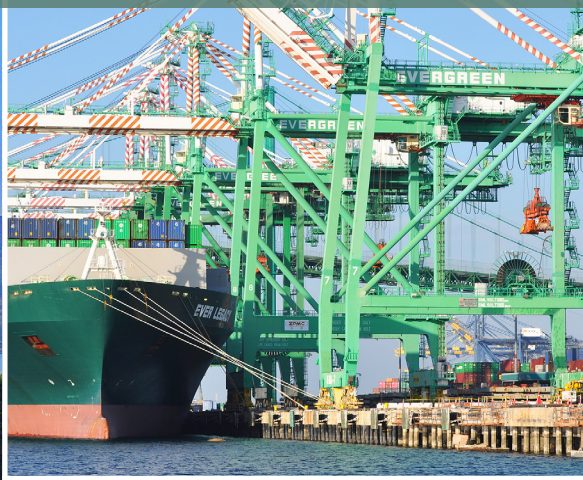
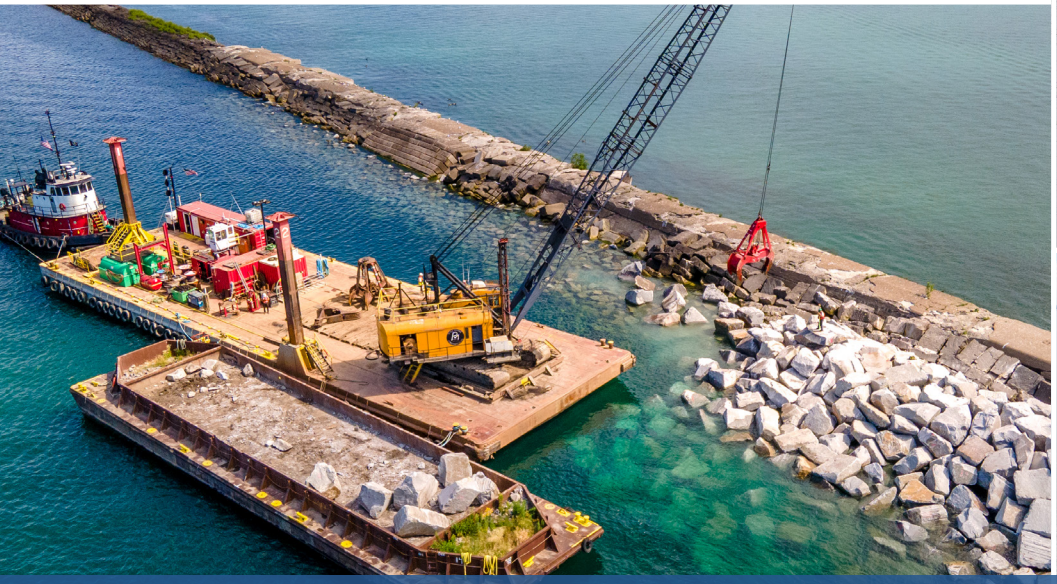
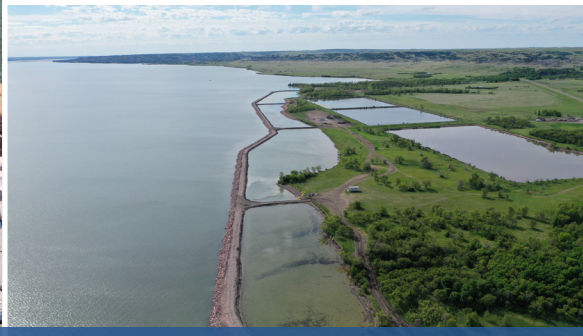


USACE Climate Adaptation Plan

2022 Progress Report





U.S.ARMY

US Army Corps of Engineers®

USACE CLIMATE PREPAREDNESS AND RESILIENCE

AGENCY	U.S. Army Corps of Engineers (USACE)
CLIMATE ADAPTATION OFFICIAL	Mr. Michael L. Conner
AGENCY CLIMATE ADAPTATION WEBPAGE	https://www.usace.army.mil/corpsclimate

