

OFFICE FOR URBANIZATION

Compound Vulnerabilities

THE CASE OF CAPE ANN:
Historic Extreme Storms

October 5, 2021



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Future of the American City

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Saffir-Simpson Hurricane Wind Scale

Category 1 79-95 MPH Wind Speeds
Category 2 96-110 MPH Wind Speeds
Category 3 111-130 MPH Wind Speeds
Category 4 131-155 MPH Wind Speeds
Category 5 131-155 MPH Wind Speeds

Regional Snowfall Index (RSI)

Category 0 <1 RSI Nuisance Storm
Category 1 1-3 RSI Notable Storm
Category 2 3-6 RSI Significant
Category 3 6-10 Major Storm
Category 4 10-18 Crippling Storm
Category 5 18.0+ Extreme Storm

Notes

Tropical Storms

“The Hurricane of ‘38, during the few hours its force was unleashed upon the North Atlantic coast that day, killed more than 600 persons, caused the greatest property damage in hurricane history, and left more than 60,000 people homeless.

It damaged a quarter of a billion trees. It crushed 26,000 automobiles. It completely transformed part of the New England coastline. And for weeks after the storm, home owners in Vermont, 120 miles from the sea, took visitors to see their windows made white with ocean salt - a testament to the great wind that roared out of the tropics that memorable day.”

- Irwin Ross, *New England's Disastrous Weather*¹



Jay Albert, *Swollen Essex River*, 2010, Photograph, Gloucester, Massachusetts.

Tropical Storms: **Extreme Cases**

Great New England Hurricane of 1938

DATE FORMED

September 10, 1938

MADE LANDFALL

2:45 PM EST on September 21 at Long Island; 3:40 PM in Connecticut

SHIFTED TO EXTRATROPICAL

September 22

DISSIPATED

September 23

MAXIMUM WIND SPEED

160 MPH

LOWEST BAROMETRIC PRESSURE

938 hPa

STORM SURGE

50' in Gloucester Harbor, 18-25' along the coast

TOTAL RAINFALL

3-6"

SS CATEGORY AT LANDFALL

3 (120 MPH)

FINANCIAL DAMAGES

\$463,705 across New England (\$8.9 billion adjusted for inflation)

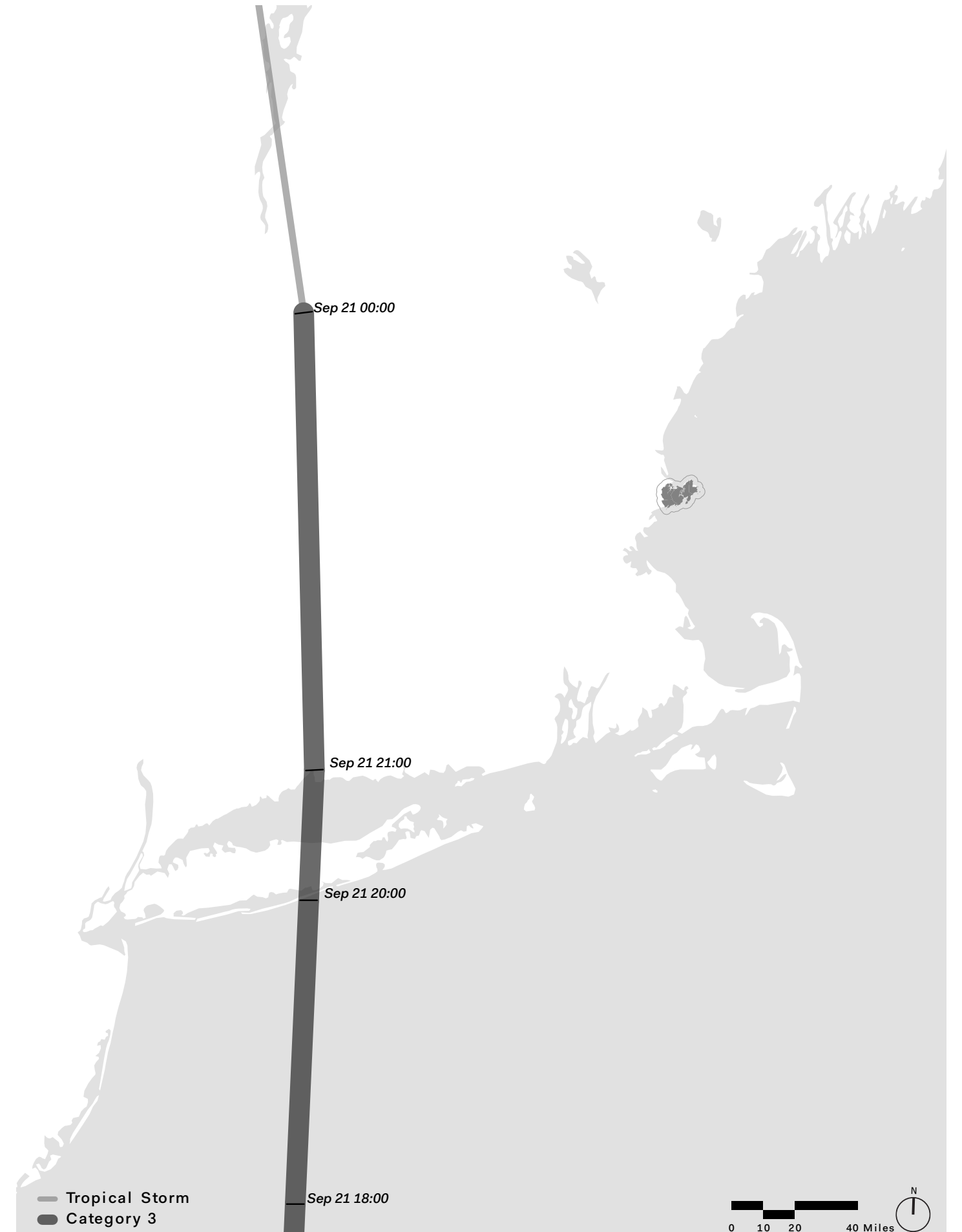
FATALITIES

682 across New England

DAMAGES

3,000 boats lost; 2 billion trees downed; power lines, roads, bridges, railroads, fishing fleets, towns flooded. Electricity not restored for months in some areas.^{2 3 4}

5 6



Tropical Storms: **Extreme Cases**

Hurricane Carol

DATE FORMED

August 25, 1954

SHIFTED TO EXTRATROPICAL

August 31

DISSIPATED

September 1

MAXIMUM WIND SPEED

115 MPH

LOWEST BAROMETRIC PRESSURE

955 hPa

STORM SURGE

14'

TOTAL RAINFALL

2-6"

SS CATEGORY AT LANDFALL

3 (115 MPH)

FINANCIAL DAMAGES

\$460 million in New England (\$4.6 billion adjusted for inflation)

