

Appendix E

Report Synopsis Following Planning Charrette

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2012

MISSOURI RIVER BED DEGRADATION
FEASIBILITY STUDY—REPORT SYNOPSIS



KANSAS CITY DISTRICT

PLANNING CHARETTE NOVEMBER 5-9 2012

12/17/2012

Missouri River Bed Degradation Feasibility Study

Report Synopsis

December 17, 2012

The Report Synopsis has been prepared by the Project Delivery Team (PDT). The Report Synopsis is one of the SMART planning tools and is designed to help the PDT focus on the foundations of the study through the development of specific documents. This synopsis provides key information to the vertical team as a result of the re-scoping charrette that was held November 5 to November 9 2012, in Lenexa, Kansas. Documents included in this synopsis are as listed below:

Study Background

Map of Study Area

Six-Step Planning Process

Problems and Opportunities

Objectives and Constraints

Evaluation Criteria

Key Uncertainties

Without-Project Condition

Measures Screened

Formulated Plans Under Consideration

Study Background

STATUS: The study has completed Planning Step 1, Identify Problems and Opportunities/Objectives and Constraints and is now working on Planning Step 2, Inventory and Forecast Conditions (Existing and Future without Project).

AUTHORITY: The study is authorized by Section 216 of Public Law 91-611, Flood Control Act of 1970, which reads:

The Secretary of the Army, acting through the Chief of Engineers, is authorized to review the operation of projects the construction of which has been completed and which were constructed by the Corps of Engineers in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significant changed physical or economic conditions, and to report thereon to Congress with recommendations on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest.

STUDY DESCRIPTION: The study area is located on the lower Missouri River, from River Mile (RM) 498 at Rulo, Nebraska, to the mouth, located north of St. Louis, Missouri. The Missouri River bisects a two-state area. Major cities affected in Missouri are St. Joseph, Kansas City, and Jefferson City. In Kansas, Kansas City and smaller communities adjacent to the Missouri River are affected. The study area also includes tributary rivers and streams where direct influence or effects between the tributary and the Missouri River are evident. Federal projects within the study area include the Missouri River Bank Stabilization and Navigation Project (BSNP) and the associated BSNP Fish and Wildlife Mitigation Project. In addition, there are significant federal Flood Risk Management Infrastructure (Levees and Floodwalls) located throughout the study area.

STUDY HISTORY:

- Reconnaissance Study - 905 (b) Analysis: Completed August, 2009
- Feasibility Cost Share Agreement (FCSA): Signed November, 2010
- Project Management Plan: September, 2011
- Decision Management Plan Concerning a Viable Array (DMP-1), December 2012
- Risk Register for DMP-1, December 2012

STUDY COST: Per the FCSA, the original estimated Total Project Cost was \$6.8M. Through the planning charrette held in November of 2012 the project cost estimate has been revised. The revised estimated Total Project Cost is \$4.9M. Using rounded numbers, this includes estimated legacy costs \$1.9 M and an estimated cost to complete of \$2.9M. It is noted that the estimated legacy costs include an estimate of work completed through November 2012. Some effort completed but remaining unbilled for obligations such as contracted work and work-in-kind was estimated and included in the legacy cost estimate. A revised estimate of the sponsor's project coordination team costs and other sponsor contributions such as communications efforts for public involvement is still being worked.

SPONSOR: Mid-America Regional Council (MARC) - A regional planning agency that facilitates engagement and funding by a stakeholder group comprised of 17 entities representing a wide range of interests; including water supply, transportation (rail and highway), levee districts, commercial dredging, city, county, and state governments.

SCHEDULED MILESTONES: The milestone chart below shows the originally planned milestone schedule and the current milestone schedule for the project.

Legacy Milestone Schedule		Current Milestone Schedule	
Date	Milestone	Date	Milestone
Nov-13	Feasibility Scoping Meeting	15-Aug-13	Alternatives Milestone and IPR (CW261)
Dec-15	Alternative Formulation Briefing	06-Jun-14	Detailed Screening and IPR (XX999)
Jan-17	Civil Works Review Board	27-May-15	Tentatively Selected Plan - IPR Draft Report (CW262)
		09-Jul-15	Agency Decision (CW263)
		02-Dec-15	Submit Final Report (CW160)
		08-Feb-16	Submit Chief's Report (CW270)

DECISION MANAGEMENT PLAN: Scoping decisions made with the vertical team at the November 2012 re-scoping charrete are recorded in the Decision Management Plan Concerning the Viable Array of Alternatives (DMP), December 2012. A number of assumptions were made. Risks associated with the decisions and assumptions are recorded in the Risk Register for DMP, December 2012. The DMP lays out the foundation for managing the project through the next decision point and beyond. The Risk Register identifies the major risks associated with the decisions and is the management tool by which risk is acknowledged and how risk is to be managed. The Report Synopsis has been updated as part of the re-scoping process. Key project information as it is being developed will be added to the Report Synopsis and will eventually serving as the foundation for the draft Feasibility Report.

