Environmental Assessment

Fort Peck Flow Modification Mini-Test

March 2004

US Army Corps of Engineers ®
Omaha District

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FINDING OF NO SIGNIFICANT IMPACT
Fort Peck Flow Modification Mini Test
Fort Peck, Montana

March 2004

In accordance with the National Environmental Policy Act and implementing regulations, an Environmental Assessment (EA) has been prepared describing the anticipated effects of the implementation of the Fort Peck flow modification mini test on the existing environment. The U.S. Army Corps of Engineers, Omaha District (Corps) prepared a draft EA that was circulated for public, agency, and Tribal review and comment prior to finalization.

Environmental and social issues relevant to the proposed project were identified during the scoping process and addressed in the EA. Concerns were raised about impacts to irrigation, water supply, reservoir levels, hydropower, eroding banks, cultural resources, and cottonwood forest. Concerns were also raised about the test in relation to the drought, potential for flooding, mosquito control efforts, operational precedent, and the scientific basis. In addition to initial scoping concerns, the EA also addressed the potential for impacts to endangered species, wetlands, fisheries, recreation, and socioeconomic resources.

There are no reasonable alternatives to conducting a mini test to achieve the following objectives:

- To test the long-term integrity of the spillway operating at higher flows,
- To test data collection methodology to be used during the mini test, and
- To gather data on temperature, based on various combined flows from the spillway and the powerhouse.

The lack of reasonable action alternatives is more thoroughly discussed in section IV of the EA. The mini test is intended to implement Reasonable and Prudent Alternative (RPA) II B (1) from the U.S. Fish and Wildlife Service's November, 2000 Biological Opinion. The mini test task is still included in the 2003 Amendment to the 2000 Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System etc. dated December 16, 2003.

The Corps has tried to resolve as many issues as possible, but a few issues remain unresolved at this time. The implementation of the mini test will likely result in the erosion of private lands directly across from the spillway. The landowner and the Corps were not able to reach an agreement on the terms of an easement needed to construct bank protection structures using the funding available during fiscal year 2003. If the landowner wants to pursue such a structure prior to the mini test or to request a sloughing easement from the Corps, he would need to resubmit an application so the Corps could re-initiate the action.

The Assiniboine and Sioux Tribes of Fort Peck are opposed to the mini test. This EA addresses the Tribal concerns, none of which result in any significant impacts related to the mini test.

Proposals for flow-related actions from Missouri River dams have been controversial and political and are also the subject of lawsuits from at least two states. The final Master Manual Environmental Impact Statement (EIS), the resulting Record of Decision, and subsequent Annual Operating Plans will inform the public on flow issues outside of this mini test.

It is my finding, based on the EA, that the proposed Federal action would have no significant adverse impacts on the environment. The proposed mini test has been coordinated with the appropriate resource agencies and there are no significant unresolved issues. An EIS is not required.

Date: March 5, 2004

Kurt F. Ubbelohde
Kurt F. Ubbelohde
Colonel, Corps of Engineers
District Engineer

FINAL
ENVIRONMENTAL ASSESSMENT

Fort Peck Flow Modification Mini Test

U.S. Army Corps of Engineers

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March, 2004

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Executive Summary

The Fort Peck flow tests consist of two separate actions: a mini test and a full test. Whether the data from these tests result in an operational change from Fort Peck Dam is currently unknown and will likely be based on the data collected. The underlying Federal purpose for the tests is to support the Endangered Species Act and the pallid sturgeon recommendations in the U.S. Fish and Wildlife Service's (Service) November, 2000 Biological Opinion on the Current Operations of the Missouri River, Kansas River, and Bank Stabilization and Navigation Project (Opinion).[1] Additionally, flow tests at Fort Peck Dam are included in the Corps of Engineers (Corps) recent 2003 Biological Assessment (BA) on the Missouri River Main stem Reservoir System, the Lower Missouri River, and the Kansas River[2] and are supported by the Service's December, 2003 Amendment to the 2000 Opinion. This Environmental Assessment (EA), however, is specific only to the mini test action. National Environmental Policy Act (NEPA) compliance for the full test will be accomplished through a separate NEPA document. The Final Missouri River Revised Environmental Impact Statement, Master Water Control Manual Review and Update (Master Manual)[3] is expected to be completed in the spring of 2004; however, it is uncertain which alternative will be selected for implementation.

The mini test consists of a discharge of up to 11,000 cubic feet per second (cfs) down the spillway for Fort Peck Dam for a period of approximately four weeks during the month of June. During the same time, at least 4,000 cfs would be released through the powerhouse, with total discharges (powerhouse + spillway) not to exceed 15,000 cfs. Anticipated flow combinations can be found in Table 2 on page 22. The primary objectives of the test are:

- To test the long-term integrity of the spillway operating at higher flows
- To test data collection methodology to be used during the mini test and full test
- To gather data on temperature, based on various combined flows from the spillway and the powerhouse

As a prerequisite to the mini test, sufficient water has to be available in Fort Peck Lake for the Corps to be able to discharge a known volume of water through the spillway gates. For the mini test to run as described, for the duration described, and to gain the best information on discharge volume and resulting temperatures, **at least five feet of water elevation is needed above the spillway gates** (e.g., lake level of at least 2230 msl[4]). Due to the ongoing drought in Montana, upper decile[5] or greater runoff would have to occur during the winter and spring of 2004 in order to run the mini test during June, 2005 (Bob Keasling, personal communication).

[1] The Opinion can be viewed at http://www.r6.fws.gov/missouririver
[2] this July 2003 BA can be found on the Master Manual webpage
[3] the draft Master Manual can be viewed at http://www.nwd.usace.army.mil
[4] mean sea level
[5] "upper decile" flow indicates a flow with a 10 percent chance of being met or exceeded in any given year

Alternatives

Since the primary objectives of the mini test are to gather data and to test data collection methodology, there are no feasible alternatives that could achieve this same purpose. Modeling of spillway function has been done in the past, but additional data is needed in order to project spillway function during prolonged flows. Modeling of projected temperatures at various flows has been done, but additional data is needed in order to determine the relationship among spillway discharge, dam discharge, and Missouri River temperatures. The inclusion of a "no action" alternative is required by NEPA and is discussed, but this alternative would not meet the objectives of the mini test.

Primary Benefits

The primary benefits of running the mini test would be as follows:

- The initial collection of data relating to spillway integrity at various discharges
- The initial collection of temperature information at various combinations of spillway/powerhouse discharges for use in temperature modeling for the full test and operational changes
- The temporary increase of water temperature in the Missouri River within a limited area downstream from the spillway (an underlying purpose for the test).
- The testing and standardization of methodology that would be used during the full test for collecting physical and biological data

Primary Impacts

The primary impacts anticipated during the mini test would be as follows:

- The likely erosion of up to 5 acres of land (and possibly irrigation intakes) directly across from the spillway
- The short-term, temporary increase in suspended solids and turbidity in the Missouri River immediately across and downstream from the spillway, associated with the erosion of up to 5 acres of land across from the spillway
- The loss of an estimated 61 gigawatt hours (GWh) of hydropower potential by discharging water down the spillway instead of through the powerhouse. This loss is estimated to be 1% of the total hydropower produced by the mainstem system. The economic cost of this loss is variable, depending on the value of energy when the mini test is actually implemented.

The Corps has pursued separate actions that would have avoided and/or minimized the above erosion impacts. However, these actions were not agreeable to all parties involved and did not develop to fruition.

Unresolved Issues

Existing conflicts having the potential to affect the decision maker are as follows:

- **Erosion.** Direct erosion across from the spillway would be likely as a result of the mini test. However, this erosion could be prevented by the construction of a structure at that location under the Water Resources Development Act 1986, Section 33 program. This structure was designed, approved, and funded. However, the landowner and the Corps could not come to agreement on the terms of the easement within the necessary timeframes for construction to begin using the funding available this fiscal year. If the landowner wants to pursue such a structure prior to the mini test, he would need to resubmit an application so the Corps could reinitiate the action. An alternative to the construction of a structure would be to purchase a sloughing easement in advance of anticipated erosion. This could also be accomplished through the Section 33 program; however, it is not the desire of the landowner. This option would be available to all landowners concerned about potential erosion, subject to approval and available funding.

- **Tribal Opposition.** The Assiniboine and Sioux Tribes of Fort Peck are opposed to the mini test. They have stated their opposition in several letters to the Corps, as well as in a resolution dated October 8, 2001. They are currently under the impression that the mini test was postponed from June, 2001 in order to resolve their issues; however, some of their issues (such as compensation if additional water treatment is needed due to turbidity) were outside of standard Corps' authorities. This EA addresses the Tribal concerns, none of which result in any significant impacts during the mini test.

- **Missouri River Flows.** Proposals for flow-related actions from Missouri River dams have been controversial and political; they are also the subject of lawsuits from at least two states. The draft Master Manual incorporated flow modifications out of Fort Peck dam for all alternatives except for the current water control plan. However, the Master Manual is being finalized, and a preferred alternative will likely be selected later this spring. It is uncertain if permanent flow changes for Fort Peck Dam will be included in that alternative. The final Master Manual EIS, the resulting Record of Decision, and subsequent Annual Operating Plans will inform the public on flow issues beyond the scope of this mini test.

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I. Introduction

Mini Test Proposal

The mini test is intended to address concerns about long-term spillway operations identified during the August 2000 Draft Fort Peck Spillway Major Rehabilitation Study. Pertinent parts of these studies can be found in Appendix A. Based on the results of these studies, long-term spillway safety during major floodwater discharge events may be of concern. An analysis of sustained or periodic flows was not included as part of either spillway engineering study. Additional spillway integrity data is needed under various flow regimes in order to determine how the spillway structure would tolerate various flow scenarios. Stress data would be collected from the spillway for flows up to 11,000 cfs during the mini test. This data could then be used to update models used in the previous studies to predict any spillway impacts associated with the implementation of the other spillway-related flow tests within the U.S. Fish and Wildlife Service's 2000 Biological Opinion (Opinion), such as the full test.

Background

Authorization for the Fort Peck Dam

Fort Peck Dam was initially authorized for the purpose of navigation by the 1935 Rivers and Harbors Act, with allowances for the possibility of future hydropower generation. The Fort Peck Act, approved May 18, 1935, authorized the completion of the dam, maintenance and operation of the dam, and hydropower generation. The Flood Control Act of 1944 authorized the construction of Garrison, Oahe, Big Bend, Fort Randall, Gavins Point dams, and administratively modified the operation of the Fort Peck Dam to incorporate it into the main stem reservoir system operations. The main stem reservoir system is authorized for multiple purposes including flood control, irrigation, navigation, and hydroelectric power. In 1986, The Water Resources Development Act (WRDA, PL 99-662) authorized recreation as a specific project purpose at Fort Peck. The lake and dam are used for flood control, irrigation, navigation, hydropower, domestic and sanitary use, wildlife, and recreation (U.S. Army Corps of Engineers, 2000a).

Authorization for the Mini Test*

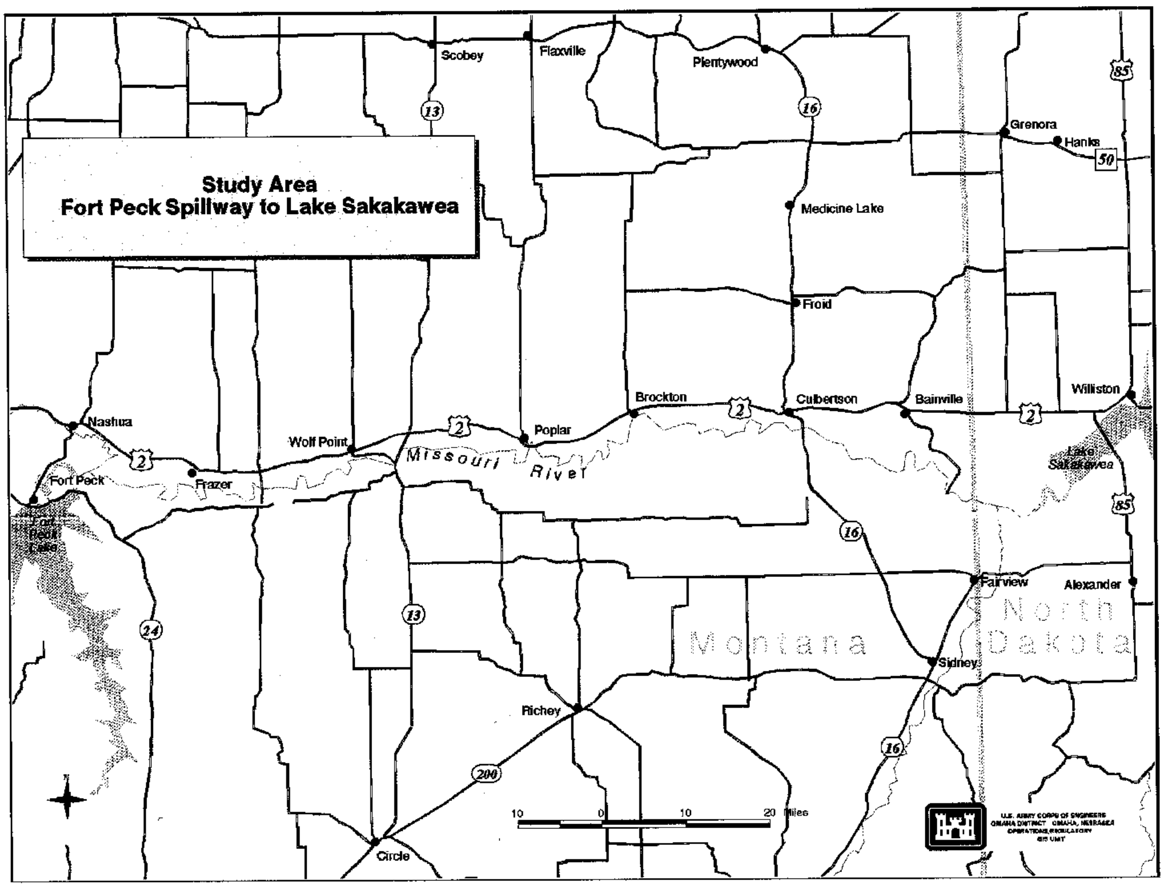
Under the general authorizing legislation for Fort Peck Dam, as supplemented, the Corps has the authority to test the stability of the spillway structure and to determine water temperatures resulting from such a test. This would be considered an "operation and maintenance" function of the dam. The authority to operate the dam for fish and wildlife also supports the fish-related tasks associated with the underlying purpose of the project.

* Throughout this document, headings for sections that address an issue raised during the scoping process are indicated by an asterisk.

Fort Peck Dam and Vicinity

Fort Peck Dam, located on the Missouri River, is 4 miles long, and 250 feet high at its highest point. The dam is located approximately 10 miles upstream from the confluence with the Milk River, and 1,772 miles upstream from the Missouri River mouth. Fort Peck Dam is the world's oldest and largest hydraulically-filled earthen dam, is listed on the National Historic Register, and is under consideration for National Historic Landmark status (Map 1).

Map 1. Fort Peck Area Map



The Fort Peck project is located 19 miles southeast of Glasgow, Montana in McCone, Valley, Garfield, Phillips, Petroleum, and Fergus Counties in northeastern Montana. After closure of the dam in 1937, the resulting reservoir, Fort Peck Lake, began to fill, ultimately covering 240,000 acres and storing 17,713,000 acre-feet of water at the maximum normal operating pool (elevation 2246 msl). Fort Peck Lake is the fifth largest man-made reservoir in the nation, with a typical length of 135 miles and width ranging from 2 to 5 miles. At maximum operating pool (2250 feet mean sea level), the surface area of the pool covers 246,000 acres.

Most of the Fort Peck Dam and Fort Peck Lake lie within the Charles M. Russell Wildlife Refuge (CMR) which is managed by the USFWS. Initially called the Fort Peck Game Range, this refuge was created on December 11, 1936 by Executive Order from President Roosevelt (1 CFR 2149). The CMR covers approximately 1.1 million acres.

The Fort Peck spillway is a constructed channel for reservoir overflow, which is generally used as an overflow channel when the reservoir elevation is in the exclusive flood zone. (See Figure 1 for a depiction of the dam's design). The spillway for Fort Peck Dam consists of sixteen 40-foot by 25-foot vertical lift gates with a discharge capacity of 230,000 cfs at maximum operating pool. The spillway crest elevation is 2,225 feet msl. Since 1967, spillway releases have occurred in conjunction with reservoir evacuation of high water due to flooding in 1975, 1976, 1996, and 1997.

Missouri River below Fort Peck Dam

A release of 9,500 cfs is equaled or exceeded 50 percent of the time at Fort Peck[6], but releases vary from a low of 4,000 cfs in dry years to as high as 20,000 to 35,000 in wet years. Channel capacity below Fort Peck Dam is approximately 35,000 cfs. Average daily releases since the Missouri River main stem system first filled in 1967 have ranged from zero to 35,400 cfs. Daily winter releases are generally 10,000 to 13,000 cfs during "normal" water years. Full hydropower capacity is 15,000 cfs. During 1975, a significant flood year, releases averaged 35,000 cfs in July. Minimum hourly releases are 4,000 cfs to maintain the trout fishery in the tailrace area (U.S. Army Corps of Engineers, 2001a). Table 1 puts these discharge values into context with the proposed mini test discharges.