FATALITIES

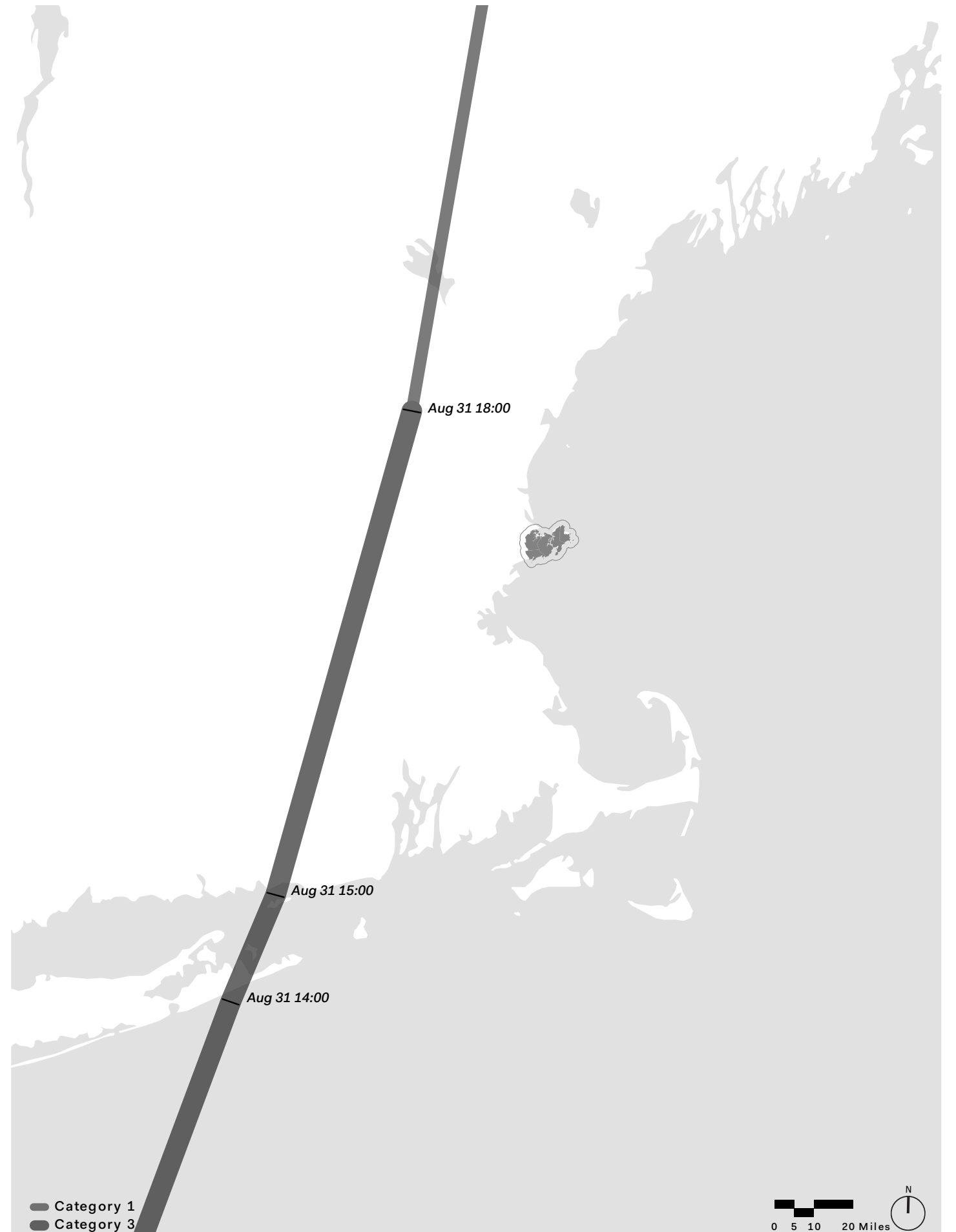
60 across New England

DAMAGES

4,000 homes, 3,500 cars, and over 3,000 boats in New England.

NOTES

Hurricane Carol struck and eroded the New England coastline just one week before Hurricane Edna. Later that year, Congress established the National Hurricane Center (NHC) to create scientifically accurate hurricane forecasts.^{7 8}



Tropical Storms: **Extreme Cases**

Hurricane Edna

DATE FORMED

September 2, 1954

MADE LANDFALL

September 11 on Cape Cod, Massachusetts

DISSIPATED

September 15

MAXIMUM WIND SPEED

125 MPH

LOWEST BAROMETRIC PRESSURE

943 hPa

STORM SURGE

6'

TOTAL RAINFALL

3-7"

SS CATEGORY AT LANDFALL

2 (125 MPH)

FINANCIAL DAMAGES

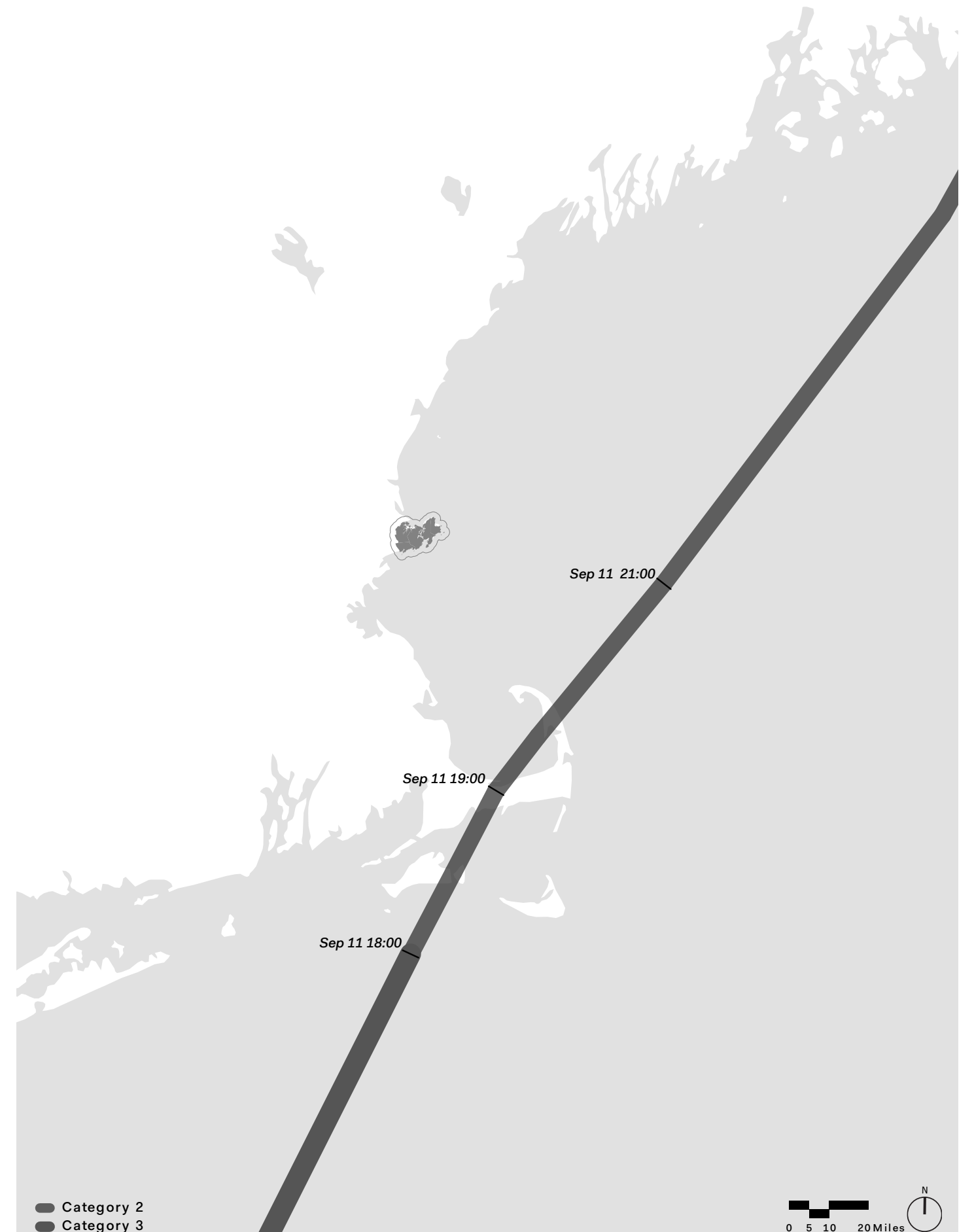
\$40 million in New England (\$406 million adjusted for inflation)

FATALITIES

21 across New England

DAMAGES

1,500 homes, power lines, ports, roads and bridges across New England.^{9 10}



Tropical Storms: **Extreme Cases**

Hurricanes of December

DATE FORMED

December 15, 21 and 27, 1839

DISSIPATED

December 27

FINANCIAL DAMAGES

\$1 million (\$29 million adjusted for inflation)

FATALITIES

600 across New England, including 50 in Gloucester, 9 in Essex and 3 in Marblehead

