



Climate Change Hazards Summary Report for Facility Investment Planning

Gateway National Recreation Area 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 Gateway National Recreation Area

- 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. Hotter days will affect visitation and may require more spaces for visitor cooling.

Annual average temperatures in New York State have risen 2.4°F since 1970, with winter warming exceeding 4.4°F (Rosenwig et al. 2011). For Gateway, models project between 3-5°F of warming by mid-century from a baseline of 53°F and as much as 5-7.5 °F warming by 2100 (Rosenwig et al. 2011, Abatzoglou and Brown 2012, [Gonzalez et al. 2018](#)). Heat waves will become more frequent and intense, increasing heat-related illness (Rosenwig et al. 2011). Higher temperatures and increased heat waves have the potential to increase the fatigue of materials in infrastructure and increase electricity demand for cooling (Rosenwig et al. 2011).

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.

For Gateway, by mid-century, models project up to 7-10% increase in annual average precipitation, from the historical average of 47 in/yr, and a 10-14% increase in annual average precipitation by 2100 (Rosenwig et al. 2011, Abatzoglou and Brown 2012, [Gonzalez et al. 2018](#)). Projected precipitation increases are largest in winter, mainly as rain (Rosenwig et al. 2011). New York State has the most days per year of freezing rain in the nation, affecting ground transportation, and causing electric and communication outages (Rosenwig et al. 2011). Heavy downpours are increasing and are projected to increase further, leading to flooding of rivers, roadways, rail lines, and key transportation hubs (Rosenwig et al. 2011).

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), and affect soil heaves and shrinkages (Fernandes et al. 2015).

The Northeast U.S. is a wet region that historically experiences damaging droughts, despite simultaneous increasing precipitation (Dupigny-Giroux et al. 2018). Climate models suggest that, despite projected increasing precipitation, increased temperatures and precipitation variability will likely lead to more frequent short, but intense drought conditions (Krakauer et al. 2019, Pendergrass et al. 2020). These "flash droughts" are characterized by short, intense sudden onset droughts and rapid intensification of conditions with severe impacts (Pendergrass et al. 2020). Summer drought is expected to increase, affecting water supply (Rosenwig et al. 2011).

Park staff assessment – relevant to GFIP Project:

☐ Yes

☐ No

Sea level rise and coastal storm surge

Global sea level is rising and will continue to increase (Tebaldi et al. 2012), with local variability. Sea level has risen about 1 foot since 1900 along New York's coast (Rosenwig et al. 2011). Higher relative sea level causes accelerated coastal erosion, saltwater intrusion and changes in groundwater, and amplifies flooding caused by higher storm surges (Field et al. 2007). Sea level rise poses considerable risks to lighthouses, forts, and other historic structures. Roads, parking lots, comfort stations, utilities, docks, marinas, walkways, and other ground level infrastructure are at increased risk with higher levels of groundwater and storm surge (Rosenwig et al. 2011). Sea level rise visualization tools are available such as the [NPS Sea Level Rise Viewer](#) and for parks with exposure or vulnerability assessment by asset through the [Climate Vulnerabilities Map](#).

For Gateway, sea level rise projections range from 0.27 meters (~1 foot) by 2050 to 0.52-0.77m (1.7-2.5 feet) by 2100 (Caffrey et al. 2018; Rosenwig et al. 2011). If melting of Greenland and Antarctic Ice Sheets continues to accelerate, sea level will exceed projections based on climate models. A rapid ice melt scenario yields sea level rise greater than 1 meter (3.28 feet) by 2100 (Rosenwig et al. 2011). The shoreline structures that stabilize and provide access to this landscape must be designed and retrofitted to accommodate elevated water levels, including storm surge, and critical systems should be elevated above future flooding levels (see Sandy Chapter in Beavers et al. 2016). As sea levels rise, many more New York City streets will flood, and many transportation related assets and utilities in also low-lying vulnerable locations will be affected (Rosenwig et al. 2011).

