	1700	40	16
938	814	294	S HURON RIVER DR	MAJOR ARTERIAL	907	1	12	4	1700	40	13
939	814	756	S HURON RIVER DR	MAJOR ARTERIAL	173	1	12	4	1700	40	12
940	815	244	NADEAU RD	MINOR ARTERIAL	1289	1	12	4	1700	50	21
941	816	224	SR 151	MINOR ARTERIAL	1232	1	12	4	1700	40	29
942	817	169	HURON RIVER DR	MAJOR ARTERIAL	786	2	12	4	1900	30	13
943	817	292	HURON RIVER DR	MAJOR ARTERIAL	750	2	12	4	1900	30	13
944	818	817	I-75 OFF-RAMP	FREEWAY RAMP	404	1	12	2	1750	40	13
945	819	820	HEISS RD	COLLECTOR	5669	1	12	2	1700	40	16

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
946	820	821	HEISS RD	COLLECTOR	1471	1	12	2	1700	40	15
947	821	822	HEISS RD	COLLECTOR	4004	1	12	2	1700	40	15
948	822	70	STEFFAS RD	COLLECTOR	2939	1	12	2	1700	40	15
949	822	227	STEFFAS RD	COLLECTOR	10641	1	12	2	1700	40	15
950	823	824	EXETER RD	COLLECTOR	3963	1	12	4	1700	40	16
951	824	109	EXETER RD	COLLECTOR	2542	1	12	4	1750	40	16
952	825	826	EXETER RD	COLLECTOR	4110	1	12	2	1700	40	16
953	826	827	EXETER RD	COLLECTOR	3300	1	12	2	1700	40	11
954	827	535	EXETER RD	COLLECTOR	5209	1	12	2	1700	40	11
955	828	676	OAKVILLE WALTZ RD	COLLECTOR	2075	1	12	2	1700	45	11
956	829	270	I-275	FREEWAY	1986	3	12	4	2250	75	11
957	829	457	I-275	FREEWAY	2325	3	12	4	2250	75	11
958	830	243	WILL CARLETON RD	MINOR ARTERIAL	3287	1	12	4	1700	45	11
959	831	125	LAPLAISANCE RD	COLLECTOR	377	1	12	4	1575	35	26
960	832	498	US 24	MAJOR ARTERIAL	619	1	12	4	1700	50	25
961	833	768	W ALBAIN RD	COLLECTOR	6098	1	12	4	1700	40	25
962	834	613	OAKVILLE WALTZ RD	COLLECTOR	4708	1	12	2	1700	50	11
963	835	195	DRIVEWAY	LOCAL ROADWAY	598	1	12	4	1750	30	3
964	836	468	DRIVEWAY	LOCAL ROADWAY	138	2	12	4	1750	30	17
965	837	765	POST RD	COLLECTOR	5205	1	12	2	1700	45	17
966	838	249	SWAN CREEK RD	MINOR ARTERIAL	3452	1	12	4	1700	50	17
967	839	661	DIXIE HWY	MINOR ARTERIAL	10577	1	12	4	1700	50	17
968	840	832	US 24	MAJOR ARTERIAL	6394	1	12	4	1700	50	25

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
969	841	66	SR 50	MAJOR ARTERIAL	1599	2	12	4	1750	45	20
970	841	67	SR 50	MAJOR ARTERIAL	6378	2	12	4	1750	65	20
971	842	287	I-75	FREEWAY	11814	3	12	4	2250	75	7
972	842	288	I-75	FREEWAY	4011	3	12	4	2250	70	7
973	8030	30	I-275	FREEWAY	1631	3	12	4	2250	75	1
974	8240	140	I-75	FREEWAY	1031	3	12	4	2250	75	3
975	8454	454	I-75	FREEWAY	1417	3	12	4	2250	70	29
995	146	143	LEWIS AVE	COLLECTOR	5771	1	12	4	1700	40	24
996	143	769	W ALBAIN RD	COLLECTOR	2960	1	12	4	1700	40	24
997	506	137	STRASBURG RD	COLLECTOR	8869	1	12	0	1700	50	20
998	149	139	LEWIS AVE	COLLECTOR	7746	1	12	4	1700	40	19
999	138	843	GEIGER RD	COLLECTOR	4004	1	12	4	1700	50	19
1000	844	143	IDA EAST RD	COLLECTOR	5204	1	12	4	1700	50	24
EXIT LINK	46	8046	ALLEN RD	COLLECTOR	1097	2	12	4	1900	50	3
EXIT LINK	55	8055	HEISS RD	MINOR ARTERIAL	951	2	12	4	1900	30	3
EXIT LINK	30	8030	I-275	FREEWAY	1631	3	12	4	2250	75	1
EXIT LINK	140	8240	I-75	FREEWAY	1031	3	12	4	2250	75	3
EXIT LINK	141	8141	MIDDLEBELT RD	COLLECTOR	1871	1	12	4	1700	30	2
EXIT LINK	142	8142	INKSTER RD	COLLECTOR	1242	1	12	4	1700	30	2
EXIT LINK	148	8148	LEWIS AVE	COLLECTOR	1834	1	12	4	1700	55	24

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
EXIT LINK	89	8089	W JEFFERSON AVE	MAJOR ARTERIAL	1049	2	12	4	1900	40	4
EXIT LINK	437	8437	SR 85	MAJOR ARTERIAL	1149	3	12	4	1900	40	3
EXIT LINK	454	8454	I-75	FREEWAY	1417	3	12	4	2250	40	29
EXIT LINK	497	8497	US 24	MAJOR ARTERIAL	2019	1	12	4	1700	40	29
EXIT LINK	510	8510	SR 125	MINOR ARTERIAL	1855	1	12	4	1700	40	29
EXIT LINK	629	8629	US 24	MAJOR ARTERIAL	1530	2	12	4	1900	40	2
EXIT LINK	631	8631	SR 50	MAJOR ARTERIAL	1762	1	12	4	1700	55	19
EXIT LINK	678	8678	OAKVILLE WALTZ RD	MINOR ARTERIAL	2207	1	12	4	1700	50	10
EXIT LINK	739	8541	OSTRANDER RD	COLLECTOR	2757	1	12	4	1700	40	14
EXIT LINK	740	8216	S STONY CREEK RD	MINOR ARTERIAL	664	1	12	2	1700	45	9
EXIT LINK	751	8751	S BEECH DALY RD	COLLECTOR	1136	1	12	4	1700	40	2
EXIT LINK	769	8769	W ALBAIN RD	COLLECTOR	1385	1	12	4	1700	40	24
EXIT LINK	773	8773	N CUSTER RD	MINOR ARTERIAL	1535	1	12	4	1700	45	19

