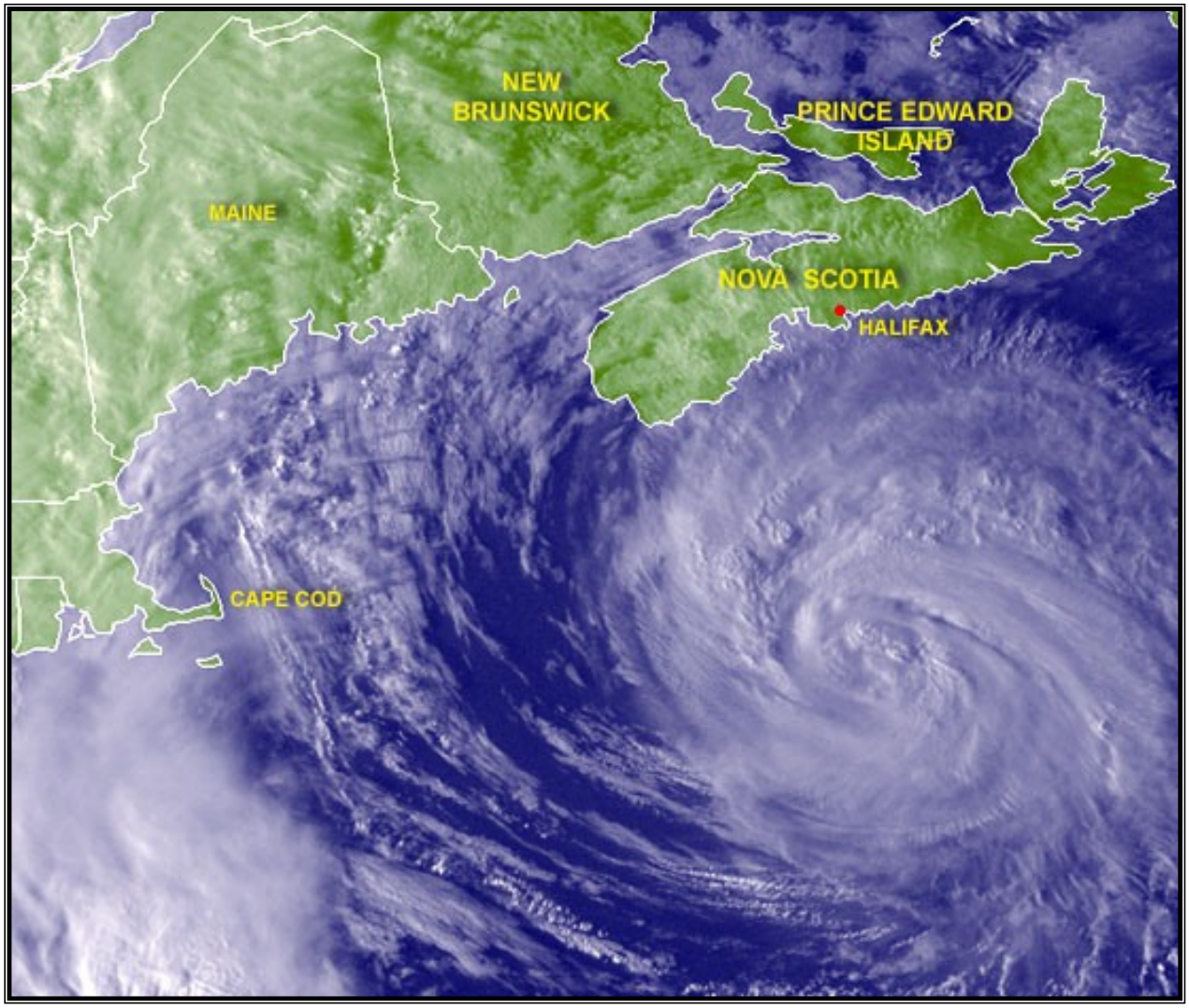
Maine
Hurricane Evacuation Study
Transportation Analysis – 2007



July 2007

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DEPARTMENT of DEFENSE, VETERANS and EMERGENCY MANAGEMENT
Maine Emergency
Management Agency
STATE OF MAINE

MAINE HURRICANE EVACUATION STUDY
TRANSPORTATION ANALYSIS 2007

FINAL REPORT

Prepared for:

U.S. Army Corps of Engineers, Boston District and
Battelle Memorial Institute

Prepared by:

Post, Buckley, Schuh and Jernigan, Inc.
1901 Commonwealth Lane
Tallahassee, Florida 32303

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TABLE OF CONTENTS

Chapter	Title	Page
	Table Of Contents	i
	List of Figures	ii
	List of Tables	iii
1.0	INTRODUCTION	
	1.1 Overview	1-1
	1.2 Analysis Objectives and Scope	1-3
	1.3 Coordination and Review Activities	1-4
2.0	TRANSPORTATION ANALYSIS AND INPUT ASSUMPTIONS	
	2.1 Traffic Evacuation Zones	2-1
	2.2 Housing and Population Data	2-17
	2.3 Behavioral Assumptions	2-21
	2.4 Roadway Network Characteristics	2-25
3.0	EVACUATION CLEARANCE TIME MODEL APPLICATION/SYSTEM FORECASTS	
	3.1 Clearance Time Model Description	3-1
	3.2 Evacuating People and Vehicles by Plan	3-4
	3.3 Public Shelter Demand/Capacity Considerations	3-10
	3.4 Evacuation Traffic Volumes and Critical Roadway Segments	3-11
	3.5 Estimated Evacuation Clearance Times	3-17
	3.6 General Traffic Control Measures	3-57

TRANSPORTATION MODEL SUPPORT DOCUMENT (under separate cover)

LIST OF FIGURES

Figure Number	Title	Page
2-1a	Traffic Analysis Sectors and Surge Zones - York	2-3
2-1b	Traffic Analysis Sectors and Surge Zones - Cumberland	2-4
2-1c	Traffic Analysis Sectors and Surge Zones - Sagadahoc	2-5
2-1d	Traffic Analysis Sectors and Surge Zones - Lincoln	2-6
2-1e	Traffic Analysis Sectors and Surge Zones - Knox	2-7
2-1f	Traffic Analysis Sectors and Surge Zones - Kennebec	2-8
2-1g	Traffic Analysis Sectors and Surge Zones - Waldo	2-9
2-1h	Traffic Analysis Sectors and Surge Zones - Hancock	2-10
2-1i	Traffic Analysis Sectors and Surge Zones - Penobscot	2-12
2-1j	Traffic Analysis Sectors and Surge Zones - Washington	2-15
2-2	Behavioral Response Curves	2-23
2-3	Evacuation Road Network - York	2-26
2-4	Evacuation Sector Loading Points - York	2-27
2-5	Evacuation Road Network - Cumberland	2-28
2-6	Evacuation Sector Loading Points - Cumberland	2-29
2-7	Evacuation Road Network - Sagadahoc	2-30
2-8	Evacuation Sector Loading Points - Sagadahoc	2-31
2-9	Evacuation Road Network - Lincoln	2-32
2-10	Evacuation Sector Loading Points - Lincoln	2-33

LIST OF FIGURES (cont.)

2-11	Evacuation Road Network - Knox	2-34
2-12	Evacuation Sector Loading Points - Knox	2-35
2-13	Evacuation Road Network - Kennebec	2-36
2-14	Evacuation Sector Loading Points - Kennebec	2-37
2-15	Evacuation Road Network - Waldo	2-38
2-16	Evacuation Sector Loading Points - Waldo	2-39
2-17	Evacuation Road Network - Hancock	2-40
2-18	Evacuation Sector Loading Points - Hancock	2-41
2-19	Evacuation Road Network – South Penobscot	2-42
2-20	Evacuation Sector Loading Points - South Penobscot	2-43
2-21	Evacuation Road Network – North Penobscot	2-44
2-22	Evacuation Sector Loading Points - North Penobscot	2-45
2-23	Evacuation Road Network - Washington	2-46
2-24	Evacuation Sector Loading Points - Washington	2-47
3-1	Transportation Model Inputs and Outputs	3-3
3-2	Components of Evacuation Time	3-18

LIST OF TABLES

Table Number	Title	Page
2-1	Key Population/Dwelling Unit Summary	2-17
3-1	Evacuating People Statistics by Storm Plan	3-5
3-2	Critical Roadway Locations/Segments	3-13
3-3a - m	Current Year Clearance Times (in hours) – In County Movement	3-19
3-4a - f	Current Year Clearance Times (in hours) – Maine Regional Movement	3-32
3-5a - l	2012 Clearance Times (in hours) – In County Movement	3-38
3-6a - f	2012 Year Clearance Times (in hours) – Maine Regional Movement	3-51

1.0 INTRODUCTION

1.1 OVERVIEW

Although the Maine coast is not normally regarded as having a hurricane threat, historical records indicate otherwise. Even in recent history Hurricanes Bob and Agnes have visited their suite of hazards of Maine, both on the coast and inland, inflicting a significant amount of hardship and damage on the people and property of the State. For that reason, the U.S. Army Corps of Engineers (USACE) and the Federal Emergency Management Agency (FEMA) has undertaken this effort to prepare a study to analyze the possible impacts of various hurricane hazards on the State, as well as determine the amount of response time necessary to ensure all populations are out of the threatened areas before the effects of any hurricane arrive.

The study area faces distinct challenges due to the variety of vulnerable populations that must be considered in the evacuation process. For example, the peak time for tourism is during the summer and fall months when large numbers of people from New England and Canada flock to the coast to enjoy the recreational and sightseeing opportunities. On a typical summer day the Maine Turnpike conveys more than twice the normal traffic volumes observed during months outside the tourist season. Furthermore, many of these tourists reside while at their vacation destinations in recreational vehicles and other camping-related shelters that are not at all viable in hurricane force winds. Consequently most of them, regardless of proximity to the coast, will be forced to evacuate from the approaching threat of a hurricane.

Additionally, many permanent residents and certainly the visitors are probably not even aware that a hurricane threat exists for that portion of the coast and accordingly are not prepared for the possibility of having to flee from such an eventuality. A further compounding problem is the speed at which these tropical systems may be traveling as they approach the Maine and New England Coastline. Once these tropical cyclones become imbedded in the jet stream, their forward movement can accelerate to speeds in excess of 65 miles AN hour covering large distances in a very short amount of time. Frequently these coastal and inland populations will have to implement their protective actions well before the onset of any obvious storm related effects, while the weather is beautiful, which will only slow their response to any directives issued from local officials relative to

the approaching hurricanes. Due to these factors, public information, effective emergency communications, and active alert and notification systems are needed not only to warn residents and visitors of the impending danger, but also to convince them that the threat is real and requires their taking protective action, in many cases sooner than later.

The roadway network in the coastal portions of Maine, especially beyond York and Cumberland Counties are not necessarily suited to handle the possibility of the large and sudden vehicle loads that a major evacuation during the high tourist season may engender. The relatively light routine daily traffic volumes do not necessarily warrant the construction of significantly larger roadways to accommodate the few weeks of relatively heavy tourist traffic during a normal summer, much less the possibility of an evacuation from a major hurricane event. Furthermore, many of the roadways that may handle even the increased vehicle loads of an evacuation could not necessarily accommodate the evacuation traffic in a rapid response scenario when many vehicles enter the roadway network simultaneously.

Furthermore, the predominant evacuation routes, namely I-95 and US 1, for the coastal areas parallel the coast and in many cases are not inland enough to provide any guarantee that vehicles traveling on those roadways would not be directly subjected to high winds and flooding before and during the onset of tropical storm force winds. Another issue with roadways running parallel, rather than perpendicular to the coast is there is no assurance that the routes will take those vehicles to points of greater safety than from where they began their evacuation trips. In the context of forecast uncertainty, the vehicles may ultimately be traveling to locations that experience far greater impacts than the coastal regions they directed to evacuate from.

During a hurricane evacuation, a significant number of vehicles will have to travel through certain segments of the local and regional road network. The quantity of evacuating vehicles will vary depending upon the magnitude of the hurricane, publicity and warnings provided about the storm and particular behavioral response characteristics of the vulnerable population. In the event of an evacuation, the entry of vehicles onto the road network typically depends on the response of evacuees to an evacuation order or storm advisory. Conversely, vehicles exit the roadway network depending on both the planned destinations of evacuees and the availability of acceptable

destinations such as public shelters, hotel/motel units and the homes of friends or relatives in non-surge prone areas. The speed at which vehicles on the road network can travel from origin to destination is dependent upon the rate of traffic loading on specific roadway segments and the ability of those segments to handle a particular volume of vehicles each hour. In order to produce accurate clearance times, the analysis of the study area must account for the impacts of evacuation traffic generated by neighboring counties using roadways within the study area.

This report documents the basic inputs and findings of the study analysis. A separately bound appendix entitled Transportation Model Support Document provides modeling information and data files too extensive for this report.

1.2 ANALYSIS OBJECTIVES AND SCOPE

Recognizing the importance of accurate clearance times, the U.S. Army Corps of Engineers (USACE) through the Battelle Memorial Institute hired Post, Buckley, Schuh and Jernigan, Inc. (PBS&J) to perform the tasks necessary to update the area's hurricane evacuation clearance times. The major objectives of the study were as follows:

(1) Use evacuation zones and scenarios developed by local emergency management, the U.S. Army Corps of Engineers (USACE) and the Maine Emergency Management Agency (MEMA) for transportation modeling and clearance time calculations for each county;

(2) Quantify the potential evacuation population for each scenario using socioeconomic and behavioral data provided by the USACE;

(3) Identify the existing evacuation roadway network, recognizing improvements that have been added since the completion of the last evacuation study by the USACE;

(4) Develop hurricane evacuation clearance times for each county and storm scenario using 2007 as the base year;

(5) Determine regional evacuation traffic that is expected to cross county lines in order to increase the accuracy of operational planning;

(6) Identify local and regional bottlenecks/critical roadway segments and where

applicable, recommend general traffic control strategies;

(7) Develop road network graphics in an ArcInfo/ArcView usable format; and

(8) Use evacuation zones and plans developed by the USACE and counties for transportation modeling and clearance time calculations for each county; develop a simplistic abbreviated model in a spreadsheet format that can be used by the USACE, the counties, and other organizations to modify clearance times based on land use and system changes.

1.3 COORDINATION AND REVIEW ACTIVITIES

This study came to fruition through extensive cooperation by the USACE with local emergency management (EM) staff, MEMA and PBS&J. The effort included the collection of socioeconomic data for hurricane evacuation zones developed by USACE and local emergency management, integrating those figures with on-hand behavioral data, as well as coordination of the various technical inputs. Zones, input assumptions, and evacuation statistics used to form the foundation of the analysis were established through study organization and kickoff meetings with local emergency management and other relevant officials held in October 2006, as well as phone coordination.

2.0 TRANSPORTATION ANALYSIS AND INPUT ASSUMPTIONS

The hurricane evacuation transportation modeling performed for the study area required a number of important data inputs and assumptions regarding anticipated evacuation behavior. All hurricanes differ from one another in some respect. Therefore, it is necessary to set forth clear assumptions about storm characteristics and the expected response from evacuees before this type of transportation modeling can begin. Not only does a storm vary in its track, intensity, and size, but also in the way residents in potentially vulnerable areas perceive it. These factors can cause a wide variance in the behavior of the vulnerable population. Even the time of day at which a storm makes landfall influences the parameters of an evacuation response.

The hurricane evacuation transportation analysis produces clearance times based on a set of assumed conditions and behavioral responses. It is likely that an actual storm will differ from a simulated storm for which clearance times are calculated in this report. Therefore, a sensitivity analysis was performed during the transportation modeling. Those variables having the greatest influence on clearance times were identified and then varied to establish the logical range within which the actual input assumption values may fall.

Key input assumptions guiding the transportation analysis include the following:

1. Traffic Evacuation Zones
2. Housing and Population Data
3. Behavioral Characteristics of the Evacuating Population
4. Roadway Network Assumptions

2.1 TRAFFIC EVACUATION SECTORS AND ZONES

The foundation of the analysis are the surge inundation limits developed by the USACE with Sea, Lake and Overland Surges from Hurricane (SLOSH) data. Using the SLOSH inundation limits for category 1 through 4 tropical cyclones and the boundaries of the Minor Civil Divisions within each County, surge or evacuation zones were developed for each jurisdiction. The primary purpose of the

surge/evacuation zones is to delineate target areas that will be directed to evacuate by local emergency management for various storm scenarios. In order to have a manageable number of analysis zones for this transportation analysis, each county was divided into a series of evacuation analysis sectors for clearance time modeling, each sector coinciding with the Minor Civil Division boundaries. Each Evacuation Sector within a county contains a different mix of surge/evacuation zones; a sector may only consist of one evacuation zone throughout its entire extent, while others may have all four levels of surge evacuation zones and an inland evacuation zone also. Figures 2-1a through 2-1j contain a breakdown of each sector (minor civil division) and the level of evacuation zones contained therein. The color of the evacuation zones corresponds to the color of the inundation limits in the State of Maine Storm Tide Atlases prepared by the U.S. Army Corps of Engineers.

Figure 2-1a

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

York County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Eliot					
Kittery					
York					
Ogunquit					
South Berwick					
Wells					
Kennebunk					
Arundel					
Kennebunkport					
Biddeford					
Saco					
Old Orchard Beach					
Acton					
Alfred					
Berwick					
Buxton					
Cornish					
Dayton					
Hollis					
Lebanon					
Limerick					
Limington					
Lyman					
Newfield					
North Berwick					
Parsonsfield					
Sanford					
Shapleigh					
Waterboro					

Figure 2-1b

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Cumberland County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Scarborough					
South Portland					
Cape Elizabeth					
Portland					
Westbrook					
Falmouth					
Cumberland					
Yarmouth					
Freeport					
Brunswick					
Harpswell					
Long Island					
Baldwin					
Bridgton					
Casco					
Frye Island					
Gorham					
Gray					
Harrison					
Naples					
New Gloucester					
North Yarmouth					
Pownal					
Raymond					
Sebago					
Standish					
Windham					

Figure 2-1c

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Sagadahoc County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Woolwich					
Bath					
West Bath					
Topsham					
Bowdoin					
Bowdoinham					
Phippsburg					
Arrowsic					
Georgetown					
Richmond					
Perkins Township					

Figure 2-1d

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Lincoln County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Bristol					
South Bristol					
Bremen					
Boothbay					
Boothbay Harbor					
Southport					
Westport Island					
Edgecomb					
Wiscasset					
Dresden					
Alna					
Newcastle					
Damariscotta					
Nobleboro					
Waldoboro					
Whitefield					
Jefferson					
Monhegan Plantation					
Somerville					
Hibberts Gore					

Figure 2-1e

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Knox County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Union					
Warren					
Thomaston					
Friendship					
Cushing					
St. George					
South Thomaston					
Muscle Ridge Shoals Township					
Rockland					
Owls Head					
Rockport					
Hope					
Camden					
North Haven					
Vinalhaven					
Isle Au Haut					
Martinicus Isle Plantation					
Criehaven Township					
Washington					

Figure 2-1f

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Kennebec County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Pittston					
Randolph					
Gardiner					
West Gardiner					
Farmingdale					
Chelsea					
Litchfield					
Monmouth					
Wayne					
Fayette					
Vienna					
Winthrop					
Readfield					
Mount Vernon					
Kome					
Belgrade					
Manchester					
Augusta					
Hallowell					
Windsor					
China					
Vassalboro					
Sidney					
Oakland					
Waterville					
Winslow					
Albion					
Benton					
Unity Township					
Clinton					

Figure 2-1g

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Waldo County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Lincolnville					
Searsmont					
Belmont					
Morrill					
Belfast					
Northport					
Islesboro					
Searsport					
Swanville					
Sockton Springs					
Prospect					
Frankfort					
Winterport					
Knox					
Waldo					
Brooks					
Monroe					
Jackson					
Troy					
Thorndike					
Burnham					
Unity					
Freedom					
Montville					
Palermo					
Liberty					

Figure 2-1h

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Hancock County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Stonington					
Deer Isle					
Swans Island					
Frenchboro					
Cranberry Isles					
Winter Harbor					
Tremont					
Southwest Harbor					
Mount Desert					
Bar Harbour					
Gouldsboro					
Brooklin					
Sedgwick					
Brooksville					
Blue Hill					
Castine					
Penobscot					
Verona Island					
Orland					
Bucksport					
Dedham					
Ellsworth					
Surry					
Trenton					
Lamoine					
Hancock					
Fletchers Landing Township					
Franklin					
Sullivan					
Sorento					
Waltham					
Eastbrook					

Figure 2-1h (cont.)

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Hancock County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Otis					
Mariaville					
Osborn					
Amherst					
Aurora					
Great Pond					
Oqiton Township					

Figure 2-1i

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Penboscot County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Orrington					
Hampden					
Holden					
Brewer					
Hermon					
Veazie					
Bangor					
Eddington					
Clifton					
Bradley					
Orono					
Glenburg					
Newburgh					
Dixmont					
Carmel					
Etna					
Plymouth					
Newport					
Stetson					
Levant					
Kenduskeag					
Old Town					
Milford					
Greenfield					
Grand Falls Township					
Summit Township					
Greenbush					
Argyle Township					
Alton					
Hudson					
Corinth					

Figure 2-1i (cont.)

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Penboscot County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Exeter					
Corinna					
Dexter					
Garland					
Charleston					
Bradford					
Lagrange					
Edinburg					
Passadumkeag					
Lowell					
Burlington					
Twombly					
Lakeville					
Pukakon Township					
Carroll Plantation					
Springfield					
Lee					
Lincoln					
Enfield					
Howland					
Maxfield					
Mattamiscontis Township					
Seboeis Plantation					
Chester					
Winn					
Webster Plantation					
Prentiss Township					
Drew Plantation					
Kingman Township					
Mattawamkeag					
Woodville					

Figure 2-1i (cont.)

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Penboscot County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Medway					
Hopkins Academy Grant					
Long A Township					
Veazie Gore					
Millinocket					
East Millinocket					
Grindstone Township					
Soldiertown Township					
Herseytown Township					
Stacyville					
Patten					
Mount Chase					

Figure 2-1j

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Washington County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Steuben					
Milbridge					
Harrington					
Addison					
Beals					
Jonesport					
Jonesboro					
Roque Bluffs					
Whitneyville					
Machias					
Machiasport					
Cutler					
Whiting					
Trescott Township					
Lubec					
Eastport					
Perry					
Pembroke					
Charlotte					
Dennysville					
Edmunds Township					
Marion Township					
East Machias					
Marshfield					
Centerville Township					
Columbia Falls					
Columbia					
Cherryfield					
No. 14 Township					
Deblois					
Beddington					

Figure 2-1j (cont.)

