

US EPA ARCHIVE DOCUMENT

Office of Solid Waste and Emergency Response
Climate Change Adaptation
Implementation Plan

June 2014

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Preface

The U.S. Environmental Protection Agency (EPA) is committed to identifying and responding to the challenges that a changing climate poses to human health and the environment.

Scientific evidence demonstrates that the climate is changing at an increasingly rapid rate, outside the range to which society has adapted in the past. These changes can pose significant challenges to the EPA's ability to fulfill its mission. The EPA must adapt to climate change if it is to continue fulfilling its statutory, regulatory and programmatic requirements. The Agency is therefore anticipating and planning for future changes in climate to ensure it continues to fulfill its mission of protecting human health and the environment even as the climate changes.

In February 2013, the EPA released its draft *Climate Change Adaptation Plan* to the public for review and comment. The plan relies on peer-reviewed scientific information and expert judgment to identify vulnerabilities to EPA's mission and goals from climate change. The plan also presents 10 priority actions that EPA will take to ensure that its programs, policies, rules, and operations will remain effective under future climatic conditions. The priority placed on mainstreaming climate adaptation within EPA complements efforts to encourage and mainstream adaptation planning across the entire federal government.

Following completion of the draft *Climate Change Adaptation Plan*, each EPA National Environmental Program Office, all 10 Regional Offices, and several National Support Offices developed a *Climate Adaptation Implementation Plan* to provide more detail on how it will carry out the work called for in the agency-wide plan. Each *Implementation Plan* articulates how the office will integrate climate adaptation into its planning and work in a manner consistent and compatible with its goals and objectives.

Taken together, the *Implementation Plans* demonstrate how the EPA will attain the 10 agency-wide priorities presented in the *Climate Change Adaptation Plan*. A central element of all of EPA's plans is to build and strengthen its adaptive capacity and work with its partners to build capacity in states, tribes, and local communities. EPA will empower its staff and partners by increasing their awareness of ways that climate change may affect their ability to implement effective programs, and by providing them with the necessary data, information, and tools to integrate climate adaptation into their work.

Each Program and Regional Office's *Implementation Plan* contains an initial assessment of the implications of climate change for the organization's goals and objectives. These "program vulnerability assessments" are living documents that will be updated as needed to account for new knowledge, data, and scientific evidence about the impacts of climate change on EPA's mission. The plan then identifies specific priority actions that the office will take to begin addressing its vulnerabilities and mainstreaming climate change adaptation into its activities. Criteria for the selection of priorities are discussed. An emphasis is placed on protecting the most vulnerable people and places, on supporting the development of adaptive capacity in the tribes, and on identifying clear steps for ongoing collaboration with tribal governments.

Because EPA's Programs and Regions and partners will be learning by experience as they mainstream climate adaptation planning into their activities, it will be essential to evaluate their efforts in order to understand how well different approaches work and how they can be improved. Each *Implementation Plan* therefore includes a discussion of how the organization will regularly evaluate the effectiveness of its adaptation efforts and make adjustments where necessary.

The set of *Implementation Plans* are a sign of EPA's leadership and commitment to help build the nation's adaptive capacity that is so vital to the goal of protecting human health and the environment. Working with its partners, the Agency will help promote a healthy and prosperous nation that is resilient to a changing climate.

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I. Climate Change Impacts to OSWER Programs

What We Do

Climate change is posing new challenges to the Environmental Protection Agency's (EPA's) ability to fulfill its mission. The Office of Solid Waste and Emergency Response's (OSWER's) mission is to protect human health and the environment, and preserve and restore land resources. OSWER strives to protect the land from contamination through sustainable materials management and the proper management of waste and petroleum products. When contamination does occur, OSWER and its partners clean up communities to create a safer environment for all Americans. In addition, OSWER prepares for and responds to environmental emergencies and promotes redevelopment of contaminated areas and emergency preparedness and recovery planning.

Without proper protections and effective restoration, the presence of uncontrolled hazardous substances in surface water, ground water, air, soil and sediment can cause human health concerns, threaten healthy ecosystems, and inhibit economic opportunities on and adjacent to contaminated properties. Waste on the land can also migrate to ground water and surface water, contaminating drinking water supplies. There are multiple benefits associated with cleaning up contaminated sites: reducing mortality and morbidity risk; preventing and reducing human exposure to contaminants; reducing impacts to ecosystems; making land available for commercial, residential, industrial, or recreational reuse; and promoting community economic development. In addition, materials management and sustainable land management practices can significantly reduce greenhouse gas emissions.

Impact of Climate Change

Changes in climate and its impacts may test OSWER's ability to serve these important functions. OSWER recognizes that anticipating and planning for future changes in the climate and incorporating climate considerations into its programs and operations is critical for OSWER to continue to achieve its mission and fulfill its statutory, regulatory, and programmatic requirements. There is some uncertainty, however, as to how and when these changes to the climate will occur. OSWER will act prudently to ensure its actions address pressing needs and will review its vulnerabilities, actions and the state of climate science to make adjustments in the future.

Vision

OSWER will continue to achieve its mission to protect human health and the environment, and preserve and restore land resources, even as the climate changes.

Purpose of this Document

In June 2011, EPA issued a *Policy Statement on Climate-Change Adaptation* which recognized that climate change can pose significant challenges to EPA's ability to fulfill its mission. It calls for the agency to anticipate and plan for future changes in climate and incorporate considerations of climate change into its activities. The *Policy Statement* also requires the development of an agencywide adaptation strategy that would integrate climate adaptation into the agency's programs, policies, rules and operations. OSWER participated in the cross-agency workgroup that developed EPA's Climate Change Adaptation Plan, which was released for public review February 2013. In addition to the Agency Plan, the *Policy Statement* also directed every EPA program and regional office to develop an Implementation Plan that provides more detail on how it will meet the priorities and carry out the work called for in the agencywide plan.

The purpose of this document is to describe OSWER's process for identifying climate change impacts to its programs and the plan for integrating consideration of climate change impacts into the office's work. OSWER will monitor the status of climate science, particularly as it relates to known or anticipated impacts on OSWER's program areas, as well as the effectiveness of its program activities under changing conditions, and update or adjust its direction as necessary. As its knowledge evolves, OSWER will continue to refine its approach to climate change adaptation and build on the current plan.

Process for Developing this Document

OSWER's Climate Change Adaptation Implementation Plan was created by a workgroup of EPA employees located throughout the United States representing each of OSWER's headquarters and regional offices. Descriptions of OSWER offices and programs are listed in Table 2.

There were three primary stages in the development of OSWER's Climate Change Adaptation Implementation Plan. First, a comprehensive set of vulnerabilities was developed, as described in Section II. Next, evaluation criteria were applied to each vulnerability to guide the development of actions. These scores are shown in Appendix C. Finally, specific actions were developed to address the vulnerabilities that were identified as most critical, as described in Section III.

This plan also includes sections on vulnerable populations, working with tribes, legal and enforcement issues, and measurement of progress.

Definition of Key Terms

Adapt, Adaptation: Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.

Adaptive capacity: The ability of a human or natural system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Mitigation: An intervention to reduce the causes of changes in climate, such as through reducing emissions of greenhouse gases to the atmosphere.

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

Risk: A combination of the magnitude of the potential consequence(s) of climate change impact(s) and the likelihood that the consequence(s) will occur.

Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Source: NRC. (2010). *America's Climate Choices: Adapting to the Impacts of Climate Change*. National Research Council.

