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Climate Resilience: Support for the Vulnerability Assessment and Resilience Plan (VARP) Development

David Werth

RemPlex 2023

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U.S. DEPARTMENT OF ENERGY

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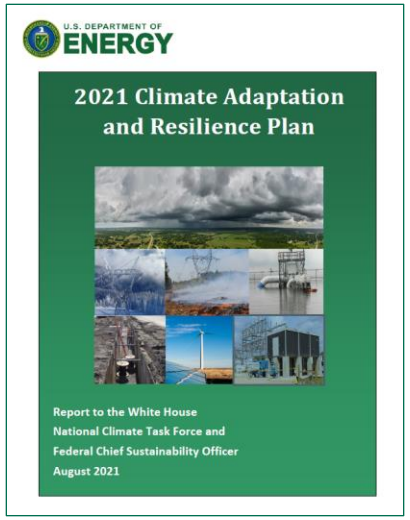
BSRA Battelle Savannah River Alliance, LLC

DOE VARP Request

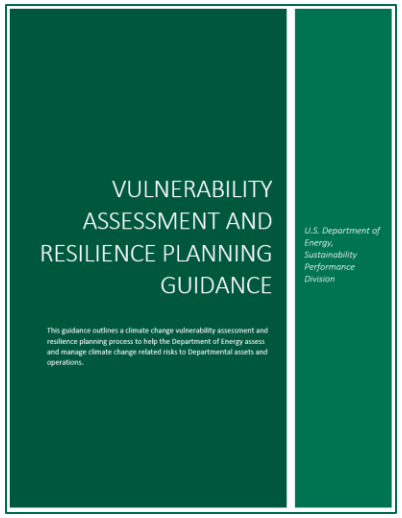
January 2021

Executive Order 14008: Tackling the Climate Crisis at Home and Abroad

August 2021



September 2021



Requires All DOE Sites & Offices to Develop and Maintain a Vulnerability Assessment and Resilience Plan (VARP)

1. Identify site planning team
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6. Characterize vulnerabilities with a risk matrix
7. Identify and assess resilience solutions
8. Develop & implement a portfolio of resilience solutions
9. Monitor, evaluate, and reassess the resilience plan

Collaborators

Phase I – VARP Development Support:
Carol Eddy-Dilek, SRNL
Emily Fabricatore, SRNL
David Werth, SRNL
Haruko Wainwright, LBNL/MIT
Zexuan Xu, LBNL

Phase II – Leveraging the VARP to Enhance Climate Resilience:
Eric Mielbrecht, EcoAdapt
Barbara Maco, Sustainable Remediation Forum
Carol Eddy-Dilek, SRNL
Emily Fabricatore, SRNL
David Werth, SRNL
Haruko Wainwright, LBNL/MIT
Zexuan Xu, LBNL

DOE-EM HQ:
Albes Gaona

DOE-EM Sites:
Hanford
Moab
Oak Ridge
Paducah
Portsmouth
Savannah River Site
Waste Isolation Pilot Plant
West Valley Demonstration Project

