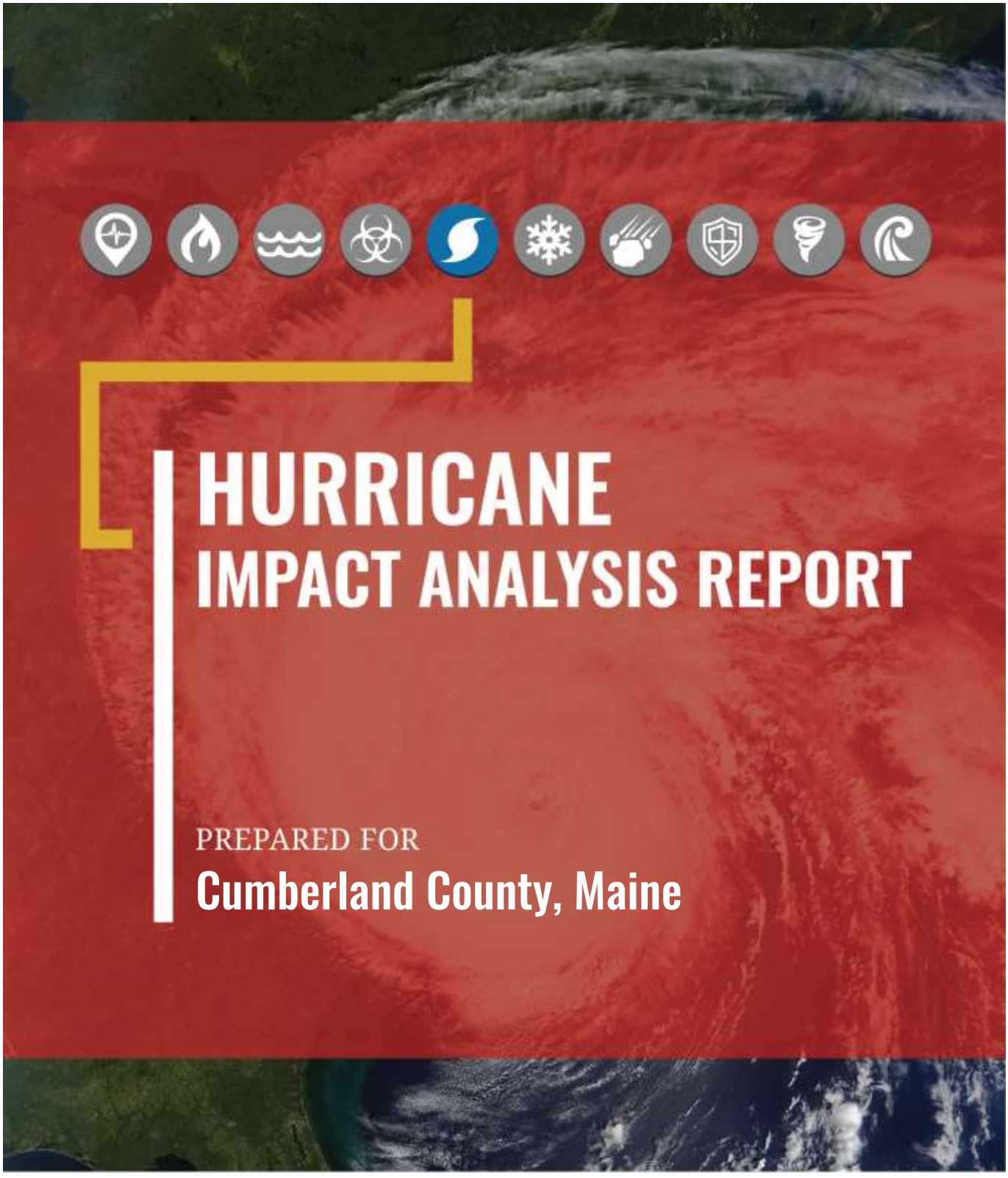

HURRICANE
IMPACT ANALYSIS REPORT

PREPARED FOR

Cumberland County, Maine

THIS REPORT DEVELOPED BY

The Northeast States Emergency Consortium

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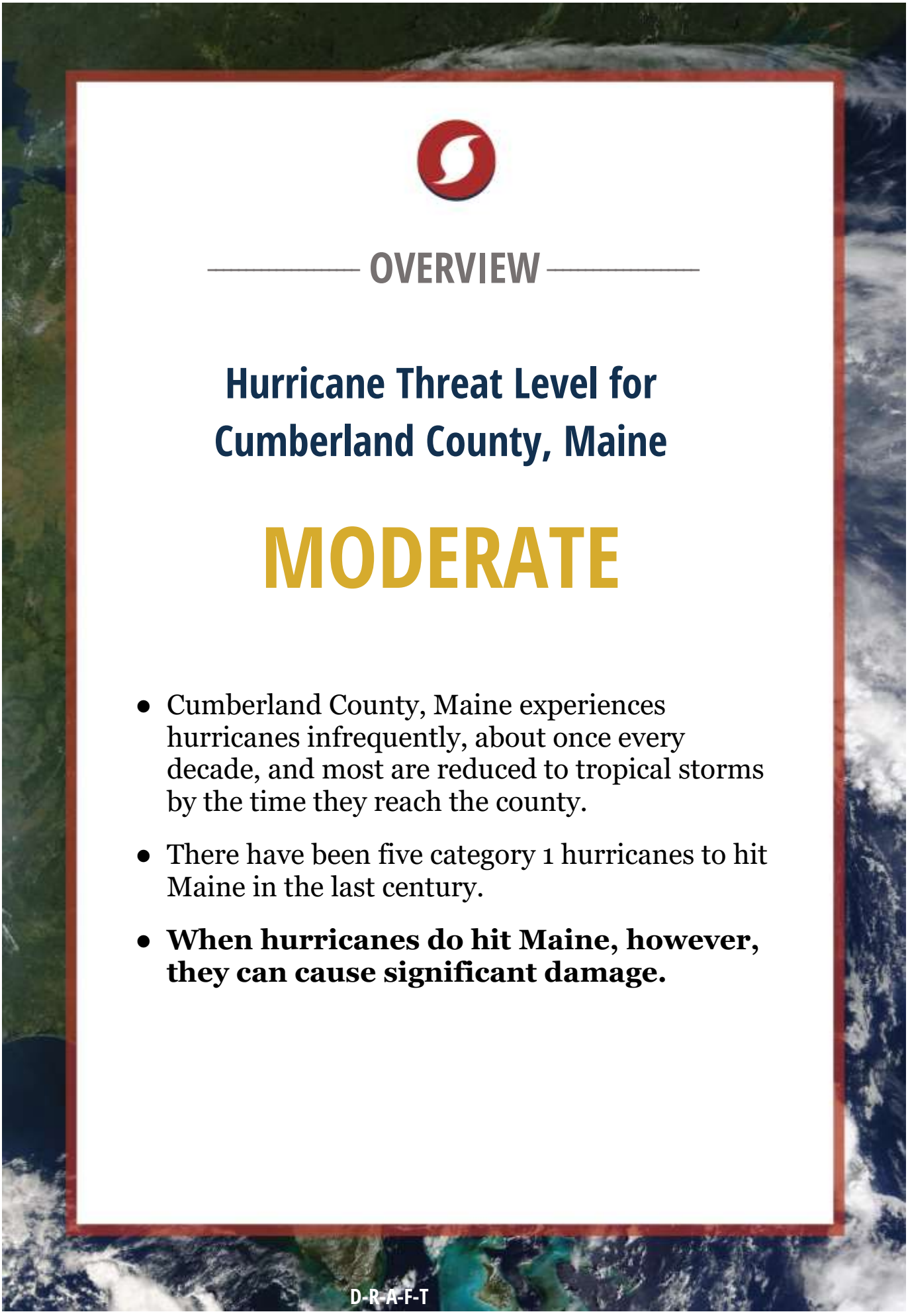
UTILIZING FEMA'S

