I. INTRODUCTION

The purpose of this report is to describe and document the development of Shallow Water Habitat (SWH) completed by the U.S. Army Corps of Engineers (Corps) since the submission of the November 2003 Final Biological Assessment on the Operations of the Missouri River Mainstem Reservoir System, the Operation and Maintenance of the Bank Stabilization and Navigation Project, and the Operation of the Kansas River Reservoir System (BA). The reinitiation of formal consultation under section 7 of the Endangered Species Act (ESA) led to the U.S. Fish and Wildlife Service (FWS) December 16, 2003 Amended Biological Opinion on the Corps operation of the Missouri River (2003 Amended BiOp).

1. Biological Opinion Requirements for SWH

The Endangered Species Act (ESA) requires that the Corps, in consultation with the FWS, will insure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any federally listed threatened or endangered species or result in the destruction or adverse modification of critical habitat. Formal consultation between the FWS and the Corps under Section 7 of the ESA culminated with the "Biological Opinion on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System" (Opinion), dated November 30, 2000. The Opinion concludes the existing operation of Missouri River Main Stem System, the maintenance and operation of the BSNP and operation of the Kansas Reservoir System jeopardizes the continued existence of the endangered interior least tern and pallid sturgeon and the threatened piping plover. It also concludes an incidental take of bald eagles.

On December 16, 2003, and in response to the Corps' request for the reinitiation of consultation, the FWS issued an amendment to its 2000 Biological Opinion (2003 Amended BiOp). The FWS determined that the 2000 Biological Opinion reasonable and prudent alternative (RPA), modified by the omission of flow changes and the addition of the proposed new RPA elements, will continue to avoid jeopardizing the continued survival and recovery of the Interior least tern and the Northern Great Plains population of piping plovers. With respect to the pallid sturgeon, the FWS determined the Corps' actions continue to appreciably reduce the likelihood of both survival and recovery of the species, thus jeopardizing the continued existence of the pallid sturgeon. The 2003 Amended BiOp includes RPA Section VII.1.a., which calls for a low summer release from the System of 25,000 cubic feet per second (cfs) each year beginning no later than July 1 and lasting for a minimum of 30 days. RPA Section VII.1.b provides that when approximately 1,200 acres of new shallow water habitat has been made available above that which currently exists between Sioux City and Omaha (approximately the amount that would be developed through flow management) the Corps, in consultation with the FWS, may modify flows to take advantage of that habitat and more fully meet project purposes.

Since the receipt of the 2003 Amended BiOp, the Corps has been working with the FWS on plans for near-term SWH development to meet the intent of the 2003 Amended BiOp; therefore allowing the Corps to operate for all congressionally authorized purposes the summer of 2004. In a letter dated February 13, 2004, the Corps provided new information to support a request that the 1200 acres of new SWH development be applied from Ponca State Park to the mouth of the Osage River, rather than limiting SWH development to the Sioux City to Platte River reach identified in the 2003 Amended BiOp. The FWS evaluated this request and concurred in a letter dated March 5, 2004.

The March 5, 2004 FWS letter also agreed that the list provided in the March 2, 2004, letter identified a sufficient number of potential sites generally suitable for the purposes of implementing RPA Section VII.1.b. (See Appendix B for letters.)

The information on the development of over 1200 acres of new shallow water habitat is provided on a site-specific basis, below. The suitability of this newly created SWH will be maximized with releases equal to or higher than full service. Accordingly the Corps is proposing to operate consistent with the 2004 AOP dated March 19, 2004, based on meeting the provisions of Section VII.1.b. of the 2003 Amended Biological Opinion.

2. US Fish and Wildlife Service Technical Clarifications for SWH

The 2000 Opinion generally described SWH as less than 5 feet and less than 2 feet per second. In the FWS letter dated March 5, 2004, the FWS provided technical assistance to assist the Corps with implementation of the 2003 Amended BiOP. Specifically the FWS provided technical guidance on the characteristics of SWH to assist river engineers and biologists in developing pallid sturgeon habitat as follows:

> Restoration of cutoff channel habitats for shallow water classification, needs to incorporate an active bed transport that functions much like secondary or main channels, that is sustainable over the long term. Flows need to be sufficient to create a mosaic of shallow, submerged sand bar (sand dune) habitats that mimic the historical frequency distribution of depths and velocities. These shallow sandbar habits that are closely associated with a thalweg are typically where pallid sturgeon juveniles and young of the year shovelnose sturgeon are found. These habitats provide the fish access to the variety of depths and flows dependant on activity and life stage. Connectivity with the main channel needs to be maintained in order to allow movement of fish among these habitats under a variety of flow conditions, seasons and species' needs over all life stages.
>
> Pallid sturgeon prefer areas where flows converge (i.e., main channel and side channel, island tips, tributary mouths). Ideally, habitat should be available over a wide range of flows. An area may provide more than one type of habitat for various life stages as the depths and velocities in that area change in response to river discharge. Thus variable river flow is as large a factor in abundance, location, and longevity of suitable habitat as the geomorphology that underlies it.
>
> Preferred shallow water habitats should be in channel with the above mentioned characteristics.
>
> Existing examples of secondary channels that have experienced success are the Lisbon Bottoms prior to modification in 2000 and Hamburg Bend. There is both biological and physical information from those areas, as well as some historic geomorphic data on DeSoto Bend (as the river), to explore potential future pallid sturgeon habitat restoration opportunities in that area. While feasible, such efforts would require considerable technical coordination, modeling, monitoring and assessment to adequately implement a project.
>
> Modeling to help inform the design process and describe project outputs is critical.

FWS also provided technical guidance for and supported the use of notching dikes as a means to diversify aquatic habitat as follows:

> The Service supports notching as an effective tool to contribute to pallid sturgeon habitat in the main channel of the river by diversifying aquatic habitat downstream of the notches. Based on discussions with the Corps regarding their most recent proposal, notches would be between 50' and 75' wide with a minimum depth of - 4' CRP. The size of the notch would depend, to a large extent, on adjacent land ownership (i.e., larger more landward notches on public lands). The results would depend on the specific location and size, but in general notches would develop a scour downstream and an associated shoal or shallower area downstream of that. The notches would also favorably modify velocities in the area around the notches. Notches in L-dikes can help flush the surrounding area, maintaining clean sand substrates. Notches in dikes at the ends of islands can improve flows and fish movement to the existing side channels.
>
> The Service's Fisheries Management Office in Columbia, Missouri (CMFRO) has documented sturgeon associated with various types of notches and believe the notches improve habitat for a number of native river species. While the true value of larger notches will likely be realized with higher flows, notches can begin responding immediately, and a variety of notch sizes and depths should help take advantage of varying habitat over a range of flows. Located throughout the lower river, the resulting habitat would also be available to young fish that hatched at different locations, and experienced varying larval drift distances. Modifications of these dikes can be accomplished this winter and spring and meet the Corps' goal of 1200 new acres of shallow water habitat available to sturgeon by July 1, 2004.

This technical guidance was utilized as SWH plans were developed and constructed.

3. SWH Construction completed under the 2000 BiOp

a. 2001

Approximately 110 new notches were cut at various locations between river mile 426 and river mile 8. These notches were larger and deeper than previous maintenance notches. The larger size notches allow for more aggressive (faster and more acreage) habitat development.

The Missouri River Bank Stabilization and Navigation Project Fish and Wildlife Mitigation Project (BSNP Fish and Wildlife Mitigation Project) created approximately 835 acres of SWH and 3,635 acres of reconnected floodplain in Fiscal Year (FY)2001. Complete details and locations are available in the Missouri River Bank Stabilization and Navigation Project Fish and Wildlife Mitigation Annual Implementation Report dated January 2002.

b. 2002

One hundred fifty six notches were constructed between Missouri River miles 456 and 110. Notches averaged 75 feet wide with a bottom depth of 4 feet below construction reference plane (CRP). The sizing and placement of these notches varied widely according to the particulars of each location. Approximately 100 of these large notches that were excavated immediately adjacent to the

bank or into the bank to encourage erosion of the high bank. The remainder of the notches were smaller notches constructed at least 100' riverward of private property. The smaller notches diversify existing SWH without eroding the high bank.

The BSNP Fish and Wildlife Mitigation Project created approximately 530 acres of SWH and 1200 acres of reconnected floodplain in FY 2002. Complete details and locations are available in the Missouri River Mitigation Project Annual Implementation Report dated January 2003.

c. 2003

The following activities were completed in calendar year 2003 as part of the SWH development program and will result in over 400 acres of new SWH when the projects are fully developed.

Eighty-five notches were constructed between river miles 21 and 112. The notches are up to 100' wide and were excavated between 2' and 5' below normal navigation stage.

Twenty-one additional notches were excavated.approximately 100' back into the bank. A pilot chute to and from each notch was excavated to the river. These notches were excavated along Overton Bottoms for the purpose of eroding the bank and increasing the amount of SWH habitat in the river.

Two chutes were constructed at Overton South . The chutes are approximately 1200' in length. Other work included realigning and enlarging the existing Overton North chute. The purpose of this work was to increase the amount and frequency of flow in the chute and to encourage erosion and widening of the chute.

Dike modification and chevron construction also took place between River Miles 555 and 541. A total of nine river miles were modified under the BSNP Fish and Wildlife Mitigation Project.

Multiple side chute projects were constructed along the right bank of the California Bend site, located north of Blair, Nebraska.

The Tieville-Decatur Bend Mitigation Project backwater area was also constructed. This is a multi-purpose project that includes native river fish benefits, waterfowl benefits, and increased flood plain connection.

4. Coordination

Since the issuance of the 2003 Amended BiOp, the Corps has been coordinating with the FWS on the implementation of the various elements of the Amended BiOp. In January 2004, the Corps held several meetings with the FWS, the Department of Agriculture's Natural Resource Conservation Service (NRCS), and the states of Iowa, Kansas, Missouri, and Nebraska to identify potential SWH sites and further clarify the characteristics of SWH to assist river engineers and biologist.

The result of this coordination resulted in the Corps letter of February 13, 2004, to the FWS. In that letter, the Corps identified new information that it is biologically warranted for the benefit of the pallid sturgeon, to extend the geographic reach of the 1,200 acres of new shallow water habitat set forth in the 2003 Amended Biological Opinion, from Ponca State Park to the mouth of the Osage River. The information provided included engineering analysis of current shallow water habitat deficiencies, biological studies of the drifting phase of pallid sturgeon, population assessment sampling below the

Platte River, and sampling within the Platte River itself. In addition, the Corps provided an initial list of SWH projects to be considered in implementing RPA Section VII.1.b.

Following the transmittal of the February 13, 2004 letter, the Corps and FWS held additional meetings on implementing Section VII.1.b of the 2003 Amended BiOP. The Corps committed to implement this RPA element by July 1, 2004, to aggressively address biological needs for pallid sturgeon and to avoid interruption in the navigation season. In addition, only shallow water habitat suitable for the various life stages of young pallid sturgeon constructed since November 2003 would be credited toward implementation of RPA VII.1.b., consistent with the environmental baseline in the 2003 Amended BiOp. In a letter dated March 2, 2004, the Corps requested technical assistance from the FWS regarding a revised list of SWH sites in order to make certain that the listed projects would provide biological benefits for pallid sturgeon.

The FWS responded in a March 5, 2004, letter. The FWS evaluated the information concerning expanding the geographical reach of river for habitat development in Section VII.1.b. and concurred. The FWS also agreed that the list provided in the March 2, 2004, letter identified a sufficient number of potential sites generally suitable for the purposes of implementing RPA Section VII.1.b. The letter also provided further technical guidance on the characteristics of SWH to assist river engineers and biologists in developing pallid sturgeon habitat. FWS also provided technical guidance for and supported the use of notching dikes as a means to diversify aquatic habitat. This technical guidance was utilized as SWH plans were developed and constructed.

Since March 2004, the Corps has worked collaboratively with the FWS, the NRCS and affected state offices to implement the identified SWH. This coordination included development of site-specific designs, field inspections of constructed sites, and identification of reference sites for verification plans.

Two meetings were held to check on the progress of SWH construction, confirm approach to verifying acres of SWH, outline reports and develop schedules for exchange of information to implement RPA Section VII.1.b. The FWS letter of May 13, 2004, discussed the results of the April 20, 2004, meeting between the FWS and the Corps. It outlines the process for monitoring and evaluating sites, the future exchange of information, and evaluation of compliance with the 2003 Amended BiOp. On May 17, 2004, one additional meeting was held to outline the content of this report.

II. DESCRIPTION OF METHODS AND PROCESS FOR 2004 SWH EFFORT

1. Work Descriptions and Definitions

a. River Structure Notching

Notching was begun as early as 1975 in an effort to halt the accretion process that was narrowing the topwidth of the river and in an effort to improve the aquatic habitat of the river. The early notches were small (less than 50’ wide and between +2 and –3 CRP in depth). They were located to prevent further accretion and to improve the aquatic habitat between the structures.

This notching effort has been expanded over the last few years in an effort to increase the amount and quality of aquatic habitat for the pallid sturgeon. Recent notches are generally wider and deeper

and placed closer to the bank than those constructed in past years. Most of the recent notching projects have shown great promise as a means of producing aquatic habitat for the pallid sturgeon.

The main benefit of notches is the immediate introduction of flow at specific points in the structures during stages lower than the top elevation of the structure. Depending on the size and location of the notch, the flow can be used to erode the bank and increase diversity upstream and downstream of the notch or, if bankline erosion cannot be tolerated, the flow can be used to simply increase diversity. In general, the larger the notch and the closer the notch is located to the bank, the more the adjacent bank will erode and the more diversity will increase in the general area. The four main types of notches used to develop SWH in 2004 are revetment notch, bank notch, dike notch and type B notch.

A notch also serves to increase the percent time that flow occurs across a particular structure. Most notched dikes have an elevation of between +1 and +3 CRP. At these elevations the dikes are overtopped approximately 50% to 20% of the time. Thus, 50% to 80% of the time the dike cuts off all flow from upstream to downstream. A notch cut to –4 CRP will have some flow through the notch up to 95% of the time, greatly increasing the percent time of flow across the structure. The length and depth of the notch must take into consideration that too much flow through the notch could reduce the effectiveness of the dike.

Velocities through a notch generally will range between 3-4.5 fps. Thus a standard notch 50' wide excavated to –4 CRP, with river stage and top of dike at elevation at +1, will have a discharge of up to 1125 cfs. This discharge will fall to zero as the river stage decreases to the bottom elevation of the notch.

Revetment Notch: Revetment notches are cut in revetments that separate the main channel of the river from existing aquatic areas landward of the revetment. At normal summer stages, these aquatic areas are poorly connected to the main channel, have little to no flow, and therefore have no diversity of velocities.

A revetment notch increases the connectivity of the aquatic area with the main channel, and increases the velocity diversity of the aquatic area and to a lesser degree increase the depth diversity of the area.

Bank Notch: Bank notches are constructed at locations where the landowner can tolerate a high degree of bank erosion and land disturbance. They are constructed on every dike in a particular reach of river so that the effects of the notch are greatly multiplied. Bank notches have numerous immediate and long-term benefits.

The immediate benefits are the creation of a secondary channel adjacent to the high banks. Water enters the upstream notch and flows along the bank through the downstream adjacent bank notches and then back out into the river. Sandbar formation and shallowing occurs in the area between the dikes and riverward of the secondary channel. The resulting habitat has greater depth and velocity variation than without the notches. In addition the excavated overbank will erode and create a more dynamic alluvial process within the dike field. Also, the cleared vegetation, which is disposed of in the river, and trees falling into the river as the bank erodes, provide structure for benthic organisms.

The long-term benefits are fairly rapid erosion of the high bank and widening of the top-width of the river. As the river widens, the total amount of aquatic habitat available is increased and sandbar formation within the dike field increases in a riverward direction.

Dike Notch: These notches range in width between 50' to 100' and are excavated to either –4 or –5 CRP. These notches are excavated along the riverward length of the dike between the high bank and no more than half-way out on the dike. As with the bank notch, the effects of a dike notch will have immediate benefits. These notches improve the depth and velocity distribution upstream and downstream of the dike by allowing a portion of the rivers flow to flow within the dike field. This point flow sets up a velocity gradient as the flow spreads out downstream and riverward of the notch. In addition to the increased velocity diversity, a deep scour hole will form immediately downstream of the notch and deposition will occur further downstream and riverward from the notch which will increase the depth diversity. The result is an area with a high degree of depth and velocity diversity upstream and downstream of the notch.

Type B Notch: A type B notch consists of excavating a 75' wide section of the dike. The excavation is 5' below the CRP. One third, or 25' of the notch width is on the exposed portion of the dike and 50 feet (2/3 of the notch) is cut into the high bank (See Figure 1 below). This allows a significant amount of flow to leave the main channel via this notch. At minimum service flows, the amount of flow through the notches would range from 350 to 1250 cfs, or 1 to 5 percent of the total flow. This split flow has two primary effects. The first is erosion of the high bank both upstream and downstream of the notch. This erosion provides for a local increase in the top width of the river, adds large woody debris to the channel, and provides for a slight increase in the amount of sediment available for alluvial processes. The second effect is an increase in the hydraulic shadow of the remaining dike, which in-turn increases the area over which the dike can influence the velocity distributions. The combination of these two effects leads to a greater diversity of depths and velocities in the vicinity of the dikes as well as riverward of the dike.

