



# **Climate Change Hazards Summary Report for Facility Investment Planning**

## **Gateway Arch National Park January 2021**

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## Introduction

Parks are required to complete a PARK Project Narrative Template for each proposed Great American Outdoors Act Facility Investment Plan (GFIP) project for Legacy Restoration Funding in fiscal years 2023-2025. Information provided in this report is intended to help parks consider climate change related hazards when addressing Question 16 of the narrative template.

*Specifically: What risks or hazards (current and projected, e.g. effects of climate change) are likely to affect this project? If applicable, what adaptation strategies and/or resiliency measures have been identified for scenarios that pose high risks to project assets?*

## Step 1: Review summary information for known or potential hazards identified for Gateway Arch National Park

- Review the list of potential hazards below and decide whether or not they apply to your specific GFIP project. NPS Climate Change Response Program (CCRP) staff attempted to identify potential hazards for the park; however, park staff and project planners have more information about hazards that are likely to be applicable to a specific project.
- The hazards below were selected from a longer list included in Appendix 1, which also indicates CCRP's 'best professional judgement' about the relevance of the hazard for this park. Note both lists serve as a "coarse filter" screening tool to help identify potential climate-related hazards for facility and asset planning.

### 1. Hotter average days and more very hot days

Climate change is already driving observable increases in average and extreme temperatures, and this trend is projected to continue, with record setting years becoming more common in the future (USGCRP 2017). The annual average temperature in the United States is expected to increase by 2.3 to 11°F by the end of the century depending on greenhouse gas emissions, relative to 1986-2015 (USGCRP 2018). Extreme temperatures can increase weathering of structures, threaten park staff and visitor safety, and increase stresses for HVAC systems. Demand for complex air conditioning systems can add stress to building envelopes and often requires significant alterations to a structure.

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes  
☐ No

### 2. Increased drought frequency, intensity, magnitude, and duration

The Midwest U.S. experiences intermittent, damaging droughts, despite increasing precipitation. Future drought behavior in is uncertain in this region, but climate change projections show that Midwest surface soil moisture will transition from saturated in the spring (due to increasing precipitation) to rapid drying in the summer, driven by higher temperatures (Wehner et al. 2017, Angel et al. 2018). The 2012 drought was the most intense and widespread drought on record for the past hundred years (Jin et al.

2019) and developed quickly with rapid intensification as summer temperatures increased. These "flash droughts" are expected to increase in frequency and severity due to increasing precipitation variability and rising temperatures and will challenge water resource management throughout the region (Pendergrass et al. 2020). Rapidly changing soil moisture with soil shrinkage and heaves can cause soil cracking and structural issues with pipes, roads, and buildings (Fernandes et al. 2015).

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

### **3. Altered precipitation patterns and changing humidity**

Changing precipitation patterns have been observed in many regions of the United States as result of climate change and changes are expected to continue. In the Midwest region, including Gateway Arch, precipitation has increased (Easterling 2017). Increases in temperature and precipitation can result in increased humidity that encourages mold growth, wood decay, increase fire risk, and intensified drought conditions, depending on the pattern of change. Increased humidity and temperature increase latent heat and cooling loads on HVAC and dehumidification equipment.

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

### **4. Increased extreme precipitation**

The frequency of intense precipitation throughout the Midwest region increased up to 53% from 1958-2016, especially in the upper central and Great Lakes states (Easterling et al. 2017) and projections for all emissions scenarios are for additional increases in the future. Intense precipitation, especially on snow, can result in record-setting flooding, higher water tables, extreme erosion and changes in stream and riverbanks, sustained loss of infrastructure (e.g. access, power, water, sewer). Saturated soils may fail to support roads, pilings, pipes, foundations and other structural supports. Increased humidity, flooding, and driving rain can damage building cladding, increase risk of mold and rot, and promote insect damage.

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

### **5. Riverine flood/Flash Flood**

Extreme precipitation events and the risk of flooding are expected to regionally intensify with a changing climate (Dethier et al. 2020, Tabari 2020). Floods threaten infrastructure and operations through a variety of mechanisms, including inundation of structures, enhanced erosional forces, road wash out,

structural collapse from force of floodwaters, sewage backup, and damage to utilities, generators, and electrical systems. Post-flooding effects include increased rot, fungal/insect attack, mold and mildew, and physical deterioration of wood, brick and stone building materials.

