APPENDIX I

MISSOURI AND KANSAS RIVER

SECTIONS AND SEGMENTS

MISSOURI RIVER ESA SECTION 7 CONSULTATION

RIVER AND RESERVOIR DESIGNATIONS

The current Endangered Species Act Section 7 consultation with the Corps of Engineers on the Missouri River issues will address the following projects:

- Operation of the Missouri River Main Stem Reservoir System
- Operation of the Kansas River Tributary Reservoir System
- Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project

In addition, as the consultation proceeds, the Missouri River Master Water Control Manual Review and Study project likely will be incorporated into the process.

The physical, chemical, and biological characteristics of the Missouri River today vary significantly throughout the 2,300 mile length of the Missouri River. Consequently, listed threatened and endangered species, candidate species, and their respective habitats within the ecosystem upon which they depend are not uniformly distributed. Thus, impacts to these species and habitats, and opportunities to implement actions necessary to conserve, restore, or recover these species and their habitats may differ by reach of river or reservoir for the Missouri River, as well as the Kansas River.

To facilitate the analysis of impacts in the biological opinion and identification of opportunities to further the conservation and recovery of listed and candidate species, the Missouri River has been divided into four distinct sections based on modern river conditions: unchannelized (UC), reservoir and headwaters (RH), inter-reservoir (IR), and channelized (C). The river has been further divided into 16 segments based on unique morphological characteristics. The Kansas River is affected by operation of the tributary reservoirs and is considered a separate segment. Thus, a total of 16 segments on the Missouri and Kansas Rivers will be addressed.

The sections and segments for the Missouri River were adapted from basin-wide study designs for the recently completed Missouri River Benthic Fishes Study (1995-99) and the Missouri River Natural Resource Committee's proposed Missouri River Environmental Assessment Program. Use of reasonably compatible designations for various sections and segments of the river will provide a consistent and logical basis of reference for information on species, habitats, impacts, and conservation or recovery actions.

Missouri River Sections

- Unchannelized (UC)
- Reservoirs & Headwaters (R&H)
- Inter reservoir (IR)
- Channelized (C)

Missouri River Segments

1. Fort Peck Lake (R&H)
   (RM 1882.7 - RM 1771.5)

2. Fort Peck Dam to Lake Sakakawea Headwaters near Williston, ND (IR)
   (RM 1771.5 - RM 1568.0)

3. Lake Sakakawea (R&H)
   (RM 1568.0 - RM 1389.9)

4. Garrison Dam to Lake Oahe Headwaters near Bismarck, ND (IR)
   (RM 1389.9 - RM 1304.0)

5. Lake Oahe (R&H)
   (RM 1304.0 - RM 1072.3)

6. Oahe Dam to Big Bend Dam (IR, Lake Sharpe - R&H)
   (RM 1072.3 - RM 987.4)

7. Lake Francis Case (R&H)
   (RM 987.4 - RM 880.0)

8. Fort Randall Dam to Niobrara River (IR)
   (RM 880.0 - RM 844.0)

9. Niobrara River to Lewis & Clark Lake, and Lewis & Clark Lake (R&H)
   (RM 844.0 - RM 811.1)

10. Gavins Point Dam to Ponca, NE (UC)
    (RM 811.1 - RM 753.0)

11. Ponca, NE to Sioux City, IA (C)
    (RM 753.0 - RM 735.0)

12. Sioux City, IA to Platte River (C)
(RM 735.0 - RM 595.5)

13. Platte River to Kansas City, MO (C)
(RM 595.5 - RM 367.5)

14. Kansas City, MO to Osage River (C)
(RM 367.5 - RM 130.4)

15. Osage River to the mouth of the Missouri River (C)
(RM 130.4 - RM 0.0)

Kansas River Segment

16. Kansas River, confluence of the Republican and Smoky Hill Rivers to the mouth of the Kansas River (UC)
(RM 170 - RM 0.0)

Missouri River Segments
Threatened and Endangered Species - Designation of Species Action Priority

All threatened and endangered species, by virtue of their listed status, are a priority for all Federal agencies under Section 7(a)(1) of the Endangered Species Act(Act). This section of the Act requires Federal agencies to use their authorities to further the conservation and recovery of listed species. Relative to the Missouri River section 7 consultation, the health and status of listed populations and their habitats, and the opportunities to further their conservation are not uniform throughout the basin and, therefore, warrant varying levels of management effort and priority within each of the 16 designated river or reservoir segments. Thus, a reasonable process is needed to prioritize actions within a river segment.

Prioritization of actions to benefit threatened and endangered species in each segment must consider the current status of the population of the species, condition and availability of habitat, needs associated with the species and habitats, and realistic management opportunities to improve the status and condition of the species and its habitats. Management direction provided by species' Recovery Plans also must be considered. Designation of a priority classification for species within each segment will help focus management on those species where both the need and opportunity most exist.

The process is somewhat subjective because of the value judgements on the aforementioned elements. However, the prioritization should not be arbitrary and capricious. Therefore, to address these factors in the prioritization process, a matrix (copy attached) was developed to help provide direction within each segment of river, as well as an efficient, logical framework for the implementation of management actions to benefit or help recover threatened and endangered species.

Initially, species/habitat needs (biology) and management opportunities for each species within a reach are respectively characterized as either high, moderate, or low. Definitions follow.

Species/habitat Needs - relates to status of populations/habitat and biological management needs.

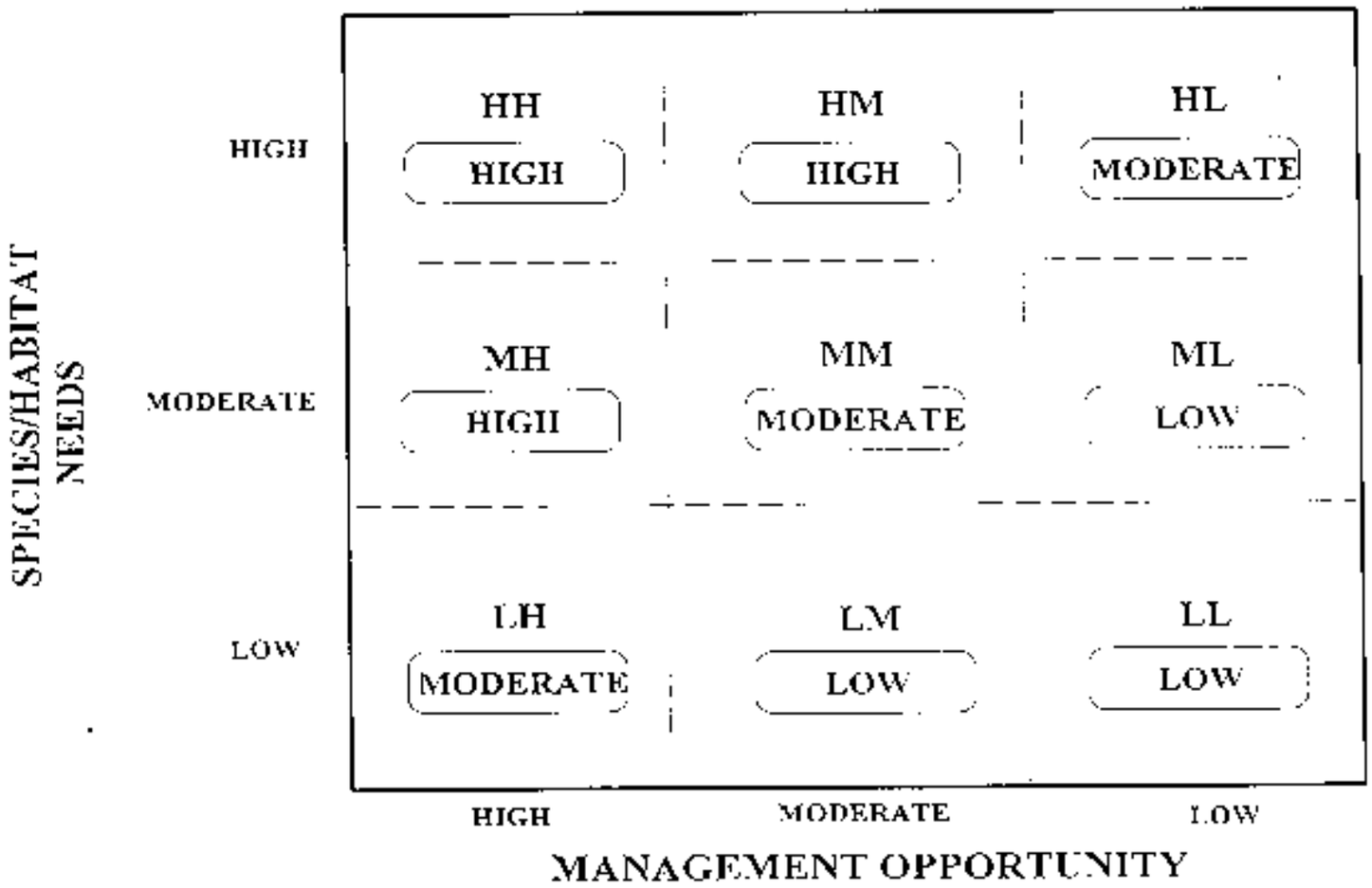
High:	population levels are low and/or habitat is degraded, general condition trend is downward, and thus, need for management is high
Moderate:	moderate populations and habitat conditions, and thus, management needs are moderate
Low:	population levels and habitat conditions are good and characterized by a stable to improving trend, and thus, need for management is relatively low

Management Opportunity - relates to ability to do things (e.g., change operations or hydrograph, restore habitats, acquire land, improve temperature or turbidity, change legislation, change management plans, etc.) and may be affected by budget, authorities, resources, feasibility, etc.

High:	many opportunities exist
Moderate:	some opportunities exist
Low:	few opportunities exist

The combination of the biological needs and management opportunities in the matrix cells yields either a high, moderate, or low priority for management of the species in a particular segment. In general, this designation means that implementation of positive actions to benefit a particular species either will be a "high, moderate, or low" priority in that river segment. However, low priority does not mean that a species is ignored, but that the species and its habitat is in relatively good shape or that management opportunities for the species in that segment are meager and would provide little return to the resource. An obvious long-term-goal would be to strive to elevate the low and moderate priorities to a higher status over time.

SPECIES ACTION PRIORITY MATRIX



SEGMENT - 1.

FORT PECK LAKE
RESERVOIR and HEADWATERS
RIVER MILE 1882.7 - RIVER MILE 1771.5

Description: Fort Peck Lake and its headwaters play a minor direct role towards recovery of least terns and piping plovers, but do not provide appreciable habitat for the pallid sturgeon and other native fish like the sturgeon chub and sicklefin chub. However, the reservoir is the key to implementation of recovery actions further down the system. The management of the reservoir will decide if habitat for terns, plovers and pallids is created or maintained throughout the system. Recovery opportunities on other reservoirs can be maximized through unbalanced, intra-system regulation of Fort Peck. Piping plovers begin arriving at Fort Peck Lake in mid May; the least terns arrive during the first two weeks in June. The lake is marginal habitat for plovers and terns and nesting sites are usually restricted to the eastern portion of the lake. The thirteen year average for the annual adult census is thirteen plovers and four terns.

Species/Priority/Objective:

Pallid Sturgeon:
Priority - Medium. The lake has not supported adequate pallid sturgeon habitat since it was filled. The headwaters of the lake may provide an important area for pallids which occupy the river reaches above the lake. The river above the lake was identified as a priority recovery area and young-of-the-year pallids were stocked above Fort Peck in 1998.
Objective - Monitor use of headwater areas.

Sicklefin and Sturgeon Chub:
Priority - Low.
Objective - Monitor use of headwater areas and tributary mouths by chubs.

Least Tern:
Priority - Low.
Objective - Maintain and increase nesting habitat for utilization by terns.

Piping Plover:
Priority - Low.
Objective - Maintain and increase nesting habitat for utilization by plovers.

Bald Eagle:
Priority - Low.
Objective - Monitor nesting activity on reservoir and headwaters.

Adaptive Management:

Goal: Use the best science available to direct future decisions on operation of the Fort Peck Lake segment. Benefits directly to endangered and threatened species on the reservoir are not as important as the role the reservoir plays in recovery efforts downstream.

Because the interrelationship between timing and magnitude of appropriate levels in Fort Peck have not been determined, we will use an adaptive management approach which specifies that the management level may be flexible in terms of the given year. Recommendations regarding elevation targets for Fort Peck will also be dependant upon snowpack and local runoff. Recommendations will be adjusted accordingly based on results of scientific studies performed to judge effects of level on recruitment of least terns and piping plovers.

We recognize that using reservoir pool elevation to manage vegetation is more difficult with larger reservoirs, but history tells us it can be done. This approach may also create difficulties in obtaining goals downstream during the same year.

Management Strategies:

The Corps has an opportunity to use the unbalanced inter-system regulation to maintain and/or increase tern and plover habitat on the reservoir. The approach of using low operational levels following a filling year to maximize bird habitat availability, particularly down stream. The Corps also has experimented with predator management related to terns and plovers and should refine that technology and implement where appropriate. The Corps should continue to map and monitor the location of nesting terns and plovers under all water regimes and develop high elevation nesting habitat (above the top of the exclusive flood pool) as appropriate. The monitoring of terns and plovers and their habitat will ensure that management of reservoir doesn't create a "sink" situation for the birds.

Also, purchase of any low lying problem areas around the reservoir can increase the Corps flexibility to manage a dynamic system. Research should be performed in the headwaters area to understand the relative importance of this stretch to terns, plovers and native fish including pallid sturgeon.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following:

Adaptive management
Public education about species biology
River ecology
Reservoir ecology
Success stories
Cooperative approach to solving problems on the river
Public's role in river management
Predator management

Corps' role in river/reservoir management
Human/fluid interaction along reservoir beaches

Unresolved Issues:

Hatcheries.
Possible need for intense management of birds.
Definition of High, Medium and Low Priority
"Lake" by reach
Definition of performance for each section where the Corps is involved

SEGMENT - 2

FORT PECK DAM to LAKE SAKAKAWEA HEADWATERS near WILLISTON, ND
INTER-RESERVOIR
RIVER MILE 1771.5 - RIVER MILE 1568.0

Description: The 202 mile Fort Peck segment is characterized as an inter-reservoir section of the Missouri River and includes the lower Yellowstone River from Intake Diversion to the confluence with the Missouri River. It is one of the last remaining segments of the Missouri River that Lewis and Clark would recognize. This segment currently serves as an important benchmark for ongoing restoration efforts throughout the Missouri River system. With a few alterations related to temperature and flow out of Fort Peck Dam, the segment could be nearly biologically intact. The lower end of this segment contains a vast majority of the last remaining adult pallid sturgeon. These fish form the foundation for the hatchery program. Other native fishes such as paddlefish, blue sucker, sicklefin chub, sturgeon chub, flathead chub, sauger and burbot rely on this segment to maintain current populations. The interrelationship of the Yellowstone River and Missouri River strengthens the importance of this segment to fishes such as the pallid sturgeon, sicklefin chub and sturgeon chub. The Fort Peck segment of the Missouri River may provide some of the greatest opportunities for physical and hydrological enhancement of the river and serves as a springboard for additional efforts within the Missouri River ecosystem.

