4.0 THE EVACUATION ROADWAY NETWORK

4.1. Evacuation Route Descriptions

The evacuation network modeled for the ETE analyses covers portions of Victoria, Goliad, and Refugio counties. The evacuation routes were developed by IEM and approved by designated local emergency management agency officials. The evacuation route network is composed of three types of roads: highways, major arterial roads (roads connecting to highways), and minor arterial or connector roads (residential roads connecting to major arterial roads).

U. S. Highway 77 (US-77) is an example of a highway in the EPZ. Examples of major arterial roads include State Road 239 (SR-239) and SW Moody Street. An example of the connector roads is Commercial Street, located within the city of Bloomington. The connector roads, although not part of the evacuation routes, actually load the evacuee population onto the evacuation routes. Evacuation route attributes, such as speed limits and the number of lanes, are described in detail in Appendix B.

Evacuation routes lead to one of three designated reception centers, which were identified by Exelon personnel in coordination with local stakeholders. Table 11 lists the designated reception centers and their associated subareas, based on evacuation network characteristics.

Table 11: Reception Centers

Reception Center	Address	Sub-Area
Victoria Community Center	2905 E North St Victoria, TX 77901	1, 2, 3, 4, 5, 7, 8, 9
Refugio County Fairgrounds	Fairgrounds Rd Refugio, TX 78377	1, 2, 6, 9, 10, 11
Bauer Community Center	2300 N Highway 35 Port Lavaca, TX	12

Evacuees north and east of VCS generally evacuate to the Victoria Community Center in Victoria County, whereas evacuees south and west of VCS generally evacuate to the Refugio County Fairgrounds. Evacuees in subarea 12, to the east of VCS, evacuate east to Bauer Community Center. This routing scheme has been adopted to ensure evacuation occurs in a radial fashion, away from the site, subject to the availability of evacuation routes. This scheme may require some evacuees to drive longer distances, but it allows for better overall protection from the event that triggers the evacuation. The evacuation routes for each subarea are described in the following and displayed in Figure 12.

Subarea 1 (Victoria County)

- Option 1: If located north of VCS, travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.
- Option 2: If located south of VCS, go south on US-77 to the Refugio County Fairgrounds.

Subarea 2 (Victoria County)

- Option 1: Go south on Warburton Road to San Antonio River Road, east on San Antonio River Road to US-77 and then proceed south to the Refugio County Fairgrounds.
- Option 2: Travel northwest on San Antonio River Road to Bayou Road. Go west on Bayou Road to Duke Bridge Road. From there, take the shortest route to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.
- Option 3: Take shortest route to Cologne Road and then go northwest on Cologne Road to US-59. Travel northeast on US-59 to merge onto SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.

Subarea 3 (Victoria County)

- Take Kemper City Road and/or Fleming Prairie Road to US-77. Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

Subarea 4 (Victoria County)

- Option 1: Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.
- Option 2: Go northwest on TX-185 to the Victoria Community Center.

Subarea 5 (Victoria County)

- Option 1: Take Farm to Market Road 1686 (FM-1686), McCoy Road, Key Road, or Farm to Market Road 616 (FM-616) to US-87 and then proceed northwest to the Victoria Community Center.
- Option 2: Go northwest on TX-185 to the Victoria Community Center.

Subarea 6 (Victoria County)

- Go west on McFaddin Road to US-77 and then proceed south to the Refugio County Fairgrounds.

Subarea 7 (Victoria County)

- Option 1: Travel northeast on US-59 to merge onto SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.

- Option 2: Take Farm to Market Road 446 (FM-446) to SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 3: Take Fleming Prairie Road to US-77. Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

Subarea 8 (Victoria County)

- Option 1: Take US-77, US-59 S, or Farm to Market Road 446 (FM-446) to SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 2: Travel north on US-77 to merge onto US-59 and then proceed north to the Victoria Community Center.

Subarea 9 (Goliad County)

- Option 1: Travel northeast on US-59 to merge onto SW Moody Street (US-77, US-59 Business Route) and then proceed northwest to the Victoria Community Center.
- Option 2: Travel west on US-59 to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.
- Option 3: Go northwest on TX-239 to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.

Subarea 10 (Refugio County)

- Option 1: Travel east on TX-239 to US-77 and then proceed south to the Refugio County Fairgrounds.
- Option 2: Travel west on TX-239 to US-183 (US-77 Alternative) and then proceed south to the Refugio County Fairgrounds.

Subarea 11 (Refugio County)

- Go east on TX-239 to TX-35, south on TX-35 to TX-774, and then proceed southwest to the Refugio County Fairgrounds.

Subarea 12 (Calhoun County)

- Go southeast on TX-185 to TX-35, and then proceed east on TX-35 to Bauer Community Center.

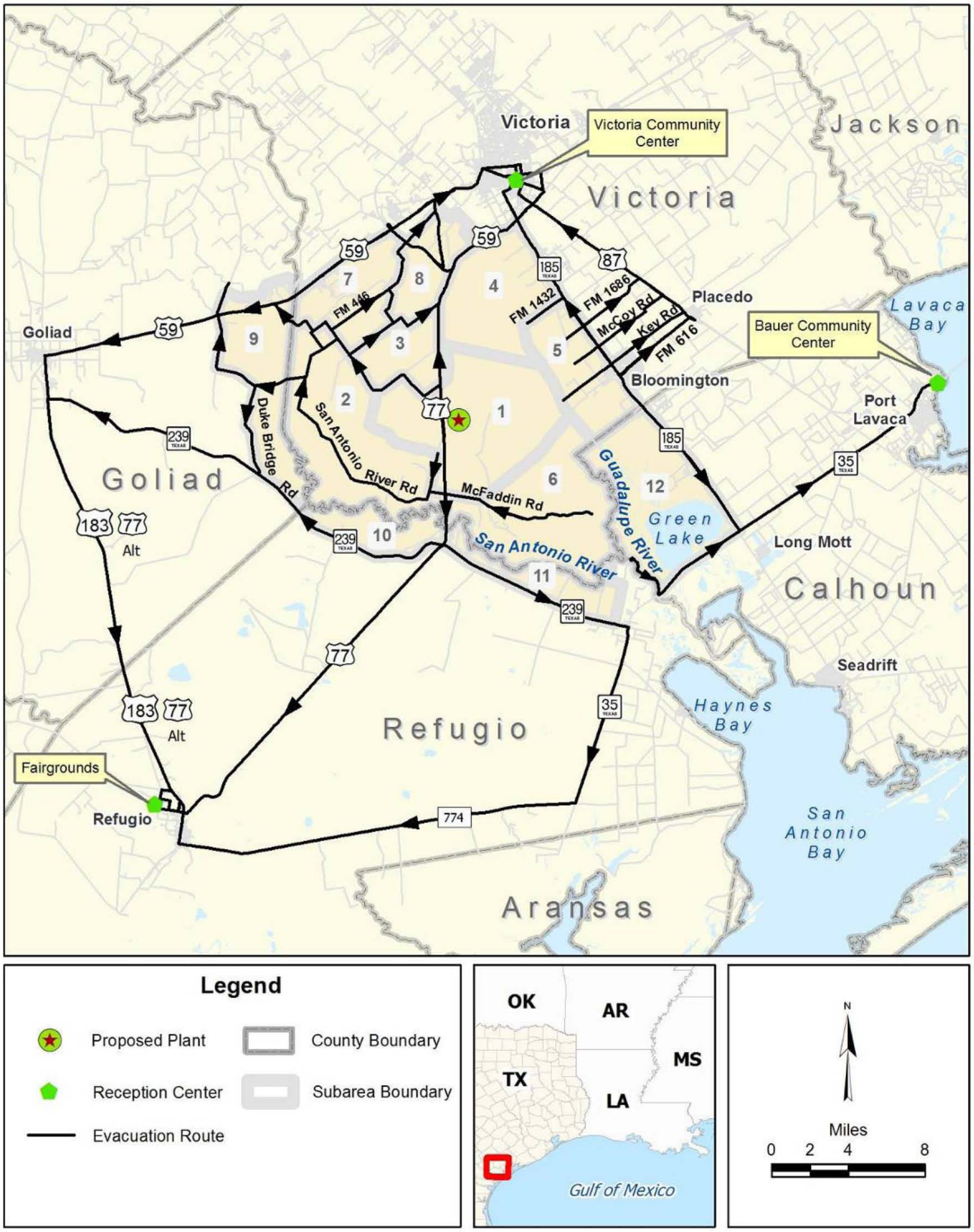

Figure 12: Evacuation Map and Routes

4.2. Evacuation Network Characteristics

A GIS file of the evacuation network was developed using road network data from NAVTEQ as a basis.[28] The high-accuracy NAVTEQ street network GIS data, obtained for the PTV Vision simulation software, was used for field validation purposes and to build the digital evacuation network database. To ensure the accuracy of this data, the entire evacuation network, including those roads outside the 10-mile EPZ leading to the reception centers, was verified by traveling each route in the network in the direction of evacuation and collecting detailed information regarding the properties of each road section using a global positioning system (GPS)-enabled device. The GPS device allowed the location of any sections that had changed in curvature, speed limits, or other necessary network information to be determined with a high degree of precision.

The specific network attributes collected during the field trip included the number of lanes, speed, turns, traffic controls, pavement type and width, shoulder width, and any other information required to model the traffic capacity of each link in the network. Any differences between the NAVTEQ data and existing field conditions were noted and, where necessary, were incorporated into the analyses.

The highways generally have a posted speed limit of 50 to 60 mph. The major and minor arterial or connector roads generally have a posted speed limit of 40 to 50 mph. On some of the roads, especially the highways, the posted speed limit decreases to 25 to 35 mph near city limit boundaries. Unpaved roads or dirt roads have randomly posted speed limits, so a speed limit of 35 mph was assumed for modeling purposes based on comfortable and safe driving speeds achieved by IEM personnel on these roads during field verification. Most of the links in the evacuation network (including some highways) generally have one lane available in the direction of evacuation. There are no interstates within the 10-mile EPZ. The U.S. highways, as well as some state highways, have two lanes available in the direction of evacuation.

[28] PTV America, Inc. "NAVTEQ Data for PTV VISION." Online: http://www.ptvamerica.com/software/ptv-vision/visum/navteq-tiles/ (last accessed July 14, 2011).

5.0 EVACUATION TIME ESTIMATE METHODOLOGY

ETE studies are performed using VISUM, one of the core components of the PTV Vision software suite. VISUM is a macroscopic transportation modeling software with the capability to do dynamic assignment (i.e., assignment and vehicle flow over time). Vehicular demand in the VISUM model was composed of a series of origin-destination (O-D) matrices, an evacuation traffic network, and a traffic assignment procedure. In the traffic network, both the link and turn movement capacities were calculated following the Highway Capacity Manual 2000 methodology using data collected from NAVTEQ, aerial imagery, and the field trip, including the number of lanes, speed limits, intersection control types, and conflicting volumes at intersection approaches. After the O-D matrices and evacuation network were input into VISUM, the dynamic user equilibrium (DUE) traffic assignment procedure was implemented to allocate vehicular demand onto appropriate routes in the traffic network for each time step. The DUE algorithm iteratively calculated the traffic volumes and associated delays on competing routes using the Akçelik volume-delay function (VDF) to assure that the travel times for alternative routes are close to each other (i.e., equilibrium loading). The Akçelik VDF was selected because it provides more accurate delay estimates than other commonly used functions, such as the Bureau of Public Roads (BPR) function, particularly for oversaturated conditions.[29]

IEM selected the DUE traffic assignment method because it allows equilibrium loading of evacuation demand onto the road network for each time step and outputs the traffic volumes on each link for each time step. This allows an analysis of vehicle flow along the evacuation routes and across the EPZ boundary over time, as well as the investigation and reporting of queuing and congestion. While VISUM has the functionality to model transit trips, no transit was modeled in this ETE study because no transit is expected to operate in the study area during the evacuation.

Estimates of people and vehicles loaded onto the network are based on the data and methods described in Section 3.0. The development of the evacuation network and collection of road network data is detailed in Section 4.0. This section details the methodology adopted to develop ETEs based on the evacuation network and population data. Key assumptions that have a substantial impact on the ETE results are also included in the following subsections.

5.1. Loading of the Evacuation Network

In the event of an emergency, the public notification will mark the beginning of the evacuation times. So, public behavior (how long it takes the population to learn of the emergency and begin to evacuate) will impact the ETEs. The loading time distributions, also known as "trip generation times," described in this section are measured from the public notification, rather than from the occurrence of a hypothetical event.

[29] Singh, R. and Dowling, R. "Improved Speed-Flow Relationships: Application to Transportation Planning Models." *Proceedings of the Seventh TRB Conference on the Application of Transportation Planning Methods*. Page 341. March 1999.

5.1.1. Trip Generation Events and Activities

NUREG-0654 requires that planners estimate the amount of time for the public to begin evacuating. These elapsed times are represented as statistical distributions to reflect the variety of activities the public may undertake before evacuating. In addition, separate distributions are prepared for each population group, because, for example, a person evacuating from home will behave differently than someone who is at work, fishing, or in a nursing home. This is due to differences in their available alert systems and also systematic differences in their pre-evacuation preparations.

Evacuation Events and Activities Series for Different Population Groups

The trip generation process consists of a series of events and activities. Each event occurs at an instant in time and is the outcome of an activity. Activities are undertaken over a period of time. As shown in Figure 13 through Figure 15, different population groups have different events and activity series for evacuation.

In Figure 13 through Figure 15, circles represent events. Each event is coded by a number, which represents the following:

1. First notification of public
2. Individual's awareness of incident
3. Leave work/facilities
4. Arrive home
5. Leave home

An arrow indicates an activity. The following describe the activities that take place between each event:

- 1 → 2: Receive notification
- 2 → 3: Prepare to leave work/facilities
- 3 → 4: Travel home
- 2 → 5: Prepare to leave home

Transient evacuees, including travelers, boaters, hunters, and employees living outside the EPZ, will follow Series A as shown in Figure 13. They will be notified of the event and will leave their activities.

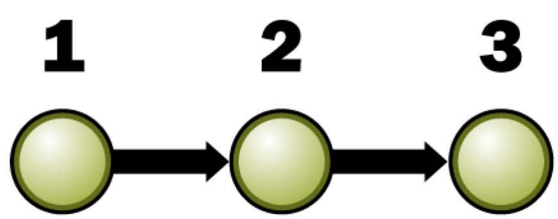

Figure 13: Evacuation Events and Activity Series for Transients, Special Facilities (Series A)

Households that do not have to wait for household members to return home will be notified of the emergency and leave home, following Series B, shown in Figure 14.