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

## **6. Extreme thunderstorms and tornadoes**

With continued climate change, the potential for severe thunderstorms that provide conditions for tornadoes may increase substantially (Abell et al. 2007, Diffenbaugh et al. 2013, Gensini and Mote 2015). Tornadoes can result in catastrophic damage to infrastructure from high winds, and associated debris, hail, and flash flooding.

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

## **7. Pest infestation**

Increased temperatures and CO<sub>2</sub>, changes in precipitation, and disturbance due to extreme climate events can increase the survival, spread, growth, and establishment of pests (IPCC 2014). Changes in distribution of wood-boring insects (e.g. termites) may be a particular concern as Gateway Arch is within the area of projected expansion of termite species (Buczowski and Bertelsmeier 2017; Vissichelli 2018). Rooting and burrowing mammals and termites have the potential to cause direct damage to power, water, transportation, and building facilities (Vissichelli 2018). Facilities may be impacted indirectly through other mechanisms exacerbated by climate change such as forest insect pest invasions or fluctuating ground water levels leading to increased tree mortality, hazard trees, and treefall.

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

## **8. Invasive species**

Increased temperatures and CO<sub>2</sub>, changes in precipitation, and disturbance due to extreme climate events can increase the survival, spread, growth, and establishment of invasive species (IPCC 2014). Weeds and aquatic mussels have the potential to cause direct damage to power, water, transportation, and building facilities (Vissichelli 2018). Non-native species that may not currently impact facilities may become harmful due to changes in local climates (NRC 2002, IPCC 2014).

*Park staff assessment – relevant to GFIP Project:*

- ☐ Yes
- ☐ No

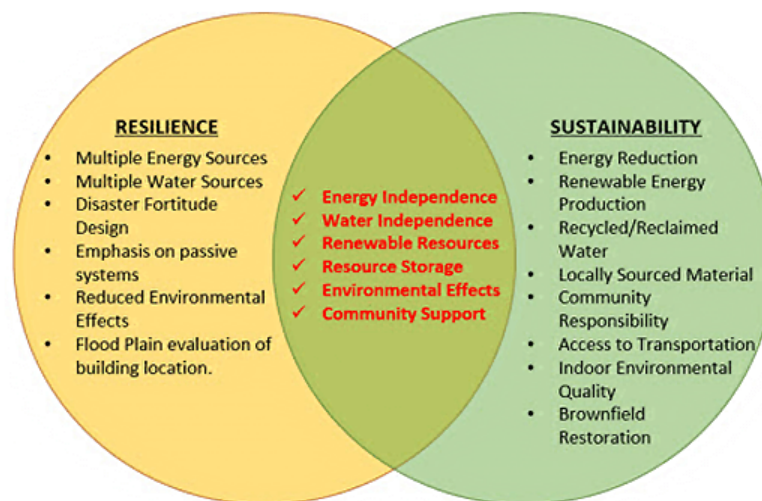
## Step 2: Consider adaptation and resiliency strategies

- Review definitions of resiliency and adaptation strategies.
- Identify adaptation strategies that will help park resources respond to the hazards identified in Step 1.

Question 16 requires a screening for climate hazards followed by a review of adaptation and resiliency strategies that would be put in place to respond to these hazards. For the purposes of this report and investment planning, resilience is a property of a system or asset and generally refers to the ability of the system or asset to maintain its intended purpose following a temporary disturbance.

Adaptation strategies, in the context of built infrastructure, refers to the intentional management decision to identify, prepare for, and respond to observed or expected sustained changes in hazards, including climate change, to adjust to a sustained change in conditions.

It is important to note that resilient park operations can be supported through the use of green infrastructure such as sustainable landscaping, as well as sustainable energy, water, and building envelope solutions. The figure below illustrates this relationship.



Lists of adaptation strategies for different types of infrastructure projects in response to different hazards can be found here: [Incorporating Climate Change Adaptation in Infrastructure Planning and Design](#) (see Chapter 4, Tables 25-34). If used, these adaptation strategies will need to be modified for proposed park projects.