DAMAGES

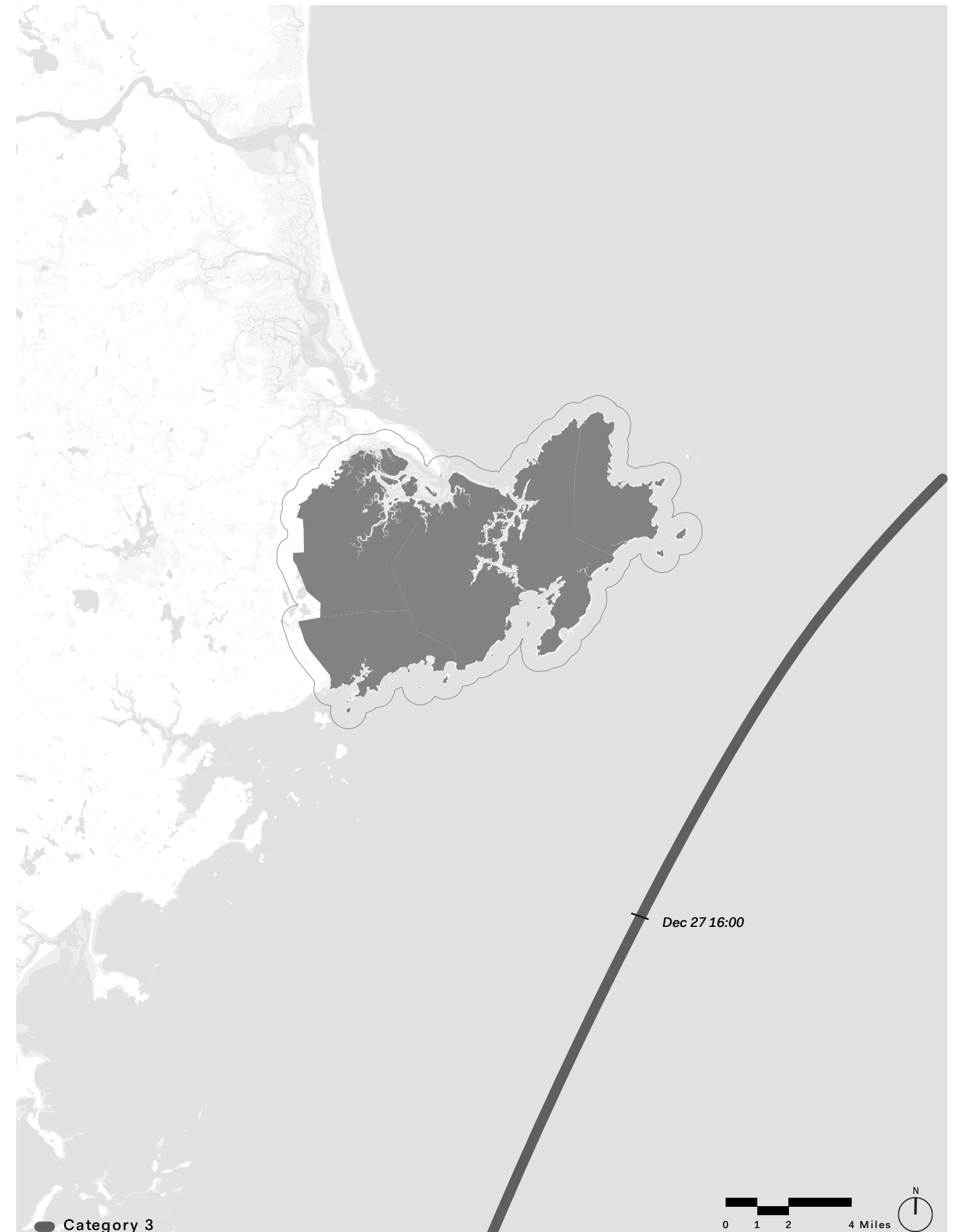
23 ships, 22 brigs, 166 schooners and 5 sloops in Gloucester's Inner Harbor.

NOTES

It is likely that the Hurricanes of December were extratropical storms.

LOCAL NEWS IN GLOUCESTER

"More than fifty vessels were either driven ashore dismantled, or carried to sea, and the loss of lives could not have fallen short of fifty. From one end of the beach to the other, nothing could be seen but pieces of broken wrecks; planks and spars shattered into a thousand splinters; ropes and sails parted and rent; flour, fish, lumber, and a hundred other kinds of lading and furniture, soaked and broken; with here and there a mangled and naked body of some poor mariner; and in one instance that of a woman lashed to the windlass-bits of a Coastline schooner, lay along the beach, while off thirty yards, with the surf breaking over them every moment and freezing in the air, lay nearly a score of lost vessels; all together forming a picture which it is in vain to attempt to copy in words. In the Midst of this scene of terror, the hardy fishermen of Cape Ann fully proved that a sailor's jacket seldom covers a craven heart. They manned two boats, the Custom House boat and the Van Buren, and fearlessly risked their lives for the safety of their fellow creatures. Vessel after vessel was visited by them; they made their way over the tops of mountain-waves, and through the gaping chasms of the hungry waters; and from the very teeth of greedy death plucked many a poor, despairing, and exhausted fellow, bringing him safe to shore. Excellent, generous men!"^{11 12}



Tropical Storms: **Extreme Cases**

Tropical Storm Irene

DATE FORMED

August 21, 2011

MADE LANDFALL

August 27 on the Outer Banks in North Carolina

SHIFTED TO BECOME EXTRATROPICAL

August 28

DISSIPATED

August 30

MAXIMUM WIND SPEED

120 MPH

LOWEST BAROMETRIC PRESSURE

942 hPa

STORM SURGE

1.72-2.87'

TOTAL RAINFALL

4-7" Irene's main impact was from rainfall, including catastrophic floods across New York and New England.

SS CATEGORY AT LANDFALL

1

FINANCIAL DAMAGES

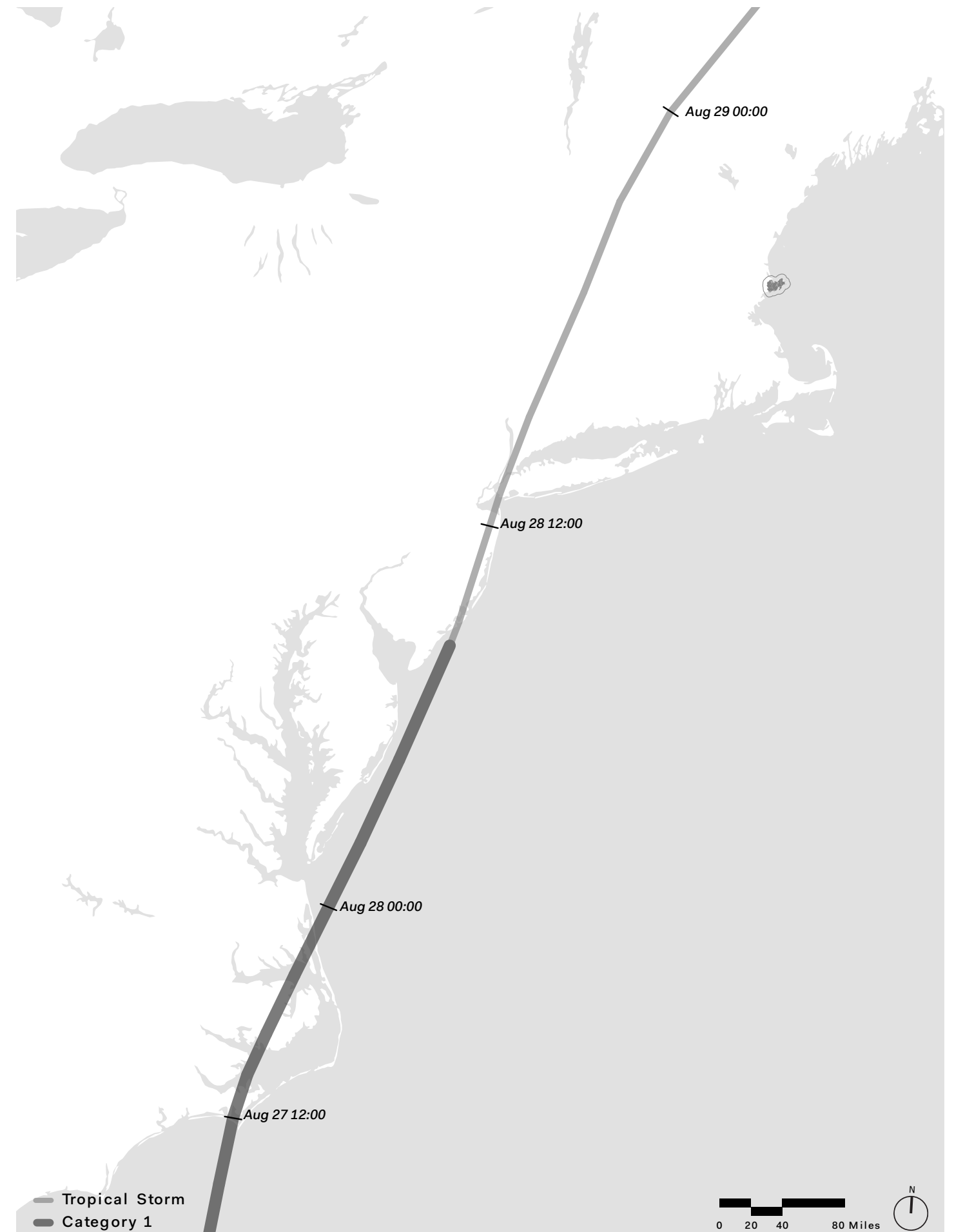
\$35 million in Massachusetts (\$42 million adjusted for inflation)