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 and insect attack, mold and mildew, and physical deterioration of wood, brick, and stone building materials.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

Hurricanes and tornadoes

Hurricanes are projected to increase in intensity and precipitation in a warmer world (USGCRP 2017). Storm surge can cause flooding and road wash outs. The combination of sea level rise and increased hurricane storm surge will flood structures that previously were outside of the floodplain. Flood and storm surge depths may be deeper than in previous storms. Flooding may occur in areas that had no flooding during past storms. Building standard guidance is based on base flood elevations of 2-3 ft above FEMA flood zones of 100-year (1%-annual chance) storms, depending on the building criticality (Beavers et al. 2016). For existing buildings that are not above base flood elevation, adaptation measures to reduce flood impacts should be considered. Hurricanes also threaten structures via damage from wind, wind-blown rain and debris; their large temperature swings stress buildings through sudden thermal expansion and can crack pipes.

North Atlantic hurricane intensity and rainfall rates are projected to increase under continued climate change, although projections of the total number of North Atlantic hurricanes under climate change vary (IPCC 2014, USGCRP 2017). Under a low greenhouse gas emissions scenario, the maximum intensity during the course of individual North Atlantic hurricanes could increase 4% and rainfall rates could increase 15% to 20% by 2100 (Knutson et al. 2015). At current sea level, maps of inundation by [hurricane](#) category are available (Caffrey et al. 2018). Both erosion and storm surge will become more damaging and more likely as sea level continues to rise.

Climate change can increase the frequency of severe thunderstorms, which generate tornadoes, although analyses of historical records from 1954 to 2017 show mixed trends in the total number of tornadoes, with decreases in the southern Great Plains, increases in the southeastern U.S., and shown no statistically significant trend for the U.S. as a whole (Agee et al. 2016, Brooks et al. 2014, Gensini and Brooks 2018). For the U.S. as a whole, the number of days with over 30 tornadoes (Brooks et al. 2014, Elsner et al. 2015) and the number of tornadoes per tornado outbreak have increased (Moore 2017, Tippet and Cohen 2016). Moreover, tornado power, a function of wind speed, tornado path area, and air density, has increased $5\% \pm 1\%$ per year from 1994 to 2016 (Elsner et al. 2019).

Under continued climate change, the potential for severe thunderstorms that provide conditions for tornadoes may increase substantially across the central and eastern U.S. (Diffenbaugh et al. 2013, Gensini and Mote 2015). Increasing urban and suburban development in tornado-prone areas increases the exposure to damage for the U.S. as a whole (Strader et al. 2017). 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

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; Rosenwig et al. 2011). 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 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

Invasive species

Increased temperatures and CO₂, 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). With warming, the length of the growing season is expected to increase, which can benefit some invasive species.

Park staff assessment – relevant to GFIP Project:

- ☐ Yes
- ☐ No

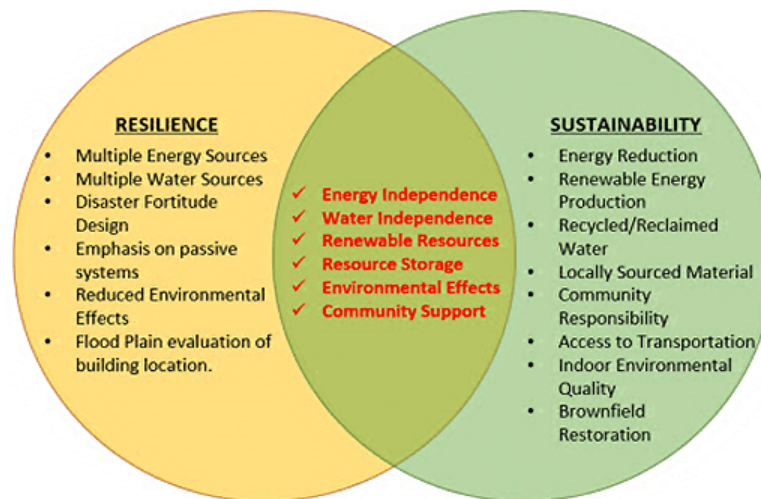
Step 2: Consider adaptation and resiliency strategies

- 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. See the NPS [Coastal Adaptation Strategies Handbook](#) (Beavers et al. 2016) for more NPS examples.