II. Vulnerability Assessment

Climate Change Impacts

The global climate is changing and the impacts of this change are being felt across the United States and the world. Many of these impacts will directly affect OSWER programs and activities. Listed below are several climate change trends described by the U.S. Global Change Research Program¹ and their potential impacts on OSWER programs.²

- *“One of the clearest precipitation trends in the United States is the increasing frequency and intensity of heavy downpours. The amount of rain falling in the heaviest downpours has increased approximately 20 percent in the last century.”* Flooding and inundation from more intense and frequent storms may lead to contaminant releases through surface soils, ground water, surface waters, sediments, and/or coastal waters at OSWER sites.
- *“During the past 50 years, sea level has risen up to 8 inches or more along some coastal areas of the United States, and has fallen in other locations.”* Rising sea level may inundate OSWER sites in coastal areas and increase flooding from storm surge, both of which could damage cleanups and increase human and ecological exposures to contaminants.
- *“The power and frequency of Atlantic hurricanes have increased substantially in recent decades.”* More powerful hurricanes may increase the area affected by these storms, putting sites and communities that had not been previously impacted by flooding and storm surge in the past at risk. More powerful storms may also increase storm debris that will need to be appropriately managed.
- *“United States average temperature has risen more than 2°F during the last 50 years.”* Increased average temperature and increased extreme temperatures may result in more frequent and longer lasting heat waves, increasing the risk of wildfires capable of spreading to OSWER sites and affecting the performance of remedies.
- *“Over the past 50 years, Alaska has warmed at twice the rate of the United States’ average. The higher temperatures are already contributing to . . . permafrost warming.”* The melting of permafrost may allow contaminants at OSWER sites in Alaska to migrate and may cause land shifting and subsidence.

¹ USGCRP. (2009). *Global Climate Change Impacts in the United States*. Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (Eds.). Cambridge University Press.

² This list is not intended to be exhaustive. A more complete list is included in subsequent parts of this section and Appendix A.

- *“In much of the Southeast and large parts of the West, the frequency of drought has increased coincident with rising temperatures.”* Decreased precipitation and increased frequency of drought may impact water-intensive remedies and site stability, as well as increase the risk of wildfires.
- *“Wildfires in the United States are already increasing due to warming. In the West, there has been a nearly fourfold increase in large wildfires in recent decades, with greater fire frequency, longer fire durations, and longer wildfire seasons.”* Wildfires at contaminated sites could promote the spread of contamination or impact remedies. Wildfire in the upland areas above contaminated sites could reduce vegetative cover, thereby increasing surface water runoff and resulting in catastrophic flooding that spreads contamination or impacts remedies.

In order for OSWER to fulfill its mission to protect human health and the environment, it is critical that OSWER anticipate and plan for future climatic conditions. OSWER must appropriately integrate consideration of climate into its program activities, policies, and regulations. Through adaptation planning, OSWER can continue to protect human health and the environment but in a way that accounts for effects of climate change.

Identification of Vulnerabilities

The first step in the development of OSWER’s Climate Change Adaptation Implementation Plan was the identification of OSWER’s vulnerabilities to climate change. A vulnerability in this context reflects the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Using expert professional judgement and information from peer-reviewed scientific literature, the OSWER workgroup used the aforementioned climate change impacts as an initial screening tool to determine vulnerabilities to OSWER’s processes, activities, and functions. OSWER did not conduct a detailed quantitative assessment of vulnerabilities. In total, 27 unique vulnerabilities were identified (Table 1).

Table 1. OSWER Climate Change Vulnerabilities

Preserving Land	Proper Management of Hazardous and Non-Hazardous Wastes	Design and placement of RCRA Treatment, Storage and Disposal facilities, non-hazardous Subtitle D landfills, Superfund remedies and municipal recycling facilities may need to change to accommodate climate change impacts.
		Hazardous waste permitting requirements may need to be updated to reflect 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 wastes generated from climate events.
		Levels of necessary financial assurance at RCRA and CERCLA facilities may need to adjust for increased risks/liabilities at specific facilities that may be directly affected by climate change impacts.
	Reducing Chemical Risks and Releases	Remediation and containment strategies and materials used in construction may need to be strengthened to reflect changing climate conditions.
		Current equipment, scientific monitoring and sampling protocols on sites may no longer be effective and therefore may require adjustments due to climate change impacts.
		Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.
		Spill Prevention Plans may need to be updated due to the significant increases in the incidence of flooding and storm events.
Restoring Land		Site characterization and design of cleanups may not reflect changing climate conditions.
		Risk factors and rankings for risk-based cleanup strategies may need to be reassessed based on changing climate conditions.
		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.
		Increased contaminant migration may lead to boundary changes at current sites or creation of new sites.
		Changes in climate conditions may alter assumptions about contaminant form/volatility.
		Current scientific monitoring and sampling protocols on sites may no longer be effective.
		Safety procedures on sites may not reflect likelihood or intensity of surrounding conditions.
		Availability of utilities and transportation infrastructure may be limited as a result of increased impacts to those systems.
		Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.
		Periodic evaluations of implemented remedies may not incorporate all climate change impacts, including changes in frequency and intensity that may impact remedy effectiveness.
		Use of natural resources impacted by sites may change as a result of increased need, resource scarcity, or compromised resources.
Emergency Response		Current levels of administrative, enforcement, and emergency response staff may be insufficient to cover needs if number of extreme events increase.
		Sufficient capability and capacity for conducting necessary lab analysis following significant weather events may not be available.
		Current waste management capacity, including interim capacity, may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed wastes generated from climate events.
		Training needs (both current and future) are likely to increase in order to meet the increase demand for response actions.
		Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.
Tools, Data, Training and Outreach		Outreach and educational materials may need to be developed for owners and operators with facilities in areas of changing environmental conditions.
		Revised training protocols and SOPs that take into account climate change impacts and what to look for may need to be developed.
		Reliable data sources to use in site-specific analyses may need to be identified
		Models, decision tools, site environmental data and information feeds may need to be updated to reflect changing climate conditions

Each vulnerability is linked to at least one climate change impact, however most vulnerabilities are linked to multiple impacts (Appendix A). For example, increased contaminant spread could occur because of the greater incidence of flooding at contaminated sites from heavy precipitation, hurricanes, and sea level rise, as well as, melting permafrost or wildfires. Several vulnerabilities, such as data collection for mapping and training are linked to all the impacts of climate change.

As the vulnerabilities were identified, they were organized by four critical OSWER programmatic focus areas and a cross-cutting category:

- Preserving Land –Proper Management of Hazardous and Non-Hazardous Wastes;
- Preserving Land –Reducing Chemical Risks and Releases;
- Restoring Land;
- Emergency Response;
- Tools, Data, Training and Outreach.

Under each focus area a vulnerability may apply to more than one OSWER program office. For example, five different OSWER offices identified contaminant migration from sites as a vulnerability for their program. In addition, there were several vulnerabilities related to training and data needs that cut across all program offices in OSWER, as well as across EPA.

