

**Problem Statement No.: 24-1019**

## ***Improving Extreme Weather Resiliency of Airport Infrastructure***

**Recommended Allocation:** \$500,000

**Tags:** Airport Planning, Emergency Management, Financial/Economic, Operations, Sustainability

**Staff Comments:** The proposed research expands on *ACRP Report 147: Climate Change Adaptation Planning: Risk Assessment for Airports*; *Report 160: Addressing Significant Weather Impacts on Airports*; and *ACRP Synthesis 33: Airport Climate Adaptation and Resilience*. The Background section of the problem statement notes the research should "identify where there could be conflicts with FAA design standards that may require a modification...." ACRP research cannot critique FAA design standards and recommend changes.

**Average Airport Employee Review Rating** (out of 5): 4.09

**ACRP Oversight Committee (AOC) Disposition:** This problem statement received an average rating of 3.77 on a scale of 1 to 5 among voting AOC members. The FAA is addressing the issue. Many airports are unsure how to address the increase in severe adverse weather events. An Insight Event would enable the sharing of practice and identify research needs. Approved as an Insight Event as ACRP Project 11-08/24-02 and funded at \$170,000.

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***Improving Extreme Weather Resiliency of Airport Infrastructure***

**Topic Areas**

Airport Planning  
Emergency Management  
Financial/Economic  
Operations  
Sustainability

**Background**

With increasing frequency and severity, U.S. airports have experienced extreme weather events. These events have ranged from hurricanes, to flooding, to tornadoes, to blizzards and extreme cold and more. Other airports can learn from these experiences to strengthen the resiliency of the overall U.S. airport system.

When extreme weather strikes an area, airports are a critical piece of the response system. To meet this critical role, the airport infrastructure needs to be planned or upgraded to minimize damage and quickly recover. ACRP has completed three studies: ACRP Report 147: Climate Change Adaptation Planning: Risk Assessment for Airports, ACRP Report 160: Addressing Significant Weather Impacts on Airports, and ACRP Research Report 199: Climate Resilience and Benefit–Cost Analysis that can assist airports in preparing for extreme weather resiliency. However, airports need an after-effect study to update and provide further guidance to implement the strategies and tools from the previous projects. The proposed research should document the impacts airports experienced due to extreme weather, the immediate steps taken to recover to serve in the community’s emergency response and the improvements made or being planned to improve the resilience of the airport infrastructure. This experiential data should be used to test the models developed in the previous studies, offer recommended improvements and use strategies, and layout a roadmap for airports of all sizes to improve extreme weather infrastructure resiliency. This roadmap should assist airports in prioritizing and funding improvements to prepare their infrastructure for extreme weather.

For example, an airport lighting system that has been inundated by saltwater storm surge associated with a hurricane and needs to be replaced at a significant cost. The electrical vault was within a few inches of also being exposed. Similarly, low-lying pavement areas at coastal airports are increasingly at risk for regular tidal or freshwater flooding. If an airport identifies they are at risk of such occurrences, they need tools to address considerations such as what proactive steps can be taken and how the steps align with FAA design standards and grant funding eligibility, how quickly should the proactive steps be taken, prioritization by criticality of the asset, the cost of action versus potential costs of inaction, financial feasibility of long term solutions versus stop gap measures, funding strategies and challenges including AIP or other grant eligibility, how to maximize improvement investments such that they are usable even if utility resources are damaged, etc.

Further, weather patterns are shifting with historical “100-year storms”, etc. occurring on a more frequent basis. The research should include an assessment of how historical weather data is being viewed for future facing design so that airports can take it into consideration when planning

improvements. This research should identify where there could be conflicts with FAA design standards that may require a modification of design standards, such as in drainage design, if communities adopt more intense storms as their design storm.

This topic fits within ACRP's identified emerging issue of enhancing the resiliency of airports and interrelated systems.

### **Objective**

The outcome of this project is a summary of case studies of extreme weather damage and recovery at U.S. airports leading to a roadmap that airports can use to assist in planning improvements to improve their infrastructure resiliency and recovery due to extreme weather. Of particular interest would be improvements that not only allow for speedy recovery, but would also allow the airport to greatly minimize climate risk in the future. The roadmap should incorporate the previously developed tools and guidance while taking it a step further to provide an easy to follow process that airports of all sizes in a variety of geographic locations can use. It should also include a section on use and cautions of historical weather data to plan improvements.

### **Research Approach**

Case studies should be conducted of airports that have experienced extreme weather events and recovery. The case studies should document the short-term and longer term (fixed but system may fail prematurely) damage and recovery steps. If available the recovery costs should be identified along with potential costs for improvements that will weather harden the infrastructure in the future. This data should be used to assist airports in identifying feasibility strategies to improve infrastructure resiliency and the associated business case. The cost/benefit and return on investment analysis should include the ability to compare the cost of continual recovery with the benefit of making a one-time capital investment that would lower the climate risk and greatly improve long term infrastructure resiliency.

