



HDI-IPEC-22-067

10 CFR 50 Appendix E

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September 9, 2022

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

Indian Point Energy Center
Facility License No. DPR-05, DPR-26 and DPR-64
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Subject: IPEC 2022 Emergency Plan Evacuation Time Estimate Study

In accordance with Title 10 of the Code of Federal Regulations Part 50 (10 CFR 50), Appendix E, *Emergency Planning and Preparedness for Production and Utilization Facilities*, Section IV, *Content of Emergency Plans*, Paragraph 4, Holtec Decommissioning International, LLC, submits the 2022 Evacuation Time Estimate (ETE) study report for the Indian Point Energy Center (IPEC).

The ETE study was completed using the guidance of Revision 1 of NUREG CR-7002, *Criteria for Development of Evacuation Time Estimate Studies*. Appendix N of the IPEC ETE report provides a checklist corresponding to the evaluation criteria in Appendix B of NUREG CR-7002. Each of the NUREG CR-7002, Appendix B, criteria are addressed, and each applicable criterion is cross-referenced to sections of the report.

This letter contains no new regulatory commitments.

If you have any questions or need further information, please contact Mr. Walter Wittich, IPEC Licensing at 914-254-7212.

Sincerely,

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Enclosure: Indian Point Energy Center – Development of Evacuation Time Estimates



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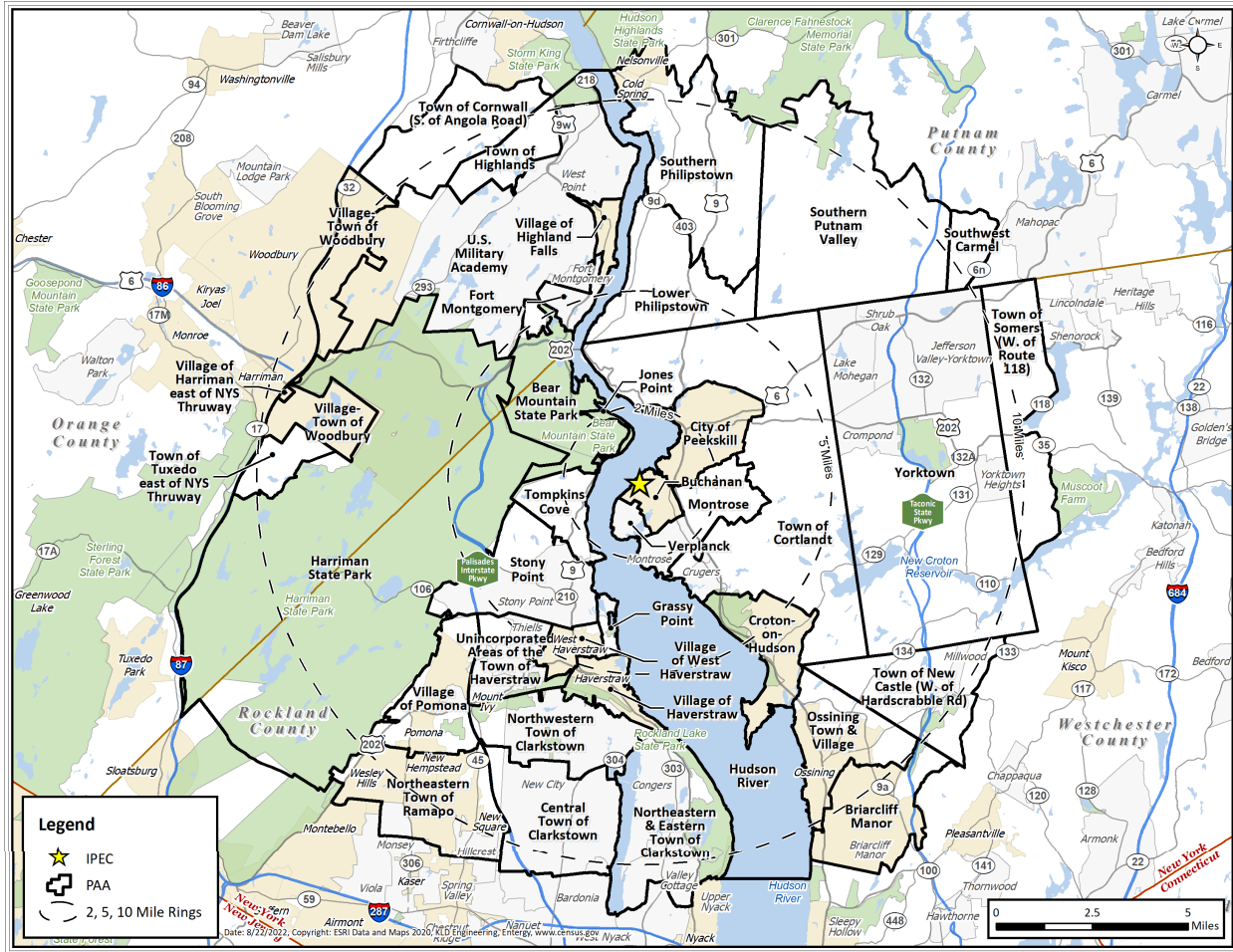
ENCLOSURE TO HDI-IPEC-22-067

Indian Point Energy Center – Development of Evacuation Time Estimates



Indian Point Energy Center

Development of Evacuation Time Estimates



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ACRONYM LIST

Table 1. Acronym List

ACRONYM	DEFINITION
AADT	Average Annual Daily Traffic
ACP	Access Control Point
ASLB	Atomic Safety and Licensing Board
ATE	Advisory to Evacuate
ATIS	Automated Traveler Information Systems
BFFS	Base Free Flow Speed
CR	County Road or County Route
D	Destination
DDHV	Directional Design Hourly Volume
DHV	Design Hour Volume
DMS	Dynamic Message Sign
DPTMS	West Point Directorate of Plans, Training, Mobilization and Security
DTA	Dynamic Traffic Assignment
DTRAD	Dynamic Traffic Assignment and Distribution
DOT	Department of Transportation
DYNEV	Dynamic Network Evacuation
EOC	Emergency Operations Center
EPZ	Emergency Planning Zone
ETE	Evacuation Time Estimate
EVAN	Evacuation Animator
FEMA	Federal Emergency Management Agency
FFS	Free Flow Speed
FHWA	Federal Highway Administration
GIS	Geographical Information System
HAR	Highway Advisory Radio
HCM	Highway Capacity Manual
HH	Household
HPMS	Highway Performance Monitoring System
IPEC	Indian Point Energy Center
ITS	Intelligent Transportation Systems
LOS	Level of Service
MOE	Measures of Effectiveness
mph	Miles Per Hour
MUTCD	Manual of Uniform Traffic Control Devices
NRC	United States Nuclear Regulatory Commission

Table 1. Acronym List

ACRONYM	DEFINITION
NYS	New York State
O	Origin
O-D	Origin-Destination
OEM	Office of Emergency Management
ORO	Offsite Response Organization
PAR	Protective Action Recommendation
PCBES	Putnam County Bureau of Emergency Services
pce	Passenger Car Equivalent
pcphpl	passenger car per hour per lane
PSL	Path-Size-Logit
QDF	Queue Discharge Flow
RC	Reception Center
RCDPT	Rockland County Department of Public Transportation
RCOFES	Rockland County Office of Fire & Emergency Services
SR	State Route
SV	Service Volume
TA	Traffic Assignment
TCP	Traffic Control Point
TD	Trip Distribution
UNITES	Unified Transportation Engineering System
USDOT	United States Department of Transportation
vph	Vehicles Per Hour
vpm	Vehicles Per Minute

EXECUTIVE SUMMARY

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the Indian Point Energy Center (IPEC) located in Westchester County, New York. ETE are part of the required planning basis and provide Holtec 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:

- Title 10, Code of Federal Regulations, Appendix E to Part 50 (10CFR50), Emergency Planning and Preparedness for Production and Utilization Facilities, NRC, 2011
- Criteria for Development of Evacuation Time Estimate Studies, NUREG/CR-7002, Rev. 1, February 2021.
- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/Radiological Emergency Preparedness Program Manual, FEMA P-1028, December 2019.

Overview of Project Activities

This project began in September 2020 and extended over a period of 2 years. The major activities performed are briefly described in chronological sequence:

- Attended “kick-off” meetings with Holtec personnel and emergency management personnel representing state and county governments.
- Accessed U.S. Census Bureau data files for the 2020 Census.
- Studied Geographic Information Systems (GIS) maps of the area in the vicinity of the IPEC, then conducted a detailed field survey of the highway network in the Emergency Planning Zone (EPZ), plus a Shadow Region covering the region between the EPZ boundary and approximately 15 miles radially from the plant to the west, east and south, and 23 miles to the north.
- Conducted a random-sample, online demographic survey of residents within the study area 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 – county and state emergency management agencies) personnel prior to conducting the survey.
- Data pertaining to employment, transients, and special facilities in each county were provided by Holtec and by the OROs, supplemented with internet searches and data from the previous study where data was missing.
- The traffic demand and trip-generation rates of evacuating vehicles were estimated from the gathered data. The trip generation rates reflect the estimated mobilization

time (i.e., the time required by evacuees to prepare for the evacuation trip) computed using the results of the demographic survey of EPZ residents.

- Following federal guidelines, the EPZ is subdivided into 38 protective action areas. These areas are then grouped within circular areas or “keyhole” configurations (circles plus radial sectors) that define a total of 44 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, Light Snow, Heavy Snow). Two special event scenarios were considered – a West Point Football Game and an event at Croton Point Park. One roadway impact scenario was considered with the following closures:
 - Orange County – 1 lane on Route 9W northbound to Newburgh, and 1 lane on Route 6 westbound from Bear Mountain Circle to Route 17
 - Putnam County – 1 lane on Taconic Parkway northbound
 - Rockland County – 1 lane on Palisades Parkway southbound
 - Westchester County – 1 lane on Taconic Parkway southbound
- Staged evacuation was considered for those regions wherein the 2-Mile Region and sectors downwind to 5 miles were evacuated.
- As per NUREG/CR-7002, Rev. 1, the Planning Basis for the calculation of ETE is:
 - A rapidly escalating accident at the IPEC that quickly assumes the status of General Emergency wherein evacuation is ordered promptly and no early protective actions have been implemented such that the Advisory to Evacuate (ATE) is virtually coincident with the siren alert.
 - While an unlikely accident scenario, this planning basis will yield ETE, measured as the elapsed time from the ATE 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, preschools/daycares, and day camps are in session, the ETE study assumes that the children will be evacuated by bus directly to school reception centers 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, wheelchair accessible vehicle, or ambulance, as required. Separate ETE are calculated for the transit-dependent evacuees, for access and/or functional needs population, and for those evacuated from special facilities.

Computation of ETE

A total of 660 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 44 Evacuation Regions to evacuate from that Region, under the circumstances defined for one of the 15 Evacuation Scenarios ($44 \times 15 = 660$). Separate ETE are calculated for transit-dependent evacuees, including children at schools, pre-schools/daycares, and day camps 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 ATE applies only to those people occupying the specified impacted region. It is assumed that 100% of the people within the impacted region will evacuate in response to this ATE. 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 and shadow evacuees could impede those who are evacuating from within the impacted region. The impedance that could be caused by voluntary and shadow 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 during a staged evacuation.

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 routing patterns for evacuating vehicles that are compliant with federal guidelines (outbound relative to the location of the plant), then simulates 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% and 100%, 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 90th percentile ETE have been identified as the values that should be considered when making protective action decisions because the 100th

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, Rev. 1.

Traffic Management

This study references the existing comprehensive traffic management plans provided by Orange, Putnam, Rockland and Westchester Counties. As discussed in Section 9 and in Appendix G, no changes to these existing plans are identified as a result of this study.

Selected Results

A compilation of selected information is presented on the following pages (ES-6 through ES-36) in the form of figures and tables extracted from the body of the report; these are described below.

- Table 3-1 presents the estimates of permanent resident population in each protective action area based on the 2020 Census data.
- Table 6-1 defines each of the 44 Evacuation Regions in terms of their respective groups of protective action areas.
- Table 6-2 defines the 15 Evacuation Scenarios.
- Tables 7-1 and 7-2 are compilations of ETE for the general population. These data are the times needed to clear the indicated regions of 90% and 100% 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 7-4 present ETE for the 2-Mile Region when evacuating additional Zones downwind to 5 miles for un-staged and staged evacuations for the 90th and 100th percentiles, respectively.
- Table 8-2 presents ETE for the schoolchildren in good weather.
- Table 8-5 presents ETE for the transit-dependent population in good weather.
- Table 8-8 presents ETE for the medical facility population in good weather.
- Figure 6-1 displays a map of the IPEC EPZ showing the layout of the 38 protective action areas that comprise, in aggregate, the EPZ.
- Figure H-8 presents an example of an Evacuation Region (Region R08) to be evacuated under the circumstances defined in Table 6-1. See Appendix H for maps of all Regions.

Conclusions

- General population ETE were computed for 660 unique cases – a combination of 44 unique Evacuation Regions and 15 unique Evacuation Scenarios. Table 7-1 and Table 7-2 document these ETE for the 90th and 100th percentiles. These ETE range from 2:50 (hr:min) to 6:10 at the 90th percentile for non-heavy snow cases, longer for heavy snow.
- 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 congestion within the EPZ. 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. See Figures 7-10 through 7-24.

- Inspection of Table 7-3 and Table 7-4 indicates that a staged evacuation protective action strategy is beneficial to the evacuees within 2 miles of IPEC, but adversely impacts many evacuees located beyond 2 miles from IPEC. See Section 7.6 for additional discussion.
- Comparison of Scenarios 9 and 13 in Table 7-1 indicates that a West Point Football Game does not significantly impact ETE for the 90th or 100th percentiles. See Section 7.5 for additional discussion.
- Comparison of Scenarios 3 and 14 in Table 7-1 indicates that an event at Croton Point Park does not significantly impact ETE for the 90th or 100th percentiles. See Section 7.5 for additional discussion.
- The last location in the EPZ to exhibit traffic congestion is I-684 northbound to the northeast of the plant. All congestion within the EPZ clears by 6 hours and 30 minutes after the ATE. See Section 7.3 and Figures 7-3 through 7-9.
- Separate ETE were computed for schools, medical facilities, transit-dependent persons and access and/or functional needs persons. The average single-wave ETE for these facilities are less than or comparable to the general population ETE at the 90th percentile. See Section 8.
- Table 8-1 indicates that there are not enough transportation resources to evacuate schools, transit dependents, medical facilities and access and/or functional needs persons in a single wave. Two waves of evacuation service may be needed for all population groups that need transportation assistance to evacuate.
- If evacuees mobilize one hour quicker, the ETE is reduced by 10 minutes and 40 minutes for the 90th and 100th percentile ETE, respectively. If evacuees take an additional hour to mobilize, the ETE is increased by 35 minutes and 1 hour for the 90th and 100th percentile ETE, respectively. Traffic congestion persists within the EPZ for approximately 6 hours and 30 minutes after the ATE. After this time, trip generation plus the time to travel to the EPZ boundary dictates the 100th percentile ETE. See Table M-1.
- The general population ETE is significantly affected by the increase in voluntary evacuation of vehicles in the Shadow Region. A full (100%) shadow evacuation increases the 90th and 100th percentile ETE by 1 hour and 10 minutes and 2 hours and 50 minutes, respectively. See Table M-2.
- A population increase of 14% or more results in ETE changes which meet the NRC criteria for updating ETE between decennial Censuses. See Section M.3.

Table 3-1. EPZ Permanent Resident Population

Protective Action Area	2010 Population	2020 Population
ORANGE COUNTY		
Bear Mountain State Park ¹	16	40
Fort Montgomery	1,837	1,870
Harriman State Park ¹	6	7
Town of Cornwall (S. of Angola Road)	1,035	1,032
Town of Highlands	0	0
Town of Tuxedo east of NYS Thruway	204	203
U.S. Military Academy	6,464	6,651
Village of Harriman east of NYS Thruway	0	30
Village of Highland Falls	4,175	3,709
Village-Town of Woodbury	2,386	2,460
<i>Orange County Subtotal:</i>	<i>16,123</i>	<i>16,002</i>
PUTNAM COUNTY		
Lower Philipstown	2,581	2,553
Southern Philipstown	4,569	4,495
Southern Putnam Valley	10,171	10,117
Southwest Carmel	2,597	2,543
<i>Putnam County Subtotal:</i>	<i>19,918</i>	<i>19,708</i>
ROCKLAND COUNTY		
Bear Mountain State Park ¹	5	27
Central Town of Clarkstown	23,052	23,697
Grassy Point	142	112
Harriman State Park ¹	9	42
Jones Point	125	86
Northeastern & Eastern Town of Clarkstown	15,127	15,216
Northeastern Town of Ramapo	25,941	29,852
Northwestern Town of Clarkstown	7,453	7,670
Stony Point	13,111	12,857
Tompkins Cove	1,797	1,887
Unincorporated Areas of the Town of Haverstraw	11,483	12,345
Village of Haverstraw	11,910	12,418
Village of Pomona	4,520	5,325
Village of West Haverstraw	10,376	10,913
<i>Rockland County Subtotal:</i>	<i>125,051</i>	<i>132,447</i>
WESTCHESTER COUNTY		
Briarcliff Manor	8,370	8,132
Buchanan	2,232	2,280
City of Peekskill	23,565	25,374
Croton-on-Hudson	8,078	8,293
Montrose	2,593	3,306

¹ PAA Bear Mountain State Park and PAA Harriman State Park cross the boundary line of Orange County and Rockland County. The numbers in this table and in the tables below represent the population and vehicles in each county portion of the PAA.

Protective Action Area	2010 Population	2020 Population
Ossining Town & Village	30,478	33,140
Town of Cortlandt	26,565	26,758
Town of New Castle (W. of Hardscrabble Rd)	4,686	4,895
Town of Somers (W. of Route 118)	4,436	5,218
Verplanck	2,183	1,984
Yorktown	36,275	36,566
<i>Westchester County Subtotal:</i>	<i>149,461</i>	<i>155,946</i>
EPZ TOTAL:	310,553	324,103
EPZ Population Growth (2010-2020):		4.36%

Table 6-1. Description of Evacuation Regions

REGION																		
2-Mile Region		5-Mile Region		Full EPZ	2-Mile Region and Sector to 5 Miles													
Region Description	Region Number	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15		
Wind Direction From:	N/A	N/A	N/A	N/A	S	SSW, SW	WSW, W	W/NW, NW	NNW	N	NNE	NE	ENE	E	ESE	SE, SSE		
PROTECTIVE ACTION AREA																		
Briarcliff Manor				X														
Central Town of Clarkstown				X														
Northeastern Town of Ramapo				X														
Northeastern & Eastern Town of Clarkstown				X														
Northwestern Town of Clarkstown				X														
Ossining				X														
Village of Haverstraw		X		X					X	X	X	X						
Town of New Castle (West of Hardscrabble Rd)				X														
Village of West Haverstraw		X		X					X	X	X	X						
Unincorporated Areas of the Town of Haverstraw		X		X					X	X	X	X	X					
Town of Tuxedo East of NYS Thruway				X														
Village of Pomona				X														
Grassy Point		X		X					X	X	X	X						
Groton-on-Hudson		X		X				X	X	X								
Stony Point		X		X						X	X	X	X	X				
Verplanck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tompkins Cove	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Buchanan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Montrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Jones Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Village of Harriman East of NYS Thruway				X														
City of Peekskill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Town of Cortlandt		X	X	X	X	X	X	X	X	X								
Bear Mountain State Park	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Harriman State Park		X	X	X								X	X	X	X	X		
Yorktown				X														
Town of Somers (West of Route 118)				X														
Fort Montgomery		X		X	X										X	X		
Southwest Carmel				X														
Village of Highland Falls				X														
Lower Philipstown		X		X	X	X										X		
Village - Town of Woodbury				X														
U.S. Military Academy				X														
Southern Putnam Valley				X														
Town of Highlands				X														
Hudson River				X														
Hudson River is cleared/closed and therefore considered 100% evacuated																		
Town of Cornwall (South of Angola Rd)				X														
Southern Philipstown				X														
Protective Action Area is not within Plume and Shelters-in-Place																		
Protective Action Area is within Plume and Evacuates																		

Region Description Region Number Wind Direction From:		REGION															
		2-Mile Region and Sector to 10 Miles/EPZ															
		R16 S	R17 SSW	R18 SW	R19 WSW	R20 W	R21 WNW	R22 NW	R23 NNW	R24 N	R25 NNE	R26 NE	R27 ENE	R28 E	R29 ESE	R30 SE	R31 SSE
PROTECTIVE ACTION AREA																	
Briarcliff Manor						X	X	X	X								
Central Town of Clarkstown								X	X	X	X						
Northeastern Town of Ramapo									X	X	X	X					
Northeastern & Eastern Town of Clarkstown							X	X	X	X							
Northwestern Town of Clarkstown								X	X	X	X	X					
Ossining Town & Village						X	X	X	X								
Village of Haverstraw								X	X	X	X						
Town of New Castle (West of Hardscrabble Road)					X	X	X	X									
Village of West Haverstraw									X	X	X						
Unincorporated Areas of the Town of Haverstraw									X	X	X	X					
Town of Tuxedo East of NYS Thruway											X	X	X	X			
Village of Pomona									X	X	X	X					
Grassy Point								X	X	X	X						
Croton-on-Hudson						X	X	X	X								
Stony Point									X	X	X	X	X				
Verplanck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tompkins Cove	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Buchanan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Montrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jones Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Village of Harriman East of NYS Thruway													X	X	X	X	X
City of Peekskill	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X
Town of Cortlandt	X	X	X	X	X	X	X	X	X						X	X	X
Bear Mountain State Park	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Harriman State Park											X	X	X	X	X	X	X
Yorktown		X	X	X	X	X	X	X									
Town of Somers (West of Route 118)			X	X	X	X											
Fort Montgomery	X	X													X	X	X
Southwest Carmel	X	X	X	X	X												
Village of Highland Falls	X	X												X	X	X	X
Lower Philipstown	X	X	X												X	X	X
Village - Town of Woodbury															X	X	X
U.S. Military Academy	X	X													X	X	X
Southern Putnam Valley	X	X	X	X													
Town of Highlands	X	X														X	X
Hudson River																	
Town of Cornwall (South of Angola Rd)	X														X	X	X
Southern Philipstown	X	X	X														X
Protective Action Area is within Plume and Evacuates																	
															</		

Region Description	REGION														
	Staged Evacuation - 2 Mile Region Evacuates, then Sector to 5 Miles Evacuates														
	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42	R43	R44		
Wind Direction From:	S	SSW, SW	WSW, W	WNW, NW	NNW	N	NNE	NE	ENE	E	ESE	SE, SSE	5-Mile		
PROTECTIVE ACTION AREA															
Briarcliff Manor															
Central Town of Clarkstown															
Northeastern Town of Ramapo															
Northeastern & Eastern Town of Clarkstown															
Northwestern Town of Clarkstown															
Ossining Town & Village															
Village of Haverstraw					X	X	X	X						X	
Town of New Castle (West of Hardscrabble Road)							X	X							
Village of West Haverstraw						X	X	X						X	
Unincorporated Areas of the Town of Haverstraw						X	X	X	X					X	
Town of Tuxedo East of NYS Thruway															
Village of Pomona															
Grassy Point					X	X	X	X						X	
Croton-on-Hudson				X	X	X								X	
Stony Point						X	X	X	X	X				X	
Verplanck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Tompkins Cove	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Buchanan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Montrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Jones Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Village of Harriman East of NYS Thruway															
City of Peekskill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Town of Cortlandt	X	X	X	X	X	X						X	X	X	
Bear Mountain State Park	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Harriman State Park								X	X	X	X	X	X	X	
Yorktown															
Town of Somers (West of Route 118)															
Fort Montgomery	X														
Southwest Carmel													X	X	
Village of Highland Falls															
Lower Philipstown	X	X												X	
Village - Town of Woodbury															
U.S. Military Academy															
Southern Putnam Valley															
Town of Highlands															
Hudson River					Hudson River is cleared/closed and therefore considered 100% evacuated										
Town of Cornwall (South of Angola Rd)															
Southern Philipstown															
Protective Action Area Evacuates														Protective Action Area Shelters-in-Place	

Table 6-2. Evacuation Scenario Definitions

Scenarios	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/Light Snow	None
8	Winter	Midweek	Midday	Heavy Snow	None
9	Winter	Weekend	Midday	Good	None
10	Winter	Weekend	Midday	Rain/Light Snow	None
11	Winter	Weekend	Midday	Heavy Snow	None
12	Winter	Midweek, Weekend	Evening	Good	None
13	Winter	Weekend	Midday	Good	West Point Football Game
14	Summer	Weekend	Midday	Good	Event at Croton Point Park
15	Summer	Midweek	Midday	Good	Roadway Impact: Route 6; Route 9W; Palisades Parkway; Taconic Parkway ³

² Winter means that school is in session, at normal enrollment levels (also applies to spring and autumn). Summer means that school is in session at summer school enrollment levels (lower than normal enrollment).

³ See Section 2.6 for the roads that are closed in each county.

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

Scenario:	Summer		Summer		Summer	Winter		Winter		Winter		Winter		Summer		Summer
	Midweek		Weekend		Midweek Weekend	Midweek		Midweek		Midweek		Midweek		Weekend	Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Region	Midday		Midday		Evening	Midday		Midday		Midday		Evening	Midday	Midday	Midday	
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Special Event	Special Event	Special Event	
Entire 2-Mile Region, 5-Mile Region, and EPZ																
R01	3:20	3:25	2:50	2:55	3:00	3:25	3:25	4:45	2:55	2:55	4:20	3:00	3:00	2:50	3:20	
R02	4:00	4:20	3:35	4:05	3:35	3:55	4:15	5:25	3:35	3:55	5:00	3:40	3:40	3:45	4:00	
R03	4:25	4:50	4:10	4:30	4:00	4:25	4:50	5:45	4:00	4:20	5:30	4:00	4:10	4:15	5:05	
Evacuate 2-Mile Region and Downwind to 5 Miles																
R04	4:15	4:25	3:40	4:05	3:40	4:00	4:25	5:30	3:35	4:00	5:00	3:45	3:35	3:40	4:15	
R05	4:15	4:30	3:40	4:00	3:45	4:05	4:35	5:30	3:35	4:00	5:00	3:40	3:35	3:40	4:15	
R06	4:10	4:20	3:40	4:05	3:40	4:05	4:25	5:35	3:35	3:55	4:55	3:45	3:35	3:30	4:10	
R07	4:00	4:20	3:35	4:00	3:40	4:00	4:20	5:35	3:35	3:55	5:05	3:35	3:35	3:35	4:00	
R08	4:05	4:20	3:35	3:55	3:40	3:55	4:15	5:35	3:35	3:55	5:05	3:35	3:35	3:35	4:05	
R09	3:55	4:10	3:35	3:55	3:35	3:55	4:10	5:20	3:30	3:50	4:55	3:35	3:30	3:35	3:55	
R10	3:40	3:45	3:15	3:30	3:25	3:35	3:45	5:05	3:15	3:30	4:45	3:25	3:15	3:15	3:40	
R11	3:45	3:55	3:25	3:45	3:25	3:35	3:45	5:05	3:25	3:35	4:55	3:25	3:25	3:25	3:45	
R12	3:40	3:40	3:10	3:25	3:00	3:25	3:35	4:45	3:05	3:20	4:25	3:05	3:05	3:00	3:40	
R13	3:40	3:40	3:20	3:30	3:05	3:30	3:30	4:45	3:05	3:20	4:35	3:00	3:05	3:15	3:40	
R14	3:30	3:30	3:10	3:30	2:55	3:20	3:20	4:40	2:50	2:55	4:15	2:55	2:50	3:00	3:30	
R15	4:05	4:20	3:40	4:10	3:45	4:00	4:20	5:25	3:35	4:00	4:55	3:40	3:30	3:40	4:05	
Evacuate 2-Mile Region and Downwind to EPZ Boundary																
R16	4:50	4:55	4:25	4:35	4:30	4:40	5:15	6:10	4:25	4:40	5:45	4:30	4:35	4:25	5:15	
R17	4:30	4:50	4:20	4:40	4:20	4:40	4:55	5:45	4:20	4:45	5:45	4:25	4:15	4:20	5:35	
R18	4:35	4:50	4:20	4:40	4:25	4:40	5:00	5:55	4:20	4:45	5:45	4:15	4:20	4:20	5:35	
R19	4:15	4:40	4:00	4:25	4:00	4:20	4:40	5:35	4:05	4:10	5:20	4:05	4:05	4:00	5:05	
R20	4:00	4:20	3:35	3:55	3:35	4:10	4:20	5:25	3:40	4:15	5:00	3:35	3:40	3:35	4:35	
R21	4:05	4:40	3:50	4:15	3:50	4:10	4:30	5:35	3:45	4:10	5:15	3:45	3:45	4:05	4:40	
R22	4:00	4:30	3:45	4:05	3:45	4:10	4:20	5:25	3:45	4:05	5:05	3:45	3:40	3:55	4:40	
R23	4:00	4:15	3:40	4:00	3:45	4:05	4:15	5:20	3:35	3:55	5:05	3:45	3:35	3:55	4:35	
R24	4:10	4:30	3:45	4:00	3:50	4:15	4:35	5:40	3:45	4:05	5:10	3:55	3:45	3:55	4:30	
R25	4:05	4:25	3:45	3:55	3:45	4:05	4:25	5:20	3:40	4:00	5:05	3:45	3:40	3:45	4:40	
R26	4:05	4:25	3:40	4:00	3:35	4:00	4:20	5:15	3:35	3:50	5:00	3:35	3:30	3:40	4:40	

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer		Summer	
	Midweek		Weekend		Midweek Weekend		Midweek		Midweek		Weekend		Midweek Weekend		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Region	Midday		Midday		Evening	Midday		Midday		Midday		Evening	Midday		Midday	Midday		Midday
	Good Weather	Rain	Good Weather	Rain		Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow		Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow
R27	3:40	3:50	3:25	3:25	3:15	3:40	3:45	4:55	3:15	3:15	4:35	3:15	3:15	3:15	3:25	3:15	3:10	4:00
R28	3:40	3:40	3:25	3:30	3:05	3:25	3:30	4:50	3:10	3:10	4:35	3:00	3:10	3:25	3:25	3:40	3:40	3:40
R29	3:55	4:10	3:45	3:55	3:00	3:55	3:55	5:10	3:05	3:20	4:35	3:00	3:55	3:45	3:45	3:55	3:55	3:55
R30	4:20	4:35	4:00	4:30	3:35	4:15	4:35	5:35	3:40	4:00	5:05	3:35	3:55	4:00	4:20	4:20	4:20	4:20
R31	4:25	4:45	4:10	4:40	3:50	4:25	4:55	5:55	3:50	4:20	5:20	3:55	4:20	4:10	4:25	4:25	4:25	4:25
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																		
R32	4:30	4:50	4:15	4:40	4:25	4:25	4:45	6:10	4:25	4:40	6:00	4:25	4:15	4:15	4:30	4:30	4:30	4:30
R33	4:30	5:00	4:15	4:35	4:25	4:30	4:45	6:10	4:25	4:50	6:00	4:25	4:15	4:15	4:30	4:30	4:30	4:30
R34	4:20	4:40	4:15	4:20	4:20	4:25	4:40	5:55	4:20	4:25	5:50	4:15	4:10	4:15	4:20	4:20	4:20	4:20
R35	4:25	4:30	4:20	4:20	4:20	4:20	4:45	6:05	4:20	4:25	5:55	4:15	4:20	4:20	4:25	4:25	4:25	4:25
R36	4:35	4:45	4:30	4:30	4:30	4:30	4:45	6:15	4:30	4:35	6:10	4:25	4:30	4:30	4:35	4:35	4:35	4:35
R37	5:00	5:15	5:00	5:15	5:05	5:00	5:15	6:55	4:55	5:10	6:55	5:00	4:55	5:00	5:00	5:00	5:00	5:00
R38	5:05	5:20	5:00	5:15	5:05	5:05	5:15	7:10	5:00	5:15	7:05	5:05	5:00	5:00	5:05	5:05	5:05	5:05
R39	5:05	5:15	5:00	5:15	5:05	5:05	5:15	7:05	5:05	5:15	7:05	5:05	5:05	5:00	5:05	5:05	5:05	5:05
R40	4:25	4:30	4:25	4:30	4:25	4:25	4:35	6:20	4:20	4:25	6:15	4:25	4:15	4:25	4:25	4:25	4:25	4:25
R41	4:10	4:10	3:50	4:00	4:00	4:00	4:15	5:45	3:50	3:55	5:35	4:00	3:50	3:50	4:10	4:10	4:10	4:10
R42	3:35	3:35	3:20	3:30	3:25	3:40	3:40	5:00	3:15	3:15	4:40	3:30	3:15	3:20	3:35	3:35	3:35	3:35
R43	4:25	4:45	4:10	4:25	4:15	4:20	4:55	6:10	4:20	4:35	5:55	4:20	4:15	4:10	4:25	4:25	4:25	4:25
R44	5:00	5:15	5:00	5:20	4:55	5:00	5:15	7:00	5:00	5:10	6:50	5:00	5:00	5:00	5:00	5:00	5:00	5:00

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

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer		Summer	
	Midweek		Weekend		Midweek		Midweek		Midweek		Midweek		Midweek		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)			
Region	Midday		Midday		Evening		Midday		Midday		Midday		Evening		Midday		Midday	
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Good Weather	Special Event	Special Event	Special Event	Roadway Impact	
	Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:15	6:20	
R02	6:25	6:25	6:20	6:20	6:20	6:20	6:25	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:25	
R03	6:30	6:30	6:30	7:05	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:50	
Evacuate 2-Mile Region and Downwind to 5 Miles																		
R04	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R05	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R06	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R07	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R08	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R09	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R10	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R11	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R12	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R13	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R14	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R15	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
Evacuate 2-Mile Region and Downwind to EPZ Boundary																		
R16	6:30	6:30	6:30	6:35	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:25	
R17	6:30	6:30	6:30	6:45	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:35	
R18	6:30	6:30	6:30	6:40	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:35	
R19	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:25	
R20	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:55	
R21	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:10	
R22	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:50	
R23	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:10	
R24	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:05	
R25	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:10	
R26	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:25	

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer		Summer	
	Midweek		Weekend		Midweek		Midweek		Weekend		Midweek		Weekend		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Region	Midday		Midday		Evening	Midday		Midday		Midday		Evening	Midday		Evening	Midday		Evening
	Good Weather	Rain	Good Weather	Rain		Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow		Good Weather	Rain/Light Snow		Good Weather	Rain/Light Snow	
R27	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R28	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R29	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R30	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R31	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																		
R32	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R33	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R34	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R35	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R36	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R37	6:20	6:50	6:20	6:55	6:20	6:20	6:45	8:55	6:20	6:40	8:50	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R38	6:20	6:50	6:20	6:50	6:20	6:20	6:45	8:50	6:20	6:45	8:55	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R39	6:20	6:45	6:20	6:45	6:20	6:20	6:45	8:55	6:20	6:45	8:50	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R40	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R41	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R42	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R43	6:20	6:20	6:20	6:20	6:20	6:20	6:40	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R44	6:25	6:45	6:20	6:55	6:20	6:20	6:45	8:55	6:20	6:45	8:55	6:20	6:20	6:20	6:20	6:20	6:20	6:25

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

	Summer		Summer		Summer	Winter			Winter			Winter			Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Midweek			Weekend			Midweek Weekend	Weekend	Weekend	
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)			
Region	Midday		Midday		Evening	Midday			Midday			Evening	Midday	Midday	Midday			
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Special Event	Special Event	Special Event	Roadway Impact		
Entire 2-Mile Region, 5-Mile Region, and EPZ																		
R01	3:20	3:25	2:55	2:55	3:00	3:25	3:25	4:45	2:55	2:55	4:20	3:00	3:00	2:55	3:20			
R02	3:45	4:05	3:10	3:40	3:20	3:35	4:10	5:00	3:15	3:45	4:30	3:10	3:10	3:10	3:30			
Evacuate 2-Mile Region and Downwind to 5 Miles																		
R04	3:45	3:55	3:10	3:45	3:20	3:35	3:55	4:50	3:05	3:40	4:30	3:20	3:10	3:10	3:30			
R05	3:50	4:05	3:10	3:40	3:20	3:40	4:10	4:55	3:05	3:45	4:25	3:15	3:05	3:05	3:35			
R06	3:50	4:00	3:15	3:45	3:15	3:35	4:05	5:00	3:10	3:50	4:25	3:15	3:10	3:15	3:30			
R07	3:40	4:00	3:20	3:45	3:15	3:40	4:00	5:10	3:05	3:40	4:35	3:10	3:05	3:05	3:30			
R08	3:45	4:05	3:15	3:45	3:15	3:35	3:55	5:10	3:05	3:40	4:45	3:20	3:05	3:15	3:30			
R09	3:55	4:00	3:10	3:50	3:20	3:40	4:25	5:00	3:10	3:35	4:40	3:20	3:20	3:15	3:35			
R10	3:25	3:25	2:50	2:55	3:00	3:25	3:30	4:45	2:55	2:55	4:20	3:00	2:55	2:50	3:30			
R11	3:25	3:25	2:55	3:00	3:00	3:25	3:20	4:45	2:55	3:05	4:20	3:00	2:55	2:55	3:25			
R12	3:25	3:25	2:55	3:00	2:55	3:25	3:30	4:40	2:50	3:00	4:20	3:05	2:50	2:50	3:25			
R13	3:25	3:25	2:55	3:00	3:00	3:25	3:30	4:45	2:50	2:55	4:30	3:00	3:00	2:50	3:25			
R14	3:25	3:30	2:50	2:55	3:05	3:25	3:20	4:45	2:50	3:00	4:25	3:00	2:50	2:50	3:35			
R15	3:55	4:05	3:15	3:50	3:15	3:30	4:00	5:00	3:05	3:45	4:30	3:10	3:05	3:10	3:30			
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																		
R32	4:10	4:20	3:50	4:15	4:05	3:50	4:15	5:35	4:00	4:15	5:20	4:05	3:50	4:00	4:05			
R33	4:00	4:25	3:55	4:15	4:00	3:50	4:15	5:35	4:00	4:20	5:30	4:05	3:50	4:05	4:10			
R34	3:45	4:20	3:55	4:10	4:00	4:05	4:15	5:25	3:55	4:00	5:10	3:50	3:45	3:40	3:50			
R35	4:10	4:10	3:50	4:05	4:05	3:45	4:30	5:30	4:00	4:05	5:15	3:55	3:55	3:55	4:05			
R36	4:05	4:15	3:55	4:00	4:05	3:50	4:10	5:25	3:55	3:55	5:15	3:55	3:50	3:55	4:05			
R37	4:20	4:20	3:50	4:00	4:05	4:00	4:10	5:25	3:45	4:00	5:15	3:55	3:55	3:50	4:20			
R38	3:25	3:35	3:00	3:00	3:15	3:35	3:40	4:45	3:00	3:05	4:30	3:20	3:05	3:00	4:00			
R39	3:35	3:35	3:00	3:00	3:10	3:25	3:35	4:50	3:00	3:00	4:25	3:20	2:55	2:55	4:00			
R40	3:30	3:30	3:05	3:00	3:20	3:30	3:45	4:45	2:55	3:00	4:35	3:20	3:30	3:00	3:55			
R41	3:30	3:35	3:00	3:05	3:20	3:30	3:40	4:50	3:00	3:05	4:25	3:20	2:55	3:40	4:10			
R42	3:30	3:30	3:00	3:05	3:15	3:35	3:30	4:45	3:15	3:00	4:30	3:20	3:00	3:00	3:40			
R43	4:10	4:30	3:50	4:20	4:00	4:05	4:30	5:40	3:55	4:20	5:20	4:05	4:00	4:05	4:15			
R44	3:55	4:15	4:00	4:20	3:55	4:00	4:20	5:40	4:00	4:05	5:15	4:05	3:55	4:05	4:15			

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

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer	
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Region	Midday		Midday		Evening		Midday		Midday		Midday		Midday		Midday	
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Evening	Good Weather	Special Event	Special Event	Roadway Impact
Entire 2-Mile Region, 5-Mile Region, and EPZ																
R01	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R02	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
Evacuate 2-Mile Region and Downwind to 5 Miles																
R04	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R05	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R06	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R07	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R08	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R09	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R10	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R11	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R12	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R13	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R14	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R15	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																
R32	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R33	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R34	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R35	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R36	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R37	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R38	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R39	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R40	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R41	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R42	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R43	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R44	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20

Table 8-2. School Evacuation Time Estimates – Good Weather

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
ORANGE COUNTY SCHOOLS									
Fort Montgomery	90	15	10.8	6.6	99	3:25	6.7	7	3:35
Village of Highland Falls	90	15	8.2	4.1	121	3:50	6.7	7	4:00
U.S. Military Academy	90	15	15.4	5.5	168	4:35	6.7	7	4:45
Village-Town of Woodbury	90	15	2.0	34.7	3	1:50	21.4	23	2:15
Harriman State Park	90	15	7.5	4.9	92	3:20	13.6	15	3:35
PUTNAM COUNTY SCHOOLS									
Southern Putnam Valley	90	15	6.1	2.4	152	4:20	12.8	14	4:35
Southern Philipstown	90	15	4.7	16.2	17	2:05	34.1	37	2:45
Southwest Carmel	90	15	2.9	1.4	124	3:50	13.5	15	4:05
Lower Philipstown	90	15	7.6	40.9	11	2:00	28.6	31	2:35
ROCKLAND COUNTY SCHOOLS									
Central Town of Clarkstown	90	15	2.6	3.6	44	2:30	2.6	3	2:35
Northeastern Town of Ramapo	90	15	4.2	6.5	39	2:25	2.0	2	2:30
Northeastern & Eastern Town of Clarkstown	90	15	4.3	5.9	44	2:30	4.3	5	2:35
Northwestern Town of Clarkstown	90	15	6.6	7.5	53	2:40	2.6	3	2:45
Village of Haverstraw	90	15	8.7	5.1	102	3:30	4.8	5	3:35
Village of West Haverstraw	90	15	8.8	6.8	77	3:05	2.0	2	3:10
Unincorporated Areas of the Town of Haverstraw	90	15	8.9	13.4	40	2:25	1.8	2	2:30
Village of Pomona	90	15	5.7	46.4	7	1:55	1.8	2	2:00
Stony Point	90	15	10.5	8.2	77	3:05	2.0	2	3:10
Grassy Point	90	15	11.8	8.4	84	3:10	2.0	2	3:15
Tompkins Cove	90	15	12.6	8.4	90	3:15	2.0	2	3:20
WESTCHESTER COUNTY SCHOOLS									
Briarcliff Manor	90	15	2.6	39.0	4	1:50	6.7	7	2:00
Ossining Town & Village	90	15	5.3	4.3	75	3:00	10.1	11	3:15
Town of New Castle (W. of Hardscrabble Rd)	90	15	3.7	22.6	10	1:55	10.8	12	2:10
Croton-on-Hudson	90	15	8.0	4.5	108	3:35	7.4	8	3:45
Buchanan	90	15	11.9	6.6	108	3:35	7.4	8	3:45
Montrose	90	15	10.5	6.1	104	3:30	7.4	8	3:40

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
City of Peekskill	90	15	16.4	32.4	30	2:15	5.8	6	2:25
Town of Cortlandt	90	15	17.4	14.0	74	3:00	15.8	17	3:20
Yorktown	90	15	9.6	35.4	16	2:05	9.4	10	2:15
Town of Somers (W. of Route 118)	90	15	7.2	4.8	90	3:15	9.7	11	3:30
Maximum for EPZ:						4:35	Maximum:		
Average for EPZ:						2:55	Average:		

Table 8-5. Transit-Dependent Evacuation Time Estimates - Good Weather

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave								
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)		
ORANGE COUNTY																
Bear Mountain State Park	1	180	9.4	52.0	11	30	3:45	19.8	22	5	10	43	30	5:35		
Fort Montgomery	1	180	10.8	6.9	95	30	5:05	6.7	7	5	10	36	30	6:35		
Harriman State Park	1	180	7.5	8.9	50	30	4:20	13.6	15	5	10	36	30	6:00		
Town of Cornwall (S. of Angola Road)	1	180	3.2	40.0	5	30	3:35	7.2	8	5	10	16	30	4:45		
Town of Tuxedo east of NYS Thruway	1	180	0.4	35.0	1	30	3:35	29.5	32	5	10	33	30	5:25		
U.S. Military Academy	4	180	15.4	6.8	136	30	5:50	6.7	7	5	10	43	30	7:25		
Village of Highland Falls	2	180	8.2	4.7	105	30	5:15	6.7	7	5	10	26	30	6:35		
Village-Town of Woodbury	2	180	2.0	35.1	3	30	3:35	21.4	23	5	10	29	30	5:15		
PUTNAM COUNTY																
Lower Philipstown	2	180	7.6	14.3	32	30	4:05	28.6	31	5	10	54	30	6:15		
Southern Philipstown	3	180	4.7	13.2	21	30	3:55	34.1	37	5	10	48	30	6:05		
Southern Putnam Valley	5	180	6.1	3.5	105	30	5:15	12.8	14	5	10	29	30	6:45		
Southwest Carmel	2	180	2.9	1.7	106	30	5:20	13.5	15	5	10	23	30	6:45		
ROCKLAND COUNTY																
Central Town of Clarkstown	6	180	2.6	6.0	26	30	4:00	2.6	3	5	10	10	30	5:00		
	5	200	2.6	6.0	26	30	4:20	2.6	3	5	10	10	30	5:20		
Grassy Point	1	180	11.8	12.4	57	30	4:30	2.0	2	5	10	35	30	5:55		
Jones Point	1	180	13.3	49.1	16	30	3:50	19.8	22	5	10	53	30	5:50		
Northeastern & Eastern Town of Clarkstown	8	180	4.3	7.4	35	30	4:05	4.3	5	5	10	20	30	5:15		
Northeastern Town of Ramapo	5	180	4.2	5.3	48	30	4:20	2.0	2	5	10	13	30	5:20		
	5	200	4.2	7.9	32	30	4:25	2.0	2	5	10	13	30	5:25		
Northwestern Town of Clarkstown	4	220	4.2	12.1	21	30	4:35	2.0	2	5	10	13	30	5:35		
	4	180	6.6	11.5	35	30	4:05	2.6	3	5	10	22	30	5:15		
Stony Point	6	180	10.5	12.0	53	30	4:25	2.0	2	5	10	32	30	5:45		

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave						
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
WESTCHESTER COUNTY														
Tompkins Cove	1	180	12.6	13.0	58	30	4:30	2.0	2	5	10	38	30	5:55
Unincorporated Areas of the Town of Haverstraw	6	180	8.9	13.5	40	30	4:10	1.8	2	5	10	24	30	5:25
Village of Haverstraw	6	180	8.7	8.6	61	30	4:35	4.8	5	5	10	30	30	5:55
Village of Pomona	3	180	5.7	50.7	7	30	3:40	1.8	2	5	10	15	30	4:45
Village of West Haverstraw	6	180	8.8	10.3	51	30	4:25	2.0	2	5	10	27	30	5:40
Briarcliff Manor	4	180	2.6	39.0	4	30	3:35	6.7	7	5	10	14	30	4:45
Buchanan	2	180	11.9	10.4	69	30	4:40	7.4	8	5	10	51	30	6:25
City of Peekskill	6	180	16.4	42.3	23	30	3:55	5.8	6	5	10	47	30	5:35
	6	200	16.4	42.9	23	30	4:15	5.8	6	5	10	47	30	5:55
Croton-on-Hudson	4	180	8.0	7.3	66	30	4:40	7.4	8	5	10	41	30	6:15
Montrose	2	180	10.5	9.6	66	30	4:40	7.4	8	5	10	41	30	6:15
Ossining Town & Village	6	180	5.3	5.4	59	30	4:30	10.1	11	5	10	40	30	6:10
	5	200	5.3	6.2	51	30	4:45	10.1	11	5	10	35	30	6:20
	5	220	5.3	7.7	41	30	4:55	10.1	11	5	10	31	30	6:25
Town of Cortlandt	5	180	17.4	15.5	68	30	4:40	15.8	17	5	10	56	30	6:40
	4	200	17.4	18.3	57	30	4:50	15.8	17	5	10	56	30	6:50
	4	220	17.4	21.2	49	30	5:00	15.8	17	5	10	56	30	7:00
Town of New Castle (W. of Hardscrabble Rd)	3	180	3.7	40.4	6	30	3:40	10.8	12	5	10	22	30	5:00
Town of Somers (W. of Route 118)	3	180	7.2	13.9	31	30	4:05	9.7	11	5	10	31	30	5:35
Verplanck	1	180	13.0	10.8	72	30	4:45	7.4	8	5	10	50	30	6:30
Yorktown	6	180	9.6	38.3	15	30	3:45	9.4	10	5	10	35	30	5:15
	6	200	9.6	37.6	15	30	4:05	9.4	10	5	10	36	30	5:40
	5	220	9.6	38.3	15	30	4:25	9.4	10	5	10	36	30	6:00
Maximum ETE:							5:50	Maximum ETE:					7:25	
Average ETE:							4:25	Average ETE:					5:55	

Table 8-8. Medical Facilities Evacuation Time Estimates - Good Weather

Medical Facilities in	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)
PUTNAM COUNTY								
Lower Philipstown	Ambulatory	90	1	188	30	7.6	12	2:15
	Wheelchair bound	90	5	22	75	7.6	26	3:15
Southern Philipstown	Ambulatory	90	1	181	30	4.7	18	2:20
Southern Putnam Valley	Ambulatory	90	1	50	30	6.1	146	4:30
ROCKLAND COUNTY								
Central Town of Clarkstown	Ambulatory	90	1	126	30	2.6	38	2:40
	Wheelchair bound	90	5	4	20	2.6	43	2:35
Northeastern & Eastern Town of Clarkstown	Ambulatory	90	1	698	30	4.3	42	2:45
	Wheelchair bound	90	5	154	75	4.3	41	3:30
Northeastern Town of Ramapo	Ambulatory	90	1	461	30	4.2	32	2:35
	Wheelchair bound	90	5	372	75	4.2	51	3:40
Northwestern Town of Clarkstown	Bedridden	90	15	25	30	4.2	32	2:35
	Ambulatory	90	1	126	30	6.6	46	2:50
Stony Point	Wheelchair bound	90	5	6	30	6.6	46	2:50
	Bedridden	90	15	3	30	6.6	46	2:50
Unincorporated Areas of the Town of Haverstraw	Ambulatory	90	1	75	30	10.5	73	3:15
Village of Haverstraw	Ambulatory	90	1	12	12	8.9	40	2:25
	Wheelchair bound	90	5	270	30	8.7	95	3:35
Village of West Haverstraw	Bedridden	90	15	10	30	8.7	71	4:00
	Ambulatory	90	1	344	30	8.8	73	3:15
Briarcliff Manor	Wheelchair bound	90	5	103	75	8.8	60	3:45
	Bedridden	90	15	16	30	8.8	73	3:15
WESTCHESTER COUNTY								
Briarcliff Manor	Ambulatory	90	1	251	30	2.6	4	2:05
	Wheelchair bound	90	5	52	75	2.6	4	2:50
	Bedridden	90	15	34	30	2.6	4	2:05

Medical Facilities in	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)
Buchanan	Ambulatory	90	1	10	10	11.9	109	3:30
	Wheelchair bound	90	5	6	30	11.9	100	3:40
	Bedridden	90	15	1	15	11.9	108	3:35
City of Peekskill	Ambulatory	90	1	189	30	16.4	26	2:30
	Wheelchair bound	90	5	30	75	16.4	23	3:10
	Bedridden	90	15	22	30	16.4	26	2:30
Croton-on-Hudson	Ambulatory	90	1	144	30	8.0	100	3:40
	Wheelchair bound	90	5	29	75	8.0	73	4:00
	Bedridden	90	15	20	30	8.0	100	3:40
Ossining Town & Village	Ambulatory	90	1	309	30	5.3	70	3:10
	Wheelchair bound	90	5	62	75	5.3	63	3:50
	Bedridden	90	15	45	30	5.3	70	3:10
Town of Cortlandt	Ambulatory	90	1	699	30	17.4	77	3:20
	Wheelchair bound	90	5	142	75	17.4	75	4:00
	Bedridden	90	15	100	30	17.4	77	3:20
Town of New Castle (W. of Hardscrabble Rd)	Ambulatory	90	1	44	30	3.7	10	2:10
	Wheelchair bound	90	5	8	40	3.7	9	2:20
	Bedridden	90	15	6	30	3.7	10	2:10
Town of Somers (W. of Route 118)	Ambulatory	90	1	16	16	7.2	87	3:15
	Wheelchair bound	90	5	3	15	7.2	90	3:15
	Bedridden	90	15	2	30	7.2	78	3:20
Yorktown	Ambulatory	90	1	532	30	9.6	16	2:20
	Wheelchair bound	90	5	107	75	9.6	15	3:00
	Bedridden	90	15	78	30	9.6	16	2:20
Maximum ETE:							Maximum ETE:	4:30
Average ETE:							Average ETE:	3:10

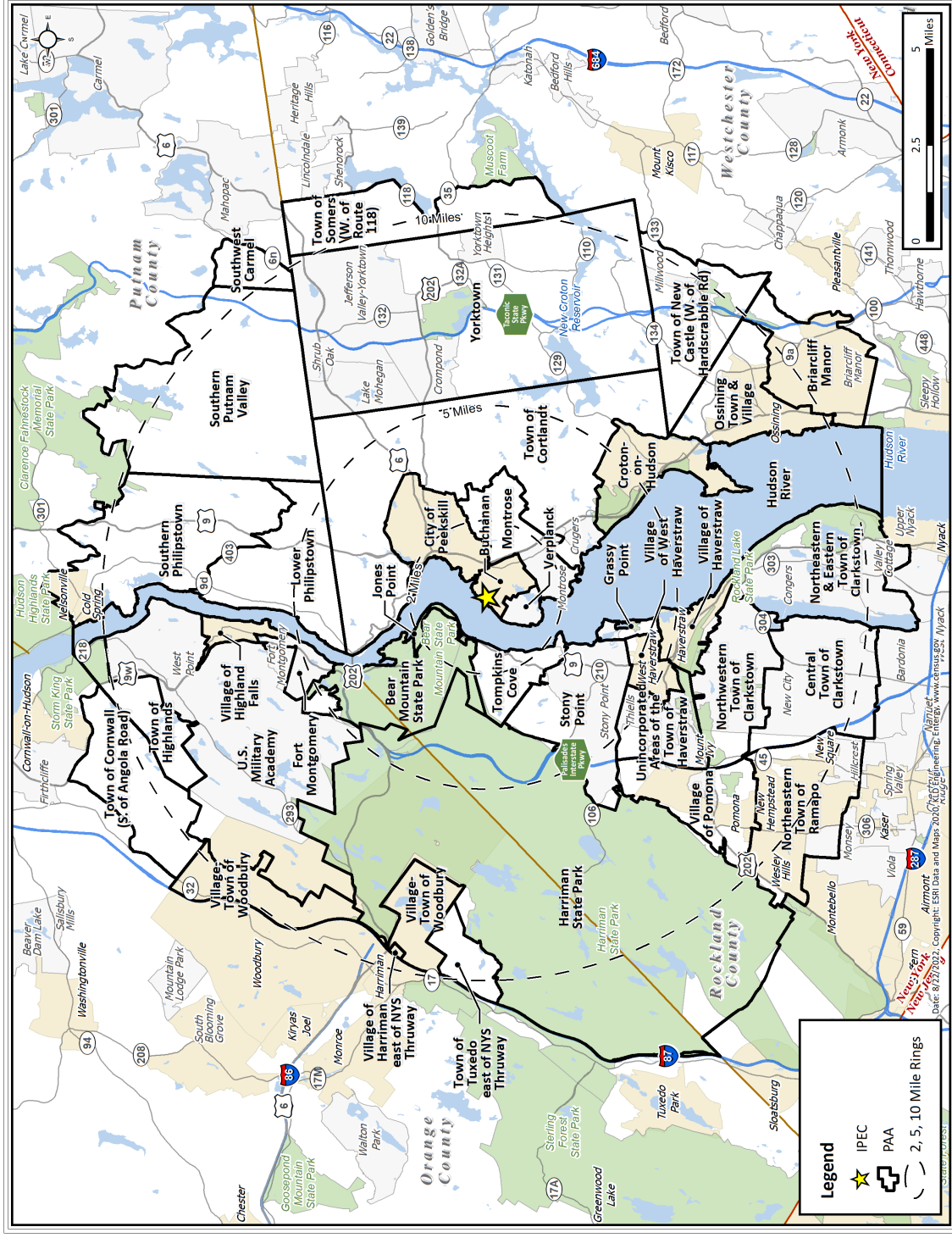


Figure 6-1. Protective Action Areas Comprising the IPEC EPZ

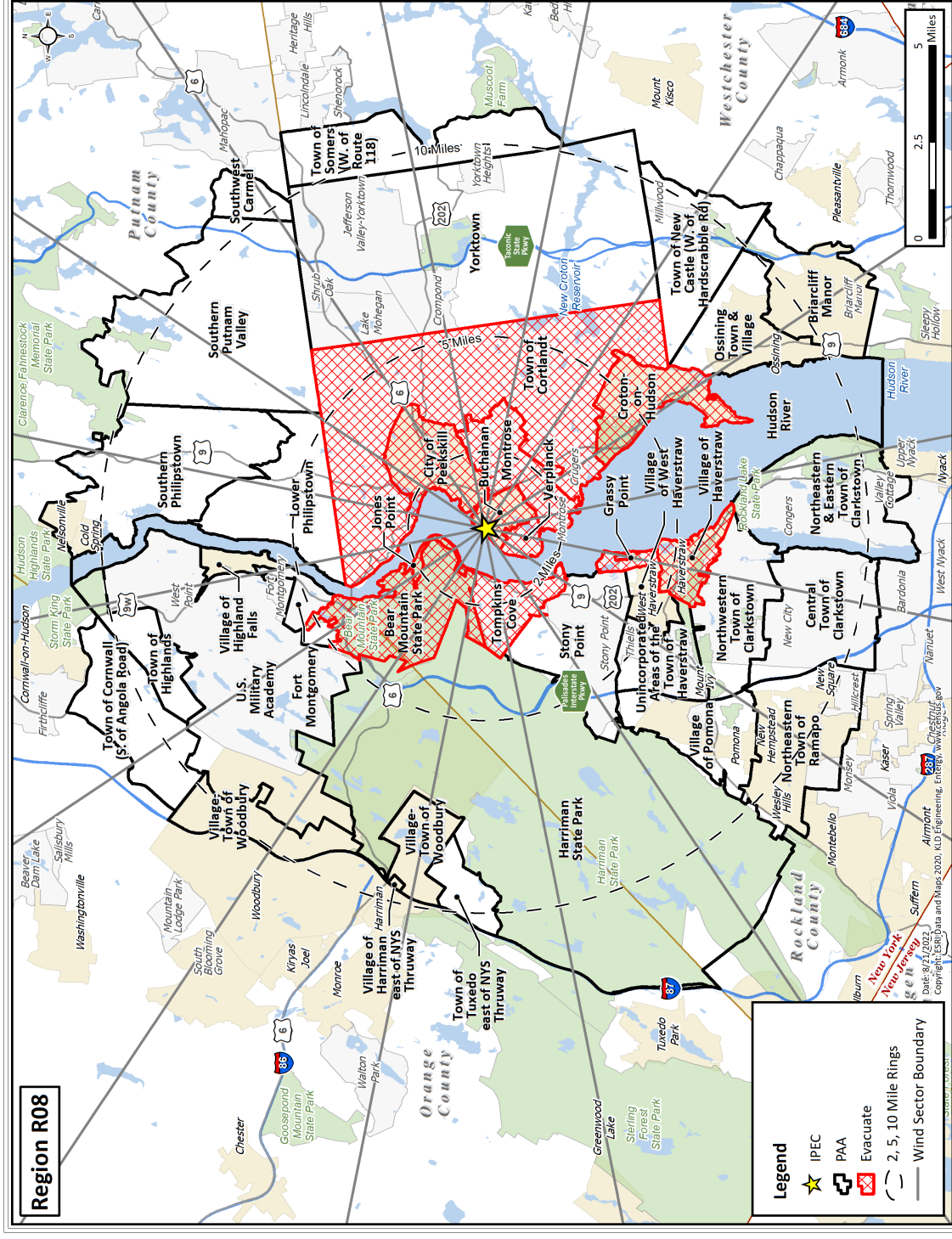


Figure H-8. Region R08

1 INTRODUCTION

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the Indian Point Energy Center (IPEC), located in Westchester County, New York. 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:

- Title 10, Code of Federal Regulations, Appendix E to Part 50 (10CFR50), Emergency Planning and Preparedness for Production and Utilization Facilities, NRC, 2011
- Criteria for Development of Evacuation Time Estimate Studies, NUREG/CR-7002, Rev. 1, February 2021.
- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/Radiological Emergency Preparedness Program Manual, FEMA P-1028, December 2019.

The work effort reported herein was supported and guided by Holtec and local stakeholders who contributed suggestions, critiques, and the local knowledge base required. The combination of these various factors explains why the 90th percentile ETE for the entire EPZ (Region R03) are longer in this study relative to the 2012 ETE study. Table 1-1 presents a summary of stakeholders and interactions.

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 Holtec.
 - b. Attended meetings with emergency planners from New York State Division of Homeland Security and Emergency Services (DHSES), Orange County Department of Emergency Management (DEM), Putnam County Bureau of Emergency Services (PCBES), Rockland County Office of Fire and Emergency Services (RCOFES), and Westchester Office of Emergency Management (OEM) 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. Reviewed existing state and county emergency plans.
 - e. Conducted an online demographic survey of EPZ residents (see Appendix F).
 - f. Obtained demographic data from the 2020 Census (see Section 3.1).

- g. Conducted a data collection effort to identify and describe special facilities (i.e., schools, preschools/daycares, day camps, and medical facilities), major employers, transient attractions, access and/or functional needs populations, transportation resources available, the special event, and other important information needed for the ETE study.
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 online demographic 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 and access control is applied at specified Traffic Control Points (TCPs) and Access Control Points (ACPs) located within the study area. See Section 9 and Appendix G.
5. Used the existing protective action areas to define evacuation regions. The EPZ is partitioned into 38 protective action areas along jurisdictional and geographic boundaries. "Regions" are groups of contiguous protective action areas 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, Rev. 1.
6. Estimated demand for transit services for persons at schools, preschools/daycares, day camps, medical facilities, transit-dependent persons at home, and those with access and/or functional needs.
7. Prepared the input streams for the DYNEV II System which computes ETE (see Appendices B and C).
 - a. Estimated the evacuation traffic demand, based on the available information derived from Census data, and from data provided by county and state agencies, Holtec and from the demographic survey.
 - b. Applied the procedures specified in the 2016 Highway Capacity Manual (HCM¹) to the data acquired during the field survey, to estimate the capacity of all highway segments comprising the evacuation routes.
 - c. Updated the link-node representation of the evacuation network, which is used as the basis for the computer analysis that calculates the ETE.
 - d. Calculated the evacuating traffic demand for each Region and for each Scenario.

¹ Highway Capacity Manual (HCM 2016), Transportation Research Board, National Research Council, 2010.

- 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 IPEC location.
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, Rev. 1.
10. Calculated the ETE for all transit activities including those for special facilities (schools, preschools/daycares, day camps, and medical facilities), for the transit-dependent population and for the access and/or functional needs population.

1.2 The Indian Point Energy Center Location

IPEC is located along the eastern bank of the Hudson River in Buchanan, Westchester County, New York. The site is approximately 35 miles north of New York City. The EPZ consists of parts of Orange, Putnam, Rockland and Westchester Counties in New York. Figure 1-1 displays the location of IPEC relative to the New York City Metropolitan area, the major roadways and the major population centers in the vicinity of the plant.

1.3 Preliminary Activities

Field Surveys of the Highway Network

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 to the south, east and west and approximately 23 miles to the north. The characteristics of each section of highway were recorded. These characteristics are shown in Table 1-2.

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 2016 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 15-46 in the HCM 2016 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. Roadway types were assigned 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 lanes in each direction
- Collector: single lane in each direction
- Local Roadway: single lane in each direction, local road with low free flow speeds

As documented on page 15-6 of the HCM 2016, the capacity of a two-lane highway is 1,700 passenger cars per hour in one direction. For freeway sections, a value of 2,250 vehicles per hour per lane is assigned, as per Exhibit 12-37 of the HCM 2016. 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 2016 Exhibit 15-46. 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 and ACPs 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, Rev. 1 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.

Demographic Survey

A demographic survey was undertaken to gather information needed for the evacuation study. The survey instrument was reviewed and approved by Holtec and the offsite support agencies prior to conducting the survey. 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).

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 output by the DYNEV II System, such as LOS, vehicles discharged, average speed, and percent of vehicles evacuated. 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 IPEC location.

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

The 90th percentile ETE for the entire EPZ increased by 20 minutes for a winter midweek midday good weather scenario (Scenario 6) and by 35 minutes for a summer weekend midday good weather scenario (Scenario 3) when compared with the 2012 study. The 100th percentile ETE decreased by 15 minutes for Scenario 6 and increased by 35 minutes for Scenario 3.

Table 1-2. Highway Characteristics

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

Table 1-3 presents a comparison of the present ETE study with the previous ETE study (KLD TR-537, dated December 2012). The major factors contributing to the differences between the ETE values obtained in this study and those of the previous study are:

- Trip-generation times for residents with commuters and without commuters are an hour longer in this study than in the previous study. Elongating the trip generation times can increase the 90th and 100th percentile ETE.
- The number of employees commuting into the EPZ decreased significantly (42%) due to

the updated NRC criteria for major employers from 50 or more employees per shift to 200 or more employees per shift. This decrease in quickly mobilizing employees can increase the 90th percentile ETE as it will take longer to reach an evacuation of 90% of the population when a larger percentage of the evacuating populace is residents who take significantly longer to mobilize than employees. Decreasing the number of employees can also decrease the 100th percentile ETE, especially for midweek scenarios as there are fewer evacuating vehicles.

- The permanent resident population increased by approximately 4% and the number of evacuating vehicles for the permanent resident population increased by 21% (approximately 28,000 vehicles). This significant increase in permanent resident evacuating vehicles is caused by the increased number of evacuating vehicles per household as per the demographic survey, resulting in a significant decrease in permanent resident vehicle occupancy. Additional resident vehicles can increase traffic congestion, prolonging both the 90th and 100th percentile ETE.
- The number of evacuating vehicles within the Shadow Region increased by 28% (largely the result of the significant decrease in permanent resident vehicle occupancy discussed above), compared to the previous ETE. The significant increase in evacuating vehicles in the Shadow Region prolongs congestion, thereby increasing ETE.

The combination of these various factors explains why the 90th percentile ETE for the entire EPZ (Region R03) are longer in this study relative to the 2012 ETE study.

Table 1-1. Stakeholder Interaction

Stakeholder	Nature of Stakeholder Interaction
Holtec	Attended meetings to define project methodology and data requirements and set up contacts with local government agencies. Reviewed and approved the demographic survey instrument and all project assumptions. Engaged in the ETE development and were informed of the study results.
Rockland County Office of Fire & Emergency Services (RCOFES)	Attended meetings to define project methodology and data requirements. Provided emergency plans and traffic management plans. Provided/ confirmed special facility data, transient data and special event data. Reviewed and approved the demographic survey instrument and all study assumptions. Engaged in the ETE development and were informed of the study results.
Putnam County Bureau of Emergency Services (PCBES)	
Orange County Department of Emergency Management (OCDEM)	
Westchester Office of Emergency Management	
New York State Division of Homeland Security and Emergency Services	Attended meetings to define project methodology and data requirements. Provided emergency plans. Reviewed and approved the demographic survey instrument and all study assumptions. Engaged in the ETE development and were informed of the study results.
West Point Directorate of Plans, Training, Mobilization and Security (DPTMS)	Attended meetings to define project methodology and data requirements. Provided/confirmed data at West Point. Reviewed and approved the demographic survey instrument and all study assumptions. Engaged in the ETE development and were informed of the study results.

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%)
- Unusual characteristics: Narrow bridges, sharp curves, poor pavement, flood warning signs, inadequate delineations, toll booths, etc.
- Posted speed
- Actual free speed
- Abutting land use
- Control devices
- Intersection configuration (including roundabouts where applicable)
- Traffic signal type

Table 1-3. ETE Study Comparisons

Topic	Previous ETE Study	Current ETE Study
Resident Population Basis	ArcGIS Software using 2010 US Census blocks; area ratio method used. Population = 310,553 Vehicles = 130,979	ArcGIS Software using 2020 US Census blocks; area ratio method used. Population = 324,103 Vehicles = 159,048
Resident Population Vehicle Occupancy	2.88 persons/household, 1.23 evacuating vehicles/household yielding: 2.34 persons/vehicle.	Orange County: 2.71 persons/household 1.42 vehicles/household Putnam County: 2.51 persons/household 1.34 vehicles/household Rockland County: 2.73 persons/household 1.40 vehicles/household Westchester County: 2.58 persons/household 1.29 vehicles/household
Shadow Population	ArcGIS Software using 2010 US Census blocks; area ratio method used. 20% Population = 106,245 20% Vehicles = 44,654	ArcGIS Software using 2020 US Census blocks; area ratio method used. 20% Population = 114,333 20% Vehicles = 57,274
Employee Population	Employee estimates based on 2010 Census data, supplemented with data provided by the plant. 1.07 employees per vehicle based on telephone survey results. Employees = 40,415 Vehicles = 37,913	Employee estimates based on 2020 Census data, supplemented with data provided by Holtec and the U.S. Military Academy West Point. 1.06 employees per vehicle based on demographic survey results. Employees = 22,149 Vehicles = 20,895
Transit-Dependent Population	Estimates based upon U.S. Census data and the results of the telephone survey. A total of 15,992 people who do not have access to a vehicle, requiring 432 buses to evacuate. An additional 440 access and/or functional needs persons needed special transportation to evacuate (167 required a bus, 172 required a wheelchair-accessible vehicle, and 101 required an ambulance).	Estimates based upon U.S. Census data and the results of the demographic survey. A total of 4,484 people who do not have access to a vehicle, requiring 169 buses to evacuate. An additional 291 access and/or functional needs persons needed special transportation to evacuate (153 required a bus, 13 required a wheelchair-accessible vehicle, and 125 required an ambulance).

Topic	Previous ETE Study	Current ETE Study
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 phone calls to facilities. Transients = 85,584 Vehicles = 24,339	Transient estimates based upon information provided by counties in EPZ, supplemented by aerial imagery. Transients = 68,651 Vehicles = 22,487
Medical Facilities Population	Medical facility population based on information provided by each county within the EPZ, supplemented with phone calls to individual facilities. Current census = 6,763 Buses Required = 150 Wheelchair Bus Required = 88 Ambulances Required = 155	Medical facility population based on information provided by each county within the EPZ, supplemented with online searches and data from the previous study. Current census = 6,327 Buses Required = 181 Wheelchair Bus Required = 120 Ambulances Required = 179
School Population	School population based on information provided by each county within the EPZ. School enrollment (includes preschools and daycares) = 72,725 Buses required = 1,539 Vans required = 140	School population based on information provided by each county within the EPZ, supplemented by internet searches where data was not provided. School enrollment (includes preschools and daycares) = 86,050 Buses required = 1,861 Commuter vehicles = 1,082
Voluntary evacuation from within EPZ in areas outside region to be evacuated	20% of the population within the EPZ, but not within the evacuation region (see Figure 2-1)	20% of the population within the EPZ, but not within the evacuation region (see Figure 2-1)
Shadow Evacuation	20% of people outside of the EPZ within the Shadow Region (see Figure 7-2)	20% of people outside of the EPZ within the Shadow Region (see Figure 7-2)
Network Size	5,110 links; 3,213 nodes	5,460 links; 3,498 nodes

Topic	Previous ETE Study	Current ETE Study
Roadway Geometric Data	Field surveys conducted in March 2011 and January 2012. Roads and intersections were video archived. Road capacities based on 2010 HCM.	Field surveys conducted in October 2020. Roads and intersections were video archived. Road capacities based on 2016 HCM.
School Evacuation	Direct evacuation to designated School Reception Center	Direct evacuation to designated School Reception Center
Ridesharing	50% of transit-dependent persons will evacuate with a relative, neighbor or friend per federal guidance.	59% of transit-dependent persons will evacuate with a relative, neighbor or friend per the demographic survey results.
External Traffic	External Traffic is loaded on I-84, I-684, I-287, I-87, Taconic State Parkway, Saw Mill Parkway, Sprain Brook Parkway, and Palisades Parkway. External-traffic trips are stopped within the 2-hour ACP activation time. Vehicles = 57,264	External Traffic is loaded on I-84, I-684, I-287, I-87, Taconic State Parkway, Saw Mill Parkway, Sprain Brook Parkway, and Palisades Parkway. External-traffic trips are stopped within the 2-hour ACP activation time. Vehicles = 67,760
Trip Generation for Evacuation	Based on residential telephone survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 30 and 315 minutes. Residents without commuters returning leave between 15 and 225 minutes. Employees and transients leave between 15 and 105 minutes. All times measured from the Advisory to Evacuate. Additional time to clear snow added to residential evacuation times for snow scenarios.	Based on residential demographic survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 30 and 375 minutes. Residents without commuters returning leave between 5 and 285 minutes. Employees and transients leave between 5 and 105 minutes. All times measured from the Advisory to Evacuate. Additional time to clear snow added to residential evacuation times for heavy snow scenarios.
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/Light Snow, or Heavy Snow. The capacity and free flow speed of all links in the network are reduced by 10% for Rain/Light Snow and 25% and 15% for Heavy Snow, respectively.

Topic	Previous ETE Study	Current ETE Study
Modeling	DYNEV II System – Version 4.0.14.0	DYNEV II System – Version 4.0.21.0
Special Events	West Point Football Game Event at Croton Point Park	West Point Football Game Event at Croton Point Park
Evacuation Cases	44 regions (3 adjoining 22.5 degree sectors with central sector corresponding to wind direction) and 15 scenarios producing 660 unique cases.	44 regions (3 adjoining 22.5 degree sectors with central sector corresponding to wind direction) and 15 scenarios producing 660 unique cases.
Evacuation Time Estimates Reporting	ETE reported for 90 th and 100 th percentile population. Results presented by region and scenario.	ETE reported for 90 th and 100 th percentile population. Results presented by region and scenario.
Evacuation Time Estimates for the 2-Mile Region (Region R01), 90th percentile	Winter Midweek MIDDAY, Good Weather (Sc. 6): 2:25 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 2:10	Winter Midweek MIDDAY, Good Weather (Sc. 6): 3:25 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 2:50
Evacuation Time Estimates for the 5-Mile Region (Region R02), 90th percentile	Winter Midweek MIDDAY, Good Weather (Sc. 6): 3:00 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 2:50	Winter Midweek MIDDAY, Good Weather (Sc. 6): 3:55 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 3:35
Evacuation Time Estimates for the entire EPZ (Region R03), 90th percentile	Winter Midweek MIDDAY, Good Weather (Sc. 6): 4:05 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 3:35	Winter Midweek MIDDAY, Good Weather (Sc. 6): 4:25 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 4:10
Evacuation Time Estimates for the 2-Mile Region (Region R01), 100th percentile	Winter Midweek MIDDAY, Good Weather (Sc. 6): 5:20 Summer Weekend, MIDDAY Good Weather (Sc. 3): 5:15	Winter Midweek MIDDAY, Good Weather (Sc. 6): 6:20 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 6:15
Evacuation Time Estimates for the 5-Mile Region (Region R02), 100th percentile	Winter Midweek MIDDAY, Good Weather (Sc. 6): 5:20 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 5:20	Winter Midweek MIDDAY, Good Weather (Sc. 6): 6:20 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 6:20
Evacuation Time Estimates for the entire EPZ (Region R03), 100th percentile	Winter Midweek MIDDAY, Good Weather (Sc. 6): 6:45 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 5:55	Winter Midweek MIDDAY, Good Weather (Sc. 6): 6:30 Summer Weekend, MIDDAY, Good Weather (Sc. 3): 6:30

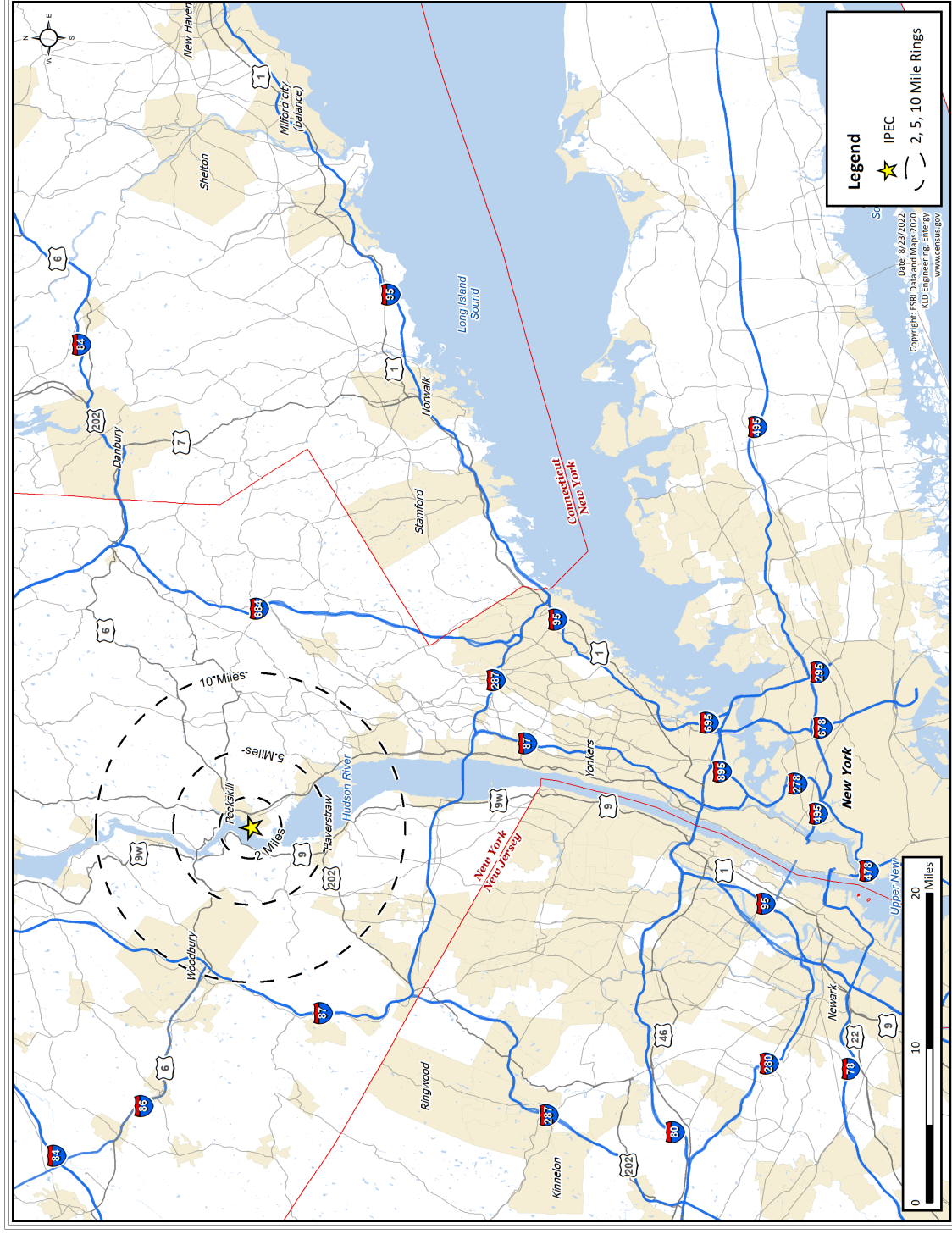
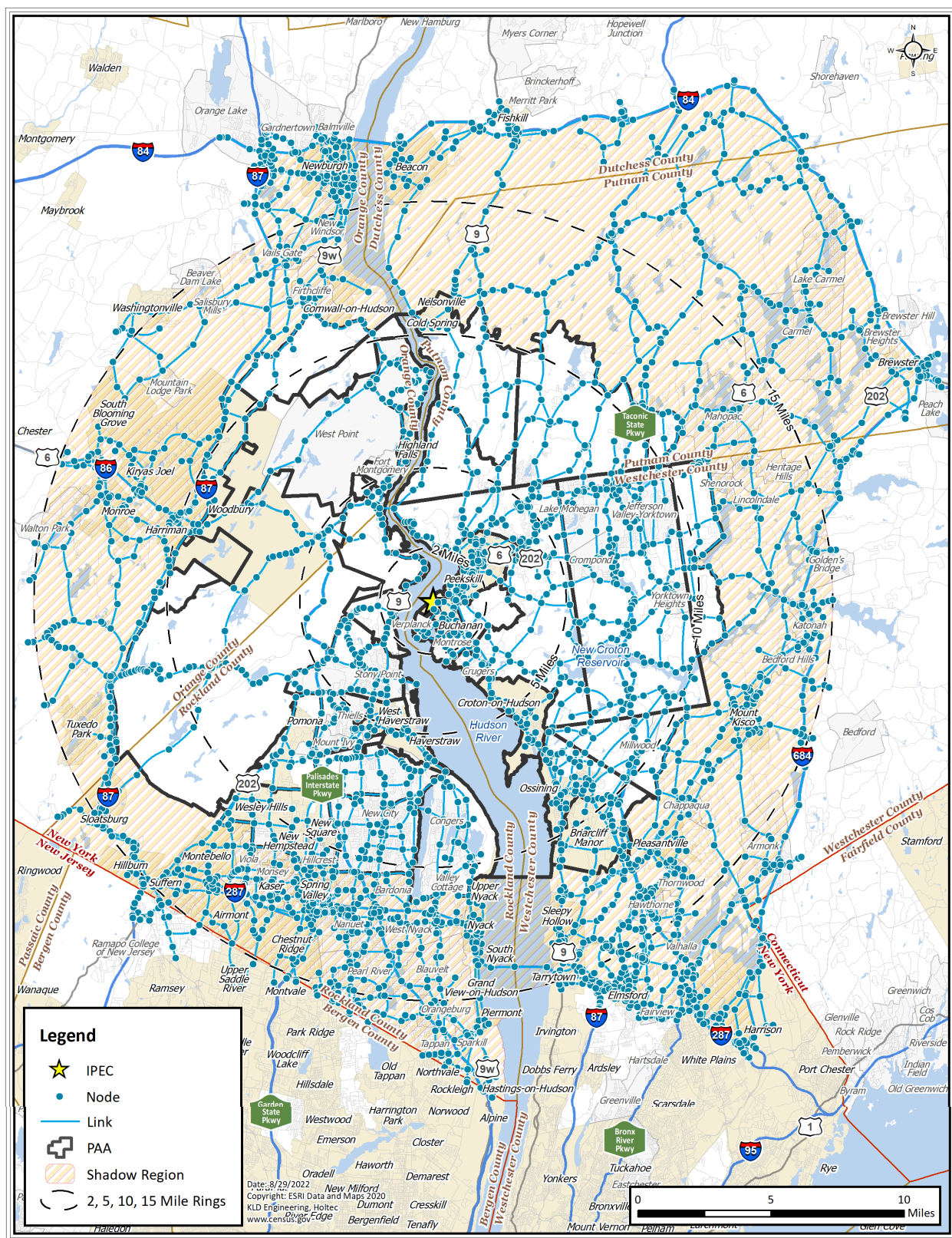


Figure 1-1. IPEC Location



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 Assumptions

1. The permanent resident population are based on the 2020 U.S. Census population from the Census Bureau website¹. A methodology, referred to as the “area ratio method”, is employed to estimate the population within portions of census blocks that are divided by PAA boundaries. It is assumed that the population is evenly distributed across a census block in order to employ the area ratio method. See Section 3.1.
2. Estimates of employees who reside outside the Emergency Planning Zone (EPZ) and commute to work within the EPZ are based on US Census Longitudinal Employer-Household Dynamics from the OnTheMap Census analysis tool². Employees who reside outside the EPZ and commute to work at IPEC are based on data provided by Holtec. See Section 3.4.
3. Population estimates at transient and special facilities are based on the data received from the EPZ county emergency management agencies and the National Center for Education Statistics website³, supplemented by internet searches and aerial imagery where data is missing.
4. The relationship between permanent resident population and evacuating vehicles is based on the results of the recent online demographic survey (see Appendix F). People per household and evacuating vehicles per household by county are used for the permanent resident population as follows:
 - a. Orange County: 2.71 People per household evacuating in 1.42 vehicles.
 - b. Putnam County: 2.51 People per household evacuating in 1.34 vehicles.
 - c. Rockland County: 2.73 People per household evacuating in 1.40 vehicles.
 - d. Westchester County: 2.58 People per household evacuating in 1.29 vehicles.
5. Where data is not provided, the average household size by county is assumed to be the vehicle occupancy rate for transient facilities and the special event.
6. Employee vehicle occupancies are based on the results of the demographic survey. The value of 1.06 employees per vehicle is used in the study. In addition, it is assumed there are two people per carpool, on average. See Appendix F, sub-section F.3.1 and Figure F-7.

¹ www.census.gov

² <http://onthemap.ces.census.gov/>

³ <https://nces.ed.gov/ccd/schoolsearch/index.asp>

7. The maximum bus speed assumed within the EPZ is 55 mph based on New York state laws for buses⁴.
8. Roadway capacity estimates are based on field surveys performed in 2020 (verified by aerial imagery), roadway construction (identified during the field survey), and the application of the Highway Capacity Manual 2016.

2.2 Study Methodological Assumptions

1. The Planning Basis Assumption for the calculation of ETE is a rapidly escalating accident that requires evacuation, and includes the following⁵ (as per NRC guidance):
 - a. Advisory to Evacuate (ATE) is announced coincident with the siren notification.
 - b. Mobilization of the general population will commence within 15 minutes after siren notification.
 - c. The ETE are measured relative to the ATE.
2. The center-point of the plant is located at the geometric center of the containment buildings for Units 2 and 3 at 41° 16' 12" N and 73° 57' 9" W.
3. The DYNEV II⁶ system is used to compute ETE in this study.
4. Evacuees will drive safely, travel radially away from the plant to the extent practicable given the highway network, and obey all traffic control devices and traffic guides. All major evacuation routes are used in the analysis.
5. The existing EPZ and PAA boundaries are used. See Figure 3-1.
6. The Shadow Region extends approximately 5 miles radially from the EPZ boundary (approximately 15 miles from IPEC) as per NRC guidance. Those areas in Putnam County and Westchester County beyond 15 miles from IPEC, which were defined in the previous ETE study as the Shadow Region extending to the bounding interstates (Interstate 84 to the north in Putnam and Orange Counties, Interstate 684 to the east in Putnam and Westchester Counties, and Interstate 287 to the south in Westchester County) are maintained. All of Rockland County is included in the Shadow Region as only a small portion of the county is more than 15 miles from IPEC. See Figure 7-2.

⁴<https://www.nysenate.gov/legislation/laws/EDN/3624#:~:text=The%20commissioner%20shall%20determine%20and,of%20fifty%2Dfive%20miles%20per>

⁵ It is emphasized 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 stages of an emergency.

⁶ 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). The models have continuously been refined and extended since those hearings and were independently validated by a consultant retained by the NRC. The DYNEV II model incorporates the latest technology in traffic simulation and in dynamic traffic assignment.

7. One hundred percent (100%) of the people within the impacted keyhole will evacuate. Twenty percent (20%) of the population within the Shadow Region and within PAA of the EPZ not advised to evacuate will voluntarily evacuate, as shown in Figure 2-1, as per NRC guidance. Sensitivity studies explore the effect on ETE of increasing the percentage of voluntary evacuees in the Shadow Region (see Appendix M).
8. Shadow population characteristics (household size, evacuating vehicles per household, and mobilization time) are assumed to be the same as that of the permanent resident population within the EPZ.
9. The ETE are presented at the 90th and 100th percentiles in graphical and tabular format, as per NRC guidance. The percentile ETE is defined as the elapsed time from the ATE issued to a specific Region of the EPZ, to the time that Region is clear of the indicated percentile of evacuees.
10. This study does not assume that roadways are empty at the start of the evacuation. Rather, there is an initialization period (often referred to as “fill time” in traffic simulation) wherein the anticipated traffic volumes from the start of the evacuation are loaded onto roadways in the study area. The amount of initialization/fill traffic that is on the roadways in the study area at the start of the evacuation depends on the scenario and the region being evacuated. See Section 3.12.
11. To account for boundary conditions (roadway conditions outside the study area that are not specifically modeled due to the limited radius of the study area) beyond the study area, this study assumed a 25% reduction in capacity on two-lane roads and multilane highways for roadways that have traffic signals downstream. The 25% reduction in capacity is based on the prevalence of actuated traffic signals in the study area and the fact that the evacuating (“main street”) traffic volume is more significant than the competing (“side street”) traffic volume at any downstream signalized intersections, thereby warranting a more significant percentage (75% in this case) of the signal green time. There is no reduction in capacity for freeways due to boundary conditions.
12. The ETE also includes consideration of “through” (External-External, traffic that originates its trip outside of the study area and has its destination outside of the study area) trips during the time that such traffic is permitted to enter the evacuated Region. See Section 3.11.

2.3 Assumptions on Mobilization Times

1. Trip generation time (also known as mobilization time, or the time required by evacuees to prepare for the evacuation) are based upon the results of the recent online demographic survey (see Section 5 and Appendix F). It is assumed that stated events take place in sequence such that all preceding events must be completed before the current event can occur.

2. One hundred percent (100%) of the EPZ population can be notified within 45 minutes, in accordance with the 2019 Federal Emergency Management Agency (FEMA) Radiological Emergency Preparedness Program Manual.
3. Commuter percentages (and the percentage of residents awaiting the return of a commuter) are based on the results of the demographic survey. According to the survey results, 66% of the households in the EPZ have at least 1 commuter; 61% of those households with commuters will await the return of a commuter before beginning their evacuation trip (see Appendix F, sub-sections F.3.1 and F.3.2). Therefore, 40% ($66\% \times 61\% = 40\%$) of EPZ households will await the return of a commuter, prior to beginning their evacuation trip.

2.4 Transit Dependent Assumptions

1. The percentage of transit-dependent people who will rideshare with a neighbor or friend is based on the results of the demographic survey. According to the survey results, approximately 59% of the transit-dependent population will rideshare (see Appendix F, sub-section F.3.1).
2. Buses are used to transport those without access to private vehicles:
 - a. Schools, preschools, daycares and day camps
 - i. If schools, preschools, daycares and day camps are in session, transport (buses) will evacuate students directly to the designated school reception centers.
 - ii. No school children are picked up by their parents prior to the arrival of the buses.
 - iii. Schoolchildren, if school is in session, are given priority in assigning transit vehicles.
 - b. Medical Facilities
 - i. Buses, wheelchair buses, wheelchair vans and ambulances will evacuate patients at medical facilities and senior facilities within the EPZ, as needed.
 - ii. The capacity, current census, and percent breakdown of ambulatory, wheelchair bound and bedridden patients at the medical facilities was provided by county emergency management agencies.
 - c. Transit-dependent permanent residents:
 - i. Transit-dependent general population are evacuated to reception centers.
 - ii. Access and/or functional needs population may require county assistance (ambulance, bus or wheelchair transport) to evacuate. This is considered separately from the general population ETE, as per NRC guidance.
 - iii. Households with 3 or more vehicles were assumed to have no need for transit vehicles.

- d. Analysis of the number of required round-trips (“waves”) of evacuating transit vehicles are presented.
 - e. Transport of transit-dependent evacuees from reception centers to congregate care centers is not considered in this study.
- 3. Bus capacity (passengers):
 - a. Orange County – 70 for elementary; 50 for middle and high schools; 30 for adults (general purpose – transit dependent)
 - b. Putnam County – 60 for elementary; 30 for middle, high schools and adults (general purpose – transit dependent)
 - c. Rockland County – use manufacturer’s recommended capacity for all buses
 - d. Westchester County – 60 for elementary; 50 for middle and high schools; 50 for adults (general purpose – transit dependent)
- 4. Capacity of medical facility and non-institutionalized mobility impaired (NIMI) transit vehicles:
 - a. Ambulances – 2 people
 - b. Wheelchair Vans – 4 people, with chairs
 - c. Wheelchair Buses – 15 people, with chairs
- 5. Transit vehicles mobilization times, which are considered in ETE calculations:
 - a. School buses arrive at schools, preschools and daycares to be evacuated within 90 minutes of the ATE.
 - b. Transit dependent buses are mobilized at 180 minutes when approximately 90% of residents with no commuters have completed their mobilization.
 - c. Vehicles arrive at hospitals, medical facilities, and senior living facilities to be evacuated within 90 minutes of the ATE.
- 6. Transit Vehicle loading times:
 - a. School buses are loaded in 15 minutes.
 - b. Transit Dependent buses require 1 minute of loading time per passenger.
 - c. Buses for hospitals and medical facilities require 1 minute of loading time per ambulatory passenger.
 - d. Wheelchair transport vehicles require 5 minutes of loading time per passenger.
 - e. Ambulances require 15 minutes of loading time per bedridden passenger.
 - f. Buses for access and/or functional needs population require 5 minute of loading time per ambulatory passenger.
- 7. It is assumed that drivers for all transit vehicles are available.
- 8. Based on the previous ETE study, the following special facilities shelter-in-place:
 - a. Orange County – none.
 - b. Putnam County – none.
 - c. Rockland:
 - i. Northern Riverview Nursing Home (Haverstraw)
 - ii. Green Hills Nursing Home (Haverstraw)

- iii. Helen Hayes Hospital (West Haverstraw)
 - iv. Yeager Health Complex (Sanatorium Rd, Pomona)
 - v. Rockland County Jail (New City)
 - vi. Friedwald House New Hempstead Rd, New Hempstead (New City mailing address)
 - vii. Pine Valley Nursing Homes, Route 45, Ramapo
 - viii. The Joe Raso Hospice facility on Buena Vista Road, New City.
- d. Westchester:
- i. Sing Sing Prison (Ossining)
 - ii. VA Hospital (Montrose)
 - iii. New York State Military Reservation at Camp Smith (Town of Cortlandt)
 - iv. Hudson Valley Hospital Center (Town of Cortlandt)
 - v. Stony Lodge Hospital (Ossining)

2.5 Traffic and Access Control Assumptions

1. Traffic Control Points (TCP) and Access Control Points (ACP) as defined in the approved county and state emergency plans are considered in the ETE analysis, as per NRC guidance. See Appendix G.
2. TCP and ACP are established 2 hours after the ATE, as per NRC guidance. It is assumed that no through traffic enter the EPZ after this 2-hour time period.
3. All transit vehicles and other responders entering the EPZ to support the evacuation are unhindered by personnel manning TCPs and ACPs

2.6 Scenarios and Regions

1. A total of 15 “Scenarios” representing different temporal variations (season, time of day, day of week) and weather conditions are considered. Scenarios to be considered are defined in Table 2-1:
 - a. Two special event scenarios are considered – a football game at West Point with 34,105 transients (Scenario 13), and an event at Croton Point Park with 10,000 transients (Scenario 14).
 - b. As per NRC guidance, one segment of one of the highest volume roadways is out of service or one lane outbound on a freeway must be closed for a roadway impact scenario. This study considers the following closures for the roadway impact scenario – Scenario 15:
 - i. Orange County – 1 lane on Route 9W northbound to Newburgh, and 1 lane on Route 6 westbound from Bear Mountain Circle to Route 17.
 - ii. Putnam County – 1 lane on Taconic Parkway northbound.
 - iii. Rockland County – 1 lane on Palisades Parkway southbound.
 - iv. Westchester County – 1 lane on Taconic Parkway southbound

2. 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 at about the same time the evacuation advisory is issued. Thus, no weather-related reduction in the number of transients who may be present in the EPZ is assumed. It is further assumed that snow removal equipment is available, the appropriate agencies are clearing/treating the roads as they would normally during snow, and the roads are passable albeit at lower speeds and capacities.
3. Adverse weather conditions affect roadway capacity and free flow speeds. Transportation research indicates capacity and speed reductions of about 10% for rain and a range of 10% to 25% for snow. In accordance with Table 3-1 of Revision 1 to NUREG/CR-7002, this study assumes a 10% reduction in speed and capacity for rain and light snow and a speed and capacity reduction of 15% and 25%, respectively, for heavy snow. These factors are shown in Table 2-2.
4. Some evacuees need additional time to clear their driveways and access the public roadway system for heavy snow scenarios. The distribution of time for this activity was gathered through the demographic survey of the public and takes up to 210 minutes (see Appendix F, Figure F-18). The time needed by evacuees to remove snow from their driveways is sufficient time for snow removal crews to mobilize and clear/treat the public roadway system.
5. Employment is reduced slightly (4% reduction) in the summer for vacations.
6. Mobilization and loading times for transit vehicles are slightly longer in adverse weather. Mobilization times are 10 minutes and 20 minutes longer in rain/light snow and heavy snow, respectively. Loading times are 5 minutes and 10 minutes longer in rain/light snow and heavy snow, respectively. Refer to Table 2-2.
7. The following seasonal roadway closures within the EPZ are also considered for snow scenarios:
 - a. Orange County:
 - i. Arden Valley Rd – gated barricades closing the road from Tiorati circle to NYS Thruway. Camps are accessible from Tiorati Circle
 - ii. Tiorati Brook Rd – hard barricades closing the road from Tiorati circle to Palisades Parkway. Camps are accessible from Tiorati Circle
 - iii. Cedar Pond Rd
 - iv. Seven Lakes Pkwy is open all year round but is listed as “Limited Winter Maintenance”
 - v. Lake Welch Drive – hard barricades closing road from Palisades Parkway to St. Johns Road
 - vi. Storm King Rd (Route 218) – closed most days throughout the year due to rockslides and adverse weather. This road was not used in the last ETE study and are not used in this study
 - b. Putnam County – none

- c. Rockland County – OFES indicated that Exit 16 (for Harriman State Park) from the Palisades Parkway southbound is closed most of the winter and into early spring (specific dates of closure are not available as closure is weather dependent). Additionally, there are roads in the park area which are not plowed when it snows
 - d. Westchester County – 50% capacity reduction on Route 9A between Route 9 and Hawkes Ave during snow
- 8. Regions are defined by the underlying “keyhole” or circular configurations as specified in Section 1.4 of NUREG/CR-7002, Rev. 1. These Regions, as defined, display irregular boundaries reflecting the geography of the PAA included within these underlying configurations. All 16 cardinal and intercardinal wind direction keyhole configurations are considered. Regions to be considered are defined in Table 6-1. It is assumed that everyone within the group of PAA forming a Region that is issued an ATE will, in fact, respond and evacuate in general accord with the planned routes.
- 9. NRC guidance requires multiple evacuation regions to be considered for an ETE study, depending on wind speed and wind direction. The NRC guidance suggests that radial evacuations be considered for the 2-mile, 5-mile and 10-mile (entire EPZ) radii. Additionally, evacuation keyholes need to be considered wherein the 2-mile radius and 3 sectors downwind (central sector defined by wind direction, plus one sector on either side to account for wind variation) to 5-miles are evacuated (“2 around, 5 down”). Similar keyholes are considered wherein the 2-mile radius and 3 sectors downwind to the EPZ boundary are evacuated (“2 around, 10 down”). Table 6-1 shows the evacuation regions to be considered. Any Protective Action Area that intersects the keyhole is evacuated. There are some exceptions to this:
 - a. The Town of Cortlandt is not included in the 2-Mile Region because the small piece of the Protective Action Area that intersects the 2-Mile Region is not populated.
 - b. The U.S. Military Academy is not included in the 5-Mile Region because the small piece of the Protective Action Area that intersects the 5-Mile Region is not populated.
 - c. Croton-on-Hudson and the Town of Cortlandt do not always evacuate together. Several evacuation regions exist which reflect an evacuation of the 2-mile radius and downwind to 5 miles wherein the Town of Cortlandt evacuates, but Croton-on-Hudson shelters in place.
 - d. Unique circumstances for the 2 around, 10 down keyholes can result in a Protective Action Area which is not in the keyhole but is surrounded by Protective Action Areas which are in the keyhole and would evacuate. In this situation, the Protective Action Area which is surrounded would be evacuated even though it is not in the projected plume. These unique cases are highlighted yellow in Table 6-1.
 - e. The Town of Cortlandt is included in Regions R15 and R30 even though the small piece of the Protective Action Area that is in the keyhole is not populated

because a heavily utilized evacuation route – US-6/US-202 from the west approach to the Bear Mountain Bridge to the former toll house, often referred to locally as the “Goat Trail” – is within the keyhole.

10. Staged evacuation is considered as defined in NUREG/CR-7002, Rev. 1 – those people between 2 and 5 miles will shelter-in-place until 90% of the 2-Mile Region has evacuated, then they will evacuate. See Regions R32 through R44 in Table 6-1.

Table 2-1. Evacuation Scenario Definitions

Scenario	Season ⁷	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/Light Snow	None
8	Winter	Midweek	Midday	Heavy Snow	None
9	Winter	Weekend	Midday	Good	None
10	Winter	Weekend	Midday	Rain/Light Snow	None
11	Winter	Weekend	Midday	Heavy Snow	None
12	Winter	Midweek, Weekend	Evening	Good	None
13	Winter	Weekend	Midday	Good	West Point Football Game
14	Summer	Weekend	Midday	Good	Event at Croton Point Park
15	Summer	Midweek	Midday	Good	Roadway Impact - Route 6; Route 9W; Palisades Parkway; Taconic Parkway

Table 2-2. Model Adjustment for Adverse Weather

Scenario	Highway Capacity*	Free Flow Speed*	Mobilization Time for General Population	Mobilization Time for Transit and Special Facility Vehicles	Loading Time for Transit and School Buses ⁸
Rain/Light Snow	90%	90%	No Effect	10-minute increase	5-minute increase
Heavy Snow	75%	85%	See Section 5.3	20-minute increase	10-minute increase

*Adverse weather capacity and speed values are given as a percentage of good weather conditions. Roads are assumed to be passable.

⁷ Winter means that school is in session at normal enrollment levels (also applies to spring and autumn). Summer means that school is in session at summer school enrollment levels (lower than normal enrollment).

⁸ Does not apply to medical facilities and those with access and/or functional needs as loading times for these people are already conservative.

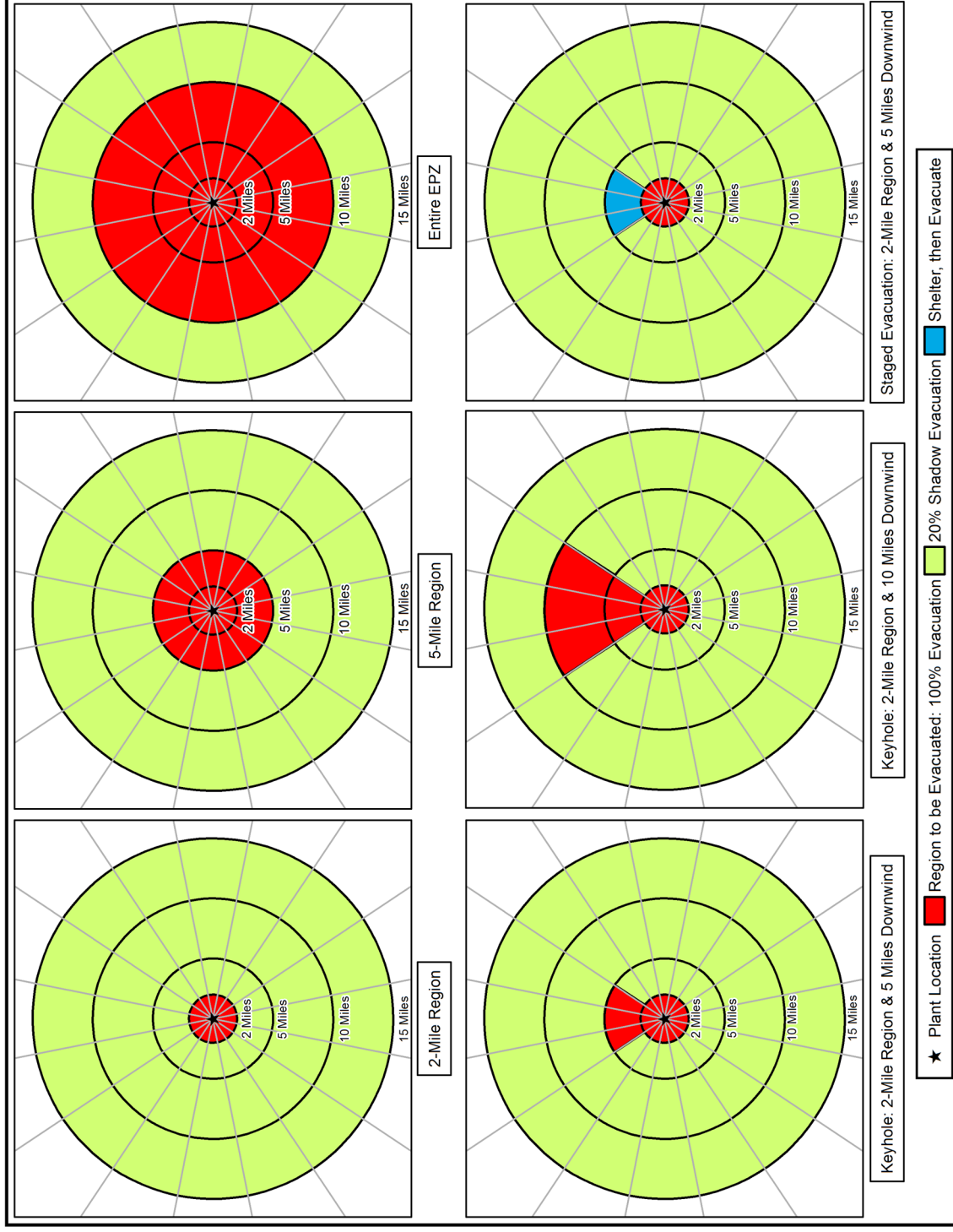


Figure 2-1. Voluntary Evacuation Methodology

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 2020 U.S. Census, 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 IPEC 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 work 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 Protective Action Area and by polar coordinate representation (population rose). The IPEC EPZ is subdivided into 38 Protective Action Areas. The Protective Action Areas comprising the EPZ are shown in Figure 3-1.

3.1 Permanent Residents

The primary source for estimating permanent population is the 2020 U.S. Census data with an availability date of September 16, 2021. The demographic survey results were used to estimate the average household size and the number of evacuating vehicles per household was estimated for each county within the EPZ (see Appendix F):

- Orange County: 2.71 people per household evacuating in 1.42 vehicles.
- Putnam County: 2.51 people per household evacuating in 1.34 vehicles.
- Rockland County: 2.73 people per household evacuating in 1.40 vehicles.
- Westchester County: 2.58 people per household evacuating in 1.29 vehicles.

The permanent resident population is estimated by cutting the census block polygons by the Protective Action Area and EPZ boundaries using GIS software. 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 the population within the EPZ. This methodology (referred to as the “area ratio method”) assumes that the population is evenly distributed across a census block. Table 3-1 summarizes the permanent resident population within the EPZ, by Protective Action Area and by county, for 2010 and for 2020 (based on the methodology above). As indicated, the permanent resident population within the EPZ has increased by 4.36% since the 2010 Census.

To estimate the number of vehicles, the 2020 Census permanent resident population in each EPZ county is divided by the corresponding average household size and then multiplied by the average number of evacuating vehicles per household. 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 the IPEC. This population “rose” was constructed using GIS software. Note, the 2020 Census includes residents living in group quarters, such as skilled nursing facilities, group homes, college/university student housing, prisons, etc. These people are transit dependent (will not evacuate in personal vehicles) and are included in the special facility evacuation demand estimates. To avoid double counting vehicles, the vehicle estimates for these people have been removed. The resident vehicles in Table 3-2 and Figure 3-3 have been adjusted accordingly.

3.2 Shadow Population

A portion of the population living outside the evacuation area extending to 15 miles radially from the plant to the east and west and as far as 23 miles to the north and south may elect to evacuate without having been instructed to do so. This area is called the Shadow Region. Based upon NUREG/CR-7002 Rev. 1 guidance, it is assumed that 20% of the permanent resident population, based on U.S. Census Bureau data, in the 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. Similar to the EPZ resident vehicle estimates, resident vehicles at group

quarters have been removed from the shadow population vehicle demand in Table 3-3 and Figure 3-5.

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 camping facilities, hotels and motels. Data for transient attractions were provided by the counties within the EPZ. When data could not be provided, transient vehicles were estimated based on the parking capacity or accommodation capacity obtained from aerial imagery or from the facility website. It is assumed that transients travel to the transient attractions as a family/household. As such, the average household sizes obtained from the demographic survey (See Section 3.1) were used to estimate the transient population for those facilities in which exact data could not be obtained. The transient attractions within the IPEC EPZ are summarized as follows:

- Beaches – 1,432 transients and 555 vehicles; 2.58 transients per vehicle
- Campgrounds – 424 transients and 328 vehicles; 1.29 transients per vehicle (Note that Recreational Vehicles (RVs) are modeled as 2 vehicles in DYNEV due to their larger size and more sluggish operating characteristics.)
- Parks – 49,584 transients and 15,480 vehicles; 3.20 transients per vehicle (Note that local parks are not included; visitors to these facilities are local residents and have already been counted as permanent residents in Section 3.1)
- Shopping Centers – 15,385 transients and 5,343 vehicles; 2.88 transients per vehicle
- Lodging Facilities – 1,826 transients and 781 vehicles; 2.34 transients per vehicle

Appendix E summarizes the transient data that was gathered for the EPZ. Table E-7 and Table E-8 present transients visiting transient attractions, while Table E-9 presents the number of transients at lodging facilities within the EPZ.

In total, there are 68,651 transients in the EPZ at peak times, evacuating in 22,487 vehicles (an average vehicle occupancy of 3.05 transients per vehicle). Table 3-4 presents transient population and transient vehicle estimates by Protective Action Area and by county. Figure 3-6 and Figure 3-7 present these data by sector and distance from the plant.

3.4 Employees

The estimate of employees commuting into the EPZ is based on the 2019 Workplace Area Characteristic (WAC) provided by the U.S. Census Bureau's OnTheMap Census analysis tool¹ extrapolated to 2020 using the short-term employment projection for the State of New York², supplemented by data provided by Holtec and by the U.S. Military Academy West Point (West Point).

¹<http://onthemap.ces.census.gov/> OnTheMap is an interactive map displaying workplace and residential distributions by user-defined geographies at census block level detail. It also reports the work characteristics detail on age, and earnings industry groups.

² <https://dol.ny.gov/employment-projections>

The WAC data provides the employee counts by industry sector for each census block within the IPEC EPZ. The employee count of each industry sector was then extrapolated 2020 for each census block using the statewide short-term employment projections. Since not all employees are working at facilities within the EPZ at one time, a maximum shift reduction was applied to each census block. Assuming maximum shift employment occurs Monday through Friday between 9 AM and 5 PM, the following jobs take place outside the typical 9-5 workday:

- Manufacturing – takes place in shifts over 24 hours
- Arts, Entertainment, and Recreation – takes place in evenings and on weekends
- Accommodations and Food Services – peaks in the evenings

Therefore, the number of extrapolated employees working in these three industry sectors was subtracted from the total number for each census block to represent the maximum number of employees present in the EPZ at any one time. As per the NUREG/CR-7002, Rev. 1, employers with 200 or more employees working in a single shift are considered as the major employers. As such, the census blocks with less than 200 extrapolated employees (during the maximum shift) are not included in this study.

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. The 2019 LEHD (Longitudinal Employer-Household Dynamics) Origin-Destination Employment Statistics (LODES) data³ from OnTheMap website was then used to estimate the percent of employees that work within the EPZ but live outside. This value, 63.3%, was applied to the maximum shift employee values to compute the number of employees commuting into the EPZ at peak times. To estimate the evacuating employee vehicles, the employee vehicle occupancy rate (1.06 – See Appendix F, Sub-Section F.3.1) obtained from the demographic survey was used.

Note, the employment data for the following two major employers were provided by local agencies:

- According to Holtec, IPEC has 400 employees in the maximum shift, and 48% of them live outside of the EPZ. Applying the commuter vehicle occupancy rate (1.06) above, there are 181 ($400 \times 48\% \div 1.06$) employee vehicles. This data is supplemented for the census block in the Westchester County employment subtotal in Appendix E, Table E-6.
- Based on the data provided by West Point, as of July 2020, the facility has 4,693 employees working on post. Using the LODES data obtained from the OnTheMap website and the vehicle occupancy rate discussed above, West Point has approximately 2,971 ($4,693 \times 63.3\%$) employees and 2,803 ($2,971 \div 1.06$) employee vehicles traveling

³ The LODES data is part of the LEHD data products from the U.S. Census Bureau. This dataset provides detailed spatial distributions of workers' employment and residential locations and the relation between the two at the census block level. For detailed information, please refer to this site: <https://lehd.ces.census.gov/data/>

from outside of the EPZ. This data is supplemented for the census blocks in the Orange County employment subtotal in Appendix E, Table E-6.

Table 3-5 summarizes the estimates of employees and employee vehicles commuting into the EPZ, by Protective Action Area and by county. Figure 3-8 and Figure 3-9 present these data by sector.

3.5 Medical Facilities

Data were provided by the counties for each of the medical facilities within the EPZ, supplemented by online searches and the previous study where data was missing. Table E-5 in Appendix E summarizes the data provided. Table 3-6 presents the current census of medical facilities in the EPZ along with the breakdown of ambulatory, wheelchair bound, and bedridden patients. The average breakdown of ambulatory, wheelchair bound, and bedridden patients by county was used where data was missing. As shown in this table, a total of 6,327 people has been identified as living in or being treated in these facilities.

The transportation requirements for the medical facility population are also presented in Table 3-6. The number of ambulance runs is determined by assuming that 2 patients can be accommodated per ambulance trip, the number of wheelchair bus runs assumes 15 wheelchairs patients per trip, and the number of bus runs estimated assumes 30 ambulatory patients per trip.

3.6 Transit Dependent Population

The demographic 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 3-7 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 ridesharing with neighbors, friends or family. For example, nearly 80% of those who evacuated from Mississauga, Ontario⁴ who did not use their own

⁴ 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

cars, shared a ride with neighbors or friends. Other documents report that approximately 70% of transit dependent persons were evacuated via ride sharing. **Based on the results of the demographic survey, 59% of the transit-dependent population will rideshare.**

The estimated number of bus trips needed to service transit-dependent persons is based on an estimate of average bus occupancy of 30 persons⁵ at the conclusion of the bus run. Transit vehicle seating capacities typically equal or exceed 60 children (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 $20 + (2/3 \times 10) = 27$. On this basis, the average load factor anticipated is $(27/40) \times 100 = 68\%$. Thus, if the actual demand for service exceeds the estimates of Table 3-7 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 3-7 indicates that transportation must be provided for 4,484 people. Therefore, a total of 150 buses are required from a capacity standpoint. The transit-dependent population by Protective Action Area was estimated by multiplying the total transit-dependent population by the ratio of the Protective Action Area permanent resident population to the EPZ permanent resident population. In order to service all of the transit dependent population and have at least one bus drive through each of the Protective Action Areas to pick up transit dependent people, **169 buses** are used in the ETE calculations; see Section 10 for further discussion. These buses are represented as two vehicles in the ETE simulations due to their larger size and more sluggish operating characteristics.

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 IPEC EPZ:

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

Where,

A = Percent of households with commuters

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

$$P = 123,233 \times [0.010 \times 1.60 + 0.232 \times (1.86 - 1) \times 0.66 \times 0.39 + 0.530 \times (2.61 - 2) \times (0.66 \times 0.39)^2] = 10,940$$

$$B = ([1 - 0.59] \times P) \div 30 = 150$$

These calculations are explained as follows:

rate of 77% (Page 5-10).

⁵ Note that bus capacities are 44 and 50 people per bus for Rockland and Westchester County, respectively. A more conservative number, 30 people per bus, was used for all transit dependents within the EPZ to account for luggage.

- The number of households (HH) is computed by dividing the EPZ population by the average household size ($324,103 \div 2.63^6$) and is 123,233.
- All members (1.60 avg.) of households (HH) with no vehicles (1.0%) will evacuate by public transit or rideshare. The term $123,233 \text{ (number of households)} \times 0.010 \times 1.60$, accounts for these people.
- The members of HH with 1 vehicle away (23.2%), who are at home, equal (1.86-1). The number of HH where the commuter will not return home is equal to $(123,233 \times 0.232 \times 0.86 \times 0.66 \times 0.39)$, as 66% of EPZ households have a commuter, 39% 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 (53%), who are at home, equal $(2.61 - 2)$. The number of HH where neither commuter will return home is equal to $123,233 \times 0.61 \times (0.66 \times 0.39)^2$. The number of persons who will evacuate by public transit or rideshare 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 number of buses needed is computed as the product of the number of people requiring public transit and the percentage of people who will not rideshare (100% minus 59%) divided by the bus occupancy.

Table 3-7 summarizes the calculation of the transit-dependent population. The estimate of transit-dependent population in Table 3-7 far exceeds the number of registered transit-dependent persons in the EPZ as provided by the counties (discussed below in Section 3.9). 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 do not register with their local emergency response agency.

3.7 School, Preschool/Daycare, and Day Camp Population Demand

Table 3-8 presents the population and transportation requirements for the direct evacuation of all schools, day cares and day camps within the EPZ. This information was provided by the counties supplemented by internet searches where no data was provided. The column in Table 3-8 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.

⁶ In order to calculate the resident vehicles inside the EPZ and shadow region, the household size obtained from the demographic survey was broken down by county. For the purposes of calculating the number of transit dependents inside the EPZ, 2.63 people per household was used which is the average household size for the whole EPZ. See Appendix F.

- While many high school students commute to school using private automobiles (as discussed in Section 2.4 of NUREG/CR-7002, Rev. 1), the estimate of buses required for school evacuation does not consider the use of these private vehicles, since the intent of schools is to evacuate all students by bus.
- Bus capacity, expressed in students per bus is county specific
 - Orange County – 70 for elementary; 50 for middle and high schools
 - Putnam County – 60 for elementary; 30 for middle, high schools
 - Rockland County – 44 students per bus, on average.
 - Westchester County – 60 for elementary; 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.

3.7.1 Colleges

There are two colleges within the EPZ: United States Military Academy and Ohr Hameir Theology Seminary. The enrollment data was provided by West Point and by Westchester County. The data/information is summarized below:

United States Military Academy:

- Located in the U.S. Military Academy, 8.3 miles north of the IPEC.
- Data provided by West Point indicates that the academy has a total enrollment of 4,440 students.
- Data collected from the previous study indicates 20% of the students own private vehicles on campus. Assuming this data is still applicable, there are 888 vehicles for evacuation. As per the official from West Point, anyone without access to vehicle would be picked up by a neighbor or a fellow classmate. Thus, no buses were estimated for West Point.

Ohr Hameir Theology Seminary:

- Located in the Town of Cortlandt, 3.3 miles east of the IPEC.
- Data provided by Westchester County indicates that the college has a total enrollment of 206 students evacuating in 194 vehicles.

Table 3-8 also includes commuter students at United States Military Academy and Ohr Hameir Theology Seminary. The column in Table 3-8 entitled “Student Vehicles” specifies the number of student vehicles at the school parking lots during an evacuation.

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.

Figure 10-11 through Figure 10-14 presents a list of the school reception centers for each school in the EPZ. Students will be transported to these centers where they will be subsequently retrieved by their respective families.

3.8 Special Events

Two special events (Scenarios 13 and 14) are considered for the ETE study – a football game at the US Military Academy (West Point) and an event at Croton Point Park. The special event vehicle trips were generated utilizing the same mobilization distributions for transients. Public transportation is not provided for these events and was not explicitly considered in the special event analysis.

Information on the West Point football game was confirmed to be still accurate from the previous study. West Point football games occur on Saturdays during the fall football season – a winter, weekend, midday, good weather scenario. It was indicated that games attract approximately 34,105 transients in 5,000 vehicles. This high vehicle occupancy rate (6.8 attendees per vehicle) suggests that some attendees travel by van or bus. These vehicles were distributed among the three gates exiting campus in the simulation model.

There are several events at Croton Point Park each year, located in Croton-on-Hudson. Based on discussions with Westchester County, it was decided to choose a generic event with 10,000 transients. The event would most likely occur on a summer weekend during good weather. The vehicle occupancy rate was assumed to be the same as the average household size of 2.63. A total of 3,803 vehicles ($10,000 \div 2.63 = 3,803$) were incorporated at the park for this event.

3.9 Access and/or Functional Needs Population

The county emergency management agencies provided the number of registered access and/or functional needs persons. Based on data provided by the counties, there are an estimated 12 access and/or functional needs people within the Putnam County portion of the EPZ, 16 people within the Orange County portion of the EPZ, 165 within the Rockland County Portion of the EPZ, and 98 people within the Westchester County portion of the EPZ who require transportation assistance to evacuate. Of these 291 people, 153 are ambulatory, 13 are wheelchair-bound and 125 are bedridden. If the percent breakdown of the access and/or functional needs persons was not provided, the average breakdown from medical facilities were used.

3.10 Correctional Facilities

Sing Sing correctional facility and Rockland County Jail shelter-in-place in the event of an emergency (see Section 2.4, assumption 8).

3.11 External Traffic

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-84, I-684, I-287, I-87, Taconic State Parkway, Saw Mill Parkway, Sprain Brook Parkway and Palisades Parkway. 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 New York Department of Transportation's (NYDOT) website 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 3-10, 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 67,760 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.

3.12 Background Traffic

Section 5 discusses the time needed for the people in the EPZ to mobilize and begin their evacuation trips. As shown in Table 5-9, there are 14 time periods during which traffic is loaded on to roadways in the study area to model the mobilization time of people in the EPZ. Note, there is no traffic generated during the 15th time period, as this time period is intended to allow traffic that has already begun evacuating to clear the study area boundaries.

This study does not assume that roadways are empty at the start of Time Period 1. Rather, there is an initialization time period (often referred to as “fill time” in traffic simulation) wherein the traffic volumes from Time Period 1 are loaded onto roadways in the study area. The amount of initialization/fill traffic that is on the roadways in the study area at the start of Time Period 1 depends on the scenario and the region being evacuated (see Section 6). There are 19,056 vehicles on the roadways in the study area at the end of fill time for an evacuation of the entire EPZ (Region R03) under Scenario 1 (summer, midweek, midday, good weather) conditions.

3.13 Summary of Demand

A summary of population and vehicle demand is provided in Table 3-11 and Table 3-12, respectively. This summary includes all population groups described in this section. A total of 671,614 people and 342,190 vehicles are considered in this study.

Table 3-1. EPZ Permanent Resident Population

Protective Action Area	2010 Population	2020 Population
ORANGE COUNTY		
Bear Mountain State Park ⁷	16	40
Fort Montgomery	1,837	1,870
Harriman State Park ⁷	6	7
Town of Cornwall (S. of Angola Road)	1,035	1,032
Town of Highlands	0	0
Town of Tuxedo east of NYS Thruway	204	203
U.S. Military Academy	6,464	6,651
Village of Harriman east of NYS Thruway	0	30
Village of Highland Falls	4,175	3,709
Village-Town of Woodbury	2,386	2,460
<i>Orange County Subtotal:</i>	<i>16,123</i>	<i>16,002</i>
PUTNAM COUNTY		
Lower Philipstown	2,581	2,553
Southern Philipstown	4,569	4,495
Southern Putnam Valley	10,171	10,117
Southwest Carmel	2,597	2,543
<i>Putnam County Subtotal:</i>	<i>19,918</i>	<i>19,708</i>
ROCKLAND COUNTY		
Bear Mountain State Park ⁷	5	27
Central Town of Clarkstown	23,052	23,697
Grassy Point	142	112
Harriman State Park ⁷	9	42
Jones Point	125	86
Northeastern & Eastern Town of Clarkstown	15,127	15,216
Northeastern Town of Ramapo	25,941	29,852
Northwestern Town of Clarkstown	7,453	7,670
Stony Point	13,111	12,857
Tompkins Cove	1,797	1,887
Unincorporated Areas of the Town of Haverstraw	11,483	12,345
Village of Haverstraw	11,910	12,418
Village of Pomona	4,520	5,325
Village of West Haverstraw	10,376	10,913
<i>Rockland County Subtotal:</i>	<i>125,051</i>	<i>132,447</i>
WESTCHESTER COUNTY		
Briarcliff Manor	8,370	8,132
Buchanan	2,232	2,280
City of Peekskill	23,565	25,374
Croton-on-Hudson	8,078	8,293
Montrose	2,593	3,306

⁷ PAA Bear Mountain State Park and PAA Harriman State Park cross the boundary line of Orange County and Rockland County. The numbers in this table and in the tables below represent the population and vehicles in each county portion of the PAA.

Protective Action Area	2010 Population	2020 Population
Ossining Town & Village	30,478	33,140
Town of Cortlandt	26,565	26,758
Town of New Castle (W. of Hardscrabble Rd)	4,686	4,895
Town of Somers (W. of Route 118)	4,436	5,218
Verplanck	2,183	1,984
Yorktown	36,275	36,566
<i>Westchester County Subtotal:</i>	<i>149,461</i>	<i>155,946</i>
EPZ TOTAL:	310,553	324,103
EPZ Population Growth (2010-2020):		4.36%

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

Protective Action Area	2020 Population	2020 Resident Vehicles
ORANGE COUNTY		
Bear Mountain State Park	40	21
Fort Montgomery	1,870	982
Harriman State Park	7	4
Town of Cornwall (S. of Angola Road)	1,032	536
Town of Highlands	0	0
Town of Tuxedo east of NYS Thruway	203	107
U.S. Military Academy	6,651	1,159
Village of Harriman east of NYS Thruway	30	16
Village of Highland Falls	3,709	1,940
Village-Town of Woodbury	2,460	1,281
<i>Orange County Subtotal:</i>	<i>16,002</i>	<i>6,046</i>
PUTNAM COUNTY		
Lower Philipstown	2,553	1,272
Southern Philipstown	4,495	2,356
Southern Putnam Valley	10,117	5,396
Southwest Carmel	2,543	1,359
<i>Putnam County Subtotal:</i>	<i>19,708</i>	<i>10,383</i>
ROCKLAND COUNTY		
Bear Mountain State Park	27	14
Central Town of Clarkstown	23,697	11,936
Grassy Point	112	58
Harriman State Park	42	21
Jones Point	86	44
Northeastern & Eastern Town of Clarkstown	15,216	7,716
Northeastern Town of Ramapo	29,852	15,007
Northwestern Town of Clarkstown	7,670	3,899
Stony Point	12,857	6,559
Tompkins Cove	1,887	969
Unincorporated Areas of the Town of Haverstraw	12,345	6,301

Protective Action Area	2020 Population	2020 Resident Vehicles
Village of Haverstraw	12,418	6,201
Village of Pomona	5,325	2,681
Village of West Haverstraw	10,913	5,559
<i>Rockland County Subtotal:</i>	<i>132,447</i>	<i>66,965</i>
WESTCHESTER COUNTY		
Briarcliff Manor	8,132	3,952
Buchanan	2,280	1,131
City of Peekskill	25,374	12,564
Croton-on-Hudson	8,293	4,055
Montrose	3,306	1,636
Ossining Town & Village	33,140	15,514
Town of Cortlandt	26,758	12,721
Town of New Castle (W. of Hardscrabble Rd)	4,895	2,408
Town of Somers (W. of Route 118)	5,218	2,597
Verplanck	1,984	989
Yorktown	36,566	18,087
<i>Westchester County Subtotal:</i>	<i>155,946</i>	<i>75,654</i>
EPZ TOTAL:	324,103	159,048

Table 3-3. Shadow Population and Vehicles by Sector

Sector	2020 Population	Evacuating Vehicles
N	26,615	12,253
NNE	6,765	3,475
NE	33,110	17,481
ENE	35,734	18,478
E	13,355	6,012
ESE	20,749	10,284
SE	50,373	24,262
SSE	43,219	20,690
S	53,822	26,413
SSW	124,537	63,076
SW	24,916	12,419
WSW	4,948	2,430
W	5,991	3,105
WNW	62,603	32,263
NW	8,324	4,353
NNW	56,606	29,378
TOTAL:	571,667	286,372

Table 3-4. Summary of Transients and Transient Vehicles

Protective Action Area	Transients	Transient Vehicles
ORANGE COUNTY		
Bear Mountain State Park	48	24
Fort Montgomery	121	60
Harriman State Park	12,204	4,864
Town of Cornwall (S. of Angola Road)	0	0
Town of Highlands	0	0
Town of Tuxedo east of NYS Thruway	0	0
U.S. Military Academy	292	97
Village of Harriman east of NYS Thruway	0	0
Village of Highland Falls	150	70
Village-Town of Woodbury	0	0
<i>Orange County Subtotal:</i>	<i>12,815</i>	<i>5,115</i>
PUTNAM COUNTY		
Lower Philipstown	0	0
Southern Philipstown	11	5
Southern Putnam Valley	0	0
Southwest Carmel	0	0
<i>Putnam County Subtotal:</i>	<i>11</i>	<i>5</i>
ROCKLAND COUNTY		
Bear Mountain State Park	2,700	900
Central Town of Clarkstown	0	0
Grassy Point	0	0
Harriman State Park	14,293	4,134
Jones Point	0	0
Northeastern & Eastern Town of Clarkstown	7,648	1,624
Northeastern Town of Ramapo	0	0
Northwestern Town of Clarkstown	150	52
Stony Point	68	34
Tompkins Cove	75	26
Unincorporated Areas of the Town of Haverstraw	20	10
Village of Haverstraw	700	190
Village of Pomona	4,500	1,200
Village of West Haverstraw	0	0
<i>Rockland County Subtotal:</i>	<i>30,154</i>	<i>8,170</i>
WESTCHESTER COUNTY		
Briarcliff Manor	179	87
Buchanan	0	0
City of Peekskill	1,894	684
Croton-on-Hudson	1,456	658
Montrose	1,052	387
Ossining Town & Village	1,229	436
Town of Cortlandt	2,743	1,019

Protective Action Area	Transients	Transient Vehicles
Town of New Castle (W. of Hardscrabble Rd)	0	0
Town of Somers (W. of Route 118)	0	0
Verplanck	0	0
Yorktown	5,262	1,809
<i>Westchester County Subtotal:</i>	<i>13,815</i>	<i>5,080</i>
Shadow Region⁸:	11,856	4,117
STUDY AREA TOTAL:	68,651	22,487

Table 3-5. Summary of Employees and Employee Vehicles Commuting into the EPZ

Protective Action Area	Employees	Employee Vehicles
ORANGE COUNTY		
Bear Mountain State Park	0	0
Fort Montgomery	0	0
Harriman State Park	0	0
Town of Cornwall (S. of Angola Road)	0	0
Town of Highlands	0	0
Town of Tuxedo east of NYS Thruway	0	0
U.S. Military Academy	2,971	2,803
Village of Harriman east of NYS Thruway	0	0
Village of Highland Falls	0	0
Village-Town of Woodbury	0	0
<i>Orange County Subtotal:</i>	<i>2,971</i>	<i>2,803</i>
PUTNAM COUNTY		
Lower Philipstown	0	0
Southern Philipstown	0	0
Southern Putnam Valley	0	0
Southwest Carmel	0	0
<i>Putnam County Subtotal:</i>	<i>0</i>	<i>0</i>
ROCKLAND COUNTY		
Bear Mountain State Park	0	0
Central Town of Clarkstown	1,361	1,284
Grassy Point	0	0
Harriman State Park	0	0
Jones Point	0	0
Northeastern & Eastern Town of Clarkstown	2,151	2,029
Northeastern Town of Ramapo	4,286	4,044
Northwestern Town of Clarkstown	821	774
Stony Point	266	251
Tompkins Cove	0	0
Unincorporated Areas of the Town of Haverstraw	0	0
Village of Haverstraw	148	140

⁸ There is a shopping center – Woodbury Commons – in the Shadow Region. As per the discussion with Orange County officials, this facility is included in this study due to its close proximity to the EPZ boundary.

Protective Action Area	Employees	Employee Vehicles
Village of Pomona	0	0
Village of West Haverstraw	0	0
<i>Rockland County Subtotal:</i>	<i>9,033</i>	<i>8,522</i>
WESTCHESTER COUNTY		
Briarcliff Manor	531	501
Buchanan	192	181
City of Peekskill	1,080	1,018
Croton-on-Hudson	390	368
Montrose	0	0
Ossining Town & Village	788	744
Town of Cortlandt	2,221	2,095
Town of New Castle (W. of Hardscrabble Rd)	1,201	1,133
Town of Somers (W. of Route 118)	0	0
Verplanck	0	0
Yorktown	3,742	3,530
<i>Westchester County Subtotal:</i>	<i>10,145</i>	<i>9,570</i>
EPZ TOTAL:	22,149	20,895

Table 3-6. Medical Facility Transit Demand

Protective Action Area	Current Census	Ambulatory	Wheel-chair Bound	Bed-ridden	Bus Runs	Wheel-chair Bus Runs	Ambulance Runs
PUTNAM COUNTY							
Lower Philipstown	210	188	22	0	7	2	0
Southern Philipstown	181	181	0	0	8	0	0
Southern Putnam Valley	50	50	0	0	2	0	0
<i>Putnam County Subtotal:</i>	<i>441</i>	<i>419</i>	<i>22</i>	<i>0</i>	<i>17</i>	<i>2</i>	<i>0</i>
ROCKLAND COUNTY							
Central Town of Clarkstown	130	126	4	0	3	1	0
Northeastern & Eastern Town of Clarkstown	852	698	154	0	18	12	0
Northeastern Town of Ramapo	858	461	372	25	8	6	3
Northwestern Town of Clarkstown	135	126	6	3	3	1	1
Stony Point	75	75	0	0	2	0	0
Unincorporated Areas of the Town of Haverstraw	12	12	0	0	1	0	0
Village of Haverstraw	420	270	140	10	3	0	0
Village of West Haverstraw	463	344	103	16	5	0	0
<i>Rockland County Subtotal:</i>	<i>2,945</i>	<i>2,112</i>	<i>779</i>	<i>54</i>	<i>43</i>	<i>20</i>	<i>4</i>
WESTCHESTER COUNTY							
Briarcliff Manor	337	251	52	34	10	8	20
Buchanan	17	10	6	1	2	2	1
City of Peekskill	241	189	30	22	21	9	15
Croton-on-Hudson	193	144	29	20	5	4	11
Ossining Town & Village	416	309	62	45	21	19	28
Town of Cortlandt	941	699	142	100	26	24	45
Town of New Castle (W. of Hardscrabble Rd)	58	44	8	6	2	1	3
Town of Somers (W. of Route 118)	21	16	3	2	2	2	2
Yorktown	717	532	107	78	32	29	50
<i>Westchester County Subtotal:</i>	<i>2,941</i>	<i>2,194</i>	<i>439</i>	<i>308</i>	<i>121</i>	<i>98</i>	<i>175</i>
EPZ TOTAL:	6,327	4,725	1,240	362	181	120	179

Table 3-7. Transit-Dependent Population Estimates

2020 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							
324,103	1.60	1.86	2.61	123,233	1.0%	23.2%	53.0%	66.0%	39.0%	10,940	59.0%	4,485	1.4%	

Table 3-8. School, Preschool/Daycare and Day Camp Population Demand Estimates

Protective Action Area	Enrollment	Buses Required	Commuter Vehicles
ORANGE COUNTY			
Harriman State Park	730	15	0
Fort Montgomery	807	16	0
Village of Highland Falls	348	7	0
Village-Town of Woodbury	16	2	0
U.S. Military Academy	4,968	8	888
<i>Orange County Subtotal:</i>	<i>6,869</i>	<i>48</i>	<i>888</i>
PUTNAM COUNTY			
Southwest Carmel	110	4	0
Lower Philipstown	70	3	0
Southern Putnam Valley	2,906	87	0
Southern Philipstown	1,147	28	0
<i>Putnam County Subtotal:</i>	<i>4,233</i>	<i>122</i>	<i>0</i>
ROCKLAND COUNTY			
Harriman State Park	620	15	0
Central Town of Clarkstown	8,356	201	0
Northeastern Town of Ramapo	12,732	304	0
Northeastern & Eastern Town of Clarkstown	2,163	54	0
Northwestern Town of Clarkstown	318	8	0
Village of Haverstraw	1,285	33	0
Village of West Haverstraw	1,262	33	0
Unincorporated Areas of the Town of Haverstraw	5,618	130	0
Village of Pomona	3,107	72	0
Grassy Point	50	2	0
Stony Point	1,974	49	0
Tompkins Cove	220	5	0
<i>Rockland County Subtotal:</i>	<i>37,705</i>	<i>906</i>	<i>0</i>
WESTCHESTER COUNTY			
Briarcliff Manor	2,294	48	0
Ossining Town & Village	7,009	143	0
Town of New Castle (W. of Hardscrabble Rd)	1,110	22	0
Croton-on-Hudson	2,363	49	0
Buchanan	373	8	0
Montrose	1,476	31	0
City of Peekskill	4,847	109	0
Town of Cortlandt	3,960	79	194
Yorktown	10,556	220	0
Town of Somers (W. of Route 118)	2,334	53	0
<i>Westchester County Subtotal:</i>	<i>36,322</i>	<i>762</i>	<i>194</i>
Shadow Region	921	23	0
TOTAL:	86,050	1,861	1,082

Table 3-9. Access and/or Functional Needs Population Estimates

Population Group	Transportation Needed	Population	Vehicles deployed
PUTNAM COUNTY			
Ambulatory	Bus	11	3
Wheelchair bound	Wheelchair Bus	1	1
Bedridden	Ambulance	0	0
<i>Putnam County Subtotal:</i>		<i>12</i>	<i>4</i>
ORANGE COUNTY			
Ambulatory	Bus	5	1
Wheelchair bound	Wheelchair Bus	5	1
Bedridden	Ambulance	6	3
<i>Orange County Subtotal:</i>		<i>16</i>	<i>5</i>
ROCKLAND COUNTY			
Ambulatory	Bus	48	10
Wheelchair bound	Wheelchair Bus	7	2
Bedridden	Ambulance	110	55
<i>Rockland County Subtotal:</i>		<i>165</i>	<i>67</i>
WESTCHESTER COUNTY			
Ambulatory	Bus	89	17
Wheelchair bound	Wheelchair Bus	0	0
Bedridden	Ambulance	9	5
<i>Westchester County Subtotal:</i>		<i>98</i>	<i>22</i>
TOTAL:		291	98

Table 3-10. IPEC EPZ External Traffic

Upstream Node	Downstream Node	Road Name	Direction	AADT ⁹	K-Factor ¹⁰	D-Factor ¹⁰	Hourly Volume	External Traffic
8399	1565	I-84	EB	52,011	0.091	0.5	2,367	4,734
8233	1588	I-84	WB	52,011	0.091	0.5	2,367	4,734
8283	283	I-684	NB	46,079	0.107	0.5	2,465	4,930
8357	1631	I-684	SB	46,079	0.107	0.5	2,465	4,930
8244	1435	I-287	EB	137,621	0.082	0.5	5,642	11,284
8242	3095	I-287	WB	137,621	0.082	0.5	5,642	11,284
8689	1549	I-87	NB	61,491	0.091	0.5	2,798	5,596
8030	1019	I-87	SB	61,491	0.091	0.5	2,798	5,596
8676	1557	Taconic State Pkwy	SB	37,557	0.107	0.5	2,009	4,018
8262	1606	Saw Mill Pkwy	NB	15,500	0.116	0.5	899	1,798
8214	1765	Sprain Brook Pkwy	NB	58,230	0.091	0.5	2,649	5,298
8448	3346	Palisades Pkwy	NB	33,248	0.107	0.5	1,779	3,558
							TOTAL	67,760

⁹ <https://gisportalny.dot.ny.gov/portal/apps/webappviewer/index.html?id=28537cbc8b5941e19cf8e959b16797b4>
¹⁰ HCM 2016

Table 3-11. Summary of Population Demand¹¹

Protective Action Area	Residents	Transit-Dependent	Transients	Employees	Special Facilities ¹²	Commuter Schools	Schools and Preschools/Daycares/Day Camps	Special Event	Shadow Population ¹³	External Traffic	Total
ORANGE COUNTY											
Bear Mountain State Park	40	2	48	0	0	0	0	0	0	0	90
Fort Montgomery	1,870	26	121	0	0	0	807	0	0	0	2,824
Harriman State Park	7	1	12,204	0	0	0	730	0	0	0	12,942
Town of Cornwall (S. of Angola Road)	1,032	14	0	0	0	0	0	0	0	0	1,046
Town of Highlands	0	0	0	0	0	0	0	0	0	0	0
Town of Tuxedo east of NYS Thruway	203	3	0	0	0	0	0	10,000	0	0	10,206
U.S. Military Academy	6,651	92	292	2,971	0	4,440	528	0	0	0	14,974
Village of Harriman east of NYS Thruway	30	0	0	0	0	0	0	0	0	0	30
Village of Highland Falls	3,709	51	150	0	0	0	348	0	0	0	4,258
Village-Town of Woodbury	2,460	34	0	0	0	0	16	0	0	0	2,510
Orange County Subtotal:	16,002	223	12,815	2,971	0	4,440	2,429	10,000	0	0	48,880
PUTNAM COUNTY											
Lower Philipstown	2,553	35	0	0	210	0	70	0	0	0	2,868
Southern Philipstown	4,495	62	11	0	181	0	1,147	0	0	0	5,896
Southern Putnam Valley	10,117	140	0	0	50	0	2,906	0	0	0	13,213
Southwest Carmel	2,543	35	0	0	0	0	110	0	0	0	2,688
Putnam County Subtotal:	19,708	272	11	0	441	0	4,233	0	0	0	24,665
ROCKLAND COUNTY											
Bear Mountain State Park	27	0	2,700	0	0	0	0	0	0	0	2,727
Central Town of Clarkstown	23,697	328	0	1,361	435	0	8,356	0	0	0	34,177
Grassy Point	112	2	0	0	0	0	50	0	0	0	164
Harriman State Park	42	0	14,293	0	0	0	620	0	0	0	14,955
Jones Point	86	1	0	0	0	0	0	0	0	0	87

¹¹ Since the spatial distribution of the access and/or functional needs population is unknown, they are not included in this table.

¹² Special Facilities includes both medical facilities and correctional facilities.

¹³ Shadow Population has been reduced to 20%. Refer to Figure 2-1 for additional information.

Protective Action Area	Residents	Transit-Dependent	Transients	Employees	Special Facilities ¹²	Commuter Schools	Schools and Preschools/Daycares/Day Camps	Special Event	Shadow Population ¹³	External Traffic	Total
Northeastern & Eastern Town of Clarkstown	15,216	211	7,648	2,151	852	0	2,163	0	0	0	28,241
Northeastern Town of Ramapo	29,852	411	0	4,286	858	0	12,732	0	0	0	48,139
Northwestern Town of Clarkstown	7,670	106	150	821	135	0	318	0	0	0	9,200
Stony Point	12,857	178	68	266	75	0	1,974	0	0	0	15,418
Tompkins Cove	1,887	26	75	0	0	0	220	0	0	0	2,208
Unincorporated Areas of the Town of Haverstraw	12,345	171	20	0	12	0	5,618	0	0	0	18,166
Village of Haverstraw	12,418	172	700	148	420	0	1,285	0	0	0	15,143
Village of Pomona	5,325	74	4,500	0	0	0	3,107	0	0	0	13,006
Village of West Haverstraw	10,913	151	0	0	463	0	1,262	0	0	0	12,789
<i>Rockland County Subtotal:</i>	<i>132,447</i>	<i>1,831</i>	<i>30,154</i>	<i>9,033</i>	<i>3,250</i>	<i>0</i>	<i>37,705</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>214,420</i>
WESTCHESTER COUNTY											
Briarcliff Manor	8,132	113	179	531	337	0	2,294	34,105	0	0	45,691
Buchanan	2,280	32	0	192	17	0	373	0	0	0	2,894
City of Peekskill	25,374	351	1,894	1,080	241	0	4,847	0	0	0	33,787
Croton-on-Hudson	8,293	115	1,456	390	193	0	2,363	0	0	0	12,810
Montrose	3,306	46	1,052	0	0	0	1,476	0	0	0	5,880
Ossining Town & Village	33,140	459	1,229	788	1,522	0	7,009	0	0	0	44,147
Town of Cortlandt	26,758	370	2,743	2,221	941	206	3,754	0	0	0	36,993
Town of New Castle (W. of Hardscrabble Rd)	4,895	68	0	1,201	58	0	1,110	0	0	0	7,332
Town of Somers (W. of Route 118)	5,218	72	0	0	21	0	2,334	0	0	0	7,645
Verplanck	1,984	27	0	0	0	0	0	0	0	0	2,011
Yorktown	36,566	506	5,262	3,742	717	0	10,556	0	0	0	57,349
<i>Westchester County Subtotal:</i>	<i>155,946</i>	<i>2,159</i>	<i>13,815</i>	<i>10,145</i>	<i>4,047</i>	<i>206</i>	<i>36,116</i>	<i>34,105</i>	<i>0</i>	<i>0</i>	<i>256,539</i>
Shadow Region	0	0	11,856	0	0	0	921	0	114,333	0	127,110
TOTAL:	324,103	4,485	68,651	22,149	7,738	4,646	81,404	44,105	114,333	0	671,614

Table 3-12. Summary of Vehicle Demand¹⁶

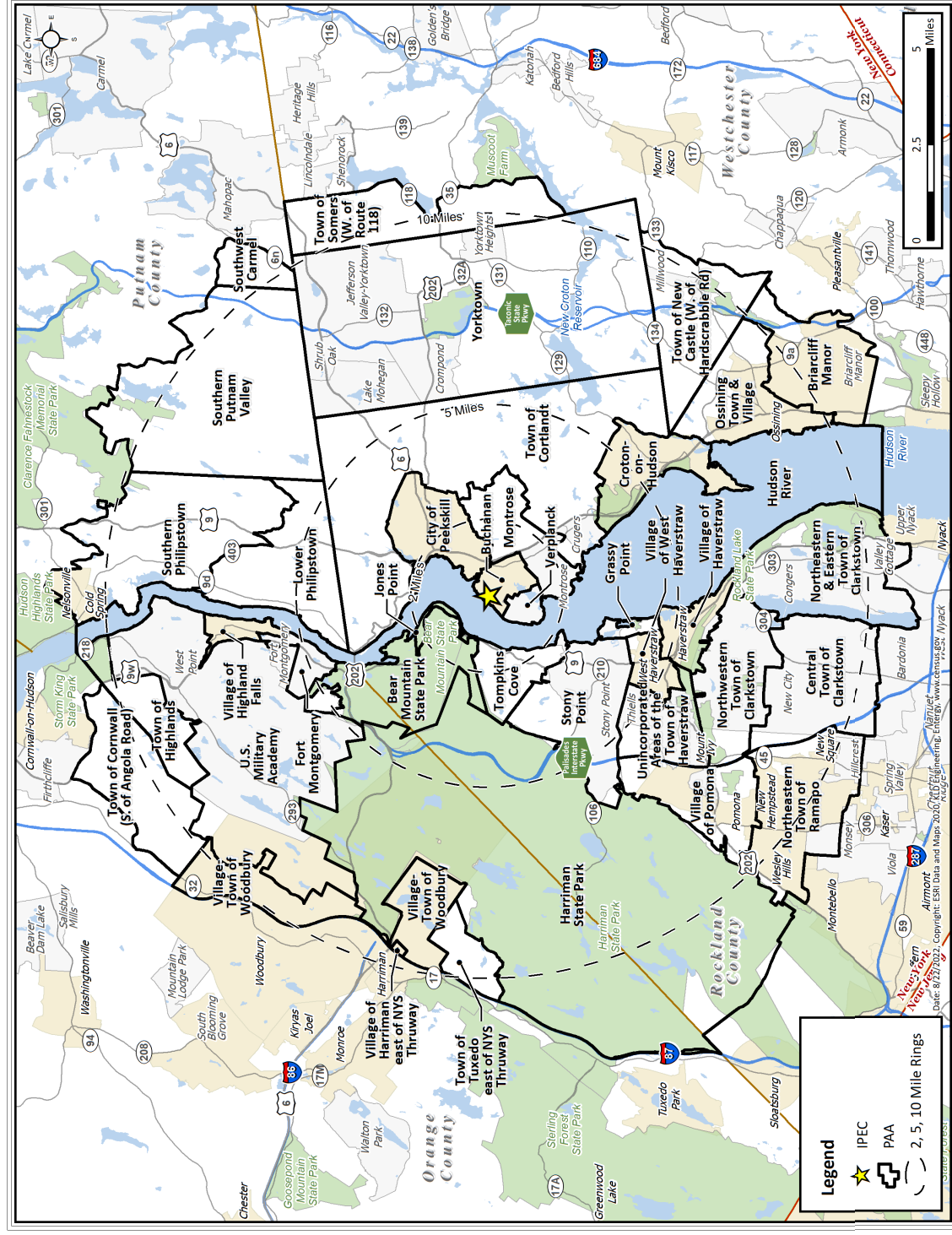
Protective Action Area	Residents	Transit-Dependent ¹⁷	Transients	Employees	Medical Facilities ¹⁸	Commuter Schools	Schools and Preschools/Daycares/Day Camps	Special Event	Shadow Population	External Traffic	Total
ORANGE COUNTY											
Bear Mountain State Park	21	2	24	0	0	0	0	0	0	0	47
Fort Montgomery	982	2	60	0	0	0	32	0	0	0	1,076
Harriman State Park	4	2	4,864	0	0	0	30	0	0	0	4,900
Town of Cornwall (S. of Angola Road)	536	2	0	0	0	0	0	0	0	0	538
Town of Highlands	0	0	0	0	0	0	0	0	0	0	0
Town of Tuxedo east of NYS Thruway	107	2	0	0	0	0	0	0	0	0	109
U.S. Military Academy	1,159	8	97	2,803	0	888	16	5,000	0	0	9,971
Village of Harriman east of NYS Thruway	16	0	0	0	0	0	0	0	0	0	16
Village of Highland Falls	1,940	4	70	0	0	0	14	0	0	0	2,028
Village-Town of Woodbury	1,281	4	0	0	0	0	4	0	0	0	1,289
<i>Orange County Subtotal:</i>	<i>6,046</i>	<i>26</i>	<i>5,115</i>	<i>2,803</i>	<i>0</i>	<i>888</i>	<i>96</i>	<i>5,000</i>	<i>0</i>	<i>0</i>	<i>19,974</i>
PUTNAM COUNTY											
Lower Philipstown	1,272	4	0	0	18	0	6	0	0	0	1,300
Southern Philipstown	2,356	6	5	0	16	0	56	0	0	0	2,439
Southern Putnam Valley	5,396	10	0	0	4	0	174	0	0	0	5,584
Southwest Carmel	1,359	4	0	0	0	0	8	0	0	0	1,371
<i>Putnam County Subtotal:</i>	<i>10,383</i>	<i>24</i>	<i>5</i>	<i>0</i>	<i>38</i>	<i>0</i>	<i>244</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>10,694</i>
ROCKLAND COUNTY											
Bear Mountain State Park	14	0	900	0	0	0	0	0	0	0	914
Central Town of Clarkstown	11,936	22	0	1,284	8	0	402	0	0	0	13,652
Grassy Point	58	2	0	0	0	0	4	0	0	0	64
Harriman State Park	21	0	4,134	0	0	0	30	0	0	0	4,185
Jones Point	44	2	0	0	0	0	0	0	0	0	46

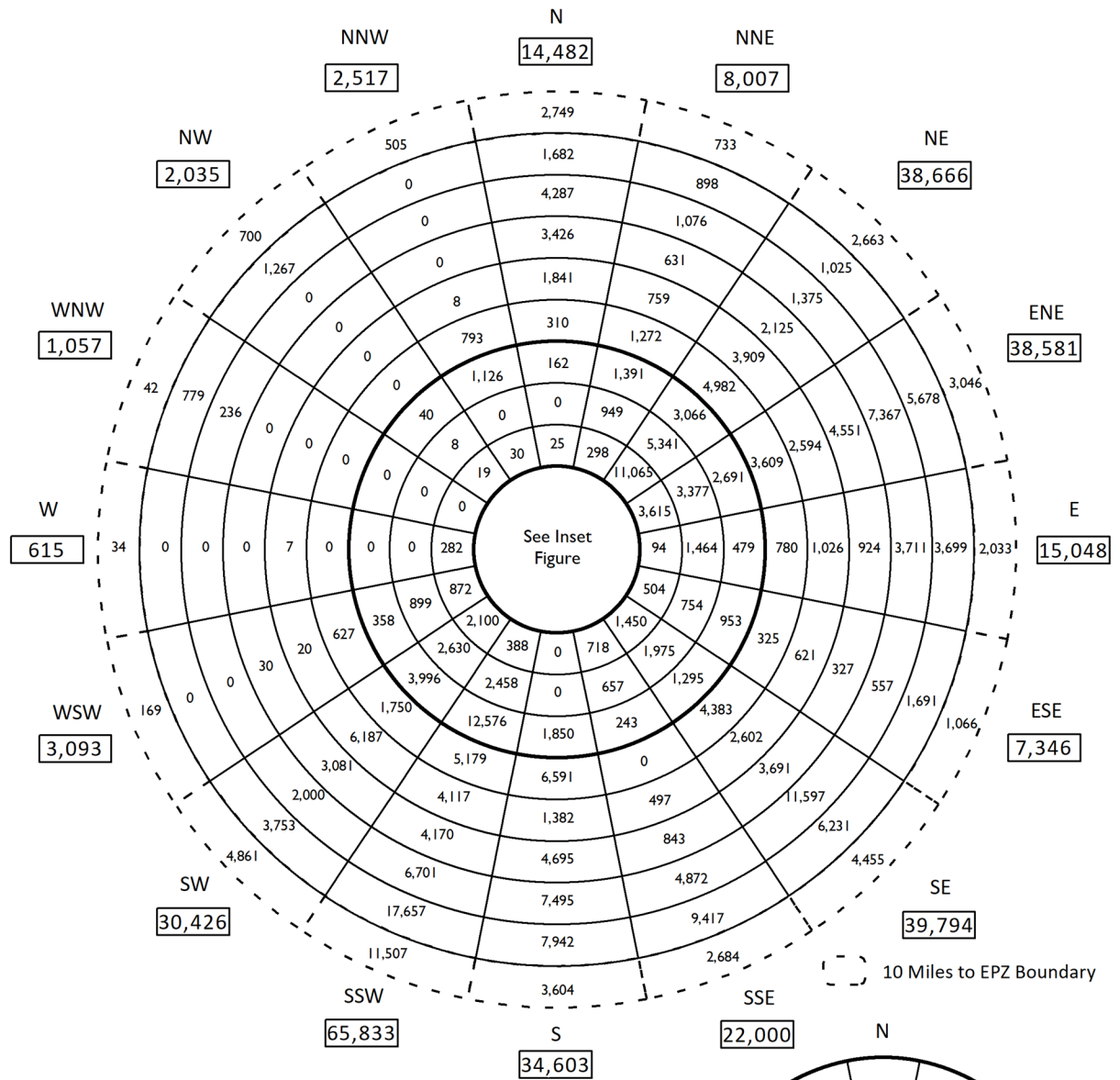
¹⁶ Since the spatial distribution of the access and/or functional needs population is unknown, they are not included in this table.

¹⁷ Buses evacuating transit-dependent residents are represented as two passenger vehicles. Refer to Section 3.6 and Section 8 for additional information.

¹⁸ Buses and wheelchair buses are represented as two passenger vehicles. Refer to Section 3.5 and Section 8 for additional information. Note that correctional facilities are not included here as they shelter in place. See Section 3.10.

Protective Action Area	Residents	Transit-Dependent ¹⁷	Transients	Employees	Medical Facilities ¹⁸	Commuter Schools	Schools and Preschools/Daycares/Day Camps	Special Event	Shadow Population	External Traffic	Total
Northeastern & Eastern Town of Clarkstown	7,716	16	1,624	2,029	60	0	108	0	0	0	11,553
Northeastern Town of Ramapo	15,007	28	0	4,044	31	0	608	0	0	0	19,718
Northwestern Town of Clarkstown	3,899	8	52	774	9	0	16	0	0	0	4,758
Stony Point	6,559	12	34	251	4	0	98	0	0	0	6,958
Tompkins Cove	969	2	26	0	0	0	10	0	0	0	1,007
Unincorporated Areas of the Town of Haverstraw	6,301	12	10	0	2	0	260	0	0	0	6,585
Village of Haverstraw	6,201	12	190	140	6	0	66	0	0	0	6,615
Village of Pomona	2,681	6	1,200	0	0	0	144	0	0	0	4,031
Village of West Haverstraw	5,559	12	0	0	10	0	66	0	0	0	5,647
<i>Rockland County Subtotal:</i>	<i>66,965</i>	<i>134</i>	<i>8,170</i>	<i>8,522</i>	<i>130</i>	<i>0</i>	<i>1,812</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>85,733</i>
WESTCHESTER COUNTY											
Briarcliff Manor	3,952	8	87	501	56	0	96	0	0	0	4,700
Buchanan	1,131	4	0	181	9	0	16	0	0	0	1,341
City of Peekskill	12,564	24	684	1,018	75	0	218	0	0	0	14,583
Croton-on-Hudson	4,055	8	658	368	29	0	98	3,803	0	0	9,019
Montrose	1,636	4	387	0	0	0	62	0	0	0	2,089
Ossining Town & Village	15,514	32	436	744	108	0	286	0	0	0	17,120
Town of Cortlandt	12,721	26	1,019	2,095	145	194	158	0	0	0	16,358
Town of New Castle (W. of Hardscrabble Rd)	2,408	6	0	1,133	9	0	44	0	0	0	3,600
Town of Somers (W. of Route 118)	2,597	6	0	0	10	0	106	0	0	0	2,719
Verplanck	989	2	0	0	0	0	0	0	0	0	991
Yorktown	18,087	34	1,809	3,530	172	0	440	0	0	0	24,072
<i>Westchester County Subtotal:</i>	<i>75,654</i>	<i>154</i>	<i>5,080</i>	<i>9,570</i>	<i>613</i>	<i>194</i>	<i>1,524</i>	<i>3,803</i>	<i>0</i>	<i>0</i>	<i>96,592</i>
Shadow Region	0	0	4,117	0	0	0	46	0	57,274	67,760	129,197
TOTAL:	159,048	338	22,487	20,895	781	1,082	3,722	8,803	57,274	67,760	342,190





2020 Permanent Resident Population

Miles	Subtotal by Ring	Cumulative Total
0 - 1	1,714	1,714
1 - 2	11,682	13,396
2 - 3	21,460	34,856
3 - 4	20,512	55,368
4 - 5	30,226	85,594
5 - 6	30,601	116,195
6 - 7	25,570	141,765
7 - 8	28,494	170,259
8 - 9	51,274	221,533
9 - 10	61,719	283,252
10 - EPZ	40,851	324,103
Total:		324,103

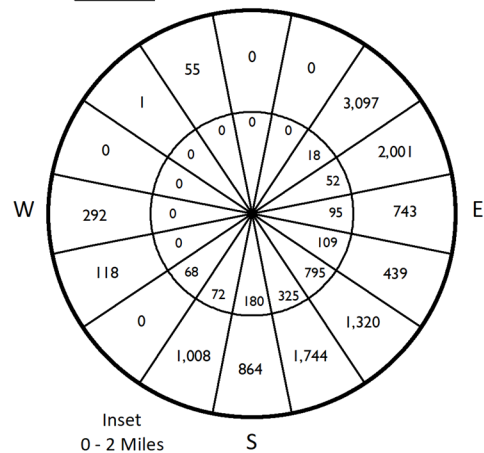
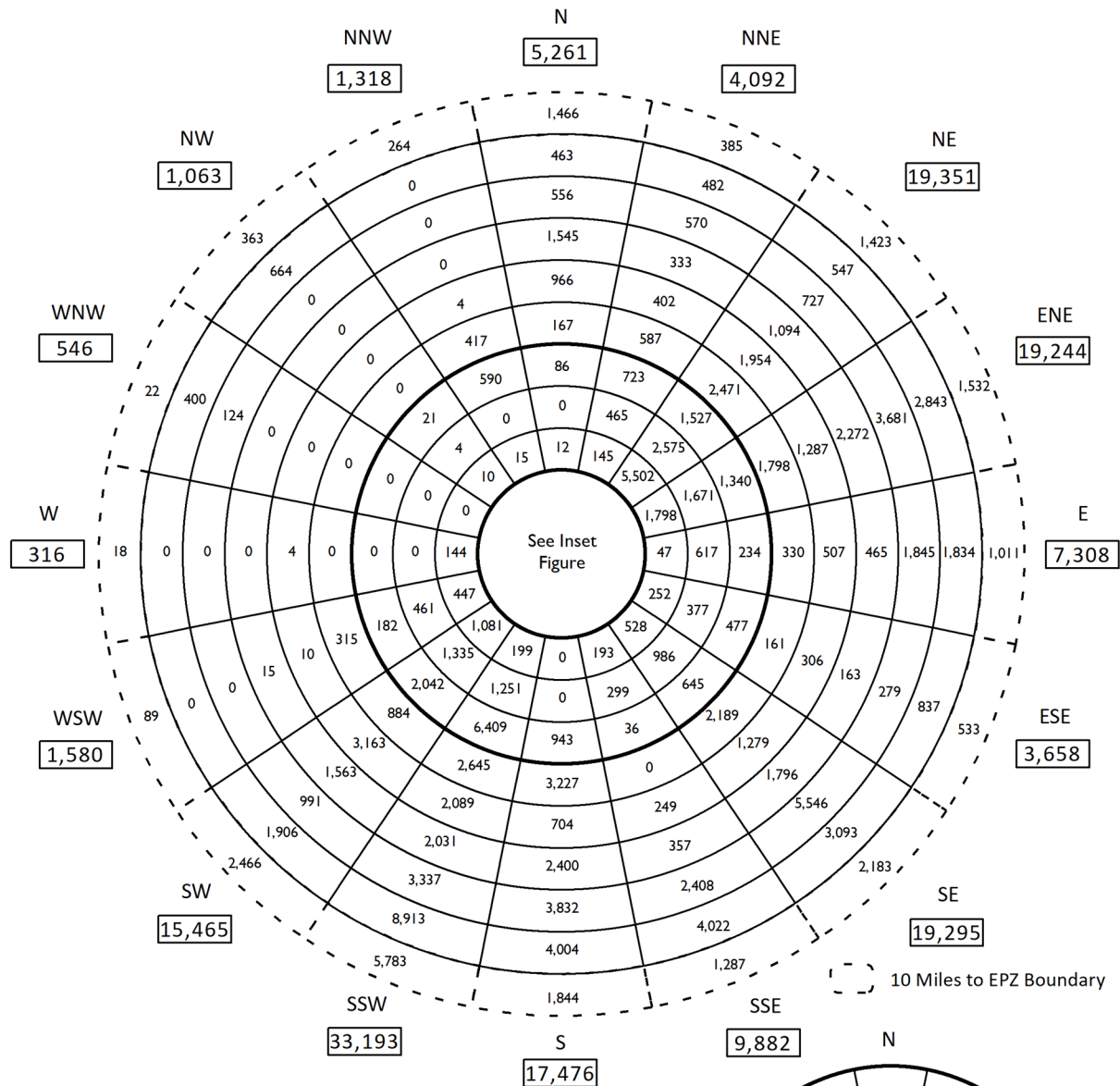


Figure 3-2. Permanent Resident Population by Sector



Resident Vehicles

Miles	Subtotal by Ring	Cumulative Total
0 - 1	857	857
1 - 2	5,800	6,657
2 - 3	10,373	17,030
3 - 4	10,041	27,071
4 - 5	15,255	42,326
5 - 6	15,191	57,517
6 - 7	12,924	70,441
7 - 8	14,034	84,475
8 - 9	23,896	108,371
9 - 10	30,008	138,379
10 - EPZ	20,669	159,048
Total:		159,048

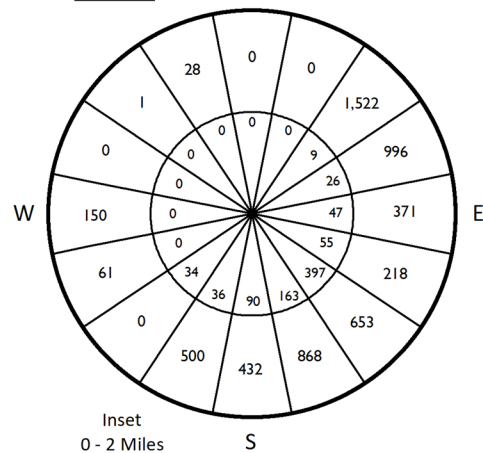
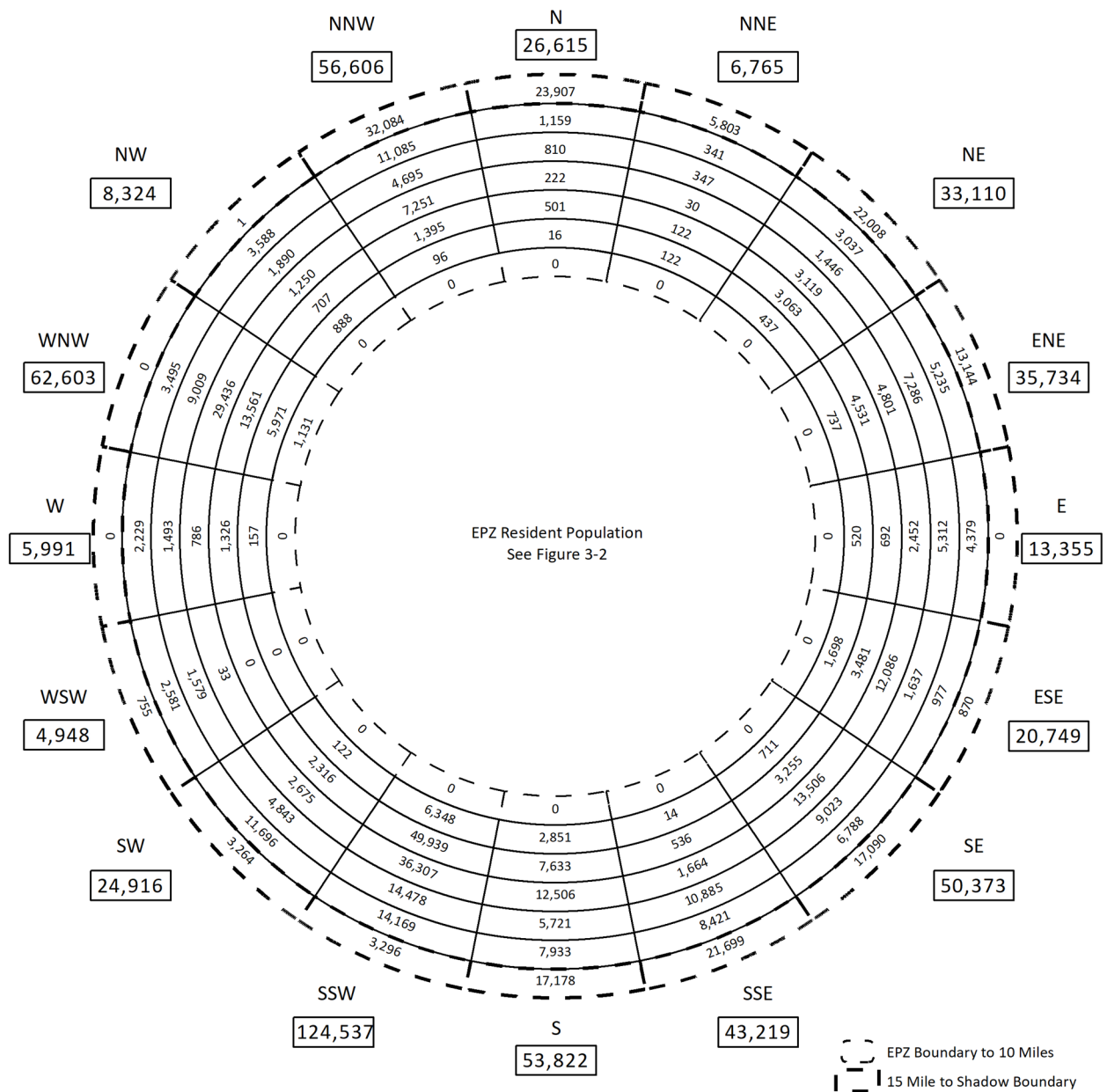


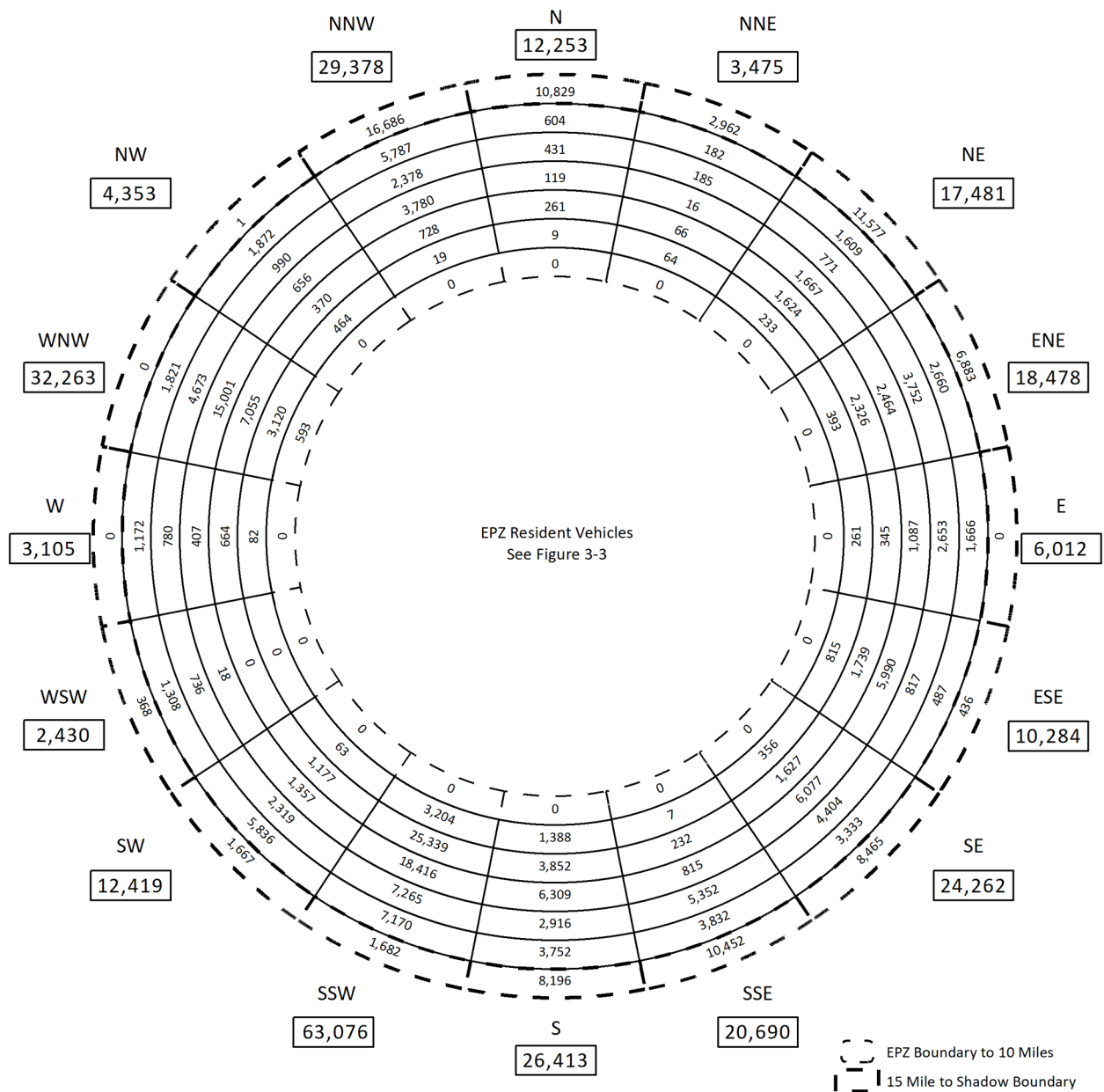
Figure 3-3. Permanent Resident Vehicles by Sector



2020 Shadow Population

Miles	Subtotal by Ring	Cumulative Total
EPZ - 10	1,131	1,131
10 - 11	20,688	21,819
11 - 12	93,058	114,877
12 - 13	128,124	243,001
13 - 14	80,454	323,455
14 - 15	87,113	410,568
15-Shadow	161,099	571,667
Total :		571,667

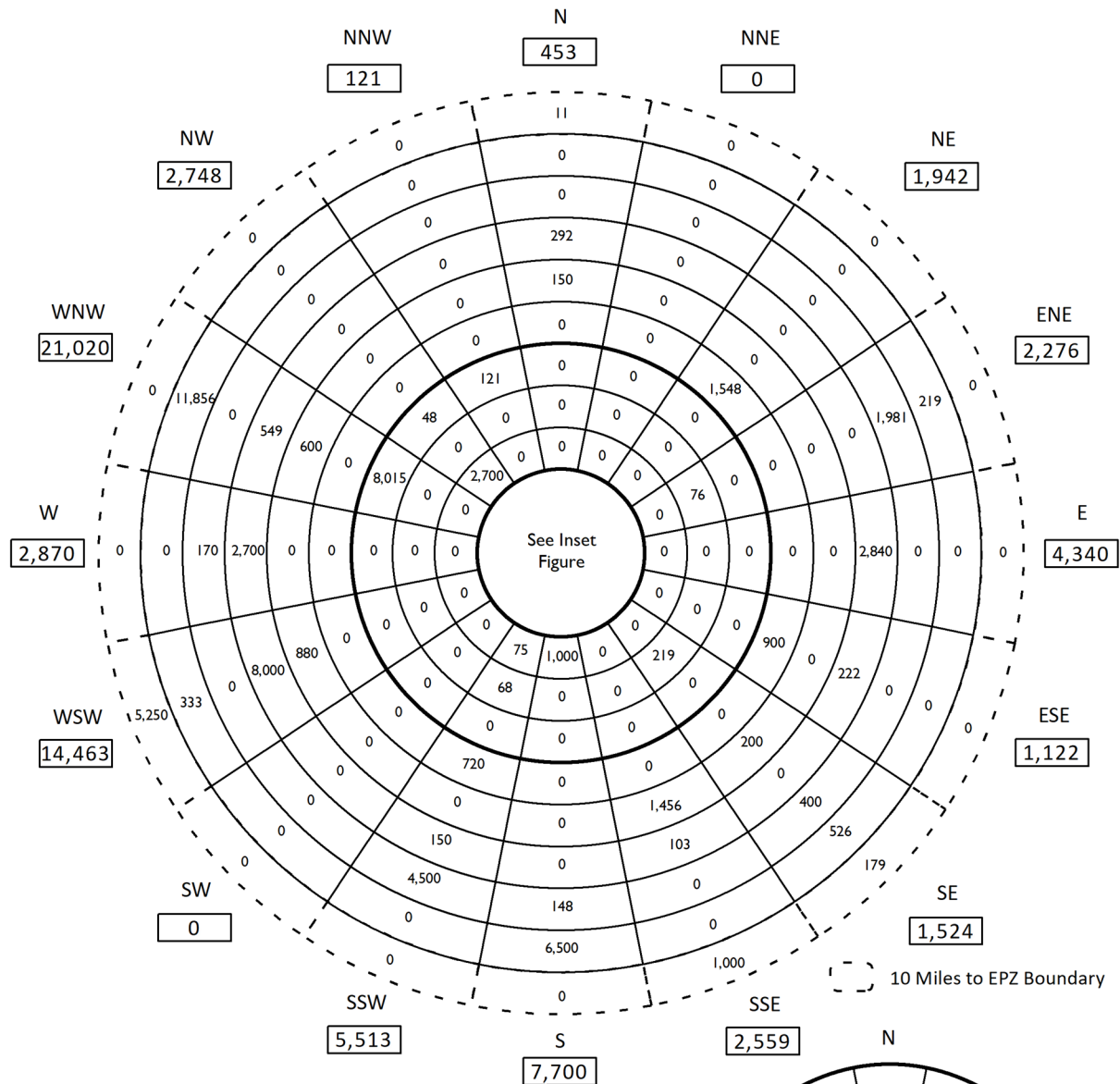
Figure 3-4. Shadow Population by Sector



Shadow Vehicles

Miles	Subtotal by Ring	Cumulative Total
EPZ - 10	593	593
10 - 11	10,478	11,071
11 - 12	47,405	58,476
12 - 13	64,179	122,655
13 - 14	40,422	163,077
14 - 15	43,091	206,168
15-Shadow	80,204	286,372
Total :		286,372

Figure 3-5. Shadow Vehicles by Sector



Transients

Miles	Subtotal by Ring	Cumulative Total
0 - 1	196	196
1 - 2	1,750	1,946
2 - 3	3,775	5,721
3 - 4	363	6,084
4 - 5	8,184	14,268
5 - 6	3,168	17,436
6 - 7	3,286	20,722
7 - 8	14,856	35,578
8 - 9	7,199	42,777
9 - 10	19,434	62,211
10 - EPZ	6,440	68,651
Total:		68,651

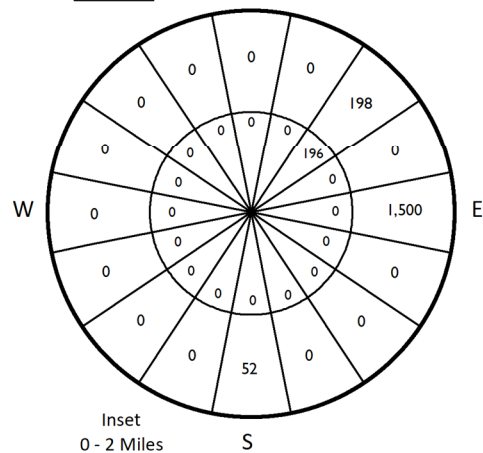
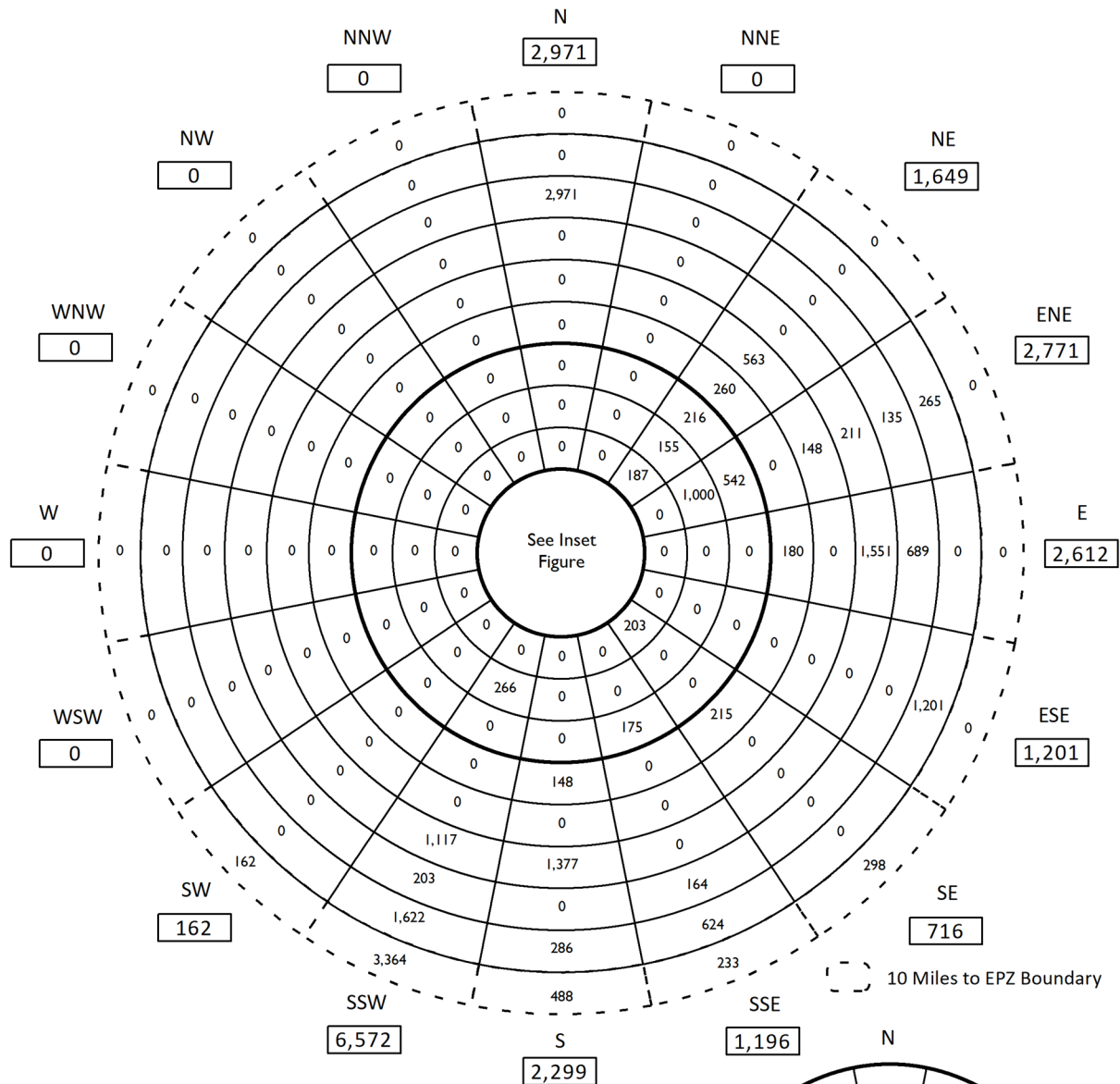


Figure 3-6. Transient Population by Sector



Employees

Miles	Subtotal by Ring	Cumulative Total
0 - 1	930	930
1 - 2	0	930
2 - 3	390	1,320
3 - 4	1,421	2,741
4 - 5	933	3,674
5 - 6	803	4,477
6 - 7	711	5,188
7 - 8	4,256	9,444
8 - 9	4,162	13,606
9 - 10	3,998	17,604
10 - EPZ	4,545	22,149
Total:		22,149

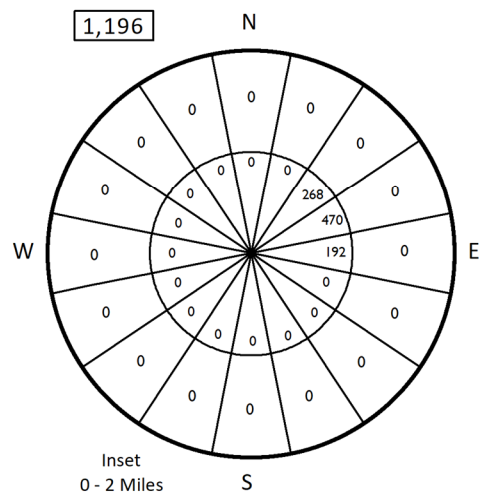
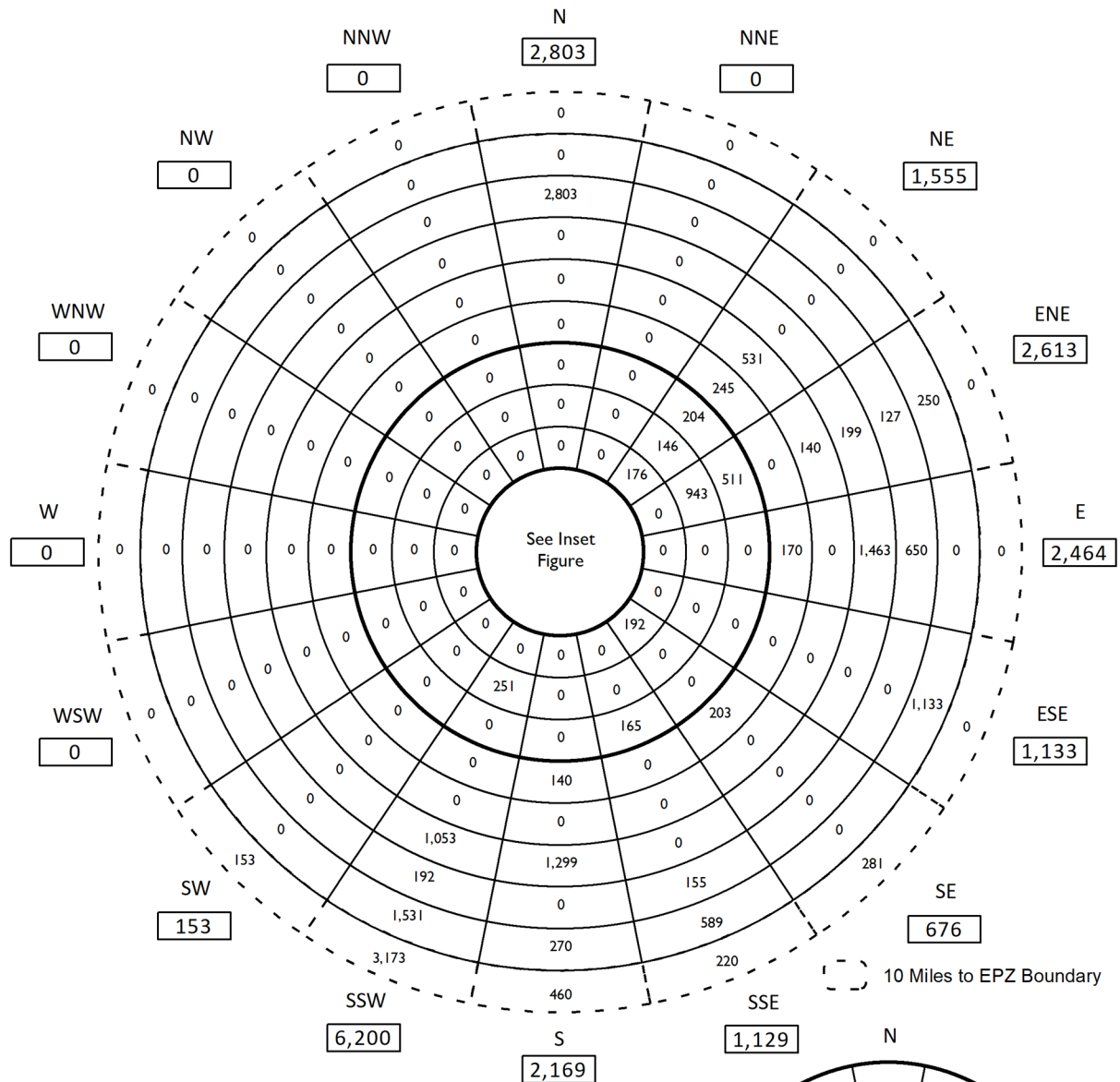


Figure 3-8. Employee Population by Sector



Employee Vehicles

Miles	Subtotal by Ring	Cumulative Total
0 - 1	877	877
1 - 2	0	877
2 - 3	368	1,245
3 - 4	1,340	2,585
4 - 5	880	3,465
5 - 6	758	4,223
6 - 7	671	4,894
7 - 8	4,014	8,908
8 - 9	3,927	12,835
9 - 10	3,773	16,608
10 - EPZ	4,287	20,895
Total:		20,895

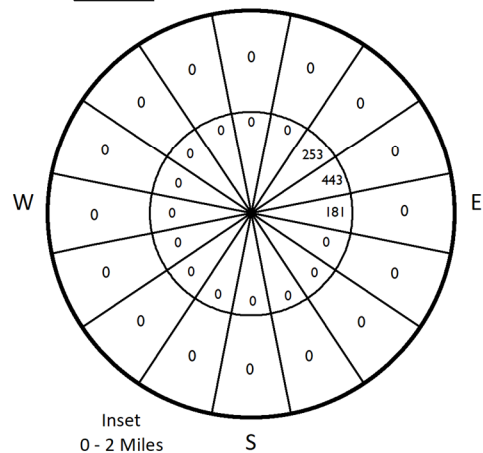


Figure 3-9. Employee Vehicles by Sector

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 2016 Highway Capacity Manual (HCM 2016). This section discusses how the capacity of the roadway network was estimated.