TRAFFIC ANALYSIS SECTORS AND SURGE/EVACUATION ZONES

ASSUMED VULNERABILITY BY STORM SCENARIO BY COUNTY

Maine Hurricane Transportation Analysis 2007

Washington County

Surge Analysis Sectors	Category 1 Surge Zone	Category 2 Surge Zone	Category 3 Surge Zone	Category 4 Surge Zone	Inland Evacuation Zone
Northfield					
Wesley					
Cooper					
Meddybemps					
Baring Plantation					
Calais					
Robbinston					
Baileyville					
Alexander					
Crawford					
Princeton					
No. 21 Township					
Devereaux Township					
Fowler Township					
Indian Township Passamaquoddy Indian Reservation					
Grand Lake Stream Plantation					
Sakom Township					
Talmadge					
Waite					
Dyer Township					
Kossuth Township					
Topsfield					
Codyville Plantation					
Lambert Lake Township					
Vanceboro					
Forest Township					
Brookton Township					
Danforth					
Forest City Township					

2.2 HOUSING AND POPULATION DATA

PBS&J developed the socioeconomic parameters for each traffic evacuation zone, such as dwelling unit totals and persons per dwelling unit, by collecting data from the Decennial Census taken by the U.S. Census Bureau for the year 2000, as well as housing data obtained from the Maine State Planning Office. A multiplier for each minor civil division was determined and used to reconcile the Maine State Planning Office Data with the specific housing type in the 2000 U.S. Census, with those figures then extrapolated to develop the Year 2007 projections. The Maine State Planning Office housing estimates also included annual projections out to 2015 so that Year 2012 clearance times could be developed. The key socioeconomic data for the county is summarized in Table 2-1, and this data is provided by traffic evacuation zones in the Transportation Model Support Document.

Table 2-1

KEY POPULATION/DWELLING UNIT SUMMARY

Maine Hurricane Transportation Analysis 2007

York County
Year 2007 Permanent Population – 206,498
Permanent occupied dwelling units – 81,590
Mobile homes – 7,759
Seasonal units – 19,179
Tourist units – 11,933*
Year 2012 Population – 219,456
People per permanent unit (county-wide average) – 2.46
Vehicles per permanent unit (county-wide average) – 1.82

Cumberland County
Year 2007 Permanent Population – 279,255
Permanent occupied dwelling units – 116,980
Mobile homes – 6,235
Seasonal units – 12,388
Tourist units – 7,980*
Year 2012 Population – 288,723
People per permanent unit (county-wide average) – 2.43
Vehicles per permanent unit (county-wide average) – 1.78

Sagadahoc County
Year 2007 Permanent Population – 38,072
Permanent occupied dwelling units – 15,232
Mobile homes – 1,841
Seasonal units – 1,912
Tourist units – 636*
Year 2012 Population – 39,934
People per permanent unit (county-wide average) – 2.25
Vehicles per permanent unit (county-wide average) – 1.73

Lincoln County
Year 2007 Permanent Population – 36,302
Permanent occupied dwelling units – 15,808
Mobile homes – 2,491
Seasonal units – 6,651
Tourist units – 2,556*
Year 2012 Population – 38,161
People per permanent unit (county-wide average) – 2.16
Vehicles per permanent unit (county-wide average) – 1.83

Knox County
Year 2007 Permanent Population – 41,894
Permanent occupied dwelling units – 18,384
Mobile homes – 1,995
Seasonal units – 4,826
Tourist units – 1,996*
Year 2012 Population – 43,404
People per permanent unit (county-wide average) – 2.15
Vehicles per permanent unit (county-wide average) – 1.74

Kennebec County
Year 2007 Permanent Population – 122,072
Permanent occupied dwelling units – 51,624
Mobile homes – 6,888
Seasonal units – 6,847
Tourist units – 1,570*
Year 2012 Population – 124,261
People per permanent unit (county-wide average) – 2.34
Vehicles per permanent unit (county-wide average) – 1.75

Waldo County
Year 2007 Permanent Population – 39,498
Permanent occupied dwelling units – 16,808
Mobile homes – 3,717
Seasonal units – 3,631
Tourist units – 1,111*
Year 2012 Population – 41,686
People per permanent unit (county-wide average) – 2.34
Vehicles per permanent unit (county-wide average) – 1.85

Hancock County
Year 2007 Permanent Population – 54,790
Permanent occupied dwelling units – 24,770
Mobile homes – 3,555
Seasonal units – 12,103
Tourist units – 5,491*
Year 2012 Population – 56,901
People per permanent unit (county-wide average) – 2,14
Vehicles per permanent unit (county-wide average) – 1.78

Penobscot County
Year 2007 Permanent Population – 149,662
Permanent occupied dwelling units – 62,359
Mobile homes – 10,166
Seasonal units – 5,059
Tourist units – 3,838*
Year 2012 Population – 151,619
People per permanent unit (county-wide average) – 2.36
Vehicles per permanent unit (county-wide average) – 1.78

Washington County
Year 2007 Permanent Population – 33,128
Permanent occupied dwelling units – 12,496
Mobile homes – 3,332
Seasonal units – 5,893
Tourist units – 1,112*
Year 2012 Population – 32,592
People per permanent unit (county-wide average) – 2.32
Vehicles per permanent unit (county-wide average) – 1.68

*Includes RV units and campground sites

Note: Socioeconomic data provided by the U.S. Census and the Maine State Planning Office

The use of GIS technology (ArcInfo, ArcView) facilitated the re-aggregation of all socio-economic data obtained from the U.S. Census and the Maine State Planning Office into the surge analysis sectors and surge/evacuation zones. Nonetheless, the entire coastline was surveyed using remote sensing imagery to determine the number of residential/seasonal/tourist units located in each surge zone. This was necessary because the normal methodology of applying the aerial extent of each surge inundation limit to determine the percentage of the population of that area should be committed to the evacuation did not work. That methodology, which normally is appropriate for

other study areas, resulted in very inflated estimates of the number of units to be evacuated in each category of hurricane. Once the units actually located in each storm surge inundation limit were counted, those figures were then used to determine the actual percentage of homes, seasonal units and hotels in each U. S. Census block-group or Maine Minor Civil Division were subject to storm surge or winds in each category of storm. GIS was used throughout the entire process to export the surge inundation limits prepared by the Boston District of the USACE to Keyhole Markup Language (KML) for incorporation in Google Earth Pro imagery, as well as to overlay the same surge data on Digital Ortho Quads obtained from the Maine Office of GIS (MEGIS). GIS was also used to calculate the percentage of U. S. Census block-groups in each surge zone. Despite the time and effort needed to prepare the socio-economic data in this way, the resulting hurricane vulnerability figures were much more accurate and defensible.

2.3 BEHAVIORAL ASSUMPTIONS

A future tropical cyclone in the coastal Maine regions will involve evacuation decision-making by individuals and households. In order to develop meaningful behavioral assumptions which account for variations in decision-making, PBS&J reviewed previous behavioral analyses conducted by the Hazard Management Group for the New England states in October of 1988 for previous studies, as well as for the Mid-Atlantic and Northeastern States studied in July, 1988 after Hurricane Gloria. Additionally, further insight regarding the possible actions of the resident populations was provided by the county emergency management offices during interviews conducted in October 2006. The PBS&J team then used this data source to focus the transportation analysis on the following behavioral aspects:

- Participation rates - What percent of the population in different areas will evacuate their dwelling units for future hurricane threats;
- Evacuation rapidity of response rates - How quickly will evacuees respond to specific protective action instructions from local and or state officials;
- Destination percentages - What percent of the population sub-area will evacuate to in-county locations versus out of the county entirely, as well as to local public shelters; and
- Vehicle usage - Of the vehicles available to evacuating households, what percent of those vehicles will be used in an evacuation.

A great deal of judgment was needed in order to develop the necessary parameters on a zone-by-zone basis. PBS&J has accumulated a wealth of experience around the country developing and applying behavioral parameters for evacuation analysis. This experience aided significantly in the process of generating assumptions.

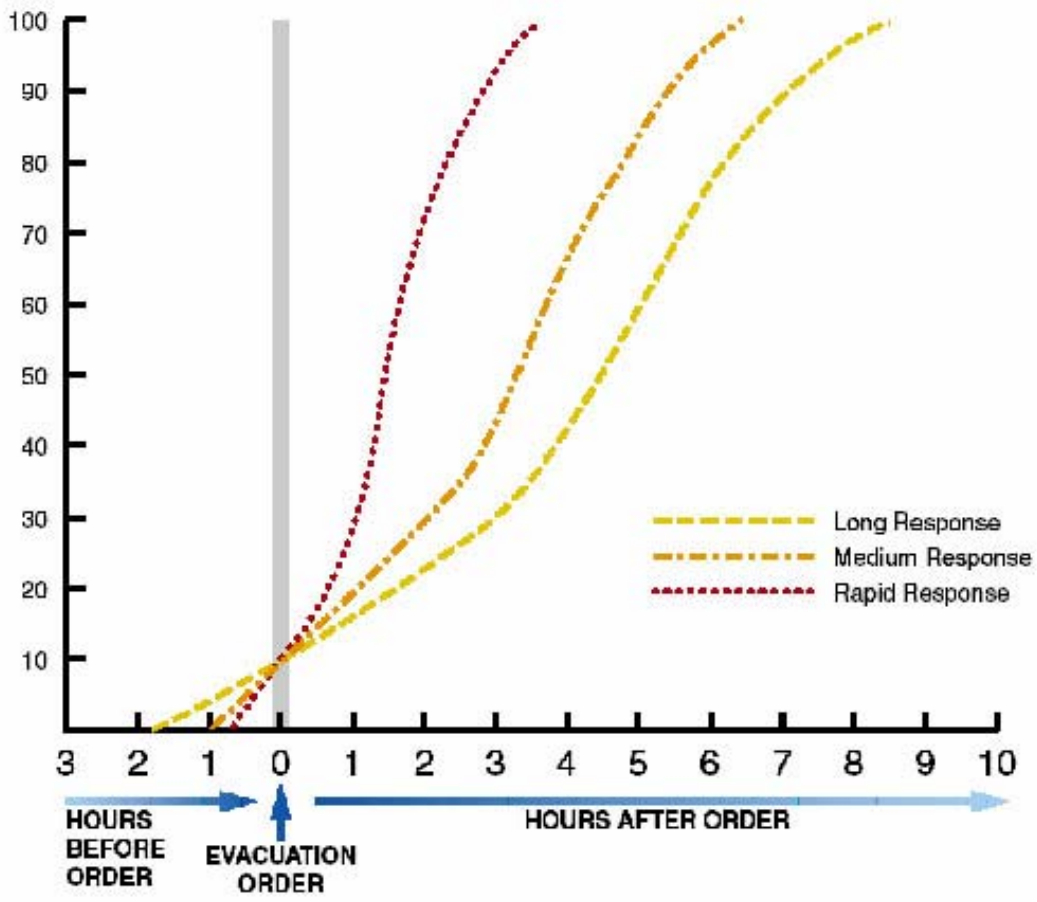
During the modeling process, the primary behavioral assumptions made by zone were developed by PBS & J from behavioral work conducted in New England in 1988 and reviewed by state and local emergency management officials. These assumptions are provided in the evacuating people and vehicle/trip generation portion of summary sheets located in the Transportation Model Support Document. In addition, the assumed participation rates developed by surge zones, and for each

scenario, are provided in the model support document as well. The primary participation assumptions are as follows:

- The category 1 surge zones shown in light green in the Storm Tide Atlases and in Figure 2-1a through 2-1j above were assumed to have a 100% participation rate, even though in actuality these rates will likely be lower. As a matter of public safety, the clearance times calculated in this study should allow those who are vulnerable to category 1 storm surge the opportunity to evacuate whether they choose to or not. All other zones were assigned participation rates that were a more realistic figure, although probably slightly higher than the percentages that may really comply with evacuation orders.
- All mobile homes located in surge zones are assumed to evacuate, although in reality a lower percentage will actually comply with evacuation orders. In inland, non-surge zones, the mobile home participation rates were somewhat lower than full compliance, especially in lesser category events.
- A portion of the theoretically non-vulnerable population (shadow evacuees) are also assumed to evacuate in the model; in an actual evacuation, the percentages could be significantly higher than the figures used for modeling purposes (1% - 10%), particularly for more intense hurricanes; this difference however will balance out with less than 100% of surge residents participating in an actual event.

One set of critical behavioral assumptions included in the transportation analysis involves the rapidity of evacuation response by the evacuating population, or establishing how quickly the vulnerable population will respond to an evacuation order or advisory. Behavioral data from past hurricane evacuation research demonstrates that mobilization and actual departures of the evacuating population can occur over a very brief time, or over a period of many hours. To account for this variation, clearance times were tested for three evacuation response rates represented by different behavioral response curves. The response curves in Figure 2-2 reflect rapid, medium and long responses and are designed to include the range of mobilization times that may be experienced in a hurricane evacuation situation. For analysis, the mobilization/traffic loading time varied between 5 and 10 hours.

Figure 2-2 Evacuation Behavioral Response Curves



A second essential input into the transportation analysis involved the percentage of evacuees assumed to travel to one of two general destination types by scenario. These assumptions include the expected percent of evacuees from each surge zone within each evacuation analysis sector traveling to in-county locations including local hotels/motels, friends and family, and local public shelters, or out of the county entirely. A separate sub-category of in-county public shelter destinations were developed to assist in the shelter planning process. Destination percentages were varied for each surge zone within each evacuation analysis sector in the county depending on the category of risk (distance from the coastline), or special characteristics of a zone or sector such as a high number of mobile home units. Assumptions were also varied for permanent residents versus seasonal visitors as well as tourists in hotels/motels, bed and breakfasts, RV spaces and campsites.

One important behavioral aspect built into the rates is that a larger percentage of evacuees will go out of county for each successive step in storm intensity. Also, in the lower intensity hurricanes, most of the evacuees in non-surge areas are mobile home residents who have a higher propensity to use public shelters. This is reflected in the assumptions as well.

The final set of behavioral assumptions concerns vehicle usage rates during an evacuation. Vehicle usage rates pertain to the percentage of vehicles available at the home origin, assumed to be used in the evacuation. Vehicle usage percentages are 70% to 80% (depending on distance from the coastline) for this transportation analysis.

2.4 ROADWAY NETWORK CHARACTERISTICS

A final group of assumptions used for input to the transportation analysis is related to the roadway system chosen for the evacuation network and traffic control measures considered for traffic movement. Although the assumptions developed for the transportation analysis are general, the efforts at the county and municipal level regarding traffic control and roadway selection must be quite detailed. In areas throughout the Maine study areas, most intersections will be controlled by existing traffic signals. However, as resources permit, traffic control officers will be stationed at bottlenecks identified in this study, as well as other local locations of concern. A detailed law enforcement assignment to major bottlenecks involves extensive coordination among local and state officials. This study does not presume to replace those efforts, but seeks to quantify the time elements within such personnel would operate.

The county/ies reviewed draft evacuation network maps, and roadways were added to the analysis where appropriate. In choosing roadways to be used for the evacuation network, an effort was made to include street facilities with sufficient elevations, substantial shoulder width and surface, and roadways already contained in existing hurricane evacuation plans.

In order to determine the routing of evacuation traffic, a representation of the roadway system was developed using a "link-node" system to identify roadway segments. Nodes are used to identify the intersection of two roadways or changes in roadway characteristics. Links are the roadway segments between nodes. Each modeled link is identified by a letter designation. Figures 2-3, 2-5, 2-7, 2-9, 2-11, 2-13, 2-15, 2-17, 2-19, 2-21 and 2-23 illustrate the coded evacuation network with link letters for York, Cumberland, Sagadahoc, Lincoln, Knox, Kennebec, Waldo, Hancock, Penobscot and Washington counties respectively. Figures 2-4, 2-6, 2-8, 2-10, 2-12, 2-14, 2-16, 2-18, 2-20, 2-22 and 2-24 show the sector connections to the links, or loading points on the evacuation network, for each county as represented by the dots with the minor civil division names and dashed lines in black.

