



Climate Change Hazards Summary Report for Facility Investment Planning

Martin Luther King Jr. National Historical Park April 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 Martin Luther King Jr. National Historical 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.

Hotter average days and more very hot days

Extreme temperatures can increase weathering of structures, threaten park staff and visitor safety, and increase stresses for HVAC systems. If not addressed through building design or more efficient temperature control systems, the increased demand for complex air conditioning systems can add stress to building envelopes and can require significant alterations to a structure.

Temperature can be used to predict visitation patterns with 62% accuracy at MALU, with peak visitation occurring in the summer (Fisichelli et al. 2015). It's possible that increasing temperatures during the peak of the summer could lead to more visitor center use. Low greenhouse gas scenarios for this century (RCP 2.6) lead to projections of annual mean temperature increase of 1.4° C. Higher greenhouse gas scenarios (RCP 8.5) project an increase of annual mean temperature of 4.5° C (Gonzalez et al. 2018). An analysis of conditions over the last century at the (relatively) nearby Kennesaw Mountain National Battlefield Park and Chattahoochee River National Recreation Area documented that both sites have been significantly warmer and drier in recent decades (Monahan and Fisichelli 2014). Heat waves are projected to increase, with extreme heat of particular concern for Atlanta where the urban heat island effect raises summer temperatures. High temperatures, combined with high humidity, can create dangerous heat index values (Frankson et al. 2017). The threats of future heat waves and extended periods of above average temperatures are associated with spikes in unhealthy ozone levels. Extreme

temperatures and elevated ozone levels can increase weathering of structures, threaten park staff and visitor safety, and increase stresses for HVAC systems.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Altered precipitation patterns, increased extreme precipitation, and changing humidity

Changing precipitation and humidity conditions can result in local flooding, encourage mold growth, wood decay, increase fire risk, and intensify drought conditions, depending on the pattern of change. Extreme precipitation events present a variety of threats to infrastructure and operations including flooding of sites, sewage backup, accelerated decay of masonry, overcoming drainage systems, road wash out, cracks in building infrastructure, destabilization of buildings and pipes, erosion of supporting ground around structures, among many other effects.

An analysis of CHAT and KEMO, but not MALU, showed that climate conditions have become significantly drier (Monahan and Fisichelli 2014), a result that plausibly also applies to MALU. However, we do not know if this seasonal phenomena will continue. Average annual total precipitation at MALU is projected to increase by 6% (RCP 2.6) to 9% (RCP 8.4) (Gonzalez 2018), though the projections vary widely across global climate models.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Increased drought frequency, intensity, magnitude, and duration

Rising air temperatures and changing precipitation patterns are exacerbating drought risk in many parts of the United States (Wehner et al. 2017). Changing drought conditions (frequency, severity, duration) can challenge a variety of infrastructure and operations (Department of Homeland Security 2015) in the NPS (e.g., water supply and wastewater systems), impair water quality (Mosley 2015), affect soil heaves and shrinkages (Fernandes et al. 2015).

Although annual precipitation totals in the Southeastern U.S. overall haven't changed statistically over the past century, increasing intensity of extreme events and hotter, drier summers have led to droughts becoming more intense and longer (Kunkel et al. 2013, USDA 2017, Carter et al. 2018). Climate change is expected to continue intensifying the hydrological cycle, increasing the frequency and severity of extreme events like drought (Mitchell et al. 2014, Carter et al. 2018).

Park staff assessment – relevant to GFIP Project:

- ☐ Yes

☐ No

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.

The frequency of floods has spiked in recent decades in Georgia, especially in metro Atlanta. For example, Fulton County recorded 4 floods in a 10-year period from 1975 to 1984 (1980s) but 16 floods in an 8-year period from 2005 to 2012 (Binita et al. 2015). Thunderstorms that bring heavy rains, and can cause severe flooding, happen year-round, but are more common in the spring and summer months (Frankson et al. 2017). Climate change is expected to increase the intensity of extreme rainfall events.

Pest infestation

Increased temperatures and CO₂, changes in precipitation, and disturbance due to extreme climate events can increase the survival, spread, growth, and establishment of pests (IPCC 2014). Rooting and burrowing mammals and termites have the potential to cause direct damage to power, water, transportation, and building facilities (Vissicelli 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.

Increased temperatures will result in redistribution of pests and intensification of pest outbreaks (Logan et al. 2003). Because temperature and other environmental conditions influence forest insect populations and outbreaks, climate change has and will continue to impact pest infestations (Pureswaran et al. 2018). In an extensive review of US forest pests, Pureswaran and others (2018) noted that expansions and/or the area of outbreak of defoliators and wood boring insects is associated with warmer winter temperatures.

