FTA RESEARCH
FEDERAL TRANSIT ADMINISTRATION

REPORT SUMMARY

U.S. Department of Transportation
Federal Transit Administration

Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation

Background

Climate change impacts such as heat waves and flooding will degrade transit assets and services while hindering agencies' ability to achieve key goals such as attaining a state of good repair and providing reliability and safety.

Objectives

The objective of this project is to provide transit professionals with information and analysis relevant to adapting U.S. public transportation assets and services to climate change impacts.

Findings and Conclusions

Impacts will vary, but all regions and public transportation systems, large and small, will be affected by climate change. The most disruptive near-term impact is likely to be intense rainfall that floods subway tunnels and low-lying facilities, bus lots, and rights of way. Heat waves will stress materials, buckle rails, and jeopardize customer and worker safety and comfort. In the longer term, rising sea levels, compounded by worsening storm surges, will threaten assets in many coastal areas. Landslides, heavy snowfall, wildfires, droughts, and power blackouts also pose threats. Persons with disabilities, the elderly, and low-income individuals – groups who disproportionately depend on public transportation – will suffer disproportionately from disruptions and degradation in service. Transit agencies will also be called upon to provide evacuation services in response to more frequent extreme events.

Recent extreme weather events are consistent with observed climate trends and as such, the transit impacts associated with these incidents offer illustrations. For example: In Vicksburg, Mississippi, river flooding from heavy rains in spring 2011 forced transit providers to shutter routes and relocate paratransit operations. In New York, heavy rainfall in 2007 shut down 19 major segments the subway system, flooding the third rail and affecting two million customers. Heat waves in New Jersey and Los Angeles stretched overhead catenary, disrupting power supply to rail vehicles while heat waves in Boston and Washington, DC necessitated that transit agencies replace sections of rail that had buckled in the heat. Electronic train control equipment and farebox machines in Portland overheated during high-heat days in the historically mild Pacific Northwest. Hurricane Katrina's storm surge devastated transit agencies along the Gulf Coast, flooding buses and depositing debris.

Risk assessment tools developed by governments and non-profits offer transit agencies guidance on how to prioritize climate risks by assessing the likelihood of occurrence and the magnitude of consequence. Taking a risk management approach mitigates risk without expensively over-engineering assets and maintains flexibility in the face of uncertainty.

While adaptation is a new issue for the transit industry, a handful of agencies have already begun work in the area. New York State Metropolitan Transportation Authority (MTA) found that a 100-year flood with a 4-foot rise in sea level would flood a large fraction of Manhattan subways, including virtually all of the tunnels crossing into the Bronx beneath the Harlem River and the tunnels under the East River. Responding to heavy downpours already being experienced, MTA built raised ventilation grates to prevent stormwater incursion. Waves Transit in Mobile, Alabama participated in a multi-modal climate vulnerability assessment while Los Angeles Metro and New Jersey Transit each began similar assessments in 2011. Portland's TriMet participated in a cross-sectoral adaptation initiative. The metropolitan planning organization for the San Francisco Bay Area is participating in a study of sea-level rise impacts on transportation infrastructure. Maps from the study show transit stations impacted as today's 100-year flood becomes tomorrow's high tide. Internationally, London's transit agency integrated climate risks into its asset management systems, and included protections against climate change induced flooding in the design of its major new rail construction project, Crossrail. A new commuter rail link in Istanbul, Turkey was built to withstand three feet of sea-level rise.

There are four broad categories of overall adaptation strategies: maintain and manage, strengthen and protect, enhance redundancy, and abandon infrastructure in extremely vulnerable areas. Strategies for responding to flooding in particular include moving vehicles and other mobile assets out of harm's way, preventing water incursion, improving drain maintenance and debris clearance, increasing pumping capacity, strengthening or raising bridges, and capturing stormwater with natural ecosystem approaches (for example Kansas City BRT's rain gardens). Strategies for responding to high heat include shade shelters, efficient air conditioning, heat-resistant or reflective materials, and worker/customer heat management plans.

Factors for success in transit adaptation efforts include: a high-level push from outside the agency, a champion or central point person for coordination, interdisciplinary seminars with engaging narratives, coordination with other infrastructure providers and government entities, reliance on existing climate data from reputable sources, and the embedding of climate change into existing work streams (asset management systems, emergency preparedness and response plans, the transportation planning process, and the project development process).

Benefits

Climate change adaptation is essentially responsible risk management. It involves planning for system preservation and safe operation under current and projected conditions, recognizing that hazard mitigation costs less than the damage from inaction. We hope this report provides a useful departure point to help place the transit industry on the track to climate resilience.

Project Information

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This research project was conducted by FTA staff, with Tina Hodges of the FTA Office of Budget and Policy serving as the primary author. For more information, contact Tina Hodges, at 202-366-4287, tina.hodges@dot.gov. All research reports can be found at **www.fta.dot.gov/research**