Table 2. OSWER Programs

Office of Superfund Remediation and Technology Innovation and Federal Facilities Restoration and Reuse Office	
The Superfund Remedial and Federal Facilities Program addresses long-term risks to human health and the environment resulting from releases of hazardous substances at the nation's highest priority sites. Superfund sites are found throughout the country. The Federal Facilities Program works with federal entities to ensure fast and effective cleanup at federally-owned sites, and facilitates partnerships between the other federal agencies and the surrounding communities. The Superfund Remedial Program works on non-federally owned sites.	
Office of Brownfields and Land Revitalization	
The Brownfields Program addresses environmental site assessment and cleanup of abandoned and potentially contaminated sites through grants, cooperative agreements, and technical assistance to communities, states, and tribes. Brownfields' 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 much less contaminated than Superfund and RCRA Corrective Action sites. Funding to states and tribes helps develop and enhance their voluntary cleanup programs for these sites.	
Office of Emergency Management	
The Superfund Emergency Response and Removal Program functions as the backbone federal response to many 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.	
The Oil Spill Program 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 navigable waters of the United States.	
The EPA Chemical Emergency Preparedness and Prevention Program is the national regulatory framework to prevent, prepare for and respond to catastrophic accidental chemical releases at industrial facilities throughout the United States.	
Office of Resource Conservation and Recovery	
The Resource Conservation and Recovery Act (RCRA) Solid Waste Program 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 of this program is to look for and incentivize more sustainable ways to manage our materials, prolonging the life of materials as usable commodities for as long as possible.	
The RCRA Hazardous Waste Program issues comprehensive, national regulations, defines solid and hazardous wastes, and imposes standards on anyone who generates, recycles, transports, treats, stores or disposes of hazardous waste. This program also monitors the movement of hazardous waste in and out of U.S. borders and works to help ensure the waste that is exported is properly recycled or disposed of.	
The RCRA Corrective Action Program directly implements the corrective action (CA) program in 13 states and territories, and performs as lead regulator at an increasingly significant number of facilities undergoing CAs in 42 states across the country that are authorized for the RCRA CA Program. An essential element of EPA's hazardous waste management program is the statutory requirement that facilities managing hazardous wastes must clean up releases of hazardous constituents that could adversely impact human health and the environment. The CA program is critical to preventing future Superfund sites and the associated resources and expenditures.	
Office of Underground Storage Tanks	
The Underground Storage Tanks (UST) Prevention Program works with state, tribal and inter-agency partners to set and implement standards which prevent and detect releases from underground storage tanks. EPA provides resources to support the infrastructure of state and tribal UST programs and provides regulations, guidance and policies to support program implementation. An essential element of the UST program is full implementation of the Energy Policy Act of 2005.	
The Leaking Underground Storage Tank (LUST) Cleanup Program works with state and tribal partners to clean up releases from LUST sites, many of which impact ground water resources. Cleaning up LUSTs is a key part of protecting our environment. EPA provides resources to support the infrastructure of state LUST programs so that private and state resources can directly finance the field work necessary to address contamination at federally-regulated tank releases. EPA also provides regulations, guidance and policy to support cleanup of tank releases.	

III. Addressing Impacts of Climate Change

Focusing on Specific Vulnerabilities

In a resource-constrained environment, in order to prioritize and focus OSWER's efforts to address the impacts of climate change, each vulnerability was evaluated based on a set of criteria. Together, these criteria allowed each OSWER office to use its best professional judgment to evaluate the areas that needed the most or immediate attention and where its contribution would be most effective.

The first two criteria, referred to as the "Characterization Criteria", were designed to enhance the understanding of the overall impact of a particular vulnerability. Because climate change is a long-term problem, both the scale and timing of adaptation actions are important.

Characterization Criteria:

- Scale of impact to human health, the environment or vulnerable communities because of the vulnerability – The scores for this criterion reflect the potential for harm to human health, the environment, or a vulnerable community, if the vulnerability is not addressed.
- Likelihood of occurrence because of the vulnerability – This criterion is a reflection of what impacts have already occurred at OSWER sites and programs.

The second set of criteria reflect EPA roles in addressing the impacts of these vulnerabilities and are collectively referred to as "Opportunities for OSWER to make a difference". These criteria are intended to identify those vulnerabilities for which action by OSWER would significantly advance adaptation efforts and ones in which OSWER is more directly responsible for addressing.

Opportunities for OSWER to make a difference:

- Does EPA have a unique or lead role or technical expertise in this area?
- To what extent are climate impacts currently not considered in this area?
- To what extent could additional EPA involvement build momentum or leverage current activities?
- Is there an opportunity to incorporate climate change into an ongoing effort (e.g., rulemaking, changes to grant criteria, updates to guidance and training)?

Each OSWER office determined which vulnerabilities were applicable to its work and developed a score for the vulnerability. When applying the criteria, offices did not rank vulnerabilities in relation to each

other, but instead considered each vulnerability independently. These scores were used to aid OSWER offices in determining which vulnerabilities were most critical to focus actions.

The score sheet with the criteria is shown in Appendix B. To maintain transparency OSWER has included all identified vulnerabilities regardless of the final score.

Developing Priority Actions

Using the vulnerability criteria as a guide, the following OSWER offices developed priority actions:

- ◆ CPA – Center for Program Analysis
- ◆ FFRRO –Federal Facilities Restoration and Reuse Office
- ◆ OBLR – Office of Brownfields and Land Revitalization
- ◆ OEM – Office of Emergency Management
- ◆ ORCR – Office of Resource Conservation and Recovery
- ◆ OSRTI – Office of Superfund Remediation and Technology Innovation
- ◆ OUST – Office of Underground Storage Tanks

In addition, EPA regional offices play a central role in implementing OSWER programs. Regions work closely with states, tribes, and other stakeholders to protect the environment and human health at a more localized, geographically focused level than the OSWER national program. OSWER reviewed actions proposed by Regional offices in their climate change adaptation plans and supports them as a crucial element to advancing climate change. OSWER regional actions were primarily in support of EPA's Strategic Goal 3: Cleaning Up Communities and Advancing Sustainable Development.

Continued Actions to Lessen Climate Change Impacts

While preparing for the potential impacts of climate change, leveraging materials and land management programs to achieve measurable greenhouse gas (GHG) reductions remains a focus of OSWER programs. It is estimated that approximately 42% of GHG emissions are attributable to materials management activities and approximately 16% are related to land management choices. To promote continued GHG reductions, OSWER is increasing efforts for the advancement of life-cycle-analyses, the promotion of sustainable production and material management, as well as promoting the use of green remediation principles that reduce emissions during cleanups.

Source: USEPA. (2009). Opportunities to Reduce or Avoid Greenhouse Gas Emissions through Materials and Land Management Practices.

Priority Actions

OSWER has identified 26 priority actions to begin over the next 3 years. These actions are in one or more of the four programmatic focus areas and one cross-cutting category. The actions are found in a summary chart in Appendix C and are listed below by programmatic focus area and office.

Preserving Land – Proper Management of Hazardous & Non-Hazardous Wastes

Proper treatment, storage, and disposal of hazardous waste protect the environment from harmful contamination. To ensure these materials are properly managed, OSWER supports prevention by activities such as permitting and inspections. Non-hazardous waste must also be properly managed, both routinely and in times of emergency.

In the “Proper Management of Hazardous and Non-Hazardous Wastes” focus area, the vulnerability that ranked the highest was the management of surges in waste, particularly from the impacts of extreme events. ORCR is already involved in several efforts in this area and has identified several actions to respond to this vulnerability. These actions are also applicable in the “Emergency Response” focus area.

As a crucial part of the RCRA program, ORCR has also identified a long-term action that will begin to look at issues related to climate change and permitting programs. Even though, vulnerabilities related to permitting did not receive high criteria scores, particularly in terms of likelihood of occurrence and potential impacts.

Actions:

ORCR

- Based on outreach to states and tribes, develop recommendations for these stakeholders to incorporate climate change into RCRA Permitting Programs as appropriate (e.g., through robust implementation of technical standards for facility location and design).

ORCR (also in the Emergency Response section)

- Prepare Fact Sheets on 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 ORCR Homeland Security Website with updated waste management planning information.

Preserving Land – Reducing Chemical Risks and Releases

EPA has several programs in place to prevent contamination from chemical releases. Prevention is accomplished through effective operation and maintenance activities, containment strategies, as well as inspection and monitoring of facilities that deal with hazardous materials.

The actions in this programmatic focus area address activities that prevent contamination from occurring. Other vulnerabilities with high scores in this focus area will benefit from the actions to address remediation and containment approaches as described in “Restoring Land”.

Actions:

OEM

- Incorporate sensitivity for climate change vulnerabilities into oil Spill Prevention, Control, and Countermeasure (SPCC) and Facility Response Plan (FRP) ³ inspector training.
- Incorporate into 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) ⁴ inspector training and guidelines.

Restoring Land

Accidents, spills, leaks and past improper disposal and handling of hazardous materials and wastes have resulted in tens of thousands of contaminated sites in the United States. Contaminated land can threaten human health and the environment, impact our water and air quality, and potentially hamper economic growth and the vitality of local communities. Numerous activities address the contamination, reduce risk to human health and the environment, and move the contaminated site along the cleanup process to return the site to use or reuse.

Two primary types of vulnerabilities were identified as the most critical in the “Restoring Land” focus area. First, several offices identified increased contaminant migration as having a high potential impact,

³ The Spill Prevention, Control, and Countermeasure (SPCC) rule includes requirements for oil spill prevention, preparedness, and response to prevent oil discharges to navigable waters and adjoining shorelines. The rule requires specific facilities to prepare, amend, and implement SPCC Plans. The SPCC rule is part of the Oil Pollution Prevention regulation, which also includes the Facility Response Plan (FRP) rule. A Facility Response Plan (FRP) demonstrates a facility's preparedness to respond to a worst case oil discharge. Under the Clean Water Act, as amended by the Oil Pollution Act, certain facilities that store and use oil are required to prepare and submit these plans.

⁴ Under the authority of section 112(r) of the Clean Air Act, the Chemical Accident Prevention Provisions require facilities that produce, handle, process, distribute, or store certain chemicals to develop a Risk Management Program, prepare a Risk Management Plan (RMP), and submit the RMP to EPA.

high probability of occurrence, and often under the control of EPA programs. Second, remedy effectiveness, which includes three separate vulnerabilities representing various stages of the cleanup process (remedy selection, remedy effectiveness during cleanup, and remedy effectiveness after a cleanup is complete), was also identified by several offices as having a high vulnerability score and a role for EPA involvement.

Numerous OSWER offices involved in cleanup activities identified either a short- or long-term action related to the vulnerabilities mentioned above. Due to the differences in how OSWER cleanup programs are implemented, whether at the headquarters office, in partnerships with states, or through grants, the actions differ across offices. There may, however, be areas where offices can share resources and knowledge, for example, as we learn more about the effectiveness of particular remedies under extreme climate conditions.

Actions:

ORCR

- Develop recommendations for states and tribes to encourage climate change considerations be incorporated into all of their RCRA Corrective Action Programs (e.g., regarding remedy selection, etc.).

OUST

- Work with the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) to gather information on if and how states currently:
 - alter remediation plans in response to changing climate impacts;
 - alter site assessments in response to flooding or drought conditions;
 - alter risk factors and rankings in response to flooding or drought conditions.
- Share information among states, tribes, and EPA regions regarding:
 - new or modified investigation strategies and remediation techniques;
 - new or modified assessment techniques;
 - how climate conditions may impact risk-based cleanup factors and rankings.

OBLR

- Work with regional staff to update the Analysis of Brownfields Cleanup Alternatives (ABCA) language in the brownfield grant Terms and Conditions to include language that requires recipients take potential changing climate conditions into consideration when evaluating cleanup alternatives.

- 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 is important to consider when developing revitalization plans in their community.

OSRTI and FFRRO

- 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 (Remedial Investigation/Feasibility Study, Record of Decision, Remedial Design/Remedial Action, Five Year reviews, etc.) for implementation of climate change adaptation protocols to ensure continuing protectiveness of current and future remedies.
- Prepare training materials, coordinate with the National Association of Regional Project Managers (NARPM) co-chairs and Superfund forums to integrate the training into future NARPM events, and provide web-based content and training.
- Participate with OSWER and other EPA programs to initiate conversations as appropriate regarding approaches for handling remedy impacts from climate change.

Emergency Response

OSWER responds to a variety of emergencies, varying greatly in size, nature, and location, including natural disasters. OSWER staff act as response coordinators and on-site responders. In all cases, prompt action is crucial and the first priority is to eliminate dangers to the public; dangers include contamination from chemical releases in the air, water or soil and large amounts of waste. In addition to the responsibilities of OSWER's Office of Emergency Management, many other OSWER and EPA program offices play a role in addressing the impacts of emergency events.

The management of debris was a highly ranked vulnerability in this category, as well as in the "Proper Management of Hazardous and Non-Hazardous Waste" focus area. Several actions are identified to address this vulnerability.

The Emergency Operations Center (EOC) is a vital part of OSWER's response program. Actions are identified to ensure EOC staff are provided with the most accurate and comprehensive information that takes into consideration changes in climate.

Actions:

OUST

- 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).
- Analyze lessons learned from Hurricanes Katrina (2005) and Sandy (2012) to identify how EPA can help states respond to UST-related hurricane impacts.
- Share information among states, tribes, and EPA regions regarding emergency response and preparedness (e.g., OUST's Flood Guide).

ORCR (also in the Proper Management of Hazardous and Non-Hazardous Wastes section)

- Prepare Fact Sheets on 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 ORCR Homeland Security Website to incorporate facts sheets, 4 Step Process, and updated waste management planning information.

OEM

- Utilize the National Response Team multi-agency membership (e.g., National Oceanic and Atmospheric Administration, Federal Emergency Management Agency, 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.
- 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 Geographic Information System (GIS) mapping of watersheds and coastal areas impacted by climate change.
- Incorporate materials on the impacts of climate change as EOC training materials are updated and exercises are planned.

Tools, Data, Training and Outreach

In order to make informed decisions about program direction, design, and implementation, OSWER must use the best available data. As a result of climate change, assumptions about ecosystem conditions are shifting more rapidly, affecting the ability to predict potential weather patterns and map the geographic conditions at and around its sites.

Several vulnerabilities, including data collection and training, were identified as applicable and important to all OSWER offices. One of the primary challenges to incorporating climate change into its activities will be obtaining reliable projections of sea level rise, flooding zones, and other impacts of climate change. These projections will help guide decisions such as remedy selection. Access to this data is needed by all programs. In addition, training is a vital component of information dissemination and use; therefore, OSWER must appropriately consider relevant training. To best address these vulnerabilities it will be necessary for OSWER to work with regions and other EPA offices, including the Office of Research and Development, to ensure consistency across the agency.

Actions:

CPA

- Provide recommended data sources and parameters to OSWER offices and regions to ensure consistent mapping data and protocols. Develop these recommendations by working with the agency's climate change workgroup and EPA's Office of Research and Development.
- Participate in agency climate change adaptation training development, as well as develop specific training as needed for OSWER staff.
- Work with EPA partners and external experts to monitor evolving assumptions related to climate science. Develop a method for disseminating this information to OSWER offices that ensures consistent assumptions are used across all activities.

IV. Disproportionately Affected Populations

Disproportionate Impact

While climate change will affect all parts of society, it will have disproportionate effects on particular communities, demographic groups and geographic locations.⁵ Certain parts of the population, such as children, the elderly, minorities, the poor, persons with underlying medical conditions and disabilities, those with limited access to information, and tribal and indigenous populations can be especially vulnerable to the impacts of climate change. These disproportionately affected groups may have less ability to cope with or adapt to climate change due to economic, social, physical, or health constraints. Also, certain geographic locations and communities are particularly vulnerable, such as those located in low-lying coastal areas.

Populations that are already overburdened by environmental contamination, poverty, and environmental health issues, may face greater adaptation challenges.⁶ Though Hurricane Sandy was not necessarily due to climate change, the impacts resulting from associated flooding are similar to what could occur in a climate related flooding or storm surge event. Many of the elderly and poor in New York and New Jersey suffered significantly from flooding-associated power and heat loss, scarcity of food and supplies, and difficulty in accessing medical care.⁷ These populations may have lacked the resources to evacuate outside the affected areas and as a result could not as readily avoid the adverse conditions resulting from the storm. During the recovery and reconstruction phases, vulnerable populations may also have a more difficult time due to underlying factors such as economic and social resource base and health status that can limit their access to resources as well as their ability to take action.

