Office of Land and Emergency Management

2022-2023 Climate Change Adaptation Implementation Plan

Draft

February 2022
Disclaimer

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Preface

Climate change poses significant threats to all Americans. Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, sets U.S. policy for taking a government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth. Such an approach requires the U.S. Environmental Protection Agency (EPA) and other federal agencies to coordinate their planning and implementation of key actions that address the policy’s goals, and to substantively engage with stakeholders, including state, local, and tribal governments.

In accordance with EPA’s 2021 *Climate Adaptation Action Plan*, the Agency’s Office of Land and Emergency Management (OLEM) is proactively incorporating climate adaptation planning into its mission, programs and management functions. OLEM manages programs such as the Superfund Remedial Program, RCRA Corrective Action Program, and PCB Cleanup Program under various statutory authorities. The program offices and supporting offices worked together to identify shared climate vulnerabilities and identify actions that will be taken to address the climate vulnerabilities. We want to ensure the actions we take are protective of human health and the environment, regardless of future climate conditions.

Assessing the climate vulnerability of our programs and connected communities and building the appropriate level of resilience when and where required is a major challenge. Sharing of experiences and lessons learned across our programs, including those gained in EPA regional offices, is critical to effectively implementing OLEM’s climate adaptation plan while maximizing the return on federal dollars invested in accomplishing OLEM’s mission. The effort requires significant engagement with overburdened and underserved communities that are likely to bear greater risks and burdens from extreme climate-driven events and experience greater difficulties recovering from such events. It also requires consideration of tribal treaties and protection of tribal reserved rights relating to natural resources, such as hunting, fishing and gathering.

Building our understanding of science-based projections on future climate scenarios and associated implications faced by our programs, as well as expanding our internal and external climate-related training efforts, are key components of OLEM’s climate adaptation plan. The current plan outlines priority actions to be taken in fiscal years 2022 and 2023. OLEM will annually update the plan through fiscal 2026 to clarify the status of climate vulnerabilities not yet fully addressed or to specify additional priority actions.
The U.S. Environmental Protection Agency’s Office of Land and Emergency Management (OLEM) maintains a Climate Resilience Workgroup currently comprising 32 representatives of six OLEM offices responsible for managing regulatory programs or providing mission support. Sixteen members serve on the Workgroup’s Coordinating Committee (*):

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# Table of Contents

1. Introduction .................................................................................................................. 1
2. Climate Vulnerability Assessment ................................................................................. 3
3. Identification of Priority Actions .................................................................................. 4
4. Climate Change Resilience Training Plan ..................................................................... 6
5. Relevant Science Needs ............................................................................................... 8
6. Partner and Stakeholder Engagement .......................................................................... 9
7. Summary of Actions and Next Steps ........................................................................... 10

Appendix A: Climate Vulnerabilities and Actions Identified in 2014

List of Tables:

<table>
<thead>
<tr>
<th>Table Number</th>
<th>Table Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>OLEM Program Operations Addressed in EPA Strategic Plan “Goal 6”</td>
</tr>
<tr>
<td>3.1</td>
<td>OLEM Priority Adaptation Actions Completed</td>
</tr>
<tr>
<td>3.2</td>
<td>OLEM Priority Adaptation Actions in FY 2022-2023</td>
</tr>
<tr>
<td>5.1</td>
<td>Relevant Science Challenges and Needs</td>
</tr>
</tbody>
</table>
1. Introduction

The U.S. Environmental Protection Agency (EPA) Office of Land and Emergency Management (OLEM) evaluated actions it could take to advance progress in meeting goals of EPA’s 2021 Climate Adaptation Action Plan. The Agency-wide plan accelerates and focuses attention on five priority actions to be taken in fiscal years (FYs) 2023 through 2026 to increase human and ecosystem resilience as the climate changes and disruptive impacts increase:

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.
5. Identify and address climate adaptation science needs.

OLEM provides policy, guidance, direction, oversight and funding for the Agency’s hazardous waste management, underground storage tanks, brownfields, and accidental oil and chemical release programs. OLEM also provides funding and support to states, tribal nations and territories carrying out site specific, waste program, emergency response and disaster preparedness activities. When contamination does occur, OLEM and its partners investigate, assess and clean up contaminated sites and work with affected communities to create a safer environment. OLEM also prepares for and responds to environmental emergencies, aids emergency preparedness and recovery planning across the nation, and promotes redevelopment of formerly contaminated areas. OLEM mission activities operate through six offices that administer 11 programs and coordinate with EPA regional offices through periodic meetings and working groups to assure that regional priorities and needs are addressed.

Building on its previous (FY 2014) climate adaptation plan, OLEM assessed potential climate vulnerabilities of its programs and evaluated associated actions that could be integrated to increase human and ecosystem resilience to climate change. Evaluation of potential actions considered the FY 2022-2026 EPA Strategic Plan with respect to one goal directly applying to OLEM program operations (Table 1.1):

- Goal 6: Safeguard and Revitalize Communities.
  - Objective 6.1: Clean up and restore land for productive uses and healthy communities.
  - Objective 6.2: Reduce waste and prevent environmental contamination.
  - Objective 6.3: Prepare for and respond to environmental emergencies.