Table K-2. Nodes in the Link-Node Analysis Network which are Controlled

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
6	13389814	165512	Stop	21
18	13393958	161732	TCP-No Control	21
20	13349552	162613	Stop	19
32	13402229	158900	Actuated Signal	22
33	13405644	160866	Actuated Signal	22
34	13409067	163763	Actuated Signal	22
35	13413812	167808	Actuated Signal	22
36	13416333	173396	Actuated Signal	22
37	13410915	184755	Stop	17
40	13437216	209104	Stop	13
42	13439153	218935	Actuated Signal	13
43	13433198	219129	Actuated Signal	13
47	13426311	218845	Actuated Signal	13
48	13422085	229229	Stop	6
49	13418940	218522	Pretimed Signal	12
50	13417697	218492	Actuated Signal	12
51	13415941	218492	Stop	12
52	13415630	218201	Stop	12
53	13394252	153607	Stop	21
54	13413989	218181	Pretimed Signal	12
56	13409043	207827	Actuated Signal	12
57	13398457	186471	Actuated Signal	16
58	13393590	176666	TCP-Actuated	16
59	13386491	165850	Pretimed Signal	21
60	13385323	163097	Pretimed Signal	21
61	13384697	161596	Pretimed Signal	21
62	13383736	159207	Pretimed Signal	21
63	13393170	150769	Stop	26
64	13381884	154431	Actuated Signal	21
65	13380978	154527	Actuated Signal	21
66	13376230	155455	Actuated Signal	20
67	13369123	159109	TCP-Actuated	20
72	13359842	114038	Actuated Signal	29
73	13376536	142088	TCP-Actuated	25
74	13379232	148321	Actuated Signal	26
75	13381477	152904	Actuated Signal	21
76	13383802	153968	Actuated Signal	21
78	13387085	153275	Pretimed Signal	21

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
79	13387402	153931	Actuated Signal	21
80	13388193	153584	Actuated Signal	21
81	13391793	152205	Actuated Signal	21
82	13392540	153288	Actuated Signal	21
83	13396311	156758	Pretimed Signal	21
84	13396685	156896	Actuated Signal	21
88	13405696	244557	Actuated Signal	2
90	13448715	248874	Actuated Signal	4
91	13421520	245130	Actuated Signal	2
94	13428774	246220	Actuated Signal	3
95	13450881	230706	Actuated Signal	8
96	13371561	134179	Yield	25
97	13379506	140955	Actuated Signal	26
98	13382311	145516	Pretimed Signal	26
99	13383253	147002	Pretimed Signal	26
100	13385181	150107	Pretimed Signal	26
101	13385979	151399	Pretimed Signal	21
104	13387818	155116	Actuated Signal	21
105	13389054	160052	Pretimed Signal	21
106	13390950	164976	Pretimed Signal	21
107	13393433	171051	Actuated Signal	21
109	13380746	191718	Actuated Signal	16
110	13365310	196200	Stop	15
113	13390954	160659	Pretimed Signal	21
114	13414541	219170	Actuated Signal	12
115	13416253	222716	Actuated Signal	6
116	13416777	223829	Actuated Signal	6
117	13419313	229192	Actuated Signal	6
118	13421849	234519	Actuated Signal	6
120	13421692	239698	Actuated Signal	6
121	13388197	138026	TCP-No Control	26
123	13388700	134552	Stop	26
124	13388063	132773	TCP-No Control	26
126	13382523	133621	Stop	26
134	13372097	135006	Stop	25
137	13358516	152084	Stop	20
138	13346396	154767	Stop	19
139	13340076	156098	Stop	19

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
143	13339160	150760	Stop	24
144	13339981	134462	Stop	24
145	13355925	135146	Stop	25
146	13339501	144999	Stop	24
149	13342883	163317	Stop	19
151	13442618	247850	Stop	3
152	13442609	246567	Actuated Signal	3
153	13419043	236602	Stop	6
154	13442956	241255	Actuated Signal	7
155	13443066	238582	Actuated Signal	7
156	13442588	235929	Actuated Signal	7
158	13433176	220471	Stop	13
159	13432007	219090	Actuated Signal	13
160	13432376	219116	Actuated Signal	13
162	13401454	158586	Actuated Signal	22
163	13400780	170860	Actuated Signal	22
166	13424382	234576	Stop	7
167	13436105	199541	Yield	13
168	13419420	234449	Stop	6
169	13425007	210687	Stop	13
170	13426650	209106	Actuated Signal	13
171	13441763	225349	Yield	7
172	13443730	230647	Actuated Signal	7
173	13443779	231070	Actuated Signal	7
174	13444606	235020	Actuated Signal	7
175	13391771	149988	Stop	26
177	13387102	148960	Stop	26
178	13445822	235842	Actuated Signal	7
179	13441489	235895	Actuated Signal	7
180	13440557	235856	Pretimed Signal	7
182	13387349	146456	Stop	26
185	13436604	235705	Pretimed Signal	7
187	13433965	235651	Pretimed Signal	7
188	13432648	235618	Actuated Signal	7
190	13389260	153223	Actuated Signal	21
191	13427243	234683	Actuated Signal	7
192	13425889	234591	Actuated Signal	7
194	13425262	240277	Actuated Signal	7