Buildings and assets within national parks may include cultural resources (e.g., historic and pre-historic buildings and structures). The adaptation and resiliency options for cultural resources often overlap with

those defined for facilities; however, NPS has detailed specific strategies when dealing with cultural resources and climate change in national parks. ([Cultural Resources Climate Change Strategy](#)). “Climate change poses an especially acute problem for managing cultural resources because they are unique and irreplaceable — once lost, they are lost forever.” ([NPS Policy Memorandum 14-02](#)).

### Step 3: Develop an answer to Question 16 for your specific project and location, as well as strategies to address each hazard

- Two example responses to Question 16 are provided below. THESE ARE GENERIC EXAMPLES FROM OTHER PARKS.
- You will need to develop park specific answers based on the hazards identified in Step 1 and the adaptation strategies identified in Step 2 for your park and project. The park response should be as project-specific as possible.

*Question 16: What risks or hazards (current and projected, e.g. effects of climate change) are likely to affect this project? If applicable, what adaptation strategies and/or resiliency measures have been identified for scenarios that pose high risks to project assets?*

#### ***Example from Minute Man National Historic Park: Restoring historic structures***

Several climate change hazards have been identified that may affect building-related projects at MIMA, including hotter average days, more extreme heat days, increased hurricane impacts from wind and flooding, altered precipitation patterns, and increased extreme precipitation. Adaptation and resiliency strategies for the expected hazards are described below:

- Hotter average days and more extreme heat days will increase demand and requirements for appropriately sized air conditioning systems.
- Extreme heat and humidity can stress the building envelope and will require significant humidity control alterations for structures.
- Hurricane force wind and wind-blown rain as well as damage from wind-blown debris or treefall will require wind resistant fortification of the structure. Addressing hazardous trees and retrofitting roof structures to be more wind resistant may also be required.
- Flooding from increased hurricane events, increased extreme precipitation, or in conjunction with altered precipitation patterns may require modifications to building infrastructure location and landscape drainage systems.
- Post-flooding effects may include increased rot, mold and mildew, and physical deterioration of wood, brick and stone building materials. Adaptation actions will include identifying appropriate dehumidification and air handling systems and coordinating with the NPS Historic Architecture, Conservation and Engineering Center or Historic Preservation Training Center regarding alternatives and maintenance for historic structures.

***Example from Grand Teton National Park: Building assets, water development, or road construction***

Several climate change hazards have been identified that may affect projects in GRTE, including hotter average days, more extreme heat days, increased drought frequency and intensity, altered precipitation and flooding patterns, increased wildfire, and increased invasive species abundance or distribution. Some example adaptation and resiliency strategies for the expected hazards are described below:

- Hotter average days and more extreme heat days will increase demand and requirements for appropriately sized air conditioning systems.
- Energy demand increases should be offset by conservation measures and renewable energy implementation where possible.
- Extreme heat can stress the building envelope and may require significant humidity control alterations for structures.
- Increased and more intense wildfires will require more planning in the wildland-urban interface, either by relocating park assets, using fire-resistant building materials, reducing fuels near structures, or all of these measures.
- Increased drought and faster runoff can reduce the amount of water available for park use. New water sources might need to be identified and water conservation measures should be prioritized.
- Heavy rains during the spring thaw can cause rapid melting of the snowpack resulting in severe flooding. Road construction may require relocation, as well as larger culverts and other flood control measures to accommodate heavy runoff.
- Buildings, infrastructure, and roads in existing flood zones may need additional mitigation.
- The potential for increased invasive species should be mitigated. Measures include mitigation during construction (e.g., using weed-free gravel and cleaning construction equipment) and increased weed treatment post construction.
- Termites are likely to arrive in GRTE by mid-century. Early detection monitoring and eradication, if possible, will help protect historic structures and other buildings.

## Step 4: Seek additional assistance if desired

- Additional resources for answering question 16 and related questions can be found in:
  - Appendix 1 below, which includes a full hazards checklist, providing additional links for supporting information related to each hazard.
  - Appendix 2 below, which provides a map to visualize how climate is changing for the park.
  - The [GFIP Guidance and Logistics](#) folder under the [Resources to Assess Risks and Hazards tab](#) includes:
    - An Excel workbook labeled [T75 Parks GFIP NRSS Supporting Materials](#) that provides links to information for natural resources to be considered during project design and construction.
    - A [FAQs – Assessing Risks and Hazards](#) document that provides detailed guidance for answering Question 16.

