MEMO

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www.kwo.org

DATE: March 22, 2017
TO: Missouri RAC Members and Advisors
FROM: Kirk Tjelmeland
RE: April 3, 2017 Meeting

The next meeting of the Missouri Regional Advisory Committee will be held on **Monday, April 3, 2017 at 9:00 a.m. in the USD 409 Community Room, 626 Commercial, Atchison, Kansas.**

As Regional Advisory Committee Members you have devoted much of your valuable time towards water related issues in your Region, thank you. The April 3rd meeting has another full agenda of important items: Chris Griffin will present on a RCPP project. Jack Brown will give a presentation on Current and Proposed well policies, expecting some feedback from the group. The MO River Subcommittee will present a set of draft comments on the MO River Draft EIS which will require action by the RAC. Rebecca Thacker, MO-KAN, will also give a presentation on Healthy Watersheds, in Particular the Independence-Sugar Creek Watershed.

In addition, the RAC needs to review the Action Plan for Carl's presentation to the KWA in August.

Enclosed please find the following meeting materials:

- Agenda
- February 14th Meeting Notes
- Press Release
- Action Plans
- Executive Summary-Draft EIS

If you cannot attend, or have any questions or concerns regarding the meeting, please feel free to contact me at Kirk.Tjelmeland@kwo.ks.gov or by phone at 785-368-8149.

Meeting Agenda
Missouri Regional Advisory Committee
Monday April 3, 2017, 9:00 a.m.
USD 409 Meeting Room
626 Commercial
Atchison, Kansas

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1. Welcome/Introductions

2. Public Comments*

3. RAC Business -

    a. Review of February 14th Meeting Notes

4. **Action Plan Item** – DP Conservation District – RCPP Proposal (Chris Griffin)

5. **Action Plan Item** - Update on KGS Phase 1 Groundwater study – (KWO)

6. Sub-committee recommendations on Draft Missouri River Recover Plan and Environmental Impact Statement – (Michelle, Allen and Joel)

7. Analysis of Kansas Water Well Policies and Proposal of New Water Well Policies – (Jack Brown)

8. Legislative Fact Finding Tour – (Alan Kelley)

9. Healthy Watershed, a MO DNR program – (Rebecca Thacker, MO-KAN)

10. Plan for 2017 RAC activities – Implementing the Action Plans – (Carl Johnson)

11. Agency Reports:

12. Other issues:

13. Next Meetings:

    a. KWA – May 17-18, 2017, Garden City

    b. MO RAC Meeting (June or July?)

*These reports are limited to 3-5 minutes.

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Tracy Streeter, Director

Sam Brownback, Governor

For Immediate Release:
March 20, 2017

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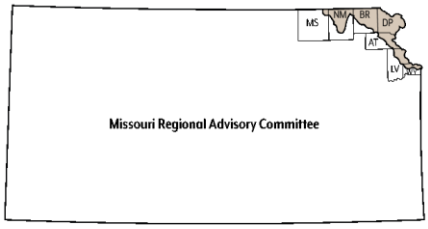

Missouri RAC Meeting in Atchison

April 3 at 9 a.m., in the USD 409 Community Room

The Kansas Water Office's (KWO) Missouri Regional Advisory Committee (RAC) is set to meet to discuss current water issues affecting the region, as well as the state.

The meeting is scheduled for Monday, April 3 at 9 a.m., in the USD 409 Community Room, 626 Commercial in Atchison, Kansas. The agenda includes several items such as a presentation by Chris Griffin, Doniphan County NRCS, on a Regional Conservation Partnership Program (RCPP) proposal and Jack Brown from KU will give a presentation on current and proposed well policies. A sub-committee of the RAC will also present information on the Missouri River Draft EIS and propose comments to be submitted to the U.S. Army Corps of Engineers.

The agenda and meeting materials will be available at www.kwo.org or you may request copies by calling (785) 296-3185 or toll-free at (888) KAN-WATER (526-9283).

If accommodations are needed for a person with disabilities, please notify the Kansas Water Office at 900 SW Jackson Street, Suite 404, Topeka, KS 66611-1249 or call (785) 296-3185 at least five working days prior to the meeting.

Note to Editor: The Americans with Disabilities Act, (42 U.S.C. 12101) requires the Kansas Water Office to print the reasonable accommodations messages.

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As the state's water office, KWO conducts water planning, policy coordination and water marketing as well as facilitates public input throughout the state.

The agency prepares the KANSAS WATER PLAN, a plan for water resources development, management and conservation. KWO also reviews all water laws and makes recommendations to the Governor and Legislature for needed legislation.

Missouri Regional Advisory Committee Meeting Notes

Missouri Regional Advisory Committee Meeting
February 14, 2017, 9:00 am
USD 409 Meeting Room
Atchison, Kansas

Members Attendance:

Name	City	Category	Term	Present
Carl Johnson (Chair)	Leavenworth, KS	Conservation/Environment (cc)	2019	Yes
John Bishop	Atchison, KS	Recreation	2019	Yes
Neil Coufal	Troy, KS	At Large Public (cc)	2017	No
Stephen Glaser	Atchison, KS	Industry/Commerce (cc)	2019	Yes
Jeffrey Grossenbacher	Bern, KS	Agriculture (cc)	2019	Yes
Carol Hughes	Seneca, KS	WRAPs	2017	Yes
Alan Kelley	White Cloud, KS	Iowa Tribe of Kansas and NB	2019	Yes
Joel Mahnken	Leavenworth, KS	Public Water Supply (cc)	2017	Yes
Brett Neibling	Highland, KS	Agriculture 2	2019	Yes
Darcy Nightingale	Hiawatha, KS	Agriculture Industry	2017	Yes
Bill Shroyer	Sabetha, KS	Public Water Supply 2	2019	No
Luke Terry	Robinson, KS	Fish and Wildlife	2017	No
Michelle Wirth	Kansas City, KS	Public Water Supply 3	2017	Yes

Others in attendance:

Name	Town	Representing
Alan Larson	Atchison	Atchison Co Conservation District
Larry Purcell	Atchison	KDA, Division of Water Resources
Chris Griffin	Troy	DP Co Conservation District
Judy Wegener-Stevens	Troy	DP Co Conservation District
Gary Satter		Glacial Hills RC&D and Missouri River WRAPS
Ethel Campbell		Atchison District Conservation Board
Goldie Boldridge-Brown		Atchison County Conservation District
Troy Munsch	Salina	Natural Resources Conservation Service
Margaret Chemas		K-State Extension
Kelli Baker		Atchison Co Conservation District
Brett Bunger	Topeka	KDA-DWR
Kirk Thompson		Ks Dept. of Wildlife, Parks and Tourism
Jake Geiger	Robinson	Self
Christina Ostrander	Kansas City	US Army Corp of Engineers
Chuck Vollmer		Agriculture
Ray Scherer	St Jo News	Press
Kirk Tjelmeland	Topeka	Kansas Water Office
Margaret Fast	Topeka	KWO

Welcome and Introductions:
Carl asked those in attendance to introduce themselves.

Review of Sept 22, 2016 Meeting Notes:
The notes were accepted as sent.

Public Comments:
There were none.

Report from November, 2016 Governor's Conference and January Kansas Water Authority meeting:
Carl Johnson mentioned the legislative visits went well with legislators understanding the need to fund the State Water Plan but also knowing the State's current budget situation. Carl also reported on items discussed at the KWA meeting: the Smoky Hill Access District-water from Kanopolis Reservoir; Quivira National Wildlife Refuge and the water impairment it is suffering; John Redmond dredging; Kickapoo water rights and water transfers-Hays.

RAC Operations:
Carl explained the Chair and Vice-Chair positions of the RAC are two-year terms, ending August, 2017. They are appointments by the Chairperson of the KWA. A vice-chair is in the process of being appointed. Carl encouraged individuals to step up if asked to fill the position.

A Missouri River Issues Sub-Committee of the RAC has been established consisting of three members: Michelle Wirth, Alan Kelley and Joel Mahnken.

Presentation on Action Plan Item - Tile outlet terrace systems:
Ted Peltier, University of Kansas, presented a series of slides that showed the constructed wetlands in Douglas County and gave an idea as to what they expected to see from the constructed wetlands at the end of a tile system. The nutrient outcome was slightly different than what they expected for 2014-2015 and what they plan to do different for 2017-2018. An exchange of good questions followed. The presentation is available on the RAC page of KWO.org.

Presentation on Action Plan Item – Progress on KGS report:
Margaret Fast (KWO) stated that KGS has been compiling data and that we are expecting a final report in late May. The scope of work had been included in the progress report with the mailing materials.

Update on Missouri River Bed Degradation Study – KC District COE:
Christy Ostrander gave a series of slides that talked about the study history, movement of the head-cut, destruction of infrastructure and possible alternative actions. Since none of alternatives showed measurable results, a technical paper will be prepared. Several questions followed dealing with the movement and damage of the incising that is taking place. The presentation is available on the RAC page of KWO.org.

Overview of Draft Missouri River Recover Plan and Environmental Impact Statement (EIS) – KC District COE:
Christy Ostrander presented a couple of slides that laid out the reasoning behind the Draft Missouri River Recovery Management Plan and the EIS. She encouraged the committee to attend the meeting on February 15th in Kansas City and said that the public comment period is open until April 24, 2017. Links to the executive summary and lots of other information are available at: http://moriverrecovery.usace.army.mil/mrrp/f?p=136:1:0:::::

Plan for 2017 RAC activities – Implementing the Action Plans – Carl lead this lengthy discussion on where the RAC is headed with the Action Plans and which items the Committee should tackle and which should be left to others. Also several ideas were presented on how often the Committee should meet; on that note, quarterly before the Kansas Water Authority (KWA) meetings was suggested.

Next Meeting

RAC Meeting: April 3, 2017- 9:00 am, USD 409 Meeting Room 626 Commercial, Atchison, KS

KWA Meeting: May 17-18, 2017, Garden City, KS

Missouri Regional Advisory Committee
Priority Goal #2 Action Plan

Priority Goal #2**:** To ensure a reliable surface water supply in the future, best management practices will be implemented so surface water quality in identified drainages is maintained or improved using goals and milestones as identified in the Missouri Watershed Restoration and Protection Area 9 Element Plan.

Guiding Principle:

Over the next 50 years, there needs to be an adequate, sustainable and affordable quality water supply in the Missouri Region, while protecting Tribal water rights and sacred and cultural sites. All government agencies, local through state, shall vigorously uphold and enforce all water conservation and management rules and regulations throughout the state.

Action Steps

- **Collection of Additional Data**
  - Collect data on a voluntary basis to evaluate the benefits of tile outlet terrace systems within the Missouri Region. Prior to proposing any design changes to outlets of tile terraces in the Missouri Region, conduct research on cropland field input amounts (rates, dates applied, how it was applied, etc.) and collect water samples to evaluate the water runoff into the streams in the region. Collect data working with interested local landowners with assistance of area conservation districts, Kansas Department of Health and Environment (KDHE), Natural Resources Conservation Service (NRCS) and other existing agencies. Collection sites will be: tile terrace runoff, waterway runoff, land with no conservation work or no conservation tillage, and land with no conservation work but using no-till.
  - Collect data on the benefits of capturing and reusing water on a producer's property.
  - Gather existing information on the impact of extreme events (droughts and floods) on water quality and availability of water resources into the future in the Missouri Region.
  - Assess what other interest groups, agencies and individuals locally and from states with similar topography and precipitation (Iowa, South Dakota, Nebraska, and Missouri,) can provide on alternative projects that could contribute to water quality in the Missouri Region.

- **Implementation**
  - Support and encourage implementation of the best management practices (BMPs) in the adopted 9-Element Plan. Those BMPs are: No-till, cover crops, grassed and forested buffers, convert steep slopes, sediment basins, pasture management, nutrient management, livestock waste management, alternative watering supplies, streambank stabilization, onsite wastewater system repair, urban lawn management, pet waste management. The Plan should be updated every 5-years.
  - Focus on finding local volunteers that are willing to adopt and promote new practices, including streambank stabilization.
  - Ensure the value of maintenance of BMPs is understood to allow BMPs to have the desired long term effects, through education and outreach.
  - Recognize the value of protection of water quality through education and outreach.
  - Prevent sedimentation by using existing cost - share programs through the Kansas Department of Agriculture, Division of Conservation (DOC); KDHE; and NRCS, to fund conservation practices in the Missouri Region.
  - Continue to use the NRCS for technical assistance on implementation practices suited to the unique topography of the Missouri Region.
  - Prioritize the existing ranking systems from agencies, to secure funding for protecting water quality and water supply in the Missouri Region.
  - Raise awareness about water quality and the importance of proper urban lawn application.

- **Monitoring**
  - Determine if additional monitoring sites are needed to better characterize and prioritize project priorities in the Region.

- **Funding Needs**
  - To ensure water quality is maintained and improved, the state should fully fund the Kansas Water Plan for implementation of best management practices through programs of the DOC, KDHE and others as needed.
  - Ensure continued and improved coordination with the NRCS to access and make the best use of funding for priority projects for water quality protection in the Region.
  - Assess possible involvement of other agencies, businesses and interest groups to determine interest and possible funding of water quality projects in the Region.
  - Continue to ensure that funding from the Clean Drinking Water Fee Fund for technical assistance for small public water supply systems is maintained at least at the current level.
  - Include funding for streambank stabilization projects as identified in the WRAPS 9 Element Plan.
  - Fully fund the 9-Element Plan implementation (approximately $140,000/year).
  - Develop a funding strategy within the next year for additional data collection and implementation as identified above in a phased manner in conjunction with DOC, NRCS, and KDHE and others as appropriate. Funding needs will then be reviewed on an annual basis and brought to the KWA.

Missouri Regional Advisory Committee
Priority Goal #1 & #3 Action Plan

Preamble

Groundwater quality and groundwater quantity are closely related and the approaches to understanding each are similar. For that reason, the 2 goals and the overall guiding principle are recognized in this action plan.

Regional Goals as adopted by the Kansas Water Authority, August 2015

Guiding Principle:

Over the next 50 years, there needs to be an adequate, sustainable and affordable quality water supply in the Missouri Region, while protecting Tribal water rights and sacred and cultural sites. All government agencies, local through state, shall vigorously uphold and enforce all water conservation and management rules and regulations throughout the state.