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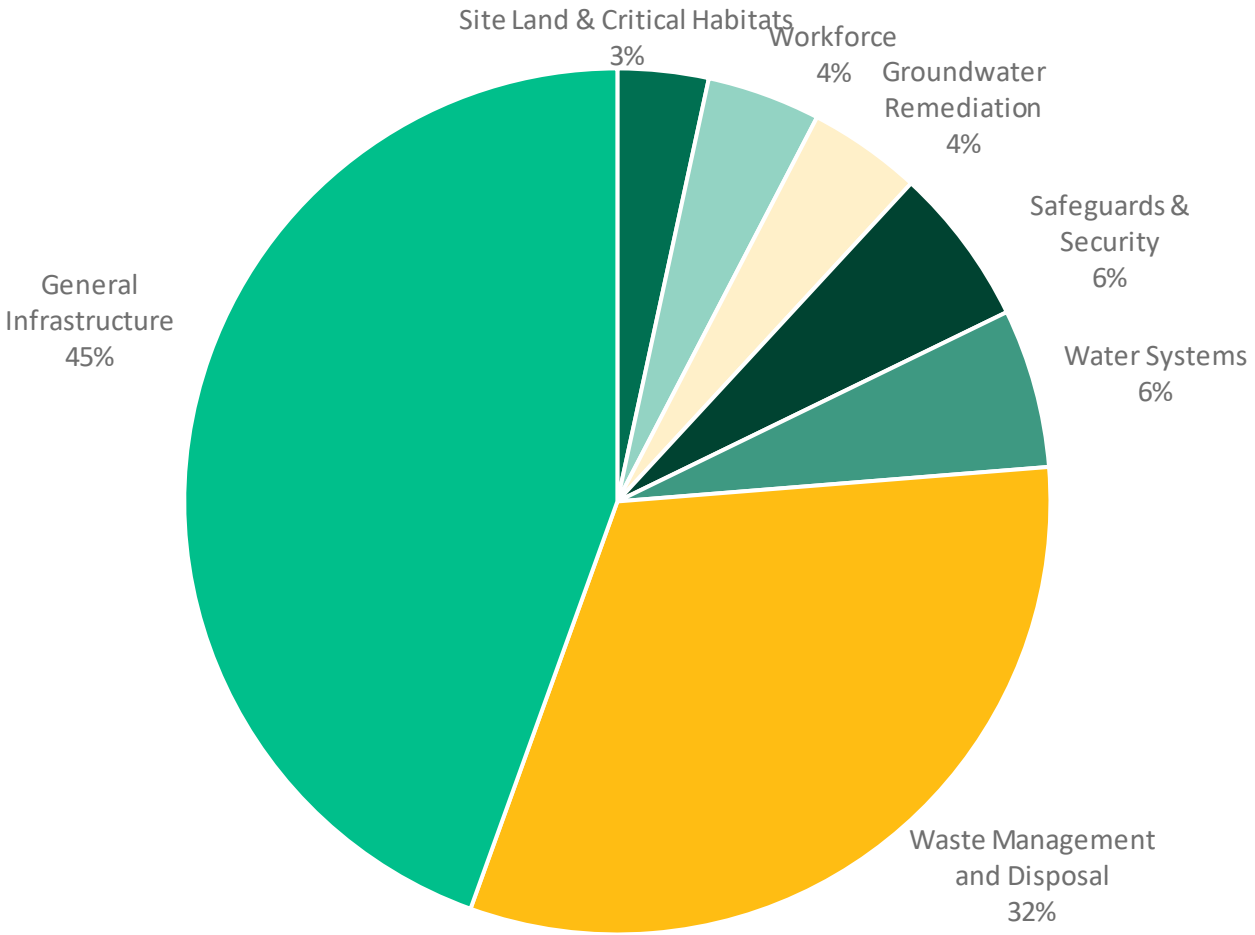
Identify Critical Assets & Infrastructure



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Characterize Climate Trends, Events, Hazards, & Impacts

	hist_mean	hist_std	1990_2019_mean	rcp45_mean	rcp45_max	rcp85_mean	rcp85_max	shifting_rcp45	shifting_rcp85
Annual precipitation (mm/day)	3.24	0.14	3.33	3.52	3.92	3.58	4.05	medium	high
Extreme precipitation day	2.20	1.61	2.49	2.83	8.62	3.25	9.86	low	medium
Annual avg Tmax (C)	24.79	0.31	25.35	26.63	27.53	27.50	31.07	high	high
Maximum Daily Precipitation (mm/day)	66.45	23.67	70.53	72.33	179.05	82.04	231.20	low	medium
SPEI	-0.01	0.30	0.03	0.15	-0.63	0.22	-0.49	negative	negative
Heating Degree Days	2311.46	290.89	nan	1837.28	2592.96	1670.98	2597.32	negative	negative
Extreme Degree Days	0.14	0.58	nan	1.33	23.93	10.77	148.44	high	high
Cooling Degree Days	2065.04	180.91	nan	2776.65	3495.15	3167.67	4626.22	high	high

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How do we characterize the threat posed by future climate change at SRS?