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?

3 Examples from Gateway National Recreation Area:

As a marine park located at the lower end of New York Harbor and the Atlantic Ocean and Jamaica Bay (NY), any project contemplated within the park must consider the following complex issues: Climate Change, Sea Level Rise, Historic Storm Surge Events and Park Policy (Superstorm Sandy), Geomorphic Data (Water Table & Subsidence Issues), FEMA Flood Zone Designations, Coastal Management and Compliance. The Secretary of the Interior’s standards for Flood Adaptation, Sustainability, and Resiliency will also be incorporated as required to meet NPS standards. Many of these issues have been previously addressed through recovery projects completed during Superstorm Sandy Recovery but each new project will require examination, review, and approval based on the specific elements of the project.

1) Marine structures: Docks, bulkheads, etc.

Projects involving marine structures must consider sea level rise and potential for increased future storm surge. Shoreline protection structures will evaluate how their intended function will change under higher sea level and storm surge. Projects to repair replace decks, boardwalks, and boat docks will include flow-through decking, up-sized pile foundations, and elevated boardwalk and docks where applicable. All site infrastructure may need to be raised to accommodate King Tide elevations (high tide flooding), ~50 years of sea level rise (adjusted for life cycle of the assets), and wave action. All structures must incorporate design elements to address impacts to adjacent and down-drift natural and cultural resources since many marine structures alter sediment transport pathways.

2) Historic Structures at Sandy Hook

By nature of their purpose, forts and batteries are in locations of increased exposure to storm flooding and sea level rise, but for the most part are not especially sensitive. Climate impacts increase maintenance and replacement needs for some features, e.g. metal doors, increased concrete spalling. Electrical and ventilation systems need to be adapted to reduce system vulnerability. Hurricane force wind and wind-blown rain as well as damage from wind-blown debris will require wind resistant fortification of some structures; for rehabilitation of hangars in particular, retrofitting roof structures to be more wind resistant may be required. Adaptation actions for most structures, including operations buildings, maintenance and housing, will include identifying appropriate sustainable infrastructure and facility designs that are more resilient to heavy precipitation, basement flooding, mold and pest infestations. Actions will include assessing building drainage systems, identifying appropriate dehumidification and air handling systems. For historic structures, coordinate with historic preservation experts including the NPS Historic Architecture, Conservation and Engineering Center (HACE) regarding alternatives and maintenance for historic structures that are sustainable and meet the Secretary of the Interior's Standards for the Treatment of Historic Properties. Additionally, the park has submitted a project for consideration of Legacy Restoration Funding that addresses deferred maintenance and repairs to a seawall protecting historic structures at Sandy Hook. Additional seawall projects have been submitted into Line Item Construction for funding consideration to make repairs to the seawall adjacent Officer's Row. Both projects seek to address potential climate change issues over the lifespan of the existing seawalls at the park.

3) Coastal roads and utilities

Coastal roads and utilities are vulnerable to the effects of climate change through sea level rise and its associated impacts such as increased coastal erosion, flooding from increased precipitation events and decreased drainage, inundation from salt water storm surge, increased coastal erosion, high winds, and elevation of groundwater and saltwater intrusion. Older sewer lines and storm water systems that have breaks and are very porous will result in the treatment facility processing larger volumes of rainwater as storm water. Newer/repared systems will process less rainwater as storm water, which will 1) reduce overall load on a treatment facility, and 2) allow the rainwater to recharge surface water and groundwater ecosystems.

