Extreme Weather Events

DOT Lessons Learned

For the Resilient & Sustainable Transportation Systems Program

MAY 2017
What is resiliency?

**AASHTO Definition:**
The ability to prepare and plan for, absorb, recover from, or more successfully adapt to adverse events.
Considering Resilience in Planning and Policy

Prioritization Criteria
How do weather events impact state DOTs?

Extreme weather events involve impacts that are specific to a single event or series of events - and the number of events may increase with climate change.
How do weather events impact state DOTs?

DOTs can be impacted in the following ways:

- Accelerated degradation of assets
- Short-term intensive demand on staff and other resources
- Impacts on communication and effectiveness
How do weather events impact state DOTs?

**DOTs can be impacted in the following ways:**

- Concentrated interaction and partnerships with numerous agencies and groups
- Long-term questioning of how to incorporate risk into decision making
- Image and perception of the agency handling disruptions (perception of agency effectiveness)
Project Overview

- How have DOTs responded to recent extreme weather events?
- What are the lessons learned from these events?
- What policies should DOTs put in place to better prepare for future weather events?
- Knowledge sharing among DOTs can create new frameworks for policies that can mitigate the impacts of extreme weather events
Case Studies

- California Flooding and Landslides
- Colorado Wildfire, Flooding and Landslides
- Florida Tropical Storms
  ✓ Georgia Ice Storm
  ✓ Louisiana Flooding
- Minnesota Riverine Flooding
  ✓ North Carolina Flooding
- Oklahoma Tornadoes
- South Carolina Flooding
  ✓ Vermont Flooding and Washouts
Case Study Overviews

- Vermont
  Hurricane Irene
- Georgia
  Atlanta Ice Storm
- North Carolina
  Hurricane Matthew
- Louisiana
  2016 precipitation events
Vermont Case

Hurricane Irene was a tropical cyclone that hit the U.S. in 2011, which caused almost every river and stream to flood in Vermont, and ranked overall as the seventh-costliest hurricane in U.S. history.
Vermont Case

- Roads and bridges washed out **statewide**
- **11 communities** were stranded from road damage
- **$733 million** in damages statewide
Vermont Case

Preliminary Findings

- Created the Irene Innovation Task Force after the storm to highlight positives and negatives of response
- Promote streambed stabilization
- Update bridge design criteria to include flooding resiliency
- Use cross-functional teams and recruit young talent
- Develop emergency management systems prior to events, with roles and responsibilities pre-defined

Turn bridge, Vermont 2011
Georgia Case

A rare ice storm in 2014 was one of the worst to hit the Atlanta region in decades, with changes in weather forecasts throwing the region off guard.
Georgia Case

- Deposited **3 to 5 inches of ice** on the road network throughout the region
- **Tens of thousands** of cars were abandoned on roadways
- **800 traffic accidents** were reported in Atlanta
- **Insufficient** salt supplies to cover the highway network

*Atlanta Airport and Interstates, Georgia 2014*
Georgia Case

Preliminary Findings

- Placing operations in charge of response (instead of maintenance) was a key change post event
- Internal communications that are consistent and compatible with partner organizations are critical
- Publicize any mistakes made and how they will be addressed after the event
Georgia Case

Preliminary Findings

- Plan ahead in order to acquire supplies on an emergency basis
- Media is an important partner in relaying information to the public, but can make matters worse if inaccurate
- Coordination with local jurisdictions was, and still is, one of the greatest challenges
North Carolina Case

In October, 2016 Hurricane Matthew reached the Carolina coast, causing significant flooding. Forecasters were caught off guard, expecting mostly a wind event with impacts limited to coastal areas.
North Carolina Case

- **8 inches** of rainfall caused rivers and basins to flood quickly
- **1,600** roads were flooded
- **Several dams** in the state were threatened as a result of the rainfall and erosion
- The storm resulted in **26 fatalities**, many involving individuals who drowned in automobiles
- Property damage in the state was estimated at **$16 billion**
North Carolina Case

Preliminary Findings

- Coordinating and planning for road detours during an extreme weather event is a challenge, as in-car GPS routing systems do not recognize state detours
- Road detour signs and barriers were ignored by some drivers, leading to drownings in certain cases
- Interdepartmental and inter-agency communication and coordination across the state is key
- Agreements and policy coordination with neighboring states would also be helpful
Louisiana Case

Major 500 and 1,000 year floods in March and August of 2016 caused rivers throughout the state to reach record levels as rainfall exceeded 2-3 inches per hour, and nearly two feet in total in some areas.

Denham Springs, Louisiana 2016
Louisiana Case

- **58 parishes** were declared disaster areas
- In 2016, **every interstate** in Louisiana **was closed** at some point due to severe flooding
- Flooding of the Sabine River **closed I-10 for days** at the Texas / Louisiana border; a lack of nearby alternate routes caused lengthy detours for drivers
- Significant development in flooded areas made impacts worse
Louisiana Case

Preliminary Findings

- Communicating to the public via social media is imperative. “Old ways” like radio are less effective
- Many LaDOTD staff experienced personal emergencies as a result of the floods which strained their capacity to respond at LaDOTD
- Relationships with other federal agencies (not just DOT) is important for disaster planning and response
Louisiana Case

Preliminary Findings

- In response to the extreme weather events, the LaDOTD has prioritized efforts to map waterways and watersheds so as to create a better model that can inform decision making.

- Approaches to design or response decisions needs to be re-considered given the reality of “500” or “1000-year” events in the same year.
Cross Cutting Findings

We found three key categories:

<table>
<thead>
<tr>
<th>EMERGENCY RESPONSE</th>
<th>PLANNING AND DESIGN</th>
<th>EXTERNAL COORDINATION</th>
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</table>
| Roseau Flood Risk Management  
Montana, 2015       | Charlotte Hurricane Irene Response  
North Carolina, 2011 | Clearing taxiways at Atlanta Airport  
Georgia, 2014       |
Emergency Response

- Disaster assistance agreements with neighboring state DOTs should be formalized ahead of time
- DOTs should have a close relationship with first responders, especially the state police
- Enforcement of road closures can be a challenge – new approaches may be needed
- Equipment tracking with GPS can be key to a better response
- Develop emergency mgmt. systems ahead of time and be mindful of admin/IT support
- Put cost-accounting measures in place now as they are a key to financial resiliency
Planning and Design

- Bridge design criteria should include the ability to withstand higher levels of flooding
- Consider more intensive use of rip rap along river banks prone to flooding
- Stream stabilization should be promoted in high risk areas

- Don’t locate emergency management facilities in high risk locations
- River management principles should be institutionalized amongst planners, design engineers, and other key staff as policy
External Coordination

- Land use and dam maintenance are often out of the control of DOTs and can affect roadway flooding.
- The DOT also does not have control over when large institutions close during emergency events, which can compound with other issues.
- Publicize the impacts, how they were addressed, and the next steps to be taken.
- The National Guard may be available to assist but the communication methods are different and need to be considered.
Next Steps, Work Products and Schedule

- **Ongoing:** Interviews with additional DOTs
- **June 30:** Final Report with Case Studies
Thank you

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