

U.S. ENVIRONMENTAL PROTECTION AGENCY



REGION 5

# Climate Change Adaptation Implementation Plan

OCTOBER 2022

Great Lakes MODIS Image, by NOAA Great Lakes Environmental Research Laboratory

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## UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

SEP 12 2022



DEPUTY ADMINISTRATOR

## Preface

Climate change is threatening communities across the nation. Millions of Americans feel the destructive effects of climate change each year when the power goes down, rivers and lakes go dry, homes are destroyed by wildfires and communities are flooded by hurricanes. Underserved communities are especially vulnerable to the climate crisis and are more likely to experience the negative health and environmental effects of extreme weather events.

The Biden-Harris Administration is actively confronting the climate crisis while also advancing environmental justice. As part of a whole-of-government approach, the U.S. Environmental Protection Agency is strongly committed to taking the actions necessary to protect human health and the environment and to increase the resilience of the entire nation, even as the climate changes.

The EPA's commitment to action is reflected in its FY 2022-2024 Strategic Plan and in the 2021 Climate Adaptation Action Plan. Both documents present priority actions the agency will take to ensure that its programs, policies and operations remain effective under future climate conditions while we work to support states, territories, tribes and communities in increasing their own adaptive capacity and resilience to climate change impacts.

From flooding at Superfund sites, to wildfires causing air pollution, to sea-level rise affecting water quality and infrastructure, the EPA will boldly address climate impacts in both its programs and the communities it serves. We recognize the importance of tribal, state and local government partnerships in efficient, effective and equitable implementation of climate change adaptation strategies. Our plans were informed and improved by input we received in listening sessions we held to engage these and other partners as we developed these plans.

To ensure we are addressing the climate crisis in a comprehensive way, each of our national program and regional offices has developed individual Climate Adaptation Implementation Plans that outline how the EPA will attain the agencywide goals described in the broader Climate Adaptation Action Plan. These plans describe how programs and regions will integrate climate adaptation into their programs, partnerships and operations. They also

describe how they will help partners build their resilience and capacity to adapt, while delivering co-benefits, including curbing greenhouse-gas emissions and other pollution, and promoting public health, economic growth and climate justice. Of course, the EPA has a major role to play on emissions reductions as well, though that is not the focus of these plans. Indeed, we must focus on both climate adaptation and mitigation to ensure our nation and communities thrive in an era of climate change.

As part of this effort, we will empower our staff and partners by increasing awareness of how climate change may affect our collective ability to implement effective and resilient programs. We will also provide them with the necessary training, tools, data, information and technical support to make informed decisions and integrate climate adaptation into our work.

The EPA will work to modernize its financial assistance programs to encourage climate-resilient investments across the nation. We will also focus on ensuring that investments funded by the Bipartisan Infrastructure Law, the Inflation Reduction Act and other government programs are resilient to the impacts of climate change. Finally, as our knowledge advances and as impacts continue to develop, our response will likewise evolve. We will work to share these developments to enhance the collective resilience of our nation.

The actions outlined in these implementation plans reflect the EPA's commitment to build every community's capacity to anticipate, prepare for, adapt to and recover from the increasingly destructive impacts of climate change. Together with our partners, we will work to create a healthy and prosperous nation that is resilient to the ever-increasing impacts of climate change — which is vital to the EPA's goal of protecting human health and the environment and to ensuring the long-term success of our nation.



Janet G. McCabe



## **Message from the Region 5 Administrator & Great Lakes National Program Manager**

David Orr, Paul Sears Distinguished Professor of Environmental Studies and Politics Emeritus at Oberlin College in Ohio, has referred to climate change as “the long emergency.” By this, I believe he means that we humans, being biological animals, evolved to respond to imminent danger. When a predator appears, our adrenaline kicks in, and our bodies swiftly prepare to fight or flee. This reflexive response has served us well over millennia. Climate change, however, is a slow-growing emergency. We have known it’s coming for quite some time; we’ve been witnessing its symptoms; yet we are not responding in a manner that is commensurate with its threat. Neither our biological, psychological, or societal (meaning governance) systems have evolved along with us in a way that equips us to address the challenges that climate change poses to our health and global ecosystems.

The vulnerability assessments in this Climate Adaptation Implementation Plan provide a candid view of the many challenges facing Region 5 – high heat, heavy precipitation, and extended drought affecting utilities, homes, transportation, disease vectors, air quality and public health, to name but a few. This assessment of risks and vulnerabilities will aid us in understanding and addressing the challenges to our region – and in endeavoring to assist our local and state partners, and our own R5 operations, in adapting to these challenges. Through the implementation of the Priority Actions laid out in Region 5’s Plan, we will work to ensure climate change considerations are embedded into our programs with the goal of strengthening our adaptive capacity and that of our partners, while prioritizing the most vulnerable populations.

I can’t think of any more worthy task – and I am heartened by the way our Region 5 team is leaping to tackle it.

Debra Shore

## Tribal Treaty Rights

The Regional Tribal Caucus has identified protection of ceded territories as a priority for Tribal Nations in Region 5. EPA Region 5 will continue to implement the EPA *Policy on Consultation and Coordination with Indian Tribes: Guidance for Discussing Tribal Treaty Rights* when Agency actions may relate to ceded territories. In addition, the Regional Tribal Operations Committee will continue to explore opportunities for Tribal governments and EPA to partner to protect ceded territories, with particular attention given to the potential impacts of climate change on Tribal practices and rights that rely on specific plants and animals (such as wild rice or moose) being able to thrive within ceded territory.

Under the Constitution, treaties with tribal nations are part of the supreme law of the land, establishing unique sets of rights, benefits and conditions for the treaty-making tribes who were forced to cede millions of acres of their homelands to the United States, in return for recognition of property rights in land and resources as well as federal protections. Tribal treaty rights have the same legal force and effect as federal statutes and they should be integrated into and given the fullest consideration throughout EPA's collective work. Reserved rights are the rights tribes retain that were not expressly granted to the United States by tribes in treaties. Treaty and reserved rights, including but not limited to the rights to hunt, fish and gather, may be found both on and off-reservation lands. Agencies should consider treaty and reserved rights in developing and implementing climate adaptation plans in order to protect these rights and ensure the Agencies meet their legal and statutory obligations and other mission priorities as we work to combat the climate crisis.

In September 2021, EPA joined 16 other federal agencies in signing a [Memorandum of Understanding](#) (MOU) that committed those parties to identifying and protecting tribal treaty rights early in the decision-making and regulatory processes. Accordingly, EPA will consider and protect treaty and reserved rights in developing and implementing climate adaptation plans through strengthened consultation, additional staff training and annual reporting requirements.



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## Introduction

Climate change poses a real and present danger to communities across the country, and its impacts to human health, the environment, and our economy are becoming increasingly devastating. Between 1980 and 2020, there were 285 billion-dollar (CPI-adjusted) weather and climate disasters, including a record breaking 22 separate billion-dollar disasters in 2020 alone that cost the nation a combined \$95 billion in damages and caused 262 deaths.<sup>1</sup> The 1980-2020 annual average was 7.1 events; the annual average for the most recent 5 years analyzed by NOAA (2016-2020) was 16.2 events, demonstrating a substantial increase in billion-dollar disasters.<sup>2</sup>

On January 27, 2021, President Biden issued Executive Order 14008, [Tackling the Climate Crisis at Home and Abroad](#), which requires federal agencies to develop Climate Change Adaptation Implementation Plans that describe their agency's climate vulnerabilities and the steps it will take to bolster adaptation and increase resilience to the impacts of climate change. In May 2021, U.S. Environmental Protection Agency Administrator Michael Regan issued a policy statement on climate change adaptation that directed all EPA offices to proactively incorporate climate adaptation planning into the agency's programs, policies, rules, and operations, and to work with the EPA Office of Policy to complete or update Implementation Plans.

The EPA's [Climate Adaptation Action Plan](#) was publicly released in October 2021 and identified five climate adaptation priorities:

1. Integrate climate adaptation into EPA programs, policies, rulemaking processes, and enforcement activities.
2. Consult and partner with states, Tribes, territories, local governments, environmental justice organizations, community groups, businesses, and other federal agencies to strengthen adaptive capacity and increase the resilience of the nation, with a particular focus on advancing environmental justice.
3. Implement measures to protect the agency's workforce, facilities, critical infrastructure, supply chains, and procurement processes from the risks posed by climate change.
4. Measure and evaluate performance.
5. Identify and address climate adaptation science needs.

Building upon Region 5's first [Climate Change Adaptation Implementation Plan](#) published in 2014, the Region's Climate Adaptation Implementation Plan (CAIP) incorporates the most recent science, lessons learned, and the agency's five climate adaptation priorities.

## EPA Region 5 Office

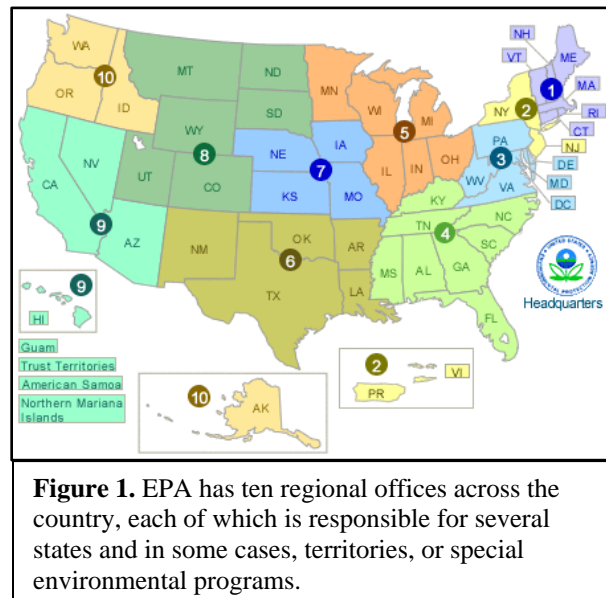
The EPA Region 5 Office is located in Chicago, Illinois and serves Illinois, Indiana, Ohio, Michigan, Minnesota, Wisconsin, and 35 Tribes (Figure 1). These states encompass over 388,000 square miles (10.2 percent of the nation's area),<sup>3</sup> share nearly 4,700 miles of freshwater shoreline,<sup>4</sup> and are home to 53.1 million residents (15.8 percent of the nation's population),<sup>5</sup> the second most populous among the 10 EPA regions. This region has a rich history of agricultural and industrial productivity, and technological innovation like the birth of the U.S. automotive industry.

All six states within EPA Region 5 enjoy a border along at least one of the North American Great Lakes, which are used as vital supplies of freshwater for agriculture, industry, shipping, recreation, and drinking water. Nearly 20 million U.S. residents and 8.5 million Canadians rely on the surface waters of the Great Lakes as their source of drinking water.<sup>6</sup>

The [Great Lakes National Program Office \(GLNPO\)](#) is co-located with the EPA Region 5 Office and coordinates U.S. efforts with Canada under the [Great Lakes Water Quality Agreement \(GLWQA\)](#) to restore and maintain the chemical, physical, and biological integrity of the Great Lakes Basin Ecosystem, which includes Lakes Superior, Michigan, Huron, Erie, and Ontario, their tributaries, and connecting waterways. GLNPO brings together federal, Tribal, state, local, and industry partners under the strategic framework of the Great Lakes Restoration Initiative (GLRI) to accomplish the objectives of GLRI action plan which in turn fulfills the aims of the GLWQA. Climate change impacts was identified as a priority by the U.S. and Canada and is designated as Annex 9 of the GLWQA, which established coordinated monitoring and reporting.

## Climate Adaptation Senior Leadership and Staffing

John Mooney, the EPA Region 5 Director of the Air & Radiation Division, is the designated Senior Career Leader for climate adaptation in Region 5. Kate Balasa is the lead staff contact for climate adaptation and represents Region 5 on the Cross-EPA Climate Adaptation Workgroup. Region 5 has a Climate Adaptation Team composed of representatives from each Division. The Region 5 Climate Adaptation Team and associated Region 5 staff were instrumental in developing this Climate Adaptation Implementation Plan and will be critical in its implementation.



## Vulnerability Assessment

Based on the latest National Climate Assessment,<sup>7</sup> this section briefly describes the climate change vulnerabilities to the Midwest geographic region and to the EPA Region 5 Office's programs, mission, facilities, and operations, and is organized by major program areas.

Limitations in the adaptive capacity and resilience of our partners, the disproportionate impacts climate change has on certain communities, and the costs associated with implementing changes are additional vulnerabilities for EPA across all program areas.

### At-Risk Communities and Populations

*The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment* states that “while all Americans are at risk, some populations are disproportionately vulnerable, including those with low income, some communities of color, immigrant groups (including those with limited English proficiency), Indigenous peoples, children and pregnant women, older adults, vulnerable occupational groups, persons with disabilities, and persons with preexisting or chronic medical conditions.”<sup>8</sup> For example, children are often more vulnerable to pollutants than adults due to differences in behavior and biology, that can lead to greater exposure and/or unique windows of susceptibility during development. The report also states, “Some groups face a number of stressors related to both climate and non-climate factors. For example, people living in impoverished urban or isolated rural areas, floodplains, coastlines, and other at-risk locations are more vulnerable not only to extreme weather and persistent climate change but also to social and economic stressors. Many of these stressors can occur simultaneously or consecutively. Over time, this ‘accumulation’ of multiple, complex stressors is expected to become more evident as climate impacts interact with stressors associated with existing mental and physical health conditions and with other socioeconomic and demographic factors.”

### Tribal Nations

The Region 5 Tribal and Multimedia Programs Office (TMPO) serves a dual purpose – helping Tribal governments in Region 5 work with EPA to build their own Tribal environmental program capacities and supporting Region 5 media divisions as they implement their statutory responsibilities in Indian country. TMPO works with each Tribal government to develop an EPA-Tribal Environmental Plan (ETEP) which outlines the tribe's priorities for building environmental program capacities. EPA supports these capacity-building priorities primarily through the Indian Environmental General Assistance Program (IEGAP), which provides funding and technical assistance. In addition to administering IEGAP in Region 5, TMPO also works with Tribal government staff to engage with the various EPA Divisions and Offices in response to environmental and public health issues facing their communities. This assistance can involve locating technical information, identifying EPA program assistance to address specific

Tribal needs, connecting Tribal and EPA technical staff, identifying and coordinating training, and strategic planning for environmental program development.

TMPO also works with the media Divisions to ensure that EPA's regulatory responsibilities are implemented in Indian country in accordance with the [1984 EPA Indian Policy](#). TMPO provides training to Divisions on working effectively with Tribal governments, tracks the status of EPA's implementation activities, and assists the media Divisions with Tribal consultation, coordination, outreach, and communication.