<table>
<thead>
<tr>
<th>Strategic Objective</th>
<th>Offices</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean up and restore land for productive uses and healthy communities</td>
<td>Office of Superfund Remediation and Technology Innovation</td>
<td>Superfund Remedial Program: Addresses long-term risks to human health and the environment resulting from releases of hazardous substances at the nation’s highest priority non-federally owned sites.</td>
</tr>
<tr>
<td></td>
<td>Federal Facilities Restoration and Reuse Office</td>
<td>Federal Facilities Program: Works with federal entities to ensure fast and effective cleanup at federally-owned sites and facilitates partnerships among other federal agencies and surrounding communities.</td>
</tr>
</tbody>
</table>

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1 U.S. Environmental Protection Agency 2021 Climate Adaptation Action Plan (EPA 231R21001), October 2021.
2 Draft FY 2022-2026 EPA Strategic Plan, October 1, 2021.
<table>
<thead>
<tr>
<th>Strategic Objective</th>
<th>Offices</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Office of Resource Conservation and Recovery</td>
<td><strong>Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) Program</strong>: Implements the CA program directly in 13 states and territories and performs as lead regulator at facilities undergoing CAs in 42 EPA-authorized states. Facilities managing hazardous wastes must clean up releases of hazardous constituents that could adversely impact human health and the environment. The program is critical to preventing future Superfund sites.</td>
</tr>
<tr>
<td></td>
<td>Office of Brownfields and Land Revitalization</td>
<td><strong>Brownfields Program</strong>: Addresses environmental site assessment and cleanup of abandoned and potentially contaminated sites through grants, cooperative agreements and technical assistance to communities, states and tribes. Brownfield sites have potential contamination that needs to be assessed, and in some instances cleaned up, before redevelopment and reuse can occur. These sites generally are less contaminated than Superfund and RCRA corrective action sites.</td>
</tr>
<tr>
<td></td>
<td>Office of Underground Storage Tanks</td>
<td><strong>Leaking Underground Storage Tank (LUST) Cleanup Program</strong>: Works with state and tribal partners to clean up releases from LUST sites, many of which impact ground water resources. EPA provides resources to support the infrastructure of state LUST programs and provides regulations, guidance and policy to support cleanup of tank releases.</td>
</tr>
<tr>
<td>Reduce waste and prevent environmental contamination</td>
<td>Office of Resource Conservation and Recovery</td>
<td><strong>RCRA Solid Waste Program</strong>: Encourages states to develop comprehensive plans to manage nonhazardous industrial solid waste and municipal solid waste, sets criteria for municipal solid waste landfills and other solid waste disposal facilities, and prohibits the open dumping of solid waste. A core function is to seek and incentivize more sustainable ways to manage our materials, thereby prolonging the life of materials as usable commodities.</td>
</tr>
<tr>
<td></td>
<td>Office of Resource Conservation and Recovery</td>
<td><strong>RCRA Hazardous Waste Program</strong>: Issues comprehensive national regulations, defines solid and hazardous wastes, and imposes standards on entities that generate, recycle, transport, treat, store or dispose of hazardous waste. The program also monitors movement of hazardous waste across U.S. borders and helps ensure that exported waste is properly recycled or disposed of.</td>
</tr>
<tr>
<td></td>
<td>Office of Underground Storage Tanks</td>
<td><strong>Underground Storage Tank (UST) Prevention Program</strong>: Works with state, tribal and interagency partners to set and implement standards that prevent and detect releases from USTs. EPA provides resources to support the infrastructure of state and tribal UST programs and provides regulations, guidance and policies to support program implementation.</td>
</tr>
<tr>
<td>Prepare for and respond to environmental emergencies</td>
<td>Office of Emergency Management</td>
<td><strong>Superfund Emergency Response and Removal Program</strong>: Functions as the backbone federal response to emergency events; provides response support to state, local, tribal and potentially responsible parties when their response capabilities are exceeded; and manages risks to human health and the environment. Removal actions are typically responses intended to protect people from threats posed by hazardous waste sites.</td>
</tr>
<tr>
<td></td>
<td>Office of Emergency Management</td>
<td><strong>Oil Spill Program</strong>: Protects U.S. waters by preventing, preparing for and responding to oil spills. Section 311 of the Clean Water Act and the Oil Pollution Act of 1990 provide EPA with the authority to establish a regulatory program for preventing, preparing for and responding to oil spills that occur in U.S. navigable waters.</td>
</tr>
<tr>
<td></td>
<td>Office of Emergency Management</td>
<td><strong>EPA Chemical Emergency Preparedness and Prevention Program</strong>: Provides the national regulatory framework to prevent, prepare for and respond to catastrophic accidental chemical releases at U.S. industrial facilities.</td>
</tr>
</tbody>
</table>

Evaluation of potential actions also considered broader goals of EPA’s strategic plan, such as:

- **Goal 1: Tackle the climate crisis.**
  - **Objective 1.1: Reduce emissions that cause climate change.**
  - **Objective 1.2: Accelerate resilience and adaptation to climate change impacts.**
Additionally, OLEM considered federal government executive orders, such as:
- Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*.