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". Service volume (SV) 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 SV at the upper bound of LOS E, only.

Thus, in simple terms, SV is the maximum traffic that can travel on a road and still maintain a certain perceived level of quality to a driver based on the A, B, C, rating system (LOS). Any additional vehicles above the SV would drop the rating to a lower letter grade.

This distinction is illustrated in Exhibit 12-37 of the HCM 2016. 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 (BFFS¹) according to Exhibit 15-7 of the HCM 2016. Consequently, lane and shoulder widths at the narrowest points were observed during the road survey and these observations were recorded, but no detailed

¹ A very rough estimate of BFFS might be taken as the posted speed limit plus 10 mph (HCM 2016 Page 15-15)

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. Free flow speeds ranged from 20 to 70 mph within the study area. Capacity is estimated from the procedures of the HCM 2016. For example, HCM Exhibit 7-1(b) shows the sensitivity of SV at the upper bound of LOS D to grade (capacity is the SV at the upper bound of LOS E).

The amount of traffic that can flow on a roadway is effectively governed by vehicle speed and spacing. The faster that vehicles can travel when closely spaced, the higher the amount of flow. As discussed in Section 2.6, it is necessary to adjust capacity figures to represent the prevailing conditions. Adverse conditions like inclement weather, construction, and other incidents tend to slow traffic down and often, also increases vehicle-to-vehicle separation, thus decreasing the amount of traffic flow. Based on limited empirical data, weather conditions such as rain reduce the values of FFS and of highway capacity by approximately 10%. Over the last decade new studies have been made on the effects of rain/light snow and heavy snow on traffic capacity. These studies indicate a range of effects between 5% and 25% depending on wind speed and precipitation rates. As indicated in Section 2.6, we employ, a reduction in free speed and in highway capacity of 10% for rain/light snow. The free speed and highway capacity reductions are 15% and 25%, respectively, during heavy snow conditions.

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. See Appendix G for more information.

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 model². The resulting values for h_m always satisfy the condition:

$$h_m \geq h_{sat}$$

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 2016.

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 19, 20 and 21 in the HCM 2016 address this topic. The factors, F_1 , F_2 , ..., influencing saturation flow rate are identified in equation (19-8) of the HCM 2016.

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 SV (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 SV increases as demand volume and density increase, until the SV 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 SV) 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.

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.

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 Levinson³ 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 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 ETE 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 15-46 in the HCM 2016 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 HCM 2016. The DYNEV II simulation model determines for each highway section, represented as a network link, whether its

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

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.

4.3 Application to the IPEC 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:

2016 Highway Capacity Manual (HCM 2016)
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
- Multilane Highways (at-grade)
- Freeways

Each of these classifications will be discussed.

4.3.1 Two-Lane Roads

Ref: HCM 2016 Chapter 15

Two lane roads comprise the majority of highways within the study area. The per-lane capacity of a two-lane highway is estimated at 1,700 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 3,200 pc/h. The HCM 2016 procedures then estimate 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 study area is 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 Multilane Highway

Ref: HCM 2016 Chapter 12

Exhibit 12-8 of the HCM 2016 presents a set of curves that indicate a per-lane capacity ranging from approximately 1,900 to 2,300 pc/h, for free-speeds of 45 to 70 mph, respectively. Based on observation, the multilane highways outside of urban areas within the study area, service

traffic with free-speeds in this range. The actual time-varying speeds computed by the simulation model reflect the demand and capacity relationship and the impact of control at intersections. A conservative estimate of per-lane capacity of 1,900 pc/h is adopted for this study for multilane highways outside of urban areas.

4.3.3 Freeways

Ref: HCM 2016 Chapters 10, 12, 13, 14

Chapter 10 of the HCM 2016 describes a procedure for integrating the results obtained in Chapters 12, 13 and 14, 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 12 of the HCM 2016 presents procedures for estimating capacity and LOS for "Basic Freeway Segments". Exhibit 12-37 of the HCM 2016 presents capacity vs. free speed estimates, which are provided below.

Free Speed (mph):	55	60	65	70+
Per-Lane Capacity (pc/h):	2,250	2,300	2,350	2,400

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 2,250 pc/h is adopted for this study for freeways.

Chapter 13 of the HCM 2016 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 13 depends on the "Type" and geometrics of the weaving segment and on the "Volume Ratio" (ratio of weaving volume to total volume).

Chapter 14 of the HCM 2016 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 14-10 of the HCM 2016 and depend on the number of freeway lanes and on the freeway free speed. Ramp capacity is presented in Exhibit 14-12 and is a function of the ramp FFS. The DYNEV II simulation model logic simulates the merging operations of the ramp and freeway traffic in accord with the procedures in Chapter 14 of the HCM 2016. 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 2016 does not address LOS F explicitly).

4.3.4 Intersections

Ref: HCM 2016 Chapters 19, 20, 21, 22

Procedures for estimating capacity and LOS for approaches to intersections are presented in Chapter 19 (signalized intersections), Chapters 20, 21 (un-signalized intersections) and Chapter 22 (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. A list that includes the total number of intersections modeled that are unsignalized, signalized, or manned by response personnel is provided in Appendix K.

4.4 Simulation and Capacity Estimation

Chapter 6 of the HCM 2016 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 involving several HCM chapters. 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 a study area 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 2016 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) 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 2016, as described earlier.

It is important to note that simulation represents a mathematical representation of an assumed set of conditions using the best available knowledge and understanding of traffic flow and available inputs. Simulation should not be assumed to be a prediction of what will happen under any event because a real evacuation can be impacted by an infinite number of things – many of which will differ from these test cases – and many others cannot be taken into account with the tools available.

4.5 Boundary Conditions

As illustrated in Figure 1-2 and in Appendix K, the link-node analysis network used for this study is finite. The analysis network extends well beyond the 15-mile radial study area in some locations in order to model intersections with other major evacuation routes beyond the study area. However, the network does have an end at the destination (exit) nodes as discussed in Appendix C. Beyond these destination nodes, there may be signalized intersections or merge points that impact the capacity of the evacuation routes leaving the study area. Rather than neglect these “boundary conditions,” this study assumes a 25% reduction in capacity on two-lane roads (Section 4.3.1 above) and multilane highways (Section 4.3.2 above) if there are traffic signals downstream. The 25% reduction in capacity is based on the prevalence of actuated traffic signals in the study area and the fact that the evacuating traffic volume (“main street”) will be more significant than the competing (“side street”) traffic volume at any downstream signalized intersections, thereby warranting a more significant percentage (75% in this case) of the signal green time. There is no reduction in capacity for freeways due to boundary conditions.

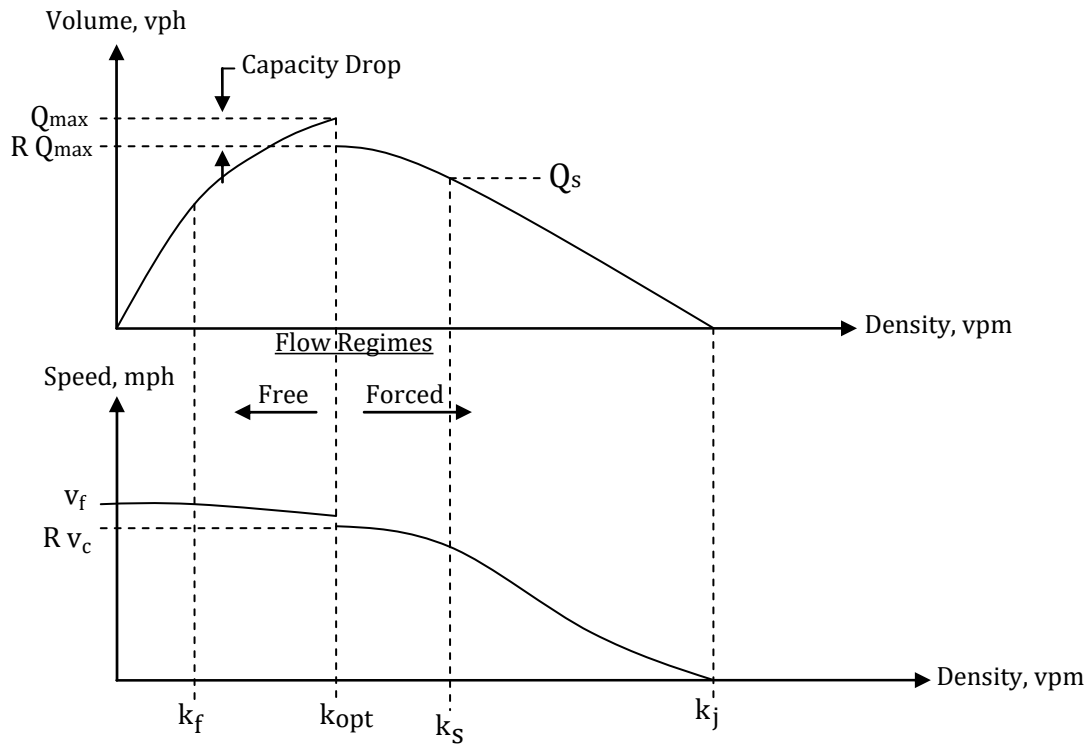


Figure 4-1. Fundamental Diagrams

5 ESTIMATION OF TRIP GENERATION TIME

Federal guidance (see NUREG/CR-7002, Rev. 1) recommends that the ETE study 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 demographic survey. The sum describing the elapsed times of each activity, is 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 Section C of Part IV of Appendix E of 10 CFR 50 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 the state and local offsite agencies. As a Planning Basis, we adopt a conservative posture, in accordance with Section 1.2 of NUREG/CR-7002, Rev. 1, that a rapidly escalating accident at the plant wherein evacuation is ordered promptly, and no early protective actions have been implemented will be considered in calculating the Trip Generation Time.

The following assumptions apply:

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

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 ATE. 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 ATE 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 broadcasted. Thus, the time needed to

complete the mobilization activities and the number of people remaining to evacuate the EPZ after the ATE, will both be somewhat less than the estimates presented in this report. Consequently, the ETE presented in this report are likely to be 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 (ANS) available within the EPZ (e.g., sirens, EAS broadcasts, and loudspeakers).
2. Receiving and correctly interpreting the information that is transmitted.

The population within the EPZ is dispersed over a large area 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 event.

This 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 people 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, Rev. 1, the information required to compute trip generation times is typically obtained from a demographic survey of EPZ permanent residents. Such a demographic survey was conducted in support of this ETE study. Appendix F discusses the survey sampling plan, the number of completed surveys obtained, documents the survey instrument utilized, and provides the 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 ETE 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 demographic 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:

<u>Event Number</u>	<u>Event Description</u>
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 in Table 5-1:

These relationships are shown graphically in Figure 5-1.

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

As such, a completed Activity changes the 'state' of an individual (i.e., 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.

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 operates on distributions – not scalar numbers).

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

Federal regulations (10CFR50 Appendix E, Item IV.D.3) stipulate, "[t]he design objective of the prompt public alert and notification system shall be to have the capability to essentially complete the initial alerting and initiate notification of the public within the plume exposure pathway EPZ within about 15 minutes". Furthermore, Part V, Section B.1, item 3 of the 2019 Federal Emergency Management Agency (FEMA) Radiological Emergency Preparedness Program Manual states that "Notification methods will be established to ensure coverage within 45 minutes of essentially 100% of the population within the entire plume exposure pathway who may not have received the initial notification."

Given the federal regulations and guidance, and the presence of sirens within the EPZ, it is assumed that 100% of the population in the EPZ can be notified within 45 minutes. The notification distribution is provided in Table 5-2. The distribution is plotted in Figure 5-2.

Distribution No. 2, Prepare to Leave Work/School: 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 demographic survey for employees working inside or outside of the EPZ who returns home prior to evacuating. This distribution is also applicable for residents to leave stores, restaurants, parks and other locations within the EPZ. This distribution is plotted in Figure 5-2.

Distribution No. 3, Travel Home: Activity 3 → 4

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

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

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

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 plowing 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. (Note – evacuation may not be a prudent protective action under such blizzard conditions.)

Consequently, it is reasonable to assume that the highway system will remain passable – albeit at a lower capacity – under the vast majority of heavy 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 demographic survey. This distribution is plotted in Figure 5-2 and listed in Table 5-6.

Note that those respondents (5.4%) who answered that they would not take time to clear their driveway were assumed to be ready immediately at the start of this activity. Essentially they would drive through the snow on the driveway to access the roadway and begin their evacuation trip.

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 → 4) must precede Activity 4 → 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 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 5-8 presents a description of each of the final trip generation distributions achieved after the summing process is completed.

5.4.1 Statistical Outliers

As discussed in the footnote to Table 5-3, some portion of the survey respondents answer “Decline to State” 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 three people say “four hours” and four people 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 alternatives 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 access and/or functional 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 non-parametric 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, and Table 5-8);

- 3) Outliers can be eliminated either because the response reflects a special population (e.g., those with access and/or functional 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 3.5 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 in Figure 5-3.
- 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, 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, not 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. Figure 5-4 presents the resultant trip generation distributions for each of the population groups identified. 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 Rev. 1, staged evacuation consists of the following:

1. Protective Action Areas (PAAs) comprising the 2-Mile Region are advised to evacuate immediately
2. PAAs 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 to prepare for an 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%.

Assumptions

1. The EPZ population in PAAs beyond 5 miles will shelter-in-place, with the exception of the 20% non-compliance.
2. The population in the Shadow Region beyond the EPZ boundary, extending to approximately 5 miles radially from the EPZ boundary (approximately 15 miles from the plant - Section 2.2 Item 6), 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 in place.

Procedure

1. Trip generation for population groups in the 2-Mile Region will be as computed based upon the results of the demographic 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 PAAs comprising the 2-Mile Region. This value, T_{Scen}^* , is obtained from simulation results is scenario specific. 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, Rev. 1 uses the statement “approximately 90 percent” as the time to end staging and begin evacuating. The value of T_{Scen}^* is 3:15 for non-heavy snow scenarios and 4:45 for heavy 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 heavy snow conditions
 - d. Residents without returning commuters and heavy snow conditions

Figure 5-5 presents the staged trip generation distributions for both residents with and without returning commuters; the 90th percentile ETE for the 2-Mile Region is approximately 195 minutes for good weather and rain/light snow and approximately 285 minutes for heavy snow scenarios. At the approximate 90th percentile evacuation time for the 2-Mile Region, approximately 20% of the permanent resident 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 30 minutes in non-heavy snow scenarios and 60 minutes in heavy snow scenarios. After $T_{Scen}^* + 30$ in non-heavy snow scenarios (60 in heavy snow scenarios), the remainder of evacuation trips are generated in accordance with the un-staged trip generation distribution.

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

5.4.3 Trip Generation for Waterways and Recreational Areas

Subsection 3.4.f(2) of the Orange County Comprehensive Emergency Management Plan dated June 15th, 2021, states that the United States Coast Guard (USCG) will coordinate the closure of the Hudson River to recreational and commercial waterborne traffic as required. In addition, the Rockland County Radiological Emergency Preparedness Plan (REP) states, “New York State personnel are also available to supplement Rockland and Orange County staffs to process park transients of the Palisades Interstate Park, Harriman State Park, and Bear Mountain State Park, if necessary.”

As indicated in Table 5-2, this study assumes 100% notification in 45 minutes. It is assumed that this timeframe is sufficient for the notification of boaters recreating on the Hudson River and park transients at the state parks of Palisades Interstate, Harriman State and Bear Mountain. Table 5-9 indicates that all transients will have mobilized within 1 hour and 45 minutes. It is assumed that this timeframe is sufficient time for campers, boaters, and other transients to return to their vehicles and begin their evacuation trip.

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

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%

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

Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work	Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work
0	0.0%	35	88.4%
5	24.6%	40	90.8%
10	42.3%	45	93.1%
15	59.6%	50	94.1%
20	67.0%	55	95.2%
25	71.8%	60	99.2%
30	85.1%	75	100.0%

NOTE: The survey data was normalized to distribute the "Decline to State" 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 "Decline to State" responders, if the event takes place, would be the same as those responders who provided estimates.

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

Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work	Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work
0	0.0%	45	60.7%
5	4.5%	50	66.5%
10	11.7%	55	69.7%
15	21.0%	60	80.1%
20	29.1%	75	87.3%
25	36.5%	90	94.5%
30	43.7%	105	97.5%
35	49.5%	120	100.0%
40	55.3%		

NOTE: The survey data was normalized to distribute the "Decline to State" response.

Table 5-5. Time Distribution for Population to Prepare to Leave Home

Elapsed Time (Minutes)	Cumulative Percent Leaving Home	Elapsed Time (Minutes)	Cumulative Percent Leaving Home
0	0%	135	88.7%
15	3.5%	150	90.3%
30	17.1%	165	91.1%
45	30.9%	180	93.0%
60	50.1%	195	96.5%
75	63.1%	210	96.7%
90	68.9%	225	96.8%
105	72.1%	240	98.1%
120	80.4%	255	100.0%

NOTE: The survey data was normalized to distribute the "Decline to State" response.

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

Elapsed Time (Minutes)	Cumulative Percent Completing Snow Removal	Elapsed Time (Minutes)	Cumulative Percent Completing Snow Removal
0	5.4%	105	78.7%
15	15.9%	120	84.5%
30	27.5%	135	94.3%
45	40.4%	150	95.4%
60	59.1%	165	95.4%
75	69.4%	180	98.1%
90	74.9%	210	100.0%

NOTE: The survey data was normalized to distribute the "Decline to State" response

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. 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).

Table 5-9. Trip Generation Histograms for the EPZ Population for Un-Staged Evacuation¹

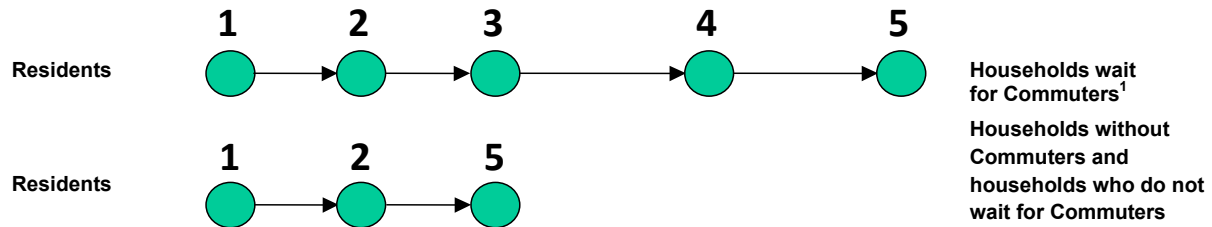
Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period					
		Employees (Distribution A)	Transients (Distribution A)	Residents with Commuters (Distribution C)	Residents Without Commuters (Distribution D)	Residents With Commuters Heavy Snow (Distribution E)	Residents Without Commuters Heavy Snow (Distribution F)
1	30	31%	31%	0%	3%	0%	0%
2	60	68%	68%	9%	52%	1%	14%
3	15	1%	1%	9%	10%	2%	8%
4	15	0%	0%	10%	6%	3%	9%
5	60	0%	0%	39%	20%	24%	32%
6	15	0%	0%	7%	1%	8%	7%
7	30	0%	0%	11%	4%	16%	11%
8	60	0%	0%	10%	4%	24%	12%
9	60	0%	0%	4%	0%	14%	5%
10	30	0%	0%	1%	0%	3%	1%
11	30	0%	0%	0%	0%	3%	1%
12	30	0%	0%	0%	0%	1%	0%
13	15	0%	0%	0%	0%	0%	0%
14	30	0%	0%	0%	0%	1%	0%
15	600	0%	0%	0%	0%	0%	0%

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

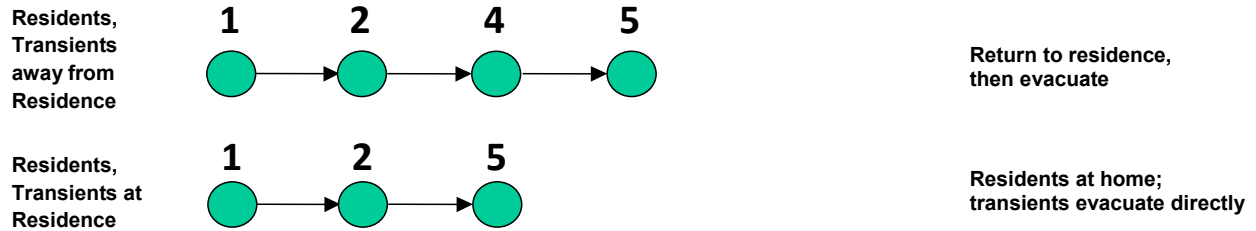
Table 5-10. Trip Generation Histograms for the EPZ Population for Staged Evacuation

Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period*2			
		Residents with Commuters (Distribution C)	Residents Without Commuters (Distribution D)	Residents With Commuters Heavy Snow (Distribution E)	Residents Without Commuters Heavy Snow (Distribution F)
1	30	0%	1%	0%	0%
2	60	2%	10%	0%	3%
3	15	2%	2%	1%	1%
4	15	2%	1%	0%	2%
5	60	7%	4%	5%	7%
6	15	2%	0%	2%	1%
7	30	70%	78%	3%	2%
8	60	10%	4%	5%	3%
9	60	4%	0%	76%	79%
10	30	1%	0%	3%	1%
11	30	0%	0%	3%	1%
12	30	0%	0%	1%	0%
13	15	0%	0%	0%	0%
14	30	0%	0%	1%	0%
15	600	0%	0%	0%	0%

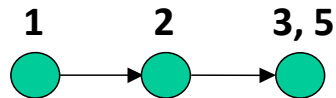
² Trip Generation for Employees and Transients (see Table 5-9) is the same for Un-Staged and Staged Evacuation.



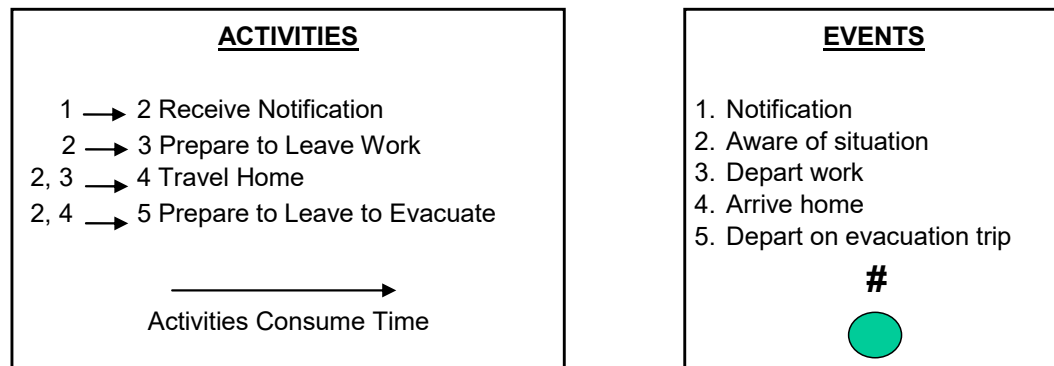
(a) Accident occurs during midweek, at midday; year round



(b) Accident occurs during weekend or during the evening²



(c) Employees who live outside the EPZ



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

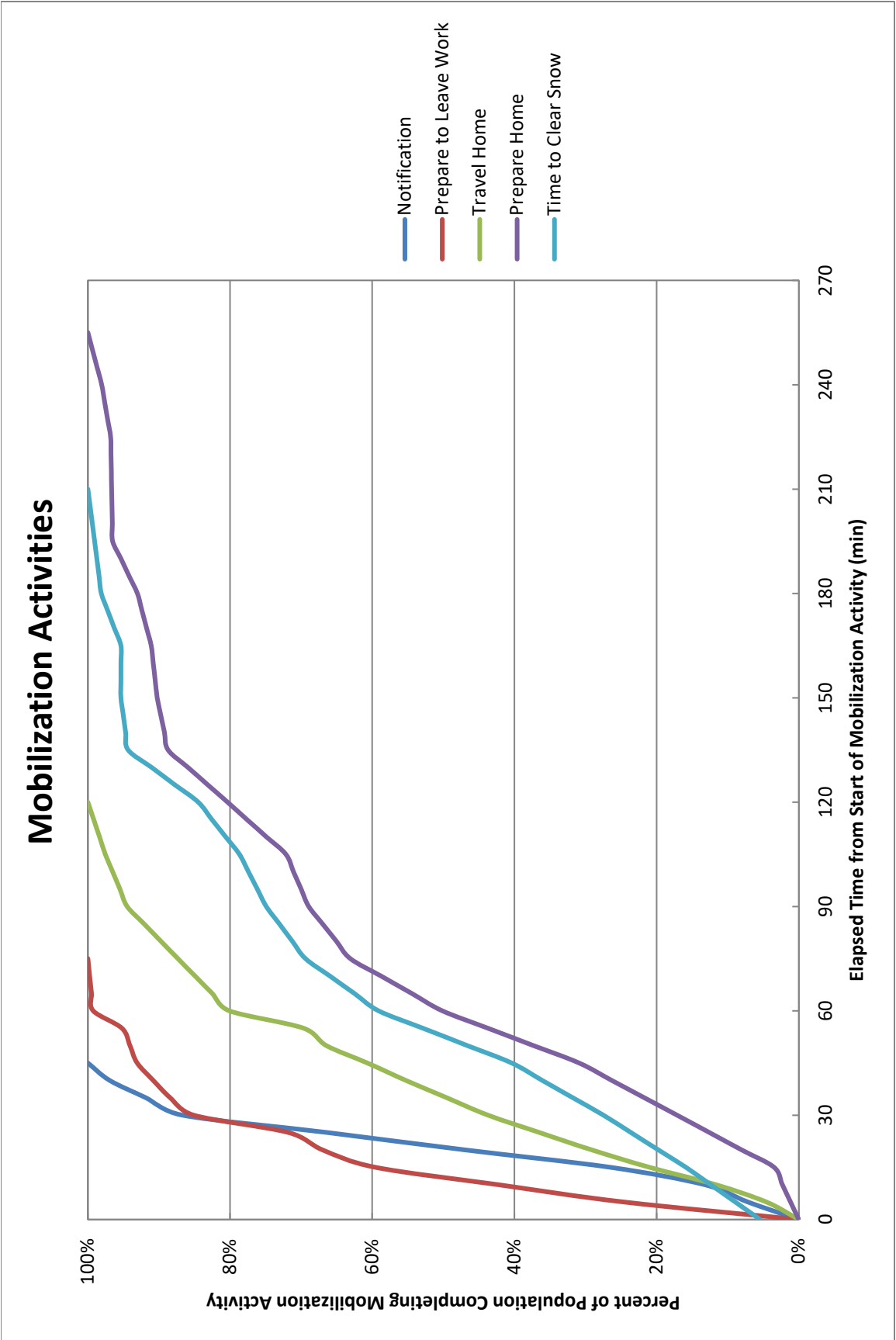


Figure 5-2. Time Distributions for Evacuation Mobilization Activities

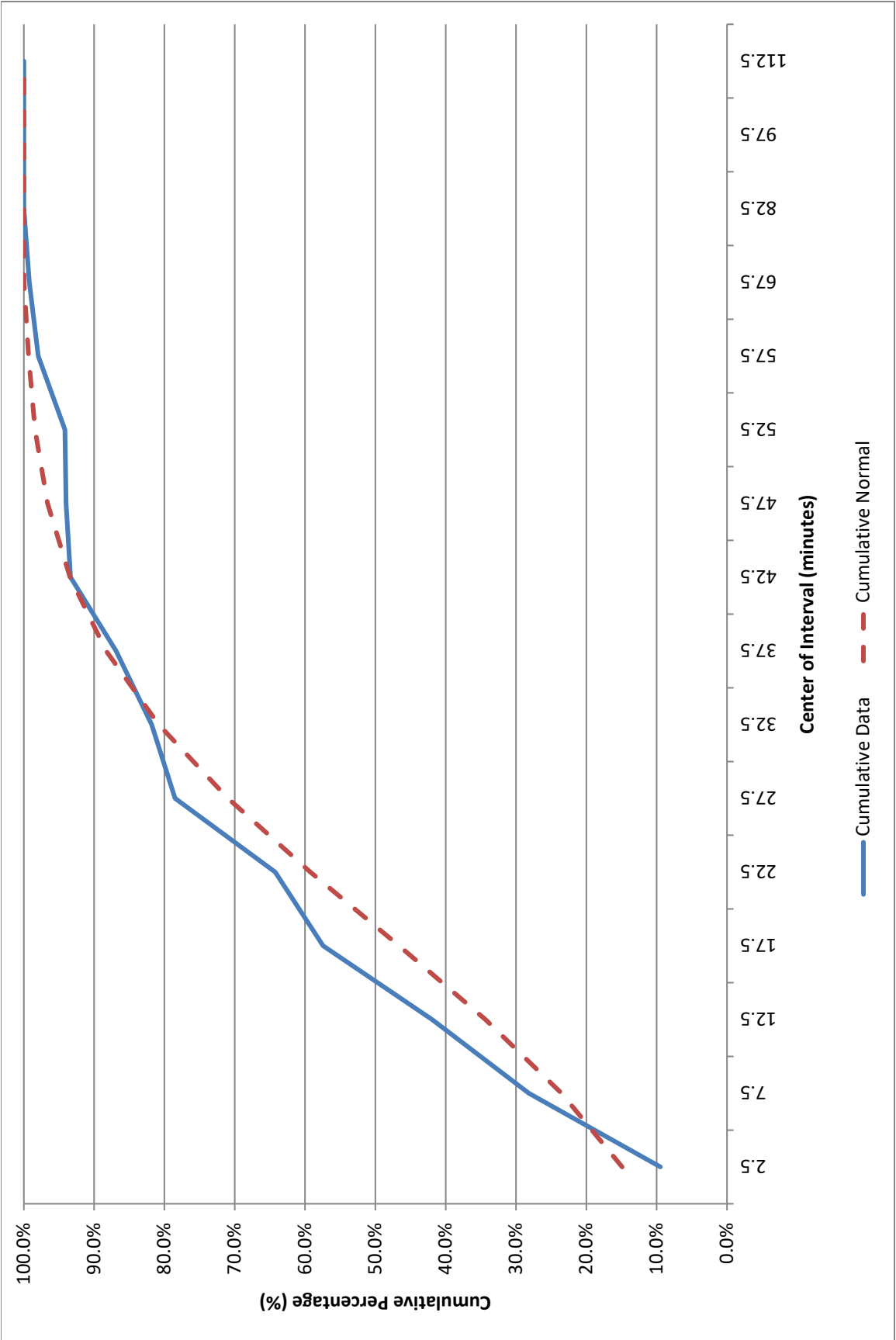


Figure 5-3. Comparison of Data Distribution and Normal Distribution

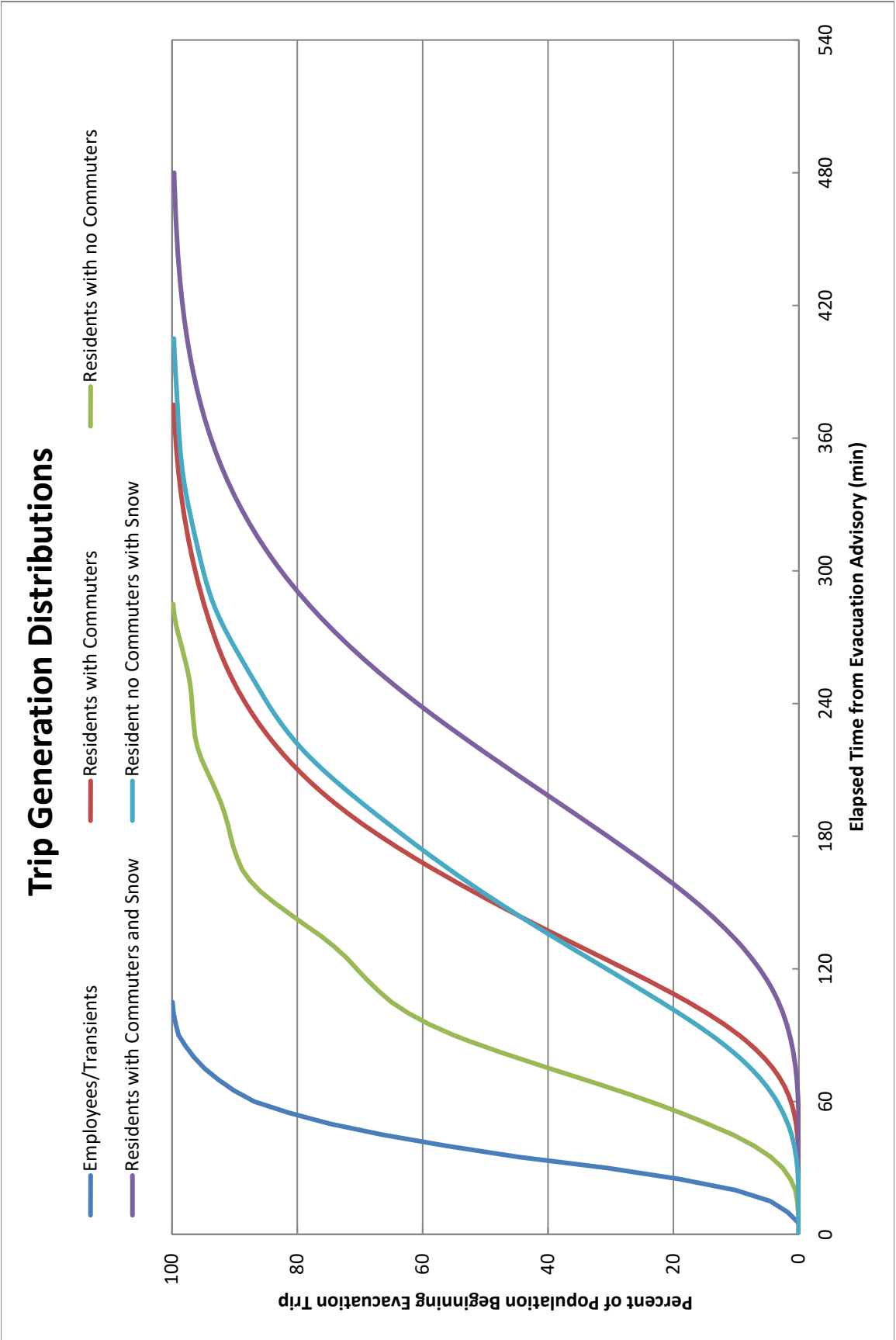


Figure 5-4. Comparison of Trip Generation Distributions

Staged and Un-Staged Evacuation Trip Generation

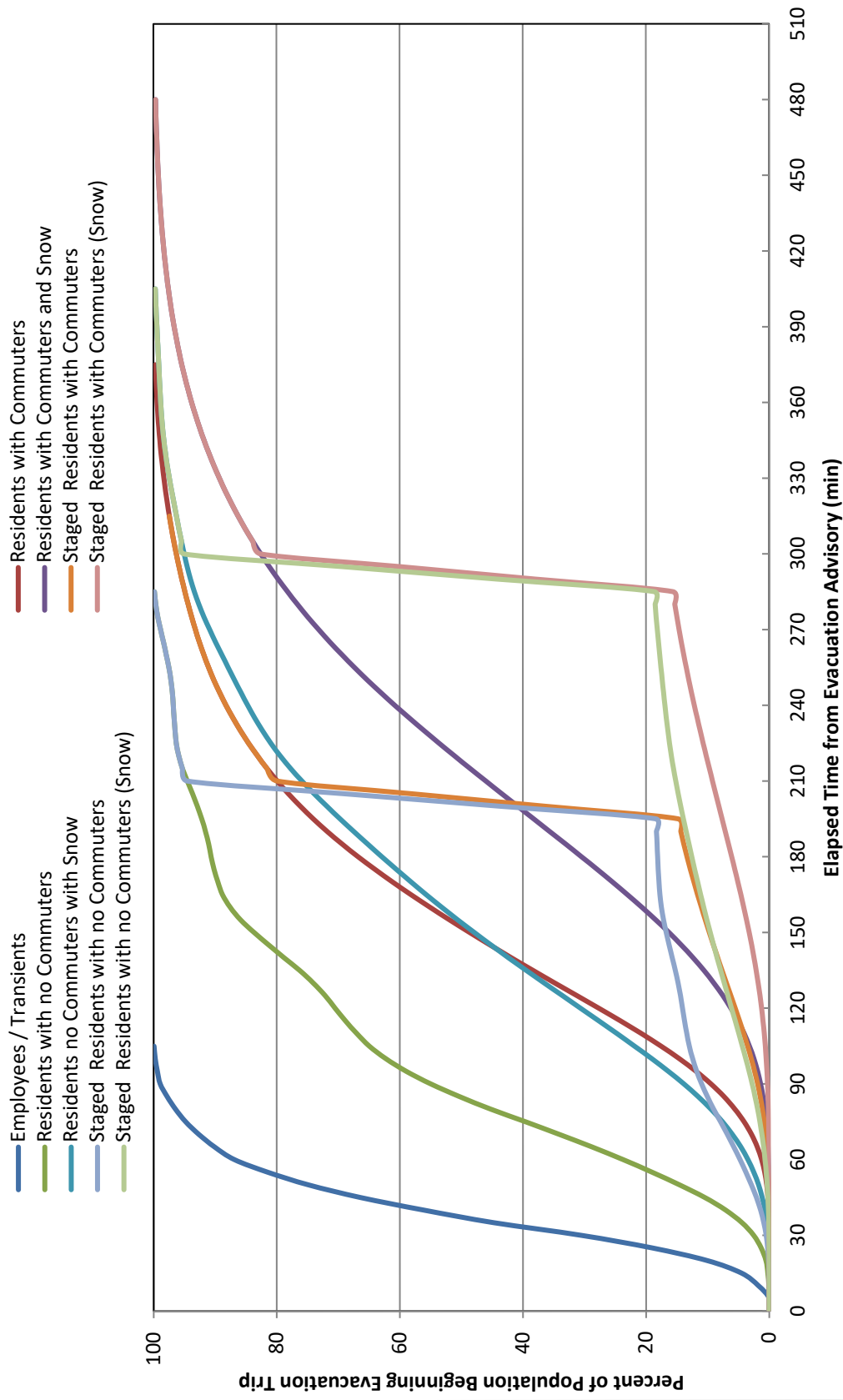


Figure 5-5. Comparison of Staged and Un-staged Trip Generation Distributions in the 2 to 5-Mile Region

6 EVACUATION CASES

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 protective action areas 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 44 Regions were defined which encompass all the groupings of protective action areas considered. These Regions are defined in Table 6-1. Each keyhole sector-based region 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, Rev. 1 guidance. The central sector coincides with the wind direction. These sectors extend to 5 miles downwind from the plant (Regions R04 through R15) or to the EPZ boundary (Regions R16 through R31).

Regions R01, R02 and R03 represent evacuations of circular areas with radii of 2, 5 and 10 miles, respectively. Regions R32 through R44 are identical to Regions R4 through R15 and R2, respectively; however, those protective action areas between 2 miles and 5 miles are staged until 90% of the 2-mile region (Region R01) has evacuated.

A total of 15 Scenarios were evaluated for all Regions. Thus, there are a total of $44 \times 15 = 660$ evacuation cases. Table 6-2 is a description of all Scenarios. Each combination of region and scenario implies a specific population to be evacuated.

The population and vehicle estimates presented in Section 3 and in Appendix E 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 for each population group are presented in Table 6-3, while the Region percentages are provided in Table H-1.

Table 6-4 presents the vehicle counts for each scenario for an evacuation of Region R03 – the entire EPZ, based on the Scenario percentages in Table 6-3. 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 40%, which is the product of 66% (the number of households with at least one commuter) and 61% (the number of households with a commuter who 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 those households with returning commuters (40%) will have a commuter at work during those times, or approximately 4% ($10\% \times 40\% = 4\%$) of households overall.

It can be argued that the 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% of all households vacation for a period over the summer.
- Assume these vacations, in aggregate, are uniformly dispersed over 10 weeks, i.e., 10% 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% 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.

Employment is assumed to be at its peak (100%) during the winter, midweek, midday scenarios. Employment is reduced slightly (96%) for summer, midweek, midday scenarios. This is based on the assumption 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 assumed that those taking vacation will be uniformly dispersed throughout the summer with approximately 4% of employees vacationing each week. It is further assumed that only 10% of the employees are working in the evening and during the weekend.

As shown in Appendix E, there are a significant number of parks and malls within the EPZ; thus, transient activity during weekends during the midday in the summer is at its peak – 100%. Since many of the parks are closed in the winter, transient activity is estimated to be 50% during weekends during the day in the winter. Transient activity on weekdays is estimated to be 65% and 30% during the summer and winter, respectively, since many facilities are open but operate at lower levels than on weekends. Due to the presence of overnight accommodations of campgrounds and lodging facilities, transient activity is at about half midday, weekday conditions during evening hours – 30% in the summer and 15% in the winter.

As noted in the shadow footnote to Table 6-3, the shadow percentages are computed using a base of 20% (see assumption 7 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:

$$20\% \times \left(1 + \frac{20,059}{64,036 + 95,012}\right) = 23\%$$

Two special events – a West Point football game and an event at Croton Point Park – are considered as Scenarios 14 and 15, respectively. Thus, the applicable special event traffic is 100% evacuated for these scenarios, and 0% for all other scenarios.

Schools (including preschools and commuter schools) are in session during the winter season, midweek, midday scenarios. As such, school buses and commuter students are estimated to be entirely present (100%) during winter, midweek, midday scenarios. It is estimated that summer school enrollment is approximately 10% of enrollment during the regular school year for summer, midweek, midday scenarios. Schools are not in session during weekends and evenings, as such school buses and commuter vehicles are assumed to be 0% for weekend and evening scenarios.

Day camps are in session during summer, midweek, midday scenarios. As such, buses serving day camps are all present during summer, midweek, midday scenarios. It is estimated that approximately 10% of day camps are in session during summer weekends. Day camps are not in session during evenings and during winter scenarios; as such, day camps are set to be 0% for evening and winter scenarios.

Transit vehicles for the transit-dependent population and medical facility population are set to 100% for all scenarios as it is assumed that these population groups are present in the EPZ at all times.

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

Region Description Region Number Wind Direction From:	REGION														
	2-Mile Region R01	5-Mile Region R02	Full EPZ R03	2-Mile Region and Sector to 5 Miles											
	N/A	N/A	N/A	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15
PROTECTIVE ACTION AREA															
Briarcliff Manor			X												
Central Town of Clarkstown			X												
Northeastern Town of Ramapo			X												
Northeastern & Eastern Town of Clarkstown			X												
Northwestern Town of Clarkstown			X												
Ossining			X												
Village of Haverstraw		X	X					X	X	X	X				
Town of New Castle (West of Hardscrabble Rd)			X												
Village of West Haverstraw		X	X						X	X	X				
Unincorporated Areas of the Town of Haverstraw		X	X						X	X	X	X			
Town of Tuxedo East of NYS Thruway			X												
Village of Pomona			X												
Grassy Point		X	X					X	X	X	X				
Croton-on-Hudson		X	X				X	X	X						
Stony Point		X	X						X	X	X	X	X		
Verplanck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tompkins Cove	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Buchanan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Montrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jones Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Village of Harriman East of NYS Thruway			X												
City of Peekskill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Town of Cortlandt		X	X	X	X	X	X	X	X						
Bear Mountain State Park	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Harriman State Park		X	X								X	X	X	X	X
Yorktown			X												
Town of Somers (West of Route 118)			X												
Fort Montgomery		X	X	X									X	X	
Southwest Carmel			X												
Village of Highland Falls			X												
Lower Philipstown		X	X	X	X										X
Village - Town of Woodbury			X												
U.S. Military Academy			X												
Southern Putnam Valley			X												
Town of Highlands			X												
Hudson River			X												
Hudson River is cleared/closed and therefore considered 100% evacuated															
Town of Cornwall (South of Angola Rd)			X												
Southern Philipstown			X												
Protective Action Area is not within Plume and Shelters-in-Place															
Protective Action Area is within Plume and Evacuates															

Region Description		REGION													
Region Number		Staged Evacuation - 2 Mile Ring Evacuates, then Sector to 5 Miles Evacuates													
Wind Direction From:		R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42	R43	R44	
PROTECTIVE ACTION AREA		S	SSW, SW	WSW, W	WNW, NW	NNW	N	NNE	NE	ENE	E	ESE	SE, SSE	5-Mile	
Briarcliff Manor															
Central Town of Clarkstown															
Northeastern Town of Ramapo															
Northeastern & Eastern Town of Clarkstown															
Northwestern Town of Clarkstown															
Ossining Town & Village															
Village of Haverstraw					X	X	X	X	X					X	
Town of New Castle (West of Hardscrabble Road)															
Village of West Haverstraw						X	X	X	X					X	
Unincorporated Areas of the Town of Haverstraw						X	X	X	X	X				X	
Town of Tuxedo East of NYS Thruway															
Village of Pomona															
Grassy Point					X	X	X	X	X					X	
Croton-on-Hudson					X	X	X							X	
Stony Point							X	X	X	X	X			X	
Verplanck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Tompkins Cove	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Buchanan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Montrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Jones Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Village of Harriman East of NYS Thruway															
City of Peekskill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Town of Cortlandt	X	X	X	X	X	X	X						X	X	
Bear Mountain State Park	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Harriman State Park									X	X	X	X	X	X	
Yorktown															
Town of Somers (West of Route 118)															
Fort Montgomery	X											X	X	X	
Southwest Carmel															
Village of Highland Falls															
Lower Philipstown	X	X											X	X	
Village - Town of Woodbury															
U.S. Military Academy															
Southern Putnam Valley															
Town of Highlands															
Hudson River															
Hudson River is cleared/closed and therefore considered 100% evacuated															
Town of Cornwall (South of Angola Rd)															
Southern Philipstown															
Protective Action Area Evacuates	Protective Action Area Shelters-in-Place, then Evacuates					Protective Action Area Shelters-in-Place									

Table 6-2. Evacuation Scenario Definitions

Scenarios	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/Light Snow	None
8	Winter	Midweek	Midday	Heavy Snow	None
9	Winter	Weekend	Midday	Good	None
10	Winter	Weekend	Midday	Rain/Light Snow	None
11	Winter	Weekend	Midday	Heavy Snow	None
12	Winter	Midweek, Weekend	Evening	Good	None
13	Winter	Weekend	Midday	Good	West Point Football Game
14	Summer	Weekend	Midday	Good	Event at Croton Point Park
15	Summer	Midweek	Midday	Good	Roadway Impact: Route 6; Route 9W; Palisades Parkway; Taconic Parkway ²

¹ Winter means that school is in session, at normal enrollment levels (also applies to spring and autumn). Summer means that school is in session at summer school enrollment levels (lower than normal enrollment).

² See Section 2.6 for the roads that are closed in each county.

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

Scenario	Households With Returning Commuters	Households Without Returning Commuters	Employees	Transients	Shadow	Event at Croton Point Park	West Point Football Game	Day Camps	School Buses & Commuter Vehicles	Transit Buses & Medical Facilities	External Through Traffic
1	40%	60%	96%	65%	23%	0%	0%	100%	10%	100%	100%
2	40%	60%	96%	65%	23%	0%	0%	100%	10%	100%	100%
3	4%	96%	10%	100%	20%	0%	0%	10%	0%	100%	100%
4	4%	96%	10%	100%	20%	0%	0%	10%	0%	100%	100%
5	4%	96%	10%	30%	20%	0%	0%	0%	0%	100%	40%
6	40%	60%	100%	30%	23%	0%	0%	0%	100%	100%	100%
7	40%	60%	100%	30%	23%	0%	0%	0%	100%	100%	100%
8	40%	60%	100%	30%	23%	0%	0%	0%	100%	100%	100%
9	4%	96%	10%	50%	20%	0%	0%	0%	0%	100%	100%
10	4%	96%	10%	50%	20%	0%	0%	0%	0%	100%	100%
11	4%	96%	10%	50%	20%	0%	0%	0%	0%	100%	100%
12	4%	96%	10%	15%	20%	0%	0%	0%	0%	100%	40%
13	4%	96%	10%	50%	20%	0%	100%	0%	0%	100%	100%
14	4%	96%	10%	100%	20%	100%	0%	10%	0%	100%	100%
15	40%	60%	96%	65%	23%	0%	0%	100%	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, Day Camp, Transit and Medical Vehicles..... Vehicle-equivalents present on the road during evacuation servicing schools, day camps, transit-dependent people and medical facilities (1 bus is equivalent to 2 passenger vehicles).

Commuter Vehicles Personal vehicles used to evacuate by college/university students.

External Through Traffic Traffic on interstates/freeways and major arterial roads at the start of the evacuation. This traffic is stopped by access control 2 hours after the evacuation begins.

Table 6-4. Vehicle Estimates by Scenario³

Scenario	Households With Returning Commuters	Households Without Returning Commuters	Employees	Transients	Shadow	Event at Croton Point Park	West Point Football Game	Medical Facilities	Commuter Students	Day Camps	School Buses	Transit Buses	External Through Traffic	Total Scenario Vehicles
1	64,036	95,012	20,059	14,617	65,866	-	-	781	108	662	306	338	67,760	329,545
2	64,036	95,012	20,059	14,617	65,866	-	-	781	108	662	306	338	67,760	329,545
3	6,404	152,644	2,090	22,487	57,274	-	-	781	-	66	-	338	67,760	309,844
4	6,404	152,644	2,090	22,487	57,274	-	-	781	-	66	-	338	67,760	309,844
5	6,404	152,644	2,090	6,746	57,274	-	-	781	-	-	-	338	27,104	253,381
6	64,036	95,012	20,895	6,746	65,866	-	-	781	1,082	-	3,060	338	67,760	325,576
7	64,036	95,012	20,895	6,746	65,866	-	-	781	1,082	-	3,060	338	67,760	325,576
8	64,036	95,012	20,895	6,746	65,866	-	-	781	1,082	-	3,060	338	67,760	325,576
9	6,404	152,644	2,090	11,244	57,274	-	-	781	-	-	-	338	67,760	298,535
10	6,404	152,644	2,090	11,244	57,274	-	-	781	-	-	-	338	67,760	298,535
11	6,404	152,644	2,090	11,244	57,274	-	-	781	-	-	-	338	67,760	298,535
12	6,404	152,644	2,090	3,373	57,274	-	-	781	-	-	-	338	27,104	250,008
13	6,404	152,644	2,090	11,244	57,274	-	5,000	781	-	-	-	338	67,760	303,535
14	6,404	152,644	2,090	22,487	57,274	3,803	-	781	-	66	-	338	67,760	313,647
15	64,036	95,012	20,059	14,617	65,866	-	-	781	108	662	306	338	67,760	329,545

³ Vehicle estimates are for an evacuation of the entire EPZ (Region R03)

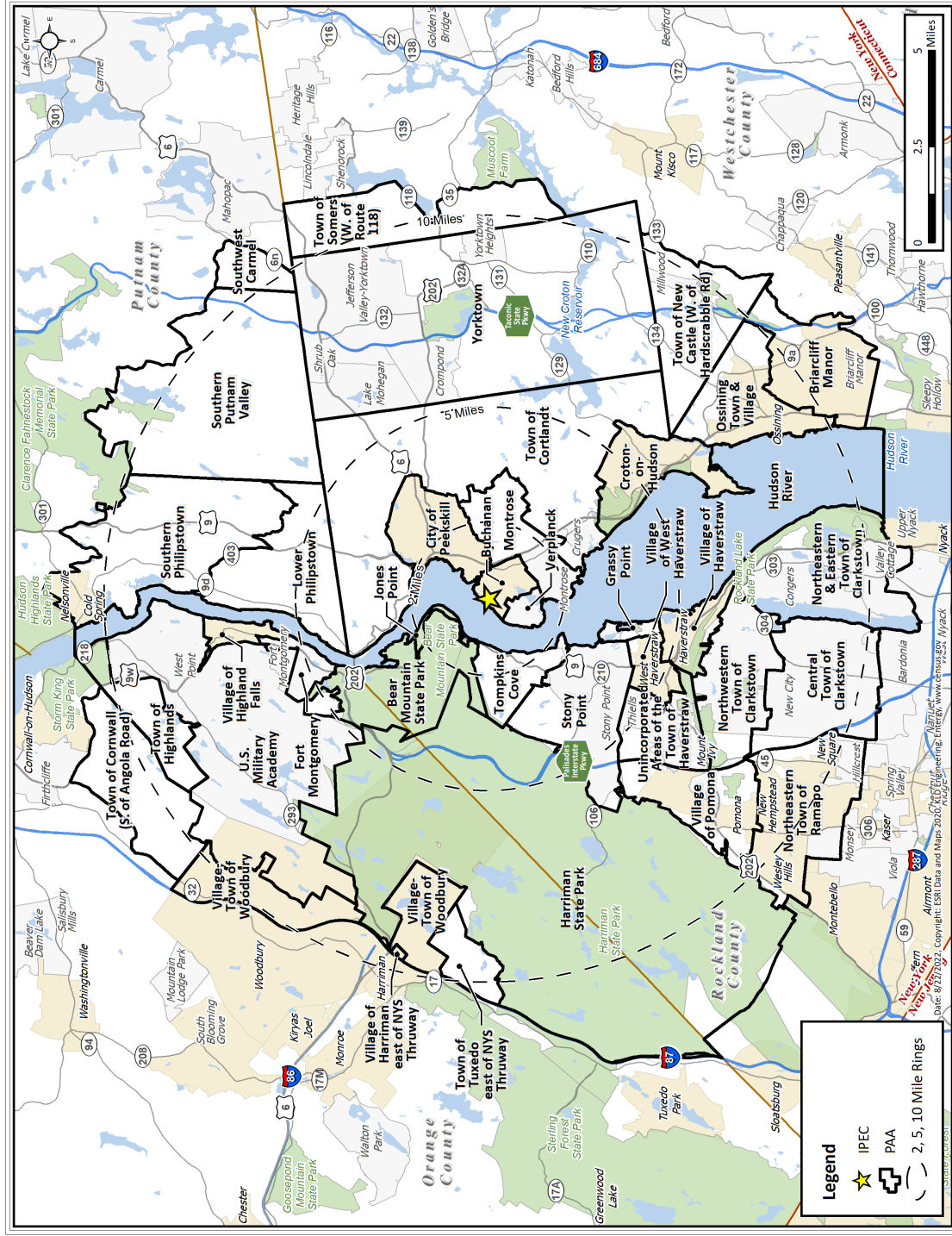


Figure 6-1. Protective Action Areas Comprising the IPEC EPZ

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 44 regions within the IPEC EPZ and the 15 Evacuation Scenarios discussed in Section 6.

The ETE for all Evacuation Cases are presented in Table 7-1 (90th percentile) and Table 7-2 (100th percentile). These tables present the estimated times to clear the indicated population percentages from the Evacuation Regions for all Evacuation Scenarios. The ETE for the 2-mile region in both staged and un-staged regions are presented in Table 7-3 (90th percentile) and Table 7-4 (100th percentile). 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 protective action areas 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 IPEC EPZ addresses the issue of voluntary evacuees in the manner shown in Figure 7-1. Within the EPZ, 20% of people located in protective action areas outside of the evacuation region who are not advised to evacuate, are assumed to elect to evacuate. Similarly, it is assumed that 20% of the permanent residents in the Shadow Region will also 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 a circle with a radius of about 15 miles to the east and west – farther to the north and south. 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 571,667 permanent residents reside in the Shadow Region; 20% 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 IPEC 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, Rev. 1, staged evacuation consists of the following:

1. Protective action areas comprising the 2-Mile Region are advised to evacuate immediately.
2. Protective action areas 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, 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 begin evacuating when approximately 90% of those originally within the 2-Mile Region evacuate crosses the 2-Mile Region boundary.
5. The population between the 5-Mile Region boundary to the full EPZ boundary (approximately 10 miles radially from plant) shelters in place.
6. 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 7-9 illustrate the patterns of traffic congestion at the indicated times that arise for the case when the entire EPZ (Region R03) is advised to evacuate during the summer, midweek, midday period under good weather conditions (Scenario 1).

Traffic congestion, as the term is used here, is defined as Level of Service (LOS) F. LOS F is defined as follows (HCM 2016, page 5-5):

The HCM uses LOS F to define operations that have either broken down (i.e., demand exceeds capacity) or have reached a point that most users would consider unsatisfactory, as described by a specified service measure value (or combination of service measure values). However, analysts may be interested in knowing just how bad the LOS F condition is, particularly for planning applications where different alternatives may be compared. Several measures are available for describing individually, or in combination, the severity of a LOS F condition:

- *Demand-to-capacity ratios* describe the extent to which demand exceeds capacity during the analysis period (e.g., by 1%, 15%).
- *Duration of LOS F* describes how long the condition persists (e.g., 15 min, 1 h, 3 h).
- *Spatial extent measures* describe the areas affected by LOS F conditions. They 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 throughout the EPZ, just 30 minutes after the ATE. At this time, the majority of evacuees are transients and employees who mobilize more quickly. There is no congestion within 2 miles of the plant. The only congestion within 5 miles of the plant is along NY State Route 35 (NY-35) eastbound as vehicles, many of which are evacuating from IPEC, travel towards the Taconic State Parkway (TSP). Beyond 5 miles, congestion exists along NY-9D northbound, US-6 eastbound, NY-9A southbound, I-87 southbound, and several of the southbound routes leaving the Rockland County portion of the EPZ. The Kanawauke Circle (intersection of Seven Lakes Drive and Kanawauke Rd) in Harriman State Park is highly congested as transients visiting the park are evacuating. Finally, US-9W northbound, NY-293 southbound and US-6/NY-17 westbound are congested largely because of the evacuation of West Point.

At one hour after the ATE, Figure 7-4 displays increasing congestion within the study area. There is still no congestion within 2 miles of the plant; however, there is congestion within the 2-mile region which includes the City of Peekskill and extends beyond the 2-mile radius. NY-35 eastbound, US-6 eastbound and the Bear Mountain State Parkway (BMSP) westbound are all congested within the City of Peekskill. Within the 5-mile region, there is pronounced congestion within the Town of Cortlandt along US-6 and US-202/NY-35 eastbound and along US-9, Pump House Rd, and Oregon Rd northbound. Congestion at the Kanawauke Circle in Harriman State Park has intensified as additional evacuees travel westbound and southbound towards the circle. Beyond 5 miles, US-9 southbound through Westchester County is congested from the EPZ boundary to Croton Point Park. NY-9A southbound is also congested from NY-100 to Stormytown Rd. Most of the roads in Putnam County giving access to the TSP are congested. Congestion is pronounced in Rockland County, especially in Haverstraw and West Haverstraw, and along US-9W and NY-45 southbound. Congestion along US-9W northbound, NY-293 southbound, and US-6/NY-17 westbound has intensified as West Point evacuates. Congestion has developed along NY-218 in Highland Falls as West Point evacuees leave Thayer Gate and merge with local traffic from Highland Falls.

At 2 hours after the ATE, Figure 7-5 displays fully developed congestion within the study area. At this time, all external traffic has been stopped by access control. All roads in the 2-mile radius are operating at LOS C or better. Congestion within Peekskill in the 2-mile region has intensified as US-202/NY-35 and US-6 eastbound are congested from near the interchanges with the TSP to the city center. The BMSP is congested in both directions in Peekskill. Highland Ave/Albany Post Rd northbound is congested from the city center to the merge with US-9. Division St/Oregon Rd northbound is congested from the city center to the Putnam/Westchester County line. The routes in Putnam County giving access to the TSP remain highly congested, especially Peekskill Hollow Rd and NY-301. The TSP northbound is also congested from the bend in the road just north of Peekskill Hollow Rd to the Putnam/Westchester County line. Congestion along US-9 and NY-9A southbound now extends from the EPZ boundary to the Town of Cortlandt. Congestion in Rockland County is extensive,

especially in West Haverstraw and Haverstraw. Although the Palisades Interstate Parkway (PIP) is not congested (LOS F conditions) within the EPZ, ramps that allow access to the parkway are congested making the on-ramps the bottlenecks, not the main thoroughfare. There is extensive traffic congestion in the Shadow Region in Rockland as vehicles try to access I-287/I-87. Congestion in Orange County in the vicinity of West Point persists, especially along US-9W northbound and NY-293 southbound. Congestion at the Kanawauke Circle persists, especially in the westbound direction as some traffic from Stony Point is diverting through the park given the extensive congestion in Haverstraw and West Haverstraw.

Figure 7-6 displays congestion at 3 hours and 30 minutes after the ATE. Congestion has migrated away from the plant, as all roads within the 2-mile radius of IPEC are operating at LOS A at this time. The 2-mile region (Region R01 which extends beyond the 2-mile radius) includes Peekskill which still has congestion, though it is dissipating. Similar to the 2-mile region, the only congestion with the 5-mile region (Region R02) is to the northeast leaving Peekskill, in the Town of Cortland and in Lower Philipstown. Congestion along the TSP northbound in Putnam County is dissipating, though the local roads giving access to the TSP are still highly congested. Congestion along US-9 and NY-9A southbound in Westchester has improved with queues now extending from the EPZ boundary to the split of US-9 and NY-9A in Ossining. I-84 eastbound and I-684 northbound are highly congested from the interchange of the two interstates. Congestion in Rockland County remains extensive along all southbound routes leaving the EPZ. Congestion has dissipated in Stony Point and is dissipating in Haverstraw and West Haverstraw. Congestion persists westbound at the Kanawauke Circle as the last of the congestion diverts from Stony Point. Congestion persists in the vicinity of West Point along US-9W northbound and NY-293 southbound.

Over the next hour (by 4:30 after the ATE), the 2-mile region (Peekskill) clears of congestion, as shown in Figure 7-7. Congestion within the 5-mile region persists along NY-9D northbound, US-6 eastbound, and Lexington Ave southbound. Congestion in Putnam County is still extensive as evacuees from Westchester County divert to the north to avoid congestion along US-6 and US-202/NY-35 eastbound. I-84 eastbound and I-684 northbound are still congested, though that congestion is dissipating. Congestion persists along US-9 southbound as vehicles continue to evacuate from Ossining and Croton-on-Hudson. There is a lane drop along US-9 southbound in Scarborough just before the EPZ boundary, which acts as a significant bottleneck. This bottleneck prolongs the ETE for Ossining and Briarcliff Manor. Congestion near West Point has almost fully dissipated as US-9W northbound is the only remaining congested route. Congestion in Rockland County has dissipated significantly as roadways in Haverstraw, West Haverstraw and Stony Point are all operating at LOS A or B. The majority of the congestion in Rockland County persists within the shadow region; however, the PIP southbound is operating at LOS F conditions within the EPZ. Congestion on the PIP southbound extends from the New York/New Jersey State line to the Village of Pomona. The last of the congestion westbound at the Kanawauke Circle is also dissipating.

Figure 7-8 displays the last remnants of traffic congestion within the EPZ at 5 hours and 30 minutes after the ATE. Congestion only persists in Briarcliff Manor along US-9 southbound and in Southern Putnam Valley along Dennytown Road and Oscawana Lake Road northbound.

Route 9D northbound is operating at LOS E (capacity) through Cold Spring. There are no congested roadways within the Orange County or Rockland County portions of the EPZ. Congestion along US-9 southbound in Westchester County clears 10 minutes later at 5 hours and 40 minutes after the ATE.

Finally, Figure 7-9 displays an EPZ that is essentially clear of evacuating traffic, at 6:30 after the ATE. The last route to clear in the EPZ is Peekskill Hollow Rd northbound. The last remnants of congestion in the Shadow Region are along NY-301 to access the TSP, I-684 northbound, NY-52 northbound near I-84 and NY-306 southbound leaving Rockland County. Traffic congestion within the study area clears at 7:35 after the ATE; I-684 northbound is the last route to clear.

7.4 Evacuation Rates

Evacuation is a continuous process, as implied by Figure 7-10 through Figure 7-24. 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 7-10, 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 evacuees (those with the longest mobilization times) travel freely out of the EPZ.

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 44 Evacuation Regions and all 15 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% 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% 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% 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% 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 7-9. Congestion exists throughout the EPZ, but intensifies the farther you get from the plant; this is reflected in the ETE statistics:

- The 90th percentile ETE for Region R01 (2-mile region) is approximately 45 minutes shorter, on average, than Region R02 (5-mile region) and ranges from 2:55 (hr:min) to 3:25 (longer for heavy snow).
- The 90th percentile ETE for Region R02 is approximately 30 minutes shorter than Region R03 (full EPZ), on average, and generally ranges from 3:35 to 4:20 (longer for heavy snow).
- The 90th percentile ETE for Region R03 generally range between 4:00 and 4:50 (longer for heavy snow and the roadway impact).

Comparison of Scenarios 9 and 13 in Table 7-1 indicates that a West Point Football Game has little impact on the ETE for the 90th percentile. The additional 5,000 vehicles present for the game increase congestion on the local roads exiting West Point's campus, US-9W and NY-293. However, the spectators at the event are fast mobilizing transients and are located a few miles from the EPZ boundary. As a result, the ETE for the 2-mile region (Region R01), 5-mile Region (Region R02) and entire EPZ (Region R03) increase by at most 10 minutes. The 90th percentile ETE for several regions decreases for the special event by up to 10 minutes. This anomaly is due to the fact that there are many additional transient vehicles evacuating from West Point which mobilize more quickly than residents and help to reach the 90th percentile earlier. Those regions wherein the 2-mile radius evacuates and downwind to the EPZ boundary, which include West Point and/or the Town of Highlands, Harriman State Park, the Town of Cornwall and the Village/Town of Woodbury (Regions R16, R29 through R31) increase by at most 50 minutes due to the additional transient vehicles and the resulting congestion. The 90th percentile ETE for the remaining regions are not significantly impacted because congestion in Rockland County and in northern Westchester County/Putnam County dictates the ETE. The 100th percentile ETE is only impacted for Region R03, increasing by 15 minutes as congestion from the football game is the last congestion to clear in the EPZ.

Comparison of Scenarios 3 and 14 in Table 7-1 indicates that an event at Croton Point Park has little impact on the ETE for the 90th percentile. The additional 3,803 vehicles present for the

event must all exit the park on Croton Point Avenue. However, the event attendees are fast mobilizing transients with ready access to US-9 southbound. As a result, the ETE for the 2-mile Region (Region R01) and 5-Mile Region (Region R02) are not affected (as is to be expected given the event is well beyond 5-miles from the plant), while the ETE entire EPZ (Region R03) increases by only 5 minutes. The 90th percentile ETE for several regions decreases for the special event by at most 10 minutes. This anomaly is due to the fact that there are many additional transient vehicles evacuating from the park which mobilize more quickly than residents and help to reach the 90th percentile earlier. Those regions wherein the 2-mile radius evacuates and downwind to the EPZ boundary, which include Briarcliff Manor and Ossining (Regions R21 through R24) increase by at most 15 minutes. Briarcliff Manor and Ossining are south of Croton Point Park. Evacuees from these protective action areas congest US-9 and NY-9A southbound, which delays evacuees from Croton Point Park and prolongs ETE. The 100th percentile ETE are not impacted.

Comparison of Scenarios 1 and 15 in Table 7-1 indicates that the roadway closures on US-6, US-9W, PIP and TSP do have a material impact on 90th percentile ETE for the full EPZ and for keyhole regions with wind from the south through east-northeast (Regions R16 through R27), with increases of up to 1 hour and 5 minutes. With a lane closed on these major evacuation routes, the capacity is significantly reduced, increasing congestion and prolonging ETE. These routes service a large number of vehicles under normal conditions. The 100th percentile ETE increase by up to 2 hours and 20 minutes for the roadway impact scenario as the congestion along the routes with lanes closed is the last congestion in the EPZ to clear.

The results of the roadway impact scenario indicate that events such as adverse weather or traffic accidents which close a lane on these major evacuation routes could significantly impact ETE. State and local police could consider traffic management tactics such as using the shoulder of the roadway as a travel lane or re-routing of traffic along other evacuation routes to avoid the roadway/lane closures. All efforts should be made to remove any blockage quickly.

7.6 Staged Evacuation Results

Table 7-3 and Table 7-4 present a comparison of the ETE compiled for the concurrent (unstaged) and staged evacuation cases. Note that Regions R32 through R44 are the same geographic areas as Regions R04 through R15 and R02, respectively. The ETEs shown in Table 7-3 and Table 7-4 are the times to clear the 2-mile region when evacuating the region shown in each row.

To determine whether a staged evacuation strategy is worthy of consideration, it must be shown that the ETE for the 2-mile region does not significantly increase (30 minutes or 25%, whichever is less, per federal guidance) when evacuating areas beyond the 2-mile region. When evacuating protective action areas beyond 2-miles (R04 through R15 and R32 through R44), the ETE for the 2-mile region increases by as much as 1 hour and 25 minutes as shown in Table 7-3. This is due to the traffic congestion in Peekskill (which is within the 2-mile region) and along US-9 southbound through the Town of Cortlandt. As discussed in Section 7.3 and shown in Figure 7-6, traffic congestion in Peekskill persists for more than 3 hours and 30 minutes when

evacuating the entire EPZ (Region R03). Traffic congestion along US-9 southbound through the Town of Cortlandt also persists for about 3 hours and 30 minutes and delays the egress of those evacuees from within the 2-mile region. When only the 2-mile region is evacuated, the additional vehicles evacuating from surrounding protective action areas are not on the roadways and the 2-mile region evacuees are not delayed.

Note that those Regions (R04 through R09, R15) with wind from the southeast through the north (wind blowing over Westchester and Putnam Counties) have a significant impact on the 2-mile region ETE whereas those regions with wind blowing over Rockland County (R10 through R14) do not have a significant impact (at most 10-minute increases) on the ETE for the 2-mile region. Again, this is due to the congestion in Peekskill and in the Town of Cortlandt. When the wind is blowing over Putnam and Westchester Counties, evacuees from protective action areas beyond 2 miles (Town of Cortlandt, Lower Philipstown, Croton-on-Hudson) congest the roadways and slow down the 2-mile evacuation. As shown in Table 7-4, the 100th percentile ETE for the 2-mile region are not impacted when protective action areas beyond the 2-mile region are evacuated.

To determine whether a staged evacuation strategy is worthy of consideration, it must also be shown that the ETE for the people beyond 2 miles does not significantly increase (30 minutes or 25%, whichever is less, per federal guidance) when staging the evacuation (advising those beyond 2 miles to shelter-in-place while the 2-mile region evacuates). A comparison of ETE for geographically identical regions – R32 through R43, R44 – with the respective ETE for R04 through R15, R02 in Table 7-1 reveals that staging prolongs the 90th percentile ETE for those in the 2 to 5-mile region by up to 2 hours and 20 minutes. This extension of ETE is due to the delay in beginning the evacuation trip, experienced by those who shelter, plus the effect of the trip-generation “spike” (significant volume of traffic beginning the evacuation trip at the same time – see Figure 5-5) that follows their eventual ATE, in creating congestion within the EPZ area beyond 2 miles. The 100th percentile ETE for those evacuating downwind to 5 miles is also increased by up to 50 minutes for regions (R09 through R11) which include Haverstraw and West Haverstraw.

In summary, a staged evacuation protective action strategy is beneficial to the evacuees within 2 miles of the IPEC; however, a staged evacuation adversely impacts many evacuees located beyond 2 miles from the IPEC. These results would lead to a staged evacuation protective action strategy not being recommended for this site based on the guidance in NUREG-0654, Supplement 3.

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/Light Snow
 - Heavy Snow
- Special Events (as applicable)
 - West Point Football Game
 - Croton Point Park Event
 - Road Closure (One lane closed on Route 6, Route 9W, Palisades Parkway, Taconic Parkway)
- 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) or (4) apply.
 - The conditions of a winter evening (either midweek or weekend) and rain/light snow are not explicitly identified in the tables. For these conditions, Scenarios (7) or (10) for rain/light snow apply.
 - The conditions of a winter evening (either midweek or weekend) and heavy snow are not explicitly identified in the tables. For these conditions, Scenarios (8) or (11) for heavy snow apply.
 - The seasons are defined as follows:
 - Summer assumes that public schools are in session at summer school enrollment levels (lower than normal enrollment).
 - Winter (includes Spring and Autumn) assumes that public schools are in session, at normal enrollment levels.
 - 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 S, SSW, SW, ...
 - 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 through R15)
 - To EPZ Boundary (Regions R03, R16 through R31)
- Enter Table 7-5 and identify the Evacuation Region identifier in that row, based on the azimuth direction of the plume, labeled “Wind Direction From”. The shaded areas in that column identify the protective action areas to be evacuated.
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 and Table 7-2 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 southwest (SW).
- Wind speed is such that the distance to be evacuated is judged to be the 2-mile region and downwind to 10 miles (to the EPZ boundary).
- The desired ETE is that value needed to evacuate 90% 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 “2-Mile Region and Sector to 10 Miles/EPZ” for wind direction from the SW and read Region R18 in the third column.
3. Enter Table 7-1 to locate the data cell containing the value of ETE for Scenario 4 and Region R18. This data cell is in column (4) and in the row for Region R18; it contains the ETE value of **4:40**.

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		Midweek		Midweek		Midweek		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Region	Midday		Midday		Evening		Midday		Midday		Evening		Midday		Midday	
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Special Event	Special Event	Special Event	Midweek Impact
	Entire 2-Mile Region, 5-Mile Region, and EPZ															
R01	3:20	3:25	2:50	2:55	3:00	3:25	3:25	4:45	2:55	2:55	4:20	3:00	3:00	2:50	3:20	3:20
R02	4:00	4:20	3:35	4:05	3:35	3:55	4:15	5:25	3:35	3:55	5:00	3:40	3:40	3:45	4:00	4:00
R03	4:25	4:50	4:10	4:30	4:00	4:25	4:50	5:45	4:00	4:20	5:30	4:00	4:10	4:15	5:05	5:05
Evacuate 2-Mile Region and Downwind to 5 Miles																
R04	4:15	4:25	3:40	4:05	3:40	4:00	4:25	5:30	3:35	4:00	5:00	3:45	3:35	3:40	4:15	4:15
R05	4:15	4:30	3:40	4:00	3:45	4:05	4:35	5:30	3:35	4:00	5:00	3:40	3:35	3:40	4:15	4:15
R06	4:10	4:20	3:40	4:05	3:40	4:05	4:25	5:35	3:35	3:55	4:55	3:45	3:35	3:30	4:10	4:10
R07	4:00	4:20	3:35	4:00	3:40	4:00	4:20	5:35	3:35	3:55	5:05	3:35	3:35	3:35	4:00	4:00
R08	4:05	4:20	3:35	3:55	3:40	3:55	4:15	5:35	3:35	3:55	5:05	3:35	3:35	3:35	4:05	4:05
R09	3:55	4:10	3:35	3:55	3:35	3:55	4:10	5:20	3:30	3:50	4:55	3:35	3:30	3:35	3:55	3:55
R10	3:40	3:45	3:15	3:30	3:25	3:35	3:45	5:05	3:15	3:30	4:45	3:25	3:15	3:15	3:40	3:40
R11	3:45	3:55	3:25	3:45	3:25	3:35	3:45	5:05	3:25	3:35	4:55	3:25	3:25	3:25	3:45	3:45
R12	3:40	3:40	3:10	3:25	3:00	3:25	3:35	4:45	3:05	3:20	4:25	3:05	3:05	3:00	3:40	3:40
R13	3:40	3:40	3:20	3:30	3:05	3:30	3:30	4:45	3:05	3:20	4:35	3:00	3:05	3:15	3:40	3:40
R14	3:30	3:30	3:10	3:30	2:55	3:20	3:20	4:40	2:50	2:55	4:15	2:55	2:50	3:00	3:30	3:30
R15	4:05	4:20	3:40	4:10	3:45	4:00	4:20	5:25	3:35	4:00	4:55	3:40	3:30	3:40	4:05	4:05
Evacuate 2-Mile Region and Downwind to EPZ Boundary																
R16	4:50	4:55	4:25	4:35	4:30	4:40	5:15	6:10	4:25	4:40	5:45	4:30	4:35	4:25	5:15	5:15
R17	4:30	4:50	4:20	4:40	4:20	4:40	4:55	5:45	4:20	4:45	5:45	4:25	4:15	4:20	5:35	5:35
R18	4:35	4:50	4:20	4:40	4:25	4:40	5:00	5:55	4:20	4:45	5:45	4:15	4:20	4:20	5:35	5:35
R19	4:15	4:40	4:00	4:25	4:00	4:20	4:40	5:35	4:05	4:10	5:20	4:05	4:05	4:00	5:05	5:05
R20	4:00	4:20	3:35	3:55	3:35	4:10	4:20	5:25	3:40	4:15	5:00	3:35	3:40	3:35	4:35	4:35
R21	4:05	4:40	3:50	4:15	3:50	4:10	4:30	5:35	3:45	4:10	5:15	3:45	3:45	4:05	4:40	4:40
R22	4:00	4:30	3:45	4:05	3:45	4:10	4:20	5:25	3:45	4:05	5:05	3:45	3:40	3:55	4:40	4:40
R23	4:00	4:15	3:40	4:00	3:45	4:05	4:15	5:20	3:35	3:55	5:05	3:45	3:35	3:55	4:35	4:35
R24	4:10	4:30	3:45	4:00	3:50	4:15	4:35	5:40	3:45	4:05	5:10	3:55	3:45	3:55	4:30	4:30
R25	4:05	4:25	3:45	3:55	3:45	4:05	4:25	5:20	3:40	4:00	5:05	3:45	3:40	3:45	4:40	4:40
R26	4:05	4:25	3:40	4:00	3:35	4:00	4:20	5:15	3:35	3:50	5:00	3:35	3:30	3:40	4:40	4:40

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer		Summer	
	Midweek		Weekend		Midweek		Midweek		Midweek		Weekend		Weekend		Midweek		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Region	Midday		Midday		Evening	Midday		Midday		Midday		Evening	Midday		Evening	Midday		Evening
	Good Weather	Rain	Good Weather	Rain		Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow		Good Weather	Rain/Light Snow		Good Weather	Rain/Light Snow	
R27	3:40	3:50	3:25	3:25	3:15	3:40	3:45	4:55	3:15	3:15	4:35	3:15	3:15	3:25	3:15	3:15	3:25	4:00
R28	3:40	3:40	3:25	3:30	3:05	3:25	3:30	4:50	3:10	3:10	4:35	3:00	3:10	3:25	3:00	3:10	3:25	3:40
R29	3:55	4:10	3:45	3:55	3:00	3:55	3:55	5:10	3:05	3:20	4:35	3:00	3:55	3:45	3:00	3:55	3:45	3:55
R30	4:20	4:35	4:00	4:30	3:35	4:15	4:35	5:35	3:40	4:00	5:05	3:35	3:55	4:00	3:35	3:55	4:00	4:20
R31	4:25	4:45	4:10	4:40	3:50	4:25	4:55	5:55	3:50	4:20	5:20	3:55	4:20	4:10	3:55	4:20	4:10	4:25
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																		
R32	4:30	4:50	4:15	4:40	4:25	4:25	4:45	6:10	4:25	4:40	6:00	4:25	4:15	4:15	4:25	4:15	4:15	4:30
R33	4:30	5:00	4:15	4:35	4:25	4:30	4:45	6:10	4:25	4:50	6:00	4:25	4:15	4:15	4:25	4:15	4:15	4:30
R34	4:20	4:40	4:15	4:20	4:20	4:25	4:40	5:55	4:20	4:25	5:50	4:15	4:10	4:15	4:15	4:15	4:15	4:20
R35	4:25	4:30	4:20	4:20	4:20	4:20	4:45	6:05	4:20	4:25	5:55	4:15	4:20	4:20	4:15	4:20	4:20	4:25
R36	4:35	4:45	4:30	4:30	4:30	4:30	4:45	6:15	4:30	4:35	6:10	4:25	4:30	4:30	4:25	4:30	4:30	4:35
R37	5:00	5:15	5:00	5:15	5:05	5:00	5:15	6:55	4:55	5:10	6:55	5:00	4:55	5:00	5:00	5:00	5:00	5:00
R38	5:05	5:20	5:00	5:15	5:05	5:05	5:15	7:10	5:00	5:15	7:05	5:05	5:00	5:00	5:05	5:00	5:00	5:05
R39	5:05	5:15	5:00	5:15	5:05	5:05	5:15	7:05	5:05	5:15	7:05	5:05	5:05	5:00	5:05	5:00	5:00	5:05
R40	4:25	4:30	4:25	4:30	4:25	4:25	4:35	6:20	4:20	4:25	6:15	4:25	4:15	4:25	4:25	4:25	4:25	4:25
R41	4:10	4:10	3:50	4:00	4:00	4:00	4:15	5:45	3:50	3:55	5:35	4:00	3:50	3:50	4:00	3:50	3:50	4:10
R42	3:35	3:35	3:20	3:30	3:25	3:40	3:40	5:00	3:15	3:15	4:40	3:30	3:15	3:20	3:30	3:20	3:20	3:35
R43	4:25	4:45	4:10	4:25	4:15	4:20	4:55	6:10	4:20	4:35	5:55	4:20	4:15	4:10	4:20	4:10	4:10	4:25
R44	5:00	5:15	5:00	5:20	4:55	5:00	5:15	7:00	5:00	5:10	6:50	5:00	5:00	5:00	5:00	5:00	5:00	5:00

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

	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer		Summer	
	Midweek		Weekend		Midweek		Midweek		Midweek		Midweek		Midweek		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)			
Region	Midday		Midday		Evening		Midday		Midday		Evening		Midday		Midday		Midday	
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Good Weather	Special Event	Special Event	Special Event	Roadway Impact	
	Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:15	6:20	
R02	6:25	6:25	6:20	6:20	6:20	6:20	6:25	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:25	
R03	6:30	6:30	6:30	7:05	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:50	
Evacuate 2-Mile Region and Downwind to 5 Miles																		
R04	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R05	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R06	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R07	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R08	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R09	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R10	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R11	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R12	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R13	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R14	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
R15	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	
Evacuate 2-Mile Region and Downwind to EPZ Boundary																		
R16	6:30	6:30	6:30	6:35	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:25	
R17	6:30	6:30	6:30	6:45	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:35	
R18	6:30	6:30	6:30	6:40	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:35	
R19	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:25	
R20	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:55	
R21	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:10	
R22	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:50	
R23	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:10	
R24	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:05	
R25	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	8:10	
R26	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	7:25	

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer		Summer	
	Midweek		Weekend		Midweek		Midweek		Midweek		Weekend		Weekend		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Region	Midday		Midday		Evening	Midday		Midday		Midday		Evening	Midday		Evening	Midday		Evening
	Good Weather	Rain	Good Weather	Rain		Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow		Good Weather	Rain/Light Snow		Good Weather	Rain/Light Snow	
R27	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R28	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R29	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R30	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
R31	6:30	6:30	6:30	6:30	6:30	6:30	6:30	8:10	6:30	6:30	8:10	6:30	6:30	6:30	6:30	6:30	6:30	6:30
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																		
R32	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R33	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R34	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R35	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R36	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R37	6:20	6:50	6:20	6:55	6:20	6:20	6:45	8:55	6:20	6:40	8:50	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R38	6:20	6:50	6:20	6:50	6:20	6:20	6:45	8:50	6:20	6:45	8:55	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R39	6:20	6:45	6:20	6:45	6:20	6:20	6:45	8:55	6:20	6:45	8:50	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R40	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R41	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R42	6:20	6:20	6:20	6:20	6:20	6:20	6:20	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R43	6:20	6:20	6:20	6:20	6:20	6:20	6:40	8:05	6:20	6:20	8:05	6:20	6:20	6:20	6:20	6:20	6:20	6:20
R44	6:25	6:45	6:20	6:55	6:20	6:20	6:45	8:55	6:20	6:45	8:55	6:20	6:20	6:20	6:20	6:20	6:20	6:25

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

	Summer		Summer		Summer	Winter			Winter			Winter			Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend	Midweek			Midweek			Weekend			Midweek Weekend	Weekend	Weekend	
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)			
Region	Midday		Midday		Evening	Midday			Midday			Evening	Midday	Midday	Midday			
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Special Event	Special Event	Special Event	Roadway Impact		
Entire 2-Mile Region, 5-Mile Region, and EPZ																		
R01	3:20	3:25	2:55	2:55	3:00	3:25	3:25	4:45	2:55	2:55	4:20	3:00	3:00	2:55	3:20			
R02	3:45	4:05	3:10	3:40	3:20	3:35	4:10	5:00	3:15	3:45	4:30	3:10	3:10	3:10	3:30			
Evacuate 2-Mile Region and Downwind to 5 Miles																		
R04	3:45	3:55	3:10	3:45	3:20	3:35	3:55	4:50	3:05	3:40	4:30	3:20	3:10	3:10	3:30			
R05	3:50	4:05	3:10	3:40	3:20	3:40	4:10	4:55	3:05	3:45	4:25	3:15	3:05	3:05	3:35			
R06	3:50	4:00	3:15	3:45	3:15	3:35	4:05	5:00	3:10	3:50	4:25	3:15	3:10	3:15	3:30			
R07	3:40	4:00	3:20	3:45	3:15	3:40	4:00	5:10	3:05	3:40	4:35	3:10	3:05	3:05	3:30			
R08	3:45	4:05	3:15	3:45	3:15	3:35	3:55	5:10	3:05	3:40	4:45	3:20	3:05	3:15	3:30			
R09	3:55	4:00	3:10	3:50	3:20	3:40	4:25	5:00	3:10	3:35	4:40	3:20	3:20	3:15	3:35			
R10	3:25	3:25	2:50	2:55	3:00	3:25	3:30	4:45	2:55	2:55	4:20	3:00	2:55	2:50	3:30			
R11	3:25	3:25	2:55	3:00	3:00	3:25	3:20	4:45	2:55	3:05	4:20	3:00	2:55	2:55	3:25			
R12	3:25	3:25	2:55	3:00	2:55	3:25	3:30	4:40	2:50	3:00	4:20	3:05	2:50	2:50	3:25			
R13	3:25	3:25	2:55	3:00	3:00	3:25	3:30	4:45	2:50	2:55	4:30	3:00	3:00	2:50	3:25			
R14	3:25	3:30	2:50	2:55	3:05	3:25	3:20	4:45	2:50	3:00	4:25	3:00	2:50	2:50	3:35			
R15	3:55	4:05	3:15	3:50	3:15	3:30	4:00	5:00	3:05	3:45	4:30	3:10	3:05	3:10	3:30			
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																		
R32	4:10	4:20	3:50	4:15	4:05	3:50	4:15	5:35	4:00	4:15	5:20	4:05	3:50	4:00	4:05			
R33	4:00	4:25	3:55	4:15	4:00	3:50	4:15	5:35	4:00	4:20	5:30	4:05	3:50	4:05	4:10			
R34	3:45	4:20	3:55	4:10	4:00	4:05	4:15	5:25	3:55	4:00	5:10	3:50	3:45	3:40	3:50			
R35	4:10	4:10	3:50	4:05	4:05	3:45	4:30	5:30	4:00	4:05	5:15	3:55	3:55	3:55	4:05			
R36	4:05	4:15	3:55	4:00	4:05	3:50	4:10	5:25	3:55	3:55	5:15	3:55	3:55	3:55	4:05			
R37	4:20	4:20	3:50	4:00	4:05	4:00	4:10	5:25	3:45	4:00	5:15	3:55	3:55	3:50	4:20			
R38	3:25	3:35	3:00	3:00	3:15	3:35	3:40	4:45	3:00	3:05	4:30	3:20	3:05	3:00	4:00			
R39	3:35	3:35	3:00	3:00	3:10	3:25	3:35	4:50	3:00	3:00	4:25	3:20	2:55	2:55	4:00			
R40	3:30	3:30	3:05	3:00	3:20	3:30	3:45	4:45	2:55	3:00	4:35	3:20	3:30	3:00	3:55			
R41	3:30	3:35	3:00	3:05	3:20	3:30	3:40	4:50	3:00	3:05	4:25	3:20	2:55	3:40	4:10			
R42	3:30	3:30	3:00	3:05	3:15	3:35	3:30	4:45	3:15	3:00	4:30	3:20	3:00	3:00	3:40			
R43	4:10	4:30	3:50	4:20	4:00	4:05	4:30	5:40	3:55	4:20	5:20	4:05	4:00	4:05	4:15			
R44	3:55	4:15	4:00	4:20	3:55	4:00	4:20	5:40	4:00	4:05	5:15	4:05	3:55	4:05	4:15			

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

Scenario:	Summer		Summer		Summer		Winter		Winter		Winter		Winter		Summer	
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Weekend		Weekend	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Region	Midday		Midday		Evening		Midday		Midday		Midday		Midday		Midday	
	Good Weather	Rain	Good Weather	Rain	Good Weather	Good Weather	Rain/Light Snow	Heavy Snow	Good Weather	Rain/Light Snow	Heavy Snow	Evening	Good Weather	Special Event	Special Event	Roadway Impact
Entire 2-Mile Region, 5-Mile Region, and EPZ																
R01	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R02	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
Evacuate 2-Mile Region and Downwind to 5 Miles																
R04	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R05	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R06	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R07	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R08	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R09	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R10	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R11	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R12	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R13	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R14	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R15	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
Staged Evacuation - 2-Mile Region and Keyhole to 5 Miles																
R32	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R33	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R34	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R35	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R36	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R37	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R38	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R39	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R40	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R41	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R42	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R43	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20
R44	6:20	6:20	6:15	6:15	6:15	6:20	6:20	8:00	6:15	6:15	8:00	6:15	6:15	6:15	6:15	6:20

Table 7-5. Description of Evacuation Regions

Region Description Region Number Wind Direction From:	REGION																	
	2-Mile Region	5-Mile Region	Full EPZ	2-Mile Region and Sector to 5 Miles														
	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15			
N/A	N/A	N/A	N/A	S	SSW, SW	WSW, W	WNW, NW	NNW	N	NNE	NE	ENE	E	ESE	SE, SSE			
PROTECTIVE ACTION AREA																		
Briarcliff Manor			X															
Central Town of Clarkstown			X															
Northeastern Town of Ramapo			X															
Northeastern & Eastern Town of Clarkstown			X															
Northwestern Town of Clarkstown			X															
Ossining			X															
Village of Haverstraw		X	X					X	X	X	X							
Town of New Castle (West of Hardscrabble Rd)			X															
Village of West Haverstraw		X	X						X	X	X							
Unincorporated Areas of the Town of Haverstraw		X	X						X	X	X	X						
Town of Tuxedo East of NYS Thruway			X															
Village of Pomona			X															
Grassy Point		X	X					X	X	X	X							
Croton-on-Hudson		X	X				X	X	X									
Stony Point		X	X						X	X	X	X	X					
Verplanck	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Tompkins Cove	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Buchanan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Montrose	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Jones Point	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Village of Harriman East of NYS Thruway			X															
City of Peekskill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Town of Cortlandt		X	X	X	X	X	X	X	X									
Bear Mountain State Park	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Harriman State Park		X	X								X	X	X	X	X			
Yorktown			X															
Town of Somers (West of Route 118)			X															
Fort Montgomery		X	X	X										X	X			
Southwest Carmel			X															
Village of Highland Falls			X															
Lower Philipstown		X	X	X	X										X			
Village -Town of Woodbury			X															
U.S. Military Academy			X															
Southern Putnam Valley			X															
Town of Highlands			X															
Hudson River			X															
Town of Cornwall (South of Angola Rd)			X															
Southern Philipstown			X															
Protective Action Area is not within Plume and Shelters-in-Place			Protective Action Area is within Plume and Evacuates															
			Hudson River is cleared/closed and therefore considered 100% evacuated															

Region Description		REGION															
		2-Mile Ring and Sector to 10 Miles/EPZ															
		R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31
Wind Direction From:		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
PROTECTIVE ACTION AREA																	
Briarcliff Manor							X	X	X	X							
Central Town of Clarkstown									X	X	X	X					
Northeastern Town of Ramapo										X	X	X	X				
Northeastern & Eastern Town of Clarkstown								X	X	X	X						
Northwestern Town of Clarkstown									X	X	X	X	X				
Ossining Town & Village							X	X	X	X							
Village of Haverstraw									X	X	X	X					
Town of New Castle (West of Hardscrabble Road)						X	X	X	X								
Village of West Haverstraw										X	X	X					
Unincorporated Areas of the Town of Haverstraw										X	X	X	X				
Town of Tuxedo East of NYS Thruway												X	X	X	X		
Village of Pomona										X	X	X	X				
Grassy Point									X	X	X	X					
Croton-on-Hudson							X	X	X	X							
Stony Point										X	X	X	X	X			
Verplanck		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tompkins Cove		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Buchanan		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Montrose		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Jones Point		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Village of Harriman East of NYS Thruway													X	X	X	X	X
City of Peekskill		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Town of Cortlandt		X	X	X	X	X	X	X	X	X							
Bear Mountain State Park		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Harriman State Park											X	X	X	X	X	X	X
Yorktown			X	X	X	X	X	X	X								
Town of Somers (West of Route 118)				X	X	X	X										
Fort Montgomery		X	X												X	X	X
Southwest Carmel			X	X	X	X											
Village of Highland Falls		X	X												X	X	X
Lower Philipstown		X	X	X													
Village - Town of Woodbury														X	X	X	X
U.S. Military Academy		X	X												X	X	X
Southern Putnam Valley		X	X	X	X										X	X	
Town of Highlands		X	X														X
Hudson River																	
Town of Cornwall (South of Angola Rd)		X													X	X	X
Southern Philipstown		X	X	X													X
Protective Action Area is within Plume and Evacuates		Protective Action Area is within Plume, but Evacuates because it is surrounded by other Protective Action Areas which are Evacuating															

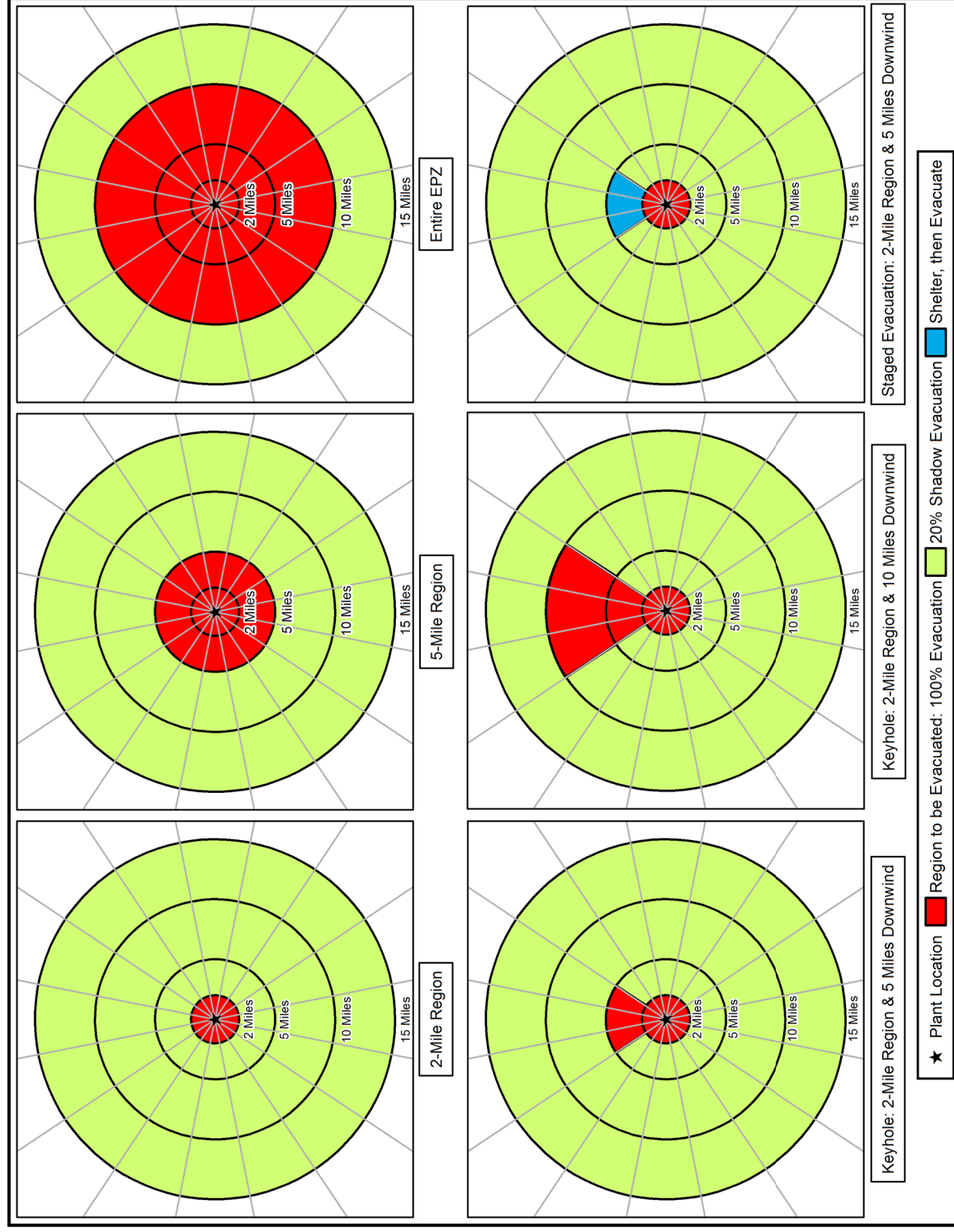


Figure 7-1. Voluntary Evacuation Methodology

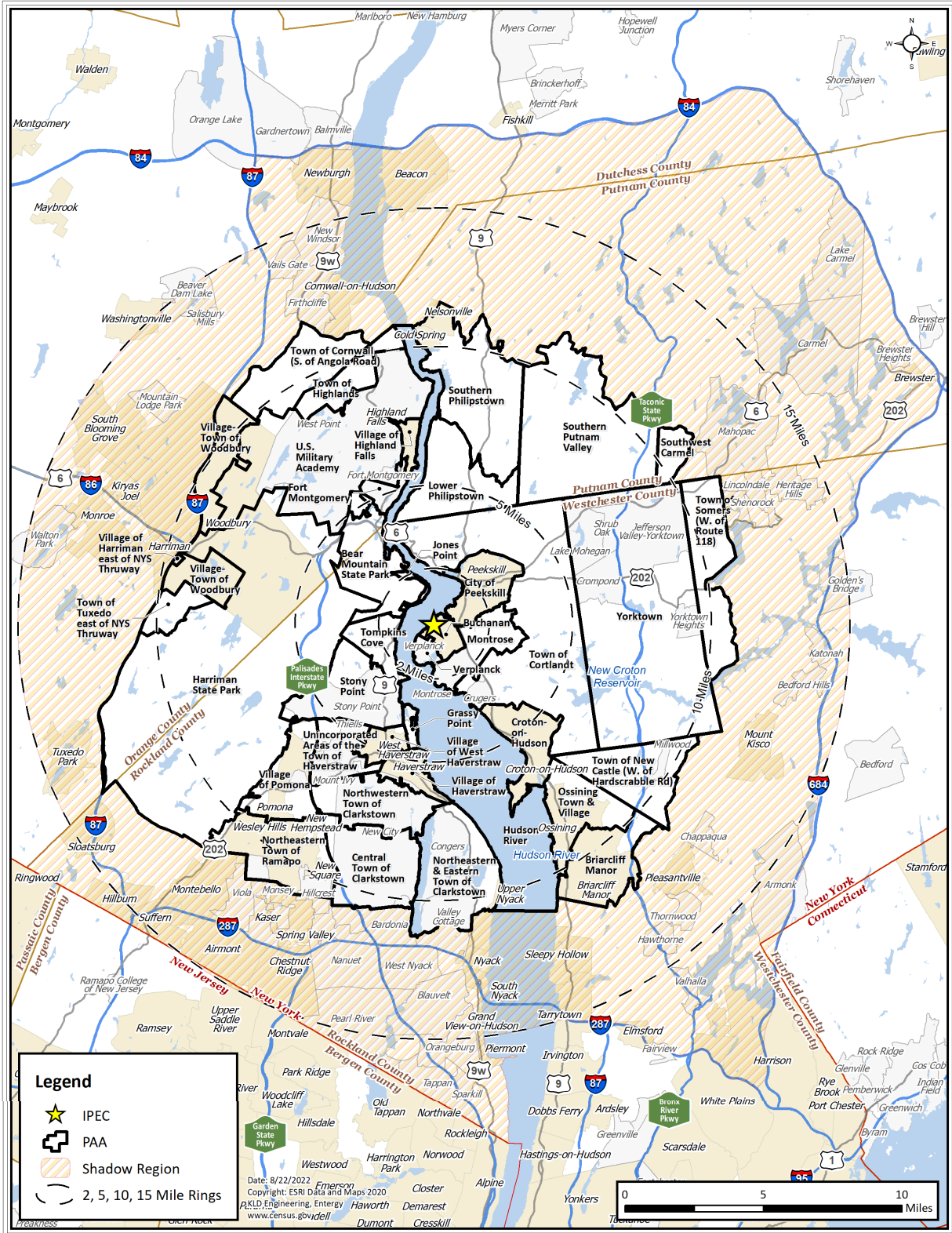
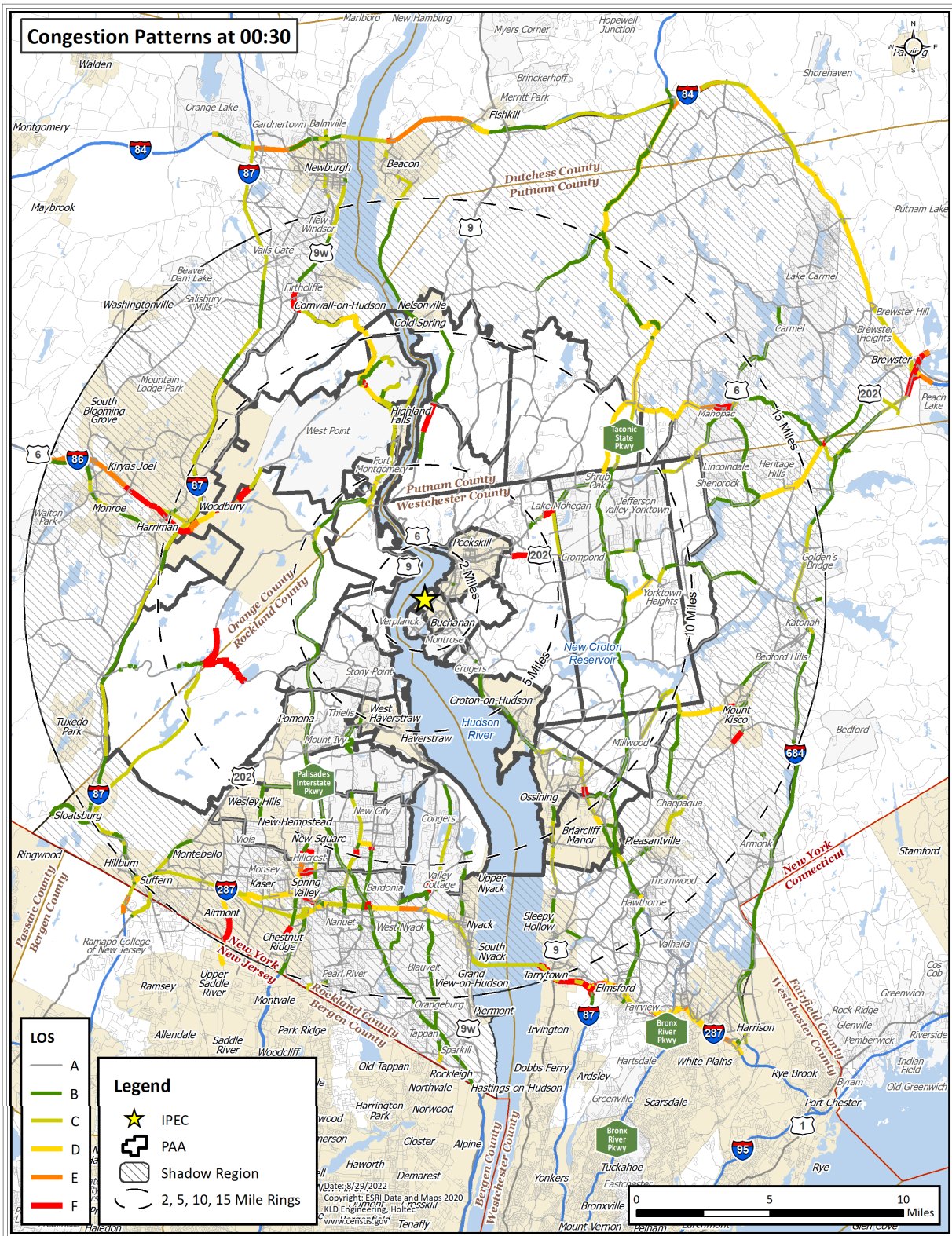
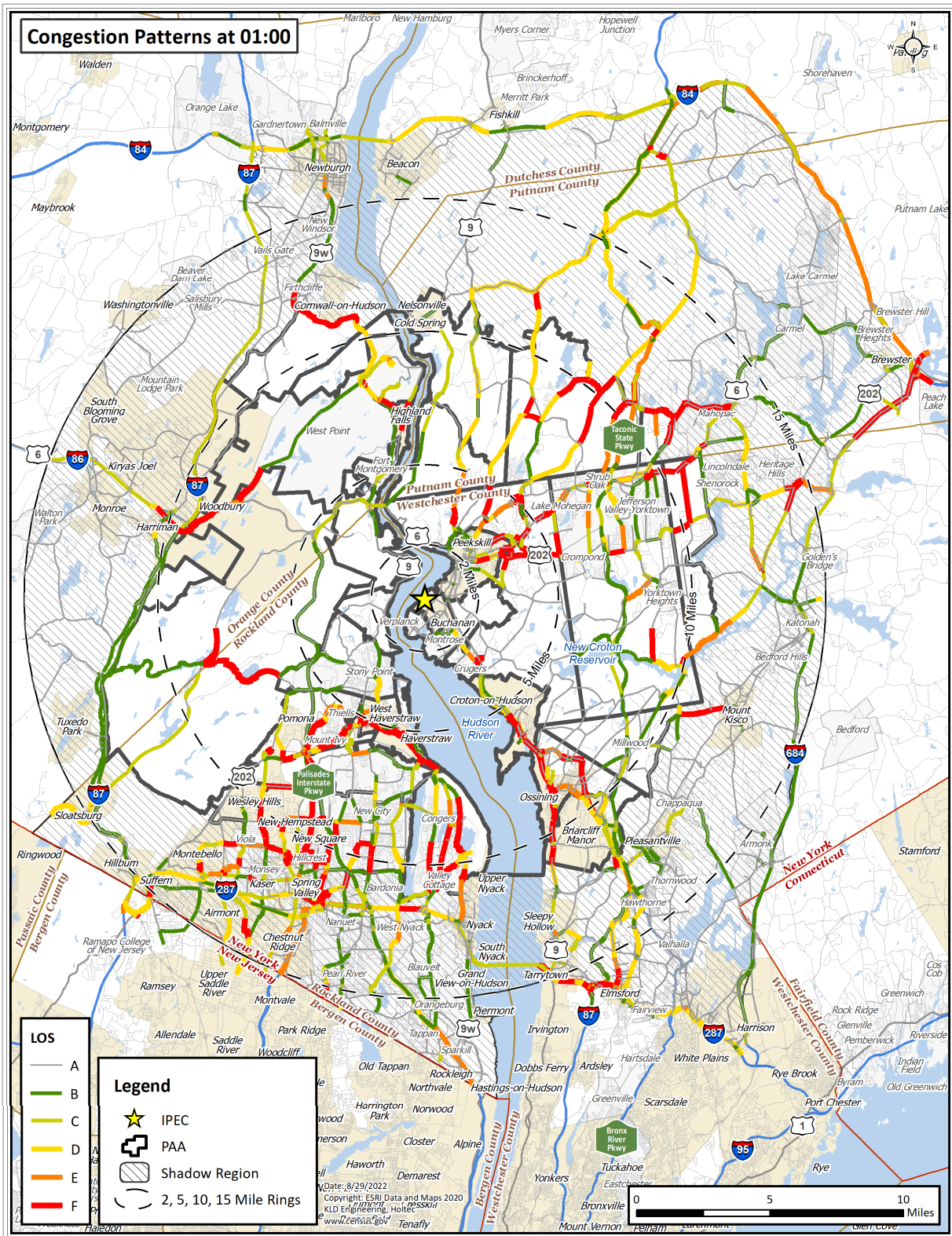
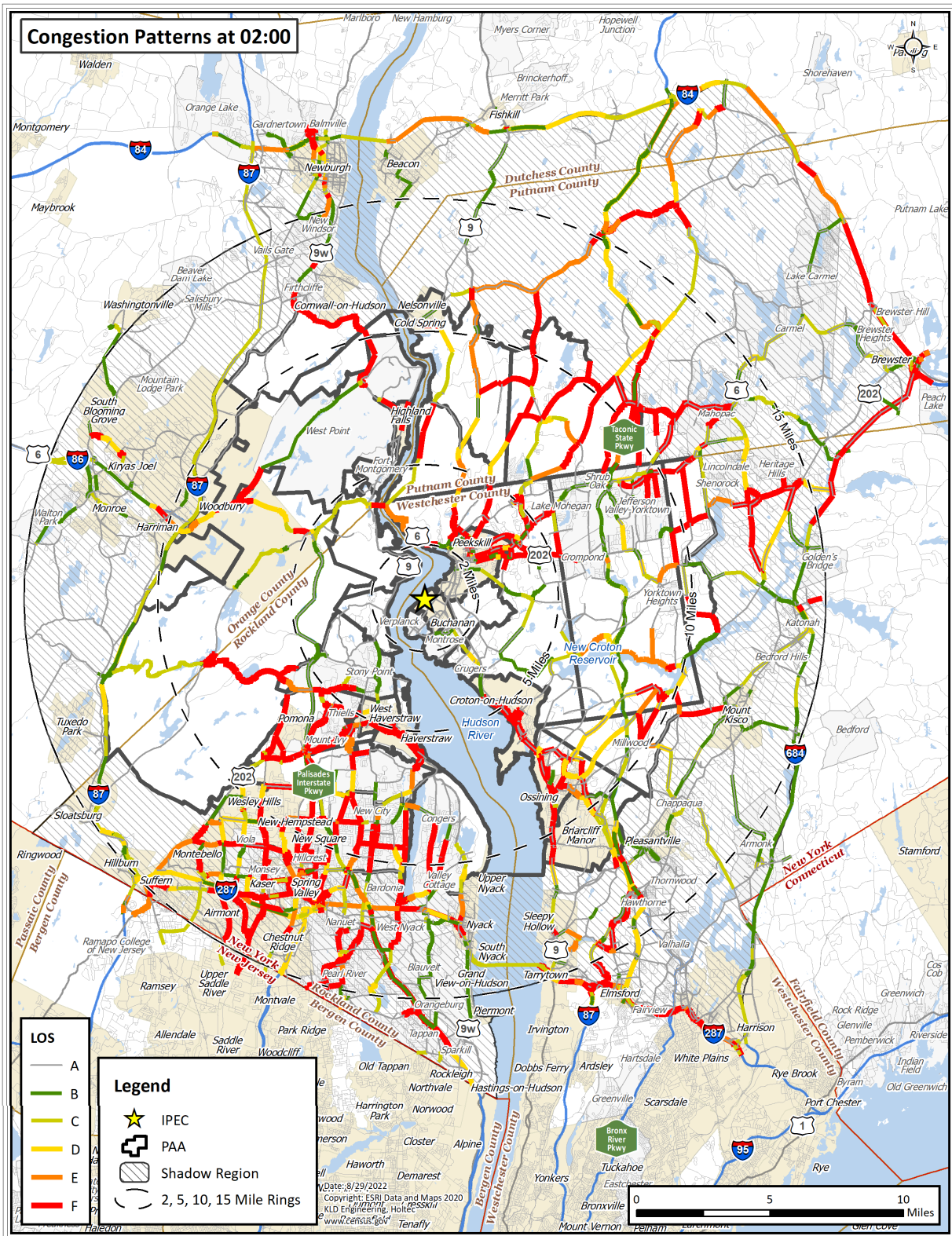
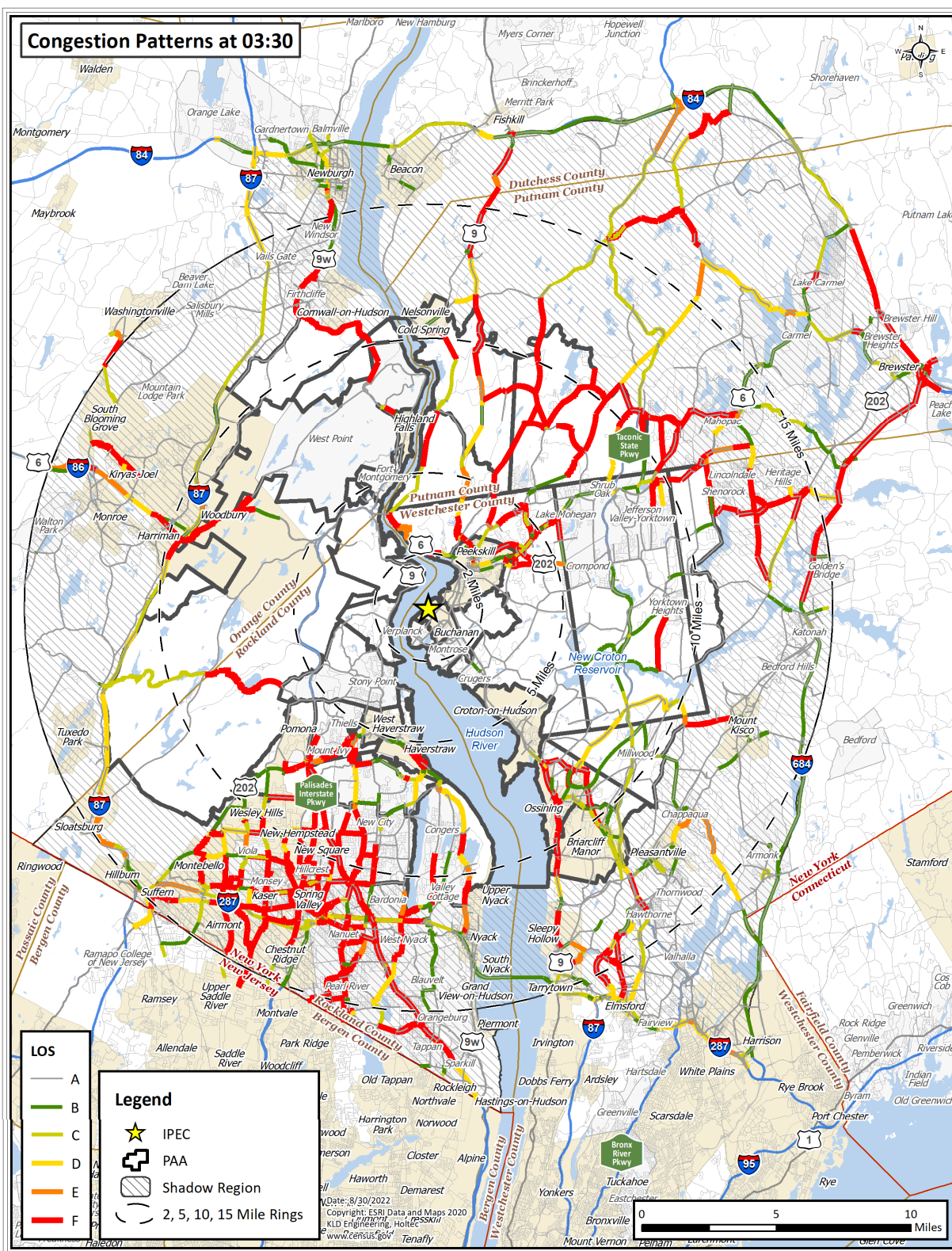


Figure 7-2. IPEC Shadow Region









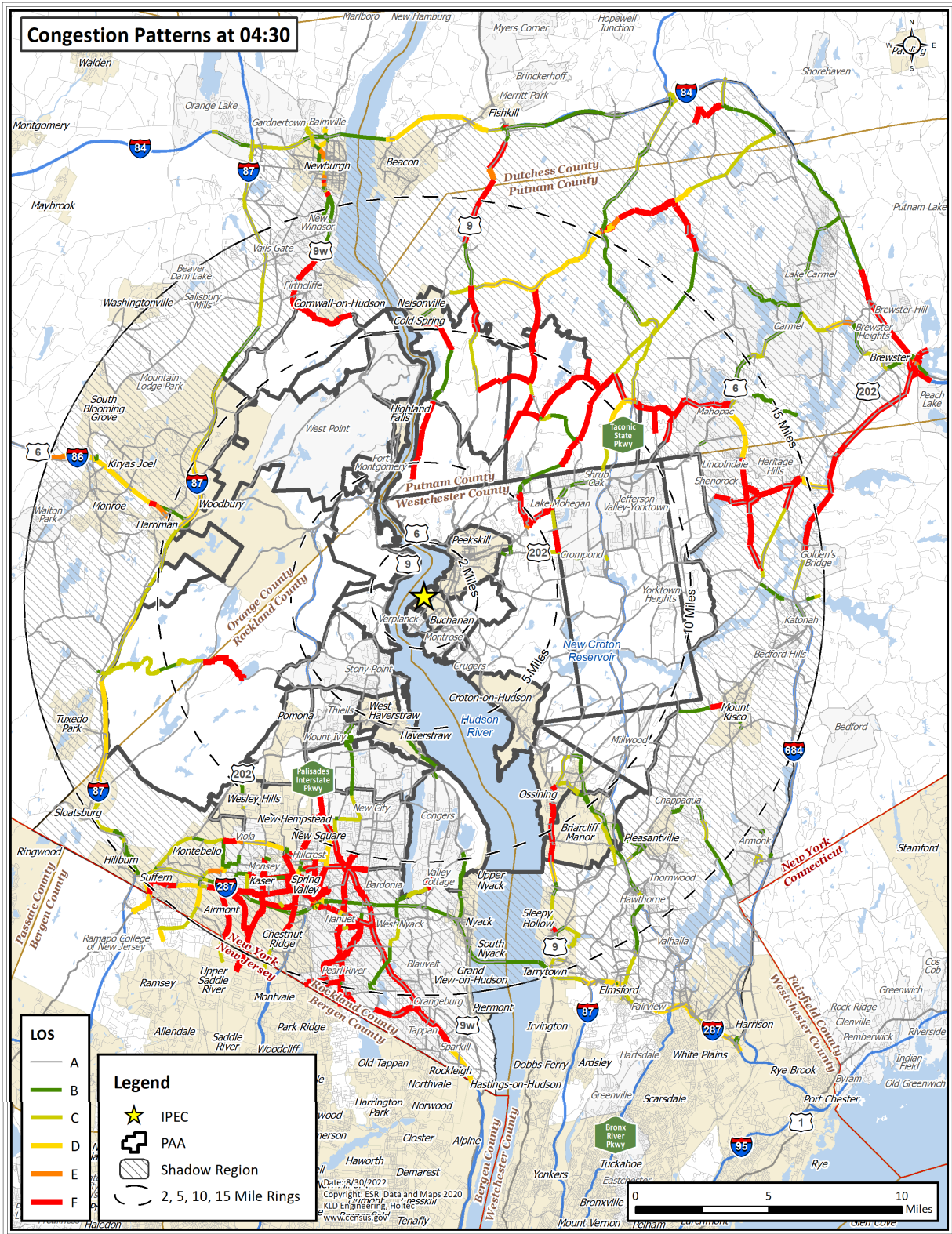


Figure 7-7. Congestion Patterns at 4 Hours and 30 minutes after the Advisory to Evacuate

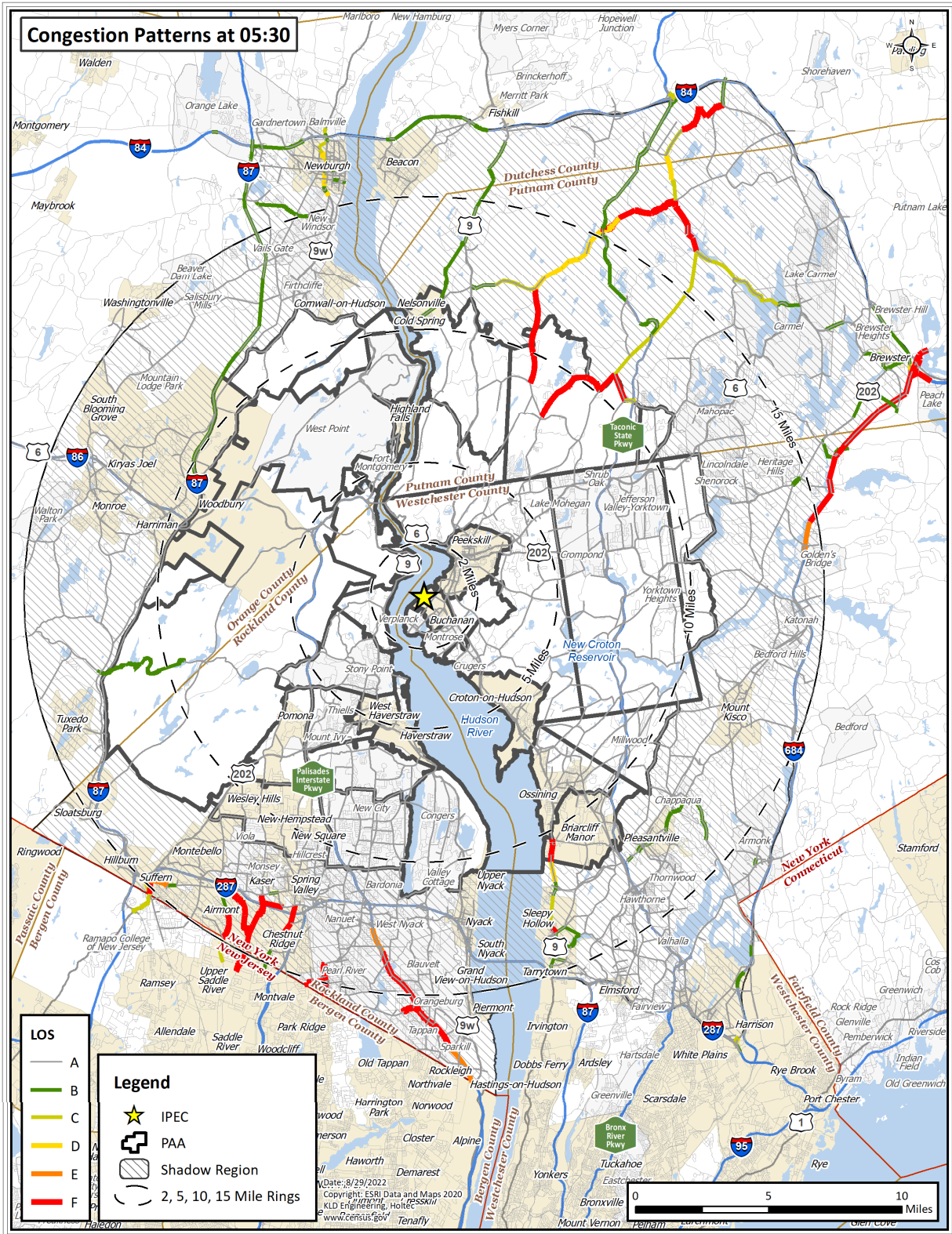
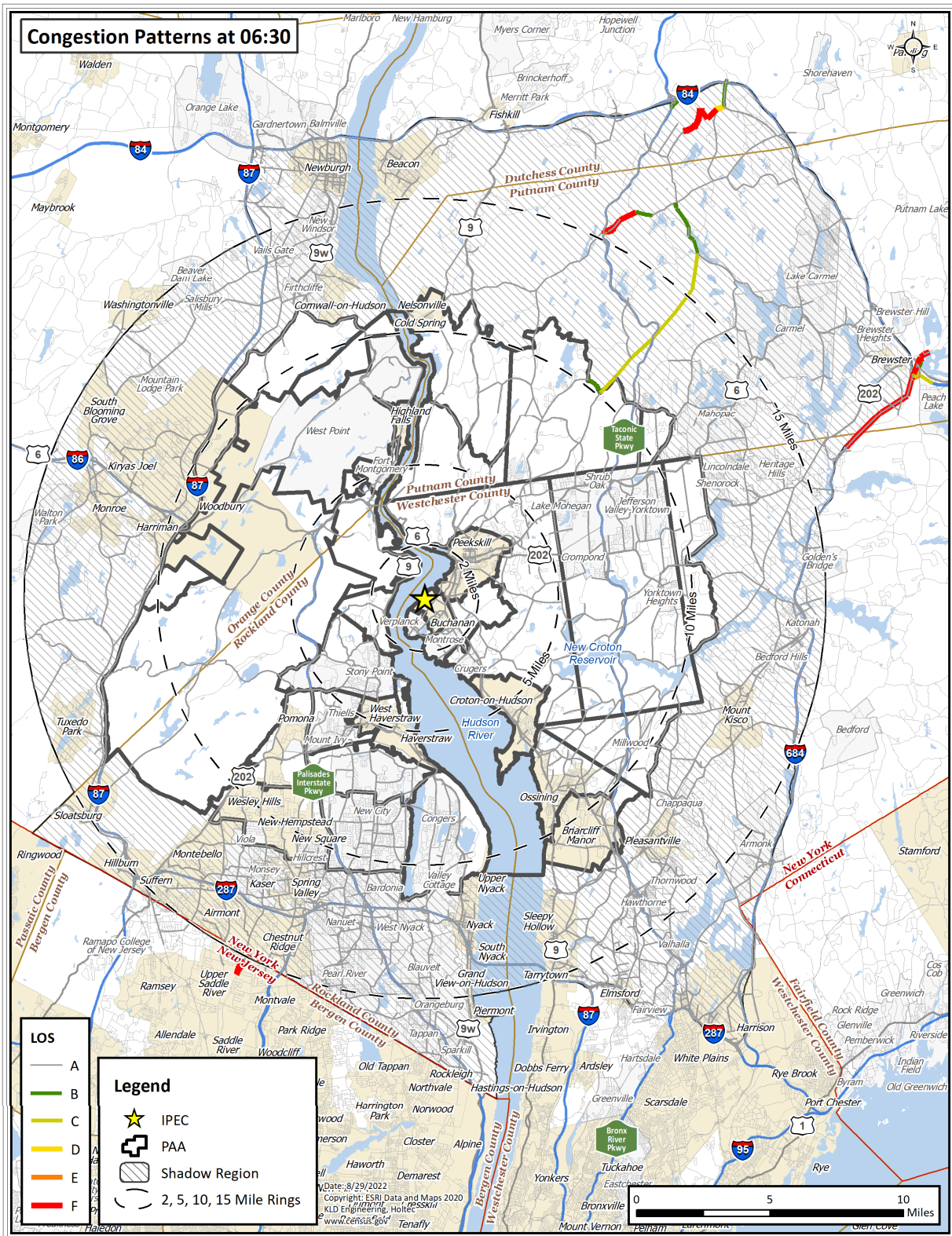


Figure 7-8. Congestion Patterns at 5 Hours and 30 minutes after the Advisory to Evacuate



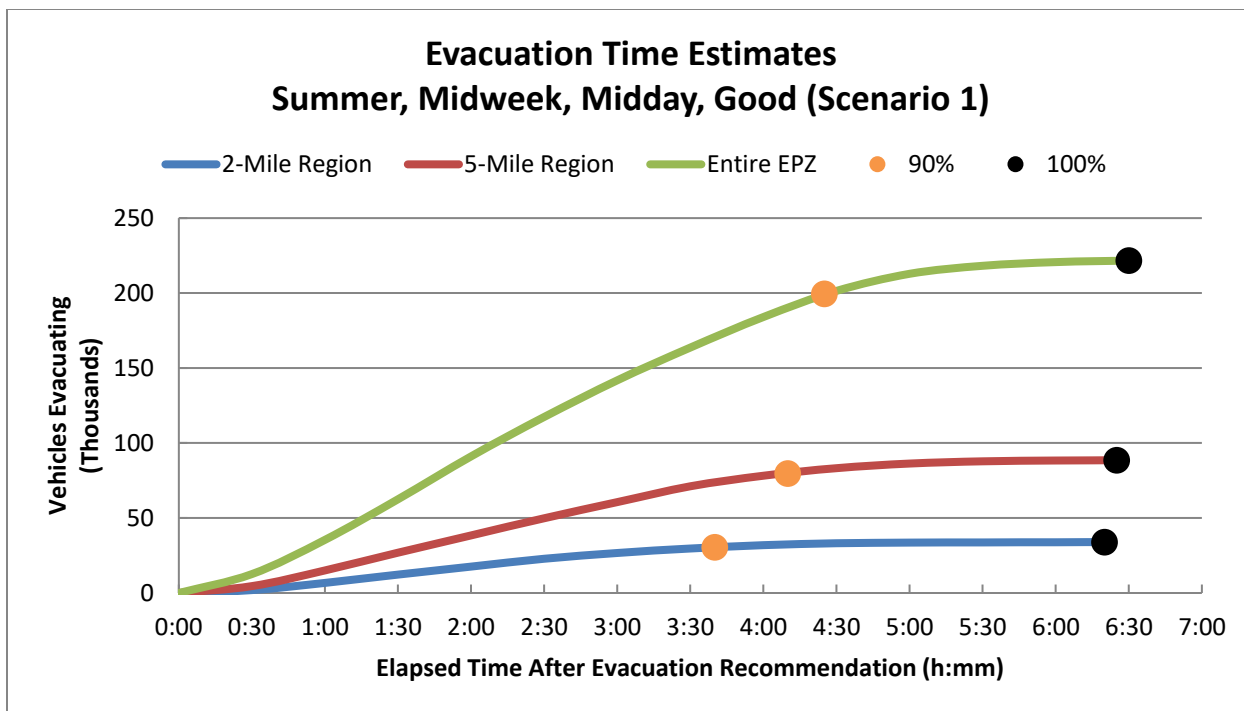


Figure 7-10. Evacuation Time Estimates - Scenario 1 for Region R03

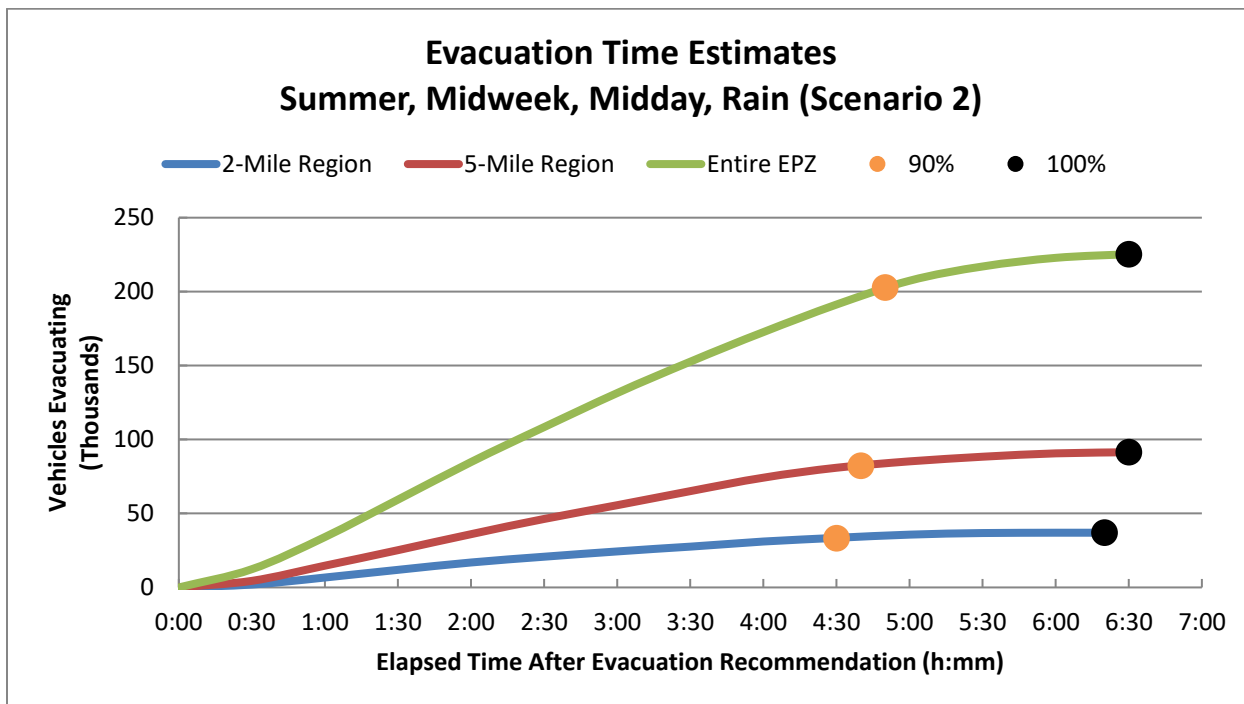


Figure 7-11. Evacuation Time Estimates - Scenario 2 for Region R03

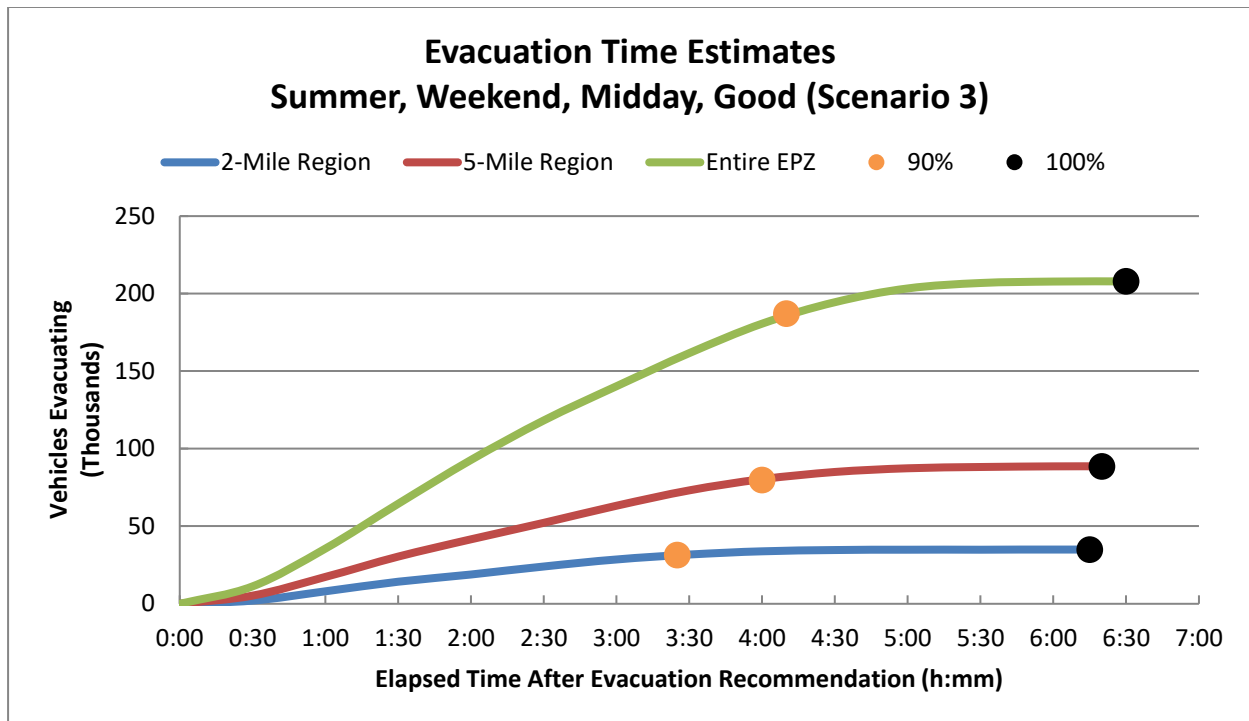


Figure 7-12. Evacuation Time Estimates - Scenario 3 for Region R03

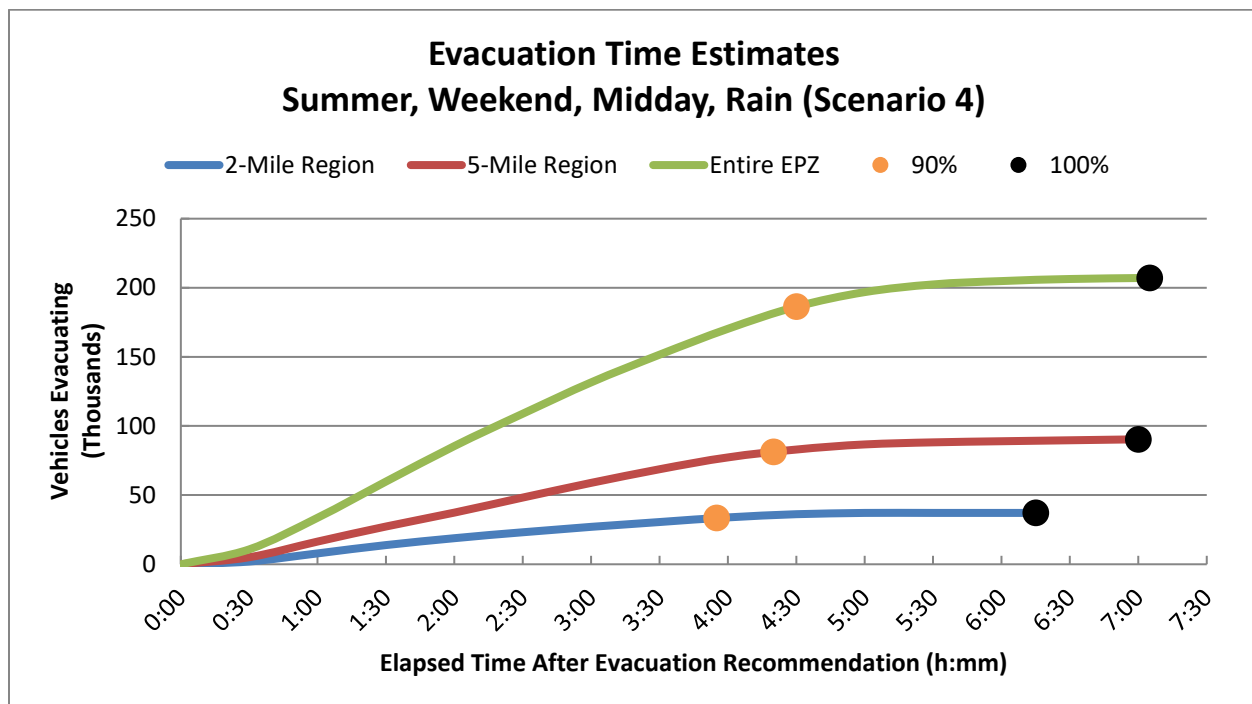


Figure 7-13. Evacuation Time Estimates - Scenario 4 for Region R03

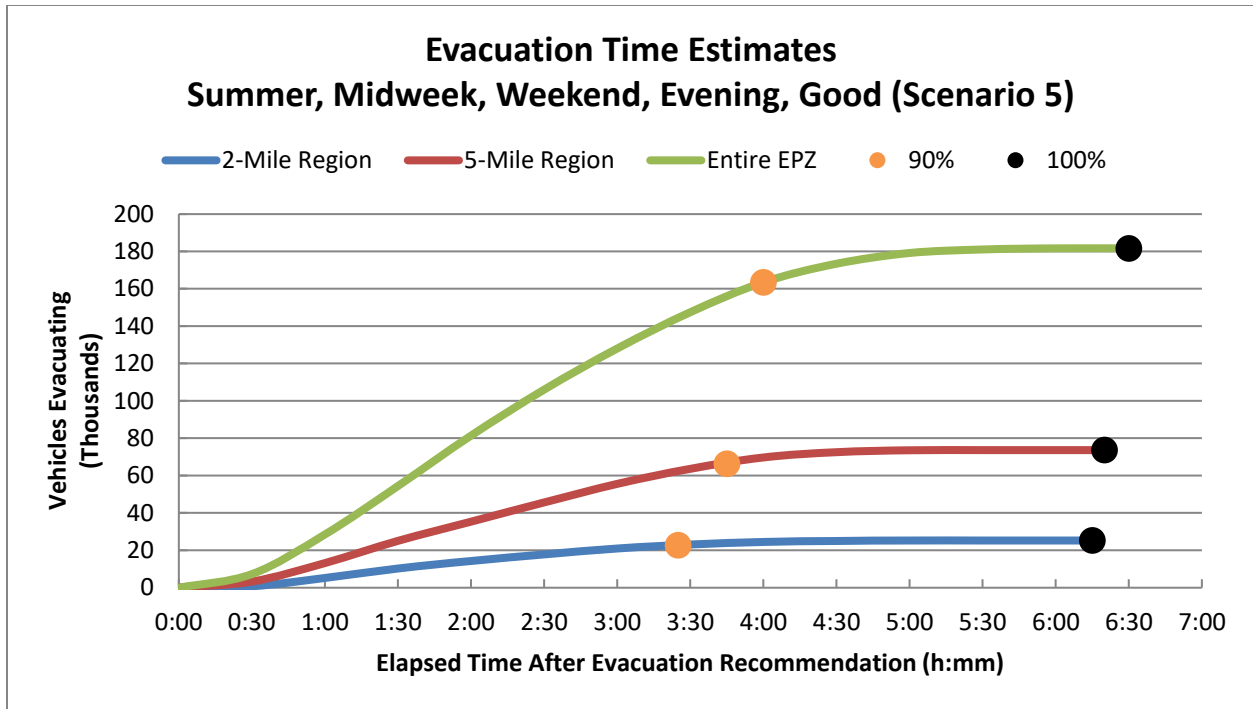


Figure 7-14. Evacuation Time Estimates - Scenario 5 for Region R03

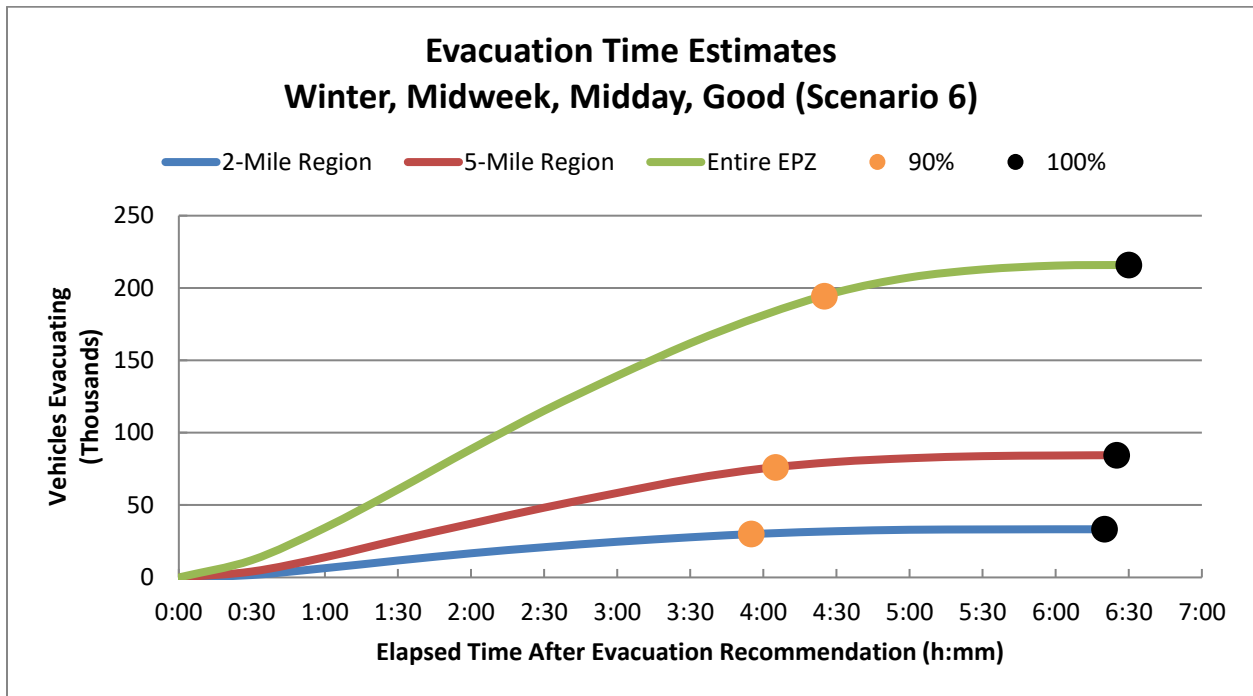


Figure 7-15. Evacuation Time Estimates - Scenario 6 for Region R03

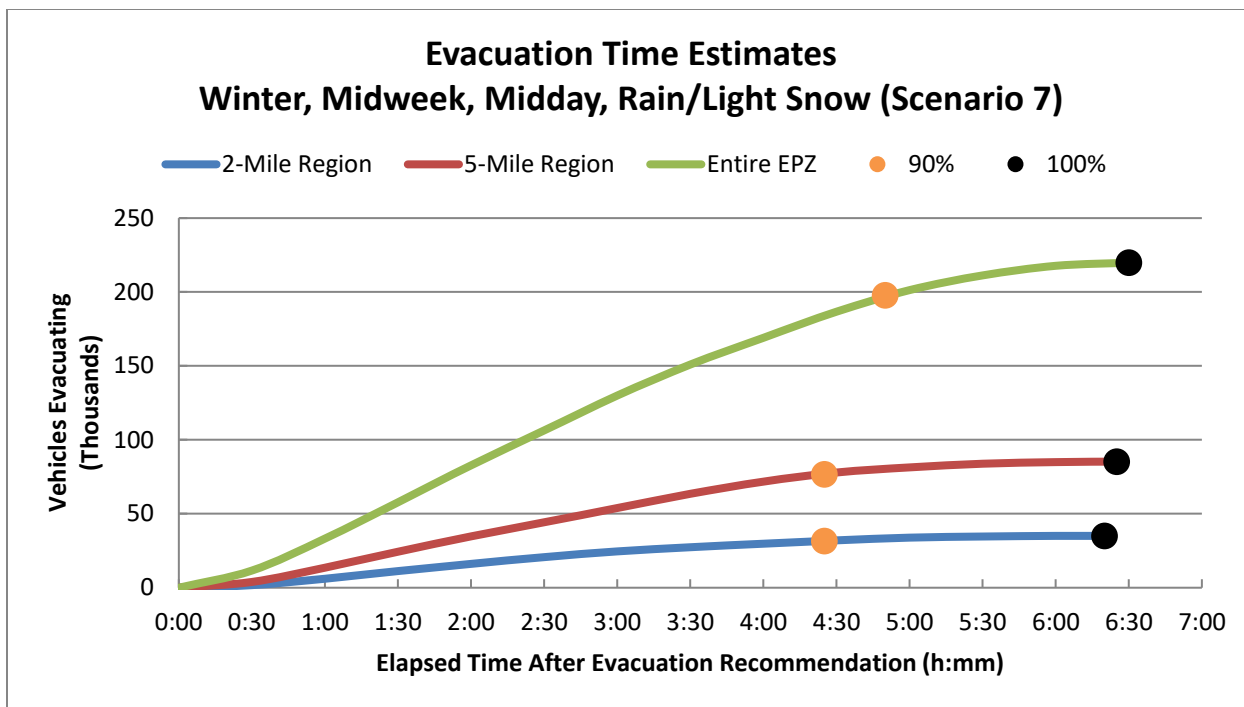


Figure 7-16. Evacuation Time Estimates - Scenario 7 for Region R03

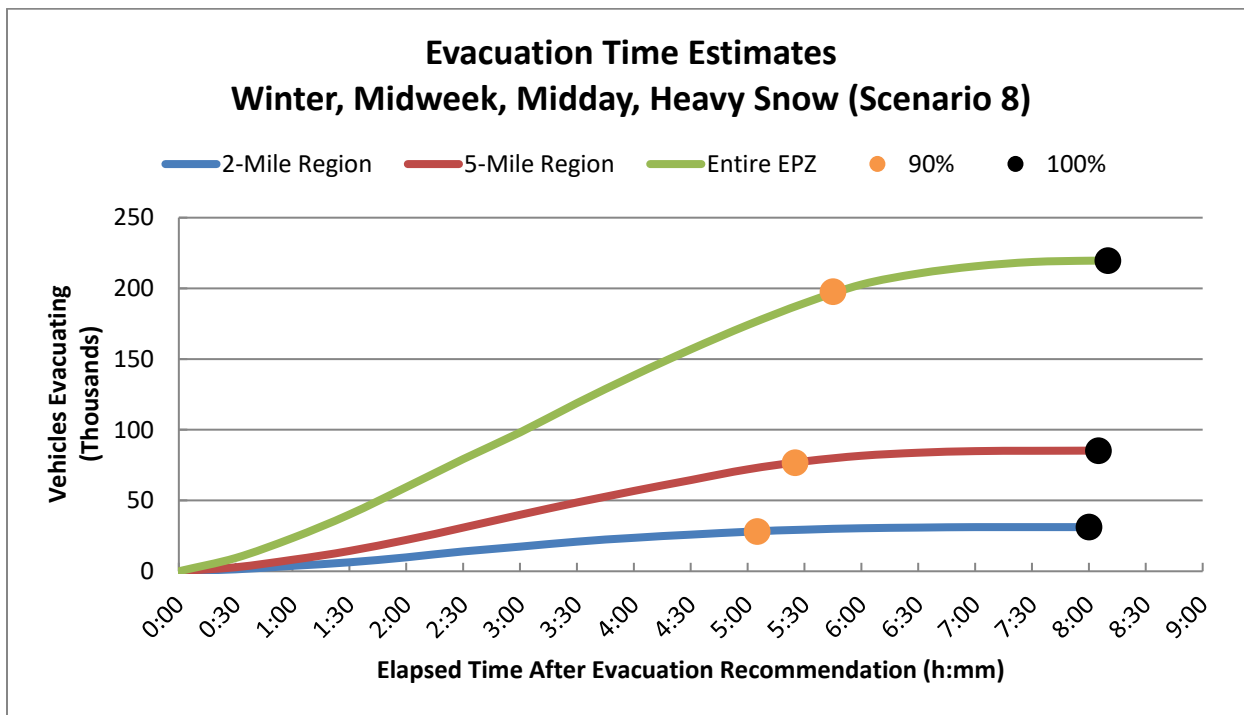


Figure 7-17. Evacuation Time Estimates - Scenario 8 for Region R03

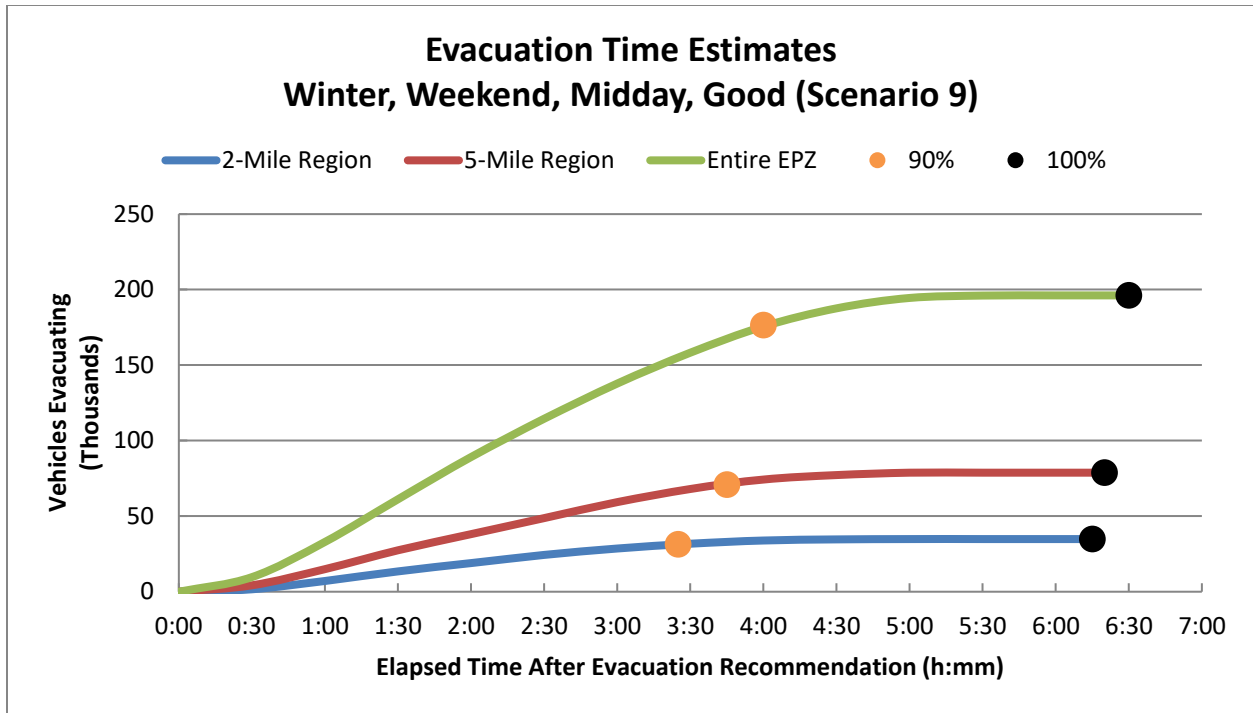


Figure 7-18. Evacuation Time Estimates - Scenario 9 for Region R03

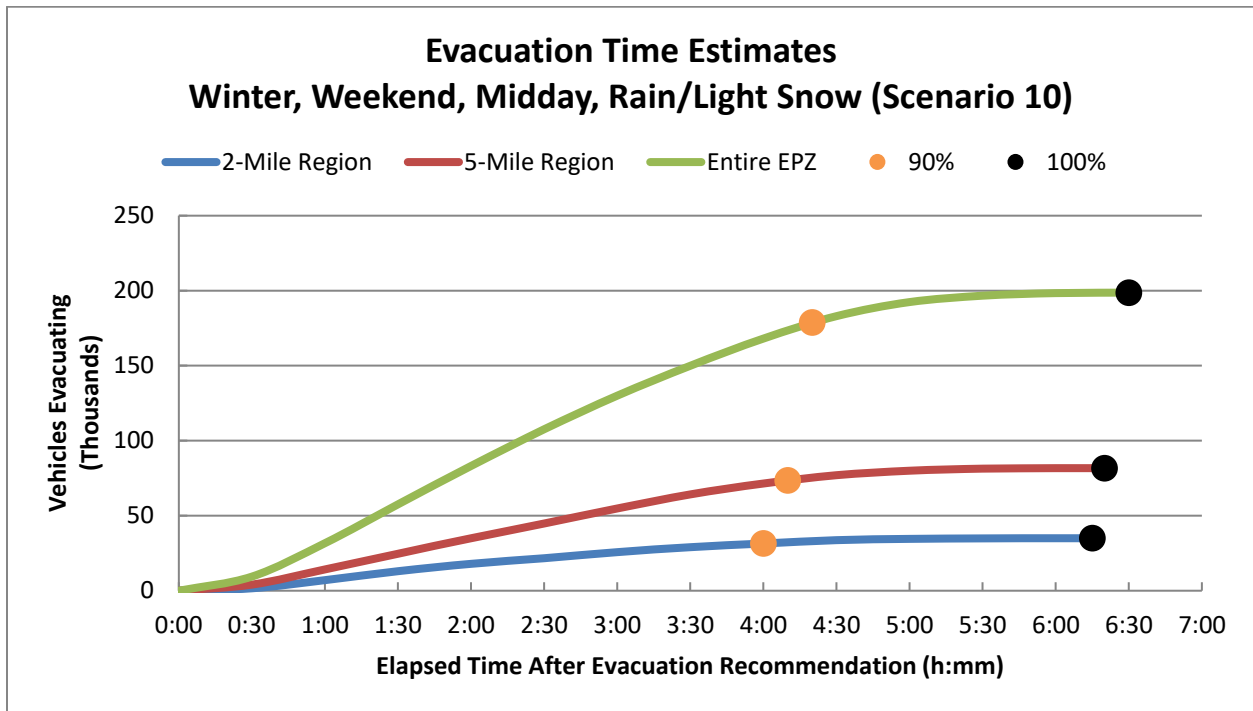


Figure 7-19. Evacuation Time Estimates - Scenario 10 for Region R03

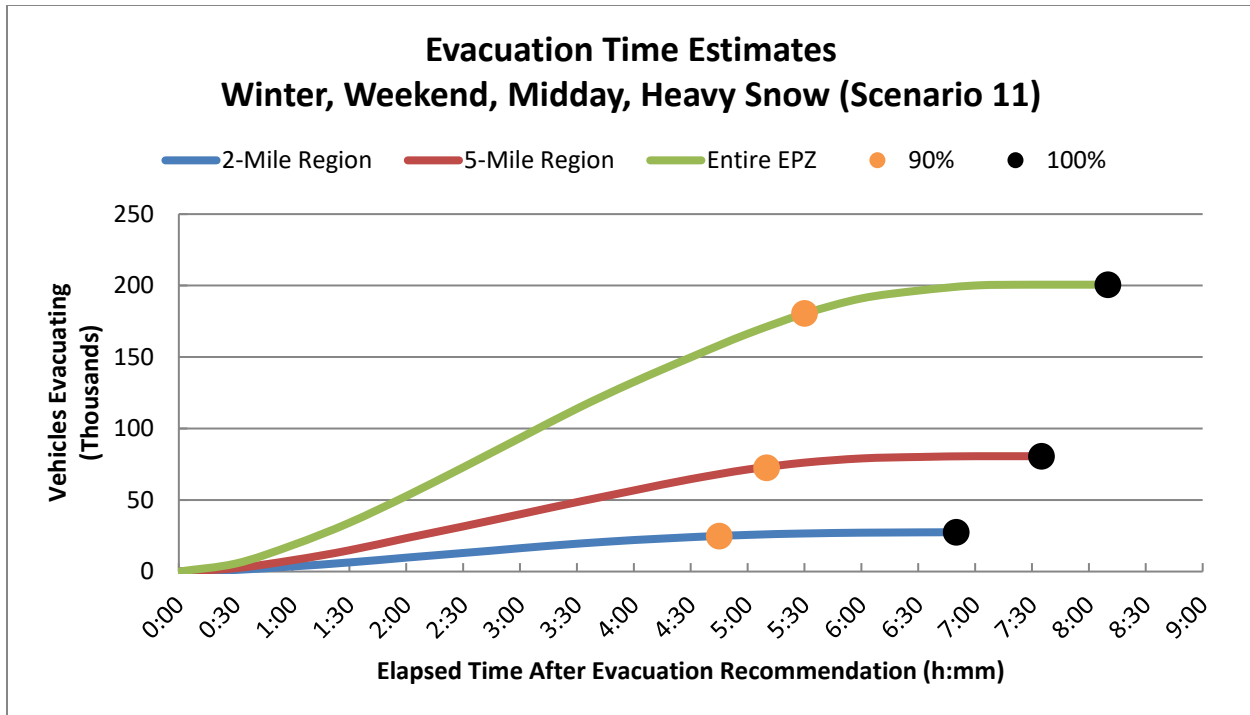


Figure 7-20. Evacuation Time Estimates - Scenario 11 for Region R03

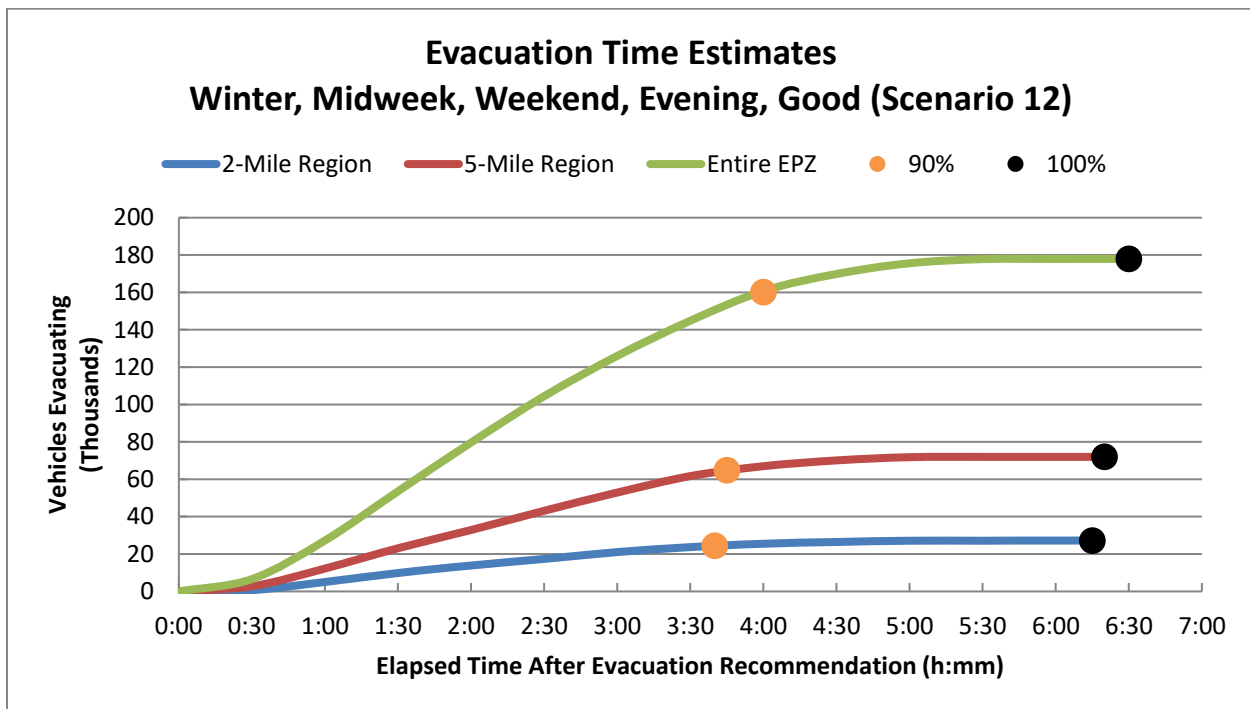


Figure 7-21. Evacuation Time Estimates - Scenario 12 for Region R03

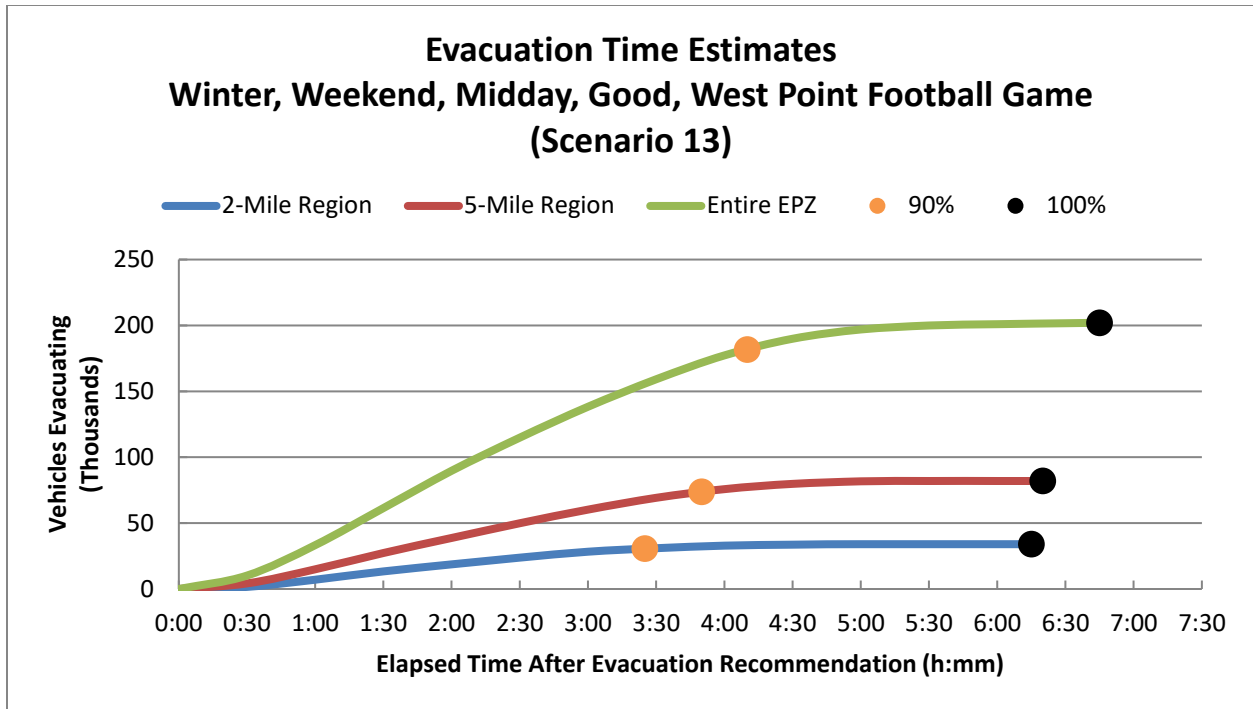


Figure 7-22. Evacuation Time Estimates - Scenario 13 for Region R03

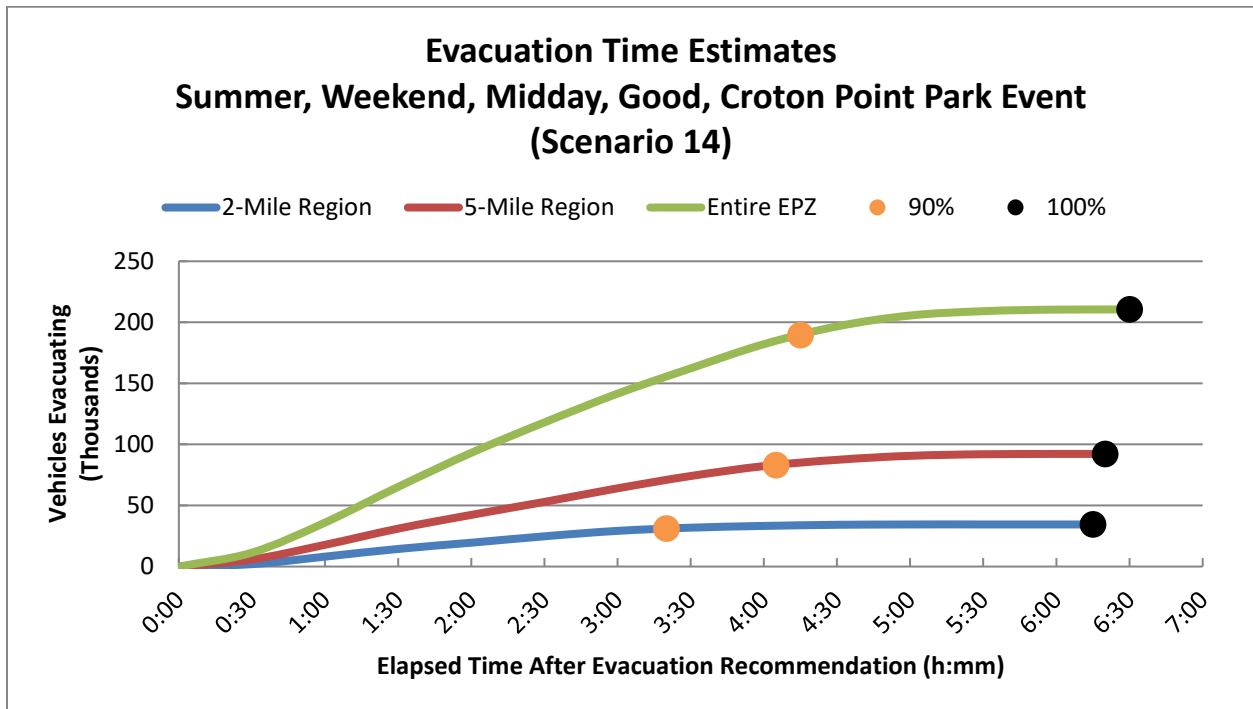


Figure 7-23. Evacuation Time Estimates - Scenario 14 for Region R03

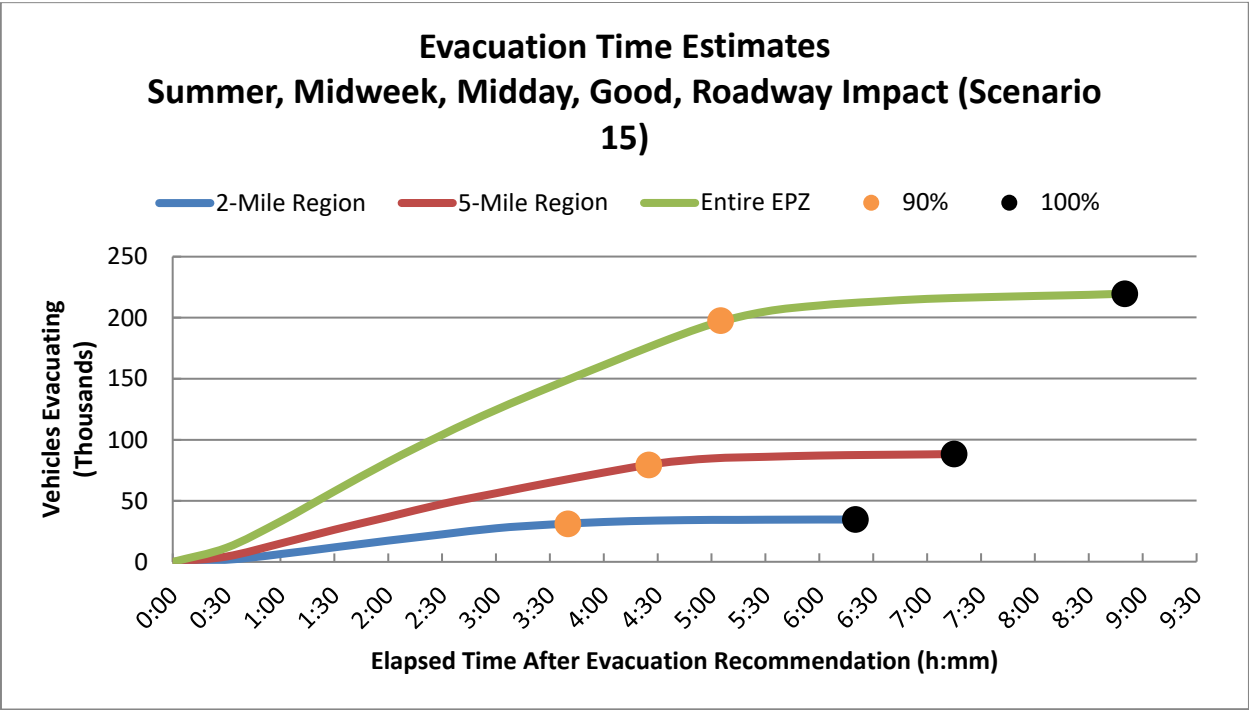


Figure 7-24. Evacuation Time Estimates - Scenario 15 for Region R03

8 TRANSIT-DEPENDENT AND SPECIAL FACILITY EVACUATION TIME ESTIMATES

This section details the analyses applied and the results obtained in the form of ETE for transit vehicles, buses, ambulances, and wheelchair transport vehicles. The demand for transit service reflects the needs of three population groups:

- residents with no vehicles available;
- residents of special facilities such as schools, preschools and childcare centers, medical facilities, and correctional facilities; and
- access and/or functional 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 larger size and more sluggish operating characteristics of a transit vehicle, relative to those of a pc. Ambulances and vans are considered as one 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. The location of bus depots impacts the time to travel from the bus depots to the facilities being evacuated. Locations of bus depots were not identified in this study. Rather, the offsite agencies were asked to factor the location of the depots and the distances to the EPZ into the estimate of mobilization time.

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 IPEC EPZ indicates that schoolchildren will be evacuated to school reception centers at emergency classification levels of Alert or higher, and that parents should pick schoolchildren up at school reception centers. As discussed in Section 2, this study assumes a fast-breaking general emergency. Therefore, schools (including day cares and camps) and special facilities receive initial notification at the same time as the rest of the EPZ, and children are evacuated to school reception centers. 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, Rev. 1), to present an upper bound estimate of buses required.

The procedure for computing transit-dependent ETE is to:

- Estimate demand for transit service (discussed in Section 3)
- Estimate time to perform all transit functions
- Estimate route travel times to the EPZ boundary and to the school/general population reception centers.

ETE 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. ETE are only presented for those facilities that are within the EPZ. The facilities that are in the Shadow Region or beyond are already out of the area being evacuated and, therefore, ETE cannot be computed.

8.1 ETEs for Schools, Transit Dependent People, Special Facilities

Table 8-1 lists the transportation resources and transportation needs to evacuate the transit dependent and special facility population in the EPZ. As shown in the table, there are not enough resources to evacuate all medical facilities, access and functional needs population, schoolchildren and transit dependent population in a single wave. Some of the buses and vans listed in Table 8-1 have wheelchair seating. For this reason, it is assumed that there are enough wheelchair accessible vehicles (combination of wheelchair buses, vans that have wheelchair seats and buses that have wheelchair seats).

The 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 centers 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 are 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. It is assumed that there are enough drivers available to staff all resources listed in Table 8-1.

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 along the bus transit route.

Evacuation of Schools and Day Cares

Activity: Mobilize Drivers (A→B→C)

Mobilization time is the elapsed time from the ATE until the time the buses arrive at the facility to be evacuated. It is assumed that for a rapidly escalating radiological emergency with no observable indication before the fact, drivers would require 90 minutes to be contacted, to travel

to the depot, be briefed, and to travel to the schools/day cares. Mobilization time is slightly longer in adverse weather – 100 minutes for rain/light snow and 110 minutes for heavy snow.

Activity: Board Passengers (C→D)

Based on discussions with offsite agencies, a loading time of 15 minutes (20 minutes for rain/light snow and 25 minutes for heavy snow) for school buses is used. See Section 2.4, assumption 6 and Table 2-2.

Activity: Travel to EPZ Boundary (D→E)

The buses servicing the schools are ready to begin their evacuation trips at 105 minutes after the ATE – 90 minutes mobilization time plus a 15-minute loading time – in good weather. 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 school reception center. 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 Section 10 in Table 10-2 (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., 105 minutes after the ATE for good weather) were used to compute the average speed for each route, as follows:

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

The average speed computed (using this methodology) for the buses servicing all of the schools within each protective action area are shown in Table 8-2 through Table 8-4. 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 school reception center was computed assuming an average speed of 40 mph for good weather, 36 mph (10% decrease) for rain/light snow, and 34 mph (15% decrease) for heavy snow. Speeds were reduced in Table 8-2 through Table 8-4 to 55 mph, 50 mph, and 47 mph for good weather, rain/light snow, and heavy snow, respectively, for those calculated bus speeds which exceed these values based on posted speeds along major evacuation routes in the EPZ.

Table 8-2 (good weather), Table 8-3 (rain/light snow) and Table 8-4 (heavy snow) present the following times (rounded up to the nearest 5 minutes) for schools in the EPZ:

1. The “ETE” or elapsed time from the ATE until the bus exits the EPZ; and
2. The “ETA to S.R.C” or elapsed time until the bus reaches the school reception center (S.R.C).

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: 90 min. + 15 + 99 = 3:25, rounded up to the nearest 5 minutes, for Schools in Fort Montgomery, in good weather). Here, 99 minutes is the time to travel 10.8 miles at 6.6 mph.

The average single-wave ETE for schools is 1 hour and 30 minutes (4:25 - 2:55 = 1:30) less than the 90th percentile ETE for evacuation of the general population in the entire EPZ (Region R03) under winter, midweek, midday, good weather (Scenario 6) conditions and should not impact protective action decision making.

The evacuation time to the school reception center is determined by adding the time associated with Activity E→F (discussed below), to this EPZ evacuation time.

Activity: Travel to School Reception Center (E→F)

The distances from the EPZ boundary to the school reception center are measured using GIS software along the most likely route from the EPZ exit point to the school reception center. The school reception centers are mapped in Figure 10-11 through Figure 10-14. For a one-wave evacuation, this travel time outside the EPZ does not contribute to the ETE. Assumed bus speeds of 55 mph, 50 mph and 47 mph for good weather, rain/light snow and heavy snow, respectively, will be applied for this activity for buses servicing the school population.

Activity: Passengers Leave Bus (F→G)

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

Activity: Bus Returns to Route for Second Wave Evacuation (G→C→D→E)

As shown in Table 8-1, there are insufficient buses for evacuation of schoolchildren in a single wave if the entire EPZ is evacuated at once (a highly unlikely event). Due to the large number of schools in the EPZ, second wave ETE were not computed for each school or each protective action area. Rather, the following representative ETE is provided to estimate the additional time needed for a second wave evacuation of schools in each protective action area. The travel time from the school reception center back to the EPZ boundary and then back to the school was computed assuming an average speed of 55 mph as buses will be traveling counter to evacuating traffic. Times and distances are based on averages for all schools in the EPZ for good weather:

- Buses arrive at the S.R.C. at 3:10 (see average value in Table 8-2)
- Bus discharges passengers (5 minutes) and driver takes a 10-minute rest: 15 minutes
- Bus returns to facility: 19 minutes (average distance to S.R.C. (8.8 miles) + average distance to EPZ boundary (8.1 miles) at 55 mph)
- Loading Time: 15 minutes
- Bus travels back to the EPZ boundary: 30 minutes [average distance to EPZ boundary (8.1 miles) at network wide average speed at 4:00 (16.54 mph)]

- Bus exits EPZ at time 3:10 + 0:15 + 0:19 + 0:15 + 0:30 = 4:30 (rounded up to nearest 5 minutes) after the ATE.

Given the average single-wave ETE for schools is 2:55 (see Table 8-2); a second-wave evacuation would require an additional 1 hour and 35 minutes on average. The average two-wave ETE of schools is 5 minutes (4:25 - 4:30 = 0:05) more than the 90th percentile ETE of the full EPZ during a winter, midweek, midday scenario (Scenario 6), and could impact protective action decision making.

Evacuation of Transit Dependent People (Residents without access to a vehicle)

A detailed computation of transit dependent population was done and is discussed in Section 3.6. The total number of transit dependent people per protective action area was determined using a weighted distribution based on population (protective action area permanent resident population divided by the total EPZ permanent resident population multiplied by the total transit dependent population). See Table 3-11 for the distribution used. The number of buses required to evacuate this population was determined using a capacity of 30 people per bus. KLD designed 35 bus routes to service the major evacuation route in each protective action area from the center of the protective action area to the EPZ boundary, for the purposes of this study. The designed routes (as discussed in Section 10) are described in Table 10-1. Those buses servicing the transit-dependent evacuees will first travel along these routes, then proceed out of the EPZ to give a representative ETE for transit dependent people within each protective action area.

Activity: Mobilize Drivers (A→B→C)

Mobilization time is the elapsed time from the ATE until the time the buses arrive at their designated route. The buses dispatched from the depots to service the transit-dependent evacuees will be scheduled so that they arrive at their respective routes after a majority of their passengers have completed their mobilization. As shown in Figure 5-4 (Residents with no Commuters), 90% of the evacuees will have completed their mobilization when the buses will begin their routes, 180 minutes after the ATE for good weather. Those routes with multiple buses have been designed such that buses are dispatched using 20-minute headways. The use of bus headways ensures that those people who take longer to mobilize will be picked up.

Activity: Board Passengers (C→D)

For multiple stops along a route, 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, $P \approx 1$ 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/light snow resulting in 5-minutes of additional loading time per bus in rain/light snow and 10-minutes of additional loading time per bus in heavy snow.

Activity: Travel to EPZ Boundary (D→E)

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 8-5 through Table 8-7 present the transit-dependent population ETE for each bus route calculated using the procedures above for good weather, rain/light snow and heavy snow, respectively.

For example, the ETE for the bus route servicing Bear Mountain State Park is computed as 180 + 11 + 30 = 3:45 for good weather (rounded up to nearest 5 minutes). Here, 11 minutes is the time to travel 9.4 miles at 52 mph, the average speed output by the model for this route at 180 minutes.