The majority of the sand/silt sandbars used by terns and plovers in this segment are situated downstream of the Milk River confluence. The Popular River also transports a considerable amount of suspended fine sediments. Pre-dam flows in this reach were generally high early in the season (spring) and steadily declining throughout the summer. High spring flows, in addition to ice, would scour the river basin, maintain the aggradation/degradation cycle of sediments in the river and prevent the establishment of emergent vegetation on seasonally exposed sandy areas. This would provide habitat ideal for tern and plover nesting. The construction of Fort Peck Dam has altered these seasonal flow rates.

Species/Priority/Objective:

Pallid Sturgeon:

Priority - High. This segment is identified in the pallid sturgeon recovery plan as a high priority recovery management area.
Objective - Reestablish a sustainable population of pallid sturgeon through improvements to aquatic habitats by development and implementation of temperature and flow recommendations at Fort Peck to achieve restoration of shallow-water, low velocity habitats.
Performance indicators/ milestones/time lines - Implementation of recovery flows and meet temperature targets at (Wolf Point, MT?) related to pallid spawning requirements for the next 10 years. Restore at least one backwater area to benefit native fish habitat in the next 3 years. Begin experimental "recovery flows" out of Ft. Peck within 2 years. Analyze results for integration into an Adaptive Management Plan. Documented increase in the index of biotic integrity (IBI) for benthic fish. (*Specifics related to this section need to be discussed with the Corps*)

Sicklefin and Sturgeon Chub:
Priority - Medium
Objective - Maintain and increase population of chub habitat within reach. Specific actions that benefit species that are already federally listed will take precedence over actions for those which are not listed.
Performance indicators/ milestones/time lines - Document population status within segment over next 5 years. Documented increase in relative abundance of chubs. Through adaptive management, the priority for the chubs can be reevaluated, if necessary, if the chubs are listed in the future. Analyze "Recovery Flows" for benefit to chub species. Documented increased in the index of biotic integrity (IBI) for benthic fish.

Least Tern:
Priority - Medium. Terns typically arrive on the reach the last week of May into the first week of June. The twelve-year adult census average is 76 terns.
Objective - Map and monitor least tern habitat. Maintain and increase nesting habitat for utilization by terns during extremely high water years.

Piping Plover:
Priority - Low. The twelve-year average is 12 adult plovers on this reach.
Objective - Map and monitor habitat to ensure a stable or increasing amount is present within reach.

Bald Eagle:
Priority - Low.
Objective - Map and monitor habitat to ensure a stable or increasing bald eagle population.

Adaptive Management:

Goal: Use the best science available to direct future decisions on operation of the Fort Peck dam to Lake Sakakawea Segment to benefit native fish and wildlife habitat. The focus on this segment will be towards fish and not birds

Because the interrelationship between timing, magnitude, temperature and duration for appropriate flows below Fort Peck have not been determined, we will use an adaptive management approach which specifies that the initiation and duration of flows may be flexible in terms of their starting date. Recommendations regarding flows will also be dependant upon snowpack and local runoff. Recommendations will be adjusted accordingly based on results of scientific studies performed to judge effects of the discharge.

The basis of our approach to adaptive management recognizes that insufficient information exists for optimal management to occur, and various levels of uncertainty exist for every decision made. Evaluation is thus a critical step in the process because it permits learning about the responses of management decisions. This approach will differ from the incremental approaches implemented by many agencies. However, aggressive experimentation with actions incurs the real risk of negatively affecting other resources (at least temporarily) which could upset users and result in political liability for a program. To offset this concern we will utilize the best science available and seek public involvement in the adaptive management approach.

This approach must be applied long enough to allow recommended actions to have a positive effect on the resource. The program stands a chance of being canceled prematurely if this is not understood when the recommendations are implemented.

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and lead to their recovery in this segment. Restoration measures will be based on an adaptive management approach (previously defined). These goals will be habitat based and not necessarily based on individual numbers of animals.

"Recovery Flows":

While we recognize that it is not feasible or desirable to replicate the magnitude of the predevelopment hydrograph because of concerns for flood control and other authorized purposes, warmer water releases from the Fort Peck reservoir should be released a minimum of 10 years, snowpack permitting, to recreate conditions more suitable for pallid sturgeon and other native fish spawning. These flows should mimic warmer historic conditions. These flows would also benefit sicklefin and sturgeon chub. (Use specific recommendations from Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc ..). Ecologically driven flow regimes would more closely mimic the historic discharge pattern in timing and temperature.

Riverine Morphology:

Backwater restoration - This segment contains some functioning backwater areas but others have

been engineered or through operations have been "cut off" from normal flows. These areas should be redesigned to allow for more potential native fish brood habitat and to allow for an increase in the ecological integrity of the segment. Restoration of the diversity of riverine habitats by reconnecting cutoff features will also be a system wide goal. A comprehensive digitized inventory of the backwater habitats in the reach would be a first step

The lower Yellowstone presents numerous opportunities to perform recovery actions which will benefit pallid sturgeon and other native fishes which spend a portion of their lives in the Missouri River. Issues such as fish passage and entrainment related to diversion structures on the Yellowstone River are pertinent to discussions related to the operation of the Missouri River in this segment.

Map and monitor trends in riverine, riparian, and floodplain habitats key to the continued existence of the pallid sturgeon, least tern, piping plover and bald eagle with the goal of maintaining and increasing habitat. Focus monitoring on the shallow-water / slow-velocity habitat (<1 meter in depth <1 meter per second) below Fort Peck to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon. Additional research and monitoring is needed on the river to establish the natural variability of populations (rare and not) within the river. Improve sandbar habitat. Increase the amount of in-channel sandbar habitat through flow manipulation.

Develop and implement minimum fishery flow recommendations below Ft. Peck.

Support Pallid Recovery Program:

Contribute necessary resources to the Services pallid sturgeon propagation program to ensure recovery goals for pallid sturgeon in Priority Management Area 2 are met. Recovery Priority Management Areas are identified in the Pallid Sturgeon Recovery Plan and are a tool to direct limited recovery resources to the highest priority areas. Investigate opportunities for pallid sturgeon recovery activities in the lower Yellowstone River. Activities performed on the lower Yellowstone River could benefit the pallid population using this reach. Research has shown that adult pallid sturgeon found below Ft. Peck will currently migrate as far up the Yellowstone River as the "Intake" diversion structure. Modification of all diversion structures on the Yellowstone River to provide fish passage could have significant benefits to pallid sturgeon on the Missouri River. Participation by the Corps in Upper Basin Pallid Workgroup. Contribute recovery funds to match Western Area Power Association's (WAPA) commitment to Upper Basin Work Group towards recovery in this region. This also should be a requirement to the Middle Basin Group (Platte River) and the Lower Basin Pallid Sturgeon Workgroup.

Acquisition of Flood-Prone Lands:

Find solutions such as purchase, in fee title, the low lying areas on the floodplain that are a chronic problem for landowners. This is consistent with the system-wide goal to maintain and increase the Corps flexibility to operate the system. The Corps should actively promote the

sloughing or "conservation" easement program between Ft Peck and Sakakawea and research the facts regarding the magnitude of erosion resulting from "recovery flows" out of Ft. Peck and the suspected need for bank stabilization.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following;

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river
Public's role in river management
Predator management
Corps' role in river management

Unresolved Issues:

Fish passage
Accountability Matrix
Sediment transport
Diversions on tributaries
Performance

SEGMENT - 3

LAKE SAKAKAWEA
RESERVOIR and HEADWATERS
RIVER MILE 1568.0 - RIVER MILE 1389.9

Description: Lake Sakakawea and its headwaters play an important role towards recovery of least terns and piping plovers. Recovery opportunities can be maximized through unbalanced, intra system regulation. The Lake Sakakawea segment consists of Lake Sakakawea and Lake Audubon. Both were created following construction of Garrison Dam. Piping plover reproductive chronology on Lake Sakakawea is similar to that observed on the adjacent prairie coteau habitats, with the birds arriving and initiating nests during early May. Least terns arrive a month later during the first three weeks in June. Nesting sites are widely scattered, dependent on availability of habitat, with the possibility of both species found anywhere on the lake except the Little Missouri Arm. Lake Sakakawea has never supported large nesting concentrations of least terns, with the thirteen-year average being about 16 breeding adults. The thirteen-year average for plovers during the adult census is 78. This is the third highest average of the eight reaches monitored by the Corps. The number of plovers using the segment can fluctuate significantly, depending on the elevation of the lake during the nesting season.

Species/Priority/Objective:

Pallid Sturgeon:
Priority - Low. This segment not supported adequate pallid sturgeon habitat since the lake filled. The headwaters of the lake may provide an important area for pallids which occupy the river reaches above the lake.
Objective - Monitor use of headwater areas.

Sicklefin and Sturgeon Chub:
Priority - Low.
Objective - Monitor use of headwater areas and tributary mouths by chubs.

Least Tern:
Priority - Medium.
Objective - Maintain and increase nesting habitat for utilization by terns.

Piping Plover:
Priority - High
Objective - Maintain and increase nesting habitat for utilization by plovers

Bald Eagle:
Priority - Low.
Objective - Monitor nesting activity on reservoir and headwaters.

Adaptive Management:

Goal: Use the best science available to direct future decisions on operation of the Lake Sakakawea segment.

Because the interrelationship between timing and magnitude of appropriate levels in Sakakawea have not been determined, we will use an adaptive management approach which specifies that the management level may be flexible in terms of the given year. Recommendations regarding elevation targets for Lake Sakakawea will also be dependant upon snowpack and local runoff. Recommendations will be adjusted accordingly based on results of scientific studies performed to judge effects of level on recruitment of least terns and piping plovers.

We recognize that using reservoir pool elevation to manage vegetation is more difficult with larger reservoirs, but history tells us it can be done. This approach may also create difficulties in obtaining goals downstream during the same year.

Management Strategies:

The Corps has an opportunity to use the unbalanced intra-system regulation to maintain and/or increase tern and plover habitat on the reservoir. This approach of uses low operational levels following a filling year to maximize bird habitat availability. The Corps also has experimented with predator management related to terns and plovers and should refine that technology and implement where appropriate. The Corps should continue to map and monitor the location of nesting terns and plovers under all water regimes and develop high elevation nesting habitat (above the top of the exclusive flood pool) as appropriate. The monitoring of terns and plovers and their habitat will ensure that management of the reservoir doesn't create a "sink" situation for the birds.

Also, purchase of any low problem areas in this segment can increase the Corps flexibility to manage a dynamic system. This is an issue in the upper end of the reservoir in the headwaters area. Research should be performed in the headwaters area to understand the relative importance of this stretch to terns, plovers and native fish including pallid sturgeon.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following.

- Adaptive management
- Public education about species biology
- River ecology
- Reservoir ecology
- Success stories
- Cooperative approach to solving problems on the river
- Public's role in river management
- Predator management
- Corps' role in river/reservoir management

Human/bird interaction along reservoir beaches

Unresolved Issues:

The importance of the tributaries to the chubs (specifically Little Missouri Rivers role in sturgeon chub recovery)

Hatcheries

Possible need for intense management of birds.

SEGMENT - 4

GARRISON DAM to LAKE OAHE HEADWATERS near BISMARCK, ND
INTER-RESERVOIR
RIVER MILE 1389.9 - RIVER MILE 1304.0

Description: The 85-mile Garrison segment is characterized as an inter-reservoir section of the Missouri River. It is one of the last remaining segments of the Missouri River that Lewis and Clark would recognize. With alterations to temperature, flow and turbidity out of Garrison Dam, the reach could be nearly biologically intact. While this segment currently does not provide suitable habitat for the pallid sturgeon, in the future it might. Other native fishes such as paddlefish, blue sucker, flathead chub, sauger and burbot are found in this segment although their numbers are reflective of the change in river dynamics in this reach.

As a result of channel degradation and the elimination of spring scouring flows, nearly all of the islands along the Garrison Reach have become vegetated. Many of the islands have mature woody vegetation including sand willows and cottonwoods. Sandbars, once formed, also are vegetated quickly or are lost to erosion at a faster rate than previously thought.

Least terns and piping plovers concentrate on this segment which historically has been an important nesting area for both species. The thirteen-year average for the adult census conducted along the Garrison segment is 160 least terns and 106 piping plovers. Major nesting sites for the two species along this segment of the Missouri include islands and sandbars at RM 1374.5, 1369.8, 1364.5, 1354, 1335, 1308.5.

Species/Priority/Objective:

Pallid Sturgeon:

Priority - Low. This segment is not identified in the pallid sturgeon recovery plan as an important recovery management area. This reach may provide some potential as a "holding area" for pallids if habitat changes are made.
Objective - Rescue existing adult population of pallid sturgeon, and implement changes in temperature, flow and turbidity as possible to achieve restoration of shallow-water, low velocity, high turbidity habitats
Performance indicators/milestones/time lines - Implementation of significant changes to meet temperature, flow and turbidity targets related to pallid sturgeon requirements is years if not decades away. Restore at least one backwater area in the next 5 years. Maintain existing shallow slow habitats within reach. Work towards development of technology to allow for warm water to be spilled at Garrison Dam. Begin experimental flows out of Garrison shortly after. Analyze results for integration into an Adaptive Management Plan. Documented increase in the index of biotic integrity (IBI) for benthic fish.

Sicklefin and Sturgeon Chub:

Priority - Low. This segment does not currently contain chub habitat.
Objective: Increase population of chubs within reach. Specific actions that benefit species that are already federally listed will take precedence over actions for those which are not listed.
Performance indicators/milestones/time lines - Document population status within segment over next 5 years. Documented increase in relative abundance of chubs. Through adaptive management, the priority for the chubs can be reevaluated, if necessary, if the chubs are listed in the future. Analyze "Recovery Flows" for benefit of chub species.

Least Tern:

Priority: High.
Objective: Map and monitor least tern habitat. Maintain and increase nesting habitat for utilization by terns during extremely high water years
Performance Indicators/Milestones/Time line: Steady to declining flows below Garrison Dam to ensure no undue threats to nesting terns and plovers. *(Pledge ratio targets or habitat targets will be developed cooperatively with the Corps of Engineers through the consultation process)*

Piping Plover:

Priority: High.
Objective: Map and monitor habitat to ensure a stable or increasing amount is present within reach. Steady to declining flows below Garrison Dam to ensure no undue threats to nesting terns and plovers
Performance Indicators/Milestones/Time line: Steady to declining flows below Garrison Dam to ensure no undue threats to nesting terns and plovers.*(Pledge*

ratio targets or habitat targets will be delveloped cooperatively with the Corps of Engineers through the consultation process)

Bald Eagle:

Priority: Medium.
Objective: Map and monitor habitat to ensure a stable or increasing bald eagle population.

Adaptive Management:

Goal: Use the best science available to direct future decisions on operation of the Garrison reach.