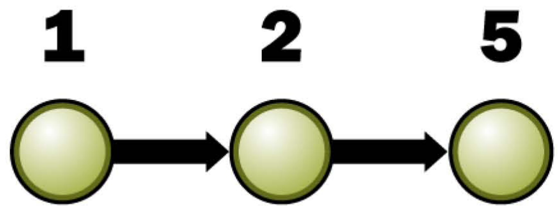

Figure 14: Evacuation Events and Activity Series for Residences without Family Members Returning Home (Series B)

The results of a phone survey suggest around 48 percent of residences have regular commuters who would wait for household members to return home before evacuating. This portion of the population will follow series C in Figure 15 to evacuate. Note the activities of the people at home (denoted with a subscript H) can be undertaken in parallel with those of the commuter (denoted with a subscript C). Specifically, an adult member of a household can prepare to leave home while others are traveling home from work. In this instance, the household members would be able to evacuate sooner than a household that prepares to leave home after all members have returned home.

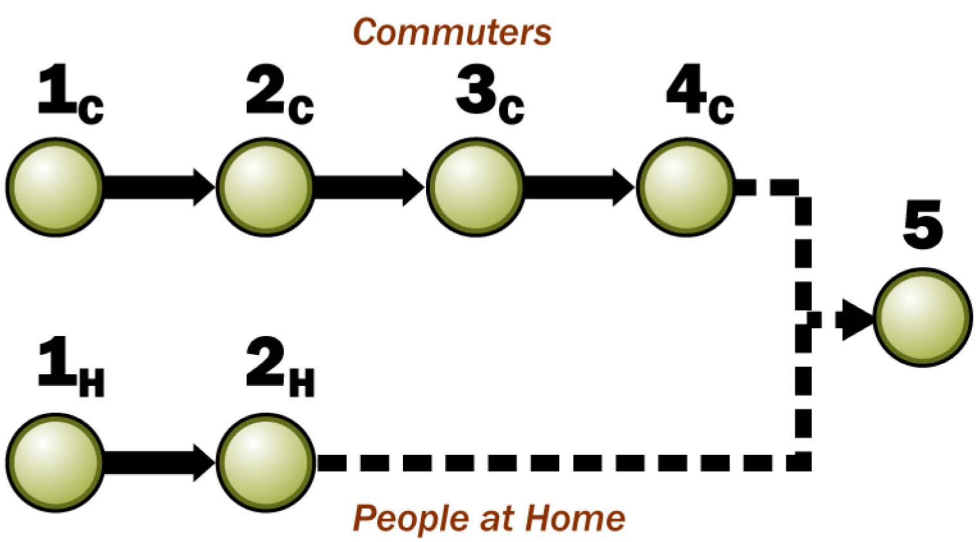

Figure 15: Evacuation Events and Activity Series for Residences with Family Members Returning Home (Series C)

Calculation of Composite Distribution for Events and Activities Series in Evacuation

As indicated by NUREG-0654, activities may be in sequence (i.e., an activity will be undertaken upon completion of a preceding event) or may be in parallel (i.e., two or more activities may take place over the same period of time). Given the assumption that the time distribution of each activity is independent, the combined trip generation time required for individual activities undertaken in sequence would be the sum of the times required for each activity. On the other hand, the combined trip generation time required for individual activities undertaken in parallel would be the maximum of the times required for each activity. Table 12 shows the approach for estimating trip generation for different evacuation activity series.

Table 12: Trip Generation Estimate for Different Evacuation Activity Series

Trip Generation Series	Composite Distribution Calculation
A	{1→2 + 2→3}
B	{1→2 + 2→5}
C	Max: $\{(1_C \to 2_C + 2_C \to 3_C + 3_C \to 4_C), (1_H \to 2_H + 2_H \to 5)\}$

5.1.2. Trip Generation Time Estimate

Trip generation consists of two phases of activities: notification (i.e., activity 1→2) and mobilization, which includes the rest of the activities. The notification process includes transmitting information and receiving and correctly interpreting the information that is transmitted. IEM adopted the time distribution for notification presented in *Evaluating Protective Actions for Chemical Agent Emergencies* (ORNL-6615).[30] This data was collected during evacuations executed in response to large-scale chemical spills and explicitly incorporates the time required for the communication of the warning. The data collected in this meta-study was based on transient, permanent, and special populations and is therefore appropriate to use as "general" notification curves for all three population types.

The underlying assumption in applying the ORNL-6615 notification curves to a nuclear ETE study is the public perception of radiological emergencies is similar to that of a chemical event. These curves were developed from the empirical data collected from real-life evacuations in response to actual events, and no similar study developed specifically for radiological events is readily available. In the absence of such a study, empirical data from similar events was deemed to be more justifiable than estimating or hypothesizing about the public response to a nuclear event. IEM has successfully used this data for multiple ETE studies in the past, both for nuclear and chemical incidents or accident scenarios.

Since the ORNL-6615 notification distribution of times depends on the warning system employed, IEM personnel incorporated the planned alert and notification systems (ANS) around the site, based on discussions with Exelon personnel. These discussions revealed the basic ANS within the VCS EPZ will include sirens and Emergency Alert Systems (EAS).

[30] Rogers, G. O., et al., *Evaluating Protective Actions for Chemical Agent Emergencies* (ORNL-6615), Oak Ridge, TN: Oak Ridge National Laboratory, 1990.

Hunters, boaters, and park visitors were expected to be notified by local emergency officials patrolling the forest, river, or park with loud speakers. These officials, in turn, were expected to be notified of the emergency via EAS. This process was incorporated into the model by adding 45 minutes to the ORNL-6615 notification time distribution for EAS.

The notification time distributions for these warning systems are shown in Figure 16. Any loss in capability of the ANS components would potentially increase the notification times and, as a result, ETEs.

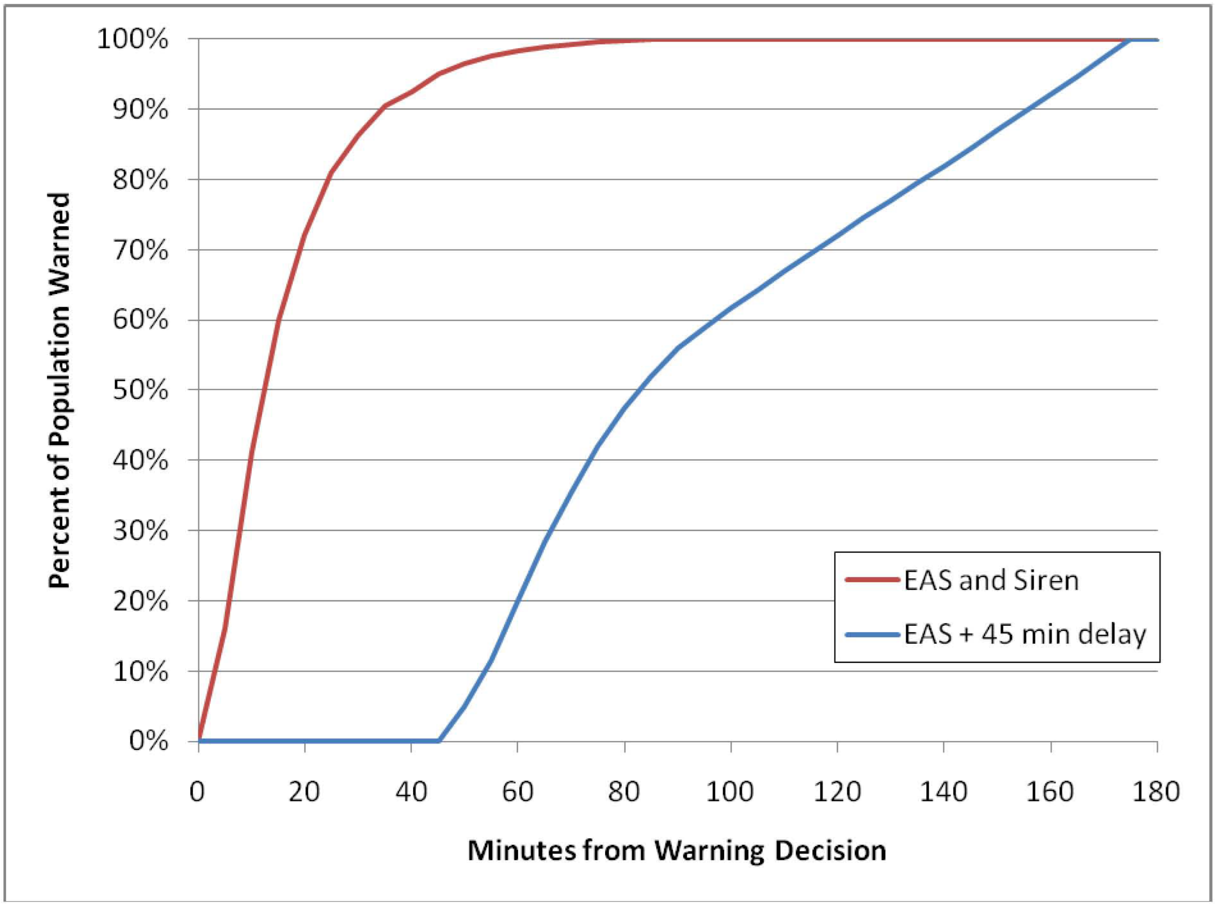

Figure 16: Notification Times for Selected Alert and Notification Systems[31]

Generally, the information required to estimate the second phase of trip generation, the mobilization process, was obtained from a telephone survey of EPZ residents. See Appendix C for details about the survey and its raw data.

Figure 17 and Figure 18 present mobilization time distribution for different activities obtained from the telephone survey. The points in the figures represent the raw data from the survey and the lines represent the smoothed cumulative distribution function obtained by applying polynomial regression to the raw data points.

[31] *Ibid.*

Mobilization times will vary from one individual to the next depending on where they are, what they are doing, and related factors. Furthermore, some people, including commuters, shoppers, and other travelers, will return home to join the other members of their households for evacuation upon receiving notification of an emergency. Therefore, the time elapsed for those people to travel home should be considered as part of the mobilization time before evacuation can begin.

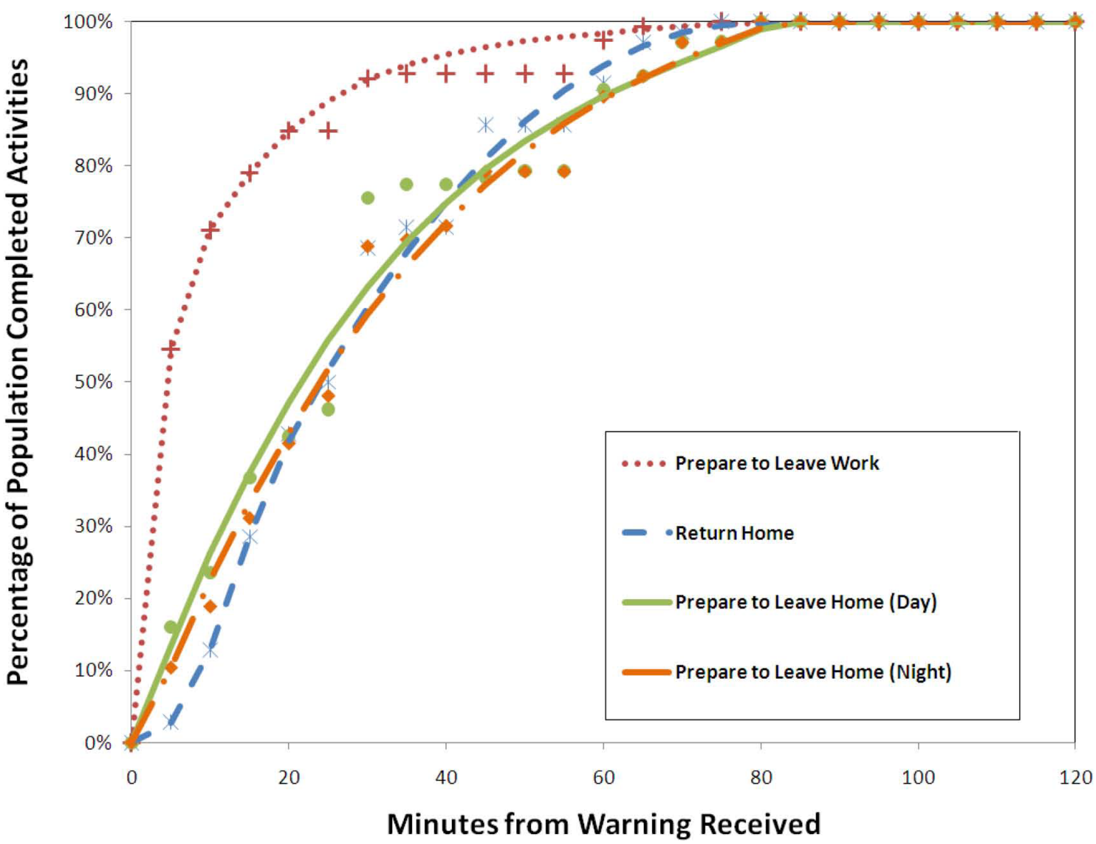

Figure 17: Non-Recreational Population Mobilization Time for Different Activities

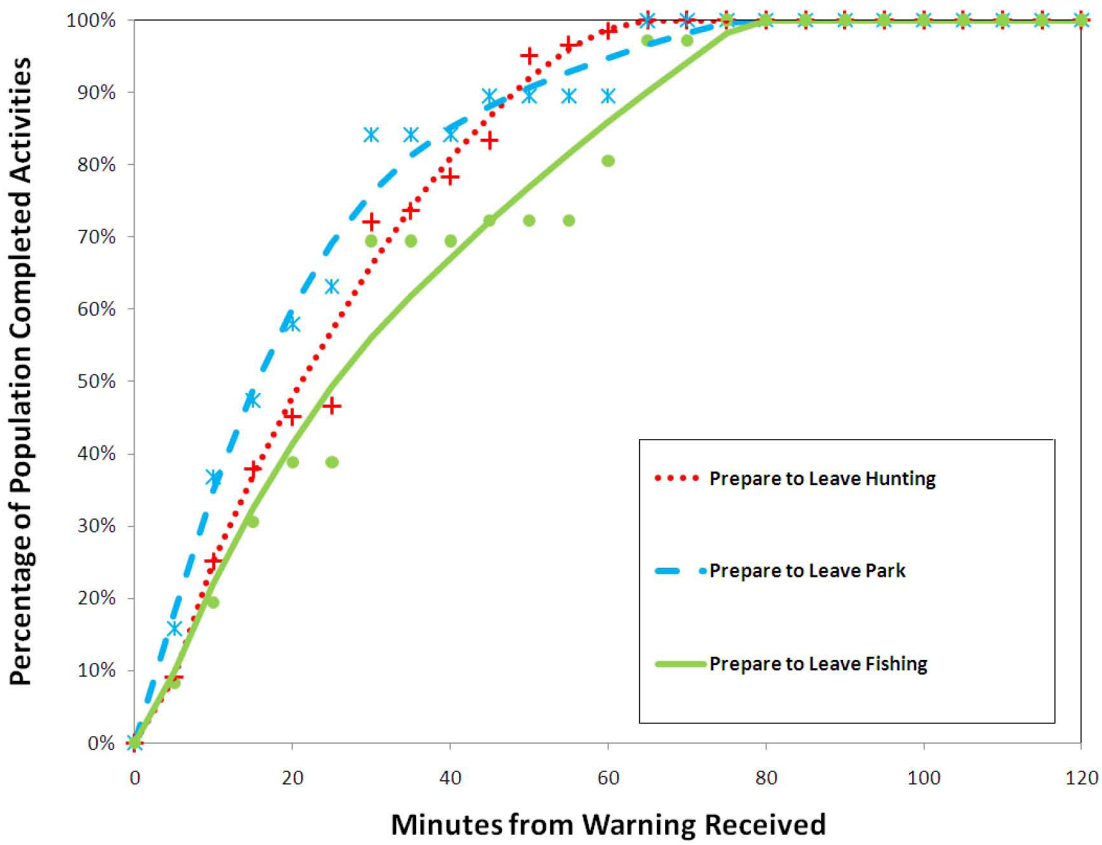

Figure 18: Recreational Population Mobilization Time for Different Activities

Figure 19 presents the distribution of trip generation times (i.e., the combination of notification and mobilization times) for different population groups. These curves were obtained by applying the methodology described in Table 12 to the activities of each population group.