The average single wave ETE (4 hours and 25 minutes) for the transit dependent population equals the 90th percentile ETE (4:25) for the general population for a winter, midweek, midday, good weather (Scenario 6) evacuation of the full EPZ (Region R03) and should not impact protective action decision making.

The ETE for a second wave (discussed below) is presented in the event there is a shortfall of available buses or bus drivers.

Activity: Travel to Reception Centers (E→F)

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 general population reception centers are mapped in Figure 10-11 through Figure 10-14. For a single-wave evacuation, this travel time outside the EPZ does not contribute to the ETE. Assumed bus speeds of 55 mph, 50 mph and 47 mph for good weather, rain/light snow and heavy snow, respectively, will be applied for this activity for buses servicing the transit-dependent population.

Activity: Passengers Leave Bus (F→G)

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

Activity: Bus Returns to Route for Second Wave Evacuation (G→C→D→E)

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 the start of 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 route servicing Bear Mountain State Park is computed as follows for good weather:

- Bus arrives at reception center at 4:07 in good weather (3:45 to exit EPZ + 22-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: 22-minutes (equal to travel time to reception center) + 21 minutes to travel to the start of the route and to rerun the route a second time (9.4 miles @ 55 mph [assumed speed since bus is traveling against traffic] + 9.4 miles @ 52.13 mph [route specific speed output from the model at this time]) = 43 minutes
- Bus completes pick-ups along route: 30 minutes.
- Bus exits EPZ at time 4:07 + 0:15 + 0:43 + 0:30 = 5:35 after the ATE.

The ETE for the completion of the second wave for all transit-dependent bus routes are provided in Table 8-5 through Table 8-7. The average ETE (5:55) for a two-wave evacuation of transit-dependent people exceeds the ETE (4:25) for the general population at the 90th percentile for an evacuation of the entire EPZ (Region R03) under winter, midweek, midday, good weather conditions (Scenario 6) and could impact protective action decision making.

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

Evacuation of Medical Facilities

Activity: Mobilize Drivers (A→B→C)

As discussed in Section 2.4, and shown in Table 2-2, it is assumed that the mobilization time for medical facilities averages 90 minutes in good weather, 100 minutes in rain/light snow and 110 minutes in heavy snow. Specially trained medical support staff (working their regular shift) will be on site to assist in the evacuation of patients. It is further assumed that additional staff (if needed) could be mobilized over this same 90-minute timeframe.

Activity: Board Passengers (C→D)

Item 6 of Section 2.4 discusses transit vehicle loading times for medical facilities. Loading times are assumed to be 1 minute per ambulatory passenger, 5 minutes per wheelchair bound passenger, and 15 minutes per bedridden passenger. Item 4 of Section 2.4 discusses transit vehicle capacities to cap loading times per vehicle type. Concurrent loading on multiple buses, wheelchair buses, and ambulances at capacity is assumed such that the maximum loading times for buses (30 passengers times 1 minute per passenger), wheelchair vans (15 passengers times 5

minutes per passenger) and ambulances (2 passengers times 15 minutes per passenger) are 30, 75 and 30 minutes, respectively.

Activity: Travel to EPZ Boundary (D→E)

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

Table 8-8 through Table 8-10 summarize the ETE for medical facilities within the EPZ for good weather, rain/light snow and heavy snow, respectively. Average speeds output by the model for Scenario 6 (Scenario 7 for rain/light snow and Scenario 8 for heavy snow), Region 3, capped at 55 mph (50 mph for rain/light snow and 47 mph for heavy snow), are used to compute travel time to the 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. All ETE are rounded up to the nearest 5 minutes.

For example, the calculation of ETE for the medical facilities within Lower Philipstown with 188 ambulatory residents during good weather is:

$$\text{ETE: } 90 + 1 \times 30 + 12 = 132 \text{ min. or } 2:15 \text{ (rounded up to the nearest 5 minutes)}$$

It is assumed that the population at medical facilities 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.

The average single wave ETE (3 hours 10 minutes) for medical facilities in the EPZ does not exceed the 90th percentile ETE (4:25) for the general population for a winter, midweek, midday, good weather (Scenario 6) evacuation of the full EPZ (Region R03) and should not impact protective action decision making.

Activity: Vehicles Travel to Reception Centers (E→F), Passengers Leave (F→G), Vehicle Returns to Route for Second Wave Evacuation (G→C→D→E)

As shown in Table 8-1, there are insufficient resources to evacuate the ambulatory patients at medical facilities within the EPZ in a single wave. A representative second wave ETE for medical facilities is computed as follows for good weather assuming the host medical facilities for these facilities are about 10 miles from the EPZ boundary following the most probable route:

Ambulatory patients (buses):

- On average, buses for ambulatory patients leave the EPZ at 2:55 after the ATE.
- Buses travels to host facility: 11 minutes (10 miles at 55 mph).
- Bus discharges passengers 27 minutes (average loading time for ambulatory patients from Table 8-8) and driver takes a 10-minute rest: 37 minutes.
- Bus returns to facility: 11 minutes to travel back to the EPZ boundary (equal to the

- average travel time to host facility) + 9 minutes to travel back to the facility (average distance to EPZ = 7.8 miles from Table 8-8 @ 55 mph) = 20 minutes.
- Remaining ambulatory patients loaded on bus: 27 minutes (average from Table 8-8).
- Bus travels to EPZ boundary: 26 minutes (average distance from medical facilities to EPZ boundary (7.8 miles) at 18.3 mph (network wide average speed at 4:30).
- Bus exits EPZ at time 2:55 + 0:11 + 0:37 + 0:20 + 0:27 + 0:26 = 5:00 after the ATE (rounded up to the nearest 5 minutes).

The average ETE for a second-wave evacuation of transit-dependent people exceeds the 90th percentile ETE for the evacuation of the entire EPZ (Region R03) for the general population for a winter, midweek, midday, good weather (Scenario 6), which could impact the protective action decision making.

Correctional Facilities

As discussed in Section 3.10, there are two correctional facilities within the EPZ – Sing Sing correctional facility and Rockland County Jail. The total inmate capacity of these facilities is 1,411 persons. It is assumed that these two facilities will shelter-in-place. As such, ETE were not calculated for these facilities.

8.2 ETE for Access and/or Functional Needs Population

The registered access and/or functional needs population was provided by the offsite agencies and is further discussed in Section 3.9. Table 8-11 summarizes the ETE for the access and/or functional needs population. The table is broken down by weather condition. It is assumed that the access and/or functional needs population will be picked up from their homes. Furthermore, it is conservatively assumed that households are spaced 3 miles apart. Vehicle speeds approximate 20 mph between households in good weather (10% slower in rain/light snow and 15% in heavy snow). Mobilization times of 180 minutes were used (190 minutes for rain/light snow and 200 minutes for heavy snow). The last household is assumed to be 5 miles from the EPZ boundary, and the network-wide average speed, capped at 55 mph (50 mph for rain/light snow and 47 mph for heavy snow), after the last pickup is used to compute travel time to the EPZ boundary.

ETE is computed by summing mobilization time, loading time at first household, travel to the subsequent households, loading time at subsequent households, and travel time to the EPZ boundary. All ETE are rounded up to the nearest 5 minutes.

For example, conservatively assuming no more than one access and/or functional needs person per household implies that 153 households require a bus. It is assumed that 31 buses are needed for ambulatory people to evacuate in a reasonable amount of time. The following outlines the ETE calculation for buses evacuating ambulatory access and/or functional needs persons:

1. Assume 31 buses are deployed, each with at most 5 stops, to service a total of 153 households.
2. The ETE is calculated as follows:

- a. Buses arrive at the first pickup location: 180 minutes
- b. Load passenger at first pickup: 5 minutes
- c. Travel to next pickup locations: 36 minutes (3 miles @ 20 mph for 4 stops)
- d. Load passenger at subsequent pickup location: 20 minutes (5 x 4 stops)
- e. Travel to EPZ boundary: 17 minutes (5 miles @ 17.4 mph).

ETE: $180 + 5 + 36 + 20 + 17 = 4:20$ after the ATE (rounded up to the nearest 5 minutes)

The ETE for the ambulatory access and/or functional needs population within the EPZ is less than the 90th percentile ETE for evacuation of the general population in the Full EPZ (Region R03) under winter, midweek, midday, good weather (Scenario 6) conditions.

The following outlines the ETE calculations for a second wave using buses after the medical facilities have been evacuated assuming host medical facilities are located 10 miles beyond the EPZ boundary:

- a. Buses arrive at host medical facilities: 3:06 (2:55 Average ETE for buses to exit the EPZ in Table 8-8 plus 11 minutes to travel 10-miles at 55 mph) on average.
- b. Unload patients at host medical facilities: 5 minutes.
- c. Driver takes 10-minute rest: 10 minutes.
- d. Travel time back to EPZ: 11 minutes (10-miles at 55mph).
- e. Travel to first household: 15 minutes (5 miles at 20 mph).
- f. Loading time at first household: 5 minutes.
- g. Travel to subsequent pickup location: 4 @ 9 minutes = 36 minutes.
- h. Loading time at subsequent household: 4 stops @ 5 minutes = 20 minutes.
- i. Travel time to EPZ boundary: 5 miles @18.46 mph (at 4:50) = 16 minutes.

Bus exits EPZ at time: $3:06 + 5 + 10 + 11 + 15 + 5 + 36 + 20 + 16 = 5:05$ after the ATE, rounded to the nearest 5-minutes.

The average ETE for a second-wave evacuation of the ambulatory access and/or functional needs population within the EPZ is longer than the 90th percentile ETE for an evacuation of the general population in the Full EPZ (Region R03) under winter, midweek, midday, good weather (Scenario 6) conditions and could impact protective action decision making.

Table 8-1. Summary of Transportation Resources

Transportation Resource	Buses	Vans	Wheelchair Buses	Ambulances
Resources Available				
ORANGE COUNTY				
West Point Tours (Highland Falls)	20	10	-	-
West Point Tours (Vails Gate)	21	-	-	-
Monroe Woodbury Transportation	80	60	-	-
Mobile Life	-	-	-	25
Ambulnz	-	-	-	8
PUTNAM COUNTY				
Putnam County Office of Senior Resources	-	-	1	-
Carmel Ambulance Corps	-	-	-	2
Haldane Central School District	8	5	-	-
Mahopac Central School District	83	30	-	-
Garrison Union Free School	6	-	2	-
Putnam Valley School	22	11	-	-
ROCKLAND COUNTY				
Sloatsburg	-	-	-	2
R.V.A.C.	-	-	-	6
W.P. Faist	-	-	-	3
Hatzolah	-	-	-	8
Pearl River	-	-	-	3
So. Orangetown	-	-	-	5
Piermont	-	-	-	1
Spring Hill	-	-	-	7
Nanuet	-	-	-	4
New City	-	-	-	4
Congers/ Valley Cottage	-	-	-	3
Nyack	-	-	-	4
Rockland Mobile Care	-	-	-	23
Haverstraw	-	-	-	5
Stony Point	-	-	-	3
Rockland Paramedics Service	-	-	-	6
New Square EMS	-	-	-	4
Chestnut Ridge Trans. Inc. Spring Valley	-	80	11	-
Chestnut Ridge Trans. Inc. Chestnut Ridge	109	2	-	-
Chestnut Ridge Trans. Inc. - Hilburn	48	36	2	-
Clarkstown Central School District	62	68	6	-
Student Bus Company - Spring Valley	-	61	3	-
Student Bus Company - Nanuet	-	52	13	-
Student Bus Company - Orangeburg	26	1	-	-
Haverstraw Transit Inc.	87	90	6	-
Peter Brega Inc.	35	35	-	-
Rockland Coaches Inc.	92	-	-	-

Transportation Resource	Buses	Vans	Wheelchair Buses	Ambulances
Monsey New Square Trails Corp	59	-	-	-
Transdev Services, Inc.	32	3	-	-
Rockland BOCES	6	29	22	-
Rockland County Dept. of Public Transportation	25	-	-	-
WESTCHESTER COUNTY				
Liberty Lines	320	-	-	-
Westchester County Office for People with Disabilities (OPWD)	-	62	-	-
PTLA	-	-	5	-
TOTAL:	1,020	565	71	101
Resources Needed				
Schools (Table 3-8):	1,861	-	-	-
Medical Facilities (Table 3-6):	181	-	120	179
Transit-Dependent Population (Section 3.6):	169	-	-	-
Access and/or Functional Needs (Table 3-9):	31		4	63
TOTAL TRANSPORTATION NEEDS:	2,242	0	124	242

Table 8-2. School Evacuation Time Estimates – Good Weather

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
ORANGE COUNTY SCHOOLS									
Fort Montgomery	90	15	10.8	6.6	99	3:25	6.7	7	3:35
Village of Highland Falls	90	15	8.2	4.1	121	3:50	6.7	7	4:00
U.S. Military Academy	90	15	15.4	5.5	168	4:35	6.7	7	4:45
Village-Town of Woodbury	90	15	2.0	34.7	3	1:50	21.4	23	2:15
Harriman State Park	90	15	7.5	4.9	92	3:20	13.6	15	3:35
PUTNAM COUNTY SCHOOLS									
Southern Putnam Valley	90	15	6.1	2.4	152	4:20	12.8	14	4:35
Southern Philipstown	90	15	4.7	16.2	17	2:05	34.1	37	2:45
Southwest Carmel	90	15	2.9	1.4	124	3:50	13.5	15	4:05
Lower Philipstown	90	15	7.6	40.9	11	2:00	28.6	31	2:35
ROCKLAND COUNTY SCHOOLS									
Central Town of Clarkstown	90	15	2.6	3.6	44	2:30	2.6	3	2:35
Northeastern Town of Ramapo	90	15	4.2	6.5	39	2:25	2.0	2	2:30
Northeastern & Eastern Town of Clarkstown	90	15	4.3	5.9	44	2:30	4.3	5	2:35
Northwestern Town of Clarkstown	90	15	6.6	7.5	53	2:40	2.6	3	2:45
Village of Haverstraw	90	15	8.7	5.1	102	3:30	4.8	5	3:35
Village of West Haverstraw	90	15	8.8	6.8	77	3:05	2.0	2	3:10
Unincorporated Areas of the Town of Haverstraw	90	15	8.9	13.4	40	2:25	1.8	2	2:30
Village of Pomona	90	15	5.7	46.4	7	1:55	1.8	2	2:00
Stony Point	90	15	10.5	8.2	77	3:05	2.0	2	3:10
Grassy Point	90	15	11.8	8.4	84	3:10	2.0	2	3:15
Tompkins Cove	90	15	12.6	8.4	90	3:15	2.0	2	3:20
WESTCHESTER COUNTY SCHOOLS									
Briarcliff Manor	90	15	2.6	39.0	4	1:50	6.7	7	2:00
Ossining Town & Village	90	15	5.3	4.3	75	3:00	10.1	11	3:15
Town of New Castle (W. of Hardscrabble Rd)	90	15	3.7	22.6	10	1:55	10.8	12	2:10
Croton-on-Hudson	90	15	8.0	4.5	108	3:35	7.4	8	3:45

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
Buchanan	90	15	11.9	6.6	108	3:35	7.4	8	3:45
Montrose	90	15	10.5	6.1	104	3:30	7.4	8	3:40
City of Peekskill	90	15	16.4	32.4	30	2:15	5.8	6	2:25
Town of Cortlandt	90	15	17.4	14.0	74	3:00	15.8	17	3:20
Yorktown	90	15	9.6	35.4	16	2:05	9.4	10	2:15
Town of Somers (W. of Route 118)	90	15	7.2	4.8	90	3:15	9.7	11	3:30
Maximum for EPZ:						4:35	Maximum:		
Average for EPZ:						2:55	Average:		

Table 8-3. School Evacuation Time Estimates – Rain/Light Snow

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
ORANGE COUNTY SCHOOLS									
Fort Montgomery	100	20	10.8	5.5	119	4:00	6.7	8	4:10
Village of Highland Falls	100	20	8.2	3.7	134	4:15	6.7	8	4:25
U.S. Military Academy	100	20	15.4	5.1	182	5:05	6.7	8	5:15
Village-Town of Woodbury	100	20	2.0	32.4	4	2:05	21.4	26	2:35
Harriman State Park	100	20	7.5	9.0	50	2:50	13.6	16	3:10
PUTNAM COUNTY SCHOOLS									
Southern Putnam Valley	100	20	6.1	2.2	163	4:45	12.8	15	5:00
Southern Philipstown	100	20	4.7	14.0	20	2:20	34.1	41	3:05
Southwest Carmel	100	20	2.9	1.4	130	4:10	13.5	16	4:30
Lower Philipstown	100	20	7.6	16.7	28	2:30	28.6	34	3:05
ROCKLAND COUNTY SCHOOLS									
Central Town of Clarkstown	100	20	2.6	3.2	49	2:50	2.6	3	2:55
Northeastern Town of Ramapo	100	20	4.2	5.8	44	2:45	2.0	2	2:50
Northeastern & Eastern Town of Clarkstown	100	20	4.3	4.8	55	2:55	4.3	5	3:00
Northwestern Town of Clarkstown	100	20	6.6	6.5	61	3:05	2.6	3	3:10
Village of Haverstraw	100	20	8.7	3.9	134	4:15	4.8	6	4:25
Village of West Haverstraw	100	20	8.8	4.0	131	4:15	2.0	2	4:20
Unincorporated Areas of the Town of Haverstraw	100	20	8.9	8.5	63	3:05	1.8	2	3:10
Village of Pomona	100	20	5.7	48.8	7	2:10	1.8	2	2:15
Stony Point	100	20	10.5	4.9	130	4:10	2.0	2	4:15
Grassy Point	100	20	11.8	5.0	142	4:25	2.0	2	4:30
Tompkins Cove	100	20	12.6	5.1	148	4:30	2.0	2	4:35
WESTCHESTER COUNTY SCHOOLS									
Briarcliff Manor	100	20	2.6	35.2	4	2:05	6.7	8	2:15
Ossining Town & Village	100	20	5.3	3.6	88	3:30	10.1	12	3:45
Town of New Castle (W. of Hardscrabble Rd)	100	20	3.7	18.6	12	2:15	10.8	13	2:30
Croton-on-Hudson	100	20	8.0	3.7	129	4:10	7.4	9	4:20

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
Buchanan	100	20	11.9	5.5	128	4:10	7.4	9	4:20
Montrose	100	20	10.5	4.9	130	4:10	7.4	9	4:20
City of Peekskill	100	20	16.4	22.4	44	2:45	5.8	7	2:55
Town of Cortlandt	100	20	17.4	11.1	94	3:35	15.8	19	3:55
Yorktown	100	20	9.6	31.0	19	2:20	9.4	11	2:35
Town of Somers (W. of Route 118)	100	20	7.2	3.0	144	4:25	9.7	12	4:40
Maximum for EPZ:						5:05	Maximum:		
Average for EPZ:						3:30	Average:		

Table 8-4. School Evacuation Time Estimates – Heavy Snow

Schools In	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 to S.R.C. (mi.)	Travel Time from EPZ to S.R.C. (min)	ETA to S.R.C (hr:min)
ORANGE COUNTY SCHOOLS									
Fort Montgomery	110	25	10.8	4.3	151	4:50	6.7	9	5:00
Village of Highland Falls	110	25	8.2	3.2	153	4:50	6.7	9	5:00
U.S. Military Academy	110	25	15.4	4.3	213	5:50	6.7	9	6:00
Village-Town of Woodbury	110	25	2.0	30.5	4	2:20	21.4	27	2:50
Harriman State Park	110	25	7.5	9.6	47	3:05	13.6	17	3:25
PUTNAM COUNTY SCHOOLS									
Southern Putnam Valley	110	25	6.1	3.7	100	3:55	12.8	16	4:15
Southern Philipstown	110	25	4.7	19.8	14	2:30	34.1	44	3:15
Southwest Carmel	110	25	2.9	1.7	104	4:00	13.5	17	4:20
Lower Philipstown	110	25	7.6	34.6	13	2:30	28.6	37	3:10
ROCKLAND COUNTY SCHOOLS									
Central Town of Clarkstown	110	25	2.6	4.9	32	2:50	2.6	3	2:55
Northeastern Town of Ramapo	110	25	4.2	8.9	28	2:45	2.0	3	2:50
Northeastern & Eastern Town of Clarkstown	110	25	4.3	6.3	41	3:00	4.3	6	3:10
Northwestern Town of Clarkstown	110	25	6.6	8.4	47	3:05	2.6	3	3:10
Village of Haverstraw	110	25	8.7	6.2	84	3:40	4.8	6	3:50
Village of West Haverstraw	110	25	8.8	7.1	74	3:30	2.0	3	3:35
Unincorporated Areas of the Town of Haverstraw	110	25	8.9	11.0	49	3:05	1.8	2	3:10
Village of Pomona	110	25	5.7	42.8	8	2:25	1.8	2	2:30
Stony Point	110	25	10.5	8.3	76	3:35	2.0	3	3:40
Grassy Point	110	25	11.8	8.2	87	3:45	2.0	3	3:50
Tompkins Cove	110	25	12.6	8.1	93	3:50	2.0	3	3:55
WESTCHESTER COUNTY SCHOOLS									
Briarcliff Manor	110	25	2.6	33.2	5	2:20	6.7	9	2:30
Ossining Town & Village	110	25	5.3	2.9	109	4:05	10.1	13	4:20
Town of New Castle (W. of Hardscrabble Rd)	110	25	3.7	35.0	6	2:25	10.8	14	2:40
Croton-on-Hudson	110	25	8.0	4.1	118	4:15	7.4	9	4:25

Schools In	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 S.R.C. (mi.)	Travel Time from EPZ Bdry to S.R.C. (min)	ETA to S.R.C (hr:min)
Buchanan	110	25	11.9	5.6	128	4:25	7.4	9	4:35
Montrose	110	25	10.5	5.1	124	4:20	7.4	9	4:30
City of Peekskill	110	25	16.4	36.6	27	2:45	5.8	7	2:55
Town of Cortlandt	110	25	17.4	20.1	52	3:10	15.8	20	3:30
Yorktown	110	25	9.6	24.8	23	2:40	9.4	12	2:55
Town of Somers (W. of Route 118)	110	25	7.2	30.4	14	2:30	9.7	12	2:45
					Maximum for EPZ:	5:50	Maximum:		6:00
					Average for EPZ:	3:25	Average:		3:40

Table 8-5. Transit-Dependent Evacuation Time Estimates – Good Weather

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave						
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	
ORANGE COUNTY														
Bear Mountain State Park	1	180	9.4	52.0	11	30	3:45	19.8	22	5	10	43	30	5:35
Fort Montgomery	1	180	10.8	6.9	95	30	5:05	6.7	7	5	10	36	30	6:35
Harriman State Park	1	180	7.5	8.9	50	30	4:20	13.6	15	5	10	36	30	6:00
Town of Cornwall (S. of Angola Road)	1	180	3.2	40.0	5	30	3:35	7.2	8	5	10	16	30	4:45
Town of Tuxedo east of NYS Thruway	1	180	0.4	35.0	1	30	3:35	29.5	32	5	10	33	30	5:25
U.S. Military Academy	4	180	15.4	6.8	136	30	5:50	6.7	7	5	10	43	30	7:25
Village of Highland Falls	2	180	8.2	4.7	105	30	5:15	6.7	7	5	10	26	30	6:35
Village-Town of Woodbury	2	180	2.0	35.1	3	30	3:35	21.4	23	5	10	29	30	5:15
PUTNAM COUNTY														
Lower Philipstown	2	180	7.6	14.3	32	30	4:05	28.6	31	5	10	54	30	6:15
Southern Philipstown	3	180	4.7	13.2	21	30	3:55	34.1	37	5	10	48	30	6:05
Southern Putnam Valley	5	180	6.1	3.5	105	30	5:15	12.8	14	5	10	29	30	6:45
Southwest Carmel	2	180	2.9	1.7	106	30	5:20	13.5	15	5	10	23	30	6:45
ROCKLAND COUNTY														
Central Town of Clarkstown	6	180	2.6	6.0	26	30	4:00	2.6	3	5	10	10	30	5:00
	5	200	2.6	6.0	26	30	4:20	2.6	3	5	10	10	30	5:20
Grassy Point	1	180	11.8	12.4	57	30	4:30	2.0	2	5	10	35	30	5:55
Jones Point	1	180	13.3	49.1	16	30	3:50	19.8	22	5	10	53	30	5:50
Northeastern & Eastern Town of Clarkstown	8	180	4.3	7.4	35	30	4:05	4.3	5	5	10	20	30	5:15
Northeastern Town of Ramapo	5	180	4.2	5.3	48	30	4:20	2.0	2	5	10	13	30	5:20
	5	200	4.2	7.9	32	30	4:25	2.0	2	5	10	13	30	5:25
Northwestern Town of Clarkstown	4	220	4.2	12.1	21	30	4:35	2.0	2	5	10	13	30	5:35
	4	180	6.6	11.5	35	30	4:05	2.6	3	5	10	22	30	5:15
Stony Point	6	180	10.5	12.0	53	30	4:25	2.0	2	5	10	32	30	5:45

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave						
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
WESTCHESTER COUNTY														
Tompkins Cove	1	180	12.6	13.0	58	30	4:30	2.0	2	5	10	38	30	5:55
Unincorporated Areas of the Town of Haverstraw	6	180	8.9	13.5	40	30	4:10	1.8	2	5	10	24	30	5:25
Village of Haverstraw	6	180	8.7	8.6	61	30	4:35	4.8	5	5	10	30	30	5:55
Village of Pomona	3	180	5.7	50.7	7	30	3:40	1.8	2	5	10	15	30	4:45
Village of West Haverstraw	6	180	8.8	10.3	51	30	4:25	2.0	2	5	10	27	30	5:40
Briarcliff Manor	4	180	2.6	39.0	4	30	3:35	6.7	7	5	10	14	30	4:45
Buchanan	2	180	11.9	10.4	69	30	4:40	7.4	8	5	10	51	30	6:25
City of Peekskill	6	180	16.4	42.3	23	30	3:55	5.8	6	5	10	47	30	5:35
	6	200	16.4	42.9	23	30	4:15	5.8	6	5	10	47	30	5:55
Croton-on-Hudson	4	180	8.0	7.3	66	30	4:40	7.4	8	5	10	41	30	6:15
Montrose	2	180	10.5	9.6	66	30	4:40	7.4	8	5	10	41	30	6:15
Ossining Town & Village	6	180	5.3	5.4	59	30	4:30	10.1	11	5	10	40	30	6:10
	5	200	5.3	6.2	51	30	4:45	10.1	11	5	10	35	30	6:20
	5	220	5.3	7.7	41	30	4:55	10.1	11	5	10	31	30	6:25
Town of Cortlandt	5	180	17.4	15.5	68	30	4:40	15.8	17	5	10	56	30	6:40
	4	200	17.4	18.3	57	30	4:50	15.8	17	5	10	56	30	6:50
	4	220	17.4	21.2	49	30	5:00	15.8	17	5	10	56	30	7:00
Town of New Castle (W. of Hardscrabble Rd)	3	180	3.7	40.4	6	30	3:40	10.8	12	5	10	22	30	5:00
Town of Somers (W. of Route 118)	3	180	7.2	13.9	31	30	4:05	9.7	11	5	10	31	30	5:35
Verplanck	1	180	13.0	10.8	72	30	4:45	7.4	8	5	10	50	30	6:30
Yorktown	6	180	9.6	38.3	15	30	3:45	9.4	10	5	10	35	30	5:15
	6	200	9.6	37.6	15	30	4:05	9.4	10	5	10	36	30	5:40
	5	220	9.6	38.3	15	30	4:25	9.4	10	5	10	36	30	6:00
Maximum ETE:							5:50	Maximum ETE:					7:25	
Average ETE:							4:25	Average ETE:					5:55	

Table 8-6. Transit-Dependent Evacuation Time Estimates – Rain/Light Snow

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave						
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)	
ORANGE COUNTY														
Bear Mountain State Park	1	190	9.4	11.9	47	35	4:35	19.8	24	5	10	47	35	6:40
Fort Montgomery	1	190	10.8	6.5	100	35	5:25	6.7	8	5	10	37	35	7:00
Harriman State Park	1	190	7.5	9.6	47	35	4:35	13.6	16	5	10	39	35	6:20
Town of Cornwall (S. of Angola Road)	1	190	3.2	36.0	5	35	3:50	7.2	9	5	10	18	35	5:10
Town of Tuxedo east of NYS Thruway	1	190	0.4	32.0	1	35	3:50	29.5	35	5	10	36	35	5:55
U.S. Military Academy	4	190	15.4	6.4	144	35	6:10	6.7	8	5	10	48	35	8:00
Village of Highland Falls	2	190	8.2	4.5	108	35	5:35	6.7	8	5	10	28	35	7:05
Village-Town of Woodbury	2	190	2.0	32.0	4	35	3:50	21.4	26	5	10	32	35	5:40
PUTNAM COUNTY														
Lower Philipstown	2	190	7.6	9.4	49	35	4:35	28.6	34	5	10	62	35	7:05
Southern Philipstown	3	190	4.7	6.0	47	35	4:35	34.1	41	5	10	53	35	7:00
Southern Putnam Valley	5	190	6.1	2.6	141	35	6:10	12.8	15	5	10	32	35	7:50
Southwest Carmel	2	190	2.9	1.6	112	35	5:40	13.5	16	5	10	24	35	7:10
ROCKLAND COUNTY														
Central Town of Clarkstown	6	190	2.6	3.1	50	35	4:35	2.6	3	5	10	11	35	5:40
	5	210	2.6	3.5	44	35	4:50	2.6	3	5	10	11	35	5:55
Grassy Point	1	190	11.8	6.6	107	35	5:35	2.0	2	5	10	38	35	7:05
Jones Point	1	190	13.3	15.7	51	35	4:40	19.8	24	5	10	58	35	6:55
Northeastern & Eastern Town of Clarkstown	8	190	4.3	7.0	37	35	4:25	4.3	5	5	10	30	35	5:50
Northeastern Town of Ramapo	5	190	4.2	6.4	39	35	4:25	2.0	2	5	10	27	35	5:45
	5	210	4.2	6.7	38	35	4:45	2.0	2	5	10	21	35	6:00
Northwestern Town of Clarkstown	4	230	4.2	7.1	35	35	5:00	2.0	2	5	10	17	35	6:10
	4	190	6.6	6.7	59	35	4:45	2.6	3	5	10	23	35	6:05
Stony Point	6	190	10.5	6.1	104	35	5:30	2.0	2	5	10	34	35	7:00

		One-Wave						Distance to R. C. (miles)	Two-Wave						
		Number of Buses Dispatched	Mobilization (min)	Route Length (miles)	Route Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
WESTCHESTER COUNTY															
	Route Servicing	1	190	12.6	7.2	105	35	5:30	2	5	10	40	35	7:05	
	Unincorporated Areas of the Town of Haverstraw	6	190	8.9	9.1	59	35	4:45	2	5	10	26	35	6:05	
	Village of Haverstraw	6	190	8.7	6.5	80	35	5:05	6	5	10	34	35	6:35	
	Village of Pomona	3	190	5.7	45.4	8	35	3:55	2	5	10	17	35	5:05	
	Village of West Haverstraw	6	190	8.8	5.1	104	35	5:30	2	5	10	29	35	6:55	
		4	190	2.6	35.2	4	35	3:50	8	5	10	16	35	5:05	
	Briarcliff Manor	2	190	11.9	8.3	86	35	5:15	9	5	10	53	35	7:10	
	Buchanan	6	190	16.4	36.8	27	35	4:15	7	5	10	52	35	6:05	
	City of Peekskill	6	210	16.4	38.9	25	35	4:30	7	5	10	51	35	6:20	
	Croton-on-Hudson	4	190	8.0	5.9	82	35	5:10	9	5	10	47	35	7:00	
	Montrose	2	190	10.5	7.5	84	35	5:10	9	5	10	48	35	7:00	
		6	190	5.3	4.8	66	35	4:55	12	5	10	46	35	6:45	
	Ossining Town & Village	5	210	5.3	5.4	59	35	5:05	12	5	10	44	35	6:55	
		5	230	5.3	6.3	51	35	5:20	12	5	10	36	35	7:00	
		5	190	17.4	12.8	82	35	5:10	19	5	10	61	35	7:20	
	Town of Cortlandt	4	210	17.4	14.1	74	35	5:20	19	5	10	61	35	7:30	
		4	230	17.4	14.6	72	35	5:40	19	5	10	61	35	7:50	
	Town of New Castle (W. of Hardscrabble Rd)	3	190	3.7	32.1	7	35	3:55	13	5	10	23	35	5:25	
	Town of Somers (W. of Route 118)	3	190	7.2	4.3	101	35	5:30	12	5	10	33	35	7:05	
	Verplanck	1	190	13.0	8.6	90	35	5:15	9	5	10	57	35	7:15	
		6	190	9.6	34.4	17	35	4:05	11	5	10	39	35	5:45	
	Yorktown	6	210	9.6	34.0	17	35	4:25	11	5	10	39	35	6:05	
		5	230	9.6	34.2	17	35	4:45	11	5	10	39	35	6:25	
		Maximum ETE:						6:10	Maximum ETE:						8:00
		Average ETE:						4:55	Average ETE:						6:35

Table 8-7. Transit-Dependent Evacuation Time Estimates – Heavy Snow

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave						
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
ORANGE COUNTY														
Bear Mountain State Park	1	200	9.4	20.7	27	40	4:30	19.8	25	5	10	50	40	6:40
Fort Montgomery	1	200	10.8	4.8	135	40	6:15	6.7	9	5	10	42	40	8:05
Harriman State Park	1	200	7.5	12.9	35	40	4:35	13.6	17	5	10	41	40	6:30
Town of Cornwall (S. of Angola Road)	1	200	3.2	34.0	6	40	4:10	7.2	9	5	10	19	40	5:35
Town of Tuxedo east of NYS Thruway	1	200	0.4	30.0	1	40	4:05	29.5	38	5	10	39	40	6:20
U.S. Military Academy	4	200	15.4	5.2	179	40	7:00	6.7	9	5	10	51	40	8:55
Village of Highland Falls	2	200	8.2	3.8	128	40	6:10	6.7	9	5	10	38	40	7:55
Village-Town of Woodbury	2	200	2.0	30.4	4	40	4:05	21.4	27	5	10	33	40	6:00
PUTNAM COUNTY														
Lower Philipstown	2	200	7.6	17.4	26	40	4:30	28.6	37	5	10	79	40	7:25
Southern Philipstown	3	200	4.7	9.9	28	40	4:30	34.1	44	5	10	101	40	7:50
Southern Putnam Valley	5	200	6.1	2.6	143	40	6:25	12.8	16	5	10	46	40	8:25
Southwest Carmel	2	200	2.9	1.6	113	40	5:55	13.5	17	5	10	27	40	7:35
ROCKLAND COUNTY														
Central Town of Clarkstown	6	200	2.6	3.4	46	40	4:50	2.6	3	5	10	25	40	6:15
Grassy Point	5	220	2.6	3.6	43	40	5:05	2.6	3	5	10	19	40	6:25
	1	200	11.8	8.4	84	40	5:25	2.0	3	5	10	43	40	7:10
Jones Point	1	200	13.3	25.2	32	40	4:35	19.8	25	5	10	62	40	7:00
Northeastern & Eastern Town of Clarkstown	8	200	4.3	6.7	39	40	4:40	4.3	6	5	10	34	40	6:15
Northeastern Town of Ramapo	5	200	4.2	7.0	36	40	4:40	2.0	3	5	10	30	40	6:10
	5	220	4.2	8.8	29	40	4:50	2.0	3	5	10	26	40	6:15
Northwestern Town of Clarkstown	4	240	4.2	13.1	19	40	5:00	2.0	3	5	10	24	40	6:25
	4	200	6.6	7.1	56	40	5:00	2.6	3	5	10	32	40	6:30
Stony Point	6	200	10.5	7.9	80	40	5:20	2.0	3	5	10	40	40	7:00
Tompkins Cove	1	200	12.6	8.4	90	40	5:30	2.0	3	5	10	44	40	7:15

Route Servicing	Number of Buses Dispatched	One-Wave					Distance to R. C. (miles)	Two-Wave					
		Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)		ETE (hr:min)	Travel Time to R. C. (min)	Unload (min)	Driver Rest (min)	Route Travel Time (min)	Pickup Time (min)
WESTCHESTER COUNTY													
Unincorporated Areas of the Town of Haverstraw	6	200	8.9	8.5	63	40	5:05	2	5	10	47	40	6:50
Village of Haverstraw	6	200	8.7	5.1	102	40	5:45	6	5	10	35	40	7:25
Village of Pomona	3	200	5.7	31.6	11	40	4:15	2	5	10	20	40	5:35
Village of West Haverstraw	6	200	8.8	6.7	79	40	5:20	3	5	10	34	40	6:55
Briarcliff Manor	4	200	2.6	33.0	5	40	4:05	9	5	10	17	40	5:30
Buchanan	2	200	11.9	5.7	125	40	6:05	9	5	10	67	40	8:20
City of Peekskill	6	200	16.4	32.5	30	40	4:30	7	5	10	55	40	6:30
	6	220	16.4	33.2	30	40	4:50	7	5	10	55	40	6:50
Croton-on-Hudson	4	200	8.0	4.2	114	40	5:55	9	5	10	56	40	7:55
Montrose	2	200	10.5	5.3	120	40	6:00	9	5	10	57	40	8:05
Ossining Town & Village	6	200	5.3	3.2	99	40	5:40	13	5	10	54	40	7:45
	5	220	5.3	3.4	95	40	5:55	13	5	10	54	40	8:00
	5	240	5.3	3.6	89	40	6:10	13	5	10	51	40	8:10
Town of Cortlandt	5	200	17.4	14.0	75	40	5:15	20	5	10	70	40	7:40
	4	220	17.4	14.1	74	40	5:35	20	5	10	66	40	8:00
	4	240	17.4	14.2	73	40	5:55	20	5	10	66	40	8:20
Town of New Castle (W. of Hardscrabble Rd)	3	200	3.7	30.1	7	40	4:10	14	5	10	25	40	5:45
Town of Somers (W. of Route 118)	3	200	7.2	6.3	68	40	5:10	12	5	10	35	40	6:55
	1	200	13.0	6.0	130	40	6:10	9	5	10	71	40	8:25
Verplanck	6	200	9.6	30.9	19	40	4:20	12	5	10	43	40	6:10
Yorktown	6	220	9.6	30.3	19	40	4:40	12	5	10	42	40	6:30
	5	240	9.6	32.6	18	40	5:00	12	5	10	42	40	6:50
Maximum ETE:							7:00	Maximum ETE:					8:55
Average ETE:							5:10	Average ETE:					7:05

Table 8-8. Medical Facilities Evacuation Time Estimates – Good Weather

Medical Facilities in	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)
PUTNAM COUNTY								
Lower Philipstown	Ambulatory	90	1	188	30	7.6	12	2:15
	Wheelchair bound	90	5	22	75	7.6	26	3:15
Southern Philipstown	Ambulatory	90	1	181	30	4.7	18	2:20
Southern Putnam Valley	Ambulatory	90	1	50	30	6.1	146	4:30
ROCKLAND COUNTY								
Central Town of Clarkstown	Ambulatory	90	1	126	30	2.6	38	2:40
	Wheelchair bound	90	5	4	20	2.6	43	2:35
Northeastern & Eastern Town of Clarkstown	Ambulatory	90	1	698	30	4.3	42	2:45
	Wheelchair bound	90	5	154	75	4.3	41	3:30
	Ambulatory	90	1	461	30	4.2	32	2:35
	Wheelchair bound	90	5	372	75	4.2	51	3:40
Northeastern Town of Ramapo	Bedridden	90	15	25	30	4.2	32	2:35
	Ambulatory	90	1	126	30	6.6	46	2:50
	Wheelchair bound	90	5	6	30	6.6	46	2:50
	Bedridden	90	15	3	30	6.6	46	2:50
Stony Point	Ambulatory	90	1	75	30	10.5	73	3:15
Unincorporated Areas of the Town of Haverstraw	Ambulatory	90	1	12	12	8.9	40	2:25
	Ambulatory	90	1	270	30	8.7	95	3:35
Village of Haverstraw	Wheelchair bound	90	5	140	75	8.7	71	4:00
	Bedridden	90	15	10	30	8.7	95	3:35
Village of West Haverstraw	Ambulatory	90	1	344	30	8.8	73	3:15
	Wheelchair bound	90	5	103	75	8.8	60	3:45
	Bedridden	90	15	16	30	8.8	73	3:15
WESTCHESTER COUNTY								
Briarcliff Manor	Ambulatory	90	1	251	30	2.6	4	2:05
	Wheelchair bound	90	5	52	75	2.6	4	2:50
	Bedridden	90	15	34	30	2.6	4	2:05

Medical Facilities in	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)	
Buchanan	Ambulatory	90	1	10	10	11.9	109	3:30	
	Wheelchair bound	90	5	6	30	11.9	100	3:40	
	Bedridden	90	15	1	15	11.9	108	3:35	
City of Peekskill	Ambulatory	90	1	189	30	16.4	26	2:30	
	Wheelchair bound	90	5	30	75	16.4	23	3:10	
	Bedridden	90	15	22	30	16.4	26	2:30	
Croton-on-Hudson	Ambulatory	90	1	144	30	8.0	100	3:40	
	Wheelchair bound	90	5	29	75	8.0	73	4:00	
	Bedridden	90	15	20	30	8.0	100	3:40	
Ossining Town & Village	Ambulatory	90	1	309	30	5.3	70	3:10	
	Wheelchair bound	90	5	62	75	5.3	63	3:50	
	Bedridden	90	15	45	30	5.3	70	3:10	
Town of Cortlandt	Ambulatory	90	1	699	30	17.4	77	3:20	
	Wheelchair bound	90	5	142	75	17.4	75	4:00	
	Bedridden	90	15	100	30	17.4	77	3:20	
Town of New Castle (W. of Hardscrabble Rd)	Ambulatory	90	1	44	30	3.7	10	2:10	
	Wheelchair bound	90	5	8	40	3.7	9	2:20	
	Bedridden	90	15	6	30	3.7	10	2:10	
Town of Somers (W. of Route 118)	Ambulatory	90	1	16	16	7.2	87	3:15	
	Wheelchair bound	90	5	3	15	7.2	90	3:15	
	Bedridden	90	15	2	30	7.2	78	3:20	
Yorktown	Ambulatory	90	1	532	30	9.6	16	2:20	
	Wheelchair bound	90	5	107	75	9.6	15	3:00	
	Bedridden	90	15	78	30	9.6	16	2:20	
						Maximum ETE:			4:30
						Average ETE:			3:10

Table 8-9 Medical Facilities Evacuation Time Estimates – Rain/Light Snow

Medical Facilities in	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)
PUTNAM COUNTY								
Lower Philipstown	Ambulatory	100	1	188	30	7.6	34	2:45
	Wheelchair bound	100	5	22	75	7.6	47	3:45
Southern Philipstown	Ambulatory	100	1	181	30	4.7	24	2:35
Southern Putnam Valley	Ambulatory	100	1	50	30	6.1	159	4:50
ROCKLAND COUNTY								
Central Town of Clarkstown	Ambulatory	100	1	126	30	2.6	50	3:00
	Wheelchair bound	100	5	4	20	2.6	49	2:50
Northeastern & Eastern Town of Clarkstown	Ambulatory	100	1	698	30	4.3	56	3:10
	Wheelchair bound	100	5	154	75	4.3	44	3:40
Northeastern Town of Ramapo	Ambulatory	100	1	461	30	4.2	44	2:55
	Wheelchair bound	100	5	372	75	4.2	44	3:40
Northwestern Town of Clarkstown	Bedridden	100	15	25	30	4.2	44	2:55
	Ambulatory	100	1	126	30	6.6	60	3:10
Stony Point	Wheelchair bound	100	5	6	30	6.6	60	3:10
	Bedridden	100	15	3	30	6.6	60	3:10
Unincorporated Areas of the Town of Haverstraw	Ambulatory	100	1	75	30	10.5	129	4:20
Village of Haverstraw	Ambulatory	100	1	12	12	8.9	63	2:55
	Wheelchair bound	100	5	140	75	8.7	95	4:30
Village of West Haverstraw	Bedridden	100	15	10	30	8.7	125	4:15
	Ambulatory	100	1	344	30	8.8	129	4:20
	Wheelchair bound	100	5	103	75	8.8	109	4:45
	Bedridden	100	15	16	30	8.8	129	4:20
WESTCHESTER COUNTY								
Briarcliff Manor	Ambulatory	100	1	251	30	2.6	4	2:15
	Wheelchair bound	100	5	52	75	2.6	4	3:00
	Bedridden	100	15	34	30	2.6	4	2:15

Medical Facilities in	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)
Buchanan	Ambulatory	100	1	10	10	11.9	137	4:10
	Wheelchair bound	100	5	6	30	11.9	125	4:15
	Bedridden	100	15	1	15	11.9	135	4:10
City of Peekskill	Ambulatory	100	1	189	30	16.4	45	2:55
	Wheelchair bound	100	5	30	75	16.4	30	3:25
	Bedridden	100	15	22	30	16.4	45	2:55
Croton-on-Hudson	Ambulatory	100	1	144	30	8.0	125	4:15
	Wheelchair bound	100	5	29	75	8.0	91	4:30
	Bedridden	100	15	20	30	8.0	125	4:15
Ossining Town & Village	Ambulatory	100	1	309	30	5.3	83	3:35
	Wheelchair bound	100	5	62	75	5.3	71	4:10
	Bedridden	100	15	45	30	5.3	83	3:35
Town of Cortlandt	Ambulatory	100	1	699	30	17.4	97	3:50
	Wheelchair bound	100	5	142	75	17.4	89	4:25
	Bedridden	100	15	100	30	17.4	97	3:50
Town of New Castle (W. of Hardscrabble Rd)	Ambulatory	100	1	44	30	3.7	8	2:20
	Wheelchair bound	100	5	8	40	3.7	6	2:30
	Bedridden	100	15	6	30	3.7	8	2:20
Town of Somers (W. of Route 118)	Ambulatory	100	1	16	16	7.2	144	4:20
	Wheelchair bound	100	5	3	15	7.2	148	4:25
	Bedridden	100	15	2	30	7.2	139	4:30
Yorktown	Ambulatory	100	1	532	30	9.6	17	2:30
	Wheelchair bound	100	5	107	75	9.6	16	3:15
	Bedridden	100	15	78	30	9.6	17	2:30
Maximum ETE:							Maximum ETE:	4:50
Average ETE:							Average ETE:	3:35

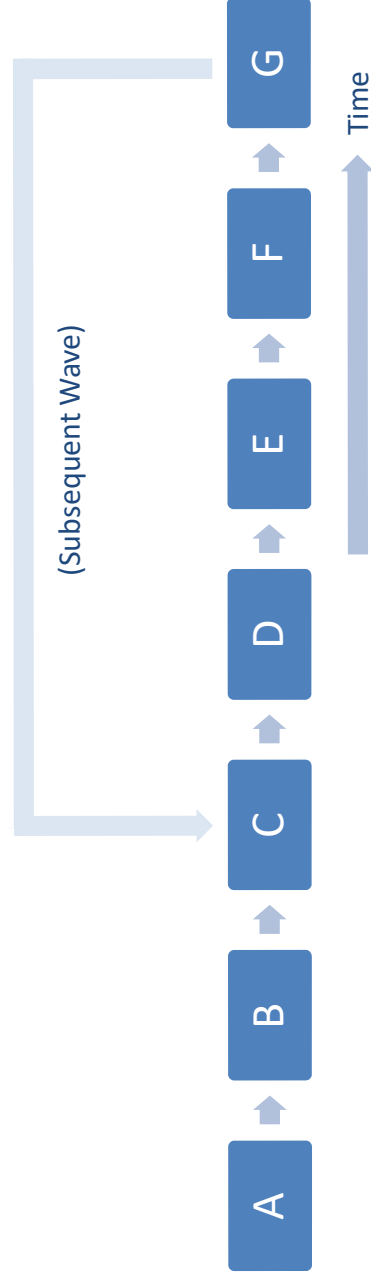
Table 8-10. Medical Facility Evacuation Time Estimates – Heavy Snow

Medical Facilities in	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)
PUTNAM COUNTY								
Lower Philipstown	Ambulatory	110	1	188	30	7.6	14	2:35
	Wheelchair bound	110	5	22	75	7.6	25	3:30
Southern Philipstown	Ambulatory	110	1	181	30	4.7	15	2:35
Southern Putnam Valley	Ambulatory	110	1	50	30	6.1	104	4:05
ROCKLAND COUNTY								
Central Town of Clarkstown	Ambulatory	110	1	126	30	2.6	34	2:55
	Wheelchair bound	110	5	4	20	2.6	30	2:40
Northeastern & Eastern Town of Clarkstown	Ambulatory	110	1	698	30	4.3	40	3:00
	Wheelchair bound	110	5	154	75	4.3	31	3:40
	Ambulatory	110	1	461	30	4.2	28	2:50
	Wheelchair bound	110	5	372	75	4.2	38	3:45
Northeastern Town of Ramapo	Bedridden	110	15	25	30	4.2	28	2:50
	Ambulatory	110	1	126	30	6.6	49	3:10
	Wheelchair bound	110	5	6	30	6.6	49	3:10
	Bedridden	110	15	3	30	6.6	49	3:10
Stony Point	Ambulatory	110	1	75	30	10.5	77	3:40
Unincorporated Areas of the Town of Haverstraw	Ambulatory	110	1	12	12	8.9	39	2:45
	Ambulatory	110	1	270	30	8.7	92	3:55
Village of Haverstraw	Wheelchair bound	110	5	140	75	8.7	106	4:55
	Bedridden	110	15	10	30	8.7	92	3:55
Village of West Haverstraw	Ambulatory	110	1	344	30	8.8	76	3:40
	Wheelchair bound	110	5	103	75	8.8	82	4:30
	Bedridden	110	15	16	30	8.8	76	3:40
WESTCHESTER COUNTY								
Briarcliff Manor	Ambulatory	110	1	251	30	2.6	5	2:25
	Wheelchair bound	110	5	52	75	2.6	5	3:10
	Bedridden	110	15	34	30	2.6	5	2:25

Medical Facilities in	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)	
Buchanan	Ambulatory	110	1	10	10	11.9	124	4:05	
	Wheelchair bound	110	5	6	30	11.9	130	4:30	
	Bedridden	110	15	1	15	11.9	125	4:10	
City of Peekskill	Ambulatory	110	1	189	30	16.4	27	2:50	
	Wheelchair bound	110	5	30	75	16.4	30	3:35	
	Bedridden	110	15	22	30	16.4	27	2:50	
Croton-on-Hudson	Ambulatory	110	1	144	30	8.0	120	4:20	
	Wheelchair bound	110	5	29	75	8.0	120	5:05	
	Bedridden	110	15	20	30	8.0	120	4:20	
Ossining Town & Village	Ambulatory	110	1	309	30	5.3	111	4:15	
	Wheelchair bound	110	5	62	75	5.3	104	4:50	
	Bedridden	110	15	45	30	5.3	111	4:15	
Town of Cortlandt	Ambulatory	110	1	699	30	17.4	54	3:15	
	Wheelchair bound	110	5	142	75	17.4	70	4:15	
	Bedridden	110	15	100	30	17.4	54	3:15	
Town of New Castle (W. of Hardscrabble Rd)	Ambulatory	110	1	44	30	3.7	6	2:30	
	Wheelchair bound	110	5	8	40	3.7	6	2:40	
	Bedridden	110	15	6	30	3.7	6	2:30	
Town of Somers (W. of Route 118)	Ambulatory	110	1	16	16	7.2	15	2:25	
	Wheelchair bound	110	5	3	15	7.2	15	2:20	
	Bedridden	110	15	2	30	7.2	14	2:35	
Yorktown	Ambulatory	110	1	532	30	9.6	24	2:45	
	Wheelchair bound	110	5	107	75	9.6	20	3:25	
	Bedridden	110	15	78	30	9.6	24	2:45	
						Maximum ETE:			5:05
						Average ETE:			3:35

Table 8-11. Access and/or Functional Needs Population Evacuation Time Estimates

Vehicle Type	People Requiring Vehicle	Vehicles deployed	Stops	Weather Conditions	Mobilization Time (min)	Loading Time at 1 st Stop (min)	Travel to Subsequent Stops (min)	Total Loading Time at Subsequent Stops (min)	Travel Time to EPZ Boundary (min)	ETE (hr:min)
Buses	153	31	5	Good	180	5	36	20	17	4:20
				Rain/Light Snow	190		40		21	4:40
				Heavy Snow	200		44		22	4:55
Wheelchair Buses	13	4	4	Good	180	5	27	15	18	4:05
				Rain/Light Snow	190		30		21	4:25
				Heavy Snow	200		33		22	4:35
Ambulances	125	63	2	Good	180	15	9	15	18	3:50
				Rain/Light Snow	190		10		22	4:05
				Heavy Snow	200		11		22	4:15
Maximum ETE:										4:35
Average ETE:										4:15



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
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

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).
- The Manual on Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration (FHWA) of the U.S.D.O.T. provides guidance for Traffic Control Devices to assist these personnel in the performance of their tasks. 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. Facilitate evacuating traffic movements that safely expedite travel out of the EPZ.
2. Discourage 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" are used 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 must 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 detailed traffic control tactics discussed in the Orange County Comprehensive Emergency Management Plan, dated June 15, 2021, the Putnam County Radiological Emergency Response Plan, dated May 2021, the Rockland County Radiological Emergency Preparedness Plan, dated July 2020, and the list of TCPs provided by Westchester County served as the basis of the traffic management plan (TMP), as per NUREG/CR-7002, Rev. 1. The ETE analysis treated all controlled intersections that are existing ACP or TCP locations in the county plan as being controlled by actuated signals.
2. Evacuation simulations were run using DYNEV II to predict traffic congestion during an evacuation (see Section 7.3 and Figures 7-3 through 7-9. These simulations help to identify the best routing and critical intersections that experience pronounced

congestion during evacuation. Any critical intersections that would benefit from traffic or access control which are not already identified in the existing county plans are examined. No additional TCPs or ACPs were identified as part of this study.

3. Prioritization of TCPs and ACPs.

- a. Application of traffic and access control at some TCPs and ACPs will have a more pronounced influence on expediting traffic movements than at other TCPs and ACPs. For example, TCPs controlling traffic originating from areas in close proximity to the power plant could have a more beneficial effect on minimizing potential exposure to radioactivity than those TCPs located far from the power plant. These priorities should be assigned by state/county emergency management representatives and by law enforcement personnel.

The TCPs and ACPs defined in the existing TMP, and how they were applied in this study, are discussed in Appendix G.

9.1 Assumptions

The following are TMP assumptions made for this study:

- The ETE calculations documented in Sections 7 and 8 assume that the TMP is implemented during evacuation.
- The ETE calculations reflect the assumption that all “external-external” trips are interdicted and diverted after 2 hours have elapsed from the ATE, by ACPs along the major highways traversing the EPZ.
- All transit vehicles and other responders entering the EPZ to support the evacuation are assumed to be unhindered by personnel manning TCPs and ACPs.
- Section 2.5 discusses TCP and ACP operations.

9.2 Additional Considerations

The use of Intelligent Transportation Systems (ITS) technologies can reduce manpower and equipment needed for MTC, 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. The DMS placed outside of the EPZ will 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 during egress through their vehicle’s stereo systems. Automated Travel 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 the on-board navigation systems (GPS units) and smartphones can be used to provide information during the evacuation trip.

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.

10 EVACUATION ROUTES AND RECEPTION CENTERS

10.1 Evacuation Routes

Evacuation routes are comprised of two distinct components:

- Routing from a protective action area being evacuated to the boundary of the Evacuation Region and thence out of the EPZ.
- Routing of transit-dependent evacuees (schools, medical facilities, or permanent residents who do not own or have access to a private vehicle) 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 major evacuation routes for the EPZ are presented in Figure 10-1 through Figure 10-4. These routes will be used by the general population evacuating in private vehicles, and by the transit-dependent population evacuating in buses, wheelchair buses and ambulances. Transit-dependent evacuees will be routed to reception centers. General population may evacuate to either a general reception center or some alternate destination (e.g., lodging facilities, relative's home, campgrounds) outside the EPZ.

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. The 35 EPZ bus routes identified in Table 10-1 were created using major evacuation routes and the bus stops (pick-up points) shown graphically in Figure 10-5 through Figure 10-10. The stops are published in the public information distributed to EPZ residents and businesses annually. It is assumed that residents will walk to and congregate at these pre-designated stops, and that they can arrive at the stops within the 180-minute bus mobilization time (good weather). The routes listed in Table 10-1 are used to compute average speeds along major evacuation routes servicing each protective action area for the computation of the transit dependent ETE discussed in Section 8.

The specified bus routes are documented in Table 10-2. Refer to the maps of the link-node analysis network in Appendix K for node locations.

10.2 Reception Centers

Figure 10-11 through Figure 10-14 map the general population and school reception centers for evacuees. Table 10-3 presents a list of school reception centers by county. Students will be transported to these school reception centers where they will be subsequently retrieved by their respective families, friends or guardians.

Table 10-1. Summary of Transit-Dependent Bus Routes

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for Bear Mountain State Park	1	Head north on Seven Lakes Drive toward Service Rd, turn left onto US-202 E/Rte 9W N, at the traffic circle, take the 3rd exit onto US-6 W heading to Central Valley/New Jersey, take exit 18 for US-6 toward NY-17/I-87/Central Valley/Seven Lakes Dr, at Long Mountain Cir, take the 1st exit onto US-6 W, take the NY-17 S ramp to NY-32/Suffern/Newburgh, turn left onto NY-17 S/Averell Ave, keep left to continue on Orange Turnpike, continue onto NY-59 E/Orange Ave, turn left onto US-202 E/Wayne Ave, turn right onto Viola Rd to the Reception Center.	9.4
Transit Dependent Representative Route for Fort Montgomery	1	Head southeast on Canterbury Rd toward Fawnwood Ln, turn left onto Firefighters Memorial Dr, turn left onto Rte 9W, continue northwest on Rte 9W, turn left onto Gidney Ave, turn left onto Roe St to the Reception Center.	10.8
Transit Dependent Representative Route for Harriman State Park	1	Head southwest on Kanawake Rd toward St Johns Rd, at the traffic circle, take the 2nd exit and stay on Kanawake Rd, turn left to merge onto NY-17 S, merge onto NY-17 S, take the NY-17 S/Interstate 87 S/New York Thruway ramp to Interstate 287, merge onto I-87 S/NY-17 S, take exit 14 B for Airmont Rd toward Airmont/Montebello, turn left onto N Airmont Rd, turn left onto Montebello Rd, turn right onto Mile Rd, turn right onto Viola Rd to the Reception Center.	7.5
Transit Dependent Representative Route for Town of Cornwall (S. of Angola Road)	1	Head northeast on NY-32 N toward Maranatha Ln, turn right onto Angola Rd, turn left to stay on Angola Rd, continue northeast on Angola Rd toward Pozo Dr, turn right and Merge onto Rte 9W N, continue straight onto Route 9W, turn left onto Gidney Ave, turn left onto Roe St to the Reception Center.	3.2
Transit Dependent Representative Route for Town of Tuxedo east of NYS Thruway	1	Head north on E Village Rd toward Center St, turn left to stay on E Village Rd, turn right onto NY-17 N, turn left to merge onto NY-17 W/ US-6, take exit 120 for NY-211 toward Middletown/Montgomery, turn left onto NY-211 W, turn left onto Carpenter Ave to the Reception Center.	0.4

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for U.S. Military Academy	4	Head northeast on NY-293 N toward Patton Rd, take the US 9W S/NY-218 N ramp, merge onto NY-218 S/US-9W S/Rte 9W S, take the NY-218 exit toward West Point/Highland Falls, merge onto Stony Lonesome Rd, turn left onto Washington Rd, head west on Washington Rd toward NY-218 N, slight left onto NY-218 S, take the US-9W N ramp on the left, turn right onto US-9W N/Rte 9W N, continue northwest on Rte 9W, turn left onto Gidney Ave, turn left onto Roe St to the Reception Center.	15.4
Transit Dependent Representative Route for Village of Highland Falls	2	Head north on Main St toward Ondaora Pkwy, turn left onto NY-218 N/Mountain Ave, take the ramp onto Rte 9W N, head northwest on Rte 9W N, turn left onto Gidney Ave, turn left onto Roe St to the Reception Center.	8.2
Transit Dependent Representative Route for Village-Town of Woodbury	2	Head southwest on Skyline Dr toward Birchwood Dr, turn left onto Pine Hill Rd, turn right onto Smith Clove Rd, turn left onto NY-32 S, take the on-ramp onto NY-17 W/US-6, take exit 120 for NY-211 toward Middletown/Montgomery, turn left onto NY-211 W, turn left onto Carpenter Ave to the Reception Center.	2.0
Transit Dependent Representative Route for Lower Philipstown	2	Head northeast on US-9 N toward Old Highland Turnpike/Old Peekskill Rd, take the ramp to Taconic Pkwy/Danbury, merge onto I-84 E, take exit 65 for NY-312 toward Carmel/Brewster/Hospital, turn left onto NY-312 E, turn left onto Farm to Market Rd, turn right onto Foggintown Rd to the Reception Center.	7.6
Transit Dependent Representative Route for Southern Philipstown	3	Head north on NY-9D N toward Meadow Ln, head northwest on NY-9D N toward Brook Trail, turn right to merge onto I-84 E/NY-52 E toward Taconic Pkwy, take exit 65 for NY-312 toward Carmel/Brewster/Hospital, turn left onto NY-312 E, turn left onto Farm to Market Rd, turn right onto Foggintown Rd to the Reception Center.	4.7
Transit Dependent Representative Route for Southern Putnam Valley	5	Head north on Oscawana Lake Rd toward Morrissey Dr, turn right onto Tinker Hill Rd, turn left onto Peekskill Hollow Rd, head northeast on Peekskill Hollow Rd toward New Hill Rd, sharp right onto NY-301 E, turn left onto Gleneida Ave, turn right onto Fair St, turn left at Twin Brook Ct to the Reception Center.	6.1
Transit Dependent Representative Route for Southwest Carmel	2	Head northeast on NY-6N N toward Pine Tree Ln, turn left onto Secor Rd, turn right onto the Taconic State Pkwy N ramp, merge onto Taconic State Parkway, take the Peekskill Hollow Rd exit, turn right onto Peekskill Hollow Rd, sharp right onto NY-301 E, turn left onto Gleneida Ave, turn right onto Fair St, turn left at Twin Brook Ct to the Reception Center.	2.9

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for Central Town of Clarkstown	11	Head south on N Main St toward Squadron Blvd, turn left onto S Main St, turn right to stay on S Main St, head south on NY-304 S toward Germonds Rd, take the ramp to NY-59 E/Nyack, turn left onto Smith St to the Reception Center.	2.6
Transit Dependent Representative Route for Grassy Point	1	Head west on Grassy Point Rd, Continue onto E Main St, turn left onto S Liberty Dr, Continue south on US 202, turn right onto W Railroad Ave, continue onto Suffern Ln, turn left onto Thiells Mt Ivy Rd, turn left onto US-202 E, turn right onto NY-45 S/ N Main St, turn right onto E Central Ave/W Rte 59, slight left onto Alturas Rd/W Rte 59 to the Reception Center.	11.8
Transit Dependent Representative Route for Jones Point	1	Head southwest on River Rd toward US-202 E, turn right onto US-202 E, at the traffic circle, take the 3rd exit onto US-6 W heading to Central Valley/New Jersey, take exit 18 for US-6 toward NY-17/I-87/Central Valley/Seven Lakes Dr, at Long Mountain Cir, take the 1st exit onto US-6 W, take the NY-17 S ramp to NY-32/Suffern/Newburgh, turn left onto NY-17 S/Averell Ave, keep left to continue on Orange Turnpike, continue onto NY-59 E/Orange Ave, turn left onto US-202 E/Wayne Ave, turn right onto Viola Rd to the Reception Center.	13.3
Transit Dependent Representative Route for Northeastern & Eastern Town of Clarkstown	8	Head south on Casper Hill Rd toward NY-303 S, turn right onto NY-303 S, take the exit (Bobby Ln) toward Spring Valley, turn right onto NY-59, turn left onto Smith St to the Reception Center.	4.3
Transit Dependent Representative Route for Northeastern Town of Ramapo	14	Head east on Grandview Ave toward Norben Rd, turn left onto Union Rd, continue onto New Hempstead Rd, turn right at the 1st cross street onto NY-45 S/N Main St, head south on NY-45 S/N Main St toward Karnell St, turn right onto E Central Ave/W Rte 59, slight left onto Alturas Rd/W Rte 59 to the Reception Center.	4.2
Transit Dependent Representative Route for Northwestern Town of Clarkstown	4	Head west on Haverstraw Rd toward Knapp Ln, slight right onto S Mountain Rd, Turn left onto Zukor Rd, continue onto N Main St, head south on N Main St toward Squadron Blvd, turn left onto S Main St, turn right to stay on S Main St, head south on NY-304 S toward Germonds Rd, take the ramp to NY-59 E/Nyack, turn left onto Smith St to the Reception Center.	6.6

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for Stony Point	6	Head south on US 202, turn right onto W Railroad Ave, continue onto Suffern Ln, turn left onto Thiells Mt Ivy Rd, turn left onto US-202 E, turn right onto NY-45 S/ N Main St, turn right onto E Central Ave/W Rte 59, slight left onto Alturas Rd/W Rte 59 to the Reception Center.	10.5
Transit Dependent Representative Route for Tompkins Cove	1	Head southwest on Buckberg Rd toward Lavender Ln, turn right onto US-202 W/N Liberty Dr/Rte 9W S, continue south on US 202, turn right onto W Railroad Ave, continue onto Suffern Ln, turn left onto Thiells Mt Ivy Rd, turn left onto US-202 E, turn right onto NY-45 S/ N Main St, turn right onto E Central Ave/W Rte 59, slight left onto Alturas Rd/W Rte 59 to the Reception Center.	12.6
Transit Dependent Representative Route for Unincorporated Areas of the Town of Haverstraw	6	Head west on Suffern Ln toward Donaldson Ln, turn left onto Thiells Mt Ivy Rd, turn left onto Rosman Rd, turn right onto US-202 W/W Ramapo Rd, continue straight to stay on US-202 W, turn left onto Viola Rd to the RC.	8.9
Transit Dependent Representative Route for Village of Haverstraw	6	Head west on Main St toward 3rd St, turn right onto Conger Ave/Rte 9W N, turn left onto Westside Ave, continue onto Ramapo Rd, turn left onto Co Rd 33/S Central Hwy, head south on Co Rd 33/S Central Hwy, continue south on N Middletown Rd/Route 33 to the Reception Center.	8.7
Transit Dependent Representative Route for Village of Pomona	3	Head southeast on Halley Dr toward Valley View Ct, turn left onto N Camp Hill Rd, turn right onto US-202 W, turn left onto Viola Rd to the Reception Center.	5.7
Transit Dependent Representative Route for Village of West Haverstraw	6	Head west on E Railroad Ave toward Carol Ave, continue onto Suffern Ln, turn left onto Thiells Mt Ivy Rd, turn left onto US-202 E, turn right onto NY-45 S, continue south on N Main St, turn right onto E Central Ave/W Rte 59, slight left onto Alturas Rd/W Rte 59 to the Reception Center.	8.8

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for Briarcliff Manor	4	Head south on Old Briarcliff Rd toward Central Dr W, turn left onto Scarborough Rd, turn right onto Sleepy Hollow Rd, turn left onto Old Sleepy Hollow Rd Ext, continue onto Sleepy Hollow Rd/Sleepy Hollow Rd Ext, continue onto County House Rd, continue onto Tower Hill Rd, turn left onto Neperan Rd, continue onto Old Saw Mill River Rd and then NY-100C East, continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	2.6
Transit Dependent Representative Route for Buchanan	2	Head northeast on Westchester Ave toward Pheasants Run, at the traffic circle take the 3rd exit onto White St, turn right onto NY-9A S/Albany Post Rd, turn right to merge onto US-9 S, slight right onto US-9 S/N Highland Ave (signs for Tarrytown), head south on US-9 S/Albany Post Rd/S Highland Ave toward Country Club Ln, continue straight onto N Broadway/ US-9, turn left onto Bedford Rd, Turn right onto County House Rd, turn left onto Neperan Rd, continue onto Old Saw Mill River Rd, keep right to continue toward 303/Old Saw Mill River Rd, turn left onto 303/Old Saw Mill River Rd/ NY-100C East, continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	11.9
Transit Dependent Representative Route for City of Peekskill	12	Head east on Hudson Ave toward 92/Washington St, Hudson Ave turns right and becomes Maple Ave, turn right onto Croton Ave, head southeast on Baptist Church Rd, turn right onto Baldwin Rd, sharp left onto Underhill Ave, sharp right to merge onto Taconic State Parkway, head south on Taconic State Parkway, continue onto Sprain Brook Pkwy S (signs for N.Y. City), take the NY-100C exit toward Eastview, turn left onto NY-100C E, continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	16.4
Transit Dependent Representative Route for Croton-on-Hudson	4	Head south on NY-9A S toward Warren Rd, continue straight onto S Riverside Ave, turn right onto Croton Point Ave, turn left to merge onto NY-9A S/US-9 S, slight right onto US-9 S/N Highland Ave (signs for Tarrytown), head south on US-9 S/Albany Post Rd/S Highland Ave toward Country Club Ln, continue straight onto N Broadway/ US-9, turn left onto Bedford Rd, turn right onto County House Rd, turn left onto Neperan Rd, continue onto Old Saw Mill River Rd, keep right to continue toward 303/Old Saw Mill River Rd, turn left onto 303/Old Saw Mill River Rd/ NY-100C East, continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	8.0

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for Montrose	2	Head south on NY-9A S/Albany Post Rd toward Lake St, turn right to merge onto US-9 S, slight right onto US-9 S/N Highland Ave (signs for Tarrytown), head south on US-9 S/Albany Post Rd/S Highland Ave toward Country Club Ln, continue straight onto N Broadway/ US-9, turn left onto Bedford Rd, turn right onto County House Rd, turn left onto Neperan Rd, continue onto Old Saw Mill River Rd, keep right to continue toward 303/Old Saw Mill River Rd, turn left onto 303/Old Saw Mill River Rd/ NY-100C East, continue onto NY-100 S, turn right onto Westchester Community College to the RC.	10.5
Transit Dependent Representative Route for Ossining Town & Village	16	Head south on Quaker Bridge Rd toward Glendale Rd, Merge onto Old Albany Post Rd, turn left onto US-9 S/Albany Post Rd/N Highland Ave, head south on US-9 S/Albany Post Rd/S Highland Ave toward Country Club Ln, continue straight onto N Broadway/US-9, turn left onto Ashford Ave, turn right onto Francis J McCormack Dr to the Reception Center.	5.3
Transit Dependent Representative Route for Town of Cortlandt	13	Head south on Westbrook Dr/Westbrook Ct, Turn right onto US-6 W, turn right onto Bear Mountain State Pkwy, turn right to stay on Bear Mountain State Pkwy, Turn left onto US-202 E/Crompond Rd, turn right onto the Taconic State Pkwy ramp, merge onto Taconic State Parkway, head south on Taconic State Parkway, continue onto Sprain Brook Pkwy S (signs for N.Y. City), take the NY-100C exit toward Eastview, turn left onto NY-100C E, Continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	17.4
Transit Dependent Representative Route for Town of New Castle (W. of Hardscrabble Rd)	3	Turn left onto Shingle House Rd, Continue onto NY-120 S/Millwood Rd, turn right onto NY-120 S, turn right onto Hardscrabble Rd, Head east on Douglas Rd toward Elizabeth St, continue onto Mill River Rd, At the traffic circle, continue straight to stay on Mill River Rd, turn left to merge onto Saw Mill River Pkwy S, take exit 23 toward Saw Mill River Rd/Eastview, turn left onto 303/Old Saw Mill River Rd, continue onto Old Saw Mill River Rd and then NY-100C East, continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	3.7
Transit Dependent Representative Route for Town of Somers (W. of Route 118)	3	Head south on Mahopac Ave, continue onto Pines Bridge Rd, continue onto Moseman Ave, turn left onto NY-100 N, turn right onto NY-35 E, turn right to merge onto I-684 S toward White Plains, take exit 4 toward NY-172 E, turn left onto NY-172 E to the Reception Center.	7.2

Route	No. of Buses	Route Description to Reception Center	Length (mi.)
Transit Dependent Representative Route for Verplanck	1	Head northeast on Broadway toward 2nd St, turn right onto 14th St, turn left onto Westchester Ave, at the traffic circle take the 3rd exit onto White St, turn right onto NY-9A S/Albany Post Rd, turn right to merge onto US-9 S, slight right onto US-9 S/N Highland Ave (signs for Tarrytown), head south on US-9 S/Albany Post Rd/S Highland Ave toward Country Club Ln, continue straight onto N Broadway/ US-9, turn left onto Bedford Rd, turn right onto County House Rd, Turn left onto Neperan Rd, continue onto Old Saw Mill River Rd, keep right to continue toward 303/Old Saw Mill River Rd, turn left onto 303/Old Saw Mill River Rd/ NY-100C East, continue onto NY-100 S, turn right onto Westchester Community College to the Reception Center.	13.0
Transit Dependent Representative Route for Yorktown	17	Head east on Strawberry Rd toward Foothill St, continue onto 1309/E Main St, head east on 1309/E Main St toward New Rd, continue straight onto Old Yorktown Rd, head southeast on Old Yorktown Rd toward Kamhi Dr, turn left onto US-202 E/Crompond Rd, turn left at the 1st cross street onto US-202 E/Saw Mill River Rd, continue straight onto NY-35 E, head southeast on NY-35 E toward Orchard Hill Rd, turn right to merge onto I-684 S toward White Plains, take exit 4 toward NY-172 E, turn left onto NY-172 E to the Reception Center.	9.6
Total:	169		

Table 10-2. Bus Route Descriptions

Bus Route Number	Route Serving	Nodes Traversed from Route Start to EPZ Boundary
1	Southern Philipstown	307, 306, 3284, 305, 303, 4369, 4368, 302, 301
2	Southern Putnam Valley	336, 337, 341, 338, 3245, 340, 1850, 342, 348, 199, 349
3	Lower Philipstown	1844, 321, 470, 320, 319, 1848, 318, 4377, 4378, 317, 475, 476, 477, 316, 312
4	Southwest Carmel	375, 1214, 1215, 677, 1012, 355
5	Town of Highlands	567, 3879, 4362, 572, 573, 3880, 549, 574
6	Town of Cornwall	575, 3877, 3878, 655
7	Village of Highland Falls	593, 561, 3930, 3787, 615, 498, 613, 4454, 558, 559, 560, 567, 3879, 4362, 572, 573, 3880, 549, 574
8	Harriman State Park	108, 4206, 4205, 109, 4204, 4203, 4202, 111, 4201, 4200, 112, 765, 729, 4348, 113, 4347, 4346, 4077, 4345, 114, 4344, 4343, 3753, 4342, 4341, 4340, 4339, 4338, 4337, 4336, 4335, 4334, 3754, 3755
9	Town of Tuxedo	4433, 3606, 3604
10	U.S. Military Academy	1248, 4448, 4450, 4449, 3888, 566, 3931, 618, 4455, 617, 558, 559, 560, 567, 3879, 4362, 572, 573, 3880, 549, 574
11	Fort Montgomery	555, 1440, 1441, 556, 584, 557, 498, 613, 4454, 558, 559, 560, 567, 3879, 4362, 572, 573, 3880, 549, 574
12	Bear Mountain State Park	3771, 3770, 3780, 509, 510, 508, 511, 645, 1397, 1396, 512, 513, 171, 515, 3762, 517, 3789, 518, 624, 3790, 623, 622, 620, 619, 605, 531
13	Village of Woodbury	459, 625, 323, 3831, 542
14	Jones Point	3779, 4293, 146, 139, 4037, 147, 148, 3770, 3780, 509, 510, 508, 511, 645, 1397, 1396, 512, 513, 171, 515, 3762, 517, 3789, 518, 624, 3790, 623, 622, 620, 619, 605, 531
15	Tompkins Cove	134, 104, 103, 3746, 90, 4272, 91, 4150, 4273, 4275, 92, 94, 4276, 4277, 3730, 141, 4240, 4241, 110, 3743, 17, 14, 152, 4237, 15, 18, 3570, 935, 19, 3561, 22, 4097, 3749, 166, 3678
16	Stony Point	134, 104, 103, 3746, 90, 4151, 89, 92, 94, 4276, 4277, 3730, 141, 4240, 4241, 110, 3743, 17, 14, 152, 4237, 15, 18, 3570, 935, 19, 3561, 22, 4097, 3749, 166, 3678
17	Grassy Point	1612, 429, 4268, 104, 103, 3746, 90, 4151, 89, 92, 94, 4276, 4277, 3730, 141, 4240, 4241, 110, 3743, 17, 14, 152, 4237, 15, 18, 3570, 935, 19, 3561, 22, 4097, 3749, 166, 3678

Bus Route Number	Route Serving	Nodes Traversed from Route Start to EPZ Boundary
18	Village of West Haverstraw	444, 89, 92, 94, 4276, 4277, 3730, 141, 4240, 4241, 110, 3743, 17, 14, 152, 4237, 15, 18, 3570, 935, 19, 3561, 22, 4097, 3749, 166, 3678
19	Village of Pomona	162, 4, 3, 4236, 4235, 2, 4234, 521, 1001, 4157
20	Unincorporated Areas of the Town	3734, 93, 16, 3573, 3732, 152, 14, 4430, 12, 4431, 4075, 4, 3, 4236, 4235, 2, 4234, 521, 1001, 4157
21	Village of Haverstraw	46, 1401, 1399, 95, 3738, 45, 36, 37, 4133, 4134, 39, 40, 3725, 41, 4162, 42, 3566, 4310, 177, 582, 43, 576
22	Yorktown	1794, 1880, 1779, 759, 4413, 760, 1218, 758, 1219, 717, 3309, 718, 825, 1250, 719, 1390, 840, 720, 721, 1387, 726, 727, 1386
23	Town of Somers	721, 233, 1380, 1381, 846, 847
24	Town of New Castle	3169, 895, 1761, 864, 4146, 900, 901, 1981
25	Briarcliff Manor	3166, 3163, 3164, 3160
26	Town of Cortlandt	743, 1793, 905, 1867, 711, 1835, 1832, 744, 276, 499, 275, 1833, 424, 416, 309, 273, 3308, 713, 247, 1249, 1259, 715, 1559, 755, 522, 756, 1262, 1263, 829, 831, 833, 834, 1265, 1266, 1267, 1268, 836, 856, 1273, 1274, 865, 892, 471, 897, 1988, 817, 899, 1494
27	City of Peekskill	772, 4389, 1728, 764, 773, 3191, 774, 1769, 775, 779, 826, 4152, 827, 828, 821, 824, 1264, 822, 834, 1265, 1266, 1267, 1268, 836, 856, 1273, 1274, 865, 892, 471, 897, 1988, 817, 899, 1494
28	Montrose	3178, 3222, 789, 791, 3193, 44, 3195, 792, 961, 801, 4144, 783, 785, 3287, 814, 815, 816, 1047, 867, 3071, 485, 3069, 3067, 882, 3058, 3059, 487, 3065, 489, 3080, 1997, 869
29	Buchanan & Verplanck	3177, 3183, 1457, 3184, 1458, 3187, 3186, 3178, 3222, 789, 791, 3193, 44, 3195, 792, 961, 801, 4144, 783, 785, 3287, 814, 815, 816, 1047, 867, 3071, 485, 3069, 3067, 882, 3058, 3059, 487, 3065, 489, 3080, 1997, 869, 3078, 868
30	Croton-on-Hudson	1498, 810, 1256, 1257, 812, 3201, 813, 425, 3204, 1003, 4187, 1017, 815, 816, 1047, 867, 3071, 485, 3069, 3067, 882, 3058, 3059, 487, 3065, 489, 3080, 1997, 869, 3078, 868
31	Ossining Town & Village	3073, 1503, 3075, 1504, 867, 3071, 485, 3069, 3067, 882, 3058, 3059, 487, 3065, 489, 3080, 1997, 869, 1998, 3078, 868
32	Northeastern Town of Ramapo	169, 25, 27, 28, 26, 22, 4097, 3749, 166, 3678
33	Central Town of Clarkstown	3716, 57, 34, 442, 4101, 3713, 58, 60, 3567, 180, 4058

Bus Route Number	Route Serving	Nodes Traversed from Route Start to EPZ Boundary
34	Northwestern Town of Clarkstown	49, 50, 4304, 4303, 1572, 1571, 1570, 4302, 51, 1573, 185, 56, 3720, 4312, 3716, 57, 34, 442, 4101, 3713, 58, 60, 3567, 180, 4058
35	Northeast & East Town of Clarkstown	494, 70, 71, 197, 72, 3698, 73

Table 10-3. School Reception Centers

School Reception Center
Orange County
South Middle School
Putnam County
Kent Elementary School
Kent Primary School
Rockland County
Bergen Catholic High School
Bergen CO. VO-TECH Paramus Special Needs
Rockland Community College
St. Thomas Aquinas Collage
Bergen County Vocational Tech H.S Central Technical Education Center
Dominican College
SO. Orangetown Middle School
ST. Joseph's Regional High School
Westchester County
Pace University
Horace Greeley High School
Westchester Community College Student Center
Manhattanville College
SUNY Purchase
Valhalla Middle/High School
Bruno Ponterio Ridge
Dobbs Ferry Middle/High School
Mercy College
Ardsley High School
Lee F. Jackson Elementary School
Woodlands Middle/High School
Richard J. Bailey Middle School
Highview Elementary School
North Salem High/Middle School
Pequannock Elementary School
Meadow Pond Elementary School
Increase Miller Elementary School
Katonah Elementary School
John Jay Middle School
John Jay Senior High School

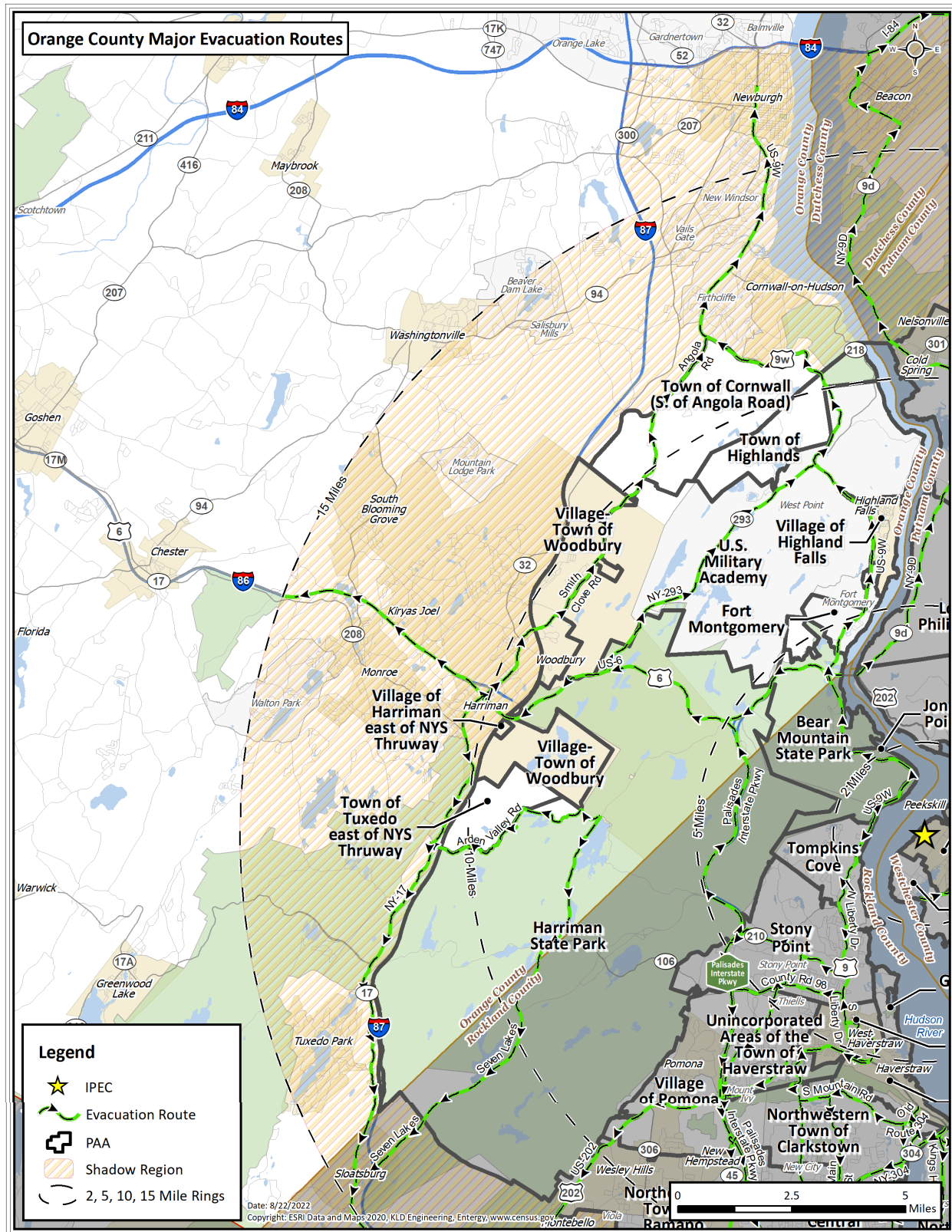


Figure 10-1. Orange County Major Evacuation Routes within the IPEC Study Area

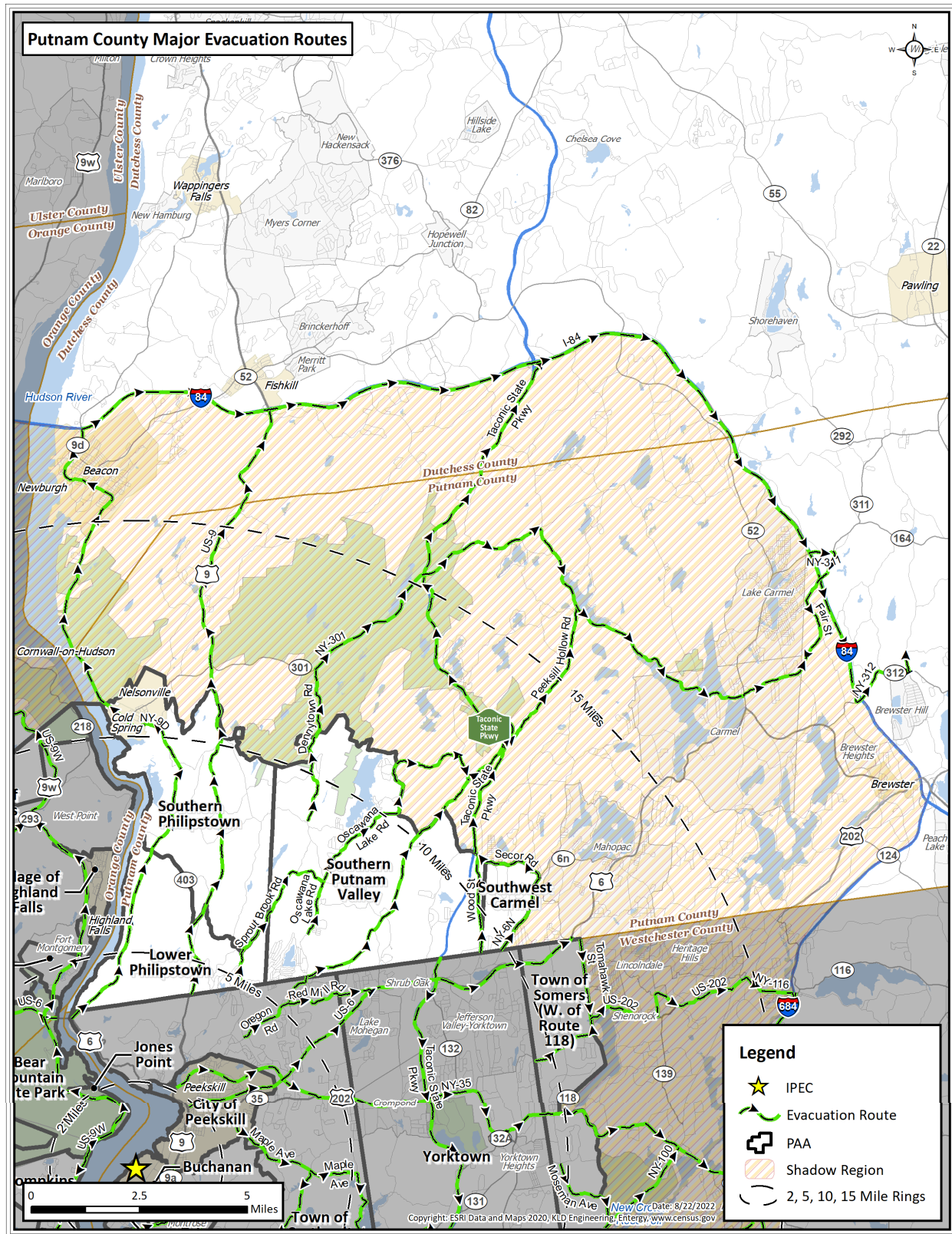


Figure 10-2. Putnam County Major Evacuation Routes within the IPEC Study Area

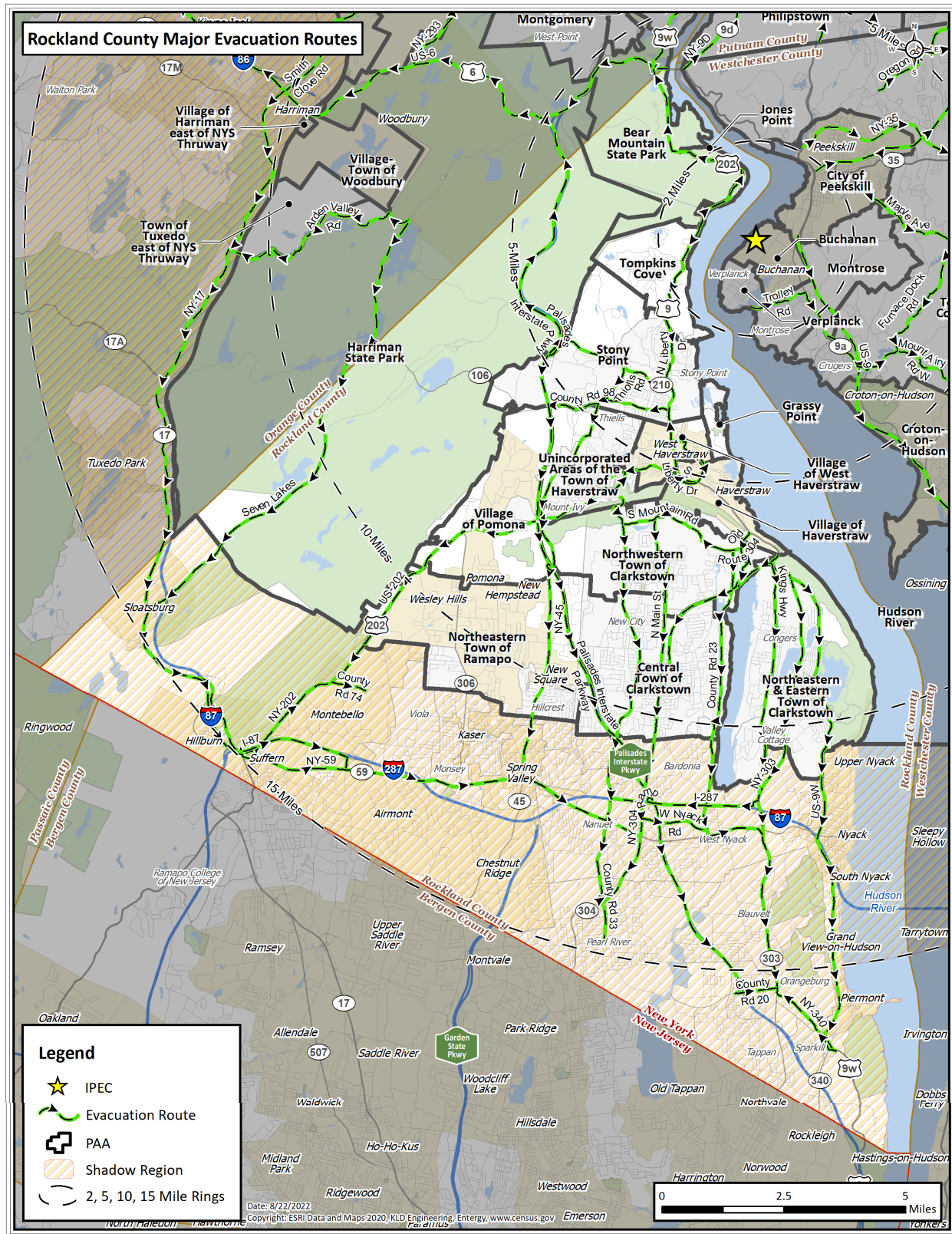


Figure 10-3. Rockland County Major Evacuation Routes within the IPEC Study Area

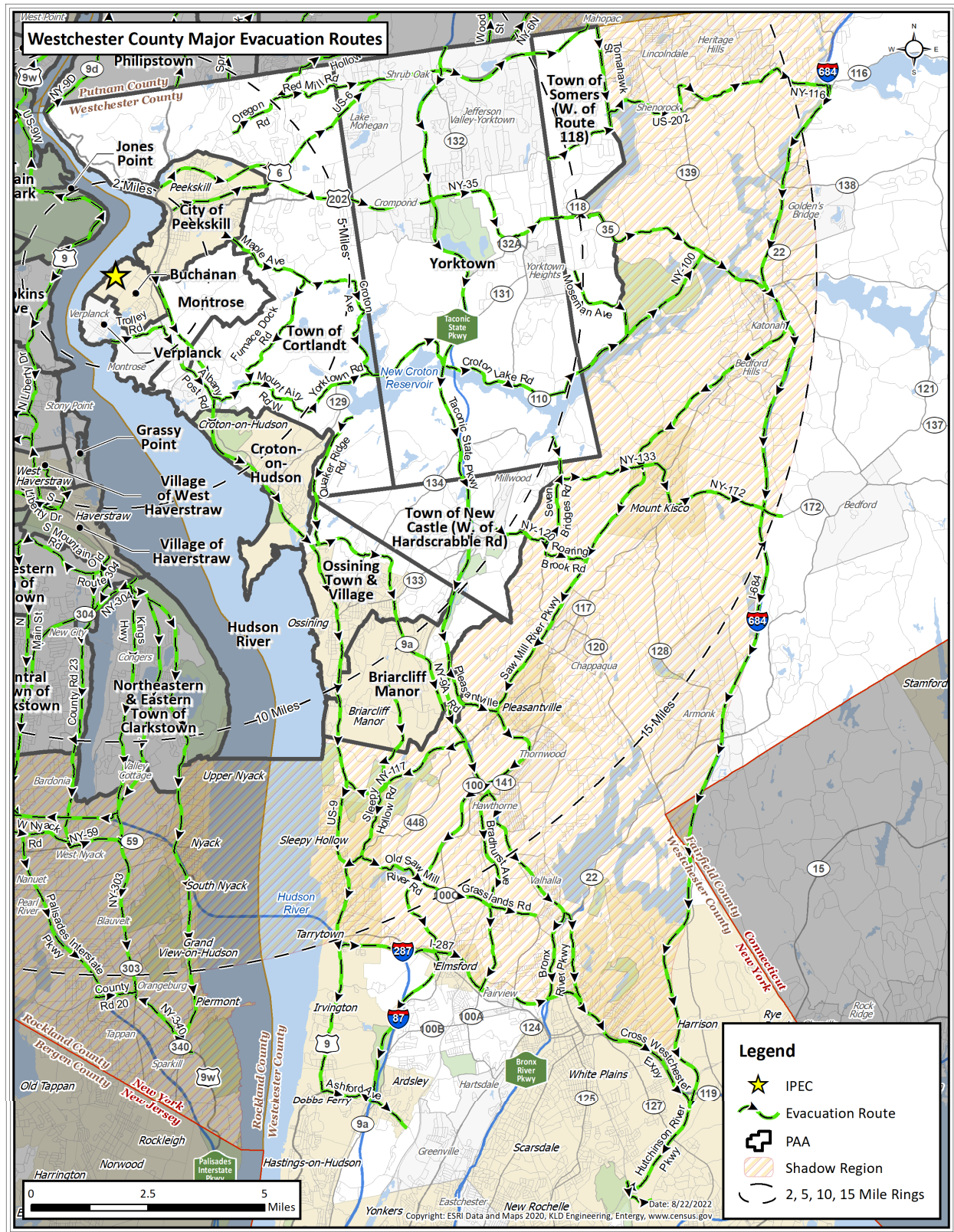


Figure 10-4. Westchester County Major Evacuation Routes within the IPEC Study Area

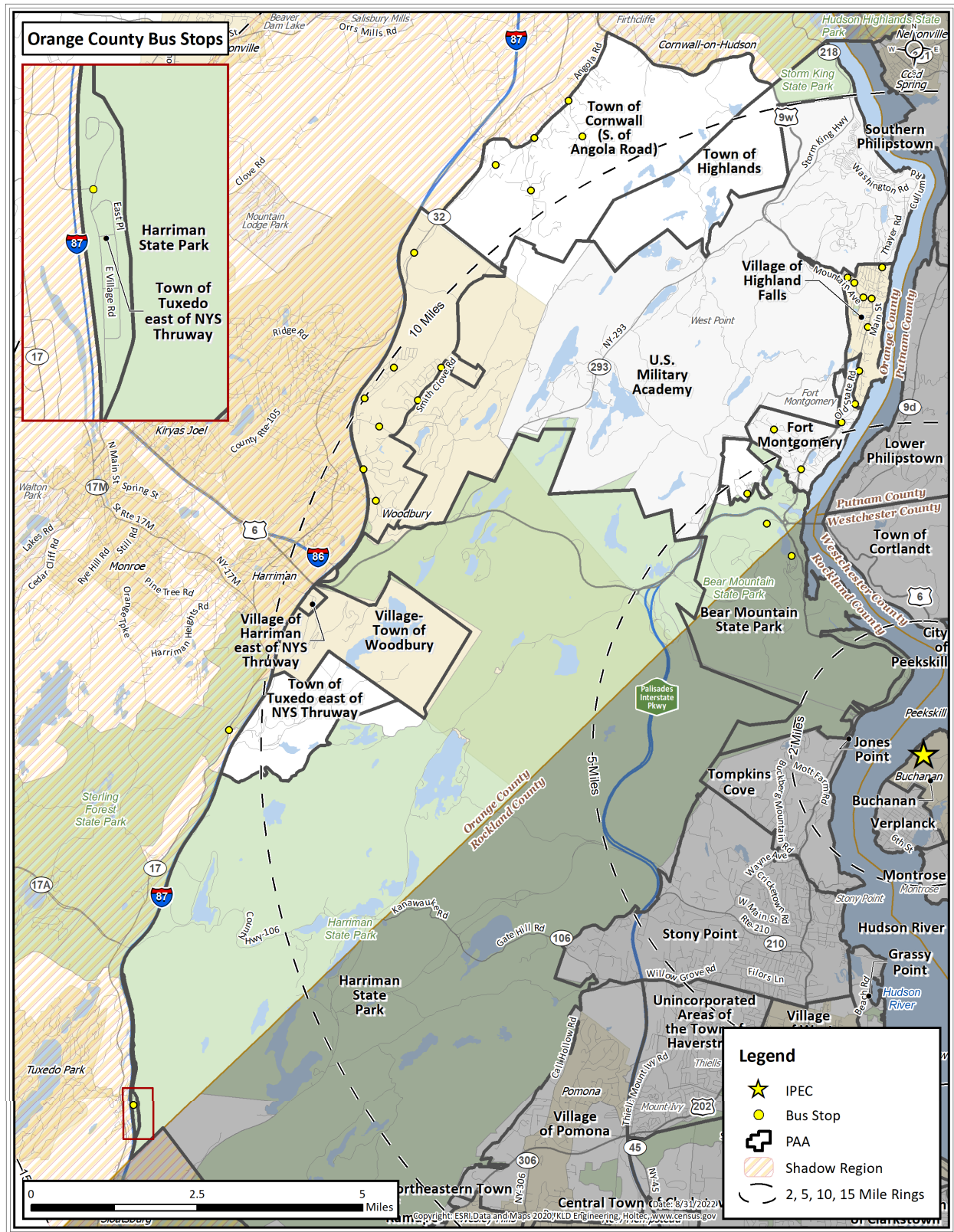


Figure 10-5. Orange County Bus Stops

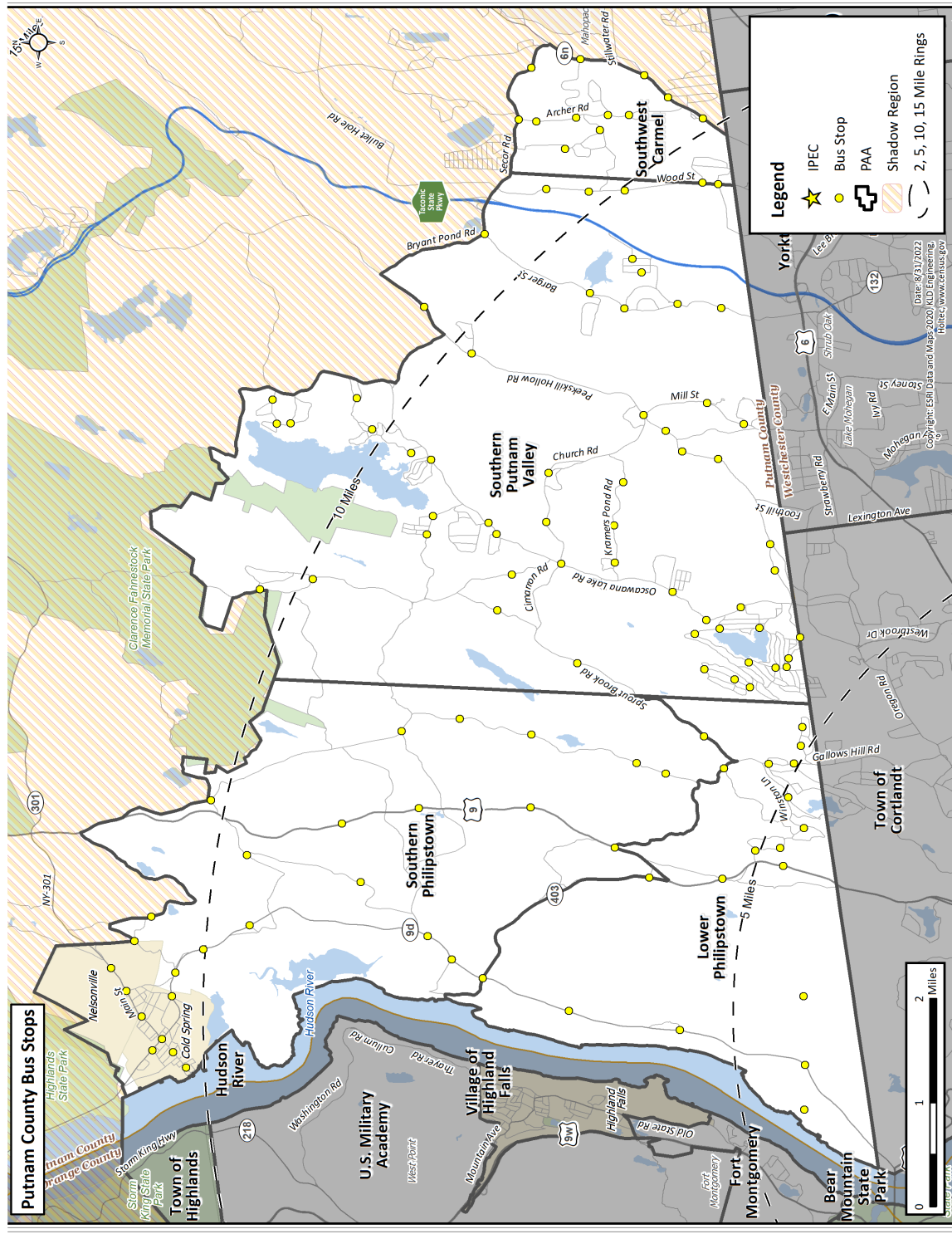


Figure 10-6. Putnam County Bus Stops

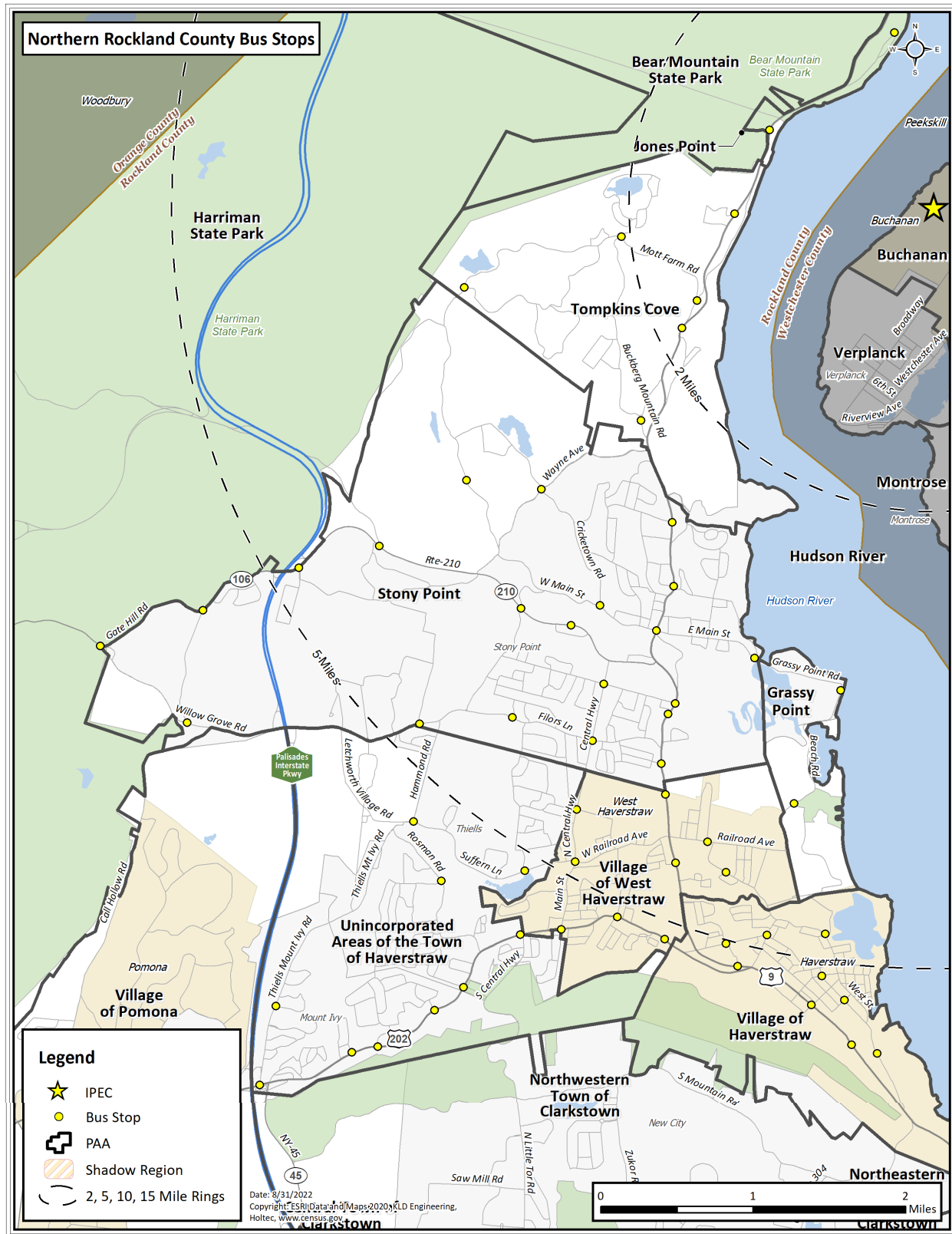


Figure 10-7. Northern Rockland County Bus Stops

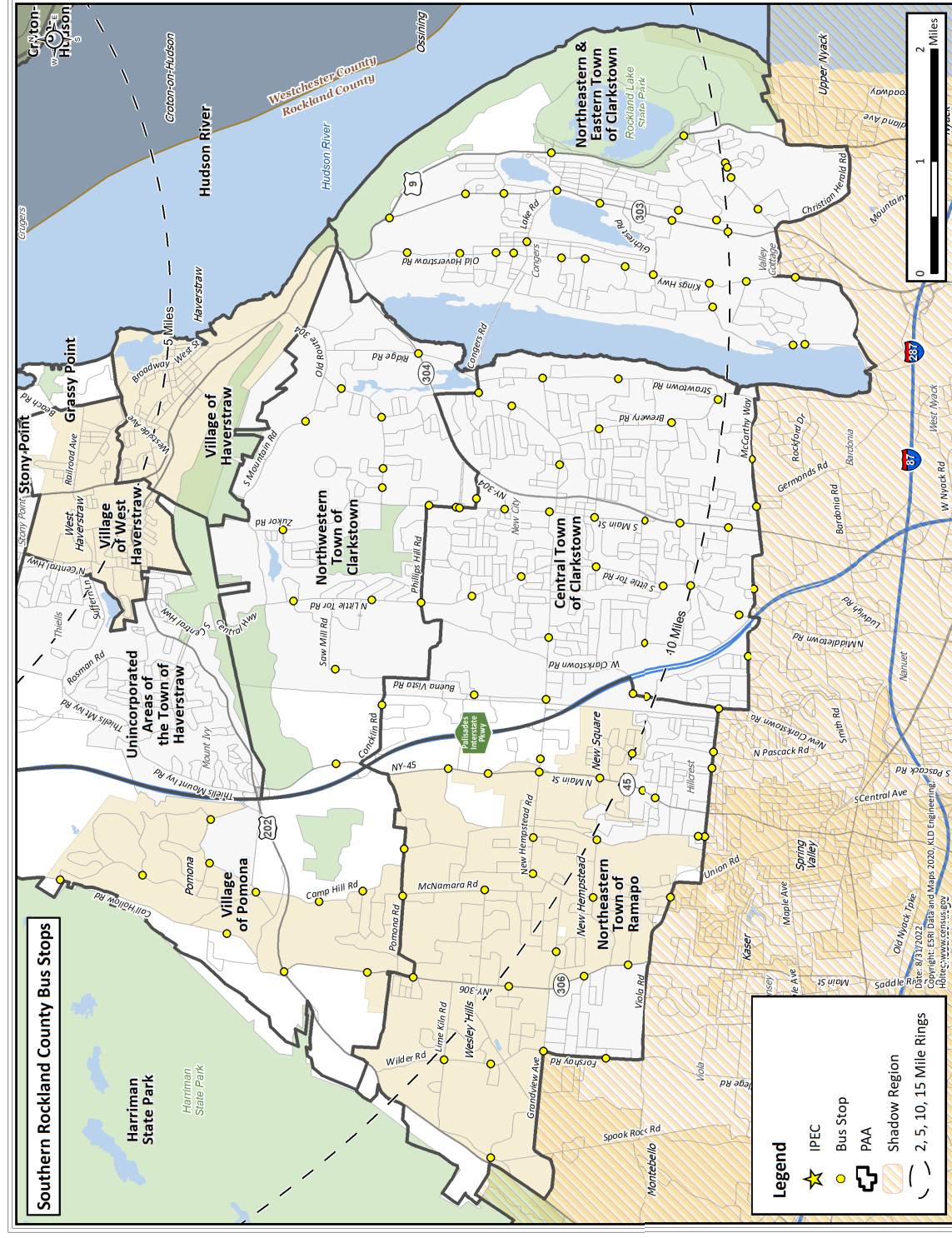
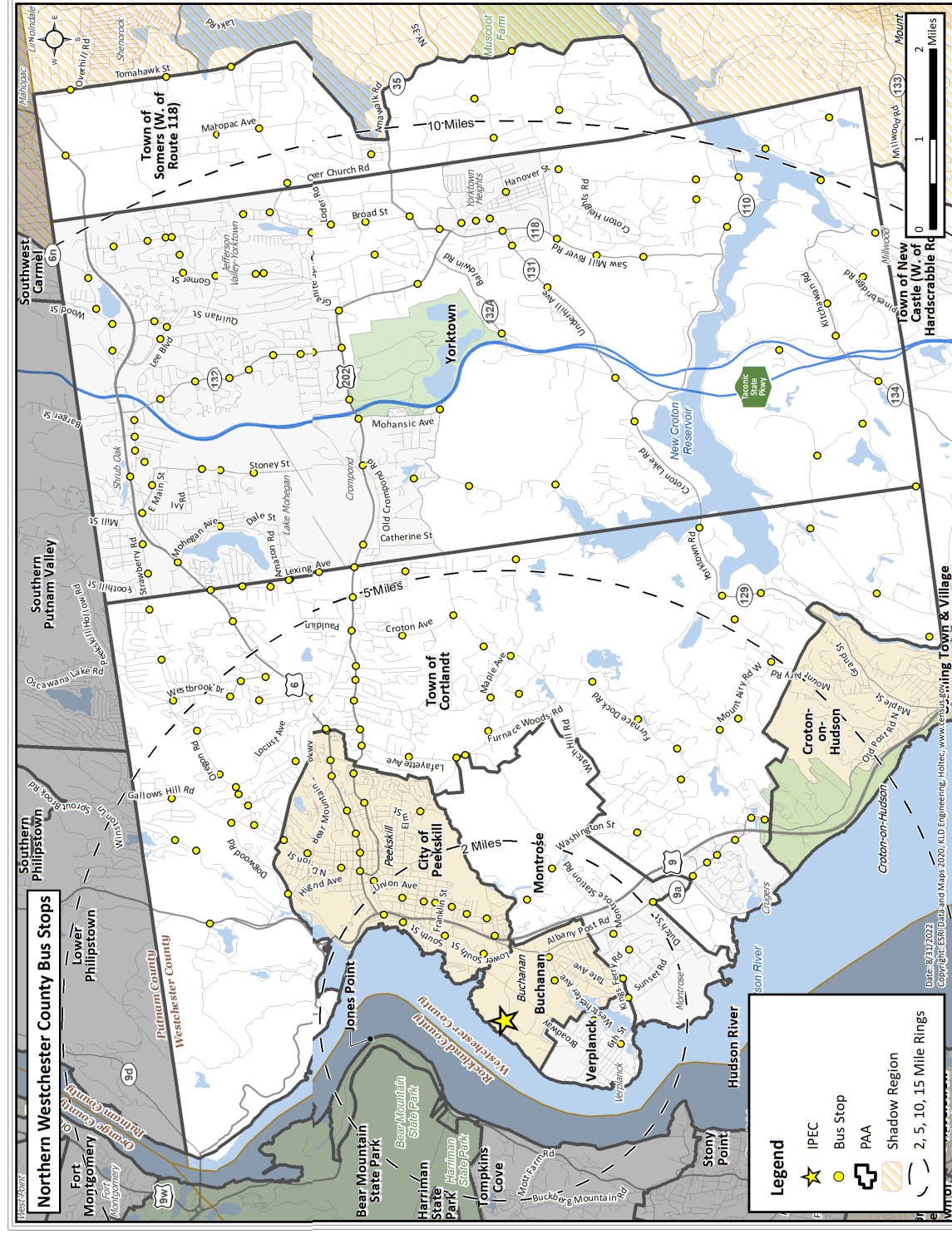


Figure 10-8. Southern Rockland County Bus Stops



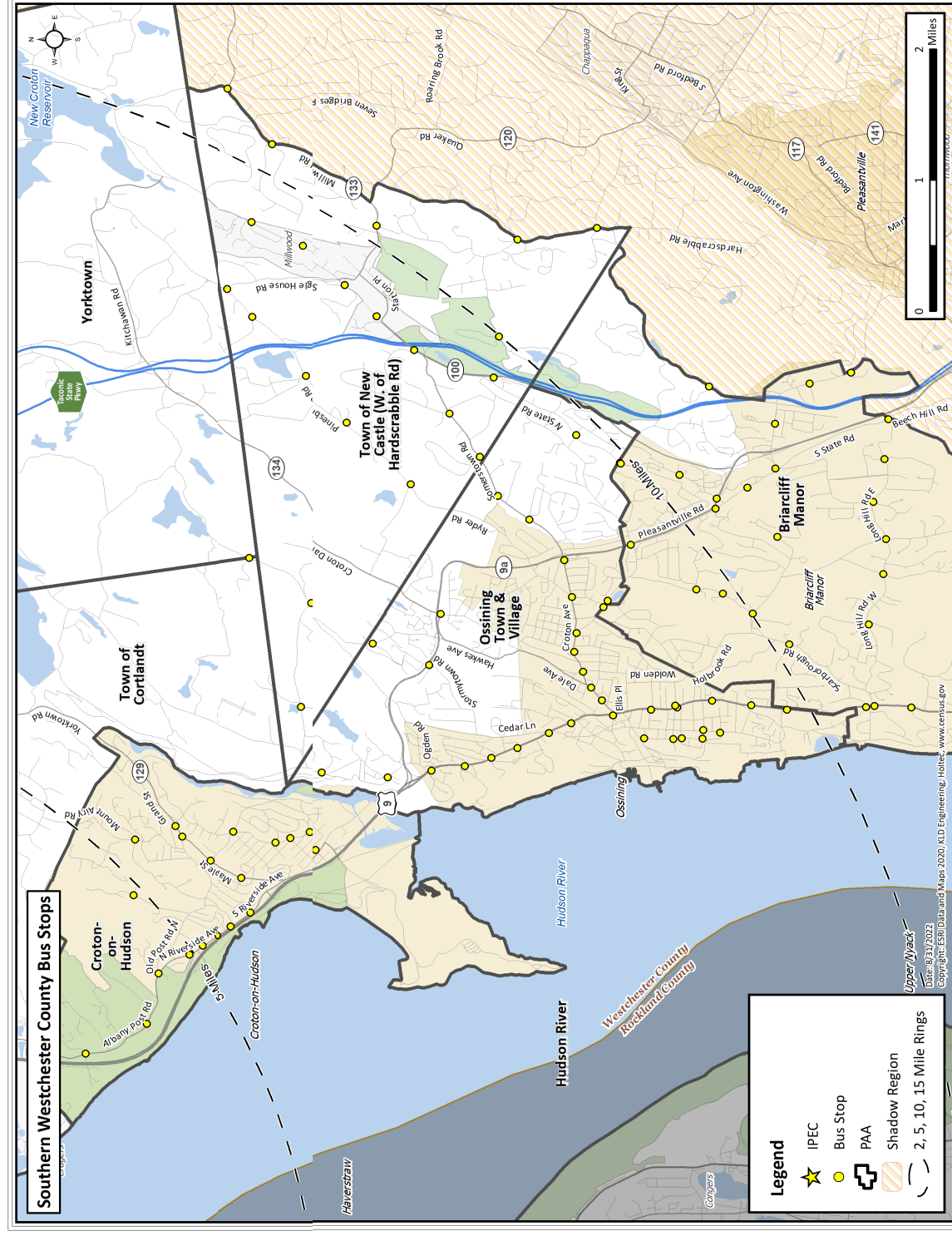


Figure 10-10. Southern Westchester County Bus Stops

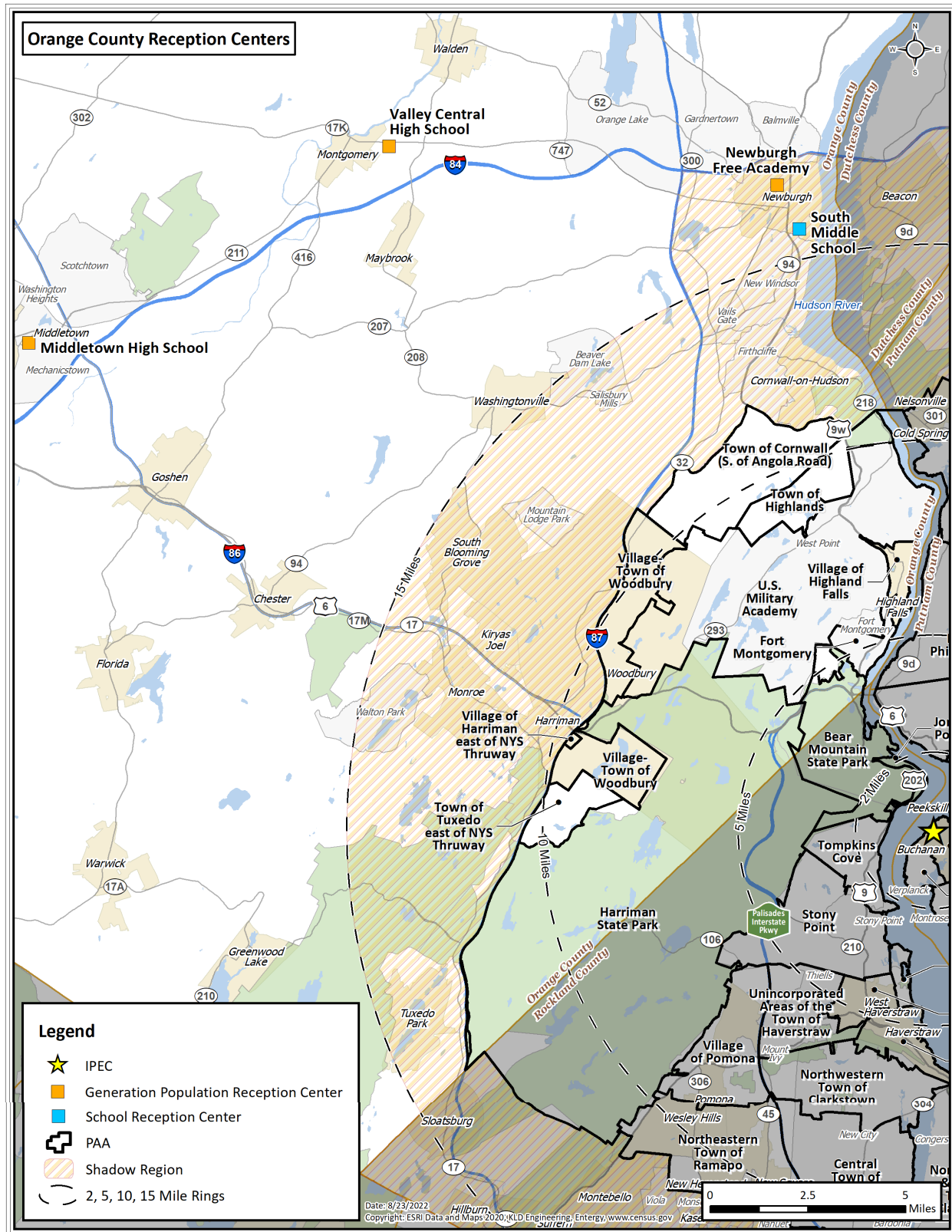


Figure 10-11. Reception Centers and School Reception Centers for Orange County

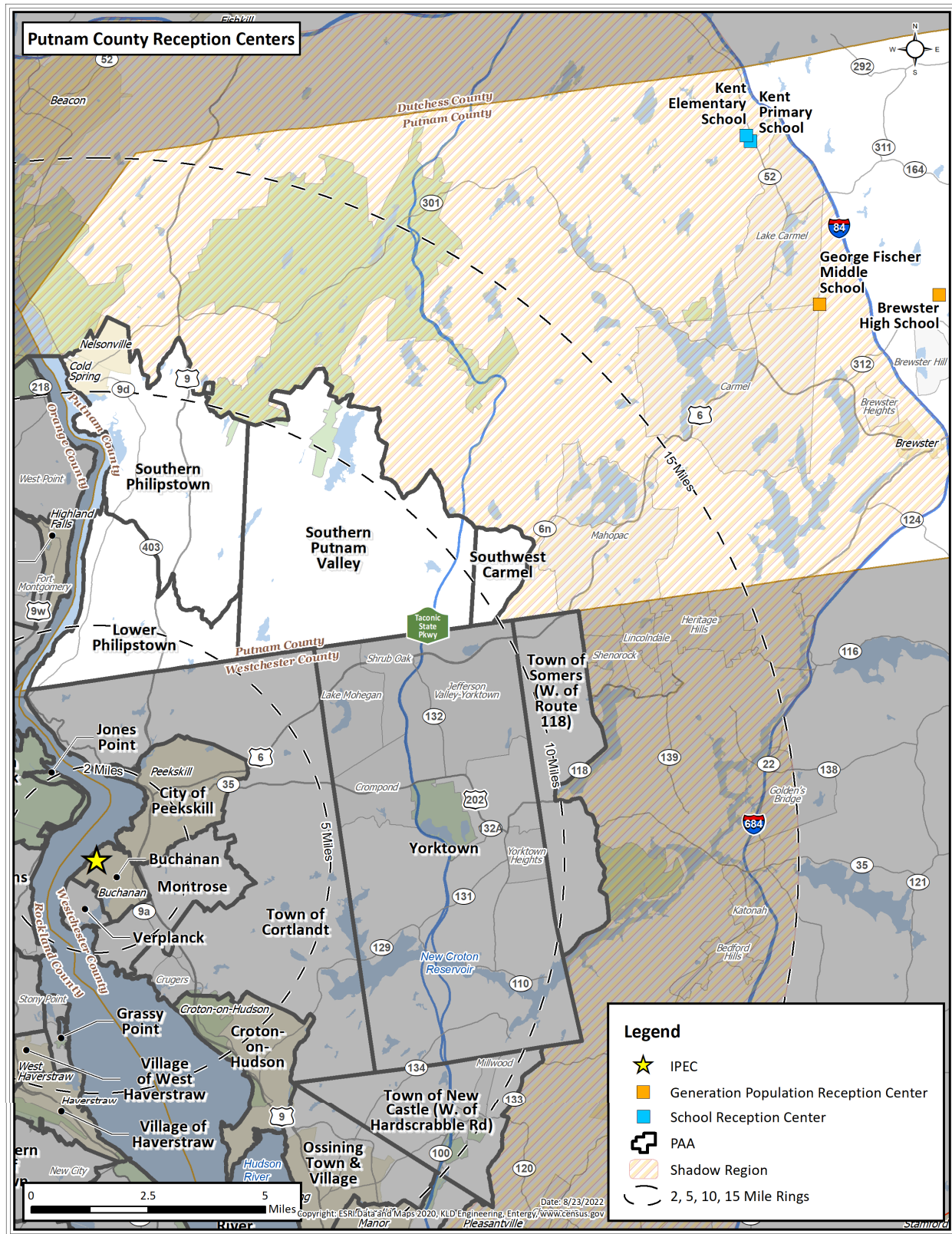


Figure 10-12. Reception Centers and School Reception Centers for Putnam County

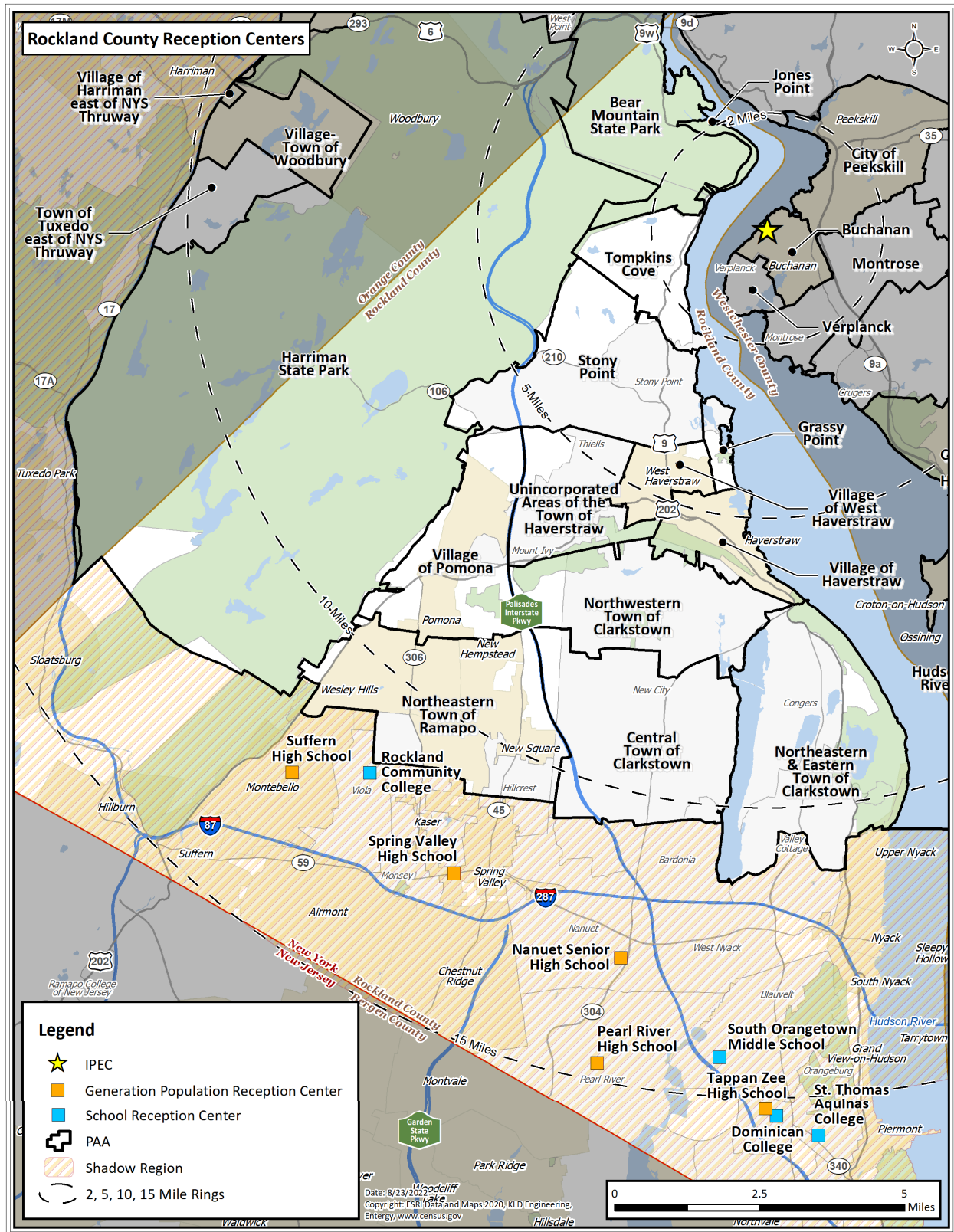


Figure 10-13. Reception Centers and School Reception Centers for Rockland County

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.

Table A-1. Glossary of Traffic Engineering Terms (continued)

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 appendix 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 (O-D) 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 DYNEV II 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 DTRAD 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 traffic assignment (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:

$$s_a = -\beta \ln(p), 0 \leq p \leq 1; \beta > 0$$

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

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_0 = 13 miles, the outer distance of the EPZ. 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.

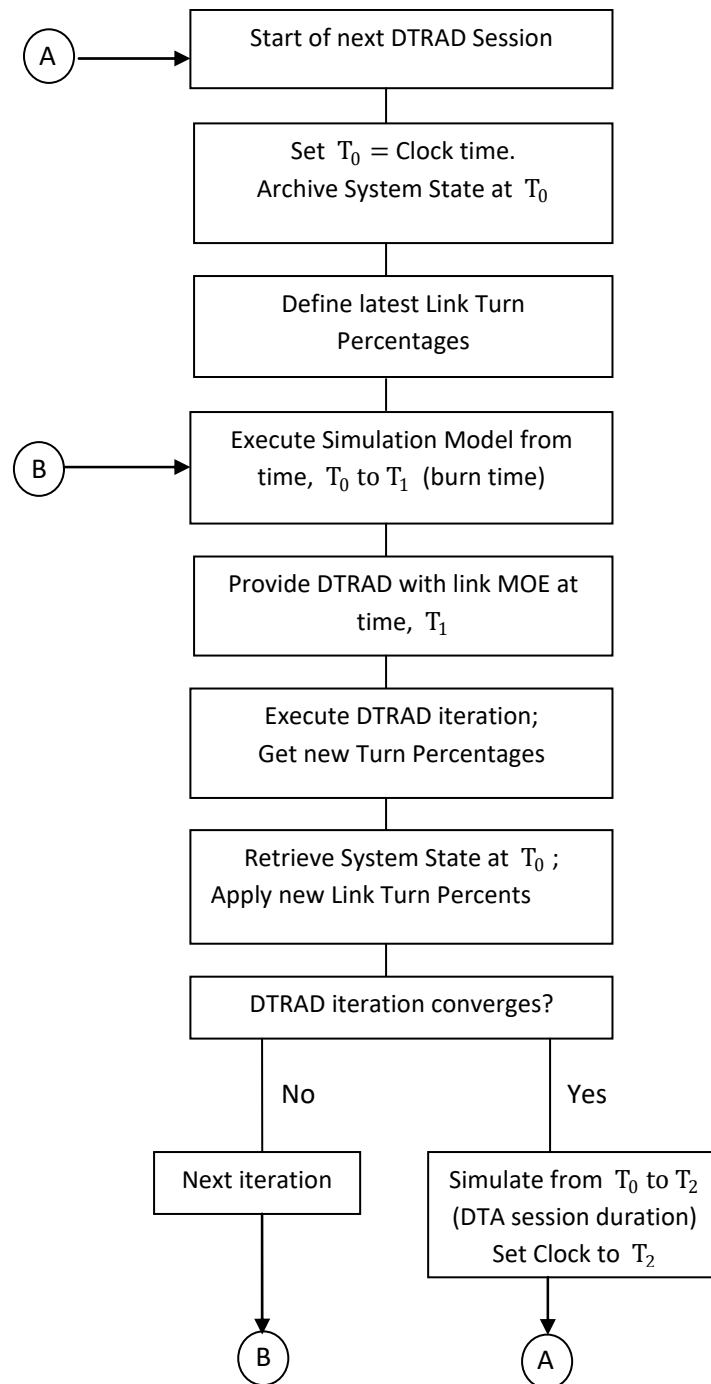


Figure B-1. Flow Diagram of Simulation-DTRAD Interface

APPENDIX C

DYNEV Traffic Simulation Model

C. DYNEV TRAFFIC SIMULATION MODEL

This appendix describes the 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.

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, $k_f \leq k \leq k_c = 45$ vpm, the density at capacity. In the flow-density plane, a quadratic relationship is prescribed in the range, $k_c < k \leq k_s = 95$ 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, $k_c = 45$ 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.

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 $Cap = \frac{Q_{max}(TI)}{3600} (G/C) LN$, 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 $t_1 < 0$, 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 $Q_b \geq Cap$, then

$O_Q = Cap, O_M = O_E = 0$

If $t_1 > 0$, then

$Q'_e = Q_b + M_b + E_1 - Cap$

Else

$Q'_e = Q_b - Cap$

End if

Calculate Q_e and M_e using Algorithm A (below)

6. Else ($Q_b < Cap$)

$O_Q = Q_b, RCap = Cap - O_Q$

7. If $M_b \leq RCap$, then

8. If $t_1 > 0$, $O_M = M_b$, $O_E = \min\left(RCap - M_b, \frac{t_1 \text{Cap}}{TI}\right) \geq 0$
 $Q'_e = E_1 - O_E$
 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, $\bar{k}_n = \frac{1}{4}[k_b + 2k_m + k_e]$,
 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 $|\bar{k}_n - \bar{k}_{n-1}| > \epsilon$ 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

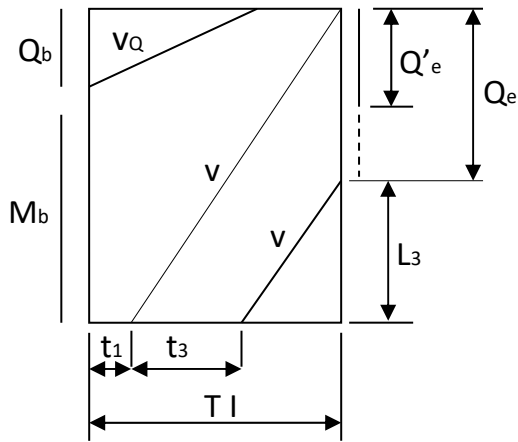
The number of excess vehicles that cause spillback is: $SB = Q_e + M_e - \frac{(L-W) \cdot LN}{L_v}$,
where W is the width of the upstream intersection. To prevent spillback, meter the outflow from the feeder approaches and from the source flow, S , during this TI by the amount, SB . That is, set

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

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:

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

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

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

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: Q_e and 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 MOEs for each link and turn movement for output purposes. It then prepares for the following time interval by defining the values of Q_b and M_b for the start of the next TI as being those values of Q_e and 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.

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 dynamic traffic

assignment (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.

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

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 2016.
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 downstream) 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 <u>moving</u> 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.

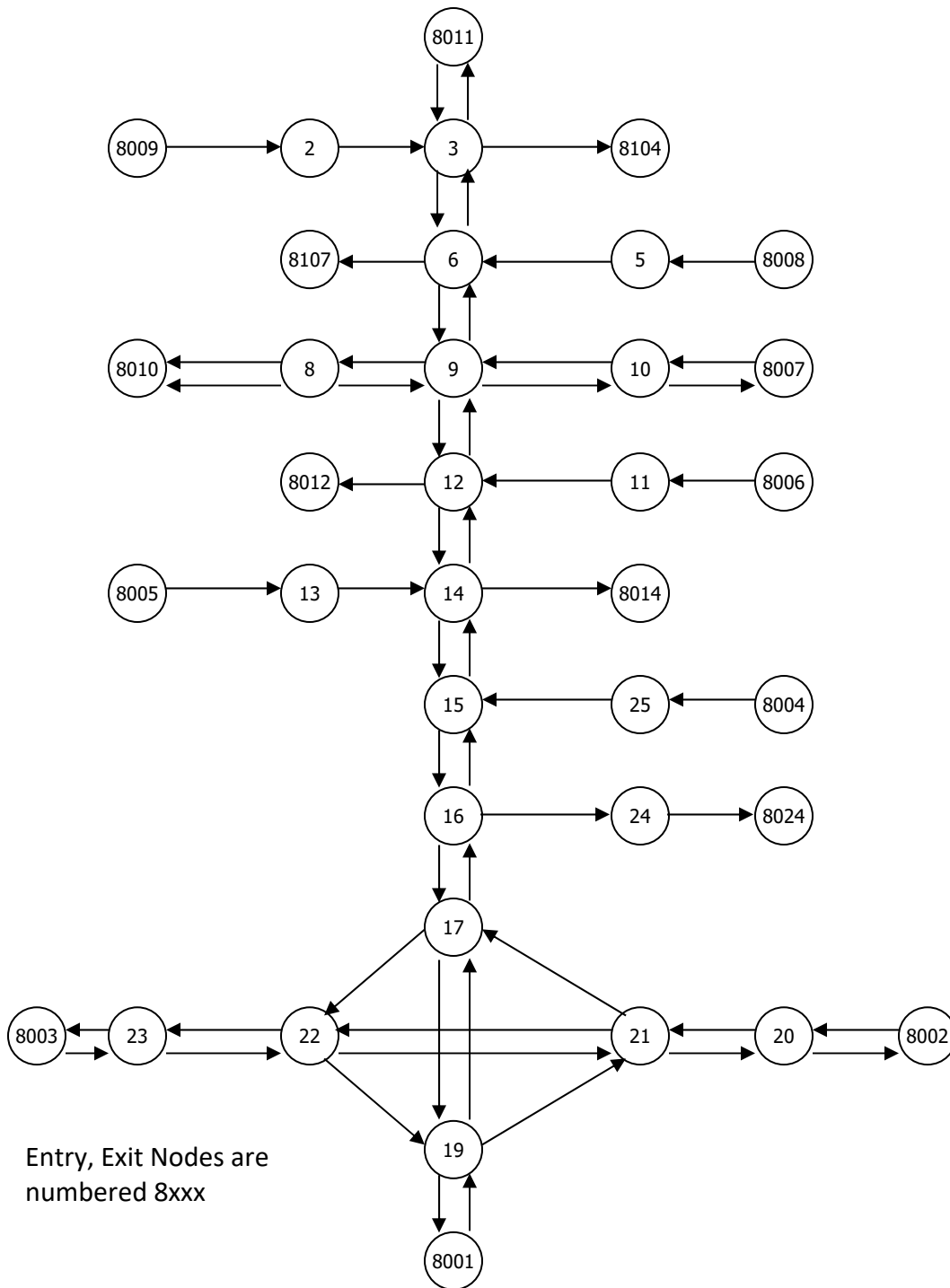


Figure C-1. Representative Analysis Network

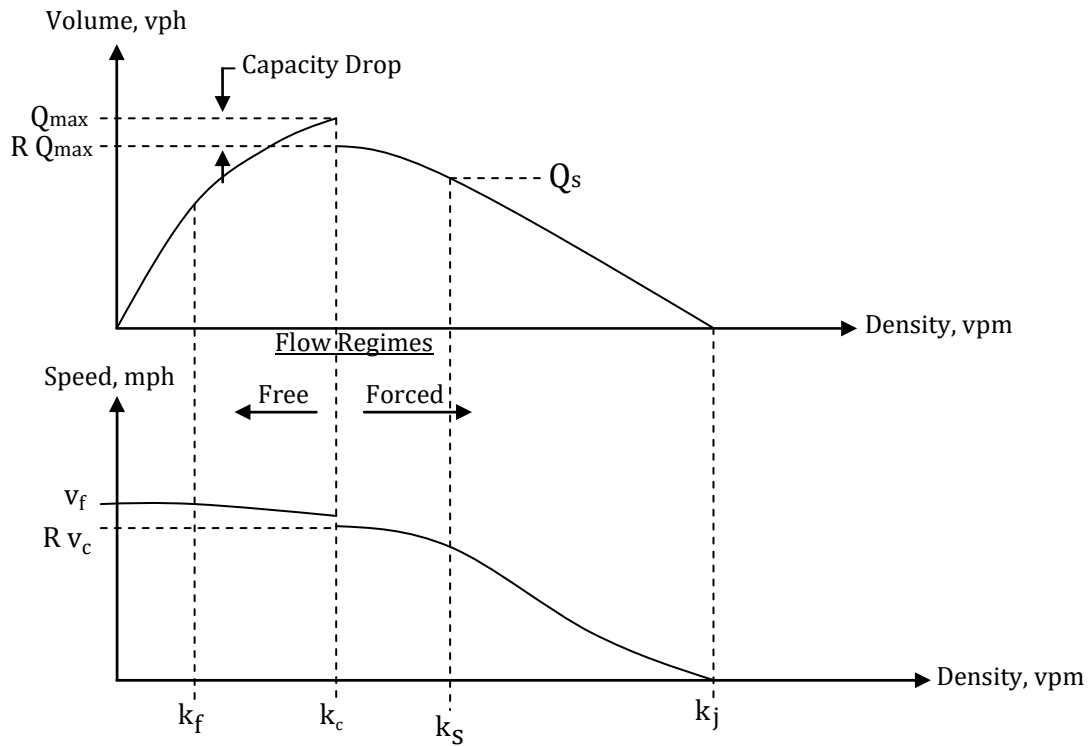


Figure C-2. Fundamental Diagrams

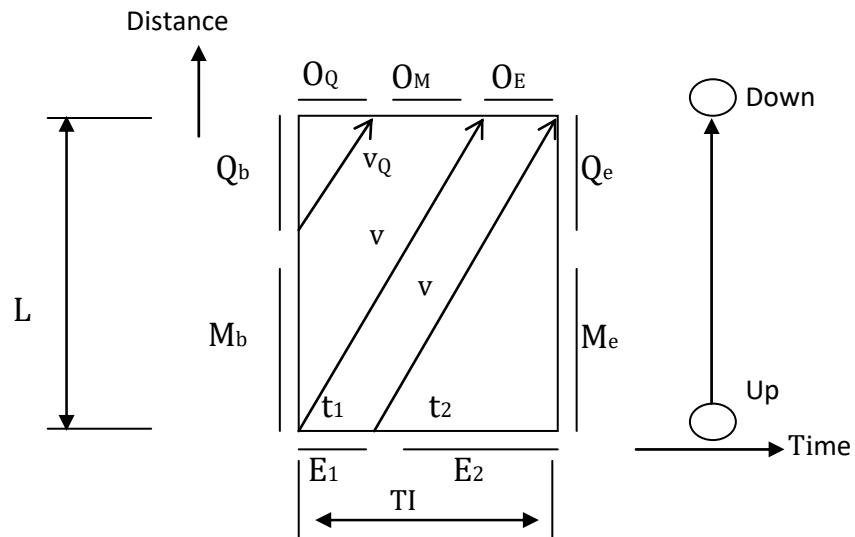


Figure C-3. A UNIT Problem Configuration with $t_1 > 0$

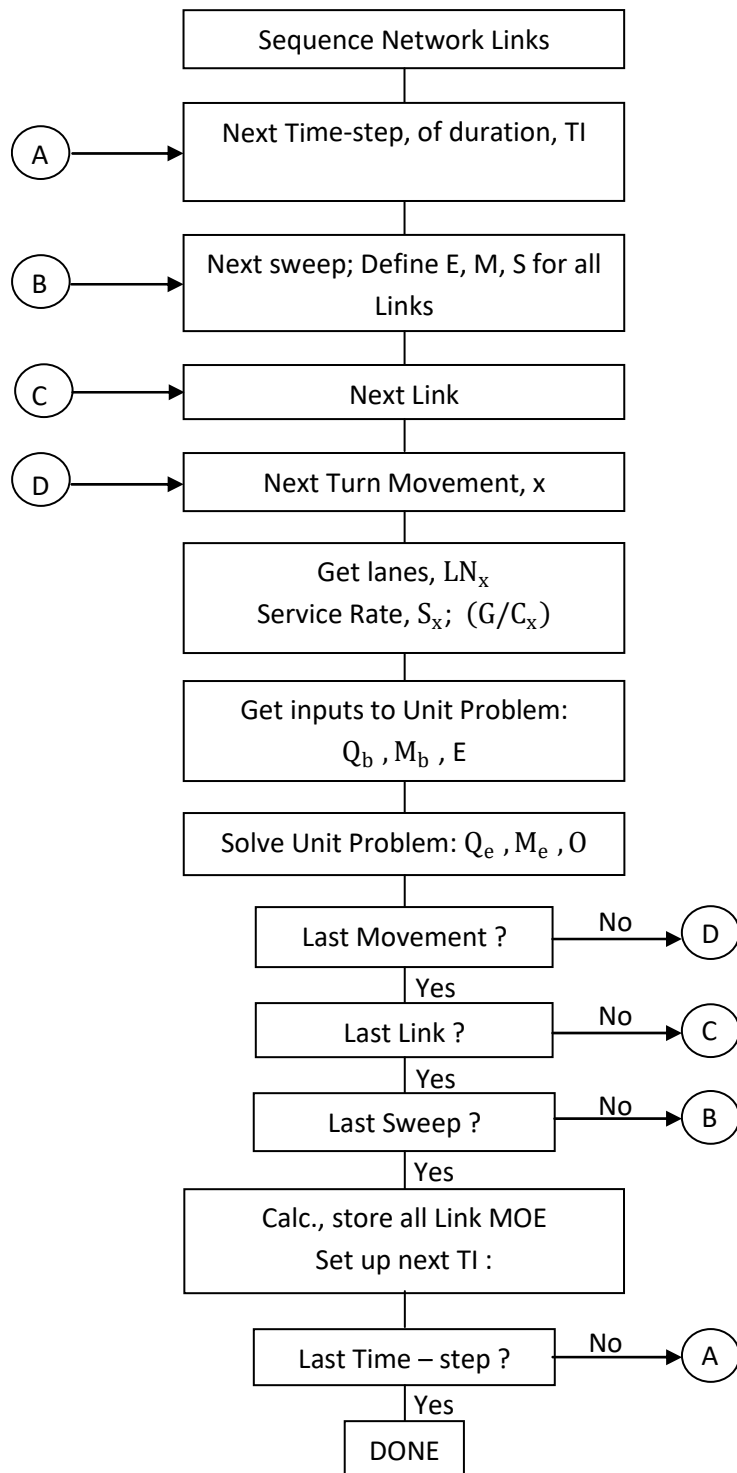


Figure C-4. Flow of Simulation Processing (See Glossary: Table C-3)

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 (ETE). 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 the EPZ boundary information and create a GIS base map. The base map extends beyond the Shadow Region which extends approximately 15 to 23 miles (radially) from the power plant location. The base map incorporates the local roadway topology, a suitable topographic background and the EPZ and Protective Action Area boundaries.

Step 2

The 2020 Census block population information was obtained in GIS format. This information was used to estimate the permanent resident population within the EPZ and Shadow Region and to define the spatial distribution and demographic characteristics of the population within the study area. Estimates of employees who reside outside of the EPZ and commute to work within the EPZ was based on US Census Longitudinal Employer-Household Dynamics from the OnTheMap Census analysis tool¹. Employees who reside outside the EPZ and commute to work at IPEC was based on data provided by Holtec. Transient facility, school, commuter school, preschool/day care, day camp, medical facility and correctional facility data were obtained from county emergency management agencies and the National Center for Education Statistics website², supplemented by aerial imagery for parking spaces and internet searches where data was missing. In addition, transportation resources available during an emergency were provided by the counties within the EPZ.

Step 3

A kickoff meeting was conducted with major stakeholders (state and county emergency managers and licensee off-site emergency personnel). 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. Individual kickoff meetings were also held with each county to discuss county specific concerns that should be addressed by the ETE study. Specific requests for information were presented to Holtec and the state and county emergency managers.

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 (if any exist within the study area), and to make the necessary observations needed to

¹ <http://onthemap.ces.census.gov/>

² <https://nces.ed.gov/ccd/schoolsearch/index.asp>

estimate realistic values of roadway capacity. Roadway characteristics were also verified using aerial imagery.

Step 5

An online demographic survey of the 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 most recent UNITES software (see Section 1.3) 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) and information obtained from aerial imagery. 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. The 2020 permanent resident population estimates (Step 2) 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 38 Protective Action Areas. Based on wind direction and speed, Regions (groupings of Protective Action Areas) 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 - see Section 1.3) 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, adding minor routes (which are paved and traversable) that were not previously modelled but may assist in an evacuation and increase the available roadway network capacity, 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. Traffic management plans are analyzed, and traffic control points are prioritized, if applicable. Additional analysis is conducted to identify the sensitivity of the ETE to change in some base evacuation conditions and model assumptions.

Step 16

Once vehicular evacuation results are accepted, average travel speeds for transit and special facility routes were used to compute ETEs for transit-dependent permanent residents, schools, commuter schools, preschools/day cares, day camps, and medical facilities and correctional facilities.

Step 17

The simulation results are analyzed, tabulated and graphed. The results were then documented, as required by NUREG/CR-7002 Rev. 1.

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.

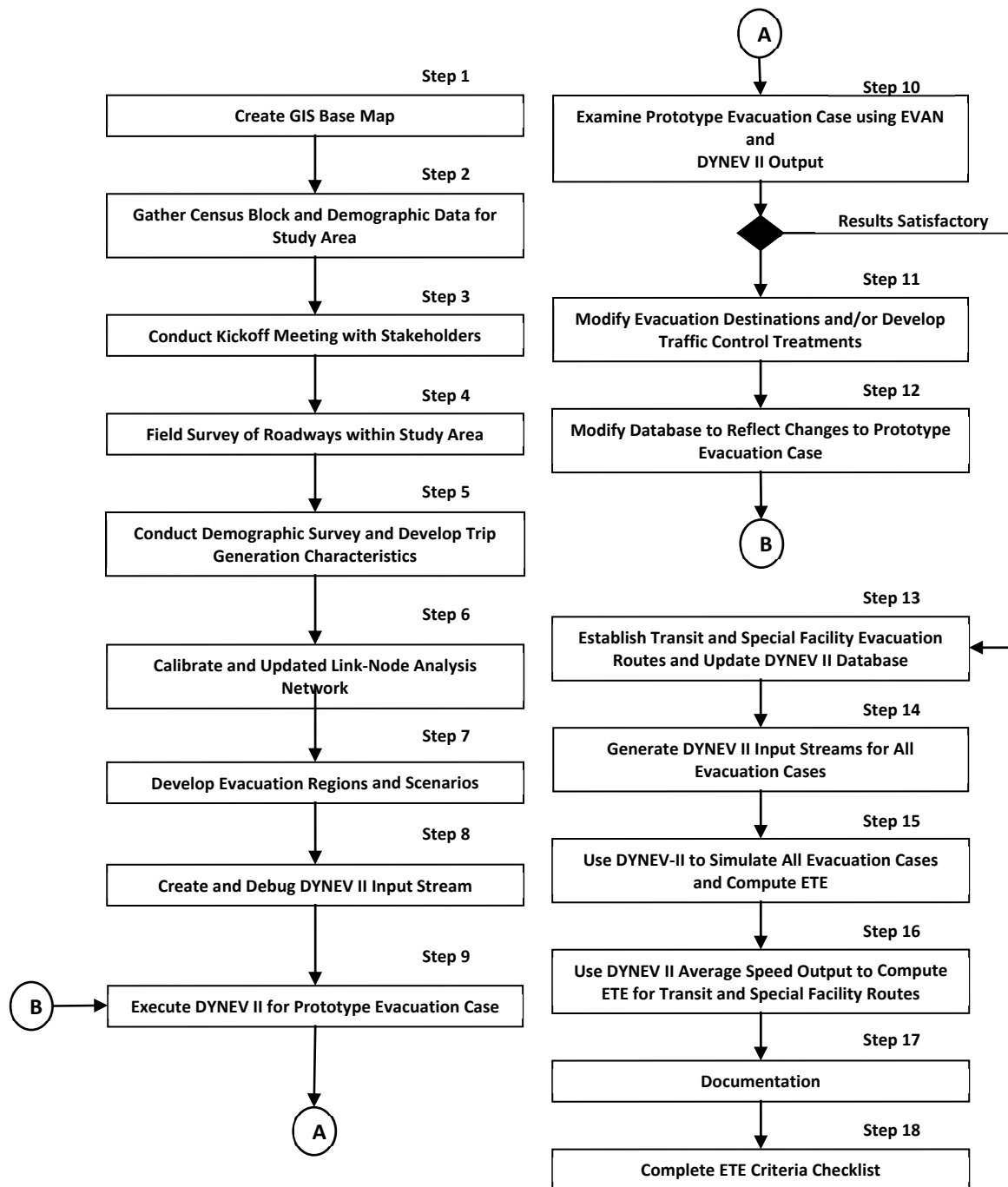


Figure D-1. Flow Diagram of Activities

APPENDIX E

Special Facility Data

E. SPECIAL FACILITY DATA

The following tables list population information, as of August 2022, for special facilities, transient attractions and major employers that are located within the IPEC EPZ. Special facilities are defined as schools, colleges, preschools/daycares, day camps, medical facilities, and correctional facilities. Transient population data is included in the tables for transient attractions (beaches, campgrounds, parks, shopping centers) and lodging facilities. 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, college, preschool/daycare, day camp, medical facility, transient attraction (beach, campground, park, shopping center), lodging facility, and correctional facility are also provided. Note, several facilities are located in the Shadow Region but are included in this study due to their close proximity to the EPZ boundary.

Table E-1. Schools within the EPZ

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
ORANGE COUNTY						
Fort Montgomery	4.8	NNW	Fort Montgomery Elementary School	895 US-9W	Highland Falls	243
Fort Montgomery	5.9	NNW	James O'Neill High School	US-9W	Highland Falls	548
Village of Highland Falls	7.1	N	Highland Falls Middle School	52 Mountain Ave	Highland Falls	348
U.S. Military Academy	9.3	N	West Point Elementary School	705 Barry Rd	West Point	528
Orange County Subtotal: 1,667						
PUTNAM COUNTY						
Southern Putnam Valley	6.6	NE	Putnam Valley Middle School	142 Peekskill Hollow Rd	Putnam Valley	511
Southern Putnam Valley	6.7	NE	Putnam Valley High School	146 Peekskill Hollow Rd	Putnam Valley	592
Southern Putnam Valley	7.2	NE	Putnam Valley Elementary School	171 Oscawana Lake Rd	Putnam Valley	531
Southern Philipstown	7.7	N	Garrison Elementary School	1100 NY-9D	Garrison	219
Southern Philipstown	10.3	N	Manitou School	1656 NY-9D	Cold Spring	103
Southern Philipstown	10.6	N	Haldane Elementary School	15 Craigside Dr	Cold Spring	300
Southern Philipstown	10.7	N	Haldane High School	15 Craigside Dr	Cold Spring	305
Putnam County Subtotal: 2,561						
ROCKLAND COUNTY						
Central Town of Clarkstown	7.7	SSW	Woodglen Elementary School	121 Phillips Hill Rd	New City	459
Central Town of Clarkstown	8.2	S	Clarkstown High School North	151 Congers Rd	New City	1,335
Central Town of Clarkstown	8.3	SSW	New City Elementary School	60 Crestwood Dr	New City	395
Central Town of Clarkstown	8.3	SSW	Little Tor Elementary School	56 Gregory St	New City	285
Central Town of Clarkstown	8.7	S	New City Jewish Center ECC	47 Old Schoolhouse Rd	New City	31
Central Town of Clarkstown	9.0	SSW	Adolph H. Schreiber Hebrew Academy of Rockland Co.	360 New Hempstead Rd	New City	407
Central Town of Clarkstown	9.8	SSW	Link Elementary School	51 Red Hill Rd	New City	364
Central Town of Clarkstown	9.9	S	Laurel Plains Elementary School	14 Teakwood Ln	New City	367
Central Town of Clarkstown	10.2	S	Strawtown Elementary School	413 Strawtown Rd	West Nyack	305
Central Town of Clarkstown	10.3	S	Felix Festa Middle School	30 Parrot Rd	West Nyack	1,928
Northeastern Town of Ramapo	8.7	SSW	Summit Park Elementary School	925 NY-45	New City	548
Northeastern Town of Ramapo	8.8	SW	Pomona Middle School	101 Pomona Rd	Suffern	397
Northeastern Town of Ramapo	8.8	SSW	Ateres Bais Yaakov	200 Summit Park Rd	Spring Valley	300
Northeastern Town of Ramapo	9.5	SSW	Yeshiva Avir Yaakov (Boys)	64 Polnova Rd	Spring Valley	150
Northeastern Town of Ramapo	9.6	SSW	Yeshiva Avir Yaakov (Boys)	26 Benzion Dunner Dr	New Square	200

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
Northeastern Town of Ramapo	9.7	SSW	Yeshiva Avir Yaakov (Girls)	15 N Roosevelt Ave	Spring Valley	1,100
Northeastern Town of Ramapo	9.7	SSW	Yeshiva Avir Yaakov (Girls)	32 Addison Boyce Dr	New City	650
Northeastern Town of Ramapo	9.8	SSW	Yeshiva Avir Yaakov (Boys)	103 Clinton Ln	Spring Valley	1,500
Northeastern Town of Ramapo	9.8	SSW	Yeshiva Avir Yaakov (Boys) - North Main	766 N Main St	Spring Valley	450
Northeastern Town of Ramapo	9.8	SW	Lime Kiln Elementary School	35 Lime Kiln Rd	Suffern	451
Northeastern Town of Ramapo	9.9	SSW	Yeshiva Avir Yaakov (Boys) Washington Ave.	91 Washington Ave	New Square	450
Northeastern Town of Ramapo	10.2	SSW	Hempstead Elementary School	80 Brick Church Rd	Spring Valley	494
Northeastern Town of Ramapo	10.3	SSW	Bais Malka (Girls)	40 Grandview Ave	Spring Valley	700
Northeastern Town of Ramapo	10.3	SSW	Hebrew Academy for Special Children	46 Grandview Ave	Spring Valley	120
Northeastern Town of Ramapo	10.5	SW	Grandview Elementary School	151 Grandview Ave	Monsey	513
Northeastern Town of Ramapo	10.5	SW	Yeshiva Spring Valley (Girls)	142 Grandview Ave	Monsey	1,000
Northeastern Town of Ramapo	10.9	SSW	Ramapo High School	400 Viola Rd	Spring Valley	1,415
Northeastern & Eastern Town of Clarkstown	7.6	S	Lakewood Elementary School	77 Lakeland Ave	Congers	437
Northeastern & Eastern Town of Clarkstown	9.4	S	St. Paul's School	365 Kings Hwy	Valley Cottage	215
Northeastern & Eastern Town of Clarkstown	9.7	S	Liberty Elementary School	142 Lake Rd	Valley Cottage	510
Northeastern & Eastern Town of Clarkstown	10.4	S	Valley Cottage Elementary School	26 Lake Rd	Valley Cottage	454
Northwestern Town of Clarkstown	7.5	SSW	Chabad Lubavitch of Rockland	315 N Main St	New City	80
Village of Haverstraw	4.9	S	Haverstraw Elementary School	16 Grant St	Haverstraw	629
Village of West Haverstraw	4.1	SSW	West Haverstraw Elementary School	71 Blauvelt Ave	West Haverstraw	787
Village of West Haverstraw	4.6	SSW	North Rockland High School Ext.	65 Chapel St	Garnerville	104
Unincorporated Areas of the Town of Haverstraw	4.5	SSW	St. Gregory Barbarigo School	29 Cinder Rd	Garnerville	203
Unincorporated Areas of the Town of Haverstraw	5.1	SW	North Rockland High School	106 Hammond Rd	Thiells	2,660
Unincorporated Areas of the Town of Haverstraw	5.4	SW	Thiells Elementary School	78 Rosman Rd	Thiells	780
Unincorporated Areas of the Town of Haverstraw	5.4	SW	Willow Grove Elementary School	153 Storrs Rd	Thiells	671
Unincorporated Areas of the Town of Haverstraw	5.6	SW	Fieldstone Middle School	100 Fieldstone Dr	Thiells	1,304

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
Village of Pomona	8.3	SW	Bais Yaakov Chofetz Chaim of Pomona	44 Camp Hill Rd	Pomona	360
Stony Point	2.9	SW	Stony Point Elementary School	7 Gurnee Dr	Stony Point	673
Stony Point	3.8	SW	Farley Elementary School	140 NY-210	Stony Point	582
Rockland County Subtotal:						26,763
WESTCHESTER COUNTY						
Briarcliff Manor	9.5	SE	Congregation Sons of Israel Religious School	1666 Pleasantville Rd	Briarcliff Manor	250
Briarcliff Manor	10.6	SSE	Clearview School	480 Albany Post Rd	Briarcliff Manor	120
Briarcliff Manor	10.9	SE	Todd Elementary School	45 Ingham Rd	Briarcliff Manor	554
Briarcliff Manor	11.8	SE	Briarcliff High School	444 Pleasantville Rd	Briarcliff Manor	583
Briarcliff Manor	11.8	SE	Briarcliff Middle School	444 Pleasantville Rd	Briarcliff Manor	348
Ossining Town & Village	7.2	SE	Saint Augustine School	381 N Highland Ave	Ossining	500
Ossining Town & Village	8.1	SE	Anne M. Dörner Middle School	100 Van Cortlandt Ave	Ossining	1,127
Ossining Town & Village	8.2	SE	Claremont Elementary School	2 Claremont Rd	Ossining	741
Ossining Town & Village	8.3	SSE	Cardinal McCloskey School	155 N Highland Ave	Ossining	9
Ossining Town & Village	8.9	SE	Brookside Elementary School	30 Ryder Rd	Ossining	733
Ossining Town & Village	8.9	SE	Roosevelt School	190 Croton Ave	Ossining	363
Ossining Town & Village	9.0	SSE	Ossining High School	29 S Highland Ave	Ossining	1,430
Ossining Town & Village	9.2	SSE	Park Elementary School	22 Edward St	Ossining	679
Town of New Castle (W. of Hardscrabble Rd)	10.0	ESE	West Orchard Elementary School	25 Granite Rd	Chappaqua	418
Town of New Castle (W. of Hardscrabble Rd)	10.3	ESE	Seven Bridges Middle School	222 Seven Bridges Rd	Chappaqua	624
Croton-on-Hudson	4.9	SE	Temple Israel of Northern Westchester	31 Glengary Rd	Croton-on-Hudson	100
Croton-on-Hudson	5.6	SE	Croton-Harmon High School	36 Old Post Rd S	Croton-on-Hudson	525
Croton-on-Hudson	5.7	SE	Pierre Van Cortlandt Middle School	3 Glen Pl	Croton-on-Hudson	517
Croton-on-Hudson	5.7	SE	Carrie E. Tompkins Elementary School	8 Gerstein St	Croton-on-Hudson	594
Buchanan	0.7	SSE	Buchanan-Verplanck Elementary School	160 Westchester Ave	Buchanan	325
Montrose	1.3	SE	Hendrick Hudson High School	2166 Albany Post Rd	Montrose	851
Montrose	1.4	SE	Frank G. Lindsey Elementary School	57 Trolley Rd	Montrose	405
City of Peekskill	0.8	NE	Keon Center	2 John Walsh Blvd # 2	Peekskill	30
City of Peekskill	1.6	ENE	Woodside Elementary School	612 Depew St	Peekskill	563
City of Peekskill	1.9	NE	Peekskill Middle School	212 Ringgold St	Peekskill	748
City of Peekskill	2.2	ENE	Peekskill High School	1072 Elm St	Peekskill	1,010
City of Peekskill	2.2	NE	Oakside Elementary School	200 Decatur Ave	Peekskill	493

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
City of Peekskill	2.8	NE	Uriah Hill Elementary School	980 Pemart Ave	Peekskill	221
City of Peekskill	3.0	NE	Hillcrest Elementary School	4 Horton Dr	Peekskill	523
Town of Cortlandt	3.3	ESE	Furnace Woods Elementary School	239 Watch Hill Rd	Cortlandt Manor	249
Town of Cortlandt	3.6	E	Blue Mountain Middle School	7 Furnace Woods Rd	Cortlandt Manor	546
Town of Cortlandt	3.9	NE	Saint Columbanus School	122 Oregon Rd	Cortlandt Manor	200
Town of Cortlandt	4.7	ENE	Lincoln-Titus Elementary School	10 Lincoln Ave	Crompond	387
Town of Cortlandt	4.9	E	Walter Panas High School	300 Croton Ave	Cortlandt Manor	1,000
Town of Cortlandt	5.1	NE	Van Cortlandtville Elementary School	3100 E Main St	Mohegan Lake	579
Yorktown	6.1	NE	George Washington Elementary School	3634 Lexington Ave	Mohegan Lake	417
Yorktown	6.8	ENE	Shrub Oak International School	3151 Stoney St	Mohegan Lake	14
Yorktown	7.1	NE	Saint Elizabeth Ann Seton School	1375 E Main St	Shrub Oak	200
Yorktown	7.1	ENE	Lakeland High School	1349 E Main St	Shrub Oak	984
Yorktown	7.6	ENE	Alternative High School	845 Fox Meadow Rd	Yorktown Heights	65
Yorktown	7.6	ENE	Fox Meadow Middle/High School ¹	845 Fox Meadow Rd	Yorktown Heights	N/A
Yorktown	7.6	ENE	Crompond Elementary School	2901 Manor St	Yorktown Heights	513
Yorktown	7.7	ENE	Benjamin Franklin Elementary School	3149 Kamhi Dr	Yorktown Heights	539
Yorktown	7.9	ENE	Mohansic Elementary School	704 Locksley Rd	Yorktown Heights	445
Yorktown	8.0	ENE	Lakeland-Copper Beech Middle School	3417 Old Yorktown Rd	Yorktown Heights	1,403
Yorktown	8.0	ENE	Yorktown High School	2727 Crompond Rd	Yorktown Heights	1,230
Yorktown	8.1	ENE	Mildred E. Strang Middle School	2701 Crompond Rd	Yorktown Heights	783
Yorktown	8.2	E	Maryel School - Westchester	2405 Crompond Rd	Yorktown Heights	68
Yorktown	9.0	E	Brookside Elementary School	2285 Broad St	Yorktown Heights	474
Yorktown	9.3	E	Saint Patrick School	117 Moseman Rd	Yorktown Heights	180
Yorktown	9.5	ENE	Thomas Jefferson Elementary School	3636 Gomer St	Yorktown Heights	480
Town of Somers (W. of Route 118)	9.8	E	CTE - Building E	200 Boces Dr	Yorktown Heights	150
Town of Somers (W. of Route 118)	9.8	E	CTE - Tech Center	200 Boces Dr	Yorktown Heights	700
Town of Somers (W. of Route 118)	9.8	E	CTE - Tech South	200 Boces Dr	Yorktown Heights	300
Town of Somers (W. of Route 118)	9.8	E	Putnam Northern Westchester BOCES	200 Boces Dr	Yorktown Heights	69
Town of Somers (W. of Route 118)	9.8	E	Pines Bridge School	200 Boces Dr	Yorktown Heights	67
Town of Somers (W. of Route 118)	9.8	E	Walden School	200 Boces Dr	Yorktown Heights	125
Westchester County Subtotal:						27,551
EPZ TOTAL:						58,542

¹ Data for Fox Meadow Middle/High School is unavailable.

Table E-2. Colleges within the EPZ

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Students	Vehicles
ORANGE COUNTY							
U.S. Military Academy	8.3	N	United States Military Academy	646 Swift Rd	West Point	4,440	888
Orange County Subtotal:						4,440	888
WESTCHESTER COUNTY							
Town of Cortlandt	3.3	E	Ohr Hameir Theology Seminary	141 Furnace Woods Rd	Cortlandt Manor	206	194
Westchester County Subtotal:						206	194
EPZ TOTAL:						4,646	1,082

Table E-3. Preschools/Daycares within the EPZ

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
ORANGE COUNTY						
Fort Montgomery	4.9	NNW	Nursery School of the Highlands	895 US-9W	Highland Falls	16
Village-Town of Woodbury	9.9	NW	Sue's Play & Learning Center	63 Elmwood Dr	Highland Mills	8
Village-Town of Woodbury	10.0	WNW	Skyline Family Daycare	36 Skyline Dr	Highland Mills	8
Orange County Subtotal:						32
PUTNAM COUNTY						
Southwest Carmel	10.9	NE	Cozy Corner Child Care	21 Dreps Dr	Mahopac	16
Southwest Carmel	10.9	ENE	Noah's Ark Nursery School	250 NY-6N	Mahopac	40
Southern Putnam Valley	6.2	NE	Once Upon a Time Preschool & Daycare	47 Peekskill Hollow Rd	Putnam Valley	65
Southern Putnam Valley	6.3	NE	St. Luke's Nursery School	65 Oscawana Lake Rd	Putnam Valley	115
Southern Putnam Valley	7.2	NE	Putnam Valley Parks and Recreation Dept.	171 Oscawana Lake Rd	Putnam Valley	80
Southern Putnam Valley	8.5	NE	Valley Day Care Center	337 Peekskill Hollow Rd	Putnam Valley	37
Southern Philipstown	7.8	N	St Philip's Nursery School	1101 NY-9D	Garrison	38
Southern Philipstown	10.3	N	The Nest Childcare/Nursery School	44 Chestnut St	Cold Spring	68
Southern Philipstown			Comm. Nursery School of 1st Presbyterian Church	10 Academy St	Cold Spring	26
Shadow Region	10.4	N				
Shadow Region	10.8	NE	Mama's Playhouse	36 Secor Rd	Mahopac	16
Putnam County Subtotal:						501
ROCKLAND COUNTY						
Central Town of Clarkstown	7.7	SSW	Jawonio, Inc	155 Phillips Hill Rd	New City	170

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
Central Town of Clarkstown	7.9	SSW	Tutor Time Child Care	227 N Main St	New City	100
Central Town of Clarkstown	8.9	SSW	Temple Beth Sholom Nursery School	228 New Hempstead Rd	New City	47
Central Town of Clarkstown	8.9	SSW	Temple Beth Sholom Religious School	228 New Hempstead Rd	New City	165
Central Town of Clarkstown	8.9	SSW	Benim Scholastic Academy	114 S Main St	New City	108
Central Town of Clarkstown	9.1	SSW	Cornerstone Christian Community School	384 New Hempstead Rd	New City	120
Central Town of Clarkstown	9.1	SSW	Sonshine Community Nursery School & Daycare Center	384 New Hempstead Rd	New City	43
Central Town of Clarkstown	9.5	SSW	St. Paul's Christian Day School	323 S Main St	New City	152
Northeastern Town of Ramapo	9.0	SSW	Rockland Worksite Daycare	50 Sanatorium Rd	Pomona	114
Northeastern Town of Ramapo	9.3	SSW	Smarty Pants Day Care	484 New Hempstead Rd	New City	42
Northeastern Town of Ramapo	9.7	SSW	NSCIC Day Care	15 N Roosevelt Ave	Spring Valley	80
Northeastern Town of Ramapo	9.8	SSW	NSCIC Early Head Start Annex	103 Clinton Ln	Spring Valley	56
Northeastern Town of Ramapo	9.9	SSW	NSCIC Early Head Start	1 Washington Ave	Spring Valley	48
Northeastern Town of Ramapo	9.9	SSW	NSCIC Early Head Start (Pre-Schoolers)	1 Washington Ave	Spring Valley	68
Northeastern Town of Ramapo	10.7	SSW	Tiny Scholars World	224 Brick Church Rd	New Hempstead	50
Northeastern & Eastern Town of Clarkstown	8.0	S	Clarkstown Kids	58 Endicott St	Congers	16
Northeastern & Eastern Town of Clarkstown	8.2	S	CCSD Childcare & Early Learning Program	9 Lake Rd	Congers	100
Northeastern & Eastern Town of Clarkstown	10.2	S	Playgarten Pre-school	58 Lake Rd	Valley Cottage	90
Northwestern Town of Clarkstown	7.5	SSW	Prime Time For Kids	70 Phillips Hill Rd	New City	120
Village of Haverstraw	4.9	SSW	BOCES Hilltop School	20 George St	Haverstraw	106
Village of Haverstraw	4.9	S	Haverstraw Head Start 3	39 Division St	Haverstraw	17
Village of Haverstraw	5.0	S	Haverstraw Head Start 2	36 Division St	Haverstraw	36
Village of Haverstraw	5.1	SSW	Haverstraw Daycare	212 US-9W	Haverstraw	62
Village of Haverstraw	5.3	S	Haverstraw Head Start 1	138-146 Maple Ave	Haverstraw	105
Village of West Haverstraw	4.2	SSW	The Jan & Niles Davies Learning Center	51-55 US-9W	West Haverstraw	137
Village of West Haverstraw	4.4	SSW	Learning Ladder Child Care Center	18 N US-9W	West Haverstraw	90
Village of West Haverstraw	5.0	SSW	Haverstraw Daycare Learning Center	71 US-9W Suite 1	West Haverstraw	89
Village of West Haverstraw	5.1	SSW	Building Blocks Day Care	52 Main St	Garnerville	55
Stony Point	3.5	SSW	Children of America	32 S Liberty Dr	Stony Point	85
Shadow Region	10.6	SSW	Busy Bee Play School	39 Germonds Rd	New City	105
Rockland County Subtotal:						2,576

Protective Action Area	Distance (miles)	Direction	School Name WESTCHESTER COUNTY	Street Address	Municipality	Enrollment
Briarcliff Manor	9.9	SSE	Children's Corner Learning Center	325 S Highland Ave	Briarcliff Manor	129
Briarcliff Manor	10.0	SE	Young Wonders	446 N State Rd	Briarcliff Manor	96
Briarcliff Manor	10.2	SE	Menon, Rajashree	292 N State Rd	Briarcliff Manor	8
Briarcliff Manor	10.4	SSE	Scarborough Presbyterian Children's Center	671 Scarborough Rd	Scarborough	57
Briarcliff Manor	10.8	SE	Garden House School of Briarcliff	25 S State Rd	Briarcliff Manor	37
Briarcliff Manor	10.9	SE	Family YMCA at Tarrytown	45 Ingham Rd	Briarcliff Manor	104
Briarcliff Manor	11.1	SE	Defino, Anne	17 Oak Rd	Briarcliff Manor	8
Ossining Town & Village	7.8	SE	All Aboard on the Hudson	255 N Highland Ave	Ossining	206
Ossining Town & Village	8.2	SE	Family YMCA at Tarrytown	2 Claremont Rd	Ossining	60
Ossining Town & Village	8.2	SE	Healthy Kids Extended Day Program	2 Claremont Rd	Ossining	40
Ossining Town & Village	8.3	SE	A Journey By Faith DayCare	Bracken Rd	Ossining	8
Ossining Town & Village	8.5	SE	Kelly's Kids Family Childcare LLC	34 Pershing Ave	Ossining	16
Ossining Town & Village	8.5	SSE	Westcop St Matthew's Head Start	50 No. Malcolm St	Ossining	54
Ossining Town & Village	8.5	SE	123 Steps Day Care	81 Ferris Pl	Ossining	8
Ossining Town & Village	8.7	SE	Salazar, Lorenza	24 Park Ave	Ossining	8
Ossining Town & Village	8.8	SSE	Rose's Friendly Play and Learn Corp.	10 Prospect Pl	Ossining	16
Ossining Town & Village	8.8	SSE	St. Ann's Peas and Karrots	16 Elizabeth St	Ossining	264
Ossining Town & Village	8.9	SE	Healthy Kids Extended Day Program Inc.	30 Ryder Rd	Ossining	60
Ossining Town & Village	9.0	SE	Healthy Kids Extended Day Program	190 Croton Ave	Ossining	20
Ossining Town & Village	9.0	SSE	Ossining Children's Center Inc.	3 Emwilton Pl	Ossining	80
Ossining Town & Village	9.2	SSE	Park Early Childhood Center	22 Edwards St	Ossining	40
Ossining Town & Village	9.2	SSE	Ossining Children's Center Inc	90 S Highland Ave	Ossining	71
Ossining Town & Village	9.2	SSE	Ossining Children's Center #4	92 S Highland Ave	Ossining	41
Ossining Town & Village	9.7	SSE	Corrales, Grace	46 Revolutionary Rd	Ossining	8
Ossining Town & Village	9.8	SE	For Kids Only, Inc.	577 N State Rd	Briarcliff Manor	74
Ossining Town & Village	9.9	SE	Berlow's Taekwondo Academy Inc.	528 N State Rd	Briarcliff Manor	60
Town of New Castle (W. of Hardscrabble Rd)	7.4	SE	Sunshine RN, PT, OT, SLP & Psychology, PLLC	15 Spring Valley Rd	Ossining	48
Town of New Castle (W. of Hardscrabble Rd)	10.0	ESE	Chappaqua Children's Workshop, Inc.	25 Granite Rd W	Chappaqua	20
Croton-on-Hudson	5.4	SE	Holy Name Of Mary Montessori School	110 Grand St	Croton-on-Hudson	48
Croton-on-Hudson	5.5	SE	Happy Hearts On The Hudson Inc.	10 Old Post Rd S	Croton-on-Hudson	144
Croton-on-Hudson	5.5	SE	Childrenspace	119 Maple St	Croton-on-Hudson	30

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
Croton-on-Hudson	5.6	SE	Vergara, Nadine	102 Maple St	Croton-on-Hudson	14
Croton-on-Hudson	5.7	SE	Childrenspace Inc.	3 Glen Pl	Croton-on-Hudson	60
Croton-on-Hudson	5.7	SE	Childrenspace, Inc.	10 Gerstein Dr	Croton-on-Hudson	125
Croton-on-Hudson	5.7	SE	Johnson, Tabitha	15 Gerstein St	Croton-on-Hudson	14
Buchanan	0.7	SSE	The Mother Connection of Cortlandt, Inc.	160 Westchester Ave	Buchanan	40
Buchanan	0.8	ESE	Play & Learn Daycare	3201 Albany Post Rd	Buchanan	8
Montrose	1.4	SE	The Mother Connection of Cortlandt, Inc.	57 Trolley Rd	Montrose	63
Montrose	1.7	SE	Premier Athletic Club Camp	2127 Albany Post Rd	Montrose	29
Montrose	1.8	SE	Mt. Airy Montessori School	2124 Albany Post Rd	Montrose	38
City of Peekskill	1.2	ENE	McKinley Street Daycare	846 McKinley St	Peekskill	7
City of Peekskill	1.5	ENE	Personal Touch Child Care Service	640 Ringgold St	Peekskill	18
City of Peekskill	1.6	NE	Angels Daycare Program, Inc	345 Simpson Pl	Peekskill	16
City of Peekskill	1.6	ENE	Healthy Kids Extended Day Program (Woodside)	702 Depew St	Peekskill	40
City of Peekskill	1.7	NE	Kidz On The Go Family Daycare, Inc.	157 Hudson Ave	Peekskill	16
City of Peekskill	1.9	NE	Westcop Peekskill Day Care Center	705 S St	Peekskill	64
City of Peekskill	2.0	NE	Tees Little Bees	613 Belden St	Peekskill	16
City of Peekskill	2.1	NE	Westcop Aunt Bessies Open Door	137 Union Ave	Peekskill	45
City of Peekskill	2.2	NE	Healthy Kids Extended Day Program Inc.	200 Decatur Ave	Peekskill	60
City of Peekskill	2.2	NE	Little Kings & Queens Day Care, Inc.	822 Paulding St	Peekskill	14
City of Peekskill	2.5	NE	Under My Wings Family Daycare Inc.	517 Harrison Ave	Peekskill	16
City of Peekskill	2.6	ENE	Jump For Joy Day Care Center II	501 Georgian Ct	Peekskill	16
City of Peekskill	2.6	ENE	Jump for Joy Day Care Center Inc.	400 Georgian Ct	Peekskill	16
City of Peekskill	2.7	NE	Bond, Sandra	635 N Division St	Peekskill	8
City of Peekskill	2.7	NE	Happy Beginning Daycare II	1451 Main St	Peekskill	16
City of Peekskill	2.8	NE	NYS ARC, INC	980 Pemart Ave	Peekskill	15
City of Peekskill	2.9	NE	ABC Academy	1624 Park St	Peekskill	16
City of Peekskill	2.9	NE	Loving Day Care Services	1692 Larch Ct	Peekskill	16
City of Peekskill	3.0	NE	Healthy Kids Extended Day Program	4 Horton Dr	Peekskill	70
City of Peekskill	3.0	NE	Under My Wings Family Day Care Inc.	715 Kossuth Pl	Peekskill	16
City of Peekskill	3.0	ENE	Little Kings and Queens Inc	1825 Crompond Rd	Peekskill	16
City of Peekskill	3.1	NE	J & B Day Care	820 Oakwood Dr	Peekskill	8
City of Peekskill	3.4	ENE	Child's World Academy Child Care Center	50 Dayton Ln	Peekskill	151
City of Peekskill	3.4	ENE	Lil' Sprouts Early Learning Center	1821 E Main St	Peekskill	85

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
City of Peekskill	3.5	NE	Nana's Place Child Care, Inc.	165 Benefield Blvd	Peekskill	16
Town of Cortlandt	2.5	SSE	Montrose Child Care Center	138 Albany Post Rd	Montrose	61
Town of Cortlandt	3.3	ESE	The Mother Connection of Cortlandt, Inc.	239 Watch Hill Rd	Cortlandt Manor	80
Town of Cortlandt	3.5	NNE	Happy Tots Child Care, Inc.	18 Radio Terrace	Cortlandt Manor	83
Town of Cortlandt	3.7	ENE	Little Kings & Queens Day Care Inc	7 Sonoma Rd	Cortlandt Manor	16
Town of Cortlandt	3.7	NE	Julie's Little School	82-A Oregon Rd	Cortlandt Manor	12
Town of Cortlandt	3.8	ENE	Monge, Cindy	4 Northridge Rd	Cortlandt Manor	16
Town of Cortlandt	4.2	E	A Rising Star Children's Center	29 William Puckey Dr	Cortlandt Manor	17
Town of Cortlandt	4.4	NE	Reliable Learning	1050 Oregon Rd	Cortlandt Manor	46
Town of Cortlandt	4.7	ENE	Lakeland Children's Center, Inc.	10 Lincoln Ave	Crompond	114
Town of Cortlandt	5.0	NE	Children of America Mohegan Lake, LLC	3093 E Main St	Mohegan Lake	188
Town of Cortlandt	5.1	ENE	Lamberti, Marilena	108 Baron De Hirsch Rd	Crompond	14
Town of Cortlandt	5.1	NE	Lakeland Children's Center, Inc.	3100 E Main St	Mohegan Lake	116
Town of Cortlandt	5.2	ENE	Morning Star Day Care	18 N First St	Cortlandt Manor	22
Town of Cortlandt	6.4	SE	Miles, Dea	16 Teatown Rd	Croton-on-Hudson	8
Yorktown	5.4	E	The Early Learning Center at Fieldhome	2300 Catherine St	Cortlandt Manor	30
Yorktown	6.0	NE	Tom Thumb Campus	1949 E Main St	Mohegan Lake	167
Yorktown	6.0	ENE	Little Learners of Westchester, Inc.	3565 Crompond Rd	Cortlandt Manor	47
Yorktown	6.1	NE	Lakeland Children's Center, Inc.	3634 Lexington Ave	Mohegan Lake	116
Yorktown	6.2	NE	Strawberry Early Childhood Development Center	1770 Strawberry Rd	Mohegan Lake	81
Yorktown	6.3	NE	The Learning Experience	3555 Mohegan Ave	Mohegan Lake	141
Yorktown	6.7	E	Our Montessori School Stepping St. Program	1243 Whitehill Rd	Yorktown Heights	20
Yorktown	7.5	ENE	Growing Hearts Daycare LLC	2838 Larkspur St	Yorktown Heights	16
Yorktown	7.7	ENE	Lakeland Children's Center, Inc.	3477 Kamhi Dr	Yorktown Heights	68
Yorktown	7.7	ENE	The Little Red House of Westchester LLC	2754 Old Yorktown Rd	Yorktown Heights	16
Yorktown	8.0	ENE	Lakeland Children's Center, Inc.	3401 Old Yorktown Rd	Yorktown Heights	60
Yorktown	8.2	ENE	Enrichment Center of Yorktown, Inc.	590 Waverly Rd	Yorktown Heights	60
Yorktown	8.3	E	Grow With Grace Day Care, Inc.	514 Yorkhill Rd	Yorktown Heights	16
Yorktown	8.4	E	Fidelio, Caterina	1814 French Hill Rd	Yorktown Heights	16
Yorktown	8.5	E	Children's Corner Learning Center	2051 Baldwin Rd	Yorktown Heights	195
Yorktown	8.5	E	The Seed Day Care Center	2084 Baldwin Rd	Yorktown Heights	87
Yorktown	8.5	ENE	Kidz Time Daycare	2613 Ridge St	Yorktown Heights	8

Protective Action Area	Distance (miles)	Direction	School Name	Street Address	Municipality	Enrollment
Yorktown	8.5	ENE	Deb's Day Care	2541 Ridge St	Yorktown Heights	16
Yorktown	8.6	E	Pied Piper School	2090 Crompond Rd	Yorktown Heights	66
Yorktown	8.8	ESE	Country Children's Center	862 Kitchawan Rd	Ossining	68
Yorktown	8.9	E	The Little Red House of Westchester, LLC	333 Kear St	Yorktown Heights	16
Yorktown	8.9	E	Bright Beginnings	1974 Commerce St	Yorktown Heights	59
Yorktown	8.9	E	Enrichment Center of Yorktown, Inc.	1974 Commerce St	Yorktown Heights	40
Yorktown	8.9	E	Westcop Yorktown Heights Headstart	1974 Commerce St	Yorktown Heights	63
Yorktown	8.9	ENE	Wiggles 'N' Giggles Daycare	2731 Hedwig Dr	Yorktown Heights	14
Yorktown	9.0	ENE	Child Care of Yorktown Inc.	374 Granite Springs Rd	Yorktown Heights	16
Yorktown	9.0	E	Yorktown Community Nursery School	247 Veterans Rd	Yorktown Heights	32
Yorktown	9.0	ESE	Country Children's Center	823 Pinesbridge Rd	Yorktown Heights	44
Yorktown	9.1	E	The Goddard School	62 Triangle Center	Yorktown Heights	144
Yorktown	9.5	ENE	Lakeland Children's Center, Inc.	3636 Gomer St	Yorktown Heights	93
Yorktown	9.6	ENE	Amuso, Beatriz	3452 Flanders Dr	Yorktown Heights	8
Yorktown	9.9	ENE	Creative Kids Enrichment LLC.	2985 Navajo St	Yorktown Heights	148
Town of Somers (W. of Route 118)	9.9	E	Milo's Play School	47 Mahopac Ave	Amawalk	16
Town of Somers (W. of Route 118)	10.3	ENE	Westcop Therapeutic Nursery and Head Start	6 Old Tomahawk St	Yorktown Heights	64
Town of Somers (W. of Route 118)	10.8	ENE	Yorktown Assembly of God Sonshine Preschool & Day School	253 Mahopac Ave	Yorktown Heights	61
Town of Somers (W. of Route 118)	10.9	ENE	Tender Care of New York, Inc.	8 Granite Springs Rd	Granite Springs	16
Town of Somers (W. of Route 118)	11.0	ENE	The Learning Garden Day Care Center, Inc	141 Tomahawk St	Yorktown Heights	142
Town of Somers (W. of Route 118)	11.1	ENE	Westcop Therapeutic Nursery and Head Start	6 Old Tomahawk St	Granite Springs	64
Westchester County Subtotal:						6,158
EPZ TOTAL:						9,267

Table E-4. Day Camps within the EPZ

Protective Action Area	Distance (miles)	Dire- ction	Camp Name	Street Address	Municipality	Enroll- ment
ORANGE COUNTY						
Harriman State Park	6.9	W	Day Camp In the Park	556 Tiorati Brooke Rd	Harriman	450
Harriman State Park	8.3	W	Camp Makeeya	Lake Cohasset	Tuxedo Park	280
Orange County Subtotal:						730
PUTNAM COUNTY						
Southwest Carmel	10.9	ENE	Noah's Ark Summer Camp	250 NY-6N	Mahopac	54
Lower Philipstown	5.5	N	Manitoga Nature Camp	584 NY-9D	Garrison	70
Southern Putnam Valley	6.1	NE	Pine Grove Summer Camp	47 Peekskill Hollow Rd	Putnam Valley	85
Southern Putnam Valley	6.7	NE	Putnam Valley Summer Camp	142 Peekskill Hollow Rd	Putnam Valley	70
Southern Putnam Valley	6.9	NE	Camp Floradan	10 Floradan Rd	Putnam Valley	265
Southern Putnam Valley	7.5	NE	John V Mara Park	197 Peekskill Hollow Rd	Putnam Valley	380
Southern Putnam Valley	10.9	NNE	Eden Village Camp	392 Dennytown Rd	Putnam Valley	175
Southern Philipstown	8.9	N	St Basil Academy Main Office	79 St Basil Rd	Garrison	30
Southern Philipstown	10.2	N	The Nest Summer Camp	44 Chestnut St	Cold Spring	58
Putnam County Subtotal:						1,187
ROCKLAND COUNTY						
Central Town of Clarkstown	7.7	SSW	Camp Clarkstown - Woodglen	121 Phillips Hill Rd	Clarkstown	230
Central Town of Clarkstown	8.4	SSW	Camp Clarkstown - Little Tor Elem.	56 Gregory St	Clarkstown	100
Central Town of Clarkstown	8.4	S	Camp Clarkstown - New City Elem. (Sum Prog)	60 Crestwood Dr	New City	165
Central Town of Clarkstown	8.7	SSW	Candy Mountain Day Camp	420 Phillips Hill Rd	Clarkstown	710
Central Town of Clarkstown	10.1	S	Strawtown Elementary (Summer Prog)	413 Strawtown Rd	West Nyack	120
Central Town of Clarkstown	10.2	S	Felix Festa Middle School Campus	30 Parrott Rd	West Nyack	250
Northeastern Town of Ramapo	8.8	SW	Pomona Jr. High School (Middle school)	104 Pomona Rd	Suffern	112
Northeastern Town of Ramapo	10.0	SW	Deer Kill Day Camp	54 Wilder Rd	Suffern	700
Northeastern Town of Ramapo	10.1	SSW	Champion Day Camp	175 W Clarkstown Rd	Clarkstown	650
Northeastern Town of Ramapo	10.4	SSW	Colton Elementary School	40 Granview Ave	Rockland	112
Northeastern Town of Ramapo	10.8	SW	Grandview Elementary School	151 Grandview Ave	Monsey	112
Northeastern Town of Ramapo	11.0	SW	Robin Hill Day Camp (school)	70 Wesley Chapel Rd	Suffern	150
Northeastern & Eastern Town of Clarkstown	7.7	S	Camp Clarkstown - Lakewood Elem (Sum Prog)	77 Lakeland Ave	Congers	183
Northeastern & Eastern Town of Clarkstown	10.2	S	Playgarten	58 Lake Rd	Valley Cottage	158

Protective Action Area	Distance (miles)	Direction	Camp Name	Street Address	Municipality	Enrollment
Northwestern Town of Clarkstown	7.5	SSW	Camp Gan Israel of Rockland	N Main St & Phillips Hill Rd	Clarkstown	118
Village of Haverstraw	5.1	S	Village of Haverstraw Day Camp	40 New Main St	Haverstraw	330
Village of Pomona	7.6	SW	Cavaliers Summer Day Camp(Cavaliers Athletic Club)	113 Calls Hollow Rd	Pomona	175
Village of Pomona	7.7	SW	Deer Mountain Day Camp	63 Calls Hollow Rd	Pomona	1,050
Village of Pomona	8.3	SW	Camp Ramaquouis	30 Mountain Rd	Pomona	1,100
Village of Pomona	8.4	SW	Camp Fun For Girls B.Y.C.C.	44 Camp Hill Rd	Ramapo	250
Village of Pomona	8.7	SW	A-Rave-M Camp	656 USHY 306 & US-202	Pomona	172
Grassy Point	4.0	S	Haverstraw Bay (County Park)	Beach Rd & Grassy Point Rd	Haverstraw	50
Stony Point	3.1	WSW	Camp Bullowa	15 Franck Rd	Stony Point	225
Stony Point	3.3	SSW	Stony Point Day Camp	74 E Main St	Rockland	228
Stony Point	4.4	SW	Camp Don Bosco	174 Filors Ln	Stony Point	181
Tompkins Cove	3.2	W	Camp Addison Boyce	30 Mott Farm Rd	Tompkins Cove	220
Harriman State Park	5.2	WSW	Gate Hill Day Camp	750 Gate Hill Rd	Stony Point	620
Shadow Region	11.1	S	Camp Ramah	299 Christian Herald Rd	Nyack	800
Rockland County Subtotal: 9,271						
WESTCHESTER COUNTY						
Ossining Town & Village	8.2	SE	Ossining Rec @ Claremont ²	Claremont Rd	Ossining	N/A
Ossining Town & Village	8.5	SE	Ossining Rec @ Veterans Park	Narragansett Ave	Ossining	87
Ossining Town & Village	8.6	SSE	Ossining Rec After School Day Camp	95 Broadway	Ossining	46
Ossining Town & Village	9.6	SE	Ossining Rec @ Ryder Park	Morningside Dr	Ossining	160
Town of New Castle (W. of Hardscrabble Rd)	8.6	SE	Camp Adventure ²	Hoags Cross Rd	Ossining	N/A
Croton-on-Hudson	5.7	SE	Tiny Tots Day Camp	3 Glen Pl	Croton-on-Hudson	192
Montrose	1.3	SE	Cortlandt Rec 5th & 6th Camp	2166 Albany Post Rd	Montrose	90
City of Peekskill	1.6	NE	Peekskill Rec Teen Travel	36 Hudson Ave	Peekskill	92
City of Peekskill	1.9	NE	Peekskill Rec Day Camp	212 Ringgold St	Peekskill	390
Town of Cortlandt	5.6	ESE	Young Judaea Sprout Westchester Day Camp ²	500 Yorktown Rd	Cortlandt Manor	N/A
Yorktown	6.3	ENE	Camp Nabby	1 Nabby Hill	Mohegan Lake	570
Yorktown	7.6	ESE	Teatown Lake Reservation Natural SCI ²	341 Illington Rd	Ossining	N/A
Yorktown	7.7	ENE	Yorktown Rec Lakeland Day Camp	3149 Kamhi Dr	Yorktown Heights	196

² Data for these day camps are unavailable.