Global Climate Model Data

Data from the Climate Model Intercomparison Project, version 5 (CMIP-5)

21 Models (CanESM2, CCSM4, GFDL-CM3, etc.)

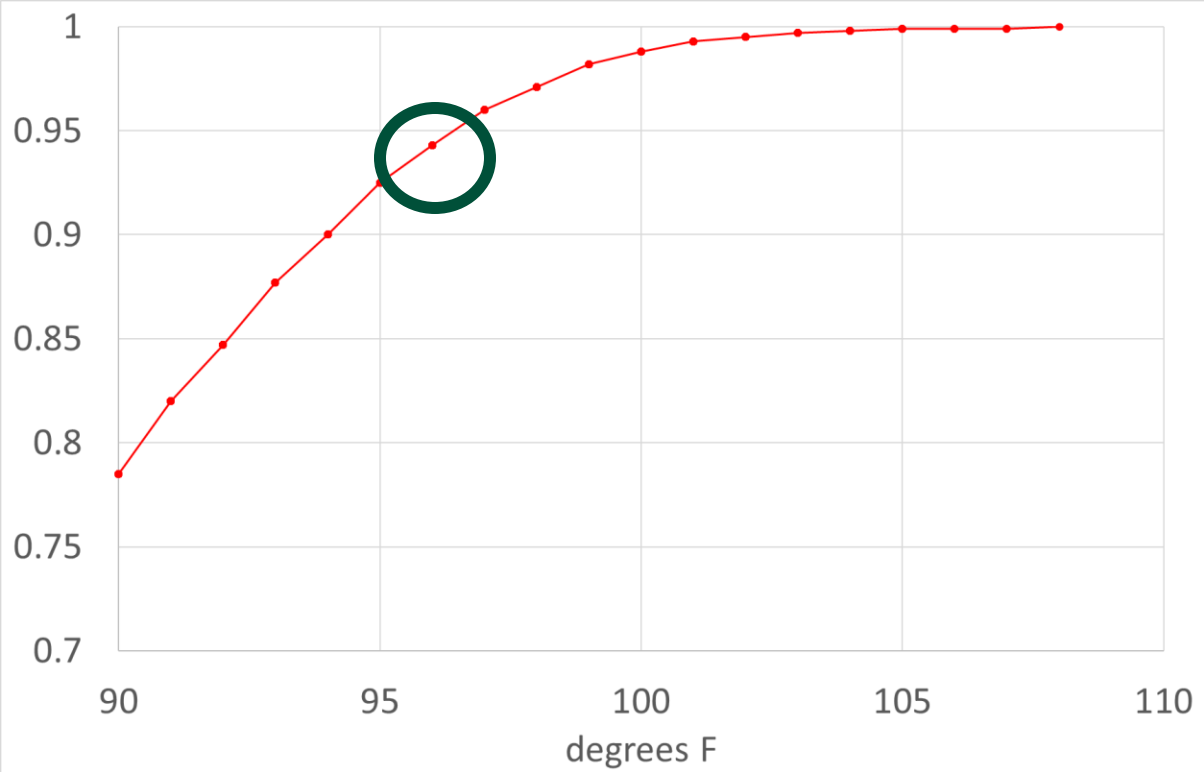
Statistically-downscaled

Historical	Observed forcing	Jan 1, 1950 – Dec. 17, 2005
Rcp4.5	4.5W/m^2	Jan 1, 2006 – Dec. 30, 2099
Rcp8.5	8.5W/m^2	Jan 1, 2006 – Dec. 30, 2099

- Daily maximum temperature
- Daily minimum temperature
- Daily total precipitation

