US Army Corps
of Engineers ®
Albuquerque District

DRAFT INTEGRATED LETTER REPORT AND PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

Federal Participation in Watercraft Inspection Stations Upper Colorado River Basin

Prepared in response to Section 104 of the River and Harbor Act of 1958, as amended by Section 1039(d) of the Water Resources Reform and Development Act of 2014, Section 1178 of Water Infrastructure Improvements of the Nation Act of 2016, and Section 1170 of the Water Resources Development Act of 2018.

October 2020

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EXECUTIVE SUMMARY

The Water Resources Development Act (WRDA) 2018 amended section 104 to authorized Federal funding for the expansion of watercraft inspection stations. This Integrated Letter Report and Programmatic Environmental Assessment presents the results of economic and environmental impact evaluations performed to determine if the Federal government should participate in an ongoing State-managed program to establish and operate watercraft inspection stations to protect the Upper Colorado (UC) River Basin, where the Federal government has made significant water supply, navigation, hydropower, and environmental infrastructure investments. The UC states have successfully contained invasive zebra or quagga mussels (referred to as dreissenids) to a small number of isolated waterbodies .

The UC is at high risk of dreissenid infestation due to the mobility of watercraft transported between watersheds over both interstate highways and other highways. In addition, the high survival rate of dreissenids once established, their ability to be hidden on or inside of boats and other structures, and the high fiscal and environmental costs of infestation present serious problems to those who live, work, or recreate in the UC.

The existing watercraft inspection program has been managed collaboratively since 2009 by the States of Colorado, New Mexico, Utah, Wyoming and Arizona, where watercraft transported along highways are inspected for the presence of dreissenids and other aquatic invasive species (AIS) and decontaminated when AIS are detected. If approved, Federal participation in the program would be cost-shared (50 percent) with each of the States and would employ a regional strategy to identify locations that would provide the greatest likelihood of preventing the spread of AIS to reservoirs operated and maintained by the Corps in the UC.

A wide range of measures to augment and improve the effectiveness and efficiency of the program was considered. The Selected Alternative would augment the existing watercraft inspection program by incorporating a comprehensive range of measures that function as a suite of tools that would be applied and adjusted annually by each state based on its need and ability to fund its portion of the program, the results of the regional coordination efforts, and the availability of Federal funding. These measures include: Corps participation in the regional coordination efforts, expanding the number of locations or hours of operation, adding canine detection capabilities, increasing public awareness, constructing site improvements, as well as augmenting existing monitoring efforts and contingency and response planning efforts.

Although it is not possible to determine the precise level of prevention effectiveness the inspection stations provide, conservative estimates of the average annual operations and maintenance cost savings associated with deferring an infestation for fifty years is approximately $62,054,081. Estimated average annual costs of the inspection station program over 50 years is approximately $7,400,000, resulting in a benefit to cost ratio (BCR) of about 8.4 to 1. These economic benefits do not include the ecosystem benefits associated with delaying an infestation.

Because Federal participation would augment an existing State-managed program that is operated primarily along developed portions of major highways, there are only minimal direct effects to the environment. The indirect environmental effects of the proposed action on water quality and recreation are beneficial. Based on limited scope and effects and the coordination performed for this study, no controversy is anticipated. Because federal support for expansion of state watercraft inspection programs has such a limited initial investment and scope, and can be terminated at any time, there is extremely low residual risk.

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INTEGRATED LETTER REPORT AND PROGRAMMATIC ENVIRONMENTAL ASSESSMENT
FEDERAL PARTICIPATION IN WATERCRAFT INSPECTION STATIONS
UPPER COLORADO BASIN

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ACRONYMS AND ABBREVIATIONS

AIS	aquatic invasive species
BCR	benefit-to-cost ratio
BPA	Bonneville Power Administration
CEQ	Council on Environmental Quality
CO2	carbon dioxide
EA	Environmental Assessment
EDRR	early detection and rapid response
EIS	Environmental Impact Statement
ESA	Endangered Species Act
CFR	Code of Federal Regulations
FONSI	Finding of No Significant Impact
km	kilometer
MBTA	Migratory Bird Treaty Act
mgd	million gallons per day
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRA	National Recreation Area
NWPCC	Northwest Power and Conservation Council
O&M	operation and maintenance
PNWER	Pacific Northwest Economic Region
RHA	River and Harbor Act
SHPO	State Historic Preservation Office
STS	submerged traveling screen
UC	Upper Colorado River Basin
UC RR Plan	Upper Colorado River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species
U.S.C.	United States Code
VBS	vertical barrier screen
WIIN	Water Infrastructure Improvements for the Nation
WRDA	Water Resources Development Act
WRRDA	Water Resources and Reform Development Act

ORGANIZATIONS

100th	100th Meridian Initiative (www.100thmeridian.org)
AFS	American Fisheries Society (fisheries.org)
ANSTF	Aquatic Nuisance Species Task Force (www.anstaskforce.gov)
NISC	National Invasive Species Council (www.doi.gov/invasivespecies)
WRP	Western Regional Panel (westernregionalpanel.org)
WAIS	Western Aquatic Invasive Species Network (westernais.org)
SAHH	Stop Aquatic HitchHikers (stopaquatichitchhikers.org)

AGENCIES

AZFGD	Arizona Fish and Game Department (www.azgfd.gov)
CPW	Colorado Parks and Wildlife (cpw.state.co.us)
EPA	Environmental Protection Agency (www.epa.gov)
NMFS	National Marine Fisheries Service (www.noaa.gov/fisheries)
NMDGF	New Mexico Department of Game and Fish (wildlife.state.nm.us)
NWPCC	Northwest Power and Conservation Council
NOAA	National Oceanic and Atmospheric Administration (noaa.gov)
PSMFC	Pacific States Marine Fisheries Commission
Reclamation	U.S. Bureau of Reclamation (www.usbr.gov)
USDA	U.S. Department of Agricultural (www.usda.gov)
USFWS	U.S. Fish and Wildlife Service (www.fws.gov)
UDWR	Utah Division of Wildlife Resources (wildlife.utah.gov)
USGS	U.S. Geological Survey (www.usgs.gov)
WDFW	Washington Department of Fish and Wildlife (wdfw.wa.gov)
WGFD	Wyoming Game and Fish Department (wgfd.wyo.gov)

U.S. ARMY CORPS OF ENGINEERS

NWD	Northwestern Division
NWO	Omaha District
NWP	Portland District
NWW	Walla Walla District
SPD	South Pacific Division
SPA	Albuquerque District
SPK	Sacramento District

CHAPTER 1 - INTRODUCTION

This Integrated Letter Report and Programmatic Environmental Assessment (LR/Programmatic EA) presents the results of U.S. Army Corps of Engineers (Corps/USACE) evaluations of potential and anticipated consequences of a proposed Federal action to participate in a cost-shared effort to coordinate and establish watercraft inspection stations in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming in order to help reduce the risks associated with infestations of aquatic invasive species (AIS) at Corps and other federal reservoirs within the Upper Colorado River Basin (UC). This report documents the environmental, planning, and economic considerations used to develop and support the concluding recommendations. It also documents the coordination and evaluations performed for the proposed Federal action to comply with Title 33 Code of Federal Regulations (CFR) Part 230, Procedures for Implementing the National Environmental Policy Act (NEPA) (Engineer Regulation (ER) 200-2-2, Procedures for Implementing NEPA); and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA, Title 40 CFR Part 1500-1508.

NEPA is a full disclosure law that provides opportunity for public involvement in the Federal decision making process. All persons and organizations that have a potential interest in this proposed action—including the public, other Federal agencies, State and local agencies, Native American tribes, and interested stakeholders—are encouraged to participate in the NEPA process. This LR/Programmatic EA has been prepared to be programmatic in scope to allow for necessary minor changes in the proposed action to be implemented in response to changing physical and environmental conditions and changes in state and Federal laws over time, including changes to program authorities.

This LR/Programmatic EA includes an evaluation of potential environmental effects of the proposed establishment of watercraft inspection stations throughout the UC at locations with the highest likelihood of preventing the spread of AIS at Corps reservoirs. If such effects are less than significant, a Finding of No Significant Impact (FONSI) would be issued and the Corps would proceed with the proposed Federal program. If the environmental effects are determined to be significant, an Environmental Impact Statement (EIS) would be prepared before a decision is reached on whether to implement the program.

1.1 AUTHORITY AND GUIDANCE

This report was prepared pursuant to Section 104 of the River and Harbor Act (RHA) of 1958 (33 United States Code [U.S.C.] 610), as amended by Section 1039(d) of the Water Resources Reform and Development Act (WRRDA) of 2014 (Public Law 113-121), Section 1178 of the Water Infrastructure Improvements for the Nation Act (WIIN Act) of 2016 (Public Law 114-322), and by Section 1170 of the Water Resources Development Act of 2018 (P.L. 115-270). Section 104 of the RHA reads:

(a) In general

(1) In general

There is hereby authorized a comprehensive program to provide for prevention, control, and progressive eradication of noxious aquatic plant growths and aquatic invasive species from the navigable waters, tributary streams, connecting channels, and other allied waters of the United States, in the combined interest of navigation, flood control, drainage, agriculture, fish and wildlife conservation, public health, and related purposes, including continued research for development of the most effective and economic control measures, to be administered by the Chief of Engineers, under the direction of the Secretary of the Army, in cooperation with other Federal and State agencies.

(2) Local interests

Local interests shall agree to hold and save the United States free from claims that may occur from control operations and to participate to the extent of 30 per centum of the cost of such operations.

(3) Federal costs

Costs for research and planning undertaken pursuant to the authorities of this section shall be borne fully by the Federal Government.

(b) Authorization of appropriations

(1) In general There is authorized to be appropriated to carry out this section $110,000,000 for each fiscal year, of which—

(A) $30,000,000 shall be made available to carry out subsection (d)(1)(A)(i);

(B) $30,000,000 shall be made available to carry out subsection (d)(1)(A)(ii); and

(C) $30,000,000 shall be made available to carry out subsection (d)(1)(A)(iii).

(2) Control operations

Any funds made available under paragraph (1) to be used for control operations shall be allocated by the Chief of Engineers on a priority basis, based on the urgency and need of each area and the availability of local funds.

(c) Support

In carrying out the program under this section, the Secretary is encouraged to use contracts, cooperative agreements, and grants with colleges and universities and other non-Federal entities.

(d) Watercraft inspection stations

(1) In general

(A) Watercraft inspection stations In carrying out this section, the Secretary shall establish (as applicable), operate, and maintain new or existing watercraft inspection stations—

(i) to protect the Columbia River Basin;

(ii) to protect the Upper Missouri River Basin; and

(iii) to protect the Upper Colorado River Basin and the South Platte and Arizona River Basins.

(B) Locations

The Secretary shall establish watercraft inspection stations under subparagraph (A) at locations with the highest likelihood of preventing the spread of aquatic invasive species at reservoirs operated and maintained by the Secretary, as determined by the Secretary in consultation with States within the areas described in subparagraph (A).

(C) Rapid response

The Secretary shall assist States within the areas described in subparagraph (A) with rapid response to any aquatic invasive species, including quagga or zebra mussel, infestation.

(2) Cost share The non-Federal share of the cost of constructing, operating, and maintaining watercraft inspection stations described in paragraph (1) (including personnel costs) shall be—

(A) 50 percent; and

(B) provided by the State or local governmental entity in which such inspection station is located.

(3) Coordination In carrying out this subsection, the Secretary shall consult and coordinate with—

(A) the Governors of the States within the areas described in each of clauses (i) through (iii) of paragraph (1)(A), as applicable;

(B) Indian tribes; and

(C) other Federal agencies, including—

(i) the Department of Agriculture;

(ii) the Department of Energy;

(iii) the Department of Homeland Security;

(iv) the Department of Commerce; and

(v) the Department of the Interior.

(e) Monitoring and contingency planning In carrying out this section, the Secretary may—

(1) carry out risk assessments of water resources facilities;

(2) monitor for aquatic invasive species;

(3) assist States in early detection of aquatic invasive species, including quagga and zebra mussels; and

(4) monitor water quality, including sediment cores and fish tissue samples.

The U.S. Army Corps of Engineers Headquarters (USACE, HQ 2016) provided guidance for Northwestern Division (NWD) to undertake an evaluation to determine the locations for establishing watercraft inspection stations in the Columbia River Basin (Columbia Basin) in the States of Idaho, Montana, Oregon, and Washington that would provide the greatest likelihood of preventing the spread of aquatic invasive species (AIS) at reservoirs operated and maintained by the Corps. NWD would use funding specifically appropriated for watercraft inspection stations for implementation. The Corps guidance requires documentation in the form of a letter report, and an appropriate NEPA document, and outlines the specific requirements regarding content, which have been incorporated into this LR/Programmatic EA. Completion of the LR/Programmatic EA was assigned by NWD to the Walla Walla District (NWW) (USACE, NWD 2016). The requirements to be included in the LR/Programmatic EA and the sections in which those items are addressed are outlined in the Table 1.

The U.S. Army Corps of Engineers Headquarters (USACE, HQ 2017) provided guidance for (NWD), in reorganization of WRDA 2016 amendments, to permit the watercraft stations to be located anywhere in the four states to protect the Columbia River Basin, and to also to recommend action to assist these states in rapid response to infestation.

The WRDA 2018 amendment to section 104, added the additional basins. The Assistant Secretary of the Army (CW) issued Implementation guidance dated 12 April 2019. The guidance was to produce a letter report for each basin following the process and procedures outlined in the 18 March 2016, 06 March 2017 Implementation Guidance.

Table 1. Guidance Requirements and Location in Document

Guidance Requirements	Location Addressed in Document
1) Analysis of problems, needs, and opportunities in the affected area related to spread of AIS.	Section 3.1
2) Cost and impact information of invasive species on Corps projects and facilities.	Section 3.1 and 4.1.2.1
3) Locations of existing watercraft inspection stations operated by others.	Section 2.2.2
4) Identification of locations for establishing new watercraft inspection stations with the highest likelihood of preventing the spread of AIS at Corps reservoirs.	Section 2.2.2, 3.4 and 9.1
5) Analysis on cost effectiveness, engineering feasibility, and environmental acceptability.	Sections 4.1 and 4.3 (cost effectiveness);
6) Lifecycle costs associated with any proposed watercraft stations.	Section 2.2.6 (Due to the simplicity of watercraft inspection stations, life cycle costs are minimal.)
7) Delineation of Federal and non-Federal roles and responsibilities, including real estate requirements.	Chapter 10
8) Recommendations on further action, including those that may require additional authorization to implement.	Chapter 9

1.2 STUDY AREA

The location of the proposed action (as defined by the legislative authority) is within the Upper Colorado (UC) River Basin in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming (sometimes referred to as the study area States throughout the report). The UC is illustrated in Figure 1.

The UC encompasses the drainage of approximately 75,530 square miles (668,000 kilometers [km]²) of the Southwest, comprising portions of Colorado, New Mexico, Utah, and Arizona. This region is bounded the Rocky Mountains (north and east), the Great Basin (west), and the Colorado Plateau (south). The major tributaries include the Green River (730 miles with 48,100 square miles) and San Juan River (383 miles with 24,600 square miles). The headwaters of the Upper Colorado begin at La Poudre Pass, Colorado, USA. The river flows west through the Rocky Mountains, then southwest across the Colorado Plateau. Glen Canyon Dam divides the Upper Colorado from the Lower Colorado River. The Green River watershed covers Wyoming, Colorado and Utah. The San Juan River watershed begins in southwestern Colorado, passing through New Mexico and Utah before emptying into Lake Powell.

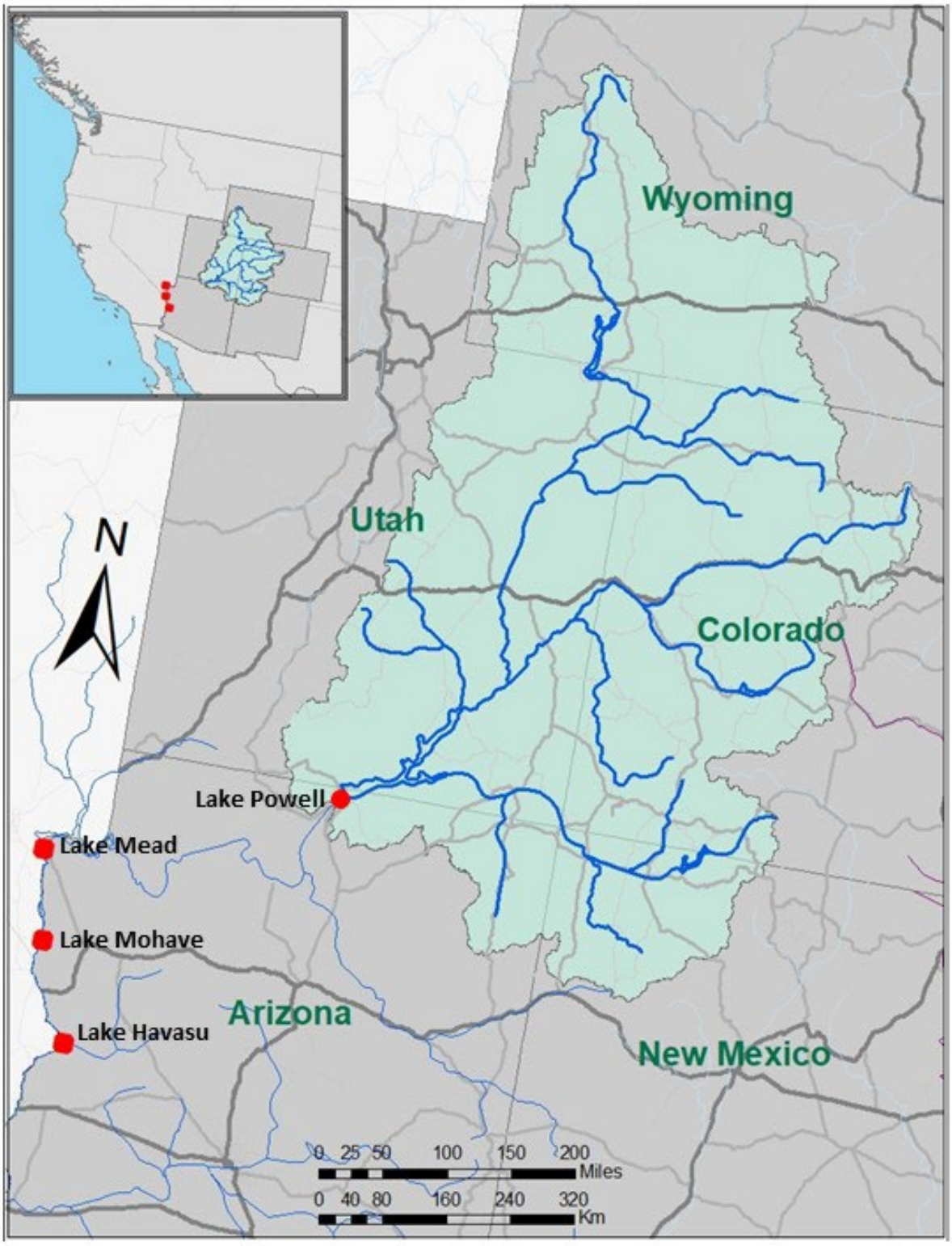

Figure 1. The Upper Colorado River Basin and State Boundaries

1.3 KEY TERMINOLOGY

Definitions of key terms used throughout this report are provided below.

Aquatic Invasive Species

An "invasive species" is defined with regard to a particular ecosystem, as a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health (Executive Order 13751). Aquatic invasive species (AIS) are invasive species that inhabit the aquatic environment.

Dreissenid

Currently, the AIS of particular concern in the UC basin are zebra (*Dreissena polymorpha)* and quagga mussels (*Dreissena rostriformis bugensis)*, which are freshwater mussels from the family Dreissenidae. Collectively, they are called dreissenids.

Due to the growing concern of a dreissenid infestation in the Lower Colorado Basin, the focus of this LR/Programmatic EA is on dreissenids. However, methods used for preventing the spread of dreissenids are also effective for other types of AIS, such as Eurasian watermilfoil (*Myriophyllum spicatum*), flowering rush (*Butomus umbellatus*), curlyleaf pondweed (*Potamogeton crispus*), purple loosestrife (*Lythrum salicaria)* and common water hyacinth (*Eichhornia crassipes) (*EDDMapsS 2020).

In this report, the term "dreissenids" is used throughout the document, unless the idea of AIS in general, or plant AIS is intended. In instances where information came from an outside source, the term mussel, zebra mussel, or quagga mussel was used as applicable. Statements that pertain to a particular dreissenid species may or may not apply to the other species.

Establishing a Watercraft Inspection Station

Establishing a watercraft inspection station means to select and prepare the site, to provide and/or mobilize the equipment and materials needed to perform watercraft inspection activities, and to construct facilities as needed.

Facility Vulnerability Assessments

Facility vulnerability assessments are performed to determine the components of a hydropower facility that would be affected in the event of a dreissenid infestation and how the function of those components would be affected (DeBruyckere and Phillips 2015).

Maintaining a Watercraft Inspection Station

Maintaining a watercraft inspection station means to perform routine equipment and annual facility maintenance (outside summer recreation season during the fall or spring months) required for the hot water pressure washers (wash unit), including winterization, changing the oil, and replacing tires, valves, thermostats, hoses, and fittings. It may include demobilizing the equipment and materials from the site and placing equipment at storage facilities.

Operating a Watercraft Inspection Station

Operating a watercraft inspection station means to provide the manpower needed to set up and operate the station at a site for the duration of the season.

Regional Defense

Regional defense is defined as "using resources in a cost-effective, inter-jurisdictional, coordinated, and collaborative response to prevent mussels from entering uninfested areas and to contain aquatic invasive species at their source" (PNWER and PSMFC 2015).

Veliger

A veliger is the free swimming larvae of freshwater mussels, including zebra and quagga mussels.

