

Climate Resilience at Superfund Sites

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Superfund Redevelopment Program Webinar on
Climate Resiliency and Superfund Site Reuse

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Overview

- ◆ Core messages on Superfund remedy protectiveness in light of climate change
- ◆ Early visioning of resilient reuse or redevelopment at Superfund sites
- ◆ Leveraging our mission and cleanup authorities at Superfund sites to help communities address broader vulnerabilities to climate change
- ◆ Finding long-term opportunities to adapt to the changing climate while potentially mitigating climate change

<https://www.epa.gov/superfund/superfund-climate-resilience>

Climate Change is Real, Though Not Always Dramatic

Sidewalk along the Tidal Basin in Washington DC, now only visible at low tide. What was lawn is now a mud flat and beach (April 2022).



Today's high tides used to be floods.



Two Key Climate Concepts

- ◆ Climate change mitigation: How can we contribute to minimize GHG emissions generated by site cleanups? Efforts are folded into green remediation.



- ◆ Climate change adaptation: How do we integrate what we know about changes in our climate into program operations? Efforts are known as climate resilience.

Key Concepts Driving Superfund Climate Resilience

Basic Question for the Agency:

How is climate change likely to affect the ability of your office to achieve its mission and strategic goals?

Basic Question for the Site Manager:

How is climate change likely to affect the protectiveness of my remedy, and what actions do I need to take to ensure its resilience under future climate conditions?

Key Federal and Agency Climate Adaptation and Mitigation Policy Drivers

- ◆ EPA 2022—2026 Strategic Plan Goal 1 Tackle Climate Crises
 - » Objective 1.1: Reduce Emissions that Cause Climate Change
 - » Objective 1.2: Accelerate Resilience and Adaptation to Climate Change Impacts
- ◆ [EO 14008](#): Tackling the Climate Crisis at Home and Abroad
- ◆ [EO 14057](#): Catalyzing Clean Energy Industries and Jobs Through Sustainability
- ◆ [EO 14072](#): Strengthening the Nation’s Forests, Communities and Local Economies
- ◆ [EO 13690](#), Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input

“... key Federal actions to reduce climate pollution; increase resilience to the impacts of climate change; protect public health; conserve our lands, waters, oceans, and biodiversity; deliver environmental justice; and spur well-paying union jobs and economic growth.”

2022 and 2023 Priority Actions for OLEM Climate Change Adaptation Plan

Actions completed **since 2014**

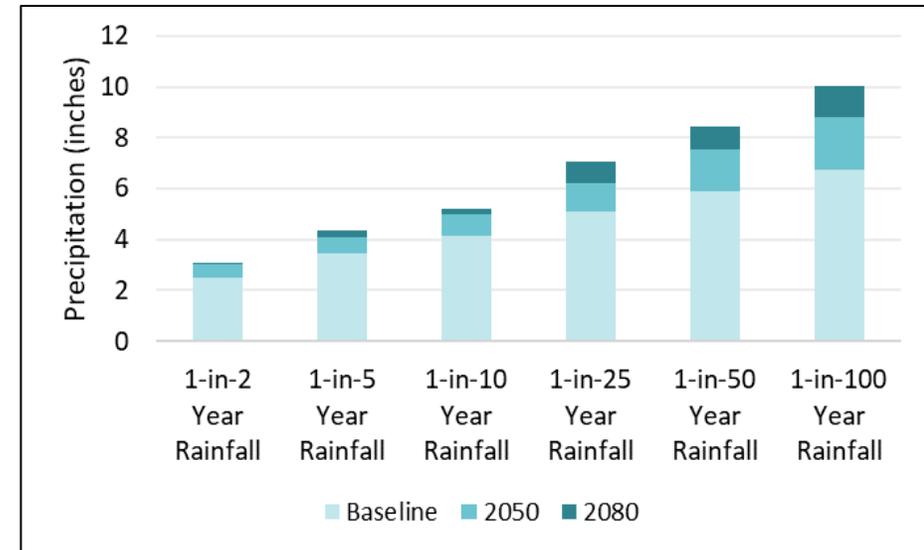
- i. OUST released two sets of guidelines with useful information for state, local, and tribal authorities in the event of a threatened or actual flood or wildfire.
- ii. OSRTI OD memorandum signed and distributed to regions to identify existing remedial program authorities and processes to ensure continuing protectiveness of current and future remedies.
- iii. Worked 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.
- iv. Produced three fact sheets for sites with sediment, containment and groundwater remedies.

Proposed new **actions for 2022 and 2023**

- v. Release OLEM Adaptation Plan.
- vi. Develop core adaptation training and identify stakeholder/audiences and channels.
- vii. Deploy technical capacity for climate vulnerability assessments.
- viii. Expand assessments for newly identified climate vulnerabilities (particularly communities near contaminated or chemical facilities).
- ix. Develop new climate adaptation fact sheets on site characterization, known and recurring non-severe weather climate adaptation challenges, and update the existing sediment fact sheet.
- x. Develop memorandum requiring that climate change impacts be considered in RCRA cleanups.