FATALITIES

16 across New England

DAMAGES

1,100 homes and 21,220 businesses impacted in Massachusetts. Power lines downed across New England.^{13 14 15 16 17}



Tropical Storms

Great Colonial Hurricane 1635 (Great Storm of August 1635)

DATE FORMED

August 24, 1635

DISSIPATED

August 25

MAXIMUM WIND SPEED

130 MPH

LOWEST BAROMETRIC PRESSURE

930 hPa

STORM SURGE

14'-20'

SS CATEGORY AT LANDFALL

3

FINANCIAL DAMAGES

\$460 million in New England (\$4.6 billion adjusted for inflation)

FATALITIES

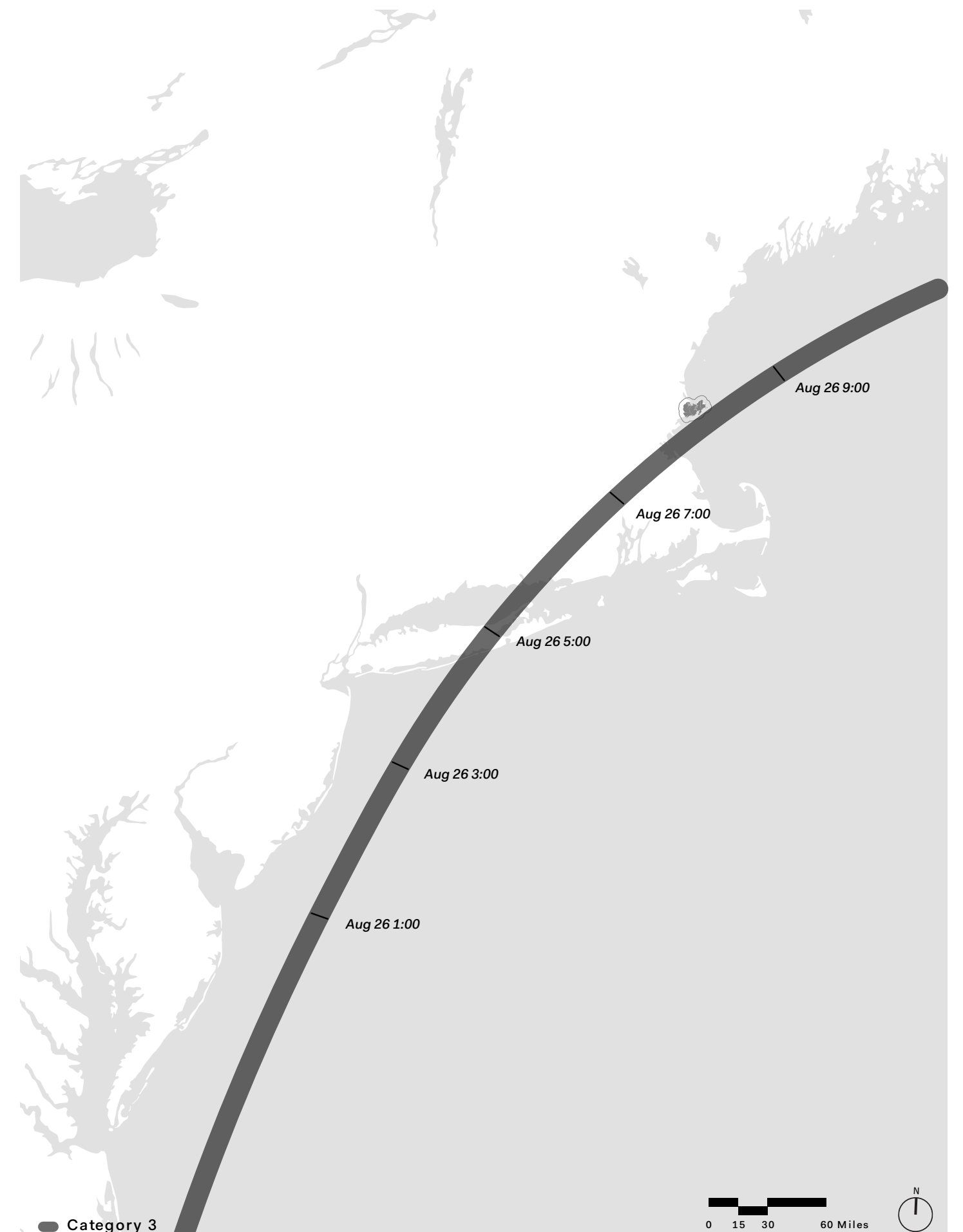
46 across New England, including 21 near Thacher Island

DAMAGES

Thousands of trees blown away, homes destroyed, and ships wrecked. The damage from the storm was visible across the New England landscape for 50 years.

NOTES

Anthony Thacher, an Englishman, was on course from Ipswich to Marblehead in 1635 when he was caught in the storm. He lost four of his children, his cousin, and seven nieces and nephews. Only Thacher and his wife climbed the rocks of the yet-to-be-named Thacher Island (then named one of the three "Turks Heads" by Captain John Smith). The Massachusetts Bay Colony awarded the island to Thacher for his losses, and it remained in their family for 80 years, before it was sold back to the Colony of Massachusetts for 500 pounds in 1771. ^{18 19}



Tropical Storms

Great September Gale of 1815 (1815 New England Hurricane)

DATE FORMED

September 18, 1815

MADE LANDFALL

August 27 on the Outer Banks in North Carolina

SHIFTED TO BECOME EXTRATROPICAL

August 28

DISSIPATED

August 30

MAXIMUM WIND SPEED

120 MPH

LOWEST BAROMETRIC PRESSURE

942 hPa

STORM SURGE

14'-15'

TOTAL RAINFALL

4-7" Irene's main impact was from rainfall, including catastrophic floods across New York and New England.