MISSOURI RIVER AUTHORITIES, OPERATIONS, MANDATES, AND REGULATORY DECISIONS: There are a number of authorities and operational constraints that drive planning decisions for the Missouri River. The authorities will affect the study in various aspects of the study process. Below is a listing and general description of the key management authorities, operations, mandates and regulatory decisions that may have an impact on the study. Some of these may affect plan formulation options while information gained from some of the work being conducted under different study authorities may provide the feasibility study with useful planning level information.

STUDY AUTHORITIES:

1) Missouri River Ecosystem Restoration Study (MRERP).

Water Resources Development Act of 2007 (WRDA 2007) H.R. 1495, Section 5018:

The Secretary, in consultation with the Missouri River Recovery Implementation Committee to be established under subsection (b)(1), shall conduct a study of the Missouri River and its tributaries to determine actions required—

- (A) to mitigate losses of aquatic and terrestrial habitat;
- (B) to recover federally listed species under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.); and
- (C) to restore the ecosystem to prevent further declines among other native species.

Note: Currently authorized, but appropriation prohibited in FY 12 appropriation bill.

2) Missouri River Authorized Purposes Study (MRAPS).

In the FY 2009 Omnibus Appropriations Act, in particular, Section 108, Division C, Congress authorized and provided first year funding for a study of the Missouri River Projects in the Missouri River Basin to review the original project purposes based on the Flood Control Act of 1944, as amended, and other subsequent relevant legislation and judicial rulings to determine if changes to the authorized project purposes and existing Federal water resources infrastructure may be warranted:

Areas/issues to be addressed by the study include:

- Flood Risk Prevention
- Water Supply
- Navigation
- Recreation
- Fish and Wildlife
- Hydropower
- Power Plants and Cooling Water
- Irrigation
- Cultural Resources
- Social, economic and other impacts from construction of the main stem reservoir system
- Ecosystem Restoration
- Sedimentation
- Future Development
- Tribal Water Rights
- Impact of climate change on the basins water supply
- Economic and other costs and benefits

Note: Not appropriated in FY 12.

- 3) **Kansas City Levees Phase II Feasibility.** This study is authorized by Section 216 of the Flood Control Act of 1970, which provides general authority to review completed projects. The purpose of the original project was to provide flood risk management to Kansas Citys, MO and KS, and North Kansas City, MO. The project was originally authorized in 1936, modified in 1944, 1954, and 1962. Study is in the process of determining if Kansas River units require raises. These recommendations will be published in the Final (Phase 2) Report.
- 4) **Missouri River Levee System (MRLS) R471 – 460 & L-455.** Purpose of the original project is to provide flood risk management to City of St. Joseph, MO, Cities of Elwood and Wathena, KS, and surrounding agricultural areas. Purpose of the study was to determine if the system was still providing the intended/authorized level of protection following the overtop/breach failure in 1993. The study found that the existing two unit system as originally designed and constructed did not provide the authorized protection even when originally built. The recommendations of the Feasibility Report were approved as corrections of Design Deficiencies under the existing original authority from 1944. **NOTE: The recommended plan will not fully restore the original authorized level of protection. The recommended plan is the economically justified NED plan that improves the existing protection,**

avoids induced damages to other existing project, and will allow for FEMA recertification of the right bank unit.

CONSTRUCTION AUTHORITIES:

- 1) **Flood Control Act of 1944 (historic).** Following a major Missouri River flood in 1943, the USACE prepared a report to Congress proposing five major dams on the mainstem Missouri River, two on the Yellowstone River, and five on the Republican River. These flood damage reduction works would be supplemented by levees on the banks of the Missouri River from Sioux City, Iowa, to St. Louis, Missouri, and would complement another ten dams already authorized for construction on Missouri River tributaries (Ferrell 1993, as cited in NRC 2002). The authorization of the Pick Sloan Missouri Basin Program gave the USACE the responsibility for navigation and flood control on the mainstem river, resulting in the construction of five mainstem dams between 1946 and 1963. These include Garrison Dam, Oahe Dam, Big Bend Dam, Fort Randall Dam, and Gavins Point Dam.
- 2) **Missouri River Bank Stabilization and Navigation Project.** Authorized by the River and Harbor Act of 1945. This authorization provides for a continuous 9-foot navigation channel, 300-foot wide from Sioux City, IA to the mouth. The Act extended the navigation limits and modified earlier congressional authorizations in 1912 and 1927 that had provided for a 6-foot deep, 200-foot wide navigation channel.
- 3) **Missouri River Fish and Wildlife Mitigation Project (Mitigation Project).** The Kansas City and Omaha Districts of the USACE undertook the Mitigation Project as a result of two Congressional authorizations, WRDA 1986, and WRDA 1999. The original Mitigation Project, authorized by WRDA 1986, included the development of 48,100 acres of fish and wildlife habitat along the Lower Missouri River. The final environmental impact statement (FEIS) and Record of Decision on the original Mitigation Project were completed in 1987. The original Mitigation Project was substantially modified by Congressional authorization in WRDA 1999 and required the completion of a supplemental environmental impact statement (SEIS) in 2003.
- 4) **Kansas City Levees Phase I.** The Recommended Plan presented in the Interim (Phase 1) Feasibility Report was authorized by WRDA 2007. Study determined that geotechnical and structural reliability modifications were required on the Missouri River units to maintain authorized level. This study seeks to reduce flood damages and reduce the flood risks for four of the seven levee units within the existing Kansas Cities levee system. These include the Argentine Levee Unit, the North Kansas City Levee Unit, the East Bottoms Levee Unit, and the Fairfax-Jersey Creek Levee Unit. A fifth levee unit, the Birmingham Levee Unit, does not need improvements. The pending final feasibility report will address the two remaining levee units at Armourdale and the Central Industrial District.
- 5) **PL 84-99.** USACE also has authority under PL 84-99, Flood Control and Coastal Emergencies (FCCE) (33 U.S.C. 701n) (69 Stat. 186) for emergency management activities. Under PL 84-99, the Chief of Engineers is authorized to undertake activities including disaster preparedness, Advance Measures, emergency operations (Flood Response and Post Flood Response), rehabilitation of flood control works threatened or destroyed by flood, protection or repair of federally authorized shore protective works

threatened or damaged by coastal storm, and provisions of emergency water due to drought or contaminated source.

OPERATIONS:

- 1) The USACE **Missouri River Main Stem System Reservoir Regulation Manual (Master Manual)**, which was first prepared in 1960 by USACE staff in Omaha, Nebraska, is the primary guidance document for operation of the mainstem reservoirs. It reflects the USACE interpretation of its statutory responsibilities and operating approaches developed in coordination with state agencies and other federal agencies. To supplement the Master Manual, the USACE prepares a more detailed Annual Operating Plan each year.
- 2) **Missouri River Master Water Control Manual (Master Manual) Update.** Subsequent to the issuance of a March 19, 2004, Record of Decision on the USACE Master Manual Update, the USACE, in coordination with the USFWS and with the assistance of the United States Institute for Environmental Conflict Resolution, coordinated with basin Tribal representatives, states, and stakeholders in an attempt to develop a basin consensus for bimodal spring pulse release criteria meeting the requirements of the Amended BiOp. While this process was not successful in developing consensus within the basin, it did assist the USACE in developing spring pulse release technical criteria for inclusion in the Master Manual. Recognizing the unique government-to-government relationship between Native American Tribes and the United States, and in light of the USACE Trust responsibilities and commitments pursuant to the March 2004 “Programmatic Agreement for the Operation and Management of the Missouri River Mainstem System for Compliance with the National Historic Preservation Act,” additional consultation/meetings were held with Tribal representatives and members regarding the spring pulse release technical criteria to address Tribal issues.
- 3) **BSNP Operations.** The Construction Reference Plane (CRP) and design criteria are used to determine the adjustment of BSNP structures in routine maintenance activities. The following are key references for BSNP maintenance activities. “The Missouri River Navigation Project: Sioux City to the Mouth: Design Criteria”, Missouri River Division, U.S. Army Corps of Engineers, 1994, and “Operation & Maintenance Manual: Missouri River Bank Stabilization Project: Sioux City, Iowa to the Mouth,” Omaha District, November 2011.