Figure 2-3 York County Evacuation Roadway Segments

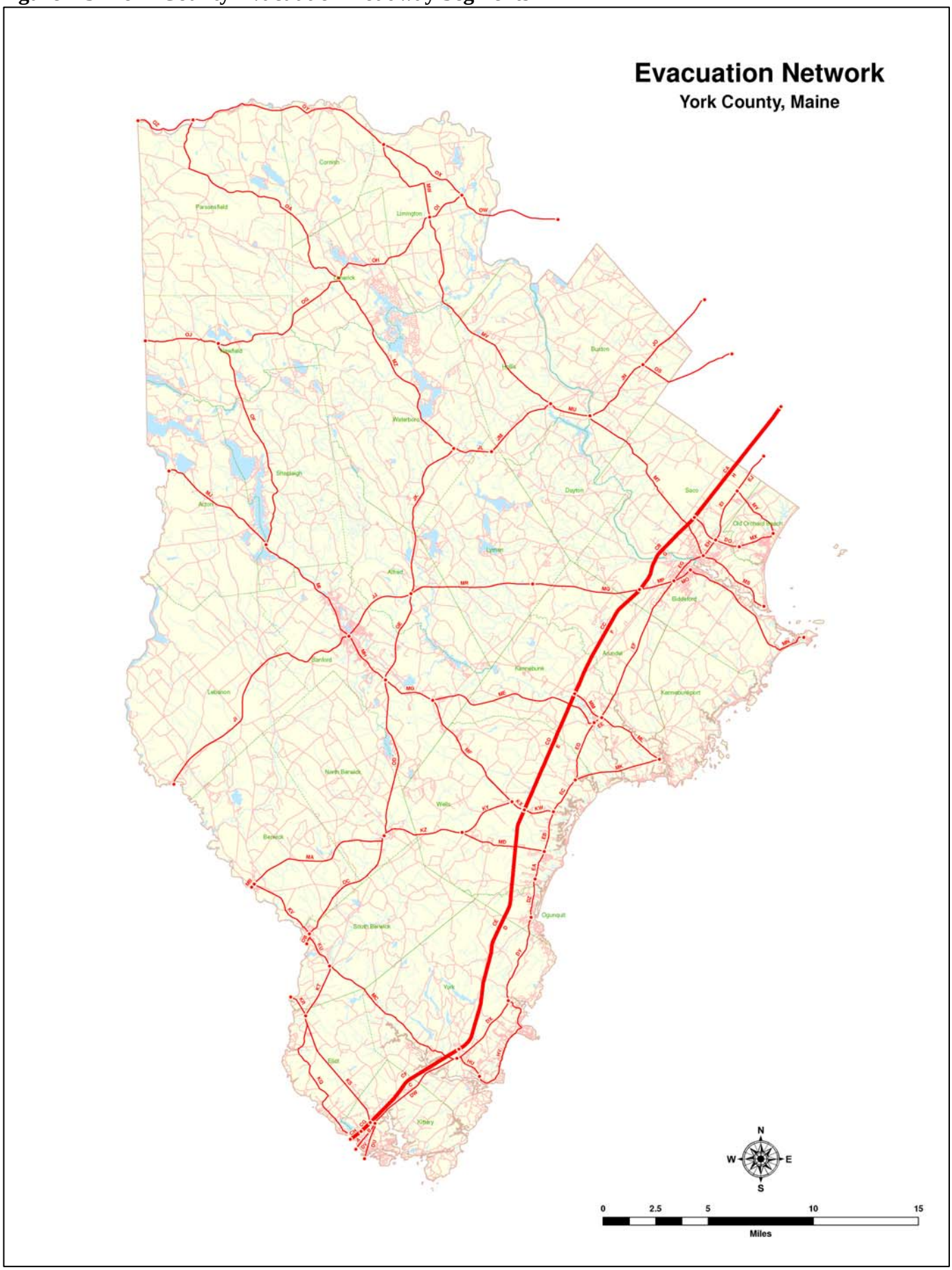


Figure 2-4 York County Evacuation Roadway Segments and Loading Points

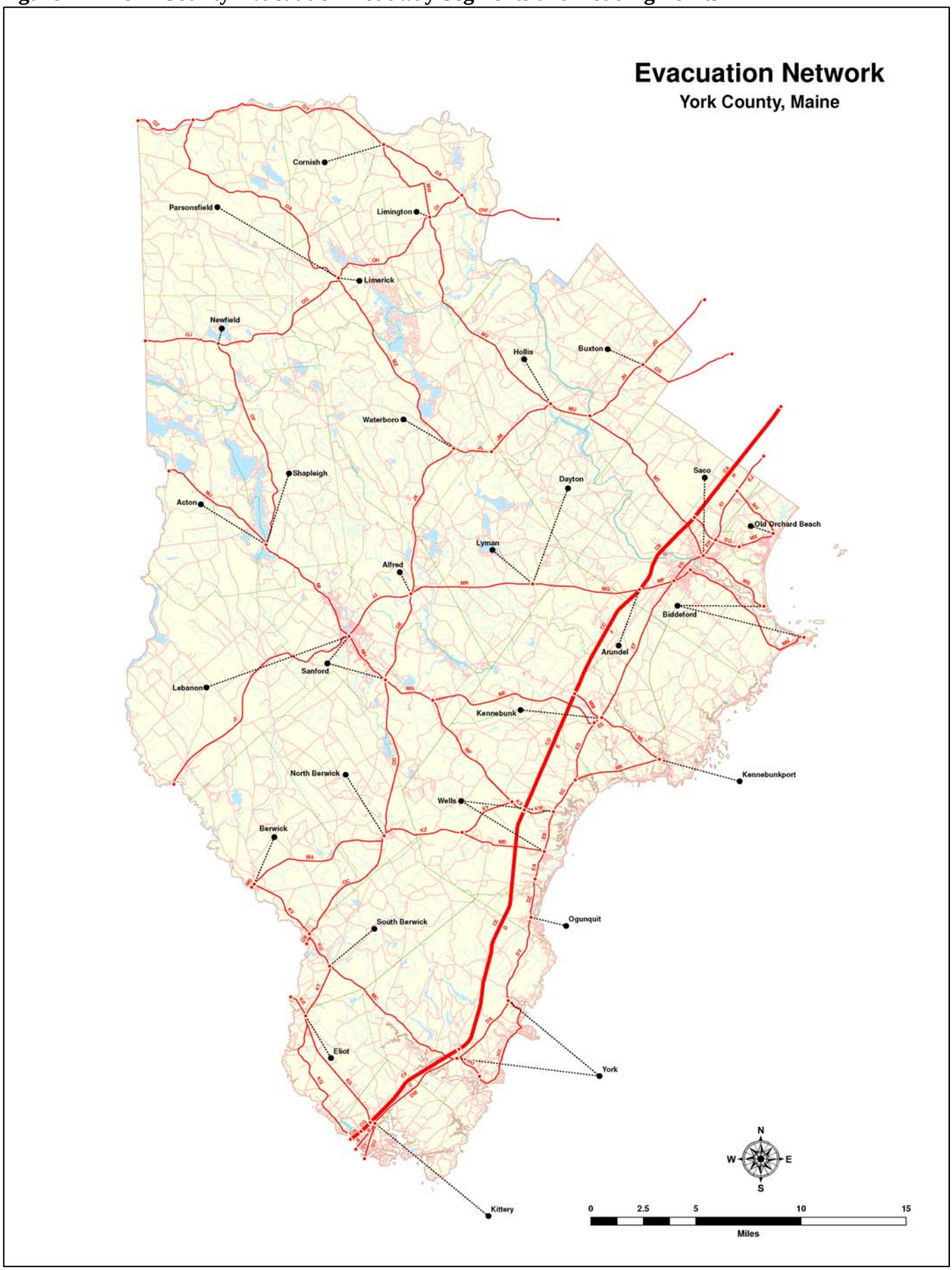


Figure 2-5 Cumberland County Evacuation Roadway Segments

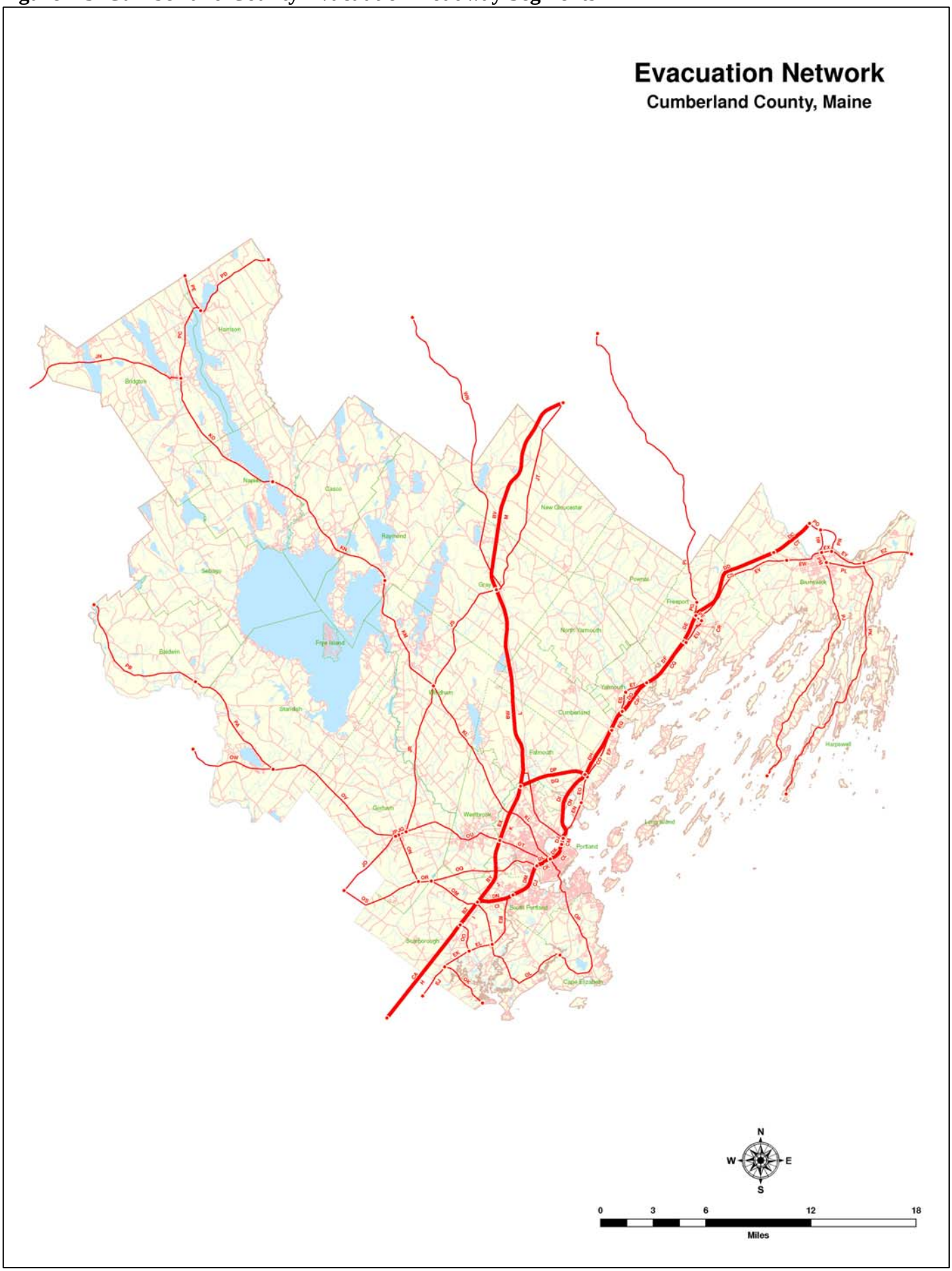


Figure 2-6 Cumberland County Evacuation Roadway Segments and Loading Points

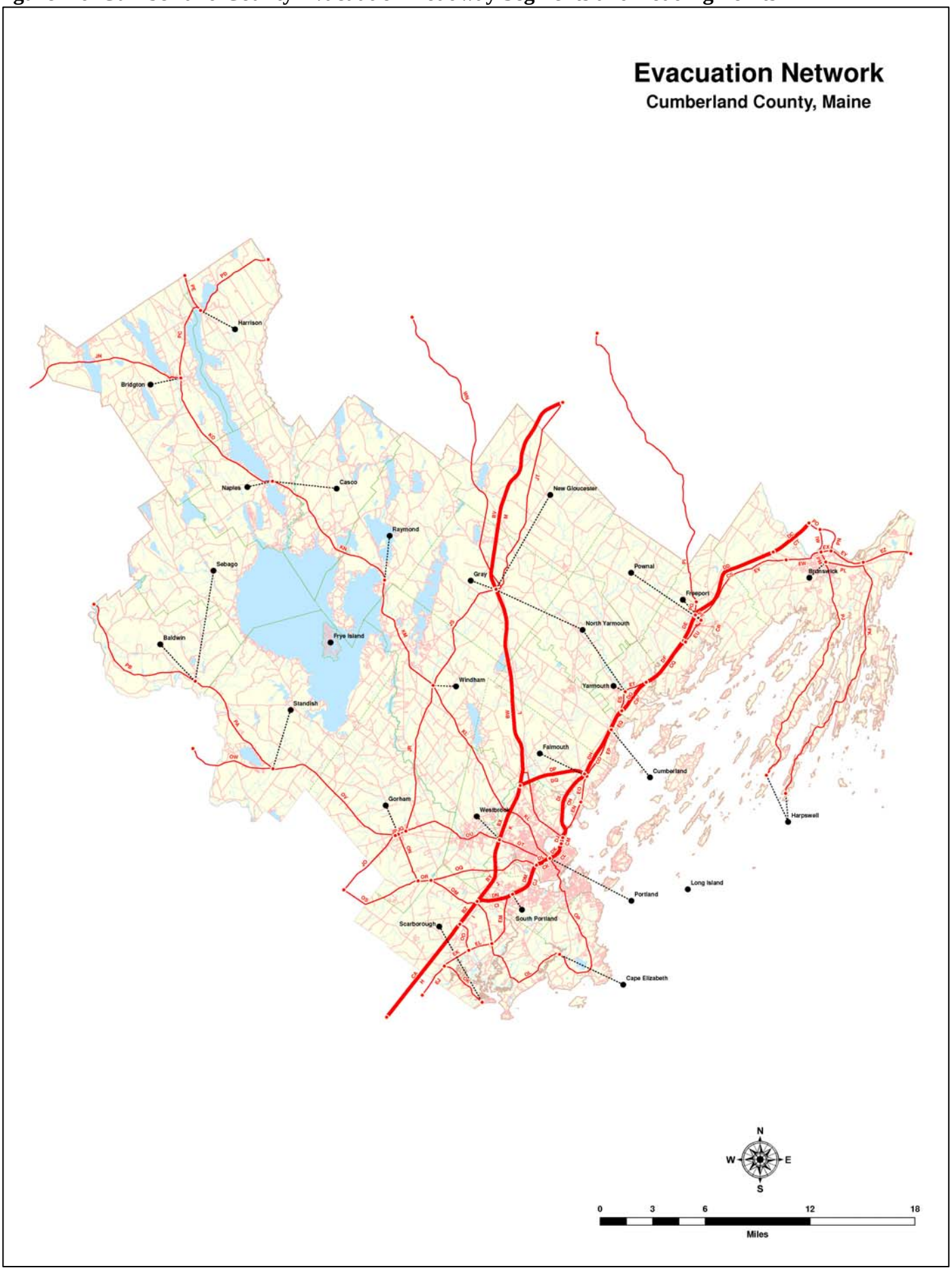


Figure 2-7 Sagadahoc County Evacuation Roadway Segments

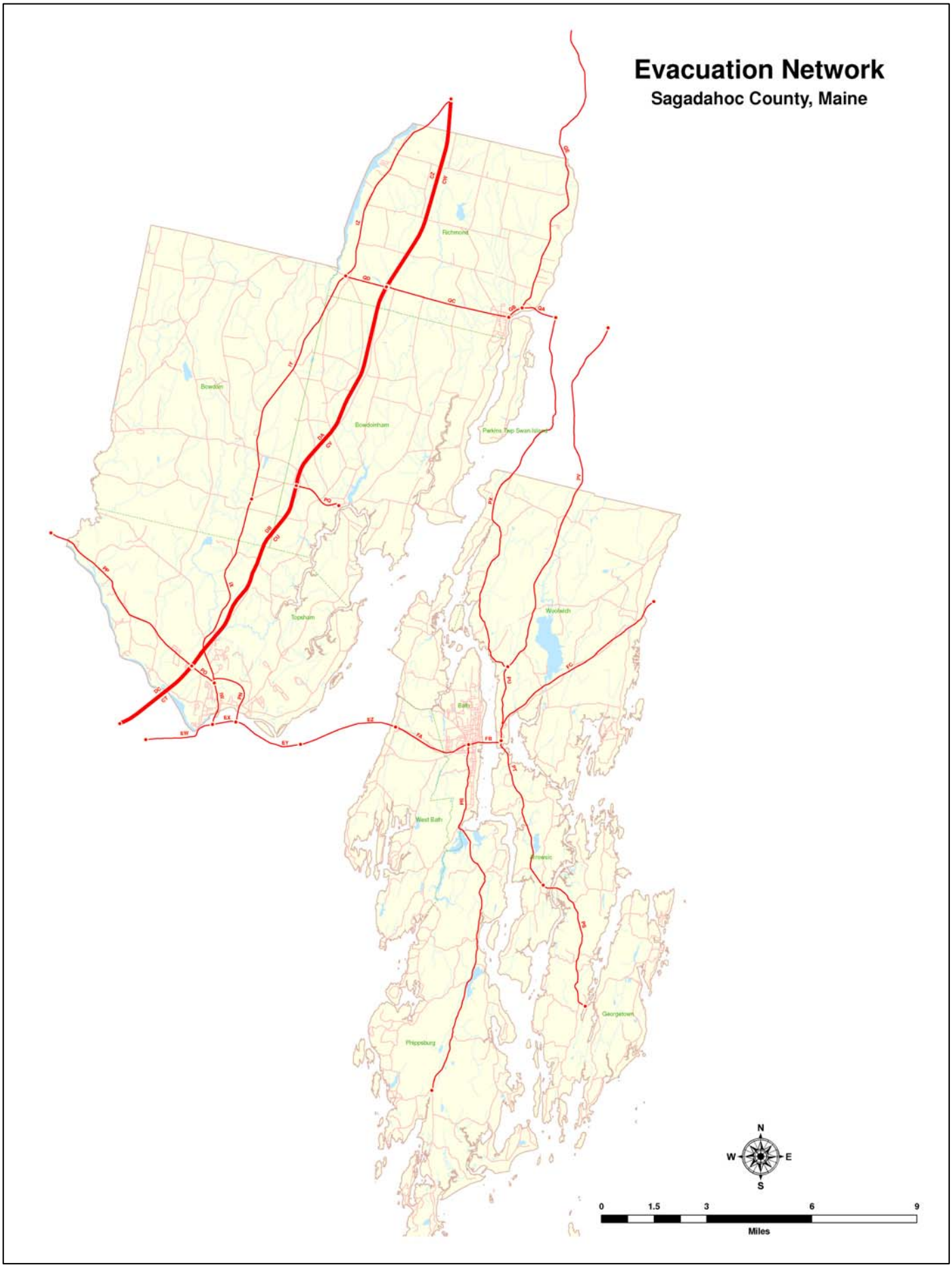


Figure 2-8 Sagadahoc County Evacuation Roadway Segments and Loading Points

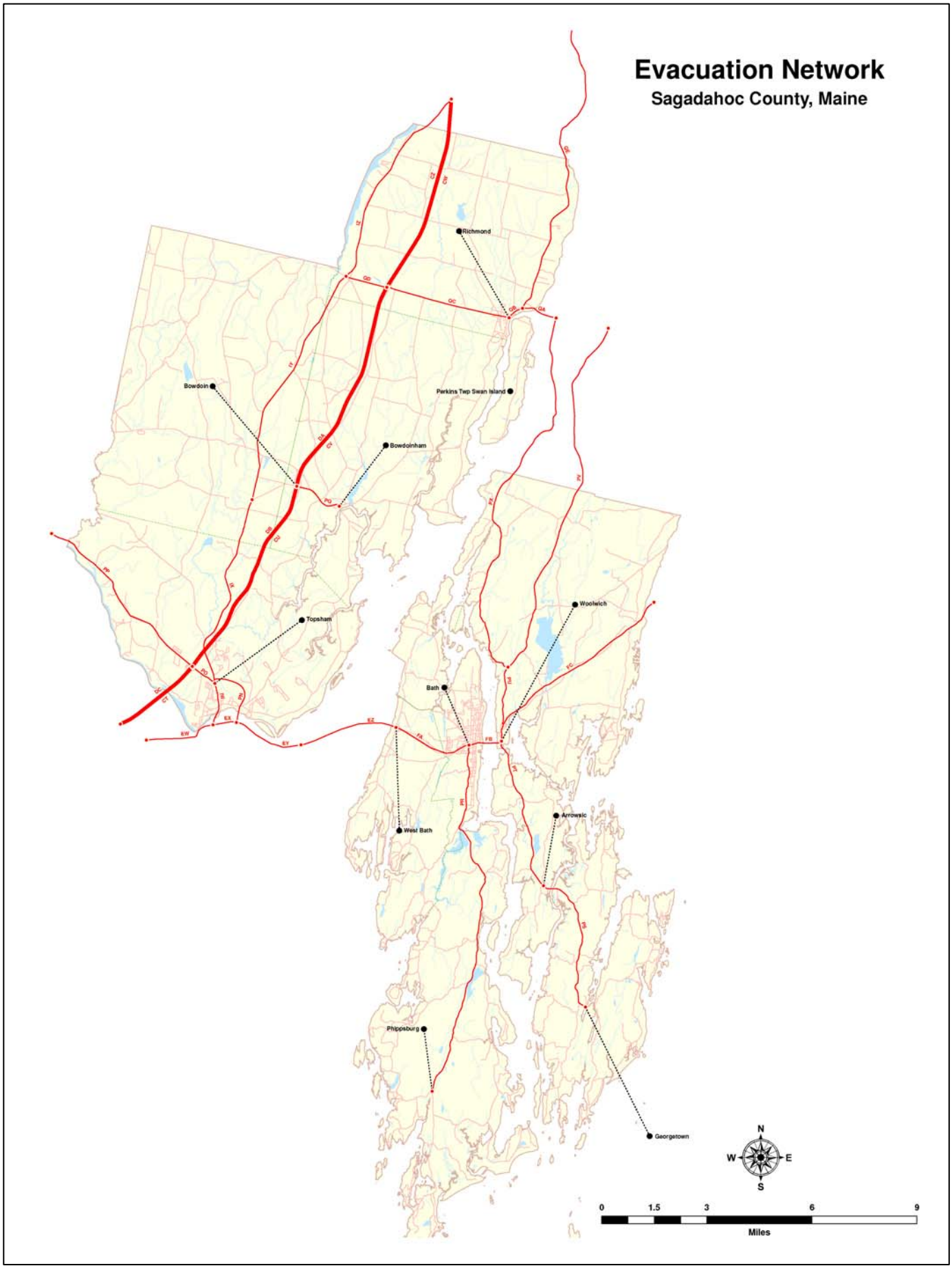


Figure 2-9 Lincoln County Evacuation Roadway Segments