In addition, a community's location near a vulnerable ecosystem or a contaminated site may also result in differential impacts depending on how that ecosystem or site is impacted by climate change. Degraded ecosystems or those changed from human activities may place communities near them at higher risk for the effects of climate change. The ecosystems that may have served as a natural buffer against storm surge or may have provided valuable cultural, recreational, or other resources can no longer serve this purpose due to their altered state.⁸ For example, an environmental justice community's resilience and ability to adapt to climate change may be complicated by their location both near a hazardous waste site

⁵ USEPA. (2012). *Climate Change Adaptation Plan: Public Review Draft*.

⁶ *ibid.*

⁷ USEPA. (2012). *Region 2 Adaptation Plan*.

⁸ USGCRP. (2009). *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (Eds.). Cambridge University Press.

and in an area prone to increased climate-related storm surge. It is important to recognize the factors that may compound a community's vulnerability to climate change in order to implement effective strategies to increase adaptive capacity.

Climate change may also pose unique challenges to tribes and other indigenous populations. Tribes are particularly vulnerable to the impacts of climate change, due to the integral nature of the environment within their traditional lifestyles and culture. Partly due to their dependence upon a specific area for their livelihood, the degree to which those geographic areas embody climate-sensitive environments, and their unique cultural, economic, or political characteristics and contexts, tribes and indigenous groups may be especially sensitive to climate change related shifts in their environment.⁹ Their ability to cope with climate-related hazards is further restricted by limited access to preparedness, response, and recovery resources.¹⁰ While tribes and indigenous populations will likely be disproportionately vulnerable to climate change, they are uniquely positioned to provide valuable community level, culturally relevant data, information on climate change impacts, and relevant solutions.

For instance, Alaskan Natives are one population that is experiencing disproportionate impacts from climate change. Temperature increases associated with climate change have led to the melting of permafrost. In some cases, permafrost acts as a barrier to the transport of contaminants. With increased temperatures, thawing could allow contaminants to migrate more freely to adjoining areas, and those effects would only accelerate with continued changes in the climate.¹¹ In several Alaskan coastal communities, melting ice and erosion have caused landfills to fall into the ocean, affecting environmental and human health.¹²

Partnerships

States, tribes, and local communities share responsibility for protecting human health and the environment, and partnerships with EPA are at the heart of the country's environmental protection system. These partnerships will be critical for efficient, effective, and equitable implementation of climate adaptation strategies. Strong partnerships make the most effective use of partners' respective bodies of knowledge, resources, and talents. Below is a summary of how OSWER currently works with underserved populations and tribes.

⁹ USEPA. (2012). *Climate Change Adaptation Plan: Public Review Draft*.

¹⁰ Cutter, S.L. and C. Finch. (2008). "Temporal and spatial changes in social vulnerability to natural hazards." *Proceedings of the National Academy of Science* 105(7): 2301-2306.

¹¹ USGCRP. (2009). *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (Eds.). Cambridge University Press.

¹² The National Climate Assessment and Development Advisory Committee Report (Draft for public comment)

Ongoing Partnerships to Address Vulnerable Populations and Places

OSWER has identified three focus areas to address environmental justice (EJ) in its programs. These focus areas are designed to integrate ongoing EJ activities and produce tangible outcomes in overburdened and underserved communities impacted by OSWER programs. These focus area activities listed below are designed to meaningfully advance EJ in OSWER programs, have EJ as the central focus, and can produce meaningful, measurable outcomes in low income and minority communities.

- **Focus Area #1:** Incorporate EJ considerations into OSWER programs, policies, and activities by addressing disproportionately high, adverse human health and environmental impacts on overburdened and underserved populations to the greatest extent practicable and permitted by law
- **Focus Area #2:** Institute a continual learning process through training and the use of agency environmental justice tools to help OSWER staff better serve overburdened and underserved communities
- **Focus Area #3:** Expand community engagement approaches and increase partnership building which allows overburdened and underserved communities to meaningfully participate in decision making activities and address local environmental concerns.

Ongoing Partnerships with Tribes

EPA values its unique government-to-government relationship with Indian tribes in planning and decision making. This trust responsibility has been established over time and is further expressed in the *1984 EPA Policy for the Administration of Environmental Programs on Indian Reservations* and the *2011 Policy on Consultation and Coordination with Indian Tribes*. These policies recognize and support the sovereign decision-making authority of tribal governments. OSWER works as a partner with many Tribal Nations to implement OSWER programs. OSWER's partnership with tribes is based on its tribal strategy.¹³ The long-term goal of the tribal strategy is to support and provide direction for OSWER's Indian program, enhance outreach efforts with tribes on environmental protection in Indian country, and maintain consistency with EPA's Indian Policy. OSWER short-term strategies include:

- Ensure appropriate government-to-government consultation and communication with tribal leaders in accordance with EPA's *2011 Policy*.
- Build tribal capacity. OSWER provides support through training, financial support, and technical assistance to tribes to build capacity in assuming regulatory and program management responsibilities. Additionally, OSWER develops guidance and provides for research in

¹³ USEPA, Office of Solid Waste and Emergency Response. (2008). *Tribal Strategy: EPA & Tribal Partnership to Preserve and Restore Land in Indian Country*.

cooperation with tribes to clarify key issues and/or obtain relevant information for addressing issues potentially affecting tribal health and the environment.

- Facilitate meaningful communication, coordination, and cooperation within OSWER on tribal issues and cultural awareness.

EPA engaged tribes through a formal consultation process in the development of the agency's *Climate Adaptation Plan*. Tribes identified erosion, temperature change, drought, and various changes in access to and quality of water as some of the most pressing issues. Tribes recommended a number of tools and strategies to address these issues, including improving access to data and information; supporting baseline research to better track the effects of climate change; developing community-level education and awareness materials; and providing financial and technical support. At the same time, tribes challenged EPA to coordinate climate change activities among federal agencies so that resources are better leveraged and administrative burdens are reduced.

Priority Actions

Community Engagement

One of the principles guiding OSWER's efforts to integrate climate adaptation into its programs, policies, and rules calls for its adaptation plans to prioritize helping people, places, and infrastructure that are most vulnerable to climate impacts, and to be designed and implemented with meaningful involvement from all parts of society. Within OSWER, community engagement is a critical component to how the office does its job of protecting human health and the environment. Effective community engagement is about a process of interactions that builds relationships over time and recognizes and emphasizes the community's role in identifying concerns and participating in formulating solutions. It establishes a framework for collaboration and deliberation. In the broadest sense, community engagement in environmental decision-making is the inclusion of the community in the process of defining the problem and developing solutions and alternatives.

For climate change decision-making processes to be effective they must be transparent and accessible and communities must be well informed and engaged. Communities should therefore have access to clear and understandable information. The local knowledge and input gained from meaningful engagement with the full diversity of the community will help to strengthen OSWER's decisions about climate change adaptation and the actions developed to address vulnerabilities, ensuring that these activities are well suited to the community's particular needs and circumstances. OSWER will work in partnership with communities to increase their adaptive capacity and resilience to climate change impacts. These efforts

will be informed by experiences with the impacts of previous extreme weather events (*e.g.*, Hurricane Katrina and Superstorm Sandy) and the subsequent recovery efforts.

Adaptation actions must recognize and be tailored to the specific issues at the regional, state, local, and community levels.¹⁴ OSWER can provide federal leadership, guidance, information, and support which are vital to planning for and implementing adaptive actions, however, adaptation planning must include collaboration between multiple stakeholders including state and local governments, tribes, communities, non-governmental organizations and others.

Vulnerable Population Actions

OSWER will give special attention to populations and places that are most vulnerable to climate related impacts to its sites. OSWER will also continue to work to better understand the populations that surround these sites in order to expand its knowledge on potential impacts and better protect vulnerable communities and places.

