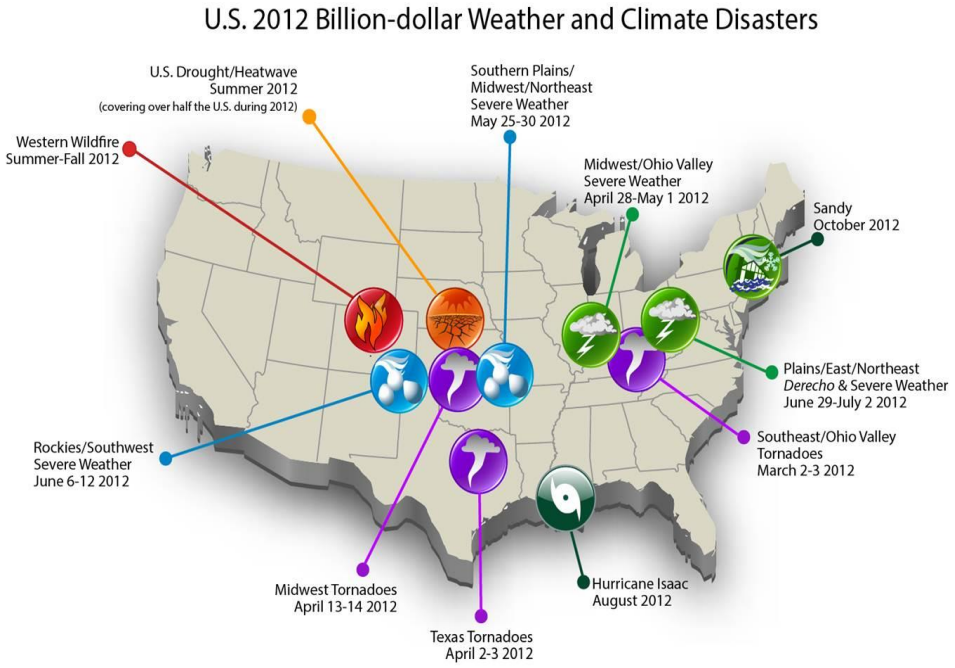
AASHTO
EXTREME WEATHER & THE TRANSPORTATION SYSTEM

How Do Extreme Weather Events Affect Emergency Management?

Extreme weather events affect nearly every state in the U.S. In 2012, for example, a total of 133 disaster events[i] occurred resulting in about $881 billion in damages[ii] (see NOAA NCDC graphic[iii] at right). Events ranged from hurricanes, droughts, heat waves, severe local storms, non-tropical floods, and winter storms, to wildfires and freezes. In addition, many parts of the country have witnessed gradual shifts in average temperatures and rainfall patterns over the past several decades. These events can cause electrical system malfunctions or brownouts, freight disruptions, icing, and road closures and detours due to flooding, wash-outs, or wildfires. There is strong evidence that events related to heat, heavy precipitation, and coastal flooding will grow in frequency and severity in coming decades and we will likely continue to experience droughts and tropical storms.



How Can Emergency Managers Prepare for Extreme Weather Events?

Although transportation agency experiences will vary by state and topic, below is a "Top 10" list of suggestions for transportation emergency management staff to better prepare for extreme weather and shifting climate trends.

1. **Assess Vulnerabilities:** Based on past extreme weather events, experiences in neighboring states, available data, and expert judgment, identify what components of your system—including specific facilities or operational activities—may be most vulnerable to extreme weather events and develop appropriate strategies to minimize risks.
2. **Coordinate:** Coordinate across departments within your agency and with federal, local, and private-sector partners to share information about real-time conditions, closures, plans, initiatives, risks, and resources.
3. **Update Emergency Preparedness Plans:** Continuously improve all-hazards emergency preparedness plans. Update plans as necessary to incorporate changing frequency or severity of weather events.
4. **Train Workforce:** Provide greater cross-training of staff, across the agency, to enhance the ability to adapt and mobilize for emergency situations. Make sure all staff know their emergency management roles, responsibilities, and duties.
5. **Adopt Early Warning Systems:** Incorporate "early warning indicators" such as the use of Roadway Weather Information Stations (RWIS) to plan for extreme weather-related risks.
6. **Harden the System:** As opportunities arise through regular maintenance or replacement activities, "harden" facilities and other system components such as back-up generators, signs, and signals.
7. **Debrief and Assess:** After weather events occur, gather staff to debrief and conduct after-action assessments. Identify areas for improvement and continually update emergency preparedness plans.
8. **Improve Back-up Communications:** Prepare backup communications such as satellite phones, portable highway advisory radios, truck radios, and alternative networks.
9. **Pre-position Materials and Equipment:** Develop strategies for responding to transportation system disruptions due to weather-related events, including pre-positioning replacement materials (culverts, etc.) in vulnerable areas.
10. **Provide Traveler Information:** Develop effective public and traveler information systems/services to inform travelers of travel options (including social media tools, mobile apps, and collecting real time conditions through vehicle technology).