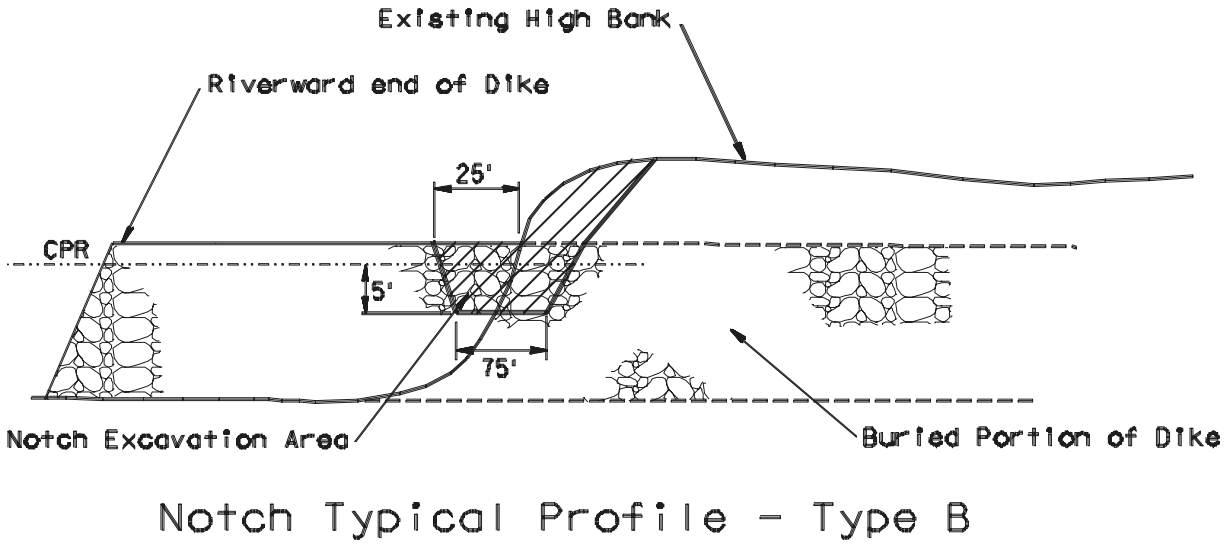

Figure 1. Type B Notch Design.

b. Dredging

The material is dredged with a hydraulic dredge and then discharged into the Missouri River. The side slopes are the angle of repose of the soil. The end of the discharge pipe is submerged at a location in the water column where mixing and integration into the bed load occur quickly. Studies and construction experience for other projects indicate that suspending the discharge 4 to 6' off the bottom of the river provides for adequate entrainment of the dredge material.

c. Pilot Channel

These are trenches excavated immediately landward of a stone fill revetment. The earthen trenches are connected to the river by notches in the adjacent revetment. Pilot channels are at least 50' wide, excavated to –3 CRP in depth, and range between 1000' and 2400' in length. Approximately 40 cubic yards of bank material is excavated per foot of channel. Cleared vegetation and excavated bank material is placed riverward of the adjacent revetment. It is also expected that the aquatic habitat in the dike field across the river from a pilot channel will experience some shallowing due to the redirection of water out of the main channel.

d. Chute

These are earthen trenches excavated within the overbank to create a secondary channel connected to the river only at the entrance and exist. The excavated material is disposed of in spoil piles immediately adjacent to the high banks of the chute or into the river.

e. Major Dike Modification
(Dike Lowering and Chevron Construction)

Dike Lowering: Modification of the 85 dikes is accomplished by removing rock starting from the riverward end of the dike and extending 100 to 125 feet back into the bank. Removal of material at the bankline and landward involves "unburying" the dikes via excavation of alluvial material and then removal of stone from the dike. The dikes are lowered to –5 feet CRP. The rock removed from the dikes is used to construct the chevrons. Excess material (sand, stones, trees, brush, etc.) is placed just downstream of the existing structure and at least 100 feet landward from the end of the dike excavation, allowing the river to eventually reclaim it through erosion. Any pilings that are in the dikes aree broken off at the desired elevation using an excavator and disposed of by either taking them to a landfill or burying them in an excavated hole with at least five feet of fill placed over top. This disposal occurs at least 100' landward from the end of the dike excavation.

Dike Lowering Goals:

1. Allow the river to erode the portions of the bank where the rock has been removed in order to increase the topwidth of the river and create shallow water adjacent to the main channel.

2. The varying elevations would allow a diversity of depths and velocities to be established in order to increase the chances of always having some portion of the modified area within the recommended 0 to 5-foot depth range as river discharges fluctuate.

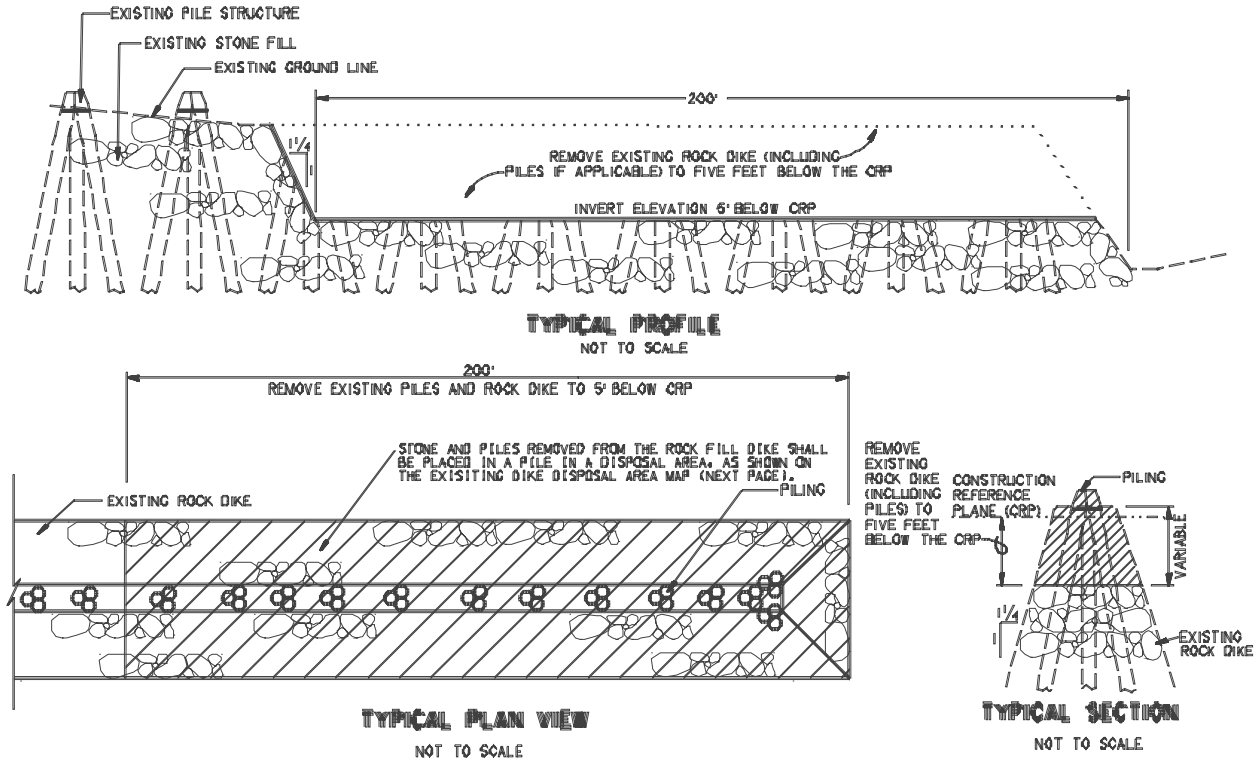

Figure 2. Typical Dike Lowering Details.

Chevron Construction: The chevrons are V-shaped rock structures with a gap at the point of the V so that the two sides of the V do not touch. The two sides of the V flare out in the downstream direction forming a 60-degree angle. Because the desire is to maintain open water between the chevron and riverbank, the landward wings need to be short enough to allow a significant amount of flow around the right side of the structure. Assessment of the dike fields indicate an inboard wing length of 75 feet would allow water to circulate between the chevron and the river bank. Each chevron would be placed out from the bank in line with the riverward ends of the existing dikes about half way between the nearest upstream and downstream dikes at any of the 40 locations. The chevrons would be constructed at varying elevations at, or one foot below CRP.

Chevron goals:

1. To direct flows towards the riverbank to create erosion and scour in the areas where the dikes would be lowered.

2. To create deposition of sand bars downstream of the chevrons. It has been shown that a chevron constructed in the proposed configuration will create sandbars that occupy 30 to 50 percent of the length between the two dikes it is constructed between (Remus and Davinroy, 2001).

3. To direct flows toward the navigation channel to prevent the formation of shoals, which could interfere with navigation.

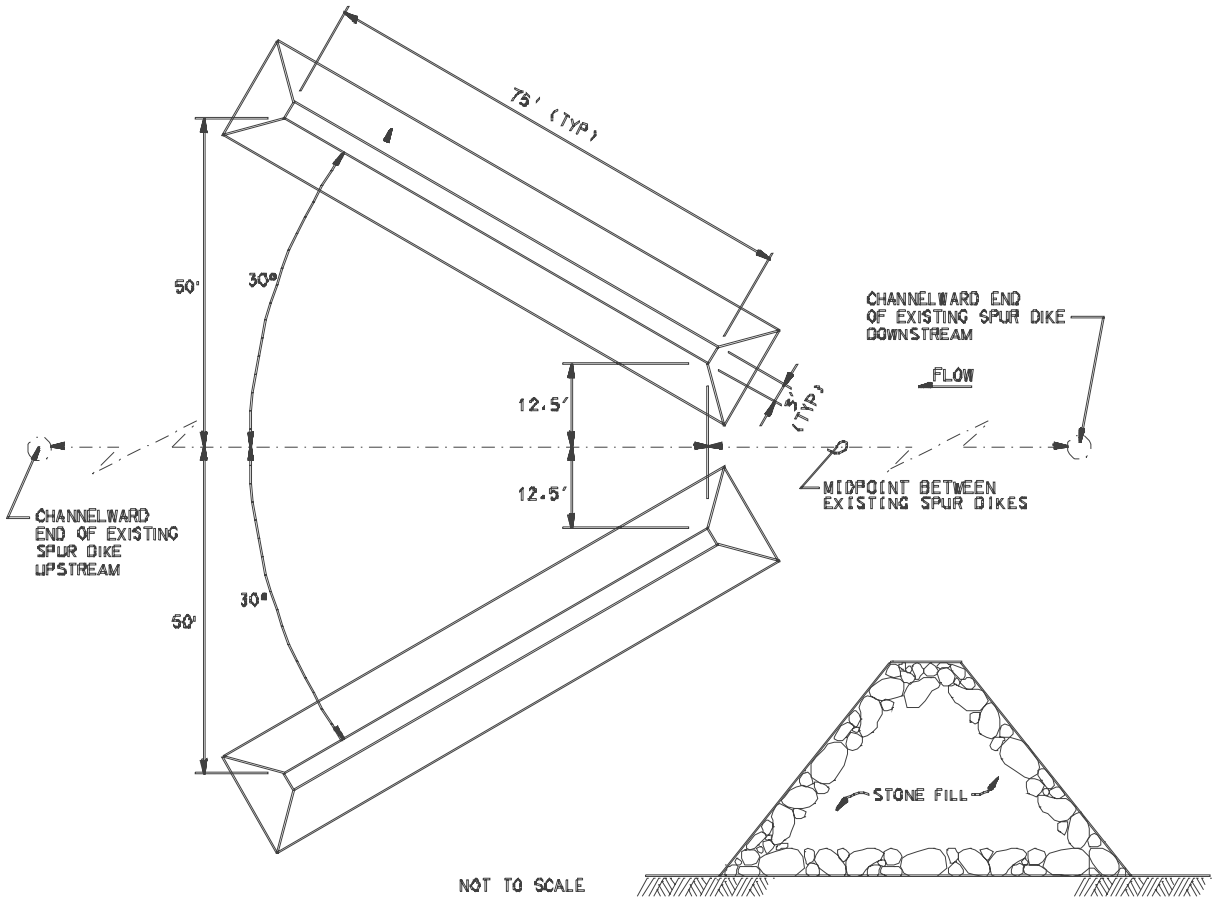

Figure 3. Typical Chevron Construction Details.

2. Site Selection Process

A list of potential sites suitable for SWH development were originally selected by the Corps based on a number of criteria including: meeting the SWH definition in the 2003 Amended BiOp; land ownership; ability to comply with the National Environmental Policy Act, Section 404 of the Clean Water Act, and Section 10 of the Rivers and Harbors Act of 1899; logistics of awarding a contract; logistics of Corps in-house crews being able to work at the site before July 1; and cost per acre of return on the created habitat. The Corps' original list was vetted with the FWS, the Department of Agriculture's Natural Resource Conservation Service, and the states of Iowa, Kansas, Missouri, and Nebraska in a January, 2004 meeting. The FWS and States also offered additional sites where work might be possible. The list was vetted one final time with the FWS and then within the Corps, particularly with the river engineers to ensure feasibility of the proposed work. It was recognized by both agencies that the list was not necessarily complete, as some sites might be added as opportunities presented themselves and that some sites might drop out. The FWS agreed that the list provided in the March 2, 2004, letter identified a sufficient number of potential sites generally suitable for the purposes of implementing RPA Section VII.1.b.

An example of a site where work has been postponed is the Tobacco Island Major Dike Modifications where a nesting bald eagle forced a ½ mile construction buffer to avoid disturbing the nesting birds. Work will proceed at Tobacco Island after the eagles fledge and leave. Other sites dropped out for a variety of reasons as explained in the remarks. The vetted list is Table 1.

Site	Remarks
Ponca	Dredging Project with ESH
Winnebago/Snyder	Dike Modification Project
Tieville-Middle Decatur Bend	Chute and backwater area
Soldier Bend	Dredge project
Tyson Bend	Dredge project
Desoto Bend Dikes	Dredge project
Tobacco Bend	Postponed due to eagle nest
Upper Hamburg Bend	Dike Modification
Lower Hamburg Bend	Dike Modification
Langdon Bend	Dike Modification
Deroin Bend	Type B Notching
Rush Bottoms	Postponed due to real estate issues
NWO Dike Notching	120 Type B notches in the Omaha District
NWK Dike Notching	400 Dike Notches in the Kansas City District
Bob Brown	Deleted because too close to the levee
Monkey Mountain	Bank Notching
Worthwine Island	Bank Notching
French Bottoms	Deleted because too close to the levee
Benedictine Bottoms	Bank notches
Fort Leavenworth	Dike and bank notches
Weston Bend State Park	Bank notches
Kansas City Reach	100 dike and bank notches
Liberty Bend	Bank Notching
Baltimore Bend	Bank Notching
Grand Pass	Bank Notching
Lisbon – Jameson Island	Chute Construction
Franklin Island	Bank Notching
Diana Bend	Bank Notching
Overton Bottoms South	Postponed due to real estate issues
Eagle Bluffs	Bank Notching, revetment notching
Marion Bottoms	Chute, revetment notching
Smokey Waters	Chute, Bank notching

Table 1: List of Proposed SWH Construction Sites

3. Physical Monitoring

HISTORICAL:

Although many of the construction methods such as notching, pilot channel and chutes have been used in the past to create shallow water habitat, very little survey data has been collected at any of these sites due to limited funding. Assessment of the suitability of the resulting habitat has been limited to pedestrian surveys on site visits and discussions with fisheries biologists as to the suitability of the created habitat.

A number of the existing projects constructed over the last seven years have yielded high quality, slow, shallow and diverse aquatic habitat. The engineering and results of these projects served as the basis for the designs of the current work effort. It is expected that the results of the current projects will be similar to the results of these past projects.

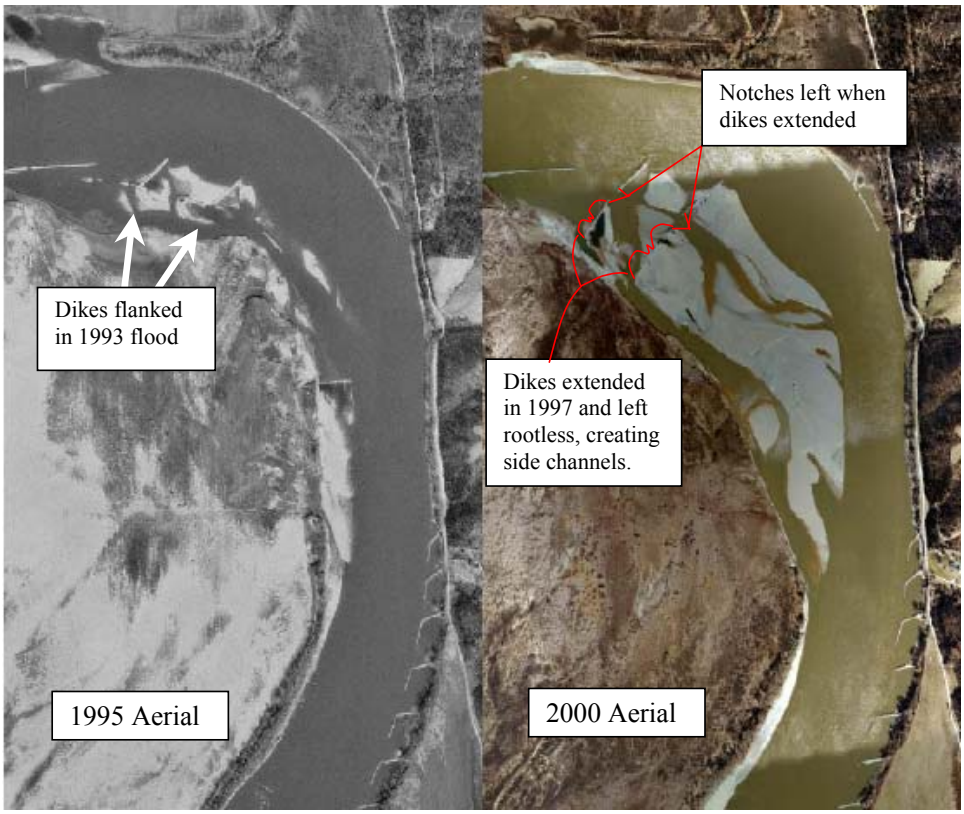

Figure 4: Jameson Island. These pictures illustrate the habitat that developed as a result of structure modifications on two dikes at Jameson Island. These two dikes were heavily damaged by the 1995 flood. The dikes were repaired with large notches and detached from the bank. Bank notches function much like rootless dikes.