- A [Natural Hazard Assessment Webinar](#) recording that provides key information, definitions, and guidance for understanding natural hazards and related resources.
- The NPS Climate Change Response Program (CCRP) and Sustainable Operations and Maintenance Branch (SOMB) are also available for assistance in evaluation of climate change hazards and resiliency strategies as they relate to specific projects. Questions can be sent to the NPS [GFIP Hazards and Risk Assistance email account](#) and a member of that team will reply with support.

## Appendix 1: The Climate-Related Hazard Checklist

This appendix provides an initial evaluation of climate hazards for **Gateway Arch National Park** according to the hazard ratings identified below. The information used to identify hazards in the checklist is mostly from regional assessments. Park and project specific information was generally not available when assessing these hazards. NPS Climate Change Response Program (CCRP) staff made an initial attempt to identify potential hazards for the park broadly (see 'Best Professional Judgment' column); however, park staff and project planners have more information about hazards that are likely to be applicable to a specific project.

### Explanation of Hazard Ratings

**Known hazard:** Conditions that cause the hazard are well documented in the area where the park occurs. If applicable to the project site, these hazards should always be addressed in the project plan.

**Potential hazard:** Conditions that cause or underlie the hazard are known to occur nearby or are likely to occur based on studies with conditions similar to the park. If applicable to the project site, these hazards should be considered for inclusion in the project plan.

**Not applicable:** No evidence *was identified* showing this hazard is relevant to the park. Note this is a coarse filter evaluation; local knowledge of a hazard(s) should be used, when available.

**Table 1. Climate-related Hazards Checklist**

| Potential Climate Hazard                   | Best Professional Judgment                                                                                                                                | Examples of risk or secondary hazard                                                                                                                                                                                      | Sources of General Non-site specific Data                                                                                                     | Sources for Site Specific Data                                                                                                                                                                                                        |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hotter average days and more very hot days | Known Hazard<br><input checked="" type="checkbox"/><br><br>Potential Hazard<br><input type="checkbox"/><br><br>Not Applicable<br><input type="checkbox"/> | <ul style="list-style-type: none"><li>• Inadequate HVAC</li><li>• Road surface degradation</li><li>• Lack of water due to increased water for irrigation</li><li>• Increased humidity</li><li>• Danger to staff</li></ul> | <ul style="list-style-type: none"><li>• <a href="#">National Climate Assessment</a></li><li>• <a href="#">State climate summary</a></li></ul> | <ul style="list-style-type: none"><li>• <a href="#">National Climatic Data Center</a></li><li>• <a href="#">DAYMet gridded climate data</a></li><li>• <a href="#">National park historical and projected climate change</a></li></ul> |

| Potential Climate Hazard                                         | Best Professional Judgment                                                                                                                              | Examples of risk or secondary hazard                                                                                                                                                                                                                                                                                        | Sources of General Non-site specific Data                                                                                                                                                                                                                     | Sources for Site Specific Data                                                                                                                                                                                                      |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Increased drought frequency, intensity, magnitude, and duration  | <p>Known Hazard <input type="checkbox"/></p> <p>Potential Hazard <input checked="" type="checkbox"/></p> <p>Not Applicable <input type="checkbox"/></p> | <ul style="list-style-type: none"> <li>Limited water supply for cooling, landscaping, structural fire suppression, other equipment</li> <li>Increased competition for available water and water rights conflicts</li> <li>Crack/heave damage in drier soils</li> <li>Increased vulnerability to wildfire (below)</li> </ul> | <ul style="list-style-type: none"> <li><a href="#">Drought Monitor</a></li> <li><a href="#">National Integrated Drought Information Center</a></li> <li><a href="#">National Climate Assessment</a></li> <li><a href="#">State climate summary</a></li> </ul> | <ul style="list-style-type: none"> <li><a href="#">Drought Monitor</a></li> <li><a href="#">National Integrated Drought Information Center</a></li> </ul>                                                                           |
| Increased wildfire frequency, intensity, magnitude, and duration | <p>Known Hazard <input type="checkbox"/></p> <p>Potential Hazard <input type="checkbox"/></p> <p>Not Applicable <input checked="" type="checkbox"/></p> | <ul style="list-style-type: none"> <li>Damage to facilities and contents</li> <li>Smoke damage</li> <li>Air quality dangerous to staff and visitors</li> <li>Increased runoff</li> <li>Increased erosion</li> <li>Damage to water treatment plants</li> </ul>                                                               | <ul style="list-style-type: none"> <li><a href="#">Barbero et al. 2015 International Journal of Wildland Fire</a></li> </ul>                                                                                                                                  | <ul style="list-style-type: none"> <li><a href="#">NIFC</a></li> <li><a href="#">International Wildland-Urban Interface Code</a></li> </ul>                                                                                         |
| Altered precipitation patterns and changing humidity             | <p>Known Hazard <input type="checkbox"/></p> <p>Potential Hazard <input checked="" type="checkbox"/></p> <p>Not Applicable <input type="checkbox"/></p> | <ul style="list-style-type: none"> <li>Local flooding</li> <li>Mold growth</li> <li>Wood decay</li> <li>Drought</li> <li>Fire</li> <li>Groundwater change</li> </ul>                                                                                                                                                        | <ul style="list-style-type: none"> <li><a href="#">National Climate Assessment</a></li> <li><a href="#">State climate summary</a></li> </ul>                                                                                                                  | <ul style="list-style-type: none"> <li><a href="#">National Climatic Data Center</a></li> <li><a href="#">DAYMet gridded climate data</a></li> <li><a href="#">National Park historical and projected climate change</a></li> </ul> |