1.4 PURPOSE AND NEED FOR ACTION

The purpose of the proposed action is to assist the States of Arizona, Colorado, New Mexico, Utah, and Wyoming with establishing and operating watercraft inspection stations, monitoring, and rapid response actions to aid in preventing the spread of AIS to reservoirs operated and maintained by the Corps within the UC. The proposed action would be conducted in collaboration with regional partners as part of a larger, comprehensive defense strategy to protect water bodies in the UC, pursuant to Section 104 of the RHA 1958 (33 U.S.C 610).

The effort would include Corps engagement in monitoring and contingency planning in accordance with Section 104(e) of the RHA which may include developing risk assessments, early detection of aquatic invasive species, and monitoring water quality.

Funding for establishing watercraft inspection stations would be cost-shared with the States of Arizona, Colorado, New Mexico, Utah, and Wyoming at 50 percent Federal/50 percent non-Federal.

The proposed action is needed because the risk of the spread of AIS to rivers and Federal reservoirs in the UC is high, and the introduction and establishment of AIS (particularly dreissenids) has the potential to cause damage and increased operation and maintenance costs to water-related infrastructure, recreation, and the ecosystem

(Wong et al. 2010). Dreissenids present a direct threat to Corps authorized purposes including hydropower, navigation, and fish and wildlife mitigation. Once a waterway is infected, dreissenids can reproduce rapidly and spread throughout a reservoir, and downstream in the watershed (Wong et al. 2010; Figure 5).

CHAPTER 2 - BACKGROUND

As stated in Chapter 1, the main AIS of concern in the western US at this time are zebra and quagga mussels (Figure 2), which are also known as dreissenids. Dreissenids are nonnative organisms that were first discovered in the Great Lakes in the late 1980s, and they quickly spread to the middle and northeastern United States. Since then, established populations have also been detected in California, Nevada, Utah, Colorado, and Arizona. According to the Pacific States Marine Fisheries Commission (PSMFC) and the Pacific Northwest Economic Region (PNWER) (2015), the Pacific Northwest and the southeastern United States are the only regions without established populations of dreissenids. Figure 4 illustrates how they are distributed throughout the United States as of December 2019.

Figure 2. Zebra and Quagga Mussels
Source: PSMFC GIS Center

Figure 3. Adult Dreissenids Surface Attachment
Source: Earthtec 2015

Dreissenids have few natural predators, so introduced populations grow unchecked. According to a New York Times article (Boyle 2014), dreissenids are "highly prolific" and "attach themselves to boats or any hard surface with their byssus, or beard. They can live out of water for two weeks, and their larvae, known as veligers, use currents to colonize new waters. As many as 700,000 mussels can pile up in a square yard." Figure 3 shows an example of them attaching to a surface.

An example of their ability to quickly colonize and rapidly achieve high densities is provided in Figure 5, which demonstrates the increase in quagga mussel densities in Lake Michigan over a 10-year period. Once established, they cause considerable impacts to the ecosystem and water-related infrastructure. The invasion of dreissenids has already generated extensive costs related to infrastructure, biodiversity, and water quality in other regions of the United States.

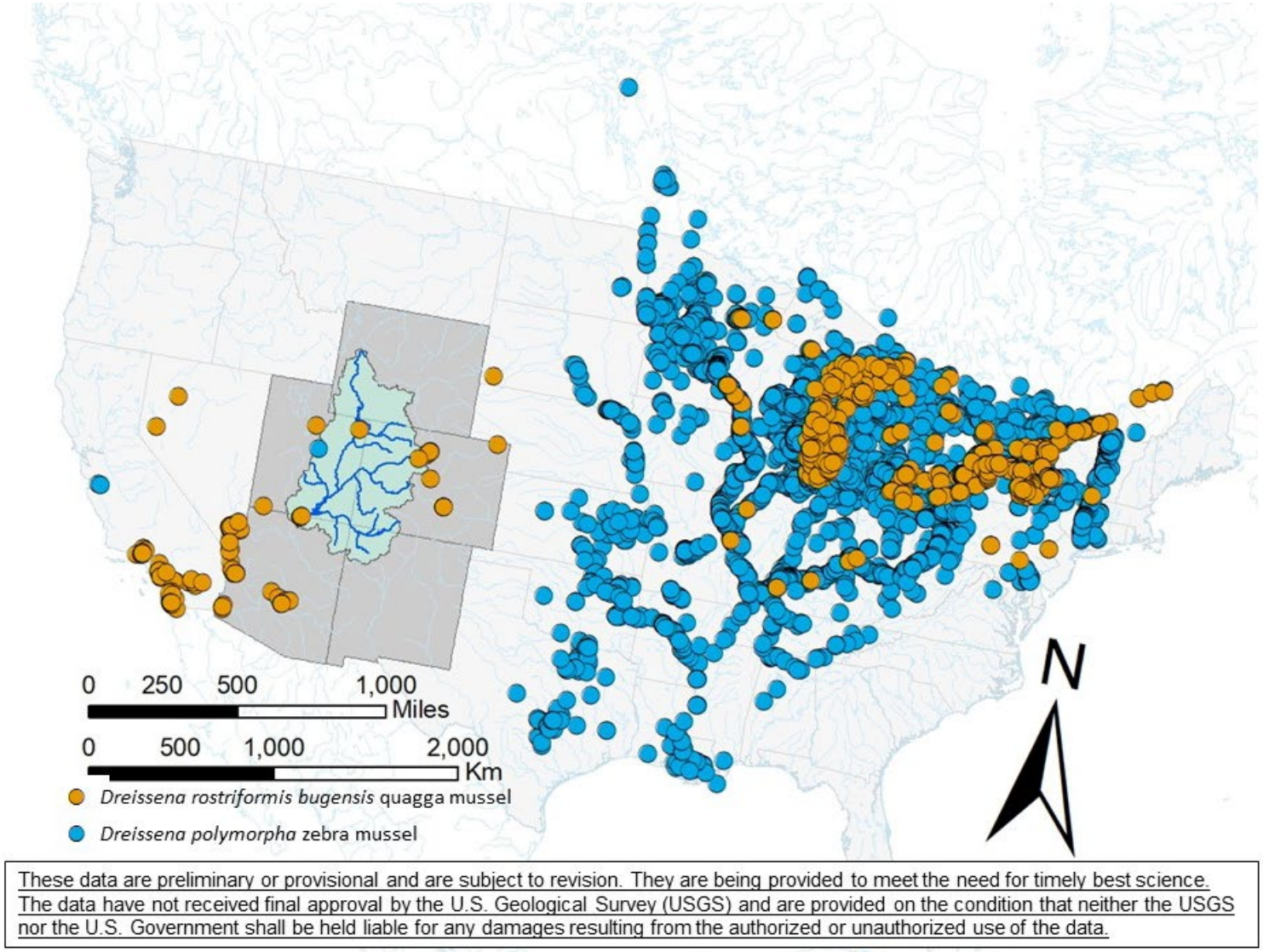

Figure 4. Established Dreissenid Populations in 2019
Source: USGS 2020

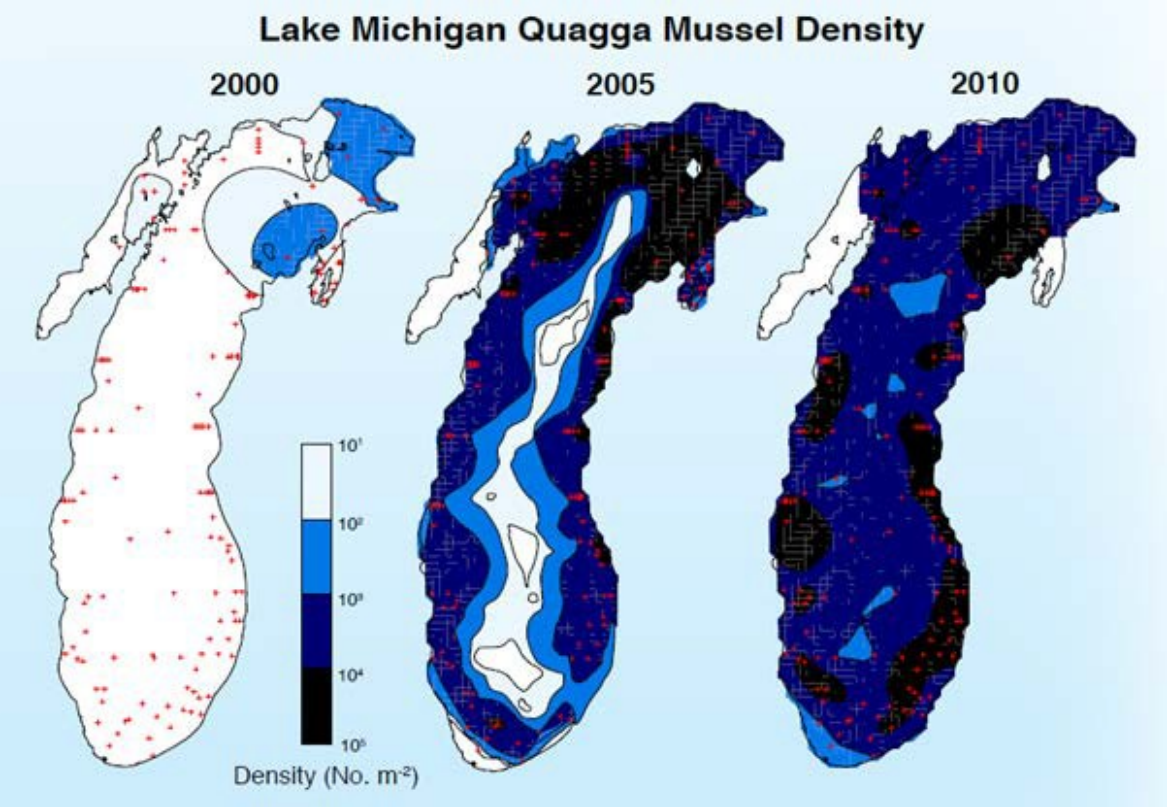

Figure 5. Quagga Mussel Density Lake Michigan 2000-2010
Source: NOAA Great Lakes Environmental Research Laboratory, n.d.

2.1 REGIONAL RESPONSE

The discovery of adult quagga mussels at Lake Mead, Nevada, in 2007, led many resource management agencies in the western United States to initiate watercraft inspection and decontamination programs (Elwell and Phillips 2016). Thirteen years later, not only have watercraft inspection station programs expanded significantly, but State, Federal, provincial, Tribal, local, and non-governmental organizations are engaged in regionally coordinated efforts in the defense against dreissenids throughout the west, including the UC Basin. The State of Colorado Zebra and Quagga Mussel Management Plan (2009) established training criteria for watercraft inspections and decontamination that have been replicated by other UC basin states. Arizona, Colorado, New Mexico, Utah, and Wyoming, in cooperation with other states, coordinate efforts and make decisions as part of this regional strategy, while operating within the scope of their specific budgets and statutory authorities. Regional coordination occurs through partnerships with the AIS-prevention organizations described below.

The Aquatic Nuisance Species Task Force (ANSTF; www.anstaskforce.gov) was established by the Nonindigenous Aquatic Nuisance Species Prevention and Control Act of 1990 (Public Law 101-636). The ANSTF is an interagency organization co-chaired by U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA) (ANSTF 2017). Activities of the ANSTF include

aquatic nuisance species prevention, research, and control; public and stakeholder education; and state coordination efforts (ANSTF 2017). The ANSTF works with six regional panels. The mission of the Western Regional Panel is "to protect western aquatic resources by preventing the introduction and spread of non-native invasive or nuisance species into western marine, estuarine, and freshwater systems" through coordination with State, Tribal, Federal, and other entities (PNWER and PSMFC 2015).

The Western Regional Panel (WRP; westernregionalpanel.org) on Aquatic Nuisance Species is one of six regional panels under the ANSTF that meets annually to address the spread of invasive species in the waters of the Western US. The WRP Annual Meeting brings together the public and private sectors in the form of researchers, industry representatives, agency representatives, and legislators to discuss invasive species management in 19 western states and four Canadian provinces. The meeting focuses on ANS research and development including the most innovative and forward-thinking research in the region. WRP documents (westernregionalpanel.org/key-documents/) provide stakeholders with standardized training for conducting inspections and monitoring.

Regional coordination efforts by the WRP also include establishing protocols and standards, which are provided in a PSMFC document called Uniform Minimum Protocols and Standards for Watercraft Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States III (Elwell and Phillips 2016). These protocols and standards are scientifically based and are intended to help provide consistency across watercraft inspection stations in the Pacific Northwest. The five States in the study area aim to meet these standards and protocols commensurate with their budgets and authorities.

The (Western) Aquatic Invasive Species Network (AISN, westernais.org) website supported by the Pacific States Marine Fisheries Commission is collaborative source of information. It provides information on the efforts of states and provinces in the United States and Canada to prevent the introduction and spread of aquatic invasive species. The network maintains links to a broad range of activities throughout western North America and around the world. The site complements information maintained by the WRP and other organizations.

The Stop Aquatic Hitchhikers! (stopaquatichitchhikers.org/) campaign was launched by the Aquatic Nuisance Species Task Force in 2002. It is designed to raise awareness about aquatic invasive species with the Clean-Drain-Dry message for recreational watercraft.

The 100th Meridian Initiative (100th Meridian; www.100thmeridian.org/) was one of the first organizations with a goal of preventing the spread of AIS in the western US. The 100th Meridian provided the foundation for the WRP.

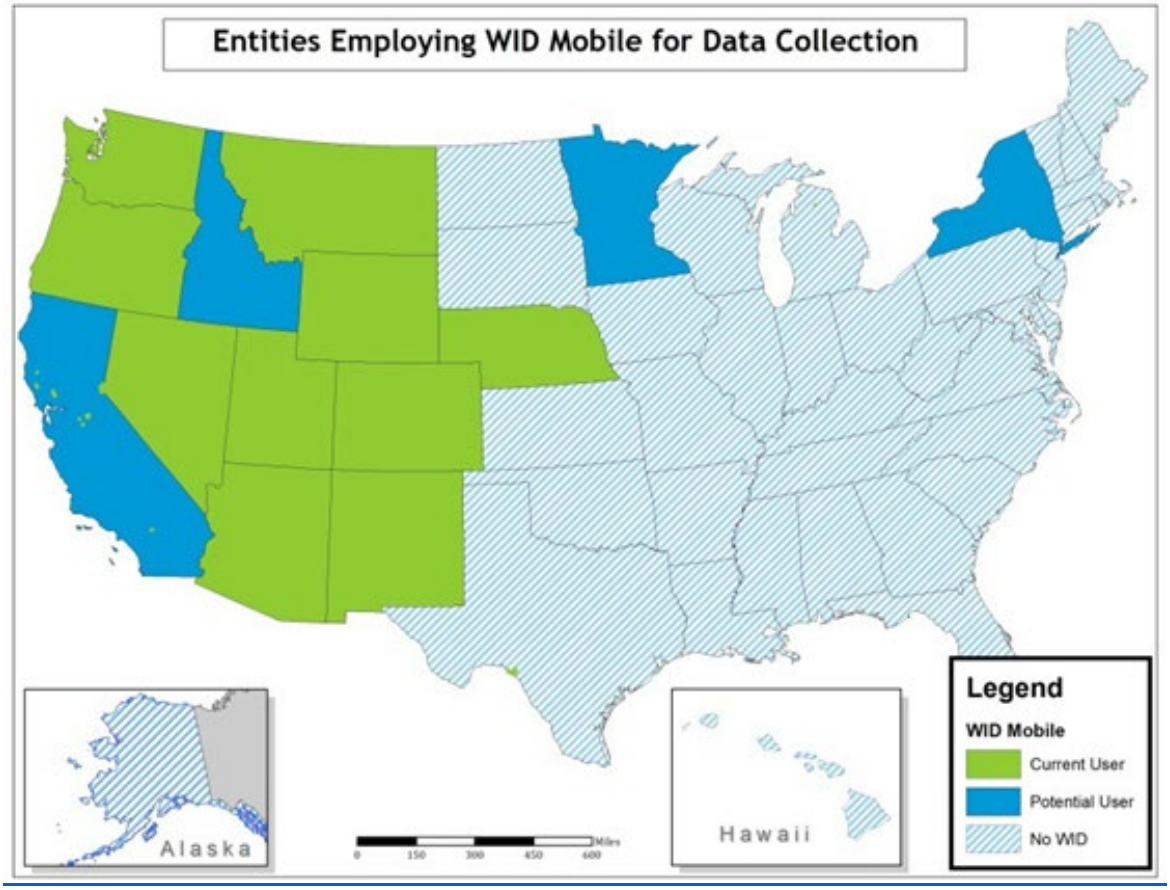

Figure 6. Map showing states using the WID mobile app.

In addition to participation in a number of cooperative organizations, States coordinate their watercraft inspection station efforts through the Regional WID Data Sharing System (WID System) is in use at more than 200 locations across the west (Figure 6; CPW 2020a,b). CPW developed the System to record WID information electronically and share information in a timely manner across jurisdictions to aid collaborative efforts to prevent the spread of zebra and quagga mussels and other ANS. The System consists of a website, shared database, and phone app for iOS and Android devices. The System reduces operating costs for mobile data collection while increasing accuracy and reliability, and can be queried for on-demand reporting. The System includes a risk assessment tool shows where boats are moving after launching in mussel infested waters and sends an alert to the next known destination. With the benefits of data sharing proving to be abundant, the states of Arizona, Nevada and Utah have been using the System to send out timely electronic alerts of watercraft leaving infested waters. This increased timely communication has directly increased the number of infested watercraft being intercepted within the western region before launching in un-infested waters.

The Western Area Power Administration (WAPA 2020) was established in 1977 as an interstate agency under the Department of Energy for managing hydropower across 15 western and central states including the UC Basin. WAPA is a federal partner in the

Upper Colorado River Endangered Fish Recovery Program established in 1988 (USFWS 2020a).

The Pacific Northwest Economic Region (PNWER) is a statutory bi-national body that coordinates State AIS efforts with the Canadian jurisdictions of British Columbia, Alberta, Saskatchewan, Yukon, and Northwest Territories (USACE 2017). Coordination with the Canadian provinces in the defense against a dreissenid introduction in the CRB is important because the Columbia River flows north into Canada, and then south into Washington State. There is already an example of dreissenids spreading from Minnesota, across the border, and into Manitoba through the Red River.

The Northwest Power and Conservation Council (NWPCC) is an interstate compact agency (Washington, Oregon, Idaho, and Montana) established in 1980 under the authority of the Northwest Power Act (USACE 2017). It is charged with developing a 20-year energy plan for the Pacific Northwest, as well as a CRB Fish and Wildlife Program (www.nwcouncil.org/fw/program/2014-12/Program). Under the Fish and Wildlife Program, the NWPCC provides independent scientific review of fish and wildlife projects implemented by four Federal action agencies (i.e., the Corps, Bonneville Power Administration, U.S. Bureau of Reclamation [Reclamation], and the Federal Energy Regulatory Commission). A key strategy of the NWPCC's 2014 Fish and Wildlife Program focuses on reducing the threats from AIS through preventing the establishment of dreissenids, monitoring and managing introduction pathways, promoting regional coordination and collaboration, and promoting public education and outreach about invasive species.

2.2 EXISTING WATERCRAFT INSPECTION STATIONS IN UC

As previously stated, watercraft inspection stations are part of the regional response to the growing concern of an introduction of dreissenids into the UC. Watercraft inspection programs were established in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming between 2006 and 2011. Watercraft inspection stations for these States are operated by the following organizations:

- Arizona – *Aquatic Invasive Species Program*, Arizona Game and Fish Department (AZGFD 2011).
- Colorado – *Aquatic Invasive Species Program,* Colorado Parks and Wildlife (CPW 2020b).
- New Mexico –*Aquatic Invasive Species Program*, New Mexico Department of Game and Fish (NMDGF 2008).
- Utah –*Aquatic Invasive Species Program*, Utah Division of Wildlife Resources (UDWR 2009).
- Wyoming –*Aquatic Invasive Species,* Wyoming Game and Fish Department (WGFD 2010).

These States have enforcement capabilities/jurisdiction over prohibited AIS and/or the possession or transportation of AIS that vary according to their statutes and regulations (enforcement programs are generally through fish and wildlife agencies and/or state/county police agencies). The common state law concerning mandatory watercraft inspection stations is that persons transporting watercraft and/or conveyances must stop for inspection or be subject to criminal prosecution in state courts. On the Federal side, zebra mussels are listed as an injurious species under the Lacey Act (18 U.S.C. §§ 42-43; 16 U.S.C. §§ 3371-3378), which makes importation (transportation) across state lines a violation and therefore federally enforceable.

2.2.1 Types of and Operations

Many watercraft inspection stations in AZ, CO, NM, UT, WY are established at selected locations near popular lakes each year during the recreation season, or available by appointment at state wildlife management offices (AZ, WY) or private businesses. The recreation season typically ranges from early or late spring to late summer or early fall, depending on the state and specific station. Hours of operation vary by state and specific station. Operations for most stations begin between approximately 7 a.m. and 10 a.m. and end between 5 p.m. and 9 p.m. Stations are typically operated by two personnel for each shift, with additional personnel for high traffic areas or on weekends and holidays.

For this LR/Programmatic EA, watercraft inspection stations were separated into five types:

- Roadside inspection station, which is “conducted at a port of entry, major highway junction, management area, or other geographically relevant choke point. The roadside inspection is typically used to prevent AIS from entering a defined geographic area” (Elwell and Phillips 2016).
- Rampside station, which is set up at a specific water body to inspect watercraft entering/exiting a lake or reservoir (Elwell and Phillips 2016).
- Inspection conducted by appointment at state agency offices. Available in most of the UC states.
- Authorized private inspections by appointment. Independent contractors identified by the state agency are available by appointment to inspect boats at locations throughout the state. These commercial inspections provide flexible options for inspection compliance.
- Roving station, which are typically assigned to a predetermined geographical area, sometimes remaining in a location for only hours at a time, which makes them effective for inspections at high-use boating recreational areas or during watercraft-related activities such as fishing tournaments or boating related competitions.