[6] based on a duration curve developed from an analysis of historic daily flows

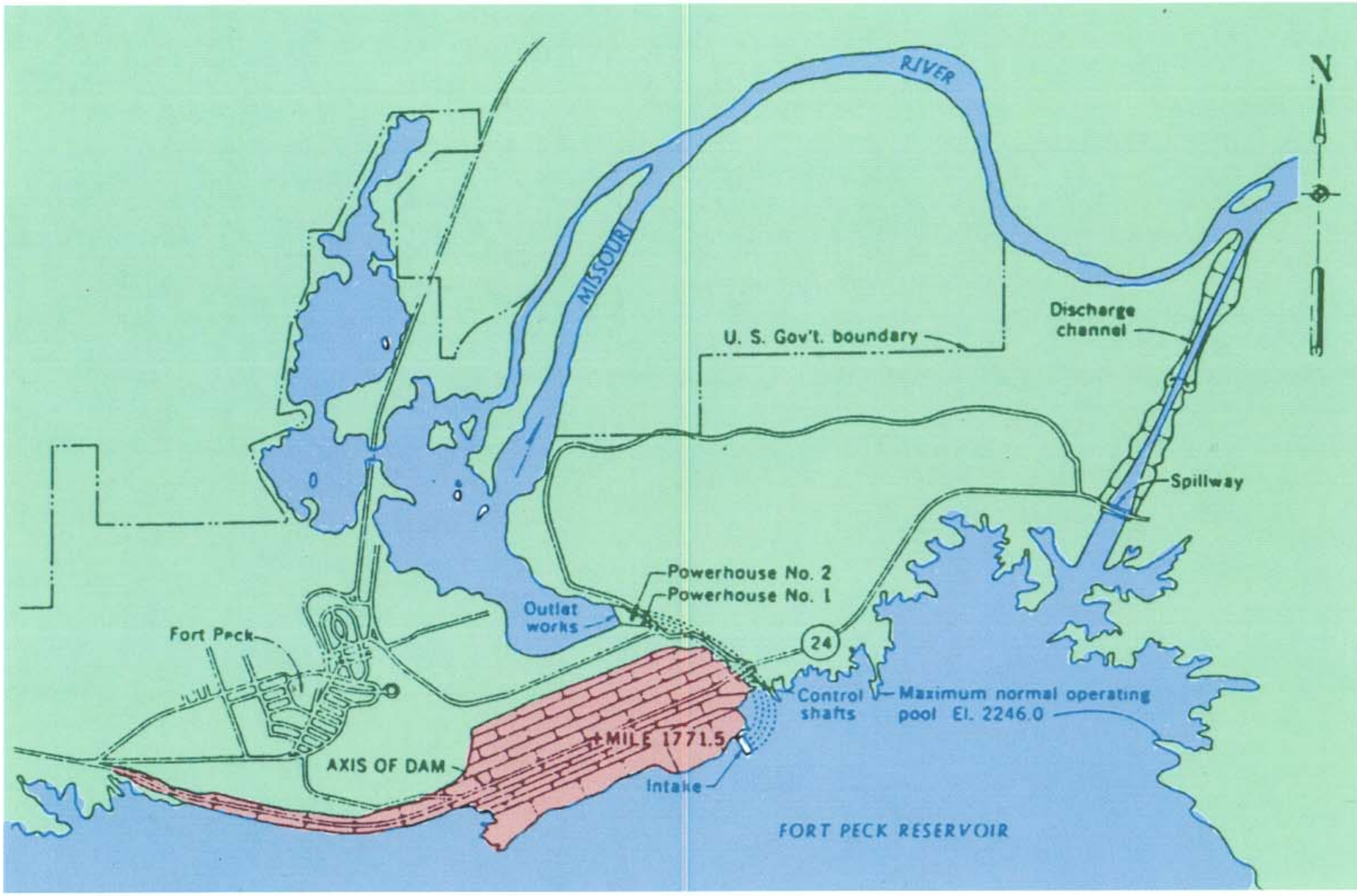


Figure 1. Parts of Fort Peck Dam

Table 1. Ft. Peck Dam Discharge Comparison
Mini Test vs. Historical Discharge (1943[7] - 2001)

EVENT	TOTAL DISCHARGE (powerhouse + spillway)	SPILLWAY
maximum daily discharge (Separate listing of powerplant and spillway releases began June 1981.)	35,400 Jul 7, 1975	Estimated 20,000
maximum daily discharge in June	35,100 (1975)	
channel capacity of river	35,000	Not applicable
highest average June discharge	26,200 (1975)	
maximum discharge in 1997 (high water year)	22,300 Nov 7, 1997	7,500
full hydropower capacity	16,000 at rated head	Not applicable
daily winter[8] discharge range[9]	16,000 - 4,500	0
average discharge in 1975 (high water year)	15,700	Not available
mini test total discharge (June)	**15,000 maximum**	**11,000 maximum**
average discharge in 1997 (high water year)	13,300 (year)	200 - 7,000
daily winter average - Jan/Feb	12,000	0
daily June average (1967 - 2000)	10,500	0
daily winter average - Dec	10,000	0
50 percent exceedance discharge	9,500	0
current minimum discharge (instantaneous)	4,000	0
historical minimum discharges	4,000 min daily avg 3/16-4/30, 2001; 9/4-11/25, 2001	0
	3,000 min daily avg 9/1-11/29, 1992; 9/9-10/28, 1993; 3/9-3/20, 1996	0
	0 daily avg 3/12, 1958; 8/12, 1959; 12/12, 1960	0

[7] Fort Peck began generating hydropower in July, 1943
[8] high flows occur in winter for hydropower purposes (highest power demand)
[9] 1967 - 2001

Summary of Public Involvement and Coordination

The scoping process for the Fort Peck mini test began in October 2000 with public, agency, and Tribal meetings. Pre-scoping meetings with the Tribes began in August, 1999 on general flow-related issues, and in August, 2000 for the mini test specifically. In addition to verbal comments, written comments on the mini test were received. Comments were summarized, grouped by category, and are addressed in this document to the best extent possible with existing information.

Tribal Consultation

Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, 6 November 2000 and other Army, Corps, and Northwestern Division Policies on Consultation require the Corps to consult on a government-to-government basis with federally recognized Tribes on activities that have the potential to impact Tribes, Tribal assets, or Tribal trust resources.

The initial Tribal consultation meetings on the mini test were held on August 7 to 9, 2000 near Poplar, Montana on the Assiniboine and Sioux Tribes of the Fort Peck Reservation. Representatives from the Fort Peck Tribe were in attendance. Non-Tribal attendees included Corps' District personnel from Omaha, Kansas City, and the Fort Peck Project office. Additional information on Tribal consultation and cultural resources compliance can be found in Appendix D.

In addition to the meetings held in Montana, the following Tribes were also informed about the project and are part of the Corps' formal consultation process:

- Fort Belknap
- Three Affiliated Tribes (Mandan, Arikria and Hidatsa Nations)
- Crow
- Northern Cheyenne
- Salish-Kootenai

A summary of consultation actions, including meetings and written correspondence, is presented below. Phone and e-mail correspondence are not included in this summary.

August 6, 1999	Initial consultation meeting with the Fort Peck Tribes on flow-related issues and the Master Manual; Poplar, Montana.
August 8, 2000	Initial consultation meeting with the Fort Peck Tribes on the mini test; Poplar, Montana.
September 12, 2000	Corps sends letter to Tribal chairmen, notifying the Tribes of the public scoping meetings for the mini test and full test being held in the vicinity (Wolf Point, Montana).

October 17, 2000	Corps receives letter from the Bureau of Indian Affairs providing comments on the test (the letter didn't specify which test).
November 20, 2000	Corps receives letter from the Fort Peck Tribes providing comments on the mini test, full test, and ongoing operational changes (Master Manual).
December 7, 2000	Corps sends a letter reply in response to the Fort Peck Tribes' November 20 letter. This letter includes a plan to address Tribal concerns throughout the mini test, full test, and Master Manual process. This letter also states which Tribal issues are outside Corps' authorities to implement.
December 14, 2000	Second consultation meeting with the Fort Peck Tribes; Poplar, Montana.
December 22, 2000	Corps receives request from Senator Conrad's office to address a November 30, 2000 letter from the Trenton Indian Service Area. The November 30 letter indicated opposition to the tests, in part due to "a lack" of consultation on the flow modification plan (assumed to be the mini test and full test).
January 23, 2001	Corps responds to Senator Conrad's office, indicating that the Corps will include the Trenton Indian Service Area in future consultation efforts. *The Corps project manager was in the process of scheduling a meeting with the chairman of the Trenton Indian Service, then a new chairman was elected.*
February 16, 2001	Third consultation meeting with the Fort Peck Tribes on the mini test and the full test; Poplar, Montana.
March 19, 2001	Corps receives a letter from the Fort Peck Tribes, following up on the consultation meeting.
April 30, 2001	Fourth consultation meeting with the Fort Peck Tribes on the mini test and the full test; Poplar, Montana.
May 3, 2001	First consultation meeting with the Trenton Indian Service on the mini test and the full test; Trenton, North Dakota.
May 30, 2001	Corps receives another comment letter from the Fort Peck Tribes, referring to the April 30 consultation meeting.

October 5, 2001	Corps receives comment letter from Fort Peck Tribes on the Master Manual Revised Draft EIS, referencing flow modification actions.
October, 2001	Corps receives cottonwood survey report from Fort Peck Tribes.
February 13, 2002	Fifth consultation meeting with the Fort Peck Tribes on the mini test, full test, and Master Manual; Poplar, Montana.
March, 2002	Corps sends letter to Fort Peck Tribes replying to issues raised in the March 19 and May 30 letters, as well as during the meetings held on February 13, 2002, April 30, 2001, and February 16, 2001.

Summary of Tribal Issues

The following summary of Tribal issues was determined based on letters received and feedback from consultation meetings. The comments received address the full spectrum of flow modification actions, ranging from the mini test through the potential for full implementation of a flow modification from the dam. This EA only addresses comments related to the mini test, however all Tribal issues are identified below. Additional information on how the Corps is addressing Tribal issues can be found in Chapter VI of this EA. Tribal concerns include:

- lack of consultation and coordination on the mini test and full test
- impact on Tribal water intakes
  - a plan for protection of the intake site and related facilities
  - a plan for mitigation and/or replacement of facilities due to impacts from the full test
  - a mechanism for financing repairs/replacement of intakes at Federal cost
  - a plan for funding the additional costs of treating Missouri River water
  - a plan for protection, mitigation, replacement, and funding impacted existing intake sites along the north bank of the river within the Reservation boundaries
- impact of the mini test, full test, and any future operational changes on the erosion of the north bank of the Missouri River
- safety during the tests
  - plan to notify water users
  - reservoir flood control capability prior to the test
  - spillway performance during the tests
- impacts to human remains and cultural, historical, and archeological resources
- identify benefits to the Tribes, their lands and resources, resulting from proposed revisions in the operation of Fort Peck Dam
- impacts of the mini test, full test, and ongoing operational changes on
  - aquatic habitat
  - riparian habitat (especially cottonwood forests)
  - endangered and threatened species
  - other species
- impacts to the Tribal hydropower allocation

- baseline development and monitoring
  - river banks
  - river bed
  - suspended sediment and bedload
  - aquatic habitat
  - riparian habitat (especially cottonwood forests)
  - other resources and facilities

Agency Scoping Meeting

One agency scoping meeting was held in Helena, Montana on October 2, 2000. The mailing list was developed from the Master Manual mailing list, initially selecting agencies in Montana and North Dakota. State water resource agencies and state game offices for all states within the Missouri River basin were included on the distribution. A total of 91 letters were sent out to agency representatives from the following agencies:

- U.S. Fish and Wildlife Service
- U.S. Bureau of Reclamation
- Western Area Power Administration
- State Historic Preservation Offices (Montana and North Dakota)
- U.S. Geological Survey
- Bureau of Indian Affairs
- U.S. Department of Agriculture
- Fort Peck Advisory Council
- Montana Department of Natural Resources and Conservation
- Department of Transportation
- Natural Resources Conservation Service
- Environmental Protection Agency
- National Park Service
- Buford-Trenton Irrigation District
- Roosevelt County Conservation District
- Bureau of Land Management
- Missouri River Basin Association
- Corps of Engineers (local project and regulatory offices)
- State game offices (Montana, North Dakota, South Dakota, Nebraska, Iowa, Missouri, Kansas)
- State water resources offices (Montana, North Dakota, South Dakota, Nebraska, Iowa, Missouri, Kansas)

Five agency representatives and one non-agency representative (American Rivers) attended the meeting in Helena. The following agencies were represented at the meetings:

- Western Area Power Administration
- Montana Department of Fish, Wildlife, and Parks

- U.S. Geological Survey
- Montana Department of Natural Resources and Conservation
- U.S. Fish and Wildlife Service

Public Scoping Meetings

Three public scoping meetings were held to date. Letters were sent to 117 members of the public, 18 political representatives, and 21 Tribal members inviting them to the meetings. The mailing list was initially developed from the Master Manual mailing list; however, names have been added as a result of the public meetings.

In addition, press releases were sent to the following media outlets:

- Radio Stations

- KOJM/KPOX - FM	Havre, Montana
- KCAP - AM	Helena, Montana
- KXLO/KLCM - FM	Lewistown, Montana
- KEYZ Radio	Williston, North Dakota
- Prairie Public Radio	Bismarck, North Dakota
- KBMR/KQDY - FM	Bismarck, North Dakota
- KEYZ/KLAN - FM	Williston, North Dakota
- KDPR - FM	Bismarck, North Dakota
- KFYR/KYYY- FM	Bismarck, North Dakota

- Television Stations

- KUMV - TV	Williston, North Dakota
- KBOM?	Bismarck, North Dakota
- KIZZ?	Minot, North Dakota
- KUMV - TV	Williston, North Dakota
- KFYR - TV	Bismarck, North Dakota
- KKOA	Minot, North Dakota

- Newspapers

- Helena Independent - Record	Helena, Montana
- Wolf Point Herald News	Wolf Point, Montana
- Williston Plains Reporter	Williston, North Dakota
- Williston Herald	Williston, North Dakota
- Bismarck Tribune	Bismarck, North Dakota
- Bismarck Tribune	Valley City, North Dakota
- Minot Daily News	Minot, North Dakota

Public scoping meetings were held in Glasgow, Culbertson, and Wolf Point, Montana during October 3 and 4, 2000. Additional meetings were planned for November 6 in Williston, North Dakota, and November 7 in Culbertson, Montana. However, a severe winter storm limited participation at the Williston meeting and resulted in the cancellation of the Culbertson meeting due to road closures. A make-up meeting was held in Culbertson on February 15, 2001.

Corps representatives were present to answer questions about the tests and to receive feedback or concerns about the tests. The meetings were open-house format, and tables were set up to address the following topics:

- NEPA/Biology
- Cultural Resources/Tribal Issues
- Erosion/Spillway Stability
- Mini test/Full Test Project Description

Meeting Date	Meeting Location
Glasgow, MT	October 3, 2000
Culbertson, MT	October 4, 2000
Wolf Point, MT	October 4, 2000
Williston, ND	November 6, 2000
Culbertson, MT	November 7, 2000[10]
Culbertson, MT	February 15, 2001[11]

Written Scoping Comments

Comment forms for the mini test and for the full test, as well as stamped, addressed envelopes were available for all attendees. Almost all of the 200 comment forms for each test were distributed at the public meetings, with approximately 20 forms (and envelopes) for each test remaining left at the Helena Regulatory office and the Fort Peck Project office. Comments were also received by phone, e-mail, and by personal letter. The comment period for the mini test was extended from November 1 to November 22, 2000 in response to requests from the public. All comments were included in the EA analysis, however, regardless of whether the comment was received prior to November 22.

Based on verbal and written scoping comments (about 30 letters) received from the Tribes, agencies, and the public, concerns have been expressed in the following general categories:

- Erosion
- Irrigation
- Water supply
- Lake levels
- Operational precedent
- Hydropower impacts
- Drought
- Discharge volume
- Scientific basis
- Mosquito control
- Flooding
- Paddlefish impacts

[10] cancelled, due to snowstorm
[11] replaced 11/7/00 meeting

Issue statements have been developed using the Tribal and public feedback to further clarify issues under each general category.

Erosion

What is the impact on lands located directly across from the spillway?

How will the Corps compensate for eroded lands?

Can the Corps protect lands from erosion (e.g. bank stabilization)?

Can the Corps open up (dredge) the mudflat downstream from the spillway[to allow for greater channel capacity]?

Irrigation

What is the impact on irrigation intakes and pumps located directly across from the spillway?

Can the Corps protect or compensate to avoid impacting these intakes?

Concern about irrigation intake problems due to low water levels upstream from the spillway during low discharges out of Fort Peck.

Water supply

Would the test increase water supply turbidity levels?

Would the test affect water supply intakes through erosion or sedimentation?

Reservoir levels

Can the Corps avoid lowering Fort Peck Lake during the forage fish spawn?

Can the Corps keep Fort Peck Lake levels steady during the test?

Operational precedent

Will the mini test set the stage for the full test and future operational changes?

Hydropower impacts

What are the hydropower costs of the test?

Drought

Will the test be conducted if we are in a drought?

Discharge volume

Keep the discharge less than 12,000 cfs.

Discharges of 9.000 are just right; at 13,000, the banks start to move.

Scientific basis

How can a spring rise with clear water benefit the pallid sturgeon when historically these spring rises were very turbid?

It's more efficient and avoids erosion damage to raise pallid sturgeon in a hatchery.

There was a request that an independent group (e.g. not the USFWS) do the monitoring.

Mosquito control

Would the increased water impact vector (mosquito) control efforts in Williston?

Flooding

There is concern that any increase in water would increase the risk of farmland flooding along the river.

Would the increased flows flood lowland sugarbeet fields?

Cottonwood Forest

Would the mini test affect cottonwood forests?

Paddlefish

Would the warm water from the mini test cause paddlefish to leave the Yellowstone River and move into the Missouri River?

Reservoir Fish

Would the mini test result in lake fish being spilled into the river along with the spillway discharge?

Comments on the Draft Environmental Assessment (EA)

The Draft EA for the Fort Peck Mini Test was released for comment on April 8, 2002, with an initial comment closing date of May 10, 2002. The Corps sent out a letter to the mailing list dated May 8, 2002 extending the comment period until August 9, 2002. An errata sheet containing omitted economic information was also included in this letter.

Three press releases that were issued by the Corps related to the Draft EA are:

- an initial press release announcing the availability of the Draft EA for review and comment
- a second press release dated May 3, 2002 announcing the extension of the comment period
- a third press release reminding people of the upcoming comment period closing date

Written comments on the Draft EA were received from six agencies, three public groups, and 330 private citizens (including several comments received after the August 9 comment closing date). No written comments on the Draft EA were received from any municipalities or Tribes.