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
195	13429369	245982	Actuated Signal	3
196	13432288	246120	Actuated Signal	3
197	13436271	246269	Actuated Signal	3
198	13437958	246333	Actuated Signal	3
199	13441179	246486	Actuated Signal	3
200	13445345	246636	Actuated Signal	3
202	13441593	241244	Actuated Signal	7
203	13436408	240966	Actuated Signal	7
205	13432580	238238	Actuated Signal	7
207	13432865	230266	Actuated Signal	7
208	13433118	224948	Pretimed Signal	7
217	13387975	140240	Stop	26
221	13378649	128877	Stop	26
225	13374879	113967	Stop	29
227	13370995	194197	Stop	15
230	13362844	114102	Actuated Signal	29
237	13385921	205855	Stop	11
239	13390728	217962	TCP-Actuated	11
250	13423292	184853	TCP-Actuated	17
252	13429428	219007	Actuated Signal	13
258	13383177	157841	Pretimed Signal	21
265	13395253	156410	Stop	21
307	13380614	125337	TCP-No Control	30
317	13395336	165276	TCP-No Control	21
319	13392552	169000	Stop	21
320	13388709	154844	Actuated Signal	21
323	13384201	155424	Pretimed Signal	21
325	13387967	153072	Actuated Signal	21
332	13395871	181222	Stop	16
336	13400925	186608	TCP-Actuated	17
338	13404146	197996	Stop	12
341	13399868	218063	TCP-No Control	11
347	13414706	219486	Stop	12
350	13414946	219932	Actuated Signal	12
362	13427404	229389	Stop	7
363	13411545	228899	Actuated Signal	6
366	13411322	234120	Actuated Signal	6
367	13423441	237175	Actuated Signal	6

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
390	13435993	225037	Pretimed Signal	7
392	13439356	230580	Actuated Signal	7
398	13442329	235352	Actuated Signal	7
419	13442966	240649	Actuated Signal	7
421	13446462	241383	Actuated Signal	7
424	13442754	245827	Actuated Signal	3
467	13410843	184997	Stop	17
468	13416927	182226	TCP-Actuated	17
470	13424969	206827	Actuated Signal	13
472	13428586	187554	TCP-Actuated	18
477	13433363	192998	TCP-No Control	18
498	13371028	135735	Stop	25
502	13383121	152809	Stop	21
505	13374079	150361	Stop	25
506	13361776	160332	Stop	20
507	13365686	150643	TCP-No Control	25
508	13369579	160020	TCP-No Control	20
512	13381848	126370	TCP-No Control	30
514	13382921	139340	Stop	26
519	13386936	150844	Pretimed Signal	26
520	13387508	145240	Stop	26
531	13386893	161062	Actuated Signal	21
535	13380416	207006	TCP-No Control	11
545	13433249	208933	Stop	13
547	13437651	215152	Actuated Signal	13
552	13433224	221999	Stop	7
557	13445620	234930	Actuated Signal	7
558	13447843	246774	Actuated Signal	4
559	13432377	240859	Actuated Signal	7
569	13392282	149993	Stop	26
580	13391184	206047	Stop	11
593	13421847	236396	Actuated Signal	6
605	13422576	208276	Stop	12
606	13419142	215004	Stop	12
608	13426854	246184	Actuated Signal	3
609	13410869	244828	Actuated Signal	2
616	13382178	156083	Stop	21
617	13382826	155914	Stop	21

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
618	13383032	155860	Stop	21
620	13385267	222982	TCP-No Control	5
621	13384939	233717	Pretimed Signal	5
623	13418473	239675	Stop	6
627	13411015	239464	Actuated Signal	6
628	13405823	239320	Stop	6
630	13372418	177159	TCP-No Control	15
635	13435322	198363	TCP-No Control	13
645	13433230	218221	Stop	13
650	13406243	228888	Actuated Signal	6
657	13437465	230442	Actuated Signal	7
661	13422799	197865	TCP-No Control	12
667	13354549	184782	Stop	15
670	13348193	203935	Stop	9
677	13380096	216764	TCP-No Control	11
679	13414074	218324	Actuated Signal	12
683	13427988	218963	Actuated Signal	13
684	13436545	238380	Stop	7
692	13427281	246392	Actuated Signal	3
695	13410182	185332	Actuated Signal	17
714	13445437	235906	Actuated Signal	7
716	13439841	235833	Actuated Signal	7
718	13438476	235777	Actuated Signal	7
720	13437524	235742	Actuated Signal	7
722	13435491	235729	Actuated Signal	7
726	13371768	168846	TCP-Actuated	20
730	13386830	151365	Stop	21
732	13386936	152995	Actuated Signal	21
736	13397811	157296	TCP-Actuated	21
737	13402674	159175	Stop	22
743	13431938	251472	Actuated Signal	3
744	13426640	251253	Actuated Signal	3
745	13421311	251012	Actuated Signal	2
746	13410800	250110	Actuated Signal	2
747	13405529	249923	Actuated Signal	2
748	13416039	250638	Actuated Signal	2
752	13395149	244243	Actuated Signal	1
753	13395313	239049	Stop	5