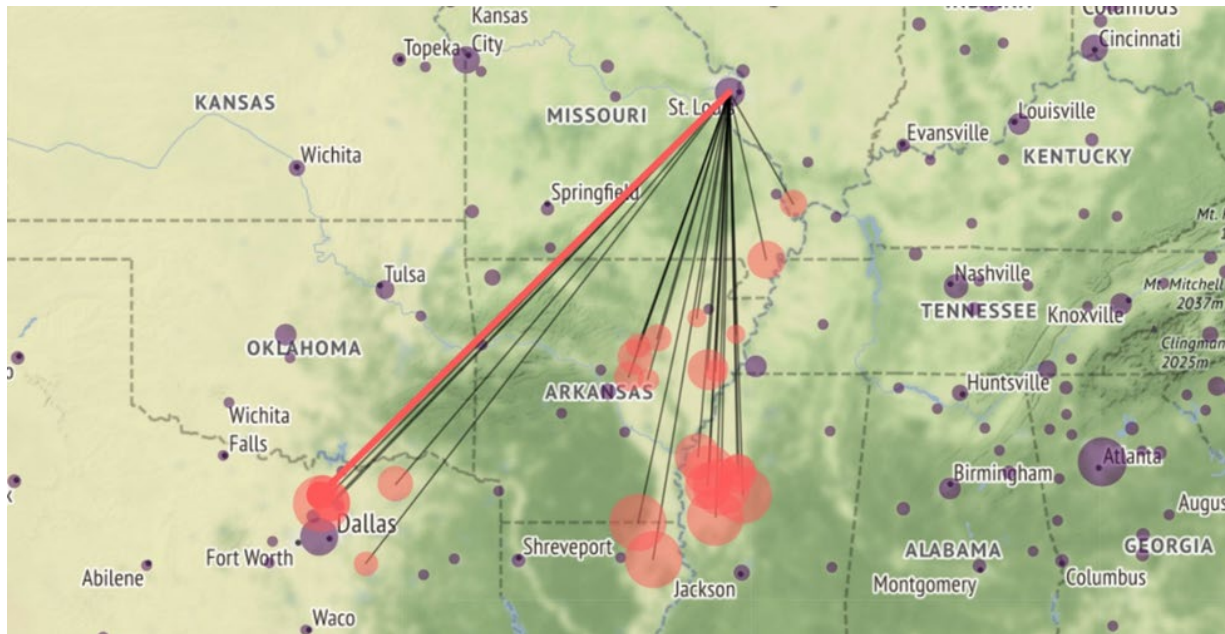
| Potential Climate Hazard                      | Best Professional Judgment                                                                                                               | Examples of risk or secondary hazard                                                                                                                                                                                                                                                                                                                          | Sources of General Non-site specific Data                                                                                                                           | Sources for Site Specific Data                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Increased extreme precipitation               | Known Hazard <input checked="" type="checkbox"/><br>Potential Hazard <input type="checkbox"/><br>Not Applicable <input type="checkbox"/> | <ul style="list-style-type: none"> <li>• Surface erosion</li> <li>• Floods (see below)</li> <li>• Water damage to structures from driven rain</li> <li>• Unstable saturated soils</li> </ul>                                                                                                                                                                  | <ul style="list-style-type: none"> <li>• <a href="#">National Climate Assessment</a></li> <li>• <a href="#">State climate summary</a></li> </ul>                    | <ul style="list-style-type: none"> <li>• Evaluations are mostly at regional scales</li> </ul>                                                                                                                                                                                                                                                                         |
| Riverine flood/flash flood                    | Known Hazard <input checked="" type="checkbox"/><br>Potential Hazard <input type="checkbox"/><br>Not Applicable <input type="checkbox"/> | <ul style="list-style-type: none"> <li>• Damage or destruction of infrastructure</li> <li>• Stream channel migration</li> <li>• Stream bank erosion/extreme erosion</li> <li>• Safety</li> <li>• Water quality diminished</li> <li>• Damage to water source and delivery infrastructure</li> <li>• Changing requirements for culvert flow capacity</li> </ul> | <ul style="list-style-type: none"> <li>• <a href="#">FEMA Flood map service</a></li> </ul>                                                                          | <ul style="list-style-type: none"> <li>• <a href="#">FEMA Map Service Center</a></li> <li>• <a href="#">Floodplain maps for HUD projects</a></li> <li>• <a href="#">Van Dusen et al. 2020</a> (for select parks)</li> <li>• May require a special flood study</li> </ul>                                                                                              |
| Sea/lake level change and coastal storm surge | Known Hazard <input type="checkbox"/><br>Potential Hazard <input type="checkbox"/><br>Not Applicable <input checked="" type="checkbox"/> | <ul style="list-style-type: none"> <li>• Rising sea and lake levels</li> <li>• Rising water – wind driven (e.g. hurricane, nor’easter)</li> <li>• Saltwater intrusion</li> <li>• Vegetation damage</li> </ul>                                                                                                                                                 | <ul style="list-style-type: none"> <li>• <a href="#">NOAA SLR viewer</a></li> <li>• <a href="#">NOAA - Great Lakes Environmental Research Laboratory</a></li> </ul> | <ul style="list-style-type: none"> <li>• <a href="#">IRMA – Coastal reports</a></li> <li>• NPS <a href="#">SLR viewer</a></li> <li>• <a href="#">Specific Hazard Assessment: Coastal Storm Surge with Climate Change Effects</a> (requires VPN connection)</li> <li>• <a href="#">SLR reports</a></li> <li>• <a href="#">Great Lakes Dashboard Project</a></li> </ul> |

