The National Dam Safety Program

Biennial Report to the United States Congress, Fiscal Years 2016–2017

May 3, 2019

Homeland Security

Federal Emergency Management Agency

Message from the Administrator

May 3, 2019

I am pleased to submit the following report, "The National Dam Safety Program Biennial Report to the United States Congress, Fiscal Years 2016–2017."

The Federal Emergency Management Agency (FEMA) prepared this document pursuant to section 10 of the *National Dam Safety Act* (NDSA) codified at 33 U.S.C. § 467h. The NDSA was enacted under Section 215 of the W*ater Resources Development Act of 1996,* Pub. L. No. 104-303.

Pursuant to congressional requirements, this report is being provided to the following Members of Congress:

- The Honorable John Barrasso, Chairman, Environment and Public Works Committee, U.S. Senate
- The Honorable Thomas R. Carper, Ranking Member, Environment and Public Works Committee, U.S. Senate
- The Honorable Shelley Moore Capito, Chair, Transportation and Infrastructure Subcommittee, Environment and Public Works Committee, U.S. Senate
- The Honorable Benjamin L. Cardin, Ranking Member, Transportation and Infrastructure Subcommittee, Environment and Public Works Committee, U.S. Senate
- The Honorable Peter A. DeFazio, Chairman, Transportation and Infrastructure Committee, U.S. House of Representatives
- The Honorable Samuel Graves, Ranking Member, Transportation and Infrastructure Committee, U.S. House of Representatives
- The Honorable Dina Titus, Chairman, Economic Development, Public Buildings, and Emergency Management Subcommittee, Transportation and Infrastructure Committee, U.S. House of Representatives
- The Honorable Mark Meadows, Ranking Member, Economic Development, Public Buildings, and Emergency Management Subcommittee, Transportation and Infrastructure Committee, U.S. House of Representatives

Inquiries relating to this report may be directed to the Congressional Affairs Division at (202) 646-4500.

Sincerely,

Pete Gaynor
Acting Administrator
Federal Emergency Management Agency

Executive Summary

The Nation has faced numerous challenges in areas near dams over the past two years that have tested its resilience and recovery capabilities. In October 2015, the eastern United States weathered severe storms and historic flooding in the Carolinas, resulting in 19 deaths. The flooding led to dozens of dam failures which strengthened the floodwaters exponentially. In 2016, Hurricane Matthew resulted in a record 17 dam failures in North Carolina alone. In February 2017, the main spillway at the Lake Oroville Dam in California failed, forcing the evacuation of 180,000 people in the surrounding communities. In late 2017, the Atlantic Ocean produced a succession of storms including Hurricanes Harvey, Irma and Maria, and flooded areas across the United States. Hurricane Harvey filled the reservoirs of the Addicks and Barker Dams in Texas to record levels, prompting emergency actions to relieve pressure on the dams and prevent overtopping. In Florida, strong winds and rain from Hurricane Irma raised concern for potential over wash at the Herbert Hoover Dike, prompting evacuations. In Puerto Rico, the Guajataca Dam overtopped, prompting evacuations there as well and significant concern over potential dam failure.

The frequency and severity of these events highlights the importance of a 'whole community' approach to dam safety that takes into consideration the integrity of dams, emergency management and preparedness for potential dam failures, and communicating the risks and impacts in areas around dams. The National Dam Safety Program (NDSP) is an essential part of the Nation's comprehensive approach to dam safety and dam risk management.

Creation of the National Dam Safety Program

In response to the Buffalo Creek flood disaster in 1972, Congress enacted Public Law 92-367, the *National Dam Inspection Act*, which authorized the U.S. Army Corps of Engineers (USACE) to inventory and inspect non-federal dams. In November 1977, in response to the Kelly Barnes Dam failure, President Jimmy Carter directed the Corps, in cooperation with the states, to proceed under the authority of Public Law 92-367 to inspect non-federal dams classified as high-hazard potential because of the downstream population at risk. In 1979, Executive Order 12148 established FEMA and provided it the authority to coordinate all national efforts in dam safety, and to "reduce the risk of life and property from dam failure in the United States through the establishment and maintenance of an effective National Dam Safety Program to bring together the expertise and resources of the federal and non-federal communities in achieving national dam safety hazard reducton." FEMA has continued to act as the lead federal agency on dam safety in the United States and to support the safety of the Nation's dam infrastructure through state assistance funds, emergency action planning, training, public outreach, researching, and creating new guidance regarding the maintenance and construction of dams.

The NDSP was reauthorized in May 2014 as part of the *Water Resources Reform and Development Act* (WRRDA). The NDSP has a maximum budget authorization of $13.4 million annually. The budget is allocated among training, technical assistance, research funding, public awareness, and support to states through grant awards that encourage improved dam safety and public awareness. In FY 2017, the NDSP was amended under the Water Infrastructure Improvements for the Nation Act (WIIN) which authorized FEMA to establish a new grant program under the NDSP (33 U.S.C. 467f). Section 5006 of the WIIN Act, Rehabilitation of

High Hazard Potential Dams, provides technical, planning, design, and construction assistance in the form of grants for rehabilitation of eligible high hazard potential dams.

The past few years have been a reminder that, despite the progress FEMA has made through the NDSP, continued investment in dam infrastructure is required to safeguard the lives and property of American citizens. FEMA continues its NDSP mission to research new technologies and methodologies, while also assisting other entities with dam safety interests to adequately prepare communities across the nation on how to address dam risks.

Between FY16-17, FEMA demonstrated progress toward all goals and objectives in the NDSP strategic plan. Throughout this biennial report, activities performed that were related to a strategic goal or objective are noted. The goals and objectives include:

- **Goal 1: Reduce risks to life and property associated with dams.**
    - Objective 1: Identify and inventory all dams, and assess the risks dams pose to life, property, and the environment.
    - Objective 2: Reduce the likelihood of dam failures.
    - Objective 3: Identify, coordinate, and align relevant federal programs on dam safety to leverage capabilities.
    - Objective 4: Promote a program of Emergency Action Plan (EAP) development, implementation, and exercise for dams in the United States.
    - Objective 5: Support and improve effectiveness of state dam safety programs.
- **Goal 2: Increase awareness of the risks associated with dams and the benefit of federal and state dam safety programs.**
    - Objective 6: Assist federal and state dam safety programs in effectively communicating with the public.
    - Objective 7: Develop guidance and resources to engage with stakeholders to increase awareness of effective methods to reduce risks related to dams.
    - Objective 8: Educate dam owners on effective risk reduction methods and risk communication related to dams.
- **Goal 3: Advance the state of practice of dam safety and dam risk management.**
    - Objective 9: Promote dam safety hazard education to facilitate effective federal and state dam safety programs.
    - Objective 10: Promote research to facilitate effective federal and state dam safety programs.
    - Objective 11: Incorporate lessons learned from dam incidents and failures to improve dam safety programs and inform research.

The following is a sample of the many accomplishments and improvements FEMA has completed through the NDSP in FY 2016 and FY 2017:

- FEMA developed the South Carolina White Paper in FY 2016. It provided state and local officials with consolidated data about the 49 state-regulated dams that breached during

the flooding event which resulted in disaster, including recommendations on improvements to state and federal programs and processes for dam safety.

- FEMA invested NDSP research funding in the Decision Support System for Water Infrastructure Security (DSS-WISE™ Lite), a geospatial, web-based, automated dam-break flood simulation and mapping system. The computational speed of DSS-WISE™ Lite makes it an ideal tool for operational modeling during dam safety emergencies and for developing dam breach inundation maps for emergency action planning. DSS-WISE™ Lite was used extensively by the State of California during the Oroville Dam spillway incident.
- FEMA streamlined its grants management process for the NDSP state assistance grants starting in FY 2016, and delegated program and grants management responsibilities to each of the ten FEMA Regions.
- The FEMA Administrator released the Strategic Plan for the NDSP for FY 2018 through 2023 as required by the Water Resources Reform and Development Act of 2014 (Public Law 113-121). The Strategic Plan presents strategic goals and objectives to reduce the risks to life and property from dam failure in the United States, and it identifies supporting activities funded under the Dam Safety Act of 2014.
- In FY 2017, FEMA entered into a partnership with the Association of State Dam Safety Officials (ASDSO) that provides state dam safety officials unlimited access to ASDSO's Web-Based Training Program live webinars held October 2017 through September 2018 and access to ASDSO's archived webinars at no cost to the state dam safety program. This partnership also includes financial support to ASDSO for maintaining and updating the Dam Failure and Incidents website.
- In February 2017, FEMA's Emergency Management Institute (EMI), continued the tradition of conducting an annual NDSP Technical Seminar, "Interim Risk Reduction Measures". More than 200 attendees were present, with representation from federal agencies, state dam safety officials, and county emergency management officials.
- FEMA released the Hurricane Matthew North Carolina Dam Risk Assessment Report which assessed post-Hurricane Matthew dam safety. The intent is to promote resiliency and reduce future dam-related risks in North Carolina and throughout the country. The findings demonstrate the importance of a coordinated approach towards managing risks associated with dams.
- In 2017, FEMA entered into a partnership with Argonne National Laboratory to develop a collaborative technical assistance series to help communities at-risk of dam-related flooding to gain a better understanding of their risk landscape and the potential consequences of dam-related emergencies. The assistance will include planning for emergencies related to operational discharges or dam-related infrastructure failure.

The National Dam Safety Program: Biennial Report to the United States Congress, Fiscal Years 2016–2017

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I. Legislative Requirement

This document responds to the reporting requirement set forth in Section 10(b) of the *National Dam Safety Program Act* (codified at 33 U.S.C. 467h):

> (b) BIENNIAL REPORTS. -- Not later than 90 days after the end of each odd-numbered fiscal year, the Administrator shall submit a report to Congress that:
>
> (1) describes the status of the Program;
>
> (2) describes the progress achieved by federal agencies during the 2 preceding fiscal years in implementing the Federal Guidelines for Dam Safety;
>
> (3) describes the progress achieved in dam safety by States participating in the Program; and
>
> (4) includes any recommendations for legislative and other action that the Administrator considers necessary.

II. Background

The first federal legislation for dam safety, the *National Dam Inspection Act* (P.L. 92-367), was enacted in 1972 and codified under Title 33 United State Code, Chapter 9, Subchapter VII. This act authorized the Secretary of the Army to inspect dams across the country, to create the National Inventory of Dams (NID) and to provide recommendations for a national program for the inspection and regulation for the safety of dams.

In 1979, the Federal Guidelines for Dam Safety (Guidelines) were prepared by the ad hoc Interagency Committee on Dam Safety (ICODS) of the Federal Coordinating Council for Science Engineering and Technology. In 1979, a Presidential Memorandum required the head of each federal dam safety agency to implement the Guidelines.

FEMA was created by Presidential Reorganization Plan No. 3 of 1978. However, Executive Order 12127, dated March 31, 1979, began implementing the operation of FEMA on April 1, 1979, by transferring various key functions and offices from various organizations to FEMA and abolishing those offices in the originating organizations in agreement with the Reorganization plan. Executive Order 12148, Federal Emergency Management, dated July 20, 1979, continued to transfer or reassign key functions, offices and established key responsibilities and delegations to the FEMA Director, among other items. One of the new responsibilities given to FEMA was the responsibility for coordinating federal dam safety activities.

The action of the Executive Branch was followed in 1986 by federal legislation to address dam safety, the Water Resources Act of 1986. Title XII of this legislation authorized the state assistance program, the establishment of a National Dam Safety Review Board (NDSRB), research and training programs, and funds to maintain and update the NID. Despite this recognition, there was no legislatively mandated NDSP until 1996, when Congress enacted Public Law 104-303.

In 1996, the National Dam Safety Program Act, included within the *Water Resources Development Act* (P.L. 104-303), was passed with the Director of FEMA designated as the Administrator of the NDSP. This act authorized the formation of the National Dam Safety Review Board (NDSRB), financial assistance (in the form of grants) to state dam safety programs, and funding for maintaining the NID, research, and training related to dam safety. The act calls for FEMA to provide education to the public, to dam owners, and others about the

Figure 1 – Timeline of legislation creating and authorizing the NDSP

need for strong dam safety programs, nationally and locally, and to coordinate partnerships among all stakeholders within the dam safety community to enhance dam safety.

NDSP was reauthorized in 2002 under the *National Dam Safety and Security Act*, in 2006 and again in 2014 under WRRDA, Public Law 113-121. NDSP was reauthorized in 2002 under the *National Dam Safety and Security Act*, in 2006 and again in 2014 under WRRDA, Public Law 113-121. Amendments were made again in December 2016 to the National Dam Safety Program Act to implement NDSP High Hazard Potential Dam Rehabilitation Grant Program in accordance with the 2016 *Water Infrastructure Improvements for the Nation (WIIN) Act.*

The purpose of the NDSP is to "reduce the risks to life and property from dam failure in the United States through the establishment and maintenance of an effective national dam safety program to bring together the expertise and resources of the federal and non-federal communities in achieving national dam safety hazard reduction" (33 U.S.C. § 467).

III. Results and Analysis

Progress on Implementation of the Federal Guidelines for Dam Safety

A. Organization, Administration, and Staffing

The NDSP plays a pivotal role in understanding the complex nature of FEMA's core competencies related to dam risk management.

FEMA headquarters currently employs three full-time employees (FTE) which include the NDSP Manager and two Civil Engineers. In FY 2016, FEMA delegated certain program and grants management responsibilities to each of the ten FEMA Regions. However, the FEMA Regional offices do not have dedicated FTE dam safety positions. Rather, the delegated points of contact manage dam safety responsibilities in addition to other FEMA programs. While the NDSP operates at the most effective level possible, the lack of staff hinders the capacity at which the NDSP can be administered both nationally and to the states.

B. Dam Safety Training Activities

A key element in FEMA's dam safety strategy is training. NDSP and its partners all offer a wide range of training to people who work in the dam sector through traditional in-person and online or virtual formats. All training that is necessary to improve the Nation's dams infrastructure is readily available at little or no cost. Organizations ranging from the Department of Labor's Mine Safety and Health Administration to FEMA's EMI provided the learning sessions required to make ideas surrounding dam safety more broadly known to others. Throughout FY 2016 and FY 2017, training opportunities were offered internationally, on the web, and within classrooms settings.

C. Dam Inventories

The National Dam Inspection Act of 1972 (33 U.S.C. § 467) authorized the USACE to inventory dams in the United States. USACE published the initial National Inventory of Dams (NID) in 1975 and has continued to maintain and update the NID through today, working closely with FEMA and state regulatory offices to obtain more accurate and complete information. The goal

of the NID is to include all dams in the United States that meet at least one of the following criteria:

- High hazard potential classification – loss of one human life is likely if the dam fails;
- Significant hazard potential classification – no probable loss of human life but possible economic loss, environmental damage, disruption of lifeline facilities, or impact on other concerns if the dam fails;
- Equal to or more than 25 feet tall and more than 15 acre-feet in storage capacity; or,
- More than 6 feet tall and equal to or more than 50 acre-feet storage capacity.

USACE maintains the NID by periodically collecting dam characteristics from 50 states (Alabama currently has no dam safety legislation or formal dam safety program but they do share some data), Puerto Rico, and 18 federal agencies. In 2016, USACE developed a web-based application that allows state and federal agencies to map their local database fields and values to NID database fields and values. USACE completed its most recent update to the NID in FY 2016, using this new tool. USACE then resolved duplicate and conflicting data from 69 data sources to obtain the most complete, accurate, and updated NID. Today, the NID consists of 70 database fields that describe the physical and regulatory aspects of a dam.

The updated NID captures more accurate and comprehensive data on existing dams, changes in existing dams, and new dams. As the update process continues, the quality of information at all levels in the Nation's dam safety community continues to improve. State inspections and data sharing among state and federal agencies verify or amend existing data and identify or provide missing information. This approach leverages the economic advantages of a partnership effort, fosters cooperation among state and federal agencies, and strengthens government and non-government risk management and decision-making at the state, local, and national levels.

Since the authorization and implementation of the NDSP, it has become increasingly clear that additional information is required to support dam safety. These data needs include:

- Documenting the condition of the Nation's dams
- Tracking the existence and progress of dam safety programs
- Supporting dam safety professionals responsible for evaluating and maintaining the safety of dams in the United States

In response to a FY 2017 NDSRB recommendation, USACE is considering modifying security restrictions to the NID. USACE proposes that the benefits of making the information accessible to the public could outweigh the security risks; to continue to restrict access to the information could pose significant challenges to facilitating effective risk communication with stakeholders, and these changes could result in more accurate and complete NID data. USACE is currently seeking input from the other federal agencies on the following proposed actions:

- Opening the Condition Assessment data fields to unrestricted public access
- Opening the Hazard Potential Classification data field to unrestricted public access
- Allowing full download of the publicly available NID database information

D. Grant Assistance to the States

The primary purpose of the NDSP is to provide financial assistance to the states to strengthen their dam safety programs. The states use NDSP funds for the following types of activities:

- Dam safety training for state personnel

- Increase in the number of dam inspections
- Increase in the submittal and testing of EAPs
- A timely review and issuance of permits
- Improve coordination with state emergency preparedness officials
- Identify dams in need of repair or removal
- Conduct dam safety awareness workshops and creation of dam safety videos and other outreach materials

During the reporting period of FY 2016 – FY 2017, NDSP awarded a total of $6,800,000 and $7,500,000 in grant funding to the states.

E. Dam Safety Research

NDSP has a stated goal to "Promote research and training for state dam safety and other professionals." Research investments were made in DSS-Wise and the Zantech IT Services training research team.

DSS-Wise

In late September 2015, FEMA entered into a 5-year contract with the University of Mississippi National Center for Computational Hydroscience and Engineering to:

- Open the DSS-WISE™ Lite capability for use by state dam safety offices and FEMA staff and relevant stakeholders.
- Develop and deliver training and materials for users on how the acquire and utilize services provided.
- Provide an online technical support hotline for users.
- Develop additional 2-dimensional modeling capabilities during the four optional years that can be used by state dam safety offices and FEMA to conduct analytics in various areas of interest, such as dam/levee breach floods, fluvial floods, landslide waves, and their consequences.

Background

Providing the DSS-WISE Lite capability to state dam safety offices aligns with the Department of Homeland Security (DHS) Quadrennial Homeland Security Review Mission 5: Strengthen National Preparedness and Resilience, FEMA Strategic Priority 4: Enable Disaster Risk Reduction Nationally, and Objective 4.1: Provide credible and actionable data and tools to support risk-informed decision-making. Also, providing this capability also enables FEMA to meet NDSP objective 5: Develop technical materials for federal and state dam safety programs.

The DSS-WISE Lite capability also enables FEMA Headquarters and Regional Offices to run rapid dam break inundation analyses when existing data is not available. The DSS-WISE capability can be leveraged by multiple components within FEMA. Dam inundation maps can be used to support FEMA's Risk Mapping, Planning and Assessment (Risk MAP) activities, response and recovery planning, and emergency preparedness activities such as planning and designing exercise scenarios. The total amount of the contract is $1,222,285.

An important outcome for NDSP and the Nation, if Strategic Priority 4 is achieved, includes enhanced, focused, and comprehensive dam risk management research and development products. The intent of this Dam Safety Research Process Management Plan is to identify specific actions FEMA can take to support the goals and objectives of the current and future NDSP Strategic Plan.

Zantech IT Services Research Reports

Two reports were developed under a contract with Zantech IT Services. AECOM provided subcontractor support:

- Technical Assistance and Training Management Plan
  - Develop a training baseline by assessing current stakeholder training and technical assistance needs for dam safety and initiating a gap analysis.
  - Develop recommendations for a NDSP Training and Technical Assistance Management Plan that will be used to address the shortfalls and gaps identified in the gap analysis. Recommendations include procedures for managing training development, identifying logistics requirements, developing methods of measuring customer satisfaction, acquiring the tools and materials needed to ensure the quality of this effort and establishing performance tracking measures that can be used to maintain and update the training materials
- Research Process Management Plan
  - Develop recommendation for a Dam Safety Research Management Process to evaluate and prioritize dam research projects.

Figure 2 – The NDSP strategic outreach process.

The total contract amount for both reports was $389,798.40.

F. Public Awareness and Outreach

The 2014 Reauthorization of NDSP: Section 11 notes:

The FEMA Administrator, in consultation with the other federal agencies, state, and local governments, dam owners, the emergency management community, the private sector, non-governmental organizations and associations, institutions of higher education, and any other appropriate entities shall, subject to the availability of appropriations, carry out a nationwide public awareness and outreach initiative to assist the public in preparing for, mitigating, responding to, and recovering from dam incidents.[1]

Given this charge, NDSP sought to find a common thread and leverage ongoing FEMA and DHS activities and priorities to create well defined strategic communication workplan to guide the

1 This aligns with Goal 3, Objectives 7 and 8 of the NDSP Strategic Plan.

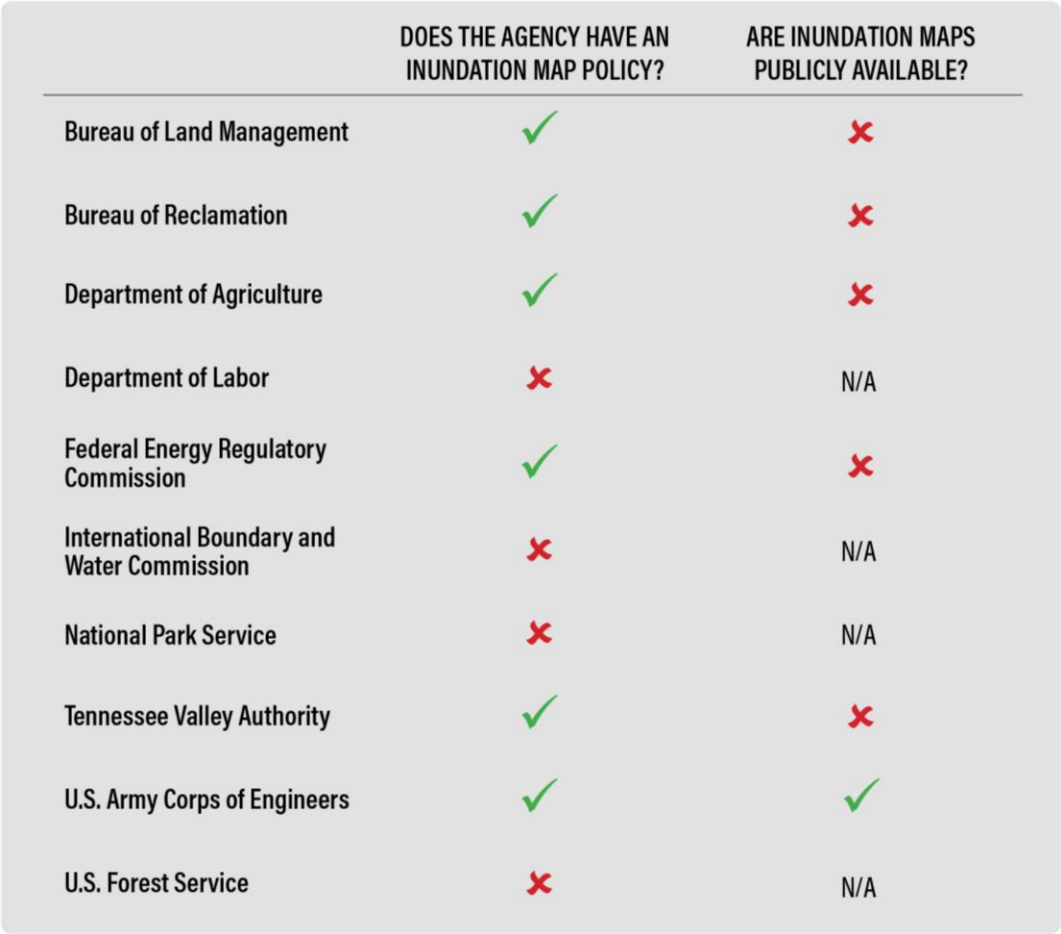

Figure 3– Six agencies represented in ICODS have internal inundation policies. One makes inundation maps publicly available.

programs efforts. Figure 2 outlines the process that was utltized to find the linkages and develop the plan.

The initial plan has been completed and will be implemented. This plan will be used to establish performance measures and as a means of tracking outcomes, while simultaneously allowing NDSP to assess efforts on a regular basis and inform future development of strategic goals.

Inundation maps can be an important tool to inform policy prescribing the protection of the public during an event. However, there are security concerns over the availability of these maps, given their nature is to identify potential for the dam to not perform as intended. Figure 3 shows ICODS member agency policies toward inundation mapping and sharing with the general public.

The NDSRB formed the Information Sharing Task Group to identify the most effective ways to communicate dam risk to populations at risk from dam operations and emergencies. The purpose of the Task Group is to guide the development of products for stakeholders with a role and responsibility in communicating the risk associated with dam related hazards associated with dams throughout the five FEMA mission areas: prevention, protection, mitigation, response and recovery. Stakeholders include security professionals, state and local emergency managers, dam safety professionals, and floodplain managers, among others.

The following identifies the objectives and scope of activities of the Task Group:

- Identify existing methods on effective risk communication related to dams.
- Develop a guideline outlining how dam owners/operators can effectively communicate dam risk information to emergency services/support organizations while protecting sensitive information.
- Develop tools and resources for emergency services/support organizations on the most effective use of the information while protecting sensitive information.
- Develop an outreach strategy for FEMA to communicate and distribute the products developed by the Task Group.

G. Publications and Resources

To encourage individual and community responsibility for dam safety, NDSP coordinates through two federal partnerships, the NDSRB and the Interagency Committee on Dam Safety (ICODS). It is through these partnerships that the NDSP is able to leverage resources and subject matter expertise to produce technical manuals and guidelines each year. The following is a summary of the NDSP publications that were produced during FY 2016 and FY 2017:

- Be Aware of Potential Dam Failure in Your Community Fact Sheet
  - https://www.fema.gov/media-library-data/1485871092404-7a14db27056f2f5bb7bb75cfcbe017d1/damsafety_factsheet_2016.pdf
- Catalog of FEMA Dam Safety Resources (*2016 Update*)
  - https://www.fema.gov/media-library/assets/documents/4603
- FEMA P-911: Pocket Safety Guide for Dams and Impoundments (*2016 Update*),
  - https://www.fema.gov/media-library/assets/documents/127281
- FEMA P-1069: FEMA National Dam Safety Program Overview Fact Sheet,
  - https://www.fema.gov/media-library/assets/documents/5865
- FEMA P-1801: South Carolina Dam Failure Assessment and Advisement,
  - https://www.fema.gov/media-library/assets/documents/129760

Notable Incidents During the Reporting Period[2]

South Carolina (October 2015)

At the onset of fiscal year 2016, South Carolina was inundated by record rainfall. The weather caused 1000-year flooding through the majority of the state. The already historic circumstances were further aggravated when dozens of dams failed – 49 state regulated dams, one federally regulated dam, two sections of the levee adjacent to the Columbia Canal, and multiple unregulated dams.

To assist with the recovery efforts, FEMA's Mitigation Directorate deployed a team, including the NDSP Manager, assisted South Carolina in assessing the dams and providing insights to the regional authorities: the State of South Carolina, FEMA's Region IV and the Joint Field Office

2 This aligns with Goal 1, Objective 4 of the NDSP Strategic Plan.

leadership coordinating the disaster response and recovery efforts. The white paper that was developed from these efforts included a recommendation for the Hazard Mitigation Technical Assistance Program to issue a task order to aid the citizens of South Carolina in their recovery efforts.

The Carolinas (October 2016)

Shortly after the one year anniversary of South Carolina's historic flooding, Hurricane Matthew formed in the Atlantic Ocean and impacted both North and South Carolina to devastating effect. Rain fell across the states, resulting in numerous dams failing once more across the eastern portions of area. Some North Carolina locations experienced up to 15 inches of rainfall in a 24-hour period. North Carolina saw 12 state regulated dams fail while 20 state regulated dams breached in South Carolina as well. Between the 2015 and 2016 events, there were 83 state regulated dams that were breached in two states alone.

In their follow up study, NDSP recommended numerous steps for the pertinent regional authorities to undergo to mitigate future risks. These steps included recommended alterations to current processes in place for dam regulations, preparedness, response, recovery, and mitigation.

Incidents Throughout 2017

In mid-February 2017, the Lake Oroville Dam spillway failed. Heavily inundated by seasonal weather, dam operators, following standard practices, opened the gates to relieve pressure. This intentional release led to the main spillway crumbling along one side and water to escape. While the dam's primary facilities were not compromised, a list of structure issues were uncovered that had aided in the deterioration and failure of the spillway. Over 200,000 people were displaced in the resulting floods.

In late summer of 2017, the Atlantic Ocean has seen its busiest hurricane season on record. A succession of storms impacted and flooded multiple areas of the United States including the Gulf Coast, South Carolina and Georgia, the U.S. Virgin Islands, Florida, and Puerto Rico.

As Hurricane Harvey impacted eastern Texas, engineers were periodically releasing water from area dams to relieve pressure to prevent overtopping. The Addicks and Barker Dams in Houston did not fail, however both reservoirs were filled to record levels from the storm.

In Puerto Rico, the Guajataca Dam began spilling over and left many concerned that it might trigger a potentially life-threatening situation. Preemptively, local officials urged residents to evacuate out of potential harms way. In these situations, dam failure has been a looming cause for concern in the communities impacted by these events.

These separate incidents all made national news, highlighting the need for a holistic approach to dam safety that takes into consideration the structural integrity of dams and their potential impacts upstream and downstream.

State Dam Safety Program Performance in the Reporting Period

State dam safety programs regulate 70 percent of the 90,580 dams listed in the NID. State dam safety programs inspect existing dams, oversee remediation of deficient dams, and work with local officials and dam owners on emergency preparedness. States provide annual program performance information on key metrics such as having an EAP, inspections of existing dams, remediation, staffing and budgets, while ASDSO and USACE compile the information for state and national trends.

National EAP Completion Percentage for States

The percentage of state-regulated high hazard potential dams nationally with an EAP increased from 32 to 79 percent from 1998 to 2016. Nearly every state has shown improvement in the number of EAPs for high hazard potential dams with no state showing a significant decrease. Many states had increases of several hundred to several thousand percent.

In 2016, 27 states reported having state-regulated high hazard potential dams with an EAP at 90 percent or greater, an increase from nine states in 1998 (see Figure 8 and 10).

National Inspection Completion Percentage for State

The national average for the inspection of existing state-regulated high hazard potential dams has remained relatively steady during the reporting period from 1998 to 2016, as inspection of existing dams has been a state priority. States reported completion of 107 percent of scheduled inspections for state-regulated high hazard potential dams in 2016. Inspection percentages may vary above and below 100 percent for any given year based on a state's inspection frequency and scheduling (e.g., a state with an inspection frequency of every two years might inspect more than half of the dams in the first year, or greater than 100 percent, in order to take advantage of their close proximity) (see Figure 4, 5, 6 and 7).

National Percentage of State Identification of Deficient High Hazard Potential Dams

In 2009, the NID began collecting condition rating data on high hazard potential dams. Those with poor or unsatisfactory ratings are considered in need of remediation. In the 2016 NID, 85 percent of state-regulated high hazard potential dams are rated. States voluntarily submitted this data and the number of dams not rated continued to decrease. From 2009 to 2016, there was a 36 percent increase (34 to 70 percent) in dams with either a satisfactory or fair rating. The percentage of dams with condition ratings of poor and unsatisfactory (those in need of remediation) increased from 7 to 15 percent as more dams were rated (see Figure 9).

Application of ICODS Technical Guidance: Identifying Dam Status and Implementing EAPs

A large part of ensuring dam safety is knowing the status and circumstances of any given dam. Dam assessment allows for the establishment of an inventory of needs. For dams that are considered healthy, the development of EAPs creates a contingency plan to protect life and property in the future. For the dams that are not currently in good standing, the discovery of those unsatisfactory conditions helps establish a platform for moving forward. The platform that developed from the aforementioned information went into the development of the NDSP Strategic Plan.

State-regulated dam inspections increased. Formal inspections include a review to determine whether the dam meets current accepted design criteria and practices. The inspection should include a review of all pertinent documents including instrumentation, operation, maintenance and, to the degree necessary, documentation on investigation, design, and construction. The inspection should also verify that operating and emergency response instructions are available and understood, instrumentation is adequate, and data are assessed to ensure that structures are performing as designed. Intermediate inspections include a thorough field inspection of the dam and appurtenant structures and a review of the records of inspections made at and following the last formal inspection.

Based on state dam safety legislation, below is the state-regulated inspection frequency for high hazard potential dams.

State regulated High Hazard Potential Dam Inspections	
Number of states	**Frequency**
16 states	Every year
18 states	Every 2 years
5 states	Every 3 years
1 state	Every 4 years
9 states	Every 5 years
1 state	Every 6 years

Table 1 – State-regulated high hazard potential dam inspections.

Figure 3 shows the percentage of state-regulated high hazard potential dams that were inspected of the total number that were due for inspection from 2006 to 2016. Inspection percentages may vary above and below 100 percent for any given year based on a state's inspection frequency and scheduling.

Figure 4 shows the percentage of state-regulated significant hazard potential dams that were inspected of the total number that were due for inspection from 2006 to 2016. Table 2 shows the frequency of inspections on state-regulated significant hazard potential dams.

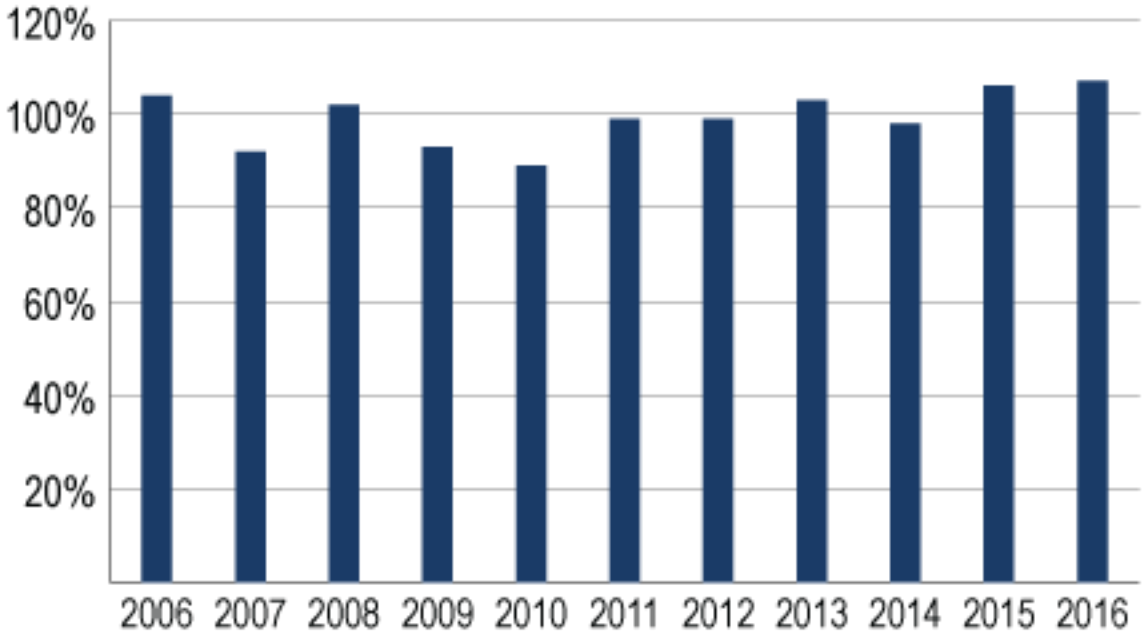

Figure 4– National inspection percentage calculated from the total number of state-regulated high hazard potential dams scheduled and inspected.

