Emergency Evacuation and ITS - weather and special events: 
Plan, implement, post-event assessment

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Overview of Presentation

- Explore the weather and climate challenge
- Describe how our current efforts provide a solid foundation for highway operations
  - Highlight the role of ITS
- Consider the emerging changes and how we could respond
- Define agency considerations and next steps
Crash History Under Adverse Weather

Total Annual Crashes
Average = 6,301,000

Weather Related Crashes
By Road Weather Condition*

Other Crashes 76%
Weather Related Crashes 24%

Wet Pavement 75%
Icy Pavement 13%
Snow/Slushy Pavement 11%
Fog 1%

Source: Road Weather Management Program, Table: Weather-Related Crash Statistics (Annual Averages), Available at: http://www.ops.fhwa.dot.gov/weather/q1_roadimpact.htm
Weather-related Costs

• Direct costs to State DOTs are:
  - $2 billion/yr on snow and ice control
  - $5 billion/yr on snow & ice infrastructure repairs

• Indirect costs in terms of travel time delay for...
  - all travelers is $11.6 billion/yr from snow/ice/fog
  - the freight community is $8.7 billion/yr nationwide;
    $3.1 billion/yr in the 50 largest cities

• Considering lost wages, taxes and retail sales of a one-day shutdown, the costs are estimated to be $3.8 billion across 15 northern states
Significant Weather & Climate Events in 2008

- **SNOW**
  Record snowfall in parts of MT, WY and ID (Oct)

- **TEMPERATURE**
  The 2008 national average temperature was the coolest since 1997

- **WINTER STORMS**
  Ice storm leaves a million homes and businesses without power, series of snow storms follow (Dec)

- **DROUGHT**
  Moderate to severe drought in much of West

- **SEVERE STORMS**
  2008 was one of the top 10 years for tornado-related fatalities since reliable records began in 1953

- **WILDFIRES**
  Severe fires driven by high temperatures, dry conditions, and strong Santa Ana winds destroy hundreds of dwellings

- **WET**
  Heavy rain and flooding across Midwest (Jun)

- **DROUGHT**
  Extreme to exceptional drought conditions in the Southern Plains

- **SNOW**
  Second highest winter (2007-08) snowfall in Bethel, Second snowiest season in Nome

- **HURRICANES**
  16 named storms in Atlantic Basin - 2 tropical storms and 4 hurricanes make landfall

- **WET**
  Heavy rains and flooding - Hilo sets new daily rainfall record - 11 inches (Feb)

- **IKE**
  Hurricane Ike and its remnants cause havoc in TX and Midwest (Sep)

- **TS FAY**
  First storm to make 4 landfalls in one state (FL - Aug), parts of FL receive over two feet of rain
Billion Dollar Weather Disasters

1980 - 2011

Not to scale

Puerto Rico - 4
Hawaii - 1
Virgin Islands - 3
Alaska - 3

NUMBER OF EVENTS

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ITS World Congress 2012
Billion Dollar Weather Disasters

The graph shows the number of events and the cost associated with billion-dollar weather disasters over the years from 1980 to 2012. The cost is represented by blue bars, while the CPI-adjusted cost is represented by red bars. The number of events is represented by light blue bars, and the CPI-adjusted number of events is represented by red dotted bars. The graph highlights the increase in both cost and the number of events in recent years, particularly a peak in 2004.
Complete Failure
Results in total loss or ruin of asset. Asset may be available for limited use after at least 60 days and would require major repair or rebuild over an extended period of time.

“Complete and/or catastrophic failure” typically involves:

- Immediate road closure
- Travel disruptions
- Vehicles forced to reroute to other roads
- Reduced commerce in affected areas
- Reduced or eliminated access to some destinations

May sever some utilities. May damage drainage conveyance or storage systems.

Temporary Operational Failure
Results in minor damage and/or disruption to asset. Asset would be available with either full or limited use within 60 days.

“Temporary operational failure” typically involves:

- Temporary road closure, hours to weeks
- Reduced access to destinations served by the asset
- Stranded vehicles

Possible temporary utility failures.

Reduced Capacity
Results in little or negligible impact to asset. Asset would be available with full use within 10 days and has immediate limited use still available.