2.2.2 Station Locations

All types of watercraft inspection stations are used within the study area, focused on rampside stations associated with lakes or reservoirs (Figure 7). Rampside stations within the study area are usually established at locations to provide the primary defense against dreissenids and prevent the spread of locally established plant AIS (e.g., Eurasian watermilfoil [*Myriophyllum spicatum*], flowering rush [*Butomus umbellatus*], curlyleaf pondweed [*Potamogeton crispus*], purple loosestrife [*Lythrum salicaria]* and common water hyacinth [*Eichhornia crassipes];* EDDMapsS 2020). Roadside inspection stations are strategically located along state borders, with an emphasis on major routes entering the UC basin from the Lower Colorado River Basin and the Great Lakes, two areas in which dreissenids are well established. Many of these stations have a site arrangement that allows some equipment to remain onsite until the end of season. Figure 7 illustrates the station network, operated by the states within the UC Basin. Up to date inspection station information can be accessed using the hyperlinks in Table 2. The map does not show commercially operated station locations.

Table 2 Upper Colorado River Basin AIS Inspections Station Locations

State	Station information
Arizona	www.azgfd.gov/AIS
Colorado	cpw.state.co.us/Documents/ANS/WatercraftInspectionStationList.pdf
New Mexico	www.wildlife.state.nm.us/fishing/fishing-regulations/aquatic-invasive-species/
Utah	utahdnr.maps.arcgis.com/apps/webappviewer/index.html
Wyoming	wgfd.wyo.gov/Fishing-and-Boating/Aquatic-Invasive-Species-Prevention/AIS-Inspection-Locations

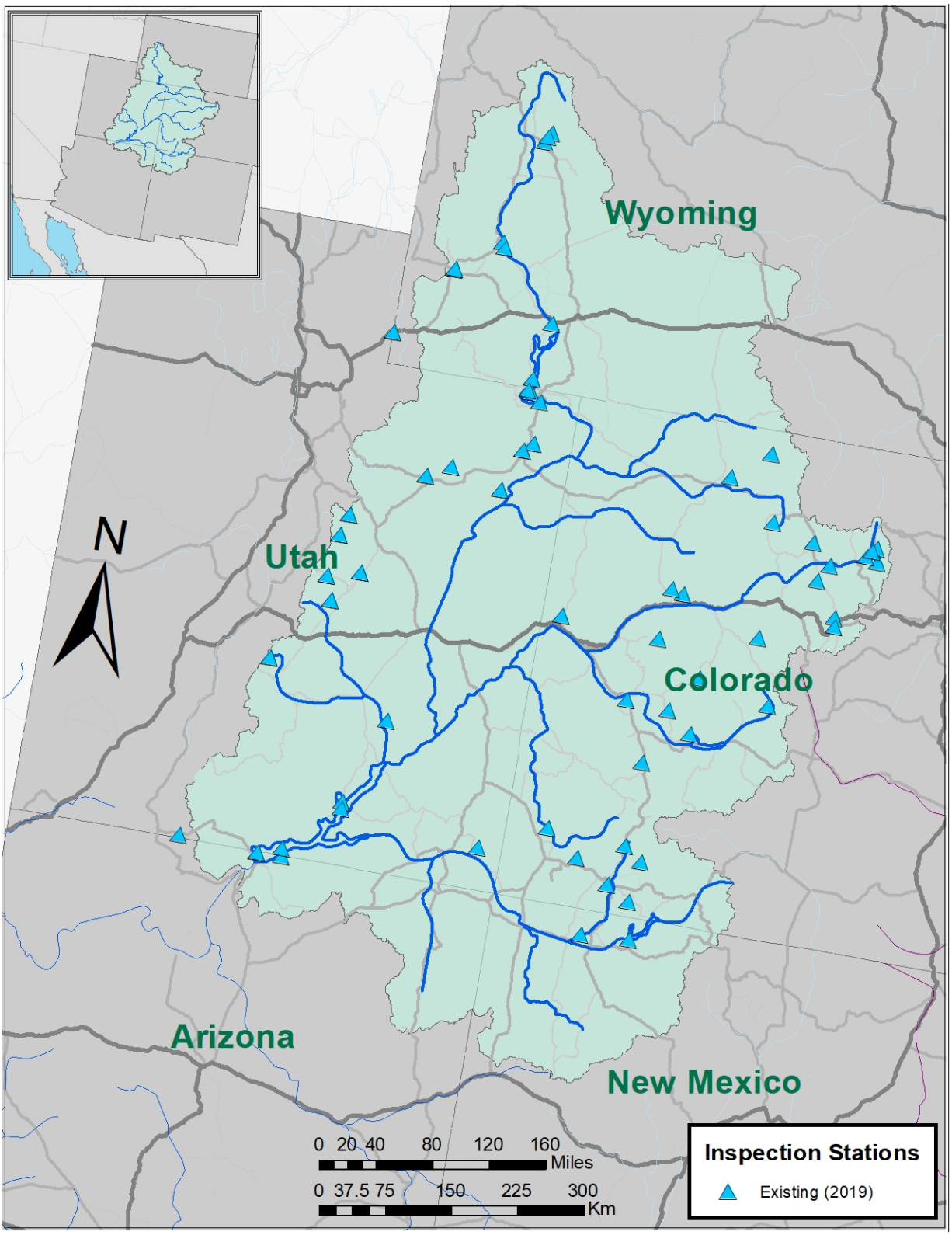

Figure 7. 2019 UC Watercraft Inspection Stations operated by state agencies.
Stations by state: AZ-2; CO-29; NM-2; UT-17; WY-8. Note: Legend was modified to reflect terminology in this LR/Programmatic EA. Temporary stations indicate that the station is not established for the entire season.

The process of selecting locations for watercraft inspection stations takes into account the following factors: safety of personnel and public; ease of public access; infrastructure availability for setting up facilities (electricity, water, restrooms, etc.); and where applicable, a suitable space for conducting decontamination procedures that does not pose any threat to the environment. Although only water is used to decontaminate watercraft, watercraft inspection stations are set up in parking lots, gravel pits, or other areas where water run-off does not present an environmental concern. Some States use a catch mat that is placed under the vessel to capture the run-off, as shown in the figure below (Figure 8).

Figure 8. A Portable Decontamination Unit with a Containment Mat for Wastewater

Most watercraft inspection stations can easily be moved and placed in the most effective locations. Each year, the States engage in an evaluation process to determine whether stations should be added, relocated, or closed, or if hours of operation should be adjusted. This evaluation process includes coordination among States and takes into account their specific budgets and statutory authorities as well as data collected related to boat transportation traffic and fouled boat interceptions.

Together, the States provide multiple levels of protection as vessels travel north or west through the region. As stated in the report by PNWER and PSMFC (2015), “It is important to understand that no one station is the key to prevention efforts. There are examples of fouled conveyances passing through stations, or avoiding stations on certain roadways. As a result, a network of perimeter and interior stations, including permanent and roving stations, is integral to preventing a dreissenid introduction.”

The States have been refining the selection of watercraft inspection station locations for several years. The States of Colorado and Utah are further in this process than Arizona New Mexico, and Wyoming, which are still gathering data to determine the most effective locations. Nearly all of the inspection stations in Colorado, Wyoming, and Utah are established in the same location for the entire season, and many of the roadside

and rampside stations have a site arrangement that allows some equipment to remain onsite until the end of the season. Some stations in Utah are set up for shorter time periods, ranging from hours to days and they cover significantly more locations than the other States.

2.2.3 Station Equipment and Inspection and Decontamination Procedures

A typical station consists of a shelter/covering, such as a shipping container, a construction trailer, canopy, or tent; a transport vehicle; a hot water pressure washer; outreach and educational materials; directional devices such as cones and signage; and applicable personnel amenities (heaters for cold weather, portable restrooms, etc.).

Figure 9. Watercraft Inspection Stations in Utah.

The States follow similar protocols and standards for watercraft inspections based on the Uniform Minimum Standards and Protocols for Watercraft Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States III (Elwell and Phillips 2016; WRP 2019). Procedures include a screening interview to assess the risk level of the watercraft, distribution of information about AIS (Section 3.3), and a boat inspection based on risk level.

The screening interview includes questions pertaining to watercraft origin; usage, including when and where it was last used; whether it was cleaned, drained, and dried; knowledge of AIS; etc. Based on the interview, the inspector conducts an inspection ranging from a cursory investigation of key boat and trailer elements to a full investigation of all potentially infested areas. The outcome of the inspection results in

either letting the boat pass through or performing a partial decontamination (often called a “hot wash” or standing water decontamination) or full decontamination.

A partial decontamination is typically performed when a vessel has recently been in a water body that is dreissenid infested, positive, or suspect; maybe grimy; or AIS plants. It entails using a pressure washer to spray hot water over the exterior surface of the vessel and in the engine and other compartments that had been exposed to water to kill anything not seen and takes approximately 20 minutes to complete (USACE, NWW 2016).

A full decontamination is performed when live or dead mussels are present. Full decontaminations involve the same equipment, but are more detailed, taking hours instead of minutes ((Elwell and Phillips 2016; WRP 2019)). Some decontaminations can be performed onsite at the inspection station if equipment and situation allow, and some decontaminations require sending the boat to another location, such as a shipyard, impound lot, or other location. Following a full decontamination, additional dry time may be required to ensure no live mussels remain on the vessel. In the UC States, a 30-day dry time is the typical protocol. In its simplest form, drying is a technique for desiccating dreissenids or other invasive species to decrease their viability (Morse 2009).

On occasion, watercraft owners request a decontamination if they have been at infested water bodies; these decontaminations may be performed at the owner’s home if there are adequate containment provisions. To achieve effective decontaminations (partial or full), inspectors use water temperatures of 120°F for interior compartments and 140°F for the exterior (hull, engine, and trailer) (Elwell and Phillips 2016).

2.2.4 Magnitude of Existing Watercraft Inspection Programs

Table 3 identifies the numbers of boats inspected in 2019, with the number of fouled dreissenid boats intercepted. Of the over 844,000 watercraft that passed through inspection stations in the five UC states, 362 were fouled.

Table 3. 2019 Watercraft Inspection/Interception Program Data by Select States

State	Number of Stations	Total Days	# BOATS INSPECTED	FOULED DREISSENID BOATS INTERCEPTED
Arizona	16	264	617	235
Colorado	72	9,900	481,453	86
New Mexico	8	1,124	42,363	12
Utah	17	3,020	301,332	12
Wyoming	4	462	18,642	17
Total	121	14,506	844,407	362

Source: Data provided by the five UC states AZ, CO, NM, UT, and WY.

2.2.5 Public Awareness

Public awareness about the seriousness of AIS is an important element of the ongoing efforts to prevent an introduction of dreissenids and further spread of other AIS within the UC. The States of Arizona, Colorado, New Mexico, Utah, and Wyoming and regional organizations work to educate the general public about AIS issues and ways individuals can help with prevention efforts. Public outreach includes ad campaigns such as "Clean. Drain. Dry." and "Stop Aquatic Hitchhikers" and "Don't Let it Loose," which are aimed at keeping boats free from AIS. These and other AIS messages are communicated through targeted trainings and presentations, social media, news releases, videos, public service announcements, signage, materials included with fishing and boating licenses, and flyers and brochures distributed at sporting and boat shows, fairs, and other special events.

Figure 10. Display Demonstrating How Mussels Can Attach to Watercraft

Watercraft inspection stations provide a valuable opportunity to increase public awareness opportunity. During the inspection, educating the public about AIS is a main focus of every inspector/boat owner interaction whether or not any type of AIS is found on the watercraft. Additionally, most inspection stations offer displays (Figure 9), posters, brochures, rack cards, etc. to educate the public about AIS.

To address public awareness at points of entry at the United States/Canada border, informational brochures have been developed by the States for U.S. Customs and Border Protection for members of the general public who tow watercraft. These outreach materials identify high risk locations for watercraft entering the UC from the Lower Colorado River Basin, or entering the United States from Canada. They also list specific 24/7 call centers in each border state and locations and hours of watercraft inspection stations in each of the four study area States.

In addition to educating recreational boaters about AIS, regional partners such as PMFSC and PNWER are communicating with commercial entities on the issue. They are communicating with boat manufacturers about providing easy access to ballast water tanks on wakeboard boats, which would allow decontamination of water left in the ballast tanks. The regional partners are also communicating with commercial boat haulers, boat brokers, auctions, online sale sites, and marinas with moored boats in infested water bodies such as the Lower Colorado River and Great Lakes.

2.2.6 Current Costs

In 2019, there were 121 watercraft inspection stations established in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming (Table 3). Of those stations, 53 were located in the UC, and 68 outside of the UC. In 2020, the total number of stations projected for the year is the same as 2019. Annual costs for operating watercraft inspection stations in each state are provided in Table 4.

Table 4. Annual Watercraft Inspection Station Operating Costs by State (Fiscal Year 2019)

State	Outside UC	Inside UC	Total	Average Daily Station Cost
Arizona	$466,621	$87,491	$554,112	$110
Colorado	$3,167,245	$2,136,049	$5,303,294	$536
New Mexico	$285,662	$202,275	$487,937	$434
Utah	$798,500	$1,384,810	$2,183,310	$294
Wyoming	$125,000	$73,500	$198,500	$430
Total	$4,843,027	$3,884,125	$8,727,153	---

Source: Data provided by the five UC states AZ, CO, NM, UT, and WY.

In addition to operating costs, annual maintenance required for the hot water pressure washers (wash unit), include winterization, changing the oil, and replacing tires, valves, thermostats, hoses, and fittings. The annual maintenance cost for the wash unit averages $1,500 per unit, and the total estimated annual maintenance cost for the wash units for stations inside the UC is $39,000 and outside the UC is $28,500.

2.3 EXISTING WATERCRAFT INSPECTION STATIONS AT SOURCE WATER BODIES

Infested water bodies of significant concern (Figure 4) include the Great Lakes; Lake Powell (Utah and Arizona), Lake Mead (Nevada and Arizona), and Lake Havasu (Arizona and California) on the lower Colorado River (Figure 1); Lake Pleasant (Arizona) on the Central Arizona Project; and Apache Lake, Canyon Lake, Saguaro Lake on Salt River in Tonto National Forest (AZ). In 2015, over half of the fouled vessels intercepted at watercraft inspection stations in the Columbia River Basin (CRB) originated from these lakes (USACE 2017).

Currently, there are no watercraft inspection stations at the Great Lakes mainly due to the vast area and multiple access points. Watercraft inspection requirements at infested water bodies within or bordering Arizona are voluntary and variable. Lakes Powell and Mead are both within National Recreational Areas (NRA) and are administered by the National Park Service. Lake Powell is within the Glen Canyon NRA, and Lake Mead within the Lake Mead NRA. Jurisdiction over Lake Havasu is complex, including Federal, State, Tribal, and local government agencies. The roles and responsibilities of these agencies at Lake Havasu are outlined in a memorandum of understanding (BLM 2014). Currently, fouled boats can legally leave the NRAs in

several states without requirement of decontamination. However, no fouled boat is legally allowed to leave Glen Canyon NRA within Utah. Over a third of the fouled boats intercepted in Idaho, Montana, Oregon, and Washington in 2015 originated from Lake Mead, Lake Powell, and Lake Havasu (USACE 2017).

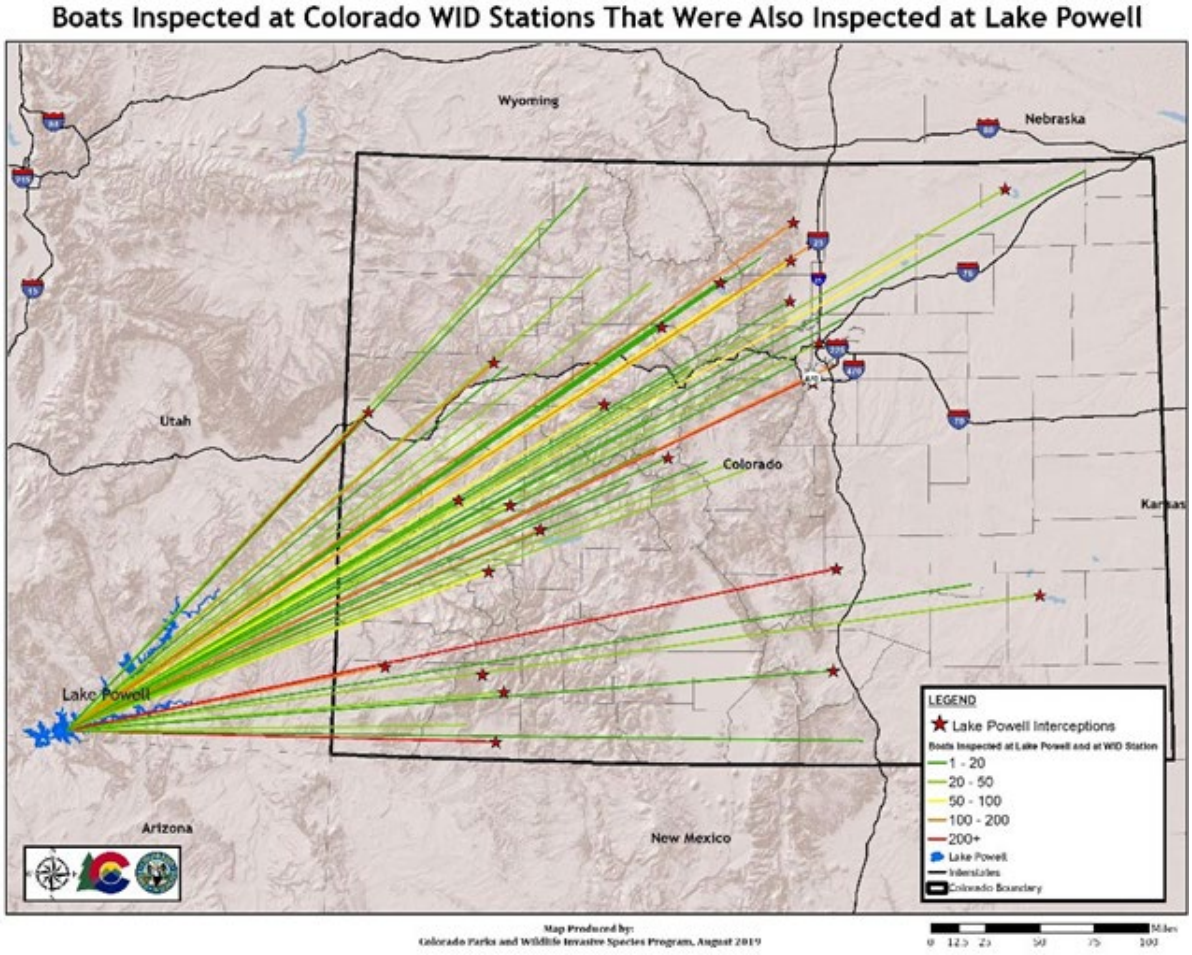

Figure 11. Dispersal of boats from Lake Powell into Colorado (CPW 2020a).

In September 2016, the Arizona Game and Fish Department updated Director's Order 3 – R09/18, which establishes the mandatory conditions and protocols for all watercraft movement from AIS-infested waters and locations (AZGFD 2011). The protocols use exposure time in infested waters to determine which treatment to apply to watercraft, vehicles, conveyances, or other equipment. For example, if the watercraft was exposed or moored in infested waters less than 5 days, the watercraft is only required to use the clean, drain, dry criteria, and remove the drain plug during transport. If AIS are observed on a boat it will be mandated for a partial decontamination (see Section 2.2.3 for description). If the watercraft was exposed or moored in infested waters 6 or more days, the watercraft is mandated for a decontamination with drying times of 7 days during May through October and 18 days during November through April. Several States mentioned above with infested water bodies do not have mandatory conditions

and protocols for watercraft movement from AIS waters. All boats leaving Lake Powell within UT must be fully drained of all water and free of all mussels. UDWR has the authority to require a boat to be decontaminated prior to leaving Lake Powell on the UT side.

2.4 EXISTING MONITORING ACTIVITIES

This LR/Programmatic EA addresses two kinds of monitoring, water chemistry monitoring and early detection monitoring. Water chemistry monitoring includes monitoring water bodies to identify a variety of characteristics, including temperature, minerals, sedimentation, etc. Water chemistry information of infested and uninfested water bodies can be compared to determine if dreissenids in particular infested water bodies could pose a greater risk for establishment in particular uninfested water bodies due to similar water chemistry. When considered in conjunction with pathways (transportation routes and boater traffic) that exist between the water bodies, this information can help determine the level of risk different infested water bodies may pose to a specific uninfested water body, such as specific Corps reservoirs. Currently, the Corps does not perform water chemistry monitoring.

Detection monitoring is required to assess the efficacy of prevention efforts, like watercraft inspection programs, and the early detection of new dreissenid populations. Under certain circumstances, small isolated dreissenid populations could be controlled or eradicated. Failure to detect new populations through early detection programs would likely result in rapid uncontrolled spread of dreissenids throughout the UC.

The States of Colorado, New Mexico, Utah, Wyoming, and Reclamation perform early detection monitoring for dreissenids in the UC. The PSMFC (2011) monitoring database can be found at http://psmfc.maps.arcgis.com/apps/MapSeries/index.html?appid=d317e395e88c48de8302a5753cf8789c. However, current monitoring efforts are insufficient according to a report by Counihan and Bollens (2016) that discusses early detection monitoring for veligers. Without adequate monitoring, dreissenids could go undetected and become established, while at the same time, watercraft inspections stations are established in locations based on inaccurate dreissenid population location data. An example of the importance of monitoring is as follows: Montana tested positive for veligers in the Tiber Reservoir in November 2016, although they were previously not thought to be present in the state at all (Montana Fish, Wildlife and Parks, FWP; 2016). With this information, FWP increased watercraft inspections to reduce the risk of the mussels spreading. Reservoir drawdown may have killed mussels in the shallows before they became established.

Seasonal veliger sampling and adult mussel monitoring at various locations within the UC use two standard methods: plankton tows and solid substrate inspections. A plankton tow is a method of collecting plankton, other organisms, and sedimentation by towing a net- like structure through the water. Solid substrate inspections involve placing a structure in the water that is composed of various surface types known to be conducive to dreissenid establishment and inspecting regularly for the presence of dreissenids.