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
755	13391240	205447	Actuated Signal	11
756	13423593	207333	Stop	12
760	13411623	165904	TCP-Actuated	22
762	13363971	215196	Stop	10
763	13385190	225765	Stop	5
765	13407881	176294	TCP-No Control	17
767	13356049	145801	Stop	25
774	13368351	160603	TCP-Actuated	20
775	13382606	156381	Stop	21
780	13416405	176515	TCP-Actuated	17
785	13385526	150743	Stop	26
788	13445870	236336	Actuated Signal	7
790	13445938	236790	Actuated Signal	7
791	13446110	238145	Actuated Signal	7
793	13442632	248868	Actuated Signal	3
795	13382161	133903	Stop	26
796	13387613	152585	Stop	21
797	13388817	151846	Stop	21
798	13390142	151005	Stop	26
799	13390479	150757	Actuated Signal	26
800	13412029	166290	TCP-Actuated	22
802	13399281	176042	TCP-No Control	16
805	13418162	182753	TCP-Actuated	17
807	13425996	186097	TCP-No Control	18
808	13402429	181512	TCP-No Control	17
810	13400206	189935	TCP-No Control	16
811	13409890	192102	TCP-No Control	17
812	13401183	191935	Stop	17
814	13423754	207267	TCP-No Control	12
815	13398864	170854	TCP-No Control	21
816	13373646	113993	TCP-No Control	29
817	13425565	210132	TCP-Actuated	13
821	13375287	183774	TCP-No Control	15
822	13371288	183561	TCP-No Control	15
824	13380810	189177	TCP-No Control	16
825	13380588	194390	TCP-No Control	16
826	13380436	198497	TCP-No Control	11
827	13380397	201797	TCP-No Control	11

Node	X Coordinate[1] (ft)	Y Coordinate[1] (ft)	Control Type	Grid Map Number
829	13391811	217083	TCP-No Control	11
830	13395932	218144	TCP-No Control	11
831	13386974	130423	TCP-No Control	26
832	13371430	136205	TCP-No Control	25
834	13385526	217849	TCP-No Control	11

[1]Coordinates are in the North American Datum of 1983 Michigan South State Plane Zone

APPENDIX L

Protective Action Area Boundaries

L. PROTECTIVE ACTION AREA BOUNDARIES

PAA 1 County: Monroe

- Berlin Township east of North Dixie Highway, and south of U.S. Turnpike and Reaume Road.
- Frenchtown Township east of North Dixie Highway and north of Brest Road.

PAA 2 County: Monroe

- Berlin Township south of Sigler Road, west of North Dixie Highway, north of U.S. Turnpike and Reaume Road.

PAA 3 County: Monroe

- Frenchtown Township west of North Dixie Highway, south of Brest Road, east of I-75 and north of Hurd Road.

PAA 4 County: Monroe

- Berlin Township north of Sigler Road.
- Ash Township east of Maxwell Road and south of Carleton West Road.
- Exeter Township south of O'Hara Road and east of Finzel Road.

County: Wayne

- Brownstone Township south of Vreeland Road and the municipalities of Rockwood, Gibraltar, and Flat Rock.

PAA 5 County: Monroe

Frenchtown Township west of I-75 and south of Hurd Road.

- Raisinville Township east of Steffas Road and North Raisinville Road and north of North Custer Road.
- Monroe Township east of Herr Road, north of Dunbar Road, east of South Telegraph Road, north of Albain Road, east of I-75, and north of Mortar Creek Road.
- City of Monroe.

APPENDIX M

Evacuation Sensitivity Studies

M. EVACUATION SENSITIVITY STUDIES

This appendix presents the results of a series of sensitivity analyses. These analyses are designed to identify the sensitivity of the ETE to changes in some base evacuation conditions.

M.1 Effect of Changes in Trip Generation Times

A sensitivity study was performed to determine whether changes in the estimated trip generation time have an effect on the ETE for the entire EPZ. Specifically, if the tail of the mobilization distribution were truncated (i.e., if those who responded most slowly to the Advisory to Evacuate, could be persuaded to respond much more rapidly), how would the ETE be affected? The case considered was Scenario 6, Region 3; a winter, midweek, midday, good weather evacuation of the entire EPZ. Table M-1 presents the results of this study.

Table M-1. Evacuation Time Estimates for Trip Generation Sensitivity Study

Trip Generation Period	Evacuation Time Estimate for Entire EPZ	
	90^{th} Percentile	100^{th} Percentile
3 Hours	2:05	3:10
3 Hours 30 Minutes	2:05	3:40
4 Hours (Base)	2:05	4:10

As discussed in Section 7.3, traffic congestion persists within the EPZ for about 2 hours. As such, the ETE for the 100^{th} percentile mirrors trip generation time. The 90^{th} percentile ETE are not sensitive to truncating the tail of the mobilization time distribution. The results indicate that programs to educate the public and encourage them toward faster responses for a radiological emergency, translates into shorter ETE at the 100^{th} percentile. The results also justify the guidance to employ the [stable] 90^{th} percentile ETE for protective action decision making.

M.2 Effect of Changes in the Number of People in the Shadow Region Who Relocate

A sensitivity study was conducted to determine the effect on ETE of changes in the percentage of people who decide to relocate from the Shadow Region. The case considered was Scenario 6, Region 3; a winter, midweek, midday, good weather evacuation for the entire EPZ. The movement of people in the Shadow Region has the potential to impede vehicles evacuating from an Evacuation Region within the EPZ. Refer to Sections 3.2 and 7.1 for additional information on population within the shadow region.

Table M-2 presents the evacuation time estimates for each of the cases considered. The results show that the ETE is not impacted by shadow evacuation from 0% to 20%. Tripling the shadow percentage only increases the ETE by 5 minutes at the 90th percentile – not a material impact.

Table M-2. Evacuation Time Estimates for Shadow Sensitivity Study

Percent Shadow Evacuation	Evacuating Shadow Vehicles	Evacuation Time Estimate for Entire EPZ	
		90th Percentile	100th Percentile
0	0	2:05	4:10
15	7,704	2:05	4:10
20 (Base)	10,272	2:05	4:10
60	30,817	2:10	4:10

M.3 Effect of Changes in EPZ Resident Population

A sensitivity study was conducted to determine the effect on ETE of changes in the resident population within the study area (EPZ plus Shadow Region). As population in the study area changes over time, the time required to evacuate the public may increase, decrease, or remain the same. Since the ETE is related to the demand to capacity ratio present within the study area, changes in population will cause the demand side of the equation to change. The sensitivity study was conducted using the following planning assumptions:

1. The percent change in population within the study area was increased by 55%. Changes in population were applied to permanent residents only (as per federal guidance), in both the EPZ area and in the Shadow Region.
2. The transportation infrastructure remained fixed; the presence of new roads or highway capacity improvements were not considered.
3. The study was performed for the 2-Mile Region (R01), the 5-Mile Region (R02) and the entire EPZ (R03).
4. The good weather scenario which yielded the highest ETE values was selected as the case to be considered in this sensitivity study (Scenario 6).