Priority Goal #1: Since groundwater quality is not well known, compile existing and collect additional data over the next 5 years to establish a baseline. Within 3 years after the baseline is established, a plan to implement best management practices will be developed to maintain and improve existing conditions. Monitoring and reevaluation of groundwater quality conditions and should continue at 5 year intervals.

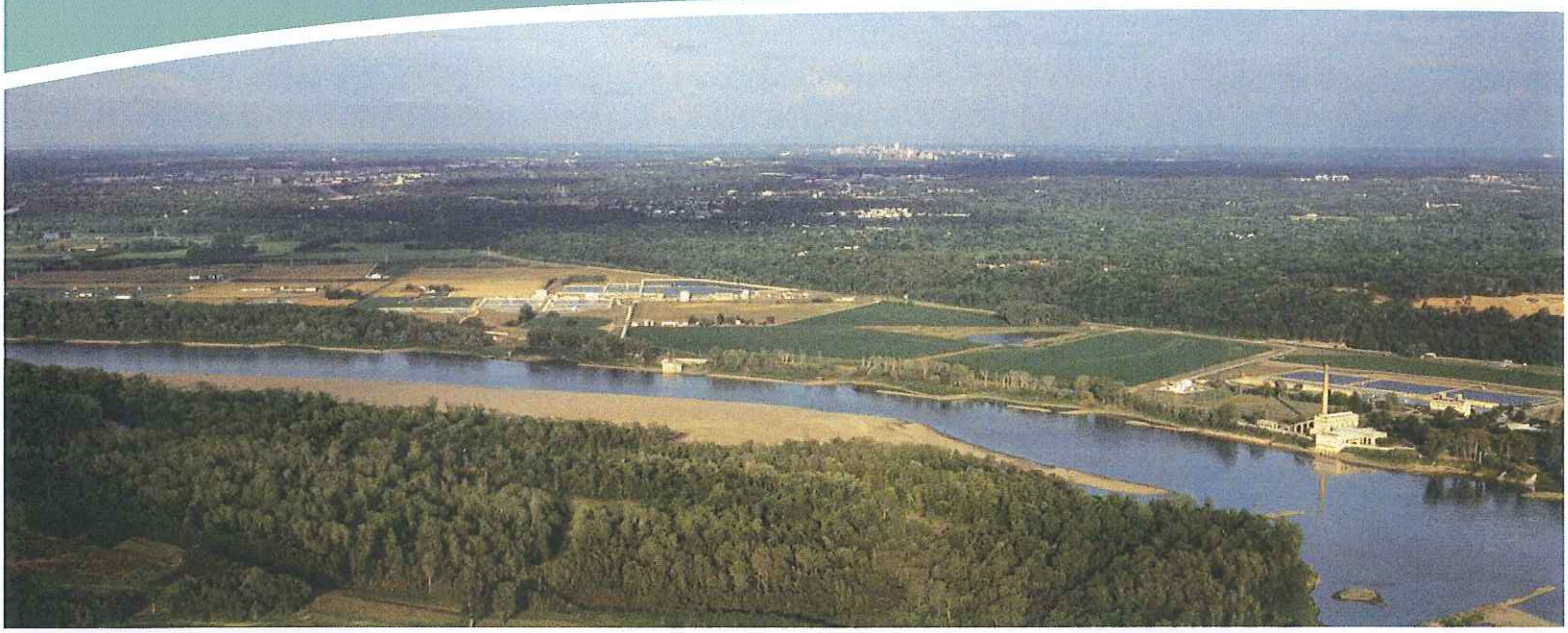
Priority Goal #3: Collect additional information to improve safe yield estimate of groundwater and tributary streams within 3 years. Place a moratorium on additional permits until safe yield is identified. Once determined, only issue permits that do not exceed that yield. Safe yield should then be continuously monitored.

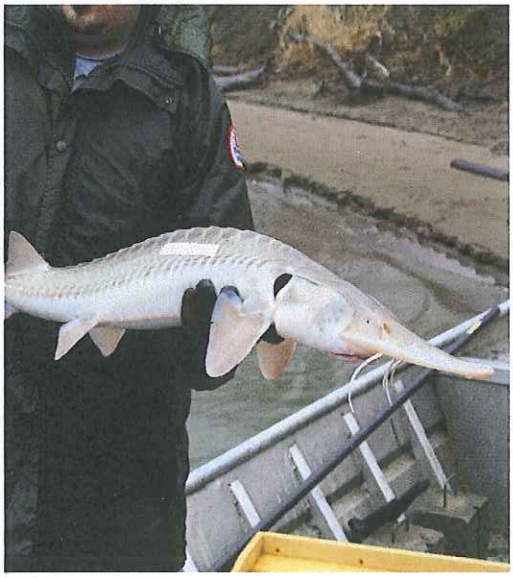
Action Steps

- **Evaluate what is known about groundwater quantity and quality in glacial, alluvial and bedrock aquifers in the Missouri Region**
  - Any and all available information about groundwater quality and quality will be collected and compiled.
  - Digital database from the collected historical and online existing data would be constructed.
  - Digital maps of updated bedrock surface topography, saturated aquifer thickness, pre-glacial drainage ways, water use, and groundwater quality from digital databases would be prepared
  - An assessment report would be prepared that includes:
    - A determination of groundwater in storage and groundwater quality conditions in the glacial, alluvial and bedrock aquifers in the area.
    - A determination of the greatest needs for collection of additional data.
    - Recommendations on the need for, and number and location of wells to allow for well level and quality monitoring on a continuing basis.
  - This phase would be conducted by the KGS for at a cost of $50,000. The work would take 12 months, beginning August 2016.
- **Collection of additional data and re-evaluation of groundwater information**
  - Based on needs as determined in the evaluation phase, obtain a scope of work on collection of additional data that would improve the characterization of the glacial, alluvial and bedrock aquifers. Main expected field activities would include: drilling, hydraulic testing, and groundwater sampling and analysis.
  - Enter new data into databases developed in the evaluation phase.

- Re-evaluate groundwater recharge estimates at a more detailed scale than the currently available potential annual recharge estimates based on soils.
- Combine existing and new data to establish safe groundwater yields and a groundwater quality baseline.
- On the basis of future climate and water usage conditions, establish a plan to periodically update safe yield estimates of groundwater resources.
- This phase would be a minimum of 18 months, as determined in the evaluation phase. Cost would be determined in Phase 1.

- **Maintain and Improve groundwater quality conditions**
  - Evaluate groundwater quality protection practices based on needs as determined in the assessment.
  - Within 3 years after the baseline is established, a plan to implement best management practices will be developed to maintain and improve existing conditions.
- **Ongoing monitoring and evaluation**
  - Expand groundwater level monitoring wells as determined during Assessment phase.
  - Monitoring and reevaluation of groundwater quality conditions should continue at 5 year intervals.





MISSOURI RIVER
RECOVERY PROGRAM

DRAFT
Missouri River Recovery Management Plan and Environmental Impact Statement

VOLUME 1

December 2016

MISSOURI RIVER RECOVERY MANAGEMENT PLAN AND ENVIRONMENTAL IMPACT STATEMENT

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Abstract

On January 18, 2013, the United States Army Corps of Engineers (USACE) issued a Notice of Intent to prepare an environmental impact statement for the Missouri River Recovery Management Plan (MRRMP-EIS). The MRRMP-EIS is a joint effort between the Omaha and Kansas City Districts of the USACE, in cooperation with the United States Fish and Wildlife Service. The purpose of the MRRMP-EIS is to develop a suite of actions that meets Endangered Species Act (ESA) responsibilities for the piping plover, the interior least tern, and the pallid sturgeon. Authorities used to meet this purpose may include existing USACE authorities related to Missouri River System operations for listed species and acquisition and development of land needed for creation of habitat for listed species provided by Section 601(a) of the Water Resources Development Act (WRDA) 1986, as modified by Section 334(a) of WRDA 1999, and further modified by Section 3176 of WRDA 2007, although alternatives formulation was not limited to these authorities.

The document is divided into six chapters. "Chapter 1.0: Purpose, Need and Problem Definition" describes why USACE is taking action at this time and what USACE intends to achieve. "Chapter 2.0: Alternatives" presents the approach to developing and screening alternatives and six alternatives examined in-detail—five action alternatives and the no-action alternative. The alternatives evaluated provide different approaches to addressing the need for the EIS and meeting species objectives. "Chapter 3.0: Affected Environment and Environmental Consequences" describes the existing conditions of 22 resource topics including physical, natural, and human consideration resources and the projected impacts to those resources from the six alternatives evaluated. "Chapter 4.0: Implementation of Preferred Alternatives under Adaptive Management" describes how adaptive management would be used to adjust the initial suite of actions over time based on new understanding of biological responses. The accompanying Draft Science and Adaptive Management Plan details the full adaptive management plan for the MRRP. "Chapter 5.0: Tribal, Agency, and Public Involvement" describes the public involvement process and the Tribal and state consultation processes that contributed to the development of the Draft MRRMP-EIS. Finally, "Chapter 6.0: Compliance with Other Environmental Laws" describes how the USACE has complied with or will comply with other laws prior to implementing any decision.

The six alternatives considered in this Draft MRRMP-EIS include the following: Alternative 1—no action alternative, as required by the National Environmental Policy Act and based on the current system operation and current implementation of the Missouri River Recovery Program; Alternative 2—USFWS 2003 BiOp Projected Actions; Alternative 3—Mechanical Construction Only; Alternative 4—Spring Emergent Sandbar Habitat (ESH) Creating Release; Alternative 5—Fall ESH Habitat Creating Release; and Alternative 6—Pallid Sturgeon Spawning Cue.

The Draft MRRMP-EIS evaluates the direct, indirect, and cumulative impacts of the six alternatives. Based on these projected impacts, the ability to meet the plan's purpose, need, and species objectives, and other decision criteria, USACE has identified Alternative 3—Mechanical Construction Only as its preferred alternative. Importantly, Alternative 3 would be implemented under the science and adaptive management framework summarized in Chapter 4.0 of the Draft MRRMP-EIS and detailed within the Draft Science and Adaptive Management Plan.

Missouri River Recovery Management Plan and Environmental Impact Statement

Volume 1

EXECUTIVE SUMMARY

Introduction

The Kansas City and Omaha Districts of the U.S. Army Corps of Engineers (USACE), in cooperation with the U.S. Fish and Wildlife Service (USFWS), have developed the Missouri River Recovery Management Plan and Environmental Impact Statement (MRRMP-EIS or Management Plan). This document is a programmatic assessment of

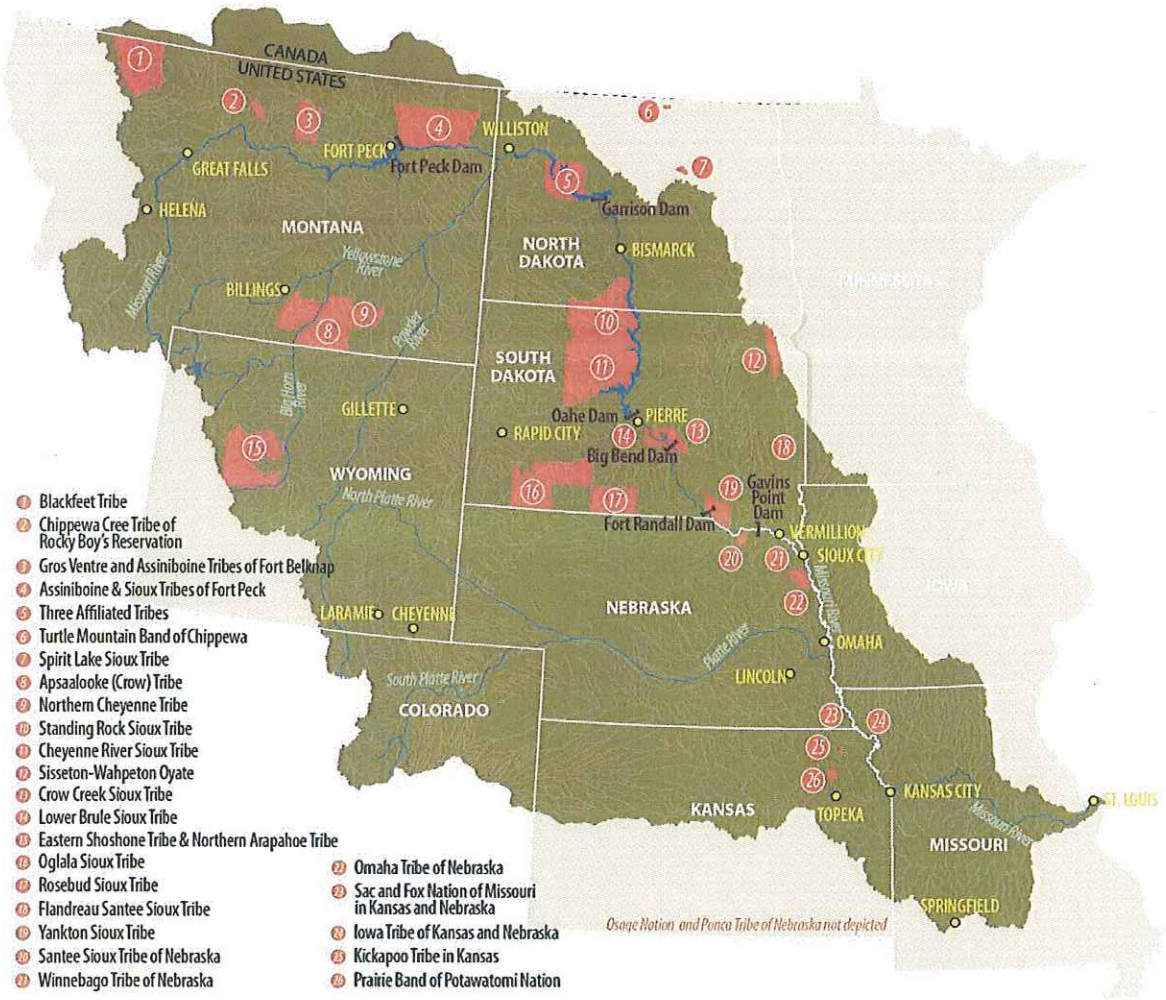
1. major federal actions necessary to avoid a finding of jeopardy to the pallid sturgeon (*Scaphirhynchus albus*), interior least tern (*Sterna antillarum athalassos*), and the Northern Great Plains piping plover (*Charadrius melodus*) caused by operation of the Missouri River Mainstem and Kansas River Reservoir System and operation and maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP) in accordance with the Endangered Species Act (ESA) of 1973, as amended; and
2. the Missouri River BSNP fish and wildlife mitigation plan described in the 2003 Record of Decision (ROD) and authorized by the Water Resources Development Act (WRDA) of 1986, 1999, and 2007.