Building on the Science: Forward Looking Climate Data

- ◆ Climate is already factored into our decision-making process; the key questions are:
 - » What does a forward-looking climate analysis tell us about conditions at our site?
 - » What is the “delta” over current conditions?
 - » How does that delta affect remedy decisions, site operations, etc.?
- ◆ Expertise is needed in climate analysis, mapping/GIS, and contaminated site science and engineering



LOCA downscaled precipitation projection data (Pierce et al, 2014); RCP 8.5, 90th percentile model values

Climate Change Adaptation Management Strategy



From EPA 2019 "Climate Resilience Technical Fact Sheet" series

Assess System Vulnerability

Remedy Component	Temperature				Precipitation / Flooding				Drought						
Groundwater Treatment System Infrastructure	Climate Exposure	High	Yellow	Orange (X)	Red	Climate Exposure	High	Yellow	Orange	Red	Climate Exposure	High	Yellow	Orange	Red
		Med	Light Green	Yellow	Orange		Med	Light Green	Yellow	Orange		Med	Light Green (X)	Yellow	Orange
		Low	Green	Light Green	Yellow		Low	Green	Light Green	Yellow (X)		Low	Green	Light Green	Yellow
		Low	Med	High		Low	Med	High		Low	Med	High			
	Remedy Sensitivity				Remedy Sensitivity				Remedy Sensitivity						
Landfill Covers	Climate Exposure	High	Yellow	Orange (X)	Red	Climate Exposure	High	Yellow	Orange	Red	Climate Exposure	High	Yellow	Orange	Red
		Med	Light Green	Yellow	Orange		Med	Light Green	Yellow	Orange (X)		Med	Light Green	Yellow	Orange (X)
		Low	Green	Light Green	Yellow		Low	Green	Light Green	Yellow		Low	Green	Light Green	Yellow
		Low	Med	High		Low	Med	High		Low	Med	High			
	Remedy Sensitivity				Remedy Sensitivity				Remedy Sensitivity						
Former Waste Channels	Climate Exposure	High	Yellow (X)	Orange	Red	Climate Exposure	High	Yellow	Orange	Red (X)	Climate Exposure	High	Yellow	Orange	Red
		Med	Light Green	Yellow	Orange		Med	Light Green	Yellow	Orange		Med	Light Green (X)	Yellow	Orange
		Low	Green	Light Green	Yellow		Low	Green	Light Green	Yellow		Low	Green	Light Green	Yellow
		Low	Med	High		Low	Med	High		Low	Med	High			
	Remedy Sensitivity				Remedy Sensitivity				Remedy Sensitivity						

Adaptation and Resilience Measures

◆ Identify, prioritize and implement measures that address known vulnerabilities at your site:

» Climate resilience technical fact sheets

	Temperature	Precipitation	Wind	Sea Level Rise	Wildfires	Potential Climate Resilience Measures for System Components
Groundwater Extraction and Control System		◆				Dewatering well system <i>Installing additional boreholes at critical locations and depths to maintain target groundwater levels in the extraction/containment zone and reduce groundwater upwelling without compromising the remediation system</i>
	◆	◆	◆	◆	◆	Remote access <i>Integrating electronic devices that enable workers to remotely suspend pumping during extreme weather events, periods of impeded access or unexpected hydrologic conditions</i>
	◆	◆	◆			Well-head housing <i>Building insulated cover systems made of high density polyethylene or concrete for control devices and sensitive equipment situated aboveground for long periods</i>

» Climate resilience case studies, e.g. those available at [Climate Change Adaptation Resource Center \(ARC-X\)](#)

When to Consider Climate Change in the Superfund Remedial Process?

- ◆ CERCLA and the NCP provide the foundational basis for consideration of potential extreme weather/climate impacts (long-term and short-term protectiveness)
- ◆ It's never too early or too late to assess vulnerabilities and build in resilience
- ◆ Remedial investigation/feasibility study
 - » Nature and extent of contamination
 - » Human and ecological risks
 - » Remedial alternatives development and screening
 - » Anticipated reuse
- ◆ Remedy selection
- ◆ Remedy design & action
- ◆ Post construction



Leveraging the Process: Envision Site Reuse and Redevelopment

The existing Superfund community involvement framework is a valuable channel to engage and inform community stakeholders on climate vulnerability and adaptation.

Climate Considerations: Examples Along the Superfund Pipeline

◆ **Site Assessment:** Kerr-McGee Navassa Superfund Site (Navassa, NC)

The site includes a tidal wetland where creosote-related constituents were found. Region 4 is collaborating with the USACE to assess the potential vulnerabilities and adaptation measures associated with climate change impacts such as greater tidal fluence and future groundwater-surface water interactions. **Anticipated end use: residential, commercial, industrial or recreational use.**

◆ **ROD:** Newport Naval Education & Training Center, Site 22 OU10 (Portsmouth, RI)

“The design will ensure no net loss of beach or flood storage and will include storm and sea level rise considerations ... Monitoring wells will be installed and maintained in a manner to withstand potential damage from up to a 500-year storm and potential flood events for the duration of the monitoring program.” **Anticipated end use: continued operation of naval base and transfer of selected properties.**

◆ **RI/FS:** Portland Harbor Superfund Site (Portland, OR)

EPA considered climate change impacts on river flows in the Willamette watershed. Climate change is anticipated to result in an increase in winter flow and a decrease in summer flow, with an earlier peak flow. More high flow events are expected but of less magnitude than the large historical flood events. **Anticipated end use: mixed use.**



Continental Steel Corp.