TMPO is always seeking ways to better integrate Tribal and federal environmental programs and addressing climate change is a critical area to invest in our partnership. As Tribes plan for and address climate change impacts to their communities, their environmental programs will likely need to enhance or add specific capacities. As part of this work, Tribal environmental programs will reach out to EPA for financial and technical assistance to retool their programs to meet these new threats and needs. TMPO must be prepared to respond to different and/or novel requests for assistance. Challenges that TMPO may face related to climate change could include:

- Tribes will want to use IEGAP funding to address climate change impacts. Region 5 will need to advise Tribal governments on the types of climate-change related activities that are eligible for support.
- Tribal environmental programs that have limited staff may request direct assistance from EPA to plan for and implement climate change adaptation projects or programs. TMPO will need to determine what types of direct technical assistance Region 5 may be able to offer, both through TMPO and through the media Divisions.
- More extreme weather will likely result in more severe natural disasters that may impact facilities and sites in Indian country that EPA has regulatory primacy over. TMPO may be contacted first by Tribal governments, requesting EPA assistance for response and remediation, and will need to be prepared to provide information on EPA roles and potential assistance and be able to coordinate efficiently with the media Division.
- There may be cumulative impacts from a changing climate that adversely affect Tribal lands and treaty areas, making them more vulnerable to pollution. Tribes will look to EPA to ensure that environmental standards, permitting, enforcement, and other Agency actions are more protective. TMPO will need to assist with meaningful consultation and coordination between Region 5 and Tribal governments to ensure the Agency is fully meeting its trust responsibilities.
- TMPO should be prepared to assist Region 5 media Divisions to develop ways to identify and integrate Traditional Ecological Knowledge into their decisions, consistent with EPA's authority under federal law, including work related to climate change.

Examples of recent events or situations where Tribal governments in Region 5 have needed to respond to impacts related to climate change:

- Over a two-day period in July 2016, heavy rains fell in northern Wisconsin resulting in a disaster declaration for numerous counties and the Bad River Band reservation. About 1,500 residents of the reservation were affected in four different communities. Approximately 590 homes were damaged or destroyed, roadways were washed out making for difficult travel, and utilities were disrupted. Some Tribal citizens were airlifted by helicopter to receive medical treatment.
- High water levels in Lake Superior and extreme storm events in the summer and fall of 2019 caused major shoreline erosion on the Keweenaw Bay Indian Community (KBIC) L'Anse reservation. The eroding shoreline left an active underground storage tank system exposed, increasing the risk for a release to Keweenaw Bay.
- Wildfires associated with climate change in the western United States and throughout Canada in 2021 resulted in elevated levels of particulate matter (PM) noted in PM2.5 monitors operated by Tribes in Region 5. These off-reservation sources of pollution are a concern for Tribal citizens.
- On-going substantial fluctuations in water levels around the Great Lakes Basin have had significant adverse impacts on the viability of Manoomin (wild rice), a species of great cultural, economic, and subsistence importance to many Tribes in Region 5.

### **Communities with Environmental Justice Concerns**

Climate change directly and indirectly impacts human health. Midwestern populations are already experiencing adverse health impacts from climate change, and these impacts are expected to worsen in the future. The risks are especially high for people who are less able to cope because characteristics such as age, income, or social connectivity make them more vulnerable.

The Fourth National Climate Assessment<sup>9</sup> states how climate change affects vulnerable communities in the Midwest region.

- Increased daytime and nighttime temperatures are associated with heat-related diseases (for example, dehydration and heatstroke) and death in the Midwest. Extreme heat in urban centers like Chicago, St. Louis, Cincinnati, Minneapolis/St. Paul, Milwaukee, and Detroit can cause dangerous living conditions. High rates of heat-related illness also have been observed in rural populations, where occupational exposure to heat and access to care is a concern. Exposure to high temperatures impacts workers' health, safety, and productivity.
- Compared to other regions where worsening heat is also expected to occur, the Midwest is projected to have the largest increase in extreme temperature-related premature deaths under the higher scenario: by 2090, 2,000 additional premature deaths per year, compared to the base period of 1989–2000, are projected due to heat alone without adaptation

efforts. Northern midwestern communities and vulnerable populations that historically have not experienced high temperatures may be at risk for heat-related disease and death.

- Unabated climate change will translate into costs among the workforce and in utility bills, potentially exacerbating existing health disparities among those most at risk. By 2050, increased temperatures under the higher scenario (RCP8.5) are estimated to cost around \$10 billion (in 2015 dollars) due to premature deaths and lost work hours. Increased electricity demand is estimated to amount to \$1.2 billion by 2090 (in 2015 dollars). For those who are chronically ill or reliant on electronic medical devices, the increased cost of electricity, which contributes to energy insecurity, may introduce financial and health burdens.
- Higher temperatures, more variable precipitation patterns, and changes in lake levels will likely increase vulnerability to extreme events (including flooding, drought, heat waves, and more intense urban heat island effects), compounding non-climate stressors such as economic downturns, shrinking cities, and deteriorating infrastructure.<sup>10</sup>
- Attempts to assess vulnerabilities, especially for poor urban communities, face persistent environmental and social justice barriers, such as lack of participation and historical disenfranchisement, despite evidence that these communities are going to be disproportionately affected by climate impacts.

The White House Environmental Justice Advisory Council advises on how to increase the Federal Government's efforts to address current and historic environmental injustice through strengthening environmental justice monitoring and enforcement. The *May 13, 2021 Final Interim Recommendations* provided specific challenges and recommendation for a "whole of government" approach to environmental justice.<sup>11</sup> As climate change cuts across all programs this recommendation will require several government agencies coming together and working in tandem to address the major sustainability problems of entire communities. To support this approach, inter- and intra-agency coordination will provide for a more cohesive strategy for addressing environmental injustice.

## **Air Quality**

Climate change and air pollution are critical environmental issues that can have adverse effects on each other. Although tremendous progress has been made in improving air quality, air pollution remains a challenging problem. Many of the impacts from climate change - including increased summer temperatures, increased wildfires, changes in precipitation, and severe weather events - are likely to impact both ambient and indoor air quality within the Midwest states. These impacts will present new challenges to Region 5 and its partners to ensure the continued protection of public health and the environment.

**Tropospheric ozone pollution is likely to increase in certain regions because of climate change:** Tropospheric, or ground-level ozone, is created by photochemical reactions of short-

lived pollutants in the atmosphere. Emissions from industrial facilities, electric utilities, motor vehicles, chemical solvents, controlled agricultural burning, and oil and gas production are some of the major sources of these pollutants in Region 5. High temperatures and regional air stagnation associated with climate change may lead to more ozone formation, even with the same level of emissions.

Increases in tropospheric ozone due to climate change may require greater pollution controls to attain or maintain the ozone National Ambient Air Quality Standard (NAAQS). Region 5 works with partners at the Tribal, state, and local levels to meet this standard through State Implementation Plans (SIPs) and other measures. These efforts may need to be adjusted as climate change progresses. Although Region 5's adaptive capacity concerning this impact is dependent on national standard-setting efforts, there are some points of leverage and voluntary programs such as [EPA's Advance Program](#) that can be utilized.

**Particulate Matter (PM) levels are likely to be affected through changes in frequency and intensity of wildfires and droughts:** Climate change may affect PM levels through changes in the frequency or intensity of wildfires and the effects of drought on the land. Wildfires are already increasing within the region and are likely to intensify in a warmer future with drier conditions. Drought can also cause wind-borne dust or PM during high wind events in agricultural areas during the land preparation (tilling, fertilizing, and planting) period.

Increased PM due to wildfires, drought, and high winds may present challenges in attaining or maintaining the PM NAAQS, especially if these events are not considered "exceptional events," which are exempt from certain regulatory actions under the Clean Air Act and the NAAQS. Moreover, the projected rise of exceptional event package submissions may result in additional workloads related to attainment designations. These PM-related climate impacts could complicate regional efforts to reduce public health risks, particularly for vulnerable populations, and may require the utilization of voluntary measures, as Region 5 and its partners adapt to this impact.

**Climate change may worsen the quality of indoor air and increase exposure to contaminants:** Climate change may not only exacerbate existing indoor environmental problems but introduce new ones due to warmer temperatures and an increased frequency and/or severity of extreme weather events. Temperature increases may affect the emergence, evolution, and geographic ranges of pests, infectious agents, and disease vectors, which in turn may lead to shifting patterns of indoor exposure to pesticides as occupants respond to new infestations. Additionally, heavy precipitation associated with extreme weather events may contribute to increased flood events and the risk of mold in buildings. The extreme weather events and prolonged periods indoors may increase an occupant's exposure to environmental asthma triggers and other biological contaminants, as well as emissions from building materials. The health risks and impacts from poor indoor air quality may be greater for susceptible populations - the young, the elderly, the chronically ill, communities with environmental justice (EJ) concerns, and socioeconomically disadvantaged populations across the region.



Residents may weatherize buildings to increase comfort, indoor environmental quality, and energy efficiency. Although in general these actions should be encouraged, this may lead to a reduction in ventilation and an increase in indoor environmental pollutants unless measures are taken to preserve or improve indoor air quality. EPA has developed practical guidance for improving or maintaining indoor environmental quality during home energy upgrades or remodeling for single-family homes and schools. This guidance may need to be revised to include considerations for these projected climatic changes, and relevant workers (building managers, contractors, etc.) may need training on proper techniques for maintaining or improving indoor environments.

Region 5 can utilize various EPA programs, tools, resources, and partnerships such as the Indoor Air Quality and Radon Programs, Healthy Homes, and Healthy Schools initiatives, to adapt to this impact.

**Climate change may affect the response of ecosystems to the atmospheric deposition of sulfur, nitrogen, and mercury:** While there is limited scientific evidence on this topic, additional research is underway to better understand how patterns in the atmospheric deposition of sulfur, nitrogen, and mercury with projected changes in the climate and carbon cycle will affect ecosystem growth, species changes, surface water chemistry, and mercury methylation (a natural process which makes mercury biologically available to fish and humans) and bioaccumulation. Increased concentrations of sulfates, nitrates, and mercury could cause adverse effects on ecosystems throughout the region as well as mercury contamination levels in lakes, rivers, and streams. The relative importance of these effects on the Region 5 states is still to be determined; however, there may be opportunities to adapt to this climate change impact through partnerships and public education.

## **Water Quality**

Climate change poses several challenges to drinking water, wastewater, and storm water systems in the Midwest. Annual precipitation in the Midwest has increased by 5 percent to 15 percent from the first half of the last century (1901-1960) compared to present day (1986-2015). Winter and spring precipitation are important to flood risk in the Midwest and are projected to increase by up to 30 percent by the end of this century. Heavy precipitation events in the Midwest have increased in frequency and intensity since 1901 and are projected to increase through this century.

There has been an increase in extreme precipitation events that overwhelm storm water sewage systems, disrupt transportation networks, and cause damage to infrastructure and property. Runoff from extreme precipitation events can exceed the capacity of storm water systems, resulting in property damage, including basement backups. In addition, in metropolitan areas with older sewer systems that combine sanitary sewage with storm water, extreme rain can result in the release of raw sewage into rivers and streams, posing both health and ecological risks. These releases, known as combined sewer overflows (CSO), pose challenges to major sources of

drinking water including the Mississippi River and the Great Lakes. On the Great Lakes, increases in CSO frequency and volume are projected under mid-high and higher scenarios (RCP6.0 and RCP8.5). The EPA estimates that the cost of adapting urban storm water systems to handle more intense and frequent storms in the Midwest could exceed \$480 million per year (in 2015 dollars) by the end of the century under either the lower or higher scenario (RCP4.5 or RCP8.5).

An increase in localized extreme precipitation and storm events can lead to an increase in flooding. River flooding in large rivers like the Mississippi, Ohio, and Missouri Rivers and their tributaries can flood surface streets and low-lying areas, resulting in drinking water contamination, evacuations, damage to buildings, injury, and death. Precipitation events can transport pathogens that cause gastrointestinal illnesses, putting populations who rely on untreated groundwater (such as wells) at an increased risk of disease, particularly following large rainfall events. Many midwestern communities use wells as their drinking water sources. Adaptive measures, such as water treatment installations, may substantially reduce the risk of gastrointestinal illness, despite climate change.

These precipitation extremes cause excessive runoff and soil erosion, which directly impacts agricultural fields and soil health. Degraded soils not only impact crop production may also impact downstream water quality by increasing nutrient loads, which can lead to eutrophication and hypoxia in surface waters.

An example of these increased nutrient loads is the steady increase of harmful algal blooms (HABs) in western Lake Erie over the past decade. Warmer temperatures and heavy precipitation associated with climate change lead to increased nutrients, which contribute to the development of HABs. Harmful algal blooms can introduce cyanobacteria into recreational and drinking water sources, resulting in restrictions on access and use. Conditions that encourage cyanobacteria growth, such as higher water temperatures, increased agricultural and stormwater runoff, and nutrient-rich habitats, are projected to increase in the Midwest.

Across the Nation, much of the critical water infrastructure is aging and, in some cases, deteriorating or nearing the end of its design life, presenting an increased risk of failure. Estimated reconstruction and maintenance costs aggregated across dams, levees, aqueducts, sewers, and water and wastewater treatment systems total in the trillions of dollars based on a variety of different sources.

## **Great Lakes National Program Office**

Changes in average temperature and precipitation patterns have begun to have noticeable impacts on the Great Lakes ecosystem. For example, extreme storm events have sometimes resulted in unprecedented sediment inputs to the lakes, ice cover on the Great Lakes has been declining thereby increasing evaporation in winter, and Lake Superior saw its first confirmed rare algal blooms in 2012, with a subsequent major bloom in 2018. Heightened storm intensities are

increasing flooding, combined sewer overflows, beach closures, waterborne diseases, wildfires, and other stressors on the Great Lakes ecosystem. These trends are likely to continue.

These and other climate vulnerabilities threaten EPA's ability to achieve the objectives of the Great Lakes Restoration Initiative (GLRI) and fulfill the commitments of the Great Lakes Water Quality Agreement of 2012 (GLWQA).

Flooding and streambed scouring from intense precipitation events may affect Great Lakes Legacy Act (GLLA) sediment remediation projects. Intense rain events may resuspend and disperse contaminants making clean-ups more difficult. Climate impacts will affect the design and implementation of future GLLA projects.

Climate impacts are also increasing the potential for aquatic invasive species to enter, establish, expand, and/or cause harm in the Great Lakes, thereby putting pressure on GLRI efforts to monitor, prevent and control those invasives, and possibly requiring new priorities, new approaches, and/or increased costs.

Together with increasing water temperatures, which can promote the growth of harmful algal blooms, increased nonpoint source nutrient loads are contributing to harmful algal blooms and other nearshore health impacts, making it harder to achieve nutrient load reduction targets under GLWQA.

Coastal habitat restoration projects under GLRI and related efforts to protect critical native species are being challenged by lake level changes, heavy precipitation events, warming waters, changes in streamflow, decreasing ice cover, longer stratification periods and other climate impacts. These impacts may:

- Spark new design and cost considerations;
- Require additional analyses and tools;
- Require new approaches; and
- Result in changing restoration priorities.

GLNPO's federal partners, Tribal governments, states, and other partners under GLRI will face increasing pressure to address local climate impacts to Great Lakes resources, which may increase pressure on GLRI programs and funding sources. GLNPO may also face an increased workload in helping them develop and implement climate resilient GLRI projects.