MANDATES:

- 1) **2000 Biological Opinion.** According to section 7 of the Endangered Species Act the USACE initiated consultation with the U.S. Fish and Wildlife Service in 1989 to address the operation of the Missouri River Main Stem Reservoir System (MRMSR). Section 7 consultation is required by Federal agencies when the agency’s proposed actions may affect the status of species listed as endangered or threatened. Species of concern for the USACE MRMSR project were the endangered pallid sturgeon (*Scaphirhynchus albus*), endangered interior least tern (*Charadrius melodus*), threatened interior least tern (*Sterna antillarum*), and the threatened bald eagle (*Haliaeetus leucocephalus*). At the time of initial consultation, the pallid sturgeon had not been a listed species, and bald eagles were listed as endangered. The designation of these

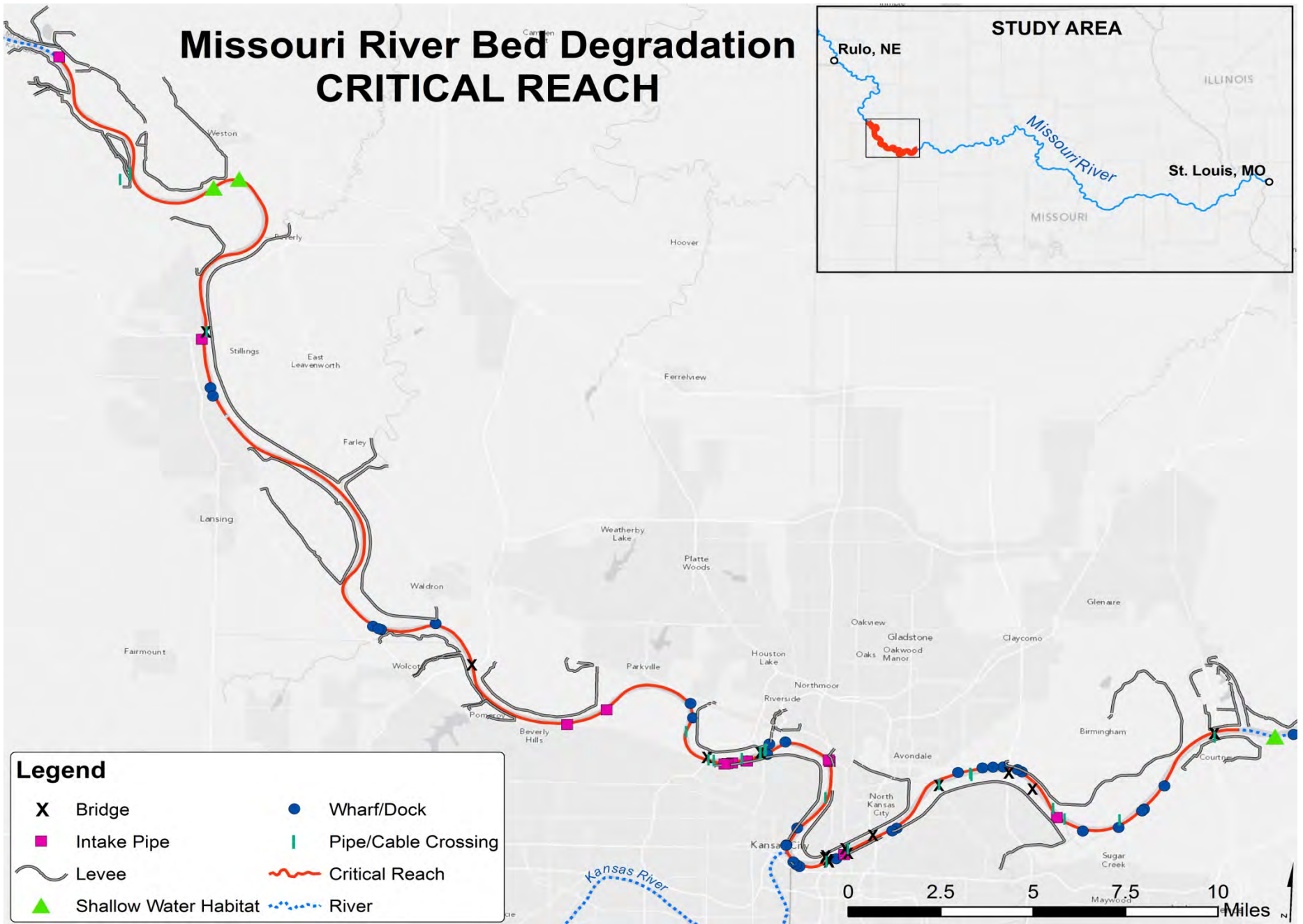
species as jeopardized provides a need for restoration of the Missouri River. Formal and informal consultation between the USACE and USFWS continued until a Biological Opinion (BIOP) was published in 2000. The BIOP covered the MRMSR, as well as Operation and Maintenance of the Missouri River Bank Stabilization and Navigation (MRBSN), and Operation of the Kansas River Reservoir System (KRRS). The USFWS found that implementation of the above projects would result in the jeopardy of the piping plover, least tern, and pallid sturgeon. Reasonable and prudent alternatives (RPAs), such as the formation of emergent sandbar habitat, were provided to the USACE. USFWS claimed if the RPAs were implemented the three species would be precluded from jeopardy.