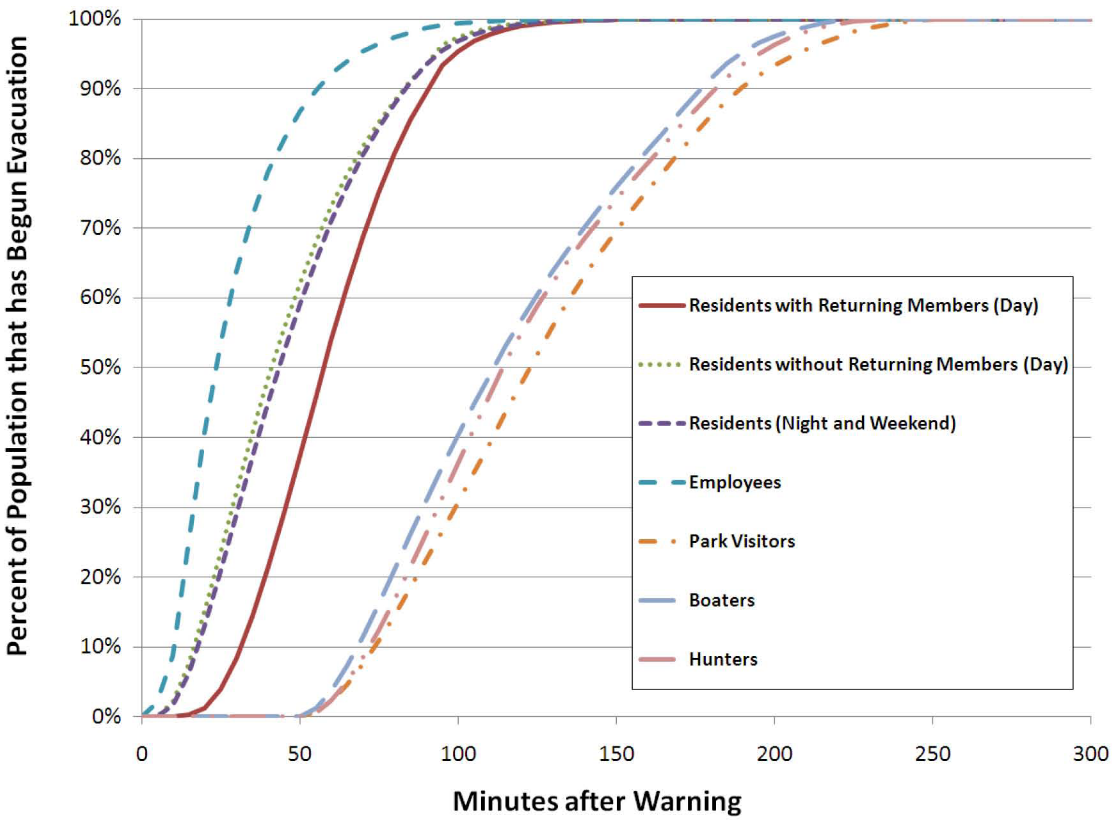

Figure 19: Distribution of Trip Generation Times by Population Group

5.1.3. Trip Generation Times for Special Facilities

As described in Section 3.3, the special facilities within the VCS EPZ include the Ineos Nitriles Green Lake Plant, Bloomington Elementary School, Victoria Spiritual Retreat Center, and proposed Victoria County Station. Table 13 shows the assumptions for determining trip generation times for the population segments associated with these facilities. The trip generation times for special facilities in each category were determined by consulting with relevant personnel at the facilities.

Sirens will be the warning system available to the Victoria Spiritual Retreat Center, though the population at this facility is expected to evacuate in a group in the event of an emergency. According to Figure 3.4 of ORNL-6615,[32] the probability of a population being warned by sirens reaches 50 percent approximately 15 minutes following the warning decision, so 15 minutes was used as the warning time for the Victoria Spiritual

[32] *Ibid.*

Retreat Center. This was combined with an estimated 25 minutes for mobilization to create a loading time for the center's vehicles of 40 minutes.

Table 13: Trip Generation Time for Population in Special Facilities

Facility Category	Facility Name	Assumptions	Trip Generation Time
Industry Factory	Ineos Nitriles Green Lake Plant	Personnel will evacuate in a similar manner to employees in the rest of the EPZ	Trip generation time for employees (as shown in Figure 19)
School Students	Bloomington Elementary School	Student will evacuate in 40 minutes	40 minutes
School Staff	Bloomington Elementary School	Staff will not leave until students have evacuated	Trip generation time for students (40 minutes) plus 5 minutes
Chapel	Victoria Spiritual Retreat Center	People will be warned by siren; people will leave using personal vehicles	40 minutes
Nuclear Plant	Victoria County Station	Personnel will evacuate in a similar manner to employees in the rest of the EPZ	Trip generation time for employees (as shown in Figure 19)

5.2. Evacuation Simulation

Evacuations were simulated using the population and vehicle demand data, evacuation network data, and loading distribution data discussed in the previous sections. VISUM was used to simulate evacuations. Figure 20 describes the framework of the analysis and three of its main features: the demand model, the network model, and the impact model.

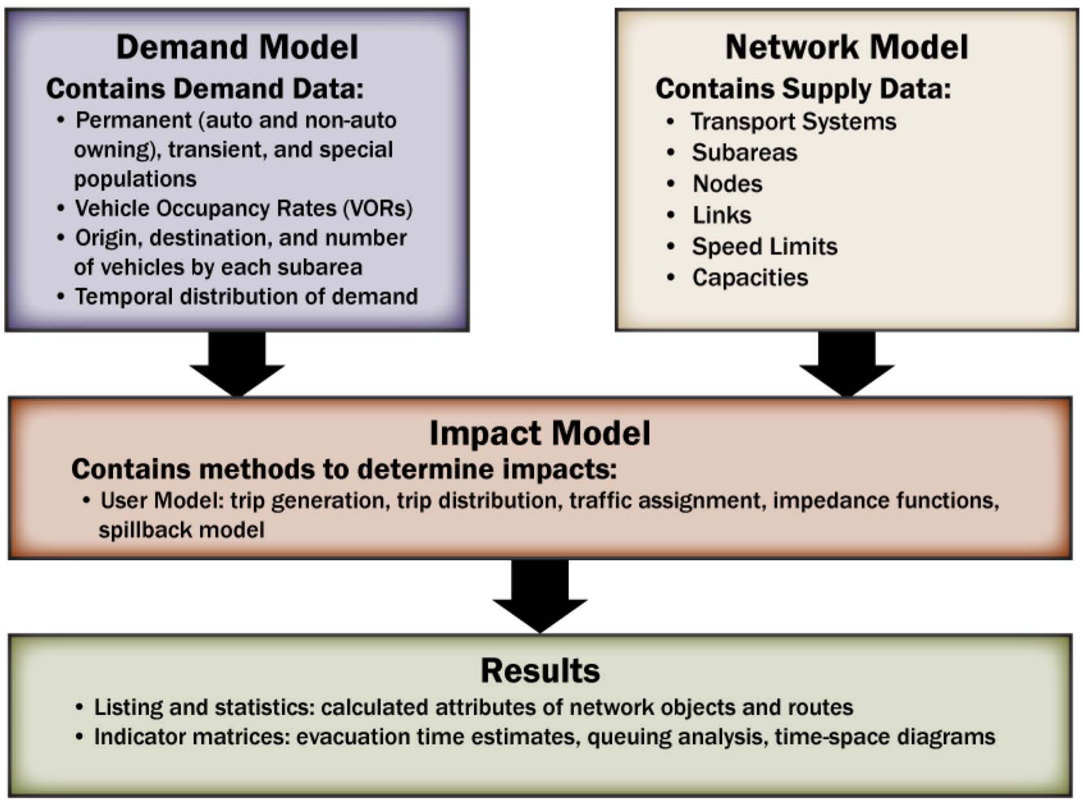

Figure 20: ETEs Analysis Framework Using VISUM

5.2.1. The Demand Model

The demand model contains the travel demand data. The total number of vehicles originating from a subarea is calculated by dividing a population by its expected vehicle occupancy rate. The total number of vehicles originating from a subarea is then distributed to different time intervals based on the loading distribution curve for the subarea. The loading distribution curve for the subarea depends on the warning system available for that subarea. The travel demand is described by an O-D matrix. The O-D matrix refers to a time interval and the total number of vehicles departing in that time interval.

5.2.2. The Network Model

The network model describes the relevant supply data of an evacuation network. The supply data consists of subareas, nodes, links, speed limits, and capacities. The subareas describe areas with particular boundaries based on demography, topography, land characteristics, access routes, and local jurisdictions. They represent the origin and destination of trips within the evacuation network. Nodes define positions of intersections in the evacuation network. Links connect nodes and, therefore, describe the road infrastructure. Every network object is described by its attributes (e.g., speed limits and capacities for the links). The travel time of a vehicle on a given link depends on the permitted speed and the capacity (i.e., the traffic volume a road can handle before the formation of a traffic jam) of the link. The roadway capacities used in the evacuation analysis were based on estimates from PTV/NAVTEQ. These values were verified using field collected road attributes and capacity calculation methodology from the FHWA.[33]

5.2.3. The Impact Model

The impact model takes its input data from the demand model and the network model. PTV Vision provides different impact models to analyze and evaluate the evacuation network. A user model simulates the behavior of travelers. It calculates traffic volumes and service indicators, such as travel time. The VISUM traffic assignment procedure chosen for this analysis simulates the movement of vehicles on the network as time passes in the evacuation and outputs volumes for each link at each time after analyzing the queuing behavior. This time-dynamic functionality allows for loading of the network via distributions, as when using a range of mobilization times.

The ETE is measured by noting when the last car passes the boundary of the EPZ. VISUM displays the calculated results in graphic and tabular forms and allows graphical analysis of results. In this way, for example, routes per O-D pair, traffic flow, and isochrones can be displayed and analyzed.

[33] U.S. Federal Highway Administration. "Highway Performance Monitoring System Field Manual, Appendix N - Procedures for Estimating Highway Capacity." Online: http://www.fhwa.dot.gov/ohim/hpmsmanl/appn.htm.

6.0 ANALYSIS OF EVACUATION TIMES

Evacuation times were estimated in order to give emergency planners in the area as well as the proposed VCS personnel an approximate time required for evacuation of various parts of the footprint. The estimates were derived by using population (demand) data to determine the number of vehicles and then by modeling the travel of the vehicles along the evacuation routes from their origin to their assigned reception center. The evacuation time estimate is the time between public notification and when the last evacuating vehicle exits the EPZ.

The ETEs are composed of two components. The first is loading (or "trip generation") time, which is the time required for residents within the area to prepare and then begin their evacuation. Loading times depend, in part, on how long it takes residents to receive the warning and is, thus, dependent on the warning systems in their area. The trip generation times estimated for the VCS EPZ are described in detail in Section 5.1. The second component of an ETE is travel time, which is the time between the resident's departure and when they cross the EPZ boundary. The travel time is determined via the evacuation model.

As a part of the analysis, subareas in the study area were grouped to represent the different areas that might need to be evacuated during an emergency so decision makers could more effectively order evacuations based on the scenarios and potential wind direction. These areas are discussed in more detail in Section 1.3.

Each subarea has been assigned a set of evacuation routes, developed by IEM in coordination with Exelon and designated local emergency management agency officials. The route restrictions were then reflected in the modeling of the scenarios. The routing guidance generally routes evacuees to evacuate in a radial manner away from VCS, subjected to the availabilities of roadway networks. The evacuation routes are described in more detail in Section 4.1.

6.1. Summary of ETE Results

The evacuation time estimate results are displayed and discussed in Sections 6.2, 6.3, 6.4, and 6.5. Evacuation times listed include warning diffusion, public mobilization, and travel time out of the EPZ. They do not include the travel time from the EPZ boundary to the reception centers. It is also important to note the evacuation time is the time from the moment public notification begins and not at the start time of an event. The analysis of ETEs revealed the following general trends:

- The ETEs, in either normal or adverse weather, are driven more by the planned alert and notification systems rather than by the roadway capacities, because vehicular demand is low compared to the available roadway capacities. While some congestion was observed in the network, it was minor enough that the last vehicles to exit the EPZ did not have to wait in queuing before reaching the EPZ boundary.

- Adverse weather conditions have little impact on the ETEs with an increase of 0 to 10 minutes due primarily to reduced travel speeds.
- For each evacuation area, the weekend scenario produced the highest evacuation times. This is due to the increased amount of recreational transients in the area (e.g., hunters, boaters, and park visitors) on the weekend. This population has a higher trip generation time than other populations and therefore takes longer to begin evacuating.
- The addition of subarea 12 to the EPZ increased the ETEs by 0 to 10 minutes. This is mostly because the recreational populations in the area, who as described above have a higher trip generation time than other population segments, increased the chance that at least one evacuating vehicle would take longer to depart, increasing the ETEs by a small amount. There was no observed congestion related to the evacuation of subarea 12.

6.2. ETEs for NUREG-0654 Evacuation Areas

The evacuation time estimate for the NUREG-0654 evacuation areas are displayed in Table 14.