## **Enforcement and Compliance Assurance**

The EPA derives its authority to act from the laws passed by Congress. The Agency is committed to ensuring that its actions are constitutional, authorized by statute, consistent with Congress's vision and intent, and otherwise legally supported. Congress has given the Agency the broad mandates to protect human health and the environment. This mandate affords the Agency with the broad legal authority to support climate change adaptation work. Specific questions, however, may arise during the course of adaptation planning and implementation that cannot be answered without a legal review of Agency policies and/or guidance as well as court

precedents. Region 5 Divisions and Offices and Office of Regional Counsel will continue to work closely on matters related to climate change adaptation.

Within this broad framework, the Region 5 Enforcement and Compliance Assurance Division (ECAD) is responsible for developing and implementing regional enforcement and compliance assurance programs. ECAD works closely with the other Region 5 Divisions, Office of Regional Counsel (ORC), Criminal Investigations Division (CID), and Department of Justice (DOJ) to deliver a comprehensive enforcement and compliance assurance program utilizing the entire spectrum of compliance assurance tools available to the region. The program includes:

- developing strategic planning for enforcement;
- engaging in compliance monitoring and compliance assistance activities;
- conducting inspections;
- developing enforcement cases;
- preparing and issuing administrative actions;
- assessing penalties;
- developing judicial enforcement action;
- negotiating settlements, and
- measuring and reporting results of the Region's enforcement efforts.

Escalating risk and noncompliance due to climate change impacts require that ECAD and the regulated community adapt to changing conditions caused by climate change. The increasing frequency of climate-driven extreme events including heavy precipitation events, tornadoes, flooding, rising or fluctuating lake levels and wildfire lead to power outages and general infrastructure challenges in Region 5. Region 5's regulated community needs to be as resilient as possible to prevent harm to human health and the environment by reducing noncompliance with environmental regulations and requirements both during extreme events, and as climate conditions change. ECAD needs to employ enforcement tools and authorities that allow us to urge the regulated community to begin adapting their compliance systems so that they can address more extreme conditions and avoid harm to human health and the environment.

EPA's historic use of enforcement discretion for violations caused by "Unforeseen Circumstances" or "Acts of God" is a key element that needs to be continuously examined as increasingly severe events become the "new normal" of climate change. ECAD must remain flexible in its use of enforcement discretion to ultimately assure more compliance by encouraging adaptation by the regulated community to prevent escalating harm to human health and the environment. As part of this effort, staff focus might shift to both climate driven violations and risk, as well as compliance assistance and risk communication.

It is anticipated that the impacts of climate change will lead to increasing claims of force majeure. A "force majeure" clause is a contract provision that relieves the parties from performing their contractual obligations when certain circumstances beyond their control arise, making performance inadvisable, commercially impracticable, illegal, or impossible. These

clauses often arise in enforcement mechanisms, like a consent decree, and can free the responsible party from liability or obligation when such an event occurs. With climate change causing more such events the foreseeability of these events may become increasingly challenging to determine. At a minimum, it is to be expected that the regulated community will assert this claim more and more frequently.

As increases in violations in specific programs and industry are identified, ECAD must be ready to shift its enforcement focus to address these violations. And as extreme events increasingly occur, ECAD must build the capacity to respond to these situations and utilize its discretion to continuously focus its resources and its enforcement priorities as necessary to protect human health and the environment. ECAD may need to shift normal duties of staff to address more urgent, and continuously changing work requirements. ECAD works closely with its state counterparts. This is especially true in the case of authorized or delegated state programs. And as state officials face these same challenges, ECAD, in its oversight and assistance role may come under resource pressure to address appropriate response and assistance to the states.

Generally, climate change will present increasingly challenging enforcement scenarios, with shifting federal and state priorities. ECAD will need to remain flexible in addressing legal and enforcement issues as they arise. It will do this in consultation with the Office of Regional Counsel (ORC), as well as with the Office of General Counsel (OGC) and the Office of Enforcement and Compliance Assurance (OECA), as necessary.

## **Waste Management and Remediation Sites**

Despite ongoing progress in cleaning up contaminated sites and ensuring the safety of industrial facilities, climate change can exacerbate the already toxic conditions at contaminated sites, including polychlorinated biphenyl (PCB) cleanup sites subject to the Toxic Substances Control Act (TSCA), and can disrupt existing cleanup remedies. Flooding from more intense and frequent storms may lead to contaminant releases from Corrective Action sites, Superfund sites, Brownfield sites and other waste management sites. These sites are often in or near overburdened and underserved communities. These communities are likely to bear greater risks and burdens from climate-driven extreme events and to have a harder time recovering. Remedy resiliency is the challenge climate change presents at contaminated sites.

Region 5 has the most National Priorities List sites with 327. Climate change may impact our removal, remedial and other waste management sites in many ways including:

- Vegetation considerations to ensure plants are tolerant to heat or excessive water. This could also result in additional resources during the operation and maintenance of remedies.
- Drier conditions may cause severe erosion issues on terrain and constructed landfills. Landfills adjacent to rivers may experience significant erosion issues during high flow events.

- Frequent flooding may require the need to design more robust caps and armoring to remain effective against increased flooding. High flood events might wash away constructed remedies and increase contamination to the environment. Standing water could bring contaminants to the surface and increase exposure potential.
- Increased generation of debris and wastes requiring management due to flooding, tornadoes, or other storm events. Climate change is expected to produce more frequent and powerful natural disasters, which will increase the number of disaster-related wastes.
- Current controls and management standards for permitted treatment, storage, and disposal facilities across Resource Conservation and Recovery Act (RCRA) Construction & Demolition programs may not adequately factor in the climate impacts, possibly leading to increased risk of contaminant release or odors from waste management facilities. Authorized/approved state programs may not factor in climate impacts.
- Current solid waste and recycling infrastructure may not be sufficient to appropriately manage all the debris generated by storms or other climate impacts.
- Increased odor issues at solid waste disposal sites due to flooding.
- Fluctuations in the water table could cause contamination plumes to change direction and impact the effectiveness of containment and treatment systems.
- Erratic weather could impact construction seasons. Investigations and remedies may take longer to implement.
- Increased sedimentation and scouring due to larger rain events could impact sediment sites.
- Population densities along rivers in the Midwest and increased precipitation may lead to increased riverine flooding and the generation of additional hazardous waste and domestic white goods (refrigerators, stoves) requiring cleanup.
- The frequency of events may stress the availability of emergency response teams to react quickly.
- Erratic weather, hotter summers and colder winters may result in health and safety considerations for the workers implementing clean up actions.

Region 5 remedial sites undergo an evaluation of the effectiveness of the remedy every 5 years. During this review climate impacts are evaluated to ensure our remedies remain protective of human health and the environment. Climate impacts can also be evaluated when permits are renewed for waste management sites by Region 5 and/or the State.

### **Chemical Safety and Pollution Prevention**

Climate change impacts specific to EPA Region 5 can increase the likelihood of exposure to a wide range of chemicals. According to [EPA's Toxic Release Inventory \(TRI\)](#), the region had received reports from over 5,000 facilities, across all six states, regarding industrial facility "releases" of toxic chemicals occurring in 2020.<sup>12</sup> Throughout the region, flooding from more intense and frequent storms, and extreme temperatures can affect the presence and concentration of chemicals in the environment. More specifically, regional risk assessments could vary from those previously recorded as weather and climate events influence RCRA/TSCA and Superfund

interpretations of risk at the facility level. Particularly near sites with large densities of chemical Manufacturers, Processors and Formulators (MPFs), RCRA and Superfund sites involving permitting and planning activities, facilities may not have previously required an awareness for water releases, or risk management for water/flooding. In addition, reporting of chemical spills and emergency releases is expected to increase via the [National Response Center](#).

Extreme temperatures and changing weather patterns can impact crop growth not only through the onset of pests, but also weeds, fungus, and other ailments that can impede crop production and threaten food security in the Midwest. As climate change brings pests into new areas, the use of crop protection tools will increase, such as pesticides, herbicides, and fungicides. Without proper pesticide application and management, this may lead to more chemicals present in soil and water. Chemical safety can be affected by changing chemical use patterns resulting from climate change. For example, an increase in the frequency of new or foreign pest problems could cause requests for exemptions under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) if currently registered pesticides are ineffective.

### **EPA's Facilities and Operations**

Increased frequency and severity of extreme weather events can affect the agency's personnel health & safety, facilities, water management, transportation shutdowns, product and service delays, and emergency response support.

The impacts of climate change pose health risks to the human population, causing people to take more time off or become unable to work. Region 5 could face delays in completing core and mission critical work as the availability of staff is impacted by health risks. Poor air quality, fires, floods, and other extreme events will lead to an increase in safety hazards while performing field work. This will result in more work-related injuries and illness for Region 5 personnel. Region 5 may experience more frequent and extended facility interruptions as extreme weather events increase. In addition, changes in water supply or quality can impact Region 5's ability to manage water in all regional facilities, including challenges related to important laboratory analyses conducted by Region 5's Analytical Services Branch (ASB). Climate change will impact global supply chains, increasing the likelihood that Region 5 will experience product and service delays. Regional transportation shutdowns caused by climate change will impact the ability for Region 5 staff to commute to the regional building and the ASB (both located in the City of Chicago). Lastly, there will be a higher demand for emergency response support as the frequency of national disasters increase. This will impact the availability of Region 5 personnel and resources to support emergency response or cause delays in core regional work.

## Priority Actions

Region 5 will continue to integrate climate change adaptation and resiliency into its existing programs and identify new opportunities to increase adaptive capacity and resiliency as regulations change, new initiatives and priorities are instituted, and funding opportunities are identified. Region 5's Priority Actions align with the five agency-wide priorities outlined in the 2021 *EPA Climate Adaptation Action Plan*:

1. Integrate climate adaptation into EPA programs, policies, rulemaking processes, and enforcement activities.
2. Consult and partner with states, tribes, territories, environmental justice organizations, community groups, businesses, and other federal agencies to strengthen adaptive capacity and increase the resilience of the nation, with a particular focus on advancing environmental justice.
3. Implement measures to protect the agency's workforce, facilities, critical infrastructure, supply chains and procurement processes from the risks posed by climate change.
4. Measure and evaluate performance.
5. Identify and address climate adaptation science needs.

Region 5's Priority Actions rely on partnerships with tribal, state, and municipal governments, as well as non-governmental organizations. For example, local decisions about facility siting may need to consider implications related to climate change vulnerability that cannot be adequately addressed through permit conditions alone. These Priority Actions are extensions of existing or planned program actions which are tailored to address climate change vulnerabilities, and include efforts related to technical assistance, outreach, and building adaptive capacity.

## Climate Adaptation and Financial Mechanisms

Region 5 will take steps to ensure the outcomes of infrastructure investments using Infrastructure Investment and Jobs Act (IIJA, or Bipartisan Infrastructure Law [BIL]) funds are resilient to the impacts of climate change. Region 5 will explore opportunities to integrate climate change considerations into its financial assistance programs in order to expand support for projects that increase climate resilience while delivering co-benefits for public health, the mitigation of greenhouse gases, and the reduction of other pollution. [XXX] will also provide technical assistance to recipients of BIL funds to help them make climate smart infrastructure investments.

The Infrastructure Investment and Jobs Act (IIJA, or Bipartisan Infrastructure Law [BIL]) is a historic investment in the water infrastructure improvements, pollution cleanup initiatives, and workforce opportunities necessary to transform communities around the country. Much of the federal assistance provided through BIL will scale up EPA's existing grant and loan programs, such as the State Revolving Fund Programs and Brownfields Grants. It will also be delivered through the creation of new low-interest financing programs, primarily for tribes and rural or



disadvantaged communities. With this significant influx of capital from BIL, it will be more important than ever for EPA – and our state, tribal, and local partners – to invest in resilient infrastructure projects that withstand climate change for decades to come.

EPA’s National Program and Regional Offices will work through the programs that received BIL funding to encourage resilient infrastructure outcomes across the country. Internally, EPA is taking steps to consider how its policies, operations, and program activities can be better aligned to accelerate resilient infrastructure projects, with an emphasis on the most vulnerable communities. EPA will take steps to ensure that its financial assistance programs support resilient infrastructure investments that consider anticipated climate change impacts. It will also be critical that EPA’s technical assistance programs are readily accessible to stakeholders as they take intermediate steps to make climate-informed infrastructure investments. EPA will support its external partners by providing technical assistance opportunities for BIL-funded projects to help build their adaptive capacity. Consistent with the Agency’s Climate Adaptation Action Plan, EPA’s Offices will seek opportunities to engage with other federal agencies, external partners, and federal funding recipients to achieve climate-resilient infrastructure.

*Priority Actions*

Beginning in FY22 and continuing through FY23, Region 5 will prioritize the following suite of actions for targeted investment and assessment, in addition to the broad array of existing climate actions already underway:

<b>1. Establish a cross-regional Climate Change Workgroup to collaboratively address climate vulnerabilities and implement priority actions identified in the R5 CAIP and other key plans.</b>	
<i>Lead</i>	Senior Career Leader and Regional Climate Adaptation Coordinator
<i>Fiscal Year Start - Complete</i>	2022
<i>Performance Metric</i>	Establish workgroup by end of FY22
<i>Associated Vulnerability</i>	All vulnerabilities impacting the Region
<i>Co-benefits</i>	Environmental protection
<i>Resource Requirement</i>	Can accomplish with existing resources

<b>2. Workforce Protection: In order to provide greater protection for our workforce, Region 5 will increase awareness of hazard recognition, risk mitigation tools, Health and Safety Plan (HASP) Development, and EPA’s Job Hazard Analysis (JHA) tool through training opportunities</b>	
<i>Lead</i>	MSD – ESB
<i>Fiscal Year Start - Complete</i>	2023 – ongoing
<i>Performance Metric</i>	- 2.9 or lower Occupational Health Administration (OSHA) incident rate each year. - To achieve this, 85% of Region 5 field staff should attend an annual JHA/HASP awareness training course.
<i>Associated Vulnerability</i>	An increase in work-related injuries and/or illnesses.
<i>Co-benefits</i>	Public health protection
<i>Resource Requirement</i>	Can accomplish with existing resources.