Most of the citizen letters were "form" letters consisting of four basic types. An example of each form letter can be found in Appendix M, as well as copies of each non-form comment letter received. Corps responses to the comments can also be found in Appendix M. The comments did not result in any substantial changes to the text of the final EA; however, the content of the Errata sheet has been added into the EA text. The final EA also includes updated information from pre-test monitoring and information from the Biological Opinion Amendment and the Master Manual.

Agency Comments

The following agencies sent written comments on the Draft EA:

- State of Missouri Department of Natural Resources
- North Dakota State Water Commission
- Montana Fish, Wildlife, and Parks (two letters)
- Montana Department of Natural Resources and Conservation
- Richland County
- McCone County

Agency letters can be found in Appendix M. Primary issues raised in the letters are as follows:

- Disagree with erosion analysis (North Dakota Water Commission)
- Food habits study not adequate to prove that sturgeon are NOT being eaten (State of Missouri)

- Supports mini test and monitoring plan; concerned about fishing access on school trust land (a separate project) conflicting with pallid sturgeon goals (Montana Fish, Wildlife, Parks)
- The discharge of water could be detrimental to farmers, ranchers, and taxpayers; loss of land due to erosion and flooding could be costly to the county (Richland County)
- Questions the need for the tests and scientific basis for tests; lack of compensation plan; concern about spread of noxious weeds; compensation for higher electricity costs (McCone County)
- Provide adequate safety warnings; elaborate on stop protocol; low lake levels; impacts to trout fishery below dam (Montana Department of Natural Resources)

Public Group Comments

Written comments on the Draft EA were received from the following groups:

- Burleigh, Oliver, McLean, Mercer, Morton (BOMMM) County Water Resources Districts Joint Water Resource Board
- Missouri Levee & Drainage District
- McCone Conservation District

Copies of these written comments can be found in Appendix M. Primary issues raised in these comments are as follows:

- Concerned about non-native fish preying on the pallid sturgeon (Missouri Levee and Drainage District)
- Disagrees with erosion analysis (BOMMM Board)
- Want a plan to protect pump sites, electric costs, erosion may cause influx of noxious weeds (McCone District)

Public Comments

The Corps received 326 written comments from the public. A sample of each of the form letters received can be found in Appendix M, as well as a copy of each original (not form) letter received on the Draft EA. Although the vast majority of comments were from Montana and North Dakota, comments were also received from Minnesota, California, and Idaho. Primary issues raised in these comments are as follows:

- extend comment period 90 days
- requesting that an EIS be done and full economic analysis
- increase discussions of landowner rights, mineral rights, and water rights
- include a plan for compensation, mitigation, repair, or replacement of agriculture-related operations if damage is incurred
- include a plan to handle increased silt deposit and related flood risks

- more consideration should be given to propagating the pallid in a hatchery instead of flow modifications
- lowering of the water level in Lake Peck will affect walleye and other lake species
- consistency with the Montana Stream Bank Preservation Act of 1975
- keep Montana's water in Montana, especially during the summer
- don't think cold lake water will raise river temps
- concerned about flooding birds for pallid support flows
- use money ear-marked for tests to support the Fort Peck fish hatchery instead
- specify stop protocol flows (e.g., for Yellowstone); environmental bias

II. Purpose of and Need for the Mini Test

This section is separated into three parts that discuss various aspects of the purpose and need for the mini test. The first section discusses the "underlying purpose" of the test, which describes the relationship among this mini test and other Corps actions (and potential actions) of a similar nature at Fort Peck Dam. The second section discusses the specific purpose for the mini test, its objectives, and desired data outcomes as a "stand alone" project. The third section discusses the need for the mini test from a NEPA perspective.

Underlying Purpose for Flow Tests at Fort Peck

The underlying purpose for the Fort Peck flow tests is to support the Endangered Species Act and the Fort Peck pallid sturgeon flow tasks found within the Opinion. The mini test and full test at Fort Peck Dam are included as part of the "Reasonable and Prudent Alternative" to alleviate jeopardy to the pallid sturgeon (USFWS 2000). The potential for permanent flow modifications at Fort Peck Dam is unknown at this time until data from the tests are available for review. Pertinent parts of the Opinion can be found in Appendix B.

Flow changes out of Fort Peck Dam were first suggested during the 1997-98 Annual Operating Plan (AOP) process. The Missouri River Natural Resources Committee[12] (MRNRC) included the following paragraph in its comment letter on the draft AOP (letter dated September 5, 1997):

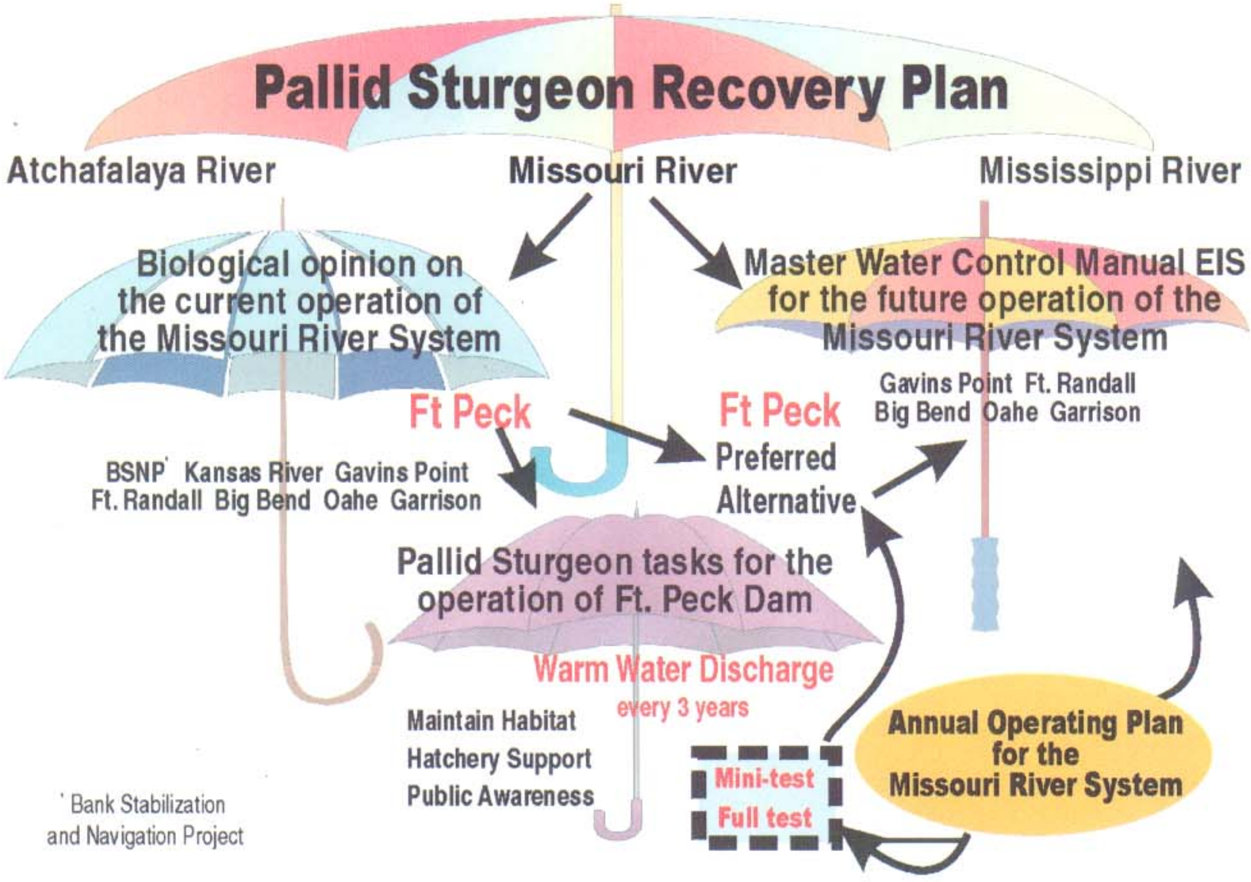
> For runoff projections between median and upper quartile, operations for Fort Peck should be as follows: between May 15 and June 15 releases from Fort Peck should be 25 kcfs with approximately 50 percent of these flows originating through the traditional power plant and the remaining 50 percent from the spillway. The purpose for this release is two-fold. First, field personnel will monitor movements of native fish in relationship to flows. Secondly, habitat changes due to a month of relatively high flows will be documented. Further justification and reasoning for this release scenario was established last year by the Montana-North Dakota pallid sturgeon work group (refer to the Chris Hunter letter to Col. Richard Craig dated February 13, 1997, Appendix B).

Similar comments have been received from the MRNRC through the AOP process annually since 1997. Other agencies or groups with flow recommendations below Fort Peck Dam include the Missouri River Basin Association[13] (MRBA) and the USFWS. These comments can also be found in Appendix B.

[12] The MRNRC is a group composed of representatives from each Missouri River basin state.
[13] The MRBA is a group composed of state water resource agency appointees from each Missouri River basin state.

The purpose of the tests (mini test and full test) is to gain information on the relationships among discharge volume, resulting river temperatures, and pallid sturgeon spawning behavior. These tests may determine if operational changes could benefit pallid sturgeon. The tests would also result in data that could address spillway integrity and other issues.

Figure 2. Relationship Among Related Missouri River Actions



The figure above illustrates the relationship among the mini test (in the dashed box) and other related actions. The mini test is one of the recommended pallid sturgeon tasks for Fort Peck Dam (purple umbrella), which fall under the Biological Opinion (blue and white umbrella), which ultimately fall under the Pallid Sturgeon Recovery Plan. The mini test is also related to potential future flow alternatives from Fort Peck Dam, if supported by the data, as well as the draft and final revised Master Water Control Manual (pink and yellow umbrella), as well as the Annual Operation Plans for the Missouri River main stem system (gold oval).

The specific purposes of the mini test and full test are not identical and are being addressed separately. Each test has separate utility beyond its relationship to the other test.

Specific Purpose of the Mini Test

The purpose and objectives of the mini test are as follows:

- To test the long-term integrity of the spillway operating at higher flows
- To test data collection methodology to be used during the mini test and full test
- To gather data on temperature, based on various combined flows from the spillway and the powerhouse

The proposed flows during the mini test are not expected to be high enough to result in any significant pallid sturgeon benefits. However, the pallid sturgeon monitoring plan, developed for use during the full test, would be tested and standardized during the mini test.

The mini test, as described in the Opinion, is to take place during a four-week period between May 15 and July 1 during the first year that reservoir elevation and runoff criteria can be met. A June 1 start date is tentatively planned, since a June start date increases the likelihood that the reservoir water would be warm enough to increase the Missouri River water temperatures.

The mini test was originally planned for a June 2001. However, runoff as low as 33 percent of normal in June 2001 resulted in a pool elevation 2.5 feet below the spillway crest; consequently the mini test was not conducted. A press release initially notified the public, agencies, and Tribes of the delay. AOP meetings throughout the Missouri River basin during the spring and fall further addressed questions on the timing for the mini test. Water elevations have remained low due to drought conditions, so the mini test was not conducted during June 2002 or June 2003, and is not expected to be conducted until June 2005 at the earliest.

The Need for the Mini Test

The mini test is needed to collect data on the status of the Fort Peck Dam spillway. This data could be used to update existing models and better refine future operation and maintenance needs for the spillway. Additionally, the temperature data collected could be used to more accurately model downstream temperatures under various combinations of dam discharge and spillway discharge to best meet the target temperature of 18 degrees C (64.4 degrees F) at Frazier Rapids (approximately 25 miles downstream from the powerhouse) as stated in the Opinion.

During scoping meetings for the mini test (and the full test), as well as in some of the written comments received during the scoping process, the need for the mini test (and full test, and potential future operational changes) was questioned. The public questioned the scientific basis for the test, as well as the stated causes for the decline of the pallid sturgeon.

Scientific Basis*

The need for the mini test (and the underlying need for the mini test, full test, and potential future operational changes) is discussed in detail in the Opinion, which is hereby incorporated by reference to avoid unnecessary redundancy. Pertinent parts of the Opinion (those specifically relating to the Fort Peck tests), as well as a clarifying letter from the USFWS, are included in Appendix B. The mini test (and full test) were also included in the December, 2003 Biological Opinion Amendment.

The mini test and full test have been included as part of the Corps Proposed Action (PA) in its July, 2003 Biological Assessment to avoid jeopardizing threatened and endangered species and adversely modifying critical habitat. The data collected from these tests could be used in an adaptive management framework to determine if future tests, or future potential flow modifications, are warranted.

The Corps intends to implement those tasks withn the Opinion which are reasonable and prudent, in coordination with the USFWS, which is the agency with primary expertise with regard to the needs of endangered species. Any further explanation of the scientific basis for this test is outside the scope of this EA.

* An issue raised during public scoping

III. Description of the Proposed Test

The proposed mini test components are identified as follows, all of which in combination constitute the proposed mini test. Several of the components (indicated by asterisk*) were included to address issues raised as a result of scoping meetings and written comments during the NEPA process[14]. Other components (indicated by double asterisks**) are monitoring components that were already included in the test proposal.

- Test various combinations of spillway and powerhouse flows with periodic data collection periods of 4 to 12 hours
- Combined spillway and powerhouse flows not to exceed total of 15,000 cfs
- Release a minimum of 4,000 cfs through powerhouse to support coldwater fishery
- Set spillway discharges ranging from 0 to 11,000 cfs
- Minimum combined flows (spillway plus powerhouse) would remain above 8,000 cfs in order to address irrigation concerns*
- Fish nets or other deterrents may be used to prevent fish movement over the spillway during the test, except for one experimental test discharge*
- Low lake elevations or projections of less than "upper quartile" inflows may cause modification or postponement of the mini test*
- Data Collection includes:
  - temperature data in the reservoir and river**
  - fisheries data**
  - spillway integrity data**
  - depth and shape of scour holes**
  - erosion rate at a sample of downstream sites**
  - inventory of potential cultural resources sites and traditional cultural properties**
  - monitoring of water quality, primarily turbidity, around water intake sites*
- "Stop" protocol as determined by the Missouri River Basin Water Management Division
  - spillway slab movement
  - life in danger
  - Missouri River flow out of banks
  - major loss of historical remains[15]
  - energy shortage

[14] The "NEPA process" refers to the National Environmental Policy Act (1978) that requires the federal agency to fully disclose the proposed federal action and its impacts to the public and agencies. This process includes a "scoping" process during which the federal agency requests information from the public, agencies, and Tribes in order to better determine impacts and benefits associated with the proposed project.

[15] based on criteria to be developed through ongoing consultation between the Tribes and the Corps

General Release Adjustment Guidelines

For the purpose of blending flows and altering Missouri River water temperature, the flow test scenarios would require a series of combinations of powerhouse and spillway releases. Local interests indicated that a fluctuating river elevation wreaks havoc with irrigation intakes. Therefore, each change in flow releases would be phased such that the total flow remains roughly the same. As the spillway release is altered (raised or lowered), a corresponding change in the power release would be required to maintain a constant combined flow total. Reductions in spillway releases would make it difficult to maintain the desired temperatures downstream

Strategy for Changing to a New Flow

The spillway exit channel enters the Missouri River at an angle that could direct flows toward the opposite, or left, bank. To minimize the spillway release impact on the left bank, power tunnel releases would be used to provide a backwater effect. When the flow scenario causes an increase in the combined total flow, the increase would first be accomplished with the power tunnel to the extent practical. After the river was stabilized, power tunnel flows would be reduced while spillway flows are increased.

Constant Flow Period

Constant flows from both the spillway and power tunnel would be required for data collection for the duration of each flow combination. Severe winds or extreme inflows could affect the pool elevation enough that the spillway release could vary during the test. Spillway flow measuring equipment would be monitored during the test. If the monitoring equipment indicates a spillway flow change greater than 500 cfs, adjustments to the spillway gate setting would be performed. No adjustment to power tunnel release would be expected during the constant flow period. Power plant peaking or variation from a constant flow would not be allowed during the test flow test period. If unforeseen power plant flow variation occurs, the test period would be lengthened accordingly.

Pool Elevation Requirements

Annual Operating Plan simulations indicate that Upper Quartile or greater runoff would be needed in 2004 to raise Fort Peck Lake to an elevation sufficient for spillway releases. The Fort Peck spillway rating curve indicates that a pool elevation of 3.5 to 4 feet above the gate crest elevation of 2,225 feet msl is required for a spillway discharge of 11,000 cfs. However, for conditions of pool depth less than 5 feet, meeting the test flow rate for the entire test duration may be difficult, possibly resulting in a shortened test. In addition, our release would fluctuate with the pool level since it wouldn't be regulated by the gate. Wind effects could be substantial and cause flow variation and test day analysis problems. **Therefore, at least 5 feet of lake elevation above the gates (2230+ feet msl) would be needed to run the mini test in order to maintain uniform discharges and minimize data analysis problems.** Hydraulic head elevation losses within the upstream approach channel and through the gate structure would impact the required pool elevation. Spillway monitoring equipment would include flow measurement capability. Factors that impact the spillway rating curve (e.g., wind setup, hydraulic losses, etc.) would be evaluated during testing.

"Stop Protocol" to Avoid or Minimize Impacts

The operational "stop protocol" for the mini test, or the criteria under which the Corps would stop the test (once the test has begun) are as follows:

- Spillway slab movement or excess erosion of spillway banks
- Danger of loss of life
- Missouri River flow exceeding capacity of banks
- Major loss or potential loss of historical remains
- An energy shortage within the region

Normal erosion rates are expected to continue during the mini test. Also, no significant cultural sites have been identified adjacent to the bank of the river. Areas of concern would be monitored weekly during the test, however, to verify the condition of cultural sites.

Data Collection

The collection methodology proposed in the Fort Peck data collection plan has been tested and is in the process of being standardized using data collected during the summers of 2001 - 2004, as well as the data that would be collected during subsequent "pre-test" years, as well as during the mini test itself. The primary data collected during the mini test would be physical data (spillway stress data, temperature data, turbidity data, etc). The Fort Peck data collection plan (Appendix F) is designed to evaluate the biological response of pallid sturgeon and other native fish species to modified dam operations anticipated during the full test. This data collection plan augments the existing Western Area Power Administration's (WAPA)-sponsored data collection efforts in this reach.