Table M-3 presents the results of the sensitivity study. Section IV of Appendix E to 10 CFR Part 50, and NUREG/CR-7002, Section 5.4, require licensees to provide an updated ETE analysis to the NRC when a population increase within the EPZ causes ETE values (for the 2-Mile Region, 5-Mile Region or entire EPZ) to increase by 25 percent or 30 minutes, whichever is less. Note that all of the base ETE values, except the 90th percentile ETE for the 2-mile region, are greater than 2 hours; 25 percent of these base ETE are always greater than 30 minutes. Therefore, 30 minutes is the lesser and is the criterion for updating these regions. Twenty-five percent of the 90th percentile ETE for the 2-mile region (1:55) is 29 minutes, which is less than 30 minutes.

Those percent population changes which result in ETE changes greater than 30 minutes, or 29 minutes for the 2-mile region at the 90th percentile, are highlighted in red below – a 55% increase in the EPZ population. DTE Energy will have to estimate the EPZ population on an annual basis. If the EPZ population increases by 55% or more, an updated ETE analysis will be needed.

Table M-3. ETE Variation with Population Change

Resident Population	Base	Population Change		
		30%	50%	55%
	97,825	127,173	146,738	151,629
ETE for 90th Percentile				
Region	**Base**	**Population Change**		
		30%	**50%**	**55%**
2-MILE	1:55	1:55	2:00	2:00
5-MILE	2:00	2:00	2:00	2:00
FULL EPZ	2:05	2:20	2:30	**2:35**
ETE for 100th Percentile				
Region	**Base**	**Population Change**		
		30%	**50%**	**55%**
2-MILE	4:00	4:00	4:00	4:00
5-MILE	4:05	4:05	4:05	4:05
FULL EPZ	4:10	4:10	4:10	4:10

APPENDIX N

ETE Criteria Checklist

N. ETE CRITERIA CHECKLIST

Table N-1. ETE Review Criteria Checklist

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
1.0 Introduction		
a. The emergency planning zone (EPZ) and surrounding area should be described.	Yes	Section 1
b. A map should be included that identifies primary features of the site, including major roadways, significant topographical features, boundaries of counties, and population centers within the EPZ.	Yes	Figure 1-1, Figure 3-1
c. A comparison of the current and previous ETE should be provided and includes similar information as identified in Table 1-1, "ETE Comparison," of NUREG/CR-7002.	Yes	Table 1-3
1.1 Approach		
a. A discussion of the approach and level of detail obtained during the field survey of the roadway network should be provided.	Yes	Section 1.3
b. Sources of demographic data for schools, special facilities, large employers, and special events should be identified.	Yes	Section 2.1, Section 3, Section 8
c. Discussion should be presented on use of traffic control plans in the analysis.	Yes	Section 1.3, Section 2.3, Section 9, Appendix G
d. Traffic simulation models used for the analyses should be identified by name and version.	Yes	Section 1.3, Table 1-3, Appendix B, Appendix C

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
e. Methods used to address data uncertainties should be described.	Yes	Section 3 – avoid double counting Section 5, Appendix F – 4.17% sampling error at 95% confidence interval for telephone survey
1.2 Assumptions		
a. The planning basis for the ETE includes the assumption that the evacuation should be ordered promptly and no early protective actions have been implemented.	Yes	Section 2.3 – Assumption 1 Section 5.1
b. Assumptions consistent with Table 1-2, "General Assumptions," of NUREG/CR-7002 should be provided and include the basis to support their use.	Yes	Sections 2.2, 2.3
1.3 Scenario Development		
a. The ten scenarios in Table 1-3, Evacuation Scenarios, should be developed for the ETE analysis, or a reason should be provided for use of other scenarios.	Yes	Tables 2-1, 6-2
1.3.1 Staged Evacuation		
a. A discussion should be provided on the approach used in development of a staged evacuation.	Yes	Sections 5.4.2, 7.2
1.4 Evacuation Planning Areas		
a. A map of EPZ with emergency response planning areas (ERPAs) should be included.	Yes	Figure 6-1
b. A table should be provided identifying the ERPAs considered for each ETE calculation by downwind direction in each sector.	Yes	Table 6-1, Table 7-5, Table H-1

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
c. A table similar to Table 1-4, “Evacuation Areas for a Staged Evacuation Keyhole,” of NUREG/CR-7002 should be provided and includes the complete evacuation of the 2, 5, and 10 mile areas and for the 2 mile area/5 mile keyhole evacuations.	Yes	Table 6-1, Table 7-5, Table H-1
2.0 Demand Estimation		
a. Demand estimation should be developed for the four population groups, including permanent residents of the EPZ, transients, special facilities, and schools.	Yes	Permanent Residents – Section 3 Employees, transients – Section 3, Appendix E Special facilities, schools – Section 8, Appendix E
2.1 Permanent Residents and Transient Population		
a. The US Census should be the source of the population values, or another credible source should be provided.	Yes	Section 3.1
b. Population values should be adjusted as necessary for growth to reflect population estimates to the year of the ETE.	Yes	2010 used as the base year for analysis. No growth of population necessary.
c. A sector diagram should be included, similar to Figure 2-1, “Population by Sector,” of NUREG/CR-7002, showing the population distribution for permanent residents.	Yes	Figure 3-2