Where pests and invasive species may be anticipated due to climate change (or other factors), [building](#) and [landscaping](#) projects can be designed to prevent pest invasions (Geiger and Cox 2012; and Geiger and Baefsky 2020, respectively). MALU is in a region that will likely be subject to colonization by additional species of termites, which may require enhanced protection of buildings and other wooden structures (Buczowski and Bertelsmeier 2017). When facilities are not designed to deter pests and impacts due to invasions, facilities managers may increase their reliance of pesticides, which will result in increased potential of exposure of people to pesticides, in both indoor and outdoor environments (IOM 2011).

When and where invasions and infestations may occur is difficult to predict because multiple factors such as landscape change, habitat disturbance, and human-facilitated vectors interact with climate change to limit or accelerate the range-expansion of invasive species and pests. Consult with your [regional NPS pest and invasive species management coordinators](#) to identify current and potential invasive and pest infestation threats, as well as management strategies, including contracting BMPs to prevent invasions and spread of invasive/pest species, early detection/rapid response, mitigation, and eradication tactics to help design, construct, and manage your facilities and managed landscapes to minimize the impacts of invasive species and pests.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

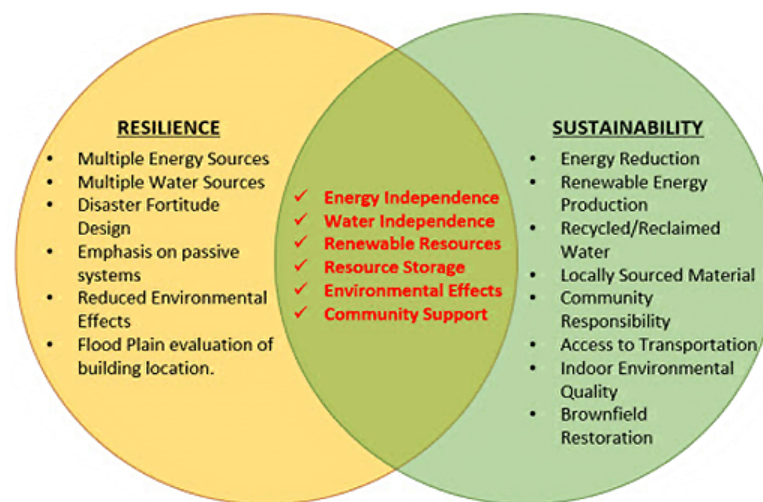
Step 2: Consider adaptation and resiliency strategies

- 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

- Example responses to Question 16 are provided below. THESE ARE GENERIC EXAMPLES FROM OTHER PARKS. You can view other examples here: [Example responses to Q16 on hazards Organized by Park](#).
- 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.
- The NPS Climate Change Response Program (CCRP) and Sustainable Operations and Maintenance Branch (SOMB) are available to help evaluate climate change hazards and resiliency strategies for your specific projects. Requests should be sent to the NPS [GFIP Hazards and Risk Assistance email account](#); a member of the team will reply with support.

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 Grand Teton National Park: Road improvement project

Several climate change related 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. The primary hazard affecting this project is spring runoff and flooding. Projected warmer and wetter spring seasons are likely to result in increased rain on snow events, which lead to higher peak spring runoff volume, flooding, and streambank scour/erosion. Increased flooding along with potential impacts from increased wildfire (erosion and reduced infiltration) will cause the river channel to become even more dynamic and increase the likelihood of road bank failure.

Past weather-related impacts at Gros Ventre Road include:

- The Gros Ventre River is a braided river that is roughly 1,500 feet wide and the active flow channels frequently migrate and avulse across the braided channel. In recent years, unprecedented spring high water flows have caused the main channels of the river to erode the bank adjacent to and undercutting the Gros Ventre Road. In 2017, the road washed out and required \$6M in repairs.

Future climate changes that may impact this project could include:

Precipitation changes

- Expected warmer and wetter spring seasons are likely to result in rain over snow events, which lead to higher peak spring runoff volume and water velocity. It is predicted that the temporary fixes have a limited lifespan if runoff and higher than average spring flows continue to increase, and the river does not change course.
- If precipitation increases or changes, this too may cause increased soil moisture which may affect the structural integrity of the roads and slopes.

Increased temperatures may contribute to pavement degradation. Crack/heave damage occurs in drier soils.

The park will consider the following measures to improve resilience to these hazards:

- Design and Engineering Enhancements:
 - This project will either armor the bank or relocate the roadway away from the river (onto a nearby bench away from the highly eroded riverbank allowing the river to maintain a more natural course), depending on future studies (archeological, hydrologic, engineering, etc.), environmental analysis, and potential lifecycle costs of both options taking into account the future potential hazard of increased flows and the river changing course.
 - Slopes may need to be adjusted and properly placed culverts installed.
- Planning
 - Revegetation will be a vital component to increase resilience to precipitation changes and increased temperatures. Design and maintenance are vital.