Table 14: ETEs in Minutes for NUREG-0654 Evacuation Areas

Evacuation Area	Subareas Impacted	Normal Weather			Adverse Weather		
		Weekday	Weeknight	Weekend	Weekday	Weeknight	Weekend
0–2 Miles, Full	1	125	125	185	125	130	190
0–5 Miles, Full	1, 2, 3, 4, 6	210	155	245	215	160	250
0–10 Miles, 90° NE	1, 4, 5	165	150	230	170	150	235
0–10 Miles, 90° SE	1, 6, 11, 12	160	135	235	160	135	235
0–10 Miles, 90° SW	1, 2, 9, 10	165	140	235	170	145	235
0–10 Miles, 90° NW	1, 2, 3, 7, 8, 9	175	165	235	180	165	235
0–10 Miles, 180° N	1, 2, 3, 4, 5, 7, 8, 9	210	165	245	210	165	245
0–10 Miles, 180° E	1, 4, 5, 6, 8, 11, 12	205	165	245	205	165	245
0–10 Miles, 180° S	1, 2, 5, 6, 9, 10, 11, 12	210	165	250	210	165	250
0–10 Miles, 180° W	1, 2, 3, 4, 6, 7, 8, 9, 10, 11	215	165	250	220	165	250
0–10 Miles, Full EPZ	All Subareas	225	170	255	225	170	255

Table 15: ETEs in Minutes for Bloomington Elementary School

Evacuation Area	Weekday, Normal Weather	Weekday, Adverse Weather
0–2 Miles, Full	60	65
0–10 Miles, 90° NE	60	65
0–10 Miles, 180° N	60	65
0–10 Miles, 180° E	60	65
0–10 Miles, 180° S	60	65
0–10 Miles, Full EPZ	60	65

6.2.1. Evacuation Area 1: 0 to 2 Miles

The majority of the population within the two-mile radius (subarea 1) consists of a small number of permanent residents and transient employees. The loading time for this population was small due to the combined warning system of sirens and EAS. Depending on their location relative to VCS, this population will evacuate using the high capacity highway, US-77, to travel to either the north or south reception center. The evacuation times for this evacuation area range from 2 hours 5 minutes to 3 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning diffusion times and are not influenced by significant congestion.

6.2.2. Evacuation Area 2: 0 to 5 Miles

This evacuation area includes all population in subareas 1, 2, 3, 4, and 6. This population includes permanent residents, transient employees, and recreational fishers and hunters. During an emergency, evacuees will proceed north to the reception center at the Victoria Community Center or south to the reception center at the Refugio County Fairgrounds. The evacuation times range from 2 hour 35 minutes to 4 hours 10 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven by the time required for population notification and mobilization and are not influenced by significant congestion.

6.2.3. Evacuation Area 3: 0 to 10 Miles, 90° NE

This evacuation area includes all population in the 0 to 10 miles 90° northeastern area (consisting of subareas 1, 4, and 5). This population includes permanent residents, transient employees, and recreational fishers and hunters. This area also includes Bloomington Elementary School in Victoria County. The evacuation times ranged from 2 hours 30 minutes to 3 hours 55 minutes. The highest evacuation times are for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the evacuation times are mainly driven by notification and mobilization times. The congestion points are presented and discussed in Section 8.0.

6.2.4. Evacuation Area 4: 0 to 10 Miles, 90° SE

This evacuation area includes all population in the 0 to 10 miles 90° southeastern area (consisting of subareas 1, 6, 11, and 12). This population includes permanent residents, transient employees, the Ineos Nitriles facility, and recreational fishermen and hunters. The evacuation times ranged from 2 hours 15 minutes to 3 hours 55 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven primarily by loading times and are not influenced by significant congestion.

6.2.5. Evacuation Area 5: 0 to 10 Miles, 90° SW

This evacuation area includes all population in the 0 to 10 miles 90° southwestern area (consisting of subareas 1, 2, 9, and 10). This population includes permanent residents, transient employees, and recreational fishers and hunters. The evacuation times ranged from 2 hours 20 minutes to 3 hours 55 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven primarily by loading times. No significant congestion occurred in this scenario.

6.2.6. Evacuation Area 6: 0 to 10 Miles, 90° NW

This evacuation area includes all population in the 0 to 10 miles 90° northwestern area (consisting of subareas 1, 2, 3, 7, 8, and 9). This population includes permanent residents, transient employees, and recreational fishers and hunters. The evacuation times ranged from 2 hours 45 minutes to 3 hours 55 minutes with the highest ETE occurring under the weekend scenario under adverse weather conditions. These times are driven primarily by loading times and are not influenced by significant congestion.

6.2.7. Evacuation Area 7: 0 to 10 Miles, 180° N

This area includes each of the 10-mile subareas north of VCS (consisting of subareas 1, 2, 3, 4, 5, 7, 8, and 9). The evacuation times ranged from 2 hours 45 minutes to 4 hours 5 minutes. These times are higher than the evacuation times for the 0 to10 miles 90° NE and 0 to 10 miles 90° NW scenarios because the shared use of some evacuation routes produced additional congestion. For each scenario, the evacuation time for the 0 to 10 miles 180° N was 0 to 35 minutes higher than the highest time for the 0 to 10 miles 90° NE and 0 to 10 miles 90° NW scenarios.

6.2.8. Evacuation Area 8: 0 to 10 Miles, 180° E

This area includes each of the 10-mile subareas east of VCS (consisting of subareas 1, 4, 5, 6, 8, 11, and 12). The evacuation times ranged from 2 hours 45 minutes to 4 hours 5 minutes. These times are higher than the evacuation times for the 0 to 10 miles 90° NE and 0 to 10 miles 90° SE scenarios because the shared use of some evacuation routes and additional evacuees from subarea 8 produced additional congestion. For each scenario, the evacuation time for this area was 10 to 40 minutes higher than the highest time for the 0 to 10 miles 90° NE and 0 to 10 miles 90° SE scenarios.

6.2.9. Evacuation Area 9: 0 to 10 Miles, 180° S

This area includes each of the 10-mile subareas south of VCS (consisting of subareas 1, 2, 5, 6, 9, 10, 11, and 12). The evacuation times ranged from 2 hours 45 minutes to 4 hours 10 minutes. These times are higher than the evacuation times for the 0 to10 miles 90° SE and 0 to 10 miles 90° SW scenarios because the shared use of some evacuation routes and additional evacuees from subarea 5 produced additional congestion. For each scenario, the evacuation time for the 0 to 10 miles 180° N was 15 to 45 minutes higher than the highest time for the 0 to 10 miles 90° NE and 0 to 10 miles 90° NW scenarios.

6.2.10. Evacuation Area 10: 0 to 10 Miles, 180° W

This area includes each of the 10-mile subareas west of VCS (consisting of subareas 1, 2, 3, 4, 6, 7, 8, 9, 10, and 11). The evacuation times ranged from 2 hours 45 minutes to 4 hours 10 minutes. These times are higher than the evacuation times for the 0 to 10 miles 90° NW and 0 to 10 miles 90° SW scenarios, because the shared use of some evacuation routes and additional evacuees from subarea 4, 6, and 11 produced additional congestion. For each scenario, the evacuation time for this area was 0 to 40 minutes higher than the highest time for the 0 to 10 miles 90° NW and 0 to 10 miles 90° SW scenarios.

6.2.11. Evacuation Area 11: 0 to 10 Miles, Full EPZ

The evacuation times for the entire 10-mile EPZ ranged from 2 hours 50 minutes to 4 hours 15 minutes. These times were driven by warning times and not influenced by significant congestion. For all scenarios, the 10-mile radius evacuation times were 5 to 10 minutes longer than the highest 180° sector evacuation time. No significant congestion occurred in this scenario.

6.3. ETEs for PAR Evacuation Areas

The evacuation time estimate for the PAR evacuation areas are displayed in Table 16.

Table 16: ETEs in Minutes for PAR Evacuation Areas

Evacuation Area		Subareas Impacted	Normal Weather			Adverse Weather		
Distance	Wind Direction[34]		Weekday	Weeknight	Weekend	Weekday	Weeknight	Weekend
2-mile Radius, 5 miles Downwind	160°-204°	1, 3, 4	165	150	230	170	150	230
	205°-234°	1, 4	160	145	230	160	145	230
	235°-274°	1, 4, 6	180	145	240	180	145	240
	275°-334°	1, 6	150	130	225	150	130	225
	335°-49°	1, 2, 6	175	145	240	180	145	240
	50°-74°	1, 2	155	140	230	160	145	230
	75°-129°	1, 2, 3	165	150	230	170	150	235
	130°-159°	1, 2, 3, 4	190	155	240	195	155	245
5-mile Radius, 10 miles Downwind	165°-184°	1, 2, 3, 4, 6, 7, 8	215	160	245	215	165	250
	185°-194°	1, 2, 3, 4, 5, 6, 7, 8	215	165	245	220	165	250
	195°-224°	1, 2, 3, 4, 5, 6, 8	215	160	245	215	160	250
	225°-264°	1, 2, 3, 4, 5, 6, 12	220	165	250	220	165	250
	265°-314°	1, 2, 3, 4, 5, 6, 11, 12	220	165	250	220	165	250
	315°-334°	1, 2, 3, 4, 6, 11	210	155	245	215	160	250
	335°-29°	1, 2, 3, 4, 6, 10, 11	215	155	245	215	160	250
	30°-44°	1, 2, 3, 4, 6, 9, 10, 11	215	155	245	215	160	250
	45°-84°	1, 2, 3, 4, 6, 9, 10	215	155	245	215	160	250
	85°-99°	1, 2, 3, 4, 6, 7, 9, 10	215	160	250	220	165	250
	100°-109°	1, 2, 3, 4, 6, 7, 9	215	160	245	215	165	250
	110°-164°	1, 2, 3, 4, 6, 7, 8, 9	215	160	245	215	165	250

6.3.1. Evacuation Area 1: 2-mile Radius and 5 miles downwind with Wind From 160° to 204°

The evacuation times for this evacuation area range from 2 hours 30 minutes to 3 hours 50 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

[34] Wind direction is the direction (in degrees) from which the wind is blowing (000° or 360° represents a wind from north to south).

6.3.2. Evacuation Area 2: 2-mile Radius and 5 miles downwind with Wind From 205°to 234°

The evacuation times for this evacuation area range from 2 hours 25 minutes to 3 hours 50 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.3. Evacuation Area 3: 2-mile Radius and 5 miles downwind with Wind From 235°to 274°

The evacuation times for this evacuation area range from 2 hours 25 minutes to 4 hours and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.4. Evacuation Area 4: 2-mile Radius and 5 miles downwind with Wind From 275°to 334°

The evacuation times for this evacuation area range from 2 hours 10 minutes to 3 hours 45 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.5. Evacuation Area 5: 2-mile Radius and 5 miles downwind with Wind From 335°to 49°

The evacuation times for this evacuation area range from 2 hours 25 minutes to 4 hours and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.6. Evacuation Area 6: 2-mile Radius and 5 miles downwind with Wind From 50°to 74°

The evacuation times for this evacuation area range from 2 hours 20 minutes to 3 hours 50 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.7. Evacuation Area 7: 2-mile Radius and 5 miles downwind with Wind From 75°to 129°

The evacuation times for this evacuation area range from 2 hours 30 minutes to 3 hours 55 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.8. Evacuation Area 8: 2-mile Radius and 5 miles downwind with Wind From 130° to 159°

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 5 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.9. Evacuation Area 9: 5-mile Radius and 10 miles downwind with Wind From 165° to 184°

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.10. Evacuation Area 10: 5-mile Radius and 10 miles downwind with Wind From 185° to 194°

The evacuation times for this evacuation area range from 2 hours 45 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.11. Evacuation Area 11: 5-mile Radius and 10 miles downwind with Wind From 195° to 224°

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.12. Evacuation Area 12: 5-mile Radius and 10 miles downwind with Wind From 225° to 264°

The evacuation times for this evacuation area range from 2 hours 45 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.13. Evacuation Area 13: 5-mile Radius and 10 miles downwind with Wind From 265° to 314°

The evacuation times for this evacuation area range from 2 hours 45 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. The population concentration in the city of Bloomington will result in minor to moderate congestion on the designated evacuation routes during an emergency. However, the congestion is minor enough that evacuation times are mainly driven by notification and mobilization times. Congestion points are presented and discussed in Section 8.0.

6.3.14. Evacuation Area 14: 5-mile Radius and 10 miles downwind with Wind From 315° to 334°

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.15. Evacuation Area 15: 5-mile Radius and 10 miles downwind with Wind From 335° to 29°

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.16. Evacuation Area 16: 5-mile Radius and 10 miles downwind with Wind From 30° to 44°

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.17. Evacuation Area 17: 5-mile Radius and 10 miles downwind with Wind From 45° to 84°

The evacuation times for this evacuation area range from 2 hours 35 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.18. Evacuation Area 18: 5-mile Radius and 10 miles downwind with Wind From 85° to 99°

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.19. Evacuation Area 19: 5-mile Radius and 10 miles downwind with Wind From 100° to 109°

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.3.20. Evacuation Area 20: 5-mile Radius and 10 miles downwind with Wind From 110° to 164°

The evacuation times for this evacuation area range from 2 hours 40 minutes to 4 hours 10 minutes and are highest for the weekend scenario, when the recreational population is at its peak. These evacuation times are driven by warning and diffusion times and are not influenced by significant congestion.

6.4. ETEs for Individual Subareas

Evacuation time estimates for the individual evacuation of each subarea, which were prepared at Exelon's request, are displayed in Table 17. ETEs for the subareas were prepared for the adverse weather weekend scenario, which was chosen to represent the "worst" case, because ETEs for this scenario were typically the longest for other evacuation areas. ETEs for the individual subareas ranged from 1 hour 20 minutes to 3 hours 40 minutes. These individual ETEs cannot be combined to produce ETEs for combinations of subareas because they do not account for interactions between evacuating vehicles from different subareas.

The ETEs are mainly driven by warning systems and free flow speeds rather than by roadway capacities, because vehicular demand is low compared to available roadway capacities. Since the recreational transient evacuees have a higher trip generation time than other populations, the ETE for each subarea is greatly impacted by number of hunters, boaters, and park visitors.

Table 17: ETEs in Minutes for Individual Subareas

Subarea	Weekend with Adverse Weather
1	190
2	220
3	150
4	215
5	150
6	210
7	160
8	130
9	80
10	155
11	105
12	210

6.4.1. Subarea 1

The majority of the population in subarea 1 consists of a limited number of permanent residents and a few hunters and boaters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.2. Subarea 2

The majority of the population in subarea 2 consists of permanent residents and a few hunters. The Victoria Spiritual Renewal Center is also located within this subarea. The notification time for this facility will be longer, because people inside it may not be notified by media and have to rely on the siren to be warned during the weekend. The evacuation time for subarea 2 is among the highest of the individual subareas because this subarea has a relatively large number of recreational transients, who take longer to mobilize than other population segments in the EPZ. The ETE is not influenced by significant congestion.

