

2016 Highlights of Progress: Responses to Climate Change by the National Water Program

January 2017



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Office of Water
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Manistee River, Michigan**

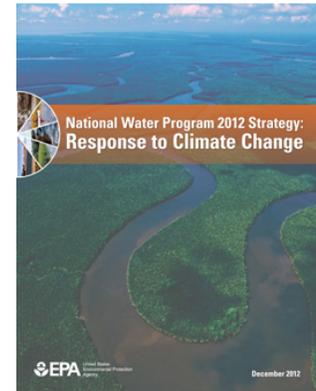
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Introduction

The National Water Program at the U.S. Environmental Protection Agency (EPA) released the *National Water Program 2012 Strategy: Response to Climate Change* (2012 Strategy) in December 2012 as an update to an initial climate change and water strategy released in 2008.



The *2012 Strategy* describes long-term goals for the management of sustainable water resources for future generations in light of climate change and is intended to be a roadmap to guide future programmatic planning and inform decision makers during the Agency's annual planning process. The *Strategy* is available [here](#).

This *2016 Highlights of Progress* report provides a summary of the major accomplishments of national water programs and EPA regional water programs in 2016. In addition, major research projects addressing climate change and water that were completed in 2016 by the EPA Office of Research and Development (ORD) are described.

This is the seventh climate change progress report for the National Water Program and is modeled after previous highlights of progress reports from 2012, 2013, 2014, 2015 (see <https://www.epa.gov/climate-change-water-sector/planning-and-management-programmatic-response-climate-change-and-water>). Like these previous reports, this report is organized around the six long-term programmatic vision areas described in the *2012 Strategy*:

- water infrastructure;
- watersheds and wetlands;
- coastal and ocean waters;
- water quality;
- working with Tribes; and
- cross-cutting program support.

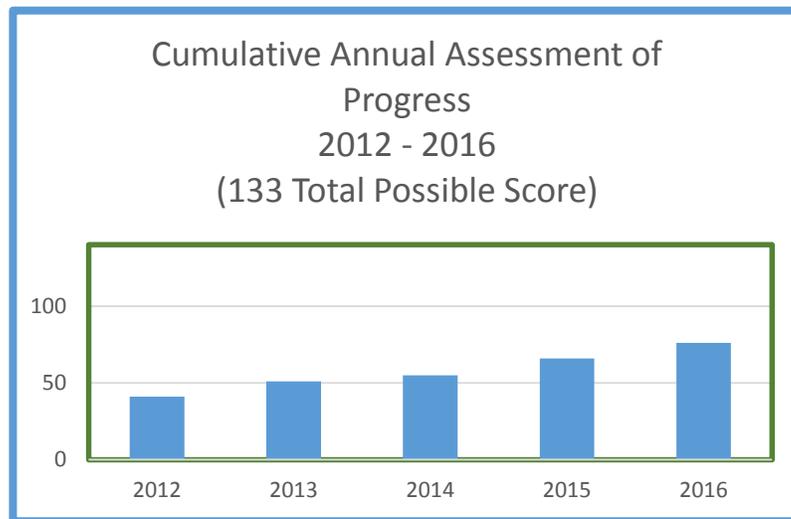


Part I of this report presents key “highlight” projects and products implemented by the National Water Program and Office of Research and Development in 2016 in each of these six vision areas. Part II of this report includes descriptions of key 2016 “highlights” of climate change and water work in each of the 10 EPA Regional offices.

In addition to the major accomplishments highlighted in each of these vision areas and for each EPA Region, other important projects and activities were accomplished in 2016. A detailed compendium of 2016 activities and accomplishments related to climate change and water programs underway in EPA national water program offices, the EPA Office of Research and Development, and Regional water programs is provided in the Appendices.

In addition to reporting on highlights of progress for 2016, the National Water Program is continuing past work to assess progress in the overall implementation of the *2012 Strategy* in the context of the stage or phase of development of climate change response programs. Part III of this report includes an assessment of the status of progress toward each of the 19 goals described in the *2012 Strategy* with respect to seven stages of implementation. This assessment builds on the first, baseline assessment of implementation of climate change adaptation programs and projects across the National Water Program that was provided in the *2012 Highlight of Progress* report. The numerical scores representing the 1-7 phases of implementation progress under each of the 19 goals in the *2012 Strategy* have a total possible score of 133. The total annual scores for overall implementation progress (i.e.; total score for the 1-7 assessment for each of 19 goals) are:

- 2012: 42
- 2013: 51;
- 2014: 55;
- 2015: 67; and
- 2016: 76



OVERVIEW OF 2016 NATIONAL HIGHLIGHTS

National Water Programs/Research Products

Vision Area 1: Water Infrastructure

1. Release Climate Resilience Evaluation and Awareness Tool (CREAT) 3.0
2. Release “Adaptation Case Study and Information Exchange” and “Workshop Planner for Climate Change and Extreme Adaptation”
3. Develop Modeling Framework to Address Drinking Water Impairments Triggered by Climate Change (Office of Research and Development product)

Vision Area 2: Watersheds and Wetlands

4. Beta Test Climate Features of Hydrologic and Water Quality System (HAWQS) Model
5. Improve Critical Streamflow Statistics

Vision Area 3: Coastal and Ocean Waters

6. Climate Ready Estuaries Program Makes Project Grants for Changing Climate
7. Release Online Climate Planning Tool for Estuaries

Vision Area 4: Water Quality

8. Address Climate Change in the Nonpoint Source Program
9. Add Climate Change to Fifth Annual Campus RainWorks Challenge

Vision Area 5: Working with Tribes

10. Regional Initiatives to Support Tribes in Responding to Climate Change Challenges

Vision Area 6: Cross-cutting Program Support

11. Identify and Describe State Water Agency Climate Adaptation Practices: Round 2
12. Review Scientific Literature for Assessment of Climate Impacts on Water Programs (with Office of Research and Development)

OVERVIEW OF 2016 HIGHLIGHTS

EPA Regional Water Programs

Region 1: Worked with all six New England states to develop and **approve updated Nonpoint Source Management Plans under section 319 of the Clean Water Act that consider climate change.**

Region 2: Worked with **Puerto Rico and the Virgin Islands to finalize a Memorandum of Understanding (MOU) to reduce the risks of climate change and to promote climate change resilience.**

Region 3: Developed modeling **tools and procedures for the Chesapeake Bay watershed to quantify the effect of climate change** on watershed flows and pollutant loads, storm intensity, increased estuarine temperatures, sea level rise, and ecosystem influence.

Region 4: Updated the *Water Efficiency Guidelines*, previously used to review proposed water supply projects (e.g. reservoirs) in the region under the Section 404 wetlands regulatory program. The document provides utilities with a set of guidelines of the best management practices, inclusive of WaterSense program standards.

Region 5: Worked with federal partners to **finalize a standardized set of climate resiliency criteria for grants to implement the Great Lakes Restoration Initiative (GLRI).** The criteria will help GLRI funded projects be more resilient to the effects of projected climate change including the likelihood of future climate impacts such as the increased frequency of more intense storms and shifts in ranges of particular species.

Region 6: Promoted the **beneficial use of suitable dredged material** to support environmentally sound projects to provide protection from sea level rise and storm surge.

Region 7: Region 7 **developed a harmful algal bloom action plan**, communication plan, and sampling protocol using the guidance from the EPA document, *Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water* published in June 2015.

Region 8: Co-lead the **Montana Drought Demonstration Project (MDDP)** in partnership with the Montana Department of Natural Resources and Conservation (DNRC).

Region 9: Completed a partnership project with the Pacific Islands Climate Change Cooperative (PICCC) and NOAA on the **Resilient Lands and Waters (RLW) Initiative** in Hawai'i for protecting and restoring vital lands and waters in West Maui, West Hawai'i, and He'eia in Oahu.

Region 10: Requested in the 2016 Request for Proposals to support the Puget Sound Partnership (PSP) Action Agenda **that applicants discuss how they propose to incorporate climate change into their programs.**

PART I NATIONAL PROGRAM HIGHLIGHTS

Vision Area 1: Water Infrastructure



Vision: In the face of a changing

climate, resilient and adaptable drinking water, wastewater and stormwater utilities (water sector) ensure clean and safe water to protect the nation's public health and environment by making smart investment decisions to improve the sustainability of their infrastructure and operations and the communities they serve, while reducing greenhouse gas emissions through greater energy efficiency.

1. Release Climate Resilience Evaluation and Awareness Tool (CREAT) 3.0: EPA developed and released a new, improved version 3.0 of the Climate Resilience Evaluation and Awareness Tool. CREAT assists drinking water, wastewater, and stormwater utility owners and operators in understanding potential climate change threats and in assessing the related risks at their individual utilities. CREAT 3.0 is now web-based and features a series of intuitive modules designed to help utilities complete a climate change risk assessment, redesigned from the ground up to provide a more user-friendly experience. The Climate Ready Water Utilities initiative has updated its Climate Projection Scenario Map using data provided in CREAT. The map gives access to projected changes in annual total precipitation, annual average temperature, annual number of days over 100°F, 100-year storm intensity, and sea-level rise at their location.



2. Release “Adaptation Case Study and Information Exchange” and “Workshop Planner for Climate Change and Extreme Adaptation”: EPA’s Climate Ready Water Utilities initiative launched two tools to promote a clear understanding of climate science and adaptation options by translating complex climate projections into understandable, actionable, localized information for the water sector:

- the “Adaptation Case Study and Information Exchange” gives water utilities an interactive platform to explore real-world climate adaptation case studies and encourages utilities to connect with one another and share adaptation strategies; and
- the “Workshop Planner for Climate Change and Extreme Events Adaptation” is web-based and assists water sector stakeholders with conducting climate change adaptation workshops, helping utilities and communities explore and understand how more intense and frequent extreme weather events can affect water resources.

- 3. Develop Modeling Framework to Address Drinking Water Impairments Triggered by Climate Change:** The Office of Research and Development (ORD) developed a modeling framework to illustrate climate adaptation mechanisms that can enable conventional drinking water treatment systems to accommodate water quality impairments triggered by climate change and related meteorological events. The capacity reserve concept discussed in the paper provides an organizing principle that could be useful for prioritizing climate adaptation strategies such as major or minor treatment/infrastructure modifications, system-wide upgrades such as off-line storage, operational changes in distribution systems, or the use of supplemental water sources including reclaimed or recycled water. (ORD Product)

Vision Area 2: Watersheds and Wetlands



***Vision:** Watersheds are protected, maintained and restored to ensure climate resilience and to preserve the social and economic benefits they provide; and the nation's wetlands are maintained and improved using integrated approaches that recognize their inherent value as well as their role in reducing the impacts of climate change.*

- 4. Beta Test Climate Features of Hydrologic and Water Quality System (HAWQS) Model:** In 2016, the Office of Water (OW) finished development and beta tested the new Hydrologic and Water Quality System model. HAWQS is a tool that includes three modules for incorporating climate change effects at the 8 and 10-digit watershed scale, a slider bar for proportional changes to precipitation and temperature, and a sensitivity test for particular parameters affecting the weather inputs. Further improvements in the near future will include user guidance on climate scenario selection as well as further exploration of methods for more sophisticated water temperature modeling.
- 5. Improve Critical Streamflow Statistics:** EPA has been collaborating with the U.S. Geological Survey (USGS) to update and improve methods for calculating streamflow statistics. In 2016, USGS developed the first version of the Surface Water Toolbox (SWToolbox) and, in preparation for its public release, drafted a user manual for the software. Initial studies were conducted to examine changes in surface water flows in the Chesapeake Bay watershed and to test alternative methods for estimating low flow statistics in ungauged locations. A paper has been submitted to Journal of Hydrology and a second journal article is being drafted. Future efforts will include development of training materials for the SWToolbox and additional flow analyses.

Vision Area 3: Coastal and Ocean Waters



Vision: *Adverse effects of climate change and unintended adverse consequences of responses to climate change have been successfully prevented or reduced in the ocean and coastal environment. Federal, tribal, state, and local agencies, organizations, and institutions are working cooperatively; and information necessary to integrate climate change considerations into ocean and coastal management is produced, readily available, and used.*

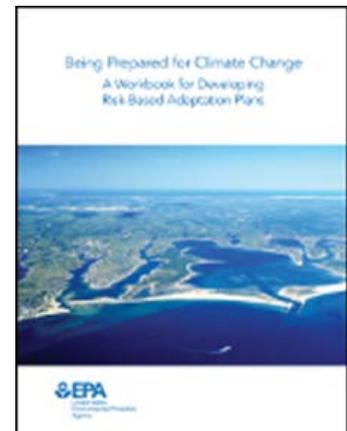
6. Climate Ready Estuaries Program Makes Project

Grants for Changing Climate: In addition to base grant funding, the National Estuary Program (NEP) made grants to NEPs for projects in several key areas related to climate change including:

- financial assistance to three National Estuary Programs for state-of-the-art instrumentation to collect high precision acidity and dissolved carbon dioxide data; and
- financial assistance to five NEPs to undertake risk-based climate change vulnerability assessments.



7. Release Online Climate Planning Tool for Estuaries: EPA released the first version of the Climate Ready Estuaries workbook online tool. This tool helps users of the *Being Prepared for Climate Change Workbook* to manage their information and develop it into a vulnerability assessment report (see: <https://ofmpub.epa.gov/apex/cct/f?p=126%3A11>).



**Vision Area 4:
Water
Quality**



***Vision:** The Nation’s surface water, drinking water, and ground water quality are protected, and the risks of climate change to human health and the environment are diminished, through a variety of adaptation and mitigation strategies.*

8. Address Climate Change in the Nonpoint Source Program: The National Nonpoint Source (NPS) Program hosted the 2016 National Nonpoint Source Training Workshop in Boston, MA. Approximately 200 representatives from regional, state, and tribal NPS programs were in attendance. The workshop featured a Climate Change Planning and Resiliency session, which provided an overview of the U.S. Department of Agriculture (USDA) Climate Hubs Program and EPA’s National Water Program efforts on climate change. The session also featured a facilitated dialogue to discuss efforts to integrate climate change planning into the NPS program. Program managers from Headquarters and Regions agreed to form a team to explore steps needed to expand attention to climate change challenges within nonpoint source programs.

9. Add Climate Change to Fifth Annual Campus RainWorks

Challenge: In 2016, EPA announced the fifth annual Campus RainWorks Challenge prize competition that asks student



teams to design green infrastructure for their campus. This year, teams will incorporate climate resiliency and consider community engagement in their stormwater management designs. Students will form teams with a faculty advisor to submit in either the master plan or demonstration project categories. Registration for this year’s competition was open in September 2016 and submissions were due in December. Winners will be announced in Spring 2017.

Vision Area 5: Working with Tribes



***Vision:** Tribes are able to preserve, adapt, and maintain the viability of their culture, traditions, natural resources, and economies in the face of a changing climate.*

10. Regional Initiatives to Support Tribes in Responding to Climate Change Challenges for

Water Resources: The National Water Program is working with EPA Regional water programs to support tribes and to help develop effective responses to the challenges that a changing climate poses for tribal water resources. Some highlights from regions are summarized below:

- In Region 1, the five Maine tribes are in the process of **establishing a Tribal Cooperative Landscape Conservation Program to take steps forward in adapting Maine’s Wabanaki culture and economy to the changing climate.** Through this program, the Passamaquoddy Tribe, which is heading the effort, seeks to create an accessible climate science information stream, connect the Wabanaki reservations to each other through this information stream, and provide the tools necessary for each Wabanaki reservation (tribe) to initiate a climate adaptation planning process.
- The Region 5 source water protection team **updated “Protecting Drinking Water: A Workbook for Tribes,” originally published in 2000, to include suggestions for incorporating climate change considerations into source water protection planning.** The workbook now includes examples of climate change effects that have the potential to impact drinking water supplies, as well as a worksheet to evaluate potential climate change effects on the quality and quantity of a tribe’s drinking water source(s). Resources related to climate change and resilience are provided at the end of the workbook.
- Region 6 **initiated discussions with tribal water operators and the Indian Health Service regarding climate change,** including adaptation features at a given utility, drought and extreme heat preparedness, and Climate 101 training opportunities.
- Region 7 participates in **federal agency development of workshops for tribal climate change adaptation training.** The federal partners made presentations to 22 tribal environmental staff in Nebraska City, Nebraska about all of our climate change programs.
- Region 8 worked with Confederated Salish and Kootenai Tribes, the Gros Ventre and Assiniboine Tribes at Fort Belknap, and the Assiniboine and Sioux Tribes at Fort Peck to

incorporate climate change adaptation planning into their FY17 work plans and as well as in the EPA Tribal Environmental Plans (ETEPs). The Region facilitated strategic planning retreats with the Assiniboine and Sioux Tribes (Fort Peck) and the Gros Ventre and Assiniboine Tribes (Fort Belknap) and conducted one-day meetings with each of the Tribes in Montana to assist in the development of these five-year planning documents.