Because the interrelationship between timing, magnitude, temperature and duration for appropriate flows below Garrison have not been determined, we will use an adaptive management approach which specifies that the initiation and duration of flows may be flexible in terms of their starting date. Recommendations regarding flows will also be dependant upon snowpack and local runoff. Recommendations will be adjusted accordingly based on results of scientific studies performed to judge effects of the discharge.

The basis of our approach to adaptive management recognizes that insufficient information exists for optimal management to occur, and various levels of uncertainty exist for every decision made. Evaluation is thus a critical step in the process because it permits learning about the responses of management decisions. This approach will differ from the incremental approaches implemented by many agencies. However, aggressive experimentation with actions incurs the real risk of negatively affecting other resources (at least temporarily) which could upset users and result in political liability for a program. To offset this concern we will utilize the best science available and seek public involvement in the adaptive management approach.

This approach must be applied long enough to allow recommended actions to have a positive effect on the resource. The program stands a chance of being canceled prematurely if this is not understood when the recommendations are implemented.

Management Strategies:

"Recovery Flows":

Warmer more turbid water and higher spring flows from Garrison Dam. This would be a long term objective not expected to be implemented in the near future. Technology advances may be necessary prior to implementation of significant changes to temperature or turbulity below Garrison Dam. These recovery flows would also be used to increase and sustain in-channel sand bar habitat through flow manipulation. *(Specific flow targets will be a discussion topic for Corps/FWS consultation meetings)*

Riverine Morphology:

Backwater restoration - This segment contains some functioning backwater areas but others have been cut off from normal flows (i.e., Painted-Woods Lake). These areas should be redesigned to allow for more potential native fish brood habitat and to allow for an increase in the ecological integrity of the segment. Restoration of the diversity of riverine habitats by reconnecting cutoff features will also be a system wide goal. A comprehensive digitized inventory of the backwater habitats in the reach would be a first step.

Map and monitor trends in riverine, riparian, and floodplain habitats key to the continued existence of the pallid sturgeon, least tern, piping plover and bald eagle. Monitoring of the shallow water / slow-velocity habitat (<1 Meter in depth, <1 Meter per second) below Garrison Dam to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon and foraging least terns. Additional research and monitoring is needed on the river to establish the natural variability of populations (rare and not) within the river.

Other Issues - Develop and implement minimum fishery flow recommendations below Garrison Dam. Research the facts behind the suspected need for bank stabilization below Garrison Dam. Actively promote the sloughing or "conservation" easement program below Garrison Dam. Purchase, in fee title, the low-lying areas on the floodplain that are a chronic problem for landowners. This is consistent with the system wide goal to maintain and increase the Corps flexibility to operate the system.

Outreach:

Develop and implement a robust outreach plan for the segment including, but not limited to the following:

Adaptive management
Public education about species biology
River biology
Success stories
Cooperative approach to solving problems on the river
Public's role in river management
Predator management
Corps' role in river management

Unresolved Issues:

Fish passage
Accountability Matrix
Sediment transport

SEGMENT - 5

LAKE OAHE
RESERVOIR and HEADWATERS
RIVER MILE 1304.0 - RIVER MILE 1072.3

Description: Lake Oahe and its headwaters play an important role towards recovery of least terns and piping plovers. Recovery opportunities can be maximized through unbalanced, intra-system regulation. During the drought of the early 90's the northern limit of Lake Oahe was in South Dakota, approximately 100 miles south of the northern limit during more "normal" water years. Piping plover reproductive chronology on Lake Oahe is similar to that observed on other South Dakota Reservoirs, with the birds arriving and initiating nests during the first week in May. Least terns arrive a month later during the first three weeks in June. Few nests are found in the middle of the lake but terns utilize shoreline beaches along the Cheyenne River Arm. The most important nesting site on Lake Oahe is Dredge Island at RM 1270.0. This site has been home to nearly 50% of all nests found on the lake since surveys began. Lake Oahe harbors substantial numbers of both species with a thirteen-year average of 97 terns and 67 plovers observed on this segment during the annual census. Although significant numbers of terns have been observed on this segment, nesting success has been below average with only 23% of nests successful.

Species/Priority/Objective:

Pallid Sturgeon:

Priority - Low. This segment has not supported adequate pallid sturgeon habitat since the lake was filled. Any pallids found in the lake should probably be relocated to more suitable habitat. The headwaters of the lake may provide an important area for pallids which occupy the river reaches above the lake.

Objective - Monitor use of headwater areas.

Sicklefin and Sturgeon Chub:

Priority - Low.

Objective - Monitor use of headwater areas and tributary mouths by chubs.

Least Tern:

Priority - Medium.

Objective - Maintain and increase nesting habitat for utilization by terns. High water habitat is crucial on Lake Oahe as noted by Dredge Island. Predator management is also an important issue when dealing with a relatively high concentration of adult birds as found on the island.

Piping Plover:

Priority - High.

Objective - Maintain and increase nesting habitat for utilization by plovers. High water habitat is crucial on Lake Oahe as noted by Dredge Island. Predator management is also an important issue when dealing with a relatively high concentration of adult birds as found on the island.

Bald Eagle:

Priority - Low.

Objective - Monitor nesting activity on reservoir and headwaters.

Adaptive Management:

Goal: Use the best science available to direct future decisions on operation of the Lake Oahe segment.

Because the interrelationship between timing and magnitude of appropriate levels in Oahe have not been determined, we will use an adaptive management approach which specifies that the management level may be flexible in terms of the given year. Recommendations regarding elevation targets for Lake Oahe will also be dependant upon snowpack and local runoff. Recommendations will be adjusted accordingly based on results of scientific studies performed to judge effects of levels on recruitment of least terns and piping plovers.

We recognize that using reservoir pool elevation to manage vegetation is more difficult with larger reservoirs, but history tells us it can be done. This approach may also create difficulties in obtaining goals downstream during the same year.

Management Strategies:

The Corps has an opportunity to use the unbalanced intra-system regulation to maintain and/or increase tern and plover habitat on the reservoir. This approach uses low operational levels following a filling year to maximize bird habitat availability. The Corps also has experimented with predator management related to terns and plovers and should refine that technology and implement where appropriate. The Corps should continue to map and monitor the location of nesting terns and plovers under all water regimes and develop high elevation nesting habitat (above the top of the exclusive flood pool) as appropriate. The monitoring of terns and plovers and their habitat will ensure that management of the reservoir doesn't create a "sink" situation for the birds.

Also, purchase of any low problem areas in this segment can increase the Corps flexibility to manage a dynamic system. This is an issue in the upper end of the reservoir in the headwaters area. Research should be performed in the headwaters area to understand the relative importance of this stretch to terns, plovers and native fish including pallid sturgeon.

Outreach

Develop and implement a robust outreach plan for the segment including, but not limited to the following:

Adaptive management
Public education about species biology
River ecology
Reservoir ecology
Success stories
Cooperative approach to solving problems on the river
Public's role in river management
Predator management
Corps' role in river/reservoir management
Human/bird interaction along reservoir beaches

Unresolved Issues:

Hatcheries.
Possible need for intense management of birds.

SEGMENT - 6

OAHE DAM to BIG BEND DAM
INTER-RESERVOIR, LAKE SHARPE - RESERVOIR and HEADWATERS
RIVER MILE 1072.3 RIVER MILE 987.4

Description: This reach begins at the Oahe Dam a peaking power plant and extends southeast 80 miles downstream to Big Bend Dam. The total Missouri River drainage upstream of Big Bend Dam is 243,500 square miles most of which is controlled by Big Bend Dam and the three upstream main stem dams. Many channel stabilization structures exist in this reach including training dikes and channel blocks, extensive bank protection and a causeway across the left channel at the upstream end of LaFramboise Island. Lake Sharpe has a very small amount of carryover and multiple use storage space. The IR portion of this reach extends about 10 miles from Oahe Dam to almost 4 miles below the Bad River that has a drainage of 3,100 square miles. The measured annual sediment inflow from the Bad River is 2,900,000 tons per year. Delta formations in the headwaters of the Lake Sharpe reservoir began soon after the closure of Big Bend Dam in 1963. Topography adjacent to the IR portion of this reach includes old forested flood plain on the right bank intermixed with residential development and small hilly areas, bottes and hogbacks intermixed with residential development on the left bank. At six miles just

upstream of the Bad River lies the Cities of Pierre (left bank) and Ft. Pierre (right bank) with LaFramboise Island between. LaFramboise Island is a cottonwood floodplain forest with prairie. Lake Sharpe itself includes Farm Island and is surrounded by mixed prairie, small hilly areas, buttes, hoghacks and a few small flat drainage areas where tributaries enter the reservoir. More than 1,000 wetland and marsh acres hug the Lake Sharpe shoreline, with more than 400 acres associated with LaFramboise and farm Islands and the mouths of tributaries. Submerged aquatic vegetation (3-7 feet of water)is extensive in this reach and is associated with the Bad River Delta and small embayments at tributary mouths.

Human activities are prevalent in this reach including recreation, agriculture, bank stabilization projects, and housing developments. Recreational uses include fishing, both from shore and boats, pleasure boating, jet skis, canoeing, swimming, and sunbathing.

Both the least tern and the piping plover historically nested in this river reach but limited habitat and heavy recreation have virtually eliminated these birds from this reach. However, any future potential for island and sandbar development is possible with changes caused by the formation of the Bad River delta.

We know that pallid sturgeons exist in the headwaters of this reach but have been found by researchers to be in poor condition.

More than 100 bald eagles winter in mature cottonwood forests next to the river and on LaFramboise and Farm Island. One forested area just upstream of Ft. Pierre on the right bank meets the requirement of essential bald eagle wintering habitat.

Species/Priority/Objective:

Bald Eagle:

Priority - High

Objective - Encourage re-colonization of historic eagle habitat by restoring and improving riparian forested habitat for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Interior Least Tern:

Priority - Low.
Objective - Monitor island and sandbar formation in this reach and evaluate potential to establish successful reproduction.
Performance indicator -

Piping Plover:

Priority - Low.
Objective - Monitor island and sandbar formation in this reach and evaluate potential to establish successful reproduction
Performance indicator -

Pallid Sturgeon:

Priority - Medium.
Objective - Rescue the existing population for hatchery propagation efforts or relocation to priority management reaches.
Performance indicator -

Sicklefin and Sturgeon Chubs:

Priority - Low.
Objective - Explore opportunity to use any existing population for hatchery propagation efforts or relocation to priority management reaches.
Performance indicator -

Management Strategies:

Goal: Use the best science available to improve habitat for federally listed species and lead to their recovery. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will be experimental as this reach has limited opportunities for management at this time

"Recovery Flows":

Discharges from this reach should be used to benefit other reaches. However where opportunities may be taken to enhance habitats for federally listed species those opportunities should be managed.

Riverine Morphology:

Due to the dynamic nature of sandbar creation/erosion(both shallow water and above water sandbars), siltation, and vegetative encroachment processes and the importance of habitat occurring as a "complex" of secure nesting substrate, wet sand or wash area, and shallow submerged aquatic substrates, with the most successful nesting sites having at least one third of the complex in the wet sand and submerged substrate categories there should be an integration of orthophotography, habitat modeling, existing geographic information system layers, river flow

and siltation models and previous habitat assessments to monitor changes in the quantity and distribution of habitat. This effort would identify factors resulting in positive or negative shifts in habitat and develop and rank habitat management alternatives.

Acquisition of flood-prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes in other more ecologically significant reaches. Acquisition could aid in restoration of those areas while providing floodwater storage and reducing flood damages. This would further the system-wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Address aggradation in this reach - Significant sedimentation has occurred in this reach. Partnerships need to be continued in the Bad River watershed to address sedimentation and restoration of habitats. Cooperation should continue with Corps on the local buy out and with the evaluation of potential solutions to sediment transport issues.

Maintain and increase riverine habitat diversity and abundance - Evaluate opportunities to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds.

Other Efforts:

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of federally listed species. Focus monitoring on sandbar and forested areas in this reach.

Outreach:

Develop and implement an outreach plan for the reach including but not limited to the following:

Adaptive management
Public education about species biology
Angler education to identify and distinguish sturgeon species
River ecology
Success stories
Cooperative approach to solving problems on the river

Corps' role in river management
Public's role in river management

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority. [further define influence of tributary regarding species and their recovery; define tributaries in general, i.e., all are included and then address those significant tributaries by reach; appendix with list of tribs.; also need decide how to address lower Missouri connection with middle Mississippi River]. This issue not only relates to physical/biological contributions of these tributaries but also individual species populations interconnectivity with the Missouri river(e.g., Platte River/Missouri River least terns)

Sediment Transport/by-pass

Fisheries access to trib.

SEGMENT - 7

LAKE FRANCIS CASE
RESERVOIR and HEADWATERS
RIVER MILE 987.4 - RIVER MILE 880.0

Description: This reach begins at the Big Bend Dam a peaking power plant and extends southeast about 107 miles downstream to Ft. Randall Dam and covers 102,000 acres. Lake Francis Case remains filled into the annual flood control and multiple use zone each year. The greatest variability occurs in the fall when they do not replace releases from Ft. Randall Dam with releases from above dams (Oahe and Big Bend). This results in a drawdown of 18 feet on the lake that they gradually refill during the winter from peak power demand releases. These drawdowns are a limiting factor affecting fish reproduction and recruitment. The only major tributary in this reach is the White River that contributes a substantial amount of sediment into the lake. A large delta is forming at the confluence of the White River and the lake. Large areas of forested wetlands and riparian forests occur within the delta. Other forested areas are limited to embayments of secondary tributaries and within 8 miles downstream of Big Bend Dam. Other topography adjacent to the lake includes mixed prairie, small hilly areas, buttes and bogbacks intermixed with agricultural and residential development.

Human activities are prevalent in some parts of this reach (e.g., Chamberlain, South Dakota area) including recreation, agriculture, bank stabilization projects, and housing developments. Recreational uses include fishing, both from shore and boats, pleasure boating, jet skis, canoeing, swimming, and sunbathing.

Both the least tern and the piping plover may have historically nested in this river reach but lack of habitat has eliminated these birds from this reach. However, any future potential for island and sandbar development is possible with changes caused by the formation of the White River delta.

No pallid sturgeons have been found in this reach. Bald eagles winter in mature cottonwood forests next to the river in the White River delta area and the first 8 miles below Big Bend Dam

Species/Priority/Objective:

Bald Eagle
Priority- Low
Objective - Encourage re-colonization of historic eagle habitat by restoring and improving riparian forested habitat for nesting and wintering bald eagles
Performance indicator Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Interior **Least** Tern:
Priority - Low.
Objective - Monitor island and sandbar formation in this reach and evaluate potential to establish successful reproduction.
Performance indicator

Piping Plover:
Priority - Low.
Objective - Monitor island and sandbar formation in this reach and evaluate potential to establish successful reproduction.
Performance indicator

Pallid Sturgeon:
Priority - Low.
Objective - None.
Performance indicator -

Sicklefin and Sturgeon Chubs:
Priority - Low.
Objective - None.
Performance indicator -

Management Strategies:

Goal: Use the best science available to improve habitat for federally listed species and lead to their recovery. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will be experimental as this reach has limited opportunities for management at this time.