### **Cost Estimate and Backup**

To allow for sufficient case study data gathering and potentially some site visits, the project budget is estimated as \$500,000.

### **Related Research**

There are three previous ACRP projects upon which this research should build.

ACRP Report 147: Climate Change Adaptation Planning: Risk Assessment for Airports (2015) - It provides the Airport Climate Risk Operational Screening (ACROS) tool for airports to use to assess their climate change risk. This tool is used to provide data to support climate adaptation planning.

ACRP Report 160: Addressing Significant Weather Impacts on Airports (2016) - this study provides airports with the Airport Weather Advanced Readiness (AWARE) tool to assist in identifying vulnerabilities and developing contingency and recovery plans. The tool was developed using historical weather data and airports' responses to significant weather.

ACRP Research Report 199: Climate Resilience and Benefit–Cost Analysis: A Handbook for Airports (2019) - this study focused on two stressors sea level rise and storm surge (flooding) and high temperatures and provides a benefit-cost analysis strategy for considering improvements.

An ACRP synthesis was a precursor to those studies.

ACRP Synthesis 33: Airport Climate Adaption and Resiliency. Prepared (2012), the case studies included in the synthesis are primarily actions airport we taken to assess their vulnerabilities and start to plan resiliency improvements.

Other organizations such as the American Society of Civil Engineers are looking at the application of weather data for future infrastructure development. An example of this is Impacts of Future Weather and Climate Extremes on United States Infrastructure: Assessing and Prioritizing Adaptation Actions, Mari R. Tye, Ph.D., CEng; and Jason P. Giovannettone, Ph.D., P.E., 2021, American Society of Civil Engineers that considers changes in extreme weather events and the vulnerability of critical infrastructure sectors including aviation.

**Author**

Chris Rozansky  
Executive Director  
Naples Airport Authority

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**Airport Employee Comments**

As global warming creates more powerful and abundant storms, being able to withstand these storms and return to operational readiness quickly is a top priority. This is first accomplished by building airports that can withstand more than is required and in a way that creates redundancy and proper passenger flow for ingress and egress.
Useful for non-coastal airports as well (e.g. rainstorms, wind storms).
I see this as being most useful to Primary Airports - in that they have the resources to fund the recommended improvements that this report might offer.
When you combine the aging infrastructure of airports, extreme weather events and copious funding from the FAA for Terminal and infrastructure improvements, the timing of this project couldn't be better.
The proposed Roadmap is greatly needed by US airports in all categories. Though not mentioned, the research would likely involve airport stakeholders such as NWS, FAA ATC and FAA ATSS. A potential outcome of the Roadmap may be additional guidance for Airport Emergency Plans.
this past winter the west coast airports were faced with extreme whether condition. therefore, it is imperative we research ways and methods to be resilient.
Extreme weather appears to be on the increase. Airports are seeing unforeseen costs driven by these events. The potential for loss of life is increasing and recovery time is extending. This project would airports improve extreme weather plans. Also, the weather is part of every Airport Emergency Plan. All parts of the country are experiencing this.
This is a true problem for airports of all sizes because of the increased frequency of extreme weather events. The definition of true resiliency for airports is still evolving and would benefit from research. This is a timely topic for research and will help most if not all airports. In addition to case studies, the problem statement would need to include the role of technology systems and incorporation of approaches used by military entities like stress testing and Multi-Criteria-Decision-Making (MCDM).

**TRB Committee Comments**

AV030 AV090	<p>ENVIRONMENTAL ISSUES IN AVIATION (AV030): Because this project overlaps with the FAA's pilot program for the Airport Resilience Analysis Framework (ARAF), it is not recommended for funding. However, the problem statement can be re-cast as a synthesis topic to summarize case studies from extreme weather events.</p> <p>AVIATION SAFETY, SECURITY AND EMERGENCY MANAGEMENT (AV090): Although there are existing post-disaster recovery guides and other resources already available from various organizations such as FEMA, USDOE, state and regional government agencies, and by the American Planning Association, none specifically address issue unique to airports. The ACRP Synthesis 60 covered recovery/response, but not specially focused on extreme weather. Some relevant issues are covered by ongoing ACRP 04-26 Uncontrolled Terminal Evacuations: Planning, Response, and Recovery as</p>
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	<p>well as ACRP RR 229. The focus on airport “after action” assessments associated with extreme weather events doesn’t seem to be covered by existing resources. Some type of guidance with additional case study examples would be useful. While the focus on extreme weather is topical, the study could consider all hazards, not just extreme weather. It should include a best practice and decision matrix of recovery/repair options appropriate for critical airport infrastructure based on the type and degree of damage/outage. Case studies should also include examples (effectiveness) of successful mitigation which protected the infrastructure from damage or lose of function in subsequent events. A web-based tool similar to OSHA's Hurricane eMatrix with guidebook would be useful as part of the study effort. Optionally an Insight event might be a good starting point. The study can also be used as stand alone, where airports will learn from the experience of other airports that were already impacted by climate-related events and thus be better prepared to mitigate the outcomes of such events.</p>
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