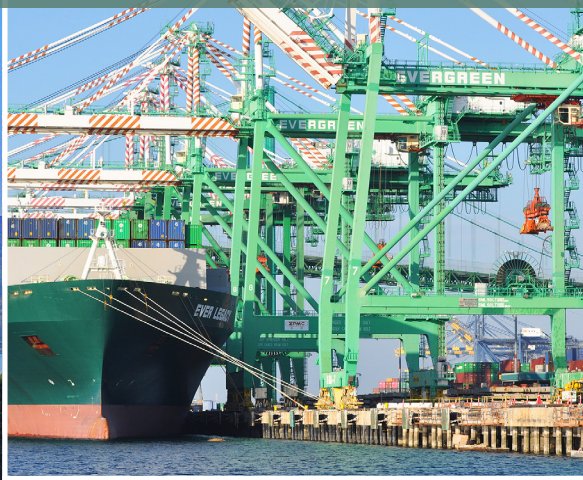
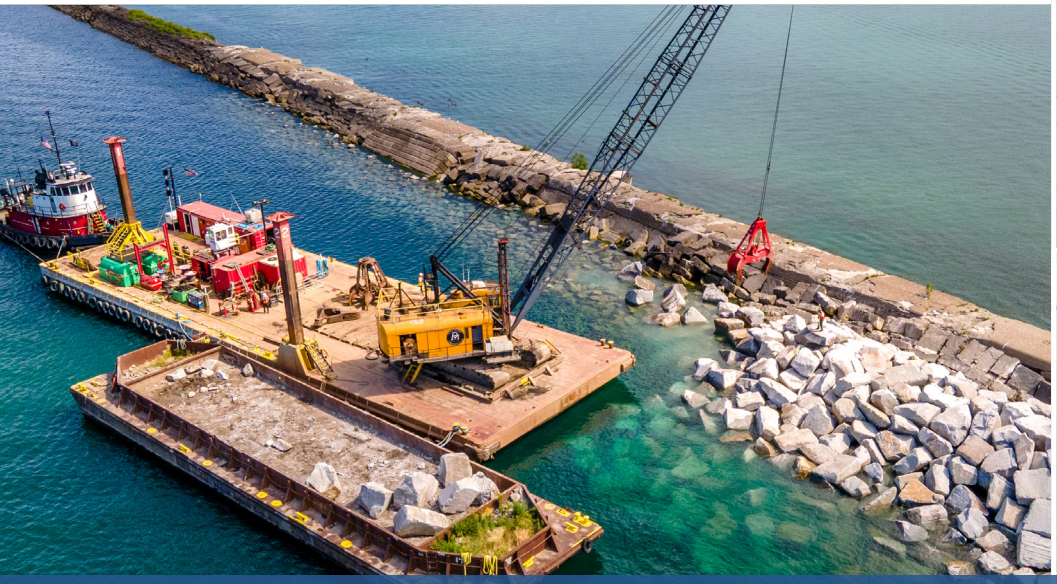
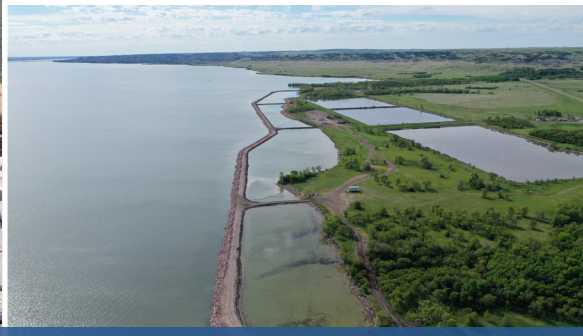


USACE Climate Action Plan

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





USACE CLIMATE PREPAREDNESS AND RESILIENCE

Executive Summary

The U.S. Army Corps of Engineers (USACE) works closely with our non-federal cost-sharing partners to plan, design, and construct projects to address our nation's toughest water resource challenges. Many of these federally authorized projects are ultimately owned, operated and maintained by our non-federal partners. Strong partnerships with other federal, state, tribal, and local government agencies and program and project stakeholders are critical to ensuring we understand and meet our shared responsibility to address the issues posed by a changing climate.

This USACE Climate Action Plan details the USACE commitment to integrate the best available observed and forward-looking climate information into its missions, programs, and management functions, as allowed within relevant authorities. This plan describes how climate effects and vulnerabilities are and will be considered in USACE decision-making for managing procurement, real property, and public lands and waters.[1] The USACE Climate Action Plan builds on prior adaptation plans to create a streamlined strategy consisting of five priority adaptation actions:

Action 1: **MODERNIZE** USACE programs and policies to support climate-resilient investments

Action 2: **MANAGE** USACE lands and waters for climate preparedness and resilience

Action 3: **ENABLE** state, local, and tribal government preparedness

Action 4: **PROVIDE** actionable climate information, tools, and projections

Action 5: **PLAN** for climate change-related risks to USACE missions and operations

This plan also addresses three specific topic areas of USACE climate action:

Topic Area 1: **UPDATES** to USACE climate vulnerability assessments

Topic Area 2: **EFFORTS** to enhance USACE climate literacy in its management workforce

Topic Area 3: **ACTIONS** to enhance the climate resilience of USACE sites, facilities, and supply chains

[1] In accordance with Executive Order 14008, the USACE Climate Action Plan applies to USACE facilities and operations. It does not apply to the USACE Regulatory Program and its administering of Section 404 of the Clean Water Act, Sections 9 and 10 of the Rivers and Harbors Act of 1899, and Section 103 of the Marine Protection, Research, and Sanctuaries Act ("Ocean Dumping Act"). Regulatory requirements as they pertain to climate change will be addressed through separate regulations, guidance, and/or policies, as appropriate.

Introduction

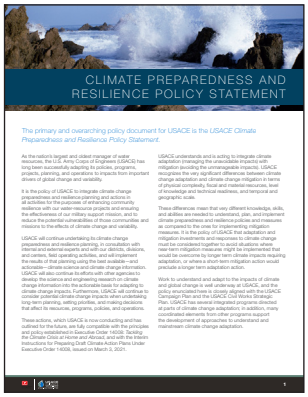
The U.S. Army Corps of Engineers (USACE) first established an overarching USACE Climate Change Adaptation Policy Statement and governance structure to support mainstreaming adaptation in 2011. For the past decade, USACE policy has required the agency to mainstream climate change preparedness and resilience in all USACE activities—while considering adaptation and mitigation responses to climate change together—to help improve the resilience of USACE-built and natural water-resource infrastructure, enhance the effectiveness of USACE military mission support, and reduce potential vulnerabilities to the effects of climate change and variability. In carrying out its climate policy and conforming to Department of Defense (DOD) and Army policy, USACE seeks to ensure the principles of Environmental Justice are integrated into its operations and activities by providing meaningful engagement and evaluating (and mitigating if required) impacts to environmental justice communities.

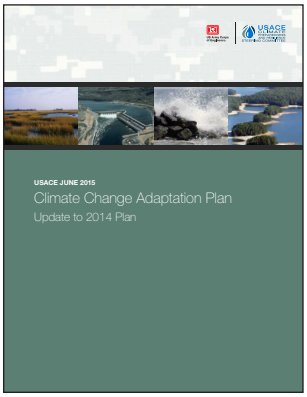
Agency Policy for Climate Change Adaptation and Resilience

- The USACE policy on climate adaptation is formalized in the USACE Climate Adaptation Policy Statement attached to this plan. It is USACE policy to integrate climate adaptation preparedness and resilience planning and actions, and that mitigation and adaptation investments and responses to climate change should be considered together. This policy reaffirms and supersedes the 2014 USACE Climate Adaptation Policy Statement.
- The June 2015 update to the USACE Climate Change Adaptation Plan is the immediate predecessor to the present plan. That adaptation plan detailed the agency's vision, goals, and priority areas for climate adaptation. It also identified climate impacts to agency missions, activities to mitigate those impacts, and efforts to address risks and opportunities presented by climate change.

Agency Official for Climate Change Adaptation

- The senior point of contact for climate preparedness and resilience is the Assistant Secretary of the Army for Civil Works.
- The senior official responsible for executing climate preparedness and resilience across USACE is the Chief, Engineering and Construction, who oversees the Climate Preparedness and Resilience Community of Practice.