HAZUS-MH
EARTHQUAKE • WIND • FLOOD

PROGRAM

D-R-A-F-T



OVERVIEW

Hurricane Threat Level for Cumberland County, Maine

MODERATE

- Cumberland County, Maine experiences hurricanes infrequently, about once every decade, and most are reduced to tropical storms by the time they reach the county.
- There have been five category 1 hurricanes to hit Maine in the last century.
- **When hurricanes do hit Maine, however, they can cause significant damage.**

CONTENTS

I. INTRODUCTION

The first step in preparing for and mitigating any disaster is to estimate its potential impact on an area or region. The purpose of this study is to provide emergency managers and other government decision makers with an estimate of the potential impact of a major hurricane affecting Cumberland County, Maine.

METHODOLOGY The methodology used to produce the results contained in this report is called HAZUS-MH (referred to as HAZUS) which was developed by the Federal Emergency Management Agency (FEMA) in cooperation with the National Institute of Building Sciences (NIBS). HAZUS uses Geographic Information System (GIS) software to calculate, map and display hurricane loss data. HAZUS uses mathematical formulas and information about building stock, demographics, sustained wind speeds and peak gusts, economic data and other information to estimate losses.

DATA COMPILATION This report utilizes default data contained in the HAZUS software compiled from available national databases. This data has been augmented using available state and county data. These default databases describe in general terms the building inventory and economic and social structure of Cumberland County, Maine. The default data provide a preliminary estimate of hurricane losses and impacts. More accurate estimates require detailed information about local buildings and other specific information. This data is usually available from local and state agencies and departments and typically can be added to the HAZUS data base by local and state emergency personnel. In some cases, however, technical assistance from engineers and GIS experts may be required.

ESTIMATION It is imperative to point out that this HAZUS impact analysis is not a precise prediction, but rather a rough estimate of potential damage, human and economic impacts that may result from a hypothetical hurricane affecting Cumberland County, Maine. While this estimate is based on current scientific and engineering knowledge, there are large uncertainties in the results, especially for essential facilities. Moreover, the study results are area-wide and tend to be less accurate for individual sites or facilities. More accurate site-specific results typically require meteorological and engineering analyses beyond the scope and intent of HAZUS.

***DISCLAIMER** The estimates of social and economic impacts contained in this report are based on HAZUS Version Hurricane that utilizes 2010 census data and current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific hurricane. These results can be improved by using enhanced inventory and wind data.*

II. EXECUTIVE SUMMARY OF IMPACT

The following is an Executive Summary of the estimated potential impact of a major hurricane making landfall off the coast of Maine and affecting Cumberland County, Maine.

Estimated Direct Losses

Calculated by estimating the damage to buildings by wind effects from the storm.

Hurricane Wind General Building Stock	$ 839,008,000

Essential Facilities

By averaging probabilities, we have calculated how the functionality of essential facilities will be impacted.

FACILITY	PROBABILITY OF FUNCTIONALITY
Emergency Operations Centers (EOC's)	100%
Police Stations	100%
Fire Stations	100%
Hospitals and Medical Care Facilities	100%
Schools	70%

Estimated Debris

Calculated by estimating the total amount of debris generated.

Hurricane Wind Debris Generated (Tons)	519,966

Estimated Social Impact

By averaging probabilities, we have calculated how many individuals and households will be affected.

Displaced Households for Hurricane Wind	205
People Requiring Shelter for Hurricane Wind	94

III. THE HURRICANE HISTORY OF CUMBERLAND COUNTY, MAINE

The Northeast and Maine are susceptible to hurricanes, as demonstrated by past and recent events and coastal geographic location. One of the largest hurricanes to occur in the Northeast was the Great Hurricane of 1938 which caused substantial damage in Maine. Other significant storms that affected Maine include Hurricane Gloria in 1985, Hurricane Bob in 1991, Hurricane Floyd in 1999 and Hurricane Katrina in 2005. Since 1954, there have been three major hurricanes that have significantly impacted Cumberland County, Maine: Hurricane Edna in 1954, Hurricane Gloria and Hurricane Floyd. Most hurricane damage is done by heavy rains causing floods. Wind damage is usually limited to power outages and minor structural damage from tree limbs falling on power lines and buildings. All of Cumberland County is vulnerable to severe summer storms, which range from hurricanes and wind events to heavy rain events and lightning storms. However, they have a greater chance to affect the mountainous and less populated western part of the County as opposed to the southern areas. Based on Cumberland County's location in the Northeast, it has the chance for at least one summer storm to occur per year. Although the greatest chance for hurricanes is during August and September, it is important to understand hurricanes can occur any time between June and October.[1] For additional information on the history and probability of hurricanes see Appendices B and C.

The Study Hurricane

The scenario used for this study is a Worst Case Scenario hurricane. Figure 1 illustrates the track of the hurricane. Figures 2 and 3 show the peak gust wind speeds and maximum sustained wind speeds by census tract. It is important to note that this event does not necessarily represent the greatest impact a hurricane could have on Cumberland County, Maine. Though the chances for a severe hurricane occurring in the Northeast are low to moderate, any hurricane that tracks along the East Coast has the potential to negatively impact Maine. For additional information on the hurricane scenario data see Appendix A.

The Study Area

The area chosen for this study was Cumberland County, Maine with a land area of approximately 835 square miles and a 2010 US Census population of 281,674. The study area includes 66 census tracts which are the basic units of analysis for the HAZUS Methodology.

Figure 1 illustrates the location of the study area.

[1] Piscataquis County Emergency Management Agency, *Piscataquis County, ME Hazard Mitigation Plan,* 2017

IV. DIRECT ECONOMIC IMPACT

General Building Stock

HAZUS estimates losses to the general building stock using default national inventories. This report was compiled based on HAZUS default data and has been augmented using available state and county data. Damage to the general building stock is not evaluated on a building by building basis. Rather, the methodology estimates losses based on the general character of the building stock (e.g. occupancy, age, height, floor area, foundation type and class) in each census tract. Damage estimates are then converted into dollar losses.

The direct losses to the general building stock were estimated to be $839,008,000. HAZUS estimates the total value of the building stock exposure for Cumberland County, Maine to be $38,909,008,000. Therefore, these losses represent approximately 2.2 percent of the total building stock value.

Tables 1, 2, 3 and 4 contain additional information on building exposure, building damage for wind, building loss for wind, and direct economic losses respectively. Figure 4 is a map of Economic Losses for Buildings by census tracts.

Essential Facilities

The HAZUS methodology estimates losses for selected types of essential facilities. These include hospitals, police stations, fire stations, emergency operating centers and schools. Schools are included because of the critical role they often play as emergency shelters. Estimated losses to essential facilities are expressed in the average probability of functionality of each facility as a whole following the hurricane. The estimated probability of functionality for essential facilities for hurricane wind was estimated as follows:

FACILITY	PROBABILITY OF FUNCTIONALITY
Emergency Operations Centers (EOC's)	100%
Police Stations	100%
Fire Stations	100%
Hospitals and Medical Care Facilities	100%
Schools	70%

Tables 5, 6, 7, 8 and 9 contain additional information about the functionality for hospitals, schools, emergency operations centers, police stations and fire stations respectively for hurricane wind.