SS CATEGORY AT LANDFALL

1

FINANCIAL DAMAGES

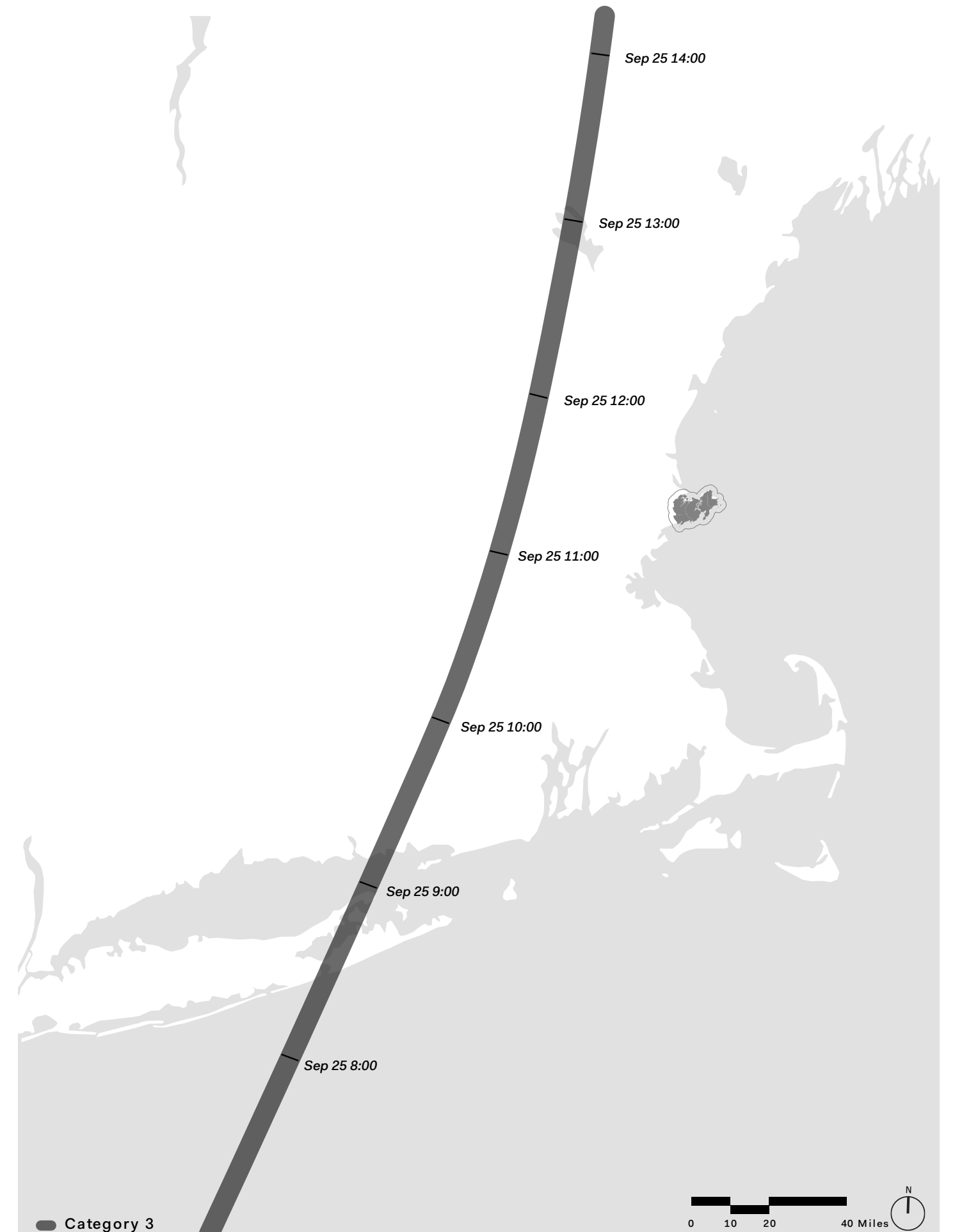
\$35 million in Massachusetts (\$42 million adjusted for inflation)

FATALITIES

38

DAMAGES

1,100 homes and 21,220 businesses impacted in Massachusetts. Power lines downed across New England.²⁰



Tropical Storms

1944 Great Atlantic Hurricane

DATE FORMED

September 9, 1944

MADE LANDFALL

September 15 in Southhampton, NY, and Point Judith, RI

SHIFTED TO BECOME EXTRATROPICAL

September 15

DISSIPATED

September 16

MAXIMUM WIND SPEED

145 MPH

LOWEST BAROMETRIC PRESSURE

933 hPa

TOTAL RAINFALL

7-10"

SS CATEGORY AT LANDFALL

3

FINANCIAL DAMAGES

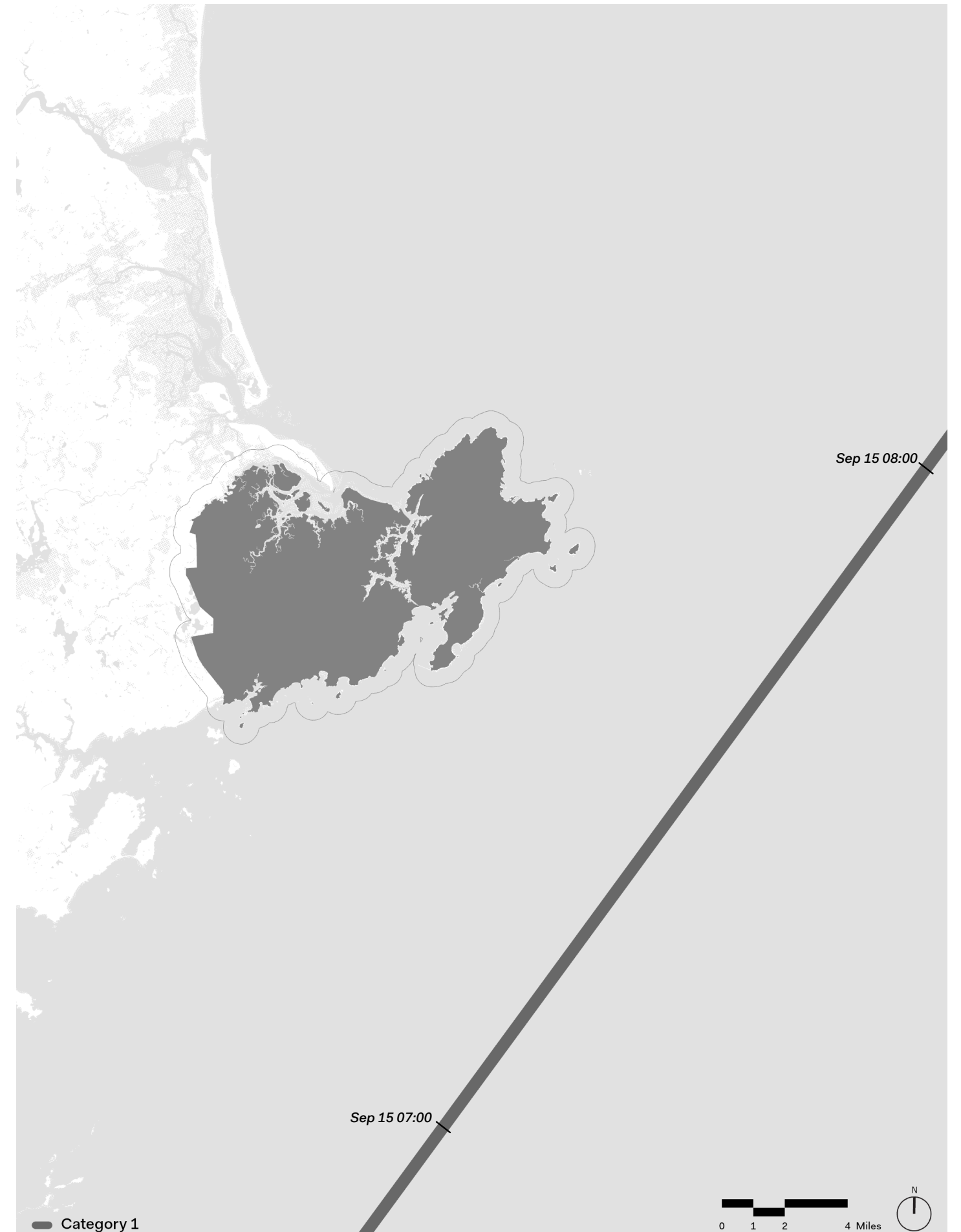
\$5 million across New England (\$77 million adjusted for inflation)

FATALITIES

28 across New England

DAMAGES

115 homes, downed power lines, fallen trees, destroyed shipyards and boats left in harbors.^{21 22}



Tropical Storms

Hurricane Bob

DATE FORMED

August 16, 1991

MADE LANDFALL

September 15 in Southhampton, NY, and Point Judith, RI

SHIFTED TO BECOME EXTRATROPICAL

August 20

DISSIPATED

August 29

MAXIMUM WIND SPEED

115 MPH

LOWEST BAROMETRIC PRESSURE

950 hPa

STORM SURGE

5.8'-6.7'

TOTAL RAINFALL

5.3-7.83"

SS CATEGORY AT LANDFALL

2

FINANCIAL DAMAGES

\$524 million in Massachusetts insured property damages (\$1 billion adjusted for inflation)