Protective Action Area	Distance (miles)	Direction	Camp Name	Street Address	Municipality	Enrollment
Yorktown	8.5	E	Yorktown Rec Full Day Camp ²	2051 Baldwin Rd	Yorktown Heights	N/A
Yorktown	8.7	ENE	Club Fit Sports Summer Camp	600 Bank Rd	Jefferson Valley	24
Yorktown	9.5	E	Yorktown Rec Half Day Camp ²	99 Moseman Rd	Yorktown Heights	N/A
Town of Somers (W. of Route 118)	10.2	ENE	Summer Trails Day Camp	93 Mahopac Ave	Granite Springs	560
Westchester County Subtotal:						2,407
EPZ TOTAL:						13,595

Table E-5. Medical Facilities within the EPZ

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
PUTNAM COUNTY										
Lower Philipstown	5.3	NNE	Franciscan Sisters-Atonement	41 Old Highland Tpke	Garrison	80	80	58	22	0
Lower Philipstown	5.5	NNE	St Christopher's Inn Inc	21 Franciscan Way	Garrison	177	130	130	0	0
Southern Putnam Valley	7.5	NE	Blair Lodge	Peekskill Hollow Rd	Putnam Valley	50	50	50	0	0
Southern Philipstown	6.1	NNE	St. Paul's Friary of the Atonement	Old W Point Rd E	Garrison	100	100	100	0	0
Southern Philipstown	6.2	NNE	Mother Lurana House	166 Old W Point Rd E	Garrison	10	6	6	0	0
Southern Philipstown	8.2	N	Walter Hoving Home	40 Walter Hoving Rd	Garrison	75	75	75	0	0
Putnam County Subtotal:						492	441	419	22	0
ROCKLAND COUNTY										
Central Town of Clarkstown	7.6	SSW	Rockland ARC: Prime Time for Kids	60 Phillips Hill Rd	New City	160	130	126	4	0
Northeastern Town of Ramapo	8.8	SSW	Rockland County Adult Home	50 Sanatorium Rd	Pomona	41	23	23	0	0
Northeastern Town of Ramapo	8.8	SSW	Rockland County Infirmary/Summit Park Hospital	50 Sanatorium Rd	Pomona	57	52	5	39	8
Northeastern Town of Ramapo	9.0	SSW	Summit Park Hospital & Nursing	50 Sanatorium Rd	Pomona	341	341	259	77	5
Northeastern Town of Ramapo	9.3	SSW	Friedwald Center for Rehabilitation & Nursing Inc.	475 New Hempstead Rd	New City	180	180	40	140	0

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
Northeastern Town of Ramapo	9.8	SW	Keahon House / Loeb House Inc.	17 Skyline Terrace	Wesley Hills	12	12	12	0	0
Northeastern Town of Ramapo	9.8	SSW	L'Dor Adult Home (was Laurel Manor)	156 W Clarkstown Rd	New City	44	44	44	0	0
Northeastern Town of Ramapo	10.2	SSW	Pine Valley Center for Rehabilitation and Nursing	661 N Main St	Spring Valley	200	206	78	116	12
Northeastern & Eastern Town of Clarkstown	7.4	S	Rockland ARC (Day Hab)	25 Hemlock Dr	Congers	612	610	569	41	0
Northeastern & Eastern Town of Clarkstown	10.1	S	Tolstoy Foundation Adult Home	104 Lake Rd	Valley Cottage	42	10	10	0	0
Northeastern & Eastern Town of Clarkstown	10.1	S	Tolstoy Foundation Nursing Home Cottage	100 Lake Rd	Valley Cottage	96	86	7	79	0
Northeastern & Eastern Town of Clarkstown	10.6	S	Nyack Manor Nursing Home	470 Christian Herald Rd	Valley Cottage	160	146	112	34	0
Northwestern Town of Clarkstown	7.4	SSW	Joe Raso Hospice Residence	415 Buena Vista Rd	New City	10	10	6	3	1
Northwestern Town of Clarkstown	7.9	SSW	Squadron Gardens	20 Squadron Blvd	New City	100	125	120	3	2
Village of Haverstraw	5.2	SSW	Warren Knolls Apartments	500 Warren Knolls Dr	Haverstraw	96	96	96	0	0
Village of Haverstraw	5.2	SSW	Northern Riverview Healthcare	87 Rte 9W	Haverstraw	180	160	10	140	10
Village of Haverstraw	5.3	S	Green Hills Estate Home for Adults	1 Rte 9W	Haverstraw	164	164	164	0	0
Village of West Haverstraw	4.5	SSW	Helen Hayes Hospital	51 US-9W	West Haverstraw	283	283	164	103	16
Village of West Haverstraw	4.5	SSW	Walnut Hill Apts.	W Railroad Ave & US-9W	West Haverstraw	180	180	180	0	0
Unincorporated Areas of the Town of Haverstraw	5.2	SW	Venture North	80 Suffern Ln	Thiells	13	12	12	0	0
Stony Point	3.0	SSW	Sopko Apartments	1 Knights Corner	Stony Point	75	75	75	0	0
Rockland County Subtotal:						3,046	2,945	2,112	779	54
WESTCHESTER COUNTY										
Briarcliff Manor	9.3	SE	NYS Arc Westchester County Chapter	86 Macy Rd	Briarcliff	7	7	5	1	1

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
Briarcliff Manor	9.8	SE	Community-Based Services (ICS) Group Home	129 Willow Dr	Briarcliff Manor	10	10	7	2	1
Briarcliff Manor	10.2	SE	The Club at Briarcliff Manor	25 Scarborough Rd	Briarcliff Manor	162	100	75	15	10
Briarcliff Manor	10.3	SE	Hudson Valley Developmental Disabilities Services Office	90 Saw Mill River Rd	Briarcliff Manor	12	12	9	2	1
Briarcliff Manor	10.8	SE	Atria Briarcliff Manor	1025 Pleasantville Rd	Briarcliff Manor	185	93	70	14	9
Briarcliff Manor	11.0	SSE	Hudson Valley Developmental Disabilities Services Office	510 NY-9	Briarcliff Manor	10	10	7	2	1
Briarcliff Manor	11.6	SSE	Briarcliff Manor Center For Rehabilitation And Nursing	620 Sleepy Hollow Rd	Briarcliff Manor	131	105	78	16	11
Ossining Town & Village	6.6	SE	NYS Arc Westchester County Chapter	7 Riverview Farm Rd	Ossining	7	7	5	1	1
Ossining Town & Village	6.8	SE	Young Adult Institute, Inc.	16 Waterview Dr	Ossining	6	6	4	1	1
Ossining Town & Village	7.4	SE	Ossining Group Home	185 Cedar Ln	Ossining	8	8	6	1	1
Ossining Town & Village	7.6	SE	Atria On The Hudson	321 N Highland Ave	Ossining	185	101	76	15	10
Ossining Town & Village	7.7	SE	Cardinal McCloskey School And Home For Children	4 Locust Rd	Ossining	5	5	3	1	1
Ossining Town & Village	7.8	SE	Opengate, Inc.	36 McCarthy Dr	Ossining	9	9	7	1	1
Ossining Town & Village	7.8	SE	Hawthorne Foundation, Inc.	2 Audubon Dr	Ossining	4	4	3	1	0
Ossining Town & Village	7.8	SE	Cedar Manor Nursing & Rehabilitation Center	32 Cedar Ln	Ossining	153	123	93	18	12
Ossining Town & Village	7.8	SE	NYS Arc Westchester County Chapter	238 N Highland Ave	Ossining	28	28	21	4	3
Ossining Town & Village	8.3	SE	Community-Based Services	14 Hawkes Close	Ossining	8	7	5	1	1
Ossining Town & Village	8.6	SE	Hudson Valley Developmental Disabilities Services Office	47 Narragansett Ave	Ossining	10	10	7	2	1
Ossining Town & Village	8.7	SE	Bethel Nursing Home Company Inc	17 Narragansett Ave	Ossining	79	36	27	5	4
Ossining Town & Village	8.9	SSE	Senior Services At Maple House	15 Maple Pl	Ossining	25	25	18	4	3
Ossining Town & Village	9.0	SSE	NYS Arc Westchester County Chapter	94 Hunter St	Ossining	2	2	2	0	0
Ossining Town & Village	9.1	SE	Hawthorne Foundation, Inc.	53 Somerstown Rd	Ossining	6	6	4	1	1
Ossining Town & Village	9.1	SSE	Faith Adult Home	141 Spring St	Ossining	14	14	10	2	2

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
Ossining Town & Village	9.2	SE	Richmond Children's Center, Inc.	14 Donald Ln	Ossining	6	6	4	1	1
Ossining Town & Village	9.7	SSE	Ferncliff Manor, Inc.	64 Revolutionary Rd	Ossining	4	4	3	1	0
Ossining Town & Village	9.8	SE	Artis Senior Living of Briarcliff Manor	553 N State Rd	Briarcliff Manor	64	15	11	2	2
Town of New Castle (W. of Hardscrabble Rd)	7.4	SE	Sunshine Children's Home and Rehab Center	15 Spring Valley Rd	Ossining	54	55	41	8	6
Town of New Castle (W. of Hardscrabble Rd)	9.7	ESE	Another Step, Inc.	112 Millwood Rd	Millwood	3	3	3	0	0
Croton-on-Hudson	4.4	SSE	Sky View Rehabilitation & Health Care	1280 Albany Post Rd	Croton-on-Hudson	192	177	132	27	18
Croton-on-Hudson	5.1	SE	The Institutes of Applied Human Dynamics, Inc.	1 Mt Green Rd	Croton-on-Hudson	7	7	5	1	1
Croton-on-Hudson	5.9	SE	NYS Arc Westchester County Chapter	87 Old Post Rd S	Croton-on-Hudson	9	9	7	1	1
Buchanan	1.0	SE	Community-Based Services	197 Henry St	Buchanan	10	10	5	5	0
Buchanan	1.3	SSE	Ability Beyond Disability	113 Burke Ct	Buchanan	7	7	5	1	1
City of Peekskill	0.9	NE	Abbott House	2 John Walsh Blvd	Peekskill	25	25	18	4	3
City of Peekskill	0.9	NE	NYS Arc Westchester County Chapter	2 John Walsh Blvd	Peekskill	33	33	25	5	3
City of Peekskill	1.3	NE	Mt. St. Francis & Franciscan Sisters	250 S St	Peekskill	32	32	28	2	2
City of Peekskill	1.3	NE	Richmond Children's Center, Inc.	622 Mountain View Rd	Peekskill	6	6	4	1	1
City of Peekskill	2.2	NE	Waterbury Manor Group Home	46 Waterbury Pkwy	Peekskill	6	6	4	1	1
City of Peekskill	2.6	NNE	NYS Arc Westchester County Chapter	3 Pemart Ave	Peekskill	6	6	4	1	1
City of Peekskill	2.9	ENE	NYS Arc Westchester County Chapter	1701 Crompond Rd	Peekskill	2	2	2	0	0
City of Peekskill	2.9	ENE	Community Living Corporation	78 Villa at the Woods	Peekskill	1	1	1	0	0
City of Peekskill	3.2	ENE	Community Living Corporation	1879 Crompond Rd	Peekskill	9	9	7	1	1
City of Peekskill	3.4	NE	The Institutes of Applied Human Dynamics, Inc.	1 Stacey Ct	Peekskill	6	6	4	1	1

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
City of Peekskill	3.5	ENE	The Emerald Peek Rehabilitation & Nursing Center	2000 E Main St	Peekskill	100	91	68	14	9
City of Peekskill	3.6	ENE	NYS Arc Westchester County Chapter	4 Poplar Cir	Peekskill	3	3	3	0	0
City of Peekskill	3.7	NE	Community Living Corporation	26 Huntington Cir	Peekskill	2	2	2	0	0
City of Peekskill	3.7	NE	Community Living Corporation	34 Huntington Cir	Peekskill	3	3	3	0	0
City of Peekskill	3.7	NE	Community Living Corporation	14 Nottingham Cir	Peekskill	3	3	3	0	0
City of Peekskill	3.7	NE	Community Living Corporation	2 Edinburgh Dr	Peekskill	3	3	3	0	0
City of Peekskill	3.7	NE	Community Living Corporation	5 Edinburgh Dr	Peekskill	3	3	3	0	0
City of Peekskill	3.7	NE	Community Living Corporation	12 Edinburgh Dr	Peekskill	2	2	2	0	0
City of Peekskill	3.7	NE	Community Living Corporation	14 Edinburgh Dr	Peekskill	2	2	2	0	0
City of Peekskill	3.7	ENE	Community Living Corporation	7 Redtwig Ct	Peekskill	3	3	3	0	0
Town of Cortlandt	2.4	SSE	New York State Veterans Home at Montrose	2090 Albany Post Rd	Montrose	252	184	138	28	18
Town of Cortlandt	2.4	SSE	VA Hudson Valley Healthcare System Montrose	2094 Albany Post Rd	Montrose	252	252	186	38	28
Town of Cortlandt	2.8	SSE	Bethel Nursing & Rehabilitation Center	67 Springvale Rd	Croton-on-Hudson	200	130	97	20	13
Town of Cortlandt	2.9	ESE	Special Citizens Futures Unlimited, Inc.	106 Watch Hill Rd	Cortlandt Manor	8	8	6	1	1
Town of Cortlandt	2.9	ESE	Special Citizens Futures	106 Watch Hill Rd	Cortlandt Manor	8	8	6	1	1
Town of Cortlandt	3.0	ENE	Hawthorne Foundation, Inc.	287 Lafayette Ave	Cortlandt	6	6	4	1	1
Town of Cortlandt	3.0	SE	The Springvale Inn	62 Springvale Rd	Croton-on-Hudson	125	62	47	9	6
Town of Cortlandt	3.3	ENE	Hudson Valley Hospital Center	1980 Crompond Rd	Cortlandt Manor	128	93	70	14	9
Town of Cortlandt	3.5	NNE	Cardinal McCloskey School And Home For Children	15 Susan Ln	Cortlandt Manor	6	5	5	0	0
Town of Cortlandt	3.5	SE	Ferncliff Manor, Inc.	84C Furnace Dock Rd	Croton-on-Hudson	5	5	3	1	1
Town of Cortlandt	3.7	NE	Abbott House	22 Fox Hill Rd	Cortlandt Manor	6	6	4	1	1
Town of Cortlandt	3.8	NE	Cardinal McCloskey School And Home For Children	46 Waterbury Pkwy	Cortlandt Manor	6	6	4	1	1
Town of Cortlandt	3.8	NE	Cortlandt Healthcare	110 Oregon Rd	Peekskill	120	112	84	17	11

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
Town of Cortlandt	3.8	E	NYS Arc Westchester County Chapter	17 Shaw Highway	Cortlandt Manor	9	9	7	1	1
Town of Cortlandt	4.1	ENE	Richmond Children's Center, Inc.	36 Rick Ln	Cortland Manor	6	6	4	1	1
Town of Cortlandt	4.5	NE	Ability Beyond Disability	269 Millington Rd	Cortlandt Manor	6	6	4	1	1
Town of Cortlandt	4.6	NNE	NYS Arc Westchester County Chapter	102-A Gallows Hill Rd	Cortlandt Manor	6	6	4	1	1
Town of Cortlandt	5.1	ENE	Hawthorne Foundation, Inc.	68 Baron De Hirsch Rd	Crompond	5	5	3	1	1
Town of Cortlandt	5.1	E	Hudson Valley Developmental Disabilities Services Office	455 Croton Ave	Cortlandt Manor	7	7	5	1	1
Town of Cortlandt	5.4	ENE	Richmond Children's Center, Inc.	2820 Lexington Ave	Mohegan Lake	6	6	4	1	1
Town of Cortlandt	5.7	NE	Abbott House	143 Red Mill Rd	Cortlandt Manor	7	7	5	1	1
Town of Cortlandt	5.8	NE	Community Based Services, Inc.	17 E Hill Rd	Cortlandt Manor	8	8	6	1	1
Town of Cortlandt	6.0	NE	Taconic Innovations, Inc.	3469 Lexington Ave	Mohegan Lake	4	4	3	1	0
Yorktown	5.4	E	Yorktown Assisted Living Residence	2276 Catherine St	Cortlandt Manor	85	49	37	7	5
Yorktown	5.4	E	Yorktown Rehabilitation and Nursing Center	2300 Catherine St	Cortlandt Manor	200	104	78	16	10
Yorktown	5.9	NE	Mohegan Manor	3441 Lexington Ave	Mohegan Lake	150	88	66	13	9
Yorktown	5.9	ENE	NYS Arc Westchester County Chapter	1765 Decatur Rd	Mohegan Lake	7	7	5	1	1
Yorktown	6.0	NE	North Westchester Restorative Therapy and Nursing	3550 Lexington Ave	Mohegan Lake	120	109	82	16	11
Yorktown	6.3	ENE	NYS Arc Westchester County Chapter	2500 Linette Ct	Yorktown	6	6	4	1	1
Yorktown	6.5	ESE	St. Jude Habilitation Inst.	1520 Croton Lake Rd	Croton-on-Hudson	14	8	8	0	0
Yorktown	6.5	ENE	Hudson Valley Developmental Disabilities Services Office	2745 Stoney St	Mohegan Lake	6	6	4	1	1
Yorktown	6.5	ENE	Hudson Valley Developmental Disabilities Services Office	2749 Stoney St	Mohegan Lake	6	6	4	1	1
Yorktown	6.5	ENE	Opengate, Inc.	1480 Florida Rd	Mohegan Lake	4	4	3	1	0

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Patients	Bed-ridden Patients
Yorktown	7.0	NE	Opengate, Inc.	3793 Marcy St	Mohegan Lake	6	6	4	1	1
Yorktown	7.2	ENE	Richmond Children's Center, Inc.	738 E Main St	Shrub Oak	6	6	4	1	1
Yorktown	7.6	ENE	Community Based Services, Inc.	3525 Buckhorn St	Shrub Oak	5	5	3	1	1
Yorktown	7.8	NE	Abbott House	1078 Spillway Rd	Shrub Oak	7	7	5	1	1
Yorktown	8.1	E	Young Adult Institute, Inc.	2346 Vista Ct	Yorktown Heights	6	6	4	1	1
Yorktown	8.4	E	Country House in Westchester	2000 Baldwin Rd	Yorktown Heights	100	55	41	8	6
Yorktown	8.5	E	Beaver Ridge (Senior Housing)	1965 Allan Ave	Yorktown Heights	167	167	123	25	19
Yorktown	8.7	ENE	Community Living Corporation	477 London Rd	Yorktown Heights	7	7	5	1	1
Yorktown	8.7	E	Opengate, Inc.	2043 Crompond Rd	Yorktown Heights	8	8	6	1	1
Yorktown	8.8	E	Community Based Services, Inc.	2127 Ridge St	Yorktown Heights	8	8	6	1	1
Yorktown	9.0	E	Community-Based Services (ICF Autism)	2466 Broad St	Yorktown Heights	10	10	7	2	1
Yorktown	9.1	ESE	Community Living Corporation	304 Jaclyn Ln	Ossining	8	8	6	1	1
Yorktown	9.2	E	Ability Beyond Disability	2319 Brookside Ave	Yorktown	4	4	3	1	0
Yorktown	9.3	ENE	Hudson Valley Developmental Disabilities Services Office	3492 Gomer St	Yorktown Heights	13	13	10	2	1
Yorktown	9.5	E	Hudson Valley Developmental Disabilities Services Office	52 Moseman Rd	Yorktown Heights	8	8	6	1	1
Yorktown	9.5	ENE	Opengate, Inc.	2799 Evergreen St	Yorktown Heights	7	7	5	1	1
Yorktown	9.6	ENE	Community Living Corporation	3610 Curry St	Yorktown	5	5	3	1	1
Town of Somers (W. of Route 118)	9.9	E	Community Living Corporation	34 Moseman Ave	Katonah	8	8	6	1	1
Town of Somers (W. of Route 118)	10.6	ENE	Living Resources Corporation	186 Mahopac Ave	Granite Springs	13	13	10	2	1
Westchester County Subtotal:						3,852	2,941	2,194	439	308
EPZ TOTAL:						7,390	6,327	4,725	1,240	362

Table E-6. Major Employers³ within the EPZ

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Employees (Max Shift)	% Employees Commuting into the EPZ	Employees Commuting into the EPZ	Employee Vehicles Commuting into the EPZ
ORANGE COUNTY									
Various locations throughout the EPZ									
				Orange County Subtotal ⁴ :		4,693	63.3%	2,971	2,803
						4,693	-	2,971	2,803
PUTNAM COUNTY									
No major employers within the Putnam County portion of the EPZ ⁵									
				Putnam County Subtotal:		-	-	-	-
ROCKLAND COUNTY									
Various locations throughout the EPZ									
				Rockland County Subtotal:		14,272	63.3%	9,033	8,522
						14,272	-	9,033	8,522
WESTCHESTER COUNTY									
Various locations throughout the EPZ									
				Westchester County Subtotal ⁶ :		16,120	62.9%	10,145	9,570
						16,120	-	10,145	9,570
				EPZ TOTAL:		35,085	-	22,149	20,895

³ The major employer locations identified by the Census Bureau are shown in Figure E-20. The locations are represented by circles which increase in size proportional to the number of employees commuting into the EPZ in each census block.

⁴ As per the emergency management official from the U.S. Military Academy, the academy has 4,693 employees (as of July 2020). The maximum shift employment data supplemented the census block data in Protective Action Area U.S. Military Academy in the Orange County portion of the EPZ.

⁵ Data obtained from the U.S. Census Bureau indicates there are no major employers within the Putnam County portion of the EPZ.

⁶ Based on the data provided by Holtec, IPEC has a maximum of 400 employees in a single shift, and 48% of the employees living outside of the EPZ. This employment data supplemented the census block data in Protective Action Area of Buchanan in the Westchester County portion of the EPZ.

Table E-7. Beaches, Campgrounds and Shopping Centers within the Study Area

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Facility Type	Transients	Vehicles
ORANGE COUNTY								
Shadow Region	9.6	WNW	Woodbury Commons	498 Red Apple Ct	Central Valley	Shopping Center	11,856	4,117
<i>Orange County Subtotal:</i>							11,856	4,117
WESTCHESTER COUNTY								
Croton-on-Hudson	6.0	SE	Silver Lake Park & Beach	198 Truesdale Dr	Croton-on-Hudson	Beach	Local residents only	
Croton-on-Hudson	6.5	SSE	Croton Point Beach	1 Croton Point Ave	Croton-on-Hudson	Beach	1,213	470
Croton-on-Hudson	6.9	SSE	Croton Point Family Campground	Croton Point Ave	Croton-on-Hudson	Campground	243	188
Montrose	1.4	S	Verplanck Riverside Park	250 Kings Ferry Rd	Cortlandt Manor	Campground	52	40
Town of Cortlandt	3.2	SE	Post Road Trailer Park	2038 Albany Post Rd	Croton-on-Hudson	Campground	129	100
Town of Cortlandt	5.1	NE	Cortlandt Town Center	N/A	Cortlandt	Shopping Center	1,548	538
Yorktown	5.8	ENE	Mohegan Colony Association Beach	Oak & High St	Mohegan Lake	Beach	Local residents only	
Yorktown	6.3	ENE	Mohegan Beach Park District	3320 Lakeshore Dr	Mohegan Lake	Beach	Local residents only	
Yorktown	8.6	ENE	Jefferson Valley Mall	650 Lee Blvd	Yorktown Heights	Shopping Center	1,981	688
Yorktown	9.2	ENE	Sparkle Lake	176 Granite Springs Rd	Mohegan Lake	Beach	219	85
<i>Westchester County Subtotal:</i>							5,385	2,109
STUDY AREA TOTAL:							17,241	6,226

Table E-8. Parks within the EPZ

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Transients	Vehicles
ORANGE COUNTY							
Harriman State Park	4.2	WNW	Harriman State Park: Anthony Wayne Rec.	N/A	N/A	8,015	3,455
Harriman State Park	6.3	WNW	Harriman State Park: Silver Mine	Upper Twin Lake (UT-2)	Upper Twin Lake	600	200
Harriman State Park	7.1	W	Harriman State Park: Lake Tiorati Beach	N/A	N/A	2,700	900
Harriman State Park	7.3	WNW	Harriman State Park: Oratam	Lake Kanawauke (K-5 & 13)	Bear Mountain	200	69
Harriman State Park	7.3	WNW	Harriman State Park: Wakoda	Lower Twin Lake (LT-1)	Lower Twin Lake	100	35
Harriman State Park	7.3	WNW	Harriman State Park: Wakonda	Lower Twin Lake (LT-4)	Lower Twin Lake	129	45
Harriman State Park	7.4	WNW	Harriman State Park: Kiwago	Upper Twin Lake (UT-1)	Woodbury	120	42
Harriman State Park	8.6	W	Harriman State Park: Leneloc	N/A	N/A	100	35
Harriman State Park	8.7	W	Harriman State Park: Me-Kee-Ya	Lake Cohasset (C-6)	Bear Mountain	70	24
Harriman State Park	9.5	WSW	Harriman State Park: Michikamo	Lake Cohasset (C-7 & 9)	Bear Mountain	170	59
Orange County Subtotal:						12,204	4,864
ROCKLAND COUNTY							
Northeastern & Eastern Town of Clarkstown	9.2	S	Rockland Lake State Park	N/A	Clarkstown	6,500	1,500
Northeastern & Eastern Town of Clarkstown	10.2	SSE	Nyack Beach State Park	698 N Broadway	Upper Nyack	1,000	50
Northwestern Town of Clarkstown	7.1	SSW	Kennedy - Dells County Park	355 N Main St	New City	150	52
Village of Haverstraw	5.6	SSW	High Tor State Park	417 S Mountain Rd	New City	700	190
Village of Pomona	8.2	SSW	Provident Bank Park	1 Provident Bank Park Dr	Pomona	4,500	1,200
Tompkins Cove	2.3	SSW	Stony Point Battlefield State	44 Battlefield Rd	Stony Point	75	26
Bear Mountain State Park	2.9	NW	Bear Mountain State Park	N/A	Stony Point	2,700	900
Harriman State Park	6.5	WSW	Harriman State Park: Beaver Pond Campground	700 Kanawauke Rd	Pomona	880	220
Harriman State Park	7.6	WSW	Harriman State Park: Lake Welch Beach	800 Kanawauke Rd	Stony Point	8,000	2,500
Harriman State Park	9.0	WSW	Harriman State Park: Camp Ma-He-Tu	N/A	Monroe	163	84
Harriman State Park	10.0	WSW	Harriman State Park: Lake Sebago Beach	7 Lakes Dr	Monroe	5,000	1,246
Harriman State Park	10.5	WSW	Harriman State Park: Sebago Cabin Camp	7 Seven Lakes Dr	Sloatsburg	250	84
Rockland County Subtotal:						29,918	8,052
WESTCHESTER COUNTY							
Ossining Town & Village	6.8	SE	Gerlach Park	N/A	Ossining	200	69
Ossining Town & Village	8.5	SE	Veterans Park	Narragansett Ave	Ossining	400	139

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Transients	Vehicles
Ossining Town & Village	9.6	SE	Ryder Park	Morningside Dr	Ossining	400	139
Montrose	2.1	S	Georges Island Park	N/A	Cortlandt Manor	1,000	347
City of Peekskill	1.2	E	Blue Mountain Trail Lodge	435 Welcher Ave	Peekskill	1,500	521
Town of Cortlandt	5.7	ESE	Croton Gorge Park	RR 129	Cortlandt Manor	900	313
Yorktown	7.3	E	Mohansic Park and Golf Course	1500 Baldwin Rd	Yorktown Heights	340	118
Yorktown	7.6	E	Franklin D Roosevelt State Park	2957 Crompond Rd	Yorktown Heights	2,500	868
Yorktown	7.9	ESE	Camp Kiryas Pupa-Yeshiva Kehilath Yakov	341 Illington Rd	Ossining	222	50
				Westchester County Subtotal:		7,462	2,564
				EPZ TOTAL:		49,584	15,480

Table E-9. Lodging Facilities within the EPZ

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Transients	Vehicles
ORANGE COUNTY							
Bear Mountain State Park	4.2	NW	Bear Mountain Inn - Overlook Lodge	55 Hessian Dr	Highland Falls	48	24
Fort Montgomery	4.9	NNW	Holiday Inn Express Hotel & Suites West Point	1106 US-9W	Fort Montgomery	111	55
Fort Montgomery	4.9	NNW	Bear Mountain Bridge Motel	1041 US-9W	Fort Montgomery	10	5
Village of Highland Falls	6.0	N	FairBridge Inn & Suites at West Point	17 Main St	Highland Falls	69	32
Village of Highland Falls	6.1	N	US Academy Motel	41 Main St	Highland Falls	16	8
Village of Highland Falls	6.5	N	West Point Motel	156 Main St	Highland Falls	65	30
U.S. Military Academy	7.5	N	The Thayer Hotel at West Point	674 Thayer Rd	West Point	292	97
Orange County Subtotal:						611	251
PUTNAM COUNTY							
Southern Philipstown	10.2	N	The Pig Hill Inn	73 Main St	Cold Spring	9	4
Southern Philipstown	11.0	N	Hudson House Inn	2 Main St	Cold Spring	2	1
Putnam County Subtotal:						11	5
ROCKLAND COUNTY							
Northeastern & Eastern Town of Clarkstown	8.3	S	Green Inn Motel On the Lake	65 N US-9W	Congers	30	15
Northeastern & Eastern Town of Clarkstown	8.5	S	Holiday Court Motel	30 N US-9W	Congers	78	39
Northeastern & Eastern Town of Clarkstown	9.0	S	Congress Motel	972 S US-9W	Congers	40	20
Unincorporated Areas of the Town of Haverstraw	5.9	SSW	Rockland Motel	152 US-202	Garnerville	20	10
Stony Point	3.7	SSW	Budget Motor Inn	87 S Liberty Dr	Stony Point	68	34
Rockland County Subtotal:						236	118
WESTCHESTER COUNTY							
Briarcliff Manor	10.7	SE	Camp Andre Clark	550 Old Chappaqua Rd	Briarcliff Manor	134	52
Briarcliff Manor	10.7	SE	Edith Macy Conference Center	550 Old Chappaqua Rd	Briarcliff Manor	45	35
Ossining Town & Village	7.7	SSE	Mariandale Retreat & Conference Center	299 N Highland Ave	Ossining	103	40
Ossining Town & Village	9.2	SE	Bethany Arts Community	40 Somerstown Rd	Ossining	126	49
City of Peekskill	0.9	NE	Holiday Inn Express & Suites	2 John Walsh Blvd	Peekskill	196	76
City of Peekskill	1.9	NE	Inn on the Hudson	634 Main St	Peekskill	90	45
City of Peekskill	2.0	NE	The Abbey Inn & Spa	900 Fort Hill Rd	Peekskill	108	42

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Transients	Vehicles
Town of Cortlandt	3.6	SE	Watergate Inn	Furnace Dock Rd & N Riverside Ave	Croton-on-Hudson	90	30
Town of Cortlandt	3.8	ENE	Town Lyne Motel	2381 Crompond Rd	Cortlandt	76	38
				<i>Westchester County Subtotal:</i>		<i>968</i>	<i>407</i>
				EPZ TOTAL:		1,826	781

Table E-10. Correctional Facilities within the EPZ

Protective Action Area	Distance (miles)	Direction	Facility Name	Street Address	Municipality	Capacity
ROCKLAND COUNTY						
Central Town of Clarkstown	8.6	SSW	Rockland County Jail	53 New Hempstead Rd	New City	305
				Rockland County Subtotal:		305
WESTCHESTER COUNTY						
Ossining Town & Village	9.1	SSE	Sing Sing Correctional Facility	354 Hunter St	Ossining	1,106
				Westchester County Subtotal:		1,106
				EPZ TOTAL:		1,411

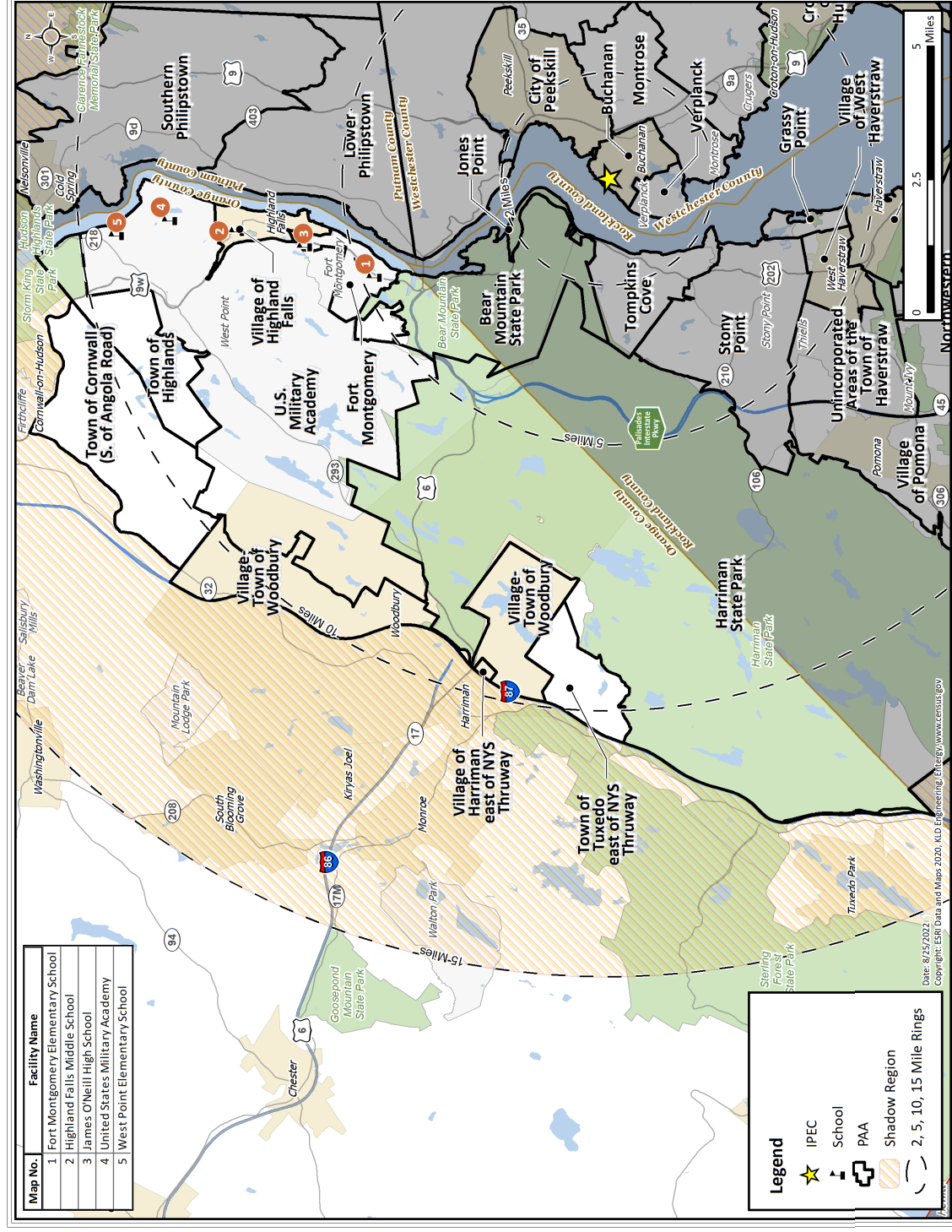


Figure E-1. Orange County Schools and Colleges within the EPZ

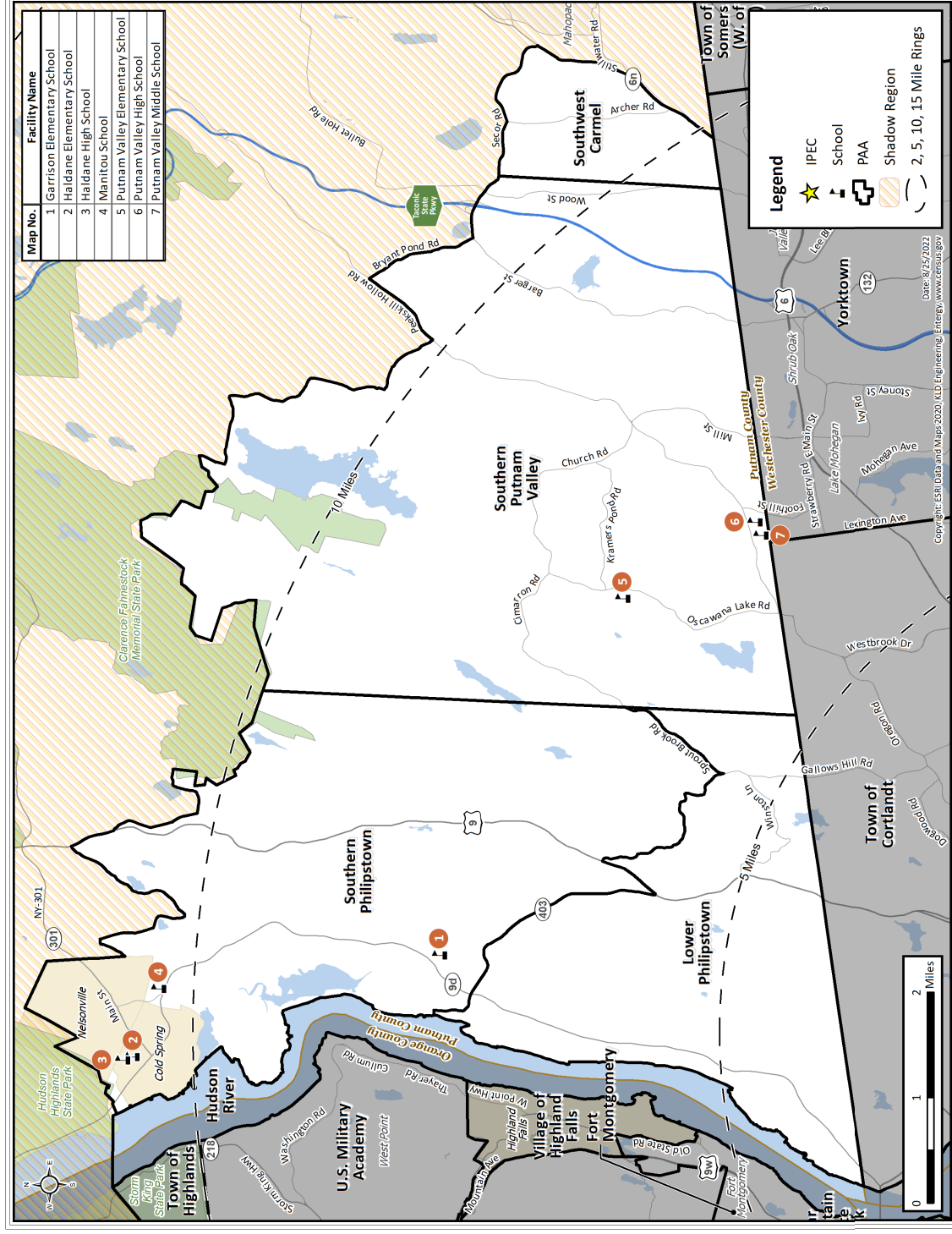


Figure E-2. Putnam County Schools within the EPZ

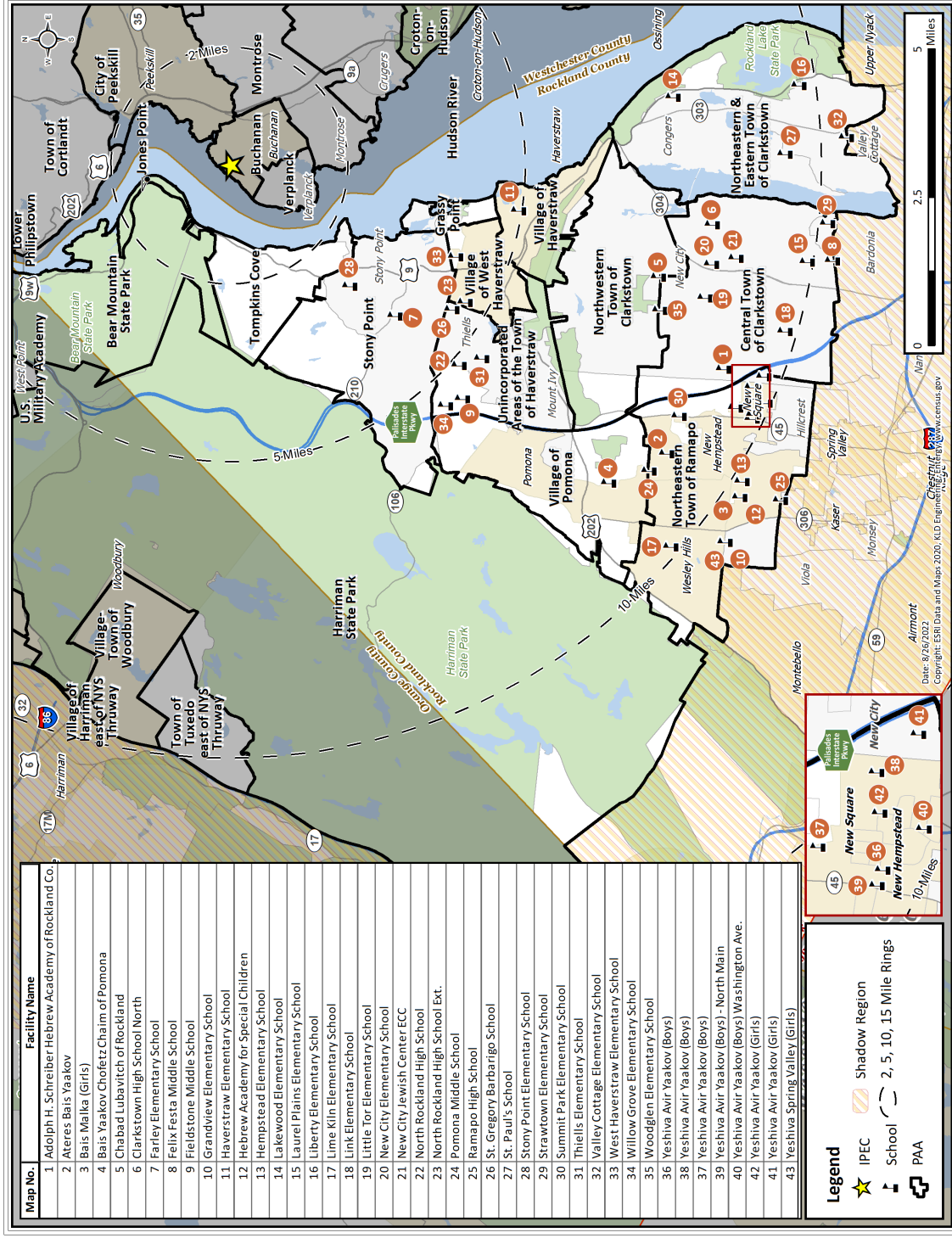


Figure E-3. Rockland County Schools within the EPZ

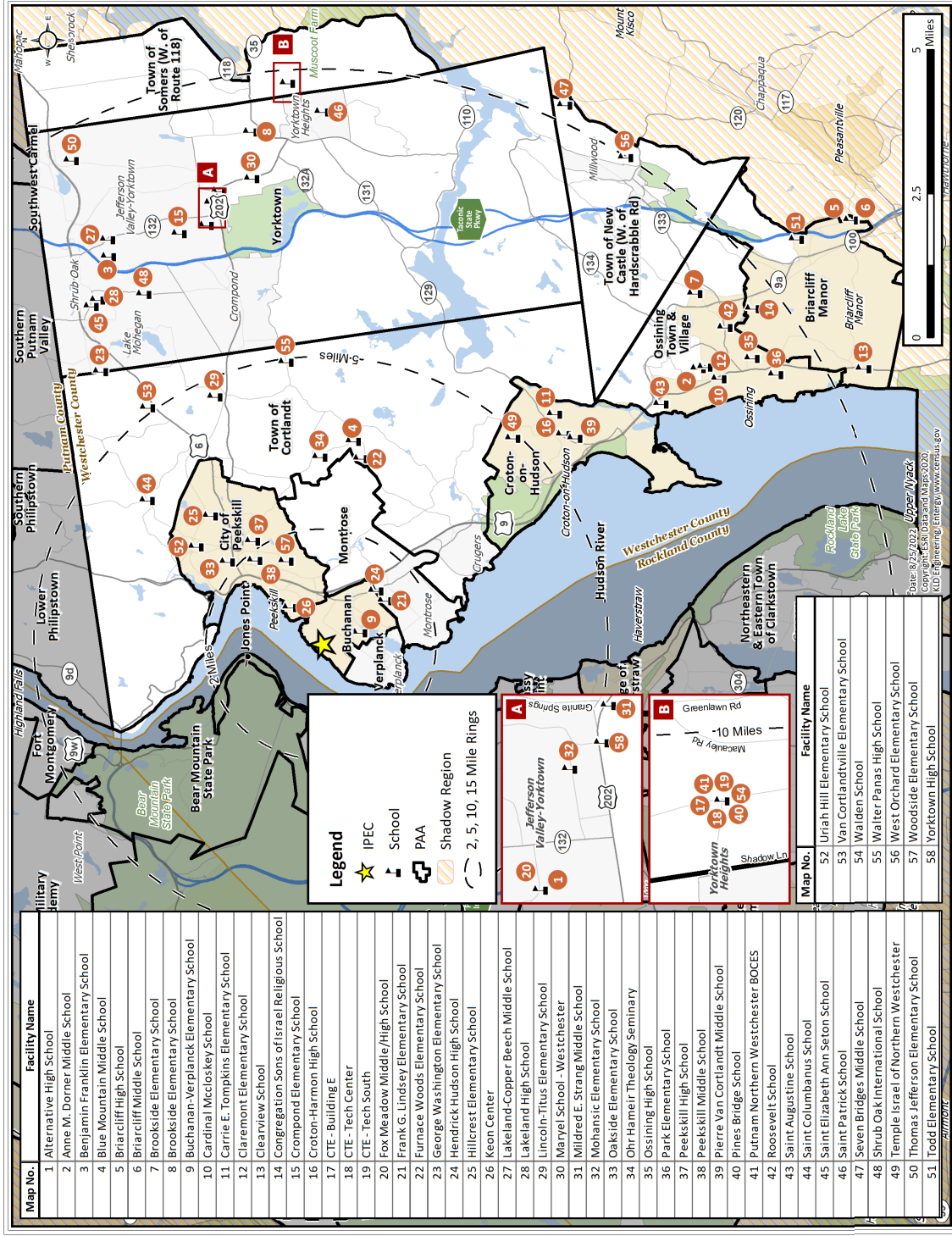


Figure E-4. Westchester County Schools and Colleges within the EPZ

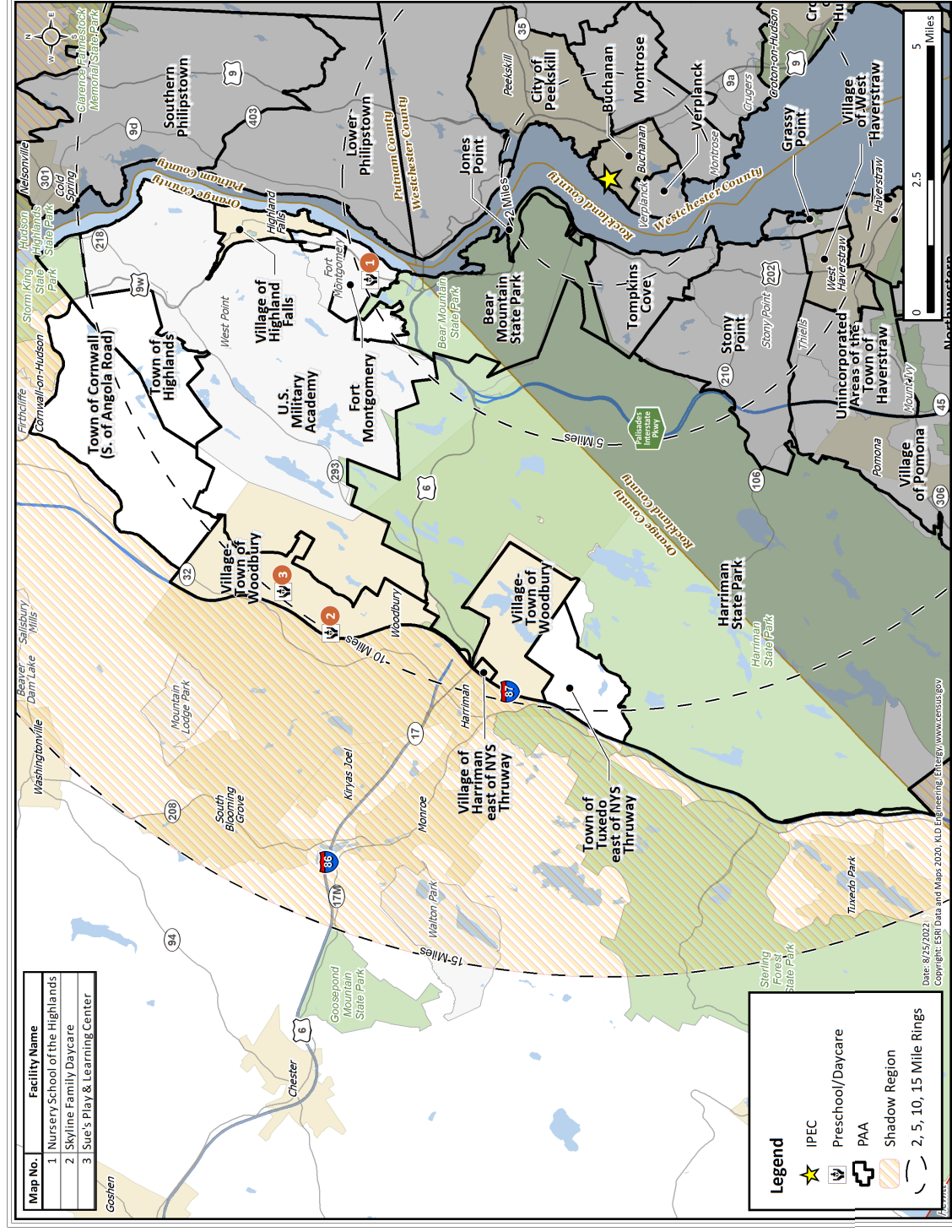


Figure E-5. Orange County Preschools/Daycares within the EPZ

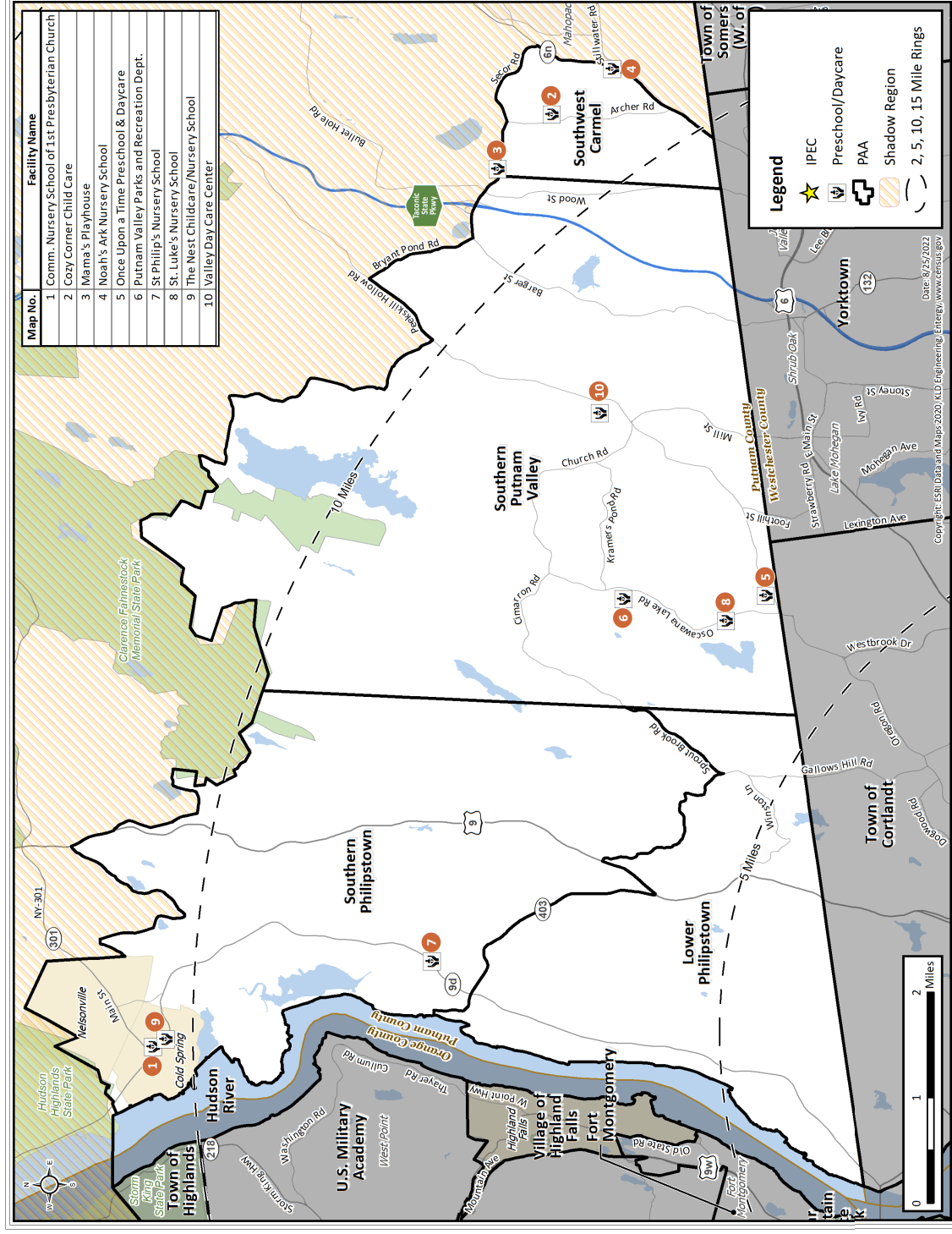


Figure E-6. Putnam County Preschools/Daycares within the EPZ

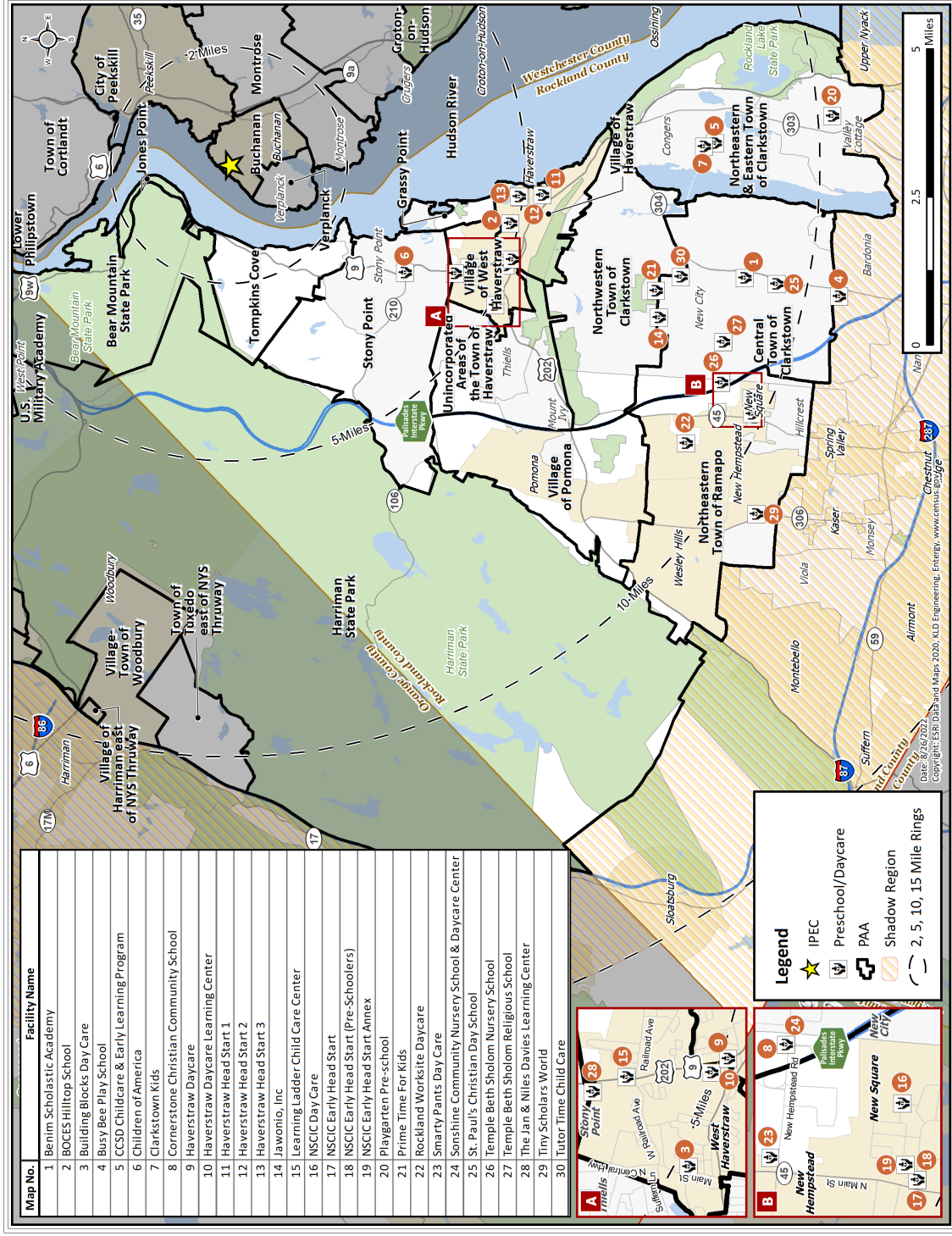


Figure E-7. Rockland County Preschools/Daycares within the EPZ

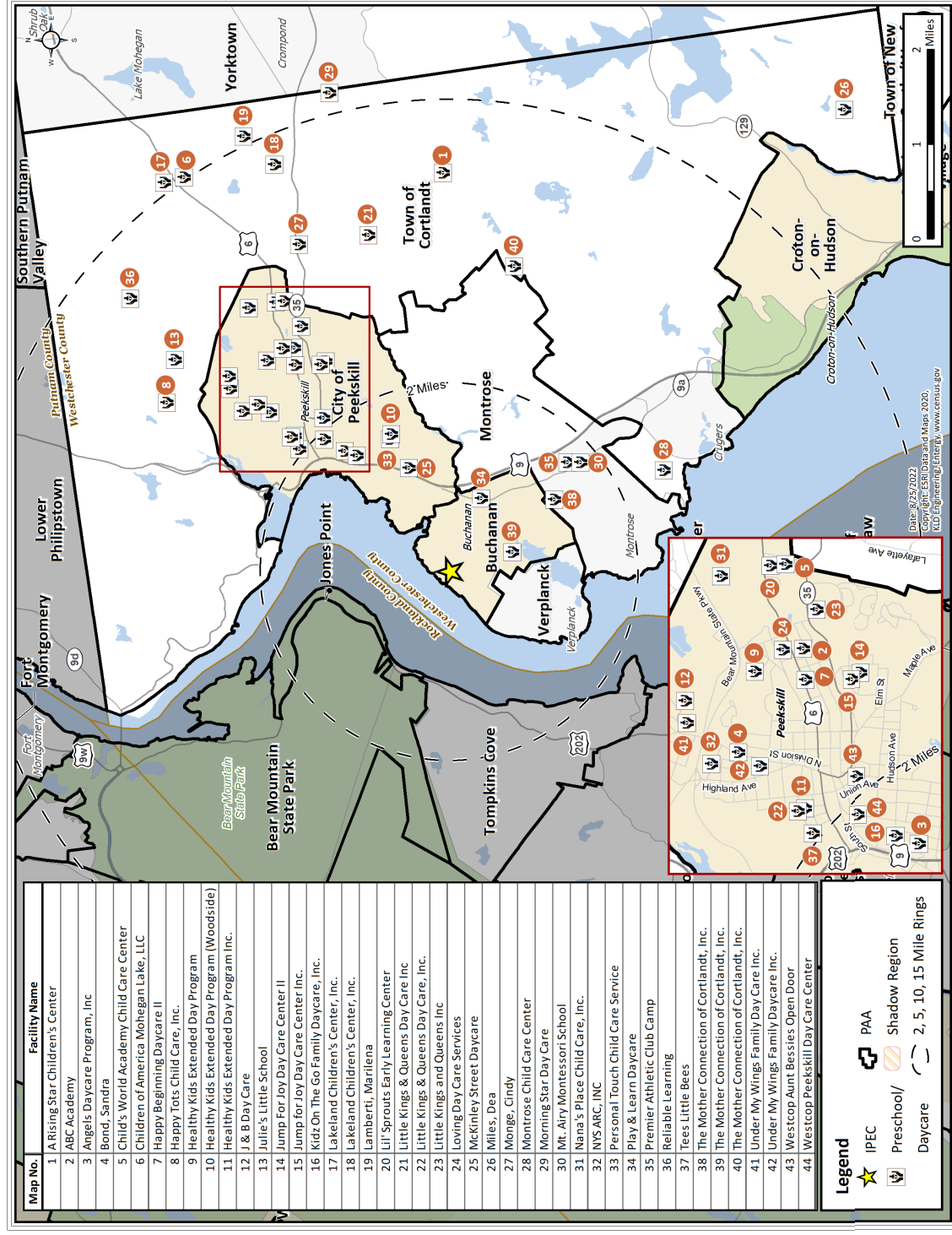


Figure E-8. Westchester County Preschools/Daycares within the Buchanan, City of Peekskill, Montrose and Town of Cortlandt Protective Action Areas

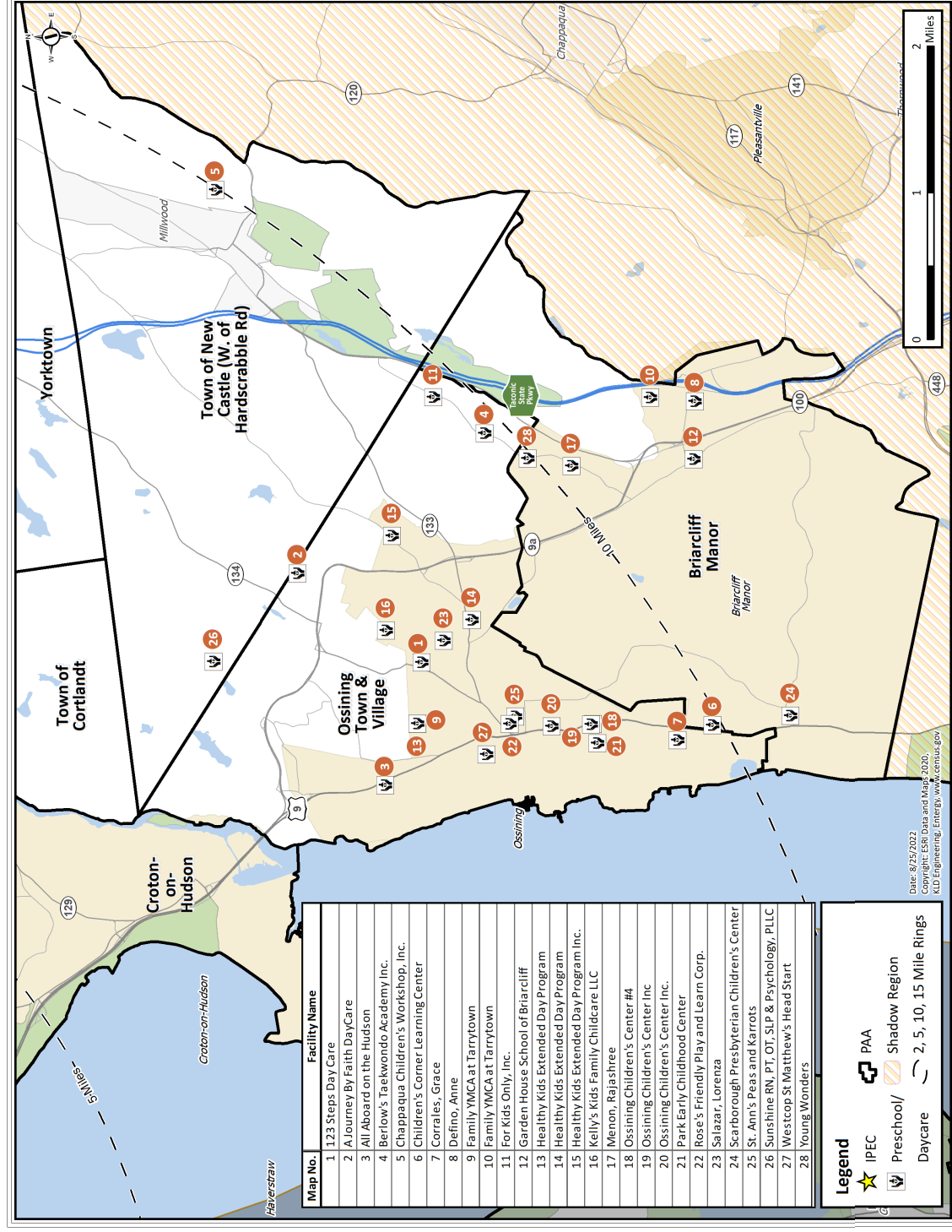
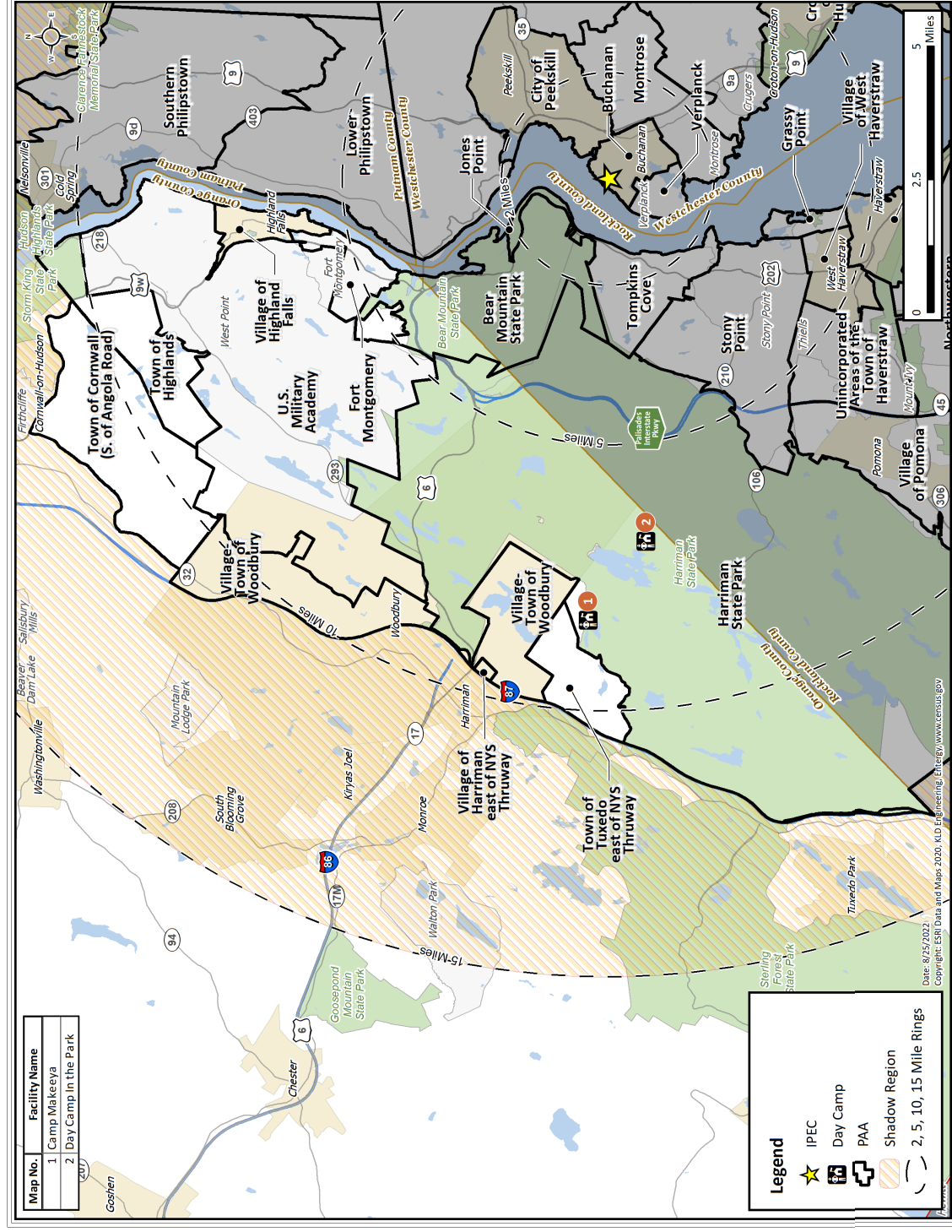


Figure E-10. Westchester County Preschools and Daycares within the Briarcliff Manor, Ossining Town & Village, and Town of New Castle (W. of Hardscrabble Rd) Protective Action Areas



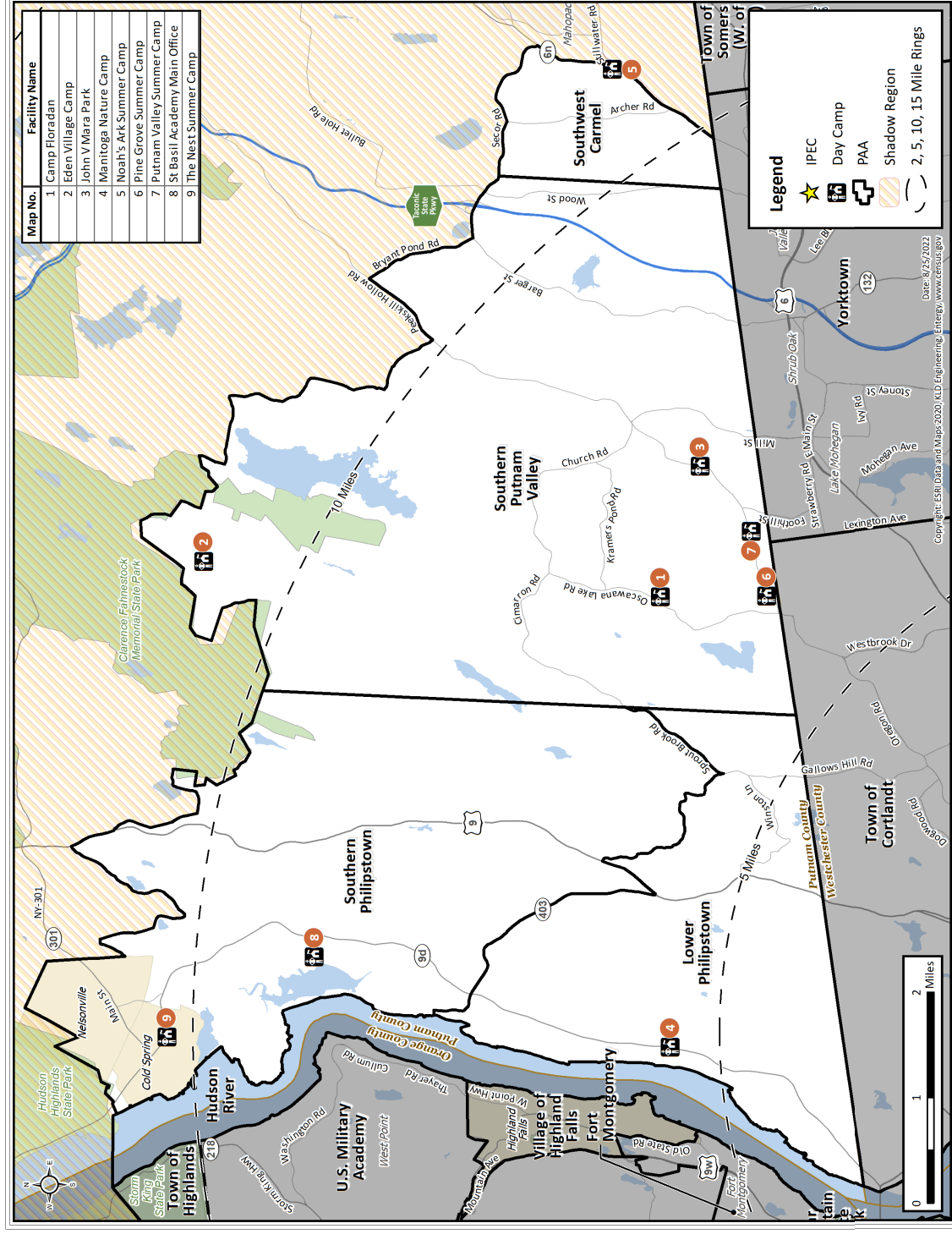


Figure E-12. Putnam County Day Camps within the EPZ

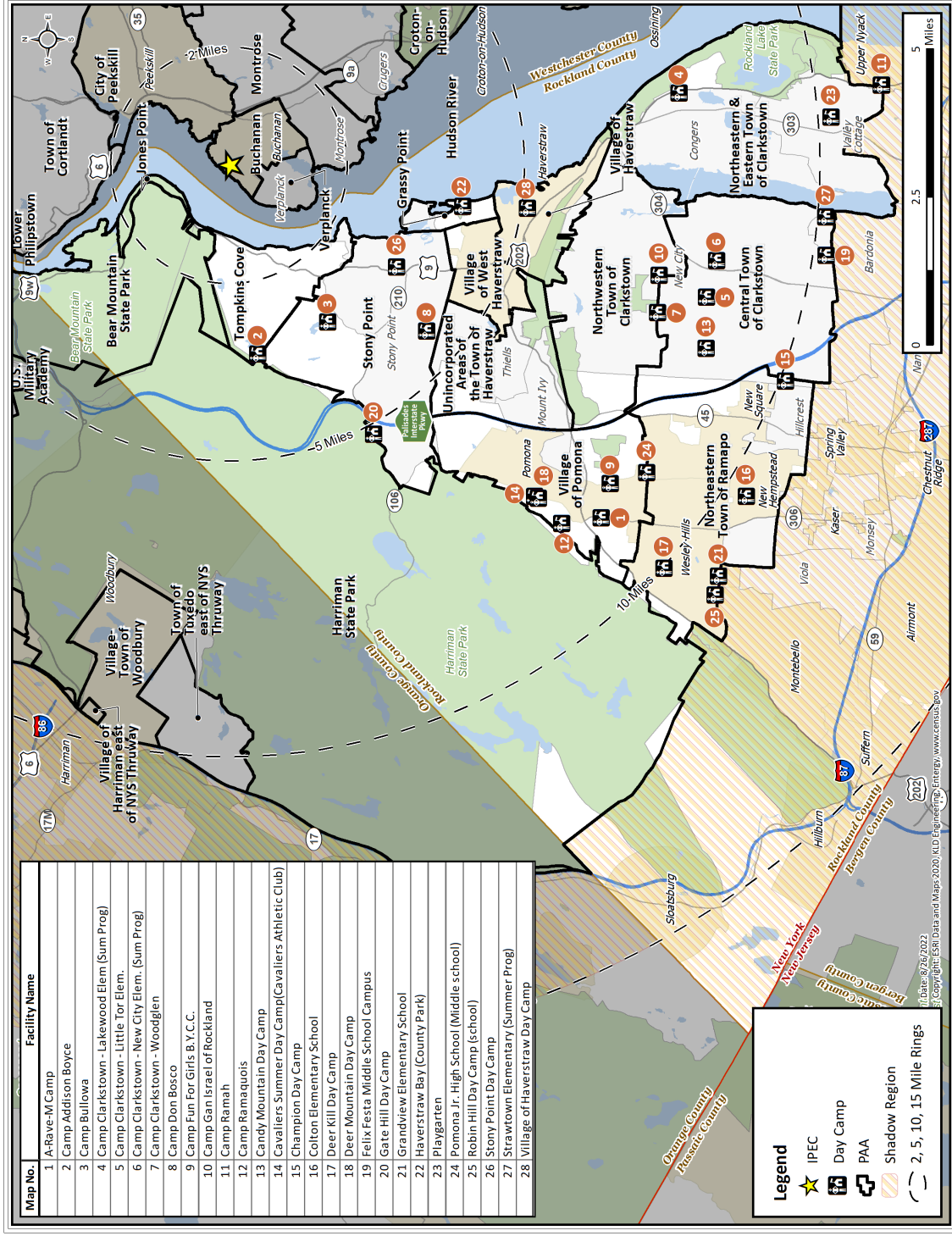


Figure E-13. Rockland County Day Camps within the EPZ

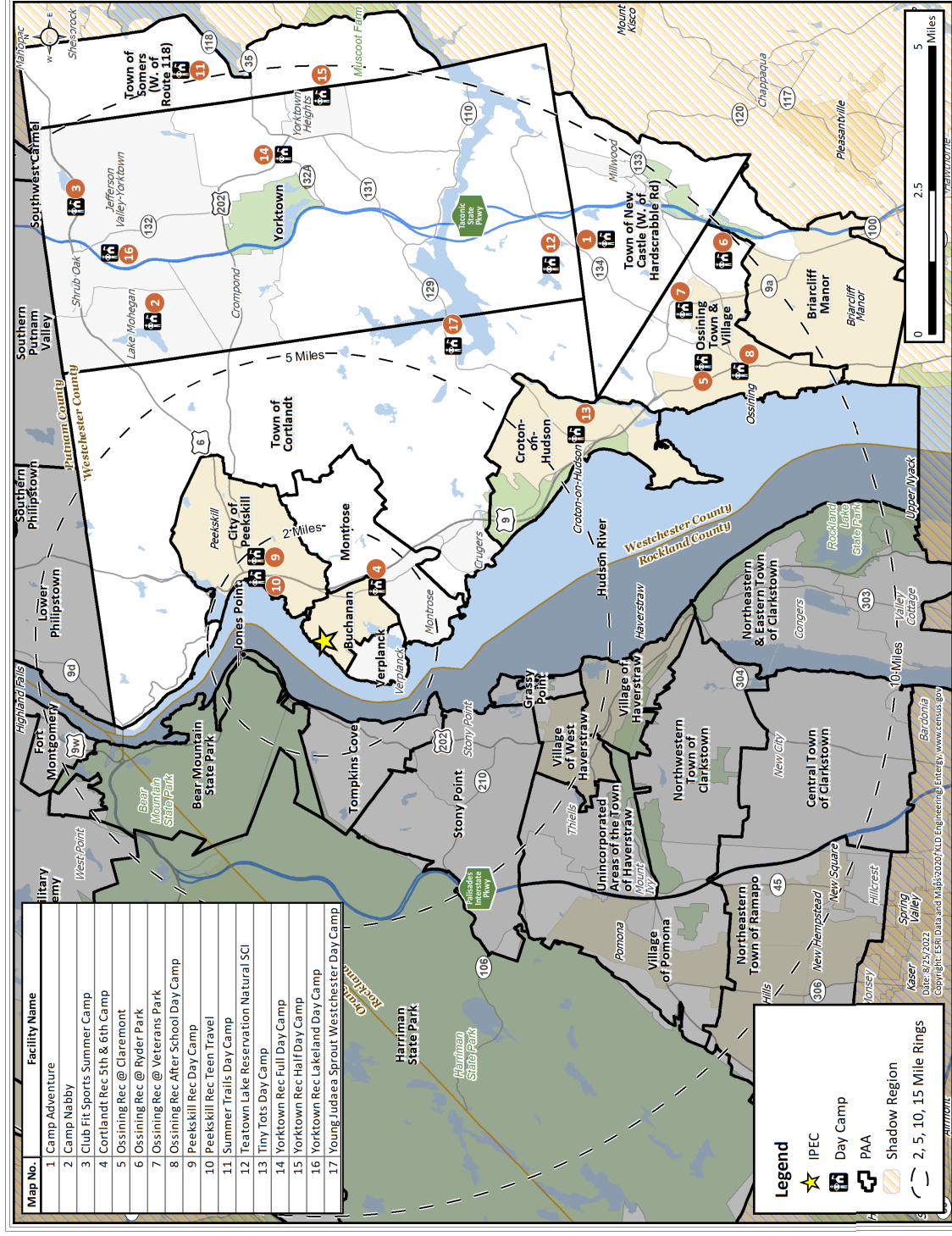


Figure E-14. Westchester County Day Camps within the EPZ

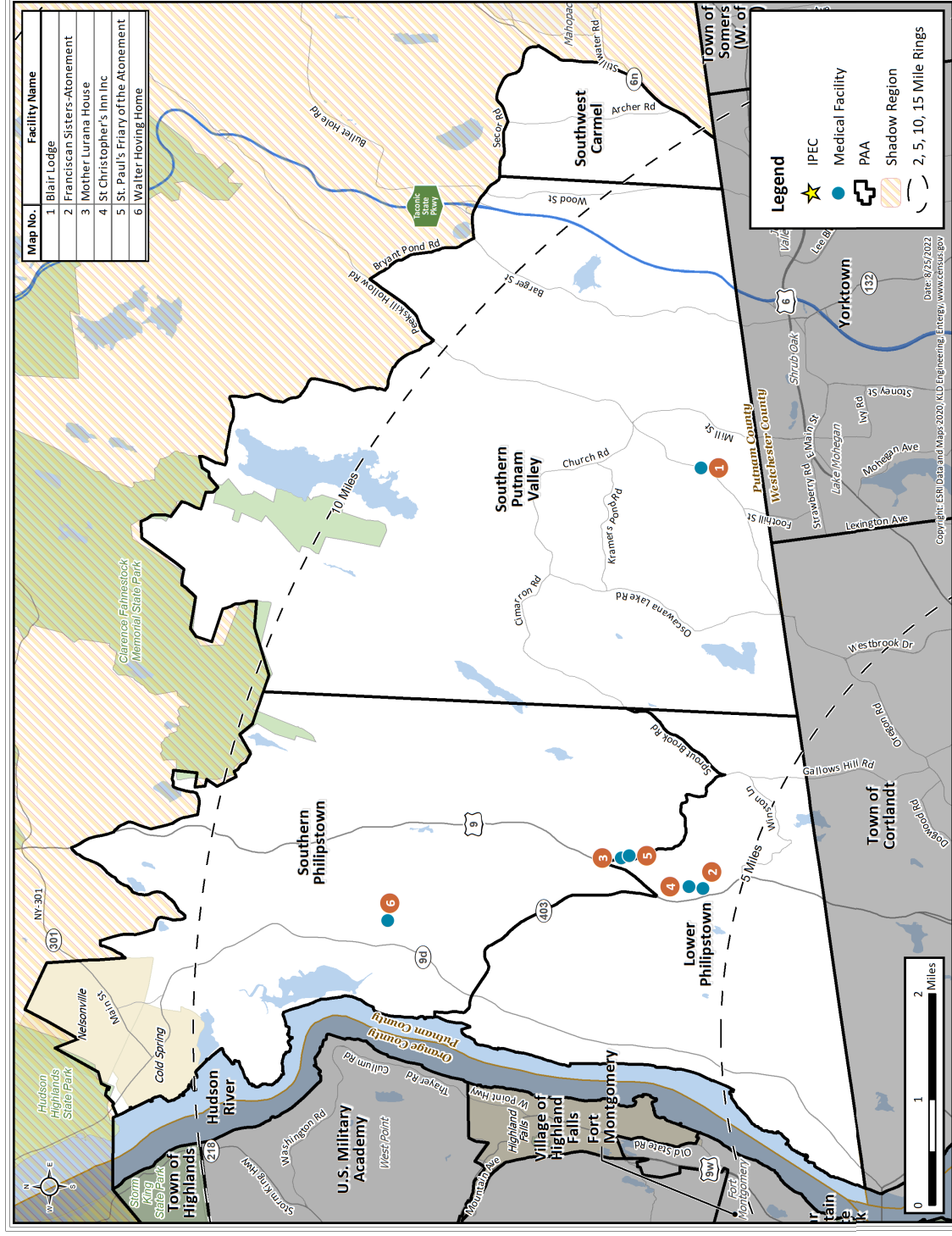


Figure E-15. Putnam County Medical Facilities within the EPZ

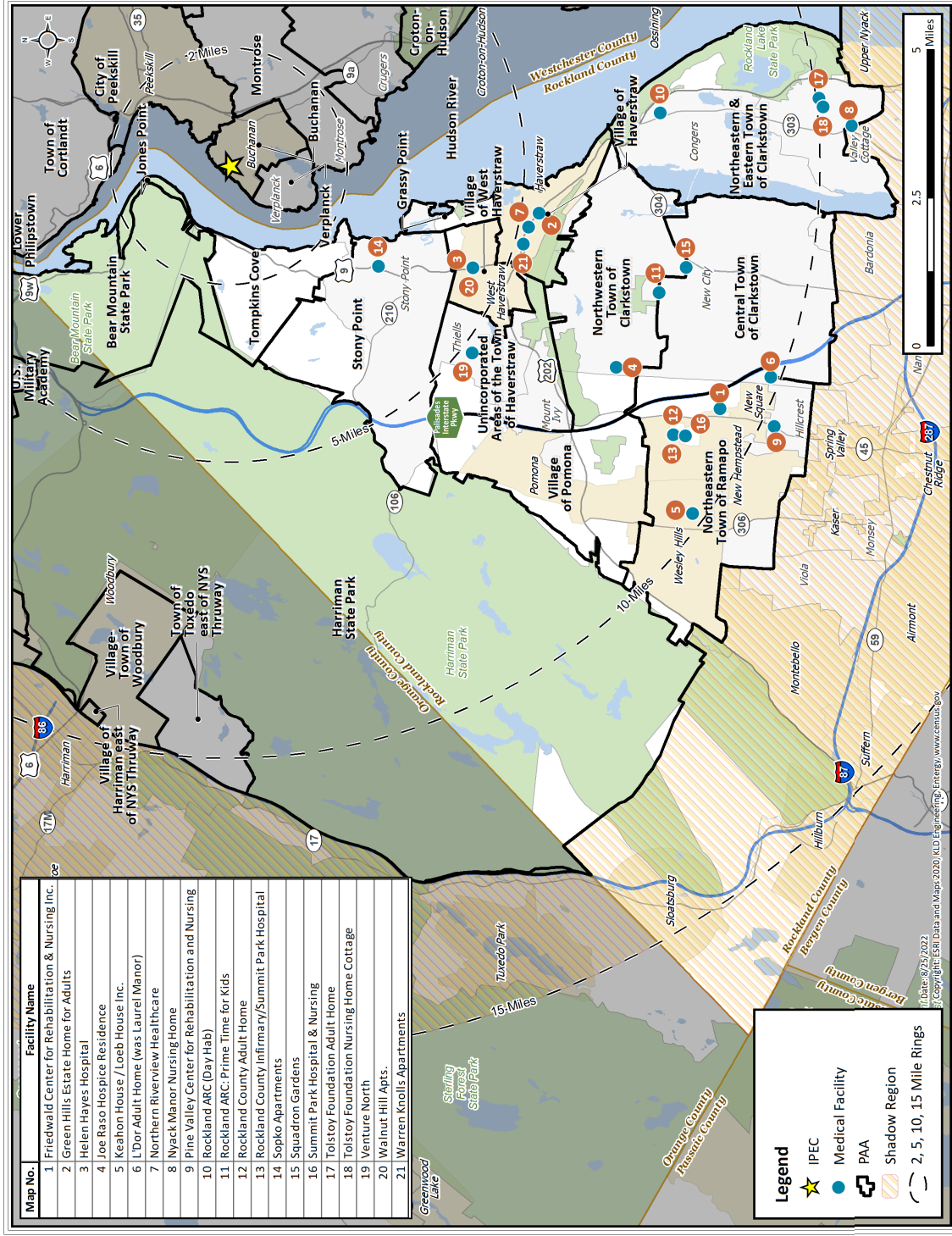


Figure E-16. Rockland County Medical Facilities within the EPZ

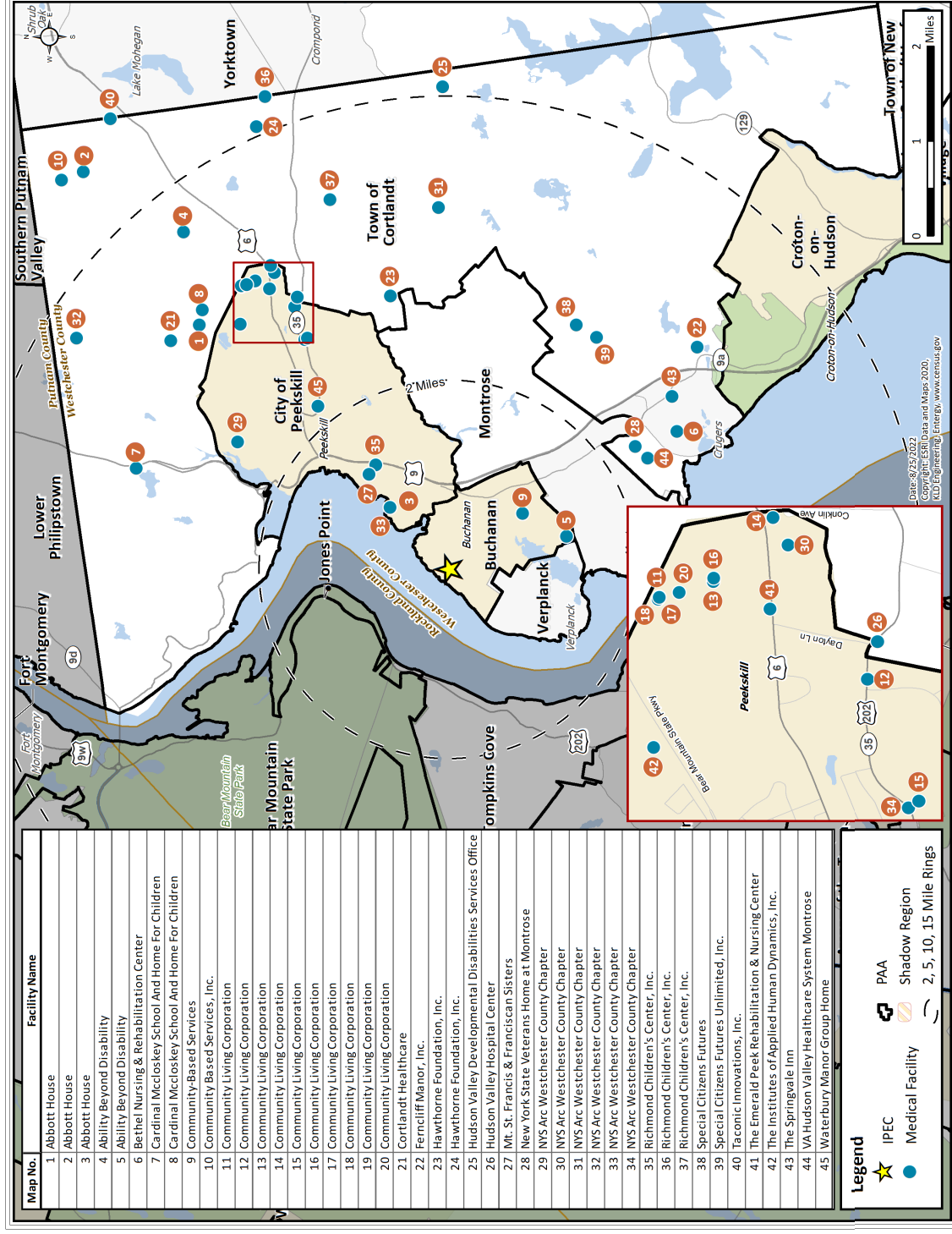


Figure E-17. Westchester County Medical Facilities within the Buchanan, City of Peekskill, and Town of Cortlandt Protective Action Areas

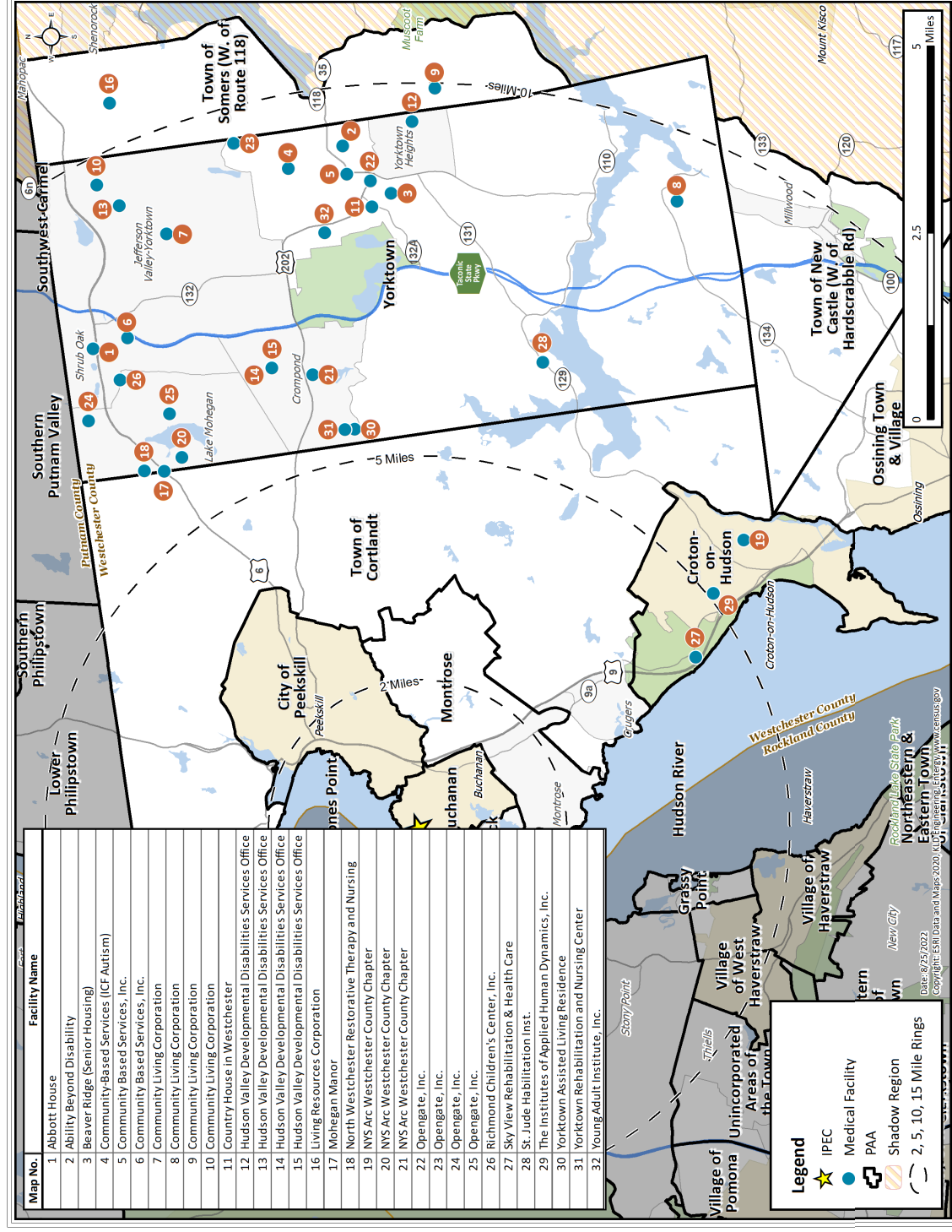


Figure E-18. Westchester County Medical Facilities within the Croton-on-Hudson, Town of Somers (W. of Route 118) and Yorktown Protective Action Areas

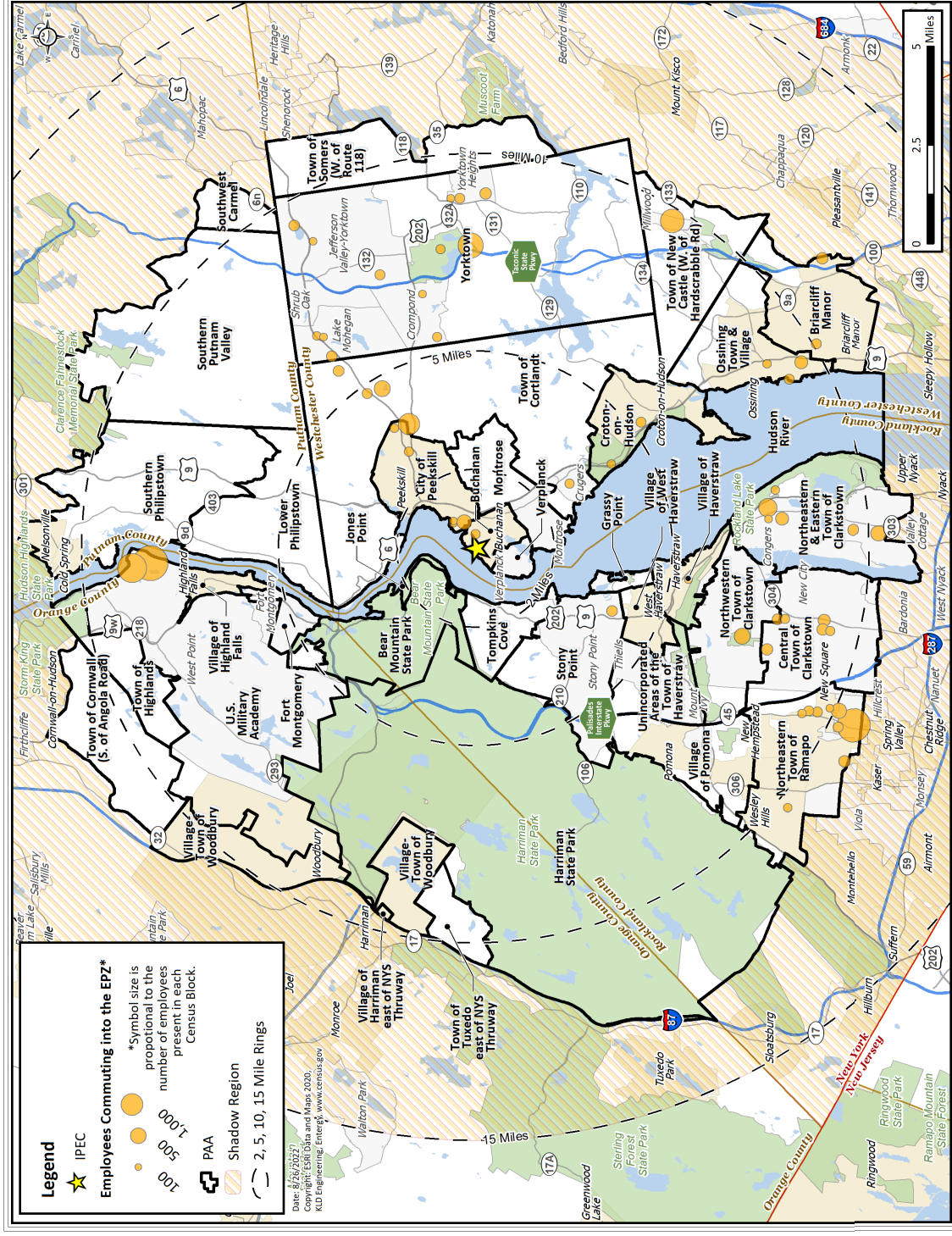


Figure E-20. Major Employers within the EPZ

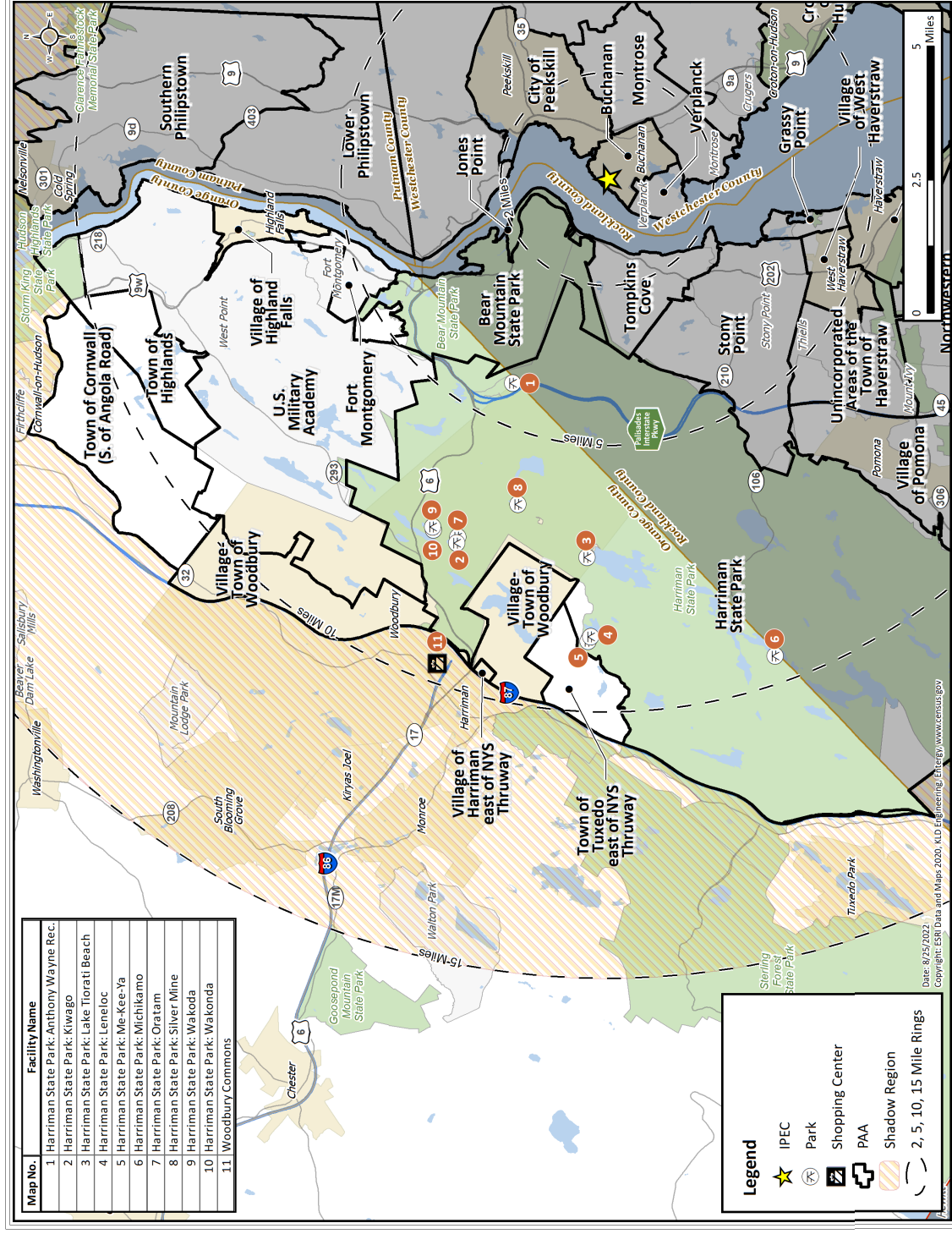
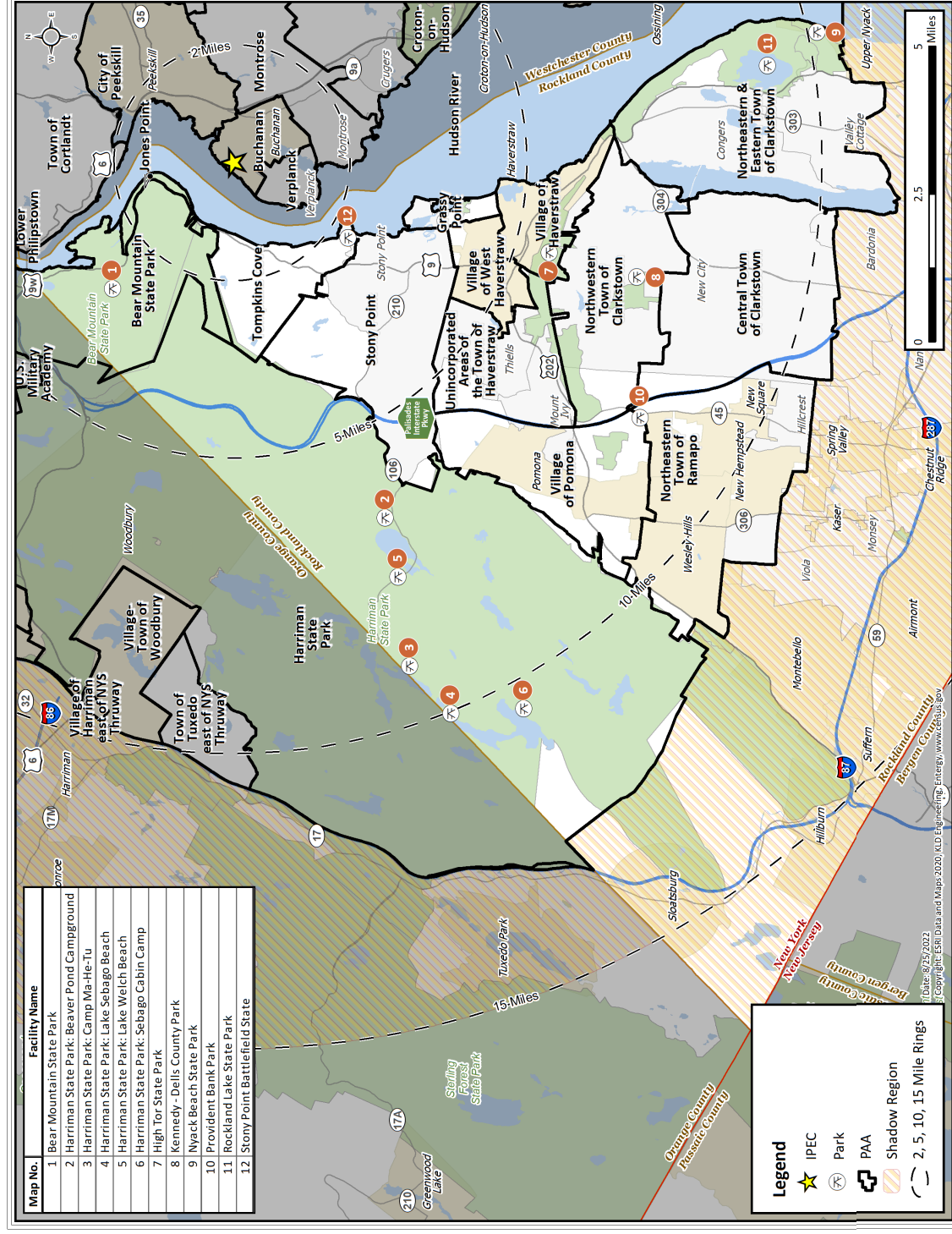


Figure E-21. Orange County Transient Attractions within the Study Area



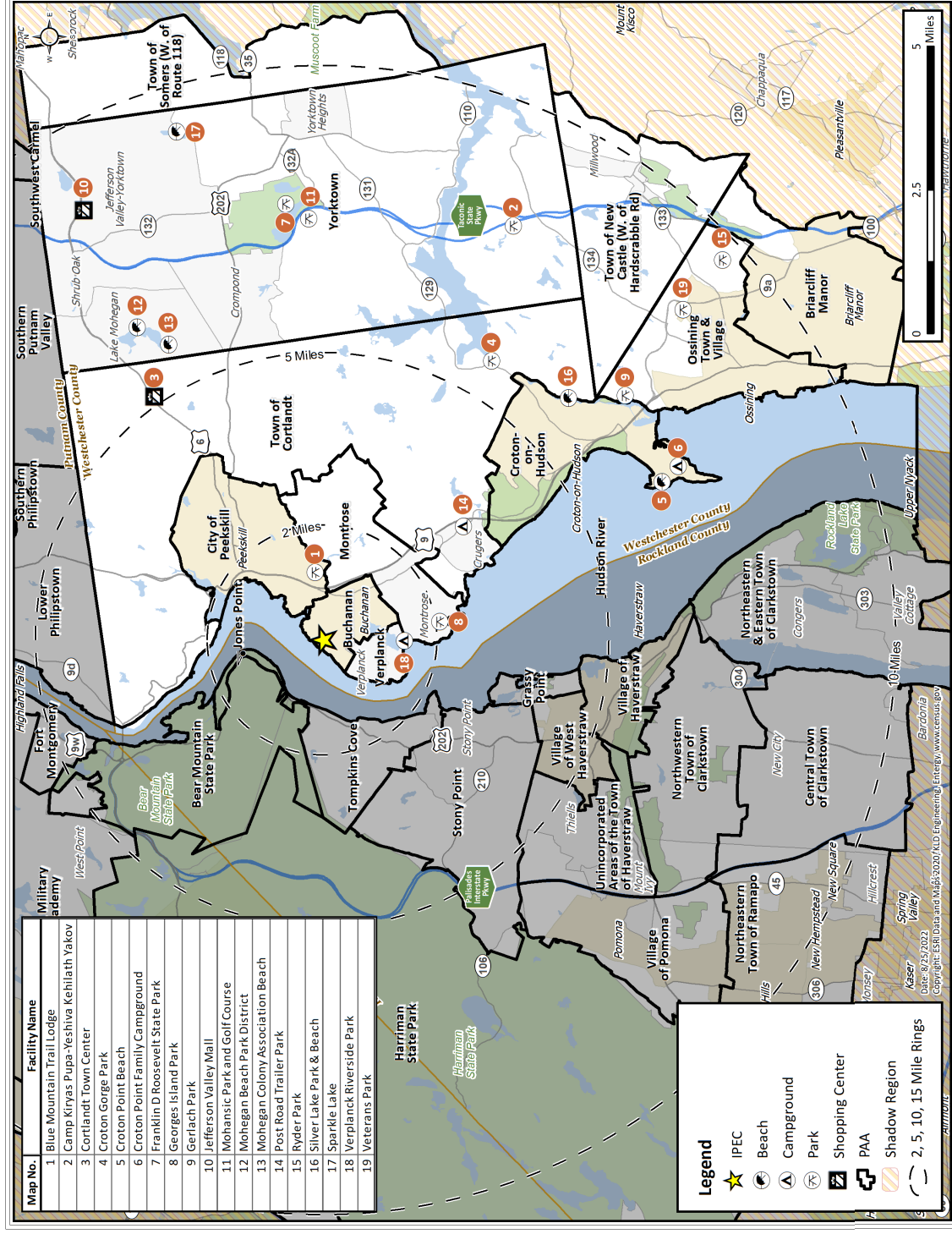


Figure E-23. Westchester County Transient Attractions within the EPZ

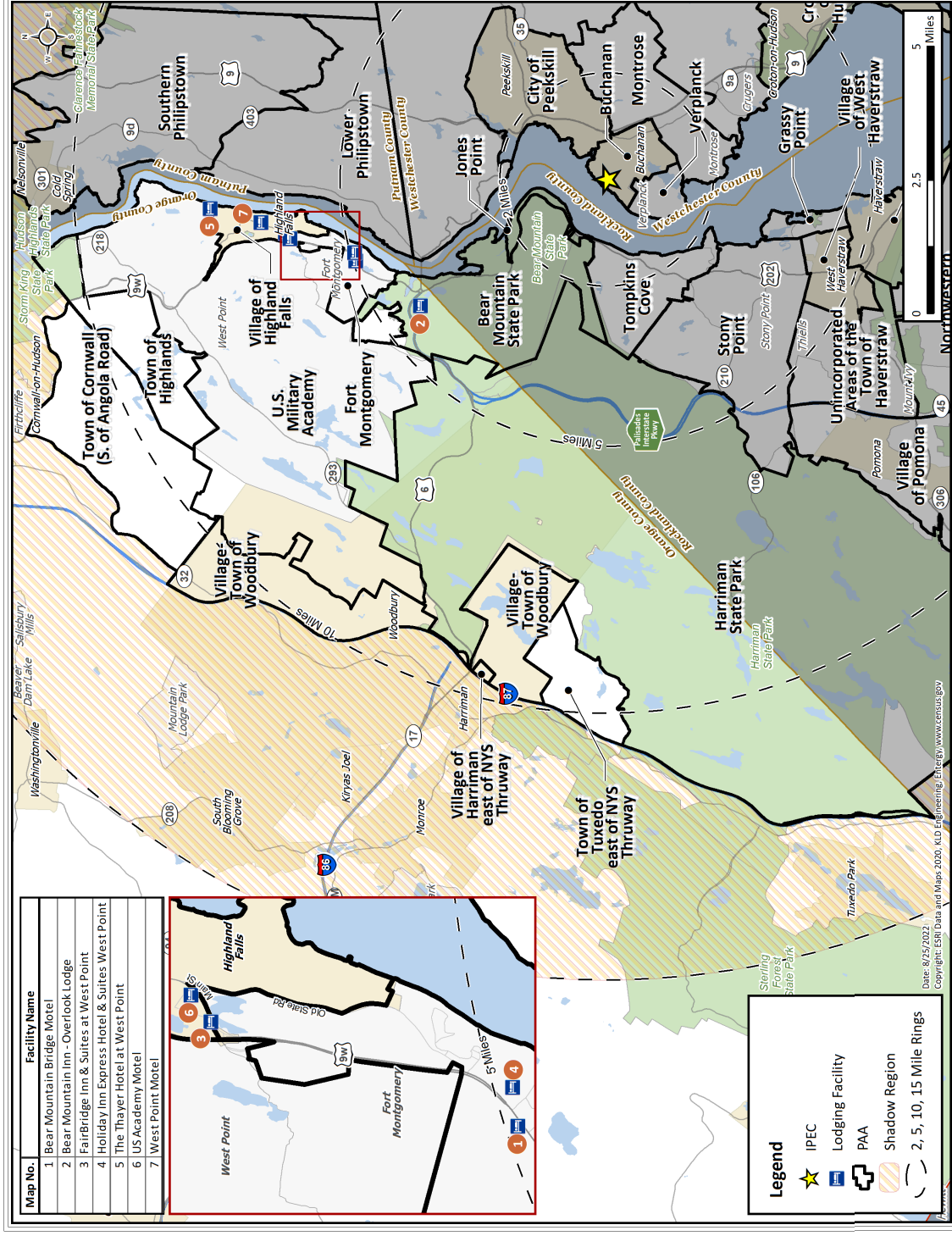
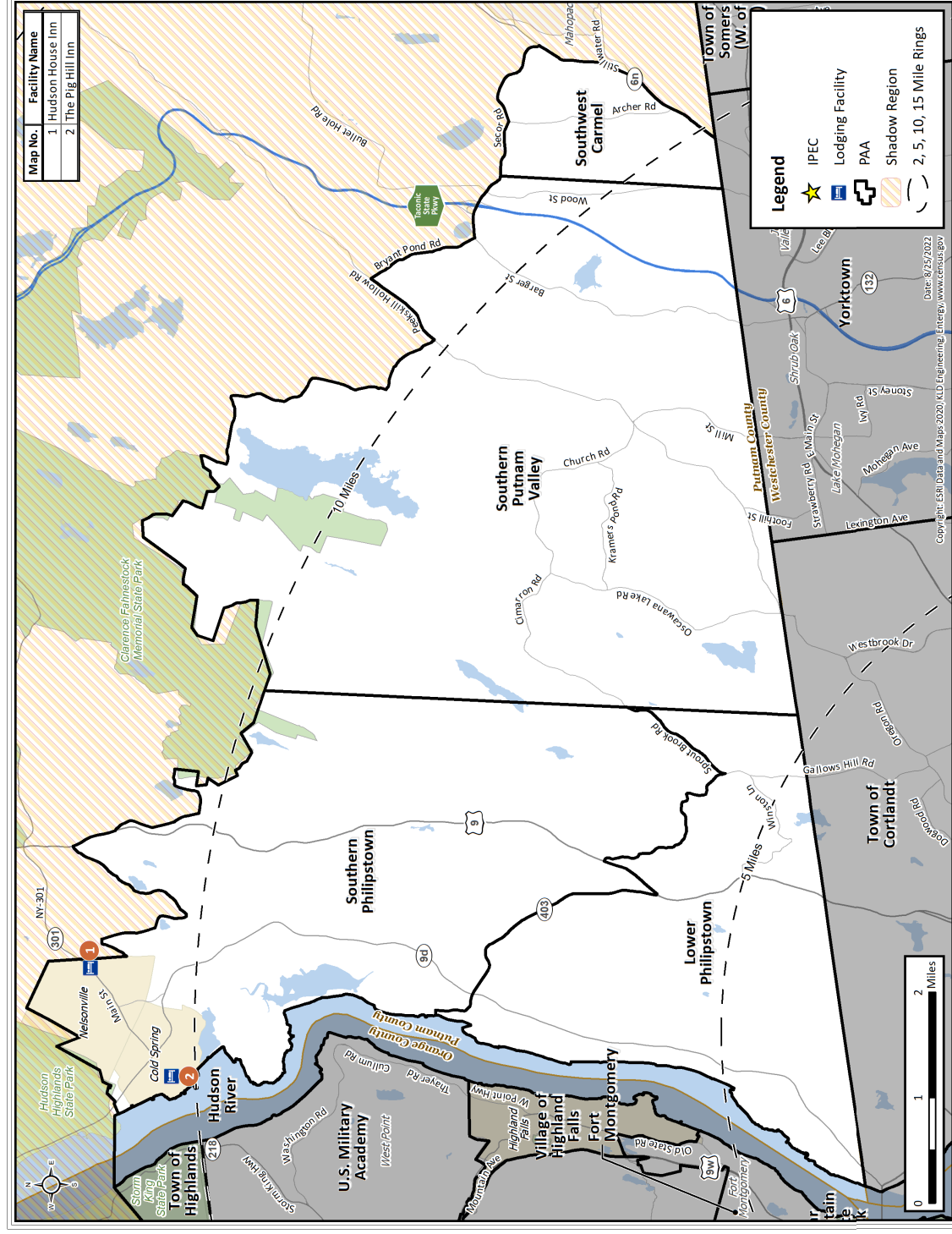


Figure E-24. Orange County Lodging Facilities within the EPZ



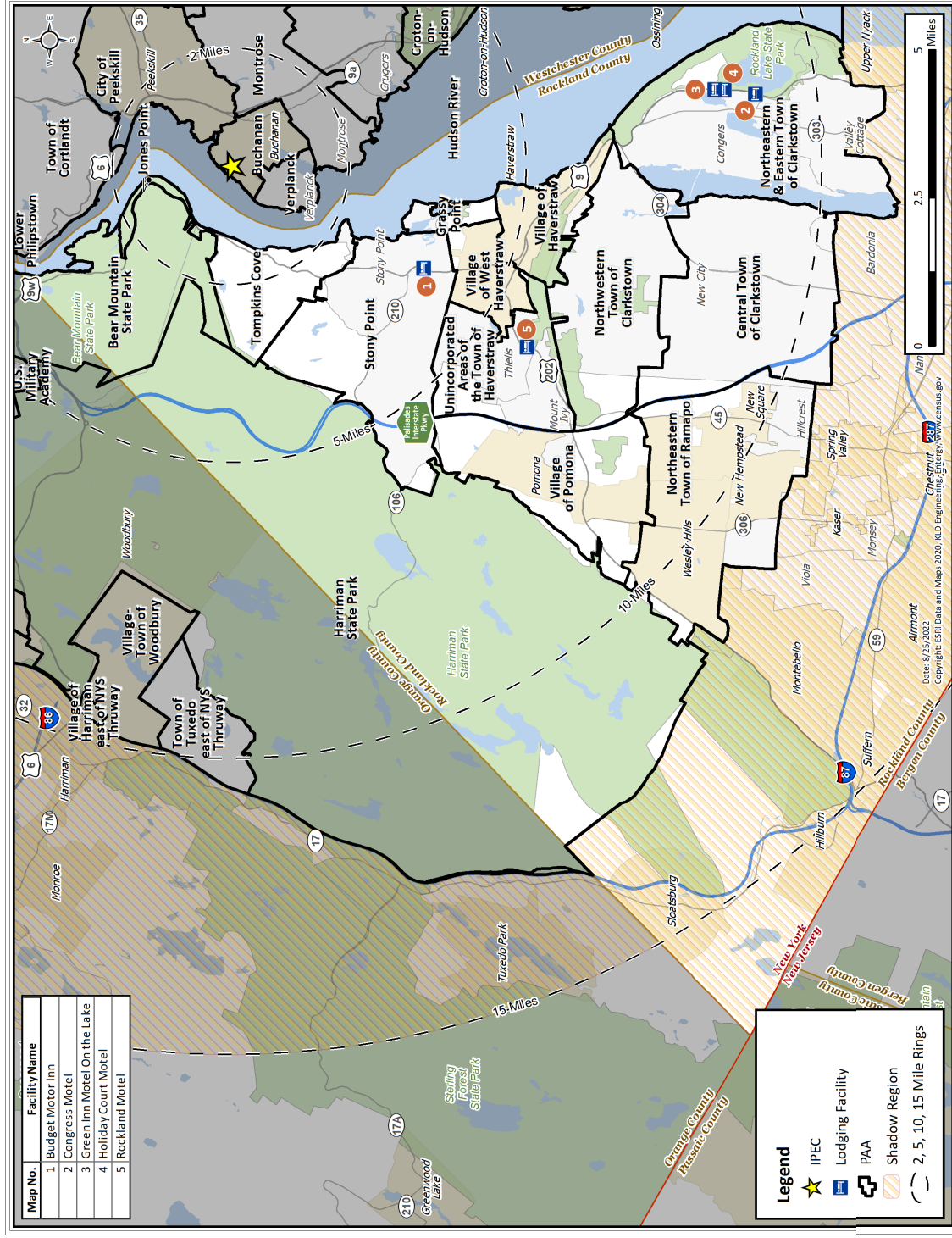
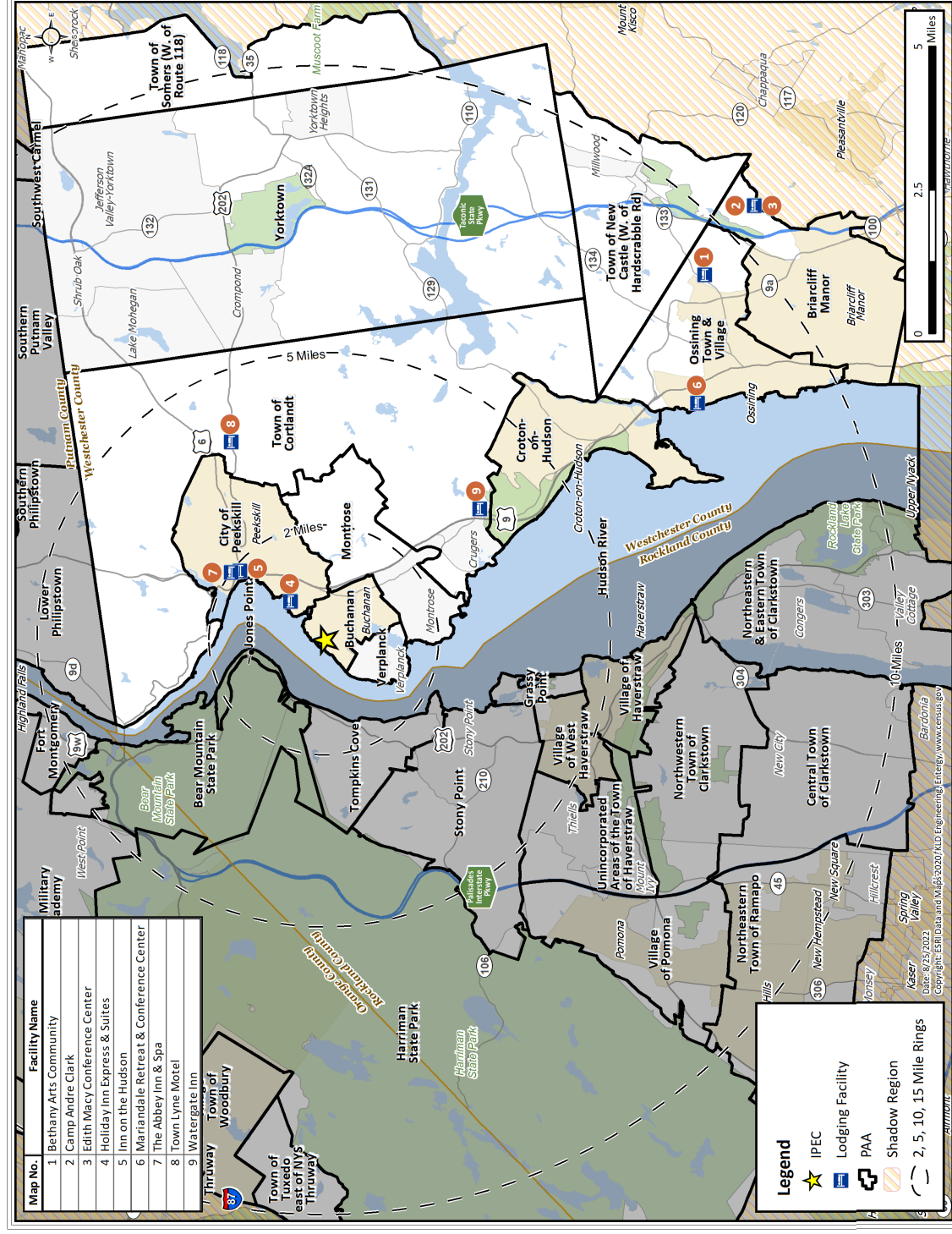


Figure E-26. Rockland County Lodging Facilities within the EPZ



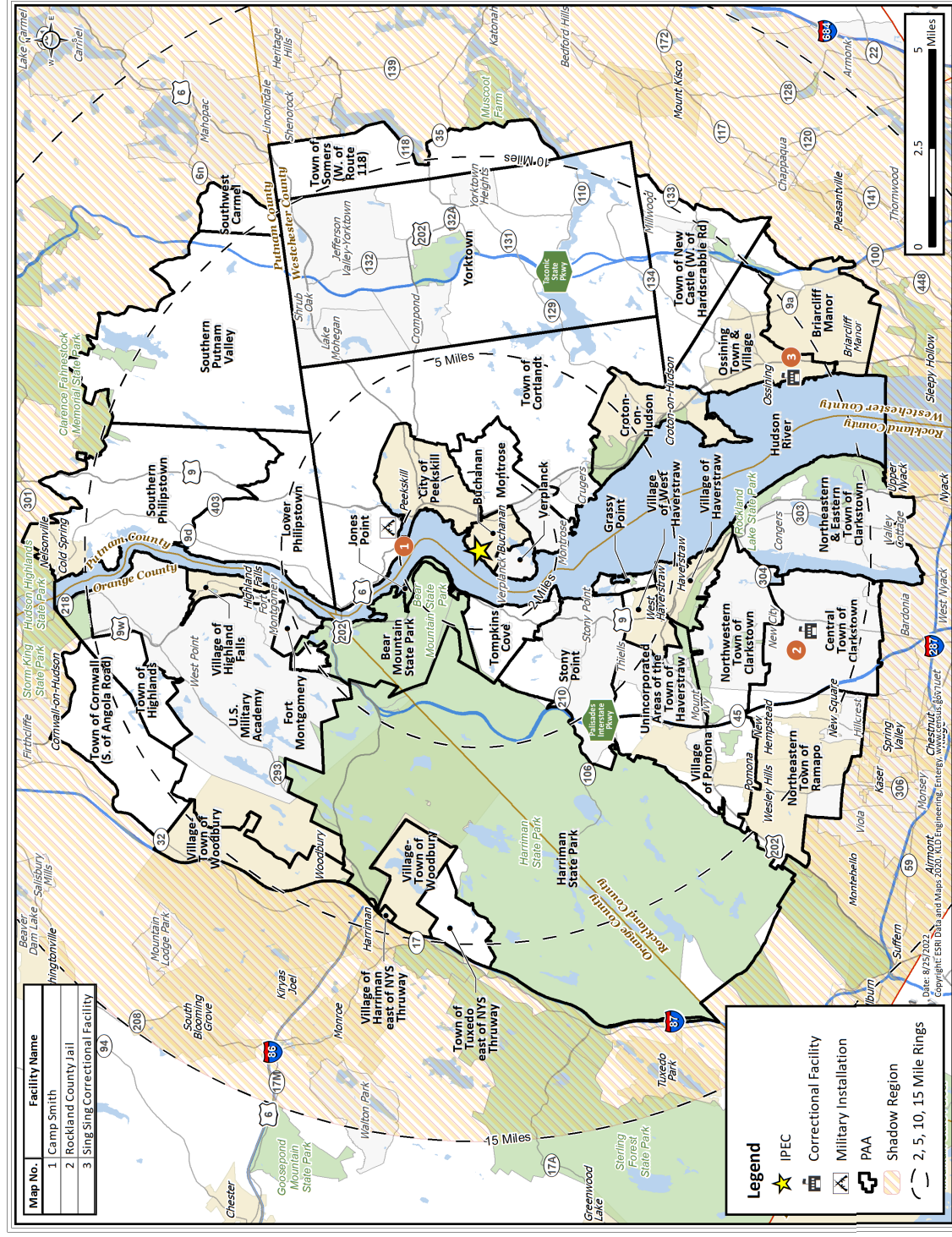


Figure E-28. Correctional Facilities and Military Installations within the EPZ

APPENDIX F

Demographic Survey

F. DEMOGRAPHIC SURVEY

F.1 Introduction

The development of evacuation time estimates for the Indian Point Energy Center 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 demographic 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 475 **completed** survey forms yields results with a sampling error of $\pm 4.5\%$ at the 95% confidence level. The sample should 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 of sampling purposes and was not used in the ETE study.

The results of the survey exceeded the sampling plan. A total of 755 completed samples were obtained corresponding to a sampling error of $\pm 3.55\%$ at the 95% confidence level based on the 2020 Census Data. Table F-1 also shows the number of samples obtained within each zip code.

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 “decline to state” entry for a response. It is accepted practice in conducting surveys of this type to accept the answers of a respondent who offers a decline to state response for a few questions or who refuses to answer a few questions. To address the issue of occasional decline to state 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 decline to state 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 based on the responses to the demographic survey. The estimated household size from the 2020 Census data is 3.00 people. The average EPZ household size calculated from the demographic survey is 2.63 people per household. Upon discussions with the county emergency personal, the following people per household by county (results of the demographic survey) was used for this study:

- Orange County: 2.71 People per household
- Putnam County: 2.51 People per household
- Rockland County: 2.73 People per household
- Westchester County: 2.58 People per household.

Note that Figure F-1 includes all responses and is not broken down by county.

Automobile Ownership

The average number of automobiles available per household in the EPZ is 2.07. It should be noted that 1.1% 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 (99%) households of 2 or more people have access to at least one vehicle.

Ridesharing

Approximately 59% of the households surveyed responded that they would share a ride with a neighbor, relative, or friend if a car was not available to them when advised to evacuate in the event of an emergency. Figure F-5 presents this response.

Commuters

Figure F-6 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 1.12 commuters in each household in the EPZ, and approximately 66% of households have at least one commuter.

Commuter Travel Modes

Figure F-7 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 1.06 employees per vehicle, assuming 2 people per vehicle – on average – for carpools.

Impact of COVID-19 on Commuters

Figure F-8 presents the distribution of the number of commuters in each household that were temporarily impacted by the COVID-19 pandemic. Approximately 44% of households indicated someone in their household had a work and/or school commute that was temporarily impacted by the COVID-19 pandemic.

Functional or Transportation Needs

Figure F-9 presents the distribution of the number of individuals with functional or transportation need. Approximately 8% of households responded to the survey as having functional or transportation needs. Of those with functional or transportation needs, 37% require a bus, 13% require a medical bus/van, 21% require a wheelchair accessible vehicle, 7% require an ambulance and 22% require other types of transportation.

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-10. On average, evacuating households would use 1.34 vehicles. After discussions with the county emergency personnel, the following evacuating vehicles by county (results of the demographic survey) was used for this study:

- Orange County: 1.42 vehicles
- Putnam County: 1.34 vehicles
- Rockland County: 1.4 vehicles
- Westchester County: 1.29 vehicles.

Note that Figure F-10 includes all responses and is not broken down by county.

“Would you await the return of family members prior to evacuating the area?” Of the survey participants who responded, 61% said they would await the return of other family members before evacuating and 39% indicated that they would not await the return of other family members.

“What would you do with your pet(s) and/or animal(s) if you had to evacuate?” Based on responses from the survey, 49% of households have pet(s) and/or animal(s). Of the households with pet(s) and/or animal(s), 25% indicated that they would take their pet(s) and/or animal(s) with them to a shelter, 73% indicated that they would take their pet(s) and/or animal(s)

somewhere else and only 2% would leave their pet(s) and/or animal(s) at home, as shown in Figure F-11. Of the households that would evacuate with their pet(s) and/or animal(s), 97% indicated that they have sufficient room in their vehicle to evacuate with their pet(s)/animal(s).

“What type of pet(s) and/or animal(s) do you have?” Based on responses from the survey, 96% of households have a household pet (dog, cat, bird, reptile, rodent, rabbit, ferret, fish, guinea pig, eel, rat, and chinchilla), 3% of households have farm animals (horse, chicken, goat, or bees) and less than one percent of households have other types small pets/animals, as shown in Figure F-12.

“Emergency officials advise you to take shelter at home in an emergency. Would you?” This question is designed to elicit information regarding compliance with instructions to shelter in place. The results indicate that 80% of households who are advised to shelter in place would do so; the remaining 20% would choose to evacuate the area. Note the baseline ETE study assumes 20% of households will not comply with the shelter advisory, as per Section 2.5.2 of NUREG/CR-7002, Rev 1. Thus, the data obtained in the survey is in excellent agreement with the federal guidance.

“Emergency officials advise you to take shelter at home now in an emergency and possibly evacuate later while people in other areas are advised to evacuate now. Would you?” This question is designed to elicit information specifically related to the possibility of a staged evacuation. That is, asking a population to shelter in place now and then to evacuate after a specified period of time. Results indicate that 58% of households would follow instructions and delay the start of evacuation until so advised, while the balance of 42% would choose to begin evacuating immediately.

“Emergency officials advise you to evacuate due to an emergency. Where would you evacuate to?” This question is designed to elicit information regarding the destination of evacuees in case of an evacuation. Approximately 48% of households indicated that they would evacuate to a friend or relatives’ home, 6% to a reception center/emergency shelter, 11% to a hotel, motel or campground, 7% to a second or seasonal home, less than 1% of households would not evacuate, and the remaining 27% answered other/don’t know to this question. See Figure F-13.

“How would you prefer to receive information regarding planning for emergencies from your county office of emergency management?” This question was asked to provide useful information to county emergency planners on how to provide emergency information to the EPZ residents. As shown in Figure F-14, 27% would prefer a detailed booklet, 13% would prefer an abbreviated booklet, 30% would prefer an E-mail, 12% would prefer to receive information from the county website, 8% would prefer a newsletter, 6% would prefer social media, and the remaining 4% would prefer a calendar, a cell phone, mail or other/don’t know.

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.

As discussed in Section F.3.1 and shown in Figure F-8, the majority (56.4%) of respondents indicated no commuters were impacted by the COVID-19 pandemic; therefore the results for the time distribution of commuters (time to prepare to leave work/college and time to travel home from work/college) were used, as is, in this study.

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-15 presents the cumulative distribution; in all cases, the activity is completed within 75 minutes. 85% can leave within 30 minutes.

“How long would it take the commuter to travel home?” Figure F-16 presents the work to home travel time for the EPZ. About 80% of commuters can arrive home within 60 minutes of leaving work; all within 120 minutes.

“How long would it take the family to pack clothing, secure the house, and load the car?” Figure F-17 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-17 has a long “tail.” About 90% of the households can be ready to leave home within 2 hours and 15 minutes; the remaining households require up to an additional 2 hours.

“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 may need to 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-18 presents the time distribution for removing 6 to 8 inches of snow from a driveway. Approximately 75% of driveways are passable within 90 minutes; the remaining households would require up to an additional two hours and 30 minutes to begin their evacuation trip. Thus, the last driveway is cleared 3 hours and 30 minutes after the start of this activity. Note that those respondents (about 5%) who answered that they would not take time to clear their driveway were assumed to be ready immediately at the start of this activity. Essentially, they would drive through the snow on the driveway to access the roadway and begin their evacuation trip.

Table F-1. Indian Point Demographic Survey Sampling Plan

Zip Code	2020 Population	2020 Households	Desired Sample Size	Achieved Sample Size
Orange County¹				
10910	34	3	0	0
10911	7	0	0	0
10917	544	179	1	3
10922	1,743	739	3	1
10926	30	2	0	0
10928	3,874	1,650	7	9
10930	2,293	714	3	10
10953	16	2	0	0
10987	169	70	0	1
10996	6,729	768	3	0
12518	639	271	1	1
<i>Orange County Subtotal:</i>	<i>16,078</i>	<i>4,398</i>	<i>18</i>	<i>25</i>
Putnam County				
10516	2,758	1,180	5	21
10524	4,329	1,534	7	25
10537	2,293	892	4	5
10541	3,086	1,021	4	9
10579	7,169	2,536	11	40
10588	73	20	0	2
<i>Putnam County Subtotal:</i>	<i>19,708</i>	<i>7,183</i>	<i>31</i>	<i>102</i>
Rockland County				
10901	2,876	815	4	9
10920	8,703	2,929	13	24
10923	9,124	3,032	13	20
10927	12,268	3,640	16	13
10952	3,727	816	4	8
10956	32,339	10,191	45	85
10960	153	51	0	1
10970	11,019	3,762	17	32
10974	0	0	0	0
10977	22,159	4,743	21	18
10980	13,349	4,624	20	29

¹ There are 14 ppl and 3 occupied housing units in Harriman State Park, where no zip code exists. These 14 people and 3 households were not included in this table.

Zip Code	2020 Population	2020 Households	Desired Sample Size	Achieved Sample Size
10984	3,100	958	4	7
10986	1,826	624	3	6
10989	6,300	2,209	10	20
10993	5,113	1,685	7	5
10994	391	121	1	0
<i>Rockland County Subtotal:</i>	<i>132,447</i>	<i>40,200</i>	<i>178</i>	<i>277</i>
Westchester County				
10501	1,507	466	2	0
10505	509	284	1	0
10510	9,114	3,334	15	19
10511	2,369	861	4	11
10514	1,948	561	2	1
10517	682	233	1	2
10520	12,967	5,280	23	55
10524	1	0	0	-. ²
10527	784	247	1	1
10535	551	230	1	0
10536	1,414	464	2	3
10537	257	54	0	-
10545	160	4	0	0
10546	1,381	483	2	2
10547	7,381	2,617	12	13
10548	3,913	1,268	6	14
10549	219	71	0	1
10562	34,329	11,955	53	58
10566	25,369	9,805	43	51
10567	20,292	6,767	30	76
10588	2,293	856	4	-
10596	1,519	601	3	2
10598	26,987	9,711	43	42
<i>Westchester County Subtotal:</i>	<i>155,946</i>	<i>56,152</i>	<i>248</i>	<i>351</i>
EPZ TOTAL	324,179	107,933	475	755
Average HH Size (Census):		3.00		

² Zip Codes 10524, 10537, and 10588 are in both Westchester and Putnam County. Given the uncertainty on which county these samples were collected, all samples for these zip codes were counted in Putnam County.

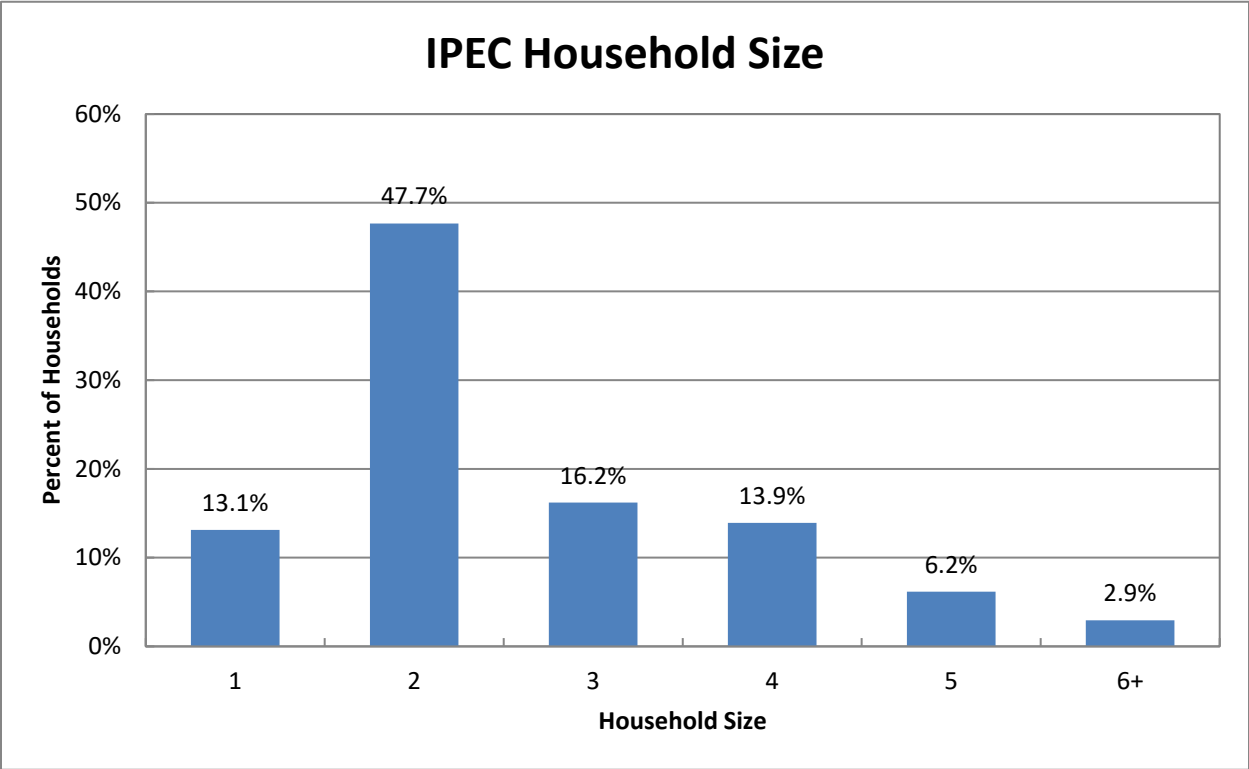


Figure F-1. Household Size in the EPZ

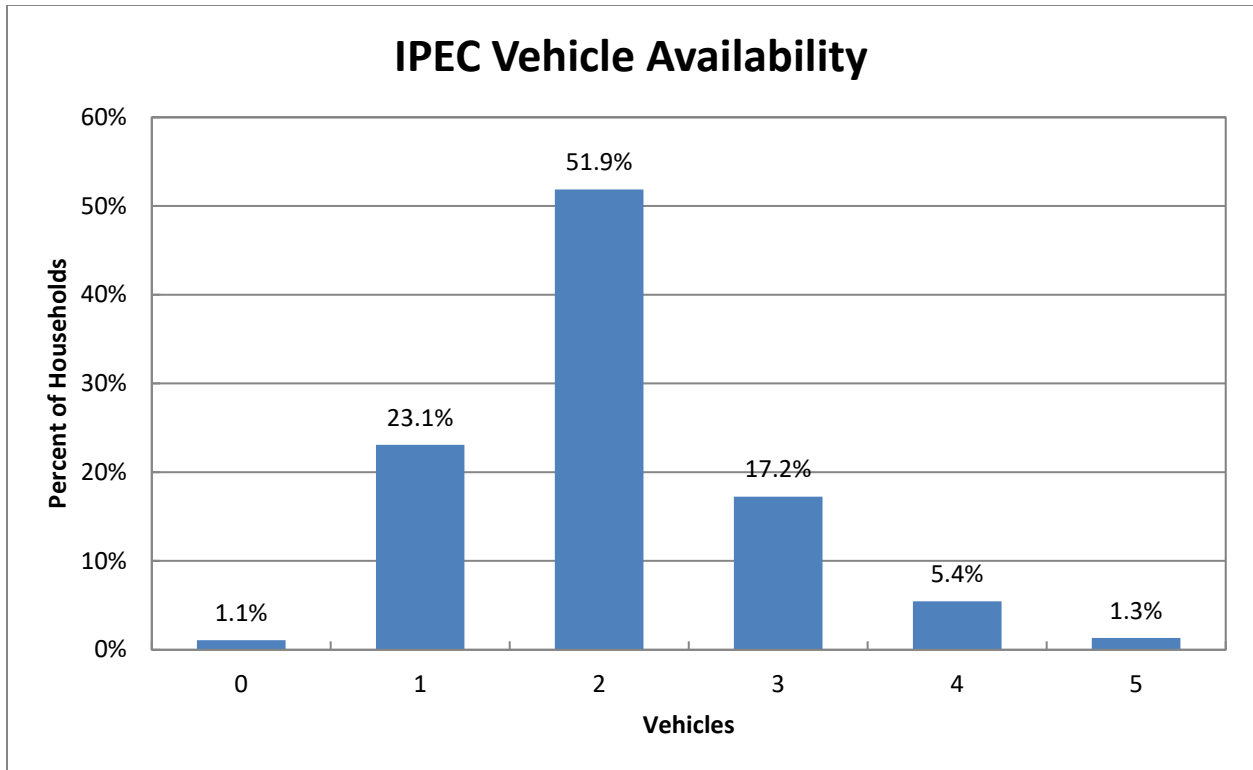


Figure F-2. Household Vehicle Availability

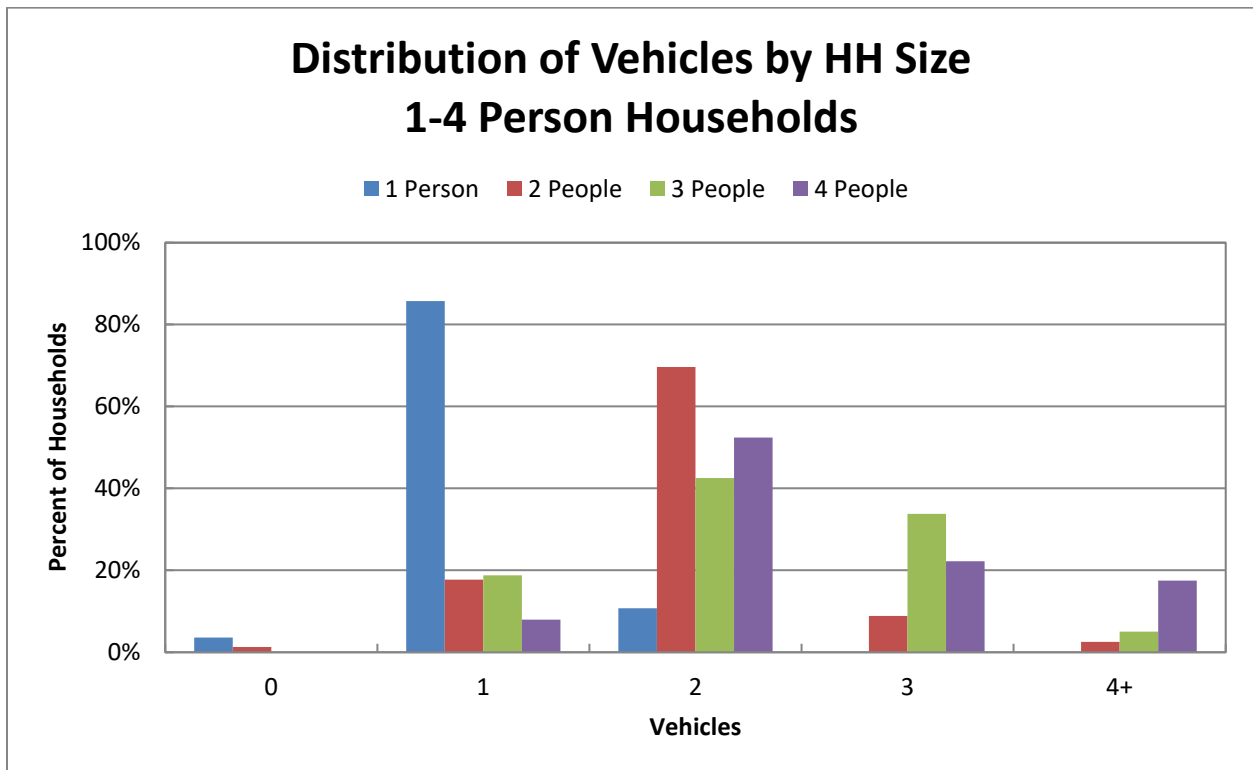


Figure F-3. Vehicle Availability - 1 to 4 Person Households

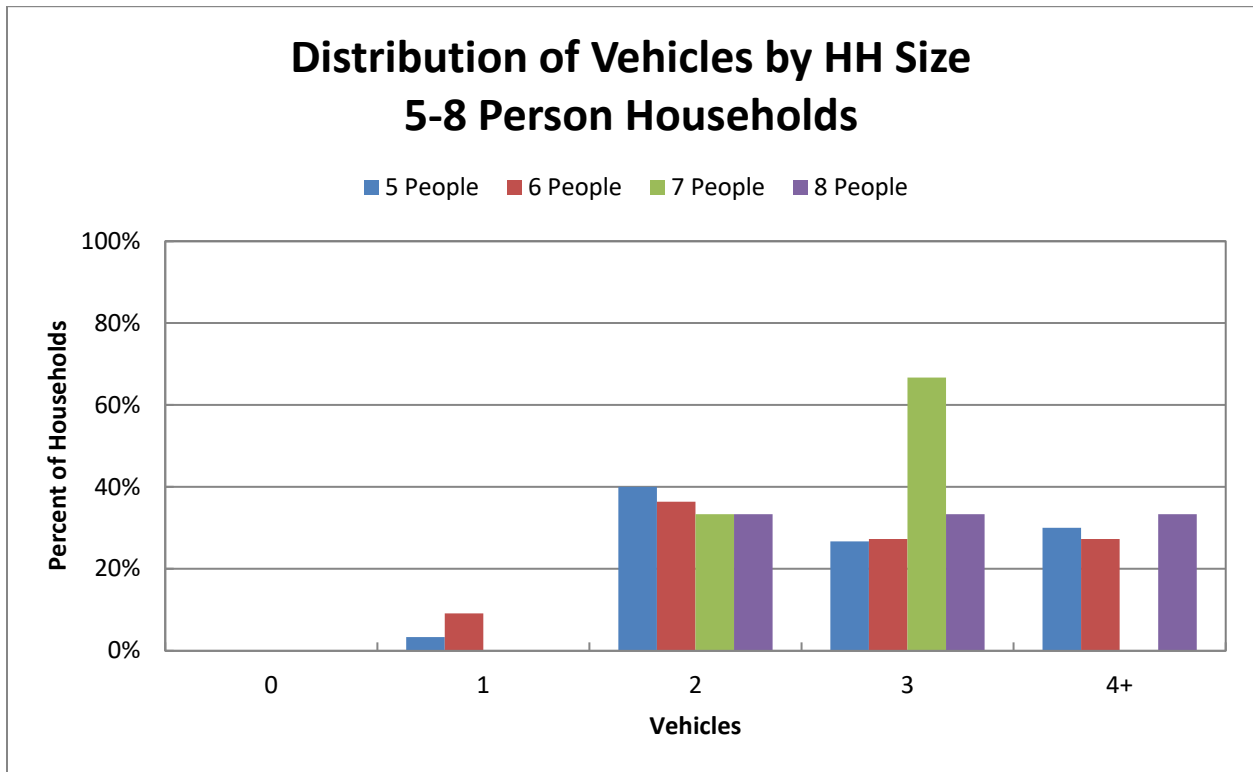


Figure F-4. Vehicle Availability - 5 to 8 Person Households

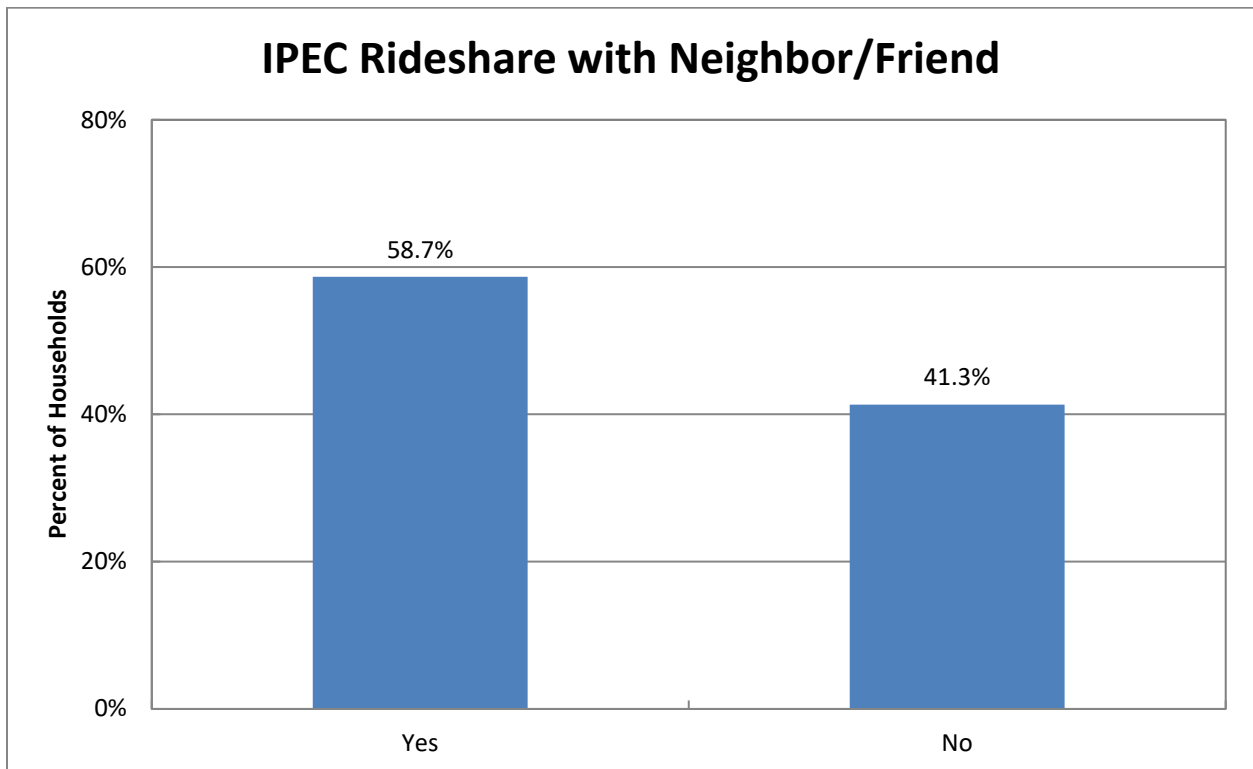


Figure F-5. Household Ridesharing Preference

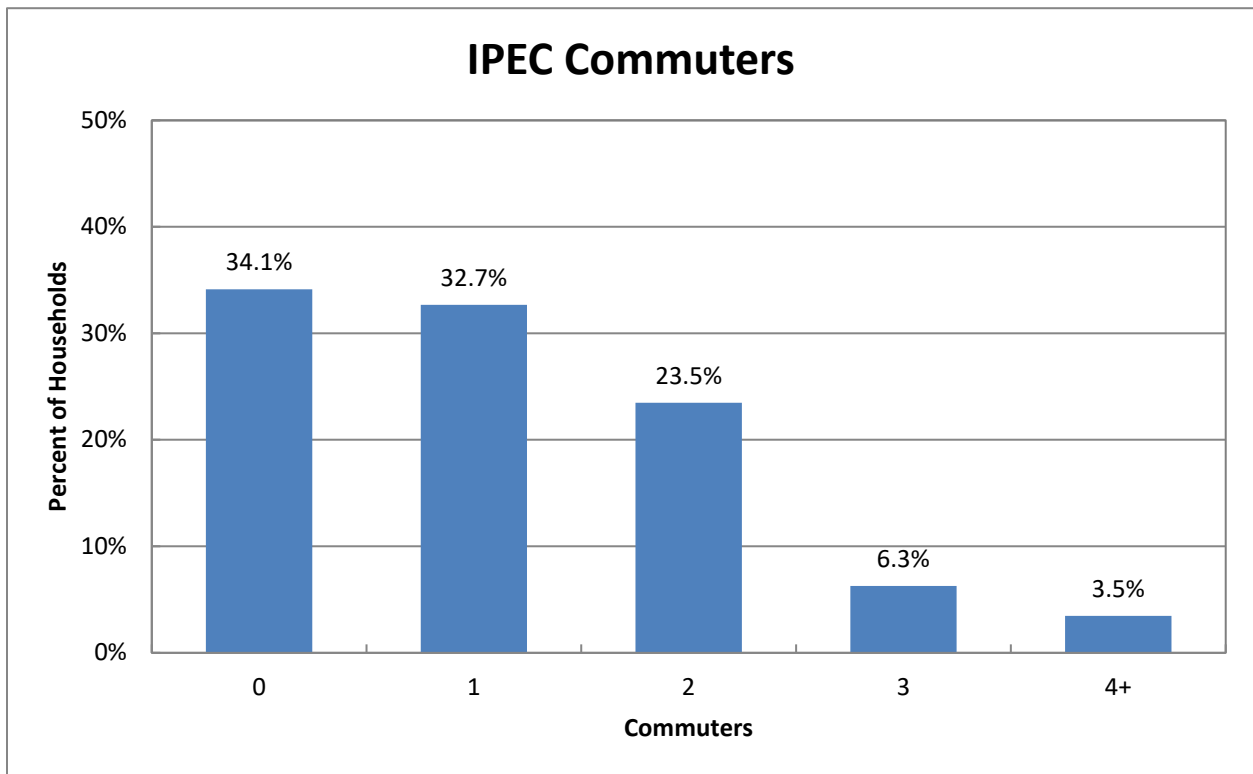


Figure F-6. Commuters in Households in the EPZ

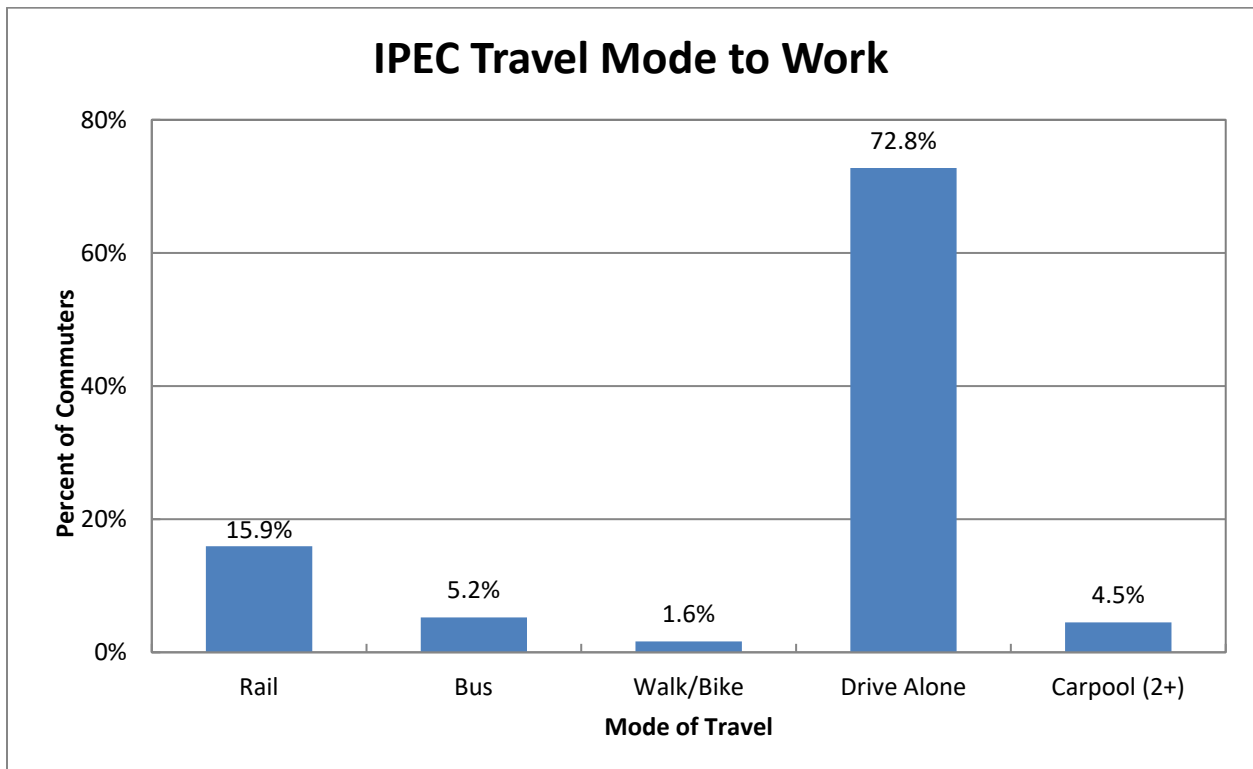


Figure F-7. Modes of Travel in the EPZ

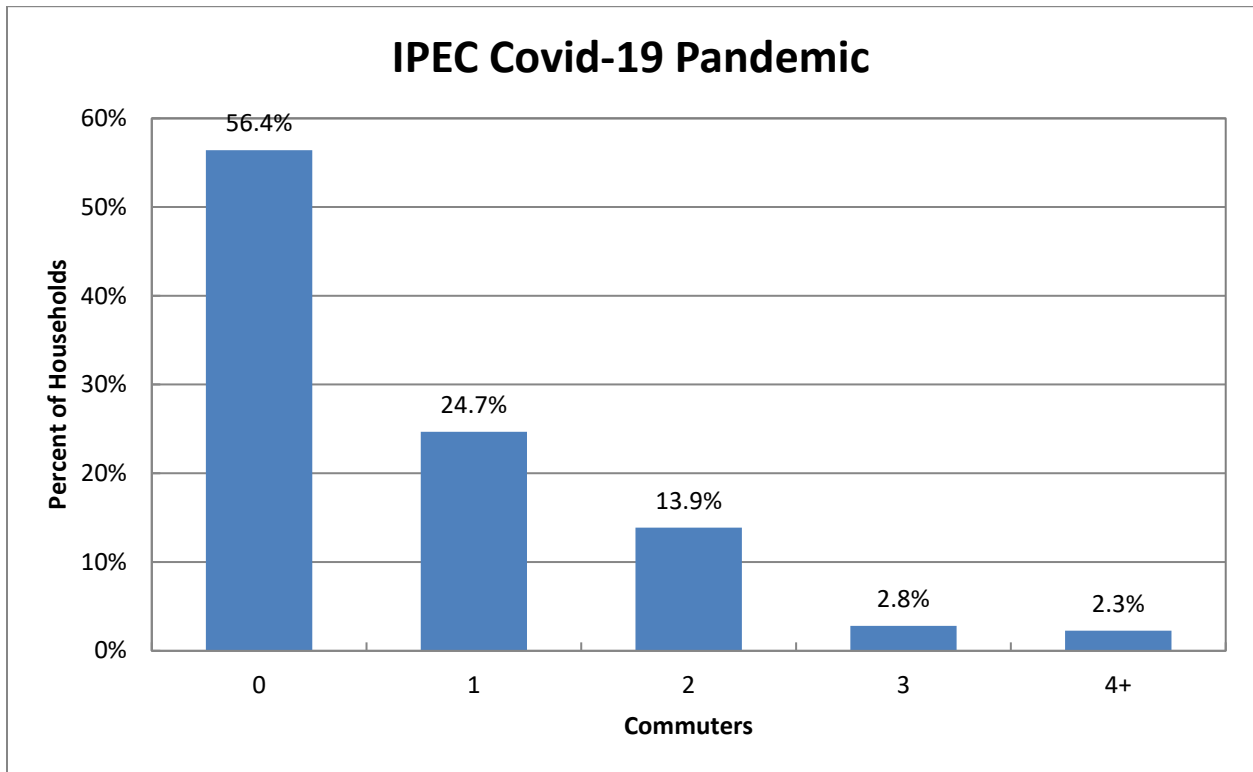


Figure F-8. Impact to Commuters due to the COVID-19 Pandemic

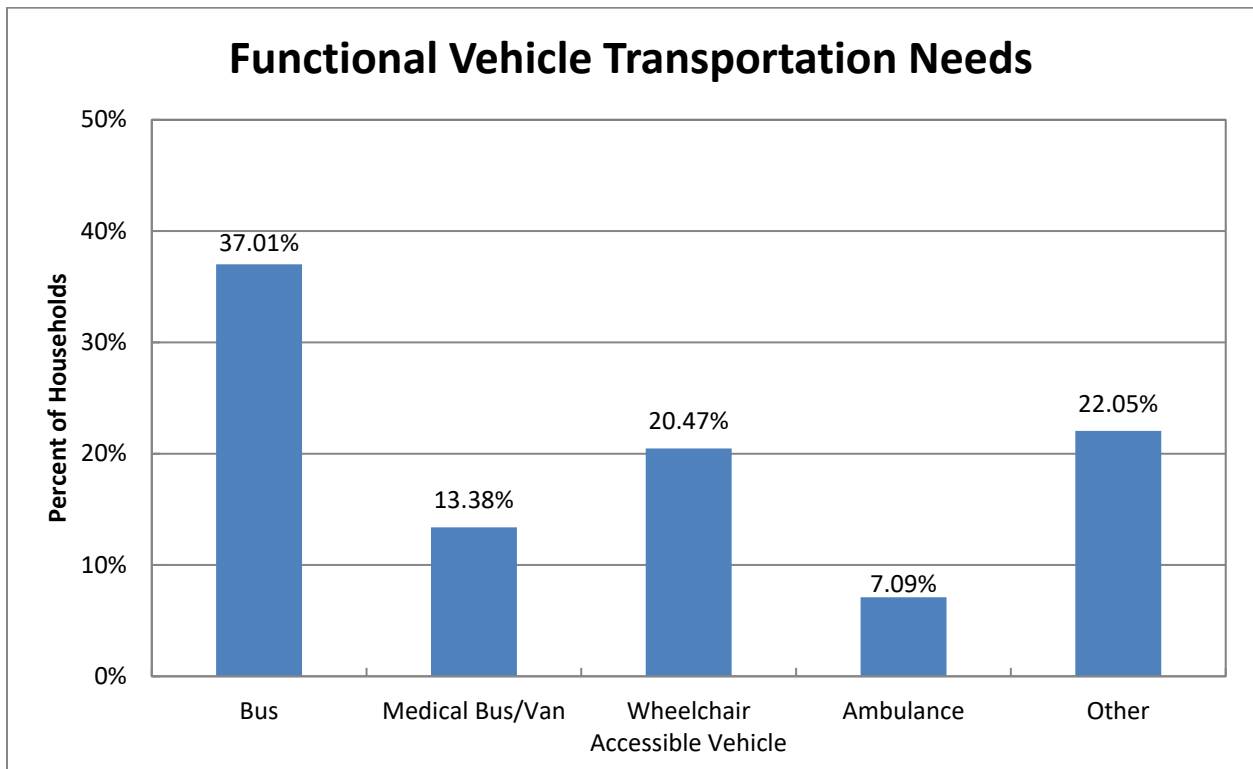


Figure F-9. Households with Functional or Transportation Needs

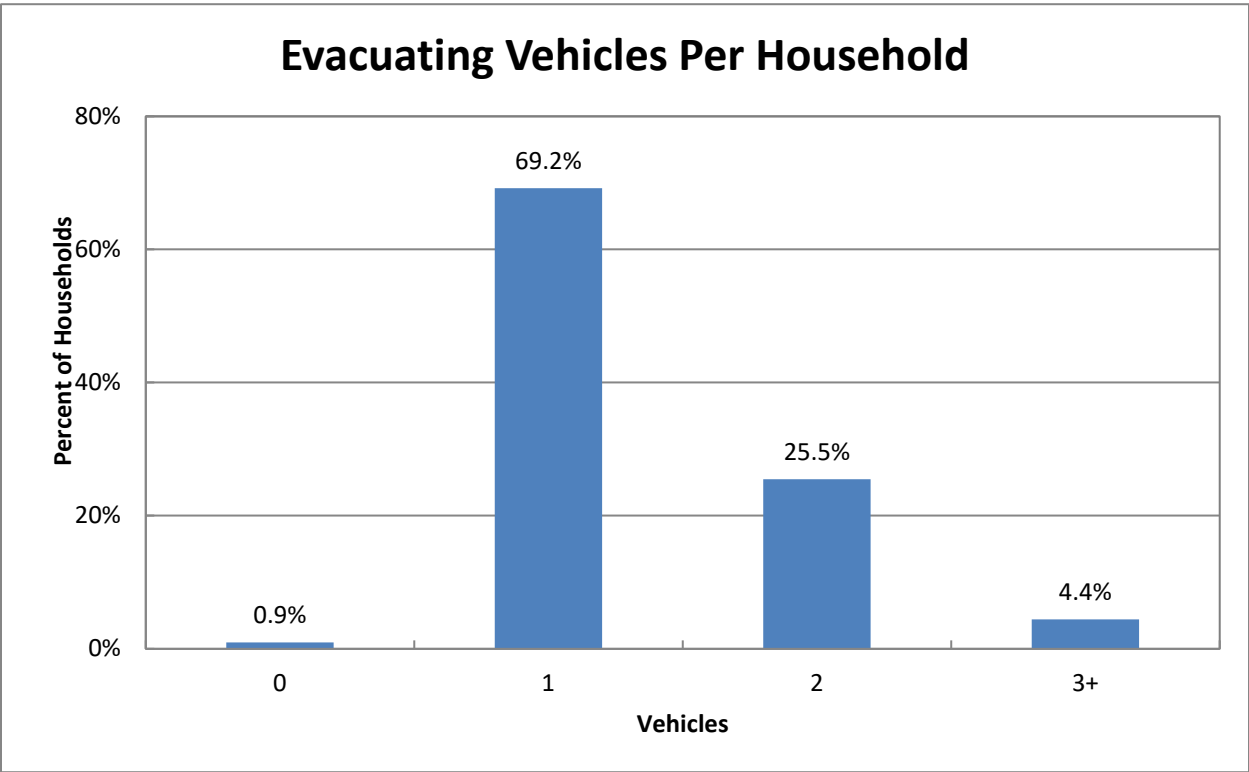


Figure F-10. Number of Vehicles Used for Evacuation

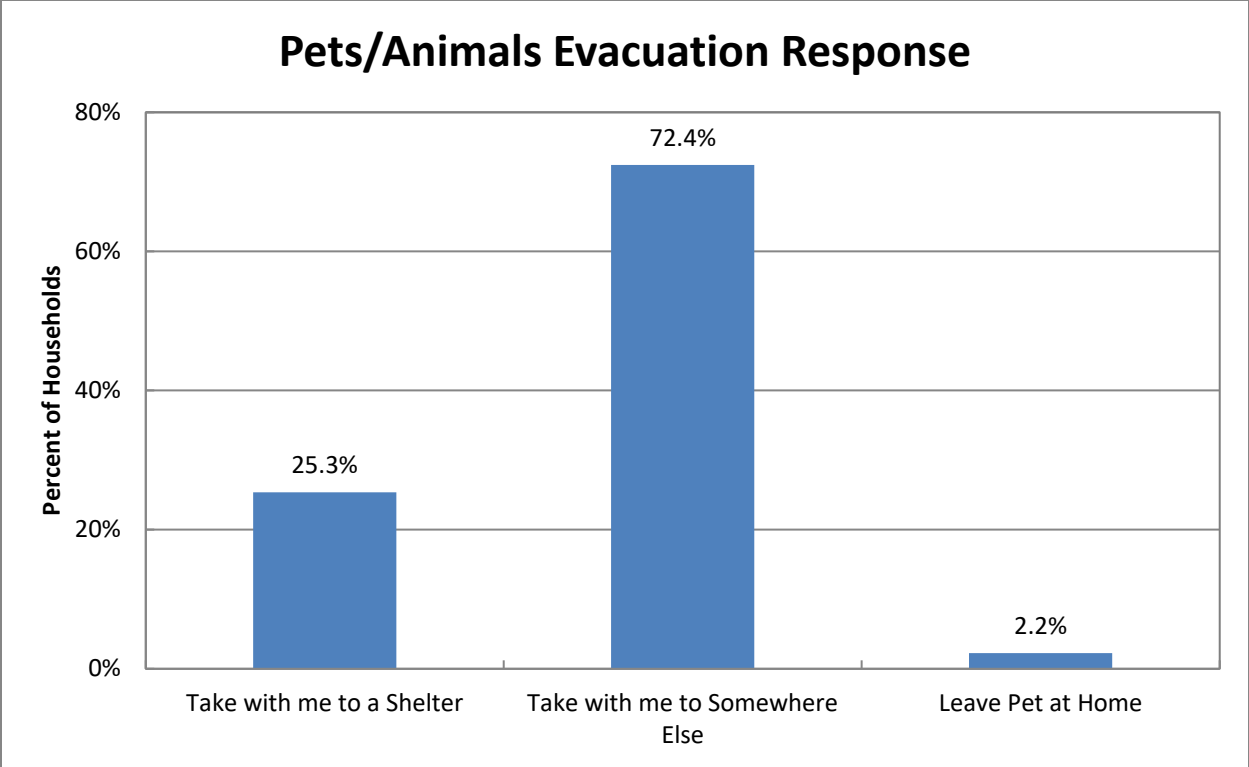


Figure F-11. Households Evacuating with Pets

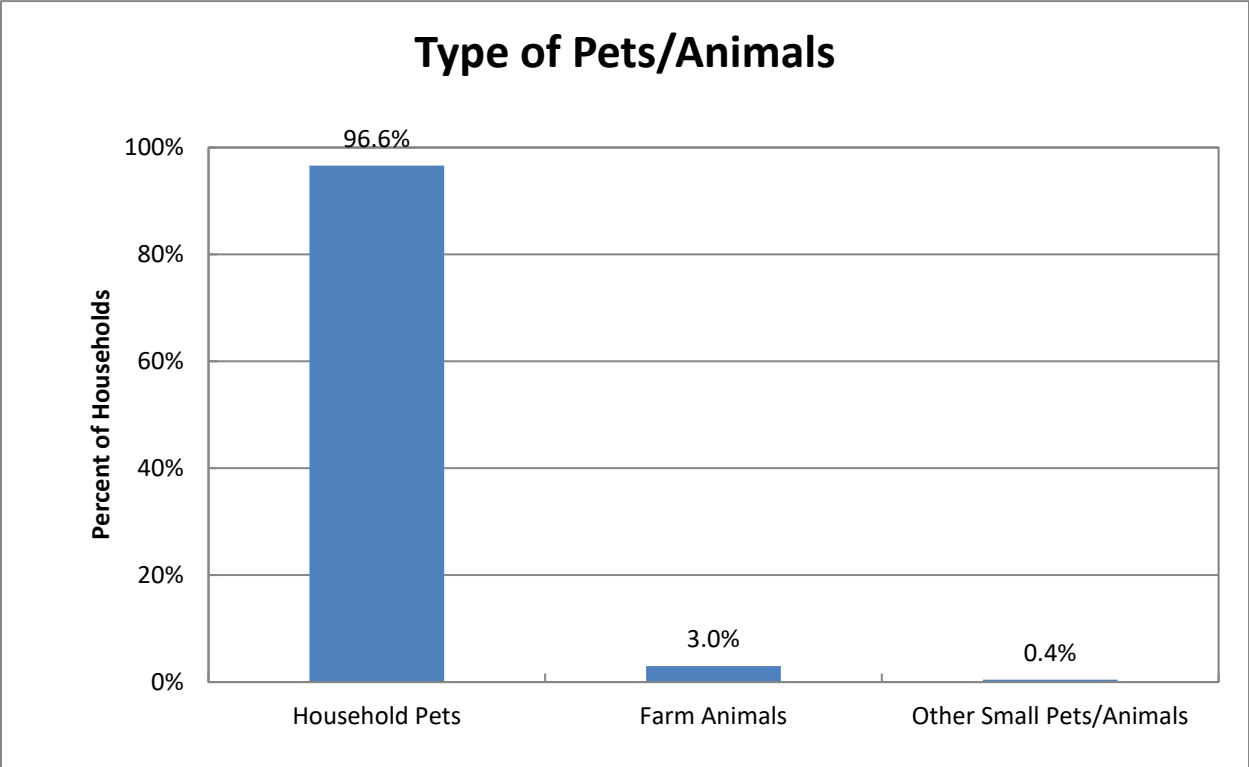


Figure F-12. Types of Pets/Animals

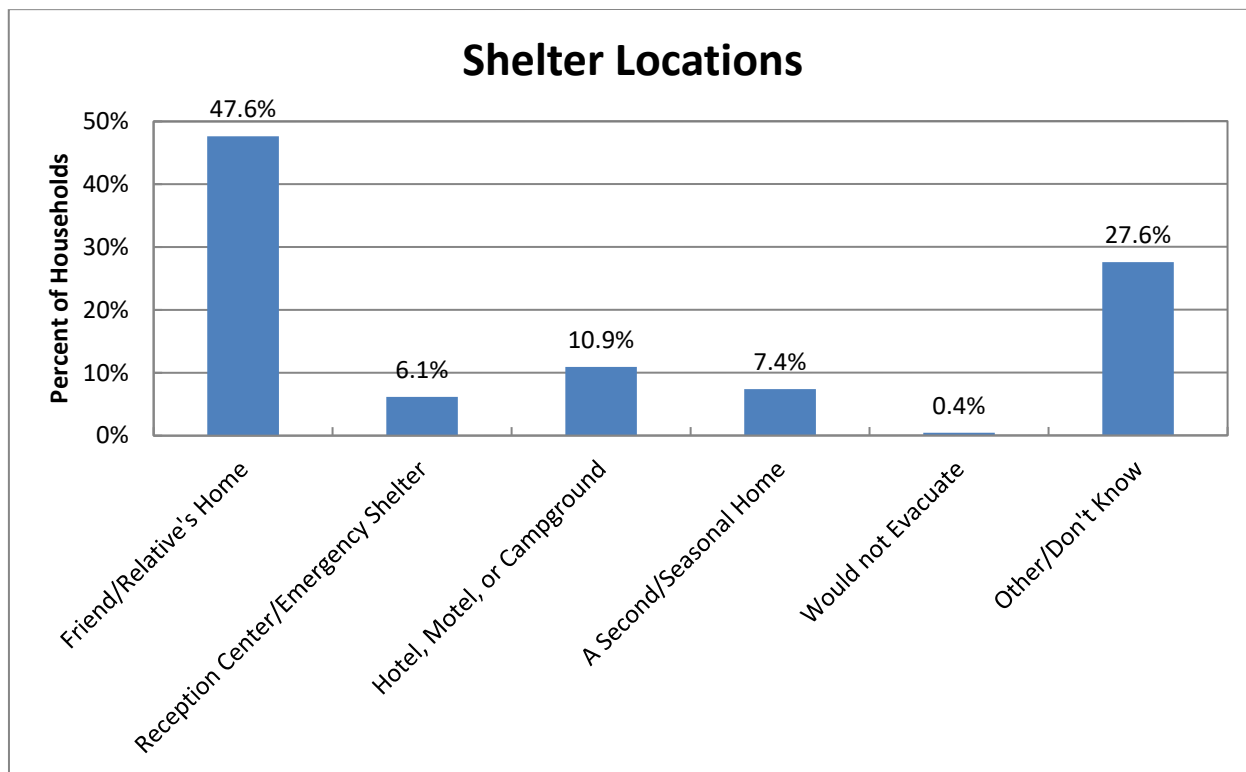


Figure F-13. Shelter Locations

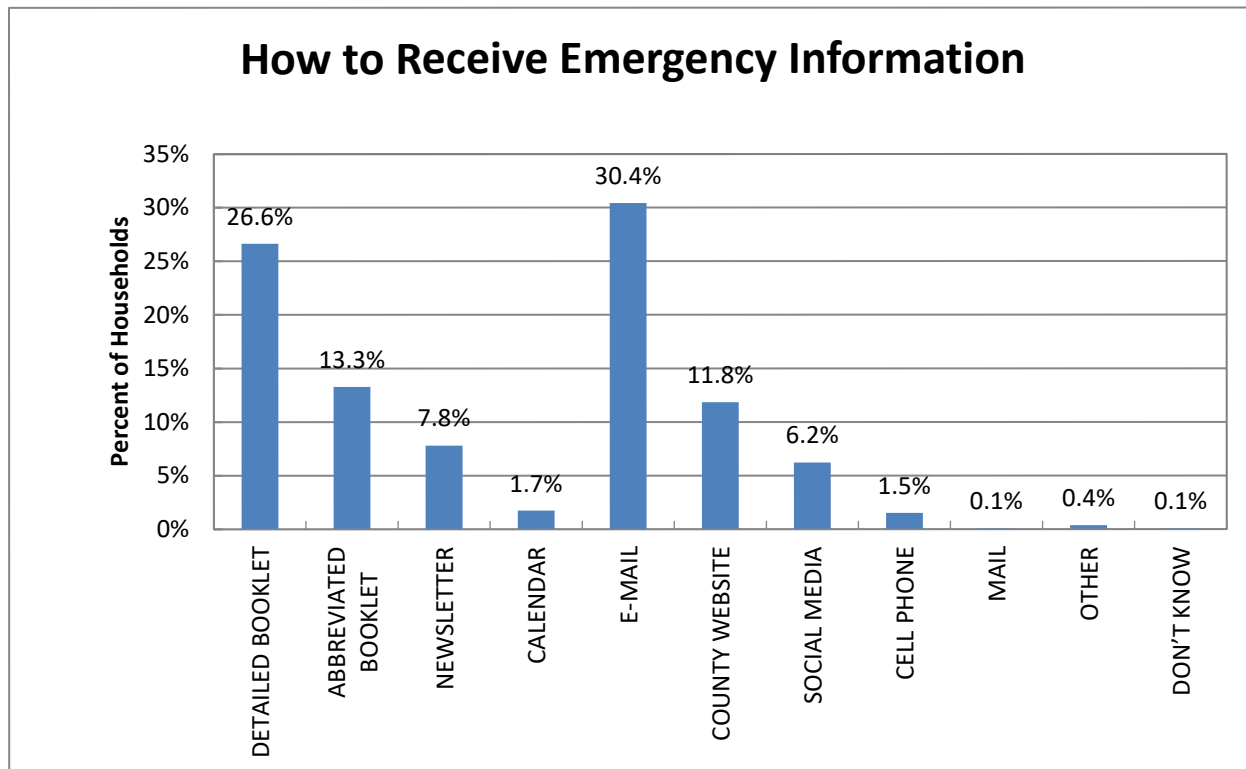


Figure F-14. How to Receive Emergency Information

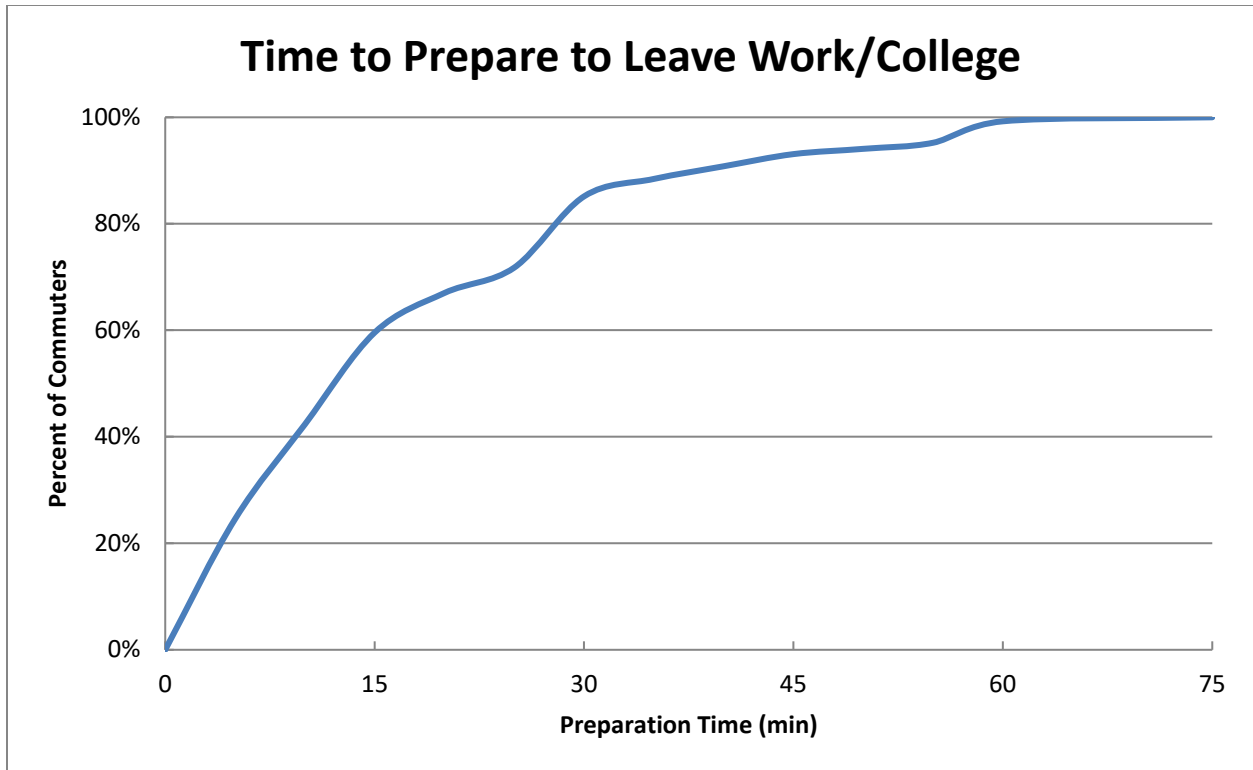


Figure F-15. Time Required to Prepare to Leave Work/School

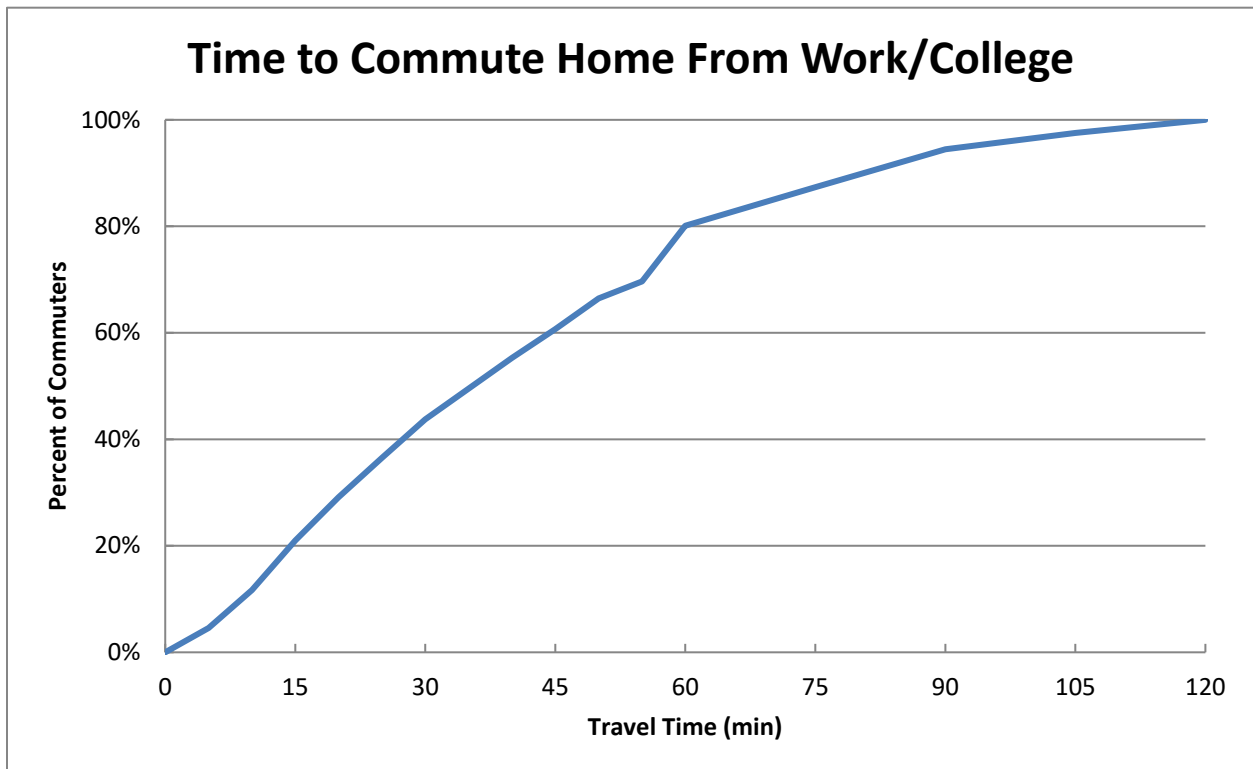


Figure F-16. Work to Home Travel Time

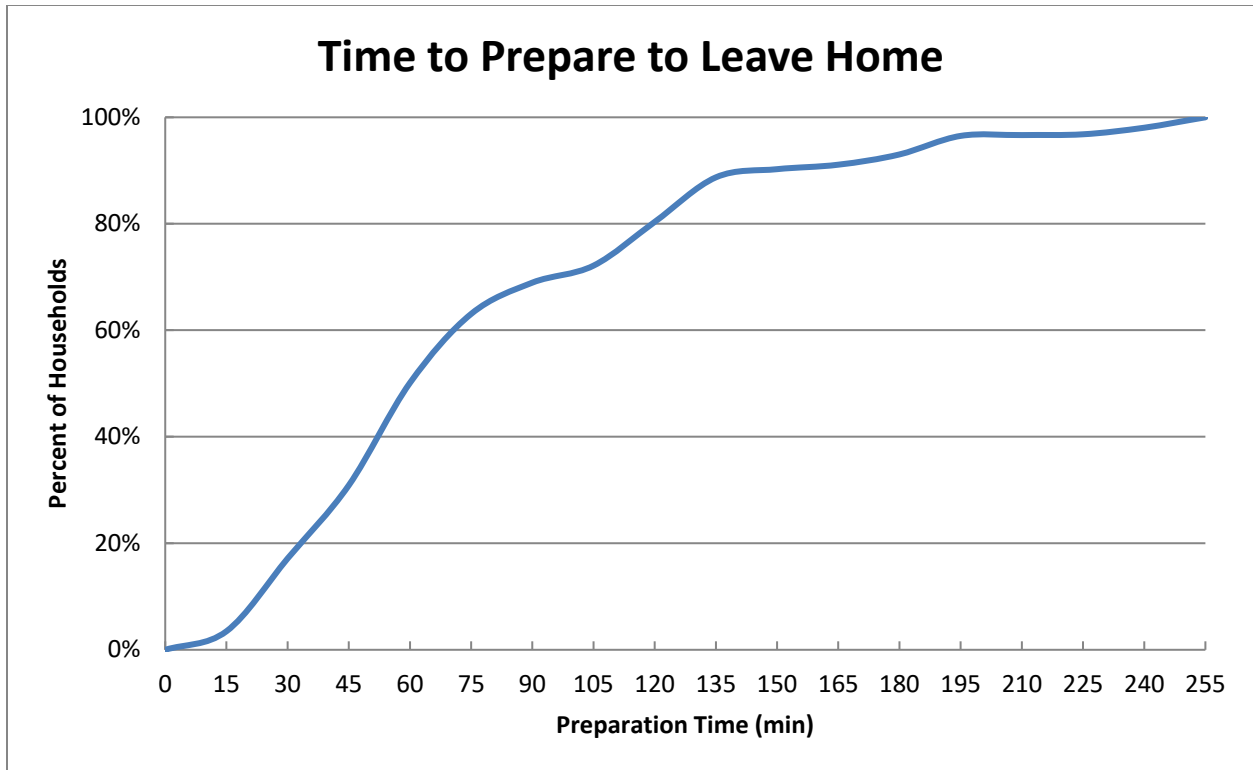


Figure F-17. Time to Prepare Home for Evacuation

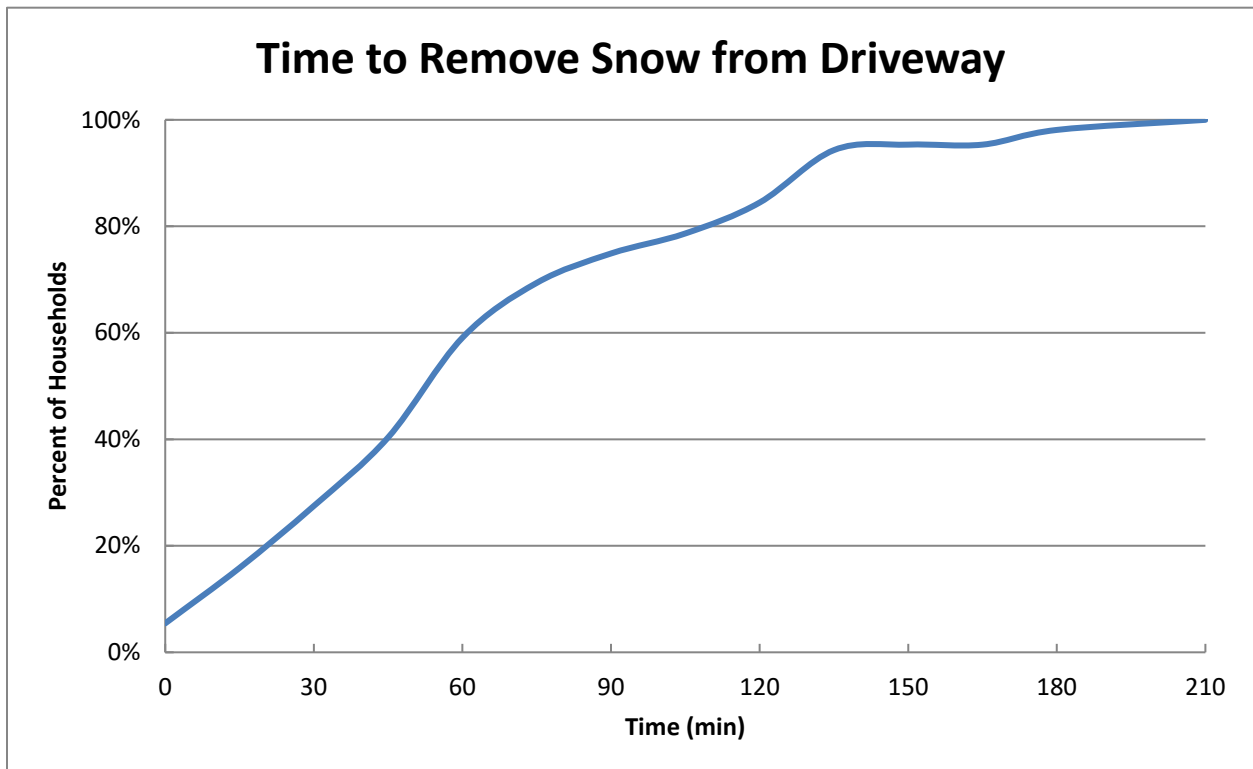


Figure F-18. Time to Clear Driveway of 6"-8" of Snow

ATTACHMENT A

Demographic Survey Instrument

County Emergency Response Demographic Survey

* Required

Purpose

The purpose of this survey is to identify local behavior during emergency situations. This survey is being conducted by a traffic engineering firm under contract with Holtec, new owner of the Indian Point Energy Center, and will be used to enhance emergency response plans in your area. **Please only complete one survey per household. Please have the head of the household (18 years or older) complete the survey.** Do not provide your name or any personal information, and the survey will take less than 5 minutes to complete.

