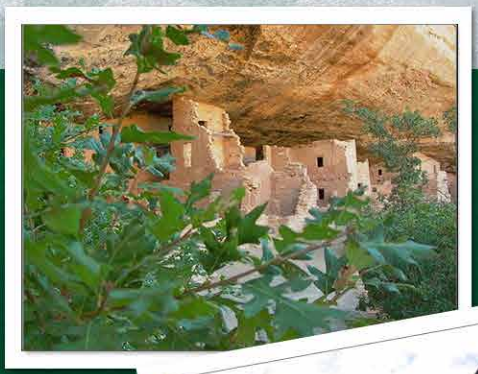
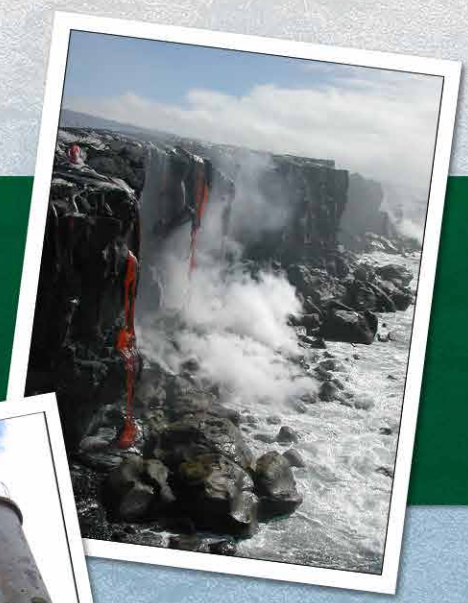
NATIONAL PARK SERVICE • U.S. DEPARTMENT OF THE INTERIOR

RESOURCE STEWARDSHIP STRATEGY

SUPPLEMENTAL GUIDANCE: INTEGRATION OF CLIMATE CHANGE SCENARIO PLANNING INTO THE RESOURCE STEWARDSHIP STRATEGY PROCESS





RSS
RESOURCE STEWARDSHIP STRATEGIES

BRIDGING SCIENCE AND MANAGEMENT FOR TODAY AND TOMORROW

FEBRUARY 2020

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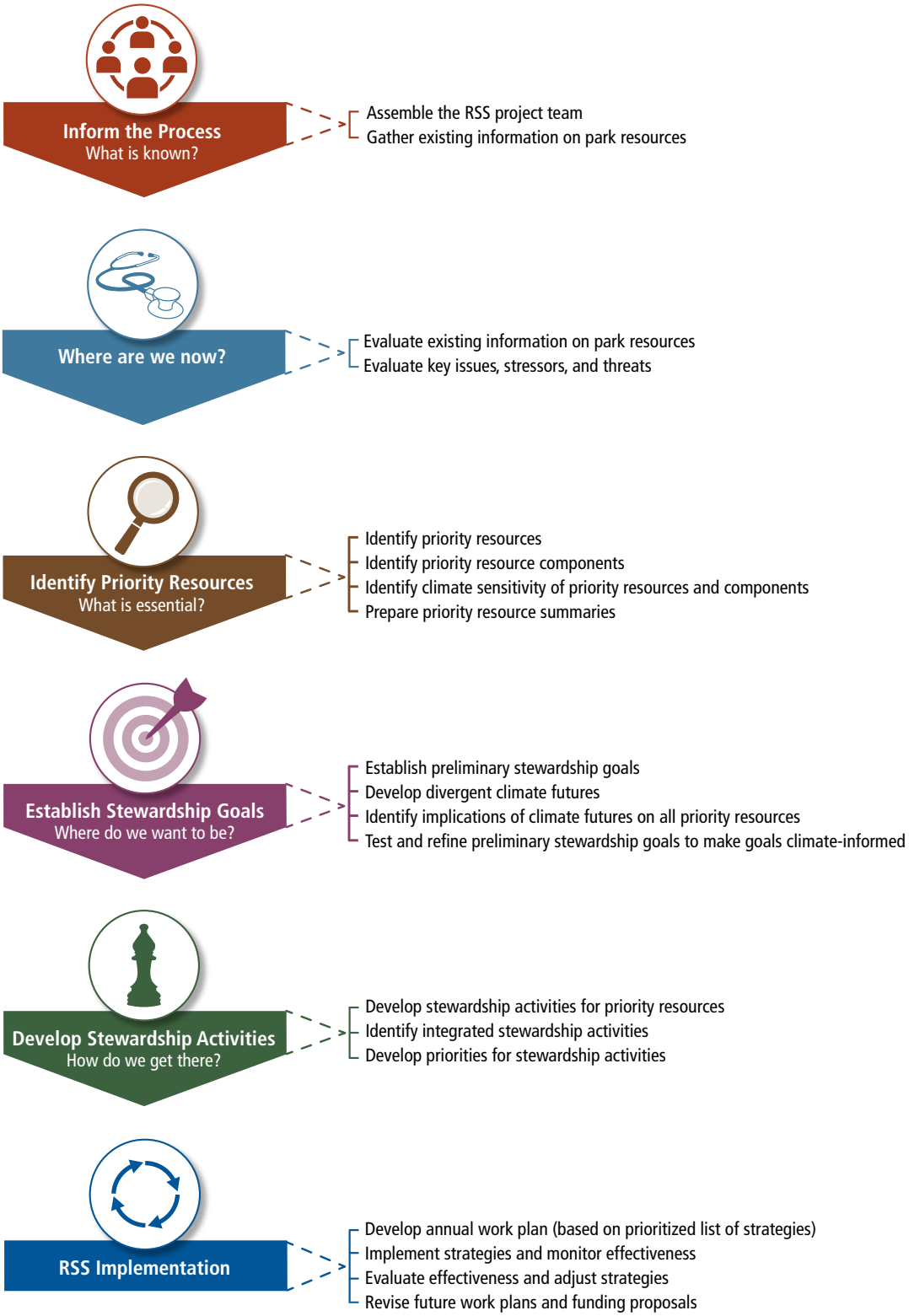
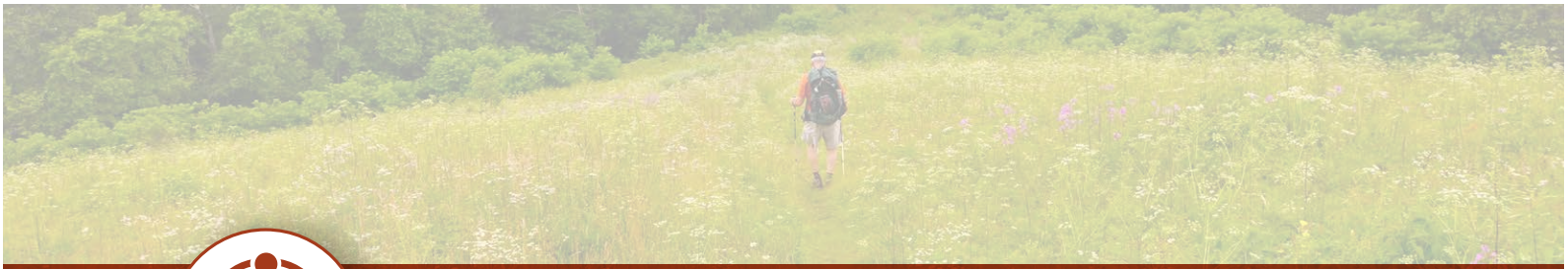
INTRODUCTION

This document is a companion to the Resource Stewardship Strategy Development Guide, developed in 2019. A resource stewardship strategy (RSS) is a strategic plan, intended to help park managers achieve and maintain desired resource conditions over time (see NPS *Management Policies 2006* [§2.3.2]). As part of a park's planning portfolio, a resource stewardship strategy serves as a bridge between the park's foundation document (which contains the park's purpose, significance, fundamental resources and values, interpretive themes, and special mandates and administrative commitments), other plans, and everyday management of its natural and cultural resources. More specifically, a resource stewardship strategy is a dynamic planning tool used to set stewardship goals and track progress in achieving and maintaining desired natural and cultural resource conditions.

This document provides a guide to more thoroughly address climate change in resource stewardship strategies through scenario planning. Climate change, in conjunction with other stressors (for example, nonnative species, overabundant herbivores, disturbances, and insect outbreaks), is fundamentally altering biological and physical properties and processes. Continued changes in the coming years will affect all aspects of park management, from natural and cultural resource management to facilities and visitor experience, yet the exact nature, timing, and location of these changes and their impacts is highly uncertain. Thus, resource managers are dealing with both rapid directional change and tremendous uncertainty. Scenario planning is an important tool for managing parks and moving ahead with decisions that are as fully informed as possible despite climate uncertainty. Scenario planning enables stakeholders to identify key climate sensitivities in resources and management concerns, examine a range of relevant and plausible future conditions, and explore management options that can be appropriate and effective across a range of potential futures. The intent of this guidance is to provide a repeatable methodology that the National Park Service can use to better incorporate scenarios and climate science into resource stewardship strategies. Figure 1 provides a high-level illustration of the integrated methodology.