SECTION 1: UPDATES ON PRIORITY ACTIONS

1. PRIORITY ACTION PROGRESS SUMMARY

PRIORITY ACTION PROGRESS			
ACTION	**CURRENT STATUS**	**ESTIMATED DATE OF COMPLETION**	**BRIEF DESCRIPTION OF PROGRESS 1-2 SENTENCES**
Modernize USACE Programs and Policies to Support Climate-Resilient Investments	In progress	Continuous action. Will continue to advance as additional sources of information (e.g., climate projections) become available and climate/sea level change science evolves.	To modernize our programs and policies in support of climate-resilient investments, USACE updated numerous policy documents, guidance documents, and project support tools and resources. We also continued to incorporate the best available science into existing decision-making tools and make our tools and documents more accessible to all. *(See Example 1)*
Manage USACE Lands and Waters for Climate Preparedness and Resilience (CPR)	In progress	Continuous action. Will continue to advance as additional sources of information (e.g., input from water managers) become available and climate/sea level change science and approaches to adaptative management/ resilient design evolve.	USACE completed updates to management tools and guidance that inform climate-resilient management of our lands and waters. This includes completing screening-level assessments of existing USACE project sites for climate vulnerability, updating Division and District-level Water Control Manuals (WCM) and Drought Contingency Plans (DCPs), initiating updates to our Comprehensive Evaluation of Projects with Respect to the Sea Level Change (CESL) Tool to support intermediate assessments for sea level vulnerabilities to existing projects in Fiscal Year (FY) 2023, and enhancing our work around nature-based solutions. *(See Example 2)*
Enable State, Local, and Tribal Government Preparedness	In progress	Continuous action. Will continue to evolve as more information is gathered related to the needs of state, local, and Tribal governments and as approaches to adaptative management/ resilient design evolve.	Under the National Flood Risk Management Program, USACE continues to support 54 state-led interagency Silver Jackets teams in all states, the District of Columbia, and three territories. This support has entailed coordination and outreach with state partners, local governments, and Tribes to understand flood risk challenges and identify needed data, analyses, and available technical assistance USACE and other federal partners can provide to identify solutions. *(See Example 3)*
Provide Actionable Climate Information, Tools, and Projections	In progress	Continuous action. Will continue to advance as additional sources of information (e.g., climate projections) become available and climate/sea level change science evolves.	As a leader in developing rigorous, actionable, climate information, USACE continues to collaborate with other agencies on climate resilience-related initiatives. USACE actively updates and improves its suite of climate/sea level change-related tools, resources, and technical guidance. USACE also completed migrating its web tools to a cloud-based platform to offer enhanced reliability and cybersecurity. *(See Example 4)*
Plan for Climate Change-Related Risks to USACE Missions and Operations	In progress	Continuous action. Will develop further as our understanding of future climate/sea level conditions continues to gain precision.	Under Engineering Regulation (ER) 500-1-31, USACE maintains a Continuity of Operations (COOP) Program which requires all-hazards COOP planning, including climate change-related hazards, across the USACE enterprise. *(See Example 5)*

2. PRIORITY ACTION PROGRESS EXAMPLES

EXAMPLE 1: MODERNIZE USACE Programs and Policies to Support Climate-Resilient Investments. In FY22, USACE published a series of references available to USACE staff including: a Technical Review Guide, Analyses Templates, and Review Checklists to ensure climate preparedness is appropriately incorporated into Civil Works (CW) Projects. In addition, we modernized the USACE Library of Climate Preparedness and Resilience Assessments (CAL) Portal. The CAL provides for a centralized, searchable library of completed Climate and Sea Level Change (SLC) Assessments. Examples available in the CAL are downloadable and demonstrate high quality applications of USACE climate and sea level change guidance. Examples are filterable by business line, location, and keywords. In advance of the issuance of the next National Tidal Datum Epoch in 2025, our experts are working to incorporate new datasets into estimates of observed SLC.

EXAMPLE 2: MANAGE USACE Lands and Waters for Climate Preparedness and Resilience. In FY22, USACE completed an initial vulnerability screening of existing project sites using a tool developed specifically for this action. Performing this evaluation provides for a better understanding and quantification of our vulnerabilities and supports developing strategies for increasing resilience across the portfolio of USACE projects. Between FY22 & FY23 USACE will execute a Comprehensive Evaluation of project vulnerabilities with Respect to Sea Level Change (CESL) using the CESL Tool. USACE also updated management plans, guidance, and resources critical to managing our lands and waters in the face of climate change. For example, an inventory of projects requiring Drought Contingency Plans (DCPs) was completed and 499 (83%) of USACE Water Control Manuals (WCMs) which specify normal and emergency USACE water management operations were uploaded to the Access to Water (A2W) Database. As USACE updates these WCMs, we are integrating consideration of Tribal Treaty Rights and Reserved Rights into those revisions. The USACE Engineering with Nature Program produced a 1,000-page International Guidelines in September 2021 on the use of nature-based solutions (NBS) for flood risk management. This guide is a product of five years of collaboration with more than 70 organizations around the world. As a continuing effort to inform and broaden use of natural infrastructure, a National Academy of Engineering (NAE) Workshop was conducted in May 2022 focused on defining the context, need, and content of policy and technical guidance for NBS. A proceedings brief for the NAE Workshop will be available in August 2022. A subsequent NBS workshop is also planned for July 2022 to define requirements for the development of NBS Engineering Guidance.

EXAMPLE 3: ENABLE State, Local, and Tribal Government Preparedness. Through the Floodplain Management Services (FPMS) program, Planning Assistance to States (PAS) program, and Continuing Authority Program, USACE provides direct technical and planning support to our non-federal government partners. As part of the FPMS program, USACE has supported 100 studies targeted at aiding our non-federal government partners in planning and preparing for climate change. These studies were all either initiated in FY22 or were initiated in FY21 and are ongoing in FY22. Of these 100 efforts, 33 were conducted through the FPMS base program, while 67 were conducted through the interagency nonstructural FPMS initiative. The interagency nonstructural FPMS initiative leverages the technical resources and expertise of other federal and nonfederal partners to produce effective solutions to mitigating flood risk. As part of this collaborative effort, technical support is often provided through interagency, state-led, Silver Jackets teams.

EXAMPLE 4: PROVIDE Actionable Climate Information, Tools, and Projections. USACE continues to develop high-quality, web-based tools to assist USACE teams and our partners with climate preparedness and resilience. USACE has made the following recent updates and improvements to tools:

- In FY23, the CPR Community of Practice (CoP) will begin transitioning the USACE Climate Hydrology Assessment Tool (CHAT) and Vulnerability Assessment Tool inputs from Coupled Model Intercomparison Project 5 (CMIP5) projections to CMIP6 projections as they become available and are vetted by the scientific community.
- In FY22, the CPR CoP updated the CHAT and its user interface to enable users to better communicate climate change impacts and risk in support of decision-making. Climate change projections are now provided at a finer spatial scale. Additional meteorological variables have been added to the tool and users can now visualize changes in these variables at both monthly and annual timescales.
- In FY22, the Time Series Toolbox (TST) was modified to improve the user experience and reduce sustainment costs. The TST supports the application of advanced statistical methods to evaluate the properties (e.g., breakpoints, trendlines, and changepoints) of observed hydrologic and meteorologic time series.
- In FY22, the CPR CoP plans to combine the Sea Level Curve Calculator and Sea Level Tracker Tools into the Sea Level Analysis Tool. This will improve efficiency, streamline application/data accessibility, and reduce sustainment costs.
- In FY22, to improve cybersecurity and reliability the CPR CoP migrated all of its web-based tools to the Amazon Web Services (AWS) cloud.

EXAMPLE 5: PLAN for Climate Change-Related Risks to USACE Missions and Operations. In accordance with ER 500-1-31, the USACE COOP program helps to ensure that USACE's mission can be sustained during severe weather events by creating communications redundancies, maintaining COOP sites in strategic locations, and protecting against information loss. To evaluate and identify vulnerabilities, USACE conducts a COOP exercise at least every two years. The Office of the Chief

Information Officer (CIO)/G-6 works to ensure that network services continue to be supported regardless of conditions by maintaining backup/disaster recovery plans, including those for CorpsNet, which provides access to the USACE network. Districts work though our Network Operations Center (NOC) to ensure critical data is backed up and accessible. USACE also continues to make progress in preparing our facilities to be resilient to future climate change-driven risks. For example, to reduce emissions in support of climate change mitigation we are currently transitioning the USACE vehicle fleet to being electric-powered. To support this initiative, USACE is taking steps beyond the federal Zero-emission Vehicle Planning and Charging (ZPAC) Tool. USACE deployment of charging stations and electric vehicles will be prioritized based on a baseline review of climate risks/impacts at USACE CW sites, as well as alignment with USACE's environmental and social justice initiatives. Electric vehicles can also serve as mobile, redundant energy storage which can be used during severe weather events.

SECTION 2: UPDATES ON OTHER INITIAL PLAN TOPICS

1. CLIMATE-RISK REDUCTION

A. Does the agency use a structured method for assessing operating risk to climate-related hazards (e.g., making facilities and infrastructure more resilient to climate hazards such as flooding, extreme heat)? If yes, how, and what type of risk was reduced (facilities, infrastructure)?

USACE uses a guidance-based, enterprise-wide approach to assessing climate change risk based on ECB 2018-14, *Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects* and ER 1100-2-8162, *Incorporating Sea Level Change in Civil Works Programs*. Climate and sea level change analysis is required prior to CW project implementation. While this requirement does not directly apply to existing USACE facilities, modifications to U.S. CW facilities (e.g., reservoirs, locks, and dams) and their operations are often included as part of CW initiatives covered by the guidance. USACE also supports assessments of climate-related risks to existing facilities by leveraging its emergency response, Coastal Systems Portfolio Initiative (CSPI) Tool and routinely updated USACE Flood Inundation Maps.

USACE uses targeted, metric-based mitigation activities to reduce climate change risk. These metrics are used to report to the Office of Management and Budget (OMB) Scorecard, inform the Sustainability and Climate Change Response (CCR) budget process, maintain USACE awareness of potential areas for improvement, and highlight success stories across the organization. Data anomalies are flagged as indicators of operational issues through a focused assessment process and rigorous review. This enables USACE to address issues in real time at the appropriate level and ensure future resilience. These metrics are also applied to support initiatives targeted at improving energy and water efficiency and transitioning our buildings and vehicle fleet towards being carbon-free energy. Such actions also improve resilience to outages and increase operational sustainability.

USACE is also increasing efforts to link our mitigation and resilience efforts. Through the Sustainability and CCR budget request process, CW projects can submit budget packages to improve climate change resilience through activities such as improving facility resilience through renewable energy installation (e.g., wind and solar energy), deploying incremental hydropower improvements, and relocating recreational restrooms outside of floodplains.

B. Did the agency use a method for assessing fiscal risk exposure due to climate change (e.g., likely changes in asset values as a result of physical climate risk and/or climate policy impacts)? If yes, what are the major financial risks expected in the near term and in the longer term?

USACE policy requires that climate change be incorporated into project planning, including the estimate of project costs and benefits. For coastal studies, SLC scenarios are incorporated into economic analysis across each project's lifecycle. For inland studies, climate projections are generally still too uncertain to numerically inform future economics, but USACE has produced tools and guidance to assign residual risks due to climate change. By identifying vulnerabilities, adaptation actions can be formulated. It is worth noting that USACE projects are generally optimized for net benefits. In most studies performed to date, climate/sea level change increases the value of projects by worsening the without-project conditions more than the cost of construction in the near term, making them more economically justifiable. As a result, climate change frequently does not present a financial risk to USACE projects. Instead, in most cases, climate change increases the value of projects, making them more economically justifiable. In addition, USACE EP 1100-1-5, *USACE Guide to Resilience Practices,* supports incorporating resilience into USACE missions and operations. The EP requires that projects be prepared, resistant, repairable, and adaptable to reduce downtimes and repair costs after disasters, thereby improving performance and reducing federal financial risk. One area of known, climate-related financial risk is the exposure of USACE office sites to extreme events. Offices that are located at project sites are evaluated under the vulnerability assessments that pertain to projects and are planned with climate change considerations along with the rest of the project. For office spaces leased from the General Services Administration or others, USACE has identified an action to coordinate with the site owner to manage the risk of climate impacts. For the relatively few office sites that USACE owns outright but are not associated with projects, USACE is working to develop a process for climate vulnerability assessment similar to that used for project sites.

C. What agency actions have been taken since October 2021, and what planned actions over the next year will help to reduce the agency's climate-related financial risks?

USACE intends to launch an Enterprise Risk Register (ERR) in the summer of FY22. The purpose of the ERR is to help project teams and leadership better assess, manage, reduce, mitigate for, and view risks to CW projects, including climate financial risks, through a transparent, accessible, and integrated online platform. The ERR will add consistency to USACE's risk-informed decision making across project lifecycles, portfolios, and programs. The ERR will enable personnel to learn from previously identified risks and mitigation measures both specific to a project and from USACE's entire portfolio of projects.

2. CLIMATE VULNERABILITY ASSESSMENTS

A. Has the agency completed its climate vulnerability assessment? If yes, how have you incorporated it into agency policies and decision-making?

An initial climate vulnerability screening of the USACE portfolio of projects has been conducted. To date, USACE climate change vulnerability assessments are conducted using the weight of evidence-based approach prescribed by ECB 2018-14 to determine a project's residual risk due to climate change. This approach includes applying the Civil Works Vulnerability Assessment (CW VA) Tool, scenario-based evaluations of SLC impacts (if relevant), a review of peer-reviewed literature describing observed and future trends in hydrology and meteorology, a time series based statistical assessment of the stationarity assumption, and an evaluation of watershed-specific projections of future hydrology and meteorology via the CHAT. In FY23, the CPR CoP plans to improve its CW VA Tool by updating the tool's inputs and rebuilding the tool to be targeted at evaluating climate hazard exposure (e.g., wildfire, ecosystem degradation, flood risk, coastal flooding) rather than USACE business lines. Upon re-release, a subsequent vulnerability screening of USACE projects will be completed. In support of the improved tool, updated CW VA Tool training will be offered to USACE personnel.

3. CLIMATE LITERACY

A. Has the agency conducted or begun to develop climate training programs on a broad scale?

The USACE CPR CoP's climate and sea level change training program includes on-demand training, monthly web-based technical presentations, and specified reviewer training. We offer an interactive (virtual or in-person), three-day training course to engineers, planners, and scientists that covers the following Climate Change topics: (1) Policy (2) Science, (3) Planning, (4) Vulnerability Assessments (5) SLC Science, Scenarios, and Impacts, (6) Support to DoD, (7) Nonstationarity, (8) CPR Tools, and (9) Global Climate Model (GCM)-based Projections of Hydrology and Meteorology. Participants earn continuing education credits for attendance. The Mississippi Valley, South Atlantic, and North Atlantic Divisions are receiving training in FY22.

To expand our climate training program to provide broader coverage across the organization, the CPR CoP formed a climate literacy working group in October 2021. The working group reviewed and developed strategies for meeting our agency's Climate Action Plan (CAP) training commitments. In January 2022, the group developed and delivered an executive-level briefing on the history, accomplishments, and future plans for USACE climate literacy efforts to ensure leadership support and buy-in. The group has since started developing two training courses: Climate 101 and the Commanders/Senior Executive Service (SES)-Level Course. Climate 101 will be a self-paced training course that will be deployed to all USACE functional area leads in FY22. As part of course development, the climate literacy working group collaborated with POCs from other agencies to inventory and evaluate existing introductory climate training modules. The SES-Level Climate Change Course will be incorporated into the existing SES, General Officers', and Installation Commanders' Course. As a first step, the climate literacy working group has begun researching required course specifications.

B. How is the agency fostering a culture of knowledge and practice for climate adaptation?

USACE's CPR CoP is dedicated to fostering knowledge and practice for integration of climate adaptation and resilience into all our agency's activities. The CPR CoP has over 250 members and meets monthly. The CPR CoP coordinates strategic efforts in several climate literacy areas including the revision of our CorpsClimate website, integration of context related to climate change into other training programs offered throughout the organization, delivery of presentations from USACE and external climate experts, and participation in the USACE Flood Risk Management Coordination Group and Coastal Working Group. USACE also recognizes outstanding achievements in the areas of climate preparedness and resilience annually with the Climate Champion and Resilience Role Model Awards, which may be awarded in the individual or team categories.

In FY23, USACE will conduct an enterprise-wide assessment to identify barriers to climate change literacy. Based on the barriers identified, the assessment will identify needs and develop a targeted plan for improving climate change literacy throughout USACE. This will ensure that the entire workforce receives the necessary support, information, resources, and training to foster a culture of climate change adaptation.

C. How did employees put the knowledge into practice?

Climate adaptation is a core component of successfully carrying out USACE missions. Our hydrology, hydraulics and coastal (HH&C) engineers and scientists routinely put climate adaptation into practice by using the CPR CoP's web-based tools and readily available resources to incorporate climate and sea level change considerations into USACE studies, water resources

decision-making, project engineering, and design. We employ rigorous technical guidance and review requirements, which act as a forcing function to embed climate and sea level change considerations into all USACE engineering and management activities. The CPR CoP works collaboratively with project managers, planners, economists, and environmental specialists to ensure consistent messaging and application of the latest, actionable climate and sea level change science throughout our organization.

4. TRIBAL ENGAGEMENT

A. Did implementation of the Plan include consideration of Tribal Treaty Rights? If yes, how, and what were the results?

USACE has project-specific examples of consideration of Tribal Treaty Rights, alongside climate change considerations. Since time immemorial, the Pueblo of Santo Domingo has used their traditional ecological knowledge to adapt their way of life to the existing climate, managing water and landscape resources to preserve their way of life. The mega-drought facing New Mexico and human impacts to the watershed and landscape resources, outside of Tribal lands, has threatened their livelihoods and cultural identity, leaving the Pueblo of Santo Domingo struggling to manage water and landscape resources within their Tribal lands. The Santo Domingo Watershed Study, completed in 2021, focused on drought resilience, examined flooding, erosion, and environmental restoration challenges, and development of a comprehensive watershed management plan. USACE worked closely with the Pueblo to integrate Indigenous Knowledge (IK) into the study process.

In addition to project-specific initiatives like the Santo Domingo Watershed Study, USACE is integrating Tribal Treaty Rights and Reserved Rights into revisions of WCMs.

B. Did implementation of your Plan include consideration of IK? If yes, how?

IK can provide information beyond typical information sources based in western science, including information regarding the nature and impacts of climate change, ecosystem function and the responses of ecosystems to disturbance, and historical knowledge of the physical and ecological environment of the project area. These kinds of information can be invaluable to consideration of the effects of USACE projects, and of potential options to adapt those projects to take advantage of beneficial opportunities or reduce negative effects. USACE considers IK in its CW Programs in numerous ways. USACE's Engineering with Nature Program and the Sustainable Rivers Program both consider IK in the suite of ecosystem-based solutions developed through their partnerships. USACE has also considered IK as part of climate preparedness and resilience efforts in studies and reports, including the final National Shoreline Management Study (NSMS) Great Lakes Overview Report, other NSMS Regional Assessments, and the draft NSMS National Assessment report. In addition, through its Tribal Partnership Program USACE partners fully with Tribes to include both IK and western science to find effective solutions to their water resources challenges. The Lower Brule Sioux Tribe Natural Resources Preservation and Ecosystem Restoration Project provides just one specific example. Changing climatic conditions in the decades since construction of Big Bend Dam (Lake Sharpe) have contributed to increased and continuous erosion along the shoreline of the reservoir, resulting in impacts to the Lower Brule Sioux Tribe, including loss of Tribal lands. This erosion has destroyed or damaged almost all remaining native wetland and riparian habitats on the Lower Brule Reservation and continues to threaten infrastructure and natural and cultural resources in the vicinity. The Lower Brule Sioux Tribe Natural Resources Preservation and Ecosystem Restoration Project was developed in full partnership with Lower Brule Sioux Tribe to address those issues. The approved project, currently under construction, incorporates IK provided by Tribal Elders related to historic and native plant species that were present prior to construction of Lake Sharpe, and provides increased opportunities for Tribal members to access and interact with the river and restored native habitats safely. The project is designed to incorporate climate preparedness and resilience and includes adaptive management to ensure the project fulfills its intended goals in the face of a changing environment. Going forward, USACE will continue to work to consider IK in all CW projects and embed IK throughout the CW Program, where applicable.

5. ENVIRONMENTAL JUSTICE

A. Has the agency considered environmental justice in the implementation of the Plan? If yes, how?

Since 2011, USACE has continually expanded our approach to environmental justice and community engagement in the plan formulation process. On March 15, 2022, the Assistant Secretary of the Army, Civil Works (ASA(CW)) issued interim guidance for the implementation of Environmental Justice and the Justice40 initiative which directed the USACE to work to better align our missions and authorities to enable and enhance community resilience. In addition, ASA(CW), with support from USACE, is conducting a series of public and Tribal virtual meetings this summer (June and July 2022) to gather feedback related to modernizing the USACE CW Program, including identifying opportunities to further reduce the negative impacts of climate change on disadvantaged communities. USACE will continue to identify innovative ways to assess and utilize tools that will provide better understanding of these communities' needs.

Ongoing initiatives include attending the 2022 National Academy of Sciences symposium on managed retreat and establishing a collaborative relationship with the University of California (UC)—Davis. Work with UC-Davis will include a focus on community demographics and the needs of disadvantaged communities. Since 2021, USACE has sponsored a series of webinars titled "Bridging the Equity Gap: Flood Resilience for the Whole Community." This series brings together experts and community members to explore the intersection of environmental justice with flooding and identify the conditions and factors that make people, institutions, and natural systems more vulnerable to flooding than others.

6. PARTNERSHIPS

A. Since October 2021, did the agency expand existing or establish new interagency or external partnerships on climate adaptation?

The USACE CPR CoP has built on existing interagency partnerships with the United States Geological Survey (USGS), state-level departments of transportation and departments of natural resources, the National Oceanic and Atmospheric Administration (NOAA), and the International Joint Commission (IJC). For example, in 2021 CPR CoP staff participated in a kickoff workshop with the Bureau of Reclamation as it sought to establish its own Climate Change CoP. USACE is also currently engaged in a USGS-led study of the stationarity in the Upper Mississippi River Basin, funded by the Transportation Pooled Fund-5(460), in cooperation with the IL, IA, MI, MN, MO, ND, SD, and WI Departments of Transportation and the MT Department of Natural Resources. The USACE continues to build upon its existing relationships with the IJC through its participation in transboundary studies that address the issue of climate change, including the Columbia River Basin Treaty and EIS efforts and the Souris River Plan of Study. The USACE is currently working alongside the NOAA National Marine Fisheries Service to characterize climate change impacts within the Willamette River Basin. Finally, USACE participates in numerous interagency groups focused on climate adaptation, including the White House Flood Resilience Interagency Working Group updating the Climate-Informed Science Approach for the Federal Flood Risk Management Standard, the FEMA Technical Mapping Advisory Council, the National Drought Resilience Partnership, and the Department of Defense Coastal Assessment Regional Scenarios Working Group.

SECTION 3: NEW TOPICS FROM EO 14057

1. POLICY REVIEW

A. What is the agency's approach to reviewing agency policies to ensure climate-resilient investment and to removing maladaptive policies and programs (Section 209 of EO 14057)?

USACE systematically identifies barriers to climate change adaptation and works to overcome those within the agency's purview. To meet the requirements of EO 14057, in FY22 USACE will establish the Barriers to Problem Solving project development team. This team will apply a policy analysis approach to identify maladaptive programs and policies and other potential challenges that may inhibit incorporation of climate change into water resources management. The team will also strategize paths forward to remove or refine these policies and programs and overcome any identified challenges.

The team will take a four-pronged approach: collect data, identify potential barriers, organize barriers by themes, and develop recommendations. Data collection will involve compiling, inventorying, reviewing, and organizing available assessments, reports, policy, and guidance documents including engineering, economic, social, and environmental regulations, as well as guidelines related to CW planning, climate change, and decision-making. The team will then evaluate the collected materials to identify barriers that might hinder USACE's ability to address climate change related issues. Barriers may include both real and perceived roadblocks, fundamental knowledge gaps, and novel situations that require rapid decision-making to maintain climate readiness. In this step, the team will consider both barriers already identified within the USACE CAP and additional challenges validated through consultation with the CAP's developers, and both internal and external multi-disciplinary experts. Once identified, barriers will be systematically organized into themes. Finally, the team will develop recommendations to address the water resource problems associated with each identified barrier.

2. CLIMATE SCENARIO ANALYSIS

A. Does the agency use climate projections in decision-making? If yes, what approach was taken to incorporating it into agency process and decisions?

At present, USACE's Guidance for Incorporating Climate Change Impacts to Inland Hydrology (ECB 2018-14) requires that a vulnerability assessment be conducted for all USACE projects and studies to determine the residual risk that climate change poses to proposed project features and/or measures, as well as to future watershed conditions. This evaluation of residual risk is then leveraged to improve decision-making. ECB 2018-14 will be updated by the end of calendar year 2022 to make the technical requirements more widely applicable, reflect updates to USACE tools and standards of practice, and to provide a consolidated reference that includes guidance from the now expired ETL 1110-3-2, Guidance for Detection of Nonstationarities. Components of the required vulnerability assessment that rely on climate projections include: a literature review of observed and projected trends in relevant hydrologic and meteorologic variables, application of the CHAT and CW VA Tool. Recommended literature review resources include the National Climate Assessments (NCA), as well as the 2015 USACE literature synthesis (currently slated for an update). The CHAT facilitates an evaluation of projected changes in precipitation, temperature, drought index, and streamflow response for all 8-digit hydrologic unit code (HUC) watersheds within the continental U.S. (CONUS). The CW VA Tool uses a series of indicator variables to assign vulnerability scores to 4-digit HUC watersheds within the CONUS. Some of these indicator variables rely on projections of meteorologic and hydrologic variables. The CW VA Tool identifies relatively vulnerable four-digit HUCs across USACE business lines for two subsets of outputs defined based on projected runoff quantities and two future epochs.

During FY23, the CPR CoP will update the source data applied within its tools (CHAT and CW VA Tool) from CMIP5 to CMIP6 products. CMIP6 is built from a larger suite of climate projections, that was developed with the most advanced global climate models (GCM) and is the basis for the recent IPCC Sixth Assessment Reports. This update will ensure that CPR products reflect the latest advancements in climate change science and are consistent with the current state of knowledge of potential future greenhouse gas emissions.

The results of an ECB 2018-14 analysis are incorporated into agency processes and decisions by using a weight of evidence-based approach to qualitatively define the residual risk that climate change presents to the study area, as well as the alternatives and measures being considered as part of a USACE study. The climate analysis focuses on differentiating between identified alternatives, including which identified climate change factors will influence alternatives similarly and differently in the analysis of those alternatives. Identified performance and decision risks may provide the project partners with indications of actions they may choose to take to improve community resilience to climate change in the future. For example, knowing that flood magnitudes in a stream are likely to increase over 50 years, a project partner might choose to monitor changes in flood magnitudes every decade to determine whether adaptation measures are necessary, or implement zoning to manage risks outside the current project footprint. Awareness of projected changes might also inform a project partner's decision to request a Locally Preferred Plan that confers additional resilience to the changes.

USACE has worked collaboratively with other resource agencies, universities, and science agencies to produce a publicly available archive of fine spatial resolution translations of climate projections over the contiguous United States. This archive is available at http://gdo-dcp.ucllnl.org/downscaled_cmip_projections. Inputs derived from this archive are included in the CHAT and CW VA Tool. This database is also available to study teams who seek to evaluate study-specific projections of climate changed meteorology and hydrology in support of USACE decision-making.