Background

The Missouri River flows for 2,341 miles from Three Forks, Montana at the confluence of the Gallatin, Madison, and Jefferson Rivers in the Rocky Mountains through the states of Montana, North Dakota, South Dakota, Nebraska, Iowa, Kansas, and Missouri. It is the longest river in the United States. USACE operates six dams and reservoirs with a capacity to store 72.4 million acre-feet (MAF) of water, the largest reservoir system in North America. USACE operates the System to serve eight congressionally authorized project purposes of flood control, navigation, irrigation, hydropower, water supply, water quality, recreation, and fish and wildlife. Runoff from the upper Missouri River Basin is stored in reservoirs behind the mainstem dams: Fort Peck, Garrison, Oahe, Big Bend, Fort Randall, and Gavins Point. Released water from the lowest dam in the System, Gavins Point Dam, flows down the Lower River from Sioux City, Iowa to St. Louis, Missouri (shown in the figure below). USACE operates the System in accordance with the policies and procedures prescribed in the *Missouri River Mainstem Reservoir System Master Water Control Manual* (Master Manual).

USACE also constructed and maintains the Missouri River Bank Stabilization and Navigation Project (BSNP). The BSNP consists mainly of rock structures and revetments along the outsides of bends and dikes along the insides of bends to force the river into a channel alignment that is self-maintaining.

In order to maintain System benefits, the construction, operation, and maintenance of the System and the BSNP have resulted in hydrologic alterations to the Missouri River ecosystem including changes to the natural seasonal pattern of river flow and sediment transport. Alteration and loss of aquatic and terrestrial habitat have also occurred.



Missouri River Mainstem Reservoir System

The pallid sturgeon, interior least tern, and Northern Great Plains piping plover occupy the Missouri River. The pallid sturgeon is a large, long-lived benthic (i.e., bottom-dwelling) fish that inhabits the turbid, fast-flowing rivers of the Missouri and Mississippi River basins. The interior least tern and piping plover are migratory birds that occur on the Missouri River during the breeding season and nest on emergent sandbar habitat. Declines in the populations of these species led to the USFWS listing of the interior least tern as endangered in 1985, the Northern Great Plains piping plover as threatened in 1985, and the pallid sturgeon as endangered in 1990 under the ESA.

***Jeopardy**: Occurs when an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.*

***Recovery**: An improvement in the status of listed species to the point at which listing is no longer appropriate under the ESA.*

USACE has a responsibility under the ESA to take actions to ensure that the operation of the Missouri River is not likely to jeopardize the continued existence of threatened and endangered

species or adversely modify critical habitat. Beginning in 1989, in compliance with Section 7 of the ESA, USFWS and USACE conducted informal and formal consultations on management actions that were being proposed as part of the Master Manual update. In the 2000 BiOp, USFWS concluded that operating the System, operating and maintaining the BSNP, and operating the Kansas River Reservoir System, as proposed, would jeopardize the continued existence of the federally listed pallid sturgeon, interior least tern, and piping plover. The BiOp, which applies to the portion of the Missouri River from Fort Peck, Montana, to St. Louis, Missouri, identified a Reasonable and Prudent Alternative (RPA) to avoid a finding of jeopardy consisting of several actions to be taken by USACE. In 2003, USACE reinitiated formal consultation with USFWS and provided a Biological Assessment with new proposed actions in November 2003. The 2003 Biological Assessment was provided because of new information concerning the effects of USACE actions that had previously not been considered and because USACE believed certain components of the RPA did not comport with the regulatory criteria for an RPA (USACE 2003a). Additionally, critical habitat had been designated for the piping plover, new information on the mortality of interior least terns and piping plovers was available, and an updated hydrology and hydraulics analysis indicated that some flow modifications could erode more emergent sandbar habitat than they would create. In 2003, USFWS provided a determination that the new USACE proposed action would avoid jeopardizing the continued existence of the two listed bird species, but continued to appreciably reduce the likelihood of both survival and recovery of the pallid sturgeon, thus jeopardizing its continued existence in the wild (USFWS 2003). USFWS then amended the 2000 BiOp to remove the flow modifications previously provided in the RPA, and concluded that mechanical and artificial creation for replacement of emergent sandbar habitat were acceptable means to avoid a finding of jeopardy to the interior least tern and piping plover. The 2003 Amended BiOp retained the majority of RPA actions described in the 2000 BiOp; however, it added new RPA elements to the flow enhancement action. Fifteen new RPMs were provided in the 2003 amended BiOp replacing the RPMs in the 2000 BiOp to minimize take of interior least terns and piping plovers.

Missouri River Recovery Program and the Missouri River Recovery Implementation Committee

The Missouri River Recovery Program (MRRP) was established by USACE in 2005. It is the umbrella program that coordinates the USACE efforts in the following:

- Compliance with the USFWS 2003 Amended BiOp on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the BSNP, and Operation of the Kansas River Reservoir System;
- Acquiring and developing lands to mitigate for lost habitats as authorized in Section 601(a) of WRDA 1986 and modified by Section 334(a) of WRDA 1999 (collectively known as the BSNP Fish and Wildlife Mitigation Project); and
- Implementation of WRDA 2007 including the Missouri River Recovery Implementation Committee (MRRIC) and Section 3176, which allowed USACE to use recovery and mitigation funds in the upper basin states of Montana, Nebraska, North Dakota, and South Dakota.

The MRRIC makes recommendations and provides guidance to federal agencies on the existing MRRP. The MRRIC is composed of over 70 members representing various interests, Tribes, states, and agencies from within the Missouri River basin.

In 2011, the MRRIC and USACE established the Independent Science Advisory Panel (ISAP). This panel is charged with independent science support and technical oversight by providing advice on specific topics. The first topic charged to ISAP was Missouri River spring pulse management. The Final ISAP report, published in November 2011, found the spring pulse management action as implemented was not effective at achieving pallid sturgeon objectives and called for a more formal adaptive management plan. It also called for an analysis of the effects of USACE management

actions on pallid sturgeon including further examination of various flow management actions and their relationship to habitat creation. Based on this report, the MRRIC recommended seven actions to USACE and USFWS in August 2012:

1. An effects analysis should be developed that incorporates new knowledge accrued since the 2003 Amended BiOp. As part of this analysis:
   - The effects of the Missouri and Kansas River operations on the listed species should be reviewed and analyzed in the context of other stressors on the listed species;
   - The quantitative effects of potential management actions on the listed species should be documented to the extent possible; and
   - These potential management actions should be incorporated into the conceptual ecological models (CEMs).
2. CEMs should be developed for each of the three listed species and these models should articulate the effects of stressors and mitigative actions (including, but not limited to, flow management, habitat restoration actions, and artificial propagation) on species performance.
3. Other managed flow programs and adaptive management plans should be evaluated as guidance in development of the CEMs and adaptive management strategy.
4. An overarching adaptive management strategy should be developed that anticipates implementation of combined flow management actions and mechanical habitat construction. This strategy should be used to guide future management actions, monitoring, research, and assessment activities within the context of regulatory and legal constraints.
5. Monitoring programs along the Missouri River should be reviewed to determine whether hypothesized outcomes are occurring and the extent to which the outcomes are attributable to specific management actions.
6. The agencies should identify decision criteria (trigger points) that will lead to continuing a management action or selecting a different management action. A formal process should be designed and implemented to regularly compare incoming monitoring results with the decision criteria.
7. Aspects of how the entire hydrograph influences the three listed species should be evaluated when assessing the range of potential management actions.

Effects Analysis

USACE initiated an effects analysis subsequent to receiving the MRRIC recommended actions. The concept of an effects analysis is rooted in the requirement within the ESA to evaluate the effects of actions proposed by federal agencies on listed species or designated critical habitat, using the best available science. Completion of an effects analysis is preceded by problem formulation, which includes defining the proposed action, identifying the area affected, and developing conceptual models with written descriptions and visual representations of the physical and biological relationships between actions and species responses (Murphy and Weiland 2011). The effects analysis results and products informed the development of the MRRMP-EIS alternatives and the comprehensive adaptive management approach recommended by the ISAP.

Need for the Plan

"Need" includes the identification and description of the conditions that require action. A description of the need for an action also serves to provide evidence that action is warranted. Alteration of the ecosystem and loss of aquatic and terrestrial habitats due to USACE operation of the System and BSNP have contributed to the ESA-listing of the pallid sturgeon, piping plover, and interior least tern, species that inhabit the Missouri River. A substantial amount of new knowledge about the species, their habitats, and management opportunities has been developed since the 2003 Amended BiOp for the three listed species was published. As discussed previously, in 2011 the ISAP recommended developing a new adaptive management plan that would anticipate implementation of combined flow management actions and mechanical habitat construction. Under the ISAP recommendations, this new plan would be used to guide future management actions, monitoring, research, and assessment. The ISAP also recommended basing the AM plan on an effects analysis, which would precede the development of the plan and incorporate new knowledge about the species accrued since the 2003 Amended BiOp (Doyle et al. 2011). Since the 2011 ISAP recommendation, effects analyses have been conducted for pallid sturgeon (Jacobson et al. 2016) interior least tern and piping plover (Buenau et al., in prep.), and associated habitat analyses (Fischenich et al., in prep.). The effects analysis synthesized and assessed new scientific information since the 2003 Amended BiOp. The emergence of this new information created a need for its evaluation and integration into USACE management actions on the Missouri River for the listed species and the associated adaptive management plan.

The following sections describe the need for the proposed action relative to each listed species.

- **Pallid Sturgeon**: There is a demonstrated need to develop a management plan comprised of actions informed by best available science, as presented in the effects analysis that provides an adaptive framework to address the uncertainty associated with potential pallid sturgeon limiting factors. Development of a management plan which balances the substantial uncertainty regarding the beneficial effect of actions with the need to implement actions for a meaningful biological response is difficult and requires development of a robust adaptive management plan.
- **Interior Least Tern and Piping Plover**: As with the pallid sturgeon, there is a demonstrated need to develop a management plan comprised of actions informed by best available science, as presented in the effects analysis that provides an adaptive framework to address the uncertainty associated with piping plover and interior least tern management.

Purpose of the Plan

The purpose of this MRRMP-EIS is to develop a suite of actions that meets ESA responsibilities for the piping plover, the interior least tern, and the pallid sturgeon. Authorities used to meet this purpose may include existing USACE authorities related to Missouri River System operations for listed species and acquisition and development of land needed for creation of habitat for listed species provided by Section 601(a) of WRDA 1986, as modified by Section 334(a) of WRDA 1999, and further modified by Section 3176 of WRDA 2007 although alternatives formulation was not limited to these authorities.

Plan Objectives

USFWS provided fundamental objectives, sub-objectives, targets, and metrics for each of the three listed species pursuant to their responsibilities for administering the ESA, and special expertise as a cooperating agency on this MRRMP-EIS. These objectives were informed by the effects analysis products. Achieving these objectives would meet the purpose and fulfill the need of the plan.

Pallid Sturgeon Fundamental Objective: Avoid jeopardizing the continued existence of the pallid sturgeon from the USACE actions on the Missouri River.

The following sub-objectives must be attained to ultimately achieve the stated "fundamental objective." The intent of the sub-objectives is to provide direction in the short term, provide objectives meaningful for adaptive management, and focus efforts on the desired short-term outcomes while working toward the fundamental objective.

Pallid Sub-Objective 1: Increase pallid sturgeon recruitment to age 1.

Pallid Sub-Objective 2: Maintain or increase numbers of pallid sturgeon of age 2 and older until sufficient and sustained natural recruitment occurs.

Piping Plover Fundamental Objective: Avoid jeopardizing the continued existence of the piping plover due to USACE actions on the Missouri River.

Piping Plover Sub-Objective 1 (Distribution): Maintain a geographic distribution of plovers in the river and reservoirs in which they currently occur in both the Northern and Southern River Regions.

Piping Plover Sub-Objective 2 (Population): Maintain a population of Missouri River piping plovers with a modeled 95% probability that at least 50 individuals will persist for at least 50 years in both the Northern and Southern Regions.

Piping Plover Sub-Objective 3 (Population Dynamics): Maintain a stable or increasing long-term trend in population size in both regions.

Piping Plover Sub-Objective 4 (Reproduction): Maintain fledgling production by breeding pairs sufficient to meet the population growth rate objectives within both the Northern and Southern Regions on the Missouri River.

Interior Least Tern Fundamental Objective: Avoid jeopardizing the continued existence of the endangered interior least tern due to USACE actions on the Missouri River.

For purposes of this MRRMP-EIS, it is assumed that achieving the stated objectives for the piping plover would also achieve the fundamental objective for the interior least tern.

Scope of the Plan and Environmental Impact Statement

This EIS assesses the programmatic effects of alternatives for implementing the MRRP which include actions necessary to avoid a finding of jeopardy to the federally listed species and associated actions which comply with the BSNP mitigation plan during the implementation timeframe for this EIS.

This EIS provides the necessary information for the decision maker to fully evaluate a range of alternatives to best meet the purpose and need of the MRRMP. It fully addresses the potential impacts of alternatives as required under the NEPA of 1969, as amended (42 U.S. Code (USC) 4321 et seq.); the President's Council on Environmental Quality (CEQ) Regulations (40 CFR 1500 – 1508); and USACE ER 200-2-2 (33 CFR 230). This plan will be reviewed on a regular basis to ensure compliance with applicable laws and regulations, and that circumstances have not changed that would impact the analysis and conclusions reached in the document.

Geographic, Temporal, and Substantive Scope

To facilitate plan development, an implementation timeframe of 15 years was chosen for this planning process and EIS. This is a reasonable timeframe for identification of actions which, based on the current state of the science, may provide meaningful biological responses while recognizing the potential, based on adaptive management, that substantive changes to the suite of actions identified in this MRRMP-EIS may be necessary in 15 years. However, effects to resources were based on an 82-year hydrologic period of record (POR) in order to provide an indication of the potential range of effects under the variable hydrologic conditions occurring in the Missouri River basin. The geographic scope of the federal action includes the Missouri River within its meander belt from Fort Peck Dam in Montana to its confluence with the Mississippi River near St. Louis, Missouri, and the Yellowstone River from Intake Dam at Intake, Montana to the confluence with the Missouri River.

Alternatives

NEPA requires federal agencies to evaluate and consider a range of reasonable alternatives that address the purpose of and need for action. Alternatives under consideration must include a "No Action" alternative in accordance with CEQ regulations (40 CFR 1502.14). As described in CEQ *Forty Most Asked Questions Concerning CEQ's NEPA Regulations* (Question 3), "No Action" is best defined as "no change" from current management direction or level of management intensity in situations that involve updating management plans or ongoing programs. For this plan, the No Action alternative does not mean taking no action at all, it is a continuation of the actions currently being used to comply with the 2003 Amended BiOp (USFWS 2003).Differences between alternatives are shown by comparing the impacts of the No Action alternative and the action alternatives.

An interdisciplinary planning team made up of experts from multiple federal agencies in collaboration with basin stakeholders and Tribes participated in alternatives development. Alternatives were developed in accordance with the CEQ's NEPA implementing regulations (40 CFR 1500-1508). The goal was to formulate a set of reasonable alternatives to meet the species objectives and clearly articulate the effects of those alternatives to provide necessary information to decision makers, stakeholders, Tribes and the public. The team used an iterative development process to identify and screen management actions.

Plan Alternatives Carried Forward for Detailed Evaluation

Six plan alternatives (the No Action alternative and five action alternatives) were carried forward for detailed evaluation. The names of each alternative correspond to the concept or feature that distinguishes them from all other alternatives. Some of the alternatives share management actions.

Actions Common to All Plan Alternatives

The following management actions would be implemented as part of all plan alternatives carried forward for detailed evaluation in this draft MRRMP-EIS including the No Action alternative.

- **Mechanical Emergent Sandbar Habitat (ESH) Construction for Piping Plovers and Least Terns**: All alternatives include mechanical ESH construction as a management action; however, the amounts of ESH that would be constructed mechanically vary by alternative and those differences are described in the respective section for each alternative. Mechanical construction amounts vary because this management action would be used to construct enough ESH to meet bird habitat targets after accounting for the amount of ESH created by a flow release in several alternatives. Therefore, because the amount of ESH

created by a flow release varies by alternative, so does the amount of mechanical ESH construction needed to achieve targets.

- **Vegetation Management, Predator Management, and Human Restriction Measures to benefit Piping Plovers and Least Terns**: The primary and preferred method of vegetation control and removal is application of pre- and/or post emergent herbicides to selected sandbars. Additional vegetation control and removal methods include cutting, mulching, disking, mowing, raking, and removing vegetation from sandbars. Post-treatment removal using these additional methods may be necessary depending on the height and density of the vegetation on the selected sandbar. Vegetation that is woody with large stems may need post treatment breakdown and removal.

  Predator management actions include the lethal or non-lethal removal of predators. Targeted species such as raccoons, coyotes, mink, and great horned owls are either lethally or non-lethally removed depending on the species and situation. Typically state and federal wildlife control specialists are responsible for the non-lethal and lethal removal activities of targeted species. Indirect management actions may include caging, fencing, or hazing which dissuades predators from breeding sites and are deployed when predation activities are present but not severe. Nests at risk of predation are primarily protected by placing exclosure cages around them. Exclosure cages can only be used to protect plover nests; terns frequently fly to and from their nests and are less likely to walk through the enclosure.

  Human restriction measures taken to reduce disturbance to the birds include posting signs and placing barricades to restrict access to breeding areas and outreach efforts.

- **Flow Management to Reduce Take of Piping Plovers and Least Terns**: This action involves the adjustment of reservoir releases during the nesting season to reduce take of nests, eggs, and/or chicks by rising water levels. It is referred to as Steady Release-Flow to Target and is a current management practice that would continue under each of the alternatives.

- **Piping Plover and Least Tern Monitoring and Research**: USACE conducts annual productivity monitoring of least tern and piping plover populations on the reservoir and river reaches of the Missouri River mainstem. The monitoring focuses on an adult census, measurement of fledge ratios, and documentation of incidental take. USACE also performs habitat monitoring. Monitoring results are used to determine the effectiveness of management actions for terns and plovers. In addition, USACE funds focused research projects on various aspects of least tern and piping plover demographics and habitat use.

- **Pallid Sturgeon Propagation and Augmentation**: The authority and responsibility for hatchery management lie with the USFWS for those facilities operated by the USFWS; states are responsible for the operation of their hatcheries. USACE support of pallid sturgeon propagation and augmentation efforts would continue at current levels under all plan alternatives.

- **Pallid Sturgeon Population Assessment Project (PSPAP)**: The Pallid Sturgeon Population Assessment Project (PSPAP) has been the primary fish monitoring element for the BiOp and the MRRP and would continue in some form under all plan alternatives. Data collected through the PSPAP are used to provide long-term assessment of fish metrics.

- **Monitoring and Evaluation of Pallid Sturgeon Recruitment**: Under all plan alternatives, USACE would conduct the monitoring and assessment complimentary of that for which the Bureau of Reclamation has responsibility to determine if modifications for fish passage at Intake Diversion Dam are meeting pallid sturgeon objectives. The Bureau of Reclamation is responsible for monitoring the success of fish passage at Intake following implementation of fish passage measures. USACE would be responsible for ensuring that MRRP monitoring

and assessment can determine if successful fish passage at Intake is contributing to the upper river pallid sturgeon population.

- **Lower River Pallid Sturgeon Early Life Stage Habitat Construction**: All plan alternatives include channel reconfiguration for the creation of early life stage pallid sturgeon habitat; however, the amounts and types of habitat that would be created vary by alternative and those differences are described in the respective section for each alternative. This action includes the physical manipulation of the river bed or bank to create or improve areas for provision of specific pallid sturgeon habitats thought to be limiting. Examples include adjustments to navigation training or bank stabilization structures, channel widening (i.e., top-width widening), floodplain modifications or other adjustments to channel geometry, placement of structures to encourage development of needed habitat or habitat complexity, chute development, or adjustments to existing chutes.
- **Habitat Development and Land Management on MRRP Lands**: All plan alternatives include habitat development and land management on MRRP lands; however, the amount of land acquisition varies by alternative as would the magnitude of this action. The land requirements for implementation of habitat creation can occur (1) on existing public lands if the state or federal agency owning the property is willing to cooperate with USACE on the project; or (2) on land acquired in fee title from willing sellers.

Alternative 1 – No Action (Current System Operation and Current MRRP Implementation)

Under the No Action alternative, the MRRP would continue to be implemented as it is currently. In addition to the description of actions common to all plan alternatives the USACE would implement the following under Alternative 1:

- **Mechanical ESH Construction**: USACE would mechanically construct ESH annually at an average rate of 107 acres per year across the Garrison and Gavins Point reaches.
- **Early Life Stage Habitat Construction for Pallid Sturgeon**: Under the No Action alternative, construction of habitat to support early life stage requirements of pallid sturgeon would occur as part of the shallow water habitat (SWH) program. The SWH restoration goal as outlined in the 2003 Amended BiOp (USFWS 2003) is to achieve an average of 20–30 acres of SWH per river mile. Under the No Action alternative, the USACE would achieve the low end of this acreage target (i.e., 20 acres per river mile between Ponca, Nebraska, and the mouth).
- **Spawning Cue Release for Pallid Sturgeon**: For purposes of modeling the No Action alternative, USACE assumed implementation of the plenary spring pulse as described in the Master Manual (USACE 2006) would occur. This action would include a March and May Spring Pulse from Gavins Point Dam.
- **Monitoring, Research and Adaptive Management**: In addition to the PSPAP described under actions common to all plan alternatives it was also assumed the other current USACE monitoring and research programs for pallid sturgeon would continue including the Habitat Assessment and Monitoring Program (HAMP) and focused pallid sturgeon research. USACE would also continue to implement the adaptive management approach that has been in place since 2009. It consists of two primary components: the Adaptive Management Plan for ESH (USACE 2011) and the adaptive management strategy developed for SWH creation (USACE 2012c).

Alternative 2 – U.S. Fish and Wildlife Service 2003 Biological Opinion Projected Actions

Alternative 2 represents the USFWS interpretation of the management actions that would be implemented as part of the 2003 Amended BiOp RPA (USFWS 2003). Whereas the No Action

alternative only includes the continuation of management actions the USACE has implemented to date for BiOp compliance, Alternative 2 includes additional iterative actions and expected actions that USFWS anticipates would ultimately be implemented through adaptive management and as impediments to implementation were removed. In addition to the description of actions common to all plan alternatives the USACE would implement the following under Alternative 2:

- **Mechanical ESH Construction**: USACE would mechanically construct an average of 3,546 acres of ESH annually across the Garrison, Fort Randall, Gavins Point, and Lewis and Clark Lake reaches.
- **Spring Habitat-Forming Flow Release**: A spring reservoir release for the purposes of ESH is not included in Alternative 2; however the timing and magnitude of the pallid spring flow release would provide ESH creating benefits which were accounted for in the habitat modeling.
- **Lowered Nesting Season Flows**: The low summer flow described for pallid sturgeon would also serve as a lowered nesting season flow for the benefit of least terns and piping plovers under Alternative 2.
- **Early Life Stage Habitat Construction for Pallid Sturgeon**: Under Alternative 2, the USACE would achieve the high end of the 2003 Amended BiOp acreage target (i.e., 30 acres per river mile between Ponca, Nebraska, and the mouth).
- **Spring Pallid Sturgeon Flow Release**: USFWS determined in the 2003 Amended BiOp that restoration of a normalized river hydrograph below Gavins Point Dam was necessary to avoid jeopardizing the continued existence of the pallid sturgeon. Several biologically relevant features were identified for a flow action below Gavins Point Dam including (1) flows to cue spawning that are sufficiently high for an adequate duration; and (2) flows that provide for connection of low-lying lands adjacent to the channel. The spring pallid sturgeon flow release from Gavins Point Dam would be bimodal (i.e., consisting of two separate flow pulses) and would be implemented in every year if conditions are met.
- **Low Summer Flow**: The USFWS 2003 Amended BiOp also called for modification of System operations to allow for flows that are sufficiently low to provide for SWH as rearing, refugia, and foraging areas for larval, juvenile, and adult pallid sturgeon. Alternative 2 includes a low summer flow that would be implemented to meet those purposes.
- **Floodplain Connectivity**: The USACE coordinated with the USFWS during alternatives development to identify criteria for clarification of the floodplain connectivity management action stated in the USFWS 2003 Amended BiOp. The criteria submitted to the USACE from the USFWS for Alternative 2 stated that this management action should maximize floodplain habitat by ensuring that 77,410 acres of connected floodplain are inundated at a 20 percent annual chance exceedance.
- **Monitoring, Research and Adaptive Management**: Monitoring and research efforts under Alternative 2 would be the same as described for Alternative 1. The adaptive management approach for Alternative 2 was assumed to be similar to the adaptive management approach that USACE has been implementing since 2009 and described for Alternative 1. The adaptive management approach for Alternative 2 would be the same as for Alternative 1 but would be modified to address specific alterations in proposed management actions as described by the USFWS in a November 5, 2015, Planning Aid Letter to the USACE.

Alternative 3 – Mechanical Construction Only

Under Alternative 3, current System operations as described in the Master Manual would continue except the spring plenary pulse and reservoir unbalancing would not be implemented. In addition to

the description of actions common to all plan alternatives the USACE would implement the following under Alternative 3:

- **Adaptive Management**: Under Alternative 3, the USACE would follow the Science and Adaptive Management Plan (AM Plan) that was developed based on the results of the effects analysis. The AM Plan is a companion document to the MRRMP-EIS. The AM Plan identifies the process and criteria to implement the initial management actions, assess hypotheses, and introduce new management actions should they become necessary.
- **Level 1 and 2 Studies**: As part of the AM Plan, USACE would implement Level 1 and 2 studies for better understanding of limiting factors associated with pallid sturgeon. Level 1 studies are research focused and do not change river conditions (laboratory studies or field studies under ambient conditions). Level 2 studies would focus on in-river testing of actions at a level sufficient to expect a measurable biological, behavioral, or physiological response in pallid sturgeon, surrogate species, or related habitat response. The one-time spawning cue test (Level 2) release that may be implemented under Alternatives 3, 4, and 5 was not included in the hydrologic modeling for these alternatives because of the uncertainty of the hydrologic conditions that would be present if implemented. Hydrologic modeling for Alternative 6 simulates reoccurring implementation (Level 3) of this spawning cue over the wide range of hydrologic conditions in the POR. Therefore, the impacts from the potential implementation of a one-time spawning cue test release would be bound by the range of impacts described for individual releases under Alternative 6.
- **Spawning Habitat Construction**: Under Alternative 3, USACE would construct up to three spawning habitat sites and monitor the effectiveness of this action in terms of the relative use of these sites compared to other control areas, and the relative spawning success, as determined by hatch rate, catch per unit effort of free embryos, and other indicators.
- **Mechanical ESH Construction**: Under Alternative 3, the USACE would only create ESH habitat through mechanical means at an average rate of 391 acres per year, in years where construction is needed, across the Garrison, Fort Randall, and Gavins Point reaches. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH.
- **Early Life Stage Habitat Construction**: Under Alternative 3, construction of habitat to support early life stage requirements of pallid sturgeon would occur following the IRC (interception and rearing complex) concept. During the first 6–7 years of implementation, 12 site pairs (experimental IRC site and control site) would be implemented in an experimental design to evaluate whether young fish are intercepted and retained. In addition to the IRC experiment, existing SWH sites would be evaluated to determine if they are presently functioning as IRC habitat. Those that can be most efficiently modified to provide IRC habitat would be refurbished.

Alternative 4 – Spring ESH Creating Release

Alternative 4 includes those actions identified as common to all alternatives and also includes the adaptive management approach described for Alternative 3, Level 1 and 2 studies, spawning habitat construction, and early life stage pallid sturgeon habitat as specified under Alternative 3. The spring ESH-creating flow release is the management action unique to Alternative 4.

- **Spring ESH Creating Release**: Alternative 4 would include a high spring release designed to create ESH for piping plovers and least terns. In any year, the implementation of this release would occur if System storage is at 42 MAF or greater on April 1, natural flows creating 250 acres of ESH have not occurred in the previous 4 years, and downstream flow limits are not exceeded.

- **Mechanical ESH Construction**: The average amount of ESH that would need to be constructed under Alternative 4 is less than Alternative 3 because of ESH created by the spring release. Alternative 4 would include the construction of an average of 240 acres annually across the Garrison, Fort Randall, and Gavins Point reaches in years where construction is needed.

Alternative 5 – Fall ESH Creating Release

Alternative 5 includes those actions identified as common to all alternatives and also includes the adaptive management approach described for Alternative 3, Level 1 and 2 studies, spawning habitat construction, and early life stage pallid sturgeon habitat as specified under Alternative 3. The fall ESH-creating flow release is the management action unique to Alternative 5.

- **Fall ESH Creating Release**: Alternative 5 would include a high fall release designed to create ESH for piping plovers and least terns. In any year, the implementation of this release would occur on October 17 if System storage is at 54.5 MAF or greater, natural flows creating 250 acres of ESH have not occurred in the previous 4 years, and downstream flow limits are not exceeded.
- **Mechanical ESH Construction**: The average amount of ESH that would need to be constructed under Alternative 5 is less than Alternative 3 because of ESH created by the fall release. Alternative 5 would include the construction of an average of 309 acres per year in across the Garrison, Fort Randall, and Gavins Point reaches in years where construction is needed.

Alternative 6 – Pallid Sturgeon Spawning Cue

Alternative 6 includes those actions identified as common to all alternatives and also includes the adaptive management approach described for Alternative 3, Level 1 and 2 studies (except one-time spawning cue test release), spawning habitat construction, and early life stage pallid sturgeon habitat as specified under Alternative 3. The spring pallid sturgeon spawning cue flow release is the management action unique to Alternative 6.

- **Spring Pallid Sturgeon Spawning Cue Flow Release**: Alternative 6 would attempt a spawning cue release every 3 years consisting of a bimodal pulse in March and May. These spawning cue releases would not be started or would be terminated whenever downstream flow limits are reached.
- **Mechanical ESH Construction**: The average amount of ESH that would need to be constructed under Alternative 6 is less than Alternative 3 because of incidental ESH created by the spring spawning cue release. Alternative 6 would include the construction of an average of 304 acres per year across the Garrison, Fort Randall, and Gavins Point reaches in years where construction is needed.

Summary of Key Uses / Resources and Impacts Assessment Methods

The management actions in this MRRMP-EIS that could potentially affect resources are generally construction-type activities or changes in reservoir system releases. In addition to understanding the temporary or short-term impacts that could result from these actions, it is prudent to consider long-term impacts that could occur in conjunction with the substantial hydrologic variability that exists in the Missouri River basin. Therefore, the discussion of potential impacts for many resources includes an analysis based on the results of modeling the alternatives over an 82-year (1931–2012) hydrologic POR for the Missouri River basin.

The USACE HEC River Analysis System (HEC-RAS) model uses the outputs of the Reservoir System Simulation (ResSim) model to calculate river flow and water surface elevations of the

Missouri River that were routed down the Missouri River mainstem, through thousands of river cross sections and hundreds of miles to the mouth at St. Louis. These cross sections were based on 2012 channel geometry and revised to reflect extent of early life stage pallid habitat for each alternative. It was assumed this revised geometry was in place every year of the POR. The geometry does not include any forecast of the extent of channel aggradation or degradation that might occur in the future. It is important to compare the effects of the alternatives based on conditions that are relevant to the near-term (15-year) implementation timeframe of this planning process. Therefore, speculation on the exact extent of long-term channel aggradation or degradation that might occur and which is not associated with the management actions included in the alternatives was not attempted.

One might expect the modeling output for the No Action alternative (which reflects existing operation of the system and current implementation of MRRP actions) from either ResSim or HEC-RAS to match actual observed conditions. However, this is not the case. The following is a description of the primary reasons why the modeled outputs for the No Action alternative do not match what actually occurred in the past.

- **Operational Differences**: The No Action alternative is a simulation of how the system is currently operated, including current MRRP actions, but does not and cannot take into account the numerous minor adjustments to basic rules that the USACE actually makes to reasonably address critical short-term situations (e.g., increase releases for water supply, reducing releases for ice jams, etc.) In addition to the short-term changes, the basic operational rules have changed throughout the POR. For example, drought conservation criteria have been changed as recently as 2004 and were included in simulating operation for the entire POR.
- **River Geometry Changes**: The bed profile of the Missouri River is constantly changing: eroding ("degrading") in some places and accumulating ("aggrading") in others. Long-term stage trends not associated with the management actions included in the alternatives are known to be occurring in many locations under existing operation. For the purposes of comparing the effects of the alternatives, the models were developed with the best available survey data and calibrated to the 2012 condition. This geometry was assumed for each year of the POR.
- **Depletions**: All historic POR runoff levels were adjusted for consumptive water use to the current level of depletions. Depletions consist of water use by irrigation, municipal, evaporation, etc. This assumes the current 2012 level of water use projected from 1931 including evaporation from the mainstem reservoirs.

Therefore, modeling results of the No Action alternative do not reflect actual past or future conditions but serve as a reasonable basis or "baseline" for comparing the impacts of the action alternatives on resources.

The POR is characterized by substantial variability in hydrologic conditions, which includes periods of drought (e.g., 1930s) and high runoff (e.g., 1997, 2011). This hydrologic variability results in substantial changes to resources and uses over the POR with all the alternatives, including the No Action alternative. These changes are not associated with the species management actions included in the alternatives, and therefore the following impact analyses are focused on comparing the difference the action alternatives have on resources compared to the No Action alternative. The "rules" governing system operation during periods of drought and high runoff for the action alternatives are generally the same as current system operation under the No Action alternative. Therefore, the effects of the action alternatives on reservoir elevations and releases are relatively small compared to the variation caused by the extreme hydrologic events in the POR.

Relative differences among the alternatives are important to understand. The MRRMP-EIS environmental consequences chapter presents the relative impacts of each alternative on each specific resource in order to focus on this perspective. Summary descriptions of each resource topic

are presented below followed by a summary table of the environmental consequences of the different alternatives.

River Infrastructure and Hydrologic Processes

The flow of the mainstem Missouri River is influenced by precipitation and seasonal snowmelt that occurs throughout the basin, as well as flow regulation from mainstem dams. Total annual runoff from the Missouri River varies considerably from year to year because of large variations in precipitation. The magnitude, frequency, timing, duration, and rates of change of river flows affect the geomorphology, chemistry, and biological processes in the Missouri River and groundwater elevation is a key factor in the composition and spatial distribution of vegetation communities and their associated fauna across the floodplain. The operation of the System is guided by the Master Manual (USACE 2006a). This Master Manual records the basic water control plan and objectives for the integrated operation of the mainstem reservoirs. The reservoir stage and flow releases vary throughout the year as a result of reservoir operations that follow the Master Manual.

The analysis of impacts of the alternatives to river infrastructure and hydrologic processes focuses on the impacts to hydrology, geomorphology, and infrastructure in the river, as well as groundwater along the river. Primary geomorphological processes that are relevant for the proposed management actions consist of degradation and bank erosion, reservoir sediment deposition and aggradation, reservoir shoreline erosion, and ice dynamics.

Pallid Sturgeon

The pallid sturgeon was listed as endangered under the ESA on September 6, 1990 (55 FR 36641–36647). A recent revision of the species recovery plan notes that the species status has improved and is currently stable as a result of artificial propagation and stocking efforts (USFWS 2014). If stocking were to cease, pallid sturgeon would face local extirpation in several reaches of the Missouri River (USFWS 2014). USFWS (2014) states that pallid sturgeon will be considered for reclassification from endangered to threatened when the listing/recovery factor criteria are sufficiently addressed such that a self-sustaining, genetically diverse population of 5,000 adult pallid sturgeon is realized and maintained within each management unit for two generations (20–30 years). The potential impacts of each alternative on the Missouri River pallid sturgeon population were assessed with special emphasis on the potential to increase survival of age-0 pallid sturgeon and increase recruitment.

Piping Plover and Interior Least Tern

The Northern Great Plains piping plover was listed as threatened on January 10, 1986, under provisions of the ESA (USFWS 1985). The breeding population of the piping plover extends from Nebraska north along the Missouri River through South Dakota, North Dakota, and eastern Montana, and on alkaline lakes along the Missouri River Coteau in North Dakota, Montana, and extending into Canada. Interior least terns were listed as endangered under the ESA in 1985 (USFWS 2013). The breeding population of least terns extends across the interior of the United States along the Mississippi, Missouri, and Rio Grande Rivers and their tributaries. Nesting habitat for both species includes sparsely vegetated river sandbars, sandpits, and reservoir beaches. The USFWS provided objectives, metrics, and targets for the Northern Great Plains piping plover under the MRRMP-EIS with the assumption that managing for sufficient nesting habitat to sustain a Northern Great Plains piping plover population in the Missouri River will also provide sufficient nesting habitat for the interior least tern in the Missouri River (USFWS Planning Aid Letter 2015).

A habitat/population model was used to evaluate the effectiveness of the proposed management actions and alternatives at meeting the objectives for the piping plover and least tern. ESH was calculated for each alternative along with the following metrics:

- Number of adults

- Number of fledglings
- Fledge rate
- Population growth rate
- Extinction probability (throughout the geographic scope, north region, and south region)

Fish and Wildlife Habitat

The Missouri River and its floodplain have historically consisted of a multitude of aquatic and terrestrial habitat types that sustained rich assemblages of fish and wildlife species. These assemblages include species that live year-round within the river and its floodplain as well as migratory species for which the ecosystem provides vital seasonal habitat (e.g., wintering and breeding), movement corridors, and stopover habitats. Aquatic habitats generally include open water habitats of varying depths (i.e., main channel, secondary channels and chutes, backwaters, floodplain lakes/oxbows). Terrestrial habitats include emergent wetlands, forests, woodlands, grasslands, and shrublands.

The environmental analysis for fish and wildlife focused on changes in terrestrial and aquatic habitat and considered the actions included under each alternative and their impacts to fish and wildlife habitats. Fish and wildlife habitat metrics were modeled within eight study reaches within two larger geographic regions, upstream of Gavins Point Dam to Fort Peck Dam, and downstream from Gavins Point Dam to the confluence with the Mississippi River. The eight smaller study reaches are based on logical divisions within the existing Missouri River (e.g., inter-reservoir reaches) or broad ecological similarities. For the purposes of the model, habitats were broadly categorized into six types (open water, emergent wetland, scrub shrub wetland, riparian woodland/forested wetland, forest, and upland grasslands). The results of the modeling effort only reflect the modeled flow actions, simulated conditions on the river, and associated constraints as defined under the alternatives.

Other Special-Status Species

The MRRMP-EIS assesses the potential impacts to special status species that could occur in the Missouri River and its floodplain in several ways. The EIS provides a general analysis of these species and the potential impacts that could occur from the alternatives being considered, but provides a more specific analysis of five species that were identified based on the potential for impacts that could occur to individuals, populations, or their habitat in areas where management could occur. These species include: the whooping crane, bald eagle, northern long-eared bat, Indiana bat, and western prairie fringed orchid. These species were identified because of their association with habitats in the Missouri River and its floodplain.

Impacts were analyzed based on changes to the habitat associated with the species. The associated habitat was based on the fish and wildlife habitat classes modeled in all study reaches for the POR. Thus, habitat impacts were used as a proxy for impacts to other special-status species.

Water Quality

Water quality and sources of pollution can vary greatly along the length of Missouri River. Humans have modified the Missouri River ecosystem and the resulting changes in land uses, landscape cover types, and their associated nutrient and pollutant sources within the basin influence water quality. The primary sources of pollution, both point and nonpoint sources, along the Missouri River are from urban, agricultural, and industrial land uses. The construction of the dams and impoundments trap suspended sediment and particulates, modify the flow regime of the river, and influence water quality within the reservoirs and the downstream free-flowing reaches. Additionally, the natural river flows, stages, and channel geometry can influence water quality within the river. The

physicochemical water quality parameters identified for assessment include: water temperature, dissolved oxygen, nutrients (nitrogen and phosphorus), sediment and turbidity, and other pollutants including metals/metalloids. These parameters are common water quality assessment metrics and are important for the health of ecological communities and the human uses of the river.

Air Quality

The main causes of air pollution include mobile sources such as automobile emissions along major highways as well as stationary sources such as coal-fired power plants. Other sources include diesel-powered watercraft and various industrial emissions in heavy urbanized areas such as Kansas City, Omaha, and Sioux City (USEPA 2015a). Six designated non-attainment and partial non-attainment areas exist within the lower portion of the river in Pottawattamie County, Iowa and in Missouri in Franklin County, St. Charles County, Jackson County, St. Louis County, and St. Louis City.). Greenhouse gasses are also produced from mobile sources in the project area. These sources include motor vehicles such as trucks and boats utilized for transportation of goods and materials along the Missouri River. Emissions from these vehicles impact regional air quality incrementally through contributions to levels of criteria air pollutants such as carbon monoxide, nitrogen oxide, and volatile organic compounds.

The analysis of impacts to air quality considers the potential for actions to adversely affect air quality through emissions from mobile sources of criteria air pollutants and the contribution to greenhouse gas emissions associated with habitat construction. The impacts from management actions on air quality are common to all alternatives and are not assessed individually for each alternative.

Cultural Resources

The USACE Planning Guidance Notebook (ER 1105-2-100) defines cultural resources in terms of "historic properties" as follows:

> An historic property is any prehistoric or historic district, site, building, structure or object included in or eligible for inclusion on the National Register of Historic Places (National Register). Such properties may be significant for their historic, architectural, engineering, archeological, scientific, or other cultural values, and may be of national, regional, state, or local significance. The term includes artifacts, records, and other material remains related to such a property or resource. It may also include sites, locations, or areas valued by Native Americans, Native Hawaiians, and Alaska Natives because of their association with traditional religious or ceremonial beliefs or activities.