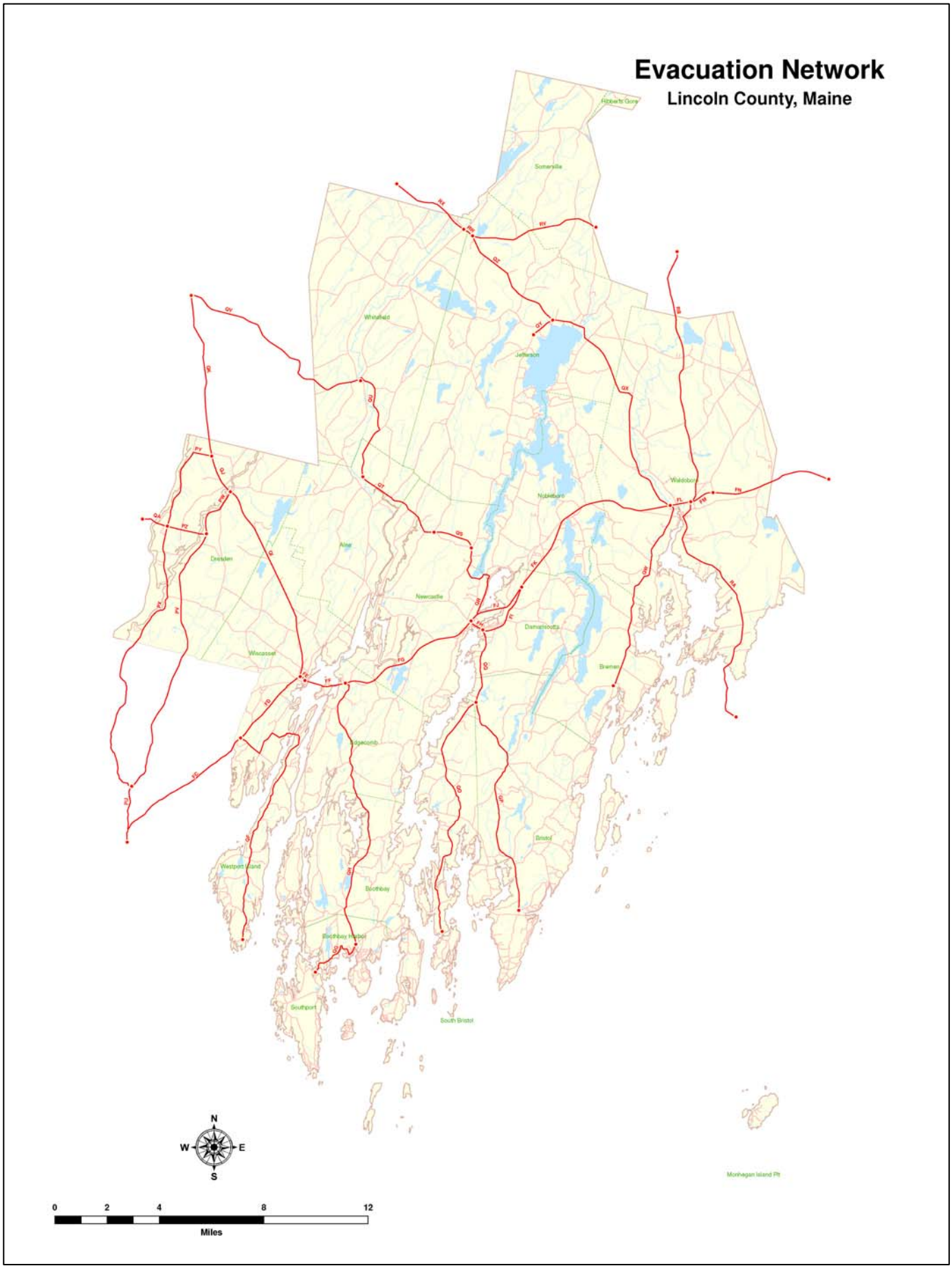


Figure 2-10 Lincoln County Evacuation Roadway Segments and Loading Points

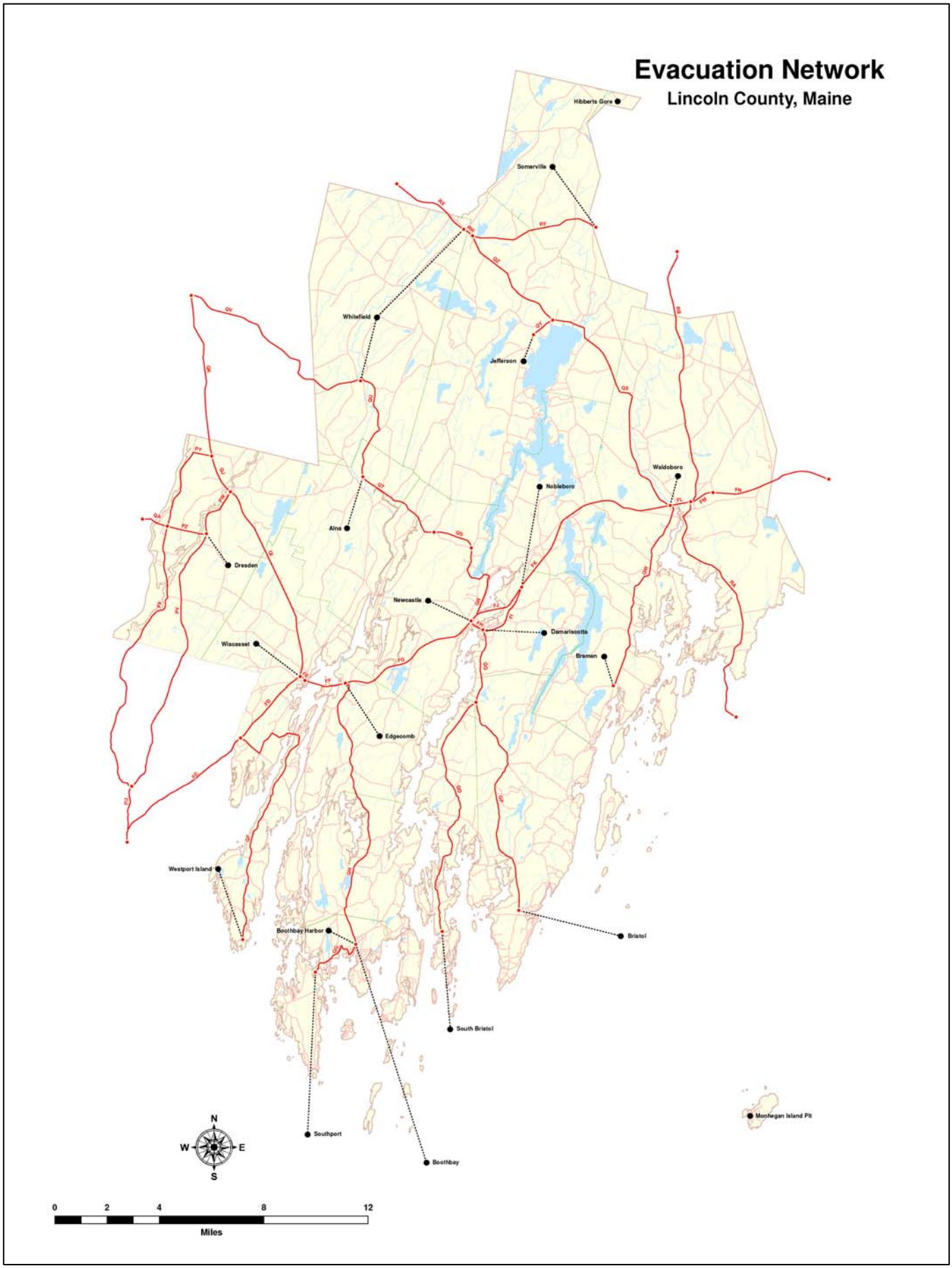


Figure 2-11 Knox County Evacuation Roadway Segments

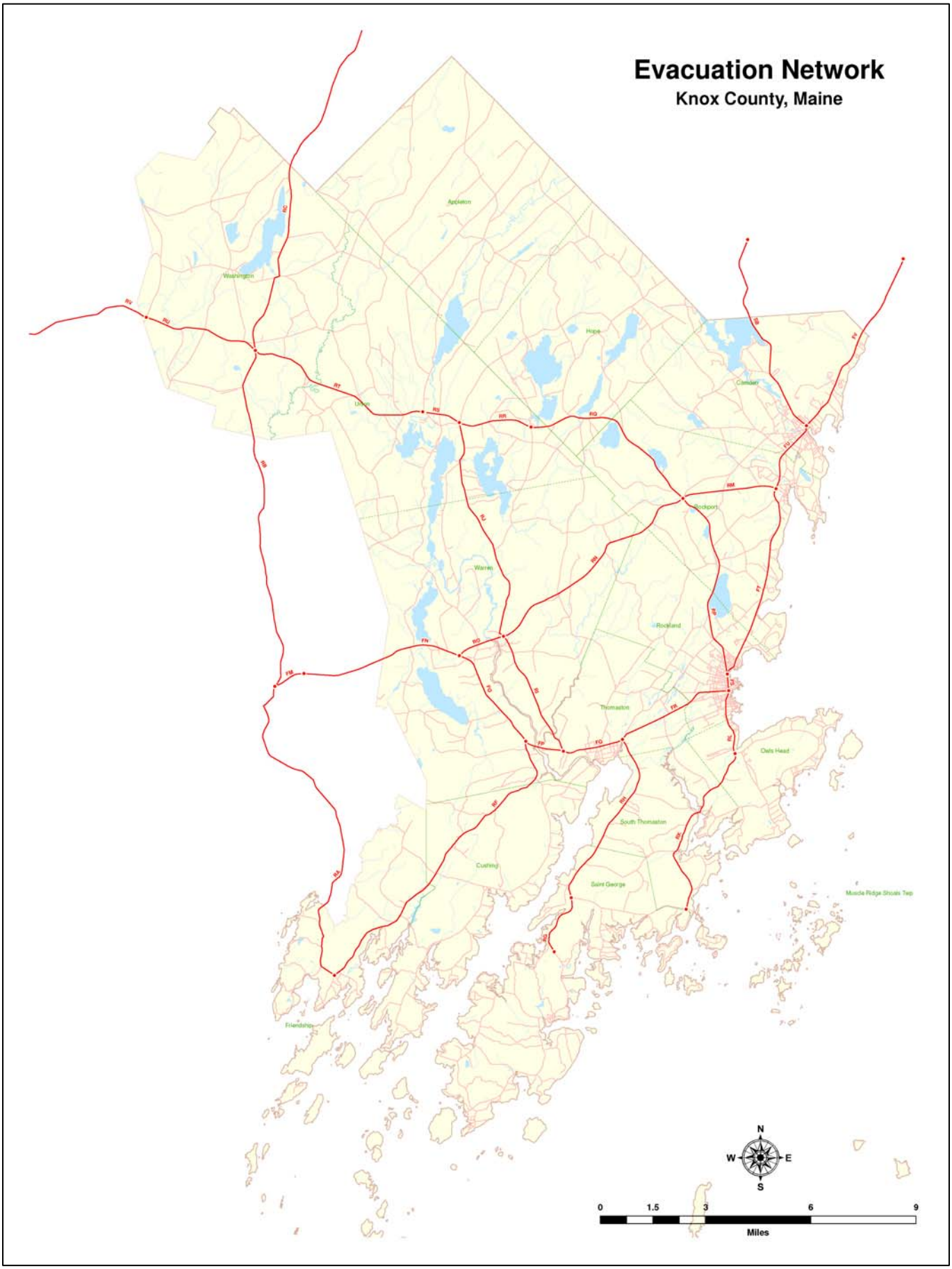


Figure 2-12 Knox County Evacuation Roadway Segments and Loading Points

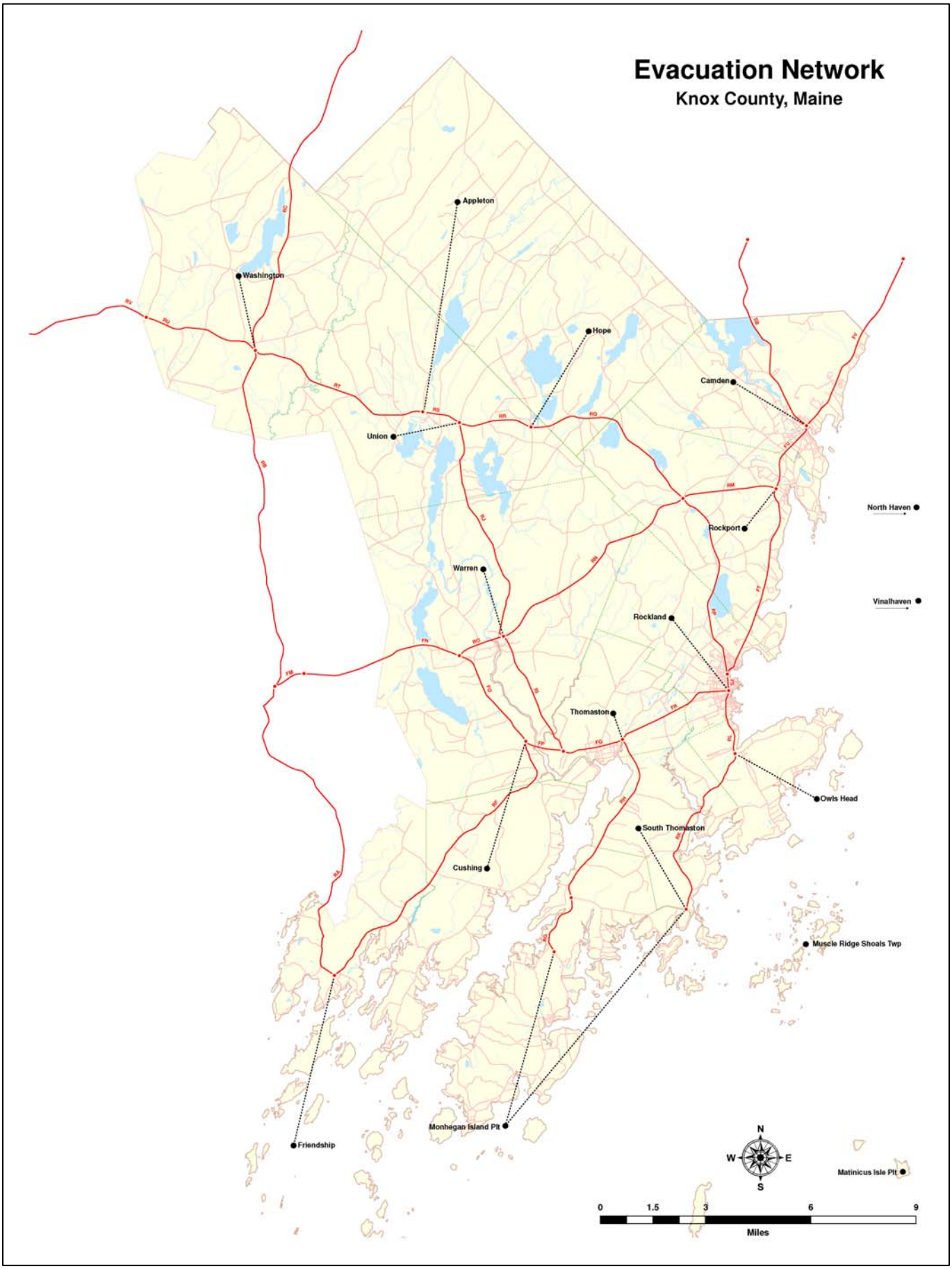


Figure 2-13 Kennebec County Evacuation Roadway Segments

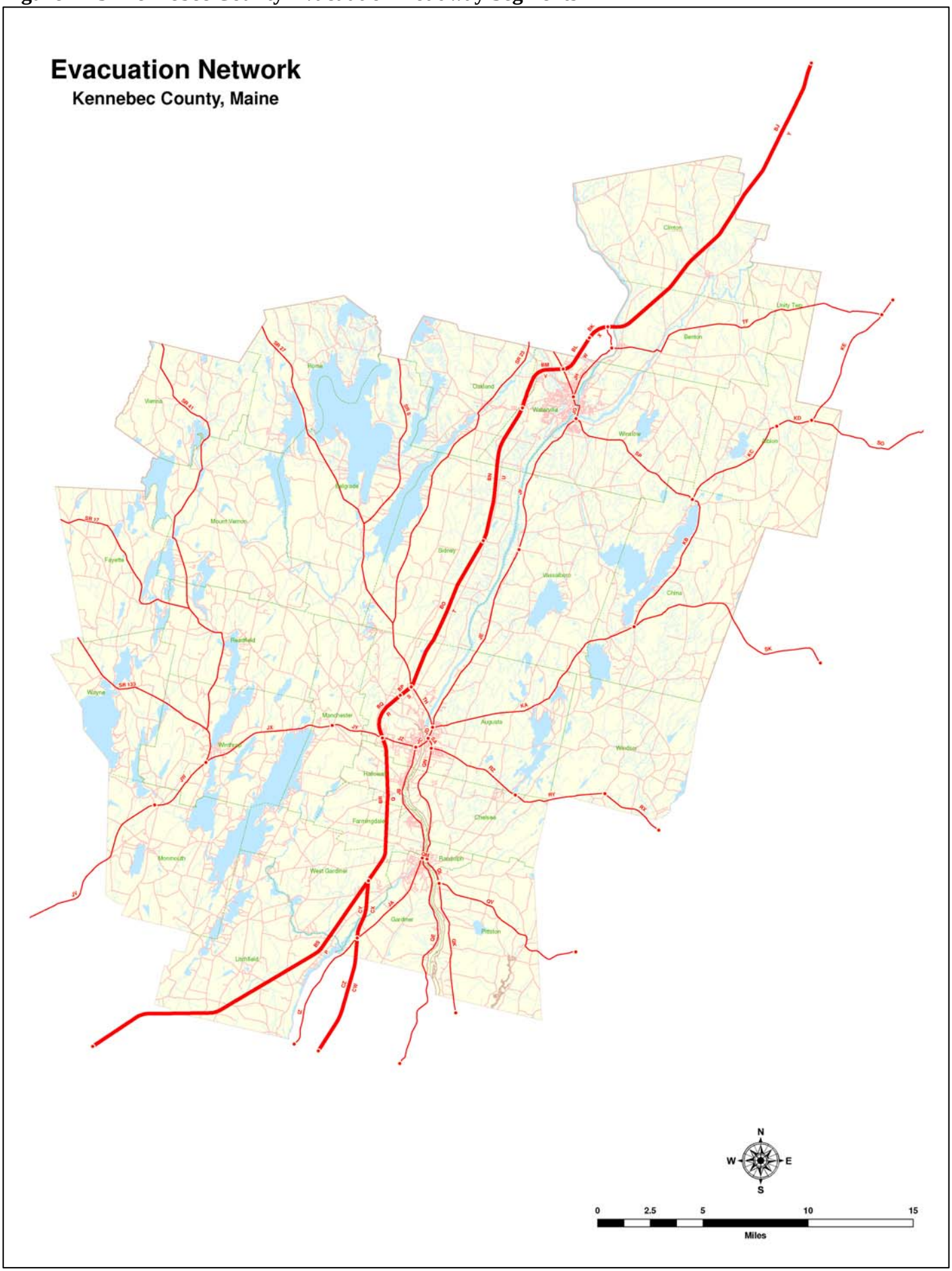


Figure 2-14 Kennebec County Evacuation Roadway Segments and Loading Points

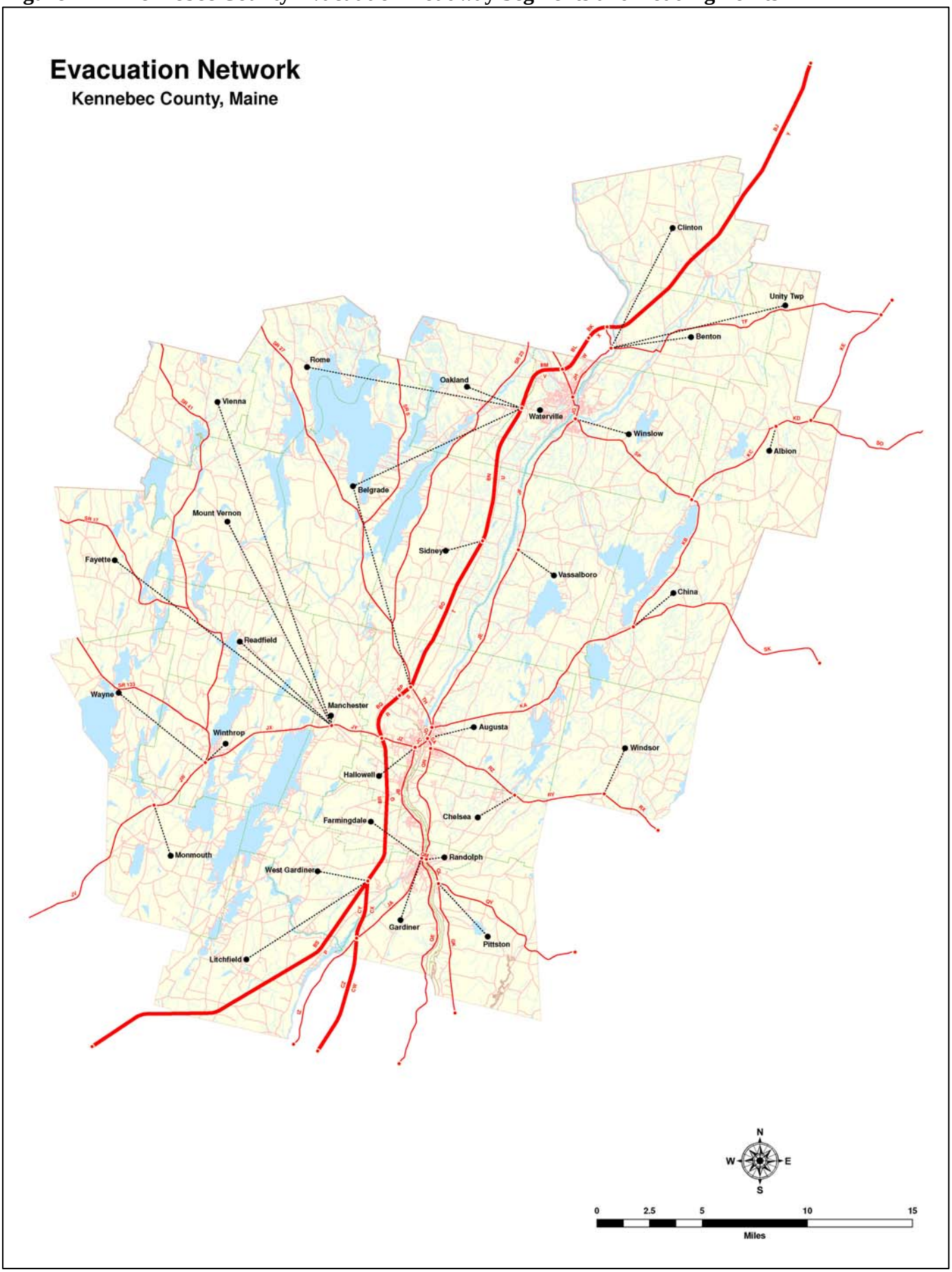


Figure 2-15 Waldo County Evacuation Roadway Segments

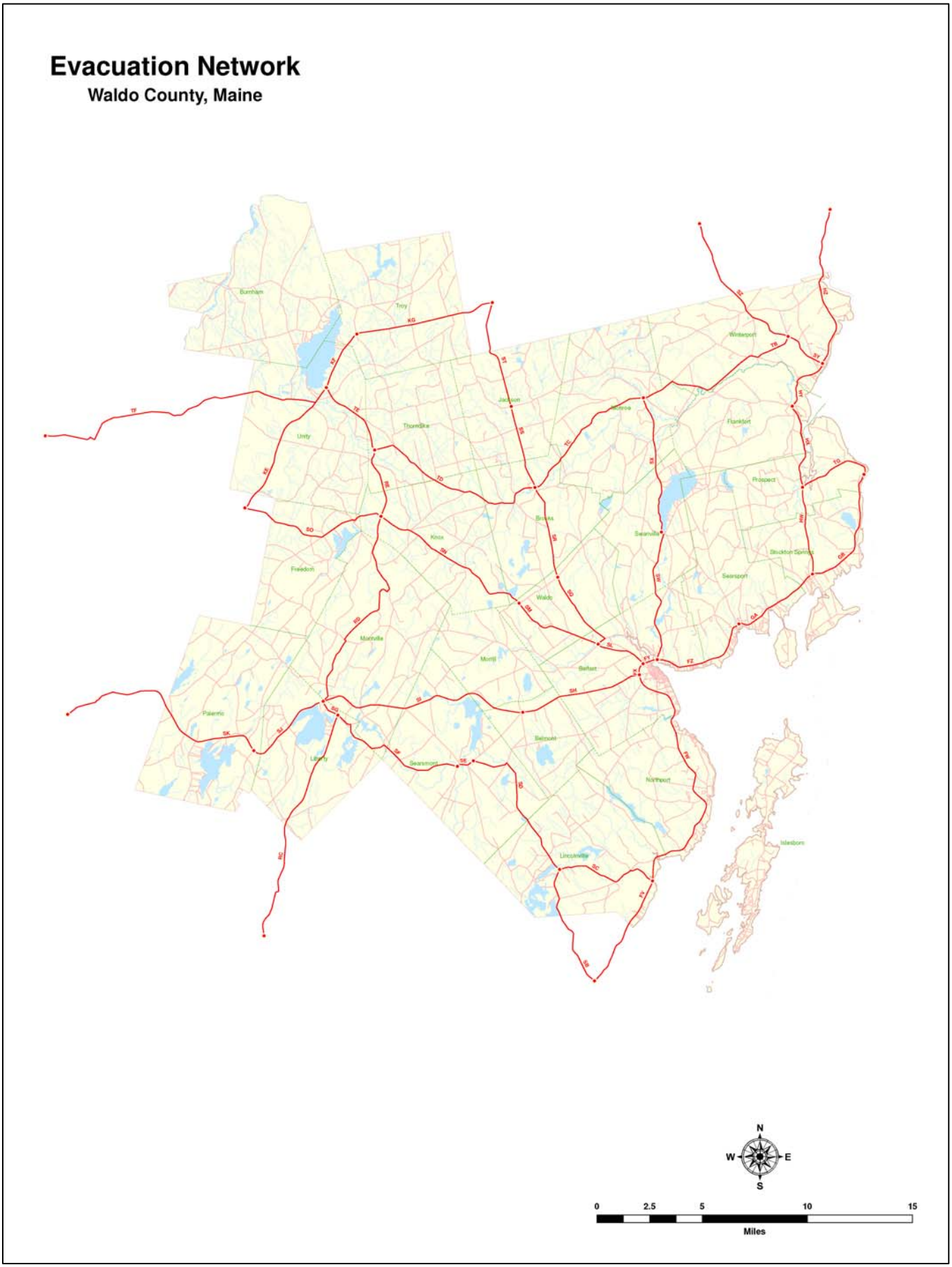


Figure 2-16 Waldo County Evacuation Roadway Segments and Loading Points