- In 2016, Region 9 supported several tribes who worked to build resilience to climate change impacts, through impact assessment, planning and action. At the 2016 Annual Region 9 Tribal-EPA Conference (October 2016, San Francisco) Region 9 helped **organize and co-hosted several sessions with tribes on water system sustainability and climate change resilience.** At the annual conference, tribes shared their experience with building resilient infrastructure through presentations. For example, Big Valley Tribe spoke about reducing water use, and San Pasqual Tribe presented on water reuse. EPA supported additional annual conference presentations by tribes on their climate change assessment and planning accomplishments and by the Bureau of Indian Affairs (BIA) on water resource sustainability tools and services.
- Region 10 sponsored a two-day **workshop with The Tulalip Tribes titled “Make Sense of Sea Level Rise”.** The workshop was attended by over 100 people from throughout the Puget Sound region. Region 10 also helped sponsor the second Tribal Climate Leaders Summit that brought together tribal leaders from throughout the Pacific Northwest to discuss how climate is impacting their communities and what can be done to make communities more resilient to climate change.

Vision Area 6:

Cross-cutting Program Support

11. Identify and Describe State Water Agency Climate

Adaptation Practices: EPA worked with state water agency organizations to identify and describe climate change practices related to the clean water and safe drinking water programs they administer. This work builds on efforts in 2015 when 10 practices were developed and posted on the internet (see: <http://www.epa.gov/climate-change-water-sector/state-water-agency-practices-climate-adaptation>). In 2016, an addition 8 practices were identified and described in cooperation with state organizations. These select state practices can serve as useful models for other state agencies seeking to make water programs more resilient to climate change. In addition, water resource planners and decision-makers from local and tribal governments and other entities may find these practices to be helpful. The practices are the result of a collaborative effort among EPA and the [Association of Clean Water](#)



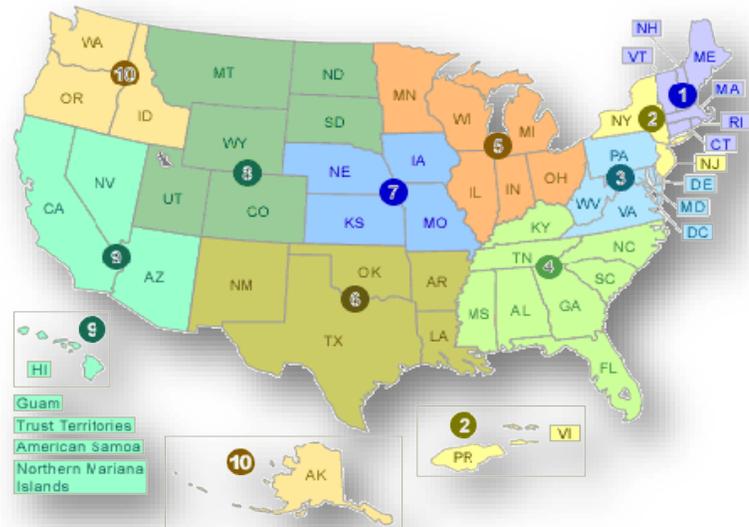
[Administrators](#) (ACWA), [Association of State Drinking Water Administrators](#) (ASDWA), and [Association of State Wetland Managers](#) (ASWM).

12. Review Scientific Literature for Assessment of Climate Impacts on Water Programs:

In 2016, the Office of Research and Development (ORD) produced draft technical literature reviews in nine topic areas addressing issues of particular relevance to EPA's programs and are intended to help water program managers better understand expected climate impacts in key areas. These documents synthesize existing research on seven water quality endpoints including streamflow, water temperature, nutrients (nitrogen and phosphorus), sediment, pathogens and harmful algal blooms, salt water intrusion and sea level, and aquatic communities. Two additional synthesis documents examine frameworks and methods for assessing vulnerability, and sources of scenario information. These documents will be posted to an ORD website along with additional information linking changes in endpoints to EPA's National Water Program. (ORD Product)

PART II HIGHLIGHTS FROM EPA REGIONAL PROGRAMS

A major highlight of work in each of the ten EPA Regional offices (see map of EPA Regions) to implement the *2012 Strategy* is described below. Additional accomplishments by EPA Regions are described in the Compendium in Appendix C.



Region 1

Worked with **all six New England states to incorporate climate change considerations into updated and approved Nonpoint Source Management Program Plans required under section 319 of the Clean Water Act**. Several states plan to update state stormwater and/or erosion control and sedimentation best management practice (BMP) design manuals to include updated design rainfall amounts, and practice standards and specifications that account for extreme wet weather events. In addition, some states plan to incorporate climate change and flood resiliency into watershed plans, as well as to begin or continue working with other state agencies on statewide and regional climate change initiatives. At least one state committed to developing outreach programs to municipal public works departments to strengthen flood resiliency and adaptation strategies (e.g., how to design, construct, and maintain roads and bridges to create more flood resilient transportation infrastructure).

Region 2

Region 2, Puerto Rico, and the Virgin Islands signed a Memorandum of Understanding (MOU) to reduce the risks of climate change in 2016. The MOU formally established a mutually beneficial working relationship with EPA Region 2 with Puerto Rico and the U.S. Virgin Islands to promote climate change resilience. The parties are identifying, developing, promoting, and carrying out cooperative activities to implement climate change mitigation and adaptation strategies to foster resilience and the regional capacity to adapt to climate change in the Caribbean.

Region 3

As part of the Chesapeake 2017 Midpoint Assessment, **modeling tools and procedures were developed to quantify the effects of climate change on watershed flows and pollutant loads, storm intensity, increased estuarine temperatures, and sea level rise in the Chesapeake Bay watershed.** Modeling efforts are underway to assess potential climate change impacts under a range of projected climate change for 2025 and 2050. Informed by the outcomes of this climate change assessment, the Chesapeake Bay Program is expected to decide, by May 2017, when and how to incorporate these climate change considerations into the jurisdictions' Phase III Watershed Implementation Plans (WIPs). Findings to date are that the estimated increase in watershed nutrient loads of nitrogen and phosphorus for the years 2025 and 2050 (compared to the 1991-2000 average hydrology) are about 2 percent and 5 percent, respectively. For the first half of this century the detrimental influence of increased nutrient loads is estimated to be somewhat offset by sea level rise which makes the Bay more open to the ocean and saltier and provides a greater exchange of ocean and Bay waters.

Region 4

Region 4 **updated the Water Efficiency Guidelines, previously used to review proposed water supply projects (e.g. reservoirs) in the region under the Section 404 wetlands regulatory program.** After being positively received by water program managers across the country, the revised document, *Best Practices to Consider When Evaluating Water Conservation and Efficiency as an Alternative for Water Supply Expansion*, was released at the national level. The document provides utilities with a set of best practices, inclusive of the WaterSense program, that can help utilities avoid the need for costly expansion of supply.

Region 5

The Great Lakers Restoration Initiative Action Plan II commits agencies to develop and incorporate climate resiliency criteria in project selection, planning, and implementation. During FY2016, federal agencies and their partners **finalized a standardized set of climate resiliency criteria.** The criteria will help GLRI funded projects be more resilient to the effects of projected climate change including the likelihood of future climate impacts including the increased frequency of more intense storms and shifts in ranges of particular species.

Region 6

The Regional ocean dumping program worked with the Army Corps of Engineers (USACE) to **maximize the amount of dredged material used to offset coastal land loss and to minimize the amount of material unused for restoration purposes by disposing at sea.** In 2016, approximately 8.5 million cubic yards of dredged material removed during maintenance of the Southwest Pass of the Mississippi River were used to construct about 700 acres of wetland

habitat. Overall, 15.5 million cubic yards of Mississippi River sediments were used beneficially to construct over 1,200 acres of coastal habitat to offset land loss along Louisiana's coastline.

Region 7

Region 7 **developed a harmful algal bloom (HAB) action plan**, communication plan, and sampling protocol using the guidance from the EPA document, *Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water* published in June 2015. These plans were developed in order to respond to requests for assistance by tribal and state partners. Warming waters associated with a changing climate can increase the occurrence and distribution of HABs.

Region 8

Region 8 is **co-leading the Montana Drought Demonstration Project (MDDP)** in partnership with the Montana Department of Natural Resources and Conservation (DNRC). The goal of the MDDP is to leverage multiple resources to engage communities in drought preparedness planning and put forward implementation projects that build resiliency in the Missouri Headwaters Basin. In 2016, the partnership accomplished the following:

- offered a course in building drought resilience and a follow-up workshop to guide drought planning for local watershed organizations;
- developed and distributed a newsletter to improve communication among the partners; secured funding from Bureau of Reclamation to assist communities with local drought planning efforts; and
- supported the establishment of a statewide soil moisture monitoring network; and
- expanded the number of streamflow gaging stations and snow telemetry (SNOTEL) sites.

Region 9

Region 9 completed a partnership project with the Pacific Islands Climate Change Cooperative (PICCC) and NOAA on the **Resilient Lands and Waters (RLW) Initiative in Hawai'i for protecting and restoring vital lands and waters in West Maui, West Hawai'i, and He'eia**. The project: 1) Identified key organizations to track climate resilience actions; 2) reviewed climate science for each area; 3) recommended updates to conservation actions that would increase climate resilience for the land and ocean; and 4) gathered strategic plans from other regions facing similar climate risks, to learn from their examples and highlight the feasibility of actions for Hawai'i.

Region 10

The 2016 Request for Proposals to support the Puget Sound Partnership (PSP) Action Agenda **requested that applicants discuss how they propose to incorporate climate change into their programs**. All of the applicants selected provided information of how they would consider

climate resiliency in ecosystem recovery plans and near-term actions. To further assist agencies who received Puget Sound funding, EPA co-sponsored a one-day climate change workshop with the PSP to develop a better understanding of how to incorporate climate change into their projects and sub-awardee projects. In addition, EPA is working with the PSP to develop a Puget Sound Wide Vulnerability Assessment and Adaptation Plan by 2020. Finally, EPA has formed a technical working group of climate change experts from the different agencies to assist in the integration of climate change into Puget Sound projects.

Part III

2016 Assessment of Progress

The National Water Program is working to implement the *2012 Climate Strategy* and is assessing progress annually. There are two key methods of assessing progress:

- **Phases of Development by Goal in 2012 Strategy:** The *2012 Strategy* describes 19 goals and 54 supporting actions (see Table II, below). The Strategy also identified stages or phases of development of efforts to implement each of the goals (see Table I, below). Starting in 2012, the National Water Program made an annual assessment of progress through the seven stages under each of the 19 goals. These annual assessments of progress, including the for 2016, are provided in Table II.
- **National Water Program Guidance Measures:** The National Water Program Guidance (NWPG) for 2016-2017 provides narrative description of water program goals, including goals related to climate change, and measures of progress supporting each program area. The 2016-2017 NWPG provided, for the first time, measures related to climate change. These four measures, described below, are as a further indication of progress in responding to climate change impacts on water programs.

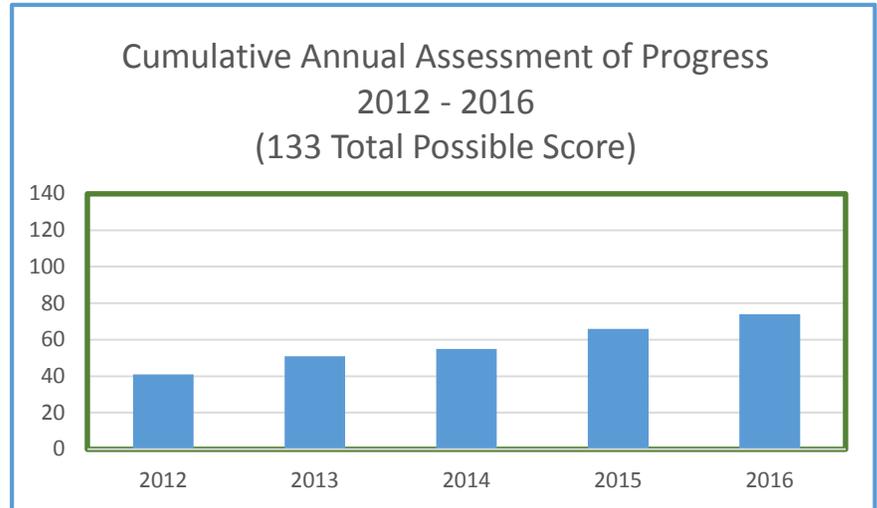
Phases of Progress by 2012 Strategy Goal

The *2012 Strategy* describes seven stages or phases of development of efforts to address the 19 climate change goals. The seven developmental phases for climate change related work are listed below and described in greater detail in Table I.

1. **Initiation;** conduct a screening assessment of potential implications of climate change to mission, programs, and operations;
2. **Assessment;** conduct a broader review to understand how climate change affects the resources in question;
3. **Response Development;** identify changes necessary to continue to reach program mission and goals and develop initial action plan;
4. **Initial Implementation;** initiate actions in selected priority programs or projects
5. **Robust Implementation;** programs are underway and lessons learned are being applied to additional programs and projects;
6. **Mainstreaming;** climate is an embedded, component of the program; and
7. **Monitor Outcomes and Adaptive Management;** continue to monitor and integrate performance, new information, and lessons learned into programs and plans.

Recognizing the long-term nature of work to address climate change, the National Water Program has identified the status of work on each of the Goals in Table II below as of December 2016. The 2012 baseline assessment has a total value of 42 out of a total possible score of 133 (i.e., 19 goals times a score of 7 for each goal equals a score of 133). This score improved each year since 2012 as program and regions made progress in implementing the *2012 Strategy*. The annual scores for overall progress, i.e.; the annual sum of scores for all 19 goals, are:

- 2012: 42
- 2013: 51;
- 2014: 55;
- 2015: 67; and
- 2016: 76



National Water Program 2016-2017 Guidance: Climate Measures

The National Water Program is assessing progress in the *2016-2017 National Water Program Guidance* using four measures of progress for responding to climate change challenges. These measures provide information to form a basis for assessment of progress in key areas of climate change adaptation and greenhouse gas mitigation. The four measures, the 2015 baseline, and the 2016 report of progress, are provided below.

- Number of WaterSense partners working to improve water use efficiency.
2015 Baseline: 1,582 2016 Report: 1,833
- Number of water and wastewater facilities that use the Energy Star Portfolio Manager to manage energy.
2015 Baseline: 2177 2016 Report: TBD
- Number of water or wastewater utilities that have registered to use Climate Resilience Evaluation and Awareness Tool (CREAT) tool.
2015 Baseline: N/A 2016 Report: 431 (since September 2016; CREAT 3.0)
- Number of CWSRFs and DWSRFs that used financial incentives to promote climate resilience projects in the last year. (OW/IO program offices and Regions)
2015 Baseline: N/A 2016 Report: 17 Clean Water; 15 Drinking Water

Table I - Description of Implementation Phases

Program Implementation Phases	Explanation	Examples of Evidence of Achievement
1. Initiation	Conduct a screening assessment of potential implications of climate change to mission, programs, and operations	<ul style="list-style-type: none"> ○ Preliminary information is developed to evaluate relevance of climate change to the mission or program; a decision is made as to whether to prepare a response to climate change; further exploration of climate change implications has been authorized ○ Responsibilities are assigned at appropriate levels within the organization and resources are available to develop more in-depth assessments
2. Assessment	<p>Conduct a broader review to understand how climate change affects the resources in question</p> <p>Work with stakeholders to develop an understanding of the implications of climate change to the mission, programs, and operations</p>	<ul style="list-style-type: none"> ○ Review science literature and assessments to understand how climate change affects the resources being protected (threat to mission); ○ Engage internal staff and external stakeholders in evaluation ○ Identify climate change issues and concerns and communicate with internal and external stakeholders and partners. ○ Identify which specific programs are threatened and what specific information or tools need to be developed ○ Communicate findings to partners and stakeholders and engage them in dialogue on building adaptive capacity
3. Response development	<p>Identify changes necessary to continue to reach program mission and goals</p> <p>Develop initial action plan</p> <p>Identify and seek the research, information and tools needed to support actions</p> <p>Begin to build the body of tools, information and partnerships needed to build capacity internally and externally</p>	<ul style="list-style-type: none"> ○ Develop initial program vision and goals for responding to climate change. ○ Identify needed response actions or changes that will allow the organization to begin to address climate impacts on its mission ○ Initiate strategies and actions in a few key areas to begin to build organizational ability to use climate information in decision processes ○ Identify program partners’ needs for building adaptive capacity ○ Begin working with an external ‘community of practice’ to engage in tool and program development ○ Rudimentary methods are put in place to track progress and options for more formal measures are identified and evaluated ○ Develop a strategy and partnerships to obtain additional needed research

4. Initial Implementation	Initiate actions in selected priority programs or projects	<ul style="list-style-type: none"> ○ Make it clear within the organization that incorporating climate change into programs is critical ○ Initiate actions and plans identified in Step 3 ○ Initiate projects with partners ○ Develop needed information and tools ○ Initial implementation of measures capable of documenting the extent of implementation of needed actions by partners/stakeholders ○ Some program partners have begun to implement response actions
5. Robust Implementation	Programs are underway and lessons learned are being applied to additional programs and projects	<ul style="list-style-type: none"> ○ Lessons learned are evaluated and strategies are refined ○ Efforts are initiated to consider climate change in additional program elements ○ Continue to institute institutional changes to include climate change in core programs, including refinement of measures ○ External communities of practice are in place to support ongoing capacity development
6. Mainstreaming	Climate is an embedded, component of the program	<ul style="list-style-type: none"> ○ The organization's culture and policies are aligned with responding to climate change ○ All staff have a basic understanding of climate change causes and impacts ○ All relevant programs, activities, and decisions processes intrinsically incorporate climate change ○ Measures for documenting progress among partners/stakeholders are well established and support program evaluation
7. Monitor Outcomes and Adaptive Management	Continue to monitor and integrate performance, new information, and lessons learned into programs and plans	<ul style="list-style-type: none"> ○ Progress is evaluated and needed changes are implemented ○ As impacts of climate change unfold, climate change impacts and organizational responses are reassessed

**TABLE II - Climate Goals with 2012 Baseline
and 2013, 2014, 2015, and 2016 Assessment Scores**

<i>Visions and Goals</i>	<i>Strategic Actions (SA)</i>	<i>Assessment</i>
<p>Infrastructure: In the face of a changing climate, resilient and adaptable drinking water, wastewater and stormwater utilities (water sector) ensure clean and safe water to protect the nation’s public health and environment by making smart investment decisions to improve the sustainability of their infrastructure and operations and the communities they serve, while reducing greenhouse gas emissions through greater energy efficiency.</p>		
<p>Goal 1: Build the body of information and tools needed to incorporate climate change into planning and decision making.</p>	<p>SA1: Improve access to vetted climate and hydrological science, modeling, and assessment tools through the Climate Ready Water Utilities program.</p> <p>SA2: Assist wastewater and water utilities to reduce greenhouse gas emissions and increase long-term sustainability with a combination of energy efficiency, co-generation, and increased use of renewable energy resources.</p> <p>SA3: Work with the States and public water systems, particularly small water systems, to identify and plan for climate change challenges to drinking water safety and to assist in meeting health based drinking water standards.</p> <p>SA4: Promote sustainable design approaches to provide for the long-term sustainability of infrastructure and operations.</p>	<p>2012 Baseline: 3 2013 Assessment: 3 2014 Assessment: 4 2015 Assessment: 5 2016 Assessment: 5</p>
<p>Goal 2: Support Integrated Water Resources Management (IWRM) to sustainably manage water resources.</p>	<p>SA5: Understand and promote through technical assistance the use of water supply management strategies.</p> <p>SA6: Evaluate and provide technical assistance on the use of water demand management strategies.</p> <p>SA7: Increase cross-sector knowledge of water supply climate challenges and develop watershed specific information to inform decision making.</p>	<p>2012 Baseline: 2 2013 Assessment: 2 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 5</p>

<i>Visions and Goals</i>	<i>Strategic Actions</i>	<i>Assessment</i>
Watersheds & Wetlands: Watersheds are protected, maintained and restored to ensure climate resilience and to preserve the social and economic benefits they provide; and the nation’s wetlands are maintained and improved using integrated approaches that recognize their inherent value as well as their role in reducing the impacts of climate change.		
<p>Goal 3: Identify, protect, and maintain a network of healthy watersheds and supportive habitat corridor networks.</p>	<p>SA8: Develop a national framework and support efforts to protect remaining healthy watersheds and aquatic ecosystems.</p> <p>SA9: Collaborate with partners on terrestrial ecosystems and hydrology so that effects on water quality and aquatic ecosystems are considered.</p> <p>SA10: Integrate protection of healthy watersheds throughout the National Water Program (NWP) core programs.</p> <p>SA11: Increase public awareness of the role and importance of healthy watersheds in reducing the impacts of climate change.</p>	<p>2012 Baseline: 3 2013 Assessment: 3 2014 Assessment: 4 2015 Assessment: 5 2016 Assessment: 5</p>
<p>Goal 4: Incorporate climate resilience into watershed restoration and floodplain management.</p>	<p>SA12: Consider a means of accounting for climate change in EPA funded and other watershed restoration projects.</p> <p>SA13: Work with federal, state, interstate, tribal, and local partners to protect and restore the natural resources and functions of riverine and coastal floodplains as a means of building resiliency and protecting water quality.</p>	<p>2012 Baseline: 3 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 4</p>
<p>Goal 5: Watershed protection practices incorporate Source Water Protection to protect drinking water supplies.</p>	<p>SA14: Encourage States to update their source water delineations, assessments or protection plans to address anticipated climate change impacts.</p> <p>SA15: Continue to support collaborative efforts to increase state and local awareness of source water protection needs and opportunities, and encourage inclusion of source water protection areas in local climate change adaptation initiatives.</p>	<p>2012 Baseline: 2 2013 Assessment: 2 2014 Assessment: 2 2015 Assessment: 3 2016 Assessment: 3</p>

<p>Goal 6: Incorporate climate change considerations into the Clean Water Act (CWA) 404 regulatory program as they relate to permit reviews and compensatory mitigation.</p>	<p>SA16: Consider the effects of climate change, as appropriate, when making significant degradation determinations in the CWA Section 404 wetlands permitting and enforcement program.</p>	<p>2012 Baseline: 1 2013 Assessment: 1 2014 Assessment: 1 2015 Assessment: 1 2016 Assessment: 2</p>
	<p>SA17: Evaluate, in conjunction with the U.S. Army Corps of Engineers, how wetland and stream compensation projects could be selected, designed, and sited to aid in reducing the effects of climate change.</p>	
<p>Goal 7: Improve baseline information on wetland extent, condition and performance to inform effective adaptation to climate change.</p>	<p>SA18: Expand wetland mapping by supporting wetland mapping coalitions and training on use of the new federal Wetland Mapping Standard.</p>	<p>2012 Baseline: 1 2013 Assessment: 2 2014 Assessment: 2 2015 Assessment: 3 2016 Assessment: 4</p>
	<p>SA19: Produce a statistically valid, ecological condition assessment of the nation’s wetlands.</p>	
	<p>SA20: Work with partners and stakeholders to develop information and tools to support long term planning and priority setting for wetland restoration projects.</p>	
<p><i>Visions and Goals</i></p>	<p><i>Strategic Actions</i></p>	<p><i>Assessment</i></p>
<p>Coastal and Ocean Waters: Adverse effects of climate change and unintended adverse consequences of responses to climate change have been successfully prevented or reduced in the ocean and coastal environment. Federal, tribal, state, and local agencies, organizations, and institutions are working cooperatively; and information necessary to integrate climate change considerations into ocean and coastal management is produced, readily available, and used.</p>		
<p>Goal 8: Collaborate to ensure information and methodologies for ocean and coastal areas are collected, produced, analyzed, and easily available.</p>	<p>SA21: Collaborate to ensure that synergy occurs, lessons learned are transferred, federal efforts effectively help local communities, and efforts are not duplicative or at cross-purposes.</p>	<p>2012 Baseline: 3 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 4</p>
	<p>SA22: Work within EPA and with the U.S. Global Change Research Program and other federal, tribal, and state agencies to collect, produce, analyze, and format knowledge and information needed to protect ocean and coastal areas and make it easily available.</p>	

<p>Goal 9: EPA geographically targeted programs support and build networks of local, tribal, state, regional and federal collaborators to take effective adaptation measures for coastal and ocean environments.</p>	<p>SA23: Work with the NWP’s larger geographic programs to incorporate climate change considerations, focusing on both the natural and built environments.</p>	<p>2012 Baseline: 2 2013 Assessment: 2 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 5</p>
	<p>SA24: Address climate change adaptation and build stakeholder capacity when implementing NEP Comprehensive Conservation and Management Plans and through the Climate Ready Estuaries Program.</p>	
	<p>SA25: Conduct outreach and education, and provide technical assistance to state and local watershed organizations and communities to build adaptive capacity in coastal areas outside the NEP and Large Aquatic Ecosystem programs.</p>	
<p>Goal 10: Address climate driven environmental changes in coastal areas and ensure that mitigation and adaptation are conducted in an environmentally responsible manner.</p>	<p>SA26: Support coastal wastewater, stormwater, and drinking water infrastructure owners and operators in reducing climate risks and encourage adaptation in coastal areas.</p>	<p>2012 Baseline: 2 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 3 2016 Assessment: 3</p>
	<p>SA27: Support climate readiness of coastal communities, including hazard mitigation, pre-disaster planning, preparedness, and recovery efforts.</p>	
	<p>SA28: Support preparation and response planning for diverse impacts to coastal aquatic environments.</p>	
<p>Goal 11: Ocean environments are protected by EPA programs that incorporate shifting environmental conditions, and other emerging threats.</p>	<p>SA29: Consider climate change impacts on marine water quality in NWP ocean management authorities, policies, and programs.</p>	<p>2012 Baseline: 2 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 3 2016 Assessment: 4</p>
	<p>SA30: Use available authorities and work with the regional Ocean Organizations and other federal and state agencies through regional ocean groups and other networks so that offshore renewable energy production does not adversely affect the marine environment.</p>	
	<p>SA31: Support the evaluation of sub-seabed sequestration of CO₂ and any proposals for ocean fertilization.</p>	

	SA32: Participate in interagency development and implementation of federal strategies through the National Ocean Council (NOC) and the NOC Strategic Action Plans.	
Visions and Goals	Strategic Actions	Assessment
Water Quality: Our Nation’s surface water, drinking water, and ground water quality are protected, and the risks of climate change to human health and the environment are diminished, through a variety of adaptation and mitigation strategies.		
<p>Goal 12: Protect waters of the United States and promote management of sustainable surface water resources.</p>	SA33: Encourage States and communities to incorporate climate change considerations into their water quality planning.	<p>2012 Baseline: 2 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 3 2016 Assessment: 4</p>
	SA34: Encourage green infrastructure and low-impact development to protect water quality and make watersheds more resilient.	
	SA35: Promote consideration of climate change impacts by National Pollutant Discharge Elimination System permitting authorities.	
	SA36: Encourage water quality authorities to consider climate change impacts when developing wasteload and load allocations in TMDLs where appropriate.	
	SA37: Identify and protect designated uses that are at risk from climate change impacts.	
<p>Goal 13: As the nation makes decisions to reduce its greenhouse gas emissions and develop alternative sources of energy and fuel, the NWP will work to protect water resources from unintended adverse consequences.</p>	SA38: Clarify how to re-evaluate aquatic life water quality criteria on more regular intervals; and develop information to assist States and Tribes who are developing criteria that incorporate climate change considerations for hydrologic condition.	<p>2012 Baseline: 1 2013 Assessment: 2 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 4</p>
	SA39: Continue to provide perspective on the water resource implications of new energy technologies.	
	SA40: Provide assistance to States and permittees to assure that geologic sequestration of CO2 is responsibly managed.	
	SA41: Continue to work with States to help them identify polluted waters, including those affected by biofuels production, and help develop & implement TMDLs for those waters	

	SA42: Provide informational materials for stakeholders to encourage the consideration of alternative sources of energy and fuels that are water efficient and maintain water quality.	
	SA43: As climate change affects the operation or placement of reservoirs, EPA will work with other federal agencies and EPA programs to understand the combined effects of climate change and hydropower on flows, water temperature, and water quality.	
Goal 14: Collaborate to make hydrological and climate data and projections available.	SA44: Monitor climate change impacts to surface waters and ground water.	2012 Baseline: 3 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 5
	SA45: Collaborate with other federal agencies to develop new methods for use of updated precipitation, storm frequency, and observational streamflow data, as well as methods for evaluating projected changes in low flow conditions.	
	SA46: Enhance the flow estimation using National Hydrography Dataset Plus (NHDPlus).	
<i>Visions and Goals</i>	<i>Strategic Actions</i>	<i>Assessment</i>
<u>Working With Tribes:</u> Tribes are able to preserve, adapt, and maintain the viability of their culture, traditions, natural resources, and economies in the face of a changing climate.		
Goal 15: Incorporate climate change considerations in the implementation of core programs, and collaborate with other EPA Offices and federal agencies to work with Tribes on climate change issues on a multi-media basis.	SA47: Through formal consultation and other mechanisms, incorporate climate change as a key consideration in the revised NWP Tribal Strategy and subsequent implementation of CWA, Safe Drinking Water Act (SDWA), and other core programs.	2012 Baseline: 3 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 3 2016 Assessment: 3
	SA48: Incorporate adaptation into tribal funding mechanisms, and collaborate with other EPA and federal funding programs to support sustainability and adaptation in tribal communities.	

Goal 16: Tribes have access to information on climate change for decision making.	SA49: Collaborate to explore and develop climate change science, information, and tools for Tribes, and incorporate local knowledge.	2012 Baseline: 2 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 3 2016 Assessment: 3
	SA50: Collaborate to develop communication materials relevant for tribal uses and tribal audiences.	
<i>Visions and Goals</i>	<i>Strategic Actions</i>	<i>Assessment</i>
<u>Cross-Cutting Program Support</u>		
Goal 17: Communication, Collaboration, and Training	SA51: Continue building the communication, collaboration, and training mechanisms needed to effectively increase adaptive capacity at the federal, tribal, state, and local levels.	2012 Baseline: 3 2013 Assessment: 4 2014 Assessment: 4 2015 Assessment: 5 2016 Assessment: 5
Goal 18: Tracking Progress and Measuring Outcomes	SA52: Adopt a phased approach to track programmatic progress towards Strategic Actions; achieve commitments reflected in the Agency Strategic Plan; work with the EPA Work Group to develop outcome measures.	2012 Baseline: 3 2013 Assessment: 4 2014 Assessment: 4 2015 Assessment: 4 2016 Assessment: 5
Goal 19: Climate Change and Water Research Needs	SA53: Work with ORD, other water science agencies, and the water research community to further define needs and develop research opportunities to deliver the information needed to support implementation of this 2012 Strategy, including to provide the decision support tools needed by water resource managers.	2012 Baseline: 2 2013 Assessment: 3 2014 Assessment: 3 2015 Assessment: 4 2016 Assessment: 5

TOTAL Implementation Phase Assessment Score: 2012 = 42
TOTAL Implementation Phase Assessment Score: 2013 = 51
TOTAL Implementation Phase Assessment Score: 2014 = 55
TOTAL Implementation Phase Assessment Score: 2015 = 67
TOTAL Implementation Phase Assessment Score: 2016 = 76
TOTAL Possible Annually = 133

Appendices

In addition to the accomplishments highlighted for each of the vision areas and EPA regions, other important projects are in development and a number of supporting activities are being implemented. A complete summary of activities related to climate change and water programs is provided below for:

- National Water Program Offices;
- EPA Office of Research and Development; and
- EPA Regional Water Programs.

NOTE that accomplishments described in the highlights portion of this report are not repeated in this Appendix.

Appendix A

National Water Program 2016 Climate Change Accomplishments

Office of Wetlands, Oceans, and Watersheds

- EPA launched the **Healthy Watersheds Consortium Grant Program in FY2016 to accelerate and expand the strategic protection of healthy freshwater ecosystems and their watersheds across the country and improve resilience to climate change.** In addition, an updated Healthy Watersheds website includes a discussion of healthy watershed vulnerability to climate change on the “Vulnerability Index” area of the website. The Program leverages a moderate federal investment with other partners and resources to grow state healthy watersheds programs and to sponsor local projects to protect and maintain intact watersheds. Nine projects were funded in partnership with the Endowment for Forestry and Communities, Inc. A total of \$1.4 million was committed. These awards are expected to leverage tens of millions in projected additional funding, to ultimately result in more than 200,000 acres of watersheds permanently protected.
- Office of Wetlands, Oceans, and Watersheds (OWOW) and ORD provided co-sponsorship, along with other federal agencies, for a 2017 National Academy of Sciences **workshop examining blue carbon within a suite of carbon dioxide removal and sequestration approaches.** The panel will produce a report that will identify the most urgent unanswered scientific and technical questions needed to assess benefits, risks, sustainable scale potential, and commercial viability of carbon dioxide removal and sequestration methods, and scope out a research and development program.
- The Climate Ready Estuaries (CRE) program works with the National Estuary Programs and the coastal management community to assess climate change vulnerabilities, develop and implement adaptation strategies, and engage and educate stakeholders. **Recently added resources to the CRE website address how much the sea has risen, how much it might rise, and what the impacts might be.** Resources for overall climate change adaptation planning, including resources for adaptation options, planning frameworks and more, can be found on the Coastal Adaptation Toolkit page on the website.
- **EPA and NOAA Develop New Tool for Sea Surface Temperatures:** EPA initiated a collaboration with NASA and NOAA to use archived and future satellite observations to produce sea surface temperature climatologies for U.S. estuaries. The tool will provide users interested in understanding climate change impacts on coastal waters with easy access to NOAA remote sensing satellite data on changes to water temperatures in estuarine and coastal areas.
- EPA continued the Hydrology Futures partnership with USGS **to develop estimates of the range of plausible future hydrologic conditions for the rivers and streams** of the lower 48 States under climate change influences.

- EPA created a **new website focused on ocean acidification topics** including basic information on ocean acidification, effects on ecosystems and marine life, ideas for “what you can do” and a summary of steps EPA is taking in this area. See the website at: <https://www.epa.gov/ocean-acidification>.
- EPA released a **Frequently Asked Questions document that provides information on EPA programs that apply to the removal of obsolete dams**. EPA developed this document to assist non-government organizations, state and local officials, and private landowners in making decisions regarding the removal of obsolete dams. Removal of dams can help restore connectivity among water segments within a watershed and support movement by aquatic species in response to climate change. The document describes the impacts of obsolete dams on water quality and public safety, the permitting requirements for removal of these dams, and potential sources of funding that may be available to support removal of obsolete dams.

Office of Ground Water and Drinking Water

- EPA released a **Drought Response and Recovery Guide for Water Utilities**. The guide is an innovative interactive tool designed to assist small- to medium-sized water utilities with responding to drought. It features best practices and customizable worksheets and focuses on short-term/emergency drought mitigation actions that also build long-term resilience to drought. Accompanying the guide is an interactive drought case studies map and a multimedia GeoPlatform website documenting, in both video and written form, the stories of seven utilities which have responded to extreme drought conditions.
- EPA released a **Hazard Mitigation Guide which helps identify cost-effective projects that will increase a utility's resilience to natural disasters**. Water and wastewater utilities are vulnerable to a variety of hazards including earthquakes, flooding, drought, tornadoes, and wildfires. A changing climate is expected to make some of those hazards more challenging.
- EPA worked with permit applicants and permittees on geologic sequestration of carbon dioxide (**CO₂**) **permits, evaluating applications and issuing Class VI permits for geologic sequestration projects**. For example:
- EPA issued a **major permit modification for the Class VI permit issued to the Archer Daniels Midland Company**, in support of a decision to authorize injection and continued to work with an additional Class VI permit applicant (Berexco/KGS; Kansas). EPA also engaged other prospective applicants by providing guidance and support to facilitate efficient and effective permitting that ensures protection of Underground Sources of Drinking Water.

Office of Science and Technology

- EPA and USGS **published a final report that provides information on aquatic life use protection in flowing waters for interested water quality managers and other stakeholders.** The report discusses the natural hydrologic flow regime and potential effects of flow alteration on aquatic life, Clean Water Act programs that can be used to support the natural flow regime and maintain healthy aquatic biota, and the potential effects of climate change on hydrologic flow. The report provides a flexible, non-prescriptive framework that could be considered by water quality managers and other stakeholders to establish targets for flow that are protective of aquatic life.
- EPA updated its **Water Quality Standards (WQS) Academy module** that discusses WQS and climate impacts for use at the December 2016 WQS Academy. The purpose of the module is to help communicate the National Water Programs latest activities to address climate change, as well as educate public and private sector participants of the importance of considering climate change impacts on water quality management.
- An EPA Headquarters/Regional team **conducted a survey to identify Regional priorities and key concerns regarding the impacts of climate change on water quality criteria and standards.** The team also held discussions with HQ and Regional staff and managers on considerations for water quality standards tools that may build resilience to climate impacts in surface waters.
- EPA co-chairs with NOAA, the **Interagency Working Group on HABHRCA (IWG-HABHRCA)** as required in the Harmful Algal Bloom and Hypoxia Research and Control Amendments Act of 2014 (HABHRCA 2014, P.L. 113-124). The IWG coordinates and convene federal agencies to discuss HAB and hypoxia issues, including climate change, and to develop action plans, reports, and assessments of HABs and hypoxia events in the United States.
- EPA released a **fact sheet on the potential impacts of climate change on the occurrence of harmful algal blooms (HABs) in freshwater and marine ecosystems.** The purpose of the fact sheet is to discuss the various environmental conditions that could affect the natural properties of fresh and marine waters and could favor the growth of HABs. The fact sheet is at: <http://water.epa.gov/scitech/climatechange/>

Office of Wastewater Management

- EPA **highlighted green streets as a technique for managing stormwater and providing other economic and community benefits, including building resilience to climate change, through a video *Green Streets: The Road to Clean Water*.** The video shows examples of green streets in localities that have worked with EPA and other partners to incorporate green streets as part of their stormwater management plans. Green features shown include porous pavement, rain gardens, vegetative curb areas, and sidewalk trees.

- EPA released *Green Infrastructure and Climate Change: Collaborating to Improve Community Resilience*. In 2015, EPA **convened charrettes, or intensive planning sessions, in four cities to demonstrate how this type of planning could be applied to communities dealing with a range of challenges, including a changing climate**. Each city's charrette focused on different issues based on the most pressing climate change impacts they were facing and their current level of green infrastructure implementation. This new publication summarizes those issues and the recommendations developed by each charrette.
- EPA launched a **guide, toolkit, and technical assistance to promote comprehensive, community-wide planning approaches to manage stormwater**. With long-term stormwater plans, communities can make strategic investments in their stormwater systems that yield strong environmental results and helps improve resources to more variable storm events that result from a changing climate. Along with EPA's continued commitment to support communities' water infrastructure investments, EPA will provide coordinated technical assistance to five communities to develop community-based integrated plans that will serve as national models. EPA will leverage the lessons learned from these efforts to help lower barriers to long-term stormwater planning, improve water quality, improve resilience to climate change, and decrease the costs of stormwater management.
- **EPA finalized a paper on Clean Water State Revolving Fund (CWSRF) eligibilities**, which includes information on eligible climate and extreme weather resilience projects.
- **EPA announced the CWSRF Performance and Innovation in the SRF Creating Environmental Success (PISCES) recognition program** which will recognize outstanding CWSRF projects, including climate change resiliency projects.

Office of Water Immediate Office

- The Climate Change Team in the immediate office of the Assistant Administrator for Water **managed the continuing operation of the National Water Program Climate Change Workgroup**, including monthly meetings of the Workgroup and added monthly Region-led subject-oriented conference calls.
- The Climate Change Team **represented the National Water Program within EPA and among other federal agencies** working to adapt to a changing climate including the:
 - EPA Cross-Agency Climate Change Adaptation Workgroup;
 - Climate Change Workgroup of the Advisory Committee on Water Information (ACWI);
 - Water Resources Workgroup of the Interagency Council on Climate Change Resilience and Preparedness;
 - Interagency Joint Implementation Working Group implementing the final "*Fish Wildlife and Plants Climate Adaptation Strategy*"; and the

- Advisory Committee on Climate Change and Natural Resources Science, supporting the Department of Interior Climate Science Centers.
- As co-chair of the interagency Climate Change and Water Workgroup, **EPA managed the development and publication, in December 2016, of *Looking Forward: Priorities for Managing Freshwater Resources in a Changing Climate***. This report, which updates the 2011 *National Action Plan* for climate change and freshwater, provides recommendations for key next steps for federal agency climate adaptation efforts related to freshwater.
- The Climate Team worked with water program offices to **monitor and report on measures related to climate change included in the 2016-2017 National Water Program Guidance**. Annual progress under the four climate change measures is included in Office of Water performance reports as well as this climate change report (see Part III).
- The Climate Team **developed annual reports of progress** in implementing the *2012 Climate Change Strategy* for the Office of Water (i.e.; the *2015 Highlights Report*) and the **annual workplan for climate related activities**.
- The Climate Team **maintained communications on climate change and water topics** with EPA staff, states, tribes, local governments and others through a bi-monthly newsletter and the EPA Office of Water climate website: <https://www.epa.gov/climate-change-water-sector>.
- The Climate Team worked with the Office of Wetlands, Oceans and Watersheds to **promote the Climate Change and Water Training Module for the EPA Watershed Academy**. The training was published in 2015 and is intended to increase water resource professionals' understanding of the causes of climate change and its potential impacts on water resources. The module describes how federal, state, tribal, and local governments and communities are working to make the United States more resilient to the impacts of climate. The 45-minute training was posted online in early 2016 as a part of the EPA Watershed Academy Web certificate program at: www.epa.gov/watershedacademy.
- The Office of Water, in cooperation with the Office of Air and Radiation (OAR), **developed a series of upgrades to the wastewater and water elements of the Portfolio Manager** energy management system. These upgrades are designed to make the system more user friendly and encourage wider use of the system by water utilities.

Appendix B

Office of Research and Development (ORD)

2016 Climate Change and Water Accomplishments

Infrastructure and Water Resources Management

- ORD published the **National Water Infrastructure Adaptation Assessment Part I: Climate Change Adaptation Readiness Analysis**. The report “National Water Infrastructure Adaptation Assessment” is comprised of four parts (Part I to IV), each in an independent volume. The Part I report describes a preliminary regulatory and technical analysis of water infrastructure and regulations in the United States under the climate and socioeconomic changes. Specifically, a nation-wide assessment was conducted to analyze priority issues facing water and wastewater utilities.
- ORD released version 2 of the **Watershed Management Optimization Tool (WMOST v2)**, which evaluates the **relative cost effectiveness of management practices at the local or watershed scale**. Although the tool does not estimate water quality, it evaluates projects related to stormwater (including green infrastructure), water supply, wastewater, and land use practices such as low-impact development and land conservation. WMOST v2 was developed for use by local water resource managers, including municipal water works superintendents and their consultants.

Watersheds and Wetlands

- Based on the final ORD report on **regional monitoring networks (RMNs) to detect changing baselines in freshwater wadeable streams**, RMNs have been established in the Northeast, Mid-Atlantic, and Southeast. ORD researchers are working with regional offices, states, tribes, and other entities to establish Regional Monitoring Networks (RMNs) at which biological, thermal, and hydrologic data are collected to quantify and monitor climate change effects. Efforts are underway to expand into other regions.
- ORD and the National Oceanic and Atmospheric Administration released a final report summarizing **the findings of a series of stormwater and climate change workshops held in the Great Lakes and Chesapeake Bay**. The report focuses on lessons learned about the impacts of climate and land-use change on water quality and precipitation-driven flooding, and the implications for stormwater management. The report explores stormwater adaptations, particularly green infrastructure or other low-impact development strategies; and identifies information gaps and other barriers preventing local-level consideration and implementation of these strategies along with some example solutions.
- ORD partnered with the USFS and several university researchers to publish a report on **seasonal movements of juvenile salmon in a major Pacific coastal river**. Variation among tributaries in the spatial pattern of fall movement of juvenile Coho Salmon shows that the functional connectivity of seasonal habitats is complex. Efforts to evaluate the connectivity

of overwinter habitat in life-cycle models or plan habitat restoration or conservation are best served by taking into account both the network position and the physical characteristics of a stream over a multi-kilometer scale.

- In cooperation with a large number of universities and agencies, ORD published a review on **managing climate change refugia for climate adaptation**. Refugia, are areas relatively buffered from contemporary climate change over time that enable persistence of valued physical, ecological, and socio-cultural resources. The researchers characterize physical and ecological processes that create and maintain climate change refugia and delineate how refugia can fit into existing decision support frameworks for climate adaptation and describe seven steps for managing them. Managing climate change refugia can be an important option for conservation in the face of ongoing climate change.
- A team of researchers at ORD and the University of Cincinnati published a report on the **hydrologic impacts of climate change and urbanization in the Las Vegas Wash Watershed, Nevada**. A cell-based model for the Las Vegas Wash Watershed in Clark County, Nevada, USA, was developed and used to predict the 2030 and 2050 hydrologic conditions under future scenarios of climate and land-use changes. Results indicate that the future surface runoff in the watershed will significantly decrease in winters but increase in summers. Climate change will be the primary controlling factor over runoff. Urban development is projected to increase runoff and may contribute 1.1–18.7% of the changes. This finding will be useful in devising future urban development plans and water management policies.
- ORD worked with Region 10, the Nooksack Indian Tribe, Lummi Nation, and Washington Department of Ecology to complete a project to use a **temperature load allocation** for the South Fork Nooksack River as a pilot **for integrating climate change into a watershed-specific plan for improving water quality**. Based on this work, ORD published a synthesis of information to promote capacity building in EPA Regions to incorporate climate change mitigation and adaptation into their operating programs.

Coastal and Ocean Waters

- ORD has developed an **Adaptation Planning Framework for ecosystem management**. Working with stakeholders in Regions 9 and 2, ORD tailored and demonstrated methods at coral reef case study locations. A journal article was published describing this application. ORD is currently building an Adaptation Design Tool for crafting climate-smart actions and is developing an online learning module for The Nature Conservancy's Reef Resilience Toolkit, for use by managers worldwide.
- ORD worked with Regions 1 and 10 to investigate the **role of nutrients from fertilizer and wastewater sources in accelerating the resultant changes in carbonate chemistry parameters** in a nearshore environment. Work in Region 1 investigated impacts of coastal acidification on the ecological health of shellfish in Southern New England, and work in Region 10 examined acidification in Puget Sound.

Water Quality

- Researchers from ORD, NOAA, and Cedars Sinai Medical Center examined the environmental influences on the **seasonal distribution of *Vibrio parahaemolyticus*** in the Pacific Northwest. They investigated the potential links between seasonal temperatures and other environmental factors on the prevalence and virulence of vibrio associated with conditions that can trigger harmful algal blooms, including temperature. While vibrio is expected to increase in occurrence as climate change increases temperatures, the research suggests factors other than temperature increase alone play a role in vibrio occurrence.
- ORD published a report on the development of a **hydrologic landscape (HL) characterization** for the Pacific Northwest as a component of research to assess the vulnerability of regional hydrologic landscapes and streamflow to climate change. The revised approach developed in the current study has several advantages compared with previous versions: it is not limited to areas that have an aquifer permeability map; it uses a flexible approach to converting a nationally available geospatial dataset into assessment units; and it is more robust. These improvements should allow the revised HL approach to be applied more often in situations requiring hydrologic classification and allow greater confidence in results, which can be used in evaluating regional hydrologic vulnerability due to climate change.
- ORD scientists developed a set of data estimating **edge-of-field nitrogen and phosphorus levels for the US at the 12-digit HUC scale**, for historical and possible future climate and crop production scenarios. The estimates were produced using a loosely-coupled suite of cropping, weather, air quality, and nutrient behavior models to gain an understanding of the dynamic interactions between crop production, changes in climate, and nutrient emissions, deposition, and transport, now and into the future.

Appendix C

2016 Climate Change Accomplishments: EPA Regional Water Programs

Climate change accomplishments in 2016 related to water programs by EPA Regional Offices are described below. Accomplishments already noted in the Regional Highlights section of this report, or described in Vision Area 5: Working with Tribes, are not repeated here.

Region 1

- Region 1 worked with the New England Interstate Water Pollution Control Commission to **publish “Preparing for Extreme Weather at Wastewater Utilities: Strategies and Tips” a climate preparedness guidance** for water and wastewater facilities with a focus on preparing for extreme weather events.
- Region 1 **completed two Water Resilience Pilots** in Hinsdale NH and Lawrence, MA, as part of the region’s Making a Visible Difference (MVD) community work. These pilots are based on tools developed through the national pilot with the Berwick, Maine water system. This work included progress on a Flood Vulnerability and Resilience Plan for Hinsdale, NH water system and Flood Risk Management project with Army Corps in Hinsdale, NH.
- Region 1 **supported the use of the CREAT tool** to conduct vulnerability assessments for wastewater and drinking water utilities in Hingham/Hull, MA and Keene, NH.
- Region 1 completed a **joint emergency response/water sector workshop/tabletop exercise** with focus on flooding and water-emergency sector interconnections in Lincoln, RI.
- Region 1 completed a **Tri-State Community-based Water Resiliency workshop** with water sector and emergency managers in Hadley, MA (for MA, NH, and VT).
- The Region worked with the Southeast Vermont Watershed Alliance to **begin a citizen science volunteer monitoring program of stream temperature** in Whetstone Brook; monitoring began in summer 2016.
- Region 1 continued to **facilitate planning meetings with the Passamaquoddy Tribe – Pleasant Point on climate change mitigation planning**. Through these efforts, the tribe awarded a contract to evaluate the POTW for vulnerability to flooding and the U.S. Army Corps of Engineers initiated planning and design of the revetment to combat erosion and the impacts of climate change. The tribe secured an additional \$600,000 in EPA and Indian Health Service funding.

- The Region continued the cross-office climate mapping workgroup's efforts **to create intranet resources for Region 1 staff on climate adaptation and resilience mapping**. The group also kept working on five mapping questions and analysis to focus on possible EPA actions and results, including analyzing climate change impacts to regulated facilities to support R1's Climate Adaptation Plan (RCAP) for resilience prioritization.
- Region 1 and ORD **completed and conducted a one-day training on WMOST (Watershed Management Optimization Support Tool) version 2 on June 8, 2016**, which includes a flooding module and allows greater consideration of climate change effects.
- Region 1 continued meetings of EPA and National Marine Fisheries Service interagency workgroup, with U.S. Army Corps of Engineers attending, to **explore integration of climate preparedness and resiliency into the CWA Section 404 permitting process**. EPA made comments to the Corps recommending inclusion of climate preparedness and resiliency language in the revised Connecticut General Permit.
- Under Wetland Program Development Grants, there are several projects related to climate change undertaken in Region 1 in FY16, including:
 - The Massachusetts Department of Environmental Protection is creating coastal hazard maps and **developing policies for coastal wetland resilience**;
 - The Massachusetts Office of Coastal Zone Management is developing a program to monitor and **assess long-term impacts of climate change on tidal marshes** through the application of image analysis and remote sensing techniques;
 - The University of Massachusetts, Amherst is making CAPS assessments and tools available to all the New England states to allow users to **create scenarios for restoring aquatic connectivity (culvert replacement, dam removal)**;
 - The New Hampshire Department of Environmental Services is assisting municipalities in **identifying and prioritizing areas that are vulnerable to climate change** and areas to improve river crossings for habitat, public safety, and overall ecosystem function; and
 - The Rhode Island Department of Environmental Management, in collaboration with the Rhode Island Coastal Resources Management Council, is carrying out a multi-year project **to strengthen the wetland monitoring and assessment components of state programs to support adaptation of wetland protection and restoration programs to changing climate conditions**, with an emphasis on coastal wetlands.
- As federal co-chair for the Northeast Regional Ocean Council (NROC) in 2016, and co-chair of NROC's Ocean and Coastal Ecosystem Health Committee, Region 1 continued to **participate in a wide range of interagency efforts to collect and disseminate data** on ocean uses and natural resources that will support climate change vulnerability assessments and adaptation planning (see www.northeastoceandata.org).

- Region 1 continued to co-chair a steering committee that led a joint effort by NROC and the Northeastern Regional Association of Coastal and Ocean Observing Systems to finalize and release the **Integrated Sentinel Monitoring Network for Change in Northeastern Marine and Estuarine Ecosystems** Science and Implementation Plan. The steering committee and partners have begun to strategize on funding sources for implementation.
- Region 1 worked with ORD and the Buzzards Bay National Estuary Program to **complete RARE (Regional Applied Research Effort) and RESES (Regional Sustainable Environmental Science) climate change projects for the Mattapoissett Water System** and other watershed communities in Massachusetts. These projects consisted of a vulnerability assessment of the drinking water system, as well as development of vulnerability communication tools, such as a Story Map depicting historical and projected hurricane impacts.
- Region 1 continued to provide support to the **six New England National Estuary Programs (NEPs) to assess the vulnerability of their study areas to the impacts of climate change** and to promote actions that prioritize adaptation and resilience in their Comprehensive Conservation Management Plans (CCMPs).
- The **Casco Bay Estuary Partnership completed a Climate Change Risk Assessment Report**, which identifies climate risks of primary concern for the implementation of the Casco Bay Plan (CCMP) in the short (10-20 years) and medium (30-40 years) term.
- Region 1 continued to participate on the **Northeast Coastal Acidification Network (NECAN) Steering Committee to help coordinate research and management of coastal acidification issues**, including a final stakeholder workshop conducted and held in partnership with Casco Bay Estuary Partnership focusing on controlling nutrients.
- The **Casco Bay ocean acidification sensors are in the second year of operation**, and a first year data report has been completed. **Additional ocean acidification sensors are being established in Massachusetts Bay and Long Island Sound**, with funding provided by the Office of Water through the National Estuary Program.
- A draft **Practical Monitoring Guidance for measuring changes in seawater pH** has been completed by Region 1, and will be reviewed by EPA technical reviewers as well as NECAN.
- Two **Regional Applied Research Efforts (RARE) projects** occurred in FY16, one investigating impacts of coastal acidification on the ecological health of shellfish in Southern New England and the other focused on **eelgrass and Blue Carbon to determine if eutrophication negatively effects ecosystem function** and carbon accretion in eel grass meadows.
- The Region continued to serve on the steering committee of the U.S. Geological Survey Northeast Climate Science Center and the Department of Interior's North Atlantic Landscape Conservation Cooperative (NALCC) to **identify key research needs for effects of climate induced changes on thermal regimes**.

- As part of the settlement of a lawsuit over EPA's approval of TMDLs for nitrogen-impaired embayment's on Cape Cod, **EPA completed a feasibility study for how to address climate change for those and future nitrogen TMDLs on the Cape.** EPA has also approved eight new sets of Cape Cod embayment TMDLs for nitrogen since the settlement.
- EPA **approved a revised TMDL for phosphorous loading to Lake Champlain that takes into consideration climate change impacts through the TMDL's Implementation Plan.** The TMDL Implementation Plan includes appropriate selection and sizing of infrastructure and other practices to account for climate change impacts.
- The Region awarded a Healthy Communities grant for the Merrimack watershed (in Nashua, NH) to **conduct a regional vulnerability assessment and draft climate change action strategy;** work should be completed in early FY17.
- The Region held a state-federal workshop to further the protection of buffers to streams, wetlands, lakes and ponds. **Climate change considerations was a significant driver in our discussions and the format of the agenda.**
- Region 1 continued to update and promote the publicly available version of the Region's **new Resilience and Adaptation in New England (RAINE) data base,** (<http://www.epa.gov/raine>) an on-line tool showcasing communities that have conducted vulnerability assessments and climate adaptation planning.

Region 2

- Region 2 **hosted two one-day CREAT Workshops in Belmar, NJ** in August, 2016 with over 50 participants attending. It was the EPA's first workshop for CREAT 3.0 and served as a preliminary run for future trainings nationwide.
- The Water Infrastructure and Resiliency Finance Center (WIRFC) announced in January, 2016 that **South Orange Village, NJ** will participate in the Center's **newly created Community Assistance for Resiliency and Excellence (WaterCARE) pilot program .**
- The **Syracuse University Environmental Finance Center** annually receives a grant from EPA that helps fund its environmental activities. Recent activities include releasing the **2016 Field Guide of Financial Support for Capital Projects in New York State,** hosting a **Risk, Resiliency, and Managing Your Assets Workshop** in Syracuse, NY, and conducting **webinars for small water systems** including "Rural Water Resiliency through Watershed and Roadway-Stream Intersection Management" and "Financing Resilient Communities."
- Region 2 hosted **Community Based Water Resiliency Tools workshops** and events in Trenton, NJ and a **Drinking Water Tabletop Exercise** in Newburgh, NY to test the

communities' and government partner's ability to handle emergencies that impact their water systems.

- The **Disaster Relief Appropriations Act (DRAA)** provided \$570 million for drinking water and wastewater resiliency projects in areas in New Jersey and the lower 14 counties of New York State that were severely impacted by **Superstorm Sandy**. Work is ongoing until 2021 for eligible projects whose purpose is to reduce flood damage risk and vulnerability or to enhance resiliency to rapid hydrologic change or a natural disaster.
- EPA Region 2 has been involved in **Superstorm Sandy Recovery** efforts through the **New York-New Jersey Federal Leadership Resilience Collaborative and Technical Coordination Teams**. Projects and issues these teams focused on include rebuilding/protecting water and wastewater treatment plants, coastal stabilization studies and restoration, living breakwaters, wetland restoration projects, flood mapping, infrastructure funding programs, and Rebuild by Design projects.
- EPA Region 2 has been working with local, state and federal partners on **coastal resiliency efforts** including:
 - the construction of a tall bulkhead along Reynolds Channel in Long Beach, NY;
 - the development of the Long Slip and Rail Enhancement Project in Hoboken, NJ;
 - the review of the Mid-Island Bluebelt Drainage Plan which proposes to construct a buried seawall/armored levee in Staten Island to reduce storm risk; and
 - coordination on Rebuild by Design projects in the Meadowlands (NJ), Staten Island (NY), and along the Hudson River that include strategies whose purpose is to reduce flood hazard risks (see <http://www.rebuildbydesign.org/our-work/sandy-projects>).
- Region 2 and the Office of Water **provided technical assistance** to evaluate and improve existing city business processes in order to streamline the development and implementation of **green infrastructure (GI)** in Newark, NJ. In April, 2016, the contractor presented 10 key components to a successful GI program based upon reviews of the NYC, Philadelphia and Seattle GI programs, which include standardized GI project designs and dedicated funding sources.
- EPA Region 2 placed **greater focus on enforcement and inspections of facilities in flood-prone areas** by targeting industries in FEMA 100-year flood zones. A map developed using EPA's GeoPlatform and ECHO (Enforcement and Compliance History Online) and state databases was used by inspectors to identify facility locations in relation to flood zones.
- A Great Lakes Restoration Initiative grant was awarded to the State University of New York College at Brockport to **study long term changes in Lake Ontario and Upper St. Lawrence River coastal wetlands using historical aerial photos**.

- The **Rockland County Task Force** worked with [The Rockland Water Coalition](#) and EPA's WaterSense program to **identify conservation opportunities and supply alternatives** which will ensure a safe, cost-effective, long-term water supply for Rockland County in lieu of constructing a proposed desalinization plant.
- **A dozen organizations and municipalities joined the EPA's WaterSense promotional partnership** family in 2016.
- EPA staff conducted **WaterSense outreach by presenting Climate Resiliency Through WaterSense** at the New York State American Water Works Association's Spring Water Event on "Climate Resiliency Through WaterSense" and at the Risk, Resiliency, and Managing Your Assets Workshop for Small Water Systems held at the Center for Excellence in Syracuse, NY.
- **Regional Wetland Program Development Grants** that were awarded in FY15-16 are in progress and are projected to be completed in 2017 or 2018. The grants were given to:
 - the Meadowlands Environmental Research Institute (of the NJ Sports and Exposition Authority) to **examine greenhouse gas exchange and carbon sequestration potential throughout the Meadowlands** to inform wetland preservation and mitigation decisions;
 - the New York City Department of Parks and Recreation to **develop core indicators of wetland vulnerability to storm water disturbance** and prepare preliminary guidelines for storm water management to better protect downstream wetlands;
 - the Barnegat Bay Program of Ocean County College, partnering with Partnership for the Delaware Estuary, to develop methods to **evaluate the progress of tidal wetland restoration projects**, compare restoration to regional tidal wetland conditions and use these data to **improve restoration practices and success**; and
 - the New Jersey Department of Environmental Protection to facilitate web access to coastal wetland reference data, determine reference baselines to enable evaluations of impacts and change, and expand its network of surface elevation table stations to **monitor coastal marsh trends in elevation**.
- During the **Triennial Review of state water quality standards**, Region 2 will continue to work with our states to identify ways to better integrate climate change considerations into water quality standards.
- Region 2 and ORD collaborated to create a **Triple Value (3V) systems and sustainability model for Suffolk County Nutrient (Nitrogen) issues that incorporates coastal resiliency and sustainability in the face of a changing climate**. Region 2 and ORD lead this local stakeholder driven effort which in 2016 included multiple stakeholder meetings, webinars, and teleconferences and resulted in a conceptual model of the environmental, social and economic system in Suffolk County, NY.

- The Climate Ready Estuaries program funded a FY2016 EPA-Long Island Sound Study (LISS) project which is **evaluating remote sensing imagery for various biogeochemical properties (e.g., phytoplankton, sediments, and sea surface temperature) in Long Island Sound**. The data will be used to develop a climatology model and assess the spatial patterns of biomass and the relationships between temperature and chlorophyll in this region.
- In 2016, the Long Island Sound Study's **website added new web pages** to assist academic institutions, non-governmental organizations and others who are interested in understanding a **computer model's predictions on how salt marshes in Long Island Sound may to respond to sea level rise**.
- The Long Island Sound Study's revised **habitat restoration database went online** on the Long Island Sound Study (LISS) website (www.liSSHabitatRestoration.com). LISS also created **a new website, The Climate Change in Long Island Sound: A Long Island Sound Resource Guide**, to help Long Island Sound stakeholders learn more about climate change issues that can impact Long Island Sound (www.liSSClimateChange.net).
- The **New York – New Jersey Harbor & Estuary Program (HEP) has undertaken a climate change vulnerability assessment** which will be based on a series of multi-layered engagement and listening sessions convened in support to the development of its 2016-2021 Action Plan.
- The **New York – New Jersey Harbor & Estuary Program (HEP) is coordinating USEPA's Climate Change Capacity Building in Three Estuaries of National Significance project** with the Association of National Estuary Programs (ANEP) and will work with local partners to build capacity for climate change adaptation in disadvantaged communities. The project's goals are to engage these communities in understanding and adapting to the risks posed by an increased incidence of coastal storms and rising sea levels and build the local capacity and means of improving community resiliency while protecting natural resources and enhancing ecosystem services.
- The Barnegat Bay Program and the Partnership for the Delaware Estuary is working with partners on the **Blue Carbon Storage in Natural Estuarine Wetlands and Living Shorelines of Delaware and New Jersey project** to evaluate the carbon dioxide mitigation benefits provided by natural and restores coastal wetlands in Delaware and New Jersey.
- The **Barnegat Bay Program's (BBP) Coastal Wetlands Assessment project** continues to assess Barnegat Bay's coastal wetlands and shorelines and their response to sea level rise and accelerated shoreline erosion. BBP is providing technical input to New Jersey Department of Environmental Protection in the development of a standardized set of coastal restoration monitoring metrics.

- The Partnership for the Delaware Estuary received approval for its Quality Assurance Program Plan and drafted the experimental design for the **Regional Applied Research Effort grant to improve tidal marsh shoreline restoration tactics to enhance ribbed mussel densities, sizes, and spatial coverage**. The project goal is to improve the success of tidal marsh restoration efforts and concurrently improve water quality ecosystem services in those restorations through establishing ribbed mussel populations.
- The San Juan Bay and Estuary Program (SJBEP) was the first National Estuary Program to complete and implement the Climate Ready Estuaries workbook entitled “Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans” in 2015. To follow up on this effort, **in 2016 SJBEP was able to publish Puerto Rico’s first climate change community guide** which is being used in schools, communities, and educational activities to explain in simple terms the complex issues of climate change.
- EPA Region 2 continues to participate in the **Caribbean Regional Ocean Partnership (CROP) which focuses on coastal and marine planning issues** and the **Puerto Rico Climate Change Council (PRCCC)**, which has been very important in ensuring that climate change vulnerabilities were included **latest Land-Use Plan (LUP)** for Puerto Rico.

Region 3

- A Mid-Atlantic **Regional Stream Monitoring Network (RMN) to detect climate change effects in streams** has been established in the Mid-Atlantic in coordination with Region III’s aquatic biology team in Wheeling, WV and ORD and includes participation from Region 2 (New Jersey) and Region states (i.e.; Delaware, Maryland, Pennsylvania, West Virginia and Virginia); the Susquehanna River Basin Commission and the Delaware River Basin Commission, and Fairfax County, VA. Overall, the goal of the RMNs is to help the Agency respond to climate change by monitoring changes in biological indicators, informing climate change vulnerability assessments, developing statistical models to project future changes in stream condition, and providing insights on how organisms respond to and recover from extreme weather events.
- Region 3 partnered with the West Virginia Region II Planning & Development Council, Huntington, WV, and other parties to **develop a winning proposal securing \$40,000 for incorporating green infrastructure into local hazard mitigation planning**. The funding will be used to develop a guide for the Huntington, WV Region on how to **incorporate GI into hazard mitigation plans making GI eligible for FEMA mitigation funds**. This project will also serve as a national pilot for GI in hazard mitigation. The project team was also able to develop a successful US Army Corps of Engineers Silver Jackets proposal which will bring over \$100,000 of additional support to this effort.
- 2016 was another successful year for the Green Streets, Green Jobs, Green Towns effort. **Seventeen grants were awarded totaling \$803,489** in funding provided by EPA (\$515,000)

and the Chesapeake Bay Trust (\$288,489). These funds have been matched with over **\$5.80** million in local funding. EPA dollars have been leveraged \$11.86 to \$1 (nearly 12-1) and the combined EPA-CBT dollars have been leveraged \$7.25 to \$1.00 (more than 7-1).

- Through Office of Sustainable Communities funding, EPA Region 3 **coordinated with the city of Norfolk to convene a Building Blocks for Sustainable Communities Green and Complete Streets workshop for community members and various city departments in Norfolk in March 28 and 29, 2016.** Norfolk sees green streets as a way to incorporate green infrastructure to manage stormwater and reduce pollution, reduce flooding, increase green space and reduce demand on the city's stormwater drainage system which is integral to their plans to address resilience and prepare for sea level rise.
- The Region 3 Office of Infrastructure Assistance:
 - conducted 3 Energy Audit Courses to audiences of Bay Watershed treatment plant operators;
 - conducted training and onsite visits promoting energy saving solutions and optimization opportunities resulting in a **potential energy savings of 1,565,580kWh/year or 1,054 metric tons of CO₂**;
 - worked with the U.S. Department of Energy's Industrial Assessment Centers to conduct 4 energy audits in the MD and VA Chesapeake Bay watersheds;
 - made 2 presentations on Energy and Optimization; and
 - conducted training courses on Do It Yourself (DIY) Energy Audit Course and 3hr Energy – The Math Behind the Savings.
- The Region 3 State Revolving Fund (SRF) All-States Meeting in April 2016 covers 1.5 days of presentations on various topics of interest to the State SRF Program Managers. This year's meeting included the following **presentations directly related to climate change concerns**:
 - a proposed HQ's \$70 million drinking water/energy project;
 - EPA-Region 3's Optimization Work (technical articles, energy audits, operating training);
 - Talbot County, MD wind turbine project; and
- EPA-HQ Repowering Program (EPA maintains a database of sites available for solar panels or wind turbines that are within 1 mile of water and wastewater facilities and utilities interested in renewable energy sources that lack adequate space).
- As part of the annual SRF Program reviews conducted in FFY 2016, the Office of Infrastructure and Assistance (OIA) **held discussions with each State CWSRF and DWSRF State Management that updated the previous year's discussion of the 14 page "SRF Sustainability Conversation Guide"** dated August 13, 2014. Topics that were discussed with State SRF managers included: asset management, user rate structures, green infrastructure, decentralized wastewater systems, energy efficiency, renewable energy, water efficiency, water audits, water reuse, climate change, climate-related planning, climate resilience, and recovering from extreme weather events.

- Beginning in FY2016, EPA began **counting the number of State CWSRF and DWSRF Programs that provide incentives to water and wastewater facilities to incorporate potential climate change impacts** or strategies for building resilience to extreme events in new or revised facility plans. For example, Pennsylvania's SRF program offers the following incentives for water and wastewater infrastructure projects:
 - PENNVEST's outreach and marketing efforts include a discussion on the need to address potential climate change impacts;
 - all costs associated with addressing potential climate change impacts are eligible as part of a CWSRF loan;
 - a borrower may use up to \$25,000 of approved budget to develop an asset management plan; and
 - the CWSRF priority ranking system awards additional points for borrowers that already have an asset management plan or are developing one as part of its project.
- The Office of State and Watershed Partnerships has been working with Newport News to bring together the City and the Newport News Public Schools to discuss the City's stormwater requirements (MS4 Phase I Permit) and how NNPSs can support the City in **complying with their MS4 permit by installing green infrastructure practices on school grounds**. The green infrastructure practices can then be integrated in the NNPSs educational curriculum to support the environmental literacy goals of the Chesapeake Bay Agreement.
- The Regional Office of Drinking Water and Source Water Protection held its semi-annual meeting (via conference call) with the states and Basin Commissions to discuss **source water protection (SWP). Topics included FY15 SWP performance measures and FY16 commitments, SWP funding opportunities, climate change adaptation**, harmful algal bloom monitoring and economic impacts, EPA's Drinking Water Mapping Application tool, and upcoming SWP workshops.
- A series of **seminars on Biochar were presented by external speakers to approximately 50 Superfund Remedial Project Managers from the Hazardous Site Cleanup Division (HSCD)**. Biochar is essentially a charcoal carbon-rich solid produced by heating biomass in the absence of oxygen. **ORD research has demonstrated that biochar can help our soils mitigate and adapt to climate change by sequestering carbon and improving infiltration and water holding capacity, respectively**. It can help make contaminants less mobile and available and help establish vegetation on degraded sites.
- EPA Region 3 **hosted a NOAA-led training on Climate Adaptation for Coastal Communities**. The event was attended by EPA staff from Region 2 and 3, FEMA, USACOE, and other local officials.
- Region 3 **hosted a water and climate change for internal training of employees**. Attendees learned about climate change networks and organization in Region 3; programs and

priorities in the Office of Water; and resources and tools available for incorporation of climate change into water program work.

- Regions 2 and 3 have **continued to support the Partnership for the Delaware Estuary (PDE)** including the following climate related activities:
 - PDE has continued to promote living shorelines, enabling installation of 350 feet of living shorelines to build climate resilience;
 - PDE continued to hold Climate Outreach Roundtable meetings which foster collaboration and aid in resource sharing, providing a sounding board for new climate change outreach initiatives and efforts in the estuary watershed; and
 - PDE capitalized on the initial Weathering Change outreach effort by fostering engagement with communities in resilience planning efforts.
- Region 3 continues to assist the Chesapeake Bay Program Office (CBPO) on implementation of the Climate Resiliency workplan that includes **integration of climate considerations into Chesapeake Bay restoration.**
- Region 3 scientists are working with EPA ORD to **assess implications of climate change on wetland ecosystems.** The Wetland and Climate Change Vulnerability Assessment Project has completed a phase 1 report, detailing hydrologic modeling concepts for detecting water budget changes in wetlands and watersheds. A second phase of the project is evaluating methods in pilot watersheds in Region 3 that would help practitioners and managers take into account climate change considerations in state and regional programs.

Region 4

- Region 4 assisted six school districts, which represented approximately 500 schools in the metropolitan Atlanta area, to **develop best management practices, internal water usage benchmarking and retrofitting plans.** Region 4 also provided the Roman Catholic Archdiocese of Atlanta with best management practices that can positively impact water stewardship in their parishes and facilities in North and Central Georgia.
- Region 4 hosted a meeting with State Ground Water and Source Water Protection coordinators in July 2016. At the meeting, Region 4 provided **hands on demonstrations and discussion of the capabilities of the Drinking Water Mapping Application to Protect Source Waters (DWMAPS) mapping tool as well as having expert discussions on harmful algal blooms and their control and treatment.**
- Region 4 **supported the EPA Healthy Watersheds Program** in several ways:
 - reviewed, ranked and provided comments to EPA Headquarters on applications from throughout Region 4 for the newly implemented Healthy Watersheds Consortium Grant;

- led a discussion on opportunities to integrate healthy watersheds into other water quality protection and restoration programs, as part of our Ecosystem Protection Webinar Series; and
- coordinated with the Southeastern Partnership for Forests and Water to help them build support for drinking water and source water protection in the southeast.
- With the help of a Region 4 wetlands grant, the Governors South Atlantic Alliance **hosted the South Atlantic Living Shorelines Summit**. The purpose of the Summit was to share information on the management, research, regulation, and implementation of living shorelines in the South Atlantic region, building knowledge and relationships that expand the use of appropriate stabilization alternatives to traditional shoreline hardening. Researchers, regulators and policymakers, property owners and managers, planners, contractors, and non-profit organizations were all invited to attend and benefit from the expertise and networking opportunities at the Summit.
- A study completed by the Tampa Bay Estuary Program in partnership with EPA and Restore Americas Estuaries (RAE) **highlighted the role of Tampa Bay coastal habitats (seagrass, mangroves and salt marshes) in removing carbon from atmosphere**. The data and modeling will help Tampa Bay coastal managers adapt to rising seas and identify priority restoration sites. The Tampa-specific carbon sequestration data also presents an added opportunity to use market incentives to foster support for restoration efforts.
- Region 4 **funded a new Urban Waters Small Grant in the Proctor Creek Watershed** in Atlanta, Georgia with The Conservation Fund - "Addressing Stormwater Runoff through Community-Driven Green Infrastructure Projects in the Headwaters of Proctor Creek." The Conservation Fund (TCF) plans **to expand community engagement for two upcoming green infrastructure projects through a series of educational charrettes, community tours of GI demonstration sites and flood-prone areas**.

Region 5

- Region 5 **implemented a regional monitoring network (RMN) for wadeable streams with several tribes and states monitoring 16 stream sites for the RMN**. Streams are being sampled for continuous temperature and water level and annual sampling of macroinvertebrates. The goal of this work is to **determine how climate and other phenomena are affecting stream water quality over the long term**. The data will also provide tribes and states with a valuable dataset on reference sites which will enhance Clean Water Act assessment capabilities in the region.
- Region 5 is currently in discussions with tribes and states to **develop and implement a regional monitoring network for inland lakes**. Indicators are currently undecided but will include ice on/ice off dates, vertical temperature profiling, and water level tracking. The

goal of this network is similar to those of the streams RMN. The hope is that this new RMN will be implemented beginning in 2017.

- Region 5 promoted the **Water Utility Response On-the-Go mobile website that provides water and wastewater utilities with critical, real-time information on impending severe weather events** including weather tracking, contact details for local and state response partners, rip-and-run action lists specific to several types of extreme weather events, a field-based means for documenting damage, and key Incident Command System response forms.
- The Region also promoted new [Water Sector Incident Action Checklists](#) providing outline critical measures that drinking water and wastewater utility personnel can take immediately before, during, and after an emergency to protect their systems. Ten incident types are highlighted, including drought, earthquake, extreme cold, extreme heat, flooding, hurricane, tornado, tsunami, volcanic activity and wildfire.
- Region 5 worked with EPA HQ to conduct the **Ohio Emergency Response and Recovery Exercise for the Water and Wastewater Sector** as well as a **Community Based Water Resiliency Tool** workshop for the Wisconsin Rural Water Association.
- Region 5 continued to promote the **Water/Wastewater Agency Response Network (WARN)** in the region and specifically in Illinois during the ILWARN tabletop exercise.
- Region 5 drinking water program **initiated a technical assistance contract with a provider to offer assistance to tribal water utilities in Wisconsin and Minnesota that includes activities related to climate adaptation** such as source water protection, water efficiency and energy efficiency.

Region 6

- EPA Region 6 **continues to host a Region 6 Water Division intranet site addressing drought issues** at: http://region6.epa.gov/intranet/6wq/drought/drought_index.html. This site provides centralized links to current resources on and contains information on the latest drought news, states' drought plans, water conservation resources, WaterSense, climate change issues, U.S. Army Corps of Engineers Lake and River Conditions, the Electric Reliability Council of Texas, and city water programs for the major cities in Region 6.
- Region 6 promoted energy efficiency by **conducting two energy management workshops for water and wastewater utilities in the Dallas-Fort Worth metroplex**, and conducted an energy management webinar.
- Region 6 and the Border Environment Cooperation Commission (BECC) are **planning an energy management workshop to assist water and wastewater utilities**, focusing on the U.S.-Mexico Border area, in 2017.

- In partnership with the Office of Water, Water Security Division, a **CREAT 3.0** (Climate Resilience Evaluating and Assessment Tool) **workshop was held at the City of Houston** Permitting Center on February 1-2, 2016 and engaged water utility operators, planners, technical assistance providers, and consultants from across Texas. During the workshop Region 6 also provided a presentation on resiliency financing for water utilities.
- Region 6 **recruited thirteen WaterSense partners** as part of a regional water efficiency and conservation campaign. Region 6 has 173 WaterSense Partners. Region 6 also supported partnerships with states, tribes, municipalities, non-profit organizations, and businesses to promote the WaterSense program throughout 2016 including:
 - Fix a Leak Week;
 - Earth Day activities;
 - National Drinking Water Week;
 - Regional Sustainability Day;
 - Smart Irrigation Month;
 - Dallas-Fort Worth Irrigation Professional Workshop;
 - SepticSmart Week;
 - Shower Better Month; and
 - recruitment, outreach, media support, and presentations at various Region 6 meetings and events.
- In conjunction with The Nature Conservancy, the Coast Bend Bays and Estuaries Program **completed a regional climate change vulnerability assessment**, which will be factored into a forthcoming revision of the comprehensive Coastal Bend Bays Plan.
- The Coast Bays and Estuary Program continued efforts to **monitor and evaluate the effects of climate change on relative sea level**, water quality, seagrass and other coastal resources.
- Region 6 managed the Coastal Wetlands Planning, Protection, and Restoration Action's (CWPPRA) "Bayou Dupont Sediment Delivery - Marsh Creation #3 and Terracing Project," and completed the marsh creation component. This resulted in **137 acres restored in the Barataria Basin of Louisiana to help adapt to rising sea levels**. Particularly noteworthy are innovations in construction planning that resulted in time and cost savings through coordination with restoration projects in the same area that were managed by other agencies. All of these projects were designed to function synergistically around an initial EPA-managed Bayou Dupont marsh restoration project. In total, approximately 1,680 acres of the Bayou Dupont marsh area have been restored since 2010.
- Region 6 advanced engineering and design work on two barrier headland projects for an area of Louisiana's Barataria Bay coastline where shoreline migration rates have averaged 41 feet per year over the last century. These **two projects are expected to restore 373 acres of back barrier intertidal marsh and nourish 456 acres of emergent marsh** using dredged material pumped from the Gulf of Mexico.

- The Region provided policy and technical assistance to ongoing Deepwater Horizon oil spill coastal ecosystem restoration efforts organized through the NRDA and RESTORE programs. Staff were invited by the Coalition to Restore Coastal Louisiana and the Louisiana Coastal Protection and Restoration Authority to work a year in advance on planning for the State of the Coast conference, held in June 2016. This is a key coastal conference for Louisiana and the Gulf coast and it makes a **significant contribution to the field of sea level rise adaptation and coastal resiliency.**
- Region 6 coastal program **staff developed an applied demonstration of conceptual blue carbon models by using existing coastal habitat restoration acreage** data from 2014 -2015 Region 6 National Estuary Program and CWPPRA projects. The data was translated into estimates of sequestered atmospheric carbon for each project, applying values from the *“Methodology for Tidal Wetland and Seagrass Restoration,”* which was approved in late 2015 by the Verified Carbon Standard. The project concept was incorporated and expanded upon in the 2016 *“Tampa Bay Blue Carbon Assessment.”* Training is now being developed for the National Estuary Programs by Restore America’s Estuaries (RAE) on how to apply blue carbon principles to calculate sequestered carbon for coastal restoration projects.
- The Housing and Urban Development Resiliency competition announced in 2015 the award to the City of New Orleans of \$141 million for a variety of activities that include coastal restoration and supporting the Gentilly Neighborhood in planning, development and implementation of a more resilient community. EPA through the Urban Waters federal Partnership will support the local co-leads, City of New Orleans and Sewage and Water Board staffers, in planning for up-coming community meetings/workshops as needed. **EPA will support any project work that can incorporate Green Infrastructure into any new revitalization or redevelopment scoped in storm water management.**
- Region 6’s Tribal Drinking Water Team **added a climate-related question to the Sanitary Survey.** This has served the dual purpose of both initiating a climate change discussion with tribal operators and leadership and gauging the baseline of climate comprehension and preparedness in tribal drinking water utilities.
- Region 6 participated in the annual South Central Climate Science Center Stakeholder Advisory Committee (SC CSC) meeting on November 7, 2016. Additionally, Region 6 helped make climate science and adaptation opportunities and practices accessible to the public as a significant contributor of knowledge about climate communication to the SC CSC.
- **A Sustainability Workgroup for employees in Region 6 was formed.** This workgroup allows Region 6 employees to increase collaboration and communication while decreasing duplication of climate-related efforts. This monthly workgroup additionally engages members and provides a forum for members to brainstorm and discuss current climate change work and research. The Sustainability Workgroup was a core component of the planning team for Region 6’s Sustainability Day.

- The Region **implemented a survey of Region 6 employees in order to gather information about what areas of climate change adaptation education and training** need to be prioritized and to promote the new Watershed Academy training, “Climate Change and Water Resources”.
- The Region worked with the Good Neighbor Environmental Board (GNEB), **to develop and transmit to the White House Council on Environmental Quality (CEQ) a report on climate change and its impacts along the US-Mexico Border.** The report identifies the environmental and health effects specific to the border region and outlines existing programs and resources to mitigate and adapt to climate change. Based on these findings, the GNEB made recommendations on steps necessary to continue support for programs and initiatives already targeted at alleviating the effects of climate change.

Region 7

- Region 7 has **encouraged all regional states that implement the Clean Water and Drinking Water State Revolving Funds to incorporate climate change considerations** into their intended use plans and priority point systems.
- In the Fall of 2016, Region 7 coordinated with EPA Headquarters' Water Security Division, U.S. Army Corps of Engineers, Federal Emergency Management Agency (FEMA), and the Iowa Homeland Security and Iowa Department of Natural Resources to **have discussions about flood resilience with water and/or wastewater facilities in Hopkinton, Charles City, and Ogden, Iowa.** Each of the communities discussed their utility's vulnerability to flooding as well as previous flood damage. In turn, EPA and the state partners provided tools available for flood mitigation as well as an onsite inspection of the facility
- Region 7 **encouraged green infrastructure** through participating in discussions with our federal partners such as HUD and the General Services Administration. Over 5 federal agencies that are a part of the Federal Executive Board Sustainability Committee attended a green infrastructure tour of the regional office and follow up discussions about other federal offices in the region that also include these practices.
- The green infrastructure coordinators in Region 7 met with each Water Division program to learn about their intersection with and knowledge of GI. They then **planned, organized, and hosted the Water Division GI training** on May 19th, 2016. Presentations were on urban waters, climate change, wetlands, stormwater, state revolving funds, and other cross-program GI applications.
- In a cross-EPA effort, Region 7 worked with the ORD and Headquarters to pilot an **EPA Green Infrastructure Technical Assistance Program** in the Region. The goal of the project is to **estimate changes in air quality and/or emissions reductions due to trees, green streets and green roofs in the Kansas City Region.**

- A **Net Zero project** in Region 7 is geared toward helping the bases and communities become more **sustainable and resilient with an emphasis on taking a systems approach**. One of these projects is focused on a green infrastructure demonstration project and outreach in Fort Riley, KS.
- Region 7 traveled to Johnston, IA for the **Iowa Silver Jackets quarterly meeting and discussed the drinking water and wastewater flood resiliency projects** with EPA Water Security, FEMA, USACE and Iowa state partners (Homeland Security and Department of Natural Resources).
- Region 7 is a working group member for the federal Partners in Mitigation and Resilience. **EPA hosted the over 40 federal partners in January for a discussion on climate change programs at each agency.**
- The Region assisted with the **development of flood resiliency workshop modules for state partners** related to economic development, ecosystem services, and water quality. Over 50 state and federal employees attended the workshop. The region also stayed to participate at the Cooperating Technical Partners Rendezvous at FEMA.
- Region 7 continues to **participate in federal partnerships** such as the Missouri Basin federal Climate Collaboration and as a member of the Joint Stakeholder Committee for the North Central Climate Science Center.
- The Midwest Drought Early Warning System meeting was hosted in St. Louis, MO in 2016. Region 7 was a panel member with other federal agencies. **The agencies discussed EPA climate change programs and research on drought initiatives.**
- Region 7 held a 3rd Enhancing State and Tribal Program's Workshop for the states and tribes. Region 7 had a total of 38 participants from Kickapoo Nation, Santee Sioux Nation, Meskwaki Nation, Oklahoma, Kansas, Nebraska, Iowa, and Missouri (Regions 7, 8, 9, HQ). There were **14 presentations focused on Climate Change**, Wetland Restoration, CWA Section 401, Wetland Water Quality Standards, and Wetland Monitoring and Assessment.
- Region 7 **participated in a panel during the meeting of the Indigenous Peoples Climate Change Working Group at Haskell Indian Nation University** in September. Region 7 continues to work with Haskell as well as new partners (e.g. NASA's climate change programs).
- The Region developed a **harmful algal bloom action plan, communication plan, and sampling protocol** using the guidance from the EPA document, *Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water*. These plans were developed in order to respond to requests for assistance by tribal and state partners.

- Region 7 participates in the Clean Water Act Section 303(d) program national workgroup who meets regularly, **looking at options and considerations for climate change within the 303(d) program particularly within Total Maximum Daily Loads.**
- Region 7 **recruited 2 new WaterSense Partners** to further water efficiency and conservation efforts; Bridging the Gap and the Iowa Department of Natural Resources.
- On March 2, 2016, Iowa Association of Municipal Utilities hosted a conference on Advanced Water Treatment in Ankeny, Iowa. Region 7 **presented on sustainability and power resiliency for drinking water systems.**
- Region 7 continues to partner with the *Central Plains Climate Change Monitoring Network* to develop a **climate change regional monitoring network** by deploying remote sensors on Central Plains streams. The Region is also beginning an effort to expand the network with the participation of EPA Region 5 and 6 offices and their states and tribes.
- On May 18 2016, a **Flood Resiliency Training was co-sponsored by EPA and the Iowa Rural Water Association in Newton, Iowa.** Region 7 participated with about 40 water and/or wastewater operators and utility managers. The Water Security Division contractor provided detailed information about how to use the EPA's climate resiliency tools.
- On May 22, 2016, a **Drought Resiliency Training was co-sponsored by the City of Monett, EPA, and the Missouri Department of Natural Resources** in Monett, MO. Region 7 participated with about 35 water and/or wastewater operators and utility managers. The workshop featured information on the American Water Works Association (AWWA) water loss guide and EPA's *Drought Response and Recovery: A Basic Guide for Utilities* and EPA's *Control and Mitigation of Drinking Water Loss in Distribution Systems Guide*.
- On September 1st, Region 7 staff participated in the Multi-Hazard Mitigation Tournament in Cedar Rapids, Iowa. This tournament was sponsored by the Army Corp of Engineers with assistance from various federal and state agencies. **The focus was on climate events in the Cedar River watershed and what preventative and resiliency measures** the communities in the watershed could take based on funding levels. There were about 50 participants from federal, state, local agencies/governments and other organizations.
- In September 2016, **climate issues, drought, temperature increases, and flooding were discussed at the State/EPA Region 6-10 Workshop in Denver Colorado.**
- As part of the Middle Blue Urban Waters Federal Partnership, a climate forest matrix with US Forest Service was created. Region 7 and our partners are currently **drafting a 5-year Blue River Action Plan that is informed by the Climate Forest Matrix.**
- Region 7 worked with USACE, Section 404 programs to **incorporate climate change impacts in permits, compensation plans and draft EIS documents.**

- Region 7 contributed to the development of the joint EPA-USGS document “**Final EPA–USGS Technical Report: Protecting Aquatic Life from Effects of Hydrologic Alteration.**”
- To increase outreach to high school students, Region 7 **presented on climate change and led a watershed activity with students from a Liberty, MO high school.** The students developed projects to educate elementary students on climate change and presented their results on December 15th to Region 7, federal partners, and other community members.
- Friends of the Kaw, an Environmental Justice Small Grant recipient in Region 7, has a project called KAW Curriculum (Kids About Water: An Issues and Action Approach to Water Quality Education). Student interns are selected from local schools such as Wyandotte and Harmon High School. They will attend community events **where they will teach about climate change and water quality to adults.**
- In February 2016, Region 7 presented on **climate change drinking water tools at the Kansas Municipal Utility conference in Newton, KS.**

Region 8

- Region 8 and Headquarters **worked with two Colorado communities to implement pilot projects using EPA’s Climate Resilience Evaluation and Awareness Tool (CREAT)** in 2016: 1) the Evergreen Metropolitan District/Bear Creek Watershed Association (Aurora, CO), and 2) the City of Ft. Collins, CO. The communities received training and technical assistance in using CREAT to better plan for the effects of climate change and to provide information to make their facilities more resilient.
- Region 8 initiated **discussions with State Source Water Protection Programs and State Rural Water Association source water specialists** on the potential impacts that climate change may have on small water utilities and potential tools EPA has available to help with climate resiliency planning. There was consensus that the CREAT tool would be beneficial to small community water systems, who are among the most vulnerable to changes from climate change but lack the technical capacity to implement the tools. The region continues to explore options for providing technical assistance to these groups in the future.
- Region 8 and Headquarters **provided assistance and training to water and wastewater systems on water security in Wyoming and Utah.** In Wyoming, Region 8 provided training on CREAT and gave an introduction to other tools on EPA’s Water Security website. Region 8 attended a functional exercise with the state of Utah where the EPA Water Emergency Response Team assisted in a response to a water-based emergency.
- Region 8 supported states and tribes in developing strategies to deal with Harmful Algae Blooms. The Region 8 lab provided **analytical support for drinking water utilities to help them determine whether cyanotoxins are present during blooms.**

- Region 8 participated in several **climate adaptation planning meetings with the Blackfoot Tribe and climate workgroup meetings with Confederated Salish and Kootenai Tribes (CSKT)** as part of an ongoing effort to develop climate adaptation plans for these Tribes. This work is being done in partnership with the Center for Large Landscape Conservation (CLLC) under a grant issued by the Bureau of Indian Affairs.
- Region 8 participated in **CSKT's Climate Change Advisory Committee (CCAC)**, which is charged with initiating "collective beneficial climate impact mitigation and adaptation solutions." The Committee revised the *2013 Climate Change Strategic Plan* in 2016 to include updated information, activities, and additional emphasis on incorporating traditional ecological knowledge into the planning and mitigation efforts. In addition, CSKT's climate leadership has encouraged other nearby tribes to participate in the CCAC and take action themselves, including representatives from Chippewa Cree (Rocky Boy's), Blackfeet, and Gros Ventre and Assiniboine (Fort Belknap) Tribes.
- In the **Wetland Program Development Grant** competition, the Region awarded priority points for projects that included adaptation of wetlands management and protection to expected ecosystem responses to climate change. As a result, nearly all of the projects selected for funding will help plan for the effects of climate change.
- Region 8 continued to explore opportunities to **collaborate with the State of Colorado to incorporate climate change considerations** into TMDLs, Alternative Plans, Nonpoint Source Management Planes and Water Quality Standards in response to the State's release of its Climate Adaptation Plan.
- Region 8 continued **education and outreach on the use of green infrastructure and provided technical assistance** on a number of projects, including the South Platte Natural Capital Project.
- **Region 8 continued to participate in the Geological Sequestration (GS) workgroup** to develop guidance, share permitting experiences, resources, and technical information, as well as to facilitate implementation of CO₂ geological sequestration final rules designed to protect drinking water resources, while encouraging successful deployment of commercial scale sequestration projects. Work continued with States (notably Wyoming and North Dakota) to help them obtain primacy for the Class VI UIC program, and issue permits for projects where state primacy has yet to be established.
- The large number of national parks located within EPA Region 8 offers a unique opportunity to monitor climate change impacts at minimally impacted wetlands, streams and rivers. In 2016, building from efforts initiated by USGS, the National Park Service and the Great Northern Landscape Conservation Collaborative, Region 8 **explored opportunities to leverage existing efforts to develop a regional climate change monitoring network.** To

date, the group has organized a series of webinars designed to provide information on the current monitoring efforts underway to evaluate impacts associated with climate change.