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
2.1.1 Permanent Residents with Vehicles		
a. The persons per vehicle value should be between 1 and 2 or justification should be provided for other values.	Yes	2.19 persons per vehicle – Table 1-3 Vehicle occupancy was determined from the results of a telephone survey of EPZ residents.
b. Major employers should be listed.	Yes	Appendix E – Table E-3
2.1.2 Transient Population		
a. A list of facilities which attract transient populations should be included, and peak and average attendance for these facilities should be listed. The source of information used to develop attendance values should be provided.	Yes	Section 3.3, section 3.4, Appendix E
b. The average population during the season should be used, itemized and totaled for each scenario.	Yes	Tables 3-4, 3-5 and Appendix E itemize the transient population and employee estimates. These estimates are multiplied by the scenario specific percentages provided in Table 6-3 to estimate transient population by scenario.
c. The percent of permanent residents assumed to be at facilities should be estimated.	Yes	Sections 3.3, 3.4
d. The number of people per vehicle should be provided. Numbers may vary by scenario, and if so, discussion on why values vary should be provided.	Yes	Sections 3.3, 3.4
e. A sector diagram should be included, similar to Figure 2-1 of NUREG/CR-7002, showing the population distribution for the transient population.	Yes	Figure 3-6 – transients Figure 3-8 – employees

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
2.2 Transit Dependent Permanent Residents		
a. The methodology used to determine the number of transit dependent residents should be discussed.	Yes	Section 8.1, Table 8-1
b. Transportation resources needed to evacuate this group should be quantified.	Yes	Section 8.1, Tables 8-5, 8-10
c. The county/local evacuation plans for transit dependent residents should be used in the analysis.	Yes	Sections 8.1, 8.4
d. The methodology used to determine the number of people with disabilities and those with access and functional needs who may need assistance and do not reside in special facilities should be provided. Data from local/county registration programs should be used in the estimate, but should not be the only set of data.	Yes	Section 8.5
e. Capacities should be provided for all types of transportation resources. Bus seating capacity of 50% should be used or justification should be provided for higher values.	Yes	Section 2.3 – Assumption 10 Sections 3.5, 8.1, 8.2, 8.3
f. An estimate of this population should be provided and information should be provided that the existing registration programs were used in developing the estimate.	Yes	Table 8-1 – transit dependents Section 8.4 – transit-dependents Section 8.5 – special needs
g. A summary table of the total number of buses, ambulances, or other transport needed to support evacuation should be provided and the quantification of resources should be detailed enough to assure double counting has not occurred.	Yes	Section 8.4 – page 8-6 Table 8-5, Section 8-3

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
2.3 Special Facility Residents		
a. A list of special facilities, including the type of facility, location, and average population should be provided. Special facility staff should be included in the total special facility population.	Yes	Appendix E – Table E-2, Table E-6 – list facilities, type, location and population
b. A discussion should be provided on how special facility data was obtained.	Yes	Section 8.3, Section 3.5 – medical facilities Section 8.6 – correctional facility
c. The number of wheelchair and bed-bound individuals should be provided.	Yes	Section 8.3, Table 8-4, Table E-2
d. An estimate of the number and capacity of vehicles needed to support the evacuation of the facility should be provided.	Yes	Section 8.3, Section 8.6 Tables 8-4, 8-5
e. The logistics for mobilizing specially trained staff (e.g., medical support or security support for prisons, jails, and other correctional facilities) should be discussed when appropriate.	Yes	Section 8.4, Section 8.6
2.4 Schools		
a. A list of schools including name, location, student population, and transportation resources required to support the evacuation, should be provided. The source of this information should be provided.	Yes	Table 8-2, Table E-1 Section 8.2
b. Transportation resources for elementary and middle schools should be based on 100% of the school capacity.	Yes	Table 8-2

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
c. The estimate of high school students who will use their personal vehicle to evacuate should be provided and a basis for the values used should be discussed.	Yes	Section 8.2
d. The need for return trips should be identified if necessary.	Yes	There are sufficient resources to evacuate schools in a single wave. However, Section 8.3 and Figure 8-1 discuss the potential for a multiple wave evacuation
2.5.1 Special Events		
a. A complete list of special events should be provided and includes information on the population, estimated duration, and season of the event.	Yes	Section 3.7
b. The special event that encompasses the peak transient population should be analyzed in the ETE.	Yes	Section 3.7
c. The percent of permanent residents attending the event should be estimated.	Yes	Section 3.7
2.5.2 Shadow Evacuation		
a. A shadow evacuation of 20 percent should be included for areas outside the evacuation area extending to 15 miles from the NPP.	Yes	Section 2.2 – Assumption 5 Figure 2-1, Figure 7-1 Section 3.2
b. Population estimates for the shadow evacuation in the 10 to 15 mile area beyond the EPZ are provided by sector.	Yes	Section 3.2 Figure 3-4 Table 3-3

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
c. The loading of the shadow evacuation onto the roadway network should be consistent with the trip generation time generated for the permanent resident population.	Yes	Section 5 – Table 5-9
2.5.3 Background and Pass Through Traffic		
a. The volume of background traffic and pass through traffic is based on the average daytime traffic. Values may be reduced for nighttime scenarios.	Yes	Section 3.6, Section 6 Table 3-6, Table 6-3
b. Pass through traffic is assumed to have stopped entering the EPZ about two hours after the initial notification.	Yes	Section 2.3 – Assumption 5 Section 3.6 Table 6-3 – External through traffic footnote
2.6 Summary of Demand Estimation		
a. A summary table should be provided that identifies the total populations and total vehicles used in analysis for permanent residents, transients, transit dependent residents, special facilities, schools, shadow population, and pass-through demand used in each scenario.	Yes	Tables 3-7, 3-8
3.0 Roadway Capacity		
a. The method(s) used to assess roadway capacity should be discussed.	Yes	Section 4
3.1 Roadway Characteristics		
a. A field survey of key routes within the EPZ has been conducted.	Yes	Section 1.3