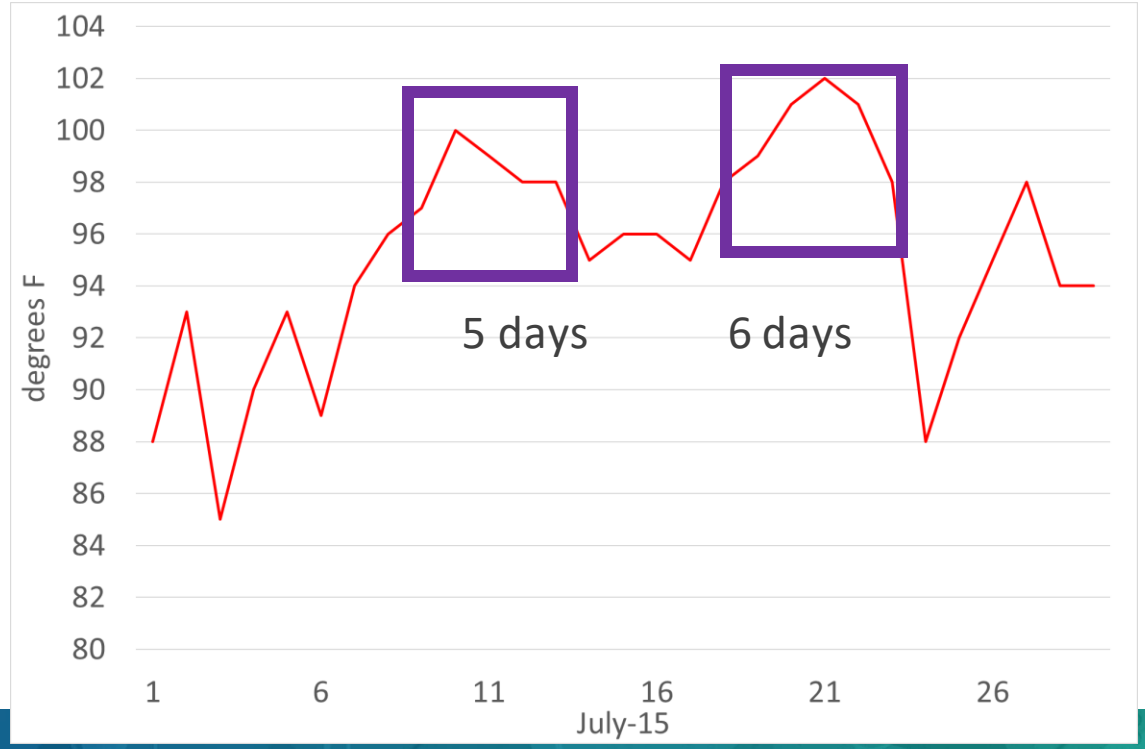
Heat Wave: A prolonged period of days in which the maximum temperature exceeds the 95th percentile.

1. Calculate 95th percentile of daily maximum temperature (SRS = 96°F)



Heat Wave: A prolonged period of days in which the maximum temperature exceeds the 95th percentile.

1. Calculate 95th percentile of daily maximum temperature (SRS = 96°F)
2. Calculate the number of times the temperature hits or exceeds that value for 5 days in a row, 6 days in a row, etc.



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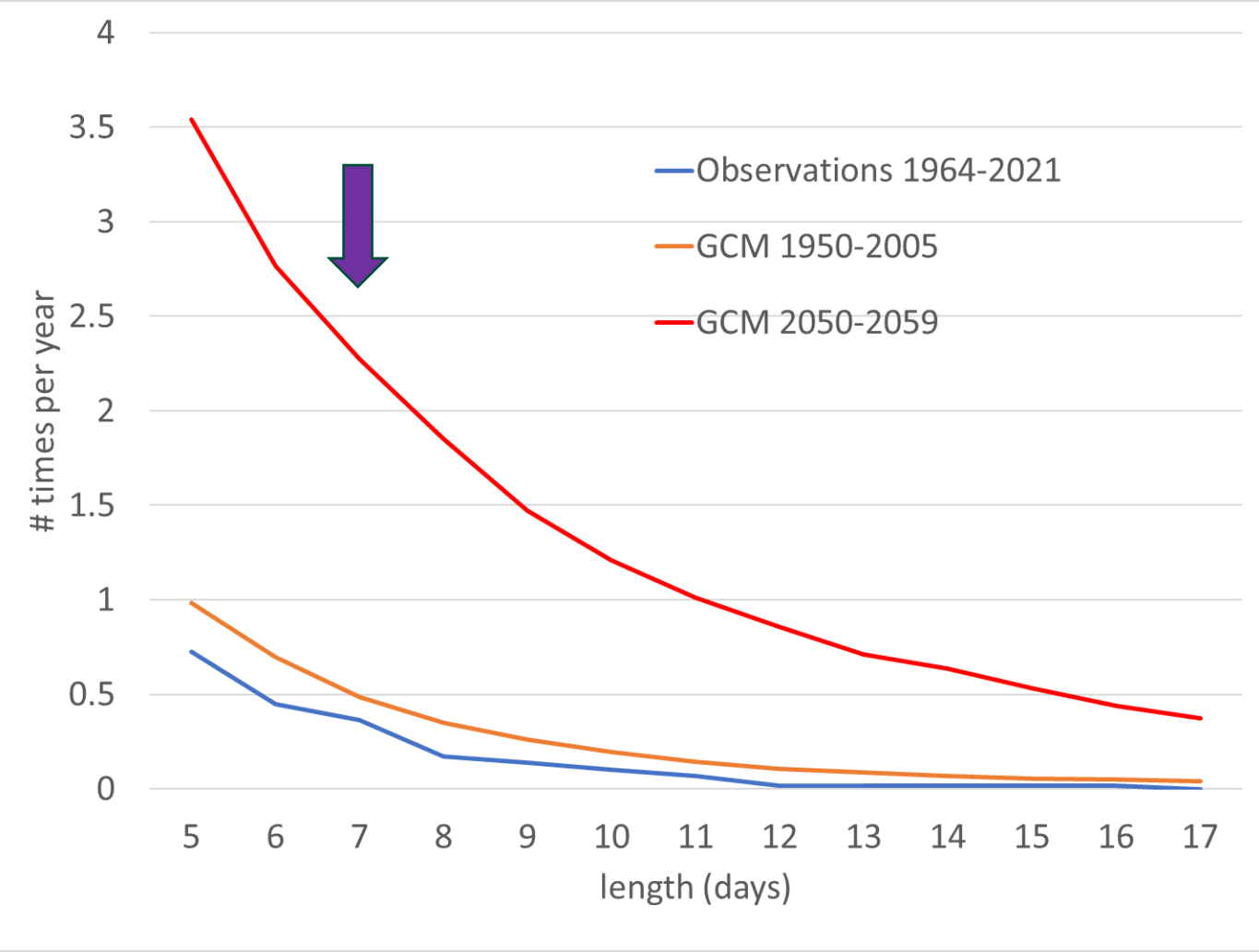