Monitoring locations are generally determined by the proximity of watercraft recreation areas to river confluences and likely areas of introduction. Sampling typically starts in early June and runs until early October, which is when the number of veligers are expected to be the highest. Samples from these monitoring are processed at various labs using standard methods for analysis.

2.5 EXISTING CONTINGENCY AND RESPONSE PLANNING

Regional Efforts

Wimbush et al. (2009) demonstrated the potential for eradicating zebra mussels with a robust rapid response plan. The Western Regional Panel developed the Quagga-Zebra Mussel Action Plan (QZAP; WRP 2010) in response to the rising threat of invasive quagga and zebra mussels in the West. The QZAP summarizes strategies to address the invasion of zebra and quagga mussels in the West, and to identify and prioritize the specific actions that are needed to comprehensively prevent the further spread of quagga and zebra mussels, respond to new infestations, and manage existing infestations. The most recent QZAP update (WRP 2019) documents progress made over the last ten years, provides direction and informs future decision making for quagga and zebra mussel management.

The Columbia River Basin developed the first Invasive Species Response Plan for Zebra Mussels (CRB RR Plan; Heimowitz and Phillips 2008, 2017). The CRB RR Plan effectiveness is "tested" by holding periodic table-top exercises of a dreissenid mussel discovery scenario in the basin, with exercises held in 2019 (AISN). A lessons learned report (PSFMC 2019) summarizes best management practices including participant roles, documentation, Incident Command System, process and training.

State Efforts

The earliest invasive species rapid response plan was written by WRP (2003). Colorado (2020) includes a rapid response strategy in their management plan. Other UC states (AZ, NM, UT, WY) have identified the importance and need for rapid response planning in their management plans. Development of specific rapid response plans for 23 high risk waters (WY), including Flaming Gorge and Fontenelle Reservoirs, based on updated risk assessment (Bear 2009; Leonard and Bear 2019) should be completed by December 2020. The CRB (2017), Oregon (2013, 2017), Washington (2014, 2017), and Idaho (2012) have free-standing rapid response planning documents (see AISN). These plans provide critical guidance for natural resource managers to plan and implement a rapid response effort to a dreissenid mussel infestation in their State waters.

Federal Efforts

The Department of Interior framework (US DOI 2016) provides guidance for developing rapid response plans. The Reclamation (2010) Regional Plan covers the UC basin along with the Rio Grande basin. Reclamation compiled data for 18 UC hydropower facilities at risk from zebra mussels.

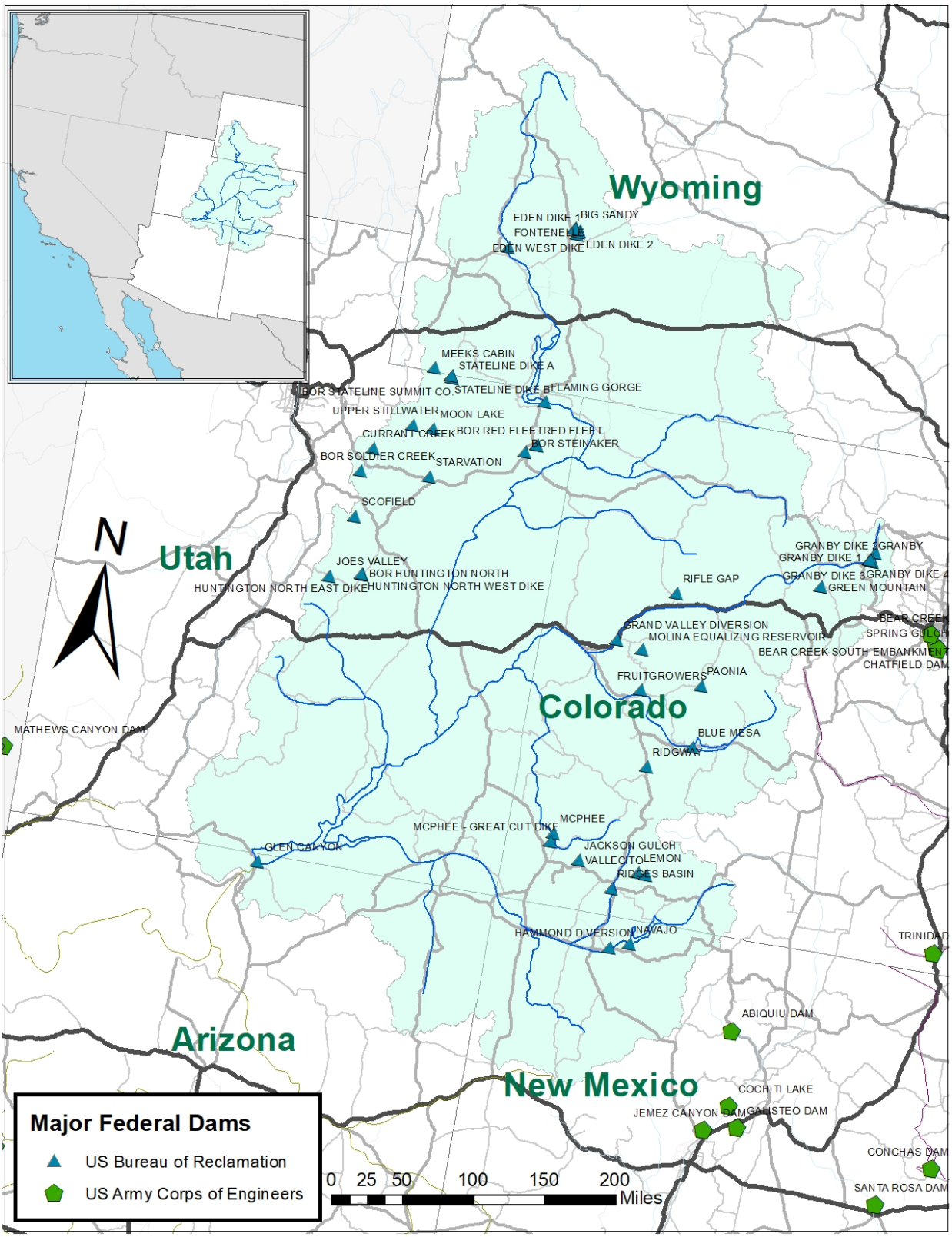

Figure 12. Major Upper Colorado (UC) River Dams.

CHAPTER 3 - PLAN FORMULATION

Development of this report generally followed the Corps six-step planning process. This process identifies and responds to problems and opportunities associated with the Federal objective, as well as specified State and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step based on constraints, objectives, and assumptions. This allows the interested public and decision-makers to be fully aware of the basic assumptions employed, the data and information analyzed, the areas of risk and uncertainty, and the significant implications of each plan that is considered.

3.1 PROBLEMS

The UC is at high risk of dreissenid infestation due to the mobility of recreational boats and other watercraft which are trailered across watersheds over interstate transportation systems, providing an easy mechanism for transferring infestations. In addition, the high survival rate of the dreissenids once established, their ability to be hidden on or inside of boats and other structures, and the high fiscal and environmental costs of infestation present serious problems to those who live, work, or recreate in the UC. Fundamentally, the problems can be divided into two categories: 1) Impacts to Infrastructure and 2) Impacts to the Environment. These impacts are summarized in the bullets, below. Additional details related to the impacts are provided in the subsequent paragraphs and in Chapter 4.

Infrastructure Impacts:

- Dreissenids attach to submerged hydropower, navigation, and water supply infrastructure, making equipment and infrastrucure less efficient or entirely ineffective, resulting in significant impacts to electrical generation; the movement of goods; and irrigation, municipal, and industrial water supplies.
- A dreissenid infestation is rapid and destructive and may not be noticed until it causes a failure of operations of critical infrastructure. By that time, significant actions may be required to clean and restore infrastructure functions.
- Infestation could present safety issues for employees of utilities, dams, and other facilities if fire suppression systems are impacted or disabled by dreissenids.
- The presence of dreissenids and the shells of dead dreissenids along beaches raise the risk of physical injury (cuts and scrapes), albeit minor, to the recreating public.
- Dense colonies of dreissenids attached to docks, buoys, and other recreational boating infrastructure can negatively impact the integrity of such structures and represent safety risks to the recreating public.

Environmental Impacts:

- Dreissenids colonize rapidly, and have potential to dramatically affect water quality once established (Wong et al 2010). Their ability to filter and remove nutrients from the water affects the base of the food chain by significantly reducing the nutrients that are available to other organisms.
- The habitat impacts of an infestation of dreissenids and the potential cascading effects to the food chain would be expected to negatively impact ESA species in the UC in a significant way. An uncontrolled infestation in the UC Basin could reduce the quality of designated critical habitat for ESA-listed fish, diminish necessary aquatic resources that contribute to the critical habitat, and undo millions of dollars in Federal investment in salmon recovery improvements made over the previous 20 years.
- An infestation of dreissenids in the UC could significantly disrupt hatchery operations, affecting sport fish abundance, and recovery efforts for endangered Colorado River species.

The inherent potential for dreissenids to spread via fouled watercraft, combined with the large adverse impacts to existing infrastructure and ecosystems that would result from an infestation, present significant risks to the UC. Once established in one area, they can rapidly spread downstream within watersheds during their free-swimming larval stage. The presence of veligers at Apache Lake, Canyon Lake, Saguaro Lake on Salt River in Tonto National Forest (AZ) is further indication of the level of risk.

Dreissenids have an ability to rapidly colonize and their high water filtration rate (Fanslow et al. 1995) causes dramatic effects on water quality and the base of the food chain, causing detrimental effects to native fish populations and the entire food web, with the potential for cascading trophic effects. Invasive mussels filter particles from the water column and concentrate nutrients in their feces, changing the nutrient regime and enriching sediment. Water clarity can increase as plankton are filtered out of the water column, which can alter the prey base of native fishes. This can also lead to an increase in aquatic plants, as well as aquatic plants taking root in deeper water.

Conditions for invasive plants and non-native fish improve, which further decreases habitat for native organisms and could result in increased competition and predation on native fishes, including Endangered Species Act (ESA)-listed species. In the Great Lakes, zebra mussels contributed to a bloom of toxic cyanobacteria (Vanderploeg et al. 2001), sometimes called blue-green algae, which can have a detrimental effect on water quality, as well as cause health impacts to people and pets.

Adult dreissenids attach to surfaces, and as they colonize, they can biofoul all types of water-related infrastructure. Many facilities located in basins already infected by dreissenids face costs from control measures and additional O&M required to manage the impacts of an infestation. These costs are typically passed on to consumers or taxpayers. From 1989 to 2006, estimated direct costs associated with zebra mussels in

the Great Lakes and Mississippi Basin ranged from $1 billion to $1.5 billion, and similar costs are expected in the west in the event of an invasion (Connelly et al. 2007).

Based on the facility vulnerability assessments completed by Reclamation, Corps authorized purposes (e.g., hydropower, navigation, and fish and wildlife mitigation) are all vulnerable to the impacts of a dreissenid infestation. Examples of infestation impacts include:

- Major hydropower components at risk of being fouled or damaged by a dreissenid infestation include:
  - Raw water systems, which could result in a powerhouse shutdown.
  - Flap gates, which could result in water entering protected areas.
  - Instrumentation, which could result in plant operation problems.
- Major fish passage and hatchery facility components at risk of being fouled or damaged by a dreissenid infestation include all submerged surfaces in low velocity areas, screens, and fish bypass systems.
- Major water supply and treatment facilities components at risk of being fouled or damaged by a dreissenid infestation include all submerged surfaces and screens.
- Dreissenid establishment in the bypass system and piping of juvenile and adult fish bypass and monitoring facilities would cause extraordinary stress on ESA-listed fish due to injury, descaling, and impact trauma.
- Due to their water filtration abilities, dreissenids can affect the food chain, decreasing the food supply for young and small fish, and increasing habitat for fish that prey on ESA-listed fish.
- Recreation, Tourism, and Waterfront Property Values – a dreissenid infestation also affects the recreational fishery by altering fish population dynamics, and the fresh water beaches, turning sandy beaches to jagged shorelines due to life cycle of the dreissenids. The negative effects to both the recreational fishery and the quality of the fresh water beaches will reduce recreation and tourism in the affected area.

An example of the degree of damage they can impose is shown in Figure 13. More detailed descriptions of impacts and associated estimated costs to Corps authorized purposes, as well as to water supply, recreation, and tourism is provided in Chapter 4.

Figure 13. Quagga Mussels on the Davis Dam in California
Source: Reclamation 2007

3.2 OPPORTUNITIES

Within the limits of the authorizing legislation, several opportunities were identified to address the significant problems associated with dreissenids and other AIS by decreasing the risk of infestations within the UC and at Corps-owned and operated reservoirs. The opportunities, which were developed by collaborating with the States of Arizona, Colorado, New Mexico, Utah, and Wyoming, include augmenting the AIS detection and decontamination efforts and expanded monitoring and contingency planning activities.

The Corps has the opportunity to collaborate in a multi-state and multi-agency partnership that will:

- Use existing knowledge to identify high risk infestation areas, transportation corridors, and types of infrastructure to partner with the study area States to address UC vulnerabilities to an infestation by inspecting watercraft traveling from infested waters to the UC.
- Educate recreational users of watercraft and public lands about the risk and damages caused by aquatic invasive species.
- Intercept dreissenids to reduce the risk of an infestation in the UC.
- Monitor the water chemistry in the UC and compare it to the water chemistry of infested water bodies to help determine the risk of dreissenids from specific infested water bodies becoming established in the UC. This provides an opportunity to inform risk management decisions.

- Detect veligers before populations of dreissenids become established in the UC.
- Develop rapid response plans, which would be implemented upon initial detection of dreissenids in the UC.

3.3 PLANNING OBJECTIVES AND CONSTRAINTS

Planning Objectives

Planning objectives represent desired positive changes. They are generated to describe how problems could be addressed by taking advantage of available opportunities. The following objectives were identified for this evaluation:

- Intercept watercraft on existing pathways between infested water bodies and federal reservoirs in the UC to detect dreissenids on the watercraft and decontaminate the watercraft to reduce the risk of infestation.
- Identify water chemistry of the UC and compare it to the water the chemistry of infested water bodies to better understand the risks to federal reservoirs in the UC, and to prioritize areas for development of follow-up actions.
- Prepare rapid response plans in the event dreissenids are detected.
- Using the existing facility vulnerability assessments performed by Reclamation (2013; 2015a-e), prepare site-specific contingency plans at Corps and other federal facilities with a focus on areas that monitoring efforts determined to be a priority.

Planning Constraints

Project constraints are resource, legal, or policy considerations that limit the range or type of actions that could be implemented to meet planning objectives. The following constraint was identified for this evaluation:

- Legal authority to implement.
- Avoid adverse effects to Threatened and Endangered Species.

3.4 MEASURES

The purpose of the following sections is to show potential improvements and expansions of the current operations through a Federal partnership. This evaluation does not attempt to precisely define the future program. Optimization will occur annually at the regional level. Instead of attempting to define an optimal set of conditions, this report assumes that providing Federal funding to assist the State programs across the region will result in an increase in the investment and effectiveness of the overall program and a decrease in the risk of infestations. The measures discussed below were developed in cooperation with State AIS Coordinators.

Measure 1 – Federal Participation in the Process to Strategically Select and Prioritize Locations to Establish Watercraft Inspection Stations in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

This measure would augment the future program by allowing the Corps to participate in the process used to select locations to establish watercraft inspection stations to reduce the risk of dreissenids being introduced into federal reservoirs in the UC (see Section 2.2, Existing Watercraft Inspection Stations in the UC, for further description). There is an opportunity to increase communication among state and federal partners through periodic virtual meetings.

Measure 2 – Increase the Number of Watercraft Inspection Stations in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

This measure would augment the future program by increasing the number of watercraft inspection stations in the program to reduce the risk of dreissenids being introduced into federal reservoirs in the UC. The type of inspection locations would be roadside, rampside, and roving (see Section 2.2.1, Types and Operations, for further description). New inspection locations would be established, depending on the availability of Federal funding and each State's need to increase program effectiveness and its ability to share in the associated costs.

Measure 3 – Extend Daylight Inspection Hours to the Watercraft Inspection Program in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

This measure would augment the future program by extending daylight inspection hours to reduce the risk of dreissenids being introduced into federal reservoirs in the UC. Daylight inspection hours would be expanded based on each State's need to increase program effectiveness and its ability to share in the associated costs.

Measure 4 – Increase Nighttime Watercraft Inspections in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

This measure would augment the future program by adding or increasing the number of nighttime inspections that are performed. In 2015, Washington State Department of Fish and Wildlife (WDFW) implemented nighttime operations, from 10 p.m. to 6 a.m., through a grant from PSMFC and Bonneville Power Administration. Nighttime operations were conducted on six different occasions in August in Plymouth, Ridgefield, and Spokane, Washington. During this pilot program, 182 boats were inspected.

Although no dreissenids were found during these inspections, two boats originated from waters infested with dreissenids. A majority of the boats (~70%) were stopped between 3 a.m. and 6 a.m. (WDFW and PSMFC 2015). The effectiveness of nighttime inspection stations is dependent on the location of the inspection station and major events in the area. This pilot program proved there can be a significant amount of nighttime watercraft transportation occurring within and outside a basin. The pilot program indicated a potential for boats originating from infested waters to enter the basin at night. Establishing nighttime operations at consistent locations could further

reduce the risk of a dreissenid introduction in federal reservoirs in the basin. Night operations are not typically conducted without the presence of law enforcement, due to the need to ensure the safety of watercraft inspection personnel and the public. Law enforcement personnel can significantly increase the cost of station operations, and they are not always available. In some locations, law enforcement agencies either do not patrol after 10 p.m. or reduce their nighttime patrols, which limits their availability to assist with watercraft inspection stations. The ability to hire inspectors for night operations could also present a challenge, especially in more remote areas where recruiting daytime inspectors has also been challenging. Another challenge is that the lack of effective lighting at night can limit the inspector's ability to accurately conduct inspections.

Nighttime inspections would be added depending on the availability of Federal funding and each State's need to increase program effectiveness and its ability to share in the associated costs. If a Federal partnership is established, the nighttime operations could be phased in as States establish agreements with law enforcement and as inspection personnel are hired and trained. The nighttime inspection locations and nighttime shift durations would be further developed based on the regional strategy.

Measure 5 – Construct Site Improvements at Watercraft Inspection Locations in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

This measure would augment the future program by helping to construct site improvements such as, but not limited to, utility connections and pavement.

Installing utilities at watercraft inspection stations provides several benefits, including lighting for expanded hours of operation, electricity without the need for portable generators, and increased reliability of systems that require electricity, such as data input and real-time communications. Utility connections would be implemented depending on the availability of Federal funding and each State's need to increase program effectiveness and its ability to share in the associated costs.

Paving and otherwise developing site conditions at watercraft inspection stations has the potential to increase the efficiency and effectiveness of the existing inspection stations. Hardening the stations by adding pavement (concrete or asphalt) or gravel would provide additional safety buffers and ease ingress and egress at the inspection stations. Site improvements would be implemented depending on the availability of Federal funding and each State's need to increase program effectiveness and its ability to share in the associated costs.

Providing electrical hookups and constructing trailer pads would have the added benefit in remote areas of attracting potential watercraft inspectors requiring living quarters. Inspectors could either bring their own trailers, or trailers could be provided.

In locations where water availability is scarce, providing additional water capacity in the form of large water containers or through the construction of a wastewater recirculation

and filtration system could provide inspection station staff with the greater ability to perform hot water decontaminations on high-risk boats.

The details of site improvements would be developed after the Federal partnership is established. When improvements are planned at an inspection station location that involves any ground disturbance, the Corps may need to tier from this LR/Programmatic EA and complete site-specific NEPA analysis, depending on the nature and magnitude of proposed work and associated impacts.

Measure 6 – Add Optional Canine Detection Capabilities to the Existing Watercraft Inspection Program in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

For States that determine nighttime inspections are feasible and effective in certain areas, the use of canines can assist with the challenge of inadequate lighting. Dogs can use their keen sense of smell to detect dreissenids without light, and they have been shown to be more effective than human inspectors. Both the Canadian Province of Alberta and the State of California have trained dogs to successfully locate dreissenids at watercraft inspection stations and have demonstrated substantial results through their K-9 programs. Montana has also collaborated with Alberta in training dogs for use in some of their watercraft inspection stations. This measure would augment the future program by increasing canine detection capabilities and would be implemented depending on the availability of Federal funding and each State's needs to increase program effectiveness and its ability to share in the associated costs.

Measure 7 – Increase Public Awareness and Education Related to the Existing Watercraft Inspection Program in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming

This measure would augment the future program by increasing public awareness and education efforts, which could include ad campaigns; communication with commercial boat haulers, marinas, etc.; and the addition of permanent signs at locations where inspection stations are routinely established each year (such as at points of entry along interstates and major highways). Informing the public of the risks of AIS can increase their involvement in prevention efforts and potentially decrease the numbers of infested boats that enter the UC. Increasing public awareness and education efforts would be implemented depending on the availability of Federal funding and each State's needs to increase program effectiveness and its ability to share in the associated costs. Development of a social science survey/study to help support the states with identifying which stakeholders and communities would benefit from additional educational materials and which messages more effectively communicate issues and how to prevent introduction of mussels into water bodies.

Measure 8 – Require Watercraft Inspections at Federal Facilities at Infested Lakes

This measure would require that watercraft leaving infested water bodies (e.g., Great Lakes in the Midwest, Mississippi River Basin, and multiple Federal lakes in the southwest) be inspected and decontaminated.

Measure 9 – Monitor to Identify UC Water Chemistry and Compare to Water Chemistry of Infested Water Bodies

This measure would augment the future program by identifying water chemistry of the UC for comparison to the water chemistry of infested water bodies to help inform early monitoring locations and risk management decisions within the UC. Dreissenids acclimated to the water chemistry of a particular water body may become established in the UC more easily than those established in a different water body. Using these monitoring results, the Corps would develop a risk assessment matrix of infested water bodies of similar water chemistry to the UC in order to determine the risk of those dreissenid populations becoming established in the UC.