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
b. Information should be provided describing the extent of the survey, and types of information gathered and used in the analysis.	Yes	Section 1.3
c. A table similar to that in Appendix A, “Roadway Characteristics,” of NUREG/CR-7002 should be provided.	Yes	Appendix K, Table K-1
d. Calculations for a representative roadway segment should be provided.	Yes	Section 4
e. A legible map of the roadway system that identifies node numbers and segments used to develop the ETE should be provided and should be similar to Figure 3-1, “Roadway Network Identifying Nodes and Segments,” of NUREG/CR-7002.	Yes	Appendix K, Figures K-1 through K-23 present the entire link-node analysis network at a scale suitable to identify all links and nodes
3.2 Capacity Analysis		
a. The approach used to calculate the roadway capacity for the transportation network should be described in detail and identifies factors that should be expressly used in the modeling.	Yes	Section 4
b. The capacity analysis identifies where field information should be used in the ETE calculation.	Yes	Section 1.3, Section 4
3.3 Intersection Control		
a. A list of intersections should be provided that includes the total number of intersections modeled that are unsignalized, signalized, or manned by response personnel.	Yes	Appendix K, Table K-2

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
b. Characteristics for the 10 highest volume intersections within the EPZ are provided including the location, signal cycle length, and turn lane queue capacity.	Yes	Table J-1
c. Discussion should be provided on how signal cycle time is used in the calculations.	Yes	Section 4.1, Appendix C.
3.4 Adverse Weather		
a. The adverse weather condition should be identified and the effects of adverse weather on mobilization time should be considered.	Yes	Table 2-1, Section 2.3 – Assumption 9 Mobilization time – Table 2-2, Section 5.3 (page 5-10)
b. The speed and capacity reduction factors identified in Table 3-1, "Weather Capacity Factors," of NUREG/CR-7002 should be used or a basis should be provided for other values.	Yes	Table 2-2 – based on HCM 2010. The factors provided in Table 3-1 of NUREG/CR-7002 are from HCM 2000.
c. The study identifies assumptions for snow removal on streets and driveways, when applicable.	Yes	Section 5.3 – page 5-10 Appendix F – Section F.3.3
4.0 Development of Evacuation Times		
4.1 Trip Generation Time		
a. The process used to develop trip generation times should be identified.	Yes	Section 5
b. When telephone surveys are used, the scope of the survey, area of survey, number of participants, and statistical relevance should be provided.	Yes	Appendix F

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
c. Data obtained from telephone surveys should be summarized.	Yes	Appendix F
d. The trip generation time for each population group should be developed from site specific information.	Yes	Section 5, Appendix F
4.1.1 Permanent Residents and Transient Population		
a. Permanent residents are assumed to evacuate from their homes but are not assumed to be at home at all times. Trip generation time includes the assumption that a percentage of residents will need to return home prior to evacuating.	Yes	Section 5 discusses trip generation for households with and without returning commuters. Table 6-3 presents the percentage of households with returning commuters and the percentage of households either without returning commuters or with no commuters. Appendix F presents the percent households who will await the return of commuters.
b. Discussion should be provided on the time and method used to notify transients. The trip generation time discusses any difficulties notifying persons in hard to reach areas such as on lakes or in campgrounds.	Yes	Section 5.4.3
c. The trip generation time accounts for transients potentially returning to hotels prior to evacuating.	Yes	Section 5, Figure 5-1
d. Effect of public transportation resources used during special events where a large number of transients should be expected should be considered.	Yes	Section 3.7

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
e. The trip generation time for the transient population should be integrated and loaded onto the transportation network with the general public.	Yes	Section 5, Table 5-9
4.1.2 Transit Dependent Residents		
a. If available, existing plans and bus routes should be used in the ETE analysis. If new plans should be developed with the ETE, they have been agreed upon by the responsible authorities.	Yes	Section 8.3 – page 8-7. Pre-established bus routes do not exist. Basic bus routes were developed for the ETE analysis – see Figure 8-2, Table 8-10.
b. Discussion should be included on the means of evacuating ambulatory and non-ambulatory residents.	Yes	Section 8.4, Section 8.5
c. The number, location, and availability of buses, and other resources needed to support the demand estimation should be provided.	Yes	Section 8.4, Table 8-5
d. Logistical details, such as the time to obtain buses, brief drivers, and initiate the bus route should be provided.	Yes	Section 8.4, Figure 8-1
e. Discussion should identify the time estimated for transit dependent residents to prepare and travel to a bus pickup point, and describes the expected means of travel to the pickup point.	Yes	Section 8.4, page 8-7 and page 8-8
f. The number of bus stops and time needed to load passengers should be discussed.	Yes	Section 8.4
g. A map of bus routes should be included.	Yes	Figure 8-2

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
h. The trip generation time for non-ambulatory persons includes the time to mobilize ambulances or special vehicles, time to drive to the home of residents, loading time, and time to drive out of the EPZ should be provided.	Yes	Section 8.5
i. Information should be provided to supports analysis of return trips, if necessary.	Yes	Sections 8.3, 8.4 Figure 8-1 Tables 8-11 through 8-13
4.1.3 Special Facilities		
a. Information on evacuation logistics and mobilization times should be provided.	Yes	Section 8-4, page 8-9 and 8-10 Section 8.6 Tables 8-14 through 8-16
b. Discussion should be provided on the inbound and outbound speeds.	Yes	Sections 8.4, Section 8.6
c. The number of wheelchair and bed-bound individuals should be provided, and the logistics of evacuating these residents should be discussed.	Yes	Section 8.4 Table 8-4, Tables 8-14 through 8-16
d. Time for loading of residents should be provided	Yes	Section 8.4, Section 8.6
e. Information should be provided that indicates whether the evacuation can be completed in a single trip or if additional trips should be needed.	Yes	Section 8.4, page 8-9 Table 8-5 There are sufficient resources to evacuate special facilities in a single wave.