In 2016, the national inspection percentage was 107 percent, and in 52 percent of the states those inspections were formal. Therefore, in 2016, of the inspections performed on state-regulated high hazard potential dams, 71 percent of those inspections were formal. Figure 5 and Table 3 show the percentage of the state-regulated high hazard potential dams that were inspected of the total number of state-regulated high hazard potential dams due for inspection in 2016.

State regulated Significant Hazard Potential Dam Inspections	
Number of states	**Frequency**
1 state	Every year
7 states	Every 2 years
13 states	Every 3 years
6 state	Every 4 years
17 states	Every 5 years
1 state	Every 6 years
1 state	Every 10 years

Table 2 – State-regulated significant hazard potential dam inspections.

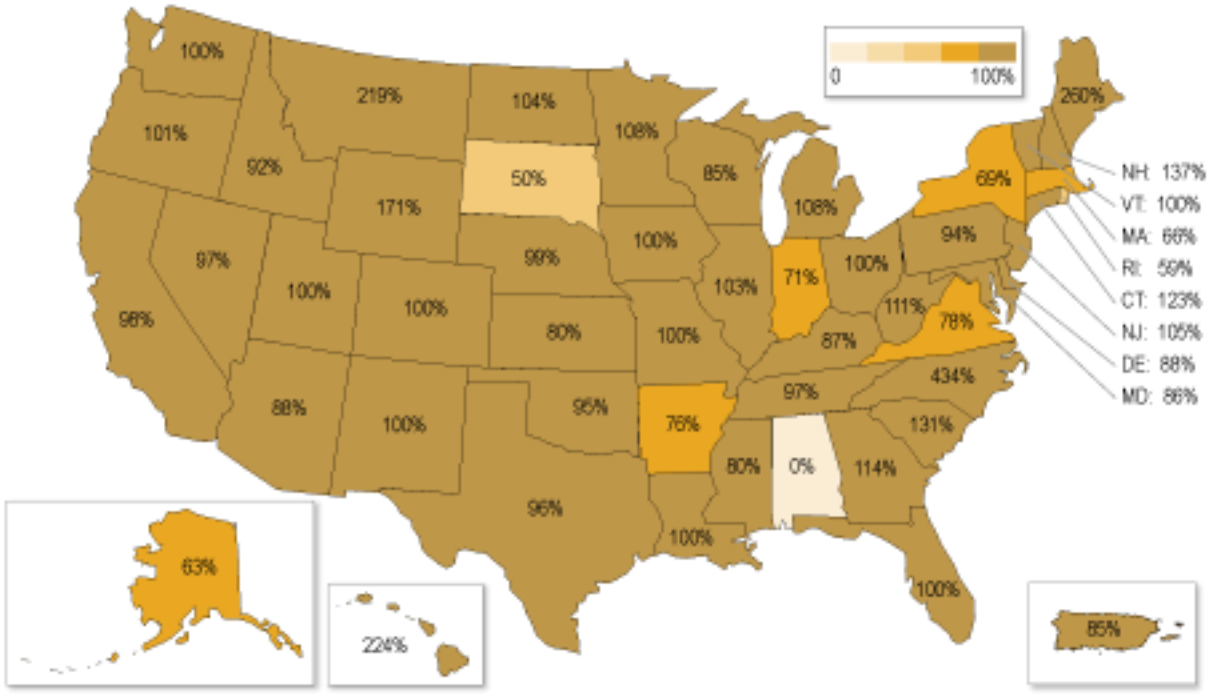

Figure 5 (above) and Table 3 (below) – The percentage of state-regulated high hazard potential dams that were inspected of the total number of state-regulated high hazard potential dams that were due for inspection in 2016.

State	HHP Dams Inspected	State	HHP Dams Inspected	State	HHP Dams Inspected
Alabama	0%	Louisiana	100%	Ohio	100%
Alaska	63%	Maine	260%	Oklahoma	95%
Arizona	88%	Maryland	86%	Oregon	101%
Arkansas	76%	Massachusetts	66%	Pennsylvania	94%
California	98%	Michigan	108%	Puerto Rico	85%
Colorado	100%	Minnesota	108%	Rhode Island	59%
Connecticut	123%	Mississippi	80%	South Carolina	131%
Delaware	88%	Missouri	100%	South Dakota	50%
Florida	100%	Montana	219%	Tennessee	97%
Georgia	114%	Nebraska	99%	Texas	96%
Hawaii	224%	Nevada	97%	Utah	100%
Idaho	92%	New Hampshire	137%	Vermont	100%
Illinois	103%	New Jersey	105%	Virginia	78%
Indiana	71%	New Mexico	100%	Washington	100%
Iowa	100%	New York	69%	West Virginia	111%
Kansas	80%	North Carolina	434%	Wisconsin	85%
Kentucky	87%	North Dakota	104%	Wyoming	171%

Inspection percentages for a particular state may vary above and below 100% for any given year based on a state's inspection frequency and scheduling due (e.g., a state with an inspection frequency of every two years might inspect more than half of the dams in the first year, or greater than 100%, in order to take advantage of their close proximity).

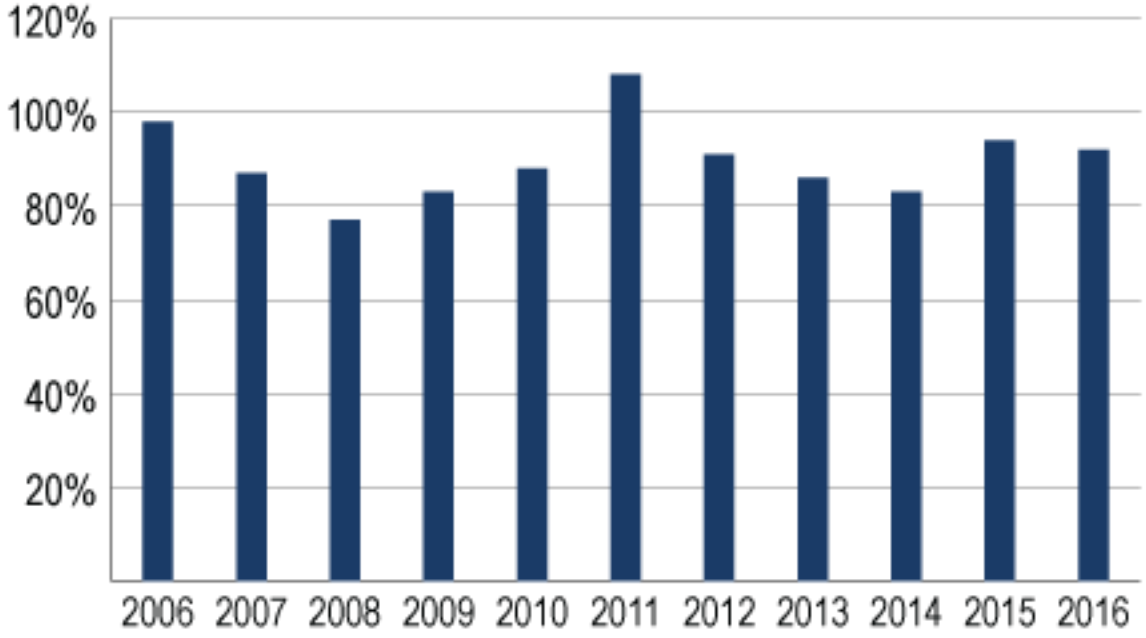

Figure 6 – Percentage of state-regulated significant hazard potential dams inspected.

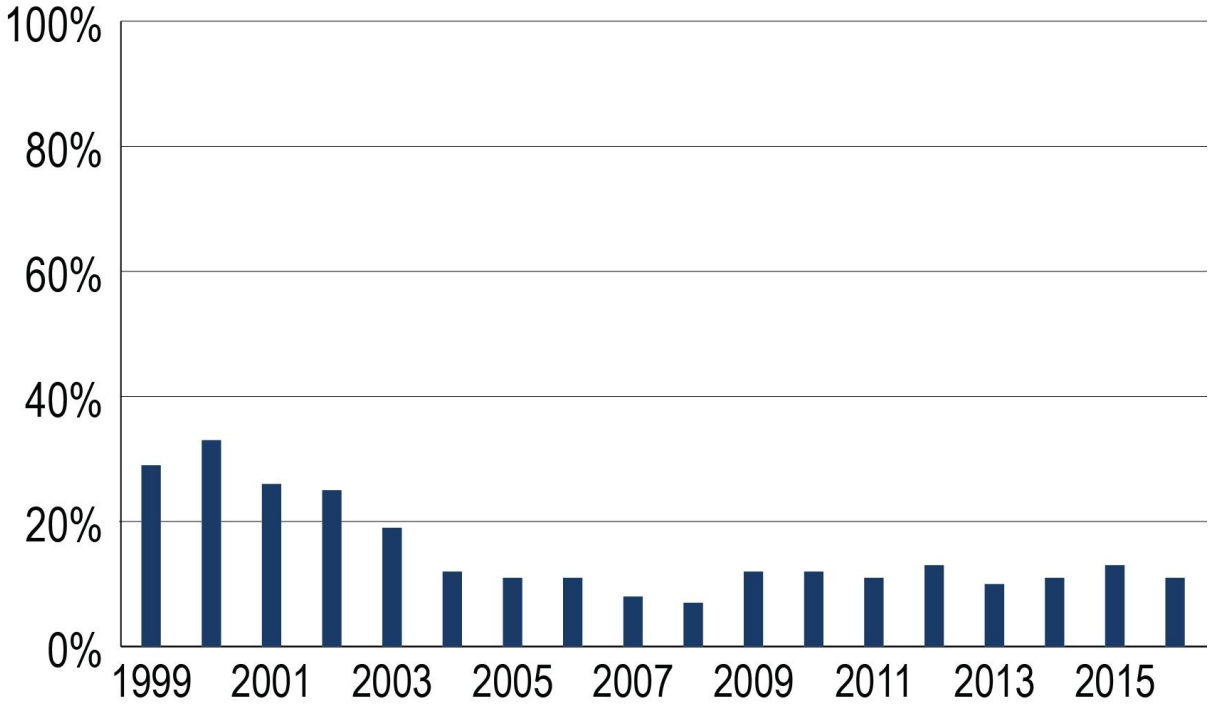

Figure 7– Percentage of state-regulated high hazard potential dams remediated

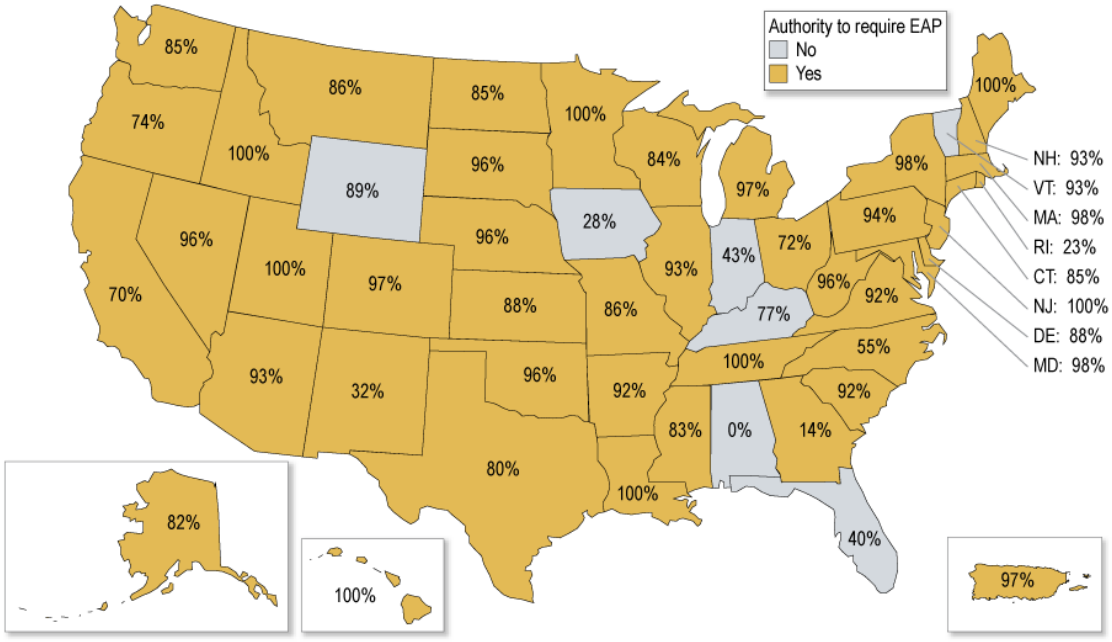

Figure 9- Percentage of state-regulated high hazard potential dams with an EAP and the states with and without the authority to require dam owners to prepare an EAP.

The 2013 NID reported 76 percent of state-regulated high hazard potential dams included a condition assessment and the 2016 NID reported 85 percent of state-regulated high hazard potential dams included a condition assessment. Figure 9 shows the percentage of state-regulated high hazard potential dams remediated between 1999 and 2016. Beginning in 2013, data collection included the number of state-regulated high hazard potential dams that have used

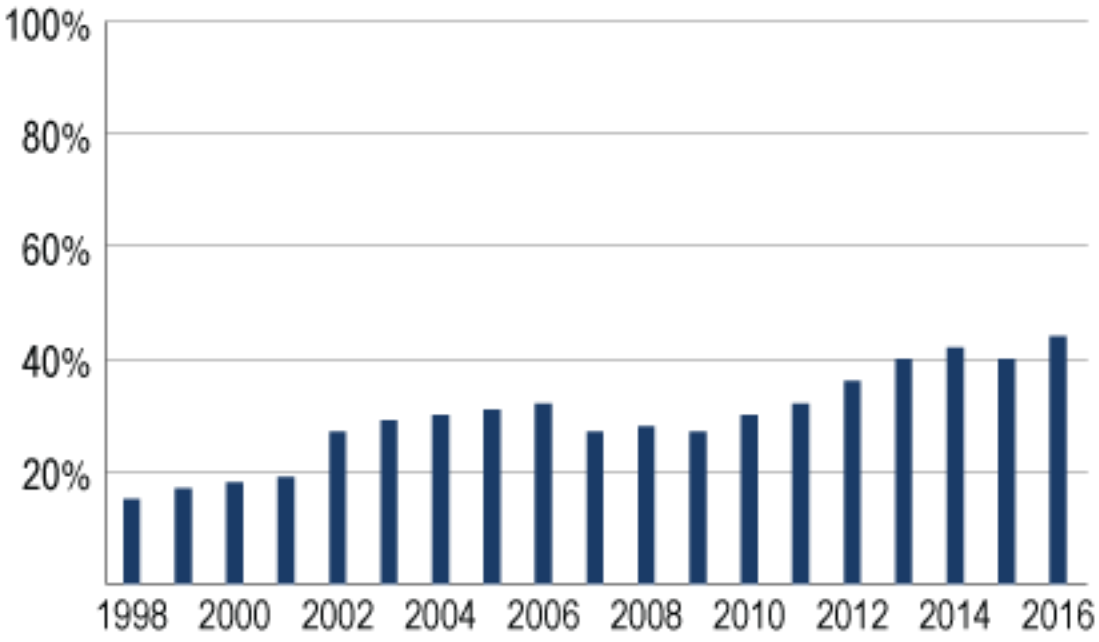

Figure 8 – EAP completion percentage for state-regulated significant hazard potential dams.

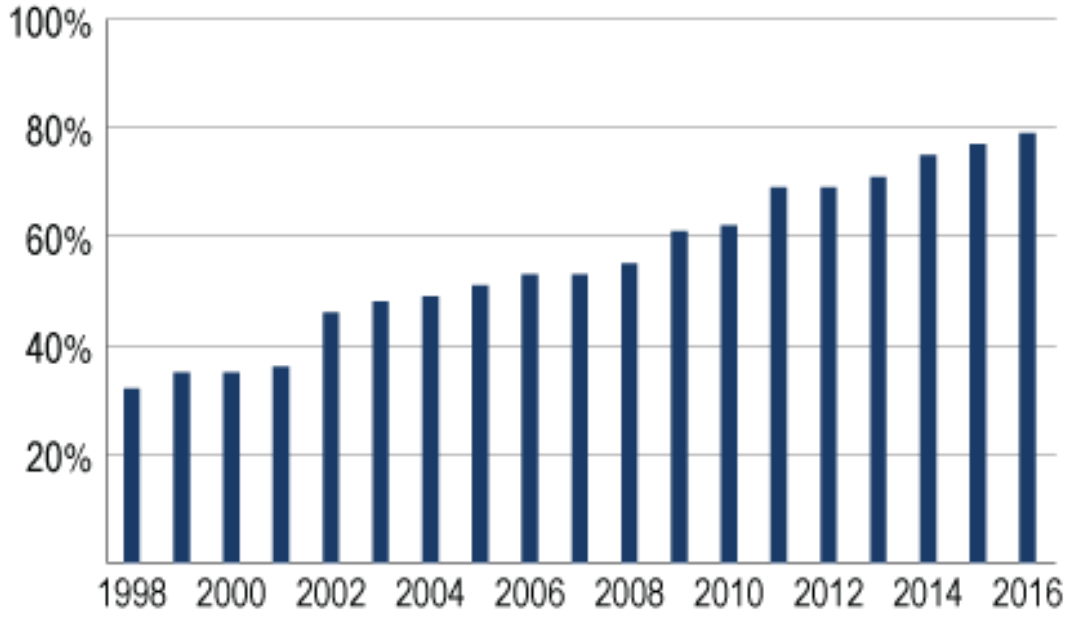

Figure 10 – Percentage of state-regulated high hazard potential dams with an EAP.

other risk reduction measures, such as reservoir restrictions, early warning systems, or plans for emergency reservoir drawdown.

The NDSP Strategic Plan Goal 2 addresses the second component of the risk equation, the consequences of a dam failure. The most common consequences are loss of human life, injuries and damage to property. Emergency action planning, particularly for the dams that pose the greatest risk, is one of the cornerstones of Goal 2. Equally important are the ongoing efforts of the NDSP to improve the consequence evaluation of dam failure.

EAPs for state-regulated high and significant hazard potential dams increased. Today, approximately 79 percent of all state-regulated high hazard potential dams have an existing EAP, a significant improvement since 1998 when states participating in the NDSP began to receive grant funding (see Figures 7 and10.

Eight states do not have the authority to require a dam owner of a high hazard potential dam to prepare an EAP: Alabama, Florida, Indiana, Iowa, Kentucky, Vermont, and Wyoming. Note – recent changes to California and Georgia legislation now requires EAPs

The state regulatory agencies and the NDSP have been focusing on high hazard potential dams as there is potential loss of life. For significant hazard potential dams, there is no potential loss of life but failure can cause severe economic and environmental damage. Less than half of all state-regulated significant hazard potential dams have an existing EAP (see Figure 9). Twenty-one states do not have the authority to require a dam owner of a significant hazard potential dam to prepare an EAP.

For 2016, 27 states reported 90 percent or more of their state-regulated high hazard potential dams had an existing EAP. In the last five years, two states have increased the number of EAPs for state-regulated high hazard potential dams more than 50 percent. Eight states have increased EAPs from 20 to 49 percent, and thirty-three states have seen a smaller increase at less than 20

percent. Five states have decreased their EAP completion percentage due to an increase in the number of state-regulated high hazard potential dams (see Figures 11 and 12).

Twenty-one states do not have the authority to require a dam owner of a significant hazard potential dam to prepare an EAP. For 2016, eight states reported 70 percent or more of their state-regulated significant hazard potential dams had an existing EAP (see Figure 8).

Figure 11 – EAP implementation and increases in EAPs for state-regulated high hazard potential dams for report years 2006 (top) and 2016 (bottom)

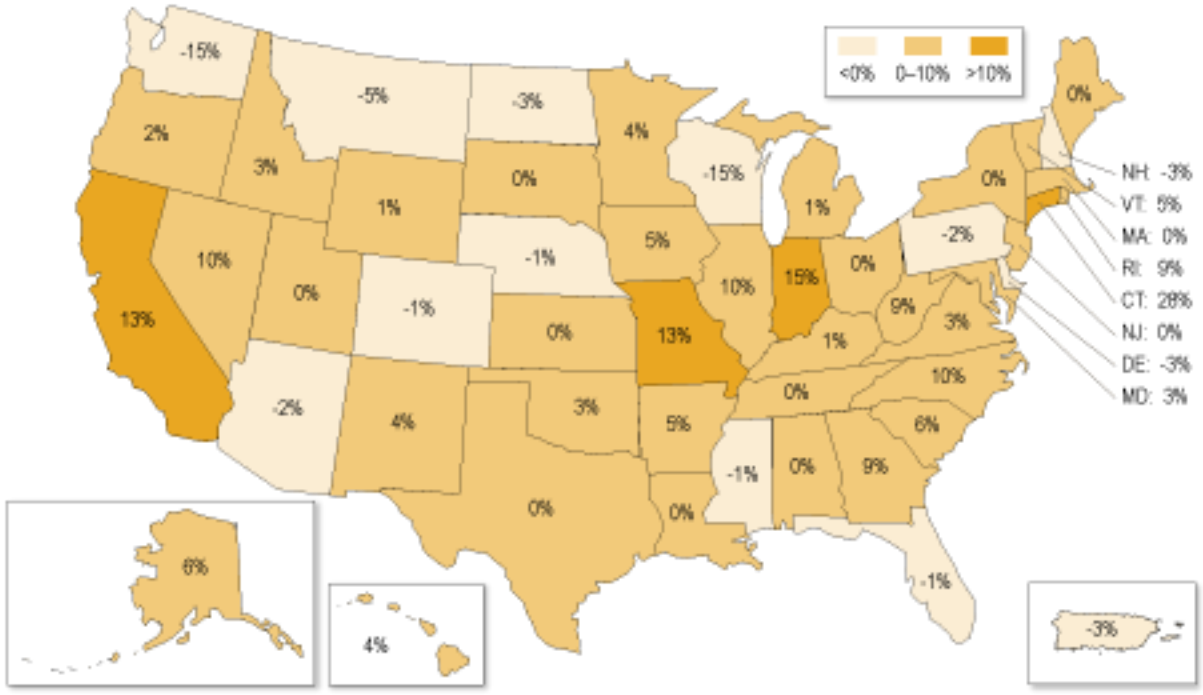

Figure 12 – Changes in EAP since 2006 (2014) for state-regulated high hazard potential dams.

The Mission is Ours: Summaries from Key NDSP Partners[3] [4]

Dam safety is a joint responsibility of dam owners, states, and federal agencies. Since the implementation of the Federal Guidelines for Dam Safety in 1979, federal agencies have done an exemplary job in ensuring the safety and improvement of dams within their jurisdiction by sharing resources. Many Federal agencies also maintain comprehensive research and development and training programs, and have now incorporated security considerations and requirements into these programs to protect their dams against terrorist threats.

United States Department of Agriculture

- **Agricultural Research Service –** The Agricultural Research Service (ARS) conducts research in support of the programs of the United States Department of Agriculture (USDA), and partners with the Natural Resources Conservation Service (NRCS) in developing the technology required for the design, construction, maintenance, rehabilitation, and safety of the dams constructed with USDA assistance. ARS works closely with NRCS to identify technology needs and to implement research results. Within ARS, research related to dam safety is carried out in National Program 211, Water Availability and Watershed Management, in the Natural Resources and Sustainable Agriculture Systems area. Federal Guidelines for Dam Safety relate primarily to ARS's activities in providing technical tools and associated information to the dam safety community. Over a period of years, the ARS has developed, or contributed to the development of, technology and engineering design criteria for pipe spillway inlets, trash racks, plunge pools and stilling basins, free-surface stilling basins, shoreline wave protection methods, reservoir sedimentation, embankment overtopping and internal erosion, and vegetated and non-vegetated earth auxiliary spillways. Research to advance the technology and refine engineering criteria is ongoing within ARS, as described in the current NP211 Action Plan. Results of this research are published in scientific journals and incorporated into design and analysis tools for application by the engineering community. Significant accomplishments are also reported annually in the ARS NP211 program reports. The ARS dam safety officer as appointed by the ARS Administrator serves on the USDA Dam Safety Committee.

  ARS has responsibility for a single, high hazard dam located at the Southern Plains Research Station (SPRS) in Woodward, Oklahoma. The SPRS conducts research on sustaining and enhancing Southern Plains rangelands and pastures. The water contained by the dam is used for irrigation and production agriculture. Lands adjacent to the impoundment are owned by the city and local property owners. In 2016, a dam assessment was completed by an independent engineering consultant for the SPRS dam. In FY 2016, ARS funded an interagency agreement with the Oklahoma NRCS to conduct annual dam inspections and to develop a design for the rehabilitation of the dam. An

[3] This aligns with Goal 5, Objective 12 of the NDSP Strategic Plan.

[4] A summary of each agency is listed below. More detailed information about each program can be found in the Federal Agencies Dam-Related Activities section.

inspection of the dam was completed in FY 2017. Additionally, the EAP for the dam is being updated.

- **United States Forest Service –** The United States Forest Service (FS) is a land management agency comprised of nine regions:
    - Region 1 – Northern Region (northeastern Washington, northern Idaho, Montana, North Dakota and northwestern South Dakota)
    - Region 2 – Rocky Mountain Region (Colorado, Nebraska, western South Dakota, Kansas and Wyoming)
    - Region 3 – Southwestern Region (Arizona, New Mexico and the panhandles of Texas and Oklahoma)
    - Region 4 – Intermountain Region (Utah, Nevada, western Wyoming, southern and central Idaho)
    - Region 5 – Pacific Southwest Region (California)
    - Region 6 – Pacific Northwest Region (Washington and Oregon)
    - Region 8 – Southern Region (Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Tennessee, Alabama, Florida, Georgia, Kentucky, Virginia, North Carolina, South Carolina and Puerto Rico)
    - Region 9 – Eastern Region (Connecticut, Delaware, Illinois, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia and Wisconsin)
    - Region 10 – Alaska Region (Alaska)

  In these nine regions there are 154 national forests, 20 national grasslands and one prairie encompassing 193 million acres.

  The FS is responsible for FS-owned dams in these regions. In addition, it is responsible for the regulation of Special Use (permitted) dams and Ditch Bill easement dams on Forest Service land not regulated by other federal or state agencies. The FS also participates in dam safety activities on USDA easement dams in many regions, but has no authority to regulate easement dams that existed in these regions prior to the FS jurisdiction.

  The FS has a variety of FS-owned dams including concrete arch, concrete gravity, timber cribbing and even steel. However, embankment dams made of either earth or rock fill constitute over 80 percent of the dams. While the Forest Service's highest FS-owned dam is 140 feet in height, 90 percent of the dams are equal to or less than 50 feet in height. About 80 percent have normal reservoir storage less than 500-acre feet. Recreation, wildlife, and wildfire response are the primary purposes for the dams. Dam ages range from 6 to over 100 years old, with over half 50 years old or greater and 80 percent older than 30 years.

  In addition to dams, the FS has approximately 370,000 miles of roads, 13,000 bridges, 40,000 buildings (administrative, recreation, research, toilet structures), 4,700 drinking water systems, 4,700 wastewater systems and over 25,000 recreational sites.

  In FY 2017, there was no funding strictly dedicated to dams. Dam operation and maintenance is funded out of the facility budget which also supports fire, administrative and other facilities. Facility budgets were allocated to the regions to prioritize regional needs across their portfolio of dams, buildings, water/wastewater system, and recreation sites. Major maintenance or rehabilitation (greater than $250,000) competes for funding

in the FS Capital Improvement Process. Facility budgets have dropped over the years making the capital improvement process very competitive.

In FY 2018, the FS a portion of the facility budget to funds dam safety, critical dam repairs, and disposal of dams. The FS attempts to prioritize their limited resources for use on their higher hazard dams or to address urgent situations.

- **Natural Resources Conservation Service – The Natural Resources Conservation Service (**NRCS) designs, finances, and constructs dams under its technical and financial assistance programs for individuals, groups, organizations, and governmental units for water storage, sediment detention, and flood protection. NRCS assumed all of the programs of the former Soil Conservation Service in the 1994 USDA reorganization. NRCS has provided technical assistance for over 29,000 National Inventory of Dams (NID)-size dams and has provided financial assistance for approximately 12,000 of these dams. NRCS maintains a staff of engineers skilled in all aspects of planning, design, construction, operation, and maintenance of dams.

  NRCS actively participates in the technical activities of the Interagency Committee on Dam Safety (ICODS), Association of State Dam Safety Oofficials (ASDSO), United States Society on Dams (USSD), and the National Dam Safety Review Board (NDSRB).

- **Rural Utilities Service –** The Rural Utilities Service (RUS) is the successor agency to the Rural Electrification Administration and includes certain programs that were formerly a part of the Farmers Home Administration and the Rural Development Administration. RUS has three major program divisions - the Electric Program, the Telecommunications Program, and Water and Environmental Programs that provide funding for infrastructure or infrastructure improvements to rural communities. The Electric Program and Water and Environmental Programs provide financial assistance for projects which could include dams. The Telecommunications Program does not finance dams.

  The RUS Electric Program is authorized to make loans and loan guarantees for rural electrification purposes to cooperatives, corporations, states, territories, subdivisions, municipalities, utility districts and non-profit organizations for financing the construction or improvement of electric distribution, transmission and generation facilities in rural areas. RUS-financed electric generation facilities could include associated dams and most hyroaulic facilities incorporate dams.Many thermal power plants also incorporate dams encompassing cooling water reservoirs, waste treatment facilities, and water storage reservoirs. RUS reviews borrowers' plans and specifications for dams but only to confirm the security of the loan or loan guarantee.

  The purpose of the RUS Water and Environmental Programs is to provide financial assistance to cooperatives, corporations, states, territories, subdivisions, municipalities, utility districts and non-profit organizations and Indian tribes for drinking water, sanitary sewer, solid waste and storm drainage facilities in rural areas. On occasion, these systems involve the construction or repair of a dam. Agency regulations for approval of financial assistance require that the owner's facility design comply with the Federal Guidelines for Dam Safety. NRCS is sometimes the lead agency on projects that include dams. Rural Development’s RUS agency regulations for approval of financial assistance require that the owner’s facility design comply with 7 CFR 1724.55 which identifies RUS specific policy regarding dams and that borrowers must utilize the “Federal Guidelines for Dam Safety” as applicable. Additionally, RUS program regulations require the

agency's state engineer to review the applicant's development plans. This review is conducted from the perspective of a lending institution, not an owner or regulator of a dam. RUS relies on the individual state dam permitting process or private engineering consultants retained by the borrower to review the safety of dams.

Any RUS financed dam must follow requirements identified in 7 CFR 1724.55 and must be designed by a professional engineer registered in the state where the dam is located. This professional engineer is responsible for ensuring that the dam is properly designed and will apply a professional engineering seal to the plans, drawings, and other design documents. This professional engineer is also responsible for verifying that the dam is constructed in accordance with the design. The borrower (owner of the dam) is responsible for obtaining and complying with federal and state permit requirements for construction and operation of a dam, and for proper operation and maintenance, including dam safety.

United States Department of Defense

- **United States Air Force –** The United States Air Force (USAF) is currently reporting on the status of 57 dams, an increase of four from the 2016 report. There have been no new dams constructed. The increase is due to basing actions and USACE identification of facilities that should have been classified as dams. At the USAF Academy, four dams have been updated since the last NID download including Kettle Lake #1, Sapphire Lake, Leo Lake, and Grace Lake. The hazard potential type and condition of these facilities are unknown at this time, but data collection efforts are currently underway.

  None of these four dams are considered "High" hazard potential dams and additional inspection and inventory efforts are required to determine which, if any, are "Significant" or "Low" hazard potential dams.

  The USAF dams are designed primarily for flood control, recreation, and water supply. These are routinely inspected and maintained using the FEMA policies and procedures for the maintenance and repair of Air Force real property. Malmstrom AFB has an impoundment dam, Pow Wow Pond that does not meet the criteria for reporting. Barksdale AFB reports on three dams: Austin Pond, Flag Lake and Harmon Lake. Although, Austin Pond is not captured in the 57 dams report for the FY 2016 report.

  The USAF continues to use a decentralized management philosophy for the dam safety program. At the installation level, all dam maintenance and/or repair projects compete for funding with the other O&M facility requirements. Programming and budgeting for the physical requirements of the dam safety program also occur at this level. There is no anticipated reduction in safety inspections or monitoring; however, budget constraints could impact future efforts.

  The USAF has recently written a Facilities Criteria-3-310-09, Dam Safety, for implementing the Air Force Dam Safety Program. This document outlines the management concepts for the Air Force dam safety program.

- **United States Army –** The Department of the Army, Assistant Chief of Staff for Installation Management (ACSIM) provides oversight to the Installation Management Command (IMCOM) and Army Landholding Command garrisons to assure they are aware of their responsibilities. ACSIM is responsible for the Army policy on dam safety, maintenance, operation, and minor repair of Army dams. Policy is addressed in Chapter

7 of the Army Regulation 420-1, "Army Facility Management." The Commander, IMCOM, is the Army Dam Safety Officer for dams that are either on Army garrisons or controlled by Army garrisons. The IMCOM provides technical support and training to Army garrisons and implements policy. Each Land Holding Command is responsible for funding within their own command and garrisons. The Army garrisons have responsibility for meeting federal laws and guidelines. Risk Management of dams at garrisons is the responsibility of the Senior Commander and Garrison Commander. High and Significant Hazard dams with Critical or Serious conditions are reported upward to the Land Holding Command for oversight and Risk Management decisions. USACE provides technical assistance as requested. Continuing Resolutions impact the scheduling of safety inspections and necessary repairs needed to keep dams in a safe operating condition.

- **U.S. Army Corps of Engineers –**USACE has a diverse inventory of 555 projects that include 714 dams located in 44 states. The dams provide a variety of project purposes including navigation, flood risk management, water supply, irrigation, hydropower, recreation, environmental, and combinations of these purposes. USACE dams are constructed from a wide range of materials including concrete, rock, earth fill, and combinations of these materials. The dams vary in age from more than 100 years old to less than 10 years old. Approximately 95 percent of USACE dams are more than 30 years old and more than half are more than 50 years old. Most have not been filled to their maximum design event. In 2016, USACE flood risk management projects prevented $196.7B of damages and, from 2007-2016, they prevented an average of $67.5B in damages annually. Historically, USACE projects avoid $9 of damages for each $1 invested. USACE is the number one United States hydropower producer at 25 percent of national capacity. 600M tons of cargo moves on inland waterways. To support this, USACE maintains 12,000 miles of inland and inter-coastal waterways. Along these waterways, USACE operates and maintains 236 navigation lock chambers at 192 sites.

  The Continuing Resolution (CR) environment within the federal budget adds complexity to managing the USACE dam portfolio as some repair contracts are deferred during CR. Risk management helps mitigate the impacts by enabling informed decisions to make the best use of available funding. CR is not impeding USACE compliance with the Federal Guidelines for Dam Safety.

- **U.S. Marine Corps –** Headquarters Marine Corps is responsible for the following relative to ensuring the adequacy of the dam safety program:
  - Establish an inspection program for all dams on their installations to include formal and special inspection programs.
  - Develop and implement Marine Corps dam safety and inspection policy
  - Program and resource to ensure the safe design, construction, operation, and inspection of Marine Corps Dams.
  - Establish, and appoint, a dam safety officer.

  The Marine Corps has established a dam safety officer at the Headquarters and has designated and trained dam safety officers at Marine Corps installations where reported dams exist.

While the Marine Corps has experienced impacts to their budget, they have not taken risks in sustainment of critical assets, including dams and dam safety.

- **U.S. Navy –** Commander Navy Installations Command (CNIC) continues their responsibility for both ownership and funding requirements for dams under their respective jurisdiction. Furthermore, United States Army Corps of Engineers (USACE) continues in the role as execution agent for performing periodic inspections, dam break analyses, Hydraulic and Hydrology (H&H) surveys, and provides support in development of EAPs when required. USACE Norfolk District has been designated as primary point of contact for this effort. Naval Facilities Engineering Command has responsibility for technical liaison between CNIC and USACE. There have been 18 candidate dams under the Navy jurisdiction for formal dam safety inspection, during this reporting period. One dam (Lake Norconian Dam (NORCO California) is a double structure dam holding back the same body of water, thus the Navy formally inspects 18 dams, though 17 are listed in the NID. There is one more dam which will be added in FY18, renovations are making it into a reportable dam (Holton Pond, MD).

U.S. Department of Energy

- **U.S. Department of Energy –** This report is to fulfill the Department of Energy's (DOE's) responsibility to provide FEMA with a dam safety program progress report for FY 2016-2017 in conformance with the FEMA Guidelines.

  In the earlier FY 2014-2015 progress report, DOE reported a total of 12 water impoundment structures under its jurisdiction that met the Federal definition of a dam. There are no changes from the last report. Of these 12 dams, two are defined as having high hydrological hazard potential, and one is defined as having significant hydrological hazard potential. The remaining nine are defined as having low hydrological hazard potential.

  DOE contractors operate the dams. The contractors report to DOE Operations/Project Offices located in Oak Ridge, Tennessee, Grand Junction, Colorado, and Aiken, South Carolina. Inspections of the DOE dams are conducted by Federal Energy Regulatory Commission (FERC), Division of Dam Safety and Inspection, personnel under local DOE contract.

  The number and hydrological hazard potential classification of DOE dams in each geographical location are as follows:

  - Oak Ridge has one dam, one dam has hydrological high or significant hazard potential, and none have hydrological low hazard potential.
  - Rocky Flats has three dams, none have hydrological high or significant hazard potential, and three have hydrological low hazard potential.
  - Savannah River has eight dams, two have hydrological high or significant hazard potential, and six have hydrological low hazard potential.

  There have been no significant changes in DOE contractor staff responsible for the operation of DOE-owned dams or in the dam safety program during this reporting period.

- **The Power Marketing Administrations –** There are four DOE Power Marketing Administrations (PMAs) – Bonneville Power Adminstration, Southeastern Power Administration, Southwestern Power Administration, and Western Area Power

Administration – responsible for marketing power generated at 133 multi-purpose Federal dams owned primarily by USACE and the Bureau of Reclamation. Power rates charged to not-for-profit wholesale utility customers recover all costs associated with power production and transmission. This includes a share of the dam's joint construction and operation and maintenance costs assigned to the Congressionally authorized project purposes. For certain dam safety repairs, Congress specified distinct cost share assignment responsibilities in the Reclamation Safety of Dams Act of 1978 for the Bureau of Reclamation dams and Section 1203 of the Water Resources Development Act of 1986 for the USACE dams. Appropriate guidance and application for all provisions of these dam safety statutes is important to ensure the PMAs are not inappropriately assigned costs for repayment that should be borne elsewhere.

- **Federal Energy Regulatory Commission – The Federal Energy Regulatory Commission (FERC)** Purpose and Scope: This report describes the FERC's actions and activities for FY 2017 (October 1, 2016 to September 30, 2017) to implement the Federal Guidelines for Dam Safety.

  This progress report is the 21st report provided to the FEMA describing the FERC's progress in implementing the Federal Guidelines. The initial progress report of January 1980 and subsequent reports show that the FERC's Dam Safety Program conforms to all provisions of the Federal Guidelines and that FERC has carried out all proposals to improve the administration of the program.

  Description of Dam Safety Responsibilities and Jurisdiction: Part I of the Federal Power Act (FPA or "the Act") authorizes FERC to license non-federal hydroelectric projects. The FPA authorizes FERC to issue licenses to individuals, corporations, states, and municipalities to construct, operate, and maintain dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary for the development of non-federal hydroelectric projects located (a) on navigable streams, (b) on public lands of the United States, (c) at any Government dam or (d) on streams over which Congress has jurisdiction under the Commerce Clause of the Constitution.

  Section 30 of the FPA and the Energy Security Act of 1980 (ESA), Public Law 96-294, authorizes FERC to exempt certain small hydroelectric power projects from all or part of Part I of the Act, including licensing. This exemption authority was provided to encourage small hydropower development. FERC's implementation of its exemption authority for small hydroelectric projects provides that such projects are exempted from all licensing provisions of the Act, except as related to dam safety.

  Notable changes from the last report include FERC's response to the Oroville Dam Service Spillway Incident, a change in inspection frequency for selected low hazard dams and external reviews on FERC's Dam Safety Program.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** The Bureau of Indian Affairs (BIA) is responsible for over 900 dams on Indian reservations; of which 138 are high and significant hazard. The BIA Safety of Dams Program works with Indian tribes to maintain the high and significant hazard dams. The BIA is responsible for all dams on Indian lands in accordance with the Indian Dam Safety Act of 1994 (Public Law 103-302).

Tribes can play an active role in the BIA Safety of Dams (SOD) Program through Self-Governance or Public Law 93-638 (Indian Self-Determination and Education Assistance Act) contracting of the program for dams on their reservations or by Public Law 100-472 (Indian Self-Determination Amendments of 1987) compacting the SOD Program. The BIA maintains overall SOD Program responsibility.

The BIA developed its SOD Program policies and procedures based upon the "Federal Guidelines for Dam Safety" (FEMA 64) and the Department of the Interior Manual, Part 753. Regional Directors, Agency Superintendents, Regional SOD Officers, and Project Engineers are responsible for the safety of all dams under their jurisdictions.

- **Bureau of Land Management –** The Bureau of Land Management (BLM) owns 10 high hazard dams and approximately 682 low hazard dams. Additionally, the BLM maintains permits for 146 high hazard dams and approximately 543 private dams (dams owned by others but located on BLM lands). Since the last reporting period, BLM has continued to verify the existence of and locations of private dams on BLM land. BLM's dam safety program is in conformance with Federal Guidelines for Dam Safety (DM 753 (Department of the Interior Manual 753), FEMA 64 (Emergency Action Plans), and FEMA 333 (Downstream Hazard Classification). The DM 753 manual is being revised to reflect FEMA's ICODS recommendations and current industry best practices. Approval/ Publication is expected to be approved by the next reporting period.

  BLM's engineering and dam safety personnel are organized by state. There are BLM state engineers in Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Wyoming, and Eastern States (covering all the public land east of the Mississippi River). Eastern states do not have a state engineer or any owned dams. In the 11 western states BLM is responsible for the operation, maintenance, inspection, and inventory of BLM owned dams on BLM land. In many cases where dams are located on BLM land but owned by others, the state dam safety authorities perform inspections. BLM is responsible for maintaining the inventory, deficiency data, and condition of all its owned dams in the Facility Asset Management System (FAMS). There are no impacts to budget by continuing resolution on the execution and efficiency of risk reduction efforts and compliance with the Guidelines.

- **Bureau of Reclamation –** Responsibilities: The mission of the Bureau of Reclamation (Reclamation) is "to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public." Through the *Reclamation Act of 1902* and subsequent legislation, Reclamation is authorized to operate as a federal water resource management and development agency in the 17 western states. The Reclamation inventory currently consists of 492 dams located throughout the west. Approximately 83 percent of these are more than 50 years old. As structures age, the verification of their continued satisfactory performance receives increased attention from Reclamation's Dam Safety Program.

  All dams present some level of risk to the public and the environment. The objectives of Reclamation's Dam Safety Program are to identify all structures that pose unreasonable risks to public safety, property, the environment, and cultural resources, and to take appropriate action to reduce and manage risks in an efficient and cost-effective manner. The Dam Safety Program activities implement the *Federal Guidelines for Dam Safety* as directed by the President's October 4, 1979, memorandum.

The Commissioner of Reclamation, in addition to directing the activities of Reclamation, also continues in the delegated role as the U.S. Department of Interior (Department) coordinator for dam safety. In this role, the Commissioner advises the Secretary of the Interior on program development and operations of the Dam Safety Programs within the Department. These responsibilities include:

- Assisting other Departmental agencies with their individual Dam Safety Programs.
- Developing dam safety policy, standards, guidelines, and practices for implementation within the Department.
- Evaluating the dam safety practices of other Departmental Bureaus and Offices.
- Promoting interagency cooperation where operations at a given dam affect the operations of facilities administered by another agency.
- Coordinating with FEMA and other federal agencies regarding the Department's dam safety issues.

Jurisdiction: Reclamation uses a variety of authorities and program activities under the organizational responsibilities of the Commissioner's Office, the five Regional Directors, and the 25 Area Managers to accomplish an effective dam safety program. A critical component to Reclamation's risk management role is the authority to modify dams for the purposes of dam safety through the *Reclamation Safety of Dams Act of 1978* (Public Law 95-578), and the *Reclamation Safety of Dams Act Amendments of 1984* (P.L. 98-404), 2000 (P.L. 106-377), 2001 (P.L. 107-117), 2004 (P.L. 108-439), and 2015 (P.L. 114-113). This last bill, which was signed by the President on December 18, 2015, increased Reclamation's available authorization by $1.1 billion and increased the Commissioner's authority to approve modifications from $1.25 million to $20 million. The bill also authorized the Secretary of the Interior to develop additional project benefits through the construction of new or supplementary works on a project in conjunction with Dam Safety modifications if such additional benefits are determined necessary and in the interests of the United States.

In FY 2017, Reclamation has 363 high and significant hazard dams in its inventory that could potentially lead to life loss or property damage should a partial or complete failure of the dam occur. The 363 dams, located at 242 different facilities, form the core of the Dam Safety Program. This facility inventory is used to report on program activities in this report.

Reclamation designed and managed construction for most of the Reclamation owned dams as part of authorized federal water projects. However, Reclamation owns some dams which were designed and constructed by non-federal entities and have become part of a Reclamation project through authorizing legislation.

Approximately one-third of Reclamation-owned dams are operated and maintained by Reclamation employees. The remaining two-thirds of Reclamation-owned dams are operated and maintained by the beneficiary water districts through contracts with Reclamation.

Continuing Resolution: A potential impact from a continuing resolution is that award of construction contracts for dam safety modification early in the FY may be delayed due to lack of sufficient funding. This did not occur during FY 2017.

- **U.S. Fish and Wildlife Service –** The *Fish and Wildlife Service Coordination Act of 1934* (U.S.C. 661-666) granted the authority to the U. S. Fish and Wildlife Service (Service) to operate facilities associated with fish and wildlife conservation. Service dams are located on national wildlife refuges, waterfowl production areas, national fish hatcheries and, in some cases, on private land through easement agreements with the Service. The dams help to fulfill the Service's mission in preserving and enhancing the Nation's fish and wildlife resources. The Service is the owner of the dams; therefore, the agency is responsible for the safety of these structures.

  The Service's Dam Safety Program was implemented in response to the President's memorandum dated October 4, 1979, and Secretarial Order 3048, dated February 28, 1980. These directives provided the basis for the development of a Dam Safety Program to inspect, repair and rehabilitate dams to correct deficiencies or structural problems identified through a Safety Evaluation of Existing Dams (SEED) program.

  The Service's Dam Safety Policies (361 FW 1-3) provide guidance and direction related to dam inspections, classifications, emergency action plans, standard operating procedures as well as design criteria.

  Since the program's inception, there have been no significant changes in the Service's dam safety responsibilities or jurisdiction, other than the addition of existing dams to the Service's dam inventory which were obtained through new land acquisition. The Service continues to investigate existing impoundments on Service land to identify those dams meeting the dam definition which will be added to the Service Dam Inventory, ensuring that our inventory is complete.

  The Service has been re-evaluating hazard classification potential for many small dams classified as high or significant hazard using FEMA 333. The use of two-dimensional modeling software and dramatically improved digital elevation data has provided the Service with the opportunity to better define dam failure flooding characteristics such as flood depth, velocity as well as rate of rise and arrival time. This enabled the Service to re-evaluate the probability of loss of life from either a "sunny day" failure of a flood-induced failure by more accurately identifying "lethal flooding". The U.S. Fish and Wildlife Service has confidently re-classified more than 12 dams from high or significant to low hazard because of this new technology and insisting on accurately defining dam break flood characteristics.

  The Service fully embraced risk as the driver of dam safety decisions including prioritization of our portfolio of dams, inspection frequency, and establishing risk-based values to guide repair and rehabilitation decisions.

  Implementing dam safety program activities, including inspections, engineering evaluations, EAP exercises, were hampered by continuing resolutions as their dam safety program receives increments of the annual program funding. Incremental funding limits our ability to award task orders to consultants who perform inspections and engineering analyses to a prioritized fraction of the work they need to complete during the FY. The uncertainly of receiving the additional funding delays the start of the remaining activities for that year. In addition, major design and repair projects, which were funded separately from the annual Dam Safety programmatic funding, were not received until well into the fiscal year often postponing or significantly delaying completion of the project and frequently causing the project to be continued in the following year. Because of the CR

in 2017, they were unable to award task orders to perform inspections, EAP exercises or start engineering analyses until they receive additional funding.

- **National Park Service –** Director's Order 40, Dam Safety & Security Program, states that the National Park Service (NPS) has a responsibility to minimize the risk of dam failure through actions to improve the safety of dams, remove unnecessary dams, and conduct emergency planning to prevent catastrophic losses in the event of dam failure.

  Jurisdiction includes NPS owned Dams, Levees and Canals. Impact to Budgets: Formal Exams, Intermediate Exams and Risk Assessments are prioritized and deferred according to budget limitations. The funding of projects to correct issues is the most deficient and these projects are prioritized in accordance to funds available.

- **Office of Surface Mining Reclamation and Enforcement** – The mission of the Office of Surface Mining Reclamation and Enforcement (OSMRE), through a nationwide regulatory program, ensures that coal mining activities are being conducted in a manner that protects citizens and the environment, restores the land to beneficial use following mining, and mitigates the effects of past mining by pursuing reclamation of abandoned mine lands. These duties are performed under the Surface Mining Control and Reclamation Act (SMCRA). There are three types of programs under SMCRA that implement its provisions—Federal Programs, approved state programs, and the Indian Lands Program.

  OSMRE's Dam Safety Program ensures that dams under the OSMRE's regulatory authority (federal programs and the Indian lands program) do not present unacceptable risks to public safety, property, and the environment. All dams under our jurisdiction are required to be maintained at a level that minimizes risks to downstream population, property and the environment.

U.S. Department of Labor

- **Mine Safety and Health Administration –** The purpose of the Department of Labor's Mine Safety and Health Administration (MSHA) is to prevent death, disease, and injury from mining and to promote safe and healthful workplaces for the Nation's miners. The *Federal Mine Safety and Health Act of 1977* (Mine Act) provides that MSHA shall inspect each surface mine at least two times a year and each underground mine at least four times a year to determine whether there is compliance with health and safety standards or with any citation, order, or decision issued under the Mine Act and whether an imminent danger exists. If violations of safety or health standards are found, inspectors will issue citations to the mine operators. MSHA performs other important activities under the Mine Act. These include, but are not limited to:

  - investigating mine accidents, complaints of retaliatory discrimination, complaints of hazardous conditions, knowing or willful (criminal) violations committed by agents of mine operators, and petitions for modification of mandatory safety standards;
  - developing improved mandatory safety and health standards;
  - assessing and collecting civil penalties for violations of mine safety and health standards; and
  - reviewing for approval mine operators' mining plans, plans for dams associated with coal mine operations, and education and training programs.

Dams associated with mining operations are regulated by MSHA. Section 3(h)(1) of the Mine Act defines a "coal or other mine," as "…(A) an area of land from which minerals are extracted…, and (C) …structures, facilities,…or other property including impoundments, retention dams, and tailings ponds, …used in or to be used in, or resulting from, the work of extracting such minerals from their deposit…"

MSHA regulates dams under Title 30 of the Code of Federal Regulations (CFR). Specifically, 30 CFR § 77.216 ("Water, sediment or slurry impoundments and impounding structures") pertains to dams at coal mines and 30 CFR §§ 56.20010 and 57.20010 ("Retaining dams") pertain to dams at metal and nonmetal mines. These authorities are unchanged from the previous biennial report.

The primary responsibility for ensuring dams at mining operations are designed, constructed, maintained, and operated safely is with the mine operator. As a regulator, MSHA develops standards and conducts plan reviews, inspections, and investigations to ensure mine operators are complying with the standards. Budget issues have not affected MSHA's ability to inspect dams associated with mining operations.

U.S. Department of State

- **International Boundary and Water Commission –** The International Boundary and Water Commission (IBWC), composed of a U.S. Section and a Mexican Section, is charged with carrying out the provisions of several treaties between the United States and Mexico. Among its responsibilities, IBWC has jurisdictions over two large international storage dams (Amistad and Falcon), and four international diversion dams (International, Anzalduas, Retamal, and Morelos) on the Rio Grande and Colorado Rivers. Additionally, the U.S. Section is responsible for the annual maintenance of American Diversion Dam, and five sediment control and flood control dams (Broad, Crow, Green, Berrenda, and Jaralosa) owned by the Caballo Soil and Water Conservation District. These dams are not fully international in nature.

  The international dams under IBWC jurisdiction are jointly operated and maintained by the United States and Mexican Sections of IBWC. Due to the international character of the dams under the jurisdiction of the IBWC, the National Dam Inspection Act of 1972 (Public Law 92-367) exempted IBWC dams from inspection by the USACE, but it did not exempt the United States Section from the Act's Dam Safety provisions.

  Any negative impact, due to sequestration and budget by continuing resolution, on the execution and compliance with the federal guidelines in the agency's dam safety program was minimized because the dam safety budget program had carryover funds from previous years. This budgeting allowed for the appropriation of significant funds in dealing with major deficiencies at both of IBWC's two large international storage dams (Amistad and Falcon). Without these carryover funds in the program, sequestration and budget by continuing resolution would have had a considerable negative impact to IBWC's dam safety program.

  Additional significant appropriations are needed by IBWC in the mitigation and continued operations of the international dams under the jurisdiction of the IBWC. Due to the aging of the dams, addition resources will be required for the operation and maintenance of these dams. As noted in the 2017 Joint Technical Advisor 5-Year Inspection Report, current O&M staff needs to be increased in size and skill set to meet

the challenges of operating and maintaining both of IBWC's two large international dams. This continues to be a problem for this fiscal year.

Nuclear Regulatory Commission

- The Nuclear Regulatory Commission (NRC) was created as an independent federal agency to regulate and license nuclear facilities and the use of nuclear materials and to conduct research in support of licensing and the regulatory process. NRC does not plan, design, construct, or operate such facilities, nor does it control the land on which the facilities are constructed. The legal authority of NRC in terms of dam safety, derives from the *Atomic Energy Act of 1954*, as amended; the *Energy Reorganization Act of 1974*, as amended; and the *Uranium Mill Tailings Radiation Control Act of 1978*. With respect to dams, the NRC has regulatory authority over uranium mill tailings dams, storage water pond dams at in-situ leach uranium mining facilities, and those dams integral to the operation of licensed facilities, or the possession and use of licensed material, that pose a radiological safety-related hazard should they fail. Exceptions to dams in the third category are dams that are submerged in other impoundments (e.g., to provide an ultimate heat sink) and, therefore, do not pose flooding threats, or dams that are regulated by other federal agencies (e.g., USACE, FERC, Tennessee Valley Authority (TVA)). Additionally, the NRC may require physical security measures at certain dams consistent with the NRC's common defense and security authority. This authority was not mentioned in the last report although it existed previously. Budgeting by continuing resolution has not affected the execution or efficiency of risk reduction efforts or compliance with the Federal Guidelines for Dam Safety.

Tennessee Valley Authority

- Tennessee Valley Authroity (TVA) is a federal agency and instrumentality of the United States, organized under the TVA Act of 1933, as amended. Since 1999, TVA has funded all its operations almost entirely from the sale of electricity and power-system financings. The TVA Act directs TVA, in the operation of its dams and reservoirs, "to regulate the stream flow primarily for the purposes of promoting navigation and controlling floods" and, "so far as may be consistent with such purposes," to generate hydroelectric power. Section 26a of the Act requires TVA approval of plans for the construction, operation, and maintenance of all structures affecting flood control, navigation, or public lands or reservations in the Tennessee River system.

  In most cases, TVA has complete responsibility for the planning, design, construction, operation, and maintenance of its dams. In the case of the coal combustion residuals (CCR) facilities (e.g., ash ponds and gypsum disposal sites), the states in which such facilities are located have established or are establishing requirements for the construction, operation, and closure of these facilities. In addition, TVA's CCR facilities are subject to the EPA rule on the Disposal of Coal Combustion Residuals from Electric Utilities, published on April 17, 2015, which regulates management and closure of such facilities.

  For its river regulating dams, TVA historically has constructed new dams with its own workforce. All but one of its dams (Great Falls) are in the Tennessee River basin and operated and maintained for the unified development and regulation of the Tennessee River system. For the remainder of the inventory (i.e. holding and cooling ponds, etc.), TVA has constructed its dams using a combination of internal and external workforces.

TVA’s Dam Safety Program includes dams that are located on the Tennessee River and its tributaries; holding ponds and cooling ponds located at TVA’s nuclear plants; and ash ponds, dredge cells, coal wash ponds, and gypsum stacks located at TVA’s fossil plants.

TVA is self-financing and receives no appropriations from Congress. The Continuing Appropriations Act, 2016, did not impact TVA's Dam Safety Program budget or initiatives, including the execution and efficiency of risk reduction efforts in compliance with the Federal Guidelines for Dam Safety.

FY 2016 U.S. Budget stated that the strategic review of TVA's financial situation initiated in 2014 has been concluded, and again recognized the significant steps TVA has taken to improve its operating and financial performance, and resolve its capital financing constraints. TVA is implementing a risk informed decision making program for prioritizing dam safety work to most efficiently reduce dam safety risk with limited resources.

Federal Agency Dam-Related Activities

A Presidential Memorandum on October 4, 1979, directed the federal agencies that own or regulate dams to adopt and implement the *Federal Guidelines for Dam Safety* (*Guidelines*) (FEMA, 1979), which was issued by the ad hoc ICODS, and directed the heads of these agencies to submit progress reports to the Administrator of FEMA. Since the initial reports in 1980, the Administrator of FEMA has solicited follow-up progress reports from the agencies every 2 years.

Since the *Guidelines* were published, all of the federal agencies responsible for dams (the ICODS agencies) have been implementing to varying degrees the provisions of the *Guidelines*, sharing resources whenever possible to achieve results in dam safety and developing strategies to address diminishing resources and decreases in staffing levels. Some federal agencies also maintain comprehensive research and development and training programs.

For assessment purposes, NDSP supplies the ICODS agencies each reporting cycle with a format to ensure completeness and uniformity among responses. Using the format, the ICODS agencies supply a brief description of their dam safety responsibilities, followed by a report on their progress in complying with the areas that are covered by the *Guidelines*:

- Organization, administration, and staffing
- Independent reviews
- Dam inventories
- Inspection programs
- Dam safety rehabilitation programs
- Management effectiveness reviews
- Dam safety training
- Dam failures and remedial actions
- Emergency action planning
- Research and development and special initiatives
- State dam safety agency involvement
- Public outreach
- Public concerns
- Non-federal dams on federal lands
- Additional observations

The progress that has been made by the ICODS agencies during this reporting period in the areas specified in the *Guidelines* is described in the following subsections. More detail and background information can be found via the raw data provided by the agencies, found at**:** www.fema.gov/media-library/assets/documents/116117.

The questions that are sent to the 21 federal agencies are found in Appendix B.

Organization, Administration, and Staffing

Activities related to organization, administration, and staffing during the reporting period are as follows:

U.S. Department of Agriculture

- **Agricutlural Research Service –** The Supervisory Civil Engineer of the ARS Hydraulic Engineering Research Unit (HERU) serves collaterally as the agency's Dam Safety Officer as appointed the agency's administrator. The HERU Supervisory Civil Engineer has expertise in dam safety related research, and the research mission of the HERU encompasses providing research support to stakeholders like NRCS, USACE, and USBR for their dam related technical activities. The research program is staffed by one research leader/scientists (1 FTE), one vacant scientist (1 FTE), and four support staff (4 FTE's) The SPRS research leader oversees the day to day operation of the SPRS dam. Additional support for the SPRS dam is provided through the agency's facilities division.
- **U.S. Forest Service –** Other duties assigned to Regional Dams Engineers have reduced the amount of time dedicated to dam safety. Many regions have the equivalent of 0.5 FTE dedicated to dam safety program activities. Typically, Regional Dam Engineers are split between geotechnical and dam safety programs of work. Or a single FTE is dedicated to dam safety activities and shared between two regions.

  To increased agency focus on dam safety, an additional 1.5 FTEs have been resourced to dam safety program activities. Agency hiring restrictions are in-place, so the 1.5 FTEs are being filled with temporary detailees until permanent hires can be completed. In FY 2017, retirements and loss of specialized staff has occurred within the program. The FS will mitigate this by utilizing additional Architect-Engineer services, pursuing an interagency agreement with NRCS, and evaluating options for restructuring staff which support the dam safety program to increase efficiencies.
- **Natural Resources Conservation Service –** The agency has several staffing vacancies. The agency is backfilling engineering positions as funding allows.

U.S. Department of Defense

- **U.S. Air Force –** The recent addition of an AF Dam Safety Officer has increased oversight of the program and provides a dedicated point of contact to address issues.
- **U.S. Army –** For FY 2016, the U.S. Army reported no changes in staffing at Fort Bragg DPW. Existing staff within DPW (Water Management Section) took on additional responsibility of dam safety program related activities, i.e., annual maintenance routine inspection and inclement weather inspection. Rock Island Arsenal: Moving data to electronic filing. Fort Hood: The staff that deals with Dams is small, but adequately trained to meet the mission.

  For FY 2017, the Army has updated and clarified policy to increase awareness and management of dam safety. All Land Holding Commands, OACSIM, and each installation with dams now has a Dam Safety Officer. Responsibilities have been identified to increase awareness and management of the dams in the inventory. This has increased dam awareness and dams are now more closely managed.

- **U.S. Army Corps of Engineers –** USACE has lost some highly experienced dam engineers to retirement and migration to other internal positions or external jobs. USACE has developed new training courses and offers many temporary assignments to replenish staff expertise. There are significant challenges to development of new staff. USACE conference attendance policy constrains USACE utilization of ASDSO and USSD conferences as training, and training budgets are shrinking. Retention of staff is also challenging due to higher grades and pay offered by other agencies and private consulting firms.
- **U.S. Marine Corps –** Staffing changes occurred since the last reporting period. There were identified Dam Safety Officers at Marine Corps Installations where dams exist, and a Dam Safety Officer at Headquarters Marine Corps. This did not represent an increase in staffing, but rather an assignment of an official duty relative to dam safety.
- **U.S. Navy –** Dam Safety Inspection Program Managers turned over. There was no impact from this change on accomplishing the dam safety program activities.

U.S. Department of Energy

- **Federal Energy Regulatory Commission –** Currently, staffing changes have not impacted dam safety missions.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** BIA personnel includes 19 funded FTEs: nine Regional SOD Officers, eight (8) Central Office SOD Engineers, and two Emergency Management Specialists, of which five positions are currently vacant. Vacancies include the BIA SOD Officer due to recent retirement, two Regional SOD Officers, one Construction Management Specialist, and one Early Warning System Specialist.

  Regional Directors, Agency Superintendents, and Project Engineers and Managers have the responsibility for properly implementing the Guidelines, Departmental Manual, Secretarial Orders and Directives, along with BIA policies related to dams under jurisdiction.
- **Bureau of Land Management –** The additional FTE staff reported for FY 2016 is attributed to an increase in priorities set forth by the BLM's Washington Office. A greater emphasis on the importance of regular dam inspections and oversight on the permitted dam inventory necessitated the additional FTE time reported. Reductions in FY 2017 were due to loss of staff and lack of ability to backfill.
- **Bureau of Reclamation –** For the intent of this report, Reclamation considers FTEs to only include personnel in the Denver Dam Safety Office and the Region Dam Safety Coordinators. These FTEs spend 100 percent of their time addressing the dam safety program mission. One FTE was added to the Reclamation Dam Safety Program to improve the process for developing modification reports

  Reclamation has excellent management and technical staff resources to accomplish its dam safety activities in accordance with the Federal Guidelines for Dam Safety. Maintenance of technical expertise continues to receive the attention of Reclamation's leadership. Reclamation has implemented a workforce capability planning process that uses a strategic planning approach to match staff resources with future program needs.

- **National Park Service –** There haven't been any staffing changes. The single FTE is focused primarily on program oversite and management of Interagency Agreement and A/E contract for services. An additional FTE is planned to support program implementation, documentation, formulation of corrective action projects and funding projects from various fund sources.

U.S. Department of Labor

- **Mine Safety and Health Administration –** [Note - numbers reported in 2015 were reversed and should have been Technical 13, Other 20. The result is an overall loss of 6 FTE, all in the Technical category.] The reduction in technical personnel, primarily in MSHA's Technical Support center, may result in longer turn-around times for the review and approval of coal impoundment design plans. In FY 2017, engineers were able to spend more time on the technical review of design plans.

U.S. Department of State

- **International Boundary and Water Commission –** FTEs increased during the reporting period improving program activities. However, there are still deficiencies in personnel particularly at the High Hazard Potential Dams: Amistad and Falcon Dams.

Nuclear Regulatory Commission

- No staffing deficiencies or significant changes to the NRC dam safety program.

Tennessee Valley Authority

- Staff to support river dams has increased due to increased work demands. A reorganization in the field personnel supporting the CCR impoundments now provides dedicated on-site personnel instead of regional oversight.

  Recent new hires have been experienced engineers rather than college recruits. Additionally, a progression program is required for lower level engineers to progress to senior classification. Training is also provided. TVA nuclear implemented a voluntary reduction in force during the fiscal year 2016. Dam Safety Program activities were generally covered by site civil design engineers as a core business activity. Also, TVA was in the process of soliciting and reviewing bids for the sale of the Bellefonte Nuclear Plant site and staffing levels associated with the BLN site have been reduced. While staffing levels across TVA nuclear have decreased, the workload will be absorbed by existing staff. The FTE was not a dedicated employee for the dam safety program, but instead an estimated FTE of time spent by TVA Nuclear employees performing dam safety program activities.

  Dam safety governance and oversight ended the reporting period with two vacancies, which are in the process of being filled. No current impact to accomplishment of dam safety program activities.

  TVA nuclear implemented a voluntary reduction in force during the FY 2017. Dam Safety Program activities are generally covered by site civil design engineers as a core business activity. While staffing levels across TVA nuclear have decreased, the personnel performing dam safety program activities were not impacted. FTE reported is not a dedicated employee for dam safety program, but instead an estimated FTE of time spent by TVA nuclear employees performing dam safety program activities.

Within the Coal Combustion Product organization, a reorganization in the field personnel supporting the impoundments now provides dedicated on-site personnel instead of regional oversight.

Independent Reviews

Activities related to independent reviews during the reporting period are as follows:

U.S. Department of Agriculture

- **Agricultural Research Service –** ARS has a Dam Safety P&P. Operation and maintenance of the SPRS dam is the responsibility of the SPRS research leader, with support provided by the agency dam safety officer, facilities division and business service centers (i.e. general engineering, safety officer, etc.). The P&P allows for the dam safety officer to seek qualified engineering assistance (i.e. partnering agencies within USDA, independent engineering consulting firms, etc.) as needed. In FY 2016, ARS established an interagency agreement with the Oklahoma NRCS for annual inspections of the SPRS dam and rehabilitation design of the dam. In-kind assistance has been provided by the Oklahoma Conservation Commission for establishing and updating the EAP for the SPRS dam.
- **U.S. Forest Service –** FS conducts independent reviews in many ways across the regions depending on the region's expertise and available resources. Region 1 and Region 4 cooperate with the States and FERC to review rehabilitation/modification plans. Region 2 and Region 3 collaborate with the Bureau of Reclamation for Screening Level Risk Assessments, hazard classifications and safety inspections. Region 8 utilizes state dam safety departments and the NRCS. Region 9 has several IDIQ contracts with A&E firms for review and design. Several regions have used the U.S. Army Corps of Engineers.

  Independent reviews are also conducted internally within the Forest Service between regions or within regions.

  Regional Dam Engineers conducted functional assistance trips to National Forest within their regions. These trips included Operation and Maintenance (O&M) inspections, site assessments for construction, construction monitoring, incident evaluation, post fire structural analyses, assessments of burnt watersheds upstream of dams, and installation of early warning systems.

  The Regional Director of Engineering within each region approves all plans and specifications for modifications and construction of FS-owned dams and dams to be operated by the holder of a special use authorization.
- **Natural Resources Conservation Service –** NRCS policy requires an independent review for the design of dams with a high hazard potential classification, a drainage area greater than 40 square miles, or a height greater than 50 feet. Dams designed by a NRCS state or multi-state staffs undergo an independent review by other qualified NRCS staff. Dams designed by private engineering firms undergo an independent review by a qualified NRCS staff. Other federal agencies occasionally review NRCS designs. State regulatory agencies customarily review NRCS designs.

NRCS conducted 455 design, construction, and operation reviews. Other federal agencies conducted 13 design, construction, and operation reviews. State agencies conducted 220 design, construction, and operation reviews. Independent consultants conducted 10 design, construction, and operation reviews.

When requested, NRCS provides technical and administrative review assistance related to the safety aspects of dam design, construction, operation, and maintenance.

U.S. Department of Defense

- **U.S. Air Force –** The Air Force does not use outside consultants or other agencies to perform an independent review of the broader AF dam safety program. Arnold AFB, Beale AFB, Arnold AFB, and Joint Base MDL each contract with USACE to perform dam inspections and assist with development of emergency action plans. At the US Air Force Academy, design and construction reviews are completed by the State of Colorado and independent consultants. Independent consultants have prepared all design drawings and specifications. At JBMDL, review of dam design and construction permits is done by the NJ Department of Environmental Protection Bureau of Dam Safety & Flood Control. At the US Air Force Academy, design and construction reviews are completed by the State of Colorado and independent consultants. Independent consultants have prepared all design drawings and specifications. At Buckley AFB, office of the State Engineer Division of Water Resources - Colorado Region 1 - reviews plans for removal and breaching of dams. No-projects are reviewed at Dobbins and at HQ. If the project is done for Dobbins AFB via USACE then they perform their own review in addition. At Barksdale AFB, in the past, the Louisiana Dept. of Transportation and Development has inspected the dams on a 3- to 4-year basis. Eglin AFB conducts design reviews involving many different sections. Construction is monitored by Construction inspectors, internal. At JBMDL, New Jersey Department of Environmental Protection Bureau of Dam Safety & Flood Control reviews all design and construction permits.
- **U.S. Army –** The Army has USACE Districts available for independent reviews as required. In addition:
    - Fort Bragg: All dam design and construction plans are reviewed by Wilmington District, USACE as part of the permitting process. In addition, NCDEQ reviews all dams under their jurisdiction.
    - Fort Carson: Collaborates with Colorado Division of Water Resources to conduct annual inspections of dams. The Colorado Division of Water Resources is also involved in charrettes and design reviews of major renovation projects.
    - Fort Hood: There is no formal policy on independent reviews; however, review is done on all designs and anything affiliated with Dam Safety. Fort Hood has an Architectural-Engineering Firm which is available thru an existing contract to ensure Dams are compliant regarding the Dam Safety Guidelines.
    - Fort Campbell: There is nothing in place (formally) but they consult with the USACE Louisville District.
    - Aberdeen Proving Ground: No – APG is only considering action on one dam, which it would like to decommission, so there is no need for outside design, construction or operation review.

- **U.S. Army Corps of Engineers –** USACE has established an accountable, comprehensive, life-cycle review strategy for Civil Works products with a seamless process for review of all these projects from initial planning through design, construction, and Operation, Maintenance, Repair, Replacement and Rehabilitation. Reviews are scalable and concurrent with normal business processes. Depending on the circumstances, reviews may be managed entirely within USACE or in various combinations with external parties. In cases requiring the most independence, the management of the review is performed by an organization other than USACE and involves independent experts. All civil works planning, engineering, and O&M products undergo review. All products undergo District Quality Control/Quality Assurance. Subsets of these work products undergo Agency Technical Review. Smaller subsets of the ATR group undergo one or both types of Independent External Peer Review (IEPR). The procedures are detailed in engineer circular 1165-2-214. The procedures ensure the quality and credibility of USACE decision, implementation, and operations and maintenance documents and work products. This engineer circular puts quality on equal footing with cost and schedule compliance. It presents a framework for establishing the appropriate level of independence of reviews as well as detailed requirements, including documentation and dissemination. The engineer circular also addresses OMB peer review requirements under the "Information Quality Act" and the Final Information Quality Bulletin for Peer Review by the Office of Management and Budget (referred to as the "OMB Peer Review Bulletin"). It also provides guidance for the implementation of IEPR in accordance with both Sections 2034 and 2035 of the Water Resources Development Act (WRDA) of 2007 (Public Law (P.L.) 110-114), as amended by Sections 1044 and 3028 of the WRRDA of 2014 (Public Law (P.L.) 113-121).

- **U.S. Marine Corps –** Independent review of the inspection reports is conducted by the Norfolk District U.S. Army Corps of Engineers to ensure any operational issues are identified, recorded, and addressed.
- **U.S. Navy –** USACE has been periodically paid for independent reviews of dam operations.

U.S. Department of Energy

- **U.S. Department of Energy –** DOE performs independent reviews of various aspects of DOE's dam operations. Private consultant services are commissioned as needed.
- **Federal Energy Regulatory Commission –** The procedures and policies of the FERC's Dam Safety Program include the review and monitoring of all phases of project development to ensure that licensees carry out their responsibilities. FERC's staff independently reviews and evaluates the safety of dams under FERC's jurisdiction during the design and construction phases, and ensures that existing dams are properly operated and maintained. Within the definitions contained in the Federal Guidelines, these staff reviews are considered external from those done by the licensee/owner and therefore, are consistent with the intent stated in the Guidelines. To supplement the external review of staff, the terms and conditions of the license for major unconstructed projects require the licensee to engage an independent qualified Board of Consultants, approved by FERC, to review the design and construction of the project.

  In addition to the above, when FERC licenses a non-federal hydropower development at a federal dam, the design and construction of the licensed hydropower facility is also subject to the review and approval of the federal agency that owns the dam to provide the Federal Agency the opportunity to review the effects on the federal structure(s).

  FERC's staff reviews the safety of existing dams in detail when an application for a license is submitted for a constructed hydroelectric power project not previously licensed or when construction is proposed at an existing non-federal dam. Dam safety is reviewed again during the relicensing process that occurs at the end of the initial license period (maximum of 50 years). Inspections and evaluations are performed by staff and periodic independent inspections and evaluations are performed throughout the licensing period.

  FERC's staff monitors construction activities at dams under its jurisdiction through staff inspections. For major unconstructed or complex construction projects, Boards of Consultants are utilized to assist in determining the adequacy of construction and to evaluate the effect any unanticipated site conditions may have on the safety and adequacy of the project. FERC requires licensees to maintain a detailed construction quality control program to ensure adequate inspection during construction of a project and for any alteration of a project. The construction quality control inspection program is reviewed and approved by staff consistent with FERC's dam safety regulations and is reviewed by staff throughout the construction.

  All constructed and operating projects are subject to inspection by FERC. All constructed and operating projects with an application for a license or exemption filed and those with a license or exemption issued are also subject to inspection by FERC. All licensed and exempted projects that are classified as high and significant hazard potential are inspected annually by staff to ensure that they are being operated in a safe condition, with proper maintenance and to determine if any dam safety issues exist; that unauthorized modifications have not been made to the projects; and that projects are being operated efficiently in compliance with the terms of the license or exemption. These periodic inspections are intermediate inspections as defined by the Guidelines. In addition, low hazard potential licensed and exempted projects are inspected every three to five years.

Part 12, Subpart D, (18 CFR 12) of the FERC's regulations requires inspection and evaluation every five years by an independent consultant of licensed or exempted dams that exceed 32.8 feet (10 meters) in height, have a reservoir with a gross storage capacity of 2,000 acre-feet or more, or have a high downstream hazard potential. These inspections are considered formal inspections as defined by the Guidelines. The inspection is performed by a qualified consultant retained by the licensee and approved by staff. The purpose of the inspection is to provide an independent/outside view as to whether there are current or potential deficiencies in the condition of the structures, quality and adequacy of maintenance, or methods of operation that might endanger project structures and public safety. The consultant is required to evaluate the adequacy of spillways and the stability and structural adequacy of all structures under all credible loading conditions to determine if the structures meet currently accepted engineering design criteria and practices. FERC's regulations require that the results of the inspection and evaluation be submitted in a report to the Regional Engineer. To help in the preparation of these reports, staff has developed an outline that it provides to licensees or exempted entities at the time of staff approval of the independent consultant. The staff reviews the reports of these inspections to ensure that the inspection and evaluation conforms to FERC's regulations and Engineering Guidelines, that the recommendations are sound and complete, and that the licensee properly implements the recommendations. In addition, based upon staff knowledge obtained from operation inspections performed by staff, additional analyses and reviews may be required by staff.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** Independent technical reviews of analyses and designs for all dam modifications are completed by consultants and in-house engineers, consultants, or by SOD Officers at various Regional Offices.
- **Bureau of Land Management –** The Bureau of Reclamation is responsible for conducting Independent Oversight Reviews within the Department of the Interior. The reviews are conducted every 5 years. BLM's most recent review was in December 2014, with the next scheduled for 2019.
- **Bureau of Reclamation –** Independent review of design and construction of modifications to existing dams and associated structures is accomplished using independent Consultant Review Boards. Consultant Review Boards are hired to review dam safety issues and analyses and to review proposed risk reduction actions.

  Reclamation utilizes a three member Independent Review Panel (IRP) to conduct an annual review of Reclamation's Dam Safety Program. The IRP consisists of independent experts in the field of Dam Safety. The IRP conducts thorough reviews of all aspects of Reclamation's Dam Safety Program. The IRP provides a report to Reclamation's Dam Safety Officer (DSO) containing findings and recommendations for program improvements for consideration by the DSO.

  Reclamation also develops annual Dam Safety Program Accomplishment reports that summarize dam safety related issues, activities, and accomplishments by each region. The information is presented at a meeting attended by the Regional Director, the Chief, Dam Safety Office, and the Reclamation Dam Safety Officer. The Dam Safety Officer then prepares a Dam Safety Program Assessment Report documenting his/her assessment of Reclamation's Dam Safety Program. This assessment includes the results of the Dam

Safety Accomplishment Report and the Independent Review Panel's findings and recommendations. The Accomplishment Report and the Assessment Report are transmitted to the Commissioner of Reclamation for consideration.

- **U.S. Fish and Wildlife Service –** For large rehabilitation projects, the U.S. Fish and Wildlife Service obtains independent design review from the Bureau of Reclamation or from the A/E consulting engineers. The U.S. Fish and Wildlife Service does not seek independent reviews of construction or operations; except through formal programmatic Peer Reviews performed by Reclamation every five years.
- **National Park Service –** Independent Reviews are completed by the Bureau of Reclamation about every 5 years to satisfy their dam safety oversight as identified in Department of the Interior Manual Part 753. The NPS Denver Service Center performs quality assurance reviews.
- **Office of Surface Mining Reclamation and Enforcement – The Office of Surface Mining Reclamation and Enforcement (**OSMRE) is a regulatory agency and as such, is responsible for reviews of design, construction, and operation of privately owned SMCRA-dams. The regulatory authority ensures that the dam remains in the "as-designed" condition through construction and operation inspections. There are not federal regulations requiring SMCRA permittees to conduct independent reviews for their dams.

U.S. Department of Labor

- **Mine Safety and Health Administration –** Dams at Coal Mines: Before a coal mine operator can build a dam that meets or exceeds the size or hazard potential criteria set forth in MSHA's safety standards, an engineering design plan must be submitted to and approved by MSHA (30 CFR § 77.216). It is common practice for mine operators to hire a consulting firm to oversee or perform all work required to develop a design plan. A primary reference for designers is MSHA's Engineering and Design Manual for Coal Refuse Disposal Facilities, published in 2009 and revised in 2010.

  Submitted design plans are reviewed by trained and experienced engineers located either in a district enforcement office or in MSHA's Technical Support office to ensure they are consistent with current, prudent engineering practice. When the technical review identifies issues potentially affecting the dam's safety, the mine operator is notified that the issues need to be resolved before the plan can be approved. The technical review continues after revised plans are received. After all issues potentially affecting the dam's safety have been resolved, the design plans are approved by the District Manager.

  District and Technical Support personnel meet with mine operators and their design consultants, as needed, to discuss and resolve design and operational issues.

  State agencies also review design plans for dams associated with coal mines. MSHA and the states often communicate during the technical reviews. Typically, the states will not approve a design plan until MSHA has completed its review and issues an approval.

  Dams at Metal and Nonmetal Mines: MSHA standards (30 CFR § 56.20010 and § 57.20010) do not require design plans for dams at metal and nonmetal mines to be submitted to MSHA. MSHA inspectors are trained to identify potential deficiencies and issue citations when potentially hazardous conditions exist at a dam. Technical Support

engineers assist the Metal and Nonmetal district offices in evaluating conditions or concerns related to the design, construction, or performance of these dams and conduct investigations of sites where inspectors have identified potential deficiencies.

State agencies also regulate dams at metal and nonmetal mines. MSHA confers with the state agencies as needed to ensure the safety of dams at these operations.

U.S. Department of State

- **International Boundary and Water Commission –** Independent reviews of all major design, construction, or operation considerations are normally performed through a Contract by the Dam Safety Technical Divisions of the following U.S. government agencies: 1) USACE, and/or 2) the U.S. Bureau of Reclamation (USBR). These "Independent Reviews" are often bi-national in nature involving Technical Representatives from the following Mexico Governmental Agencies: 1) Mexico's National Water Commission (Comision Nacional del Agua (CONAGUA)), and/or 2) Mexico's Federal Electric Commission.

  Additional "Independent Reviews" may occur involving private sector consultants of each respective country. The specifics on the hiring of independent or bi-national consultants is delegated to each Section of the IBWC as determined by IBWC and as required by the respective laws and directives of each country.

  During this reporting period, a panel of bi-national "expert consultants" was convened to review the Dam Safety Modification Study for Amistad Dam, to include the further investigations needed for the whole dam. The bi-national expert panel consisted of the USACE, USBR, CONAGUA, CFE, and Consultants hired by the USACE for the U.S. Section of IBWC.

  Other "agency" reviews occur on a regular basis and are conducted by engineers within the agency. These agency reviews can be of a bi-national nature, involving engineers from both Sections of IBWC, however, this is not always the case. One in-house project was reviewed during this reporting period.

Nuclear Regulatory Commission

- The NRC does not own dams. If an NRC licensee (e.g. power plant owner or uranium tailing mill owner) owns a dam subject to NRC safety inspection (i.e. dams described in the response to question 1), the NRC will perform an independent review of the dam. During the current reporting period, the NRC continued to use the FERC to assist with dam safety inspections at NRC-licensed facilities. From the standpoint of the dam owner, these are independent reviews.

Tennessee Valley Authority

- TVA maintains a Dam Safety Independent Review Board (IRB) for obtaining programmatic and technical expertise, guidance, and recommendations in the areas of design, construction, operation, and maintenance of dam safety structures. Currently, the IRB consists of six members who meet periodically to evaluate and provide recommendations on major projects, initiatives, and engineering methods. During the reporting period, the IRB was engaged on the following projects and initiatives:
  - Boone Dam Rehabilitation

- River and Coal Combustion Products Dams Programmatic and Risk Updates
- Guntersville Dam Seepage Remediation
- Pickwick Dam Seismic Remediation
- Blue Ridge Dam Risk Assessments
- Little Bear Creek Seepage Investigation
- Quality Assurance of TVA Landfills (CCP)

TVA engages consultants for independent technical reviews of engineering analyses and designs on an as-needed basis.

TVA maintains an Interagency Agreement with USACE to provide independent technical reviews of dam safety designs, construction documents, and quality control/quality assurance plans.

TVA also maintains a program of external reviews on its Dam Safety Program. The next external review is scheduled for FY 2018.

Dam Inventories

Activities related to dam inventories during the reporting period are as follows:

U.S. Department of Agriculture

- **Agricultural Research Service** – ARS has a complete inventory of dams, which includes one high-hazard potential dam. ARS's inventory has 100 percent coverage for condition assessments.
- **Forest Service** – The internal FS database for tracking real property is poorly suited for managing engineering assets. Competing GSA, FRPP, CFO and other federal real property regulations are imposed on the database and internal software is inadequate for dam safety program needs. Multiple issues/bugs within the software remain unresolved and data quality issues reduce confidence in the software inventory counts.

  The FS inventory includes 58 high hazard potential dams, 92 significant hazard potential dams and 314 low hazard potential dams.
- **Natural Resources Conservation Service** – NRCS has a complete inventory of dams, which includes 2,480 high hazard potential dams; 2,178 significant hazard potential dams; and 24,497 low hazard potential dams for a total of 29,155 dams. NRCS's inventory has 60 percent coverage for condition assessments on high hazard potential dams and 20 percent for significant hazard potential dams.

U.S. Department of Defense

- **U.S. Air Force** – The USAF is reporting 12 dams under its jurisdiction; two high hazard potential dams, two significant hazard potential dams and eight low hazard potential dams. USAF's inventory has 100 percent coverage for condition assessments.
- **U.S. Army** – The Army is reporting 254 dams under its jurisdiction; 45 high hazard potential dams, 22 significant hazard potential dams and 187 low hazard potential dams. The Army's inventory has 100 percent coverage for condition assessments.
- **U.S. Army Corps of Engineers** – USACE has a complete inventory of dams, which includes 512 high hazard potential dams, 150 significant hazard potential dams and 52 low hazard potential dams for a total of 714 dams. USACE inventory has 100 percent coverage for condition assessments.
- **U.S. Marine Corps** – The USMC has a complete inventory of dams, which includes 3 high hazard potential dams and 4 low hazard potential dams for a total of 7 dams. USMC's inventory has 100 percent coverage for condition assessments.
- **U.S. Navy** – The Navy has a complete inventory of dams, which includes four high hazard potential dams, two significant hazard potential dams and 12 low hazard potential dams for a total of 18 dams. Navy has 100 percent coverage for condition assessments for their dams.

U.S. Department of Energy

- **U.S. Department of Energy** – The DOE dam inventory is current and complete, including two high hazard potential dams, one significant hazard potential dam and nine low hazard potential dams.
- **Federal Energy Regulatory Commission** – FERC has a complete inventory of dams, which includes 816 high hazard potential dams, 187 significant hazard potential dams and 1,511 low hazard potential dams for a total of 2,514 dams. FERC's inventory has 100 percent coverage for condition assessments.

U.S. Department of the Interior

- **Bureau of Indian Affairs** – BIA has a complete inventory of dams, which includes 138 high hazard potential dams and 774 low hazard potential dams for a total of 909 dams. BIA's inventory has 100 percent coverage for condition assessments.
- **Bureau of Land Management** – BLM has a complete inventory of dams, which includes 10 high hazard potential dams, 2 significant hazard potential dams, and 658 low hazard potential dams for a total of 670 dams. BLM's inventory has 100 percent coverage for condition assessments.
- **Fish and Wildlife Service** – The FWS is continuing to investigate dams that appear as "owned by the FWS" on the NID or are listed in the NID as "non-federal dams on FWS land" to complete the FWS inventory. FWS currently has 18 high hazard potential dams and 285 low hazard potential dams for a total of 340 dams. FWS reports 100 percent coverage for condition assessments.
- **National Park Service** – NPS has a complete inventory of dams, which includes 14 high hazard potential dams, 10 significant hazard potential dams and 30 low hazard potential dams for a total of 54 dams. NPS uses a mix of quantitative and qualitative risk assessments, not condition assessments, for their dam inventory.
- **Office of Service Mining Reclamation and Enforcement** – OSMRE has a complete inventory of dams, which includes 10 high hazard potential dams, 11 significant hazard dams and 48 low hazard potential dams for a total of 69 dams. OSMRE maintains 100 percent coverage for condition assessments on their dams.
- **U.S. Bureau of Reclamation** – USBR maintains a current, comprehensive inventory of dams. USBR has 492 dams. Of these, 363 are classified as high potential and 129 are low hazard potential dams.

U.S. Department of Labor

- **Mine Safety and Health Administration** – There are 1,711 dams listed in the MSHA inventory; 424 are classified as high hazard potential, 233 are classified significant hazard and 1,054 are low hazard potential dams. MSHA is in the process of updating the NID with condition.

U.S. Department of State

- **International Boundary and Water Commission –** IBWC has a complete inventory of dams, which includes 3 high hazard potential dams, 2 significant hazard potential dams and 2 low hazard potential dams for a total of 7 dams. IBWC's inventory has 100 percent coverage for condition assessments on their high hazard potential dams.

Nuclear Regulatory Commission

- **Nuclear Regulatory Commission –** NRC reports no change to their inventory, which includes nine low hazard potential dams.

Tennessee Valley Authority

- **Tennessee Valley Authority –** TVA has a complete inventory of dams, which includes 70 high hazard potential dams, 28 significant hazard potential dams and 21 low hazard potential dams for a total of 119 dams. TVA uses a dam safety action rating system, which contains 5 categories, ranging from 1 (highest risk/urgency) to 5 (lowest risk/urgency). All of TVA's traditional river dams are classified using this system.

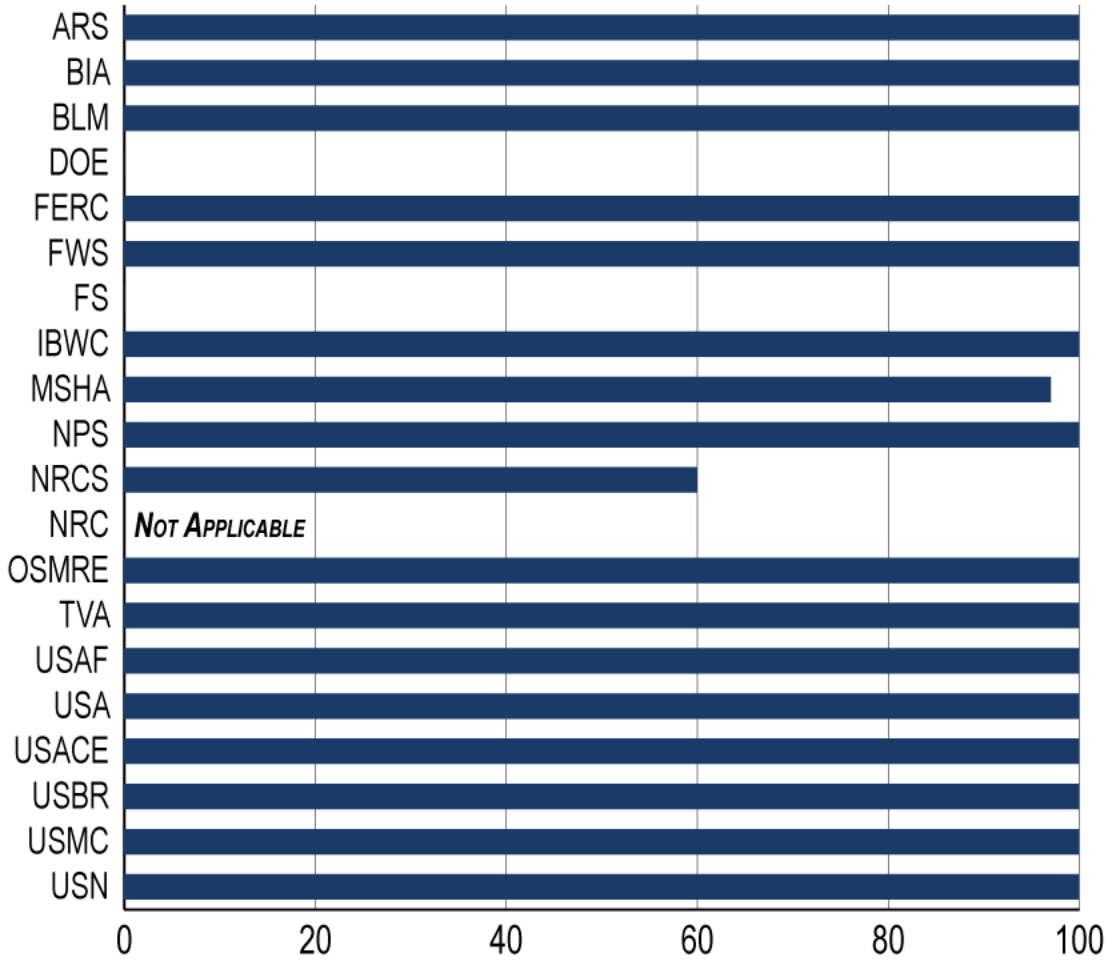

Figure 13 – Percentage of High Hazard Potential Dams with a Condition Assessment.

Inspection Programs

Activities related to inspection programs during the reporting period are as follows:

U.S. Department of Agriculture

- **Agricultural Research Service –** In FY 2016, ARS established an interagency agreement with the NRCS that included annual inspections of the SPRS dam. In FY 2017, NRCS confirmed the high hazard classification of the SPRS dam. An independent A&E consultant dam assessment report confirmed the high hazard classification of the SPRS dam and needs related to maintenance. Because of the report findings, ARS entered into an interagency agreement with the NRCS Oklahoma office. Future inspections of the SPRS dam will be completed by the NRCS, and a rehabilitation design is being completed by NRCS for the dam as well.
- **Forest Service –** The FS addresses all dam safety deficiencies identified during inspections that pose a threat to human life or property as soon as practicable. When these deficiencies cannot be addressed promptly, operational actions are taken to reduce risk to human life and property, such as imposing reservoir restrictions, closing administrative and recreational facilities located within the dam inundation zone, or draining the reservoir.
- **Natural Resources Conservation Service –** NRCS works with project sponsors to address any issues identified.
- **Rural Utilities Service –** RUS does not own, operate, or regulate any of the dams it may finance. The owners of these dams are responsible for the proper operation, maintenance, and inspection of these facilities. The owners of the dams are subject to all applicable federal and state requirements regarding inspection, maintenance, and operation.

U.S. Department of Defense

- **U.S. Air Force –** Once a critical finding has been identified, installation personnel submit a work order for corrective action. Where required, state agencies are notified. Work orders are reviewed for necessary action, i.e. base/contract maintenance, engineering design, etc. Larger requirements that cannot be addressed by base personnel are typically executed by contract through different agencies (aka USACE). Senior leadership and higher headquarters are notified of the findings and actions being taken to correct the issue. Once the course of action has been determined, funding is requested for project award and execution as an emergency project (aka emergent project). The next major periodic formal inspection by the USACE is scheduled for August 2020, for Arnold AFB. Funding was requested for the removal of Lake Williams dam; the dam is in poor condition and is considered a BASH hazard to the air field. After reviewing inspection results, JB MDL creates and awards construction projects to address any critical findings.

- **U.S. Army –** Army policy is that work orders are to be submitted upon discovery of critical findings and funded as soon as funds are available. High and Significant Hazard dams with Critical or Serious conditions are to be reported to Land Holding Commands and Army HQ with actions to be taken to eliminate the safety hazard. Pools are to be lowered and LHC to determine Risk and prioritize work necessary.
- **U.S. Army Corps of Engineers –** Actions are tailored based upon an understanding of the risks, and the source of the risks. Actions may include risk assessment, interim risk reduction measures (IRRMs) such as lowering pool, permanent repairs, and risk communication to stakeholders and potentially affected public.
- **U.S. Marine Corps –** Determination of actions required. Critical findings which require repair or restoration of the physical plant are identified and entered into their work management system (MAXIMO based) for corrective action. Small scopes of work are prioritized and scheduled at the Installation level, while larger scopes of work are developed into a project for execution and funding at the Headquarters Marine Corps level.
- **U.S. Navy –** Local Installation Public Work Departments create service requests to correct any deficiencies.

U.S. Department of Energy

- **U.S. Department of Energy –** Local DOE site offices take corrective actions, as appropriate.
- **Federal Energy Regulatory Commission –** FERC provides comments and recommendations to the licensee following the inspection. FERC then requires a plan and schedule to be provided to further address critical findings through studies, analyses, and/or remediation. If a finding is highly critical, FERC has the authority to immediately require risk reduction measures, which often includes reservoir drawdowns.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** BIA has determined that future dam comprehensive examinations and periodic examinations will be performed on a five-year alternating schedule. This schedule, along with the current annual inspections and extensive dam monitoring program, has been determined to maintain the required level of risk reduction and will result in a program savings of over $2 million, which will be reallocated to the reduction of overall dam safety risk.

  Critical findings of the inspections may result in an expedited action, which is an immediate action to mitigate the consequences of an identified high-risk failure mode. The response may include installation of engineering work stations, reservoir restrictions, increased monitoring, and in severe instances, a breach of the facility to reduce the risk of an incident or failure that may result in serious downstream impacts including possible loss of life. The interim expedited action and mitigation is a short-term reduction in risk until resources are available to effectively correct the potential failure mode or deficiency.
- **Bureau of Land Management –** If BLM discovered a critical finding emergency maintenance action would be taken. Actions would be taken to stabilize the dam, lower the operating water level, or breach the embankment and take the dam out of operation. Emergency repairs are conducted as required.

- **Bureau of Reclamation –** Findings from facility reviews are documented in a review report. Issues that require action are itemized in the form of Safety of Dams or Operation and Maintenance recommendations. Inspection results and recommendations are formally presented to the individuals delegated with decision-making authority for the Dam Safety Office, the regional office, and the area office. The Dam Safety Advisory Team, which consists of senior-level engineers from the Technical Service Center, provides input for the decision-makers. The facility is assigned a Dam Safety Priority Rating, which considers the immediacy and criticality of the potential dam safety issues, as part of the final decision for the facility. Critical recommendations are prioritized for action based upon the Dam Safety Priority Rating for the facility.
- **Fish and Wildlife Service –** FWS reviews and confirms the critical findings, sometimes with additional field visits to the dam, followed by an assessment of the urgency of the findings and takes appropriate action including implementing the EAP, lowering the reservoir level or other interim risk reduction measures. Once any emergency has been stabilized, the Dam Safety Program would develop a plan of action including critical timelines to perform additional analyses, develop remedial plans, design plans and seek funding to complete the analyses, design and construction. The timelines would reflect the estimated risk and urgency of the needed remediation.
- **Office of Surface Mining Reclamation and Enforcement –** OSMRE, upon identification of a deficiency in a dam, according to the approved design and maintenance plan, will issue a Notice of Violation and can issue an Imminent Harm Cessation of Operation Order. OSMRE can stop the permittee's operation until the dam is brought back into "as-designed" specifications. Any deficiency identified that poses a safety risk is immediately brought to the attention of the appropriate Regional Director.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA requires mine operators to conduct regular inspections of their dams. In addition, MSHA inspects each dam at least twice and potentially four times each year. MSHA inspectors issue citations when deficiencies are found or, in the case of coal impoundments, the approved design plan is not being followed. The mine operator must address the deficiencies to terminate the citation. When more detailed inspections or investigations are warranted, engineers from MSHA's Directorate of Technical Support will be involved.

U.S. Department of State

- **International Boundary and Water Commission –** If IBWC discovers a critical finding that is urgent, unsafe or potentially unsafe, immediate action is taken to fund the studies/repairs needed to reduce the risk.

Nuclear Regulatory Commission

- No critical findings were identified. However, in the event of a critical finding, the NRC would discuss the issue with the owner/operator to ensure the licensee remains in compliance with the applicable regulations. NRC licensees must maintain their dams in a condition such that they can perform their intended safety function.

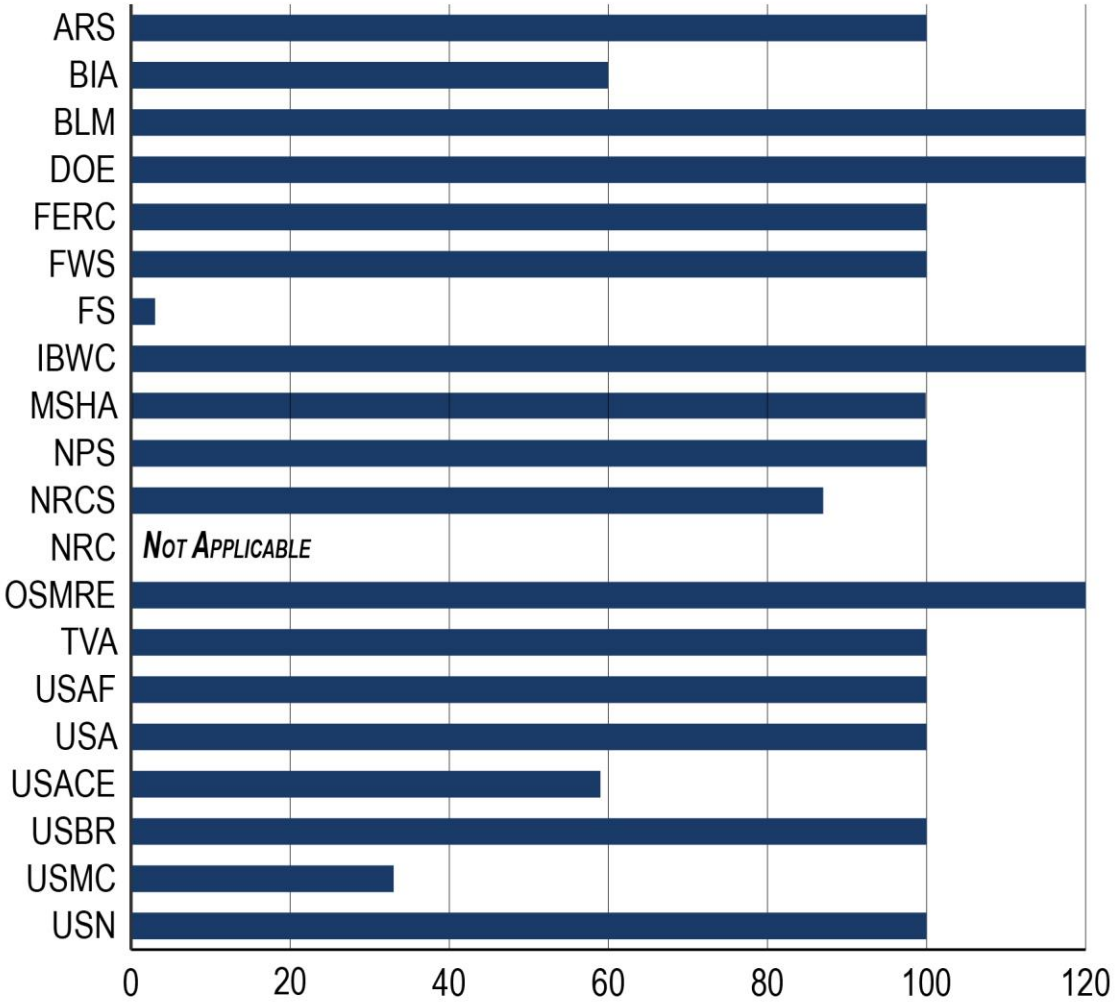

Figure 14 – Percentage of high hazard potential dams inspected.

Dam Safety Rehabilitation Programs

Activities related to dam safety rehabilitation programs during the reporting period are as follows:

U.S. Department of Agriculture

- **Agricultural Research Service** – ARS does not have the technical staffing to complete a design for a dam rehabilitation, so the agency sought assistance through an interagency agreement with the Oklahoma NRCS for the design of the SPRS dam rehabilitation. The SPRS dam rehabilitation design is under development.

- **Forest Service –** FS completed work at Hume Lake Dam, Houston Dam, and Knutson Dam during the reporting period with 13 more planned.
- **Natural Resources Conservation Service –** NRCS completed construction of 19 rehabilitation projects, totaling almost $75 million. There are multiple rehabilitation projects ongoing during this reporting period, totaling $380 million.

U.S. Department of Defense

- **U.S. Air Force –** The USAF completed one dam rehabilitation project at Eglin AFB in Florida. The USAF has four planned rehabilitation projects.
- **U.S. Army –** The Army completed two dam rehabilitation projects and has thirteen planned dam safety modification.
- **U.S. Army Corps of Engineers –** USACE completed three dam rehabilitation projects this reporting period and is continuing efforts of ongoing dam safety modifications. The completed rehabilitation projects total $531 million.
- **U.S. Marine Corps –** The USMC has two upcoming dam safety modifications totaling $7.4 million.
- **U.S. Navy –** The Navy has one planned dam rehabilitation project during this period totaling $600 million.

U.S. Department of Energy

- **Federal Energy Regulatory Commission –** FERC completed 43 dam safety modifications at a cost of $590 million. In addition, 59 planned dam safety modifications are ongoing or under review.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** BIA completed three dam safety modifications with an approximate total cost of $23 million and has 14 ongoing planned modifications with an approximate total cost of $84.8 million.
- **Bureau of Land Management –** BLM completed 11 dam safety modifications during this reporting period and have three planned ongoing modifications. The total cost for completed and planned rehabilitations totals approximately $4.7 million.
- **Bureau of Reclamation –** Reclamation completed one dam safety modification during this period with a total approximate cost of $600,000 and 15 planned ongoing modifications during this reporting period with a total approximate cost of $1.7 billion.
- **Fish and Wildlife Service –** FWS has two planned rehabilitation projects, one at Dorris Dam in Alturas, California, and the other at Crab Orchard Dam in Marion, Illinois.
- **National Park Service –** NPS has six planned ongoing dam modifications totaling approximately $5 million. NPS also reports one completed rehabilitation project at Sprague Lake in Rocky Mountain National Park.

U.S. Department of Labor

- **Mine Safety and Health Administration –** All dams under MSHA jurisdiction are owned by mining companies and constructed by these companies or their contractors.

The goal of MSHA is to ensure that the dams are designed, constructed, and maintained in accordance with current, prudent engineering practice. MSHA does not maintain data on the cost of repair because dams within MSHA's jurisdiction are privately, rather than publicly, owned. All responsibility for the cost of repair lies with the mining company.

Tennessee Valley Authority

- TVA completed a total of three rehabilitation projects and have six planned. Dams that need remediation—but where construction has not yet been completed—have used other methods of risk reduction including reservoir restriction, early warning systems, temporary flood wall construction, supplemental EAPs, and stock piled materials to install a temporary flood wall.

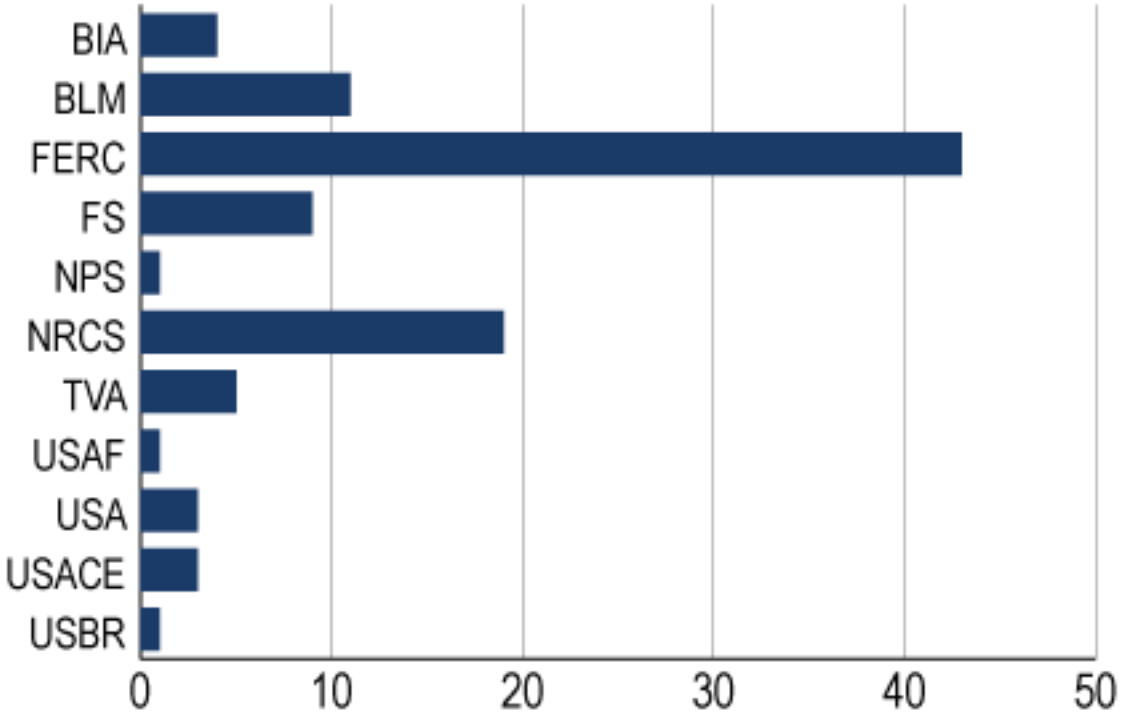

Figure 15 – Number of dams rehabilitated.

Management Effectiveness Reviews

U.S. Department of Agriculture

- **Agricultural Research Service –**ARS has conducted an internal review of its activities regarding dam safety. Internal review by the agency resulted in the funding of an interagency agreement with the Oklahoma NRCS to complete inspections and a dam rehabilitation design of the SPRS dam.
- **Forest Service –** The USDA Office of Inspector General (OIG) review of Forest Service controls over deferred maintenance concluded that they were adequate to mitigate threats to public health and safety. The scope of OIG scope included all Forest Service asset portfolio with reported deferred maintenance (dams, buildings, bridges, roads, etc.). This review started in quarter 4 of FY 2016, completed in FY 2017, and encompassed eight

National Forest within three Regions. OIG recommendations included developing a strategy, measurable goals and milestones to adequately focus financial and staffing resources on the dam safety program.

Actions are currently underway to address OIG comments. The FS dedicated funding in FY 2018 for dam safety and is making progress on evaluating options for restructuring staffing for the dam safety program given hiring and resource constraints. Specific actions taken toward addressing OIG recommendations are as follows:

- OIG recommendation to improve data quality in tracking completion of inspections, repair needs, and inspections are documented consistently: the FS is planning to incorporate a standard inspection checklist for informal inspections into FS guidance and a report outline format for formal inspections.
- OIG recommendation to develop and implement inspection requirements for water conveyance systems and mine tailing dams: the FS is evaluating the need to develop inspection requirements based on the existence of industry standards and other federal agency regulatory responsibilities.
- OIG recommendation to improve oversight of non-federal dams on FS-land by tracking compliance and retaining inspection documents and emergency action plans for Special Use Authorized dams: the Special Uses Permitting process is undergoing re-evaluation and a lean six-sigma process to improve efficiency. Efforts are currently underway to improve the Special Use Database to track inspection and emergency action plan compliance.

- **Rural Utilities Service –** Neither the General Accounting Office nor RUS conducted any management effectiveness reviews during the reporting period.

U.S. Department of Defense

- **U.S. Army –** Fort Hood Fort Hood contracted an Architectural Engineering Firm to conduct a Phase 1 & 2 analysis of the Dams. Phase 1 consisted of assessing 51 Dams for the Fort Hood Dam Safety Program. The Phase 1 assessment consisted of a visual inspection, data research, topographic survey, and simplified breach analysis. The Phase 2 assessment consisted of continued data research, bathymetric survey of 25 selected lakes, hydrologic capacity evaluation, geotechnical investigations and geotechnical analysis of 12 selected dams. Phase 2 also included the revision of Phase 1 assessment reports with updated conclusions, recommendations, and construction cost estimates.

  Fort Hood: Most recommendations involve general maintenance (example: remove woody vegetation/trees, repair erosion) work. A small percentage of Dams have recommendations to increase the hydrologic capacity based on safely passing the Inflow Design Flood.

- **U.S. Army Corps of Engineers –** GAO-16-106 examined cost sharing for USACE dam safety repairs. USACE completed an IEPR of its Dam Safety Program's policies, procedures, and performance to assess how well it is implementing the Federal Guidelines for Dam Safety and executing its dam safety mission. The external peer review included on-site visitation to HQUSACE, the USACE Dam Safety Officers Workshop, three MSC Division-level offices, three District-level offices and field visits at three USACE dam sites. USACE Division offices also review District dam safety programs on a periodic basis.
- The 2017 IEPR identified emergency preparedness, instrumentation monitoring, and assessing "Fundamental Dam Safety Activities" for all projects as the most important needs for improvement. Policy updates and training are under development to address these issues. GAO recommended policy clarification for usage of the "state of the art" provision and improve communication with sponsors regarding cost sharing agreements. Section 1139 of the Water Resources Development Act of 2016 mandated the issuance of guidance on the "state of the art" provision.
- **U.S. Marine Corps –** The Department of Defense Inspector General conducted a follow up to an audit conducted during the last reporting period (Report No. DODIG-2015-062, *DOD Needs Dam Safety Inspection Policy to Enable Services to Detect Conditions That Could Lead to Dam Failure*). The follow up objective was to determine whether the Marine Corps had initiated a dam safety program as recommended by the Audit Report.

  The USMC reported that the Commandant of the Marine Corps issued guidance in December 2014 that conforms with Section 215 of Public Law 104-303, "Water Resources Development Act of 1996" and the Federal Guidelines for Dam Safety.

U.S. Department of Energy

- **U.S. Department of Energy –** The scope of the DOE Dam Safety Program is small, encompassing 12 dams. Management effectiveness and General Accounting Office reviews are not considered necessary.
- **The Power Marketing Administrations –**Section 1139 of the Water Resources Development Act mandated that the Secretary of the Army issue guidance on the "state of the art" provision for dam safety in Section 1203(a) of the Water Resources Development Act of 1986. It is important that USACE develop appropriate guidance and application for this provision to ensure the PMAs are not inappropriately assigned costs for repayment that should be borne elsewhere.
- **Federal Energy Regulatory Commission –** During the reporting period, members of the House Committee on Energy and Commerce requested the GAO undertake a review of the Commission's Division of Dam Safety and Inspections, the FERC dam inspection process, and the role of FERC's Division of Dam Safety in evaluating dams and their related structures during the hydroelectric relicensing process. In addition, during the reporting period, the Department of Energy Office of the Inspector General initiated an audit on the Division of Dam Safety which has since been terminated.

  The Commission's Division of Dam Safety and Inspections also conducted a Summary Management Review as mandated by the Federal Managers' Financial Integrity Act, which requires the establishment and maintenance of an internal control program. On

July 7, 2017, an Assurance Memorandum was forwarded to the Chairman of the FERC through the Director, Office of Energy Projects attesting that there is reasonable assurance that the overall system of internal control was effective. Based on this review, there is reasonable assurance that the controls were working effectively, and that program and administrative functions were performed in an economical and efficient manner consistent with applicable laws; property, funds and other resources were safeguarded against waste, loss, unauthorized use or misappropriation; obligations and costs were proper; and accountability for assets was maintained.

- **Bureau of Indian Affairs –**

  IORBIA-SAF15-01 – Focus on filling vacant positions to return the program to full staffing. Address the impact of budget constraints on training by encouraging employees to take advantage of distance-learning opportunities, such as those offered by ASDSO.

  - Action Taken: Currently filled 4 of the 5 vacant positions identified on June 1, 2015. The last of the 5 vacant positions is scheduled to be filled the first two weeks of January 2017.

  IORBIA-SAF15-02 – Ensure that contracting staff is available to address construction contracts and emergency procurements in a timely manner, that Architect/Engineering companies (A/Es) selected for IDIQ contracts are familiar with the BIA formats and requirements, and that the process of assigning work to A/E contractors is streamlined as much as possible.

  - Action Taken: Will be hiring new IDIQ contractors in February 2017 which will be a 1-year contract with 4 option years for a total of up to 5 years. BIA will staff this contract with very experienced A/E contractors matching their requirements.

  IORBIA-SAF15-03 – Continue to work with Regional Dam Safety Officers (RDSOs) and tribes to educate them on the importance of dam safety; to provide dam tenders with appropriate training and assistance; to provide useful emergency management information; and to obtain their commitment in helping write, exercise, and execute EAPs.

  - Action Taken: BIA has continued to provide twice a year 24-hour training "Workshops" both to governmental Regional Dam Safety staff and to Tribes. BIA has begun to hold its own dam tender training on a regular basis and must provide appropriate training to governmental staff and Tribes. The BIA now has two permanent Emergency Management Specialist to provide scheduled emergency management Tabletop Exercises and the continued effort and commitment in helping and to write, exercise, and execute EAPs.

  IORBIA-SAF15-04 – Develop clear definitions of the roles and responsibilities of the Dam Safety Officer (DSO) and the RDSOs, and of the communication protocols between them. The proposed reorganization could be one way of improving communication.

  - Action Taken: BIA now has an organizational chart and is rewriting the *Indian Affairs Manual, Chapter 1 & 2,* which will clearly define the roles and responsibilities of the Dam Safety Officer (DSO) and the RDSOs, and of the communication protocols between them.

  IORBIA-SAF15-05 – Continue to implement risk management practices to inform priorities and decisions and to explain those decisions clearly to regions and tribes. Explore options to increase program funding to reduce the backlog of modification work and minimize the necessity of breaching dams because funds are not available to take other risk mitigation actions.

  - Action Taken: BIA has stated its needs to OMB on several occasions and received in FY 2016 an additional 2 million dollars for construction, but also need

its current O&M budget increased which hasn't been increased for at least 10 years. BIA is also hopeful that the "DRIFT ACT" is passed, if so, this bill would inject 22 million into rehabilitation of high hazard dams and would also inject 10 million into the BIA's low hazard dam inventory.

IORBIA-SAF15-06 – Establish a consistent direction for Reclamation's role with BIA and how the two agencies will share information and ensure that this direction is broadly disseminated within the BIA to gain consensus and support.

- Action Taken: The BIA has re-established an "Interagency Agreement" in which the BIA works with Reclamation in passing dam safety work to Reclamation in accomplishing BIA program goals.

IORBIA-SAF15-07 – Ensure that BIA dam safety staff at all levels of the organization have received training on the new handbook and are implementing its directives.

- Action Taken: Currently the BIA is completing and revising parts of the BIA Safety of Dams Handbook (set to be completed before December 31, 2016. Central Safety of Dams Office has also given training to the Regional Dam Safety Officers this past August 2016. It is also planned to have consultation and training with Tribes on the handbook in FY2017.

IORBIA-SAF15-08 – Develop a process for producing an Annual Report or conducting Annual Status Briefings.

- Action Taken: BIA produces an Annual Report each year in December.

- **Bureau of Reclamation –** Facility Reliability Ratings: Reclamation utilized an in-house developed Facility Reliability Rating system to assess the reliability/condition of its high and significant hazard dams. The Facility Reliability Rating is intended to provide an outcome-oriented performance measure for Government Performance and Results Act reporting purposes, as well as a tool for use in evaluating where necessary future funding/resources should be directed to certain dams. Ratings are based on a set of weighted criteria to evaluate operations, maintenance, and management factors/activities that affect the reliability or condition of these dams.

  Reclamation Dam Safety Officer Program Evaluation: Reclamation's Dam Safety Officer provides an annual review of dam safety activities. The Dam Safety Officer convenes an Independent Review Panel consisting of dam safety experts from outside of Reclamation to review Reclamation's overall Dam Safety Program and related activities. The Independent Review Panel develops findings and recommendations for improvements in the program. They also review progress and accomplishment of previous recommendations for improvement. The Dam Safety Officer provides an annual Program Evaluation Report to the Commissioner that includes formal recommendations based on the Dam Safety Officer and Panel findings. The status of the following ongoing and completed Dam Safety Officer recommendations are from the *Annual Dam Safety Program Accomplishment Report* dated March 16, 2017.

  According to the *Annual Dam Safety Program Accomplishment Report* dated March 16, 2017, the Dam Safety Office completed five Dam Safety Officer recommendations and three remain incomplete but with progress. Three new recommendations were made and processes to address each are being developed.

- **Fish and Wildlife Service –** The Department of the Interior, through the Bureau of Reclamation, conducts an Independent Oversight Review every five years. Reclamation is currently conducting an IOR for the U.S. Fish and Wildlife Service though a contract with the ASDSO.

  Recommendation: Develop and Annual Dam Safety Report to include incidents, accomplishments, challenges, successes, funding and future strategies.

  - Action Taken: Draft Annual Report has been completed.

  Recommendation: Complete the inventory of Low Hazard Potential Dams.

  - Action Taken: This is an ongoing effort. The Dam Safety Program has researched the NID and the USFWS Asset database for impoundments that qualify as a dam. In addition, during their field visits to refuges and hatcheries they search any other impoundments to determine if they qualify as a dam; and perform a preliminary inspection and add the structure to the dam inventory.

  Recommendation: Develop a "legacy" document (Procedures manual) for the Headquarters Dam Safety Program to include decision-making process, emergency response, training and a training program for new refuge managers and new Regional Dam Safety Officers.

  - Action Taken: None

  Develop security plans for high hazard dams and incorporate security awareness training in Dam safety 101 training and Emergency Action Plan exercises.

  - Action Taken: None

- **National Park Service –** Reclamation completed an independent oversight review of their program. Recommendations for exams are in process of being addressed. Recommendation for increasing the budget is under consideration by NPS administration. The recommendation for an additional FTE has not been yet addressed.

- **Office of Surface Mining Reclamation and Enforcement –** During 2015, Secretary-U.S. Department of the Interior (DOI), through Bureau of Reclamation and ASDSO conducted a comprehensive review of OSMRE's dam safety program. The review consisted of on-site interviews, request for materials, phone interviews with dam safety staff and supervisors, and dam inventory. The final report with findings has not been finalized yet.

U.S. Department of Labor

- **Mine Safety and Health Administration –** A dam safety specific accountability review was not conducted during the reporting period. The Dam Safety Officer (DSO) prepares a report for the Assistant Secretary summarizing the status of the MSHA Dam Safety Program and providing an assessment of the program's operation. An annual questionnaire is sent to each program area involved in the Dam Safety Program as well as each district office to obtain information needed to prepare the report. The Dam Safety Officer also has frequent discussions with the program areas on issues affecting the Dam Safety Program.

U.S. Department of State

- **International Boundary and Water Commission –** During this reporting period, the agency conducted no relevant management effectiveness reviews.

Tennessee Valley Authority

- Tennesse Valley Authority (TVA) conducts assessments consisting of monthly, quarterly, and annual reports of dam safety activities and asset owner implementation performance. The monthly reports include a measurement of the number of intermediate and formal dam safety inspections completed by TVA's dam asset owning organizations, as well as a Dam Safety Activity Report covering dam safety related activities (design, intrusive field investigations, and construction).

  The quarterly reports reflect the asset owners' implementation of the dam safety program, including summaries of:

  - Notifications to the DSO of significant dam safety events
  - Issues presented to the Independent Review Board
  - Asset owner requests of the DSO
  - Status of corrective and preventive maintenance activities
  - Changes to the TVA Dam Inventory
  - Asset owner performance indicators (report card), including information on inspections and instrumentation evaluations completed

  The annual reports reflect the following additional information:

  - Joint project team meeting schedules
  - Dam Safety training information
  - Dam Safety independent reviews
  - Dam Safety staffing levels
  - Status of completion or update of Supporting Technical Information documents
  - Status of completion or update of Potential Failure Modes Analysis documents
  - Informal inspections completed
  - Significant inspection or instrumentation findings
  - Status of Emergency Action Plans and exercises
  - Hazard classification verification for low and significant hazard structures

  In FY 2017, TVA's internal compliance organization conducted assessments on the TVA Dam Safety Risk Management program and Dam Safety Construction and Modification program.

  Recommendations arising out of the Dam Safety Risk program assessment centered around clarity of description and communication of governance, oversight, execution, and support roles and responsibilities in the risk management procedure and training. TVA is currently revising the subject procedure to incorporate the associated corrective actions.

  The Construction and Modification program recommendation was to implement a plan to strengthen teamwork and communication throughout all organizations involved in dam

safety modifications. TVA plans to train affected organizations on expectations for teamwork and collaboration, and strengthen individual goals for affected employees.

Dam Safety Training

U.S. Department of Agriculture

- **Agricultural Research Service –** ARS provides technology transfer by means of refereed journal articles and conference proceedings. ARS has developed numerous tools (e.g. SITES, WinDAM, rock chute design tool, rass-lined channel design guidelines, etc.) and standard designs (e.g. trash racks, outlet protection for cantilever pipe outlets, SAF basins, stilling basins, auxiliary earthen spillways, stepped chutes applicable for embankment dams, etc.) for earthen embankment dam design, which are made available to the dam safety community. Research scientists at the ARS HERU provide training in the form of technical presentatios, workshops, symposums as it relates to embankment dam failure due to overtopping and/or internal erosion (e.g. WinDAM, prediction of earthen spillway erosion (e.g. SITES), and embankment overtopping protection systems (e.g. RCC stepped spillway design). In FY 2016-2017, ARS specifically provided training on WinDAM, software for predicting earthen embankment failure due to overtopping or internal erosion, and the hydraulic design of stepped chutes to approximately 55 stakeholders representing federal agencies, state dam safety agencies, academia, and private engineering consultants across the world. This represented approximately 410 class room hours. ARS employees attend the ASDSO's Dam Safety Annual Meeting, where they obtain training through attendance of technical sessions or take part in technical workshops.
- **Forest Service –** FS held one internal training for five employees on dam operations and maintenance. The training took eight hours to complete.
- **Natural Resources Conservation Service –** NRCS hosted a total of 34 different training events for more than 12,000 training hours. The training events were held virtually, in the classroom, at workshops, and at conferences. These opportunities afforded NRCS the opportunity to be a trainer, presenter, lead, provider, conductor, creator, presenter, participant, and supporter.

U.S. Department of Defense

- **U.S. Air Force –** The USAF held an event titled "Field Training of Engineering and Operations Staff" that was attended by one person for a total of 40 hours. The USAF's role during the event was as leader.
- **U.S. Army –** The Army hosted one classroom event called "ATIIP Dam Safety Class." Approximately 50 people were in attendance for 48 hours, which was administrated by The United States Army Installation Management Command (IMCOM).
- **U.S. Army Corps of Engineers –** USACE held 28 events with approximately 1,394 people in attendance. USACE was the leader/instructor in each situation.

U.S. Department of Energy

- **Federal Energy Regulatory Commission –** FERC hosted six classroom training events totaling 45 people trained. Topics were Dam Safety 101, Emergency Action Plan Training, Security Training, Shear Strength, Structural Training, and a Surveillance & Monitoring Workshop.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** BIA supported two workshops and one conference that saw approximately 181 people attend for a total of 53 training hours. Additionally, BIA had 65 employees attend training and conferences sponsored by other agencies, including the annual ASDSO and USSD conferences.
- **Bureau of Land Management –** BLM traditionally hosts one event titled "Comprehensive CAs of Dams" in a classroom setting. There were zero attendees during the usually offered 24 training hours. This course was not held during the reporting period due to lack of attendees but traditionally it has been offered annually.
- **Bureau of Reclamation –** Reclamation hosted a mixture of eight conferences, workshops, classrooms, and web-based/virtual sessions. These events hosted 1,542 people.
- **Fish and Wildlife Service –** FWS held a Dam Safety Fundamentals workshop over three days. This event saw 40 employees in attendance.
- **National Park Service –** NPS held one event titled "Dam Examiner Training." It was a workshop that hosted 39 people for six hours. NPS also held a Tabletop EAP workshop for five employees.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA hosted 11 events during 2016 and 2017, totaling more than 13,000 training hours. The agency provided and organized all the training for each event. MSHA provides training to mine operators, engineering consultants, and others to meet MSHA's requirement that a qualified person conduct inspections of dams.

U.S. Department of State

- **International Boundary and Water Commission –** IBWC hosted a workshop titled "IBWC Annual Flood Workshop" for each year in the reporting period. In 2016, 43 employees were in attendance, with 78 percent in 2017. The purpose is to provide joint training to field office personnel from both Sections of IBWC on flood operations.

Nuclear Regulatory Commission

- NRC organized a workshop entitled Probabilistic Flood Hazard Assessment, with 13 employees in attendance. Due to a contract with small businesses, NRC also hosted a classroom training opportunity for Advanced HEC-HMS to 22 employees.

Tennessee Valley Authority

- TVA offered 11 training opportunities on topics such as excavating and trenching, the risk management tool iSite, and different courses as part of the CCR Rule Workshops.

Dam Failures and Remedial Actions

U.S. Department of Agriculture

- **U.S. Forest Service –** During the reporting period, FS reported one embankment overtopping event at Sterling Hallow Dam in the Mark Twain National Forest in Missouri. No details were provided regarding any damage to the embankment. The structure was acquired in a land acquisition, has minimal spillway capacity and may have originally been intended to have overtopping flow. Follow-up actions included activating the Emergency Action Plan (EAP), notifying the county sherriff, and monitoring and clearing the spillway. The dam was acquired in a land acquisition and is in the process for decommissioning.

  At Little Buffalo Dam in Nebraska, the Service reported concentrated seepage flow at the downstream toe of the dam. The dam is a low hazard potential dam and is being monitored.

- **Natural Resources Conservation Service –** NRCS had 35 dam incidents resulting from multiple issues to include seepage, auxiliary spillway erosion, damage to principal spillway conduits, gate cavitation, damage to drain pipes, plunge basin erosion, failed principal spillway outlet, etc. Follow-up actions include emergency watershed repairs, replacing CMP tailpipe with RCP pipe, monitoring during annual O&M inspections, replacing the structure, among other, more specific actions.

U.S. Department of Defense

- **U.S. Air Force –** The Air Force noted eight incidents, including five failures at Beale AFB and surface failure and cracking of dirt at Lake Williams Dam in Aurora, CO. Follow-up actions include increased monitoring and temporary repairs.

- **U.S. Army –** The Army had seven incidents during the reporting period. All incidents were structural failures and resulted in the replacement of the structure.

- **U.S. Army Corps of Engineers –** During the reporting period, USACE endured nine dam incidents. Notably, historic flooding in southeast Texas lead to record pool elevations within the Addicks and Barker Reservoirs. Concerns over the stability of the outlet works and downstream embankment slopes required careful operation of low level outlets within the scope of the water control manual to protect these DSAC 1 structures. The releases from both reservoirs were reduced slowly to allow the stabilizing tailwater on both dams to be gradually drawn down. The risk informed operation of both projects prevented any possible instability. Both structures were able to successfully pass the inflows from the record storm with minimal distress.

  Heavy rains during the 2017 hurricane season raised the pool elevation behind Herbert Hoover Dike. Daily inspections were required along some portions of the alignment. The combination of strong winds and rain from Hurricane Irma raised the concern for potential over wash around the project site with the most likely location being the southwest portion of the reservoir. At this location is a cofferdam with an elevation below that of the adjacent embankment crest. The anticipation of intermittent waves causing flood waters to escape the reservoir and flood the adjacent town of Clewiston FL prompted a mandatory evacuation to be issued by the local emergency management agency. The path and intensity of Irma was constantly changing such that when the storm

reached Herbert Hoover Dike the over wash of the cofferdam was minimal. After the storm passed, the evacuation order was lifted.

U.S. Department of Energy

- **Federal Energy Regulatory Commission –** At Oroville Dam in California, the service and emergency spillways failed while passing flood flows. Replacement of the service spillway and repair of the emergency spillway were the remedial actions taken.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** There were 12 reported dam incidents at BIA during the reporting period. The incidents resulted from several issues to include high water near overtopping and flooding downstream, rapidly increasing reservoir levels, gushing water from an abandoned diversion construction outlet pipe, all of which led to the Emergency Action Pplan (EAP) activation.
- **Bureau of Land Management –** BLM reported five dam incidents including primary spillway pipe failure, uncontrolled release through the auxiliary spillway due to a clogged principal spillway, and erosion caused by overflow. Immediate remediation included repairing failed pipes, re-grading of auxiliary spillway, and repair of erosion.
- **Bureau of Reclamation –** At Minidoka Dam in Idaho, Reclamation reported a radial gate arm failure. Remedial actions were undertaken to evaluate the cause of failure of a buckled member on the left portion of the gate arm, repairing the damaged gate with planned modifications to the remaining gates. New seepage due to a plugged drain was reported at Ortega Dam in California. Modification was undertaken to further evaluate and remediate the cause of new seepage, inlcudingremoved blockage and improved access to the drain system.
- **U.S. Fish and Wildlife Service –** The Service reports three incidents in total. A sinkhole that was eight inches in diameter and one foot deep formed on top of Redington Dam with seepage observed at the toe. Investigation including excavation revealed that there was not a connection between the sinkhole and the seepage. The seepage was monitored daily for months. The seepage is now monitored monthly. The dam is 13 feet in height.

  At Lake Elmer Thomas Dam, unexploded ordnances were found by recreational divers. U.S. Army Base at Fort Sill was notified, as they share the reservoir with the Service.The unexploded ordinances have been safely removed and disposed of by Fort Sill.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA reported 12 dam incidents for the reporting period. The incidents included new seepage producing high flow near the base of the dam; the failure of a Coal Combustion Residuals (CCR) abandonment cap resulting in an uncontrolled release; a sinkhole in the pool area; erosion due to heavy rains, overtopping due to heavy snow runoff; and cracking and scarping. The remediation actions included lowering the reservoir pool; monitoring of the seep and piezometer levels; construction of a new underdrain to intercept subsurface flow from the abutment; installation of a new toe drain; dumping of clay and bentonite along the drainage path to create a seepage barrier, among other more site-specific actions.

Tennessee Valley Authority

- TVA reported one incident during the reporting period. Muddy seep was discovered at Little Bear Creek in Vina, AL. TVA lowered headwater, conducted daily inspections, installed sand and stone filter to slow seepage and prevent material to be removed from the foundation, installed an automated instrument to measure seepage flow, performed geophysical investigation, and performed water chemistry testing and dye trace testing. TVA reports the investigation is ongoing.

Emergency Action Planning

Activities related to emergency action planning during the reporting period are as follows:

U.S. Department of Agriculture

- **Agricultural Research Service –** The Emergency Action Plan (EAP) for the SPRS Dam includes coordination with the Woodward City/County Emergency Manager in case of emergency. Although the State of Oklahoma doesn't have jurisdiction over federally owned dams, the Oklahoma Water Resources Board dam safety office has been notified that ARS owns one high hazard dam, and ARS has provided a copy of the EAP as a matter of courtesy to the Oklahoma Water Resources Board dam safety office. The EAP is updated annually. The updated EAP is distributed to ARS leadership and tolocal and state officials. The EAP for the SPRS Dam was developed through in kind assistance from the Oklahoma Conservation Commission.
- **U.S. Forest Service** – The Forest Service coordinates with State and local offices of emergency management on EAP preparations and execution.
- **Natural Resources Conservation Service** – NRCS collaborated with Association of State Dam Safety Officials (ASDSO) to develop a sample EAP for small embankment dams. NRCS incorporated this information as an amendment to the NRCS National Operation and Maintenance Manual. This information has been widely used by the NRCS, state dam safety agencies, and local sponsors and owners to develop new and update outdated EAPs. NRCS uses this information to train NRCS staff, state dam safety agencies, other federal and state agency personnel, dam owners, and engineering consultants.
- **Rural Utilities Service** – The Rural Utiliites Service (RUS) does not own, operate, or regulate the dams that it may finance. The owners of these dams are responsible for the proper operation, maintenance, and inspection of these facilities. The owners of the dams are subject to all applicable federal and state requirements regarding inspection, maintenance, and operation.

U.S. Department of Defense

- **U.S. Air Force** – Installations share EAP(s) with state and local governments and participate in Emergency Operation Center (EOC) tabletop exercises. They also participate in design review meetings and charrettes, and provide input. Arnold Air Force Base (AFB), Elk River Dam EAP has not been exercised, however, the Emergency Management Section has used the dam in some of their real-life scenario exercises. All local and state authorities have coordinated with the Elk River Dam EAP. USAF Academy meets with State Dam Engineer at least twice a year and coordinates action

plans for findings. Host a state and local seminar on Kettle Creek Dam (Dry) annually. Buckley AFB has confirmation that removal of the Lake Williams Dam is acceptable to City of Aurora. At Joint Base McGuire-Dix-Lakehurst, the EAP is shared with local officials and the County EOC is provided the notification flowchart.

- **U.S. Army** – The Army policy coordinates EAPs and construction design with state agencies. Garrisons are encouraged to invite state agencies to attend inspections.

  Fort Hood: Plans to conduct a table top exercise with entities as identified in the EAPs. Ft. Hood stays in communication with various entities on new regulations, workshops, outreach, and any training opportunities.

  Fort Campbell: Reached out to local first responders to share the EAP, areas of concern, and to confirm points of contact.

  Aberdeen Proving Grounds: The state agency has been out to the dam both previously to the inspection and during the inspection.

  Rivanna Station: Planning local government discussions in the coming year.

  Schofield Barracks: No activities related to emergency action planning were conducted during the reporting period. The state has the current EAP for KuTree the High Hazard Dam.

- **U.S. Army Corps of Engineers** – USACE coordinates with state and locals during dam emergency exercises and high-water events. Having both a plan and advance coordination with local and state emergency management officials are critical in facilitating a timely response to an emergency.

- **U.S. Marine Corps** – There is a formal Marine Corps dam safety program, however, there is not a known effort regarding coordination with state and local governments. As they move in development of this program, especially the EAPs, coordination with local and/or state agencies will be paramount.

U.S. Department of Energy

- **U.S. Department of Energy** – EAPs have been prepared and approved for all dams that are defined as having a high or significant hydrological hazard potential.

- **Federal Energy Regulatory Commission –** FERC encourages dam owners to develop EAP exercises that include active participation by upstream and downstream dam owners. Both FERC-regulated dams and non-FERC-regulated dams would be included. This widened approach for coordination will optimize the time and effort required by the local response agencies. It will also encourage many non-FERC-regulated dam owners to participate in an EAP exercise for the first time and provide opportunities for state dam safety officials to participate and test dams under state regulation.

U.S. Department of the Interior

- **Bureau of Indian Affairs** – The BIA invites state and local governments to their exercises and facilitates preparedness planning efforts.

- **Bureau of Land Management** – In Montana, all EAP exercises include the local Disaster and Emergency Services coordinator as the incident lead. The Montana Department of Natural Recourses and Conservation Safety of Dams regional engineers

are included in the exercises and have up to date copies of the EAPs. When the EAPs are exercised the Mayor (if a town is affected), county commissioners, county Sheriff, county road Forman, National Weather Service and all local government officials are included in the exercise and are provided with up to date copies of the EAPs.

In Oregon, BLM meets annually with the Oregon Water Resources Department about the Dam Safety Program. They invite local agencies to participate in their table top exercises.

The EAP that is under development in Nevada is being coordinated with local governments.

- **Bureau of Reclamation –** Reclamation completed a comprehensive revision to its directive and standard covering Emergency Action Planning (EAP) for High- and Significant-Hazard Dams to provide a planning framework to manage risk during floods and dam safety incidents. Exercises are conducted for all EAPs on a regular basis to ensure appropriate testing and training of systems and personnel. Reclamation's EAP program requirements, templates, and standards are applied at other bureaus and partner organizations for which Reclamation conducts EAP development, annual training, and exercising. Reclamation provides ongoing oversight and direction for all staff to ensure a continuous cycle of preparedness through the emergency management program..
- **U.S. Fish and Wildlife Service** – Invitations to their EAP exercises (Periodic Test) are sent to the state dam safety official, emergency management agencies, local police, sheriff, and additional stakeholders. In addition, they solicit comments on the EAP during the exercise; and provide written comments 30 days after the exercise and request comments from organizations that play a role in the implementation of the EAP if they do not attend the exercise.
- **National Park Service** – Included in EAP if NPS owned Dam, NPS included in EAP if not owned by the NPS. Participate in Table Top Exercises. State reps and local reps are invited to EAP exercises.
- **Office of Surface Mining Reclamation and Enforcement** – Currently the federal regulations that govern coal mining activities do not require EAP development, nor the exercising of EAPs. Through policy, OSMRE has established a requirement that significant and high hazard dams must have an EAP. They are working to strengthen their stance by developing federal regulations that will not only require an EAP in accordance with FEMA 64 but will also have annual update and functional testing requirements.

U.S. Department of Labor

- **Mine Safety and Health Administration** – MSHA's standards for coal industry dams (30 CFR § 77.216-3) require that the mine operator take certain actions when a potentially hazardous condition develops. When a potentially hazardous condition is identified, the mine operator must:
    - Take action to eliminate the potentially hazardous condition;
    - Notify the MSHA District Manager;

- Notify and prepare to evacuate, if necessary, all coal miners from the coal mine property who may be affected by the potentially hazardous condition; and
- Direct a qualified person to monitor all instruments and examine the structure at least once every eight hours, or more often as required by an authorized representative of the Secretary.

MSHA's Coal Mine Impoundment Inspection and Plan Review Handbook states that mine operators should develop and maintain EAPs to be consistent with current, prudent engineering practice and the Federal Guidelines for Dam Safety. However, MSHA's coal mining standards do not require an emergency action plan. MSHA issued a Program Information Bulletin in 1994 that informed coal mine operators of the "need to develop an emergency action plan for impoundments that constitute a hazard to life and property in the event of failure." The Bulletin encouraged mine operators to develop EAPs consistent with the Federal Guidelines for Dam Safety and refers mine operators to FEMA Report No. 64, "Emergency Action Planning Guidelines for Dams."

The standard for dams at metal and nonmetal mines does not address actions to be taken if potentially hazardous conditions develop. MSHA issued a Program Information Bulletin in 2004 encouraging metal and nonmetal mine operators to develop EAPs for dams that would cause loss of life in the event of failure. The operators also were referred to FEMA Report No. 64.

Many of the dams under MSHA's jurisdiction are required to have EAPs by state regulations. Emergency action plans are not required to be submitted to MSHA. MSHA recognizes the benefits of emergency action plans for dams. MSHA will continue to encourage mine operators to develop emergency action plans for high hazard potential dams. Occasionally, MSHA has participated in table-top exercises involving testing of emergency action plans.

U.S. Department of State

- **International Boundary and Water Commission** – Extensive Flood Emergency Workshops continue to be held annually with participation of both Sections of IBWC and the participation of the National Weather Service. Workshops were held for Amistad, Falcon, and Lower Rio Grande Field Offices for FY 2017.

  U.S. Area Operations Managers make annual personal contacts with various county, city, and federal agencies to inform them of potential flood assistance in times of emergencies. The last table top exercise was conducted at each site in 2011 with local elected officials and state and federal agency representatives.

Tennessee Valley Authority

- EAPs are developed through annual engagement with emergency management agencies and other external emergency response partners. TVA holds face-to-face meetings with county emergency management agencies where a Coal Combustion Products (CCP) or river dam is located. EAPs are reviewed and emergency resources, expectations, and roles and responsibilities are discussed. TVA invites state and local emergency management agencies and other stakeholders to dam safety EAP exercises.

  In 2015, the River Dam Asset Owner engaged in emergency action planning by including meetings with state and local emergency management agencies and the local National

Weather Service offices associated with Boone and Pickwick Dams. Feedback was sought from state and local emergency management agencies, seeking to better understand the specific attributes of each region, incorporating improvements (TEENS, predetermined Incident Command Post locations at each dam, and updated inundation mapping), using the latest technology to provide the best product and keep stakeholders' interest, offering dam tours during tabletop exercises, and keeping counties informed of issues in their area.

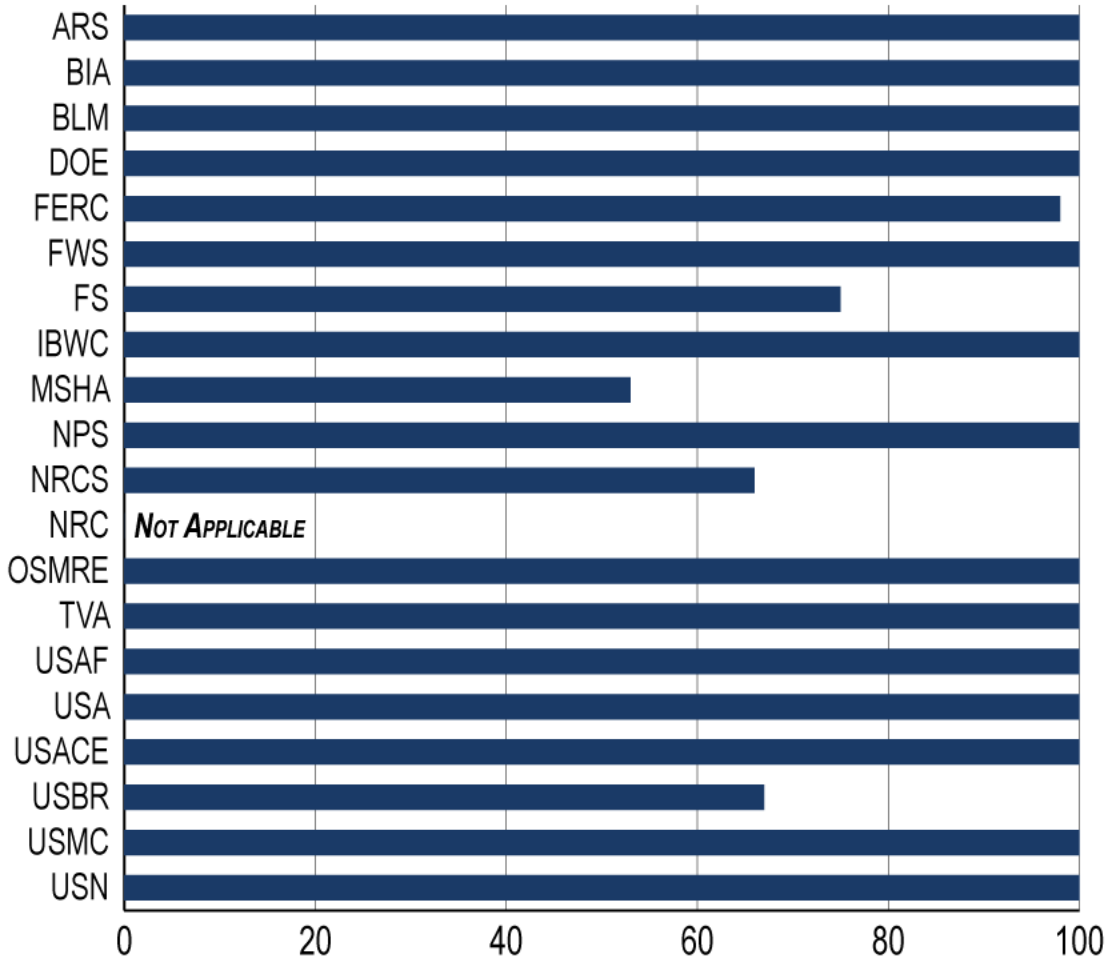

Figure 16 – Percentage of high hazard potential dams with an EAP.

Research and Development and Special Initiatives

U.S. Department of Agriculture

- **Agricultural Research Service –** ARS has on-going research programs focused on dam rehabilitation and dam safety. During the reporting period, scientists have:

- Conducted research on stilling basin design and downstream rock apron (Figure 1) as an energy dissipater for stepped chutes. Research was provided by scientists at the USDA-ARS Hydraulic Engineering Research Unit.

Figure 17 – Large scale flume of a stepped chute study on the effects of stilling basin design and downstream rock apron.

- Conducted initial studies to further validate relationships for determining training wall heights necessary to contain flow within converging stepped chutes (Figure 2). Continuation of research is expected to determine if stilling basin and downstream rock apron requirements for converging stepped chutes applied to embankment dams.

Figure 18 – Converging stepped chute model to further validate training wall height requirements for containing flow in stepped chutes and to determine stilling basin and rock apron requirements for converging stepped chutes applied to embankment dams.

- Updated WinDAM guides rehabilitation priorities for aging dams. WinDAM C, a Common Computing Environment-certified software, was released by NRCS in cooperation with ARS and Kansas State University (Figure 3). This software incorporates algorithms developed by ARS scientists for predicting failure of embankment dams due to internal erosion and embankment overtopping. Code

verification was completed in a collaborative effort by ARS, NRCS, Kansas State University, and collaborators. Although further validation of the tool is required for the internal erosion component, WinDAM C was tested against USDA-ARS physical model study data of embankment dam failures resulting from internal erosion and overtopping. This technology is anticipated to assist dam safety engineers in NRCS and other federal and state agencies in the prioritization of aging multi-purpose embankment dams for rehabilitation.

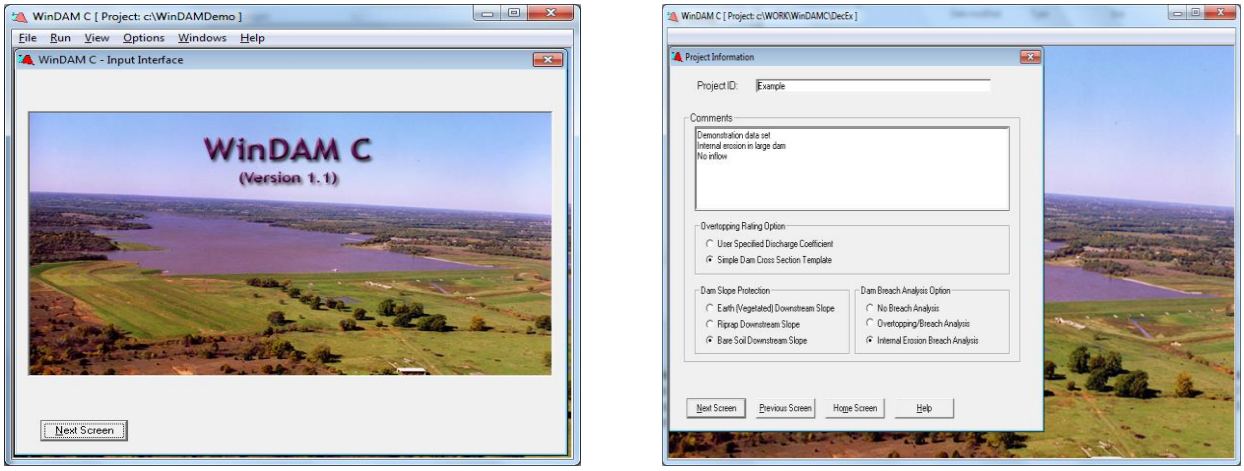

Figure 19 – Screenshots from WinDAM C, computational tool for predicting embankment performance through overtopping or internal erosion event.

- National Center for Computational Hydroscience and Engineering, the University of Mississippi, has recently developed a two-dimensional numerical model for simulating embankment breaching and flooding process. The model has been validated using several sets of USDA experimental data and demonstrated to have a potential to be applied to simulate single or multiple embankment breaching of dams or levees.
- Scientists with the ARS Hydraulic Engineering Research Unit conducted research on USBR Type I, II, III, and IV stilling basins associated with stepped
- ARS researchers in Oxford, Mississippi, have developed numerical simulation technology to study the realistic breach erosion process of earthen dams and levees.

- **U.S. Forest Service –** In 2017, the region-3 dams engineer participated in a project with the Vietnam Ministry of Agriculture and Rural Development, which oversees dam safety at more than 6,000 irrigation and flood control dams. The purpose of this project was to assist the Vietnamese in developing a risk assessment strategy for dam program management and prioritization of repair/rehabilitation projects.

  This project is funded through the Department of the Interior, International Technical Assistance Program and is based on three phases. The first phase took place in March 2016, and involved site visits to various dams to assess the Vietnamese dams program. The second phase took place in September 2017 and involved providing training at a workshop to the Vietnamese engineers in the development of risk assessment strategy and

dams inspections and operations. The workshop was attended by engineers from over 10 irrigation management companies.

- **Natural Resources Conservation Service –** NRCS and ARS are continuing a major, long-term research and development effort to model erosion processes in earth spillways during flood flows and on embankment dams during overtopping flows.

  The latest ARS developed earth spillway erosion model was been incorporated into existing NRCS SITES design software. The current version of SITES dated 2007 can be used to develop inflow hydrographs by NRCS curve number procedures, compute spillway system hydraulics, calculate peak reservoir elevations, and determine ultimate spillway head cut advance for a single dam site or multiple sites in series. Various versions of SITES have been distributed and presented at many recent ASDSO Conferences.

  The latest ARS developed embankment overtopping erosion model and an ARS breach model are included in NRCS WinDAM software. Future versions of WinDAM will import inflow hydrographs from other existing models, compute discharge ratings for combined pipe spillways, earth spillways, dam overtopping, and embankment breaches, dynamically flood route the inflow, determine overall erosional stability of the dam system, and export outflow hydrographs into other existing models for downstream routing.

U.S. Department of Defense

- **U.S. Air Force –** USAF Academy entered into an interagency contract with the United States Geological Survey (USGS) to install at Kettle Creek Dam (inflow streamflow gage, gaging station), Non-Potable Reservoir #1 (inflow and outflow streamflow gages, crest stage gage) and Non-Potable Reservoir #4 (inflow streamflow gage). At Joint Base McGuire-Dix-Lakehurst (JB MDL), proper turnover Standard Operating Procedures will be implemented when transferring dam manager responsibilities.

- **U.S. Army –** Due to its remote location on the fort's south side, Fort Carson currently has extensive remote monitoring of Teller Dam, including video feed and several flow and depth gages. This technology allows readings and visibility of the dam during adverse weather events where they cannot physically access it. This is accomplished through the USGS.

  Fort Hood contracted an Architectural Engineering Firm to conduct a Phase 1 & 2 analysis of the Dams. Phase 1 consisted of assessing 51 Dams for the Fort Hood Dam Safety Program. The Phase 1 assessment consisted of a visual inspection, data research, topographic survey, and simplified breach analysis.

  The Phase 2 assessment consisted of continued data research, bathymetric survey of 25 selected lakes, hydrologic capacity evaluation, geotechnical investigations and geotechnical analysis of 12 selected dams. Phase 2 also included the revision of Phase 1 assessment reports with updated conclusions, recommendations, and construction cost estimates. U.S. Engineering Research and Development Center conducting research on using various systems for reporting and warning.

- **U.S. Army Corps of Engineers –** USACE Civil Works R&D program directly supports the established business programs and strategic direction of the Civil Works Program.

Specific topics include: methodologies for monitoring, inspecting, nondestructive testing, and condition assessment of steel and concrete components; evaluation and quantification of failure modes in earth structures resulting from internal and external erosion; improved modeling of hydraulic impacts; and evaluation of multiple facets of the aging infrastructure. In addition to internal research efforts, USACE is working with the Dam Safety Interest Group of the Centre of Energy Advancements through Technological Innovation (CEATI) to share research efforts for dam safety with other dam owners around the world.

USACE has transitioned to a risk informed dam safety program. This shift has led to the creation of tools for risk assessment, including tools to calculate risk for various types of dam failure modes. There are tools used for geotechnical, hydrological, structural, and mechanical issues, among others. The Modeling, Mapping and Consequences Production Center (MMC) provides hydraulic modeling, consequence estimates, and flood inundation mapping for dams and levees. The MMC supports risk assessments, prioritization, and management decisions for dam safety. While improving its own Dam Safety Program management, USACE has also improved the communication of its findings with those most affected by changes in the operation of USACE dams.

- **U.S. Marine Corps –** USMC will authorize training of the designated Dam Safety Officers at the Headquarters and Installation levels.

U.S. Department of Energy

- **U.S. Department of Energy –** No activities during the reporting period.
- **Federal Energy Regulatory Commission –** As a regulatory agency, FERC is limited in the extent of actual research and development activity it can initiate and fund. Research activities are generally carried out by the federal agencies that own and operate dams, as well as coalitions of private owners such as Electric Power Research Institute and Edison Electric Institute. FERC is active in participating in important dam safety research that will benefit the owners of non-federal hydropower projects. Commission staff participates and provides technical expertise to numerous research task forces and committees as well as guidelines and technical criteria development efforts sponsored by both federal and private, non-profit, organizations, groups and committees. It is anticipated that this research will provide dam owners the capability to assess the susceptibility of their dams to damage from overtopping flood flows.

  FERC has been an active participant in an organization named the Centre for Energy Advancement through Technological Innovation (CEATI). This organization brings electrical utility industry professionals together, through focused interest groups and collaborative projects, to identify and address technical issues that are critical to their organizations. The U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, Tennessee Valley Authority as well as many international owner's operators belong to CEATI. Several ongoing research projects are directly related to FERC Dam Safety mission and as such FERC is actively assisting in helping to develop these guidelines.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** The BIA has completing a geodatabase with pertinent information of BIA dams in identifying physical characteristics of dams (height, storage

volume, type) and the downstream channel slope that will establish threshold flooding values below the dams and the size of flood which would likely cause lethal flooding.

BIA has developed and implemented a dam tender training course.

BIA developed and held an Early Warning System (EWS) Training Workshop where they hosted 13 Tribal EWS Technicians and taught hands on maintenance procedures and troubleshooting. Feedback was positive, and BIA hopes to continue hosting course yearly.

BIA maintains a unique and expansive EWS monitoring program, able to automatically notify and alert downstream residents and emergency officials of pending incidents or dam safety issues at program dams. The EWS uses state-of-the-art satellite telemetry communication and benefits from a National Monitoring Center, staffed 24/7, that makes phone calls to personnel during emergency situations.

- **Bureau of Reclamation –** Enterprise Architecture (EA) Reduce Dam Safety Risk (RDSR) Modernization: In 2006, the Working Group on Dam Safety and Security (WGDSS), chartered by the department, began an Enterprise Architecture Initiative to transform the business practices of reducing dam safety risk within the department. The initiative was consistent with the President's Management Agenda and expanded electronic government. The intent was to simplify and modernize business practices and integrate individual bureaus' processes for lower costs and greater efficiencies. The EA RDSR Modernization Blueprint was signed in 2009 by all six of the department bureaus with dams. All blueprint recommendations were to be addressed in a five-phase effort. Phase 3 was completed early in FY 2015, when the Working Group and Executive Steering Committee signed the final report. RDSR products included numerous documents for training those involved in dam safety and documentation of the best practices regarding dam hazard classification. The documents are housed on a SharePoint site for use by departmental dam safety staff.

  After RDSR phase 3, the WGDSS determined that the formal RDSR initiative could be considered successfully completed, and an overall final report is under review. Draft revisions to the Departmental Manual, DM 753, developed during the three RDSR phases, are under solicitor review before entering the departmental review and acceptance process. The WGDSS will continue to pursue opportunities to effectively and efficiently reduce dam safety risks, and are beginning the process of developing a strategic plan for the WGDSS.

  Special Initiative to Implement Risk Analysis and Risk Assessment Techniques: Reclamation continues to emphasize the use of risk analysis in its evaluation processes. Experiences and approaches in risk analysis and risk assessment are shared with international dam safety agencies and groups as we further develop and refine risk approaches. Reclamation also collaborates with other federal agencies, including USACE, FERC, TVA, and FEMA on developing joint federal risk management approaches and policies. Reclamation collaborated with other Department of Interior agencies that own or regulate dams to develop joint risk management guidelines as part of the RSDR, and the WGDSS will continue to refine those guidelines in the future.

  Technology Development Projects: Reclamation continues to consider risk-informed decision processes when prioritizing and evaluating dam safety technology development

funds. The general objective of the Dam Safety Program's Technology Development Program is to develop tools that will enhance risk-informed decision assessment techniques. In many cases, Reclamation has collaborated with other interested parties to obtain funds and provide a broader benefit. Results of Reclamation projects funded by the Dam Safety Office are published as part of the Dam Safety Office Report Series. Technology development projects have been completed or are underway in the following disciplines: Risk Management, Material Properties, Geotechnical, Seismology/Geophysics, Hydrology, Palaeohydrology, and Concrete Dams. The reports for all completed Technology Development Projects can be found at http://www.usbr.gov/ssle/damsafety/TechDev/index.html.

- **U.S. Fish and Wildlife Service –** FWS is starting a "Screening Level Hazard Classification" intended to identify low hazard dams that may need additional analysis to confirm the hazard class. This project will create shape files by modeling dam failures and using conservative depths and velocities to simulate lethal flooding. They will search within the shape files for structures or roads or other potential areas that people may be exposed to lethal flooding. Any potential structures, roads campgrounds etc. within the inundation shape file will require a full hazard classification analysis. The inundation shape file will be used to perform "hazard creep" review every five years.
- **National Park Service –**NPS participated in the Urban Sustainability Directors Network (USDN) input to the Presidential Task Force on Climate Resilience and Preparedness. The President's Climate Preparedness and Resilience Task Force was convened to develop recommendations on how the federal government can better support local, state and tribal governments in achieving resilience through disaster preparedness, built systems, natural systems and agriculture, and community development and health.

  Initiative to document the Dam and Levee facilities in the database used by the National Park Service – Facility Management Software System.

  Developed an Access Database to document and track exam recommendations.

  Interagency agreement with Reclamation to provide technical assistance with dam inspections, incident response, dam monitoring, issue evaluation, risk assessment, dam repair design & construction and Emergency Action Plans.

  Completed a pilot risk screening of 7 NPS levee systems. The USACE also participated on 3 of the systems. The study results are being used to improve the USACE levee risk screening tool.
- **Office of Surface Mining Reclamation and Enforcement –** Impoundment Breakthrough Potential Oversight Review-OSMRE's Appalachian Region is working through a random sampling of each state's impoundments to determine the levels of risk that currently exist with respect to SMCRA impoundment potential to breakthrough into abandoned underground coal mines.

  Compaction Study – The dam structure for slurry impoundments are generally constructed by using course coal refuse. This study is examining achieved compaction with field density testing and laboratory material testing. OSMRE questions the current testing methods identified in SMCRA permits are not applicable and thus additional testing or treatment of course coal refuse may need to be employed.

Geotechnical Properties and Flow Behavior of Coal Refuse under Static and Impact Loading – Millions of tons of coal waste are produced every year and stored in coal waste slurry impoundments. Since impounded slurry waste has high water content and low shear strength, an inadequately designed or constructed impounding structure is susceptible to the flow failure via a breach of its embankment following static or impact (e.g. blast-induced) loading. In other cases a flow failure may occur in the form of a breakthrough into an adjacent or subjacent underground mine. Both types of failure endanger public safety and health, property, and natural ecosystems. They may result from several factors including poor embankment construction or a weak barrier between an impoundment basin and an underground mine. They always result from impounded slurry that remains flowable because of insufficient consolidation to resist the effects of static or dynamic forces. Before this study there has been no comprehensive work on the geotechnical and rheological properties of impounded coal waste slurry, and the mechanisms that cause and sustain slurry flow. This project studied the geotechnical properties and flow behavior of coal waste slurry under static and impact loading.

The influence of important parameters such as water content, particle size distribution, viscosity, and magnitude of static and impact loading on the material's flowability was investigated.

Blasting Effects on Refuse Impoundment Structures – In process, this study intends to install geophones, stress gauges, etc. on coal slurry dams while blasting is being performed in the vicinity. The objective is to examine how compacted course coal refuse reacts at different ground vibration frequency and amplitudes.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA's Office of Technical Support, Mine Waste and Geotechnical Engineering Division continued to refine its guidance related to designing and performing upstream construction at coal mine impoundments. The document was provided to numerous design firms involved with dam design and to other government agencies for comment. Input from responders is being used to improve the document before dissemination.

U.S. Department of State

- **International Boundary and Water Commission –** IBWC does not do Research and Development. No dam safety research studies have been accomplished.

Nuclear Regulatory Commission

- The NRC completed its reevaluation of flooding hazards at all US nuclear power plant sites, including from the potential failure of upstream dams. The NRC worked closely with the USACE, FERC, and US Bureau of Reclamation to complete analyses involving failure of federally owned, operated, and/or regulated dams.

  The NRC has a contract with the Bureau of Reclamation to evaluate erosion processes in zones rockfill embankment dams using a physical modeling approach. Data from these tests will be compared and analyzed against physical model of erosion processes of dam breach progression.

The NRC is sponsoring a research project with a US Department of Energy National Laboratory to develop the technical basis for application of approaches, models, and tools for assessing dam risk at downstream nuclear power plant sites.

Tennessee Valley Authority

- TVA conducted a special investigation into the behavior of low mobility grouting for the remediation of dams. This study involved the injection of various grouting mixtures that have been utilized in the grouting practice and then the excavation of the grout bodies to understand the behavior. This work is also being coupled with a laboratory triaxial shear study of the grout behavior during injection. The results of the study will impact the ASCE Compaction Grouting Guidelines by providing updated information for specifying low mobility grouts and admixtures. The study will be a step forward in developing a guidance document for designers to use in determining pressures and low mobility grout mixtures.

  TVA implemented the use of Georgraphic Information System (GIS) systems that allow for the collection and interpretation of geophysical data, design drawings, inspection records, geotechnical data, grouting records, topography, and subsurface information that allows for the rapid evaluation of its dam sites.

  TVA completed development of a seismic assessment guidance document for assessing the seismic performance of earthen embankment dams, including saddle dams, dikes, etc. These guidelines will be used to evaluate embankment dams for TVA. The guidance document outlines the basis and steps for performing a seismic assessment, with documentation and reporting requirements. The recommended process and procedures form a consistent methodology for evaluating embankment dams, and provide guidance for acceptable engineering analysis practices. TVA uses seismic assessments to understand how their embankment dams are expected to perform during an earthquake. The conclusions may suggest the need for additional study and further refinement to the analyses, may be used to help quantify the risks associated with a facility, or may establish the basis for decisions to mitigate performance deficiencies.

  TVA has continued to integrate and refine a new Instrumentation and Monitoring Risk Management Tool for its Coal Combustion Products (CCP) impoundments. The tool manages real time instrumentation data on a GIS platform, and incorporates documentation control associated with surveillance and monitoring. A monitoring center was established for the Risk Management Tool that allows real time monitoring and emergency response.

  TVA's CCP impoundment asset owner has continued to implement the Intelligent Compaction Program. The program provides testing over 100 percent of the surface area for daily CCP placement, reduces risks of building in imperfections, reduces risks of future stability issues, and facilitates documentation / data management of construction activities. They have also continued to implement and utilize a best management practices drilling method for obtaining CCP material properties.

State Dam Safety Agency Involvement

U.S. Department of Agriculture

- **Agricultural Research Service –** ARS provides technology transfer by means of refereed journal articles and conference proceedings. In addition, ARS has developed numerous tools (e.g., SITES, WinDAM, rock chute design tool, grass-lined channel design guidelines) and standard designs (e.g., trash racks, outlet protection for cantilever pipe outlets, SAF basins, stilling basins) for earthen embankment dam design, which are made available to the dam safety community including state agencies. Although Oklahoma does not have jurisdiction over federally owned dams, the Oklahoma Water Resources Board (OWRB) Dam Safety Office has been notified out of courtesy of ARS's ownership of the SPRS dam and provided a copy of its current EAP for the dam. The OWRB is also notified of the hazard classification of the SPRS dam. Research engineers at the ARS Hydraulic Engineering Research Unit provide training in the form of technical presentations, workshops, and symposiums as it relates to embankment dam failure due to overtopping and/or internal erosion (e.g WinDAM), prediction of earthen spillway erosion (e.g. SITES), and embankment overtopping protection systems (e.g., RCC stepped spillway design). Target audiences for these trainings include state dam safety officials, federal agencies, academia, and national and international engineering consultants. Additionally, ARS's dam safety officer serves as the federal co-chair of FEMA's National Dam Safety Review Board Research Work Group, a group co-chaired by a state respresentative. The intent of this work group is to advise FEMA on national priorities as it relates to dam safety research and to serve as an information source on federal agencies conducting dam safety research.
- **U.S. Forest Service –** Due to the small staff associated with dam safety in the FS, State dam safety involvement is a crucial component of the FS dam safety mission. Most Regions have cooperative relationships with States.
- Region 1 cooperates with the State of Montana on Dam Owner Workshops. Regions 2 and 3 have cooperative relationships with all the states in their regions. For example, South Dakota has funded several rehabilitation and emergency repair projects of FS owned dams in the Black Hills and Nebraska National Forests, and New Mexico provided funds for survey and bathymetric data collection of Canjilon Lake dams at the Carson National Forest. Region 5 has cooperative relationships with both federal and state dam regulatory entities in the Pacific Region. Those include the Federal Energy Regulatory Commission, Bureau of Reclamation ,Army Corps, and the California Division of the Safety of Dams. FS is negotiating an MOU/ with the State of California Division of the Safety of Dams.

  Many state dam safety agencies provide technical assistance and support primarily to Non-Federal dams on FS Lands, providing the non-federal owner with a low-cost option to comply with scheduled inspections and maintenance. In most instances state dam safety laws have been written to give the regulating state dam safety agency jurisdictional authority over non-federal dams on federal lands in their respective states.
- **Natural Resources Conservation Service –** NRCS policy is to support and complement strong State dam safety programs, and to establish working arrangements in each state. Headquarters NRCS and ASDSO are in process of signing a new MOU to regularly exchange information on dam safety activities provide data to the National Performance of Dams Program, maintain data in the National Inventory of Dams, and share research or technology.

The majority of NRCS states work closely with their state agencies and meet routinely to discuss issues and exchange information. NRCS has MOUs with dam safety agencies in 28 states to coordinate on dam safety activities. Most NRCS states continue to meet with a range of state agencies to discuss NRCS aging watershed issues and recent rehabilitation authorities.

The NRCS is requesting input from the state dam safety agencies to assist with the prioritization of dams needing a rehabilitation assessment. An assessment is the first step in the process to determine the need and feasibility to rehabilitate a dam.

- **Rural Utilities Service –** RUS regulations for approval of financial assistance require that the owner's facility design comply with all applicable federal and state regulatory requirements, including dam safety programs.

U.S. Department of Defense

- **U.S. Air Force –** The USAF Academy closely coordinates all aspects of the Dam Safety program with the State of Colorado's Division of Water Resources. During preparation of reports and designs, the Division of Water Resources is provided draft copies of the various efforts and is encouraged to comment on the findings and recommendations. They also participate in design review meetings and charrettes where all plans and specifications for construction or reconstruction of Jurisdictional structures are reviewed and signed by the State of Colorado prior to construction. During the construction, their field personnel observe the progress of the work. After construction is complete, they receive and record the redlined drawings. EAP are prepared following the Colorado DWR guidelines. They are provided to DWR for their review and filing. The DWR participates in all exercises outlined in the EAP.

  Arnold AFB – TVA works with the Arnold AFB Emergency Management Section to coordinate emergency action planning. Arnold AFB does not have the authority to provide technical assistance for dam safety or dam risk management. The Elk River Dam EAP has not been exercised, but the Emergency Management Section has used the dam in some of their real-life scenario exercises. All local and state authorities have coordinated with the Elk River Dam EAP.

  Joint Base McGuire-Dix-Lakehurst – JBMDL is in close contact with the State of New Jersey to coordinate required inspections. The State of New Jersey and local officials are notified of dam repairs/rehabilitation/construction work. EAP is shared with local officials and the County EOC is provided with the Notification Flowchart.

  At Barksdale AFB, their natural resource office works with the LADOT when interacting with dams. Barksdale AFB, civil engineer is consulted when needed. At JB MDL Lakehurst AFB maintains relationships with state agencies for inspections, training, and inventories.

- **U.S. Army –** Fort Hood: They maintain a relationship with neighboring entities on inspections, training and any outreach sharing opportunities.

  Fort Campbell: There was involvement from the state environmental department as far as permitting for the removal of Lake Taal Dam

Aberdeen PG: APG has maintained a constant relationship with the state regulatory agency during the past few years. The state has conducted its own inspection, APG attended state sponsored training and the dam is in the state's inventory of dams.

Schofield Barracks: State has inspected the high hazard dam twice.

- **U.S. Army Corps of Engineers –** USACE Districts invite state dam safety officials to participate in formal periodic inspections. District dam safety personnel have responded to state requests for assistance during emergencies and to other requests for technical assistance. States with dam safety programs are very involved in the design and construction of USACE dams that will be turned over to local sponsors for operation and maintenance. USACE is working closely with ASDSO, the states, U.S. Territories, FEMA and the other federal agencies to update and improve the National Inventory of Dams.
- **U.S. Marine Corps –** Nothing to report for this period.
- **U.S. Navy –** Local installations communicate with state agencies and when requested, provide inspection report data.

U.S. Department of Energy

- **U.S. Department of Energy –** All DOE dams are on federal property under federal control. In general, there is minimal interaction with state dam safety agencies.
- **Federal Energy Regulatory Commission –** FERC regularly coordinates dam safety inspections, reviews, and training with a multitude of individuals. All inspection reports and dam safety information are available to the state dam safety offices upon request.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** The federal government has a unique relationship with the Native American Nations through the Department, especially through the BIA. States do not generally have any authority over Native Americans without the individual Tribes giving specific authority. The BIA has full responsibility for implementing the SOD Program on Indian Reservations. States are included when appropriate and in consultation with the Tribes involved.
- **Bureau of Land Management –** State agency cooperative relationships vary by state in BLM:
    - Montana BLM works closely with the Safety of Dams Section of the Department of Natural Recourses and Conservation of the State of Montana and includes them in all EAP updates, exercises, incidents, and coordination of condition assessments on some of the permitted dams. BLM attends all state sponsored training sessions that are within the BLM budget.
    - In Utah (BLM) there is no formal agreement in place but since the State of Utah has primacy over all water related facilities and structures, the state performs inspections on all BLM hazard rated dams and include deficiencies and

recommended corrective actions. The local BLM District Engineer typically accompanies the State of Utah on dam inspection activities.

- The Idaho Department of Water Resources controls all water rights within the state, maintaining inventories and inspection, risk assessment, and EAP responsibility on all dams. This includes dams on BLM land that are permitted through rights of way to others. BLM self-inspects its own low hazard dams or accompanies Idaho Department of Water Resources on BLM-owned dam inspections as available.
- The New Mexico Office of the State Engineer, Dam Safety Bureau has jurisdiction on the permitted dams located on BLM land and provides BLM NM with the inspection reports. BLM also participates in the NM Watershed and Dam Owners Coalition Workshop that includes many of the permitted dam authorization holders.
- In Oregon, the State of Oregon: Water Resources Departmnet (OWRD) inspects all permitted dams on BLM lands. If there are any major deficiencies found at those dams, BLM is notified. If BLM has a reason to inspect a permitted dam, they provide a copy of the report to OWRD. They also hold a biennial Dam Safety Conference and annual meeting with the federal partners whom manage dams within the state. OWRD is the agency who provides NID numbers for any dams they have. Now that the BLM manages three structures in WA they will need to develop a relationship with WA Department of Ecology.
- In Nevada, the Nevada Division of Water Resources (NDWR) performs inspections on BLM owned and non-federal dams. BLM is charged for the inspection/ permits of those dams.

- **Bureau of Reclamation –** Reclamation continues to maintain strong working relationships with state dam safety agencies. Reclamation has memorandums of understanding with each of the 17 western states where Reclamation has facilities. Meetings between Reclamation and the states are conducted as needed.

  State representatives may also participate with Reclamation staff on dam safety inspections. States have participated with Reclamation on specific issues associated with individual structures, such as issues associated with modifications, reservoir restrictions, and environmental concerns.

- **U.S. Fish and Wildlife Service –** The Service continues to invite state dam safety officials to the inspections and provide a copy of all Inspection Reports to the state dam safety officer. The Service continues to coordinate with the State Dam Safety official on state criteria and Service design documents for rehabilitation of high and significant hazard dams. The Service continues to invite State and local emergency responders to the EAP exercises. The Service seeks State review and comments on important engineering investigations such a hazard classification re-evaluation.

- **National Park Service –** Cooperate with the State of California for the management of risks of the four privately owned dams in Sequoia National Park. There are not any other cooperative relationships with states other than associated with EAPs.

- **Office of Surface Mining Reclamation and Enforcement**

  State Regulatory Programs

  Surface Mining Control and Reclamation (SMCRA) created a limited initial regulatory program directly administered and enforced by OSMRE. However, Congress intended that this program be only a temporary measure until states adopted regulatory programs consistent with the Act. Section 101 of SMCRA specifies that, because of the diversity in terrain, climate, biology, geochemistry, and other physical conditions under which mining operations occur, the primary governmental responsibility for regulating surface coal mining and reclamation operations should rest with the states. To achieve primary regulatory responsibility, often referred to as primacy, a state must develop and obtain Secretarial approval of a program that meets the requirements of the Act and that is no less effective than the federal regulations in achieving the requirements of the Act. The state also must demonstrate that it has the administrative, financial, and legal capabilities to carry out the provisions of the Act.

  Specifically, state regulatory programs must include:

  - Laws providing the state with the authority to regulate coal exploration and surface coal mining and reclamation operations in a manner consistent with SMCRA.
  - State regulations and policies consistent with the federal regulations implementing SMCRA.
  - Plans for implementation, maintenance, and enforcement of an effective permit system.
  - A process for coordinating the review and issuance of SMCRA permits with any other federal or state permitting requirements applicable to the proposed operations.
  - A program to assist small operators in the preparation of permit applications, to the extent federal funds are available for this purpose.
  - A program for the training, examination, and certification of persons engaged in the use of explosives in surface coal mining operations.
  - Sanctions for violations of state laws, regulations, or permit conditions.
  - A process for the designation of areas as unsuitable for surface coal mining operations.
  - Sufficient administrative and technical personnel and funding to operate the regulatory program.

  Through OSMRE, the Secretary of the Interior reviews the proposed state program to determine its consistency with the Act and the regulatory program established by the Secretary. The public and other federal agencies can review each state program. The Secretary either approves or disapproves the proposed state program after evaluating the comments received and after soliciting and publicly disclosing the views of the

Environmental Protection Agency, the Secretary of Agriculture, and heads of other federal agencies.

Upon program approval, the state becomes the primary regulatory authority for coal mining and coal exploration within its borders. Currently, 24 states have primacy: Alabama, Alaska, Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Mississippi, Missouri, Montana, New Mexico, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, Utah, Virginia, West Virginia and Wyoming. Most state programs were approved in 1980-1982. In primacy states, OSMRE has no role in the initial permit application and decision-making process. There are two principal exceptions: (1) OSMRE must ensure National Environmental Policy Act (NEPA) must review and approve mine plans for all proposed coal mines on lands containing leased federal coal.

States must amend their programs to maintain consistency with revised federal statutes and regulations. OSMRE reviews and processes all proposed amendments in a manner generally analogous to the procedure that applies to the review of initial state program submissions.

If a state fails to administer or maintain its approved program, OSMRE may initiate an action (known as a Part 733 notification) that may ultimately result in the substitution of federal enforcement of the state program and/or withdrawal of approval of the state program. However, such actions are rare, numbering only eleven since the enactment of SMCRA. Most states receiving Part 733 notifications ultimately implemented the necessary corrective measures. OSMRE has taken over all or part of the administration or enforcement of the state program in only three cases: Tennessee and Oklahoma in 1984 and Missouri in 2003. Only Tennessee permanently relinquished primacy.

State Regulatory Program Funding

Subject to appropriation, primacy states receive an annual grant for up to 50 percent of the costs of administering their regulatory programs, with 100 percent reimbursement for the costs of regulating coal mining on federal lands.

Oversight of State Regulatory Programs

OSMRE assumes a monitoring role following approval of a state regulatory program. That role includes both programmatic evaluations and inspections of individual mine sites. Section 517(f) of SMCRA requires that OSMRE make such inspections as are necessary to evaluate the administration of approved state programs. In primacy states, SMCRA requires that the OSMRE inspector issue a ten-day notice to the state whenever, based on any available information, including a federal inspection or any information received via a citizen complaint, the inspector has reason to believe that a violation exists. This provision applies to all potential violations, including violations of permitting requirements, performance standards, and permit conditions. The notice is issued to the state, which then has ten days to take enforcement action, initiate other action to cause the violation to be corrected, or demonstrate good cause for not taking such action. If OSMRE determines that the state response is not appropriate, an OSMRE inspector will conduct a federal inspection of the site and take any necessary enforcement action.

In the mid-1990s, in partnership with the states, OSMRE developed an approach to oversight that focused on evaluations of reclamation success, prevention of offsite

impacts, and public participation. In 2011, as the culmination of an oversight improvement initiative that began in 2009, OSMRE revised its oversight policies and procedures to establish a methodology for determining the minimum number and type of oversight inspections that it will conduct in each state and to clarify that, while OSMRE will work with states and Indian tribes to achieve consensus on oversight activities, the bureau will maintain its independence and objectivity in carrying out oversight responsibilities. The vast majority of oversight inspections are joint inspections, in which the state or tribal inspector accompanies the OSMRE inspector. However, the revised directive provides authority for independent oversight inspections to validate and enhance the credibility of both the regulatory program and the oversight process. As a general guideline, the directive provides that ten percent of all oversight inspections should be independent inspections, for which OSMRE will provide no more than 24 hours' notice to the state.

The revised directive also provides for enhanced outreach to the public in designing the oversight plan for each state each year. In addition, it expands the data elements in the annual report and requires that charts and tables in the annual report include historical trends to facilitate analysis. It requires that all data be more readily available to the public.

OSMRE provides extensive training to the states to assist them in implementing their approved programs. OSMRE-state teams jointly develop and revise course offerings to meet state needs and improve state capabilities on a continuing basis. States also provide many of the instructors. Most states have limited training budgets or stringent restrictions on out-of-state travel. The courses offered by OSMRE represent a rare opportunity to either obtain needed training within the state or to interface with other individuals in the same line of work but with different practical experience.

OSMRE provides technical and financial support in the areas of data processing and computer technology, especially in terms of analysis of permit application data. It represents a significant cost savings to states by allowing them to share expensive software.

Federal Regulatory Programs for non-federal Lands

As provided by section 504 of SMCRA, OSMRE directly regulates surface coal mining and reclamation activities on non-federal, non-Indian lands within a state if the state does not adopt its own program pursuant to section 503 of SMCRA. OSMRE currently operates federal programs in 12 states: Arizona, California, Georgia, Idaho, Massachusetts, Michigan, North Carolina, Oregon, Rhode Island, South Dakota, Tennessee, and Washington. Of those states, only Tennessee has active coal mining.

Federal Lands

Section 523(a) of SMCRA requires the Secretary to establish and implement a federal regulatory program applicable to all surface coal mining and reclamation operations taking place on federal lands. Through cooperative agreements, the Secretary may delegate the administration of most surface coal mining requirements for the federal lands program to states with an approved regulatory program. Currently, the Secretary has entered into cooperative agreements with 14 states: Alabama, Colorado, Illinois, Indiana,

Kentucky, Montana, New Mexico, North Dakota, Ohio, Oklahoma, Utah, Virginia, West Virginia, and Wyoming.

Indian Lands

As provided by section 710 of SMCRA, OSMRE directly regulates all surface coal mining and reclamation operations on Indian lands, with tribal input and assistance. However, with the enactment of the SMCRA Amendments Act of 2006, Indian tribes may apply for and obtain primacy for the regulation, in whole or in part, of surface coal mining and reclamation operations on reservation land under the jurisdiction of the tribe.

After obtaining primacy, the tribe may apply for grants to receive reimbursement for 100 percent of the cost of regulating mines on Indian lands.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA interacts and cooperates with all states when dams are regulated by both agencies. They communicate information related to inspections, incidents, and plan reviews. Personnel from state agencies also attend the annual Dam Safety Training at the Mine Health and Safety Academy in Beckley, WV.

  MSHA has developed an MOU template to be signed by all coal enforcement offices and their respective state regulatory agencies. The MOU states that MSHA and the state will share inspection, violation, and design plan information.

U.S. Department of State

- **International Boundary and Water Commission –** Due to the international character of the dams under the jurisdiction of the IBWC, they do not have any relationship with any state agency for such activities as inspections, training, or inventories. It has jointly been agreed by the U.S. and Mexican Sections that the USACE and CONAGUA engineers would be the joint technical advisors for these international dams and would perform the 5-year safety of dam inspections. All the international dams under the Commission's jurisdiction were entered the National Inventory of Dams.

  A per agreement (IBM-65-356, signed in December 10, 1965), the U.S. Section of IBWC is responsible for only the maintenance of five flood/sediment control dams owned by the Caballo Soil and Water Conservation District of New Mexico. These dams are jointly inspected by the New Mexico Natural Resource Conservation Service (NRCS) and U.S. Section Engineers. Additionally, the New Mexico State Engineer Office conducts the 5-year Dam Safety inspections for these dams.

Nuclear Regulatory Commission

- NRC staff interacted with dam safety agencies in various states to avoid duplicated effort and inventory data. Since dams associated with a nuclear power plant are not necessarily related to radiological safety, the NRC and the states coordinated to ascertain that no dams are excluded from the NID. Currently, the NRC has no direct relationship with the various states in terms of training or performance of inspections.

Tennessee Valley Authority

- TVA's dam safety program maintains cooperative relationships with counties, states, and other response partners that are located in the vicinity of the dams and inundation zones. These entities are considered partners and receive revised EAP annually. During the

annual face-to-face delivery of the EAP, contact information is confirmed, EAP orientation is presented, and the opportunity to discuss questions and suggestions is provided.

In addition to maintaining current EAPs, TVA conducts exercises to ensure the effectiveness of the plans. The counties, states, and other response partners participate in these events, which include seminars, drills, tabletops, and functional exercises.

The state agencies participating in exercises during this reporting period included:

- North Carolina Department of Emergency Management
- Tennessee Emergency Management Agency
- Georgia Emergency Management Agency
- Mississippi Emergency Management Agency

The federal agencies participating in exercises during this reporting period included:

- FEMA Region IV
- National Weather Service
- USACE
- U.S. Coast Guard
- DOE

Public Outreach

U.S. Department of Agriculture

- **Agricultural Research Service –** Scientists at the ARS Hydraulic Engineering Research Unit provide public outreach annually through stakeholder meetings; training workshops; technical presentations at professional society conferences and collegiate and secondary academic institutions; and technical tours of the Unit. Approximately a dozen tours of the ARS Hydraulic Engineering Research Unit are held annually with outreach provided to 200+ stakeholders. Updated EAP are provided to the Woodward City/County Emergency Manager and the Oklahoma Water Resources Board Dam Safety Office annually, and the agency Dam Safety Officer provides an annual briefing on the SPRS stakeholders attending the annual SPRS stakeholder meeting.
- **U.S. Forest Service –** Region 1 cooperates with State of Montana on Dam Owner Workshops. Region 5 conducted a tabletop exercise with local emergency personnel for Hume Lake dam. Region 9 released a press release and conducted public meetings concerning the reclassification of Crane Lake to a High Hazard potential dam and the subsequent effort to lower the lake.

  The Forest Service sent out an advisory and public notice informing the public of a potential hazard at Olive Lake in Oregon, and issued a partial lake closure to prohibit entry within the vicinity of an malfunctioning gate. The Campground host also monitored the vicinity to ensure individuals did not enter within the closure area, and the Forest signed and placed buoys to define the closure area.

- **Natural Resources Conservation Service –** NRCS developed and released the DamWatch dam monitoring tool for NRCS employees, project sponsors, and state dam safety officials. The deployment of DamWatch included an announcement by former Agriculture secretary Tom Vilsack and former NRCS Chief Jason Weller. NRCS also distributed several news releases related to the deployment of DamWatch nationally and within states.
- **Rural Utilities Service –** The RUS does not own or regulate any dams; therefore, dam safety awareness is handled by NRCS and dam owners and regulators.

U.S. Department of Defense

- **U.S. Air Force –** USAF Academy conducts annual Kettle Creek Dam (DRY) seminar with local response agencies.
- **U.S. Army –** Fort Hood: Work with Bell County Water Control Improvement District #6, City of Killeen, federal Stakeholders and other entities as identified in the EAPs on any outreach or training opportunities.

  Fort Campbell: A public affairs plan was in place by means of the EAP for Lake Taal Dam which has now been breached. The plan included announcements for both possible and in progress failures.
- **U.S. Army Corps of Engineers –** USACE provides risk information on a project basis to affected stakeholders and the public. An informed and engaged public that better understands risk can contribute to the evaluation of risk reduction options, and as well as take appropriate personal actions for their safety.

  In FY 2017, an effort initiated through the Flood Plain Management Services Program in conjunction with state and other federal partners encompasses plans for community outreach and engagement. Each partner in the effort is undertaking a particular role. USACE is providing technical and planning assistance regarding flood risk assessment and mitigation actions, and the Town is coordinating community outreach and engagement.

U.S. Department of Energy

- **Federal Energy Regulatory Commission –** Their dam safety program works closely with their Office of External Affairs whenever there are dam safety issues requiring public outreach at a project. During major dam safety incidents, they often put project information on our website and update as the project progresses.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** Local officials are invited to attend and participate in the EAP exercises. During EAP exercises, the BIA staff reaches out and communicates with the local community and public and makes awareness activities which are associated with the BIA's Dam Safety Program. Dam risk issues are always communicated with the public at risk and the local communities. BIA hosts an annual SOD Conference, with the next workshop currently scheduled for early 2018.
- **Bureau of Land Management –** Local officials are invited to attend and participate in the EAP exercises. BLM ensures that the National Weather Service and local authorities are notified when any dam safety incident occurs.

- **Bureau of Reclamation –** Press releases are submitted to local newspapers that announce planned modifications or other dam safety news of interest. The release provides the locations and times for public meetings; where interested individuals can learn about planned modifications and specifically about the alternatives being analyzed, environmental effects, and to update the public on project developments. Reclamation also maintains a public website, which has all dam safety new releases and other multimedia connections.
- **Fish and Wildlife Service –** There are currently no public outreach or awareness activities beyond the EAP exercise program.
- **National Park Service –** Outreach is targeted to those that own dams on NPS property and those that are upstream of NPS property that would affect NPS land upon release or failure. Downstream populations are reached through public notice, provided opportunity to comment, and public meetings.
- **Office of Surface Mining Reclamation and Enforcement –** SMCRA permits are required prior to commencing surface coal mining operations. During the permitting process, the public has access to the permit files and can provide public comment.

  Secondarily, OSMRE has a process, whereby, a citizen can file a formal complaint against a permittee and the complaint can include impounding structures. A citizen complaint can be received by OSMRE staff or it can be submitted through OSMRE's website. The citizen complaints are the investigated through OSMRE's enforcement process.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA has a dam safety web page. The page provides information relative to dam safety program contacts, MSHA safety standards, and reference and policy documents. In June 2017 MSHA held a stakeholders meeting where dam safety issues were brought to the attention of owners, designers, and other regulators.

U.S. Department of State

- **International Boundary and Water Commission –** Quarterly Citizens Forum meetings at each field offices where various issues are discussed with public.

Tennessee Valley Authority

- TVA communicated potential flooding risk information about their dams with local emergency management officials and participated in readiness exercises and drills. With the implementation of the dam safety risk informed decision-making process within TVA, communication of risk is becoming a focus of the organization both internally and externally. Dam safety risks are currently estimated based on available engineering information and potential consequences, and dam safety actions to reduce risks and assign urgency are informed by these estimates. Assessing the risk for dam safety involves communicating the risk to those responsible for making decisions to take action, and to stake holders who share in the risk consequences. TVA regularly participates in national dam safety awareness activities which perform information outreach to the local communities about the benefits and risks of dams in the community.

In general, TVA uses ads, news releases, and media alerts, along with stakeholder notifications and public meetings to keep the public informed of dam safety issues and risk. TVA provides dam safety program and issue information to the public on a case-by-case basis. In this reporting period, TVA has conducted the following public outreach activities:

- Hosted Great Falls Dam 100th year celebration for public to tour the dam and provided dam safety education
- Public outreach for the Boone dam issue included media releases, media events, and frequent status updates on the TVA website
- Public outreach for the Little Bear Creek Dam issue included media releases, media events, and the status update on the TVA website
- Published weekly Boone Dam Newsletter for local communities
- Held Media and Stakeholder Boone Dam project update in July
- Hosted numerous other visits, meetings, events, clean ups, clean marina outreach, etc., for the Boone community
- Posted updates and info on TVA.com
- Met several times with Bear Creek Development Agency in Russellville, Ala., to inform and educate local stakeholder about work at Little Bear Creek Dam
- Conducted media outreach, talking points and posted information on TVA.com about Little Bear Creek Dam
- Conducted media outreach, news release, TVA Today and video story about Pickwick Dam seismic work
- Stories following Oroville Dam spillway issues in February to ease concerns about TVA dams
- Feature stories on National Dam Safety Awareness Day May 30
- Dozens of educational public tours of TVA dams, including large public celebration events at Norris and Great Falls in 2017
- Hosted for the first time a series of joint dam/lock tours with the USACE in 2017
- Timely features on TVA dams on TVA.com as part of the Built for the People campaign
- Developed and distributed a series of TVA Dam Trading Cards to promote TVA dam awareness

TVA.com articles on the following topics were published during the reporting period:

- How TVA Safeguards Its Dams. Published in response to the crisis at Oroville Dam in California
- Dam Safety Every Day. Published in observance of National Dam Safety Awareness Day
- Little Bear Creek Dam Seepage Statement
- Boone Dam Project
- Lessons from Oroville brought to TVA
- TVA encourages dam safety awareness

- Stakeholder and media updates held at Boone Dam; construction resumes
- TVA's Stuart Harris named to U.S. Society on Dams Board of Directors
- Additional sensors, drilling to begin at Boone Dam

TVA also makes extensive use of social media as a primary communication outlet, including during critical or crisis communications, such as heavy rain events or dam safety issues.

Public Concerns

U.S. Department of Agriculture

- **Agricultural Research Service –** ARS holds an annual planning and strategy meeting with NRCS on dam safety research needs. ARS conducts periodic stakeholder meetings including an annual briefing on the status of the SPRS dam.
- **Forest Service –** Public meetings were held when the reservoir level at Crane Lake Dam in Missouri was lowered as a risk reduction measure. Previously not reported in FY 2016, there was local interest in Summit Lake dam during a June 23, 2016 storm event. NWS/NOAA erroneously broadcasted the dam had breached.

  Most dam removals/rehabilitations require National Environmental Policy Act environmental analysis, including public involvement, in defining project parameters.
- **Natural Resources Conservation Service –** NRCS frequently receives concerns from project sponsors regarding funding for the rehabilitation of dams. NRCS uses guidance outlined in the NRCS National Watershed Program Manual.

U.S. Department of Defense

- **U.S. Air Force –** Increased monitoring for sediment transport off base is currently being conducted to address environmental and erosion concerns.
- **U.S. Army –** Fort Jackson and Fort Bragg have Public concern due to recent dam failures. Schofield Barracks: Hawaii has shown concern with the dams due to a recent dam failure on the Island of Kauai. Fort McCoy has a public affairs information office which can disseminate information to the public as well as the media.

  In addition, depending on the project, there are requirements such as Environmental Assessments, National Environmental Policy Act and Record of Environmental Consideration that Fort McCoy prepares to accompany the design documentation. These requirements are performed not only for dams, but for any construction or repair having impacts to the environment. Fort Carson has a great working relationship with community partners and pursues public engagement at appropriate stages of projects.
- **U.S. Army Corps of Engineers –** USACE is proactive in making the public aware of deficiencies, interim measures to reduce risks, and the status of study and repair efforts. Studies are being conducted to determine where project modifications are appropriate. To reduce the greatest amount of risk within a constrained budget, USACE completed an Agency-wide portfolio risk assessment. The results of this effort have helped prioritize future work.

All USACE projects having dam safety deficiencies have been the subject of public meetings to inform those impacted. An Environmental Impact Statement or Environmental Assessment is prepared, as appropriate, with complete National Environmental Policy Act documentation and is included with Dam Safety Reports. Any recommended alternative has been fully coordinated with outside agencies and any other appropriate resource agency/group.

Multiple lawsuits have been filed in relation to flooding in the aftermath of Hurricane Harvey. Most of the plaintiffs are home owners or owners of businesses who filed suit seeking compensation for flooding that allegedly resulted from Corps operations at Addicks and Barker Dams in response to Hurricane Harvey. All the claims in litigation are constitutional takings claims under the Fifth Amendment. As of November 17, 2017, there are 146 cases claiming over $5 Billion dollars in compensation.

For new projects, USACE has a procedure in place during all phases (reconnaissance, feasibility, design and construction) to include the public views as well as the views of other federal and state government bodies. All new USACE projects will have a local sponsor/partner with a Project Cooperation Agreement signed by both parties that provides a project amenable to all those impacted.

- **U.S. Marine Corps –** The Marine Corps dam safety program currently does not specifically identify the early assimilation of public views into dam planning, construction, and operations. However, while the Marine Corps has not recently constructed, nor has plans for construction of any dams, the very nature of this type of work would require that these actions follow the National Environmental Policy Act requirements. Public views and opinions would be solicited through this process for any future Dam construction. This process would be coordinated through a normal planning and contracting flow.
- **U.S. Navy –**Note from 2016: Same dam, public works department called to get a new SOP written for the dam, as it might be in a higher hazard. USACE will conduct that in FY 2018, along with the routine inspection.

  Note from 2017: USACE will be conducting formal inspection in FY 2018, along with updating dam water level management SOP and inundation map.

U.S. Department of Energy

- **Federal Energy Regulatory Commission –** Many of their projects have public concerns tied to the operation of the project. Many competing interests involving environmental issues, reservoir levels, recreational issues, etc., are raised by the public on numerous projects every year. FERC addresses these issues on a case-by-case basis by enforcing the conditions of the License for the project.

  Oroville Dam – Major damage occurred to the Oroville Dam Service Spillway during spillway operation on February 7, 2017. Additionally, due to high inflows and reduced service spillway capacity, the ungated emergency spillway saw overtopping flow beginning on February 11, 2017, for the first time. Excessive erosion of the bedrock downstream of the emergency spillway threatened the stability of the structure on February 12, 2017. The reservoir was immediately lowered using the service spillway to prevent potential erosion of the emergency spillway's foundation. Due to the magnitude of this event and the potential for additional issues, the Commission required the

California Department of Water Resources to initiate immediate design of emergency repair to minimize further degradation of both the emergency spillway and service spillway. In addition, the Commission required the California Department of Water Resources to convene an Independent Board of Consultants to review and assess:

- Current measures being implemented at the project to pass inflows.
- Current condition of the service spillway and adjacent areas of the project.
- Current condition and capability of the Emergency Spillway to safely pass flood flows.
- Risk reduction measures currently implemented, and any additional risk reduction measures proposed.
- Measures to keep the Powerhouse operable during the short-term and long-term.
- All proposed remedial options for the service spillway.
- All proposed remedial options for the emergency spillway.
- Long-term, permanent modifications and project operations.
- Any additional information or analysis requested by the BOC.

The Commission also ordered new focused spillway assessments for both concrete chute spillways and unlined spillways at dams. Detailed assessments of these types of spillways at high and significant hazard dams were mandated including a Potential Failure Modes Analysis in addition to or during the annual dam safety inspection.

FERC's comprehensive and intensive licensing process allows for public views to be conveyed formally to the Commission. Environmental, recreational, social, and safety concerns are assessed and addressed through the licensing process.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** BIA serves Tribal entities that have sensitive cultural and natural resource interests as well as unique political concerns.
- **Bureau of Land Management –** All dam reconstruction projects have an Environmental Assessment completed with public input prior to construction.
- **Bureau of Reclamation –** Reclamation continues to consider dam safety activities to be federal actions, and accordingly, provides opportunities to the public for information and involvement. Public involvement can occur at any time but is generally emphasized during modification corrective action alternatives development and the National Environmental Policy Act process.

  The Reclamation Manual includes requirements for the notification and participation of project beneficiaries in dam safety modification projects. Project beneficiaries are notified of Reclamation's intent to pursue modification activities and are invited to participate in the process of developing and implementing corrective actions. Reclamation has received a range of public responses to dam safety activities. The

Reclamation Safety of Dams Act Amendments of 1984, Public Law 98-404, require 15 percent reimbursement of the cost of dam modifications by project beneficiaries. This reimbursement responsibility sometimes results in difficult negotiations for repayment contracts.

Guidelines for public involvement requirements are outlined in the Federal Guidelines for Dam Safety, Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, and the Council on Environmental Quality regulations. Additional requirements for participation by project beneficiaries is identified in Reclamation SOD Act as amended, PL 108-439, Section 2 and Section 5A. PL 108-439 provides for notification to project beneficiaries. On larger projects a separate Public Involvement Plan may need to be developed by the PMT in conjunction with the Public Affairs Office.

During the corrective action study phase, when structural or nonstructural corrective actions are assessed and the NEPA process is ongoing, the public is invited to review and comment. The regional or area office will coordinate public involvement during this phase. Release of information to the public during the design/procurement/construction phases is coordinated through regional or area office public information channels. During construction, it may be appropriate to invite the news media to tour facilities as different phases of the project unfold, including first filling or refilling, for the public to be aware of the progress of the work.

- **National Park Service –** Public notification included in Emergency Action Plans and public notice, public comment, and public meetings. The National Environmental Policy Act requires public notice, public comment, and public meetings. The NPS abides by the NEPA requirements.
- **Office of Surface Mining Reclamation and Enforcement –** SMCRA permits are required prior to commencing surface coal mining operations. During the permitting process, the public has access to the permit files and can provide public comment.

  Secondarily, OSMRE has a process, whereby, a citizen can file a formal complaint against a permittee and the complaint can include impounding structures. A citizen complaint can be received by OSMRE staff or it can be submitted through OSMRE's website. The citizen complaints are the investigated through OSMRE's enforcement process.

U.S. Department of State

- **International Boundary and Water Commission –** News releases by IBWC public affairs officer. Quarterly Citizens Forum meetings at each field offices where issues are discussed with public.

Nuclear Regulatory Commission

- The NRC has a long-standing practice of conducting its regulatory responsibilities in an open manner, and keeping the public informed of the agency's regulatory, licensing, and oversight activities. For that reason, the NRC is committed to informing the public about its licensing activities, and providing opportunities for the public to participate in the agency's decision-making process. The public can become involved in the licensing of a facility (including a dam) and can make their views known to the Commission at various

stages in the process. Additional details on the public involvement during the licensing process (for new or modification to dams) is available at the following link: http://www.nrc.gov/about-nrc/regulatory/licensing/pub-involve.html

In summary, the U.S. NRC focuses on open, accountable, and accessible government. The NRC has a long history of, and commitment to, transparency, participation, and collaboration in their regulatory activities. The following link describes the open policies of the NRC: http://www.nrc.gov/public-involve/open.html.

Tennessee Valley Authority

TVA responds appropriately to questions posed by the public with regarding dams. Within this reporting period, TVA has addressed public concerns regarding the following:

- Published Weekly Boone Dam Newsletter for local communities
- Held Media and Stakeholder Boone Dam project update in July
- Hosted numerous other visits, meetings, events, clean ups, clean marina outreach, etc., for the Boone community.
- Posted updates and info on TVA.com
- Met several times with Bear Creek Development Agency in Russellville, Ala., to inform and educate local stakeholder about work at Little Bear Creek Dam.
- Conducted media outreach, talking points and posted information on TVA.com about Little Bear Creek Dam.
- Conducted media outreach, news release, TVA Today and video story about Pickwick Dam seismic work.
- Stories following Oroville Dam spillway issues in February to ease concerns about TVA dams
- Feature stories on National Dam Safety Awareness Day May 30
- Dozens of educational public tours of TVA dams, including large public celebration events at Norris and Great Falls in 2017
- Hosted for the first time a series of joint dam/lock tours with the USACE in 2017.
- Timely features on TVA dams on TVA.com as part of the Built for the People campaign

TVA has held several public meetings to address any potential concerns that the public may have. They provided toll free numbers, email addresses, and contact information to provide access to those who may have additional questions or concerns.

State issued Solid Waste Permits for closure of TVA CCR impoundments and EPA's CCR Rule will drive more public attention. The CCR Rule requires information / calculations to be placed on TVA's website which is open for public viewing.

TVA meets with local officials, conducts public meetings, and issues news releases prior to the start of construction. TVA is also subject to NEPA, which provides multiple opportunities for public involvement / communication during the planning and decision-

making stage of a project. TVA conducts environmental reviews according to NEPA to document the potential consequences of proposed actions.

Posted NEPA public comment opportunities announcements on TVA.com for projects at Boone and Pickwick

Posted public ads on NEPA meetings in local newspapers

Also, the CCR Rule requires continuous information to be provided to the public on the condition and status of TVA's CCP facilities. Information that was posted on the public website includes: inspections, run-on/run-off control plans, inflow design flood control plans, construction history, safety factor assessments, hazard classifications, and structural stability assessments. Additional information will be provided, such as emergency action plans, fault areas demonstrations, seismic impact zone demonstrations, and unstable areas demonstrations.

Non-Federal Dams on Federal Lands

U.S. Department of Agriculture

- **U.S. Forest Service –** The FS has no authority to regulate easement dams that existed on the lands prior to FS jurisdiction. Most of these dams are regulated by state dam safety agencies. There is a small percentage of these dams that exist in states that do not regulate non-federal dams on federal lands. The FS tries to work with these dam owners.

  Three Regions are working on agreements with their respective states. Region 2 is working on an agreement with Colorado. Region 5 is working on an agreement with California. Region 1 is working on an agreement with Montana.

U.S. Department of Defense

- **U.S. Air Force –** The AF Academy has executed a Memorandum of Understanding with the State of Colorado regarding federal dams on federal property. Buckley AFB is in the process to get rid of Lake Williams Dam. No current MOUs regarding Lake Williams Dam.
- **U.S. Army Corps of Engineers –** States are regulating the non-federal dams on USACE property. USACE is not regulating these dams.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** BIA has not been funded nor has the personnel resources devoted in looking for non-federally owned low hazard dams on BIA land.
- **Bureau of Land Management –** There are an additional 56 permitted dams on BLM land that do not have a designated hazard class. The BLM is working with the permitted dam owners to have a hazard classification study performed.

  In OR there are some private dams that do not have right-of-way permits, but the water rights are held privately. They do not have legal documentation to require compliance, nor can they take an enforcement role without violating their water rights. They rely heavily on OWRD to work with these folks on developing EAPs and enforcing maintenance/repairs.

The New Mexico Office of the State Engineer Dam Safety Bureau has jurisdiction on the permitted dams located on BLM land. The NMOSE continues to work with the Dam owners to bring them in compliance. Due to resource and funding constraints of the authorization holders many are not always financially able to comply with the requirements.

In the State of Colorado, the Engineers Office is responsible for regulating permitted dams and do not always communicate with the BLM (overlooked), also sometimes the permitted dam owners do not respond to state requirements.

Montana is currently working on an Memorandum of Understanding (MOU) with the State of Montana Department of Natural Resources and Conservation (DNRC).

- **Bureau of Reclamation –** Reclamation continues to assess locations, ownership, and regulatory responsibility of private low hazard dams on Reclamation property.
- **U.S. Fish and Wildlife Service –** FWS has policies in place to require owners of non-federal dams on Service property to perform dam safety activities such as inspections, operation and maintenance, repairs and emergency preparedness. However, these policies have not always been enforced during land acquisition proceedings. Past agreements allowing non-federal entities to operate/maintain dams on Service property have not included dam safety requirements.

U.S. Department of Labor

- **Mine Safety and Health Administration –** MSHA does not own land. However, MSHA does regulate dams regardless of land ownership.

Tennessee Valley Authority

- Big Ridge and Caryville Dams are owned by the State of Tennessee. They were sold to the State by TVA in 1949 and 1950, respectively, and inspected by TVA until 2010. The use of land on which the dams sit, and the land submerged by their respective impoundments, is provided by TVA to the State of Tennessee through an easement, while the surrounding land is owned by the state. While TVA transferred responsibility for management of the dams to the state at the time of sale, TVA does maintain the right to inspect the dams at any time, and the right to reacquire the property should the state fail to maintain the dams properly or comply with other conditions of the conveyance, as stipulated in the transfer documents.

  Transfer agreements exist between TVA and the State of Tennessee detailing the transfer of property, including the Caryville and Big Ridge dam structures, and the associated easements and stipulations of management responsibility.

Additional Observations

U.S. Department of Agriculture

- **Agricultural Research Service –** The SPRS dam is included in the NRCS DamWatch. DamWatch is a monitoring tool for alerting agency engineers when USDA assisted dams experience extreme weather events such as auxiliary spillway flood flows activation or dams are located within the vicinity of seismic (e.g. earthquake) activity.

- **U.S. Forest Service –** One of the biggest challenges of the dam safety program within the Forest Service is competition for resources across all land management programs. Many Regional Dam Engineers are shared over 2 regions and have multiple program responsibilities other than dam safety. Dam operation and maintenance is funded out of the facility budget, and this also includes fire, administrative and other facilities. Major maintenance or rehabilitation (greater than $250,000) competes for funding in the FS Capital Improvement Process. As wildland fire management budgets have significantly increased in recent years, facility budgets have dropped, making the capital improvement process very competitive. Local FS managers distribute funds and personnel resources based upon needs and location conditions (priorities). With the increasing age of the dams, there is a need for heightened awareness of potential dam failures and their impacts and consequences. The Forest Service is developing a strategy to improve the efficiencies of its dam safety program and will prioritize limited resources to address the highest identified hazards and risk.

  The Forest Service was affected by wildfire fighting efforts and hurricanes in many of the National Forests. As a result, many regions and forests were not able to provide updates within the requested timeframe. FY 2017 information was provided with best data available.

  One OIG review recommendation was partly related to Forest Service assets built in response to the 1980 Mount St. Helens eruption and the volcanic debris flow causing natural landslide damming of surrounding lakes. The Spirit Lake Outlet Tunnel is owned by the FS and was designed/constructed by USACE to limit the rise of Spirit Lake levels and prevent a mobilizing of the massive debris flow deposited during the 1980 eruption. The OIG recommended that the FS develop a strategy and procedures to address similar structures.

  The FS utilizes many dam safety practices in managing the risk associated with Spirit Lake and the Spirit Lake Outlet Tunnel – even though neither are considered dams. There is public concern for Spirit Lake Outlet Tunnel and FS Region 6 has conducted public outreach and coordinated EAP table top exercises with the community and local government. Region 6 has agreements with the National Academy of Science, Engineering, and Medicine, USACE - Portland District, and others to conduct technical analysis to manage this structure.

U.S. Department of Defense

- **U.S. Army Corps of Engineers –** Awareness of the current condition of dams, the risks they pose, and the undelivered benefits is critical to understanding the larger infrastructure issues facing the nation. Additional investment in dam rehabilitation will help stem the growth of risks and likelihood of a major dam incident, and enable dams to deliver the multiple benefits originally intended, including the second and third order effects of economic stability and viability they offer communities. At the current rate of investment in USACE dams, it will take approximately five to six decades to address the known dam safety concerns they know about today, and much longer if the inevitable degradation and risk growth continue.

U.S. Department of the Interior

- **Bureau of Indian Affairs –** The BIA SOD is working on updating the Indian Affairs Manual part 55, Chapters 1 & 2 which will address new changes to the BIA SOD Program.

  A BIA handbook revision is in draft form with finalization following Tribal input.

  BIA is hopeful that the Water Infrastructure for Improvements to the Nation (WIIN) Act, passed this year, will be appropriated with funds that will alleviate deferred maintenance needs and improve overall SOD Program.

- **U.S. Fish and Wildlife Service –** Resources for dam safety are extremely limited for the FWS as they are for many dam safety programs. Most of the dams (70 percent) owned by FWS are small low hazard dams. Many of these impoundments barely qualify as dams based on the current and long-standing definition of a dam. The threshold values qualifying impoundments as dams date back to 1972 when the first nation-wide dam safety legislation was passed authorizing the U.S. Army Corps of Engineers to conduct dam safety inspections, following the failure of the Buffalo Creek Dam in West Virginia

  Small impoundments that qualify as dams based on height and/or storage volume obligate the owners as well as some regulators to perform dam safety functions with little likelihood of providing significant dam safety benefits or any genuine risk reduction. Given the minimal benefits derived from dam safety inspections/evaluations of these very small "dams" and limited resources, the current definition of what constitutes a dam should be assessed by the National Dam Safety Review Board; and be either confirmed, or hopefully, revised to reflect genuine risk. This will release owners and regulators from the unnecessary burden of performing dam safety actions on dams too small to gain benefit commensurate with the level-of-effort.

- **National Park Service –** The need for managing levee risks is stressing available resources for dam safety.

U.S. Department of State

- **International Boundary and Water Commission –** In reference to security, both Sections of the IBWC work diligently to secure their respective projects. USIBWC is continuously working to improve the security at each of the USIBWC dams along the U.S/Mexico border. Threat analyses and vulnerability assessments have been conducted at Retemal, Anzalduas, International, and American dams this year. There are several additional security enhancement projects projected over the next several years for the Falcon and Amistad facilities. Anzalduas and Retamal Dams are currently going through a security enhancement program for this fiscal year and will continue through next fiscal year.

  The Safety and Security Division has implemented a Safety Campaign for the entire agency and has focus on operational safety at all IBWC facilities responsible for operating dams. This campaign includes training, awareness, and inspections of the facilities. The initial inspections and training was completed last FY 2016. The campaign will continue through this fiscal year with training and continuous awareness.

Related Programs

Cybersecurity and Infrastructure Security Agency

Presidential Policy Directive (PPD)-21, *Critical Infrastructure Security and Resilience*, advances a national unity of effort to strengthen and maintain secure, functioning and resilient critical infrastructure. PPD-21 establishes national policy on critical infrastructure security and resilience. This is a shared responsibility among the federal, state, local, tribal and territorial entities, and public and private owners and operators of critical infrastructure (herein referred to as "critical infrastructure owners and operators"). This directive also refines and clarifies the critical infrastructure-related functions, roles, and responsibilities across the federal government, as well as enhances overall coordination and collaboration. Federal Sector Specific Agency (SSAs) are responsible for the 16 sectors defined. As such, the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA) serves as the SSA for the Dams Sector.