Transportation and utility corridors must address these coastal hazards:

- Coastal erosion – destabilizes the ground on which the systems are constructed.
- Flooding due to precipitation – a sea level rise elevated water table and increased intensity of storms could combine to slow drainage and add volume to the amount of water a drainage system needs to accommodate, resulting in an exceedance of the capacity of existing drainage systems.
- Inundation by saltwater storm surge – when inundated, storm water pipes can float to the road surface damaging the road, and the roadbed can become saturated damaging pavement substructures. Frequently flooded roads are more likely to experience pavement damage during any given flood event. Electrical systems may need to be shut off and must incorporate flood proofing elements.
- Elevated water table - Groundwater is expected to rise with sea level rise and will intersect the unbound layers of coastal road infrastructure, thus reducing the service life of pavement. As groundwater interacts with pavement materials, the road will experience fatigue and rutting with service life reduction, the magnitude and timing of which depended on the current depth to groundwater.

- High winds – Above ground utilities are subject to downed power lines and hazard trees. Due to the increasing number of flooding events, storm surges, and beach erosion, there will be a need for more frequent and extensive maintenance and rehabilitation of transportation infrastructure.

Adaptation can reduce these costs through three approaches: protection, accommodation, and retreat:

- Protection – For roads: increase drainage system capacity, install/increase pumping stations, divert to water retention areas, install structures like seawalls to divert storm surge, and plan for higher water level including last water intrusion. Move existing above ground electric transmission lines impacted by weather and place them in underground conduit. Weather-proof electrical disconnect switchgear and incorporate transformers with disconnects for continuity of service isolation.
- Accommodation – elevate roads and utilities to avoid the impacts of flooding, use pervious materials to increase drainage capacity of roads and impervious material to limit infiltration of water lines; install pumps; eliminate exfiltration trenches as a drainage solution; install WellPoint dewatering, re-engineer canal systems, control structures, and pumping stations.
- Retreat – anticipate vulnerable sections of road and move them out of harm's way or switch to an alternate mode of transportation. Allow for wetlands and beaches to move or grow. Aside from these direct impacts to roads themselves, there are concerns that inundation or closure of some roads can cause congestion to others within the overall transportation network (Nazarina et al. 2020).

Example from San Francisco Maritime National Historic Park: pier repair, historic building restoration, road repair, or water system project

Several climate change hazards may affect a (pier repair, historic building restoration, road repair, or water system) project at San Francisco Maritime National Historical Park, including sea level rise, storm surge, more frequent storms, San Francisco Bay flooding, increased street stormwater runoff, hotter temperatures, and increased insect pests. Possible adaptation and resiliency strategies include:

- Adoption of sea-level rise adaptation measures developed by Golden Gate National Recreation Area in a plan for Crissy Field ([CMG Landscape Architecture 2016](#)) that covers an area up to the western boundary of San Francisco Maritime National Historical Park.
- Natural shoreline features along Aquatic Park Beach to handle some inundation from sea level rise.
- Vegetated catch basins for urban street stormwater runoff.
- Drainage systems and culverts that could handle greater water flows.
- Relocation of any infrastructure from an area where a hazard cannot be avoided.
- Water conservation measures to reduce water use during droughts.
- Strengthening structures to prevent damage from extreme storms or treefall.
- Changes in building design or post-flooding dehumidification systems, coordinating with the NPS Historic Architecture, Conservation and Engineering Center or Historic Preservation Training Center and avoiding any increase in energy use, which would increase greenhouse gas emissions and exacerbate climate change.
- Changes in building design or building systems to maintain appropriate temperatures and humidity without increasing energy use, which would increase greenhouse gas emissions and

exacerbate climate change. Energy conservation and renewable energy systems to prevent any increase in fossil fuel energy use.

- Early detection and removal of termites or other pests or hazards.

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 **Gateway National Recreation Area** 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 ☒ 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.