- 2) **Amended Biological Opinion 2003 (Amended BiOp).** The USACE Missouri and Kansas Rivers Mainstem Reservoir System operations and Bank Stabilization and Navigation Project were studied again. Among other actions, the Amended BiOp called for bimodal spring pulse releases from Gavins Point Dam for the benefit of the endangered pallid sturgeon. Under the terms of the Amended BiOp, a plan for the bimodal spring pulse releases and construction of shallow water habitat was to be implemented.

REGULATORY:

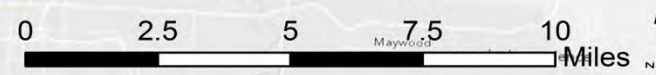
- 1) **Missouri River Commercial Dredging Final Environmental Impact Statement (EIS).** The purpose of this study was to assess is the reauthorization by the USACE of eight existing dredging permits (to six applicants); authorization of three additional proposed dredging permits; and authorization of any as yet unforeseen proposed dredging permits. The Record of Decision for Authorization of Commercial Sand and Gravel Dredging, on the Lower Missouri River, was issued on March 31, 2011.

Missouri River Bed Degradation CRITICAL REACH

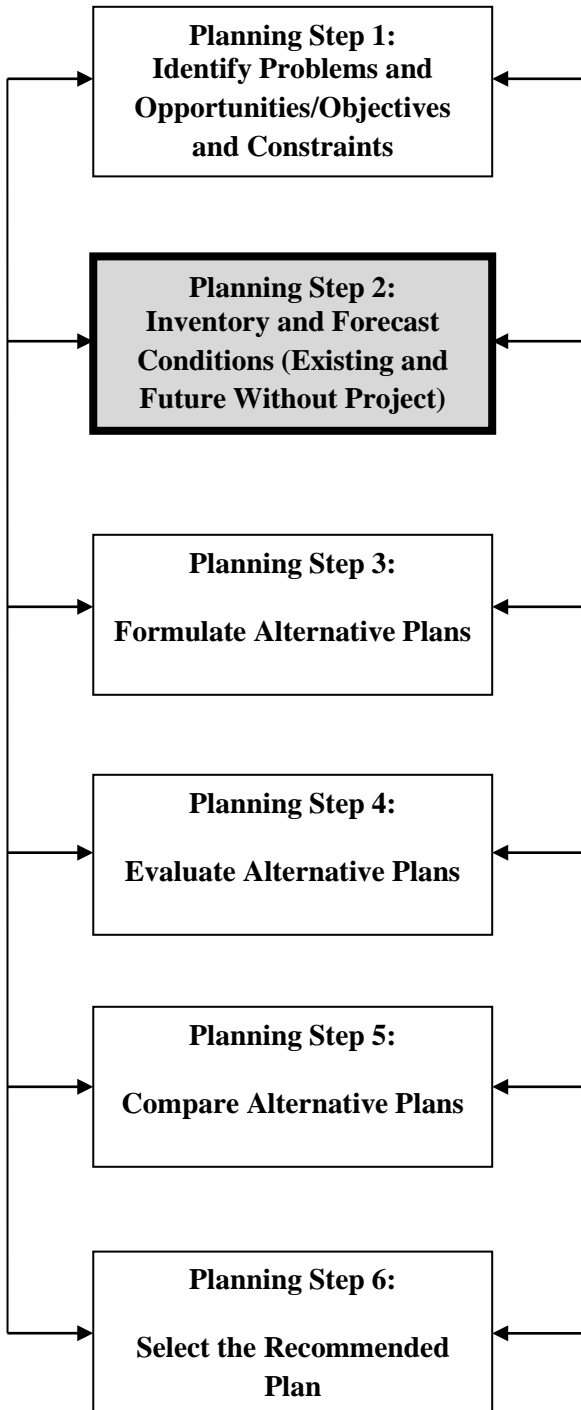


Legend

- X Bridge
- Intake Pipe
- Levee
- Shallow Water Habitat
- Wharf/Dock
- Pipe/Cable Crossing
- Critical Reach
- River



Six Step Planning Process



The study is currently in the Inventory and Forecast phase (Step 2) of the planning process as outlined in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983)*. Step 1: Specification of Problems and Opportunities has been completed by the study team, which is currently developing without-project conditions.

