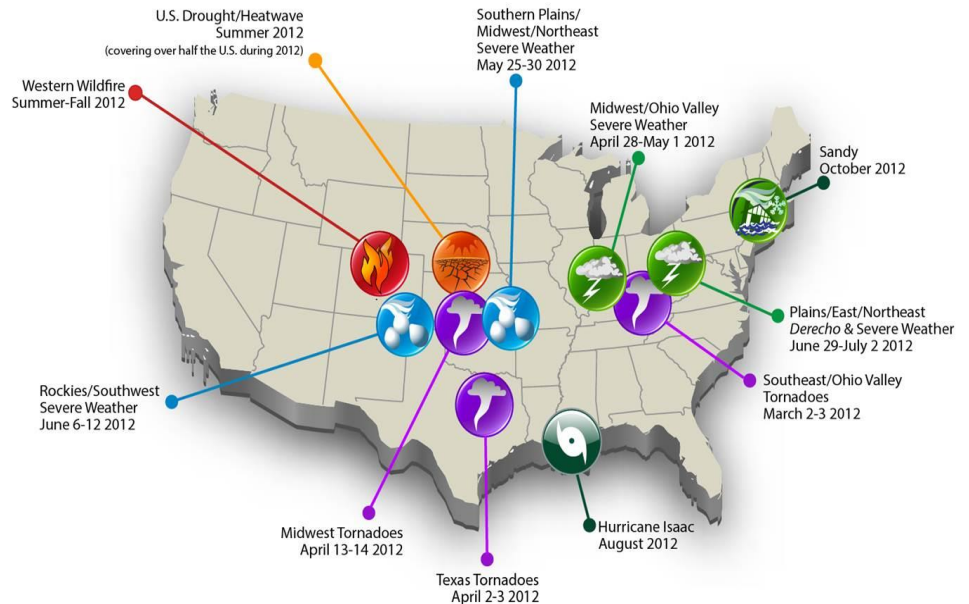




## Extreme Weather Events and Potential Impacts on Construction

Extreme weather events affect nearly every state in the U.S. In 2012, a total of 133 disaster events<sup>i</sup> occurred resulting in about \$881 billion in damages<sup>ii</sup> (see NOAA NCDC graphic<sup>iii</sup> at right). Events ranged from hurricanes, droughts, heat waves, severe local storms, non-tropical floods, and winter storms, to wildfires and freezes. 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. Changes in the frequency or intensity of extreme weather could require changes in construction schedules or materials. For example, how does one plan for the construction of transportation infrastructure differently provided changes in weather-related stressors like increased temperatures, precipitation, freeze-thaw cycles, wind or storm exposure?

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



## How Can Construction Managers and Staff Prepare for Extreme Weather Events?

Although DOT experience will vary by state, below is a “Top 10” list of construction suggestions to better prepare for extreme weather.

1. **Construction Season:** Consider the implications of a longer construction season on project phasing and workforce utilization.
2. **Construction Needs:** Anticipate the need for more emergency construction-related projects due to increased asset damage from extreme weather events.
3. **Construction Scheduling:** Encourage more night/cooler weather work to reduce equipment failures due to electrical malfunctions and overheating and to prevent damage such as slab curling, premature cracking, loss of air entrainment in concrete pavements, rutting, and flushing in asphalt pavements.
4. **Construction Site Safety:** Utilize contract provisions to safeguard construction workers against extreme weather conditions (e.g., extreme temperatures, precipitation, etc.). Consider night work to minimize worker exposure to extreme temperatures. Also consider stronger specifications for dust control and wind erosion.
5. **Contingency Plans:** Have contingency plans for power outages, detours, debris clearance, and routing for overweight or disabled trucks - to include pre-approved contractors and funds. Consider stronger specifications that require contractor response plans for work zones impacted by high intensity storms.
6. **Resilient Power Supply:** Increase resiliency of power supply and electrical equipment by protecting or relocating equipment out of harm’s way.
7. **Back up Communications:** Prepare backup communications such as satellite phones, portable highway advisory radios, truck radios, and alternative networks.
8. **Work Zone Safety:** Plan for more extreme weather events as they affect the movement of traffic through a work zone (e.g., wind effects on signs, more standing water on the road surface, etc.). Address possible changes in erosion and sediment control approaches to protect construction sites.
9. **Workforce Training:** Greater cross-training of staff, perhaps from across the agency, so that the ability to adapt and mobilize for emergency situations is enhanced.
10. **Future Protection:** Consult with designers about more durable materials and designs (e.g., paints, paving materials, drainage features) with consideration for likely future conditions (e.g., higher temperatures, increased rainfall intensities). Incorporate materials whose performance is less variable in weather extremes.





## Construction 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.
- **Expedited Procurement Procedures for Emergency Construction Services** (NCHRP Synthesis 438, Nov. 2012). This report explores procurement procedures being utilized by State DOTs in coordination with Federal agencies to repair and reopen roadways in emergency situations.
- **Response to Extreme Weather Impacts on Transportation Systems** (NCHRP Synthesis 454, May 2014). This report examines eight recent cases of extreme weather in the United States from the perspectives of transportation operations, maintenance, design, construction, planning, communications, interagency coordination, and data and knowledge management.
- **Climate Change Adaptation and Canadian Infrastructure** (International Institute for Sustainable Development, Nov. 2013). This report summarizes climate impacts and risks for key infrastructure types, tools, and approaches to support climate resiliency. Construction-related impacts and adaptation strategies, including materials, are also discussed.
- **Transportation Research Record Journal No. 2292: Maintenance and Preservation** (Dec. 2012). This journal is a compilation of 20 research papers on roadway maintenance and preservation-related topics including maintenance costs of extreme weather events, climate impact on asphalt pavement preservation, and carbon emissions of road maintenance.
- **Western Iowa Missouri River Flooding – Geo-Infrastructure Damage Assessment, Repair, and Mitigation Strategies** (Aug. 2013). The Center for Earthworks Engineering Research report addresses the effects of the 2011 Missouri River flooding on Iowa's geo-infrastructure systems (e.g., levees, bridge abutments and foundations, paved and unpaved roadways, culverts and embankment slopes) and offers 20 potential repair and mitigation solutions related to damage type.

### GUIDANCE AND RULES

- **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/](http://climatechange.transportation.org/symposium/)
- **FHWA Climate Change Adaptation Website:** [www.fhwa.dot.gov/environment/climate\\_change/adaptation/](http://www.fhwa.dot.gov/environment/climate_change/adaptation/)
- **Emergency Management Assistance Compact (EMAC):** <http://www.emacweb.org/>
- **Center for Climate and Energy Solutions:** Interactive map depicting extreme weather events, 1990-2012. [www.c2es.org/science-impacts/maps/extreme-weather](http://www.c2es.org/science-impacts/maps/extreme-weather)

### OTHER RESOURCES

**AASHTO's Sustainable Transportation: Energy, Infrastructure, and Climate Solutions (STEICS) 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/steering\\_committee.aspx](http://climatechange.transportation.org/about/steering_committee.aspx))

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<sup>i</sup> "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.

<sup>ii</sup> Smith and Katz, *Natural Hazards*, June 2013, Volume 67, Issue 2, pp. 387-410.

<sup>iii</sup> Source: NOAA NCDC at [www.ncdc.noaa.gov/billions/summary-stats](http://www.ncdc.noaa.gov/billions/summary-stats)