Direct Social Impact

DISPLACED HOUSEHOLDS AND SHELTERING NEEDS The HAZUS methodology estimates the number of displaced households and the number of those households expected to seek shelter based on the number of non-functioning or inhabitable units. For this hurricane scenario, it is estimated that 205 displaced households would result in 94 people requiring emergency shelter. Individuals whose housing becomes uninhabitable will likely seek alternative shelter. Many will stay with friends and relatives. Others will stay in hotels. Some will stay in public shelters. In addition, observations from past disasters show that approximately 80% of the pre-disaster homeless population will seek public shelter in time of disaster.

Table 10 contain summaries of estimated displaced households and shelter needs for hurricane wind.

Induced Physical Damage

DEBRIS The first type of debris for hurricane wind is reinforced concrete and steel. This type of debris is unlikely to contribute significantly to the debris total, as steel and concrete are generally unaffected by wind alone. If foundations and building frames are impacted, it is likely that cranes and other heavy equipment would be required to remove this type of debris. It is estimated that 51 tons of reinforced concrete and steel debris will be generated from this hurricane.

The second type of debris include brick, wood, glass, furniture, equipment, plaster walls and other materials that are smaller in size and more easily prone to being blown away or becoming hazardous projectiles. This type of debris will likely need to be removed with a bulldozer or smaller machines and tools. It is estimated that the hurricane will generate 61,443 tons of brick, wood, glass and other small pieces of debris.

The third type of debris is tree debris. Trees can easily be blown down during hurricanes, scattering large amounts of trunks, branches and limbs on public right of ways and residential properties. It is likely that specialized crews and machinery will be required to remove and dispose this type of debris. It is estimated that 458,472 tons of tree debris will be generated from hurricane winds.

Figure 5 is a map of the total tree debris broken down by census tract. Table 11 contains a summary of the debris generated by hurricane wind broken down by type.