6.4.3. Subarea 3

The majority of the population in subarea 3 consists of permanent residents and a small number of hunters. Because this subarea has less recreational transients, it is closer to the EPZ boundary, and its area is relatively small, the ETE of this area is shorter than that of subarea 1. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.4. Subarea 4

The majority of the population in subarea 4 consists of permanent residents and a few hunters and boaters. Subarea 4's ETE is among the highest of the individual subareas because it has a relatively large number of recreational transients, the slowest population to mobilize in the EPZ. The evacuation time is not influenced by significant congestion.

6.4.5. Subarea 5

The majority of the population in subarea 5 consists of a massive amount of permanent residents and a small number of hunters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.6. Subarea 6

The majority of the population in subarea 6 consists of permanent residents and a few hunters and boaters. The evacuation time for subarea 6 is among the highest of the individual subareas because this subarea has a relatively large number of recreational transients, who take longer to mobilize than other population segments in the EPZ. The ETE is not influenced by significant congestion.

6.4.7. Subarea 7

The majority of the population in subarea 7 consists of a significant amount of permanent residents and a small number of hunters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.8. Subarea 8

The majority of the population in subarea 8 consists of permanent residents and a small number of hunters. This subarea is close to the EPZ boundary. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.9. Subarea 9

The majority of the population in subarea 9 is outside the 10-mile radius. There are only a small number of households residing within the EPZ. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.10. Subarea 10

The majority of the population in subarea 10 consists of a massive amount of permanent residents and a small number of hunters. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.11. Subarea 11

The majority of the population in subarea 11 is outside the 10-mile radius. There are only a small number of households residing within the EPZ. This evacuation time is driven by warning and diffusion times and is not influenced by significant congestion.

6.4.12. Subarea 12

The population in subarea 12 is composed of a small number of residents, employee and recreational transient populations, and the Ineos Nitriles facility. This evacuation time is driven by warning and diffusion times for the recreational populations and is not influenced by significant congestion.

6.5. ETE of the Special Scenario: Full EPZ with VCS Operations and Construction Personnel

The large construction and operation workforce at the VCS when Unit 1 is operational and Unit 2 is under construction creates a unique evacuation scenario should an event occur at Unit 1. The VCS is located in the heart of subarea 1 and is close to US-77. During an evacuation, the construction and operation personnel will split and evacuate to both the northern and southern reception centers to make full use of the roadway capacity. As shown in Table 18, ETEs are 6 hours 30 minutes and 6 hours 35 minutes for normal and adverse weather conditions, respectively. All evacuees proceeding to the northern and southern reception centers have to transfer from the high capacity US-77 highway to the low capacity local streets in the cities of Victoria and Refugio. Congestion will occur at those intersections, as the bottleneck for the network. Additionally, the large vehicular demand created in a short period will form queues in the network, which will take a long time to dissipate.

Table 18 : ETEs in Minutes for Special Scenario

Weather Condition	ETE
Normal	390
Adverse	390

7.0 CONFIRMATION OF EVACUATION

The confirmation of evacuation process determines if the evacuation has been completed. The time required for confirmation of evacuation is dependent upon the method employed. The most time-consuming method typically employed is to use ground vehicles. The time required involves the driving time for each route selected.

Informing people to leave some standard signs on their doors or windows, such as tying a white cloth to the front doorknob of the house or to the mailbox when they leave their homes, would help authorities in the confirmation of evacuation. The presence of TCPs at strategic locations within the evacuation network could provide real-time feedback regarding the progress of the evacuation process. All evacuees are encouraged to go to their designated county reception center. It is recommended that they register as they arrive. This procedure helps authorities to account for the population within the designated county. This can be counted as one of the means of confirmation of evacuation, only under the assumption all the evacuees would actually report to the reception centers and nowhere else. A similar method would be to monitor key evacuation routes using personnel or electronic equipment to determine whether the number of evacuating vehicles is consistent with high compliance rates.

Telephoning people at their homes could also be considered as a means of ensuring completion of evacuation; the time required to conduct such a survey is estimated in the following.

7.1. Time Estimate for Telephone Confirmation

For the VCS EPZ, which has approximately 2,120 households, IEM estimates that a phone survey would need to reach 325 households in order to obtain a 5.0 percent margin of error.[35] This estimate is conservative in that it assumes that no prior information is known about the expected proportion of evacuation compliance; if compliance is assumed to be roughly 75 percent, then the required survey size would be reduced to 254.

To estimate the time required to conduct a survey, IEM contacted CR Dynamics, a phone survey company. IEM assumed that the survey would be conducted by manually dialing numbers, since setting up an automated operation on short notice would be difficult. In this case, CR Dynamics estimated that approximately 20 dials could be completed per hour per person. Therefore, a survey of 325 households would take approximately 16 person hours to complete, or one hour if the calls were divided among 16 personnel.

As described in Section 3.1.1, only 125 phone surveys were completed for this ETE study, despite several attempts to obtain a larger sample size. Based on this experience, IEM recommends that offsite response organizations conduct outreach to EPZ residents

[35] Simple random sample methodology taken from: Scheaffer, Richard L., Mendenhall William, and Ott Lyman. "Elementary Survey Sampling 2nd Edition." Boston, MA: Duxbury Press, p. 45–49, 79. 1979.

to assemble a larger phone survey sample if they want to use telephone as a means of evacuation confirmation.

8.0 CONCLUSION AND RECOMMENDATIONS

The ETEs developed for the 11 NUREG-0654 evacuation areas, 20 PAR evacuation areas, 12 individual subareas, and special scenario within the 10-mile VCS EPZ measured the time from the public notification to when the last evacuating vehicle exited the EPZ boundary.

ETEs for the NUREG-0654 evacuation areas ranged from 2 hours 5 minutes to 4 hours 15 minutes for the normal weather scenarios and from 2 hours 5 minutes to 4 hours 15 minutes for scenarios occurring in adverse weather. ETEs for the PAR evacuation areas ranged from 2 hours 10 minutes to 4 hours 10 minutes for the normal weather scenarios and from 2 hours 10 minutes to 4 hours 10 minutes for scenarios occurring in adverse weather. ETEs for the individual subareas, which were conducted for the adverse weather weekend scenarios, ranged from 1 hour 20 minutes to 3 hours 40 minutes. Variations in ETEs between scenarios generally correlated to differences in the number of evacuating vehicles, the capacity of the evacuation routes, the roadway conditions, and/or the distance from the origin subareas to the EPZ boundary. The weekend scenario produced the highest evacuation times due to the longer mobilization time for the higher number of recreational transients (hunters and fishers) in the area on the weekend. The evacuation times for the special scenario to evacuate construction and operation workforce from the VCS along with the full EPZ populations are 6 hours 30 minutes and 6 hours 35 minutes for normal and adverse weather conditions, respectively. The increased evacuation demand from the VCS caused substantial congestion at the bottleneck, which resulted in long ETEs. These congestion points are discussed in the following sections.

8.1. Congestion Points

The analysis shows that for most scenarios the capacity of the roadway network within the EPZ is sufficient to accommodate the evacuating vehicles with limited congestion. However, a few intersections, where two heavily-traveled evacuation routes converge, were identified from the model as possible congestion points. These points are listed in Table 19.

Table 19: Potential Congestion Points for Evacuation of the VCS EPZ

Operation Control	Inside EPZ	Description
Victoria County	Yes	Access Road to VCS and US-77[36]
Victoria County	No	Anthony Road and US-59[36]
Victoria County	No	Hanselman Road and US-59[36]
Victoria County	No	McCoy Road and US 87
Victoria County	No	Key Road and US 87
Victoria County	No	FM-616 and US-87
Victoria County	Yes	FM-616 and TX-185
Victoria County	Yes	Key Road and TX-185
Refugio County	No	Houston Street and US 77[36]

All of the points listed with the exception of Houston Street and US-77, which is located too far outside the EPZ for queuing to affect evacuation within the EPZ, have the potential to impact ETEs in at least one scenario. The traffic model showed that congestion at the other traffic congestion points located outside the EPZ contributed to vehicle queuing within the 10-mile EPZ, increasing ETEs. To reduce this effect, these intersections could be controlled (i.e., through manual control of the intersection) to facilitate a smoother evacuation to reception centers (see Section 8.2). Providing an efficient and effective flow of traffic through these intersections will ensure the evacuees en route to reception centers are outside of the EPZ before encountering potential congestion points.

8.2. Traffic Control Points

In order to efficiently promote smooth traffic flow during an evacuation of the VCS EPZ, IEM has identified several locations recommended for TCPs. These TCPs are listed in Table 20 and shown graphically in Figure 21. The TCPs were not modeled in the ETE study. Conversely, the TCP locations were identified as part of a recommendation for future evacuation implementation via two methods. Nine of the sites were identified as potential congestion points based on the outputs from the evacuation model; these points are denoted by a "Yes" in the "Model Congestion Point" column of the Table 20. The remaining three locations were identified by reviewing the hurricane evacuation TCPs in Victoria, Goliad, and Refugio counties for sites that would facilitate traffic flow along VCS evacuation routes.[37] Some of the locations are well outside of the EPZ and implementing TCPs at these sites would likely not affect ETEs; however, they would help minimize congestion as the evacuating traffic passes through the towns of Goliad, Refugio, Placedo, and Victoria and ease the flow to the reception centers.

[36] Congestion at these intersections occurred only during the special scenario.
[37] Texas Highway Patrol District "3A" Corpus Christi. "Traffic Management Plan". April 2007.

Table 20: Traffic Control Points for the VCS EPZ

Map ID	Subarea	Model Congestion Point	Town	County	Location
1	1	Yes	McFaddin	Victoria	Access Road to VCS and US-77
2	-	Yes	Placedo/DaCosta	Victoria	McCoy Road and US-87
3	-	Yes	Placedo	Victoria	Key Road and US-87
4	-	Yes	Placedo	Victoria	FM-616 and US-87
5	5	Yes	Bloomington	Victoria	FM-616 and TX-185
6	5	Yes	Bloomington	Victoria	Key Road and TX-185
7	-	Yes	Victoria	Victoria	Anthony Road and US-59
8	-	Yes	Victoria	Victoria	Hanselman Road and US-59
9	-	Yes	Refugio	Refugio	Houston Street and US 77
10	4	No	Victoria	Victoria	TX-185 and US-59
11	-	No	Victoria	Victoria	US-87 and US-59
12	-	No	Goliad	Goliad	US-183 and US-59

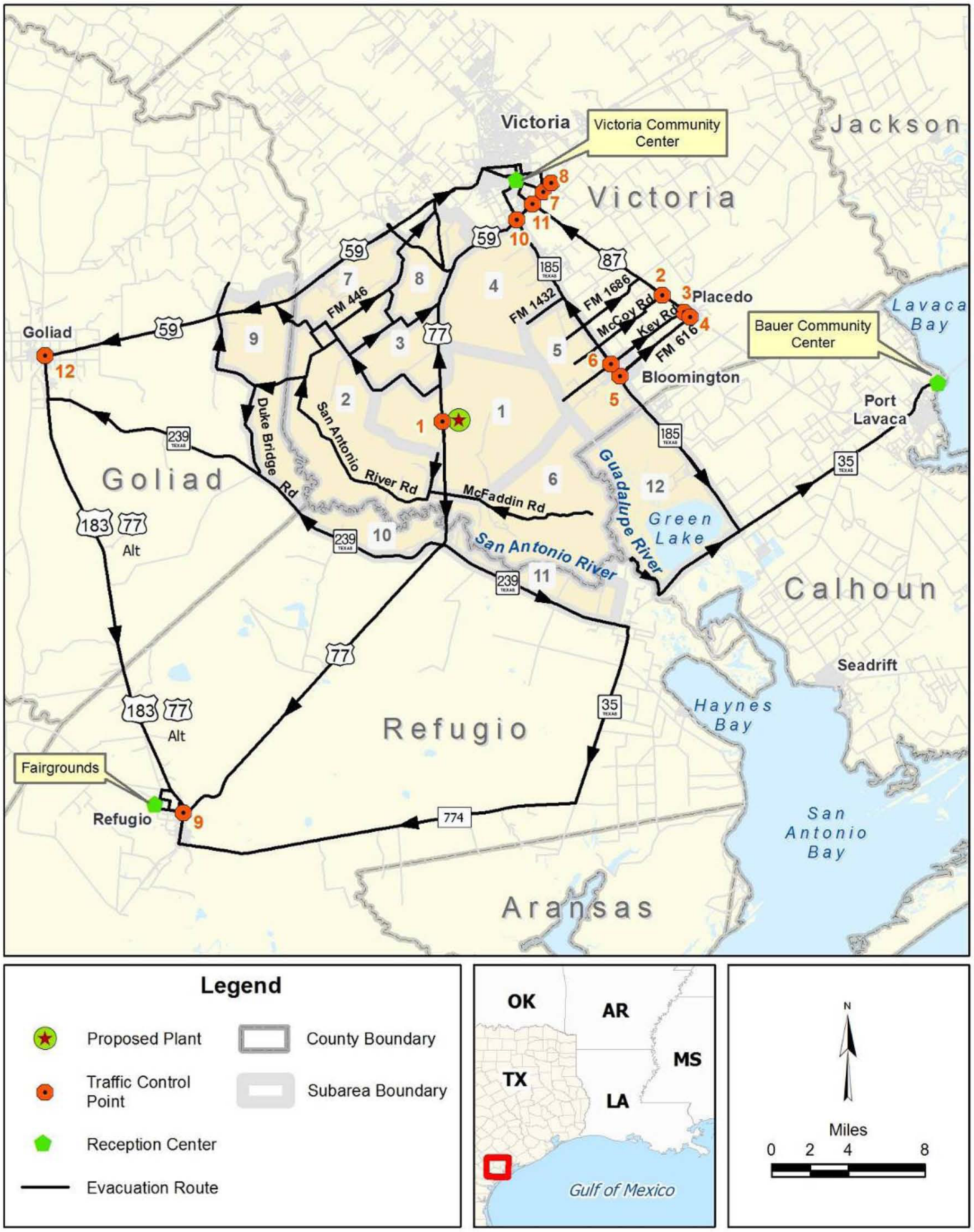

Figure 21: Traffic Control Points in and around the VCS EPZ

The responsibility of supervising traffic controls during an evacuation will be shared between the state's and counties' emergency management and law enforcement agency personnel, as available. Each TCP will be staffed and/or road blocks will be established to direct evacuees out of the EPZ and to deny access into the affected area. Also, route markers will be placed along the evacuation routes at critical intersections and road block locations to promote more efficient traffic flow out from the EPZ.