Center for Environmental Excellence

Emergency Management Resources for Extreme Weather Preparedness

PUBLICATIONS

- **Climate Change, Extreme Weather Events and the Highway System** (NCHRP Report 750, Volume 2, 2014). This report presents guidance for practitioners on adaptation strategies to likely impacts of climate change in the planning, design, construction, operation, and maintenance of infrastructure assets in the U.S.
- **FHWA Climate Change and Extreme Weather Vulnerability Assessment Framework** (FHWA, December 2012). This document is a guide for transportation agencies interested in assessing their vulnerability to climate change and extreme weather events. The accompanying "Virtual Framework" is a web resource with step-by-step guidance and tools for transportation agencies.
- **Transportation Research Record Journal No. 2234: Critical Infrastructure Protection and Resilience: Emergency Evacuation** (February 2012). This issue includes 14 research papers on issues including improving the resilience of critical infrastructure systems post-disaster.
- **Response to Extreme Weather Impacts on Transportation Systems** (NCHRP Synthesis 454, May 2014). Report examines eight recent cases of extreme weather in the U.S. from the perspectives of transportation operations, maintenance, design, construction, planning, communications, interagency coordination, and data and knowledge management.
- **Lessons Learned from Irene: Vermont RPCs Address Transportation System Recovery, National Association of Development Organizations** (June 2012). The report provides lessons learned from this collaborative effort for future disaster preparedness and recovery.

FEDERAL GUIDANCE AND RULES

- **FHWA Order 5520 – Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events** (Dec. 15, 2014). Directive establishes FHWA policy that FHWA programs, policies, and activities integrate consideration of climate change and extreme weather event impacts and adaptation into planning, operations, policies, and programs.
- **Eligibility of Activities To Adapt To Climate Change and Extreme Weather Events Under the Federal-Aid and Federal Lands Highway Program** (Sept. 24, 2012) – Memo clarifies activities eligible for FHWA funding, including vulnerability assessments, design and construction of projects or features to protect assets from damage associated with climate change.
- **MAP-21, Section 1315 – USDOT Final Rule on Categorical Exclusions (CE) for Emergency Repair Projects** (Feb. 19, 2013). Rule revises the existing CE for emergency repair projects under Moving Ahead for Progress in the 21st Century Act (MAP-21).
- **MAP-21, Section 1511 – Special Permits During Periods of National Emergency Implementation Guidance, Revised** (June 2013). Section provides policy direction on special permits for divisible loads and guidance describing the program's purpose, permit requirements, and ineligible activities.

WEBSITES

- **AASHTO Transportation and Climate Change Resource Center:** Extreme Weather Symposium, 2013. Materials on recent extreme weather events, costs, and how DOTs can manage them. climatechange.transportation.org/symposium/
- **FHWA Climate Change Adaptation Website:** www.fhwa.dot.gov/environment/climate_change/adaptation/
- **Center for Climate and Energy Solutions:** Interactive map depicting extreme weather events, 1990-2013. www.c2es.org/science-impacts/maps/extreme-weather

OTHER RESOURCES

AASHTO's Resilient and Sustainable Transportation Systems (RSTS) Technical Assistance Program provides timely information, tools, and technical assistance to State DOTs to manage challenging issues associated with extreme weather events. (http://climatechange.transportation.org/about/technical_assistance_program.aspx)

For questions or for more information, please contact Patrick Zelinski, Engineering Operations Specialist at PZelinski@aashto.org or Shannon Eggleston, Program Director for the Environment at SEggleston@aashto.org.

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[i] "Disaster events" in this context have been defined as tropical cyclones (e.g., hurricanes), droughts/heatwaves, severe local storms, non-tropical floods, winter storms, wildfires, and freezes.

[ii] Smith and Katz, Natural Hazards, June 2013, Volume 67, Issue 2, pp. 387-410.

[iii] Source**:** NOAA NCDC at www.ncdc.noaa.gov/billions/summary-stats