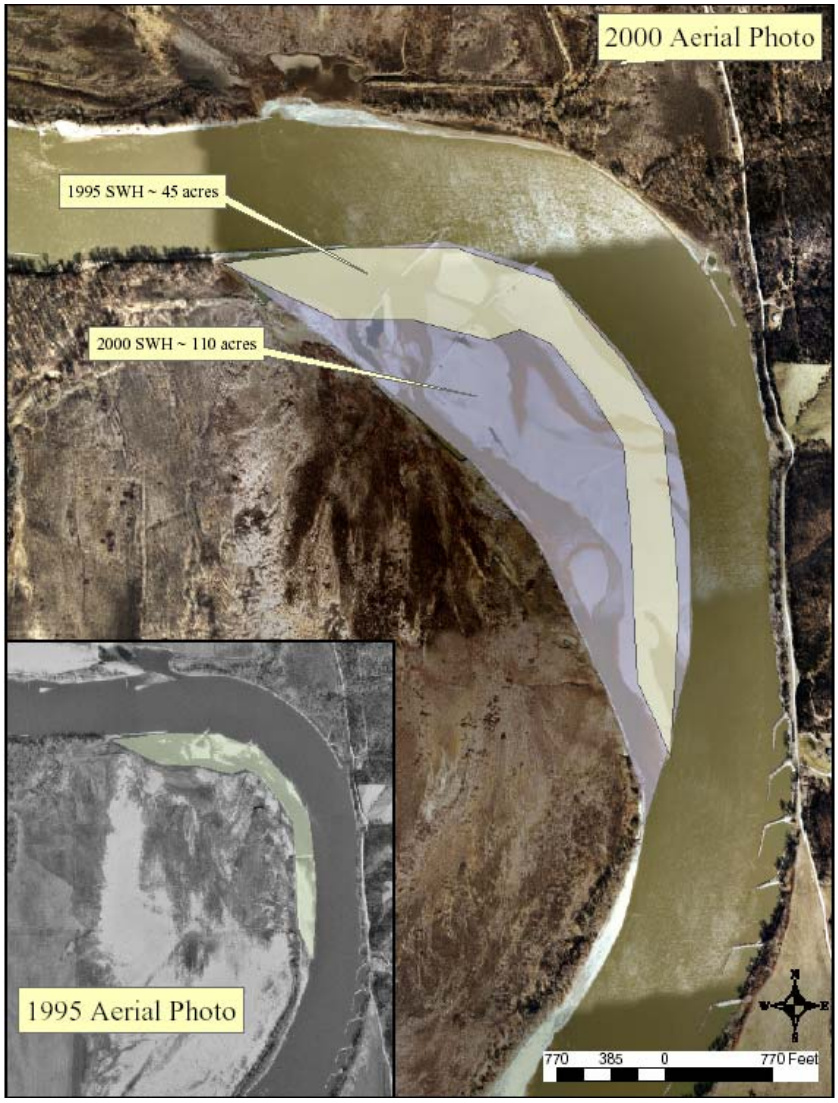

Figure 5: Jameson Island. This figure illustrates the amount of aquatic habitat developed between 1995 and 2000 as a result of the notched and rootless dikes. Considerable landward migration of the bankline has occurred leaving high quality aquatic habitat.

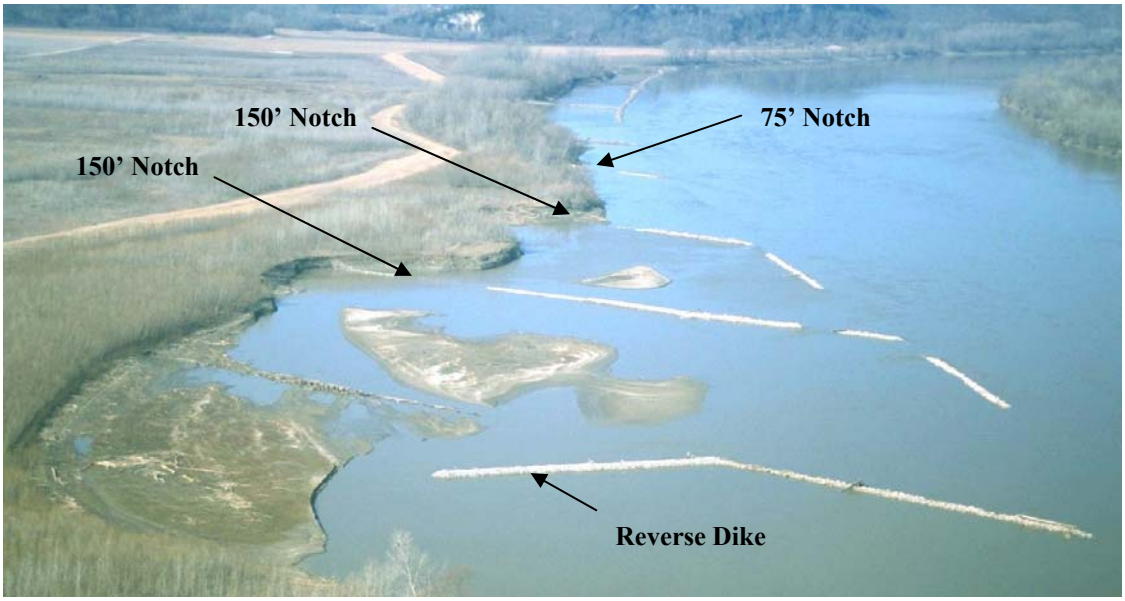

Figure 6: Plowboy Bend Mitigation Site. A series of notches were cut in the dikes to create a secondary channel by the bank and a reverse dike constructed at the lower end to force water against the bank. Highly diverse aquatic habitat has resulted from the structure modifications.

PRESENT:

Physical monitoring plans were developed in conjunction with the FWS that were aimed at gathering quantitative and qualitative information for the various project modifications, from all of the separate river segments. The physical monitoring plan is summarized below. A more detailed description of the monitoring plan is provided in Appendix D.

a. ERDC Support

The Corps' Omaha District contracted the Coastal and Hydraulics Lab at Engineering Research and Development Center (ERDC) to obtain detailed bathymetry and velocity data for a six mile reach of the Missouri River from river mile 556 to 550 (Upper and Lower Hamburg Bends). The original intent was to use this data to construct and calibrate a 2-dimensional math model of this reach. Upper and Lower Hamburg Bends are located in 2000 Biological Opinion Segment 13. The river control structures in these two bends were modified from the summer of 2003 through the spring of 2004. After completion of the river modifications, ERDC was contracted to repeat the original survey in order to obtain data that could be used to verify the model, and to provide further insight as to the type and extent of channel geometry changes that could be expected over the near-term. Bed contour maps from both the pre- and post construction surveys were generated. Depth analysis was performed on both contour maps for discharges of 26,000, 30,000 and 35,000 cfs, which correspond to Gavins Point releases of 21,000, 25,000 and 30,000 cfs, respectfully.

b. Verification Inspections

Joint verification inspections were conducted during the construction period. The purpose of these inspections were to view the modifications while they were being constructed, verify construction was taking place, and develop a common understanding of the possible river response. The inspection dates were as shown in the table below.

Inspection Date	River Reach (miles)	Participating Agencies
April 27. 2004	715 to 627	Corps of Engineers, U.S. Fish and Wildlife Service
April 28, 2004	591 to 550	Corps of Engineers, U.S. Fish and Wildlife Service
May 4, 2004	715 to 681	Corps of Engineers, Omaha Tribe, Iowa DNR
May 5, 2004	569 to 516	Corps of Engineers, Iowa DNR, Missouri Department of Conservation, Nebraska Game and Park Commission.
June 3, 2004	722 to 642	Corps of Engineers, U.S. Fish and Wildlife Service
June 4, 2004	591 to 542	Corps of Engineers, U.S. Fish and Wildlife Service

Table 2: SWH Verification Inspections

c. Pre and Post Construction Surveys:

Kansas City District

Physical monitoring of selected sites was conducted in order to help quantify the number of acres of aquatic habitat created from the various types of construction methods. Under ideal conditions the pre-construction data set would be collected immediately prior to construction when the river's discharge was at a minimum navigation flow and the post construction data set would be collected at the end of June under similar discharge conditions. This sequencing would have allowed more time to elapse between pre and post construction data sets and offered the most realistic assessment of the amount of habitat available on July 1. In contrast, the short timeline for this current assessment required that the post construction data sets be collected before the end of May, one full month before the habitat is scheduled to be fully functional. In addition, at some locations data sets collected up to four years prior to construction were used as the pre construction survey because scheduling conflicts prohibited data set collection immediately prior to construction.

The restrictions on timing of data set collection means that any analysis of the data should used only be used as a guide in determining acres of habitat produced from the various construction methods and will not fully represent the acreage developed. Furthermore, the usefulness of the data sets is restricted at some locations by the absence of velocity data or if included, velocity data that was not collected at minimum navigation discharges.

1. Pre and post construction bathymetry data was collected at six sites by in-house survey crews. The six sites were at locations of dike and revetment notches excavated by floating plant. The pre-construction bathymetry was collected May 11 and 12. The post construction bathymetry was collected May 25. Thus less than 15 days elapsed between the pre and post surveys during which time stages were slightly below normal. Of the four sites, one site contained three structures with one notch each and three sites contained one structure with one notch. Therefore, 6 notches were analyzed as part of this effort. This analysis is in Appendix D.

2. In-house survey crews also collected bathymetry data for bank notches constructed at Baltimore Bend, Grand Pass and Benedictine Bottoms. At Baltimore Bend, pre-construction bathymetry was collected May 6 and post-construction bathymetry was collected on May 28. At the two other sites, the pre-construction bathymetry consisted of data gathered during 1999 and the post construction bathymetry was collected on May 24 and 28. This analysis is in Appendix D.

3. The USGS collected pre and post-construction bathymetry, velocity, and substrate data at 5 sites. The five sites contained dike and revetment notches constructed by floating plant. The pre construction data was collected during summer 2003 as part of an ongoing study by the USGS. The post construction data was collected May 21 and 24.

Omaha District

Major Dike Modifications. A dike-chevron-dike complex was selected at two of the six major dike modification sites listed in Section VI. The selected sites are Desoto Bend (RM 644 to 642), which is located in BiOp Segment 12, and Tobacco Island (RM 589 to 586), which is located in BiOp Segment 13. A pre-construction survey was obtained at each of the sites that included both bathymetry and velocity data. The original plan included bi-monthly bathymetric surveys at index ranges to monitor the rate at which changes occurred. Due to the compressed construction schedule the bi-monthly surveys could not be obtained. General construction quantity over runs and high water during the week of May 24th, 2004 slowed the rate of construction from the Contractor's original schedule. The initiation of post construction surveys at Desoto Bend were delayed by 10 days. This slip in the overall schedule will not allow the post construction data to be included in this report. When the data are received, they will be processed in a similar manner to the ERDC data and the results provided to the FWS. It is schedule to provide this information prior to June 30, 2004.

Also, due to the presence of an active Bald Eagle nest, only the upstream and downstream ends of the Tobacco Island site could be constructed by July 1, 2004 and counted towards the 1,200 acres. The remainder of the construction will be completed once the eaglets have fledged. The most likely completion date will be early to mid August 2004. Once the construction at Tobacco Island is complete, and the site has had time to under go some adjustments, the post construction survey will be completed, data analyzed and the results shared with the FWS. The surveys described in this paragraph will be used to further verify the SWH acreages, aid in the refinement of future project modifications, and support the biological monitoring. These data were collected by A-E contract.

Type B Notch. The U.S. Geological Survey (USGS) – Council Bluffs, Iowa Office was contracted to complete pre- and post construction surveys on 16 dikes that received type B notched dikes. At each selected dike, a series of cross sections were obtained upstream and downstream of the dike. Cross sections were approximately perpendicular to the general flow line of the river and extended from high bank to high bank. The first upstream cross section was located approximately 25' upstream of the dike and the second and third cross sections were spaced at approximately 50' intervals further upstream. The first downstream cross section was approximately 25' downstream of the dike and the remaining cross sections were spaced at approximately 50' intervals downstream for a total of 6 downstream cross sections. Two longitudinal profiles were obtained. The first longitudinal profile was from the most upstream cross section through the notch to the most downstream cross section. The second longitudinal profile was approximately parallel to the first profile and extended from the most upstream to the most downstream cross section and was immediately riverward of the end of the dike. This survey provides an accurate estimate of the aerial extent of riverbed changes. Velocity data was collected at four points along each cross section. These locations are along a line approximately

parallel to the edges of the notches (two locations), at a point approximately equal to the end of the dike, and approximately 1/2 the length of a dike length riverward of the end of dike. At each dike a minimum of four velocity measurements were obtained in depths of less than 5 feet. At each location that velocity data was obtained, the velocity at the riverbed and at the mid point of the water column was recorded.

The pre-construction surveys were completed as scheduled, but high water during the week of May 24 and May 31, 2004, caused a delay in collection of the post construction field data. For this reason, not all data for all the dikes will be incorporated into this report. This information will be provided to the FWS prior to June 30, 2004. Also, four dikes that were surveyed during the pre-construction activities were not notched, due to Iowa Department of Natural Resources denial of permission to notch at these sites. Therefore a total of 12 type B notches will be included in the final analysis. Data from a total of 6 dikes were included in the analysis for this report.

Dredging. The physical verification process for the dredging will be based on pre- and post construction surveys conducted as part of the construction contract. Construction is not scheduled to be complete until the latter half of June 2004 and this information is therefore not available for this report. However, the construction contract requires specified areas and depths as indicated in Section VI. Completion of the dredging contracts will serve as verification of channel changes.

4. Biological Monitoring

Biological Monitoring Plan for 2004 SWH: The Corps has assembled a team of scientists (Shallow Water Habitat Monitoring Team) represented by various state agencies, federal agencies and academia to develop the criteria (physical and biological) to evaluate the various types of river modifications resulting in shallow water habitat. This team will identify goals and objectives and then work toward developing the specific criteria to set up the sampling strategy.

State and federal entities will be used to conduct the field biological data collection efforts. When applicable, the framework and standardized protocols for the ongoing "Pallid Sturgeon Population Assessment" program will be utilized (i.e., segment numbers, species codes, etc.). This approach will provide consistency and power (statistical) to the overall pallid sturgeon program.

Data sheets will be standardized and a single entity will be responsible for data entry, QA/QC, and Analysis. The agencies/field crews collecting the data will be responsible for putting together an annual report. A standardized format for reporting will be developed.

This information will be used in an "Adaptive Framework" to help guide future modifications and maximize the biological benefits for these river modifications.

Current SWH Monitoring: The Columbia Fishery Resource Office's 2002 sampling efforts collected 12 pallid sturgeon. Of these, 7 pallid sturgeon were captured in the "Overton Bottoms" area where a great deal of dike notching has taken place as well as the development of the chute. Notched L-dikes provide flow sufficient to move sediments resulting in the creation of bar habitats behind these structures. Pallid sturgeon, lake sturgeon, young of year paddlefish and shovelnose sturgeon have all been collected during fisheries sampling in conjunction with these modifications. Pallid sturgeon and associated native species have been collected on both the channel side and bank side of these L-Dike structures downstream from various notching efforts.

In 2003/2004, the Nebraska Game and Parks Commission have conducted sampling in the Missouri River from the Platte River to the Kansas River. This crew has captured two pallid sturgeon in conjunction with the downstream bars along the channel side of Chevron structures in the channel border, one in the upper end of the Hamburg Chute and another in an outside bend revetment "Scallop". Additionally, during a unique opportunity of lower flows, over 900 plains minnows were seined from an outside bend revetment scallop. This effort accounted for approximately 80% of all plains minnows sampled in this river segment.

Sand shiner (95 fish) were collected primarily in "Bar" mesohabitats (<1.2 meter depths) in inside bends.

All nine representative native Missouri River species identified in the population assessment program were collected in inside bends. Sauger, bigmouth buffalo, plains minnow, sand shiner and the speckled chub were sampled in water less than 1.2 meters deep. The shallow water habitat efforts are increasing the quantity of bar and channel border mesohabitats where all of the pallid sturgeon were sampled as well as the majority of the shovelnose sturgeon, blue sucker, sicklefin chub and sturgeon chub.

III. DESCRIPTION OF ACTIVITY AND ESTIMATED ACREAGES

1. Corps capabilities

The Corps used two authorities for complying with the BiOp and Amended BiOp in 2004—Operations and Maintenance (O&M) and BSNP Fish and Wildlife Mitigation (Mitigation). O&M funds are appropriated funds used for the operations and maintenance of existing completed projects. Mitigation funds were authorized by the 1986 WRDA, where the purpose of the project is to mitigate losses of fish and wildlife resources resulting from construction and operation of the BSNP, which extends from Sioux City, Iowa to the mouth of the Missouri River near St. Louis, Missouri. Both construction and operation of the project are at 100 percent Federal cost. Mitigation funding this year was used to enhance SWH as much as possible both in planning and necessary land acquisitions for futre work.