The resulting FY 2022-2023 OLEM plan for implementing climate change adaptation, as outlined herein, will be annually reviewed and updated through 2026.

### 2. Climate Vulnerability Assessment

OLEM used information in the Fourth U.S. National Climate Assessment to update the 2014 OLEM vulnerability assessment. Information sources used to further evaluate and document climate vulnerabilities of OLEM programs and connected communities as of 2022 included:

- The U.S. EPA Adaptation Resource Center (ARC-X).
- The U.S. Climate Resilience Toolkit Climate Explorer.
- Regional climate change trends documented in site-specific feasibility studies, records of decision and five-year reviews under the Superfund Program.
- Regional climate change trends documented in facility-specific corrective measures under the RCRA program.
- EPA’s GeoPlatform and EnviroAtlas web-based tools.

OLEM’s updated assessment identified additional program vulnerabilities beyond those noted in OLEM’s 2014 plan, such as:

- Climate change impacts at currently contaminated lands may limit future land redevelopment.
- Inaccurate, incomplete or outdated information may result in less recognition of local hazards and vulnerabilities affecting sites and adjacent communities.
- Flooding, drought, soil erosion, plant disease and food shortages may be caused and/or enhanced by the impacts of climate change.
- Solid waste management infrastructure including recycling might be vulnerable to climate-related disruptions, which could affect the disposal or management of waste and recyclable materials (resulting in an accumulation of materials) and limit inputs to products made with recycled material.
- Community infrastructures for sustainable materials management may not have been built for climate resilience, which may result in larger quantities of disaster debris during an extreme weather or climate event.

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As the core of our efforts to build climate resilience into OLEM programs, we seek to ensure that forward-looking climate data are consistently applied in decisions informing site operations.

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3 *Tackling the Climate Crisis at Home and Abroad*, Executive Office of the President, February 2, 2021.
6 Adaptation Resource Center (ARC-X), an interactive resource to help local governments effectively deliver services to their communities even as the climate changes.
7 Climate Explorer, which provides interactive graphs and maps showing past and projected climate conditions for counties and county-equivalents across the United States.
8 The National Risk Index, a dataset and online tool to help illustrate the U.S. communities most at risk for 18 natural hazards.
9 GeoPlatform, which provides public access to EPA geospatial information.
10 EnviroAtlas, which provides geospatial data, tools and other resources concerning ecosystem services.
• The frequency and severity of accidental chemical releases and oil spills could increase due to climate change impacts such as more intense flooding or more frequent wildfires.
• Climate change and natural hazard risks need to be considered when developing chemical release and oil spill prevention regulations or issuing or updating policies and guidance materials.
• Tribal nations may require additional assistance in evaluating and addressing climate vulnerabilities.
• Communities with potential environmental justice concerns may require additional engagement, technical assistance, or resources to evaluate and address climate vulnerabilities they may face related to the proximity of chemical facilities, contaminated sites, waste management facilities and oil facilities.
• Existing EPA mechanisms to fund state, tribal and territorial grants and programs are unlikely to have provisions concerning climate change.

3. Identification of Priority Actions

Since 2014, OLEM completed four priority actions to address certain climate vulnerabilities previously identified (Table 3.1). Ongoing implementation of these actions continues to help the corresponding OLEM programs address the vulnerabilities identified above. (Appendix A provides information about other actions and vulnerabilities identified in the 2014 plan.)

Table 3.1 OLEM Priority Adaptation Actions Completed

<table>
<thead>
<tr>
<th>Relevant Program</th>
<th>Priority Action</th>
<th>Vulnerability Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>All programs</td>
<td>Develop technical fact sheets on climate adaptation for the types of sites most vulnerable to climate change impacts (contaminated sediment sites, contaminated waste containment systems, or groundwater remediation systems) (2019).(^\text{11})</td>
<td>Projected climate conditions should be used in assessing sites, selecting remediation and containment strategies, and designing and constructing contaminated site cleanups.</td>
</tr>
<tr>
<td>Superfund Remedial</td>
<td>Provide guidance to EPA regions on approaches to consider when evaluating climate resilience throughout the remedy selection and implementation process for non-federally owned sites proposed or currently listed on the National Priorities List (2021).(^\text{12})</td>
<td>Projected climate conditions should be used in assessing sites, selecting remediation and containment strategies, and designing and constructing contaminated site cleanups.</td>
</tr>
<tr>
<td>Brownfields</td>
<td>Update the “analysis of brownfields cleanup alternatives” language in brownfields grant “terms and conditions” to include a requirement that recipients consider potential changing climate conditions when evaluating cleanup alternatives (2017).</td>
<td>Projected climate conditions should be used in assessing sites, selecting remediation and containment strategies, and designing and constructing contaminated site cleanups.</td>
</tr>
<tr>
<td>UST Prevention</td>
<td>Update or develop guidelines for state, local and tribal authorities to use in the event of a threatened or actual flood or wildfire affecting underground or aboveground storage tanks (2020, 2021).(^\text{13})</td>
<td>Remediation and containment strategies and materials used in construction may need to be strengthened to reflect changing climate conditions.</td>
</tr>
</tbody>
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\(^{12}\) Memorandum from Office of Superfund Remediation and Technology Innovation to regional Superfund national program managers, June 2021 (applying to non-federal facilities).