Figure 1. Overview of RSS development process with integration of climate change scenario planning.





STEP 1: INFORM THE PROCESS

A. ASSEMBLE THE RSS PROJECT TEAM

Follow the standard RSS process for assembling the *RSS Project Team* as outlined in the RSS Development Guide. In addition, for scenario integration, it is important to include at least one climate change adaptation and scenario planning specialist on the *RSS Core Team*. This person (or people) will serve as the lead(s) for the *RSS Climate Change Team* (see team make-up details in figure 2) and will contribute technical expertise and guidance that will be key to successful integration throughout the RSS process. Staff from the NPS Climate Change Response Program can assist the Denver Service Center (DSC) planning staff in identifying such experts who may reside within the National Park Service or outside the agency. The adaptation/scenario planning specialist(s) will lead the development of climate-resource scenarios for the resource stewardship strategy, a process that will usually involve a wider group of experts. This group will work together as the *RSS Climate Change Team* and may include additional adaptation/scenario planning specialists, climatologists, and scientists with applicable resource expertise. The *RSS Climate Change Team* and/or the *RSS Core Team* will consult other *Subject-Matter Experts* (SMEs) as necessary.

Prior to the standard RSS project kick-off meeting with the full RS*S Project Team*, the project manager should plan a separate meeting to introduce the *RSS Core Team* to the *RSS Climate Change Team*. Then, in turn, the RSS project kick-off meeting will be used to orient the full *RSS Project Team* to climate-resource-scenario integration in the RSS process. In this meeting, the project manager should

1. provide an overview presentation of the RSS process and climate-resource scenario integration,
2. review and discuss the best practices for this integration,
3. establish a common understanding of the project scope, and
4. confirm the goals of climate-resource scenario integration in the resource stewardship strategy.

The ideal make-up of the various subgroups involved in this integrated process is detailed in figure 2, and the relationships of those subgroups is illustrated in figure 3.

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Figure 2. Ideal make-up of subgroups involved in an RSS process that involves scenario integration.

RSS CORE TEAM

- Project manager (DSC)
- Natural resource specialist (DSC)
- Cultural resource specialist (DSC)
- Park Chief of Resources or other designee(s) (i.e., primary park point(s) of contact)
- Lead climate adaptation/scenario planning specialist(s)
- Regional RSS liaison (optional)

RSS CLIMATE CHANGE TEAM

- Lead climate change adaptation/ scenario planning specialist(s)
- Additional climate change adaptation/ scenario planning specialists
- Climatologist
- Climate data specialist
- Scientist(s) with applicable resource expertise

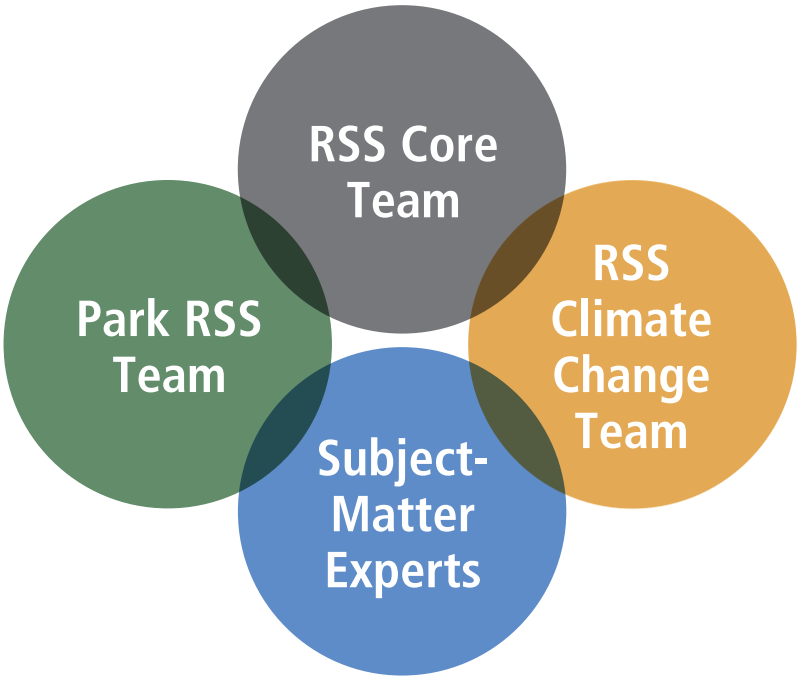
SUBJECT-MATTER EXPERTS

- Topic-specific experts on *Priority Resources* or processes that affect those resources, especially in—but not limited to—the context of climate change. These may include NPS staff at the park, regional, and national levels, as well as experts from outside organizations. Examples of SMEs include NRSS specialists, NPS regional cultural and natural resource socialists, NPS regional cultural and natural resource staff, park specialists, university climate scientists, and U.S. Geological Survey ecologists or other scientists.

PARK STAFF

- Superintendent
- Park Chief of Resources or other designee(s) (i.e, primary park points(s) of contact)
- Natural resources staff
- Cultural resources staff
- Other relevant staff

Figure 3. Representation of subgroups within the *RSS Project Team* and their overlap. Note that some subject-matter experts and climate change team members may not be involved in the full RSS process.



B. GATHER EXISTING INFORMATION ON PARK RESOURCES

When gathering useful primary information sources (as outlined in Step One in the RSS Development Guide), look for previously developed sets of climate futures and climate-resource scenarios for the park or region. A climate future is a specific, quantitative, climate projection, whereas a climate-resource scenario includes resource and management concerns and vulnerabilities associated with a specific climate future. Also seek relevant climate-related information, such as information about recent years of extreme weather and associated resource impacts or completed climate change vulnerability assessments. This information may contribute to either updating existing scenarios or creating new ones. If previously prepared climate futures or climate-resource scenarios exist, the full *RSS Project Team* should evaluate them to assess their relevance for informing the resource stewardship strategy.

Assessment of a climate future set asks whether it is

1. plausible: based on valid and appropriate climate data,
2. relevant: suitable in terms of geographic scope, temporal and spatial scale, and resources, and
3. divergent: spanning the range of plausible future climatic conditions for climate variables relevant to the park's highest priority resources and divergent enough to challenge preconceived notions and longstanding assumptions about these resources.

Furthermore, consider the following questions (making a best guess as to what the park will identify as the *Priority Resources*):

- *Are the futures based on valid and suitable climate projections (considering such factors as the climate models and their performance in the region, emissions pathway(s), and Coupled Model Intercomparison Project phase)?*
- *Do the futures include projections of climate metrics corresponding to the full suite of the park's Priority Resources, or could these metrics be derived from the projections on which the scenarios are based?*

Negative answers to any of these questions indicates that the existing climate futures and any climate-resource scenarios based on them may need to be replaced by new ones or else substantially updated. If the answers are all affirmative, further assessment of climate-resource scenarios is still needed, asking whether

1. the scenarios address the range of resources likely to be encompassed in the resource stewardship strategy,
2. resource and management implications are plausible (based on the current state of science and knowledge), and
3. the scenarios focus on a time period relevant to a resource stewardship strategy (i.e., next few decades for most resources).

Definitive affirmation that a climate future or climate-resource scenario set is adequate, or precise description of how a set needs to be updated, awaits identification of *Priority Resources* in Step Three. However, this assessment is necessary during Step One to determine how much time is required to develop new futures and/or scenarios or to update the existing set.

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BEST PRACTICES

- Include at least one climate adaptation/scenario planning specialist on the *RSS Core Team* who is willing to 1) provide both technical expertise and guidance to the *RSS Project Team* on scenario development and integration and 2) lead other climate change specialists contributing to the process.
- Prepare a kick-off meeting to orient the full *RSS Project Team* to integration of scenario planning into the RSS process and for confirming the project scope and goals.
- Look for existing climate futures and climate-resource scenarios already developed for the park or region. If found, begin to evaluate them to determine whether they can support the RSS process as-is or require updating, or whether new futures and/or climate-resource scenarios need to be developed.
- If new futures and/or climate-resource scenarios are required or if existing ones require substantial updating or expansion, build in additional time (possibly several months or more) and work from the *RSS Core Team* to support this effort. Create a plan to develop or update scenarios by working closely with the adaptation/scenario planning specialists.