<b>3. Facilities Protection: Increase water management awareness for staff and consult with the General Services Administration (GSA) on potential water conservation projects by implementing a water conservation project in one of Region 5’s facilities each year</b>	
<i>Lead</i>	MSD – ESB
<i>Fiscal Year Start – Complete</i>	2023 – ongoing
<i>Performance Metric</i>	- 1 new water conservation project completed in one of Region 5’s facilities each year; - 10% of Region 5 staff attends annual water conservation awareness training.
<i>Associated Vulnerability</i>	Drought
<i>Co-benefits</i>	Water conservation
<i>Resource Requirement</i>	Can accomplish with existing FTE

<b>4. Support states and Tribes to assess and fund climate resilient drinking water and wastewater infrastructure</b>			
<i>Subcomponents</i>	<b>4.1</b> Increase engagement with states for use of state revolving funds (SRFs) and infrastructure dollars for green infrastructure and climate resiliency	<b>4.2</b> Assist Tribes by developing and/or updating Source Water Protection Plans and Asset Management Plans/Programs for Tribal Community Water Systems	<b>4.3</b> Ensure use of contemporary data to reflect current receiving water and precipitation conditions in NPDES programs
<i>Lead</i>	State and Tribal Programs & Support Branch	Groundwater & Drinking Water Branch	Permits Branch
<i>Fiscal Year Start-Complete</i>	2022-ongoing	2023-ongoing	2023-ongoing
<i>Performance metric</i>	6 discussions with state SRF programs on climate at annual reviews each FY	1 Source Water Protection Plan or Asset Management Plan/Program for Tribal Community Water Systems revised/developed each fiscal year	For each State NPDES program, Permits Branch will identify the (1) publication date of critical low flow statistics, (2) publication date of precipitation statistics data, and (3) references and methods used to estimate

			background ambient water temperature in NPDES permit development (3 data points for each state is 18 data points) for FY23.  PB will work with states in the Region each fiscal year beginning not later than FY24 to ensure State NPDES programs (i.e., rules, policy, or practice) use contemporary statistics and references, and appropriate methods, based on the prior assessment. (goal is at least 2 per year and builds on FY23 work)
<i>Associated Vulnerability</i>	Extreme weather events (e.g., flooding, heavy rain), CSOs, damage to infrastructure	Impacts to drinking water sources and water system assets.	Protection of designated uses
<i>Co-benefits</i>	More efficiency at WWTP to handle influent during storms, assistance to partners, climate-ready workforce and facilities	Better financial planning, public health	Public health
<i>Resource requirements</i>	Existing resources are available to implement this activity	Existing resources are available to implement this activity	Existing resources are available to implement this activity

<b>5. Develop a resource sheet for GAP recipients that explains how Region 5 Tribal and Multi-media Programs Office (TMPO) can support climate change assessment and adaptation work and provides examples of activities/grant deliverables</b>	
<i>Lead</i>	Tribal and Multi-media Programs Office (TMPO)
<i>Fiscal Year</i>	2022-2023
<i>Performance Metric</i>	Tribal and Multi-media Programs Office (TMPO) will work with the Regional Indian Workgroup (RIWG) to develop a resource sheet that describes how the Indian Environmental General Assistance Program can be used to support climate change assessment and adaptation work, including examples of eligible grant activities and potential EPA technical assistance. TMPO will share the final document with Tribal governments in the first quarter of FY23.
<i>Resource Requirement</i>	Existing resources are available to implement this activity
<i>Vulnerability</i>	There may be cumulative impacts from a changing climate that adversely affect Tribal lands and treaty areas, making them more vulnerable to pollution.
<i>Co-benefits</i>	Supports EPA Strategic Plan long-term performance goal to assist federally recognized Tribes to act on climate change.  Inform Region 5 cross-program planning for direct implementation and technical assistance work with Tribes to address climate assessment, adaptation, and mitigation in grants; and to inform future development of cross-program capacity to support this work.

<b>6. Provide trainings to Region 5 Tribes to address climate change impacts on Tribal lands, which may include Tribal Disaster Debris Management Training</b>	
<i>Lead</i>	Superfund & Emergency Management Division (SEMD)
<i>Fiscal Year Start – Complete</i>	2022-Ongoing
<i>Performance Metric</i>	On-Scene Coordinators (OSCs) will lead trainings for Region 5 Tribes to address climate change impacts on Tribal lands. Integrate planning and preparedness for extreme weather events into Tribal trainings and exercises, where possible. [1 training session in 2022; 2 in 2023].
<i>Associated Vulnerability</i>	All climate impacts
<i>Co-benefits</i>	Human Health and Environmental Protection
<i>Resource Requirement</i>	Existing resources are available to implement this activity

<b>7. Provide continued coordination with our air partners</b>			
<i>Subcomponents</i>	<b>7.1</b> Increase awareness and community preparedness to address indoor air quality (IAQ) issues from climate impacts.	<b>7.2</b> Develop communication tools and interventions to respond to wildfire impacts in partnership with Region 5 state air agencies.	<b>7.3</b> Promote voluntary programs like PM and Ozone Advance as proactive measures to combat poor air quality due to climate change and in communities with EJ concerns.
<i>Lead</i>	ARD	ARD	ARD
<i>Fiscal Year Start - Complete</i>	2022-2023	2022-2023	2022-2023
<i>Performance metric</i>	Promote relevant IAQ resources (e.g., Indoor airPLUS, IAQ renovation guidelines, integration of IAQ into green building standards) to three stakeholders by end of FY23.	Meet with all Region 5 states by Q2 FY23 to develop communication tools and interventions that reduce health risks from wildfires.	Increase regional enrollment in the program by 20% by the end of FY23.
<i>Associated Vulnerability</i>	Increasing extreme temperatures Increasing heavy precipitation events	Increased frequency or intensity of wildfires	Increasing extreme temperatures Decreasing precipitation days and increasing drought intensity
<i>Co-benefits</i>	Improved IAQ and reduced health impacts from asthma triggers and other indoor pollution.	Improved communications and health outcomes.	Provides voluntary control measures for maintaining attainment statuses and provides technical assistance to Tribal, state and local partners.
<i>Resource requirements</i>	Will require 0.25 FTE to coordinate with HQ, identify outreach targets, and develop messages and presentations.	Air monitoring state leads will add this as an agenda item to existing calls with states.	Will require 0.25 FTE to recruit new members.

<b>8. Integrate principles of climate resiliency into Great Lakes Restoration Initiative (GLRI)-funded projects to ensure the latest science informs project designs</b>			
<i>Subcomponents</i>	<b>8.1</b> Develop climate resiliency terms and conditions for assistance agreements and incorporate as appropriate.	<b>8.2</b> Develop climate resiliency terms and conditions for inclusion in Interagency Agreements	<b>8.3</b> Incorporate climate resiliency terms and conditions into EPA contracts, where warranted
<i>Lead</i>	GLNPO-FAOMB	GLNPO-FAOMB	GLNPO-FAOMB
<i>Fiscal Year Start-Complete</i>	2022-ongoing	2022-ongoing	2022-ongoing
<i>Performance metric</i>	1 set of Terms and Conditions developed	1 set of Terms and Conditions developed	1 set of Terms and conditions developed
<i>Associated Vulnerability</i>	GLRI project designs that are threatened by climate change	GLRI project designs that are threatened by climate change	GLRI project designs that are threatened by climate change
<i>Co-benefits</i>	Resilience against multiple stressors	Resilience against multiple stressors.	Resilience against multiple stressors.
<i>Resource requirements</i>	Can accomplish with existing resources	Can accomplish with existing resources.	Can accomplish with existing resources.

<b>9. Incorporate climate resiliency principles into Great Lakes strategic implementation documents</b>			
<i>Subcomponents</i>	<b>9.1</b> Complete GLRI study to develop more accurate predictions regarding weather conditions likely to occur in areas across the basin which will enable the planning, design, and implementation of resilient and sustainable projects along the Great Lakes coast.	<b>9.2.</b> Incorporate climate resiliency principles into Lakewide Action and Management Plans (LAMPs) and Remedial Action Plans for Areas of Concern.	<b>9.3</b> Utilize GLNPO long-term ecosystem monitoring programs implemented under the Great Lakes Water Quality Agreement and GLRI to assess and evaluate Great Lakes water quality and ecosystem health impacts related to climate change.
<i>Lead</i>	GLNPO - GLNPO Front Office/U.S. Army Corps of Engineers	GLNPO-GLRRB	GLNPO-GLRRB
<i>Fiscal Year Start-Complete</i>	2021-2024	2022-ongoing	2022-ongoing
<i>Performance metric</i>	Study completed (1) and shared with GLRI partners in 2024	One set of principles incorporated into 5 LAMPs beginning in 2022.	Triennial State of the Great Lakes reports (1)
<i>Associated Vulnerability</i>	Overall climate vulnerabilities to the Great Lakes	Overall climate vulnerabilities to the Great Lakes	Impacts to Great Lakes water quality and ecosystem health from climate change
<i>Co-benefits</i>	Increased public awareness, resilience against multiple stressors	Increased public awareness, resilience against multiple stressors	Public awareness
<i>Resource requirements</i>	Can accomplish with existing resources	Can accomplish with existing resources	Can accomplish with existing resources.

<b>10. Provide technical assistance (TA) to R5 stakeholders for climate adaptation readiness &amp; preparedness.</b>	
<i>Lead</i>	LCRD - Brownfields/RCRA C&D
<i>Fiscal Year Start - Complete</i>	2022-2023
<i>Performance Metric</i>	<ul style="list-style-type: none"> <li>- One Municipality (Brownfields) to receive TA regarding climate adaptation by end of FY22.</li> <li>- One Municipality (Brownfields) &amp; 8 Tribes to receive TA regarding climate adaptation practices by end of FY23.</li> </ul> <p>Stakeholders - those that can receive technical assistance regarding climate adaptation practices, including disaster debris management. (Includes outreach that we do w/ communities related to disaster debris, erosion control, green infrastructure, etc.)</p>
<i>Associated Vulnerability</i>	Flood-prone brownfields and hazardous waste sites
<i>Co-benefits</i>	Assistance to partners, improved local economy & public health, climate-ready workforce and facilities, mitigation of other pollution.
<i>Resource Requirement</i>	<p>Brownfields: Expend up to 1 FTE among current staff</p> <p>RCRA C&amp;D: 0.5 FTE workload divided among several current staff for debris management outreach. Staff training needed.</p>

<b>11. Develop R5 GIS Map on climate change hazards (flood prone areas) for land program sites.</b>	
<i>Lead</i>	LCRD/RPSB
<i>Fiscal Year Start - Complete</i>	2022-2023
<i>Performance Metric</i>	<ul style="list-style-type: none"> <li>- One climate data layer (100yr flood plain) to be added to mapping tool by end of FY22; Two climate data layers to be added in FY23</li> <li>- Brief &amp; Share climate change hazard map with 3 States, 10 Tribes by end of FY23</li> <li>- 5 Views by end of FY22, 15 by the end of FY23</li> </ul>
<i>Associated Vulnerability</i>	Flood-prone RCRA sites & hazardous waste facilities
<i>Co-benefits</i>	<p>Assistance to partners, climate-ready workforce and facilities, mitigation of other pollution, increased recycling, improved public health through decrease in odors</p> <p>Inform facility siting decisions across media programs by identifying vulnerability to flooding.</p>
<i>Resource Requirement</i>	0.5 FTE needed for coordination b/w regional & HQ staff to ensure data layers (i.e., climate hazards, disaster debris) in map are updated on an annual basis.

<b>12. Collaborate with Tribes and states to consider climate change impacts to water quality standards programs and develop shared recommendations.</b>					
<i>Subcomponents</i>	<p><b>Orientation</b></p> <p>1. Review Region 5 Tribal and state climate change-related reports and relevant portions of QAPPS to understand where Tribes and states are foundationally</p> <p>2. Develop structured interview questions</p>	<p><b>Collection of data and input from Tribal and state partners</b></p> <p>1. Organize and conduct virtual meetings with Region 5 Tribes and states with EPA approved WQS to hear their concerns/consideration of climate change with respect to WQS</p>	<p><b>Develop a joint summary of priority concerns, questions, and considerations related to climate for WQS in collaboration with Tribal and state partners</b></p>	<p><b>Receive and review comments from Tribes and states and revise summary report</b></p>	<p><b>Prepare final report</b></p> <p>1. Obtain concurrence from Tribal and state partners at staff level</p> <p>2. Presentation to Water Program Directors for review and input</p> <p>3. Revise and finalize report</p> <p>4. Initiate discussion with HQ/OST on priorities identified in the report</p>
<i>Lead</i>	WD -WWB	WD-WWB	WD-WWB	WD-WWB	WD-WWB
<i>Fiscal Year Start-Complete</i>	2022-2023	2022-2023	2023-2024	2023-2024	2023-2024
<i>Performance metric</i>	<p>-Review Water Climate QAPPS in R5</p> <p>-Develop interview questions to discuss with Tribes and states</p>	<p>-Conduct 2 Tribal government sessions</p> <p>-Conduct 2 state sessions</p>	<p>-Develop a preliminary report</p> <p>-Present preliminary report and request feedback</p>	<p>-Gather feedback and incorporate</p>	<p>-Develop final report</p> <p>-Present to program directors</p> <p>-Discuss with HQ</p>
<i>Associated Vulnerability</i>	Climate change will likely impact the ability to meet WQS and protect designated uses	Climate change will likely impact the ability to meet WQS and protect designated uses	Climate change will likely impact the ability to meet WQS and protect designated uses	Climate change will likely impact the ability to meet WQS and protect designated uses	Climate change will likely impact the ability to meet WQS and protect designated uses
<i>Co-benefits</i>	Development of a better baseline understanding of how Tribes and states consider impacts of climate change. Maintaining public health, ensuring healthy aquatic ecosystems and recreational opportunities.	Listening sessions will gather input directly from Tribes and states. Gathering data and information directly will allow EPA to be proactive on addressing climate change problems with Tribal and state partners. Strengthen working relationships with the Tribes and states.	Strengthen working relationships with the Tribes and states. Maintaining public health, ensuring healthy aquatic ecosystems and recreational opportunities.	Increase collaborative effort on climate change. Strengthen working relationships with the Tribes and states. Maintaining public health, ensuring healthy aquatic ecosystems and recreational opportunities.	Increased understanding of Tribal and state priority concerns, questions, and considerations related to climate for WQS. Improved communication between EPA headquarters, R5, and Tribal and state governments. Maintaining public health, ensuring healthy aquatic ecosystems and recreational opportunities.
<i>Resource requirements</i>	0.25-0.5 between two staff	0.25-0.5 between two staff	0.25-0.5 between two staff	0.25-0.5 between two staff	0.25-0.5 between two staff

<b>13. ORA-led Action (NEPA): Strengthen expertise and keep abreast of changing climate conditions, assessment methodologies, and adaptation and mitigation measures to assist lead federal agencies in achieving more climate resilient projects with less adverse climate impacts.</b>	
<i>Lead</i>	Tribal and Multi-media Programs Office (TMPO), NEPA Section
<i>Fiscal Year Start - Complete</i>	2022-ongoing
<i>Performance Metric</i>	1) By the end of FY22, meet with R5 associate reviewers to update as needed climate change recommendations for NEPA comment letters; 2) R5 meet 100% of HQ deadlines for contributing to NEPA tools and guidance documents. 3) Incorporate climate adaptation recommendations in 100% of applicable EPA NEPA comment letters.
<i>Resource Requirement</i>	We currently have 0.05 staff time dedicated, however we need 0.5 FTE to implement this action.
<i>Vulnerability</i>	Communities in Region 5 will experience increases in flooding, erosion, water quality concerns, roadway washouts, and other events impacting infrastructure, communities, and federal lands, triggering an increase in federal agency actions subject to analysis under the National Environmental Policy Act (NEPA) and subject to EPA review and comment under Clean Air Act Section 309.
<i>Co-benefits</i>	More informed EPA staff and tools/guides for EPA NEPA reviewers will enable EPA to appropriately engage and comment on NEPA projects. We anticipate this to result in more informed decision-making by lead agencies and ultimately lower GHG emissions and increase the resilience of NEPA projects (e.g., roadways, forest management plans, shoreline stabilization measures, pipelines, etc.). This will benefit Tribes, rural communities, communities with EJ concerns, and other communities across Region 5.