Annual reports from data collected during 2001 and 2002 are included in Appendix L.

Table 2. Mini Test Flow Scenarios

Duration (days)	Spillway Flow (1000 cfs)	Power Tunnel (1000 cfs)	Combine Flow Total (1000 cfs)
Adjustment: Initial power flow at 8K, reduce to 4K while increasing spillway flow from 0 to 4K.			
4	4	4	8
Adjustment: Increase power flow from 4 to 8K while reducing spillway flow from 4 to 0K.			
1[1]	0[1]	8	8
Adjustment: Increase power flow from 8 to 11K. Reduce power flow from 11 to 7K while increasing spillway flow from 0 to 4K.			
4	4	7	11
Adjustment: Increase power flow from 7 to 14K while reducing spillway flow from 4 to 0K.			
4	0	14[2]	14[2]
Adjustment: Reduce power flow from 14 to 11K while increasing spillway flow from 0 to 4K.			
4	4	11	15
Adjustment: Reduce power flow from 11 to 7K while increasing spillway flow from 4 to 8K (maintain a maximum total of 15K). Further reduce power flow from 7 to 4K.			
4	8	4	12
Adjustment: Increase power flow from 4 to 7K.			
4	8	7	15
Adjustment: Reduce power flow from 7 to 4K while increasing spillway flow from 8 to 11K (maintain a maximum total of 15K).			
4[3]	11	4	15
1[4]	11 (no fish barrier)	4	15
Adjustment: Day 1- Reduce spillway flow from 11 to 5K while increasing power flow from 4 to 7K. Day 2 - Reduce spillway flow from 5 to 0K while increasing power flow from 7 to 9K. Day 3 - Further reduce power flow from 9K to the desired flow (7 or 8K).			
NA	0[1]	Normal	Normal

1. Monitoring Period. Spillway flow will be stopped during a 4-12 hour period to perform scour hole and exit channel surveys. The monitoring is scheduled to start at approximately 0830 after the listed spillway flows are stopped. After completion of monitoring, the spillway and power flows will be adjusted to the next flow combination.
2. Approximate power flow will vary depending upon pool elevation.
3. Flow combination duration may vary from 4-9 days depending upon monitoring results.
4. Flow combination duration as required may vary to provide data without the fish barrier.

IV. Alternatives

Alternatives Considered but Rejected

Alternative actions to achieve the three objectives described for the mini test were considered in preliminary discussions with regard to flow modifications out of Fort Peck Dam. Alternatives are described below, by mini test objective.

Objective - To test the long-term integrity of the spillway operating at higher flows

Alternatives - The only other method to determine spillway integrity is through modeling. As part of the Fort Peck Dam Major Rehabilitation Spillway Report, spillway stress was modeled. Additional modeling using existing data would not add to the knowledge of the spillway stability. New data is needed and could be provided by stress monitors during a spillway discharge event. With additional data, the model could be updated to provide a more accurate estimate of the spillway integrity situation.

Objective - To test data collection methodology to be used during the mini test and the full test

Alternatives - Although the methodology to collect most of the fisheries and water quality data is standard, there are some "on site" adjustments that are needed for this reach of the Missouri River. Additionally, this is the first time that remote telemetry receiving stations will be used in this reach; therefore, field-testing is prudent prior to using this equipment to determine pallid sturgeon response during the full test. There is no alternative to field-testing, other than to not test.

Objective - To gather data on temperature, based on various combined flows from the spillway and powerhouse

Alternatives - Although some temperature data are available for the Missouri River below Fort Peck, as well as for Fort Peck Lake and Fort Peck Dam discharge water, the relationship among the reservoir temperature, spillway discharges, and resulting river temperatures is unknown. The USFWS has identified 18 degrees Celsius (64.4 degrees Fahrenheit) as a target at Frasier Rapids (USFWS 2000); however, it is unknown whether this temperature is attainable using the spillway as a discharge vehicle for the warmer water of the upper lake. By collecting temperature information for a series of flows during the spillway stress tests, a model could be developed based on the relationship among the lake temperature, spillway discharge volume, powerhouse discharge volume, and the resultant river temperature at Frasier Rapids. This model may be able to further define the relationship among spillway flow volume and powerhouse discharges and resulting temperature conditions downstream. There is no alternative to collecting the temperature data other than to model the situation without the availability of true temperature data for model calibration.

Alternatives Outside the Scope of the Mini Test

There may be alternative actions (other than a spillway discharge) that could be taken to achieve the underlying purpose of the test ("..to support the Endangered Species Act and the Biological Opinion....to achieve 64.4 degrees F at Frazier Rapids ....to facilitate pallid sturgeon spawning..."). Warm water releases may also be potentially achieved by holding water in constructed shallow ponds for later release, running water through a heating component prior to discharge from the powerhouse, relaxing restrictions on warm-water effluent discharges along this reach, etc. However, none of these actions could achieve the specific purpose of the mini test, which is to test the spillway integrity, test data collection methodology, and to test various combinations of spillway and powerhouse releases. Therefore, these alternatives are not considered within this EA.

No Action Alternative

The Council on Environmental Quality (CEQ) requires that a "no action" alternative be included within a NEPA document. If the Federal action (mini test) is not pursued, then this "no action" alternative would consist of a continuation of the previous pattern of discharges from Fort Peck Dam. These discharges relate to precipitation and water availability, as well as hydropower demands, and would not be discharged for test purposes. The "no action" alternative would not meet the purpose and need for the mini test, would not result in the collection of spillway stability data, the testing of data collection methodology, nor the collection of temperature information about the various combinations of spillway and powerhouse releases.

V. Existing Conditions

This section describes the current conditions within the project area and its immediate vicinity. The current conditions may also include information on "normal" variability among water years (low flow, high flow, etc.). Physical and biological parameters that are discussed in this EA reflect the comments of the public, agencies, and Tribes that were collected during scoping. Those resources not impacted as a result of the mini test and not raised as scoping concerns are not included in this evaluation.

Environmental Baseline and Existing Conditions

Water Quality*

Temperature

Lake Temperatures

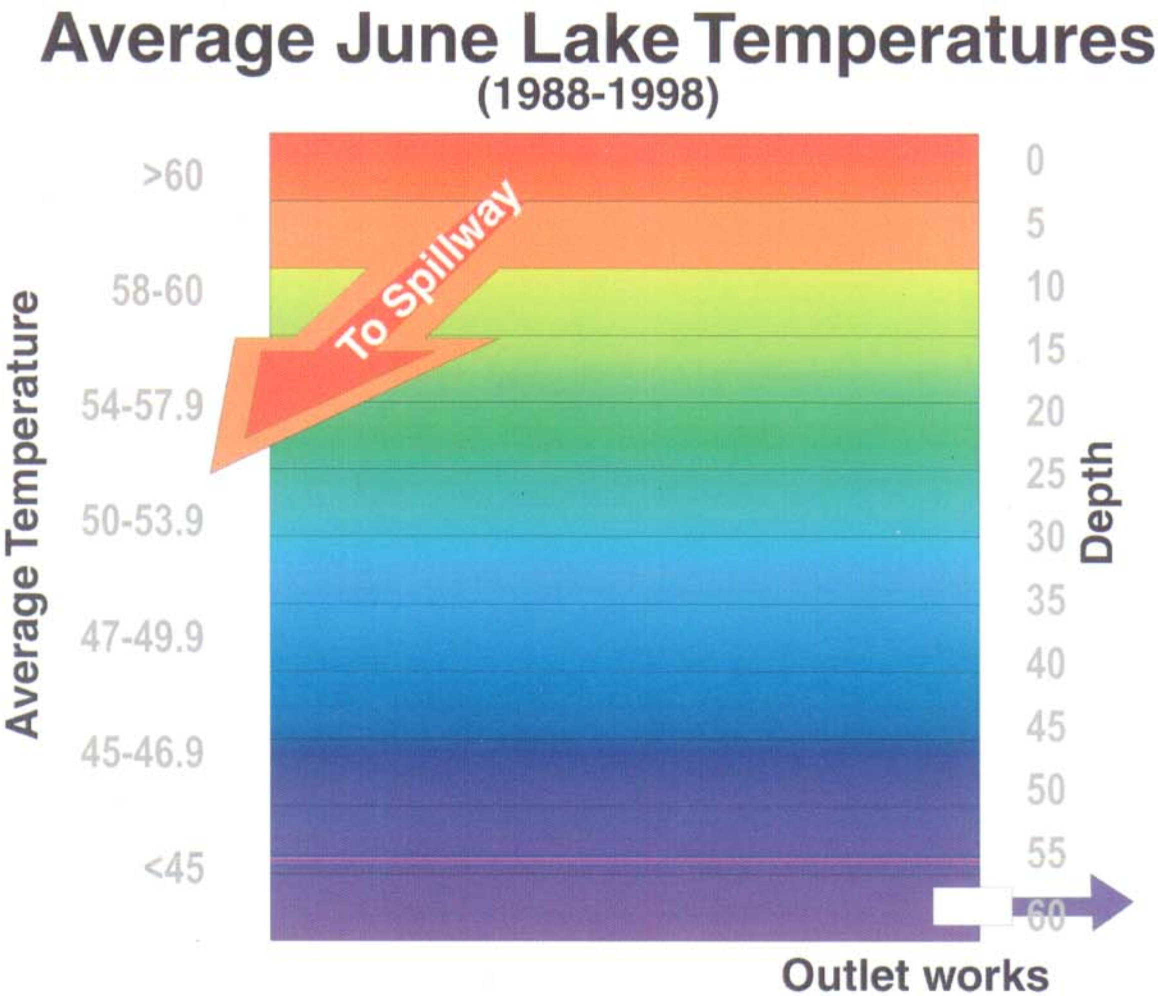
The water temperature in Fort Peck Lake varies from month to month, from year to year, and from the top of the lake to the bottom of the lake. Temperatures on the bottom of the lake are the same as the temperatures discharged from the outlet works, since the inlet pipe to the powerhouse is located near the bottom of the lake.

The intent of the mini test (and other flow modification actions) is to draw warmer water from the top of the lake down the spillway and into the Missouri River. The water from the upper tenth of a meter (about 4 inches) of the lake ranged from 71.6 (June 18, 1986) to 50.4 (June 7, 1982) degrees F during the month of June, based on monthly lake temperature measurements taken from 1976 to 1998. Since water would be drawn from 5 feet above the spillway gates and the relationship between the lake surface elevation varies by water year, the temperature range from a depth of 5 meters (about 15 feet) was used for temperature analysis. The historic temperature range for the upper 15 feet ranged from 68 to 55 degrees F during the month of June. The warmer the water discharged down the spillway, the greater the likelihood for temperature changes in the Missouri River resulting from the mini test.

By contrast, the water 55 meters (about 165 feet) below the surface of the lake ranged from 42.8 to 50.0 degrees F during the month of June. The average lake temperatures from 1988 to 1998 are graphed by depth in Figure 3. Depth for the figure is in meters.

* An issue raised during public scoping

Figure 3. Average June Lake Temperatures



<u>Temperature of Water Discharged from Dam</u>

The powerhouse inlet pipe is located near the bottom of Fort Peck Dam, and therefore water discharged from the powerhouse comes from the hypolimnion, or bottom, of the lake. This water is almost always the coldest water available from the lake. Water temperatures were taken for water in the tailrace immediately below the dam, which is where the water is discharged from the powerhouse. Tailwater temperatures during the month of June (1990 - 1997) ranged from 44.6 - 53.8 degrees F (U.S. Army Corps of Engineers, unpublished data).

Table 3. Tailwater Temperature Data, 1990 to 1997

Month	Minimum	25th percentile	Median	75th percentile	Maximum	Observations
January	33.9	35.0	35.6	36.6	42.9	170
February	34.8	35.1	35.3	36.5	38.0	147
March	35.0	35.6	36.2	36.9	43.7	166
April	35.9	37.3	38.2	39.9	47.1	125
May	39.5	42.4	44.0	46.2	54.1	111
June	**44.6**	**46.5**	**48.2**	**50.7**	**53.8**	**114**
July	46.5	47.9	49.9	52.2	57.9	88
August	47.5	51.3	52.9	56.1	59.7	127
September	50.8	53.0	54.3	57.5	71.2	106
October	50.7	54.2	55.5	57.3	64.8	125
November	38.4	45.1	46.9	49.2	53.1	150
December	34.4	37.0	39.1	41.2	44.2	168

Missouri River Temperatures

As the water from the tailrace moves downstream, it is warmed by solar radiation, atmosphere interaction, wind action, and incoming warmer tributaries. The intent of the mini test is to see how the introduction of warmer lake water, via the spillway, affects the Missouri River temperatures downstream. Average daily Missouri River temperatures, based on data collected during June 2001, ranged from 49.6 to 75.9 degrees F, and increased as one progressed downstream (Yerk and Baxter, 2001).

Hypolimnetic releases (coming from the bottom of the lake) through Fort Peck Dam have altered the water temperature regime of the Missouri River downstream from Fort Peck Dam based on a comparison with the Missouri River above Fort Peck Lake. Gardner and Stewart (1987) found that average temperatures (in degrees F) between June and September were 66.9[16] in the Missouri River above Fort Peck Lake, 52.5 downstream from the Fort Peck Dam, and 58.8 at Wolf Point, and 61 near Culbertson. Thus, mean water temperatures are suppressed 5.9 to 14.4 degrees F compared to conditions upstream from Lake Peck.

During 2001, mean water temperature between mid-May and mid-October was 6.3 degrees C cooler at Frazer Rapids (mean = 13.8 degrees C) than in the free-flowing Missouri River upstream from Fort Peck Dam (mean = 20.1 degrees C) (Braaten and Fuller, 2002). Temperatures at Frazer Rapids, the targeted area for 18 degree C in the 2000 Biological Opinion, did not reach 18 degrees even during late summer months, according to temperature data collected during 2001 and 2002.

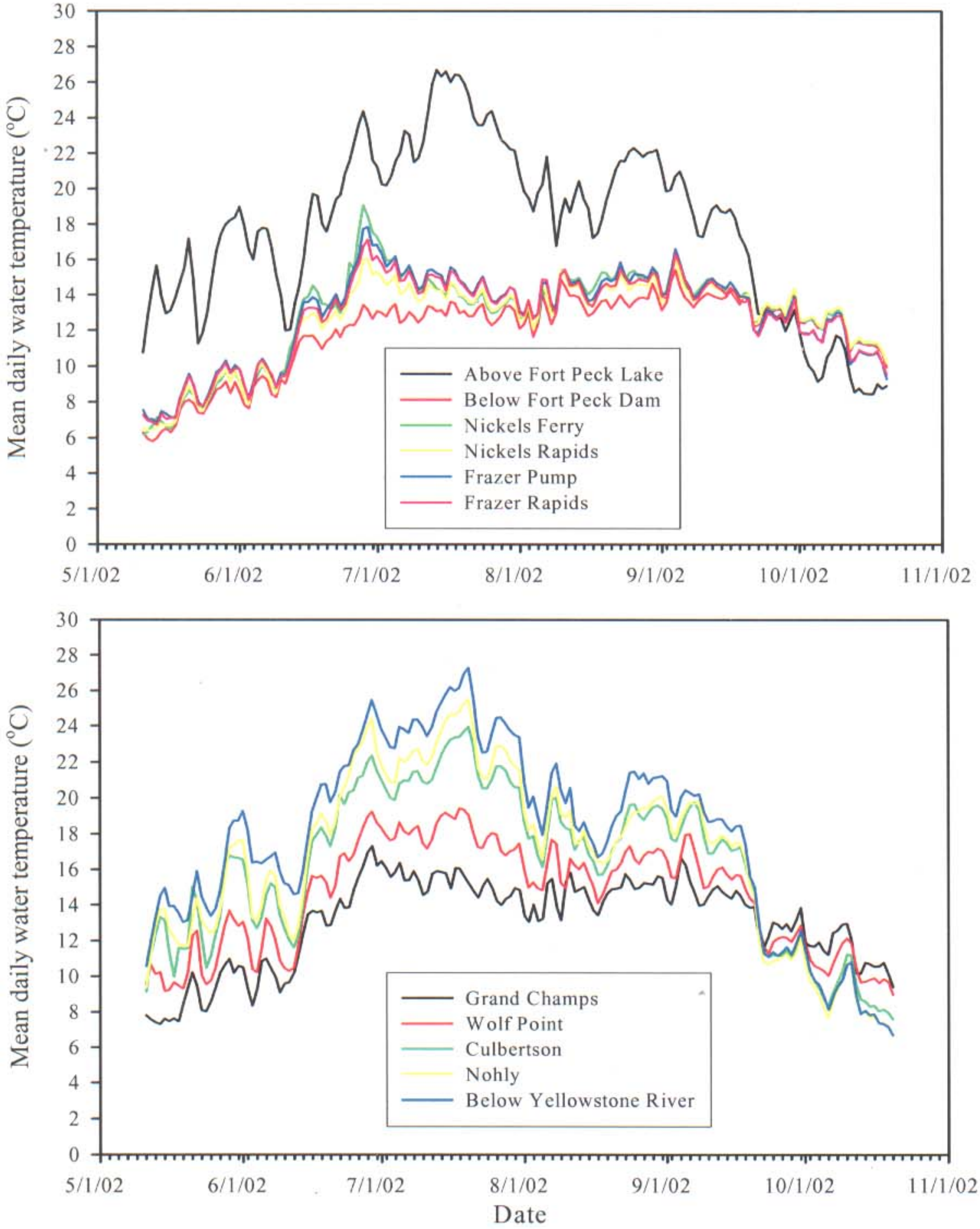
The Opinion states that a minimum water temperature of 18 degrees C (64.4 degrees F) will be established at Frazer Rapids (river mile 1746) via spillway releases. According to the Opinion, pallid sturgeon spawning is thought to occur as water temperatures approach 18 degrees C. The existing temperature in the Missouri River at Frazier Rapids during

[16] Gardner and Stewart reported results in degrees C which have been converted to degrees F for understandability in the EA using the formula F = 1.8 (degrees C) + 32.

the month of June, based on data collected during 2001, ranged from 49.7 (June 14, right bank) to 63.6 (June 29, left bank) degrees F. The temperature varies from right bank to left bank, and from the surface to the bottom within the water column, with an average June water temperature in 2000 and 2001 of 55.5 degrees F (Yerk, 2001 and Braaten, 2001). Maximum daily temperatures at the Frazier Rapids site targeted for temperature increases averaged 17.0 degrees to 17.1 degrees C from 2000 - 2002 data collection efforts (Yerk and Baxter 2000, Braaten and Fuller 2002, Braaten and Fuller 2003).