Please refer to appendix A for a glossary of climate change-related terms.

STEP 2: EVALUATE PARK RESOURCES

A. EVALUATE EXISTING INFORMATION ON PARK RESOURCES

Follow the standard RSS process for evaluating existing information on park resources as outlined in the RSS Development Guide. Although the standard RSS process involves an evaluation of information on park resources in this step, please note that the evaluation of existing information on climate-resource scenarios for the park is included in Step One. This initial evaluation in Step One is done so that a decision on whether new climate-resource scenarios need to be developed, or whether existing scenarios are adequate as-is or need to be updated, is made as early in the RSS process as possible.

B. EVALUATE KEY ISSUES, STRESSORS, AND THREATS

Follow the standard RSS process for evaluating and compiling key issues, stressors, and threats as outlined in the RSS Development Guide. Climate change will inevitably be identified as a key stressor or threat during this process. At this point, however, for the purpose of identifying *Priority Resources* in Step Three, focus on the aspects of climate change that are already occurring or will inevitably occur in the future (e.g., rising sea level, air and water temperatures, and storm severity). Also direct climate-related discussion to ask park staff how recent and historical extreme weather events and periods impacted park or nearby resources. These discussions provide the *RSS Climate Change Team* with critical insight on which *Priority Resources* may be climate-sensitive and to which aspects of climate they are sensitive. Climate change-related stressors or threats that *may* occur, depending on how future climate plays out, will be analyzed in much greater detail later in this modified RSS process (modified Step Four).

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STEP 3: IDENTIFY PRIORITY RESOURCES

A. IDENTIFY PRIORITY RESOURCES

Follow the standard RSS process for identifying *Priority Resources* as outlined in the RSS Development Guide. As with the standard process, the park staff will ultimately decide on the final set of *Priority Resources* to carry forward in this integrated RSS process.

As part of the climate change scenario planning integration, the *RSS Climate Change Team* is charged with identifying *Climate-Sensitive Priority Resources* and their specific climate sensitivities as an integral element of Step Three. In some cases, it may be possible to identify climate sensitivities at the *Priority Resource* level, but it is more likely that resource climate sensitivity will need to be discussed at the *Component* level. Thus, the process for identifying climate sensitivities is described after *Component* identification.

B. IDENTIFY PRIORITY RESOURCE COMPONENTS

Follow the standard RSS process for identifying *Priority Resource* components as outlined in the RSS Development Guide. As noted in the Development Guide's best practices for this step, some *Priority Resources* may be "stand-alone" and do not need to be broken down into *Components*. However, while the *RSS Project Team* might determine that not every *Component* requires a unique stewardship goal as part of Step Four, it is very helpful to identify/list the various *Components* that are integral to the overarching priority resource. This helps ensure that the entire *RSS Project Team* and all future inheritors of the RSS product are aware of the intended scope and make-up of the broader, overarching *Priority Resource* categories. In addition, the *RSS Climate Change Team* often focuses on *Components* when conducting resource sensitivity research, because *Components* may differ significantly in their climate change sensitivities. For example, built resources made out of different materials or located in different places can have very different sensitivities to wildfire or flooding, and different native vegetation communities (e.g., prairie, riparian) can be sensitive to different aspects of climate.

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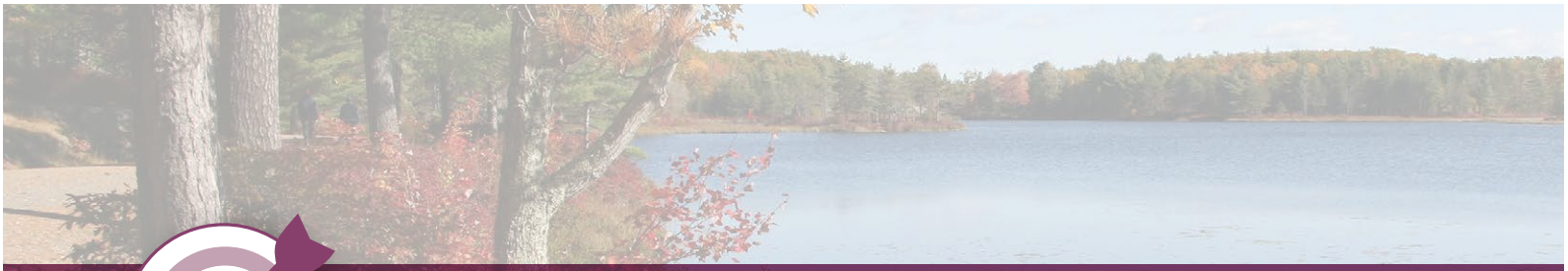
C. IDENTIFY THE SUBSET OF PRIORITY RESOURCES OR RESOURCE COMPONENTS THAT ARE CLIMATE SENSITIVE AND THEIR CLIMATE SENSITIVITIES

This task will be handled by the *RSS Climate Change Team*, but it will likely also engage the *RSS Core Team* and should involve input from subject-matter experts. The goal of this substep is to develop, as much as is possible, a detailed and thorough understanding of each Priority Resource (and *Components*, where appropriate) and its climate sensitivity, typically relying on existing knowledge. The process begins with the *RSS Climate Change Team* compiling the relevant information gleaned from Step Two-B and Steps Three-A and -B into a preliminary matrix of resource components and the aspects of climate to which those components are sensitive (e.g., drought, high temperatures, extreme cold, or heavy precipitation events). The *RSS Climate Change Team* then consults park staff and other subject-matter experts, the scientific literature, park planning documents, and previously prepared climate-resource scenarios to fill in the resource climate-sensitivity matrix with written descriptions of how each resource component responds to, or is affected by, various aspects of climate (see appendix C). Keep in mind that, even if previously prepared climate-resource scenarios do not meet the criteria for use in RSS preparation, they may still provide valuable information for filling in this matrix.

D. PREPARE PRIORITY RESOURCE SUMMARIES

Follow the standard RSS process as outlined in the RSS Development Guide. Climate sensitivities are not typically included in resource summaries because these are high-level descriptions of priority resources that do not usually address specific resource issues, stressors, and threats. Rather, climate sensitivities are captured in an accompanying scenario planning report, which should be referenced in the summary document.



STEP 4: ESTABLISH STEWARDSHIP GOALS

Step Four of the integrated RSS-scenario process is where most of the procedural and sequential process modifications (relative to the basic RSS approach) take place. Given this complexity, the basic elements of the modified Step Four and the primary teams responsible for each are listed below.

STEP FOUR TASK	TEAM RESPONSIBLE FOR TASK
A. Establish general, preliminary stewardship goals for each identified Priority Resource (and Components, where appropriate) based on Step Two analysis of key issues, stressors, and threats (i.e., not divergent climate futures) and other desired resource conditions.	Full *RSS Project Team*
B. Develop or update divergent climate futures based on the *Climate-Sensitive Priority Resource* list.	*RSS Climate Change Team* (with input from subject-matter experts and other project team members)
C. Identify implications of each climate future for each Priority Resource (i.e., identify vulnerabilities), and merge these climate-resource scenarios with the list/table of implications of all non-climate stressors and threats compiled in Step Two.	Full *RSS Project Team*
D. Examine and test preliminary stewardship goals for each Priority Resource (developed earlier in the Step Four) in the context of climate-related implications of each scenario, and refine goals to make climate-informed as needed.	Full *RSS Project Team*

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A. ESTABLISH PRELIMINARY STEWARDSHIP GOALS

Refer to Step Four of the standard RSS process in the RSS Development Guide for information on goal development for this preliminary step. As noted above, this step is based on Step Two analysis of key issues, stressors, and threats (including ongoing or widely anticipated climate changes) and does not yet consider the climate projections in detail or divergence among plausible climate futures (which are only developed in Step Four-B). The *RSS Project Team* can develop stewardship goals at the *Priority Resource* or *Component* level. Additionally, this step is completed independently of identifying resource climate sensitivities in Step Three-C and thus could be completed immediately after *Priority Resources* and *Components* are identified.

Stewardship goal setting can be accomplished with various approaches noted in the RSS Development Guide (long-term/short-term, management priorities, and/or single goals). The *RSS Project Team* should consider which approach would be most effective for the particular park unit in question while considering the timeframes of climate change scenario planning. Goal-setting with a tiered structure of both long-term and short-term goals allows park resource managers to develop interim 'benchmark' short-term goals that would allow them to monitor progress towards more broad-level, long-term goals or management priorities that are robust across all climate-resource scenarios. The chosen timeframe for the long-term goal will depend on the nature of the resource in question and the severity of the threat on the resource, as well as park staff management preferences. This timeframe informs the development of new, or assessment of existing, climate futures and climate-resource scenarios.