In FY 2022-2023 OLEM will initiate six additional priority actions to accelerate climate adaptation in OLEM programs and connected communities (Table 3.2). Identification of the priority actions included collaborations with EPA regional offices, which carry out the program work in accordance with relevant statutory and regulatory authorities.

Table 3.2 OLEM Priority Adaptation Actions in FY 2022-2023

<table>
<thead>
<tr>
<th>Relevant Program</th>
<th>Priority Action</th>
<th>Vulnerability Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>All programs</td>
<td>Develop core adaptation training and identify stakeholder audiences and channels.</td>
<td>Agency priority 1: Integrate climate adaptation into programs (addressing multiple specific vulnerabilities).</td>
</tr>
<tr>
<td>All programs</td>
<td>Develop climate adaptation fact sheets focusing on (a) characterization of sites with known or potential contamination and (b) known, recurring non-severe weather and climate adaptation challenges. Additionally, update the existing climate adaptation fact sheet on sediment remedies to include technical guidance specific to evaluating and addressing climate vulnerabilities affecting sediment caps.</td>
<td>Projected climate scenarios should be used in assessing contaminated sites, selecting site remediation and waste containment strategies at contaminated sites, and designing and constructing remedies at contaminated sites.</td>
</tr>
<tr>
<td>All programs</td>
<td>Deploy technical capacity to provide climate vulnerability assessments.</td>
<td>Agency priority 1: Integrate climate adaptation into programs (addressing multiple specific vulnerabilities).</td>
</tr>
<tr>
<td>All programs</td>
<td>Expand assessments for newly identified climate vulnerabilities, with a focus on communities located near contaminated or waste management sites, municipal waste management facilities or waste recycling facilities.</td>
<td>Communities with potential environmental justice concerns may require additional engagement and resources to evaluate and address climate vulnerabilities they may face related to the proximity of chemical facilities, contaminated sites, waste management facilities and oil facilities.</td>
</tr>
<tr>
<td>RCRA Corrective Action</td>
<td>Develop a memorandum that calls for climate change impacts to be considered as part of the remedial investigation, remedy selection, and statement of basis for any necessary corrective action at a RCRA facility.</td>
<td>Projected climate scenarios should be used in assessing contaminated sites, selecting site remediation and containment strategies at contaminated sites, and designing and constructing remedies at contaminated sites.</td>
</tr>
</tbody>
</table>

Identification of the OLEM priority actions included collaborations with EPA regional offices, which carry out the program work in accordance with relevant statutory and regulatory authorities. Other anticipated OLEM actions complement actions underway or planned in regional offices, such as:

- Working with the U.S. Geological Survey’s National and Regional Climate Adaptation Science Centers.\(^\text{14}\)
- Developing geographic information system (GIS)-based capability to provide site- and facility-specific information about projected climate conditions.
- Incorporating flooding- and stormwater-related risk factors into Superfund remedy decisions and five-year reviews.
- Improving public awareness on the links between waste (particularly food waste) and climate change.
- Conducting outreach to state and tribes about the Agency’s guidelines for preparing for and recovering from wildfire or flooding events that affect underground or aboveground storage tanks.

\(^{14}\)Climate Adaptation Science Centers, a partnership-driven program that teams scientists with natural and cultural resource managers and local communities to help fish, wildlife, waters and lands across the country adapt to changing conditions.
• Promoting the use of green infrastructure and other nature-based systems to address conditions such as flooding and urban heat islands at brownfields.
• OLEM-focused venues and EPA national-regional collaborations that provide opportunities to engage communities with environmental justice concerns, community organizations, and tribes.

OLEM also will continue actions such as:
• Working with EPA’s Office of Research and Development (ORD) and regional offices to improve climate-related GIS mapping and modeling capabilities at regional and local levels.
• Refining the data and inputs required for models typically used for site-and facility-specific planning.
• Compiling site- and facility-specific examples of measures that have been taken in OLEM-connected communities to increase resilience to extreme weather events and gradually changing conditions on a local level.
• Offering technical assistance grants and services and establishing cooperative agreements that help communities with environmental justice concerns evaluate and address climate vulnerabilities.

OLEM will annually evaluate the progress of each priority action, review associated outcomes such as co-benefits, identify any changes in resource requirements, and assess the status of key partnerships or stakeholder communities. Potential co-benefits include advancing mitigation of greenhouse gases, achieving greater energy independence, optimizing management of waste streams and promoting infill revitalization to protect undeveloped areas. Annual updates to this plan may include additional priority actions.

4. Climate Change Resilience Training Plan
To ensure field readiness of OLEM personnel, project stakeholders, and connected communities, OLEM will implement a training plan that enhances general and technical knowledge of relevant climate impacts and climate adaptation approaches. The 2022-2023 training plan builds on multiple activities initiated in 2014-2021, with an emphasis on:
• Advancement of OLEM’s 2022-2023 priority actions (outlined in Table 3.2).
• Greater collaboration among the OLEM offices responsible for managing and overseeing regulatory programs, to maximize the exchange of new information about technical parameters, shared vulnerabilities, innovative adaptation approaches and lessons learned.
• Increased transferability and synergies of program-specific training components, to maximize return on associated investments.
• Enhanced partnerships with other federal agencies, states, tribes, territories and non-government organizations, to mutually strengthen adaptive capacity while advancing environmental justice. Such partnerships may consider traditional ecological knowledge, unique exposure pathways, cultural considerations and existing climate adaptation plans, as appropriate, from tribes and local communities.