8.3. Summary of Recommendations

The following recommendations will help emergency managers to improve the evacuation times from an event at VCS:

- ETEs can be reduced by implementing additional measures to shorten the time the public requires to begin evacuating after the event's occurrence, especially for recreational area users, such as hunters and fishers.
- Use TCPs to facilitate traffic flow out of the EPZ in populated areas where congestion may occur during an evacuation (see Sections 8.1 and 8.2).
- Develop comprehensive regional evacuation plans to enhance the effectiveness and efficiency of cross-institutional coordination and cooperation during evacuation. A regional evacuation plan requires the involvement of all the EPZ counties to contribute collaboratively, and it incorporates the individual county evacuation plans in to a broader regional context.
- Encourage that the construction and operation workforce carpool when evacuating from the VCS.
- Develop specific site-dismissal plans and procedures for VCS personnel to possibly consider for staggered or phased evacuation process.

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9.0 APPENDIX A: GEOGRAPHICAL BOUNDARIES OF EVACUATION SUBAREAS

Evacuation Subareas	Subarea Boundaries	Landmark Descriptions
1	**North:** Kemper City Road E, Kemper City Road S, Old Refugio Road, a line from the intersection of Old Refugio Road and Kemper City Road E to the intersection of Levee Road and Dupont Road, Levee Road **East/South:** railway tracks, FM-445 **West:** Warburton Road, Murphy Road, a line from the western end of Murphy Road to the southern end of Morris Town Road, Morris Town Road	Victoria County Station (VCS)
2	**North/East:** Cologne Road, Kemper City Road W, Morris Town Road, a line from the southern end of Morris Town Road to the western end of Murphy Road, Murphy Road, Warburton Road, San Antonio River Road, US-77 **South/West:** Victoria-Refugio County line, Victoria-Goliad County line	Diocese of Victoria Spiritual Renewal Center
3	**Northwest:** Fleming Prairie Road **East:** US-77, Old Refugio Road **South/West:** Kemper City Road S, Kemper City Road E, Kemper City Road W	
4	**North/West:** US-77, US-59 S **East:** TX-185, FM-1432, canal **South:** a line from the intersection of Levee Road and Dupont Road to the intersection of Old Refugio Road and Kemper City Road E, Kemper City Road E	
5	**North:** FM-1432 **East:** TX-185, Key Road, Philips Road, E Kings Road, TX-185 **South:** Victoria-Calhoun County line **West:** Levee Road, canal	City of Bloomington
6	**Northwest:** FM-445, railway tracks **East:** Levee Road, Victoria-Calhoun County line **South:** Victoria-Refugio County line **West:** US-77	McFaddin
7	**North:** US-59 **East:** FM-446, Givens Road **South:** Fleming Prairie Road, Kemper City Road W, Cologne Road **West:** Victoria-Goliad County line	
8	**West/North:** Givens Road, FM-446, Timber Drive, Fordyce Road, Fox Road **East/South:** US-59 S, US-77, Fleming Prairie Road	Saxet Lakes Park

Evacuation Subareas	Subarea Boundaries	Landmark Descriptions
9	**North:** south shore of Coleto Creek Reservoir **East:** Victoria-Goliad County line **South:** Refugio-Goliad County line **West:** TX-239, Duke Bridge Road, FM-2506, FM-2987	Lott Lake
10	**North:** Victoria-Refugio County line **East:** US-77 **South:** TX-239 **West:** Refugio-Goliad County line	
11	**North:** Victoria-Refugio County line **East:** Dedear Road **South:** TX-239 **West:** US-77	
12	**North/West:** Victoria-Calhoun County line **North/East:** TX-185 **South/East:** TX-35 **South/West:** Guadalupe River, Refugio–Calhoun County line	Green Lake

10.0 APPENDIX B: EVACUATION NETWORK LINKS

Table 21 summarizes the links used in the evacuation model. The roads in the evacuation network are shown in Figure 22 and identified by the map ID column.

Table 21: Summary of Evacuation Links

Map ID	Road Name	Number of Links	Number of Lanes (max)	Length (miles)	Capacity (veh/hr)	Speed Limit (max)
1	Alamo St N	15	2	0.9	3,200	50
2	Alamo St S	9	2	0.6	3,000	50
3	Anthony Rd	8	1	2.1	800	35
4	Bayou Rd	1	1	1.8	800	35
5	Ben Jordan St N	2	1	0.2	800	35
6	Ben Jordan St S	6	1	0.5	800	35
7	Ben Jordan St SW	4	1	0.8	800	35
8	Ben Wilson St N	36	1	2.7	800	35
9	Ben Wilson St S	6	1	0.4	800	35
10	Black Bayou Rd No 1	18	1	4.0	800	35
11	Burke St S	10	1	1.0	800	35
12	Canal Rd	4	1	2.1	1,500	45
13	Cologne Rd	12	1	5.5	1,500	40
14	Cologne Rd S	2	1	2.5	800	35
15	Duke Bridge Rd	3	1	5.0	1,500	45
16	Empresario St E	7	1	0.6	1,500	45
17	Fairground Rd	10	1	2.0	800	35
18	Fannin Rd	2	1	2.0	800	35
19	Fleming Prairie Rd	6	1	6.1	800	35
20	FM 1432	2	1	2.3	1,500	35
21	FM 1686	6	1	3.9	1,500	45
22	FM 2506	19	1	5.0	1,500	45
23	FM 2987	1	1	1.3	1,500	45
24	FM 446	17	1	9.2	1,500	45
25	FM 616	10	1	4.5	1,500	45
26	FM 774	11	1	20.4	1,500	45
27	Givens Rd	2	1	4.2	800	35
28	Houston Hwy	4	1	0.2	1,500	45
29	Houston Hwy/E Rio Grande St E	2	1	0.2	1,500	45

Map ID	Road Name	Number of Links	Number of Lanes (max)	Length (miles)	Capacit y (veh/hr)	Speed Limit (max)
30	Houston St E	1	1	0.2	800	35
31	Houston St W	12	1	1.3	800	35
32	Jefferson St S/US Hwy 183 S	4	2	0.1	3,200	45
33	Johnson St	10	1	0.6	1,500	45
34	Kemper City Rd	1	1	1.6	1,500	40
35	Kemper City Rd S	4	1	5.2	1,500	40
36	Kemper City Rd W	8	1	8.1	1,500	40
37	Key Rd	10	1	7.8	800	35
38	La Valliere St	12	1	1.0	800	35
39	Laurent St S	42	1	3.2	1,500	45
40	Lone Tree Rd	48	1	3.8	800	35
41	McCoy Rd	13	1	10.3	800	35
42	McFaddin Rd	8	1	7.8	1,500	35
43	Moody St N	12	2	0.8	3,000	50
44	Moody St S	15	2	0.8	3,000	50
45	Moody St SW	27	2	5.1	3,600	60
46	Moody St SW/US Hwy 59 S	2	2	0.1	3,000	50
47	North St E	66	1	6.3	800	35
48	North St W	6	1	0.4	800	35
49	Obrian Rd	2	1	1.0	800	35
50	Old Beeville Rd	2	1	1.0	800	35
51	Pearl St E	8	1	0.6	1,500	50
52	Port Lavaca Dr	18	2	1.9	3,000	50
53	Proctor St	2	1	0.4	800	35
54	Rio Grande St E	16	2	0.8	3,000	50
55	Rio Grande St W	6	2	0.4	3,000	50
56	San Antonio River Rd	11	1	21.1	800	35
57	Shepley St N	22	1	1.4	1,500	45
58	Shepley St S	14	1	0.6	1,500	45
59	SR 185 N	55	1	10.8	1,500	45
60	SR 202	5	1	0.5	1,800	55
61	SR 239 (to Duke Bridge)	7	1	19.8	1,500	45
62	SR 239 E (E of US-77)	18	1	10.7	1,800	55

Map ID	Road Name	Number of Links	Number of Lanes (max)	Length (miles)	Capacity (veh/hr)	Speed Limit (max)
63	SR 239 W (to US-183/77)	6	1	12.0	1,500	45
64	SR 239/35	7	2	1.6	3,600	55
65	SR 35	7	2	8.0	3,600	55
66	SR 91 spur	9	2	1.5	3,600	60
67	Stolz St	2	1	0.7	800	35
68	Swift St	14	1	1.1	800	35
69	US Hwy 183 S	21	2	16.6	3,600	55
70	US Hwy 59	16	2	8.4	3,600	60
71	US Hwy 59 N	23	2	6.1	3,600	60
72	US Hwy 59 N (connector)	2	1	0.4	1,500	55
73	US Hwy 59 N (SE belt)	19	2	6.0	3,600	60
74	US Hwy 59 S	13	2	9.0	3,000	50
75	US Hwy 59 S (SW belt)	7	2	3.0	3,000	45
76	US Hwy 77 N	14	2	6.8	3,600	60
77	US Hwy 77 N (inside belt)	12	1	3.6	1,500	55
78	US Hwy 77 S	46	2	26.3	3,600	60
79	US Hwy 77/183 S	15	2	7.5	3,600	55
80	US-87 N	29	2	10.5	3,600	55
81	Warburton Rd	2	1	2.0	800	35
82	Guadalupe River Oaks Rd	1	1	3.0	800	10
83	SR 185 S	13	2	8.3	3,000	45
84	SR 35 N	60	2	18.7	3,600	55

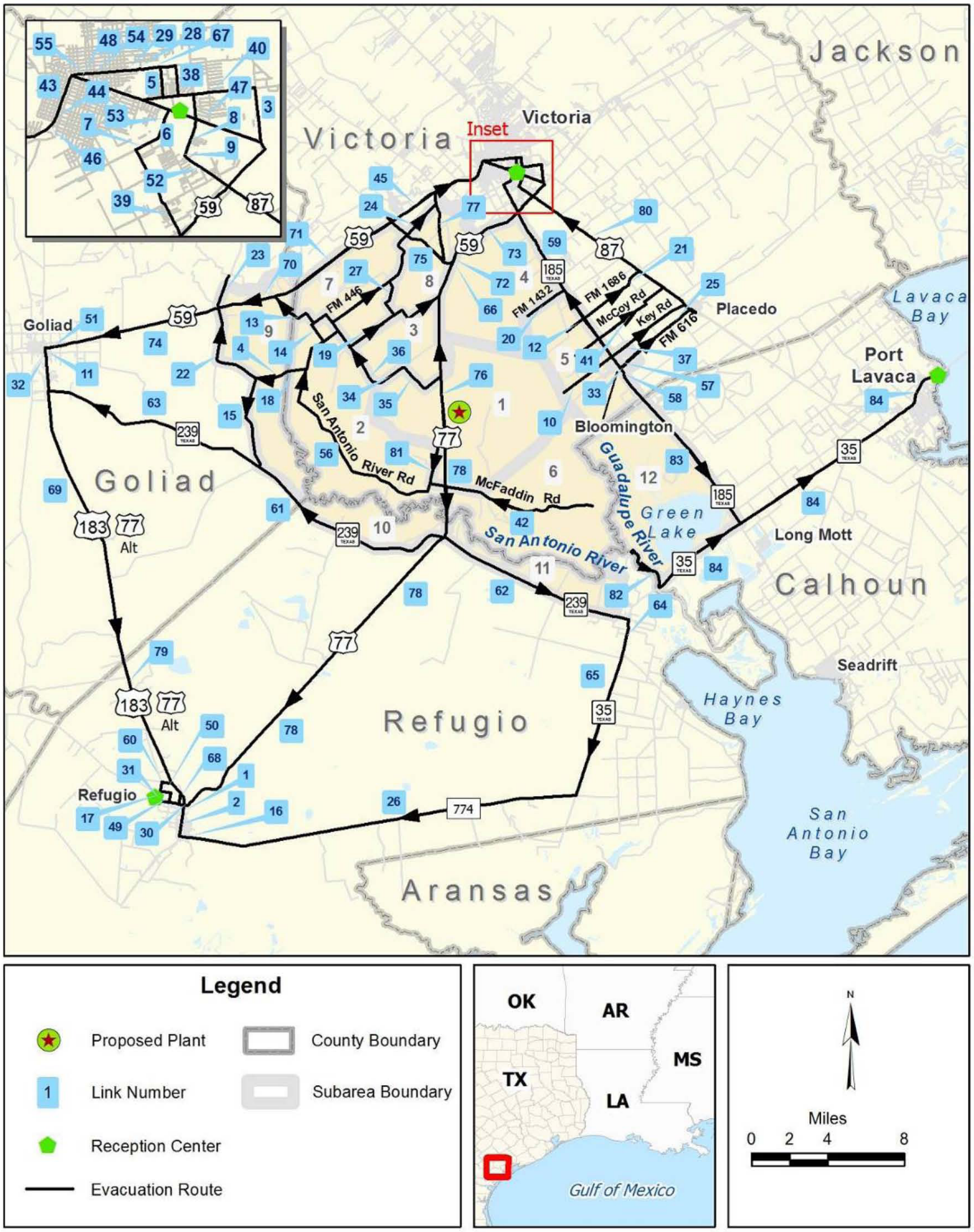

Figure 22: Map of Evacuation Network Links (from Table 21)

11.0 APPENDIX C: TELEPHONE SURVEY

Introduction

The development of evacuation time estimates (ETE) for the area surrounding the Victoria County Station requires the identification of travel patterns, available vehicles, and household size of the people who live or work in the area. Specific data is needed in developing ETEs in order to effectively quantify mobilization time and vehicle usage for residents responding to an evacuation advisory. A bilingual (English and Spanish) telephone survey was conducted to interview a sample of residents who live within the 10-mile EPZ of the proposed nuclear power plant site to acquire information required for the ETE study.

IEM secured the services of DataSource in San Marcus, Texas to conduct the telephone survey and provide data to IEM for analysis.

Survey Instrument and Sampling Plan

A survey instrument/questionnaire was developed by IEM, and was reviewed and approved by Exelon and Bechtel project personnel, as well as the state and county emergency management personnel during the project kick-off meeting in Victoria, TX. The approved survey questionnaire was used to interview a sample of residents who live or work within 10 miles of the site to acquire information required for the ETE study. To achieve a representative sample of households living in the emergency planning zone (EPZ), respondents were randomly selected to participate in the survey. DataSource fielded the telephone survey and provided data to IEM for analysis. Calls were conducted in the early evening hours from Wednesday, May 21, 2008, to Thursday, May 29, 2008. Only residents 18 years of age and older were allowed to participate in the survey. All telephone calls were made during weekday evenings or on weekends in an attempt to reach households with both workers and non-workers. The survey was conducted in both English and Spanish. To ensure that the highest quality of work was performed, a quality assurance plan was implemented in this survey process that included call-taker training, telephone monitoring by IEM, and extensive data quality control checks.