“Reduced capacity” typically involves:

- Less convenient travel
- Occasional/brief lane closures, but roads remain open
- Some vehicles may move to alternate routes.
Proactively Operating the Transportation System Requires:

- Real-time and forecasted information
- Measuring / monitoring performance
- Good analytical foundation / tools
- State of the art technologies and strategies
- Integration across system elements, jurisdictions, and modes
- An organization and workforce capable of managing all of the above
The Role of ITS

• ITS encompasses managing the transportation system for ever-changing conditions, including:
  - Incident and Emergency Management
  - Active Traffic and Demand Management
  - Integrated Corridor Management
  - Road Weather Management

and all the supporting technologies and institutional relationships to make them work.
Road Weather Management

Maintenance Decision Support System
Emerging Changes to the System

- Our work today is based on current conditions
- What happens when the climate changes?
  - What are the impacts to highway operations if there’s an increase in coastal flooding?
  - What are the impacts to highway operations if we experience more icing events instead of snow events
  - Or what if we have more frequent and severe thunderstorms and flash floods?
Responding to the Changes

We are exploring the climate effects, the transportation impacts of these effects, and the potential responses for the following sectors:

- System Maintenance
- System Operations
- Travelers (including Traveler Behavior)
- Freight Transportation
Climate Change Effects and Potential Responses: System Maintenance

• Shifting rain/snow/ice line will mean...
  - Changes in resource needs (e.g., less snow fighting, more ice fighting, more flooding)
  - Altered construction and maintenance schedules
• Increased frequency, duration and intensity of droughts
  - Changes in vegetation management
• Increased coastal and inland flooding
  - Increased and more frequent use of resources (e.g., staff, evacuation materials)
• Increase in magnitude & duration of severe heat waves
  - Altered construction and maintenance schedules
  - Deploy “quick maintenance” patrols to address potholes and buckling issues
Climate Change Effects and Potential Responses: System Operations

- Increased coastal and inland flooding will mean...
  - Increased and more frequent use of resources (e.g., staff, evacuation materials)

- Increase in intensity of tropical cyclones, rising sea levels, increased occurrence of wildfires
  - Broader preparedness for potential evacuation
  - Increase TMC staff and ITS resources to provide traveler information during evacuations
  - More frequent disaster preparation, operations and recovery

- Increase in energy demand
  - Need for more resilient TMC communications and ITS hardware
Climate Change Effects and Potential Responses: Travelers & Traveler Behavior

- Increased exposure to hazardous driving conditions (e.g., flooding, road conditions, smoke from wildfires) and human health impacts
  - Increased need for timely, accurate and relevant traveler information from TMC’s and private sector information service providers to support route & mode choice, departure times
  - Less consistent mode split impacting day-to-day congestion and safety issues
  - Potential mode shift to/from alternate modes, e.g., using transit, biking, or walking
  - Increased emphasis on carpooling and teleworking to reduce impacts to highways
Climate Change Effects and Potential Responses: Freight Transportation

- Increased frequency, duration and intensity of droughts; increased coastal and inland flooding
  - Restricted access to ports and shipping channels for inland waterways
  - Mode shift - e.g., from inland waterways to highways due to changes in reliability

- Increase in magnitude & duration of severe heat waves
  - Mandatory freight diversion to more robust alternate routes
  - Dynamic or seasonal restrictions for trucks or rail during times of high heat, reducing either acceptable speed or weight
  - Policy and regulation changes to restrict truck size and weights
Framing the Questions: Agency Considerations

• What can we do to improve our abilities to manage the system?
  - Build more robust, resilient and flexible Intelligent Transportation Systems
  - Integrate sophisticated weather & road condition information into transportation operations centers
  - Establish greater inter- and intra-agency cooperation, especially for resource/asset management and resource allocation
  - Examine Standard Operating Procedures for rapid mobilization and deployment
  - Cross-train staff, especially for unusual events
Our Next Steps

• Information sharing across agencies and countries
  - Work with the weather and climate communities to better understand the emerging changes
• Capture the state-of-the-practice
• Conduct gap analyses
  - Technical capabilities
  - Institutional capabilities
• Explore more formal ways to incorporate risk and uncertainty