B. DEVELOP OR UPDATE DIVERGENT CLIMATE FUTURES

The *RSS Climate Change Team* is charged with this task, but occasional check-ins with the *RSS Core Team* will likely be necessary and helpful. The *Climate-Sensitive Priority Resources* will be used to inform the development or updating of divergent climate futures and therefore ultimately the development or updating of the climate-resource scenarios for this project. In most instances, parks will not have appropriate climate futures or scenarios at the beginning of the RSS process. Consequently, the guidance henceforth assumes this is the case. If the assessment of existing climate futures or scenarios conducted in Step One suggests that they are appropriate, this is the time to use the following guidance to reassess their utility, determine what expansions or updates are required, and achieve those updates.

The *RSS Climate Change Team* first translates climate sensitivities of *Priority Resources* or *Components* into corresponding climate metrics that can be calculated from the available climate projection data and appropriate models. For example, sensitivity to flooding might be addressed by running a hydrological model to project future river flow rates or frequencies of flows over a certain threshold. More often, such models will not be available, and a proxy will be needed. In the flooding example, an appropriate proxy metric might be the frequency (days/year) when precipitation exceeds a particular threshold. The *RSS Climate Change Team* then draws on the expertise of the *RSS Core Team* to categorize the resulting set of metrics into tier-1 metrics (i.e., those aspects of climate that impact the highest-priority resources or most strongly impact the largest set of park resources) and tier-2 metrics (i.e., aspects that impact lower-priority resources or a more narrow set of resources). The *RSS Climate Change Team* selects a set of three to five, though typically four, specific climate projections1 that are maximally divergent with regard to the tier-1 metrics. They then produce climate futures by summarizing (in figures, tables, and text) tier-1 and tier-2 metrics for the relevant historical period (often 1950-1999), current period (often the last 20 years), future period (typically a 30-year period centered on ~20 years in the future), and the change from the historical or current to the future for each selected projection.

C. IDENTIFY IMPLICATIONS OF CLIMATE FUTURES FOR ALL PRIORITY RESOURCES AND MERGE CLIMATE-RESOURCE SCENARIOS WITH IMPLICATIONS OF NON-CLIMATE STRESSORS/THREATS

Assessing the climate change-related stressors and threats and their specific implications for resources, assets, or values is known in climate adaptation as vulnerability assessment. When conducted for a set of divergent climate futures, the product is a set of climate-resource scenarios. These scenarios organize detailed information that will become the basis for developing or refining appropriate and meaningful RSS goals and activities that respond to those stressors and threats. Although climate change implications (otherwise known as vulnerabilities) are already often considered as one type of stressor or threat to park resources in the standard RSS process, climate-resource scenario integration is a more thorough assessment with more precisely characterized climate projections that includes an additional step for organizing the implications of these climate stressors and threats under each plausible climate future. This step is typically accomplished in the course of a distinct workshop that involves all or most of the *RSS Project Team*.

The implications of all non-climate stressors and threats should also be carried forward (from Step Two), because these too can have substantial effects on resource stewardship, and climate change may amplify their effects.

As part of Step Three, the *RSS Project Team* may have identified *Components* for some or all *Priority Resources*. It may not be necessary to run each individual *Component* for a Priority Resource through the vulnerability assessment if *Components* do not differ significantly in their climate sensitivity. For example, the *RSS Project Team* may identify 'historical structures' as a Priority Resource with individual buildings identified as separate *Components*; if these structures are made out of similar building materials and are exposed to similar climate drivers, they would likely have similar climate sensitivities. During the *RSS Climate Team's* identification of resource climate sensitivities as part of Step Three-C, they will have gathered the information necessary to understand whether climate implications should be identified at the *Priority Resource* or *Component* level for each *Priority Resource*.

EXERCISE: ANALYZE THE CLIMATE AND NON-CLIMATE IMPLICATIONS FOR PRIORITY RESOURCES

The goal of this exercise is to analyze, identify, and affirm the implications of all climate and non-climate key issues, stressors, and threats for all identified Priority Resources under all climate futures. The steps for completing this exercise are as follows:

1. Using a table like table 1, list all of the *Priority Resources* and *Components* identified in Step Three in the first column.
2. Compile the implications of non-climate key issues, stressors, and threats for each *Priority Resource* in the second column of the table. Some of this information can be drawn directly from Step Two, with some likely amendments because of the structure of *Priority Resources* and *Components* identified in Step Three.
3. Compile all implications of each climate future (i.e., climate change vulnerability) for each *Priority Resource* (and *Components,* where appropriate). Record in the appropriate columns ("Scenario 1…" and "Scenario 2…" in table 1). Begin by referring to the resource-climate sensitivity matrix for existing information regarding the implications of future climate conditions on park resources, then use best judgment and group expertise to fill in when relevant information does not exist. Note that only two climate-resource scenarios are illustrated in table 1 because of space limitations.
4. In consultation with park staff, highlight in red any implications that are "red flags" — i.e., those that may be a "very big deal" or may have severe ramifications on park resources, park management needs, or perhaps park significance or purpose. These should be noted for consideration later when goals/activities are refined in the next substep of Step Four and again in Step Five (activity development).
5. (Optional). Identify and record any important climate implications that occur across most or all scenarios in the column entitled "*Climate Change Implications: Common to Most / All*."
6. Capture in the "Notes" column any pertinent notes that are important to remember in later stewardship strategy development discussion.

Table 1. Example of Priority Resources with Key Issues, Stressors, and Threats

PRIORITY RESOURCE	NON-CLIMATE STRESSOR/THREAT IMPLICATIONS	SCENARIO 1: HOT AND DRY IMPLICATIONS	SCENARIO 2: WARM AND WET IMPLICATIONS	CLIMATE CHANGE IMPLICATIONS: COMMON TO MOST/ALL	NOTES/ RATIONALE
PARKWIDE ARCHEOLOGICAL RESOURCES	- Damage to sites in areas of high visitor use and encroachment	- Increased fire damages and exposes archeological sites - Changes in visitor season may push visitors to new areas where sites may be disturbed	- Sites lost to erosion from heavy precipitation and vegetation growth - Changes in visitor season may push visitors to new areas where sites may be disturbed	- Loss of archeological sites overall - Changes in visitor season may push visitors to new areas where sites may be disturbed	- Archeological resources are a FRV and are vulnerable to climate and non-climate stressors and threats that risk permanent damage to sites
WOLCOTT CANYON HISTORIC DISTRICT	- Loss of technical expertise for traditional building maintenance - Poor condition and ongoing deterioration of Wolcott Canyon Historic District	- Increased air conditioning creates more condensation and mold - Increased maintenance needs in response to damage caused by more frequent storm events	- Increased air conditioning creates more condensation and mold - Increased maintenance needs in response to damage caused by more frequent storm events	- Increased air conditioning creates condensation and mold - Increased maintenance needs in response to damage caused by more frequent storm events	- This historic district is an FRV and needs immediate attention to address these threats
GRASSLAND VEGETATION	- Weeds brought by wind, visitors, and wildlife outcompete native vegetation	- Drought-tolerant invasive plant species increase - Short-grass prairie species expand, replacing mixed-grass prairie species	- Invasive plants (cheatgrass, Canada Thistle) increase, altering habitat composition - Increased litter load from higher production combined with difficulty in conducting prescribed fires threaten grassland habitat	- Invasive plants increase	- Vegetation is key to the park's FRV Prairie Landscape, so these threats need to be addressed in the next five years
BISON	- Disease (Brucellosis in bison)	- Hotter, drier conditions mean less forage, less water, and fewer bison	- Higher grass production provides more forage for bison if invasives do not prevail	- Potential, though not guaranteed, loss of forage	- Bison are the wildlife species most threatened by all key issues, stressors, and threats

PRIORITY RESOURCE	NON-CLIMATE STRESSOR/THREAT IMPLICATIONS	SCENARIO 1: HOT AND DRY IMPLICATIONS	SCENARIO 2: WARM AND WET IMPLICATIONS	CLIMATE CHANGE IMPLICATIONS: COMMON TO MOST/ALL	NOTES/ RATIONALE
NATIVE FISH SPECIES	- Reduced water quality from upstream contaminants; reduced fish and therefore reduced food supply for terrestrial wildlife	- Warmer water reduces the coldwater fish population; reduced food supply for terrestrial wildlife	- Warmer water reduces the coldwater fish population; reduced food supply for terrestrial wildlife	- Reduced coldwater fish populations; reduced food supply for terrestrial wildlife	N/A
RIPARIAN COMMUNITIES	- Reduced water quality from upstream contaminants; reduced fish and therefore reduced food supply for terrestrial wildlife	- Reduced rainfall decreases river flow, resulting in slower-moving, warmer water - Drought will diminish riparian vegetation; loss of cottonwood trees	- Increased rainfall may affect river flow, depending on the amount of water released from dam - Increased flow could elevate levels of suspended solids and reduce water quality	N/A	- River flow is also influenced by uses outside the park - Since park does not directly manage the river, it will focus efforts on mitigating stressors and threats to the riparian areas to improve its condition

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D. TEST AND REFINE PRELIMINARY STEWARDSHIP GOALS FOR EACH PRIORITY RESOURCE TO MAKE GOALS CLIMATE INFORMED

This is a critical substep in the process, where the RSS and climate change scenario planning approaches become fully integrated. In this substep, the preliminary stewardship goals developed above under Step Four-A are revisited by the full *RSS Project Team* and assessed for applicability and viability under each climate-resource scenario. The goals should be refined accordingly.