"Recovery Flows":

Discharges from this reach should be used to benefit other reaches. However where opportunities may be taken to enhance habitats for federally listed species those opportunities should be managed

Riverine Morphology:

Due to the dynamic nature of sandbar creation/erosion(both shallow water and above water sandbars), siltation, and vegetative encroachment processes and the importance of habitat occurring as a "complex" of secure nesting substrate, wet sand or wash area, and shallow submerged aquatic substrates, with the most successful nesting sites having at least one third of the complex in the wet sand and submerged substrate categories there should be an integration of orthophotography, habitat modeling, existing geographic information system layers, river flow and siltation models and previous habitat assessments to monitor changes in the quantity and distribution of habitat. This effort would identify factors resulting in positive or negative shifts in habitat and develop and rank habitat management alternatives.

Other Efforts:

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of federally listed species. Focus monitoring on sandbar and forested areas in this reach

Outreach:

Develop and implement an outreach plan for the reach including but not limited to the following;

Adaptive management
Public education about species biology
Angler education to identify and distinguish sturgeon species
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority (further define influence of tributary regarding species and their recovery, define tributaries in general, i.e., all are included and then address those significant tributaries by reach; appendix with list of tribs ; also need decide how to address lower Missouri connection with middle Mississippi River). This issue not only relates to physical/biological contributions of these tributaries but also individual species populations interconnectivity with the Missouri riverine g . Platte River/Missouri River least terns)

Sediment Transport/by-pass

Fisheries access to trib.

SEGMENT - 8

FORT RANDAL DAM to NIOBRARA RIVER
INTER-RESERVOIR
RIVER MILE 880.0 - RIVER MILE 844.0

Description: The Fort Randall Reach begins at the Fort randall Dam in southeast South Dakota and travels in a southeasterly direction 35 miles to the western boundary of Lewis and Clark Lake. Most of the water for this reach is through releases from Fort Randall. Controlled releases from fort Randall Dam have eliminated periodic flooding for most of the reach. The topography varies from relatively flat floodplain on the eastern shore to high wooded bluffs on the western shore. The bluffs in turn are dissected by coulees and ravines that lead down to the river.

The floodplain forest is the dominat ecosystem along the eastern and the western shore XX miles belwo the dam. In many areas farmlands have eliminated the forest from the banks. Oaks and Cedars occur on the western shore and bluffs. Without scouring by floods, vegetation, including grasses, forbs and shrubs, has become established on most of the islands in the reach. Some islands have established into mature stands of cottonwood forest.

Human activities are prevalent in this reach including recreation, agriculture, bank stabilization projects, and housing developments. Recreational uses includes fishing, both from shore and boats, pleasure boating, jet skis, canoeing, swimming, and sunbathing. In the Niobrara Scenic River Designation Act of 1991 this 35 mile porton of the Missouri river was designated a National Recreation River. With this designation increased recration pressure on the reach is expected. The establishment of homes and the development of agricultural tracts along the river has lead to increased demands for bank stabilization projects

Both the least tern and the piping plover historically nested in this river reach, and this reach continues to be important to both species. (?) Although the sturgeon and sicklefin chub historically occurred along this reach, habitat alterations and flow modification are believed to have led to the extirpation of both species from this area. Along this reach, such alterations are

particularly important to the chubs that are believed to have occurred only in the main stem of the river. Bald eagles nest in mature cottonwood forests next to the river. Karl Mundt National Wildlife Refuge which was established for bald eagles is located below Ft. Randall Dam.

Species/Priority/Objective:

Bald Eagle:

Priority - Medium.

Objective - Encourage re-colonization of historic eagle habitat by restoring and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Interior Least Tern:

Priority - High.

Objective - Map and monitor nesting and foraging habitat to ensure a stable and/or increasing amount is present within this reach. Use river flows as the primary tool for recovery and maintenance of nesting and foraging habitat. Obtain functioning sandbar life cycles with self-perpetuating sediment redistribution to maintain habitat sandbar suitability. Create suitable (unattached) sandbar complexes and off-channel, shallow water habitat that provides forage for nesting and migrating terns. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years. (*Establish fledge ratio goals and/or habitat targets with Corps and Service tern experts*)

Piping Plover:

Priority - High.

Objective - Map and monitor nesting and foraging habitat to ensure a stable and/or increasing amount is present within this reach. Use river flows as the primary tool for recovery and maintenance of nesting and foraging habitat. Obtain functioning sandbar life cycles with self-perpetuating sediment redistribution to maintain habitat sandbar suitability. Create suitable (unattached) sandbar complexes and off channel, shallow water habitat that provides forage (i.e., invertebrates) for nesting and migrating plovers.

Performance indicator - Establishment and successful reproduction of nesting piping plovers along this reach over the next five to ten years. (*Establish fledge ratio goals and/or habitat targets with Corps and Service tern experts*)

Pallid Sturgeon:

Priority - High. (Recovery-priority management area #3)

Objective - Reestablish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat

manipulation. Flow alterations should move to a more natural hydrograph that provides reproduction and habitat suitability for pallid sturgeon including, timing, duration, temperature and variability. In the spring, flows should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off channel habitats with the river. Summer and early fall flows should allow development of shallow, slow-water habitats and exposed sandbars for young-of-the year fish. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).

Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction over the next ten years. (Note: relying only on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking has influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - High

Objective - Increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood-plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).

Performance indicator - Increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available to improve habitat for federally listed species and lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Fort Randall Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing and variability as well. Releases should be tied to the projected water-year inflows (i.e., high water years would have larger spring discharges than low water years). While annual events may be limited in magnitude, a significant event should occur at least once every five years. This is critical to regenerate and maintain habitat quality and quantity. High flows would allow for channel migration, redistribution of sediments, vegetative scouring, increased water fertility, predator population regulation and creation of high elevation sandbar habitat. Discharges should strive to maintain steady to (or ideally) declining flows during summer and

should avoid flow reversals (no peaking). Such operations would benefit both fish and birds improving conditions for forage availability, reproduction and survival of young. The recovery flows should also include a minimum flow (e.g., May 15 June 15-- 15,000 cfs to maintain paddlefish spawning habitat and June 16 May 14-- 9,000 cfs) out of Ft. Randall Dam to maintain a wetted perimeter that would sustain fish populations. (Adapt specific recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Due to the dynamic nature of sandbar creation/erosion(both shallow water and above water sandbars), siltation, and vegetative encroachment processes and the importance of habitat occurring as a "complex" of secure nesting substrate, wet sand or wash area, and shallow submerged aquatic substrates, with the most successful nesting sites having at least one third of the complex in the wet sand and submerged substrate categories there should be an integration of orthophotography, habitat modeling, existing geographic information system layers, river flow and siltation models and previous habitat assessments to monitor changes in the quantity and distribution of habitat. This effort would identify factors resulting in positive or negative shifts in habitat and develop and rank habitat management alternatives.

Backwater restoration - This segment contains few functioning backwater areas. Redesigning structures in these areas could partially restore historic off-channel habitat that would allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoring diverse riverine habitats by reconnecting such areas would also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Increase flood plain/river connectivity might be completed in combination with fee title and easement acquisitions. Where Corps bank stabilization projects are in place and next to potential backwater restoration areas adjustments in these projects might need to be considered (*need to check with Remus; it has been a while since I have spent any time on the river so I am not certain what changes have occurred and where the best potential for restoration exists*). Increasing floodplain connectivity would maximize the benefits of a more natural hydrograph by providing fisheries spawning and nursery habitats, and organic contributions to the river. In addition, it would provide additional areas for floodwater storage during high water.

Acquisition of flood-prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes along this reach of the river. In addition, many of those areas historically were river backwaters. Acquisition could aid in restoration of those areas while providing floodwater storage and reducing flood damages. This would further the system wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Reverse bed degradation - Significant channel degradation along this reach must be reversed to

maintain existing habitat and the potential to restore historic flood plain habitats. Channel degradation will continue to limit the potential to successfully reconnect the flood plain or backwater areas with the river during any but the highest river flows. That makes it more difficult to implement a hydrograph that can benefit flood plain and riverine fish and wildlife. In addition, such degradation has led to dewatering of flood plain wetlands, further reducing important habitat to bald eagles and many other fish and wildlife species. A sediment starved channel also limits the potential to develop riverine shoals, sand bars, and islands that are so important to federally listed species.

Increase riverine habitat diversity and abundance - more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds. To that end, the Corps should pursue the feasibility of sloughing easements in problem areas that could address erosion concerns, provide a sediment source, and create more opportunities for greater riverine and riparian habitat diversity. An evaluation of current Corps bank stabilization projects in this reach may identify areas that they could abandon for sloughing easements. Because this reach in not authorized for navigation, there may be greater opportunity to carry out and evaluate the above measures without unacceptable adverse impacts to the river channel.

Other Efforts:

Pallid Sturgeon:

Support pallid sturgeon recovery program by contributing necessary resources to the Service's pallid sturgeon propagation program to ensure we meet recovery goals for pallid sturgeon in priority Management Area 3. Artificial propagation efforts and augmentation of pallids in this reach may be necessary. The Pallid Sturgeon Recovery Plan identifies Recovery Priority management Areas that are a tool to direct limited resources to the highest priority areas. Contribute recovery funds to the Upper, Middle(Platte River), and Lower Basin Pallid Workgroups. Participate Corps in the Platte and Lower Basin Pallid Workgroups to improve coordination and information exchange on pallid sturgeon science.

Tern and Plover Management:

Where predator management cannot be addressed by flow management there is a need to assess the short and long-term roles of predator management measures including intensive (e.g., trapping, fencing etc.) and system oriented (e.g., large amounts of habitat reducing predator efficiency, high spring flow effects on riparian predators) measures. Management efforts will need to be continued to reduce human/bird conflicts. Alternative tern and plover management strategies will need to be developed for intensive management efforts (i.e., captive rearing and habitat creation) with the goal in mind of phasing out intensive management efforts.

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon and sicklefin and sturgeon chubs. Focus monitoring on the

shallow water/slow velocity habitat (< 1 meter in depth, < 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by these fish species

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population plus those on the tributaries.

Map and monitor bald eagle habitat along this reach and nest numbers to assess recolonization and reproductive success

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following;

- Adaptive management
- Public education about species biology
- Angler education to identify and distinguish sturgeon species
- River ecology
- Success stories
- Cooperative approach to solving problems on the river
- Corps' role in river management
- Public's role in river management

RIN - Misc. Things We Need To Address:

Tributaries defined by where operations have influence or where the Corps has jurisdiction by ownership or authority. [further define influence of tributary regarding species and their recovery; define tributaries in general, i.e., all are included and then address those significant tributaries by reach; appendix with list of tribs ; also need decide how to address lower Missouri connection with middle Mississippi River]. This issue not only relates to physical/biological contributions of these tributaries but also individual species populations interconnectivity with the Missouri river(e.g., Platte River/Missouri River least terns)

Sediment Transport/by-pass

Fisheries access to trib.

SEGMENT - 9

NIOBRARA RIVER to LEWIS & CLARK LAKE, and LEWIS & CLARK LAKE RESERVOIR and HEADWATERS

RIVER MILE 844.0 - RIVER MILE 811.1

Description: Gavin's Point Dam created Lewis and Clark lake with the impoundment of the Missouri river. Water from 279,480 square miles of the Missouri River Basin flow into Lewis and Clark lake. Ft. Randall Dam 39 miles upstream from the lake, controls all but 16,000 square miles of this drainage. Most of the Lewis and Clark uncontrolled drainage comes from the Niobrara River that enters the lake at river mile 844.0. The Niobrara transports a heavy sediment load into this reach. It is estimated the Niobrara contributes 60% of the annual sediment inflow to the Lake, making it the major contributor to the accumulation of sandbars and formation of the delta in the upper third of the lake. The Corps manages Lewis and Clark Lake between 1208 feet msl (maximum) and 1204.5 feet msl (minimum) operating pool levels. Under flood conditions they can raise the lake an additional two feet to 1220 feet msl. The reach's topography is divided into two distinct types. The Missouri River breaks that rise to 100 feet above the lake confine the eastern half the lake. The western half is a relatively flat floodplain headwater area of braided channels and islands that become rolling prairie hills away from the lake.

Tern and plover habitat in this reach is limited to islands in the deposition zone at the headwaters of the lake. These sites, with very little relief are susceptible to flooding with even slight increases in lake elevation or tributary contribution.

Both the least tern and the piping plover historically nested in this river reach, and this reach continues to be important to both species. (Check status of chubs) Although the sturgeon and sicklefin chub historically occurred along this reach, we believe that habitat alterations and flow modification led to the extirpation of both species from this area. Along this reach, such alterations are particularly important to the chubs that we believe that occurred only in the main stem of the river.

The topography of this reach is that of a relatively flat floodplain with some prairie bluffs on the South Dakota side and a floodplain interspersed with steep, tree covered bluffs on the Nebraska side. Primary use of the floodplain includes farming and livestock grazing. Mature cottonwood trees are found only in a narrow broken corridor next to the river and on some islands because of clearing and agricultural development on the rest of the floodplain. River flows in this reach create sandbars susceptible to inundation and growth of aquatic vegetation creating floating mats except the delta area that is building high sandbars that quickly revegetate with annual weeds and grasses, sedges, and woody species.

Species/Priority/Objective:

Bald Eagle:

Priority - Medium.

Objective - Encourage re-colonization of historic eagle habitat by restoring and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations

along this reach over the next five to ten years.

Interior Least Tern:

Priority - High.

Objective - Map and monitor nesting and foraging habitat to ensure a stable and/or increasing amount is present within this reach. Use river flows as the primary tool for recovery and maintenance of nesting and foraging habitat. Obtain functioning sandbar life cycles with self-perpetuating sediment redistribution to maintain habitat sandbar suitability. Create suitable (unattached) sandbar complexes and off-channel, shallow water habitat that provides forage for nesting and migrating terns. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years. (*Establish fledge ratio goals and/or habitat targets with Corps and Service tern experts)*

Piping Plover:

Priority - High.

Objective - Map and monitor nesting and foraging habitat to ensure a stable and/or increasing amount is present within this reach. Use river flows as the primary tool for recovery and maintenance of nesting and foraging habitat. Obtain functioning sandbar life cycles with self-perpetuating sediment redistribution to maintain habitat sandbar suitability. Create suitable (unattached) sandbar complexes and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for nesting and migrating plovers.

Performance indicator - Establishment and successful reproduction of nesting piping plovers along this reach over the next five to ten years. (*Establish fledge ratio goals and/or habitat targets with Corps and Service tern experts)*

Pallid Sturgeon:

Priority - High. (Recovery-priority management area 4?)

Objective - Reestablish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Flow alterations should move to a more natural hydrograph that provides reproduction and habitat suitability for pallid sturgeon including, timing, duration, temperature and variability. In the spring, flows should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off-channel habitats with the river. Summer and early fall flows should allow development of shallow, slow water habitats and exposed sandbars for young-of-the year fish. Structural alterations of the river should also increase shallow water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).

Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction over the next ten years. (Note: relying only on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking has influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - High.

Objective - Increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).

Performance indicator - Increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available to improve habitat for federally listed species and lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Ft. Randall Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing and variability as well. Releases should be tied to the projected water-year inflows (i.e., high water years would have larger spring discharges than low water years). While annual events may be limited in magnitude, a significant event should occur at least once every

five years. This is critical to regenerate and maintain habitat quality and quantity. High flows would allow for channel migration, redistribution of sediments, vegetative scouring, increased water fertility, predator population regulation and creation of high elevation sandbar habitat. Discharges should strive to maintain steady to (or ideally) declining flows during summer and should avoid flow reversals (no peaking). Such operations would benefit both fish and birds improving conditions for forage availability, reproduction and survival of young. The recovery flows should also include a minimum flow (e.g., May 15-June 15 – 15,000 cfs to maintain paddlefish spawning habitat and June 16-May 14 – 9,000 cfs) out of Ft. Randall Dam to maintain a wetted perimeter that would sustain fish populations. (Adapt specific recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Due to the dynamic nature of sandbar creation/erosion(both shallow water and above water sandbars), siltation, and vegetative encroachment processes and the importance of habitat occurring as a "complex" of secure nesting substrate, wet sand or wash area, and shallow submerged aquatic substrates, with the most successful nesting sites having at least one third of the complex in the wet sand and submerged substrate categories there should be an integration of orthophotography, habitat modeling, existing geographic information system layers, river flow and siltation models and previous habitat assessments to monitor changes in the quantity and distribution of habitat. This effort would identify factors resulting in positive or negative shifts in habitat and develop and rank habitat management alternatives.

Backwater restoration - This segment contains few functioning backwater areas. Redesigning structures in those areas could partially restore historic off-channel habitat that would allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoring diverse riverine habitats by reconnecting such areas would also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Increase floodplain/river connectivity might be completed in combination with fee title and easement acquisitions. Where Corps bank stabilization projects are in place and next to potential backwater restoration areas adjustments in these projects might need to be considered (*need to check with Remus; it has been a while since I have spent any time on the river so I am not certain what changes have occurred and where the best potential for restoration exists*). Increasing floodplain connectivity would maximize the benefits of a more natural hydrograph by providing fisheries spawning and nursery habitats, and organic contributions to the river. In addition, it would provide additional areas for floodwater storage during high water.

Acquisition of flood prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes along this reach of the river. In addition, many of those areas historically were river backwaters. Acquisition could aid in restoration of those areas while providing floodwater storage and reducing flood

damages. This would further the system-wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Manage aggradation - Managing aggradation to help restoration of ecological functions may be possible, e.g., dredging to create island complexes; mechanical means to increase turbidity.

(?) Restore river connectivity - Restore, enhance, manage backwater areas to the river.

Increase riverine habitat diversity and abundance - more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds. To that end, the Corps should pursue the feasibility of sloughing easements in problem areas that could address erosion concerns, provide a sediment source, and create more opportunities for greater riverine and riparian habitat diversity. An evaluation of current Corps bank stabilization projects in this reach may identify areas that they could abandon for sloughing easements.

Other Efforts:

Pallid Sturgeon:

Support pallid sturgeon recovery program by contributing necessary resources to the Service's pallid sturgeon propagation program to ensure we meet recovery goals for pallid sturgeon in priority Managements Area 3. Artificial propagation efforts and augmentation of pallids in this reach may be necessary. The Pallid Sturgeon Recovery Plan identifies Recovery Priority management Areas that are a tool to direct limited resources to the highest priority areas. Investigate opportunities for pallid sturgeon recovery activities in the lower Niobrara River. The Recovery Plan also states that there is a need to restore free movements of pallid sturgeon within high priority recovery areas. Dams impede pallid sturgeon from migration to and from traditional spawning areas. Modification or decommission of the Spencer Dam on the Niobrara River may be necessary for recovery of the pallid sturgeon in this reach. Contribute recovery funds to the Upper Middle(Platte River) and Lower Basin Pallid Workgroups. Participate (Corps) in the Platte and Lower Basin Pallid Workgroups to improve coordination and information exchange on pallid sturgeon science.

Tern and Plover Management:

Where predator management cannot be addressed by flow management there is a need to assess the short and long-term roles of predator management measures including intensive (e.g., trapping, fencing etc.) and system oriented (e.g., large amounts of habitat reducing predator efficiency, high spring flow effects on riparian predators) measures. Management efforts will need to be continued to reduce human/bird conflicts. Alternative tern and plover management strategies will need to be developed for intensive management efforts (i.e., captive rearing and habitat creation) with the goal in mind of phasing out intensive management efforts.

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon and sicklefin and sturgeon chubs. Focus monitoring on the shallow water/slow velocity habitat (<1 meter in depth, < 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by these fish species

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population plus those on the tributaries

Map and monitor bald eagle habitat along this reach and nest numbers to assess recolonization and reproductive success.

Outreach:

Develop and carry out a robust outreach plan for the reach including but not limited to the following:

Adaptive management
Public education about species biology
Angler education to identify and distinguish sturgeon species
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority. (further define influence of tributary regarding species and their recovery; define tributaries in general, i.e., all are included and then address those significant tributaries by reach; appendix with list of trib.s; also need decide how to address lower Missouri connection with middle Mississippi River) This issue not only relates to physical/biological

contributions of these tributaries but also individual species populations interconnectivity with the Missouri river(e.g., Platte River/Missouri River least terns)

Sediment Transport/by pass

Fisheries access to trib

SEGMENT : 10

GAVINS POINT DAM to PONCA, NE
UNCHANNELIZED
RIVER MILE 811.1 - RIVER MILE 753.0

Description: The river along this reach retains much of its historical character of a braided channel within a wide meander belt. Like the reach immediately downstream, this part of the river was wider, more sinuous and underwent more natural cutoffs than reaches along the lower river. Construction of the main stem dams however, has led to some significant changes along this reach. The dams have greatly reduced downstream sediment transport resulting significant channel degradation (i.e., 8 feet, average) that affects both riparian habitats and tributaries to the river. Reduced sediment supply and channel degradation have also lowered habitat diversity by reducing shallow water habitats, sand shoals, bars, and islands. Reservoir releases dominate flow patterns in this reach and have greatly altered the annual hydrograph. As the last control structure on the Missouri river, Gavins Point Dam serves to provide stabilized downstream releases, maintaining municipal water supplies and the navigation channel below Sioux City, Iowa. The dam operations attenuate naturally high spring flows, eliminating spawning cues and reducing river/flood plain connectivity. Such operations eliminate suitable fish spawning and nursery habitat on the floodplain and allochthonous contribution of organic matter and nutrients to the river. Outside unusually high water years, those attenuated flows are not sufficient to rebuild high elevation sandbars and associated shallow water areas that are so important to young-of-the-year fish and nesting terns and plovers. Present water management also creates a highly altered temperature regime that may influence seasonal fish behaviors (e.g., spawning) and invertebrate production. Flooding from the James and Vermillion rivers however can affect this reach. These tributaries and their sediment loads have maintained a pseudo cycle of habitat aggradation and degradation critical to maintaining some young-of-the year fish and nesting tern and plover habitat.

Both the least tern and the piping plover historically nested in this river reach, and this reach continues to be extremely important to both species. This reach is the only area in the lower river that provides substantial amounts of suitable plover and tern nesting habitat. Although the sturgeon and sicklefin chub historically occurred along this reach, habitat alterations and flow modification are believed to have led to the extirpation of both species from this area. Along this reach, such alterations are particularly important to the chubs that are believed to have occurred only in the main stem of the river.

The topography of this reach is that of a broad flat floodplain on the South Dakota side and a

floodplain interspersed with steep, tree covered bluffs on the Nebraska side. Primary use of the floodplain includes farming and livestock grazing. However, residential development is growing in this reach. Mature cottonwood trees are found only in a narrow broken corridor next to the river because of clearing and agricultural development on the rest of the floodplain. There are two islands in this reach more than one hundred acres in size that are occupied by mature cottonwood forest including James River Island and Goat Island. Because of stabilized river flows, sandbars quickly revegetate with annual weeds and grasses, sedges, and woody species.

Species/Priority/Objective:

Bald Eagle.

Priority - Medium.

Objective - Encourage re-colonization of historic eagle habitat by restoring and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Interior Least Tern:

Priority - High.

Objective - Map and monitor nesting and foraging habitat to ensure a stable and/or increasing amount is present within this reach. Use river flows as the primary tool for recovery and maintenance of nesting and foraging habitat. Obtain functioning sandbar life cycles with self-perpetuating sediment redistribution to maintain habitat sandbar suitability. Create suitable (unattached) sandbar complexes and off-channel, shallow water habitat that provides forage for nesting and migrating terns. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years. *(Establish fledge ratio goals and/or habitat targets with Corps and Service tern experts)*

Piping Plover:

Priority - High

Objective - Map and monitor nesting and foraging habitat to ensure a stable and/or increasing amount is present within this reach. Use river flows as the primary tool for recovery and maintenance of nesting and foraging habitat. Obtain functioning sandbar life cycles with self-perpetuating sediment redistribution to maintain habitat sandbar suitability. Create suitable (unattached) sandbar complexes and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for nesting and migrating plovers.

Performance indicator - Establishment and successful reproduction of nesting piping plovers along this reach over the next five to ten years. *(Establish fledge ratio goals and/or habitat targets with Corps and Service tern experts)*

Pallid Sturgeon:

Priority - High

Objective - Reestablish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Flow alterations should move to a more natural hydrograph that provides reproduction and habitat suitability for pallid sturgeon including, timing, duration, temperature and variability. In the spring, flows should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off-channel habitats with the river. Summer and early fall flows should allow development of shallow, slow-water habitats and exposed sandbars for young-of-the-year fish. Structural alterations of the river should also increase shallow-water and off channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).

Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction over the next ten years. (Note: relying only on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking has influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - High.

Objective - Increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).

Performance indicator - Increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available to improve habitat for federally listed species and lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Gavins Point Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing and variability as well. Releases should be tied to the projected water year inflows (i.e., high water years would have larger spring discharges than low water years). While annual events may be limited in magnitude, a significant event should occur at least once every five years. This is critical to regenerate and maintain habitat quality and quantity. High flows would allow for channel migration, redistribution of sediments, vegetative scouring, increased water fertility, predator population regulation and creation of high elevation sandbar habitat. Discharges should strive to maintain steady to (or ideally) declining flows during summer and should avoid flow reversals (no peaking). Such operations would benefit both fish and birds improving conditions for forage availability, reproduction and survival of young. The recovery flows should also include a minimum flow (e.g., 9,000 cfs.) out of Gavins Point Dam to maintain a wetted perimeter that would sustain fish populations. (Adapt specific recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Due to the dynamic nature of sandbar creation/erosion(both shallow water and above water sandbars), siltation, and vegetative encroachment processes and the importance of habitat occurring as a "complex" of secure nesting substrate, wet sand or wash area, and shallow submerged aquatic substrates, with the most successful nesting sites having at least one third of the complex in the wet sand and submerged substrate categories there should be an integration of orthophotography, habitat modeling, existing geographic information system layers, river flow and siltation models and previous habitat assessments to monitor changes in the quantity and distribution of habitat. This effort would identify factors resulting in positive or negative shifts in habitat and develop and rank habitat management alternatives.

Backwater restoration - This segment contains few functioning backwater areas. Redesigning structures in those areas could partially restore historic off-channel habitat that would allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoring diverse riverine habitats by reconnecting such areas would also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Increase flood plain/river connectivity might be completed in combination with fee title and easement acquisitions. Where Corps bank stabilization projects are in place and next to potential backwater restoration areas adjustments in these projects might need to be considered *(need to check with Remus; it has been a while since I have spent any time on the river so I am not certain what changes have occurred and where the best potential for restoration exists)*. Increasing floodplain connectivity would maximize the benefits of a more natural hydrograph by providing

fisheries spawning and nursery habitats, and organic contributions to the river. In addition, it would provide additional areas for floodwater storage during high water.

Acquisition of flood-prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes along this reach of the river. In addition, many of those areas historically were river backwaters. Acquisition could aid in restoration of those areas while providing floodwater storage and reducing flood damages. This would further the system wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Reverse bed degradation - Significant channel degradation along this reach must be reversed to maintain existing habitat and the potential to restore historic flood plain habitats. Channel degradation will continue to limit the potential to successfully reconnect the flood plain or backwater areas with the river during any but the highest river flows. That makes it more difficult to implement a hydrograph that can benefit flood plain and riverine fish and wildlife. In addition, such degradation has led to dewatering of flood plain wetlands, further reducing important habitat to bald eagles and many other fish and wildlife species. Sediment-starved channel also limits the potential to develop riverine shoals, sand bars, and islands that are so important to federally listed species.

Increase riverine habitat diversity and abundance - more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds. To that end, the Corps should pursue the feasibility of sloughing easements in problem areas that could address erosion concerns, provide a sediment source, and create more opportunities for greater riverine and riparian habitat diversity. An evaluation of current Corps bank stabilization projects in this reach may identify areas that they could abandon for sloughing easements. Because this reach is not authorized for navigation, there may be greater opportunity to carry out and evaluate the above measures without unacceptable adverse impacts to the river channel.

Other Efforts:

Pallid Sturgeon:

Support pallid sturgeon recovery program by contributing necessary resources to the Service's pallid sturgeon propagation program to ensure we meet recovery goals for pallid sturgeon in priority Managements Area 4. Artificial propagation efforts and augmentation of pallids in this reach may be necessary. The Pallid Sturgeon Recovery Plan identifies Recovery Priority management Areas that are a tool to direct limited resources to the highest priority areas. Contribute recovery funds to the Upper, Middle(Platte River), and Lower Basin Pallid Workgroups. Participate (Corps) in the Platte and Lower Basin Pallid Workgroups to improve coordination and information exchange on pallid sturgeon science.

Tern and Plover Management:

Where predator management cannot be addressed by flow management there is a need to assess the short and long-term roles of predator management measures including intensive (e.g., trapping, fencing etc.) and system oriented (e.g., large amounts of habitat reducing predator efficiency, high spring flow effects on riparian predators) measures. Management efforts will need to be continued to reduce human/bird conflicts. Alternative tern and plover management strategies will need to be developed for intensive management efforts (i.e., captive rearing and habitat creation) with the goal in mind of phasing out intensive management efforts.

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon and sicklefin and sturgeon chubs. Focus monitoring on the shallow water/slow velocity habitat (<1 meter in depth, < 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by these fish species.

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population plus those on the tributaries

Map and monitor bald eagle habitat along this reach and nest numbers to assess recolonization and reproductive success.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following;

Adaptive management
Public education about species biology
Angler education to identify and distinguish sturgeon species
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority. [further define influence of tributary regarding species and their recovery; define tributaries in general, i.e., all are included and then address those significant tributaries by reach; appendix with list of tribs ; also need decide how to address lower Missouri connection with middle Mississippi River]. This issue not only relates to physical/biological contributions of these tributaries but also individual species populations interconnectivity with the Missouri river(e.g., Platte River/Missouri River least terns)

Sediment Transport/by-pass

Fisheries access to trib.