1. 1. What is your gender?

Mark only one oval.

- ☐ Male
- ☐ Female
- ☐ Decline to State
- ☐ Other: _____

2. 2. What is your home zip code? *

3. 3A. In total, how many running cars, or other vehicles are usually available to the household?

Mark only one oval.

- ☐ ONE
- ☐ TWO
- ☐ THREE
- ☐ FOUR
- ☐ FIVE
- ☐ SIX
- ☐ SEVEN
- ☐ EIGHT
- ☐ NINE OR MORE
- ☐ ZERO (NONE)
- ☐ DECLINE TO STATE

4. 3B. In an emergency, could you get a ride out of the area with a neighbor or friend?

Mark only one oval.

- ☐ YES
- ☐ NO
- ☐ DECLINE TO STATE

5. 4. How many vehicles would your household use during an evacuation?

Mark only one oval.

- ☐ ONE
- ☐ TWO
- ☐ THREE
- ☐ FOUR
- ☐ FIVE
- ☐ SIX
- ☐ SEVEN
- ☐ EIGHT
- ☐ NINE OR MORE
- ☐ ZERO (NONE)
- ☐ I WOULD EVACUATE BY BICYCLE
- ☐ I WOULD EVACUATE BY BUS
- ☐ DECLINE TO STATE

6. 5. How many people usually live in this household?

Mark only one oval.

- ☐ ONE
- ☐ TWO
- ☐ THREE
- ☐ FOUR
- ☐ FIVE
- ☐ SIX
- ☐ SEVEN
- ☐ EIGHT
- ☐ NINE
- ☐ TEN
- ☐ ELEVEN
- ☐ TWELVE
- ☐ THIRTEEN
- ☐ FOURTEEN
- ☐ FIFTEEN
- ☐ SIXTEEN
- ☐ SEVENTEEN
- ☐ EIGHTEEN
- ☐ NINETEEN OR MORE
- ☐ DECLINE TO STATE

- Mark only one oval.

☐ ONE

☐ TWO

THREE

☐ FOUR OR MORE

☐ DECLINE TO STATE

- *

☐ ZERO *Skip to question 53*

☐ ONE *Skip to question 9*

☐ TWO *Skip to question 10*

☐ THREE *Skip to question 11*

☐ FOUR OR MORE *Skip to question 12*

☐ DECLINE TO STATE *Skip to question 53*

9. 8. Thinking about each commuter, how does each person usually travel to work or college?

[illegible]

Skip to question 13

Mode of Travel

10. 8. Thinking about each commuter, how does each person usually travel to work or college?

Mark only one oval per row.

	Rail	Bus	Walk/Bicycle	Drive Alone	Carpool-2 or more people	Don't know
Commuter 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuter 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Skip to question 15

Mode of Travel

11. 8. Thinking about each commuter, how does each person usually travel to work or college?

Mark only one oval per row.

	Rail	Bus	Walk/Bicycle	Drive Alone	Carpool-2 or more people	Don't know
Commuter 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuter 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuter 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Skip to question 19

Mode of Travel

12. 8. Thinking about each commuter, how does each person usually travel to work or college?

Mark only one oval per row.

	Rail	Bus	Walk/Bicycle	Drive Alone	Carpool-2 or more people	Don't know
Commuter 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuter 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuter 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Commuter 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Skip to question 25

Travel Home From Work/College

13. 9-1. How much time on average, would it take Commuter #1 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

14. If Over 2 Hours for Question 9-1, Specify Here
leave blank if your answer for Question 9-1, is under 2 hours.

Skip to question 33

Travel Home From Work/College

15. 9-1. How much time on average, would it take Commuter #1 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

16. If Over 2 Hours for Question 9-1, Specify Here
leave blank if your answer for Question 9-1, is under 2 hours.

17. 9-2. How much time on average, would it take Commuter #2 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

18. If Over 2 Hours for Question 9-2, Specify Here
leave blank if your answer for Question 9-2, is under 2 hours.

Skip to question 35

Travel Home From Work/College

19. 9-1. How much time on average, would it take Commuter #1 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

20. If Over 2 Hours for Question 9-1, Specify Here
leave blank if your answer for Question 9-1, is under 2 hours.

21. 9-2. How much time on average, would it take Commuter #2 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

22. If Over 2 Hours for Question 9-2, Specify Here
leave blank if your answer for Question 9-2, is under 2 hours.

23. 9-3. How much time on average, would it take Commuter #3 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

24. If Over 2 Hours for Question 9-3, Specify Here
leave blank if your answer for Question 9-3, is under 2 hours.

Skip to question 39

Travel Home From Work/College

25. 9-1. How much time on average, would it take Commuter #1 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

26. If Over 2 Hours for Question 9-1, Specify Here
leave blank if your answer for Question 9-1, is under 2 hours.

27. 9-2. How much time on average, would it take Commuter #2 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

28. If Over 2 Hours for Question 9-2, Specify Here
leave blank if your answer for Question 9-2, is under 2 hours.

29. 9-3. How much time on average, would it take Commuter #3 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

30. If Over 2 Hours for Question 9-3, Specify Here
leave blank if your answer for Question 9-3, is under 2 hours.

31. 9-4. How much time on average, would it take Commuter #4 to travel home from work or college?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

32. If Over 2 Hours for Question 9-4, Specify Here
leave blank if your answer for Question 9-4, is under 2 hours.

Skip to question 45

Preparation to leave Work/College

33. 10-1. Approximately how much time would it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

34. If Over 2 Hours for Question 10-1, Specify Here
leave blank if your answer for Question 10-1, is under 2 hours.

Skip to question 53

Preparation to leave Work/College

35. 10-1. Approximately how much time would it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

36. If Over 2 Hours for Question 10-1, Specify Here
leave blank if your answer for Question 10-1, is under 2 hours.

37. 10-2. Approximately how much time would it take Commuter #2 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

38. If Over 2 Hours for Question 10-2, Specify Here
leave blank if your answer for Question 10-2, is under 2 hours.

Skip to question 53

Preparation to leave Work/College

39. 10-1. Approximately how much time would it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

40. If Over 2 Hours for Question 10-1, Specify Here
leave blank if your answer for Question 10-1, is under 2 hours.

41. 10-2. Approximately how much time would it take Commuter #2 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

42. If Over 2 Hours for Question 10-2, Specify Here
leave blank if your answer for Question 10-2, is under 2 hours.

43. 10-3. Approximately how much time would it take Commuter #3 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

44. If Over 2 Hours for Question 10-3, Specify Here
leave blank if your answer for Question 10-3, is under 2 hours.

Skip to question 53

Preparation to leave Work/College

45. 10-1. Approximately how much time would it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

46. If Over 2 Hours for Question 10-1, Specify Here
leave blank if your answer for Question 10-1, is under 2 hours.

47. 10-2. Approximately how much time would it take Commuter #2 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

48. If Over 2 Hours for Question 10-2, Specify Here
leave blank if your answer for Question 10-2, is under 2 hours.

49. 10-3. Approximately how much time would it take Commuter #3 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

50. If Over 2 Hours for Question 10-3, Specify Here
leave blank if your answer for Question 10-3, is under 2 hours.

51. 10-4. Approximately how much time would it take Commuter #4 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- ☐ 5 MINUTES OR LESS
- ☐ 6-10 MINUTES
- ☐ 11-15 MINUTES
- ☐ 16-20 MINUTES
- ☐ 21-25 MINUTES
- ☐ 26-30 MINUTES
- ☐ 31-35 MINUTES
- ☐ 36-40 MINUTES
- ☐ 41-45 MINUTES
- ☐ 46-50 MINUTES
- ☐ 51-55 MINUTES
- ☐ 56 - 1 HOUR
- ☐ OVER 1 HOUR, BUT LESS THAN 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
- ☐ OVER 2 HOURS
- ☐ DECLINE TO STATE

52. If Over 2 Hours for Question 10-4, Specify Here
leave blank if your answer for Question 10-4, is under 2 hours.

Skip to question 53

Additional Questions

53. 11. If you were advised by local authorities to evacuate, how much time would it take the household to pack clothing, medications, secure the house, load the car, and complete preparations prior to evacuating the area?

Mark only one oval.

- ☐ LESS THAN 15 MINUTES
- ☐ 15-30 MINUTES
- ☐ 31-45 MINUTES
- ☐ 46 MINUTES - 1 HOUR
- ☐ 1 HOUR TO 1 HOUR 15 MINUTES
- ☐ 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
- ☐ 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
- ☐ 1 HOUR 46 MINUTES TO 2 HOURS
- ☐ 2 HOURS TO 2 HOURS 15 MINUTES
- ☐ 2 HOURS 16 MINUTES TO 2 HOURS 30 MINUTES
- ☐ 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES
- ☐ 2 HOURS 46 MINUTES TO 3 HOURS
- ☐ 3 HOURS TO 3 HOURS 15 MINUTES
- ☐ 3 HOURS 16 MINUTES TO 3 HOURS 30 MINUTES
- ☐ 3 HOURS 31 MINUTES TO 3 HOURS 45 MINUTES
- ☐ 3 HOURS 46 MINUTES TO 4 HOURS
- ☐ 4 HOURS TO 4 HOURS 15 MINUTES
- ☐ 4 HOURS 16 MINUTES TO 4 HOURS 30 MINUTES
- ☐ 4 HOURS 31 MINUTES TO 4 HOURS 45 MINUTES
- ☐ 4 HOURS 46 MINUTES TO 5 HOURS
- ☐ 5 HOURS TO 5 HOURS 30 MINUTES
- ☐ 5 HOURS 31 MINUTES TO 6 HOURS
- ☐ OVER 6 HOURS
- ☐ WILL NOT EVACUATE
- ☐ DECLINE TO STATE

54. If Over 6 Hours for Question 11, Specify Here

leave blank if your answer for Question 11, is under 6 hours.

55. 12. If there are 6-8 inches of snow on your driveway or curb, would you need to shovel out to evacuate? If yes, how much time, on average, would it take you to clear the 6-8 inches of snow to move the car from the driveway or curb to begin the evacuation trip? Assume the roads are passable.

Mark only one oval.

- ☐ LESS THAN 15 MINUTES
- ☐ 15-30 MINUTES
- ☐ 31-45 MINUTES
- ☐ 46 MINUTES – 1 HOUR
- ☐ 1 HOUR TO 1 HOUR 15 MINUTES
- ☐ 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
- ☐ 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
- ☐ 1 HOUR 46 MINUTES TO 2 HOURS
- ☐ 2 HOURS TO 2 HOURS 15 MINUTES
- ☐ 2 HOURS 16 MINUTES TO 2 HOURS 30 MINUTES
- ☐ 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES
- ☐ 2 HOURS 46 MINUTES TO 3 HOURS
- ☐ NO, WILL NOT SHOVEL OUT
- ☐ OVER 3 HOURS
- ☐ NOT ABLE TO SHOVEL DRIVEWAY/WILL NEED A RIDE/TRANSPORTATION
- ☐ DECLINE TO STATE

56. If Over 3 Hours for Question 12, Specify Here

leave blank if your answer for Question 12, is under 3 hours.

57. 13. Please specify the number of people in your household who require Functional or Transportation needs in an evacuation:

Mark only one oval per row.

	0	1	2	3	4	More than 4
Bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Medical Bus/Van	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wheelchair Accessible Vehicle	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ambulance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

58. Specify "Other" Transportation Need Below

59. 14. Please choose one of the following:

Mark only one oval.

- ☐ I would await the return of household members to evacuate together.
- ☐ I would evacuate independently and meet other household members later.
- ☐ Decline to State

60. 15A. Emergency officials advise you to shelter-in-place in an emergency because you are not in the area of risk. Would you:

Mark only one oval.

- ☐ SHELTER-IN-PLACE
☐ EVACUATE
☐ DECLINE TO STATE

61. 15B. Emergency officials advise you to shelter-in-place now in an emergency and possibly evacuate later while people in other areas are advised to evacuate now. Would you:

Mark only one oval.

- ☐ SHELTER-IN-PLACE
☐ EVACUATE
☐ DECLINE TO STATE

62. 15C. Emergency officials advise you to evacuate due to an emergency. Where would you evacuate to?

Mark only one oval.

- ☐ A RELATIVE'S OR FRIEND'S HOME
☐ A RECEPTION CENTER/EMERGENCY SHELTER
☐ A HOTEL, MOTEL OR CAMPGROUND
☐ A SECOND/SEASONAL HOME
☐ WOULD NOT EVACUATE
☐ DON'T KNOW
☐ OTHER (Specify Below)
☐ DECLINE TO STATE

63. Fill in OTHER answers for question 15C

64. 16. How would you prefer to receive information regarding planning for emergencies from your county office of emergency management?

Check all that apply.

- ☐ DETAILED BOOKLET
- ☐ ABBREVIATED BOOKLET
- ☐ NEWSLETTER
- ☐ CALENDAR
- ☐ E-MAIL
- ☐ COUNTY WEBSITE
- ☐ SOCIAL MEDIA
- ☐ DECLINE TO STATE
- ☐ Other: _____

Pet Questions

65. 17A. Do you have any pet(s) and/or animal(s)?

Mark only one oval.

- ☐ YES
- ☐ NO
- ☐ DECLINE TO STATE

Pet Questions

66. 17B. What type of pet(s) and/or animal(s) do you have?

Check all that apply.

- ☐ DOG
- ☐ CAT
- ☐ BIRD
- ☐ REPTILE
- ☐ HORSE
- ☐ FISH
- ☐ CHICKEN
- ☐ GOAT
- ☐ PIG
- ☐ OTHER SMALL PETS/ANIMALS (Specify Below)
- ☐ OTHER LARGE PETS/ANIMALS (Specify Below)
- ☐ Other: _____

67. *Mark only one oval.*

☐ DECLINE TO STATE

Pet Questions

68. 17C. What would you do with your pet(s) and/or animal(s) if you had to evacuate?

Mark only one oval.

- ☐ TAKE PET WITH ME TO A SHELTER
- ☐ TAKE PET WITH ME SOMEWHERE ELSE
- ☐ LEAVE PET AT HOME
- ☐ DECLINE TO STATE

Pet Questions

69. 17D. Do you have sufficient room in your vehicle(s) to evacuate with your pet(s) and/or animal(s)?

Mark only one oval.

☐ YES

☐ NO

☐ DECLINE TO STATE

☐ Other: _____

APPENDIX G

Traffic Management Plan

G. TRAFFIC MANAGEMENT PLAN

NUREG/CR-7002, Rev. 1 indicates that the existing Traffic Management Plans (TMP) consisting of Traffic Control Points (TCPs) and Access Control Points (ACPs) identified by the offsite agencies should be used in the evacuation simulation modeling. The TMPs for the EPZ were provided by each county.

These TMPs were reviewed and were modeled accordingly. An analysis of the TCP and ACP locations was performed, and it was determined to model the ETE simulations with the existing TCPs and ACPs that were documented in the county emergency plans, with no additional TCPs or ACPs recommended. Figure G-1 through Figure G-6 maps the existing TCPs and ACPs.

The TCPs and ACPs are forms of manual traffic control (MTC). As discussed in Section 9, MTC at intersections (which are controlled) are modeled as actuated traffic signals. If an intersection has a pre-timed signal, stop, or yield control, and the intersection is identified as a TCP or ACP, the control type was changed to an actuated signal in the DYNEV II system, in accordance with Section 3.3 of NUREG/CR-7002, Rev. 1. TCPs and ACPs at existing actuated traffic signalized intersections were essentially left alone except where modifications to green time allocation were deemed necessary.

Table K-1 provides the control type and number of nodes with each control type in the analysis network. Table G-1 through Table G-4 identify the TCP and ACPs for each county within the EPZ. No additional locations for MTC are suggested as a result of the ETE simulations in this study.

G.1 Access Control Points

It is assumed that the ACPs will be established within 120 minutes of the ATE to discourage through travelers from using the major through routes which traverse the EPZ. As discussed in Section 3.11, external traffic was considered on I-84, I-684, I-287, I-87, the Taconic State Parkway, the Saw Mill Parkway, the Sprain Brook Parkway and the Palisades Parkway in this analysis.

Table G-1. Orange County Traffic and Access Control Points

TCP ID	Intersection	Priority	Protective Action Area
O-1	Bear Mountain Circle	1	Bear Mountain State Park
O-2	Route 9W & Firefighter's Memorial Dr	3	Fort Montgomery
O-3	Route 9W & Montgomery Rd	3	Fort Montgomery
O-4	S Main St (Rte 218) & Route 9W	2	Fort Montgomery
O-5	Route 293/218 & Route 9W	2	U.S. Military Academy
O-6	Angola Rd (CR 9) & Route 9W	2	Shadow Region
O-7	Route 9W & Forge Hill Rd (CR 74)	2	Shadow Region
O-8	Route 9W & Union Ave (CR 69)	1	Shadow Region
O-9	Route 9W & Quassaick Ave (Route 94)	1	Shadow Region
O-10	Route 9W & Broadway (Rte 17K)	2	Shadow Region
O-11	Route 300, Route 32, & Route 94 -- Five Corners	1	Shadow Region
O-12	Temple Hill Rd (Rte 300) & Union Ave (CR 69)	2	Shadow Region
O-13	Temple Hill Rd (Rte 300) & Little Britain Rd (Rte 207)	2	Shadow Region
O-14	Palisades Pkwy - Exit 19	3	Harriman State Park
O-15	Palisades Pkwy - Exit 18	1	Harriman State Park
O-16	Silver Mine Circle	1	Harriman State Park
O-17	Palisades Pkwy Northbound - Exit 18	1	Harriman State Park
O-18	Averill Ave (Rte 32) & Smith Clove Rd (CR 9)	2	Shadow Region
O-19	Averill Ave (Rte 32) & Route 6/17	1	Shadow Region
O-20	Route 106 & Route 17 Access Rd	2	Shadow Region
ACP ID	Intersection	Priority	Protective Action Area
O-1	Bear Mountain Circle	1	Bear Mountain State Park
O-6	Angola Rd (CR 9) & Route 9W	2	Shadow Region
O-11	Route 300, Route 32, & Route 94 -- Five Corners	1	Shadow Region
O-18	Averill Ave (Rte 32) & Smith Clove Rd (CR 9)	2	Shadow Region
O-19	Averill Ave (Rte 32) & Route 6/17	1	Shadow Region
O-20	Route 106 & Route 17 Access Rd	2	Shadow Region
O-21	Route 32 & County Route 107	2	Shadow Region
O-22	Route 6/17 - Exit 130A	1	Shadow Region
O-23	Arden Rd & Route 17	2	Shadow Region
O-24	Arden Valley Rd & Route 17	2	Shadow Region

Table G-2. Putnam County Traffic and Access Control Points

TCP/ACP ID	Intersection	Priority	Protective Action Area
P-TC/AC-1	Peekskill Hollow Rd (CR 21) & Oscawana Lake Rd (CR 20)	2	Southern Putnam Valley
P-TC/AC-2	US 9 & NY 403	1	Lower Philipstown
P-TC/AC-3	NY 9D & NY 403	1	Lower Philipstown
P-TC-4	Peekskill Hollow Rd (CR 21) & Church Rd (CR 22) & Mill St (CR 23)	2	Southern Putnam Valley
P-TC-5	NY 9D & Peekskill Rd	1	Southern Philipstown
P-TC/AC-6	Gallows Hill Rd (CR 13) & Sprout Brook Rd	1	Lower Philipstown
P-TC-7	Gleneida Ave (NY 52) & RT 301/Fair St	2	Shadow Region
P-TC/AC-8	Lake Secor Rd (CR 30) & NY 6N	2	Shadow Region
P-TC-9	US 6 & S Lake Blvd (NY 6N)/Bucks Hollows Rd	1	Shadow Region
P-TC-10	US 6 & Cooney Rd	2	Shadow Region
P-TC-11	US 6 & Church St	2	Shadow Region
P-TC/AC-12	US 6 & NY 52	2	Shadow Region
P-TC/AC-13	US 9 (Albany Post Rd) & NY 301	1	Shadow Region
P-TC/AC-14	US 6 & Miller Rd	2	Shadow Region
P-TC/AC-15	NY 301 & Taconic State Pkwy	2	Shadow Region
P-TC/AC-16	NY 301 & Peekskill Hollow Rd	1	Shadow Region

Table G-3. Rockland County Traffic and Access Control Points

TCP/ACP ID ¹	Intersection	Priority	Protective Action Area
PK-10	Germonds Road/Palisades Pkwy Exit 10 & N Little Torr Rd	1	Central Town of Clarkstown
PK-11	Palisades Parkway Exit 11	1	Northeastern Town of Ramapo
R-101	Strawtown Road/Sickletown Road and Route 59	1	Shadow Region
TACP-R-14	Route 9W and Route 304	1	Northeastern & Eastern Town of Clarkstown
R-57	New Clarkstown Road and Route 59	1	Shadow Region
R-82	Route 9W and Route 303	1	Northeastern & Eastern Town of Clarkstown
TWY-11E	Route 59 & Access Ramps to I-87/287 E	1	Shadow Region
TWY-11W	Route 9W & Access Ramps to I-87/287 W	1	Shadow Region
TWY-12	NYS Thruway Exit 12	1	Shadow Region
TWY-13 & PK-9	NYS Thruway Exit 13 & Palisades Pkwy Exit 9	1	Shadow Region
TWY-14	Route 59 & Access Ramps to I-87/287	1	Shadow Region
R-100	Strawtown Road and Route 59A	2	Shadow Region
R-15	Route 303 and Storms Road/Crusher Road	2	Shadow Region

¹ Any TCP/ACP ID that is considered both a TCP and a ACP is designated as a TACP in this column.

TCP/ACP ID ¹	Intersection	Priority	Protective Action Area
R-17	Route 304 and South Main Street	2	Central Town of Clarkstown
TACP-R-18	Route 304 and Germonds Road	2	Shadow Region
R-21	Route 303 and Lake Road North	2	Northeastern & Eastern Town of Clarkstown
R-22	Route 303 and Lake Road South	2	Northeastern & Eastern Town of Clarkstown
R-229	Eckerson Road and W. Clarkstown Road	2	Central Town of Clarkstown
R-264	Route 9W and Birchwood Avenue	2	Shadow Region
TACP-R-272	N. Little Tor Road and Phillips Hill Road	2	Central Town of Clarkstown
R-30	N. Little Tor Road and New Valley/Milich Lane	2	Central Town of Clarkstown
R-31	N. Little Tor Road and New Hempstead Road	2	Central Town of Clarkstown
R-32	Route 304 and Cavalry Drive	2	Central Town of Clarkstown
R-34	Route 304 and Laurel Road	2	Central Town of Clarkstown
R-37	N. Main Street and Cavalry Drive	2	Central Town of Clarkstown
R-48	Strawtown Road and Old Mill Road/Germonds Road	2	Shadow Region
TACP-R-51	Route 9W and Christian Herald Road	2	Shadow Region
R-64	Strawtown Road/Ridge Road and Congers Road	2	Central Town of Clarkstown
R-67	New Hempstead Road and North Main Street	2	Central Town of Clarkstown
R-68	Congers Road and North Main Street	2	Central Town of Clarkstown
R-77	Route 9W and Lake Road	2	Northeastern & Eastern Town of Clarkstown
R-79	Route 9W and Rockland Lake Road	2	Northeastern & Eastern Town of Clarkstown
R-85	Route 303 and Gilchrest Road	2	Northeastern & Eastern Town of Clarkstown
R-86	Route 303 and Casper Hill Road	2	Shadow Region
R-90	Route 304 and New City-Congers Road	2	Central Town of Clarkstown
R-97	Strawtown Road and McCarthy Way	2	Shadow Region
R-99	Strawtown Road and DeMarest Ave	2	Shadow Region
R-25	Kings Highway and New Lake Road/Karin Court	3	Northeastern & Eastern Town of Clarkstown
R-61	New Clarkstown Road and Smith Road	3	Shadow Region
R-65	Congers Rd/Lake Rd and Kings Hwy/Old Haverstraw Rd	3	Northeastern & Eastern Town of Clarkstown

TCP/ACP ID ¹	Intersection	Priority	Protective Action Area
R-104	Route 202 and Central Highway (South)	1	Unincorporated Areas of the Town of Haverstraw
R-105	Route 202 and Main Street/Central Highway (North)	1	Village of West Haverstraw
R-12	Route 45 and Route 202	1	Unincorporated Areas of the Town of Haverstraw
R-16	Route 202 and Hurd Avenue/Bridge Street	1	Village of West Haverstraw
R-217	Route 9W and New Main Street	1	Village of Haverstraw
R-218	Route 9W and Gurnee Avenue	1	Village of Haverstraw
R-7	Route 9W and Railroad Avenue	1	Unincorporated Areas of the Town of Haverstraw
R-78	Route 202 and Palisades Parkway Ramp, Exit 13	1	Village of Pomona
R-81	Route 9W and Route 202/West Side Avenue	1	Village of Haverstraw
R-89	Route 202 and Thiells-Mt. Ivy Road	1	Unincorporated Areas of the Town of Haverstraw
R-11	W Railroad Avenue/Suffern Lane and Central Hwy/Main St	2	Village of West Haverstraw
R-13	Route 202 and Martino Way	2	Unincorporated Areas of the Town of Haverstraw
R-212	Suffern Lane and Hammond Road	2	Unincorporated Areas of the Town of Haverstraw
R-9	Route 9W and Old Route 304/Haverstraw Road	2	Village of Haverstraw
R-91	Route 202 and Rosman Road	2	Unincorporated Areas of the Town of Haverstraw
PK-5	Palisades Parkway Exit 5	1	Shadow Region
PK-6	Palisades Parkway Exit 6	1	Shadow Region
PK-7	Palisades Parkway Exit 7	1	Shadow Region
PK-8	Palisades Parkway Exit 8	1	Shadow Region
PK-12	Route 45, Palisades Pkwy Exit 12 and Conklin Road	1	Central Town of Clarkstown
PK-13	Palisades Parkway Exit 13	1	Unincorporated Areas of the Town of Haverstraw
R-207	Route 17 and Seven Lakes Road	1	Shadow Region
R-209	N. Airmont Road/Highview Road and Spook Rock Road	1	Shadow Region
R-27	Route 45 and New Hempstead Road	1	Shadow Region
TACP-R-28	Route 45 and Eckerson Road	1	Shadow Region
TACP-R-29	Route 306/Calls Hollow Road and Route 202	1	Village of Pomona
TACP-R-33	Route 306 and Viola Road	1	Shadow Region

TCP/ACP ID ¹	Intersection	Priority	Protective Action Area
R-45	W. Eckerson Road and Union Road	1	Shadow Region
R-54	New County Road/College Road and Route 59	1	Shadow Region
R-55	Cherry Lane/Spook Rock Road and Route 59	1	Shadow Region
R-56	Airmont Road and Route 59	1	Shadow Region
R-92	Route 45 and Maple Avenue	1	Shadow Region
R-93	Route 45 and Route 59	1	Shadow Region
R-94	Route 306 and Grandview Avenue	1	Northeastern Town of Ramapo
R-95	Route 306 and Maple Avenue	1	Shadow Region
R-96	Route 306 and Route 59	1	Shadow Region
R-School-1	Grandview Avenue and Forshay Road	1	Northeastern Town of Ramapo
R-School-2	Route 202 and Viola Road	1	Shadow Region
R-School-3	Spook Rock Road and Viola Road	1	Shadow Region
R-School-4	Viola Road and College Road	1	Village of West Haverstraw
R-School-5	Route 306 and Viola Road	1	Northeastern Town of Ramapo
R-School-6	N. Airmont Road/Highview Road and Spook Rock Road	1	Shadow Region
R-School-7	Highview Road and College Road	1	Shadow Region
TWY-14B	North Airmont Road and I-87/287 Ramps	1	Shadow Region
TWY-15	NYS Thruway Exit 15	1	Shadow Region
R-10	Viola Road and College Road	2	Village of West Haverstraw
R-245	Eckerson Road and Hempstead Road	2	Northeastern Town of Ramapo
R-251	New Hempstead Road and Summit Park Road	2	Northeastern Town of Ramapo
R-26	Route 45 and Pomona Road	2	Northeastern Town of Ramapo
R-47	Grandview Avenue and Forshay Road	2	Northeastern Town of Ramapo
R-49	Route 306 and Lime Kiln Road	2	Northeastern Town of Ramapo
R-58	Highview Road and College Road	2	Shadow Region
R-60	Route 202 and Viola Road	2	Shadow Region
R-72	Route 306 and Willow Tree Road	2	Northeastern Town of Ramapo
R-74	Route 202 and Camp Hill Road	2	Village of Pomona
R-7B	Seven Lakes Road and Johnsontown Road	2	Shadow Region
R-63B	Spook Rock Road and Carlton Road	3	Shadow Region

TCP/ACP ID ¹	Intersection	Priority	Protective Action Area
PK-14	Palisades Pkwy Exit 14 and Willow Grove Road	1	Unincorporated Areas of the Town of Haverstraw
PK-15	Palisades Parkway Exit 15	1	Harriman State Park
PK-16	Palisades Parkway Exit 16	1	Harriman State Park
R-103	Route 210/Route 106 and Central Highway	1	Stony Point
TACP-R-83	Route 9W and Main Street	1	Stony Point
R-84	Route 9W and Filors Lane	1	Stony Point
R-88	Route 9W and Route 210/Route 106	1	Stony Point
R-102	Route 210 and Thiells Road	2	Stony Point
R-2	Filors Lane and Central Highway	2	Stony Point
PK-17	Palisades Parkway Exit 17	1	Harriman State Park
PK-18	Palisades Parkway Exit 18	1	Harriman State Park

Table G-4. Westchester County Traffic Control Points

TCP/ACP ID	Intersection	Priority	Protective Action Area	Police Department	Department of Public Works
W-1	Albany Post Rd (Rte 9A) & Welcher Ave	1	City of Peekskill	Peekskill PD	Peekskill DPW
W-2	Rte 9 Ramps & Welcher Ave	1	City of Peekskill	Peekskill PD	Peekskill DPW
W-3	Albany Post Rd (Rte 9A) & Bleakley Ave	1	Buchanan	Buchanan PD	Buchanan Highway Dept
W-4	Albany Post Rd (Rte 9A) & Tate Ave	3	Buchanan	Buchanan PD	Buchanan Highway Dept
W-5	Albany Post Rd (Rte 9A) & Kings Ferry Rd	3	Montrose	NYSP (Cortlandt)	Cortlandt DPW
W-6	Jans Peek Bridge & Rte 9 & Bear Mtn Pkwy	1	City of Peekskill	Peekskill PD	Peekskill DPW
W-7	Annsville Rd (Rte 9) & Old Roa Hook Rd	3	Town of Cortlandt	NYSP (Cortlandt)	Cortlandt DPW
W-8	Bear Mountain Pkwy & Division St	1	City of Peekskill	Peekskill PD	Peekskill DPW
W-9	Albany Post Rd (Rte 9A) & FDR VA Hospital	3	Montrose	NYSP (Cortlandt)	Cortlandt DPW
W-10	Albany Post Rd (Rte 9A) & Crugers Station Rd	2	Town of Cortlandt	Croton on Hudson PD	Cortlandt DPW
W-11	Albany Post Rd (Rte 9A) & Springvale Rd	2	Town of Cortlandt	NYSP (Cortlandt)	Cortlandt DPW
W-12	Albany Post Rd (Rte 9A) & Access Rd from Highland Ave	2	Town of Cortlandt	NYSP (Cortlandt)	Cortlandt DPW
W-13	Main St (Rte 6) & Dayton Ln/Beecher Ln	2	City of Peekskill	Peekskill PD	Peekskill DPW

TCP/ACP ID	Intersection	Priority	Protective Action Area	Police Department	Department of Public Works
W-14	Albany Post Rd (Rte 9A) & Rte 9 Ramps	1	Town of Cortlandt	NYSP (Cortlandt)	Cortlandt DPW
W-15	Crompond Rd (Rte 202/35) & Bear Mtn State Pkwy	1	Town of Cortlandt	NYSP (Cortlandt)	Cortlandt DPW
W-16	Crompond Rd (Rte 202/35) & Maple Row/Croton Ave	3	Town of Cortlandt	NYSP (Cortlandt)	Cortlandt DPW
W-17	Rte 6 & Lexington Ave	1	Yorktown	NYSP/Yorktown PD	Yorktown Highway Dept
W-18	Crompond Rd (Rte 202/35) & Lexington Ave	3	Town of Cortlandt	NYSP (Cortlandt)	Yorktown Highway Dept
W-19	S Riverside Ave (Rte 9A) & Municipal Place	1	Croton-on-Hudson	Croton PD	Croton DPW
W-20	Crompond Rd (Rte 202/35) & Stony St	3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-21	Rte 9/9A & Croton Point Ave	2	Croton-on-Hudson	Croton on Hudson PD	Croton DPW
W-22	Rte 6 & Mill St	3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-23	Crompond Rd (Rte 202/35) & Taconic Ramps	1	Yorktown	Yorktown PD	Yorktown Highway Dept
W-24	Crompond Rd (Rte 202/35) & Strang Blvd	3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-25	Crompond Rd (Rte 202/35) & Springhurst St	1 (School), 3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-26	Baldwin Rd & Taconic Pkwy Ramps	3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-27	Albany Post Rd (Rte 9) & St. Augustine Church & School	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-28	Rte 6 & Old Yorktown Rd(Rte 132)/ Barger St	1	Yorktown	Yorktown PD	Yorktown Highway Dept
W-29	Rte 6 & Taconic Pkwy Ramps	1	Yorktown	Yorktown PD	Yorktown Highway Dept
W-30	Crompond Rd (Rte 202/35) & Granite Springs Rd	1 (School), 3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-31	Crompond Rd (Rte 202/35) & Baldwin Rd	1	Yorktown	Yorktown PD	Yorktown Highway Dept
W-32	Kitchawan Rd (Rte 134) & Taconic Northbound Ramp	3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-33	Kitchawan Rd (Rte 134) & Taconic Southbound Ramp	3	Yorktown	Yorktown PD	Yorktown Highway Dept
W-34	Pines Bridge Rd & Taconic Ramps	1	Town of New Castle (W. of Hardscrabble Rd)	New Castle PD	New Castle DPW
W-35	Rte 9A & Croton Dam Rd	1	Ossining Town & Village	Ossining Town PD	Town of Ossining DPW

TCP/ACP ID	Intersection	Priority	Protective Action Area	Police Department	Department of Public Works
W-36	Albany Post Rd (Rte 9) & Cedar Ln/ Snowden Ave	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-37	Albany Post Rd (Rte 9) & Van Cortlandt Ave	2	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-38	Albany Post Rd (Rte 9) & Croton Ave (Rte 133)	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-39	Dale Ave (Rte 134) & Croton Ave (Rte 133)	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-40	Albany Post Rd (Rte 9) & Church St	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-41	Albany Post Rd (Rte 9) & Waller Ave/ Emwilton Pl	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-42	Rte 6 & Rte 6N/Curry St	2	Yorktown	Yorktown PD	Yorktown Highway Dept
W-43	Saw Mill River Rd (Rte 35) & Pines Bridge Rd	3	Town of Somers (W. of Route 118)	NYSP (Somers)	Somers DPW
W-44	Saw Mill River Rd (Rte 35) & Tomahawk St (Rte 118/202)	3	Town of Somers (W. of Route 118)	NYSP (Somers)	Somers DPW
W-45	Somerstown Tpke (Rte 133/100) & Station Rd (Rte 133)	2	Town of New Castle (W. of Hardscrabble Rd)	TBD	TBD
W-46	Somerstown Tpke (Rte 133/100) & Northbound Taconic Pkwy Ramps	1	Town of New Castle (W. of Hardscrabble Rd)	New Castle PD	New Castle DPW
W-47	Rte 133/100 & Taconic Pkwy Ramps	1	Town of New Castle (W. of Hardscrabble Rd)	North Castle PD	TBD
W-48	Rte 9A & Chappaqua Rd	1	Briarcliff Manor	Briarcliff PD	Briarcliff DPW
W-49	Albany Post Rd (Rte 9) & Revolutionary Rd	2	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-50	Albany Post Rd (Rte 9) & Rockledge Ave	1	Ossining Town & Village	Ossining Village PD	Ossining Village DPW
W-51	Rte 6 & Rte 118/Baldwin Place Rd	1	Town of Somers (W. of Route 118)	NYSP (Somers)	Somers DPW
W-52	Tomahawk St (Rte 118/202) & Lincolndale Rd (Rte 202)	2	Town of Somers (W. of Route 118)	NYSP (Somers)	Somers DPW
W-53	Rte 9A & N State Rd	1	Briarcliff Manor	TBD	TBD
W-54	Albany Post Rd (Rte 9) & Scarborough Rd	2	Briarcliff Manor	Briarcliff PD	Briarcliff DPW
W-55	Albany Post Rd (Rte 9) & Tower Hill Rd	2	Briarcliff Manor	Briarcliff PD	Briarcliff DPW
W-56	Sleepy Hollow Rd & Old Sleepy Hollow Rd	3	Briarcliff Manor	Mount Pleasant PD	Town of Mount Pleasant DPW

TCP/ACP ID	Intersection	Priority	Protective Action Area	Police Department	Department of Public Works
W-57	Woods Bridge Rd (Rte 35) & Somerstown Rd (Rte 100)	1	Shadow Region	NYSP (Somers)	Somers DPW
W-58	Woods Bridge Rd (Rte 35) & Pepsi-Cola Entrance	3	Shadow Region	NYSP (Somers)	Somers DPW
W-59	Woods Bridge Rd (Rte 35) & Cherry St	3	Shadow Region	NYSP (Somers)	Lewisboro DPW
W-60	Woods Bridge Rd (Rte 35) & Cross River Rd (Rte 35)	3	Shadow Region	Bedford PD	Bedford DPW
W-61	Cross River Rd (Rte 35) & I-684 Ramps	3	Shadow Region	Bedford PD	Bedford DPW
W-62	Bedford Rd (Rte 117) & King St (Rte 120)	2	Shadow Region	New Castle PD	New Castle DPW
W-63	Saw Mill Pkwy & Grant St	1	Shadow Region	Westchester Cty PD on Parkway	NY State DOT
W-64	Bedford Rd & Marble Ave	1	Shadow Region	Pleasantville PD	Pleasantville DPW
W-65	Manville Rd (Rte 117) & Pleasantville Rd	1	Shadow Region	Pleasantville PD	Pleasantville DPW
W-66	Bedford Rd (Rte 117) & Rte 9A/100	1	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-67	Bedford Rd (Rte 117) & Bedford Rd (Rte 448)	1	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-68	Rte 9 & Rte 117	1	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-69	Mt Kisco Rd/ Bedford Rd (Rte 22) & Main St (Rte 128)	2	Shadow Region	North Castle PD	TBD
W-70	King St (Rte 120) & Rte 22	2	Shadow Region	North Castle PD	TBD
W-71	Rte 9A/100 Exits 26 A, B - County Police Barracks	1	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-72	Taconic State Pkwy & W Stevens Ave	1	Shadow Region	NYSP (Hawthorne)	Mount Pleasant DPW
W-73	Taconic State Pkwy & Commerce St	1	Shadow Region	NYSP (Hawthorne)	Mount Pleasant DPW
W-74	Taconic State Pkwy & Lakeview Ave	1	Shadow Region	NYSP (Hawthorne)	Mount Pleasant DPW
W-75	Taconic State Pkwy & Cleveland St	1	Shadow Region	NYSP (Hawthorne)	Mount Pleasant DPW
W-76	Saw Mill River Rd (Rte 9A) & Skyline Dr	2	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-77	Saw Mill River Rd (Rte 9A) & Saw Mill Pkwy Ramp	2	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-78	Saw Mill River Rd (Rte 9A) & Dana Rd	1	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-79	Rte 9A & Grasslands Rd (Rte 100C)	3	Shadow Region	Mount Pleasant PD	Mount Pleasant DPW
W-80	Saw Mill River Rd (Rte 9A) & Hunter Ln	2	Shadow Region	Greenburgh PD	Greenburgh DPW

TCP/ACP ID	Intersection	Priority	Protective Action Area	Police Department	Department of Public Works
W-81	Saw Mill River Rd (Rte 9A) & Fairview Park Dr	2	Shadow Region	Greenburgh PD	Greenburgh DPW
W-82	Saw Mill River Rd (Rte 9A) & Old Country Rd	2	Shadow Region	Greenburgh PD	Greenburgh DPW
W-83	Saw Mill River Rd (Rte 9A) & Beaver Hill Rd	2	Shadow Region	Greenburgh PD	Greenburgh DPW
W-84	Saw Mill River Rd (Rte 9A) & Payne St	1	Shadow Region	Greenburgh PD	Greenburgh DPW
W-85	Saw Mill River Rd (Rte 9A) & I-287 Ramps	1	Shadow Region	Elmsford PD	Elmsford DPW
W-86	Broadway (Rte 9) & Pierson Ave	2	Shadow Region	Sleepy Hollow PD	Sleepy Hollow DPW
W-87	Broadway (Rte 9) & Pocantico St	2	Shadow Region	Sleepy Hollow PD	Sleepy Hollow DPW
W-88	Broadway (Rte 9) & Bedford Rd (Rte 448)	1	Shadow Region	Sleepy Hollow PD	Sleepy Hollow DPW
W-89	Broadway (Rte 9) & Depeyster St	2	Shadow Region	Sleepy Hollow PD	Sleepy Hollow DPW
W-90	Broadway (Rte 9) & Wildey St	2	Shadow Region	Tarrytown PD	Tarrytown DPW
W-91	Broadway (Rte 9) & Neperan Rd	2	Shadow Region	Tarrytown PD	Tarrytown DPW
W-92	Broadway (Rte 9) & Benedict Ave	2	Shadow Region	Tarrytown PD	Tarrytown DPW
W-93	Broadway (Rte 9) & Prospect Ave	2	Shadow Region	Tarrytown PD	Tarrytown DPW
W-94	Broadway (Rte 9) & White Plains Rd (Rte 119)	2	Shadow Region	Tarrytown PD	Tarrytown DPW
W-95	Broadway (Rte 9) & I-287 East/ I-87 South Ramps	1	Shadow Region	Tarrytown PD	Tarrytown DPW

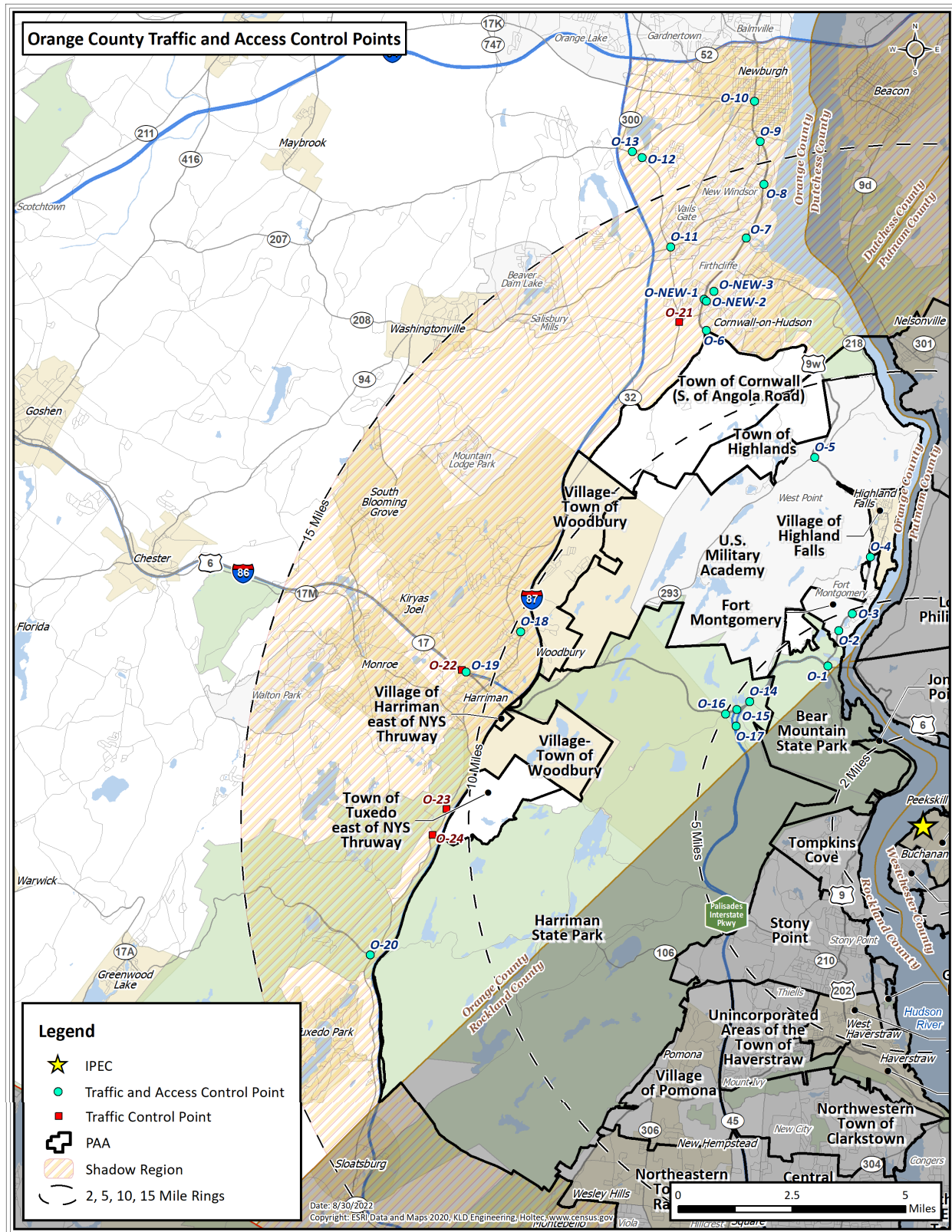


Figure G-1. Traffic and Access Control Points within the Orange County Portion of the EPZ

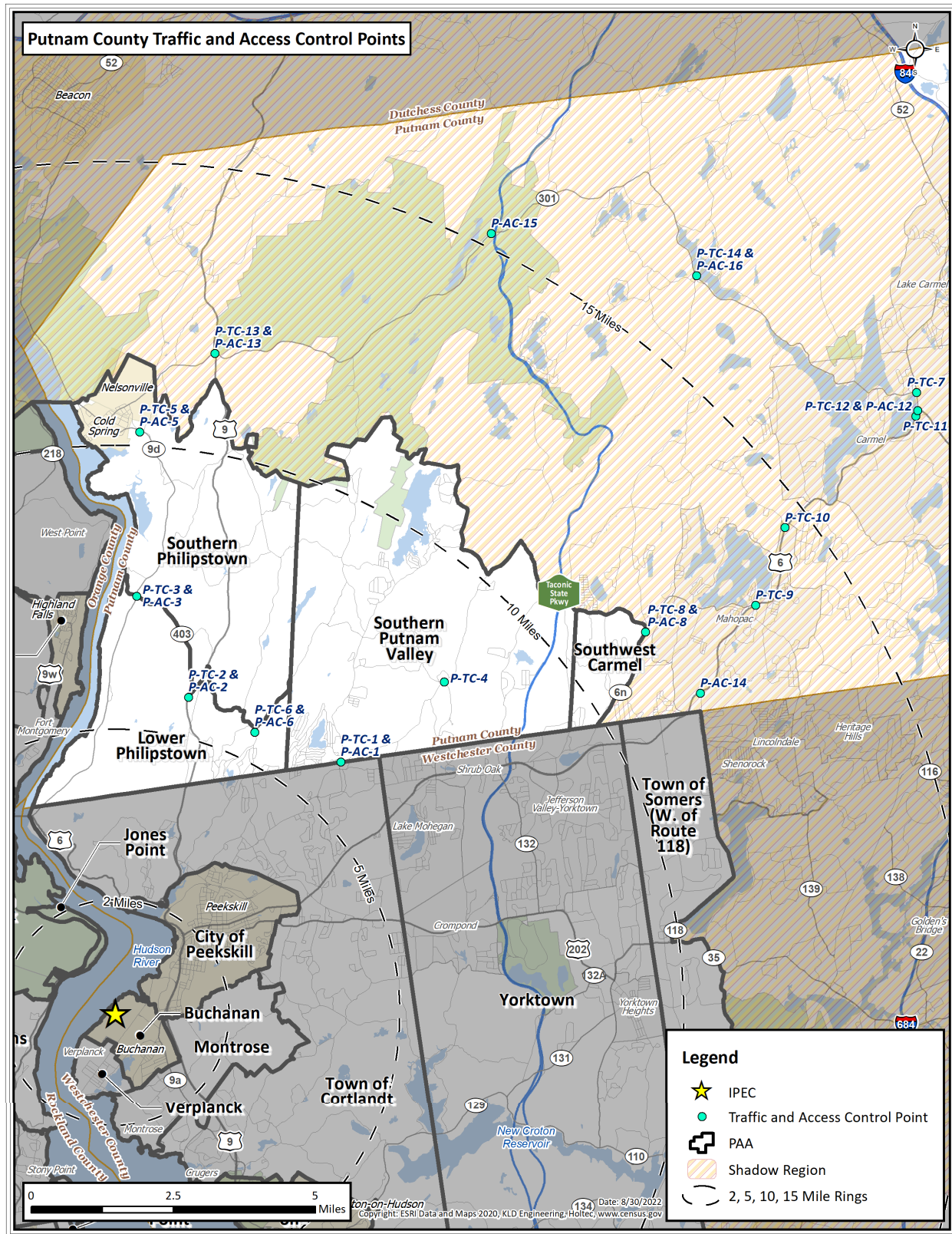
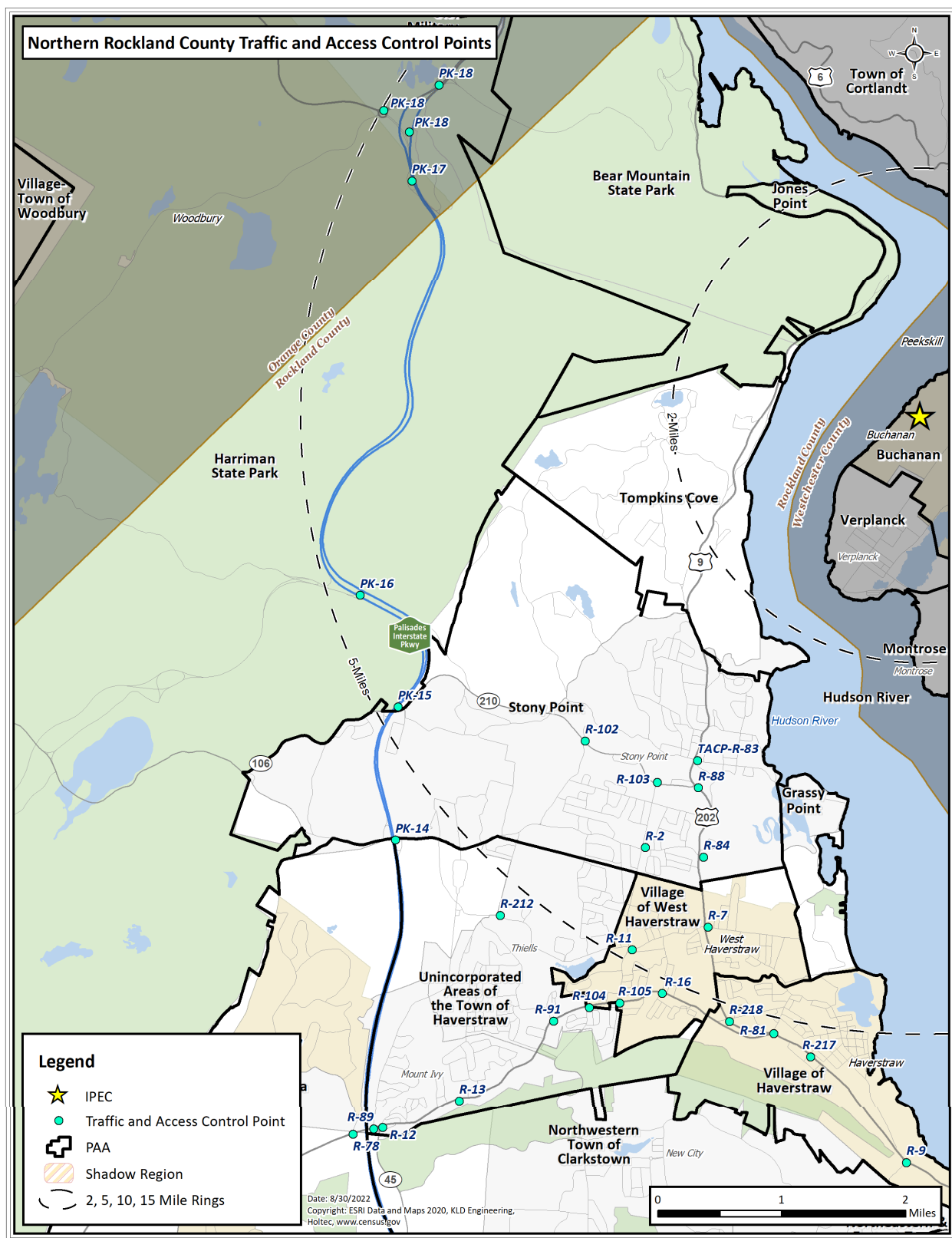
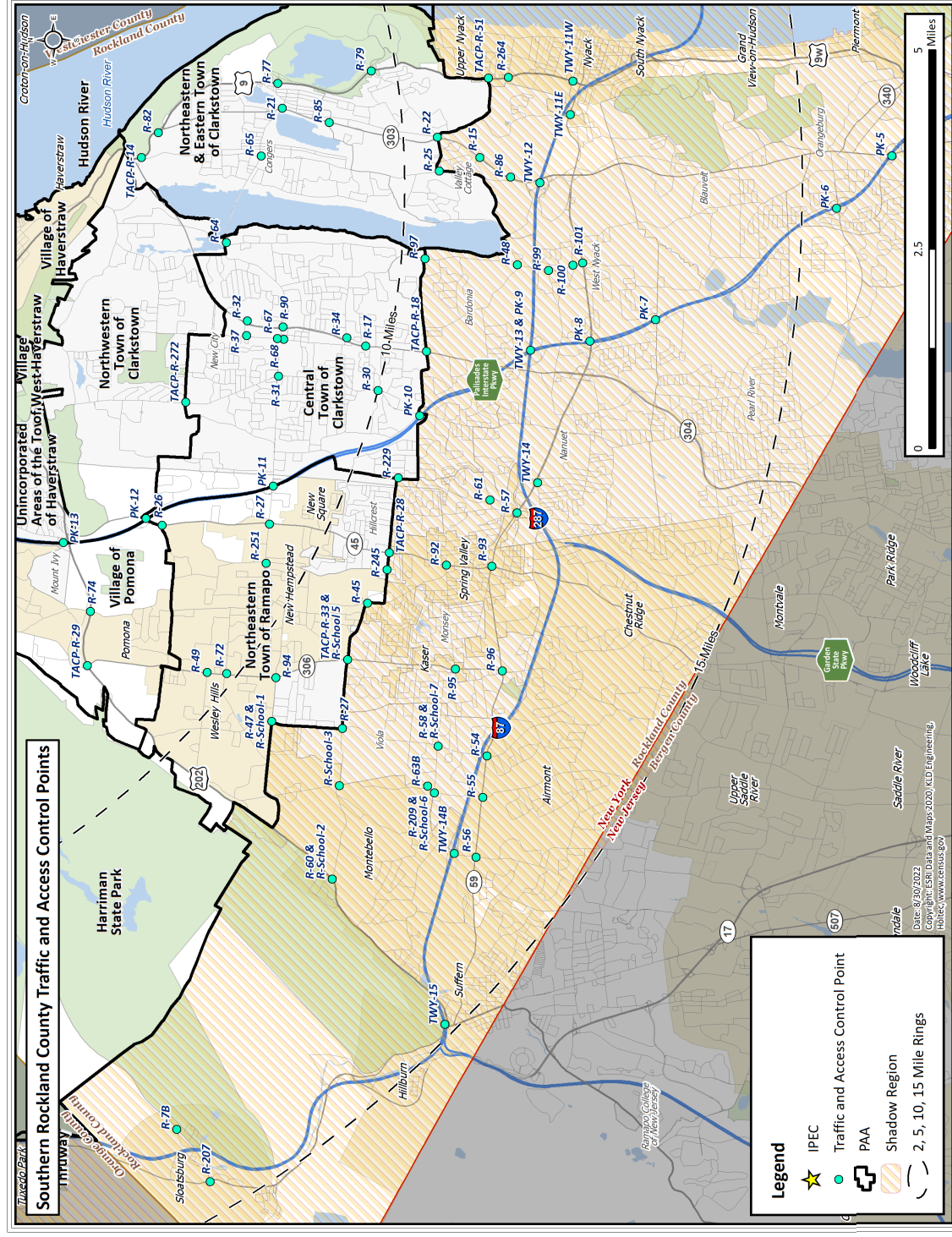
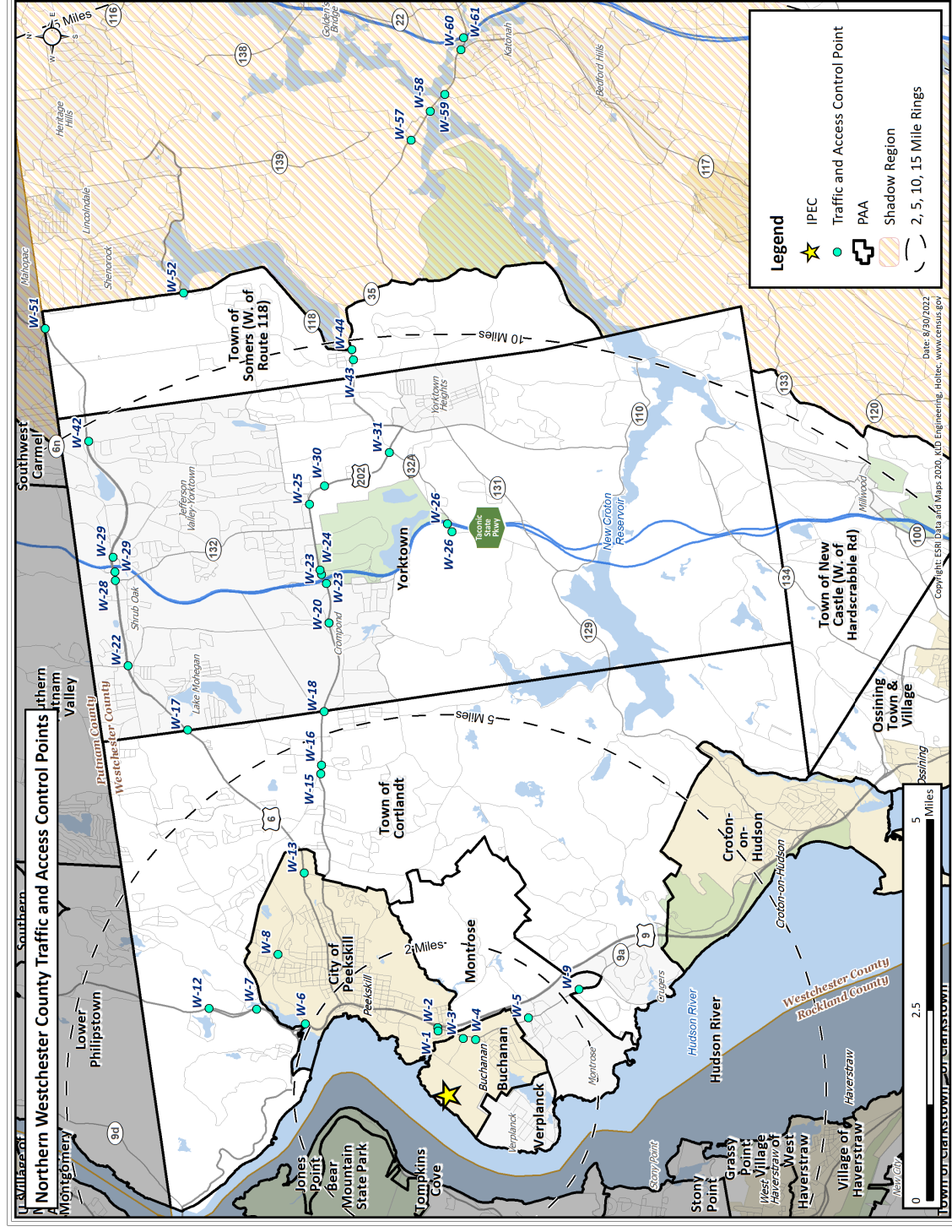


Figure G-2. Traffic and Access Control Points within the Putnam County Portion of the EPZ







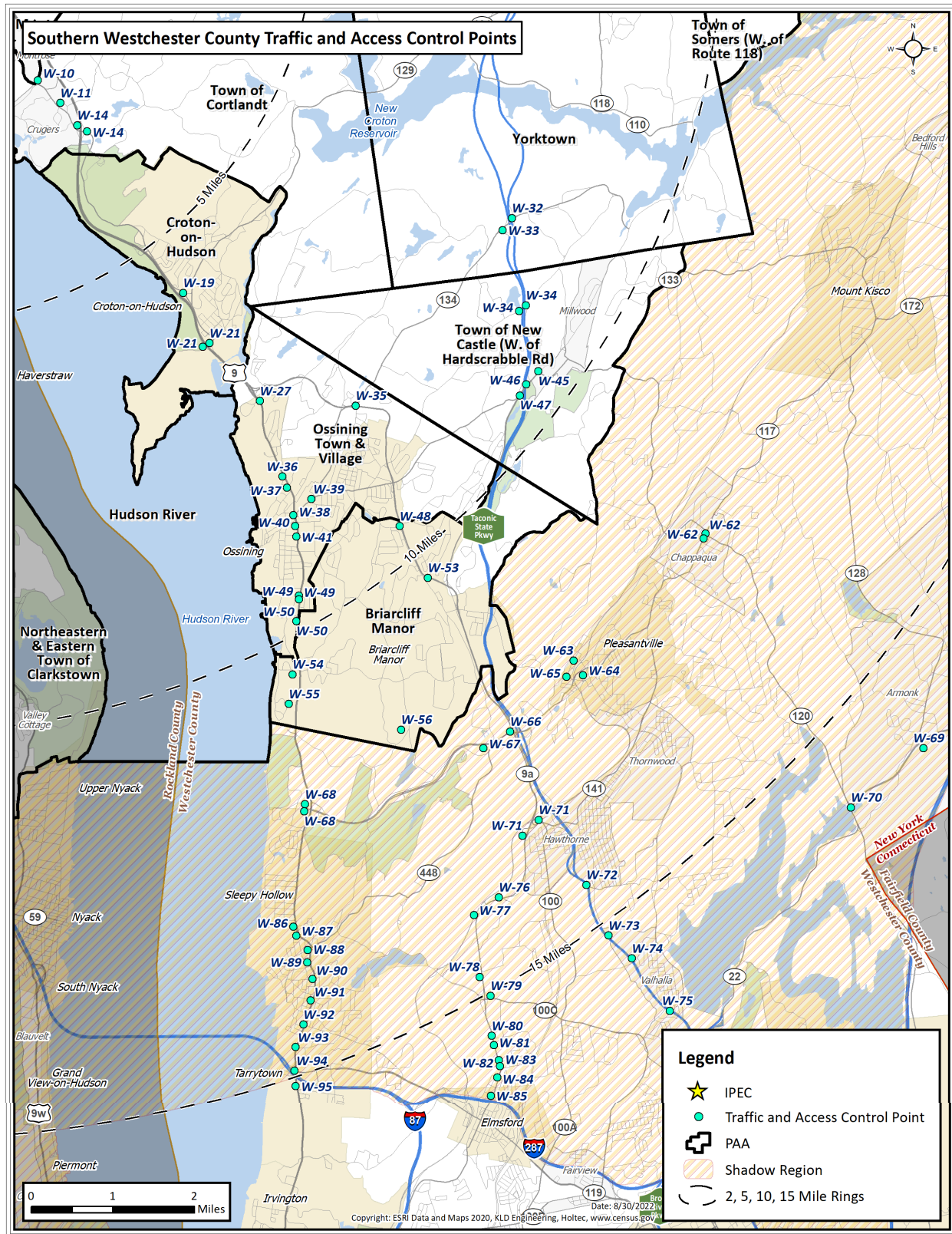


Figure G-6. Traffic and Access Control Points within the Southern Westchester County Portion of the EPZ

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 (Figure H-1 through Figure H-44). The percentages presented in the tables are based on the methodology discussed in assumption 7 of Section 2.2 and shown in Figure 2-1.

Note the baseline ETE study assumes 20% of households will not comply with the shelter advisory, as per Section 2.5.2 of NUREG/CR-7002, Rev. 1.

Table H-1. Percent of Protective Action Area Population Evacuating for Each Region

Region Description	REGION														
	2-Mile Region	5-Mile Region	Full EPZ	2-Mile Region and Sector to 5 Miles											
	Region Number	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15
	Wind Direction From:	N/A	N/A	S	SSW, SW	WSW, W	WNW, NW	NNW	N	NNE	NE	ENE	E	ESE	SE, SSE
PROTECTIVE ACTION AREA															
Briarcliff Manor	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Central Town of Clarkstown	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Northeastern Town of Ramapo	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Northeastern & Eastern Town of Clarkstown	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Northwestern Town of Clarkstown	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Ossining Town & Village	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Village of Haverstraw	20%	100%	100%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%
Town of New Castle (West of Hardscrabble Road)	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Village of West Haverstraw	20%	100%	100%	20%	20%	20%	20%	20%	100%	100%	100%	20%	20%	20%	20%
Unincorporated Areas of the Town of Haverstraw	20%	100%	100%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%
Town of Tuxedo East of NYS Thruway	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Village of Pomona	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Grassy Point	20%	100%	100%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%
Croton-on-Hudson	20%	100%	100%	20%	20%	20%	100%	100%	100%	20%	20%	20%	20%	20%	20%
Stony Point	20%	100%	100%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%
Verplanck	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Tompkins Cove	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Buchanan	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Montrose	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Jones Point	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Village of Harriman East of NYS Thruway	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
City of Peekskill	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Town of Cortlandt	20%	100%	100%	100%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%	100%
Bear Mountain State Park	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Harriman State Park	20%	100%	100%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%
Yorktown	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Town of Somers (West of Route 118)	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Fort Montgomery	20%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%
Southwest Carmel	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Village of Highland Falls	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Lower Philipstown	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%
Village - Town of Woodbury	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
U.S. Military Academy	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Southern Putnam Valley	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Town of Highlands	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Hudson River	Hudson River is cleared/closed and therefore considered 100% evacuated														
Town of Cornwall (South of Angola Rd)	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Southern Philipstown	20%	20%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Protective Action Area is not within plume and shelters-in-place															
Protective Action Area is within Plume and Evacuates															

Region Description	REGION																
	2-Mile Ring and Sector to 10 Miles/EPZ																
	Region Number	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26	R27	R28	R29	R30	R31
Wind Direction From:	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	
PROTECTIVE ACTION AREA																	
Briarcliff Manor	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%
Central Town of Clarkstown	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%
Northeastern Town of Ramapo	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	20%	20%	20%	20%
Northeastern & Eastern Town of Clarkstown	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%
Northwestern Town of Clarkstown	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	100%	20%	20%	20%	20%
Ossining Town & Village	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%
Village of Haverstraw	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%
Town of New Castle (West of Hardscrabble Road)	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%
Village of West Haverstraw	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%
Unincorporated Areas of the Town of Haverstraw	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	20%	20%	20%	20%
Town of Tuxedo East of NYS Thruway	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%
Village of Pomona	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	20%	20%	20%	20%
Grassy Point	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%
Croton-on-Hudson	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%
Stony Point	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	100%	20%	20%	20%
Verplanck	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Tompkins Cove	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Buchanan	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Montrose	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Jones Point	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Village of Harriman East of NYS Thruway	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%
City of Peekskill	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Town of Cortlandt	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%	100%	100%
Bear Mountain State Park	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Harriman State Park	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	100%	100%
Yorktown	20%	100%	100%	100%	100%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%
Town of Somers (West of Route 118)	20%	20%	100%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Fort Montgomery	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%
Southwest Carmel	20%	100%	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Village of Highland Falls	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%
Lower Philipstown	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Village - Town of Woodbury	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%
U.S. Military Academy	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%
Southern Putnam Valley	100%	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Town of Highlands	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%
Hudson River							Hudson River is cleared/closed and therefore considered X evacuated										
Town of Cornwall (South of Angola Rd)	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%
Southern Philipstown	100%	100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%
Protective Action Area is within Plume and Evacuates																	
Protective Action Area is within Plume and Evacuates because it is surrounded by other Protective Action Areas which are Evacuating																	

Region Description Region Number Wind Direction From:		REGION														
		Staged Evacuation - 2 Mile Ring Evacuates, then Sector to 5 Miles Evacuates														
		R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42	R43	R44		
PROTECTIVE ACTION AREA		S	SSW, SW	WSW, W	WNW, NW	NNW	N	NNE	NE	ENE	E	ESE	SE, SSE	5-Mile Region		
Briarcliff Manor		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Central Town of Clarkstown		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Northeastern Town of Ramapo		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Northeastern & Eastern Town of Clarkstown		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Northwestern Town of Clarkstown		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Ossining Town & Village		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Village of Haverstraw		20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	100%		
Town of New Castle (West of Hardscrabble Road)		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Village of West Haverstraw		20%	20%	20%	20%	20%	100%	100%	100%	20%	20%	20%	20%	100%		
Unincorporated Areas of the Town of Haverstraw		20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	100%		
Town of Tuxedo East of NYS Thruway		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Village of Pomona		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Grassy Point		20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	20%	100%		
Croton-on-Hudson		20%	20%	20%	100%	100%	100%	20%	20%	20%	20%	20%	20%	100%		
Stony Point		20%	20%	20%	20%	20%	100%	100%	100%	100%	20%	20%	20%	100%		
Verplanck		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Tompkins Cove		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Buchanan		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Montrose		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Jones Point		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Village of Harriman East of NYS Thruway		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
City of Peekskill		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Town of Cortlandt		100%	100%	100%	100%	100%	100%	20%	20%	20%	20%	100%	100%	100%		
Bear Mountain State Park		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Harriman State Park		20%	20%	20%	20%	20%	20%	20%	100%	100%	100%	100%	100%	100%		
Yorktown		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Town of Somers (West of Route 118)		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Fort Montgomery		100%	20%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%		
Southwest Carmel		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Village of Highland Falls		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Lower Philipstown		100%	100%	20%	20%	20%	20%	20%	20%	20%	20%	100%	100%	100%		
Village - Town of Woodbury		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
U.S. Military Academy		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Southern Putnam Valley		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Town of Highlands		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Hudson River		Hudson River is cleared/closed and therefore considered 100% evacuated														
Town of Cornwall (South of Angola Rd)		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Southern Philipstown		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%		
Protective Action Area Evacuates		Protective Action Area Shelters-in-Place, then Evacuates						Protective Action Area Shelters-in-Place								

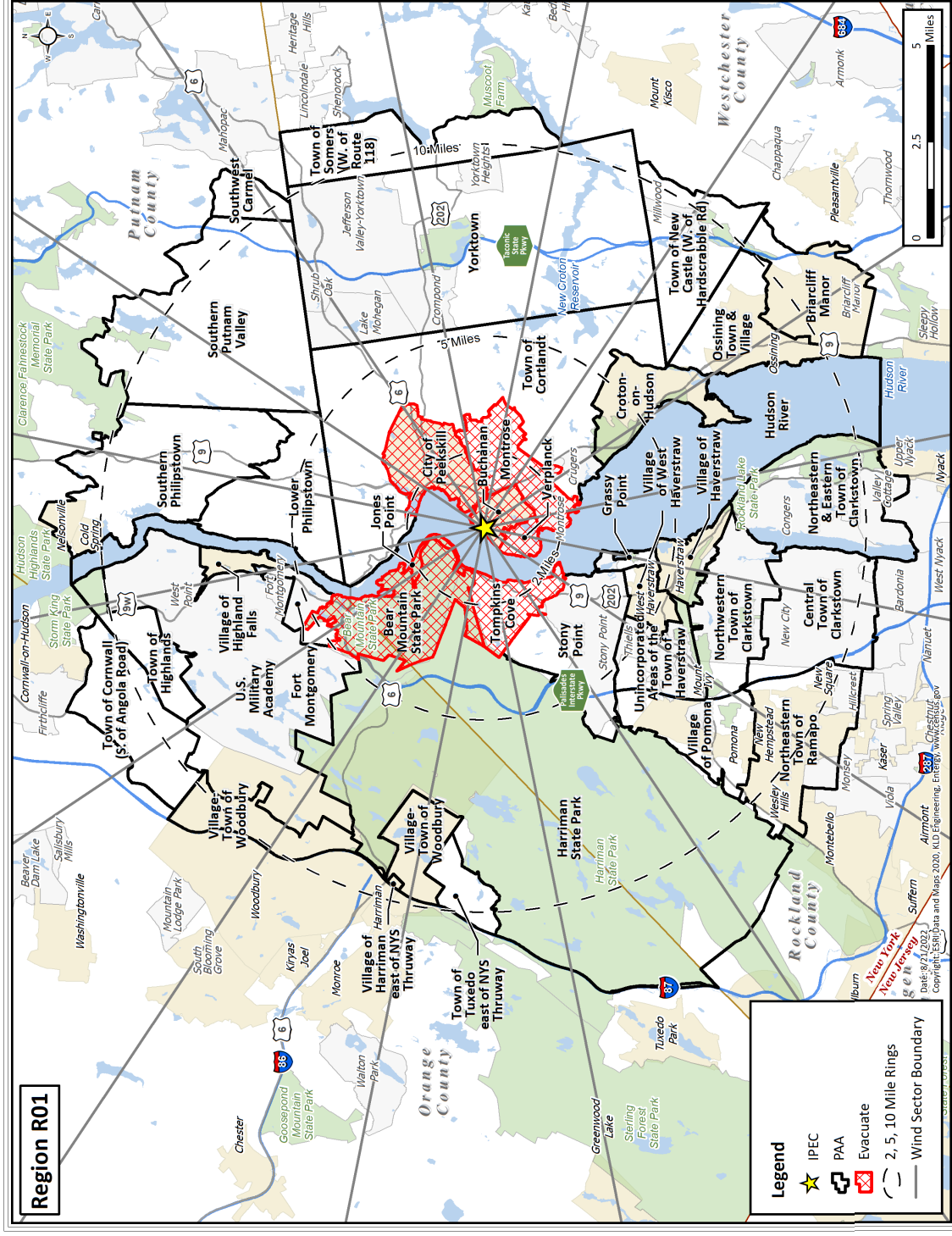
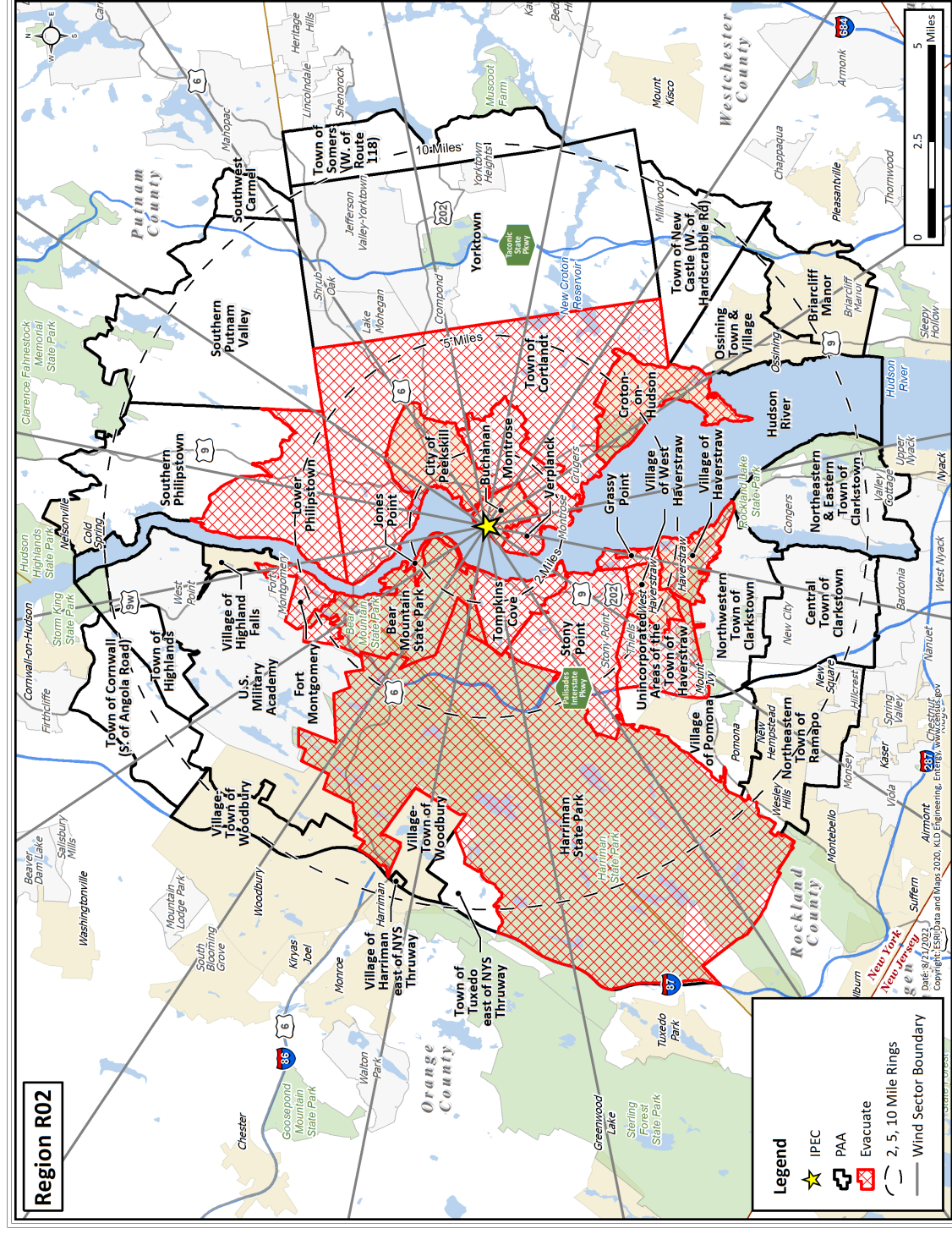
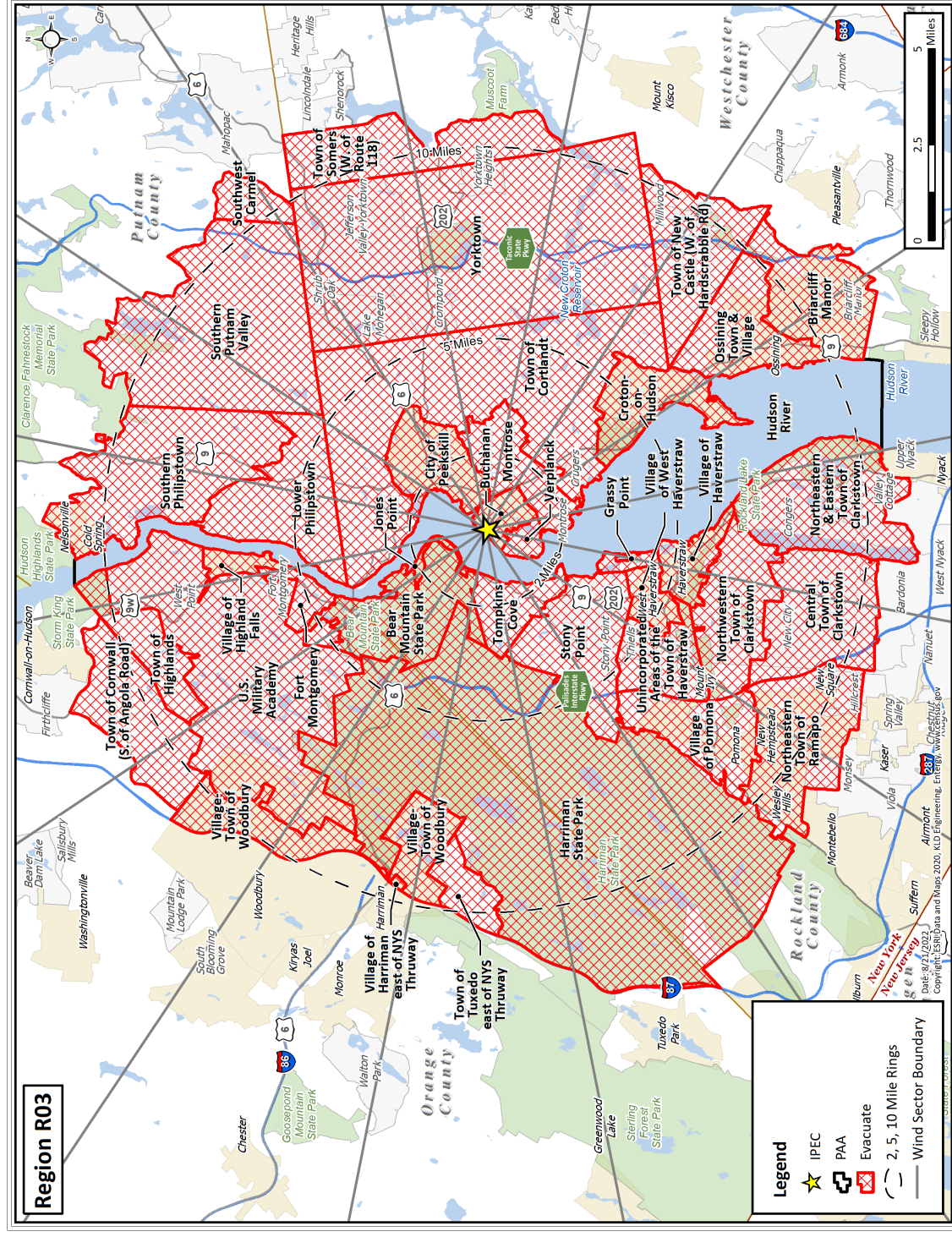


Figure H-1. Region R01





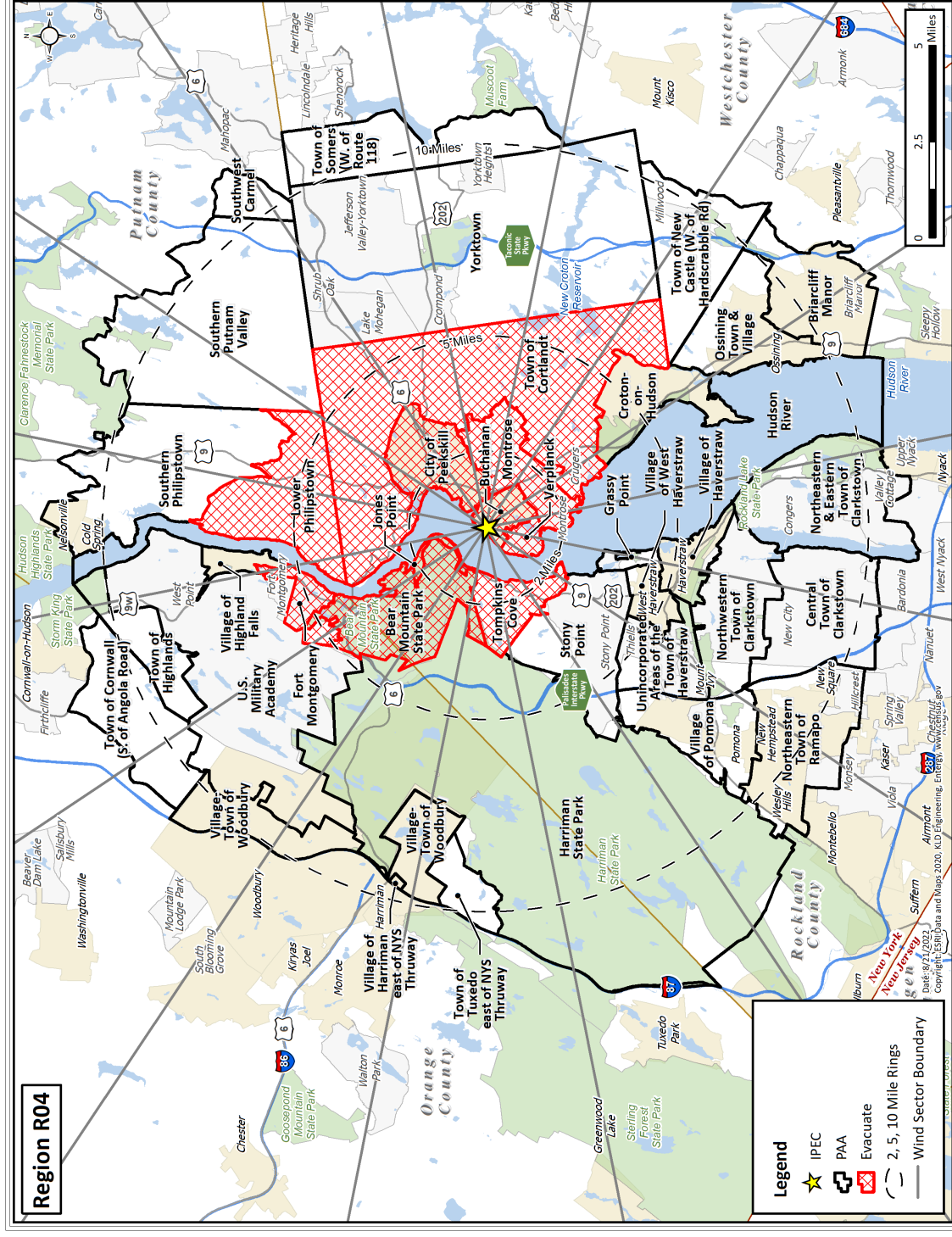
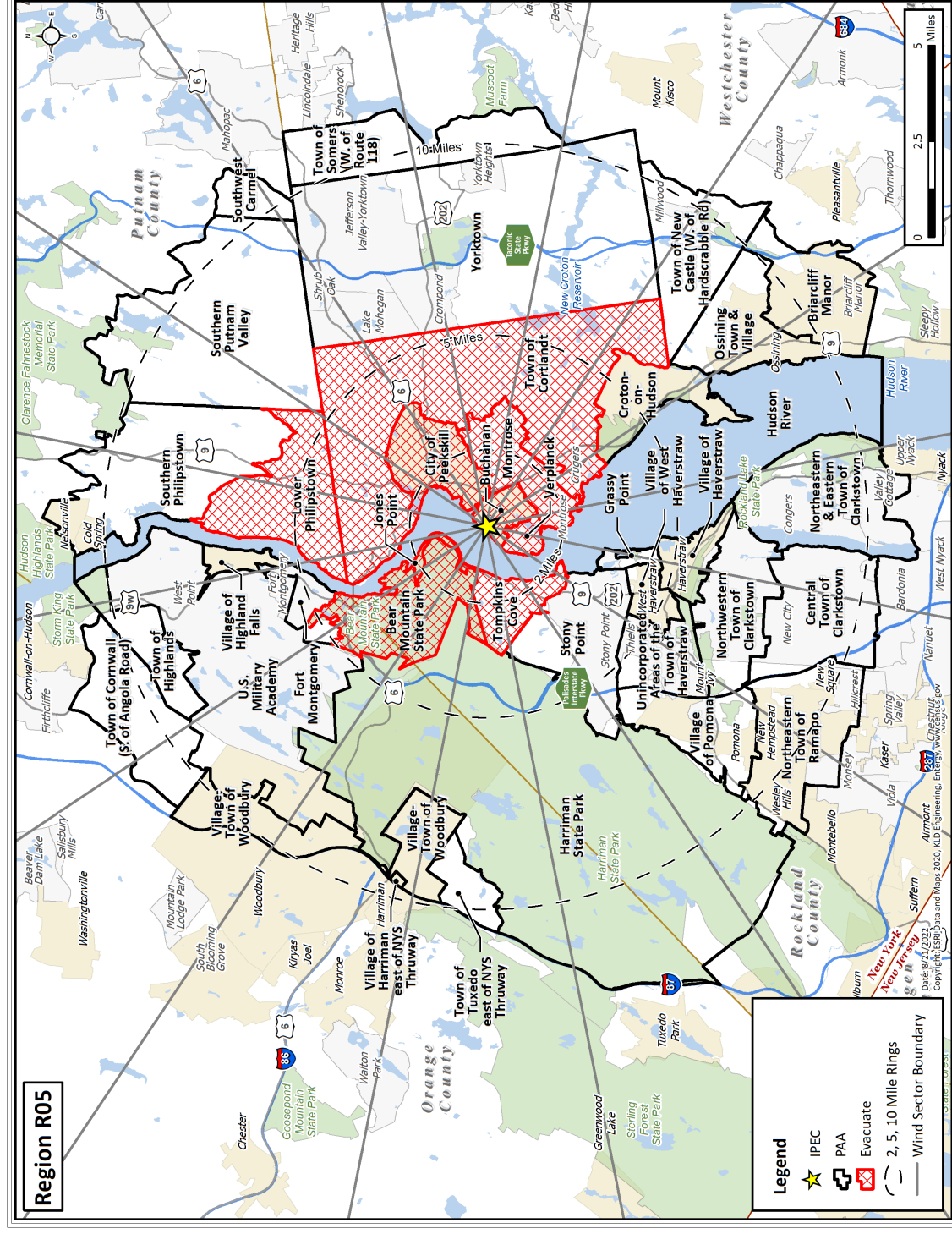


Figure H-4. Region R04



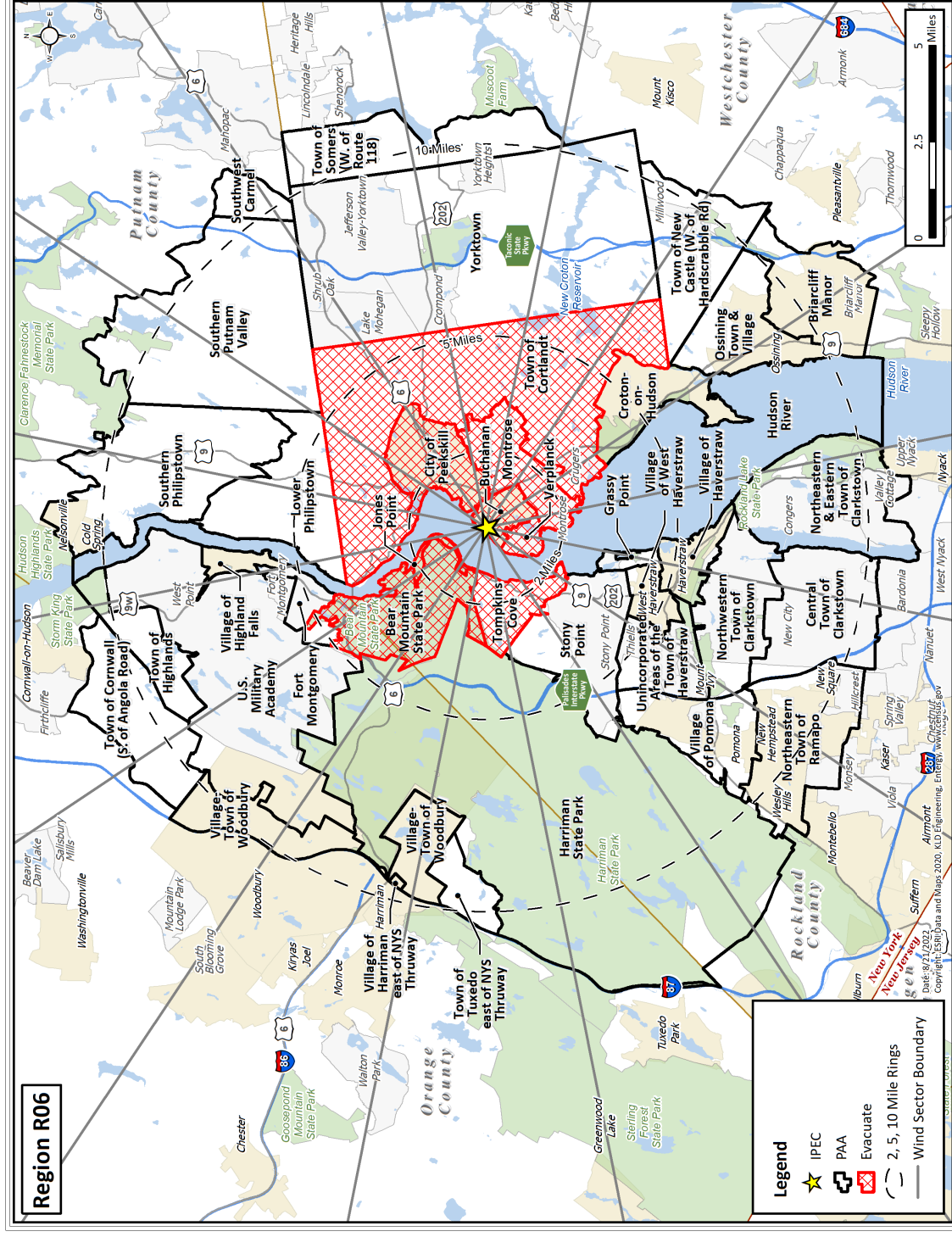


Figure H-6. Region R06

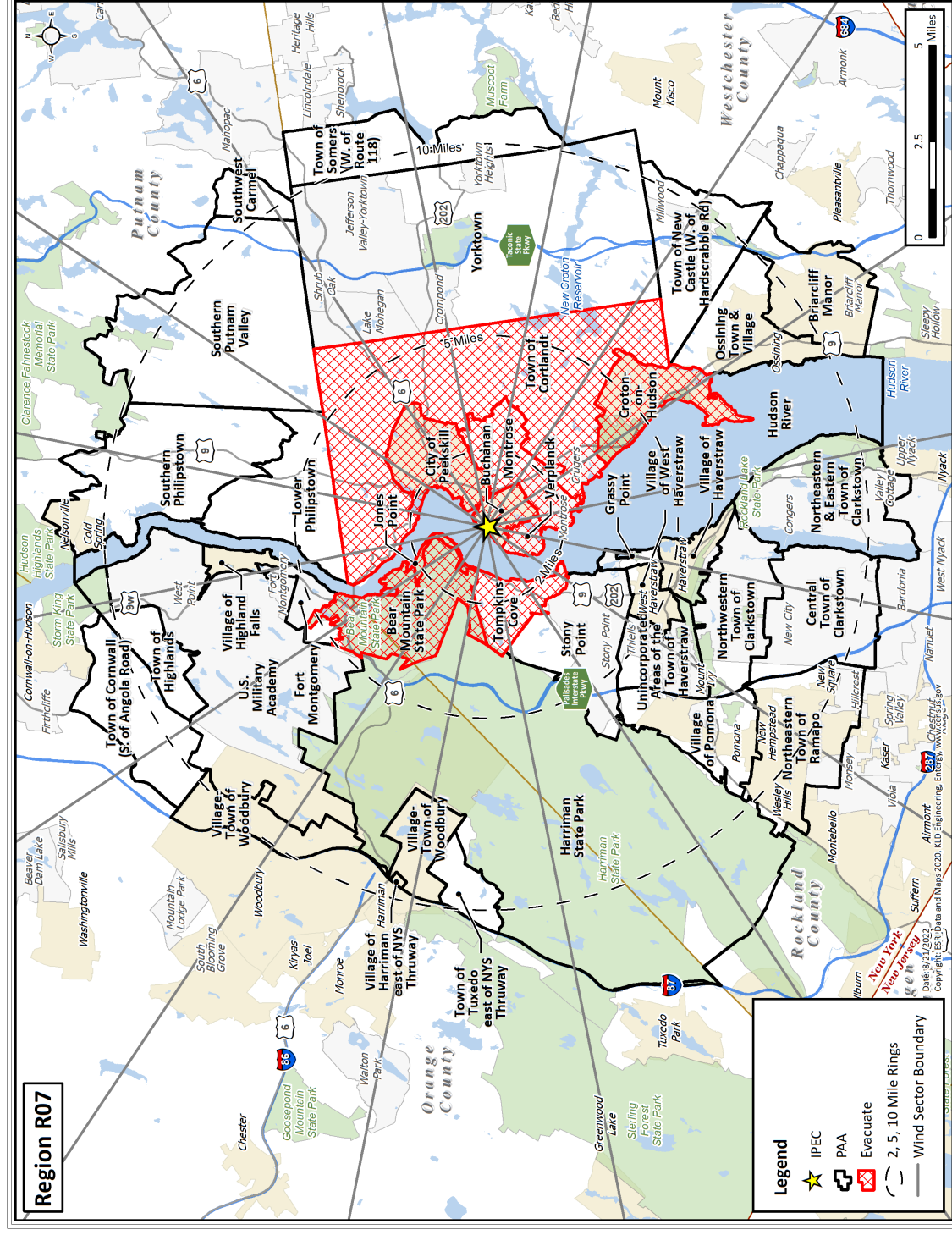
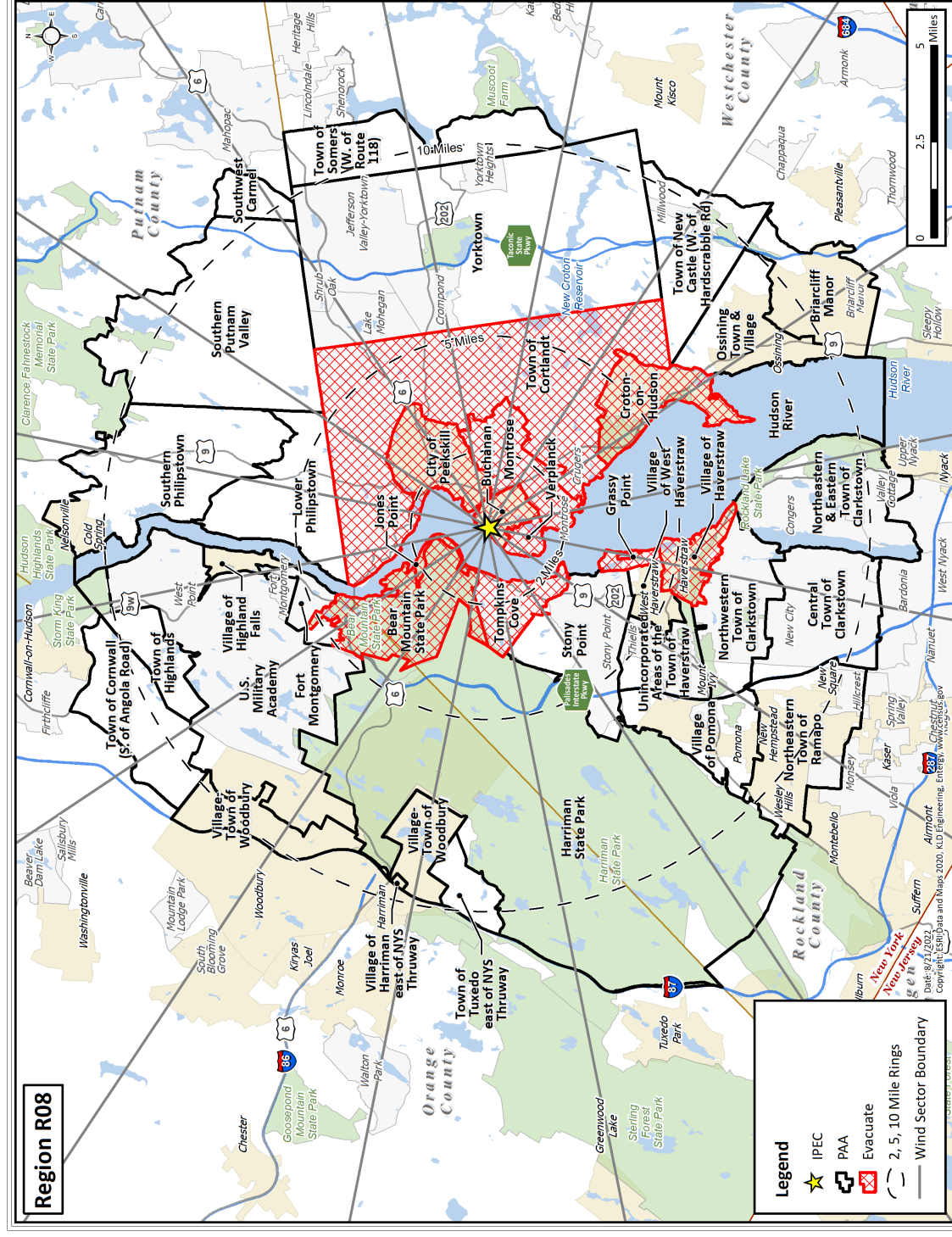
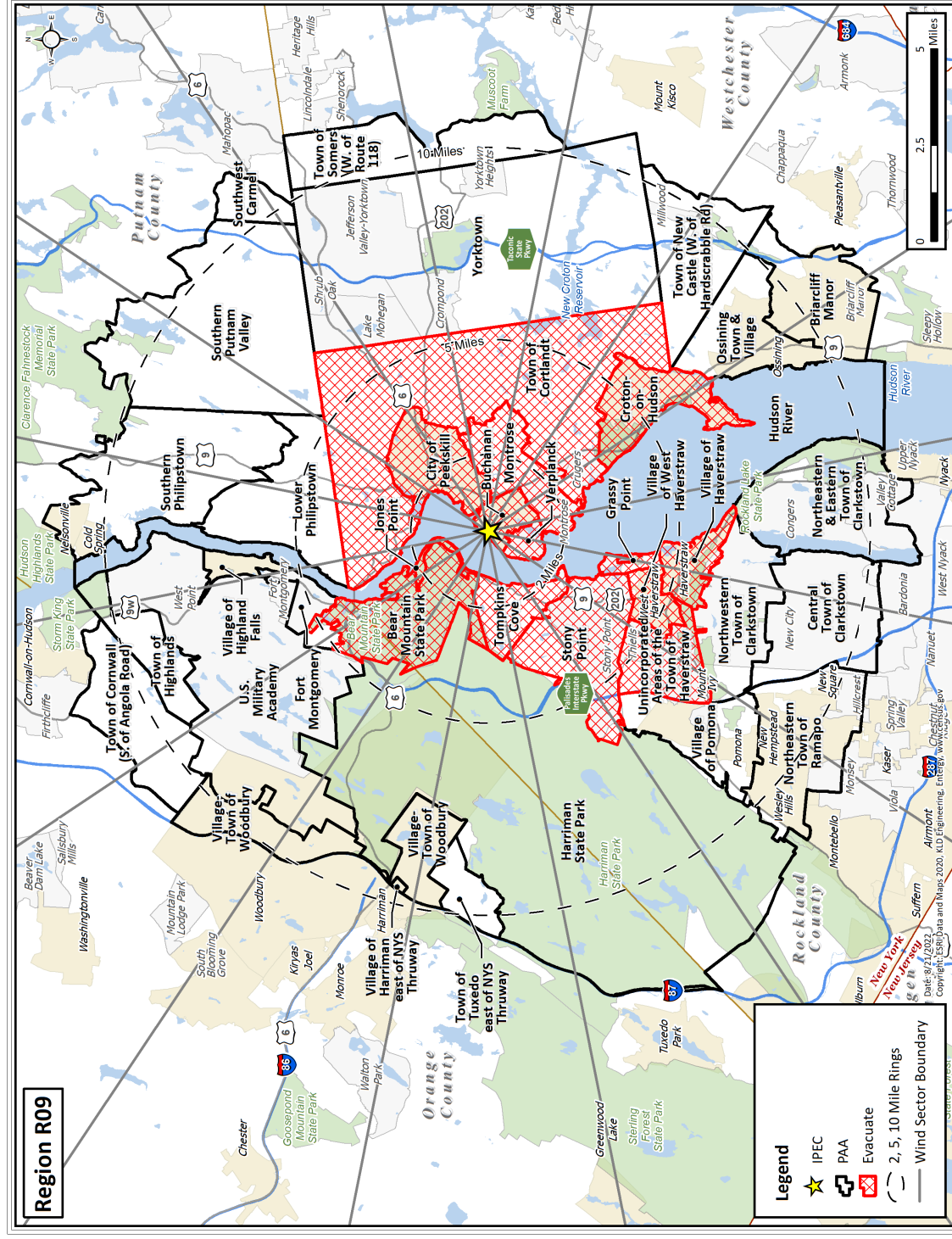


Figure H-7. Region R07





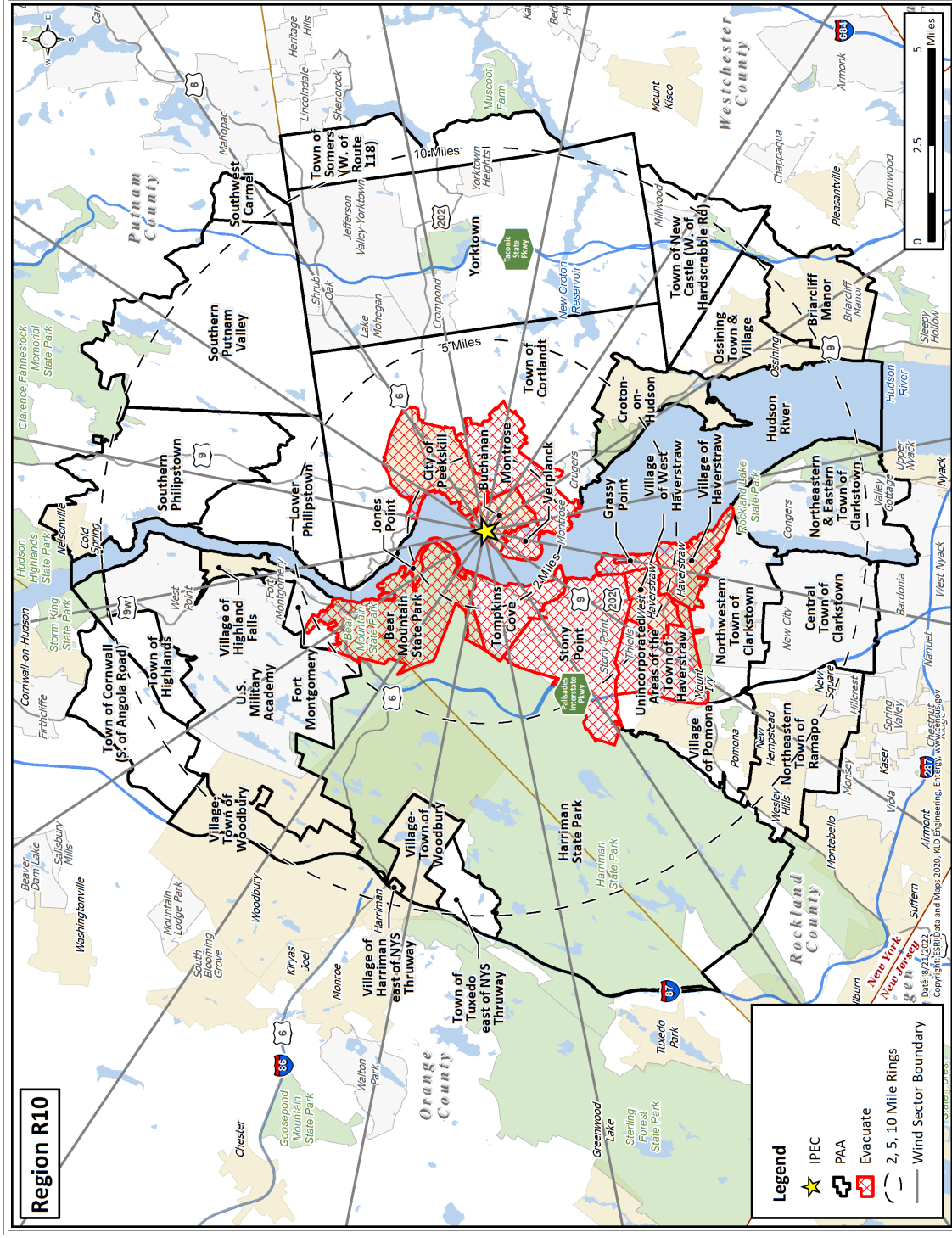
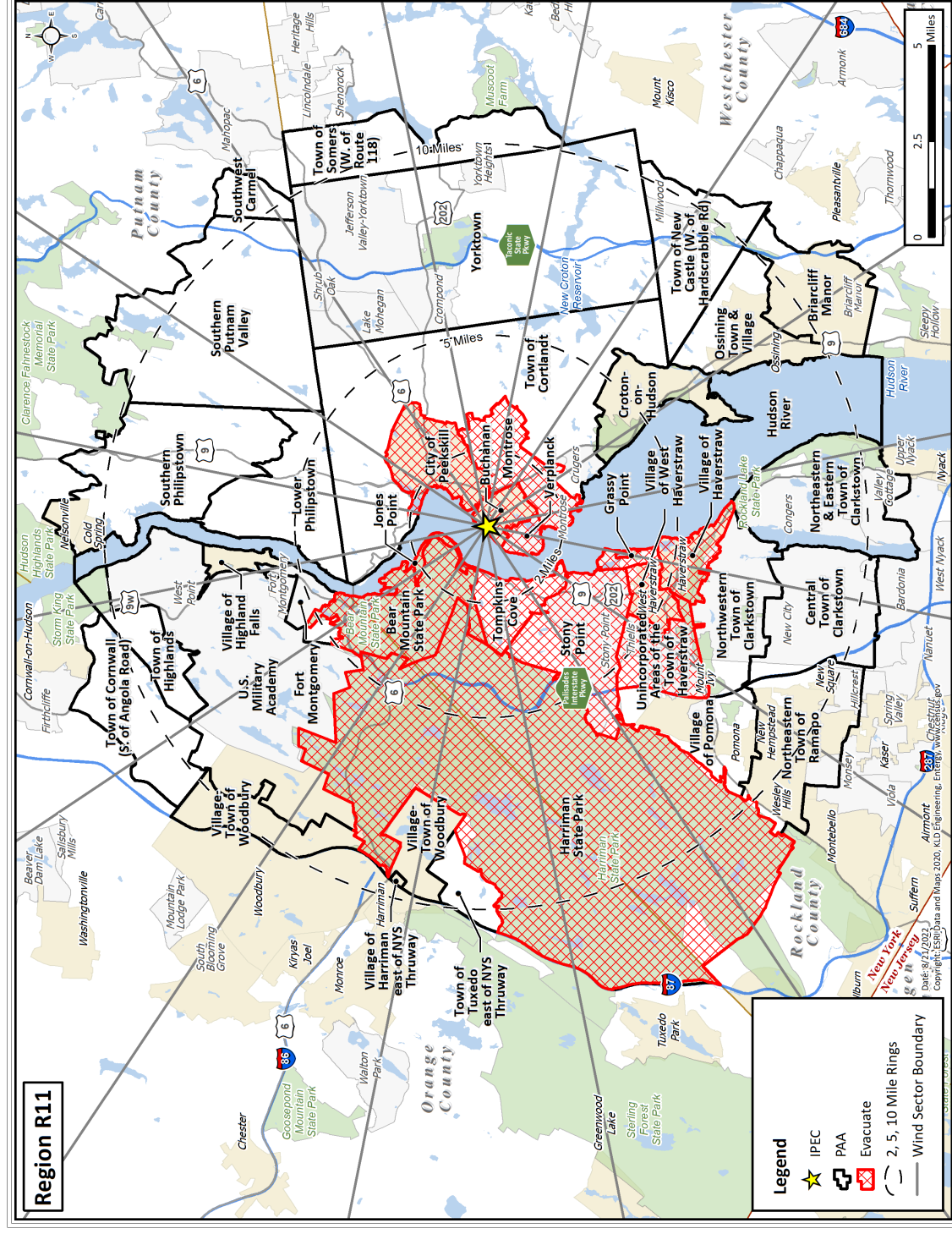
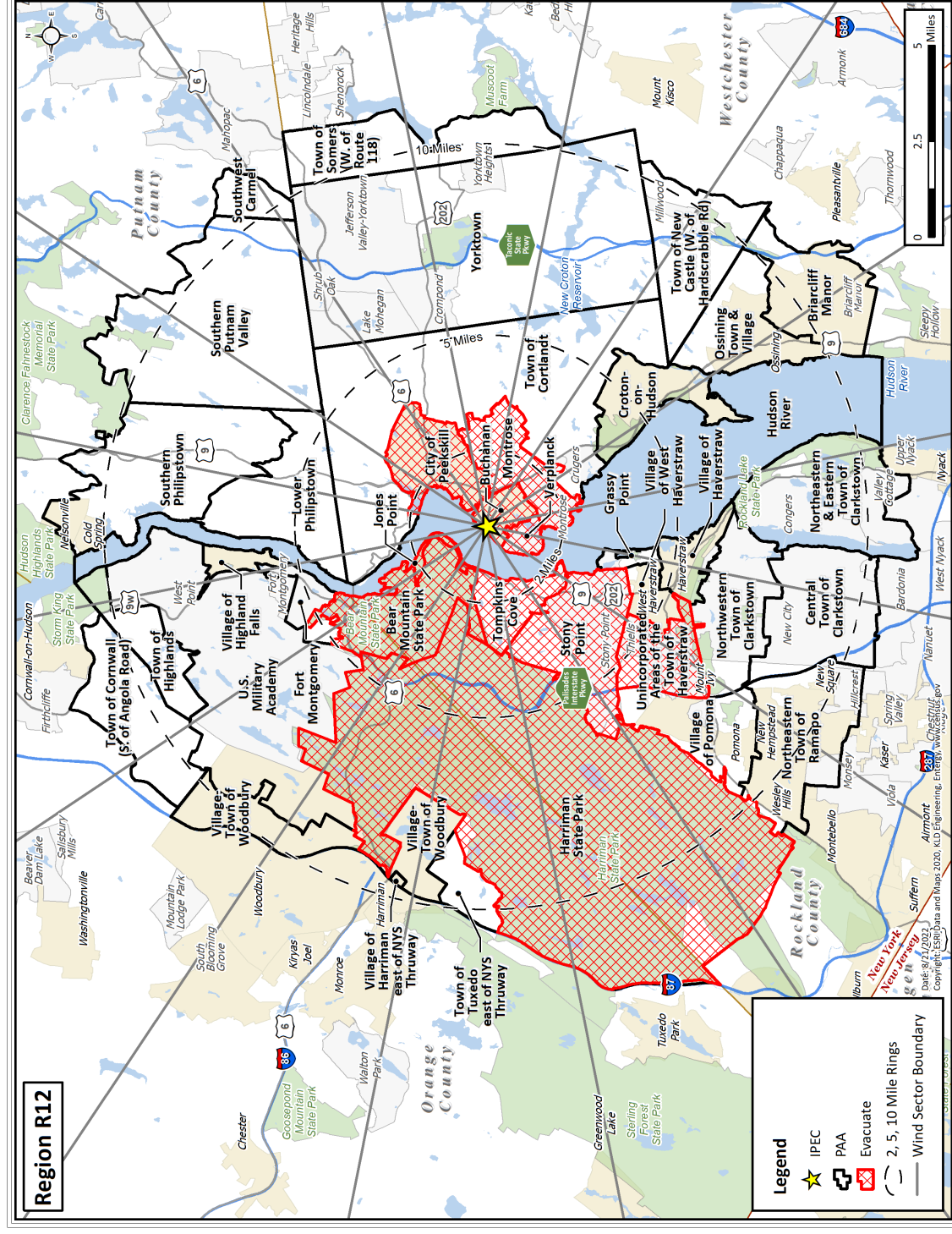
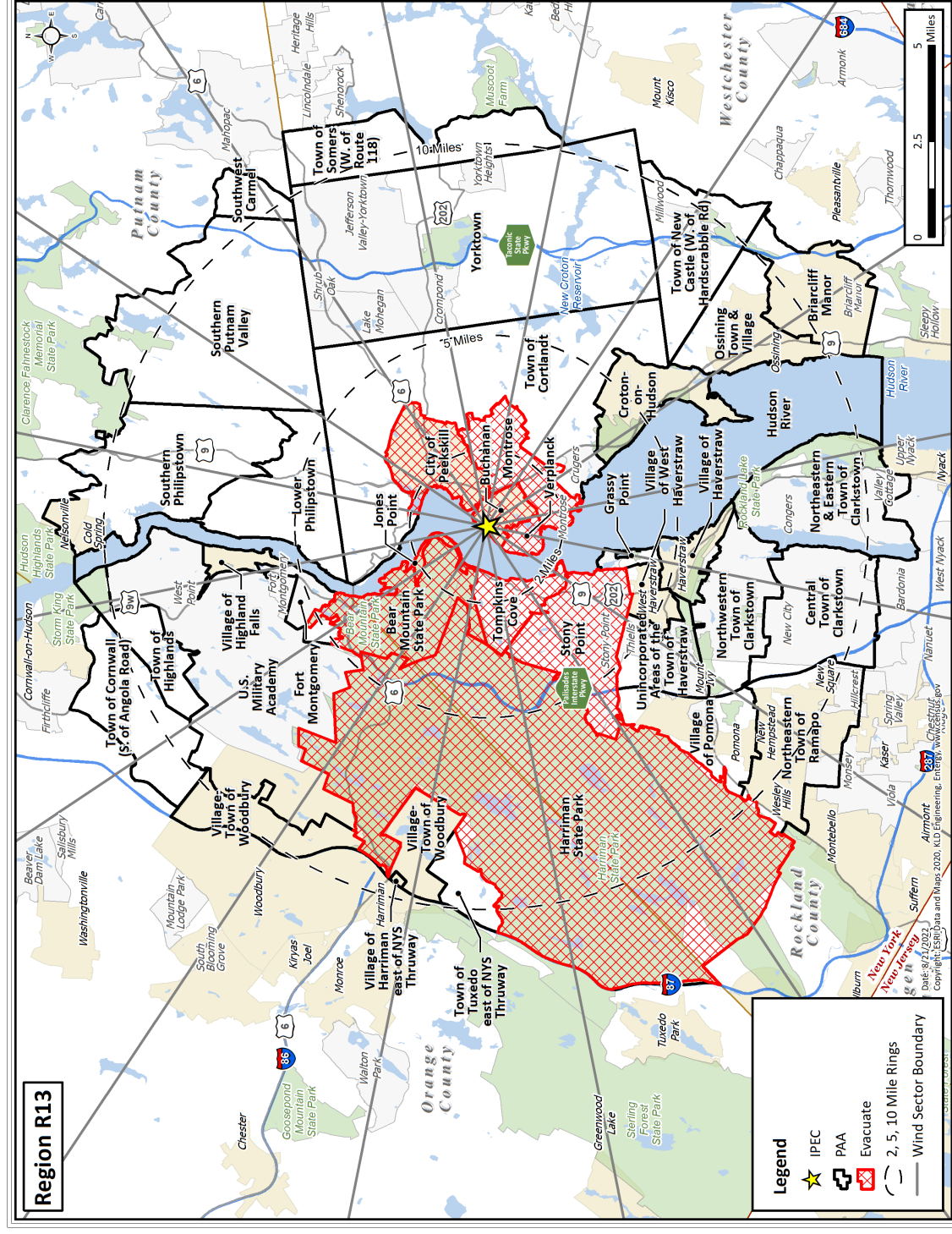


Figure H-10. Region R10







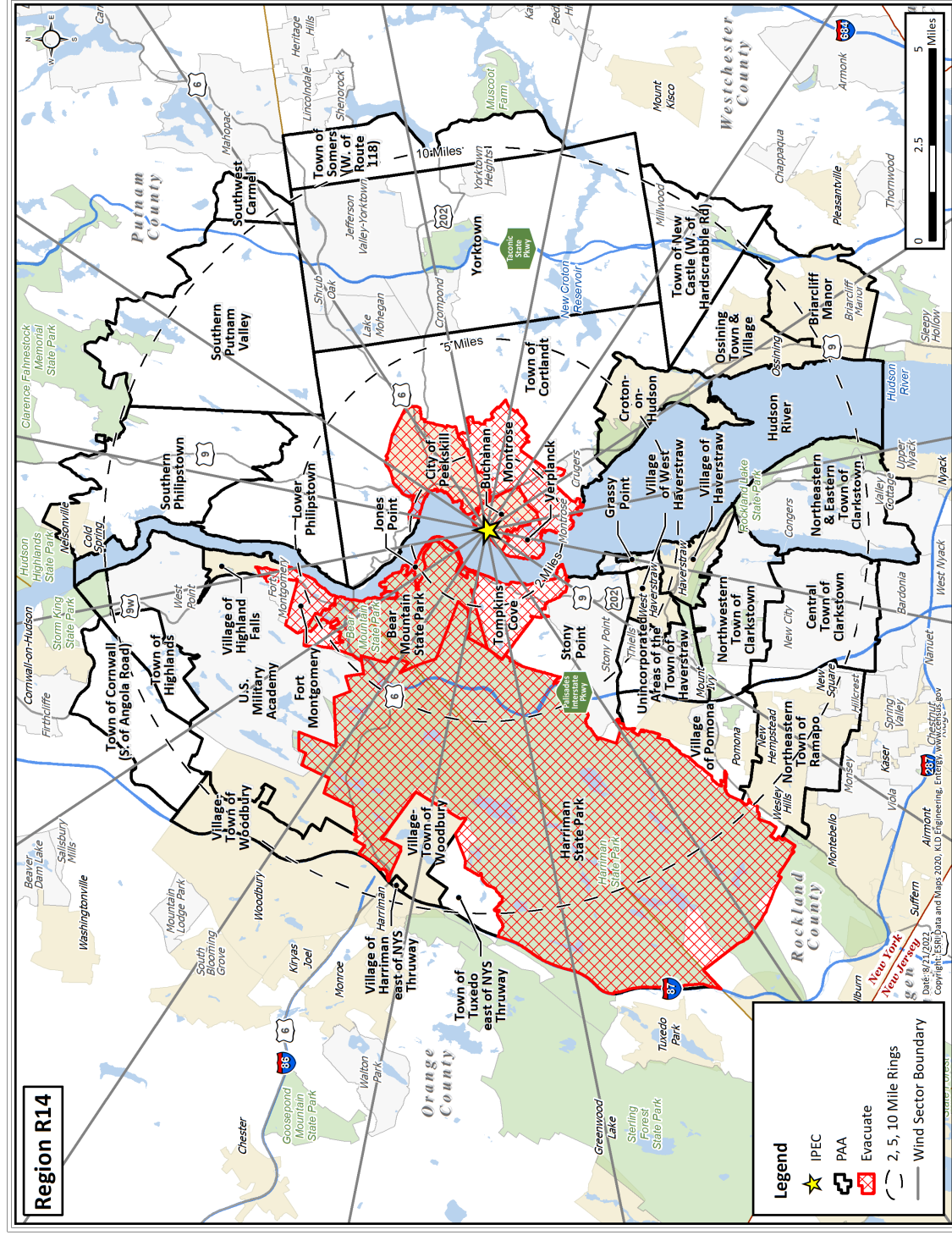


Figure H-14. Region R14

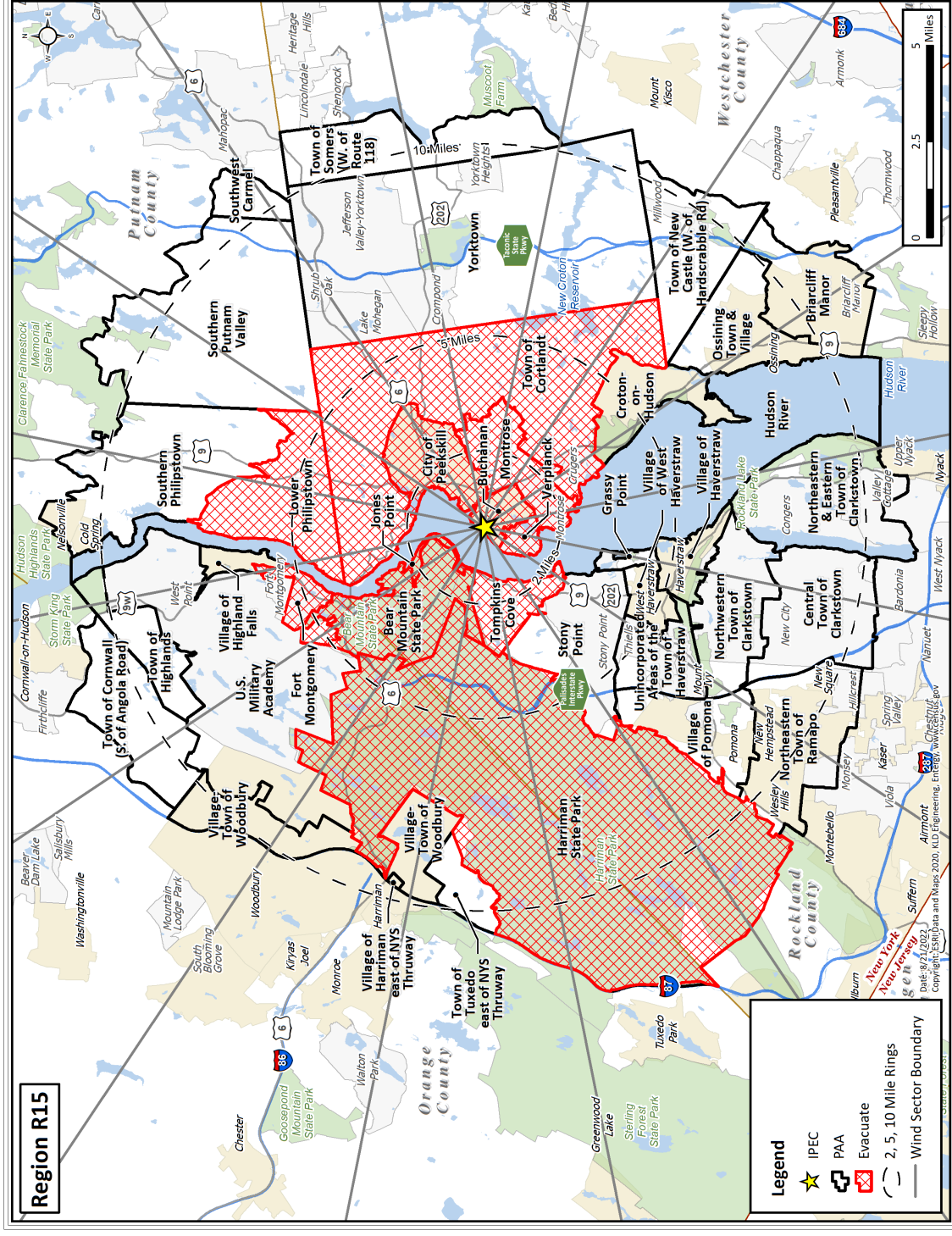
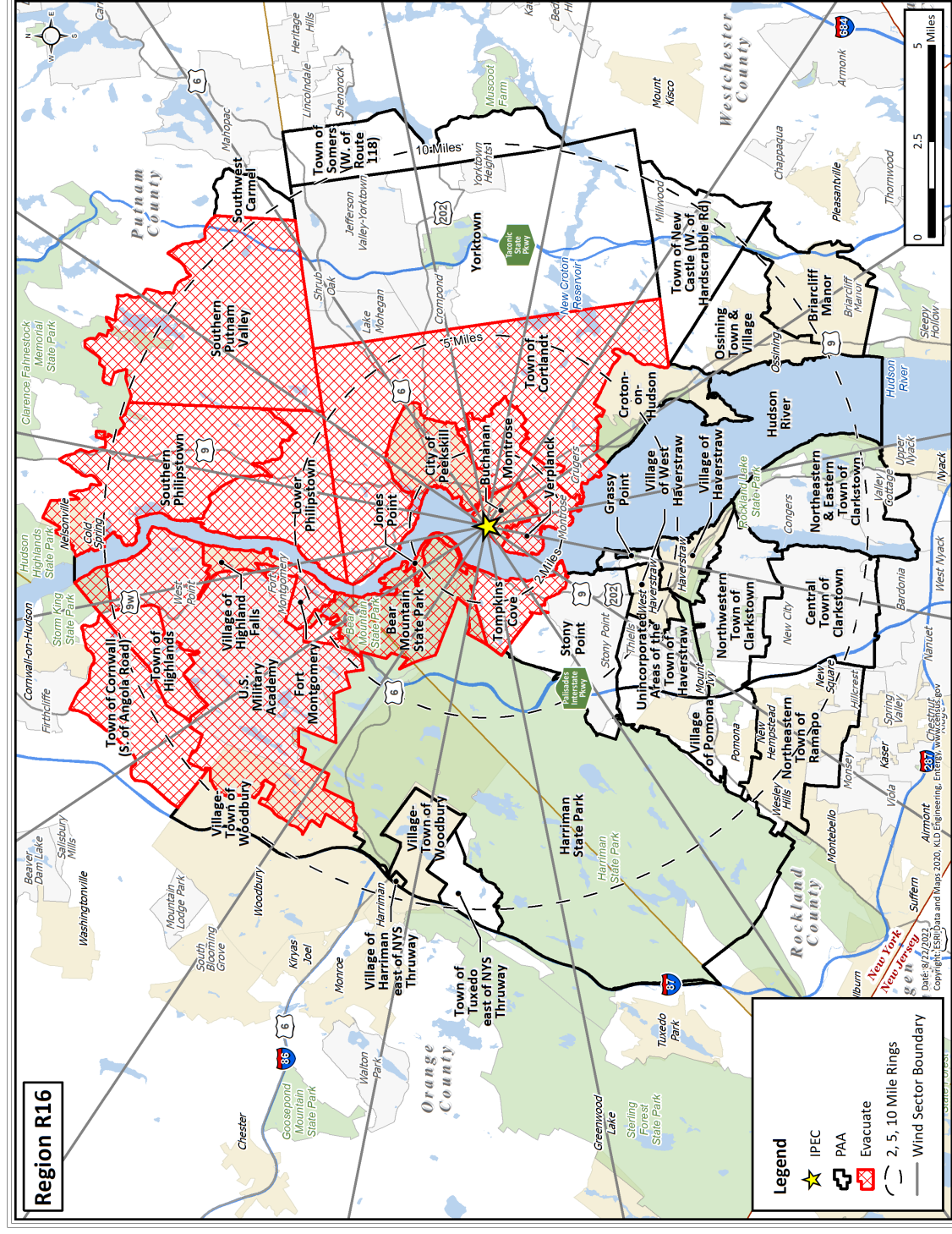
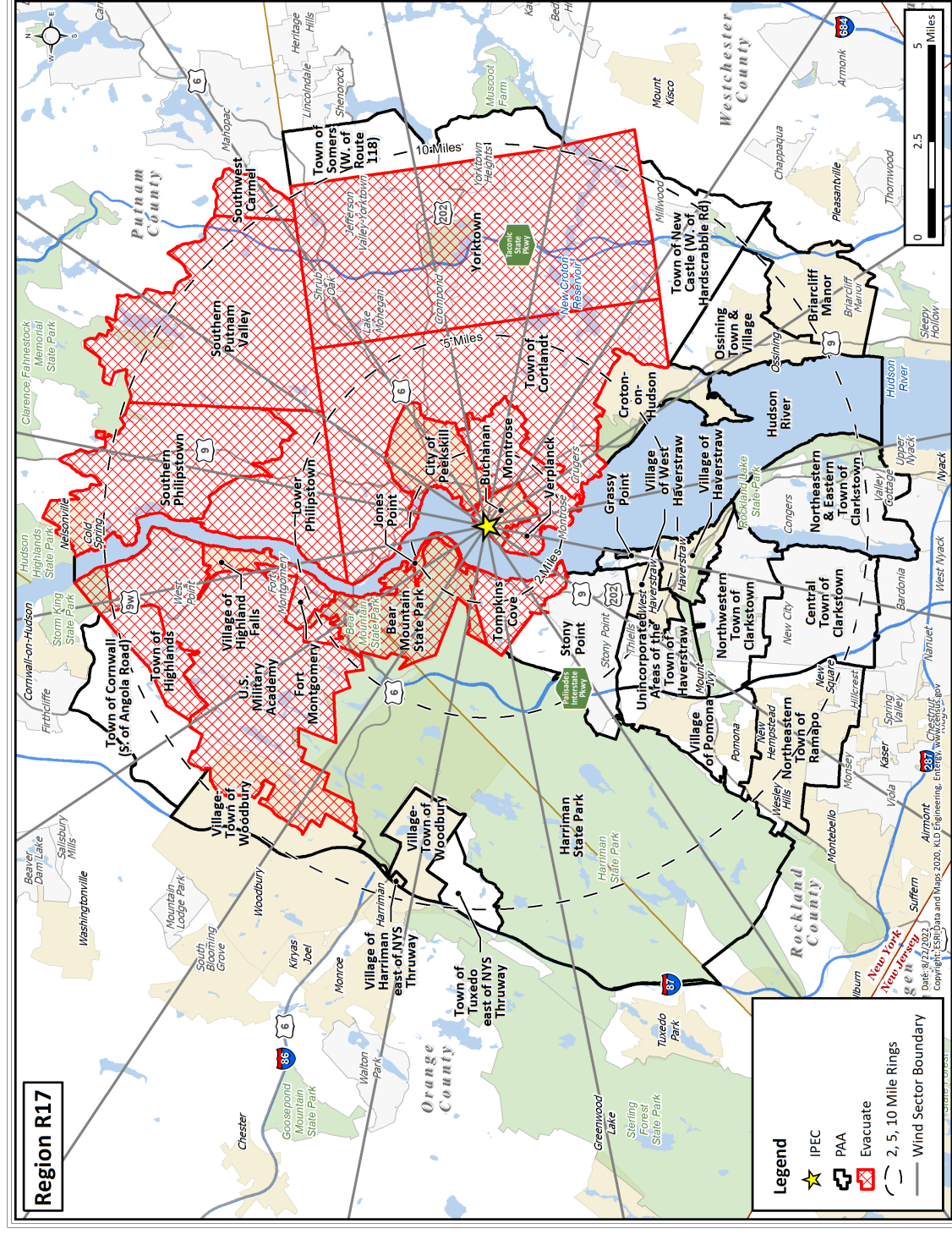


Figure H-15. Region R15





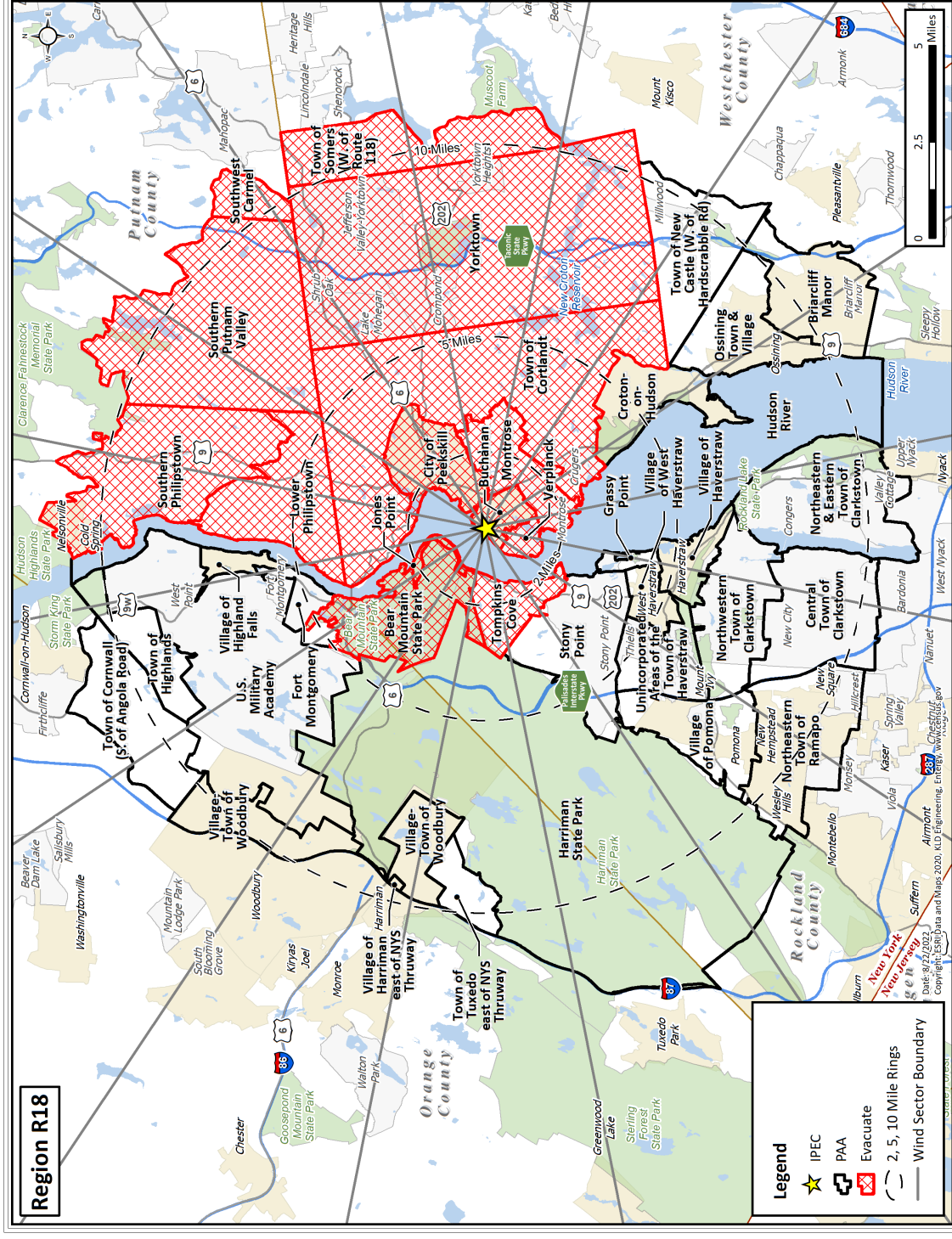


Figure H-18. Region R18

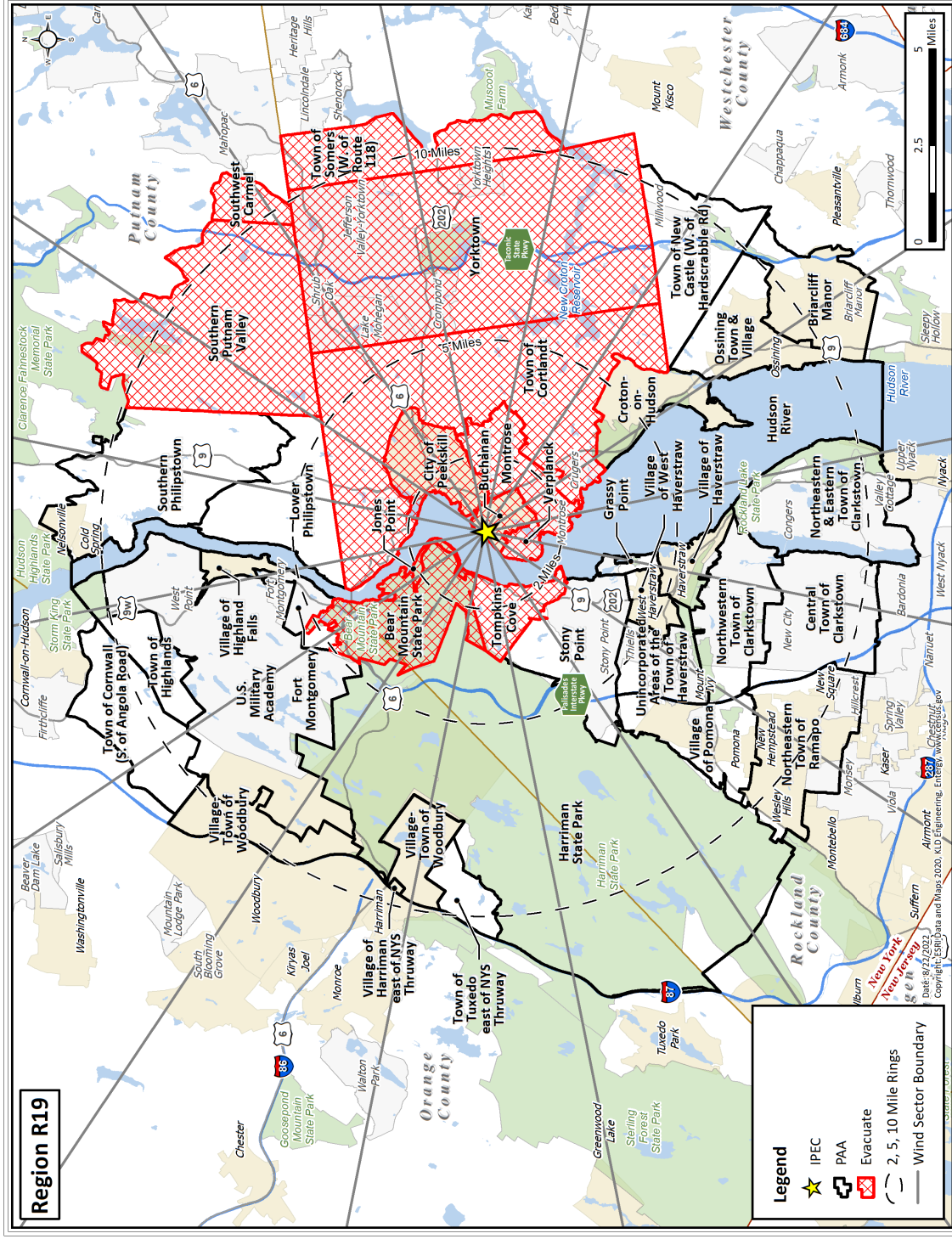


Figure H-19. Region R19

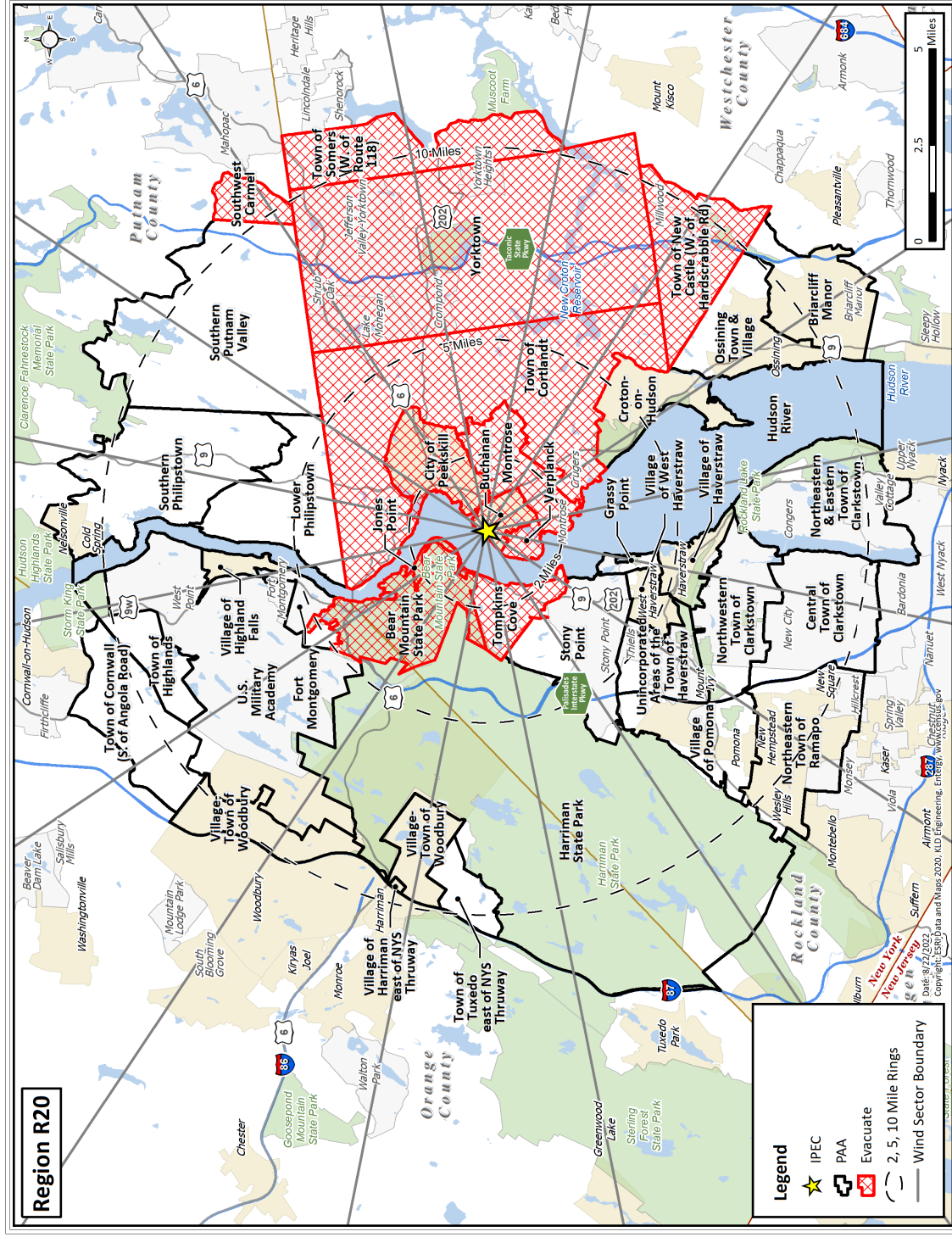
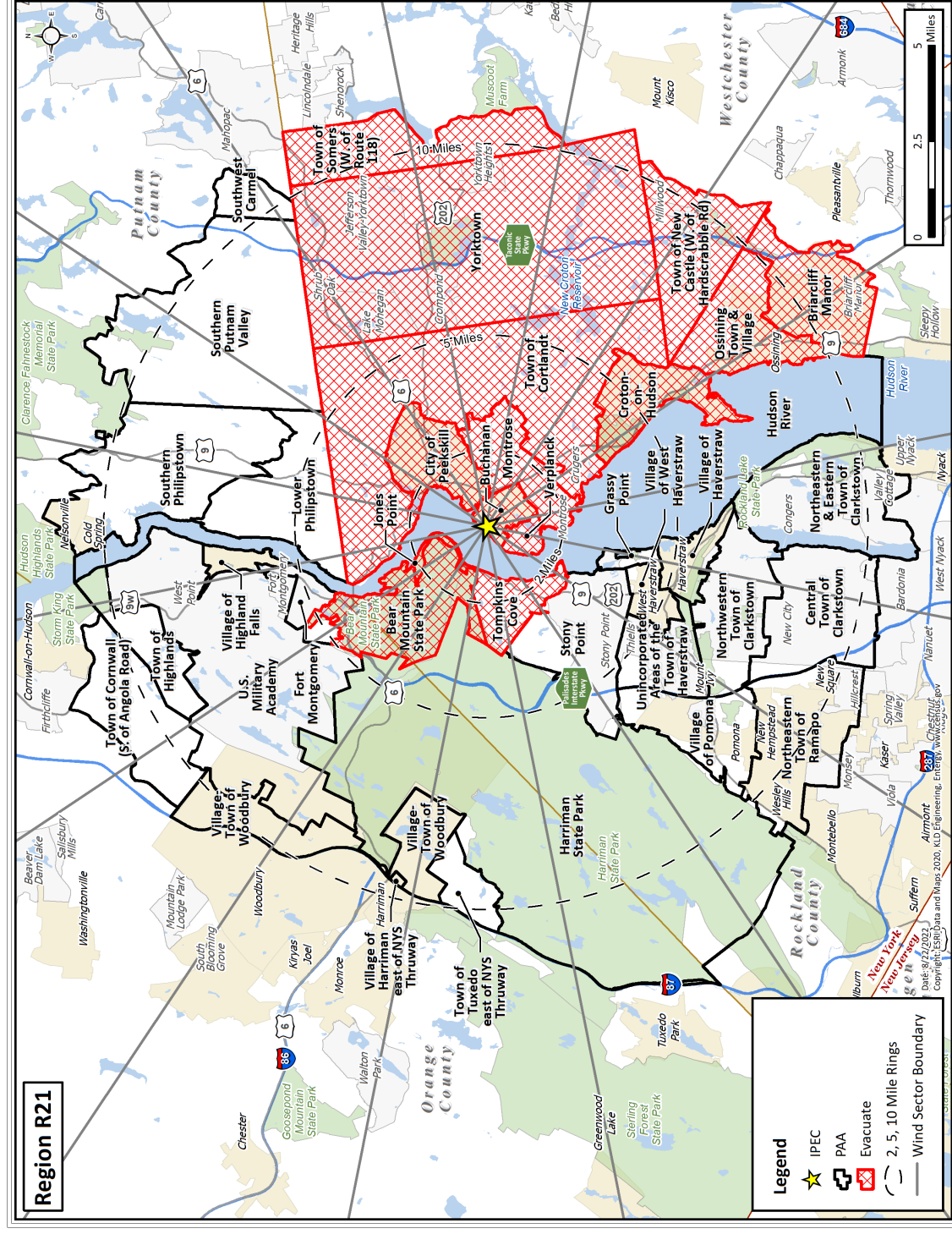


Figure H-20. Region R20



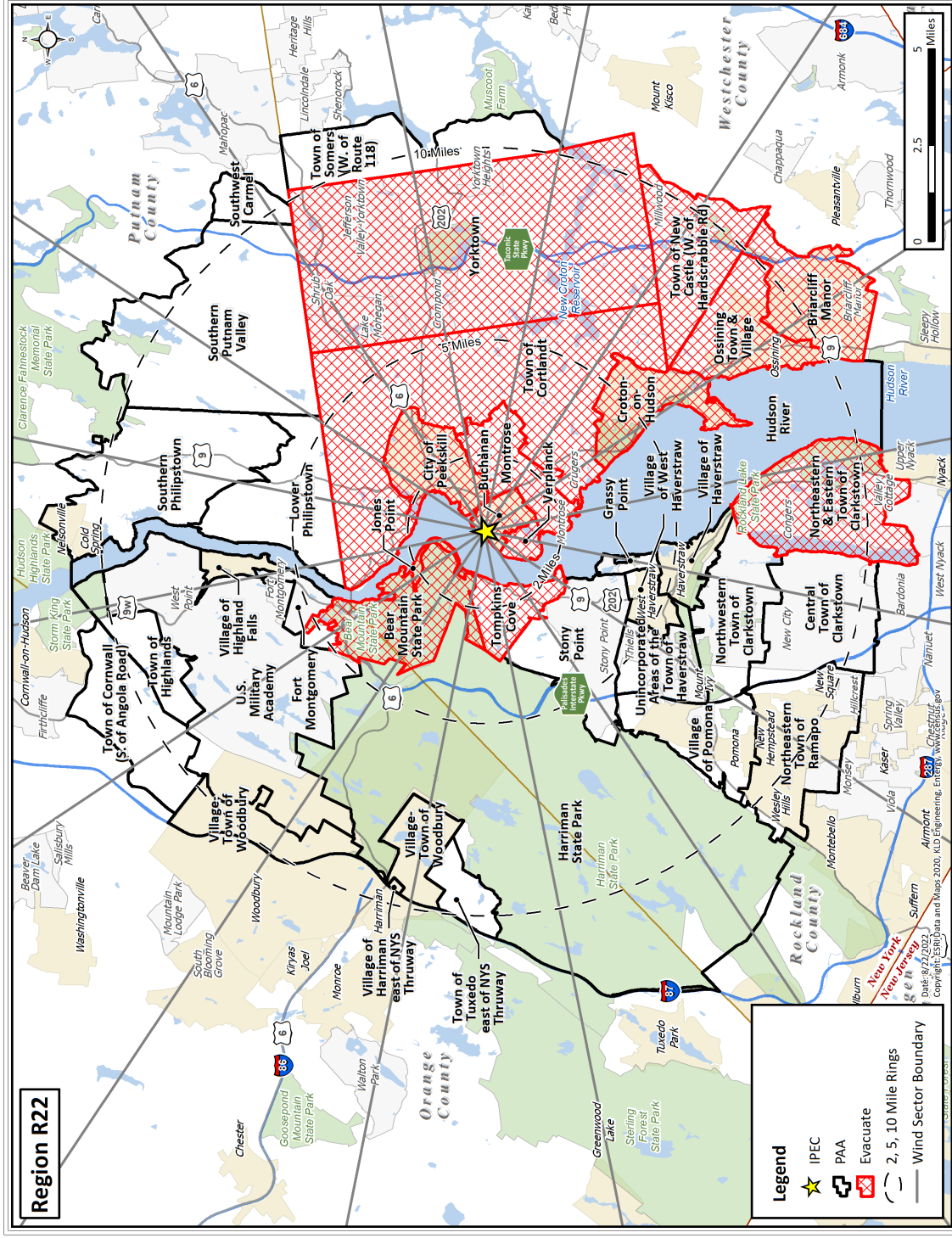
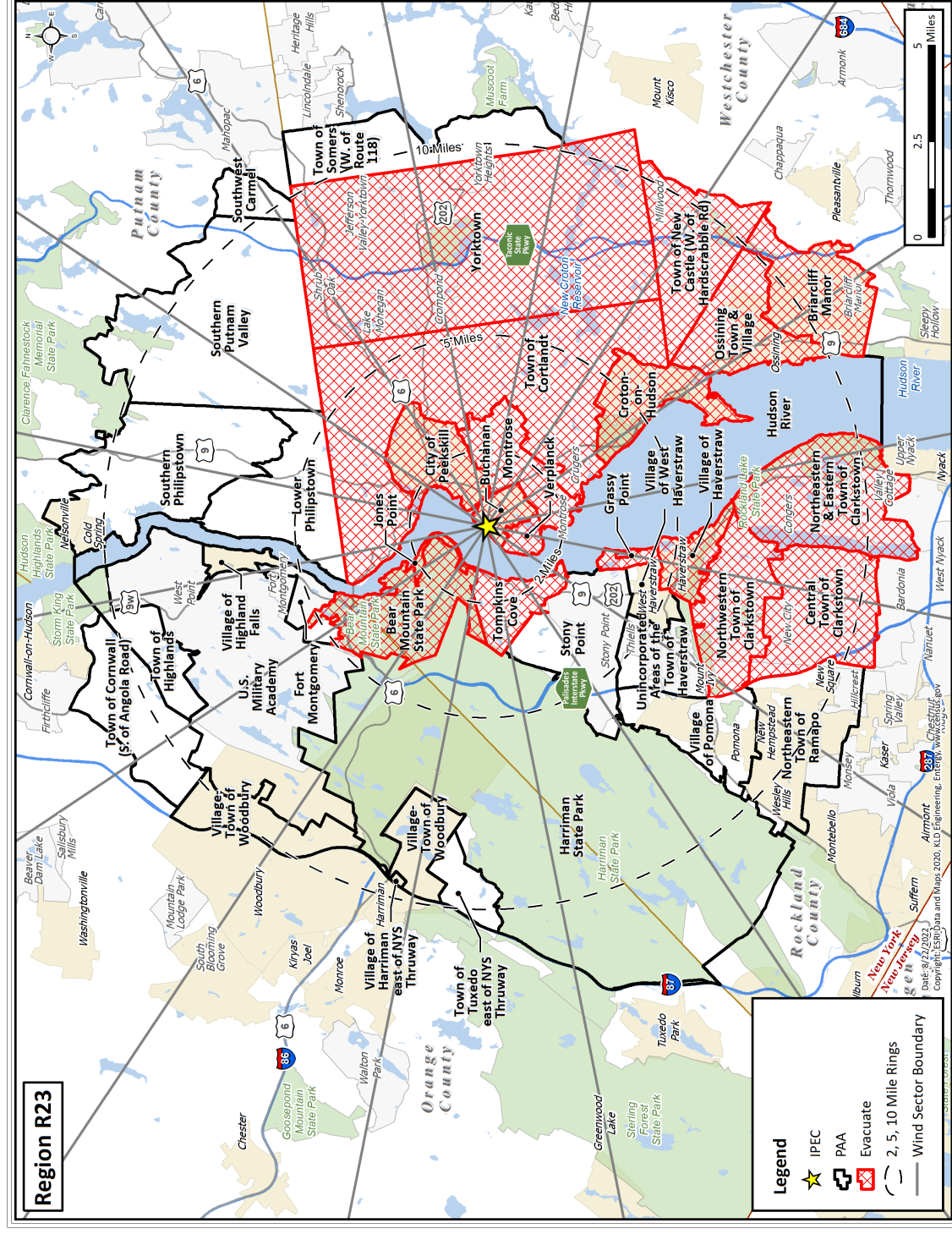
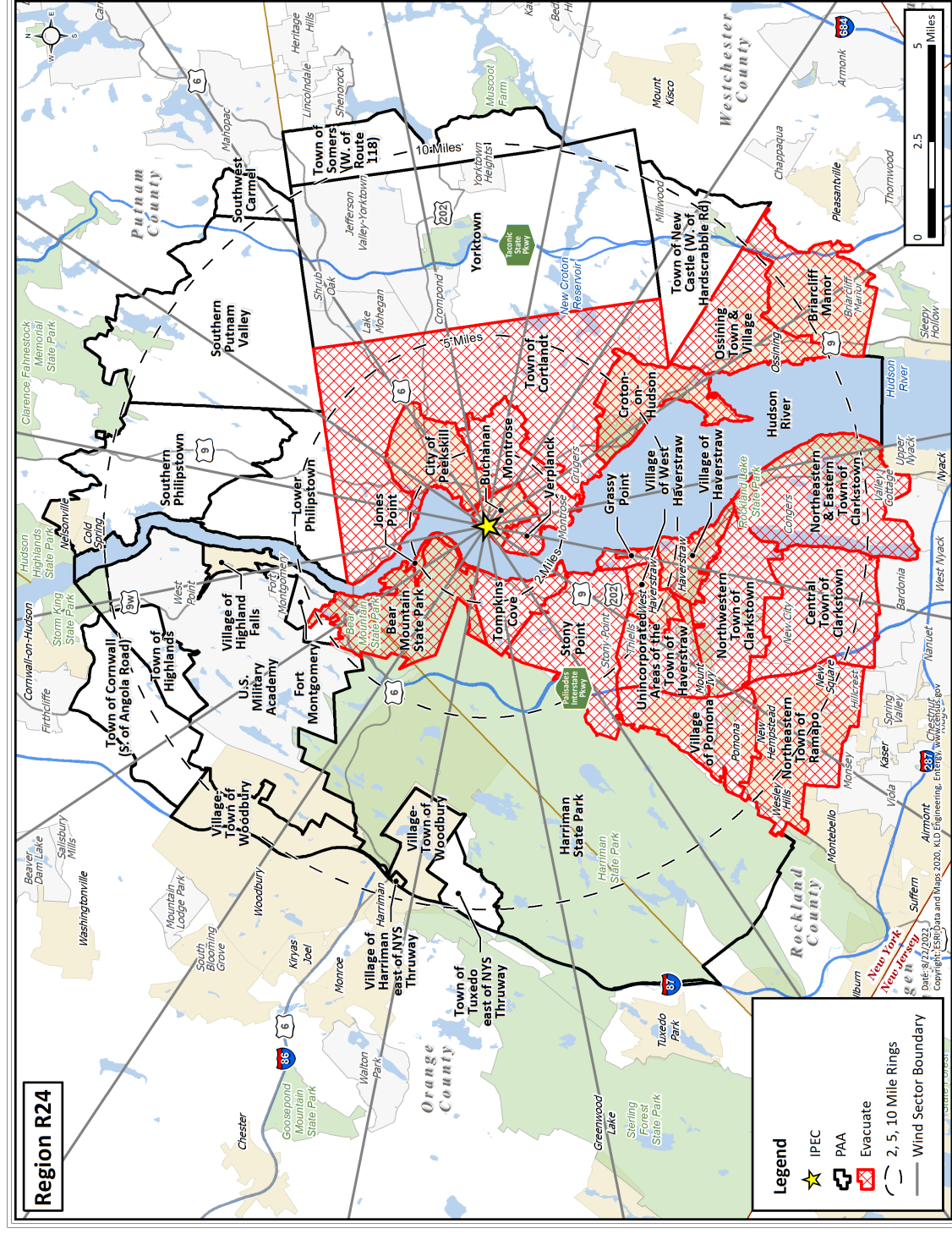
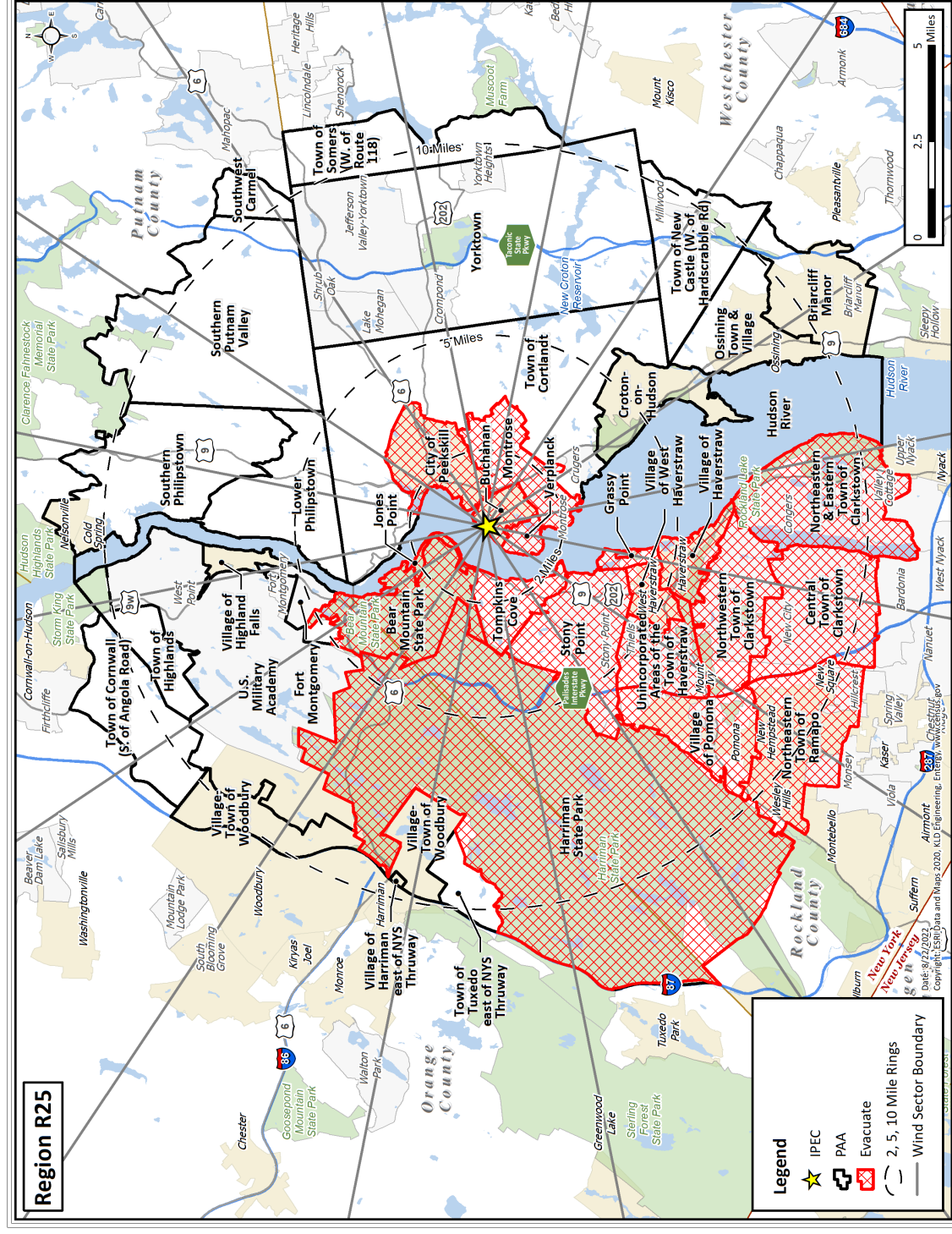
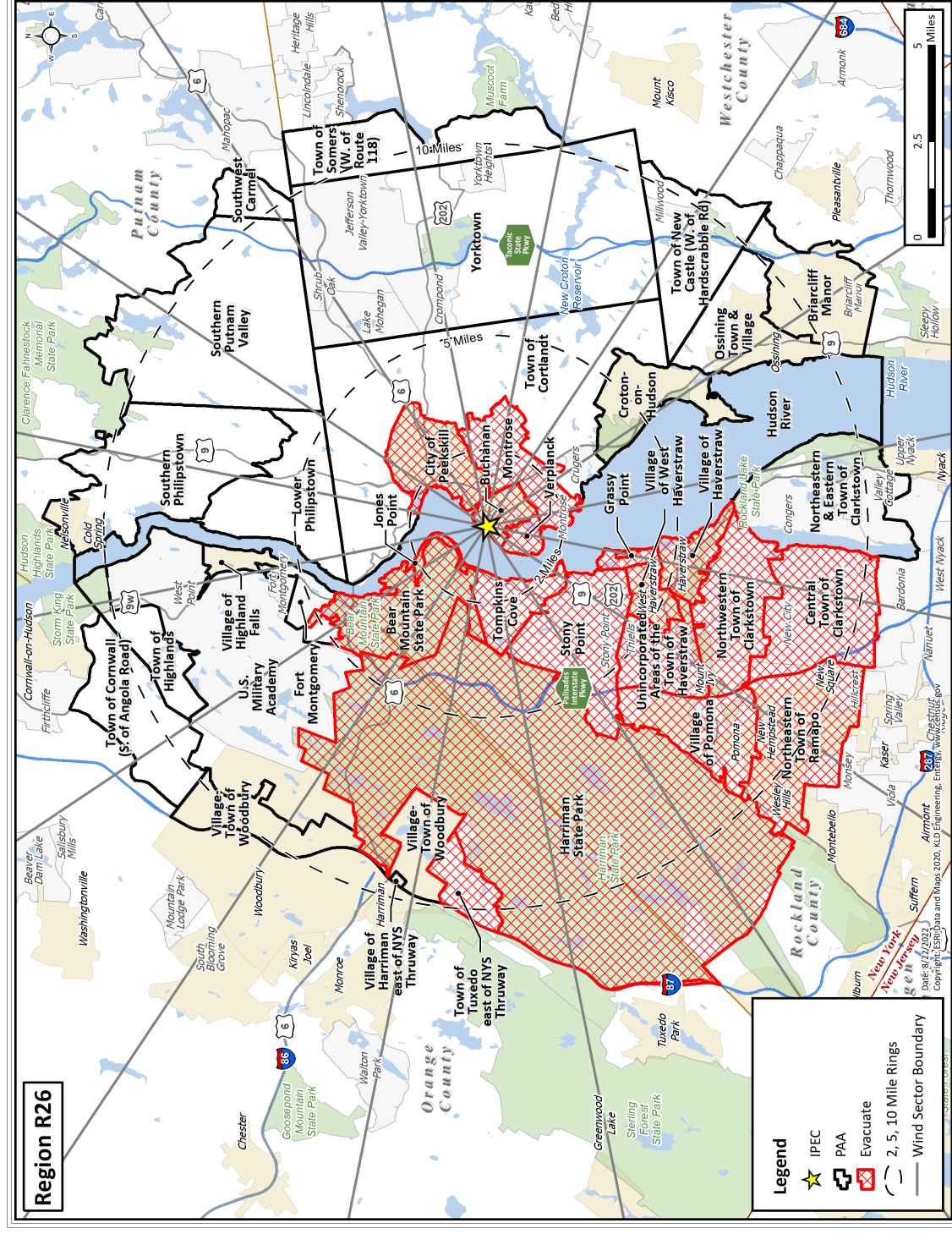


