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*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

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### Disproportionate Impact

While climate change will affect all parts of society, it will have disproportionate effects on particular communities, demographic groups and geographic locations.<sup>5</sup> 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.<sup>6</sup> 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.<sup>7</sup> 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.<sup>8</sup> 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

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<sup>5</sup> USEPA. (2012). *Climate Change Adaptation Plan: Public Review Draft*.

<sup>6</sup> *ibid.*

<sup>7</sup> USEPA. (2012). *Region 2 Adaptation Plan*.

<sup>8</sup> 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.<sup>9</sup> Their ability to cope with climate-related hazards is further restricted by limited access to preparedness, response, and recovery resources.<sup>10</sup> 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.<sup>11</sup> In several Alaskan coastal communities, melting ice and erosion have caused landfills to fall into the ocean, affecting environmental and human health.<sup>12</sup>

## **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.

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<sup>9</sup> USEPA. (2012). *Climate Change Adaptation Plan: Public Review Draft*.

<sup>10</sup> 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.

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

<sup>12</sup> 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.<sup>13</sup> 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

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<sup>13</sup> 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.<sup>14</sup> 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.

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<sup>14</sup> 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**

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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**

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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.

Program Vulnerability	Climate Change Impact								
	Increased extreme temps <sup>1</sup>	Sustained changes in average temp <sup>1</sup>	Sea level rise <sup>2</sup>	Decreased permafrost <sup>3</sup>	Decreased precipitation increasing drought <sup>4</sup>	Increased heavy precipitation events <sup>1</sup>	Increased flood risk <sup>4</sup>	Increased frequency & intensity of wildfires <sup>5</sup>	Increased intensity of hurricanes <sup>1</sup>
	Very Likely			Likely					
<b>Preserving Land – Proper Management of Hazardous and Non-Hazardous Wastes</b>									
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.	*	*	*	*	*	*	*	*	*
<b>Preserving Land – Reducing Chemical Risks and Releases</b>									
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.			*			*	*	*	*

Program Vulnerability	Climate Change Impact								
	Increased extreme temps <sup>1</sup>	Sustained changes in average temp <sup>1</sup>	Sea level rise <sup>2</sup>	Decreased permafrost <sup>3</sup>	Decreased precipitation increasing drought <sup>4</sup>	Increased heavy precipitation events <sup>1</sup>	Increased flood risk <sup>4</sup>	Increased frequency & intensity of wildfires <sup>5</sup>	Increased intensity of hurricanes <sup>1</sup>
	Very Likely			Likely					
<b>Restoring Land</b>									
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 <sup>1</sup>	Sustained changes in average temp <sup>1</sup>	Sea level rise <sup>1</sup>	Decreased permafrost <sup>2</sup>	Decreased precipitation increasing drought <sup>3</sup>	Increased heavy precipitation events <sup>1</sup>	Increased flood risk <sup>3</sup>	Increased frequency & intensity of wildfires <sup>4</sup>	Increased intensity of hurricanes <sup>1</sup>
Program Vulnerability	Very Likely			Likely					
<b>Emergency Response</b>									
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 Scorecard<sup>1</sup>

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)	
<b>Preserving Land – Proper Management of Hazardous and Non-Hazardous Wastes</b>									
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
<b>Preserving Land – Reducing Chemical Risks and Releases</b>									
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

	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)		
Program Vulnerability	Office	Total Score	Scale of impact	Likelihood of occurrence	Total Score	Role or technical expertise?	Currently considered?	Build momentum or leverage current activities.	Ongoing effort?
<b>Restoring Land</b>									
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)	
<b>Restoring Land (continued)</b>									
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

	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)	
Program Vulnerability	Office	Total Score	Scale of impact	Likelihood of occurrence	Total Score	Role or technical expertise?	Currently considered?	Build momentum or leverage current activities.	Ongoing effort?
<b>Emergency Response</b>									
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 Management 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	<p>Increased contaminant migration may lead to boundary changes at current sites or creation of new sites.</p> <p>Current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts.</p> <p>Changing climate conditions may impact continued remedy effectiveness.</p> <p>Remedies that are “complete” or are long-term actions may no longer be protective and resilient as climate conditions change at site.</p>	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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