How Can DOT Operations and Maintenance Prepare for Extreme Weather Events?

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Michigan’s Climate

Four Distinct Seasons
Michigan Facts

• Over 3,000 Miles of Shoreline
  (2nd Only to Alaska)
• Over 100,000 Miles of Roadway
• Over 10,000 Bridges
• 98 Islands
• Over 11,000 Inland Lakes
• At any Point in Michigan, you are never more than 85 Miles away from one of the Great Lakes
Michigan’s Climate Risks

- Change Level and Temperature of the Great Lakes
  - Risk to Tourism, Shipping, and Fishing
Michigan’s Climate Risks

- Impacts Local Weather Patterns
  - Potential for More Snow in Lake Effect
  - Less Ability to Moderate Weather
Michigan’s Climate Risks

- More Frequent and Intense Rain Events
  - Washout of Transportation Infrastructure
- Increased Frequency of Freeze/Thaw Cycles
Michigan’s Climate Risks

• Increased and Prolonged Summer Temperatures Extremes
  – Both Will Deteriorate Roads More Rapidly

• Changes to Maintenance Needs
Michigan’s Climate Risks

- Stress on Indigenous Vegetation and Wildlife
- Invasive Species More Tolerant of a Changed Climate
- Higher Incidence of Wildfires
What To Do

• Continue to Develop Asset Management Databases
• Data Will be Used to Identify Potential Risks
• Ideal Situation Would be to Have a set of Areas/Infrastructure That is at Greatest Risk
• Address These Risks Through Regular Transportation Program Process
What To Do (continued)

• Research Program in 2012 to Assess Available Climate Models, Compare Them to Asset Management Data and Prepare set of Infrastructure at Most Risk for Climate Change

• Looking for Research Conducted on Regional Climate Change Impacts
What Do These things Mean for Highway Operations? (Design, Construction, Systems Operations, and Maintenance)
Climate Change Design Considerations

• More Intense Storms – Strategy: Design Assets That are Less Impacted by the Effects of Climate Change
• Larger Hydraulic Openings for Bridges over Waterways
• Heavier and Lengthier Armoring of River and Stream Banks and Ditches to Prevent Erosion
• Investigate Greater Pavement Crowns to Move Runoff off of Pavement Quicker
Design Considerations (Intense Storms)

• Design of Additional in-system Detention to Meter Runoff Outflow

• Eliminate Bridge Design Elements That Could Make a Bridge Scour Critical
  – i.e. Piers in the River, Spread Footings, use More Sheet Piling Left in Place

• Design Terraced Vegetated Slopes Using a Variety of Plant Species
Design Considerations (Intense Storms – Cont’d)

• Design More Robust Pavement Markings That can be Seen During Wet/Night Conditions

• Larger Capacity Pumps/Pumping Stations for Below Grade Freeways to Prevent Flooding
Design Considerations (Hotter Drier Summers)

Strategy: Design Tougher, More Resilient, Lower Maintenance Roadways, Bridges, Facilities, and Roadsides

• Design Lower Maintenance Bridge Expansion
• Design Seed/Vegetation Mixtures That Create a Denser, Deep-rooted Vegetation Mat that is More Erosion Resistant
Design Considerations (Hotter Drier Summers – Cont’d)

- Eliminate Monoculture Roadside Vegetation Designs That may not Survive Extended Drought Periods or Invasive Species Attack

- Ensure all Roadside Building Designs are LEED Certified or Modified to be Energy Efficient
Climate Change Construction Considerations

- More Intense Storms – Strategy: protect motorists, workers, and the environment from hazards created in work zone by strong weather events
- Stronger specifications for protection of work under construction
Climate Change Construction Considerations (Cont’d)

• Stronger Specifications that require contractor response plans for work zone impacted by high intensity storms
Construction Considerations (Hotter and Drier)

Strategy: Protect Work in Progress From the Effects of Higher Temperatures for Both Short-term and Long-term Durability

- Encourage More Night/Cooler Weather Work to Prevent Damage Such as Slab Curling, Premature Cracking, Loss of Air Entrainment in Concrete Pavements, Rutting, and Flushing in Asphalt Pavements
Construction Considerations (Hotter and Drier – Cont’d)

• More Closely Monitor Moisture in Aggregate Piles
• Incorporate Materials Whose Performances are Less Variable in Weather Extremes
• Modify Vegetation Planting Periods to Ensure Optimal Growth and Survival
Construction Considerations (Hotter and Drier – Cont’d)

- Stronger Specifications for Dust Control and Wind Erosion
- Worker Safety During Extreme Heat Periods Must be Addressed
Climate Change
System Operations & Maintenance

More Intense Storms - Strategy:
Use Best Practices to Keep Transportation Infrastructure Operating as Safely and Efficiently as Possible During Increased Frequency and More Intense Winter Storms

• Increased Deployment and use of Roadway Weather Information Stations (RWIS) to Effectively Plan and Respond to Winter Storms
More Intense Storms (System Operations)

• Keep Motorists Informed of Hazardous Conditions/Roadway Closures Using Appropriate Technology (Changeable Message Boards, Etc.)

• Develop Stronger Contingency Response Plans for Extraordinary Winter Storms
System Operation and Maintenance Considerations – More Intense Storms

- Monitor potential hazard of snow accumulation during a more frequent storm period along barriers and plan for routine removal
- Create an appropriate winter maintenance budget that reflects the cost of responding to numerous and intensive storms in a manner that meets public expectation
System Operation and Maintenance Considerations – More Intense Storms (Cont’d)

• Create a Detailed Economic Model That Speaks to the Societal Costs of Delayed or Inappropriate Response to Winter Storms

• Routine Maintenance Items Such as Ditch and Drainage Structure Cleanout Must be Emphasized to Avoid Failure During an Intense Rainfall Event
System Operation and Maintenance Considerations – More Intense Storms (Cont’d)
System Operation and Maintenance Considerations – More Intense Storms (Cont’d)

- Monitor and clean, as needed, bike lanes, shoulders, and non motorized trails in vertical curve sag areas.
- Siltation, gravel, and other debris that present serious hazards to bicyclist may accumulate after winter plowing and heavy rainfall events.
System Operation and Maintenance Considerations – Hotter and Drier

Strategy: Use Best Practices to Keep Roadways and Roadsides in a Safe and Aesthetically Acceptable Condition During the Heat of Summer

- Make Sure Vegetation is Managed Appropriately During Drought Periods Near Roadsides That are Susceptible to Wildfires
- Monitor and be Ready to Respond Quickly to Pavement “Tenting” due to Excessive Heat
System Operation and Maintenance Considerations – Hotter and Drier (Cont’d)

- Monitor Health of Vegetation in Right-of-way That may be Stressed due to Extreme Weather or Invasive/New Northerly Migrating Insect Species and Remove/Replace, as necessary
Shore Rescission on Lake Superior

- Lower Lake Levels Have Exposed Softer Limestone Layers to More Intense Wave Action
- This has Caused Undermining and the Need to Relocate a Portion of US-41 Over 400’ Westward
Questions