Actions:

- Work with the agency's climate change workgroup and EPA's Office of Research and Development to ensure consistent mapping data and protocols to better understand the intersections of climate impacts and population vulnerability and help to inform future policy and office activities and ensure they take evolving climate science into account.
- 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.

In addition, the Community Engagement Network being created by OSWER may provide a valuable internal forum for sharing and gathering information about best practices for engaging communities in climate change conversations.

Tribal Actions

Supporting the development of adaptive capacity among tribes is a priority for the EPA. Networks and partnerships already in place will be used to assist tribes with climate change issues, including Regional Tribal Operations Committees, the Institute for Tribal Environmental Professionals and the Indian General Assistance Program. Transparency and information sharing will be a focus, in order to leverage activities already taking place within EPA offices and tribal governments.

¹⁴ USGCRP. (2009). *Global Climate Change Impacts in the United States*, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (Eds.). Cambridge University Press.

Actions:

- Work with the agency's climate change workgroup and EPA's Office of Research and Development to share mapping data and protocols with its partners, including tribes to help inform their adaptation activities.
- Assist the Institute for Environmental Tribal Professionals (ITEP) in developing adaptation into their normal climate change training.

Collaborative efforts on climate change will benefit from the expertise provided by tribal partners and the Traditional Ecological Knowledge (TEK) they possess. TEK is a valuable body of knowledge in assessing the current and future impacts of climate change and has been used by tribes for millennia as a valuable tool to adapt to changing surroundings. Consistent with the principles in EPA's Indian Policy, TEK should be viewed as a complementary resource that can inform planning and decision making.

Supporting Regions

While OSWER headquarters program offices are taking actions to address climate change adaptation, much of the work with tribes and vulnerable populations will occur within the EPA regions, since climate change has many impacts that transcend media and regional boundaries. OSWER plans to coordinate with and support regional and program office actions by working to ensure that they have access to evolving climate science and standardized data to inform policy and other activities. For instance, data could be used for mapping impacts relating to vulnerable populations and tribes. Data driven mapping will help ensure that adaptation actions can be prioritized and tailored to those populations who are most at risk for disproportionate impact from climate change. Data can also be shared with tribes to help them create adaptation strategies to address their climate change impacts.

V. Measures and Evaluation

The actions proposed in this plan expand OSWER's efforts to mainstream and integrate climate change adaptation into its programs. OSWER will monitor the status of climate science, particularly as it relates to known or anticipated impacts on OSWER's program areas, as well as the effectiveness of its program activities under changing conditions, and update or adjust its direction as necessary. OSWER commits to periodically publicly reporting on progress implementing these actions and what it has accomplished in website updates or factsheets.

To measure and evaluate progress toward completing actions, the workgroup that developed this document will continue to meet to discuss progress implementing actions and share information that may assist other offices in their efforts. Collaborative tools may also be utilized to facilitate the discussion.

VI. Legal and Enforcement Issues

OSWER works closely with the Office of General Counsel (OGC) to ensure that its actions are legally supported and in compliance with all applicable laws. OSWER will continue to work with OGC as it plans for and develops programming related to adaptation and the impacts of climate change.

OSWER will partner with the Office of Site Remediation Enforcement (OSRE) to address enforcement concerns related to climate change issues. OSWER and OSRE will work together to develop tools that address climate change policy questions as well as site-specific issues.

Appendix A – Effect of Climate Change Impacts on OSWER Program Vulnerabilities

The ★ symbol indicates climate change impacts that are expected to significantly contribute to the identified program vulnerabilities. Note: The likelihood of occurrence for each climate change impact is taken from EPA's Climate Change Adaptation Plan. Additional sources are found at the end of the table.

	Climate Change Impact								
	Increased extreme temps ¹	Sustained changes in average temp ¹	Sea level rise ²	Decreased permafrost ³	Decreased precipitation increasing drought ⁴	Increased heavy precipitation events ¹	Increased flood risk ⁴	Increased frequency & intensity of wildfires ⁵	Increased intensity of hurricanes ¹
	Very Likely			Likely					
Program Vulnerability									
Preserving Land – Proper Management of Hazardous and Non-Hazardous Wastes									
Design and placement of RCRA Treatment, Storage and Disposal facilities, non-hazardous Subtitle D landfills, Superfund remedies and municipal recycling facilities may need to change to accommodate climate change impacts.						★	★	★	★
Hazardous waste permitting requirements may need to be updated to reflect climate change impacts.	★	★	★	★		★	★	★	★
Current waste management capacity, including interim capacity, may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed wastes generated from climate events.						★	★	★	★
Levels of necessary financial assurance at RCRA and CERCLA facilities may need to adjust for increased risks/liabilities at specific facilities that may be directly affected by climate change impacts.	★	★	★	★	★	★	★	★	★
Preserving Land – Reducing Chemical Risks and Releases									
Remediation and containment strategies and materials used in construction may need to be strengthened to reflect changing climate conditions.	★	★	★	★		★	★	★	★
Current equipment, scientific monitoring and sampling protocols on sites may no longer be effective and therefore may require adjustments due to climate change impacts.	★	★			★	★	★	★	★
Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.	★	★	★	★	★	★	★	★	★
Spill Prevention Plans may need to be updated due to the significant increases in the incidence of flooding and storm events.			★			★	★	★	★

	Climate Change Impact								
	Increased extreme temps ¹	Sustained changes in average temp ¹	Sea level rise ²	Decreased permafrost ³	Decreased precipitation increasing drought ⁴	Increased heavy precipitation events ¹	Increased flood risk ⁴	Increased frequency & intensity of wildfires ⁵	Increased intensity of hurricanes ¹
	Very Likely			Likely					
Program Vulnerability									
Restoring Land									
Site characterization and design of cleanups may not reflect changing climate conditions.	★	★	★		★	★	★	★	★
Risk factors and rankings for risk-based cleanup strategies may need to be reassessed based on changing climate conditions.			★			★	★	★	★
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.	★	★	★	★	★	★	★	★	★
Increased contaminant migration may lead to boundary changes at current sites or creation of new sites.			★	★		★	★	★	★
Changes in climate conditions may alter assumptions about contaminant form/volatility.	★	★	★	★	★	★	★	★	★
Current scientific monitoring and sampling protocols on sites may no longer be effective.	★	★			★	★	★	★	★
Safety procedures on sites may not reflect likelihood or intensity of surrounding conditions.	★	★	★			★	★	★	★
Availability of utilities and transportation infrastructure may be limited as a result of increased impacts to those systems.	★		★	★		★	★	★	★
Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.	★	★	★	★	★	★	★	★	★
Periodic evaluations of implemented remedies may not incorporate all climate change impacts, including changes in frequency and intensity that may impact remedy effectiveness.	★	★	★	★	★	★	★	★	★
Use of natural resources impacted by sites may change as a result of increased need, resource scarcity, or compromised resources.			★		★	★	★	★	★

	Climate Change Impact								
	Increased extreme temps ¹	Sustained changes in average temp ¹	Sea level rise ¹	Decreased permafrost ²	Decreased precipitation increasing drought ³	Increased heavy precipitation events ¹	Increased flood risk ³	Increased frequency & intensity of wildfires ⁴	Increased intensity of hurricanes ¹
	Very Likely			Likely					
Program Vulnerability									
Emergency Response									
Current levels of administrative, enforcement, and emergency response staff may be insufficient to cover needs if number of extreme events increase.						★	★	★	★
Sufficient capability and capacity for conducting necessary lab analysis following significant weather events may not be available.						★	★	★	★
Current waste management capacity, including interim capacity, may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed wastes generated from climate events.						★	★	★	★
Training needs (both current and future) are likely to increase in order to meet the increase demand for response actions.						★	★	★	★
Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.	★		★			★	★	★	★

1. IPCC. (2012). "Summary for Policymakers." In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. C.B. Field, V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.). A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA.
2. IPCC. (2008). *Climate Change and Water: Technical Paper of the Intergovernmental Panel on Climate Change*. B.C. Bates, Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds. IPCC Secretariat, Geneva.
3. USGCRP. (2009). *Global Climate Change Impacts in the United States*. Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (Eds.). Cambridge University Press.
4. IPCC. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (Eds.), Cambridge, UK : Cambridge University Press.