SEGMENT - 11

PONCA, NE to SIOUX CITY, IA
CHANNELIZED
RIVER MILE 753.0 - RIVER MILE 735.0

Description: Historically, the river along this reach was braided and occupied a wide meander belt. In this area, the river was wider, more sinuous and underwent more natural cutoffs than reaches along the lower river. Construction of the main stem dams greatly reduced downstream sediment transport resulting significant channel degradation (i.e., 8 feet, average) that affects both riparian habitats and tributaries to the river. Reduced sediment supply and channel degradation have also lowered habitat diversity by eliminating shallow water habitats, sand shoals, bars, and islands. Loss of aquatic habitats has been accelerated through river training structures that reduced channel length and channel width. Consequently, suitable main channel and channel border habitats are rare and remnant off-channel habitats such as oxbow lakes, backwaters and chutes have been cut off and dewatered. Reservoir releases dominate flow patterns in this reach and have greatly altered the annual hydrograph. Dam operations attenuate naturally high spring flows which in turn reduces river/flood plain connectivity, thereby decreasing suitable fish nursery and spawning habitat, as well as allochthonous inputs of organic matter and nutrients. Present water management also results in abnormally high flows during the summer and early fall preventing the development of seasonal shallow, slow water riverine habitats. Such flow regimes magnify the poor, highly altered channel conditions for young-of-the-year fish and nesting shorebirds

Both the least tern and the piping plover historically nested in this river reach. Although there continues to be occasional records of nesting terns, habitat alterations have almost extirpated the least tern as well as the sicklefin and sturgeon chubs from this reach. Such habitat alterations are particularly important to the chubs which are found only in the main stem of the river.

Species/Priority/Objective:

Bald Eagle

Priority - Low.

Objective - Encourage re-colonization of historic eagle habitat by maintaining and improving riparian forested habitat for nesting and wintering bald eagles.
Improve/increase shallow water and off channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Indiana Bat:

Does not occur in this reach

Interior Least Tern:

Priority Medium/Low.

Objective - Re-establish nesting least tern colonies by restoring/creating suitable (unattached) sandbar habitat. Ideally, those habitats should be exposed approximately 60(?) consecutive days between June 1 and August 31. River flows should more closely approximate a natural hydrograph with a spring or early summer peak, followed by declining water levels to expose suitable habitat and encourage nesting success.
Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years.

Piping Plover:

Priority - Medium/low.

Objective - Create suitable (unattached) sandbar and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for migrating plovers. Along this reach, this may include increasing the organic inputs into the river system, ideally by reconnecting the river and the flood plain in selected areas (i.e., publically owned lands)

Performance indicator - Increased acreage of shallow-water and off-channel habitat within five years

Pallid Sturgeon:

Priority - High.

Objective - Re-establish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (e.g., timing, duration, temperature, variability). In the spring, flows should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off-channel habitats with the river. Summer and early fall flows should allow development of shallow, slow-water habitats and exposed sandbars for young-of-the-year fish. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity

(depths and velocities).
Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction over the next ten years. (Note: relying only on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking have influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - High.
Objective - Increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow water and off channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities).
Performance indicator - Increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Gavins Point Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing and variability as well. Releases should be tied to the projected water-year inflows (i.e., highwater years would have larger spring discharges than low water years). Discharges should strive to maintain steady (or ideally) declining flows during summer (after July 1) and should avoid flow reversals (no peaking). Such operations would benefit both fish and birds (terns) improving conditions for reproduction and survival of young. The recovery flows should also include a minimum flow (e.g., 9,000 cfs.) out of Gavins Point Dam to maintain a wetted perimeter that would sustain fish populations. (Adapt specific recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Backwater restoration - This segment contains few functioning backwater areas. Historic off-channel habitat (e.g. Mc Cook Lake, Miner's Bend, Big Sioux Bend) could be partially restored by redesigning structures in those areas that would allow for more potential native fish brood

habitat and an increase in the ecological integrity of this river segment. Restoring diverse riverine habitats by reconnecting such areas would also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Acquisition of flood-prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes along this reach of the river. In addition, many of those areas historically were river backwaters. Acquisition could aid in restoration of those areas while providing floodwater storage and reducing flood damages. This would further the system wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Increase flood plain/river connectivity - In combination with fee title and easement acquisitions, degrade, or eliminate maintenance of, levees that lie adjacent to flood plain and river restoration areas. That would maximize the benefits of the a more natural hydrograph by providing fisheries spawning and nursery habitats, as well as organic inputs to the river. In addition, it would provide additional areas for floodwater storage during high water.

Reverse bed degradation - Significant channel degradation along this reach must be reversed to maintain existing habitat and the potential to restore historic flood plain habitats. Channel degradation will continue to limit the potential to successfully reconnect the flood plain or backwater areas with the river during any but the highest river flows. That makes it more difficult to implement a hydrograph that can benefit flood plain as well as riverine fish and wildlife. In addition, such degradation has led to dewatering of flood plain wetlands, further reducing important habitat for bald eagles as well as numerous other fish and wildlife species. A sediment-starved channel also limits the potential to develop riverine shoals, sand bars, and islands that are so important to federally listed species.

Increase riverine habitat diversity and abundance - Efforts to widen the channel would increase habitat available to fish and foraging terns and plovers. Modify structures (e.g., notches) to create varying water depths and velocities and provide greater habitat diversity. Because the channel is narrow along this reach, measures to widen the top bank of the channel would also provide far more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds. To that end, the Corps should pursue the feasibility of sloughing easements in problem areas that could address erosion concerns, provide a sediment source, and create more opportunities for greater riverine and riparian habitat diversity. Because this reach in not authorized for navigation, there may be greater opportunity to implement and evaluate the above measures as well as manipulate channel training structures without unacceptable adverse impacts to the channel.

Close coordination on Corps O&M - O&M on all Corps structures should be consistent with species goals. O&M should, at a minimum, strive to maintain the existing habitats of high value to federally listed species. In addition, the Corps and the Service should identify opportunities

to use O&M work to further the habitat restoration efforts along this reach, including opportunistic/adaptive efforts to create scarce riverine and flood plain habitats (see above).

Other Efforts:

Pallid Sturgeon:

a) Artificial Propagation
   Augment pallid population as necessary
   - Determine need for hatchery facilities for lower Missouri River
b) Angler education - ID sturgeon species, recreational anglers

Tern and Plover Management:

a) Predator management - Assess the short and long-term roles of predator management measures including intensive (e.g. trapping, fencing etc.) and system oriented (e.g., large amounts of habitat reducing predator efficiency, high spring flows effect on riparian predators).
b) Continue efforts to reduce human/bird conflicts
c) Assess strategies to eventually phase out need for intensive bird management (i.e. captive rearing, small-scale habitat creation).

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon. Focus monitoring on the shallow water/slow velocity habitat (<1 meter in depth, < 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon (and chubs?).

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population as well as those on the tributaries.

Map and monitor bald eagle habitat along this reach as well as nest numbers to assess recolonization and reproductive success

Participate (Corps) in the Platte and Lower River Pallid Workgroups to improve coordination and information exchange on pallid sturgeon science

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following,

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management

BIN – Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority. [further define influence of tributary in regard to species and their recovery; define tributaries in general, i.e. all are included and then address those significant tributaries by reach; appendix with list of tribs.; also need decide how to address lower Missouri connection with middle Mississippi River]

Sediment Transport/by-pass

Fisheries access to tribs.

SEGMENT - 12

SIOUX CITY, IA to PLATTE RIVER
CHANNELIZED
RIVER MILE 735.0 - RIVER MILE 595.5

Description: Up to the 1930's, this reach retained much of its natural character. The braided channel covered a four-mile wide meander belt along the Iowa border. This reach had greater sinuosity and more cutoffs than reaches along the lower river. Construction of the main stem dams greatly altered the hydrograph and reduced downstream sediment transport resulting in poor bed stability (i.e., channel degradation) and lowered habitat diversity (i.e., sand shoals, bars, and islands). River training structures reduced the channel length by almost 12 miles and channel widths were almost halved. Consequently, suitable main channel and channel border habitats are essentially non-existent and remnant off-channel habitats such as oxbow lakes,

backwater, and chutes have been cut off and dewatered. Reservoir releases dominate flow patterns in this reach and have greatly altered the annual hydrograph. Upstream dam operations attenuate naturally high spring flows which in turn reduces river/flood plain connectivity, thereby decreasing suitable fish nursery and spawning habitat, as well as allochthonous inputs of organic matter and nutrients. Present water management also results in abnormally high flows during the summer and early fall preventing the development of seasonal shallow, slow water riverine habitats. Such flow regimes magnify the poor, highly altered channel conditions for young-of-the year fish and nesting shorebirds.

The areas immediately upstream and downstream of the confluence Missouri and Platte Rivers have been identified as management priority areas for pallid sturgeon recovery based on sturgeon occurrence and the potential for successful habitat restoration in those areas. Historically, both the least tern and the piping plover nested in this river reach (only known records of plover nesting in Iowa). Although there continues to be occasional records of nesting terns, habitat alterations have almost extirpated the least tern as well as the sicklefin and sturgeon chubs from this reach. Such habitat alterations are particularly important to the chubs which are found only in the main stem of the river.

Species/Priority/Objective:

Bald Eagle:

Priority - Low.

Objective - Encourage re-colonization of historic eagle habitat by maintaining and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Indiana Bat:

Does not occur in this reach.

Interior Least Tern:

Priority - Medium/Low.

Objective - Re-establish nesting least tern colonies by restoring/creating suitable (unattached) sandbar habitat. Ideally, those habitats should be exposed approximately 60(?) consecutive days between June 1 and August 31. River flows should more closely approximate a natural hydrograph with a spring or early summer peak, followed by declining water levels to encourage nesting success. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years.

Piping Plover:

Priority - Medium/Low.
Objective - Create suitable (unattached) sandbar and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for migrating plovers. Along this reach, this may include increasing the organic inputs into the river system, ideally by reconnecting the river and the flood plain in selected areas (i.e., publically owned lands).
Performance indicator - Increased acreage of shallow water and off channel habitat within five years.

Pallid Sturgeon:

Priority - High.
Objective - Re-establish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (e.g., timing, duration, temperature, variability). In the spring, flow should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off-channel habitats with the river. Summer and early fall flows should allow development of shallow, slow-water habitats and exposed sandbars for young-of-the-year fish. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities).
Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction. (Note: relying only on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking have influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - High.
Objective - Increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities).
Performance indicator - Increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and to lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge of the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Gavins Point Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing and variability as well. Releases should be tied to the projected water-year inflows (i.e., highwater years would have larger spring discharges than low water years). Discharges should strive to maintain steady (or ideally) declining flows during summer (after July 1?) and should avoid flow reversals. Such operations would benefit both fish and birds (terns) improving conditions for reproduction and survival of young. (Use recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Backwater restoration - This segment contains some functioning backwater areas but many others have been engineered to be "cut off" from normal flows (e.g., Blackbird/Treville, California, Decatur Bends). These areas should be redesigned to allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoring diverse riverine habitats by reconnecting cutoff features will also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Reverse bed degradation - Although the rate of bed degradation along this reach is stabilizing, channel degradation will continue to limit the potential to successfully reconnect the flood plain or backwater areas with the river during any but the highest river flows. That makes it more difficult to implement a hydrograph that can benefit flood plain as well as riverine fish and wildlife. In addition, such degradation has led to dewatering of flood plain wetlands, further reducing important habitat to bald eagles as well as numerous other fish and wildlife species. A sediment starved channel also limits the potential to develop riverine shoals, sandbars, and islands that are so important to federally listed species.

Acquisition of flood-prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes along this reach of the river. In addition, many of those lands historically were river backwaters. Acquisition could facilitate restoration of those areas while providing floodwater storage and reducing flood

damages. This,would further the system-wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Increase riverine habitat diversity and abundance - Efforts to widen the navigation channel would increase habitat available to fish and foraging terns and plovers. Modify structures to create varying depths and velocities and provide greater habitat diversity. Because the channel is so narrow along this reach, measures to widen the top bank of the channel would also provide for more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds. Existing navigation constraints along this reach will limit the opportunities for significant structure modification.

Increase flood plain/river connectivity - In combination with fee title (and easement?) acquisitions, degrade, or eliminate maintenance of, levees that lie adjacent to flood plain and river restoration areas. That would maximize the benefits of a more natural hydrograph by providing fisheries spawning and nursery habitats, as well as organic inputs to the river. In addition, such areas would provide additional floodwater storage during high water.

Close coordination on Corps O&M - O&M on all Corps structures should be consistent with species goals. O&M should, at a minimum, strive to maintain the existing habitats of high value to federally listed species. In addition, the Corps and the Service should identify opportunities to use O&M work to further the habitat restoration efforts along this reach, including opportunistic/adaptive efforts to create scarce riverine and flood plain habitats (see above).

Other Efforts:

Pallid Sturgeon:

a) Artificial Propagation
   - Augment pallid population as necessary
   - Determine need for hatchery facilities for lower Missouri River
b) Angler education - ID sturgeon species, recreational anglers

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon. Focus monitoring on the shallow water/slow velocity habitat (<1 meter in depth,< 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon.

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population as well as those on the tributaries.

Map and monitor bald eagle habitat along this reach as well as nest numbers to assess recolonization and reproductive success

Participate (Corps) in the Platte and Lower Missouri River Pallid Workgroup to improve coordination and information exchange on pallid sturgeon science.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following;

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority [further define influence of tributary in regard to species and their recovery; define tributaries in general, i.e. all are included and then address those significant tributaries by reach; appendix with list of tribs.; also need decide how to address lower Missouri connection with middle Mississippi River]

Sediment Transport/by-pass

Fisheries access to tribs. (e.g., Big Sioux River)

SEGMENT - L3

PLATTE RIVER to KANSAS CITY, MO
CHANNELIZED
RIVER MILE 595.5 - RIVER MILE 367.5

Description: Pre-development channel morphology, aquatic habitat conditions, and fish and wildlife resources in this reach are similar to those in the previous reach. This reach has experienced the greatest losses in chutes and side channels, as well as significant reductions in both channel width and length because of river training structures. Consequently, channel capacity has been reduced; suitable main channel and channel border habitats are essentially non-existent; and remnant off-channel habitats such as oxbow lakes, backwaters, and chutes have been cut off from the river. River flow is controlled during low and medium flows by spur dikes and revetments, while overbank flows are controlled by flood plain levees limiting overbank flooding to small areas riverward of the levees. The construction of the natural channel and levee encroachment onto the flood plain have reduced floodway conveyance and raised flood stages for a given discharge compared to historic conditions.

