

Research at a Glance

Technical Brief

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**BUREAU OF
RESEARCH, INNOVATION
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NJDOT Multi-Hazard Design of Highway Bridges Recommendations

Introduction and Purpose

New Jersey's geographic setting exposes its bridge infrastructure to a wide range of environmental and human-driven risks, including coastal storms, sea-level rise, storm surge, riverine flooding, scour, extreme temperatures, and hazards associated with dense urban development, aging industrial corridors, and heavy freight traffic. Historical events such as Hurricane Sandy and the Philadelphia I-95 fire collapse underscore the need for resilient, adaptive, performance-based bridge design, demonstrating that damage to a single structure can trigger widespread disruptions to mobility, emergency response, supply chains, and the regional economy. Yet existing standards often address hazards in isolation, which may not reflect the compound and cascading risks bridges face when storm surge, wave action, debris impact, scour, fire, or collision occur together or in rapid succession. Accordingly, NJDOT is advancing a holistic multi-hazard framework that explicitly considers these interactions, aligns design decisions with defined performance objectives, and supports the long-term safety, functionality, and resilience of New Jersey's bridge

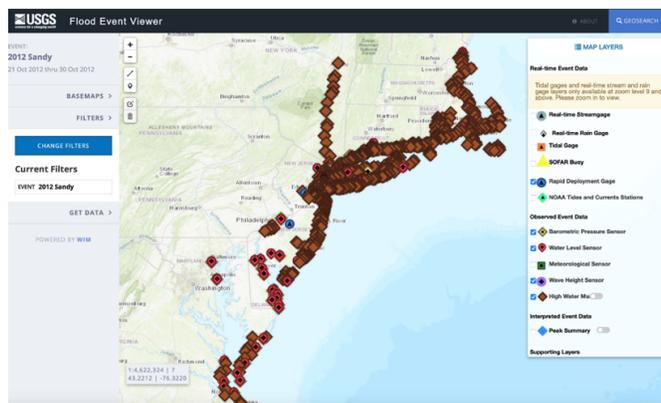


Fig. 1. USGS Flood Event Viewer

The purpose of this research project is to offer discussion and a potential framework to help develop more comprehensive, integrated recommendations for the design, assessment, and retrofitting of New Jersey highway bridges exposed to multiple hazards. These hazards include natural events - such as earthquakes, floods, hurricanes, scour, and wind - as well as human-caused threats, such as vessel and vehicle collisions, blast, and fire. These guideline recommendations are intended to supplement existing AASHTO and NJDOT requirements by highlighting how hazards can interact and by encouraging a coordinated, multi-hazard approach rather than treating each threat in isolation for both new and existing highway bridges in New Jersey, with particular emphasis on structures whose continued functionality is critical to regional mobility, emergency response, and economic activity. The framework presented here is a resource to inform future NJDOT policies, support project-specific decision-making, and advance resilient, performance-based bridge designs and retrofits in a multi-hazard environment.

Recommendation

The report identifies earthquakes, flooding, storm surge, scour, wind, collisions, fire, blast, and other site-specific risks, and describes how these threats apply in the New Jersey context. Site-specific evaluation is discussed at a conceptual level by pointing to available mapping tools, FEMA flood requirements, and Climate Adjusted Flood Elevation (CAFE)-related criteria, and by outlining how these resources can be integrated into NJDOT's existing project development process. The overall design philosophy highlights both probability-based and performance-based approaches, aiming to balance safety, cost, and long-term resilience, and notes areas where current practice may not fully account for multi-hazard interactions or evolving climate-related effects.

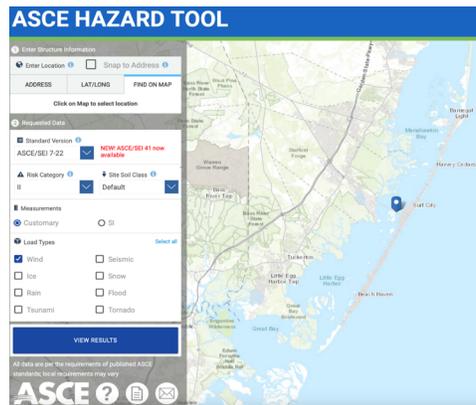


Fig. 2 ASCE 7 Hazard Tools



Fig. 3 NOAA Coastal Flood Exposure Mapper

Rather than prescribing detailed design criteria or providing language meant to be directly inserted into the NJDOT Design Manual, this framework references relevant AASHTO, FHWA, NJDOT, and NJ Department of Environmental Protection (NJDEP) provisions and highlights areas where additional refinement, coordination, or clarification may be needed for seismic, flood and storm surge, bridge scour, wind load, vehicle collision, vessel collision, blast load, and fire. It also addresses multi-hazard interactions and load combinations, along with considerations for structural systems and key bridge components, such as, superstructures, substructures, foundations, connections, bearings, and energy as well as dissipation devices to strengthen safety, durability, and resilience. Climate change impacts, including sea-level rise, increased flooding, and shifts in storm intensity and rainfall, are discussed in terms of adaptive strategies and potential future updates to NJDOT practice.

By bringing these multi-hazard considerations together into a single strategic framework, the document provides NJDOT, designers, engineers, and other decision-makers with a resource to support future policy decisions, pilot efforts, and targeted updates to existing standards. It is intended to help guide the continued evolution of NJDOT's design manuals and procedures, so New Jersey's bridges remain robust, adaptable, and prepared for both current and future challenges, while preserving NJDOT's flexibility in deciding the timing, level of detail, and format of any formal standards revisions.

This brief summarizes FHWA-NJ-2026-001, "NJDOT Multi-Hazard Design of Highway Bridges Recommendation", produced through the New Jersey Department of Transportation Bureau of Research, Innovation & Information Transfer, 1035 Parkway Avenue, P.O. Box 600, Ewing, NJ 08625 in cooperation with the U.S. Department of Transportation Federal Highway Administration.

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