Appendix B – Vulnerability Scorecard¹

Program Vulnerability	Office	Characterization Criteria			Opportunities for OSWER to Make a Difference				
		Total Score	Scale of impact	Likelihood of occurrence	Total Score	Role for EPA technical expertise?	Are climate impacts currently considered?	Would build momentum or leverage current activities.	Can incorporate into ongoing effort?
			Scale 1-10 10(High) -1(Low)			Scale 1-5 5(Yes)-1(No)	Scale 1-5 5(Not) – 1(Fully)	Scale 1-5 5(Very Likely)-1(Not Likely)	
Preserving Land – Proper Management of Hazardous and Non-Hazardous Wastes									
Design and placement of RCRA Treatment, Storage and Disposal facilities, non-hazardous Subtitle D landfills, Superfund remedies and municipal recycling facilities may need to change to accommodate climate change impacts.	FFRRO	6	5	1	12	4	2	3	3
	ORCR	6	5	1	10	2	3	4	1
	OSRTI	6	5	1	18	5	3	5	5
Hazardous waste permitting requirements may need to be updated to reflect climate change impacts.	FFRRO	15	10	5	14	5	2	4	3
	ORCR	6	5	1	13	5	3	4	1
Current waste management capacity may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed wastes generated from climate events.	FFRRO	20	10	10	8	1	3	3	1
	ORCR	15	5	10	15	4	3	4	4
	OSRTI	15	5	10	18	5	3	5	5
Levels of necessary financial assurance at RCRA and CERCLA facilities may need to adjust for increased risks/liabilities at specific facilities that may be directly affected by climate change impacts.	FFRRO	10	5	5	12	4	2	3	3
	ORCR	10	5	5	8	3	3	1	1
	OSRTI	10	5	5	15	5	3	4	3
Preserving Land – Reducing Chemical Risks and Releases									
Remediation and containment strategies and materials used in construction may need to be strengthened to reflect changing climate conditions.	FFRRO	15	8	7	8	1	2	3	2
	ORCR	10	5	5	14	5	3	4	2
	OSRTI	10	5	5	18	5	3	5	5
Current equipment, scientific monitoring and sampling protocols on sites may no longer be effective and therefore may require adjustments due to climate change impacts.	FFRRO	12	5	7	10	1	3	3	3
	ORCR	2	1	1	9	4	3	1	1
	OSRTI	2	1	1	18	5	3	5	5
Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.	FFRRO	10	5	5	8	1	2	4	1
	ORCR	15	5	10	6	3		2	1
	OSRTI	16	8	8	8	2	3	1	2
Spill Prevention Plans may need to be updated due to the significant increases in the incidence of flooding and storm events.									
	OEM	4	2	2	6	2	1	2	1

		Characterization Criteria			Opportunities for OSWER to Make a Difference				
		Total Score	Scale of impact	Likelihood of occurrence	Total Score	Role or technical expertise?	Currently considered?	Build momentum or leverage current activities.	Ongoing effort?
			Scale 1-10 10(High) -1(Low)			Scale 1-5 5(Yes)-1(No)	Scale 1-5 5(Not) – 1(Fully)	Scale 1-5 5(Very Likely)-1(Not Likely)	
Program Vulnerability	Office	Total Score			Total Score				
Restoring Land									
Site characterization and design of cleanups may not reflect changing climate conditions.	FFRRO	11	6	5	7	1	2	3	1
	ORCR	10	5	5	13	3	2	4	4
	OSRTI	10	5	5	18	5	3	5	5
	OBLR	10	5	5	13	2	4	4	3
Risk factors and rankings for risk-based cleanup strategies may need to be reassessed based on changing climate conditions.	FFRRO	15	10	5	13	4	3	3	3
	ORCR	10	5	5	14	3	3	4	4
	OSRTI	10	5	5	18	5	3	5	5
	OBLR	10	5	5	11	2	4	3	2
	OUST	6	1	5	7	1	3	1	2
Changing climate conditions may impact continued remedy effectiveness.	FFRRO	17	10	7	14	3	4	5	2
	ORCR	15	10	5	15	4	3	4	4
	OSRTI	12	7	5	18	5	3	5	5
	OBLR	15	10	5	11	2	4	3	2
Remedies that are “complete” or are long-term actions may no longer be protective and resilient as climate conditions change at site.	FFRRO	18	10	8	14	3	4	4	3
	ORCR	10	5	5	15	4	3	4	4
	OSRTI	18	8	10	18	5	3	5	5
	OBLR	10	5	5	12	2	4	3	3
Increased contaminant migration may lead to boundary changes at current sites or creation of new sites.	FFRRO	17	10	7	12	4	3	3	2
	ORCR	20	10	10	13	3	2	4	4
	OSRTI	20	10	10	18	5	3	5	5
	OBLR	20	10	10	10	2	4	2	2
	OUST	15	5	10	7	1	3	1	2
Changes in climate conditions may alter assumptions about contaminant form/volatility.	FFRRO	16	8	8	14	4	4	3	3
	ORCR	6	5	1	10	3	5	1	1
	OSRTI	6	5	1	14	3	3	3	5
	OBLR	6	5	1	8	1	3	2	2

Program Vulnerability	Office	Characterization Criteria			Opportunities for OSWER to Make a Difference				
		Total Score	Scale of impact	Likelihood of occurrence	Total Score	Role or technical expertise?	Currently considered?	Build momentum or leverage current activities	Ongoing effort?
			Scale 1-10 10(High) -1(Low)			Scale 1-5 5(Yes)-1(No)	Scale 1-5 5(Not) – 1(Fully)	Scale 1-5 5(Very Likely)-1(Not Likely)	
Restoring Land (continued)									
Current scientific monitoring and sampling protocols on sites may no longer be effective.	FFRRO	15	7	8	14	4	4	3	3
	ORCR	2	1	1	16	5	5	3	3
	OSRTI	2	1	1	16	3	3	5	5
	OBLR	2	1	1	9	1	4	2	2
Safety procedures on sites may not reflect likelihood or intensity of surrounding conditions.	FFRRO	6	5	1	15	3	5	3	4
	OSRTI	6	5	1	17	4	3	5	5
	OBLR	6	5	1	8	1	3	2	2
Availability of utilities and transportation infrastructure may be limited as a result of increased impacts to those systems.	FFRRO	10	5	5	12	3	3	3	3
	OSRTI	15	10	5	13	2	3	5	3
	OBLR	15	10	5	11	2	3	3	3
Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.	FFRRO	17	7	10	10	4	2	4	-
	ORCR	15	5	10	15	4	3	4	4
	OSRTI	15	5	10	16	5	3	3	5
	OBLR	15	5	10	12	2	4	3	3
	OUST	15	5	10	7	1	3	1	2
Periodic evaluations of implemented remedies may not incorporate all climate change impacts, including changes in frequency and intensity that may impact remedy effectiveness.	FFRRO	10	5	5	14	3	3	4	4
	ORCR	10	5	5	16	4	4	4	4
	OSRTI	10	5	5	18	5	3	5	5
	OBLR	10	5	5	8	1	4	2	1
Use of natural resources impacted by sites may change as a result of increased need, resource scarcity, or compromised resources.	FFRRO	10	5	5	12	3	3	3	3
	OBLR	6	5	1	9	2	4	2	1