VI. FIGURES, TABLES, AND APPENDICES

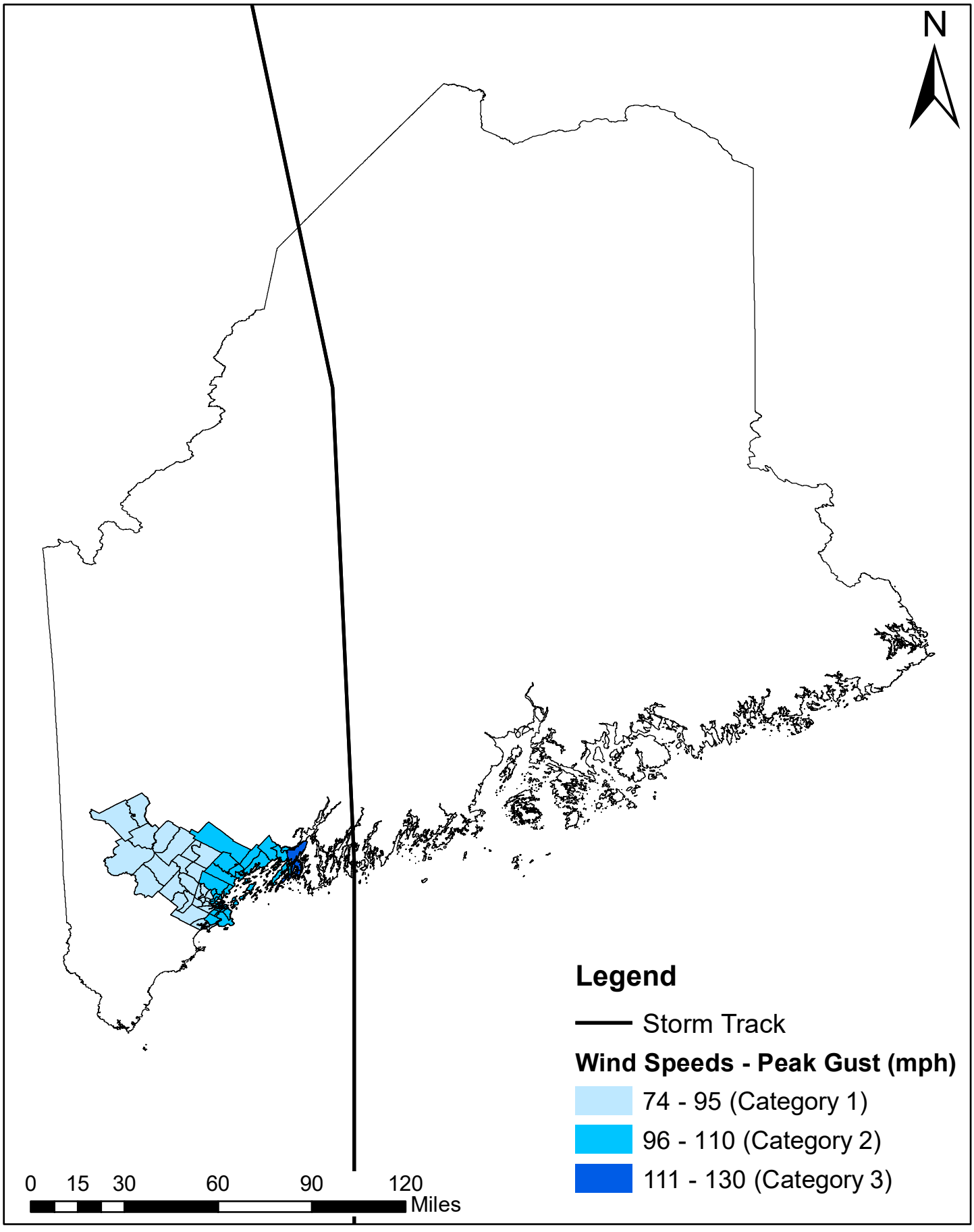
FIGURES

TABLES

APPENDICES

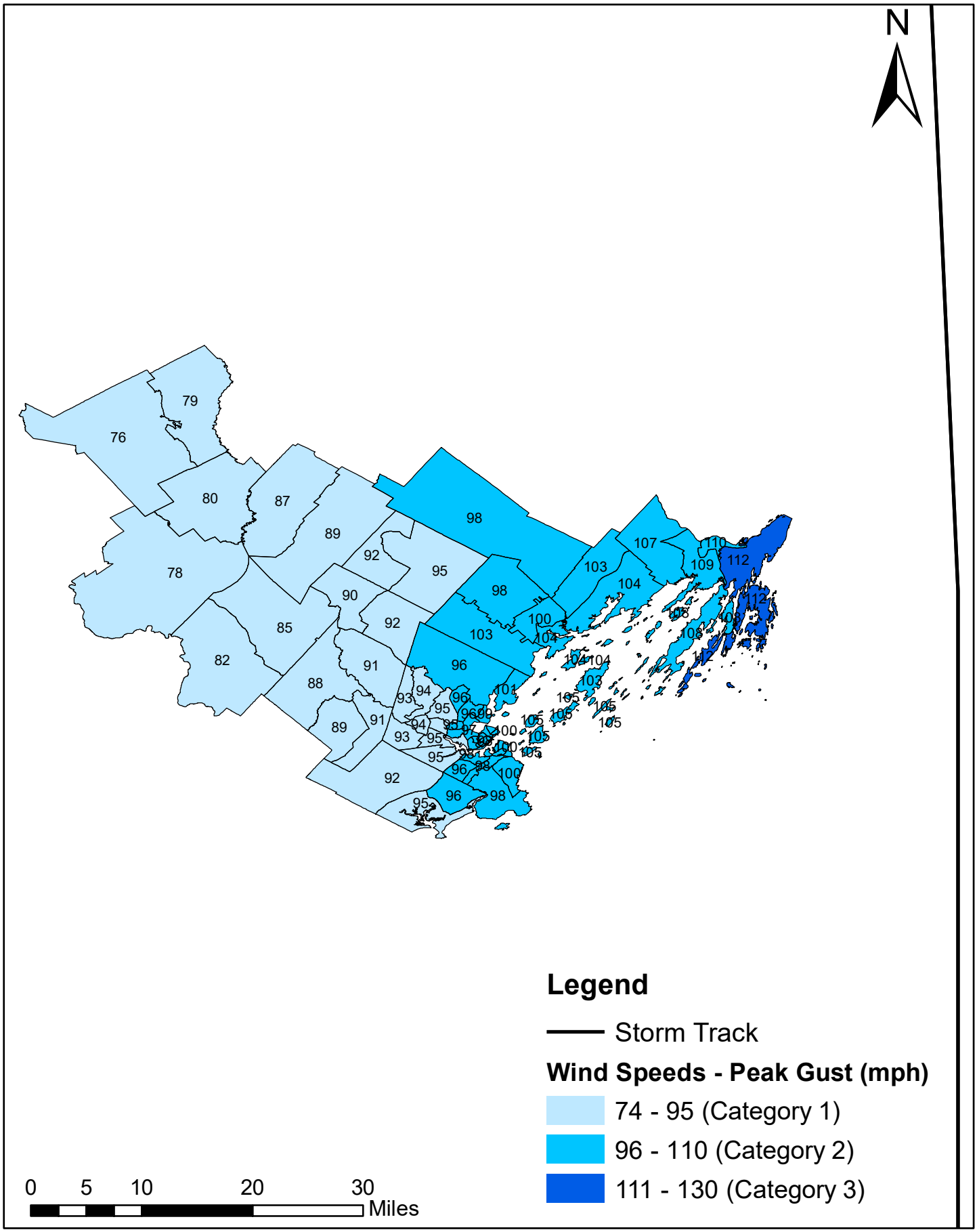
Hurricane Scenario Event
Cumberland County, Maine

Figure 1



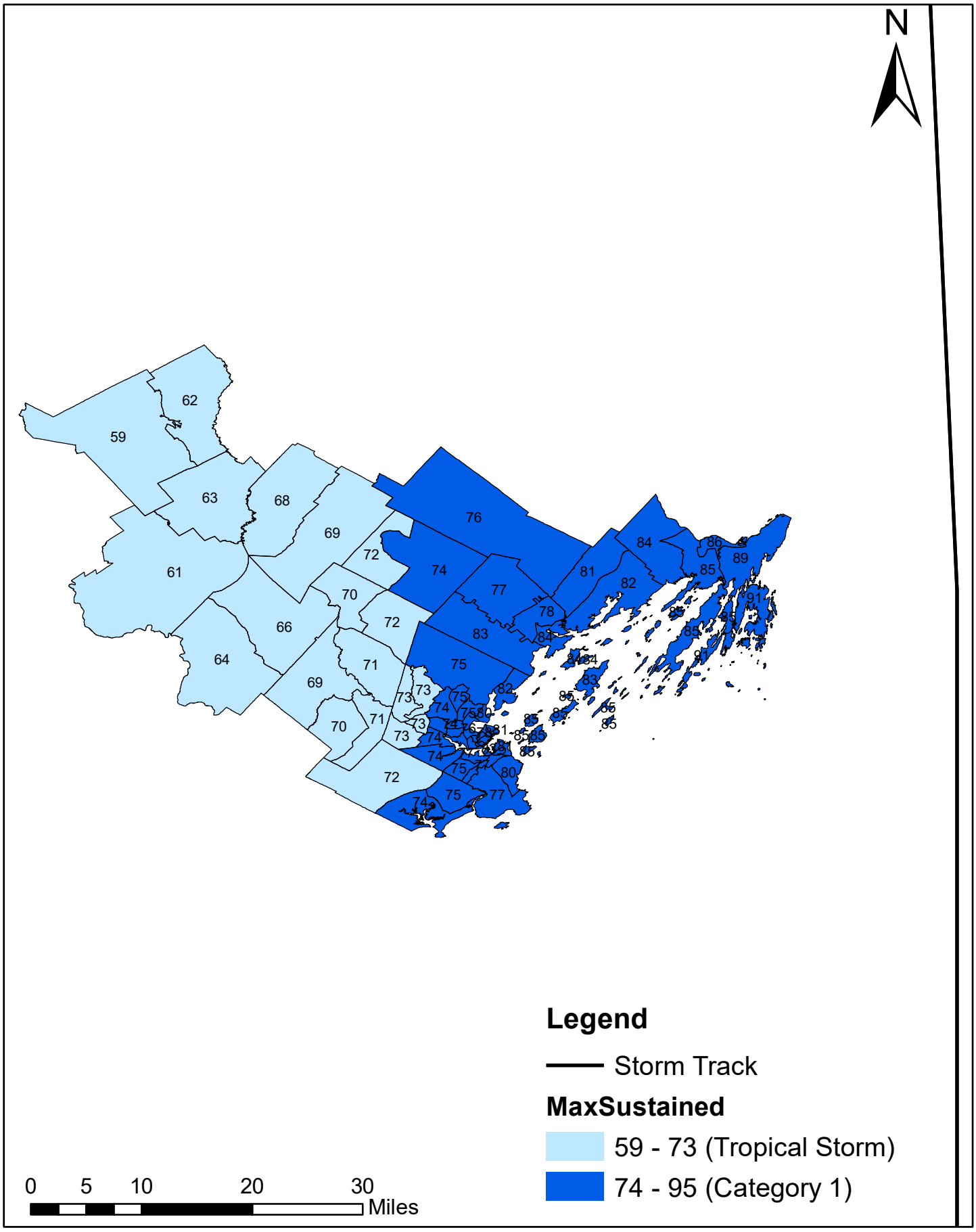
Peak Gust Wind Speeds
Hurricane Scenario Event
Cumberland County, Maine