Measure 10 – Monitor for Early Detection

This measure would augment the future program by leveraging both States and Corps efforts to engage in monitoring activities for early detection of veligers in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming, with a focus on protecting the UC. These efforts would focus on locations determined by the water chemistry data to be of highest risk and locations that State collection data indicate are high-use areas by boaters travelling from water bodies of concern.

Monitoring activities provide an additional level of defense in the event prevention measures fail and live mussels invade a water body States of Arizona, Colorado, New Mexico, Utah, and Wyoming. Early detection monitoring and having appropriate response plans in place increase the chances of initiating an effective response before widespread establishment occurs.

Measure 11 – Regional WID Data Sharing System

This measure would encourage (require) participating agencies to use the Regional WID Data Sharing System (System) to document inspections and share data with other agencies throughout the western United States (CPW 2020a,b).

CPW developed the System to record WID information electronically and share information in a timely manner across jurisdictions to aid collaborative efforts to prevent the spread of zebra and quagga mussels and other ANS. The System consists of a website, shared database, and phone app for iOS and Android devices. The System reduces operating costs for mobile data collection while increasing accuracy and reliability and can be queried for on-demand reporting. The System includes a risk assessment tool that shows where boats are traveling to after launching in mussel infested waters and sends an alert to the next known destination. With the benefits of data sharing proving to be abundant, the states of Arizona, Nevada and Utah have been using the System to send out timely electronic alerts of watercraft leaving infested waters. This increased timely

communication has directly increased the number of infested watercraft being intercepted within the western region before launching in un-infested waters.

Measure 12 – Develop and Implement Real-time Tracking of Watercraft Transportation

This measure would support the program through future development of a real-time tracking system by the states for watercraft traveling between lakes across the region, both within and outside the UC basin. The system would direct boaters toward inspection and cleaning stations to decrease the risk of introduction of invasive species into uninfested waters.

Measure 13 – Evaluate Traffic Patterns for Recreational Boating

This measure would support the future program by periodically funding regional traffic studies for identifying highway use patterns by the boating public traveling between lakes within and outside the UC basin. Understanding movement patterns of boaters would identify effective locations for permanent or roving inspection stations, support public awareness and education campaigns, and provide information for contingency and rapid response planning.

Measure 14 – Contingency Planning

This measure would augment the future program by helping to develop site-specific plans at Corps and other federal facilities, based on the facility vulnerability assessments conducted by Reclamation (2013; 2015a-e) (see Section 3.1 for information about vulnerability assessments).

Measure 15 – Rapid Response Planning

This measure would augment the future program by helping to develop rapid response measures at Corps and other federal reservoirs to find and eradicate dreissenids before they further spread and cause damage (see Section 2.5 for further information).

Preventing the introduction of invasive species is the first line of defense against biological invasion. However, for invasive species that circumvent prevention systems, early detection and rapid response (EDRR)—a coordinated set of actions to find and eradicate potential invasive species before they spread and cause harm—can help stop the next lionfish, cheatgrass, or Asian carp (U.S. DOI 2016).

Where monitoring detects the presence of dreissenids, rapid response is the next most cost-effective management tool to quickly eliminate or minimize infestation impacts. Rapid response measures include prevention, containment, control, eradication, enforcement, and education/training and outreach actions. Interagency (federal, state, local) exercises are essential for testing the strengths and identifying the weaknesses of rapid response plans. The Corps, in collaboration with the five study area States, must be prepared to quickly respond to contain and limit any infestation in the entire water system in the UC River Basin.

3.5 OBJECTIVES AND MEASURES

Table 4 lists the measures identified for this report and whether they contribute to individual objectives in the following list.

- Intercept watercraft on existing pathways between infested water bodies and federal reservoirs in the UC to detect dreissenids on the watercraft and decontaminate the watercraft to reduce the risk of infestation.
- Identify water chemistry of the UC and compare it to the water the chemistry of infested water bodies to better understand the risks to federal reservoirs in the UC, and to prioritize areas for development of follow-up actions.
- Prepare rapid response plans in the event dreissenids are detected.
- Using the existing facility vulnerability assessments performed by Reclamation (2013; 2015a-e), prepare site-specific contingency plans at Corps and other federal facilities with a focus on areas that monitoring efforts determined to be a priority.

3.6 SCREENING

The measures were screened (Table 5) to determine which met the identified objectives without violating any identified study constraints. Measure 8, Requirement of Watercraft Inspections at Infested Federal Lakes, was eliminated from further consideration due to the geographical limitations of Sec 104 of RHA. Currently, the Corps does have not the authority to execute Measure 9. All other measures were carried forward for consideration (alone or in combination) as shown in Section 3.6 below.

Table 5. Objectives and Measures

Measures	Intercept Watercraft	Water Chemistry	Rapid Response	Contingency Planning
Measure 1 – Federal Participation in Selection of Watercraft Inspection Station Locations	X			
Measure 2 – Increase Watercraft Inspection Stations	X			
Measure 3 – Extend Daylight Inspection Hours	X			
Measure 4 – Increase Nighttime Inspections	X			
Measure 5 – Construct Site Improvements	X			
Measure 6 – Add Canine Detection	X			
Measure 7 – Increase Public Awareness and Education	X			
Measure 8 – Require Watercraft Inspections at Federal Facilities at Infested Lakes	X			
Measure 9 – Monitor to Identify Water Chemistry		X		X
Measure 10 – Monitor for Early Detection		X	X	
Measure 11 – Regional WID Data Sharing System	X		X	
Measure 12 – Develop and Implement Real-time Tracking of Watercraft Transportation	X		X	
Measure 13 – Evaluate Traffic Patterns for Recreational Boating	X			X
Measure 14 – Contingency Planning				X
Measure 15 – Rapid Response Planning			X	

Table 6. Measure Screening

Measures	Sec 104 RHA	Avoid Effects Threatened and Endangered Species	Comply with Federal, State, local laws, regulation, and policies	Retained
Measure 1 – Federal Participation in Selection of Watercraft Inspection Station Locations	Yes	Yes	Yes	Yes
Measure 2 – Increase Watercraft Inspection Stations	Yes	Yes	Yes	Yes
Measure 3 – Extend Daylight Inspection Hours	Yes	Yes	Yes	Yes
Measure 4 – Increase Nighttime Inspections	Yes	Yes	Yes	Yes
Measure 5 – Construct Site Improvements	Yes	Yes	Yes	Yes
Measure 6 – Add Canine Detection	Yes	Yes	Yes	Yes
Measure 7 – Increase Public Awareness and Education	Yes	Yes	Yes	Yes
Measure 8 – Require Watercraft Inspections at Federal Facilities at Infested Lakes	No	Yes	Yes	No
Measure 9 – Monitor to Identify Water Chemistry	Yes	Yes	Yes	Yes
Measure 10 – Monitor for Early Detection	Yes	Yes	Yes	Yes
Measure 11 – Regional WID Data Sharing System	Yes	Yes	Yes	Yes
Measure 12 – Develop and Implement Real-time Tracking of Watercraft Transportation	Yes	Yes	Yes	Yes
Measure 13 – Evaluate Traffic Patterns for Recreational Boating	Yes	Yes	Yes	Yes
Measure 14 – Contingency Planning	Yes	Yes	Yes	Yes
Measure 15 – Rapid Response Planning	Yes	Yes	Yes	Yes

3.7 ALTERNATIVES

For this LR/EA, Section 104 of the RHA of 1958 (33 U.S.C. 610)[1], as amended, serves as a guide for determining the range of alternatives to be considered. When an action is taken pursuant to a specific statute, the statutory objectives of the project serve as a

[1] As amended by Section 1039(d) of the Water Resources Reform and Development Act (WRRDA) of 2014 (Public Law 113-121), Section 1178 of the Water Infrastructure Improvements for the Nation Act (WIIN Act) of 2016 (Public Law 114-322), and by Section 1170 of the Water Resources Development Act of 2018 (P.L. 115-270).

guide by which to determine the reasonableness of objectives outlined in the NEPA document. This LR/EA is being prepared to determine if there is a Federal interest in establishing or maintaining watercraft inspection stations in the States of Arizona, Colorado, New Mexico, Utah, and Wyoming (cost shared with the states) to protect the UC from the spread of aquatic invasive species at reservoirs operated and maintained by the Secretary. This alternatives analysis, therefore, focuses on identification of measures/alternatives that can be implemented under such a program. NEPA does not require an agency to consider all alternatives; rather, only "reasonable alternatives" need to be explored and objectively evaluated. As such, the Corps considered a number of alternatives, but screened them until only the "No Action" alternative and the proposed action (Comprehensive Adaptive Improvements), which is made up of all measure identified in Section 3.5 that meet the study purpose and need statement and objectives without violating any planning constraints, remained.

It is important to note that the "No Action" alternative is the result of a decade of iterative planning on the part of the States, as they one-by-one developed their own watercraft inspection station programs (2008-2011), and grew to work together towards a regional strategy. A number of the measures listed above have been considered and/or implemented to greater or lesser extents, with different timing, locations, and scale, and subject to the constraint of available funding. Absent Federal partnership, the States would continue to refine their watercraft inspection station programs, with the scale and components of those programs evolving from year to year.

Similarly, while Alternative 2 provides for comprehensive improvements (see section 3.4 Measures; Table 5) subject to the constraint of available state funding for cost-share, it is more a framework for an annual adaptive planning process, with input provided by the Corps. The measures listed are ones that were developed and analyzed through prior experience by the States. It would be possible to construct alternatives that included the listed measures separately, or in various combinations other than the final combination presented here, but they would not present a complete solution. Other measures were screened out due to inefficiency. For example, while possible to locate inspection stations at all boat ramps, such an alternative is not efficient. Other measures, including mandating closures to recreational boating at some lakes were screened because they would not be acceptable.

The Corps considered, but ultimately screened out an alternative similar to, but with a smaller scale with fewer measures than, Alternative 2. This alternative did not include increasing nighttime inspections or adding canine detection. As mentioned earlier in this report, nighttime inspections entail higher costs than daytime inspections due to the necessity of securing law enforcement personnel. Canine detection also requires specially trained personnel, and, while having a long history of use in drug interdiction efforts, is a relatively new tool for enhancing the effectiveness of watercraft inspection stations. Because of the increased cost associated with these measures, an alternative that did not include them was considered. This alternative was screened out, however, because it failed to address the significant and documented concern that a high number of watercraft were being transported within the UC at night, and these two measures directly addressed that concern: the first by having inspection stations open at night,

and the second by then making these stations more effective, due to the canine ability to detect the presence of mussels without the need for light. An alternative that did not address a significant percentage of the watercraft that potentially could be bringing aquatic invasive species into the UC would not effectively address the problem, and was therefore screened out.

Another alternative that was considered focused on locating new watercraft inspection stations at Corps reservoirs, and to have Corps employees or staff contracted by the Corps operate and maintain them. However, this alternative was eliminated from further consideration very early in the process, because it was determined that locating these stations at Corps reservoirs did not provide the highest likelihood of preventing the spread of aquatic invasive species at Corps reservoirs. As previously mentioned, the States have yearly refined their station location selection process, based on previous years' experience and data tracking. An important part of their selection process is to determine not only where boat traffic is most prevalent, but also where boats originate. Their focus is on a more efficient regional strategy which aims to intercept fouled boats before they have the opportunity to reach the UC. The Corps and the States share a common goal of keeping the UC free from an infestation, which would result in high fiscal and environmental costs to Federal and State interests. It was determined that the *most* effective solution to meet this goal is to support *existing* inspection stations and related activities carried out by the States, as reflected in the Recommended Alternative.

Finally, some alternatives not presented in the above sections were screened out due to a lack of authority. For example, while there is coordination occurring between U.S. and Canada regarding invasive species and watercraft inspection stations, there is no *authority* for cost-sharing joint stations even though the countries share a long border.

3.7.1 Alternative 1, Existing Conditions (No Action Alternative)

Alternative 1 represents a continuation of the States' current practice, in which the Corps would NOT partner with the States to establish watercraft inspection stations to protect the UC and Corps water-related infrastructure (see Section 2.2 for a description).

3.7.2 Alternative 2, Comprehensive Adaptive Improvements

Alternative 2, Comprehensive Adaptive Improvements, is made up of all measures identified in Section 3.5 that meet the study objectives without violating any planning constraints. This alternative assumes the Corps would partner with the States and their agencies using Federal funding to expand and support existing state programs, resulting in increased effectiveness in the watercraft inspection program to decrease the vulnerability of a dreissenid infestation. In coordination with their regional partners, the States would use the data gathered during the inspection season to develop a strategy and make adjustments to the program to provide a more effective regional defense. The Comprehensive Adaptive Improvements alternative also includes monitoring, contingency planning, and rapid response planning for Corps facilities and reservoirs.

These actions are not currently eligible for cost-sharing (WRDA 2016, 2018). The measures in Alternative 2 are listed in Table 6, which also identifies their corresponding authority.

Under the future program, each of the measures identified in Table 6 would be adjusted annually by each State based on its need and ability to fund its portion of the program, the results of the regional coordination effort, and the availability of Federal funding. Over time, the locations of stations and the nature and timing of their operations may change significantly as the States continue to refine and optimize the program's overall effectiveness.

Table 7. Measures Included in Alternative 2

Measures	Cost-Share 50% Federal / 50% Non-Federal	Cost-Share 70% Federal / 30% Non-Federal
Measure 1 – Federal Participation in Selection of Watercraft Inspection Station Locations	X	
Measure 2 – Increase Watercraft Inspection Stations	X	
Measure 3 – Extend Daylight Inspection Hours	X	
Measure 4 – Increase Nighttime Inspections	X	
Measure 5 – Construct Site Improvements	X	
Measure 6 – Add Canine Detection	X	
Measure 7 – Increase Public Awareness and Education	X	
Measure 9 – Monitor to Identify Water Chemistry		X
Measure 10– Monitor for Early Detection		X
Measure 11 – Regional WID Data Sharing System		X
Measure 12 – Develop and Implement Real-time Tracking of Watercraft Transportation		X
Measure 13 – Evaluate Traffic Patterns for Recreational Boating		X
Measure 14 – Contingency Planning		X
Measure 15 – Rapid Response Planning		X

CHAPTER 4 - ECONOMIC AND ECOSYSTEM CONSIDERATIONS

The UC is one of the last areas in the United States that has not been infested by dreissenids, and there is a regional effort to reduce the risk and the potential damage and economic impacts to water resource-related infrastructure and ecological resources that would result from dreissenids becoming established in the basin. The expansion of dreissenid populations from the Great Lakes to other parts of the United States and the human-assisted pathways that exist between nearby infested water bodies and the UC present a risk that the migration of dreissenids would result in an infestation in the UC. Based on that risk, this report assumes that an infestation will occur, at some point, in the future and that the risk reduction efforts described in the previous chapters would lower the overall risks, thus delaying future infestations. It further assumes that investments in watercraft inspection stations would be re-evaluated at both the federal and state levels and will be adjusted if a major infestation occurs.

This chapter evaluates the costs and benefits of the proposed action to address the economic elements of the Federal Objective. As stated in the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies (U.S. Water Resources Council 1983), the Federal Objective is "to contribute to national economic development while protecting the nation's environment." In order for there to be Federal interest, the benefits must exceed the costs.

4.1 ECONOMIC CONSIDERATIONS

4.1.1 Infestation Impacts

This chapter does not attempt to provide the total economic costs of a dreissenid infestation in the UC; such an effort would significantly exceed the scope of this report. Instead, this report focuses on describing the potential impacts to the water resource-related infrastructure and activities (Federal and non-Federal) within the UC that are most likely to be affected by a dreissenid infestation, including infrastructure related to Corps authorized purposes. The associated impact estimates are based on current available data (2019-2020) related to additional operation and maintenance (O&M) costs. Additional O&M costs are defined as the increased annual cost incurred to maintain current levels of performance in an infested watershed. These costs include accelerated cleaning schedules involving clearing any potential fouled piping, anti-fouling chemical applications, and other routine maintenance schedules impacted by the invasive species.

Cost estimates were derived from the Idaho Aquatic Nuisance Species Taskforce's 2009 report, Bonneville Power Administration's Zebra Mussel Response Plan (Athearn and Darland 2007), and the Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin report (IEAB 2013). Although anti-fouling paint cost estimates are included in this chapter as part of hydropower and fish ladder maintenance, there are currently no methods known to eradicate a dreissenid infestation in an open water environment. Additionally, established anti-fouling paint application measures may be more limited in application in the UC due to potential impacts on ESA-listed species.

Other impacts presented in the sections below include water supply and treatment facilities, boating and marine infrastructure, and recreation, tourism, and waterfront property.

Hydropower Facilities

According to Arizona Fish and Game Department (2016), "Congressional researchers estimated that zebra mussels alone cost the power industry $3.1 billion in the 1993-1999 period, with their impact on industries, businesses, and communities more than $5 billion." The major hydropower components at risk of being fouled or damaged by a dreissenid infestation include raw water systems, instrumentation, and flap gates. The raw water systems are used to provide water for cooling and fire suppression purposes and could be clogged, resulting in a complete powerhouse shutdown.

Hydropower instrumentation also runs the risk of being fouled and causing plant operation problems. Flap gates are not only susceptible to an infestation, but they are also difficult to inspect. If a flap gate is fouled and will not close, high river stage flood waters could enter protected areas. Various hydropower facility pools supply water to the local area for municipal use, fish hatcheries, irrigation, and other requirements. These systems are just as susceptible to zebra mussel infestations as are hydropower facilities.

Cost estimates referenced by a Bonneville Power Administration (BPA)-commissioned study indicate that an expected average annual cost for additional O&M implementation could be as high as $100,000 dollars per facility (Phillips et al. 2005). These costs are expected to represent recurring fees for labor and capital requirements involved in anti-fouling paint applications and parts replacement for all susceptible systems. Additionally, maintenance schedules for pipe and in-take cleaning are likely to be increased due to threat of fouling. The updated cost per facility estimated for 2017 is $134,446 using the Civil Works Construction Cost Index System Power Plant feature code index increase.

Currently, there are approximately 87 Federal and non-Federal facilities that are capable of producing hydroelectric power in the UC. Using the BPA-commissioned study cost estimates, facility additional O&M costs could be as high as $11.7 million per year for all facilities. If the same measure and operational changes are implemented for non-Federal facilities, per unit costs would likely be similar provided that non-Federal facilities implement the same measures and operational changes.

Hydropower outages are likely to occur if intake fouling occurs at a high rate. The costs associated with outages could create issues for both consumers and producers in the power market. These costs are a function of the magnitude of infestation, the cost of response measures, and the extent of impact vulnerabilities. Although dams like the Hoover, Davis, and Parker Dam are attempting to treat their infestation issues to avoid power outages, the UC has unique 65 threatened and endangered species (see Appendix B) that may require response measure different from those in other

watersheds. At this time, no cost estimates have been developed for response measures specific to the Columbia River (Streater 2009) or other watersheds.

Fish Hatchery Facilities

Fish hatcheries are at risk for incurring dreissenid-related costs. One of the biggest impacts to hatcheries would be the clogging of surface water supply systems. O'Neill's (1997) base costs estimates were escalated to present dollars, and these new estimates indicate that hatcheries may be forced to spend up to $14k per year in the event of an infestation. There are 3 federal hatcheries in the UC basin, with 7 additional federal hatcheries across the five states. The UC states operate another 21 fish hatcheries. Based on these numbers, additional O&M costs could total $435K per year for a full infestation (Table 8). As with hydropower, non-Federal hatcheries would also experience similar costs if the same O&M measures are implemented.

Fish Passage Facilities

There are a total of 12 Federal fish passage facilities located within the basin. The Upper Colorado River Recovery Program (coloradoriverrecovery.org/) operates six fish passage facilities in Colorado (5) and Utah (1), while the San Juan River Basin Recovery Implementation Program (www.fws.gov/southwest/sjrip/) operates six passage facilities on the San Juan River in New Mexico. Adult fish bypass facilities are at risk in the event of a dreissenid infestation. All submerged surfaces in low velocity areas could become colonized. Screens in places can easily become fouled as dreissenids colonize and build up, which creates blockages that may require in-water inspection and cleaning. Dreissenid establishment in the bypass system and piping would cause extraordinary stress on salmonids due to injury, descaling, and impact trauma. According to Athearn and Darland 2007, "if some components of the fish bypass systems are not functional, such as the STSs [submerged traveling screen] and VBSs [vertical barrier screen], then generally fish passage criteria do not allow efficient turbine operation in affected units." The range of impacts to fish bypass and monitoring facilities could impact normal fish operations and/or existing maintenance periods. Decontamination and recommissioning costs in the form of cleaning and clearing fish ladders at UC facilities could be as high as $0.6 million per year in the event of an infestation (Table 8).

Water Supply and Treatment Facilities

Recent studies done at multiple water treatment facilities suggest that, "the O&M-based unit costs of mussel control varied from $34.32/mil gal for 1-mgd [million gallons per day] capacity to $12.63/mil gal for 2,640-mgd capacity. The capital cost and O&M-based equivalent annual unit cost for treatment varied from $78.56/mil gal for 1-mgd capacity to $13.41/mil gal for 2,640-mgd capacity. Costs for larger water treatment plants (i.e., >10 mgd) varied between $1.00/mil gal and $13.00/mil gal" (Chakraborti et al. 2016). The Great Lakes infestation has been a prime source of impact estimates for other watersheds due to the number of historical examples indicating direct impacts on private businesses and localities. In one instance, "a Michigan town lost water for three

days after a mussel colony clogged its water-intake pipe" (Franklin County Emergency Management and Homeland Security 2013).

Given the sheer number of water supply and treatment facilities, there are issues with including an estimate for O&M. The probable differences in facility design and procedures make it impossible to predict an exact impact cost figure without performing a facility by facility analysis and inventory; therefore, an estimate was not provided.