OLEM training will include sessions dedicated to the topic of local impact assessment, including associated modeling. Effective climate modeling requires integration of regional variables such as topography, land cover, land use, island climates, and complex coastlines. It also requires accurate methods for downscaling global or regional climate models and interpreting the results of modeling.
OLEM’s climate adaptation training focuses on conveying information about the following core topics:

1. Vulnerability assessment that includes evaluating the exposure and sensitivity of a facility, system or project to hazards of concern, such as high floodwater, drought conditions or wildfire threats.
2. Identification of adaptation measures that can be taken to increase resilience to climate change.
3. Adaptive capacity that can be built by implementing adaptation measures and periodically reassessing vulnerabilities to determine if additional capacity is needed.

OLEM anticipates training channels such as:

- EPA’s annual National Association of Remedial Project Managers (NARPM) meeting.
- EPA’s Federal Facilities Academy training series\(^\text{15}\) for project managers working on federal facility Superfund sites, as well as periodic offerings of the Federal Facility RPM course\(^\text{16}\).
- OLEM’s Training Exchange, a platform for providing training to EPA, other federal, state and tribal personnel responsible for regulatory and enforcement activities relating to solid and hazardous waste cleanup and emergency response.\(^\text{17}\)
- The Association of State and Territorial Solid Waste Management Officials.\(^\text{18}\)
- The Interstate Technology and Regulatory Council.\(^\text{19}\)
- Conferences such as Brownfields 2022,\(^\text{20}\) National Tanks Conference 2022,\(^\text{21}\) and the 2022 Tribal Lands & Environment Forum.\(^\text{22}\)
- Open-access webinars addressing cross-program or program-specific topics. Each webinar will be designed to share new information or lessons learned gained through other training channels, program developments, or experiences of connected communities.\(^\text{23}\)
- ARC-X capacity to publicly share outreach materials such as videos and project descriptions.
- Other OLEM-focused venues and EPA national-regional collaborations that provide opportunities to train communities with environmental justice concerns, community organizations, and tribes.

OLEM anticipates modeling efforts that make greater use of forward-looking data to project vulnerabilities under a range of climate scenarios. This approach is demonstrated at the Malone Services Company Superfund Site in Texas City, Texas, where remedy design and construction planning involved use of National Oceanic and Atmospheric Administration models to analyze storm surge and wave run-up under various hurricane and sea level rise scenarios.

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\(^{15}\) Federal Facility Academy.

\(^{16}\) Federal Facility RPM, a 3-day training course open to federal facility remedial project managers representing federal or state agencies or tribes across the nation.

\(^{17}\) TRAINEX.

\(^{18}\) Association of State and Territorial Solid Waste Management Officials (ASTSWMO).

\(^{19}\) Interstate Technology and Regulatory Council (ITRC).

\(^{20}\) Brownfields 2022.

\(^{21}\) National Tanks Conference sponsored by NEIWPCC, a regional commission that helps the states of the Northeast preserve and advance water quality.

\(^{22}\) Tribal Lands & Environment Forum, 12\(^{th}\) annual conference.

\(^{23}\) As publicized and delivered through EPA venues such as the CLU-IN seminar series and Sustainable Materials Management Web Academy.
5. Relevant Science Needs

As stated in Executive Order 14008 of January 27, 2021, “We must listen to science – and act.” This requires that existing science be utilized to the fullest and that gaps in the science be identified and plans be put in place to fill them. OLEM has identified the need for additional science-based information and tools (Table 6.1) that are needed to ensure climate considerations are incorporated across all OLEM programs and communities and to ensure resiliency against the impacts of climate change already manifested and continuing to intensify.