Kokomo, Indiana

- ◆ 183-acre past manufacturing site, about half in 100-year floodplain
- ◆ 3-prong adaptation in collaboration with City (now owner)
 - » Weather-proof 3 groundwater extraction systems/pumphouses
 - » Optimize stormwater management
 - » Use onsite renewable energy
- ◆ Remediated and converted 4-acre former quarry pond to stormwater retention pond storing up to 58,000 cubic yards of onsite and neighborhood runoff
- ◆ Three 2.4 kW wind turbines offset ~60% of grid power to extract and direct contaminated groundwater to Kokomo wastewater treatment plant
- ◆ 7.2 MW solar energy farm above soil cap brings \$36,000 annual revenue over 20 years, with space to expand



American Cyanamid

Bridgewater, New Jersey

- ◆ Future use should respect flooding hazards; most of past chemical manufacturing site in 100-year floodplain
- ◆ Preserve and restore floodplain ecosystem to support natural stormwater management
- ◆ Manage remedy for seasonal and severe flooding impacts e.g. 2011 Hurricane Irene and 2021 Hurricane Ida tropical storms
 - » Engineered capping system designed to withstand 500-year flood, at minimum
 - » Proper maintenance of waste impoundment berms near the river
 - » Submersible pumps in bedrock wells to improve hydraulic control
 - » Electrical controls for groundwater extraction on elevated/concrete foundation
 - » Groundwater treatment plant outside 500-year floodplain



Additional examples: Integrating Adaptation and Reuse

- ◆ **General Motors** (Massena, NY): stormwater pond for landfill runoff, two drainage layers in cap; **anticipated industrial use**
- ◆ **Malone Services** (Texas City, TX): vegetated soil/waste cap near Galveston Bay, freshwater lake for wildlife habitat and stormwater storage; **future reuse for land conservation**
- ◆ **Rocky Mountain Arsenal** (Commerce City, CO): caps built to sustain 1,000-year flood; periodic prescribed burns to restore prairie and reduce wildfire fuel; **portions used for wildlife preserve, local road expansion, recreational complex, music venue**
- ◆ **Solvents Recovery Service of New England** (Southington, CN): solar array powering groundwater extraction, wetland restoration in collaboration with US FWS, portion now part of regional recreational trail system; **anticipated greenspace**



Climate Mitigation and Adaptation Action Synergies

Examples of green remediation BMPs that can help mitigate climate change **AND** adapt remedies to changing climate conditions

Green Remediation BMP	Climate Change	
	Mitigation	Adaptation
Substitute fossil fuel-derived energy with renewable energy	Reduces GHG emissions	<ul style="list-style-type: none"> • Provides a remedy with predictable on-demand power • Diversifies its energy supply
Sequester carbon through revegetation	Removes carbon from the atmosphere	<ul style="list-style-type: none"> • Immobilizes contaminated media • Enhances soil quality • Reduces erosion
Control stormwater through green infrastructure	Uses nature-based, low/no energy processes to conserve surface water and avoid soil/sediment loss	<ul style="list-style-type: none"> • Prevents physical damage to remedy • Enhances infiltration • Filters stormwater pollutants

Examples of Climate Mitigation and Adaptation Synergies

- ◆ Renewable energy: Supplying continuous power while reducing GHG emissions
- ◆ Carbon sequestration through revegetation: Removing atmospheric carbon while immobilizing contaminated media in a resilient manner with deeper O and A soil horizons
- ◆ Stormwater control through green infrastructure: Protecting remedy performance while using nature-based (low/no energy) processes to treat and conserve surface water



Re-Solve, Inc., North Dartmouth, MA



Solvents Recovery Service of New England, Southington, CN



Bunker Hill Complex – Gray's Meadow, Smelterville, ID

Food for Thought - Ecosystem Services: A Currency for Resilience and Sustainability

◆ Examples of ecosystem services:

- » Climate resilience
- » Sequester carbon
- » Provide wildlife habitat
- » Reduce wind and water erosion
- » Protect water resources
- » Create green space and corridors
- » Improve property values and aesthetics



Lower Basin of Coeur d'Alene River Superfund site in northern Idaho

◆ Examples of U.S. guidelines:

- » U.S. EPA 2020 *National Ecosystem Services Classification System (NESCOCS) Plus* framework
- » U.S. EPA *Engineering Forum Issue Paper: Ecosystem Services at Contaminated Site Cleanups*
- » U.S. Department of Defense (DOD) *Value and Resiliency of Ecosystem Services on Department of Defense Lands*, a methodology for estimating ecosystem service benefits to the public and improving resilience of DOD installation operations

Identify
Measure
Quantify
Value
Account