



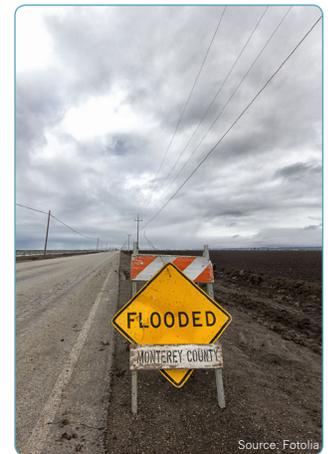
Transportation System Resilience to Extreme Weather and Climate Change

Resilience: The ability to prepare for changing conditions and withstand, respond to, and recover rapidly from disruptions.

The ability of transportation agencies' to effectively manage, operate, and maintain a safe, reliable transportation system is being threatened by a changing climate. Extreme weather events are becoming more frequent and intense due to climate change, and long-term climatological trends are slowly but inexorably changing how transportation systems need to be

planned, designed, operated, and maintained. A "new normal" is evolving and State departments of transportation (DOTs) are turning their focus toward building resilience.

Climate change will necessitate adjustments by DOT transportation systems management and operations (TSMO) and maintenance programs to ensure the resilience of activities such as traffic monitoring and management, providing traveler information, traffic incident management, and maintenance management.



Climate Change is a Business Risk

Climate change risks are not yet well-understood by TSMO and maintenance staff. Many agencies are observing changes, however. Agencies able to continually evolve practices with minimal interference to achieving their mission will be best positioned to execute a climate-sensitive approach to TSMO and maintenance. Additionally, TSMO and maintenance workers as well as DOT emergency responders with whom they coordinate are well aware that they will be the public face and the front-line of the response.

By understanding the risk and assessing the vulnerability of their operations, agencies can avoid being caught off-guard when a significant weather event threatens to overwhelm their capabilities.



Example Climate Change Impacts to TSMO and Maintenance Programs

- Increased frequencies of extreme events require additional personnel to monitor, control, report, and respond to events.
- Changes in long-term climate trends may change seasonal work requirements (e.g., changes in winter weather seasons, construction timing, or landscaping timing) and additional or unique staff expertise to monitor and respond to new types of climate events (e.g., snow storm in Atlanta).
- Increases in temperature can increase annual pavement maintenance costs, and changes in freeze/thaw cycles can increase potholes.
- Objectives and performance measures relating to emergency response or return to level of service may be affected by the frequency and severity of extreme events.
- Bridges with joints and moveable parts are more susceptible to damage due to their sensitivity to temperature and water infiltration. As a result, affected bridges may need to be closed and traffic may need to be re-routed.

Examples of Strategies to Improve Today and Prepare for Tomorrow

- Increase the availability of contract staff to assist during extreme events. Develop memorandums of understanding (MOUs) with other agencies for equipment and staff sharing during extreme weather events.
- Increase tracking of costs incurred to respond to specific extreme weather events.
- Revise budgeting process and protocols to account for recent trends that may diverge from the historical baseline.
- Include consideration of future stressors (e.g., flooding or accelerated sea level rise) when making decisions about siting equipment.
- Consider the life-cycle costs of resiliency investments and savings in budgeting and design.

What Actions Will Increase Resilience?

Adapting TSMO and maintenance programs is largely about improving capability rather than a major technology development and deployment initiative. Many TSMO and maintenance adaptations will be the “low-hanging fruit” to prepare DOTs for climate change, in contrast to necessary changes to infrastructure design. For example, many of the technology elements used to support safety, congestion mitigation, and traveler information objectives are already in place. To adapt to climate change, agencies need to consider how these existing capabilities that already help to improve operations and reliability need to evolve to meet the new and emerging requirements of a changing climate.

Getting Started

The *Climate Change Adaptation Guide for Transportation Systems Management, Operations, and Maintenance* provides the rationale and specific guidance for integrating the capability for climate change adaptation and extreme weather response into TSMO and maintenance programs. It also articulates why doing so will lead to greater sustainability. The guide provides resources to help agencies:

- Self-evaluate where practices need to be altered to enhance resiliency to climate change.
- Identify what changes need to be made.
- Assess the benefits and co-benefits of making those changes.
- Map out the changes in capabilities that need to be taken to implement them.

For More Information

Download the FHWA *Climate Change Adaptation Guide for Transportation Systems Management, Operations, and Maintenance* at <http://www.ops.fhwa.dot.gov/publications/fhwahop15026/index.htm>.



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