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Needed Information and Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure forward-looking climate data are applied in models used to evaluate and mitigate risk at sites and facilities managed or overseen by OLEM.</td>
<td>Surface water and groundwater model input data need to be updated to reflect future changes.</td>
</tr>
<tr>
<td>Understanding and quantifying the effect of soil and groundwater chemistry changes resulting from weather changes and sea level rise.</td>
<td>The effect of increased or decreased salinity of clay caps and liners in covered landfill systems, as well as the effects of increases in ionic strength, precipitation, and water content on clay mineral swelling and shrinking, needs to be better understood. Data on potential changes in subsurface microbial communities and activity with changes in salinity are needed to understand the effects of salt water intrusion on natural attenuation. Changes in sorption and cation exchange capacity with changes in ionic strength need to be better understood.</td>
</tr>
<tr>
<td>Limited ability to evaluate changes in groundwater and soil vapor hydrology resulting from short-term or sustained climate changes.</td>
<td>Development of tools for estimating changing precipitation and sea level rise effects on groundwater flow. Methods to determine if groundwater monitoring wells and sampling plans will be able to adapt to changes in groundwater levels and movement over time. Estimates of contaminant movement and release resulting from hydrology changes. Data on the effect of changing temperature, chemistry and flow conditions on vapor phase transport and vapor intrusion.</td>
</tr>
<tr>
<td>Limited ability to evaluate the effects of changes in ecological conditions on remedy effectiveness and associated exposure risks at contaminated sites.</td>
<td>Data to allow projection of expected changes in plant community and animal populations that may affect site containment, including: • Expected vegetation changes over time. • Potential increases in burrowing fauna and associated effects on terrestrial and aquatic caps. • The potential for changes in plant and animal diseases, including vector control issues.</td>
</tr>
<tr>
<td>Limited understanding of the effects of changing temperature on hazardous chemical exposure and uptake and associated effects on humans, plants and animals.</td>
<td>Updated exposure factors data are needed for risk evaluation and management. Updated model inputs to estimate changes in food and water ingestion rates, chemical uptake and depuration, metabolic effects, etc. resulting from temperature increases and other climate-related stressors.</td>
</tr>
<tr>
<td>Lack of understanding of climate change impacts on physical and chemical processes associated with soil and sediment erosion, waste submergence, and contaminant behavior at landfills and capping systems at nearshore locations.</td>
<td>Research on the erosion potential and mechanisms for landfill structures and contents. Contaminant release mechanisms and rates during extreme weather events or sustained climate changes. Information on the fate and transport of solid waste and dissolved species as soil and sediment continues to erode. Dissolution and transport rates and mechanisms when contaminated soil is eroded. Estimates of the release of insoluble materials such as micro and macro plastics from eroding landfills and associated inputs to the marine plastic load. Degradation and release of materials containing per- and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs) and other persistent, bioaccumulative and toxic (PBT) chemicals. Effects of soil and sediment erosion on local environments and associated bioavailability to local and global ecosystems and human receptors.</td>
</tr>
</tbody>
</table>

Table 5.1 Relevant Science Challenges and Needs
### Challenges Needed Information and Tools

<table>
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<tr>
<th>Challenges</th>
<th>Needed Information and Tools</th>
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<td>Experience in the use of tools for projecting changes in energy regimes in</td>
<td>Projective models of precipitation and sea level rise yielding information about future increases or decreases in surface water flow energy and erosion rates that may impact sediment caps or contaminated material left in place.</td>
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<td>rivers and nearshore sediment sites and associated effects on contaminated</td>
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<td>materials.</td>
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<td>Need to incorporate the social and behavioral aspects of climate change,</td>
<td>Quantification of potential human population changes near sites and facilities managed or overseen by OLEM, which may result in exposure and risk to different segments of society. Effect of population movements resulting from sea level rise, flooding, wildfire or other climate impacts on OLEM sites and connected communities.</td>
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<td>which may result in changed risk calculations and mitigation approaches.</td>
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### 6. Partner and Stakeholder Engagement

In 2021 OLEM engaged multiple partners in discussions about climate change vulnerabilities, priorities and actions through venues such as the:

- Federal Remediation Technologies Roundtable, which dedicated its Fall 2021 inter-agency meeting to the topic of ensuring remedy protectiveness and climate resilience in site cleanups.\(^{24}\)
- National Environmental Justice Advisory Council, a federal advisory committee to the U.S. EPA.\(^{25}\)
- Tribal Superfund Working Group efforts to mitigate and adapt to climate change at Superfund sites.\(^{26}\)
- Northwest Remediation Conference organized by the Northwest Environmental Business Council to exchange information about remediation technologies and science and brownfields redevelopment.\(^{27}\)
- Open-access Agency webinars on topics potentially influenced by climate change and associated adaptation or mitigation strategies, such as brownfields redevelopment in economically distressed areas,\(^{28}\) food waste research,\(^{29}\) optimizing renewable energy reuse on Superfund sites,\(^{30}\) and ecosystem services benefits and considerations for contaminated mine site cleanups.\(^{31}\)
- Association of State and Territorial Solid Waste Management Officials 2021 mid-year meeting.\(^{32}\)
- Quarterly meetings held with other federal agency partners to provide technical assistance for innovative remedial technologies and sustainable redevelopment, including generation of renewable energy.
- Presentations delivered to a range of stakeholders (including cities, counties, territories and tribes) regarding resilience to natural disasters and proper management of natural disaster debris, as described in EPA’s *Guidance on Planning for Natural Disaster Debris* (PNDD).\(^{33}\)

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\(^{24}\) Recordings of presentations delivered during the two-part meeting (on November 8 and November 15, 2021) a recap of the November 8 general discussions, and a summary of relevant federal policies, guidance and implementation tools (as of November 8) are available online.
\(^{25}\) The National Environmental Justice Advisory Council’s *Superfund Remediation and Redevelopment for Environmental Justice Communities* report released in May 2021 considers the impacts of climate change and natural disasters on Superfund remedies.
\(^{26}\) Activities of the Tribal Superfund Working Group are coordinated by Northern Arizona University.
\(^{27}\) The *Northwest Environmental Business Council* is a non-profit trade association that represents businesses working to protect, restore and sustain the natural and built environment.
\(^{32}\) Planning for Resiliency and Sustainability of Remedies in a Changing Climate virtual presentation, April 28, 2021.
\(^{33}\) *Planning for Natural Disaster Debris* (EPA-F-19-003), June 20, 2019.
Further development and ongoing implementation of the OLEM climate change adaptation plan will consider and protect tribal treaty and reserved rights (TTR) by strengthening consultation as well as staff training and other requirements of a September 2021 federal interagency memorandum of understanding regarding TTR. Under the Constitution, treaties with tribal nations are part of the supreme law of the land and establish 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 and for federal protections. 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.