Kansas City District in-house work crews under the direction of the Napoleon Area Office constructed Diana Bend and Franklin Island projects. These projects were constructed using a combination of government owned and rented land-based equipment. In general, the land-based equipment consisted of D-7 and D-8 bulldozers and 345 backhoes. Equipment operators on-site ranged from four up to eight government employees. This work was performed between February and June.

In addition to the land-based construction capability, the Kansas City District also has floating plant consisting of two tow boats, one spud barge with associated dragline, and numerous rock deck barges. On-site crews averaged approximately 3 to 4 government employees. This crew was utilized cutting dike and revetment notches from floating plant during of the months of May and June. Most of their work was between river miles 130 and river miles 200.

The Kansas City District contracted with the W.A Ellis construction company to cut notches from floating plant and to construct seven of the site-specific projects. Four other site-specific projects were

contracted to two companies under an Omaha District Indefinite Delivery-Indefinite Quanitity Contract (IDIQ) contract. The notice-to-proceed on the Ellis notching contract was issued March 10 and the notice-to-proceed for the seven site-specific projects also constructed under the Ellis contract was issued April 23. The IDIQ notice-to-proceed was issued May 3. The IDIQ contract was also used by the Omaha District for the dredging and major dike modification work.

The Kansas City District also staffs two full time river survey crews with the capability of structure layout and bathymetric data collection. These crews have been engaged full time during the months of March through June either laying out construction work or engaged in pre and post construction data collection.

Omaha District has a River and Structural Maintenance Team, that consist of a foreman, two Pilots, one heavy equipment operator, two motor vehicle operators and a heavy equipment mechanic all located in Omaha, NE. Omaha District Missouri River floating plant consisting of two tow boats, two equipment barges and 5 rock barges. The land based equipment includes, D-7, D-6 and D-4 dozers, John Deere 755B crawler loader, JD motor grader, 55 ton tracked crane, 400LC-6 tracked excavator, two dump trucks along with all the associated support equipment. The District has the capability to lease almost any land based equipment needed to perform the mission, for example leasing a 400LC-6 tracked excavator for two months this tyear to help in the dike notching for the SWH effort.

The Omaha District issued three task orders against the IDIQ Contract, two for dredging projects and one for major dike modifications. The Omaha District also contracted for data collection.

2. Activity description and acreage analysis

a. Notching

BANK NOTCHES: These are 75' notches excavated to –5 CRP constructed entirely landward of the high bank. These notches are constructed in straight out dikes or L-head dikes using land-based equipment. Pre-construction consists of clearing and grubbing an area of the overbank sufficient to construct the notch. The cleared vegetation is placed downstream of the notch and riverward of the high bank. After a site is cleared, the overbank and buried dike are excavated so that water will flow freely through the notch. In general, approximately 15,000 cubic yards of bank material are removed for each bank notch. The excavated bank material is pushed riverward of the high bank.

Bank notches were constructed at Monkey Mountain, Worthwine Island, Benedictine Bottoms, Baltimore Bend, Grand Pass, Franklin Island, Diana Bend, Eagle Bluffs, Marion Bottoms, and Smokey Waters. At these locations the landowners can tolerate a high degree of bank erosion and land disturbance. They are constructed on every dike in a particular reach of river so that the effects of the notch are greatly multiplied. Bank notches have numerous immediate and long-term benefits for the pallid sturgeon.

The immediate benefits include the creation of a secondary channel adjacent to the high bank. Water enters the upstream notch and flows along the bank through the downstream bank notches. Deposition will occur riverward of the secondary channel resulting in sandbar formation and shallowing of the area between the dikes. The resulting habitat has greater depth and velocity variation than the pre-notch condition. In addition, the excavated overbank will erode and create a more dynamic alluvial process within the dike field. Also, the cleared vegetation disposed of in the

river during construction, along with trees falling into the river as the bank erodes, will provide structure for benthic organisms.

The long-term benefits are fairly rapid erosion of the high bank and widening of the top-width of the river. As the river widens, the total amount of aquatic habitat available is increased and sandbar formation within the dike field increases in a riverward direction.

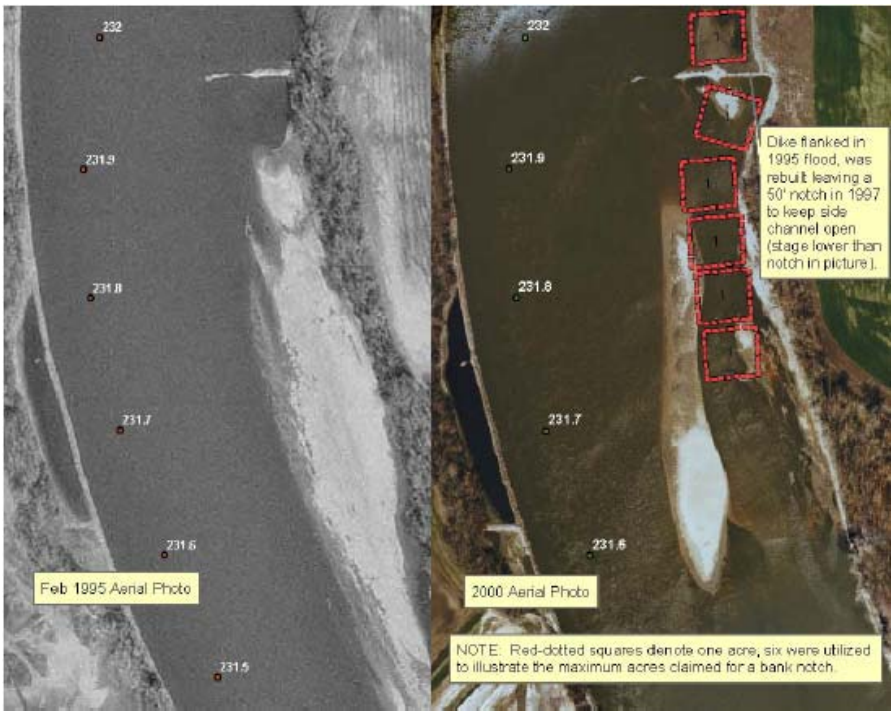

Figure 7: This figure illustrates the effect a dike that became detached from the bank as a result of high water. Bank notches will have similar effects as the water from the bank notch flows along the high bank.

Photograph 1: This photo illustrates the erosion that will occur downstream of a bank notch.

Based on analysis of past and current bank notching efforts including the data in Appendix D, one bank notch will create between 4 and 6 acres of diverse shallow water habitat. Seventy-five bank notches were constructed creating between 300 and 450 acres of diverse shallow water habitat.

Site	River Miles	# of **Bank Notches**	Min. Acres/Notch	Max. Acres/Notch	Min. SWH Acres	Max. SWH Acres
Monkey Mountain	466-464	5	4	6	20	30
Worthwine Island	459-456	11	4	6	44	66
Benedictine Bottoms	428-424	9	4	6	36	54
Weston Bend SP	403-402	0	4	6	0	0
Liberty Bend	352-351	0	4	6	0	0
Baltimore Bend	300-296	8	4	6	32	48
Grand Pass	272-267	5	4	6	20	30
Lisbon-Jameson	218-210	0	4	6	0	0
Franklin Island	195-192	9	4	6	36	54
Diana Bend	189-187	2	4	6	8	12
Eagle Bluffs	176-171	12	4	6	48	72
Marion Bottoms	164-158	9	4	6	36	54
Smokey Waters	134-131	5	4	6	20	30
Total SWH Acres	**300**	**to**	**450**			

Table 3: Number and location of bank notches excavated and the amount of SWH developed.

DIKE NOTCHES: These notches range in width between 50' to 100' and are excavated to either –4 or –5 CRP. These notches are excavated entirely riverward of the high bank between the high bank and no more than half-way out on the dike.

As with a bank notch, dike notches have immediate benefits. These notches improve the depth and velocity diversity upstream and downstream of the dike by allowing a portion of the river flow to flow within the dike field. As the flow spreads out downstream and riverward of a notch, the velocity slows down creating a high degree of velocity variability. In addition to the increased velocity diversity, a deep scour hole will form immediately downstream of a notch and deposition will generally occur further downstream and riverward from the notch increasing the depth diversity. The result is an area with a high degree of depth and velocity diversity upstream and downstream of the notch.

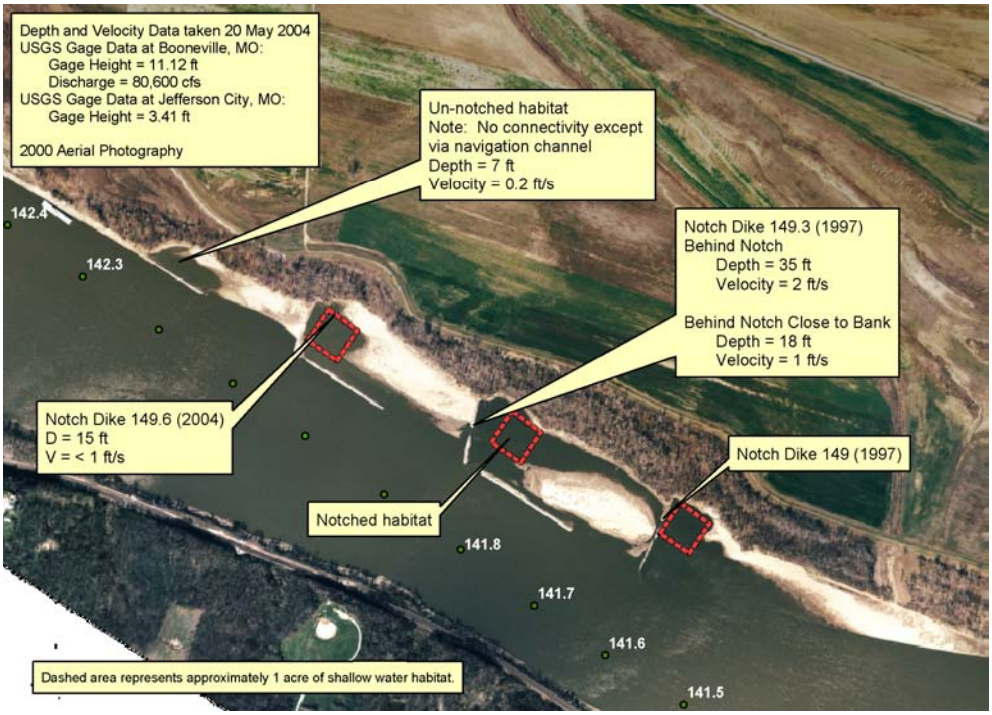

Figure 8: This figure compares the habitat downstream from two dikes with existing 50' notches and downstream from a dike without a notch. Note the secondary side channel and the more diverse habitat as a result of the notches. Red squares represent one acre. Velocities and depth data was collected May 2004 at low navigation stages.

Photograph 2: Sediment sample taken 100 yards downstream of notch at dike 149.3. Note sandy consistency.

Photograph 3: Sediment sample taken within un-notched area on left bank behind revetment at river mile 142.2. Note silty consistency.

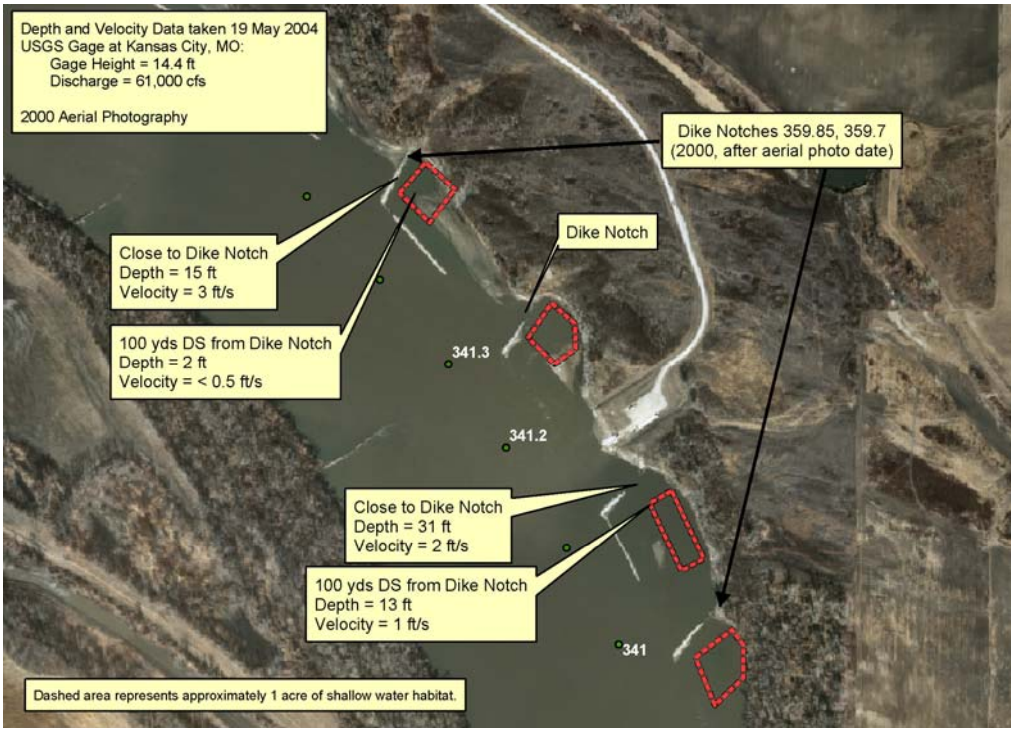

Figure 9: Notches at Cooley Lake. This figure illustrates the depth and velocity diversity resulting from a series of notches constructed in dikes by Cooley Lake. Depth and velocity data was collected May 2004 at low navigation stages. Red squares represent one acre.

Based on analysis of past and current notching, a 50' dike notch will create one acre of diverse shallow water habitat and a 100' notch will create two acres of diverse shallow water habitat.

	50'	60'	75'	100'	150'
Dike Notches	302	47	45	33	0
SWHAcres/Notch	1	1.2	1.5	2	3
SWH Created	302	56.4	67.5	66	0
Total SWH Acres			**491.9**		

Table 4: Number and size of dike notches excavated and the total amount of SWH developed.

REVETMENT NOTCHES: These notches are cut in stone fill revetments at locations where a slack water pool is separated from the main channel by a stone fill revetment. Without notches in the revetment, these aquatic areas are poorly connected to the main channel at normal summer flows, and therefore have little to no flow, and no velocity diversity. These notches range in width between 50' to 100' and were excavated to either –4 or –5 CRP. In most cases notches were cut at the upstream and downstream end of the pool to maximize the effects of the notches.

A revetment notch increases the connectivity of the slack water pool with the main channel. The increased connectivity increases the flow in the slack water area which increases the velocity diversity and increases the depth diversity of the area.

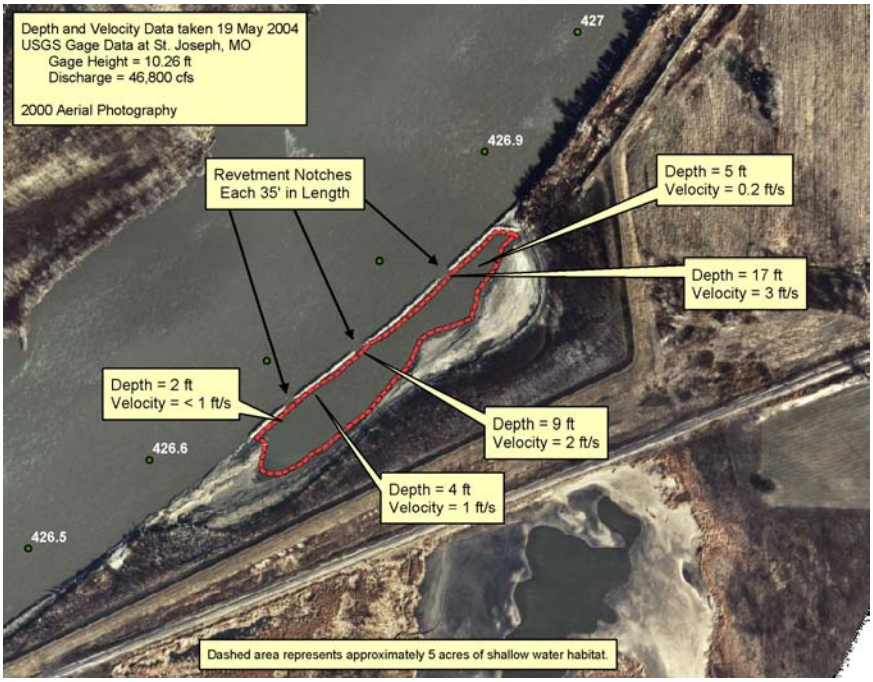

Figure 10: Revetment Notching. This figure illustrates the increased connectivity and depth and velocity diversity that results from revetment notches. Depth and velocity data were collected during May 2004 at low navigation stages.

Based on analysis of past and current revetment notching efforts, a 50' revetment notch will create one acre of diverse shallow water habitat and a 100' revetment notch will create two acres of diverse shallow water habitat.

	50'	75'	100'
Revetment Notches	56	16	19
SWHAcres/Notch	1	1.5	2
SWH Created	56	24	38
Total SWH Acres		**118**	

Table 5: Number and size of revetment notches excavated and total amount of SWH developed.