The *RSS Project Team* should revisit stewardship goals for the *Priority Resources* in the context of the climate and non-climate stressors and threats identified in prior steps. These goals may be set *in response* to existing stressors, *in preparation* for anticipated future threats, or perhaps *despite* existing and future stressors and threats. In some cases, the stewardship goals might be fully driven by desired resource conditions (i.e., not necessarily threats). Carefully considering conditions associated with a diverse set of plausible future climate conditions is essential for climate change-informed goal refinement. And, in the context of this range of plausible climate futures, each future would bring a unique set of climatic conditions with potentially unique resource impacts.

While stewardship goals serve as a tool for measuring management accomplishments, under a rapidly changing climate it may not always be possible to set quantitative, condition-based goals for some resources because of the current uncertainty regarding precisely how climate change and ecological responses will unfold in the future. This is particularly the case for long-term goals (see next section below). Whether it's because of an uncertain climate future, lack of meaningful data on resource information or condition, or limited understanding of potential ecological responses to changes in climate, the *RSS Project Team* may need to set some goals that are not quantitative or easily measurable. The divergence of climate futures should not prevent the identification of goals but should instead be used as a lens through which the *RSS Project Team* can evaluate and define goals that will be successful across the range of plausible futures.

During this goal-focused step, participants may come up with potential supporting activities. Although activities are the focus of Step Five, capturing these ideas now while participants are focused so strongly on climate change and its impacts is extremely useful and enhances the efficiency of Step Five.

Using a Tiered Approach for Climate-Informed Goal Setting

The following guidance is oriented toward parks using a tiered structure with both long-term and short-term goals; however, these instructions can be adapted for parks using other approaches for goal setting. For some resources or in some cases where the short- and long-term aspirations of the park are similar, only a single goal may be appropriate.

Long-term resource stewardship goals — Refer to Step Four of the standard RSS process in the RSS Development Guide for information on goal development. In the context of climate change scenario planning, it is also important to consider the following:

- *Long-term goals must be robust to the range of plausible climate futures.* Because of the uncertainty with future climate conditions, and thus uncertainty with future climate implications, long-term stewardship goals and management priorities should be framed in a way that makes them robust to the full set of plausible climate futures. If not (i.e., if goals address only a single potential future), stewardship efforts may be oriented around specific climate conditions that may not materialize while climate change plays out in a way that precludes goal attainment. Thus, when developing the long-term goal statements, it is important to test the statements against resource implications of each climate future to ensure the goal is still achievable regardless of precisely how climate change unfolds in the future. This testing of goals against scenarios is often referred to as "wind tunnel testing" or "wind tunneling." This wind tunneling , shown in table 2, is accomplished by screening existing goals (developed in Step Four-A) against both 1) implications common to all/most scenarios and 2) highly consequential implications found in just one or a minority of scenarios (known as "red flag" implications or vulnerabilities).

Table 2. Example Wind Tunnel Testing of Preliminary Stewardship Goals

PRELIMINARY STEWARDSHIP GOAL	FEASIBILITY UNDER SCENARIO 1 (HOT AND DRY)	FEASIBILITY UNDER SCENARIO 2 (WARM AND WET)
Retain all culturally significant tree species in landscape	Not feasible due to pathogens and shifting climate suitability	Feasible for most species currently in park.
Retain culturally appropriate ventilation in buildings	Not feasible due to increasing temperatures	Not feasible due to increasing temperatures.

If a stewardship goal is found to be not feasible under one or more scenarios, the RSS Project Team should refine the goal to be robust to the range of plausible climate futures.

- *The RSS Project Team should consider a long-term goal regarding climate and climate-indicator monitoring to inform future resource management.* To provide NPS staff with adequate information to track trends in climate conditions over time (and thus provide hints to staff on how climate change might continue to unfold in the future), a long-term stewardship goal related solely to climate information-gathering may also be useful. Although some parks may seek to monitor climate at a park to the standards required to detect changes in climate themselves, most parks will obtain sufficient climate information from existing sources (NOAA, USGS, NPS I&M, Climate Adaptation Science Centers, etc.). Each I&M network is involved in this area already, so parks can start with I&M network data sources as a default. Monitoring climate-related indicators, which could include phenology, vegetation cover, vegetation composition changes, or other metrics, may provide information more proximate to park resource goals and should therefore also be considered.

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Short-term stewardship goals — Short-term (typically three to seven years) stewardship goals tier off long-term goals or management priorities and generally have a time frame that reflects the purpose of the resource stewardship strategy to achieve resource stewardship progress within the reality of current funding cycles. Establishing short-term goals for *Priority Resources* is the first step toward guiding the development of specific resource stewardship activities that advance climate-informed long-term goals. Some short-term goals and the activities nested within them may be implemented and achieved before all the changes summarized in long-term climate-resource scenarios are fully manifested. This is to be expected. On the other hand, 1) experienced weather already routinely breaks records, 2) climate futures generally summarize a (30-year) period that begins within the next decade, and 3) climate includes inherent variability around mean conditions, so periods of historically extreme climate conditions (e.g., unprecedented heat waves, floods, droughts, etc.) are entirely possible even in the near term. In the context of climate change scenario planning, it is also important to consider the following:

- *"Robust" short-term goal setting*. Short-term goals should be robust to all climate-resource scenarios, even though park staff may later choose to tailor underlying activities identified in Step Five to climate conditions that might only be specific to one climate-resource scenario. The *RSS Project Team* should consider if a given short-term goal will allow managers to keep options open (in situations where the implications of the climate futures are divergent) or actively respond to or prepare for climate impacts (in situations where implications are common across all climate futures). If a short-term goal would unnecessarily constrain longer-term options, it may be maladaptive. Thus, caution should be taken in framing the details of such goals, and climate expertise should be consulted as part of it. Additional scenario-specific adaptive short-term goals can be added to the resource stewardship strategy at a later date if new information on climate trends emerges or existing short-term goals can be updated.
- *"Climate change adaptation capacity" short-term goal setting*. The *RSS Project Team* should consider a short-term goal to develop staff climate change adaptation capacity to support the long-term goal regarding climate monitoring. This would involve establishing relationships with the local Climate Adaptation Science Center, other regional or local organizations addressing climate change, the NPS Climate Change Response Program, the park's Inventory & Monitoring network, etc., learning from those groups, and becoming comfortable with the topic of climate change and adaptation. With this capacity in place, park staff can better use sources that provide climate information to actively track climate change occurring at the park.

EXERCISE:

Exercise: Building onto the table of climate and non-climate stressor implications for each Priority Resource (table 1), develop and/or refine a suite of long-term goals and nested short-term goals for each Priority Resource in table 3 on the following page.

Table 3. Example Development of Long-Term Goals and Short-Term Stewardship Goals

PRIORITY RESOURCE	NON-CLIMATE STRESSOR/THREAT IMPLICATIONS	SCENARIO 1: HOT AND DRY IMPLICATIONS	SCENARIO 2: WARM AND WET IMPLICATIONS	CLIMATE CHANGE IMPLICATIONS: COMMON TO ALL/ MOST SCENARIOS	LONG-TERM GOALS	SHORT-TERM GOALS
FRONTCOUNTRY ARCHEOLOGICAL SITES	- Damage to sites in areas of high visitor use and encroachment	- Increased fire would damage and expose archeological sites - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Sites would be lost to erosion from heavy precipitation and vegetation growth - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Loss of archeological sites overall - Changes in visitor season could push visitors to new areas where sites may be disturbed	- (1) Archeological sites are protected in an undisturbed condition with appropriate protocols in place to address inadvertent finds or exposure due to fire or erosion. - (2) Research on archeological resources is conducted to inform resource management (e.g., obsidian research).	- (1A) A formal archeological site monitoring program is established. - (2A) Climate change vulnerabilities for archeological resources are identified.
NATIVE GRASSLANDS	- Weeds brought by wind, visitors, wildlife outcompete native vegetation	- Short-grass prairie species expand, replacing mixed-grass prairie species - Drought-tolerant invasive plants increase	- Invasive plants increase (cheatgrass, Canada Thistle), altering habitat composition - Increased litter load from higher production combined with difficulty in conducting prescribed fires threaten grassland habitat	- Invasive plants increase	- Adaptively manage to maintain upland forest, woodland, and prairie in proportions within the historical range of variability through 2030, while preparing for potential longer-term, climate change driven changes that may be difficult or impossible to resist.	- Improved knowledge of changes in grassland species composition as a consequence of various climate change stressors. - Expanded collaboration of local and regional agencies / institutions for invasive plant early detection control efforts.