An inventory of at-risk infrastructure and habitats is currently being conducted and is near completion. The following ongoing analyses are in various stages of execution, which will be used to forecast without and with-project conditions:

- Mobile Bed Model, which forecasts bed elevations and associated river stages, has been built and calibrated. Engineers are currently assembling future conditions for use in the model;
- Levee Assessments for under seepage and stability are completed for existing conditions and for initial sensitivity assessments of various future conditions;
- Assessment of design, repair history, and current conditions of the Bank Stabilization and Navigation Project (BSNP) is under peer review;
- Assessments of infrastructure other than levees (Bridges and Water/Intakes) is underway;
- USGS regional ground water model, which forecasts ground water conditions at various bed elevations and associated river stages, has been calibrated for existing conditions. The model will be utilized for assessment of impacts under future conditions;
- Economic Damages Framework is being developed for future costs of operations, maintenance, repair, and replacement for at risk infrastructure;
- Draft Environmental Baseline Study of affected environment with gap analysis is under review; and
- Stakeholder engagement with project development occurs at monthly meetings. Public scoping and agency scoping has not been conducted.

Problems and Opportunities

Problem Statement: Since the Federally implemented BSNP was put into place there has been a change in condition on the Missouri River. The BSNP is not functioning as it was designed to and is contributing to river-bed degradation. Bed degradation in the Missouri River and tributaries impacts critical federal, municipal, and private infrastructure. Lower bed elevation (and the associated river profiles) and low flow stages impose substantial costs on maintaining the BSNP, maintaining federally constructed levees to ensure reliability, infrastructure owners and operators and affect floodplain ecosystem functionality. Within the study area, located from Rulo, NE to the mouth in St. Louis, MO the bed degradation has been characterized into categories of no-bed change, significant, severe, and critical, based on the drop in the low flow water surface profiles (1990-2009). Based on this characterization the Kansas City Reach (RM 357 to RM 410) was designated as being critical and severe and is the focus of the analysis.

Federal and non-federal infrastructure is affected by lower river profiles and stages, which result from bed degradation. Lower river bed elevations impact the structural stability of in-water and stream bank infrastructure. Infrastructure, such as bridges, utility crossings, and flood risk management structures, has been modified to maintain structural integrity with a lower river bed. Lower river stages impact the effectiveness of water intakes, some of which have been modified to operate at lower water surface elevations. Lower river stages reduce groundwater elevations, which impacts alluvial well-field water supply production. Shallow water riverine habitats and floodplain wetlands are also impacted by lower water elevations. In addition, reduced water surface elevations on the lower Missouri River also cause bed degradation on tributaries, creating similar effects to tributary in-water and stream bank infrastructure and habitats.

Bed degradation is projected to continue into the future, further lowering Missouri River and tributary bed profiles and river stages. The characterization of the degradation reaches throughout the study region may change due to the impacts from the recent flood of 2011. Post flood information is still being processed.

Opportunity Statement: The study investigates opportunities on the main stem and tributaries to:

- Improve the functionality of the BSNP
- Improve federal flood risk management, water supply, and navigation project operations, effectiveness, and efficiencies;
- Provide ancillary benefits to commercial, industrial, and municipal users of river resources;
- Bring the Missouri River and tributaries into a more stable balance with current and projected future conditions;
- Enhance water supply reliability during low flow conditions;
- Enhance and/or sustain ecosystem functions and services; and
- Reduce the risk of failure for in-water and stream bank structures.

The federal interest in this project is the potential contribution to National Economic Development, which would result from avoiding future damages due to the impacts of bed degradation in the lower Missouri River main stem and tributaries. Future damages include repair and replacement costs for at-risk-infrastructure, which is owned and maintained by federal, state, and local governments, and by private

entities. In addition, bed degradation increases BSNP maintenance and operations costs and impacts Missouri River main stem dam project operation (*e.g.* discretionary releases for downstream municipal water supply).