<b>14. Corrective Action: Analyze impacts of climate change on remedial work at hazardous waste disposal facilities through remedy selection process, remedy reviews and model orders.</b>	
<i>Lead</i>	LCRD-RCRA Corrective Action
<i>Fiscal Year Start - Complete</i>	2022-Ongoing
<i>Performance Metric</i>	1) In FY22, engage 10% of facilities developing final remedies in discussions of opportunities to incorporate green infrastructure / remediation, as climate adaptation efforts, into work; FY23, 50% of facilities developing final remedies engaged on climate adaptation opportunities.  2) Evaluate potential impacts of climate change on existing remedies during 10% of Long-Term Stewardship (LTS) reviews conducted in FY22 and 50% of reviews conducted in FY23.
<i>Associated Vulnerability</i>	Flood-prone areas at hazardous waste disposal facilities, site cleanup complications due to extreme weather events
<i>Co-benefits</i>	Assistance to partners, decrease in flooding and cooler temperatures during heatwaves, climate-ready workforce and facilities, mitigation of greenhouse gases.
<i>Resource Requirement</i>	Minimum of 3 current RCRA CA Project Manager FTEs, 1 from each section



<b>15. Increase community-based climate change related projects in “enforcement settlements”</b>	
<i>Lead</i>	Enforcement and Compliance Assurance Division (ECAD) and R5 Office of Regional Counsel (ORC)
<i>Fiscal Year Start-Complete</i>	2023-ongoing
<i>Performance Metric</i>	3 “enforcement settlements” will include climate adaptive enforcement mitigation measures, compliance terms, and/or climate adaptive enforcement SEPs in given FY.
<i>Associated Vulnerability</i>	All vulnerabilities impacting the Region
<i>Co-benefits</i>	As climate hazards escalate, Region 5 will face threats to infrastructure that extend to communities region-wide beyond the scope of our regulated community. Through offering the opportunity of SEPs and adaptation-based projects, EPA can empower respondents place-based work that directly addresses climate change impacts and adaptation needs.
<i>Resource Requirement</i>	Dependent on number of inspections and cases both ECAD and ORC can initiate that have the potential to include adaptive measures to community-level climate hazards in a resolution.  Case managers will work with management to identify mitigation measures, SEPs and compliance terms which account for a changing climate as often as possible within regulatory boundaries.

<b>16. Consider climate resilience during Superfund remedial investigations, the decision-making process, design development, construction, and post-construction to ensure that remedies selected and implemented will remain protective under a changing climate.</b>	
<i>Lead</i>	Superfund & Emergency Management Division (SEMD)
<i>Fiscal Year Start - Complete</i>	2023-Ongoing
<i>Performance Metric</i>	SEMD will increase its emphasis on climate vulnerability and remedy resiliency as part of Five-Year Review (5YR) process and reach out to our state partners to discuss remedy resiliency as part of our remedy effectiveness reviews. [12 Five-Year Reviews in 2022].  All future 5YRs will include this review. Metric/year will correspond with the number of 5YRs completed each year which fluctuates each year.
<i>Associated Vulnerability</i>	Remedy Resiliency
<i>Co-benefits</i>	Human Health and the Environmental Protection
<i>Resource Requirement</i>	Resources available

<b>17. Work through the R5 Regional Science Council to ensure science needs related to climate adaptation are identified and addressed</b>	
<i>Lead</i>	LSASD
<i>Fiscal Year Start - Complete</i>	On-going
<i>Performance Metric</i>	Add science needs related to climate adaptation as a factor to be considered when identifying science needs and in developing Regional/ORD collaborative research proposals under the ROAR program.

<i>Resource Requirement</i>	Limited staff time.
<i>Vulnerability</i>	All vulnerabilities related to research need identified by R5 Divisions
<i>Co-benefits</i>	Developmental opportunity for R5 staff to work with ORD on research related to climate adaptation.

**18. Work with the Region 5 Divisions to ensure that sufficient monitoring and analytical resources (FTE and equipment) are available to address climate change impacts on Divisional programs.**

<i>Lead</i>	LSASD
<i>Fiscal Year Start - Complete</i>	On-going
<i>Performance Metric</i>	Meet with all R5 Divisions during FY22 to discuss current and foreseeable needs related to lab capacity.
<i>Resource Requirement</i>	Limited staff time.
<i>Vulnerability</i>	All vulnerabilities impacting requests for LSASD analytical services
<i>Co-benefits</i>	Increased capacity/technical expertise to assist Tribes, States, and other Regions as requested in emergencies

## **Training**

A central element of Region 5's efforts to adapt to a changing climate will be to increase staff and partner awareness of how climate change may affect their work and community by providing the necessary data, information, and tools. Increased climate change awareness and knowledge will help staff and partners consider the changing climate during the normal course of business. As the adaptive capacity of staff and partners strengthens, Region 5 will provide specific methods and tools for integrating climate adaptation into decision-making processes within our programs, policies, and operations. With a focus on continuous improvement, Region 5's training program will develop as staff and partner needs evolve.

### **Internal Training**

Region 5's Climate Change Adaptation Team (under the direction of the Region's Climate Change Workgroup) will oversee the Region's climate change adaptation training. The workgroup will make every effort to educate, promote and host training sessions, foster buy-in from all staff, and plan for program resiliency throughout the Region.

Once available, training modules developed by each National Program Office will be disseminated to Region 5 staff for their use. Depending on need, additional climate adaptation modules may be developed to strengthen adaptive capacity throughout the Region.

As Region 5's Climate Adaptation Implementation Plan evolves, specific methods and tools for integrating climate adaptation into decision making processes will be presented to all applicable regional staff. These methods will be program-specific and operationally-based to give staff applicable tools to be used in daily work.

### **Traditional Ecological Knowledge Training**

The White House Council on Environmental Quality (CEQ) is encouraging agencies to include consideration of Traditional Ecological Knowledge (TEK) in climate adaptation plans. The CEQ, working jointly with the White House Office of Science and Technology Policy, is developing interagency guidance on how to elevate TEK in federal decision-making and is requiring progress reports on agency considerations related to TEK and climate. EPA's Office of International and Tribal Affairs (OITA) is committed to developing and deploying training to EPA staff in order to implement the interagency TEK guidance once it is final. Based on the current timeline, OITA is proposing this training for FY 2023. Region 5 commits to participate in this training.

### **External Training**

Region 5 partners will be informed of EPA's climate adaptation trainings and resources, as well as those of other external partners. As the program evolves, partners will be encouraged to utilize applicable program specific climate adaptation tools and methods in their work.

### **Continued Opportunities for Program Learning and Involvement**

All regional staff will be strongly encouraged to complete all applicable climate change adaptation trainings and modules. An increase in overall understanding of climate change and climate change adaptation is a crucial element for the Region to adapt to climate change as one.

Region 5 will incorporate climate change adaptation into existing conversations with our partners to increase knowledge of current and potential issues. We will introduce tools and resources to support adaptation activities to stakeholders and communities. Region 5 will also seek input from partner organizations and communities in reviewing existing tools and resources to address gaps and provide more meaningful assistance.

## Research Needs

The EPA Office of Research and Development (ORD) conducts regular engagement with the Regional Offices and Program Offices to identify science needs. As part of their strategic research planning effort for FY23-26, ORD conducted an internal workshop titled *Revitalizing Climate Research at EPA*, which was held in virtual format over three days in October 2021. Participants from all ten Regions and every relevant Program Office attended to discuss research needs, science gaps, and approaches to conducting research to best address the needs related to climate change. The goal of the workshop was to develop information that will guide ORD's development of a climate research agenda across media and across time frames to address the questions of greatest importance to the entire agency.

Some overarching themes identified by the EPA Program Offices and Regional Offices include: climate change as a threat multiplier; the need to look at enforcement and permitting actions more holistically, climate change impacts on community resilience, environmental justice and communities on the margins; and the need to understand and quantify the co-benefits and cross-media impacts of adaptation and mitigation actions, including a need for research in economic valuation and adaption effectiveness. This is related to the need for tools to assess the risks of climate change and different approaches to reducing those risks across media and regulatory programs. Ecological shifts and the energy system transition were noted as indications of substantial changes in the issues EPA faces. Specific topics raised at a high level included harmful algal blooms (HABs), heat impacts on human health and ecosystems, and emerging pathogens.

To a large degree, science needs identified by the Region 5 Climate Change Adaptation workgroup mirror issues raised at the ORD workshop, although the Region 5 needs are at a more granular level and reflect regional conditions. However, several important science needs identified by Region 5 were not covered at the workshop and are identified here.

- Review EPA assessment and regulatory models and tools for outdated studies or embedded assumptions that may no longer be scientifically defensible in a climate-altered environment. A specific example of this issue is the need to assess climate vulnerability in benthic macroinvertebrates to increase responsiveness and resilience of state biomonitoring programs. Tribal and state water monitoring programs have a long history of innovation in using benthic macroinvertebrates to assess the condition of waterbodies. Yet climate change poses new challenges and risks to water resources and the underlying biomonitoring frameworks that states use as benchmarks for determining waterbody health and causes of impairment. In addition, climate change may undermine or alter model assumptions and relationships used to develop Total Maximum Daily Loads (TMDLs).

- Need for more information on expected changes in air deposition of pollutants, especially to the Great Lakes, from increases in precipitation and other climate related atmospheric changes.
- Additional regional research is needed on how to best support communities whose local governments are not equipped to deal with climate change and resiliency. For example, what programs and resources can we bring to these communities to empower the skills that are needed to adapt to climate change?
- To address Tribal climate related needs more proactively, the Region should include Tribal data in models used by the Agency.

Region 5 can benefit from active and ongoing partnerships with others to identify and address current and future climate adaptation science needs. This can include leveraging ongoing interagency collaborations such as the Great Lakes Restoration Initiative (GLRI) and international cooperation with Canada under the Great Lakes Water Quality Agreement. We can maximize the impact and relevance of our work with outreach and partnerships with our States, directly and through ECOS and ERIS, and with Tribes in Region 5 through the RTOC and the Tribal Science Council, and by incorporation of Indigenous Knowledge as outlined by the White House Council on Environmental Quality.<sup>13</sup> We can utilize these partnerships and ORD programs like the Regional ORD Applied Research Program (ROAR) to address science needs identified by communities within EPA Region 5.

## Outreach and Engagement Strategy

Climate adaptation requires coordination across sectors and should build on the existing efforts and knowledge of stakeholders. Tribes, states, and local communities share responsibility for protecting human health and the environment with EPA. Working with these partners is critical for efficient, effective, and equitable implementation of climate change adaptation strategies, which will evolve over time. Region 5 will collaborate with Tribes and states on this Plan and future climate adaptation efforts, with the goal of building adaptive capacity and encouraging climate adaptation planning depending upon state and tribal needs and conditions. To do this, Region 5 developed an Outreach and Engagement Strategy to ensure meaningful feedback was obtained from our stakeholders on this Plan.

Region 5's Outreach and Engagement Strategy focused on our existing relationships with Tribes and states. As part of the Strategy each Region 5 Division identified standing meetings with various stakeholders to use as venues to raise awareness regarding this Plan and to provide opportunities for our partners to offer meaningful input on its development. Additionally, we asked our partners to identify any gaps and / or areas of intersecting work, and to inform us of their climate adaptation needs so that we could incorporate them into the work covered in this Plan. Finally, we requested input from Tribes and states on the Priority Actions. We provided outreach and engagement to partners during the following meetings in Spring/early Summer 2022:

- Joint R5 and State Clean Water and Drinking Water Directors Meeting
- Minnesota Resilience & Adaptation Action Team meeting (part of Minnesota's Climate Subcabinet)
- Monthly Region 5 State/Tribal Water Quality Standards Call
- Region 5 Tribal Lands and Brownfields All-States Call
- Tribal Water Division Call
- Region 5 Tribal Air Contacts Call
- Region 5 State Enforcement Directors Calls for Air, Land, and Water
- Region 5 Tribal Caucus Call
- Semi-Annual Region 5 Superfund & Emergency Management All-States Meeting

We will continue to seek input and learn from our partners, and where appropriate will revise this Plan to reflect stakeholder feedback. Ongoing engagement with our partners will be critical to advancing climate adaptation work in the Region, and our Outreach and Engagement Strategy will be updated as needed to reflect any targeted engagement or shifting approaches.

## **Process to Review and Update Plan**

The process to review and update this Plan is iterative and ongoing as we seek to continuously integrate climate adaptation, environmental justice, and other agency priorities into our programs and processes. As we measure and track our progress, we will assess our Priority Actions to determine whether our focus is on the most meaningful suite of activities. We will update our Priority Actions annually.



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## References

- <sup>1</sup> Smith, A. B. (2021, September 27). 2020 U.S. billion-dollar weather and climate disasters in historical context. *Beyond the Data*. <https://www.climate.gov/news-features/blogs/beyond-data/2020-us-billion-dollar-weather-and-climate-disasters-historical>
- <sup>2</sup> Smith, A. B. (2021, September 27). 2020 U.S. billion-dollar weather and climate disasters in historical context. *Beyond the Data*. <https://www.climate.gov/news-features/blogs/beyond-data/2020-us-billion-dollar-weather-and-climate-disasters-historical>
- <sup>3</sup> U.S. Census Bureau. (2021). *State Area Measurements and Internal Point Coordinates*. <https://www.census.gov/geographies/reference-files/2010/geo/state-area.html>
- <sup>4</sup> NOAA Office for Coastal Management. (2016). *Shoreline Mileage of the United States*. <https://coast.noaa.gov/data/docs/states/shorelines.pdf>
- <sup>5</sup> U.S. Census Bureau. (2021). *Historical Population Change Data (1910-2020)*. <https://www.census.gov/data/tables/time-series/dec/popchange-data-text.html>
- <sup>6</sup> Environment and Climate Change Canada and the U.S. Environmental Protection Agency. (2022). *State of the Great Lakes 2022: Technical Report*. <https://binational.net/>
- <sup>7</sup> Angel, J., C. Swanston, B.M. Boustead, K.C. Conlon, K.R. Hall, J.L. Jorns, K.E. Kunkel, M.C. Lemos, B. Lofgren, T.A. Ontl, J. Posey, K. Stone, G. Takle, and D. Today, 2018: Midwest. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 872–940. <http://doi.org/10.7930/NCA4.2018.CH21>
- <sup>8</sup> USGCRP. (2016). *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, D.C., 312 pp. <http://dx.doi.org/10.7930/J0R49NQX>
- <sup>9</sup> <https://nca2018.globalchange.gov/chapter/21/>
- <sup>10</sup> <https://toolkit.climate.gov/regions/great-lakes/building-resilience-great-lakes>
- <sup>11</sup> White House Environmental Justice Advisory Council. (2021). *Final Recommendations: Justice40, Climate and Economic Justice Screening Tool, and Executive Order 12898 Revisions* (p. 92). <https://www.epa.gov/sites/default/files/2021-05/documents/whiteh2.pdf>
- <sup>13</sup> Lander, E. S., & Mallory, B. (2021). *Indigenous Traditional Ecological Knowledge and Federal Decision Making*. White House Council on Environmental Quality: Office of Science and Technology Policy. <https://www.whitehouse.gov/wp-content/uploads/2021/11/111521-OSTP-CEQ-ITEK-Memo.pdf>