The flow regime in this reach is still greatly influenced by reservoir releases, augmented by several tributaries, most notably the Platte and Kansas rivers. Reservoir operations have greatly altered the annual hydrograph and attenuated naturally high spring flows which reduced river/flood plain connectivity, thereby reducing suitable fish nursery and spawning habitat, as well as allochthonous inputs of organic matter and nutrients. Present water management also results in abnormally high flows during the summer and early fall. Such flows prevent development of seasonal shallow, slow-water areas and exposed sandbars that are important to young-of-the-year fish and nesting birds. Unlike the Sioux City-Plattsmouth reach, however, this reach of river channel is not degrading, perhaps because of large amounts of coarse bed material introduced by the Platte River.

The areas at the confluence of Missouri and Platte rivers and the Missouri and Kansas rivers has been identified as management priority areas for pallid sturgeon recovery based on sturgeon occurrence and the potential for successful habitat restoration in those areas. Although the least tern historically nested along this reach, habitat alterations have extirpated nesting colonies from the area. In addition sicklefin and sturgeon chub populations have declined greatly from historic levels, and are limited essentially to the main stem Missouri River, with rare occurrences of sturgeon chub in the lower Platte River.

Species/Priority/Objective:

Bald Eagle:

Priority - Medium/Low.

Objective - Encourage re-colonization of historic eagle habitat by maintaining and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years

Indiana Bat:

Does not occur in this reach

Interior Least Tern:

Priority - Medium/Low.

Objective - Re-establish nesting least tern colonies by restoring/creating suitable (unattached) sandbar habitat. Ideally, those habitats should be exposed approximately 60(?) consecutive days between June 1 and 31 August). River flows should more closely approximate a natural hydrograph with a spring or early summer peak, followed by declining water levels to encourage nesting success. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years.

Piping Plover:

Priority - Low.

Objective - Create suitable (unattached) sandbar and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for migrating plovers. Along this reach, this may include increasing the organic inputs into the river system, ideally by reconnecting the river and the flood plain in selected areas (i.e., publically owned lands).

Performance indicator - Increased acreage of shallow-water and off-channel habitat within five years.

Pallid Sturgeon:

Priority - High.

Objective - Re-establish self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (e.g., timing, duration, variability). In the spring, flow should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off-channel habitats with the river. Summer and early fall flows should allow development of shallow, slow-water habitats and exposed sandbars for young-of the-year fish. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities)

Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction. (Note: relying on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking have influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - High.

Objective Maintain and increase population of chubs by restoring/improving aquatic habitats though flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities)

Performance indicator - Increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and to lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Gavins Point Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing and variability as well. Releases should be tied to the projected water-year inflows (i.e., highwater years would have larger spring discharges than low water years). Discharges should strive to maintain steady (or ideally) declining flows during summer (after July 1?) and should avoid flow reversals. Such operations would benefit both fish and birds (terns) improving conditions for reproduction and survival of young. (Use recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Acquisition of flood-prone lands - The purchase (fee title) of low-lying areas on the flood plain that are a chronic problem for landowners should be a priority along this reach. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes while minimizing flood damages along this reach of the river. This would

further the system-wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Increase flood plain/river connectivity - In combination with fee title (and easement?) acquisitions, degrade, or eliminate maintenance of, levees that lie adjacent to flood plain and river restoration areas. That would maximize the benefits of a more natural hydrograph by providing fisheries spawning and nursery habitats as well as organic inputs to the river. Such areas would also provide additional floodwater storage during high water.

Increase riverine habitat diversity and abundance - Efforts to widen the navigation channel would increase habitat available to fish and foraging terns and plovers. Because the channel is so narrow along this reach, measures to widen the top bank of the channel would also provide far more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds.

Backwater restoration - This segment contains some functioning backwater areas but many others have been engineered to be "cut off" from normal flows (e.g., Tobacco Island, Indian Cave Bend, Rush Bottom Bend). Those areas should be redesigned to allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoring diverse riverine habitats by reconnecting such features will also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Close coordination on Corps O&M - O&M on all Corps structures should be consistent with species goals. O&M should, at a minimum, strive to maintain the existing habitats of high value to federally listed species. In addition, the Corps and the Service should identify opportunities to use O&M work to further the habitat restoration efforts along this reach, including opportunistic/adaptive efforts to create scarce riverine and flood plain habitats (see above).

Other Efforts:

Pallid Sturgeon:

a) Artificial Propagation
   Augment pallid population as necessary
   - Determine need for hatchery facilities for lower Missouri River
b) Angler education - ID sturgeon species, primarily recreational anglers
c) Assess affects of training structures at the confluence of the Platte and Missouri rivers on sediment transport, shoaling, and pallid sturgeon.

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon. Focus monitoring on the shallow water/slow velocity habitat (<1 meter in depth,< 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon.

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population as well as those on the tributaries

Map and monitor bald eagle habitat along this reach as well as nest numbers to assess recolonization and reproductive success

Participate (Corps) in the Platte and Lower Missouri River Pallid Workgroup to improve coordination and information exchange on pallid sturgeon science.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following;

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps role in river management
Public's role in river management

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority [further define influence of tributary in regard to species and their recovery; define tributaries in general, i.e. all are included and then address those significant tributaries by reach; appendix with list of tribs.; also need decide how to address lower Missouri connection with middle Mississippi River]

Sediment Transport - role of the Platte and other tribs in sediment budget of the lower river and importance in channel aggradation/degradation

Fisheries access to tributaries

SEGMENT 14

KANSAS CITY, MO to OSAGE RIVER
CHANNELIZED
RIVER MILE 367.5 - RIVER MILE 130.4

Description: Pre development channel morphology, aquatic habitat conditions, and fish and wildlife resources in this reach are similar to those of the previous reach. However, overall losses of aquatic habitat as represented by water surface area while significant (4.5%), have not been as great as upstream reaches. A large part of these losses occurred upstream of Lexington and downstream of Boonville, where a large number of major island complexes once occurred. Most of the islands, chutes, sandbars, and backwaters have been eliminated in this reach. however, some large point bars in bends and several side channels remain. Along this reach the river becomes appreciably larger with greater channel widths and larger training structures. Consequently, dike notching and construction of rootless dikes has created large sandbars in main channel border areas. Although tributaries along and upstream of this reach ameliorate some effects of main stem dam operations, this area is also influenced by discharges from Gavins Point Dam. The greatest changes from the pre-development hydrograph are increased summer and early fall flows to support navigation. Such flows prevent development of seasonal shallow, slow-water areas and exposed sandbars that are important to young of the-year fish and nesting birds. Because of the influence of the tributaries, however, river flows in this reach appear to have more natural temperature and sediment regimes than upstream reaches.

The areas at the confluence of the Missouri and Kansas rivers has been identified as management priority areas for pallid sturgeon recovery based on sturgeon occurrence and the potential for successful habitat restoration in those areas. In addition, although historical records of nesting least terns are not as common along this reach as upstream reaches, habitat and flow alterations have essentially eliminated potential nesting habitat. In this reach, sicklefin and sturgeon chub populations appear to be stable or increasing over the last sixty years which makes this area particularly important as a source population for upstream reaches where they appear to have been extirpated.

Species/Priority/Objective:

Bald Eagle:

Priority - Low.

Objective - Encourage re colonization of historic eagle habitat by maintaining and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years

Indiana Bat:

Priority - Low.

Objective - Improve/increase riparian forested habitat throughout reach to support maternity roosts and suitable forage habitat for Indiana bats.

Performance indicator - Stable or increasing acreage of riparian forest throughout reach.

Interior Least Tern:

Priority - Low.

Objective - Re-establish nesting least tern colonies by restoring/creating suitable (unattached) sandbar habitat. Ideally, those habitats should be exposed approximately 60(?) consecutive days between June 1 and 31 August). River flows should more closely approximate a natural hydrograph with a spring or early summer peak, followed by declining water levels to expose appropriate habitat and encourage nesting. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years

Piping Plover:

Priority - Low.

Objective - Create suitable (unattached) sandbar and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for migrating plovers. Along this reach, this may include increasing the organic inputs into the river system, ideally by reconnecting the river and the flood plain in selected areas (i.e., publically owned lands).

Performance indicator - Increased acreage of shallow-water and off-channel habitat within five years.

Pallid Sturgeon:

Priority - High.

Objective - Re-establish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (e.g., timing, duration, variability). In the spring, flow should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off channel habitats with the river. Summer and early fall flows should allow development of shallow, slow-water habitats and exposed sandbars for young-of-the-year fish. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs) and provide greater habitat diversity (depths and velocities)

Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction. (Note: relying on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking have influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - Medium.

Objective - Maintain and increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off channel habitats with the river. Structural alterations of the river should also increase shallow water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities).

Performance indicator - Stable or increasing chub numbers throughout reach over next five years

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and to lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Gavins Point Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing as well. Releases should be tied to the projected water-year inflows (i.e., highwater years would have larger spring discharges than low water years). Discharges should strive to maintain steady (or ideally) declining flows during summer (after July 1?) and should avoid flow reversals. Such operations would benefit both fish and birds (terns) improving conditions for reproduction and survival of young. (Use recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Acquisition of flood-prone lands - Purchase (fee title) low-lying areas on the flood plain that are a chronic problems for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes while minimizing flood damages along this reach of the river. This would further the system-wide goal of maintaining

and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Increase flood plain/river connectivity - In combination with fee title (and easement?) acquisitions, degrade, or eliminate maintenance of, levees that lie adjacent to flood plain and river restoration areas. That would maximize the benefits of a more natural hydrograph by providing fisheries spawning and nursery habitats as well as organic inputs to the river. Such areas would also provide additional floodwater storage during high water.

Increase riverine habitat diversity and abundance - Efforts to widen the navigation channel would increase habitat available to fish and foraging terns and plovers. Although the channel width increases along this reach, measures to widen the top bank of the channel would likely provide far more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds.

Backwater restoration - This segment contains some functioning backwater areas but many others have been engineered to be "cut off" from normal flows (e.g., Liberty Bend Cut-off). Those areas should be redesigned to allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoration diverse riverine habitats by reconnecting cutoff features will also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats in the reach would be an important first step.

Close coordination on Corps O&M - O&M on all Corps structures should be consistent with species goals. O&M should, at a minimum, strive to maintain the existing habitats of high value to federally listed species. In addition, the Corps and the Service should identify opportunities to use O&M work to further the habitat restoration efforts along this reach, including opportunistic/adaptive efforts to create scarce riverine and flood plain habitats (see above). Ideally, innovative engineering designs of structures (e.g, selected chute reconnections and new chutes such as Lisbon Bottoms) should be monitored to evaluate structural performance.

Comprehensive flood plain management - There is a need to look at proactive, comprehensive (i.e., multiple river reaches) approach to managing flood plain development and flood control. In this reach and the reach immediately downstream, there are a number of proposed private and federal flood control levee projects (as well as highway and bridge proposals) that will significantly affect the lower Missouri River flood plain. Such projects often lead to additional structural measures to address induced flooding elsewhere (e.g., levee wars). Poorly planned flood plain development and continued encroachment of the floodway reduces the Corps flexibility to operate the river for flood control, as well as fish and wildlife. In addition, it exacerbates flooding and flood damages in low-lying areas. A comprehensive flood control strategy for the river should include non-structural alternatives consistent with system-wide goals where appropriate.

Other Efforts:

Pallid Sturgeon:

a) Artificial Propagation
   Augment pallid population as necessary
   - Determine need for hatchery facilities for lower Missouri River
b) Angler education - ID sturgeon species, recreational and commercial fishermen.

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon. Focus monitoring on the shallow water/slow velocity habitat (< 1 meter in depth,< 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon.

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows

Map and monitor bald eagle habitat along this reach as well as nest numbers to assess recolonization and reproductive success.

Participate (Corps) in the Lower Missouri River (and MICRA) Pallid Workgroup to improve coordination and information exchange on pallid sturgeon science.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following;

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management
Flood plain management an non-structural methods of flood control

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority [further define influence of tributary in regard to species and their recovery; define tributaries in general, i.e. all are included and then address those significant tributaries by reach; appendix with list of tribs., also need decide how to address lower Missouri connection with middle Mississippi River]

Fisheries access to tribs

SEGMENT - 15

OSAGE RIVER to the mouth of the MISSOURI RIVER
CHANNELIZED
RIVER MILE 130.4 - RIVER MILE 0.0

Description: Pre-development channel morphology, aquatic habitat conditions, and fish and wildlife resources in this reach are similar to those of the previous reach. Overall losses of aquatic habitat (48%) as represented by water surface area are similar to the adjacent upstream reach. A large part of these losses occurred downstream of Washington, Missouri and included islands, chutes, sandbars, and backwaters. Although a significant number of habitat features have been eliminated in this reach, it still retains more pre-development characteristics than upstream reaches. Along this reach the river becomes appreciably larger with greater channel widths and larger training structures. Consequently, dike notching and construction of rootless dikes has created large sandbars and backwaters in main channel border areas. River flows increase substantially in this reach due to inflows from two large tributaries, the Osage and the Gasconade. Tributaries along and upstream of this reach ameliorate some effects of the main stem dam operations, however, this area is still influenced by discharges from Gavins Point. The greatest changes from the pre-development hydrograph are increased summer and early fall flows to support navigation. Such flows prevent development of seasonal shallow, slow-water areas and exposed sandbars that are important to young-of-the-year fish and nesting birds. Because of the influence of the tributaries, however, river flows in this reach appear to have more natural temperature and sediment regimes than upstream reaches.

The area at the confluence of the Missouri and Osage rivers has been identified as a management priority area for pallid sturgeon recovery based on sturgeon occurrence and the potential for successful habitat restoration in those areas. In this reach sicklefin and sturgeon chub populations appear to be stable or increasing over the last sixty years, which makes this area particularly important as a source population for depleted reaches in both the Missouri and Mississippi rivers.

Species/Priority/Objective:

Bald Eagle:

Priority - Low

Objective - Encourage re-colonization of historic eagle habitat by maintaining and improving riparian forested habitat for nesting and wintering bald eagles
Improve/increase shallow water and off channel fisheries habitat to provide a forage base for nesting and wintering bald eagles

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along this reach over the next five to ten years.

Indiana Bat:

Priority - Low.

Objective - Improve/increase riparian forested habitat throughout reach to support maternity roosts and suitable forage habitat for Indiana bats.

Performance indicator - Stable or increasing acreage of riparian forest throughout reach.

Interior least tern:

Priority - Low.

Objective - Re-establish nesting least tern colonies by restoring/creating suitable (unattached) sandbar habitat. Ideally, those habitats should be exposed approximately 60(?) consecutive days between 15 June and 31 August). River flows should more closely approximate a natural hydrograph with a spring or early summer peak, followed by declining water levels to expose appropriate habitat and encourage nesting.
Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Establishment and successful reproduction of nesting least terns along this reach over the next five to ten years.

Piping Plover:

Priority - Low.

Objective - Create suitable (unattached) sandbar and off-channel, shallow water habitat that provides forage (i.e., invertebrates) for migrating plovers. Along this reach, this may include increasing the organic inputs into the river system, ideally by reconnecting the river and the flood plain in selected areas (i.e., publically owned lands).

