National Park Service
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Climate Change Response and Cultural Landscapes

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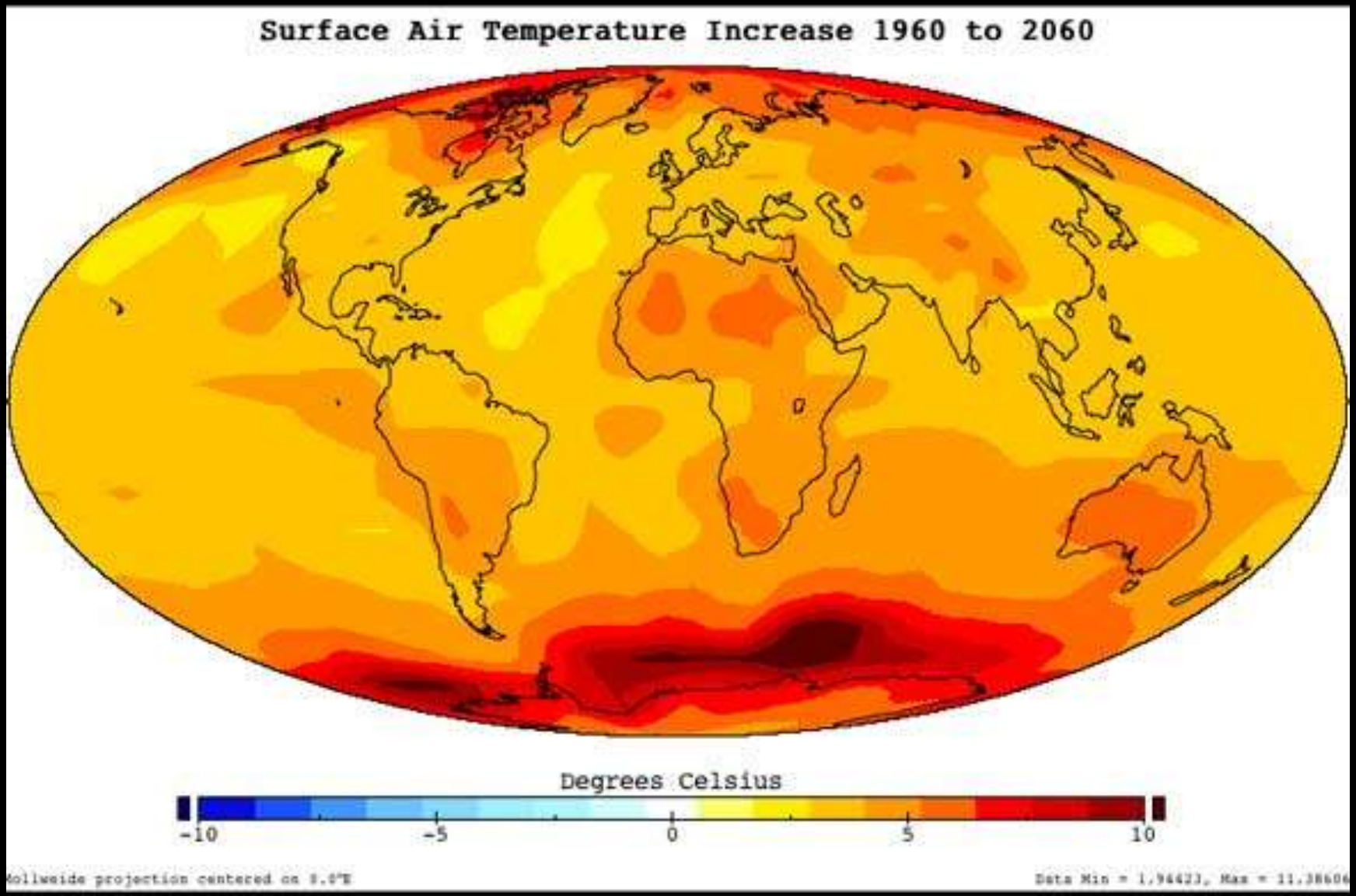
Surface Air Temperature Increase 1960 to 2060
Degrees Celsius
-10
-5
0
5
10
Mollweide projection centered on 0.0°E
Data Min = 1.94423, Max = 11.38606


Photo - John McColgan BLM Alaska Fire Se

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GRANT VILLAGE
GAS LODGING FOOD
STORE CAMPGROUND
RANGER STATION
INFORMATION

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JOHN DEERE

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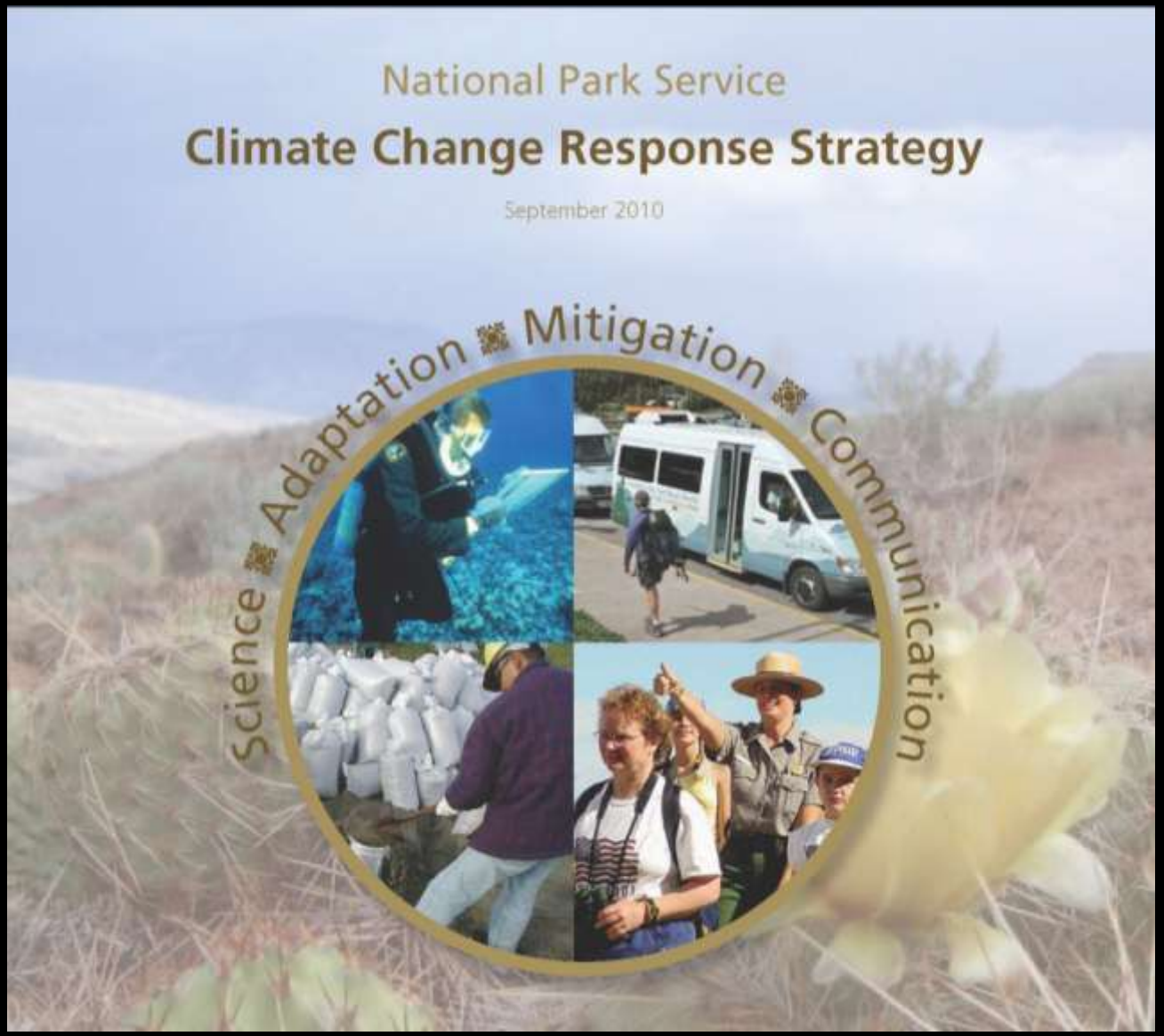

National Park Service
Climate Change Response Strategy
September 2010
Science
Adaptation
Mitigation
Communication

National Park Service
U.S. Department of the Interior

Science


Science


Adaptation

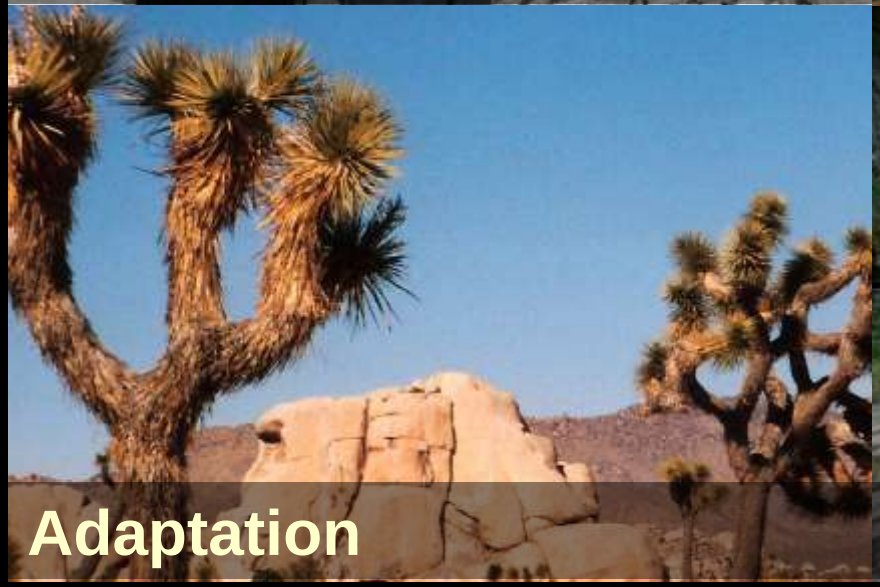

Science


SHUTTLE
Zion
Mitigation


Adaptation


Science


ZION CANYON
SHUTTLE
Zion
29
Mitigation


Adaptation


Communication

Knowledge on which actions are based

Goal 1

Use the best available scientific data and knowledge to inform decision making about climate change.

Goal 3

Inventory and monitor key attributes of the natural systems, cultural resources, and visitor experiences likely to be affected by climate change.

Historical and existing conditions research

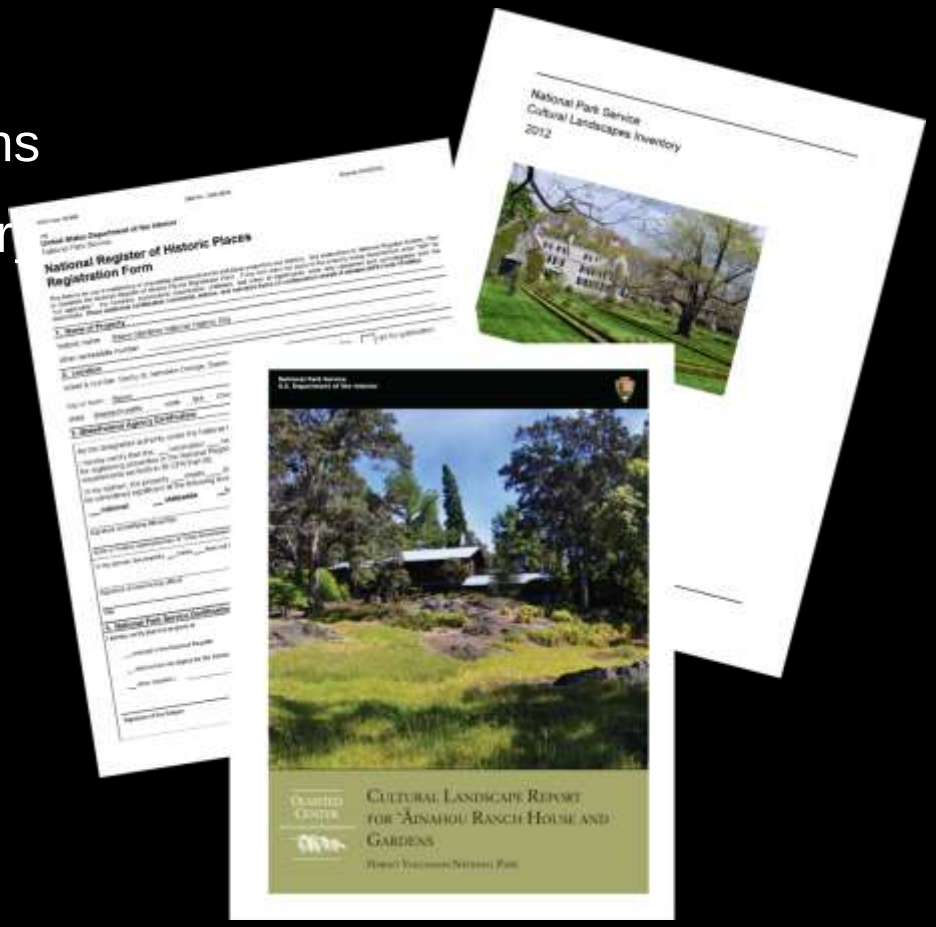
- Historic conditions documentation
- Change in the landscape over time
- Existing or potential impacts to the landscape

Natural systems research

- Climate change data and projections
- Endangered species
- Invasive species
- Hydrology/water quality

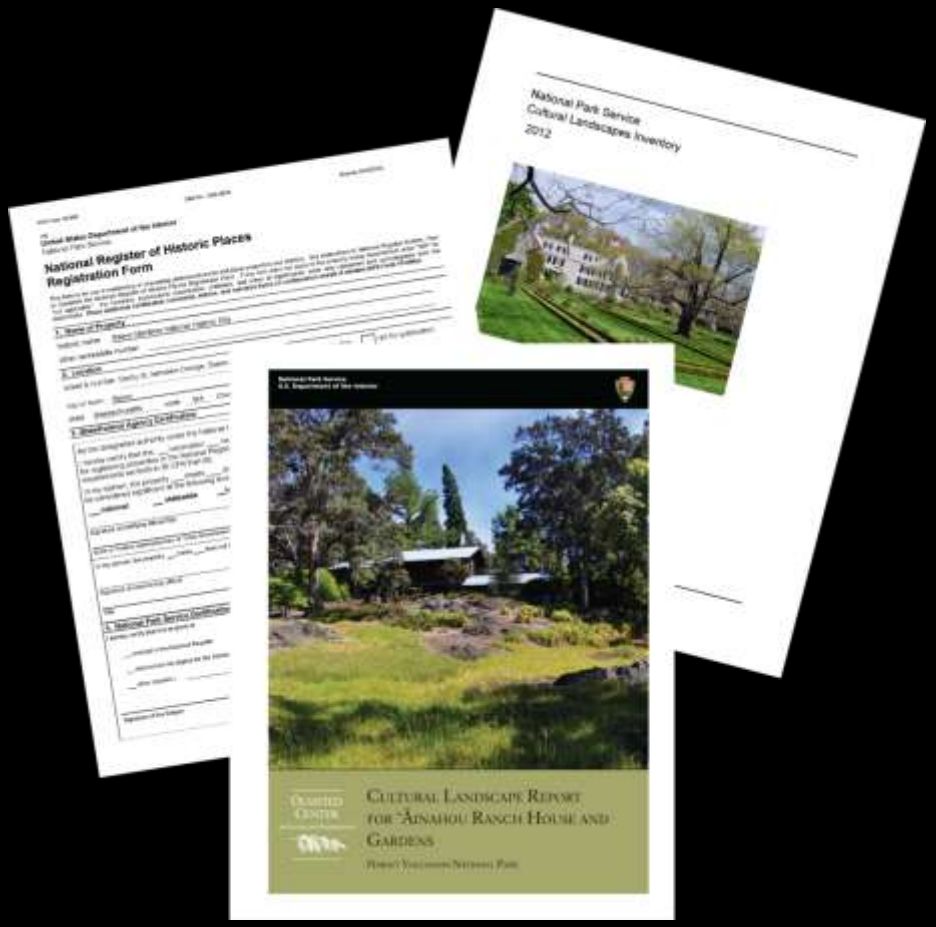
Cultural landscapes documents

- Documentation
  - National Register Nominations
  - Cultural Landscapes Inventor
  - Cultural Landscape Reports
- Monitoring
- Evaluation of Knowledge Base



Cultural landscapes documents

- Documentation
- Monitoring
  - Condition Assessments
  - Record of Treatment
  - Section 106 Process
- Evaluation of Knowledge Base



Science Adaptation Mitigation Communication

Cultural landscapes documents

- Documentation
- Monitoring
- Evaluation of Knowledge Base
  - Foundation Documents
  - State of the Parks

Science Adaptation Mitigation Communication

Big Hole National Battlefield

Science Adaptation Mitigation Communication

Big Meadows, Shenandoah NP

Bloom timing at Saint Gaudens NHS

Science Adaptation Mitigation Communication

Phenology at Boston Harbor Islands NRA

Key contributions

- Document change in the landscape
- Identify Vulnerable Cultural Resources
- Identify Sensitive Natural Systems
- Articulate Historic Character
- Inform Treatment and Maintenance

Adapting to a changing climate

Goal 6

Implement adaptation strategies that promote ecosystem resilience and enhance restoration, conservation, and preservation of park resources.

Goal 7

Develop, prioritize, and implement management strategies to preserve climate-sensitive cultural resources.

Goals of adaptation in cultural landscape management

- Preserve integrity
- Avoid impairment
- Protect cultural resources
- Protect sensitive natural systems
- Build resiliency
- Manage with future conditions in mind

Adaptation measures

- Compatible substitutions/alterations
- Physical protection
- Maintain, repair, replace
- Relocate
- Record and release

Preserve historic character (compatible substitution)

Red pine stand at Val-Kill, Eleanor Roosevelt NHS

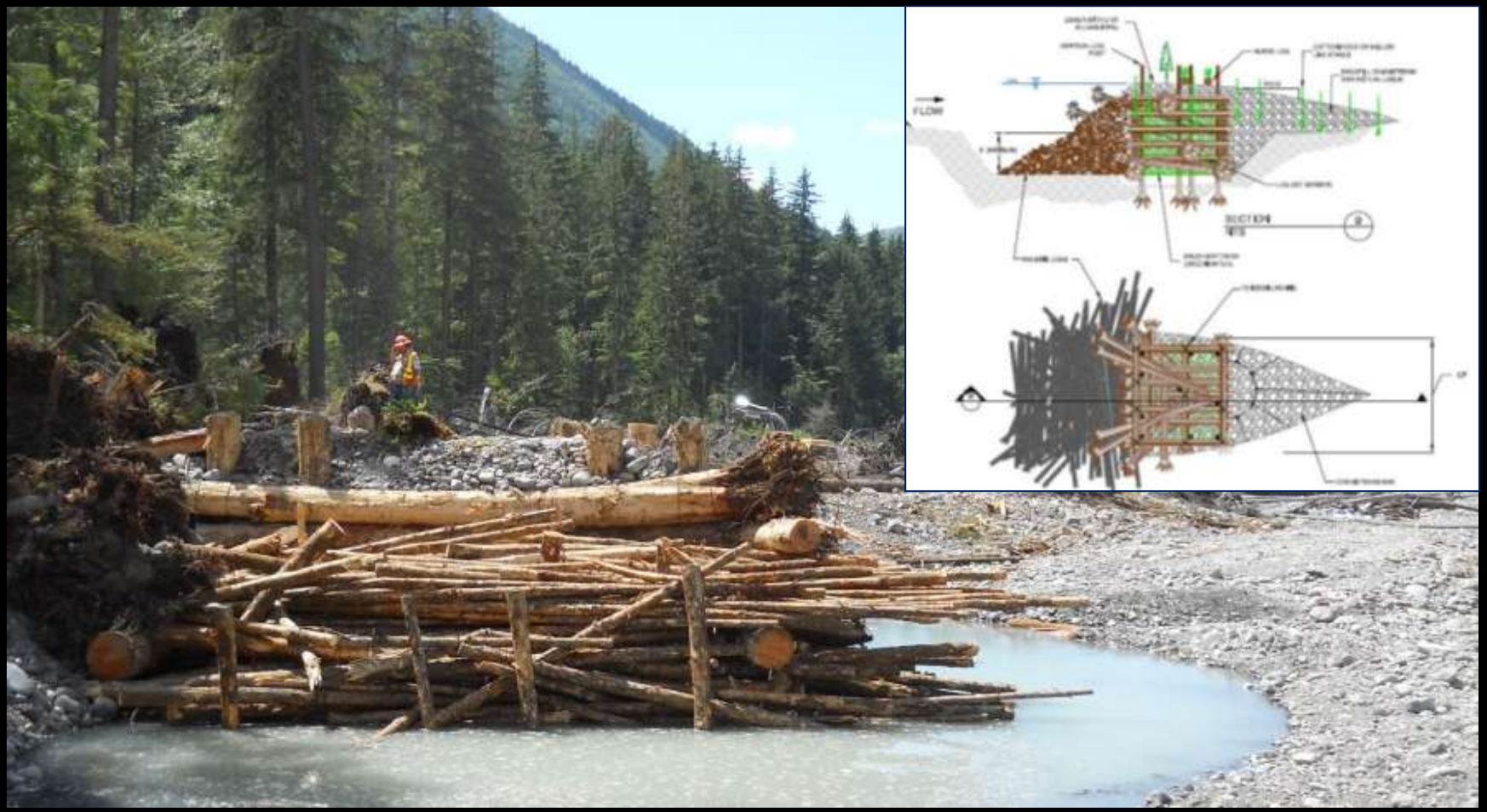
Preserve historic character (compatible substitution)

Rapidan Camp, Shenandoah NP

Protect vulnerable resources

Riparian flood protection at Rapidan Camp, Shenandoah NP

Protect vulnerable resources and build resilience



Historic road flood protection with engineered log jam at Mount Rainier NP

Protect natural systems

Invasive barberry and English ivy at Vanderbilt Mansion NHS

Protect natural systems

Endangered nēnē at ʻĀinahou Ranch, Hawaiʻi Volcanoes NP

Build resiliency (compatible substitution)

Drought tolerant native plantings at Upper Fort Mason, Golden Gate NRA

Cyclical maintenance

Maintaining historic pear trees at Manzanar NHS

Cyclical replacement

Replacement of pear trees at John Muir NHS

Relocate Resources

Cape Hatteras Lighthouse, Cape Hatteras NS

Record and Release

Fish Ponds and seawall, Pu`uhonua O H**ō**naunau

Sustainable management to reduce impact on the environment.

Goal 10
Integrate climate change mitigation into NPS business practices.

Goal 11
Promote biological carbon sequestration as a function of healthy ecosystems.

- Use low-maintenance materials/ species
- Reduce energy consumption
- Reduce use of emitting equipment
- Conserve water
- Foster healthy landscape systems
- Sequester carbon on site

- Incorporate landscape maintenance into climate friendly action plans
- Consider carbon footprint in treatment recommendations

Reducing mowing

Glenmont, Thomas Edison NHP in 1930s (left) and today (right)

Reducing mowing

Mowing plan for Glenmont, Thomas Edison NHP

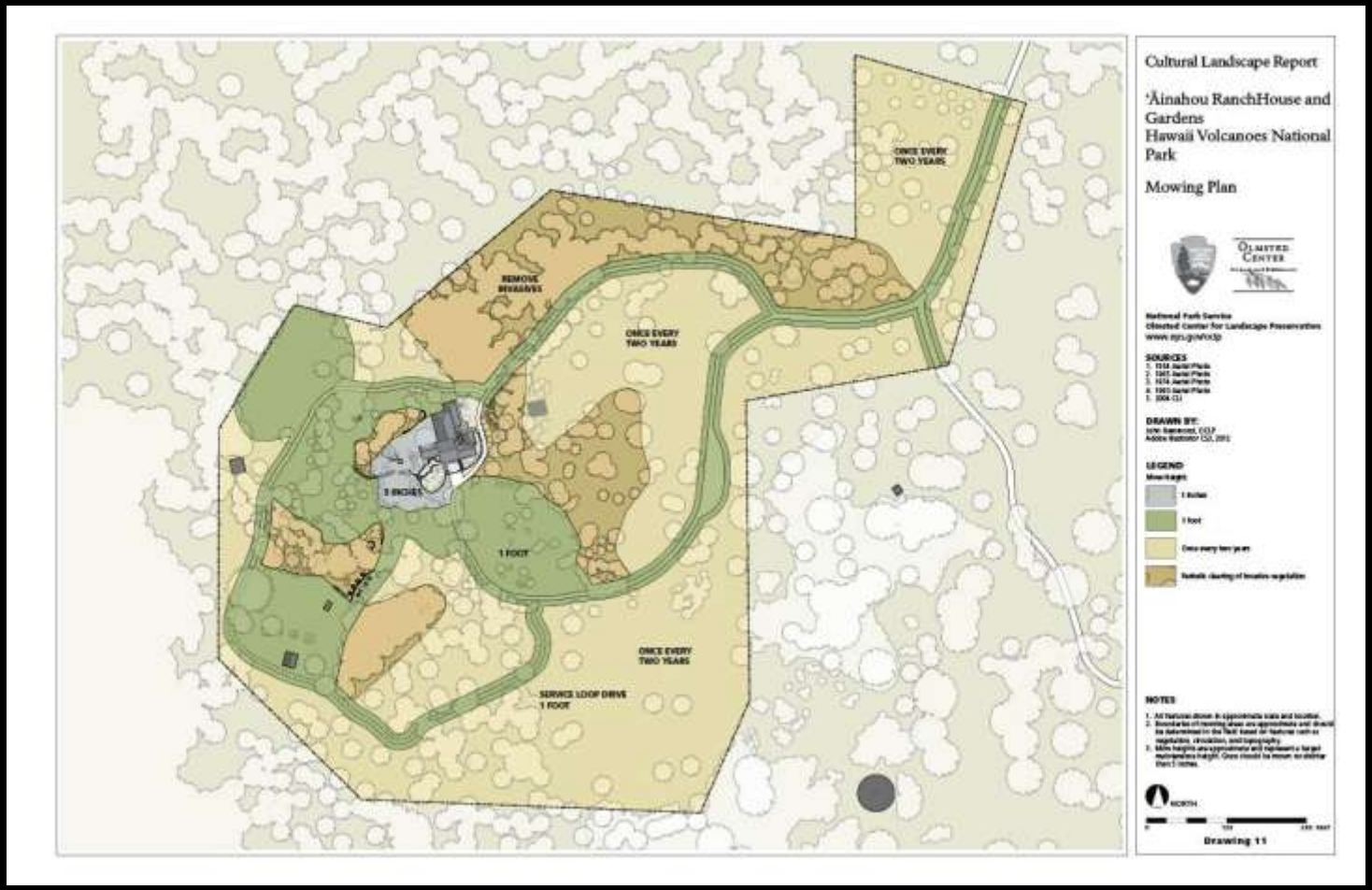
Reducing mowing

Maintained turf grass (left) and taller grass in an orchard (right)

Reducing mowing

Meadows at Valley Forge NHP

Focusing resources



'Āinahou Ranch: Hawai'i Volcanoes NP: Landscape Mowing Plan

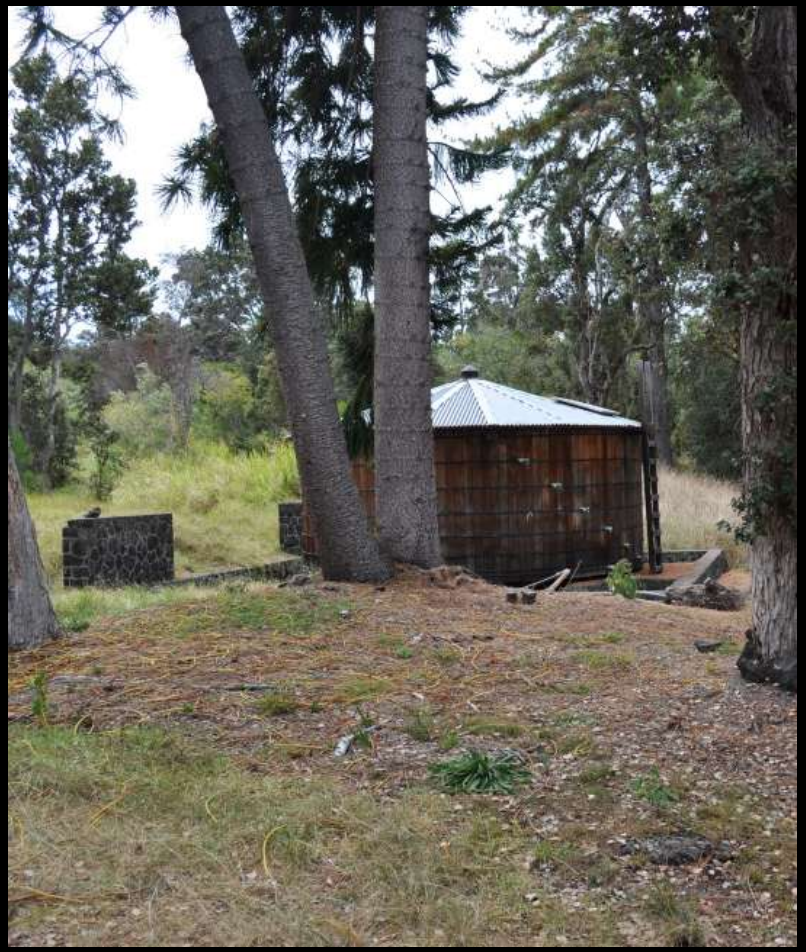
Focusing resources

Reduced mowing areas at Fort Baker, Golden Gate NRA

Compatible substitutions

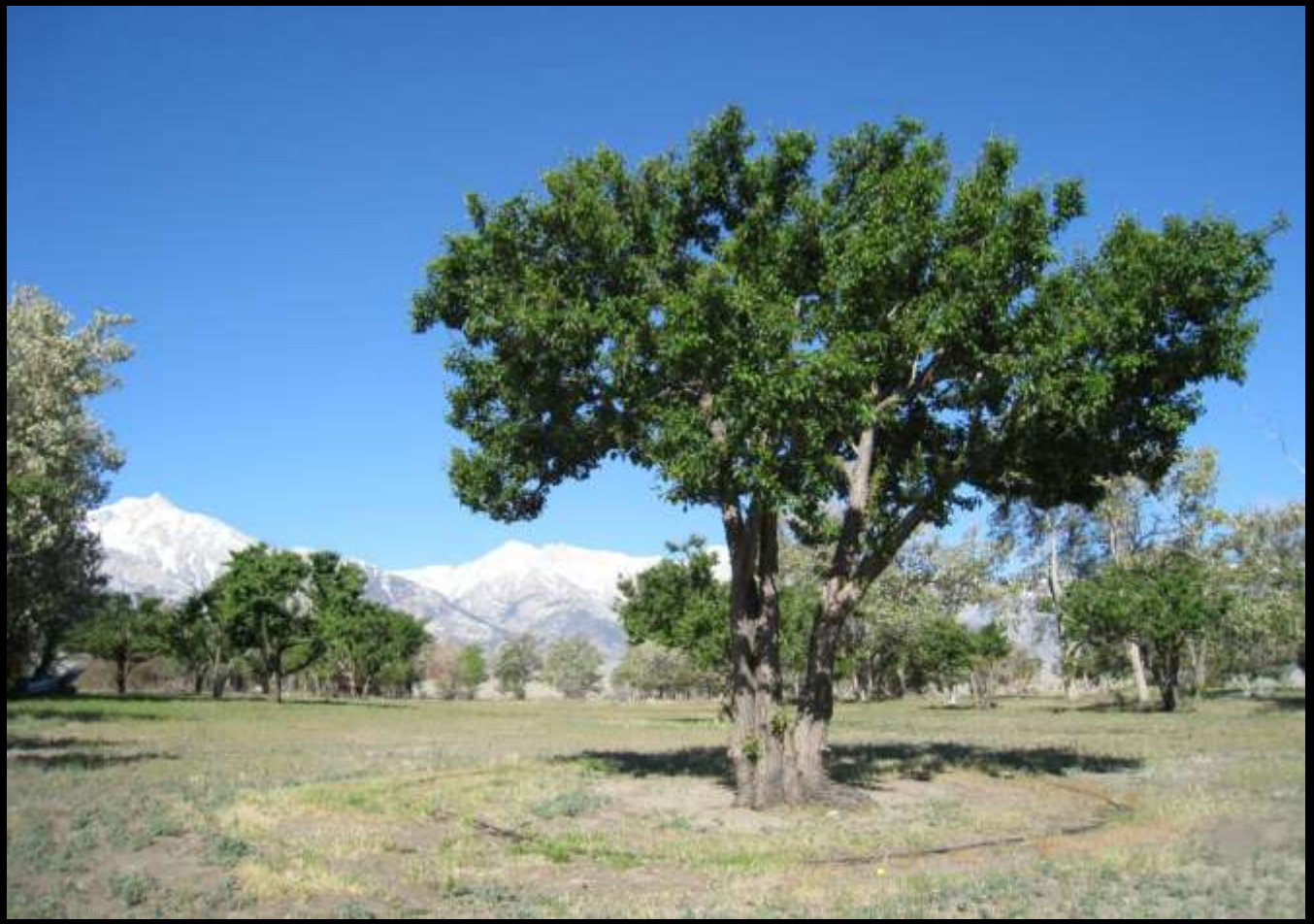
Rose garden in the Formal Gardens at Vanderbilt Mansion NHS

Historic landscape practices



Water catchment and storage system at ʻĀinahou Ranch, Hawaiʻi Volcanoes NP

Conserving water



Drip irrigation in a historic orchard at Manzanar NHS

Conserving water

Shredded bark mulch over driplines at Manzanar NHS

Utilizing alternative fuels

Propane retrofitted mower at San Antonio Missions NHP

Reduce use of herbicides, pesticides and fertilizers

Herbicide salt crystals on brick sample (NCPTT)

Reduce use of herbicides, pesticides and fertilizers

Hand-pulling, black plastic, and steam weed removal

Build landscape resiliency

- improve biotic conditions for plant health
- Improve ability to adapt to change
- Improve soil biological activity
  - Increase organic matter
  - Stimulate microbiological activity
  - Improve root health
    - Aerate
    - Add organic matter
- Prune to remove dead and diseased tissue
- Substitute non-adapted species where possible

Build landscape resiliency

Compost generated from park organic debris Marsh Billings Rockefeller NHP

Build landscape resiliency

Nutritional mulch of shredded bark and compost provides organic nutrients at San Juan Island NHP

Build landscape resiliency

Improve the overall health of the landscape and reduce the energy required to maintain it.

Heritage Oak, Fort Vancouver NHS

Spreading the message and leading by example.

Goal 13
Increase climate change knowledge and understanding within the National Park Service.

Goal 14
Provide external communications about the implications of climate change and the National Park Service response

Goal 15
Model and communicate sustainable practices that lead by example.

Communicating climate change *within* the NPS

- Demonstrate holistic approach
- Establish baseline information
- Provide information to resource managers and interpreters
- Engage multiple disciplines in cultural landscape management

Communicating climate change *beyond* the NPS

- Connect the human story with the environmental story
- Highlight human interaction with the natural environment
- Demonstrate traditional practices and relationship with the landscape
- Make green practices visible
- Lead by example

Incorporate the landscape story into interpretive programs

Tell the stories of human adaptation and response to their environment

Lead by example

Turf grass test plots at Fort Baker, Golden Gate NRA

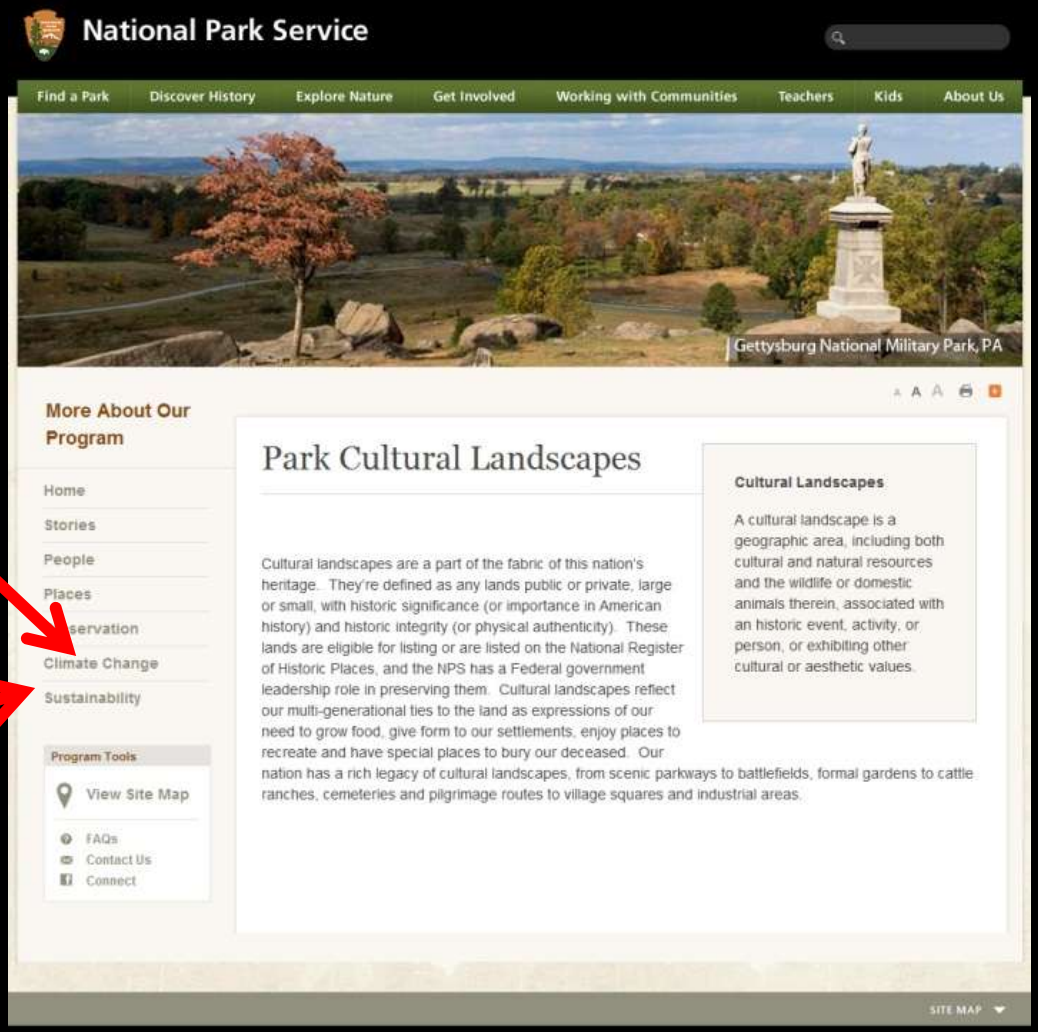
Lead by example

Turf grass test plots at Fort Baker, Golden Gate NRA

For more information: http://www.nps.gov/cultural_landscapes
also: http://www.facebook.com/NPSCLP

Climate Change and Cultural Landscapes page

Sustainability and Cultural Landscapes page



Cultural Landscapes and the Climate Change Response Strategy

When climate change first emerged as a growing environmental crisis, it was viewed as primarily a natural resource issue – the realm of polar bears and ice caps – of scenarios and theoretical models. But in recent years, as he impacts of climate change have become more evident and hit closer to home, it has become clear that climate change is not just a natural resource issue, but something we are all going to have to address.

Cultural landscapes throughout the National Park Service are vulnerable to the impacts of climate change. Severe storms – floods and landslides – rising sea level – drought – fire – invasive species – pests and disease – all threaten our historic resources. Meanwhile, the way we manage and maintain our cultural landscapes may directly contribute to the progression of global warming. Energy consumption – greenhouse gas emissions – water consumption – the use of chemical pesticides, herbicides, and fertilizers.

In 2010, the national park service formalized its response to climate change in its Climate Change Response Strategy. The strategy is presented in four components: science, mitigation, adaptation, and communication. These four components provide a helpful framework for discussing our challenges and responsibilities as cultural landscape managers in responding to climate change.

Today I'd like to talk to you about how we as stewards of cultural landscapes can address climate change, to help better understand its impacts, slow its progression, and prepare for a changing future. The presentation is divided into the four strategy components, with real-world examples of how these components might apply to what we do as cultural landscape managers.

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Science

Science here obviously refers to the data collected by climate scientists, biologists, ecologists, and so on. But in more general terms, it refers to the collective body of information that might be relevant to

climate change and how it affects our resources.

I've include here a few of the goals from the Climate Change Response Strategy that are most applicable to what we do. In the course of our work, we must be committed to utilizing the best available information about climate change to inform our management practices. This can include historical research, existing conditions analysis, *and* information about the relevant natural systems.

We also have the opportunity to contribute to the knowledge base through our processes of documentation, analysis, and monitoring of cultural landscapes. In the course of the work we do, we pull together great amounts of information about the landscape and how it has changed over time. Photos, aerials, historic maps, correspondence, contemporary descriptions. We combine these with existing conditions analysis and natural systems data to synthesize a cohesive narrative of change in the landscape over time.

These narratives, and the data that support them, are captured in the documents we produce, including CLRs, CLIs, and National Register Nominations. We are able to monitor ongoing changes through CLI condition updates and records of treatment. And we regularly assess the state of our knowledge base to ensure that the resources are being adequately documented.

Our research often allows us to monitor large-scale changes in the landscape, highlighting changes in vegetation patterns, forest cover, rainfall, and topographical features. At Big Hole National Battlefield, documentation allows us to monitor the forest encroachment on the historically clear hillside.

At Big Meadows in Shenandoah National Park, historic aerial photos from as recently as the 1950s show significant reduction in the meadow size.

At Saint Gaudens NHS, monitoring blooming times of the apple trees can give information about how the timing of the arrival of spring has changed since historic times.

And at Boston Harbor Islands NRA, an intern undertook a phonological study that established a baseline of data for the leafing times of staghorn sumac.

As we undertake cultural landscape research in support of our work, our key contributions to managing for climate change are to document change in the landscape, identify vulnerable cultural resources, identify sensitive natural systems, articulate historic character, and inform treatment and maintenance decisions.

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Adaptation

The climate is changing, and according to projections it will continue to change for the foreseeable future. Adaptation refers to the actions that are taken, and adjustments to practices, that accommodate the changing climate. In other words, how are we going to protect historic resources, preserve historic character, and protect the integrity of cultural landscapes against the impacts of climate change?

As we adapt our management practices to account for climate change, our goals include preserving historic integrity and avoiding impairment, protecting cultural and natural resources, building resiliency in the landscape, and preparing for future conditions.

Some measures we might take to adapt to the impacts of climate change include substituting or altering the components in the landscape in accordance with the Secretary's standards, physically protecting vulnerable resources, committing to on-going cycles of maintenance, repair and replacement, relocating resources under imminent threat, and a last resort, recording and releasing the resources to succession.

Preserve integrity and Avoid impairment

We often prescribe substitutions or alterations to the landscape to accommodate changing conditions. Any changes should be compatible in character and preserve the historic integrity, but we often have to make compromises between historic accuracy and the realities of maintaining resources or keeping

vegetation alive. At Eleanor Roosevelt National Historic Site, a historic red pine stand has been struggling for some time, infested with the red pine scale. Rather than replace the stand with more red pines, which will likely continue to struggle, a substitute pine species will be chosen to replicate the historic character of the stand.

The solution at Rapidan Camp in Shenandoah National Park was not as clear. The death of nearly all of the eastern hemlock trees from the hemlock wooly adelgid in the late 1990s transformed the once shady glen into an open meadow colonized by brush and invasive species. Since the adelgid is still an issue, the hemlocks can't be reinstated without extensive treatment with pesticides. When the options were weighed, and in consultation with park staff and forestry specialists, the likely recommendations are going to be to allow the native pioneering yellow poplar trees to grow into a canopy. While the character of the deciduous poplars will certainly be different from the historic hemlock glen, it *will* create a shady, closed canopy of single-age trees, quickly and with minimal intervention.

Protect cultural resources

Steps must often be taken to physically protect resources from the impacts of climate change. Heavy rains in the mountains around Rapidan Camp can cause rivers to flood, pushing down boulders, tree trunks, and debris that scours the river bed. Resources located near the river must be protected from damage.

Innovative flood protection can be effective at protecting cultural resources while preserving the natural and historic character of the views from the road. At Mount Rainier National Park, engineered log jams absorb the energy from glacial lake outburst floods, protecting historic roads from damage.

Protect sensitive natural systems

Cultural landscapes often contain vulnerable natural systems that could be affected by management actions. Treatment and maintenance recommendations must protect the historic character while protecting the natural systems. At Vanderbilt Mansion National Historic Site, historic vegetation

included highly invasive species like barberry and English ivy. Treatment recommendations specified non-invasive substitutions to prevent these from spreading into nearby forests.