## Appendix A: Region 5 Vulnerability Assessment Table

Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
ARD	Increased tropospheric ozone pollution in certain regions	Likely	Protecting public health and the environment by setting National Ambient Air Quality Standards (NAAQS) and implementing programs to help meet the standards	Could become more difficult to attain NAAQS for ozone in many areas, including areas with existing ozone problems as well as those currently in attainment.	High	Five of the six Region 5 states already struggle with attaining the ozone standard in large urban areas. Increases in tropospheric ozone could result in more nonattainment areas and lengthen the ozone season.	Important across Region, but new non-attainment areas could be in smaller metro areas and in the northern part of the Region.
ARD	Increased frequency or intensity of wildfires	Likely	Protecting public health and the environment by setting National Ambient Air Quality Standards (NAAQS) and implementing programs to help meet the standards	Could complicate Agency efforts to protect public health and the environment from risks posed by particulate matter (PM) pollution in areas affected by more frequent wildfires.	Medium	Currently wildfires are not a large contributor to PM issues in the Great Lakes States; however, a significant increase in wildfires could change this profile. Could also increase deposition of certain contaminants to the Great Lakes.	Forest areas are mostly in the northern part of the Region.
ARD	Increasing extreme temperatures	Very Likely	Protecting public health and the environment by setting National Ambient Air Quality Standards (NAAQS) and implementing programs to help meet the standards	Could complicate efforts to attain NAAQS for various criteria pollutants and increase public health risks, including risks for the young, the elderly, the chronically ill, and socioeconomically disadvantaged populations.	Medium	Increased temperatures and extreme weather events could increase demand for electricity (for example, through increased use of air conditioning units), which would require more electricity creating greater pollution from EGUs, back-up generators, and peaker plants. This could increase difficulty of meeting NAAQS for O3, PM2.5, SO2, NO2, and CO.	Important across Region but risks higher in urban areas and areas with more sources.
ARD	Increasing extreme temperatures  Increasing heavy precipitation events	Very Likely  Likely	Protect public health by promoting healthy indoor environments through voluntary programs and guidance	Could increase public health risks from indoor air pollution, including risks for the young, the elderly, the chronically ill, and socioeconomically disadvantaged populations	Medium	Susceptible individuals across Region 5 will be impacted by potentially greater exposure to air pollution, both indoors and outdoors. More time spent inside during extreme weather, mold issues because of flooding and storms, and inappropriate energy efficiency measures (i.e., making buildings too "tight") could all increase IAQ problems.	Important across the Region, but particularly in EJ areas and areas with high density of more susceptible populations.

Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
ARD	<p>Increasing extreme temperatures</p> <p>Increasing heavy precipitation events</p>	<p>Very Likely</p> <p>Likely</p>	<p>Atmospheric deposition initiatives</p> <p>Ecosystem protection from Agency emissions reduction programs</p>	<p>Effects on ecosystems, including the Great Lakes, to increased atmospheric deposition of sulfur, nitrogen, and mercury (and potentially increased methylation of mercury). Also impacts compliance with water quality standards and TMDLs.</p>	<p>High</p>	<p>Mercury is a high priority in Region 5 in both the Great Lakes and inland lakes. All of our states have water bodies impaired by mercury. Increases in mercury deposition, as well as sulfur and nitrogen, would further stress our ecosystems.</p>	<p>Very important across the Region.</p>
ARD	<p>Increasing extreme temperatures</p> <p>Decreasing precipitation days and increasing drought intensity</p>	<p>Very Likely</p> <p>Likely</p>	<p>Protecting public health and the environment by setting National Ambient Air Quality Standards (NAAQS) and implementing programs to help meet the standards</p>	<p>Could become more difficult to attain NAAQS for ozone and particulate matter (PM) in many areas and external/non-regulatory measures within voluntary programs like Advance may need to be implemented to achieve attainment.</p>	<p>High</p>	<p>For PM: Based on the NCA4 and Midwest Quarterly Climate Impacts and Outlook (September 2021) drought conditions associated with climate change can promote wind-borne dust or PM during high wind events. Wind-borne PM is principally associated with dry soil conditions and lack of adequate vegetative cover. For Ozone: See above vulnerabilities regarding the ozone and attainment.</p>	<p>Very important across the Region.</p>
ECAD	<p>Heavy precipitation events and flooding</p> <p>Increasing temperatures</p>	<p>Likely</p> <p>Likely</p> <p>Very likely</p>	<p>AECAB CAA Stationary</p>	<p>Increased landfill emissions</p> <p>Increased nonattainment areas</p> <p>Loss of environmental data, and control/monitoring equipment if facilities lose power</p>	<p>High</p>	<p>Landfills are a significant source of methane, a greenhouse gas with a global warming potential 25 times higher than carbon dioxide. Anticipated wetter weather in the Midwest will cause waste residing in landfills to decompose more quickly thereby increasing methane production in the landfill. The additional leachate generated by higher water volumes can overwhelm existing leachate handling systems, thereby causing a higher water table in the landfill. This can reduce gas collection effectiveness and increase emissions from</p>	<p>Regionwide</p>

Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
						<p>the landfill. Not only do higher emissions from landfills contribute to additional climate change, but they also cause odors and air toxic emissions that impact nearby communities.</p> <p>Warmer temperatures and wildfires may create more nonattainment areas for PM2.5 and VOC. This would mean states would need to adjust permit limits downward, making tighter limits and more controls at facilities. The facilities, unable or not accustomed to meeting these lower limits, may begin to violate their permits.</p> <p>With more severe weather events, power outages would become more common, meaning control equipment would be forced offline, and emissions increased. EPA has historically considered very infrequent events like power outages to be force majeure and not subject to penalty and remedy, but with increasing frequency, EPA would be compelled to seek penalty and remedy. Facilities would need to install back-up power.</p> <p>Similarly, more frequent storms would mean loss of environmental data. Fence line monitoring and other monitoring equipment may go offline during severe storms losing the ability to monitor the facility emissions.</p>	
ECAD	Increased Tropospheric Ozone	Likely	AECAB CAA Mobile	Program focus on reducing emissions in high-risk areas	Low	Altering mobile source engines produces higher emissions of VOC, which contribute to ground level ozone, and can reduce fuel	Urban Areas, often with EJ concerns

Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
						efficiency, causing increases of CO2 emissions per mile traveled. In line with the NCI for After Market Defeat Devices, AECAB will devote resources to reducing illegal engine tampering that increases VOC, ground level ozone, and CO2.	
ECAD	Heavy precipitation events and flooding	Likely Likely	AECAB 112R	Extreme events risk to infrastructure and need to adapt PHA as risk and types of events change.	High	Increased flooding and storms could impact infrastructure at facilities. Planning for weather emergencies/contingencies is part of Process Hazard Analysis (“PHA”) This is one of the elements of a Risk Management Plan and looked at during the 112r inspections.	Communities near the facilities. The surrounding areas are considered when the high risk is established every year.
ECAD	Heavy precipitation events and flooding	Likely Likely	WECAB CWA NPDES (Sub-Programs: CAFOs, Biosolids, Storm water, CSOs, SSO, Vessels, and Pretreatment)	Increasing infrastructure damage and decreasing infrastructure capacity. Limitations in developing orders/CDs that take long-term climate into account.	High	Heavier and more frequent rain events are overwhelming existing infrastructure that was designed 30 plus years ago or were modeling was done and plans created over a decade ago. These events are contributing to noncompliance with the CWA (CSOs, SSOs, and stormwater).	Older urban areas in Region 5 especially those with Combined Sewer systems, of which Region 5 has the most in the country.
ECAD	Heavy precipitation events and flooding  Increasing temperatures	Likely  Likely  Very likely	WECAB CWA 404	Increased environmental and public health consequences to duration and extent of unpermitted wetland removal from watershed.  Need to develop climate conscious orders/CDs.	Medium-High	Key to reducing flood impacts, and filtering out pollution, but with urbanization and development often impacts not offset most effectively to focus on these climate-adaptation related benefits. Benefits in urban areas that face development pressure specifically are very significant.  Increasing temperatures impact ecosystem resiliency and stability	Urban communities at low elevation (anyone or any infrastructure impacted by high water/flood levels)

Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
ECAD	Heavy precipitation events and flooding  Increasing temperatures  Increased severe weather events	Likely  Likely  Very likely  Likely	WECAB SDWA PWS	Monitoring needs to be adapted for increasing temperatures and changing chemical stability/treatment.  Extreme events risk to infrastructure and/or ability to operate treatment system.	High	Increasing temperatures impact the way that chemicals interact or are stable in source water and may be treated in the distribution. In particular, monitoring during warm weather months, LCR, may need to be revised based on increasing temperatures lasting longer periods. Weather / flooding impacts, cyber security risks, power loss and ability to operate treatment system.	All Public Water Systems
ECAD	Heavy precipitation events and flooding  Increased severe weather events	Likely  Likely  Likely	WECAB SDWA UIC	Extreme events risk to infrastructure and/or ability to operate injection system, potentially resulting in an above or belowground leak of waste.	Medium-High	Systems: hardening infrastructure at site to minimize potential weather/flood impacts, cybersecurity risks for records and injection pressure  Siting: assess location for escalating water hazards  Class 6 opportunities to inject more CO <sub>2</sub> , decrease emissions, need to ensure we have the staff resources to support increasing uptake in industry nationally.	Communities around wells and waterways they are near, potential releases both underground into USDW and aboveground
ECAD	Increasing heavy precipitation events  Increasing risk of floods  Changes in temperature	Likely  Likely  Very likely	LECAB RCRA C	Increased risk of contaminant release  GW and subsurface contamination could be impacted by drought and flood conditions  Contaminants increase risk of migration from floods	Medium-High	Communities around hazardous waste TSDFs	Regionwide
ECAD	Increased severe weather events	Likely	LECAB RCRA Imports	Increased risk of releases due to transportation accidents caused by severe weather events	Medium-High	Communities near major highways where imports may be transported	Regionwide

Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
ECAD	<p>Storm events <i>more frequent high winds and microbursts</i></p> <p>Storm events <i>more frequent, intense precipitation. and flooding</i></p> <p>Climate change mitigation <i>phasing out of fossil fuels</i></p>	<p>Likely</p> <p>Likely</p>	LECAB UST	<p>Outside tanks, secondary containment structures, and monitoring infrastructures are vulnerable to wind damage.</p> <p>Monitoring equipment and corrosion protection infrastructures are vulnerable to power service interruption.</p> <p>Outdoor above ground tanks are vulnerable to inadequate secondary containment where a portion of the containment is taken up by rainwater.</p> <p>Outdoor above ground tanks are vulnerable to flood water intrusion if secondary containment is not high enough.</p> <p>Underground storage tanks are vulnerable to buoyancy forces if unanchored or improperly anchored where there is flooding, or the water table rise is significant.</p> <p>Underground storage tank facilities are vulnerable to closure.</p>	Medium-High	Regionwide	Regionwide
ECAD	<p>Heavy precipitation events and flooding</p> <p>Rising temperatures</p>	<p>Likely</p> <p>Likely</p> <p>Very likely</p>	LECAB FIFRA	<p>Increased risk of chemical releases</p> <p>Increased risk of adverse application effects</p>	Medium-High	<p>Communities around pesticide producing establishments</p> <p>Communities, applicators, end users</p>	Regionwide



Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
ECAD	Heavy precipitation events and flooding	Likely Likely	LECAB TSCA Core	Increased risk of chemical releases	Medium-High	Communities around manufacturers	Regionwide
ECAD	Heavy precipitation, flooding and high wind events	Likely	LECAB TSCA AHERA	Increased risk of asbestos releases to the environment	Medium-High	Neighboring properties within communities with asbestos containing properties	Regionwide
ECAD	Heavy precipitation, flooding and high wind events	Likely	LECAB TSCA Lead	Increased risk of lead paint releases to the environment.	Medium-High	Neighboring properties within communities with pre-1978 housing	Regionwide
ECAD	Heavy precipitation events and flooding	Likely	LECAB EPCRA 313	Increased risk of chemical releases	Medium-High	Communities around manufacturers	Regionwide
ECAD	General Increasing Vulnerabilities	n/a	Enforcement Workflow	Need to allocate targeting/inspection resources in a timely and efficient matter that addresses vulnerabilities. Need to develop climate conscious orders/CDs.	High		Regionwide
EJ	Increasing heavy precipitation events	Likely	Drinking water, wastewater and stormwater infrastructure	Inadequate water supply for human consumption (Contaminated wells, water systems)	High	EJ communities will need added assistance and attention if these events compound already existing concerns.	Regionwide
	Increasing flood risk	Likely		Damage to water infrastructure from intense storms			

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GLNPO	Increasing heavy precipitation events	Very Likely	Great Lakes Legacy Act (GLLA) contaminated sediment remediation projects (GLRI Focus Area 1; GLWQA Annex 1)	Flooding and streambed scouring from intense precipitation events may affect GLLA sediment remediation projects. Intense rain events may resuspend and disperse contaminants making clean-ups more difficult.	Medium	Climate change may impact the performance and sustainability of remedies at completed GLLA projects.  Climate change may impact the design and implementation of future GLLA projects (i.e., more costly designs needed to ensure long-term sustainability).	31 U.S. Areas of Concern spread throughout the GL Basin <b>Vulnerable Communities:</b> <ul style="list-style-type: none"> <li>Underserved and disadvantaged communities that are often co-located in AOCs</li> </ul> Vulnerable populations that consume Great Lakes fish, wildlife, and harvested plant resources
GLNPO	Changes in temperature Increasing water temperatures Increasing heavy precipitation events	Very Likely Very Likely Very Likely	Invasive Species prevention and control activities (GLRI Focus Area 2; GLWQA Annex 6)	Increased potential for new aquatic invasive species to enter, establish, and/or cause harm in the Great Lakes.	High	Climate change may impact aquatic invasive species monitoring, prevention, and control activities, requiring new priorities, new approaches, and/or increased costs.  Climate change may exacerbate the harm caused by invasive species due to weakened resilience of native species.	<b>Vulnerable Communities:</b> <ul style="list-style-type: none"> <li>Vulnerable populations that consume Great Lakes fish, wildlife, and harvested plant resource</li> </ul>
GLNPO	Increasing heavy precipitation events Increasing water temperatures	Very Likely Very Likely	Reducing Nonpoint Source Runoff projects (GLRI Focus Area 3; GLWQA Annex 4)	Increased nonpoint source nutrient loads (from urban and agricultural runoff), contributing to harmful algal blooms and other nearshore health impacts.	High	The nutrient load reduction targets set under the Great Lakes Water Quality Agreement may be harder to achieve with increased runoff from more frequent and intense precipitation events.  Increasing water temperatures may promote the growth of harmful algal blooms and require additional nutrient load reductions.	Especially Lake Erie, Green Bay, Saginaw Bay, and the south shore of Lake Superior near Chequamegon Bay. <b>Vulnerable Communities:</b> Communities relying on Lake Erie for drinking water are vulnerable.
GLNPO	Changes in temperature Increasing water temperatures	Very Likely Very Likely	Habitat protection and restoration projects	Lake levels changes may significantly impact coastal restoration projects.	High	Completed GLRI habitat restoration projects may be at risk from degradation or decreased performance. Addl. costs and design	Basin-wide <b>Vulnerable Communities:</b>