	Complete					Complete	
	50'	60'	75'	100'	150'	Totals	
Dike Notches	236	34	22	21	0	**313**	
Revetment Notches	56	-	9	17	-	**82**	
Bank Notches	-	-	50	-	-	**50**	**Totals**
							427
							91
	Estimated to be complete by 30 June					**To Be**	**75**
	50'	60'	75'	100'	150'	**Totals**	
Dike Notches	66	13	23	12	0	**114**	
Revetment Notches	0	-	7	2	-	**9**	
Bank Notches	-	-	25	-	-	**25**	

Table 6: Notches completed as of June 4 and estimated to be completed by June 30 between the Osage River and Rulo Nebraska.

TYPE B NOTCH: Type B notches were constructed in the reach from Sioux City, Iowa to Rulo, Nebraska (2000 BiOp Segments 12 and 13). Type B notches were constructed in a total of 48 dikes (6 bends) in Segment 12, and a total of 75 dikes (6 bends) in Segment 13. Table 3 below summarizes the number and location of the notched dikes. For a complete listing of dikes refer to Appendix E. Type B notches were monitored both qualitatively and quantitatively. The qualitative assessments were conducted during the joint inspections outlined in Table 2.

During these inspections erosion was observed, trapping of large woody debris was noted and the change in surface flow patterns between modified and unmodified dikes was clear to see. The extent of the effect ranged from one notch width to several notch widths in the downstream direction, depending on the length of the exposed dike and the angle of the dike to the direction of flow. The observed effects upstream of the notched dike were very local and are considered insignificant at this time. Quantitative assessments were made using pre-and post construction surveys as described in Section II.c. Detailed results from these surveys are provided in Appendix D. Survey data indicate changes in shallow water (0-5 feet) were minimal. However the data show a significant change in the diversity of depths in the channel adjacent to the notched dike. Depth diversity and bankline irregularity were increased over an area of roughly two acres per notch. It is important to note that the

diversity changes extended to the limits of the survey, so it is reasonable to assume that the changes extend beyond the surveyed area. Figures 4a and 4b show typical depth diveristy in the vicinity of a type B notch. Considering the above information, and information contained in the 2003 Amended Biological it is likely that each type B notch would provide 1-2 acres of SWH.

Type B Notch Summary					
Project Site	River Miles	River Bank	Number of Notches	Acres of SWH/Notch	Total Acres of SWH
Lower Dakota Bend	722.5 – 722.1	Right	5	1-2	5-10
Lower Monona Bend	700.8 – 699.6	Right	10	1-2	10-20
Upper Blenco Bend	679.6 – 678.9	Left	6	1-2	6-12
Sandy Point Bend	657.4 – 656.5	Right	7	1-2	7-14
Lower Little Sioux Reach	672.4 – 670.5	Left	14	1-2	14-28
Tyson Bend	655.4 – 531.1	Left	7	1-2	7-14
Nottleman Island	584.8 – 582.8	Left	15	1-2	15-30
Aulden Bar	578.7 – 576.8	Left	13	1-2	13-26
Copeland Bend	569.2 – 565.4	Left	21	1-2	21-42
Nebraska Bend	562.7 – 561.5	Left	8	1-2	8-16
U/L Deroin and Indain Cave B.	519.7 – 516.3	Left/Right	17	1-2	17-34
Cottier Bend	508.4	Left	1	1-2	1-2
		Totals	**124**		**124-248**

Table 7: Type B Notch Summary

Photograph 4: Typical Type B Notches (Lower Monona Bend)

Photograph 5: Dike 626.82 (Nottleman Island), notice the woody debris falling into the river.

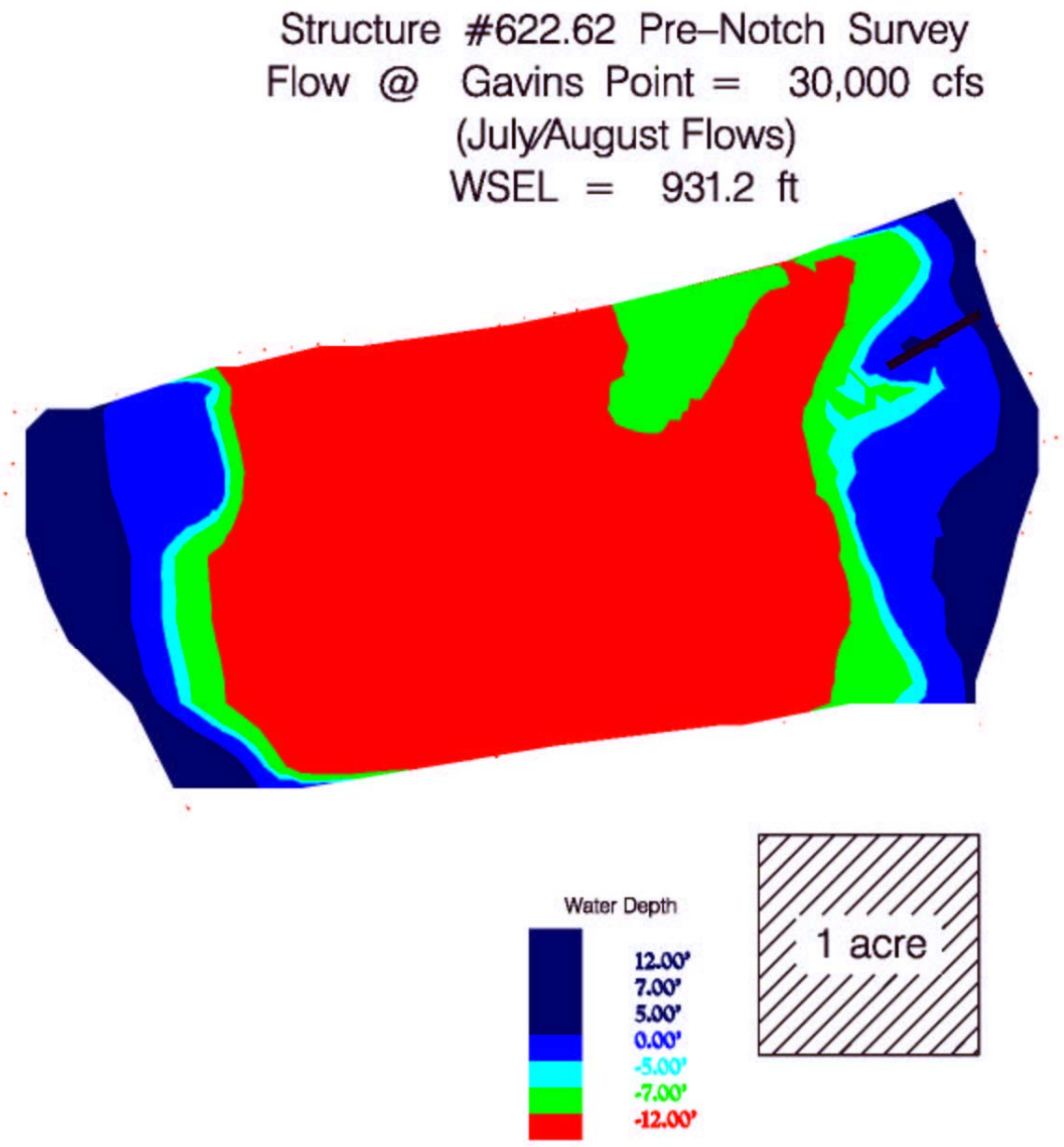

Figure 11a. Typical Pre-construction Depth Diversity in the Vicinity of a Type B Notch.

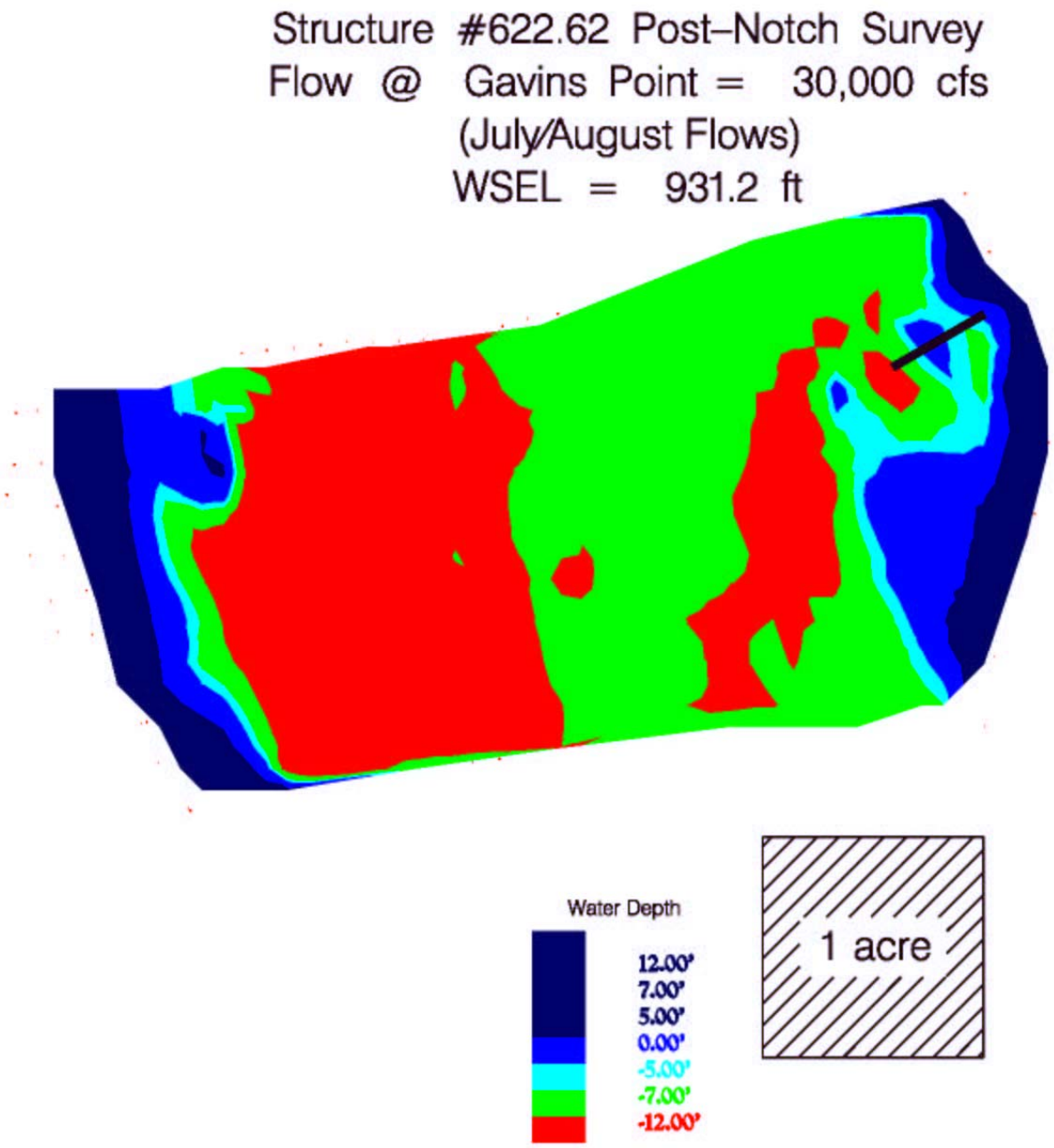

Figure 11b. Typical Post Construction Depth Diveristy in the Vicinity of a Type B Notch.

b. Dredging

During the spring of 2004 four backwater areas were dredged in the Missouri River from Ponca State Park to Blair, Nebraska. The furtherest upstream project site (Ponca) is located at river mile 754.0 which is at the intersection of BiOp segments 10 and 11. The other three dredge sites are located at river miles 661.5 (Soldier Bend), 653.0 (Tyson Bend) and 649.5 (California Bend), all of which are located in BiOp segment 12. The Ponca site consists of two separate backwater areas, each having several smaller side areas off the main backwater area. The beach slopes in the backwater areas ran from nearly vertical to approximately 1V:4H, and the bottom depth is designed to be approximately 5 feet below the water surface at full service releases from Gavins Point Dam.

The Ponca dredging operation is part of a larger restoration project that will place large woody debris along the shoreline of the backwater areas, and restoration of a tall grass prairie. Appendix G shows the dredge areas, and Photograph 6 shows the construction in progress. The other three projects consist of a single backwater area as shown in Appendix G. These projects are restoring a type of aquatic habitat that has nearly vanished for Missouri River in BiOp segment 12. These areas are relatively wide compared to their length and the beach slopes are the angle of repose. The depths are designed to be 5 feet below the CRP. Photographs 7 to 10 show the lower three backwater areas under at various stages of construction.

Construction of backwaters have been proposed before to benefit the pallid sturgeon. In the 1999 Biological Opinion from the FWS (Nebraska) on the Platte River depletions associated with the construction of the Platte West Water Production Facilities in Douglas and Saunders Counties, the FWS stated that the implementation of a "riverine habitat restoration project would offset the impacts of the project on the pallid sturgeon" (FWS, 1999). The restoration project is described in Appendices A and B of the 1999 Biological Opinion, and consisted of construction of a backwater channel complex connected to the Missouri River by the removal of a section of existing levee (Nebraska Game and Parks Commission, 1998). Citing the benefits of increased aquatic insect production, spawning and nursery areas for fish, refugia for all species of fish from the high velocities of the main channel, and backwaters being part of the historic diverse habitat assemblage, the FWS and the NGPC both indicated that pallid sturgeon would benefit from the construction of a backwater project (FWS, 1999; NGPC 1998). In fact, the 1999 Biological Opinion states that the construction of the backwater would "...benefit the recovery of the [pallid sturgeon] species," (FWS, 1999).

References:

U.S. Fish and Wildlife Service, 1999. Letter report to Ms. Candace Gorton of the Corps including the FWS's biological opinion for impacts to federally listed....species in Nebraska from the Metropolitan Utilities District...proposed project dated February 22, 1999, in Burns & McDonnell Engineering Company, 2002, Final Environmental Impact Statement for the Platte West Water Production Facilities, Douglas and Saunders Counties, Nebraska. Prepared for the U.S. Army Corps of Engineers, Omaha District and the Metropolitan Utillities District, Omaha, NE, Project Number 20383, March 2002.

Nebraska Game and Parks Commission, 1998. Letter to Bob Nebel of the Corps describing the proposed restoration project, in Appendix A of the U.S. Fish and Wildlife Service's Biological Opinion dated February 22, 1999.

The dredged areas will not be physically monitored beyond that specified in the construction contract, though they will be part of the future biological monitoring plan. Minor fluctuations in water surface elevations will cause water to circulate into and out of these backwater areas. This has been observed on numerous occasions at Hidden Lake near Bellevue, Nebraska and at several pump inlet channels along the Missouri River in BiOp segment 12 and 13. This was most recently observed at the Ponca site on May 12, 2004, where surface currents were noticed in the backwater as flows from Gavins Point Dam were being dropped. The amount of circulation will depend in the size and shape of the backwater area, and amount of direct access to flowing water. Ponca will have the least amount of circulation and California Bend will have the most.

All of the backwater dredge areas are under construction and will be completed by July 1, 2004, and when completed each will provide an increase in the amount and quality of "Secondary Channel-Non Connected Habitat," as described in Appendix B. Table 7 shows the expected range of acres of SWH that each site will contribute to the system through the construction alone. At Soldier and California Bends the dredging operations will connect existing shallow water areas to the main channel that were previously isolated. Until construction is complete the total amount of additional acres cannot be determined, but a conservative estimate would be an increase of 75% at each site for a total of additional 28 acres. Also, the Tyson Bend dredge area will intersect with a flowing side channel. This will not increase the amount of SWH acres but it will provide greater circulation within the dredged area.

Habitats created from dredging operations fall into two primary categories. Dredging in Chute habitats (Secondary Channel Connected) such as the projects at California Bend, Soldier Bend and Tyson Bend result in channel widening; whereas the dredging operations at sites such as Ponca results in the formation of a backwater (Secondary Channel Non-Connected) habitat or re-connects a backwater habitat restoring connectivity back to the river.

Biological benefits of channel widening (chutes) include the enhancement of a range of depths and velocities available to native river species, provides connectivity to the floodplain, provides off-channel habitat for spawning and promotes the erosive processes (i.e., sediment and woody debris) resulting in enhanced ecosystem diversity and function.

Backwater (Secondary channel non-connected) areas developed through dredging such as the Ponca Project increase connectivity to the floodplain, provide diversity in temperature, velocity, increased nutrient load resulting in increased energy necessary for invertebrates and native fish species while restoring functionality to the ecosystem.

Dredging Summary				
Project Site	**River Mile**	**Bank**	**Constructed Acres**	**Acres of SWH at Minimum Service**
Ponca	754.0	Right	80	60
Tieville-Middle Decatur Bend	691.0	Left	10	10
Soldier Bend	661.5	Left	25	25
Tyson Bend	653.0	Left	25	25
California Bend	649.5	Left	15	15
		Totals	**155**	**135**

Table 8: Dredging Summary

Photograph 6: Ponca Project looking SW at the dredge area and the emergent sandbar being created.

Photograph 7: Soldier Bend dredging, looking upstream. Dredging is approximately 60 percent complete. Additional acres are shown in the upper center portion of the picture.

Photograph 8: Tyson Bend Dredge Area. The approximate area to be dredged is outlined in red.

Photograph 9: California Bend Dredging, looking downstream. Dredging is nearly complete.