Figure 2



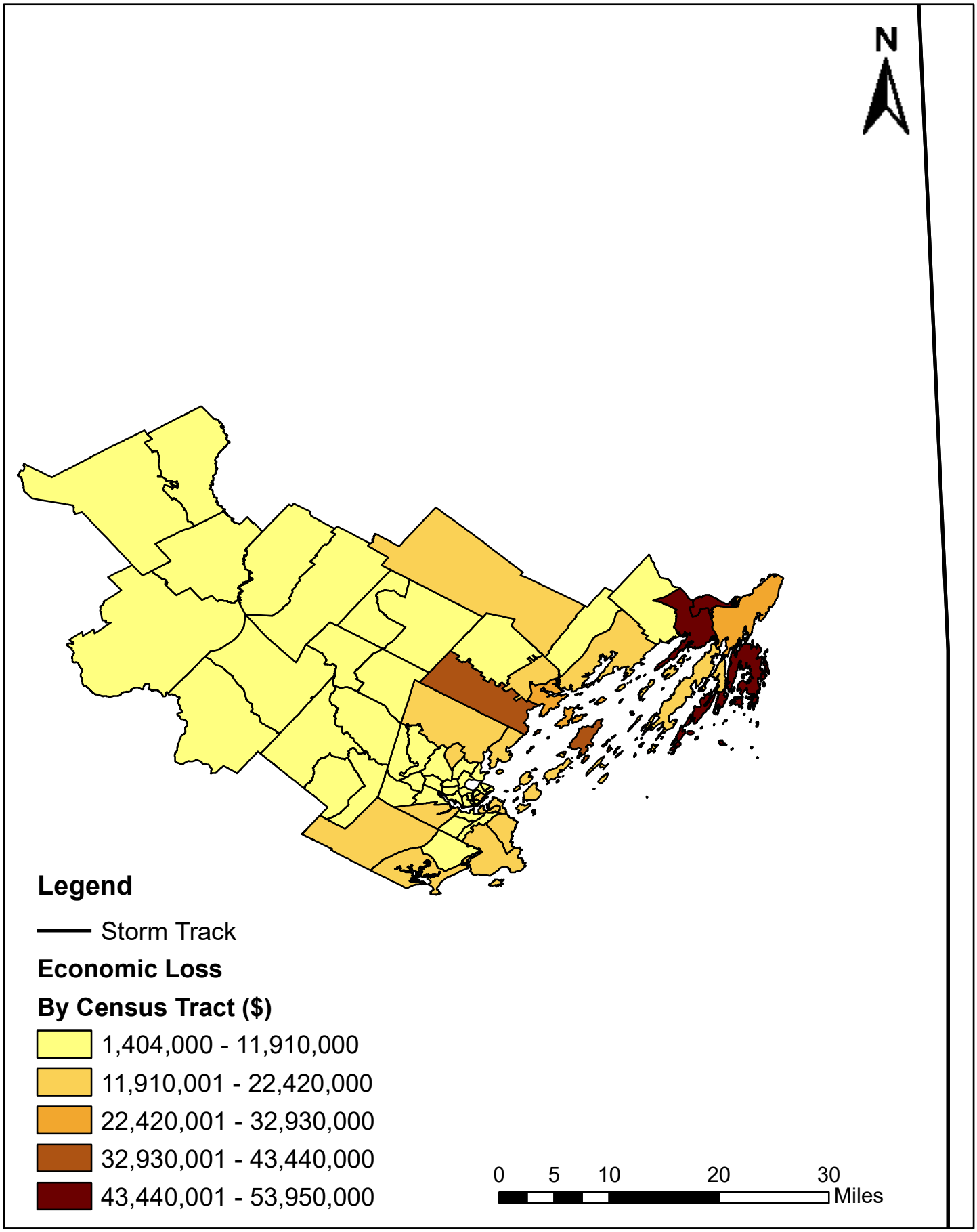
Maximum Sustained Wind Speeds
Hurricane Scenario Event
Cumberland County, Maine

Figure 3



Economic Losses for Buildings
Hurricane Scenario Event
Cumberland County, Maine

Figure 4



Estimated Tree Debris (Tons)
Hurricane Scenario Event
Cumberland County, Maine

Figure 5

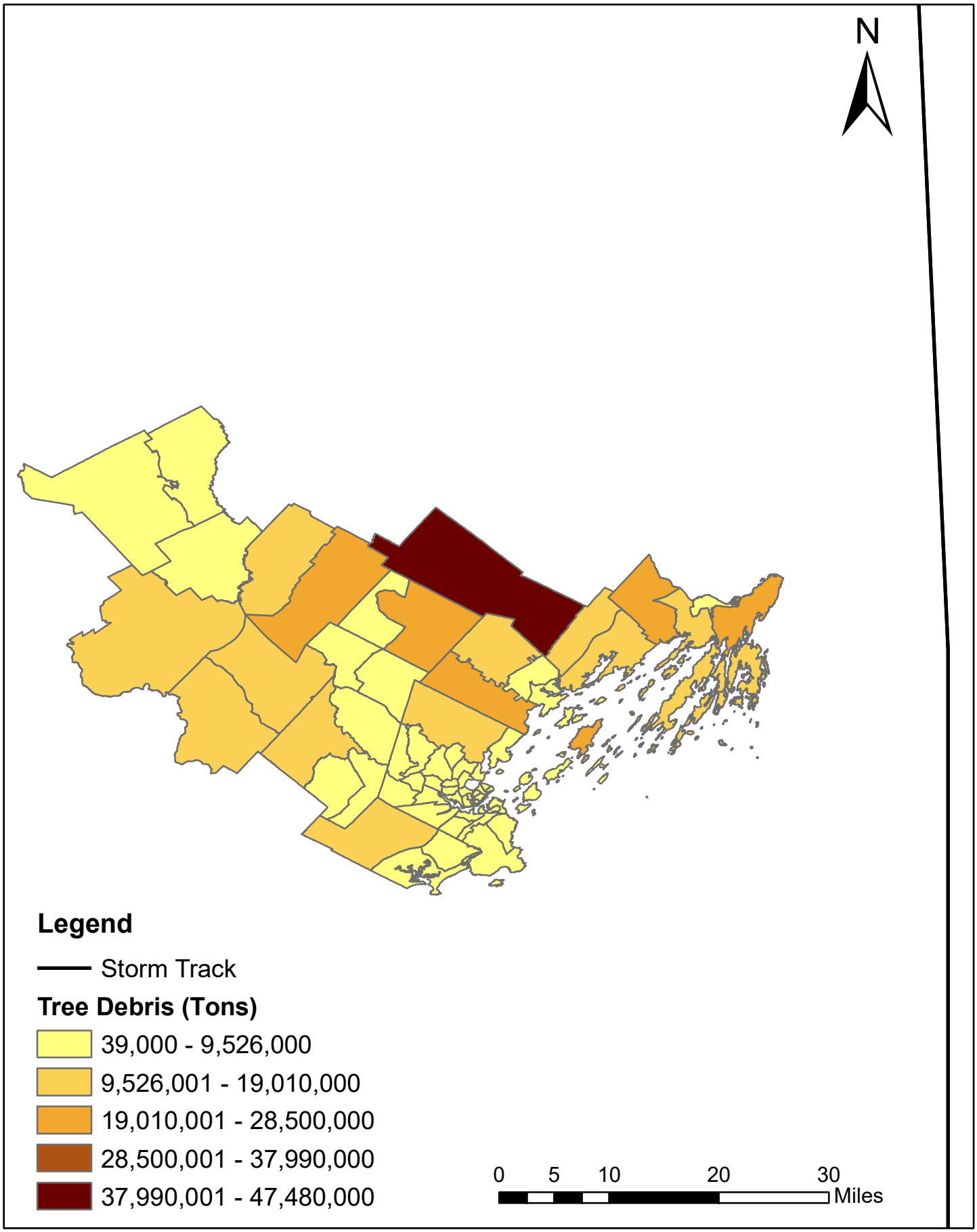


Table 1

Building Inventory

General Building Stock

Hazus estimates that there are 121,640 buildings in the region which have an aggregate total replacement value of 38,909 million (2014 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