CISA actively collaborates with sector stakeholders (including federal, state, local, tribal and territorial partners) to identify and implement programs that enhance the protection and resilience of dams across the Nation. This collaboration occurs under the auspices of the Critical Infrastructure Partnership Advisory Council (CIPAC). The CIPAC framework provides a forum that allows government and private sector partners to conduct effective information sharing and coordinate a broad spectrum of infrastructure security activities across all sectors. As part of the CIPAC framework, the Dams Sector Coordinating Council and Government Coordinating Council constitute a focal point for public-private coordination of infrastructure security efforts for dams and related facilities.

Protective programs and resilience strategies encompass a wide spectrum of efforts, including implementing active or passive countermeasures and improving security protocols, hardening or retrofitting facilities to improve their performance under extreme loadings, implementing cyber-security measures, building operational redundancy, implementing back-up systems to minimize disruptions, implementing consequence-mitigation programs, conducting exercises, enhancing business continuity planning, and designing and planning multi-scenario restoration and recovery procedures. Effective information exchange among owners, regulators, and their associated communities can also contribute to enhancing the protection and resilience of the Dams Sector.

The collaborative partnership among government and non-government entities across the Dams Sector has resulted in the development of a variety of tools and products focused on improving protection and enhancing resilience. To ensure all dams stakeholders may access information related to protective programs, sector partners collaborated with CISA to update a series of guides on personnel screening, surveillance and suspicious activity, emergency preparedness, cybersecurity, and waterside barriers. Reference documents and training resources are accessible through the Homeland Security Information Network (HSIN)-Critical Sector Dams Portal.

In support of the implementation of Executive Order 13636 (Improving Critical Infrastructure Cybersecurity), a Dams Sector Cybersecurity Working Group was established under the direction of the Dams Sector Government and Sector Coordinating Councils. The Working Group's ongoing activities support the national policy implementationto effectively integrate both physical and cybersecurity initiatives at the national level as defined by PPD-21 and the executive order. For example, CISA, in collaboration with the Cybersecurity Working Group, developed the 2016 *Dams Sector Cybersecurity Program Guidance*, which outlines various

strategies and methods to develop or improve a basic cybersecurity program. The guide enables owners and operators to select cybersecurity activities and measures appropriate to their cyber assets and risk profiles, including Industrial Control Systems (ICS); and the 2016 *Dams Sector Cybersecurity Capability Maturity Model (C2M2),* and companion document the 2017 *Dams Sector Cybersecurity Capability Maturity Model Implementation Guide*—which provide organizations, regardless of size or type, with a flexible tool to help them evaluate, prioritize, and improve their cybersecurity capabilities.

Other important activities have focused on information sharing and outreach efforts. Such as the 2016 Dams Sector Information Sharing Drill, which provided sector partners an opportunity to test the sector's information sharing protocols as described in the 2015 *Dams Sector Information Sharing Resource Guide.* The drill was made relevant to all participants through the uses of an all-hazards approach that did not focus on any particular project or region, allowing partners to test their own organization's processes as well as the sector's in an effort to enhance security and resilience.

In addition, field delivered courses were offered by CISA. The instructor-led Dam Security and Protection Technical Seminar was conducted two times at various locations across the Nation during this reporting cycle. This course provides owners/operators, state dam safety officials, and other sector stakeholders with information pertaining to security, protection and crisis management issues in order to improve understanding of dam-related security and protection concepts. The goal of this seminar is to help integrate security, protection, and resilience strategies into stakeholders' respective risk management strategies, and leverage existing Dams Sector reference materials to provide a depth and breadth of expertise and knowledge regarding dam security and protection.

Federal partners work in collaboration to continue research on the vulnerabilities associated with embankment dams (blast impact and mechanical excavation analyses), concrete dams (waterside blast impact), and spillway gate structures (land and water-side blast impact and mechanical analysis). The research also includes designing and testing of risk mitigation measures that can potentially be utilized by sector partners for risk reduction at their assets.

CISA responded to requests for information and conducted outreach to real world incidents. Automated alerts from HSIN keeps sector partners informed of suspicious activities, incidents, and developing threats across the Dams Sector and interdependent sectors.

Federal Emergency Management Agency

In addition to the initiatives set forth directly by NDSP, there are a number of programs within FEMA that provide resources and services that support dam hazard risk mitigation, preparedness, response or recovery. The following is a summary of some of those efforts:

Hazard Mitigation Assistance

Hazard Mitigation is any action taken to reduce or eliminate long term risk to people and property from natural disasters. Hazard Mitigation projects may include, but are not limited to, buy-outs, elevations and safe rooms. Currently, FEMA administers three programs that provide funding for eligible mitigation projects that reduce disaster losses and protect life and property from future disaster damage. The three programs are the Hazard Mitigation Grant Program, the

Flood Mitigation Assistance Program, and the Pre-Disaster Mitigation Program. FEMA provided $1.5 million dollars in HMA funding to complete analysis of the Aiken County Dam, South Carolina on the dam and spillway to evaluate the normal operating load condition of the headwater and tailwater, and the spillway discharge impact. This will protect the life, safety , and welfare of the homes, property, bridges, roadways, public parks, and public utility infrastructure located below the dam.

Public Assistance Program

The Public Assistance (PA) Program provides grants to state, local, and federally recognized tribal governments and certain private non-profit entities to assist them with their response to and recovery from disasters. Specifically, the program provides assistance for debris removal, emergency protective measures, and permanent restoration of infrastructure. The PA project categories include Category A: debris removal; Category B: emergency protective measures; Category C: roads and bridges; Category D: water control facilities; Category E: public buildings and contents; Category F: public utilities; and Category G: parks, recreational, and other facilities. In FY 2016, FEMA PA funded 74 dam-related projects out of 32 different disaster declarations located in 21 states. In FY 2017, FEMA PA funded 59 dam-related projects out of 31 different disaster declarations located in 22 states. In total, 31 states received FEMA PA funds for dam-related projects totaling approximately $86,229,000.50 million federal share from FY 2016 to FY 2017. Projects included debris removal on or around dams, inspections of dams, and repair/restoration of dams.

ASDSO Report to the NDSP Biennial Report

ASDSO is a national non-profit organization dedicated to improving dam safety in the U.S. The mission of ASDSO is to improve the condition and safety of dams through education, support for state dam safety programs and fostering a unified dam safety community.

Pursuit of a cohesive national approach to dam safety, which includes working closely with the National Dam Safety Program on mutual goals is one key to success. Raising awareness, providing technical training, establishing forums for information exchange, facilitating financing for dam safety activities, and advocating for strong state dam safety programs continues to be of critical importance. ASDSO is also the conduit to the states and works closely with NDSRB members, including both state representatives and federal agencies, to ensure the NDSP continues to be an effective program.

During the last two years, ASDSO has made strides toward its goals. Included is a snapshot of their activities:

Improving State Dam Safety Programs

ASDSO annually monitors and analyzes state dam safety performance data and looks at trends over time. Each state routinely receives a “report card” or “dashboard” analysis of their program performance; comparing the state to nationally agreed-upon measures including number of inspections, number of EAPs on file, and state budgets for dam safety. ASDSO continues to provide these report cards to the NDSP to inform decisions about improvements to the State Assistance Program.

During this Biennium, ASDSO focused its advocacy work on several states, including Alabama, to educate state and local lawmakers on the importance of dam safety regulation. The

beginnings of a coalition in Alabama, to work toward passage of a dam safety statute, was sparked by ASDSO's efforts, along with the American Society of Civil Engineers, State Government Relations Office.

Increasing Awareness of Dam Safety

During the Biennium, ASDSO implemented a comprehensive communications plan to provide more effective response and outreach to the media and the public, especially surrounding significant dam incidents and failures. Media hits to the ASDSO web data went up dramatically during this time. Many subject matter experts, who volunteered their time, went through media training and were able to use what they learned frequently. ASDSO data was used and experts were quoted in over 100 media stories over this two-year period.

Much of the outreach effort was focused on the new Decade Dam Failure press release series. To highlight the need for dam safety, many historic failures were researched and communicated via press releases. Of note were the 10th anniversary of the Ka Loko Dam failure in Hawaii and the 40th anniversary of the Teton Dam failure in Idaho.

ASDSO continues to promote its new goal to reduce the rash of drownings around dams—most significantly low-head dams. ASDSO launched a campaign to challenge members and partners to expand public awareness through social media. Sample messages are posted on ASDSO's Facebook and Twitter pages.

Outreach Case Study

An unprecedented amount of media coverage characterized the extreme rainfall event that hit South Carolina in early October 2015. ASDSO provided information and support to the South Carolina dam safety program and first responders, and implemented a rapid response communications plan to respond to the media requests and to bring experts from other states into communication with South Carolina officials. This allowed those who have experienced widespread dam failure flooding events to pass along lessons learned and to work out plans to provide additional manpower for post-disaster dam inspections. The Dam Failure Investigation Guide was sent and many discussions continue to work toward providing data gathering and forensic experts to study the dam failures.

ASDSO fielded dozens of press inquiries and issued a press release to provide data on the South Carolina program to the media. In the wake of the flooding, teams from the South Carolina Department of Health and Environmental Control launched an assessment of all class one and class two dams statewide and created a public information web page for status updates on dams affected by the flood.

Increasing Technical Expertise and Educating Dam Owners

ASDSO's training program includes national and regional conferences, classroom courses, and webinars on technical topics. More than 9,000 people have been trained in the past 2 years through ASDSO's Training and Education programs—that's almost double the number from the prior 2-year period. The online Resource Center is a one-stop-shop for information on dam safety engineering and related topics. The bibliography holds more than 14,000 records and is available for search thru ASDSO. Thanks go to the NDSP for providing support to allow the Training Program to grow and prosper.

The ASDSO website continues to become the information portal for the dam safety community. During the Biennium, ASDSO took on administration of the new, FEMA-funded website on dam

failures lessons learned, at DamFailures.Org. ASDSO's Dam Failures and Incidents Committee has begun a comprehensive effort, with support from the NDSP, to research and update new case studies and lessons learned for this site. Other educational websites maintained by ASDSO include LivingNearDams.org and DamOwner.Org.

It is essential that dam owners, especially those owning small, non-federal or non-federally regulated dams, are educated about their responsibilities. One way that ASDSO reaches out to owners is through its workshop program. During the biennium, ASDSO continued to increase the number of dam owners trained throughout the U.S. by hosting 9 dam owner workshops, educating over 700 owners. ASDSO began to create a web-based series of self-paced training for owners during this period and will have that project completed in 2018.

Student Outreach

Educating the next generation is a key to transferring the technology improvements and lessons learned from the past. ASDSO provides an undergraduate scholarship annually to a promising senior. During the Biennium, ASDSO awarded 6 student paper competitions winners and those winners presented their papers at ASDSO's national conferences in 2015 and 2016.

More information on ASDSO's activities can be found in their annual Reports posted to www.damsafety.org

U.S. Society on Dams

USSD is an organization dedicated to advancing the role of dam and levee systems and building the community of practice. USSD, as the United States member of the International Commission on Large Dams (ICOLD), is dedicated to:

- Advocate: Champion the role of dam and levee systems in society.
- Educate: Be the premier source for technical information about dam and levee systems.
- Collaborate: Build networks and relationships to strengthen the community of practice.
- Cultivate: Nurture the growth of the community of practice.

ICOLD is a non-government international organization that provides a forum for the exchange of knowledge and experience in dam engineering. ICOLD leads the profession in setting standards and guidelines to ensure that dams are built and operated safely, efficiently, economically, and are environmentally sustainable and socially equitable. The ICOLD membership consists of 100 countries worldwide.

For 35 years, USSD has served as a partner with the National Dam Safety Program in implementing the program's goals and objectives. USSD's 2014–2018 Strategic Plan, which identifies the four Imperatives to advance the Mission of the Society, is aligned with the goals and objectives of the National Dam Safety Program. The leadership of USSD continues to pursue the initiatives and goals identified in the Strategic Plan. Some select accomplishments for each of the four Imperatives during 2016 and 2017 are summarized below:

- Delivered the first ever Dam Safety for the Americas International Conference to compare Best Practices in Dam Safety and Engineering. The conference was held in Mexico City, Mexico during October 2016 and was attended by over 150 professionals representing 15 countries across North and South America.

- As part of the meeting in Mexico City, the representatives to the ICOLD National Committees of the Americas met to review progress of collaborative efforts between the various countries of the Americas and to begin planning the Second International Conference on Dam Safety in the Americas to be held during February 2019 in Paraguay.
- Planned and conducted an annual meeting and conference in Anaheim, California, with the theme of "It's a Small World: Managing Our Water Resources." The conference included focused training in the areas of Public Safety Program Development for Dams, Seismic Analysis of Concrete Dams, Levees and Dry Dams, and How to Communicate What Is an Environmentally Sustainable Water Project.
- Planned and conducted a 2017 USSD Workshop in Anchorage Alaska, titled The Challenges of Dams in Cold Climates. The workshop was conducted in collaboration with the National Hydropower Association.
- Delivered an International Symposium on the Mechanics of Internal Erosion for Dams and Levees that was held during August 2016 in Salt Lake City, Utah.
- Delivered an International Symposium in collaboration with the International Association for Hydro-Environment Engineering and Research (IAHR) for the 6th International Symposium on Hydraulic Structures during June 2016 in Portland, Oregon.
- Participated with ICODS in a process to update the Federal Guidelines for Dam Safety.

A new USSD website was commissioned in 2016, providing a completely re-designed approach to communicating the organization's developments and contributions, coordinating activities of the members and Technical Committees, and providing a forum for the dissemination of information related to the Best Practices in Dam and Levee Safety and Engineering.

Much of the work and stewardship of USSD is accomplished through the USSD Committees, and all USSD members are encouraged to participate. As committee chairs and members work to advance the USSD Strategic Plan, there are many opportunities for both seasoned experts and young professionals to work side by side in building the community of practice.

Committees organize the technical program for each Annual Meeting and Conference, and for a variety of workshops and symposia throughout the year. Committees prepare reports and papers for publication by USSD, and assist the associated ICOLD technical committees in preparing ICOLD Bulletins.

During 2016 and 2017, the USSD Committees advanced their objectives as identified in their approved Committee Charters. Each Charter includes Terms of Reference, Responsibilities, Goals and Membership consistent with the USSD Strategic Plan, goals, and objectives. Some select accomplishments of the USSD Committees during 2016/2017 include:

- Served as the official U.S. representatives for fifteen ICOLD Technical Committees regarding the various aspects of dam safety and engineering including participating in formal committee meetings held in Johannesburg, South Africa and the Prague, Czech Republic.
- USSD Committee on Tailings Dams organized and delivered a workshop titled Lessons Learned from Recent Tailings Dam Failures: A Path Forward, held in San Antonio, Texas during September 2017 in conjunction with the ASDSO national conference, Dam Safety 2017.
- Continued to expand the Young Professional programs and technical tracks at the USSD annual meeting and conference to facilitate engagement of young professionals within the USSD organization and cultivate the growth of the community of practice. Engaged

Young Professionals in Vice-Chair positions on all committees to provide opportunities for professional growth and coaching. Elected three Young Professional Board Advisors to represent their interests and perspectives on the USSD Board of Directors.

Conclusion

A series of dam failures in the 1970s taught the country the importance of proper inspection and preparation—that applying the right practices will help bolster the country's safety and stability. Consequently, FEMA was predicated upon the belief that the United States should prioritize resources to mitigate the effects of such events.

Shortly after the one year anniversary of South Carolina's historic flooding (2015), Hurricane Matthew formed in the Atlantic Ocean and impacted both North and South Carolina to devastating effect. North Carolina saw 12 state regulated dams fail while 20 state regulated dams breached in South Carolina as well. Between the 2015 and 2016 events, there were 83 state regulated dams that were breached in two states alone. The Hurricane Matthew North Carolina Dam Risk Assessment Report assesses dam safety within the context of the post-Hurricane Matthew environment in North Carolina. The intent is to promote resiliency and reduce future dam-related risks in North Carolina and throughout the country. The findings demonstrate the importance of a coordinated approach towards managing risks associated with dams.

The events in North Carolina and all of the historic hurricanes in 2017 which impacted Gulf Coast, South Carolina and Georgia, the U.S. Virgin Islands, Florida, and Puerto Rico are an example of what could happen across the United States and retrospectively allows the NDSP to confirm the sustainability of the dam safety conventions it advocates for and puts into practice moving forward. The major achievements that have been outlined throughout this report have protected the nation and its citizens. However, North Carolina also acts as a stark reminder that resources must be expended to uncover the measures necessary to improve dam coordination, resilience and communication for reducing future dam risks.

While the data from this period are encouraging in many areas, the larger picture of dam safety continues to pose challenges despite the past two years having seen a noticeable increase in the construction and implementation of EAPs. For example: The percentage of state-regulated high hazard potential dams nationally with an EAP increased from 32 to 79 percent from 1998 to 2016. FEMA, as the lead agency for the NDSP, strongly believes that the driving force behind the NDSP is that many Americans are living below structurally deficient, high hazard potential dams; they are unaware of the risk; there is no plan in place to evacuate them to safety in the event of a failure; or there is a plan in place, but they are not aware of it. FEMA plans to address these challenges through the development and implementation of the following activities:

- While FY 2016 changed how NDSP distributes grants, resulting in a streamlined process, improved coordination between the FEMA Regions and state dam safety offices is still needed especially during disasters.
- Coordinate with communities to ensure dam risk is adequately included in state and local hazard mitigation plans.
- Work with other federal agencies to improve how dam risk information is shared.
- Implement a cohesive strategic outreach and communication effort to advance mission of NDSP.

- Develop and deliver products and services targeted to state and local communities that address specific dam risk management challenges. Products and services could include dam breach consequence assessments; identifying high risk dams and support the development of community and Regional preparedness, response, recovery, and mitigation strategies for those risks; evacuation planning; EAP/EOP exercise planning; training on early warning systems; dam owner training and workshops; etc.

The past few years have been a reminder that, despite the progress NDSP and its partners have made, continued investment in dam infrastructure is required to safeguard the lives and property of American citizens. By continuing NDSP's mission in researching new technologies and methodologies, while also assisting other entities in the dam space, will they be certain that the communities spread across this vast nation are adequately prepared for when an incident occurs.

IV. Appendix A – Acronyms

A&E	Architecture and Engineering
ACSIM	Assistant Chief of Staff for Installation Management (Army)
ARS	Agricultural Research Service
ASDSO	Association of State Dam Safety Officials
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CCR	Coal combustion residuals
CEATI	Centre of Energy Advancements through Technological Innovation
CFR	Code of Federal Regulations
CIPAC	Critical Infrastructure Partnership Advisory Council
CISA	Cybersecurity and Infrastructure Security Agency
CNIC	Commander Navy Installations Command (USN)
CR	Continuing Resolution
DOE	Department of Energy
EAP	Emergency Action Plan
EMI	Emergency Management Institute
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FS	Forest Service
FTE	Full-time Employee
FY	Fiscal Year
FWS	Fish and Wildlife Service
GAO	Government Accountability Office
HERU	Hydraulic Engineering Research Unit
H&H	Hydrology and Hydraulics
IBWC	International Boundary and Water Commission
ICODS	Interagency Committee on Dam Safety
ICOLD	International Commission on Large Dams
IEPR	Independent External Peer Review
IMCOM	Installation Management Command (USA)
IRB	Independent Review Board
JBMDL	Joint Base McGuire-Dix-Lakehurst (USAF)
MOU	Memorandum of Understanding
MSHA	Mine Safety and Health Administration
NDSP	National Dam Safety Program
NDSRB	National Dam Safety Review Board
NEPA	National Environmental Policy Act
NID	National Inventory of Dams

NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
O&M	Operation and Maintenance
OIG	Office of Inspector General
OSMRE	Office of Surface Mining Reclamation and Enforcement
PPD	Presidential Policy Directive
Risk MAP	Risk Mapping, Planning and Assessment
RUS	Rural Utilities Service
SEED	Safety Evaluation of Existing Dams (FWS)
SMCRA	Surface Mining Control and Reclamation Act (OSMRE)
SOD	Safety of Dams (BIA)
SPRS	Southern Plains Research Station
SSA	Sector Specific Agency
TVA	Tennessee Valley Authority
USA	United States Army
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USBR	Bureau of Reclamation
USDA	Department of Agriculture
USMC	United States Marine Corps
USN	United States Navy
USSD	United States Society on Dams
WIIN	Water Infrastructure Improvements for the Nation Act
WinDAM	Windows Dam Analysis Modules
WRRDA	Water Resources Reform and Development Act

V. Appendix B – Federal Questionnaire

Section 1 – Introduction

1.1 Describe your Agency's dam safety responsibilities and jurisdiction. Highlight any changes from the last report. Describe the impact to budgets by continuing resolution on the execution and efficiency of risk reduction efforts and compliance with the Guidelines.

Section 2 – Staffing

2.1 Please list the staffing levels in the table below.

- Number FTEs
  - Administrative/Clerical
  - Technical (Engineers, Geologists, etc.)
  - Other
  - Total
- Changes Since Last Report (30 Sep 2015)
  - Administrative/Clerical
  - Technical (Engineers, Geologists, etc.)
  - Other

2.2 If staffing changes have been made, what is the impact of those changes on accomplishing dam safety program activities? Please identify actions being taken to eliminate or mitigate reported staffing deficiencies including retirements and loss of specialized staff.

2.3 Provide an estimate of the percentage of total staff time spent on each of the following activities during the reporting period (1 Oct 2015 – 30 Sep 2017). (Note – this can be a very rough estimate and extensive time taken to develop these estimates does not provide a significant benefit.)

- 2.3.1 Inspection
- 2.3.2 Permitting/Design Reviews
- 2.3.3 Regulatory Enforcement
- 2.3.4 Emergency Response/EAP Preparedness
- 2.3.5 Other

2.4 Provide Agency-wide expenditures (in $1000s) for dam safety during the reporting period (1 Oct 2015 – 30 Sep 2017). This number includes programmatic costs only and does not include rehabilitation and construction costs.

Section 3 – Training

3.1 Training Attended by Agency Employees. Please complete the following information for training classes with a minimum of four hours per person. If no dam safety-related training was attended, please indicate Not Applicable.

Section 4 – Inventory

4.1 Does your agency have a current, complete inventory of dams reflecting the status of the dams and the associated risks?

4.2 How many dams in each downstream hazard potential classification?

- 4.2.1 High Hazard Potential Dams

4.2.2 Significant Hazard Potential Dams
4.2.3 Low Hazard Potential Dams

4.3 How many dams have been removed (1 Oct 2015 – 30 Sep 2017)?

4.4 Does your inventory include a condition assessment of the dams? Condition assessment is referring to an assessment or classification based on available information. The NID includes four data fields describing condition assessment and uses the terms Satisfactory, Fair, Poor and Unsatisfactory.

4.6 What percentage of your dams has a condition assessment?
4.6.1 High Hazard Potential Dams
4.6.2 Significant Hazard Potential Dams

4.7 How many dams have been reclassified (1 Oct 2015 – 30 Sep 2017) for their downstream hazard potential classification?
4.7.1 Low hazard potential to significant hazard potential
4.7.2 Low hazard potential to high hazard potential
4.7.3 Significant hazard potential to low hazard potential
4.7.4 Significant hazard potential to high hazard potential
4.7.5 High hazard potential to significant hazard potential
4.7.6 High hazard potential to low hazard potential

4.8 Please describe changes in land use downstream from dams under your jurisdiction that resulted in dam hazard potential changes. Examples include dams with a change of hazard potential classification due to land use change or a change in the consequence area. This question is designed to address the issue of hazard creep. There are cases when the hazard potential classification changes due to better data and information but this question is specifically addressing the issue of hazard creep. Only include dams where downstream land use changed.

4.9 Number of new dams that are being constructed this reporting period (1 Oct 2015 – 30 Sep 2017), i.e. have begun but not yet completed construction.
4.9.1 Less than 50 feet tall
4.9.1.1 High Hazard Potential Dams
4.9.1.2 Significant Hazard Potential Dams
4.9.1.3 Low Hazard Potential Dams
4.9.2 50 to 100 feet tall
4.9.2.1 High Hazard Potential Dams
4.9.2.2 Significant Hazard Potential Dams
4.9.2.3 Low Hazard Potential Dams
4.9.3 Dams Under Construction Greater than 100 feet tall
4.9.3.1 High Hazard Potential Dams
4.9.3.2 Significant Hazard Potential Dams
4.9.3.3 Low Hazard Potential Dams

Section 5 – Independent Reviews

5.1 Does your agency have a policy for independent review (not necessarily external to agency) that reviews designs, construction or operations of dams? Briefly describe.

Section 6 – Inspections

6.1 Formal Inspection Frequency. Provide your agency's formal inspection frequency in years.

6.1.1 High Hazard Potential Dams
6.1.2 Significant Hazard Potential Dams
6.1.3 Low Hazard Potential Dams

6.2 Number of Formal Inspections Performed. Provide the total number of dams that had formal inspections performed during the reporting period (1 Oct 2015 – 30 Sep 2017).
6.2.1 High Hazard Potential Dams
6.2.2 Significant Hazard Potential Dams
6.2.3 Low Hazard Potential Dams

6.3 Number of Formal Inspections Due. Provide the number of dams that were due for formal inspection during the reporting period (1 Oct 2015 – 30 Sep 2017) based on the inspection frequency.
6.3.1 High Hazard Potential Dams
6.3.2 Significant Hazard Potential Dams
6.3.3 Low Hazard Potential Dams

6.4 Do you perform your own formal inspections?
6.4.1 What agency(s) or entity(s) perform your formal inspections?

6.5 Informal Inspection Frequency. Provide your agency's informal inspection frequency in years.
6.5.1 High Hazard Potential Dams
6.5.2 Significant Hazard Potential Dams
6.5.3 Low Hazard Potential Dams

6.6 Number of Informal Inspections Performed
6.6.1 High Hazard Potential Dams
6.6.2 Significant Hazard Potential Dams
6.6.3 Low Hazard Potential Dams

6.7 Number of Informal Inspections Due. Provide the number of dams that were due for informal inspection during the reporting period (1 Oct 2015 – 30 Sep 2017) based on the inspection frequency.
6.7.1 High Hazard Potential Dams
6.7.2 Significant Hazard Potential Dams
6.7.3 Low Hazard Potential Dams

6.8 Check if there were any staffing problems with conducting inspections during the report period (1 Oct 2015 – 30 Sep 2017): Quality, Quantity, Experience, Training, Not Applicable. If selected any problems, please include remarks in the Comments section.
- Quality
- Quantity
- Experience
- Training
- Not Applicable

6.9 What actions does your agency take after an inspection with critical findings?

Section 7 – Rehabilitation

7.1 Enter any dams that have been rehabilitated since the last reporting period and dams for which there is a dam safety rehabilitation scheduled, or the need for rehabilitation has been identified in the table below. Rehabilitation, as defined in Federal Guidelines for Dam Safety (FEMA 93, April 2004), refers to the repair of structure deterioration to restore original condition; alteration of structures to improve dam stability, enlarge

reservoir capacity, or increase spillway and outlet works capacity; replacement of equipment. Do not include routine maintenance items and minor repairs. If there have been no dams rehabilitated or scheduled to be rehabilitated, select Not Applicable.

7.2 For the dams that have been identified as in need of remediation and construction has not been completed during this reporting period, how many dams have used other risk reduction measures? Examples of other risk reduction measures include reservoir restrictions, early warning systems, plans for emergency reservoir drawdown, lowering reservoir in advance of storm. Only include dams that have been identified as in need of remediation (poor or unsatisfactory NID condition assessment). If a dam had a reservoir restriction in 2015 and continued into 2016, include the dam. This number should include all dams (that have been identified as in need of remediation) with risk reduction measures currently in place.

- 7.2.1 High Hazard Potential Dams
- 7.2.2 Significant Hazard Potential Dams
- 7.2.3 Low Hazard Potential Dams

Section 8 – Reviews

8.1 Identify any agency-conducted external reviews of the dam safety program and General Accounting Office reviews dealing with the activities associated with the dam safety program during the reporting period (1 Oct 2015 – 30 Sep 2017).

8.2 What were the major recommendations arising from those reviews and actions taken or scheduled to address the recommendations? Briefly describe.

Section 9 – Failures and Incidents

9.1 Identify any dam failures or incidents that have occurred during the reporting period (1 Oct 2015 – 30 Sep 2017). Incidents include activities that caused an EAP to be activated. Also include when a dam operation or mis-operation resulted in community involvement. Describe follow-up actions, both site-specific and specific to the agency's dam safety program.

Section 10 – EAPs

10.1 How many high-hazard potential dams have an existing (not necessarily current) EAP?

10.2 How many significant-hazard potential dams have an existing (not necessarily current) EAP?

10.3 Fully-compliant EAPs by Classification. Indicate the number of fully-compliant EAPs for each classification. If your agency does not track this information, enter 0 and then enter “not tracked” in the comments. A fully-compliant EAP has all the elements of FEMA 64: Notification Flowchart; Emergency Detection, Evaluation, and Classification; Responsibilities; Preparedness; Inundation Maps (could be a simplified map or no map for significant and low hazard potential dams); Appendices (as necessary for significant and low hazard potential dams).

- 10.3.1 High Hazard Potential Dams
- 10.3.2 Significant Hazard Potential Dams

10.4 Number of up-to-date EAPs by Classification. Indicate the number of up-to-date EAPs for each classification. FEMA-64 provides the following guidance for maintaining an EAP, “The EAP should be updated promptly to address changes in personnel and contact

information, significant changes to the facility, or emergency procedures. The EAP should be reviewed at least annually for adequacy and updated as needed." Each state should provide an answer for this question based on this guidance. If you do not have an exact number but can provide an estimate, please provide the estimate and indicate "estimate" in the comments. If your agency does not track this information and you cannot provide an estimate, enter 0 and then enter "not tracked" in the comments.

10.4.1 High Hazard Potential Dams

10.4.2 Significant Hazard Potential Dams

10.5 Number of EAPs Exercised by Classification. Enter the number of EAPs exercised during the past five years (up to date and exercised apply to all EAPs, not necessarily full). If your agency does not track this information, enter 0 and then enter "not tracked" in the comments.

10.5.1 High Hazard Potential Dams

10.5.2 Significant Hazard Potential Dams

10.6 How many dams do not yet have EAP programs comparable to those defined in the Guidelines?

10.6.1 High Hazard Potential Dams

10.6.2 Significant Hazard Potential Dams

10.6.3 When do you anticipate implementing emergency action planning at those dams?

0.7 What actions has your agency taken to coordinate and encourage state and local government involvement regarding your agency's dam safety program, especially in emergency action planning?

Section 11 – ICODS Technical Guidance

11.1 Please describe the actions taken by your agency to implement the guidelines (listed below) and the status of their implementation.

11.1.1 Federal Guidelines for Earthquake Analyses and Design of Dams

11.1.2 Selecting and Accommodating Inflow Design Floods for Dams

11.1.3 Hazard Potential Classification System for Dams

Section 12 – State Dam Safety Agency Involvement

12.1 Please describe in detail those areas in which your agency maintains cooperative relationships with state agencies for such activities as inspections, training, or inventories.

12.2 Does your agency have the authority to provide technical assistance for dam safety or dam risk management to non-federal stakeholders?

12.2.1 Provide short summary with examples. Highlight authority and identify specific examples during reporting period.

Section 13 – Research & Development

13.1 Identify special initiatives taken to support or improve your agency's dam safety program. Include in the discussion dam safety research studies completed or in progress, technology transfer implemented as a result of research design standards or procedural guidelines that have been published, and complete special technical or instrumentation studies with a potentially broad or significant impact on dam safety. Showcase innovative tools and technologies and, if available, send USACE (email address – nid@usace.army.mil) photos and graphics of the tools and technologies.

Section 14 – Public Concerns

14.1 Public concerns include, but are not limited to, local or regional political interests, legislation, perceptions of risk or hazard, environmental factors, and social conflict. Have dams under your jurisdiction been the subject of public concern?

14.1.1 What actions were taken?

14.2 Does your dam safety program have procedures for the early assimilation of public views into dam planning, construction, and operation?

14.2.1 What are the procedures for early assimilation of public views?

Section 15 – Public Outreach

15.1 Describe any and all risk communication and public outreach/awareness activities associated with your Dam Safety Program.

Section 16 – Non-Federal Dams on Federal Lands

16.1 How many non-federally owned dams are on your agency's land?

16.1.1 High Hazard Potential Dams

16.1.1.1 How many of the high hazard potential dams have EAPs?

16.1.2 Significant Hazard Potential Dams

16.1.3 Low Hazard Potential Dams

16.2 Does your agency regulate the safety of these dams?

16.3 How often are the dams inspected (in years)?

16.4 Are there any circumstances or instances that prevent either the regulation of these dams, or your agency from assuring these dams comply with the Guidelines?

16.4.1 What are the circumstances or instances that prevent either the regulation of these dams, or your agency from assuring these dams comply with the Guidelines?

16.5 Has your agency initiated or signed a Memorandum of Understanding or Memorandum of Agreement with a State Dam Agency in regard to non-federal dams on federal properties and the roles/responsibilities of both agencies?

16.5.1 What states?

Section 17 – Dam Safety Risk Management

17.1 With the recent adoption of the Federal Guidelines on Dam Safety Risk Management, how do you characterize your incorporation of risk concepts into your safety program?

Section 18 – Impact on Agency Operations

18.1 Provide information on the impact of the Guidelines on agency operations, both positive and negative. Beneficial impacts can be expressed by reduced risk of loss of life and reduced potential for damage losses. Negative impacts can include such aspects as additional costs or time delays in regulatory approval or the provision of federal financial assistance.

Section 19 – Additional Observations (Optional)

Provide any additional observations or comments on the National Dam Safety Program and/or your agency's implementation of the Guidelines that were not already addressed.

VI. Appendix C – Resources and Websites

Resources

Federal Emergency Management Agency (FEMA). 2016. *Be Aware of Potential Dam Failure in Your Community Fact Sheet*. https://www.fema.gov/media-library/assets/documents/18361.

FEMA. 2015. FEMA Mitigation Task Force Strategic White Paper on Dam Risk. (FEMA DR-SC-4241). https://www.fema.gov/media-library/assets/documents/112356.

FEMA. 2016. *Catalog of FEMA Dam Safety Resources (2016 Update)*. https://www.fema.gov/media-library/assets/documents/129760.

FEMA. 2016. *FEMA National Dam Safety Program Fact Sheet*. (FEMA P-1069). https://www.fema.gov/media-library/assets/documents/5865.

FEMA. 2016. *Pocket Safety Guide for Dams and Impoundments (2016 Update)*. https://www.fema.gov/media-library/assets/documents/127281.

FEMA. 2016. *South Carolina Dam Failure Assessment and Advisement*. (FEMA P-1801). https://www.fema.gov/media-library/assets/documents/129760.

Websites

- Association of State Dam Safety Officials Website: www.damsafety.org
- Bureau of Reclamation – Completed Technology Development Projects: http://www.usbr.gov/ssle/damsafety/TechDev/index.html
- Federal Emergency Management Agency – National Dam Safety Program Biennial Report to the United States Congress, Fiscal Years 2016–2017 raw data: www.fema.gov/media-library/assets/documents/116117.
- Nuclear Regulatory Commission – Public involvement during the licensing process: http://www.nrc.gov/about-nrc/regulatory/licensing/pub-involve.html
- Policies of the Nuclear Regulatory Commission: http://www.nrc.gov/public-involve/open.html


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