Photograph 10: California Bend Dredging, looking upstream. The additional acres are located in the upper left protion of the picture.

c. Pilot Channels

Pilot channels are trenches excavated immediately landward of a stone fill revetment. The trenches are connected to the river by notches in the adjacent revetment. Pilot channels have at least a 50' bottom width and range between 1000' and 2400' in length. Approximately 40 cubic yards of bank material is excavated per foot of channel. Cleared vegetation and excavated bank material is placed riverward of the adjacent revetment. Pilot channels were constructed at Eagle Bluffs, Diana Bend, Liberty Bend, Weston Bend, Benedictine, Worthwine Island, and Monkey Mountain.

By excavating the overbank, pilot channels have the immediate effect of increasing the amount of available shallow aquatic habitat. This desirable habitat will be immediately adjacent to and highly connected to the main channel. In addition, the excavated overbank and woody debris disposed of on the riverside of the revetment will provide additional habitat as the organic matter is washed into the river. It is also expected that the aquatic habitat in the dike field across the river from the pilot channel will experience some deposition due to the redirection of water out of the main channel.
Pilot channels are in general located upstream of slack water off-channel pools so that the flow through the pilot channel will flow into the pool and diversify the habitat of the pool.

It is expected that by the first of July, the pilot channels will erode to a topwidth of 100'. The result will be 2.3 acres of aquatic habitat per 1000' of pilot channel. In addition, the increased diversity of the pool area downstream of a pilot channel and the deposition in the dike field across the river will result in an additional 1.7 acres of aquatic habitat per 1000' of pilot channel. The net effect is the creation of 4 acres of shallow water habitat per 1000' of pilot channel.

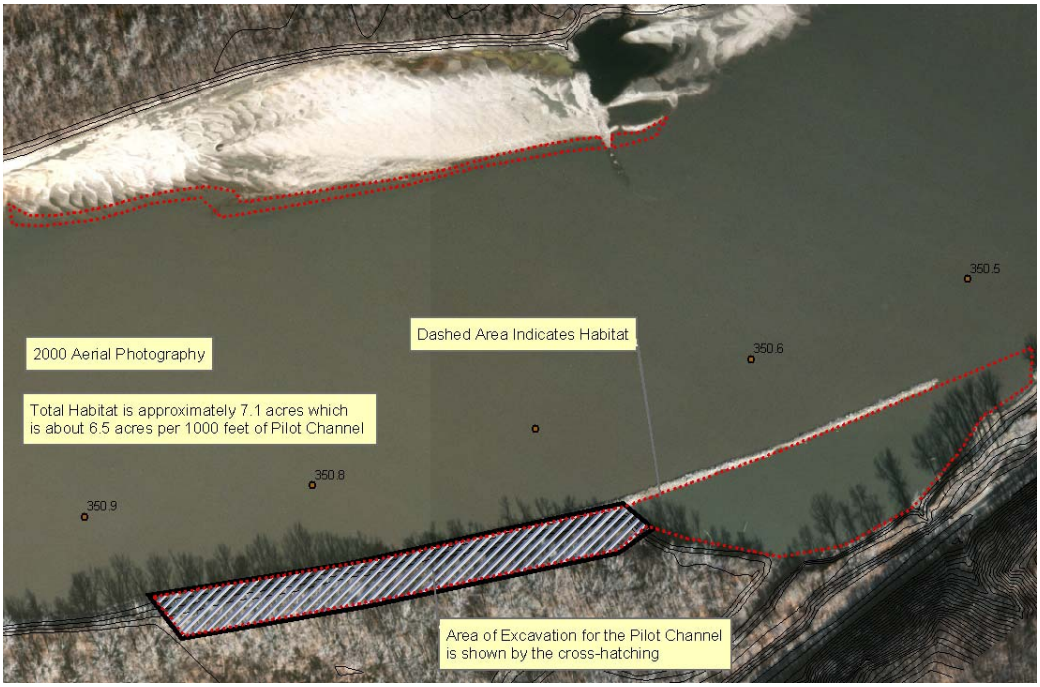

FIGURE 12: Area of improved aquatic habitat as a result of pilot channel construction at Liberty Bend near river mile 350.

Site	River Miles	Length	Local Acres/1000'	Downstream Acres/1000'	Local SWH Acres	Downstream SWH Acres	SWH Acres Created
Monkey Mountain	466-464	2500	2.3	1.7	5.75	4.25	10
Worthwine Island	459-456	2750	2.3	1.7	6.325	4.675	11
Benedictine Bottoms	428-424	2000	2.3	1.7	4.6	3.4	8
Weston Bend SP	403-402	1250	2.3	1.7	2.875	2.125	5
Liberty Bend	352-351	1100	2.3	1.7	2.53	1.87	4.4
Baltimore Bend	300-296	0	2.3	1.7	0	0	0
Grand Pass	272-267	0	2.3	1.7	0	0	0
Lisbon-Jameson	218-210	0	2.3	1.7	0	0	0
Franklin Island	195-192	0	2.3	1.7	0	0	0
Diana Bend	189-187	1000	2.3	1.7	2.3	1.7	4
Eagle Bluffs	176-171	300	2.3	1.7	0.69	0.51	1.2
Marion Bottoms	164-158	0	2.3	1.7	0	0	0
Smokey Waters	134-131	0	2.3	1.7	0	0	0
Total SWH Acres	**43.6**						

Table 9: Length and location of pilot channel excavated and the amount of SWH developed.

d. Chutes

Chutes are trenches excavated entirely within the overbank and connected to the river at the entrance and the exit. The secondary channel increases the total amount of aquatic habitat available. One 2400' x 75' chute was constructed at Smokey Waters and one 1000' x 125' chute was constructed at Diana Bend. At Smokey Waters the excavated material was disposed of on top of the adjacent high bank of the chute while at Diana Bend the excavated material was pushed into the river or disposed of on the high bank.

During normal summer flows, the flow in the chutes will be shallow and slow with a high degree of diversity. The chute bottom will be very dynamic with a sandy substrate.

At Smokey Waters, the entrance to the chute is located at the downstream end of a remnant 1993 scour hole. The revetment separating the slack water pool was notched with two 100' notches. Water will now flow through the notches, through the remnant scour hole and down through the chute. The result will be increased depth and velocity diversity in the slack water pool as well as the chute creating 25 acres of shallow water habitat.

The Diana Bend chute will add 3 acres of shallow water habitat.

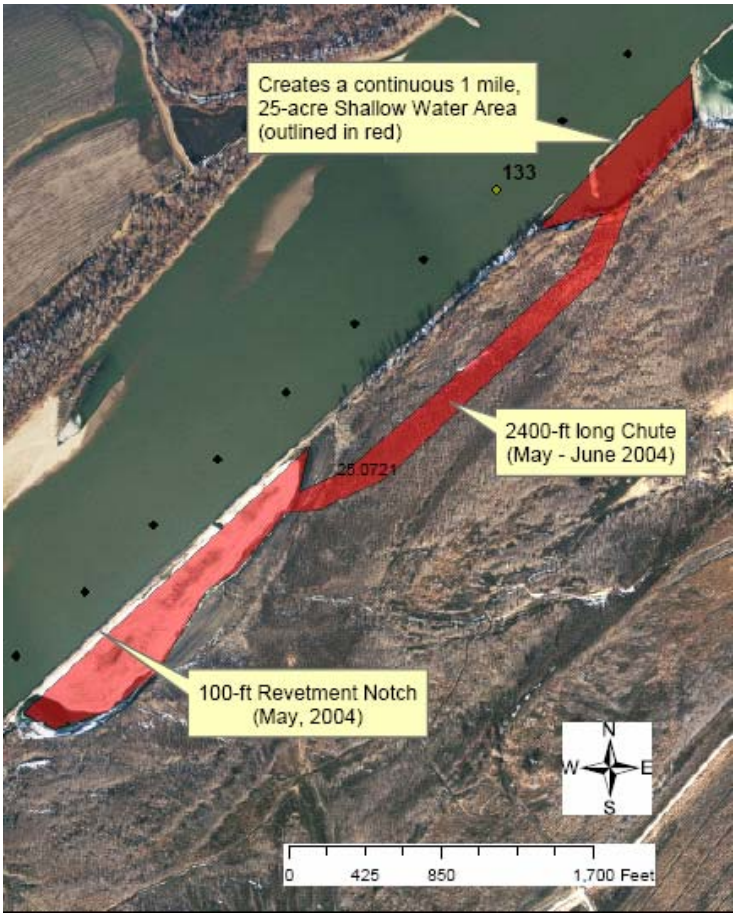

Figure 13: Area of improved aquatic habitat as a result chute construction at Smokey Waters.

Site	River Miles	Feet of **Chutes**	SWH Acres Created
Monkey Mountain	466-464	0	0
Worthwine Island	459-456	0	0
Benedictine Bottoms	428-424	0	0
Weston Bend SP	403-402	0	0
Liberty Bend	352-351	0	0
Baltimore Bend	300-296	0	0
Grand Pass	272-267	0	0
Lisbon-Jameson	218-210	*	50
Franklin Island	195-192	0	0
Diana Bend	189-187	1000	3
Eagle Bluffs	176-171	0	0
Marion Bottoms	164-158	0	0
Smokey Waters	134-131	2400	25
Total SWH Acres		**78**	

Table 10: Length of chutes constructed and the amount of SWH developed.

*LISBON CHUTE: Notches excavated in the revetment and hydraulic control weir at the Lisbon chute will increase the amount of flow entering the chute during normal summer stages. At normal summer

stages, the increased flow in the chute as a result of the new notches is estimated to amount to approximately 1,100 cfs above the existing estimated flow of 1,500 cfs. The additional flow will increase the submerged surface area within the chute and will also diversify and create a more dynamic aquatic environment in the chute in general.

At the time of the writing of this report, the new notch in the hydraulic control weir has not been constructed so it is not possible to field quantify the additional amount of aquatic habitat that will be available as a result of the new notches. However, based on past experience and engineering judgment, the additional flow should increase flow depth in the chute by approximately 5 feet at normal summer stage. As a result, flow will begin to inundate the sandbars causing an increase in topwidth of approximately 220 feet. The chute is approximately 10,000' in length; therefore the net increase in available shallow water habitat will be 50 acres ((220*10,000)/43560) after construction of the new notches.

f. Major Dike Modifications

The initial estimates for SWH created through major dike modifications was developed through reconnaissance inspections and pedestrial surveys of similar projects, and engineering analysis of a completed chevron project located along the right bank of the Missouri River at river mile 635.3 (Boyer Bend). Engineering analysis of the Boyer Bend chevrons indicates that as much as 25 percent of the cross section could be converted from deep water (greater than 10 feet) to shallow water ($\leq$ 5 feet). This is documented in: "*Remus, John I., and Robert D. Davinroy, Use of Chevron Structures to Create Depth Diversity in the Missouri River, Proceedings of the 7th Federal Interagency Sediment Conference, March 2000"*. Reconnaissance inspections and pedestrial surveys of an area along the right bank near river mile 555 indicated that removal of a large portion of two adjacent dikes coupled with the construction of a chevron structure between the dikes, initiated almost immediate erosion of the high bank and reduced depths in the hydraulic shadow of the chevron from roughly 12 feet to less than 3 feet in a matter of a few weeks. The resulting sandbar was evident for several hundred feet downstream. In addition to adding top width to the main channel of the river, the modification provided greater depth diversity to the channel riverward of the modified dikes. SWH acreage estimates at each individual site were based on engineering judgment taking into account the number and length of exposed dikes, height of the adjacent high bank, length and radius of the bend, and historic thalweg meander potential in the bend.

Major dike modifications consist of lowering a large portion of the riverward ends of the dikes (Figure 2) and construction of a chevron structure (Figure 3) between approximately every pair of lowered dikes. This type of modification was placed at 6 bends in the river as indicated on Table 6 below. For a more detailed description of the individual dike modification plans please refer to Appendix F. Four of the six sites are located in BiOp segment 12 and the other two are located in BiOp segment 13. The dike lowering will allow the high bank to erode an amount approximately equal to the amount the dike is lowered into the high bank. The chevrons will perform two functions. First, the chevrons will create an area where sediment can accumulate in and adjacent to the main channel. The second function is to force a portion of the flow against the high bank, thus facilitating the erosion process. The erosion process adds to the top width of the river, adds large woody debris to the main channel, and provides for a slight increase in the amount of sediment available for alluvial processes. The combination of these two effects leads to a greater diversity of depths and velocities through the bends. This modification results in an increase in the amount and quality of "Inside Bend Habitat," as described in Appendix B. Photographs 11 through 16 show these effects.

Qualitative analysis of these modifications indicates the erosion process leading to a greater diversity of depths and velocities can occur very quickly. During the joint inspection conducted on April 27, 2004, pre-construction depths in Snyder and Winnebago Bends were 17-20 feet. Chevrons were constructed on April 28-30. During the joint inspection conducted on May 4, 2004, depths of 2-6 feet were observed in the same area under similar discharge conditions. These changes were further verified during the joint inspection on June 2-3, 2004. This is consistent with other reconnaissance inspections conducted near river mile 555 in the fall of 2002, and with several reconnaissance inspections of the completed chevrons in Boyer Bend, river mile 635.3. Reconnaissance inspections indicate that this modification can influence the hydraulics of flow for several hundred feet downstream of each chevron.

The engineering analysis of channel geometry data indicates that the change in the number of acres of SWH was minimal as indicated in Figures 6a through 6d. A more complete synopsis of the analysis is contained in Appendix D. This analysis is inconsistent with the numerous inspections and reconnaissance surveys discussed above. However, this area has experienced relatively varying flows that have overtopped the chevrons. This has likely caused the sandbars to scour. All evidence would indicate that the sandbars will re-appear during the July-August period when the flows are expected to be at or below the tops of the chevrons. The data does show a general decline in the 7-12 foot depth range and a general increase in the 5-7 foot depths. This is adding depth diversity to the main channel. Furthermore, the fact that the sandbars are able to form and erode with changes in the hydrograph adds to the overall “natural river processes” or in other words increased alluvial dynamics.

In addition to the geometry assessment described above, a qualitative assessment of the velocity distributions was conducted. Because the velocity data was collected for the purpose of verifying a math model, the data has limited utility in assessing velocity distribution changes. However, general trends are discernable. Figures 7a through 7d show the impacts that this modification can have on the distribution of velocities within the main channel. This modifications impact the flow field locally as well as throughout the bend.

Based on the all of the information available on this type of modification the increase in SWH is 8-15 acres per mile of modification.

Photograph 11: Chevron and sandbar are near RM 635 during low winter flow.

Photograph 12: Chevron and sandbar are near RM 635 during low winter flow. Looking from the upstream end of the sandbar.

Photograph 13: Chevron and sandbar at RM 555.0 approximatly 6 weeks after construction.

Photograph 14: Chevron and SWH near RM 552,

Photograph 15: Flow Disturbance patterns of submerged chevron in Snyder Bend.

Photograph 16: Chevron and large woody debris pile in Winnebago Bend.

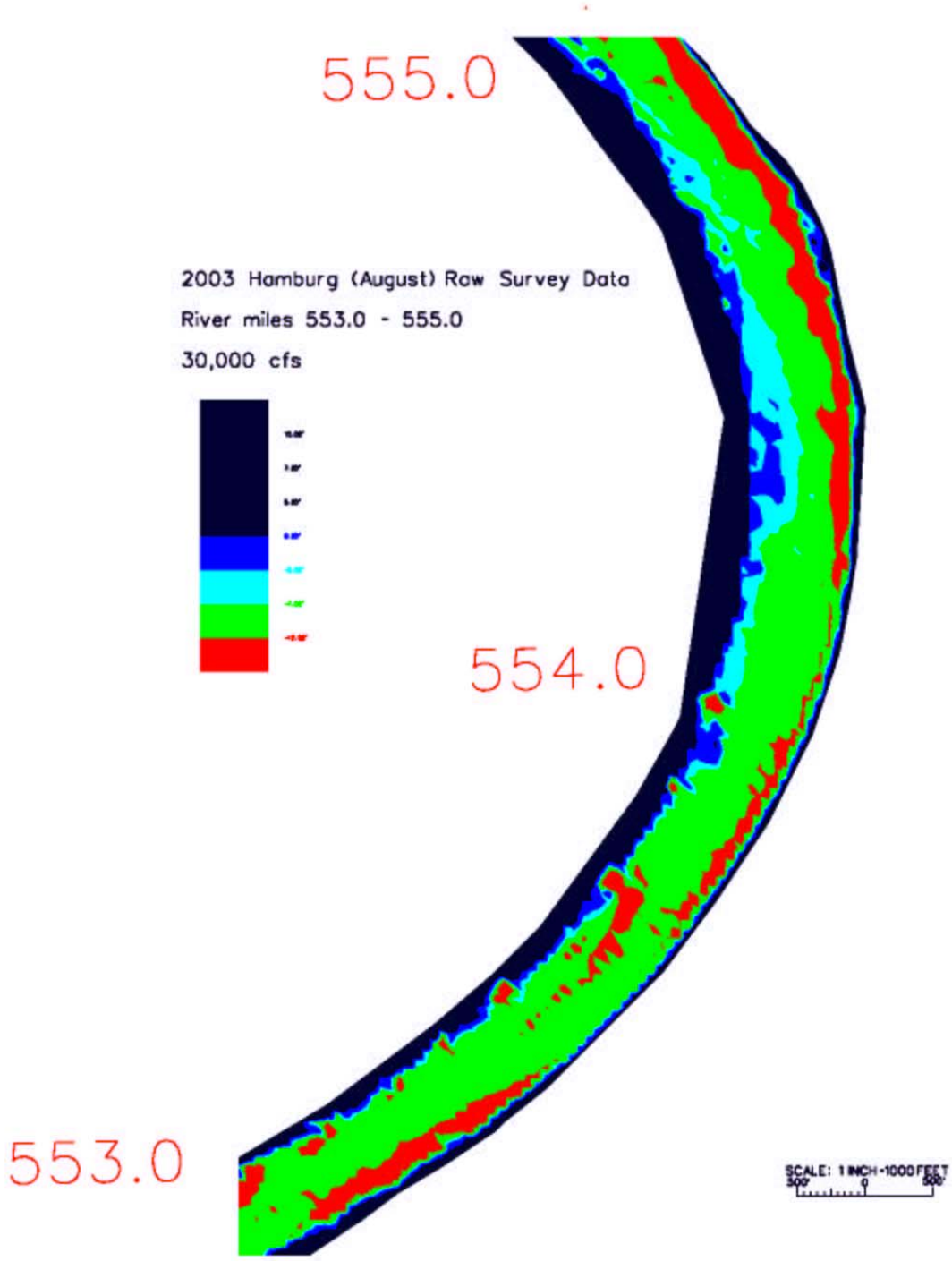

Figure 14a. Pre-construction depth distributions, Upper Hamburg Bend.