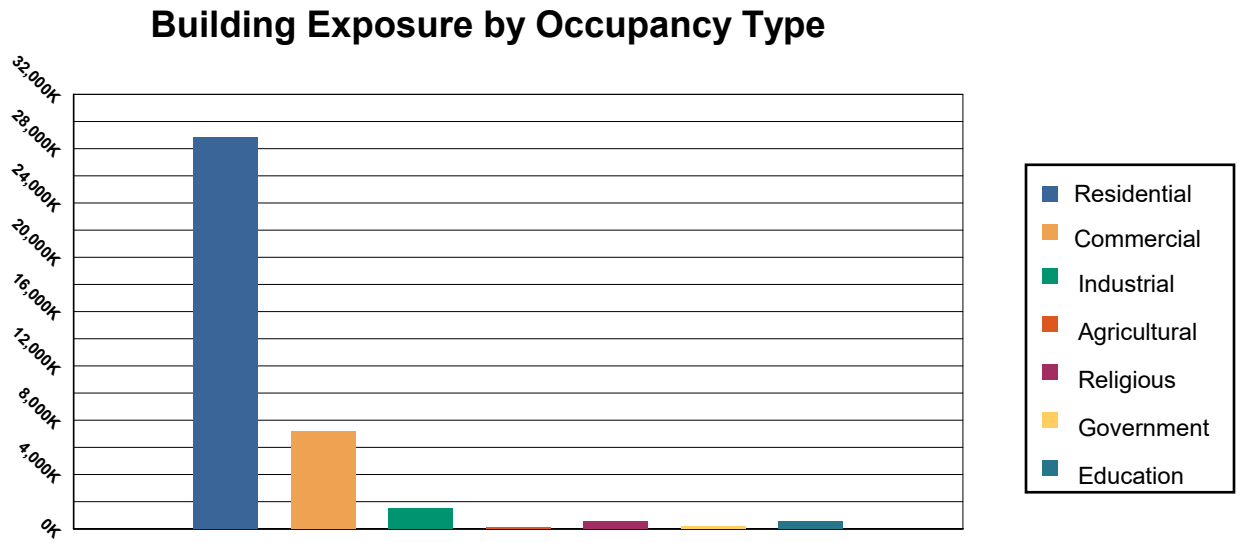


Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	28,794,748	74.01%
Commercial	7,173,398	18.44%
Industrial	1,537,876	3.95%
Agricultural	134,891	0.35%
Religious	524,932	1.35%
Government	217,553	0.56%
Education	525,610	1.35%
Total	**38,909,008**	**100.00%**

Essential Facility Inventory

For essential facilities, there are 6 hospitals in the region with a total bed capacity of 1,185 beds. There are 129 schools, 32 fire stations, 27 police stations and 29 emergency operation facilities.

Building Damage

General Building Stock Damage

Hazus estimates that about 3,319 buildings will be at least moderately damaged. This is over 3% of the total number of buildings in the region. There are an estimated 214 buildings that will be completely destroyed. The definition of the 'damage states' is provided in the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

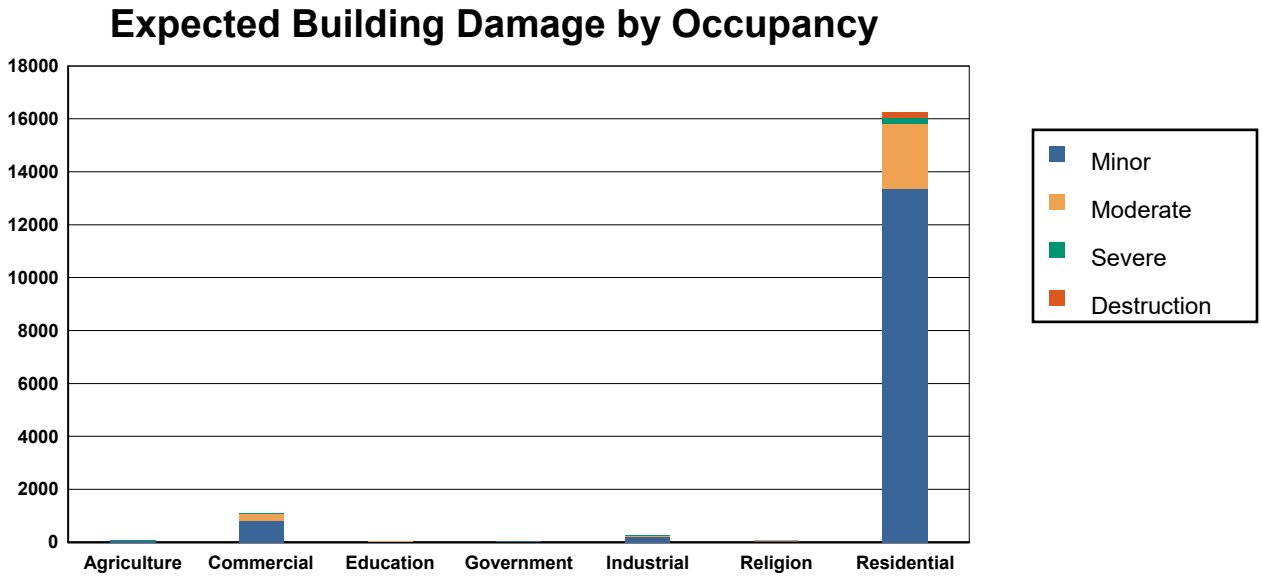
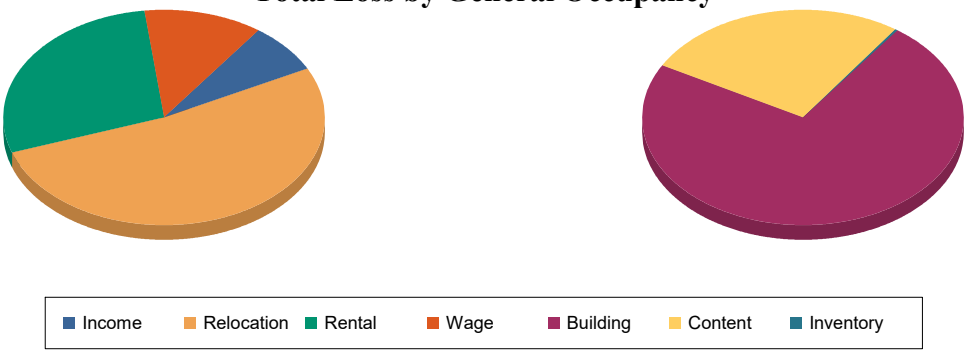


Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	348.38	84.15	45.78	11.06	13.05	3.15	6.07	1.47	0.73	0.18
Commercial	6,389.13	85.35	798.80	10.67	258.47	3.45	39.38	0.53	0.21	0.00
Education	265.29	86.13	31.82	10.33	9.76	3.17	1.13	0.37	0.00	0.00
Government	190.56	83.58	26.53	11.64	9.60	4.21	1.31	0.57	0.00	0.00
Industrial	1,788.35	87.02	192.24	9.35	60.46	2.94	13.14	0.64	0.81	0.04
Religion	472.86	85.05	65.44	11.77	15.93	2.86	1.77	0.32	0.00	0.00
Residential	94,346.51	85.31	13,359.37	12.08	2,480.09	2.24	194.52	0.18	212.51	0.19
Total	**103,801.07**		**14,519.99**		**2,847.35**		**257.33**		**214.26**	