During 2002, mean daily water temperatures for the Missouri River mainstem sites was greatest at the Robinson Bridge site (17.9 degrees C) located above Fort Peck Lake, and in the Missouri River downstream from the Yellowstone River (17.9 degrees C). Just below Fort Peck dam, temperatures averaged 11.9 degrees C. As shown on Table 4 below, throughout the summer water temperatures increased as water moved downstream to 16.7 degrees at the Nohly site and were highest below the Yellowstone confluence (Braaten and Fuller, 2003).

Table 4 - Mean Daily Water Temperatures 2002
(Braaten and Fuller, 2003)



Turbidity

Fort Peck Tailwaters

Turbidity data was collected by the Corps in the tailwaters of Fort Peck Dam during the period 1990 through 2001. During this period, turbidity was monitored sporadically during the months of February through October. A summary of this information is given below.

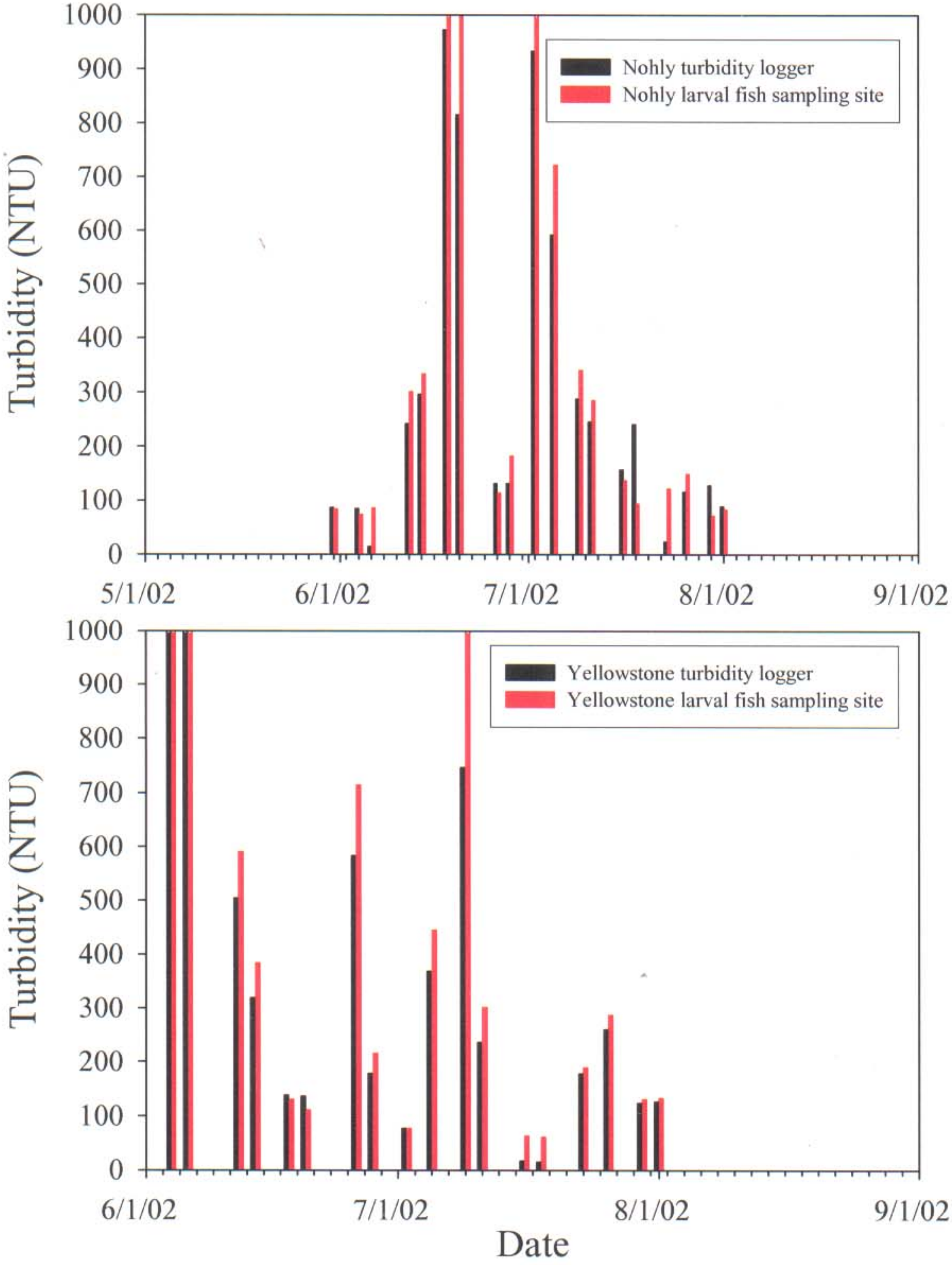
Turbidity is an important water quality variable that can influence the distribution and habitat use of pallid sturgeon. There is evidence suggesting that pallid sturgeon prefer areas of high turbidity in the Missouri River (Erickson 1992). In addition to altered discharge and reduced water temperatures, the reduced turbidity in the Missouri River downstream from Fort Peck Dam (Dieterman et al. 1996; Young et al. 1997) may inhibit use of this area by pallid sturgeon.

Missouri River Turbidity

The relatively clear water coming out of the powerhouse and into the tailwaters quickly picks up sediments as it moves downstream. Tributaries add considerable amounts of turbidity, as does rainfall runoff. During monitoring during 2001 and 2002, turbidity increased longitudinally downstream from Fort Peck Dam and generally increased during periods of elevated discharge (Braaten and Fuller, 2002; Braaten and Fuller, 2003). The ability of the water to suspend sediments is related to water temperature; warmer water can hold more sediment than cooler water. Therefore, as water temperatures increase, the potential for increased turbidity in that water is slightly greater.

Table 5 shows the variation in turbidity throughout the season in the Missouri River and in the Yellowstone River. Turbidity was taken by remote logger (in black) and in conjunction with larval drift collections (Braaten and Fuller, 2003).

Table 5 - Mean Daily Turbidity 2002
(Braaten and Fuller, 2003)



Water Chemistry

Lake Water Chemistry

Fort Peck Lake is used as a water supply by the towns of Fort Peck and Glasgow, Montana, and for numerous individual cabins in the area. The State of Montana has placed Fort Peck Lake on the 303(d) List of Impaired Waterbodies due to the presence of lead, mercury, other metals, and noxious aquatic plants. Inflows and waters within Fort Peck Lake have a low pH and elevated levels of arsenic, phosphorus, mercury, manganese, beryllium, and iron (U.S. Army Corps of Engineers, 2001a). While generally considered "good," water quality, the Fort Peck Lake has occasionally exceeded Montana water quality standards and/or EPA criteria for arsenic, mercury, cadmium, and chlordane. These pollutants apparently derive from non-point sources and enter the reservoir through inflows or from local soils. The exceedances have not been large or frequent enough to constitute a problem for water users.

The Montana Department of Public Health and Human Services has published a "Meal Advisory" for the consumption of certain species and size of fish caught in Fort Peck Lake due to mercury in the tissues of walleye, northern pike, lake trout, and chinook salmon (Environmental Protection Agency, 2001).

During the 1987 and 1989, two instances of algal blooms resulting in the release of algal toxins occurred within Fort Peck Lake. Large algae blooms occur nearly every year, which is typical for aging lakes.

River Water Chemistry

There are two Missouri River segments downstream from Fort Peck Dam that are on the State of Montana's 303(d) List of Impaired Waterbodies; from Fort Peck Dam to the Poplar River, and from the Poplar River to the North Dakota border. These segments are affected by metals and habitat alteration resulting from modified stream flows (U.S. Army Corps of Engineers, 2001a).

Lake Levels*/Discharge Volume*

The average annual daily discharge from Fort Peck Dam is 10,000 cfs. The flow duration analysis from 1960 through 1999, using data from the "below Fort Peck gauge," indicates that June's daily flow is generally in the range from 14,400 to 14,800 cfs for the 90 percent flow. This means that 10 percent of the time, the average daily flow will be higher than that value. During the mini test, the average daily discharge will range from 8,000 cfs to 15,000 cfs. An average daily discharge of 15,000 cfs or higher occurs about every 20 years.

The 50 percent exceedance lake elevation for the month of June (1898 - 1997) is 2239.5 feet msl. That means that half of the years are above that value and half of the years are below that value.

Flooding*/Drought*

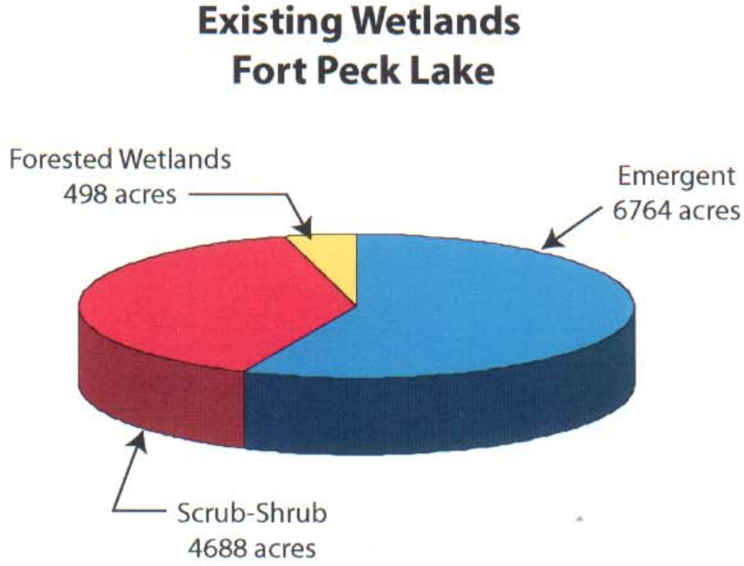
Downstream flooding was an issue raised by organizations and individuals during the scoping process. Concern was voiced regarding the flooding of valuable agricultural land near the headwaters of Lake Sakakawea and of low farm ground in general. The impact of the increased Missouri River flow in conjunction with seasonal high flows on the Yellowstone River were of special cencern. These are the result of mountain snowmelt and normally occur at the same time as the proposed mini test. This combination could impact landowners near the confluence of these rivers and downstream to Lake Sakakawea, especially flooding and an increased water table at the Buford-Trenton Irrigation District.

Wetlands

Fort Peck Lake Wetlands

Figure 4 depicts the relative acreage of wetlands by type along Fort Peck Lake. This information is based on National Wetland Inventory survey information, as summarized by the draft Master Manual (Corps of Engineers, 2001).

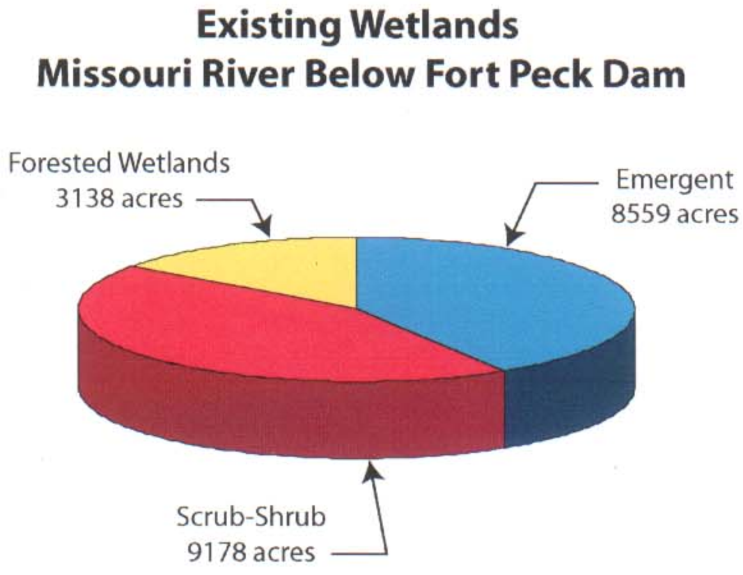
Figure 4. Fort Peck Wetlands Composition



Wetlands along the Missouri River below Fort Peck Dam

Figure 5 depicts the relative acreage of wetlands by type along the Missouri River below Fort Peck Dam. This information is based on National Wetland Inventory survey information, as summarized by the draft Master Manual (Corps of Engineers, 2001a).

Figure 5. Missouri River Wetlands Composition Below Fort Peck



Cottonwood Forest

Lake Cottonwood Habitat

The north side of the lake consists of gently rolling hills with upland vegetation, primarily mixed short-grass and mid-grass prairie. A large ponderosa pine forest is located on the east end of the lake. On the south side of the lake, vegetation consists of primarily pine forest in areas of rugged topography, as well as prairie and sagebrush on areas of level topography. Shrubs are concentrated in ravines and tributary valleys. The upstream end of the lake consists of deciduous floodplain forest. Much of the area is grazed by cattle which results in limited natural regeneration of tree seedlings. Tree plantings are regularly done by the Corps and the USFWS.

Riverine Cottonwood Habitat

The low elevation areas in the tailrace below the dam consists of deciduous floodplain forest. Higher elevation areas consist of prairie vegetation and sage on gently rolling topography. An inventory of cottonwood forest habitat was conducted by a contractor for the Fort Peck Tribes as part of riverbank monitoring for the mini test. Cottonwood trees have cultural and religious importance to the Tribes. The scope of work for this effort can be found in Appendix D, as it is a sub-set of the cultural resources inventory.

The following information is from the cottonwood study conducted by Elliot and Larix, 2001. The riparian community along the Missouri River consists of an overstory dominated by cottonwoods (40 to 80 percent of canopy cover) ranging from 12 to 40 inches in diameter. Most of the mature trees have heart rot, complicating the determination of age, however it appears as though most of the trees are over 70 years old, and many are over 100 years old. The average life expectancy for the Great Plains cottonwood is 125 years. Cottonwood vigor is poor, evidenced by dead tops, missing branches, and cavities. Live trees ranged from 30 to 250 per acre. Dead trees ranged from 0 to 100 per acre. Cottonwood reproduction is taking place along a narrow zone along the river, and these trees are extremely vulnerable to beaver-caused mortality (although older trees also show beaver damage). The cottonwood study can be found in Appendix L.

Fisheries

Fort Peck Lake

Fort Peck Lake is noted for its walleye fishery. Supplemental stocking is needed to perpetuate the species since spawning habitat is limited due to the general lack of rocky substrates. The lake also has a significant coldwater fishery for lake trout and chinook salmon. Chinook salmon do not reproduce naturally and are, therefore, stocked annually. Lake trout were introduced into the lake by stocking; however, they now spawn on riprap along the face of the dam. Erosion due to wave action and water level fluctuation preclude vegetation growth around the perimeter of the lake and severely limits spawning and rearing habitat for other game species such as northern pike, crappie, and yellow perch. Observations by Water Management personnel in recent years as the pool has lowered indicate that the soil is so sterile that no vegetation, including weeds, grows along the shoreline (Keasling, personal communication). Pallid sturgeon and paddlefish have also been found in the lake and are probably remnant river populations. These species migrate upstream into the Missouri River upstream from Fort Peck Lake on a seasonal basis (U.S. Corps of Engineers, 2001a).

As mentioned in the Water Quality section, the Montana Department of Public Health and Human Services has published a "Meal Advisory" for the consumption of certain species and size of fish caught in Fort Peck Lake due to mercury in the tissues of walleye, northern pike, lake trout, and chinook salmon (Environmental Protection Agency, 2001).

Missouri River below Fort Peck Dam

The river immediately below Fort Peck Dam is cold and clear and has little cover. The nominal sediment load in this reach contributes to the availability of gravel substrate throughout the area. The outlet works for the dam releases cold water in a "tailrace" area that supports a large population of shovelnose sturgeon, some pallid sturgeon, and rainbow trout. A lake-like "dredge cut" area also supports a paddlefish population (U.S. Army Corps of Engineers, 2001a). This section of the river is considered a coldwater fishery in Montana's state water quality regulations.

Downstream from the Milk River, the Missouri River warms and holds more sediment. The inflow from the Yellowstone River even further downstream adds sediment and nutrients to the reach. This segment of the Missouri River is considered a non-salmonid fishery.

During a 1999 study in which trammel nets were used to collect fish, 13 species were captured in the Missouri River:

pallid sturgeon	smallmouth buffalo
shovelnose sturgeon	bigmouth buffalo
paddlefish	longnose sucker
goldeye	white sucker
carp	channel catfish
river carpsucker	burbot
blue sucker	sauger
walleye	

The most numerous species captured during this study was the channel catfish, followed by the shovelnose sturgeon, and the sauger (Liebelt, 1999).

Movement of native fish species is of interest as it may relate to pallid sturgeon movement in response to flows. During 2001, 16 blue suckers, 19 paddlefish, and 29 shovelnose sturgeon were surgically implanted with radio/accoustic transmitters as part of baseline data collection efforts associated with the mini test. Movement of these fish was recorded, beginning in April 2002 to examine discharge and temperature-related movement patterns.

In 2002, additional fish were captured and implanted with monitoring transmitters: 21 shovelnose sturgeon, 21 blue suckers, and 3 paddlefish. An additional 20 paddlefish were captured and implanted by Dr. Dennis Scarnecchia from the University of Idaho. Permission has been granted to track movement information of these additional paddlefish as part of the Fort Peck telemetry project. Between April and November of 2002, telemetry relocations were obtained for 16 blue suckers (160 relocations), 27 shovelnose sturgeon (276 relocations), and 18 paddlefish (134 relocations) in the Missouri and Yellowstone Rivers (Braaten and Fuller, 2003). Shovelnose sturgeon and paddlefish were highly migratory and exhibited seasonal differences in the use of the Missouri River and the Yellowstone River. Blue suckers tended to be less migratory. See full report in Appendix L.

Threatened and Endangered Species

The following federally listed species could occur within the vicinity of the Fort Peck Dam, Corps' project areas, or downstream riverine habitat:

Black-footed ferret	Endangered	potential resident
Bald eagle	Threatened[17]	winter resident
Piping plover	Threatened	summer nesting migrant critical habitat proposed
Least tern	Endangered	summer nesting migrant
Pallid sturgeon	Endangered	resident

Black-footed Ferret

Black-footed ferrets have not been sighted on Corps' project lands. A 1967 survey indicated signs of ferrets in two prairie dog towns; however, no ferrets were observed. Due to their association with prairie dog colonies, occurrence of ferrets is possible, though unlikely. Over 100 prairie dog colonies cover about 5000 acres on project lands (USACE 1992b).

Bald Eagle

Bald eagles are common within the Fort Peck project area. An estimated 100 eagles may be present within the project vicinity on any given day during spring migration. Since 1988, eagles have been wintering in substantial numbers below Fort Peck Dam on the north edge of the Downstream Recreation Area. Eagles also winter on Scout Island, the shoreline of the Corps' group camp area, and trees on the east bank of the tailrace pool.

Piping Plover

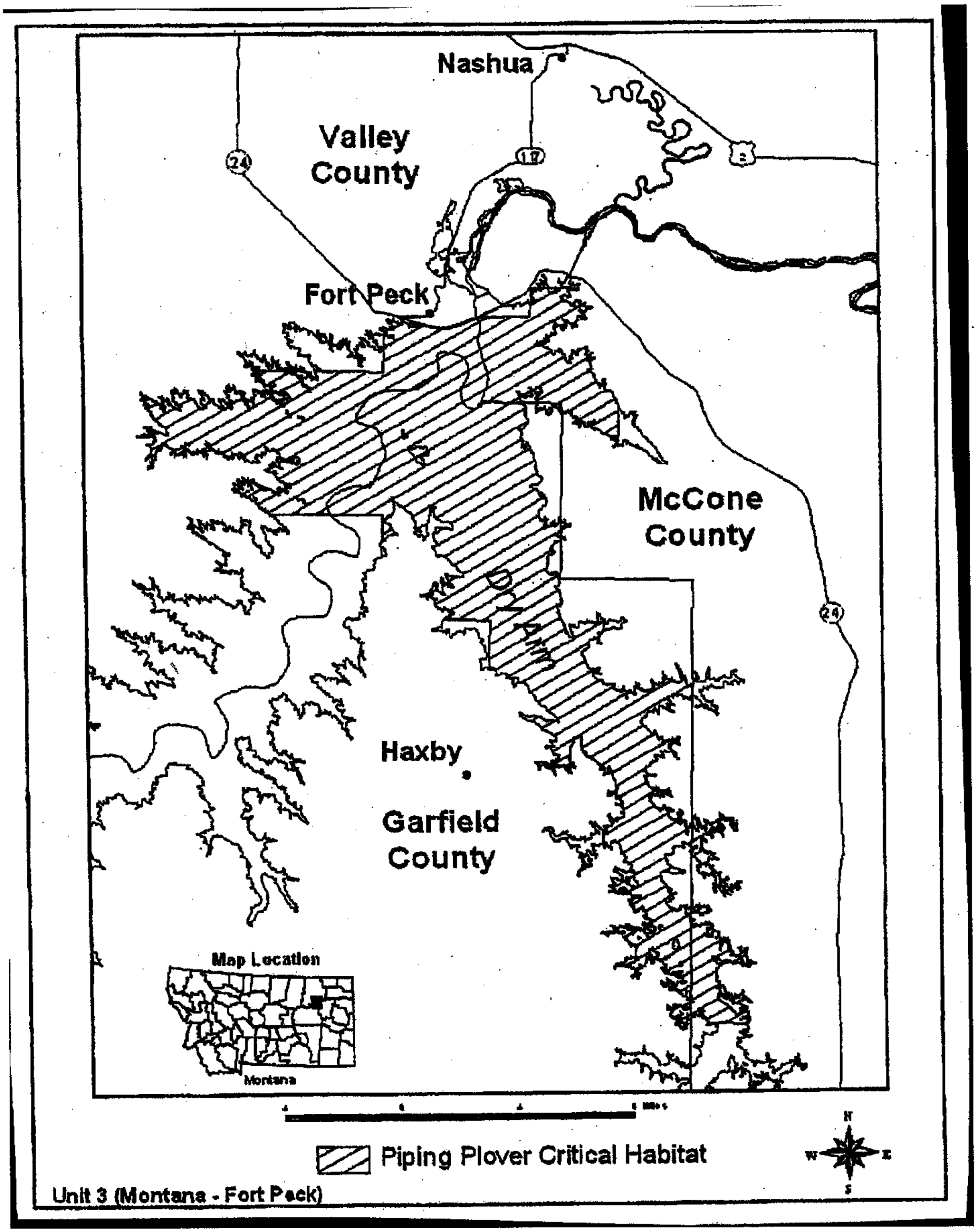
Fort Peck Lake

Piping plovers have been surveyed on Fort Peck Lake since 1986. The birds have been found on the eastern part of the lake, especially the Dry Arm and Bear Creek Bay. Plovers have been known to arrive on Fort Peck Lake as early as late April with the majority arriving and initiating nests in May. On average, 11.1 plovers have been found during the annual adult census with a high of 30 adults found in 1993 and a low of zero in 1996 and 1997. Factors influencing plover numbers include the water level of the lake and the amount of vegetative cover on the beaches. Productivity on the lake is fairly robust with 1.41 chicks fledging per adult pair. System wide the fledge ratio is 1.00 chicks per adult pair. In 2001 four adult plovers were observed on the lake. There were two nests, one was successful with two chicks fledging for a fledge ratio of 1.00.

[17] petitioned for delisting

The USFWS has listed critical habitat for the piping plover along much of the shoreline of Fort Peck Lake, as depicted in Map 2 (Federal Register Vol 66, No. 113, June 12, 2001).

Map 2. Critical Habitat – Fort Peck Lake

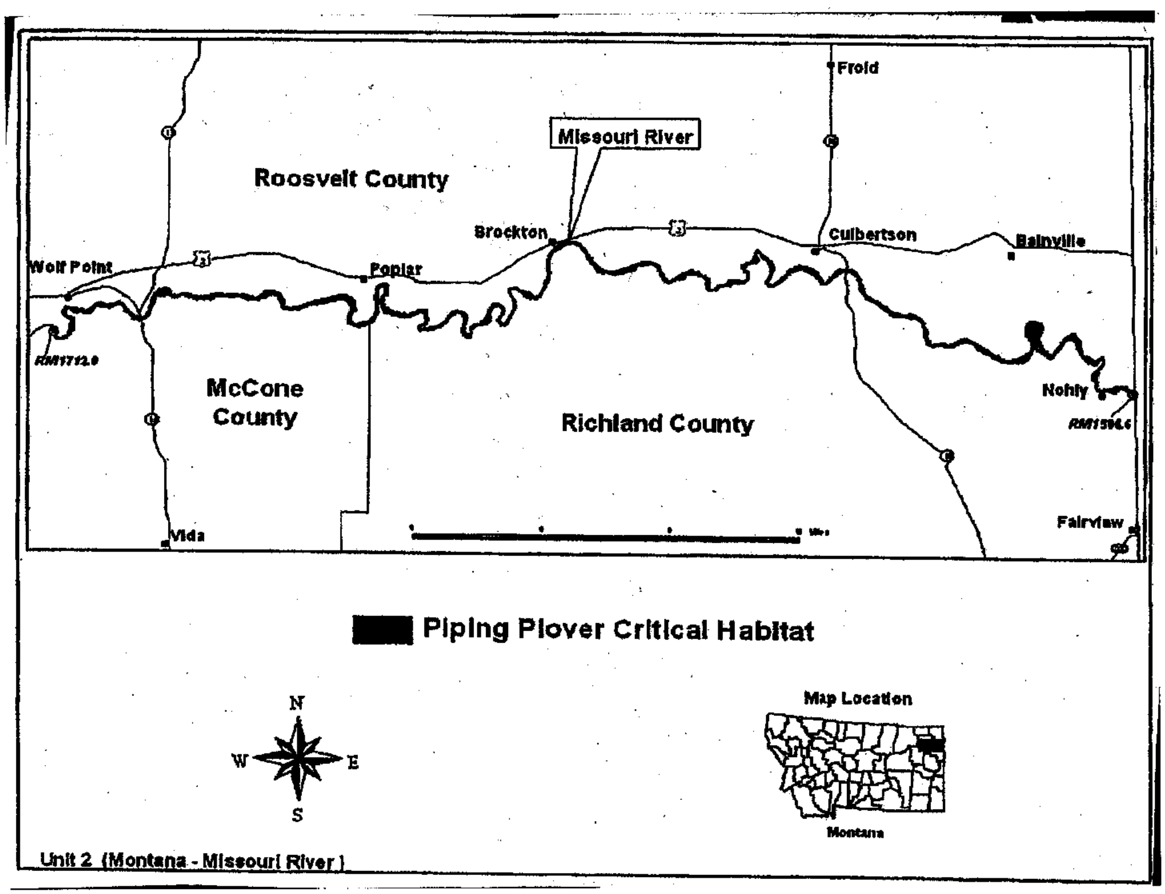


Missouri River below Fort Peck Dam (RM 1771 – RM 1568)

Piping plovers on the Missouri River below Fort Peck Dam have been surveyed from 1988 through 2001. Plover numbers are low on this stretch of the river with an average of 10.1 birds counted during the annual adult census. The high for the river was 1996 when 24 adults were seen and the low was 1992 when no plovers were observed. The highest numbers of plovers have been found on the river from RM 1690 to RM 1670. The plovers arrive on the river around mid May with the majority of nests being initiated in late May and early June. Productivity is below average compared to the entire Missouri River System with 0.86 chicks fledging per adult pair on the river and 1.00 chicks fledging per adult pair system wide. In 2001 three adult plovers were counted during the adult census. There were two nests on the river, both hatched with two chicks fledging for a fledge ratio of 1.33.

The USFWS also listed critical habitat for the piping plover along the islands within portions of the Missouri River below Fort Peck Dam, as depicted in Map 3 (Federal Register Vol 66, No. 113, June 12, 2001).

Map 3. Critical Habitat – Missouri River Below Fort Peck Dam



Least Tern

Fort Peck Lake

Least terns were first observed in the project area in 1987 and will nest in similar areas as the piping plovers, often in the same colony. Least terns nest on river islands more than the piping plovers do, however.

Least terns begin to arrive at the lake in late May with most nests being initiated in early to mid June. Tern use of Fort Peck Lake however is incidental at best. Adult censuses have been conducted on the lake from 1987 through 2001 with an average of 3.5 adults being observed. The high for the lake was 1991 when ten terns were seen. The low has been 1992, 1996, 1997, 1999 and 2001 when no terns were observed. Productivity is below average on Fort Peck Lake compared to the entire Missouri River System with .52 chicks fledging per adult pair on the lake and .72 chicks fledging per adult pair system wide.

Missouri River below Fort Peck Dam (RM 1771 – RM 1568)

Least terns on the Missouri River below Fort Peck Dam have been surveyed from 1988 through 2001. In contrast to piping plover, least tern numbers are quite good on this stretch of the river with an average of 67.5 birds counted during the annual adult census. The high for the river was 1997 when 162 adults were seen and the low was 1988 when 18 adults were observed. This part of the river can be very important for least terns if habitat is unavailable on the lower parts of the Missouri, as was the case in 1996 and 1997.

The most frequently used sections of the river are from RM 1690 to RM 1670 where 123 adults have been counted and from RM 1610 to RM 1590 where 177 adults have been counted. The terns arrive on the river around late May with the majority of nests being initiated in early to mid June. Productivity is below average compared to the entire Missouri River System with 0.62 chicks fledging per adult pair on the river and 0.72 chicks fledging per adult pair system wide. In 2001 39 adult terns were counted during the adult census. There were 20 nests on the river, 13 hatched with 20 chicks fledging for a fledge ratio of 1.03. Map depicting least tern and piping plover nesting areas within the Missouri River below Fort Peck Dam can be found in Appendix I.

Pallid Sturgeon

Pallid sturgeon are present in the lake, the tailrace pool, and the Missouri River below Fort Peck Dam. One of the few remaining concentrations of pallid sturgeon occur on the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea, and in the lower Yellowstone River (Bramblett, 1996). Appendix J provides maps indicating pallid sturgeon capture information, based on the USFWS nationwide database housed in the Bismarck, North Dakota office of the USFWS.

- Altered hydrograph
- Altered river temperatures
- Habitat alterations (including obstructions to migration, such as the dams)

Pallid sturgeon have been collected at more than 280 locations in the Fort Peck reach and the lower Yellowstone River. A detailed listing of capture locations including data, river mile, length, and weight, can be found in the Fort Peck Flow Modification Biological Data Collection Plan, hereafter referred to as the Fort Peck data collection plan, found in Appendix F).

Stomach Analyses

In addition to those reasons that most often come to mind, other, less likely potential reasons for the decline of pallid sturgeon exist within this reach. During the scoping process, local landowners indicated that piscivorous (fish-eating) fish fed on small sturgeon in tributaries to the Missouri River. This has not been documented, although few stomach analyses have been done within this reach. Collection of piscivorous fish for stomach analysis began during the summer of 2001 in order to address this concern.

Food habit data for burbot, channel catfish, freshwater drum, goldeye, northern pike, sauger, shovelnose sturgeon, and walleye were obtained during July and August of 2001 and 2002. Although each species exhibited piscivory (eating of fish), there was no evidence that sturgeon larvae or juveniles were consumed. Goldeye and catfish were found in examined stomachs, as well as parts of other unidentified fish. However, stomach evidence of predation is difficult to quantify, especially for fish such as sturgeon.

Other studies also provide some input into the predation concern. During a concurrent stomach content analysis of predators as part of an experimental predation study of larval fish by adult bluegill and white crappie, the stomach analyses did not accurately quantify predation rates or detect any consumption of small larvae which was known to occur, based on the experimental study (Kim and DeVries, 2001). Walleye are "gape limited" feeders, so the size of prey eaten is limited to the size of the fish, with small walleyes preying on age 0 or juvenile fish (Jackson et al, 1993). On average, walleye can consume prey up to 29 percent of its body length, with a maximum of 44 percent of its body length (Knight et al, 1984; Porath, 1996). The presence of large year-classes of yellow perch or alewives has been shown to buffer other prey species from walleye predation (Lyons and Magnusen, 1987).

Many predators are opportunistic feeders, so any prey species of appropriate size is a potential food source, including sturgeon, but no sturgeon remains were identified in fish stomachs to date. In addition to fish, insects, crustaceans, spiders, worms, fungi, detritus, and even parts of mammals and birds were identified in stomach contents (Braaten, 2003). Prey species that are abundant are more likely to be consumed than species that are not abundant.

Seasonal Movement

Movements of pallid sturgeon in the Missouri River and lower Yellowstone River have been investigated by telemetry and summarized by various researchers (Clancy 1990; Tews and Clancy 1993; Tews 1994; Bramblet 1996). A summary of findings from each researcher can be found in the Fort Peck data collection plan. There are some generalities that can be stated from the data currently available.

For pallid sturgeon tagged near the Yellowstone River confluence, the following patterns are suggested (Tews 1994; Bramblett 1996):

- Movement from the Missouri River to the Yellowstone River during April and May
- Residence in the Yellowstone River during May, June, and July
- Movement into the Missouri River/Yellowstone confluence during late summer
- Little movement in the winter

Pallid sturgeon tagged in the Fort Peck tailrace area exhibit different movement patterns. They either move downstream in the Missouri River during April, or they remain in the tailrace area year-round.

As part of the Fort Peck data collection plan, movements of radiotagged (CART transmitters) pallid sturgeon and selected native species will be monitored using both boat-based receiving units (summer) and multiple fixed data logging receivers (continuous). In addition to following radiotagged pallids, researchers will be drifting trammel nets over radiotagged sturgeon periodically to sample for individuals that may be associating with radiotagged pallid sturgeon.

Larval sturgeon

Larval sampling has been done at several locations in various years in the Missouri River downstream from Fort Peck Dam to determine if pallid sturgeon were successfully spawning. Details about the information collected, what was found, and the researchers can be found in the pallid sturgeon monitoring plan. Several studies reported collections of sturgeon larvae *Scaphirhynchus spp.,* but positive identifications prior to 2002 indicated that all were shovelnose sturgeon (Ruggles, MTFWP). However, Braaten and Fuller report that larval fish sampling associated with pre-test monitoring captured two larval pallid sturgeon during early September, 2002 in the Missouri River downstream from the Yellowstone River confluence. These findings are the first documented account of larval pallid sturgeon in the Missouri River downstream from Fort Peck Dam, and indicate that successful spawning by pallid sturgeon did occur during 2002. However, it is unknown whether spawning occurred in the Yellowstone River or the Missouri River (Braaten and Fuller, 2003). Larval fish sampling is ongoing as part of the Fort Peck data collection plan preceding the mini test, as well as during the mini test (and full test). Exact collection methodology and constraints are discussed in Appendix F.

Turbidity is much reduced downstream from the dam, but sediment contributions from the Milk and other tributaries seasonally elevate turbidity (Gardner and Stewart, 1987). Pallid sturgeon larvae require an extensive length of free-flowing riverine habitat to complete their 8 to 13 day larval drift period (Kynard et al, 1998). It is hypothesized that cool water temperatures in the Missouri River inhibit spawning and that suspected spawning areas in the lower Yellowstone River do not allow for sufficient drift time for successful spawning. Increasing the water temperature in the Missouri River to 18 degrees C at Frazer would not only increase the suitability of that area for pallid sturgeon spawning, but it would also allow a longer drift distance for the developing larvae if spawning was successful. Preliminary data from the larval drift study indicate that most larval sturgeon drift at the same rate as the water in the river.