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BEST PRACTICES

- When developing climate-resource scenarios, involve any members of the group who were not part of the climate future development, and re-analyze any existing climate implications information on *Climate-Sensitive Priority Resources* to confirm the accuracy of the information and build consensus among the *RSS Project Team*.
- Understand climate-related sensitivities of each *Priority Resource*. This will help identify or refine the implications for each resource under each climate-resource scenario.
- Understand climate-related implications for each *Priority Resource* under each climate future. This will help the *RSS Project Team* analyze, develop, and refine goals and potential resource stewardship activities in Steps Four and Five.
- While optional, identifying and recording any important climate implications that occur across most or all scenarios in the column will help the *RSS Project Team* in developing climate-informed goals and identifying and prioritizing stewardship activities.
- Analyze the implications for key issues, stressors, and threats for each climate future using reference materials. Appropriate reference materials include the *Cultural Resources Climate Change Strategy* (2016) and numerous park-specific climate change resource briefs produced by the NPS Climate Change Response Program (see https://www.nps.gov/subjects/climatechange/adaptation.htm), handouts prepared by *RSS Climate Change Team* members, and peer-reviewed research findings.
- Consider both direct and indirect implications (e.g., threat multipliers) of climate-related stressors on resources.
- When setting goals, consider the range of plausible ways that climate could change (i.e., divergent climate futures), trade-offs of taking action or waiting, and risk tolerance as important elements of the decision-making process.
- Develop goals that explicitly take future climate change into account and do not simply assume persistence of climate and ecological conditions. Resisting change—and not considering alternatives—until resistance is futile may not be the most strategic approach. Try to avoid goals for restoration to past conditions that will no longer be viable in the future. Be cautious of using terms like "maintain" or "preserve" or "restore" in goal-setting unless determined to be feasible under the range of plausible climate futures.
- Develop climate-informed goals that are attainable across the range of plausible climate futures. To do so, identify and consider resource implications (i.e., climate change vulnerabilities) common to all or most climate-resource scenarios *and* highly consequential "red flag" implications unique to one or a minority of scenarios.
- Prior to refining stewardship goals, the *RSS Project Team* may find it helpful to develop an interim long-term goal for each scenario where the preliminary stewardship goal is not viable. These interim long-term goals will then be used to develop a single long-term goal that is robust to the range of plausible climate futures.

- Be specific, explicit, and clear when describing future stewardship goals in the context of potential climate futures. Avoid general and vague language such as, "...manage while considering climate change;" the point of strongly integrating scenario-based vulnerability assessment and adaptation into the resource stewardship strategy is to develop and summarize the information necessary to craft specific, relevant, climate-informed goals. When goals are notably affected (or driven) by climate change implications, it is important for the goal language to make this linkage clear and explicit so that future park staff can understand the context and intent of the goal.
- Ask the tough, uncomfortable questions about current goals that may no longer be viable in the park under climate-resource scenarios. Examine whether money and staff time dedicated to achieving these goals might be better used towards achieving climate-robust goals.
- Do not forget about the non-climate implications for *Priority Resources* during the overall process. Given the heavy focus on climate change futures and implications in the process, it's quite easy to get tunnel vision and overlook other non-climate issues/implications that may be even more dire or paramount to consider in stewardship strategy development. In addition, climate change may exacerbate the impacts of some non-climate issues/implications. For this reason, the Step Four process begins (Step Four-A) by preliminarily developing goals that reflect the Step Two analysis of key issues, stressors, and threats.

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STEP 5: DEVELOP STEWARDSHIP ACTIVITIES

A. DEVELOP STEWARDSHIP ACTIVITIES

Follow the standard RSS process for identifying stewardship activities as outlined in the RSS Development Guide. In the context of climate change scenario planning, stewardship activity development should be strategic in aiming to reduce climate change vulnerabilities (i.e., enhance resource resilience or resistance) where feasible, accept and even seek to direct change (toward preferred new conditions and away from undesirable conditions) where it cannot be feasibly resisted, or provide other benefits to the *Priority Resources*. Some stewardship activities (and even considerations regarding sequencing, contingencies, and prioritization) may have already been identified during previous steps, including scenario planning and goal-screening activities (described above); these should be included for consideration during this step.

B. IDENTIFY INTEGRATED STEWARDSHIP ACTIVITIES

Follow the standard RSS process for identifying integrated stewardship activities as outlined in the RSS Development Guide. While identifying stewardship activities, it is important to consider the potential for integrated stewardship activities that capitalize on overlapping opportunities among and within disciplines and park divisions, address multiple *Priority Resources*, or resolve larger parkwide issues. This is particularly important when considering the wide-reaching and ubiquitous effects of climate change and the reality of finite resource management budgets and staffing.

EXERCISE:

Develop stewardship activities that help fulfill the short-term and long-term goals (or management priorities) for each Priority Resource in table 4. Consider all potential integrated resource stewardship opportunities.

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Table 4. Example Development of Stewardship Activities

PRIORITY RESOURCE	NON-CLIMATE STRESSOR/ THREAT IMPLICATIONS	SCENARIO 1: HOT AND DRY IMPLICATIONS	SCENARIO 2: WARM AND WET IMPLICATIONS	CLIMATE CHANGE IMPLICATIONS COMMON TO ALL SCENARIOS	LONG-TERM GOALS (FROM STEP FOUR)	SHORT-TERM GOALS (FROM STEP FOUR)	ACTIVITIES
FRONTCOUNTRY ARCHEOLOGICAL SITES	- Damage to sites in areas of high visitor use and encroachment	- Increased fire would damage and expose archeological sites - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Sites would be lost to erosion from heavy precipitation - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Loss of archeological sites overall - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Archeological sites are protected in an undisturbed condition with appropriate protocols in place to address inadvertent finds or exposure due to fire or erosion.	- A formal archeological site monitoring program is established. - The park follows management recommendations for archeological sites assessed in fair or poor condition. Site condition is improved where possible; if not feasible an alternative course of action is determined.	- Establish a formal, regular condition assessment program. Monitor vulnerable sites more frequently or collect those sites to fully protect them and prevent unauthorized excavation or looting. - Explore ways to increase the monitoring and protection of archeological sites near trails using trained volunteers, students, or others.
FRONTCOUNTRY ARCHEOLOGICAL SITES	- Damage to sites in areas of high visitor use and encroachment	- Increased fire would damage and expose archeological sites - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Sites would be lost to erosion from heavy precipitation - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Loss of archeological sites overall - Changes in visitor season could push visitors to new areas where sites may be disturbed	- Research on archeological resources is conducted to inform resource management (e.g., obsidian research).	- Climate change vulnerabilities for archeological resources are identified.	- During site assessments, include observations of site-specific climate sensitivities (e.g., site slope, soil, and other factors related to the impact of extreme rainfall events). Use this site-specific information to gain a broad understanding of climate vulnerabilities across sites.