Total Loss by General Occupancy



Loss Type by General Occupancy

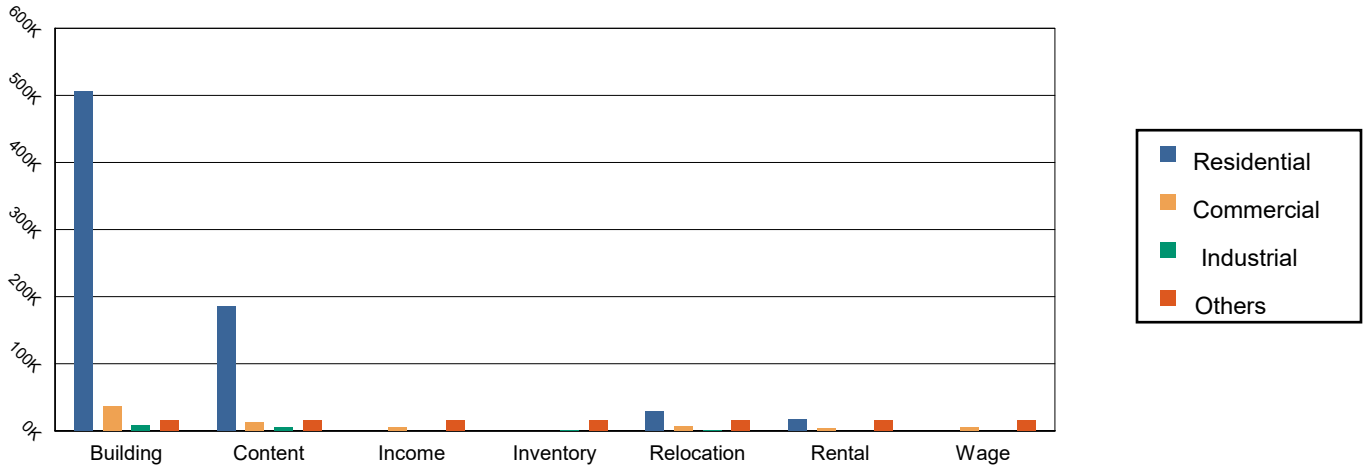


Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	505,894.69	37,162.41	8,265.67	7,690.99	559,013.75
	Content	185,559.47	12,385.20	5,111.87	2,647.69	205,704.22
	Inventory	0.00	299.92	862.74	59.91	1,222.56
	Subtotal	**691,454.15**	**49,847.52**	**14,240.28**	**10,398.58**	**765,940.54**
Business Interruption Loss						
	Income	5.44	4,720.96	110.46	700.24	5,537.10
	Relocation	29,074.97	7,020.35	567.03	1,499.24	38,161.59
	Rental	16,735.91	3,562.34	92.06	157.49	20,547.80
	Wage	12.73	5,143.89	183.48	3,480.41	8,820.51
	Subtotal	**45,829.05**	**20,447.53**	**953.03**	**5,837.38**	**73,067.00**

Direct Economic Losses For Buildings:

July 6, 2020

All values are in thousands of dollars

	Capital Stock Losses				Income Losses				
	Cost Building Damage	Cost Contents Damage	Inventory Loss	Loss Ratio %	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss
Maine									
Cumberland	559,014	205,704	1,223	1.44	38,162	5,537	8,821	20,548	839,008
Total	**559,014**	**205,704**	**1,223**	**1.44**	**38,162**	**5,537**	**8,821**	**20,548**	**839,008**
Study Region Total	**559,014**	**205,704**	**1,223**	**1.44**	**38,162**	**5,537**	**8,821**	**20,548**	**839,008**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : mastercumberland1

Scenario : Worst Case Scenario

Hospital Functionality:

July 6, 2020

		At Day 1		At day 3		At day 7		At day 30		At day 90	
	Total # of Beds	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%	# of Beds	%
Maine											
Cumberland											
Large Hospital (greater than 150 beds)	867	867	100.0	867	100.0	867	100.0	867	100.0	867	100.0
Medium Hospital (50 to 150 Beds)	293	293	100.0	293	100.0	293	100.0	293	100.0	293	100.0
Small Hospital (less than 50 Beds)	25	25	100.0	25	100.0	25	100.0	25	100.0	25	100.0
Total	**1,185**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**
Total	**1,185**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**
Study RegionTotal	**1,185**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**	**1,185**	**100.0**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : mastercumberland1

Scenario : Worst Case Scenario

Table 6

School Functionality:

July 06, 2020

	Count	Functionality (%)
Maine		
Cumberland	129	69.77
Total	**129**	**69.77**
Study Region	**129**	**69.77**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Table 7

Emergency Response Center Facility Functionality:

July 06, 2020

	Count	Functionality (%)
Maine		
Cumberland	29	100.00
Total	**29**	**100.00**
Study Region Total	**29**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Police Station Facility Functionality:

July 06, 2020

	Count	Functionality (%)
Maine		
Cumberland	27	100.00
Total	**27**	**100.00**
Study Region Total	**27**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Fire Station Facility Functionality:

July 06, 2020

	Count	Functionality (%)
Maine		
Cumberland	32	100.00
Total	**32**	**100.00**
Study Region Total	**32**	**100.00**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Table 10

Shelter Summary Report:

July 06, 2020

	# of Displaced Households	# of People Needing Short Term Shelter
Maine		
Cumberland	205	94
Total	**205**	**94**
Study Region Total	**205**	**94**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : mastercumberland1

Scenario : Worst Case Scenario

Debris Summary Report:

July 06, 2020

All values are in tons.

	Brick, Wood and Other	Reinf. Concrete and Steel	Eligible Tree Debris	Other Tree Debris	Total
Maine					
Cumberland	61,443	51	81,862	376,610	519,966
Total	**61,443**	**51**	**81,862**	**376,610**	**519,966**
Study Region Total	**61,443**	**51**	**81,862**	**376,610**	**519,966**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/state were selected at the time of study region creation.