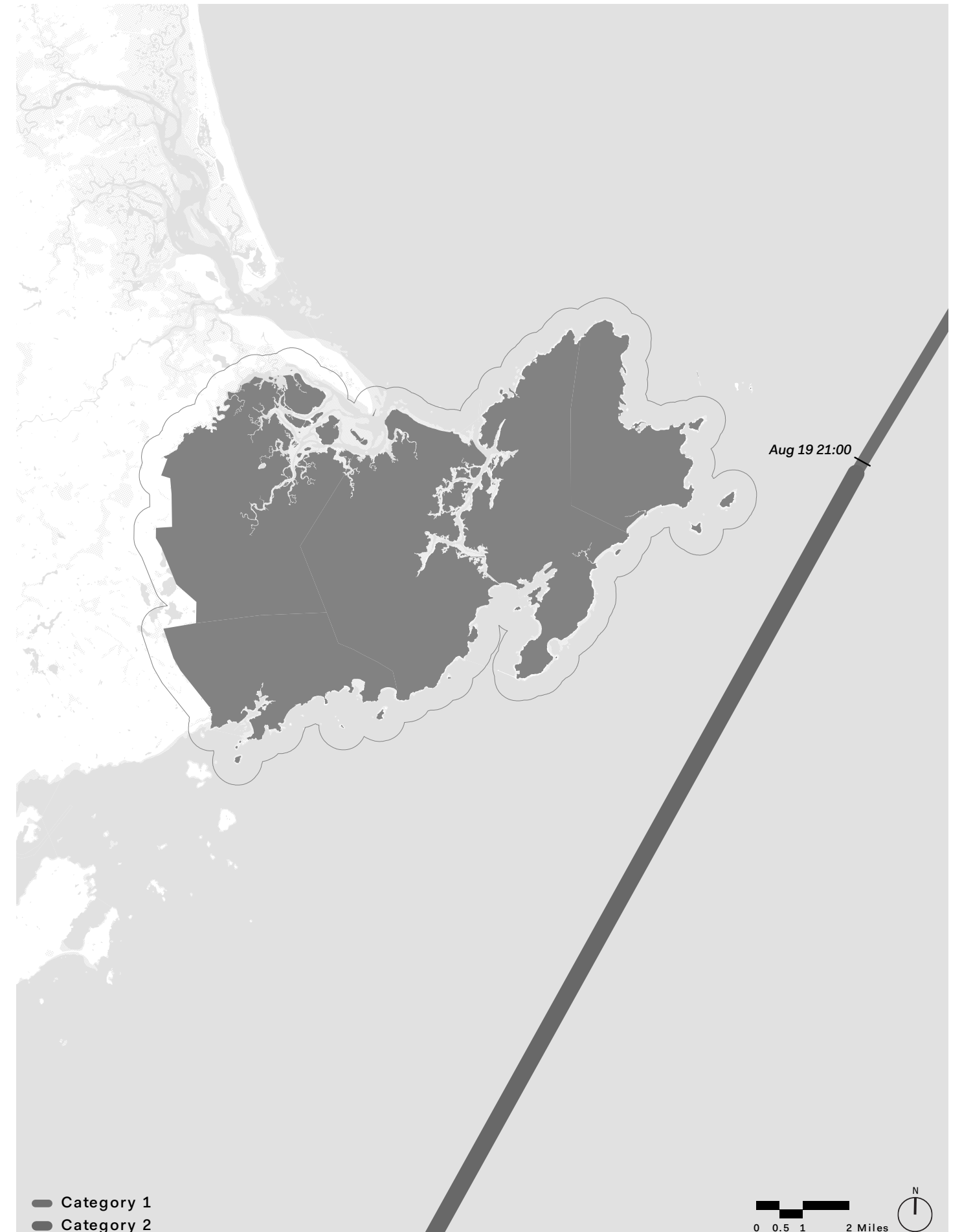
FATALITIES

12 across New England

DAMAGES

61 homes across Massachusetts were destroyed, along with power lines.

Agriculture was salinated.^{23 24 25 26 27 28}



Tropical Storms

Hurricane Sandy (Superstorm Sandy)

DATE FORMED

October 22, 2012

MADE LANDFALL

October 24 in Kingston Jamaica and Santiago de Cuba, Cuba, and October 29 in Brigantine, NJ²⁹

SHIFTED TO BECOME EXTRATROPICAL

October 29

DISSIPATED

November 2

MAXIMUM WIND SPEED

115 MPH

LOWEST BAROMETRIC PRESSURE

940 hPa

STORM SURGE

2'-4'

TOTAL RAINFALL

5-7"

SS CATEGORY AT LANDFALL

2

FINANCIAL DAMAGES

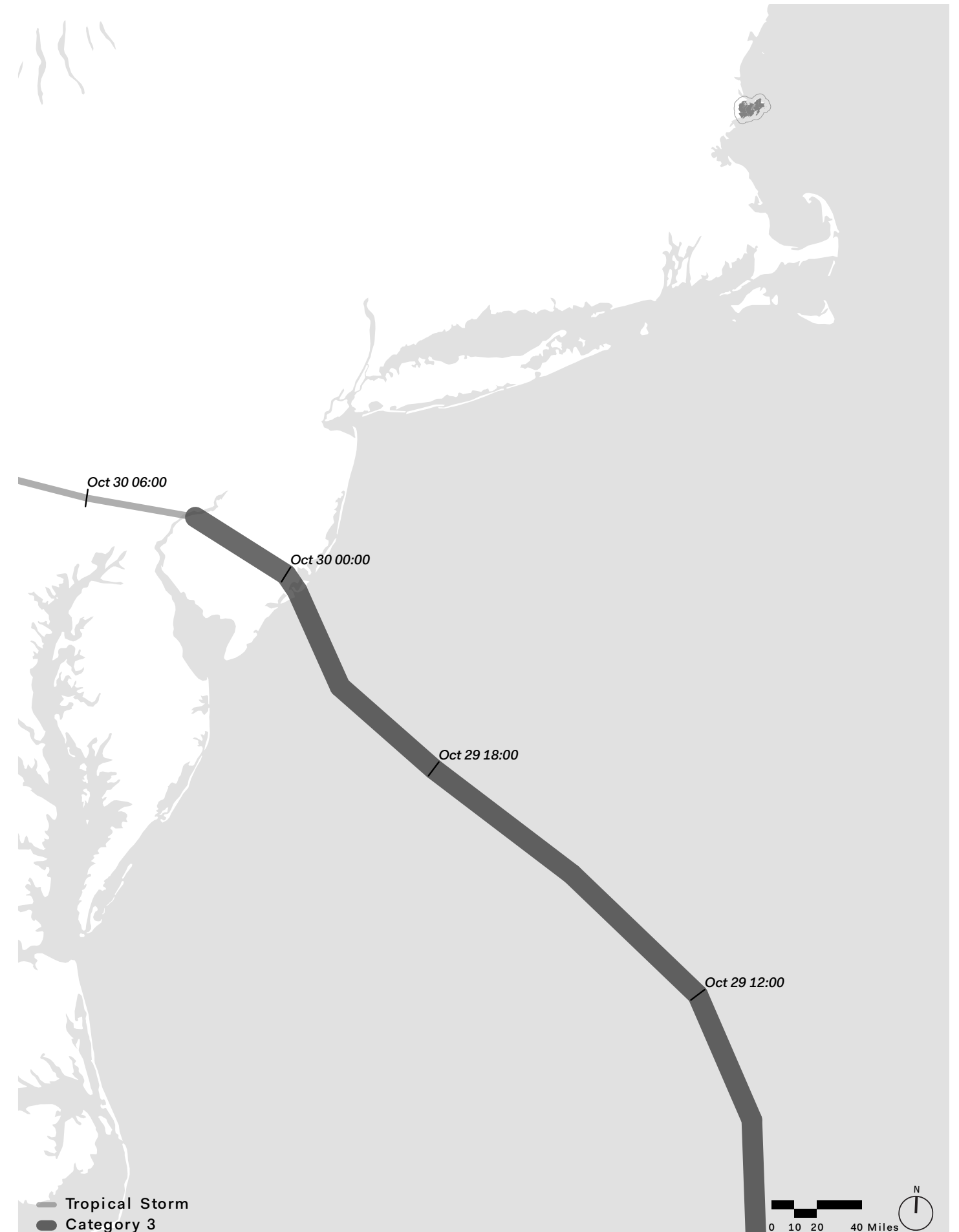
\$20.8 million in Massachusetts insured property damages (\$24 million adjusted for inflation)

FATALITIES

5 across New England

DAMAGES

650,000 homes, power lines, breaks in natural gas lines, damage to roads and bridges. The structure of FEMA was changed to deliver aid to Sandy victims.^{30 31 32}



Extratropical Storms



Chris Spittle, *Rockport's iconic Motif #1 was destroyed*, 1978, Photograph, Rockport, Massachusetts

Extratropical Storms: **Extreme Cases**

No-Name Storm (The 1991 Perfect Storm)