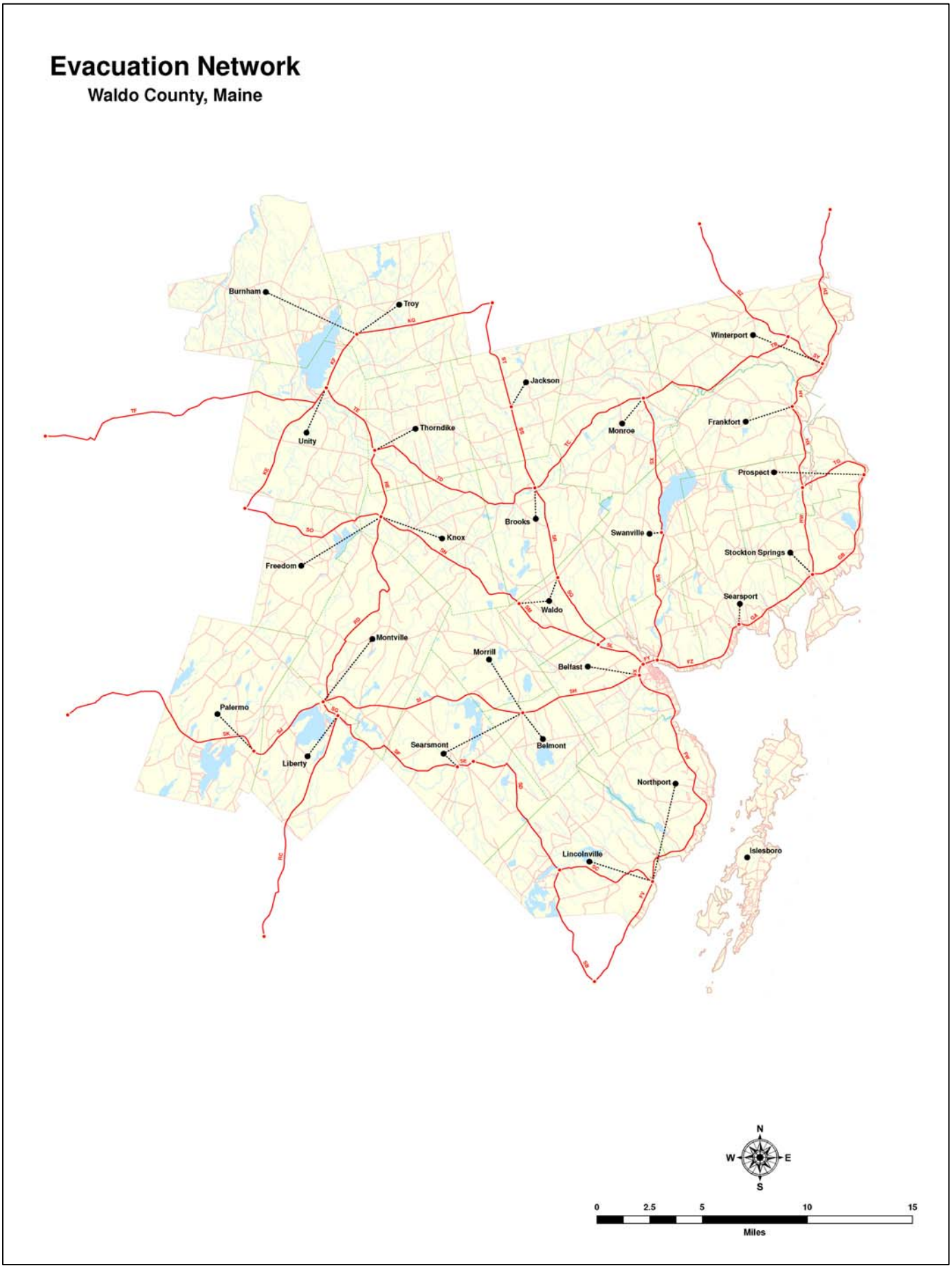


Figure 2-17 Hancock County Evacuation Roadway Segments

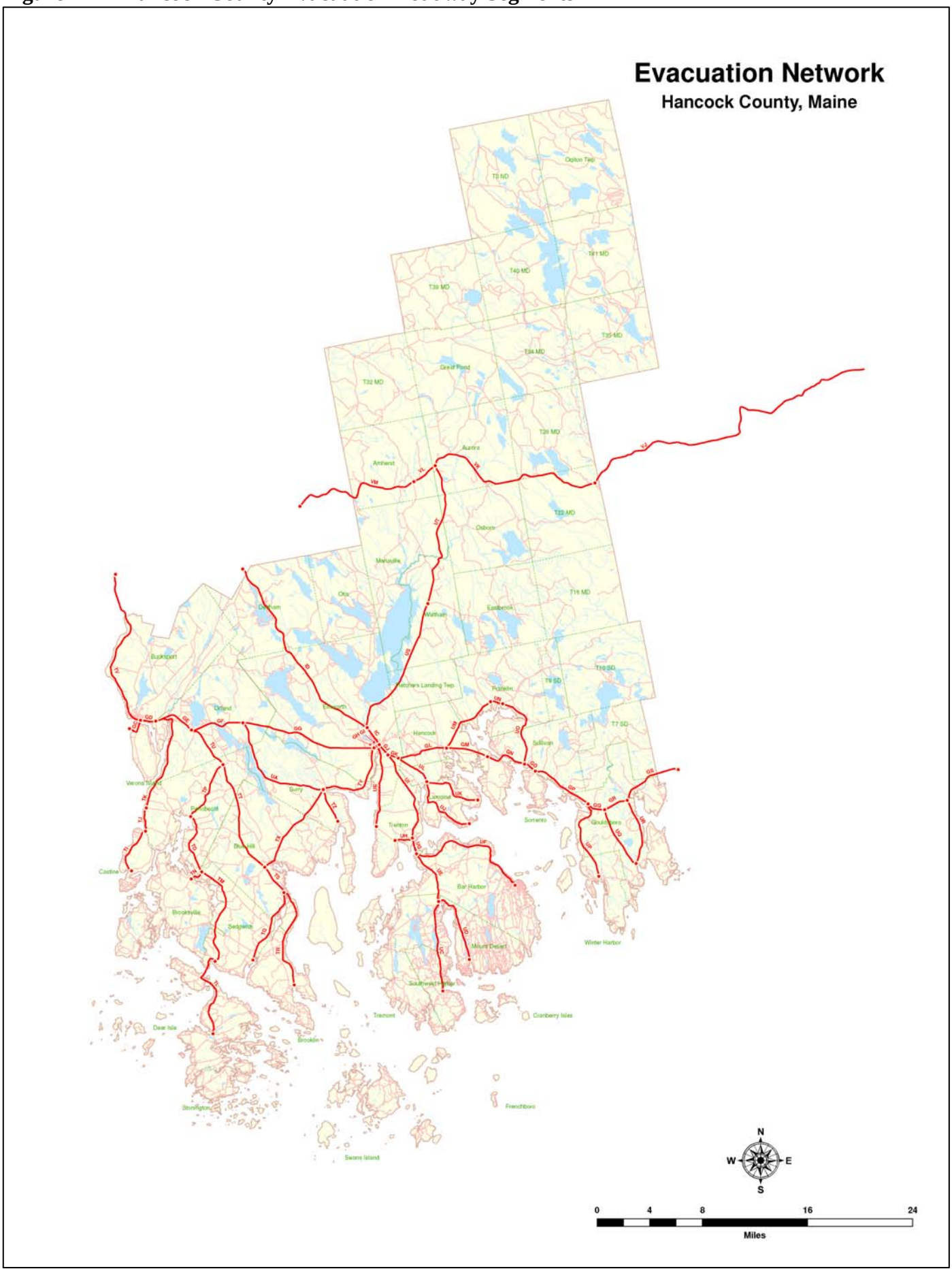


Figure 2-18 Hancock County Evacuation Roadway Segments and Loading Points

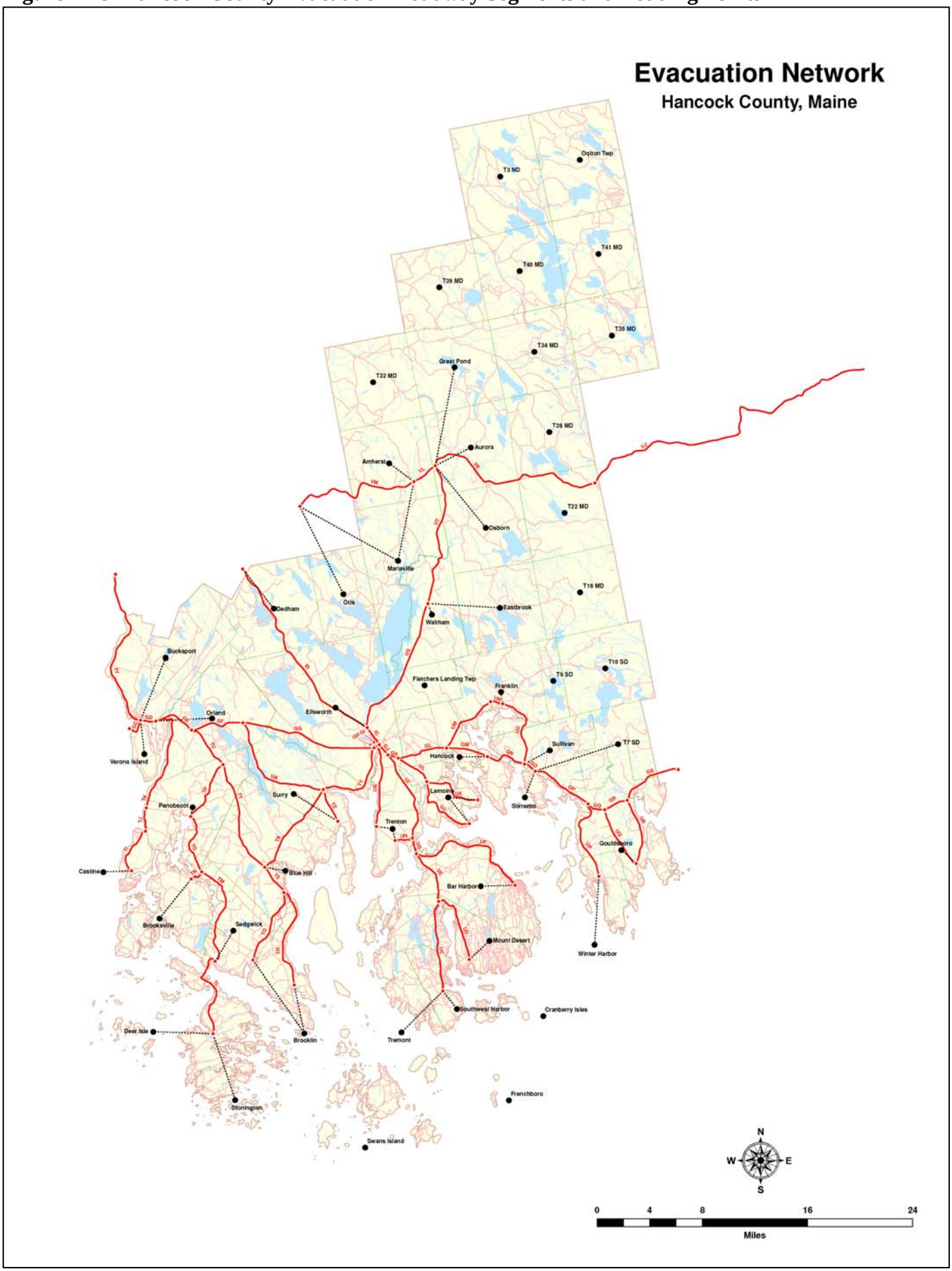


Figure 2-19 South Penobscot County Evacuation Roadway Segments

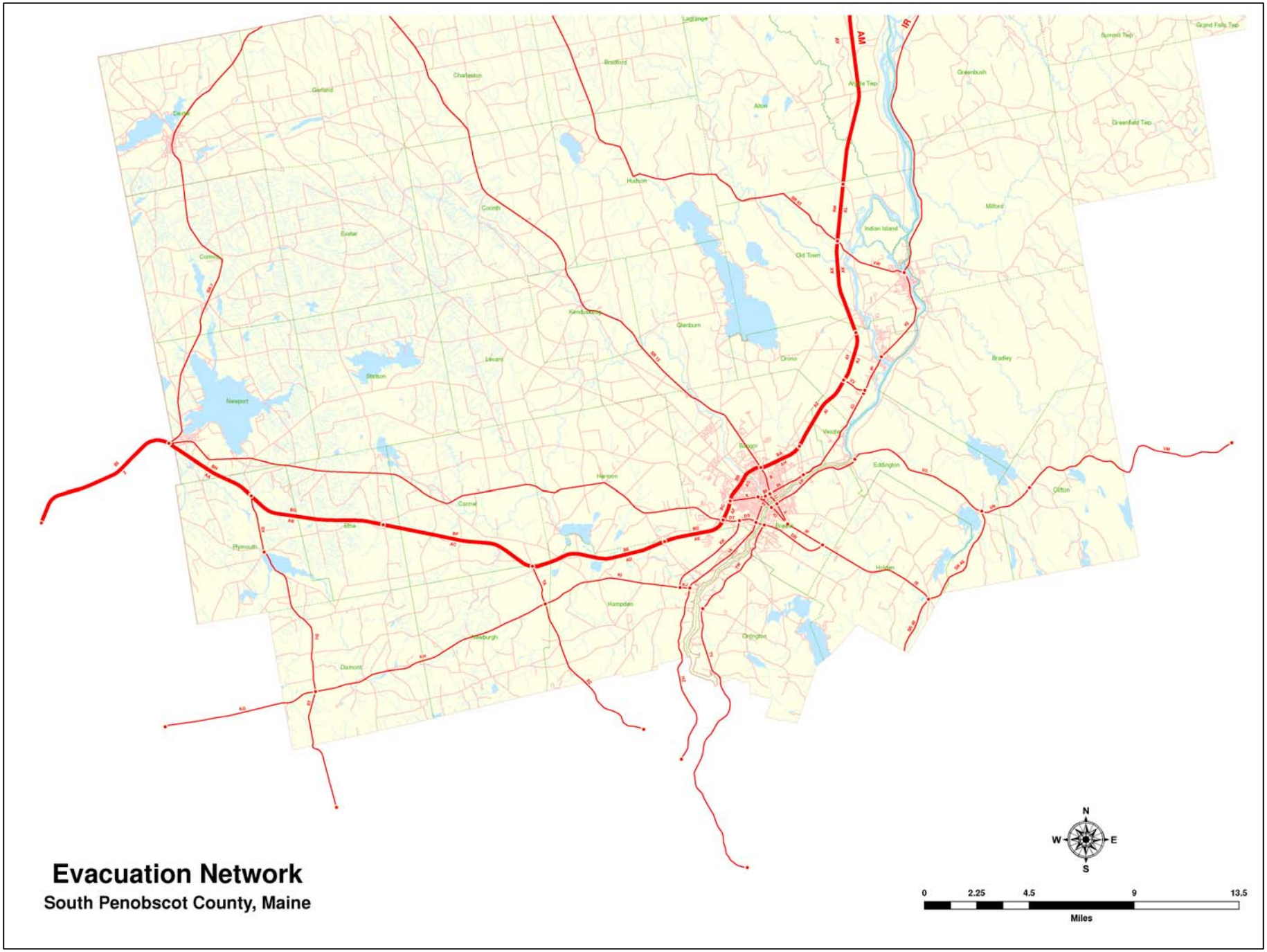


Figure 2-20 South Penobscot County Evacuation Roadway Segments and Loading Points

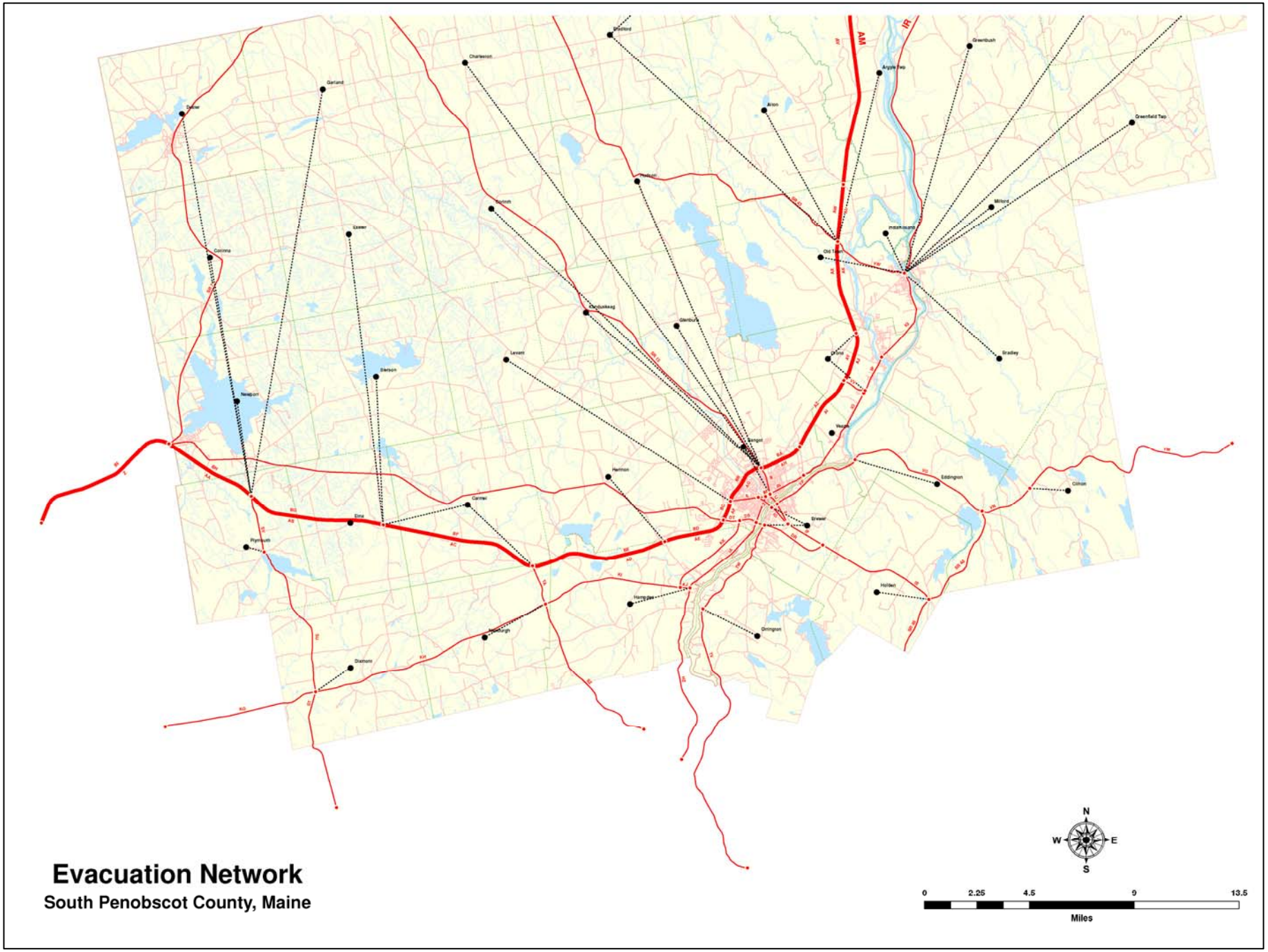


Figure 2-21 North Penobscot County Evacuation Roadway Segments

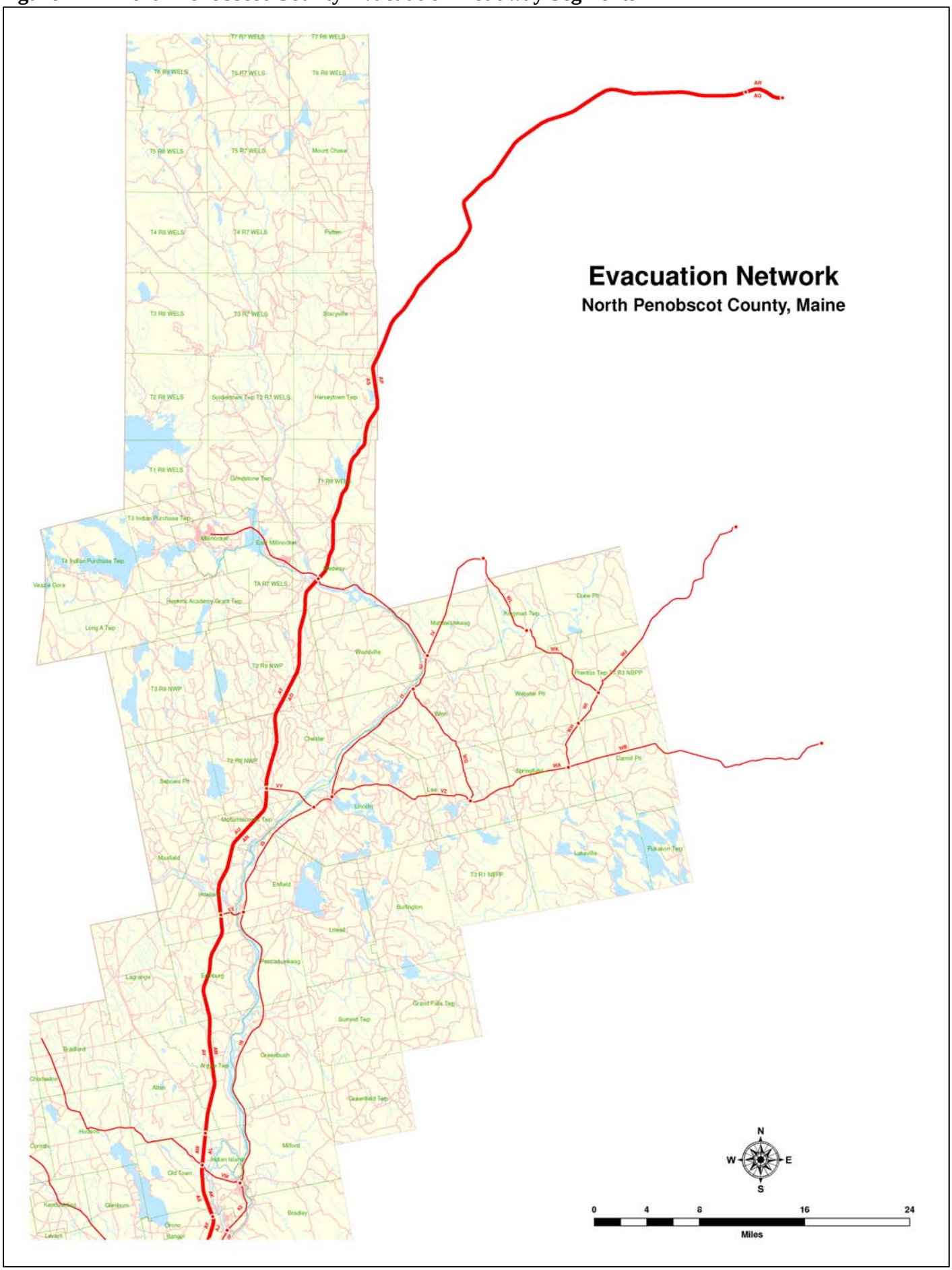


Figure 2-22 North Penobscot County Evacuation Roadway Segments and Loading Points