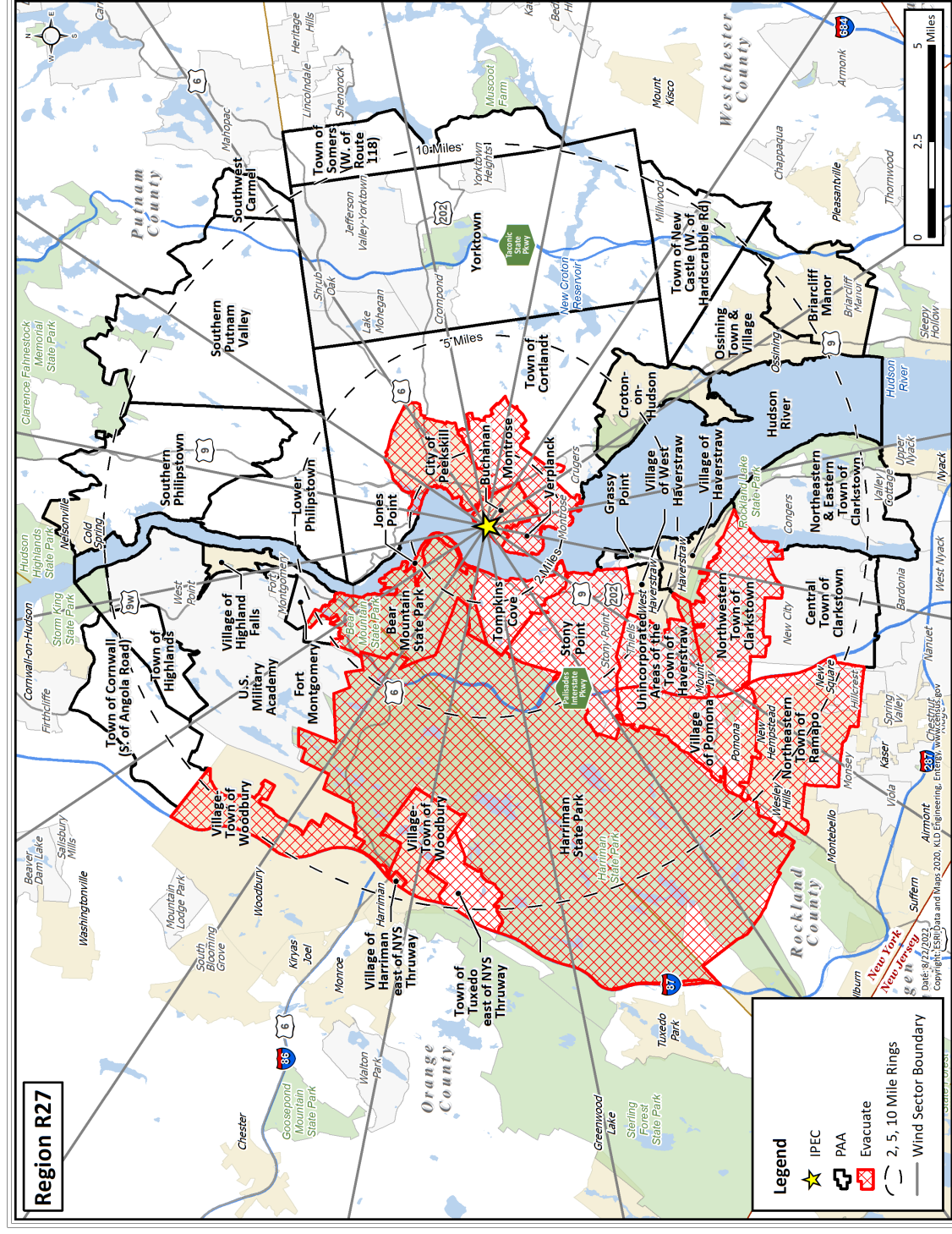
Figure H-22. Region R22











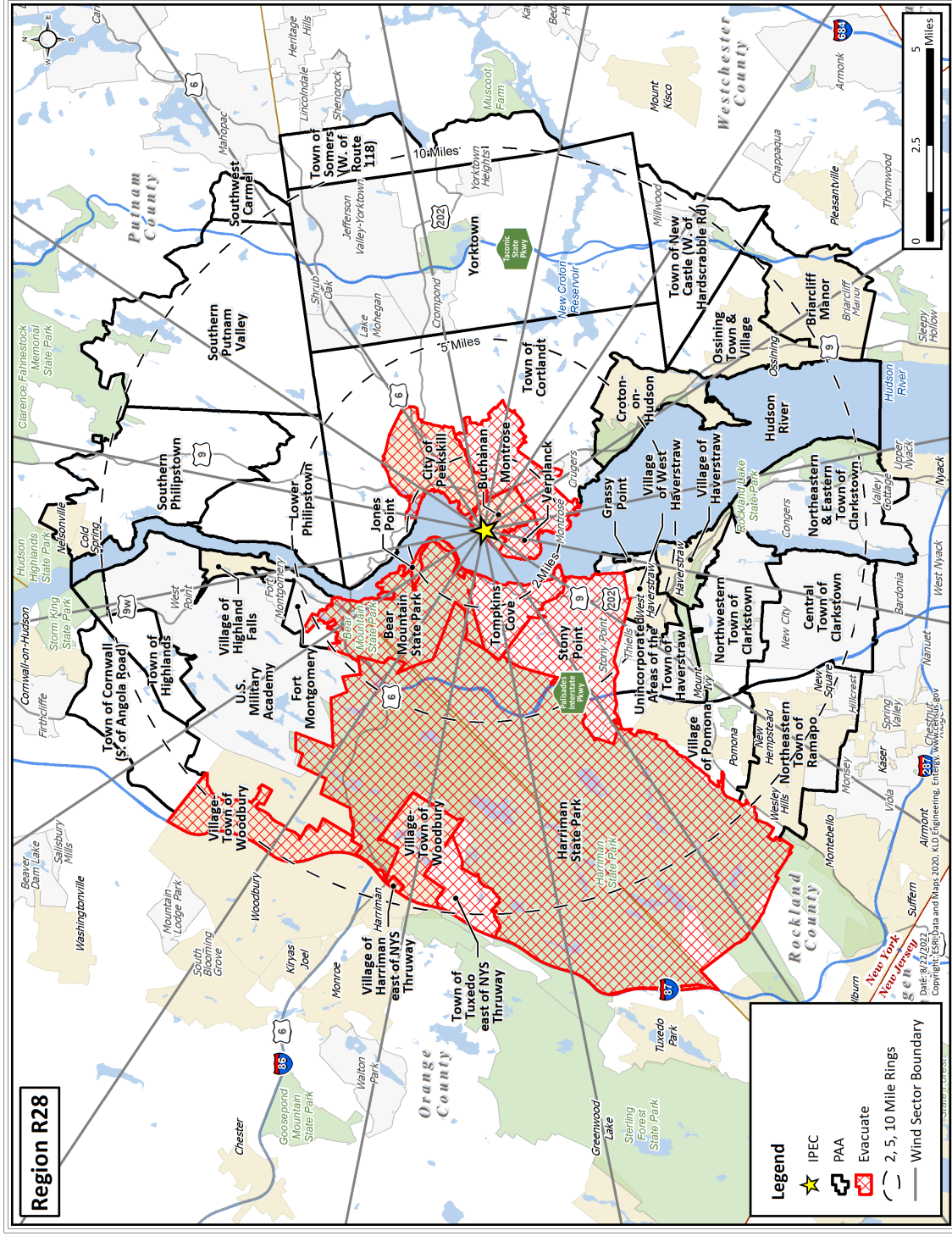


Figure H-28. Region R28

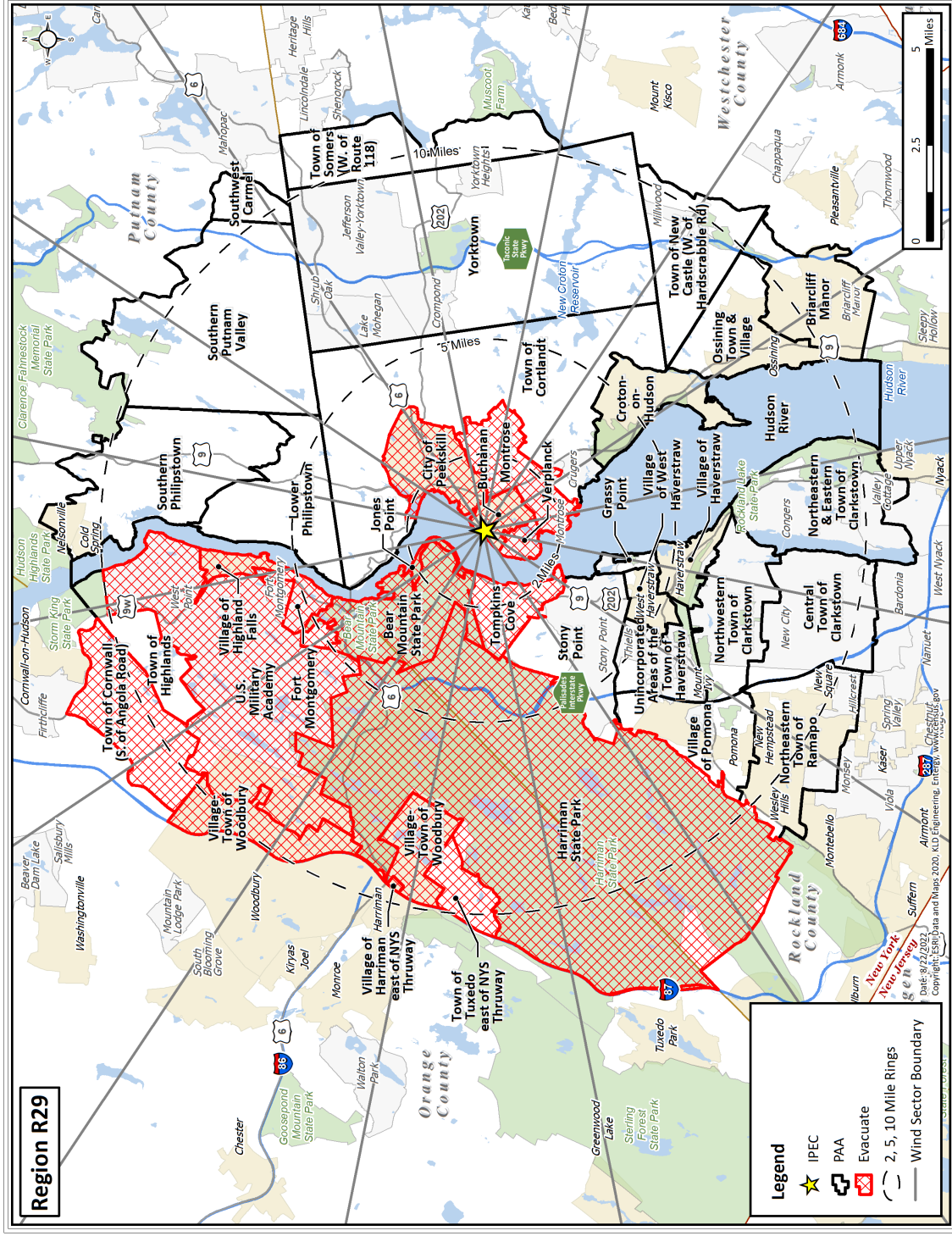
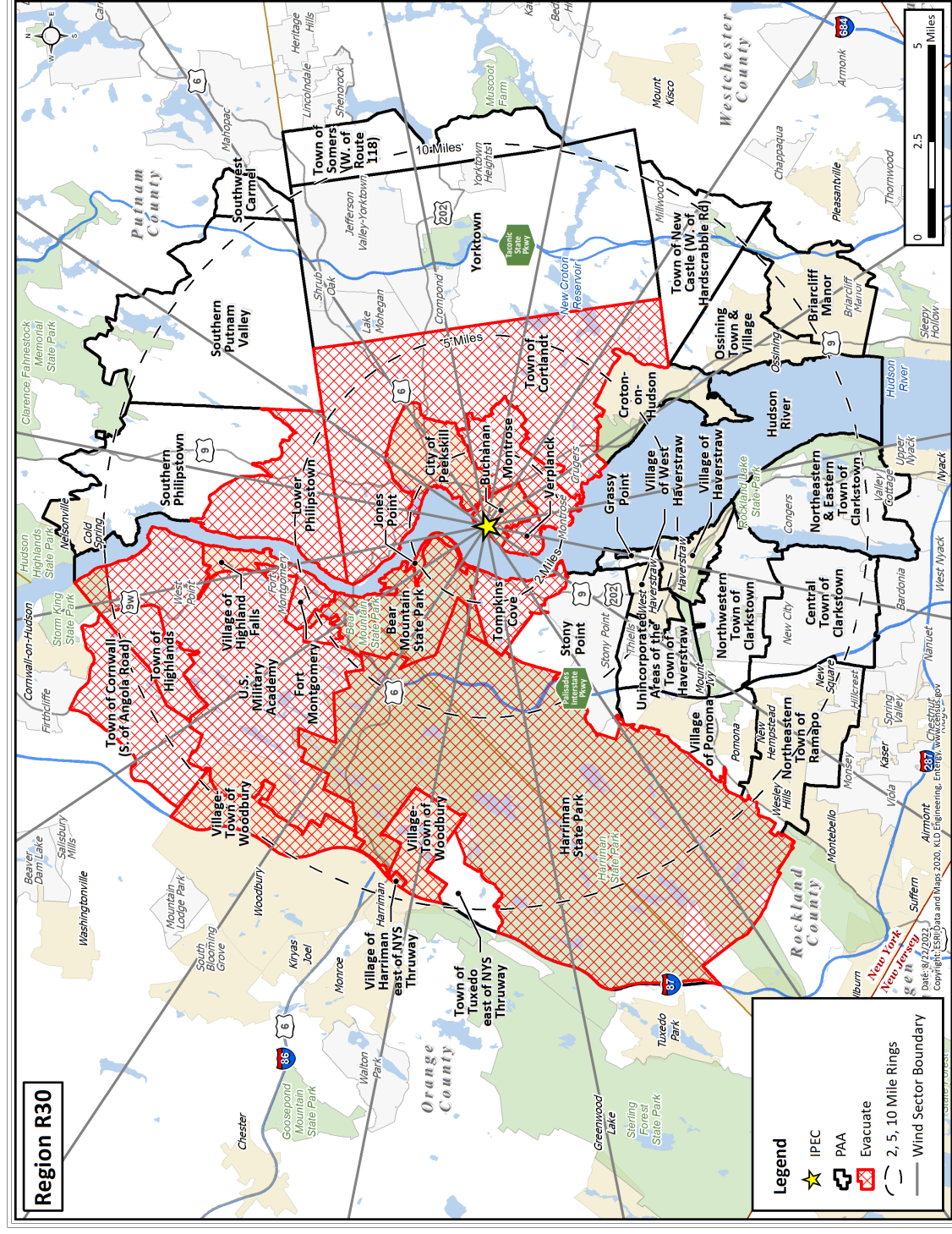
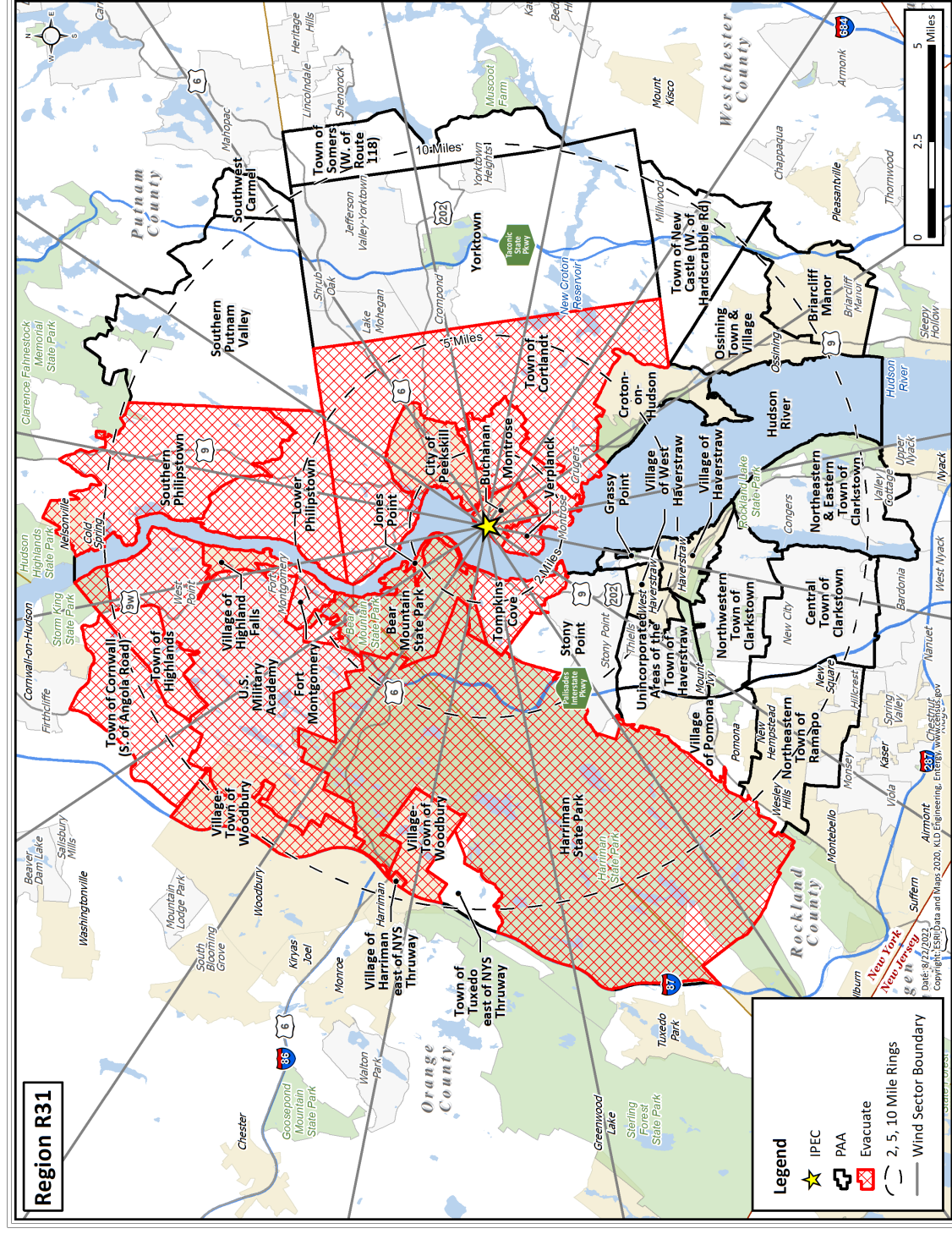


Figure H-29. Region R29





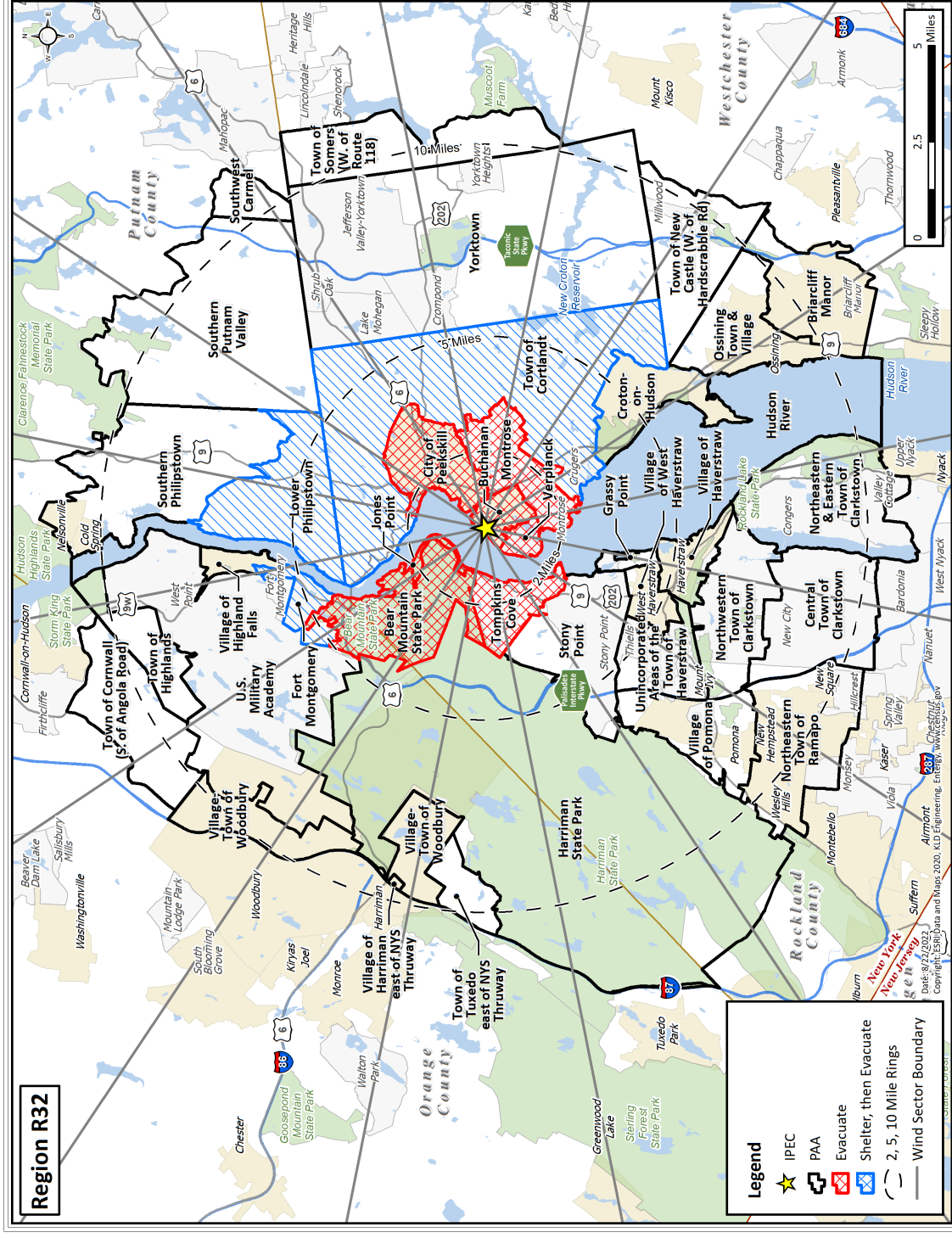


Figure H-32. Region R32

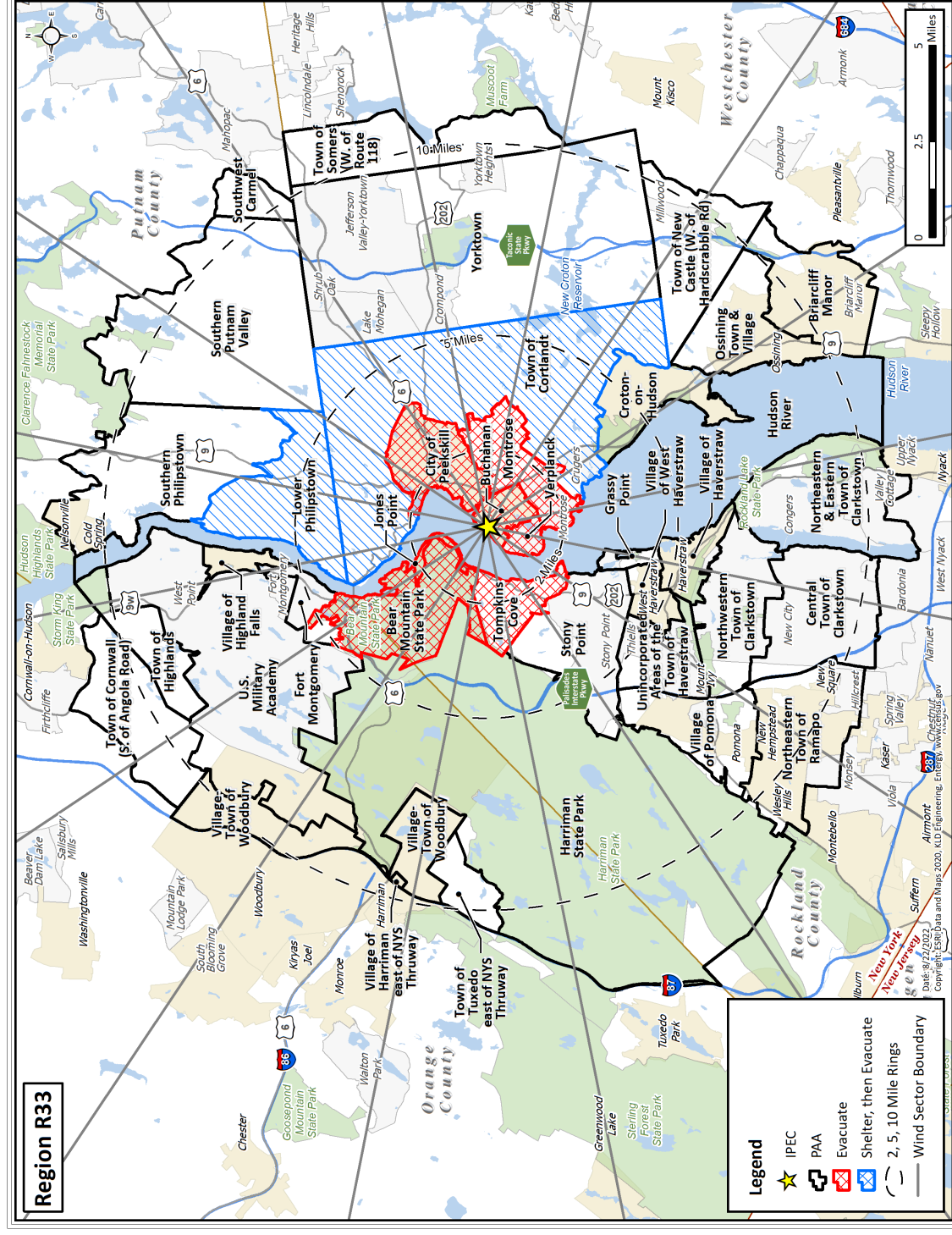
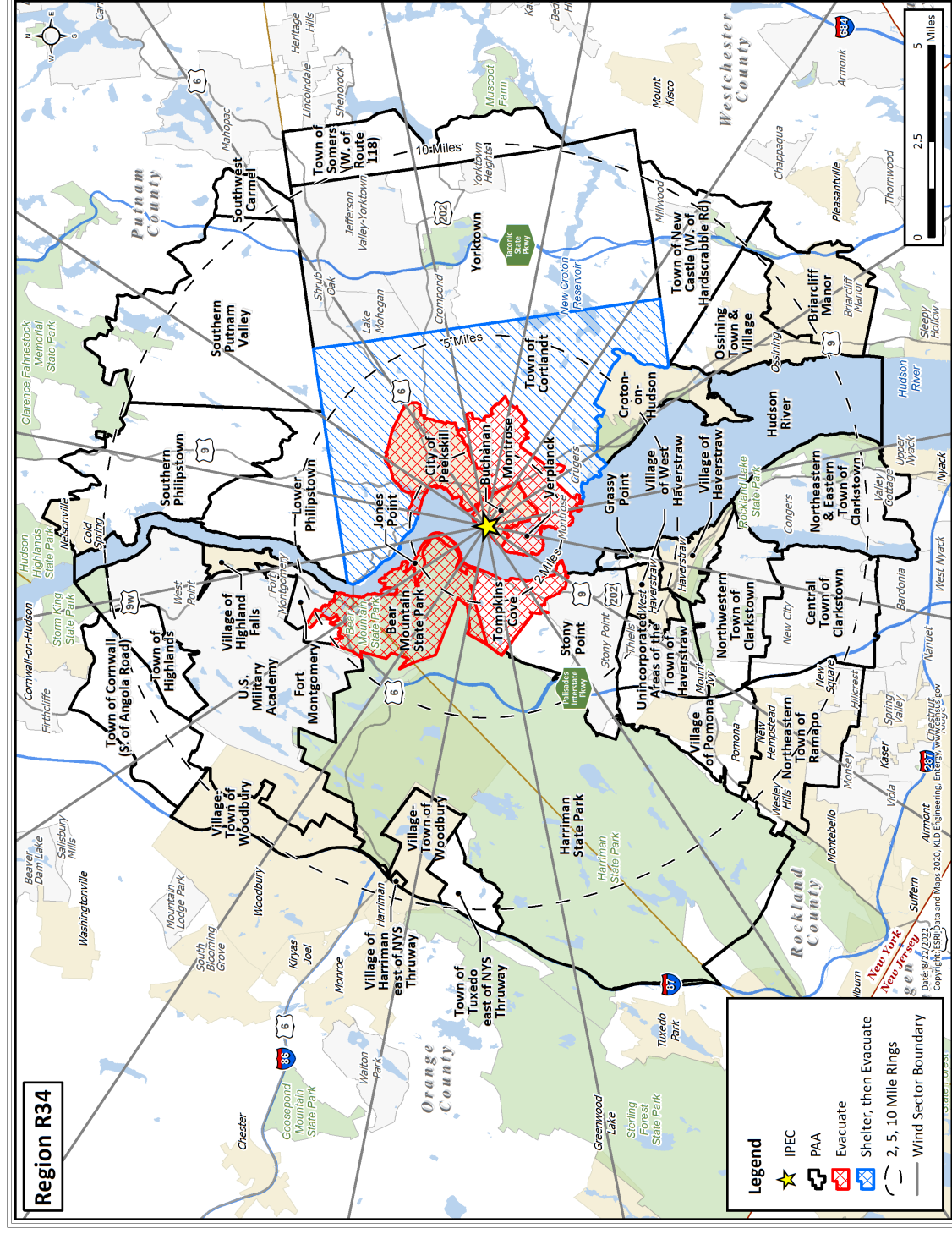


Figure H-33. Region R33



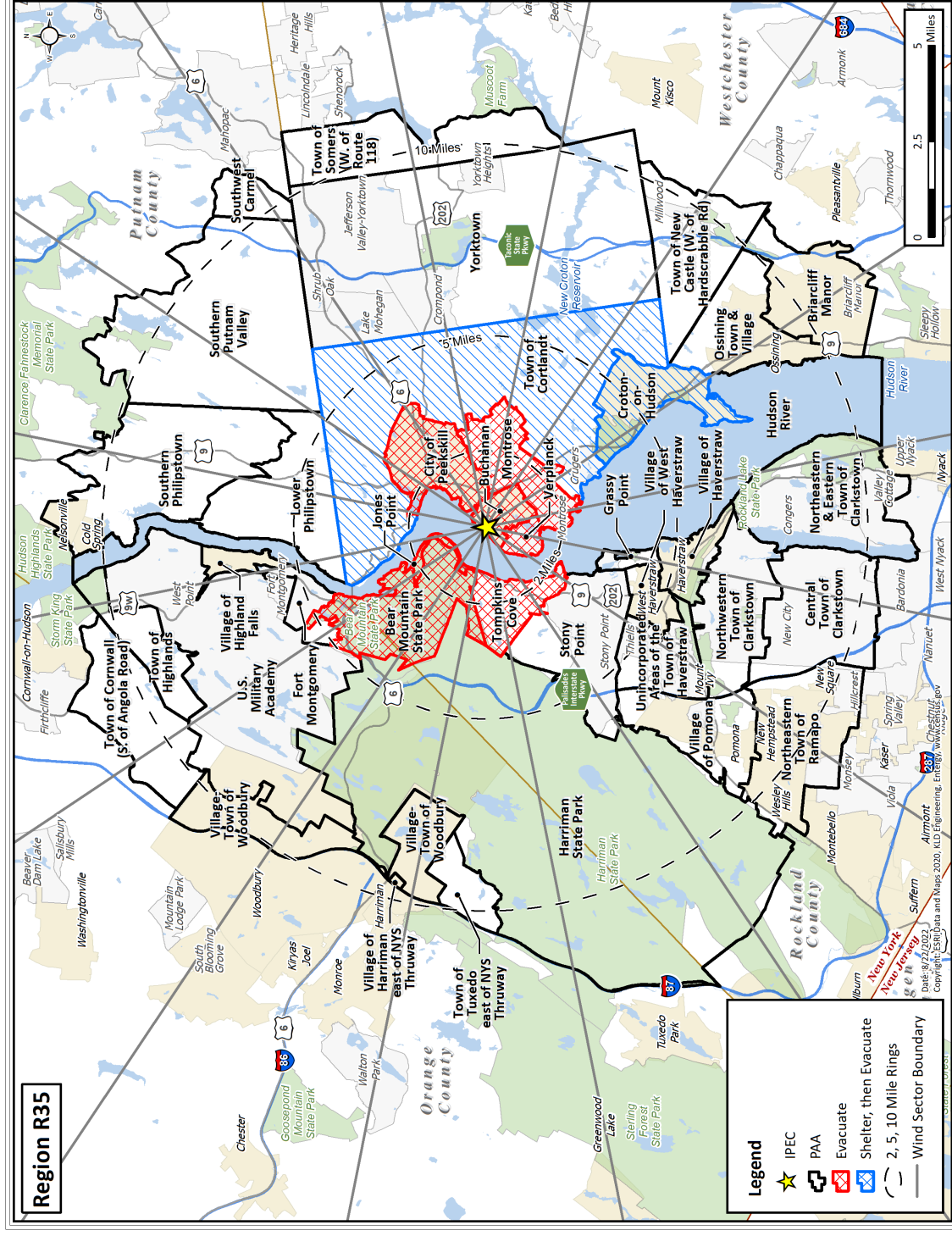


Figure H-35. Region R35

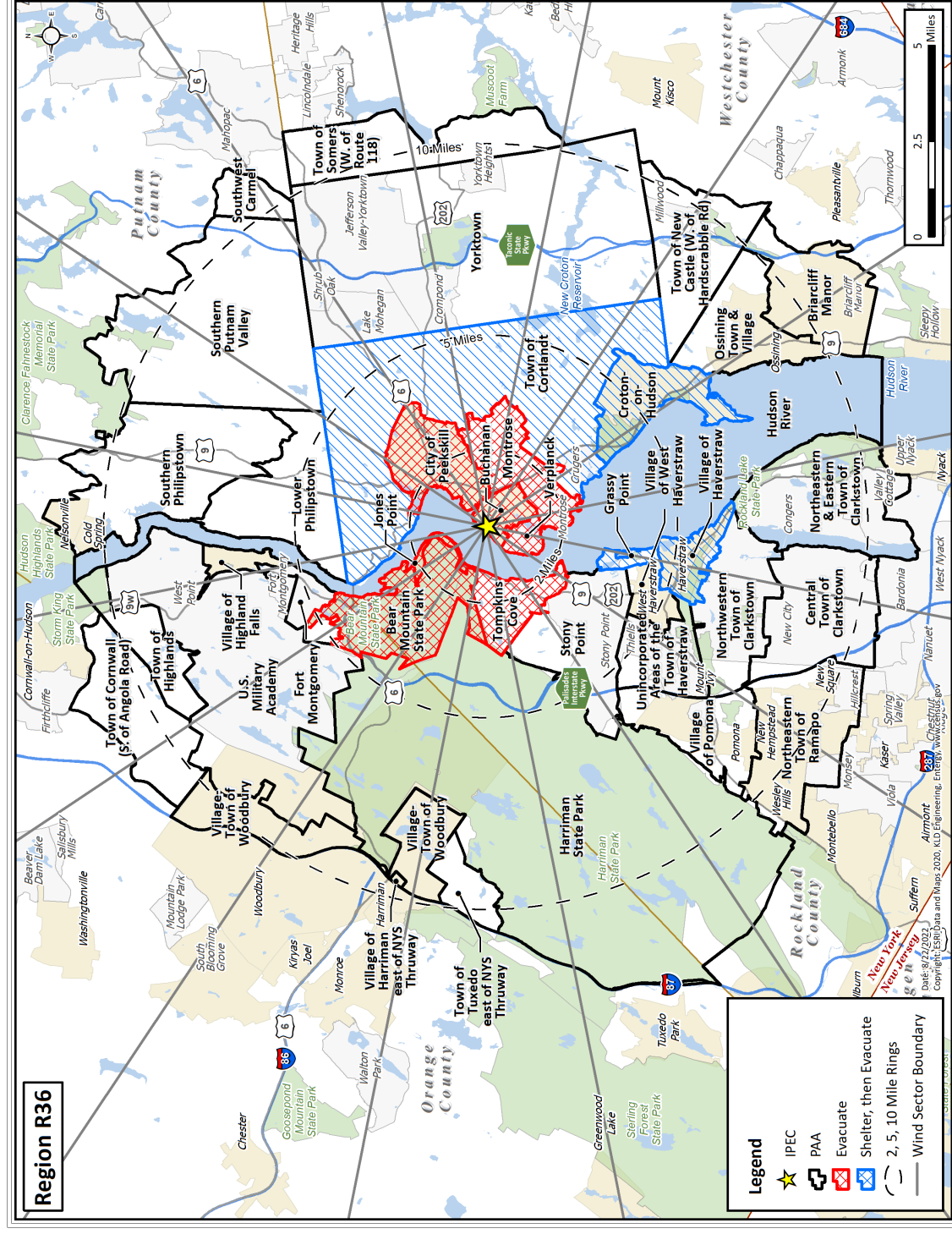


Figure H-36. Region R36

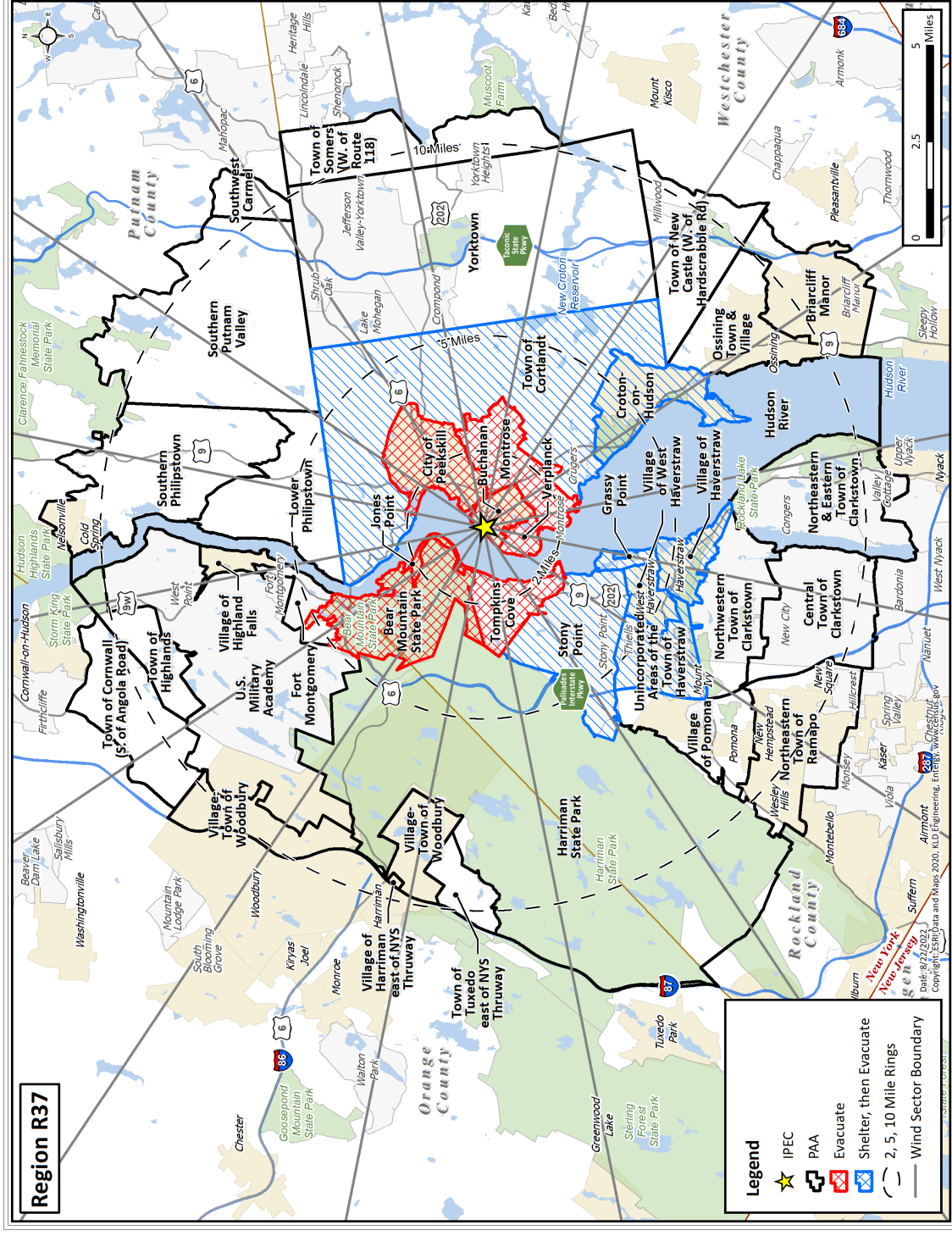
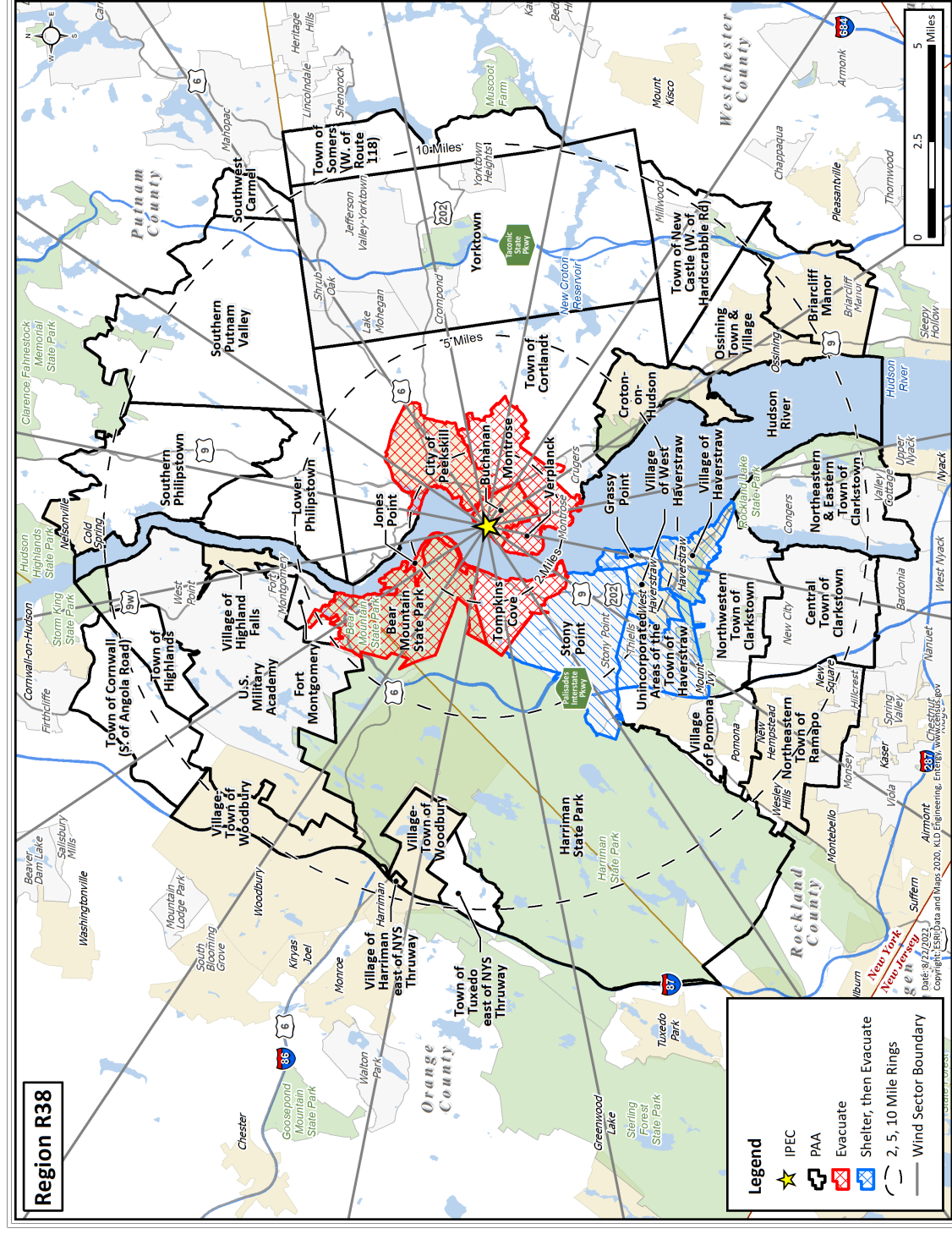


Figure H-37. Region R37



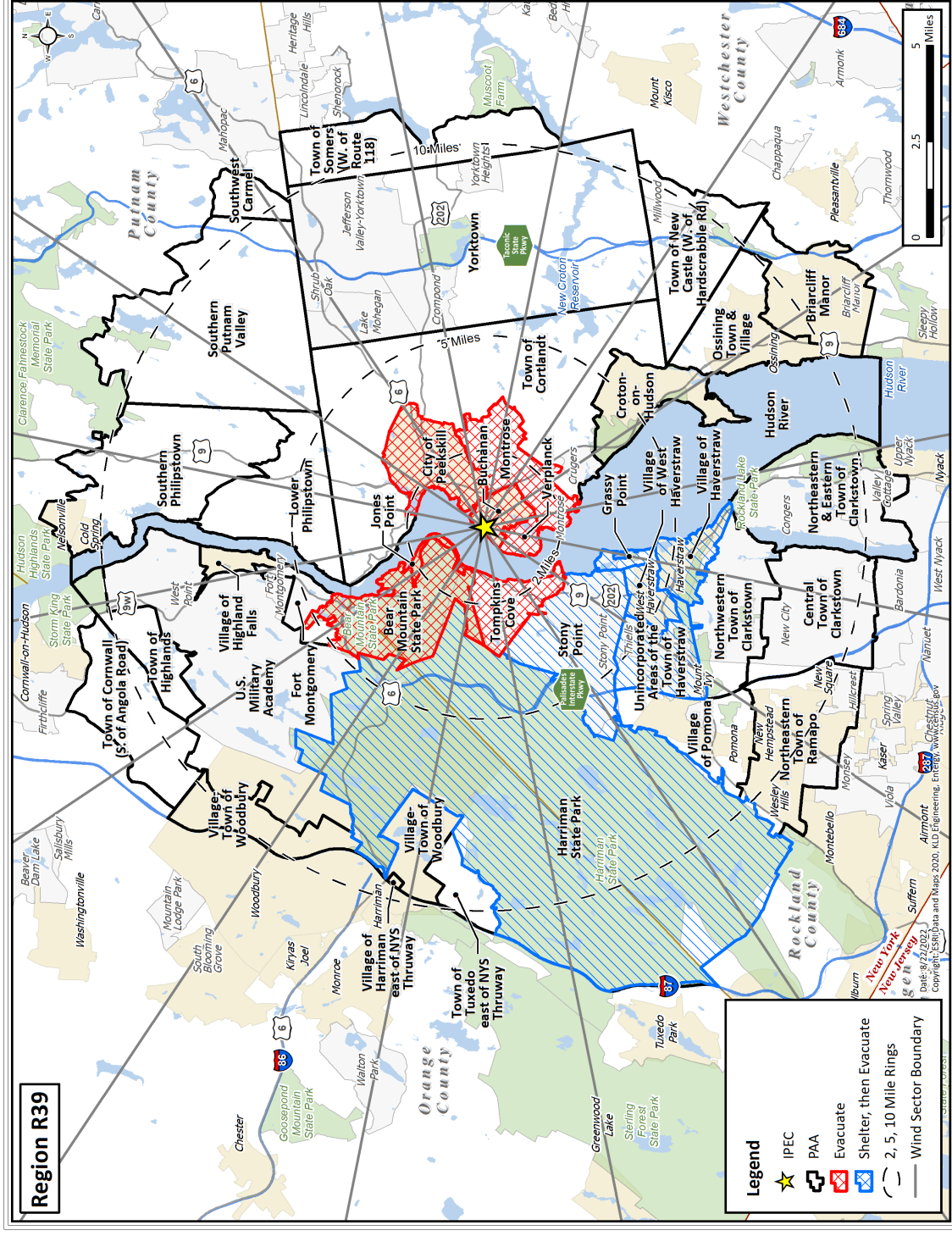


Figure H-39. Region R39

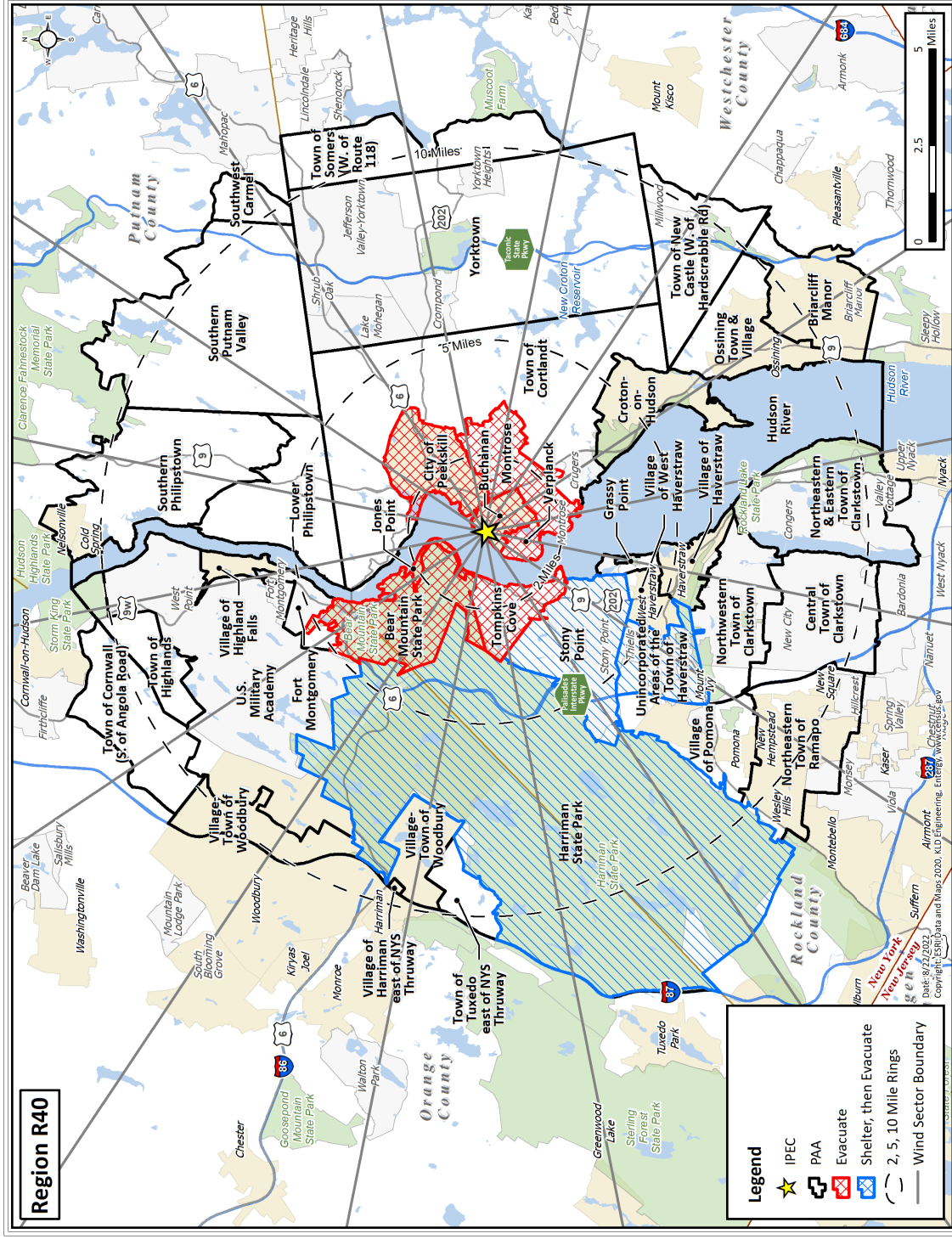


Figure H-40. Region R40

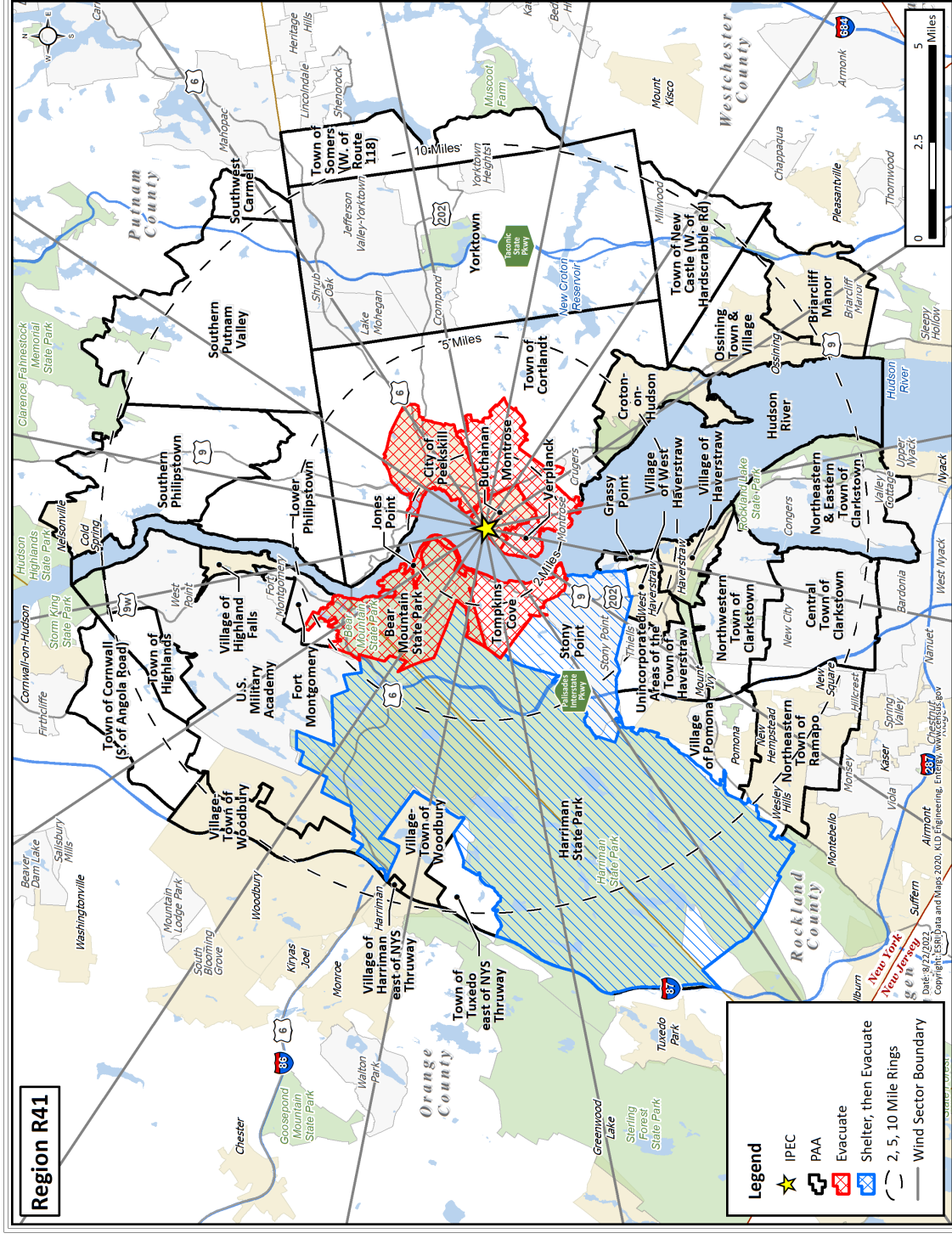


Figure H-41. Region R41

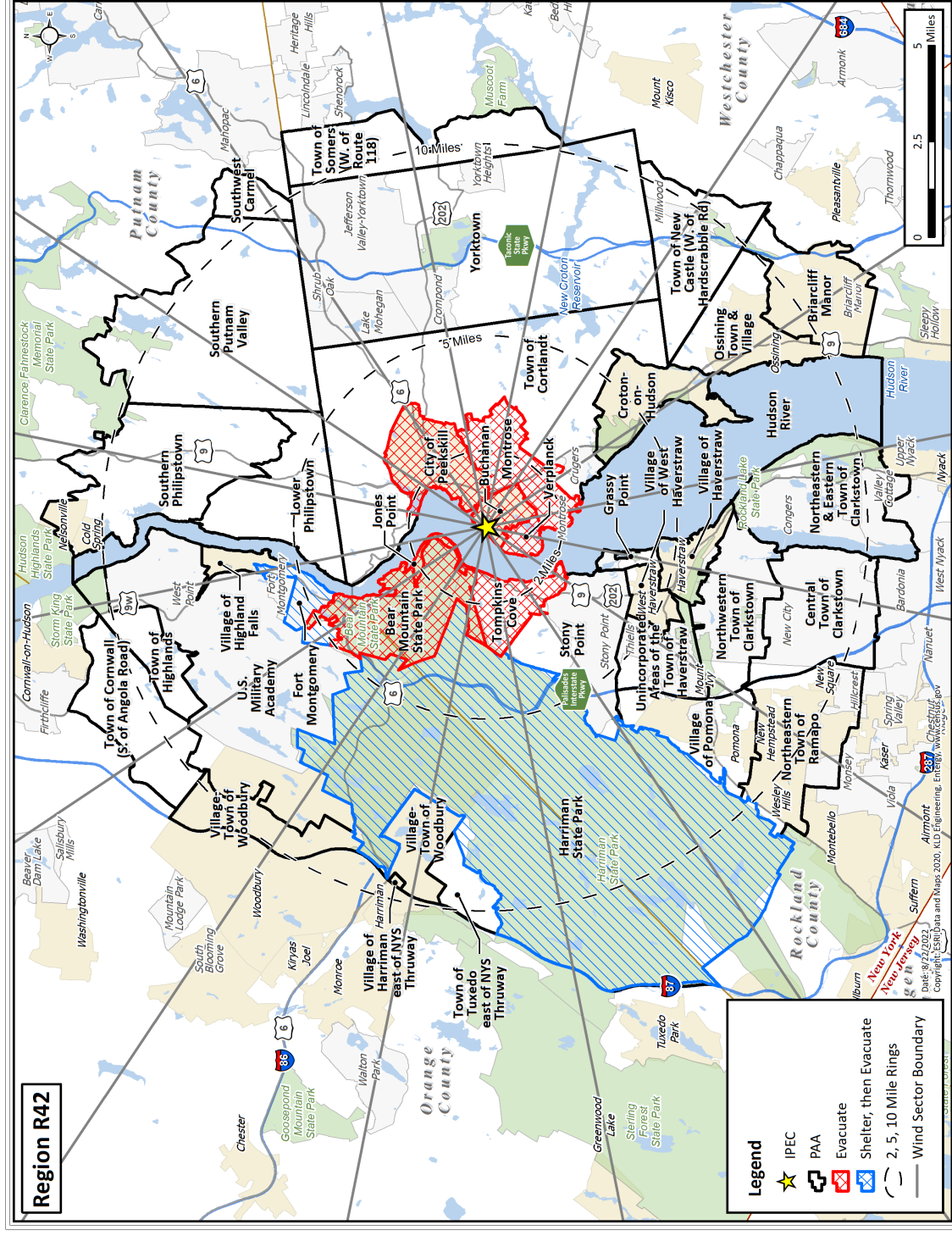
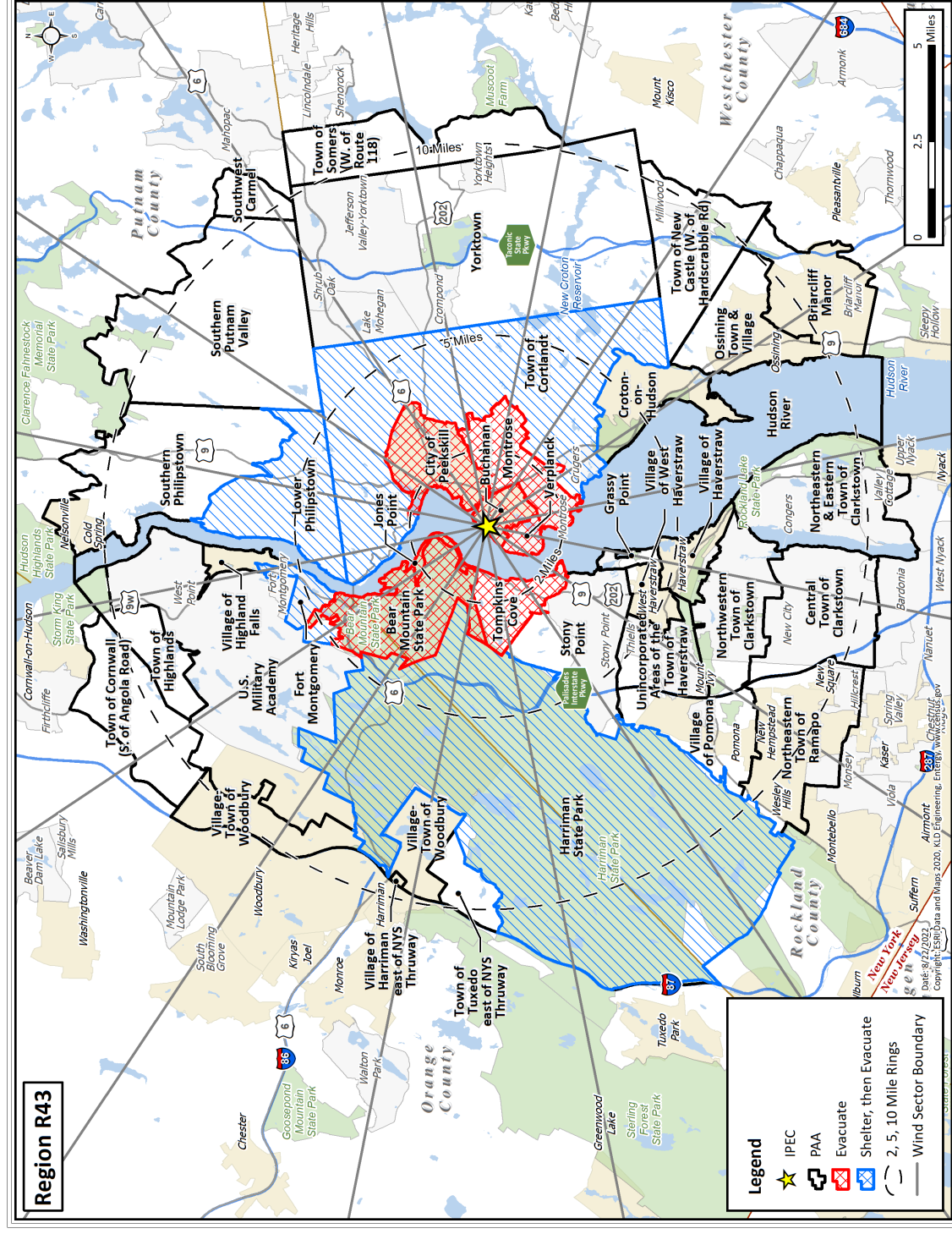
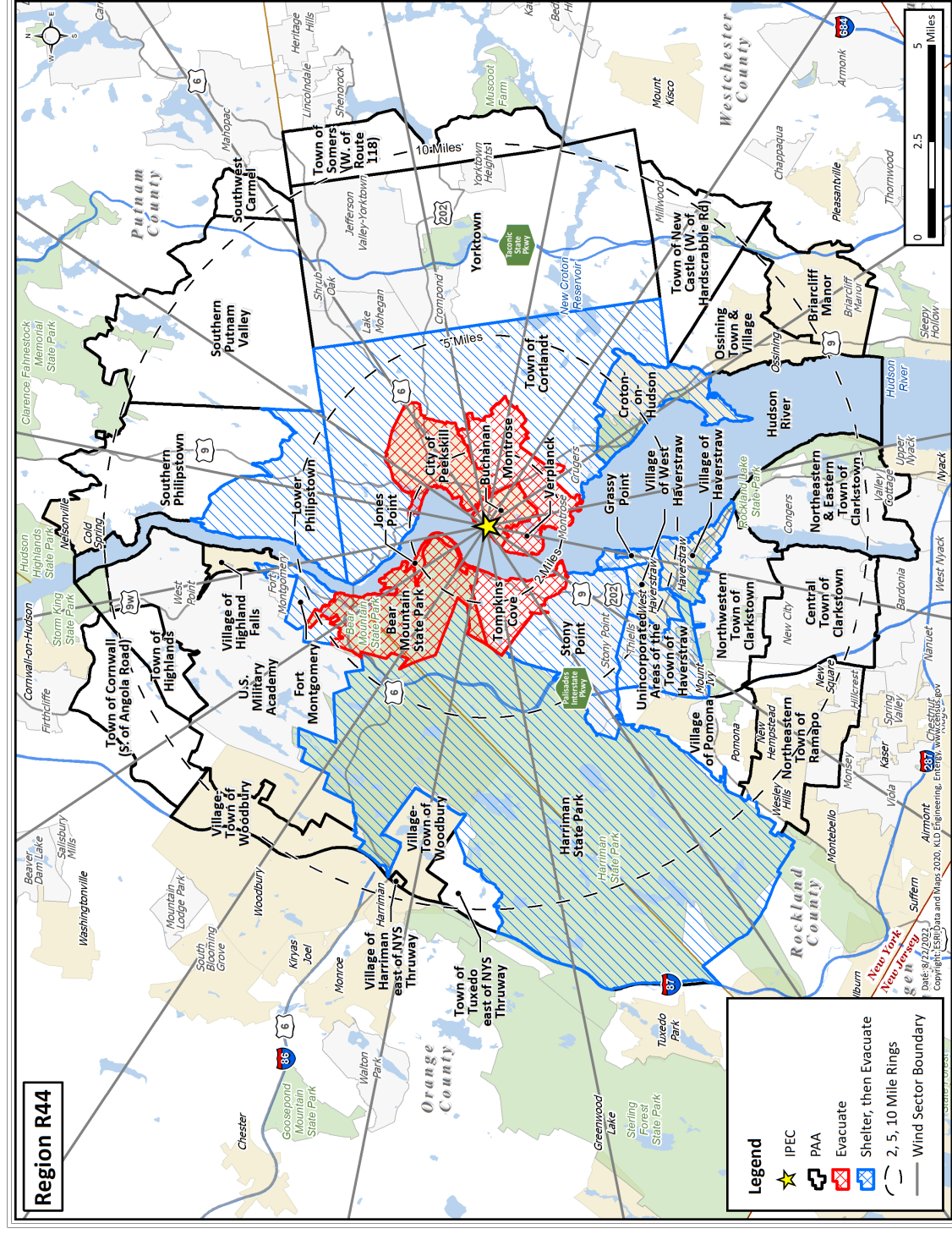


Figure H-42. Region R42





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 source (vehicle loading) and destination information for several roadway segments (links) in the analysis network. There are a total of 1,000 source links (origins) in the model. The center point of the source links are shown as centroid points in Figure J-1. Evacuees travel a straight-line distance of 4.82 miles, on average, to exit the study area.

Table J-2 provides network-wide statistics (average travel time, average delay time¹, average speed and number of vehicles) for an evacuation of the entire EPZ (Region R03) for each scenario. As expected, rain, rain/light snow and heavy snow scenarios (Scenarios 2, 4, 7, 8, 10 and 11) exhibit slower average speeds, higher delays and longer average travel times than comparable good weather scenarios. When comparing Scenario 13 (Special Event – West Point Football Game) and Scenario 9, the additional vehicles from the special event decreases the average speed and increases the average travel time while having no effect on the average delay time. When comparing Scenario 14 (Special Event – an Event at Croton Point Park) and Scenario 3, the additional vehicles from the special event has no impact on average speeds, average travel time or average delay time. When comparing Scenario 15 (roadway closure) and Scenario 1, the lane closures on US-6, US-9W, Palisades Parkway, and Taconic Parkway lowers the average speed, causes higher delay and increases the travel time.

Table J-3 provides statistics (average speed and travel time) for the major evacuation routes – Taconic State Parkway (Pkw) northbound (NB), Taconic State Pkw southbound (SB), US-9 SB, and US-6 eastbound (EB) – 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 7-9, US-6 EB and US-9 SB are heavily congested for 4 hours and 30 minutes and 5 hour and 30 minutes, respectively. The average speed on these routes is reduced significantly during these times and increases significantly as congestion dissipates.

Table J-4 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. As expected, the interstates, parkways, and US Routes (I-287, I-87, I-84, I-684, US-6, Sprain Brook Parkway, Garden State Parkway, and Palisades Parkway) are the most heavily used evacuation routes in the study area.

Figure J-2 through Figure J-16 plot the trip generation time versus the ETE for each of the 15 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-2 through Figure J-16, the curves are spatially separated as a result of the traffic congestion in the EPZ, which was discussed in detail in Section 7.3. Travel times peak

¹ Computed as the difference of the average travel time and the average ideal travel time under free flow conditions.

(approximately 1 hour and 45 minutes) for those evacuees who begin their evacuation trip at about 2 hours after the ATE when congestion is at its worst. Travel times are less for evening scenarios.

Table J-1. Sample Simulation Model Input

Route Name	Upstream Node	Downstream Node	Vehicles Entering Network on this Link	Directional Preference	Destination Nodes	Destination Capacity
W Moore Loop	4441	4440	1,817	N	8228	1,700
					8676	4,500
					8606	1,700
State Route 45	4097	3749	1,973	SW	8447	4,500
					8005	1,275
					8243	1,275
State Route 129	843	809	843	SE	8502	2,850
					8242	6,750
					8512	2,850
State Route 35	309	273	654	E	8638	3,800
					8233	4,500
					8239	1,700
Archer Road	375	360	620	NE	8233	4,500
					8227	1,700
					8234	1,700
Somerset Drive	1560	159	456	E	8239	1,700
					8233	4,500
					8638	3,800
Kings Highway	73	201	19	S	8448	4,500
					8221	1,700
					8073	1,275
County Road 20	3478	3408	144	S	8448	4,500
Water Street	3904	3905	26	N	8606	1,700
					8960	1,700
Mount Hope Road	1619	989	188	NE	8233	4,500
					8357	1,275
					8234	1,700

Table J-2. Selected Model Outputs for the Evacuation of the Entire EPZ (Region R03)

Scenario	1	2	3	4	5	6	7	8
Network-Wide Average Travel Time (Min/Veh-Mi)	2.9	3.3	3.0	3.4	2.7	2.8	3.3	3.3
Network-Wide Average Delay Time (Min/Veh-Mi)	1.6	2.1	1.7	2.1	1.4	1.5	2.0	2.0
Network-Wide Average Speed (mph)	21.0	18.0	20.1	17.6	22.5	21.6	18.3	18.1
Total Vehicles Exiting Network	357,591	359,196	337,784	339,535	266,834	353,010	354,673	353,787
Scenario	9	10	11	12	13	14	15	
Network-Wide Average Travel Time (Min/Veh-Mi)	2.7	3.2	3.2	2.7	2.8	3.0	3.4	
Network-Wide Average Delay Time (Min/Veh-Mi)	1.5	1.9	1.9	1.4	1.5	1.7	2.1	
Network-Wide Average Speed (mph)	21.9	18.9	19.0	22.6	21.3	20.1	17.8	
Total Vehicles Exiting Network	325,217	327,006	326,431	263,417	330,209	341,567	357,079	

Table J-3. Average Speed (mph) and Travel Time (min) for Major Evacuation Routes (Region R03, Scenario 1)

Route		Elapsed Time (hours:minutes)											
		1:00		2:00		3:00		4:00		5:00		6:00	
		Speed (mph)	Travel Time (min)	Speed	Travel Time	Speed	Travel Time	Speed	Travel Time	Speed	Travel Time	Speed	Travel Time
Taconic State Pkwy Northbound	Length (miles)	63.7	17.1	55.0	19.9	65.0	16.8	61.6	17.7	64.9	16.8	64.8	16.9
Taconic State Pkwy Southbound	18.2	65.0	16.8	63.7	17.2	60.4	18.1	64.2	17.0	64.0	17.1	64.8	16.9
US-9 Southbound	13.0	17.3	45.2	8.9	87.8	13.8	56.6	34.2	22.8	55.0	14.2	55.5	14.1
US-6 Eastbound	10.0	7.7	77.7	5.7	105.5	5.7	106.3	14.0	43.0	23.4	25.7	32.9	18.3
												39.5	15.2

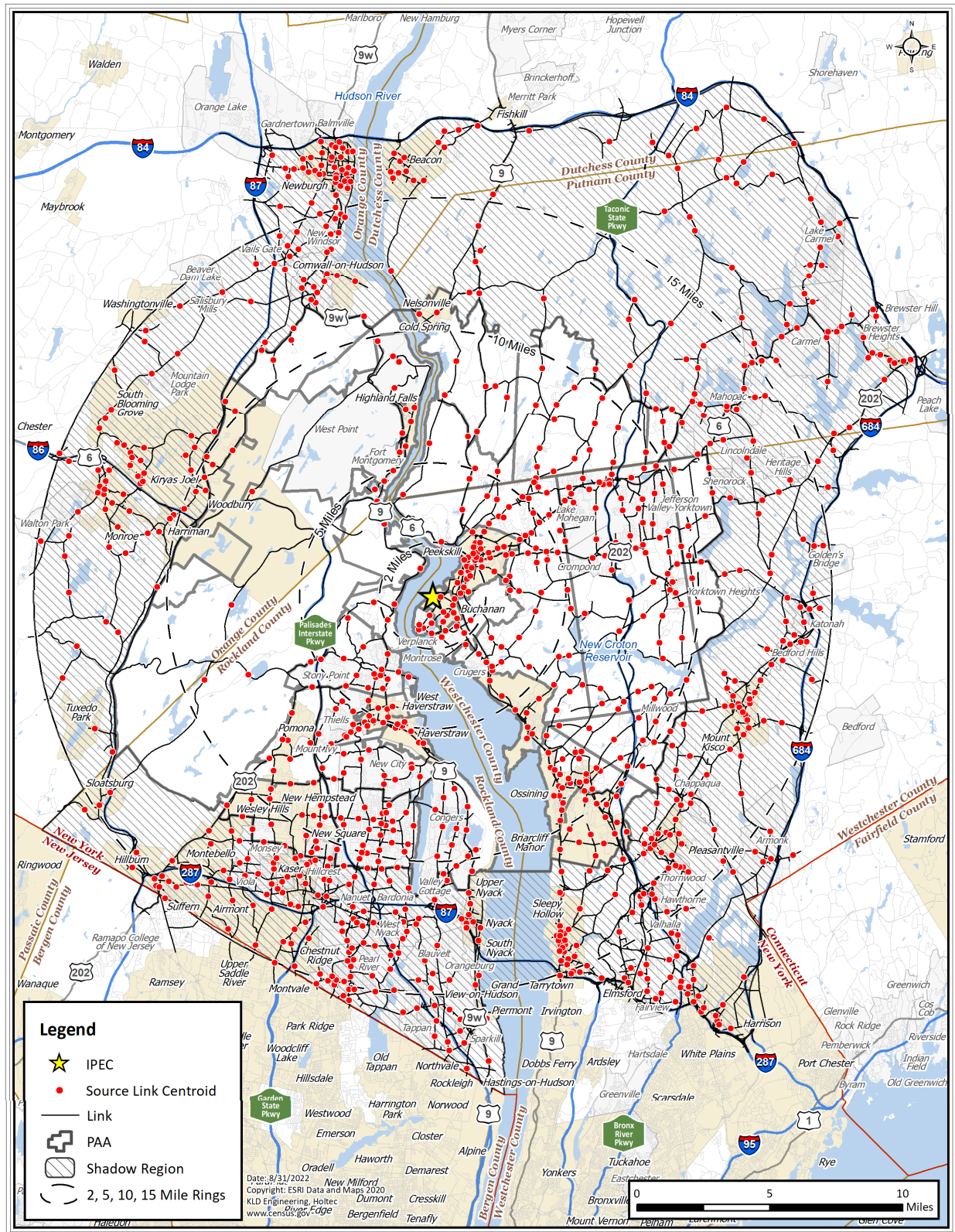
Table J-4. Simulation Model Outputs at Network Exit Links for Region R03, Scenario 1

Network Exit Link	Route Name	Upstream Node	Downstream Node	Elapsed Time (hours:minutes)						
				1:00	2:00	3:00	4:00	5:00	6:00	6:30
				Cumulative Vehicles Discharged by the Indicated Time						
				Cumulative Percent of Vehicles Discharged by the Indicated Time Interval						
270	I-84	144	1588	4,182	8,239	12,297	16,362	20,427	24,072	26,599
				8%	7%	6%	6%	6%	7%	7%
400	Sprain Brook Pkwy	214	1765	3,281	8,449	13,819	18,895	22,481	22,654	22,660
				6%	7%	7%	7%	7%	6%	6%
407	US-9	216	1607	38	42	53	68	76	82	82
				0%	0%	0%	0%	0%	0%	0%
496	SR-172	253	1696	227	678	999	1,264	1,428	1,483	1,491
				0%	1%	0%	0%	0%	0%	0%
516	Saw Mill Pkwy	262	1606	29	1,353	4,560	6,756	7,219	7,294	7,297
				0%	1%	2%	3%	2%	2%	2%
681	SR-22	357	1631	1,149	2,299	3,448	4,597	5,747	6,896	8,045
				2%	2%	2%	2%	2%	2%	2%
730	SR-207	385	386	89	158	178	190	243	528	532
				0%	0%	0%	0%	0%	0%	0%
930	NY-119	505	507	98	965	1,927	2,766	3,155	3,230	3,237
				0%	1%	1%	1%	1%	1%	1%
1115	I-87	631	1019	2,723	5,016	7,549	10,273	13,524	15,958	16,064
				5%	4%	4%	4%	4%	5%	5%
1132	US-6	638	1587	366	1,174	2,162	3,056	3,766	4,237	4,368
				1%	1%	1%	1%	1%	1%	1%
1186	SR-311	665	1668	31	367	899	1,289	1,548	1,718	1,749
				0%	0%	0%	0%	0%	0%	0%
1208	Taconic State Pkwy	676	1557	1,655	3,753	5,273	6,303	7,114	7,652	7,976
				3%	3%	3%	2%	2%	2%	2%
1524	Hardscrabble Rd	835	3239	519	1,102	1,623	2,221	2,600	2,931	2,981
				1%	1%	1%	1%	1%	1%	1%
2187	I-684	1176	283	934	2,902	5,324	7,300	8,286	9,143	9,162
				2%	2%	3%	3%	3%	3%	3%
2261	CR-30	1211	1667	19	64	153	247	336	406	416
				0%	0%	0%	0%	0%	0%	0%
2287	SR-52	1223	1227	274	1,230	2,210	3,163	4,204	5,131	6,015
				1%	1%	1%	1%	1%	1%	2%

Network Exit Link	Route Name	Upstream Node	Downstream Node	Elapsed Time (hours:minutes)						
				1:00	2:00	3:00	4:00	5:00	6:00	6:30
				Cumulative Vehicles Discharged by the Indicated Time						
				Cumulative Percent of Vehicles Discharged by the Indicated Time Interval						
2300	N Salem Rd	1233	1234	546	1,148	1,614	2,070	2,420	2,699	2,754
				1%	1%	1%	1%	1%	1%	1%
2304	SR-138	1236	1681	202	722	1,376	1,859	2,211	2,309	2,317
				0%	1%	1%	1%	1%	1%	1%
2315	I-287	1242	3095	4,906	11,080	17,172	23,053	28,566	31,080	31,196
				10%	9%	8%	9%	9%	9%	9%
2489	I-87	1333	1549	1,233	4,745	8,982	10,331	10,528	10,556	10,557
				2%	4%	4%	4%	3%	3%	3%
2524	SR-100A	1351	1608	2	14	37	52	58	60	61
				0%	0%	0%	0%	0%	0%	0%
2666	I-287	1433	1435	1,811	2,650	4,180	5,185	5,682	5,968	6,095
				4%	2%	2%	2%	2%	2%	2%
2670	SR-172	1436	1449	2,806	6,464	7,726	8,805	9,779	10,395	10,430
				6%	5%	4%	3%	3%	3%	3%
2688	US-202	1448	1450	276	528	882	1,157	1,409	1,606	1,614
				1%	0%	0%	0%	0%	0%	0%
2715	SR-127	1472	1473	12	80	198	263	290	301	303
				0%	0%	0%	0%	0%	0%	0%
2785	SR-17K	1528	390	9	16	24	29	33	38	39
				0%	0%	0%	0%	0%	0%	0%
2788	SR-9D	1531	1532	89	304	629	845	943	993	995
				0%	0%	0%	0%	0%	0%	0%
2791	SR-52	1533	3227	105	486	1,000	1,333	1,548	1,592	1,609
				0%	0%	0%	1%	0%	0%	0%
2842	I-84	1564	1565	3,608	7,788	11,666	15,307	18,489	20,516	21,226
				7%	6%	6%	6%	6%	6%	6%
2844	US-9W	1566	1567	706	1,492	2,496	3,485	4,564	5,218	5,243
				1%	1%	1%	1%	1%	2%	1%
2858	SR-32	1576	1578	66	362	1,143	1,684	1,799	1,856	1,859
				0%	0%	1%	1%	1%	1%	1%
2859	SR-52	1576	1579	12	115	438	674	726	756	758
				0%	0%	0%	0%	0%	0%	0%
2871	SR-35	1589	1590	773	2,278	3,653	4,880	5,699	5,967	6,007
				2%	2%	2%	2%	2%	2%	2%

Network Exit Link	Route Name	Upstream Node	Downstream Node	Elapsed Time (hours:minutes)						
				1:00	2:00	3:00	4:00	5:00	6:00	6:30
				Cumulative Vehicles Discharged by the Indicated Time						
				Cumulative Percent of Vehicles Discharged by the Indicated Time Interval						
2876	SR-22	1592	1593	277	798	1,247	1,551	1,684	1,734	1,741
				1%	1%	1%	1%	1%	1%	0%
3119	Bedford Center Rd	1758	1688	158	447	775	1,031	1,209	1,263	1,274
				0%	0%	0%	0%	0%	0%	0%
3419	Bronx River Pkwy	1965	1512	134	455	946	1,276	1,406	1,469	1,477
				0%	0%	0%	0%	0%	0%	0%
3531	SR-120	3041	1471	30	244	534	786	892	931	936
				0%	0%	0%	0%	0%	0%	0%
3532	Anderson Hill Rd	3041	3043	6	46	129	190	222	234	235
				0%	0%	0%	0%	0%	0%	0%
3601	120A	3091	3092	59	196	408	604	728	779	782
				0%	0%	0%	0%	0%	0%	0%
3781	US-9	3226	1534	60	281	575	766	884	912	921
				0%	0%	0%	0%	0%	0%	0%
3848	Lime Kiln Rd	3277	3276	3	20	49	65	72	75	75
				0%	0%	0%	0%	0%	0%	0%
3973	Palisades Interstate Hwy	3364	3346	1,897	6,209	10,311	14,361	18,456	22,636	22,675
				4%	5%	5%	5%	6%	6%	6%
3985	Piermont Rd	3373	3374	146	345	661	873	978	1,016	1,026
				0%	0%	0%	0%	0%	0%	0%
3986	Kings Hwy	3375	1411	703	1,521	2,400	3,159	3,505	3,585	3,593
				1%	1%	1%	1%	1%	1%	1%
4023	Woodland Rd	3400	3515	809	1,929	3,085	4,245	5,398	6,281	6,304
				2%	2%	2%	2%	2%	2%	2%
4101	CR-33	3460	3431	427	1,448	2,871	4,397	5,939	6,253	6,283
				1%	1%	1%	2%	2%	2%	2%
4171	Red Schoolhouse Rd	3512	3513	22	105	248	364	461	549	554
				0%	0%	0%	0%	0%	0%	0%
4172	SR-45	3514	3510	667	1,486	2,456	3,325	4,070	4,610	4,621
				1%	1%	1%	1%	1%	1%	1%
4195	Garden State Pkwy	3529	1581	2,980	6,838	10,414	12,267	12,862	12,911	12,920
				6%	6%	5%	5%	4%	4%	4%
4228	W Saddle River Rd	3553	3362	641	1,476	2,409	3,367	4,336	5,086	5,100
				1%	1%	1%	1%	1%	1%	1%

Network Exit Link	Route Name	Upstream Node	Downstream Node	Elapsed Time (hours:minutes)						
				1:00	2:00	3:00	4:00	5:00	6:00	6:30
				Cumulative Vehicles Discharged by the Indicated Time						
				Cumulative Percent of Vehicles Discharged by the Indicated Time Interval						
4294	CR-72	3601	3602	731	1,778	2,175	2,551	2,832	2,998	3,001
				1%	1%	1%	1%	1%	1%	1%
4325	US-6	3619	1456	3,915	7,355	11,374	15,859	18,660	18,750	18,764
				8%	6%	6%	6%	6%	5%	5%
4508	SR-17A	3757	115	269	515	644	838	1,043	1,209	1,210
				1%	0%	0%	0%	0%	0%	0%
4510	Long Meadow Rd	3759	3760	113	410	654	888	1,110	1,277	1,278
				0%	0%	0%	0%	0%	0%	0%
4568	CR-5	3811	3810	108	335	750	1,005	1,104	1,144	1,153
				0%	0%	0%	0%	0%	0%	0%
4569	CR-45	3811	3814	13	144	486	695	775	806	809
				0%	0%	0%	0%	0%	0%	0%
4605	SR-208	3845	3826	32	193	544	882	1,024	1,059	1,066
				0%	0%	0%	0%	0%	0%	0%
4609	Driveway	3100	3099	12	82	213	292	322	334	335
				0%	0%	0%	0%	0%	0%	0%
4623	SR-17M	3861	3820	509	1,159	2,301	2,975	3,295	3,429	3,449
				1%	1%	1%	1%	1%	1%	1%
4744	SR-32	3959	3960	470	1,727	3,337	4,353	5,034	5,259	5,270
				1%	1%	2%	2%	2%	2%	1%
4828	SR-94	4017	1232	58	392	1,263	2,203	2,649	2,711	2,722
				0%	0%	1%	1%	1%	1%	1%
4877	SR-304	4065	3353	580	1,728	2,877	4,026	5,176	6,101	6,117
				1%	1%	1%	2%	2%	2%	2%
4966	Westchester Ave	4131	1475	867	1,823	3,320	4,075	4,390	4,435	4,442
				2%	1%	2%	2%	1%	1%	1%
5156	Old Tappan Rd	4285	3389	174	725	1,481	2,000	2,243	2,300	2,305
				0%	1%	1%	1%	1%	1%	1%
5163	US-9W	4292	954	97	412	787	1,042	1,178	1,222	1,232
				0%	0%	0%	0%	0%	0%	0%
5341	SR-306	4435	3511	590	1,751	2,907	4,056	5,206	6,355	6,993
				1%	1%	1%	2%	2%	2%	2%
5343	US-202	4437	1446	188	878	1,847	2,750	3,681	3,923	3,933
				0%	1%	1%	1%	1%	1%	1%



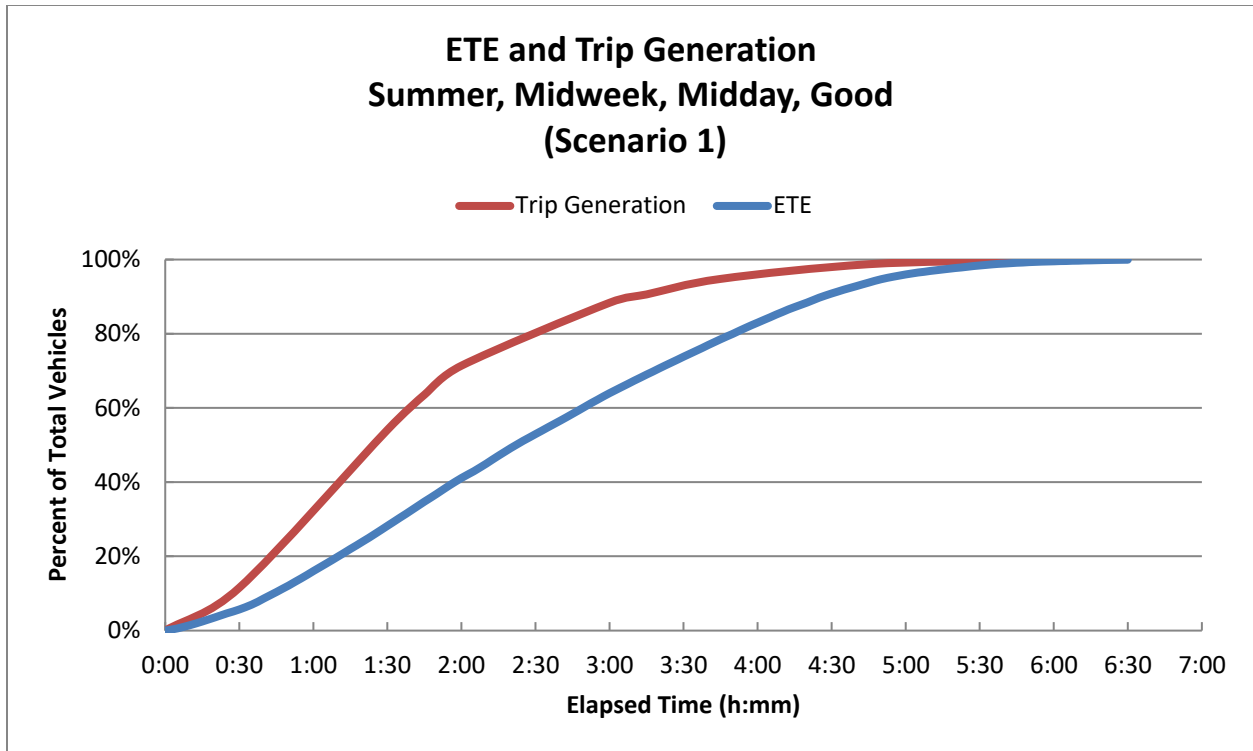


Figure J-2. ETE and Trip Generation: Summer, Midweek, Midday, Good Weather (Scenario 1)

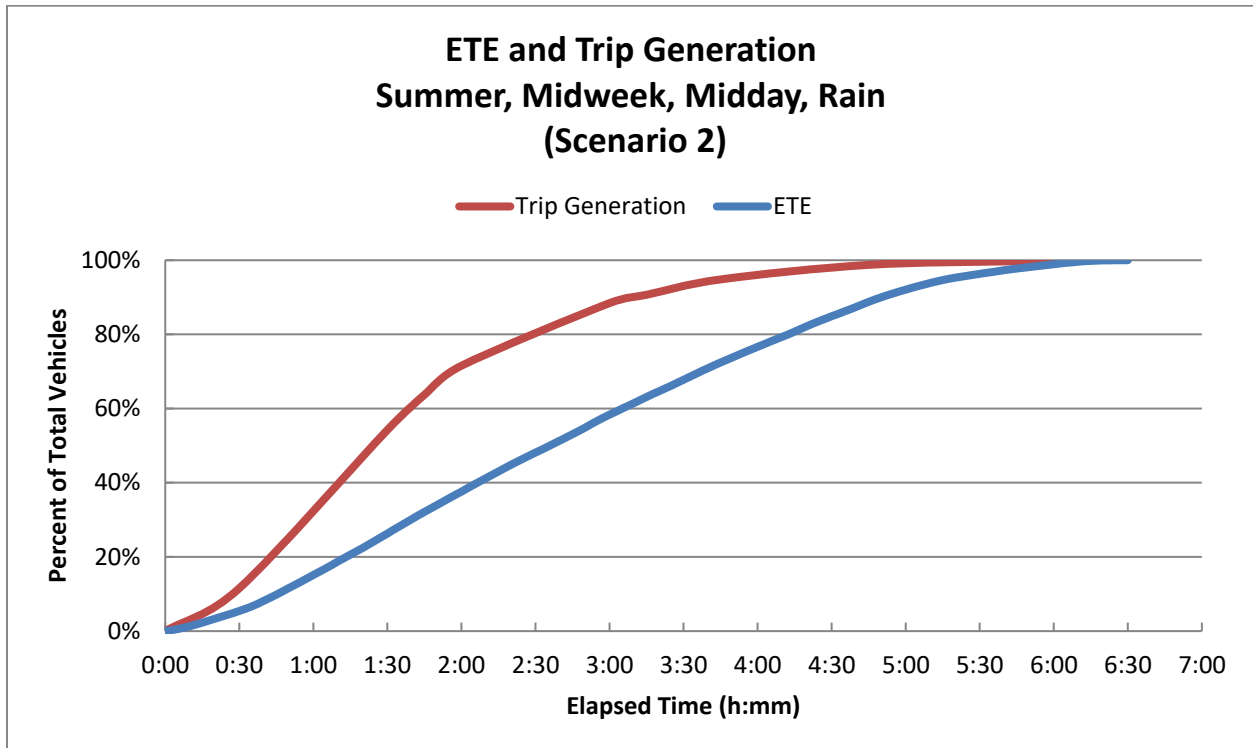


Figure J-3. ETE and Trip Generation: Summer, Midweek, Midday, Rain (Scenario 2)

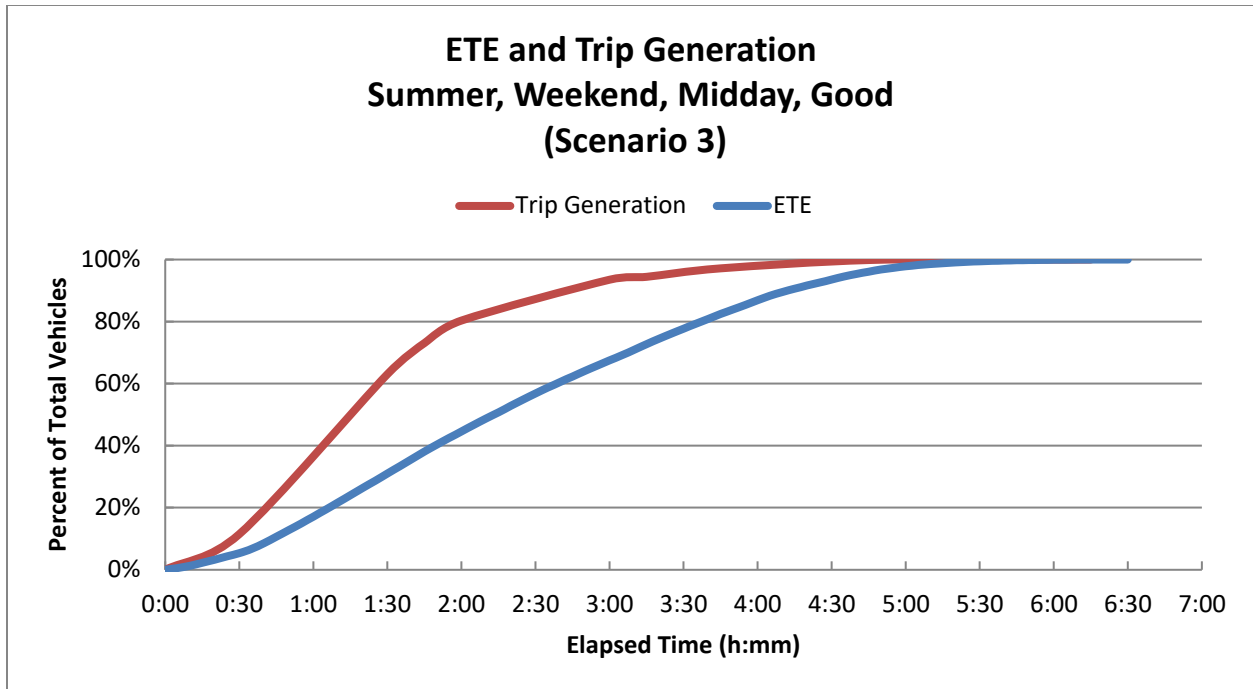


Figure J-4. ETE and Trip Generation: Summer, Weekend, Midday, Good Weather (Scenario 3)

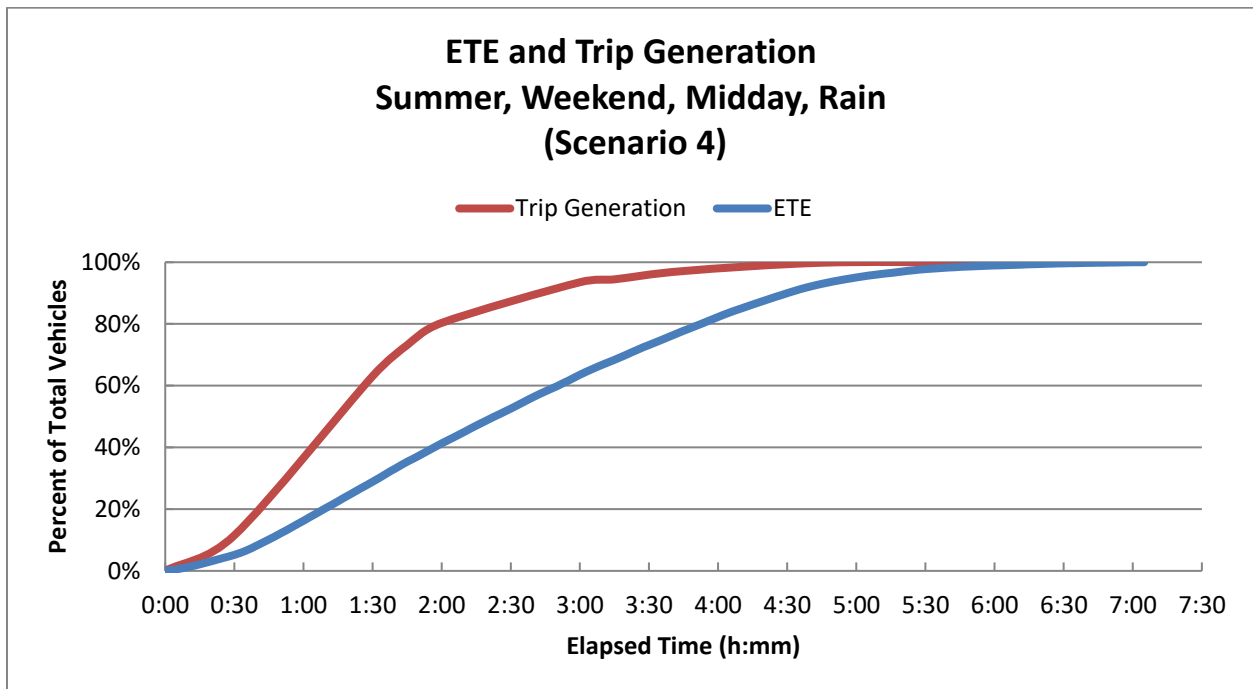


Figure J-5. ETE and Trip Generation: Summer, Weekend, Midday, Rain (Scenario 4)

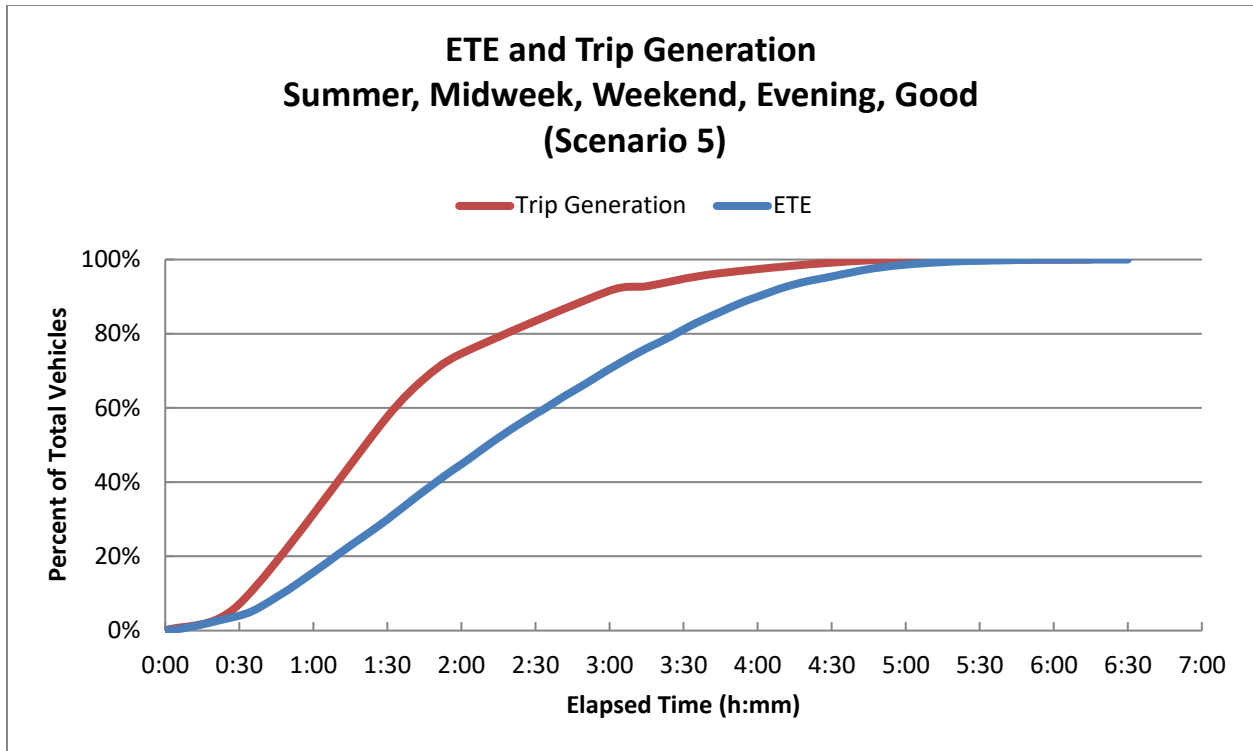


Figure J-6. ETE and Trip Generation: Summer, Midweek, Weekend, Evening, Good Weather (Scenario 5)

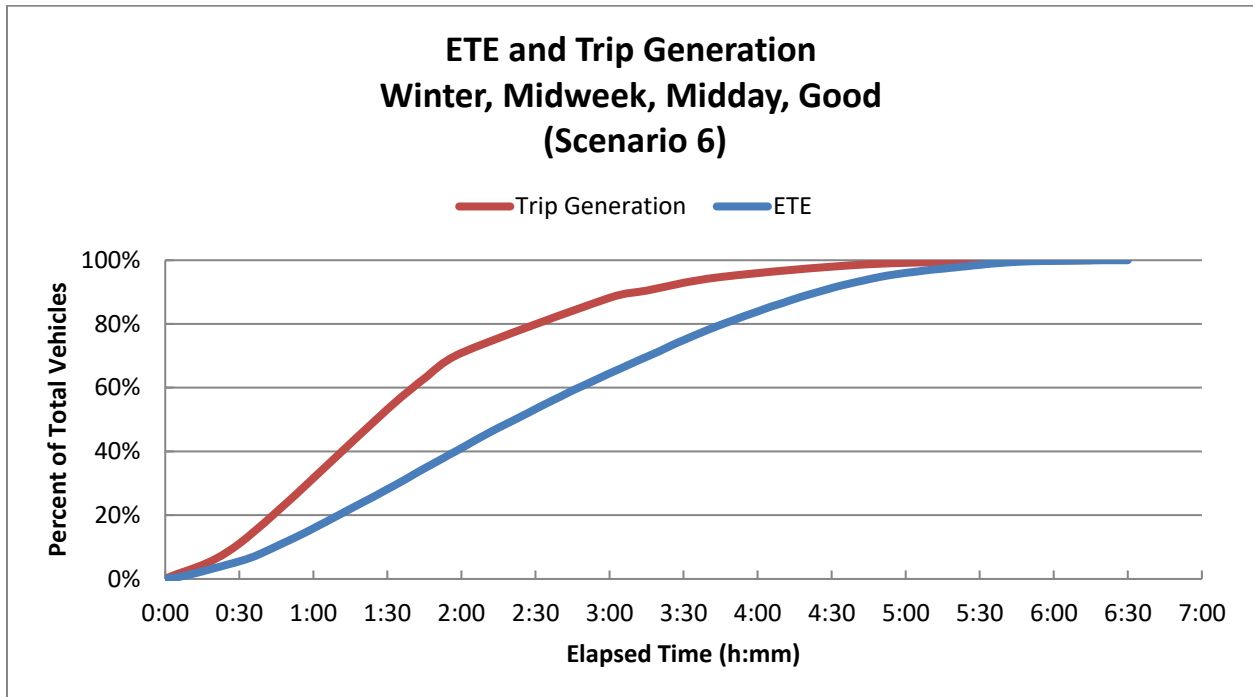


Figure J-7. ETE and Trip Generation: Winter, Midweek, Midday, Good Weather (Scenario 6)

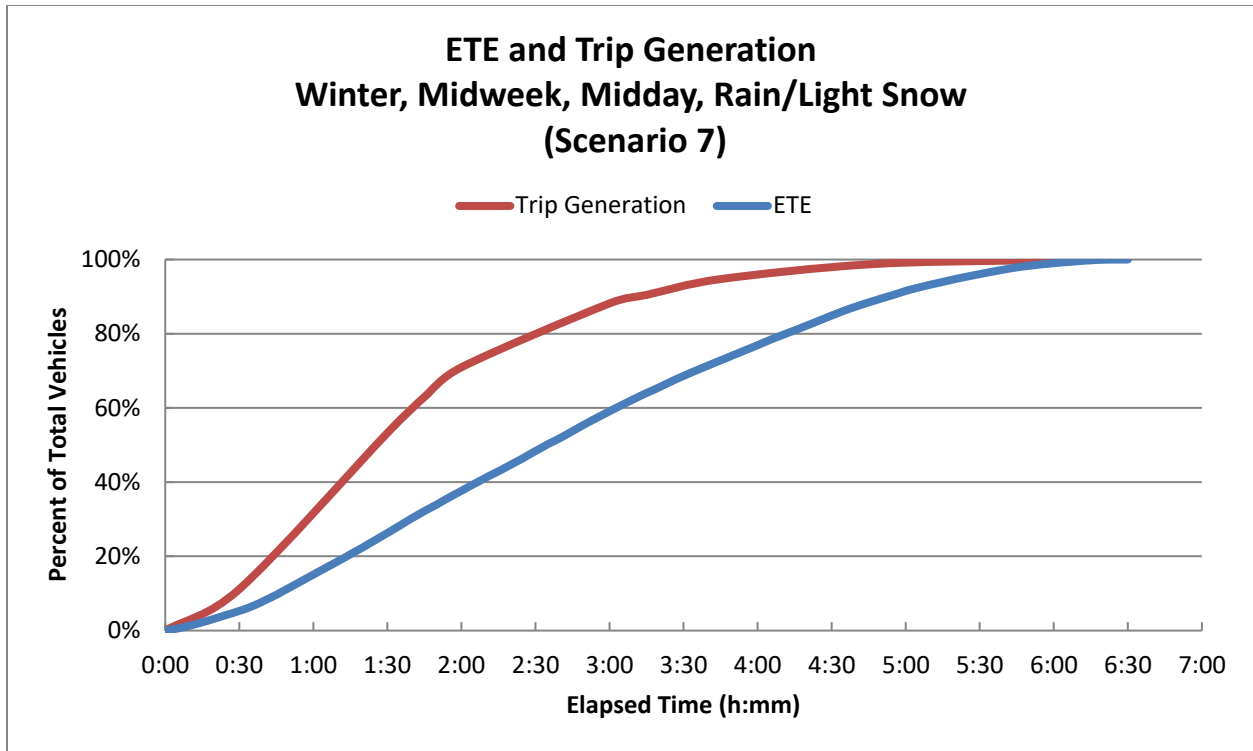


Figure J-8. ETE and Trip Generation: Winter, Midweek, Midday, Rain/Light Snow (Scenario 7)

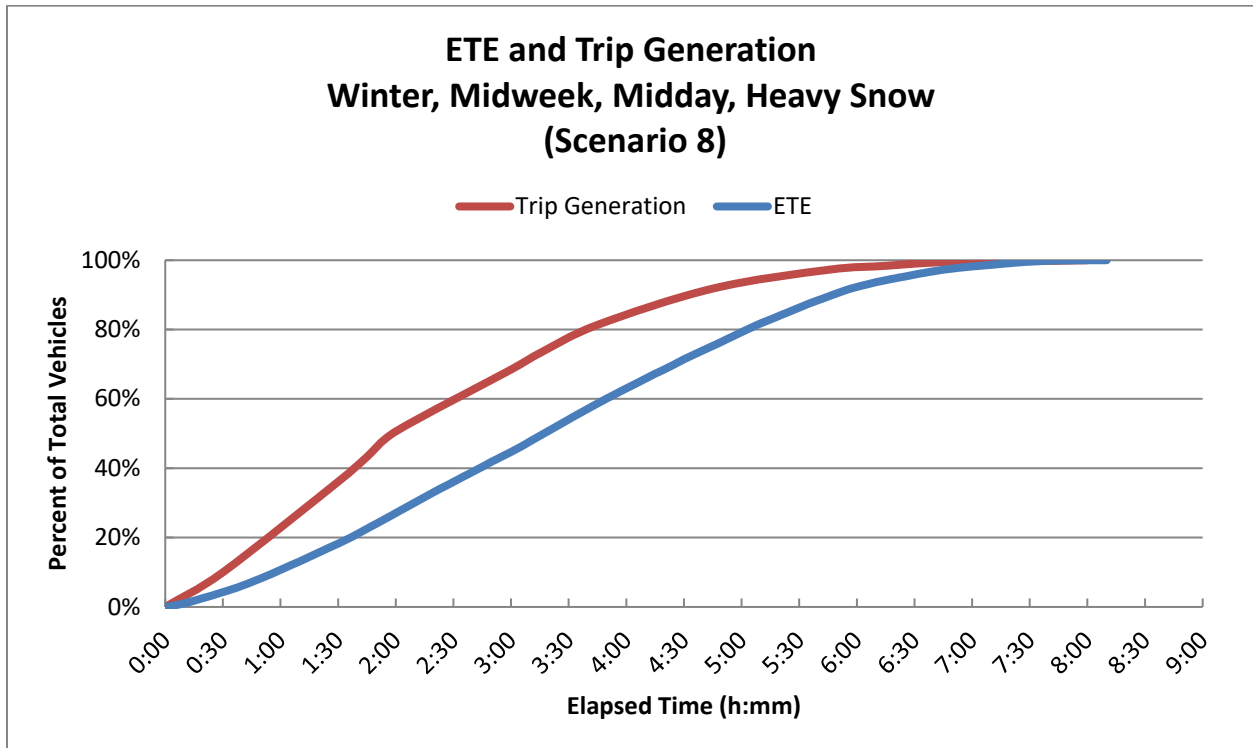


Figure J-9. ETE and Trip Generation: Winter, Midweek, Midday, Heavy Snow (Scenario 8)

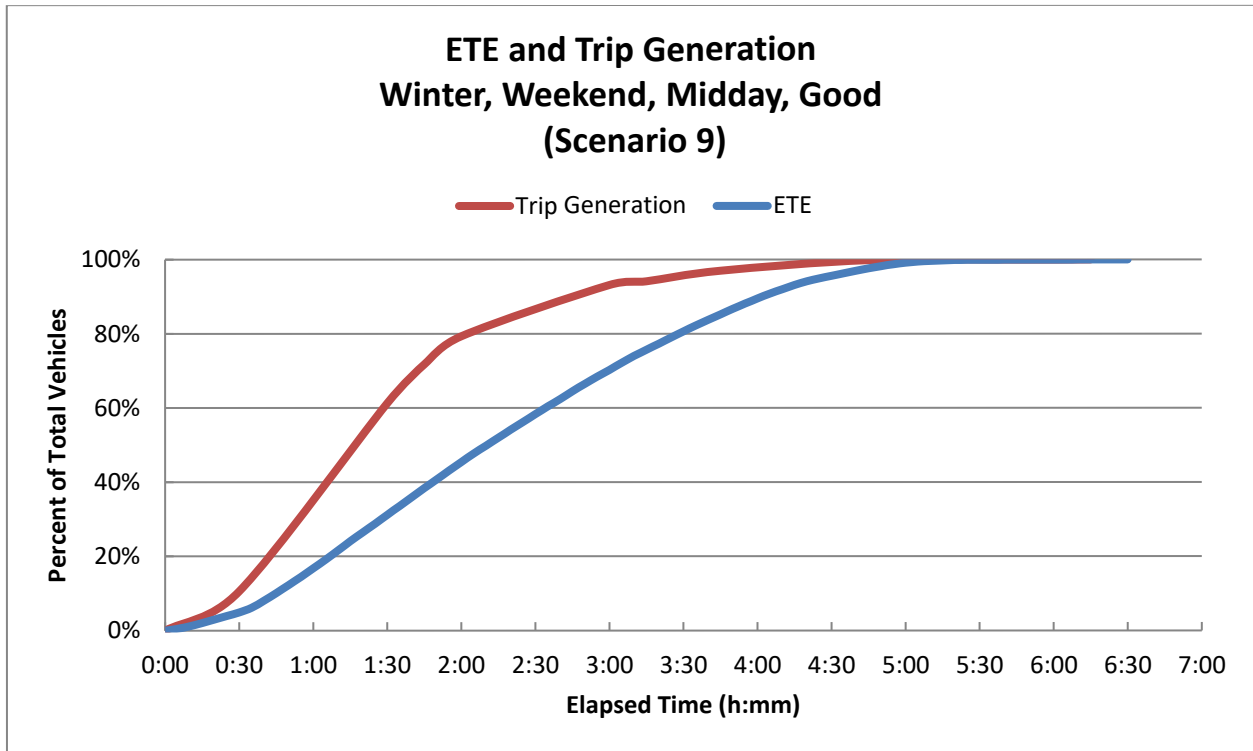


Figure J-10. ETE and Trip Generation: Winter, Weekend, Midday, Good Weather (Scenario 9)

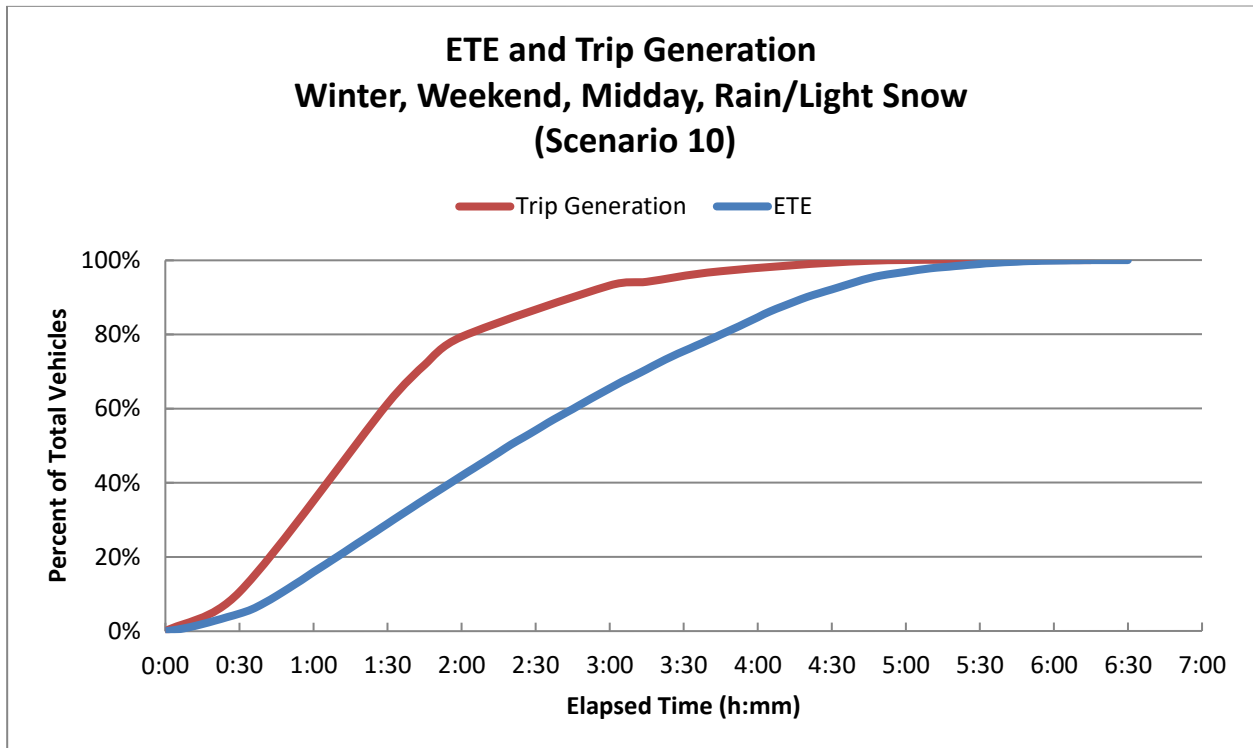


Figure J-11. ETE and Trip Generation: Winter, Weekend, Midday, Rain/Light Snow (Scenario 10)

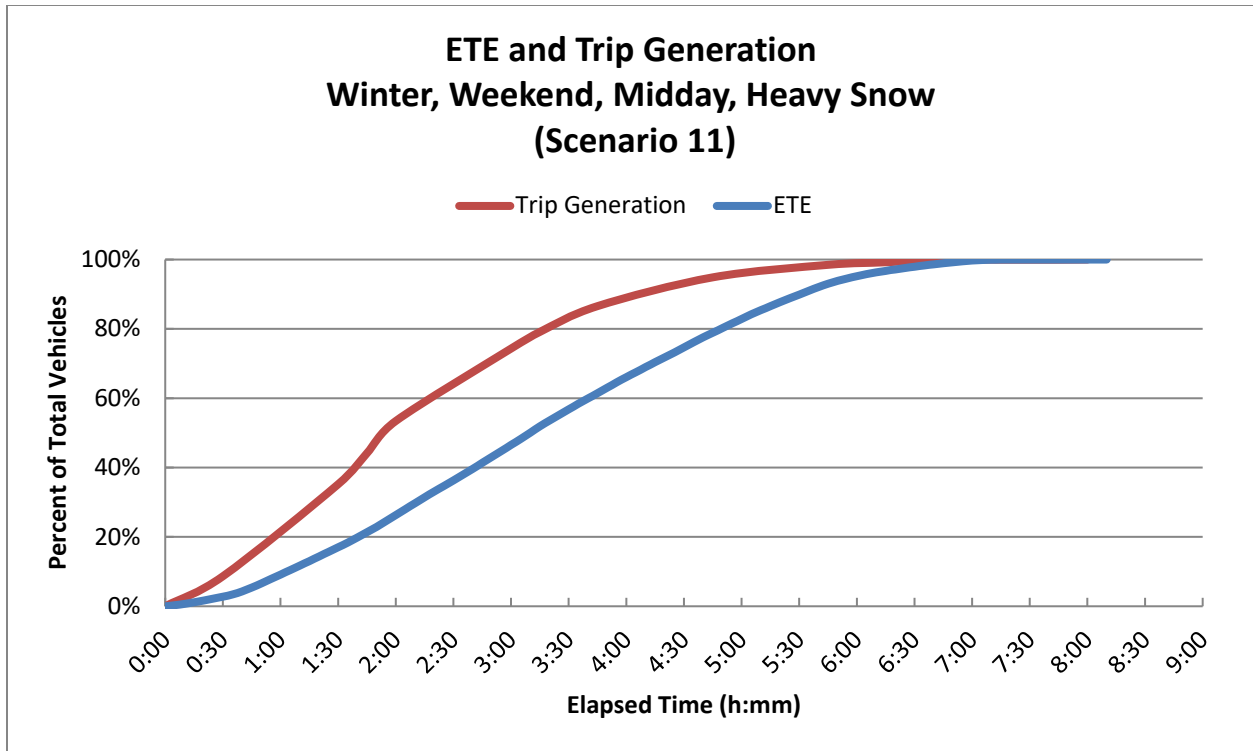


Figure J-12. ETE and Trip Generation: Winter, Weekend, Midday, Heavy Snow (Scenario 11)

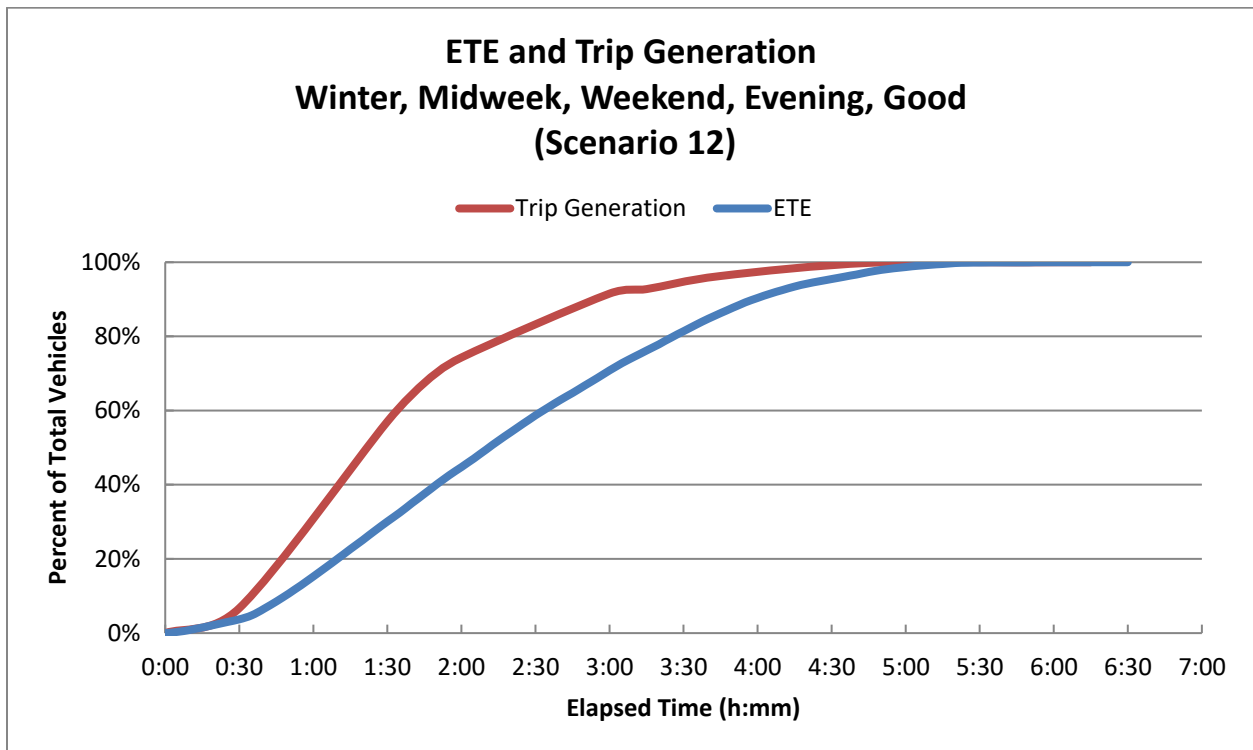


Figure J-13. ETE and Trip Generation: Winter, Midweek, Weekend, Evening, Good Weather (Scenario 12)

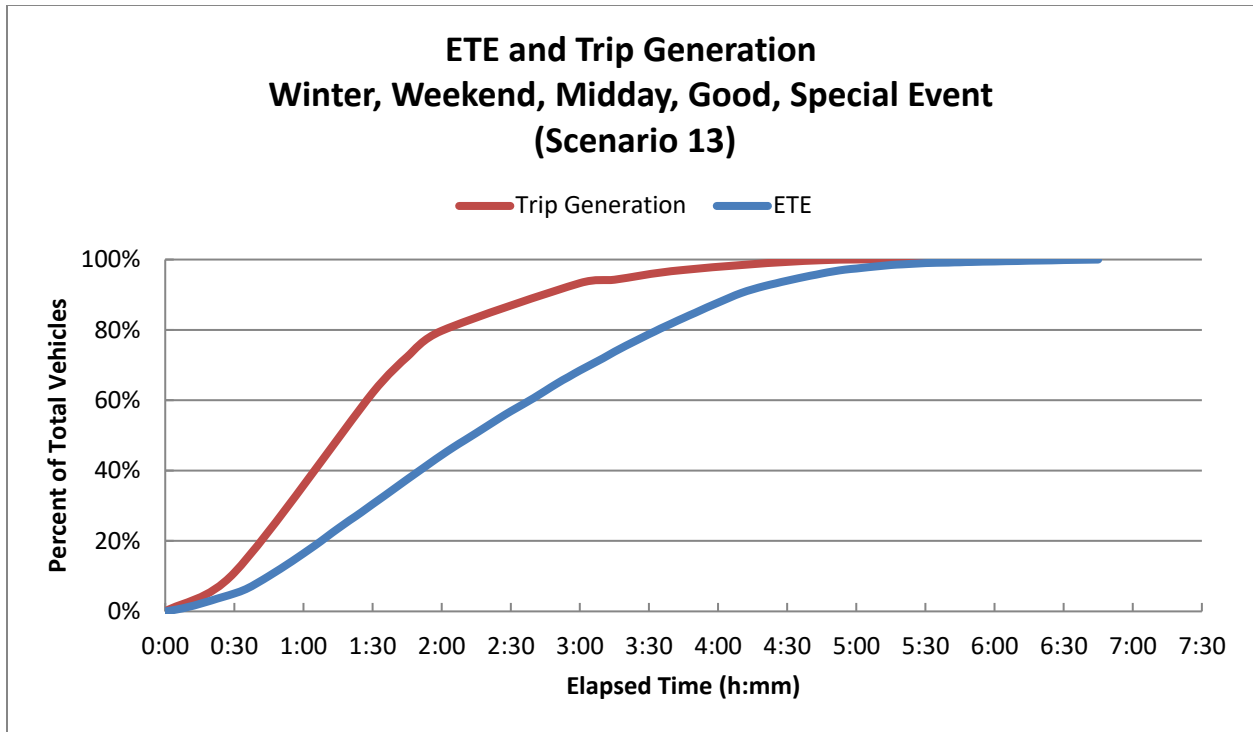


Figure J-14. ETE and Trip Generation: Winter, Weekend, Evening, Good Weather, Special Event – West Point Football Game (Scenario 13)

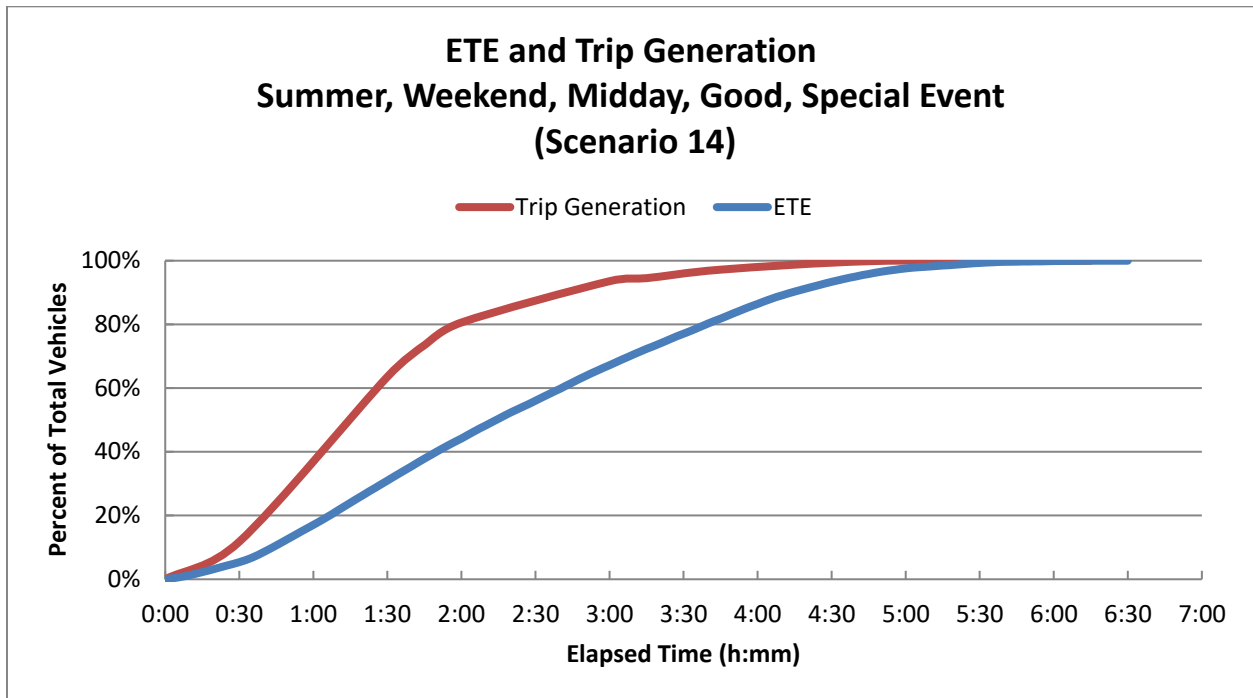


Figure J-15. ETE and Trip Generation: Summer, Weekend, Midday, Good Weather, Special Event – Event at Croton Point Park (Scenario 14)

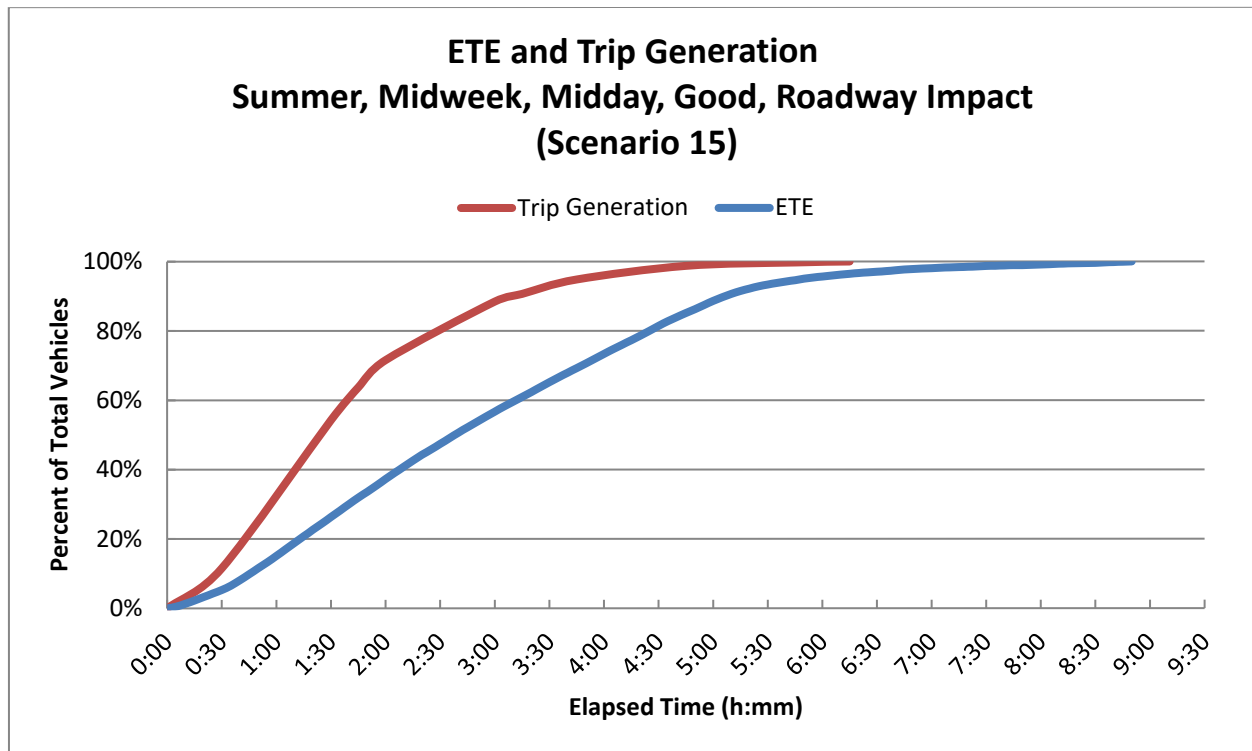


Figure J-16. ETE and Trip Generation: Summer, Midweek, Midday, Good Weather, Roadway Impact (Scenario 15)

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 102 more detailed figures (Figure K-2 through Figure K-103) which show each of the links and nodes in the network.

The analysis network was calibrated using the observations made during the field surveys conducted in October 2020.

Table K-1 summarizes the number of nodes by the type of control (stop sign, yield sign, pre-timed signal, actuated signal or traffic and access control point [TCP/ACP], uncontrolled).

Table K-1. Summary of Nodes by the Type of Control

Control Type	Number of Nodes
Uncontrolled	2,284
Pretimed	47
Actuated/TCP/ACP	782
Stop	342
Yield	43
Total:	3,498