DATE FORMED

October 22, 2012

MADE LANDFALL

October 24 in Kingston Jamaica and Santiago de Cuba, Cuba, and October 29 in Brigantine, NJ

SHIFTED TO BECOME EXTRATROPICAL

October 29

DISSIPATED

November 2

MAXIMUM WIND SPEED

75 MPH

LOWEST BAROMETRIC PRESSURE

980 hPa

STORM SURGE

13.6'

TOTAL RAINFALL

0.25-1"

SS CATEGORY AT LANDFALL

1

FINANCIAL DAMAGES

\$100 million in Massachusetts (\$200 million adjusted for inflation)

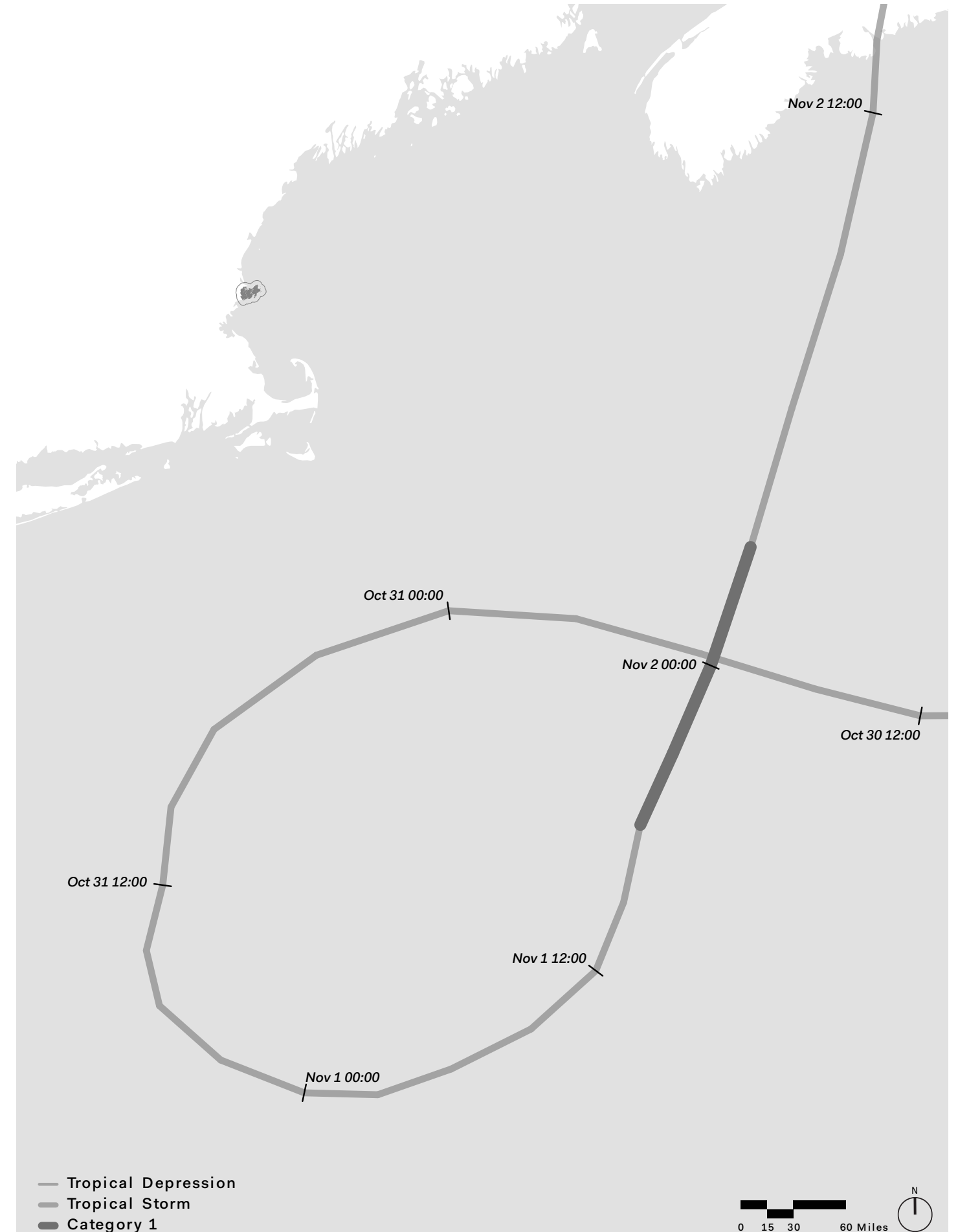
FATALITIES

13 across southern New England

DAMAGES

100 homes across Massachusetts, severe beach erosion and coastal flooding.^{33 34}

^{35 36}



Extratropical Storms: **Extreme Cases**

Northeastern United States Blizzard of 1978

DATE FORMED

February 5, 1978

AFFECTED CAPE ANN

3 PM on February 6th

REGIONAL SNOWFALL INDEX CATEGORY

5

DISSIPATED

February 7

MAXIMUM WIND SPEED

110 MPH

STORM SURGE

30'-40' in Gloucester

TOTAL SNOWFALL

12' on Cape Ann

FINANCIAL DAMAGES

\$500 million in Massachusetts (\$2.1 billion adjusted for inflation)

FATALITIES

73 in Massachusetts

DAMAGES

1,700 homes damaged across Cape Ann, with extension beach erosion. Sea walls were damaged across New England. Power lines and highways were affected throughout norther Massachusetts. Motif No. 1 was destroyed by high tides, and Pigeon Cove Harbor was damaged.^{37 38 39 40}

1993 Storm of the Century ('93 Superstorm)

DATE FORMED

March 12, 1993

REGIONAL SNOWFALL INDEX CATEGORY

5

DISSIPATED

March 15

MAXIMUM WIND SPEED

100 MPH

LOWEST BAROMETRIC PRESSURE

960 hPa

STORM SURGE

2.12'

TOTAL RAINFALL

10-20" across Cape Ann

FINANCIAL DAMAGES

\$3.7 billion (\$7.0 billion adjusted for inflation)

FATALITIES

25 across New England

DAMAGES

Power outages across New England.⁴¹

Extratropical Storms: **Extreme Cases**

Ash Wednesday Storm

DATE FORMED

March 4, 1962

REGIONAL SNOWFALL INDEX CATEGORY

4

DISSIPATED

March 9

MAXIMUM WIND SPEED

84 MPH

LOWEST BAROMETRIC PRESSURE

979 hPa

STORM SURGE

1.8' - 3'

TOTAL SNOWFALL

23" on Cape Ann

FINANCIAL DAMAGES

\$2.2 million in Massachusetts (\$19.9 million adjusted for inflation)

FATALITIES

40 across New England

DAMAGES

Tidal action impacted dunes along the New England coast. Many new channels and inlets were cut in the shoreline of southern New England, leading to ongoing erosion.⁴²

The Great Appalachian Storm of November 1950

DATE FORMED

November 24, 1950

REGIONAL SNOWFALL INDEX CATEGORY

5

DISSIPATED

November 30

MAXIMUM WIND SPEED

100 MPH

LOWEST BAROMETRIC PRESSURE

978 hPa

STORM SURGE

2.12'

TOTAL SNOWFALL

32-62"

FINANCIAL DAMAGES

\$66.7 million (\$756 million adjusted for inflation)

FATALITIES

300

DAMAGES

1,000,000 homes without power, as well as damage to railroads and roads.⁴³

Extratropical Storms

North American Blizzard of 1996

DATE FORMED

January 6, 1996

REGIONAL SNOWFALL INDEX CATEGORY

5

DISSIPATED

January 10

LOWEST BAROMETRIC PRESSURE

980 hPa

STORM SURGE

1.9' - 2.7'

TOTAL SNOWFALL

13" - 25"

FINANCIAL DAMAGES

\$350,000 in Massachusetts (\$610,000 adjusted for inflation)

FATALITIES

154

NOTES

FEMA and Federal Assistance Grants were awarded in the aftermath of the storm.