- With ORD contractor support, Region 8 worked with Montana Department of Natural Resources and Conservation and NOAA to **test Colorado’s semi-quantitative approach to conducting vulnerability assessments**. The analysis focused on potential impacts to agricultural associated with drought and was intended as a pilot to evaluate whether the data are readily available and sufficient to complete a vulnerability assessment.
- In 2016, the Office of Water Protection in Region 8 created a **strategy for incorporating climate change into the regional programs**. The strategy identifies the staff involved in several regional water programs, various leverage points for partnering with state agencies, resources such as grants where the region can include climate change language, guiding principles for state agency interactions with the regional climate change programs, opportunities for collaboration with other state and federal agencies, communications and outreach plans and opportunities to collaborate in research.
- Region 8 **incorporated climate change language into comment letters** for several NEPA documents requesting the project proponent consider how climate change will affect the objectives and implementation of the project. The Region included comments to the Corps of Engineers in the **Nationwide Permit Reauthorization** requesting that a condition of nationwide permit applications be that the applicant explain how a changing climate will affect the need and design of the project.
- The Region provided comments on a **Utah TMDL** that incorporated climate change considerations into the document.
- Region 8 hosted a summer intern to create **inventories of groups that are currently active in the states preparing for climate change**. This inventory will help the Region identify collaborative opportunities to showcase the tools EPA has developed to enhance climate adaptation and resilience at the state and local levels.
- **Region 8’s WaterSense** Program launched an outreach effort with Denver’s Registered Neighborhood Associations (RNAs) on local climate action. The Region plans to continue engagement with interested RNAs in 2017.
- **Region 8** completed a **Climate Adaptation Outreach Strategy** targeting 10 communities. The outreach will be focused on the water sector, among others, and implemented in FY17.
- The Region **outreach and communication efforts** on climate change continued including:
 - presented information on climate change and groundwater to the Executive Directors of the Region 8 Rural Water Associations;

- held a meeting with EPA Region 8, FEMA Region 8, and the USGS South Dakota Water Science Center to discuss climate change and future collaboration; and
- started a four-part biochar webinar series for EPA staff in partnership with EPA’s Air, Climate and Energy (ACE) Research Program focusing on the potential of biochar to sequester carbon and retain nutrients and water in soils, and reduce the mobility of pollutants from contaminated lands.

Region 9

- In November 2016, Region 9 **hosted five Water Loss Control (WLC) Workshops to provide information on reducing leaks in small- and medium-size water supply systems.** Workshops were attended by approximately 80 participants Arizona (Tucson, Phoenix and Prescott Valley) and approximately 50 participants in Nevada (Reno and Las Vegas).
- Region 9, in partnership with ORD, and University of California at Davis, issued a report titled, “Evaluating the Air Quality, Climate & Economic Impacts of Biogas Management Technologies”. The report is concerned with biogas generated from sources such as anaerobic digesters at wastewater treatment plants, and **provides a more complete understanding of the environmental and economic performance of biogas-to-energy technologies.**
- In 2016, Region 9 continued to **promote the use of green infrastructure (GI) in the implementation of the stormwater permit program** to increase the resilience of stormwater infrastructure. Region 9 work included reviewing and commenting on state draft Municipal Separate Storm Sewer System (MS4) permits to incorporate climate change considerations, assisting California with the development of their statewide stormwater strategy and funding a San Francisco Bay project to advance green infrastructure and working to expand GI funding opportunities. In addition, Region 9 worked with Guam to build-in GI consideration for their MS4 permits.
- Region 9 worked with the California Funding Coordinating Committee for water infrastructure projects and participated in the 2016 funding events around California to **inform municipalities and water utilities about EPA programs and tools, including WaterSense.** Twenty-three new WaterSense partners were signed up in Region 9 in 2016.
- Region 9 coordinated with the Metropolitan Water District (MWD), Bureau of Reclamation, Southern Nevada Water Authority, Southern California Gas Company, and the Central Arizona Project to fund \$566,000 in grants under the MWD’s Innovative Conservation Program. The grant program **supports innovative water savings devices, technologies and strategies.**
- In 2016, Region 9 served on the Direct Potable Reuse (DPR) Advisory Committee for the California State Water Resources Control Board (CA SWRCB). The committee **provided**

recommendations to CA SWRCB on the feasibility of, and potential requirements for Direct Potable Reuse (DPR). Recommendations included level of treatment, monitoring and reporting, as well as operator training and certification requirements. The committee also recommended that DPR systems provide clear information to the public, specifically by reporting their activities and monitoring data in their annual Consumer Confidence Reports, and presenting enhanced public outreach.

- Region 9 worked with large water utilities to encourage them to **plan now for 30 years of system-wide asset replacement, rehabilitation and maintenance; including consideration of potential impacts of sea level rise and flooding on water infrastructure.**
- At West Maui, Region 9 worked with ORD to test the Corals and Climate Adaptation Planning Project's (CCAP) Draft Adaptation Design Tool used to **review watershed plans for climate change readiness.** The test found that differences in scale, for both space and time, present challenges: for example, it is difficult to use spatially-coarse climate change predictions to inform site-specific recommendations for action, and to use relatively short lifecycle actions (ten years or less) to address long-term impacts. The test also found that watersheds need management to build climate resilience and it is important to protect off-shore coral reefs – even those many miles away from shore – as they are an important source of coral larvae.
- The **Santa Monica Bay National Estuary Program (SMB NEP)**, with funding from EPA, **completed a Climate Change Vulnerability Assessment** of their 2013 Comprehensive Conservation and Management Plan, known locally as the Bay Restoration Plan (BRP). This assessment will help the SMB NEP make their projects more resilient to changing ocean and coastal conditions.
- In 2016, SMB NEP completed design and permitting for a 3 acre fore-dune system on the beach north of the Santa Monica Pier, with funding from EPA. Fencing, maintenance and seeding will be conducted to create the necessary physical environment for the growth of native beach plants. The project is expected to form small dune hummocks, attract wildlife and provide recreational, educational and community benefits. It represents a pilot scale project **to determine the efficacy of a living shoreline approach for building resilience to climate impacts.**
- EPA approved the **San Francisco Estuary Partnership's (SFEP)** revised Comprehensive Conservation Management Plan (CCMP) in October, 2016. The revision incorporated **consideration of climate change impacts into planning and implementation** for habitat restoration, flood protection infrastructure management, and water quality protection.
- Region 9 helped convene a 2016 workshop of scientists, managers, and monitoring entities to **assess whether ocean-derived water body acidification and hypoxia are likely concerns** in the San Francisco Bay. In addition, the participants identified potential impacts

to beneficial uses, cost-effective monitoring strategies, and potential management actions. This work serves as a model for how to approach the development of Ocean Acidification and Hypoxia (OAH) monitoring strategies on the West Coast.

- Through funding from EPA, the **Morro Bay National Estuary Program completed a Climate Vulnerability Assessment Report** in February, 2016. The report evaluated potential future conditions in the Morro Bay watershed and estuary. It set the stage for identifying actions to build resilience and continue to protect and restore Morro Bay.
- Through EPA's ***Making a Visible Difference in Communities***, Region 9 worked with American Samoa EPA to **identify additional challenges that climate change poses to the territory's drinking water system**. With EPA Office of Water support, Region 9 funded the development of a \$150,000 Groundwater Exploration Plan by the University of Hawai'i, in partnership with the USGS. The island's drinking water depends on groundwater, but the groundwater is increasingly subject to salt water intrusion from rising sea levels and more frequent droughts. The purpose of the plan is to identify inland drinking water sources and build the American Samoan's resilience to climate change.
- EPA supported the analysis of Harmful Algal Blooms (HABs), and the cyanotoxins they produce, in California (i.e., Klamath River and Clear Lake). Cyanotoxins in lakes and rivers can be a serious threat to human health, fisheries, wildlife and pets. **The ability to measure cyanotoxins levels helps us understand which waterbodies are already stressed**, and therefore need attention as the climate changes if we are to protect and restore their water quality and beneficial uses.
- In 2016 EPA completed a grant to the Sonoma Land Trust which breached levees to restore over 1000 acres of tidal marsh in North San Francisco Bay (San Pablo Bay). The restoration will **build the resilience of the San Francisco Bay wetlands to sea level rise, while increasing flood protection and tidal habitat**. EPA provided almost \$2.5 million for this \$18 million project.
- Region 9 continued to **provide training on water-program-related climate change topics for Region 9 staff**. Presentations covered topics such as: measuring water infrastructure sustainability (CA Department of Water Resources and the Envision Tool), mapping for sea level rise (NOAA's Digital Coast tool), communicating potential impacts of sea level rise and options for action to communities (Marin County's Game of Floods), incorporating science on potential future conditions into decision-making for watershed protection and restoration actions (Pepperwood Preserve and Climate Ready North Bay).
- Region 9 made a presentation to the Environmental Protection Agency leads in the governments of Guam, American Samoa, Commonwealth of the Northern Mariana Islands, Marshall Islands, and Palau (July 2016, San Francisco, CA) **focusing on tools, technical assistance and case studies for sea level rise assessment and adaptation planning**.

- Region 9 met with local regional offices of other federal agencies and departments (BIA, FEMA, DoD, NOAA) to **share information on tools, funding, and opportunities for collaboration**. The aim was to coordinate and build resilience for our water infrastructure, watersheds and coastal waters in the face of climate change.
- Region 9 is an active member of the California Landscape Conservation Cooperative's (CALCC's) Tribal Committee where it works with tribes, the California Department of Water Resources, the Bureau of Indian Affairs and other agencies to **bring technical and financial assistance to California Tribes for building climate change resilience**. In June, 2016, Region 9 made a presentation to Tribes on potential funding sources for climate change assessment and planning (BIA workshop at Pala, CA).

Region 10

- In April, OW and Region 10 hosted a two-day **workshop with Bremerton, Washington on using the Climate Resilience Evaluation and Awareness Tool (CREAT 3.0)** for their drinking water utility. The workshop was initiated as part of the Administrator's Making a Visible Difference in Communities initiative and was attended by the Bremerton Public Works Director and several other staff members. The City is now interested in conducting a similar evaluation for their wastewater utility.
- The Regional WaterSense program **participated in the Living Future's Water Summit** where local governments, planners, designers, engineers and architects discussed future designs with more water efficiency in a net-zero impact approach. The program also provided outreach materials and the program mascot, FLO, to promote water efficiency and the program at the Washington State Fair.
- Region 10 and FEMA are working on a **pilot project to demonstrate how green infrastructure and low impact development can be incorporated into a FEMA hazard mitigation plan to reduce flooding in Ashland, Oregon**. The project is looking at:
 - assessing flood areas and the potential of using green infrastructure and low impact development to reduce flooding;
 - evaluating the ecosystem service benefits of the green infrastructure and low impact development;
 - reviewing state policies and local codes and ordinances to determine if they need to be modified to accommodate the green infrastructure;
 - convening two workshops to discuss the results with the community; and
 - developing final recommendations and a final report for EPA and FEMA by September 2017.
- The 2016 Request for Proposals to support the Puget Sound Partnership (PSP) Action Agenda requested that applicants discuss how they propose to incorporate climate change

into their programs. All of the applicants **selected provided information of how they would consider climate resiliency in ecosystem recovery plans and near-term actions.**

- The Region is working with the **Puget Sound Partnership to develop a Puget Sound Wide Climate Vulnerability Assessment and Adaptation Plan by 2020.** EPA has formed a technical working group of climate change experts from the different agencies to assist in the integration of climate change into Puget Sound projects.
- Region 10 is working on two projects to examine how various regional land-based sources of carbon and nutrients, such as local air emissions, wastewater treatment plants, and nonpoint discharges, **exacerbate ocean acidification in the Salish Sea, including Puget Sound, and the relative contribution of these regional sources to acidification.** The first project is working with the Washington Department of Ecology to develop a model that will help identify when and where portions of the Salish Sea are most influenced by regional sources of carbon and nutrients. The second project is a study to investigate the role of nutrients from fertilizer and wastewater sources in accelerating the resultant changes in carbonate chemistry parameters in a nearshore environment of Puget Sound.
- Region 10 is working with the State of Oregon and others to **develop cold water refuge (CWR) plans for the Columbia River and the lower 50 miles of the Willamette River.** The purpose of the plans is to implement Oregon's narrative cold water refugia criterion for the protection of salmon migration through these rivers during warm summer conditions, and to determine if sufficient CWR exists to meet the criterion.
- RRegion 10, along with the Oregon Department of Environmental Quality, used Clean Water State Revolving Funds to assist the Farmer's Irrigation District project around Hood River, Oregon **to pipe and pressurize their irrigation system and to install in-pipe hydroelectric generation.** The state of the art irrigation system provides Hood River growers and residential users with reliable access to water and a range of highly efficient water delivery systems. The new irrigation system has dramatically reduced water and energy use per acre, reduced labor costs, and improved crop quality and yield. Another benefit to this new irrigation system is the in-pipe hydroelectric system which produces enough clean, green, renewable energy to run the entire system and sell 26 million kilowatt hours annually. To help explain the complex project, EPA produced a high quality video to educate others about the CWSRF opportunity.
- Region 10 is working with ORD and **to examine the impacts of climate change on the suitability of temperature regimes for salmonids for a subset of Pacific Northwest (PNW) basins now, under restored conditions, and in the future.** The results of this research will be used to determine whether or not stream temperatures will protect cold water fish given climate change with and without restoration actions.
- Region 10 worked with OW to conduct a two-day workshop on Harmful Algal Blooms. The workshop **reviewed the current science and included several sessions on impacts from**

climate change. States and tribes also shared success stories and their needs. In addition, training provided to tribes discussed climate change. Approximately 100 people participated in the 2-day workshop.

- Region 10 has been conducting a **monthly climate change speaker series to increase awareness of staff on climate change science and to provide information they can use in their programs.** In 2016, speakers presented on various topics including: mapping tools for evaluating changes to wetlands from climate change; impacts of climate change on Puget Sound; and sea level change tools from USGS and USACE. In addition, Region 10 has a monthly newsletter, *In the Loop*, that provides staff and managers with examples of climate change and sustainability projects within Region 10, as well as with information on current topics related to climate change.
- Region 10 is **working with other federal agencies on climate adaptation.** The Region serves on the Executive Committees for the USGS Pacific Northwest Climate Science Center, the USFWS North Pacific and Great Northern Landscape Conservation Cooperatives, and the USDA Pacific Northwest Climate Hub. Region 10 staff have participated on review panels for several Requests for Proposals from these organizations. Several of the projects funded by these organizations have been useful to the Region's water program (e.g., stream temperature and cold-water refugia, impacts of sea level rise in Puget Sound, and visualization tools for projected changes in several climate stressors).
- Region 10 created a **cross-program team to assist in the implementation of activities related to climate, energy, and sustainability.** The team helps to better integrate climate and sustainability into Regional programs and coordinate efforts across programs to ensure the most effective use of resources. The team sponsored the first Climate and Sustainability month that highlighted the great work Region 10 staff and others are doing to integrate sustainability and climate change into our activities.
- Region 10 worked with USACE and the University of Washington Climate Impacts Group to **explore possible climate change futures in the Pacific Northwest.** The Time of Emergence (ToE) project uses climate information to characterize when and where climate change signals are estimated to emerge. ToE uses historical variability (noise) in key metrics throughout the Pacific Northwest. The project was designed to assist practitioners in exploring a range of possible ToE for a variety of scenarios composed to address program interests and risk tolerances.
- As a part of the Administrator's Making a Visible Difference Initiative, Region 10 provided assistance to three Alaska Native Villages to **make their drinking water and wastewater infrastructure more resilient to climate change.** Region 10 started working with the Environmental Finance Center to provide financing modules to support Alaskan communities who are facing relocation and/or adaptation in place to address the impacts of climate change.

- In order to help Alaska Native Villages, EPA in collaboration with the Institute for Tribal Environmental Professionals (ITEP) **hosted quarterly webinars that provided information to Alaska Native Villages on different issues related to climate change** and training on a variety of issues, including developing climate adaptation plans.
- Region 10 **initiated a Greener Grants Policy that builds on work already underway to incorporate sustainability and climate change considerations into grants.** The purpose of the greener grant policy is to work with our partners to ensure they are considering sustainability and climate in their work including water related grants. The policy is phased in with the first year focusing on tribal grants and competitive grants.



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