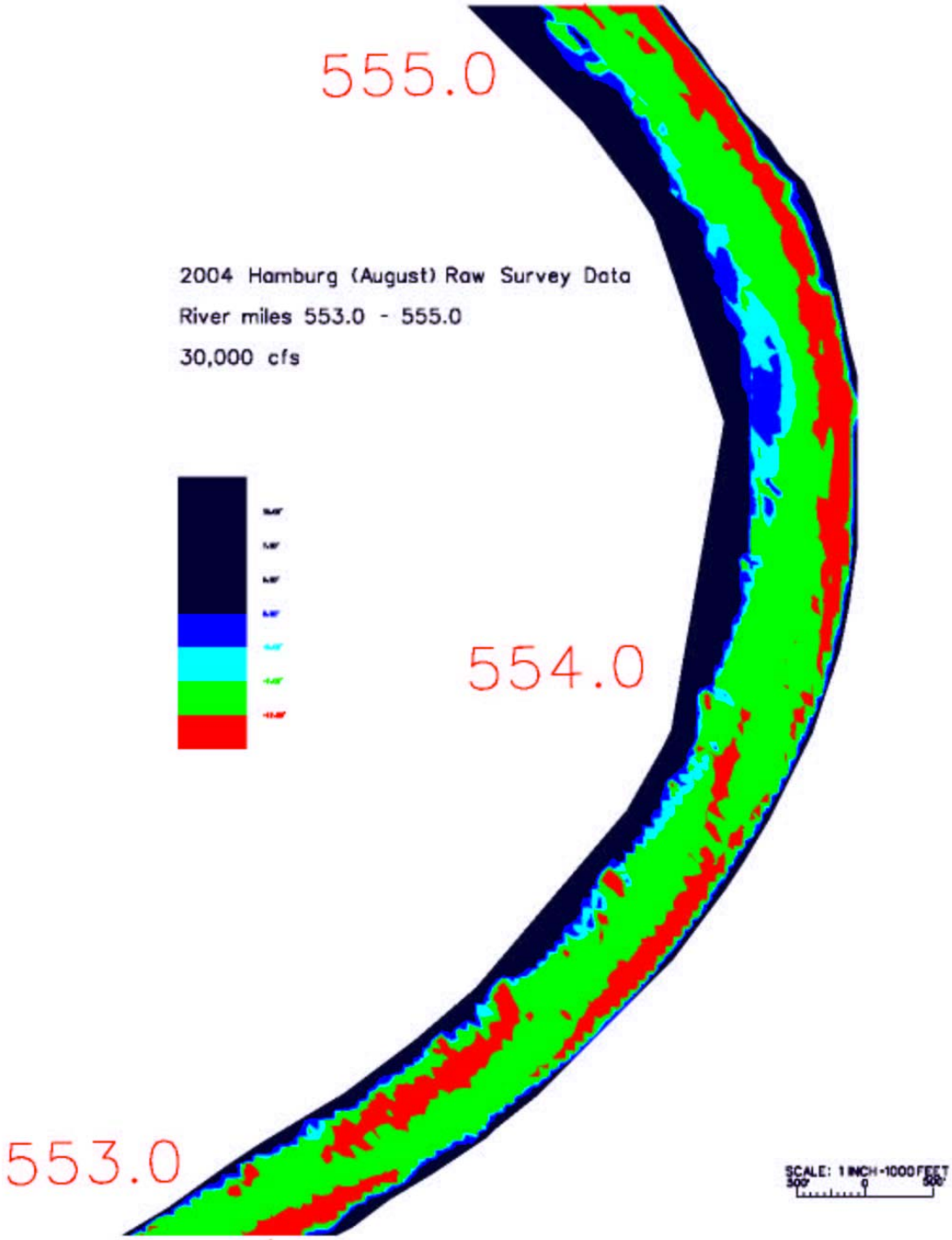

Figure 14b. Post construction depth distributions, Upper Hamburg Bend.

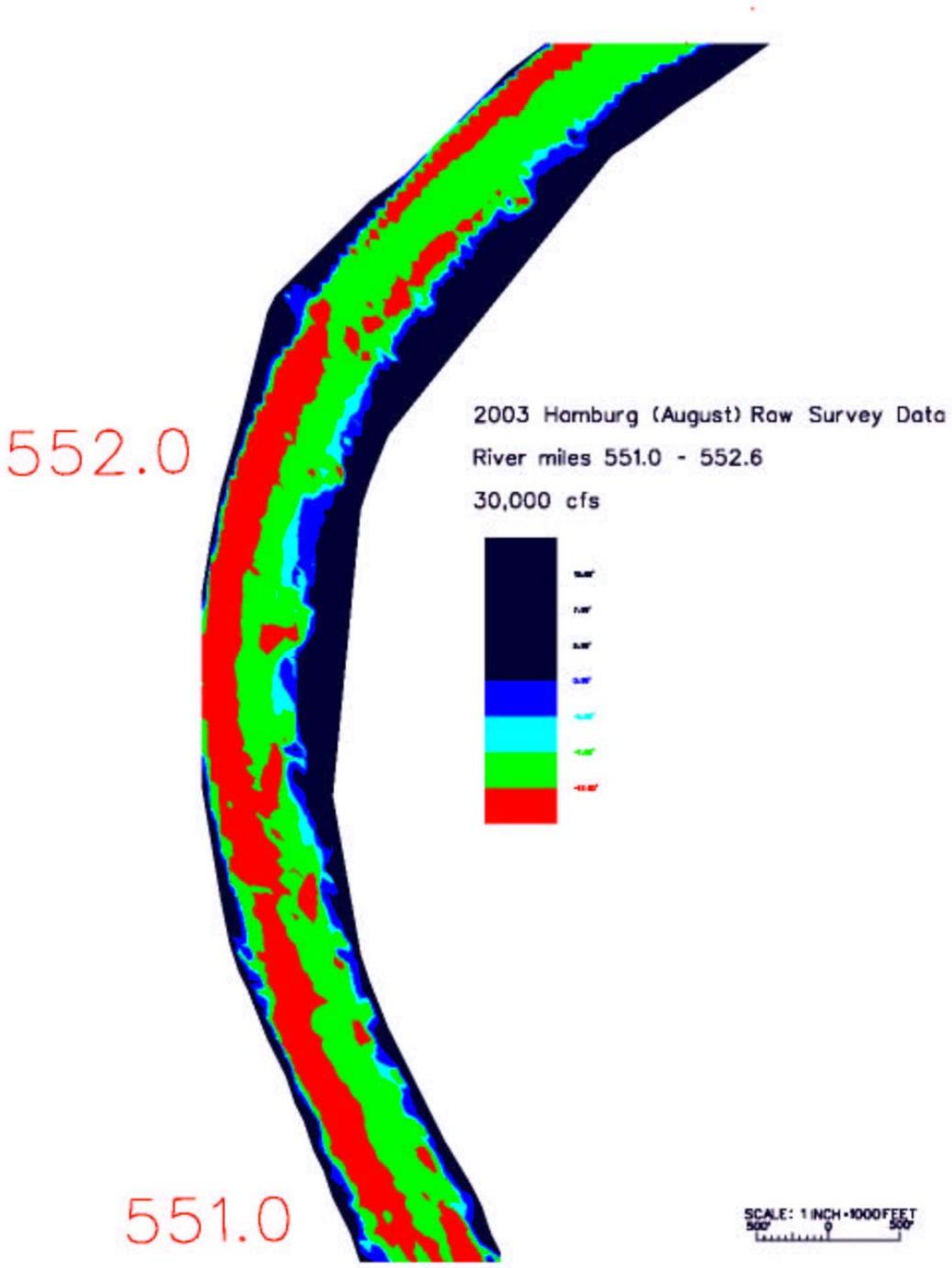

Figure 14c. Pre-construction depth distributions, Lower Hamburg Bend.

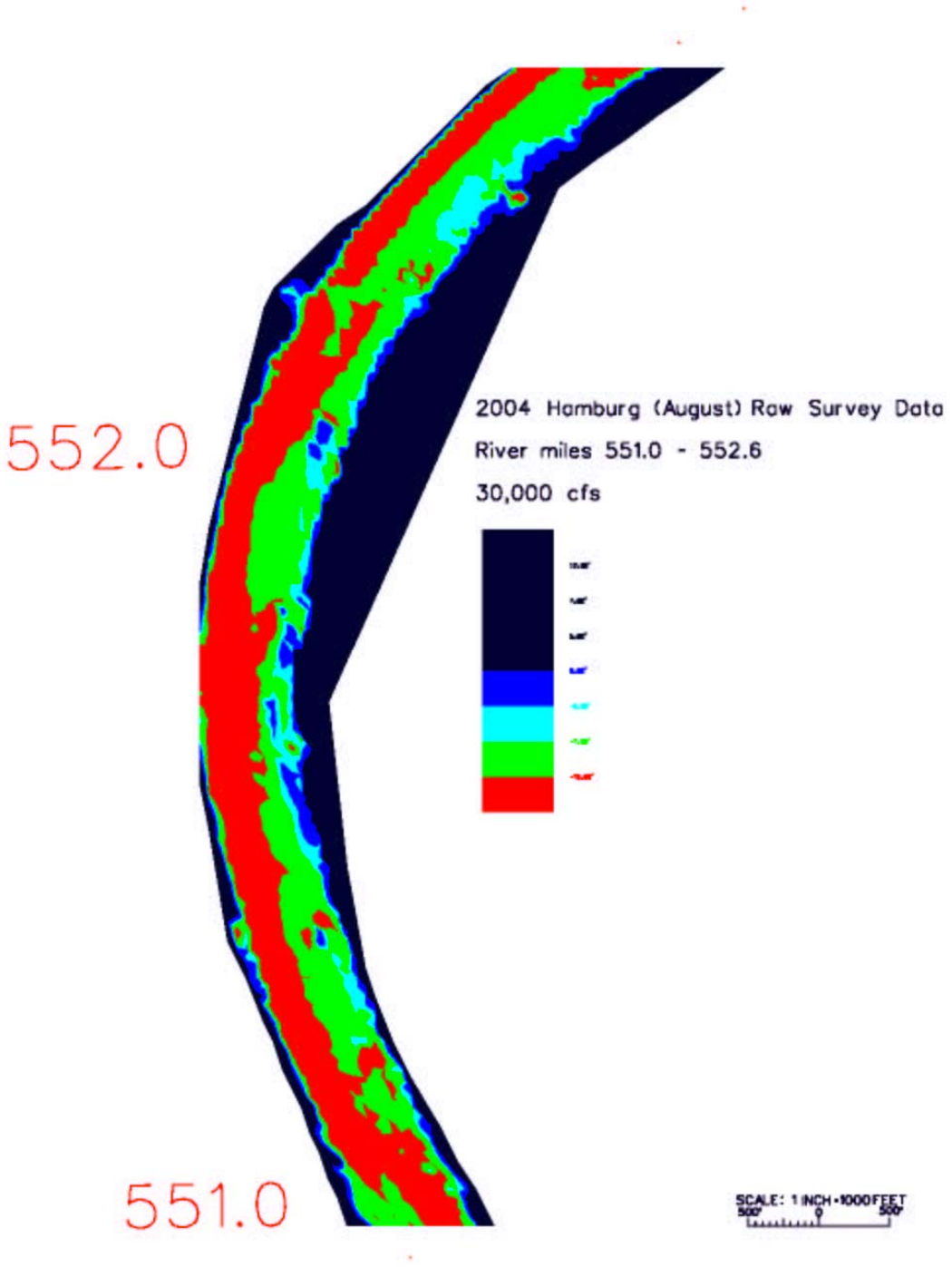

Figure 14d. Post construction depth distributions, Lower Hamburg Bend.

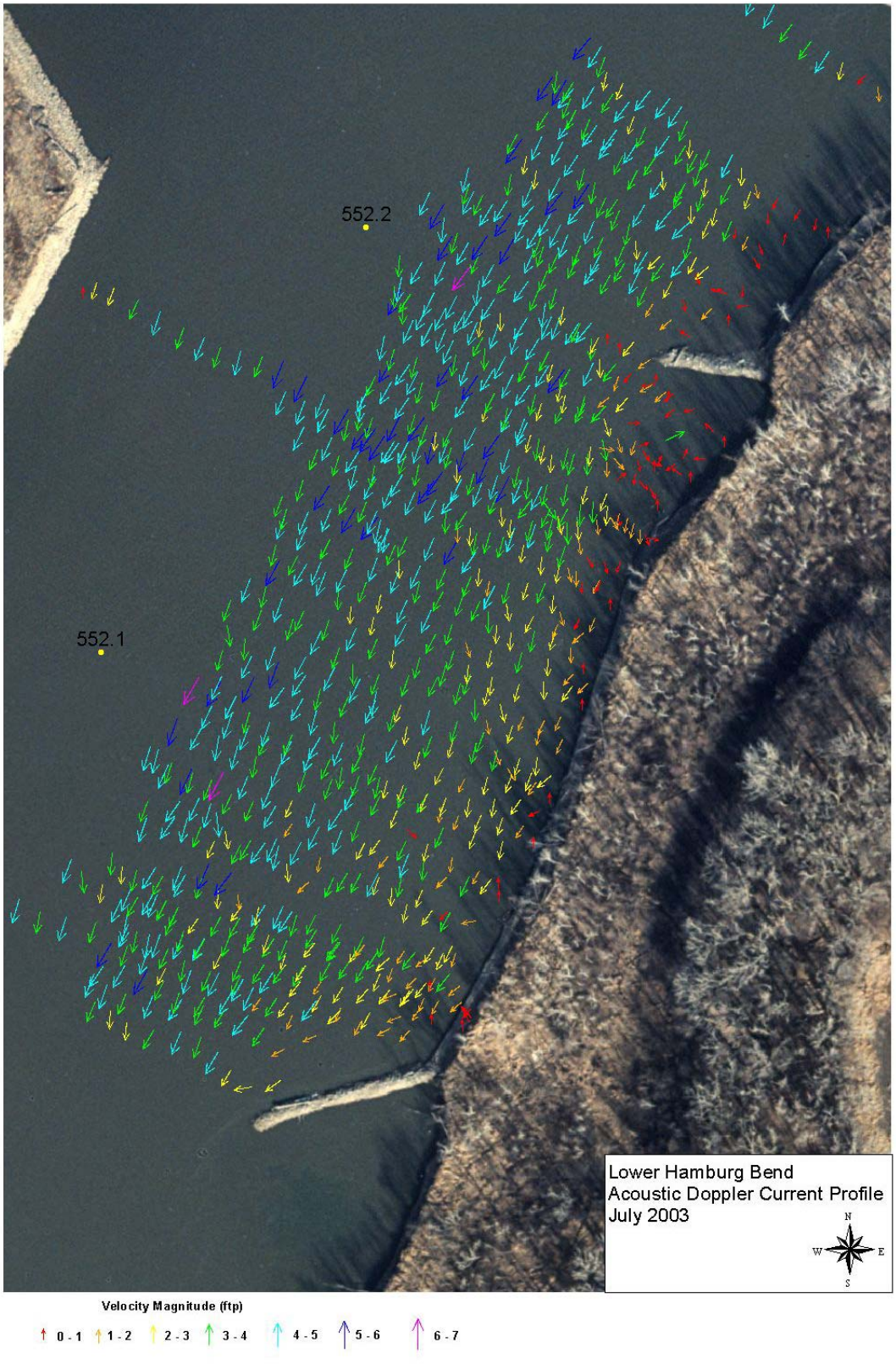

Figure 15a. Pre-construction velocity distributions, Lower Hamburg Bend.