Socioeconomic Baseline & Existing Conditions

Recreation

Fort Peck Lake

The original Corps' Master Plan for recreational use of Corps lands at Fort Peck was approved in 1946 and updated in 1965. This Master Plan, which identifies areas of recreation as well as those areas set aside for wildlife, was updated again in 1992. The 1992 update allocated approximately 2,500 additional acres to intensive recreation on Corps land within the vicinity of Fort Peck Lake for a total of over 7,000 acres identified for recreational use. The updated Master Plan identified 18 new recreation sites (US Corps of Engineers, 1992).

The Fort Peck area receives low to moderate density visitation, which is primarily concentrated at the few designated recreation areas near highways. Summer visitation primarily consists of sightseeing, camping, picnicking, fishing, hunting, and boating. Water based recreation at Fort Peck Lake includes fishing, boating, water skiing, swimming, and waterfowl hunting. Picnicking, camping, upland game hunting and sight seeing are also popular pastimes in the project area. There were 495,511 user days of recreation activity reported for the Fort Peck project, including the lake and downstream facilities, in fiscal year 2000 (October 1 through September 30). The quality and extent of these activities, for the most part, are at least indirectly dependent on the presence of the lake.

Missouri River below Fort Peck Dam

Recreational activities on and near the river include fishing, boating, water skiing, water fowl hunting, swimming, picnicking, upland game hunting, and sight seeing. Recreation facilities, including boat ramps, are located within a few miles downstream of the dam. These recreation areas include Goose Pond, Downstream, Nelson Dredge, Floodplain Recreation, Round House Point, Nature Trails, First Dredge and Second Dredge.

Fort Peck Reservation

The presence of only two boat ramps within the Fort Peck Reservation is considered a problem by the Tribes. The low number of boat ramps was brought up by the Tribes during consultation; however, this is outside the scope of the Fort Peck mini test action.

Hydropower*

The Fort Peck spillway is utilized only when release requirements exceed the 15,000 cfs discharge capacity of the two powerplants. Water power is converted to mechanical power by turbines and then to electrical power by the generators attached to the turbine shafts. Efforts are made to maximize the production of electricity within the parameters of other project purposes. The Fort Peck powerplant has a nameplate rating of 185.25 megawatts. Fiscal year 2002 main stem generation was 7272 gigawatt-hours (GWh), 73 percent of average. Fiscal year 2002 revenue for the Missouri River main stem plants was $102.8 million.

The Western Area Power Administration (WAPA) is an agency of the Federal government, within the Department of Energy, established expressly to market and distribute hydropower produced in its region at Corps of Engineers and Bureau of Reclamation projects. Total sales in fiscal year 2002 were 10,838 GWh, valued at $179,285,000. Power is distributed to preference customers as prescribed by legislation. Power in excess of these customers needs is sold on the open market. Power generated by the Corps main stem Missouri River dams and Canyon Ferry and Yellowtail dams, which are operated by the Bureau of Reclamation, is distributed in the Upper Great Plains Region. Within this region WAPA serves all or parts of the states of Montana, North Dakota, South Dakota, Nebraska, Minnesota, Iowa, and a small part of the state of Missouri.

Riverbank Erosion*

Stream bank erosion occurs at various points along the Missouri River between Fort Peck Dam and Lake Sakakawea. The location and extent of erosion varies over time and is dependent on many variables. These include the annual volume of flow, the location and duration of flows, the direction of flow, the susceptibility of the soil at a given site to erosion and other factors. Although erosion along the river varies from place to place over time, it is widely believed to increase during periods of prolonged high discharge.

Irrigation*

The Missouri River provides water for irrigation in this semi-arid region. There is normally ample water available to irrigate thousands of fertile acres of Missouri River bottomland. Without the availability of water, these acres would be committed to dry land crops, thereby producing only a fraction of the value of their current yield. The deposition of sediment and the occurrence of high bank erosion can adversely affect existing water intakes and limit the availability of good intake sites. Both deposition and bank erosion vary for a wide variety of reasons, including water flow. Water intakes between Fort Peck dam and Lake Sakakawea are normally constructed in locations believed to provide long-term use. Due to variation in periodic flows and in associated sedimentation or erosion, water intakes are required to operate within a broad range of conditions.

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* An issue raised during public scoping

Water pumped from the river in the area is used to irrigate hay, barley, sugar beets, oats, and beans (Roosevelt County Conservation District, 2002). A regional water system that would serve the Fort Peck Reservation and most of the non-Tribal lands in Montana north of the Missouri and east of Glasgow is currently being developed, with a proposed intake near the town of Poplar, Montana (ibid).

According to a 1994 survey of water intakes on Fort Peck Lake and the Missouri River below Fort Peck Dam, the following information is available for water intakes:

Table 6. 1994 Survey of Water Intakes

	Municipal	Industrial	Irrigation	Domestic	Public
Fort Peck Lake	1	0	5	101	2
Missouri River	5	4	283	162	1
Tribal Reservation	1	0	94	14	0

A survey of water pumps in the Missouri River below Fort Peck Dam during the summer of 2001 identified 143 pumps; 55 were on the north side of the river and 87 were on the south side (Roosevelt County Conservation District, 2002).

Appendix K contains maps indicating the location of water intakes based on the 2001 survey.

Water Supply*

There are no municipal or rural water district water supply intakes in the immediate vicinity of the dam. Intakes for these purposes are located at Wolfe Point and Culbertson, Montana, and Williston, North Dakota. An intake site for the Fort Peck Indian Reservation Rural Water System, which would serve the reservation and four counties in northeast Montana, has been proposed on the Missouri River near Poplar, Montana. There are also several hundred water intakes for irrigation and domestic uses between Fort Peck Dam and Lake Sakakawea.

Socioeconomic

Region of Influence

The Missouri River below Fort Peck Dam flows through Valley, Richland, McCone, and Roosevelt counties in Montana, and McKenzie and Williams counties in North Dakota.

* An issue raised during public scoping

The socioeconomic background for these counties is displayed for background information, and for consideration with regard to the Environmental Justice executive order.

Population

The year 2000 population and racial composition for the six county region are shown in Table 6. As shown in the table, population has declined during the past decade. In the year 2000, the population of all six counties totaled 55,437. The racial compositions of McCone, Richland, and Valley counties in Montana and McKenzie and Williams counties in North Dakota are predominately white. In Roosevelt County, which includes part of the Fort Peck Indian Reservation, over half of the population is classified as Native American.

Table 7. Population and Race, Ft. Peck Counties, Year 2000

State County	Population Year 2000	Percent Change Since 1990	Population by Race White	Indian	Other	Percent Population White	Indian	Other
Montana								
McCone	1,977	-13	1,917	21	39	97	1	2
Richland	9,667	-10	9,338	145	184	97	1	2
Roosevelt	10,620	-3	4,347	5,921	352	41	56	3
Valley	7,675	-7	6,765	6	904	88	0	12
North Dakota								
McKenzie	5,737	-10	4,440	1,216	80	77	21	3
Williams	19,761	-7	18,358	869	534	93	4	2
Region	55,437	-7	45,165	8,179	2,093	81	15	4

Source: U.S. Census of Population 1990 and 2000.

Employment and Income

The unemployment level is normally a good indicator of the health of an economy. The unemployment level is the percentage of the labor force who are actively seeking employment, but who are not employed. Due to normal job changes and other reasons, full employment is generally believed to exist at about the 4.0 percent unemployment level. In the year 2000, unemployment averaged 4.9 percent in the State of Montana. In McCone, Richland, Roosevelt, and Valley counties it was 3.2, 6.2, 9.5, and 4.1 percent respectively. The unemployment rate for the State of North Dakota was 3.0 percent the same year. In McKenzie and Williams counties, it was 3.1 and 3.6 percent, respectively. The six-county area experienced an unemployment level of 5.1 percent. The Fort Peck Indian Reservation had an unemployment level of 10.8 percent. Reservation unemployment levels are often under-reported because job prospects are frequently so poor that many would-be employees stop registering and are no longer counted. The unemployment rate is also reflected in the income distribution within the area. As shown in Table 7, the Montana counties of McCone, Richland, and Valley and the North Dakota counties of Williams and McKenzie all have similar income levels. The average of the median annual household income for these five counties averaged $31,145 in 1997. Roosevelt had a median income of almost 25 percent less at $23.953. Figures for Roosevelt County, which includes the Fort Peck Indian Reservation, show a high level of persons living below the poverty level and a proportion of persons in this classification twice that of the states of Montana and North Dakota. Roosevelt County has the highest concentration of low income in the six-county region as reflected by the lower median household income and number of persons living below the poverty level. All six counties have lower income and a higher percentage of people living in poverty than the United States as a whole. In 1997 the National median income was $37,005, with 13.3 percent of the population living below the poverty level.

Table 8. Income/Persons Living In Poverty, Years 1997/2000

State **County**	**Median Household Annual Income**	**Persons Below Poverty Level** **Number**	**Percent of Total**
Montana			
McCone	$28,974	285	14.4
Richland	$31,885	1,554	15.5
Roosevelt	$23,953	3,303	31.1
Valley	$29,581	1,382	18.0
State of Montana	$29,672	139,840	15.5
North Dakota			
McKenzie	$32,034	1,124	19.6
Williams	$33,249	2,589	13.1
State of North Dakota	$31,764	80,275	12.5

Note: The persons below the poverty level figures are based on 2000 population counts and 1997 income levels. Accordingly they may be off by a small margin.
Sources: Economic Census 1997. U.S. Census of Population and Housing 2000.

Cultural Resources

Archeologists divide the cultural chronology for the eastern Montana area into several different eras or periods. These include the Early Prehistoric Period, Middle Prehistoric Period, late Prehistoric, the Protohistoric Period, and the Historic Period.

The Early Prehistoric Period (similar to the Paleoindian Period in regions further east) is the time between 11,000 Before Present (BP) to 7,700 BP. The archeological record indicates that these people were big game hunters during the earlier parts of this period and bison hunters during the later parts. Included within this time period are the Clovis, Goshen, Agate Basin, Hell Gap, Alberta, and Cody complexes. Spear or dart points are part of the archeological record from this period.

The Middle Prehistoric Period is described as the time from 8,000 to 1,300 BP. This is synonymous with the Early, Middle, and Late Archaic and early Woodland periods along the Missouri River farther to the east. This period includes Mummy Cave, Oxbow, McKean, Pelican Lake, Yonkee, Sandy Creek, and Besant type projectile points. During this time, people hunted bison and many other species of animals. Late in this time period, pottery becomes part of the archeological record at some sites. The bow and arrow were also invented late in this period.

The Late Prehistoric Period runs from 100 AD to Historic times. Bison hunting was the main means of procurement and communal hunting was practiced. This period is similar to the Late Prehistoric and Protohistoric periods described for the Central Plains.

The Historic Period is marked by written records. The eastern Montana area is inhabited by Gros Ventres (or Atsina), Piegan (or Blackfoot) and Assiniboine. Much later, the Chippewa and Cree people arrived at the Rocky Boys Reservation.
The Historic Period is also marked by the travels of Lewis and Clark up the Missouri River. Much has been written about this expedition in both popular and scholarly journals. The Historic Period also includes the fur trade, ranching, railroads, the homestead era, and the Great Depression. The fur trade is highlighted by the construction of many fur trade posts and forts. Fort Galpin was constructed about 12 miles above the confluence with the Milk River in 1862. Fort Copeland was constructed in 1865 at the confluence of the Milk River and the Missouri. Fort Peck was built in 1866, near the current site of the town of Fort Peck. Fort Peck also served as an Indian Agency from 1873 to 1879. Fort Kaiser was constructed in 1885, immediately downstream from the confluence of the Milk and Missouri Rivers (near the site of the defunct Fort Copeland). All of these fur trade posts were in commission for at least one or two years and a few continued for several decades.

Ranching was also part of the historic era. Cattle and sheep ranchers settled in eastern Montana in the late nineteenth and early twentieth centuries. The construction of the Great Northern railroad in 1887 and the Chicago, Milwaukee, St. Paul, and Pacific railroad in 1905 further emphasized ranching. The railroad companies provided the means for European immigrants to settle much of the land on either side of the route. These companies also encouraged settlement with somewhat exaggerated descriptions of the land in the eastern part of the state. Homesteading began around 1900 and continued with periods of plentiful rainfall until 1916. At that point in time, rainfall amounts declined on the northeastern part of the state and many homesteaders gave up farming for other occupations.

In more recent times, the state was hit with the effects of the Great Depression. To counter unemployment, Roosevelt initiated the New Deal plan. His first big project was Fort Peck Dam which began in 1933. This project provided jobs for many of the unemployed. Workers brought their families, since it was impossible to earn enough money to maintain themselves at the dam site and their family at another location. As a result, many boomtowns sprang up around the dam site. More people arrived than the government had anticipated. Up to 10,000 people were employed, either directly or indirectly, at the height of the construction season. Almost all of these boomtowns are gone and the town site of Fort Peck has decreased to just a few hundred people. Today, the eastern Montana-Fort Peck area is working hard to maintain a viable economy with ranching, farming, and tourism as a basis for economic health.

The reach of the Missouri River downstream from the Fort Peck spillway to the Highway 85 bridge in North Dakota has the potential to contain many types of cultural sites. These could include prehistoric campsites, procurement areas, sacred areas, stone effigies, early fur trading forts, historic homesteads, sites associated with railroads (bridges, abutments, graded lines), and sites associated with farming and ranching.

Although most of the Corps' land surrounding Fort Peck Lake has not been surveyed for cultural sites, known sites consist of lithic scatters, campsites, tipi rings, and historic structures. The townsite of Fort Peck has many buildings that are listed on the National Register of Historic Places (NRHP). As mentioned earlier, Fort Peck Dam and powerhouse are listed on the NRHP. The Fort Peck Dam is under consideration for National Historic Landmark status.

Fort Peck is rich in paleontological remains, including those of world-wide significance such as the *Tyrannosaurus rex* unearthed near Nelson Creek.

The Corps funded a cultural site inventory within the project vicinity, approximately 200 miles of the Missouri River below Fort Peck Dam. The contractor surveyed lands within 150 feet of the Missouri River along both banks in order to identify cultural "features." The "features" of a site help to determine a site's significance with regard to the Natural Historic Preservation Act of 1966. "Features" are specific activity areas which have become part of the historic or prehistoric record. Features include such things as hearths, ash lenses, post molds, cache pits, root cellars, or cairns (a pile of rocks to mark a special area or part of a trail). Many other aspects of a site would qualify as a feature as well: a grain bin, a pump house, a stone or brick walkway, a windmill, a stone circle, or a tipi ring.

Generalized site information can be found in Appendix D.

VI. Environmental Impacts of the Test

This section describes the anticipated impacts to the human environment as a result of the test. Concerns identified in scoping meetings with the public, agencies, and Tribes are indicated with an asterisk (*).

The environmental impacts of the "no action" alternative (not running the test) would be a continuation of the range of conditions presented in the "Affected Environment" section of this EA.

Environmental Impacts

Water Quality

The potential change in ambient Missouri River water quality conditions would be dependent of the difference in water quality conditions between the spillway and powerhouse discharges. It is not expected that the spillway discharge would noticeably affect other water quality conditions, other than temperature.

Changes in Turbidity

Because the mini test is within the range of "normal" flows in a 5-year hydrograph, turbidity changes associated with the mini test volume of flows would not be considered abnormal; therefore, while still a concern by the public, these flows are not significant. In fact, a rainstorm event would likely provide a greater increase in turbidity than the mini test. Table 5 reflects the high degree of variation during a "no test" timeframe.

However, directly across the spillway there is the potential for up to 5 acres of erosion, if a bank stabilization is not built to prevent this erosion (see Executive Summary, "Unresolved Issues"). Turbidity monitoring would be conducted during the mini test to address this concern.

Changes in Water Temperature

Water in the spillway flows about 1½ miles from the lake before it enters the Missouri River approximately 7 river miles downstream of the dam and 1 mile upstream from the confluence of the Milk River.

During the mini test, warmer water from the upper portion of Fort Peck Lake would form a plume[18] as the spillway discharge enters the cooler Missouri River. The Missouri River above the spillway discharge point would be entirely comprised of the cooler water discharged through the powerhouse. The plume of warmer water would not be visible by sight, but may be detected by temperature sensors in the water. Since the spillway flow would be roughly 3 times the volume of the powerhouse flow during the highest spillway

[18] a temporary, concentrated area of unmixed water

discharge, complete mixing would be expected to occur in a reasonable distance downstream, depending on the angle of spillway entry into river and channel morphology. The situation is complicated by the discharge of the Milk River entering the Missouri River approximately one mile downstream of the spillway discharge. Mixing of the Milk River discharge with the powerhouse and spillway discharges (i.e., Missouri River) would be dependent on the magnitude of the discharge of the Milk River and channel conditions at the confluence of the Milk River. A plume of Milk River water should form along the north bank of the Missouri River until complete mixing occurs. The USGS maintains a gage on the Milk River at Nashua, Montana (near the mouth of the Milk River). The period of record for this gage is 1940 to present. Based on 1940 to 2000 flow measurement records, the monthly mean streamflow at this gage for May and June is 1,026 cfs and 960 cfs, respectively.

The methodology to project the potential temperature increase resulting from the mini test consists of a "mass balance" calculation, taking into consideration the volume of "warm" water from the spillway and the volume of "cool" water being discharged from the powerhouse. Initially, a plume of warmer water would enter the Missouri River water from the spillway. At complete mixing (disregarding heat radiation, spring inflows, etc.) a weighted mass balance of temperature among the three flows (spillway discharge + powerhouse discharge + Milk River discharge) would be a rough estimate of ambient river water temperature -- [(11,000 cfs x spillway temperature) + (4,000 cfs x powerhouse temperature) + (960 cfs x Milk River temperature /15,960 cfs]. The "ambient" or existing water temperature achieved downstream of the Milk River will be dependent on the amount of flow coming in from the Milk River, its temperature, and the water temperatures of the spillway and powerhouse discharges. The greater the difference in water temperature between the spillway and the powerhouse and the lesser the flow of the Milk River, the greater the increase in ambient water temperature of the Missouri River below the confluence of the Milk River. Other parameters that could affect the resulting temperature include solar radiation (number of sunny days during June), air temperature, groundwater inflow and temperature, and rainfall events.