Boats and Associated Infrastructure

The invasion of dreissenids into Lake Mead has caused concern for recreational boaters. Reports suggest that "without regular maintenance to brush away the fingernail-sized mussels, colonies can build up on the hull and in the cooling water intake of outdrives," which could result in "serious safety problems caused by drag on the boat and lack of cooling water" (Rogers 2008). According to information from the States, there are approximately 563,494 boats currently registered. Based on the percentage of each state that lies within the UC, there are 336,093 within the region that run the risk of additional maintenance costs in the event of an invasive species infestation. Research from Lake Erie suggests that per boat costs were $265 in 1994 (Vilaplana and Hushak 1994). When these costs are escalated to current year dollars, boaters in the region may face annual maintenance costs of up to $149.9 million in total costs per year if all boats are impacted.

Recreation, Tourism, and Waterfront Property Values

Where dreissenids have infested waterways, they have had serious impacts on fresh water beaches. Impacts include beach goers getting severe cuts on their feet and the stench caused by massive dreissenid die-offs covering the shoreline. In addition, watercraft inspection lines for boats departing infested waters can be extremely long, particularly on busy holiday weekends. Long wait times to depart an infested water discourage many boaters from visiting that water, impacting both recreational opportunities and local economies. This would have a significant impact on the waterways of the Southwest, which generate tourism and recreation revenue.

4.1.2 Federal Interest

To meet the economic criteria for the Federal objective, the economic benefits of a proposed action must exceed the economic costs. A Federal interest is determined to exist when those benefits exceed the costs. The ratio of the benefits to the costs is referred to as a Benefit to Cost Ratio (BCR). For this analysis, the BCR compares the relative cost of the potential impacts deferred and the cost of the risk reduction measures. In other words, benefits are derived by deferring O&M costs through the application of actions such as establishing watercraft inspection stations to reduce the risk of the spread of dreissenids into the UC.

4.1.2.1 Benefits

Table 8 highlights the costs per facility for O&M performed that were discussed in the previous sections. Non-Federal impacts have the capacity to far exceed the Federal impacts. Non-Federal cost drivers are municipal water supplies, non-Federal hydropower, and private boat maintenance.

Table 8. Average Annual O&M Costs of a Total Infestation

Structure	Number Impacted			O&M Cost Increase per Unit	Average Annual O&M Cost Increase
	USACE	Other Federal	Non-Federal		
Boats	0	0	336,093	$468	$149,953,813
Surface water treatment	0	0	643	$38,176	$24,547,026
Hydropower Facilities (MW)	13	24	50	$74 /MW	$35,752
Fish Passage	0	12	0	$9,980	$599,760
Fish Hatchery Facilities	0	10	21	$14,031	$434,967
Average Annual O&M Costs Deferred for a Total Infestation					$175,571,319

Note: Boating costs were escalated using the yearly average index from the Consumer Price Index. As such, the latest adjusted values are for calendar year 2015 only. All other costs are valued as of FY17.

The average annual O&M cost increases provided in Table 8 were based on a 50-year period of analysis. The table also indicates that total average annual additional O&M costs could be as much as $156.8 million per year for a full-scale infestation in the UC.

4.1.2.2 Risk Reduction Costs – Watercraft Inspection Stations

Table 9 shows the costs associated with watercraft inspection station operations based on current state spending inside and outside of the basin.

Table 9. Annual Watercraft Inspection Station Operating Costs by State (2018-2019)

State	Outside the UC	Inside the UC	Total costs
Arizona	$466,621	$87,491	$554,112
Colorado	$3,167,245	$2,136,049	$5,303,294
New Mexico	$285,662	$202,275	$487,937
Utah	$798,500	$1,384,810	$2,183,310
Wyoming	$125,000	$73,500	$198,500
Total	$4,843,027	$3,884,125	$8,727,153

Source: Data provided by the five UC states AZ, CO, NM, UT, and WY.

4.1.2.3 Benefit-to-Cost Ratios

For the purposes of developing a benefit-to-cost ratio, it was assumed that the purpose of watercraft inspection stations is to defer impact costs through risk reduction measures. Four scenarios were considered, with impact costs deferred for 1, 5, 10, and 50 years. Year 0 represents an infestation occurring immediately, without a deferment. It was assumed for the calculation of impact costs that an infestation would grow at a rate of 2 percent per year once an infestation occurs. This is likely a very conservative estimate because other watersheds have seen an explosion of growth once dreissenids established a foothold. This estimate is even more conservative due to the exclusion of impacts on water supply, recreation, tourism, real estate, and private and public docks (referenced in Section 4.1.1).

Using the average annual O&M costs for 2 percent of the inventory, a total impact cost was estimated for an infestation starting at year 1. Impact costs based on the deferment increments were then subtracted from the year 1 infestation to get an impact cost savings difference for each additional period of deferment. Table 9 shows the breakdown of the years deferred, impact costs, average annual station costs, total station costs, and net benefits in the form of O&M costs prevented. This was based on maintaining current state spending and matching that amount.

If an infestation in the UC runs the same course as the infestation in the Great Lakes region, firms and agencies would likely have to spend far more money than they currently are on routine operations. This would likely impact public and private budgets by increasing power, recreation, and water supply costs for individual taxpayers. The net benefits derived in this model are a total of the savings produced by avoiding or deferring those costs over the 50-year period.

Table 10. Benefit-to-Cost Rations for Incremental Deferments

Years of Deferment	Total Costs (2020$)	Average Annual Costs (2020$)	Total Benefits (2020$)	Average Annual Benefits (2020$)	Net Benefits	Benefit-to-Cost Ratio
0	$159,270,536	$5,899,527	$ -	$ -	$(159,270,536)	0.00
1	$167,997,689	$6,222,789	$175,571,319	$6,503,323	$7,573,630	1.05
5	$202,906,299	$7,515,836	$877,856,594	$32,516,615	$674,950,294	4.33
10	$246,542,063	$9,132,145	$1,755,713,187	$65,033,230	$1,509,171,124	7.12
25	$377,449,353	$13,981,071	$4,389,282,968	$162,583,077	$4,011,833,615	11.63
50	$436,357,633	$16,163,088	$8,779,316,733	$325,193,964	$8,342,959,100	20.12

4.2 ECOSYSTEM CONSIDERATIONS

If dreissenids become established in the UC, many changes to the aquatic environment would occur. As the density of dreissenids increases, water clarity would increase due to plankton being consumed. This would decrease the food supply for young and small fish. As water clarity increases, light penetration would also increase, which would lead to aquatic plants being able to take root in deeper water. The area of rooted aquatic plants would increase, which would provide additional habitat for fish that might prey on juvenile salmon. The bottom substrate would become covered with live and dead mussels. Shorelines would be lined with sharp shells. Dreissenids would also attach to native mussels, competing with them for food and eventually killing them.

Hundreds of millions of dollars have been invested within the UC to protect and recover ESA-listed salmon and steelhead and their habitat. An infestation of dreissenids would not only change the ecosystem, but could cause physical injury as fish migrate. Recreational fisheries could also be affected. Modified water quality could lead to habitat changes, which affect fish populations and composition. Native fish populations could also be negatively affected.

It may not be possible to avoid an infestation and associated impacts forever, but even delaying the establishment of dreissenids would allow for additional time for preparation. There could be additional education to reach a wider audience of the potential effects of transporting invasive species. Additional monitoring in the UC could occur that would allow for implementation of Rapid Response Plans in an effort suppress their spread.

4.3 CONCLUSION

Based on the information evaluated in this LR/Programmatic EA, the Corps has determined that there *is* Federal interest in partnering with the States of Arizona, Colorado, New Mexico, Utah, and Wyoming to address the vulnerability of the UC to a dreissenid infestation. As described in Section 4.1, a conservative estimated annual cost avoided by delaying an infestation by one year exceeds the estimated annual costs associated with the watercraft inspection station program, thus demonstrating an economic benefit. Alternative 2 helps to address the vulnerability issues indicated in this chapter. The risk reduction efforts would also protect the environment by delaying potential impacts described in Section 4.2 (effects of the prevention efforts on the environment is provided in Chapter 6).

As previously described in Section 4.2 and later in Chapter 6, Alternative 2 would also generate significant ecosystem quality benefits that have not been quantified. Although they have not been quantified, these benefits are considered in the Corps decision making process.

Consistent with the Corps planning process, projects must be formulated to consider four criteria described in the Principle and Guidelines Report (U.S. Water Resources

Council 1983) for completeness, effectiveness, efficiency, and acceptability, which are described below.

- **Completeness.** Alternative 2, Comprehensive Improvements, is the most complete solution available to reduce the risk of a dreissenid infestation. It includes every potential measure considered except Measure 9, which is outside existing authority. Together these measures address all planning objectives, without violating any planning constraints, creating powerful preventive actions, monitoring, educational opportunities, planning for contingencies, and preparing for quick response to potential infestations. While this alternative cannot completely eliminate the possibility of a dreissenid infestation, it is the most comprehensive solution available.
- **Effectiveness.** Alternative 2, Comprehensive Improvements, includes a combination of different actions to prevent the spread of dreissenids, while allowing watercraft to be transported between infested and uninfested areas of the country. In addition, the alternative promotes collaboration between the western States to continue developing methods to reduce the risk of AIS infestations. This alternative is not 100 percent effective, but it is a broad solution that will do much to prevent a dreissenid infestation.
- **Efficiency.** Based on the current level of knowledge, if dreissenids infest the waters of the UC, it is likely they will become permanently established. For every year an infestation can be deferred through the actions that comprise Alternative 2, Comprehensive Improvements, significant costs associated with an infestation can be avoided. The costs of improvements detailed in Alternative 2 would be a small fraction of the costs associated with O&M costs resulting from an infestation.
- **Acceptability.** Alternative 2, Comprehensive Improvements, is acceptable to all entities. The collaborative effort between the States will promote effective communication, intercept and prevent potential infestations, educate the public, and lead to continuous improvements in the early detection of dreissenids within the UC. The public will be able to transport watercraft from infested states to non-infested states with minimal disruption. While the solution is not all-encompassing, it is accepted as the most complete and effective solution available.

Using this guidance, each alternative was evaluated to determine if it met the four criteria described above. Using these criteria, it was determined that only Alternative 2 meets the study objectives and will contribute to an effective and efficient plan to defer dreissenid infestation and the associated negative impacts to the environment and infrastructure in the UC. There are no significant technical or engineering challenges associated with any of the measures. Based on the strong Federal interest and environmental acceptability, Alternative 2, is the Selected Alternative.

CHAPTER 5 - EXISTING CONDITIONS

This chapter provides general information about the environmental conditions within the approximately 75,530-square-mile study area. The background environmental information provided is limited due to a general lack of impacts associated with the existing inspection stations as well as any anticipated changes to the watercraft inspection station sites or their operation.

5.1 FISHERIES/AQUATIC RESOURCES

The UC study area contains habitat for hundreds of species of native and non-native aquatic organisms. The most notable fish are sport fish and endangered species which occur in the basin. The mainstem of the Colorado River is important habitat for Colorado Pikeminnow, Razorback Sucker, Bonytail, and Humpback Chub (UCREFRP 2019). Several of these species migrate upstream to spawn with their offspring dispersing downstream after hatching.

Fish passage and screening facilities have been constructed by the San Juan River Basin (4, US Fish and Wildlife Service 2020a) and Upper Colorado River Endangered Fish (7, US Fish and Wildlife Service 2020b) Recovery Programs.

5.2 WATER QUALITY

Surface water in the UC is relatively clean compared to other regions in the nation. However, concern about the permanence of this status has been growing. Population growth, mining, logging, agriculture, and industry have created, and are continuing to create water quality issues and concerns. While some streambank erosion is natural, human alterations in the watershed have caused additional erosion, leading to increased turbidity at some times of the year.

Manmade reservoirs have changed water quality characteristics of the large rivers. Due to the large volume of stored water, temperatures do not fluctuate as much as in a natural river. The reservoirs warm slower in the summer and cool slower in the fall. Daily temperature fluctuations are also depressed. Slower water velocity and water quality changes also modified the types and density of various plankton, which affects water clarity and nutrient levels.

5.3 WILDLIFE/TERRESTRIAL RESOURCES

Terrestrial habitat within the basin includes many types, from desert to alpine tundra, and mountainous forests to wide river valleys. The large quantity of water in the rivers of the basin make irrigated agriculture possible. There are approximately 1.5 million acres of irrigated agriculture (Maupin et al. 2018; Reclamation 2019), which has dramatically altered native habitats. Wildlife present throughout the basin includes both large and small mammals, birds, and reptiles. There are several protected species. Other terrestrial resources, such as plants, including a variety of trees, shrubs, forbs,

and grasses, can be found near the many and diverse habitat types throughout the states in the study area.

5.4 AESTHETICS / VISUAL RESOURCES

Aesthetics or visual resources are the natural and cultural features of the landscape that can be seen and that contribute to the public's appreciative enjoyment of the environment. The aesthetic quality of an area is a subjective measure of one's perception of how pleasing an area is. The UC consists of a complex tapestry of mountains, high plateaus, desert basins, river valleys, rolling uplands, and deep gorges woven together by the Colorado River and its tributaries. Mountains are a major and dramatic presence in the UC. There are a number of mountain ranges in the basin, including the volcanic Cascades forming the western border and the Rocky Mountains on the eastern border. However, the aesthetic values of the Colorado River, the mountains, and surrounding landscapes vary based on the viewer's perspectives and values.

5.5 RECREATION

The UC provides a wide variety of opportunities for outdoor recreation, which in turn provides genuine value to residents, as well as economic opportunities through tourism. Due largely to its rural nature and scenic terrain, the UC provides many recreation areas that attract visitors to the region. A considerable industry has been established due to water- and land-based recreational opportunities. Depending on the particular location, popular activities include boating, swimming, water skiing, jet skiing, fishing, camping, hunting, walking, biking, and bird and wildlife viewing.

5.6 CULTURAL RESOURCES

The rivers and tributaries in the UC have provided the resources needed for human occupation of the basin for thousands of years. Prehistoric populations subsisted on riverine resources well before 9,000 B.C. (Chatters and Pokotylo 1998). These riverine cultures remained along the rivers and tributaries up until the middle and late 19th century when they were relocated to reservations (Walker 1998). During their extensive occupation along the rivers and tributaries of the UC, Native Americans subsisted on the abundant salmon and aquatic resources available, and Traditional Cultural Properties and Historical Properties of Religious and Cultural Significance to Indian Tribes reflect important fishing locations and fishing villages native peoples occupied for collecting such resources.

5.7 CLIMATE CHANGE

Indications are that average global atmospheric temperatures are trending upward over the previous several decades, and are correlated to increased atmospheric carbon dioxide levels (IPCC 2001). Internal combustion engines emit carbon dioxide (CO_2) as one byproduct of efficient burning of fuel (gasoline or diesel). International efforts are being directed at reducing carbon release into the atmosphere.

In the Colorado River Basin, changes in snowpack, streamflows, and forest cover are already occurring (Colorado River Connected 2020). Future climate change would likely continue to influence these changes. The loss of snow from climate change is resulting in decreased on the Colorado River (Milly and Dunne 2020). Average annual temperature in the region is projected to increase by 3-10° F by the end of the century, with the largest increases expected in the summer. Precipitation in the region has seen a decline in both the amount of total snowfall and the proportion of precipitation falling as snow. Changes in average annual precipitation in the region are likely to vary over the century. Winter precipitation in the form of rain not snow is projected to increase while summer precipitation is projected to decline by as much as 30 percent, with less frequent but heavier downpours (EPA 2016). Along with rising air temperatures, there would be a corresponding rise in stream temperature.

CHAPTER 6 - ENVIRONMENTAL CONSEQUENCES

In addition to the significant economic and ecosystem effects described in Chapter 4, the Corps considers the environmental and social consequences of its actions when making decisions. This chapter discusses effects anticipated to occur over a wide range of environmental resources and social considerations as a result of the proposed action. The anticipated effects associated with the No Action Alternative are compared to those of the Proposed Action Alternative. The Corps analysis did not identify any adverse environmental effects.

Federal participation in the program would be dependent on the States continuing to fund the program and Congress specifically appropriating funds for the program. In 2019, expenditures by the States totaled about $7.3 million in prevention efforts.

Although individual State budgets fluctuate annually, the initial estimated annual cost to the Federal government to fully participate in the program would be the same. The commitment of resources may increase if risks increase, or it may decrease or the program may be eliminated if an infestation becomes permanently established within the UC.

As of a result of coordination with the states, the Corps did not identify any conflicts to land-use plans. The process of selecting locations for watercraft inspection stations (see section 2.2.2) accounted for existing land uses.

The Corps considered, but did not identify any potential significant effects to threatened and endangered species, noise pollution, vegetation, air quality, or hazardous/toxic materials. Thus, those resource areas are not detailed below. However, a biological evaluation is included as Appendix B, which describes the threatened and endangered species analysis and determinations.

The proposed action is intended to reduce the risk of invasive species infestations and, as a result, avoid or delay the adverse economic, environmental, and social consequences of such infestations.

6.1 ALTERNATIVES

6.1.1 Description of the No Action Alternative

The existing conditions are described in Chapter 5. The No Action Alternative represents a continuation of the States' current practice, in which the Corps would not support establishing any watercraft inspection stations to protect the UC and Corps water-related infrastructure therein. Section 2.2 provides information pertaining to existing watercraft inspection stations and their operation.

6.1.2 Description of the Proposed Action Alternative

Implementation of the proposed action would mean that the Corps, in collaboration with the AIS coordinators of the States of Arizona, Colorado, New Mexico, Utah, and

Wyoming, would establish watercraft inspection stations at locations that have the highest likelihood of preventing the spread of AIS at reservoirs operated and maintained by the federal government.

The Corps would partner with the State's AIS coordinators to establish watercraft inspection stations very similar to the existing watercraft inspection station program in terms of configuration and operations (see Sections 2.2 and 3.4.1).

6.2 FISHERIES/AQUATIC RESOURCES

A dreissenid infestation would adversely impact fisheries and aquatic resources within the UC, to include impacting species and habitats protected under the Endangered Species Act (ESA). The amount of food and shelter for fish and aquatic resources would be altered, changing the types and abundance of species able to survive.

Spawning and rearing habitat, including critical habitat, for some species would also be negatively impacted. Physical injury to fish could occur from abrasion, especially at fish passage facilities.

6.2.1 No Action Alternative

Under the No Action Alternative, the risk of infestation affecting fisheries and other aquatic resources would remain similar to existing conditions, and thus would not result in any benefits. Taking no action would not result in direct or indirect, short-term, long-term, or cumulative effects to aquatic resources, as the risk of an AIS infestation would also remain at levels similar to the existing conditions.

6.2.2 Proposed Action Alternative

Similar to the existing program, watercraft inspection stations would be established in paved or gravel areas. Any runoff from cleaning a vessel would be contained. It would either be collected, percolate directly into the ground, evaporate, or go into a retention basin where it would percolate into the ground. No new ground disturbance would occur to establish watercraft inspection stations without further environmental review.

There would be no threat of run-off into any water body, as inspection stations would not be located close enough to any water body. On occasion, watercraft owners may request a decontamination at their home if they have been at infested water bodies.

In such instances, trained staff would evaluate the location, including where any runoff could go. If there may be any chance of discharging to an uninfected water body, the watercraft would be hauled to an area where no water or debris from the wash/decontamination would be discharged to a water body.

The proposed action would not negatively affect fisheries or other aquatic resources in the UC either directly or indirectly over the short-term or long-term. There would be no additional cumulative effects on this resource. The proposed action would be expected

to positively affect fisheries and other aquatic resources due to the reduced risk of infestation provided by the additional funding allocated to support the program.

6.3 WATER QUALITY

An infestation would adversely impact water quality within the UC. The adult mussels would filter huge quantities of water as they feed. Water clarity would increase, which would have negative effects on the ecosystem. In addition to the negative effects to aquatic resources, rooted aquatic plants would persist into deeper water than normal.

6.3.1 No Action Alternative

Under the No Action Alternative, water quality would remain at levels similar to the existing conditions because the risk of an AIS infestation would also remain at levels similar to the existing conditions. Taking no action would therefore not result in direct or indirect, short-term, long-term, or cumulative effects to water quality.

6.3.2 Proposed Action Alternative

The effects on water bodies of establishing and operating watercraft inspection stations, and thus water quality, would be the same as discussed in the fisheries/aquatic resources section. The proposed action would not negatively affect water quality in the UC directly or indirectly in either the short term or long term. There would be no additional cumulative effect on this resource. The indirect effects would be positive due to the reduced risk of infestation provided by the additional funding allocated to support the program.

6.4 WILDLIFE/TERRESTRIAL RESOURCES

An infestation would adversely impact wildlife and terrestrial resources within the UC, potentially to a significant degree. Those adverse impacts would be expected to be conveyed through the ecosystem.

6.4.1 No Action Alternative

Under the No Action Alternative, the conditions related to wildlife and terrestrial resources would remain similar to the existing conditions. The risk of an AIS infestation would also remain at levels similar to the existing conditions. Taking no action would therefore not result in direct or indirect, short-term, long-term, or cumulative effects to wildlife or terrestrial resources.

6.4.2 Proposed Action Alternative

Under the Proposed Action, some wildlife could be present near a new inspection station from time to time. However, most inspection sites are established in areas that have constant human presence and wildlife would not be present. Some additional forbs or grasses could be trampled if shelters, equipment, or work vehicles are parked in vegetated areas alongside the watercraft inspection site.

The following stipulations would be followed to eliminate any impacts to ESA-listed and other protected species:

1. No new ground disturbance would occur to establish watercraft inspection stations without performing a survey of the area for ESA-listed species or protected migratory bird nests if they might be present in the area (see Table 10 in Chapter 7).
2. Water or debris from a hot wash or other decontamination would be prevented from entering any water body.
3. Wash water would not be allowed to flow over land covered by any type of vegetation without performing a survey of the area for ESA-listed plants in specific areas (see Table 10 in Section 7.1.2).
4. Any runoff from washing/decontaminating a vessel would either be captured and transferred to a location away from any water body, evaporate, percolate directly into the ground, or be collected in a retention basin with no possibility of reaching water bodies or wetlands.
5. There could be instances where a wash/decontamination would be performed at a watercraft owner's residence. In such instances, trained staff would evaluate the location, including where any runoff could go. If there is any chance of discharging to an uninfected water body, the watercraft would be hauled to an area where no water or debris from the wash/decontamination would be discharged to a water body.
6. There would be no wetland disturbances or other negative effects to wetlands.
7. Watercraft inspection station sites would be assessed/surveyed to determine presence/absence of suitable habitat/location of ground nesting or shrub nesting birds.