USACE teams have been incorporating regional or project-specific projections of climate changed meteorology and hydrology into inland analyses on a case-by-case basis. Projections of future climate changed meteorology and hydrology and impacts on local-scale hydrology can be highly uncertain. Because projections have varying degrees of reliability at finer scales, application of hydrologic and meteorologic projections for in-depth project-specific assessments requires guidance on interpretation and use. In FY 22, USACE will publish formal guidance to support these efforts. This guidance, tentatively titled *USACE Guidance for Incorporating Study Specific Projections of Climate Changed Meteorology & Hydrology into Inland Analyses* is intended to provide a consolidated reference that will guide USACE procedures for conducting analysis beyond what is currently required by existing USACE guidance. It is targeted at (1) increasing understanding of climate change information relevant to USACE projects and (2) supporting the use of that information to inform the USACE CW planning process. An example of how climate-changed projected hydrology and meteorology has been taken into consideration as part of USACE decision-making can be demonstrated by multiple long-term planning efforts for the Federal Columbia River Power System. Projected changes in future temperature, precipitation, snowpack, and streamflow are assessed to determine how these changes may affect resources and the successful accomplishment of the authorized purposes of the reservoirs in the system. Hydroclimate projections have been applied in a system-wide environmental impact statement (EIS), the Columbia River Systems Operation EIS, and continue to support ongoing litigation following publication of the EIS in September of 2020. The use of hydroclimate projections in conjunction with reservoir modeling also supports other long-term planning efforts currently ongoing, including the negotiation of the Columbia River Treaty between the United States and Canada, and local and system-wide vulnerability assessments and adaptive management analyses. Finally, USACE is currently supporting targeted investigations of analytical methods to increase the utility and informed use of hydroclimate projections in engineering and planning decisions.

While not climate projections in the sense of the modeled hydroclimatology described above, USACE requires study teams to consider a range of future SLC conditions based on empirical functions developed by interagency working groups. These scenarios include vertical land movement observed at NOAA tidal gauges. The USACE SLC scenarios are developed using the guidance in ER 1100-2-8162 and ETL 1100-2-1 (USACE 2013a, 2014) and originate in 1992 (the midpoint of the latest National Tidal Datum Epoch (NTDE) of 1983–2001).

An example of how SLC has been incorporated into the USACE decision-making process is illustrated by the East Rockaway Inlet to Rockaway Inlet and Jamaica Bay General Reevaluation Study. This project, initially authorized in 1965, addresses coastal erosion and storm risk management in the boroughs of Brooklyn and Queens, NY. After Hurricane Sandy, USACE expanded its study of coastal storm risk management alternatives beyond the Atlantic Coast of the Rockaway Peninsula to include vulnerable communities surrounding Jamaica Bay that were also significantly impacted by the storm. The selected plan includes composite beach, dune, and seawall elements that are all adaptable to sea level change to maintain project performance. Future sea level change is included in the costs and benefits of the authorized project, allowing future adaptation to occur without seeking additional Congressional authorization. Adaptation pathways include additional beach nourishment and height additions to the dune and seawall structures triggered by specified thresholds of observed sea level over defined averaging periods, to avoid premature triggering due to water level variability. For their application of climate-adaptable design, the project delivery team was recognized with the 2022 USACE Resilience Role Model award in the team category.

B. Does the agency have the climate data and information it needs for its decision-making? If yes, what is the primary information source(s)?

Yes, with limitations. As an agency, USACE has the historic, meteorologic, hydrologic, and sea level datasets and analysis expertise necessary to aid in decision-making related to climate change. The USACE CPR CoP continues to work on tools and technical guidance to augment the use of observed data to help inform how climate change may be impacting our portfolio of projects at present and in the future. USACE has well-established data sources and protocols for accounting for future SLC using a scenario-based approach. Taking into consideration the latest actionable science, USACE has been working to identify and develop datasets and resources that can be used to characterize future, climate changed conditions. However, to better characterize future climate change impacts at a watershed scale, some data and information-driven limitations remain:

- Study area-specific analysis of climate changed projected meteorology and hydrology remains resource-intensive.
- Limitations, including a lack of best practices and expertise, remain to applying watershed-specific climate changed hydrology and meteorology.
- In addition, numerous tools, data sources, and references are being developed and published by various external entities related to the characterization of climate change information and how it might be applied for water resources decision-making. It is difficult to track all these products and to evaluate whether or not they are actionable in real time.

USACE relies on numerous sources of information when producing climate and sea level change analysis. Peer-reviewed scientific literature (i.e., journal articles, the NCAs, NOAA state climate summaries) is often referenced to describe trends in observed and projected hydrology and meteorology. To provide a centralized source of reliable content, the USACE generated a synopsis of Recent U.S. Climate Change and Hydrology Literature Applicable to U.S. Army Corps of Engineers Missions in 2015. In addition to relying on externally published content, the USACE performs its own assessments of observed time series data extracted from sources like NOAA Tides and Currents (observed sea level data, datum information, trend analysis), the NOAA National Centers for Environmental Information (meteorological data), and the USGS Surface-Water Data for the Nation website (streamflow and stage data). USACE has worked collaboratively with other resource agencies, universities, and science agencies to produce a publicly available archive of fine spatial resolution translations of climate projections over the contiguous United States. This archive is available via the Lawrence Livermore Laboratory Green Data Oasis website.

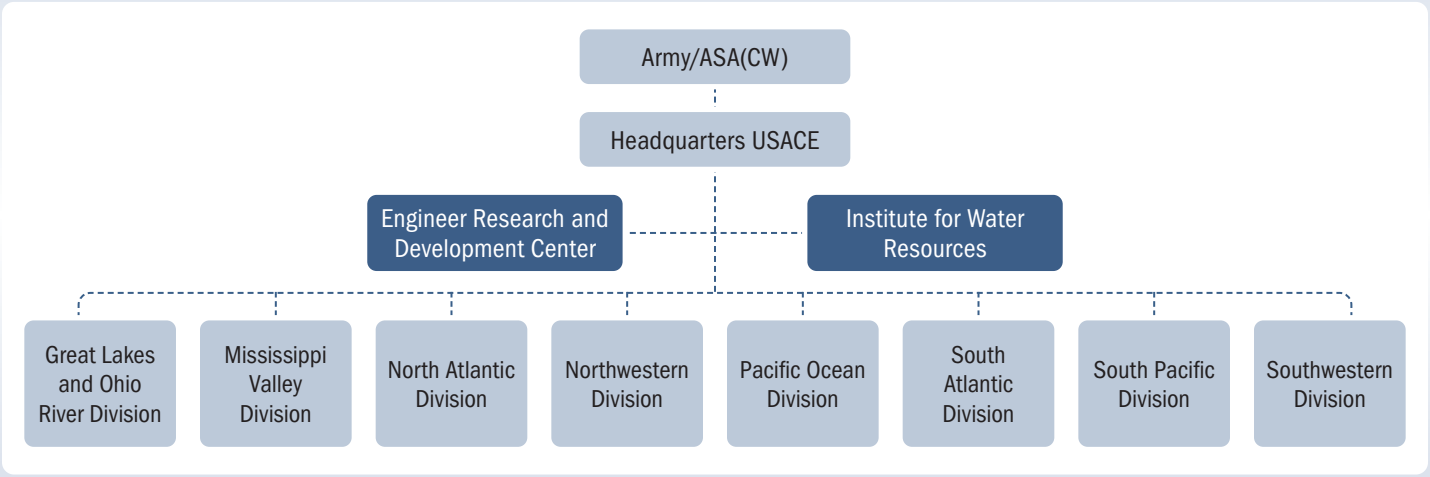
USACE tools that incorporate climate and sea level data and information to provide for analysis aimed at supporting decision-making include the: (1) USACE SLC Calculator (scenario-based visualization of future SLC), (2) Sea Level Tracker (visualizations of observed changes in mean sea level compared to USACE SLC scenarios), (3) Nonstationarity Detection Tool (application of statistical tests to access the stationarity of annual instantaneous peak streamflow and gage height data series at USGS gage sites), (4) TST (automated data pre-processing of user-inputted time series and application of standardized approaches to statistical time series analysis and modeling), (5) CHAT (facilitates an evaluation of projected changes in precipitation, temperature, drought index, and streamflow response for all 8-digit HUC watersheds within the CONUS) and the CW VA Tool (provides for a relative assessment of future, climate change vulnerability for 4-digit HUC watersheds within the CONUS).

Limitations to Data and Information Availability. The USACE could benefit from updated information related to climate and sea level change and additional sources of projected hydrologic and meteorologic output. Because the previous literature synthesis was conducted in 2015, the USACE is currently aligning the resources necessary to develop an updated synthesis and evaluation of available, actionable resources, data sources, projections, and literature applicable to USACE missions. Currently, there are limitations related to the spatial scale and timesteps at which climate changed projections of meteorology and hydrology can be applied. Resources should be dedicated to developing climate change projections at finer resolutions, for example, available Regional Climate Models (RCMs) and their output should be inventoried and evaluated. Many projected datasets end at international boundaries and thus do not fully cover transboundary watersheds. Resources should be dedicated to producing projections that fully cover transboundary watersheds, as well as areas outside the CONUS, such as Alaska, Hawaii, and U.S. territories. There is a great deal of uncertainty associated with future climate projections. Resources need to be applied to better characterize and quantify this uncertainty. Hydrologic models configured to simulate climate changed streamflow response are not widely available or applied. Resources need to be dedicated to generating more of these models and to building USACE expertise in distributed parameter modeling over long timescales.

C. Identify the offices within the agency that are already incorporating climate information into decision-making.

Since 2014, USACE policy has been to "integrate climate change preparedness and resilience planning and actions in all activities" to enhance community resilience and "to reduce the potential vulnerabilities of those communities and missions to the effects of climate change and variability." This policy is implemented across the USACE's nine divisions and 43 districts. Each USACE division is responsible for quarterly reports on sustainability targets, contributions to climate mitigation through energy and water conservation, sustainable buildings, electric vehicles, greenhouse gas reductions, and other measures. The divisions are supported by the USACE Headquarters' CW and Military Programs Directorates, the Engineer Research and Development Center, the Institute for Water Resources, the Huntsville Engineering and Support Center, and other offices throughout the agency.

USACE ORGANIZATIONAL CHART



Climate change information is mainstreamed into normal Civil Works business processes by policy.
All elements of the USACE Civil Works enterprise incorporate climate information into decision-making.

USACE CLIMATE PREPAREDNESS AND RESILIENCE