The sampling frame consisted of a list of households within the study area. The survey required around 600 completed surveys in order to achieve the desired margin of error of 4 percentage points or less. However, there were not enough telephone listings available in the databases used by DataSource to attain this sample size. Several efforts were made to get a more comprehensive listing. In an attempt to check the completeness of the telephone database used, IEM contacted other telephone data providers in the country, but the sample counts obtained from these providers were similar to what was available through DataSource. With the available telephone numbers, the survey effort produced a total of 125 completed surveys.

Survey Results

11.1.1. Household Size

Figure 23 presents the distribution of household sizes in the area. The average household contains 2.82 people.

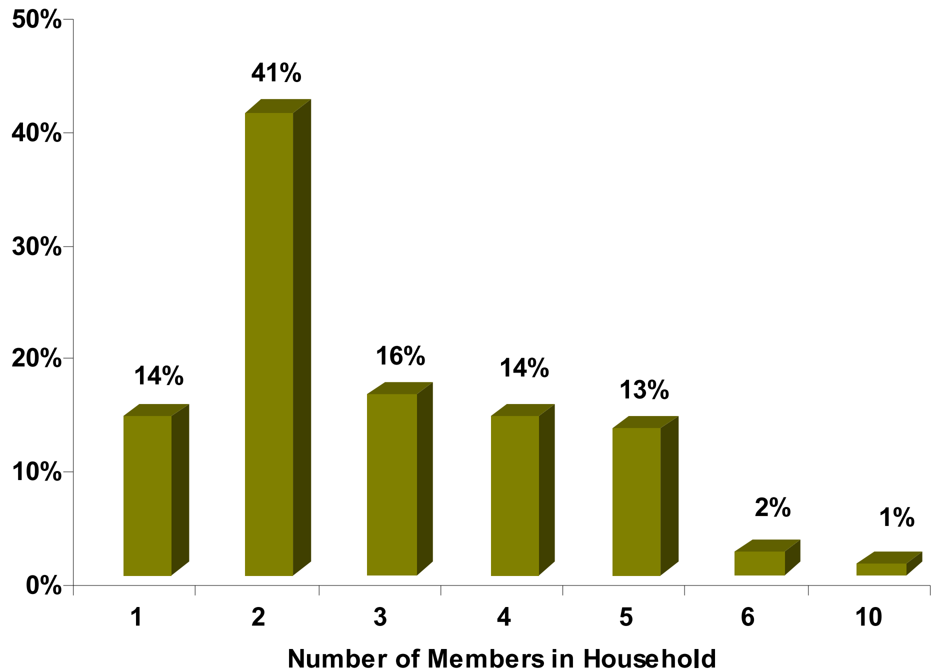

Figure 23: Distribution of Household Size

11.1.2. Automobile Ownership

The average number of vehicles per household is 2.26. Figure 24 illustrates the distribution of automobile ownership within the households.

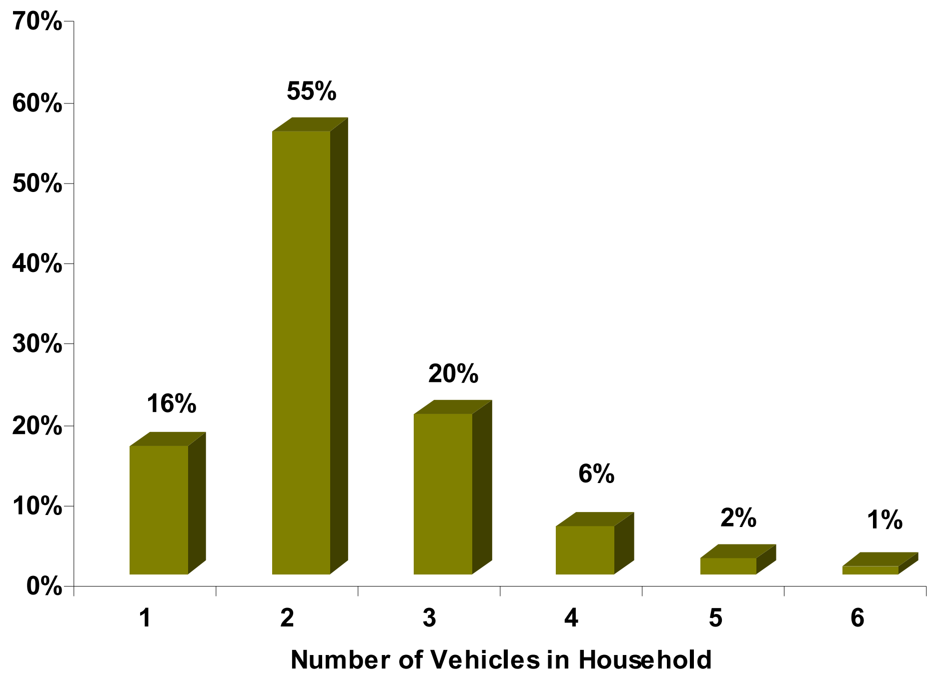

Figure 24: Distribution of Vehicles

11.1.3. Commuters

Figure 25 presents the number of commuters in each household. On average, there are 1.27 commuters per household in the area.

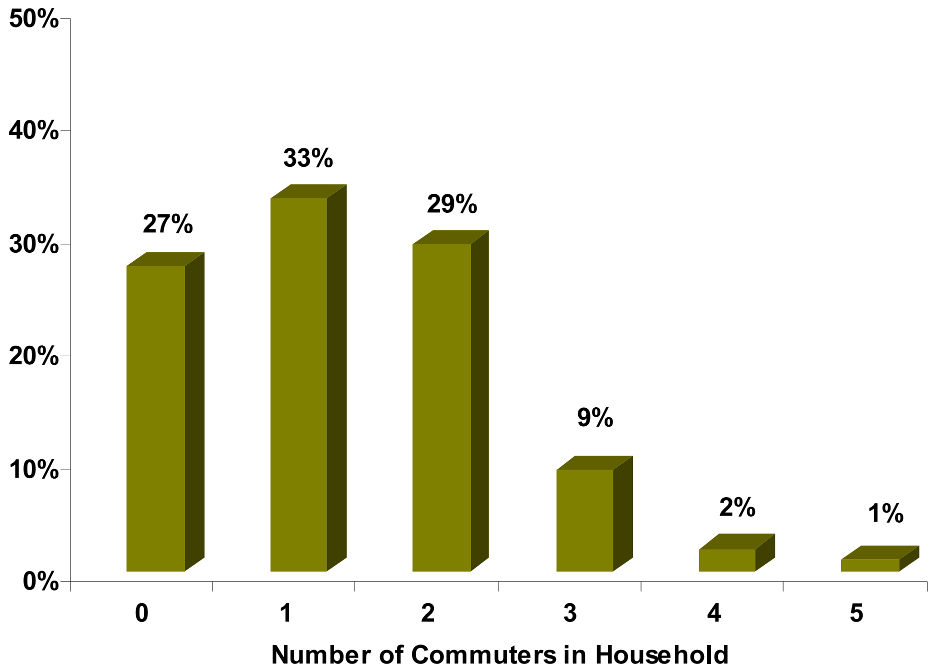

Figure 25: Distribution of Commuters

11.1.4. Trip Generation Times

On average, 1.5 vehicles would be used per household for evacuation during nighttime. Figure 26 presents the distribution of vehicles that will be used for evacuation purposes.

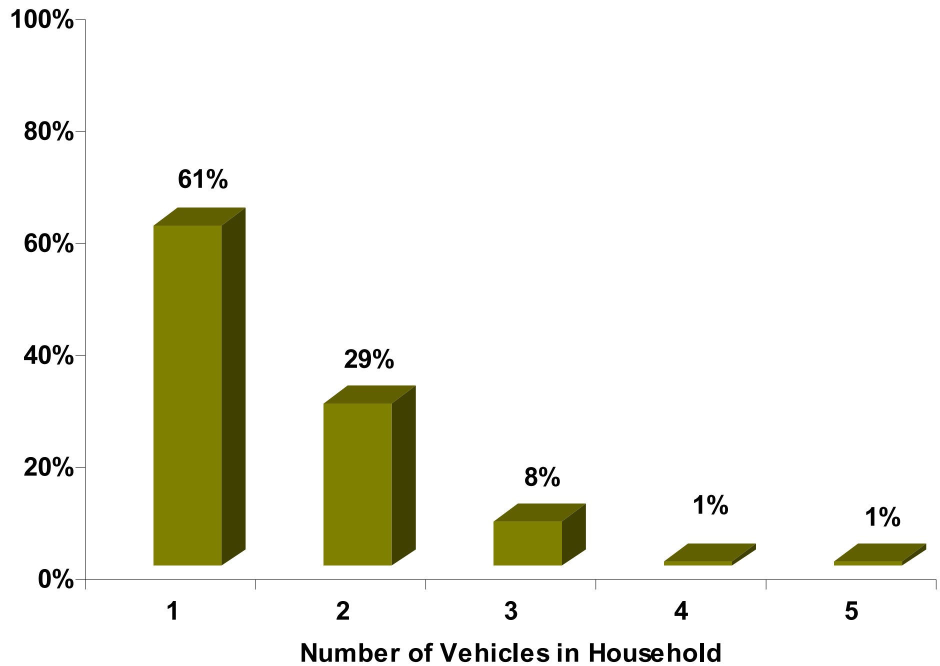

Figure 26: Number of Vehicles used for Evacuation

11.1.5. Time Distributions

Some of the questions asked on the survey were to get an estimate of how much time the residents would take in order to perform certain evacuation related activities.

Preparation to Leave Work

In the event of an emergency that does not include weather related events, approximately how long does it take to complete preparation for leaving work or college prior to departure?

Figure 27 presents the cumulative distributions for all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As depicted graphically, 92 percent of the commuters complete this activity within 30 minutes.

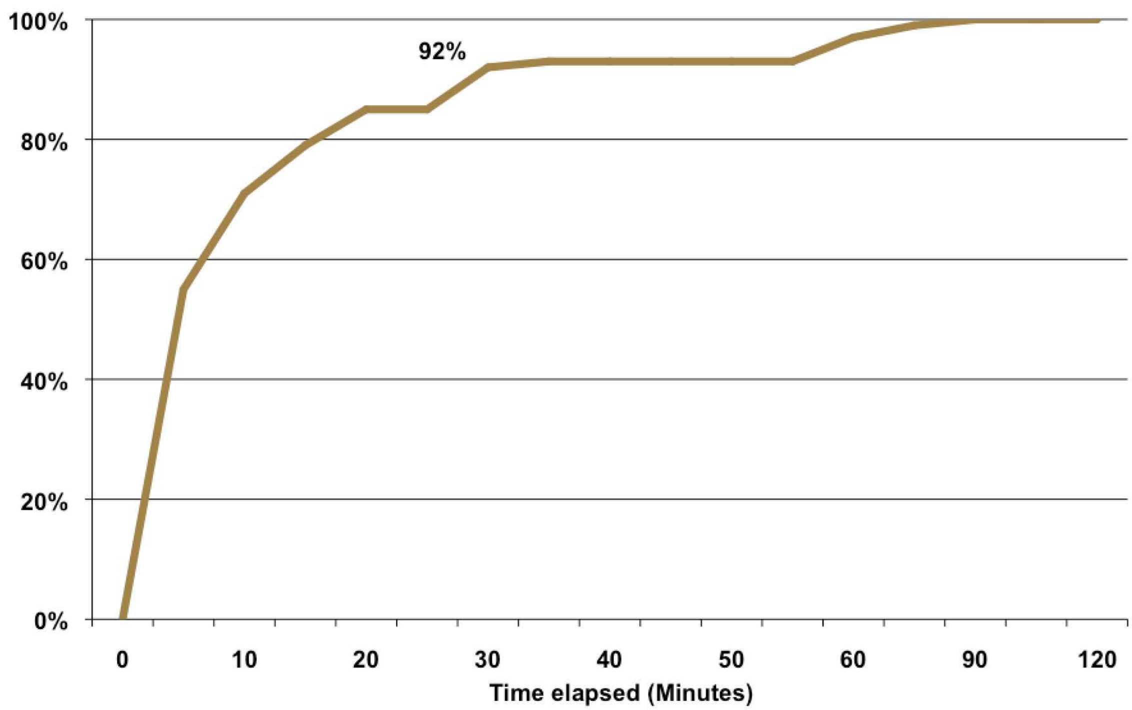

Figure 27: Preparation Time to Leave Work

Travel from Work to Home

How long would it take the returning commuter to reach home, including the preparation time to leave work? Figure 28 presents the time it takes for the commuters to travel from work to home. The figure shows cumulative percentages of all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As depicted graphically, 91 percent of the residents can reach home within 60 minutes.

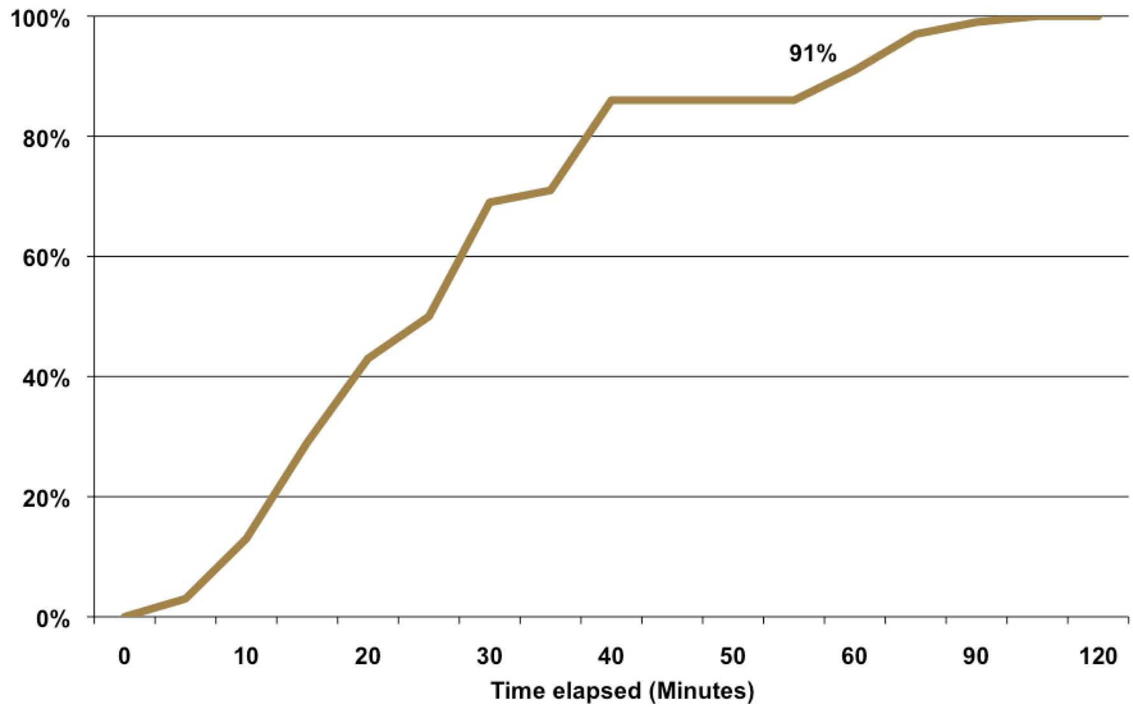

Figure 28: Preparation Time to Travel from Work to Home

Preparation during Daytime

How long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the daytime?