By following the above stipulations to avoid impacts to wildlife and terrestrial resources there would be no direct or indirect, short-term or long-term, or cumulative effects caused by the proposed action. In the absence of adverse impacts on terrestrial resources overall, the proposed action would be expected to be positive due to the reduced risk of infestation provided by the additional funding allocated to support the program.

6.5 AESTHETICS/VISUAL RESOURCES

If a dreissenid infestation were to occur there would be negative impacts on this resource. Small mussels would attach to virtually all hard surfaces, such as man-made structures, water intake pipes, rocks, boats, and others. The shoreline would eventually be lined with dead mussel shells.

6.5.1 No Action Alternative

Under the No Action Alternative conditions related to aesthetics and visual resources would remain at levels similar to the existing conditions. No significant changes would

be anticipated. Taking no action would therefore not result in direct or indirect, short-term, long-term, or cumulative effects to aesthetic or visual resources.

6.5.2 Proposed Action Alternative

The proposed action would cause minimal changes to the aesthetic or visual resources of areas where watercraft inspection stations would be located as the stations would be placed in already developed areas. Most travelers on major interstates may not notice a station. Inspection stations would include signage along the travel route requiring watercraft haulers to stop for an inspection. This is the only visual difference most travelers would notice. At the inspection location, there would most likely be a storage container or canopy, a portable restroom, and various equipment such as a pickup truck and wash-water tank, which would not be significantly aesthetically displeasing (Figure 12).

The proposed action would not significantly affect aesthetic or visual resources in the UC directly or indirectly in either the short term or long term. There would be no additional significant cumulative effect on this resource.

Figure 14. State-Operated Watercraft Inspection Station in Wyoming

6.6 RECREATION

If dreissenids were to become established, recreationists would be negatively impacted. Anyone walking along the shoreline or in the water would need to wear shoes, or risk being cut by sharp shells. The types and abundance of fish sought by anglers would likely change.

6.6.1 No Action Alternative

Under this alternative, the AIS coordinators in the four study area States would continue their programs to prevent the spread of dreissenids, and the risk would remain unchanged. Taking no action would therefore not result in direct or indirect, short-term, long-term, or cumulative effects to recreation resources.

6.6.2 Proposed Action Alternative

The Corps' involvement in establishing watercraft inspection stations would have negligible effects on recreation and the recreating public in the proposed action area. Because the state AIS coordinators have been conducting watercraft inspections for the past ten years, most people hauling boats and other watercraft are accustomed to the routine of stopping for inspections.

Some people transporting watercraft may initially have a negative reaction to the inspection stations due to the feeling they are being inconvenienced or being required to stop for additional or multiple stations. However, many of these people may change their position once they learn the importance of stopping the spread of AIS (especially dreissenids) and that if they take the necessary cleaning actions and precautions, their delay would not be very lengthy.

The proposed action would therefore not negatively affect recreational activities in the UC directly or indirectly in either the short term or long term. There would be no additional cumulative effect on this resource. The indirect effects would be positive due to the reduced risk of infestation provided by the additional funding allocated to support the program.

6.7 CULTURAL AND HISTORICAL RESOURCES

6.7.1 No Action Alternative

The four study area States are likely to continue their watercraft inspection programs without Federal funding or support. Therefore, negligible impacts to cultural and historical resources would remain as they are today, which is minimal.

6.7.2 Proposed Action Alternative

The proposed action would require the Corps to collaborate with AIS coordinators of the study area States to establish watercraft inspections stations at and within the perimeter of the UC. These inspection stations would be located where infrastructure would support the facilities, and where a suitable space for decontamination as to not allow contaminated effluent to reach UC waters. This would, therefore, limit inspection stations to parking lots, gravel pits, and other surface-disturbed localities. If permanent improvements are proposed, specifically if they include any ground disturbing activity, the Corps would complete a separate NEPA analysis to include National Historic Preservation Act (NHPA) Section 106 review. After the site-specific analysis is complete and corresponding consultation with appropriate entities (State Historic

Preservation Officers [SHPO], Tribal Historic Preservation Officers, and concerned Tribes) concur with the findings, the improvements would be authorized.

There would be no additional cumulative effects to cultural or historical resources.

6.8 CLIMATE CHANGE

Thermal ranges for dreissenid persistence are from approximately 3°C to as high as 30°C. Optimal thermal conditions for dreissenid reproduction and larval development are from 14°C to 22°C and would generally occur in the spring and summer (USGS 2016).

The Colorado River and major tributaries are typically within the range for mussel reproduction from May to as late as November. Summer temperatures typically do not exceed this range (USGS 2020). The UC is currently highly susceptible to dreissenid infestation as water temperatures are suitable for reproduction with a long potential reproductive season.

Potential consequences of climate change include reduced snow packs, higher winter streamflows, earlier snowmelt-generated peak flows, and lower summer flows (WDOE 2016). These conditions are likely to result in higher stream temperatures and an extended range of time within the suitable dreissenid thermal reproductive range, which could result in higher susceptibility to infestation and greater impacts of infestation. This assessment is consistent with the President's Climate Action Plan of June 2013, which included actions to help prepare the United States for the impacts of climate change; Executive Order (E.O.) 13653, which directed Federal agency actions to incorporate climate-resilience considerations into agency operations and other mission objectives; E.O. 13677, which set requirements for systematically integrating climate-resilience considerations into U.S. international development work; and E.O. 13693, which directed federal actions to improve environmental performance and Federal sustainability.

6.8.1 No Action Alternative

There would not be any effects to climate change as a result of implementing the No Action Alternative. Gradual climate change would continue, in correlation with increasing CO_2 emissions worldwide. In addition, climate change would not affect implementation of the No Action Alternative.

6.8.2 Proposed Action Alternative

There would be extremely negligible effects on climate change as a result of implementing the proposed action. Vehicles idling at watercraft inspection stations is a part of world-wide cumulative contributions to change in climate by way of increases in greenhouse gas emission. Given the minuscule contribution of CO_2 emissions resulting from the proposed action to overall global emissions, effects are considered to be insignificant. Therefore, there would be no significant direct, indirect, short-term, long-term, or cumulative effects to climate change.

As with the No Action Alternative, climate change would not affect implementation of the proposed action.

6.9 CUMULATIVE EFFECTS

NEPA and the CEQ regulations for implementing NEPA require Federal agencies to consider the cumulative effects of their actions. Cumulative effects are defined as effects "on the environment which result from incremental impact of an action when added to other past, present and reasonable foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.

Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time" (40 CFR § 1508.7).

The primary goal of a cumulative effects analysis is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and reasonably foreseeable future actions.

Past and Present: Prior to 2007 there were no regional organizations whose primary missions were focused on aquatic invasive species prevention. The 100th Meridian Initiative – Columbia River Basin Team (CRB Team), which is administered by the PSMFC, was one of the first organizations with a goal of preventing the spread of AIS in the Pacific Northwest. The 100th Meridian Initiative – Columbia River Basin Team (see Section 2.1) is the cornerstone of consistent efforts between the U.S. and Canada, which has instituted many of the actions contained in this report and their participation would contribute to the overall success of this project.

Reasonably Foreseeable Future: Federal investment in this project will further expand and support existing state and Canadian programs, resulting in increased effectiveness in the watercraft inspection program to decrease the vulnerability to a dreissenid infestation to the UC. It is likely that the program would expand into the future to address a wide suite of aquatic pests.

The analysis of the environmental resources above concludes that implementation of the proposed action would not result in significant adverse effects, either individually or cumulatively with other effects. Additionally, successful implementation of the program is intended to maintain the status quo (i.e., the UC without the presence of Dreissenids or other new aquatic pests), but with an appreciably reduced risk of future infestation.

CHAPTER 7 - COMPLIANCE WITH APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

This chapter identifies the legal, policy, and regulatory requirements applicable to the proposed action. The implications for each requirement are discussed with respect to the proposed action. Summaries of compliance and coordination activities for each of the laws, policies, or regulation are also provided. Also included in this chapter are additional authorities and guidance related to the proposed action.

7.1 FEDERAL LAWS

7.1.1 National Environmental Policy Act

As required by NEPA and subsequent implementing regulations promulgated by the Council on Environmental Quality, this LR/Programmatic EA was prepared to determine whether the proposed action constitutes a "…major Federal action significantly affecting the quality of the human environment…" and whether an EIS is required. This LR/Programmatic EA documents the evaluation and consideration of potential environmental effects associated with the proposed action.

The Corps prepared this LR/Programmatic EA and will circulate it to State and Federal agencies, Tribes, and the public for review and comment. The Corps identified no impacts significantly affecting the quality of the human environment prior to distribution of the LR/Programmatic EA. If no such impacts are identified during the public review process, compliance with NEPA would be achieved upon signing a Finding of No Significant Impact (FONSI). However, if such impacts are identified during the public review, an EIS would be required, and compliance with NEPA would be achieved upon completion of the EIS and the signing of a Record of Decision.

7.1.2 Endangered Species Act

The ESA established a national program for the conservation of threatened and endangered fish, wildlife, and plants and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS if an action may affect a listed species to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(c) of the ESA and the Federal regulations on endangered species coordination (50 CFR § 402.12) require that Federal agencies prepare biological assessments of the potential effects of major actions on listed species and critical habitat.

If any ESA-listed small mammal or plant species could be in a county or watershed where watercraft inspection stations are established and any ground disturbing or vegetation disturbing activity is planned, surveys for their presence would be conducted and the protected species avoided. Table 10 lists the ESA-listed species and the locations where surveys would be conducted to ensure there would be no effect on them.

Table 11. ESA-Listed Species Requiring Site Specific Survey for Any Projects with Ground Disturbing or Vegetation Disturbing Activities

Species	Location
Clay-loving Wild Buckwheat	Central Colorado
Debeque Phacelia	Colorado
Pagosa Skyrocket	Colorado
Parachute Beardtongue	Central Colorado
Heliotrope Milk-vetch	Central Utah
Navajo Sedge	Northern Arizona, Southern Utah

The Corps determined that the establishment of watercraft inspection stations would have no effect on ESA-listed species or designated or proposed critical habitat. However, there are some stipulations required to justify this determination (see Section 6.4.2 and Appendix B for detailed discussion).

7.1.3 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712, as amended) prohibits the taking of and commerce in migratory birds (live or dead), any parts of migratory birds, their feathers, or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof.

Watercraft inspection station sites would be assessed/surveyed to determine presence/absence of suitable habitat/location of ground nesting or shrub nesting birds. No trees, shrubs, or other bird habitat is proposed to be cut or damaged by the establishment of watercraft inspection stations. Birds would not be affected. There would be no take of migratory birds.

7.1.4 National Historic Preservation Act

The NHPA of 1966 as amended directs Federal agencies to assume responsibility for all cultural resources under their jurisdiction. Section 106 of NHPA requires agencies to consider the potential effect of their actions on properties that are listed, or are eligible for listing, on the National Register of Historic Places. The NHPA implementing regulations, 36 Code of Federal Regulations (CFR) Part 800, requires that the Federal agency consult with the SHPO, Tribes, and interested parties to ensure that all historic properties are adequately identified, evaluated, and considered in planning for proposed undertakings.

The Corps has determined the establishment of watercraft inspection stations, as currently operated, has no potential to affect historical properties. However, if additional amenities requiring ground disturbing activity are requested, supplemental Section 106 review will be required before approval.

7.1.5 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act addresses the discovery, identification, treatment, and repatriation of Native American and Native Hawaiian human remains and cultural items (i.e., associated funerary objects, unassociated funerary objects, sacred objects, and objects of cultural patrimony).

Although not expected, in the event of an inadvertent discovery during construction, work would immediately halt and reasonable resource protective measures would be implemented. After the area is secured, the appropriate authorities should be contacted, including local law enforcement, the Federal land manager, appropriate SHPO, and regional Tribal groups.

7.1.6 Clean Water Act

The Federal Water Pollution Control Act (33 U.S.C. § 1251 et seq., as amended) is more commonly referred to as the Clean Water Act. This act is the primary legislative vehicle for Federal water pollution control programs and the basic structure for regulating discharges of pollutants into waters of the United States. The act was established to restore and maintain the chemical, physical, and biological integrity of the Nation's waters and sets goals to eliminate discharges of pollutants into navigable water, protect fish and wildlife, and prohibit the discharge of toxic pollutants in quantities that could adversely affect the environment. The act has been amended numerous times and given a number of titles and codifications.

Section 402 of the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) program, pertains to discharge of pollutants. No pollutants would be discharged into waters of the United States by activities proposed in this LR/Programmatic EA; therefore, a NPDES permit would not be needed.

7.2 Executive Orders

7.2.1 Executive Order 11988, Floodplain Management, May 24, 1977

This Executive Order outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency must evaluate the potential effects of actions on floodplains and avoid undertaking actions that directly or indirectly induce development in the floodplain or adversely affect natural floodplain values.

The proposed action would not further alter the floodplain.

7.2.2 Executive Order 11990, Protection of Wetlands, May 24, 1996

This order directs Federal agencies to provide leadership in minimizing the destruction, loss, or degradation of wetlands. Section 2 of this order States that, in furtherance of the NEPA, agencies shall avoid undertaking or assisting in new construction located in wetlands unless there is no practicable alternative.

No wetlands would be impacted by the proposed action.

7.2.3 Executive Order 12898, Environmental Justice, February 11, 1994

This order directs Federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law.

The proposed program would not adversely or disproportionately affect minority or low-income populations.

7.3 Additional Authority And Guidance

Additional authority and guidance related to the proposed action includes the following:

Executive Order 11987, Exotic Organisms. This Executive Order directs Federal agencies as follows:

- Executive agencies shall, to the extent permitted by law, restrict the introduction of exotic species into the natural ecosystems on lands and waters which they own, lease, or hold for purposes of administration; and, shall encourage the States, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the United States.
- Executive agencies, to the extent they have been authorized by statute to restrict the importation of exotic species, shall restrict the introduction of exotic species into any natural ecosystem of the United States.

Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species. Under this Executive Order, Federal agencies are required to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established. See also, Executive Order 13112.

USACE Invasive Species Policy. Corps Invasive Species Policy of June 2, 2009, compliments the National Invasive Species Act (and related laws) and directs Civil Works to address invasive species concerns in analyses of project impacts, and authorizes permits to include stipulations regarding control of invasive species.

The Corps Environmental Operating Principles. The Corps Environmental Operating Principles (EOPs) have been taken into consideration throughout the study process, and would continue to be part of the implementation of the proposed action. Below are the Corps EOPs:

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all Corps activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.

- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by Corps, which may impact human and natural environments.
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.
- Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

In coordination with the agencies and other stakeholders, the Corps proactively considered the environmental consequences several measures and developed a comprehensive solution that supports economic and environmentally sustainable solutions.

CHAPTER 8 - COORDINATION, CONSULTATION, AND PUBLIC INVOLVEMENT

In preparation for developing this LR/Programmatic EA, AIS coordinators from the five Upper Colorado study area States provided information on their respective watercraft inspection programs and reviewed sections of the document during development.

In October 2020, the Corps mailed information letters to Native American Tribes in the UC to notify them of the proposed action and upcoming opportunity to review the NEPA documents. In this letter the Corps also extended the invitation of Government-to-Government consultation.

The LR/ Programmatic EA and draft FONSI were made available to interested members of the public, Tribes, and Federal, State, and local agencies for a 25-day review and comment period. Federal agencies contacted include the departments of Agriculture (Animal and Plant Health Inspection Service), Interior (U.S. Fish and Wildlife Service and National Park Service). The Corps considered all comments received, prepared responses, and made clarifications to the report to address the comments. The comments received were not substantive and did not affect the decision-making process. The Corps will complete the NEPA process by signing the FONSI.

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CHAPTER 9 - RECOMMENDATIONS

The following recommendations include actions within the authority of Section 104 of the River and Harbor Act (RHA) of 1958 (33 United States Code [U.S.C.] 610), as amended by Section 1039(d) of the Water Resources Reform and Development Act (WRRDA) of 2014 (Public Law 113-121) and Section 1178 of the Water Infrastructure Improvements for the Nation Act (WIIN Act) of 2016 (Public Law 114-322), as well as actions that will require additional authority to implement.

9.1 WATERCRAFT INSPECTION STATIONS IN ARIZONA, COLORADO, NEW MEXICO, UTAH, AND WYOMING

Arizona, Colorado, New Mexico, Utah, and Wyoming annually establish seasonal watercraft inspection stations in strategic locations both in and outside the UC based on several factors: safety of personnel and public; ease of public access; infrastructure availability for setting up facilities (electricity, water, restrooms, etc.); and where applicable, a suitable space for conducting decontamination procedures that does not pose any threat to the environment. Although only water is used to decontaminate watercraft, watercraft inspection stations are set up in parking lots, gravel pits, or other areas where water run-off does not present an environmental concern. The States' goal, as part of a regional strategy, is to build a multi-layered line of defense, first by intercepting fouled boats coming across state lines (within and outside of the UC), and then providing additional protection closer to and within the UC. The Corps has deemed this strategy to be the most effective means of protecting all waters in the UC, including those maintained and operated by the Corps. To focus only on preventive efforts inside the basin excludes a critical layer of protection.

Based on the information evaluated in this LR/Programmatic EA, the Corps selects Alternative 2, Comprehensive Improvements, as the Recommended Alternative. The features of the Recommended Alternative include augmenting the future watercraft inspection program by the cost-shared actions below:

- Corps participation in the process to select locations to establish watercraft inspection stations.
- Adding locations.
- Extending daylight inspection hours.
- Adding nighttime inspections.
- Constructing site improvements.
- Adding canine detection.
- Increasing public awareness and education.

The Recommended Alternative assumes the Federal investment would augment State funds, resulting in increased effectiveness in the watercraft inspection program to decrease the risk of a dreissenid infestation. In coordination with the regional strategy

and the data gathered during the inspection season, the States would use the data gathered during the inspection season to develop a strategy and make adjustments to the program to provide a more effective regional defense. With a BCR of 8.4, the Corps has determined that there is Federal interest in partnering with the States of Arizona, Colorado, New Mexico, Utah, and Wyoming to address the vulnerability of the UC to a dreissenid infestation. The Recommend Alternative also includes monitoring in Corps reservoirs, contingency planning, and rapid response planning for Corps facilities and reservoirs.

9.2 WATERCRAFT INSPECTION STATIONS – IN OTHER STATES

The Corps recommends the States of Nevada and California implement similar or reciprocal laws governing watercraft movement from AIS watercraft bodies as Arizona Fish and Game Department Director's Order 3 – R05/15. Until reciprocal laws are passed, the Corps also recommends mandated watercraft inspections at federally owned water bodies in Arizona, Nevada and California. Additionally, all watercraft inspection stations that border the UC to the south should have mandatory inspections, especially at infested water bodies.

Considering the numerous access points at the Great Lakes, the establishment of the watercraft inspection program in that area may be impracticable or infeasible; however, there is still a need to inspect watercraft leaving the Great Lakes traveling to the UC. Performing regional inspections with a decontamination database system with standard protocols potentially could be a first step. This would allow the other States to accept the inspections and decontamination performed in other locations.

9.3 MONITORING

Identification of water chemistry within the States of Arizona, Colorado, New Mexico, Utah, and Wyoming and comparison to water chemistry of infested water bodies could be used to inform risk management decisions within and outside the UC. Monitoring water bodies within the four Northwest States could provide early detection of dreissenids and facilitate rapid response measures to minimize infestation impacts. Congress would need to appropriate separate funding for monitoring under 33 U.S.C. 610(e), which is authorized to be cost-shared at 70 percent Federal/30 percent non-Federal.

9.4 CONTINGENCY PLANNING AND RAPID RESPONSE PLANS

Prevention remains the first priority for addressing the threat of dreissenid mussels in the Colorado River Basin. This includes keeping contaminated watercraft from entering uncontaminated water bodies in the basin. However, should prevention efforts fail and live mussels invade a water body within the Colorado River Basin, advanced planning is needed to ensure an effective inter-jurisdictional response. The Corps recommends the development of site-specific plans at the facilities using the facility vulnerability assessments conducted by Reclamation (2013; 2015a-e), with a focus on priority areas identified in the risk assessment matrix. Congress would need to appropriate separate

funding for contingency planning under 33 U.S.C. 610(e), which is authorized to be cost-shared at 70 percent Federal/30 percent non-Federal. The Corps also recommends developing rapid response measures in coordination with the States of Colorado, New Mexico, Utah, and Arizona to find and eradicate dreissenids in the event an introduction occurs.

9.5 PUBLIC AWARENESS

As previously mentioned, public awareness about the seriousness of AIS is an important element of the ongoing efforts to prevent an introduction of dreissenids and further spread of other AIS within the UC. The Corps recommends the following pertaining to public awareness:

- Continue AIS ad campaigns, with collaboration among States, where possible, to obtain greater consistency and better recognition as boaters travel through the UC.
- Target outreach efforts to commercial boat haulers and other boat vector pathways such as boat brokers, auctions, online sale sites, and marinas with moored boats in infested hot spots such as the Lower Colorado River and Great Lakes. For example, PSMFC and partners including Idaho Department of Agriculture, Nevada Department of Wildlife, and others will be undertaking an outreach project in the coming year to provide messaging to these sources/haulers on the dreissenid issue and what they can do to reduce the risk of spreading dreissenids and lessen their chances of unknowingly (or knowingly) breaking State and Federal laws.
- Increase efforts to communicate and work with boat manufacturers—especially to provide easy access to ballast water tanks on wakeboard boats, which would allow decontamination of water left in the ballast tanks.
- Continue to provide brochures, literature, and ads about AIS in State fishing and boating license applications and at recreational boating outlets and events.