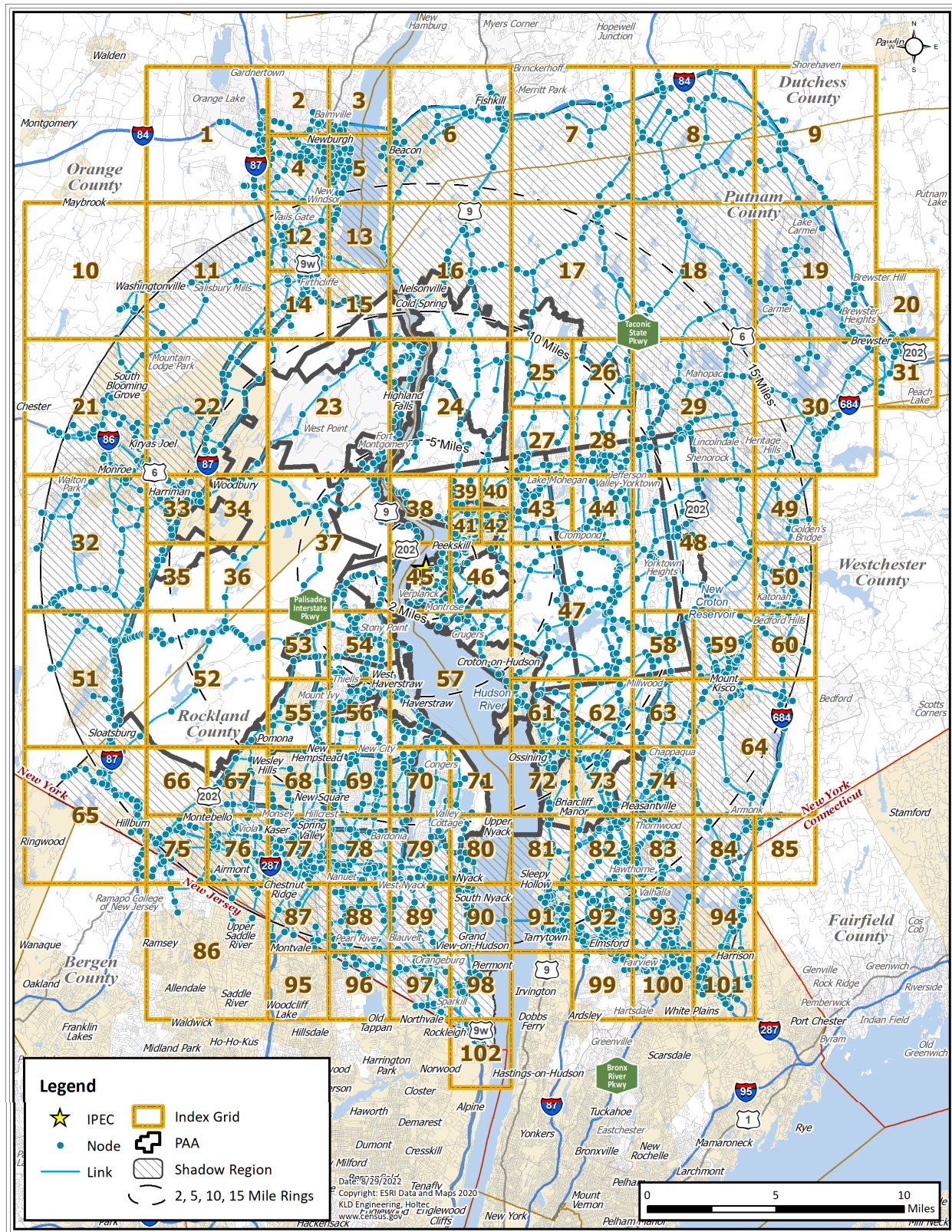


Figure K-1. IPEC Link-Node Analysis Network

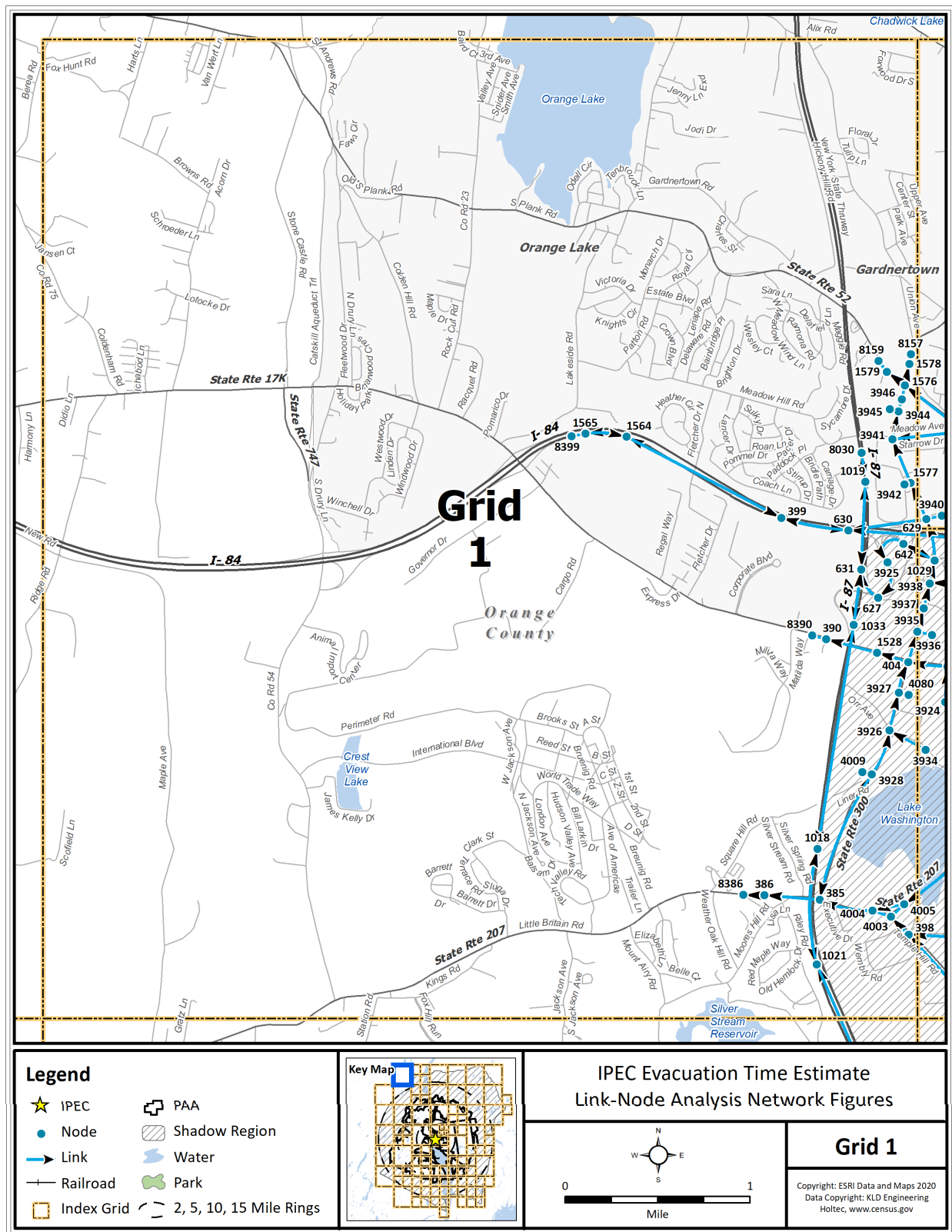


Figure K-2. Link-Node Analysis Network – Grid 1

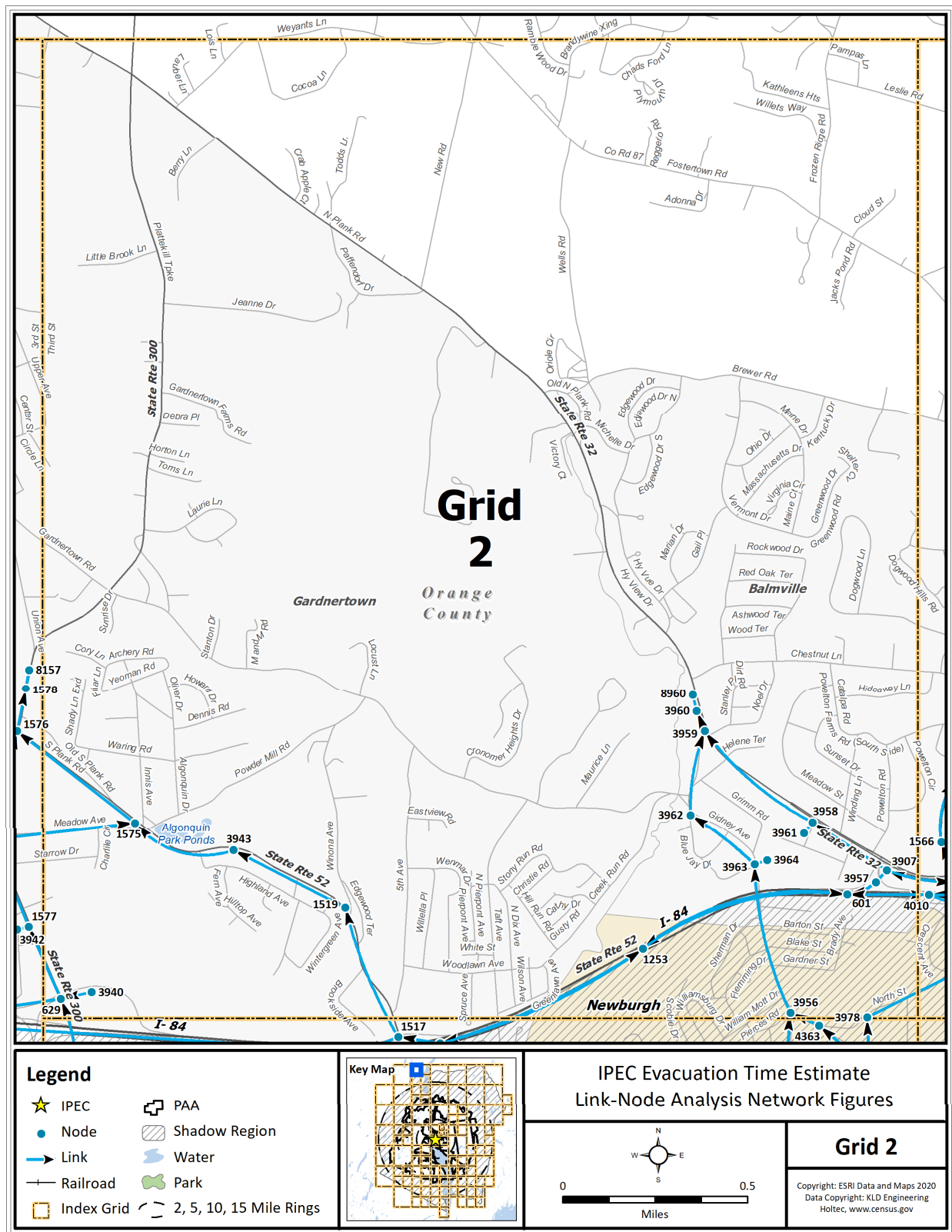


Figure K-3. Link-Node Analysis Network – Grid 2

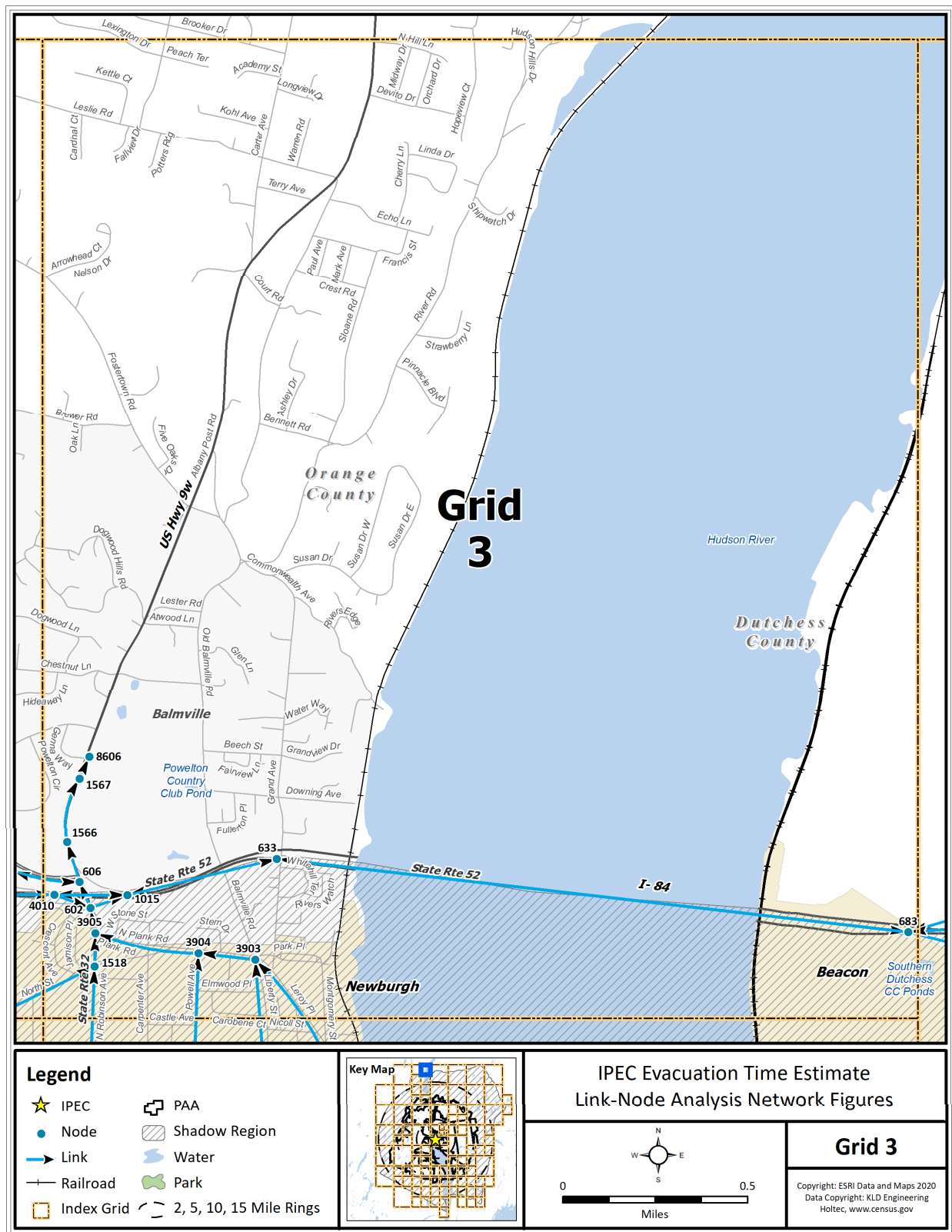


Figure K-4. Link-Node Analysis Network – Grid 3

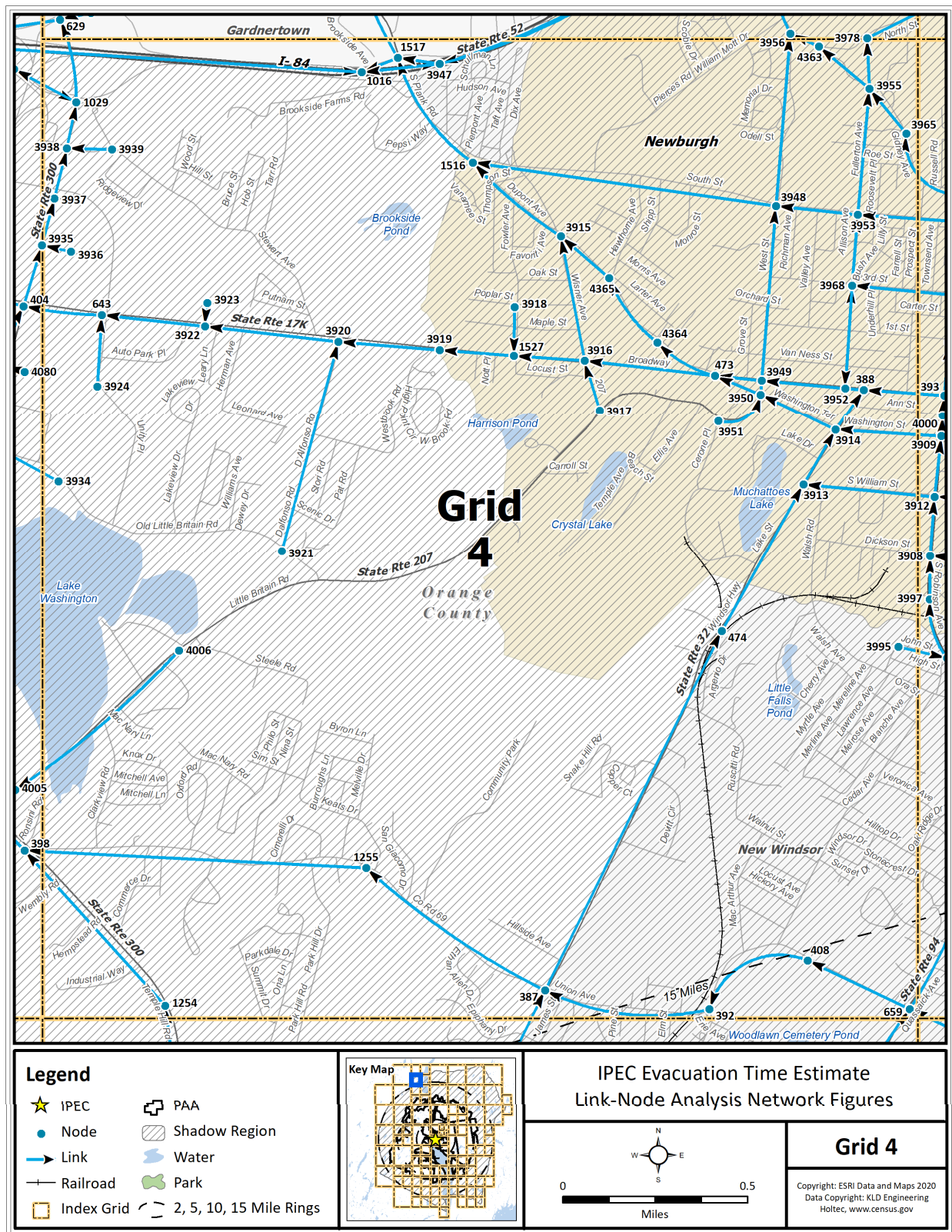


Figure K-5. Link-Node Analysis Network – Grid 4

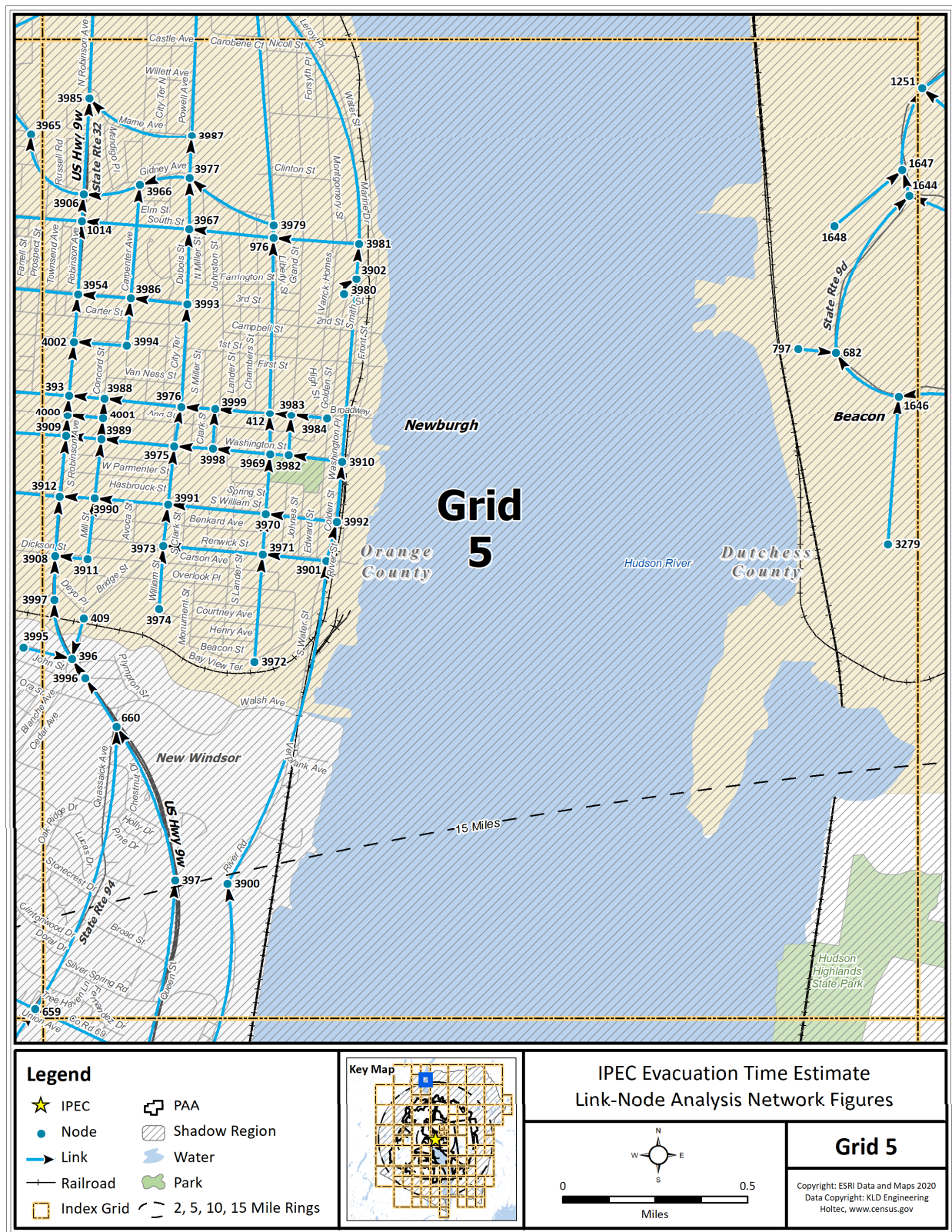


Figure K-6. Link-Node Analysis Network – Grid 5

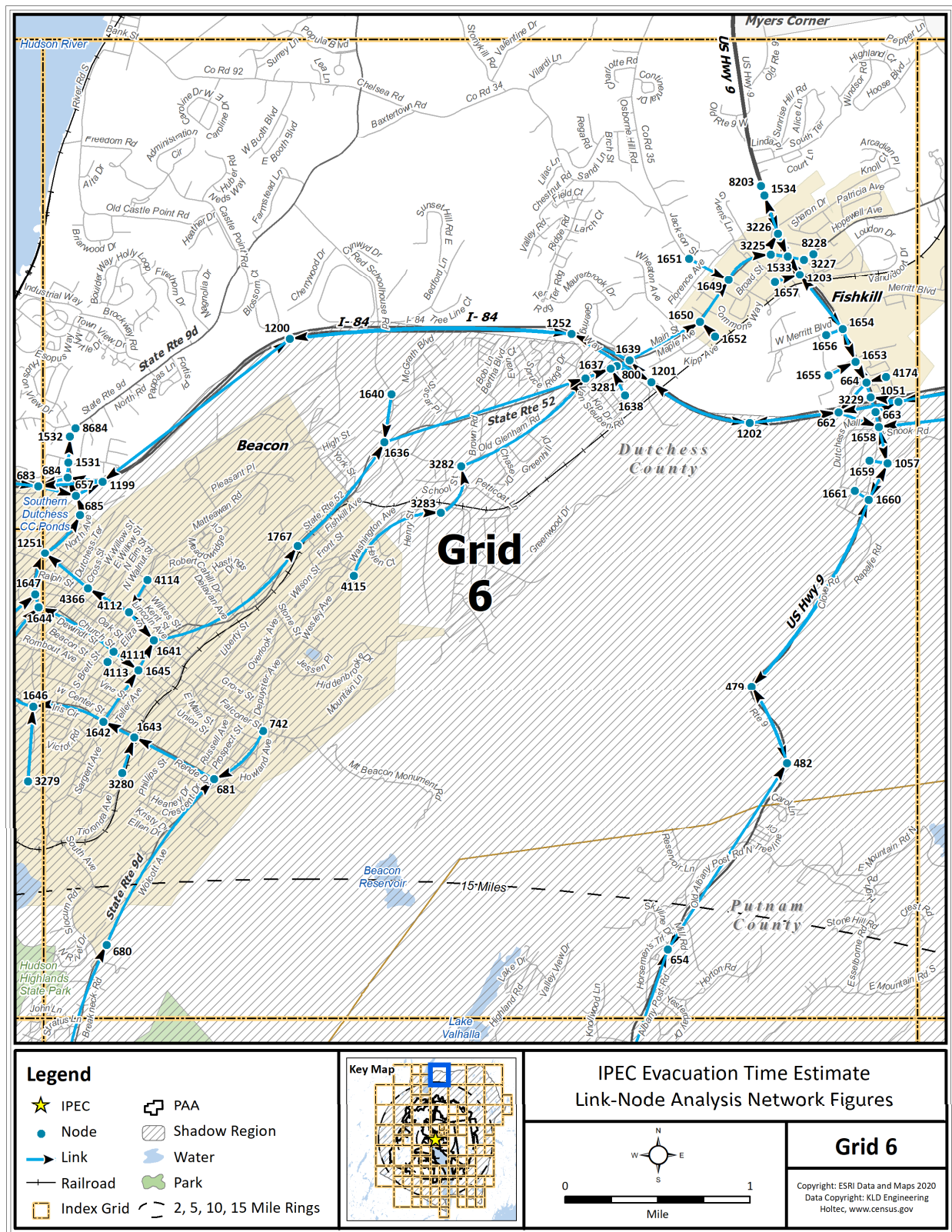


Figure K-7. Link-Node Analysis Network – Grid 6

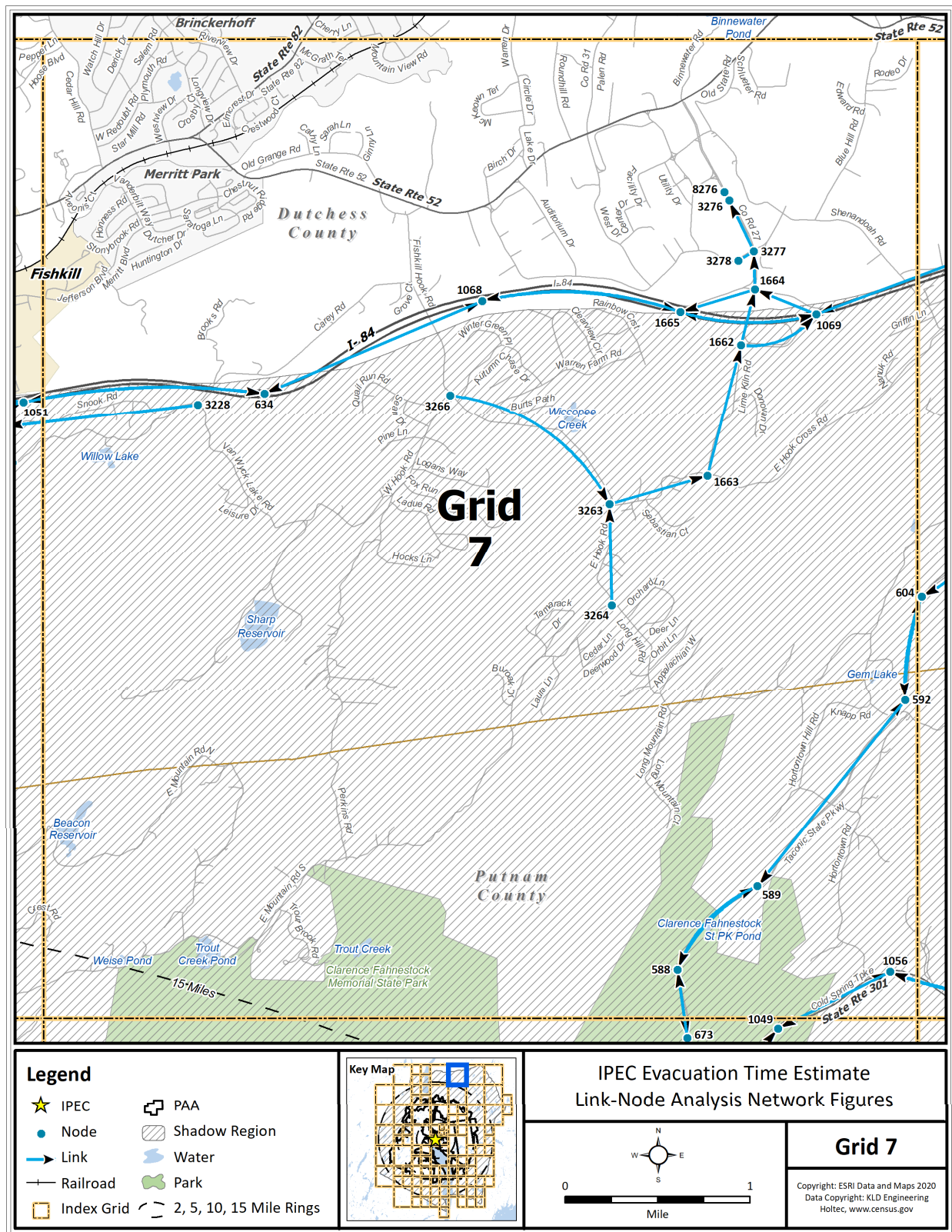


Figure K-8. Link-Node Analysis Network – Grid 7

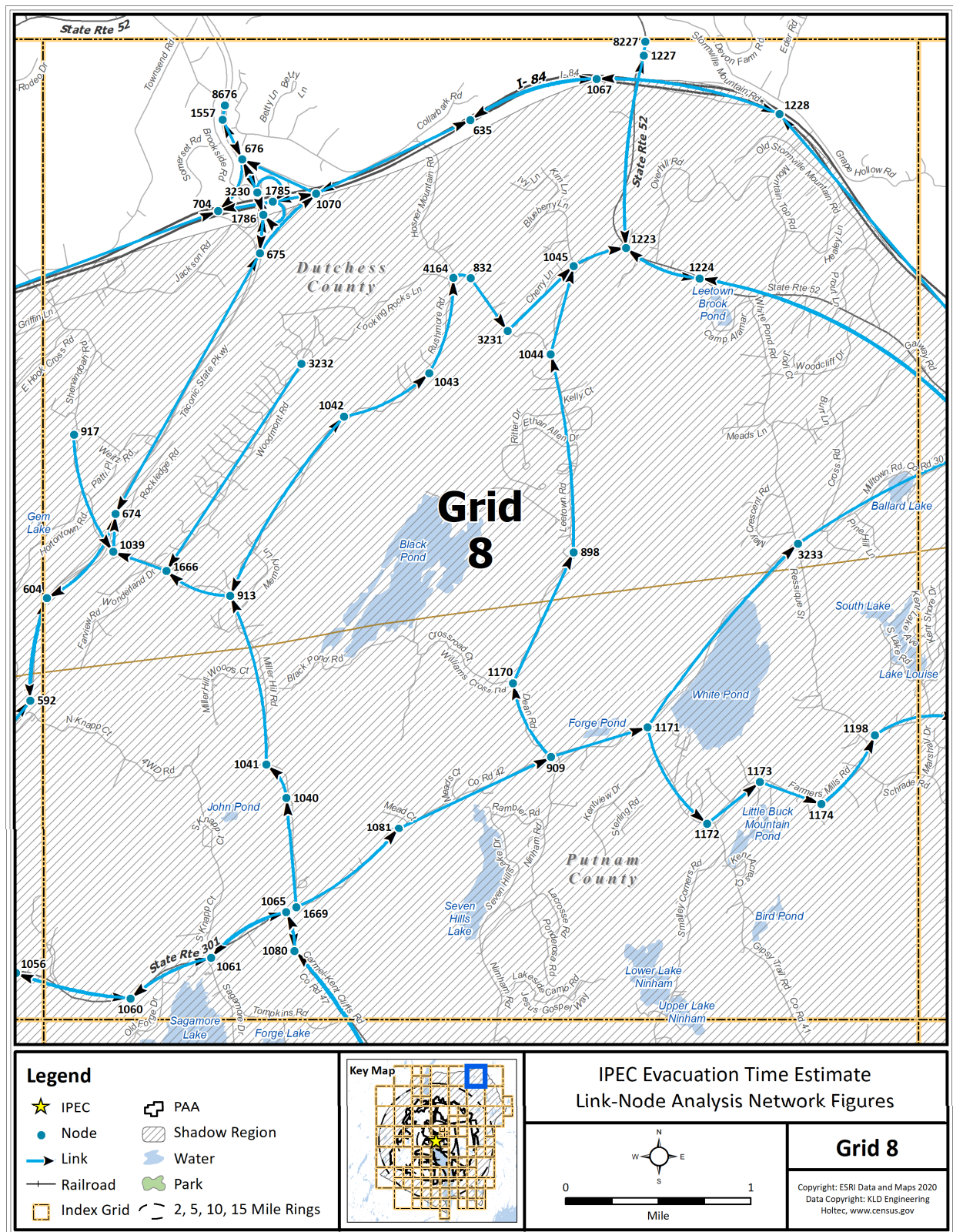


Figure K-9. Link-Node Analysis Network – Grid 8

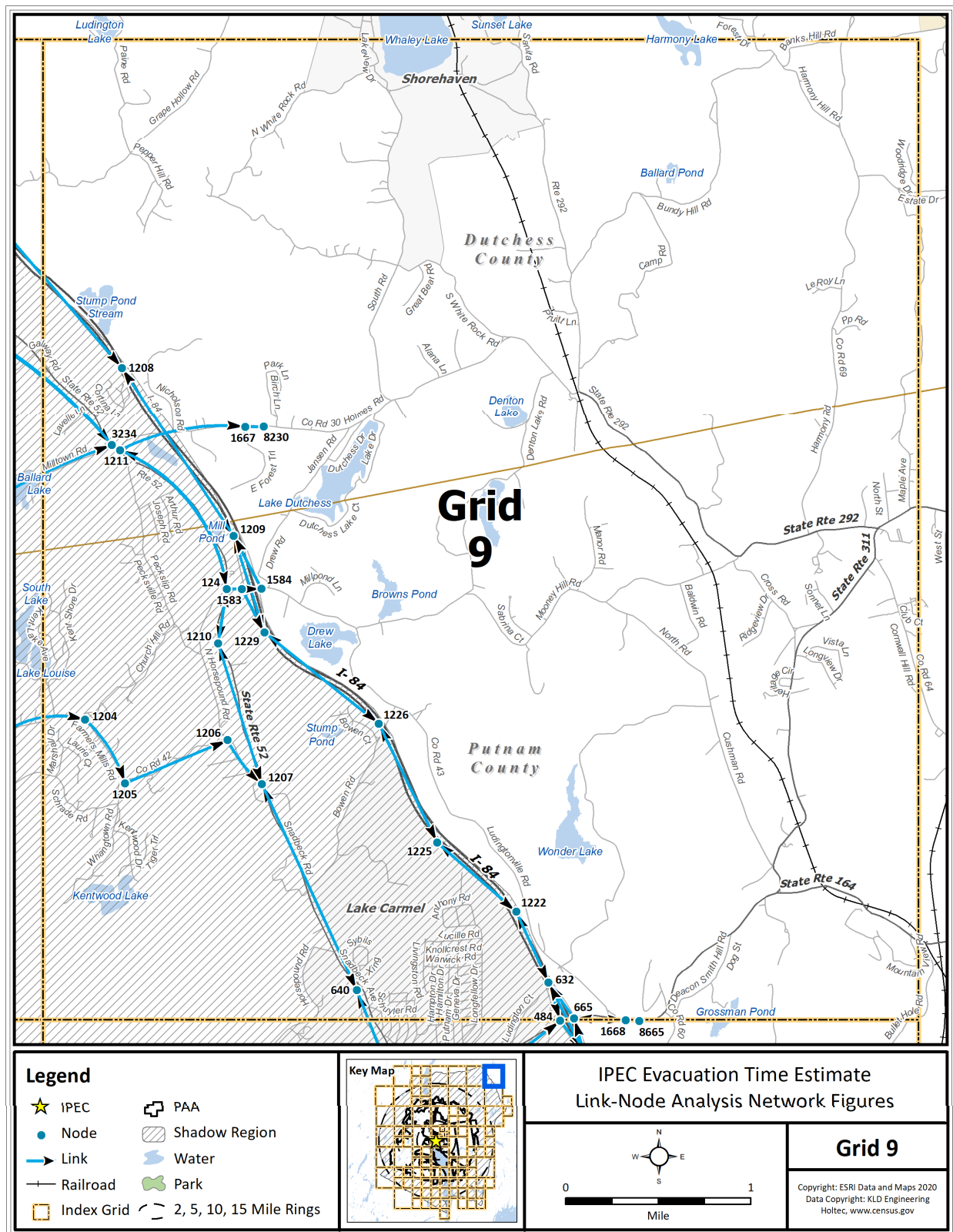


Figure K-10. Link-Node Analysis Network – Grid 9

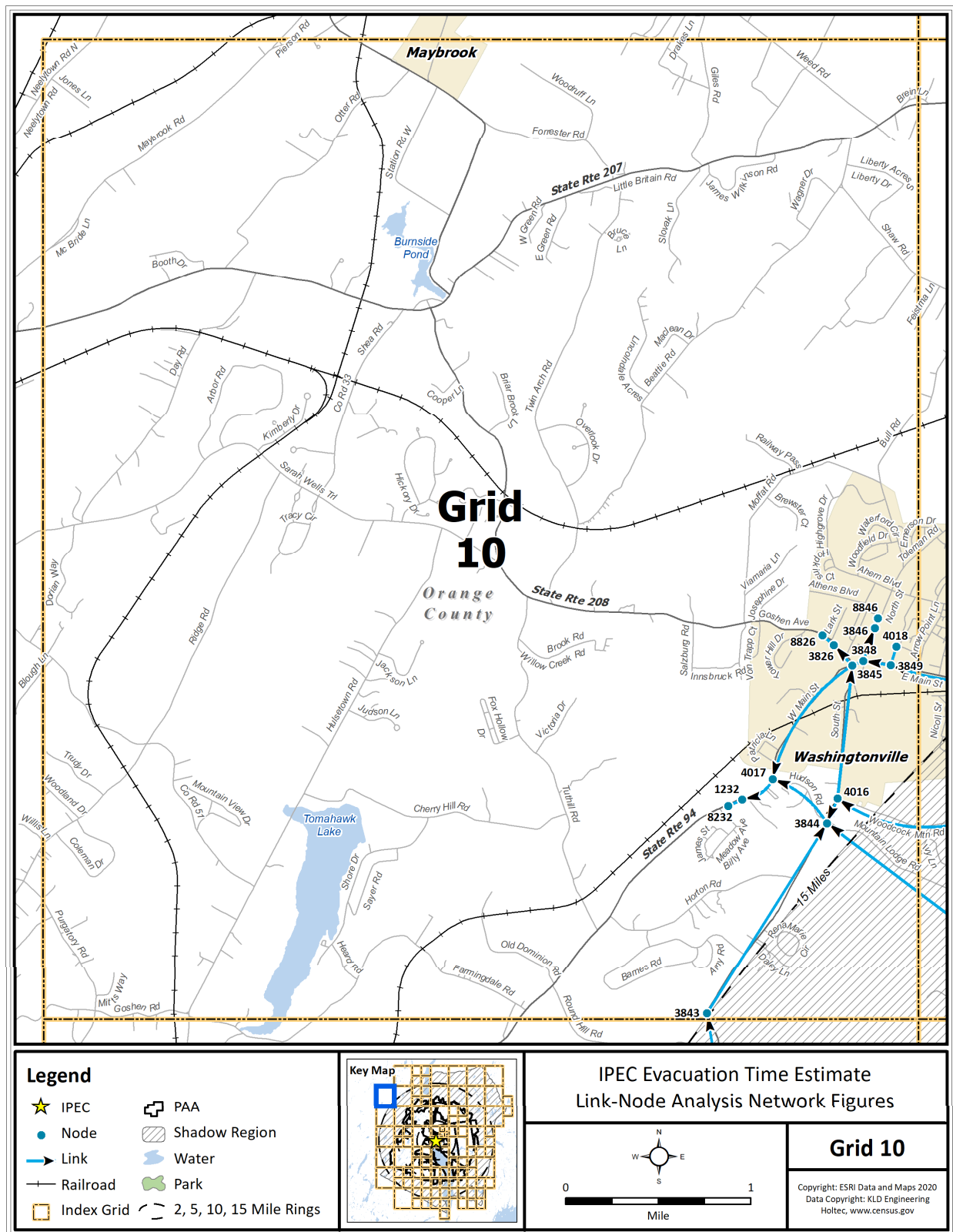


Figure K-11. Link-Node Analysis Network – Grid 10

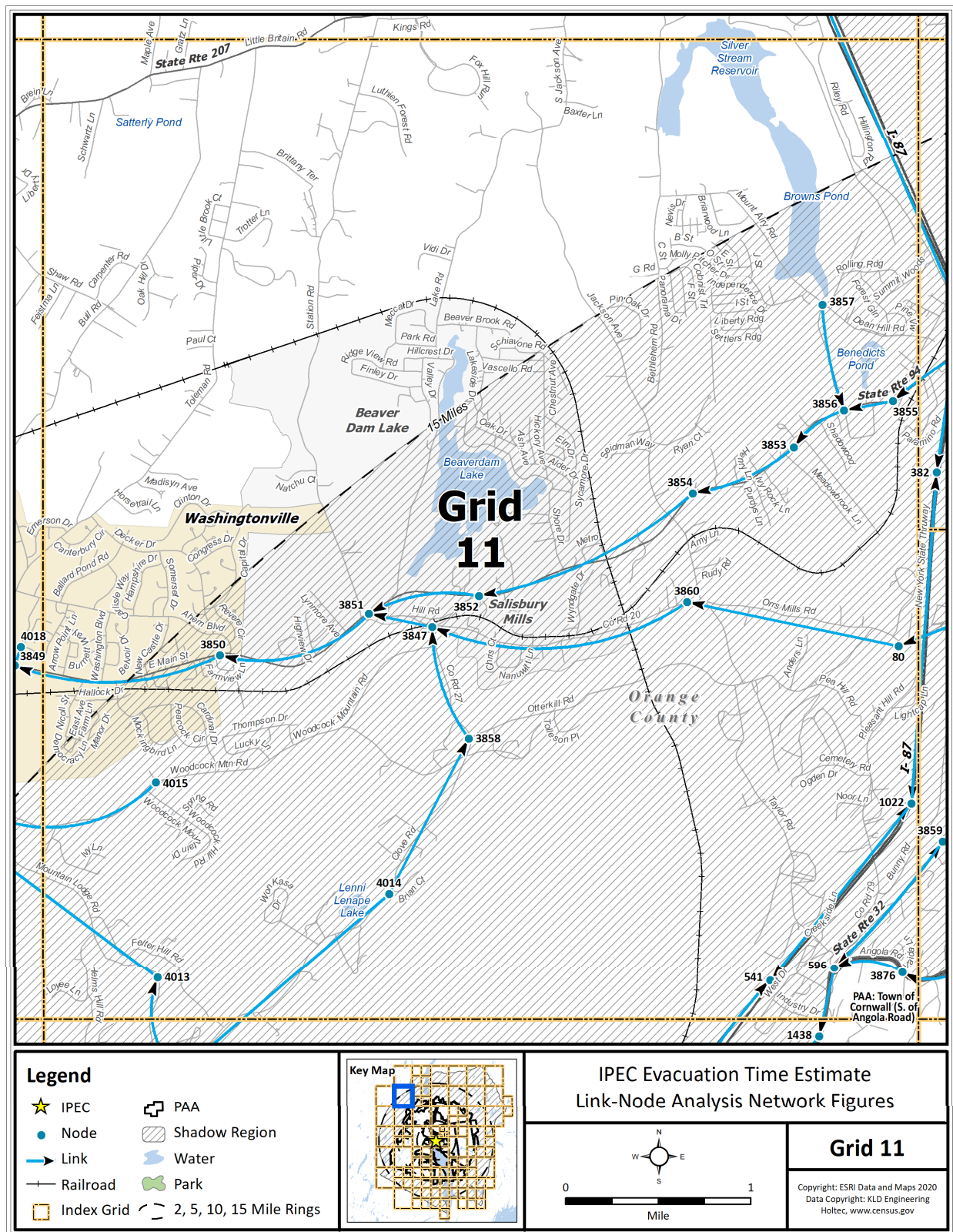


Figure K-12. Link-Node Analysis Network – Grid 11

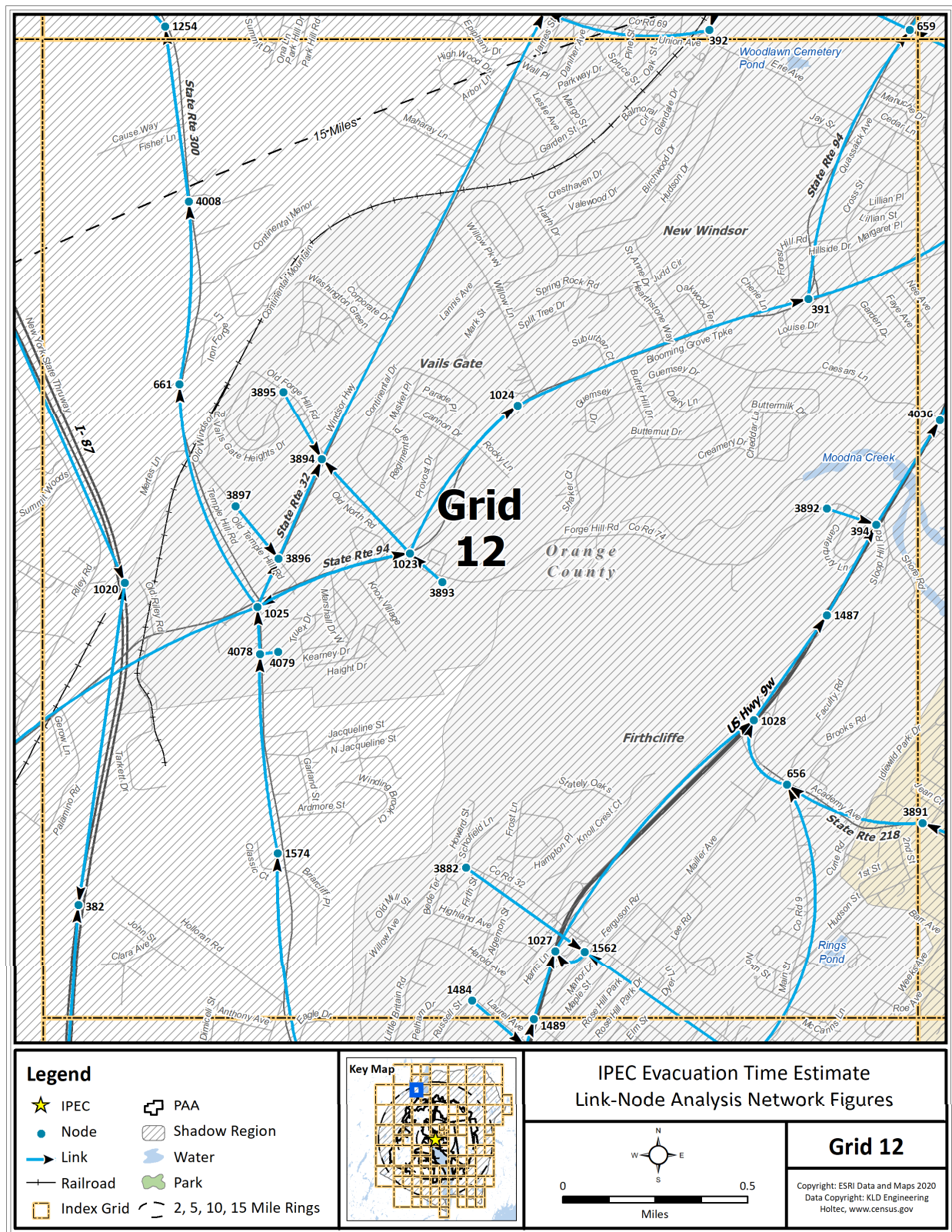


Figure K-13. Link-Node Analysis Network – Grid 12

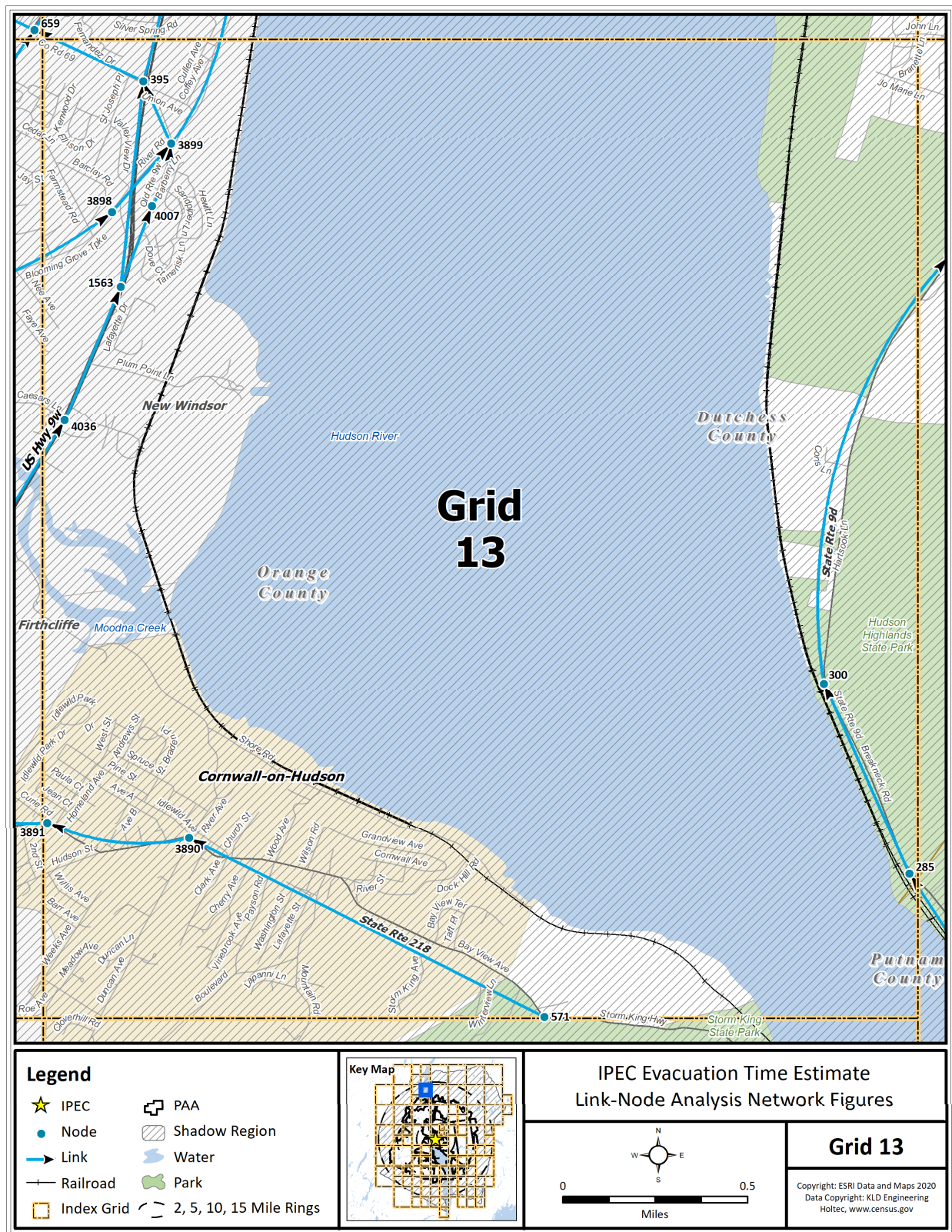


Figure K-14. Link-Node Analysis Network – Grid 13

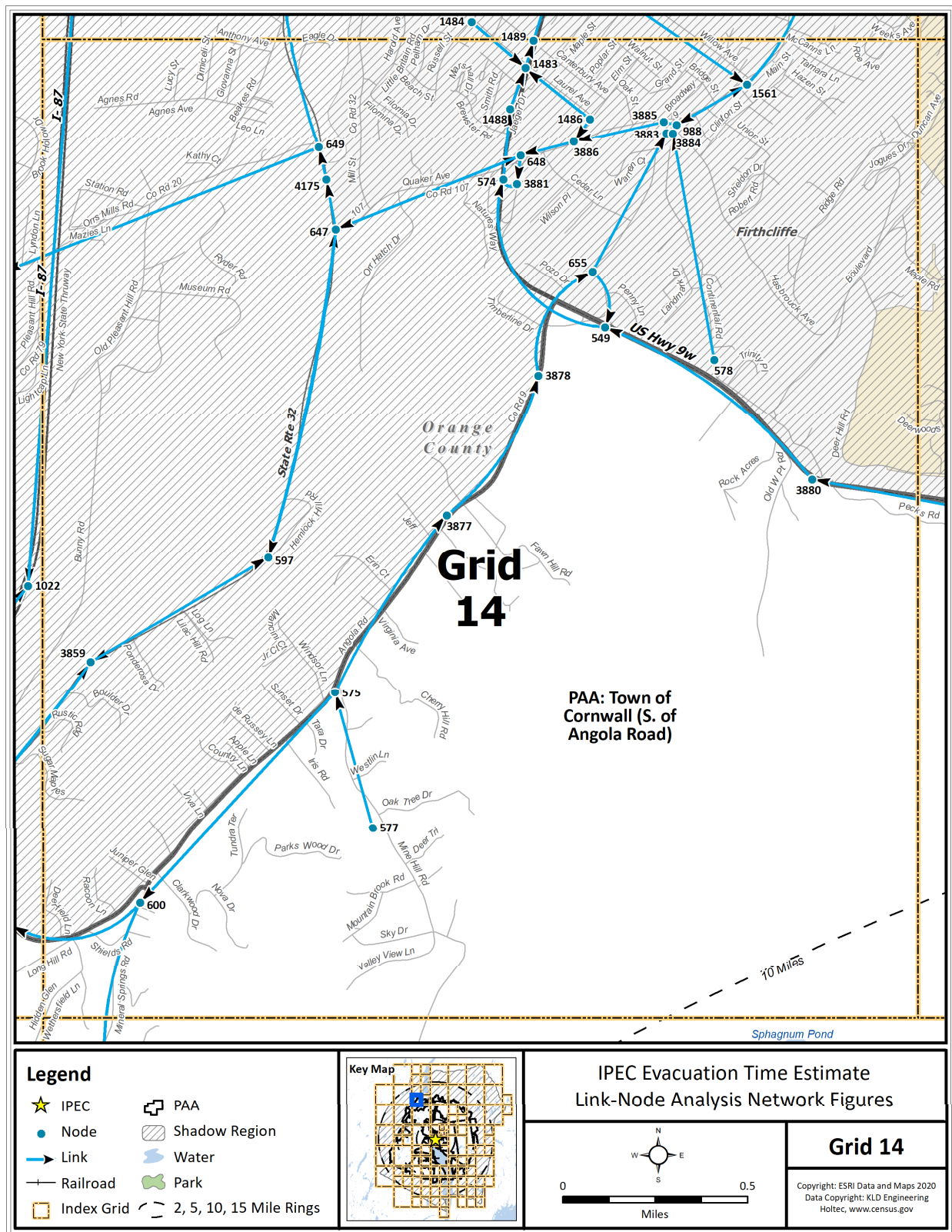


Figure K-15. Link-Node Analysis Network – Grid 14

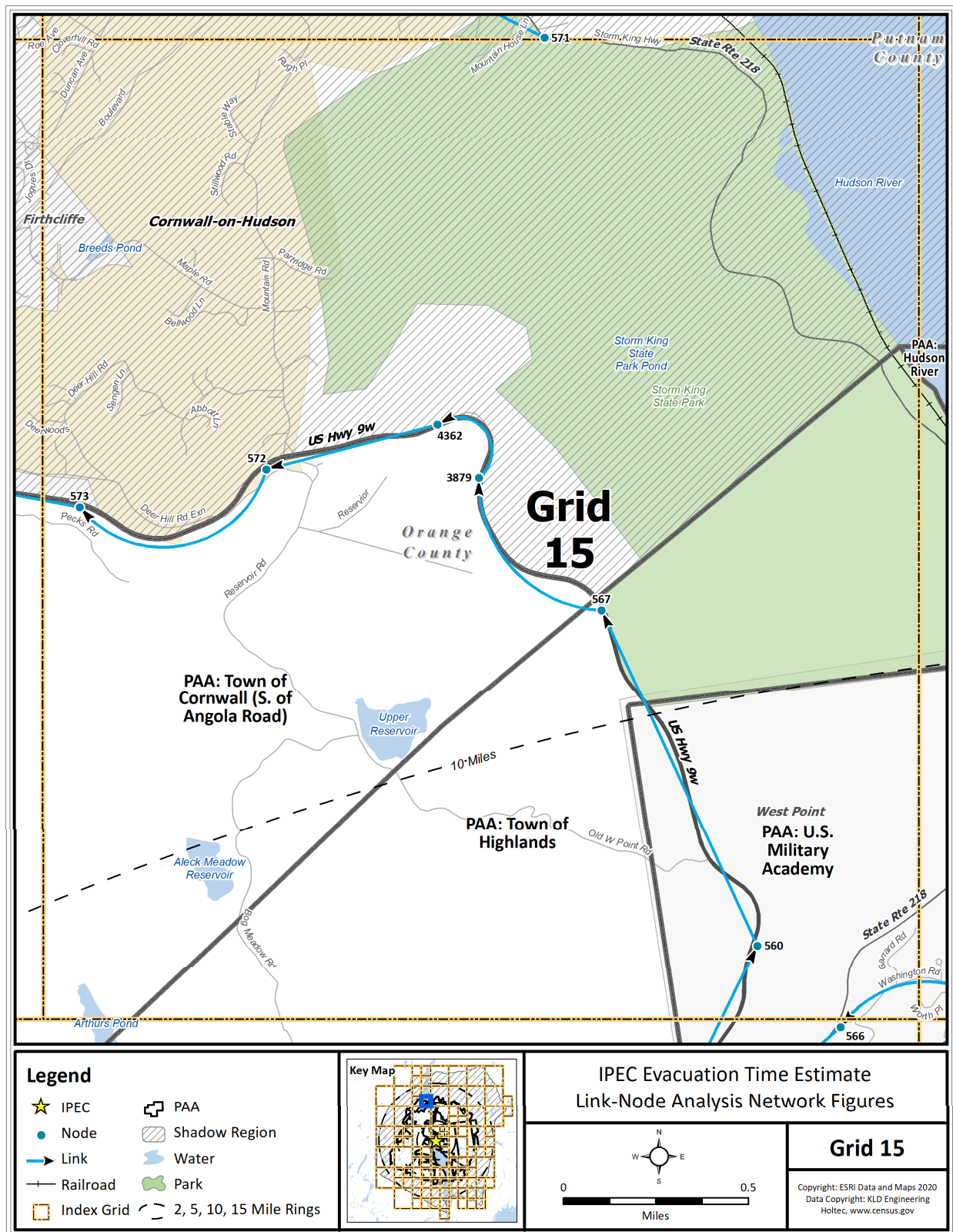


Figure K-16. Link-Node Analysis Network – Grid 15

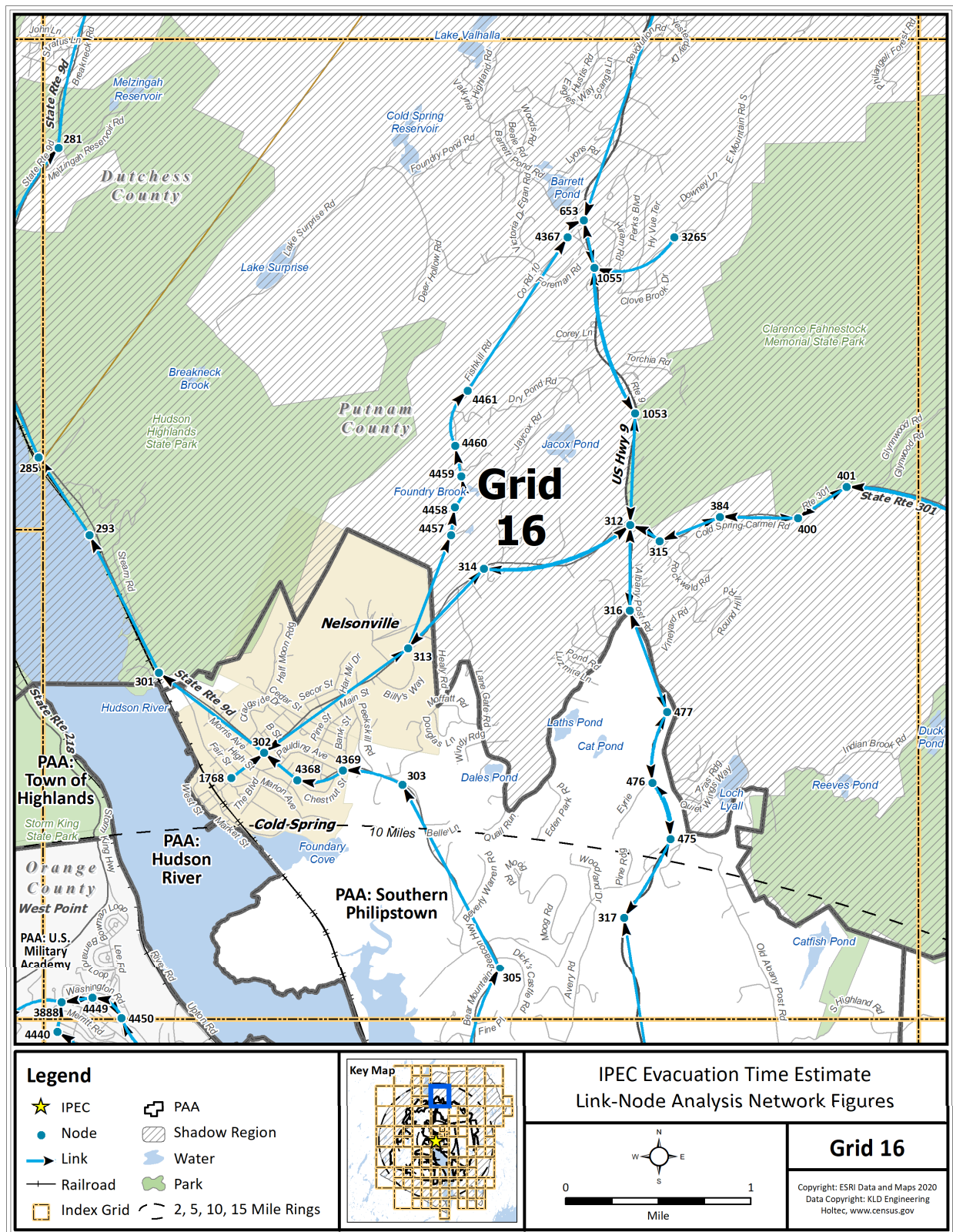


Figure K-17. Link-Node Analysis Network – Grid 16

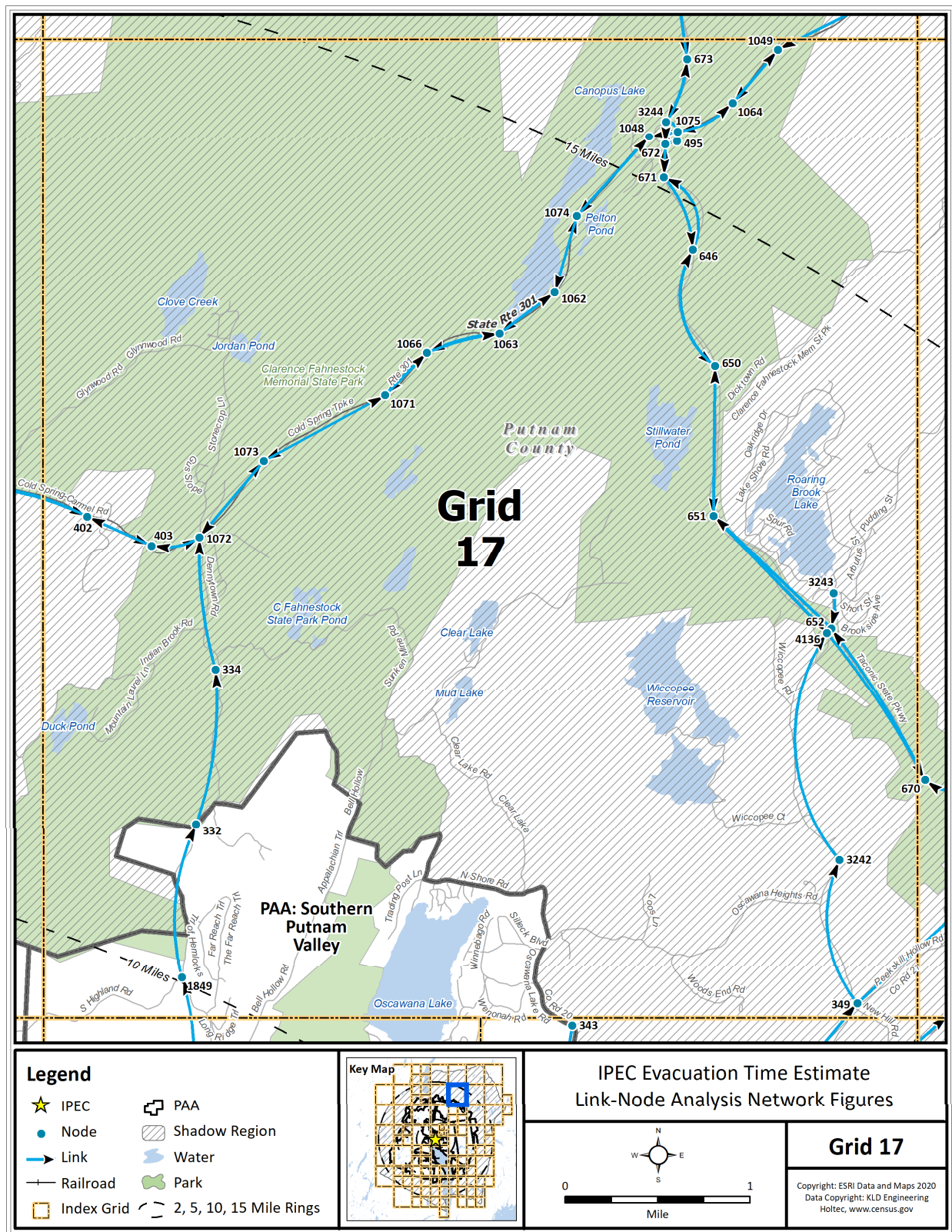


Figure K-18. Link-Node Analysis Network – Grid 17

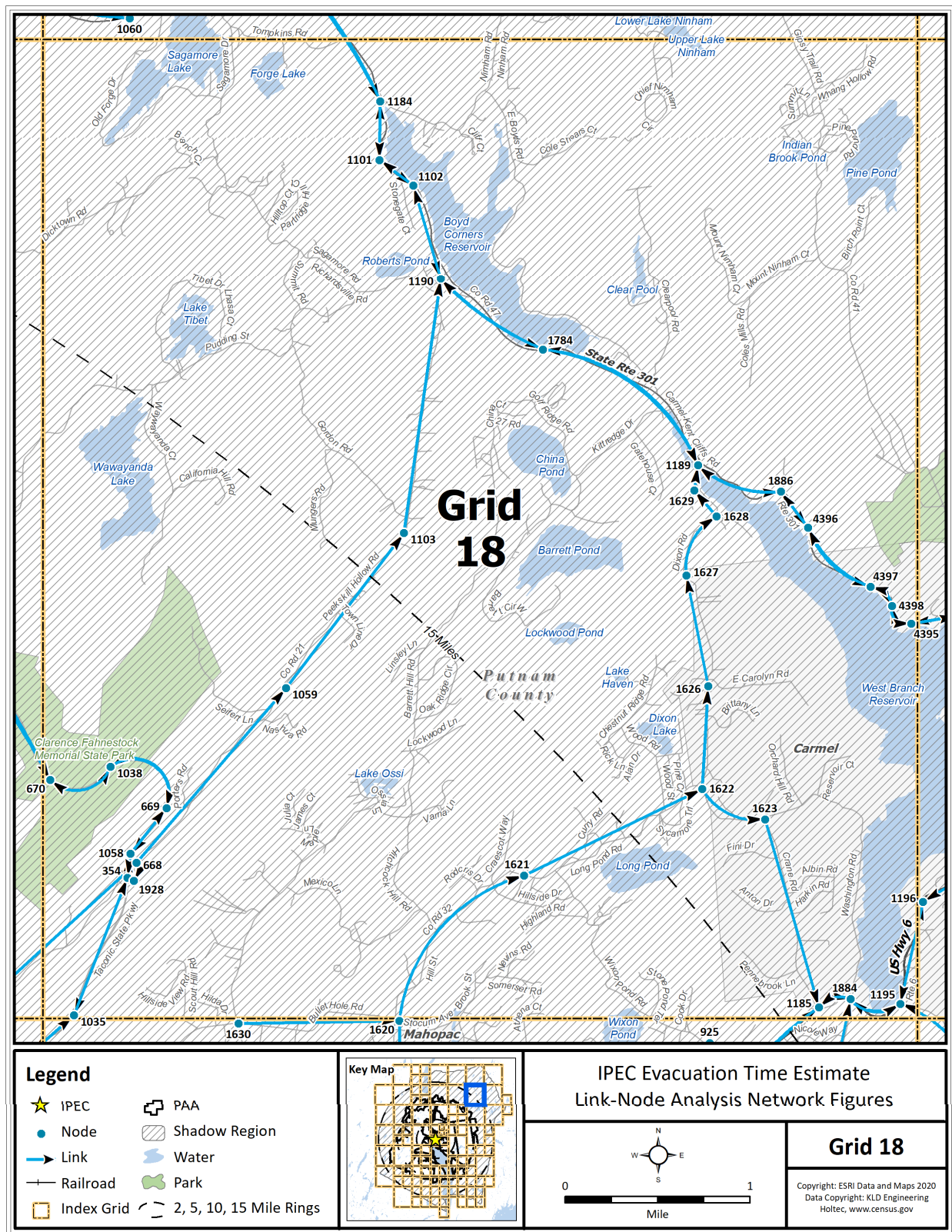


Figure K-19. Link-Node Analysis Network – Grid 18

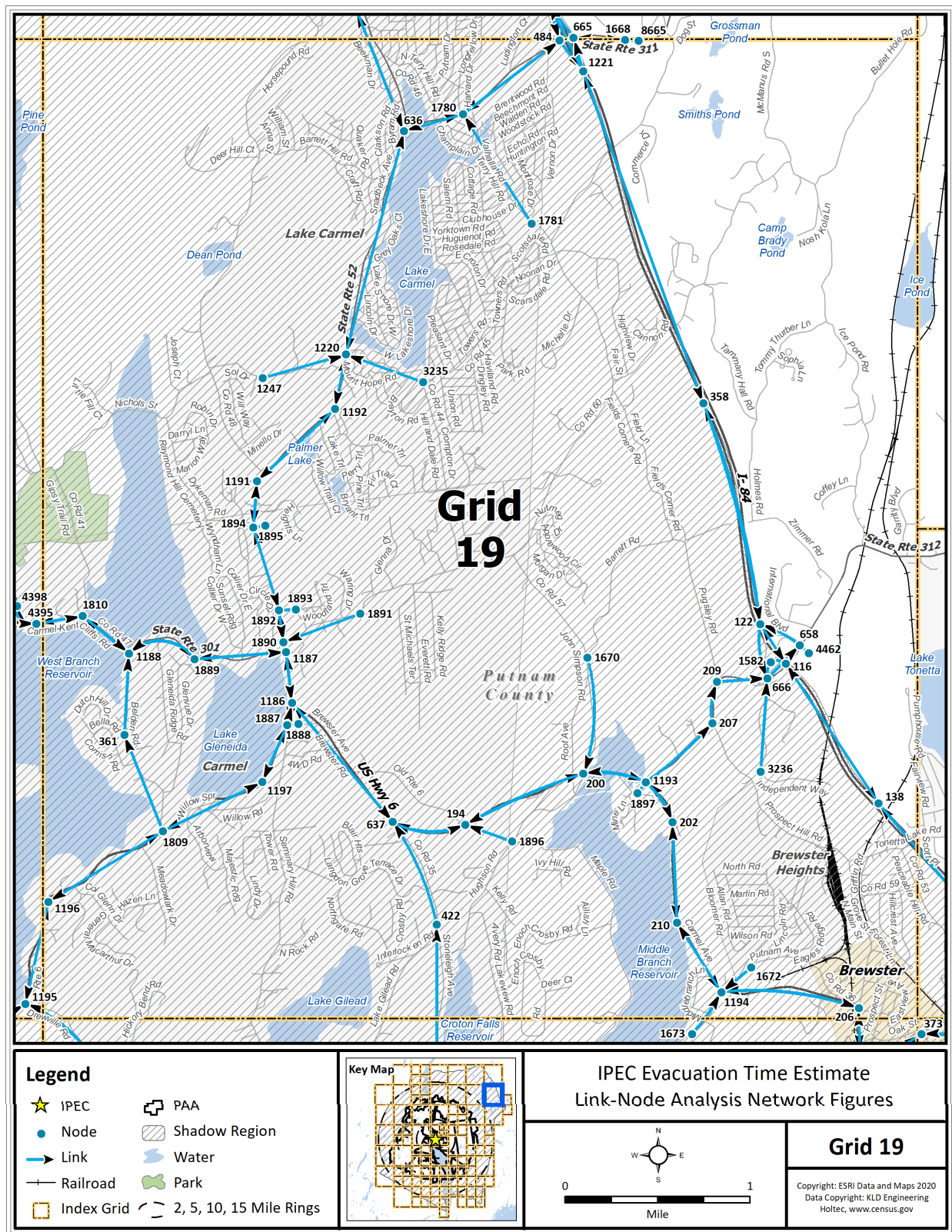


Figure K-20. Link-Node Analysis Network – Grid 19

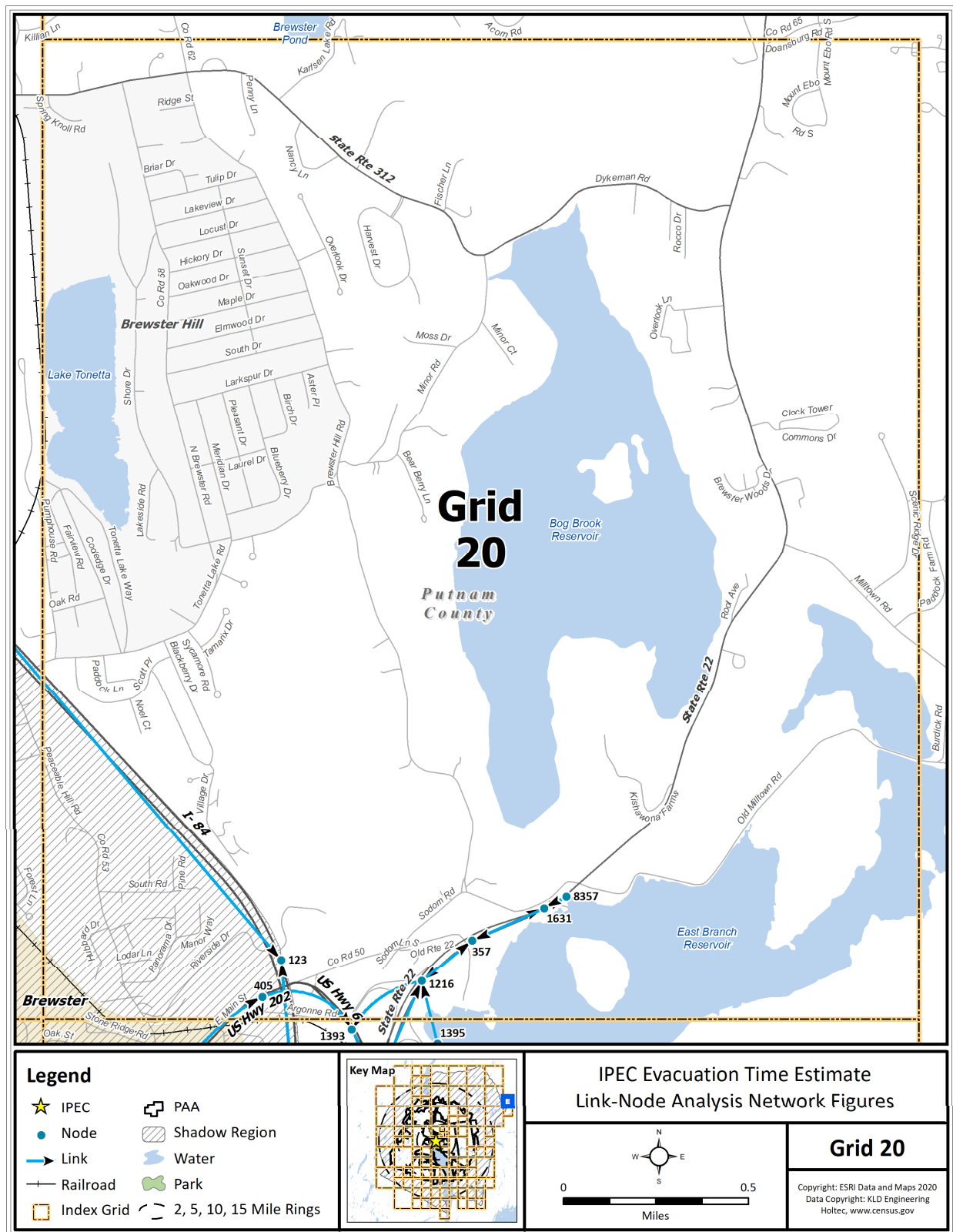


Figure K-21. Link-Node Analysis Network – Grid 20

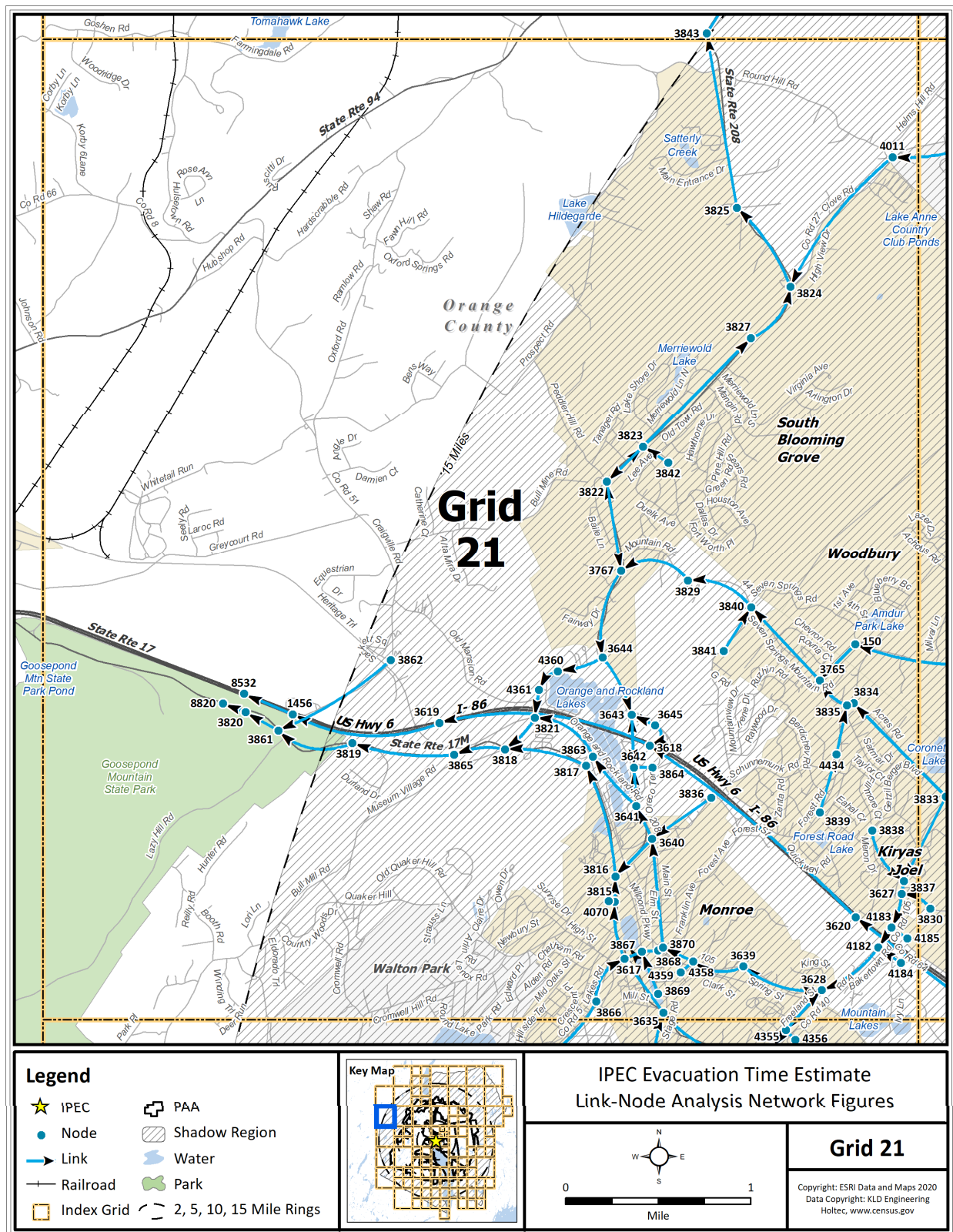


Figure K-22. Link-Node Analysis Network – Grid 21

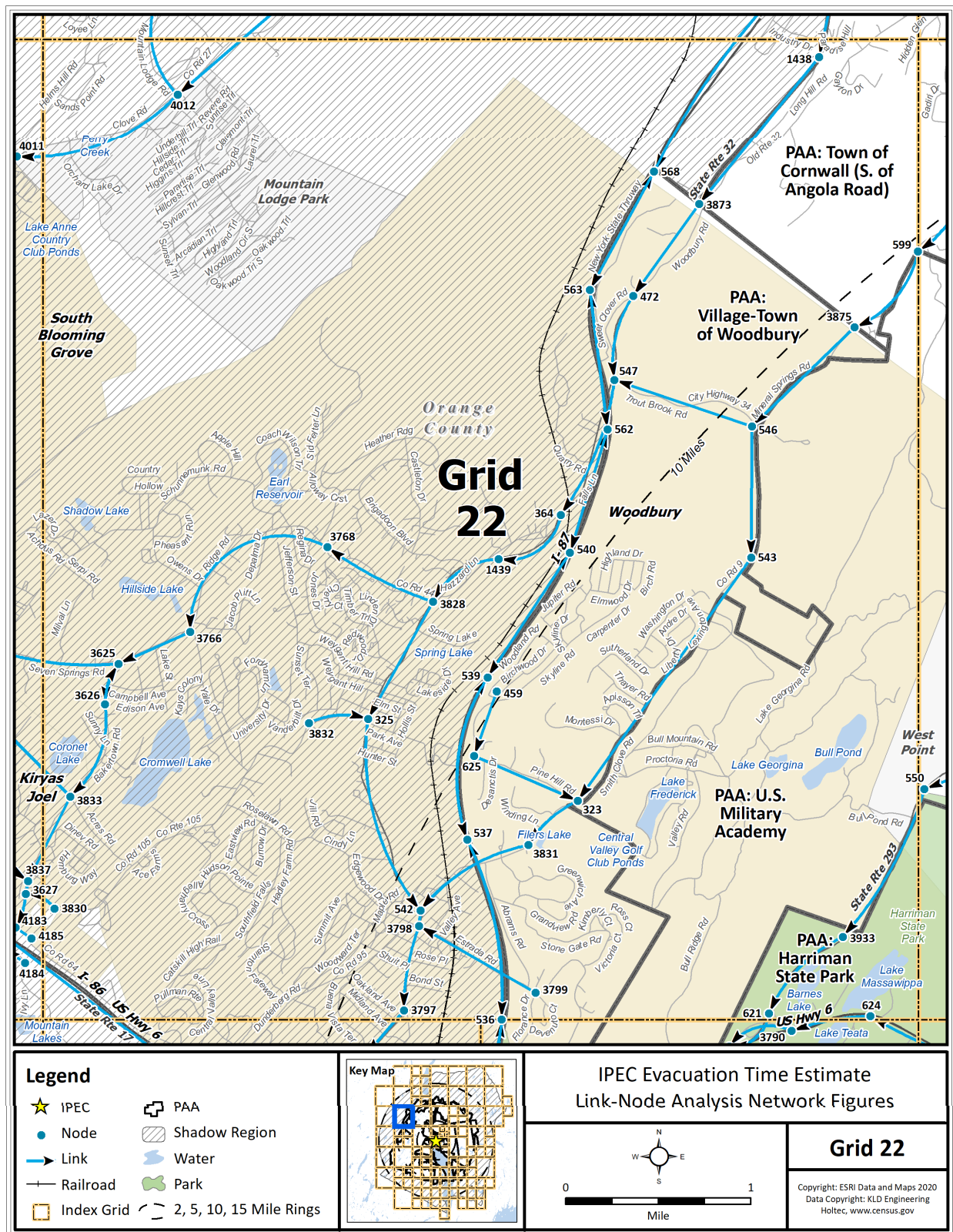


Figure K-23. Link-Node Analysis Network – Grid 22

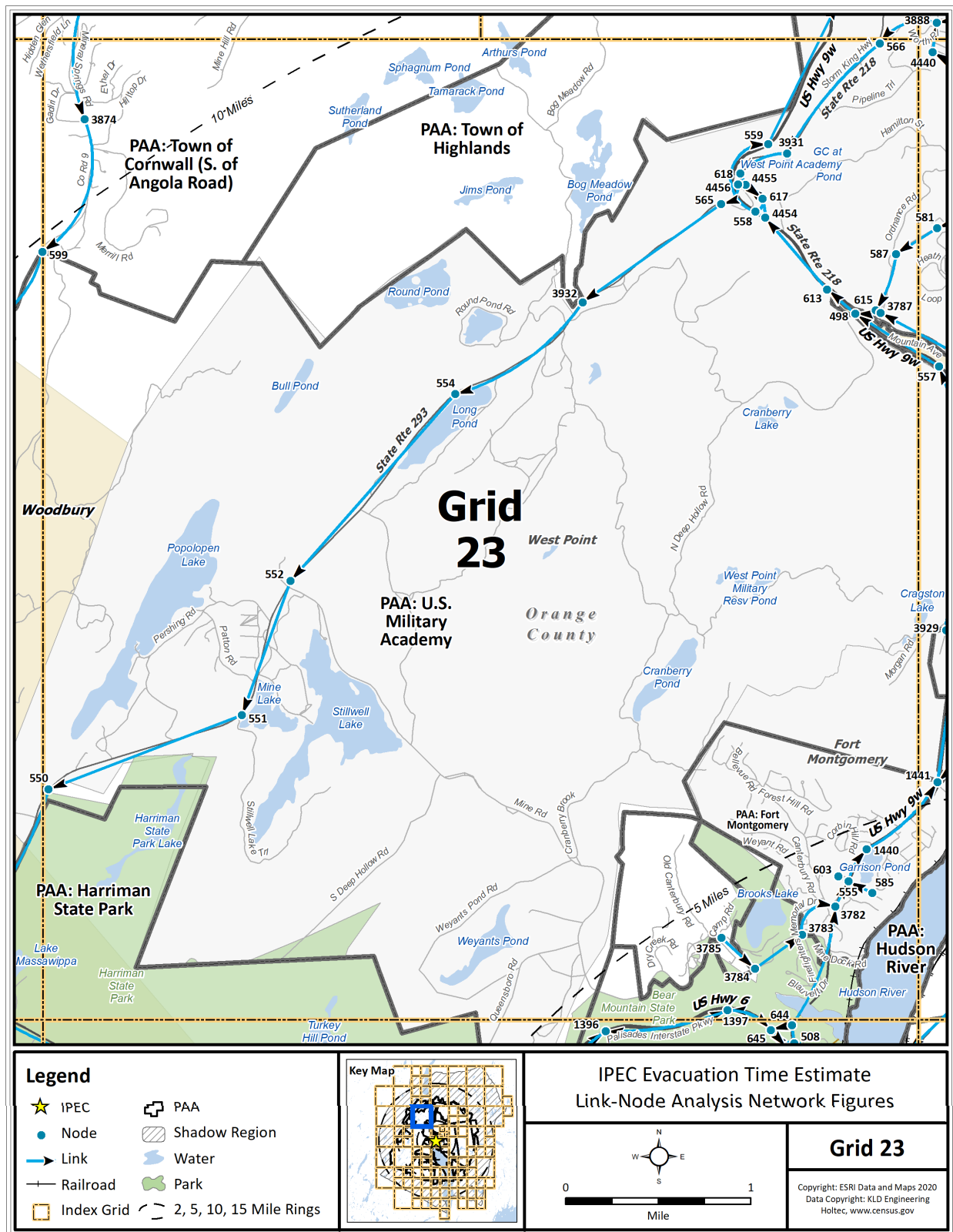


Figure K-24. Link-Node Analysis Network – Grid 23

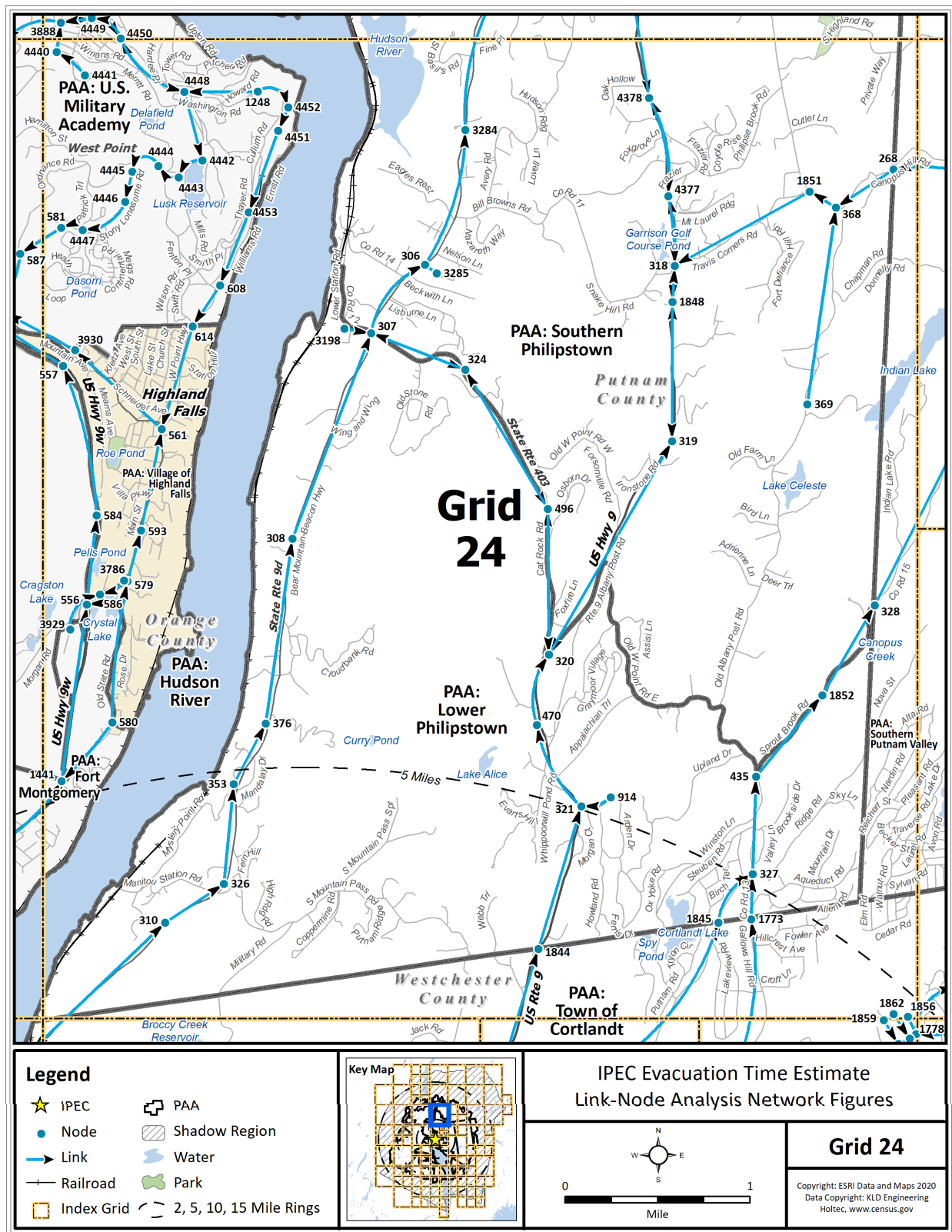


Figure K-25. Link-Node Analysis Network – Grid 24

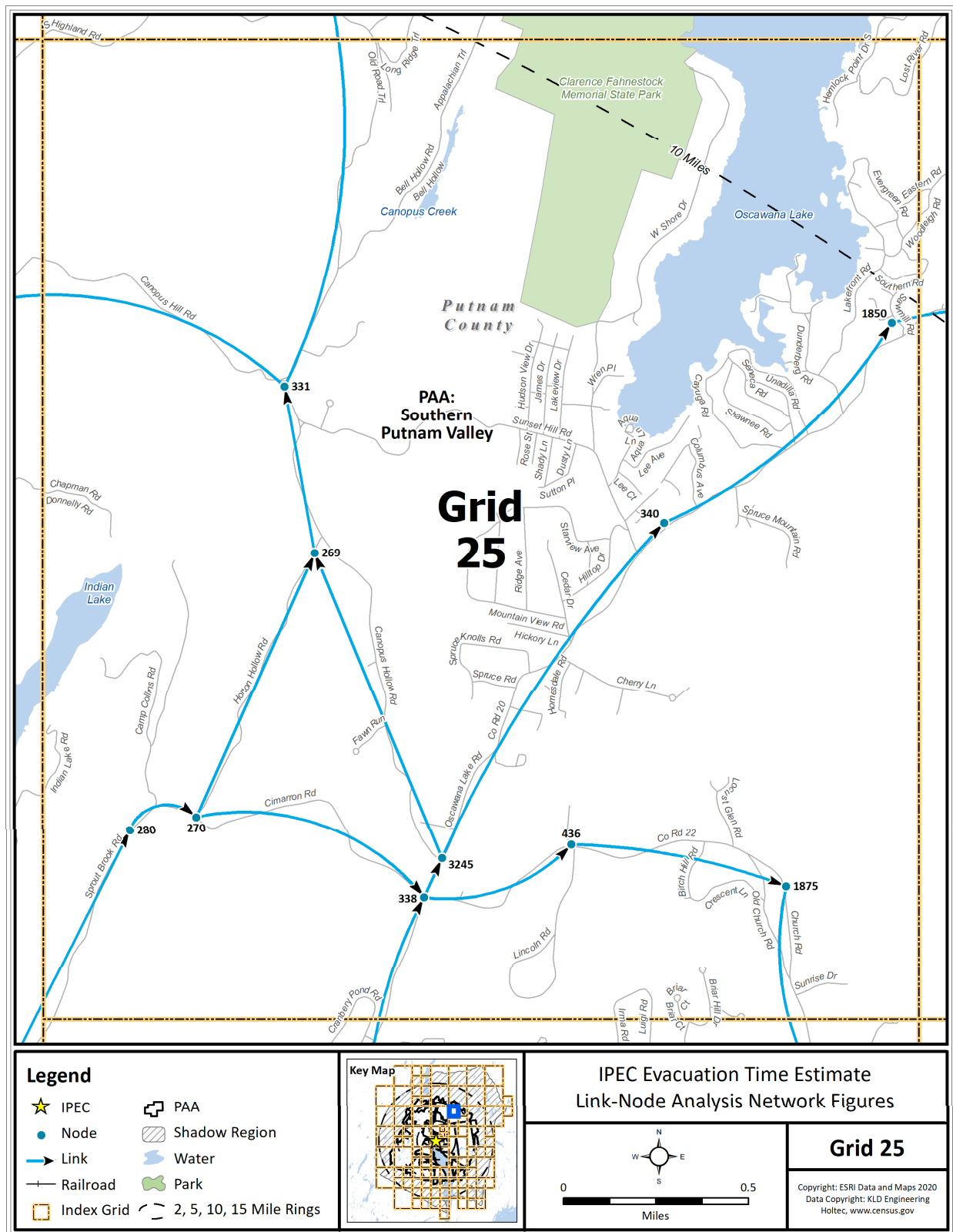


Figure K-26. Link-Node Analysis Network – Grid 25

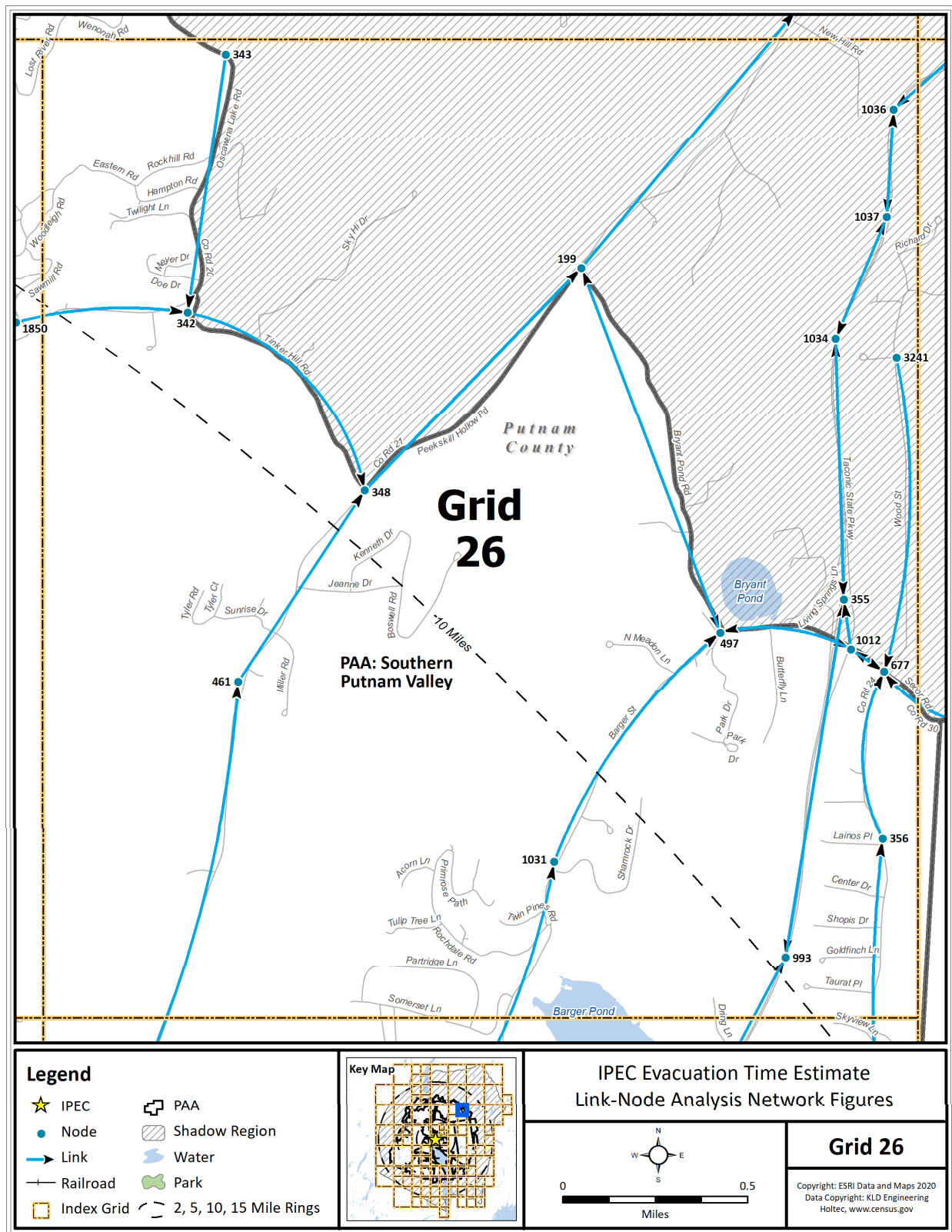


Figure K-27. Link-Node Analysis Network – Grid 26

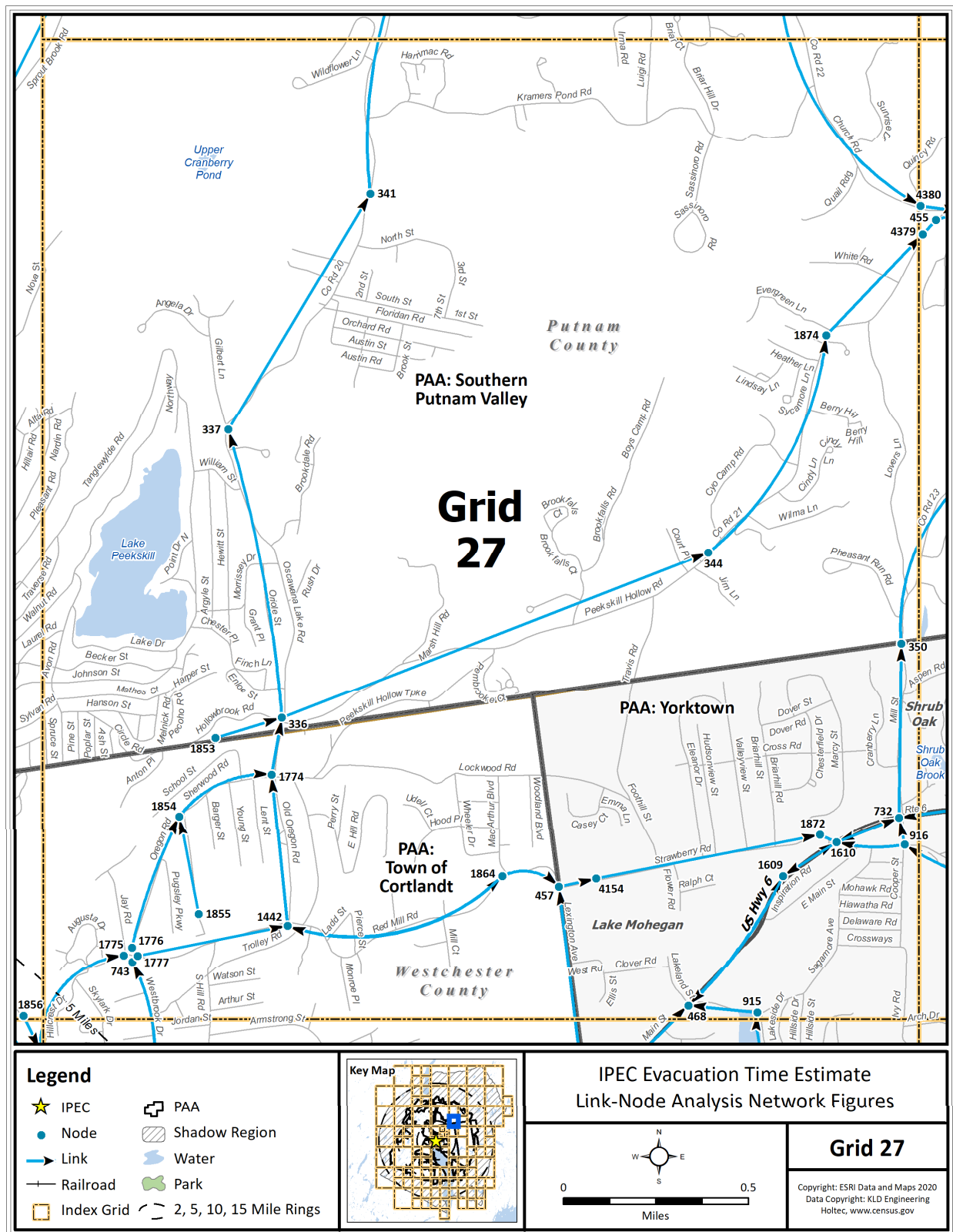


Figure K-28. Link-Node Analysis Network – Grid 27

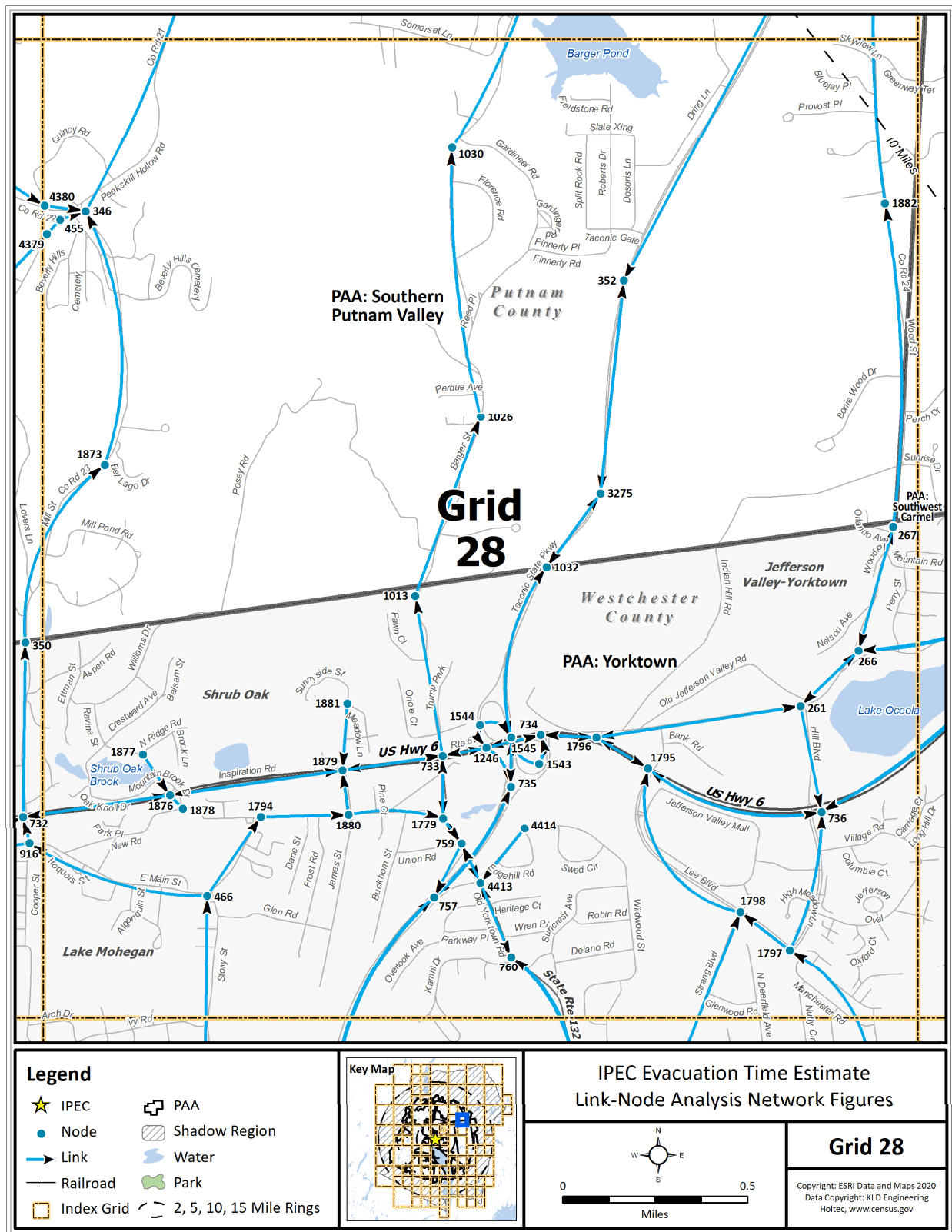


Figure K-29. Link-Node Analysis Network – Grid 28

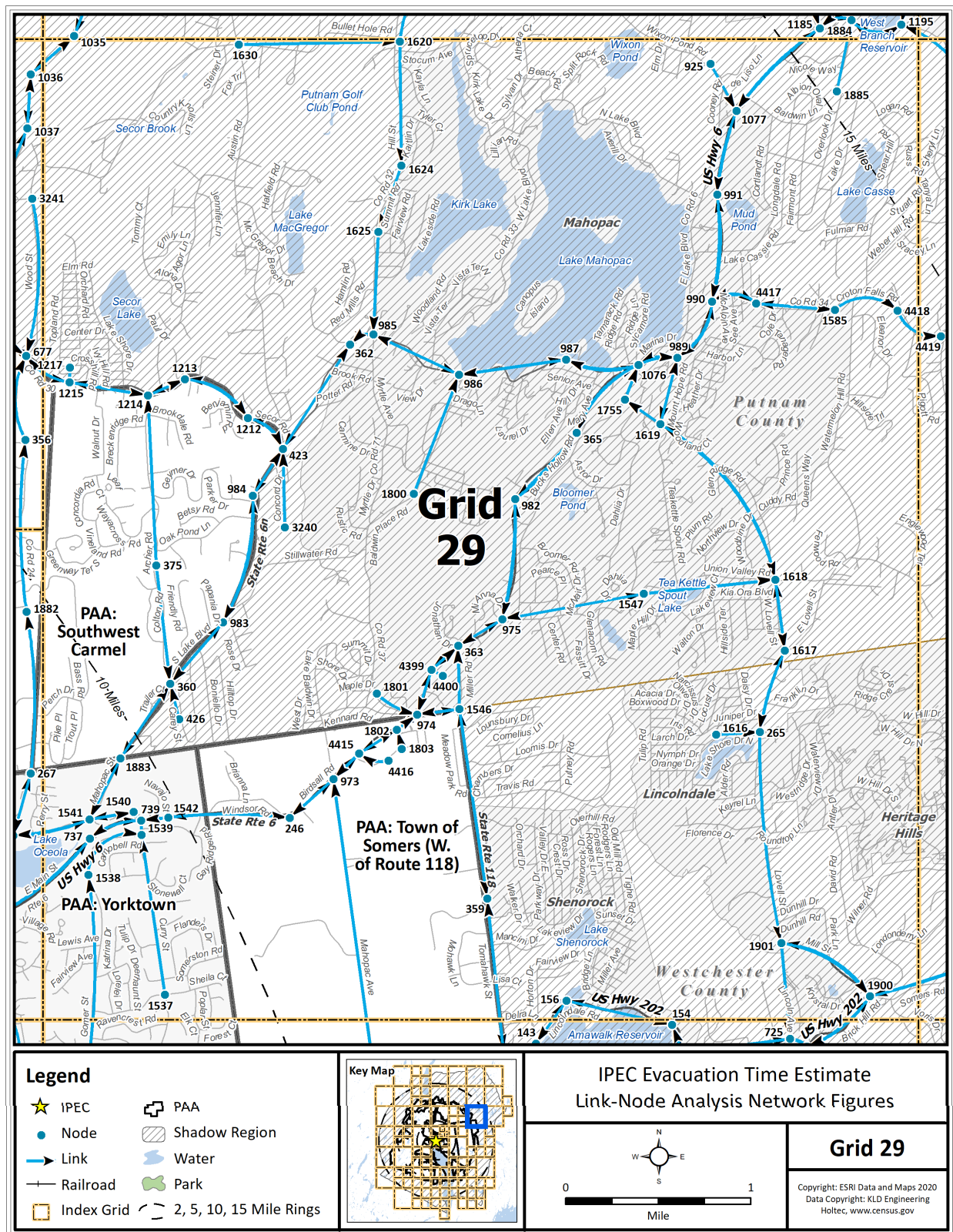


Figure K-30. Link-Node Analysis Network – Grid 29

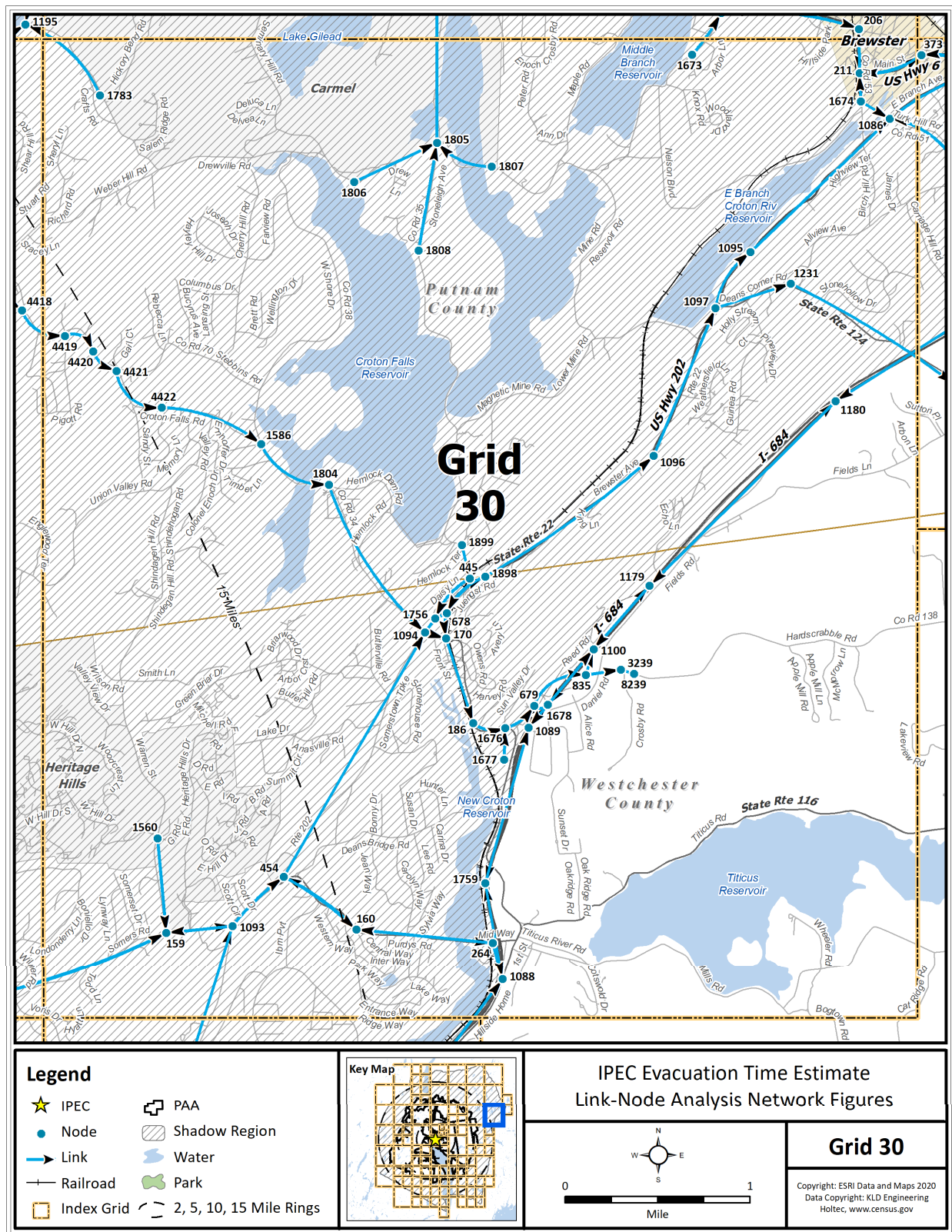


Figure K-31. Link-Node Analysis Network – Grid 30

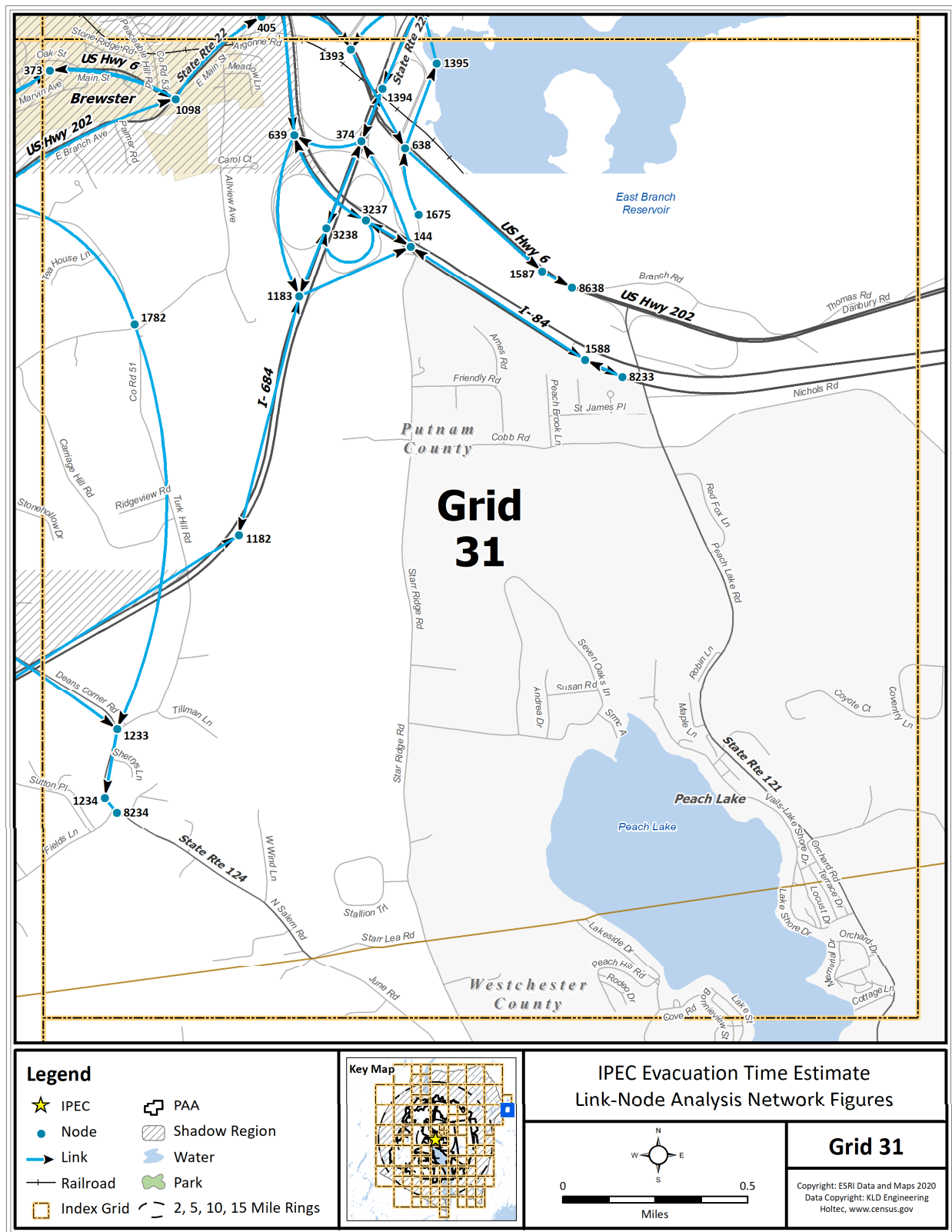


Figure K-32. Link-Node Analysis Network – Grid 31

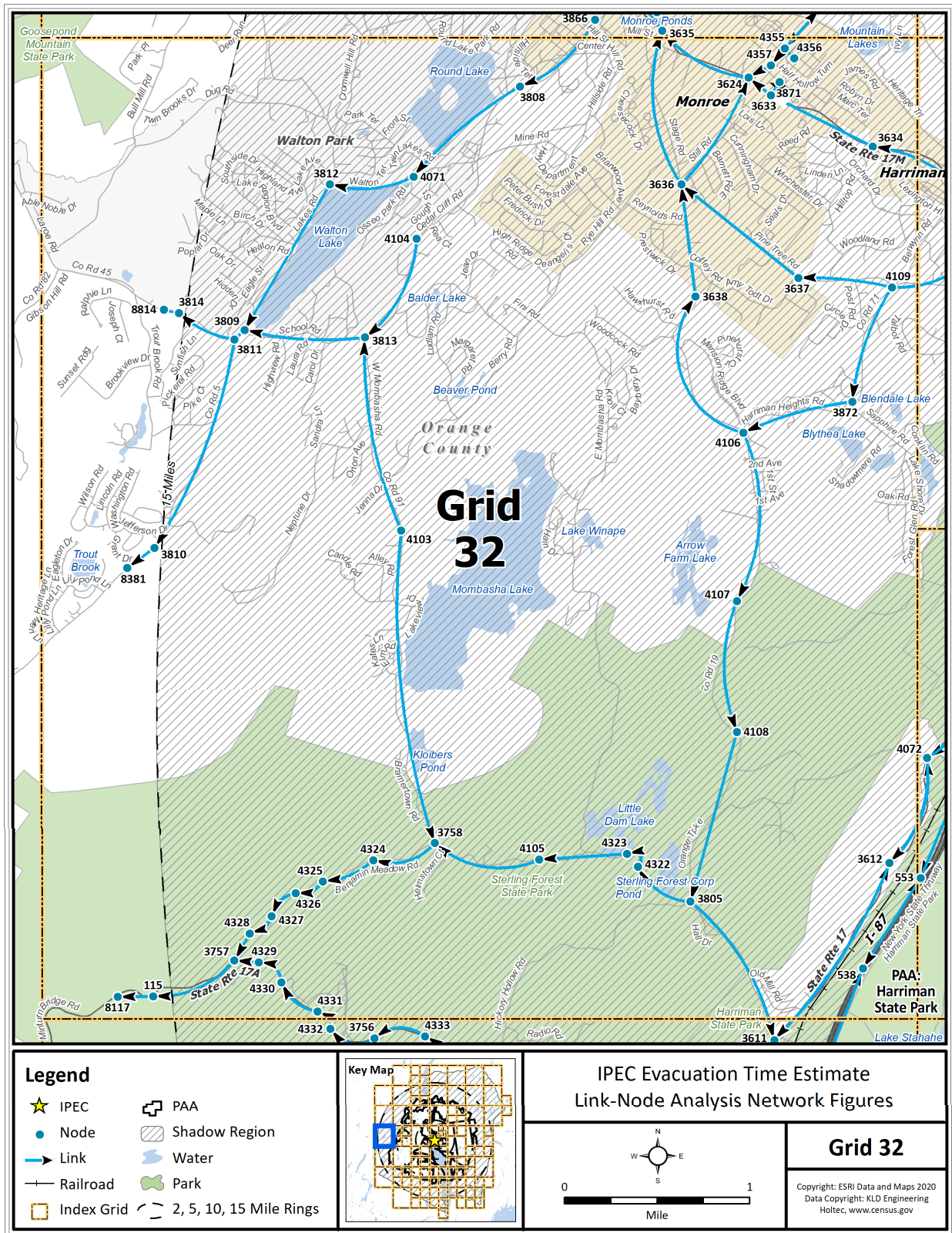


Figure K-33. Link-Node Analysis Network – Grid 32

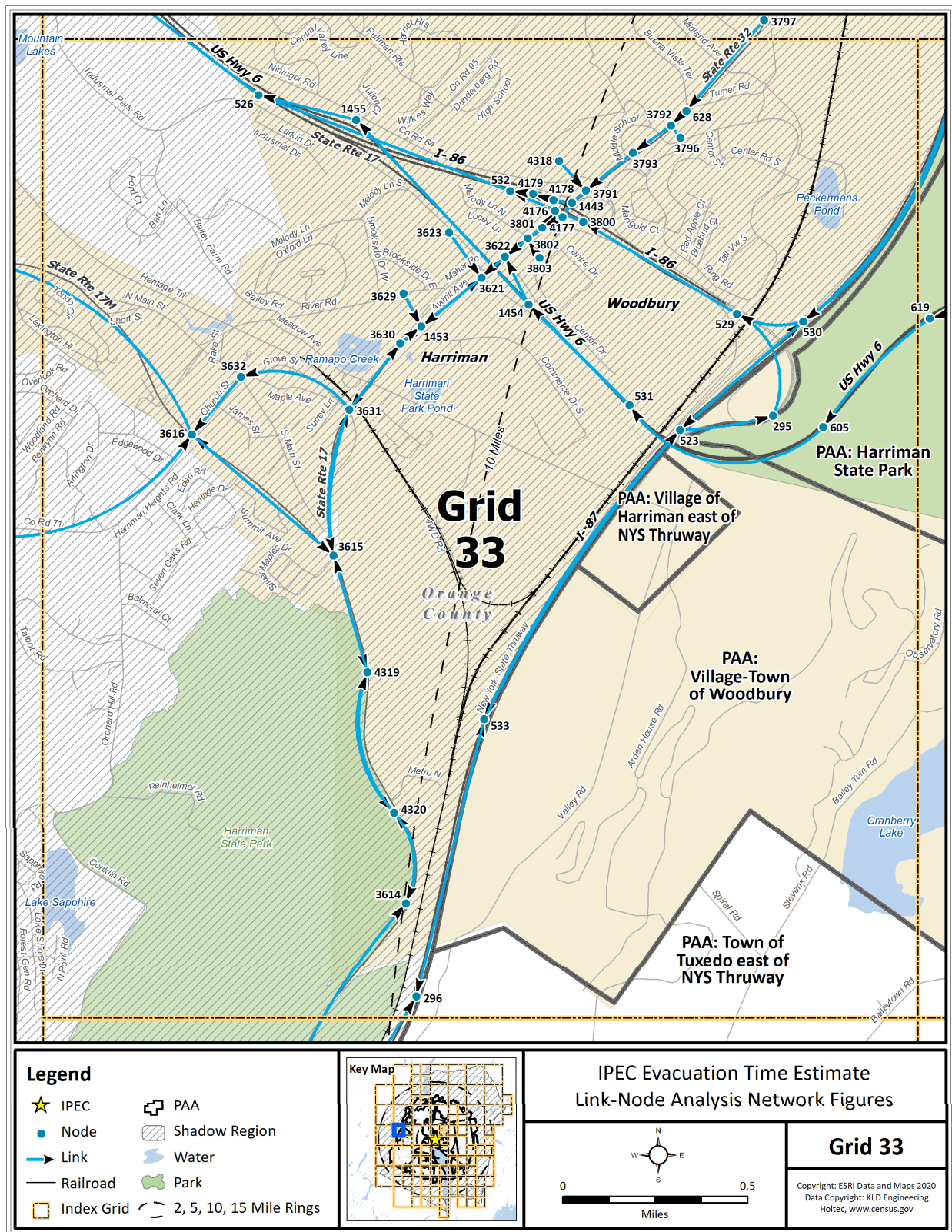


Figure K-34. Link-Node Analysis Network – Grid 33

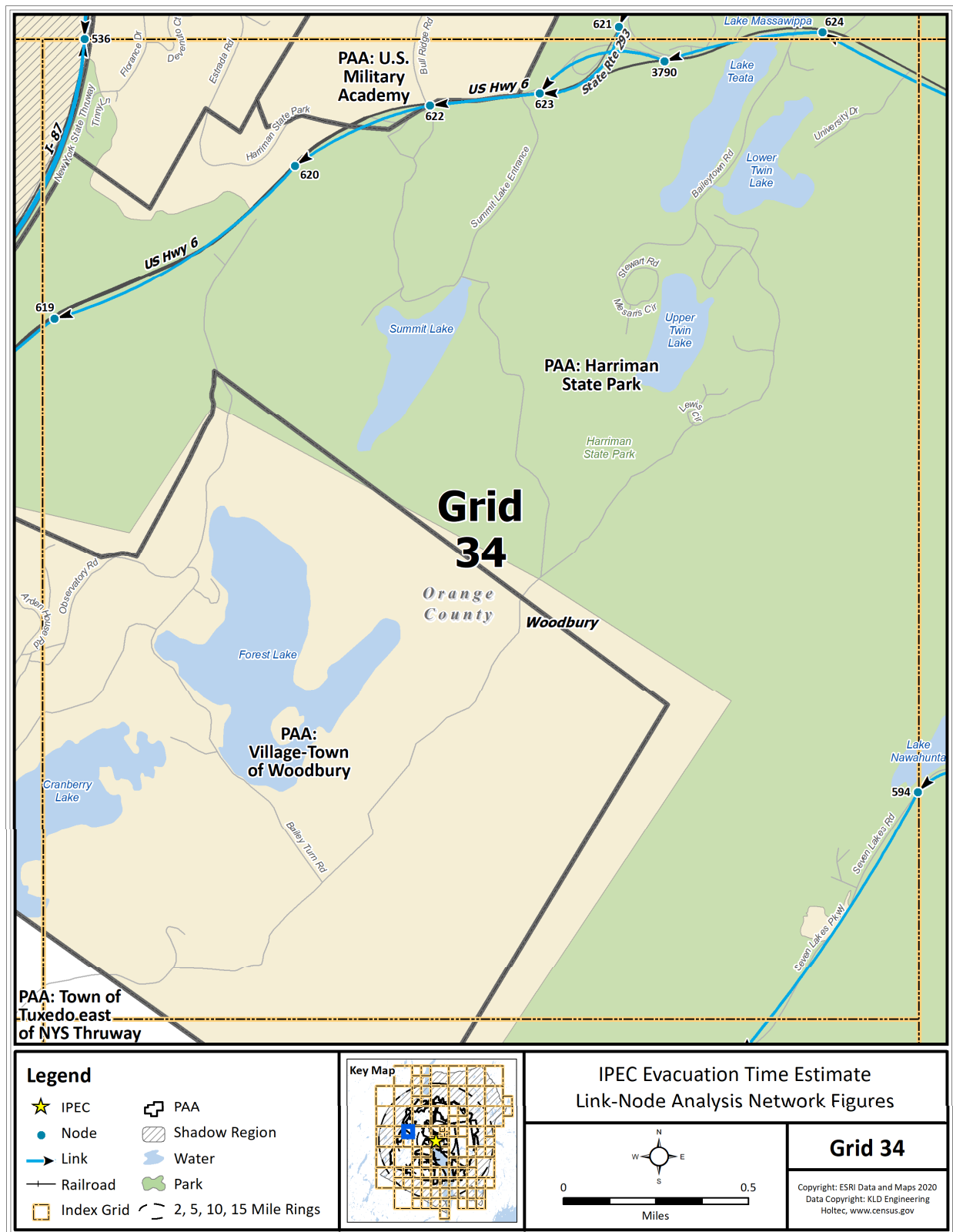


Figure K-35. Link-Node Analysis Network – Grid 34

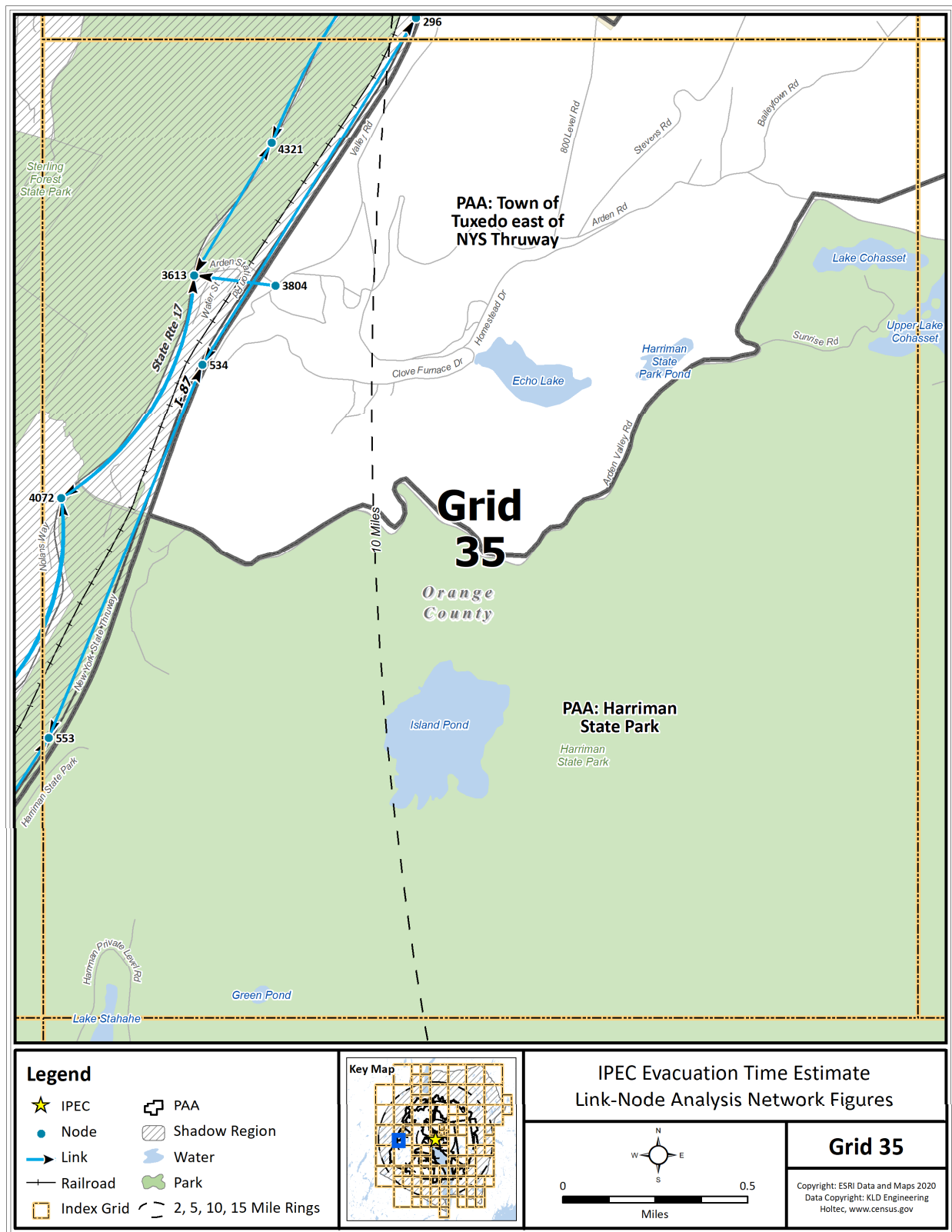


Figure K-36. Link-Node Analysis Network – Grid 35

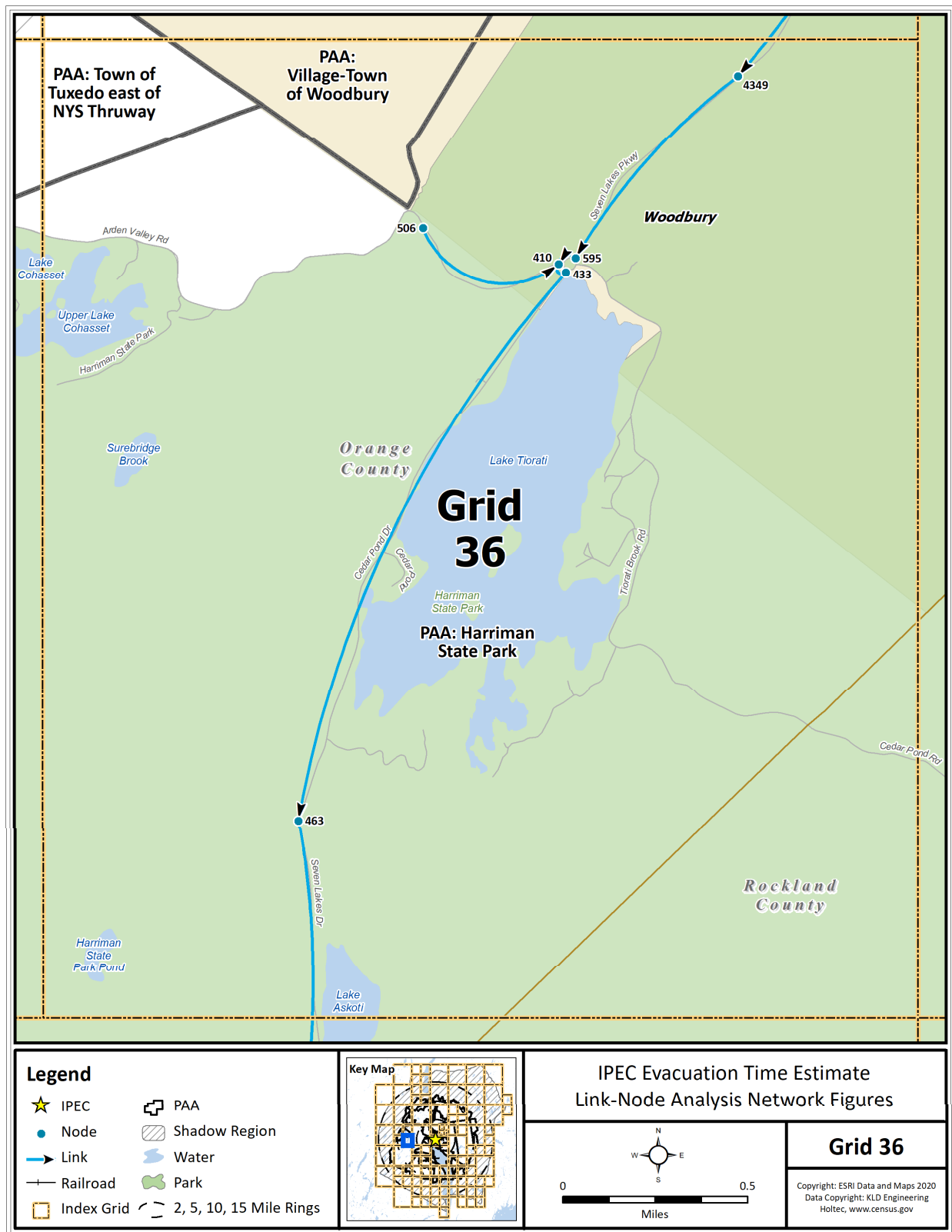


Figure K-37. Link-Node Analysis Network – Grid 36

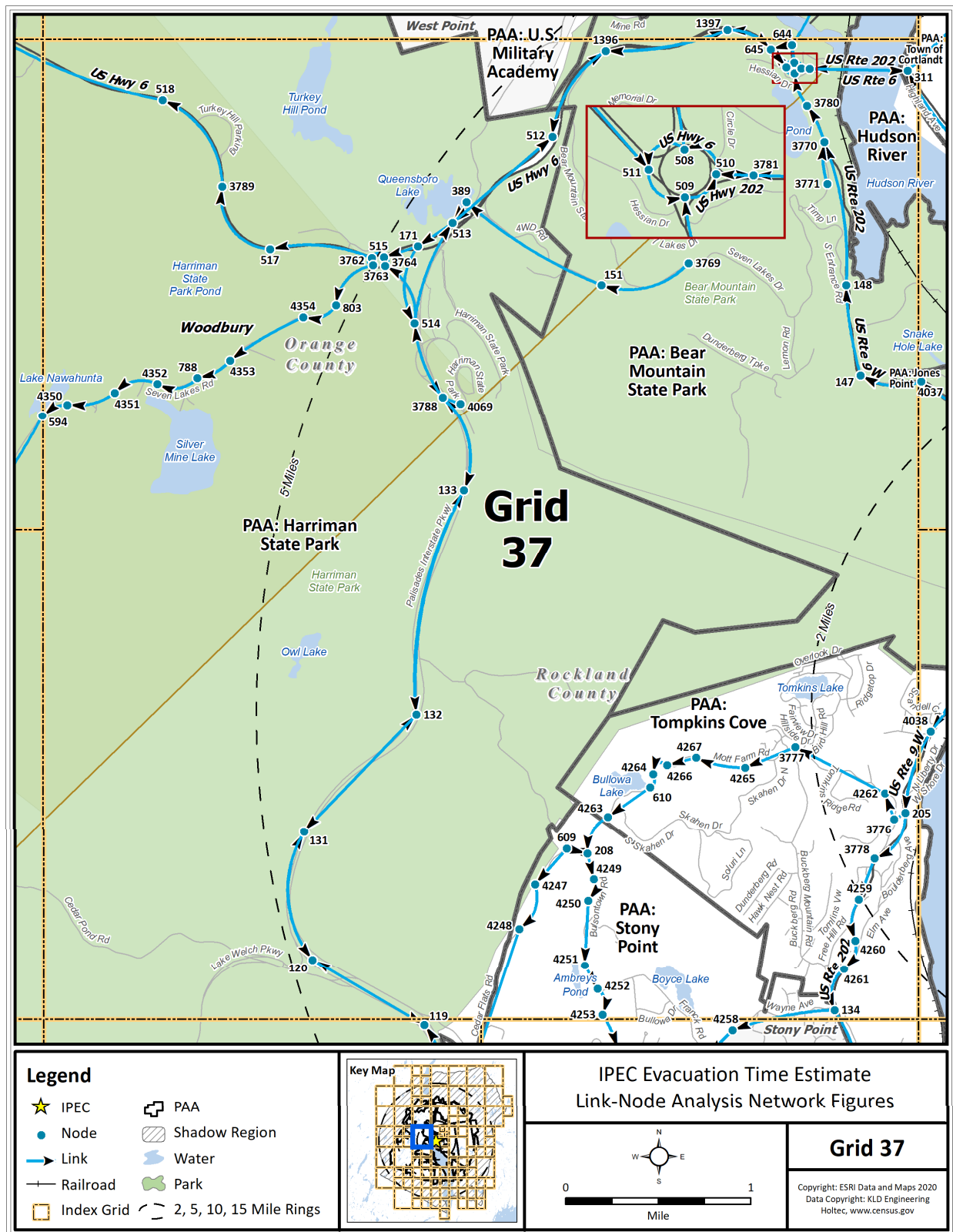


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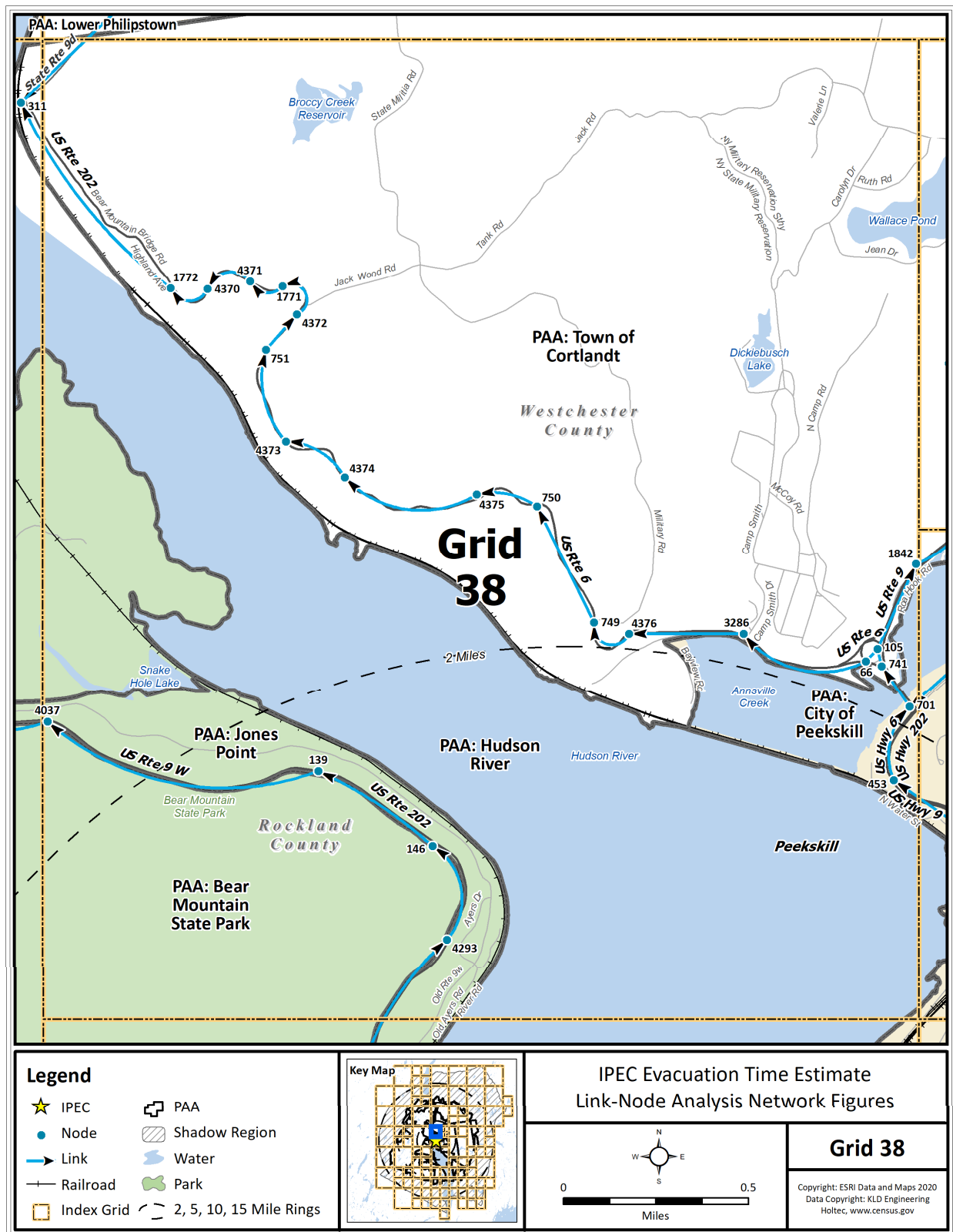


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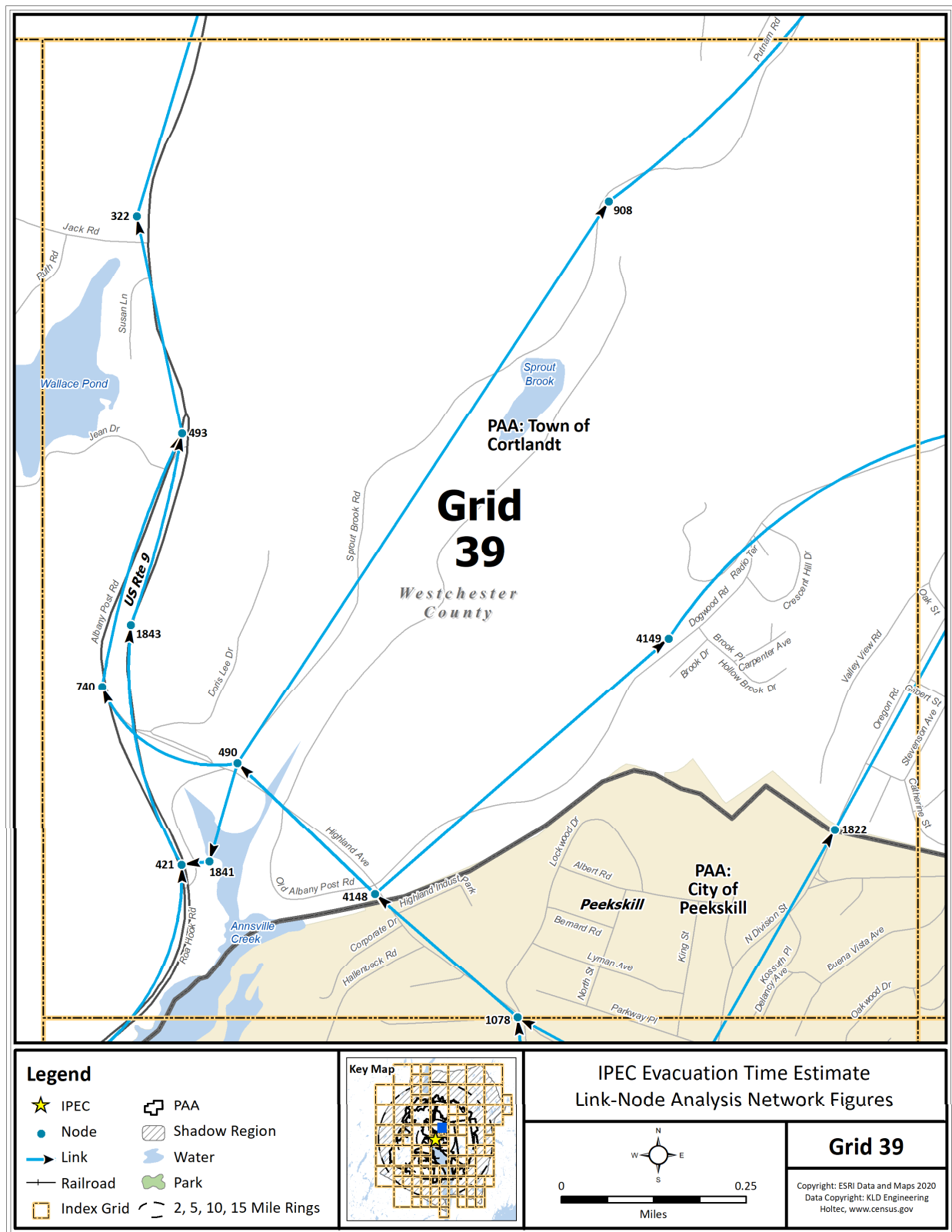


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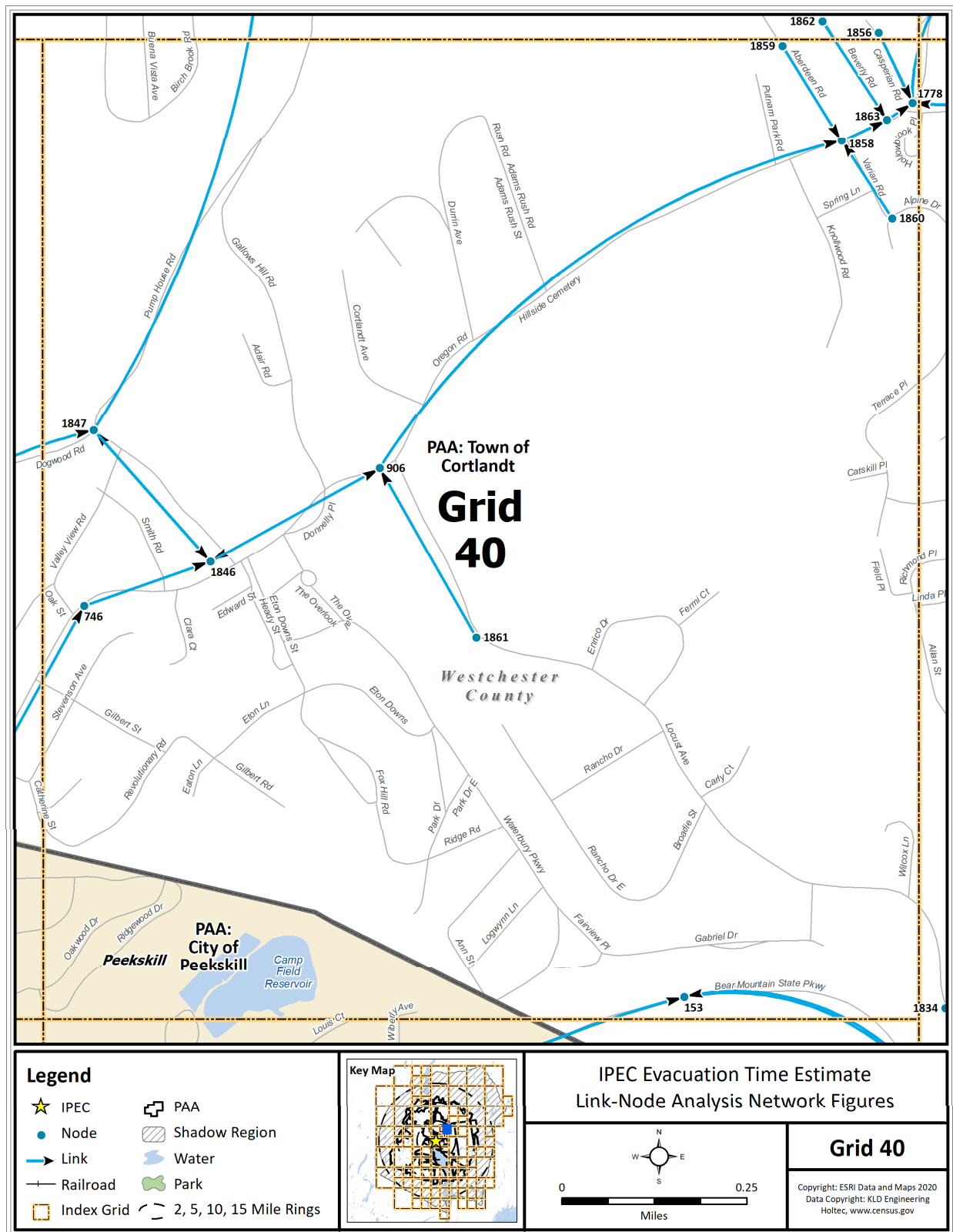


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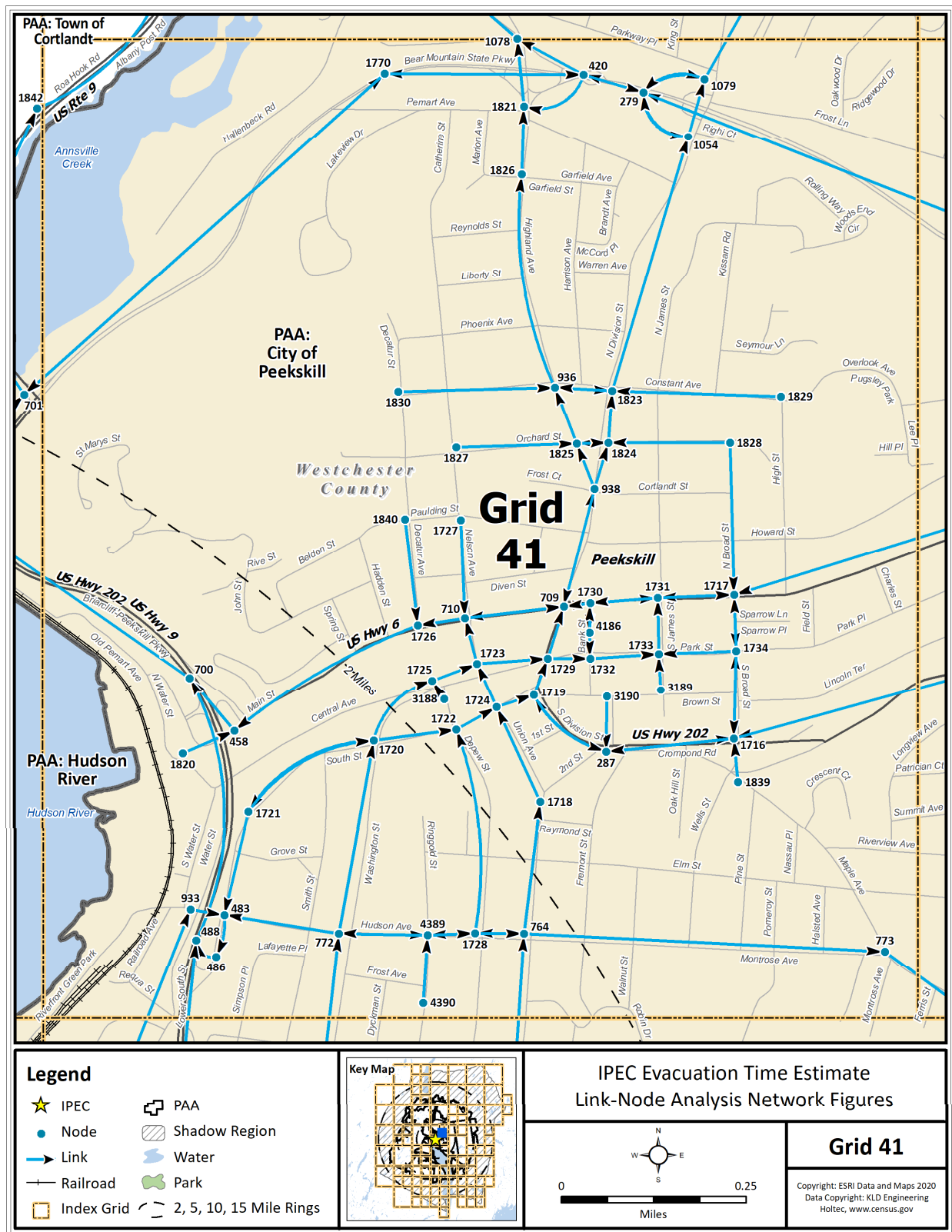


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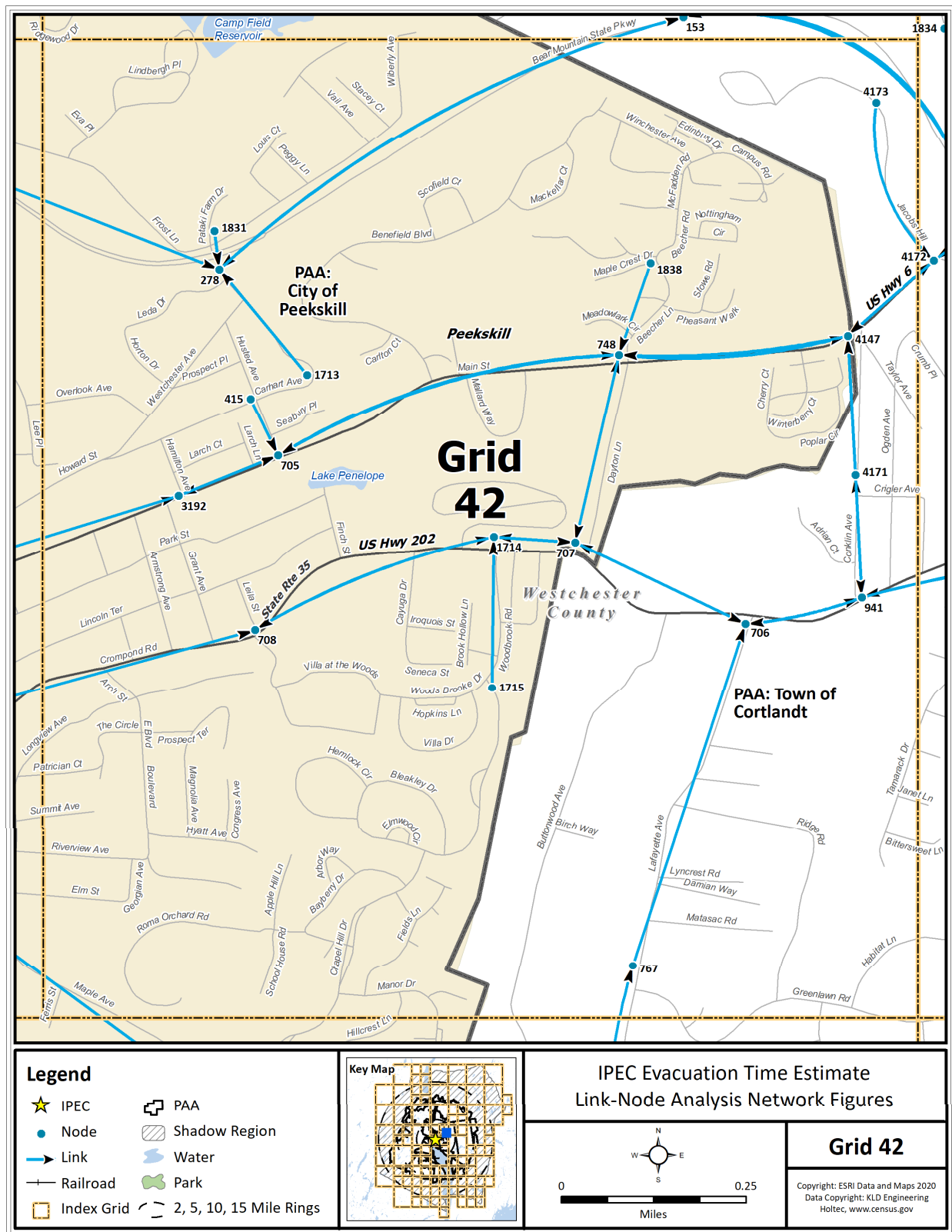


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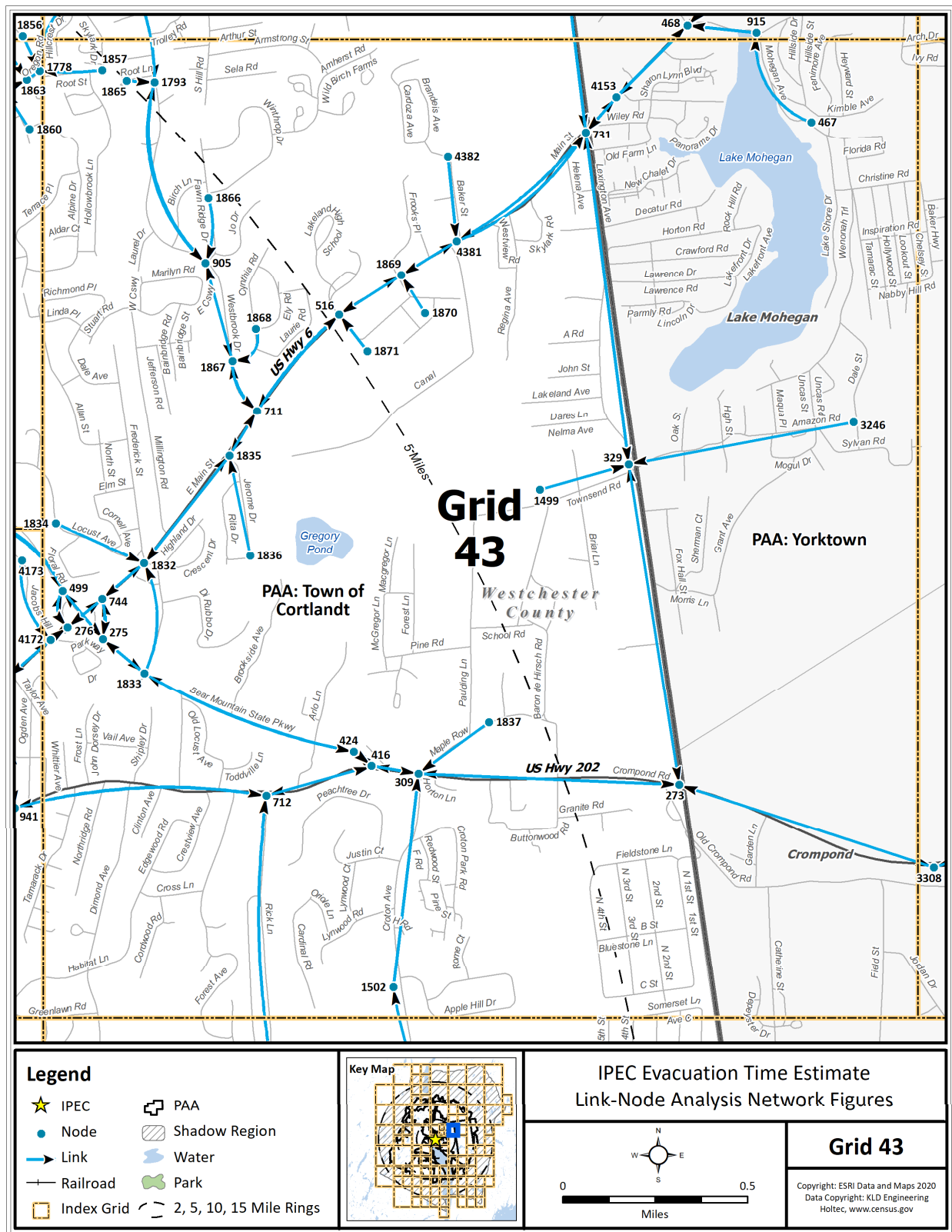


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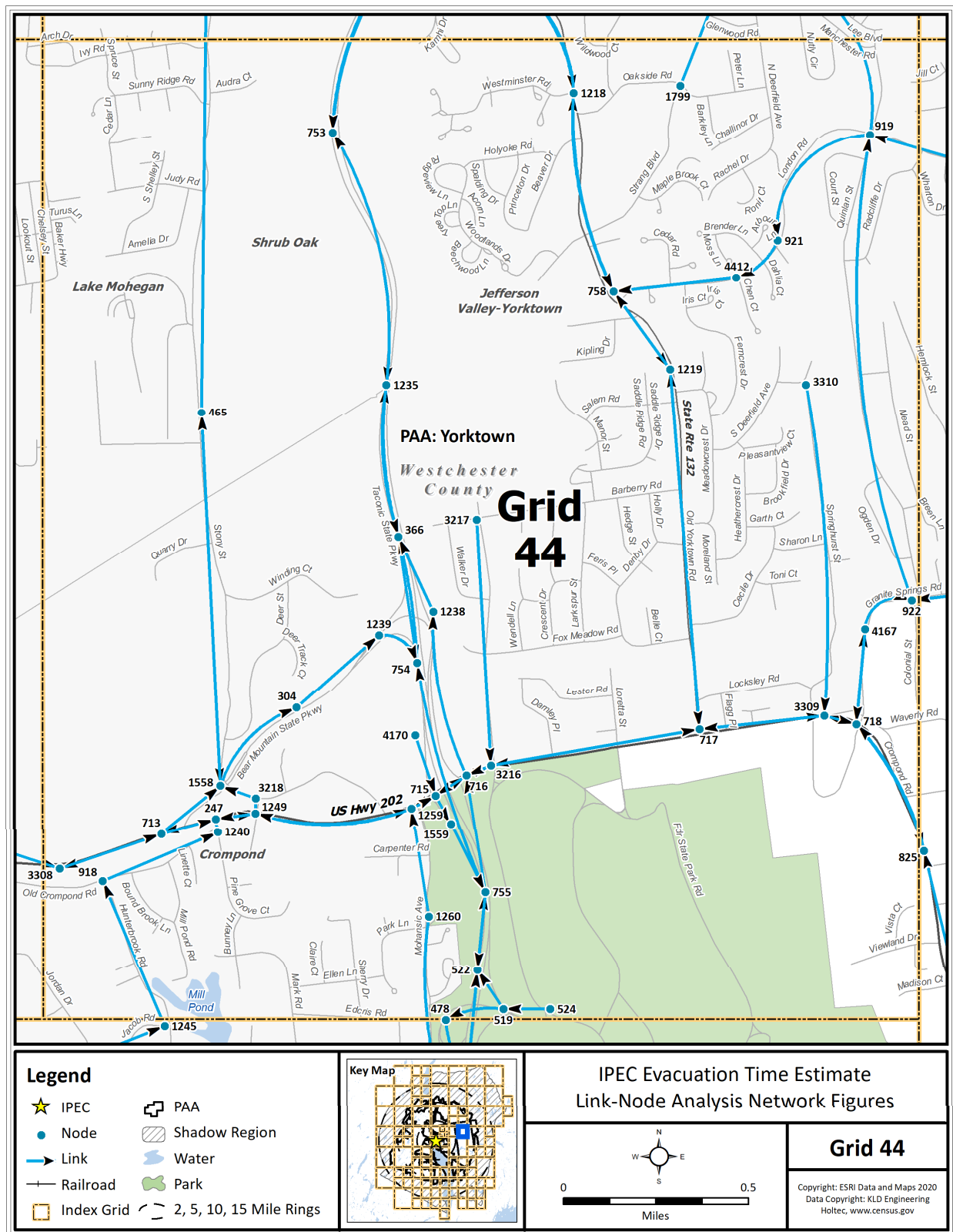


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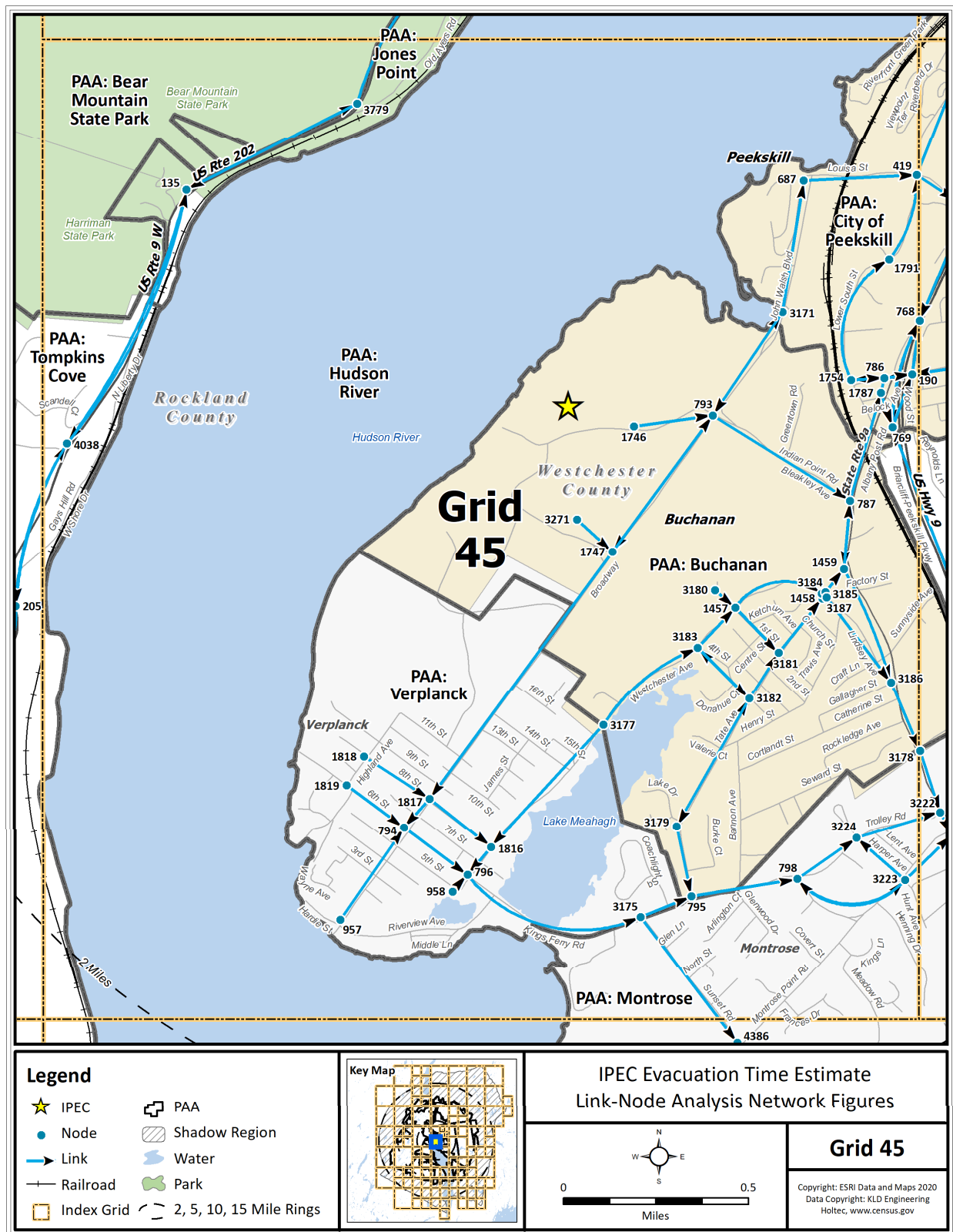


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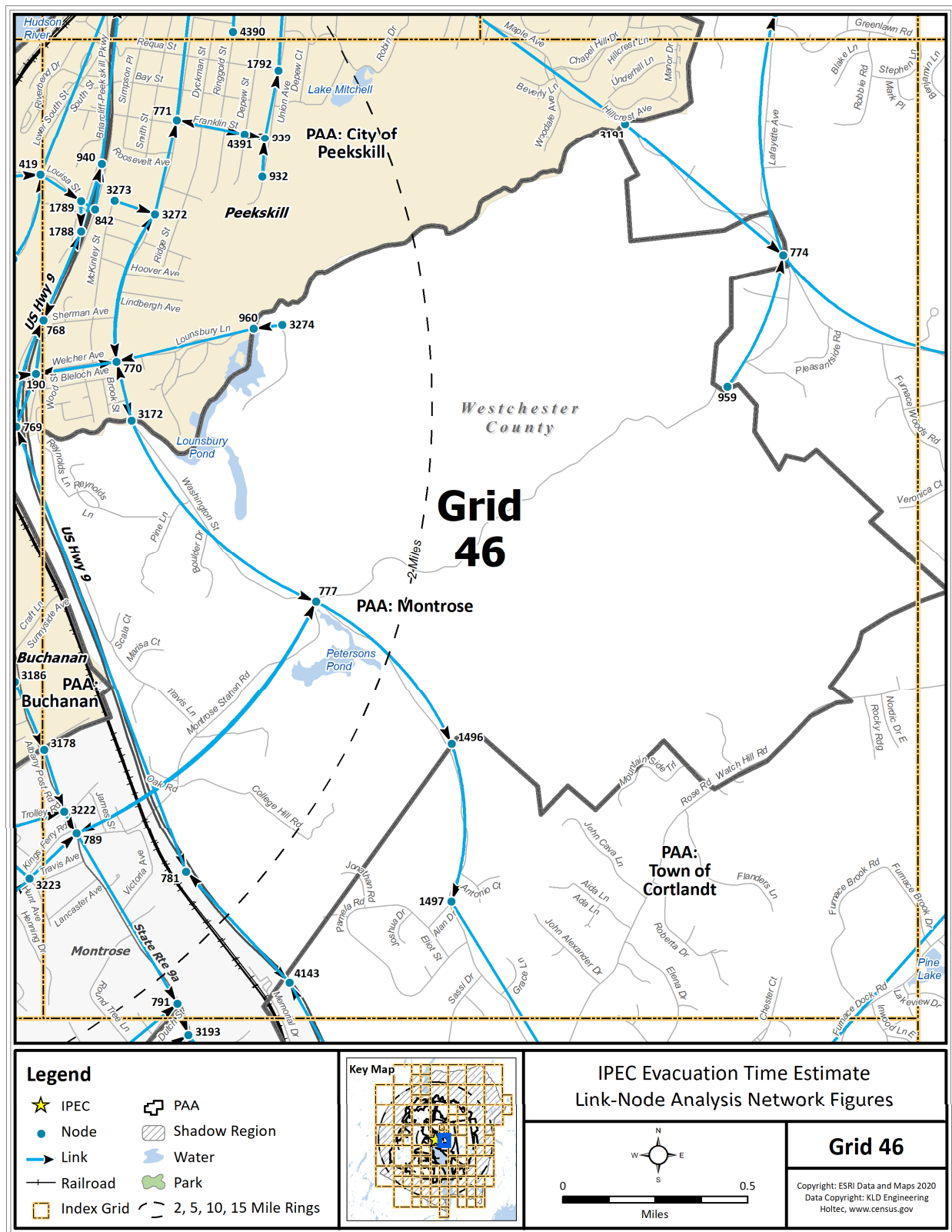


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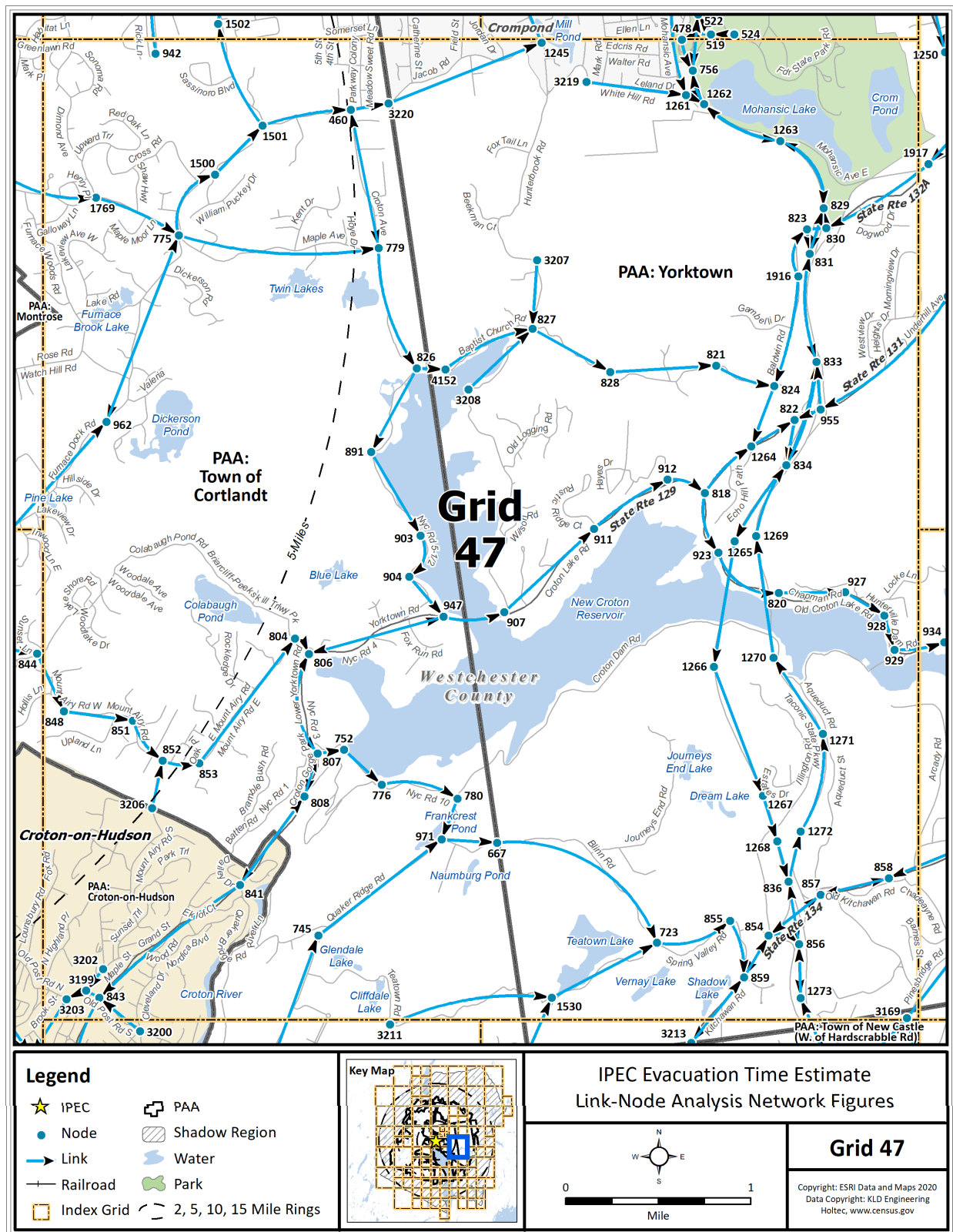


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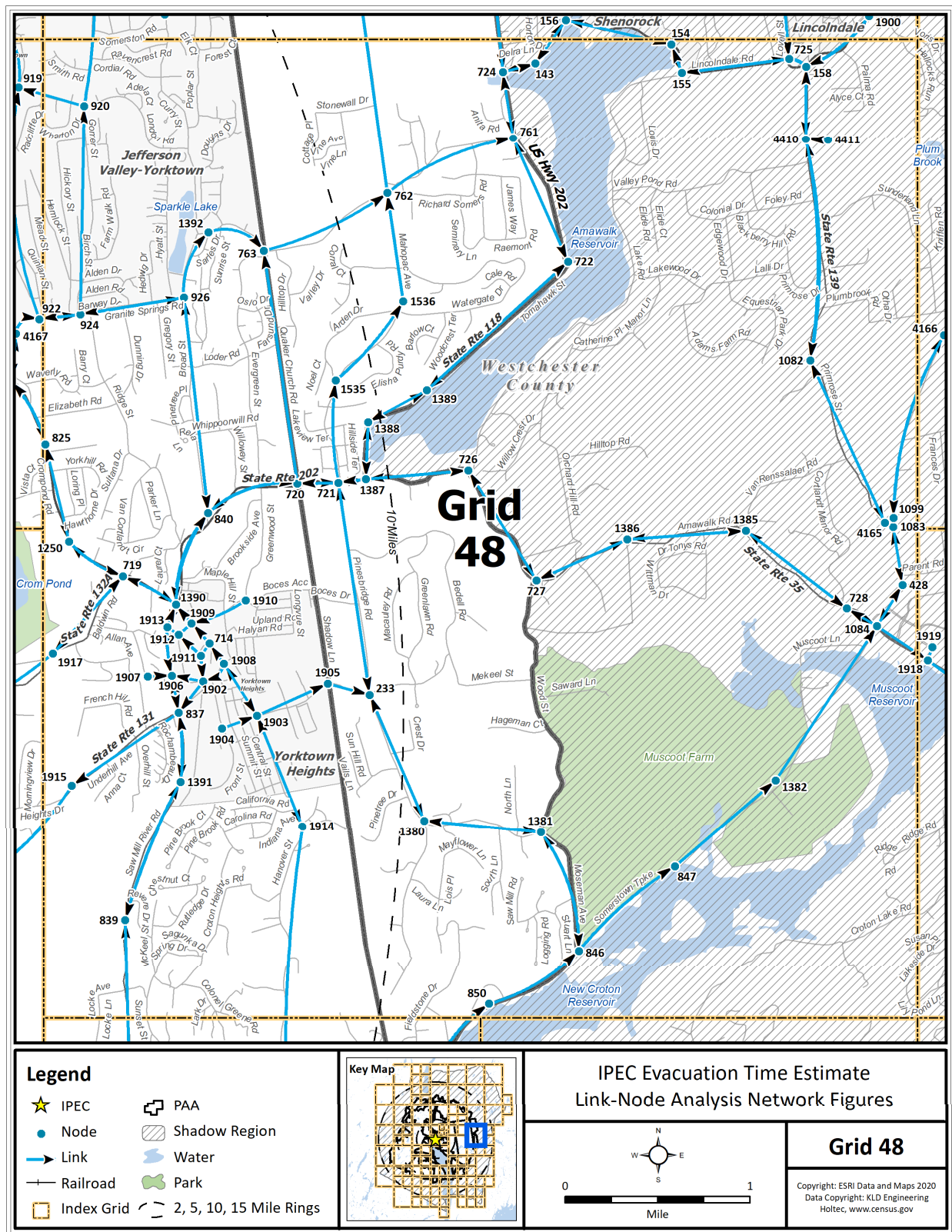


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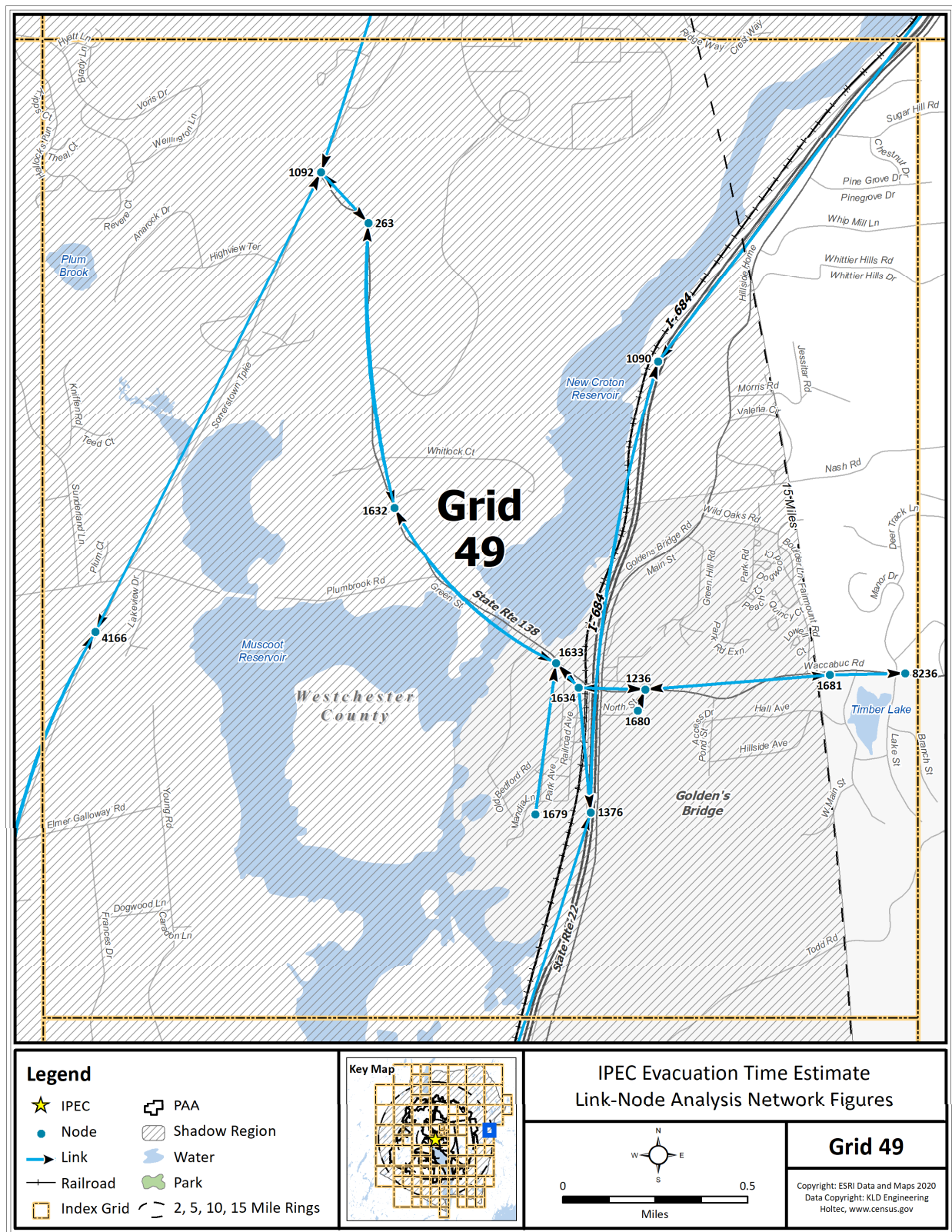


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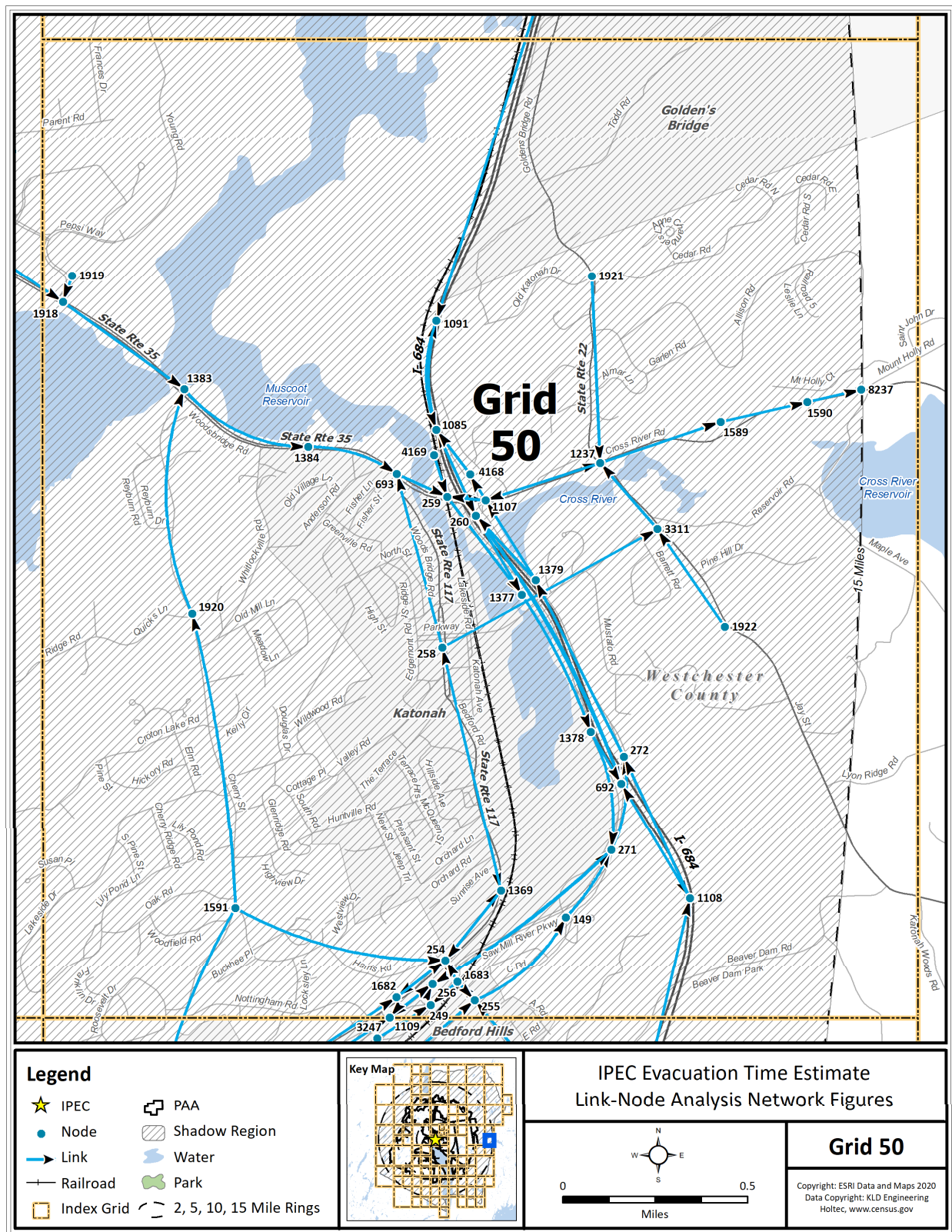


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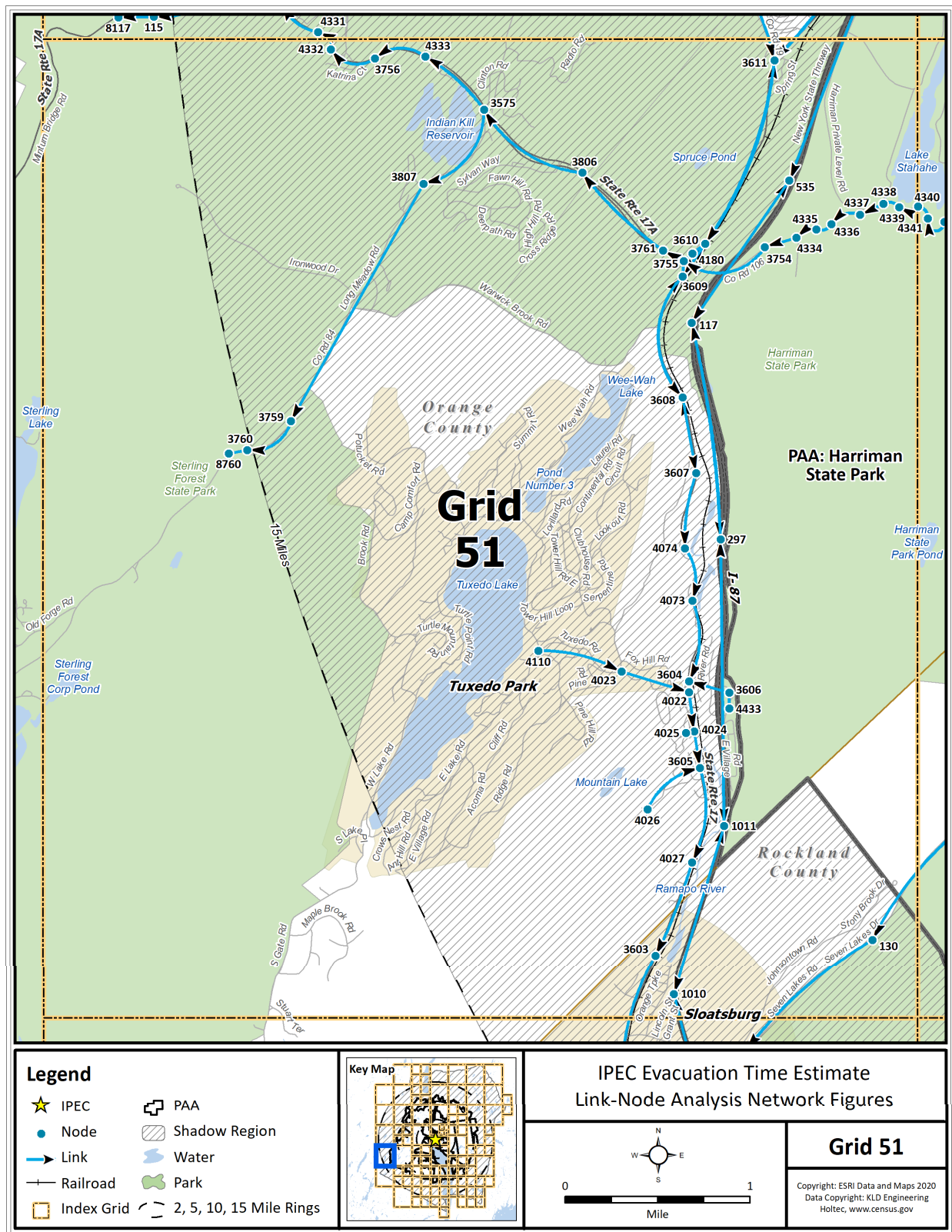


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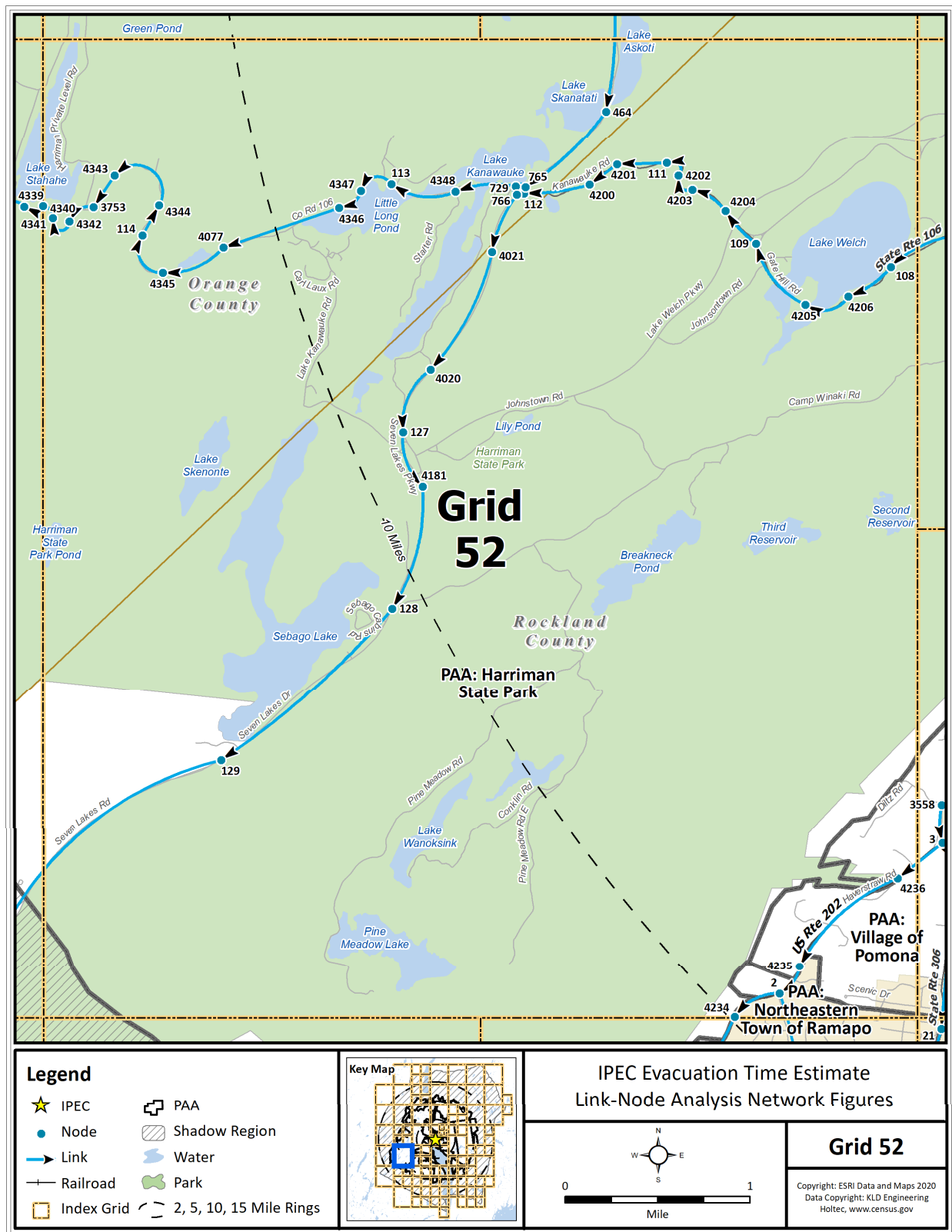


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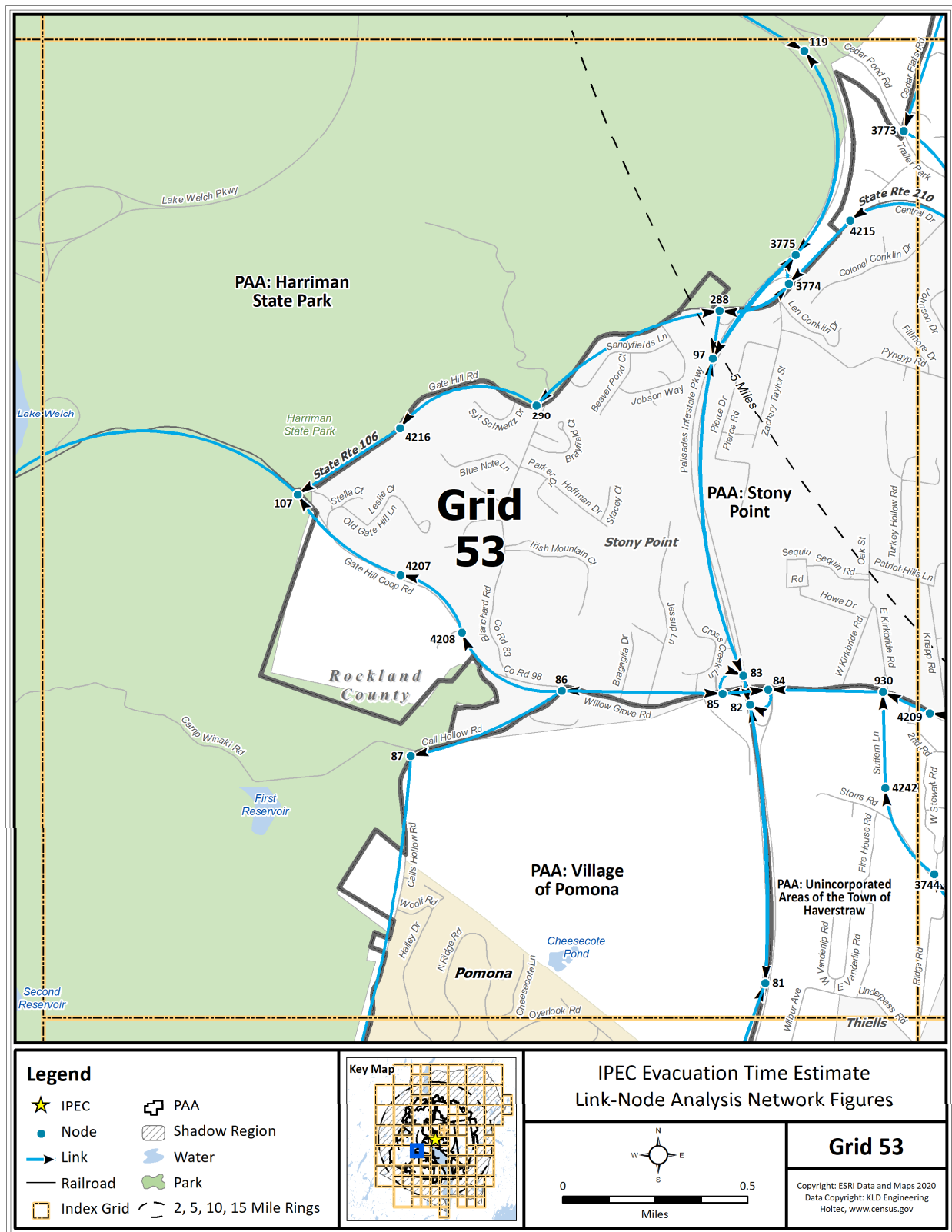


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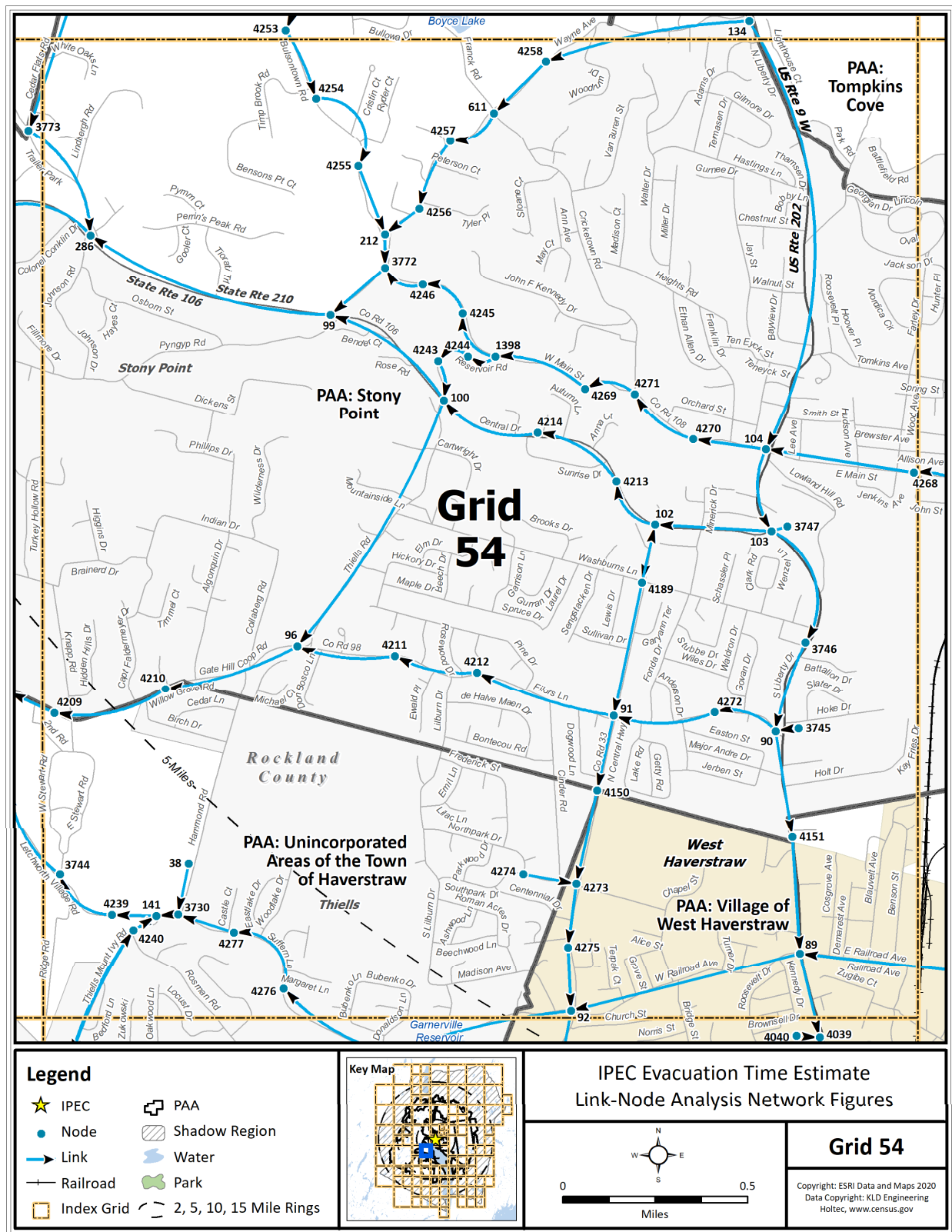


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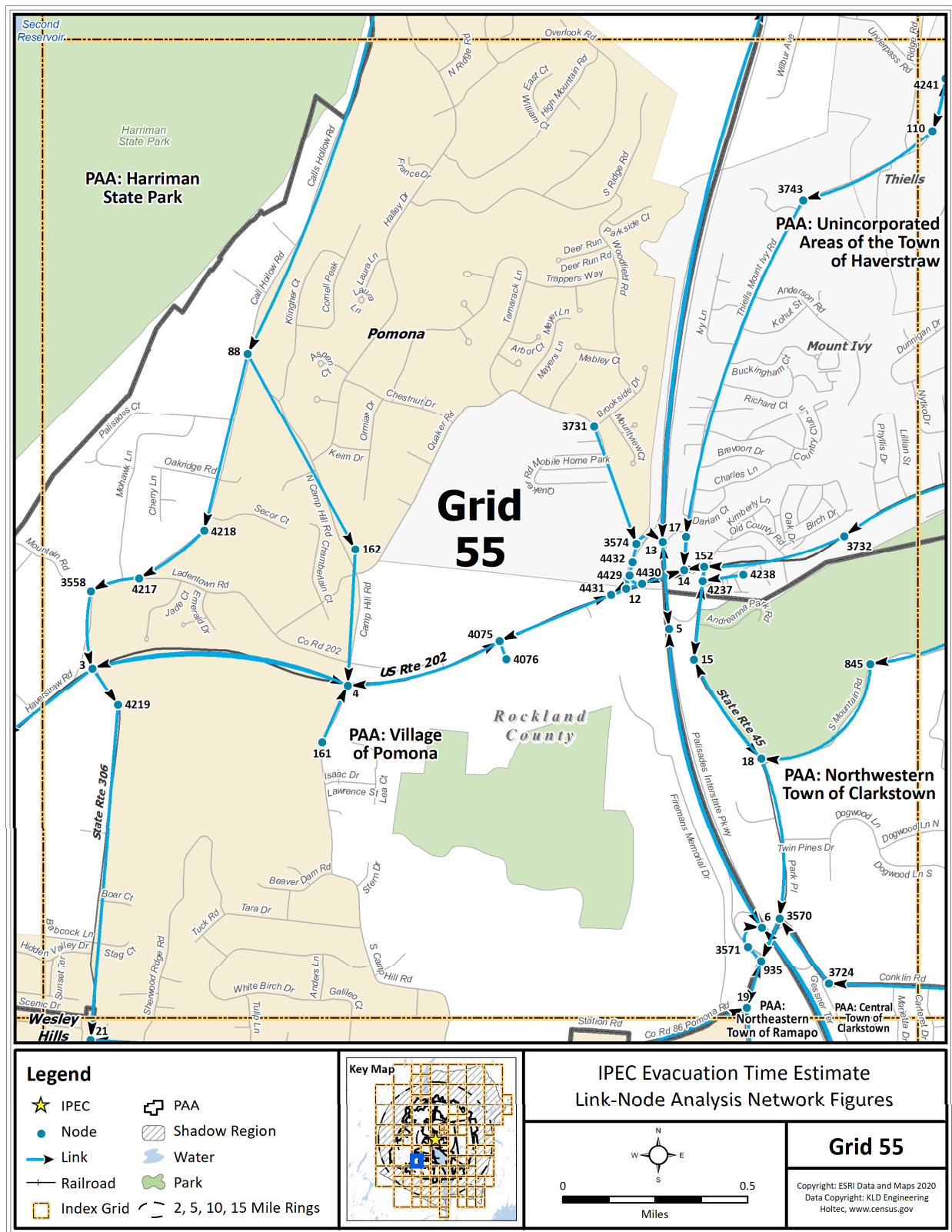


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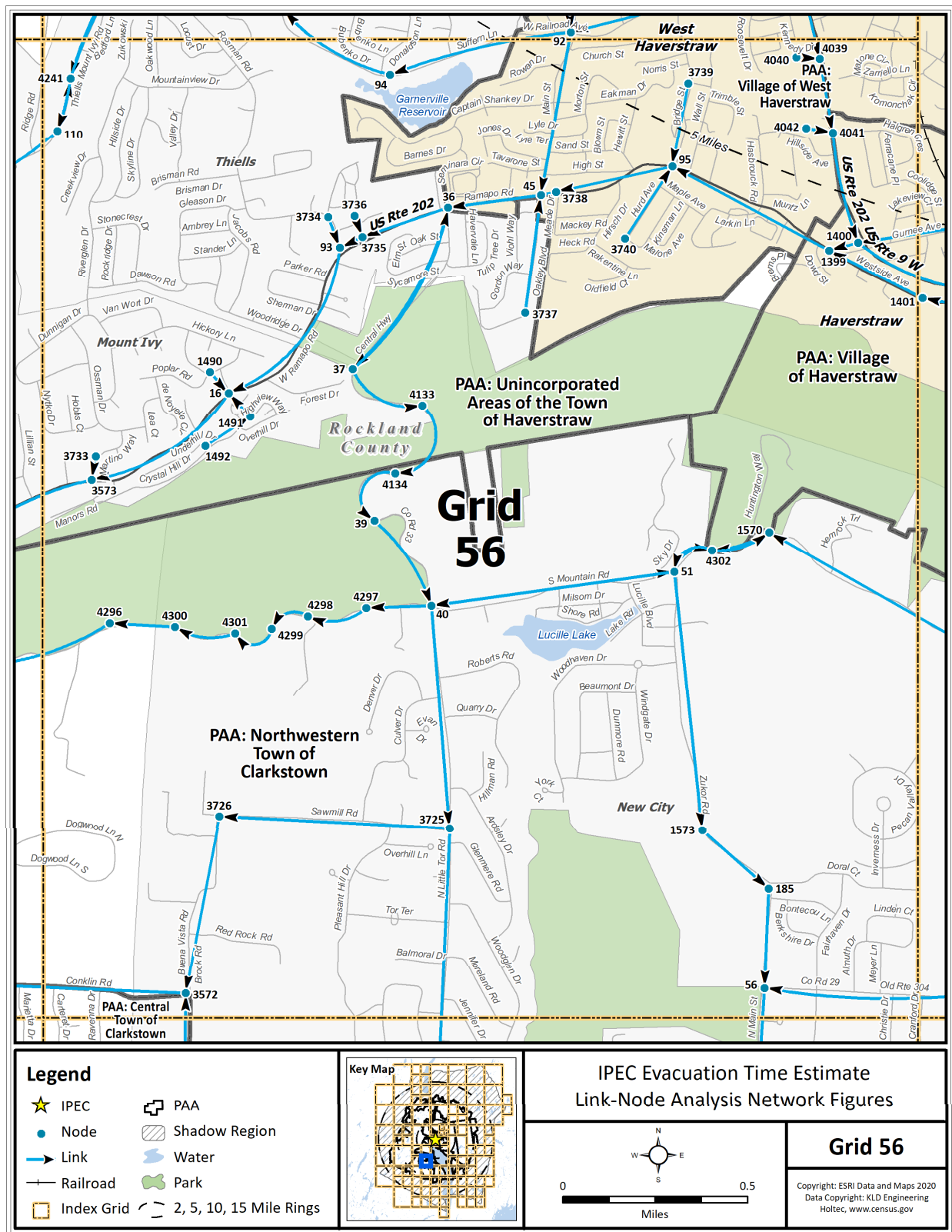


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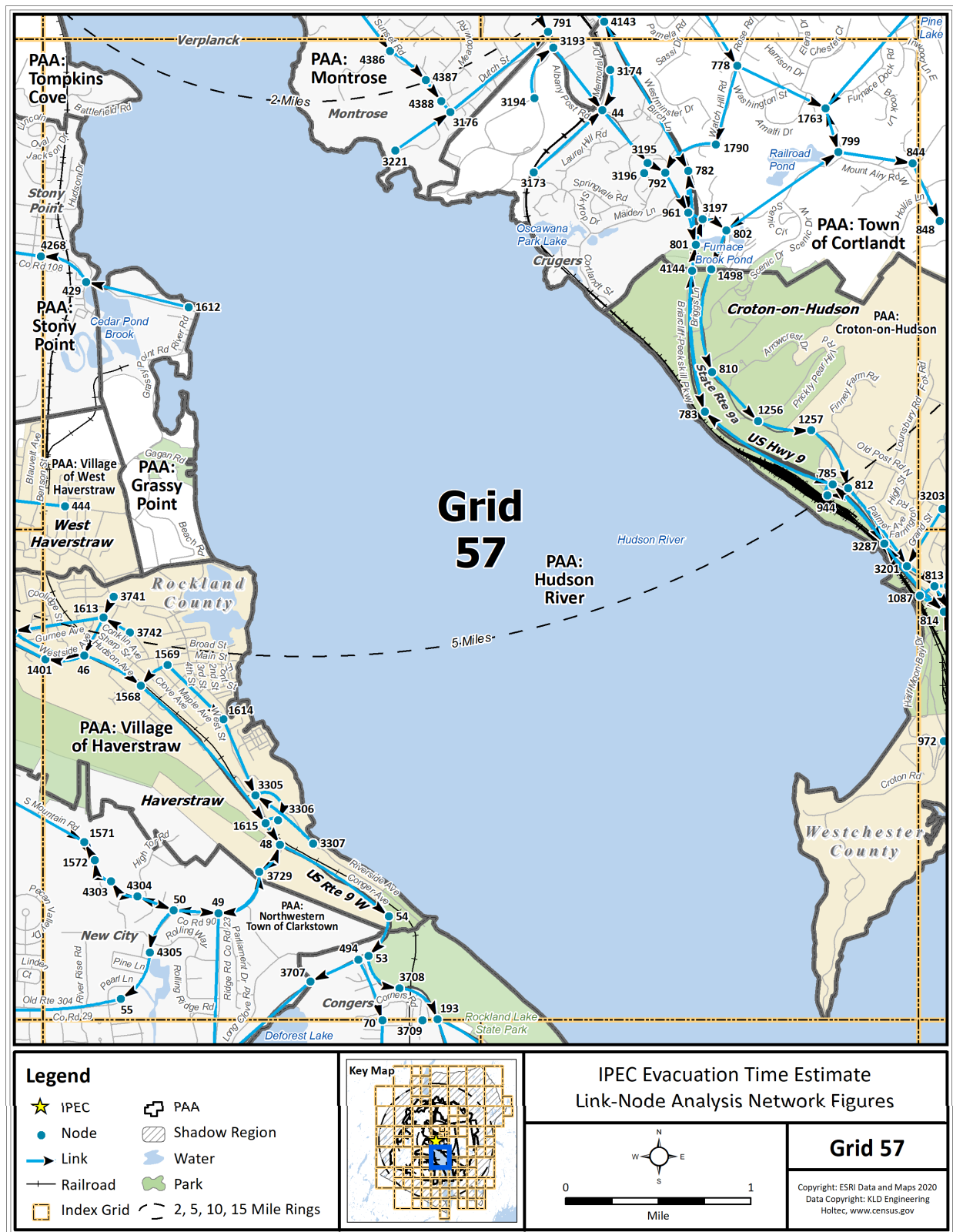


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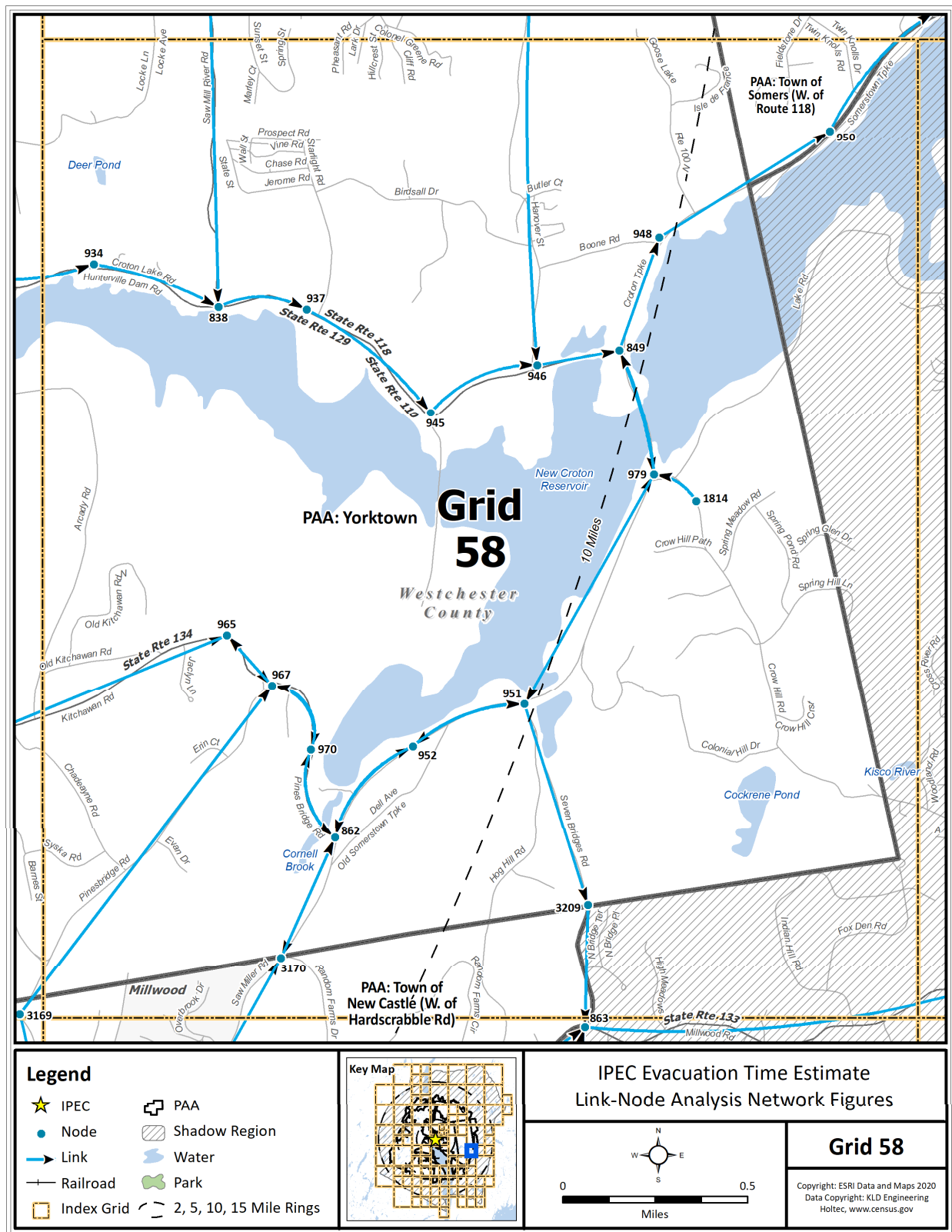


Figure K-59. Link-Node Analysis Network – Grid 58

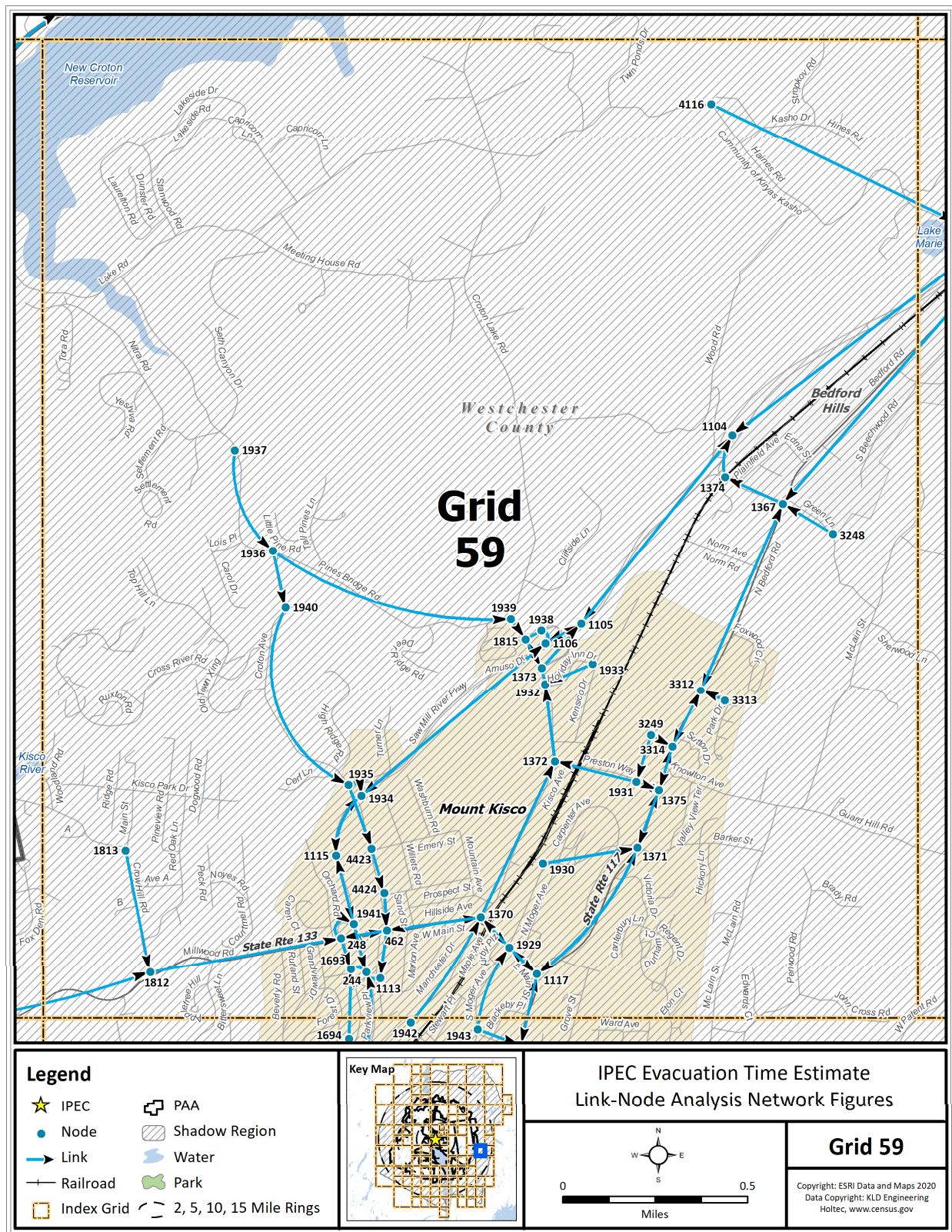


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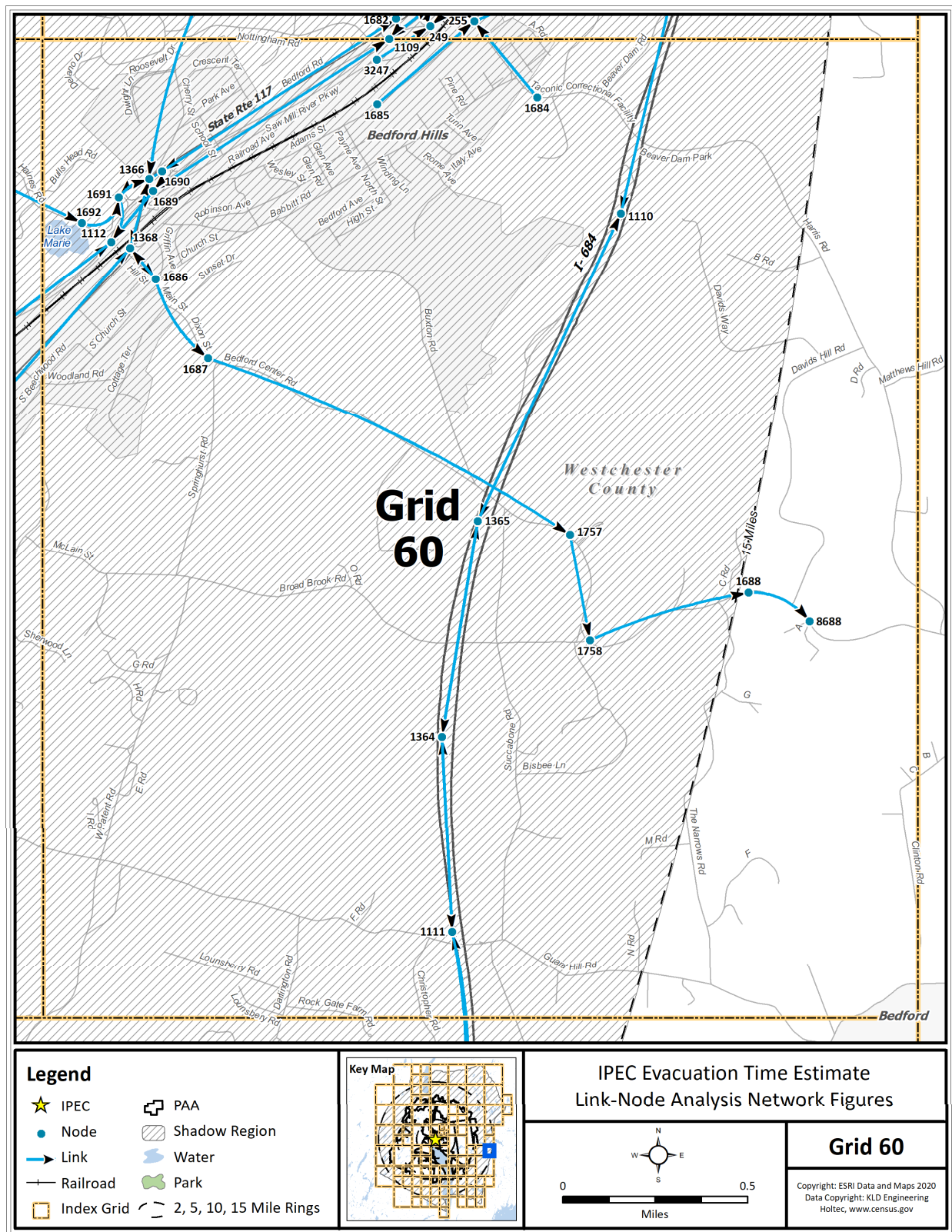


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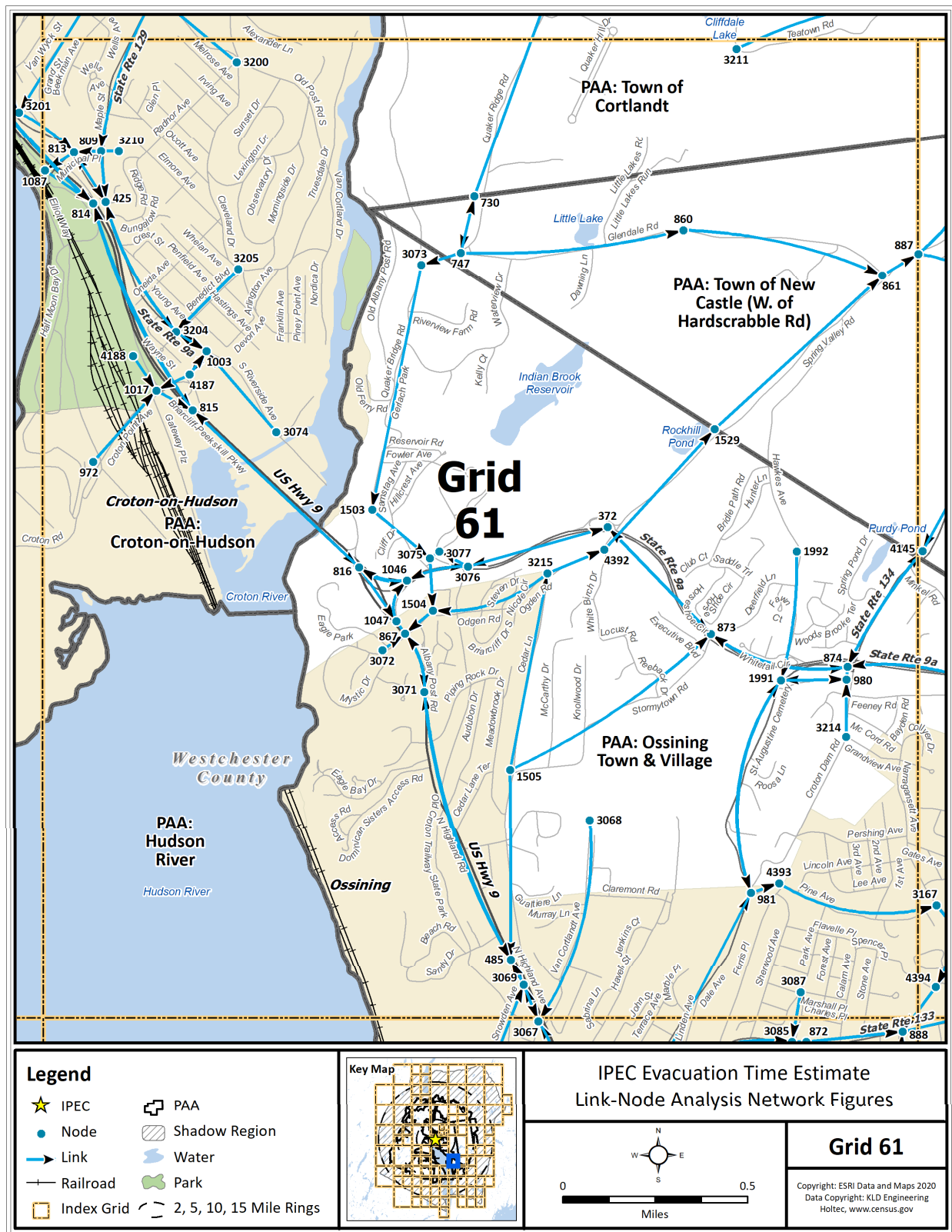