Performance indicator - Increased acreage of shallow-water and off-channel habitat within five years.

Pallid Sturgeon:

Priority - High.

Objective - Re-establish a self-sustaining population of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (e.g., timing, duration, variability). In the spring, flow should be suitable to trigger spawning cues in pallid sturgeon and seasonally reconnect selected flood plain areas and off-channel

habitats with the river. Summer and early fall flows would allow development of shallow, slow water habitats and exposed sandbars for young-of-the year fish. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities).

Performance indicator - Increased ratio of pallid sturgeon to shovelnose sturgeon sampled along the reach and evidence of pallid sturgeon reproduction. (Note: relying on acres of suitable habitat would not assess the extent to which the hydrograph is providing the appropriate spawning cues to the sturgeon. The ratio of pallid/shovelnose sturgeon may better integrate the extent to which habitat, hydrograph, and stocking have influenced the pallid population.)

Sicklefin and Sturgeon Chubs:

Priority - Medium.

Objective - Maintain and increase population of chubs by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that would include a more natural hydrograph (timing and duration being suitable to trigger spawning cues in the chubs) that would seasonally reconnect selected flood plain areas and off-channel habitats with the river. Structural alterations of the river should also increase shallow-water and off-channel habitats (i.e., side channels, chutes, sloughs)and provide greater habitat diversity (depths and velocities).

Performance indicator - Stable or increasing chub numbers throughout reach over next five years.

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and to lead to their recovery in this reach. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat needs.

"Recovery Flows":

Discharges from Gavins Point Dam should attempt to reflect more of the pre-project hydrograph. Ecologically driven flow regimes would more closely mimic not only the historic discharge pattern, but timing as well. Releases should be tied to the projected water-year inflows (i.e., highwater years would have larger spring discharges than low water years). Discharges should strive to maintain steady (or ideally) declining flows during summer (after July 1?) and should avoid flow reversals. Low flows would maximize benefits from existing aquatic habitat by forming shallow water areas and exposing sandbars, islands, and shoals presently covered by artificially high summer flow. Such operations would benefit both fish and birds (terns) improving conditions for reproduction and survival of young. (Use recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Acquisition of flood-prone lands - Purchase, in fee title, the low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes while minimizing flood damages along this reach of the river. This would further the system-wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Increase flood plain/river connectivity - In combination with fee title (and easement?) acquisitions, degrade, or eliminate maintenance of, levees that lie adjacent to flood plain and river restoration areas. That would maximize the benefits of a more natural hydrograph by providing fisheries spawning and nursery habitats as well as organic inputs to the river. Such areas would also provide additional floodwater storage during high water.

Increase riverine habitat diversity and abundance - Efforts to widen the navigation channel would increase habitat available to fish and foraging terns and plovers. Although the channel width increases along this reach, measures to widen the top bank of the channel would likely provide far more opportunity to maintain and increase shallow, slow water/sandbar pool complexes that are important to both fish and nesting birds.

Backwater restoration - This segment contains some functioning backwater areas but many others have been engineered to be "cut off" from normal flows. Those areas should be redesigned to allow for more potential native fish brood habitat and an increase in the ecological integrity of this river segment. Restoration diverse riverine habitats by reconnecting cutoff features will also contribute to system-wide goals. A comprehensive digitized inventory of the backwater habitats on the reach would be an important first step.

Close coordination on Corps O&M - O&M on all Corps structures should be consistent with species goals. O&M should, at a minimum, strive to maintain the existing habitats of high value to federally listed species. In addition, the Corps and the Service and should identify opportunities to use O&M work to further the habitat restoration efforts along this reach, including opportunistic/adaptive efforts to create scarce riverine and flood plain habitats (see above). Ideally, innovative engineering designs or structures (e.g., selected chute reconnections, new chutes, and associates structures such as chevrons) should be monitored to evaluate structural performance.

Comprehensive flood plain management - There is a need to look at proactive, comprehensive (i.e., multiple river reaches) approach to managing flood plain development and flood control. In this reach and the reach immediately upstream, there are a number of proposed private and federal flood control levee projects (as well as highway and bridge proposals) that will significantly affect the lower Missouri River flood plain. Such projects often lead to additional structural measures to address induced flooding elsewhere (e.g., levee wars). Poorly planned flood plain development and continued encroachment of the floodway reduces the Corps flexibility to operate the river for flood control, as well as fish and wildlife. In addition, it exacerbates flooding and flood damages in low-lying areas. A comprehensive flood control strategy for the river should include non-structural alternatives consistent with system-wide goals where appropriate.

Other Efforts:

Pallid Sturgeon:

a) Artificial Propagation
   - Augment pallid population as necessary
   - Determine need for hatchery facilities for lower Missouri River
b) Angler education - ID sturgeon species, recreational and commercial fishermen.
c) Interaction with Mississippi River "population"

Sicklefin and Sturgeon Chub:

Interaction with Mississippi River "populations"

Monitoring Program and Coordination:

Map and monitor trends in riverine, riparian, and flood plain habitats key to the continued existence of the pallid sturgeon. Focus monitoring on the shallow water/slow velocity habitat (<1 meter in depth,< 1 meter per second velocity) along this reach to ensure any changes in management are having desired effect. The goal of this effort would be to document an increase in the shallow and slow water habitat preferred by pallid sturgeon.

Map and monitor tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows.

Map and monitor bald eagle habitat along this reach as well as nest numbers to assess recolonization and reproductive success.

Participate (Corps) in the Lower Missouri River (and MICRA?) Pallid Workgroup to improve coordination and information exchange on pallid sturgeon science

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following.

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river
Corps' role in river management
Public's role in river management
Flood plain management an non-structural methods of flood contro.

BIN - Misc. Things We Need To Address:

Tributaries - defined by where operations have influence or where the Corps has jurisdiction by ownership or authority. [further define influence of tributary in regard to species and their recovery, define tributaries in general, i.e. all are included and then address those significant tributaries by reach, appendix with list of trabs.; also need decide how to address lower Missouri connection with middle Mississippi River]

Fisheries access to tribs.

SEGMENT - 16

KANSAS RIVER (CONFLUENCE of the REPUBLICAN and SMOKY HILL RIVERS to the mouth of the KANSAS RIVER)
UNCHANNELIZED
RIVER MILE 0 - RIVER MILE 0030

Description. Historically the Kansas River was braided and occupied a wide meander belt. Construction of the major tributary dams greatly reduced downstream sediment transport resulting in significant channel degradation and bank sloughing that affects both riparian and in stream habitats. Many main channel and channel border habitats have been lost, and remnant off-channel habitats such as oxbow lakes, backwater, and chutes have been cut off and dewatered. Reservoir releases significantly affect flow patterns in this River and have greatly altered the annual hydrograph. Dam operations attenuate naturally high spring flows which in turn reduces river/floodplain connectivity, thereby decreasing suitable fish nursery and spawning habitat, as well as allochthonous inputs of organic matter and nutrients. Present water management also results in higher flows later in the summer and early fall, affecting the development of seasonal shallow, slow water riverine habitats.

Neither the least tern nor the piping plover historically nested on the mainstem Kansas River, although there are historic records of nesting least terns on some of the larger tributaries in the western part of the basin. The first records of least terns nesting on the mainstem, and the first records for piping plovers nesting anywhere in the state, occurred in 1996 on the Kansas River

near Wabaunsee (RM 131). Their occurrence is believed due to habitat alterations resulting from floods in 1993 and 1995. Both species have returned each year since 1996. Anecdotal accounts indicate bald eagles historically present on the Kansas River during the nesting season, but the first mainstem nest was not documented until 1997. Habitat alterations have resulted in no recent records for pallid sturgeon, as well as the sicklefin and sturgeon chubs, from the Kansas River.

Species/Priority/Objective:

Bald Eagle

Priority - Low

Objective - Encourage colonization of bald eagle habitat by maintaining and improving riparian forested habitat for nesting and wintering bald eagles. Improve/increase shallow water and off channel fisheries habitat to provide a forage base for nesting and wintering bald eagles.

Performance indicator - Stable or increasing nesting and wintering bald eagle populations along the river over the next five to ten years.

Indiana Bat:

Does not occur in this reach.

Interior Least Tern

Priority - High.

Objective - Maintain nesting least tern colonies by restoring/creating suitable (unattached) sandbar habitat. Ideally, those habitats should be exposed approximately 60(?) consecutive days between June 15 and 31 August. Reservoir releases should attempt to provide elevated flows sometime during late winter to early summer, followed by declining water levels to encourage nesting success. Improve/increase shallow water and off-channel fisheries habitat to provide a forage base for least terns near nesting colonies.

Performance indicator - Maintenance and successful reproduction of nesting least terns along the river at least ? out of every five years.

Piping Plover:

Priority - Medium/Low.

Objective - Nesting piping plovers appear to be associated with nesting least terns, so it is believed that measures taken to enhance least tern reproductive success will result in the same effect on the piping plover.

Performance indicator - Same as for the least tern (or possibly reduced % of time??)

Pallid Sturgeon:

Priority - Low.

Objective - Attempt to re-establish flow patterns in the lowest reach of river, below Bowersock Dam (RM 52), for the benefit of pallid sturgeon by restoring/improving aquatic habitats through flow alterations and structural habitat manipulation. Ideally, that

would include a more natural hydrograph (e.g., timing, duration, temperature, variability). Implement monitoring protocol to document use of this reach of the river by the species.
Performance indicator - Captures of pallid sturgeon would indicate the species is utilizing this reach at least part of the time.

Sicklefin and Sturgeon Chubs:
Priority - Low.
Objective - Same as for pallid sturgeon.
Performance indicator - Same as for pallid sturgeon.

Management Strategies:

Goal: Use the best science available in directing efforts to improve habitat for federally listed species and lead to their recovery in this river. Restoration measures will be based on an adaptive management approach (previously defined), which in this reach will reflect growing knowledge on the relationships between various river flows, temperatures, sediment dynamics, and habitat goals.

"Recovery Flows":

Discharges from Tuttle Creek and Milford reservoirs should attempt to reflect a combination of the pre- and post-impoundment hydrographs, primarily for the benefit of least terns and piping plovers. Releases should be tied to the projected water-year inflows (i.e., highwater years would have larger spring discharges than low water years). Discharges should strive to maintain high flows during the period late winter to early summer, including sufficient flows sometime during this period to remove/retard sandbar vegetative growth, followed by steadily declining flows after June 15, and should avoid flow reversals (no peaking). Such operations would benefit terns and plovers in the occupied reach (RM 145 - 70).

Discharges from Perry and Clinton reservoirs should attempt to mimic pre-impoundment hydrograph whenever possible, to create multiple habitat types within the channel and off-channel, to benefit bald eagle, pallid sturgeon and the two chubs. Discharges from Glen Elder, Wilson, and Kanopolis reservoirs should be implemented to assist the other four reservoirs in meeting their stated species goals. Release patterns from all reservoirs in the Kansas River system should avoid sharp decreases from high flows, a practice which facilitates bank sloughing and riparian vegetation degradation. (Adapt specific recommendations from MRNRC Fish Tech Committee, Master Manual Alternative, Tern and Plover Group AOP's etc.)

Riverine Morphology:

Acquisition of flood-prone lands - Purchase, in fee title, the low-lying areas on the flood plain that are a chronic problem for landowners. Not only would those areas then be available for restoration of flood plain fish and wildlife habitat, but purchase of critically-located flood-prone areas may allow greater flexibility in achieving ecologically driven flow regimes along this reach

of the river. In addition, many of these areas probably occur in acres that historically were river backwaters. Acquisition could also aid in restoration of those areas while providing flood water storage and reducing flood damages. This would further the system-wide goal of maintaining and possibly increasing the Corps operational flexibility to provide flood control and improve habitat management.

Increase flood plain/river connectivity - In combination with fee title and easement acquisitions, degrade, or eliminate maintenance of, levees that lie adjacent to flood plain and river restoration areas. That would maximize the benefits of the a more natural hydrograph by providing fisheries spawning and nursery habitats, as well as organic inputs to the river. In addition, it would provide additional areas for flood water storage during high water.

Reverse bed degradation. Significant channel degradation along the lower reach of river (RM 50 - 0), primarily due to commercial sand dredging, must be reversed to maintain existing habitat and the potential to restore historic channel and floodplain habitats. Channel degradation will continue to limit the potential to successfully reconnect the flood plain or backwater areas with the river during any but the highest river flows. That makes it more difficult to implement a hydrograph that can benefit flood plain as well as riverine fish and wildlife. In addition, such degradation has led to dewatering of flood plain wetlands, further reducing important habitat to bald eagles as well as numerous other fish and wildlife species. Sediment-starved channel also limits the potential to develop riverine shoals, sand bars, and islands that are so important to federally listed species.

Increase riverine habitat diversity and abundance - In the lower reach (RM 50 - 0), the Corps should pursue the feasibility of sloughing easements in problem area that could address erosion concerns, provide a sediment source, and create more opportunities for greater riverine and riparian habitat diversity. Because this reach in not authorized for navigation, there may be greater flexibility to evaluate the above measures as well as manipulate channel training structures without unacceptable adverse impacts to the channel. The Corps' Regulatory Branch should condition Clean Water Act section 10/404 bank stabilization projects to utilize non-traditional methods, favoring bank reshaping and use of bioengineering in place of steep rocked banks.

Close coordination on Corps O&M - O&M on all Corps structures should be consistent with species goals. O&M should, at a minimum, strive to maintain the existing habitats of high value to federally listed species. In addition, the Corps and the Service and should identify opportunities to use O&M work to further the habitat restoration efforts along this reach, including opportunistic/adaptive efforts to create scarce riverine and flood plain habitats (see above). Coordination should also include the Kansas Department of Wildlife and Parks, which is charged with management of reservoir lands and waters for the benefit of sport fish and waterfowl habitat.

Other Efforts:

Bald Eagle Management

a) Through Clean Water Act section 10/404 permit authority, and reservoir release management, mature riparian trees should be protected and enhanced. The Corps should adopt a policy of "no net loss" of riparian timber along the Kansas River

Tern and Plover Management

a) Assess the short and long-term roles of predator management measures including intensive (e.g. trapping, fencing etc) and system oriented (e.g., large amounts of habitat reducing predator efficiency, high spring flows' effects on riparian predators).

b) If human use of colonized river reaches increases, encourage efforts to reduce human/bird conflicts.

Monitoring Program and Coordination:

Map and monitor trends in riparian and off-channel habitats necessary for the maintenance and expansion of nesting bald eagles on the Kansas River.

Map and monitor annual tern and plover habitat and assess nesting/foraging use of those habitats to evaluate management performance. Relate to long term trends habitat/species trends and effects of ecologically driven river flows. Relate species trends of each reach and their interactions to the main stem population as well as those on the tributaries.

Outreach:

Develop and implement a robust outreach plan for the reach including but not limited to the following:

Adaptive management
Public education about species biology
River ecology
Success stories
Cooperative approach to solving problems on the river

Corps' role in river management
Public's role in river management

BIN - Misc. Things We Need To Address: