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SABIN CENTER FOR CLIMATE CHANGE LAW

**Considering the Effects of Climate Change
on Natural Resources in Environmental
Review and Planning Documents**

Guidance for Agencies and Practitioners

By Jessica Wentz

September 2016

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The Sabin Center for Climate Change Law develops legal techniques to fight climate change, trains law students and lawyers in their use, and provides the legal profession and the public with up-to-date resources on key topics in climate law and regulation. It works closely with the scientists at Columbia University's Earth Institute and with a wide range of governmental, non-governmental and academic organizations.

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Acknowledgments: Special thanks to Michael Gerrard and Michael Burger for their assistance with this project, as well as all of the attendees of the stakeholder workshop on June 15, 2016 for their perspectives on how climate change can be accounted for in natural resource planning and their feedback on the model protocol.

The June 18, 2015 Workshop that was convened to discuss a draft of this report and the model protocols was generously supported by the David Sive Memorial Fund.

EXECUTIVE SUMMARY

Climate change has important implications for the management and conservation of natural resources. The government agencies responsible for managing these resources have generally recognized that climate change adaptation should be mainstreamed into their planning processes, and yet this topic is still treated as an afterthought in many planning documents.

One problem is a lack of guidance: only a few federal agencies have published detailed guidance on how managers should consider climate change impacts and management implications in resource management plans (RMPs), environmental impact statements (EISs), and other planning documents. The Council on Environmental Quality (CEQ) recently issued guidance directing all federal agencies to account for climate change impacts in environmental review documents, but the CEQ guidance does not contain detailed instructions on how to analyze these impacts in the context of natural resource management actions, nor does it address the need to account for climate change impacts in other types of planning documents. In the absence of more detailed guidance, there is considerable variation in terms of whether and how climate change impacts are management implications are discussed in these documents.

To help fill the guidance gap, the Sabin Center for Climate Change Law has published a model protocol: *Considering the Effects of Climate Change on Natural Resources in Environmental Review and Planning Documents*. The protocol was developed in consultation with federal agencies, environmental consulting firms, non-governmental organizations, and academic institutions. It identifies critical decision points where managers should account for climate change impacts (e.g., sustainable yield and multiple use determinations) and contains general recommendations on how to go about conducting climate impact analyses in the context of different types of planning documents.

This paper presents some of the key findings from the research underpinning the model protocol project. It begins with a discussion of how climate change may affect natural resources in the United States. This discussion is followed by an analysis of federal planning and environmental review laws, and the extent to which those laws can be interpreted as either requiring or authorizing agencies to consider the effects of climate change in planning documents. Briefly stated, the key findings from the legal analysis are:

- Management directives related to the sustainable use and conservation of natural resources cannot be fulfilled without consideration of how climate change may affect those resources.
- The National Environmental Policy Act (NEPA) also requires consideration of how climate change may affect future conditions in the planning area.
- Most of the statutes governing the management of natural resources provide ample leeway to experiment with different responses to climate change.

This analysis of planning mandates is followed by a review of federal agency efforts to ensure that projections of climate change impacts are accounted for in natural resource planning processes. One key finding is that the issuance of specific directives and/or guidance describing how natural resource managers should account for climate change impacts and corresponding management implications is fundamentally important in this context: without such guidance, there is no guarantee that climate change impacts will be discussed at all, let alone in sufficient detail to inform the decision-making process.

Finally, the paper discusses how natural resource managers can effectively integrate information about climate change impacts and adaptation measures into planning documents. It presents a variety of recommendations aimed at satisfying legal requirements and promoting better informed decision-making:

- Managers should focus on climate change-related impacts that have the greatest implications for management decisions.
- The climate change impact analysis should be used to evaluate the efficacy and environmental outcomes of different management approaches.
- Managers should account for the impacts of climate change when determining sustainable yields, resource uses, and resource allocations.
- Managers should account for the impacts of climate change in Endangered Species Act listing decisions, critical habitat designations, and recovery and habitat conservation plans.
- Uncertainty is not a basis for inaction: adaptation measures can be implemented in the near-term to improve the resilience and adaptive capacity of landscapes and ecosystems.
- Greater specificity is needed to guide the implementation of monitoring and adaptive management programs.

Each of these recommendations is accompanied by one or more examples from specific planning documents.

The model protocol, included as an Appendix to this paper, incorporates all of these recommendations into a clear set of directives for natural resource managers. Many of these directives are linked to federal planning mandates, but the protocol could nonetheless be adapted for use by state and local officials and private managers. Notably, the protocol does not discuss how agencies or other entities should account for the effects of climate change on buildings and infrastructure. The Sabin Center has published a separate protocol for conducting that type of analysis in the context of environmental review documents.¹ That protocol was also developed through extensive consultation with government agencies and other stakeholders.

¹ *Model EIA Protocols*, SABIN CENTER FOR CLIMATE CHANGE LAW, <http://bit.ly/2czpDr0> (last visited Sept. 12, 2016).

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INTRODUCTION

Climate change is already affecting public lands and natural resources in the United States. Increasing temperatures, changing precipitation patterns, and other climate-related phenomena are altering the biophysical characteristics of habitats, the composition and range of species, and the timing of critical biological events such as spring bud burst.¹ These alterations can impair ecological integrity, resource productivity, and the delivery of critical ecosystem services.² All of these impacts will become more pronounced as the climate continues to warm.

The agencies responsible for managing public lands and natural resources are currently assessing how climate change may affect resources under their jurisdiction and how they should respond to those effects. Most of these agencies have acknowledged that climate change impacts and adaptation options should be routinely accounted for in planning documents, such as resource assessments, management plans, and environmental impact statements (EISs), but only a few have promulgated specific guidelines for conducting such analysis. The Council on Environmental Quality (CEQ) has promulgated guidance directing all federal agencies to account for the effects of climate change in environmental reviews in order to more accurately assess the environmental consequences of proposed actions, but this guidance does not contain detailed instructions on how this analysis should be performed in the context of natural resource management decisions, nor does it apply to other types of planning documents.³

There is still considerable variation in how natural resource planning documents address considerations related to climate change impacts and adaptation. Most of the recent planning documents published by federal agencies do contain some discussion of how climate change may affect the area or resource being managed, but the discussion tends to be quite general and the findings typically have little or no impact on management decisions or conclusions about environmental outcomes. Some documents still do not contain any reference to climate change.

¹ U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT, 17, 196-201, 562 (2014), <http://bit.ly/2bXRM9B>.

² *Id.* at 196-201.

³ U.S. Council on Environmental Quality, *Final Guidance for Federal Departments and Agencies on Consideration of Climate Change in National Environmental Policy Act Reviews* (2016), <http://bit.ly/2aBwZ8g>.

On June 15, 2016, the Sabin Center for Climate Change Law convened a workshop with stakeholders from federal agencies, environmental consulting firms, non-governmental organizations, and academic institutions to discuss how we can work together to improve the quality and consistency of the climate change impact analysis in natural resource planning documents. The federal agency representatives discussed how their agencies are preparing for the effects of climate change, participants shared examples of how climate change impacts were accounted for in specific planning documents, and the entire group provided feedback on a draft model protocol that contained instructions on how natural resource managers can account for the effects of climate change in different types of planning documents.

This paper presents some of the key findings from the workshop and research underpinning the model protocol project. Part 1 summarizes the latest scientific research on how climate change may affect natural resources in the United States and what measures can be undertaken to prepare for and respond to those effects. Part 2 explains why federal planning and environmental review mandates, although largely silent on the issue of climate change, nonetheless require agencies to account for the effects of climate change on the natural resources that they manage. Part 3 describes the efforts undertaken by federal agencies to ensure that climate change impacts are accounted for in planning and environmental review documents, and finds that the issuance of directives or guidance on how climate change should be addressed in these documents can significantly improve the quality and consistency of the analysis. Part 4 presents recommendations on how natural resource managers can effectively integrate information about climate change impacts and adaptation measures into planning documents. Finally, the model protocol is attached as an appendix to the report.

1. EFFECTS OF CLIMATE CHANGE ON NATURAL RESOURCES

There is an extensive body of research pertaining to how climate change may affect natural resources in the United States and how managers can respond to and mitigate these effects. This section will summarize the key findings from research with respect to: (1) terrestrial ecosystems, (2) freshwater resources, (3) coastlines, (4) wetlands, (5) wildlife and endangered and threatened species, and (6) fisheries.

One key finding is that adaptation efforts need not be delayed by uncertainty about the timing, nature and magnitude of climate change impacts. In the near term, resource managers can implement actions aimed at reducing other stressors on natural resources (particularly those related to human use and development) and improving the ecological integrity of landscapes and ecosystems. Such actions will typically improve the adaptive capacity and long-term resilience of species and biological communities to the effects of climate change.⁴ Resource managers can also designate and protect habitat corridors and areas for future habitat—the idea being to allow wildlife and vegetation to migrate naturally in response to changing bioclimatic conditions.⁵

In some cases, more proactive adaptation measures may be needed to preserve natural resources in the face of climate change—for example, assisted migration programs may be used to facilitate the movement of species that are located in isolated geographic areas, such as mountain tops and islands, in response to changing bioclimatic conditions.⁶ It may be prudent for natural resource managers to monitor and accumulate more data before implementing some of these more proactive measures.⁷

1.1 Terrestrial Ecosystems

There are a variety of ways in which climate change can affect the composition and health of terrestrial ecosystems such as forests and grasslands, potentially impairing their productivity and ability to deliver critical ecosystem services. Some of the key impacts include:

- **Rising temperatures:** Increases in temperature represent one of the broadest possible stressors to terrestrial ecosystems, directly affecting the health of these ecosystems and contributing to the other stressors described below.⁸

⁴ See Robert L. Beschta et al., *Adapting to Climate Change on Western Public Lands: Addressing the Ecological Effects of Domestic, Wild, and Feral Ungulates*, ENVIRONMENTAL MANAGEMENT (2012), <http://bit.ly/2coXpPU>; JILL S. BARON ET AL., U.S. GLOBAL CHANGE RESEARCH PROGRAM, PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES (SAP 4.4) (2008), <http://bit.ly/2bDbSSQ>.

⁵ Baron et al. (2008), *supra* note 4; Veronica A. J. Doerr et al., *Connectivity, Dispersal Behaviour, and Conservation Under Climate Change: A Response to Hodgson et al.*, 48 JOURNAL OF APPLIED ECOLOGY 143 (2011).

⁶ Jason S. McLachlan et al., *A Framework for Debate of Assisted Migration in an Era of Climate Change*, 21 CONSERVATION BIOLOGY 297 (2007).

⁷ Justin Travis et al., *Dispersal and Species' Responses to Climate Change*, 122 OIKOS: SYNTHESISING ECOLOGY 1532 (2013).

⁸ Craig D. Allen et al., *A Global Overview of Drought and Heat-Induced Tree Mortality Reveals Emerging Climate Change Risks for Forests*, 259 FOREST ECOLOGY AND MANAGEMENT 660 (2010); Beverly E. Law, *Regional Analysis of Drought and Heat Impacts on Forests: Current and Future Science Directions*, 20 GLOBAL CHANGE BIOLOGY 3595 (2015); Deborah M. Finch et al., *Climate Change, Animal Species, and Habitats: Adaptation and Issues*, Ch. 5 in CLIMATE CHANGE IN GRASSLANDS, SHRUBLANDS,

- **Water stress and drought:** Many terrestrial ecosystems will experience an increase in water stress and drought due to changes in the amount and type of precipitation (e.g., rain instead of snow) and higher temperatures (which increase evaporation).⁹
- **Increased wildfire risk:** Hotter and drier weather will increase the occurrence of wildfires, as well as the duration of the wildfire season. Climate-related stressors will also impair the ability of terrestrial ecosystems to withstand and recover from wildfires. Rising temperatures and earlier springs have already contributed to increased wildfire activity in the western United States.¹⁰
- **Insects and pathogens:** Warmer weather and changes in precipitation can contribute to the spread of exotic insects, such as the mountain pine beetle, and exotic diseases, such as Phytophthora root rot.¹¹
- **Invasive species:** Changes in bio-climatic conditions can also contribute to the spread of invasive species like Privet, Kudzu, Russian thistle, and cheatgrass.¹²
- **Extreme weather events:** Extreme weather events such as drought, high winds, ice storms, hurricanes and landslides affect forest and grassland dynamics.¹³
- **Changes in soil moisture and nutrient content:** Increases in wildfires, insect outbreaks, and droughts can alter soil moisture and nutrient content, which has implications for vegetation growth as well as carbon sequestration.
- **Tree mortality:** Drought, temperature stress, pathogens, and other climate-related stressors will also contribute to a higher incidence of tree mortality in some regions.¹⁴ Drought-induced widespread forest die-off has already been observed in the western United States.¹⁵
- **Changes in ecosystem dynamics:** These stressors will affect the composition and health of terrestrial ecosystems, with adverse effects on the growth rate, vigor and health of many

AND DESERTS OF THE INTERIOR AMERICAN WEST: A REVIEW AND NEEDS ASSESSMENT (Deborah M. Finch, ed., U.S. Forest Service, 2012).

⁹ U.S. Global Change Research Program (2014), *supra* note 1, at 197-98; Law (2015), *supra* note 8; Allen et al. (2010), *supra* note 8; Finch et al. (2012), *supra* note 8.

¹⁰ A. L. Westerling, *Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity*, 313 SCIENCE 940 (2006).

¹¹ Outbreaks of the mountain pine beetle are already occurring in areas outside of the recorded historical range. Barbara J. Bentz et al., *Climate Change and Bark Beetles of the Western United States and Canada: Direct and Indirect Effects*, 60 BIOSCIENCE 602 (2010).

¹² See Bethany A. Bradley et al., *Climate Change Increases Risk of Plant Invasion in the Eastern United States*, 12 BIOLOGICAL INVASIONS 1855 (2009); Jack B. Runyon et al., *Invasive Species and Climate Change*, Ch. 7 in CLIMATE CHANGE IN GRASSLANDS, SHRUBLANDS, AND DESERTS OF THE INTERIOR AMERICAN WEST: A REVIEW AND NEEDS ASSESSMENT (Deborah M. Finch, ed., U.S. Forest Service, 2012), <http://bit.ly/2bPBUau>.

¹³ U.S. Global Change Research Program (2014), *supra* note 1, at 199.

¹⁴ Allen et al. (2010), *supra* note 8.

¹⁵ William R. L. Anderegg, *Consequences of Widespread Tree Mortality Triggered by Drought and Temperature Stress*, 3 NATURE CLIMATE CHANGE 30 (2013).

important species.¹⁶ Some species' suitable habitat will move northward in latitude and upward in elevation in response to changing bio-climatic conditions.¹⁷

- **Carbon storage capacity:** The carbon storage capacity of terrestrial ecosystems may decline due to changes in tree density, tree composition, and soil composition.¹⁸
- **Timber and forage production:** The quality and quantity of timber and forage production can be affected by changes in forest dynamics, wildfires, and other stressors.¹⁹

All of these changes can affect the capacity of ecosystems to sustain certain uses, such as timbering and livestock grazing, and deliver services, such as water filtration and flood protection.

Researchers have identified a number of adaptation strategies for terrestrial ecosystems, which encompass more conventional conservation measures as well as non-conventional measures that are uniquely intended as a response to climate change. These strategies include:

- **Ecological restoration and conservation:** Healthy, functioning ecosystems are more resilient to external shocks and changing bioclimatic conditions. Managers can thus prepare for the effects of climate change by protecting areas of high ecological integrity and restoring degraded ecosystems.²⁰ The effectiveness of this approach will depend on the rate of change in the management area: in some areas, climate-related changes may outpace the inherent adaptive capacity of healthy ecosystems.²¹
- **Reducing disturbances:** One of the most effective ways to restore or maintain ecological integrity in an ecosystem is to reduce other stressors such as timbering, grazing, mining, road construction, and pollution.²²

¹⁶ U.S. Global Change Research Program (2014), *supra* note 1, at 200.

¹⁷ Anita T. Morzillo & Ralph J. Alig, *Climate Change Impacts on Wildlife and Wildlife Habitat*, Ch. 1 in EFFECTS OF CLIMATE CHANGE ON NATURAL RESOURCES AND COMMUNITIES: A COMPENDIUM OF BRIEFING PAPERS (U.S. Forest Service, 2011), <http://bit.ly/2cpiQ3j>.

¹⁸ Susan H. Julius et al., *Climate Change and U.S. Natural Resources: Advancing the Nation's Capability to Adapt*, ISSUES IN ECOLOGY REPORT no. 18 (2013), <http://bit.ly/2bA9jk5>.

¹⁹ Roger Sedjo, *The Future of Trees: Climate Change and the Timber Industry*, 174 RESOURCES 29 (2010); Rebecca Chaplin-Kramer & Melvin R. George, *Effects of Climate Change on Range Forage Production in the San Francisco Bay Area*, 8(3) PLoS One e57723 (2013); Andrei P. Kirikenko & Roger A. Sedjo, *Climate Change Impacts on Forestry*, 104 PNAS 19697 (2007).

²⁰ Note that the restoration of ecosystems to a healthy, functioning state in the context of climate change does not necessarily entail the restoration of these ecosystems to a historical baseline: rather, new indicators must be developed to define "ecological integrity" in the context of a changing baseline. See James A. Harris et al., *Ecological Restoration and Global Climate Change*, 14(2) Restoration Ecology 170 (2006); Nathaniel E. Seavy et al., *Why Climate Change Makes Riparian Restoration More Important Than Ever: Recommendations for Practice and Research*, 27(3) Ecological Restoration 330 (2009).

²¹ JASON FUNK & STEPHEN SAUNDERS, ROCKY MOUNTAIN FORESTS AT RISK: CONFRONTING CLIMATE-DRIVEN IMPACTS FROM INSECTS, WILDFIRES, HEAT, AND DROUGHT (Union of Concerned Scientists & The Rocky Mountain Climate Organization 2014); Michael Köhl et al., *Combating the Effects of Climatic Change on Forests by Mitigation Strategies*, 5 CARBON BALANCE AND MANAGEMENT 8 (2010).

²² U.S. Global Change Research Program (2014), *supra* note 1, at 183, 199, 217.

- **Managing plant composition and structure:** Managers can also improve the resilience of forests and grasslands by proactively managing the composition and structure of trees, grasses, and other vegetation.²³ For example, managers can deploy a mixed planting strategy to maintain or increase species diversity while removing “high risk” species, such as those that are likely to transmit pathogens. Managers may want to plant alternative genotypes or new species to account for shifting bioclimatic conditions (e.g., drought tolerant species).²⁴
- **Fuel management:** Managers can reduce the risk of uncontrolled wildfires through fuel reduction treatments, such as prescribed burns, mechanical thinning, and commercial harvest.²⁵ Managers should aim to leave larger trees of fire-resistant species in place when thinning forests.²⁶
- **Managing drought impacts:** Measures to ameliorate drought impacts include reductions in stand or vegetation density, removal of dry or flammable vegetation, selection of drought-tolerant species and genotypes, artificial regeneration, and the development of multi-structured stands.²⁷
- **Managing invasive species, insects and pathogens:** Measures to address these risks include partial cutting or thinning of vegetation; reducing disease losses through sanitation cuts that remove infected trees or unwanted species; using insecticides and fungicides; and planting tree species that are more resistant to pests.²⁸
- **Improving rangeland health:** Range improvements can be constructed or implemented to improve watershed conditions, supplement existing water supplies, enhance wildlife habitat, and serve other purposes related to climate change adaptation. Managers can also adjust grazing practices, e.g., by reducing the total number of grazing ungulates, changing the timing of grazing, changing the species composition of ungulates, or changing the species composition of forage.²⁹

²³ Köhl et al (2010), *supra* note 21.

²⁴ Julius et al. (2013), *supra* note 18.

²⁵ For an overview of forest fuel reduction treatments, see James K. Agee & Carl N. Skinner, *Basic Principles of Forest Fuel Reduction Treatments*, 211 *FOREST ECOLOGY AND MANAGEMENT* 83 (2005).

²⁶ Stephen Fitzgerald and Max Bennett, *A Land Manager’s Guide for Creating Fire-Resistant Forests*, Oregon State University EM 9087 (2013).

²⁷ James S. Clark et al., *The Impacts of Increasing Drought on Forest Dynamics, Structure, and Biodiversity in the United States*, 22(7) *GLOBAL CHANGE BIOLOGY* 2329 (2016).

²⁸ T. D. Ramsfield et al., *Forest Health in a Changing World: Effects of Globalization and Climate Change on Forest Insect and Pathogen Impacts*, 89 *FORESTRY* 245 (2016).

²⁹ Legume species may be more resilient than grass species, and can provide more nutrients for grazing ungulates. Bison and smaller ruminant livestock (e.g., goats and sheep) tend to be more resilient to environmental shocks than cattle and they have a less negative impact on grassland health—thus, replacing cattle with Bison may prove to be a helpful adaptation strategy. See Curtis Freese et al., *Climate Change Mitigation and Adaptation through Large-Scale Grassland Conservation* (American Prairie Reserve 2016); David D. Briske et al., *Climate-change Adaptation on Rangelands: Linking Regional Exposure with Diverse Adaptive Capacity*, 13(5) *FRONTIERS IN ECOLOGY AND THE ENVIRONMENT* 249 (2015); Linda A. Joyce et al., *Climate Change and North American Rangelands: Assessment of Mitigation and Adaptation Strategies*, 66(5) *RANGELAND ECOLOGY & MANAGEMENT* 512 (2013); Beschta et al. (2012), *supra* note 4.

- **Connected landscapes and habitat corridors:** The capacity to move or migrate in response to changing conditions will be key to the survival of many species. Managers can enable movement by creating connected landscapes and habitat corridors.³⁰
- **Assisted migration:** Managers may consider relocating species that will not be able to move on their own, such as species located in isolated geographic areas.³¹
- **Genetic preservation:** Seed banks and living collections can be used as means of preserving genetic information, particularly for species that may go extinct in the wild as a result of climate change.³²

1.2 Freshwater

The impacts of climate change on hydrologic conditions and freshwater resources will vary depending on the location and the time of year. The most significant impacts on freshwater resources will come from changes in the quantity, timing, and type of precipitation – some areas, like the Pacific Northwest, may experience an increase in winter precipitation and a decrease in summer precipitation; others, like the Southwest, may experience less precipitation year-round.³³ Flood and drought risk may increase in many areas.³⁴ Other climate-related drivers, such as increased temperatures, will also affect freshwater resources. Key impacts include:

- **Changes in precipitation patterns:** Changes in the quantity, timing, and type of precipitation will affect surface and groundwater hydrology with corresponding impacts on water quantity and quality.
- **Rising temperatures:** Rising temperatures are accelerating the rate at which snowpack, ice, and permafrost are melting, which can contribute to temporary increases in river flows and flooding, followed by decreases in river flows. Rising temperatures will also cause greater water loss through evapotranspiration and will have a direct effect on water quality and the health of aquatic ecosystems (e.g., when water is too warm it cannot hold enough oxygen for aquatic organisms to survive).
- **Extreme weather events and floods:** The number and intensity of heavy precipitation events will most likely increase, affecting hydrologic conditions and water quality (e.g., through increased flooding, erosion and runoff).

³⁰ Constance I. Millar et al., *Climate Change and Forests of the Future: Managing in the Face of Uncertainty*, 17(8) ECOLOGICAL APPLICATIONS 2145 (2007).

³¹ Mark W. Schwartz, *Managed Relocation: Integrating the Scientific, Regulatory, and Ethical Challenges*, 62(8) BIOSCIENCE 732 (2012).

³² U.S. Global Change Research Program (2014), *supra* note 1, at 202.

³³ *Id.* at Ch. 3.

³⁴ P. Döll et al., *Integrating Risks of Climate Change Into Water Management*, 60 HYDROLOGICAL SCIENCES JOURNAL 4 (2015).

- **Sea level rise:** Sea level rise will contribute to coastal flooding and salt-water intrusion into coastal aquifers and surface waters.
- **Water scarcity and drought:** Increased temperatures and decreases in rainfall and snowpack will contribute to water scarcity and drought in some regions, particularly arid regions like the Southwest.³⁵
- **Changes in groundwater supply:** The aforementioned impacts on precipitation and hydrology will affect the rate of aquifer recharge – some areas may experience more rapid recharge, but areas that are already water-stressed will likely experience a decline in the rate of aquifer recharge. Groundwater availability will also likely be affected by increases in withdrawals in these areas (correlated with increased water demand and decreased availability of surface water).³⁶

These impacts have implications for water supply, water quality, flood management, and aquatic ecosystem health. For example, reductions in river flow affect water quality (e.g., through increased concentrations of pollutants) as well as aquatic ecosystem health. Flooding also damages habitats and impairs water quality. Adaptation measures to help mitigate these impacts include:

- **Integrated water resources management (IWRM):** IWRM is an adaptive approach to water management, the goal of which is to supply fresh water for human uses in way that does not compromise the sustainability aquatic ecosystems. IWRM entails scenario planning, experimentation, learning from experience, and “developing flexible and low-regret solutions that work satisfactorily within the range of possible climate futures.”³⁷
- **Reducing water consumption:** Efforts to reduce consumption in times of water scarcity and drought can be used to preserve freshwater resources for future use and reduce stress on aquatic ecosystems.³⁸
- **New water storage facilities:** Reservoirs and off-river storage basins can be used to mitigate flood risk and store freshwater for future use.³⁹
- **Flood control and stormwater management:** Physical infrastructure and natural systems can be used to control flooding and reduce runoff into freshwater systems.⁴⁰
- **Protection and restoration of aquatic ecosystems:** Managers can also seek to restore aquatic ecosystems and protect these ecosystems from other stressors, such as water pollution, in order to improve their resilience to changing conditions.

³⁵ U.S. Global Change Research Program (2014), *supra* note 1, at 71.

³⁶ Thomas Meixner et al., *Implications of Projected Climate Change for Groundwater Recharge in the Western United States*, 534 JOURNAL OF HYDROLOGY 124 (2016).

³⁷ Döll et al. (2015), *supra* note 34.

³⁸ U.S. Global Change Research Program (2014), *supra* note 1, at 89.

³⁹ *Id.*

⁴⁰ *Id.*

1.3 Coastlines

The coastline of the United States is heavily populated, with approximately 40% of U.S. citizens living in coastal counties and nearly 5 million people living within four feet of the local high-tide level.⁴¹ Coastal habitats provide key ecosystem services, such as “reducing the impacts of floods, buffering from storm surge and waves, and providing nursery habitat for important fish and other species, water filtration, carbon storage, and opportunities for recreation and enjoyment.”⁴² Sea level rise, more intense storms, and other climate-related phenomena will transform these areas in the coming decades, with marked effects on sensitive and unique ecosystems such as estuaries and salt marshes. Effects which are unique to coastal areas include:

- **Sea level rise:** Average sea level has already risen by about eight inches since 1880, and it is projected to rise another one to four feet by 2100. Precise estimates will vary depending on coastal geography and the rate of climate change. New York State, for example, is anticipating 11-75 inches of sea level rise along its coastlines and estuaries by 2100.⁴³ The primary effect of sea level rise is land submergence—according to the *National Climate Assessment*, coastal infrastructure and habitats are already being inundated and otherwise damaged by sea level rise.⁴⁴
- **Saltwater intrusion:** Sea level rise will also contribute to salt-water intrusion into freshwater resources, soils, and coastal ecosystems.
- **More intense storms and coastal flooding:** Climate change is projected to increase the occurrence of more intense coastal storms, storm surges, and flooding, the effects of which will be exacerbated by sea level rise.⁴⁵
- **Changes in estuarine habitats:** Changing precipitation patterns will affect stream flow, leading to lower flow levels and higher flow levels depending on the location and time of year (see above). The changes in stream flow will affect salinity, sediment loading, pollution levels, and other conditions in estuarine habitats.⁴⁶

Other phenomena discussed in Section 1.1 (Terrestrial Ecosystems), such as increasing temperatures and the spread of invasive species, will also affect coastal habitats.

⁴¹ *Id.* at 45.

⁴² *Id.* at 592.

⁴³ 6 NYCRR Part 490, Projected Sea-Level Rise (proposed 2015).

⁴⁴ *Id.* at 414.

⁴⁵ Jonathan D. Woodruff et al., *Coastal Flooding by Tropical Cyclones and Sea-Level Rise*, 504 NATURE 44 (2013).

⁴⁶ NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), CLIMATE SENSITIVITY OF THE NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM (July 2013).

Coastal ecosystems are particularly vulnerable to the impacts of climate change because (i) they have already been dramatically altered by human stressors, and (ii) they often occupy relatively narrow strips of land, and as a result, there are limited opportunities for species to adapt through movement. Sea level rise is the greatest threat to these ecosystems, but they will also be adversely affected by more intense storms and storm surges, rising air temperatures, rising sea temperatures, acidified water, and altered river flows that affect the health of estuaries. Adaptation strategies for these ecosystems include:

- **Restoring and protecting coastal habitats:** By restoring and protecting coastal habitats, managers can address problems such as shoreline erosion, create ecological buffers to storm impacts, and make coastal ecosystems more resilient to the impacts of climate change. Possible measures include: (i) planting native vegetation, (ii) removing invasive species, (iii) avoiding additional construction or development in coastal areas, (iv) managed coastal retreat, and (v) cleaning up water pollution or other forms of pollution.⁴⁷
- **Expansion of coastal habitat:** Managers can create new coastal habitat further inland and at a higher elevation to provide areas where species can move into as sea levels rise.⁴⁸ Restoring and expanding coastal habitats also serves the added benefit of providing additional protection to communities and structures from storms, storm surges, and flooding.
- **Soft shoreline protection:** Beach replenishment and coastal habitat restoration are examples of “soft” shoreline protection measures that can be used to mitigate the effects of sea level rise and storms.⁴⁹
- **Hard shoreline protection:** Physical buffers such as sea walls and riprap can be constructed to temporarily protect human developments from sea level rise, but such structures generally aggravate erosion and beach loss and cause negative effects on coastal ecosystems. For this reason, soft protection measures are generally preferred.⁵⁰
- **Assisted relocation of coastal ecosystems and species:** Managers may want to consider more active assisted relocation programs where simply creating or protecting coastal habitat is insufficient to assure the survival of a coastal ecosystem or species.⁵¹

⁴⁷ Jenny L. Davis et al., *Living Shorelines: Coastal Resilience with a Blue Carbon Benefit*, PLOS ONE (2015); Mark D. Spalding et al., *The Role of Ecosystems in Coastal Protection: Adapting to Climate Change and Coastal Habitats*, 90 OCEAN & COASTAL MANAGEMENT 50 (2014).

⁴⁸ Joanna R. Bernhardt & Heather M. Leslie, *Resilience to Climate Change in Coastal Marine Ecosystems*, 5 ANNUAL REVIEW OF MARINE SCIENCE 371 (2013).

⁴⁹ U.S. Global Change Research Program (2014), *supra* note 1, at 589.

⁵⁰ *Id.*

⁵¹ Robert W. Kates et al., *Transformational Adaptation When Incremental Adaptations to Climate Change are Insufficient*, 109(19) PNAS 7156 (2012).

1.4 Wetlands

Wetlands are recognized as a critically important natural resource due to the ecosystem services they provide, and are subject to special protections under both international law⁵² and domestic law.⁵³ Wetlands are particularly sensitive to changes in hydrological conditions which will occur as a result of altered precipitation patterns and sea level rise. Key impacts include:

- **Changes in precipitation:** Changes in precipitation and hydrologic conditions can fundamentally alter wetland dynamics. Some wetlands may diminish or disappear due to reduced inflow.⁵⁴
- **Rising temperatures:** Rising temperatures will increase evapotranspiration, causing greater water loss from wetlands, and directly affect water quality and ecosystem dynamics.⁵⁵
- **Sedimentation and water quality:** Increased erosion and runoff from storms and higher volume precipitation will likely result in addition pollution entering wetland ecosystems, which will further impair the functioning of these systems.⁵⁶
- **Sea level rise:** Wetlands are situated in coastal areas will also be affected by sea level rise, which can submerge these areas or otherwise result in modifications to hydrologic conditions (e.g., through salt water intrusion).⁵⁷
- **Shifts in species composition, range and abundance:** Changing conditions with wetlands will alter the composition, range and abundance of wetland species. Wetlands contain a high percentage of rare plant and animal species, many of which are highly sensitive to change and geographically isolated and thus vulnerable to the effects of climate change.⁵⁸
- **Net loss in carbon storage:** Wetlands sequester carbon dioxide (CO₂), but they also emit methane (CH₄), a much more potent greenhouse gas. Climate change may reduce the carbon storage capacity of or increase methane emissions from wetlands.⁵⁹

⁵² The United States is a signatory to the Ramsar Convention on Wetlands, 967 UNTS 245 (1972), which provides for the protection of wetland ecosystems.

⁵³ For example, federal law requires the U.S. Army Corps of Engineers (USACE) to ensure that its projects cause “no net loss” of wetlands. 33 USC 2317(a)(1). In addition, the Clean Water Act prohibits the unpermitted discharge of water pollution and dredge and fill material into wetlands. 33 U.S.C. § 1344.

⁵⁴ Kevin L. Erwin, *Wetlands and Global Climate Change: The Role of Wetland Restoration in a Changing World*, 17 WETLANDS ECOLOGY AND MANAGEMENT 71 (2009).

⁵⁵ Wolfgang J. Junk et al., *Current State of Knowledge Regarding the World’s Wetlands and Their Future Under Global Climate Change: A Synthesis*, 75 AQUATIC SCIENCE 151 (2013); Virginia Burkett & Jon Kusler, *Potential Impacts of Climate Change in Wetlands of the United States*, 36(2) JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION 313 (2000).

⁵⁶ Junk et al. (2013), *supra* note 55.

⁵⁷ *Id.*; ASSOCIATION OF STATE WETLAND MANAGERS, WETLANDS AND CLIMATE CHANGE: CONSIDERATIONS FOR WETLAND PROGRAM MANAGERS (2015).

⁵⁸ *Id.*

⁵⁹ Erwin (2009), *supra* note 54.

These changes may impair the ability of wetlands to deliver ecosystem services, such as water filtration and storm buffering. Adaptation measures for wetlands include:

- **Restoring wetlands and mitigating other disturbances:** Activities aimed at restoring impaired wetlands and mitigating other disturbances (such as invasive species) can be implemented to improve the resilience of these ecosystems to change and to enhance their ability to provide critical ecosystem services.⁶⁰
- **Inflow and outflow management:** Measures to manage inflows: limiting upstream withdrawals, channeling water into the wetland, constructing water storage systems so that water can be released when needed, treating inflows to remove pollution, diverting sediment to nourish wetlands that are subsiding, and limiting outflows to reduce drainage from the wetland.⁶¹
- **Maintain connectivity:** Managers can maintain wetland connectivity by preventing fragmentation and protecting wetland habitat corridors.⁶²
- **Wetland buffers:** Managers can also create wetland buffers zones to moderate the effects of stormwater runoff, prevent erosion, reduce sediment and nutrient input, and filter pollution. Such buffers also provide habitat for wetland-associated species.⁶³

1.5 Wildlife and Endangered and Threatened Species

According to the U.S. Fish and Wildlife Service (FWS), climate change has already caused “observed changes in fish and wildlife, their populations, and their habitats in the United States.”⁶⁴ Going forward, the effects of climate change on habitats and wildlife will become even more pronounced. Key impacts include:

- **Rising temperatures:** Increased air and water temperatures will adversely affect living conditions for temperature-sensitive species like salmon and the American pika.⁶⁵
- **Melting snow, glaciers and sea ice:** These changes will adversely affect ice-dependent species such as polar bears and wolverines.⁶⁶
- **Extreme weather events and wildfires:** These events can cause habitat destruction.⁶⁷

⁶⁰ *Id.*; ASSOCIATION OF STATE WETLAND MANAGERS (2015), *supra* note 57.

⁶¹ NATIONAL RESOURCES CONSERVATION SERVICE, U.S. DEPARTMENT OF AGRICULTURE, WETLAND RESTORATION, ENHANCEMENT, AND MANAGEMENT (2003).

⁶² ASSOCIATION OF STATE WETLAND MANAGERS, RECOMMENDATIONS FOR A NATIONAL WETLANDS AND CLIMATE CHANGE INITIATIVE (2009).

⁶³ ASSOCIATION OF STATE WETLAND MANAGERS (2009), *supra* note 62; WASHINGTON DEPARTMENT OF ECOLOGY, WETLAND BUFFERS: USE AND EFFECTIVENESS (1992).

⁶⁴ FWS, *Conservation in a Changing Climate: Consequences for Wildlife*, <http://bit.ly/2cayqwS> (last visited Sept. 7, 2016).

⁶⁵ U.S. Global Change Research Program (2014), *supra* note 1, at 200, 341.

⁶⁶ *Id.* at 204, 518.

- **Water stress and drought:** These pose a threat to species in arid and semi-arid regions.⁶⁸
- **Rising sea levels:** These can lead to loss of habitats for fish, wildlife, and plants that occupy coastal areas such as marshes, tidal flats and estuaries.⁶⁹
- **Increased ocean acidity:** Increasing acidity levels are already affecting shellfish and may have profound effects on marine ecosystems.⁷⁰
- **Shifts in range:** Suitable habitat ranges for many species will shift northward in latitude and higher in elevation as a result of bioclimatic changes.⁷¹
- **Migratory species:** Migration cycles will be altered by changing bioclimatic conditions.⁷²
- **Invasive species, pests and pathogens:** Increased temperatures and variations in the timing of biological cycles can contribute to the spread of invasive species, pests, and pathogens.⁷³

These impacts will increase the risk of extinction for many endangered and threatened species, such as polar bears, sea turtles, bull trout, and salmon, as well as presently unlisted species, such as wolverines. Generally speaking, species with limited climatic ranges and restricted reproductive strategies or physiologies will be most at risk from climate change.⁷⁴

Most adaptation strategies for wildlife focus on ecosystem-based management approaches, although more species-specific interventions (e.g., assisted migration) are being considered for species that are particularly vulnerable to climate change. Adaptation strategies include:

- **Protection and restoration of existing ecosystems and critical habitat:** Managers can offset the adverse impacts of climate change by protecting and restoring existing ecosystems and critical habitat.⁷⁵
- **Reducing disturbances:** Managers can also offset climate-related impacts by reducing other disturbances on species, including those caused by other species and by humans.
- **Increase extent and diversity of protected areas:** To accommodate shifts in suitable habitat, managers may want to increase the extent of terrestrial and aquatic habitat that is protected

⁶⁷ Morzillo & Alig (2011), *supra* note 17.

⁶⁸ *Id.*

⁶⁹ VICTOR S. KENNEDY ET AL., COASTAL AND MARINE ECOSYSTEMS AND GLOBAL CLIMATE CHANGE: POTENTIAL EFFECTS ON U.S. RESOURCES (2002).

⁷⁰ *Id.*

⁷¹ Morzillo & Alig (2011), *supra* note 17; U.S. Global Change Research Program (2014), *supra* note 1, at 205, 302.

⁷² U.S. Global Change Research Program (2014), *supra* note 1, at 402.

⁷³ U.S. Geological Survey, *Climate Change and Wildlife Health: Direct and Indirect Effects* (2012).

⁷⁴ Morzillo & Alig (2011), *supra* note 17.

⁷⁵ Jonathan R. Mawdsley et al., *A Review of Climate Change Adaptation Strategies for Wildlife Management and Biodiversity Conservation*, 23(5) CONSERVATION BIOLOGY 1080 (2009); Morzillo & Alig (2011), *supra* note 17.

from human use and occupation. Managers can also seek to build a more comprehensive and diverse portfolio of protected areas and aim to conserve multiple examples of each ecosystem type.⁷⁶

- **Habitat corridors:** Managers can also prioritize the protection and restoration of habitat corridors, stepping stones, and refugia to allow species to migrate naturally in response to climate change.⁷⁷
- **Assisted migration:** For species that are unable to move naturally, managers can pursue assisted migration programs to relocate these species in new suitable habitat (but this approach should be undertaken with caution).⁷⁸
- **Genetic preservation:** As a last resort, managers can establish captive populations and gene banks for species that would otherwise go extinct.⁷⁹

1.6 Fisheries

Increasing ocean temperatures and acidification will significantly affect the health and productivity of marine fisheries in the coming decades. Other impacts, such as sea level rise and hydrologic changes, will also affect coastal and freshwater fisheries. The key impacts include:

- **Rising river and ocean temperatures:** The warming of rivers and oceans affects the health and reproduction of most fish species. The most acute changes will occur in rivers, shallow water bodies, and the top layer of the ocean, where warming is occurring more rapidly than in deep waters.⁸⁰
- **Changes in river flow:** Increases and decreases in river flow can directly affect the health and propagation of fish species. Flow changes also affect pollution and sediment accumulation, saline levels and other characteristics of rivers, estuaries and coastal waters, with adverse effects on fish habitat. When water levels become too low, fish species may be unable to reach upstream spawning grounds.⁸¹
- **Increasing ocean acidification:** The ocean absorbs about a quarter of the CO₂ that is released into the atmosphere, so as atmospheric CO₂ levels rise, so do levels in the ocean. The CO₂ absorbed by the ocean is changing the chemistry of the water by reducing seawater pH and making it more acidic. Ocean acidification is causing many parts of the ocean to become under-saturated in calcium carbonate minerals, which are the building

⁷⁶ Mawdsley et al. (2009), *supra* note 75.

⁷⁷ *Id.*; Molly S. Cross et al., *From Connect-the-Dots to Dynamic Networks: Maintaining and Enhancing Connectivity to Address Climate Change Impacts on Wildlife*, Ch. 15 in *WILDLIFE CONSERVATION IN A CHANGING CLIMATE* (Jedediah F. Brodie et al. eds., University of Chicago Press 2012).

⁷⁸ Schwartz (2012), *supra* note 31.

⁷⁹ U.S. Global Change Research Program (2014), *supra* note 1, at 202.

⁸⁰ *Id.* at 404, 558, 564.

⁸¹ Ashley D. Ficke et al., *Potential Impacts of Climate Change on Freshwater Fisheries*, 17(4) *Reviews in Fish Biology and Fisheries* 581 (2007).

blocks for the skeletons and shells of many marine organisms. This has the most dramatic effect on calcifying species such as oysters and clams because it interferes with their ability to produce and maintain their shells.⁸²

- **Rising sea levels:** Sea-level rise can adversely affect estuarine fisheries through changes in salinity levels and physical characteristics of estuaries. It can also adversely affect coral reefs by increasing the depth of water above the reefs and thus reducing light penetration.⁸³
- **Changes in composition, range and abundance of fish species:** The impacts described above are causing shifts in the ranges and population abundances of many fish species, as well as changes in the timing of periodic life cycle events, such as when fish breed and migrate.⁸⁴

These impacts will further degrade fisheries that are already in poor condition due to overfishing and other stressors, thus reducing the overall productivity of fisheries. Adaptation measures for fisheries include:

- **Reduce external stressors on natural systems:** For example, managers can reduce land-based sources of pollution (e.g., agricultural and urban runoff) and restrict vessel discharges.⁸⁵
- **Protection and restoration of critical fish habitat:** Managers can seek to protect or restore areas of critical habitat for fish reproduction and growth in order to offset the impacts of climate change, including riparian, marine, and estuarine habitats.⁸⁶
- **Reduce fish and seafood quotas:** Fishery managers can re-assess the maximum and optimum sustainable yields from marine fisheries in light of predicted climate changes and adjust fishing quotas accordingly.
- **Flow regulation:** Measures to regulate river flow, and ensure that there is adequate flow for fish to survive and propagate—e.g., adequate flow to allow fish to travel upstream to reach their spawning grounds.⁸⁷

⁸² U.S. Global Change Research Program (2014), *supra* note 1, at 48-49.

⁸³ Julie M. Roessig et al., *Effects of Global Climate Change on Marine and Estuarine Fishes and Fisheries*, 14 REVIEWS IN FISH BIOLOGY AND FISHERIES 251 (2004).

⁸⁴ U.S. Global Change Research Program (2014), *supra* note 1, at 205, 563.

⁸⁵ Food and Agriculture Organization (FAO), *Climate Change Adaptation in Fisheries and Aquaculture*, FAO Circular No. 1988 (2014).

⁸⁶ *Id.*

⁸⁷ INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT (IFAD), GUIDELINES FOR INTEGRATING CLIMATE CHANGE ADAPTATION INTO FISHERIES AND AQUACULTURE PROJECTS (2014).

2. NATURAL RESOURCE PLANNING MANDATES

Climate change clearly has implications for the management of natural resources. But there is very little statutory guidance on how natural resource managers, and in particular federal agencies, should account for the effects of climate change when developing resource assessments, management plans, and environmental review documents. Indeed, all but one of the federal statutes that deal with natural resource management are totally silent on the issue of climate change. The only exception is the National Forest Management Act (NFMA), which was amended in 1990 to require the U.S. Forest Service (USFS) to account for the effects of climate change when assessing the status of resources under its jurisdiction and developing recommendations for their management.⁸⁸

While the statutes do not contain explicit guidelines on climate change, it is nonetheless clear that federal agencies should be accounting for climate change in planning and environmental review documents. This is because: (1) many of the natural resource management directives contained therein, particularly those pertaining to the sustainable use of resources, cannot be fulfilled without consideration of how climate change will affect those resources, (2) NEPA also implicitly requires consideration of climate change impacts for many natural resource management decisions, and (3) most resource planning statutes provide ample leeway to respond to the effects of climate change in management decisions. This section will discuss each of these findings and their effect on the model protocol.

2.1 Management Directives Require Consideration of How Climate Change Will Affect Natural Resources

Almost all of the federal statutes that govern the administration of public lands and natural resources contain mandates related to the sustainable use and/or conservation of these resources. For example, USFS, the Bureau of Land Management (BLM), and the National Marine Fisheries Service (NMFS) must manage resources under their jurisdiction in accordance with the principle of sustained yield—the idea being that forests, rangelands, fisheries, and other resources should be

⁸⁸ 16 U.S.C. § 1601(a)(5); 16 U.S.C. § 1602(5)(F).

used in a manner that will not impair their use and enjoyment by future generations.⁸⁹ Similarly, the conservation of certain natural resources is the primary mandate of the Fish and Wildlife Service (FWS) and the National Park Service (NPS).⁹⁰

Federal statutes also require natural resource management agencies to undertake a comprehensive planning process in order to ensure that they comply with substantive mandates pertaining to sustainable resource development. The planning processes typically involve the development and periodic revision of resource assessments and management plans for specific units of land.⁹¹ The resource assessments must include an evaluation of the health and status of the resources that are managed by the agency, and the management plans must use the information in these assessments to evaluate the sustainability of different management approaches.⁹² In some instances, the statutes (or implementing regulations) explicitly require the agencies to account for the future condition of resources or long-term trends in resource conditions.⁹³ Even where laws do not explicitly call for consideration of future conditions, the need for such analysis can be inferred from mandates to ensure a “sustained yield” of resources over a long period of time and to conserve resources for future generations.⁹⁴

The statutes governing the activities of the U.S. Army Corps of Engineers (USACE) and the Bureau of Reclamation (BR) are exceptions to the general approach described above: they do not explicitly require USACE and BR to manage resources in accordance with the principle of sustained yield. However, these statutes do impose other requirements related to resource

⁸⁹ 16 U.S.C. § 529; 16 U.S.C. 742f; 16 U.S.C. § 1600(6); 43 U.S.C. § 1701(a)(8).

⁹⁰ 54 U.S.C. § 100101(a); 16 U.S.C. § 668dd(a)(2).

⁹¹ See, e.g., 16 U.S.C. §§ 1600-1605; 43 U.S.C. §§ 1711-1712 (BLM planning requirements); 54 U.S.C. §§ 100502-100503, 100704, 100706 (NPS planning requirements); 16 U.S.C. §668dd (National Wildlife Refuge System planning requirements); 16 U.S.C. §§1851-1855, 1881-1884 (National Fishery planning requirements).

⁹² *Id.*

⁹³ See, e.g., 16 U.S.C. 1853(a)(3) (fishery management plans must include an assessment of the “present and probable future condition of, and the maximum sustainable yield and optimal yield from, the fishery”); 36 C.F.R. § 219.5(a)(1) (USFS assessments must “consider and evaluate existing and possible future conditions and trends of the plan area”); U.S.C. § 100704 (directing NPS to “undertake a program of inventory and monitoring of System resources to establish baseline information and to provide information on the long-term trends in the condition of System resources”);

⁹⁴ See, e.g., 16 U.S.C. § 1600(6) (specifying that USFS “has both a responsibility and an opportunity to be a leader in assuring that the Nation maintains a natural resource conservation posture that will meet the requirements of our people in perpetuity”); 43 U.S.C. § 1702 (c) (specifying that BLM should promote a combination of resource uses “that will best meet the present and future needs of the American people” taking into account “the long-term needs of future generations for renewable and nonrenewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific and historical values” and “without permanent impairment of the productivity of the land and the quality of the environment”).

conservation and preservation: such as requirements that USACE mitigate any damages to fish, wildlife and wetlands caused by its projects,⁹⁵ and a requirement that BR “encourage the full consideration and incorporation of prudent and responsible water conservation measures in the operations of non-Federal recipients of irrigation water from Federal reclamation projects.”⁹⁶

Climate change will affect the ability of landscapes, ecosystems, and individual species to sustain certain uses and to recover from human disturbances and other shocks. It also has implications for the efficacy of resource management and conservation measures. For example, changes in hydrologic conditions will affect the capacity of a rangeland to accommodate livestock grazing, and the risk of more intense droughts will affect the determination of what constitutes a “prudent and responsible” water conservation measure. Thus, in order for agencies to fulfill management directives related to sustainable use, conservation, and environmental protection, they must account for the effects of climate change on the natural resources that they manage. This finding is consistent with multiple Executive Orders calling on agencies to evaluate how climate change will affect their mission and operations and to develop adaptation plans.⁹⁷

Impact on protocol: The model protocol directs natural resource managers to account for the effects of climate change when preparing resource assessments, strategic plans, and resource management plans. It identifies specific components of these planning documents that should be informed by an analysis of climate change impacts (e.g., resource management objectives, sustainable yield determinations, and resource allocations). It does not, however, dictate exactly how agencies should respond to specific climate impacts, as this will vary depending on the type of management action, geographic locations, and other contextual factors.

⁹⁵ 33 U.S.C. §§ 2282, 2283, 2316, 2317, 2317a, 2317b.

⁹⁶ 43 USC s 390jj(a).

⁹⁷ Exec. Order No. 13,514: Federal Leadership in Environmental, Energy, & Economic Performance (2009); Exec. Order No. 13,547: Stewardship of the Ocean, Our Costs, and the Great Lakes (2010); Exec. Order No. 13,653: Preparing the United States for the Impacts of Climate Change (2013); Exec. Order No. 13690: Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input (2015); Exec. Order No. 13,693: Planning for Federal Sustainability in the Next Decade (2015).

2.2 NEPA Also Requires Consideration of Climate Change Impacts

CEQ has issued guidance directing agencies to account for the impacts of climate change during NEPA reviews of major federal proposals.⁹⁸ The guidance clarifies that agencies have an existing legal obligation to consider “the ways in which a changing climate over the life of the proposed project may alter the overall environmental implications of such actions.”⁹⁹ For example, agencies should consider the extent to which climate change may increase the vulnerability of a resource, ecosystem, human community within the affected environment of a proposed action, both to establish baseline conditions and to determine if these resources will be more susceptible to impacts or risks posed by the project.¹⁰⁰ The guidance states that such considerations fit “squarely within the scope of NEPA” informing decisions on “whether to proceed with, and how to design, the proposed action to eliminate or mitigate impacts exacerbated by climate change.”¹⁰¹ Such analysis can also “inform possible adaptation measures to address the impacts of climate change, ultimately enabling the selection of smarter, more resilient actions.”¹⁰²

The CEQ guidance is consistent with the statutory and regulatory requirements of NEPA. For example, when preparing an EIS under NEPA, agencies must describe the affected environment, which is the “environment of the area(s) to be affected or created by the alternatives under consideration.”¹⁰³ While the statute and regulations do not explicitly state that agencies must account for future conditions in the affected environment, this requirement can be inferred from the fact that agencies must use the description of the affected environment as a basis for evaluating *future* environmental impacts in the area, including impacts from the proposal and reasonable alternatives, as well as cumulative impacts from “past, present, and reasonably foreseeable future actions” regardless of who undertakes those actions.¹⁰⁴

Indeed, it is necessary for an agency to consider the future conditions in which management activities will be implemented in order to accurately characterize environmental

⁹⁸ CEQ, *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews* (Aug. 1, 2016).

⁹⁹ *Id.* at 9.

¹⁰⁰ *Id.* at 21.

¹⁰¹ *Id.*

¹⁰² *Id.* at 22.

¹⁰³ 40 C.F.R. § 1502.15.

¹⁰⁴ 40 C.F.R. §§ 1508.7, 1508.8.

impacts, compare impacts from a reasonable range of alternatives, and consider mitigation measures provide an independent basis for concluding that the effects of climate change should be accounted for in environmental reviews.¹⁰⁵ Take, for example, decisions about grazing allocations: the responsible agency must consider the future rangeland conditions and carrying capacity in order to evaluate how different grazing scenarios will affect the landscape, and to make reasonable choice among those scenarios, and to determine whether measures can be implemented to mitigate the adverse effects of grazing on the landscape.

Also relevant are the requirements that an EIS describe the purpose of and need for the project,¹⁰⁶ the “relationship between local short-term uses of man’s environment and the maintenance and enhancement of long-term productivity,” and “any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.”¹⁰⁷ Climate change may affect whether there is a need for the action, the ability of the action to fulfill its intended purpose, and the extent to which there are irreversible and irretrievable commitments of natural resources involved in the proposed action. This is particularly true for actions that involve the management of resources that will become increasingly scarce in the context of climate change, such as freshwater resources and coastal wetlands. The effects of climate change could provide the primary rationale for a project aimed at conserving these types of resources, but they could also thwart such conservation efforts if they are ignored by decision-makers: for example, sea level rise could completely undermine efforts to conserve coastal wetlands if it is not accounted for in the design of the conservation project.

CEQ’s recommended approach is also consistent with case law. There are several federal decisions holding that an agency acted arbitrarily and capriciously by failing to consider future conditions in the affected environment when evaluating the environmental impacts of a proposed action, as well as one decision affirming that it is proper for an agency to consider future conditions.¹⁰⁸ There have also been several recent decisions that deal directly with agency

¹⁰⁵ 42 U.S.C. § 4332(2)(C)(i)-(iii); 40 C.F.R. §§ 1502.14, 1502.16, 1508.20.

¹⁰⁶ 40 C.F.R. § 1502.13.

¹⁰⁷ 42 U.S.C. § 4332(2)(C)(iv) and (v).

¹⁰⁸ *Am. Canoe Ass’n v. White*, 277 F. Supp. 2d 1244 (N.D. Ala. 2003) (agency failed to consider future condition of project); *California ex rel. Imperial Cty. Air Pollution Control Dist. v. U.S. Dep’t of the Interior*, 767 F.3d 781 (9th Cir. 2014) (agency properly considered future conditions when establishing “no action” alternative); *Klamath-Siskiyou*

obligations to evaluate the effects of climate change under NEPA.¹⁰⁹ In these cases, the courts recognized that an analysis of how climate change may affect a project and its affected environment falls within the scope of issues that should be considered under NEPA, but they ultimately deferred to agencies' judgment about the proper scope and depth of such analysis.

Impact on protocol: The model protocol includes guidelines on how agencies should account for the impacts of climate change when conducting NEPA reviews. It contains specific guidelines for different phases of the NEPA review process, including scoping, the preparation of environmental assessments and significance determinations, and the preparation of EISs.

2.3 Agencies Have Discretion to Experiment with Adaptation Measures

The statutes and management directives governing the administration of federal lands and natural resources provide agencies with ample leeway to experiment with different adaptation responses. This is particularly true for agencies implementing multi-use mandates, whereas agencies implementing conservation mandates may be slightly more constrained in terms of the measures they can adopt to respond to changing conditions.¹¹⁰ There is only one context where constraints on agency discretion could be interpreted as truly impeding adaptation efforts: the management of National Wilderness areas, which must be preserved and protected in their "natural state." But even this mandate should not pose a serious barrier to federal adaptation efforts, since the removal or cessation of human disturbances is one of the most effective methods

Wildlands Ctr. v. Bureau of Land Mgmt., 387 F.3d 989 (9th Cir. 2004) (agency failed to consider future effects of other actions in cumulative effects analysis); Oregon Nat. Res. Council Fund v. Brong, 492 F.3d 1120 (9th Cir. 2007) (agency failed to consider future effects of other actions in cumulative effects analysis).

¹⁰⁹ A district court in Alaska held that the Corps must consider whether to prepare a supplemental EIS for a § 404 permit to fill certain wetlands in the National Petroleum Reserve in light of new information on how climate change would affect the project site. *Kunaknana v. U.S. Army Corps of Engineers*, 23 F. Supp. 3d 1063 (D. Alaska 2014). On remand, the Corps prepared a supplemental information report in which it concluded that a supplemental EIS was not necessary; the district court affirmed the Corps' determination, finding that plaintiffs had not identified any specific climate change impacts that would be relevant to the drilling pad and its environmental effects. *Kunaknana v. U.S. Army Corps of Engineers*, No. 3:13-CV-00044-SLG, 2015 WL 3397150 (D. Alaska 2015). In an unrelated case, a district court in the Western District of Washington concluded that the Corps had conducted an adequate analysis of how climate change would affect sediment loading in an EIS for dredge and fill work in the Lower Snake River. *Idaho Rivers United v. U.S. Army Corps of Engineers*, No. 2:2014cv01800 (W.D. Wash. 2016). There have also been cases in California holding that CEQA requires an analysis of how climate change will affect a project insofar as those effects have implications for the environmental consequences of the project. See *No Wetlands Landfill Expansion v. Cty. of Marin*, No. A137459, 2014 WL 7036032 (Cal. Ct. App. Dec. 12, 2014); *Sierra Club v. City of Oxnard* 2012 WL 7659201 (Cal. Super. Ct. Oct. 15, 2012).

¹¹⁰ See Alejandro Camacho & Robert Glicksman, *Legal Adaptive Capacity: How Program Goals and Processes Shape Federal Land Adaptation to Climate Change*, 87 U. COLO. L. REV. 711 (2016).

for improving the resilience and adaptive capacity of ecosystems and landscapes. Moreover, as noted in a recent analysis of adaptation planning in Wilderness areas, the Wilderness Act does not contain “an absolute prohibition on active management for climate change adaptation” but rather “the vast majority of management options are available to agencies that manage wilderness areas, though the agency must jump through a variety of procedural and substantive hoops to justify active management for climate change adaptation.”¹¹¹

Impact on protocol: The model protocol defines adaptation measures broadly to include any management actions undertaken to either minimize the harm caused by climate change or take advantage of any beneficial opportunities created by climate change. It also recognizes that adaptation can and should be considered in a broad array of planning decisions, such as decisions about the timing, nature, and scale of any resource uses.

3. AGENCY DIRECTIVES AND GUIDANCE

Some federal agencies have promulgated regulations or guidance specifying that considerations related to climate change and adaptation should be accounted for in planning and environmental review documents, and this appears to have a positive effect on the quality and consistency of the climate change impact analysis in these documents. Of course, the nature of the effect depends on the content of the guidance – for example, guidance that calls for consideration not only of climate change impacts but also the corresponding management implications will result in analysis that is more useful to decision-makers.

Where such guidance does not exist, there is no guarantee that climate change impacts will be discussed at all, let alone in sufficient detail to inform the decision-making process. Granted, most of the recent planning documents published by federal resource management agencies do contain some information about climate change impacts, and some even contain an exemplary analysis of climate change impacts. But most of the documents published in the absence of guidance do not include a critical component of this analysis: the evaluation of whether and how management strategies should be adjusted to account for the effects of climate change.

¹¹¹ Elisabeth Long & Eric Biber, *The Wilderness Act and Climate Change Adaptation*, 44 ENVIRONMENTAL LAW 623 (2014).

This section will summarize of efforts undertaken by federal agencies to mainstream climate impact analysis into planning and environmental review processes and how this has affected the content of the planning documents they publish.

3.1 U.S. Forest Service

USFS is responsible for managing all lands within the National Forest System (NFS), which encompasses approximately 193 million acres of national forests and national grasslands.¹¹² The NFS is generally managed for multiple use, with the exception of certain protected areas, including 36.5 million acres of wilderness areas and 58.5 million acres of roadless areas.¹¹³

The NFMA is the primary statute governing the administration of NFS resources. It directs USFS to manage these resources in a manner consistent with the principles of multiple use and sustained yield,¹¹⁴ and to implement a systematic planning process that involves the periodic assessment of NFS resources and the promulgation of specific management plans for NFS units.¹¹⁵ It also requires USFS to account for the effects of climate change during this planning process (and is the only statute discussed in this report which contains an explicit requirement of this sort).¹¹⁶

USFS has made a concerted effort to evaluate the effects of climate change on the resources it manages and to ensure that adaptation and resilience considerations are mainstreamed into its planning and decision-making processes. USFS has not only published an agency-wide adaptation policy,¹¹⁷ strategic plan,¹¹⁸ and research agenda¹¹⁹—it has also developed relatively specific directives for land managers, as well as scientific studies and other tools to facilitate compliance with these directives. Two of the most notable developments have been: (i) a 2009 guidance document describing how USFS officials should account for the effects of climate change during

¹¹² USFS, *Frequently Asked Questions: Final Planning Directives for the Implementation of the 2012 Planning Rule* (Jan. 30, 2015), <http://bit.ly/2cGIIIIn>.

¹¹³ USFS, *Roadless Area Conservation Website*, <http://bit.ly/2adoeT1> (last visited Sept. 8, 2016); Wilderness.Net, *Wilderness Statistics: Wilderness Acreage by Agency*, <http://bit.ly/2cnpoOB> (last visited Sept. 8, 2016).

¹¹⁴ 16 U.S.C. § 529.

¹¹⁵ 16 U.S.C. §§ 1601-1604.

¹¹⁶ 16 U.S.C. § 1601(a)(5); 16 U.S.C. § 1602(5)(F).

¹¹⁷ USFS, *CLIMATE CHANGE ADAPTATION PLAN* (2014).

¹¹⁸ USFS, *USDA FOREST SERVICE STRATEGIC PLAN: FY 2015-2020*, FS-1045 (2015).

¹¹⁹ USFS, *FOREST SERVICE GLOBAL CHANGE RESEARCH STRATEGY, 2009-2019*, FS-917A (June 2009).

NEPA reviews,¹²⁰ and (ii) the 2012 “planning rule” which amended USFS regulations to explicitly provide for the adaptive management of NFS resources in the context of climate change.¹²¹ USFS also updated its planning handbook with more detailed instructions on how the planning rule amendments should be implemented, and intends to update its NEPA guidance now that CEQ has issued final guidance on the subject.¹²²

USFS has developed programs and resources to support the implementation of the policies and legal directives described above. For example, it has worked with the U.S. Department of Agriculture (USDA) to prepare regional vulnerability assessments,¹²³ and has introduced technical support tools for agency planners, including: an online Climate Change Resource Center with links to different informational resources,¹²⁴ a Climate Project Screening Tool which describes the types of impacts that may affect certain categories of projects (e.g., fuels management, restoration, and grazing) and provides a list of recommended actions to address those impacts,¹²⁵ a guidebook on adaptation in national forests,¹²⁶ a Template for Assessing Climate Change Impacts and Management Options (TACCIMO),¹²⁷ and an Adaptation Workbook.¹²⁸

As a result of these developments, USFS now routinely examines the effects of climate change and management implications in its planning and environmental review documents,¹²⁹ and has stated that it intends to update existing plans to account for the effects of climate change.¹³⁰ In some of these documents, USFS has outlined programs to monitor climate change impacts and

¹²⁰ USFS, *Climate Change Considerations in Project Level NEPA Analysis* (Jan. 13, 2009).

¹²¹ USFS, NFS Land Management Planning, 77 Fed. Reg. 21161 (April 9, 2012), codified at 36 CFR Part 219.

¹²² USFS, NFS Land Management Planning Directives, 80 Fed. Reg. 6683 (Feb. 6, 2015); USFS, *2012 Planning Rule Final Directives*, <http://bit.ly/1znZEon> (last visited March 28, 2016).

¹²³ *Regional Vulnerability Assessments*, <http://bit.ly/2ctIuQ8> (last visited Sept. 7, 2016).

¹²⁴ USFS, *Climate Change Resource Center*, <http://www.fs.usda.gov/ccrc/> (last visited Sept. 7, 2016).

¹²⁵ USFS, *Climate Project Screening Tool*, <http://bit.ly/2bTFtHi> (last visited Sept. 7, 2016).

¹²⁶ DAVID L. PETERSON ET AL., USFS, *RESPONDING TO CLIMATE CHANGE IN NATIONAL FORESTS: A GUIDEBOOK FOR DEVELOPING ADAPTATION OPTIONS* (2011).

¹²⁷ *TACCIMO*, <http://www.taccimo.sgccp.ncsu.edu/> (last visited Sept. 7, 2016).

¹²⁸ *Adaptation Workbook*, <http://adaptationworkbook.org/> (last visited Sept. 7, 2016).

¹²⁹ See, e.g., *Future of America’s Forest and Rangelands: Forest Service 2010 Resources Planning Act Assessment*, Gen Tech. Rep. WO-87 (2012); USFS, *LAKE TAHOE BASIN MANAGEMENT UNIT FEIS*, (2015); USFS, *DRAFT REVISED LAND MANAGEMENT PLAN, FRANCIS MARION NATIONAL FOREST* (2015); USFS, *DEIS FOR THE REVISED LAND MANAGEMENT PLAN, FRANCIS MARION NATIONAL FOREST* (2015); USFS, *APPENDIX G: CLIMATE CHANGE TRENDS AND MANAGEMENT STRATEGY FOR THE SAN JUAN NATIONAL FOREST AND TRES RIOS FIELD OFFICE LAND AND RESOURCE MANAGEMENT PLAN* (2013).

¹³⁰ See, e.g., USFS, *EL YUNQUE NATIONAL FOREST ASSESSMENT REPORT* (2014).

adjust management practices based on findings.¹³¹ Section 4 includes some examples of how USFS documents address certain aspects of the climate impact analysis as a means of illustrating best practices in this field.

3.2 Bureau of Land Management

BLM manages approximately 250 million acres of public lands in the United States.¹³² These lands are used for a variety of purposes, including grazing, recreation, energy development, timber harvesting, and resource conservation. Approximately 27 million acres of BLM-managed lands are part of the National Landscape Conservation System, which includes 221 Wilderness Areas, 16 National Monuments, and a variety of other protected sites.¹³³

The Federal Land Policy and Management Act (FLPMA) governs the management of these public lands. Like the NFMA, the FLPMA requires BLM to manage its lands in accordance with the principles of multiple use and sustained yield.¹³⁴ It also establishes a similar land use planning process.¹³⁵ However, unlike the NFMA, the FLPMA has not been amended to expressly require consideration of climate change, nor has BLM promulgated regulations describing how climate change should be accounted for in planning and environmental review documents.

BLM's parent agency, the Department of Interior (DOI), has issued a variety of policies and directives describing how its various bureaus and offices should account for the effects of climate change in planning and environmental review processes. For example, Secretarial Order 3289 (2009/2010) called upon BLM and other agencies to consider and analyze potential climate change impacts when undertaking long-range planning exercises, and to develop landscape-level strategies for understanding and responding to climate change impacts.¹³⁶ Consistent with the DOI's guidance, BLM has announced that it intends to address climate change through a *Landscape Approach for Managing Public Lands*. This approach involves five core elements: (1) the preparation

¹³¹ See, e.g., USFS, DRAFT REVISED LAND MANAGEMENT PLAN FOR THE INYO NATIONAL FOREST (2016); USFS, DRAFT REVISED LAND MANAGEMENT PLAN FOR THE SEQUOIA NATIONAL FOREST (2016); USFS, DRAFT REVISED LAND MANAGEMENT PLAN FOR THE SIERRA NATIONAL FOREST (2016); USFS, TONGASS NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN, 6-6 (2008).

¹³² BLM, PUBLIC LAND STATISTICS 2015 (2016).

¹³³ BLM, *The Bureau of Land Management: Who We Are, What We Do*, <http://on.doi.gov/1Rvrvw5D> (last visited Sept. 8, 2016).

¹³⁴ 43 U.S.C. § 1701(a)(7); 43 U.S.C. § 1732(a).

¹³⁵ 43 U.S.C. §§ 1711-1712.

¹³⁶ DOI Secretarial Order 3289, Amendment No. 1 (Feb. 22, 2010); DOI Secretarial Order 3289 (Sept. 14, 2009).

of *Rapid Ecoregional Assessments* (REA)—reports that examine ecological values, conditions, and trends (including climate change-related trends) within large connected areas with similar environmental characteristics; (2) the incorporation of REA findings into landscape-level management strategies, referred to as *Ecoregional Direction*; (3) field implementation of the *Ecoregional Direction*, (4) monitoring for adaptive management; and (5) coordinating with DOI’s Climate Science Centers throughout this process.¹³⁷

BLM is currently implementing the first step of the *Landscape Approach*, conducting REAs for fifteen regions in the western United States and Alaska. As of April 2016, BLM had completed ten of the fifteen REAs.¹³⁸ The REA reports that have been released thus far contain a detailed analysis of projected trends related to climate change, including changes in temperature, precipitation, and sea level rise (where applicable), and the corresponding impacts on landscapes, wildlife, and other natural resources. The REAs thus serve a function that is quite similar to the regional vulnerability assessments prepared by USDA and USFS.

However, the REAs do not address the effects of grazing on BLM lands. BLM justified this decision on the grounds that it lacked sufficient data about the effects of grazing.¹³⁹ The impacts of wild horse grazing and off-highway vehicles were also omitted from the assessments for the same reason. BLM has not clarified whether or how it intends to account for these omitted impacts when it proceeds with step two (the incorporation of REA findings into landscape-level management strategies or *Ecoregional Direction*).

BLM has not yet issued any plans, policies, or guidance documents outlining how its officials should evaluate and respond to the effects of climate change. It appears that BLM is forgoing agency-wide adaptation guidelines in lieu of the region-specific *Ecoregional Direction* that it intends to develop after completing the REAs. However, BLM has been developing internal guidance on how to account for climate change in NEPA reviews, and BLM intends to finalize this guidance now that the CEQ guidance has been finalized.¹⁴⁰ It is unclear what the final BLM guidance will cover, as there is no draft currently available for public review.

¹³⁷ BLM, *The BLM’s Landscape Approach for Managing Public Lands*, <http://on.doi.gov/2cIDyeS> (last visited Sept. 8, 2016).

¹³⁸ BLM, *Rapid Ecoregional Assessments (REAs)*, <http://bit.ly/2cnrLRr> (last visited Sept. 8, 2016).

¹³⁹ BLM, *Questions & Answers: Rapid Ecoregional Assessments (REAs)*, <http://on.doi.gov/2c0YNpi> (last visited Sept. 8, 2016).

¹⁴⁰ See Memo from Ed Roberson to Senior BLM Managers (April 2015), <http://bit.ly/2bVmSKY>.

In the absence of concrete guidance, the analysis of climate change effects and adaptation measures varies considerably in different BLM planning and environmental review documents. Notably, while most of these documents do contain a brief summary of climate change impacts in the management area, they do not typically go into much detail about these impacts and the corresponding management implications.¹⁴¹ Take, for example, a recent amendment to BLM's Northwestern Colorado Greater Sage-Grouse Resource Management Plan (RMP). The amended RMP contained a brief discussion of how climate change may affect the region and the greater sage-grouse, but it did not discuss possible management responses, such as measures that could be implemented to reduce the cumulative threats of climate change and other stressors on the sage grouse.¹⁴² This omission has led to a lawsuit, with environmental groups challenging BLM's failure to adequately evaluate climate change and other threats to the sage grouse.¹⁴³

This is not to say that all BLM documents contain similar omissions: as noted above, there is a good deal of variation in the scope and depth of the climate impact analysis in these documents. There are some BLM documents that contain an exemplary analysis of climate change impacts and potential response measures. Some of these are discussed in Section 4. The point is simply that, in the absence of guidance, the analysis of climate change impacts is not always as thorough and useful to decision-makers as might otherwise be the case.

3.3 National Park Service

NPS manages 413 units spanning 84 million acres in the National Park System. The System includes national parks, monuments, battlefields, historic sites, lakeshores, seashores, recreation areas, scenic rivers and trails, and other protected sites.¹⁴⁴

The National Park Service Organic Act specifies that NPS lands should be managed for two purposes: public enjoyment and resource conservation.¹⁴⁵ It also establishes a planning process

¹⁴¹ See, e.g., BLM, ROAN PLATEAU PLANNING AREA PROPOSED RMP & EIS (2016) (describing, in general terms, how climate change will affect the planning area, but failing to address how these effects may influence management decisions or the environmental outcomes of those decisions); BLM, BEAVER DAM WASH NATIONAL CONSERVATION AREA AND RED CLIFFS NATIONAL CONSERVATION AREA PROPOSED RMP & EIS (2016) (same); BLM, WINNEMUCCA DISTRICT RMP (2015) (same).

¹⁴² BLM, NORTHWEST COLORADO GREATER SAGE-GROUSE RMP AMENDMENT, §§ 3.13, 4.19 (2015).

¹⁴³ Advocates for the West, *Sage-Grouse RMP Challenge*, <http://bit.ly/2c9VXMA> (last visited Sept. 8, 2016).

¹⁴⁴ NPS, *About Us*, <http://bit.ly/2bBHE7u> (last visited Sept. 8, 2016).

¹⁴⁵ 54 U.S.C. § 100101(a).

that involves national strategic planning as well as the promulgation of specific management plans for individual units.¹⁴⁶ The statute and regulations do not explicitly refer to climate change, but they do require NPS to conduct resource monitoring and assessments as part of the planning process, and thus provide for some level of adaptive management over the System.¹⁴⁷

NPS has developed a Climate Change Action Plan that contains high-level guidance to NPS managers and staff on planning for and responding to climate change.¹⁴⁸ NPS has also completed 289 unit-specific vulnerability assessments.¹⁴⁹ The information gathered through these assessments will help inform “foundation documents” that it is preparing for each NPS unit, which are intended to provide a “basic understanding of a park’s resources, values, and history” and thus serve as a “foundation for planning and management.”¹⁵⁰ NPS has also developed a wide array of decision-support tools for NPS managers. These include the vulnerability assessments noted above, an Adaptation Resources Website,¹⁵¹ workshops and a written guide on Scenario Planning for Climate Change,¹⁵² a set of Coastal Adaptation Case Studies,¹⁵³ and guidance on Cultural Resources Adaptation.¹⁵⁴

Although NPS has not published detailed guidance on how to account for climate change impacts when drafting General Management Plans (GMPs) or NEPA documents, it has officially stated that these documents will account for the effects of climate change.¹⁵⁵ As a result of this policy, it appears that NPS field units are now accounting for climate change impacts in most (or perhaps all) of management plans and EISs. That said, there is still variation in terms of whether and how management implications and adaptation options are discussed.¹⁵⁶ To improve the quality and consistency of this analysis, NPS is currently working on guidance for addressing

¹⁴⁶ 54 U.S.C. §§ 100502-100505.

¹⁴⁷ 54 U.S.C. § 100702-100706 (requirements for NPS resource assessments and monitoring).

¹⁴⁸ NPS CLIMATE CHANGE ACTION PLAN 2012-2014 (2012). *See also* NPS CLIMATE CHANGE RESPONSE STRATEGY (2010).

¹⁴⁹ NPS, *Climate Exposure of U.S. National Parks in a New Era of Change*, <http://bit.ly/2csblW9> (last visited Sept. 8, 2016).

¹⁵⁰ NPS, *Foundation Documents for National Park Units*, <http://bit.ly/2c8wunI> (last visited Sept. 8, 2016).

¹⁵¹ NPS, *Adaptation Resources*, <http://bit.ly/2csc8q3> (last visited Sept. 8, 2016).

¹⁵² NPS, *USING SCENARIOS TO EXPLORE CLIMATE CHANGE: A HANDBOOK FOR PRACTITIONERS* (2013).

¹⁵³ NPS, *Coastal Adaptation Strategies: Case Studies*, <http://bit.ly/2csbGIo> (last visited Sept. 8, 2016).

¹⁵⁴ NPS, *Cultural Resources Adaptation*, <http://bit.ly/2cnAK5b> (last visited Sept. 8, 2016).

¹⁵⁵ NPS, *Policy and Planning*, <http://bit.ly/2cwnsjP> (last visited Sept. 8, 2016).

¹⁵⁶ *Compare* NPS, GRAND CANYON BACK COUNTRY MANAGEMENT PLAN (2015) (describing how climate change will affect backcountry use without discussing adaptation measures) *with* NPS, ASSATEAGUE ISLAND NATIONAL SEASHORE GENERAL MANAGEMENT Plan (2015) (describing both climate change effects and implications for management in considerable detail).

climate change in NEPA reviews, which it intends to finalize now that CEQ has issued final guidance.¹⁵⁷

3.4 Fish and Wildlife Service

FWS manages the National Wildlife Refuge System, which consists of more than 560 national wildlife refuges and 38 wetland management districts encompassing 150 million acres of land and water.¹⁵⁸ These refuges provided habitat for more than 700 species of birds, 220 species of mammals, 250 species of reptile and amphibian species, more than 1,000 species of fish, and more than 380 threatened or endangered plants and animals.¹⁵⁹ FWS is also responsible for administering the Endangered Species Act (ESA) along with NMFS (see Section 3.6 for more on that topic).

The primary purpose of the National Wildlife Refuge System is to provide for the conservation, management and restoration of wildlife.¹⁶⁰ Recreation and other human uses may be permitted so long as they are consistent with wildlife conservation objectives.¹⁶¹ The system to be managed through a planning process that entails the development of conservation plans for each refuge, as well as periodic monitoring and assessment.¹⁶²

FWS has published a strategic plan for responding to climate change¹⁶³ and a joint adaptation strategy for wildlife management that it plans to implement in coordination with NMFS.¹⁶⁴ FWS has also provided additional guidance to managers through an amendment to its handbook¹⁶⁵ and instructional reports on planning for adaptation in the National Wildlife

¹⁵⁷ NPS (2012), *supra* note 149, at 21.

¹⁵⁸ FWS, *National Wildlife Refuge System Overview* (2013).

¹⁵⁹ *Id.*

¹⁶⁰ 16 U.S.C. § 668dd(a)(2).

¹⁶¹ 16 U.S.C. § 668dd(a)(3)(B)-(C); 16 U.S.C. § 668ee(2); 16 U.S.C. § 668dd(d)(1)(A). *See also* 16 U.S.C. § 668dd(a)(4)(H)-(K) (providing specific directions on how the system should be administered for recreational use and public access). *See also* 50 C.F.R. § 26.31 (FWS regulations providing that “[p]ublic recreation will be permitted on national wildlife refuges as an appropriate incidental or secondary use, only after it has been determined that such recreational use is practicable and not inconsistent with the primary objectives for which each particular area was established”).

¹⁶² 16 U.S.C. § 668dd(d)-(e).

¹⁶³ FWS, *RIISING TO THE URGENT CHALLENGE: STRATEGIC PLAN FOR RESPONDING TO ACCELERATED CLIMATE CHANGE* (2010).

¹⁶⁴ NATIONAL FISH, WILDLIFE AND PLANTS CLIMATE ADAPTATION PARTNERSHIP, NATIONAL FISH, WILDLIFE AND PLANTS CLIMATE ADAPTATION STRATEGY (2012).

¹⁶⁵ FWS Handbook, 056 FW 1 (2013); FWS Handbook, 056 FW 2 (2014).

Refuges.¹⁶⁶ The handbook specifies that FWS will “integrate climate change adaptation strategies into all aspects of our policies, planning, programs, and operations” and the reports describe how FWS officials can account for climate change impacts and adaptation opportunities when developing conservation plans. To support this work, FWS has begun to conduct vulnerability assessments for specific refuges,¹⁶⁷ promulgated guidance for future vulnerability assessments,¹⁶⁸ and created an online portal of resources on climate change impacts and adaptation strategies (organized by region).¹⁶⁹

As a result of the policies outlined in the FWS handbook and the accompanying guidance, climate change impacts and adaptation measures are now routinely discussed in the agency’s refuge planning documents.¹⁷⁰ Many of these documents outline adaptive management programs that will be implemented to monitor and respond to the effects of climate change.¹⁷¹ As discussed in further detail below, FWS also routinely accounts for climate change in ESA listing decisions and planning documents.¹⁷²

3.5 National Marine Fisheries Service

NMFS, also known as the National Oceanic and Atmospheric Administration (NOAA) Fisheries Unit, is primarily responsible for the stewardship of fisheries in U.S. federal waters. It manages national fisheries in coordination with eight Regional Fishery Management Councils.¹⁷³

¹⁶⁶ B.S. CZECH ET AL., FWS, PLANNING FOR CLIMATE CHANGE ON THE NATIONAL WILDLIFE REFUGE SYSTEM (2014); ERIKA L. ROWLAND ET AL., FWS, CONSIDERING MULTIPLE FUTURES: SCENARIO PLANNING TO ADDRESS UNCERTAINTY IN NATURAL RESOURCE CONSERVATION (2014).

¹⁶⁷ See, e.g., FWS, VULNERABILITY ASSESSMENT AND STRATEGIES FOR THE SHELDON NATIONAL WILDLIFE REFUGE AND HART MOUNTAIN NATIONAL ANTELOPE REFUGE COMPLEX (2011); FWS, RESOURCE VULNERABILITY ASSESSMENT AND STRATEGIES FOR MANAGEMENT OPTIONS FOR THE EASTERN SHORE OF VIRGINIA AND FISHERMAN ISLAND NWRs (2011).

¹⁶⁸ FWS, THE REFUGE VULNERABILITY ASSESSMENT AND ALTERNATIVES TECHNICAL GUIDE (2012) (describes a general methodology for producing Resource Vulnerability Assessments for Wildlife Refuges); FWS, MANAGER’S GUIDE TO REFUGE VULNERABILITY ASSESSMENT & ALTERNATIVES (2012) (aimed at assisting managers in using the methodology defined in the Technical Guide by addressing practical considerations such as costs and timeframes).

¹⁶⁹ FWS, *Conservation in a Changing Climate, Consequences for Wildlife*, <http://bit.ly/2cayqwS> (last visited Sept. 8, 2016).

¹⁷⁰ See, e.g., NPS, KLAMATH BASIN NATIONAL WILDLIFE REFUGE DRAFT CONSERVATION PLAN AND EIS, 5-2 – 5-4, 4-33 – 4-73 (2016) (summarizing projections of future climate change impacts on local climate, hydrological resources, vegetation and wildlife, and describing how different alternatives would integrate adaptive management to respond to those effects); NPS, DEER FLAT NATIONAL WILDLIFE REFUGE FINAL COMPREHENSIVE CONSERVATION PLAN AND EIS, 2-7 – 2-8, 3-4 – 3-10, 4-29 (2015) (same); NPS, SAN LUIS VALLEY NATIONAL WILDLIFE REFUGE COMPLEX, FINAL COMPREHENSIVE PLAN AND EIS, 3, 39-40, 154, 169-171, 174 (2015) (same).

¹⁷¹ *Id.*

¹⁷² See Section 3.6.

¹⁷³ NOAA Fisheries, *Regional Fishery Management Councils*, <http://bit.ly/22dZQri> (last visited Sept. 8, 2016).

NMFS also manages the Marine Sanctuary System which currently consists of 13 marine sanctuaries and two marine national monuments.¹⁷⁴

The planning mandate for U.S. fisheries is similar to the mandates for national forests and public lands: FWS is to manage each fishery so as to obtain an “optimum yield” of resources while also maintaining the long-term health and stability of the fishery.¹⁷⁵ The management framework for National Marine Sanctuaries is similar to the Wildlife Refuge System framework: these areas are managed for the conservation and protection of the species located therein.¹⁷⁶

NMFS has issued a Climate Science Strategy which links fishery management objectives and research goals – for example, the guidance calls for the development of ecosystem based reference points that include climate change in order to better inform management plans.¹⁷⁷ The strategy notes that, going forward, all fishery management plans, ecosystem plans, and species recovery plans, need to include decision criteria that explicitly account for climate change.¹⁷⁸ The strategy is being implemented through regional action plans. NFS has completed at least three draft regional action plans covering the Southeastern Bering Sea Region,¹⁷⁹ the Western Region,¹⁸⁰ and the Northeast Region.¹⁸¹ These plans outline more detailed agendas for scientific research, but do not contain guidance on accounting for climate change impacts in management decisions.

NMFS also contributed to the National Fish, Wildlife, and Plants Climate Adaptation Strategy (published in conjunction with FWS), which discusses possible impacts on fisheries, including declines in fish stocks and shifts of stocks to higher latitudes.¹⁸² The Strategy recognizes that new regulations will be needed to confirm to the new stock boundaries. Such regulations have not yet been proposed by NMFS or the Fishery Management Councils.

NMFS has not yet published guidance or regulations describing how fishery managers should account for the effects of climate change in planning documents such as fishery stock

¹⁷⁴ NOAA Fisheries, *National Marine Sanctuary System*, <http://sanctuaries.noaa.gov/> (last visited Sept. 8, 2016).

¹⁷⁵ 16 U.S.C. 1851(a). *See also* 16 U.S.C. 1801(b)(3).

¹⁷⁶ 16 U.S.C. § 1431.

¹⁷⁷ NOAA FISHERIES CLIMATE SCIENCE STRATEGY (Jason S. Link et al., eds. 2015).

¹⁷⁸ *Id.* at 20.

¹⁷⁹ MIKE SIGLER ET AL., NOAA, REGIONAL ACTION PLAN FOR SOUTHEASTERN BERING SEA CLIMATE SCIENCE, DRAFT (2016).

¹⁸⁰ NOAA FISHERIES CLIMATE SCIENCE STRATEGY (NCSS) WESTERN REGIONAL ACTION PLAN, DRAFT VERSION (2016).

¹⁸¹ JONATHAN A. HARE ET AL., NORTHEAST REGIONAL ACTION PLAN, NOAA FISHERIES CLIMATE SCIENCE STRATEGY, DRAFT VERSION (NCSS) WESTERN REGIONAL ACTION PLAN, DRAFT VERSION (2016).

¹⁸² NATIONAL FISH, WILDLIFE AND PLANTS CLIMATE ADAPTATION PARTNERSHIP (2012), *supra* note 164.

assessments, management plans, and NEPA review documents. In the absence of such guidance, many of the assessments do not even discuss climate change impacts, let alone management implications.¹⁸³ For example, none of the national stock assessment summary reports contain any reference to climate change.¹⁸⁴ There are some exceptions—for example, a recent stock assessment for the mid-Atlantic lobster did discuss the effects of climate change and warming temperatures on the lobster, and the lobster management plan is now being updated in response to that assessment.¹⁸⁵ A recent allocation plan for the red snapper also noted that climate change was affecting the snapper and that there appeared to be a distributional trend towards deeper water, but there was no discussion of management implications.¹⁸⁶

NMFS has published guidance on how to describe and respond to the impacts of climate change in Marine Sanctuary Plans, as part of its Climate-Smart Sanctuaries Program.¹⁸⁷ The program also outlines requirements for being certified as a “Climate-Smart Sanctuary” – for example, one requirement is that managers have a site plan to manage climate change impacts.¹⁸⁸ As a result, the sanctuary management plans now routinely discuss how climate change will affect the sanctuary and strategies for managing those impacts.¹⁸⁹

3.6 Endangered and Threatened Species

While all federal agencies have an obligation to refrain from undertaking actions that would jeopardize the existence of endangered and threatened species, FWS and NMFS are primarily responsible for implementing the Endangered Species Act (ESA): they decide whether to list a species as endangered or threatened, designate critical habitat for those species, develop recovery plans for the species, and supervise federal consultations when federal actions may

¹⁸³ See, e.g., M. ELIZABETH CONNERS & CHRISTINA CONRATH, ASSESSMENT OF THE OCTOPUS STOCK COMPLEX IN THE GULF OF ALASKA (2015); OLAV ORMSETH, ASSESSMENT OF THE SQUID STOCK COMPLEX IN THE GULF OF ALASKA (2015); PAUL SPENCER & JAMES IANELLI, ASSESSMENT OF THE NORTHERN ROCKFISH STOCK IN THE EASTERN BERING SEA AND ALEUTIAN ISLANDS (2015).

¹⁸⁴ NOAA Office of Science and Technology, *2015 National Fish Stock Assessment Summaries*, <http://bit.ly/2cFytQr> (last visited Sept. 8, 2016).

¹⁸⁵ ATLANTIC STATES MARINE FISHERIES COMMISSION, AMERICAN LOBSTER STOCK ASSESSMENT PEER REVIEW REPORT (2015).

¹⁸⁶ NMFS, RED SNAPPER ALLOCATION PLAN AND EIS (2015).

¹⁸⁷ NOAA’S CLIMATE-SMART SANCTUARIES: HELPING THE NATIONAL MARINE SANCTUARY SYSTEM ADDRESS CLIMATE CHANGE (2010).

¹⁸⁸ *Id.*

¹⁸⁹ See, e.g., NOAA OFFICE OF MARINE SANCTUARIES, FAGATELE BAY NATIONAL MARINE SANCTUARY MANAGEMENT PLAN AND FEIS (2012); NOAA OFFICE OF MARINE SANCTUARIES, GULF OF THE FARALLONES NATIONAL MARINE SANCTUARY FINAL MANAGEMENT PLAN (2014).

jeopardize the species.¹⁹⁰ FWS has primary responsibility for terrestrial and freshwater organisms, whereas NMFS has primary responsibility for marine wildlife.

Neither FWS nor NMFS has promulgated any new regulations or guidance that contain specific directions on how the effects of climate change should be considered in listing decisions, critical habitat determinations, recovery plans, and biological opinions under the ESA. Nor have they developed guidance on how other federal agencies should account for the effects of climate change on endangered and threatened species when undertaking activities within those species' ranges or when developing habitat conservation plans. However, the adaptation strategy co-authored by FWS and NMFS does recognize that climate change will affect endangered and threatened species under their jurisdiction.¹⁹¹ The amended FWS handbook also recognizes that climate change impacts should be considered in endangered species recovery plans.¹⁹²

Accordingly, FWS and NMFS have begun to account for the effects of climate change in ESA planning documents.¹⁹³ It appears that both agencies now routinely account for climate change in listing decisions, and some recent listings have been based predominantly on the current and projected effects of climate change.¹⁹⁴ Climate change impacts are also frequently discussed in critical habitat designations, although this analysis has not yet influenced most of the designations.¹⁹⁵ Similarly, climate change impacts are frequently discussed in recovery plans and

¹⁹⁰ 16 USC §§ 1533, 1536.

¹⁹¹ NATIONAL FISH, WILDLIFE AND PLANTS CLIMATE ADAPTATION PARTNERSHIP (2012), *supra* note 164.

¹⁹² FWS Handbook, 056 FW 1, § 1.6(B).

¹⁹³ The journal *Conservation Biology* dedicated an entire issue to papers describing how FWS and NMFS are working to account for climate change in the implementation of the ESA. See *Incorporating Climate Change into Risk Analyses under the ESA* (2013), <http://onlinelibrary.wiley.com/doi/10.1111/cobi.2013.27.issue-6/issuetoc>.

¹⁹⁴ See, e.g., Determination of Threatened Status for the Polar Bear (*Ursus maritimus*) Throughout Its Range, 73 Fed. Reg. 28,212 (May 15, 2008); Final Listing Determinations on Proposal to List 66 Reef-building Coral Species and to Reclassify Elkhorn and Staghorn Corals, 79 Fed. Reg. 53,851 (Oct. 10, 2014); Threatened Status for the Beringia and Okhotsk Distinct Population Segments of the *Erignathus barbatus nauticus* Subspecies of the Bearded Seal, 77 Fed. Reg. 76,740 (Dec. 28, 2012); Threatened Status for the Arctic, Okhotsk, and Baltic Subspecies of the Ringed Seal and Endangered Status for the Ladoga Subspecies of the Ringed Seal, 77 Fed. Reg. 76,706 (Dec. 28, 2012); Final Rule to List Eleven Distinct Populations Segments of the Green Sea Turtle (*Chelonia mydas*) as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act, 81 Fed. Reg. 20,058 (Apr. 6, 2016).

¹⁹⁵ See, e.g., Critical Habitat for Endangered North Atlantic Right Whale, 82 Fed. Reg. 4,837 (Jan. 27, 2016); Proposed Designation of Critical Habitat for the Arctic Ringed Seal, 79 Fed. Reg. 73,010 (Dec. 9, 2014); Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary, 79 Fed. Reg. 54,782 (Sept. 12, 2014); Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS, 79 Fed. Reg. 38,855 (July 10, 2014); Designation of Critical Habitat for Jaguar, 79 Fed. Reg. 12,572 (Mar. 5, 2014).

habitat conservation plans, but the analysis doesn't necessarily influence final decisions about recovery or protection measures.¹⁹⁶ There are, of course, some exceptions. Section 4.4 provides examples of how FWS and NMFS have meaningfully accounted for climate change in a variety of different ESA documents.

It is worth noting that there has been a fair amount of litigation involving the question of whether and how climate change impacts should be considered in ESA listing decisions (more so than any of the other natural resource management decisions noted here). In most of these cases, the courts have deferred to FWS and NMFS on whether or not a listing is warranted in light of climate change impacts.¹⁹⁷ More recently, however, there have been two decisions overturning NMFS listing decisions *because* they were based on future climate change-related risks,¹⁹⁸ and another decision holding that FWS's failure to list the wolverine as threatened was arbitrary and capricious because it did not adequately account for future climate change-related risks.¹⁹⁹ In the latter case, the court noted that "[n]o greater level of certainty is needed to see the writing on the wall for this snow-dependent species standing squarely in the path of global climate change."²⁰⁰

There was also a recent case involving the critical habitat designation for the polar bear. The key issue there was whether FWS could designate critical habitat for polar bear denning in areas where there was no proof of existing polar bear activity. One of the key justifications for designating these areas was to provide future denning habitat in the context of coastal erosion caused by climate change. Industry groups challenged the designation, contending that FWS "can

¹⁹⁶ See, e.g., NMFS, ESA RECOVERY PLAN FOR SNAKE RIVER SOCKEYE SALMON, 206-207 (2015) (describing how climate change will affect the habitat and survival of the Sockeye Salmon and stating that these changes will be monitored, but failing to list specific management activities aimed at mitigating the impacts of climate change on the species; BEXAR COUNTY AND CITY OF SAN ANTONIO, SOUTHERN EDWARDS PLATEAU FINAL HABITAT CONSERVATION PLAN 148 (2015) (recognizing that climate change could cause the permanent loss of habitat for the covered species, but concluding that there is not sufficient information to inform the design of alternative or additional mitigation measures that would compensate for any adverse effects from climate change).

¹⁹⁷ See, e.g., *W. Watersheds Project v. U.S. Fish & Wildlife Serv.*, No. 4:10-CV-229-BLW, 2012 WL 369168 (D. Idaho Feb. 2, 2012) (upholding FWS decision that a listing for the greater sage grouse was warranted but precluded; listing would have been based on threats exacerbated by climate change); *In re Polar Bear Endangered Species Act Listing & 4(d) Rule Litig.*, 794 F. Supp. 2d 65 (D.D.C. 2011), *aff'd*, *In re Polar Bear Endangered Species Act Listing & Section 4(d) Rule Litig.*, 709 F.3d 1 (D.C. Cir. 2013) (upholding the polar bear listing); *Ctr. for Biological Diversity v. Lubchenco*, 758 F. Supp. 2d 945 (N.D. Cal. 2010) (upholding NMFS decision not to list ribbon seal as threatened or endangered despite climate-related threats).

¹⁹⁸ *Alaska Oil & Gas Ass'n v. Pritzker*, Case No. 4:13-cv-00018-RRB, p. 31 (D. Alaska 2014); *Alaska Oil & Gas Ass'n v. Nat'l Marine Fisheries Serv.*, No. 4:14-CV-00029-RRB, 2016 WL 1125744, at *14 (D. Alaska Mar. 17, 2016).

¹⁹⁹ *Def. of Wildlife v. Jewell*, No. 14-247-M-DLC, 2016 WL 1363865 (D. Mont. Apr. 4, 2016).

²⁰⁰ *Id.* at *29 (D. Mont. Apr. 4, 2016).

only designate habitat that contains essential features at the time the species is listed, not habitat that may become critical in the future because of climate change or other potential factors.”²⁰¹ While the plaintiffs won in district court, the Ninth Circuit Court of Appeals ultimately reversed that decision. In upholding FWS’s determination, the court noted that the ESA “is concerned with protecting the *future* of the species, not merely the preservation of existing bears” and thus consideration of future climate change effects is an appropriate basis for designating critical habitat.²⁰²

3.7 Rivers and Wetlands

A variety of federal agencies are responsible for the management of freshwater resources in the United States. USACE builds and maintains navigation and flood protection projects²⁰³ and regulates discharges from dredge and fill activities in accordance with Section 404 of the Clean Water Act (CWA).²⁰⁴ BR manages freshwater supply and hydroelectric projects in the Western United States.²⁰⁵ Other federal agencies are responsible for managing freshwater resources located on the lands that they administer in accordance with the legal mandates in their respective management statutes as well as Section 313 of the CWA (which requires federal agencies to adhere to all CWA requirements respecting the control and abatement of water pollution). There are also special requirements for the management of “Wild and Scenic Rivers” (which are managed by whichever agency has jurisdiction over the area in which they are located): these are to be “protected for the benefit and enjoyment of present future generations.”²⁰⁶ This section will focus on the extent to which climate impacts are being accounted for in planning activities undertaken by USACE and BR, and in management plans for Wild and Scenic Rivers.

USACE and BR have both published adaptation plans that describe how climate change will affect the resources they manage and outline broad strategic objectives for responding to those

²⁰¹ Alaska Oil & Gas Ass’n v. Jewell, 815 F.3d 544, 558 (9th Cir. 2016).

²⁰² *Id.* at 555, 559 (emphasis added).

²⁰³ Some of the key statutes authorizing and governing Corps projects include the Rivers and Harbors Act of 1890, the Rivers and Harbors Act of 1899, the Flood Control Act of 1936, the Flood Control Act of 1944.

²⁰⁴ 33 U.S.C. § 1344.

²⁰⁵ 43 U.S.C. § 411.

²⁰⁶ 16 U.S.C. § 1271.

impacts.²⁰⁷ They have also collaborated in the development of a Climate Change and Water Working Group (CCAWWG) to provide technical support on how to manage water resources for adaptation and resilience.²⁰⁸ The CCAWWG has published several reports describing the types of information and research that are needed to help water managers adapt to climate change.²⁰⁹

Both agencies have also published guidance documents on how to account for the effects of climate change on hydrologic systems. BR has published *Technical Guidance for Incorporating Climate Change Information into Water Resources Planning Studies* which contains detailed instructions on topics such as the selection of data and methodologies for predicting climate impacts on hydrologic systems and the level of analysis required for different types of projects (e.g., qualitative vs. quantitative).²¹⁰ USACE has published *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects* (which applies to “all hydrologic analyses supporting planning and engineering decisions having an extended decision time frame”).²¹¹ Unlike the BR guidance, the USACE guidance only instructs agencies to conduct a qualitative analysis of climate impacts, and specifies that future guidance will be developed to support quantitative analysis. USACE has also issued a Climate Preparedness and Resilience Policy Statement in which it states that climate change adaptation “will be considered at every step in the project life cycle for all USACE projects, both existing and planned... to reduce vulnerabilities and enhance the resilience of our water-resource infrastructure.”²¹²

BR and USACE are developing data resources and conducting vulnerability assessments to support water management planning. For example, USACE and BR have worked with other partners to develop downscaled climate projection data and hydrologic simulations in the

²⁰⁷ BR, CLIMATE CHANGE ADAPTATION STRATEGY (2014), USACE, CLIMATE CHANGE ADAPTATION PLAN (2015).

²⁰⁸ The CCAWWG was formed in 2008 to provide technical support for water management activities in the context of climate change. Some key goals include: facilitating understanding of how climate variability and change will affect future hydrologic conditions, identifying adaptation strategies, and building working relationships across the federal/non-federal spectrum. CCAWWG conducts trainings and workshops and also publishes reports. *Climate Change and Water Working Group*, <http://www.ccawwg.us/> (last visited Sept. 9, 2016).

²⁰⁹ CCAWWG, ADDRESSING CLIMATE CHANGE IN LONG-TERM WATER RESOURCES PLANNING AND MANAGEMENT: USER NEEDS FOR IMPROVING TOOLS AND INFORMATION (2011); CCAWWG, SHORT-TERM WATER MANAGEMENT DECISIONS: USER NEEDS FOR IMPROVED CLIMATE, WEATHER, AND HYDROLOGIC INFORMATION (2013).

²¹⁰ BR, TECHNICAL GUIDANCE FOR INCORPORATING CLIMATE CHANGE INFORMATION INTO WATER RESOURCES PLANNING STUDIES (2014).

²¹¹ USACE, *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects*, ENGINEERING AND CONSTRUCTION BULLETIN No. 2014-10 (2014).

²¹² USACE, ADAPTATION POLICY STATEMENT, 2 (2014).

contiguous United States.²¹³ BR is also spearheading collaborative studies of how climate change will affect certain water basins as part of the WaterSMART Program.²¹⁴

Both agencies have begun to account for the effects of climate change and adaptation measures in environmental review and planning documents, but the treatment of these issues varied between the two agencies. The recent planning documents from BR all contained a relatively thorough and quantitative discussion of climate change impacts, consistent with the technical guidance document published by the Bureau. However, the USACE documents were less consistent in their treatment of these issues – in some environmental review documents, climate change impacts were ignored or discussed in a very cursory fashion. This may be because the existing guidance only calls for a qualitative analysis of climate impacts.

As for wild and scenic rivers: EPA published guidance on adaptation planning for these rivers in 2008.²¹⁵ The guidance describes the types of impacts that managers should account for when assessing current and future conditions in wild and scenic rivers, and recommends the use of monitoring, adaptive management, and collaboration with non-federal partners to prepare for and manage these impacts.²¹⁶ Following the publication of this guidance, several of the wild and scenic river management plans have recently been revised to incorporate monitoring and adaptive management programs to mitigate risks associated with climate change.²¹⁷

3.8 National Wilderness Preservation System

The Wilderness Act of 1964 established a National Wilderness Preservation System and a policy to guide the management and protection of units within this system. There are currently 759 Wilderness Areas covering 57.5 million acres.²¹⁸ These areas are administered by the USFS, NPS,

²¹³ *Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections*, <http://bit.ly/2c5oaYF> (last visited Sept. 12, 2016).

²¹⁴ BR, *WaterSMART Basin Studies Program*, <http://on.doi.gov/2cDfFBX> (last visited Sept. 12, 2016).

²¹⁵ Margaret A. Palmer et al., *Wild and Scenic Rivers*, Ch. 6 in PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS (SAP 4.4) (EPA 2008).

²¹⁶ *Id.*

²¹⁷ NPS, TUOLUMNE WILD AND SCIENCE RIVER FINAL COMPREHENSIVE MANAGEMENT PLAN AND EIS (2014); NPS, MERCED WILD AND SCENIC RIVER FINAL COMPREHENSIVE MANAGEMENT PLAN AND EIS (2014); USFS, SNAKE RIVER HEADWATERS COMPREHENSIVE RIVER MANAGEMENT PLAN (2014).

²¹⁸ Ross W. Gorte et al., Congressional Research Service, *Federal Land Ownership: Overview and Data* (2012).

BLM, and FWS (some are managed by multiple agencies). USFS manages the largest amount of Wilderness—442 wilderness areas covering 36 million acres.²¹⁹

In contrast to national forests, public lands, and fisheries, which are to be managed for human use, wilderness areas are to be managed for “preservation and protection in their natural condition.”²²⁰ From an adaptation perspective, this management directive has both pros and cons. On the one hand, the protection and preservation of wilderness areas means that they are not subject to the same types of human disturbances as other areas, and thus may be in a better ecological condition and better able to naturally adapt to the impacts of climate change. On the other hand, this directive could be interpreted as preventing managers from undertaking any adaptation measures apart from ecological restoration—such as assisted migration—because such activities might conflict with the mandate that wilderness be preserved in its natural condition.

Perhaps as a result of this perceived management constraint, there are no federal adaptation initiatives or policies for wilderness areas. Some of the wilderness management plans do briefly describe how climate change will affect the area and resources contained therein, but they do not go into detail about management implications.²²¹

It is important to keep in mind that this constraint is not absolute: as noted in Section 2.3, the Wilderness Act does not contain an absolute prohibition on active management of the landscape (particularly where such active management is needed to respond to the effects of human activities, including climate change). Agencies must simply jump through a variety of procedural and substantive hoops to justify the implementation of active management measures.²²²

4. RECOMMENDATIONS

The recommendations presented in this section are aimed at ensuring that the assessment of climate change impacts and management implications in natural resource planning and environmental review documents is reasonably thorough and useful to decision-makers. These

²¹⁹ USFS, FISCAL YEAR 2016 BUDGET OVERVIEW (2015).

²²⁰ 16 U.S.C. § 1131(a).

²²¹ NPS, CABEZA PRIETA NATIONAL WILDLIFE REFUGE, COMPREHENSIVE CONSERVATION PLAN, WILDERNESS STEWARDSHIP PLAN, AND EIS, 147-48, 159-60 (2006); NPS, BLACK CANYON OF THE GUNNISON NATIONAL PARK, WILDERNESS AND BACKCOUNTRY MANAGEMENT PLAN AND ENVIRONMENTAL ASSESSMENT, 26-27 (2011).

²²² Long & Biber (2014), *supra* note 111.

recommendations were developed in response to some of the key findings from our review of federal documents, specifically that: (i) although most of these documents contained some analysis of climate change impacts, there was considerable variation in the scope, depth, and quality of the analysis; (ii) it was often unclear whether or how the analysis of climate change informed management decisions; and (iii) when planning documents did discuss possible adaptation measures, the description tended to be quite vague (e.g., “we will monitor the impacts of climate change and respond accordingly”) and there was no firm commitment to actually implement the proposed measures.

Each recommendation is illustrated with reference to specific planning documents that contain an exemplary analysis of climate change impacts and/or management implications, and accompanied by an explanation of how the recommendation informed the model protocol.

4.1 Focus on Impacts with Greatest Implications for Management Decisions and Environmental Outcomes

Many of the planning documents in our survey described, in very general terms, all of the ways in which climate change may affect the management area, without going into much (or any) detail about the nature of these impacts or implications for the sustainable use and conservation of natural resources.²²³ Others briefly discussed only one or two climate-related considerations while ignoring other relevant impacts.²²⁴ Either way, the result was a superficial analysis of climate change that did very little to inform management decisions.

It is not necessary to include an in-depth analysis of all possible climate impacts in every planning document—this would be unwieldy and unhelpful for decision-makers. While it is a good idea to briefly acknowledge any impacts that may occur in the management area, the bulk of the analysis should focus on those impacts that have the greatest implications for management decisions and their environmental outcomes.

²²³ See, e.g., BLM, RESOURCE MANAGEMENT PLAN AND FEIS FOR THE NORTHWEST COLORADO GREATER SAGE GROUSE, §§ 3.18, 4-19 (2015); NPS, MERCED WILD AND SCENIC RIVER COMPREHENSIVE MANAGEMENT PLAN AND EIS, 5-37, 5-50 (2014).

²²⁴ See, e.g., USACE, OCEAN ISLE BEACH SHORELINE MANAGEMENT PROJECT FEIS, 139-140 (2016) (briefly discussing sea level rise and ignoring other impacts).

Take, for example, BR’s DEISs for the Glen Canyon Dam²²⁵ and the Rio Grande Project.²²⁶ These documents contain a detailed analysis of how climate change will affect hydrologic conditions and the corresponding implications for the management of dams and reservoirs. The hydrologic analysis is comprehensive: it accounts for changes in precipitation, temperature, and water demand, and corresponding impacts on water quality and quantity, aquatic habitats, and fish species. The documents also briefly mention other types of impacts, such as impacts on terrestrial species, but these are not the focal point of the analysis because they are less important for management purposes.

Impact on protocol: The model protocol states that the scope and depth of the climate impact analysis should be tailored to provide useful information for decision-makers, and should reflect the magnitude of the risk posed by climate change and the correlated vulnerability of affected natural resources.

4.2 Use Climate Change Projections to Evaluate Management Strategies

We found that there was a disconnect between the discussion of climate change impacts and the assessment of alternative management strategies in many planning documents. Often, the topic of climate change was addressed in isolation—perhaps in a separate chapter or appendix—and then ignored in other sections of the document. Some of these documents even highlighted potential adaptation measures in complete isolation from the broader assessment of management strategies, and failed to consider whether the proposed management strategies would advance or conflict with those adaptation measures.

For example, a 2013 EIS for a grazing permit recognized that climate change was a “stressor on the sagebush-steppe semi-arid ecosystem” which “can, when found in conjunction with cattle grazing, further stress the ecosystem’s vegetation” and that the best adaptation measures are “appropriate livestock management practices that improve and maintain healthy and functioning vegetation communities that provide for proper nutrient cycling, hydrologic cycling, and energy

²²⁵ BR, GLEN CANYON DAM LONG-TERM EXPERIMENTAL AND MANAGEMENT PLAN DEIS (2015).

²²⁶ BR, RIO GRANDE OPERATING AGREEMENT DEIS (2016).

flow.”²²⁷ But these considerations were discussed in isolation (in the “affected environment” section), and were not mentioned in the agency’s assessment of alternative management actions.

To provide useful information for decision-makers, the analysis of climate change impacts should be directly integrated into the assessment of the efficacy and environmental outcomes of alternative management strategies. We identified several good examples of this:

- **Upper Truckee Marsh Restoration Project Final EIS (BR, 2015):** The Bureau of Reclamation prepared the EIS for this project in conjunction with several state and local planning agencies. The agencies considered the impacts of climate change when evaluating the environmental and economic costs of alternative management actions, and ultimately selected the preferred response because it was “the most feasible, the most highly responsive to public comments, *and the most resilient to the potential impacts of climate change.*”²²⁸ This alternative entailed restoration elements that would help improve marsh ecosystem function, water quality, and habitat connectivity, all of which would make the area more resilient to climate change.²²⁹
- **Assateague Island National Seashore Draft General Management Plan/DEIS (NPS, 2015):** NPS discussed how climate change (primarily sea level rise) will affect the National Seashore and implications for management decisions in the draft management plan / DEIS for this project.²³⁰ For example, the plan recognizes that repairing and reconstructing facilities over the long-term may not be a sustainable approach.²³¹ The preferred alternative was described as “sustainable recreation and climate change adaptation,” reflecting the amount of emphasis that NPS placed on this issue.²³² NPS also prepared two additional documents to support preparation of the draft plan and DEIS: (1) climate change projections for the area,²³³ and (2) implications for visitor use and management.²³⁴ In the second document, NPS acknowledged that “[n]ew ways of providing sustainable access and infrastructure are needed” and identified adaptive measures that were already being implemented (low impact road and parking lot construction techniques and mobile visitor facilities) as well as future measures that could be implemented (relocating infrastructure

²²⁷ BLM, JUMP CREEK, SUCCOR CREEK, AND COW CREEK WATERSHEDS GRAZING PERMIT RENEWAL FEIS, 2, 84-85 (2013).

²²⁸ BR, UPPER TRUCKEE MARSH RESTORATION PROJECT FINAL EIS, ES-3 (2016).

²²⁹ *Id.*

²³⁰ NPS, ASSATEAGUE ISLAND NATIONAL SEASHORE DRAFT GENERAL MANAGEMENT PLAN AND DEIS (2015).

²³¹ *Id.* at v, 1-32.

²³² *Id.* at xxii.

²³³ NPS, CLIMATE CHANGE PROJECTIONS FOR ASSATEAGUE ISLAND NATIONAL SEASHORE (2010).

²³⁴ NPS, CLIMATE CHANGE IMPLICATIONS FOR ASSATEAGUE ISLAND NATIONAL SEASHORE (2010).

such as parking lots and campgrounds to the adjacent mainland, and using alternative transportation systems).²³⁵

- **Rio Grande Operating Agreement DEIS (BR, 2016):** The DEIS for this multi-dam operating agreement incorporates climate change projections into a quantitative analysis of reservoir conditions both with and without the planned project (three hydrologic projections are used to analyze the potential effects of climate change).²³⁶ The EIS also accounts for the potential impacts of climate change on water demand.²³⁷ These projections inform the Bureau’s analysis of environmental impacts under each alternative.²³⁸

Impact on protocol: In the “Overarching Principles” section, the model protocol directs managers to consider how climate change will affect the implementation and efficacy of resource management actions and the environmental outcomes of those actions, and what adaptation measures can be implemented to enhance the resilience and adaptive capacity of natural resources. These principles are reiterated in more specific guidelines for resource management plans and NEPA review documents. For example, the NEPA guidelines specify that agencies should rank alternatives and management components based on adaptation objectives.

4.3 Evaluate How Climate Change May Affect the Sustainability of Uses

Climate change will affect the ability of landscapes and ecosystems to sustain certain uses. For example, higher temperatures, water scarcity, and wildfires can impair the growth of trees and vegetation, leading to a long-term decline in timber and forage production on federal lands. Higher ocean temperatures will also affect the abundance and ranges of fish and other marine species. It is therefore important for resource managers to assess how climate change will affect the maximum or optimum sustainable yield of resources such as timber, forage, and fisheries. If these assessments indicate that stocks will decline, the manager should adjust resource uses and allocations as necessary to ensure the ongoing preservation of the resource base.

²³⁵ *Id.*

²³⁶ BR, RIO GRANDE OPERATING AGREEMENT DEIS, Chapters 3 and 4 (2016).

²³⁷ *Id.*

²³⁸ *Id.*, Chapter 4.

Remarkably few of the planning documents we reviewed contained a detailed analysis of how climate change may affect resource yields and what should be done to address those impacts.²³⁹ There were at least two planning documents that did contain such an analysis:

- **Public Land Management in Western Oregon Proposed RMP/FEIS (BLM, 2016):** BLM acknowledged that climate change creates uncertainty that “reserves will function as intended and that planned timber harvest levels can be attained” and explored how different alternatives (which involved different levels of timber harvest) would affect the resilience and adaptive capacity of the surrounding environment and BLM’s ability to implement future adaptation measures.²⁴⁰
- **American Lobster Stock Assessment (Atlantic States Marine Fisheries Commission, 2015):** The Commission found that the lobster is highly influenced by temperature and thus climate change is expected to significantly impact the health and distribution of the species.²⁴¹ As a result of increasing water temperatures and over-fishing, the southern new England stock has already declined sharply, and this will likely continue as the species shifts northward in response to climate change.²⁴² Based on this assessment, the Atlantic States Marine Fisheries Commission American Lobster Board has agreed to initiate the development of an addendum to address the poor condition of the stock by lowering fishing mortality and increasing egg production through measures such as gauge size changes, season closures, area closures, and trap reductions.²⁴³ The Board also considered but ultimately rejected a moratorium on the fishery.²⁴⁴

Impact on protocol: The model protocol directs resource managers to account for the effects of climate change when: (i) preparing natural resource assessments and inventories that underpin management decisions and resource allocations, including renewable resource assessments, fishery stock assessments, and rangeland health assessments, (ii) determining the sustainable yield for a particular resource; and (iii) making decisions about the timing, nature, and scale of any resource uses, and whether the agency should suspend or limit uses.

²³⁹ See, e.g., USFS, SADDLE LAKES TIMBER SALE FEIS, (2015) (briefly acknowledging that climate change may affect tree growth, but failing to account for this in its analysis of forest yield and optimal timber harvest).

²⁴⁰ BLM, PROPOSED RESOURCE MANAGEMENT PLAN AND FEIS FOR WESTERN OREGON, 165-212 (2016).

²⁴¹ ATLANTIC STATES MARINE FISHERIES COMMISSION, AMERICAN LOBSTER STOCK ASSESSMENT, 1, 25-26, (2015).

²⁴² *Id.*

²⁴³ News Release, Atlantic States Marine Fisheries Commission, *ASMFC American Lobster Board Approves Jonah Carb Addendum I & Initiates Addendum to Establish a Coastwide Standard for Claw Landings* (May 3, 2016).

²⁴⁴ *Id.*

4.4 Consider Climate Change in ESA Listing and Management Decisions

As noted in Section 3, FWS and NMFS now routinely account for climate change impacts in ESA documents. The analysis of current and future climate risks has played a key role in some recent decisions about whether to list species as endangered or threatened, but has not been a significant factor in other ESA decisions such as critical habitat designations and the selection of recovery measures. There are also some instances where environmental groups have argued (and at least one court has found) that climate change was not adequately accounted for listing decisions, such as those for the wolverine and the sage grouse.²⁴⁵ Thus, more could be done to ensure that ESA listing decisions, critical habitat designations, and recovery plans are fully informed by an assessment of how climate change will affect the species and its habitat.

There are a variety of recent examples of how climate change has meaningfully influenced listing decisions, including:

- **Polar Bear (FWS, 2008):** FWS listed the polar bear as threatened because they are dependent on sea ice for their survival, sea ice is declining across the bear's habitat, and climate change has and will continue to reduce the extent of sea ice to a degree that polar bear populations are likely to become endangered within the foreseeable future.²⁴⁶ The polar bear listing was upheld by the D.C. Circuit District Court and Court of Appeals.²⁴⁷
- **Coral (NMFS, 2014):** The impacts of climate change on coral habitat and health in the Atlantic and Caribbean was one of the primary reasons for listing twenty coral species as threatened.²⁴⁸
- **Bearded Seal (NMFS, 2012):** NMFS listed two subspecies of the bearded seal as threatened, based largely on the impact of climate change on their sea ice habitat.²⁴⁹ In reaching this

²⁴⁵ See *Defs. of Wildlife v. Jewell*, No. 14-247-M-DLC, 2016 WL 1363865, at *20 (D. Mont. Apr. 4, 2016) (court agreed that FWS failed to use best available science, including science on climate change, when deciding not to list wolverine as threatened); *W. Watersheds Project v. U.S. Fish & Wildlife Serv.*, No. 4:10-CV-229-BLW, 2012 WL 369168 (D. Idaho Feb. 2, 2012) (petitioners argued that FWS failed to use best available science, including science on climate change, when deciding that sage grouse listing was warranted but precluded; court deferred to FWS's judgment because FWS was working to reduce its listing decision backlog).

²⁴⁶ *Determination of Threatened Status for the Polar Bear (Ursus maritimus) Throughout Its Range*, 73 Fed. Reg. 28,212 (May 15, 2008).

²⁴⁷ *In re Polar Bear Endangered Species Act Listing & 4(d) Rule Litig.*, 794 F. Supp. 2d 65 (D.D.C. 2011), *aff'd*, *In re Polar Bear Endangered Species Act Listing & Section 4(d) Rule Litig.*, 709 F.3d 1 (D.C. Cir. 2013).

²⁴⁸ *Final Listing Determinations on Proposal to List 66 Reef-building Coral Species and to Reclassify Elkhorn and Staghorn Corals*, 79 Fed. Reg. 53,851 (Oct. 10, 2014).

²⁴⁹ *Threatened Status for the Beringia and Okhotsk Distinct Population Segments of the Erignathus barbatus nauticus Subspecies of the Bearded Seal*, 77 Fed. Reg. 76,740 (Dec. 28, 2012).

conclusion, NMFS considered climate impacts through 2100. A district court in Alaska recently overturned the decision, holding that forecasting more than 50 years into the future was too remote and speculative to support the determination that these subspecies were in danger of becoming extinct.²⁵⁰ The case is now on appeal.

- **Arctic Ringed Seal (NMFS, 2012):** NMFS recognized that habitat loss caused by climate change is the primary long-term threat to the continued survival of the Arctic Ringed Seal, and this was the predominant factor underpinning its decision to list three subspecies as threatened and one as endangered.²⁵¹ This decision was also overturned by the district court in Alaska for the same reason noted above, and is also now on appeal.²⁵²
- **Green Turtle (NMFS, 2016):** NMFS cited climate change as a threat to green sea turtles and thus one factor contributing to its decision to list eleven population segments of these turtles as threatened or endangered. Specific impacts included: temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, juveniles, and adults; ocean acidification is likely to affect the forage-base of green turtles; and sea level rise will reduce the availability and increase erosion rates of nesting beaches.²⁵³

FWS has also considered the effects of climate change in recent proposals to list population segments of the wolverine and greater sage grouse as threatened,²⁵⁴ but ultimately withdrew these proposals due to uncertainty about those impacts.²⁵⁵ As discussed above, a district court recently held that the withdrawal of the proposed listing was arbitrary and capricious because there was sufficient evidence that climate change posed an imminent threat to the species.²⁵⁶

²⁵⁰ *Alaska Oil & Gas Ass'n v. Pritzker*, Case No. 4:13-cv-00018-RRB, p. 31 (D. Alaska 2014).

²⁵¹ Threatened Status for the Arctic, Okhotsk, and Baltic Subspecies of the Ringed Seal and Endangered Status for the Ladoga Subspecies of the Ringed Seal, 77 Fed. Reg. 76,706 (Dec. 28, 2012).

²⁵² *Alaska Oil & Gas Ass'n v. Nat'l Marine Fisheries Serv.*, No. 4:14-CV-00029-RRB, 2016 WL 1125744, at *14 (D. Alaska Mar. 17, 2016).

²⁵³ Final Rule to List Eleven Distinct Populations Segments of the Green Sea Turtle (*Chelonia mydas*) as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act, 81 Fed. Reg. 20,058 (Apr. 6, 2016).

²⁵⁴ Proposed Rule, Threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States, 78 Fed. Reg. 7,864 (Feb. 4, 2013); Proposed Rule, Threatened Status for the Bi-State Distinct Population Segment of Greater Sage-Grouse with Special Rule and Designation of Critical Habitat, 79 Fed. Reg. 26684 (May 9, 2014).

²⁵⁵ Withdrawal of Proposed Rule, Threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States; Establishment of a Nonessential Experimental Population of the North American Wolverine in Colorado, Wyoming, and New Mexico, 79 Fed. Reg. 47,522 (Aug. 13, 2014); Withdrawal of the Proposed Rule to List the Bi-State Distinct Population Segment of Greater Sage-Grouse and Designate Critical Habitat, 80 Fed. Reg. 22828 (April 23, 2015).

²⁵⁶ *Def. of Wildlife v. Jewell*, No. 14-247-M-DLC, 2016 WL 1363865, at *29 (D. Mont. Apr. 4, 2016).

Notably, all of the affirmative listing decisions cited above involved arctic species and species that are highly sensitive to changes in air and water temperatures, and thus warming trends pose a direct and significant threat to the survival of these species. For other species, such as the sage grouse, the effects of climate change may be less direct and severe than other threats, but should nonetheless be accounted for in the listing decision (especially insofar as they may exacerbate more immediate threats to the species' survival).

The effects of climate change should also be considered in critical habitat designations. This may entail designating habitat that is further north in latitude, higher in elevation, or further set back from shorelines for terrestrial species, and waters that are cooler or deeper for marine species. It may also entail designating habitat corridors that will help promote the connectivity of the species' range. The ESA provides adequate statutory authority for this, as it allows FWS and NMFS to designate critical habitat that is "outside of the geographic area occupied by the species at the time it is listed... upon a determination... that such areas are essential for the conservation of the species."²⁵⁷

It appears that FWS and NMFS have been hesitant to designate critical habitat based on the projected impacts of climate change due to uncertainty about those impacts. There are many examples of climate change impacts being discussed in critical habitat designations,²⁵⁸ but only two examples where this discussion clearly affected the habitat boundaries:

- **Polar Bear (FWS, 2010):** FWS accounted for coastal erosion caused by climate change when defining the inland boundary of the bear's terrestrial denning habitat.²⁵⁹ FWS also rejected comments from the State of Alaska urging it to reduce the extent of protected sea ice habitat and redefine habitat boundaries based on seasonal parameters, finding that this approach was impracticable due to "the extreme variability and dynamic nature of the sea ice,

²⁵⁷ 16 USC § 1532(5)(A).

²⁵⁸ Critical Habitat for Endangered North Atlantic Right Whale, 82 Fed. Reg. 4,837 (Jan. 27, 2016); Proposed Designation of Critical Habitat for the Arctic Ringed Seal, 79 Fed. Reg. 73,010 (Dec. 9, 2014); Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx and Revised Distinct Population Segment Boundary, 79 Fed. Reg. 54,782 (Sept. 12, 2014); Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS, 79 Fed. Reg. 38,855 (July 10, 2014); Designation of Critical Habitat for Jaguar, 79 Fed. Reg. 12,572 (Mar. 5, 2014).

²⁵⁹ Final Rule, Designation of Critical Habitat for the Polar Bear (*Ursus maritimus*) in the United States, 75 Fed. Reg. 76,086, 76,095 (Dec. 7, 2010).

especially in the face of climate change.”²⁶⁰ The habitat designation was vacated by a district court in Alaska but ultimately upheld by the Ninth Circuit Court of Appeals.²⁶¹

- **Haleakala Silversword (FWS, 2016):** FWS recognized that this plant species was limited to a small range at higher elevations in one portion of east Maui, making it highly vulnerable to climate change, and thus that the establishment of additional populations in currently unoccupied areas would be essential for its continued survival.²⁶² This decision illustrates how FWS and NMFS can use their authority to designate critical habitat in areas “outside the geographic area occupied by the species to the time it is listed... [that are] essential for the conservation of the species”²⁶³ to address the effects of climate change on a species. As many species’ suitable ranges will shift northwards in latitude or higher in altitude as a result of climate change, it would make sense to take a similar approach in future habitat designations.

FWS was also planning to account for climate change in its proposed critical habitat designation for a population segment of the greater sage grouse, although that designation was never finalized because FWS ultimately decided to withdraw its proposal to list that population segment as threatened. There, FWS proposed to designate corridors of land as critical habitat, even though the corridors did not contain ideal habitat for the sage grouse, in order to improve the connectivity between current populations and reduce habitat fragmentation.²⁶⁴ Although the proposal was ultimately revoked, it nonetheless provides another useful example of how climate change can be accounted for in critical habitat designations despite uncertainty about future impacts.

Finally, the recovery plans and habitat conservation plans for species that are adversely affected by climate change should include measures to alleviate climate-related stressors wherever possible. Most of the plans that were reviewed for this project discussed how climate change may affect the species and its habitat, and in some instances specified that climate-related indicators would be monitored, but did not identify any other management actions that could be

²⁶⁰ *Id.* at 76,094.

²⁶¹ *Alaska Oil & Gas Ass'n v. Salazar*, 916 F. Supp. 2d 974 (D. Alaska 2013), *rev'd and remanded sub nom.* *Alaska Oil & Gas Ass'n v. Jewell*, 815 F.3d 544 (9th Cir. 2016).

²⁶² *Designation and Nondesignation of Critical Habitat on Molokai, Lanai, Maui, and Kahoolawe for 135 Species*, 81 Fed. Reg. 17,790, 17795 (Mar. 30, 2016).

²⁶³ 16 USC § 1532(5)(A).

²⁶⁴ *Designation of Critical Habitat for the Bi-State Distinct Population Segment of Greater Sage Grouse*, Proposed Rule, 78 Fed. Reg. 64328, 64338 (Oct. 28, 2013).

implemented to mitigate any risks or harms caused by climate change.²⁶⁵ There were four plans that did identify specific adaptation measures that would or could be implemented by the agency or other stakeholders:

- **Polar Bear Draft Conservation Management Plan (FWS, 2015):** The conservation plan recognizes that slowing the rate of global warming is the most important action that can be undertaken to protect polar bears, and commits FWS to implementing a “science-based communication effort highlighting the urgent need for sufficient reductions in greenhouse gas emissions to support conditions for the recovery of polar bears from projected declines.”²⁶⁶ The plan also highlights actions that can be undertaken to improve the resilience of the polar bear population in the near term, including: (1) conserving the broad spatial distribution and ecological diversity of polar bear populations (including populations outside of the United States); (2) focusing resources on the conservation of terrestrial habitats for use by polar bears during ice-free months, particularly denning areas; (3) accounting for climate change when establishing subsistence harvest levels; and (4) strategic monitoring and research to better understand how to respond to the effects of climate change.²⁶⁷
- **Bull Trout Recovery Plan (FWS, 2015):** The recovery plan describes how climate change will affect the bull trout and its habitat, and that FWS will address these impacts by: (1) utilizing a system of monitoring and adaptive management, and (2) allocating conservation resources to those areas with coldest water temperatures to offer the greatest long-term benefit for the bull trout.²⁶⁸ Other management strategies that are contemplated in the plan include artificial propagation and translocation.²⁶⁹
- **Elkhorn Coral and Staghorn Coral Recovery Plan (NMFS, 2015):** The recovery plan notes that rising ocean temperatures and acidification will affect the threatened coral species, and while emission reductions are needed for a long-term solution, geo-engineering solutions to increase surface ocean alkalinity and reduce thermal stress may provide a short-term solution to protect the coral. It identifies potential geo-engineering measures, including:

²⁶⁵ See, e.g., NMFS, ESA RECOVERY PLAN FOR SNAKE RIVER SOCKEYE SALMON, 206-207 (2015) (describing how climate change will affect the habitat and survival of the Sockeye Salmon and stating that these changes will be monitored, but failing to list specific management activities aimed at mitigating the impacts of climate change on the species; BEXAR COUNTY AND CITY OF SAN ANTONIO, SOUTHERN EDWARDS PLATEAU FINAL HABITAT CONSERVATION PLAN 148 (2015) (recognizing that climate change could cause the permanent loss of habitat for the covered species, but concluding that there is not sufficient information to inform the design of alternative or additional mitigation measures that would compensate for any adverse effects from climate change).

²⁶⁶ FWS, POLAR BEAR CONSERVATION MANAGEMENT PLAN, DRAFT, 12 (2015).

²⁶⁷ *Id.* at 12, 14, 27, 40.

²⁶⁸ FWS, RECOVERY PLAN FOR THE COTERMINOUS UNITED STATES POPULATION OF BULL TROUT, 31, 53 (2015).

²⁶⁹ *Id.* at 31-33.

shading of strategic, high-value populations of reefs, and pumping of cooler subsurface or chilled waters onto reef habitats.²⁷⁰

- **Butte Regional Draft Conservation Plan (Butte County, 2015):** This plan includes management actions aimed at ensuring that the protected lands “will be spatially distributed to provide a mosaic of geographically and ecologically diverse natural communities, habitat for covered and other native species, and to facilitate elevational and latitudinal movement of natural communities and species in response to climate change.”²⁷¹ It also includes a monitoring and adaptive management component to help track and respond to the impacts of climate change on the species’ habitat.²⁷²

These conservation plans provide examples of the types of adaptation measures that can be implemented both to facilitate species’ natural adaptation and resilience to climate change (e.g., by improving habitat in a manner that facilitates natural migration) and directly reduce climate-related stressors on the species (e.g., by shading or pumping cooler waters onto reefs).

Impact on protocol: The model protocol directs managers to account for the effects of climate change when preparing assessments that underpin Endangered Species Act listing decisions, critical habitat designations, recovery plans, and habitat conservation plans. For recovery plans and habitat conservation plans, it also calls for consideration of management practices, proactive measures, and other actions to protect natural resources in the context of climate change, and the implementation of monitoring and adaptive management programs to manage uncertainty.

4.5 Identify Near-Term Actions to Improve Ecosystem Resilience and Adaptive Capacity

Uncertainty about the future effects of climate change was one of the primary rationales for dismissing these effects from further consideration and omitting any discussion of potential adaptation measures.²⁷³ But in many cases, adaptation efforts need not be delayed by uncertainty

²⁷⁰ NMFS, ELKHORN AND STAGHORN CORAL RECOVERY PLAN, IV-18 (2015).

²⁷¹ BUTTE COUNTY, BUTTE REGIONAL CONSERVATION PLAN, PUBLIC CONSULTATION DRAFT, 5-25 (2015).

²⁷² *Id.* at Ch. 7

²⁷³ *See, e.g.*, Designation of Critical Habitat for Mount Charleston Blue Butterfly, Fed. Reg. 37,404, 37,408 (June 30, 2015) (FWS concluded that site-specific information on climate change and its effects on the butterfly and its habitat are not available at this time, and thus it did not identify any additional areas to include in the critical habitat designation based on climate change).

about the timing, nature and magnitude of climate change impacts. As discussed in Section 1, resource managers can implement near-term actions aimed at reducing other stressors on natural resources (particularly those related to human use and development) and improving the ecological integrity and connectivity of landscapes and ecosystems. Such actions generally improve the adaptive capacity and long-term resilience of species and biological communities to the effects of climate change.

There are many examples of adaptation planning that is already underway (in addition to those noted above):

- **Lake Tahoe Basin Management Unit FEIS (USFS, 2015):** This FEIS for a revised LRMP goes into a fair amount of detail about how climate change will affect the area, and the role of ecological restoration plays as an adaptation strategy. The FEIS identifies nine specific strategies for building the adaptive capacity of ecosystems through ecological restoration, and explains how these strategies would (or would not) be implemented under each of the alternative management approaches under consideration. It then ranks the alternatives based on this analysis.²⁷⁴
- **Francis Marion National Forest Draft Revised LRMP and DEIS (USFS, 2015):** The draft revised plan and DEIS both discuss how climate change will affect natural resources in the area and corresponding management implications. For example, the DEIS notes that: “Maintaining highly functioning ecosystems across the landscape is the most effective response to potential changes in climate” and that “partnerships with adjacent landowners that create avenues or mitigation corridors for species migration is critical” because these corridors may prevent pockets of isolated species.²⁷⁵ It also describes specific partnerships that will be used to promote conservation across a multi-state landscape and create ecosystem linkages.²⁷⁶ The draft LRMP contains additional details about resource vulnerability, adaptation measures, and monitoring.²⁷⁷
- **Kaibab National Forest LRMP and FEIS (USFS, 2014):** The LRMP and FEIS both discuss climate change effects and adaptation options. The LRMP recognizes that the desired conditions for wildlife must include habitat that is configured to allow wildlife populations to adjust their movements (e.g., seasonal migration, foraging, etc.) in response to climate change.²⁷⁸ It also contains management objectives aimed at increasing the amount and rate

²⁷⁴ USFS, LAKE TAHOE BASIN MANAGEMENT UNIT FEIS, § 3.4.7 (2015).

²⁷⁵ USFS, DEIS FOR THE REVISED LAND MANAGEMENT PLAN, FRANCIS MARION NATIONAL FOREST, 69 (2015).

²⁷⁶ *Id.*

²⁷⁷ USFS, DRAFT REVISED LAND MANAGEMENT PLAN, FRANCIS MARION NATIONAL FOREST, 11, 34, 50, 54, 58, 65, 168 (2015).

²⁷⁸ USFS, LAND AND RESOURCE MANAGEMENT PLAN FOR THE KAIBAB NATIONAL FOREST, 49 (2014).

of mechanical thinning and managed fire treatments to reduce wildfire risk,²⁷⁹ which, according to the FEIS, should make the forest more resilient to climate change.²⁸⁰

- **San Juan National Forest LRMP and FEIS Appendix (USFS, 2013):** This appendix is dedicated to the discussion of climate change trends and management strategies for species and ecosystems that are already changing.²⁸¹ It specifies the desired conditions in light of climate change, management objectives for attaining those conditions, and guidelines for implementing the objectives.²⁸²
- **Hawaii Volcanoes National Park Final General Management Plan/EIS (NPS, 2016):** The general management plan/EIS recognizes the need to respond to climate change, and contains guidance how NPS will assess, respond to, and interpret the impacts of global climate change.²⁸³ The plan identifies general management objectives, such as “climate change-related research, adapting management activities based on climate projections, and building resilience among populations of rare native species, communities, and ecosystems” as well as more specific adaptation measures, such as “long-term weather monitoring of park ecosystems, establishing wildlife corridors through restoration of forest fragments, and expanding populations of rare species throughout their former range.”²⁸⁴

Impact on Protocol: The protocol directs managers to consider what adaptation measures can be implemented to enhance the resilience and adaptive capacity of natural resources, ensure the long-term sustainable yield of natural resources, and otherwise fulfill resource management objectives in the context of a changing climate. To help manage uncertainty about the future effects of climate change, it also recommends including monitoring and adaptive management programs in resource management plans. Finally, the protocol contains specific directions on how to account for uncertainty in the context of NEPA reviews (which refer to back to uncertainty guidelines in the NEPA regulations).²⁸⁵

²⁷⁹ *Id.* at 19, 23, 26, 71.

²⁸⁰ USFS, FEIS FOR THE KAIBAB NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN, 12 (2014).

²⁸¹ USFS, APPENDIX G: CLIMATE CHANGE TRENDS AND MANAGEMENT STRATEGY FOR THE SAN JUAN NATIONAL FOREST AND TRES RIOS FIELD OFFICE LAND AND RESOURCE MANAGEMENT PLAN (2013).

²⁸² *Id.*

²⁸³ NPS, HAWAII VOLCANOES NATIONAL PARK DRAFT MANAGEMENT PLAN/DEIS, 20 (2013) (incorporated into final by reference).

²⁸⁴ *Id.* at 146

²⁸⁵ 40 CFR § 1502.22.

4.6 Establish Clear Parameters for Monitoring and Adaptive Management

Some of the planning documents we reviewed stated that the agency would engage in monitoring and adaptive management but provided very little detail about what this would entail.²⁸⁶ This finding is the basis for our final recommendation, which is that planning documents should establish clear parameters for monitoring and adaptive management programs which ensure that managers will collect data and respond to new information about the effects of climate change as well as the efficacy of management strategies. In particular, planning documents should specify the indicators that will be monitored, thresholds at which adaptive management responses will be implemented, and the types of management activities that may be implemented when those thresholds are reached. There are several examples of documents that contain some or all of this information:

- **Tuolumne Wild and Science River Final Comprehensive Management Plan and EIS (NPS, 2014):** NPS acknowledged that climate change could affect stream flows in the Tuolumne Meadows area, and outlined the following water conservation measures: (i) future water withdrawals would be restricted no more than 10% of lowest flow or 65,000 gallons per day, whichever is less, (ii) water conservation measures, such as the replacement of leaking water lines and installation of low-flow fixtures would be included under all alternatives; and (iii) long-term monitoring would be used to detect future decreases in river flows, and the findings would be used to impose additional restrictions on water use. In addition to these measures, the EIS also noted that one of the alternatives (which would have increased visitor activity in the area) was rejected because it would

²⁸⁶ See, e.g., BLM, WINNEMUCCA DISTRICT PROPOSED RMP AND FEIS, 3-13 – 3-14, 4-12, 4-46 (2013) (this document discusses how climate change is already affecting and projected to affect the planning area, and states that the RMP is based on the concept of adaptive management and “dynamic enough to account for changes in resource conditions,” but it does not contain details about what indicators will be monitored or how management practices would be adapted in light of certain types of changes); FWS, DEER FLAT NATIONAL WILDLIFE REFUGE FINAL COMPREHENSIVE CONSERVATION PLAN/EIS, 2-7–2-8, 3-4–3-10, 4-29 (2015) (this document describes how climate change will affect local climate and hydrology and states that all of the alternatives under consideration entail the adaptive management of the refuge and monitoring for the effects of climate change; but apart from a general description of adaptive management and monitoring, it does not go into detail about indicators, thresholds, or adaptive management responses); FWS, KLAMATH BASIN NATIONAL WILDLIFE REFUGE DRAFT CONSERVATION PLAN / DEIS, 4-33, 5-2 – 5-4 (2016) (this document summarizes projections of future climate change impacts on local climate, hydrological resources, vegetation, and wildlife, and specifies that all of the alternatives under consideration will involve adaptive management, but does not go into detail about indicators, thresholds, or adaptive management responses).

increase water demand and this demand likely could not be met in the context of future climate change.²⁸⁷

- **San Luis Valley National Wildlife Refuge Complex, Final Comprehensive Conservation Plan and EIS (FWS, 2015):** One purpose of the revised plan is to provide for the conservation of species despite challenges such as drought, water shortages, and the effects of climate change.²⁸⁸ The plan/EIS describes how climate change will affect the refuge complex (focusing on hydrological impacts),²⁸⁹ and cites these impacts as one reason for developing a water monitoring program that will measure the quantity, timing, and location of surface and ground water that is sufficient for the refuges' biological management objectives.²⁹⁰ The plan/EIS also identifies various research objectives aimed at improving assessment and predictions related to climate change.²⁹¹ It also proposes that \$150,000 be allocated for responding to climate change under the proposed plan.²⁹²
- **Inyo, Sequoia, and Sierra national Forest Draft Management Plans (USFS, 2016):** The management plans for these three national forests (located in the same region in California) all included the same monitoring plan, which outlined specific monitoring questions related to the impacts of climate change on the forests (e.g., are high-elevation white pines and red fir being sustained or increasing across the landscape?) and associated indicators for answering those questions.²⁹³ The plans state that monitoring data will be evaluated every two years and USFS will develop new indicators and management approaches if needed.²⁹⁴
- **Tongass National Forest Land and Resource Management Plan (USFS, 2008):** This LRMP included a monitoring and evaluation plan intended to facilitate adaptive management of the forest. One of the objectives is to monitor long-term changes to permanent snowpack caused by climate change and the effects on the physical and biological environment. The plan states that USFS will use data from remote sensing, GIS, watershed layers, and wildlife habitat maps to evaluate these impacts.²⁹⁵

²⁸⁷ NPS, TUOLUMNE WILD AND SCIENCE RIVER FINAL COMPREHENSIVE MANAGEMENT PLAN AND EIS, ES-6, ES-10, 5-39, 5-93-5-96 (2014).

²⁸⁸ FWS, SAN LUIS VALLEY NATIONAL WILDLIFE REFUGE COMPREHENSIVE CONSERVATION PLAN, 3 (2015).

²⁸⁹ *Id.* at 39-40.

²⁹⁰ *Id.* at 154.

²⁹¹ *Id.* at 169-171.

²⁹² *Id.* at 174.

²⁹³ USFS, DRAFT REVISED LAND MANAGEMENT PLAN FOR THE SEQUOIA NATIONAL FOREST, CH. 5 (2016); USFS, DRAFT REVISED LAND MANAGEMENT PLAN FOR THE SIERRA NATIONAL FOREST, CH. 5 (2016); USFS, DRAFT REVISED LAND MANAGEMENT PLAN FOR THE INYO NATIONAL FOREST (2016).

²⁹⁴ *Id.*

²⁹⁵ USFS, TONGASS NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN, 6-6 (2008).

Impact on protocol: The protocol specifies that monitoring and adaptive management programs should be designed so that managers can collect data and respond to new information about the effects of climate change as well as the efficacy of management actions, and that the descriptions of such systems should clearly specify: (a) the monitoring system (e.g., which indicators will be monitored, what technology will be used, and how frequently will data be collected); (b) the thresholds for the implementation of future management actions (e.g., when a species population or stream flow falls below a certain level); and (c) the types of management activities that will or may be implemented in the event that those thresholds are reached.

CONCLUSION

Climate change has important implications for the management of natural resources and the environmental outcomes of management actions, and yet the impacts of climate change are often treated as an afterthought in natural resource planning and environmental review documents. This appears to be due to a lack of guidance on how to meaningfully evaluate the effects of climate change and adjust management practices in light of those effects. This report and the accompanying protocol aim to fill the guidance gap by providing instruction on how to account for climate change in natural resource assessments, management plans, and environmental review documents, as well as citations to documents that embody the recommendations presented herein. Such guidance is only the first step to ensuring meaningful consideration of climate change impacts in planning documents: going forward, it will also be critically important to support continued research on climate change impacts as well as concerted efforts to make the findings of that research accessible to natural resource planners.

APPENDIX

Model Protocol: Considering the Effects of Climate Change on Natural Resources in Environmental Review and Planning Documents

Note: This protocol only concerns how the effects of climate change on natural resources and management decisions should be considered in planning documents. It does not address how decision-makers should account for the effect of natural resource management decisions on climate change (i.e., through greenhouse gas emissions or changes in carbon sequestration), nor does it address how decision-makers should account for the effects of climate change on buildings and infrastructure. The Sabin Center has developed a separate protocol for assessing the effects of climate change in NEPA reviews for buildings and infrastructure, which is available on our website.¹

Most of the directives outlined here are based on federal requirements for natural resource planning and environmental reviews. References to the corresponding statutory and regulatory requirements are provided below. The protocol could also be adapted for use by non-federal entities, including foreign, state, and local governments and private actors. Please refer to Section 4 of the accompanying report for examples of documents that contain the type of analysis recommended in this protocol.

Overarching Principles

1. Natural resource managers (“managers”) should consider how climate change may affect natural resources in planning and environmental review documents, and use this analysis to inform resource management decisions.
2. The analysis of climate change effects should encompass the following considerations:
 - a. **No action baseline:** How might climate change affect current and future baseline conditions, including temperature, precipitation, hydrology, vegetation, wildlife, and ecosystem function?
 - b. **Sustainable use:** How might climate change affect the sustainable use of natural resources from forests, grazing lands, fisheries, and other managed landscapes?
 - c. **Management implications:** How might climate change affect the implementation and efficacy of resource management actions?
 - d. **Environmental impacts:** How might climate change affect the environmental impacts of resource management actions?
 - e. **Adaptation:** What adaptation measures could be implemented to enhance the resilience and adaptive capacity of natural resources, ensure the long-term sustainable use of

¹ The buildings and infrastructure protocol is available at: <http://bit.ly/2czpDr0> (last visited Sept. 12, 2016).

- natural resources, and otherwise fulfill resource management objectives in the context of a changing climate?
- f. **Environmental impact mitigation:** If a management activity may have adverse environmental effects that are exacerbated by climate change, what mitigation measures can be implemented to eliminate or reduce those effects?
 - g. **Monitoring and adaptive management:** How can planning and decision-making processes be structured to account on an ongoing basis throughout the life of an activity for uncertainty and new information about the effects of climate change and the efficacy of management actions and to ensure that this information informs future management decisions? What types of monitoring programs are needed to obtain relevant information about the effects of climate change on the managed resources, to assess the outcomes of management decisions, and to modify decisions as appropriate?
3. To address uncertainty about the pace and magnitude of climate change, managers should assess management decisions and environmental outcomes under a range of plausible climate change scenarios. To frame these scenarios, managers should refer to the most recent Representative Concentration Pathways (RCPs) for greenhouse gas emissions that have been released by the Intergovernmental Panel on Climate Change (IPCC), as well as any other relevant projections (such as sea level rise projections) that have been developed or adopted by authoritative bodies. The probabilities of each of the scenarios should be disclosed if they can be estimated.
 4. The analysis of climate change and its effect on temperatures, precipitation, and other environmental phenomena should account for changes in both long-term average conditions and the range of variability. When considering the range of variability, managers should be sure to account for changes in the frequency and magnitude of extreme weather events such as heavy downpours, cold snaps, and heat waves.
 5. The timeframe for this analysis should encompass not only the duration of management activities but also the duration of their long-term effects on the environment and natural resource base.
 6. The scope and depth of this analysis should be tailored to provide useful information for decision-makers, and should reflect the magnitude of the risk posed by climate change and the correlated vulnerability of affected natural resources.
 7. The analysis of climate change impacts should inform final management decisions, including decisions about resource use and conservation, and whether to approve actions that may impair the resilience or adaptive capacity of natural resources.
 8. Managers should engage with relevant stakeholders to obtain information about the impacts of climate change, better understand the implications of those impacts for natural resource management decisions, and develop appropriate response measures. Relevant stakeholders

may include (but are not limited to) government representatives (from federal, state, local and tribal entities), scientists, businesses, environmental NGOs, and members of the affected public.

Definitions

1. “Adaptation measures” refers to management actions undertaken to either minimize the harm caused by climate change or take advantage of any beneficial opportunities created by climate change.
2. “Adaptive capacity” refers to the ability or potential of a system to adapt to changing conditions, without significant impairment of ecological, social, or economic values.
3. “Areas of special environmental concern” refers to any areas that require special management attention due to the unique value and/or vulnerability of the natural resources located therein. Such areas would include, but not be limited to, critical habitat for endangered and threatened species and the areas of “critical environmental concern” designated by the Bureau of Land Management on public lands.
4. “Ecological integrity” refers to, *inter alia*, the health of an ecosystem, taking into account its ability to support and maintain biological communities, deliver ecosystem services, and withstand and recover from disturbances.
5. “Ecosystem services” refers to beneficial services obtained from ecosystems, including provisioning services (e.g., the production of food and water), regulating services (e.g., control of climate, flooding and water quality), cultural services (e.g., recreational opportunities), and supporting services (e.g., crop pollination).
6. “Environmental mitigation measure” refers to an action that is undertaken to minimize or otherwise mitigate any adverse environmental effects from a proposed action.
7. “Environmental review documents” refers to any documents prepared to fulfill the requirements of the National Environmental Policy Act (NEPA) and state equivalents, including environmental impact statements and environmental assessments.
8. “Natural resources” refers to any natural assets that provide environmental, economic, health, social, cultural, recreational or aesthetic value for present and future generations, including but not limited to ecosystems and the services they provide, fresh water, clean air, biodiversity, wildlife, fisheries, timber, forage, minerals, and scenic views.
9. “No action baseline” refers to baseline conditions that would occur in the absence of a proposed or prospective management action and in the presence of future climate change.
10. “Planning documents” refers to environmental review documents as well as natural resource assessments, resource management plans, and other documents that dictate or guide future management activities for public lands and natural resources in the United States.

11. “Resilience” refers to the ability of natural resources to adapt to changing conditions and withstand, respond to, and recover from disruptions.
12. “Sustainable use” refers to the human use of natural resources in a manner that does not reduce or impair the resource base for the use and enjoyment of future generations.
13. “Sustainable yield” refers to the ecological yield (i.e., harvestable population growth) that can be extracted from a natural resource base without reducing or impairing the resource base for the use and enjoyment of future generations.

Natural Resource Assessments and Inventories

1. Managers should account for the effects of climate change when preparing natural resource assessments and inventories, including but not limited to:
 - a. Renewable resource assessments;
 - b. Multi-resource assessments;
 - c. Landscape-scale assessments;
 - d. Fishery and marine mammal stock assessments;
 - e. Rangeland health assessments;
 - f. Natural resource condition assessments;
 - g. Assessments underpinning Endangered Species Act listing decisions, critical habitat designations, interagency consultations and jeopardy determinations, recovery plans, and habitat conservation plans;
 - h. Assessments underpinning Clean Water Act § 404 determinations; and
 - i. Assessments included in environmental review documents.
2. When conducting this analysis, managers should consider:
 - a. How might climate change affect current and future baseline conditions and natural processes in the area, such as local climate and hydrology?²
 - b. How might climate change affect the health, abundance and distribution of natural resources in the near- and long-term?³

² Relevant mandates include: 16 U.S.C. §§ 1601(a)(5), 1603 (directing USFS to develop an inventory of present and potential renewable resources which includes “an analysis of the potential effects of global climate change on the condition of renewable resources on the forests and rangelands of the U.S.” and to keep the inventory current “so as to reflect changes in conditions and identify new and emerging resources and values”); 43 U.S.C. § 1711(a) (requiring BLM to prepare and maintain an inventory of all public lands and their resource and other values and to keep the inventory “current so as to reflect changes in conditions”); 54 U.S.C. § 100704 (directing NPS to “undertake a program of inventory and monitoring of System resources to establish baseline information and to provide information on the long-term trends in the condition of System resources”); 16 U.S.C. 1853(a)(3) (requiring NMFS to conduct an assessment of the “present and probable future condition of, and the maximum sustainable yield and optimal yield from” fisheries).

- c. What implications does climate change have for the productivity and sustainable use of natural resources, the ecological integrity of ecosystems, and the delivery of ecosystem services?⁴
- d. What implications does climate change have for the protection and preservation of natural resources such as endangered species and wilderness areas?⁵
- e. How might climate change affect the anticipated uses of and demand for natural resources?⁶

Strategic Plans

1. Managers should account for the effects of climate change when preparing high-level strategic plans, such as the national strategic plans prepared by federal agencies in accordance with the Government Performance and Results Modernization Act. This analysis should cover the following considerations:
 - a. Broadly speaking, how might climate change affect the natural resources that are managed under the strategic plan? What are the most serious and pervasive impacts?

³ See *id.* (USFS, BLM, NPS, and NMFS mandates); 16 U.S.C. § 742d(a) (directing DOI to “conduct continuing investigations, prepare and disseminate information, and make periodical reports” regarding the “availability and abundance and the biological requirements of the fish and wildlife resources” in the country, and any progress that the department has made to acquire additional wildlife refuges and develop wildlife values); 16 U.S.C. § 704 (specifying that FWS must consider “the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, to determine when, to what extent, if at all, and by what means, it is compatible with the terms of the conventions to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof”).

⁴ See *id.*; 16 U.S.C. 742f (directing NMFS to develop measures for the maximum sustainable production of fish; make economic studies of the industry and recommend measures to insure stability of the domestic fisheries; and take steps “required for the development, advancement, management, conservation, and protection of the fisheries resources”); 43 U.S.C. §§ 1701(a)(8) (stipulating that BLM should manage public lands “in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy”); 16 U.S.C. § 668dd(a)(4)(A)-(B) (directing FWS to “ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans”); 16 U.S.C. § 1601(a)(2) (specifying that USFS resource inventory should include “an evaluation of opportunities for improving [the] yield of tangible and intangible goods and services” from renewable resources); 36 C.F.R. § 219.6 (specifying that USFS assessments must account for system drivers, including the “ability of terrestrial and aquatic ecosystems on the plan area to adapt to change” and effects on ecosystem services).

⁵ See 16 U.S.C. § 1533(d) (directing the FWS and NMFS to promulgate regulations for the protection of endangered and threatened species as they deem “necessary and advisable to provide for the conservation of such species.”); 16 U.S.C. § 1536(a)(2) (directing all federal agencies ensure any “action authorized, funded or carried out” by them “is not likely to jeopardize the continued existence” of any endangered or threatened species); 36 C.F.R. § 219.6 (specifying that USFS assessments must account for the latest science on threatened, endangered, proposed and candidate species, and potential species of conservation concern present in the plan area).

⁶ See 16 U.S.C. § 1601(a)(1) (USFS inventory must evaluate the “present and anticipated uses, demand for, and supply of the renewable resources”).

To what extent do these impacts create new risks, opportunities, or implications for management?⁷

- b. What are the manager's overarching natural resource management objectives and implementation strategies, and how should these be modified to account for the effects of climate change?⁸
- c. What are the manager's top adaptation priorities, and how can these be integrated into its objectives and implementation strategies?⁹
- d. What indicators does the manager currently use to assess the health and productivity of natural resources under its jurisdiction, and should these be modified to account for the effects of climate change?
- e. Are there major gaps in information about the effects of climate change on the natural resources managed under the strategic plan, and if so, what sort of broad-scale research and data collection efforts could be implemented to fill these gaps?¹⁰
- f. Does the manager's capacity to respond to climate change impacts depend on actions undertaken by other entities, and how might partnerships be formed with these entities to fulfill management and adaptation objectives?¹¹

Resource Management Plans

1. Managers should account for the effects of climate change when preparing management plans for specific regions or units, including but not limited to:
 - a. Land Management Plans (LMPs) for National Forest System units,
 - b. Resource Management Plans (RMPs) for public land units,
 - c. Comprehensive Conservation Plans (CCPs) for wildlife refuges,
 - d. General Management Plans (GMPs) for national parks,
 - e. Fishery management plans,
 - f. Species recovery plans,
 - g. Habitat conservation plans,
 - h. Water management plans,

⁷ See 5 U.S.C. § 306 (a)(7) (federal agency strategic plans shall identify "those key factors external to the agency and beyond its control that could significantly affect the achievement of the [agency's] general goals and objectives").

⁸ See 5 U.S.C. § 306 (a)(2) (strategic plans shall specify general goals and objectives of the agency).

⁹ See *id.*

¹⁰ See 5 U.S.C. § 306(a)(4)(A) (strategic plans shall include a description of the resources required to achieve goals and objectives).

¹¹ See 5 U.S.C. § 306 (a)(4)(B) (strategic plans shall include a description of how the agency is working with other agencies to achieve its goals and objectives).

- i. Livestock allotment plans, and
 - j. Wildlife and wetland mitigation plans.
2. In general: The effects of climate change should be considered when developing the following components of resource management plans (to the extent applicable):
- a. Resource management objectives and desired natural resource conditions, and the agency's ability to meet these objectives and conditions;¹²
 - b. The manager's determination of the sustainable yield of specific resources;¹³
 - c. Any other assessments related to the productivity and sustainable use of natural resources, such as assessments regarding the carrying capacity of ecosystems and the delivery of ecosystem services;¹⁴
 - d. The management practices, protective measures, and any other actions that will be implemented to restore landscapes and ecosystems, conserve natural resources for future generations, and otherwise fulfill planning mandates related to the sustainable use and non-impairment of natural resources;¹⁵
 - e. The timing, nature, scale, and location of any resource uses, including but not limited to timbering, grazing, hunting, fishing, and recreational use, and whether the agency should suspend or seriously limit certain uses;¹⁶ and

¹² See 36 C.F.R. § 219.7(e) (NFS plans must specify desired conditions for the area and standards for attaining those conditions); 43 C.F.R. § 1601.0-5(n) (resource management plans for public lands shall specify "resource condition goals and objectives to be attained"); 50 C.F.R. § 25.12 (comprehensive conservation plans for wildlife refuges should describe the "desired future conditions" of the refuge or planning unit and provide long-range guidance on management direction to achieve the purposes of the refuge).

¹³ See 16 U.S.C. § 1604(e)(1) (NFS plans must provide for multiple use and sustained yield of the products and services obtained therefrom) 16 U.S.C. §§ 1851, 1853 (fishery management plans must specify the maximum sustainable yield and optimum yield from the fishery and provide for catch limits to ensure that harvests do not exceed the optimum yield); 43 U.S.C. § 1701(a) (public lands must be managed on the basis of multiple use and sustained yield).

¹⁴ See *id.*; 54 U.S.C. § 100101 (national parks must be managed "to conserve the scenery, natural and historic objects, and wildlife... and to provide for the enjoyment of the scenery, natural and historic objects, and wildlife in such manner and by such means as will leave them unimpaired for the enjoyment of future generations"); 16 U.S.C. § 668dd (the Wildlife Refuge System should be managed in a fashion that will "ensure the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans"); 16 U.S.C. § 1604(e)(2) (NFS plans must determine forest management systems, harvesting levels, and procedures as necessary to ensure the sustained yield of resources).

¹⁵ See 116 U.S.C. 1853(a)(1)(A) (fishery management plans must list conservation and management measures that will "protect, restore and promote the long-term health and stability of the fishery") 43 C.F.R. § 1601.0-5(n) (resource management plans for public lands shall specify resource protection measures that may be needed to achieve resource condition goals); 36 C.F.R. § 219.8 (NFS plans must include components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems); 36 C.F.R. § 219.9 (establishing detailed criteria for the protection of biodiversity in National Forest service units).

¹⁶ See *id.*; 36 C.F.R. § 219.7 (NFS plans shall identify the suitability of areas for resource management and uses, the maximum quantity of timber that may be removed from the plan area, and standards for resource uses as necessary to protect ecology integrity in the area); 43 C.F.R. § 1601.0-5(n) (resource management plans for public lands shall specify

- f. The designation of any protected areas or areas of special environmental concern.¹⁷
3. **Monitoring and Adaptive Management:** To manage uncertainty, managers should incorporate a system of monitoring and adaptive management into resource management plans. Such systems should be designed to allow managers to collect data and respond to new information about the effects of climate change as well as the efficacy of management actions and adaptation measures.¹⁸ The descriptions of such systems should clearly specify:
 - a. The monitoring system (e.g., which indicators will be monitored, what technology will be used, how frequently will data be collected, and how the data will be reported);
 - b. The triggers and other criteria for determining when to implement, terminate or modify management actions in response to new information (e.g., a triggering event could be when a species population or stream flow falls below a certain level); and
 - c. The types of management activities that will be implemented, terminated, or modified when triggers occur or criteria are met. This should be a tentative list of management actions that can be adjusted based on new information about the impacts of climate change and the efficacy of different management responses.
4. **Revisions:** Managers should consider whether existing management plans should be updated in light of the considerations outlined above, the results of monitoring programs, and new information about the present and future effects of climate change.

Environmental Impact Analysis

1. **Scoping:** Managers should conduct a preliminary analysis of climate change impacts and possible responses to those impacts during the scoping phase to identify issues that should be explored in greater depth in subsequent environmental review documents, and to receive public input on the scope of the climate change impact analysis before the publication of the

allowable resource uses and related levels of production or use to be maintained and the sequence of implementation actions).

¹⁷ See 36 C.F.R. § 219.7 (NFS plans must identify areas that are not suitable for timber production); 43 C.F.R. § 1601.0-5(n) (public lands management plans must specify land areas for limited, restricted or exclusive use); 16 U.S.C. § 1271 (declares that rivers with “outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values” shall be “protected for the benefit and enjoyment of present future generations.”).

¹⁸ See 16 U.S.C. § 1604(g)(3)(C) (requiring USFS to develop guidelines to ensure that there will be continuous monitoring and assessment of the effect of management systems to confirm that they do not produce substantial and permanent impairment of the productivity of the land); 36 C.F.R. § 219.2(b)(1) (describing the management planning process for the NFS as a “responsive planning process that informs integrated resource management and allows the Forest Service to adapt to changing conditions, including climate change, and improve management based on new information and monitoring”); 36 C.F.R. § 219.5 (describing USFS monitoring program guidelines); 54 U.S.C. § 100704 (directing NPS to undertake a program of inventory and monitoring for the National Park System); 43 C.F.R. § 1601.0-5(n)(8) (requiring BLM plans for public lands to include intervals and standards for monitoring and valuating the plan to determine its effectiveness); 50 C.F.R. § 31.1 (FWS guidelines for monitoring in wildlife refuges).

draft environmental impact statement or environmental assessment.¹⁹ In particular, through the scoping process, the manager should:

- a. Identify the most important ways in which climate change may affect natural resources in the management area, taking into account different climate change scenarios and how these could influence average conditions and the range of variability in the area;
 - b. Identify previous studies and assessments on how climate change may affect the management area, so that these can be incorporated by reference into the subsequent environmental review document;
 - c. Consider whether adaptation measures or environmental mitigation measures are needed to address the impacts of climate change and how these should inform the development of action alternatives;
 - d. Consider whether and how the effects of climate change may influence the purpose of, need for, or size or timing of the proposed action;
 - e. Solicit information from stakeholders regarding any data or local knowledge that is relevant for the purpose of assessing the impacts of climate change on natural resources and developing action alternatives and environmental mitigation measures to address those impacts; and
 - f. Use the “rule of reason” to determine the scope of the analysis for subsequent environmental review documents and to eliminate from detailed study those issues which are not significant.²⁰
2. Categorical Exclusions: Managers should consider whether and how the impacts of climate change may affect determinations that a particular class of actions will not have individually or cumulatively significant effects on the environment and should therefore be categorically excluded from environmental review.²¹

¹⁹ See 40 C.F.R. § 1501.7 (“Scoping”); CEQ, *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews*, 27 (2016) (guidance on scoping for climate change impacts).

²⁰ The “rule of reason” dictates that the scope of the environmental review should focus on information that is most useful to decision-makers and the public for the purpose of evaluating environmental impacts and making an informed decision about the proposal under review. This is implied by CEQ regulations, which require “[e]mphasizing the portions of the environmental impact statement that are useful to decisionmakers and the public and reducing emphasis on background material” and “[u]sing the scoping process, not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly.” 40 C.F.R. § 1508.7.

²¹ For example, BLM has a categorical exclusion for the issuance of livestock grazing permits and leases where the new permit/lease is consistent with the terms of the old lease and the allotment is either meeting land health standards or not meeting land health standards due to factors that do not include existing livestock grazing. DOI, Departmental Manual, Part 516, Ch. 11, § 11.9(D)(11) (2008). The BLM may want to revisit this categorical exclusion, particularly for grazing

3. **Environmental Assessments:** When preparing an environmental assessment, managers should evaluate how climate change may affect natural resources in the area, and determine whether these impacts have implications for:
 - a. The purpose and need for the proposed project;
 - b. The selection of alternatives;
 - c. The agency's determination of whether the proposed action may have significant environmental impacts; and
 - d. The efficacy of any mitigation measures, including but not limited to mitigation measures that are used to justify a finding of no significant impact (FONSI).²²

4. **Environmental Impact Statements:** When preparing an environmental impact statement, agencies should account for climate change in the following ways:
 - a. **Describe the impacts of climate change on the affected environment, including both near- and long-term impacts, under the no action baseline.** This discussion should encompass any significant impacts on natural resources in the management area, and should describe both the primary impacts (e.g., increases in precipitation or temperature), and the processes through which these impacts could affect the abundance, distribution, and health of natural resources, taking into account the vulnerability, resilience, and adaptive capacity of these resources.²³
 - b. **Describe how climate change may affect the proposed action and alternatives.** This discussion should encompass whether the impacts of climate change have implications for: (i) the purpose of and need for the proposal; (ii) the commitment of resources required to implement the proposed action and alternatives, and (iii) the efficacy of natural resource management activities included in the proposed action and alternatives. Managers should use this information to inform decisions about the design, location, and other features of the proposed action and alternatives.²⁴
 - c. **Describe how the effects described in (a) and (b) may have implications for the environmental consequences of the proposed action and alternatives.** This discussion should address whether proposed alternatives (and management components within each alternative) may exacerbate or alleviate adverse impacts of climate change on

allotments that are not meeting land health standards, since the combined effects of grazing and climate change can result in further deterioration of the allotment area.

²² See 40 C.F.R. § 1508.9 ("Environmental assessment"). See also CEQ, *Appropriate Use of Mitigation and Monitoring and Clarifying the Appropriate Use of Mitigated Findings of No Significant Impact* (2011).

²³ This is consistent with CEQ's guidance on accounting for climate change in NEPA reviews, which specifies that the "current and projected future state of the environment without the proposed action... should be described based on authoritative climate reports." CEQ Final Guidance (2016), *supra* note 19, at 20-21.

²⁴ See CEQ Final Guidance (2016), *supra* note 19, at 9.

natural resources or take advantage of beneficial impacts, and vice versa (e.g., whether climate change may exacerbate adverse impacts from the action).²⁵

- d. **Evaluate alternatives and management components based on environmental and adaptation objectives.** Based on the analysis described above, managers should consider which alternatives and management activities are most likely to advance environmental objectives (and, where appropriate, adaptation objectives). In conducting this analysis, managers should also consider whether the alternatives and management activities would yield climate mitigation co-benefits, such as through enhanced carbon sequestration, since climate change mitigation often also advances environmental and adaptation objectives.
 - e. **Identify whether there is a need for additional adaptation or environmental mitigation measures.** Managers should consider whether any additional measures—beyond those envisioned in the alternatives and their management components—could be implemented to adapt to the impacts of climate change or mitigate the environmental impacts of the proposed action. They should also consider whether climate change has implications for how environmental mitigation and restoration projects should be designed, sited, and implemented.
5. **Decision Document:** When issuing final decisions, managers should disclose whether and how their analysis of how climate change may affect the proposal and its environmental outcomes has influenced their final decision about the proposed action, and whether any adaptation or environmental mitigation measures may be implemented in response to concerns about the impacts of climate change.
 6. **Data sources:** Managers should clearly disclose the sources of data used in the climate change impact analysis, and should incorporate by reference the relevant scientific literature, data sources, models, and other resources used in the analysis. Whenever possible, managers should provide hyperlinks to these resources to allow the public to easily obtain them for further review. Managers should also use the best available scientific data in their analysis of climate change impacts.²⁶
 7. **Uncertainty:** Managers should disclose all assumptions that underpin their climate change impact analysis, and any major information gaps or areas of uncertainty. Agencies can address uncertainty by:
 - a. Describing impacts under a range of different scenarios, referring to the most recent Representative Concentration Pathways (RCPs) for greenhouse gas emissions that have

²⁵ See CEQ Final Guidance (2016), *supra* note 19, at 21-22.

²⁶ NEPA regulations require federal agencies to “insure the professional integrity, including scientific integrity, of the discussions and analyses in environmental impact statements” and to “identify any methodologies used and... make explicit reference by footnote to the scientific and other sources relied upon for conclusions.” 40 CFR § 1502.24.

- been released by the Intergovernmental Panel on Climate Change (IPCC), as well as any other relevant projections (such as sea level rise projections) that have been developed or adopted by authoritative bodies; and
- b. Where appropriate, considering past extremes as an indicator of future trends; and
 - c. Complying with the regulatory guidelines for dealing with “incomplete or unavailable information” in NEPA reviews.²⁷
8. Monitoring Mitigation Measures: If a manager decides to implement environmental mitigation measures in an area that may be affected by climate change, it should also conduct monitoring to gauge whether it should change its approach in light of new information about climate change or the efficacy of the mitigation measures.

²⁷ See 40 CFR § 1502.22.