Figure 29 presents the distribution of the time it would take for residents to make preparations to leave the house during the daytime. The distribution is based on all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As depicted graphically, 75 percent of the residents would be ready for evacuation in about 30 minutes. However, it might take as long as two hours for some to complete preparations for the leave.

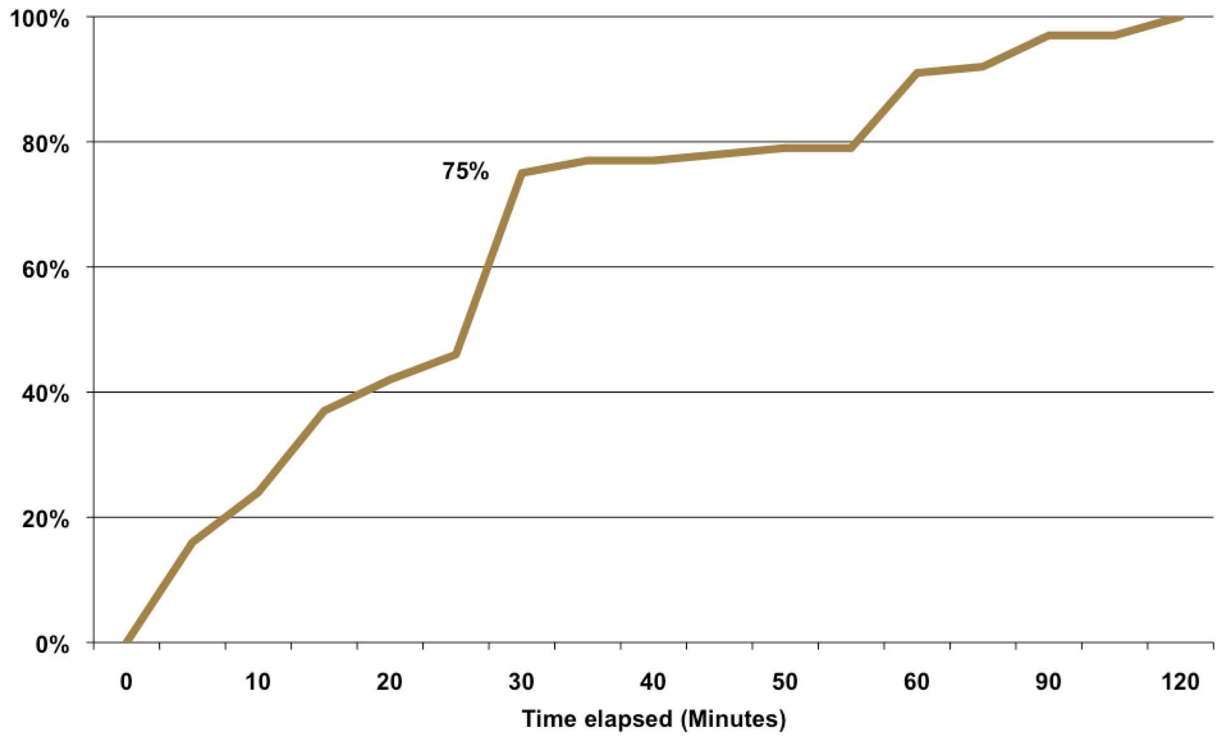

Figure 29: Time to Prepare for Evacuation from Home (Daytime)

Preparation during Nighttime

How long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the nighttime?

Figure 30 presents the distribution of the time it would take for residents to make preparations to leave the house during the nighttime. The figure shows cumulative percentages of all numerical responses to this survey question; responses of "Other" or "Don't Know/Refused" were omitted. As expected, the preparation times would be slightly more during the night compared to the daytime. Approximately 69 percent of the residents would be ready for evacuation in about 30 minutes.

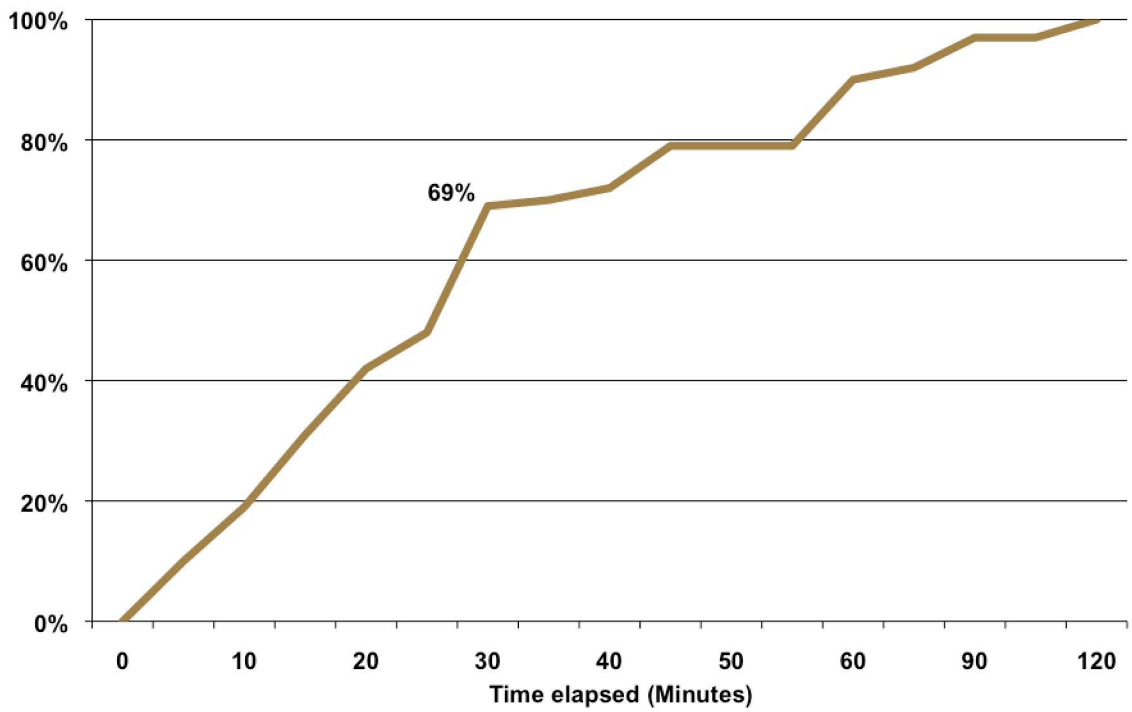

Figure 30: Time to Prepare for Evacuation from Home (Nighttime)

Survey Tabulations

1. How many members are there in your household?

Table 22: Responses to Question 1

Response	Percentage of Households
One	14%
Two	41%
Three	16%
Four	14%
Five	13%
Six	2%
Seven	—
Eight	—
Nine	—
Ten	1%
Others	—

2. In total, how many cars or other vehicles are usually available to your household?

Table 23: Responses to Question 2

Response	Percentage of Households
One	16%
Two	55%
Three	20%
Four	6%
Five	2%
Six	1%
Seven	—
Eight	—
Nine or more	—
None	—
Don't Know/Refused	—

3. How many people in your household commute to a job or to college at least four times a week?

Table 24: Responses to Question 3

Response	Percentage of Households
One	27%
Two	33%
Three	29%
Four	9%
Five or more	2%
None	—
Don't Know/Refused	—

4. How many of the commuters you just mentioned are in a carpool?

Table 25: Responses to Question 4 (Only Households That Have Commuters)

Response	Percentage of Households
One	10%
Two	4%
Three	—
Four	—
Five or more	—
None	86%
Don't Know/Refused	—

5. In the event of an emergency that does not include weather related events, approximately how long does it take Commuter #1 (repeat for all commuters) to complete preparation for leaving work or college prior to departure?

Table 26: Responses to Question 5

Response	Percentage of Commuters
5 minutes or less	52%
6–10 minutes	16%
11–15 minutes	8%
16–20 minutes	6%
21–25 minutes	—
26–30 minutes	7%
31–35 minutes	1%
36–40 minutes	—
41–45 minutes	—
46–50 minutes	—
51-55 minutes	—
56 minutes to an hour	4%
Between 1 hour and 1 hour 15 minutes	2%
Between 1 hour 16 minutes and 1 hour 30 minutes	1%
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	—
Other	3%
Don't Know/Refused	2%

6. In the event of an emergency when the commuters are away from home, is there a working vehicle available for the family members at home that could be used for evacuation?

Table 27: Responses to Question 6

Response	Percentage of Households
Yes	79%
No	21%

7. In the event of an emergency, would the members at home await the return of the family members prior to evacuating the area?

Table 28: Responses to Question 7

Response	Percentage of Households
Yes	42%
No	46%
Don't Know/Refused	13%

8. In the event of an emergency, will the members at home wait for a ride from the commuter or leave with someone else?

Table 29: Responses to Question 8

Response	Percentage of Households
Wait	46%
Leave with someone else	38%
Don't Know/Refused	15%

9. In the event of an emergency, would anyone go home before evacuating?

Table 30: Responses to Question 9

Response	Percentage of Households
Yes	37%
No	53%
Don't Know/Refused	10%

10. How many would return home?

Table 31: Responses to Question 10

Response	Percentage of Households
One	48%
Two	38%
Three	10%
Four	—
Five or more	5%

11. How long would it take the returning commuter (repeat for all returning commuters) to reach home, including the preparation time to leave work?

Table 32: Responses to Question 11

Response	Percentage of Commuters
5 minutes or less	3%
6–10 minutes	9%
11–15 minutes	15%
16–20 minutes	14%
21–25 minutes	7%
26–30 minutes	18%
31–35 minutes	3%
36–40 minutes	—
41–45 minutes	14%
46–50 minutes	—
51–55 minutes	—
56 minutes to an hour	5%
Between 1 hour and 1 hour 15 minutes	5%
Between 1 hour 16 minutes and 1 hour 30 minutes	1%
Between 1 hour 31 minutes and 1 hour 45 minutes	1%
Between 1 hour 46 minutes and 2 hours	—
Other	4%
Don't Know/Refused	1%

12. In the event of an emergency, how long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the daytime?

Table 33: Responses to Question 12

Response	Percentage of Households
5 minutes or less	15%
6–10 minutes	7%
11–15 minutes	13%
16–20 minutes	5%
21–25 minutes	4%
26–30 minutes	28%
31–35 minutes	2%
36–40 minutes	—
41–45 minutes	1%
46–50 minutes	1%
51–55 minutes	—
56 minutes to an hour	11%
Between 1 hour and 1 hour 15 minutes	2%
Between 1 hour 16 minutes and 1 hour 30 minutes	5%
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	3%
Other	5%
Don't Know/Refused	—

13. In the event of an emergency, how long would it take for the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area during the nighttime?

Table 34: Responses to Question 13

Response	Percentage of Households
5 minutes or less	10%
6–10 minutes	8%
11–15 minutes	12%
16–20 minutes	10%
21–25 minutes	6%
26–30 minutes	20%
31–35 minutes	1%
36–40 minutes	2%
41–45 minutes	7%
46–50 minutes	—
51–55 minutes	—
56 minutes to an hour	10%
Between 1 hour and 1 hour 15 minutes	3%
Between 1 hour 16 minutes and 1 hour 30 minutes	5%
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	3%
Other	5%
Don't Know/Refused	—

14. How many of the vehicles usually available to your household would your family use for evacuation during the night/weekend?

Table 35: Responses to Question 14

Response	Percentage of Households
One	61%
Two	29%
Three	8%
Four	1%
Five	1%
Six	—
Seven	—
Eight	—
Nine or more	—
None	1%
Don't Know/Refused	—

15. Do you or any member of your household hunt, fish, or visit parks within five miles from your home?

Table 36: Responses to Question 15

Response	Percentage of Households
Hunt	18%
Fish	33%
Visit Parks	17%

16. How many people typically travel in the same vehicle for this purpose?

Table 37: Responses to Question 16

Response	Percentage of Households
One	23%
Two	31%
Three	15%
Four	17%
Five or more	13%

17. In the event of an emergency when you are asked to evacuate, how long would it take you to complete preparations to evacuate the area?

    a. Hunting

Table 38: Responses to Question 17a. (Percentages of Hunters)

Response	Percentage of Households
5 minutes or less	26%
6–10 minutes	13%
11–15 minutes	9%
16–20 minutes	4%
21–25 minutes	4%
26–30 minutes	13%
31–35 minutes	—
36–40 minutes	—
41–45 minutes	9%
46–50 minutes	—
51–55 minutes	—
56 minutes to an hour	13%
Between 1 hour and 1 hour 15 minutes	—
Between 1 hour 16 minutes and 1 hour 30 minutes	—
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	—
Other	9%
Don't Know/Refused	—

b. Fishing

Table 39: Responses to Question 17b. (Percentages Fishers)

Response	Percentage of Households
5 minutes or less	7%
6–10 minutes	10%
11–15 minutes	10%
16–20 minutes	7%
21–25 minutes	—
26–30 minutes	27%
31–35 minutes	—
36–40 minutes	–
41–45 minutes	2%
46–50 minutes	—
51–55 minutes	—
56 minutes to an hour	7%
Between 1 hour and 1 hour 15 minutes	15%
Between 1 hour 16 minutes and 1 hour 30 minutes	—
Between 1 hour 31 minutes and 1 hour 45 minutes	2%
Between 1 hour 46 minutes and 2 hours	—
Other	12%
Don't Know/Refused	—

c. Park Visitors

Table 40: Responses to Question 17c. (Percentages of Park Visitors)

Response	Percentage of Households
5 minutes or less	14%
6–10 minutes	19%
11–15 minutes	10%
16–20 minutes	10%
21–25 minutes	5%
26–30 minutes	19%
31–35 minutes	—
36–40 minutes	—
41–45 minutes	4%
46–50 minutes	—
51–55 minutes	—
56 minutes to an hour	—
Between 1 hour and 1 hour 15 minutes	10%
Between 1 hour 16 minutes and 1 hour 30 minutes	—
Between 1 hour 31 minutes and 1 hour 45 minutes	—
Between 1 hour 46 minutes and 2 hours	—
Other	10%
Don't Know/Refused	—