This project will advance sustainability through the following strategies:

- The 2006 Transportation Plan which analyzed 22.5 miles of multiuse pathways and 18.8 miles widened shoulders to be used as a bike lane, including this segment of the Gros Ventre Road. These pathways and widened shoulders are not only used by park visitors recreationally, but also for local residents commuting to and from work in the park and the town of Jackson, providing enhanced recreational and transportation opportunities that are low carbon output.

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.
 - 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 Martin King Jr. National Historical 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 Judgement' 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 ☒ Potential Hazard ☐ Not Applicable ☐	• Inadequate HVAC • Road surface degradation • Lack of water due to increased water for irrigation • Increased humidity • Danger to staff	• National Climate Assessment • State climate summary	• National Climatic Data Center • DAYMet gridded climate data • National park historical and projected climate change

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	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Limited water supply for cooling, landscaping, structural fire suppression, other equipment • Increased competition for available water and water rights conflicts • Crack/heave damage in drier soils • Increased vulnerability to wildfire (below)	• Drought Monitor • National Integrated Drought Information Center • National Climate Assessment • State climate summary	• Drought Monitor • National Integrated Drought Information Center
Increased wildfire frequency, intensity, magnitude, and duration	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Damage to facilities and contents • Smoke damage • Air quality dangerous to staff and visitors • Increased runoff • Increased erosion • Damage to water treatment plants	• Barbero et al. 2015 International Journal of Wildland Fire	• NIFC • International Wildland-Urban Interface Code

Potential Climate Hazard	Best Professional Judgment	Examples of risk or secondary hazard	Sources of General Non-site specific Data	Sources for Site Specific Data
Altered precipitation patterns, increased extreme precipitation, and changing humidity	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Local flooding • Mold growth • Wood decay • Drought • Fire • Groundwater change • Surface erosion • Floods (see below) • Water damage to structures from driven rain • Unstable saturated soils	• National Climate Assessment • State climate summary	• National Climatic Data Center • DAYMet gridded climate data • National Park historical and projected climate change • Evaluations are mostly at regional scales
Riverine flood/flash flood	Known Hazard ☒ Potential Hazard ☐ Not Applicable ☐	• Damage or destruction of infrastructure • Stream channel migration • Stream bank erosion/extreme erosion • Safety • Water quality diminished • Damage to water source and delivery infrastructure • Changing requirements for culvert flow capacity	• FEMA Flood map service	• FEMA Map Service Center • Floodplain maps for HUD projects • Van Dusen et al. 2020 (for select parks) • May require a special flood study

Potential Climate Hazard	Best Professional Judgment	Examples of risk or secondary hazard	Sources of General Non-site specific Data	Sources for Site Specific Data
Sea level change and coastal storm surge	Known Hazard ☐ Potential Hazard ☐ Not Applicable ☒	• Rising sea and lake levels • Rising water – wind driven (e.g. hurricane, nor’easter) • Saltwater intrusion • Vegetation damage	• NOAA SLR viewer • NOAA - Great Lakes Environmental Research Laboratory	• IRMA – Coastal reports • NPS SLR viewer • Specific Hazard Assessment: Coastal Storm Surge with Climate Change Effects(requires VPN connection) • SLR reports • Great Lakes Dashboard Project
Lake and reservoir level change	Known Hazard ☐ Potential Hazard ☐ Not Applicable ☒			
Hurricanes and tornadoes	Known Hazard ☐ Potential Hazard ☐ Not Applicable ☒	• Building destruction • Flying debris • Storm surge • Tree fall (see other categories for associated intense rainfall and floods)		• Wind speed data – from local codes • International Building Code • FEMA Map Service Center

Potential Climate Hazard	Best Professional Judgment	Examples of risk or secondary hazard	Sources of General Non-site specific Data	Sources for Site Specific Data
Pest infestation	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Historic/facility fabric loss • Vegetation loss • Disease vectors may increase • Termites and other woodboring pests expanding range with warming and increased humidity	• USFS Forest Health Advisory System	• NPS Pest and Invasive Species Management Contacts • Fisichelli et al. forest pests • USFS maps
Invasive species	Known Hazard ☐ Potential Hazard ☒ Not Applicable ☐	• Aquatic mussels – water intakes clogged • Vegetation (kudzu, vines) – damage buildings, kill trees, obstruct waterways	• National Invasive Species Council	• NPS Pest and Invasive Species Management Contacts • Early Detection and Distribution Mapping System (current distribution) • Early Detection and Distribution Mapping System (projected distribution)

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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.