Objectives and Constraints

Study Objectives¹: The objective of the study is to identify a plan which contributes to national economic development by:

- Reducing future damages, repair and replacement costs for in-water and stream bank Federal infrastructure;
- Reducing future Federal operations and maintenance costs for in-water and stream bank infrastructure, flood plain habitats, and shallow water habitats;
- Reduce the negative environmental impacts of bed degradation in the main stem Missouri River and tributaries;
- Improve infrastructure reliability and reduce risk of failure; and
- Minimize uncertainty and variance of future water surface and bed elevations as they affect infrastructure

Local Study Objectives:

- Reducing future damages, repair and replacement costs for in-water and stream bank non-federal infrastructure;
- Reducing future operations and maintenance costs for in-water and stream bank non-federal infrastructure
- Improve infrastructure reliability and reduce risk of failure of non-federal infrastructure;
- Minimize uncertainty and variance of future water surface and bed elevations as they affect infrastructure

Categories of at-risk infrastructure along the 53 river miles identified for detailed investigation in this analysis include:

- BSNP bank stabilization component (federal);
- Power utility water intakes (multiple public utilities);
- Pipelines (multiple private owners);
- Levees (multiple federal and local projects);
- Roadway bridges (multiple public agencies);
- Railway bridges (multiple private owners);
- Municipal water supply (multiple public agencies); and
- Critical shallow water habitat (federally implemented).

The study objectives may change with future public scoping and National Environmental Policy Act (NEPA) considerations.

¹ “An objective is a statement of the intended purpose of the planning process; it is a statement of what an alternative plan should try to achieve” Charlie Yoe and Kenneth Orth, 1996. Planning Manual. IWR Report 96-R-21 (page 79).

Study Constraints²:

- Do not implement measures which would impact the Missouri River System's ability to meet all authorized project purposes (flood control, navigation, water supply, recreation, hydropower, fish and wildlife, water quality and irrigation);
- Do not implement measures which would require system operations that are inconsistent with the Master Manual; and
- Do not reduce habitat area required by the 2000 Biological Opinion (BiOp) as amended (2003)
- Zero net loss in habitat established under Missouri River Mitigation Program
- Ensure compliance with applicable Federal laws and regulations

² "Planning objectives are the things we want to accomplish with a plan...In contrast, study specific planning constraints are things we want to avoid doing" Ibid. (page 80).

EVALUATION CRITERIA

Objectives		Metric
1	Reduce future repair and replacement costs for in-water and stream bank infrastructure.	Difference between without and with-project projected average annual equivalent value of repair and replacement costs.
2	Reduce future operations and maintenance costs for in-water and stream bank infrastructure, flood plain habitats, and shallow water habitats.	Difference between without and with-project projected average annual equivalent value of operations and maintenance costs.
3	Reduce the negative environmental impacts of bed degradation in the main stem Missouri River and tributaries.	Projected acres of suitable habitat: Note that same metric will be used to ensure compliance with Constraint #3 (Biop constraint)
4	Improve infrastructure reliability and reduce risk of failure.	Probability of levee failure modeling results, first year critical bed elevation and associated profile results from Mobile Bed Model, first year low flow critical water level elevation results from Mobile Bed Model.
5	Reverse bed degradation (bed aggradation) where beneficial.	Projected bed elevations (and associated river profiles).
Constraints		Metric
1	Do not implement measures which would impact the Missouri River System's ability to meet all authorized project purposes	Proposed changes to release schedules (CFS)
2	Do not implement measures which would require system operations that are inconsistent with the Master Manual	Proposed changes to release schedules (CFS)
3	Do not reduce habitat area required by the 2000 Biological Opinion as amended (2003)	Projected acres of suitable habitat

COMPARISON CRITERIA

•	Objectives 1, 2, and 4 can be combined into a single dollar value
•	Habitat acres (Objective 3) can be combined into a single value, which assumes that all habitat types are weighted equally
•	More aggradation (Objective 5) is better than halting degradation, but only to the extent that the incremental addition to aggradation generates incremental increases in economic and environmental benefits
•	Note that improved reliability and risk reduction (Objective 4) may also be applied as a threshold criterion for preliminary screening (e.g. a plan may be advanced for detailed analysis only if reliability is improved).

SELECTION CRITERIA

Use a hierarchy of objectives, such as
Dollar value is the primary objective;
habitat acres is the secondary objective; and
total aggradation is the tertiary objective.
—Under the hierarchical scenario, the alternative plan with the highest dollar value (net benefits) would be the selected plan. If there were two plans with the same dollar value, then (out of those two plans) the plan with the most habitat acres would be selected, and so on.