Program Vulnerability	Office	Characterization Criteria			Opportunities for OSWER to Make a Difference				
		Total Score	Scale of impact	Likelihood of occurrence	Total Score	Role or technical expertise?	Currently considered?	Build momentum or leverage current activities.	Ongoing effort?
			Scale 1-10 10(High) -1(Low)			Scale 1-5 5(Yes)-1(No)	Scale 1-5 5(Not) – 1(Fully)	Scale 1-5 5(Very Likely)-1(Not Likely)	
Emergency Response									
Current levels of administrative, enforcement, and emergency response staff may be insufficient to cover needs if number of extreme events increase.	OEM	4	3	1	5	2	1	1	1
	ORCR	20	10	10	9	1	4	2	2
Sufficient capability and capacity for conducting necessary lab analysis following significant weather events may not be available.	FFRRO	10	5	5	-	-	-	-	-
	ORCR	10	5	5	9	1	4	2	2
Current waste management capacity, including interim capacity, may be insufficient to handle surges in necessary treatment and disposal of hazardous and municipal wastes, as well as mixed wastes generated from climate events.	FFRRO	15	7	8	-	-	-	-	-
	ORCR	15	5	10	18	5	3	5	5
Training needs (both current and future) are likely to increase in order to meet the increase demand for response actions.	ORCR	15	5	10	12	3	4	3	2
Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.	OUST	10	5	5	10	3	3	2	2

1. OSWER did not conduct a detailed quantitative assessment of vulnerabilities to determine scores. Using best professional judgement and information from peer-reviewed scientific literature, the OSWER workgroup members determined values for each criteria. When applying the criteria, offices did not evaluate vulnerabilities in relation to each other, but instead considered each vulnerability independently. These tables are not intended to be a ranking, but rather as a useful and informative guide for OSWER offices as they determine which vulnerabilities to focus activities.

Characterization Criteria:

Scale of impact to human health, the environment or vulnerable communities because of the vulnerability.

Likelihood of occurrence because of the vulnerability.

Opportunities for OSWER to Make a Difference:

Does EPA have a unique or lead role or technical expertise in this area?

To what extent are climate impacts currently not considered in this area?

To what extent could additional EPA involvement build momentum or leverage current activities?

Is there an opportunity to incorporate climate change into an ongoing effort (e.g., rulemaking, changes to grant criteria, updates to guidance and training)?

Appendix C – OSWER Actions

Theme		Vulnerability	Office	Action	Timing
Preserving Land	Proper Management of Hazardous and Non-Hazardous Waste	Design and placement of RCRA Treatment, Storage and Disposal facilities may need to change to accommodate climate change impacts.	ORCR		L
		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. <i>(Actions also in Emergency Response)</i>		Prepare Fact Sheets on the proper management of wastes/debris associated with large natural disasters (e.g., electronic, household hazardous wastes, white goods, etc.)	S
				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.	L
				Finalize a document describing the “4 Step Process for Waste Managment Planning.”	M
				Update the ORCR Homeland Security Website with updated waste management planning information.	M
	Reducing Chemical Risks and Releases	Spill Prevention Plans may need to be updated due to the significant increases in the incidence of flooding and storm events.	OEM	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).	M
				Incorporate in SPCC and FRP guidance the statement of potential vulnerabilities to oil facilities from catastrophic weather events due to climate change.	M
				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).	M

Theme	Vulnerability	Office	Action	Timing
Restoring Land	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.	ORCR	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.)	L
		OSRTI/ FFRRO	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.	M
			Prepare remedy-specific climate change adaptation fact sheets for remedies most likely to be impacted and identify potential vulnerabilities and adaptation recommendations.	M
			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.	S
			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.	M
			Participate with OSWER and other EPA programs to initiate conversations as appropriate regarding approaches for handling remedy impacts from climate change.	M
			Work with ASTSWMO to gather information on if and how states currently alter remediation plans in response to changing climate impacts.	L
			Share information among states, tribes and EPA regions regarding new or modified investigation strategies and remediation techniques.	L
			Work with ASTSWMO to gather information on if and how states currently alter site assessments in response to flooding or drought conditions.	L
			Share information among states, tribes and EPA Regions regarding new or modified assessment techniques.	L
	Risk factors and rankings for risk-based cleanup strategies may need to be reassessed based on changing climate conditions.		Work with ASTSWMO to gather information on if and how states currently alter risk factors and rankings in response to flooding or drought conditions.	L
			Share information among states, tribes and EPA regions regarding how climate conditions may impact risk-based cleanup factors and rankings.	L
	Site characterization and design of cleanups may not reflect changing climate conditions.	OBLR	Work with regional staff to update the Analysis of Brownfields Cleanup Alternatives (ABCA) language in the brownfield grant T&Cs to include language that requires recipients take potential changing climate conditions into consideration when evaluating cleanup alternatives.	S
			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.	S

Theme	Vulnerability	Office	Action	Timing
Emergency Response	Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.	OUST	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).	M
			Analyze lessons learned from Hurricanes Katrina (2005) and Sandy (2012) to identify how EPA can help states respond to UST-related hurricane impacts.	M
			Share information among states, tribes and EPA regions regarding emergency response and preparedness (e.g., OUST's Flood Guide).	M
	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. <i>(Actions also in Proper Management of Hazardous and Non-Hazardous Waste)</i>		Prepare fact sheets on the proper management of wastes/debris associated with large natural disasters (e.g., electronic, household hazardous wastes, white goods, etc.)	S
			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.	L
			Finalize a document describing the "4 Step Process for Waste Management Planning."	M
			Update the ORCR Homeland Security Website with updated waste management planning information.	M
	Current levels of administrative, enforcement, and emergency response staff may be insufficient to cover needs if number of extreme events increase.	OEM	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.	S
	Existing emergency planning currently required or employed by OSWER may not sufficiently consider elevated risks from multiple climate impacts.		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.	S
	Training needs (both current and future) are likely to increase in order to meet the increase demand for response actions.		Incorporate materials on the impacts of climate change as EOC training materials are updated and exercises are planned.	M
Tools, Data, Training and Outreach	Identification of reliable data sources to use in site-specific analyses may need to be identified.	CPA	Provide recommended data sources and parameters to OSWER offices and Regions to ensure consistent mapping data and protocols. Develop these recommendations by working with the agency's climate change workgroup and EPA's Office of Research and Development.	S
	Revised training protocols and SOPs that take into account climate change impacts and what to look for may need to be developed.		Participate in agency climate change adaptation training development, as well as develop specific training as needed for OSWER staff.	S
	Models, decision tools, site environmental data and information feeds may need to be updated to reflect changing climate conditions.		Work with EPA partners and external experts to monitor evolving assumptions related to climate science. Develop a method for disseminating this information to OSWER offices that ensures consistent assumptions are used across all activities.	S

Theme	Vulnerability	Office	Action	Timing
Vulnerable Populations and Tribes	All vulnerabilities should include consideration of potential impacts to vulnerable populations and tribes. To emphasize the importance of this, consideration of impacts to vulnerable populations was included in the characterization criteria.	All OSWER Offices	Work with the agency's climate change workgroup and EPA's Office of Research and Development to ensure consistent mapping data and protocols to better understand the intersections of climate impacts and population vulnerability and help to inform future policy and office activities and ensure they take evolving climate science into account.	S
			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.	M
			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.	S
			Assist the Institute for Environmental Tribal Professionals (ITEP) in developing adaptation into their normal climate change training.	M

Key:Timing:

S: Short-term, initiated within one year

M: Medium-term, initiated within two years

L: Long-term, initiated after 3 years

Offices:

CPA—Center for Program Analysis; FFRRO—Federal Facilities Restoration and Reuse Office; OBLR—Office of Brownfields and Land Revitalization; OEM—Office of Emergency Management; ORCR—Office of Resource Conservation and Recovery; OSRTI—Office of Superfund Remediation and Technology Innovation; OUST—Office of Underground Storage Tanks

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