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
f. If return trips should be needed, the destination of vehicles should be provided.	Yes	Section 8.4
g. Discussion should be provided on whether special facility residents are expected to pass through the reception center prior to being evacuated to their final destination.	Yes	Section 8.4
h. Supporting information should be provided to quantify the time elements for the return trips.	Yes	Section 8.4, page 8-8
4.1.4 Schools		
a. Information on evacuation logistics and mobilization time should be provided.	Yes	Section 8.4, Table 8-7 through 8-9
b. Discussion should be provided on the inbound and outbound speeds.	Yes	School bus routes are presented in Table 8-6. School bus speeds are presented in Tables 8-7 (good weather), 8-8 (rain), and 8-9 (snow). Section 8.4 discusses inbound and outbound speeds.
c. Time for loading of students should be provided.	Yes	Tables 8-7 through 8-9, Discussion in Section 8.4
d. Information should be provided that indicates whether the evacuation can be completed in a single trip or if additional trips are needed.	Yes	Section 8.4 – page 8-6 Table 8-5 There are sufficient resources to evacuate schools in a single wave.

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
e. If return trips are needed, the destination of school buses should be provided.	Yes	Return trips are not needed, however host schools are listed in Table 8-3
f. If used, reception centers should be identified. Discussion should be provided on whether students are expected to pass through the reception center prior to being evacuated to their final destination.	Yes	Table 8-3. Students are evacuated to host schools where they will be picked up by parents or guardians.
g. Supporting information should be provided to quantify the time elements for the return trips.	Yes	Return trips are not needed. Tables 8-7 and 8-8 provide time needed to arrive at host school, which could be used to compute a second wave evacuation if necessary
4.2 ETE Modeling		
a. General information about the model should be provided and demonstrates its use in ETE studies.	Yes	DYNEV II (Ver. 4.0.11.0). Section 1.3, Table 1-3, Appendix B, Appendix C.
b. If a traffic simulation model is not used to conduct the ETE calculation, sufficient detail should be provided to validate the analytical approach used. All criteria elements should have been met, as appropriate.	No	Not applicable as a traffic simulation model was used.

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
4.2.1 Traffic Simulation Model Input		
a. Traffic simulation model assumptions and a representative set of model inputs should be provided.	Yes	Appendices B and C describe the simulation model assumptions and algorithms Table J-2
b. A glossary of terms should be provided for the key performance measures and parameters used in the analysis.	Yes	Appendix A Tables C-1, C-2
4.2.2 Traffic Simulation Model Output		
a. A discussion regarding whether the traffic simulation model used must be in equilibration prior to calculating the ETE should be provided.	Yes	Appendix B
b. The minimum following model outputs should be provided to support review: 1. Total volume and percent by hour at each EPZ exit node. 2. Network wide average travel time. 3. Longest queue length for the 10 intersections with the highest traffic volume. 4. Total vehicles exiting the network. 5. A plot that provides both the mobilization curve and evacuation curve identifying the cumulative percentage of evacuees who have mobilized and exited the EPZ. 6. Average speed for each major evacuation route that exits the EPZ.	Yes	1. Table J-5. 2. Table J-3. 3. Table J-1. 4. Table J-3. 5. Figures J-1 through J-14 (one plot for each scenario considered). 6. Table J-4. Network wide average speed also provided in Table J-3.

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
c. Color coded roadway maps should be provided for various times (i.e., at 2, 4, 6 hrs., etc.) during a full EPZ evacuation scenario, identifying areas where long queues exist including level of service (LOS) “E” and LOS “F” conditions, if they occur.	Yes	Figures 7-3 through 7-8
4.3 Evacuation Time Estimates for the General Public		
a. The ETE should include the time to evacuate 90% and 100% of the total permanent resident and transient population	Yes	Tables 7-1, 7-2
b. The ETE for 100% of the general public should include all members of the general public. Any reductions or truncated data should be explained.	Yes	Section 5.4 – truncating survey data to eliminate statistical outliers Table 7-2 – 100th percentile ETE for general public
c. Tables should be provided for the 90 and 100 percent ETEs similar to Table 4-3, “ETEs for Staged Evacuation Keyhole,” of NUREG/CR-7002.	Yes	Tables 7-3, 7-4
d. ETEs should be provided for the 100 percent evacuation of special facilities, transit dependent, and school populations.	Yes	Section 8.4 Tables 8-7 through 8-9 - Schools Tables 8-11 through 8-13 – Transit-dependents Tables 8-14 through 8-16 – Medical facilities Table 8-17 – homebound special needs Section 8.6 – correctional facilities

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
5.0 Other Considerations		
5.1 Development of Traffic Control Plans		
a. Information that responsible authorities have approved the traffic control plan used in the analysis should be provided.	Yes	Section 9, Appendix G
b. A discussion of adjustments or additions to the traffic control plan that affect the ETE should be provided.	Yes	Appendix G
5.2 Enhancements in Evacuation Time		
a. The results of assessments for improvement of evacuation time should be provided.	Yes	Section 13, Appendix M
b. A statement or discussion regarding presentation of enhancements to local authorities should be provided.	Yes	Results of the ETE study were formally presented to local authorities at the final project meeting. Recommended enhancements were discussed.
5.3 State and Local Review		
a. A list of agencies contacted and the extent of interaction with these agencies should be discussed.	Yes	Table 1-1
b. Information should be provided on any unresolved issues that may affect the ETE.	Yes	No issues were found after review from the offsite agencies.
5.4 Reviews and Updates		
a. A discussion of when an updated ETE analysis is required to be performed and submitted to the NRC.	Yes	Appendix M, Section M.3

NRC Review Criteria	Criterion Addressed in ETE Analysis	Comments
5.5 Reception Centers and Congregate Care Center		
a. A map of congregate care centers and reception centers should be provided.	Yes	Figure 10-1
b. If return trips are required, assumptions used to estimate return times for buses should be provided.	Yes	Section 8.3 discusses a multi-wave evacuation procedure. Figure 8-1
c. It should be clearly stated if it is assumed that passengers are left at the reception center and are taken by separate buses to the congregate care center.	Yes	Section 2.3 – Assumption 7h Section 10