Characterize Vulnerabilities with a Risk Matrix

SRS Risk Matrix Excerpt

Asset Type	Cold Wave	Drought	Heat Wave	Winter Weather	Precipitation	Ice Storm	Lightning	Wildfire	Tornado
Site workforce	4.3		8.1	6.7	6.7	6.7	8.3	6.8	4.8
Site Ecology & Land Preservation		6.3	7.8	5.3		5.5		6.5	4.5
IT and Telecom Systems	4.0		8.5		7.0	7.0		8.0	4.5

DOE VARP Risk Score = Criticality x Hazard Likelihood x Impact x Vulnerability

IT and Telecom Systems & Heat Wave Example
Criticality = Moderate = 10
Hazard Likelihood = Almost certain = 3
Impact = High impact = 100
Vulnerability = Unlikely to fail = 30

DOE VARP Risk Score = 10 x 3 x 100 x 30

Overall Scoring: Log10(Risk)+3.5

Log10(90000)+3.5 = 8.45

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Identify, Assess, Develop, and Implement Resilience Solutions

Site	Resilience Solution	Priority	Timing	Funding Mechanism	Implementation Status
Oak Ridge (ETTP)	**Repair White Oak Creek Sediment Retention Structure**	**High**	**TBD**	**Appropriated funds**	**Proposed**
	Upgrade LGWO/PWTF piping and instrumentation	High	2023-2026	Appropriated funds	Underway
	SWSAs, pits and trenches – MVGES upgrades	**High**	**TBD**	**Appropriated funds**	**Proposed**
	Perform suite of upgrades for EMWMF	High	2024-2027	Appropriated funds	Proposed
	Purchase road tractor and construct pole barn for storage	High	TBD	Appropriated funds	Proposed
	Supply chain resilience measures	High	TBD	Appropriated funds	Proposed
	Purchase generators for ORR landfills	Medium	2022	Appropriated funds	In procurement
	Install weir at K-901-A pond	**Medium**	**TBD**	**Appropriated funds**	**Proposed**
	Rent generators and air conditioning units for Y-12 excess facilities	Medium	2022	Appropriated funds	Planned

Site	Resilience Solution	Priority	Timing	Funding Mechanism	Implementation Status
Paducah & Portsmouth	*PPPO – Lexington; electric vehicle charging station*	*Low*	*Complete end of FY23*	*Direct (line item)*	*Funded*
	Increase HVAC capacity and efficiency	Low	Evaluate in FY26 or sooner if warranted	Direct (M&R)	Identified
SRS	*Convert to all electric fleet*	*High*	*Planned start in FY22*	*Direct – HQ*	*Identified*
	Replace transmission transformers with right size	High	Planned start in FY22	SRS Power Pool	Identified
	Right size HVAC systems to meet climate change	High	Planned start in FY22	SRS Power Pool	Identified
WIPP	**Restore wetland area**	**High**	**Planned start in FY24**	**Direct – SLI**	**Identified**
	Replace backup water pumps with variable speed drive pumps at on-site waste disposal system	High	Planned start in FY23	ESPC Enable	Identified
WVDP	Finalize options analysis, select engineering approach, and initiate actions to reduce spillway activations	N/A	FY23	N/A	Engineering evaluation and options selection in process

