Extreme Weather Vulnerability Assessment - ADOT Pilot Study for Transportation Infrastructure

Kris Gade1, Steven Olmsted1, Darcy Anderson2, Thor Anderson3, Charles Beck1, and Josh DeFlorio4

1Environmental Planning Group, Arizona Department of Transportation, 1111 W. Jackson St. MD-E902, Phoenix, AZ 85029; 2Pinal County Air Quality Control District, 31 N Pinal St., Building F, Florence, AZ 85132; 3Yavapai Metro Planning Division, Arizona Department of Transportation, 236 S 1st Ave. MD 1106, Flagstaff, AZ 86001; and 4Cambridge Systematics, Inc., 38 East 32nd St, 7th Floor, New York, NY 10016

Study Area:
Corridor, Watersheds and Land Cover

Abstract
The Arizona Department of Transportation (ADOT) conducted a pilot study to assess the vulnerability of its infrastructure to extreme weather, including high temperatures, drought and intense storms within the context of the surrounding landscape. The pilot study focused on a 322-mile study corridor. The analysis considered high temperatures, drought, and intense storms and how they contribute to dust storms, wildfire and flash flooding as well as how these stressors affect pavement, bridges and culverts, and road closures. The pilot study was based on a framework for vulnerability assessment and adaptation developed by the Federal Highway Administration (FHWA). Nineteen groups are plotting the framework; ADOT’s study is one of the first to consider multiple biotic communities in the analysis. The objectives of the study were:

1. Identify and prioritize vulnerable assets and stressors of most concern within the study corridor, and
2. Assess the effects of extreme weather stressors in different biotic communities within the study corridor with the goal of developing model approaches for assessing transportation infrastructure throughout the state.

Input was gathered from a large number of internal and external stakeholders. The results of the pilot study will be used to inform further research, both more intensive analysis of portions of the initial study corridor as well as extending the analysis to additional roads in the state highway system.

Future steps
- Expand data sets used to assess repeated maintenance actions and road closures
- Expand analysis to include state highways and state routes, which may be more susceptible to effects of extreme weather
- Hydrologic modeling of runoff and flooding risks with updated USGS StreamStats modules
- Refine wildfire and dust analyses with help of external stakeholders
- Incorporate changing biotic community composition and geographic distribution over time
- Cost benefit analysis of different adaptation strategies
- Consider integrating risks into a scenario planning framework

Downscaled Climate Projections - U.S. DOT’s CMIP3 Processing Tool

Projected 100-Year (1-Percent Chance) Rainfall (2065 to 2095), Flagstaff District

FHWA Vulnerability Assessment Framework

Min Precipitation Drought Dust, Wildfire
Max Precipitation 24 hr precipitation Flood
Min Temperature Cold
Max Temperature Heat
Average Temperature
Average Precipitation
Average Wind Speed

Future steps
- Evolve data sets used to assess repeated maintenance actions and road closures
- Evolve analysis to include state highways and state routes, which may be more susceptible to effects of extreme weather
- Hydrologic modeling of runoff and flooding risks with updated USGS StreamStats modules
- Refine wildfire and dust analyses with help of external stakeholders
- Incorporate changing biotic community composition and geographic distribution over time
- Cost benefit analysis of different adaptation strategies
- Consider integrating risks into a scenario planning framework

Particular Transportation Concerns

• Match time frames to transportation planning horizons
• Output parameters comparable to those used in engineering design
• Which CMIP models to use with focus on extreme events rather than averages?
• Direct relevance to design and maintenance decisions

Acknowledgments
The completion of this project would not have been possible without assistance from many other parties. The project would not have been possible without ADOT’s sponsorship of the pilot study. The study was partially funded by a FHWA grant and FHWA provided both technical resources and the assistance of knowledgeable staff who made this study a reality and also made it possible to travel to the study area.

ADOT would particularly like to acknowledge the efforts of Cambridge Systematics for their project management efforts to enhance the functionality of the U.S. Department of Transportation’s Climate Data Processing Tool.