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	<p>Increasing heavy precipitation events</p> <p>Increasing frequency/intensity of drought days</p>	<p>Very Likely</p> <p>Likely</p>	<p>(GLRI Focus Areas 1 and 4; GLWQA Annexes 1 and 7)</p>	<p>Warming waters affect cold water species such as coho, lake trout and whitefish.</p> <p>Shifting habitat ranges and migration patterns of Great Lakes species may affect viability of native species.</p> <p>Longer warm seasons and shorter and less intense winters can lead to more parasites overwintering and increased chances of diseases in important species.</p> <p>Changing seasonality, including decrease in ice cover and more intense/longer stratification, may affect foodweb dynamics and all trophic levels.</p> <p>Reduced streamflow, altering aquatic environments.</p>		<p>considerations may be needed to maintain intended benefits.</p> <p>Future GLRI habitat restoration projects may require more costly designs to ensure long-term sustainability.</p> <p>Heavy precipitation events will put watershed, aquatic ecosystems, and wetlands at increased risk from erosion, scouring, wave action and runoff contamination.</p> <p>Protecting GLRI-critical species may require additional analysis and tools to address species migrations that may be increasingly out-of-sync with the appearance of their food sources.</p> <p>Climate change may impact aquatic habitat and species restoration and protection activities, requiring new priorities, new approaches, and/or increased costs.</p> <p>Native species at risk may be weakened by climate change warming waters, making them more susceptible to invasive species predation.</p> <p>The livelihood of Indigenous peoples' is at risk with disappearance of fisheries and moose, an important food source. Moose are dying due to weakened immunity from ticks and brainworm overwintering.</p>	<p>Tribal communities and fishing/recreational economy are vulnerable</p>
GLNPO	Increasing extreme temperatures	Very Likely	GLNPO Programs	Overall climate change impacts to Great Lakes water	Medium	States, Tribes and other GLRI partners may face increasing pressure to address local impacts to Great Lakes resources, which may	Basin-wide. However, climate change impacts may be more significant for the upper Great

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	<p>Increased water temperatures</p> <p>Increasing heavy precipitation events</p>	<p>Very Likely</p> <p>Very Likely</p>		<p>quality and ecosystem characteristics.</p>		<p>increase pressure on GLRI programs and funding sources.</p> <p>GLNPO may face an increased workload in helping states, Tribes and local partners develop and implement climate-resilient GLRI projects.</p> <p>Reduced ability to manage the ecosystem as scientific uncertainty increases.</p>	<p>Lakes than the lower Great Lakes.</p> <p><b>Vulnerable Communities:</b></p> <p>Tribal communities may suffer disproportionate impacts from climate change</p>
<p>Homeland Security</p>	<p>Increasing risk of floods</p> <p>Decreasing precipitation days and increasing drought intensity</p> <p>Increasing intensity of hurricanes</p>	<p>Likely</p> <p>Likely</p> <p>Likely</p>	<p>COOP</p> <p>Occupant Emergency Plan</p> <p>Activation of Homeland Security Frameworks</p>	<p>Increased occurrence and intensity of natural disasters increase the risks to Region 5 personnel and facilities</p>	<p>Medium</p>	<p>Impact to EPA Personnel and facilities; response to Natural Disasters; Emergency Communications; Activation of FEMA Support Functions</p>	<p>Regionwide</p>
<p>TMPO-TIA</p>	<p>Tribal communities in Region 5 will experience:</p> <p>Increased heavy precipitation events</p> <p>Increased risk of floods</p> <p>Changes in temperature</p> <p>Increased tropospheric ozone pollution in certain areas</p> <p>Impacts from increased frequency or intensity of wildfires</p>	<p>Likely</p> <p>Likely</p> <p>Very likely</p> <p>Likely</p> <p>Likely</p> <p>Very likely</p>	<p>General Assistance Program (GAP) capacity building program</p> <p>Internal and external coordination through the Regional Indian Work Group, Regional Tribal Operations Committee, and Multi-Agency MOU Work Group</p>	<p>Flooding, heat waves, droughts, etc. can interrupt essential services such as drinking water systems and wastewater treatment facilities. Potential for significant amounts of solid waste debris that must be managed after natural disasters.</p> <p>Subsistence resources may also be affected.</p> <p>Some tribal communities are experiencing elevated levels</p>	<p>Medium</p>	<p>Increased requests for assistance from Tribes that are experiencing climate-related hazards and impacts. Tribes will likely contact TMPO to request assistance from EPA. TMPO and the media Divisions will need to identify the types of assistance (technical training, financial, assigned personnel, etc.) that may be available from the Agency and if coordination with other federal agencies is needed</p> <p>May need to adjust how the Indian Environmental General Assistance Program (GAP) can be used by the Tribes to plan for or respond to climate change impacts.</p>	<p>Tribal impacts would mostly be limited to MI, WI, MN, and IN</p>

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	Increased surface water and ground water levels	Very likely		<p>of ozone as a result of long-distance transport.</p> <p>Some tribal communities are experiencing air quality impacts from wildfires located in the western U.S. and Canada.</p> <p>High water levels are causing erosion and contributing to non-point source pollution in some tribal communities.</p>		Region 5 may need to evaluate whether climate impacts may trigger additional EPA direct implementation responsibilities in Indian country.	
LCRD	<p>Increasing heavy precipitation events</p> <p>Increasing risk of floods</p> <p>Changes in temperature</p>	<p>Likely</p> <p>Likely</p> <p>Very likely</p>	Cleaning up Contaminated Sites and Waste Management	<p>Increased risk of contaminant release from EPA Sites.</p> <p>GW and subsurface contamination could be impacted by drought and flood conditions. Increased risk of contaminant migration from floods.</p> <p>Increased risk of washout of waste from floods</p> <p>Increased generation of debris and wastes requiring management due to flooding, tornadoes, or other storm events.</p> <p>Increased odor issues at solid waste disposal sites due to flooding</p>	Medium	<p>May need to consider altering selected remedies to ensure protection; altering (hazardous/nonhazardous) landfill criteria and BMPs to ensure protection; conduct more frequent targeted inspections at hazardous waste disposal facilities; increase oversight of authorized states and/or provide increased technical assistance.</p> <p>Climate changes may trigger the following impacts at Corrective Action, waste management sites, or brownfields and the selected remedies or permits will reflect these considerations:</p> <p>Increased flood and drought conditions will impact mobilization of contaminants at sites and may alter the time, cost, and effectiveness of cleanups.</p> <p>Vegetation considerations: Whatever plants are used may not be tolerant to heat or</p>	Little variation in impact across Midwest; potentially increased risk in Great Lakes Basin and Ohio River Valley

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						<p>excessive water. May need to change plant species or do additional maintenance.</p> <p>Drier conditions might cause severe erosion issues on terrain and constructed landfills. Might have 500-year flood events. Drier conditions combined with larger rain events might contribute to additional erosion concerns.</p> <p>Could have water table fluctuations - wells might need to be screened in different zones. Contaminant plumes might change direction. Groundwater monitoring efforts and remedies might become ineffective due to fluctuating water tables which could increase smear zones and additional remedy options may need to be considered.</p> <p>Frequent Flooding – may need to design corrective actions or other operational requirements to ensure they are protective given possible increased flooding. High flood event might wash away constructed remedies, waste management structure, and increase contamination or releases to the environment. Standing water could bring contaminants to the surface and increase exposure potential.</p> <p>Colder weather and erratic weather - could change construction season. Investigations and remedies may take longer to construct.</p>	

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						Increased sedimentation and scouring due to larger rain events could impact sediment sites.	
LCRD	Increasing intensity of hurricanes Increasing heavy precipitation events Increasing risk of floods Increasing extreme temperatures Increasing risk of wildfires	Likely  Likely  Likely  Very likely  Likely	Remedial Response Clean-Up & Corrective Action	Increased PBT chemical impacts to surface water  Increased air contamination and damage to land tied to need for remediation and heightened protective human health measures of workers on-site	Low	Programs will need to consider updates to operating facility SPCC, contingency and other risk management and P2 plans for listed wastes, solid wastes and PBTs/Chemicals of Concern.  Consideration/evaluation of appropriate work times for remedial/removal activities and impacts to clean-up timelines.  Consideration of facility and siting issues, as permitting occurs.  Potential increased need for emergency response	Regionwide, particularly for permitting and planning activities, where facilities may not have previously required an awareness for water releases, or risk management for water/flooding.
LCRD	Increasing intensity of hurricanes Increasing heavy precipitation events Increasing risk of floods Increasing extreme temperatures	Likely  Likely  Likely  Very likely	debris management and recovery related to disaster response to storm events, flooding, etc.)	Increased need for emergency response and debris/waste management due to storms resulting in large-scale releases of chemicals and/or air emissions (e.g., asbestos, PCBs, Hg, PBTs, SO <sub>2</sub> ) from flooded/damaged and/or demolished buildings.	High	Possible limitations to response capability due to staff and financial resource constraints.  Possible increased need for emergency disposal permits.	Regionwide
LCRD	Increasing extreme temperatures Increasing heavy precipitation events	Very likely  Likely	Protecting human health and ecosystems from chemical, hazardous substances, and petroleum risk.	Increased need for emergency response and debris/waste management due to storms resulting in large-scale releases of chemicals from	High	Risk Assessment Framework may need adjustments in order to: Assure that chemical exposure models reflect changes in the environment; Perform climate change assessments on contaminated mediums in LCRD (soil, groundwater, etc.). Address	More relevant near sites with large densities of chemical Manufacturers, Processors and Formulators (MPFs), and RCRA and Superfund sites.

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	Increasing flood risk	Likely	EPCRA (TRI): <ul style="list-style-type: none"> <li>o Maintaining inventory of chemical releases</li> <li>o Maintaining lists of facilities releasing chemicals</li> </ul> TSCA: <ul style="list-style-type: none"> <li>o Maintaining chemical database (inventories, dossiers and information) on chemicals within U.S. commerce (currently and previously, including allowances and prohibitions)</li> <li>o Maintaining lists of major chemical manufacturers, processors and formulators (MPFs)</li> </ul> FIFRA: <ul style="list-style-type: none"> <li>o Maintain Registration Review schedules/information</li> <li>o Maintaining establishment (facility) information</li> <li>o Monitor shifts in crop cycles and efficacy of pesticides</li> </ul>	flooded/damaged and/or demolished buildings.  Any regional risk assessments could be affected as weather and climate events could affect RCRA/TSCA and Superfund interpretations of risk at the facility level.		risk-shifting and new risk considerations where chemicals impact---or are impacted by---climate change (e.g., changes in chemical applications or uses).  Will need to keep other media offices aware of chemical use trends that affect their programs. Crop cycles and presence of pests may shift and are likely to get more invasive species from equatorial regions.  Facility awareness of these emerging chemical and risk issues and addressing them within their Operation and Emergency Management plans, as needed, but particularly where risk shifting, or new risk considerations occur.	Extremely relevant, particularly for permitting and planning activities, where facilities may not have previously required an awareness for water releases, or risk management for water/flooding.
MSD	Increased water temperatures Decreasing precipitation days and	Very likely  Likely	Water usage at EPA facilities	Water temperatures impact research activities or cooling requirements.	Low	Use of water in facilities is of low importance since GSA owns most EPA buildings in the region. R5 has COOP and extensive flexiplace availability.	All field offices except the Lake Guardian



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	increasing drought intensity			Facilities could be located in areas with water shortages			
MSD	Extreme heat, increased precipitation, poor air quality, poor water quality	Very likely	Health risks of EPA staff	Increase in health risks of Region 5 staff may impact the length of time to get work completed (increase in work delays)	Medium	Health risks of Region 5 staff is of high importance since health and well-being of staff is a top priority of the Agency.	All Region 5 staff and programs.
MSD	Extreme heat	Very likely	Electrical demand (infrastructure)	Facilities may experience power outages resulting in the increasing need for back-up power sources and contingency plans (especially for: security, lighting, and communication systems).	Low	Increased demand on electrical grids is of low importance since Region 5 currently has back-up power sources and contingency plans in place (COOP).	All Region 5 staff and programs; except the Lake Guardian.
MSD	Extreme heat and increasing storm intensity	Very likely	Transportation and commuting	Public transportation systems may experience closures or temporary shutdowns, thus preventing Region 5 staff from commuting into work.	Medium	Transportation and commuting of Region 5 staff is of medium importance. Contingency plans are in place, but staff away from the office for extended periods of time may pose a challenge to the completion of core programmatic work.	All Region 5 staff and programs; except the Lake Guardian.
MSD	Increasing storm intensity and flooding	Very likely	Emergency Response Support (personnel and property)	Increased demand of emergency response support may result in more staff away from the office for extended periods of time.	Low	Increase demand of emergency response support is of low importance. Region 5 has MOAs with R3 and R4 to assist in emergencies. An increase in Region 5 emergency response support will leave less staff available to complete core programmatic work.	All field staff and emergency response.
MSD	Increasing storm intensity and flooding	Very likely	Supply chains	Increased impact on supply chains may result in product and service delays.	High	Increased impact of supply chains is of high importance. Delays in receiving mission critical equipment and products may impact the quality and timely completion of work.	All Region 5 staff and programs.

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MSD	Increasing storm intensity, flooding, heat waves	Very likely	Facility Operations (infrastructure)	Impacts on facility operations may result in extended and more frequent shutdowns.	High	Extended and more frequent facility shutdowns is of high importance. Contingency plans are in place, but staff away from the office for extended periods of time may pose a challenge to the completion of core programmatic work.	All Region 5 facilities, especially the CRL.
MSD	Increasing storm intensity, flooding, extreme heat	Very likely	Personnel safety	Personnel engaged in field work and vulnerable to extreme temperatures or events	Medium	Personnel safety is of high importance since the health and well-being of staff is a top priority of the Agency. Increased storm intensity, flooding, and extreme heat makes Region 5 staff and contractors more vulnerable to hazards during field work. Severe Lake Weather is of high regional importance (affects GLNPO vessel operations o)	All Region 5 field staff and contractors. GLNPO has two vessels, the Lake Guardian and the Mud Puppy that are affected by changes in Great Lakes weather
SEMD	Increasing heavy precipitation events  Increasing risk of floods  Changes in temperature	Likely  Likely  Very likely	Cleaning up Contaminated Sites	Increased risk of contaminant release from EPA Sites  May need to alter selected remedies to ensure protection.	Medium	Increased flood and drought conditions will impact mobilization of contaminants at sites and may alter the time, cost, and effectiveness of cleanups.  Vegetation considerations: Whatever plants are used may not be tolerant to heat or excessive water. May need to change plant species or do additional maintenance.  Drier conditions might cause severe erosion issues on terrain and constructed landfills. Might have 500-year flood events. Drier conditions combined with larger rain events might contribute to additional erosion c-concerns.  Could have water table fluctuations - wells might need to be screened in different zones. Contaminant plumes might change direction. Remedies might become ineffective due to	Region-wide

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						<p>fluctuating water tables which could increase smear zones and additional remedy options may need to be considered.</p> <p>Frequent Flooding – may need to design corrective action to ensure it is protective given possible increased flooding. High flood event might wash away constructed remedies and increase contamination to the environment. Standing water could bring contaminants to the surface and increase exposure potential.</p> <p>Colder weather and erratic weather - could change construction season. Investigations and remedies may take longer to construct.</p> <p>Increased sedimentation and scouring due to larger rain events could impact sediment sites.</p>	
SEMD	<p>Increasing heavy precipitation events</p> <p>Increasing flood risk</p>	<p>Likely</p> <p>Likely</p>	Emergency Response	<p>Increased need for emergency response.</p> <p>Possible limitations to response capability due to staff and financial resource constraints.</p>	High	<p>Due to population densities along rivers in the Midwest, increased precipitation will lead to increased riverine flooding and to additional hazardous waste and domestic white goods (refrigerators, stoves) removal and cleanup as a result.</p> <p>Additionally, the frequency of events may stress availability of emergency response teams to react quickly.</p> <p>Hotter during days, and longer “summers” – health and safety considerations for the workers; Might need to take mid-day breaks and need more breaks - could change construction season; could take longer to conduct investigations and construct remedy;</p>	Hurricanes are not much of a risk in R5, but there may be an increased risk of extreme weather especially in the southern part of the Region (Illinois, Indiana, Ohio).