| Potential Climate Hazard | Best Professional Judgment                                                                                                                                | Examples of risk or secondary hazard                                                                                                                                                                                                                    | Sources of General Non-site specific Data                                                             | Sources for Site Specific Data                                                                                                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hurricanes and tornados  | Known Hazard<br><input type="checkbox"/><br><br>Potential Hazard<br><input checked="" type="checkbox"/><br><br>Not Applicable<br><input type="checkbox"/> | <ul style="list-style-type: none"> <li>• Building destruction</li> <li>• Flying debris</li> <li>• Storm surge</li> <li>• Tree fall</li> </ul> (see other categories for associated intense rainfall and floods)                                         |                                                                                                       | <ul style="list-style-type: none"> <li>• Wind speed data – from local codes</li> <li>• International Building Code</li> <li>• <a href="#">FEMA Map Service Center</a></li> </ul>                                                               |
| Pest infestation         | Known Hazard<br><input type="checkbox"/><br><br>Potential Hazard<br><input checked="" type="checkbox"/><br><br>Not Applicable<br><input type="checkbox"/> | <ul style="list-style-type: none"> <li>• Historic/facility fabric loss</li> <li>• Vegetation loss</li> <li>• Disease vectors may increase</li> <li>• Termites and other woodboring pests expanding range with warming and increased humidity</li> </ul> | <ul style="list-style-type: none"> <li>• <a href="#">USFS Forest Health Program</a></li> </ul>        | <ul style="list-style-type: none"> <li>• Integrated Pest Management</li> <li>• <a href="#">Fisichelli et al. forest pests</a></li> <li>• <a href="#">USFS maps</a></li> </ul>                                                                  |
| Invasive species         | Known Hazard<br><input type="checkbox"/><br><br>Potential Hazard<br><input checked="" type="checkbox"/><br><br>Not Applicable<br><input type="checkbox"/> | <ul style="list-style-type: none"> <li>• Aquatic mussels – water intakes clogged</li> <li>• Vegetation (kudzu, vines) – damage buildings, kill trees, obstruct waterways</li> </ul>                                                                     | <ul style="list-style-type: none"> <li>• <a href="#">National Invasive Species Council</a></li> </ul> | <ul style="list-style-type: none"> <li>• <a href="#">Early Detection and Distribution Mapping System</a> (current distribution)</li> <li>• <a href="#">Early Detection and Distribution Mapping System</a> (projected distribution)</li> </ul> |