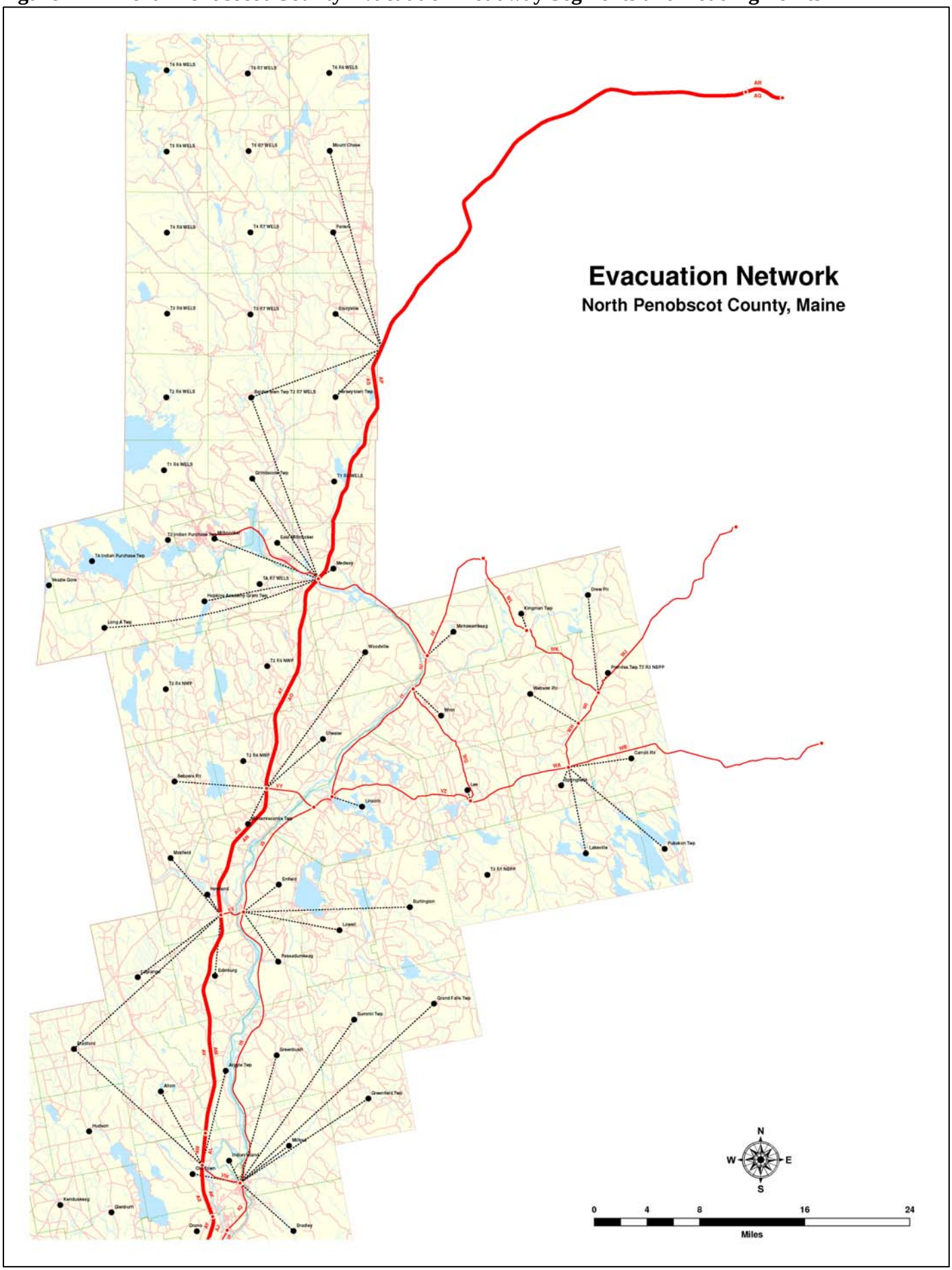


Figure 2-23 Washington County Evacuation Roadway Segments

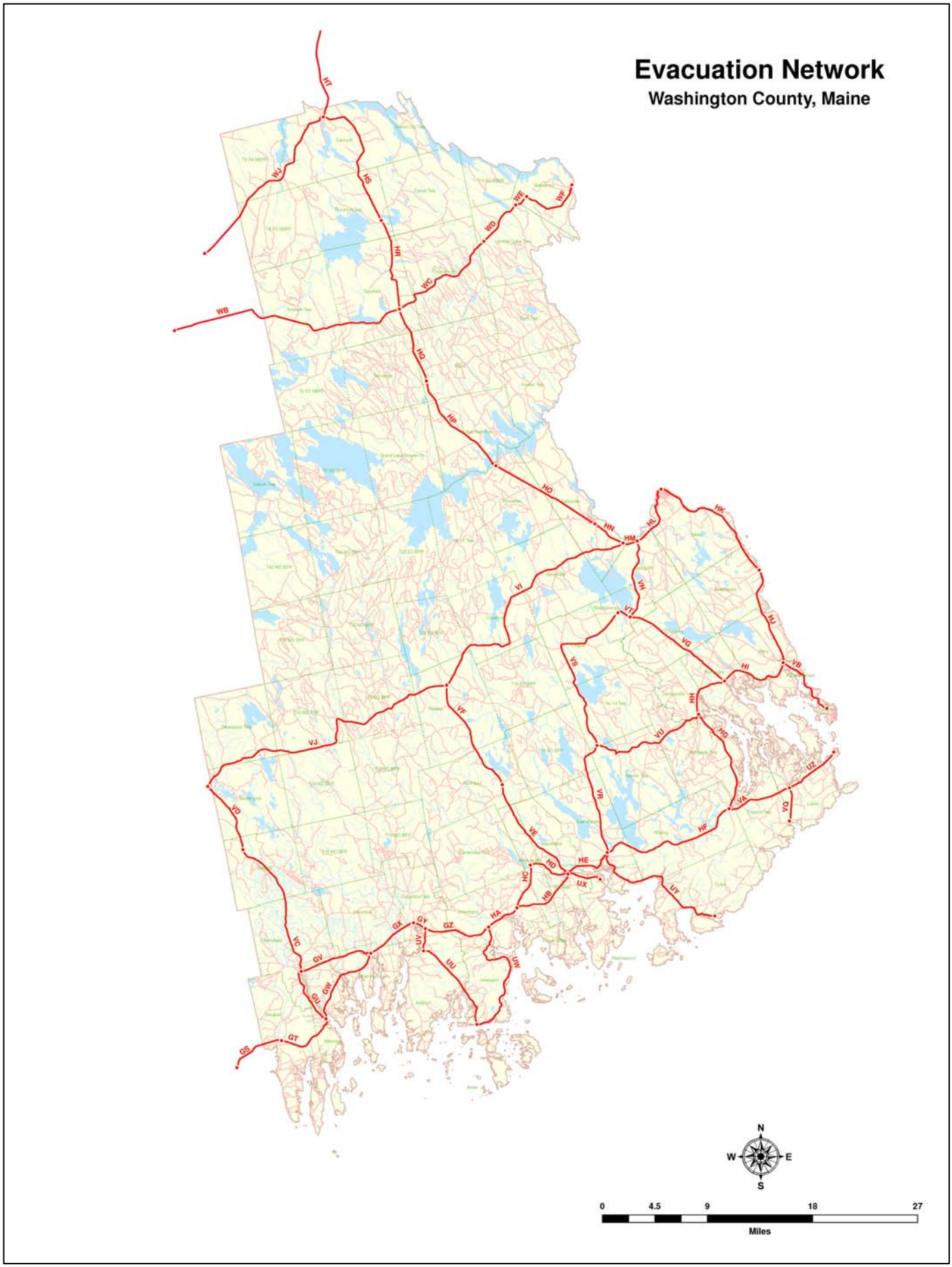


Figure 2-24 Washington County Evacuation Roadway Segments and Loading Points

Once the links and nodes were established for the evacuation routes, directional traffic service volumes appropriate for evacuations were established for each link for the Year 2007. This was accomplished by determining number of lanes, facility type, and area type information from Google Earth Pro, the Maine Department of Transportation and Maine GIS websites, as well as "field checks" updating performed by PBS&J. Tables were then used to specify a directional evacuation service volume based on link characteristics.

Important assumptions concerning the evacuation road network for the analysis that must be mentioned are:

- The evacuation of all vehicles will occur prior to the arrival of sustained tropical storm force winds (39 mph) and storm inundation of evacuation routes.

- Provisions will be made for the removal of vehicles in distress on the network through aggressive incident management and agreements worked out with tow truck operators.

- Signal timings will be "actuated" to provide the most “green time” for eastbound movements away from the coast

- The U.S. Coast Guard will be contacted to “lock down" drawbridges before the arrival of hazardous conditions

- Capacity on drawbridges will be “restrained” to account for marine movement during an evacuation.

3.0 EVACUATION CLEARANCE TIME MODEL APPLICATION/SYSTEM FORECASTS

Application of PBS&J's transportation modeling methodology for hurricane evacuations, using the inputs and assumptions discussed in Chapter 2, produced several key data items and forecasts for hurricane evacuation planning and preparedness. Completion of the transportation modeling process for the Year 2007 base year produced the following:

- Evacuating people and vehicle statistics by surge zone by storm scenario;
- Shelter demand and capacity considerations by scenario;
- Traffic volumes and critical roadway segments by scenario; and
- Estimated clearance times by scenario.

Although an extensive amount of data is generated through the transportation analysis (as provided in the Transportation Model Support Document), the items listed above constitute the most critical outputs for planning relative to identifying shelter needs, anticipating bottlenecks and defining the timing constraints of an evacuation.

3.1 CLEARANCE TIME MODEL DESCRIPTION

The general philosophy supporting all of PBS&J's hurricane evacuation clearance time work around the country is that the analysis must be technically complex enough to produce reliable estimates of hurricane evacuation clearance times, yet clear enough for the emergency management community to be able to review key modeling assumptions and products. A brief overview of the steps in the modeling process and a description of the computer program framework used in the modeling steps are discussed in this section.

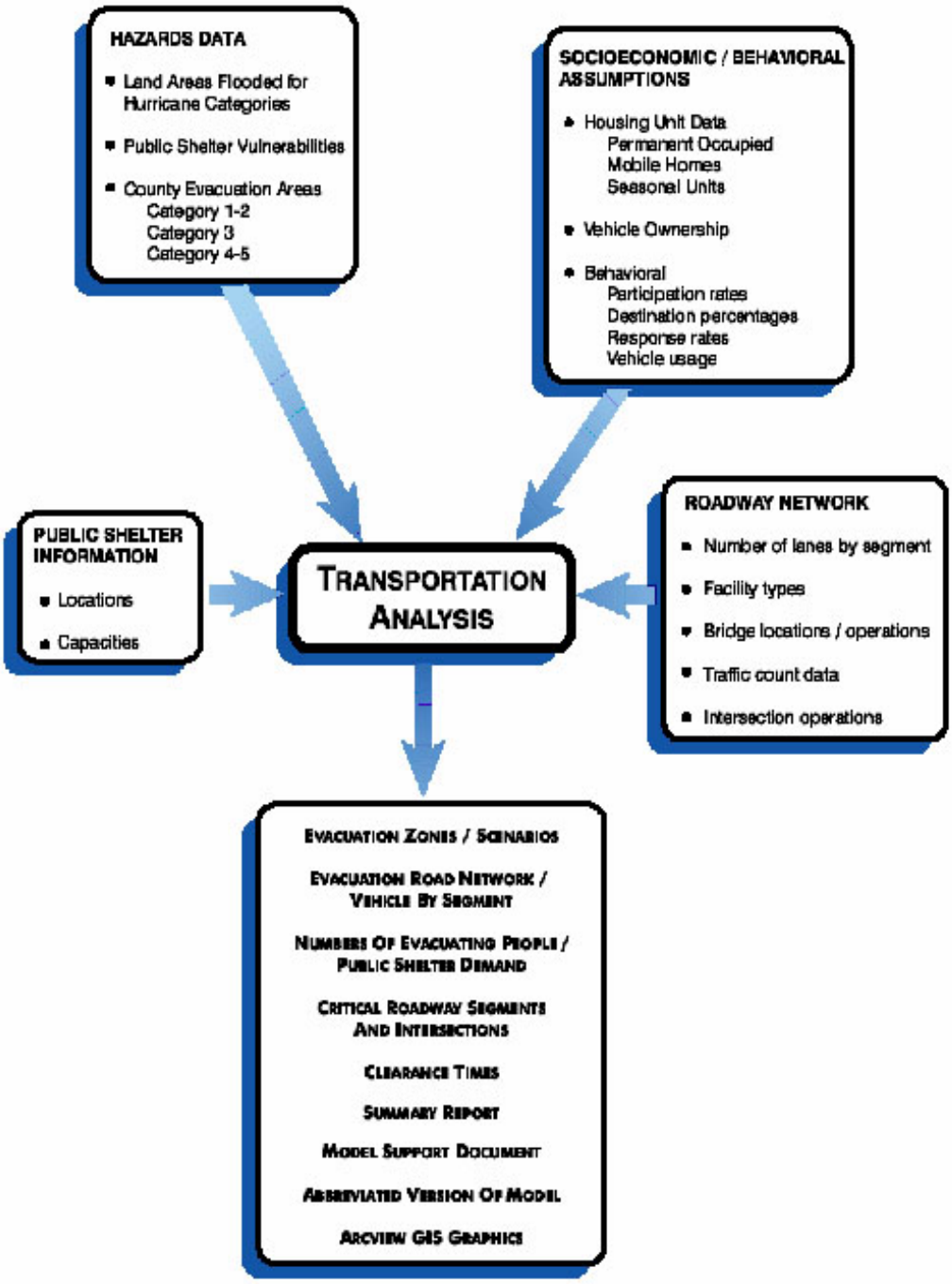
The key modeling steps used in the analysis are as follows:

- Development of Surge Zones and Data - Identifies who is vulnerable and who is evacuating;
- Trip Generation - Calculates how many evacuees will move for a particular plan;
- Trip Distribution - Determines where evacuees will go;
- Development of Evacuation Road Network –
  - Establishes which roads can be used for evacuation; and
  - Quantifies the carrying capacity of each evacuation roadway segment; and
- Trip Assignment - Determines what route(s) evacuees will use to get from their point of origin to their destination.
- Calculation of Clearance Time - Determines how much time it will take for all evacuees to clear the evacuation network

The major inputs and outputs of the overall process are illustrated in Figure 3-1. PBS&J developed an in-house set of computer programs to facilitate the transportation modeling steps described above. Programs are in Microsoft Excel and were originally developed in late 2003 by PBS&J. At the conclusion of the study, PBS&J will provide the Maine Emergency Management Agency (MEME), county Emergency Management Offices for York, Cumberland, Sagadahoc, Lincoln, Knox, Kennebec, Waldo, Hancock, Penobscot and Washington Counties and the U.S, Army Corps of Engineers with a spreadsheet tool that will allow them to retroactively add the impacts of large developments, or road construction restrictions to the evacuation transportation model. This abbreviated model is designed to facilitate analysis of the clearance time impacts caused by development and other changes to evacuation related characteristics in the modeled counties and regions.

The Transportation Model Support Document Appendix to this report provides details about the components of the model, file nomenclature and management and model application. One important aspect of operating in the Excel environment for this study is the ability to import data files directly into the initial programs. In addition, the outputs of other programs are easily captured and exported to ArcView GIS for displays and mapping. Overall, the use of GIS by PBS&J significantly enhanced the process of technical data development and documentation in the study.

Figure 3-1 Transportation Model Inputs and Outputs



3.2 EVACUATING PEOPLE AND VEHICLES BY PLAN

Using the trip generation module of PBS&J's hurricane evacuation transportation model, total evacuating people and vehicles produced by each surge zone were calculated and split by general destination type (trip purpose). The two general destination types are to in-county and out-of-county destinations, with a special category within in-county trips for public shelter locations. This was accomplished for the Year 2007 base year as well as 2012, the category 1 through 4 storm intensities and for two levels of assumed tourist occupancy. Low tourist occupancy was assumed to be 30% and high tourist occupancy was assumed to be 80%. The zone-by-zone statistics resulting from this process can be found in the Transportation Model Support Document in Annex C and D.

Table 3-1 shows the number of residents and tourists estimated to leave dwelling units for each surge zone. **The number of people involved in an actual evacuation will likely total less than these figures** due to the assumed 100 percent participation rate of people from units in storm surge vulnerable areas and mobile homes for each evacuation scenario. Even with door-to-door evacuation notification, it will be difficult to convince all who should leave to do so, even for the most intense storm threats. Participation rates in tropical storm/weak Category 1-2 hurricanes can be quite low even in potential surge areas. Conversely, for Category 3 and 4 hurricanes, media hype and continual coverage on The Weather Channel, and the public perceptions created by the 2004 and 2005 seasons, as well as Hurricanes Katrina and Rita will tend to cause high participation rates from residents that local officials would rather have stay in county, or shelter in place.

Table 3-1

EVACUATING PEOPLE STATISTICS BY STORM PLAN

Maine Hurricane Transportation Analysis 2007

County/Scenario	Year 2007 Estimated Permanent Population*	Maximum People/ Vehicles Evacuating	Maximum Public Shelter Demand	Local Public Shelter Capacity
York County	**206,498 Permanent Residents**			
Low Tourist Occupancy	232,934 including 26,436 seasonal people countywide			
Category 1 Scenario		31,861 / 16,846	3,164 People	9,820 People
Category 2 Scenario		41,497 / 21,669	3,691 People	9,820 People
Category 3 Scenario		56,543 / 29,199	4,478 People	9,820 People
Category 4 Scenario		62,560 / 32,309	4,975 People	9,820 People
High Tourist Occupancy	285,805 including 79,307 seasonal people countywide			
Category 1 Scenario		58,634 / 29,135	3,217 People	9,820 People
Category 2 Scenario		77,825 / 38,330	3,762 People	9,820 People
Category 3 Scenario		107,134 / 52,390	4,478 People	9,820 People
Category 4 Scenario		114,093 / 55,967	4,975 People	9,820 People
	Includes 19,057 mobile home residents countywide			
Cumberland County	**279,255 Permanent Residents**			
Low Tourist Occupancy	296,528 including 17,273 seasonal people countywide			
Category 1 Scenario		18,683 / 9,081	2,671 People	10,683+ People
Category 2 Scenario		26,465 / 12,790	3,617 People	10,683+ People
Category 3 Scenario		38,728 / 18,609	5,119 People	10,683+ People
Category 4 Scenario		49,346 / 23,787	6,697 People	10,683+ People
High Tourist Occupancy	331,075 including 51,820 seasonal people countywide			
Category 1 Scenario		30,070 / 13,967	3,003 People	10,683+ People
Category 2 Scenario		43,024 / 19,896	4,070 People	10,683+ People
Category 3 Scenario		63,018 / 29,036	5,699 People	10,683+ People
Category 4 Scenario		74,257 / 34,431	7,214 People	10,683+ People
	Includes 15,157 mobile home residents countywide			

Table 3-1 (Continued)

EVACUATING PEOPLE STATISTICS BY STORM PLAN

Maine Hurricane Transportation Analysis 2007

County/Scenario	Year 2006 Estimated Permanent Population*	Maximum People/ Vehicles Evacuating	Maximum Public Shelter Demand	Local Public Shelter Capacity
Sagadahoc County	**38,072 Permanent Residents**			
Low Tourist Occupancy	40,152 including 2,080 seasonal people countywide			
Category 1 Scenario		3,928 / 1,996	591 People	70+ People
Category 2 Scenario		5,378 / 2,726	780 People	70+ People
Category 3 Scenario		7,762 / 3,927	1,101 People	70+ People
Category 4 Scenario		8,909 / 4,513	1,267 People	70+ People
High Tourist Occupancy	44,311 including 6,239 seasonal people countywide			
Category 1 Scenario		5,871 / 2,929	619 People	70+ People
Category 2 Scenario		8,058 / 4,014	817 People	70+ People
Category 3 Scenario		11,543 / 5,739	1,145 People	70+ People
Category 4 Scenario		12,692 / 6,325	1,304 People	70+ People
	Includes 4,152 mobile home residents countywide			
Lincoln County	**36,302 Permanent Residents**			
Low Tourist Occupancy	43,741 including 7,440 seasonal people countywide			
Category 1 Scenario		6,877 / 3,640	725 People	465+ People
Category 2 Scenario		9,463 / 4,999	971 People	465+ People
Category 3 Scenario		13,526 / 7,141	1,343 People	465+ People
Category 4 Scenario		14,496 / 7,698	1,469 People	465+ People
High Tourist Occupancy	58,620 including 22,319 seasonal people countywide			
Category 1 Scenario		13,557 / 6,896	822 People	465+ People
Category 2 Scenario		18,744 / 9,525	1,091 People	465+ People
Category 3 Scenario		26,711 / 13,568	1,474 People	465+ People
Category 4 Scenario		27,684 / 14,126	1,586 People	465+ People
	Includes 5,359 mobile home residents countywide			

Table 3-1 (Continued)

EVACUATING PEOPLE STATISTICS BY STORM PLAN

Maine Hurricane Transportation Analysis 2007

County/Scenario	Year 2006 Estimated Permanent Population*	Maximum People/ Vehicles Evacuating	Maximum Public Shelter Demand	Local Public Shelter Capacity
Knox County	**43,404 Permanent Residents**			
Low Tourist Occupancy	48,926 including 5,522 seasonal people countywide			
Category 1 Scenario		5,513 / 2,803	694 People	980 People
Category 2 Scenario		7,539 / 3,824	918 People	980 People
Category 3 Scenario		10,663 / 5,393	1,266 People	980 People
Category 4 Scenario		11,919 / 6,047	1,427 People	980 People
High Tourist Occupancy	59,971including 16,567 seasonal people countywide			
Category 1 Scenario		9,990 / 4,876	833 People	980 People
Category 2 Scenario		13,700 / 6,679	1,086 People	980 People
Category 3 Scenario		19,282 / 9,397	1,466 People	980 People
Category 4 Scenario		20,574 / 10,069	1,606 People	980 People
	Includes 4,283 mobile home residents countywide			
Kennebec County	**122,072 Permanent Residents**			
Low Tourist Occupancy	128,968 including 6,896 seasonal people countywide			
Category 1 Scenario		10,776 / 5,514	1,945 People	* People
Category 2 Scenario		14,993 / 7,670	2,569 People	* People
Category 3 Scenario		21,528 / 11,006	3,551 People	* People
Category 4 Scenario		22,730 / 11,587	3,610 People	* People
High Tourist Occupancy	142,760 including 20,688 seasonal people countywide			
Category 1 Scenario		13,381 / 6,762	2,121 People	* People
Category 2 Scenario		19,288 / 9,720	2,832 People	* People
Category 3 Scenario		28,357 / 14,265	3,913 People	* People
Category 4 Scenario		29,836 / 14,947	3,932 People	* People
	Includes 16,108 mobile home residents countywide			

* Shelter listings included shelter locations, but not capacities.

Table 3-1 (Continued)

EVACUATING PEOPLE STATISTICS BY STORM PLAN

Maine Hurricane Transportation Analysis 2007

County/Scenario	Year 2006 Estimated Permanent Population*	Maximum People/ Vehicles Evacuating	Maximum Public Shelter Demand	Local Public Shelter Capacity
Waldo County	**39,498 Permanent Residents**			
Low Tourist Occupancy	43,406 including 3,907 seasonal people countywide			
Category 1 Scenario		5,974 / 3,106	1,011 People	150 People
Category 2 Scenario		8,336 / 4,335	1,358 People	150 People
Category 3 Scenario		12,012 / 6,239	1,898 People	150 People
Category 4 Scenario		12,868 / 6,673	1,981 People	150 People
High Tourist Occupancy	51,220 including 11,722 seasonal people countywide			
Category 1 Scenario		8,240 / 4,149	1,140 People	150 People
Category 2 Scenario		11,587 / 5,836	1,531 People	150 People
Category 3 Scenario		16,726 / 8,424	2,123 People	150 People
Category 4 Scenario		17,621 / 8,876	2,171 People	150 People
	Includes 8,693 mobile home residents countywide			
Hancock County	**54,790 Permanent Residents**			
Low Tourist Occupancy	69,066 including 14,276 seasonal people countywide			
Category 1 Scenario		12,389 / 6,386	984 People	650 People
Category 2 Scenario		17,321 / 8,963	1,369 People	650 People
Category 3 Scenario		24,483 / 12,691	1,890 People	650 People
Category 4 Scenario		26,688 / 13,932	2,199 People	650 People
High Tourist Occupancy	97,619 including 42,829 seasonal people countywide			
Category 1 Scenario		27,099 / 13,397	1,012 People	650 People
Category 2 Scenario		37,455 / 18,619	1,414 People	650 People
Category 3 Scenario		52,708 / 26,294	1,890 People	650 People
Category 4 Scenario		54,974 / 27,578	2,199 People	650 People
	Includes 7,612 mobile home residents countywide			

Table 3-1 (Continued)

EVACUATING PEOPLE STATISTICS BY STORM PLAN

Maine Hurricane Transportation Analysis 2007

County/Scenario	Year 2006 Estimated Permanent Population*	Maximum People/ Vehicles Evacuating	Maximum Public Shelter Demand	Local Public Shelter Capacity
Penobscot County	**151,619 Permanent Residents**			
Low Tourist Occupancy	157,182 including 7,520 seasonal people countywide			
Category 1 Scenario		15,210 / 7,689	2,729 People	* People
Category 2 Scenario		22,338 / 11,222	3,835 People	* People
Category 3 Scenario		31,960 / 16,033	5,261 People	* People
Category 4 Scenario		34,644 / 17,288	5,457 People	* People
High Tourist Occupancy	172,221 including 22,559 seasonal people countywide			
Category 1 Scenario		18,153 / 8,887	2,836 People	* People
Category 2 Scenario		27,382 / 13,292	3,993 People	* People
Category 3 Scenario		40,253 / 19,479	5,492 People	* People
Category 4 Scenario		43,942 / 21,142	5,684 People	* People
	Includes 23,967 mobile home residents countywide			
Washington County	**33,128 Permanent Residents**			
Low Tourist Occupancy	38,712 including 5,584 seasonal people countywide			
Category 1 Scenario		5,613 / 3,091	893 People	* People
Category 2 Scenario		7,646 / 4,187	1,164 People	* People
Category 3 Scenario		10,819 / 5,925	1,581 People	* People
Category 4 Scenario		11,758 / 6,430	1,672 People	* People
High Tourist Occupancy	49,880 including 16,752 seasonal people countywide			
Category 1 Scenario		8,576 / 4,544	1,095 People	* People
Category 2 Scenario		11,862 / 6,263	1,424 People	* People
Category 3 Scenario		17,022 / 8,979	1,913 People	* People
Category 4 Scenario		18,073 / 9,548	1,974 People	* People
	Includes 6,733 mobile home residents countywide			

* Shelter listings included shelter locations, but not capacities.