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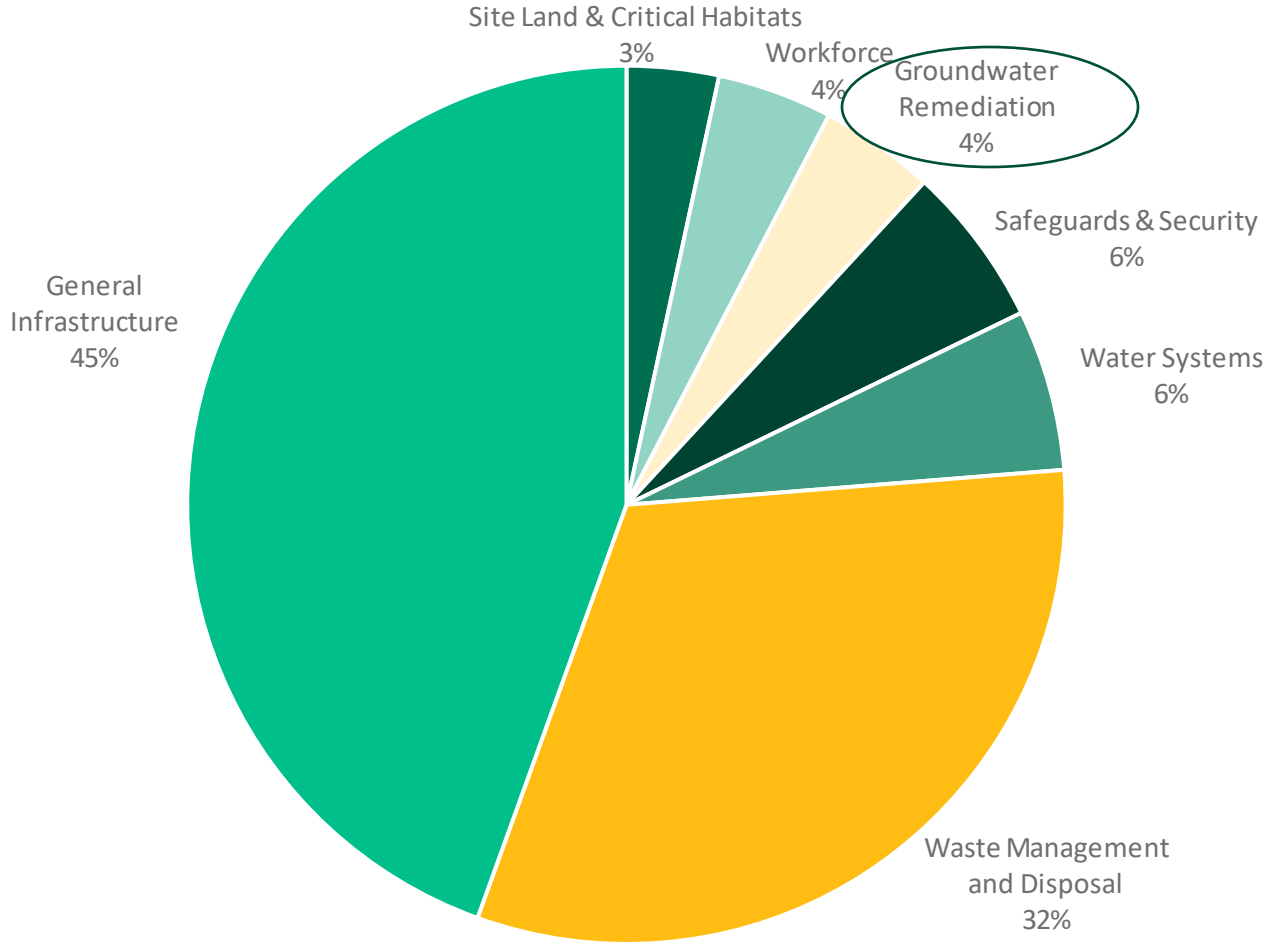
Monitor, Evaluate, and Reassess the Resilience Plan