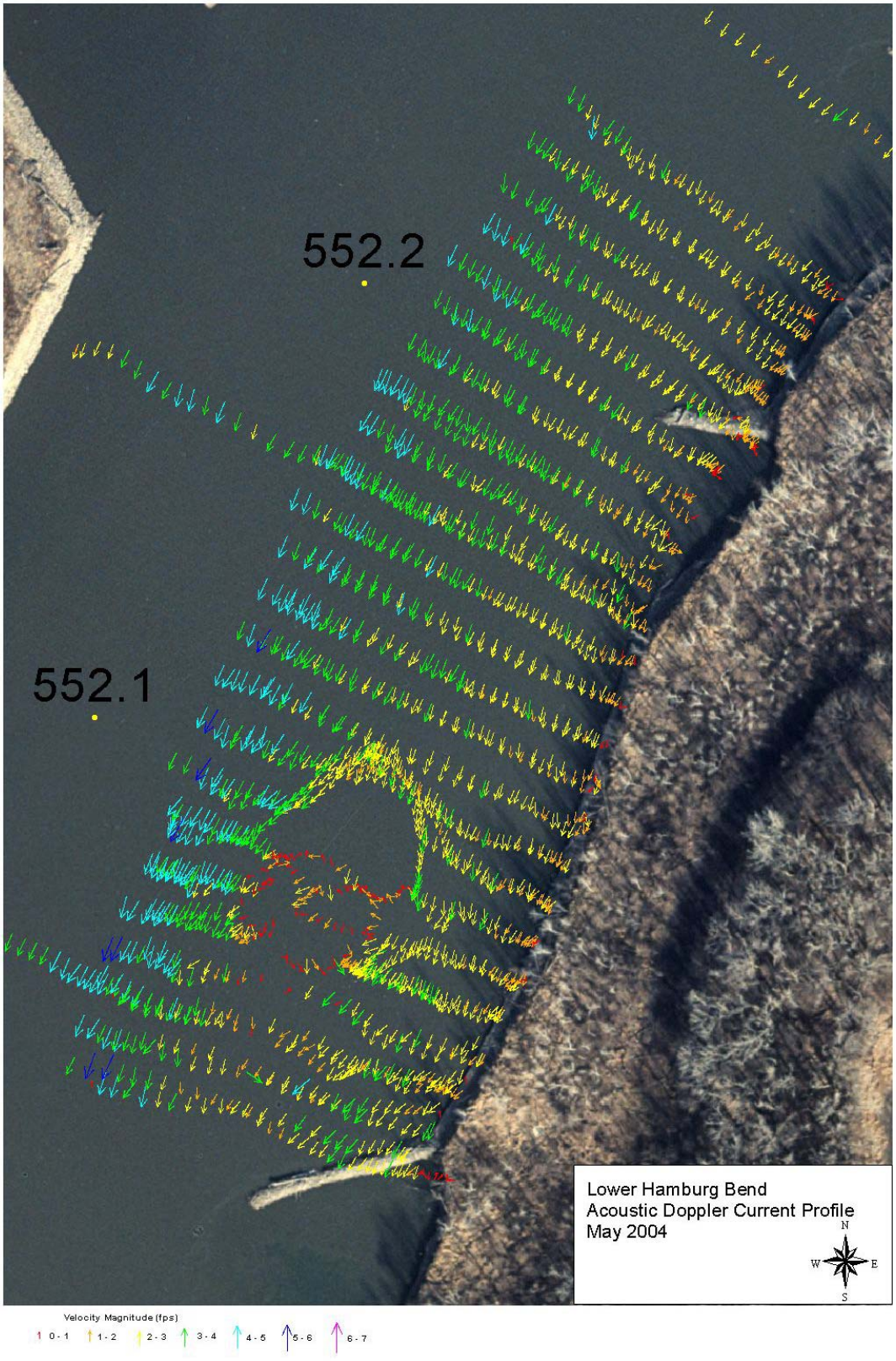

Figure 15b. Post construction velocity distributions, Lower Hamburg Bend.

Major Dike Modification Summary					
Project Site	River Miles	River Bank	Dikes Lowered	Chevrons Constructed	New SWH Acres
Snyder Bend	715.2-714.7	Left	5	3	4-8
Winnebago Bend	710.0-708.7	Left	12	5	10-19
Desoto Bend	644.0-642.0	Right	12	6	16-30
Boyer Bend	637.0-634.0	Right	20	8	24-45
Tobacco Islands (Bend) [1]	589.0-588.6 587.7-586.2	Right	9	5	15-28
	588.6-587.7		7	3	0
Upper/Lower Hamburg Bend	See Note 2				40-76
Langdon Bend	531.7-529.0	Right	20	10	21-40
		Totals	**85**	**40**	**130-246**

1 – Due to an active Bald Eagles nest in the area, the shaded area in the table will not be completed
until late July to early August 2004.
2 – This includes 3.6 miles in the Upper and Lower Hamburg Bends and 1.5 miles in Kansas Bend that was complete under the same contract.

Table 11: Major Dike Modification Summary

IV. DESCRIPTION OF CORPS 2004 SUMMER FLOW PROPOSAL

The Corps is proposing to operate this summer in accordance with the 2004 AOP dated March 19, 2004. This year's summer regulation is a steady release – flow to target operation. As identified in the 2004 AOP, the Corps had anticipated an "initial steady release from Gavins Point Dam of 28 kcfs in May and June to keep birds from nesting at low elevations, and 30 kcfs in July and August to meet flow targets as downstream tributary flows decline (see page 12)." Tributary flows were much lower than anticipated, and the Corps increased the Gavins Point Dam release to 30 kcfs in early May. Beginning in mid-May, much needed rains occurred in various parts of the lower Missouri River basin that allowed releases to be reduced.

To retain the ability to return to the higher anticipated release of 30 kcfs, the Corps elected to cycle the releases from 30 kcfs for 1 day followed by no less than 25 kcfs for 2 days, with this being repeated on a 3-day cycle. This keeps the birds nesting high enough to allow the releases to return to 30 kcfs when the tributary flows drop following the May rains. These releases are intended to provide for minimum service on the lower river while meeting the needs of listed species. Should the tributary flows drop below those experienced in early May, the Corps will consider increasing the Gavins Point Dam release to more than 30 kcfs. However, if the wet conditions persist downstream of Gavins Point Dam, releases less that 30 kcfs will be considered to meet targets and conserve water in the upstream reservoirs. The following table shows the number of years out of 100 that the specified discharge from Gavins Point Dam will meet downstream minimum service targets during the July–August time frame. This information shows the probability of what might have to be released to meet downstream targets this year during July and August.

Discharge kcfs	No. of years min. service met
21	<17
25	57
28	73
30	86

Table 12: Probability of Gavin's Point Flow Releases

The releases from Gavins Point Dam from 25 to over 30 kcfs will take advantage of the newly constructed habitat. The newly constructed habitat was designed to operate over a wide range of flows, however, these modifications will perform most effectively when the largest amount of water is diverted over/through modification. Once the modification is submerged, the effectiveness decreases. In general these modifications would operate most effectively at discharges approximately equal to or slightly higher than full service. The 30 kcfs flow is currently anticipated to be the release that will meet the minimum service requirements 86 percent of the time, based on the table above. Dropping the release to 25 kcfs reduces the anticipated minimum service to only 57 percent of the time.

1. Analysis of SWH

In order to put the construction of the 1,200 acres of new SWH into perspective with different flow scenarios, the Corps examined the net change in the amount of potential SWH from Sioux City to the Osage River. Relying on information in the Master Manual Final Environmental Impact Statement (FEIS) and the information in this report, the Corps examined differences in SWH during the summer for 25 kcfs, 28.5 kcfs and 28.5 to 34.5 kcfs as compared to 21 kcfs as identified in the 2000 BiOp.

There are three factors to be considered in this analysis. First are the estimated changes in SWH prior to construction of over 1,200 acres this spring for different flow scenarios as compared to the summer release rate of 21 kcfs. Using information from the FEIS, the Corps used the GP2028 and GP2021 flow management alternatives to estimate this change in SWH. Approximately 1,200 acres corresponds to the average annual gain in shallow water habitat that would occur in the Sioux City to the Osage River reach with a reduction in the summer Gavins Point Dam variable release under the new Water Control Plan compared to the GP 2021 alternative of 21 kcfs in the mid-July to mid-August timeframe. The variable release under the new Water Control Plan adopted in March 2004 is between 34.5 kcfs in normal to somewhat above-normal annual runoff periods and 28.5 kcfs in drought periods. A comparison of the values for the GP2028 and GP2021 alternatives provides an approach for determining the amount of habitat gained for a release of 25 kcfs, which is approximately in the middle of the 28.5 and 21 kcfs releases of the two GP options. The average annual shallow water habitat value for a release of 25 kcfs would be approximately 4,500 acres (prorated value between 4,906 for GP2021 and 4,147 acres for GP2028). The expected daily shallow water habitat in Table 13 is the result of this analysis and are the median values for shallow water habitat over the 100 years of analysis (1989 through 1997 inflow data) conducted for the Master Manual Study.

The second factor is to examine the effects of different flow scenarios on SWH that were constructed under the Missouri River Fish and Wildlife Mitigation Project and Section 1135 program. Utilizing the methodology discussed in the FEIS (see Section 7.7.7), the total acres of SWH

construction under these programs would decrease as flows were lowered. The mitigation and Section 1135 site changes from GP2021 in Table 13 is the result of this analysis.

The last factor is the construction of over 1,200 of SWH this spring. These modifications will effectively operate over a wide range of flows, however, they will perform most effectively for pallid sturgeon shallow water habitat with discharges approximately equal to or slightly higher than full service

Table 13 presents the amount of potential habitat using the FEIS data on shallow water habitat. In summary, with the construction of 1,200 acres of shallow water habitat this year and the Gavins Point Dam release set at 25 kcfs or greater, a net positive change in shallow water habitat is expected this summer. This amount is estimated to be in the range of 248 to 860 acres over what would be created with a release of 21 kcfs alone.

Table 13: Shallow Water Habitat for a Range of Gavins Point Dam Releases

Gavins Point Dam Release	(kcfs)	25	28.5	28.5/34.5*
Expected Daily Shallow Water Habitat**	(acres)	4500	4147	3767
Mitigation and Section 1135 Site Changes from GP2021	(acres)	66	123	187
Total SWH without Construction of 1200 acres	(acres)	4566	4270	3954
Total SWH with Construction of 1200 acres****	(acres)	5766	5470	5154
Total Shallow Water Habitat Increase Over GP2021	(acres)	860	564	248

* New Water Control Plan has variable summer releases:
28.5 kcfs for minimum service 34.5 kcfs for full service.
** Data based on Table 7.7-8 of the Master Manual FEIS
*** GP2021 would provide 4906 acres
****Actual constructed habitat was 1420 – 1810 acres

2. Analysis of flow effect on terns and plovers

The Corps flow proposal for 2004 below Gavins Point Dam, will minimize direct impacts to least tern and piping plover eggs and chicks. The steady release should provide static habitat conditions on the reach protecting nests from inundation and chick foraging and brooding areas from being susceptible to rising waters resulting from System operational increases.

Based on fall 2003 habitat surveys, potential nesting habitat will be approximately 4.2 acres/river mile at a 30,000 cfs release from Gavins Point. Potential nesting habitat would be approximately 10 acres/river mile at 25,000 cfs, and 14.4 acres/river mile at 21,000 cfs.

Least tern and piping plover nest monitoring and near real time data management activities will allow river managers and field technicians to minimize take to eggs and chicks by coordinating water management activities throughout the System, and by moving at-risk nests and chicks to secure habitats when possible. This work will occur regardless of flows dictated by storm events.

Eight acres of emergent sandbar habitat (ESH) were created in March of 2004 by mechanical vegetation removal on a sandbar complex downstream of Fort Randall Project. A piping plover nest was discovered on the recently cleared sandbar. A monitoring program for the sandbar is underway.

The Corps will perform vegetation removal on 200+ acres of sandbars during the summer months on Lewis and Clark Lake as well as the river reach below the dam. The Environmental Assessment (EA) is complete for the project. Vegetation removal will be accomplished utilizing a contracted helicopter spray unit applying Rodeo herbicide.

A piping plover nest was found the week of May 24, 2004, on an FY 03 test plot for the pre-emergent herbicide, Arsenal, on Lewis & Clark Lake. Monitoring programs for the project are ongoing.

At the Ponca dredging project, two 75 acre ESH islands (150 acres total) were created in the channel. These islands were constructed at navigation flow levels and will function (remain emerged) at the anticipated summer flows.

V. SUMMARY AND CONCLUSIONS

Section VII.1.b. of the Amended Biological Opinion provides that when approximately 1,200 acres of new shallow water habitat has been made available above that which currently exists between Sioux City and Omaha (approximately the amount that would be developed through flow management) the Corps, in consultation with the Service, may modify flows to take advantage of that habitat and more fully meet project purposes.

As addressed in the Corps' letters dated February 13 and March 2, 2004, the Corps believes that based on new information, it is biologically warranted for the benefit of the pallid sturgeon, to extend the geographic reach of the 1,200 acres of new shallow water habitat set forth in the 2003 Amended Biological Opinion, from Ponca State Park to the mouth of the Osage River. The information provided included engineering analysis of current shallow water habitat deficiencies, biological studies of the drifting phase of pallid sturgeon, population assessment sampling below the Platte River, and sampling within the Platte River itself. The FWS letter of March 5, 2004, evaluated the information and concurred in the modification of the geographical reach of river for habitat development in Section VII.1.b.

The Corps is developing over 1,200 acres of shallow water habitat by modification of the existing channel and bank stabilization structures from the Ponca State Park to the Osage River. As described above, this work has included bank, dike, and revetment notches, dredging to widen the existing channel and to connect backwater areas, creation of pilot channels and chutes, and major dike modifications. These modifications will effectively operate over a wide range of flows, however, they will perform most effectively for pallid sturgeon shallow water habitat with discharges approximately equal to or slightly higher than full service.

The Corps' technical engineering studies conservatively estimate that as of July 1, 2004, between 1420 and 1810 acres of shallow water habitat will have been created since the issuance of the 2003 Amended Biological Opinion. Table 14 summarizes total amount of SWH developed by construction method.

Summary Table SWH Acres		
Structure Type	Minimum Acres	Maximum Acres
Bank Notches	300	450
Dike Notches	492	492
Revetment Notches	118	118
Type B Notches	124	248
Dredging	135	135
Pilot Channels	43	43
Chutes	78	78
Dike Modifications	130	246
TOTAL SWH ACRES	1420 Minimum	1810 Maximum

Table 14: Amount of SWH developed by construction method.

Table 15 is a summary of where all the work has occurred and the range of acreages of SWH to be expected.

Shallow Water Habitat Site	Approximate River Mile	Low Range of Acres	High Range of Acres
Bank Notching		**300**	**450**
Monkey Mountain	465	20	30
Worthwine Island	460	44	66
Benedictine Bottoms	428	36	54
Baltimore Bend	300	32	48
Grand Pass	270	20	30
Franklin Island	194	36	54
Diana Bend	192	8	12
Eagle Bluffs	170	48	72
Marion Bottoms	158	36	54
Smokey Waters	130	20	30
Dike Notches			
NWK Dike Notches	130 - 466	**492**	**492**
Revetment Notches			
NWK Revetment Notches	130 - 466	**118**	**118**
Type B Notches		**124**	**248**
Lower Dakota Bend	722	5	10
Lower Monona Bend	700	10	20
Upper Blenco Bend	679	6	12
Sandy Point Bend	657	7	14
Lower Little Sioux Reach	671	14	28
Tyson Bend	655	7	14
Nottlemen Island	585	15	30
Aulden Bar	577	13	26
Copeland Bend	567	21	42
Nebraska Bend	562	8	16
Upper & Lower Deroin Bend	518	17	34
Cottier Bend	508	1	2

Dredging		**135**	**155**
Ponca	754	60	80
Tieville-Middle Decatur Bend	693	10	10
Soldier Bend	663	25	25
Tyson Bend	654	25	25
California Bend	650	15	15
Pilot Channel		**44**	**44**
Monkey Mountain	465	10	10
Worthwine Island	457	11	11
Benedictine Bottoms	426	8	8
Weston Bend SP	402	5	5
Liberty Bend	351	4	4
Diana Bend	188	4	4
Eagle Bluffs	175	2	2
Chutes		**78**	**78**
Lisbon-Jameson	215	50	50
Diana Bend	188	3	3
Smokey Waters	133	25	25
Major Dike Modifications		**130**	**246**
Snyder Bend	715	4	8
Winnebago Bend	709	10	19
Desoto Bend Dikes	644	16	30
Boyer Bend	637	24	45
Tobacco Bend	589	15	28
Upper/Lower Hamburg Bend	556	40	76
Langdon Bend	532	21	40
TOTAL		**1420**	**1810**

Table 15: Site and Acreage Summary of SWH.

This shallow water habitat meets the criteria discussed in the 2003 Amended Biological Opinion and further described in the FWS March 5, 2004, letter to the Corps. Over time, flows that meet all project purposes are expected to increase the effectiveness of these structural modifications and further expand the amount of shallow water habitat already created as well as increase the biological productivity of these sites.

The Corps is proposing to operate in accordance with the 2004 AOP dated March 19, 2004, based on meeting the provisions of Section VII.1.b. of the 2003 Amended Biological Opinion. The AOP provides for releases of 30,000 cfs in July and August to meet flow targets as downstream tributary flows decline, but as noted in the AOP, actual releases will be dependent on the hydrologic conditions existing at that time. Should the tributary flows drop below the high run-off flows experienced in early May, the Corps will consider increasing the Gavins Point Dam releases to more than 30,000 cfs. However, if wet conditions persist downstream of Gavins Point Dam, releases less that 30,000 cfs will be considered to meet service levels and to conserve water in the upstream reservoirs. As stated above, the releases above those described in Section VII 1.a., are intended to optimize the newly created shallow water habitat maximizing benefits to pallid sturgeon while providing for authorized purposes on the lower river.

VI. APPENDIX

Appendix A: Location Maps
Appendix B: Coordination Letters
Appendix C: Weekly Situation Reports
Appendix D: SWH Monitoring Data
Appendix E: Dike Notching Summary
Appendix F: Major Dike Modification Designs
Appendix G: Backwater Dredging Designs
Appendix H: Individual Project Designs