USACE has a federal compliance and stewardship responsibility to ensure the preservation and protection of cultural resource sites located on federal lands and for historic properties that may be affected by USACE undertakings, as outlined in the National Historic Preservation Act of 1966 (NHPA) and other pertinent laws, regulations, and policies, as described in Chapter 6 of this EIS. Numerous cultural resource sites have been identified within the Missouri River Basin. Most of these cultural resource sites included represent archaeological sites, historic structures, and/or shipwrecks. Within the upper Missouri River Basin, USACE has inventoried the mainstem reservoir system. State Historic Preservation Offices (SHPOs) within the basin provided inventory data for sites in riverine settings (i.e., downstream of Gavins Point Dam, as well as riverine reaches between the mainstem reservoirs). These inventories of cultural resource sites in riverine settings (developed largely through an accumulation of site-specific compliance with NHPA) are less thorough than the inventories at the reservoirs. The analysis of effects on cultural resources differentiated two categories of cultural resource sites. "Reservoir sites" were sites located on federal fee-owned lands of the six USACE-managed Missouri River mainstem reservoirs. "Riverine sites" were all sites located within the bluff-to-bluff Missouri River floodplain that were not already included in the inventories of USACE-managed Missouri River mainstem reservoir sites. These riverine sites are

located in the Missouri River floodplain south of Gavins Point Dam and on sections of the river between the mainstem reservoirs. Impacts were primarily assessed in relation to modifications of flow and changes in reservoir pool elevations that could change the frequency of risk of erosion and/or vandalism and looting.

Land Use and Ownership

Land ownership within the Missouri River floodplain includes federal, state, and local government lands, Tribal lands, and private lands. Various land uses are present within the Missouri River floodplain, including developed lands, agricultural lands, open water, and other types of use. Developed lands refers to communities, towns, and cities, including commercial, industrial, and residential uses, as well as lands developed to support transportation (highways, roads, bridges, railroads) and other infrastructure. Agriculture is the dominant land use in the floodplain between Gavins Point Dam and the mouth, accounting for between 63 to 72 percent of floodplain land. Federal conservation lands and lands managed for natural habitat and recreation include those administered under the USACE MRRP, U.S. National Park Service lands, and USFWS National Wildlife Refuge lands, among others. There are also state and local government-owned lands, Tribal lands, and private lands managed for conservation and recreation within the floodplain.

The impacts as a result of the federal government acquiring lands from willing sellers to construct pallid sturgeon early life stage habitat are evaluated using two of the four planning accounts: Regional Economic Development (RED) and Other Social Effects (OSE).

Commercial Sand and Gravel Dredging

The volume of commercial sand and gravel dredged on the Missouri River fluctuates annually based on economic conditions (primarily market demand), availability of materials in the river system, and other factors. Approximately 92 percent of commercial sand and gravel from the Missouri River is used by the general public for residential and nonresidential construction (excluding state transportation projects). Commercial sand and gravel production primarily serves 40 counties across the three states of Kansas, Missouri, and Iowa, with a population of nearly 5.1 million.

River flows, the volume of water in the river, and sediment conditions directly affect whether dredges are able to operate and how much sediment is being transported for extraction. Changes in those physical conditions can directly affect access to sand and gravel.

The commercial sand and gravel dredging impacts analysis primarily focuses on determining if changes in river and reservoir conditions could result in an impact to commercial sand and gravel dredging operations. The impacts to commercial sand and gravel dredging are evaluated using the NED, RED, and OSE accounts.

Flood Risk Management and Interior Drainage

A main objective of Mainstem Reservoir System is to regulate the reservoirs to reduce the risk of Missouri River flows from contributing to flood damage in the reaches downstream from dams. Regulation of individual reservoirs is coordinated to reduce flood risk from a particular reservoir. The usual reservoir operation is to store flood inflows, which generally extend from March through July, and to release them during the remainder of the year. Most of these releases are made before December. Winter releases are restricted due to the formation of ice bridges and the associated higher river stages. The objective is to have reservoir levels lowered to the bottom of the annual flood control and multiple use zone by March 1 of each year. Operations during the winter require special consideration because ice bridges restrict channel capacity. Upstream from Gavins Point, releases from Fort Peck, Garrison, Oahe, and Fort Randall Dams are reduced during periods of ice formation until an ice cover is formed, after which releases can be gradually increased. Minimal ice problems exist directly downstream from Big Bend Dam due to its proximity to Lake Francis Case. Operation of the reservoirs for flood risk management must take into account highly variable flows

from numerous tributaries. During any flood season, the existence of upstream tributary storage reduces mainstem flood volumes to some extent. Normally, the natural crest flows on the mainstem reservoirs will also be reduced by the existence of tributary reservoir storage, provided significant runoff contributing to the crest flows originates above the tributary projects.

Levees also play a role in flood risk management along the Missouri River. Federal agricultural levee construction in accordance with the 1941 and 1944 Flood Control Acts began in 1947. Most existing federal levees are in the reach located between Omaha and Kansas City. The levees help to manage flood risk to these localities during the most severe flood events of record. Between Sioux City and the mouth of the Missouri River, local interests have built many miles of levees, consisting of about 500 non-federal levee units through this reach of the river. Most of these levees are inadequate to withstand major floods, but generally protect against floods smaller than a 5 percent annual chance of exceedance event (20-year).

Water surface elevations within the landward side of federal levee areas are affected by the ability to drain interior runoff into the Missouri River. High water can result in poor drainage, higher groundwater, blocked access, and associated damage and inconvenience. Hundreds of individual gravity drainage structures (e.g., culverts with flapgates) and pumping plants exist along levees near the Missouri River. The Kansas City and Omaha USACE districts have survey data on approximately 1,400 individual interior drainage structures across approximately 115 Missouri River levee segments. Most of the interior drainage issues occur along leveed areas below Omaha to the mouth of the Missouri River, with over 70 percent of the flapgates located between Rulo and the mouth of the Missouri River.

Land, property (both urban and rural), infrastructure, and people in the floodplain can be affected by Missouri River flooding. Approximately 167,000 people reside along the Missouri River floodplain with the majority of these populations living in the lower river, including the cities of Omaha, St. Joseph, Kansas City, and St. Louis. There are over 56,300 residential and 11,400 nonresidential structures in the floodplain. The total estimated value of these structures is $23.1 billion. The Missouri River from Rulo to the mouth of the Missouri River was divided into four reaches: Rulo to Platte River (St. Joseph Reach), Platte River to Grand River (Kansas City Reach), Grand River to Osage River (Boonville Reach), and Osage River to the mouth of the Missouri River (Hermann Reach).

The alternatives evaluated include management actions with potential to affect river flows, channel form, and river stage. The flood risk management impacts analysis focuses on determining if changes in river and reservoir conditions associated with each of the alternatives could result in an impact to risk of flooding. The impacts to flood risk management are evaluated using three of the four accounts (NED, RED, and OSE). An interior drainage analysis was conducted on a subset of federal levees to evaluate elevations within the landward side of federal levee areas along the Missouri River.

Hydropower

The Missouri River hydropower system contains six USACE facilities with a combined nameplate capacity of 2,500 megawatts (MW). Mainstem dams hold water in the river reservoir system, passing water through the hydropower plants electricity-generating turbines and creating a source of low cost, renewable energy. Hydropower generation is dependent on three primary features of the Missouri River system: river flows (dam releases), water elevations, and reservoir system storage. Changes in available water, including daily and hourly river flows and system storage to meet other needs, can impact both the magnitude of normal seasonal generating patterns and reduce the flexibility to meet hourly peaking demands. The value associated with hydropower is based on the accrued cost of the most likely energy source that would replace lost hydropower generation. In the Missouri River Basin, peak energy loads (demand) increase in the summer months, when temperatures are highest and farm communities may be pumping water for irrigation or operating

grain-drying machinery. These loads are intended to be met by generating the maximum amount of energy during the month of August.

Hydropower generation on the Missouri River depends primarily on river flows and dam releases, reservoir elevations, and system storage. Changes in available water can impact both the magnitude of normal seasonal generating patterns and reduce the flexibility to meet hourly peaking demands. The analysis used the HEC-ResSim Missouri River model that simulates reservoir operations over an 82-year POR, as well as the Missouri River Hydropower Benefits Calculator model to calculate impacts to generation and capacity for each of the six mainstem dams.

Irrigation

Irrigators in 42 counties in Montana, North Dakota, South Dakota, and Nebraska hold permits to use water from the Missouri River for the purpose of agriculture production. This generally includes the area extending from Fort Peck Reservoir to Rulo, Nebraska. A majority (94 percent) of the 816 irrigation intakes along the reservoir system are located in Montana, North Dakota, and South Dakota, while North Dakota has the greatest number of permitted acres of the four states (89,106 acres in 2015). Of 12.5 million acres of cropland harvested in these 42 counties in 2012, approximately 2,266,000 acres, or 18.1 percent, consisted of irrigated cropland. In the upper reaches of the river, the irrigation season lasts approximately from May through September. In the lower river reaches, in Nebraska, the growing season also begins in May but typically extends through October.

In addition to the above, Tribes irrigate an estimated 350,000 acres of agricultural lands using water from either the Missouri River or mainstem reservoirs. Many of the mechanical intakes used for water extraction by the Tribes are outdated and are prohibitively expensive to repair, and may need to be replaced in order to accommodate changing levels of sediment, high levels of erosion, or reduced access to water.

The environmental consequences analysis for irrigation intakes focuses on changes in river and reservoir conditions associated with each of the alternatives. The environmental consequences to irrigation intakes were evaluated using three of the four accounts (NED, RED, and OSE). As river flows and reservoir elevations fall below minimum operating requirements, intakes become unavailable to provide water to farm operations (including private farms, Tribes, and commercial operations). This, in turn, can result in changes to net farm income.

Navigation

The navigation channel in the mainstem of the Missouri River stretches 735 miles, from Sioux City, Iowa to St. Louis. This stretch of the river includes a navigation channel measuring nine feet deep and 300 feet wide. In 2014, there were about 48 docks and terminals along the lower river. The navigation season is limited to periods of time when the river is ice-free. While the length of the flow supported season varies along the river, a full-length season is considered eight months long. Navigation service on the lower river is provided by a combination of water from major tributaries and the release of water from Gavins Point Dam necessary to maintain 8 to 9 feet of water depth in the navigation channel.

The level of navigation service (full, reduced, or minimum) depends on the level of system releases. These full-service flows generally provide the authorized 9-foot navigation channel, and they allow the capability to load barges to an 8.5-foot draft. The level of navigation service provided is determined according to how much water is available in storage on two constant key dates of each year (March 15 and July 1). On March 15, if total system storage is greater than 54.5 MAF, then full service is provided. If system storage is between 31.0 and 49.0 MAF, then minimum service is provided. If system storage is below 31.0 MAF, no service level is computed and there will be no navigation season. The navigation impacts analysis focuses on determining if changes in river and

reservoir conditions associated could result in an impact to service level and season length. The impacts to navigation are evaluated using three of the four accounts (NED, RED, and OSE).

Recreation

The Missouri River corridor between Fort Peck Lake and St. Louis, Missouri, supports a wide range of water, land, and wildlife-related recreational activities and is a popular destination for outdoor enthusiasts, attracting millions of visitors each year. Recreational opportunities, settings, and access to public facilities vary considerably along the river and can be divided into three main geographic locations: mainstem reservoirs; inter-reservoir river reaches; and the lower river below Gavins Point Dam to the confluence with the Mississippi River. Water-based recreation includes shoreline fishing, boat fishing, power boating, waterskiing, tube towing, jet skiing, tubing, canoeing, kayaking, and swimming. Sport fishing (i.e., fishing for sport or recreation) is a prevalent activity in all locations along the Missouri River and its reservoirs, including cold water and cool water reservoir fishing for salmon and walleye; rainbow trout fishing along the river reaches of Montana; and warm water fishing for bass and catfish. The wetlands and shoreline along the river corridor provide waterfowl habitat that supports waterfowl hunting and bird watching. Camping and picnicking are very popular activities at many of the recreation areas during the warmer months. The natural landscapes and viewscapes of the Missouri River reservoirs and inter-reservoir river reaches also attract a large number of sightseers. Visitation to the reservoirs varies from year to year in response to environmental conditions and water elevations, which can affect fishing opportunities and access to shoreline facilities and boat ramps.

The environmental consequences analysis for recreation focuses on how changes in the prevalence of habitat and river and reservoir conditions could affect visitation, recreational opportunities, and the value of the recreational experiences. Environmental consequences were evaluated using three of the four accounts (NED, RED, and OSE).

Thermal Power

There are 22 thermal power plants (3 nuclear and 19 coal-fired power plants) located along the mainstem of the Missouri River or its reservoirs. One power plant is located on Lake Sakakawea in North Dakota; six are located on the river below Garrison Dam in North Dakota; and the remaining power plants are located on the river downstream of Sioux City, Iowa. Nineteen of the Missouri River power plants are coal-fired plants, while three are nuclear plants. Of the 22 power plants, 9 have units with recirculating cooling systems or cooling ponds, while 13 plants withdraw water from the river for once-through cooling. River flows and associated water surface elevations can affect the amount, timing, frequency, and duration of access to water through the intakes. Low river flows and high river water temperatures can affect plant operational efficiency as well as the ability of the plants to meet their National Pollutant Discharge Elimination System (NPDES) effluent and temperature requirements. The NPDES permit of a thermal power facility includes temperature limits for maximum river water temperature and maximum change in river water temperature within the mixing zone (the volume and flow of the receiving water below the outfall). Critical low flow conditions are used to define mixing zones and the effluent requirements.

The environmental consequences analysis for thermal power plants focuses on changes in river and reservoir conditions associated with each of the alternatives. Environmental consequences were evaluated using three of the four accounts (NED, RED, and OSE). The analysis focuses on the costs (replacement costs of reduced power generation, capital costs for lost capacity, and variable costs) to power plants and utilities to adapt to changing river and reservoir conditions.

Water Supply

Water is withdrawn from the Missouri River and its mainstem lakes for multiple purposes including municipal, industrial, and commercial water supply as well as domestic and public uses. Municipal

water supply includes Tribal and public supply of water to reservations, residents of cities and towns, and customers of rural water districts and associations. Commercial and industrial use includes self-supplied water for commercial, manufacturing, and other processing uses other than thermal power use. There are an estimated 52 municipal intakes and 3 commercial/industrial water supply intakes on the reservoirs and river reaches of the Missouri River mainstem. Water supply for municipal and industrial/commercial uses along the Missouri River can be affected by conditions such as river flows and stages, reservoir water surface elevations, river water chemistry including sediment, and channel locations. Changes to these physical components, in turn, lead to changes in the interrelated water supply conditions of access to water, operation and maintenance, and water treatment requirements.