7. Summary of Actions and Next Steps
OLEM will initiate or continue actions to ensure resilience of its programs and connected communities as the climate continues to change. Most of the 2022-2023 priority actions address climate-related vulnerabilities that are shared among OLEM programs:

- Current and projected climate conditions should be used, as appropriate, to assess sites with suspected or known contamination, select any remediation and containment strategies, and design and construct remedies at contaminated sites.
- Communities with potential environmental justice concerns may require additional engagement, user-friendly tools, and resources to evaluate and address climate vulnerabilities they may face due to their proximities to chemical facilities, contaminated sites, waste management facilities or oil facilities.
- Training on the core components of climate adaptation is needed to assure use of a consistent science-based approach across OLEM programs and to facilitate adaptation in connected communities.
- Outreach materials such as technical fact sheets and related case studies are needed to share lessons learned and new information across OLEM programs and connected communities.
- OLEM technical assistance may be needed to assess climate vulnerabilities at specific sites or facilities.

OLEM’s Climate Resilience Workgroup will continue to work with OLEM management and staff to track action progress, potentially refine actions, and document any climate vulnerabilities not yet identified. OLEM anticipates updating its climate adaptation implementation on an annual basis and making each update publicly available online.

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34 Memorandum of Understanding Regarding Interagency Coordination and Collaboration for the Protection of Tribal Treaty Rights and Reserved Rights. Tribal treaty rights have the same legal force and effect as federal statutes and 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.

35 Office of Land and Emergency Management information supporting EPA’s Climate Adaptation Plan.
## Appendix A: Climate Vulnerabilities and Actions Identified in 2014