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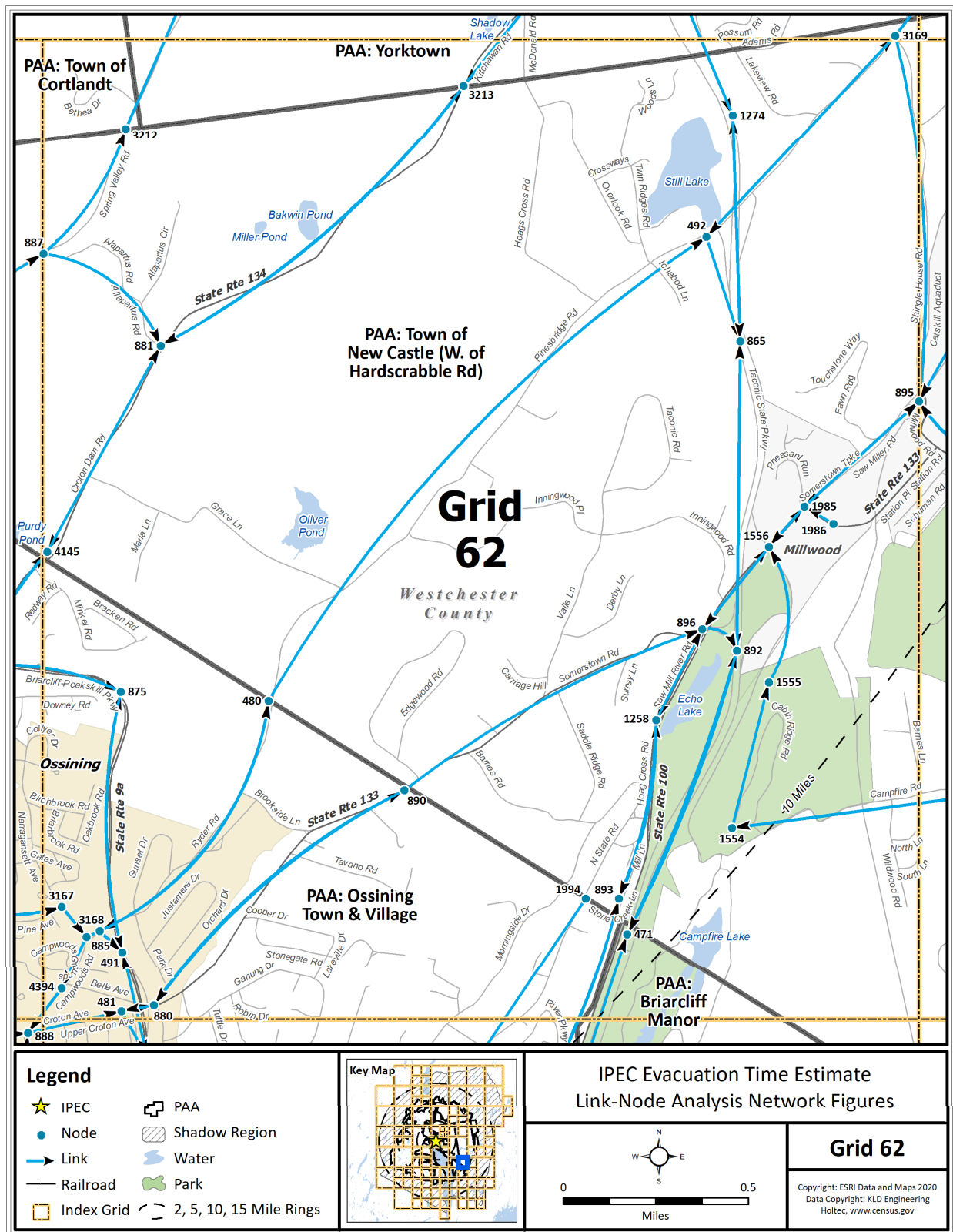


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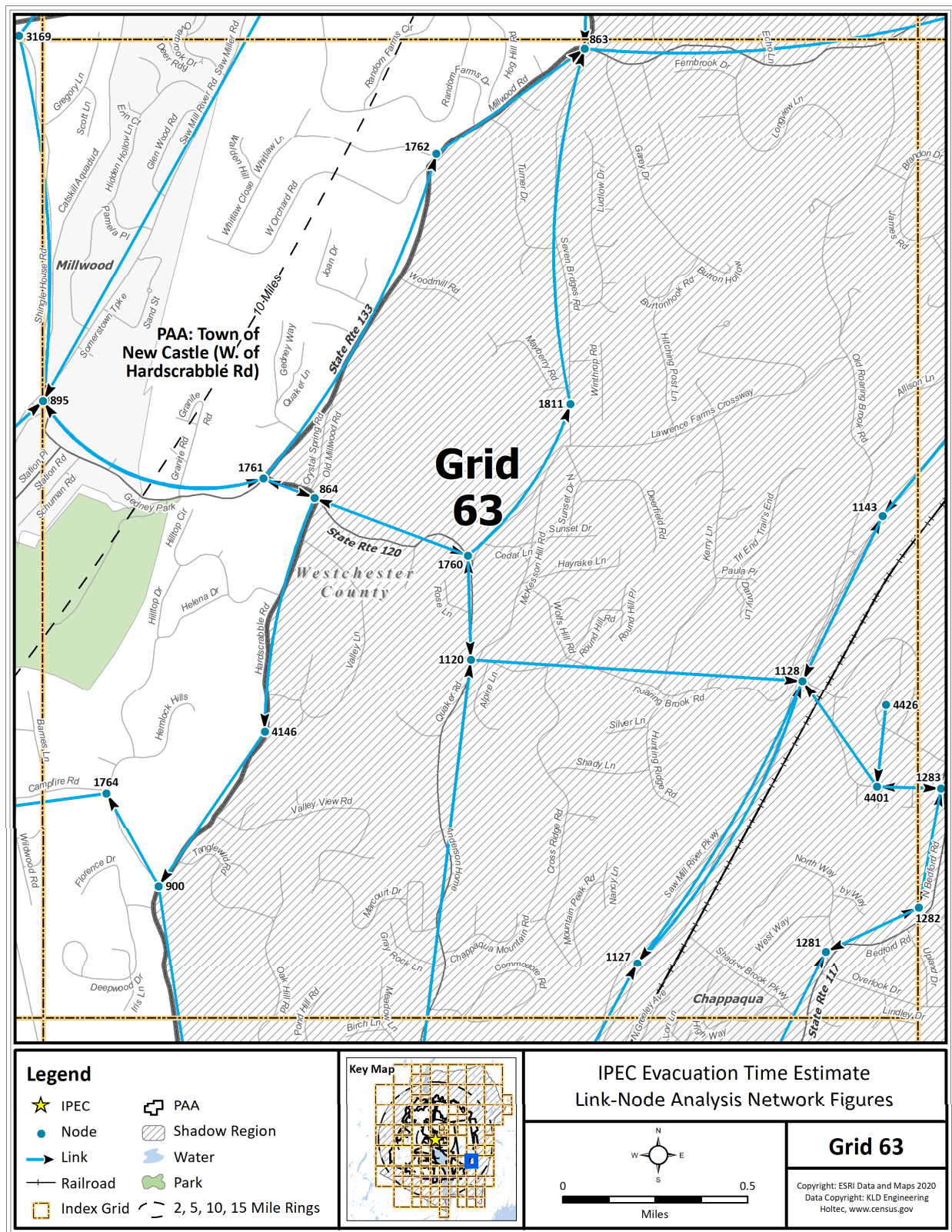


Figure K-64. Link-Node Analysis Network – Grid 63

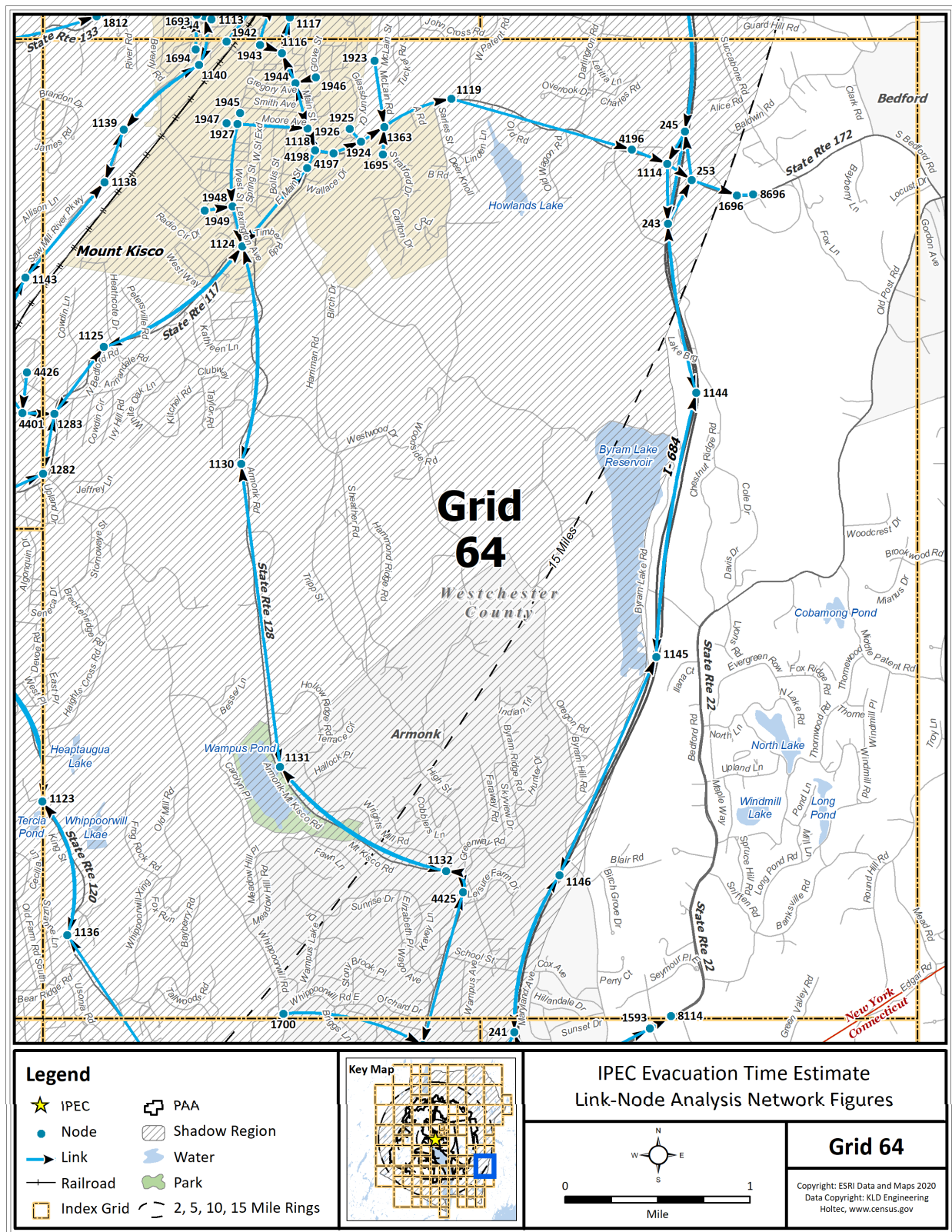


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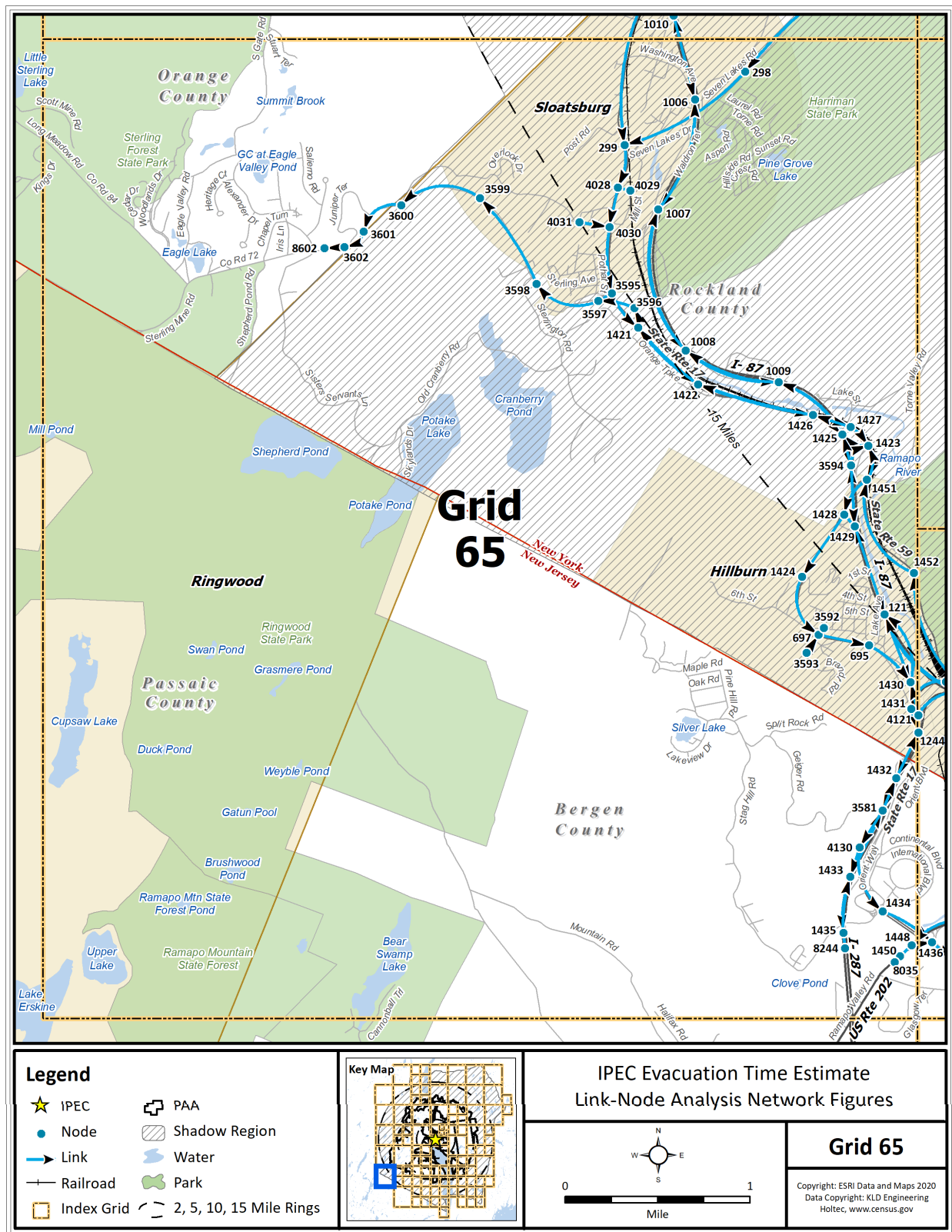


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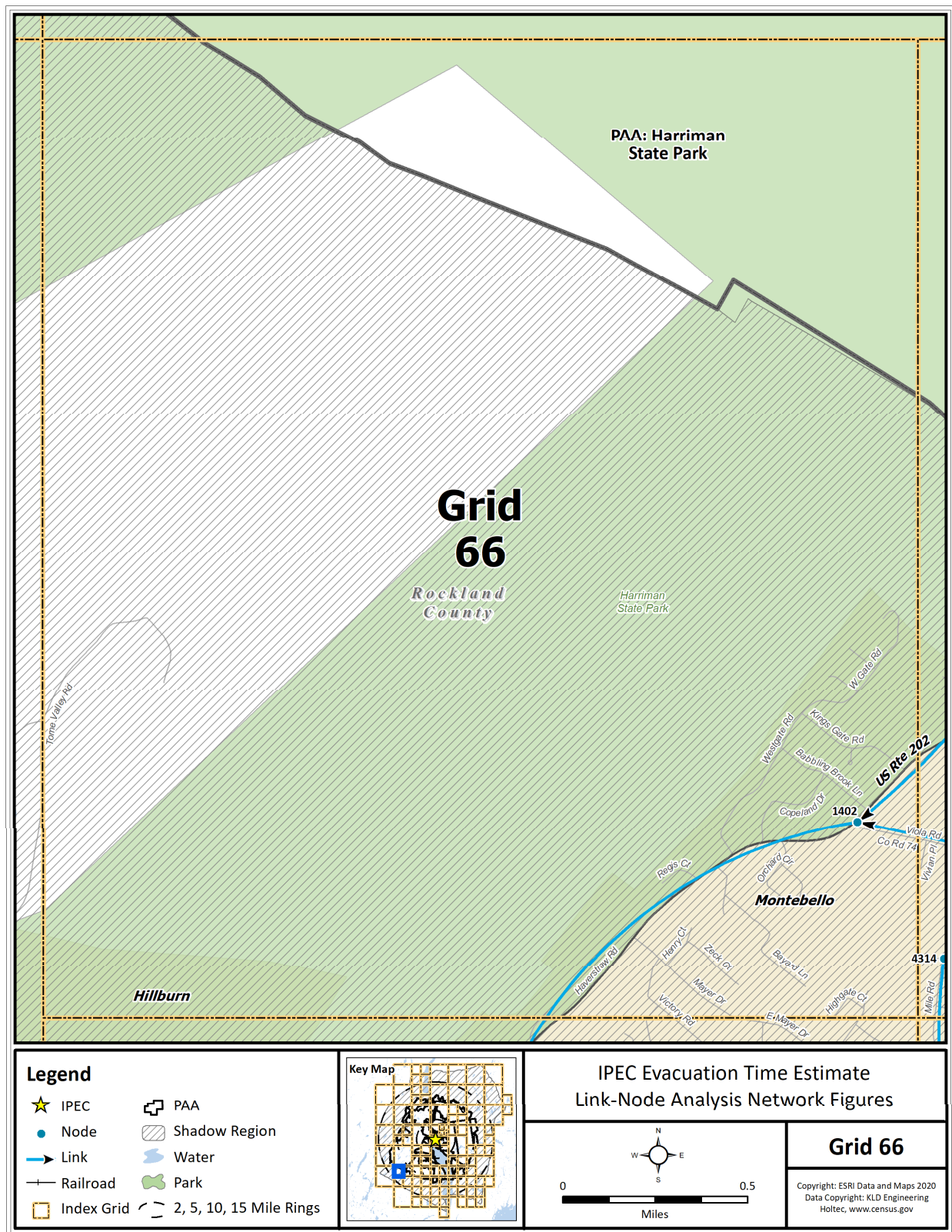


Figure K-67. Link-Node Analysis Network – Grid 66

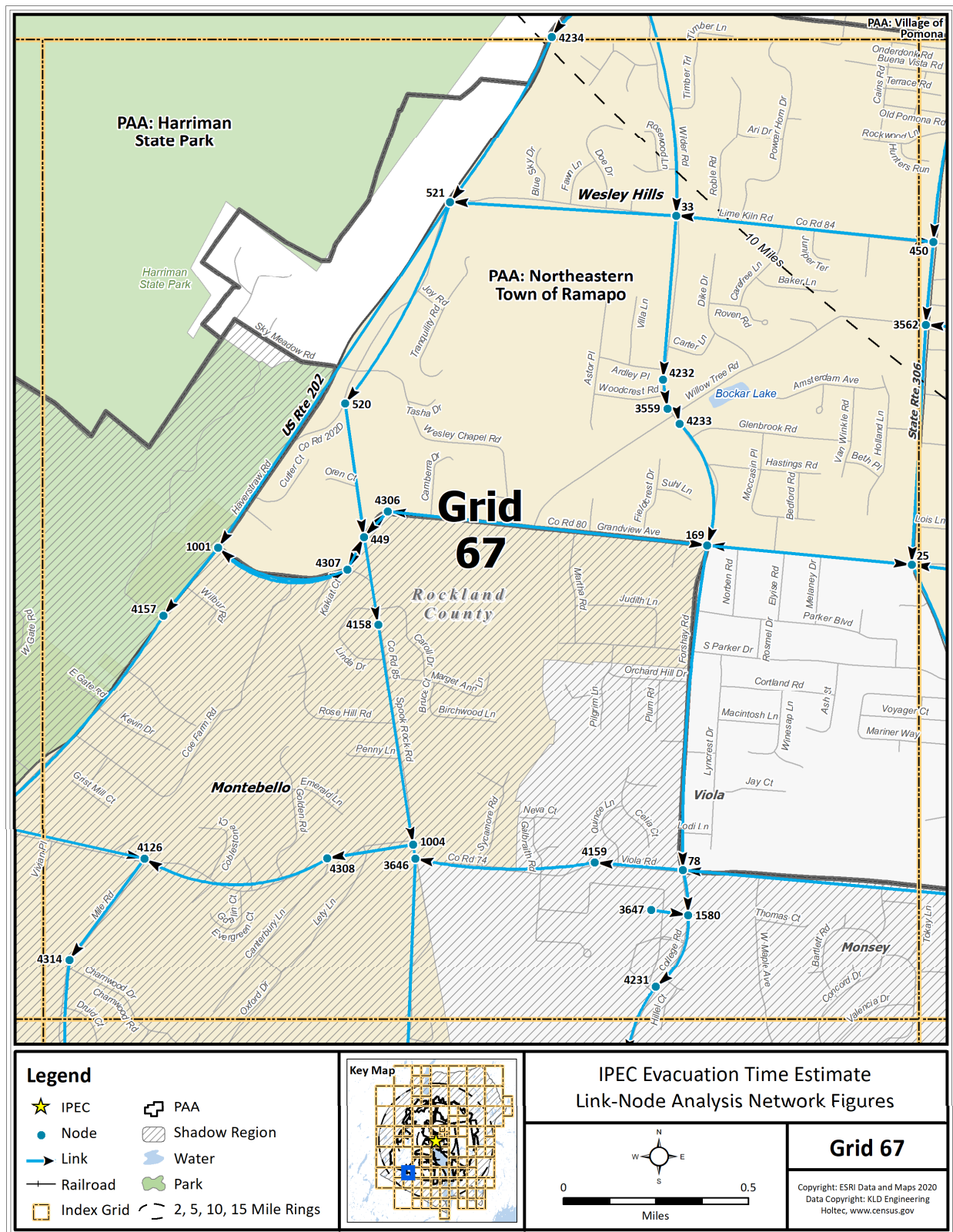


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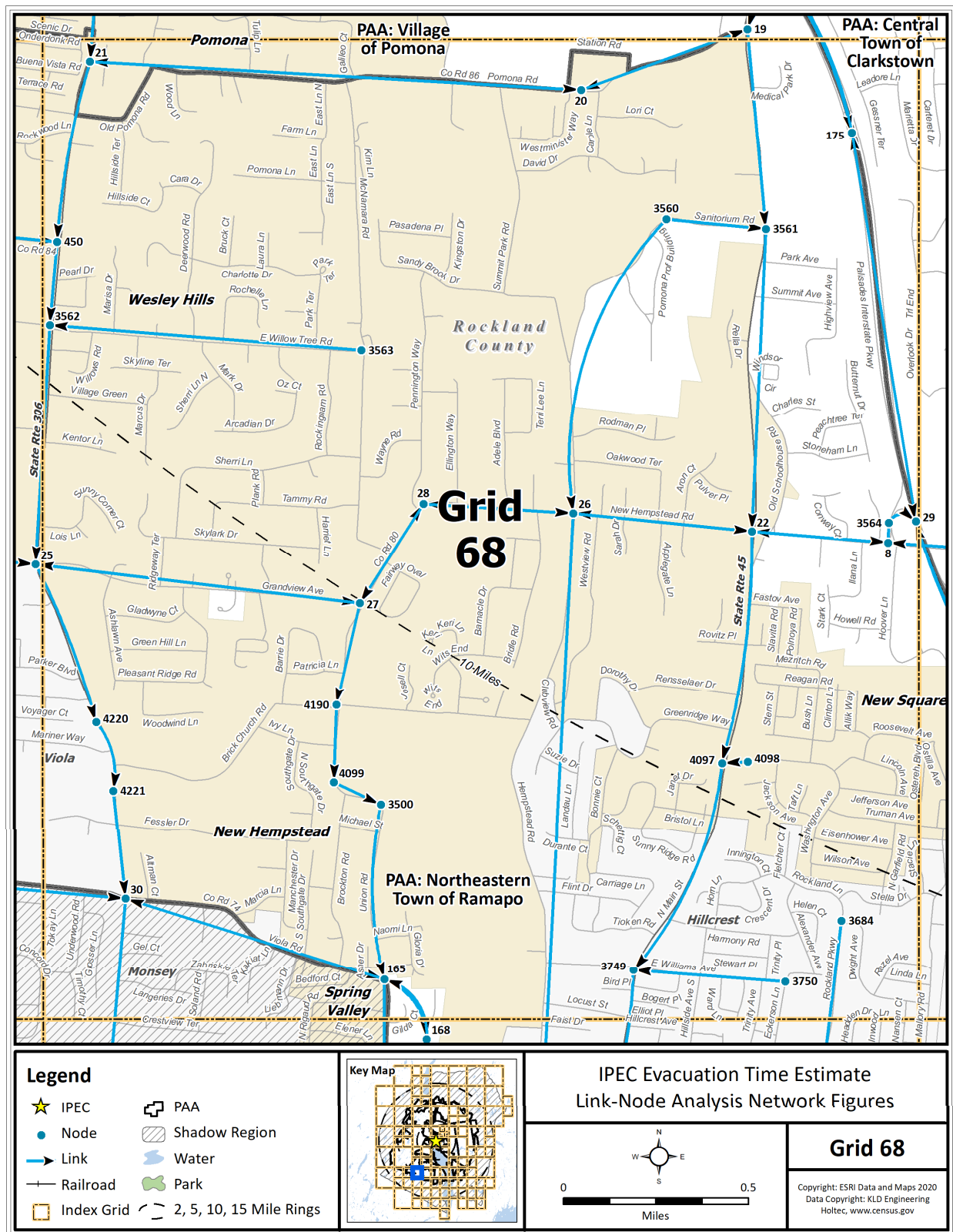


Figure K-69. Link-Node Analysis Network – Grid 68

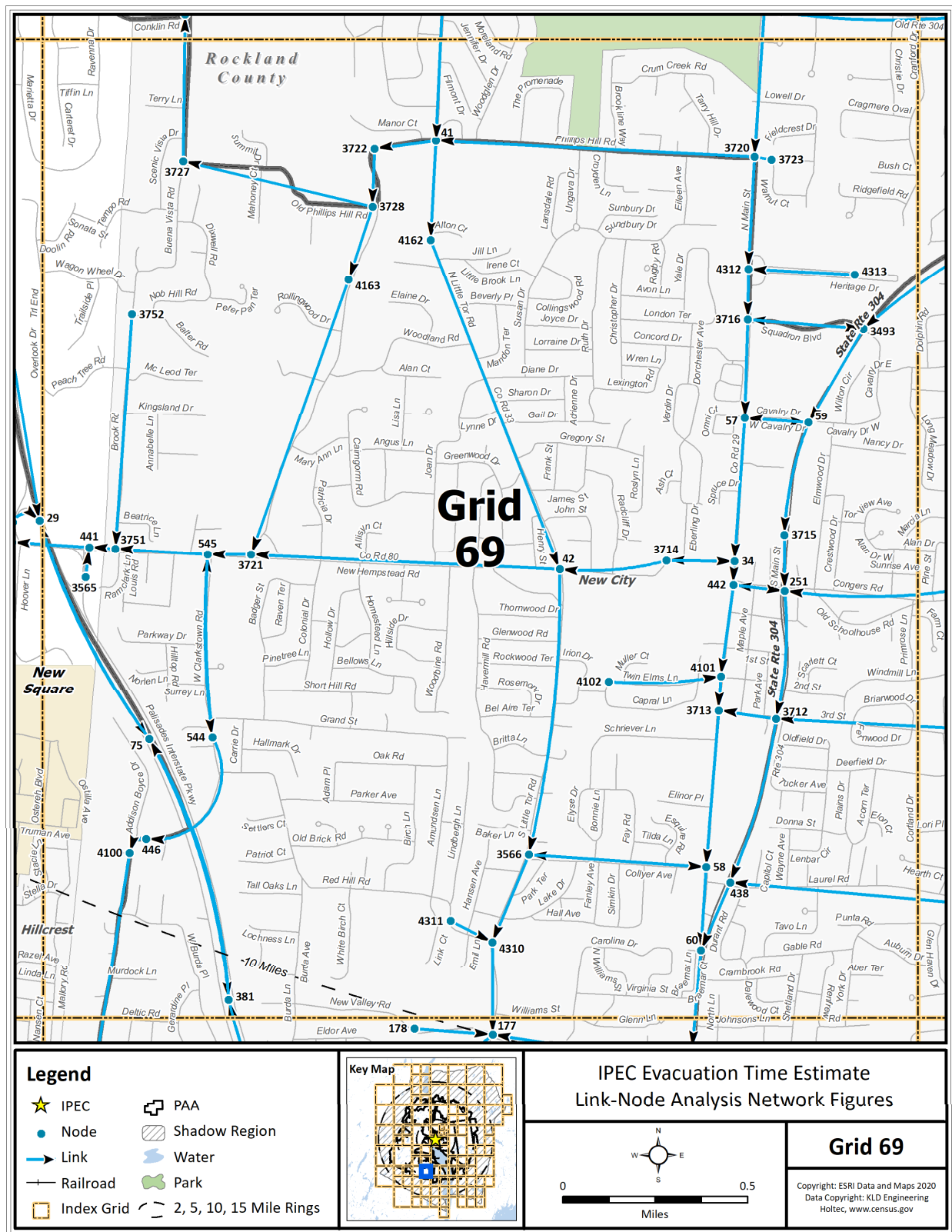


Figure K-70. Link-Node Analysis Network – Grid 69

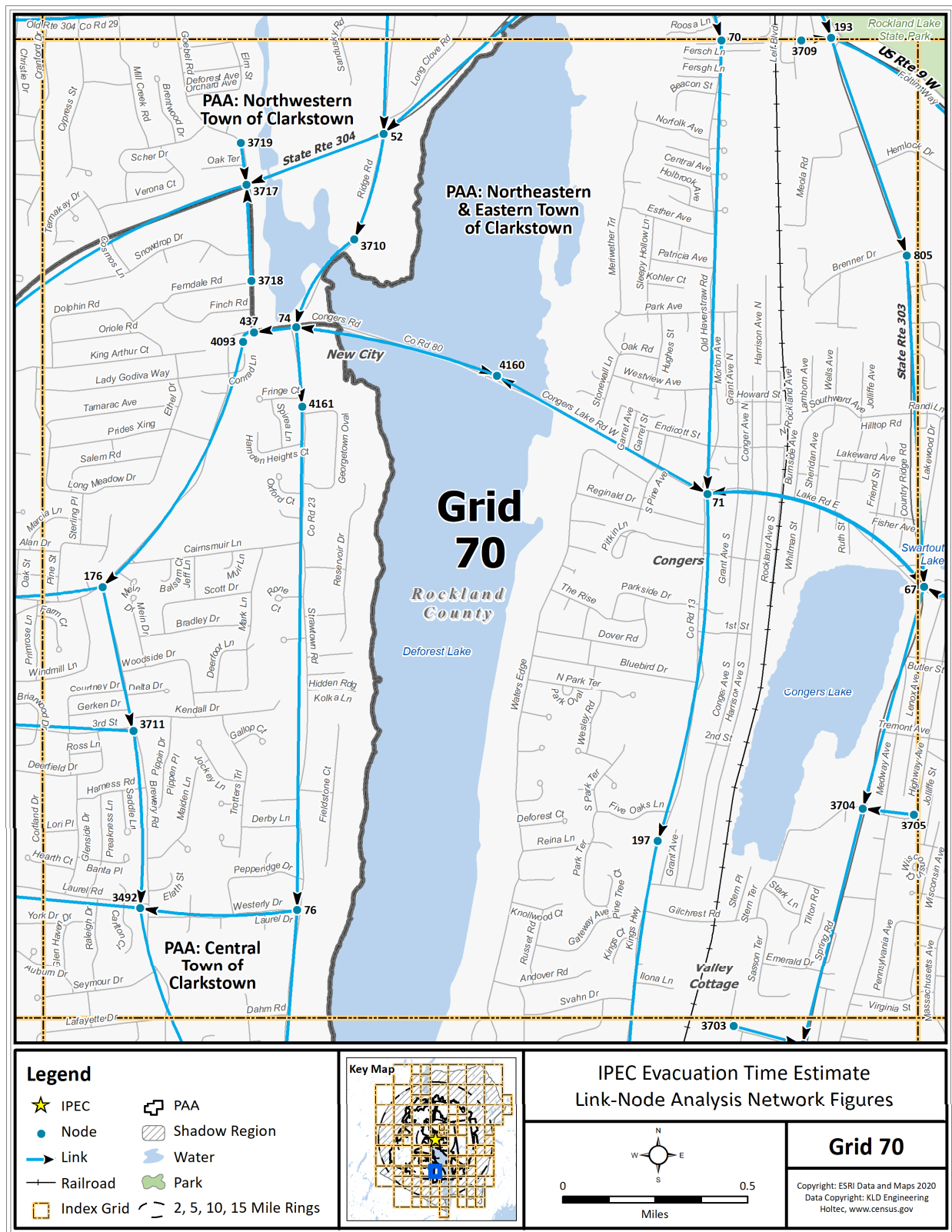


Figure K-71. Link-Node Analysis Network – Grid 70

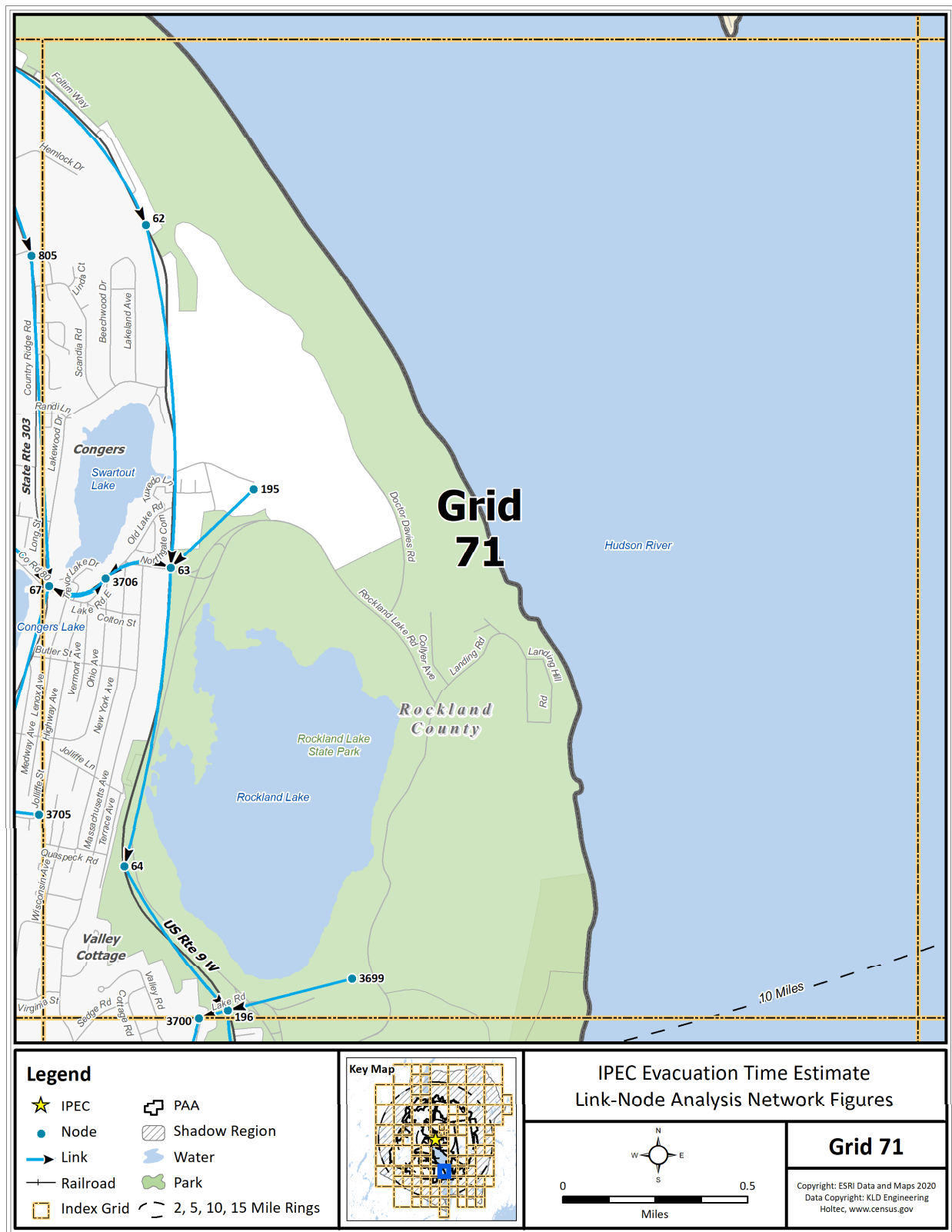


Figure K-72. Link-Node Analysis Network – Grid 71

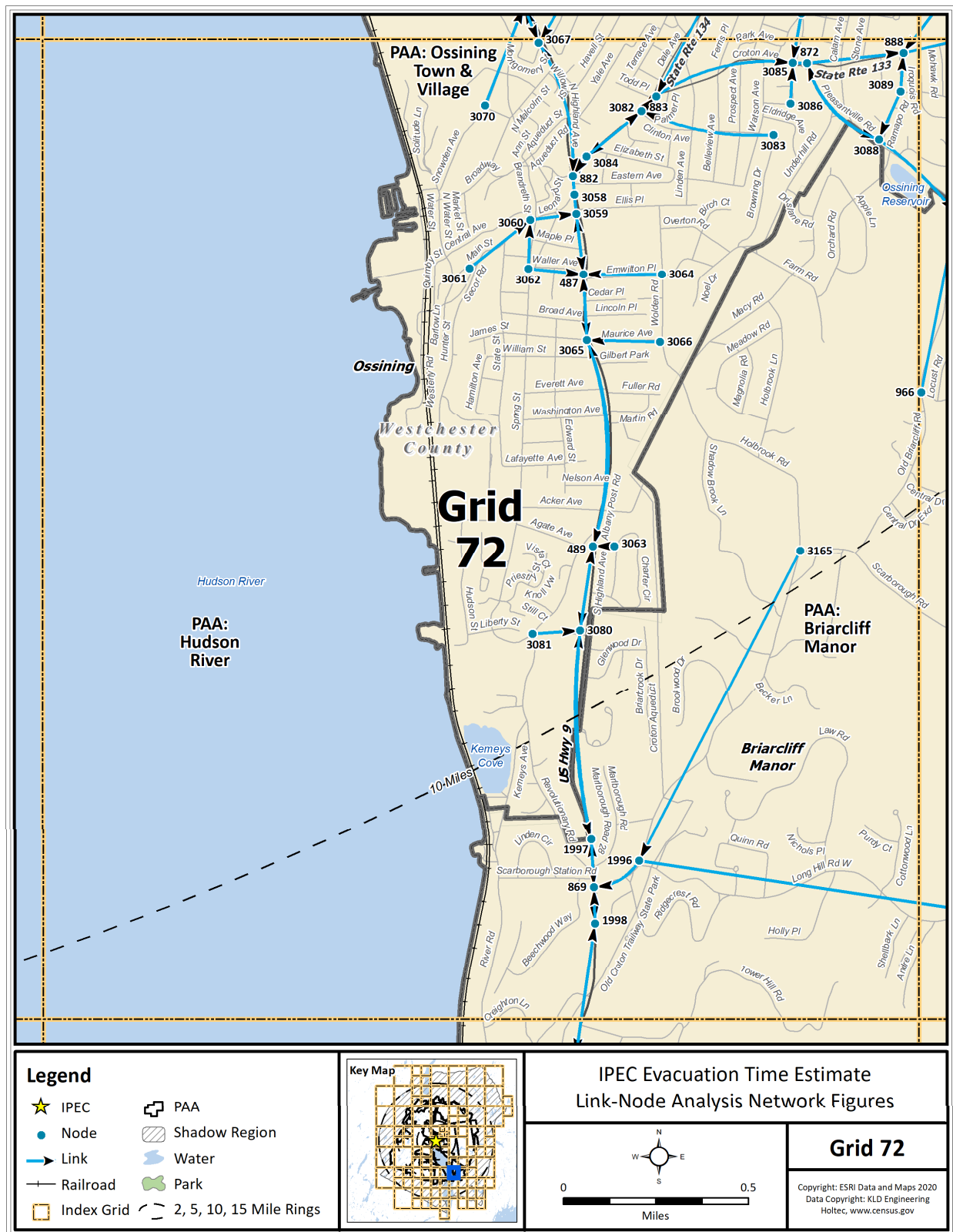


Figure K-73. Link-Node Analysis Network – Grid 72

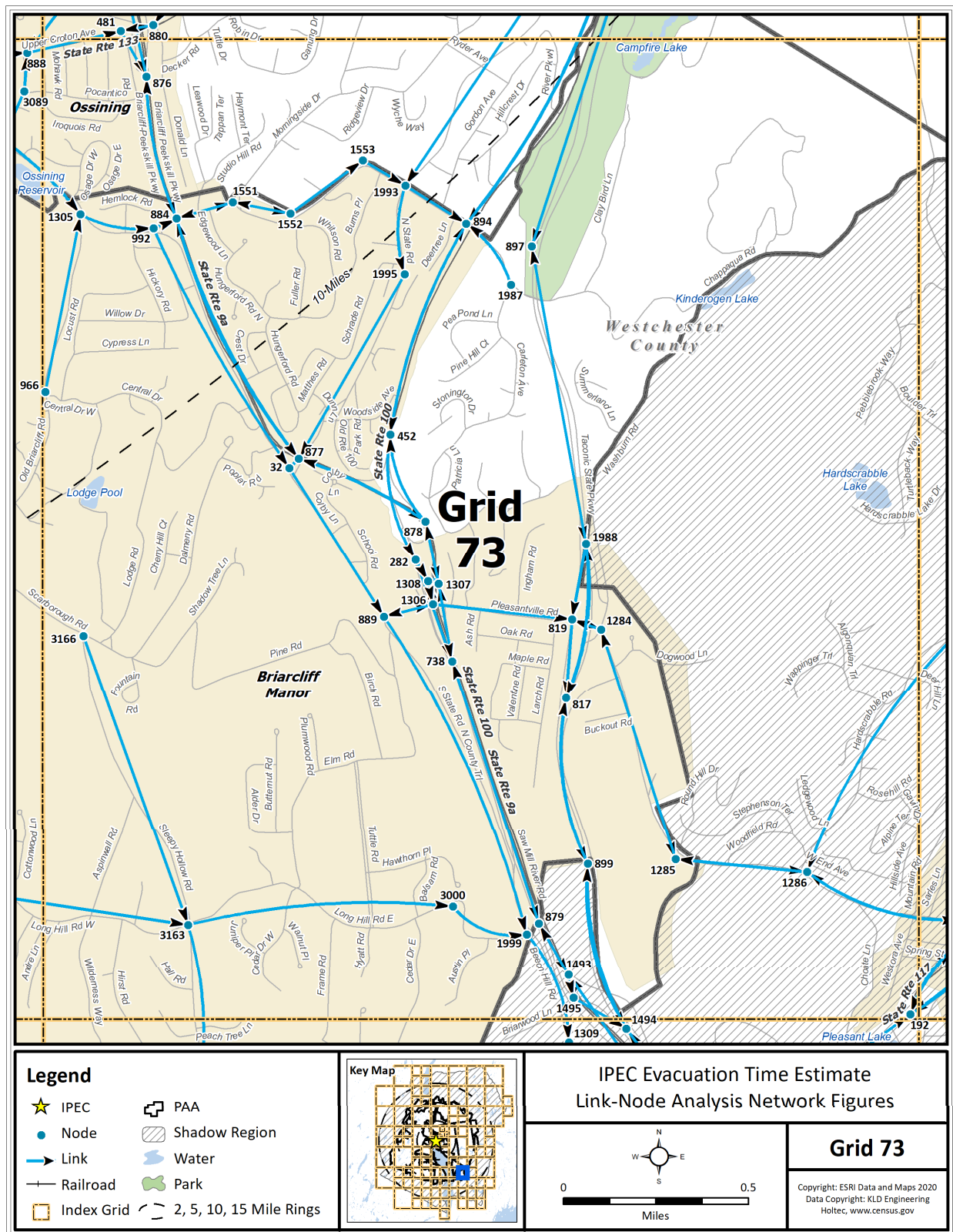


Figure K-74. Link-Node Analysis Network – Grid 73

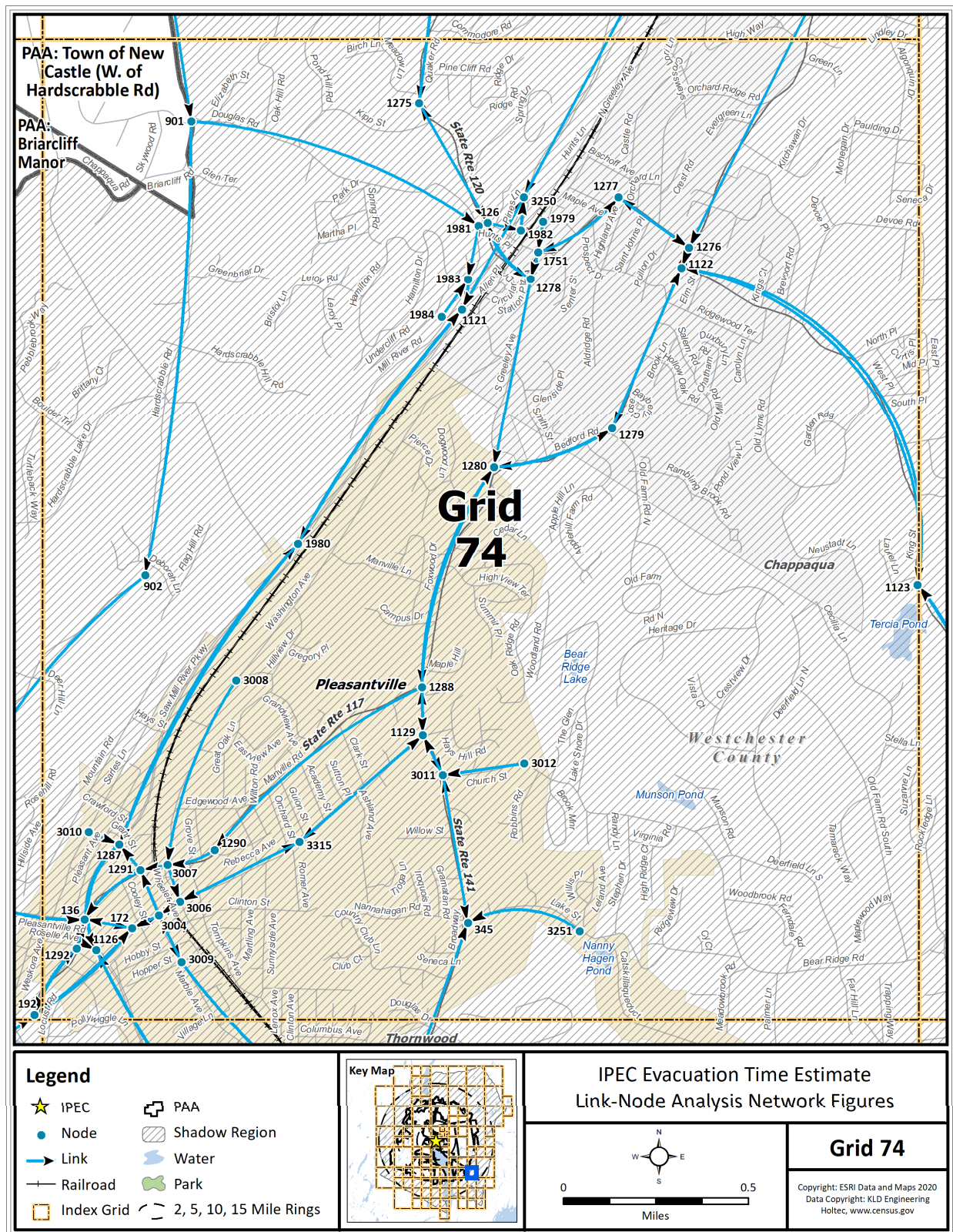


Figure K-75. Link-Node Analysis Network – Grid 74

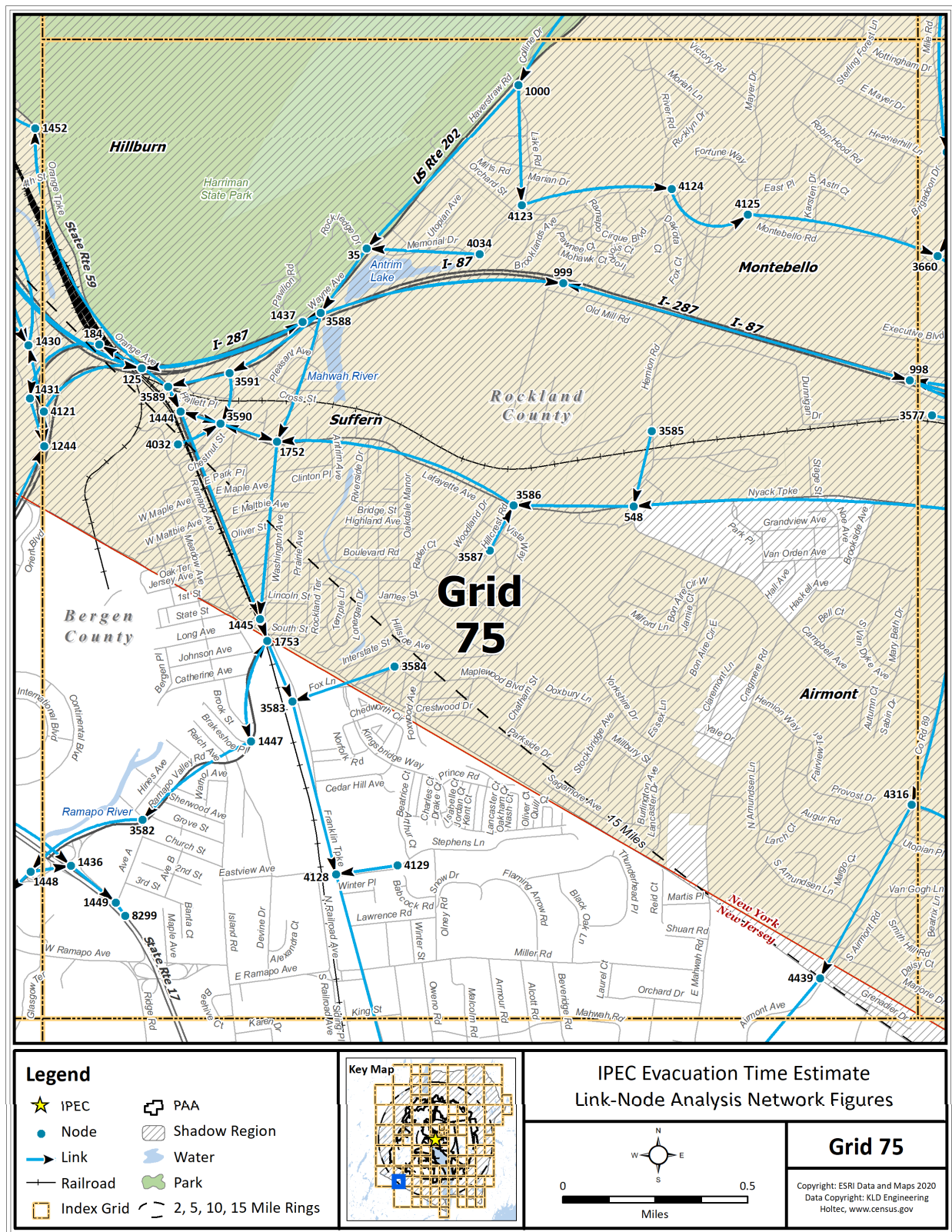


Figure K-76. Link-Node Analysis Network – Grid 75

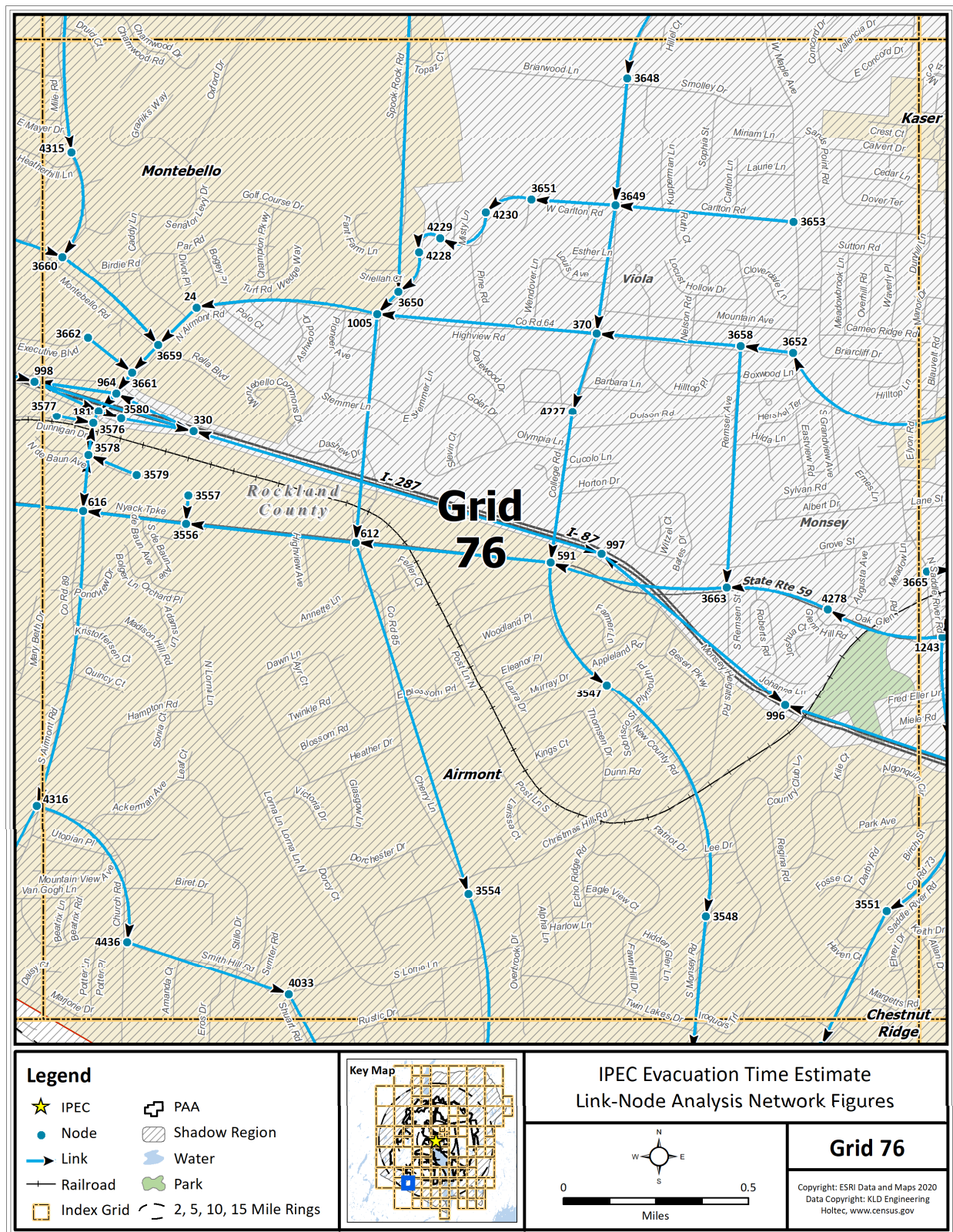


Figure K-77. Link-Node Analysis Network – Grid 76

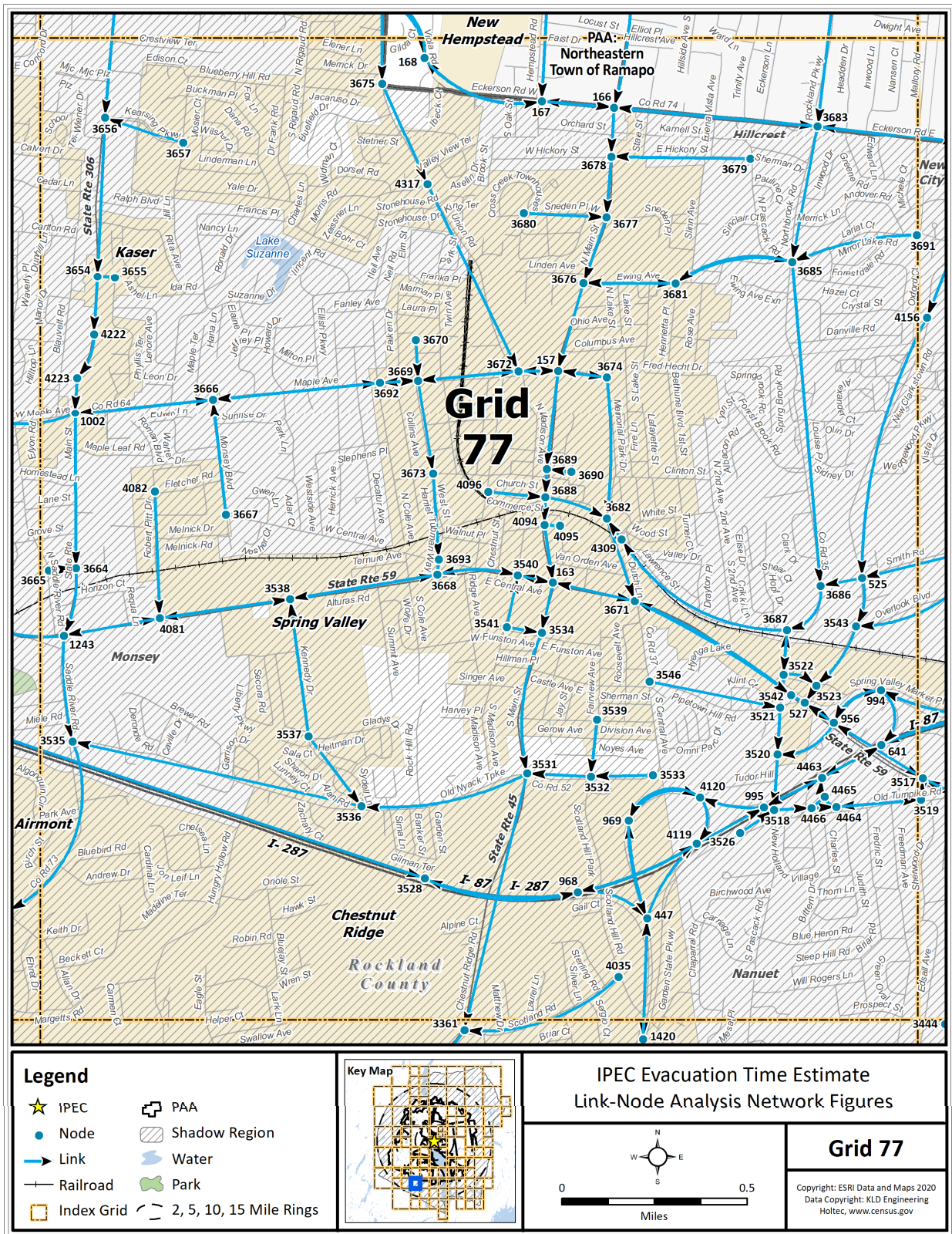


Figure K-78. Link-Node Analysis Network – Grid 77

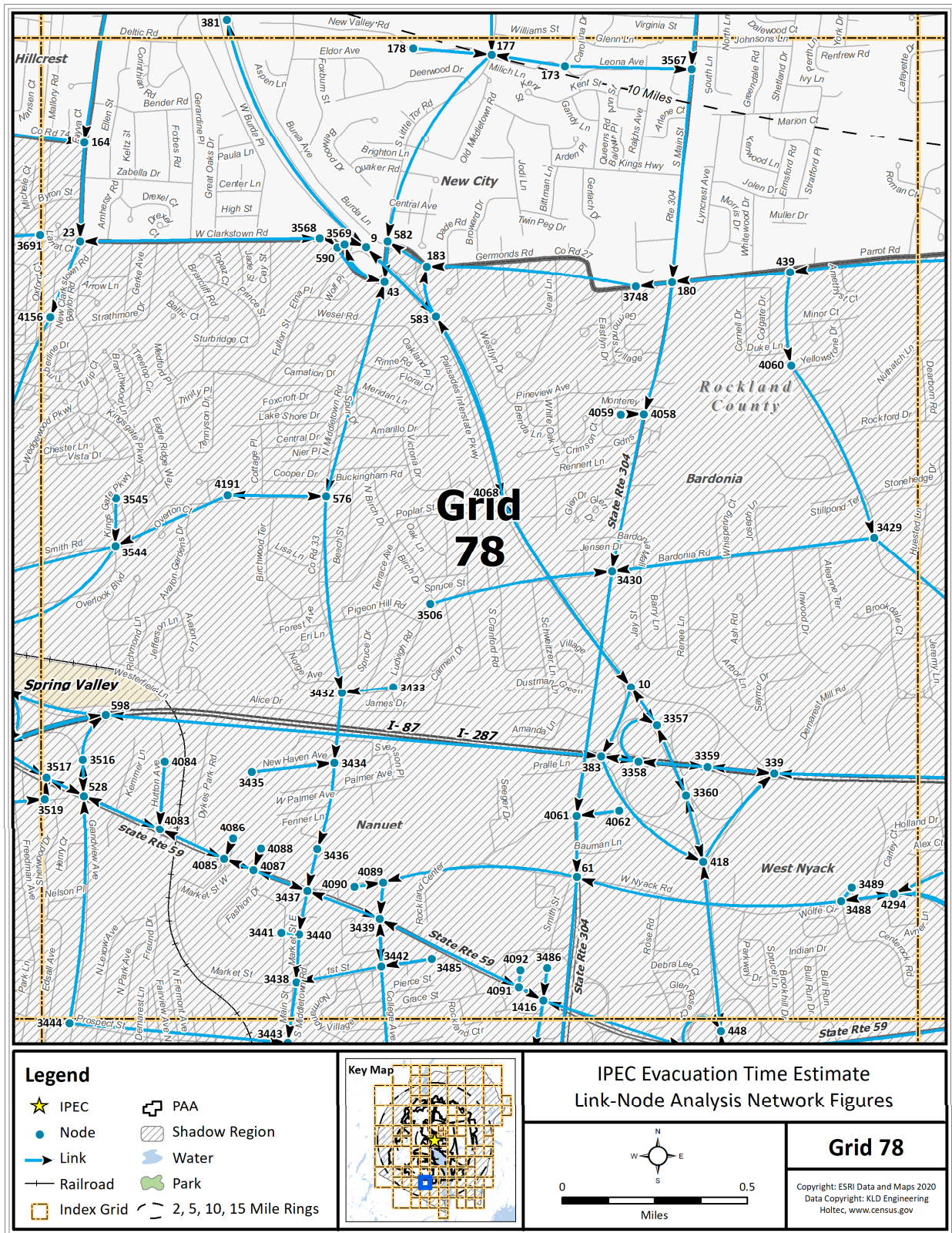


Figure K-79. Link-Node Analysis Network – Grid 78

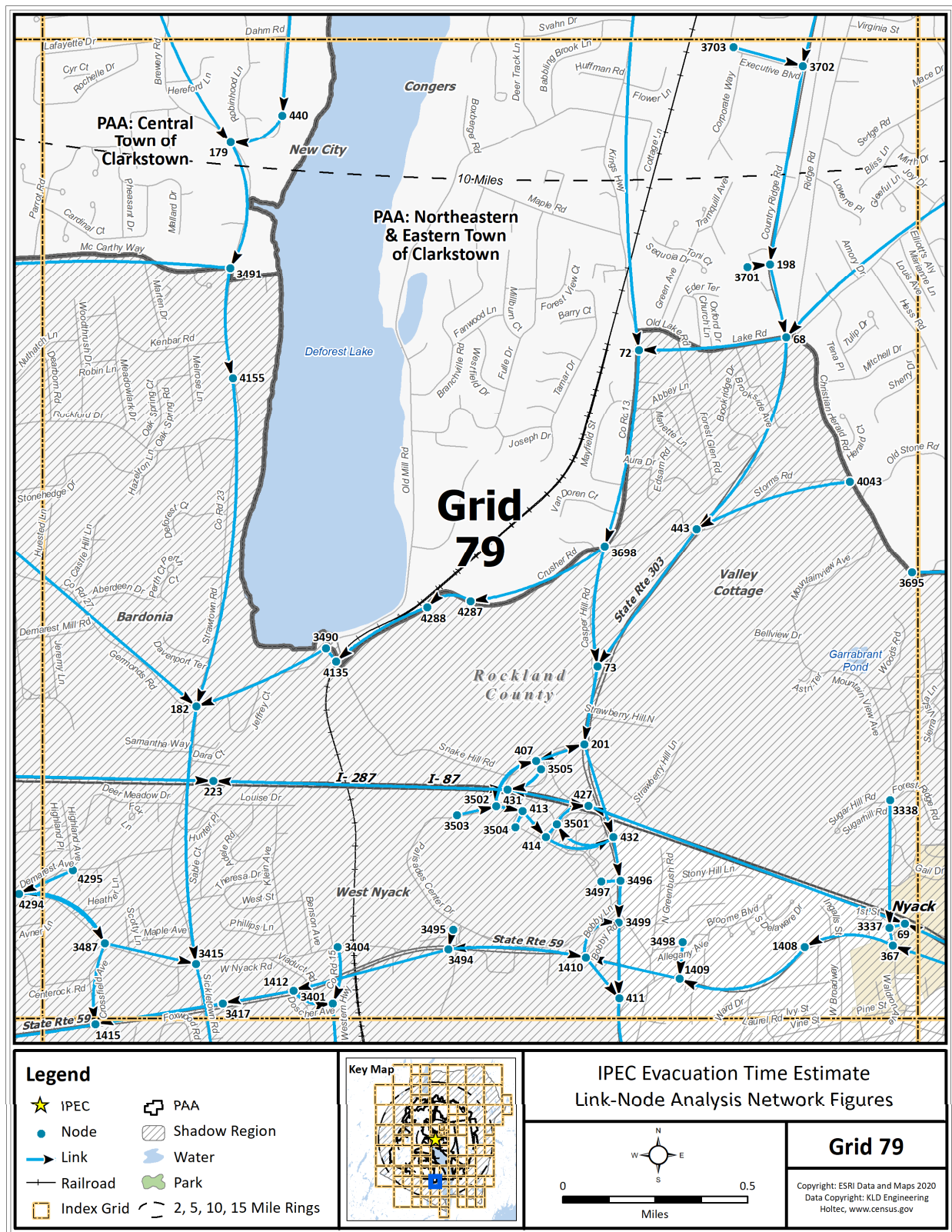


Figure K-80. Link-Node Analysis Network – Grid 79

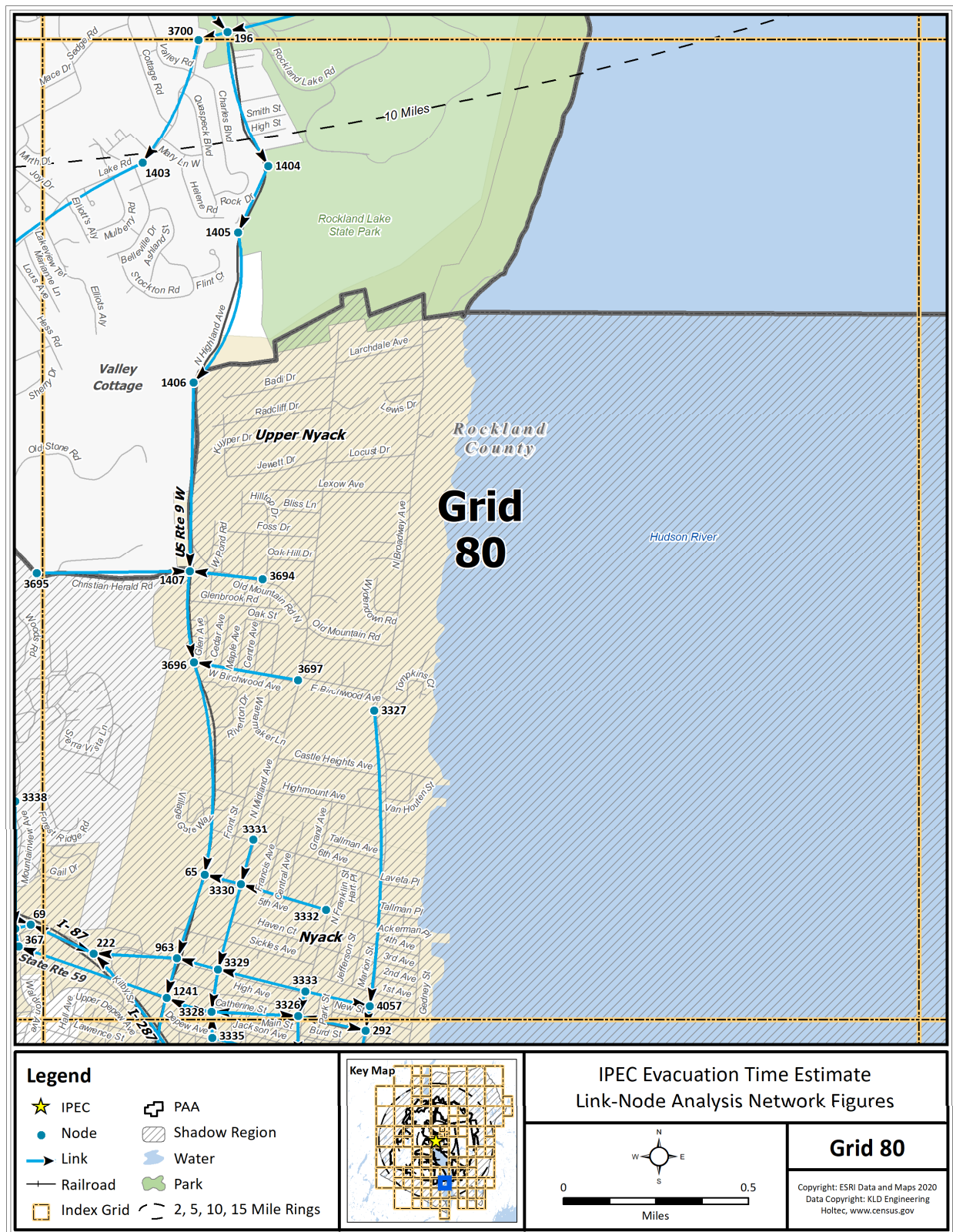


Figure K-81. Link-Node Analysis Network – Grid 80

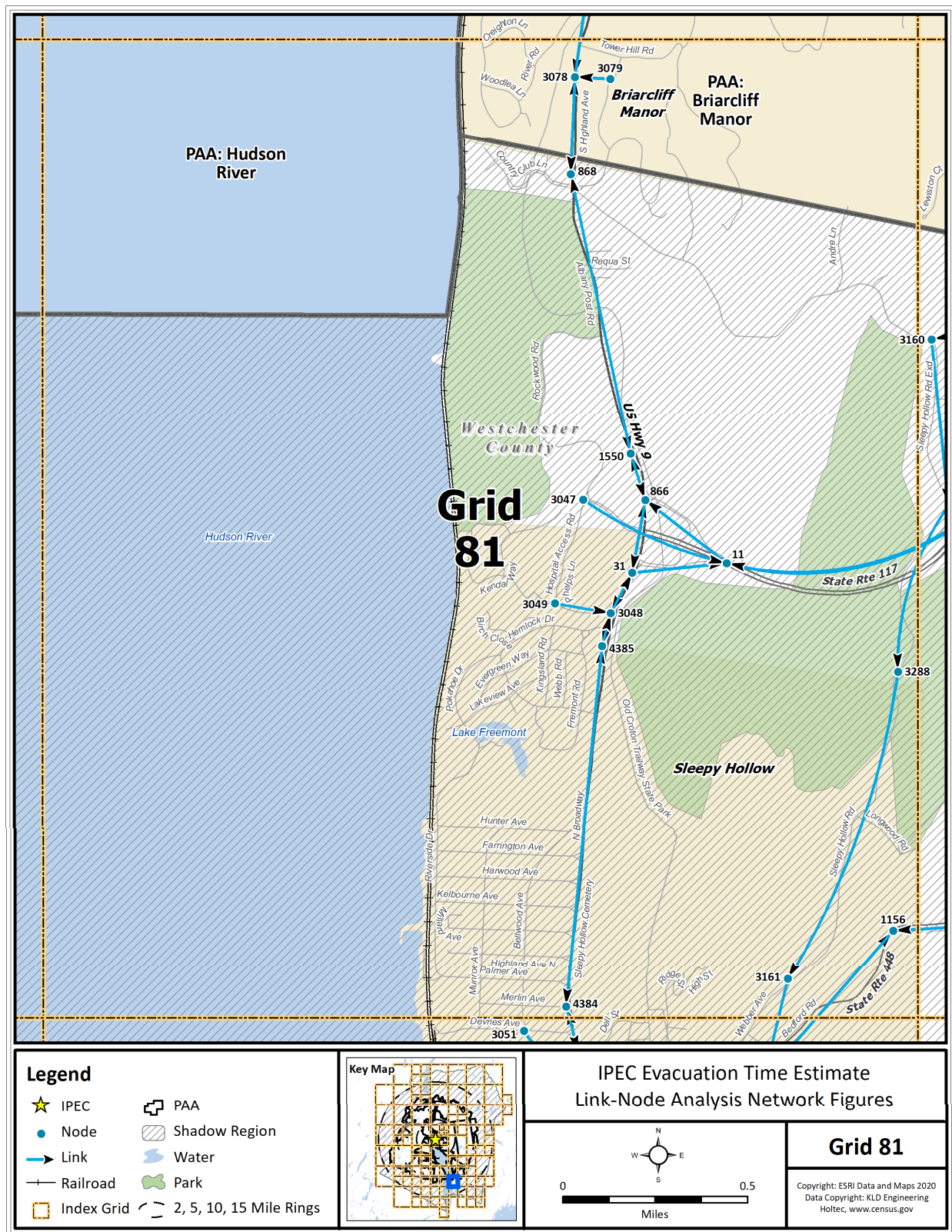


Figure K-82. Link-Node Analysis Network – Grid 81

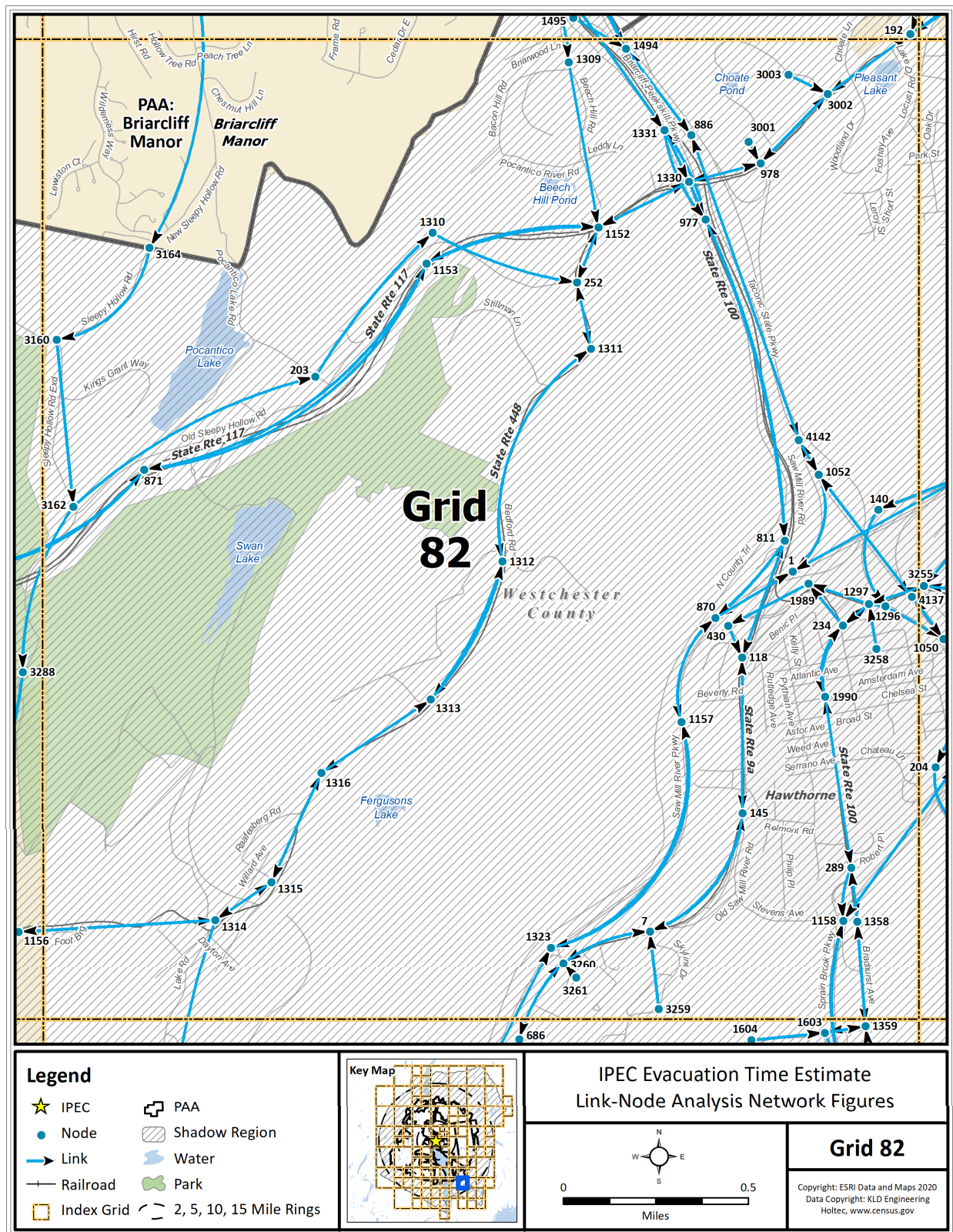


Figure K-83. Link-Node Analysis Network – Grid 82

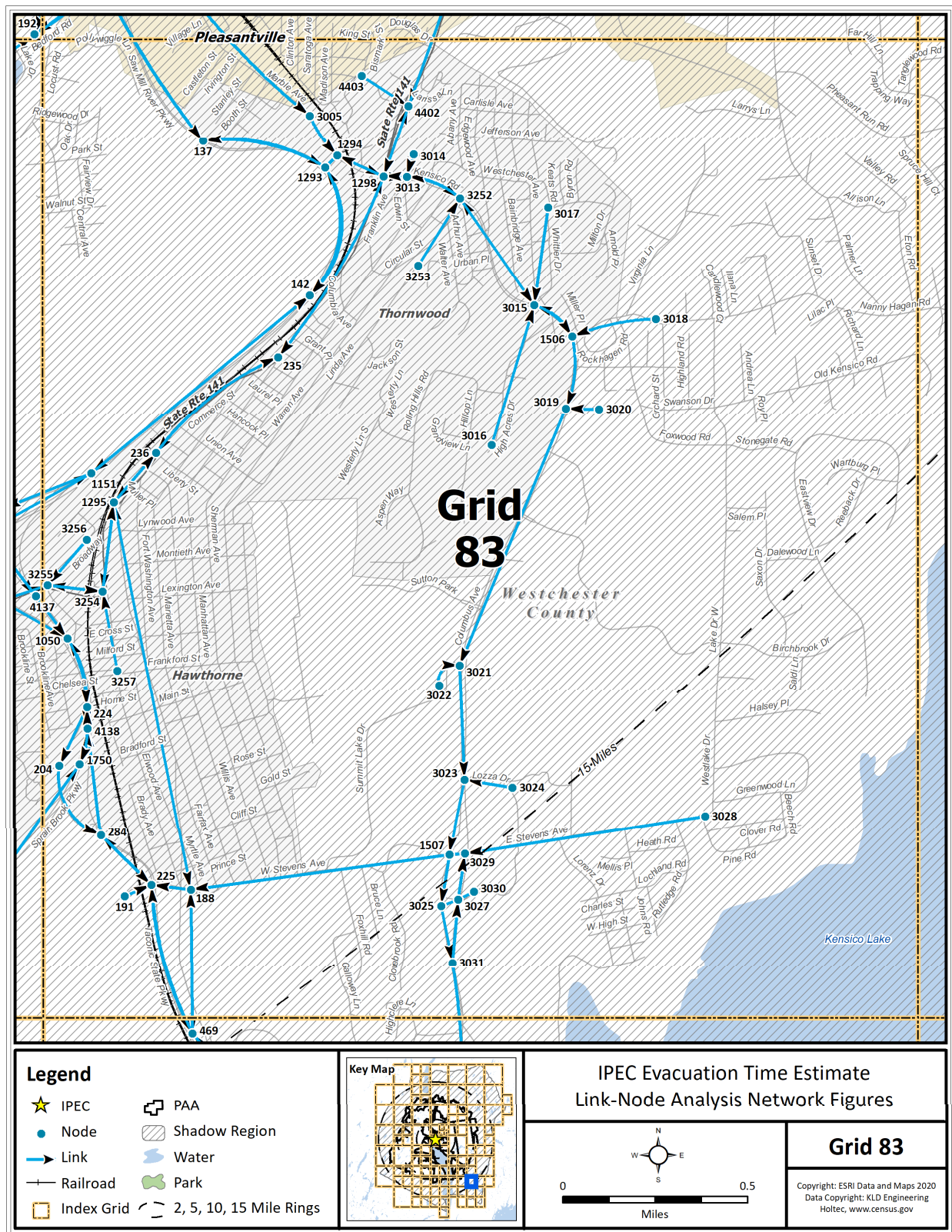


Figure K-84. Link-Node Analysis Network – Grid 83

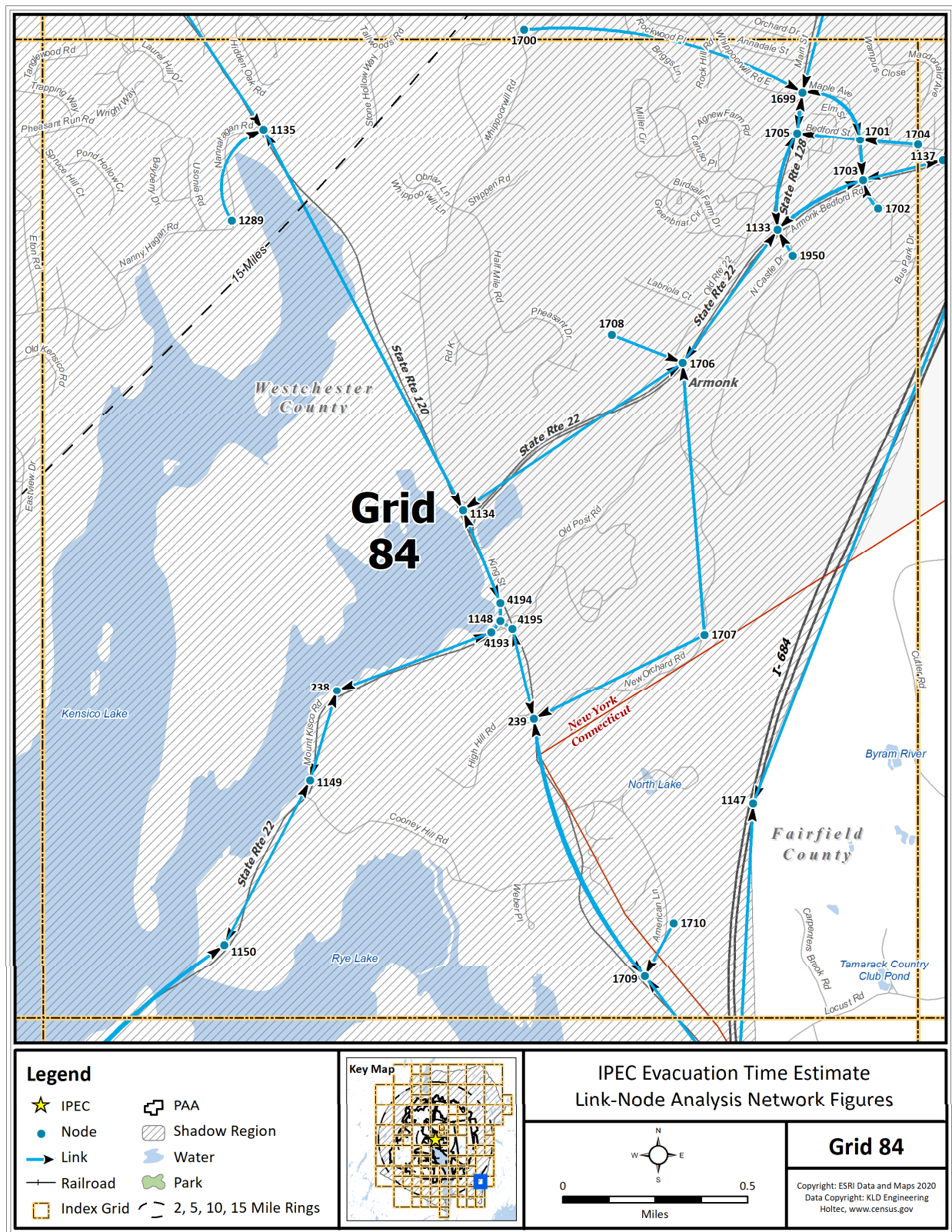


Figure K-85. Link-Node Analysis Network – Grid 84

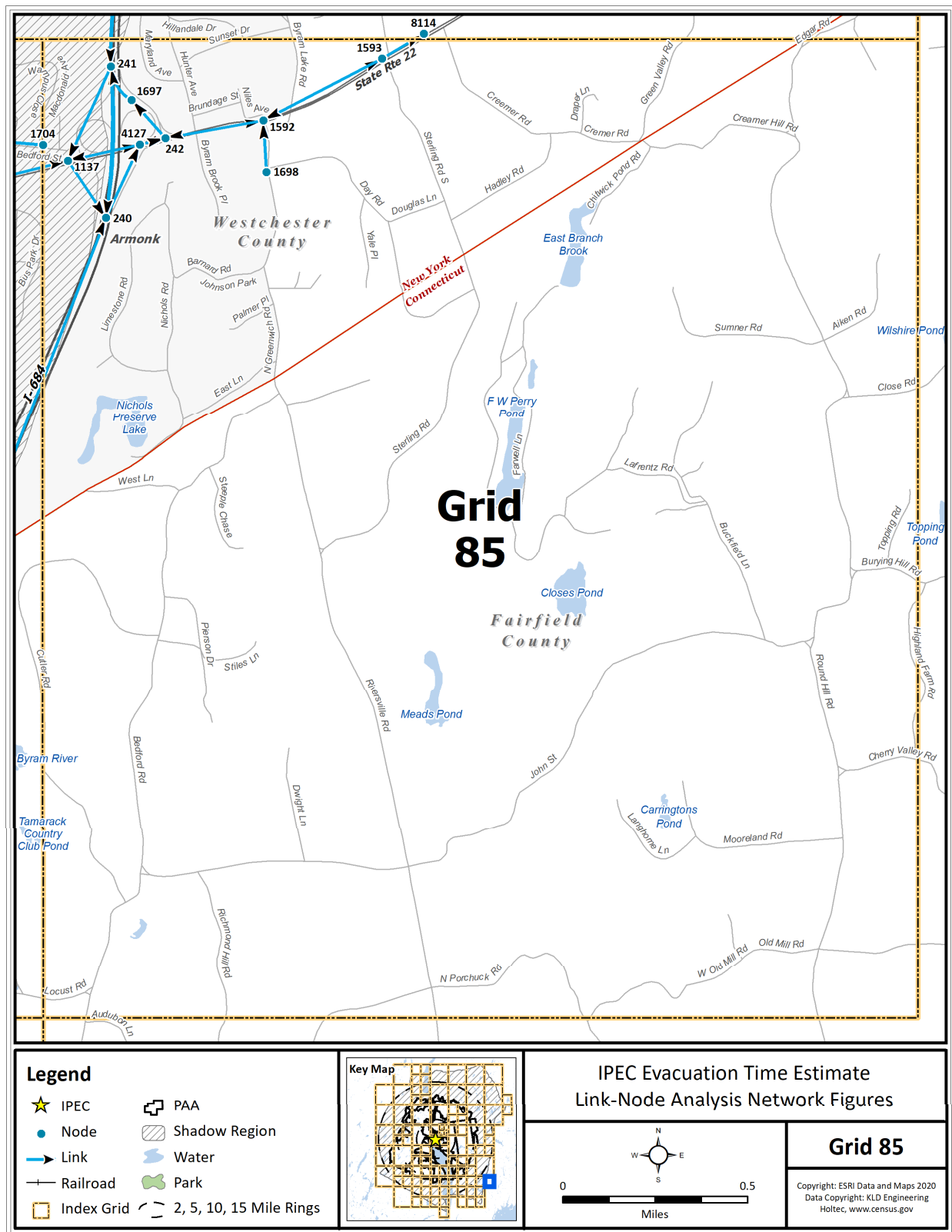


Figure K-86. Link-Node Analysis Network – Grid 85

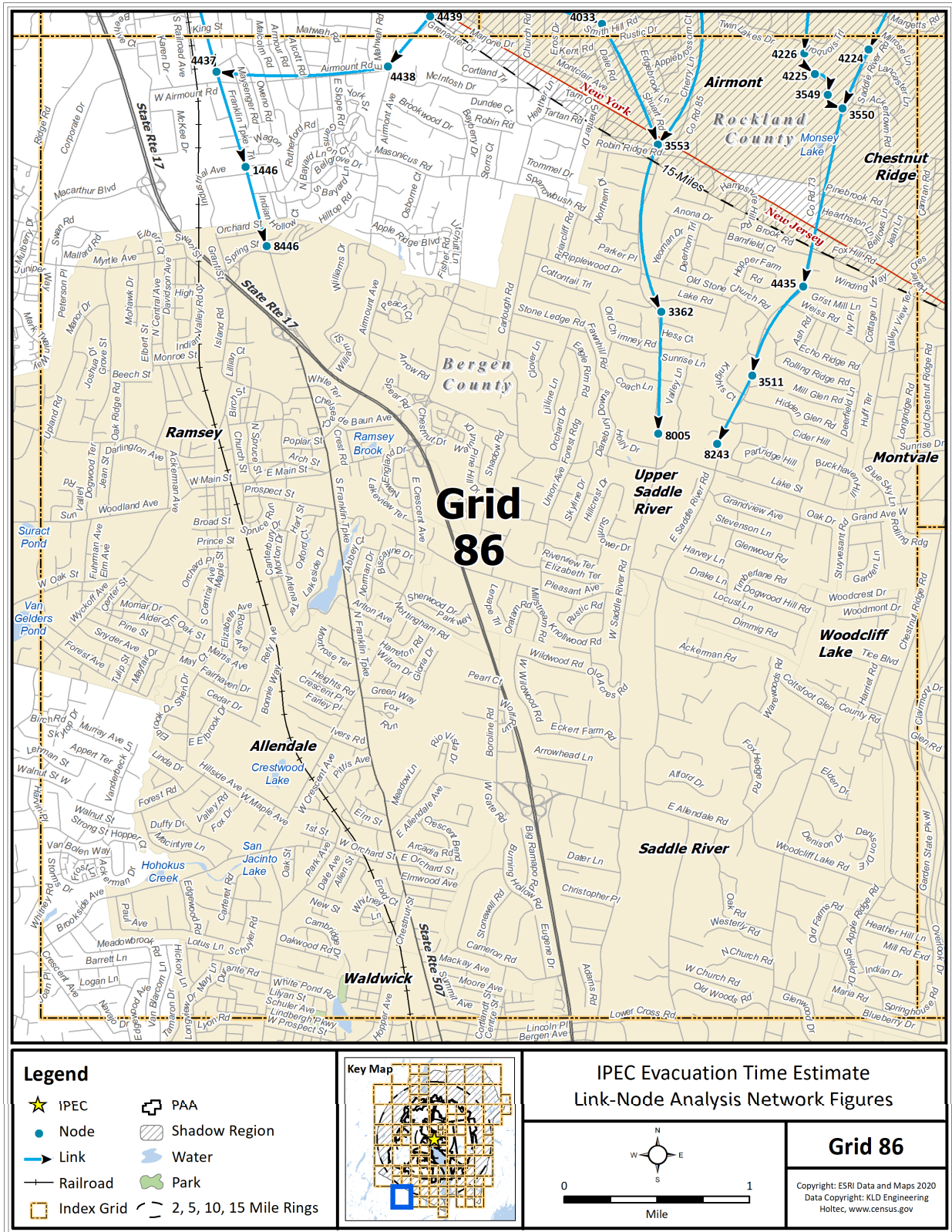


Figure K-87. Link-Node Analysis Network – Grid 86

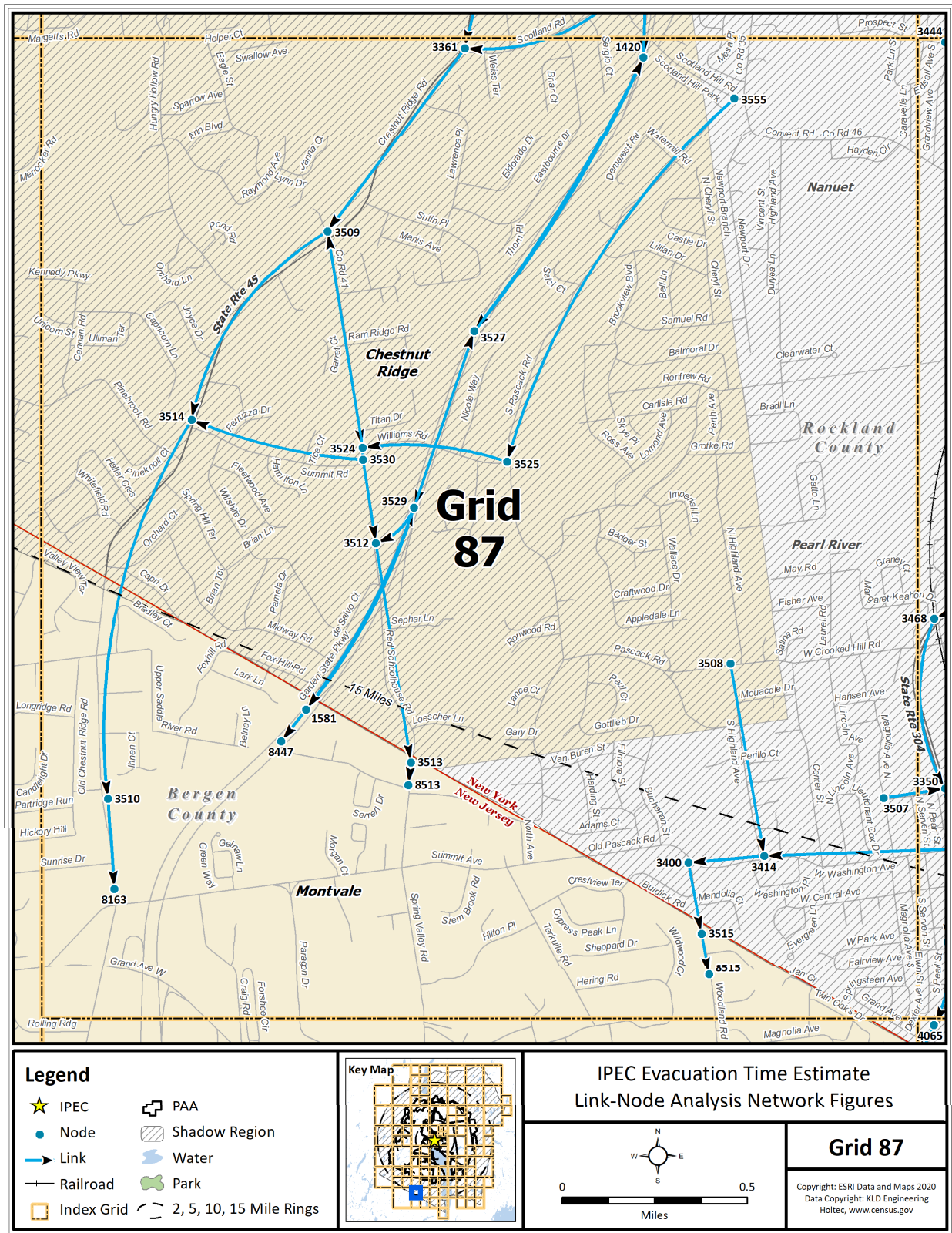


Figure K-88. Link-Node Analysis Network – Grid 87

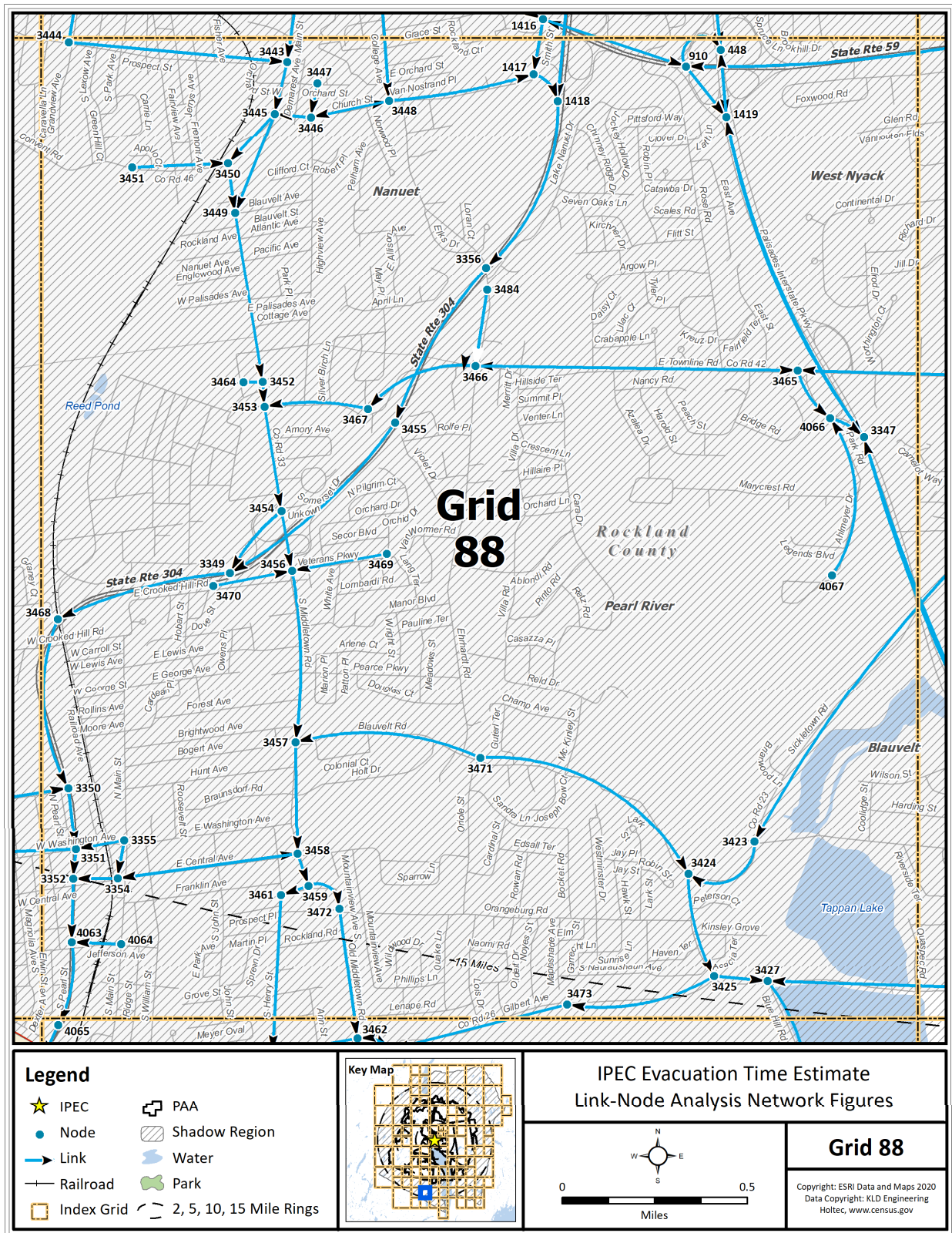


Figure K-89. Link-Node Analysis Network – Grid 88

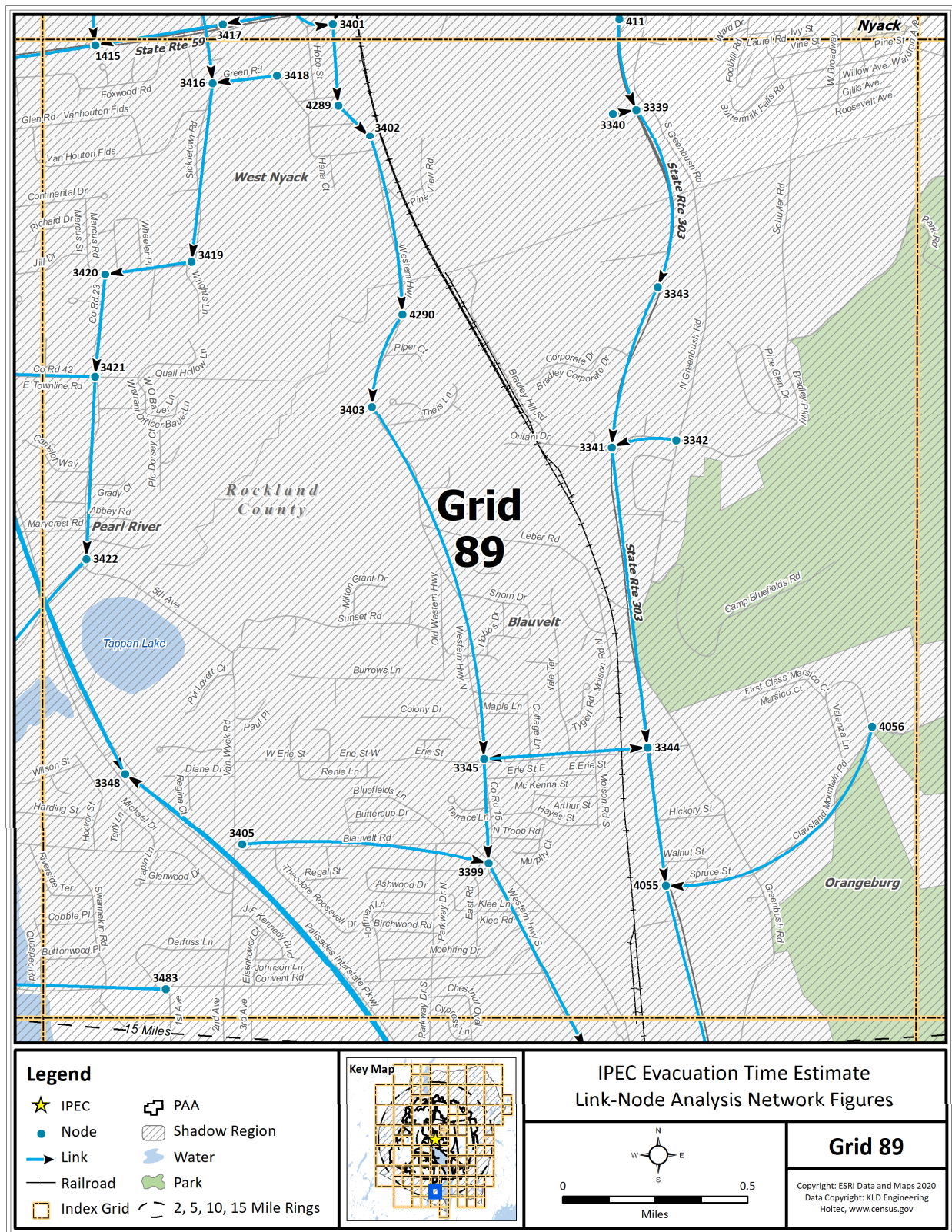


Figure K-90. Link-Node Analysis Network – Grid 89

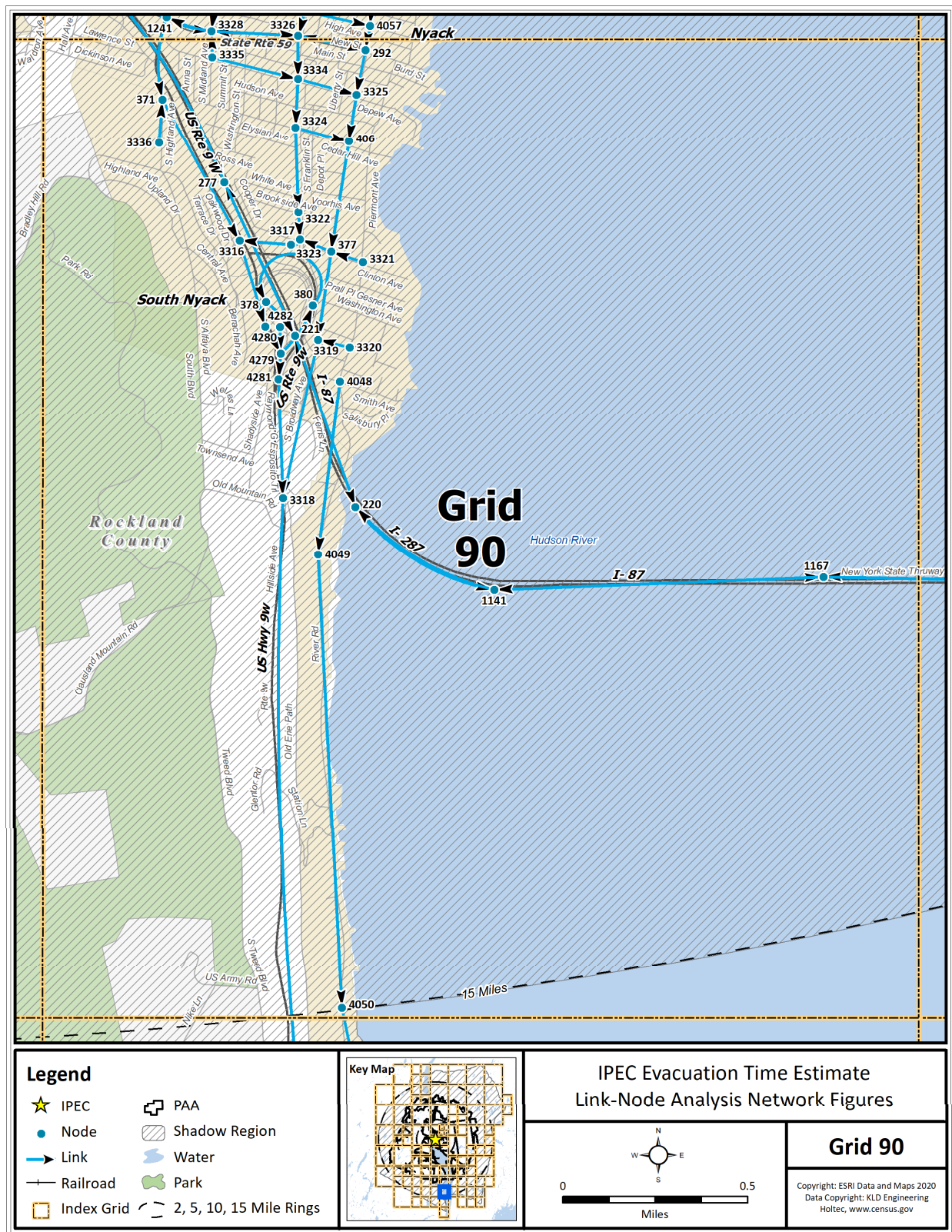


Figure K-91. Link-Node Analysis Network – Grid 90

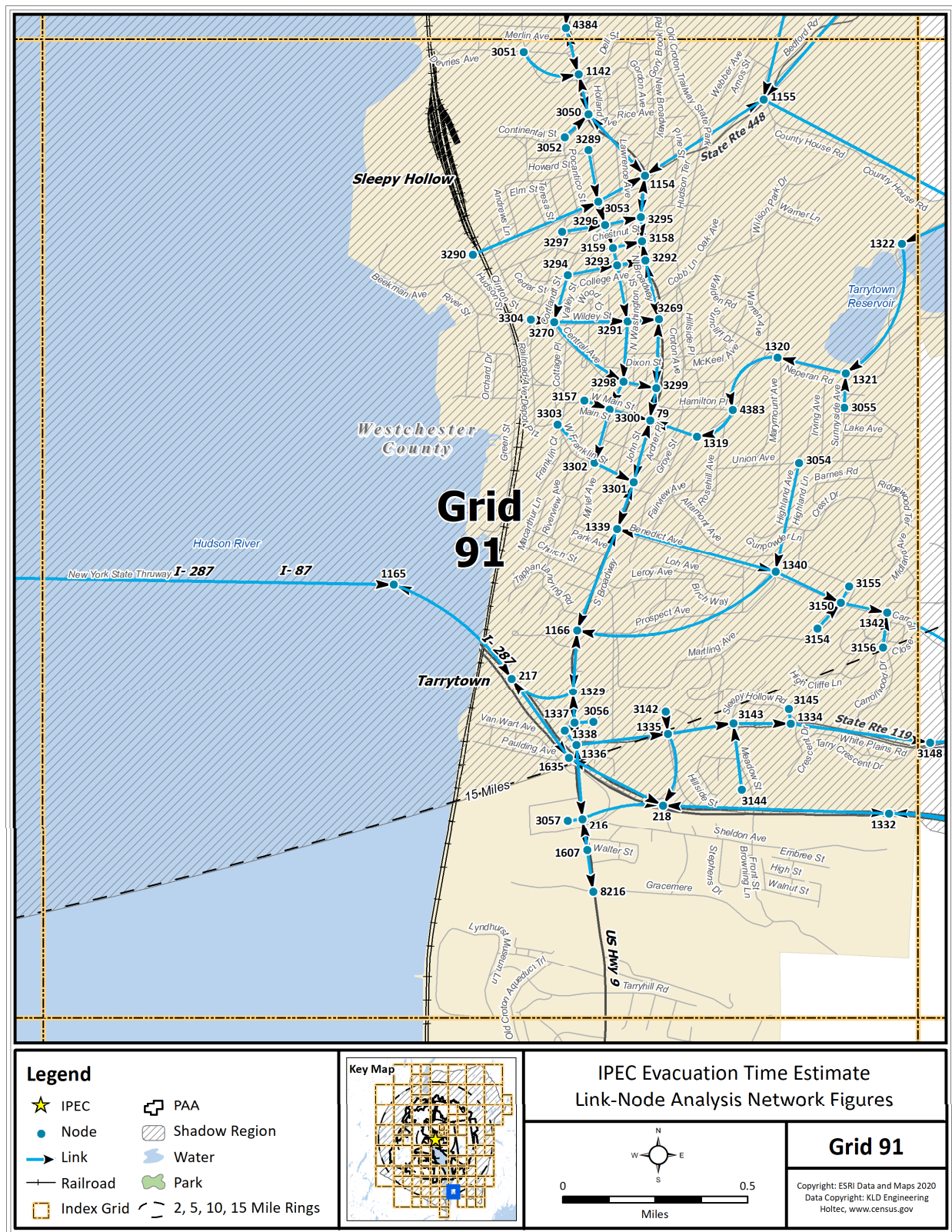


Figure K-92. Link-Node Analysis Network – Grid 91

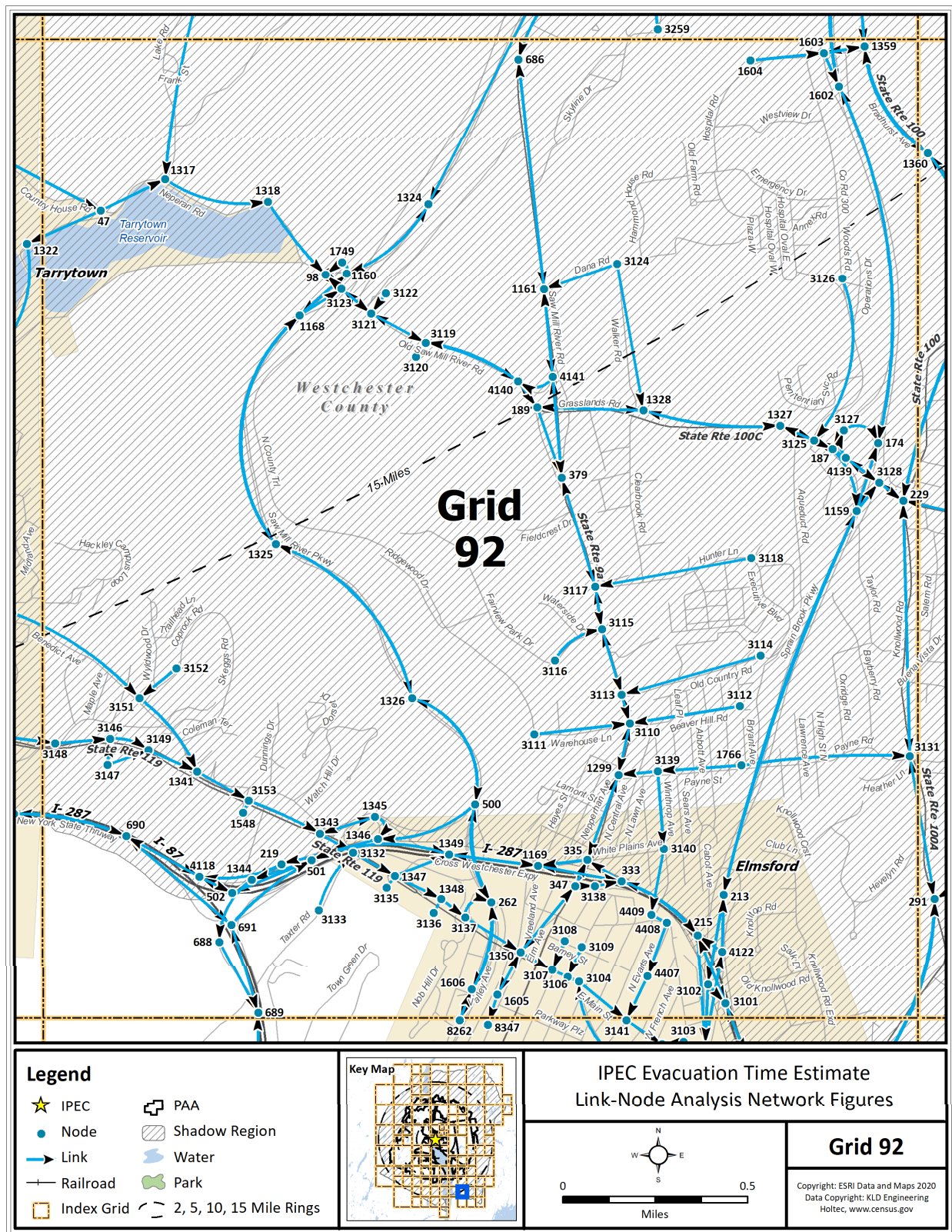


Figure K-93. Link-Node Analysis Network – Grid 92

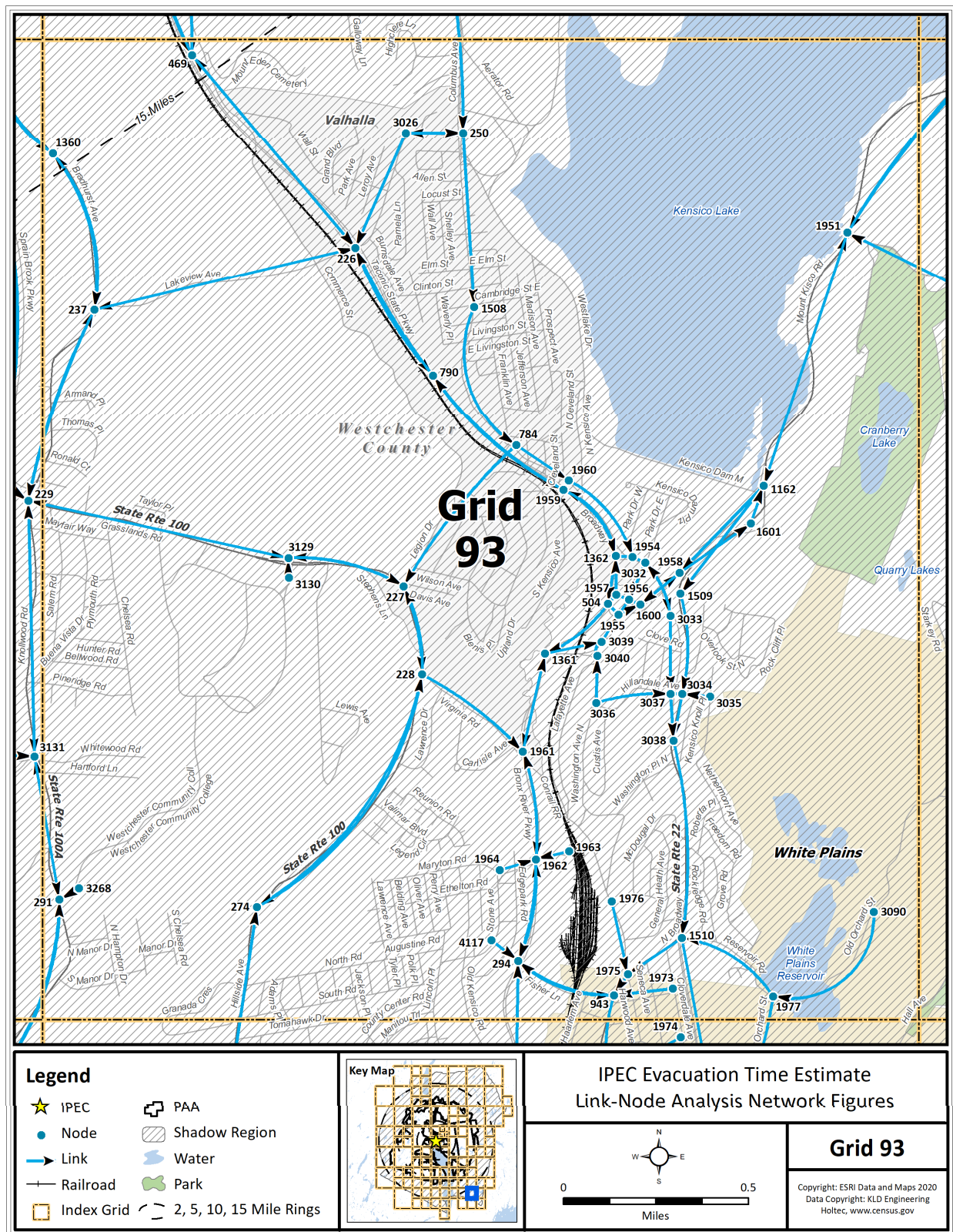


Figure K-94. Link-Node Analysis Network – Grid 93

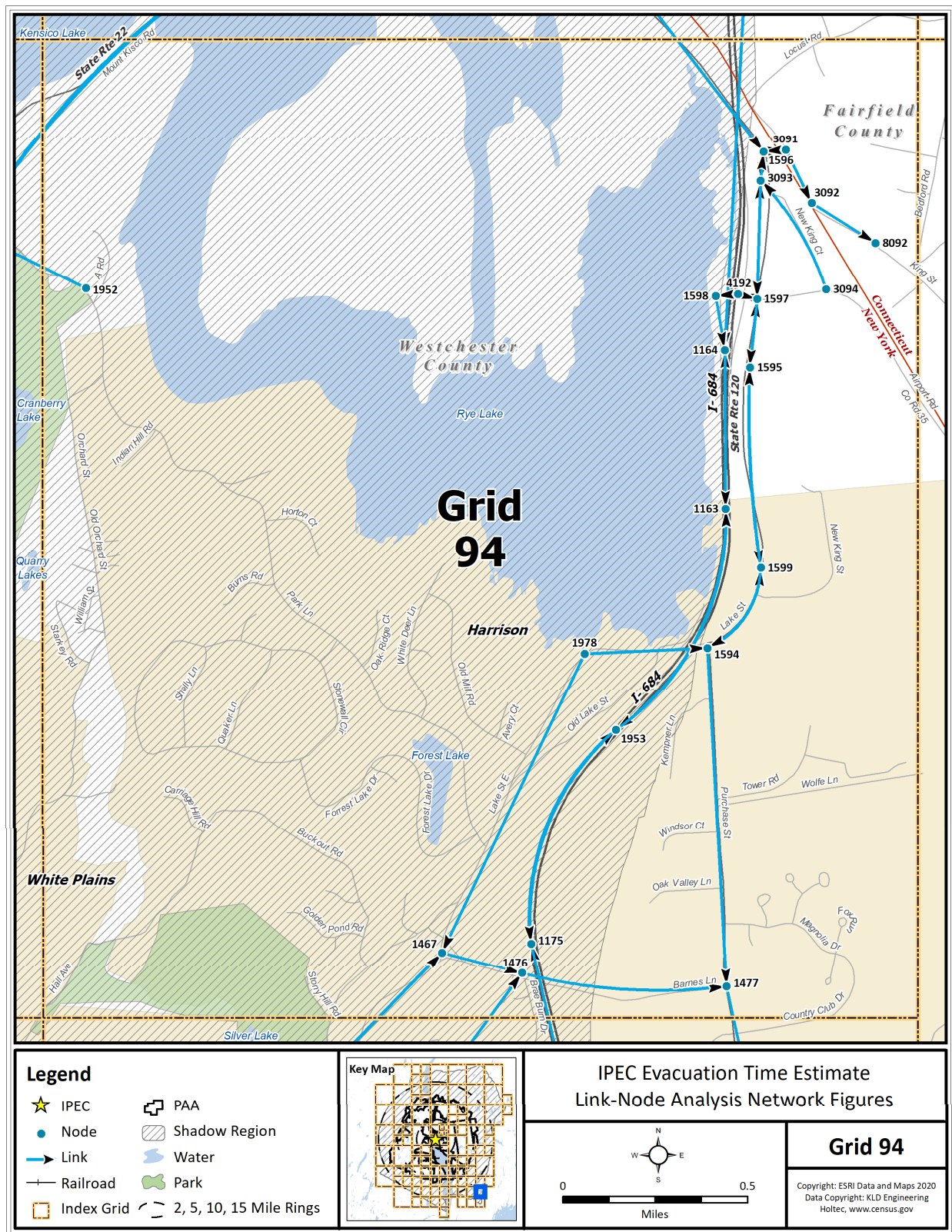


Figure K-95. Link-Node Analysis Network – Grid 94

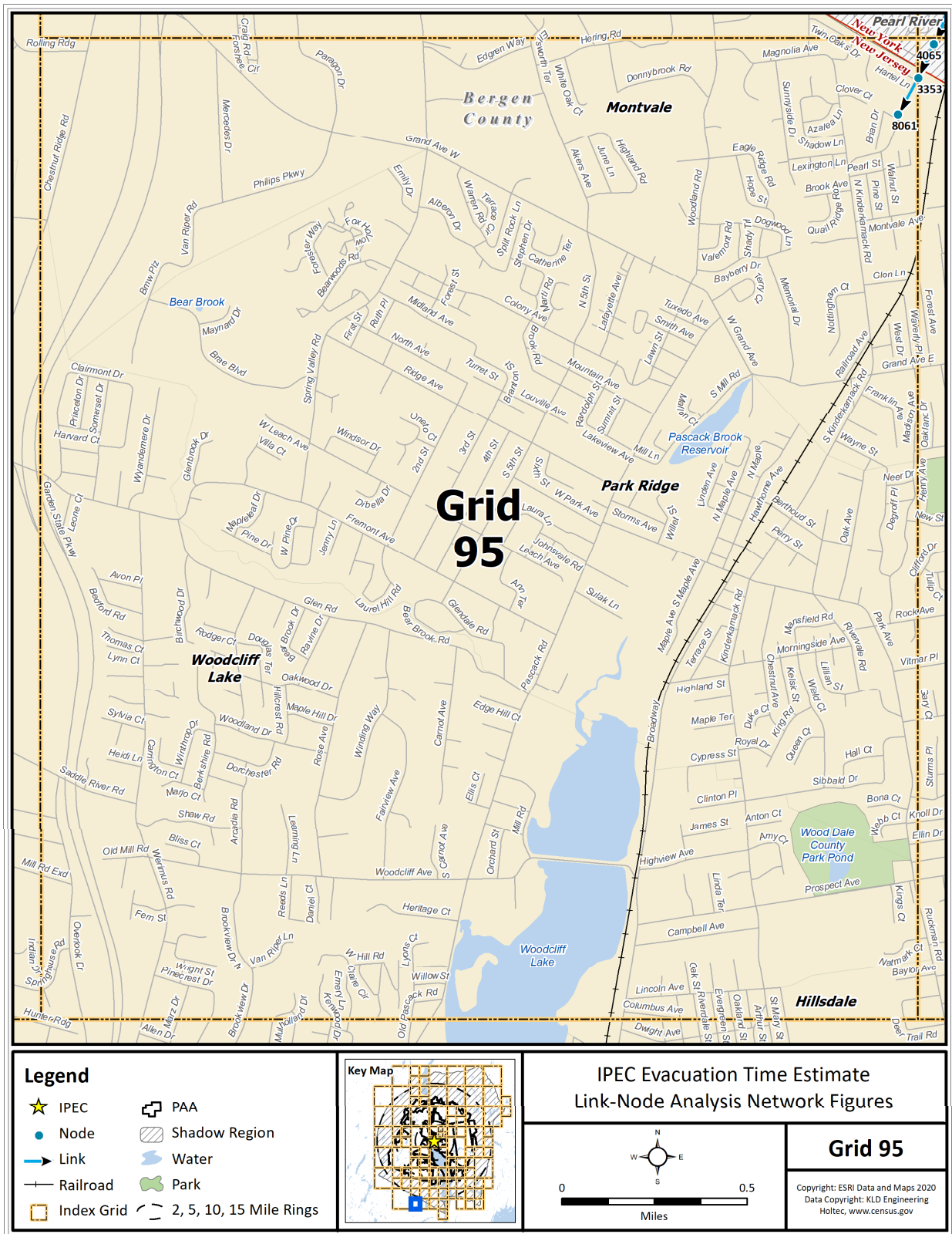


Figure K-96. Link-Node Analysis Network – Grid 95

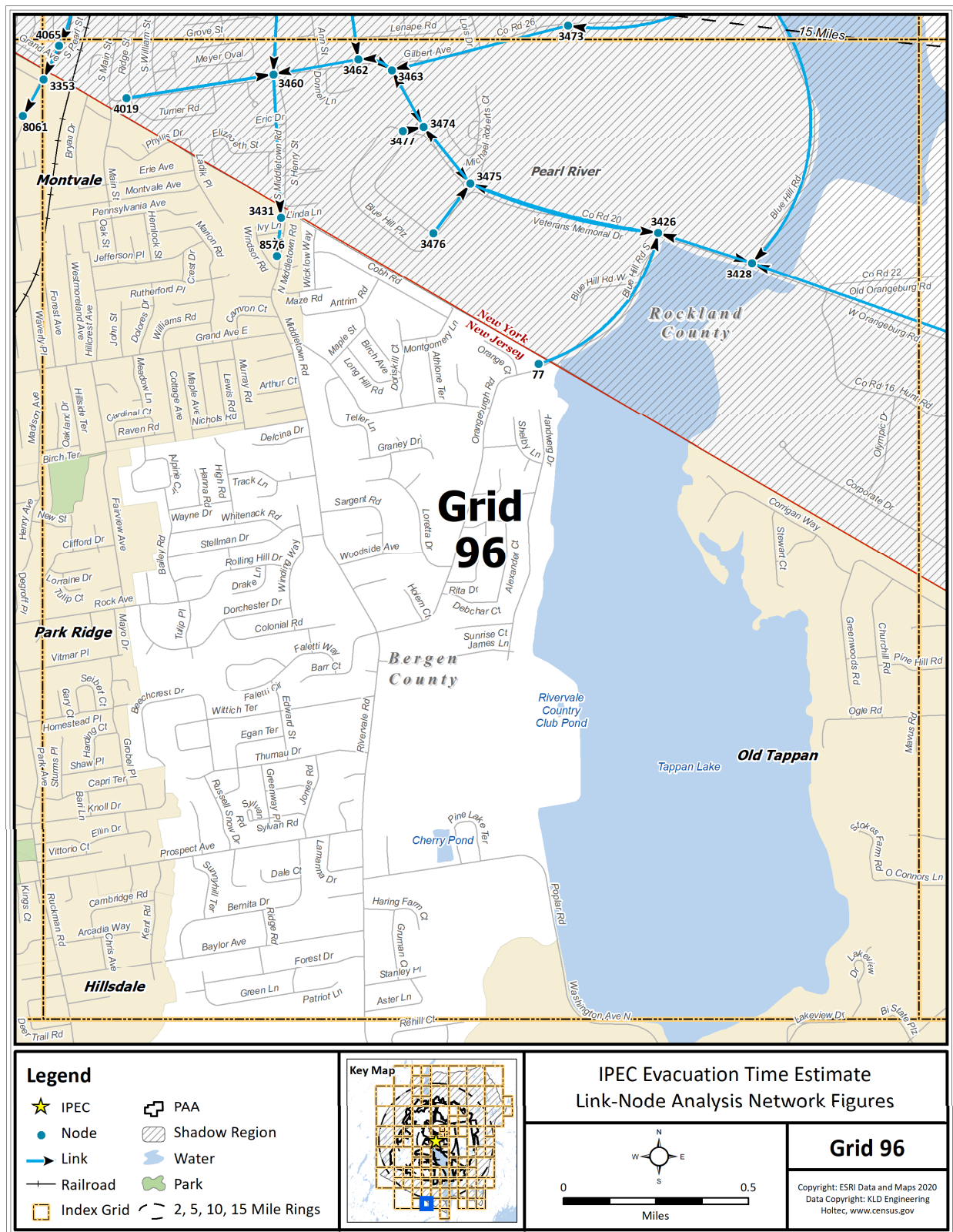


Figure K-97. Link-Node Analysis Network – Grid 96

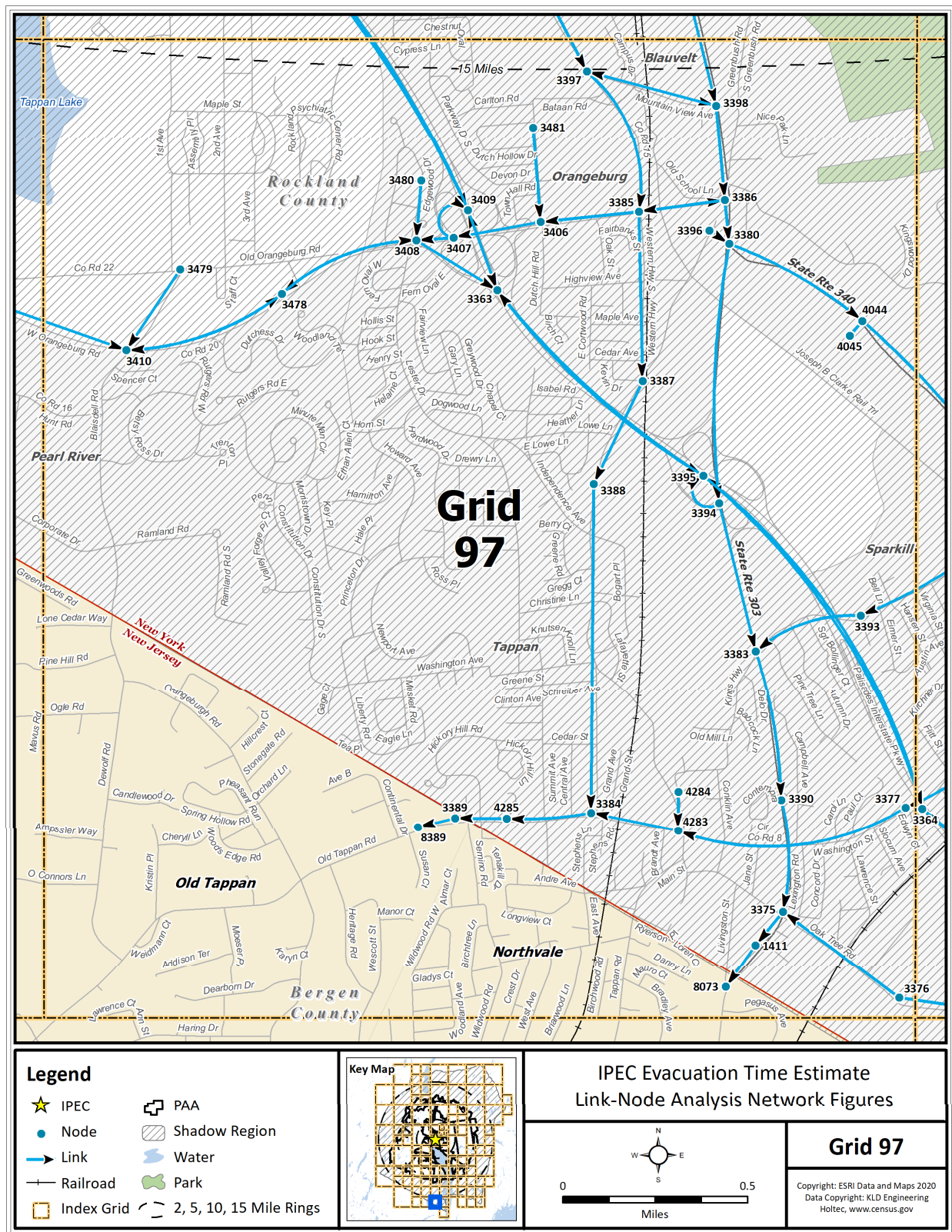


Figure K-98. Link-Node Analysis Network – Grid 97

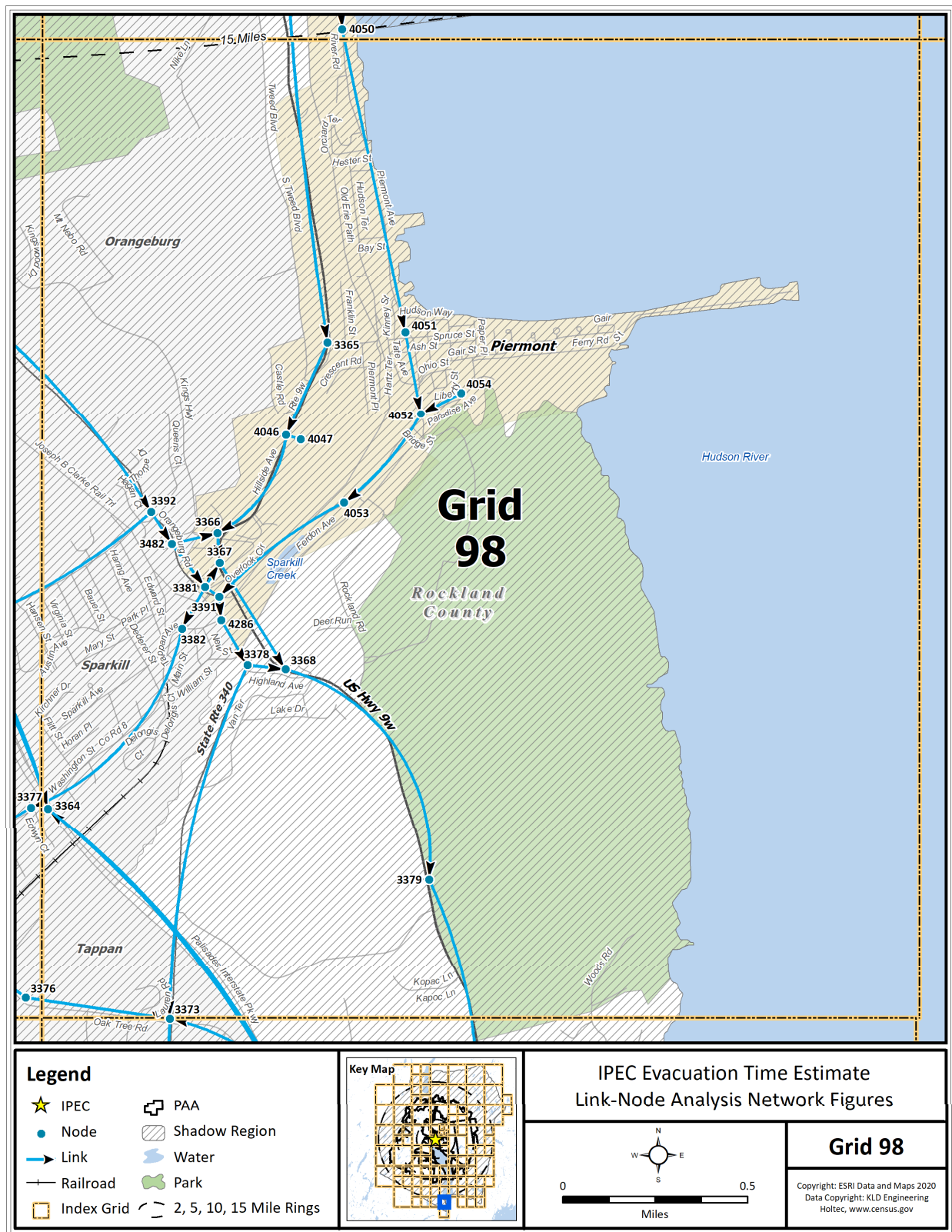


Figure K-99. Link-Node Analysis Network – Grid 98

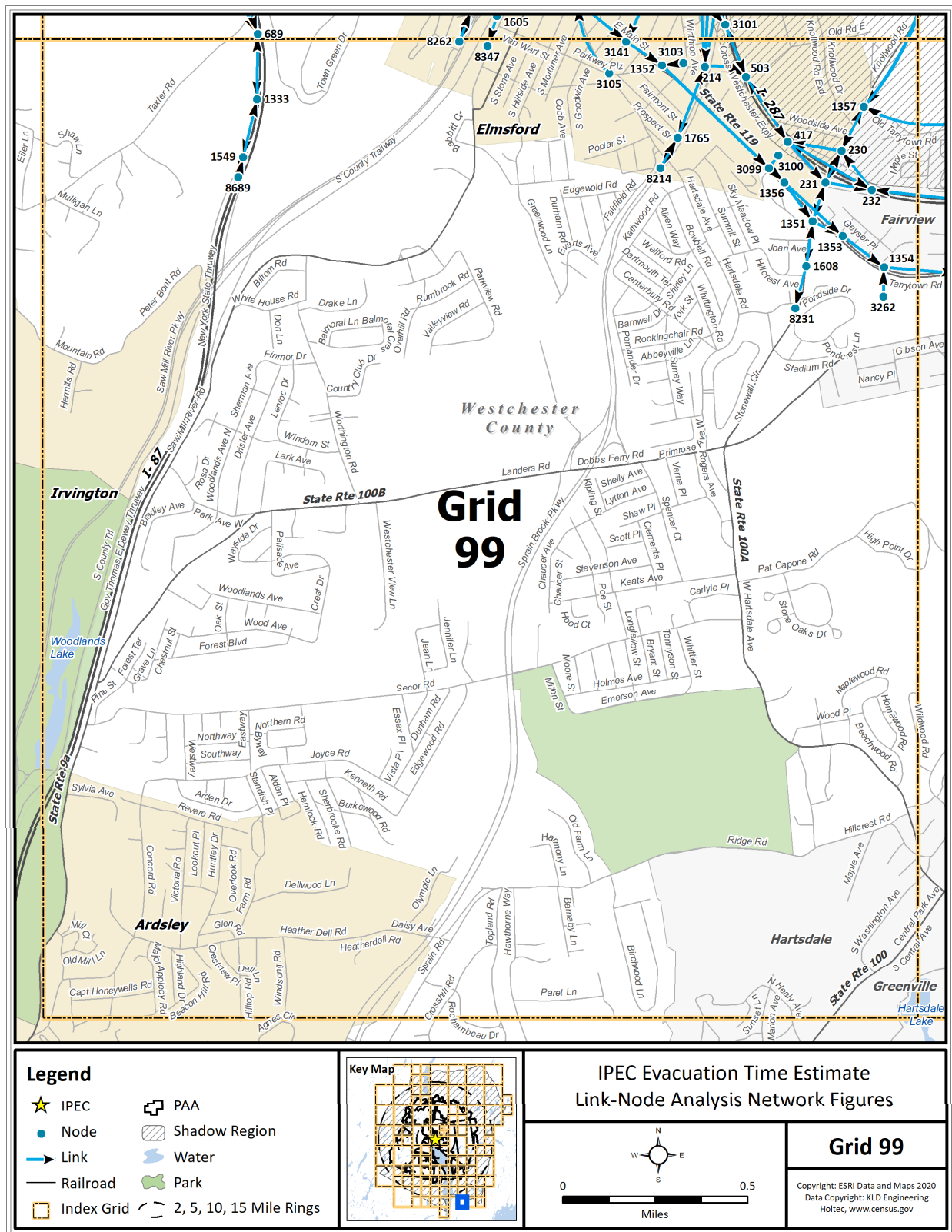


Figure K-100. Link-Node Analysis Network – Grid 99

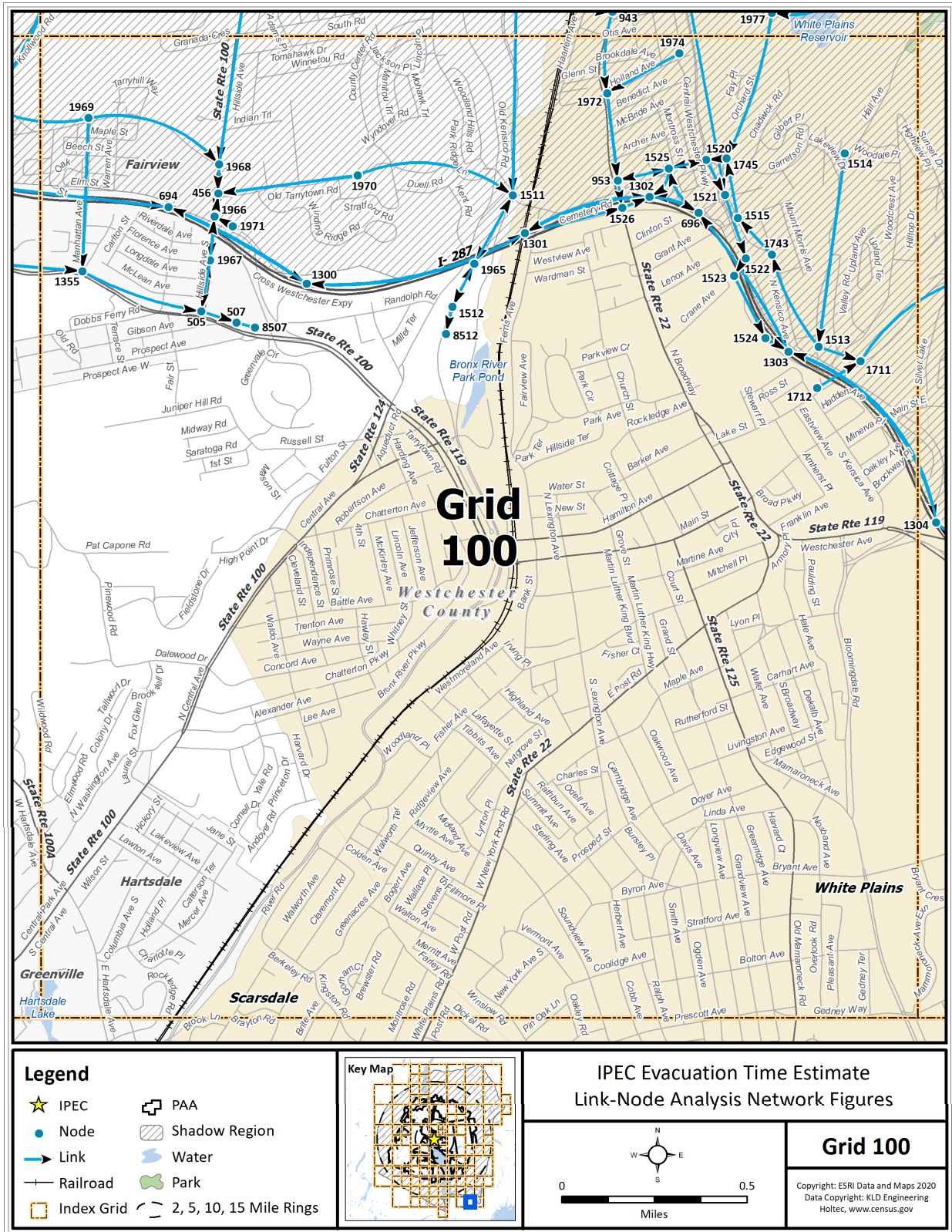


Figure K-101. Link-Node Analysis Network – Grid 100

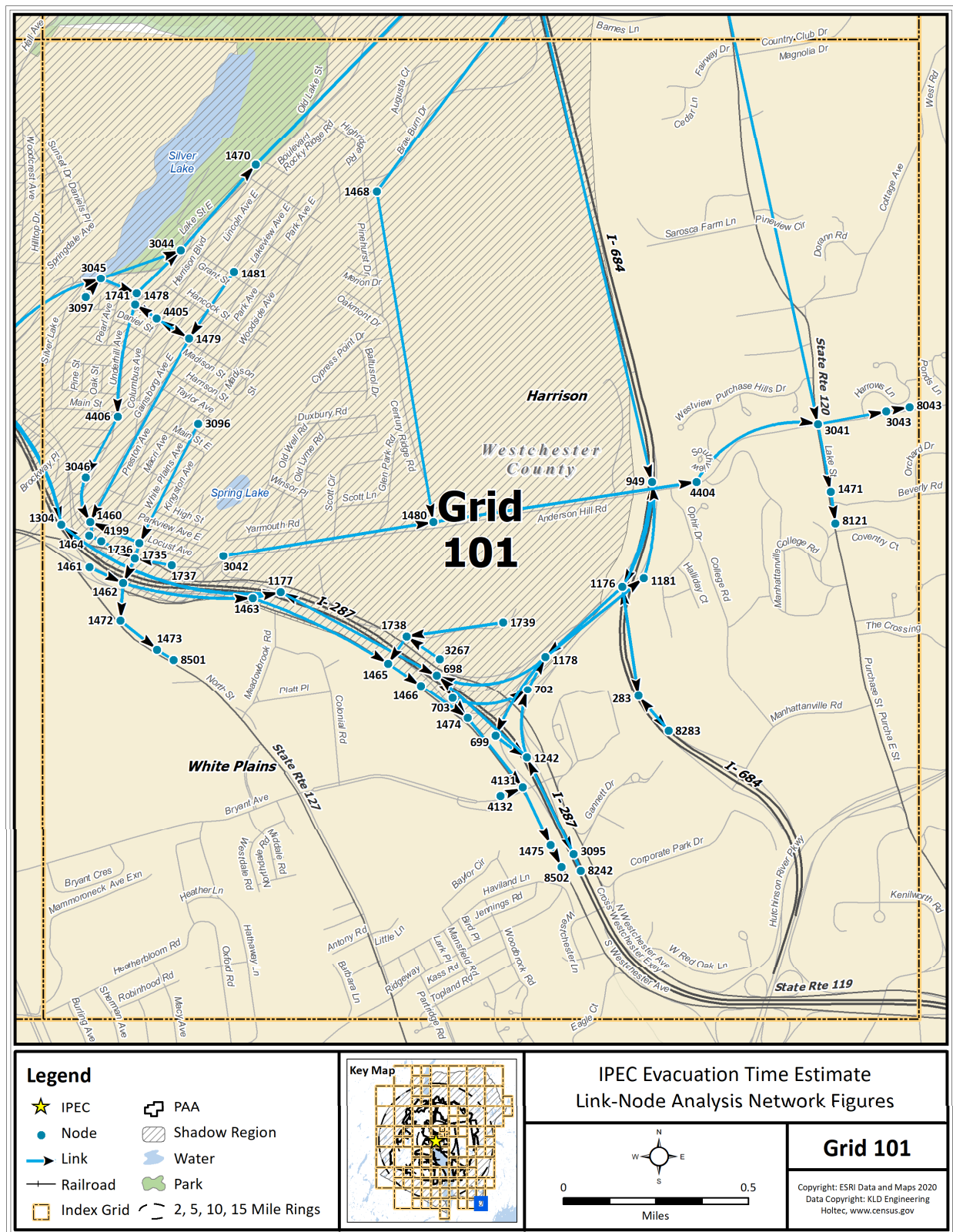


Figure K-102. Link-Node Analysis Network – Grid 101

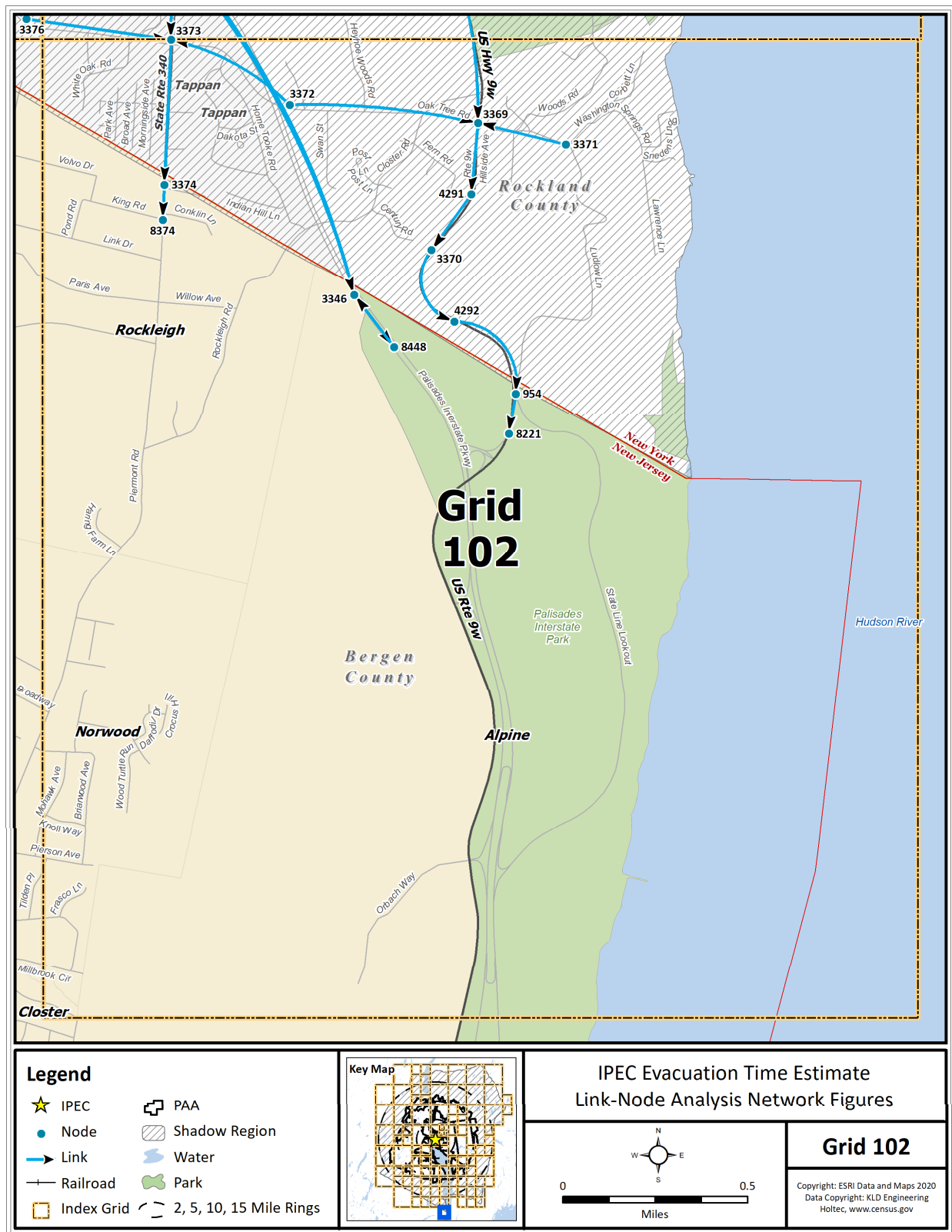


Figure K-103. Link-Node Analysis Network – Grid 102

APPENDIX L

Protective Action Area Boundaries

L. PROTECTIVE ACTION AREA BOUNDARIES

Table L-1. Orange County Protective Action Area Descriptions

Protective Action Area	Description
Town of Tuxedo east of NYS Thruway	The Town of Tuxedo east of the NYS Thruway from the Rockland County line to the Town of Woodbury town line (not in Harriman State Park).
Village of Harriman east of NYS Thruway	Village of Harriman east of NYS Thruway.
Fort Montgomery	The Hamlet of Fort Montgomery.
Village of Highland Falls	Village of Highland Falls.
Village of Woodbury east of NYS Thruway	The Village of Woodbury east of the NYS Thruway from the Town of Tuxedo to the Town of Cornwall.
U.S. Military Academy	The United States Military Academy (West Point)
Town of Highlands	The Town of Highlands excluding the Village of Highland Falls and the Hamlet of Fort Montgomery.
Town of Cornwall (S. of Angola Road)	The Town of Cornwall from the Woodbury Town Line east of Route 32 and south of Angola Rd to Route 9W west of Route 9W to the Town of Highlands town line.
Bear Mountain State Park	The portion of Bear Mountain State Park in Orange County.
Harriman State Park	The portion of Harriman State Park in Orange County.
Hudson River	The portion of the Hudson River in Orange County.

Table L-2. Putnam County Protective Action Area Descriptions

Protective Action Area	Description
Southwest Carmel	The southwestern corner of the Town of Carmel; that is, the portion south of Lake Secor Road (County Route 30), and west of State Route 6N, including the area known as Secor.
Lower Philipstown	The most southern part of the Town of Philipstown; that is, south of Canopus Hollow Road; Old West Point Road east, east of US Route Canopus Hollow Road; Old West Point Road east, east of US Route 9, south of State Route 403, Lower Station Road and a short line from Lower Station Road as it nears the river to the boat basin just south of Garrison. This part includes the area known as Continental Village.
Southern Putnam Valley	The southern portion of the Town of Putnam Valley; that is, the portion south of Clarence Fahnestock Memorial State Park and west of Sunken Mine Road, south of Northshore Road, west of Lake Road (County Route 20), south of Tinker Hill Road, Peekskill Hollow Road, Bryant Pond Road and Lake Secor Road. This portion includes the areas known as Gilbert Corners, Sunnybrook, Oscawana Corners, Crofts Corners, Adams Corners, and Lake Peekskill.
Southern Philipstown	The southern half of Philipstown, not including the area defined as Lower Philipstown; that is, the Village of Garrison and the Village of Nelsonville except for the portion of Hudson Highlands State Park, and the portion of Philipstown south of Moffett Road, Lane Gate Road, Old Albany Post Road, Indian Brook Road and south of Clarence Fahnestock Memorial State Park, and including the areas known as Nelson Corners, Garrison, Travis Corners, South Highland, Four Corners, and Forsonville.
Hudson River	The portion of the Hudson River in Putnam County.

Table L-3. Rockland County Protective Action Area Descriptions

Protective Action Area	Description
Central Town of Clarkstown	Central part of the Town of Clarkstown, bounded on the south by (west to east) West Clarkstown Road, a short segment of the Palisades Interstate Parkway (PIP), Church Road, Germonds Road, Parrott Road McCarthy Way, a short segment of Strawtown Road, and Hillcrest Road; on the east by the western edge of DeForest Lake; on the north by (east to west) Congers Road, Goebel Road northward, State Route 304, Squadron Boulevard, Main Street northward, West Phillips Hill Road, Old Phillips Hill Road, Buena Vista Road northward, and Conklin Road; and an eastern portion of the Town of Ramapo, east of the PIP and south of Conklin Road and a short section of State Route 45 connecting Conklin Road to the PIP.
Northeastern Town of Ramapo	The Town of Ramapo west of the Palisades Interstate Parkway and north of Viola and Eckerson Roads, including the Villages of Wesley Hills, New Hempstead and New Square and the Hamlet of Hillcrest.
Northeastern & Eastern Town of Clarkstown	Northeastern and Eastern-central parts of the Town of Clarkstown, excepting High Tor State Park, bounded on the south by Crusher and Christian Herald Roads and Nyack Beach State Park and on the west by Lake Deforest, including the Hamlets of Congers and Valley Cottage and Rockland Lake and Hook Mountain State Parks.
Northwestern Town of Clarkstown	Northwestern part of the Town of Clarkstown, excepting High Tor State Park, bounded on the east by the western boundary of Lake De Forest, and on the south by (east to west) Congers Road, Goebel Road northward, State Route 304, Squadron Boulevard, Main Street northward, West Phillips Hill Road, Old Phillips Hill Road, Buena Vista Road northward, and Conklin Road; and the northeastern part of the Town of Ramapo, bounded on the west by the Palisades Interstate Parkway, and on the south by Conklin Road and a short section of State Route 45.
Village of Haverstraw	In the Town of Haverstraw, the Village of Haverstraw.
Village of West Haverstraw	In the Town of Haverstraw, the Village of West Haverstraw.
Unincorporated Areas of the Town of Haverstraw	The unincorporated areas of the Town of Haverstraw including the Hamlets of Thiells and Mount Ivy.
Village of Pomona	In the Towns of Haverstraw and Ramapo, the Village of Pomona and the unincorporated portions of the Hamlet of Pomona.
Grassy Point	Grassy Point east of the Penny Bridge, Minisceongo Yacht Club, Haverstraw Marina, Haverstraw Bay County Park, Bowline Park.

Table L-3. Rockland County Protective Action Area Descriptions (continued)

Protective Action Area	Description
Stony Point	The Town of Stony Point east of Bear Mountain and Harriman State Parks, south of Tompkins Cove and west of Grassy Point.
Tompkins Cove	Tompkins Cove zip code area.
Jones Point	Eastern part of Bear Mountain State Park and the Jones Point and Dunderberg areas, south of Salisbury Meadow and Ring Meadow and east of U.S. Route 9W/202, and including the non-park areas east and south of Dunderberg Mountain, north of the main southern boundary of Bear Mountain State Park.
Bear Mountain State Park	The eastern part of Harriman State Park and Bear Mountain State Park, bounded on the west and north by the Palisades Interstate Parkway northbound and U.S. Route 6 to the Bear Mountain Bridge, and south of Salisbury Meadow and Ring Meadow, on the east by U.S. Route 9W/202 and the Park boundary, where the boundary is west of Route 9W/202.
Harriman State Park	The central and western parts of Harriman State Park, bounded on the east by the Palisades Interstate Parkway (PIP) northbound and a line connecting PIP/US. Route 6 to the West Point Military Reservation boundary where they are very close, about 1 1/2 miles W of the Bear Mountain Bridge; on the south by the Ramapo/Haverstraw Town Line and the Rockland/Orange County Line southwestward; and on the west by the New York State Thruway (Interstate Route 87/287, not included in the EPZ) and the NW/SE running utility right-of-way crossing Smith Rock and Pound Mountain.
Hudson River	The portion of the Hudson River in Rockland County.

Table L-4. Westchester County Protective Action Area Descriptions

Protective Action Area	Description
Briarcliff Manor	The Village of Briarcliff Manor.
Ossining	The Town and Village of Ossining.
Town of New Castle (W. of Hardscrabble Rd)	The Town of New Castle west of Hardscrabble Road.
Croton-on-Hudson	The Village of Croton-on-Hudson.
Verplanck	The Hamlet of Verplanck.
Buchanan	The Village of Buchanan.
Montrose	The Hamlet of Montrose.
City of Peekskill	The City of Peekskill.
Town of Cortlandt	The Town of Cortlandt excluding the Hamlets of Verplanck and Montrose, and the Villages of Buchanan and Croton-on-Hudson; including Camp Smith and the FDR VA Hospital.
Yorktown	The Town of Yorktown.
Town of Somers (W. of Route 118)	The Town of Somers west of State Route 118/Tomahawk Street.
Hudson River	The portion of the Hudson River in Westchester County.

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 ATE could be persuaded to respond much more rapidly) or if the tail were elongated (i.e., spreading out the departure of evacuees to limit the demand during peak times), how would the ETE be affected? The case considered was Scenario 1, Region 3; a summer, midweek, midday, with good weather evacuation of the entire EPZ. Table M-1 presents the results of this study.

If evacuees mobilize one hour quicker, the ETE is reduced by 10 minutes and 40 minutes for the 90th and 100th percentile ETE, respectively. If evacuees take an additional hour to mobilize, the ETE is increased by 35 minutes and 1 hour for the 90th and 100th percentile ETE, respectively.

As discussed in Section 7.3, traffic congestion persists within the EPZ for approximately 6 hours and 30 minutes after the ATE. After this time, trip generation (plus a 10-minute travel time to the EPZ boundary) dictates the 100th percentile ETE. This is why the 100th percentile parallels the mobilization time. The 90th percentile ETE is entirely dictated by traffic congestion and is less sensitive to changes in mobilization time.

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 due to changes in the percentage of people who decide to relocate from the Shadow Region. The case considered was Scenario 1, Region 3; a summer, midweek, midday, with 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 ETE for each of the cases considered. The results show that the 90th and 100th percentile ETE are not impacted when shadow evacuation is eliminated (0%) or reduced to 10%.

Tripling the shadow evacuation percentage (60%) increases the 90th percentile ETE by 30 minutes and the 100th percentile ETE by 35 minutes – both are significant changes. Full evacuation (100%) of the shadow region increases the ETE by 1 hour and 10 minutes and 2 hours and 50 minutes for the 90th and 100th percentiles, respectively – both are significant changes. The increase in ETE is due to the Shadow Region being densely populated. The last areas to clear of congestion in the Shadow Region are to the northeast and southwest, both of which are densely populated areas. Increased evacuation in these areas adds to the congestion along I-684 northbound (the last road to clear in the study area) and NY-306 southbound, thereby prolonging ETE.

M.3 Effect of Changes in the Permanent Resident Population

A sensitivity study was conducted to determine the effect on ETE due to changes in the permanent 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 and could impact ETE.

As per the NRC's response to the Emergency Planning Frequently Asked Question (EPFAQ) 2013-001, the ETE population sensitivity study must be conducted to determine what percentage increase in permanent resident population causes an increase in the 90th percentile ETE of 25% or 30 minutes, whichever is less. The sensitivity study must use the scenario with the longest 90th percentile ETE (excluding the roadway impact scenario and the special event scenario if it is a one day per year special event).

Thus, the sensitivity study was conducted using the following planning assumptions:

1. The percent change in the population within the study area was increased by up to 15%. Changes in population were applied to permanent residents only (as per federal guidance), in both the EPZ and the Shadow Region.
2. The transportation infrastructure (as presented in Appendix K) remained fixed; the presence of future proposed roadway changes and/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 scenario (excluding roadway impact and special event) which yielded the longest 90th percentile ETE values was selected as the case to be considered in this sensitivity study (Scenario 8 – Winter, Midweek, Midday with Heavy Snow).

Table M-3 presents the results of the sensitivity study. Section IV of Appendix E to 10 CFR Part 50 requires licensees to provide an updated ETE analysis to the NRC when a population increase within the EPZ causes the longest 90th percentile ETE values (for the 2-Mile Region, 5-Mile Region or entire EPZ) to increase by 25% or 30 minutes, whichever is less. All the base ETE values are greater than 2 hours; thus, 25% of these base ETE is always greater than 30 minutes. Therefore, 30 minutes is the lesser and is the criterion for updating.

Those percent population changes which result in the longest 90th percentile ETE change greater than or equal to 30 minutes are highlighted in red in Table M-3 – a 14% or greater increase in the EPZ population. Holtec will have to estimate the EPZ population on an annual basis. If the EPZ population increases by 14% or more, an updated ETE analysis will be needed.

M.4 Enhancements in Evacuation Time

This appendix documents sensitivity studies on critical variables that could potentially impact ETE.

Possible improvements to ETE are further discussed below:

- Reducing mobilization time reduces ETE (Section M.1). Public outreach encouraging evacuees to mobilize more quickly (pack a bag in advance and have a family evacuation plan) or in a timely manner could decrease ETE.
- Increased shadow evacuation significantly impacts ETE (Section M.2). Public outreach could be considered to inform those people within the EPZ (and potentially beyond the EPZ) that if they are not advised to evacuate, they should not.
- Population growth results in more evacuating vehicles, which could increase ETE (Section M.3). Public outreach to inform people within the EPZ to evacuate as a family in a single vehicle would reduce the number of evacuating vehicles and could reduce ETE or offset the impact of population growth.

Table M-1. ETE for Trip Generation Sensitivity Study

Trip Generation Period	Evacuation Time Estimate for Entire EPZ	
	90 th Percentile	100 th Percentile
5 hours and 15 minutes	4:15	5:50
6 hours and 15 minutes (Base)	4:25	6:30
7 hours and 15 minutes	5:00	7:30

Table M-2. ETE for Shadow Sensitivity Study

Percent Shadow Evacuation	Evacuating Shadow Vehicles ¹	Evacuation Time Estimate for Entire EPZ	
		90 th Percentile	100 th Percentile
0	0	4:25	6:30
10	32,933	4:25	6:30
20 (Base)	65,866	4:25	6:30
40	131,732	4:40	7:00
60	197,598	4:55	7:05
80	263,464	5:10	7:55
100	329,330	5:35	9:20

Table M-3. ETE Variation with Population Change

EPZ and 20% Shadow Permanent Resident Population	Base	Population Change		
		13%	14%	15%
	438,436	495,433	499,817	504,201
ETE (hrs:mins) for the 90 th Percentile				
Region	Base	Population Change		
		13%	14%	15%
2-MILE	4:45	4:50	4:50	4:50
5-MILE	5:25	5:40	5:40	5:40
Full EPZ	5:45	6:10	6:15	6:15
ETE (hrs:mins) for the 100 th Percentile				
Region	Base	Population Change		
		13%	14%	15%
2-MILE	8:00	8:00	8:00	8:00
5-MILE	8:05	8:05	8:05	8:05
Full EPZ	8:10	8:35	8:40	9:00

¹ The evacuating Shadow Vehicles in Table M-2 represent the residents and employees who will spontaneously decide to relocate during the evacuation. The basis for the base values shown is a 20% relocation of shadow residents along with a proportional percentage of shadow employees. See Section 6 for further discussion.

APPENDIX N

ETE Criteria Checklist

N. ETE CRITERIA CHECKLIST

Table N-1. ETE Review Criteria Checklist

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
1.0 Introduction			
a.	The emergency planning zone (EPZ) and surrounding area is described.	Yes	Section 1
b.	A map is included that identifies primary features of the site including major roadways, significant topographical features, boundaries of counties, and population centers within the EPZ.	Yes	Figures 1-1, 3-1, 6-1
c.	A comparison of the current and previous ETE is provided including information similar to that identified in Table 1-1, "ETE Comparison."	Yes	Table 1-3
1.1 Approach			
a.	The general approach is described in the report as outlined in Section 1.1, "Approach."	Yes	Section 1.1, Section 1.3, Appendix D, Table 1-1
1.2 Assumptions			
a.	Assumptions consistent with Table 1-2, "General Assumptions," of NUREG/CR-7002 are provided and include the basis to support use.	Yes	Section 2
1.3 Scenario Development			
a.	The scenarios in Table 1-3, "Evacuation Scenarios," are developed for the ETE analysis. A reason is provided for use of other scenarios or for not evaluating specific scenarios.	Yes	Section 6, Table 6-2

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
1.4 Evacuation Planning Areas			
a.	A map of the EPZ with emergency response planning areas (ERPAs) is included.	Yes	Figure 3-1, Figure 6-1
1.4.1 Keyhole Evacuation			
a.	A table similar to Table 1-4 "Evacuation Areas for a Keyhole Evacuation", is provided identifying the ERPAs considered for each ETE calculation by downwind direction.	Yes	Table 6-1, Table 7-5, Table H-1
1.4.2 Staged Evacuation			
a.	The approach used in development of a staged evacuation is discussed.	Yes	Section 7.2
b.	A table similar to Table 1-5, "Evacuation Areas for a Staged Evacuation," is provided for staged evacuations identifying the ERPAs considered for each ETE calculation by downwind direction.	Yes	Table 6-1, Table 7-5, Table H-1
2.0 Demand Estimation			
a.	Demand estimation is developed for the four population groups (permanent residents of the EPZ, transients, special facilities, and schools).	Yes	Section 3
2.1 Permanent Residents and Transient Population			
a.	The U.S. Census is the source of the population values, or another credible source is provided.	Yes	Section 3.1
b.	The availability date of the census data is provided.	Yes	Section 3.1
c.	Population values are adjusted as necessary for growth to reflect population estimates to the year of the ETE.	Yes	N/A - 2020 used as the base year of the analysis

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
d. A sector diagram, similar to Figure 2-1, "Population by Sector," is included showing the population distribution for permanent residents.	Yes	Figure 3-2
2.1.1 Permanent Residents with Vehicles		
a. The persons per vehicle value is between 1 and 3 or justification is provided for other values.	Yes	Section 3.1
2.1.2 Transient Population		
a. A list of facilities that attract transient populations is included, and peak and average attendance for these facilities is listed. The source of information used to develop attendance values is provided.	Yes	Section 3.3, Table E-7 and Table E-9
b. Major employers are listed.	Yes	Section 3.4, Table E-6
c. The average population during the season is used, itemized and totaled for each scenario.	Yes	Table 3-4, Table 3-5 and Appendix E itemize the peak transient population and employee estimates. These estimates are multiplied by the scenario specific percentages provided in Table 6-3 to estimate average transient population by scenario – see Table 6-4.
d. The percentage of permanent residents assumed to be at facilities is estimated.	Yes	Section 3.3 and Section 3.4
e. The number of people per vehicle is provided. Numbers may vary by scenario, and if so, reasons for the variation are discussed.	Yes	Section 3.3 and Section 3.4

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
f.	A sector diagram is included, similar to Figure 2-1, "Population by Sector", is included showing the population distribution for the transient population.	Yes	Figure 3-6 (transients) and Figure 3-8 (employees)
2.2 Transit Dependent Permanent Residents			
a.	The methodology (e.g., surveys, registration programs) used to determine the number of transit dependent residents is discussed.	Yes	Section 3.6
b.	The State and local evacuation plans for transit dependent residents are used in the analysis.	Yes	Section 8.1
c.	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 is provided. Data from local/county registration programs are used in the estimate.	Yes	Section 3.9
d.	Capacities are provided for all types of transportation resources. Bus seating capacity of 50 percent is used or justification is provided for higher values.	Yes	Item 3 of Section 2.4
e.	An estimate of the transit dependent population is provided.	Yes	Section 3.6, Table 3-7, Table 3-11
f.	A summary table showing the total number of buses, ambulances, or other transport assumed available to support evacuation is provided. The quantification of resources is detailed enough to ensure that double counting has not occurred.	Yes	Table 3-12, Table 8-1

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
2.3 Special Facility Residents			
a.	Special facilities, including the type of facility, location, and average population, are listed. Special facility staff is included in the total special facility population.	Yes	Table E-5 lists all medical facilities by facility name, location, and average population. Table E-10 lists all correctional facilities by facility name, location, and average population.
b.	The method of obtaining special facility data is discussed.	Yes	Section 3.5 and Section 3.10
c.	An estimate of the number and capacity of vehicles assumed available to support the evacuation of the facility is provided.	Yes	Table 3-6
d.	The logistics for mobilizing specially trained staff (e.g., medical support or security support for prisons, jails, and other correctional facilities) are discussed when appropriate.	Yes	Section 8.1 – under Evacuation of Medical Facilities and Correctional Facilities.
2.4 Schools			
a.	A list of schools including name, location, student population, and transportation resources required to support the evacuation, is provided. The source of this information should be identified.	Yes	Table 3-8, Table E-1 through E-4, Section 3.7
b.	Transportation resources for elementary and middle schools are based on 100 percent of the school capacity.	Yes	Section 3.7
c.	The estimate of high school students who will use personal vehicle to evacuate is provided and a basis for the values used is given.	Yes	Section 3.7
d.	The need for return trips is identified.	Yes	Section 8.1

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
2.5 Other Demand Estimate Considerations			
2.5.1 Special Events			
a.	A complete list of special events is provided including information on the population, estimated duration, and season of the event.	Yes	Section 3.8
b.	The special event that encompasses the peak transient population is analyzed in the ETE.	Yes	Section 3.8
c.	The percentage of permanent residents attending the event is estimated.	Yes	Section 3.8
2.5.2 Shadow Evacuation			
a.	A shadow evacuation of 20 percent is included consistent with the approach outlined in Section 2.5.2, "Shadow Evacuation".	Yes	Item 7 of Section 2.2, Figure 2-1 and Figure 7-1, Section 3.2
b.	Population estimates for the shadow evacuation in the shadow region beyond the EPZ are provided by sector.	Yes	Section 3.2, Table 3-3, Figure 3-4
c.	The loading of the shadow evacuation onto the roadway network is consistent with the trip generation time generated for the permanent resident population.	Yes	Section 5 – Table 5-9 (footnote)
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 3.11 and Section 3.12

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
b. The method of reducing background and pass-through traffic is described.	Yes	Section 2.2 – Assumptions 10 and 12 Section 2.5 Section 3.11 and Section 3.12 Table 6-3 – External Through Traffic footnote
c. Pass-through traffic is assumed to have stopped entering the EPZ about two (2) hours after the initial notification.	Yes	Section 2.5
2.6 Summary of Demand Estimation		
a. A summary table is provided that identifies the total populations and total vehicles used in the analysis for permanent residents, transients, transit dependent residents, special facilities, schools, shadow population, and pass-through demand in each scenario.	Yes	Table 3-11, Table 3-12, and Table 6-4
3.0 Roadway Capacity		
a. The method(s) used to assess roadway capacity is discussed.	Yes	Section 4
3.1 Roadway Characteristics		
a. The process for gathering roadway characteristic data is described including the types of information gathered and how it is used in the analysis.	Yes	Section 1.3, Appendix D
b. Legible maps are provided that identify nodes and links of the modeled roadway network similar to Figure A-1, “Roadway Network Identifying Nodes and Links,” and Figure A-2, “Grid Map Showing Detailed Nodes and Links.”	Yes	Appendix K

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
3.2 Model Approach			
a.	The approach used to calculate the roadway capacity for the transportation network is described in detail, and the description identifies factors that are expressly used in the modeling.	Yes	Section 4
b.	Route assignment follows expected evacuation routes and traffic volumes.	Yes	Appendix B and Appendix C
c.	A basis is provided for static route choices if used to assign evacuation routes.	N/A	Static route choices are not used to assign evacuation routes. Dynamic traffic assignment is used.
d.	Dynamic traffic assignment models are described including calibration of the route assignment.	Yes	Appendix B and Appendix C
3.3 Intersection Control			
a.	A list that includes the total numbers of intersections modeled that are unsignalized, signalized, or manned by response personnel is provided.	Yes	Table K-1
b.	The use of signal cycle timing, including adjustments for manned traffic control, is discussed.	Yes	Section 4, Appendix G
3.4 Adverse Weather			
a.	The adverse weather conditions are identified.	Yes	Assumptions 2 and 3 of Section 2.6
b.	The speed and capacity reduction factors identified in Table 3-1, "Weather Capacity Factors," are used or a basis is provided for other values, as applicable to the model.	Yes	Table 2-2
c.	The calibration and adjustment of driver behavior models for adverse weather conditions are described, if applicable.	N/A	Driver behavior is not adjusted for adverse weather conditions.

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
d.	The effect of adverse weather on mobilization is considered and assumptions for snow removal on streets and driveways are identified, when applicable.	Yes	Table 2-2
4.0 Development of Evacuation Times			
4.1 Traffic Simulation Models			
a.	General information about the traffic simulation model used in the analysis is provided.	Yes	Section 1.3, Table 1-3, Appendix B, Appendix C
b.	If a traffic simulation model is not used to perform the ETE calculation, sufficient detail is provided to validate the analytical approach used.	N/A	Not applicable since a traffic simulation model was used.
4.2 Traffic Simulation Model Input			
a.	Traffic simulation model assumptions and a representative set of model inputs are provided.	Yes	Section 2, Appendix J
b.	The number of origin nodes and method for distributing vehicles among the origin nodes are described.	Yes	Appendix J, Appendix C
c.	A glossary of terms is provided for the key performance measures and parameters used in the analysis.	Yes	Appendix A
4.3 Trip Generation Time			
a.	The process used to develop trip generation times is identified.	Yes	Section 5
b.	When surveys are used, the scope of the survey, area of the survey, number of participants, and statistical relevance are provided.	Yes	Appendix F
c.	Data used to develop trip generation times are summarized.	Yes	Appendix F, Section 5

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
d. The trip generation time for each population group is developed from site-specific information.	Yes	Section 5
e. The methods used to reduce uncertainty when developing trip generation times are discussed, if applicable.	Yes	Appendix F
4.3.1 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 before 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. Section 2.3, Assumption 1 and 3
b. The trip generation time accounts for the time and method to notify transients at various locations.	Yes	Section 5
c. The trip generation time accounts for transients potentially returning to hotels before evacuating.	Yes	Section 5, Figure 5-1
d. The effect of public transportation resources used during special events where a large number of transients are expected is considered.	Yes	Section 3.8 Public Transportation is not provided for the special event and was therefore not considered.

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
4.3.2 Transit Dependent Permanent Residents			
a.	If available, existing and approved plans and bus routes are used in the ETE analysis.	N/A	Established bus routes do not exist. Section 8.1 under Evacuation of Transit-Dependent People
b.	The means of evacuating ambulatory and non-ambulatory residents are discussed.	Yes	Section 8.1 under Evacuation of Transit-Dependent People, Section 8.2
c.	Logistical details, such as the time to obtain buses, brief drivers and initiate the bus route are used in the analysis.	Yes	Section 8.1, Figure 8-1
d.	The estimated time for transit dependent residents to prepare and then travel to a bus pickup point, including the expected means of travel to the pickup point, is described.	Yes	Section 8.1 under Evacuation of Transit-Dependent People
e.	The number of bus stops and time needed to load passengers are discussed.	Yes	Section 8.1, Table 8-5 through Table 8-7
f.	A map of bus routes is included.	Yes	Figure 10-5 through Figure 10-10 show bus stops in each county.
g.	The trip generation time for non-ambulatory persons including the time to mobilize ambulances or special vehicles, time to drive to the home of residents, time to load, and time to drive out of the EPZ, is provided.	Yes	Section 8.2
h.	Information is provided to support analysis of return trips, if necessary.	Yes	Section 8.1 and Section 8.2
4.3.3 Special Facilities			
a.	Information on evacuation logistics and mobilization times is provided.	Yes	Section 2.4, Section 8.1, Table 8-8 through Table 8-10

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
b. The logistics of evacuating wheelchair and bed bound residents are discussed.	Yes	Section 8.1, Table 8-8 through Table 8-10
c. Time for loading of residents is provided.	Yes	Section 2.4, Section 8.1, Table 8-8 through Table 8-10
d. Information is provided that indicates whether the evacuation can be completed in a single trip or if additional trips are needed.	Yes	Section 8.1
e. Discussion is provided on whether special facility residents are expected to pass through the reception center before being evacuated to their final destination.	Yes	Section 8.1
f. Supporting information is provided to quantify the time elements for each trip, including destinations if return trips are needed.	Yes	Section 8.1
4.3.4 Schools		
a. Information on evacuation logistics and mobilization times is provided.	Yes	Section 2.4, Section 8.1, Table 8-2 through Table 8-4
b. Time for loading of students is provided.	Yes	Section 2.4, Section 8.1, Table 8-2 through Table 8-4
c. Information is provided that indicates whether the evacuation can be completed in a single trip or if additional trips are needed.	Yes	Section 8.1
d. If used, reception centers should be identified. A discussion is provided on whether students are expected to pass through the reception center before being evacuated to their final destination.	Yes	Section 8.1, Table 10-11 through Figure 10-14

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
e. Supporting information is provided to quantify the time elements for each trip, including destinations if return trips are needed.	Yes	Section 8.1, Table 8-2 through Table 8-4
4.4 Stochastic Model Runs		
a. The number of simulation runs needed to produce average results is discussed.	N/A	DYNEV does not rely on simulation averages or random seeds for statistical confidence. For DYNEV/DTRAD, it is a meso-scopic simulation and uses dynamic traffic assignment model to obtain the "average" (stable) network work flow distribution. This is different from microscopic simulation, which is monte-carlo random sampling by nature relying on different seeds to establish statistical confidence. Refer to Appendix B for more details
b. If one run of a single random seed is used to produce each ETE result, the report includes a sensitivity study on the 90 percent and 100 percent ETE using 10 different random seeds for evacuation of the full EPZ under Summer, Midweek, Daytime, Normal Weather conditions.	N/A	
4.5 Model Boundaries		
a. The method used to establish the simulation model boundaries is discussed.	Yes	Section 4.5
b. Significant capacity reductions or population centers that may influence the ETE and that are located beyond the evacuation area or shadow region are identified and included in the model, if needed.	Yes	Section 4.5

NRC Review Criteria		Addressed in ETE Analysis (Yes/No/NA)	Comments
4.6 Traffic Simulation Model Output			
a.	A discussion of whether the traffic simulation model used must be in equilibration prior to calculating the ETE is provided.	Yes	Appendix B
b.	<p>The minimum following model outputs for evacuation of the entire EPZ are provided to support review:</p> <ol style="list-style-type: none"> 1. Evacuee average travel distance and time. 2. Evacuee average delay time. 3. Number of vehicles arriving at each destination node. 4. Total number and percentage of evacuee vehicles not exiting the EPZ. 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	<ol style="list-style-type: none"> 1. Appendix J, Table J-2 2. Table J-2 3. Table J-4 4. None and 0%. 100 percent ETE is based on the time the last vehicle exits the evacuation zone 5. Figures J-2 through J-15 (one plot for each scenario considered) 6. Table J-3
c.	Color coded roadway maps are provided for various times (e.g., at 2, 4, 6 hrs.) during a full EPZ evacuation scenario, identifying areas where congestion exists.	Yes	Figure 7-3 through Figure 7-9
4.7 Evacuation Time Estimates for the General Public			
a.	The ETE includes the time to evacuate 90 percent and 100 percent of the total permanent resident and transient population.	Yes	Table 7-1 and Table 7-2
b.	Termination criteria for the 100 percent ETE are discussed, if not based on the time the last vehicle exits the evacuation zone.	N/A	100 percent ETE is based on the time the last vehicle exits the evacuation zone.

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
c. The ETE for 100 percent of the general public includes all members of the general public. Any reductions or truncated data is explained.	Yes	Section 5.4.1 – truncating survey data to eliminate statistical outliers Table 7-2 – 100 th percentile ETE for general population
d. Tables are provided for the 90 and 100 percent ETEs similar to Table 4-3, “ETEs for a Staged Evacuation,” and Table 4-4, “ETEs for a Keyhole Evacuation.”	Yes	Table 7-3 and Table 7-4
e. ETEs are provided for the 100 percent evacuation of special facilities, transit dependent, and school populations.	Yes	Section 8
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 are discussed.	Yes	Section 9, Appendix G
b. Adjustments or additions to the traffic control plan that affect the ETE is provided.	Yes	Section 9, Appendix G
5.2 Enhancements in Evacuation Time		
a. The results of assessments for enhancing evacuations are provided.	Yes	Appendix M
5.3 State and Local Review		
a. A list of agencies contacted is provided and the extent of interaction with these agencies is discussed.	Yes	Table 1-1

NRC Review Criteria	Addressed in ETE Analysis (Yes/No/NA)	Comments
b. Information is provided on any unresolved issues that may affect the ETE.	Yes	Results of the ETE study were formally presented to state and local agencies at the final project meeting. Comments on the draft report were provided and were addressed in the final report. There are no unresolved issues.
5.4 Reviews and Updates		
a. The criteria for when an updated ETE analysis is required to be performed and submitted to the NRC is discussed.	Yes	Appendix M, Section M.3
5.4.1 Extreme Conditions		
a. The updated ETE analysis reflects the impact of EPZ conditions not adequately reflected in the scenario variations.	N/A	This ETE is being updated as a result of the availability of US Census Bureau decennial census data.
5.5 Reception Centers and Congregate Care Center		
a. A map of congregate care centers and reception centers is provided.	Yes	Table 10-11 through Figure 10-14