Sites & HQ – Monitor:
Sustainability Dashboard: Updated yearly to the Sustainability Dashboard for HQ progress tracking
- Sites will self-update the status
- SRNL/LBNL lab team will be available for assistance as needed

Sites & HQ – Evaluate and Reassess:
VARP Report: Updated every 4 years to align with National Climate Assessment data

SRNL/LBNL Lab Team, FY23 Support – Evaluate and Reassess:
Leveraging the VARP to Enhance Climate Resilience: Improve climate resilience at DOE-EM sites by leveraging and expanding VARPs
- Workshop held at SRS 6/6 and 6/7
- Case study: SRS F&H Area – soil and groundwater remediation
- In-person collaborative information exchange to test a framework for enhancing climate resilience at SRS
- Framework will be modified to expand further to all DOE-EM sites/areas as requested

Next Steps:
- Workshop report
- Present takeaways to DOE-EM site VARP POCs
- Support development of a similar framework at other sites

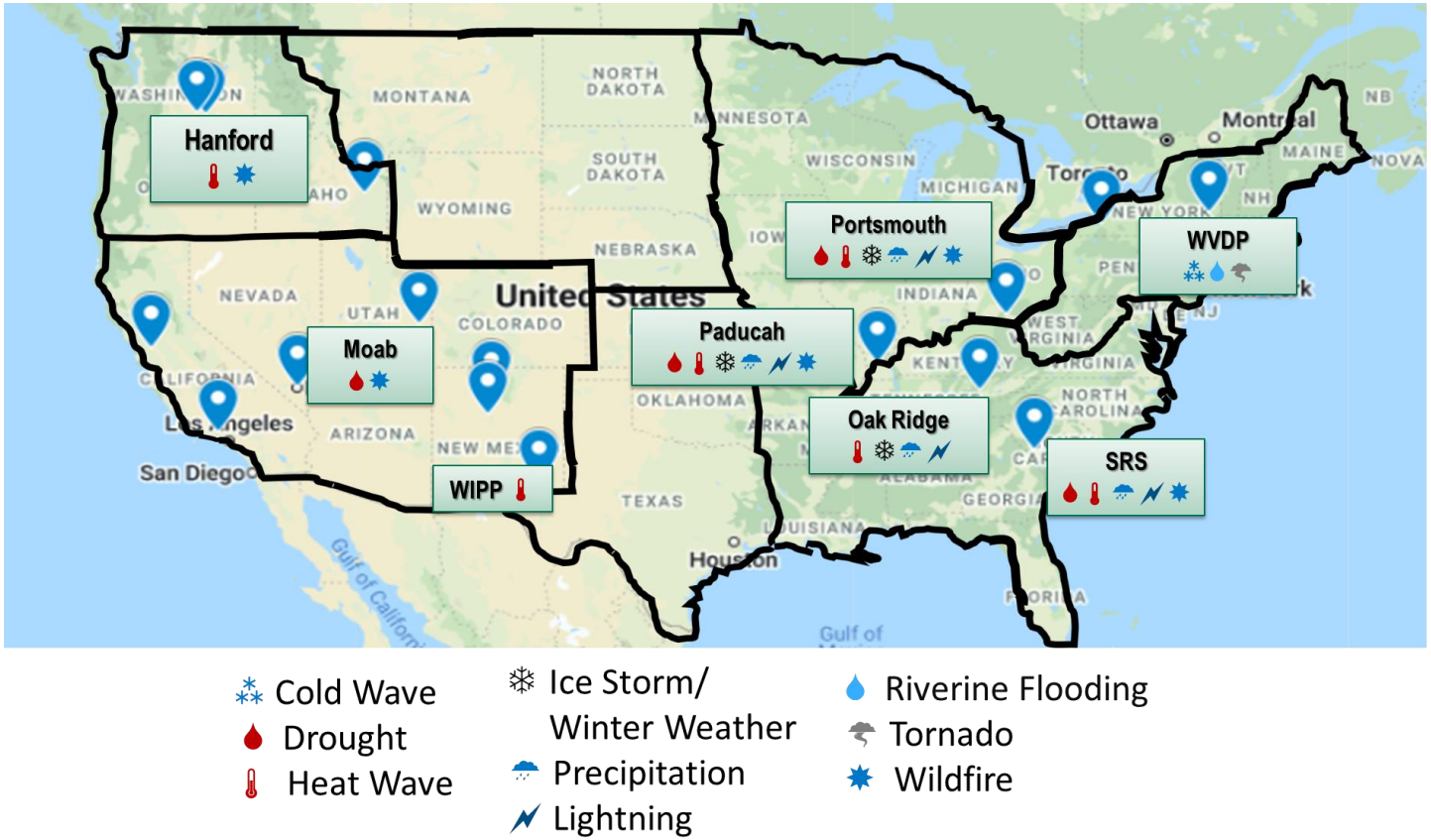


June 2023 Workshop: Leveraging VARPs to Enhance Climate Resilience on DOE-EM Sites