## Appendix 2. What Will the Park Climate Feel Like in 60 Years?

The map below is intended to help visualize how the present-day climate in the region of **Gateway Arch National Park** is projected to change as a result of climate change (Fitzpatrick and Dunn 2019). Under a high greenhouse gas emission scenario, St. Louis, Missouri's climate in 2080 may feel like today's climate

near Prosper, Texas. The typical summer in Prosper, Texas is 6.6°F (3.7°C) warmer and 18.6% drier than summer in St. Louis, Missouri. The red line shows the average of the 27 climate models; the black lines show the 27 individual projections assuming continued high emissions, providing a sense of the plausible range of future climates. Circle size gives a sense of how good of a match that location is, with larger circles indicating poorer matches; all circles (red or purple) denote cities used in the analysis. The analysis is based on twelve climate metrics, including minimum and maximum temperature and precipitation by season (spring, summer, fall, winter). More details are available in the reference cited above and the website <https://fitzlab.shinyapps.io/cityapp/>.



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## Disclaimer

### Report Purpose and Scope:

Parks identified for Legacy Restoration Funding in fiscal years 2023-2025 are required to develop a Great American Outdoors Act Facility Investment Plan (GFIP). The intended use of this series of park-specific reports is to help parks address Question 16 of the narrative template: *What risks or hazards (current and projected, e.g. effects of climate change) are likely to affect this project? If applicable, what adaptation strategies and/or resiliency measures have been identified for scenarios that pose high risks to project assets?*

Each report compiled and summarized published information on a suite of climate change hazards. Each report included an analysis of each hazard, for which the report author assigned a 'hazard rating' as follows:

**Known hazard:** Conditions that cause the hazard are well documented in the area where the park occurs. If applicable to the project site, these hazards should always be addressed in the project plan.

**Potential hazard:** Conditions that cause or underlie the hazard are known to occur nearby or are likely to occur based on studies with conditions similar to the park. If applicable to the project site, these hazards should be considered for inclusion in the project plan.

**Not applicable:** No evidence was identified showing this hazard is relevant to the park. Note this is a coarse filter evaluation; local knowledge of a hazard(s) should be used, when available.

As articulated within the report (in an appendix of the hazard ratings) those ratings constitute the author's 'best professional judgement' about the relevance of the hazard for that park based on the reviewed literature (cited in the narrative text for the hazard & provided in the report bibliography).

The intended use of each report is to inform decisions for facility investment planning related to (i) potential hazards that a suggested facility investment concept would need to appropriately consider and avoid or mitigate and (ii) identifying facilities possibly at greater relative vulnerability due to the identified hazards. The level of information quality in the report was calibrated to those purposes, i.e. to inform development of questions for a facility investment scoping process to further explore.

### Peer Review Process:

Each report was based on a template, which heavily relied on boilerplate text for the non-park specific elements. The boilerplate text underwent multiple rounds of informal peer review by assorted CCRP staff, including members of the Climate Science and Adaptation Team, the Communications Team, the Regional Climate Change Liaisons, and the Climate Change Liaison to Facilities and Planning. Each report was peer-reviewed by a member of CCRP to check interpretation, consistency in hazard ratings, improve narrative coherence, and flag priority additions/modifications. In situations where revisions were required, the peer reviewer then re-reviewed the final revised report to assure adequate resolution of the identified issues.