►All socioeconomic data developed by PBS&J for input into the transportation analysis effort. The totals presented in this table are for the entire county. Totals by individual zone may be found in Annex C and D of the Model Support document.

►Shelter data provided by the American Red Cross.

3.3 PUBLIC SHELTER DEMAND/CAPACITY CONSIDERATIONS

One crucial aspect of hurricane evacuation planning involves the coordination of shelter locations and capacity to meet the shelter demand of evacuees in any given storm or evacuation scenario. Depending upon actual behavioral response, a county's shelter capacity in this region may be generally adequate in relation to shelter demand, especially in lower categories of storm, but can be exceeded in major hurricane events, or during exigent circumstances. Public shelter locations and capacities for each county were provided by local American Red Cross chapters as well as the county emergency management offices. Table 3-1 (shown previously) shows potential public shelter demand and reported total capacities for each county based on an assumption that 20% of in-county evacuees will go to those facilities. Although this assumption is higher than the actual percentages historically observed in real hurricane events, this figure allows for any exigent circumstances (e.g. late night evacuation orders, increases in forward speed of the storm) that may serve to boost public shelter use rates above normal figures.

One of the aspects of evacuations that PBS&J has observed nationally over the last five to ten years is the extremely low public shelter demand that communities are experiencing relative to expected demand from the study processes. In that regard, shelter demand numbers shown in Table 3-1 should be considered high estimates of people seeking shelters.

As seen in Table 3-1, public shelter demand generally increases slightly from low to high tourist occupancy for lesser category storms. This demand between low and high tourist occupancy usually remains the same for more intense storms. A small portion of the tourist population generally seeks local public shelters only in lower category storms, but tourists generally tend to leave an area altogether during higher level evacuation scenarios and return home.

Since mobile home residents typically have a higher propensity to use local public shelter space more than other residents, the high mobile home population may increase the shelter demand. Growth in special needs and elderly populations could also add to the increased demand in this region.

It should be noted that not all shelters may be opened and available for use during all storms.

3.4 EVACUATION TRAFFIC VOLUMES AND CRITICAL ROADWAY SEGMENTS

The assigned evacuating vehicle figures by roadway segment for Year 2007 for each evacuation scenario can be found in the Transportation Model Support Document Annex E. Annex F contains a table with what percentage of exiting vehicles will use each county out-route from each minor civil division. Annex G also provides by evacuation scenario, as well as seasonal/tourist occupancy the actual number of vehicles forecast to use the exiting route. The tables in the annex also detail the total number of vehicles going to in-county locations such as to shelters, the homes of friends and relatives and hotels/motels.

The out of county and in-county evacuation trips from each minor civil division are compiled and routed onto the model roadway segments shown in Figures 2-3, 2-5, 2-7, 2-9, 2-11, 2-13, 2-15, 2-17, 2-19, 2-21and 2-23 above entering the evacuation roadway according to the nodes shown in Figures 2-4, 2-6, 2-8, 2-10, 2-12, 2-14, 2-16, 2-18, 2-20, 2-22 and 2-24. Annex G provides the number of evacuating vehicles forecast to use certain roadways determined to be particularly critical by virtue of their predicted levels of traffic congestion during an evacuation. The roadway segments listed in this Annex also include those roadways that also are particularly significant because they are the routes that will convey evacuation traffic directly away from the surge vulnerable zones and coastal areas to interior locations. Annex H provides clearance time details for all critical roadways listed in Annex G by evacuation scenario and tourist occupancy.

These congested roadway segments control the flow of evacuation traffic during a hurricane event and are key areas for traffic control and monitoring. Many of these same roadways will be supporting not only the evacuating public, but also the non-evacuating public attempting to gather supplies and fuel for their homes and vehicles. The hurricane evacuation transportation model considers these non-evacuation trips as background traffic which is further assumed to diminish over time as the progress of the evacuation continues. In some cases, depending upon the time of the evacuation, residents may also have to travel from work to home before beginning their evacuation movement.

Table 3-2 lists the most critical roadway segments or intersections in the county that will control the

flow of evacuation traffic. These roadway segments by virtue of their relative congestion during an evacuation event will determine the clearance times for a sector or portion of a county; the most congested roadway segment will establish the clearance time for the entire study jurisdiction (county) or region. The county and regional clearance times will be provided in this report, whereas the Annex H and the ATM will detail those times for all identified critical links. This listing of critical road segments is provided as guidance to identify which portions of the evacuation roadway network warrant special consideration for traffic control measures. Among the special traffic techniques to be considered:

- traffic control points staffed with law enforcement officials equipped with traffic signal override capabilities, where needed;
- synchronization of traffic signals to allow priority for evacuation traffic;
- variable message signs; as well as more permanent evacuation route designation signage;
- real-time observation and reporting measures to ensure that any problems or issues are resolved quickly; and
- incident management teams to rapidly minimize the impact of breakdowns and accidents.

Any problems or issues experienced at these locations during the course of an evacuation may dramatically increase the clearance times provided in this report and may result in vehicles stranded on the roadway at the onset of tropical storm force winds or greater.

Additionally, some of the critical links provided below may not be the most congested roadways in a county, but are included on the list because they are roadways that will convey most of a sector's evacuation traffic directly away from the surge-vulnerable coastal area and onto major evacuation routes. Failure to clear these specific coastal routes before the advent of tropical storm force winds may leave the stranded vehicles susceptible to flooding and severe wind conditions; therefore all measures should be undertaken to ensure that any of these roadways are allowed sufficient time to process all of the traffic that may use them during an evacuation event.

Table 3-2

CRITICAL ROADWAY LOCATIONS/SEGMENTS

Maine Hurricane Transportation Analysis 2007

York County

- ► I-95 Southbound between SR 103 & New Hampshire
- ► SR 9 between US 1 in Wells and the I-95 Interchange near Wells (KW)
- ► I-95 Interchange Access Road from US 1 to I-95 near York Village
- ► SR 35 between SR 9 in Kennebunkport and I-95 in Kennebunk (MM)
- ► SR 111 between US 1 and I-95 interchange near Biddeford
- ► I-195 between US 1 and I-95 interchange in Saco (DO)
- ► SR 9 / SR 208 from Tattle Corner to SR 111 in Biddeford (MN)
- ► SR 236 at the I-95 Interchange in Kittery

Cumberland County

- ► SR 25 between US 1 in downtown Portland and Rand Road near I-95
- ► Scarborough Connector between US 1 and I-95 / I-295
- ► SR 77 bridge between South Portland and Portland across the Fore River
- ► SR 123 between South Harpswell and SR 24 in Brunswick (PJ)
- ► SR 24 between Bailey Island and the US 1 interchange in Brunswick (PK)
- ► SR 196 between US 201 in Topsham and the I-95 interchange (in Sagadahoc County)

Sagadahoc County

- ► SR 209 between SR 217 and US 1 in Bath (PR)
- ► SR 127 between Old Stage Rd in Arrowsic and US 1 in Woolrich (PT)
- ► US 1 between SR 196 and SR 24 interchange in Brunswick
- ► SR 196 between US 201 in Topsham and the I-95 interchange

Lincoln County

- ► US 1 between SR 27 and SR 218 in Wiscasset (FE)
- ► SR 27 between SR 96 in Boothbay Harbor and US 1 in Edgecomb Township (QH)

Lincoln County (Continued)

- ► SR 129 / SR 130 from their intersection to, and including, US 1 intersection in Damariscotta (QQ)
- ► SR 27 between SR 194 and SR 9 in Randolph (QL) (in Kennebec County)
- ► SR 27 between SR 128 in Dresden Township and SR 194 in Randolph (QK)
- ► SR 144 intersection with US 1 near Wiscasset (QF)
- ► SR 32 from West Waldoboro to, and including, intersections with US 1 in Waldoboro
- ► Intersections of US 1 Bus and US 1 in Damariscotta and Newcastle
- ► US 1 between SR 196 and SR 24 interchange in Brunswick (in Sagadahoc County)

Knox County

- ► SR 97 intersection with US 1 in South Warren
- ► SR 73 between North Shore Rd in Owls Head and US 1 in Rockland (RL)
- ► SR 131 between SR 73 in St. George and US 1 in Thomaston (RH)
- ► Intersections of SR 73 and US 1A/SR 17 with US 1 in Rockland
- ► US 1 between SR 196 and SR 24 interchange in Brunswick (in Sagadahoc County)

Kennebec County

- ► SR 27 between SR 194 in Randolph and SR 9 in Randolph (QL)
- ► SR 17 between SR 9 and US 201 in Augusta (SA)
- ► I-95 Northbound between I-295 and US 202 / SR 100 near Augusta (Q)
- ► US 201 between SR 24 / SR 9 in Gardiner and US 202 / SR 100 in Augusta

Waldo County

- ► US 1A between Old Belfast Rd In Frankfort and SR 69 / SR 139 in Winterport (HY)
- ► US 1A between US 202 / SR 9 in Hampden and I-395 in Bangor (IA) (in Penobscot County)
- ► US 1 between SR 7 / SR 137 and SR 141 in Belfast (FY)
- ► US 1 between SR 52 in Camden and SR 173 in Lincolnville (FV)
- ► US 1 between SR 196 and SR 24 interchange in Brunswick (in Sagadahoc County)

Hancock County

- US 1 between US 1A and SR 3 in Ellsworth (GJ)
- US 1A between US 1 in Ellsworth and SR 179 / SR 180 (IC)
- SR 3 between SR 102 / SR 198 near Thompson Island and US 1 in Ellsworth
- Intersections of US 1 with SR 3 and US 1A in Ellsworth
- US 1A between SR 46 in East Holden and I-395 in Brewer (IE) (in Penobscot County)
- SR 15 between SR 199 in North Penobscot and US 1 in Five Mile Corners (TU)
- SR 199 between SR 175 in Penobscot and SR 15 in North Penobscot (TP)
- US 1 between SR 15 in Bucksport and SR 15 / SR 46 in Orland
- SR 175 intersection with US 1 in Orland
- US 1 intersections with SR 172 and SR 230 in Ellsworth
- SR 186 intersection with US 1 in West Gouldsboro
- I-395 Northbound between US 202 and I-95 Interchange (DT) (in Penobscot County)

Penobscot County

- US 1A between SR 46 in East Holden and I-395 in Brewer (IE)
- US 1A between US 202 / SR 9 in Hampden and I-395 in Bangor (IA) (in Penobscot County)
- SR 15 between US 2 and I-95 Interchange in Bangor (IK)
- US 2 between I-95 Interchange and US 1A in Bangor (IL)
- I-95 Northbound between Cold Brook Rd and I-395 near Bangor (AE)
- I-395 Northbound between US 202 and I-95 Interchange (DT)

Washington County

- SR 9 between SR 178 in Eddington and US 1A Business in Brewer (in Penobscot County)
- US 1 between SR 193 in Cherryfield and Centerville Rd in Columbia Falls (GX)
- SR 192 between Northfield and SR 9 near Wesley (VF)
- SR 187 between Wescogus Rd in Tracy Corners and US 1 near Columbia Falls (UV)
- SR 189 between SR 191 in West Lubec and US 1 in Whiting (VA)
- SR 190 between Eastport and US 1 in Perry (VB)
- SR 193 and US 1 intersection west of Beddington (in Hancock County)

Washington County (continued)

- ► US 1 between SR 92 / SR 192 in Machias and SR 191 in East Machias (HE)
- ► US 1 intersections with SR 187 near Jonesboro, SR 92 in Machias and SR 191in East Machias

3.5 ESTIMATED EVACUATION CLEARANCE TIMES

An important product of the transportation analysis is the clearance times based on storm category, or scenario and behavioral characteristics. Clearance time is one of two major considerations involved in issuing an evacuation order or advisory. The other time aspect, which must be weighed, is the arrival of sustained tropical storm winds. Figure 3-2 illustrates these two timing issues of evacuation and their relation to one another.

Clearance time is the time required to clear the roadway of all vehicles evacuating in response to a hurricane situation. Clearance time begins when the first evacuating vehicle enters the road network (as defined by a hurricane evacuation behavioral response curve) and ends when the last evacuating vehicle reaches an assumed point of relative safety. Clearance time includes:

- Mobilization Time - the time required by evacuees to prepare for evacuation and enter the road network;
- Travel Time - the time needed to travel along the road network; and
- Queuing Delay Time – the cumulative times for all stops caused by traffic congestion.

Clearance time does not relate to the time any one vehicle spends traveling on the road network and does not include time needed for local officials to assemble and make a decision to evacuate.

Tables 3-3a through 3-3m provide the hurricane evacuation clearance times developed for the Maine coastal region for the Year 2007. These times reflect local in-county movement. Clearance time runs were generated based on differing intensity strengths of hurricanes, levels of background traffic, the rapidity of response by evacuees, and different tourist occupancy levels. In-county clearance times range from 1 ¾ hours in a category 1 low tourist occupancy scenario to 20 ¾ hours based on the Year 2007 socio-economic data, as affected by the level of evacuation, the amount of mobilization time exhibited by the public, degree of background traffic and tourist occupancy.

Clearance times were also developed to include regional, as well as extra-regional traffic, or factoring in those tourist trips from other New England States and Canada. Tables 3-4a through 3-4f provide regional clearance times including those on I-95 Southbound with and without toll operations on the Maine Turnpike. The same county and regional clearance time figures have been calculated for 2012 and are represented in Tables 3-5a through 3-5m and Tables 3-6a through 6f.

Figure 3-2 Components of Evacuation Time

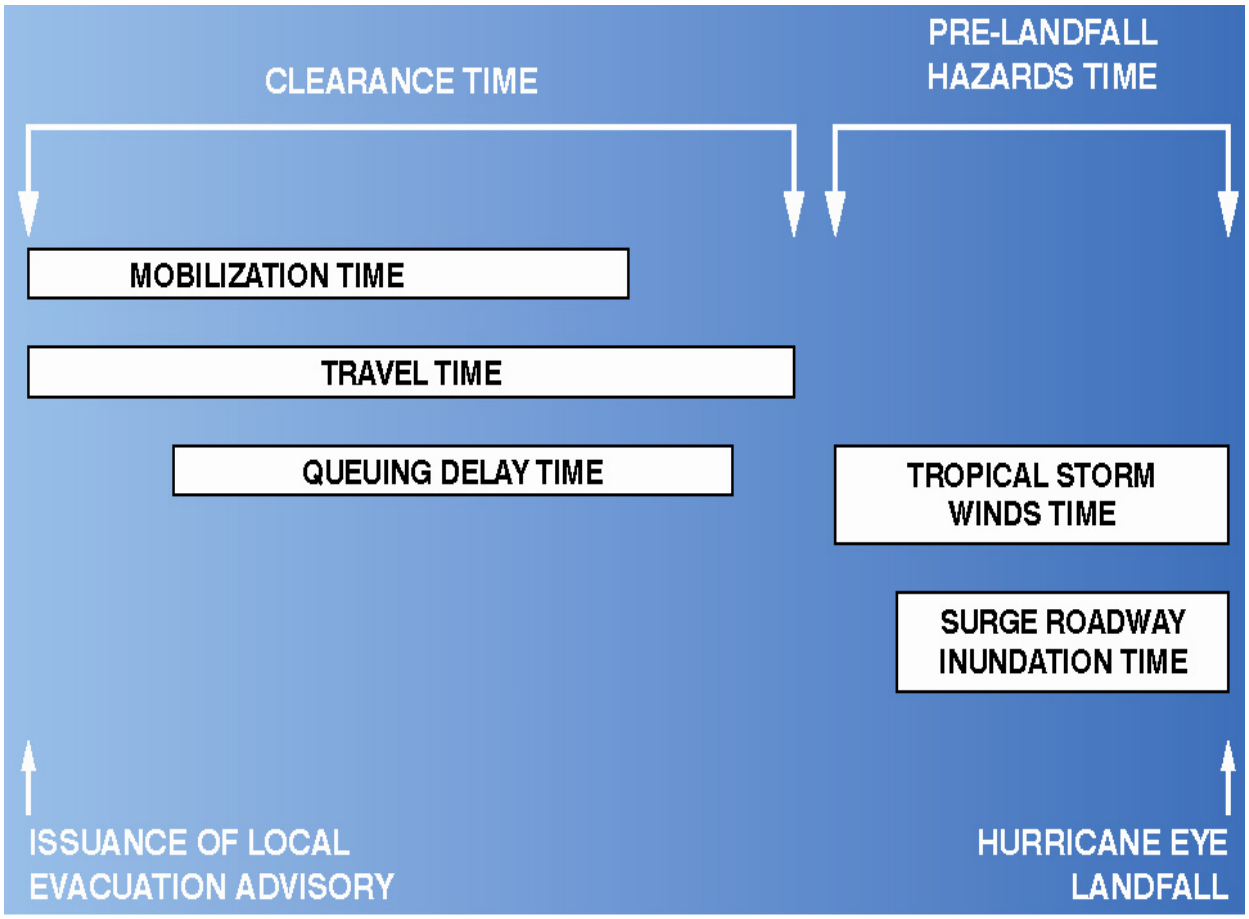


Table 3-3a

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

York Local In-County Movement and Regional Movement

(I-95 Southbound to New Hampshire State Line – Peak Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	4 ¾
Medium Response	3 ½	5 ½
Long Response	4 ½	6 ½

Worst individual household commute time – ½ hour to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	6
Medium Response	4	6 ¾
Long Response	5	7 ¾

Worst individual household commute time – 1 ¾ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8
Medium Response	4 ¾	8 ¾
Long Response	5 ¾	9 ¾

Worst individual household commute time – 3 ¾ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ½
Medium Response	5 ¼	9 ¼
Long Response	6	10

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Table 3-3b

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

York Local In-County Movement and Regional Movement

(I-95 Southbound to New Hampshire State Line – Normal Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ½
Medium Response	3	5
Long Response	3 ¾	5 ¾

Worst individual household commute time – ¼ hour to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5 ¾
Medium Response	3 ½	6 ¼
Long Response	4 ¼	7

Worst individual household commute time – 1 ½ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	7 ¾
Medium Response	4 ¼	8 ¼
Long Response	5	9

Worst individual household commute time – 3 ½ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8 ¼
Medium Response	4 ½	8 ½
Long Response	5 ¼	9 ¼

Worst individual household commute time – 4 hours to New Hampshire state line

Table 3-3c

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

York Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5
Medium Response	3	5 ¼
Long Response	3 ¼	5 ½

Worst individual household commute time – 1 hour to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	6 ¼
Medium Response	3 ½	6 ¼
Long Response	3 ¾	6 ¾

Worst individual household commute time – 2 hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	8
Medium Response	4	8
Long Response	4 ¼	8 ¼

Worst individual household commute time – 3 ¾ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8
Medium Response	4 ¼	8
Long Response	4 ½	8 ½

Worst individual household commute time – 4 hours to New Hampshire state line

Table 3-3d

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Cumberland Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	4 ¼
Medium Response	6 ¼	6 ½
Long Response	8 ¼	8 ½

Worst individual household commute time – ½ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	4 ½
Medium Response	6 ¼	6 ½
Long Response	8 ½	8 ¾

Worst individual household commute time – ¾ hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	5
Medium Response	6 ¾	7 ¼
Long Response	8 ¾	9 ½

Worst individual household commute time – 1 ½ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5 ¼	6
Medium Response	7 ½	8 ¼
Long Response	9 ¾	10 ¼

Worst individual household commute time – 2 ¼ hours

Table 3-3e

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Sagadahoc Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	3 ½
Medium Response	4 ½	5
Long Response	5 ¾	6 ½

Worst individual household commute time – ½ hour to Augusta

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	4
Medium Response	4 ¾	5 ½
Long Response	6	6 ¾

Worst individual household commute time – ½ hour to Augusta

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	4 ¾
Medium Response	5	6 ¼
Long Response	6 ½	7 ½

Worst individual household commute time – 1 hour to Augusta

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	5
Medium Response	5 ¼	6 ¼
Long Response	6 ¾	7 ¾

Worst individual household commute time – 1 ½ hours to Augusta

Table 3-3f

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Lincoln County Regional Movement (with evacuating vehicles on US 1 southbound from Knox, Waldo, Hancock and Washington Counties)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8 ¼
Medium Response	5 ¼	9 ¼
Long Response	6 ½	10 ¼

Worst individual household commute time – 4 hours

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5	10 ¾
Medium Response	6 ¼	11 ¾
Long Response	7 ¼	12 ¾

Worst individual household commute time – 6 ½ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ¾	14 ¾
Medium Response	7 ¾	15 ½
Long Response	8 ¾	16 ¾

Worst individual household commute time – 10 ½ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	7	15 ¼
Medium Response	8	16
Long Response	9 ¼	17 ¼

Worst individual household commute time – 11 hours

Table 3-3g

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Lincoln Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	6
Medium Response	4 ½	7
Long Response	5 ¾	8 ¼

Worst individual household commute time – 1 ¾ hours

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	7 ¾
Medium Response	5 ¼	8 ¾
Long Response	6 ¼	9 ¾

Worst individual household commute time – 3 ½ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5	10 ¼
Medium Response	6	11
Long Response	7 ¼	12 ¼

Worst individual household commute time – 6 hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5	10 ¼
Medium Response	6 ¼	11 ¼
Long Response	7 ¼	12 ½

Worst individual household commute time – 6 ¼ hours

Table 3-3h

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Knox Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	2 ¼
Medium Response	2 ¾	3 ¼
Long Response	3 ¾	4

Worst individual household commute time – ½ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	2 ¼
Medium Response	3	3 ¼
Long Response	4	4 ¼