USACE Climate Action Plan

The USACE Climate Action Plan consists of five priority adaptation actions, detailed below with the 12 items required by the White House Council on Environmental Quality in its 3 March 2021 *Interim Instructions for Preparing Draft Climate Action Plans Under Executive Order 14008*.

ACTION 1

Modernize USACE programs and policies to support climate-resilient investments	
Leverage and expand established adaptation practices, embrace change and emerging technologies, and develop and encourage climate-informed investment strategies.	
Action Goal	Ensure that new USACE-built projects are built to last and perform reliably for their intended design lives, despite uncertainty about future climatic conditions.
Action Lead	Directorate of Civil Works, USACE headquarters, supported by the Chief, Engineering and Construction and the Climate Preparedness and Resilience Community of Practice.
☐ **Risk or** ☑ **Opportunity**	Building on prior adaptation actions helps ensure that projects are robust, resilient, and/or adaptable to change by identifying adaptation actions and their triggers. This action is also an opportunity to support aligned actions by state, local, and tribal partners.
Scale	Global.
Timeframe	Ongoing. Modernization is a continuous process. Specific timelines include: • Publishing new guidance on use of climate-affected hydrology data for civil works studies in 2021. • Updating the Technical Review Guide and District Quality Control Checklist for climate preparedness Agency Technical Reviews in 2021. • Publishing new guidance with updated sea level scenarios for the next National Tidal Datum Epoch in 2025. • Developing high-quality data sets in 2022 to assist with the development and evaluation of options where climate changes may impact USACE projects.
Implementation Methods	• Issue new technical design guidance, and update existing guidance, to require that climate change be considered in project planning and design. • Capture lessons from complex study and implementation challenges and generate lessons for future projects.

Modernize USACE programs and policies to support climate-resilient investments (continued)	
Performance	Confirm, through Agency Technical Review and Policy and Legal Compliance Review, that all USACE civil works studies and designs follow pertinent guidance for sea level change and/or hydrologic change.
Intergovernmental Coordination	USACE relies on multimillion-dollar federal investments in science agencies to produce climate data and research for USACE to use in support of adaptation actions and investment decisions. USACE aggregates, integrates, and translates this science into actionable information for USACE decision-makers. International partnerships, such as with U.K. Environment and the Australian Commonwealth Scientific and Industrial Research Organization, enable sharing of best practices.
Resource Implications	Actions already underway or planned can be accomplished with existing resources in FY21. The FY22 Budget includes additional measures under the "Responses to Climate Change" initiative to provide methods, tools, and approaches to ensure that USACE missions and operations are prepared for and resilient to impacts from climate change.
Challenges/ Further Considerations	Climate considerations must continue to be an integral element of USACE enterprise-wide resource allocation and operational decision-making processes. Climate assessments must be based on the best available and actionable climate science and continuously updated regarding the rate of climate change and its impacts.
Highlights of Accomplishments to Date	• Guidance on use of maintained datums and the Comprehensive Evaluation of Project Datums ensures that projects are reliably referenced to tidal or geodetic elevations, ensuring accurate elevation data for reservoir pools and other projects. • Guidance on detection of change points and trends in inland hydrology annual peak flow data was issued in 2017. Guidance on sea level change impacts to civil works projects was updated in 2019, application example shown in Figure 1. New guidance on the incorporation of paleoflood hydrology information into flood frequency analysis was issued in 2020. • Recent updates to publicly available USACE web tools include: the Nonstationarity Detection Tool in 2020 included integration of new U.S. Geological Survey data in support of inland hydrology analysis; optimization of the USACE Sea Level Tracker's interface with National Oceanic and Atmospheric Administration's CO-OPS Application Programming Interface, ensuring real-time data access for coastal project studies; updates to the Climate Hydrology Assessment Tool in 2021 allowed for analysis of simulated future streamflows at finer spatial scale; improvements to Timeseries Toolbox in 2020 allowed for more sophisticated analysis of user-uploaded data. • Updates to guidance and tools that allow for more efficient evaluation of changed hydrology, including climate change, to projects and during the study phase, saving up to three weeks of labor for each study and project.

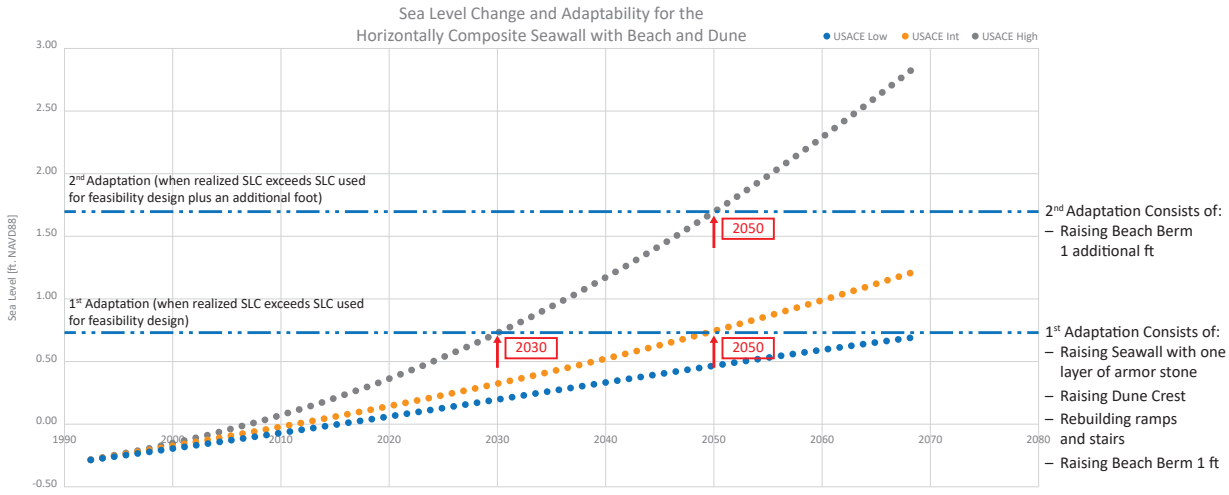


Figure 1: Adaptability of shorefront measures. Red markers indicate the years when adaptation measures are expected to occur. (After the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay Reformulation Study)

ACTION 2

Manage USACE lands and waters for climate preparedness and resilience	
Strengthen ongoing management practices to enhance climate adaptation while aligning with climate mitigation goals.	
Action Goal	Increase resilience of USACE-managed water resources, natural resources, and ecosystems, and the communities and economies that depend on them, to extreme weather and other events affected by changing climate, reducing recovery costs and minimizing impacts on USACE mission readiness.
Action Lead	Directorate of Civil Works, USACE headquarters, supported by the Chief, Engineering and Construction and the Climate Preparedness and Resilience Community of Practice.
☐ **Risk or** ☑ **Opportunity**	With more than 400 lake and river projects in 43 states, USACE manages 12 million acres of public lands and waters, 12,000 miles of inland navigation channels, 13,000 miles of intracoastal waterways, and over 900 ports and harbors. Using forward-looking climate information, USACE can reduce the negative impacts of climate change to its portfolio of water resources, natural resources, and ecosystems (and assist DOD Services with aligned actions) while supporting community goals. Managing lands and waters for increased resilience may also allow reductions in power and water use, for an overall decrease in carbon emissions.
Scale	National.
Timeframe	Ongoing. Management of lands and waters is continual and encompasses multiple, internal processes including: • Revising USACE Water Control Manuals for reservoirs and other water resource projects, with administrative updates to include recent climate information every 10 years (the same frequency as National Oceanic and Atmospheric Administration's updates to 30-year climate normals) or when regulation procedures are changed. • Revising Project Master Plans every 15–20 years to reflect recent climate in management of lands and waters. • Leveraging periods of drought to perform remote sensing (e.g., LiDAR) surveys of reservoir pools at low cost. • Generating an inventory of projects requiring drought contingency plans in 2021 and making these plans public via the USACE Access to Water[2] portal as they are produced.
Implementation Methods	Proposed implementation methods to continue or adopt include: • Continue use of web-based portals such as the Reservoir Sedimentation Portal (also used by Bureau of Reclamation) and Access to Water (for Water Control Manuals and Drought Contingency Plans) to make USACE data public. • Expanded use of unmanned aerial vehicles (UAVs) and remote-controlled vessels to make collection of sedimentation and other information faster and cheaper, providing insight into sedimentation changes as climate changes. • Develop and deliver workshops on appropriate application of natural and nature-based features, which may display some degree of self-adaptation to climate changes but also entail specific climate-related considerations. • Application of best practices for shoreline resilience of reservoirs, as vegetation adapts to changes in water level and salinity. • Consider inclusion of climate change in existing habitat models to assess impacts on species and water quality. • Screening of existing USACE project sites for vulnerabilities using indicators tied to climate projections. • Continue implementing the Sustainable Rivers Program (SRP) to further demonstrate that a strategic and science-based approach can be used at USACE reservoirs to maintain or enhance the environmental benefits and reduce negative environmental consequences of downstream flows. • Reduce extreme weather disruptions at projects by updating Water Control Manuals, Drought Contingency Plans, and natural resources management guides to reflect climate as it changes.

[2] water.usace.army.mil

Manage USACE lands and waters for climate preparedness and resilience (continued)	
Performance	Performance metrics under consideration for this goal include: complete inventory of projects requiring Drought Contingency Plans in FY21; achieve 100% implementation/update of such plans by FY25; publish 100% of Water Control Manuals in Access to Water by FY25; and complete updates to drought contingency guidance. Initial screening of project sites for climate vulnerability will occur in FY21. Intermediate assessment for sea level vulnerabilities will begin in FY22.
Intergovernmental Coordination	USACE supports DOD in providing tools to support resilient land management. Through Section 7 agreements, USACE partners with dam owners and operators to manage flood risk at multipurpose reservoirs. USACE partners with USGS via a cooperative streamgaging program to provide resilient water data networks for water management and river forecasting. USACE supports federal agency and academic partnerships in providing coastal wave data via the Coastal Data Information Program and the Integrated Ocean Observing System. The Joint Airborne Lidar Bathymetric Technical Center of Expertise supports coastal mapping and charting requirements of USACE, the U.S. Naval Meteorology and Oceanography Command, and the National Oceanic and Atmospheric Administration.
Resource Implications	USACE continues to evaluate the resource implications of this action.
Challenges/ Further Considerations	Biosequestration of carbon and harmful nutrient pollution in USACE reservoirs and restored ecosystems is complicated and requires further investigation. Effects of drier weather on wildfire, erosion, and sedimentation to reservoirs and channels require further consideration. Sedimentation events and opportunities for surveys in specific years are dependent on flood and drought events that remain difficult to predict. Preventive measures, tools, and methods to maintain natural resources are required to maintain viable ecosystems.
Highlights of Accomplishments to Date	The Initial Vulnerability Assessment phase of the Comprehensive Evaluation of Projects with Respect to Sea Level was completed in 2015, allowing a ranking of coastal projects by vulnerability to sea level change.

Figure 2: Conducting a helicopter ice-thickness measurement flight on Lake Erie, 22 Feb 2019.

ACTION 3

Enable state, local, and tribal government preparedness	
Use USACE programs and expertise to support climate preparedness for state, local, and tribal governments, including providing meaningful engagement during the project development process.	
Action Goal	Enable actions of local and state governments and tribal nations to prepare for and respond to climate change, partner when appropriate, and provide meaningful engagement opportunities.
Action Lead	Directorate of Civil Works, USACE headquarters, supported by the Chief, Engineering and Construction and the Climate Preparedness and Resilience Community of Practice.
☐ **Risk or** ☑ **Opportunity**	This action presents an opportunity to collaborate with non-federal partners to reduce the nation's vulnerability to climate change impacts and to provide meaningful engagement during the project development process.
Scale	National.
Timeframe	Ongoing. While USACE routinely engages with partners and uses its programs to support non-federal action, USACE will consider specific new emphasis on: • Use of technical services programs (e.g., Floodplain Management Services Program, Planning Assistance to States) to support non-federal planning for climate change (additional support to be provided due to increases in the FY 2022 Budget). • Considering the programs and authorities of other federal agencies when engaging in collaboration with local, state, and tribal governments to confront climate challenges. • Providing meaningful engagement on technical issues, including specific engagement to low-income communities, minority communities, and tribal communities in USACE's project development process.
Implementation Methods	The following implementation methods will be considered for this action: • Utilize Planning Assistance to States, Floodplain Management Services (FPMS), and the National Flood Risk Management Program (NFRMP), and district tribal liaisons to host awareness-building activities and enable climate preparedness. • Emphasize USACE's stakeholder engagement policies and use the expertise from USACE's Collaboration and Public Participation Center of Expertise and Collaboration Community of Practice to increase engagement capability at the district level.
Performance	Performance metrics under consideration for this goal include: the number of FPMS efforts that support planning and/or preparedness for climate change impacts and the number of NFRMP activities and Planning Assistance to States engagements related to climate change planning.
Intergovernmental Coordination	USACE's Silver Jackets (state-led interagency teams collaborating to address flood risks) participation includes intergovernmental coordination at the state and federal levels. The Tribal Liaison Program and Tribal Nations Technical Center of Expertise enable collaboration with tribal partners. Other programs typically engage with individual local and state partners.
Resource Implications	Technical services already underway or planned can be accomplished with existing resources.

Enable state, local, and tribal government preparedness (continued)	
Challenges/ Further Considerations	USACE's technical services programs can help enable community preparedness upon the request of state, local, or tribal governments, but these partners may not be aware of these programs or know how to request their implementation.
Highlights of Accomplishments to Date	• Deployment of district-level Public Involvement Specialists (located in every major subordinate command) who provide peer-to-peer support in public engagement and risk communication. • Publication of the USACE report "Strengthening USACE Collaboration with Tribal Nations for Water Resources Management" (2020-R-06, Sep 2020). • Publication of the *North Atlantic Coast Comprehensive Study* (2015).[3] • Support of Silver Jackets teams in every state (example shown in Figure 3) and multiple territories to support on-the-ground regional and local resilience efforts identified as state priorities.

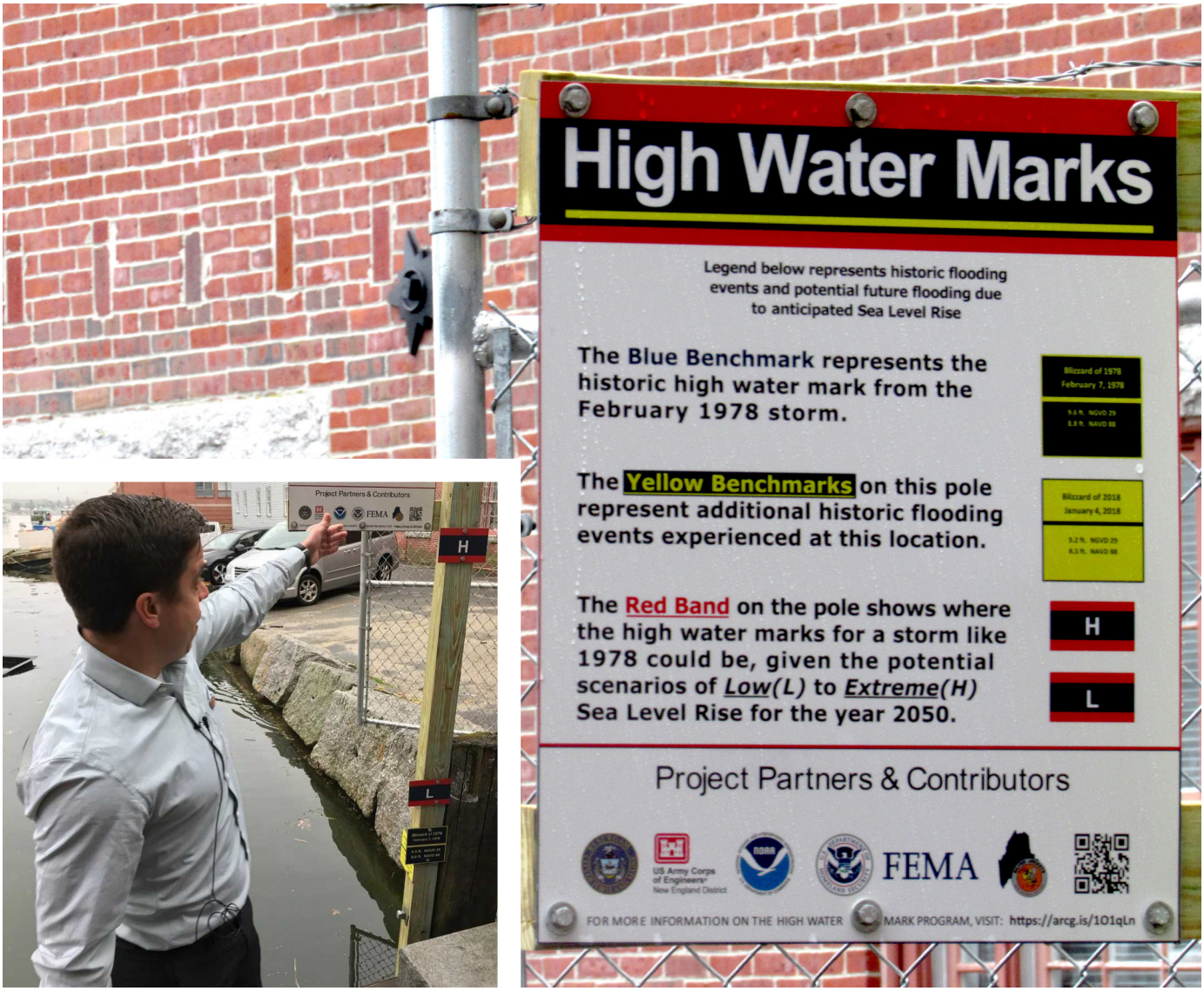


Figure 3: Coastal flood risk communication illustrating the effects of sea level rise using high water marks in Portland, Maine. Signage installed as part of the Maine Silver Jackets Program.

[3] https://www.nad.usace.army.mil/CompStudy/

ACTION 4

Provide actionable climate information, tools, and projections	
Use and make freely available Earth system information on historical and current conditions and projected future change to inform policymaking and counter climate threats to USACE programs, projects, and mission areas.	
Action Goal	Collaborate to produce freely available Earth system information, models, and tools concerning the effects of increasing climate impacts on USACE programs, projects, and mission areas.
Action Lead	Directorate of Civil Works, HQUSACE with support of the Chief, Engineering and Construction, the USACE Lead Climate Scientist, and the USACE Climate Preparedness and Resilience CoP.
☑ **Risk or** ☑ **Opportunity**	Work under this action identifies both components of climate risk to USACE programs, projects, and mission areas (specific threats, generalized vulnerabilities, etc.) and opportunities for testing possible actions to enhance resilience against those threats through adaptation and resilience measures.
Scale	Global though data availability for some products is limited to CONUS.
Timeframe	This work began in 2009 and will continue. Work restarted with program funding in Q2 FY21, with the following expectations for future work: • FY21 funding will allow priority projects to begin later in 2021. • Products and outcomes from these projects will inform future project selection for sustaining work to create and update Earth system information for water and energy security in FY22–24.
Implementation Methods	Proposed implementation methods to continue or adopt include: • Engage in close collaborations among USACE, federal science agencies (Department of Energy, National Science Foundation, National Oceanic and Atmospheric Administration, etc.), private-sector entities, and university-based researchers to support production and dissemination of new Earth system science relevant for estimating climate threats and the vulnerabilities of specific aspects of USACE and military program water and energy security missions. • Form new collaborations as work continues, objectives are met, and the need to create new information is identified to ensure continued production of information and its utility for policymaking. • Prioritize climate-related research based on existing resources provided in the budget.
Performance	Performance metrics under consideration for this goal include: measurement of utility of products from these collaborations as indicated by their uptake in the community of policymakers and technical researchers; annual summaries of progress in uptake and publication will be made available for inclusion in agency progress reports such as annual CAP updates.
Intergovernmental Coordination	USACE will continue to work through existing collaborations to produce the information needed to achieve this action goal. The USACE Climate Preparedness and Resilience Community of Practice will also continue to lead the collaborative projects that will produce information to attain this goal. This entails working with the agencies listed under the methods section, and other organizations. More general cross-agency coordination is achieved through the U.S. Global Change Research Program and other offices of the White House Office of Science and Technology Policy. The USACE Coastal Hazards System is leveraged through local and regional studies and collaborations with other federal agencies including Federal Emergency Management Agency, Department of Homeland Security, National Oceanic and Atmospheric Administration, and Nuclear Regulatory Commission, as well as state agencies and academia.

Provide actionable climate information, tools, and projections (continued)	
Resource Implications	USACE continues to evaluate the resource implications of this action.
Challenges/ Further Considerations	The nature of this work requires a multiyear timeline to produce freely available results for policy and field applications.
Highlights of Accomplishments to Date	• Development of post-wildfire debris flow tools, incorporated into the publicly available hydraulic modeling program HEC-RAS.[4] • USACE Access to Water and RiverGages.com provide real-time information of reservoir capacity, river water levels, and Water Control Manuals to keep the public informed of flood risks as they develop. • Production of ~30 terabytes (TB) of modeled historical and projected future climatology and ~20 TB of modeled historical and projected future hydrology, archived and served freely.[5] These model outputs have been in very high demand by policymakers and hydro-climate researchers: since 2011, ~3,500 users accessed ~400 TB of information in ~4,500 different spatial domains. • Development of USACE's Coastal Hazards System (CHS) to provide historical and potential future storm hazards including multiple sea level change scenarios in a freely available public database[6] supporting federal, regional, and local studies. CHS is available for the Atlantic, Gulf of Mexico, and Great Lakes coastal regions; Pacific Coast modeling was initiated in spring 2021. • Supporting development of the Defense Regionalized Sea Level (DRSL) database to allow for projections of future sea level at DOD coastal installations. Use of the DRSL is included in the latest update of the Unified Facilities Criteria for Civil Engineering (Change 5, 1 Apr 2021).

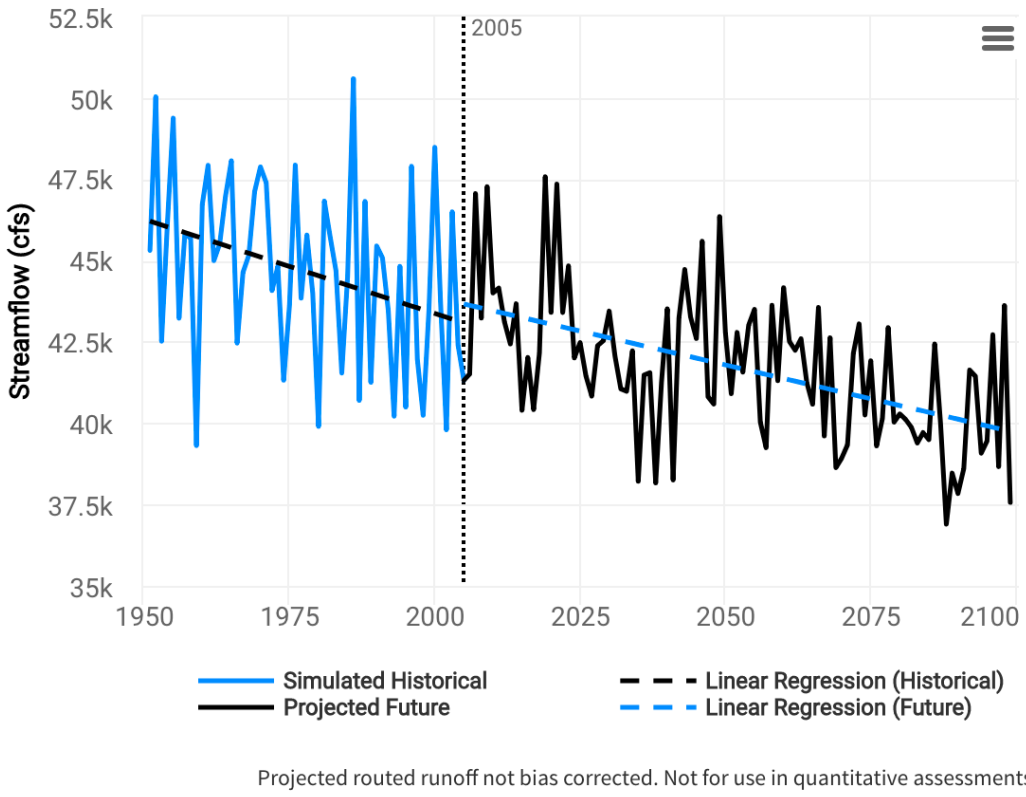


Figure 4: Simulated historical and future annual peak mean monthly streamflow across 64 projections of future climate for the Lower Colorado River watershed (HUC 15010002) from the USACE Climate Hydrology Assessment Tool.

[4] https://www.hec.usace.army.mil/software/hec-ras/ and https://erdc-library.erdc.dren.mil/jspui/handle/11681/32910

[5] gdo-dcp.ucllnl.org

[6] chs.erdc.dren.mil

ACTION 5

Plan for climate change-related risks to USACE missions and operations	
Mainstream climate adaptation and mitigation as applicable into operations, planning, and acquisition for existing USACE projects and activities.	
Action Goal	Increase the resilience and adaptability of USACE missions, activities, and actions in the face of climate change and weather events, while aligning with energy and sustainability performance targets and growing adaptation leaders.
Action Lead	Directorate of Civil Works, HQUSACE, with support of the Chief, Engineering and Construction, and the Climate Preparedness and Resilience Community of Practice and alignment with the Strategic Sustainability Committee.
☐ **Risk or** ☑ **Opportunity**	This action provides the opportunity to increase operational resilience by reducing reliance on traditional energy, water, and fuel sources that may be disrupted during severe weather events.
Scale	Global.
Timeframe	Ongoing. Increasing climate robustness of missions and operations requires a continuous improvement of processes, aligned with continuing efforts to meet performance targets of energy and water reduction, reduction in greenhouse gas emissions, and electric vehicle fleet implementation, to slow the rate of climate change.
Implementation Methods	Proposed implementation methods to continue or adopt include: • Update continuity of operations plans (COOP) so that missions and operations can continue even if individual sites are impacted or evacuated due to severe weather. • Back up data to ensure that information is not lost if data centers are impacted by extreme weather events. • Make redundant communications networks and methods to ensure communications are maintained in all weather. • Cross-train staff in districts, preparing them to assist each other in severe events, and redeploy workloads if individual teams lose capacity. • Manage facility energy and water conservation measures to reduce resource demands and make infrastructure more resilient to utility disruptions.
Performance	Performance metrics under consideration for this goal include: • Ensure all districts have updated COOPs. • Ensure data backup procedures are included in all installation data management plans. • Ensure employee status databases with redundant contact methods and emergency contacts are maintained. • Performance metrics for climate adaptation of missions and operations are an identified need.
Intergovernmental Coordination	USACE coordinates internally with DOD components, which ensures alignment with DOD policies. USACE partners with the Department of Energy and other land management agencies to develop solutions to meet sustainability program performance targets and sharing of best practices.

Plan for climate change-related risks to USACE missions and operations (continued)	
Resource Implications	USACE is considering how to continue integrating adaptation resources including life-cycle costs into plans, business processes, and strategies at all relevant levels. This evaluation includes analyzing the costs associated with climate effects and how these can be reduced or mitigated through climate change adaptation.
Challenges/ Further Considerations	Although USACE has maintained continuity in both the climate preparedness and resilience and the sustainability programs, both operate with minimal staff. Significant investment in USACE's aging infrastructure is needed to address climate vulnerabilities to missions. Adaptations and upgrades for major systems at USACE-owned facilities and water lines at campgrounds are particularly challenging because of their number and variety. USACE has sufficient authority to investigate climate adaptation needs for existing civil works projects.
Highlights of Accomplishments to Date	• Publication of the *Report on New England Harbors of Refuge and Storm Surge Barriers*,[6] an analysis of the performance and reliability of those USACE operated and maintained structures under the impacts of sea level change (Figure 5). • Creation of web-based tools for assessing operational vulnerabilities and for use in determining impacts to projects, such as the Nonstationarity Detection Tool, Climate Hydrology Assessment Tool (Figure 4), and Watershed Climate Vulnerability Assessment Tool. • Implementation and maintenance of the USACE Coastal Systems Portfolio Initiative,[7] providing a qualitative analysis of existing and future conditions facing coastal infrastructure and opportunities for action.

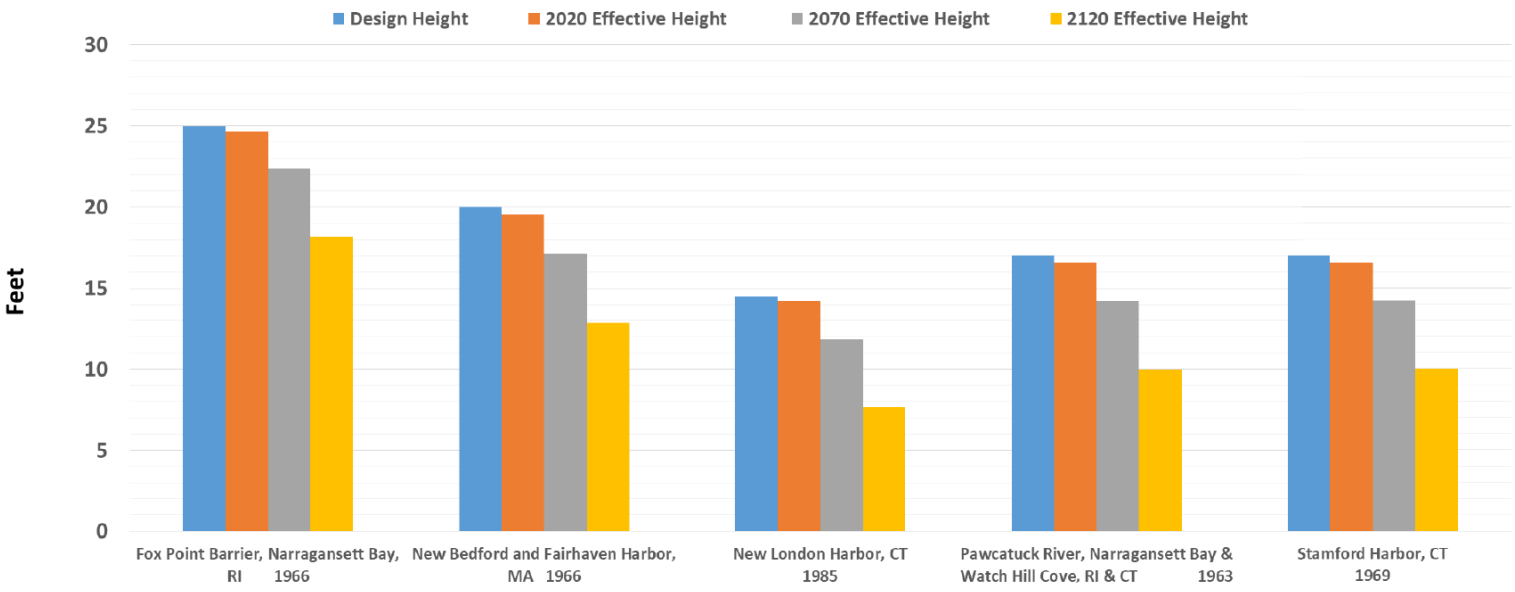


Figure 5: Illustration of effect of sea level rise on the coastal storm risk reduction provided by five USACE storm surge barriers in New England, using the metric of effective structure height.

[6] U.S. Army Corps of Engineers (2019), Report on New England Harbors of Refuge and Storm Surge Barriers, U.S. Army Corps of Engineers: Washington, DC.

[7] https://navigation.usace.army.mil/CSPI

Topic 1: Updates to Climate Vulnerability Assessments

Vulnerability 1: Portfolio Assessments

Portfolio assessments are a critical component of understanding and managing risk across USACE operated and maintained projects. Detailed assessments at the portfolio level will enable USACE to understand how infrastructure will respond to climate change and prioritize our response.

Climate Threat:
Climate change effects, including sea level change, changes in storm and flood frequency, loss of permafrost, and increasing wave impacts can increase the hazards facing the USACE portfolio of built and natural systems and the communities they serve. Portfolio assessments are needed to understand locations and conditions under which project performance or USACE missions may be at risk so steps can be taken to prioritize and implement changes.

Expected Impact:
Project performance may be compromised and USACE missions may be hindered. For example, the reliability (proportion of time available) for a navigational channel or port may decrease. Projects may also experience shortened functional lives if performance levels decline such that maintenance costs are unjustified, and/or if extreme weather events damage them beyond economical repair.

Impact of No Action:
The probability of project nonperformance and/or structural failure may increase. Without climate vulnerability assessments, the likelihood of these changes would be hidden from USACE, partners, stakeholders, and the public. As a result, actions taken by USACE and others to manage risks and opportunities could be misinformed.

Determined Adaptation Action:
An initial screening of USACE projects will result in a ranked list of projects by vulnerability and categorization into groups corresponding to high, moderate, and low risk, or no impact.

Beginning with the projects identified as high risk, more detailed assessments will be performed to determine consequences of inaction and appropriate adaptation steps.

Known Barriers to Adaptation:
Initial screenings can be performed with existing resources. Adaptation may require investigations prior to recommending implementation.

Rough Estimate of Timeline:
Future actions include:

- Initial screening of existing projects in the USACE portfolio for climate change impacts in FY21.
- More detailed assessments of the projects determined to be most vulnerable will follow, with timelines dependent on the findings of the initial screenings.

Measure for Indicating Progress Over Time and Success:
Proportion of projects in the portfolio that have received initial screening for climate vulnerability and the number of projects recommended for general reevaluation studies based on these assessments.

Determination if Managing Risk and Overcoming Barriers Are Achievable Within Existing Agency Resources:
Initial screenings are achievable with existing resources. The FY22 Budget includes additional measures under the Responses to Climate Change initiative to provide methods, tools, and approaches to ensure that USACE missions and operations are prepared for and resilient to impacts from climate change.

How the Vulnerability Is or Will Be Disclosed in Annual Agency Financial Reporting and Integrated into USACE's Enterprise Risk Management Process:
Results of the initial screening phase, including an overall cost estimate for detailed analysis, will be available on a web-based platform accessible to USACE personnel. The projects ranked most vulnerable will be detailed in a report for senior leadership, to include courses of action and the risks associate with action or inaction on each.

Vulnerability 2: Barriers to Problem Solving

Barriers to solving climate issues are matrixed throughout USACE, including real and perceived roadblocks, fundamental knowledge gaps, and novel situations requiring rapid decisions to maintain climate readiness for USACE projects and missions, among others.

Climate Threat:
Climate changes may require solutions beyond the traditional, including changes to how adaptation is evaluated and recommended, the timing of adaptation, and the types of adaptation considered.

Addressing multiple threats of climate change to USACE infrastructure requires tools, processes, and culture to act on potential threats in a timely, effective, and flexible manner. As such, USACE must continue to work to address barriers that may inhibit problem solving around climate change.

Furthermore, some evaluation techniques favor near-term benefits over long-term functionality, while intergenerational timeframes may limit the ability to identify and implement solutions that meet current project evaluation policies.

Expected Impact:
Barriers that inhibit problem solving may leave communities and projects vulnerable to climate change now and in the future.

Impact of No Action:
Responses to climate change and weather disruption will be reactive rather than proactive and limited to our current solution set and methods. Excess costs and/or project impacts may be incurred, many of which will be borne by the local implementing partner and the communities in which the projects exist.

Determined Adaptation Action:
USACE will plan for future adaptation through broad evaluation of potential future climate scenarios; develop adaptation contingency plans with triggering criteria for implementation; communicate impacts under multiple scenarios, including timing and triggers for adaptation to non-federal partners for projects with non-federal operations and maintenance responsibilities; monitor projects to track potential future impacts; and develop self-maintaining solutions through strategic placement of dredged sediments, aquatic ecosystem restoration, and nature-based flood and coastal risk management systems.

Known Barriers to Adaptation:
USACE will work to systematically identify barriers to proactive climate change adaptation and work to overcome those within the agency's purview.

Rough Estimate of Timeline:
A detailed policy analysis of barriers to problem solving is targeted for FY22.

Measure for Indicating Progress Over Time and Success:
Percentage of projects incorporating resilient features and number of projects with an identified adaptation timeline.

Determination if Managing Risk and Overcoming Barriers Are Achievable Within Existing Agency Resources:
The policy analysis is subject to the availability of funds and resources provided in the FY22 appropriation.

How the vulnerability is or will be disclosed in annual agency financial reporting and integrated into USACE's enterprise risk management process:
The standard annual financial reporting will be used. The results of the policy analysis will be presented to USACE leaders to set the context and to identify, analyze, and evaluate risks associated with the polices, which Army leaders can use to decide which, if any, to pursue for treatment or change.

Vulnerability 3: Developing a Culture of Adaptation and Resilience Thinking

To effectively address climate impacts, USACE must continue to build a culture that values and supports innovative thinking around climate change. Organizational culture underpins the shared commitment to openness and creativity required to meet the challenge of climate change.

Climate Threat:
Observed and reasonably foreseeable climate impacts exceed the natural variability of the past, so addressing climate impacts requires innovative solutions. Leaders at all levels must incentivize unconventional, creative approaches. Like other federal agencies, USACE has a historic preference for certainty, and decision-making under deep uncertainty is a new practice for many decision-makers.

Expected Impact:
As detailed in Chapter 28 of the Fourth National Climate Assessment, flexible designs and adaptive planning can reduce adaptation costs while maintaining options for later resilience. An agency culture that promotes resilient or adaptable approaches will reduce climate impacts and costs, including those due to emergency response, maladaptations, and reactive actions.

Impact of No Action:
Without action, USACE will be reactive to changes rather than preparing for unavoidable climate changes in the future. Climate and weather risks to projects and the communities they serve will remain high and poorly understood.

Determined Adaptation Action:
While USACE has taken action to promote resilience thinking (e.g., Engineering Pamphlet 1100-1-5, published 1 Dec 2020) and use of engineering judgment (Civil Works Planning Transformation Memo, 8 Feb 2012), many district teams still report discomfort with these approaches. The following actions will be taken to address this disconnect:

- Policy memos clarifying support for, and identifying resources and guidance for, innovative approaches.
- Training on applying resilience thinking and use of best professional judgment in project planning.
- Example library of projects successfully implementing adaptable and/or resilient approaches.

Known Barriers to Adaptation:
Barriers to culture change include longstanding agency preference for expected values and desire for certainty, including discomfort with ranges and distributions of values. In addition, acceptable levels of risk, uncertainty, and resilience vary in time and by region. Finally, the willingness of sponsors to partner on resilient or adaptable projects may vary depending on cost and preferences for particular patterns of land use.

Rough Estimate of Timeline:
Consistent with existing authorities, plan and deliver first training on resilience practices and establish example library and pilot project criteria (FY22).

Measure for Indicating Progress Over Time and Success:
Percentage of civil works projects incorporating resilient and/or adaptable approaches increasing year-over-year, pending further analysis to establish a long-term goal.

Determination if Managing Risk and Overcoming Barriers Are Achievable Within Existing Agency Resources:
Example library can be achieved with existing resources.

How the Vulnerability Is or Will Be Disclosed in Annual Agency Financial Reporting and Integrated into USACE's Enterprise Risk Management Process:
USACE is evaluating how this vulnerability will be disclosed in annual reporting and integrated into USACE risk management processes using existing resources.

Vulnerability 4: Building Climate Workforce

The workforce of the future requires knowledge and skills to address the challenge of climate change. USACE must transition from viewing knowledge of climate change and related issues as a specialized discipline to recognizing it as a fundamental component of a well-rounded team.

Climate Threat:
USACE will need to build new skills and competencies to learn, solve problems, and develop best practices for climate preparedness and resilience, climate change adaptation and mitigation, and assessment of impacts, risks, and vulnerabilities. The workforce will be required to address climate change and related changes that can impact USACE missions and operations such as land use/land cover changes, demographic changes, and socioeconomic changes, in a comprehensive systems approach.

Expected Impact:
To transform our civil works programs and projects to incorporate green technology, energy-efficient structures, and climate change resilience, a multidisciplined workforce with the appropriate skills and knowledge will be required.

Impact of No Action:
Without action, USACE may have difficulty deploying new methods and technologies to mitigate and/or adapt to climate change.

Determined Adaptation Action:
USACE will enhance and expand the USACE Climate Preparedness and Resilience Community of Practice (CoP), related CoPs, and centers of expertise; continue to identify skills and disciplines (including engineering disciplines, such as electrical and structural, and social science disciplines, such as sociology, demography, and anthropology) that will be required for future climate change mitigation and adaptation programs and projects; and continue to support science, technology, engineering, and mathematics (STEM) learning in schools with a focus on climate change skills and abilities to build our future workforce.

Known Barriers to Adaptation:
The magnitude and timing of the impacts of climate change are uncertain, and USACE must be prepared to respond quickly to natural disasters across the nation. In contrast, workforce planning can have extended timelines, creating mismatches between personnel needs and availability.

Rough Estimate of Timeline:
The Administration is proposing significant investment into our nation's infrastructure with a focus on mitigating and adapting to climate change. USACE will play a role in the planning, design, and construction of some of this proposed work.

Measure for Indicating Progress Over Time and Success:
Standard business practices would continue to be used to ensure USACE has the appropriate workforce to execute new projects, including typical cost, schedule, and quality metrics.

Determination if Managing Risk and Overcoming Barriers Are Achievable Consistent with the Agency's Budget Request:
USACE will continue strong "build the bench" strategies to address future climate change challenges. The actions will include continued utilization and enhancement of relevant CoPs and centers of expertise within USACE, promoting innovative Research & Development with our centers and reaching out to support STEM events for our future workforce.

How the Vulnerability Is or Will Be Disclosed in Annual Agency Financial Reporting and Integrated into USACE's Enterprise Risk Management Process:
The standard USACE annual financial reporting system will be used to monitor program and project execution metrics. In addition, various human resource tools and processes including "The Army People Strategy" will be used to identify, address, and manage risks related to hiring and retention challenges and related contracting support.

Vulnerability 5: Unequal Capacity and Capability of Partners and Communities

USACE works with a wide variety of partners and stakeholders including states, municipalities, port authorities, nongovernmental organizations, and tribes. Stakeholders are diverse in their experiences and capabilities, and experience different resource constraints. To improve climate adaptation effectiveness, USACE will work to understand each partner's strengths and weaknesses and collaborate to address capacity limitations. In addition to Executive Order 14008, which establishes the requirement to develop this Climate Action Plan, the Administration also issued Executive Order 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, on 20 Jan 2021, which establishes Environmental Justice considerations to ensure that low income and minority communities are not disproportionately impacted by climate issues.

Climate Threat:
USACE's partners and stakeholders have varying levels of climate capacity and capability to address climate change. In addition, USACE has limited knowledge of these capacity variabilities.

Expected Impact:
Partners and stakeholders, especially vulnerable populations, may not be able to afford adaptation on their own or for their portion of a cost-shared project. Financial resources may necessitate near-term decision-making, including a preference for smaller than optimal projects and limited real estate acquisition. Some partners may prefer not to address climate change directly for technical, policy, or political reasons, including varying risk tolerance. In addition, USACE may not fully understand the varying levels of climate knowledge and capability of our non-federal partners and the communities in which we study and implement water-resources solutions, leading to reduced adaptation effectiveness.

Impact of No Action:
Without action, adaptation may be limited by the financial capability of the non-federal partner, which can leave the people in the community or the restored environment at greater risk. USACE may over or underestimate the ability of the partner and community to understand and make decisions with climate information.

Determined Adaptation Action:
USACE will conduct awareness-building activities for our employees and partners and enable local, state, and tribal government preparedness. USACE Silver Jackets will be used to collect information on partner capacity.

Known Barriers to Adaptation:
Some communities and partners have considerable staffs and budgets with technical skills suitable to understanding climate change adaptation and resilience, while others do not. However, USACE is not always aware of community capacity and capability to partner on adaptable, resilient projects. This knowledge gap can be a barrier to effective, collaborative adaptation.

Rough Estimate of Timeline:
Equip Tribal Liaisons with climate change information. Incorporate consideration of climate change as a factor in identifying Floodplain Management Services (FPMS) projects (begin in FY23). Leverage Silver Jackets programs to gather information on partner capacity for adaptation (begin in FY23). Use Silver Jackets teams to build capability in state agencies. These efforts will be further emphasized due to increased funding levels provided in the FY 2022 Budget.

Measure for Indicating Progress Over Time and Success:
Counts of FPMS and National Flood Risk Management Program projects, and Silver Jackets teams deliverables, that support planning for climate change impacts.

Determination if Managing Risk and Overcoming Barriers Are Achievable Within Existing Agency Resources:
USACE will implement awareness-building activities.

How the Vulnerability Is or Will Be Disclosed in Annual Agency Financial Reporting and Integrated into USACE's Enterprise Risk Management Process:
The standard annual financial reporting system will be used to monitor program execution metrics. In addition, the Program Manager will collect FPMS data. National awareness-building activities and products will be counted and tracked.

Topic 2: Agency Efforts to Enhance Climate Literacy in Its Management Workforce

The need to improve understanding of climate change and its potential future impacts to USACE missions, stakeholders, and partners extends throughout the USACE workforce. Practitioners, supervisors, and senior leaders across USACE must communicate with common messaging, methods, and understanding of future scenarios. Existing messaging, training, and interagency partnering on climate topics are numerous and will continue moving forward. These include the Climate Preparedness and Resilience Community of Practice (CoP) monthly USACE meetings; Climate Preparedness and Resilience CoP Division-level trainings on USACE climate guidance and tools; training on Risk-Informed Decision-Making; several USACE working groups on Adaptation, Non-Structural Solutions, and a Federal Climate Change Water Working Group, among others. However, there remains a need to mainstream climate understanding and adaptation across the enterprise, at all levels of the organization.

Future enhancements to climate literacy within USACE include expanding existing training, working groups, and interagency partnerships through varied and recurring communications, infused across the organization, and tied to individual performance. A focused training approach, targeted to specific portions of the workforce, is outlined below:

- Installation Commanders, General Officers (GOs), and Senior Executive Service (SES): Add a climate change module to the Commander's Course and GO/SES training course, including a summary of climate impacts to USACE missions; likely future impacts, mitigation, and sustainability; adaptation and resilience strategies; and common messaging for use with stakeholders and partners.
- USACE Functional Areas: Build upon the Commander's Course to provide "Climate 101" training.
- Entire USACE Workforce: Engage USACE social scientists to develop multi-tiered, innovative communication tools and training plans that support integration of climate change concepts as appropriate into the existing roles and responsibilities of practitioners, supervisors, and managers.

These training and collaboration actions can be accomplished with existing resources from the Climate Preparedness and Resilience CoP and aligned programs.

The proposed timeline for implementing enhanced Climate Literacy Training and Communications (CLTC) will begin with approval of this plan:

- FY21: Kick off enhanced climate training with a USACE workforce briefing on the USACE CAP by the commanding general, LTG Spellmon.
- FY22: Rely on existing climate Subject Matter Experts and Regional Technical Specialists in each major subordinate command to provide on-site training and on-call assistance as needed to the local workforce.
- FY23–26: Evaluate progress and update the CLTC plan as appropriate.

Figure 6: A Los Angeles district team is briefed about how to communicate a flood emergency to the public.

Topic 3a: Climate-Ready Sites, Facilities, Infrastructure

USACE has undertaken climate adaptation actions since the agency's first guidance on sea level change in 1986. While these activities are primarily focused on ensuring the performance of civil works projects, they can also apply to USACE's own sites, facilities, and infrastructure. For example, project offices, visitors centers, and access ramps designed as part of civil works projects are resilient to climate change and variability when those considerations are included in project planning and design, as required by policy. Furthermore, some actions taken in the name of sustainability and climate mitigation may provide adaptation benefits as well, as when water-efficiency upgrades to buildings provide resilience against droughts. Nevertheless, achieving climate readiness for USACE sites and facilities will require additional meaningful, concerted actions, to include:

- Screening of all USACE-owned facilities for climate vulnerabilities, when those facilities do not meet the definition of "projects" (the screening of which is described in Climate Vulnerability 1). These sites include revolving-fund facilities such as certain district offices. Although the number of such sites is believed to be small, they may have high local significance and visibility. USACE will develop a process to identify these sites and screen them using similar indicators and projections as described in Vulnerability 1. This process will be developed in FY21.
- Developing a process to identify climate and weather vulnerabilities for offices where USACE is a tenant, and where these vulnerabilities could interfere with mission success and/or worker safety. USACE will communicate these vulnerabilities to the facility owner or other applicable party for lease administration (e.g., U.S. General Services Administration) for resolution. This evaluation process will be developed in FY21, with communications to begin in calendar year 2022.
- Exploring and evaluating tradeoffs and co-benefits between sustainability actions and resilience. Some sustainability actions may imply tradeoffs against resilience, as when electrification of systems now powered by fossil fuels may reduce greenhouse gas emissions but expose facilities to grid outages.
- Performing a policy review to identify opportunities to reduce climate uncertainties in costs and benefits computation (FY22). Benefits are presently captured in economic evaluation by computing the damages prevented to structures and contents, as well as loss of use. However, these computed benefits can be highly uncertain when affected by climate change.