Study Region : mastercumberland1
Scenario : Worst Case Scenario

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name: ME_WorstCase

Type: Deterministic

Maximum Peak Gust in Study Region: 119 mph

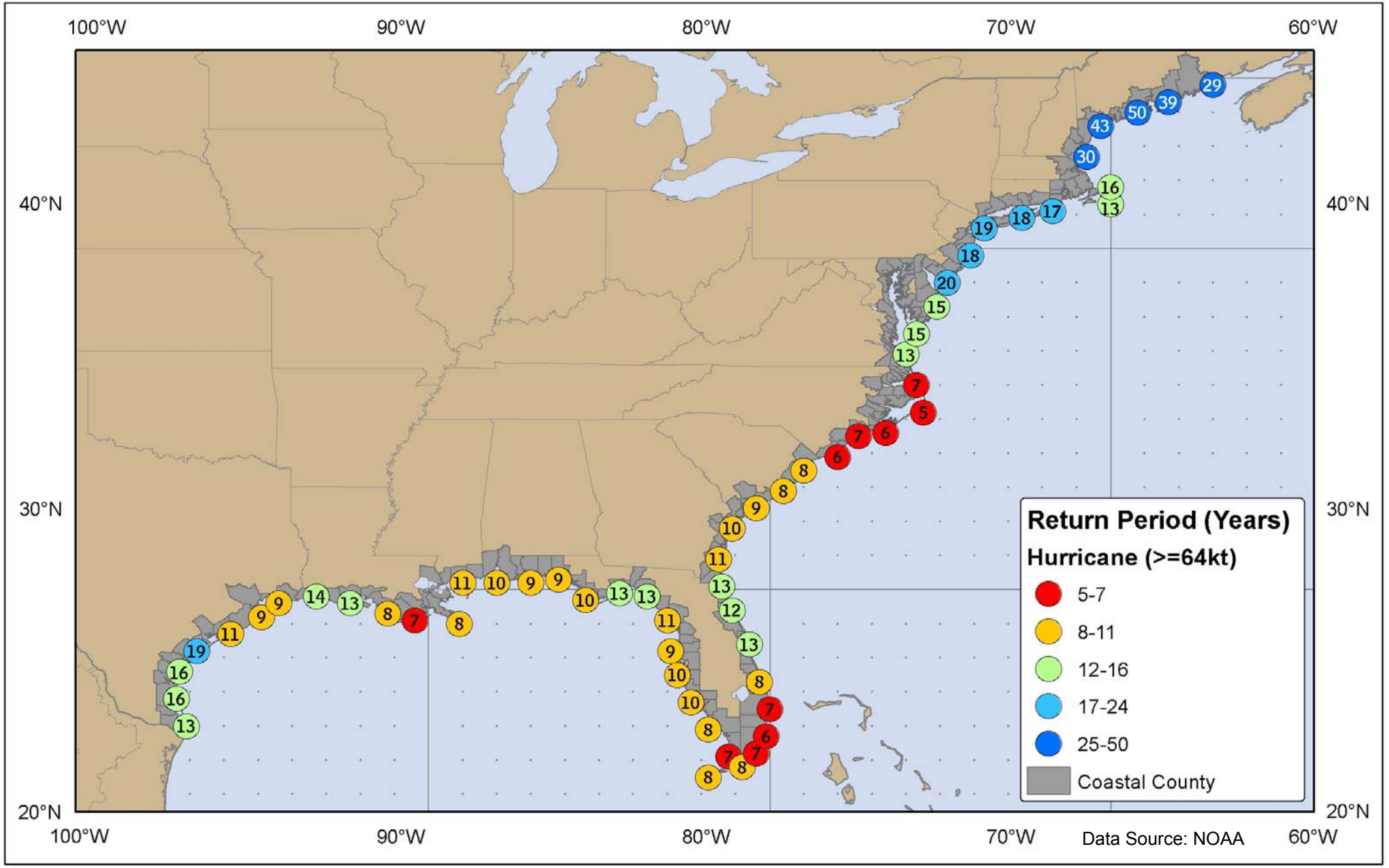
Storm Information: User Defined Scenario Import File:
File Name: \\NESEC-SHARED\shared_1\Maine Project\Counties Projects\Maine_WorstCaseHU_scenario.bin
Original Scenario Name: Maine_WorstCase

User Defined Storm Track Input Data

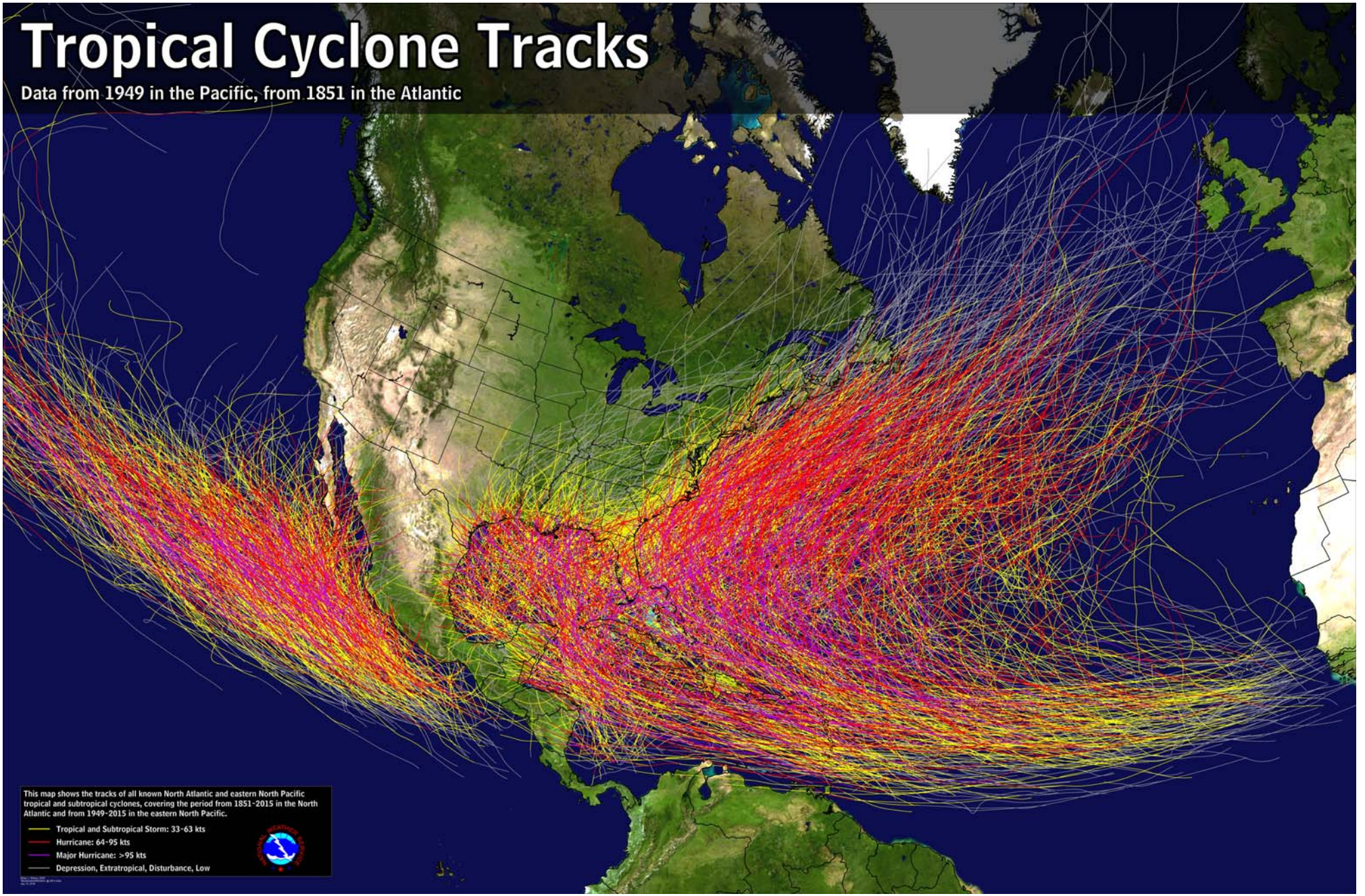
Point	Latitude	Longitude	Time Step (hour)	Translation Speed (mph)	Radius To Max Winds (miles)	Max. Sustained Wind Speed (mph @ 10m)	Cental Pressure (mBar)	Profile Parameter	Radius to Hurricane Force Winds (miles)
1	41.65	-69.64	0.00	--	30.00	115.00	935.00	--	--
2	43.85	-69.64	5.00	--	30.00	115.00	942.00	--	--
3	46.05	-69.74	10.00	--	35.00	81.00	968.00	--	--
4	47.95	-70.14	15.00	--	40.00	52.00	974.00	--	--
5	49.94	-73.64	20.00	--	45.00	40.00	976.00	--	--
6	48.05	-75.74	25.00	--	50.00	40.00	978.00	--	--

Appendix B

Hurricane Return Periods for U.S. Coastal Counties



Appendix C


Tropical Cyclone Tracks
Data from 1949 in the Pacific, from 1851 in the Atlantic
This map shows the tracks of all known North Atlantic and eastern North Pacific tropical and subtropical cyclones, covering the period from 1851-2015 in the North Atlantic and from 1949-2015 in the eastern North Pacific.
Tropical and Subtropical Storm: 33-63 kts
Hurricane: 64-95 kts
Major Hurricane: >95 kts
Depression, Extratropical, Disturbance, Low