Worst individual household commute time – ½ hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	2 ¾
Medium Response	3 ¼	3 ¾
Long Response	4	4 ½

Worst individual household commute time – ½ hour

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	2 ¾
Medium Response	3 ¼	3 ¾
Long Response	4 ¼	4 ¾

Worst individual household commute time – ½ hour

Table 3-3i

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Kennebec Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	4 ½
Medium Response	4 ¼	5 ¾
Long Response	5 ½	7

Worst individual household commute time – ¾ hours to Augusta

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	5 ½
Medium Response	4 ¾	6 ¾
Long Response	5 ¾	8

Worst individual household commute time – ¾ hours to Augusta

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	7 ¼
Medium Response	5 ¼	8 ¼
Long Response	6 ½	9 ½

Worst individual household commute time – 3 ¼ hours to Augusta

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	7 ¼
Medium Response	5 ½	8 ½
Long Response	6 ½	9 ¾

Worst individual household commute time – 3 ½ hours to Augusta

Table 3-3j

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Waldo Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	4
Medium Response	2 ¼	4 ¼
Long Response	2 ¾	4 ¾

Worst individual household commute time – <¼ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	5 ¼
Medium Response	2 ¾	5 ½
Long Response	3 ¼	6

Worst individual household commute time – 1 hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	7 ¼
Medium Response	3 ½	7 ½
Long Response	4	8

Worst individual household commute time – 3 hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	7 ¾
Medium Response	4	8
Long Response	4 ¼	8 ¼

Worst individual household commute time – 3 ½ hours

Table 3-3k

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Hancock Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ¼	11
Medium Response	7 ¾	12 ½
Long Response	9 ¼	14

Worst individual household commute time – 7 hours

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	7 ½	14
Medium Response	9	15 ½
Long Response	10 ¾	17

Worst individual household commute time – 10 hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	9 ½	18 ¾
Medium Response	11	19 ¾
Long Response	12 ½	21 ½

Worst individual household commute time – 14 ¾ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	10	19 ¼
Medium Response	11 ½	20 ¼
Long Response	13	22

Worst individual household commute time – 15 ¼ hours

Table 3-3l

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Penobscot Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	7 ¾
Medium Response	5 ¼	9
Long Response	6 ¾	10 ¼

Worst individual household commute time – 4 hours to Bangor

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5	10
Medium Response	6 ¼	11
Long Response	7 ½	12 ¼

Worst individual household commute time – 6 hours to Bangor

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ¼	13 ¼
Medium Response	7 ½	14 ¼
Long Response	8 ¾	15 ½

Worst individual household commute time – 9 ½ hours to Bangor

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ½	13 ½
Medium Response	7 ¾	14 ½
Long Response	9	15 ¾

Worst individual household commute time – 9 ¾ hours to Bangor

Table 3-3m

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Washington Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	2
Medium Response	2	2 ½
Long Response	2 ½	3

Worst individual household commute time – ½ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	2 ½
Medium Response	2 ½	3
Long Response	2 ¾	3 ¼

Worst individual household commute time – ½ hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	3 ¼
Medium Response	3	3 ¾
Long Response	3 ¼	4

Worst individual household commute time – ½ hour

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	3 ½
Medium Response	3	3 ¾
Long Response	3 ½	4 ¼

Worst individual household commute time – ½ hour

Table 3-4a

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(I-95 Southbound to New Hampshire State Line – Peak Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ¾
Medium Response	3 ½	5 ½
Long Response	4 ½	6 ½

Worst individual household commute time – ½ hour to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	6
Medium Response	4	6 ¾
Long Response	5	7 ¾

Worst individual household commute time – 1 ¾ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8
Medium Response	4 ¾	8 ¾
Long Response	5 ¾	9 ¾

Worst individual household commute time – 3 ¾ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ½
Medium Response	5 ¼	9 ¼
Long Response	6	10

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Table 3-4b

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(I-95 Southbound to New Hampshire State Line – Normal Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ½
Medium Response	3	5
Long Response	3 ¾	5 ¾

Worst individual household commute time – ¼ hour to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5 ¾
Medium Response	3 ½	6 ¼
Long Response	4 ¼	7

Worst individual household commute time – 1 ½ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	7 ¾
Medium Response	4 ¼	8 ¼
Long Response	5	9

Worst individual household commute time – 3 ½ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8 ¼
Medium Response	4 ½	8 ½
Long Response	5 ¼	9 ¼

Worst individual household commute time – 4 hours to New Hampshire state line

Table 3-4c

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(US 1 between SR 196 and SR 24 Interchange in Brunswick)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	2 ½
Medium Response	2 ¼	3
Long Response	2 ¾	3 ¾

Worst individual household commute time – ½ hour to Portland

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	3
Medium Response	2 ½	3 ¾
Long Response	3	4 ¼

Worst individual household commute time – ½ hour to Portland

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4
Medium Response	3	4 ½
Long Response	3 ½	5

Worst individual household commute time – ½ hour to Portland

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	4 ¼
Medium Response	3	4 ¾
Long Response	3 ½	5 ¼

Worst individual household commute time – ½ hour to Portland

Table 3-4d

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(US 1A between US 202 / SR 9 in Hampden and I-395 in Bangor)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ¼
Medium Response	3	4 ¾
Long Response	3 ½	5 ½

Worst individual household commute time – <¼ hour to Bangor

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5 ½
Medium Response	3 ½	6
Long Response	4 ¼	6 ¾

Worst individual household commute time – 1 ¼ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	7 ¼
Medium Response	4 ¼	7 ¾
Long Response	5	8 ½

Worst individual household commute time – 3 hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	7 ¾
Medium Response	4 ½	8 ¼
Long Response	5 ¼	9

Worst individual household commute time – 3 ½ hours

Table 3-4e

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(I-95 Northbound between I-295 and US 202 / SR 100 near Augusta)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¼	2 ½
Medium Response	1 ½	2 ¾
Long Response	1 ½	3

Worst individual household commute time – <¼ hour to Augusta

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ½	3 ½
Medium Response	1 ¾	3 ½
Long Response	2	3 ¾

Worst individual household commute time – <¼ hour to Augusta

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ¾
Medium Response	2 ¼	4 ¾
Long Response	2 ½	5

Worst individual household commute time – ¼ hour to Augusta

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	5
Medium Response	2 ½	5
Long Response	2 ¾	5 ¼

Worst individual household commute time – ¾ hours to Augusta

Table 3-4f

2007 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(SR 9 between SR 178 in Eddington and US 1A Business in Brewer)

Category 1 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	2 ¾	5
Medium Response	4	5
Long Response	5	6

Worst individual household commute time – 3 hours from Machias

Category 2 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	3 ¼	4 ¾
Medium Response	4 ½	6
Long Response	5 ½	7

Worst individual household commute time – 3 hours from Machias

Category 3 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	4	6 ½
Medium Response	5	7 ½
Long Response	6 ¼	8 ½

Worst individual household commute time – 4 ½ hours from Machias

Category 4 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	4 ¼	6 ¾
Medium Response	5 ¼	7 ¾
Long Response	6 ½	9

Worst individual household commute time – 5 hours from Machias

Table 3-5a

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

York Local In-County Movement and Regional Movement

(I-95 Southbound to New Hampshire State Line – Peak Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5
Medium Response	3 ¾	5 ¾
Long Response	4 ½	6 ¾

Worst individual household commute time – ¾ hours to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	6 ¼
Medium Response	4 ¼	7
Long Response	5	8

Worst individual household commute time – 2 ¼ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ½
Medium Response	5	9 ¼
Long Response	5 ¾	10

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ½	9
Medium Response	5 ¼	9 ½
Long Response	6 ¼	10 ½

Worst individual household commute time – 4 ¾ hours to New Hampshire state line

Table 3-5b

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

York Local In-County Movement and Regional Movement

(I-95 Southbound to New Hampshire State Line – Normal Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	4 ¾
Medium Response	3	5 ¼
Long Response	3 ¾	6

Worst individual household commute time – ½ hour to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	6
Medium Response	3 ¾	6 ½
Long Response	4 ¼	7 ¼

Worst individual household commute time – 1 ¾ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	8 ¼
Medium Response	4 ½	8 ½
Long Response	5 ¼	9 ¼

Worst individual household commute time – 4 hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ½
Medium Response	4 ¾	9
Long Response	5 ½	9 ¾

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Table 3-5c

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

York Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5 ½
Medium Response	3	5 ½
Long Response	3 ½	6

Worst individual household commute time – 1 ¼ hours to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	6 ¾
Medium Response	3 ½	6 ¾
Long Response	4	7 ¼

Worst individual household commute time – 2 ½ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8 ½
Medium Response	4 ¼	8 ½
Long Response	4 ¾	9

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ¾
Medium Response	4 ½	8 ¾
Long Response	4 ¾	9

Worst individual household commute time – 4 ½ hours to New Hampshire state line

Table 3-5d

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Cumberland Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	4 ¼
Medium Response	6 ¼	6 ½
Long Response	8 ¼	8 ½

Worst individual household commute time – ½ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	4 ½
Medium Response	6 ¼	6 ¾
Long Response	8 ½	8 ¾

Worst individual household commute time – ¾ hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ½	5
Medium Response	6 ¾	7 ¼
Long Response	8 ¾	9 ½

Worst individual household commute time – 1 ½ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5 ¼	6
Medium Response	7 ½	8 ¼
Long Response	9 ¾	10 ¼

Worst individual household commute time – 1 ½ hours

Table 3-5e

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Sagadahoc Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	3 ½
Medium Response	4 ½	5
Long Response	5 ¾	6 ½

Worst individual household commute time – ½ hour to Augusta

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	4
Medium Response	4 ¾	5 ½
Long Response	6	7

Worst individual household commute time – ½ hour to Augusta

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	4 ¾
Medium Response	5	6 ¼
Long Response	6 ½	7 ¾

Worst individual household commute time – 1 ¼ hours to Augusta

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	5
Medium Response	5 ¼	6 ½
Long Response	6 ¾	8

Worst individual household commute time – 1½ hours to Augusta

Table 3-5f

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Lincoln County Regional Movement (with evacuating vehicles on US 1 southbound from Knox, Waldo, Hancock and Washington Counties)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ¾
Medium Response	5 ½	9 ½
Long Response	6 ½	10 ¾

Worst individual household commute time – 4 ½ hours

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5 ¼	11 ½
Medium Response	6 ½	12 ¼
Long Response	7 ½	13 ½

Worst individual household commute time – 7 ¼ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	7	15 ¾
Medium Response	8	16 ¼
Long Response	9 ¼	17 ½

Worst individual household commute time – 11 ½ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	7 ¼	16 ¼
Medium Response	8 ¼	16 ¾
Long Response	9 ½	18

Worst individual household commute time – 12 hours

Table 3-5g

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Lincoln Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	6 ¼
Medium Response	4 ½	7 ¼
Long Response	5 ¾	8 ½

Worst individual household commute time – 2 hours

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8
Medium Response	5 ¼	9
Long Response	6 ¼	10

Worst individual household commute time – 3 ¾ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5	10 ½
Medium Response	6 ¼	11 ½
Long Response	7 ¼	12 ¾

Worst individual household commute time – 6 ½ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5 ¼	10 ¾
Medium Response	6 ¼	11 ½
Long Response	7 ½	12 ¾

Worst individual household commute time – 6 ½ hours

Table 3-5h

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Knox Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	2 ¼
Medium Response	3	3 ¼
Long Response	3 ¾	4

Worst individual household commute time – ½ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	2 ½
Medium Response	3	3 ½
Long Response	4	4 ¼

Worst individual household commute time – ½ hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	2 ¾
Medium Response	3 ¼	3 ¾
Long Response	4	4 ¾

Worst individual household commute time – ½ hour

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	3
Medium Response	3 ¼	3 ¾
Long Response	4 ¼	4 ¾

Worst individual household commute time – ½ hour

Table 3-5i

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Kennebec Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	4 ¾
Medium Response	4 ¼	5 ¾
Long Response	5 ½	7

Worst individual household commute time – ¾ hours to Augusta

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ½	5 ¾
Medium Response	4 ¾	7
Long Response	6	8

Worst individual household commute time – 2 hours to Augusta

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	7 ½
Medium Response	5 ½	9
Long Response	6 ½	9 ¾

Worst individual household commute time – 3 ½ hours to Augusta

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	7 ½
Medium Response	5 ½	8 ¾
Long Response	6 ¾	10

Worst individual household commute time – 3 ¾ hours to Augusta

Table 3-5j

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Waldo Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	4
Medium Response	2 ¼	4 ½
Long Response	2 ¾	5

Worst individual household commute time – <¼ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	5 ½
Medium Response	3	5 ¾
Long Response	3 ¼	6 ¼

Worst individual household commute time – 1 ¼ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	7 ¾
Medium Response	3 ¾	7 ¾
Long Response	4 ¼	8 ¼

Worst individual household commute time – 3 ¼ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	8
Medium Response	4	8 ¼
Long Response	4 ½	8 ¾

Worst individual household commute time – 3 ¾ hours

Table 3-5k

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Hancock Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ¼	11 ¼
Medium Response	8	12 ¾
Long Response	9 ½	14 ¼

Worst individual household commute time – 7 ¼ hours

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	7 ¾	14 ½
Medium Response	9 ¼	15 ¾
Long Response	10 ¾	17 ½

Worst individual household commute time – 10 ½ hours

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	9 ¾	19 ¼
Medium Response	11 ¼	20 ¼
Long Response	12 ¾	22

Worst individual household commute time – 15 ¼ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	10 ¼	20
Medium Response	11 ¾	21
Long Response	13 ½	22 ½

Worst individual household commute time – 15 ¾ hours

Table 3-5l

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Penobscot Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8
Medium Response	5 ½	9 ¼
Long Response	6 ¾	10 ½

Worst individual household commute time – 4 hours to Bangor

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	5	10 ¼
Medium Response	6 ¼	11 ¼
Long Response	7 ½	12 ½

Worst individual household commute time – 6 ¼ hours to Bangor

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ½	13 ¾
Medium Response	7 ½	14 ¾
Long Response	8 ¾	16

Worst individual household commute time – 9 ½ hours to Bangor

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	6 ½	14
Medium Response	7 ¾	15
Long Response	9	16 ¼

Worst individual household commute time – 10 hours to Bangor

Table 3-5m

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Washington Local In-County Movement

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	2 ¼
Medium Response	2 ¼	2 ½
Long Response	2 ½	3

Worst individual household commute time – ½ hour

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	2 ¾
Medium Response	2 ½	3
Long Response	2 ¾	3 ½

Worst individual household commute time – ½ hour

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	3 ½
Medium Response	3	3 ¾
Long Response	3 ½	4 ¼

Worst individual household commute time – ½ hour

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	3 ¾
Medium Response	3 ¼	4
Long Response	3 ½	4 ½

Worst individual household commute time – ½ hour

Table 3-6a

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(I-95 Southbound to New Hampshire State Line – Peak Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5
Medium Response	3 ¾	5 ¾
Long Response	4 ½	6 ¾

Worst individual household commute time – ¾ hours to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¼	6 ¼
Medium Response	4 ¼	7
Long Response	5	8

Worst individual household commute time – 2 ¼ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ½
Medium Response	5	9 ¼
Long Response	5 ¾	10

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ½	9
Medium Response	5 ¼	9 ½
Long Response	6 ¼	10 ½

Worst individual household commute time – 4 ¾ hours to New Hampshire state line

Table 3-6b

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(I-95 Southbound to New Hampshire State Line – Normal Summer Traffic)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	4 ¾
Medium Response	3	5 ¼
Long Response	3 ¾	6

Worst individual household commute time – ½ hours to New Hampshire state line

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3	6
Medium Response	3 ¾	6 ½
Long Response	4 ¼	7 ¼

Worst individual household commute time – 1 ¾ hours to New Hampshire state line

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	8 ¼
Medium Response	4 ½	8 ½
Long Response	5 ¼	9 ¼

Worst individual household commute time – 4 hours to New Hampshire state line

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4 ¼	8 ½
Medium Response	4 ¾	9
Long Response	5 ½	9 ¾

Worst individual household commute time – 4 ¼ hours to New Hampshire state line

Table 3-6c

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(US 1 between SR 196 and SR 24 Interchange in Brunswick)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	2 ½
Medium Response	2 ¼	3 ¼
Long Response	2 ¾	3 ¾

Worst individual household commute time – ½ hour to Portland

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2	3 ¼
Medium Response	2 ½	3 ¾
Long Response	3	4 ¼

Worst individual household commute time – ½ hour to Portland

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ¼
Medium Response	3	4 ¾
Long Response	3 ½	5 ¼

Worst individual household commute time – ½ hour to Portland

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	4 ¼
Medium Response	3	4 ¾
Long Response	3 ¾	5 ½

Worst individual household commute time – ½ hour to Portland

Table 3-6d

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(US 1A between US 202 / SR 9 in Hampden and I-395 in Bangor)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	4 ¼
Medium Response	3	5
Long Response	3 ¾	5 ¾

Worst individual household commute time – <¼ hour to Bangor

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¾	5 ¾
Medium Response	3 ½	6 ¼
Long Response	4 ¼	7

Worst individual household commute time – 1 ½ hours to Bangor

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	3 ¾	7 ¾
Medium Response	4 ¼	8 ¼
Long Response	5	9

Worst individual household commute time – 3 ½ hours to Bangor

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	4	8
Medium Response	4 ¾	8 ½
Long Response	5 ¼	9 ¼

Worst individual household commute time – 3 ¾ hours to Bangor

Table 3-6e

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(I-95 Northbound between I-295 and US 202 / SR 100 near Augusta)

Category 1 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¼	2 ¾
Medium Response	1 ½	2 ¾
Long Response	1 ¾	3

Worst individual household commute time – <¼ hour to Augusta

Category 2 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	1 ¾	3 ½
Medium Response	1 ¾	3 ¾
Long Response	2	4

Worst individual household commute time – <¼ hour to Augusta

Category 3 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ¼	5
Medium Response	2 ½	5
Long Response	2 ½	5 ¼

Worst individual household commute time – ½ hours

Category 4 Hurricane	Low Seasonal Occupancy	High Seasonal Occupancy
Rapid Response	2 ½	5 ¼
Medium Response	2 ¾	5 ¼
Long Response	3	5 ½

Worst individual household commute time – 1 hour

Table 3-6f

2012 CLEARANCE TIMES (in hours)

Maine Hurricane Transportation Analysis 2007

Maine Regional Movement

(SR 9 between SR 178 in Eddington and US 1A Business in Brewer)

Category 1 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	2 ¾	4
Medium Response	4	5
Long Response	5	6 ¼

Worst individual household commute time – 3 ¼ hours from Machias

Category 2 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	3 ¼	5
Medium Response	4 ½	6 ¼
Long Response	5 ½	7 ¼

Worst individual household commute time – 3 ¼ hours from Machias

Category 3 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	4 ¼	6 ¾
Medium Response	5 ¼	7 ¾
Long Response	6 ½	9

Worst individual household commute time – 4 ¾ hours from Machias

Category 4 Hurricane	**Low Seasonal Occupancy**	**High Seasonal Occupancy**
Rapid Response	4 ½	7 ¼
Medium Response	5 ½	8 ¼
Long Response	6 ½	9 ¼

Worst individual household commute time – 5 ¼ hours from Machias

3.6 GENERAL TRAFFIC CONTROL MEASURES

Some general recommendations concerning traffic control are as follows:

- Where the state and county have sufficient personnel resources, officers should be stationed at critical intersections to facilitate traffic flow. At a minimum, the primary locations for the positioning of these law enforcement personnel should coincide with locations specified in Table 3 -2.

- Consider lifting the tolls on the Maine Turnpike, certainly for southbound directions, during hurricane evacuation s. By eliminating the need to queue and stop in order to pay the tolls, the hourly directional service volume will be increased by approximately 15%. In a category 4 scenario with high tourist occupancy, the time savings would be approximately 1 hour and 24 minutes, or 16% of the worst-case clearance time, and would further reduce the amount of duress and confusion for the evacuees. Although I-95 southbound is not the most congested link on Maine's evacuation roadway network, it could receive tropical storm force winds before many surge zones, further limiting the amount of time to clear that road segment. Furthermore, vehicles stranded on the bridge over the Piscataqua River into New Hampshire during tropical storm force conditions or worse would potentially be subject to extremely dangerous winds.

- Consider a reciprocal agreement where tolls on I-95 in New Hampshire are lifted concurrently with those on the Maine Turnpike during hurricane events where mandatory evacuations are ordered. This measure could facilitate the southward movement of evacuating vehicles out of Maine thereby reducing the likelihood that toll collection would cause traffic congestion or backups that extend across the Piscataqua River .

- Fuelling and comfort stations, as well as incident management teams on SR 3 and US 1 A from Mt. Desert Island to I-395 in Brewer are strongly recommended. Given the length of clearance times and the potential for severe congestion on the corridor between

Mt. Desert Island and Bangor, any vehicle breakdowns, accidents or other incidents that impede the smooth flow of traffic could cause serous delays that may result in vehicles stranded in highly vulnerable areas during the onset of tropical storm winds or worse. Incident management teams, or contracts with towing services, with provisions for fuel (to get vehicles to the next filling station), the ability to resolve minor vehicle breakdowns (i.e., overheating, battery failures, etc.) and the means to remove vehicles from of travel lanes and transport passengers to nearby shelters will decrease the likelihood that vehicular problems will interrupt the flow of traffic or dramatically extend the clearance times on that corridor. Additionally, the possibility of long vehicle queues and the relative lack of services on the Thompson Island to Ellsworth and Ellsworth to Brewer corridors may necessitate the stationing of bathrooms, food and water at strategic points along those roadways.

- Where intersections will continue to have signalized control, synchronize traffic signal patterns to provide the most "green time" for the predominant evacuation routes. This is especially important on US 1 / US 1A through Ellsworth, SR 25 through Portland, US 1A through Brewer, SR 15 through Bangor, and US 1 through Wiscasset, Additionally, traffic control points at strategic locations along those routes to further direct/control traffic, provide directions, as well as report traffic conditions and other exigent circumstances would facilitate the movement of traffic and reduce driver frustration.

- Increase the inventory of ARC 4496-compliant public shelter facilities in all counties and develop strategies to encourage more residents and even visitors to use them rather than evacuating out of county or state. Heavy reliance on the latter as a protective action, given the expected congestion on some evacuation routes, will increase the likelihood that evacuees will be stranded on those roadways at the arrival of hurricane-force winds or greater, especially for storms on paralleling tracks close to the coast.

- Identify refuges of last resort (ROLR) along roadways such as I-95 southbound through Cumberland and York Counties, as well as on US 1A in Hancock and Penobscot Counties. As stated above an approaching hurricane may reach the I-95 location before

vehicles evacuating more northerly and easterly counties have the opportunity to travel and clear those road segments, especially if evacuation orders in those counties are issued significantly later than those in the more southerly counties. Furthermore, the relatively rural nature of much of the route between Mt. Desert Island and the greater Bangor area may result in vehicles being stranded in the open with few viable safe sheltering options as hurricane force winds approach, especially if the storm increases forward speed or changes direction to impact that area earlier than predicted/expected.