Figure 7: Contractors upgrade a 50-year-old facility at Fort Lee, Virginia with modern technology and force protection features.

Topic 3b: Climate-Ready Supply of Products and Services

USACE faces several critical supply chain challenges related to climate change and weather disruptions. While most USACE construction contractors are experienced in supply chain management and are effective at addressing potential issues proactively, an internal assessment of business line managers, acquisitions professionals, and logistics leaders revealed foreseeable shortages in goods and services, which could result in contract modifications and/or negative impacts on project delivery. Here are the three most critical services at risk to disruption due to long-term climate changes, including proposed actions to consider for enhanced resilience towards adaptation. When applicable, the actions listed below are shaped to align with the Defense Logistics Agency's Supply Chain Security Strategy to build resiliency through redundant capabilities, continuity of operations plans, and systems hardening.

1. **Ports and Inland Waterways.** Floods and droughts can impact ports and channels, damaging facilities or reducing sailing drafts that can limit access or require lightering. Damages from coastal storms can be expected to increase in frequency and severity in the future due to sea level rise. River floods can impact waterborne supply lines, as when aids to navigation (e.g., buoys, beacons, and foghorns) are damaged and cannot be immediately replaced.

   Actions to Consider: USACE will continue to integrate sea level change in vulnerability assessments and project planning, such as the multiple sea level scenario approach required by Engineer Regulation 1100-2-8162 to increase the resilience and adaptability of ports to coastal floods. USACE is investigating partnering with the U.S. Coast Guard to use rapidly deployable channel markers and virtual aids as methods to reduce downtime after flood impacts to waterways.

Figure 8: Construction of navigation guide walls at the Lake Borgne GIWW sector gate, designed for future sea level change.

2. **Labor and Lodging.** When USACE constructs a large project in a low population area, skilled or specialized labor can be scarce, requiring adjustment to standard contract labor rates. This is especially true when local populations are disrupted by severe weather events, as during post-disaster repairs or when workers are exposed to atypical risks. After disasters, worker housing can also be disrupted.

   Actions to Consider: USACE employs General Services Administration Emergency Lodging Services and will make use of military housing or temporary housing when necessary. In the aftermath of Hurricane Maria in Puerto Rico, emergency housing was scarce, requiring the use of a hospital ship, the U.S. Naval Ship *Comfort,* for lodging. Going forward, USACE is exploring new mechanisms for contracting with hotels and other properties to provide worker housing. To the extent that disasters and even pandemics could become more common in the future, the supplies of labor and lodging could become more impactful to the USACE supply chain over time.

3. **Dredging.** The USACE dredge fleet serves in a ready reserve role, with private contract dredges acting as the first option for dredging since the passage of Public Law 95-269 in 1978. As dredging demand has increased for coastal restoration and channel maintenance due to several recent large floods on U.S. rivers, supplies of dredge vessels are frequently constrained. Industry is responding to this market pressure with increased investment. As sea levels rise, sedimentation patterns in coastal channels will change and demand can be expected to increase for dredged material to replace eroding shorelines. At the same time, increasing interest in natural and nature-based features for ecosystem restoration and shoreline protection, such as beaches, dunes, and coastal wetlands, is expected to cause corresponding increases in demand for dredged material. Finally, dredge fleets can often be disrupted by the same storms and floods that leave large sediment deposits in need of removal, meaning that vessels must linger or lighter while they await dredges to arrive. This impact to navigation not only compromises the USACE supply chain of goods normally moved by barge (e.g., fuels, rock, sand, metals), and that of the nation at large, but also causes increased emissions of greenhouse gases when shipping is diverted to more carbon-intensive modes such as road or rail.

   Actions to Consider: USACE is investigating improved planning approaches to better prepare for storms, prepositioning dredges for faster response once the weather is clear.

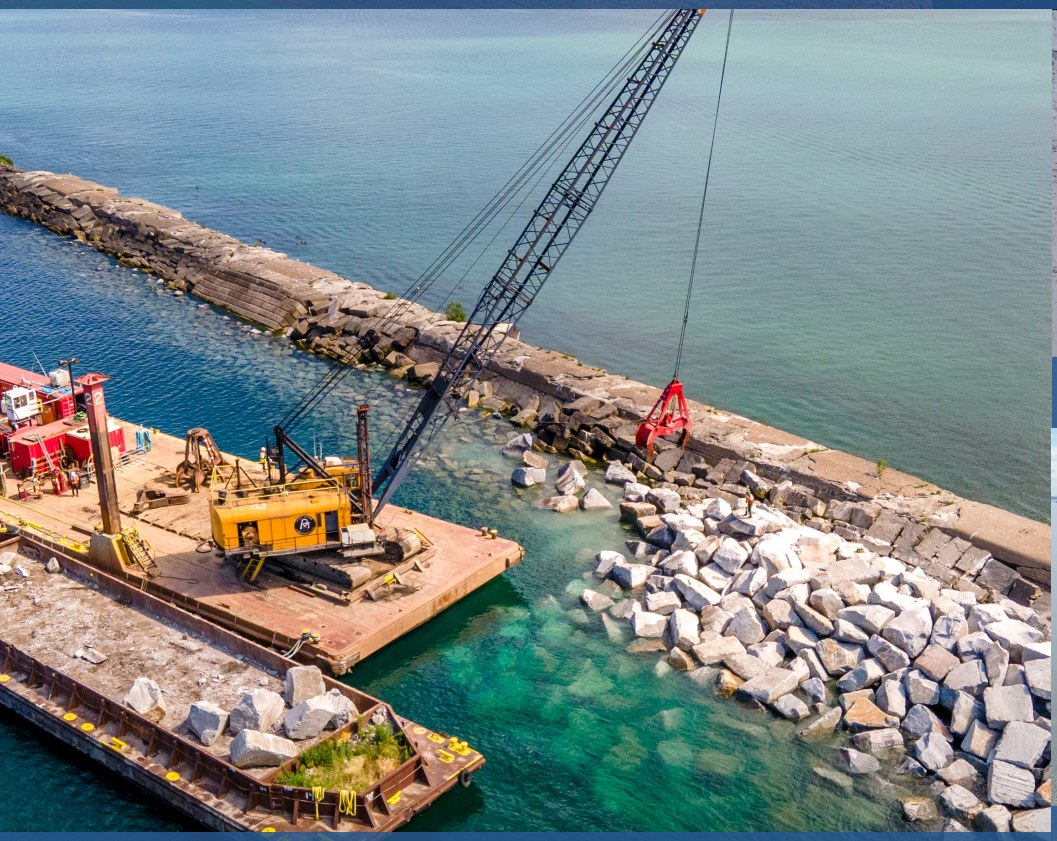
Figure 9: The McFarland is one of four USACE owned and operated deep draft dredging vessels.

U.S. Army Corps of Engineers
Climate Action Plan
Prepared per Executive Order 14008

Whitney Point Lake, one of 13 USACE reservoir projects in the Susquehanna River watershed.

Container ship docks at the Port of Los Angeles.

Flooding in a small Virginia fishing community experiencing subsidence and relative sea level rise.



Construction and repairs to the 10,200-foot south breakwater that protects the Buffalo Harbor and nearby dredged sediment confined disposal facilities from deep water wave and ice action.

Construction crews place steel cables anchoring the Bluestone Dam into the bedrock, increasing the strength of the dam.

Ecosystem Restoration Project (breakwater structure) that was the result of a Feasibility Study completed through a partnership with Lower Brule Sioux Tribe

USACE CLIMATE PREPAREDNESS AND RESILIENCE