Endangered nēnē at ʻĀinahou Ranch in Hawaiʻi Volcanoes NP use the landscape for breeding during the winter. Mowing and other maintenance activities are scheduled and carried out so that they do not impact the nēnē.

Build resiliency

By building resiliency in the landscape, it can better withstand adverse conditions. This might include selecting stronger materials, improving the health and vigor of the biotic systems, or replacing vulnerable vegetation with more resilient species. The inclusion of non-historic native plantings can be used to create a desired character, while increasing the landscape's resiliency to adverse conditions. At Golden Gate National Recreation Area, drought-tolerant native plantings enhance the historic character while standing up to dry summers.

Maintain, repair, replace

Preserving resources in the face of changing conditions often means recognizing that frequent and on-going maintenance, repair, and replacement are necessary. Properly maintaining fruit trees improves their health and helps them withstand periods of drought and fend off diseases.

Historic vegetation, such as these pear trees at John Muir National Historic Site, my need periodic replacement.

There are times when no amount of protection can ensure the survival of cultural resources. In the case of high-value resources, these may be relocated away from the threat.

And finally, some resources will not be able to be saved, and the only practical recourse will be to record them and let them go.

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Mitigation

While it is necessary to be prepared for a changing climate, we must also be doing all we can to reduce our contribution to global warming. Mitigation refers to actions that reduce gas emissions and energy and resource consumption, thus reducing our carbon footprint. The Climate Change Response Strategy directs us to include climate change mitigation into all levels of NPS practices.

As cultural landscape managers, we can reduce the impact to climate change by using environmentally friendly practices in landscape maintenance, reducing the level of maintenance required in the landscape, and building healthier, more self-sufficient systems in our historic landscapes.

Since landscape maintenance can be a significant source of a park's energy consumption and waste generation, it should be included in any discussions about a sustainable park operations. And as landscape planners, we should be incorporating potential environmental impacts and their mitigation in our treatment recommendations.

Mowing turf grass is a major source for landscape maintenance across the system and a significant source of greenhouse gas, as well as water usage, fertilizer, and herbicide. Solutions to reduce mowing can help parks move toward a lower carbon footprint.Cultural landscape reports can help define character objectives and recommend mowing plans that reduce the area or frequency of mowing.

At Thomas Edison NHP, what is today maintained as mowed turf grass was historically a meadow maintained by grazing livestock. The treatment plan recommends conversion of a portion of the lawn to meadow, with an increase in the meadow species and a reduction in the frequency of mowing. The turf areas to be converted to meadow character recommended in the treatment plan would result in a substantial reduction of area to be mowed regularly. The difference reduced mowing can make, both in terms of reduced energy consumption, and in historic character, can be striking.

We can also reduce the amount of maintenance resources needed in the overall landscape by defining

high-value areas where resources can be focused. At ʻĀinahou Ranch, maintenance resources were focused in the area around the house, where the garden had a highly ornamental, residential character. Areas associated with views or circulation receive periodic mowing to keep grass moderately low, while other regions are mowed only as needed.

A similar strategy at Fort Baker reduced the park's mowing burden by converting some turf areas to meadow character.

Substituting non-historic species or varieties that are better adapted to current conditions can reduce dependence on maintenance resources (water, pesticides, pruning, mowing, etc.).

Substitution of plant species rarely involves the removal of historic material, but rather supplementation of existing vegetation, reinstatement of vegetation that has been lost, or the replacement of non-historic vegetation.

At Vanderbilt Mansion, a plant palette was developed for the formal garden to give the park and volunteers some flexibility in the bedding plants used. Guidance was given regarding character, size, color, texture, etc., and sample lists of plants were provided.

Sometimes historic landscape practices can be revived or modified to meet current needs and reduce resource use. This can have a combined advantage of enhancing historic character through land use, employing sustainable practices, and providing an opportunity for interpretation.

Water-wise irrigation practices can provide needed water to historic vegetation while minimizing the overall consumption of water. Measures include the use of drip irrigation, use of solar pumps and controllers, irrigating at night, and irrigating only when needed.

The use of mulch reduces water consumption by reducing evaporation. The choice of mulch materials should include functional considerations as well as historic character. At Manzanar, the mulch needed to be larger particles of chipped wood to withstand the frequent high winds.

_Emissions can be reduced by purchasing or retrofitting equipment to run on alternative fuels, such as propane gas, biofuels, and electricity.

_Chemical applications of herbicides, pesticides, and fertilizers have a number of disadvantages, both to natural and cultural resources. In addition to the petroleum used to manufacture and transport them and the pollution to storm runoff, these chemicals can damage historic materials.

_Alternative methods for weed removal can be effective without the use of chemicals.

_Building resiliency in the landscape can help it resist the impacts of climate change, as I discussed earlier, but it can also reduce the need to input resources. When the landscape is composed of healthier, more balanced systems, it is more self-sustaining and requires less maintenance. This includes improving soil health, increasing organic matter and natural nutrients, encouraging healthy root systems, and maintaining vigorous, disease-free plants and trees.

_Composting landscape waste and applying it in the landscape returns nutrients to the soil, reduces the use of chemical fertilizers and other treatments, reduces exported waste, and sequesters carbon on site.

_Nutritional mulch composed of composted materials reduce water loss and returns nutrients to the soil.

_By taking a holistic approach to cultural landscape management, we can make our landscapes healthier, more balanced, and more resilient to the impacts of a changing environment. Vital, balanced systems are better able to withstand and compete with pests, diseases, drought, invasive vegetation, and high winds. When we make our landscapes healthy, they are better able to fight their own battles.

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Education

_As scholars and stewards of the landscape, our expertise spans the fields of history, horticulture, ecology, biology, and geography. This unique position allows us to connect physical changes in the

landscape to the story of how people have interacted with their environment. It allows us to make climate change, among other factors, more visible in the landscape.

Sharing our expertise with our colleagues within the park service increases the knowledge base, fosters stewardship, and allows park managers to make informed decisions about how their cultural landscapes are managed.

And communicating our efforts with visitors, neighbors, and partners brings relevance and immediacy to climate change and its impacts, and demonstrates practices that can reduce our carbon footprint.

By incorporating the landscape story into interpretive programs and materials, we impart to our visitors the potential impacts of climate change, the benefits of treating our landscapes ecologically, and the power of traditional practices in maintaining healthy, balanced ecosystems.

And by making our efforts visible and leading by example, we can have an impact that extends far beyond our park boundaries.

Thank You