CHAPTER 10 - Roles and Responsibilities

This chapter generally describes how the program would function. Upon review and approval of the LR/Programmatic EA, the Corps will execute the Watercraft Inspection Program Project Partnership Agreement (PPA) with Pacific States Marine Fish Commission (PSMFC). The PPA does not require annual signatures between the Corps and PSMFC, and the PPA allows PSMFC to act on behalf of the States of Idaho, Montana, Oregon, and Washington. The Corps would develop agreements with the States of Arizona, Colorado, New Mexico, Utah, and Wyoming.

After the Corps receives the Federal funds for the watercraft inspection program, the Corps would distribute letters to participating states requesting statement of works for the upcoming season with the budget amount based on the Federal funds available. The Corps would then work with State AIS coordinators to draft a statement of work for each State that contains inspection station activities and inspection station activities costs for the upcoming inspection season.

The term “inspection station activities” means the establishment, operation, and maintenance of new or existing watercraft inspection stations, including, but not limited to, the evaluation and selection of station locations, installation of stations, scheduling of daylight and night-time inspection hours, use of canine detection, increasing public awareness and education and other inspection enhancements, and constructing station site improvements, such as surface hardening, trailer pads, and utility connections as generally described in this LR/Programmatic EA.

The term “inspection station activities costs” means all costs incurred following the date of execution of the statement of work by the Corps, in accordance with the terms of the PPA that are directly related to inspection station activities, including planning, engineering, design, establishment, operation and maintenance, related supervision and administration costs, and the Corps’ costs of monitoring, inspection, and auditing of inspection stations activities.

During the statement of work preparation, the Corps and the States would engage in an evaluation process to determine whether stations should be added, relocated, or closed, or if hours of operation should be adjusted. This evaluation process includes coordination among States and takes into account their specific budgets and statutory authorities, as well as collection data related to boat transportation traffic and fouled boat interceptions. To be considered for this cost-share program, the inspection stations will be located in the States of States of Arizona, Colorado, New Mexico, Utah, and Wyoming, and the stations must protect the UC and provide the highest likelihood of preventing the spread of aquatic invasive species at reservoirs operated and maintained by the Corps.

The Corps, with the States’ assistance, shall complete all environmental compliance requirements, obtain all applicable licenses and necessary permits, and comply with applicable Federal labor laws covering non-Federal construction. The Corps, with the States’ assistance, will include provision for all lands, easements, rights-of-way,

relocations, and dredged material disposal areas required for establishment of watercraft inspection stations.

When site improvements are planned at an inspection station location that involves any ground disturbance, the Corps may need to tier from this LR/Programmatic EA and complete site-specific NEPA analysis, depending on the nature and magnitude of proposed work and associated impacts. The Corps would review any planned construction activities and the associated environmental compliance documentation before the construction activity is advertised for bids or executed with States' in-house labor forces. After the analysis is complete, the improvements would be allowed to proceed.

After the statement of work is finalized and approved by the Corps, the statement of work will be signed by the Corps. Signing the statement of work will commit the funds to make them available for reimbursement.

No later than the 15th of each month, or as soon thereafter as practicable, the States shall submit properly executed and duly certified invoices covering inspection station activities performed during the preceding month. Appropriate documentation includes invoices and certification of specific payments to contractors, suppliers, and State employees that are performing inspection station activities. The Corps shall review such documentation to determine and certify the inspection station activities costs as either allowable costs, not allowable costs, or costs that require additional supporting information. The States' submission must include sufficient information to support a determination by the Corps that the costs are necessary to establish, operate, and maintain those inspection stations to protect the UC at locations with the highest likelihood of preventing the spread of aquatic invasive species at reservoirs operated and maintained by the Corps. Such written certification by the Corps is required in order to support any payments under this authority. Following such certification, and subject to the availability of funding appropriated for watercraft inspection stations, the Corps shall make payment in accordance with the authority and PPA.

Federal participation in the program would be dependent on the States continuing to fund the program and Congress specifically appropriating funds for the program. In 2019, expenditures by the States totaled about $2.71 million within the UC and about $4.58 million outside the UC. Although individual State budgets fluctuate annually, the initial estimated annual cost to the Federal government to fully participate in the program within the UC would be about $1.9 million and about $1.5 million outside the UC. This number may increase if risks increase, or it may decrease, or the program may be eliminated if an infestation becomes permanently established within the UC.

CHAPTER 11 - REFERENCES

ANSTF (Aquatic Nuisance Species Task Force). 2017. "ANS Task Force." Accessed February 3, 2017, www.anstaskforce.gov/default.php.

AZGFD (Arizona Game and Fish Department) 2011. State of Arizona Aquatic Invasive Species Management Plan. September 2011. Accessed January 2, 2020 at FINAL_AIS_Management_Plan_9-12-11.

AZGFD (Arizona Game and Fish Department) 2016. Fishing, Aquatic Invasive Species, Intro to Invasive Quagga Mussels, Frequently Asked Questions. Accessed August 16, 2016, www.azgfd.com/fishing/invasivespecies/quaggamussels.

Athearn, J. and T. Darland. 2007. *Bonneville Hydroelectric Project Response Plan for Zebra Mussels* (Dreissena polymorpha*),* Appendix F-1. Pacific States Marine Fisheries Commission: Portland, OR.

Bear, B. A. 2009. Assessing the risk of a mussel invasion in Wyoming waters. Wyoming Game and Fish Department, Cheyenne, WY.

BLM (Bureau of Land Management). 2014. "Lake Havasu Management Partnership Memorandum of Understanding." Accessed November 19, 2014, http://www.blm.gov/az/st/en/info/newsroom/2014/november/lhfo-mou.html.

Boyle, R. H. 2014. "Science takes on a silent invader." *New York Times*, February 24, 2014.

CBR (Columbia Basin Research). 2016. Columbia Basin Conditions for Temperature, Dissolved Gas Percent and Spill Percent. Accessed December 7, 2016, http://www.cbr.washington.edu/dart/query/basin_conditions.

CPW (Colorado Parks and Wildlife). 2020a. State Aquatic Nuisance Species (ANS) Program Summary for Colorado Legislators per SB 08-226. January 15, 2020.

CPW (Colorado Parks and Wildlife). 2020b. State of Colorado Aquatic Nuisance Species Management Plan. March 1, 2020. Accessed March 18, 2020 at Colorado_ANS_Management_Plan_03012020.

Chakraborti, R. K., S. Madon, and J. Kaur. 2016. "Costs for Controlling Dreissenid Mussels Affecting Drinking Water Infrastructure: Case Studies." *American Water Works Association* E442-E453.

Chatters, J. C. and Pokotylo, D. L. 1998. "Prehistory: Introduction." In *Handbook of North American Indians, Vol. 12: Plateau*, volume ed. D. E. Walker Jr.; general ed., W. C. Sturtevant. Smithsonian Institution.

Colorado River Connected 2020. Climate change. Accessed June 10, 2020 at coloradoriverconnected.org/climate-change/.

Connelly N., C. R. O'Neill, B. A. Knuth, and T. L. Brown. 2007. "Economic impacts of zebra mussels on drinking water treatment and electric power generation facilities." *Environmental Management* 40(1):105–112.

Counihan, T. and S. Bollens. 2016. (In Review) *Early Detection Monitoring for Larval Dreissenid Mussels: How Much Plankton Sampling is Enough?* U.S. Geological Survey, Cook Washington.

DeBruyckere, L. and S. Phillips. 2015. *Strategies to Conduct Vulnerability Assessments for High Priority Columbia River Basin Hydropower and Dam Facilities*. Pacific States Marine Fisheries Commission, Portland Oregon.

Earthtec. 2015. Zebra and Quagga Mussel Programs. Accessed December 4, 2016, http://earthtecwatertreatment.com/zebramussels.aspx.

EDDMapsS 2020. Early Detection and Distribution Mapping System. Center for Invasive Species and Ecosystem Health, University of Georgia. https://www.eddmaps.org/

Elwell, L. C. and S. Phillips, eds. 2016. Uniform Minimum Protocols and Standards for Watercraft Inspection and Decontamination Programs for Dreissenid Mussels in the Western United States (UMPS III). Pacific States Marine Fisheries Commission, Portland, OR.

EPA (Environmental Protection Agency). 2016. Climate Impacts in the Northwest. Accessed October 3, 2016, https://www.epa.gov/climate-impacts/climate-impacts-northwest.

Fanslow, D. L., T. F. Nalepa, and G. A. Lang. 1995. "Filtration Rates of the Zebra Mussel (*Dreissena polymorpha*) on Natural Seston from Saginaw Bay, Lake Huron." *Publications, Agencies and Staff of the U.S. Department of Commerce.* Paper 393. http://digitalcommons.unl.edu/usdeptcommercepub/393.

Franklin County Emergency Management and Homeland Security. 2013. Planning, Franklin County Risk Assessments. 2013 Risk Assessment for Franklin County: Full Report. Accessed October 3, 2016, http://fcemhs.com/Planning /FranklinCountyRiskAssessment.aspx.

Heimowitz, P. and S. Phillips. 2008. *Columbia River Basin Interagency Invasive Species Response Plan: Zebra Mussels and Other Dreissenid Species*. Prepared by U.S. Fish and Wildlife Service, Pacific Region, and Pacific States Marine Fisheries Commission for the 100th Meridian Initiative Columbia River Basin Team. Updated 2014.

Idaho Aquatic Nuisance Species Taskforce. 2009. Estimated Potential Economic Impact of Zebra and Quagga Mussel Introduction into Idaho. Prepared for the Idaho Invasive Species Council. http://www.aquaticnuisance.org/resources /ais-economic-impacts.

IEAB (Independent Economic Analysis Board). 2013. Economic Risk of Zebra and Quagga Mussels in the Columbia River Basin. Task Number 201. September 3, 2013.

IPCC (Intergovernmental Panel on Climate Change). 2001. Climate Change 2001: Working Group I: The Scientific Basis. World Meteorological Organization (WMO) and United Nations Environment Programme (UNEP). Accessed October 3, 2016, http://www.grida.no/publications/other/ipcc_tar/

Leonard, J. L. and B. A. Bear. 2019. Evaluation of Wyoming waters for potential risk of invasion by dreissenid mussels. Wyoming Game and Fish Department, Cheyenne, WY.

Maupin, M.A., Ivahnenko, T., and Bruce, B., 2018, Estimates of water use and trends in the Colorado River Basin, Southwestern United States, 1985–2010: U.S. Geological Survey Scientific Investigations Report 2018–5049, 61 p., https://doi.org/10.3133/sir20185049.

Milly, P.C.D , and K.A. Dunne 2020. Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. Science 13 MAR 2020 : 1252-1255

Montana Fish, Wildlife and Parks. 2016. "Water samples test positive for invasive mussel larvae in Tiber Reservoir." Montana.gov Official State Website, News, accessed December 4, 2016, http://fwp.mt.gov/news/newsReleases/headlines/nr_4291.html.

Morse, J. T. 2009. "Assessing the effects of application time and temperature on the efficacy of hot-water sprays to mitigate fouling by *Dreissena polymorpha* (zebra mussels Pallas)." *Biofouling* 25: 605- 610.

NMFS (National Marine Fisheries Service). 2011. *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead.* NMFS Northwest Region. Portland, OR. January. Prepared for NMFS by the Lower Columbia River Estuary Partnership (contractor) and PC Trask & Associates, Inc., subcontractor.

NMDGF (New Mexico Department of Game and Fish) 2008. New Mexico Aquatic Invasive Species Management Plan September 2008. Accessed January 2, 2020 at AIS-New-Mexico-Management-Plan-Final-Oct_2008.

NOAA (National Oceanic and Atmospheric Administration). *n.d.* Invasive Mussels, Dramatically Changing the Great Lakes Ecosystem. Great Lakes Environmental Research Laboratory, Ann Arbor.

Oneida County AIS. 2016. Aquatic Invasive Species, Quagga Mussel. Accessed December 28, 2016, http://www.oneidacountyais.com/quagga-mussel.html.

O'Neill, C. 1997. "Economic impact of Zebra Mussels: Results of the 1995 Zebra Mussel Information Clearinghouse Study." *Great Lakes Res. Review*, Vol. 3, No. 1: 35-42.

Phillips, S., T. Darland, and M. Sytsma. 2005. *Potential Economic Impacts of Zebra Mussels on the Hydropower Facilities in the Columbia River Basin*. Prepared for the Bonneville Power Administration. Pacific States Marine Fisheries Commission, Portland, OR.

PNWER (Pacific Northwest Economic Region) and PSMFC (Pacific States Marine Fisheries Commission). 2015. *Advancing a Regional Defense against Dreissenids in the Pacific Northwest*.

PSFMC. 2011. Columbia River Basin Aquatic Invasive Species Database, Monitoring for Aquatic Animals. http://crbais.psmfc.org/monitoring/monitoring-for-aquatic-animals.

_____. 2016. Major Columbia River Basin Dams. Updated July 18, 2016. Accessed June 10, 2020, www.westernais.org/vulnerability-assessments.

_____. 2016. Lessons Learned State Dreissendid Rapid Response Exercises. September 2019.

Reclamation (U.S. Bureau of Reclamation). 2007. Quagga Mussels on the Lower Colorado River Photo Gallery. Accessed December 7, 2016, https://www.usbr.gov/lc/region/programs/quagga/photos.html.

_____. 2010. Upper Colorado Region Prevention and Rapid Response Plan for Dreissenid Mussels.

Reclamation (U.S. Bureau of Reclamation). 2013. *Facility Vulnerability Assessment for Lower Granite Lock & Dam, Invasive Quagga and Zebra Mussels*, prepared for U.S. Army

_____. 2015a. *Facility Assessment for Dworshak Dam, Invasive Quagga and Zebra Mussels*, prepared for U.S. Army Corps of Engineers, Walla Walla District. Technical Service Center: Denver, CO.

_____. 2015b. *Facility Assessment for Ice Harbor Lock & Dam, Invasive Quagga and Zebra Mussels*, prepared for U.S. Army Corps of Engineers, Walla Walla District. Technical Service Center: Denver, CO.

_____. 2015c. *Facility Assessment for Little Goose Lock & Dam, Invasive Quagga and Zebra Mussels*, prepared for U.S. Army Corps of Engineers, Walla Walla District. Technical Service Center: Denver, CO.

_____. 015d. *Facility Assessment for Lower Monumental Lock & Dam, Invasive Quagga and Zebra Mussels*, prepared for U.S. Army Corps of Engineers, Walla Walla District. Technical Service Center: Denver, CO.

_____. 2015e. *Facility Assessment for McNary Lock & Dam, Invasive Quagga and Zebra Mussels*, prepared for U.S. Army Corps of Engineers, Walla Walla District. Technical Service Center: Denver, CO.

_____. 2019. Upper Colorado River Basin Consumptive Uses and Losses Report 2016-2020. Provisional (Currently updated through 2018).

Rogers, K. 2008. "Boaters finding mussels big pain." *Las Vegas Review Journal*, posted March 3, 2008.

Streater, S. 2009. "Tiny Eurasian Mussel Now Threatening Mighty Hoover Dam." New York Times, December 10, 2009. http://www.nytimes.com/gwire/2009/12/10/10greenwire-tiny-eurasian-mussel-now-threatening-mighty-ho- 18381.html?pagewanted=all.

USACE (U.S. Army Corps of Engineers). 1988. Procedures for Implementing NEPA. Engineer Regulation 200-2-2.

USACE, HQ (Headquarters) (CECW-CO). 2016. Memorandum for Commander Northwestern Division, District Commands, Chiefs, Operations Divisions and Districts, SUBJECT: *Implementation Guidance for Section 1039(d) of the Water Resources and Reform Development Act of 2014, Public Law 113-121 (Watercraft Inspection Stations)*, March 18, 2016.

USACE, NWD (Northwestern Division) (CENWD-PDD). 2016. Memorandum for Commander, Walla Walla District (CENWW-PM-PD/Mr. Bret Walters), SUBJECT: *Implementation and Execution of Section 1039(d) of the Water Resources and Reform Development Act of 2014, Public Law 113-121 (Watercraft Inspection Stations)*, April 6, 2016.

USACE, NWW (Walla Walla District). 2016. Charrette held May 25, 2016. Attended by Representatives from USACE, States of Idaho, Montana, Oregon, and Washington, PSMFC, PNWER, and NWPCC.

USACE, SWF (Fort Worth District). 2013. *Zebra Mussel Resource Document, Trinity River Basin, Texas*. Prepared under USACE contract W9126G-09-D-0067 by GSRC, Alan Plummer Associates, Inc., and Lockwood, Andrews, and Newman, Inc.

USACE 2017. Final Integrated Letter Report and Programmatic Environmental Assessment. Federal Participation in Watercraft Inspection Stations Columbia River Basin.

USDA (U.S. Department of Agriculture). 2015. Natural Resources Conservation Service, Washington. "Washington State Snowpack Melting Early, Experts Say." Accessed October 3, 2016, http://www.nrcs.usda.gov/wps/portal/nrcs/detail/wa/newsroom/releases/?cid=NRCSEPRD338392.

UAFWS (US Fish and Wildlife Service) 2020a. San Juan River Basin Recovery Implementation Program. https://www.fws.gov/southwest/sjrip/index.cfm, accessed 6/9/2020.

USFWS 2020b. Upper Colorado River Endangered Fish Recovery Program. https://www.coloradoriverrecovery.org/index.html, accessed 6/9/2020.

U.S. DOI (Department of the Interior). 2016. Safeguarding America's Lands and Waters from Invasive Species: A National Framework for Early Detection and Rapid Response, Washington D.C.

U.S. Water Resources Council. 1983. Economic and Environmental Principles for Water and Related Land Resources Implementation Studies.

USGS (U.S. Geological Survey). 2016. Nonindigenous Aquatic Species, Zebra Mussel Fact Sheet. Accessed December 7, 2016, https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5.

_____. U.S. Geological Survey, 2020, Specimen observation data for *Dreissena polymorpha* (Pallas, 1771), Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=5, Access Date: 3/10/2020.

USGS and PSMFC GIS Center. 2016. 2016 Regional Watercraft Inspection Station Viewer. July 2016.

USGS (U.S. Geological Survey). 2020. National Water Information System, Colorado River Basin in Utah. Accessed 6/4/2020.

UCREFRP (Upper Colorado River Endangered Fish Recovery Program) 2019. Program Highlights 2018-2019. A.ccessed April 30, 2020 at www.coloradoriverrecovery.org.

UCREFRP (Upper Colorado River Endangered Fish Recovery Program) 2020. Program Highlights 2020. Accessed April 21, 2020 at www.coloradoriverrecovery.org.

UDWR (Utah Division of Wildlife Resources) 2009. Utah Aquatic Invasive Species Management Plan Accessed January 2, 2020 at UT_AIS_mgt_plan_full.

Vanderploeg, H. A., J. R. Liebig, W. W. Carmichael, M. A. Agy, T. H. Johengen, G. L. Fahnenstiel, and T. F. Nalepa. 2001. "Zebra mussel (*Dreissena polymorpha*) selective filtration promoted toxic *Microcystis* blooms in Saginaw Bay (Lake Huron) and Lake Erie." *Canadian Journal of Fisheries and Aquatic Sciences* 58: 1208-1221.

Vilaplana, J. V. and L. J. Hushak. 1994. *Recreation and the Zebra Mussel in Lake Erie, Ohio*. Technical Summary. OHSU-TS-023. Ohio Sea Grant College Program. Columbus, OH.

Walker, D. E., Jr. 1998. "Introduction." In *Handbook of North American Indians, Vol. 12: Plateau,* volume ed. D. E. Walker Jr.; general ed. W. C. Sturtevant. Smithsonian Institution.

WAPA (Western Area Power Administration) 2020. WAPA History Shapes Its Future. https://www.wapa.gov/About/history/Pages/history.aspx, Access Date: 8/18/2020.

Wikipedia. 2016. "Columbia River." Columbia River Drainage Basin (map). Modified December 25, 2016.

WDFW (Washington Department of Fish and Wildlife) and PSMFC (Pacific States Marine Fisheries Commission). 2015. *Aquatic Invasive Species, Final After Action Report, Operation "Dark Crossing*."

WDOE (Washington Department of Ecology). 2016. Climate Change and the Columbia River Basin. Accessed December 7, 2016, http://www.ecy.wa.gov/programs/wr/cwp/cr_climate.html.

Western Regional Panel (WRP) on Aquatic Nuisance Species. 2003. Model Rapid Response Plan for Aquatic Nuisance Species. Denver, CO. 82pp.

Western Regional Panel (WRP) 2010. Quagga-Zebra Mussel Action Plan for Western U.S. Waters. Submitted to the Aquatic Nuisance Species Task Force Final February 2010 by the Western Regional Panel on Aquatic Nuisance Species. westernregionalpanel.org/QZAP_Report_Feb_2010.

Western Regional Panel (WRP) 2019. Quagga-Zebra Mussel Action Plan for Western U.S. Waters Status Update Report. Submitted to the Aquatic Nuisance Species Task Force Final February 2010 by the Western Regional Panel on Aquatic Nuisance Species. westernregionalpanel.org/QZAP-Update-Report-2019.

Wimbush J, Frischer ME, Zarzynski JW, Nierzwicki-Bauera SA 2009. Eradication of colonizing populations of zebra mussels (*Dreissena polymorpha*) by early detection and SCUBA removal: Lake George, NY. Aquatic Conservation: Marine and Freshwater Ecosystems 19: 703–713.

WGFD (Wyoming Game and Fish Department). 2010. Wyoming Aquatic Invasive Species Management Plan Accessed January 2, 2020 at WY_AIS_Management_Plan_Final_20092010.

Wong WH, Tietjen T, Gerstenberger S, Holdren GC, Mueting S, Loomis E, Roefer P, Moore B, Turner K, Hannoun I. 2010. Potential ecological consequences of invasion of the quagga mussel (Dreissena bugensis) into Lake Mead, Nevada–Arizona. Lake Reserv Manage. 26:306–315.