PRIORITY RESOURCE	NON-CLIMATE STRESSOR/ THREAT IMPLICATIONS	SCENARIO 1: HOT AND DRY IMPLICATIONS	SCENARIO 2: WARM AND WET IMPLICATIONS	CLIMATE CHANGE IMPLICATIONS COMMON TO ALL SCENARIOS	LONG-TERM GOALS (FROM STEP FOUR)	SHORT-TERM GOALS (FROM STEP FOUR)	ACTIVITIES
NATIVE GRASSLANDS	- Weeds brought by wind, visitors, wildlife outcompete native vegetation	- Short-grass prairie species expand, replacing mixed-grass prairie species - Drought tolerant invasive plants increase	- Invasive plants increase (cheatgrass, Canada Thistle), altering habitat composition - Increased litter load from higher production and difficulty in conducting prescribed fires threaten grassland habitat	- Invasive plants increase	- Adaptively manage to maintain upland forest, woodland, and prairie in proportions within the historical range of variability through 2030, while preparing for potential longer-term, climate change driven changes that may be difficult or impossible to resist.	- Expand park knowledge base about upland vegetation community condition and trends via vegetation inventory, monitoring, and assessments.	- Stay current on emerging information on climate change implications to regional plant species abundance and distribution.
NATIVE GRASSLANDS	- Weeds brought by wind, visitors, wildlife outcompete native vegetation	- Short-grass prairie species expand, replacing mixed-grass prairie species - Drought tolerant invasive plants increase	- Invasive plants increase (cheatgrass, Canada Thistle), altering habitat composition - Increased litter load from higher production and difficulty in conducting prescribed fires threaten grassland habitat	- Invasive plants increase	- Maintain abundance proportion of exotic/invasive plants at low level (<10%) in identified priority areas and keep noxious weeds in other areas at socially acceptable levels.	- Expand collaboration of local and regional agencies / institutions for invasive plant early detection control efforts.	- Develop partnership agreement for working with Johnson County and the state weed crews on early detection and rapid treatment capacity.

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C. ASSIGN PRIORITIES FOR STEWARDSHIP ACTIVITIES

Follow the standard RSS process for prioritizing stewardship activities as outlined in the RSS Development Guide. In addition to the criteria noted in the RSS Development Guide for activity prioritization that is applicable to all climate and non-climate related activities, some additional criteria for the *RSS Project Team* to consider include the following:

- The activity could be effective across all or most plausible climate-resource scenarios.
- The activity directly or indirectly prepares for or safeguards against the consequences of a particular "red flag" vulnerability that would be especially dire for the park. Although planning and acting today in anticipation of a particular potential future impact involves costs, preventive planning may reduce or eliminate even more costly impacts down the road.
- The activity helps achieve climate-informed management goals. In some cases, park managers may need to judge trade-offs among adaptation strategies and activities to achieve different goals. For instance, implementing certain activities, such as active grazing management, may run counter to a goal to preserve wilderness character. NPS wilderness and climate change specialists can assist with this matter.
- The activity helps achieve other social, cultural, or economic goals in concert with co-benefits of climate adaptation. While these factors may not be the primary focus of management efforts, assessing strategies in light of broader goals can create a space where possible synergies and trade-offs can be openly explored and managed. For example, a project focused on restoring wetlands for fish and wildlife habitat might also provide flood protection to nearby communities or enhance carbon sequestration.
- The activity takes advantage of time-limited opportunities. Some activities might become more expensive to implement in the future or become infeasible under future climate-resource scenarios but could be feasible and cost-effective now. For instance, now might be the time to acquire upland areas adjacent to neighboring coastal parks as potential areas to eventually relocate facilities and cultural resources or allow for habitat migration as sea levels rise. Otherwise, those lands might be lost to development or other land use changes before the impacts of sea-level rise are fully felt.
- The activity is important for detecting trends in or responses of resources to climate change. For instance, updating monitoring and assessment approaches for a native vegetation complex in the near-future (to begin to provide an understanding of recruitment rates and spatial shifts in boundaries between major vegetation communities, for example) will provide the information needed to inform further vegetation management goal development and adaptation actions.
- The activity helps meet intermediate benchmarks that are necessary for the completion of longer-term, high-priority activities. Some activities may not be deemed a high priority when viewed in isolation yet serve as critical steps toward avoiding consequential climate impacts in the future.

EXERCISE:

Discuss and record the most pertinent prioritization criteria for the park as an *RSS Project Team* and assign "High," "Medium," and "Low" stewardship priorities to all activities developed in the above strategy development steps.

BEST PRACTICES

- Include as candidate activities all activities identified in previous scenario planning and goal-screening exercises that are appropriate for the park to consider within the resource stewardship strategy's five- to seven-year time frame.
- The *RSS Climate Team* should record candidate activities that were not accepted for inclusion in the resource stewardship strategy so that the fact that they were considered but not adopted can be included in the accompanying scenario planning report.
- Reference climate-resource scenario implications (table 1) during activity development. Only referencing goals (without considering climate implications) risks missing "red flags" or other important changes that the park would like to avoid (or opportunities they want to take advantage of) that are not explicitly part of goals.
- Consider activities that explicitly take future change into account and do not just assume persistence of conditions.
- Develop activities with "intentionality," making the climate linkage clear. If the activity is notably affected by or a response to climate change, be deliberate in stating why or when the action should be done so its role in climate change adaptation is clear to future park staff.
- While considering the above criteria when assigning priorities to activities (along with the criteria noted in the RSS Development Guide), one must still be careful not to get tunnel vision by only prioritizing activities that address climate change threats and stressors; other unrelated activities that respond to non-climate stressors or issues may very well warrant equal or greater prioritization.
- Improve opportunities for successful climate change adaptation strategies by integrating adaptation into existing processes, working with diverse partners, proactively engaging stakeholders and visitors, and demonstrating success.

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RSS IMPLEMENTATION

One frequent additional product of the integrated RSS-CCSP process is a Natural Resource Report (NRR) that describes the scenario planning process in detail and summarizes the park-specific climate-resource scenarios and management implications. The scenario planning natural resource report should be referenced in both the RSS summary document and the desktop application.

The RSS summary document summarizes the final outcomes that were generated through the development process, including the park's identified priority resources and components and their associated stewardship goals and activities. The summary document should reference the scenario planning natural resource report in its description of how climate change-informed scenario planning was incorporated into the RSS development process because the natural resource report captures important information about the process—including key choices and rationales—that will be important for managers to be aware of as they continue to update and revise their resource stewardship strategy. The summary document should also reference the natural resource report in the implementation section as a reminder of the management options available to respond to and prepare for climate-related risks, as well as the dangers of ignoring such risks.

BEST PRACTICES

- Consider adding a custom field in the RSS desktop application where resource managers can tag "climate-relevant" activities that will help a park or resource adapt to climate change.
- When populating the desktop application with stewardship goals developed as part of the RSS process, include a reference to the scenario planning natural resource report in the goal notes field. As resource and management conditions change and activities are completed, resource managers may want to refer to the natural resource report for additional activities that were considered but not adopted to be included in the park's initial resource stewardship strategy.

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APPENDIX A: GLOSSARY

This glossary defines terms that are relevant to climate change scenario planning. Not all terms included below appear in the RSS Supplemental Guidance.

Adaptation strategies and actions. Adaptation strategies are the broadest level of adaptation efforts (e.g., enhance ecological resilience or resistance; offset stresses; accept and manage for change). Actions are the specific activities in support of an adaptation strategy (e.g., restore beavers or apply sandbags; install air conditioning; facilitate inland movement of a coastal salt marsh). In this guidance, the term "action" is used very generally and is not necessarily intended to trigger assessment requirements under NEPA.

Adaptive capacity. The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. (IPCC 2014).

Adaptive management. Decision making that accounts for what is uncertain as well as what is known about the processes that influence natural resource behavior through time and the influence of management on resource changes. Adaptive decision making seeks to reduce this uncertainty and thereby improve management through enhanced understanding of management effects (Williams and Brown 2012). Adaptive management is not managing by "trial and error." As defined in the U.S. Department of the Interior Technical Guide, adaptive management is "[a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood."

Climate change adaptation. An intentional management strategy that involves identifying, preparing for, and responding to observed or expected climate changes in order to retain current conditions, to recover gracefully from climate variations (perhaps to an altered state), or to adjust to changing conditions that may include major transformation in practices or state.

Climate driver. (1) When referring to an effect of climate on a conservation target (e.g. change in species distribution), any climate variable or effect that results in a response. For this use, common climate drivers include temperature, precipitation, sea level rise, and snow cover. (2) When referring to changes in climate, any natural or human-induced factor that directly or indirectly causes a change in climate. Greenhouse gases and land use are important drivers of climate (Gross et al. 2016).

Climate future. A specific climate projection. Typically, multiple climate futures are used in planning as a context for broader scenarios, to identify and evaluate management options, or to assess vulnerability to a range of potential climate factors. Also see "scenario."

Climate-informed goals. Forward-looking goals that bridge existing park management values to new realities and challenges resulting from a shift in climate.

Climate-resource scenarios. A set of plausible, divergent, relevant, and challenging scenarios that are based on climate futures but include resource/management concern vulnerabilities associated with each climate future.

Climate projections. The simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative-forcing scenario used, which is in turn based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized (IPCC 2014).

Climate refugia. Areas that are characterized by the occurrence of relatively stable local climate conditions that persist over time, despite change at regional and global scales. Such areas may enable persistence of valued resources or specific conditions for longer than surrounding areas.