Goal: Further refine the climate change resilience of DOE-EM sites

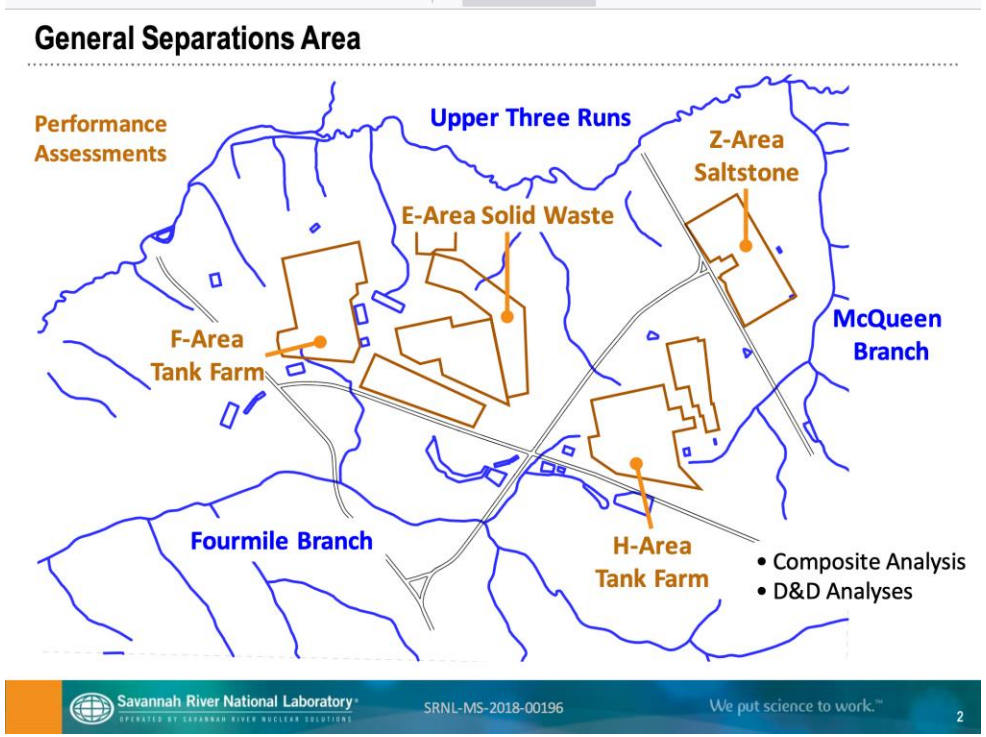
Savannah River Site

- Waste management
- Disposal cells
- Additional operations



Workshop Activities

- Site tour of General Separations Area (focus of workshop)
- Presentation on site context
- Discussion of sensitive operations & assets
- Presentations on local climate change & vulnerability
- Vulnerability assessment discussion
- Presentations on resilience solutions, implementation, monitoring & evaluation
- Resilience solutions roundtable discussion



Workshop Findings

Vulnerability of landfill caps and supporting systems

- Precipitation extremes & timing
- High heat events & drought
- Wildfire
- Drought / extreme precipitation cycles
- Ecological shifts

➢ Existing landfill caps design sufficient

➢ Mobile pump systems to address localized flooding

➢ Better understanding of surface water dynamics

➢ Plant future-tolerant vegetative cap cover

Regulatory and stakeholder hurdles around implementing creative climate resilience actions

➢ Work with regulators to co-develop a regulatory context for resilience that has been tested to be effective and economically reasonable

Path Forward

- Currently developing a framework to expand the workshop process to other DOE-EM sites to enhance climate resiliency
- The option for workshops at the sites will be available upon request
- Currently targeting Y-12 and Portsmouth/Paducah for next phase