The water supply impacts analysis focuses on determining if changes in river and reservoir conditions associated with each of the alternatives could result in an impact to water supply intakes. The impacts to water supply are evaluated using three of the four accounts (NED, RED, and OSE). The analysis focuses on the costs to water supply intake operators to adapt to changing river and reservoir conditions.

Wastewater Facilities

Several facilities discharge treated wastewater to the Missouri River and its reservoirs. The facilities include publicly owned treatment works (POTWs) or sewerage facilities and other types of industrial discharges from fertilizer and agricultural chemical companies and meat processing facilities. Several Tribes also discharge treated wastewater into the Missouri River and its tributaries after using wastewater plants or lagoons to treat the water. There are 37 major wastewater facilities discharging to the Missouri River. Most of the discharging facilities are located in the lower river below Gavins Point Dam. These facilities can be affected by river flows, stages, and channel geometry.

Wastewater facilities require a NPDES permit to discharge wastewater, which specifies the effluent requirements for the relevant parameters for the facilities. The parameters typically regulated by water quality-based effluent limits include ammonia, total residual chlorine, whole effluent toxicity tests, and acute toxicity. Wastewater discharge facility operations can be sensitive to changes in river flows. For facilities with water quality-based effluent limits, low river flows can have a direct relationship with the effluent limits and resulting wastewater treatment requirements. A low-flow criteria analysis was conducted on modeled rivers flows under the alternatives for locations close to the wastewater discharge facilities. The scope of analysis included facilities in Iowa, Nebraska, Kansas, and Missouri. Twenty-nine major wastewater facilities that discharge to the Missouri River were identified in these four lower river states. Each of the wastewater facilities discharging to the Missouri River in Iowa, Nebraska, Kansas, and Missouri were evaluated and facilities were removed from further analysis if they met a set of criteria. The result was five facilities (two in Iowa and three in Missouri) that could potentially be affected under the alternatives.

Tribal Resources

The Tribes of the Missouri River basin are diverse in their histories and their perspectives regarding the Missouri River. There are a total of 29 Tribes located within or having expressed significant interest in their historical connection to the Missouri River Basin. These Tribes maintain current and ancestral ties to the Missouri River and possess cultural, economic, and social interests in the river. Federal agencies planning and implementing recovery and mitigation actions on the river have a trust responsibility to work with Tribes on a government-to-government basis in recognition of Tribal sovereignty. Thirteen of the Tribal reservations (as well as a portion of the Ponca trust land) are adjacent to the river and/or partially within the floodplain. Additional Tribes with ancestral ties to the basin are being contacted to determine their consulting interest.

Tribes of the Missouri River Basin have an interest in many of the resources described elsewhere in this document, including agriculture, irrigation, water supply, thermal power, recreation, flood risk management, and fish and wildlife. There are also additional connections to the Missouri River that are unique to Tribal members. Tribal reservations are located in rural areas, where opportunities for fishing, hunting, and trapping can be essential for Tribal members. Through subsistence hunting, fishing, and gathering, some Tribal members use the fish, wildlife, and vegetation of the Missouri River and its floodplain to account for a significant portion of their food supply. Many Tribal members also gather native plants for medicinal and ceremonial uses. The availability of resources that allow for subsistence and/or traditional cultural practices contributes to the cultural identity of many Tribal members.

Many Tribal members use the Missouri River and its floodplain for traditional cultural practices, including traditional Tribal ways of daily life (which may include seeing and interacting with the river throughout the day) and sacred/spiritual values through ceremonies, sundances, vision quests, and sweat lodges. Protection of cultural resources and preservation of cultural practices are paramount for many Tribal members. These values and ways of life are affected by the physical components of the Missouri River and its floodplain, including its effect on physical resources such as plants, berries, trees, and water. Natural aquatic and floodplain habitats resemble the conditions under which traditional cultural practices were developed. Similarly, the educational opportunities are improved by natural aquatic and floodplain habitats on current and historic Tribal land.

Alternatives are evaluated for their effects on subsistence hunting, fishing, and gathering, as well as traditional cultural practices and educational opportunities. Some of these effects are specific to reservations, while some effects occur on other parts of the Missouri River but are relevant to Tribes nonetheless. The impacts to these specific Tribal interests are evaluated using the OSE account.

Human Health and Safety

Mosquitoes are serious nuisance pests that affect the health and well-being of humans, companion animals, livestock, and wildlife with their persistent biting behavior. Accordingly, human health and safety could be affected by the implementation of actions associated with this MRRMP-EIS if they result in changed in the availability of mosquito breeding habitat along the mainstem Missouri River that lead to the potential for increased risk of transmission of disease.

The most common mosquito-transmitted disease within the Missouri River Basin, and in the United States as a whole, is West Nile Virus. Other mosquito-transmitted diseases that are less prevalent but known to occur within the mainstem Missouri River states include St. Louis encephalitis, western equine encephalitis, and LaCrosse encephalitis. The Zika virus, while not yet known to be transmitted within the Missouri River Basin, represents an emerging threat to human health and safety in states along the mainstem Missouri River and throughout the country.

The most common nuisance mosquitoes in all of the mainstem Missouri River states include *Aedes vexans* and several different species within the *Culex* genus. These species use both natural and man-made breeding habitats that include tree holes, standing pools in agricultural fields, roadside ditches, cans, buckets, birdbaths, discarded tires, and clogged gutters. *Aedes vexans* typically lays its eggs on moist soil in vegetated areas just above the waterline in floodplains and pothole depressions. The eggs hatch into larvae when inundated by flooding.

The alternatives analyzed may have the potential to affect the health and safety of residents of communities along the Missouri River. More traditional human health and safety issues associated with the use of construction equipment and other occupational hazards involved in ESH construction and early life stage pallid habitat construction are discussed in previous USACE NEPA documents (USACE 2009 and 2012). The analysis of impacts to human health and safety focuses on the potential for increased risk of mosquito-borne diseases as a consequence of implementing any of the alternatives and considers the potential for actions to affect the availability of mosquito breeding habitat, which could in turn affect the transmission of the mosquito-borne arboviruses.

Environmental Justice

Executive Order 12898, issued in 1994, directs federal agencies to incorporate environmental justice as part of their mission by identifying and addressing the effects of programs, policies, and activities on minority and low-income populations.

The vast majority of environmental justice populations in the project area are located in the states of Nebraska and Missouri, with approximately 150,084 affected residents located in identified environmental justice communities in both states. These populations are largely concentrated within the Omaha-Council Bluffs metropolitan area and the urban areas of Kansas City, St. Louis, St. Joseph, and Jefferson City, Missouri. The environmental justice populations are predominantly located within rural counties on Tribal lands or within larger cities in urbanized areas, having high concentrations of both minority and low-income populations.

The impact analysis for environmental justice focuses on determining if any of the management actions described under the alternatives would have disproportionate impacts on environmental justice populations. The environmental justice assessment evaluated the nature and extent of impacts evaluated under the other resource areas addressed in the EIS (including flood risk management, water supply, thermal power, hydropower, land acquisition, irrigation, recreation, navigation, water quality, and others) and then evaluated whether these impacts would fall disproportionately on potential environmental justice populations that live within the floodplain.

Ecosystem Services

Although modified, the Missouri River ecosystem provides a steady flow of environmental benefits that sustain life and bestow values for humans. These benefits include tangible goods and intangible services that are often referred to as ecosystem services. Ecosystem services provided by the Missouri River support economic activity and contribute to regional quality of life. These environmental goods and services contribute in ways that may or may not be considered in market transactions or economic activity. Some of the notable ecosystem services provided by the Missouri River ecosystem include natural resource goods (food, fiber, fuel, construction materials, etc.), water supply, water quality, waste assimilation and nutrient regulation (recycling of nutrients and removal of pollutants by ecological processes), flood attenuation, recreation, and other cultural services.

Benefits derived from ecosystem services include those from both their direct and indirect uses or through their intrinsic values (not tied to uses). For example, cool-water fisheries along the Missouri River provide direct use benefits to anglers who visit the area, and indirect benefits to people who may enjoy watching fishing programs at home. Non-use values (passive use values), are values that are not associated with actual use, nor are they directly valued in the market. Non-use values stem from a desire to preserve or improve a resource (e.g., restored ecosystem, endangered species) as a public good, for future use, or for enjoyment by future generations. Since impacts to many ecosystem services are discussed in other sections, this analysis of impacts focuses on the effects to climate regulation and carbon sequestration, other cultural services, and non-use values.

Mississippi River Impacts

The middle Mississippi River is the portion of the Mississippi River that lies between the confluence with the Ohio River at Cairo, Illinois and the confluence with the Missouri River at St. Louis. The Missouri River contributes almost 50 percent of the flow of the middle Mississippi River and contributes approximately 75 to 95 percent of the suspended sediment load.

The Mississippi River basin has been shaped over time by a variety of actions, including urbanization, agriculture, levee construction, dam construction, and river training structure placement. Many of the changes in the middle Mississippi River which have led to its current condition are due to improvements made for navigation including river training structure placement and associated sedimentation patterns. These alterations in structure and condition affect the

biological resources in the middle Mississippi River. Similar to the Missouri River, variety of habitat types are found in the middle Mississippi River, which support a large diversity of macroinvertebrate and fish communities. Side channel habitats in particular are known to support a greater abundance of macrohabitat generalists compared to other macrohabitat types, likely due to the shallow, low-velocity habitat they provide at certain river stages. Side channels provide a well-defined gradient between flowing to non-flowing water, depending on their level of connectivity to the main channel. Flowing side channels, those connected to the main channel, generally have a sand and gravel substrate and support large river aquatic species (suckers, minnows, and darters) tolerant of current and/or turbidity. This diversity of habitat provides important feeding, spawning, nursery, and overwintering habitat for fish, and habitat for other environmentally sensitive macroinvertebrates, fish, and wildlife. As such, side channels are important to the health of the river ecosystem as a whole, and are even more important in the middle Mississippi River because of the loss of connectivity between the river and floodplain.

Biological Resources: Impacts to biological resources in the middle Mississippi River were analyzed based on stage and flow simulated for each alternative by modeling the alternative operation over the POR (USACE H&H Tech Report 2016). Side channel habitat has been identified as the most diverse and representative habitat in the middle Mississippi River that supports the highest abundance of aquatic species. Impacts to the three representative side channels were quantitatively analyzed in terms of how changes in stage may potentially alter or impact side channel habitat through altering connectivity with the main channel. It is assumed that changes in stage can alter or impact the condition and accessibility of side channel habitat. It is assumed that the changes in stage modeled under each alternative at the St. Louis gage is representative of the Middle Mississippi River and each of the representative side channels.

Flood Risk Management: Within the Middle Mississippi River floodplain between St. Louis and Thebes, Illinois, a majority of the area is leveed. A total of 13 levee systems comprised of 20 levee districts protect over 310,000 acres of floodplain. Nineteen of these levees were federally constructed. Additional flood risk reduction is realized through flood storage in the many reservoirs in the Missouri, Upper Mississippi, and Kaskaskia River basins. This series of levee systems is very robust. Since they were completed, only four of the federal systems have been overtopped and breached, which occurred during the record-breaking flood of 1993. Analysis of the potential for flood risk management impacts along the middle Mississippi River downstream of St. Louis was conducted through comparison of change in flood flow frequency curves at St. Louis. Data for this analysis were taken from hydraulic modeling conducted as part of this study. Flow frequency curves were calculated with a procedure matching that used in the Upper Mississippi River Flow Frequency Study (USACE 2004).

Given the more-detailed hydrology and hydraulics modeling from the confluence of the Missouri River to St. Louis, the assessment of impacts upstream of St. Louis follows the impacts assessment for the Missouri River more closely than downstream of St. Louis where detailed channel cross-sections were not available. Approximately 17,994 people reside in the middle Mississippi River reach upstream of St. Louis. Residential and nonresidential structures located in areas along the Mississippi River are subject to flood risk. There are 6,501 residential and 686 nonresidential structures identified in the floodplain. Total estimated value of these structures is $2.0 billion.

Navigation: Navigation on the middle Mississippi River includes the transport of commodities using various types of vessels, including towboats and barges. The towboats on the upper Mississippi River are usually 160-foot towboats with 3,000 to 5,000 horsepower. Towboats on the lower Mississippi River can reach 180 feet in length and have an engine with 8,000 to 10,000 horsepower. The barge sizes are fairly typical in comparison to other rivers, measuring 35 feet wide by 195 feet long. Additionally, the average tow configuration on the lower Mississippi River may consist of 30 to 35 barges. The middle Mississippi River can handle these larger arrangements for much of its 195 miles, but typically averages around 25 barges per tow. Commodities transported on the middle Mississippi River include crude petroleum, petroleum produces, grain and grain products, chemicals,

aggregates, non-metallic ores and minerals, iron ore and iron and steel products, and coal. These commodities are shipped or received throughout numerous states that touch the middle Mississippi River. Between 2005 and 2014, the top three receiving states are (1) Louisiana (53.9 million tons), (2) Illinois (15.3 million tons), and (3) Pennsylvania (6.2 million tons) and the top shipping states were (1) Illinois (49.7 million tons), (2) Missouri (20.6 million tons), and (3) Louisiana (15.3 million tons). The navigation impact analysis focuses on determining if changes in river and reservoir conditions associated with each of the alternatives could affect commodities traveling on the middle Mississippi River.

Water Supply and Thermal Power: Water is withdrawn from the Mississippi River for multiple purposes including municipal, industrial, and commercial water supply as well as for cooling purposes for power plants. There are four thermal power plants or generating stations and three permanent/fixed water supply intakes located along middle Mississippi River between St. Louis to Cairo. As river flows or stages fall below minimum operating requirements, water can no longer be accessed through intakes, with adverse impacts to municipalities, commercial operations, and power plants. This in turn can drive changes in costs to operate intakes and replace power, and possibly affect capital costs to address water access issues. In addition, relatively lower river flows in the summer can affect operational efficiencies of power plants that use once through cooling and affect the ability of the plants to meet NPDES requirements. In addition, power plants can also be affected by river temperature with higher temperatures during the peak summer months causing reduced operating efficiencies and difficulties in meeting NPDES permit requirements. As a result, power plants may need to reduce their power generation.

The impact analysis for water intakes used two approaches to describe the potential impacts to water supply facilities and power plants along the middle Mississippi river. To assess the impacts of the facilities or plants when river stages fall below critical operating elevations, river stage thresholds were used from the USACE Master Manual Mississippi River Studies Volume 13 (USACE 1998, Appendix C). The analysis used these critical stages along with the outputs from the HEC-RAS Missouri River models of simulated river flows at the confluence of the Missouri and Mississippi Rivers in St. Louis at river mile 180. The impacts to thermal power facilities on the Mississippi River were also analyzed.

Regional Economic Effect of Program Expenditures

Program expenditures were used to evaluate the regional economic benefits of the MRRMP-EIS alternatives. Many types of actions and activities were included in the list of costs, including habitat construction; program management, integration, and coordination; MRRIC; among many others. Detailed costs categories can be found in Appendix E: Missouri River Recovery Management Plan, EIS Alternatives – Cost Estimates. Program costs were grouped based on the time-period in which they are anticipated to be incurred. Two periods were associated with the timing of the costs: the implementation period (year 0 to year 15) and the operations and maintenance period (year 0 to year 50). The annual costs for each year over 50 years were obtained for each cost category, and annualized using the Fiscal Year 2016 federal interest rate of 3.125 percent and an amortization rate based on the type of cost. USACE staff familiar with implementation of projects under MRRP identified two regions where spending was likely to occur: the upper river, including the states of Montana, North Dakota, and South Dakota; and the lower river, including Iowa, Missouri, Kansas, and Nebraska.

Environmental Consequences of Action Alternatives

The following table provides a summary comparison of the general environmental consequences of each action alternative compared to Alternative 1—the No Action alterative—in terms of being beneficial or adverse. The impacts of the No Action Alternative and the Action Alternatives are provided in-detail under each resource topic in Chapter 3-Affected Environment and Environmental Consequences.

In this table, the "Dir" column clarifies the directionality of the numbers for each performance measure. "H" indicates that the higher the numerical value, the better for that interest; "L" indicates the lower the value, the better. For example, some NED values (hydropower, recreation, irrigation, and navigation) are quantified in terms of benefits that the river provides. In these cases, the higher the number, the better. Other NED values (flood risk management, thermal power, water supply, and program implementation costs) are calculated in terms of costs from a hypothetical condition where no costs are incurred to that resource. For these interests, the lower the number, the better.

Although absolute values provide important context, it is more relevant to decision-makers to consider the estimated differences between each of the action alternatives and Alternative 1. The table shows the differences in the performance of Alternatives 2 to 6 in relation to Alternative 1. To make reading the table easier and to facilitate comprehension of relative beneficial and adverse effects, a color-coding scheme has been introduced.

- Differences that are improvements from Alternative 1 are shaded **green** and indicate a beneficial impact.
- Differences that are adverse impacts relative to Alternative 1 are shaded **red** and indicate an adverse impact.
- No differences are indicated by white cells.

Rows for which a -2, -1, 0, +1, +2 scale is used employ a color scheme as follows: -2=dark red (large adverse impact; -1=light red (small adverse impact); 0=white (no or negligible impact); +1=light green (small beneficial impact); and +2=dark green (large beneficial impact).

In all other cases, for any given row, a cell is dark red if it is associated with the largest adverse impact across the range of alternatives and if a cell is dark green it is associated with the largest beneficial impact across the range of alternatives. The shading of red for other alternatives with adverse impacts is linearly scaled relative to the difference between 0 and the value associated with the darkest shade. The shading of green for other alternatives with beneficial impacts is linearly scaled relative to the difference between 0 and the value associated with the darkest shade of green.

Environmental Consequences of the Actions Alternatives Compared to No Action

					Difference from Alt 1				
			Dir	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
SPECIES OBJECTIVES									
SPP OBJ	Pallid Sturgeon	Addresses Critical EA Pallid Hypotheses		NO	YES	YES	YES	YES	YES
SPP OBJ	Piping Plover and Least Tern	Expected to Meet Revised Bird Targets		NO	EXCEEDS	MEETS	MEETS	MEETS	MEETS
IMPACTS									
EQ	Fish and Wildlife	-2 to +2 rating	H	REF. COND.	+2	+1	+1	+1	+1
EQ	Other Special Status Species	-2 to +2 rating	H	REF. COND.	+2	+1	+1	+1	0
EQ	Water Quality	-2 to +2 rating	H	REF. COND.	-2	0	-1	-1	-1
EQ	Air Quality	-2 to +2 rating	H	REF. COND.	0	0	0	0	0
EQ	Cultural Resources	Site-days at Risk	L	65,464	1,164	-82	1,817	284	1,631
RED	Land Use and Ownership	Regional Employment (At End of Impl'n (15 years))	H	-26	-134	18	18	18	18
RED		Regional Income ($000, At End of Impl'n (15 years))	H	$ -1,153	$ -6,243	$ 852	$ 852	$ 852	$ 852
RED		Tax Revenues ($000, At End of Impl'n (15 years))	H	$ -75	$ -480	$ 65	$ 65	$ 65	$ 65
	Commercial Sand and Gravel Dredging			*See text*					
NED	Flood Risk Management	Ave $ 000 NED / yr	L	$ 60,958	$ -691	$ -483	$ 964	$ -287	$ 505
RED		Regional Employment (Ave)	H	-140	2	1	0	0	0
RED		Ave $ 000 RED / yr Income	H	$ -6,795	$ 64	$ 7	$ -19	$ -27	$ -58
OSE		Population at Risk	L	709	-6	-9	25	-8	0
OSE	(FRM - Channel Exceedances)	Sum of Ft Randall and Garr Exceeds in POR	L	5,402	708	19	605	422	221
NED	Hydropower	Ave $ 000 NED / yr	H	$ 525,707	$ -5,426	$ -256	$ -4,044	$ -1,784	$ -2,092
RED		Benefits to WAPA (Typ gen yr $ 000 / yr)	H	$ 27,832	$ -3,784	$ -691	$ -837	$ -3,354	$ 5,461
OSE		Ave Change in CO2 (kg/yr)	L	REF. COND.	55,292	-3,656	52,186	17,693	20,473
NED	Irrigation	Ave $ 000 NED / yr	H	$ 5,921	$ -136	$ 25	$ -210	$ -4	$ -135
RED		Regional Employment (Ave)	H	343	-1	1	-2	0	-1
RED		Ave $ 000 RED / yr Income	H	$ 10,489	$ -224	$ -150	$ -244	$ -165	$ -224
OSE		-2 to +2 rating	H	REF. COND.	0	0	0	0	0
NED	Navigation	Ave $ 000 NED / yr	H	$ 715	$ -28	$ 3	$ -45	$ -6	$ -41
RED		Regional Employment (Ave)	H	284	-7	1	-4	1	-3
RED		Ave $ 000 RED / yr Income	H	$ 19,254	$ -535	$ 33	$ -326	$ 33	$ -219
OSE		Particulates (1000 g / mile)	L	.5	.5	-.1	.4	-.1	.3
NED	Recreation	Ave $ 000 NED / yr	H	$ 38,271	$ 163	$ 23	$ -407	$ -28	$ -265
RED		Regional Employment (Ave)	H	1,235	-14	1	-21	-3	-15
RED		Ave $ 000 RED / yr Income	H	$ 29,184	$ -334	$ 17	$ -514	$ -68	$ -354
OSE		-2 to +2 rating	H	REF. COND.	-1	0	-1	0	-1
NED	Thermal Power	Ave $ 000 NED / yr	L	$ 52,933	$ 28,163	$ -1,367	$ 422	$ -1,063	$ -1,301
RED		-2 to +2 rating	H	REF. COND.	-2	0	0	0	0
OSE		-2 to +2 rating	H	REF. COND.	-2	0	0	0	0
NED	Water Supply	Ave $ 000 NED / yr	L	$ 376	$ 5	$ -4	$ 13	$ -1	$ 8
OSE		-2 to +2 rating	H	REF. COND.	0	0	0	0	0
NED	Wastewater	-2 to +2 rating	H	REF. COND.	-1	0	0	0	0
OSE	Tribal Interests (Other)	-2 to +2 rating	H	REF. COND.	0	0	0	0	0
OSE	Health & Safety	-2 to +2 rating	H	REF. COND.	0	0	0	0	0
OSE	Environmental Justice	-2 to +2 rating	H	REF. COND.	0	0	0	0	0
EQ	Ecosystem services	-2 to +2 rating	H	REF. COND.	+1	+1	+1	+1	+1
Missipp R	Biological Resources	-2 to +2 rating	H	REF. COND.	0	0	0	0	0
Missipp R	Flood Risk Management	-2 to +2 rating	H	REF. COND.	+1	+1	-1	+1	+1
Missipp R	Navigation	-2 to +2 rating	H	REF. COND.	-1	+1	-1	+1	-1
Missipp R	Water Intakes	-2 to +2 rating	H	REF. COND.	0	+1	-1	+1	-1
NED	Program Expenditures	Ave $ 000 NED / yr	L	$ 73,825	$ 263,700	$ -4,618	$ -13,417	$ -9,565	$ -8,483
RED		Regional Employment Ave	H	1,278	4,029	-129	-255	-200	-184
RED		Ave $ 000 RED / yr Income	H	$ 66,552	$ 197,502	$ -7,287	$ -13,258	$ -10,644	$ -9,910

Note: Commercial sand dredging, wastewater discharges and interior drainage are treated differently for NED/RED. See Chapter 3.

Note: All NED impacts were calculated at FY2016 price levels.

Note: MRRP Expenditures were calculated using a 50-year period of analysis and the FY2016 federal discount rate of 3.125%.

Note: For -2 to +2 scales, relative to No Action (Alt 1): -2 = "Large adverse change", -1 = "Small adverse change"

0 = "No or negligible change", +1 = "Small beneficial change", +2 = "Large beneficial change")

Dir = Numerical direction of preferred difference: H = Higher is Better, L = Lower is Better

Tribal Interests are addressed within multiple resource areas; 'Tribal Interests (Other)' reflects additional connections to the Missouri River that are unique to Tribal members.

Plan Selection – Preferred Alternative

Alternative 3 has been identified as the **preferred alternative** in this MRRMP-EIS.

In addition to the actions common to Alternatives 3–6 described above (including active adaptive management; vegetation management, predator management, and human restriction measures on ESH; Level 1 and 2 studies; propagation and augmentation; spawning habitat and channel reconfiguration for IRCs), under Alternative 3, USACE would create ESH through mechanical means at an average rate of 391 acres per year in the Garrison, Fort Randall, and Gavins Point river reaches in years where construction is needed. This amount represents the acreage necessary to meet the bird habitat targets after accounting for available ESH resulting from System operations. Alternative 3 would also include the provision for a one-time spawning cue test release from Gavins Point Dam if the results of Level 1 studies during the first 9-10 years do not provide a clear answer on whether a spawning cue is important.

Alternative 3 has a wide range of benefits relative to Alternative 1, including certain benefits to endangered species, reduced program expenditures, and increased performance for most HCs. Hydrologically, the effects of Alternative 3 would be very close to those for Alternative 1 but without the specification for spawning cue releases in March and May. Hydrological differences would be reduced flows relative to Alternative 1 in approximately 30 to 50 percent of years in late March and late April/early May, and corresponding increased flows relative to Alternative 1 during one or two weeks in October or November. The differences in magnitude of these flows would be small compared to those associated with the other alternatives. Alternative 3 would have less channel reconfiguration for pallid sturgeon early life stage habitat relative to Alternative 1, and this would have implications on flow routing and assumed stage-discharge relationships at certain locations.

Although Alternative 3 would not be the most efficient alternative from an overall National Economic Development (NED) standpoint, its lack of adverse NED impacts compared to Alternative 1 is a good balance between overall efficiency and impacts to specific NED resources. Although there are uncertainties associated with its effectiveness in meeting the species objectives (in common with all alternatives), Alternative 3 clearly demonstrates it would be the least impactive means of meeting species objectives across the full range of interests. A further description of the rationale for identifying Alternative 3 as the preferred alternative is provided in the MRRMP-EIS, Section 2.9 of Chapter 2.

Implementation of Preferred Alternative under Adaptive Management

USACE would implement the preferred alternative under the AM Plan recognizing the remaining uncertainty associated with many of the proposed management actions and with the ecology of the listed species (particularly for the pallid sturgeon). The AM Plan is a companion document to the MRRMP-EIS and includes the process and criteria to implement the initial set of actions included in the preferred alternative. NEPA and adaptive management are complementary processes as both emphasize collaboration and working with stakeholders. Adaptive management is consistent with NEPA's goal of informed decision-making and takes the NEPA process further in addressing uncertainties and data gaps that may be revealed during implementation of the preferred alternative.

The preferred alternative represents the initial set of actions the agencies believe will accomplish the objectives (avoid a finding of jeopardy to the listed species) and will allow USACE to fulfill its other statutory requirements. The AM Plan is designed to guide the implementation process and help meet Endangered Species Act (ESA) requirements while minimizing impacts on human considerations (HC), which includes the authorized purposes of the Missouri River as well as the many other services afforded by the river system.

The AM Plan provides detailed information on the strategy for addressing uncertainties for each species, provides a governance structure for the program, defines the roles and responsibilities of

the participants, and describes both how data are managed and how program actions and results will be communicated and reported.

Primary components of the AM Plan include the following:

- Monitoring program associated with the management actions and broader river system;
- Research and study activities including those to address hypotheses for which specific management actions have not yet been identified;
- Assessment methods and processes to evaluate the effectiveness of actions implemented under the preferred alternative;
- Decision criteria used to determine if changes to the preferred alternative are necessary; and
- Governance approach to be used in collaboration with stakeholders, states, and Tribes to make decisions.

The preferred alternative includes the initial suite of management actions, research, and monitoring USACE would implement over the 15 years post approval of the Record of Decision (ROD) aimed at achieving objectives for the pallid sturgeon, piping plover, and interior least tern. The initial set of actions were chosen after careful consideration of species needs, remaining critical management uncertainties, anticipated impacts to authorized purposes and other socioeconomic impacts, and existing impediments to implementation of management actions contained within the other alternatives. The AM Plan serves as the repository of knowledge related to management hypotheses, associated management actions, and remaining uncertainties and impediments. It is possible that in the future, the adaptive management process will conclude that actions which were not part of the preferred alternative may be warranted and feasible.

The ability to incorporate and adjust to new information is a central concept for successful adaptive management; therefore, if these activities lead to an adjustment in the implementation strategy laid out in the preferred alternative, a supplemental NEPA process may be necessary prior to the end of the 15-year period.