Climate-sensitive priority resources. The natural and cultural resources (or in some cases, facilities, sites, landscapes, processes, visitor use values, or other features) that are the focus of the climate change scenario planning effort, as determined by the planning purpose.

Continuous change. Defined under *Revising Leopold: Resource Stewardship in the National Parks* as: "change that is not merely constant or seasonal change; it is also the unrelenting and dynamic nature of the changes facing park systems expressed as extreme, volatiles swings in conditions (such as unexpected, severe wet seasons) within long-term trends of change (such as decadal droughts).

Desired conditions. As referenced in the NPS *Management Policies 2006*: "A park's natural and cultural resource conditions that the NPS aspires to achieve and maintain over time, and the conditions necessary for visitors to understand, enjoy, and appreciate those resources. These conditions are identified through a park's planning process."

Exposure. A measure of the character, magnitude, and rate of climatic changes a target species or system may experience. This includes exposure to changes in climatic variables (e.g. temperature, precipitation, solar radiation) as well as changes in related factors (e.g. sea-level rise, water temperatures, drought intensity, ocean acidification) (Gross et al. 2014).

Forecasts. Similar to predictions. Projections that are considered to be "most likely." A forecast is often obtained using deterministic models that enable a certain amount of confidence attached to projections.

Impacts. The specific effect (positive, negative, or neutral) of a climate driver on a park's resources.

Indicators. Quantitative or qualitative factors that signify changes in climate drivers; the condition (e.g., quality, health, integrity) of the resources in response to those changes; progress toward relevant management outcomes; and the performance of management actions.

Intentionality. The fact of being purposeful in considering and addressing climate impacts in park planning and management.

Management goals. The desired outcomes of a management decision. A goal statement conveys the underlying purpose of an effort ("why") but does not specify the means (i.e., strategies and actions) to achieve the desired outcome ("how").

Monitoring and evaluation. A process that involves collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective.

Natural conditions. As referenced in the NPS *Management Policies 2006*: "The condition of resources that would occur in the absence of human dominance over the landscape."

Non-climate drivers/stressors. Other ecological or social factors (e.g., land and water use, invasive species, and pollution) that directly or indirectly affect or have the potential to affect a park's resources, assets, and values. Climate and non-climate factors can have synergistic effects on one another.

Persistence. Current/past target (resource, asset, system, or process) conditions continue to exist, either because the target is inherently resistant to change or because of adaptation efforts to resist change (Beavers et al. 2016).

Predictions. Forecasts of what will happen in the future with some degree of certainty or assigned a probability.

Realignment strategy. A management strategy that facilitates change toward desired future conditions for resources, assets, and values.

Resilience. A capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment (US GCRP 2019).

Resist change. A class of adaptation response (alongside accommodate change and direct change) in which current/past target (resource, asset, system, or process) conditions are maintained (Beavers et al. 2016).

Risk. Threats to life, health and safety, the environment, economic well-being, and other things of value. Risks are often evaluated in terms of how likely they are to occur (probability) and the damages that would result if they did happen (consequences) (US GCRP 2019).

Robust strategies. Adaptation strategies that are likely to be effective across all scenarios.

Scenario. A coherent, internally consistent and plausible description of a possible future state of a system. An emissions scenario is a possible storyline regarding future emissions of greenhouse gases. Scenarios are used to investigate the potential impacts of climate change: emissions scenarios serve as inputs to climate models; climate scenarios serve as inputs to impact assessments (Gross et al. 2016). Also see "climate future."

Scenario planning. The use of scenarios that challenge planning participants to consider novel conditions, the consequences of those conditions on resources and issues, and how the scenarios affect the appropriateness of management responses.

Sensitivity. The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise) (IPCC 2014).

Shoulder season. A travel season between peak and off-peak seasons, especially spring and fall, when park visitation has customarily been lower.

Thresholds. See "tipping point."

Tipping point. A level of change in system properties beyond which a system reorganizes, often abruptly, and does not return to the initial state even if the drivers of the change are abated (IPCC 2014).

Threat multiplier. Climate change impacts have the potential to exacerbate other threats associated with environmental, economic, social, and political factors.

Transformation. A change in the fundamental attributes of natural and human systems (IPCC 2014).

Vulnerability. The degree to which physical, biological, and socio-economic systems are susceptible to and unable to cope with adverse impacts of climate change (US GCRP 2019).

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APPENDIX E: EXAMPLE RSS-CCSP PROJECT SCHEDULE

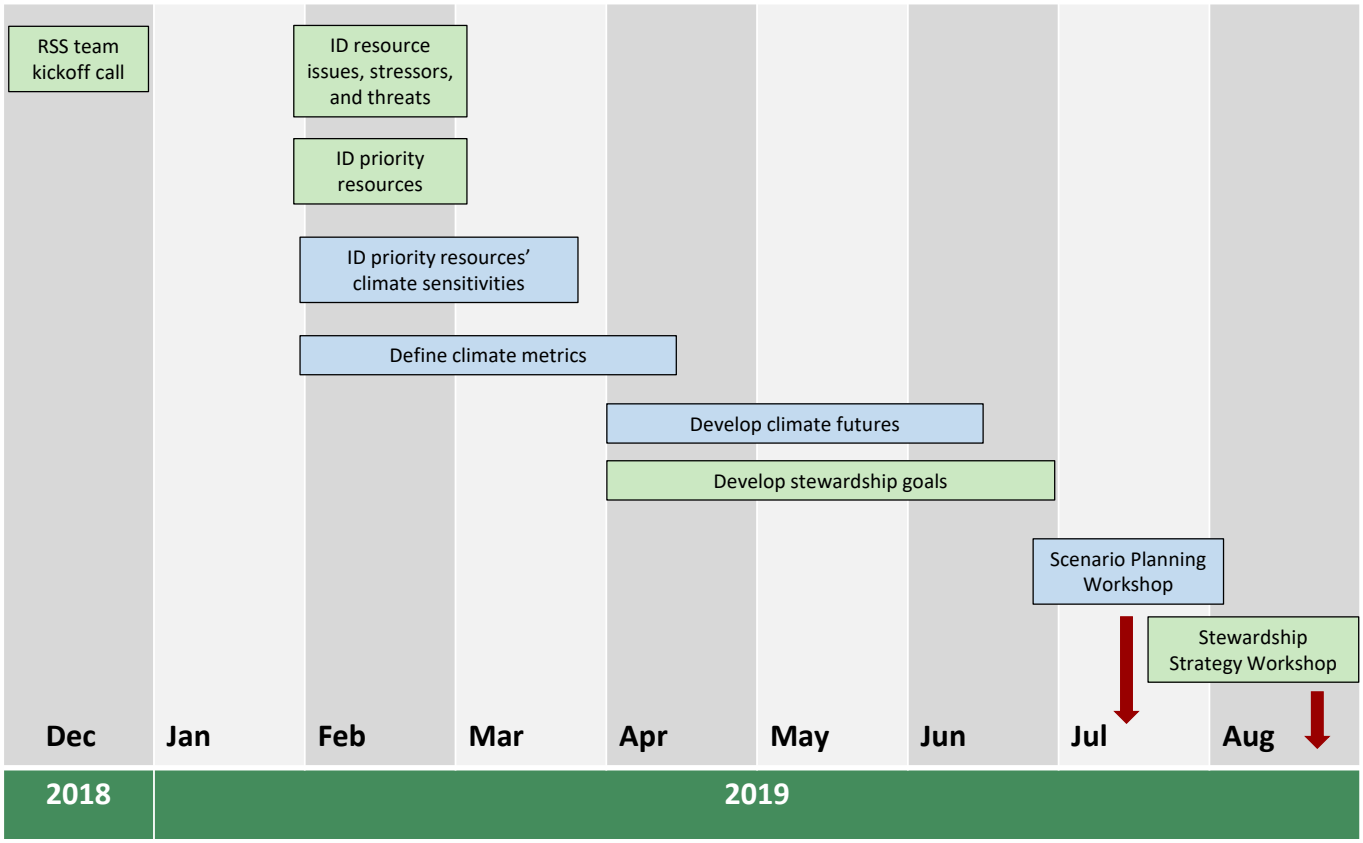

Figure E-1. Representation of the project schedule for Wind Cave National Park's RSS-CCSP project. This figure only represents tasks associated with RSS-CCSP steps. Production of the RSS summary document and desktop application are not included. Green boxes represent steps adapted from the standard RSS process, while blue boxes represent steps that support climate change scenario planning.

NOTES

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historic places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under US administration.

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RSS

RESOURCE STEWARDSHIP STRATEGIES

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