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<tr>
<th>Topic</th>
<th>Vulnerability</th>
<th>Action</th>
<th>Office</th>
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<tr>
<td>Proper Management of Hazardous and Non-Hazardous Waste</td>
<td>Design and placement of RCRA Treatment, Storage and Disposal facilities may need to change to accommodate climate change impacts. Current waste management capacity may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed waste events. <em>(Actions also in Emergency Response)</em></td>
<td>Based on outreach to states and tribes, develop recommendations for these partners to incorporate climate change into RCRA Permitting Programs as appropriate (e.g., through robust implementation of technical standards for facility location and design). Prepare fact sheets on the proper management of wastes/debris associated with large natural disasters (e.g., electronic, household hazardous wastes, white goods, etc.) Continue collaborative development with the Office of Homeland Security on an interactive electronic waste management planning tool to aid federal, state and local emergency planners and managers in development of waste/debris management plans. Finalize a document describing the “4 Step Process for Waste Management Planning.” Update the ORCR Homeland Security Website with updated waste management planning information.</td>
<td>ORCR</td>
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<td>Reducing Chemical Risks and Releases</td>
<td>Spill Prevention Plans may need to be updated due to the significant increases in the incidence of flooding and storm events.</td>
<td>Incorporate sensitivity for climate change vulnerabilities in oil Spill Prevention, Control, and Countermeasure (SPCC) and Facility Response Plan (FRP) inspector training (e.g., reminding inspectors to consider vulnerabilities at the subject facility during catastrophic weather events). Incorporate in SPCC and FRP guidance the statement of potential vulnerabilities to oil facilities from catastrophic weather events due to climate change. Incorporate sensitivity for climate change vulnerabilities in risk management plan (RMP) inspector training and guidelines. (e.g., example, reminding inspectors to consider vulnerabilities at the subject facility during catastrophic weather events).</td>
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<td>Restoring Land</td>
<td>Increased contaminant migration may lead to boundary changes at current sites or creation of new sites. Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts. Changing climate conditions may impact continued remedy effectiveness. Remedies that are “complete” or are long-term actions may no longer be protective and resilient as climate conditions change at site.</td>
<td>Develop recommendations for states and tribes to encourage that climate change considerations be incorporated into all of their RCRA Corrective Action Programs (e.g., regarding remedy selection, etc.) Share vulnerability screening protocol for regional application. - Develop criteria to identify remedies where performance may be impacted by climate change. - Develop a methodology to evaluate and ensure remedy protectiveness. Prepare remedy-specific climate change adaptation fact sheets for remedies most likely to be impacted and identify potential vulnerabilities and adaptation recommendations. Identify existing Superfund program processes (RI/FS, ROD, RD/RA, Five Year reviews, etc.) for implementation of climate change adaptation protocols to ensure continuing protectiveness of current and future remedies.</td>
<td>ORCR OSRTI FFRRO OBLR</td>
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<td>Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.</td>
<td>Prepare training materials, coordinate with NARPM co-chairs and Superfund forums to integrate the training into future NARPM events, and provide web-based content and training.</td>
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<td>Increased contaminant migration may lead to boundary changes at current sites or creation of new sites.</td>
<td>Participate with OLEM and other EPA programs to initiate conversations as appropriate regarding approaches for handling remedy impacts from climate change.</td>
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<td>Risk factors and rankings for risk-based cleanup strategies may need to be reassessed based on changing climate conditions.</td>
<td>Work with ASTSWMO to gather information on if and how states currently alter remediation plans in response to changing climate impacts.</td>
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<td>Site characterization and design of cleanups may not reflect changing climate conditions.</td>
<td>Share information among states, tribes and EPA regions regarding new or modified investigation strategies and remediation techniques.</td>
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<td>Emergency Response</td>
<td>Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.</td>
<td>Work with ASTSWMO to gather information on if and how states currently alter site assessments in response to flooding or drought conditions.</td>
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<td>Current waste management capacity may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed waste events.</td>
<td>Share information among states, tribes and EPA Regions regarding new or modified assessment techniques.</td>
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<td>Work with ASTSWMO to gather information on if and how states currently alter risk factors and rankings in response to flooding or drought conditions.</td>
<td>Share information among states, tribes and EPA regions regarding how climate conditions may impact risk-based cleanup factors and rankings.</td>
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<td>Work with regional staff to update the Analysis of Brownfields Cleanup Alternatives (ABCA) language in the brownfield grant T&amp;Cs to include language that requires recipients take potential changing climate conditions into consideration when evaluating cleanup alternatives and reuse planning.</td>
<td>Work with ASTSWMO to gather information on if and how states currently respond to climate-related emergencies (e.g., use of GIS mapping in flood-prone areas).</td>
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<td>Develop an outreach strategy to promote the importance of climate change adaptation and mitigation, explaining how it will affect all communities at varying degrees and why it’s important to consider when developing revitalization plans in their community.</td>
<td>Analyze lessons learned from Hurricanes Katrina (2005) and Sandy (2012) to identify how EPA can help states respond to UST-related hurricane impacts.</td>
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<td><strong>(Actions also in Proper Management of Hazardous and Non-Hazardous Waste)</strong></td>
<td>Current levels of administrative, enforcement, and emergency response staff may be insufficient to cover needs if number of extreme events increase.</td>
<td>Prepare fact sheets on the proper management of wastes/debris associated with large natural disasters (e.g., electronic, household hazardous wastes, white goods, etc.)</td>
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<td>Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.</td>
<td>Continue collaborative development with the Office of Homeland Security, on an interactive electronic waste management planning tool to aid federal, state and local emergency planners and managers in development of waste/debris management plans.</td>
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<td>Training needs (both current and future) are likely to increase in order to meet the increase demand for response actions.</td>
<td>Finalize a document describing the “4 Step Process for Waste Management Planning.”</td>
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<td>Update the ORCR Homeland Security Website with updated waste management planning information.</td>
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<td>Utilize the National Response Team multi-agency membership (e.g., NOAA, FEMA, U.S. Coast Guard) to monitor the state of preparedness. Based on these meetings, evaluate if additional resources and planning exercises will be needed to address the impacts from changes in the frequency and/or severity of extreme weather events.</td>
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<td>Incorporate the use of FlexViewer technology as a preparedness tool for climate change impacts. The EOC will build on-going development and use of FlexViewer technology to graphically display information on notifications and incidents in headquarters and all 10 regional EOCs. This technology will allow for improved and up-to-date GIS mapping of watersheds and coastal areas impacted by climate change.</td>
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<td>Incorporate materials on the impacts of climate change as EOC training materials are updated and exercises are planned.</td>
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<td><strong>Tools, Data, Training and Outreach</strong></td>
<td>Assist in identifying reliable data sources to use in site-specific analyses may need to be identified.</td>
<td>Provide recommended data sources and parameters to OLEM offices and Regions to ensure consistent mapping data and protocols. Develop these recommendations by working with the agency’s climate change adaptation workgroup and EPA’s Office of Research and Development.</td>
<td><strong>OCPA</strong></td>
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<td>Assist in revising training protocols and SOPs that take into account climate change impacts and what to look for may need to be developed.</td>
<td>Participate in agency climate change adaptation training development as appropriate, as well as develop specific training as needed for OLEM staff.</td>
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<td>Models, decision tools, site environmental data and information feeds may need to be updated to reflect changing climate conditions.</td>
<td>Work with EPA partners and external experts to monitor evolving assumptions related to climate science. Develop a method for disseminating this information to OLEM offices that ensures consistent assumptions are used across all activities.</td>
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<td>populations was included in the characterization criteria.</td>
<td>Expand OBLR partnership with ORD on climate vulnerable indicators partnership and community pilots.</td>
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<td>Review and update as necessary, existing community engagement tools and training to incorporate climate change concerns in how we partner with communities, based on new knowledge relating to climate change.</td>
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<td>Work with the agency’s climate change workgroup and EPA’s Office of Research and Development to ensure consistent mapping data and protocols that can be share with its partners, including tribes to help inform their adaptation activities.</td>
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<td>Assist the Institute for Environmental Tribal Professionals (ITEP) in developing adaptation into their normal climate change training.</td>
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