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						<p>need to consider health and safety of workers.</p> <p>More severe weather- could take longer to conduct investigations and construct remedy; need to consider health and safety of workers</p> <p>May have a great proliferation of pests if we have no freeze and thaw to control them. This could then require additional safety concerns for workers.</p>	
SEMD	<p>Increasing extreme temperatures</p> <p>Increasing heavy precipitation events</p>	<p>Very likely</p> <p>Likely</p>	<p>Protecting human health and ecosystems from chemical risks</p>	<p>Changing in planting timing or location may affect the volume and timing of agricultural chemical use which could impact the appropriate risk management decisions.</p>	<p>Low</p>	<p>Assure that chemical exposure models reflect changes in the environment</p>	<p>Unknown (Chemical Preparedness &amp; Prevention)</p>
WD	<p>Increasing heavy precipitation events</p>	<p>Likely</p>	<p>Restoring and protecting watersheds, aquatic ecosystems and wetlands</p>	<p>Increased number of sewer overflows and wastewater bypasses, as well increased pollutant loads in stormwater runoff, fouling streams and threatening public health.</p>	<p>High</p>	<p>Increased demand for re-evaluation of controls and effluent limitations in NPDES permits; re-evaluation of development of WQBELs and TBELs to account for the pollutant loads. There could be increased requests for variances from water quality standards. Pretreatment programs may need to be assessed for local limit revisions and other controls on industries to ensure protection of a wastewater treatment plant and the receiving water body.</p>	<p>Regionwide</p>
WD	<p>Decreasing precipitation days and increasing drought intensity</p>	<p>Likely</p>	<p>Restoring and protecting watersheds, aquatic ecosystems and wetlands</p>	<p>Reduced streamflow during summer months, altering the aquatic environments and increasing impairments.</p>	<p>Medium</p>	<p>Changes in watershed hydrology due to climate change will need to be reflected in changes to watershed assessment methodologies as well as TMDL development processes (e.g., models used to</p>	<p>Regionwide</p>

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						<p>develop TMDLs) in order to predict the effects of pollutant loadings on water quality. These methodologies and models, which are critical to state and EPA development of TMDLs, will need to be revised to ensure TMDLs continue to be effective in attaining water quality standards.</p> <p>WQBELs in NPDES permits are based on critical conditions which most frequently equate to a critical low flow value. Reduced stream flows could result in WQBELs in permits becoming more stringent to protect changing critical, lower-flow conditions.</p>	
WD	Increasing heavy precipitation events	Likely	Restoring and protecting watersheds, aquatic ecosystems and wetlands	Challenges to coastal wetlands' ability to migrate.	High	Watershed planning and permitting would be impacted should waterbody boundaries move or are displaced.	Regionwide
WD	<p>Increasing heavy precipitation events</p> <p>Decreasing precipitation days and increasing drought intensity</p> <p>Increased water temperatures</p>	<p>Likely</p> <p>Likely</p> <p>Very likely</p>	Restoring and protecting watersheds, aquatic ecosystems and wetlands	<p>Changes in hydrology may alter aquatic habitat and increase pollutant loading, compromising the ability of water bodies to support historic aquatic communities (e.g., fish and macroinvertebrates) and prompting requests for use designation changes, revised water quality standards. State and tribal bioassessment tools may not remain accurate as aquatic communities change. CWA programs, such as assessments, 303(d) lists and</p>	Medium	<p>Watershed planning efforts will need to be modified to include projections related to climate change. The 319 program may not have adequate funds and the needed technical expertise to support states/Tribes/local units of government in their efforts to continue to meet/maintain water quality standards. The research and models used to inform nonpoint source controls measures may need to be updated to reflect: new stormwater runoff scenarios in future climate conditions, best management practices (BMPs) likely to be more resilient under future climate conditions, and BMPs that will maximize pollutant reduction, particularly nutrient pollution from agricultural sources.</p>	Regionwide; tribal impacts limited to MI, WI, and MN

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				<p>TMDLs may not provide adequate protections without revisions. Increased nutrient loading and water temperatures will increase occurrences and severity of algal blooms and toxins. Current practices to control nonpoint sources and nutrient pollution may be less effective. Economic and cultural practices of tribal communities may be adversely affected.</p>		<p>Biennial CWA 303(d) listing process for TMDLs may encounter additional challenges in response to changing hydrologic conditions. Hydrology strongly affects pollutant loadings, therefore, changes in hydrology will affect the TMDL modeling and certain assumptions used in developing TMDLs to determine pollutant loading capacities.</p> <p>Impact on staff: additional time on evaluating 303(d) listings and recategorization requests on earlier listings, additional training necessary on TMDL and 319 models, more frequent reviews of TMDLs to determine if loadings are still sufficient to attain water quality standards.</p> <p>Impact to states/Tribes: additional time to evaluate the specific hydrodynamics of assessed waterbodies, possible changes in use designations, more frequent reviews of TMDLs to determine if loadings are still sufficient to attain water quality standards</p> <p>For Tribes: Conditions for wild rice stand growth in lakes and streams may be impacted by climate change, therefore, new strategies for protecting wild rice stands may be necessary.</p> <p>Water quality-based conditions in NPDES permits will require modification in response to the points made above regarding 303(d) listing status and WLA's in TMDLs.</p>	

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WD	<p>Increasing heavy precipitation events</p> <p>Increasing risk of floods</p>	<p>Likely</p> <p>Likely</p>	<p>Drinking water, wastewater and stormwater infrastructure</p>	<p>Water and wastewater infrastructure could be overwhelmed, upset or damaged, potentially resulting in disruption of the ability provide wastewater treatment until the treatment facilities operations can be restored, causing human health and aquatic life risks.</p> <p>Existing risk assessments and emergency response plans may be insufficient for affected water and wastewater utilities.</p> <p>Problems of safety as well as access to clean and safe water may be exacerbated for vulnerable and disadvantaged communities.</p>	<p>High</p>	<p>Particularly likely to affect direct implementation (DI) tribal program (provides oversight of and technical assistance to tribal public water systems), for example: Tribes may need more assistance related to infrastructure impacts associated with climate change, putting demands on the region to be aware of changes occurring at the system level and educate systems about how best to adapt, (e.g., implement an "all hazards" approach to emergency planning); the DI program could be called on to prioritize an increasing number of projects for contractors and Indian Health Service (IHS) public health officials; we may see demands to assist in emergency response efforts.</p> <p>State and tribal technical assistance (promote awareness and information exchange)—the region may face increased demands to assist states and Tribes with information sharing on available downscaled models and tools (creating resilient water utilities (CRWU) and climate resilience evaluation and awareness tool (CREAT)), as well as lessons learned associated with climate change adaptation at states, Tribes, and systems.</p> <p>State and tribal grant management and oversight may become more complicated.</p>	<p>DI—significant (, there are 112 tribal water systems in Region 5)</p>
WD	<p>Increased water temperatures</p>	<p>Very likely</p>	<p>The quality and availability of sources of safe drinking water</p>	<p>High water temperatures and increased runoff may increase the need for more</p>	<p>Medium</p>	<p>DI tribal program—water quality changes may result in more operational challenges and Safe Drinking Water Act (SDWA)</p>	<p>Inland river and reservoir sources; vulnerable groundwater</p>

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	<p>Increasing heavy precipitation events</p> <p>Decreasing precipitation days and increasing drought intensity</p>	<p>Likely</p> <p>Likely</p>		<p>source water protection measures or drinking water treatment, therefore raising costs or risk compromising quality of drinking water.</p> <p>Water supplies may be affected, forcing communities to seek alternative sources at added costs.</p> <p>Water demand may increase and prompt development of reservoirs or underground storage of treated water, requiring EPA to ensure quality.</p>		<p>violations, which would increase the work of the regional compliance officers; State and tribal voluntary programs—the region could see demands to increase technical assistance, outreach, and education to further implementation of state and tribal: (1) source water protection programs, including encouraging systems to track water quality/quantity trends (particularly static water levels) and (2) WaterSense/water efficiency/green infrastructure/water recycling and reuse programs.</p>	<p>sources; tribal impacts limited to MI, WI, and MN</p>
WD	<p>Increased water temperatures</p>	<p>Very likely</p>	<p>Restoring and protecting watersheds, aquatic ecosystems and wetlands</p>	<p>Pollutant limitations in NPDES wastewater permits may no longer be protective of water quality standards.</p>	<p>Medium</p>	<p>Water quality standards and/or effluent limitations may be revised to continue to be protective of the water body. As water temperatures increase thermal loads in permits would need to be evaluated possibly restricting thermal limitations to lower levels in permits to continue to be protective of the aquatic life in the water body. Inability of permittees to meet revised limits may prompt permit challenges or lead to noncompliance, increasing administrative or enforcement workloads, respectively.</p>	<p>Regionwide</p>
WD	<p>Increasing heavy precipitation events</p> <p>Decreasing precipitation days and</p>	<p>Likely</p> <p>Likely</p>	<p>Restoring and protecting watersheds, aquatic ecosystems and wetlands</p>	<p>Ability of water bodies to support historic aquatic life communities may be compromised, prompting</p>	<p>Medium-High</p>	<p>Requests for more WQS revisions/reviews, including revised uses, criteria, variances; more pressure from states, industry for flexibility, less stringent WQS; more stresses</p>	<p>Regionwide; impacts to aquatic communities are uncertain and will vary across the region, especially for temperature</p>



Office	Climate Change Impact <sup>a</sup>	Likelihood of Impact <sup>b</sup>	Focus of Associated EPA Program	Example of Risks if Program were Impacted	Likelihood EPA Program will be affected by Impact <sup>c</sup>	Regional Importance of Vulnerabilities	Variation in importance across the Region
	increasing drought intensity Increased water temperatures	Very likely		requests for use designation changes, revised water quality standards. State and tribal biocriteria and bioassessment tools may not remain accurate as aquatic communities change, necessitating additional monitoring and revisions. Increased nutrient loading and water temperatures will increase occurrences and severity of algal blooms and toxins, resulting in increased impairment of uses.		on listed species will mean more ESA BE work in conjunction with WQS changes; staff will spend more time working with states and Tribes to develop climate change monitoring strategies; states and Tribes will request additional staff time and resources to revise biocriteria and bioassessment tools; states and Tribes will require additional resources to address increasing impacts from algal blooms; staff will spend additional time answering questions from the public on algal bloom impacts	impacts, as coldwater communities could be more substantially affected than warmwater communities.
WD	Increasing intensity of hurricanes Increasing heavy precipitation events	Likely  Likely	Drinking water, wastewater and stormwater infrastructure	Damage from intense storms may increase the demand for public infrastructure funding and may require re-prioritizing of infrastructure projects.	High	Increased demands on the clean water and drinking water State Revolving Fund. Investments in water infrastructure may be needed to manage both decreases in rainfall (e.g., reservoirs) and increased in rainfall (e.g., increases in pipe and storm water management facilities), straining water financing generally including the State Revolving Funds.	Regionwide
WD	Decreasing precipitation days and increasing drought intensity Increasing heavy precipitation events	Likely  Likely	The quality and availability of safe drinking water Restoring and protecting watersheds, aquatic ecosystems and wetlands	Increased number of applications, increased evaluation of more complex applications, and more assistance to primacy states	Medium	Increased use of lower quality aquifers could mean more drinking water treatment residuals that are sometimes disposed of down injection wells. Increased use of aquifer recharge wells. Some of these may be injecting water from wastewater treatment plants.	Regionwide

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	Increased water temperatures	Very likely				<p>Increased use of aquifer storage and recovery wells to extend drinking water infrastructure.</p> <p>Competition for water use between agricultural, municipal/residential and energy uses. This may result in how the Agency evaluates aquifer exemptions. In some cases, aquifers could be so polluted that cleaning them up may be too expensive and they might then be granted exemption from protection under SDWA. However, if the cost of water sources rises due to droughts and dwindling resources, then the comparative cost of cleaning them up might be cheaper than exempting them.</p> <p>Increased number of storm water drainage and agricultural drainage wells</p> <p>Increased use of non-hazardous and hazardous injection wells to dispose of increased fluids that exceed the capacity of their systems (e.g., landfill leachate).</p> <p>Increased use of warm water for cooling (e.g., power plants) may result in more brackish water that will need to be disposed of instead of discharged via NPDES</p>	

<sup>a</sup> Climate Change impacts are based upon peer-reviewed scientific literature.

<sup>b</sup> In general, the sources cited in this section use Intergovernmental Panel on Climate Change (IPCC) likelihood of outcome terminology where the term ‘very likely’ means 90-100% probability and the term ‘likely’ means 66-100% probability ([https://report.ipcc.ch/ar6wg2/pdf/IPCC\\_AR6\\_WGII\\_SummaryForPolicymakers.pdf](https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf)).

<sup>c</sup> High assumes the program will be affected by the impact; Medium assumes the program could be affected under some conditions by the impact; Low assumes that there is a potential for the program to be impacted or uncertainty currently exists as to the potential nature and extent of the impact. This assessment is based on best professional judgment within EPA at this time. Please note, this column does not reflect several important considerations. For example, it does not distinguish timeframes (current, near-term, long-term). It does not account for regional and local variations. And it does not reflect the priority of actions the agency may undertake now or in the future

Angel, J. C., Swanston, C., Boustead, B. M., Conlon, K. C., Hall, K. R., Jorns, J. L., Kunkel, K. E., Lemos, M. C., Lofgren, B., Ontl, T. A., Posey, J., Stone, K., Takle, G., & Todey, D. (2018). *Impacts, Risks, and Adaptation in the United States: Midwest* (Volume II; Fourth National Climate Assessment, pp. 872–940). U.S. Global Change Research Program. <http://doi.org/10.7930/NCA4.2018.CH21>