ADDITIONAL SELECTION CRITERIA: May be used for preliminary screening or detailed analysis

•	P&G Criteria: Effectiveness, Efficiency, Completeness, Acceptability;	•	Reduce loss of life; and
•	Remaining P&G accounts: Regional Economic Development (RED) and Social Effects;	•	Improve public safety.
•	Constructability;		

KEY UNCERTAINTIES: WHAT AREAS OF UNCERTAINTY DO YOU EXPECT TO IMPACT YOUR PLANNING DECISION?**Existing Condition Uncertainty****Responsibility for causes of historical degradation**

- Responsibility information would not be available to support cost share decision making
- Determining responsibility would be expensive, time consuming, and potentially challenging to constraints
- Responsibility determination would not affect study recommendation

Without and With-Project Uncertainty**Projected bed degradation (mobile bed model output)--River profiles and stages (over and/or under estimate)**

- Over and/or under estimation of river profiles and stages would lead to over or underestimation of risks and benefits
- Sensitivity analyses may be conducted to assess impacts on study recommendation

Projected bed degradation (mobile bed model output)—timing of physical impacts (high and low flow events)

- Incorrectly projecting the timing of bed degradation would cause over or under estimation of project benefits
- Sensitivity analyses may be conducted to assess impacts on study recommendation

Projected bed degradation – relation between main stem and tributaries

- The relationship between main stem bed degradation and tributary bed degradation is not quantified
- Professional judgment will be a major factor in projecting tributary bed degradation
- Over/under estimation of tributary bed degradation will cause over/under estimation of risks and benefits
- Sensitivity analyses may be conducted to assess impacts on study recommendation

Critical bed elevations for in-water and stream bank infrastructure

- Estimates of critical bed elevations will be required for infrastructure that does not have supporting engineering data
- Incorrect critical bed elevation estimates will cause an over/under estimation of risks and benefits
- Sensitivity analyses may be conducted to assess impacts on study recommendation

Future OMR&R costs

- Future OMR&R costs will be based on a combination of historical costs and professional judgment
- Incorrect future OMR&R costs estimates will cause an over/under estimation of benefits
- Sensitivity analyses may be conducted to assess impacts on study recommendation

Regulatory decisions uncertainty

- Concerning quantity of commercial dredging (Section 404 permit)
- Section 401 State Water Quality Certification for chute construction (floodplain connections)

USACE Planning decision uncertainty

- Upper basin water supply decisions (reallocation study)
- Cottonwood management plan implementation

Regional Economic Impact effects on acceptability

- Potential impacts to dredging, construction, and navigation industries

Navigation industry engagement

- Potential response to BSNP operational changes
- Navigation industry as a whole is currently not involved with the study

Without-Project Condition

The without-project condition is currently under development and is not fully formulated. Major components of the without-project condition include:

- Continued operation and maintenance of the BSNP at current levels;
- Continuation of commercial sand and gravel dredging activities (level of dredging to be consistent with the Record of Decision for Authorization of Commercial Sand and Gravel Dredging, on the Lower Missouri River, March 31, 2011);
- Continued compliance with the 2000 BiOp as amended in 2003;
- Continued Missouri River bed degradation: Mobile Bed Model projects without-project future bed elevations, river profiles, and river stages;
- Continued tributary bed degradation: Without-project future bed elevations, river profiles, and river stages in the tributaries will be projected from Missouri River Mobile Bed output;
- Infrastructure will continue to be at risk and require repairs and replacement: Without-project damages will be projected from Mobile Bed Model output and economic model. Without-project levee reliability will be projected from levee underseepage and stability analyses; and
- Wetland and shallow water habitats will be affected by lower river stages: Mobile Bed Model output, USGS regional ground water model, and mapping of existing habitats will be used to project at-risk habitats.

Measures Screened

Measures have not been formulated, however; the district has operated the BSNP for decades, which provides substantial insight into the development of measures. Measures will be initially screened using the Mobile Bed Model, which is capable of projecting the effects on Missouri River bed degradation resulting from changes in the following factors:

- Sediment volume;
- Dredging;
- Roughness;
- Cross-sectional geometry; and
- Bed stabilization.

Upon establishing a viable array of measures or alternatives, decisions will be made concerning the level of detail required to perform screening of those measures during plan formulation. More detailed analyses may be required for the evaluation of alternative plans or of the Tentatively Selected Plan (TSP) as the mobile bed model is not necessarily suited to more detailed analysis. Additional model development may be required for the analysis of specific alternatives.

Formulated Plans Under Consideration

There are no formulated plans under consideration at the time.