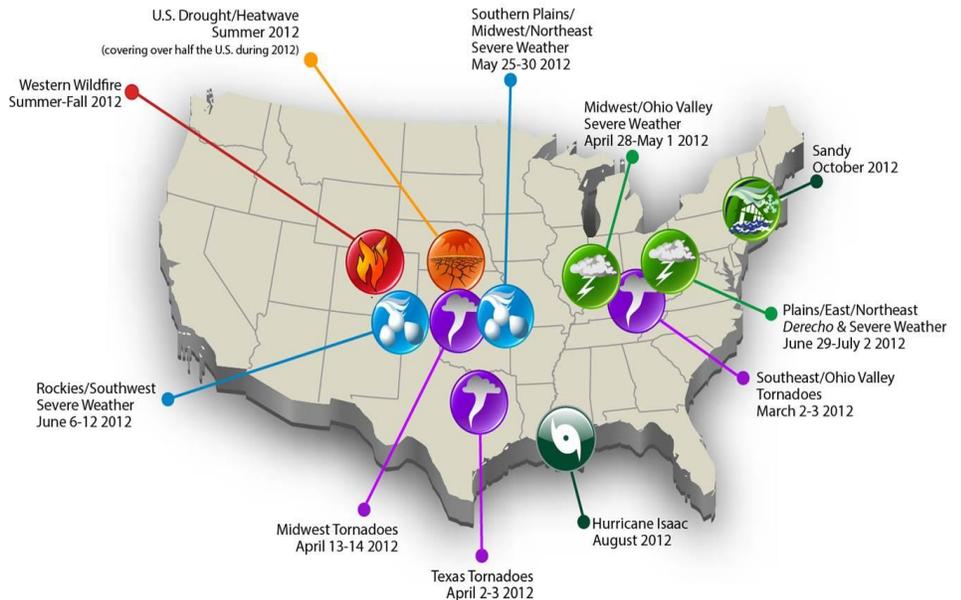




How Do Extreme Weather Events Impact Freight and Passenger Transportation?

Extreme weather events affect nearly every state in the U.S. In 2012, for example, a total of 133 disaster eventsⁱ occurred resulting in about \$881 billion in damagesⁱⁱ (see NOAA NCDC graphicⁱⁱⁱ at right). Events ranged from hurricanes, droughts, heat waves, severe local storms, non-tropical floods, and winter storms, to wildfires and freezes. Transportation system managers and operators are often at the front line preparing for and managing the impacts of these events. Examples of impacts are reduced construction hours, 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.

U.S. 2012 Billion-dollar Weather and Climate Disasters



How Can Transportation Agencies 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 planners and infrastructure, operations, emergency, and environmental managers and staff to better prepare for extreme weather.

1. **Vulnerability Assessment:** 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.
2. **Operations Planning:** Monitor trends in extreme weather events over time, and adjust operations and maintenance plans to accommodate shifting trends as needed.
3. **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).
4. **Coordination:** 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.
5. **Infrastructure Design:** Incorporate extreme weather event trends in design processes. For example, prepare for higher-than-normal weather events by “hardening” infrastructure, or incorporate flexible or adaptive design concepts into project design.
6. **Emergency Management:** Have contingency plans for vehicle and capital preservation, power outages, floods, detours, debris clearance, and routing for overweight or disabled trucks - to include pre-approved contractors and funds. Operate effective evacuation routes in high risk areas.
7. **Siting:** Consider trends in extreme weather events and risk (e.g., floodplains) in project siting.
8. **Project Planning and Prioritization:** Include resilience to extreme weather events in project evaluation criteria.
9. **Asset Management:** Use risk-based asset management systems to track relevant information on extreme weather vulnerabilities to inform decision-making over time.
10. **Data Collection:** Develop and track performance metrics related to extreme weather (e.g., number/duration of weather-related road closures).





Transportation 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.
- **Planning for Systems Management & Operations as part of Climate Change Adaptation** (FHWA, March 2013). This white paper presents effects associated with climate trends and events, how those effects will impact transportation system management and operations, and how agencies can assess the vulnerability of transportation systems and proposed changes to make its operations more resilient to climate change.
- **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 Shannon Eggleston, Program Director for the Environment at SEggleston@aaashto.org.

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