⁴⁴

Halloween Nor'easter

DATE FORMED

October 29, 2011

REGIONAL SNOWFALL INDEX CATEGORY

1

DISSIPATED

October 30

MAXIMUM WIND SPEED

100 MPH

STORM SURGE

2.42'

TOTAL SNOWFALL

31"

FINANCIAL DAMAGES

\$300,000 in Massachusetts (\$36.4 million adjusted for inflation)

FATALITIES

39

DAMAGES

Wet, heavy snow accumulated on trees and power lines, resulting in widespread tree damage and power outages across central and western Massachusetts.⁴⁵

Extratropical Storms

October Flood

DATE FORMED

October 19, 1996

DISSIPATED

October 20

STORM SURGE

1.89'

TOTAL RAINFALL

10.8"

FINANCIAL DAMAGES

\$60 million (\$104 million adjusted for inflation)

DAMAGES

300 homes were damaged, as well as underground MBTA tracks and sewer lines in Boston were flooded.^{46 47 48}



Extratropical Storms

April 2007 Nor'easter

DATE FORMED

April 15, 2007

REGIONAL SNOWFALL INDEX CATEGORY

1

DISSIPATED

April 16

STORM SURGE

3.52'

TOTAL SNOWFALL

3-6"

FINANCIAL DAMAGES

\$348 million (\$606 million adjusted for inflation)

FATALITIES

18

DAMAGES

Moderate flooding on roads and power outages.⁴⁹

Great Blizzard of 1888

DATE FORMED

March 11, 1888

DISSIPATED

March 12

STORM SURGE

3.52'

TOTAL SNOWFALL

22" - 50"

FINANCIAL DAMAGES

\$25 million (\$720 million adjusted for inflation)

FATALITIES

400

DAMAGES

200 ships across Massachusetts, railcars in New York, power lines and communication infrastructure damaged along the east coast.⁵⁰

Notes

- 1 Irwin Ross, "The Bostonian," in *New England's Disastrous Weather*, ed. Benjamin Watson (New York City: Rodale Press, 1990).
- 2 Aime Tucker, "Worst Hurricanes in New England History," *New England Today Living*, September 7, 2021.
- 3 Massachusetts Office of Coastal Zone Management, "The Worst Massachusetts Hurricanes of the 20th Century," Coastal Zone Management Hurricane Preparedness Kit, accessed September 24, 2021.
- 4 Cherie Burns, "The Great 1938 Hurricane, A Once-In-A-Lifetime Storm," *New England Historical Society*, June 13, 2021.
- 5 Stephen Long, *Thirty-Eight: The Hurricane that Transformed New England* (New Haven: Yale University Press, 2016).
- 6 Lourdes B. Aviles, *Taken by a Storm, 1938: A Social and Meteorological History of the Great New England Hurricane* (Boston: American Meteorological Society, 2013).
- 7 Paul J. Hebert, Max Mayfield, Jerry D Jarrell, and Tropical Prediction Center, *The Deadliest, Costliest, And Most Intense United States Hurricanes of This Century (and Other Frequently Requested Hurricane Facts)* (Miami: U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Weather Service Tropical Prediction Center, 1996).
- 8 Mass.gov, "The Worst Massachusetts Hurricanes."
- 9 Hebert et al., *The Deadliest Hurricanes*.
- 10 Mass.gov, "The Worst Massachusetts Hurricanes."
- 11 Sabin Americana, *Awful calamities, or, The shipwrecks of December 1839 being a full account of the dreadful hurricanes of Dec. 15, 21 & 27, on the coast of Massachusetts* (Boston: Boston Press of J. Howe, 1840).
- 12 "The Great Storm of 1839," *Out of Gloucester*, accessed September 24, 2021.
- 13 "Factbox: Cost estimates of Storm Irene on states," *Reuters*, September 11, 2011.
- 14 Dun & Bradstreet, *2011 Impact Report of Hurricane Irene* (Millburn, New Jersey: Dun & Bradstreet, September 2011).
- 15 "Massachusetts Hurricane Irene," FEMA, accessed September 24, 2021.
- 16 Lixion Avila and John Cangialosi, *Tropical Cyclone Report Hurricane Irene* (Washington, D.C.: National Hurricane Center, December 2011).
- 17 Andrew Freedman, "Hurricane Irene continues path towards New York, Philadelphia, Boston and the rest of the Northeast," *The Washington Post*, August 26, 2011.
- 18 Paul St. Germain, *Twin lights of Thacher Island, Cape Ann* (Portsmouth, NH: Arcadia Publishing, 1914).
- 19 D.M. Ludlum, *Early American hurricanes, 1492-1870* (Boston: American Meteorological Society, 1963).
- 20 Mass.gov, "The Worst Massachusetts Hurricanes."
- 21 University of Rhode Island, "1944 Great Atlantic Hurricane," *Hurricanes: Science and Society*, accessed September 24, 2021.
- 22 Mass.gov, "The Worst Massachusetts Hurricanes."
- 23 "Hurricane Bob," National Weather Service, accessed September 24, 2021.
- 24 Max Mayfield, *Preliminary Report Hurricane Bob* (Washington, D.C.: National Center Hurricane Center, August 10, 1992).
- 25 Sun Yunfang, et al., "Impact of current-wave interaction on storm surge simulation: a case study for Hurricane Bob," *Journal of Geophysical Research on Oceans* 118 (May 2013): 2685-2701.
- 26 The American Institute for Research, *A Chronology of Major Events Affecting the National Flood Insurance Program* (Washington, D.C.: FEMA, December 2005).
- 27 I. Valiela et al., "Ecological Effects of Major Storms on Coastal Watersheds and Coastal Waters: Hurricane Bob on Cape Cod," *Journal of Coastal Research* 14, no. 1 (1998): 218-238.
- 28 "East Coast Begins Hurricane Bob Cleanup: At least 16 killed between the Carolinas and Canada," *Los Angeles Times*, August 21, 1991.
- 29 "Hurricane Sandy Coastal Resilience Competitive Grant Program," National Fish and Wildlife Foundation, accessed September 21, 2021.
- 30 Deanna Moran, "Superstorm Sandy: A Near-Miss for New England and Lessons Learned for the Future," *Conservation Law Foundation*, October 28, 2016.
- 31 Eric Blake, Todd B. Kimberlain, Robert Berg, John Cangialosi, John Beven, *Tropical Cyclone Report on Hurricane Sandy* (Washington, D.C.: National Hurricane Center, February 2013).
- 32 Eric Randall, "Hurricane Sandy Live Updates: Here Comes the Rain," *Boston Magazine*, October 29, 2012.
- 33 William C. Hidlay, "Maine hit hard by storm," *Bangor Daily News*, November 1, 1991.
- 34 Sam McCown, *Perfect Storm Damage Summary* (Washington, D.C.: FEMA, 1991).
- 35 "The Perfect Storm," NOAA, accessed September 29, 2021.
- 36 Walter Drag, *A comparative retrospective on the Perfect Storm* (Washington, D.C.: FEMA, 2020).
- 37 Boston Globe Staff, "A look back at the Blizzard of 1978," Boston, accessed September 24, 2021.
- 38 "The Blizzard of '78," Cape Ann Weather, accessed September 29, 2021.
- 39 Richard Haligren, *Natural Disaster Survey Report 78-1 Northeast Blizzard of '78 February* (Washington, D.C.: US Department of Commerce, September 1978).
- 40 "Massachusetts Blizzards, High Winds And Record Snowfall," FEMA, accessed September 24, 2021.
- 41 American Institute for Research, *Chronology of Major Events*.
- 42 Hans E. Rosendal, "Great Atlantic Coast Storm," *Mariners Weather Log* 6, no. 1 (January 1962): 79-85.
- 43 Commonwealth of Massachusetts, *Massachusetts State Hazard Mitigation and Climate Adaptation Plan* (Boston: Commonwealth of Massachusetts, September 2018).
- 44 Commonwealth of Massachusetts, *Hazard Mitigation Plan*.
- 45 Commonwealth of Massachusetts, *Hazard Mitigation Plan*.
- 46 Sara Rimer, "New Englanders Cleaning Up After 3 Days of Downpours," *The New York Times*, October 23, 1996.
- 47 Jerry Harkavy, "Taps Flowing Again in Maine After Damage From Northeast Floods," *AP News*, October 23, 1996.
- 48 Glenn Hodgkins and Gregory J. Stewart, *Flood of October 1996 in Southern Maine* (Maine: U.S. Geological Survey, 1997).
- 49 Laurie Dove, "10 Worst Nor'Easters of All Time," *How Stuff Works*, February 2, 2021.
- 50 Dove, "Worst Nor'Easters."



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