The number of data observations for Fort Peck Lake surface water temperatures is limited – 9 and 11 observations for the months of May and June. In comparing the powerhouse and lake surface water temperatures for the months of May and June, it can be seen that the lake surface is only marginally warmer for the month of May, but significantly warmer for the month of June. Using the mass balance equation (11,000 x 60 degrees F) + (4,000 x 54 degrees F) + (960 x 65 degrees F)/(15,960), calculated June water temperatures would be 59 degrees F at Frazier Rapids. This temperature is about 4 degrees F higher than the measured water temperature at Frazier Rapids during 2000 and 2001. However, this temperature is still below the targeted temperature from the Opinion.

Appendix F indicates the predicted <u>maximum</u> water temperature increase due to the mini test, based on an 11,000 cfs discharge down the spillway as well as the predicted <u>minimum</u> water temperature increase due to the mini test, based on a 4,000 cfs discharge down the spillway.

Consistency with Water Quality Regulations

Usually, water is discharged through the powerhouse and is not released over the spillway except during flood events. Dam operations are considered "natural" with regard to water quality regulations since these laws were enacted after the dam was in place. However, if the predicted water temperature increase was not in conjunction with dam operations, then a temperature increase could be in conflict with State and Tribal water quality regulations. For instance, if the temperature goals of the Opinion cannot be met through changes in the operation of the dam (e.g., if water needs to be heated before being discharged, or other means such as ponding would be pursued), then additional coordination with the State and the Tribes would be needed before implementation.

A clarification of the application of the State of Montana's water quality laws and regulations regarding the potential increase in water temperature due to a purposeful spillway discharge is being pursued with the Montana Department of Environmental Quality (MDEQ). A copy of that letter, dated December 20, 2001, can be found in Appendix F. A clarification of the application of the Tribes' water quality standards to the Fort Peck mini test is also being pursued with the Assiniboine and Sioux Tribes Office of Environmental Protection in a letter dated December 21, 2001. This letter can also be found in Appendix F.

The National Academy of Sciences report referenced a legal case that indicated that dams are not considered as "point sources" with regard to Clean Water Act regulations (National Wildlife Federation v. Gorsuch, 693 F. 2d 156, D.C. Cir. 1982 in National Academy of Sciences, 2002).

Lake Levels*/Discharge Volume[*]

The 1967-2000 June average daily release from Fort Peck is 10,500 cfs or 625,000 acre-feet. Should Upper Quartile runoff occur in 2002, the forecasted Fort Peck June release is 8,500 cfs or 506,000 acre-feet. If the mini test is conducted entirely in June, the average release for the month is 12,800 cfs or 762,000 acre-feet. Therefore, an additional 256,000 acre-feet would be released as a result of the mini test and Fort Peck Lake would be at elevation 2234.7 feet msl on June 30 compared to elevation 2235.9 feet msl if the mini test is not conducted. This would result in an elevation decline (or a slowing of the rate that the lake level increases) equal to 1.2 feet.

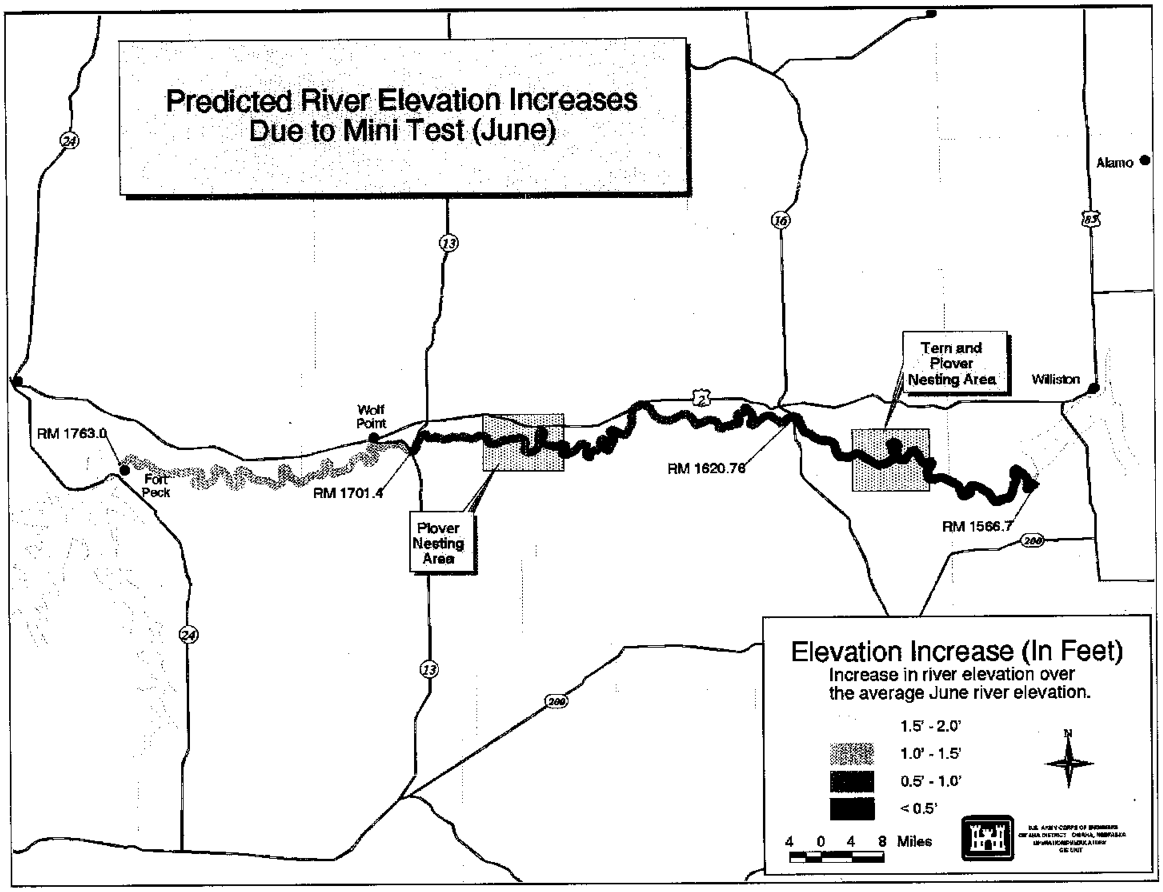
River Elevation and Flooding*

Although spring flooding and high water tables are problems along this reach of the Missouri River, the test should not greatly increase either (project increase in river elevation of approximately 1.5 feet for most of the reach). As indicated previously, the flow would be that which normally experienced or exceeded every two or three years with normal discharges. In the event of an unusually high flow on the Yellowstone

[*] An issue raised during public scoping

River, the test can be stopped to avoid adverse impacts.

Map 4. Anticipated River Elevation Increase due to Mini Test



Drought*

The mini test would not occur during a drought year, since a lake elevation of 2,230 feet msl is needed to proceed with the test. Therefore, the mini test would not exacerbate problems associated with drought.

Wetlands

Fort Peck Lake Wetlands

The discharge of water associated with the mini test would likely result in an ending June lake elevation 1.2 feet below what would be expected if the mini test didn't take place. Since the exposed shorelines along Fort Peck Lake are not prone to lush stands of wetland vegetation and since the elevation decrease is temporary, there would be no impact on wetland vegetation within the lake. Much of the lake shoreline is currently not suitable for wetland development for various reasons (soil type, wind-wave action, "normal" lake fluctuation). In other reservoirs, however, when lake levels are temporarily reduced, plant establishment along the shoreline is anticipated.

Wetlands in the Missouri River below Fort Peck Dam

The river elevation is expected to increase up to 1.5 feet in conjunction with the mini test, tapering to a lesser amount as the water moves downstream into wider river segments. River wetland communities have experienced changes in river elevation in the past and can tolerate these temporary changes in elevation. The additional water may act to facilitate additional temporary wetland growth along the river banks.

*Mosquito Control**

A concern was expressed by the public that the additional water would increase mosquitoes as a result of an increase in watered areas suitable for breeding. Since the mini test consists of discharges seen every 2 or 3 years and the overall water volume remains the same (the amount of water added to the river during the mini test = the amount of water leaving the lake during the mini test), the mosquito population in the project area (Fort Peck Lake + Missouri River below Fort Peck Dam) would not be affected by the mini test.

An increase in mosquito population is more likely due to an increase in overall precipitation (more water in the lake + more water in the river) where there is an increase in overall wet areas in the region.

Cottonwood Forest

Fort Peck Lake

The lake level drop of 1.2 feet during the month of June would have no affect on cottonwood survival or health. Cottonwoods are river pioneer species that have evolved to survive water elevation fluctuations, especially temporary fluctuations. Additionally, Fort Peck Lake fluctuates routinely (currently, the lake is over 14 feet below "normal" elevations).

Missouri River below Fort Peck Dam

The increase in river elevation from 0 to 1.5 feet above "normal" during the month of June will allow for an additional wet area along the root zone of the riparian corridor. This may trigger additional cottonwood regeneration, should a sufficient seed bank be available. Since the depth increase is temporary and is within the range of normal river elevation fluctuation, there would be no adverse effects to mature cottonwood forests.

* An issue raised during public scoping

Fisheries

Fort Peck Lake

The anticipated differential in the lake (1.2 feet lower than without the mini test) is not expected to have an adverse effect on the Fort Peck fishery. This decline is within the range of "normal" lake fluctuations over time and is much less than that seen during drought (currently the lake is over 14 feet below "normal").

Although wetland development along the shoreline of the lake is not anticipated, if wetlands (or terrestrial plants) would form along portions of the exposed shoreline, then that plant development would likely benefit fish when lake elevations increase and flood the vegetated shoreline. Submerged plants add nutrients to the water, provide a substrate for certain aquatic invertebrates, provide spawning substrate for vegetation-spawning fish, and provide cover for young fish.

The potential loss of lake fish over the spillway during the mini test will be monitored via the installation of a fish net across the spillway. By monitoring fish captured in the net during various spillway discharges, as well as the difference in fish numbers captured in the spillway pool while the net is up versus while the net is down, an approximate number of fish loss (if apparent) can be estimated to determine the scale of this concern.

Missouri River below Fort Peck Dam

Due to the minor warm-water discharge increase associated with the mini test (maximum 11,000 cfs down the spillway) and the resulting size of the temperature plume after dilution with colder Missouri River water at the spillway confluence, the warmest water (up to 4 degrees F increase) is not expected to continue downstream as far as the Yellowstone River confluence area. Therefore, impacts to paddlefish leaving a successful spawning area as a result of the mini test are unlikely. Impacts to paddlefish resulting from larger (or warmer) discharges resulting from the full test or implementation of an ongoing flow modification regime is outside the scope of this EA.

Radiotagged paddlefish are included in the Fort Peck data collection plan, and movement information from the mini test, as well as additional temperature information, will assist in better predicting the likelihood of a movement response in Yellowstone River paddlefish for future flow-related actions.

Threatened and Endangered Species

The U.S. Fish and Wildlife Service has already considered the biological effects of the mini test in the development of the Reasonable and Prudent Alternative for the Opinion and determined that the mini test is an integral component of the Fort Peck flow modifications to avoid jeopardy to listed species. Therefore, the Corps is not required to prepare a Biological Assessment (BA) for this action (U.S. Fish and Wildlife Service letter, February 20, 2002). However, for the purposes of NEPA, this EA discloses the effects/benefits of the mini test on endangered species.

Black-footed Ferret

Since the black-footed ferret is a terrestrial animal and the Fort Peck mini test does not affect terrestrial areas, there would be no adverse affect on black-footed ferrets.

Bald Eagle

Since cottonwood forests are not adversely affected by the proposed mini test, there would be no adverse affect on bald eagles.

Piping Plover

To avoid piping plover impacts, a survey of the river would be needed before June 1 to ensure no nests have been initiated within 1.5 feet of the water surface elevation. The projected river increase of 1.5 feet in the area of highest nest concentration (RM 1670 – 1690) would likely prevent new nest formation due to the resulting wet sand. Nests would be monitored, and any eggs at risk would be relocated. As a result of the higher water, some vegetation scour could occur on lower portions of some existing islands.

Potential impacts to the piping plover would be avoided by monitoring low elevation nests and, if necessary, collecting eggs for transport to the hatchery at Gavins Point Dam if water levels become threatening. The Corps already has an endangered species collection permit under which eggs at risk could be collected and relocated, if needed (see Appendix E).

The drop in lake elevations of 1.2 feet due to the mini test could provide additional nesting substrate during the mini test.

Least Tern

To avoid least tern impacts, a survey of the river would be needed before June 1 to ensure no nests have been initiated within 1.5 feet of the water surface elevation. The projected river increase of 1.5 feet in the area of highest nest concentration (RM 1670 – 1690) would likely prevent new nest formation due to the resulting wet sand. Nests would be monitored, and any eggs at risk would be relocated. As a result of the higher water, some vegetation scour could occur on lower portions of some existing islands.

Potential impacts to the least term would be avoided by monitoring low elevation nests and, if necessary, collecting eggs for transport to the hatchery at Gavins Point Dam if water levels become threatening.

The drop in lake elevations of 1.2 feet due to the mini test could provide additional nesting substrate during the mini test.

Pallid Sturgeon

The mini test is not expected to have a negative effect on pallid sturgeon and, in fact, may have a slight positive effect on pallid sturgeon movement upstream into the Missouri River due to temperature increase resulting from the mini test (up to 4 degrees F). The primary benefit resulting from the mini test is the standardization of collection and tracking methodology prior to the implementation of the full test. The likelihood for pallid sturgeon movement responses is greatest immediately downstream from the spillway area (potentially the highest water temperatures); however, the majority of pallid sturgeon would already have moved into the Yellowstone River by June, based on previous movement studies (Tews 1994; Bramblett 1996) and therefore would not receive any benefits from the mini test. It is expected that the warm water "plume," if any, would not extend far enough downstream to serve as an attractant force for the Yellowstone fish. However, the Fort Peck data collection plan, especially the movement information, could provide movement data for confirming or refining this expectation for the mini test, as well as better predicting any movement expectations during the full test.

Socioeconomic Impacts

Recreation

Fort Peck Lake

Water based recreation at the lake is dependent on a sufficient water level. Low water or drastic changes in water elevation can affect the quality and quantity of recreational activity. High inflows to the reservoir normally occur in late May and the month of June. These flows are the results of snow melt in the mountain within the basin. This period overlaps the scheduled test. The lake level would normally be increasing during this period. The test release of water, in addition to the amount normally discharged, would attenuate the normal increase to some extent. Accordingly, water levels may be slightly lower than would otherwise be experienced (a decrease of 1.2 feet); however, current water levels are over 14 feet below what is considered "normal." A reduction of 1.2 feet would have a negligible effect on Fort Peck Lake, which normally experiences annual and periodic fluctuations of a much greater magnitude. In the event water levels are low due to drought or for other reasons, the test will be postponed, as was done in the year 2001. No major fluctuation in lake level is anticipated and accordingly, no appreciable negative impact to lake recreation is foreseen.

Missouri River below Fort Peck Dam

The increased discharge from Fort Peck Dam resulting from the test is well within periodic flows equaled or exceeded every two or three years. No change in the type, quality, or quantity of river recreation below the dam is anticipated as a result of the test. Some fishing activity may move in response to water levels or changes in conditions advantageous to this activity and an increase in sightseeing as a result of spillway operation is likely. Neither is considered to be a significant impact.

Fort Peck Reservation

No change in the type, quality, or quantity of river recreation along the Missouri River shoreline within the Fort Peck Reservation is anticipated as a result of the test. Some fishing activity may move in response to water levels or changes in conditions advantageous to this activity, and an increase in sightseeing as a result of spillway operation is likely. Neither is considered to be a significant impact.

Hydropower*

During the mini test, a portion of the discharges from Fort Peck would be released through the spillway (up to 11,000 cfs) while maintaining a constant 4,000 cfs release from the powerplants. To the extent water is spilled, which would otherwise be used to generate electricity, the amount of energy generated during the test would be diminished. The amount of energy lost depends on the water level of the lake at the time of the release. More potential energy is lost at higher lake elevations due to the increased head at the powerplants.

Preliminary 2003 - 2004 Annual Operating Plan Simulations using the Current Water Control Plan indicate Fort Peck Lake would be at an elevation at which spillway releases could be made in June 2005 if upper quartile or greater runoff occurs during the next two years. A 13,000 cfs release would be required in June, July, and August 2005 to lower Fort Peck Lake to elevation 2234 feet msl (base of annual flood control pool) by March 1, 2006.

The Fort Peck mini test releases as specified in an August 28, 2001 clarification letter from the Omaha District would average 12,800 cfs in June. Therefore, the mini test would not change forecasted monthly releases from Fort Peck in 2005. The energy loss due to spillway releases would be 56 gigawatt hours (GWh) in June and 5 GWh in July 2005, reflecting the termination of spillway releases on July 2.

WAPA estimates the market value of energy in June and July 2005 at $56 per megawatt hour. The loss in energy generation is $3.4 million.

The test flow would result in a 61 GWh loss of energy. This was about 1 percent of the power generated by the main stem system during FY 2002 and 1 percent of the energy forecast to be generated during the affected period. A change of this magnitude can easily be picked up by another part of the power grid, provided other generating elements are readily available and not already working at capacity. A factor that could greatly increase the severity of this loss would be an energy shortage.

* An issue raised during public scoping

In the event there would be an energy shortage in an area impacted by the reduction in power production due to the spillway flow test, the test would be discontinued to prevent exacerbating the problem. The financial loss resulting from lost sales would be relatively small, being about 2 percent of annual sales and would not greatly affect WAPA or its service area. For these reasons, the loss of energy generation resulting from the proposed action is not considered to be significant.

Riverbank Erosion*

General Erosion

Downstream erosion to farmland, irrigation pump sites and resulting sedimentation are normal occurrences on the Missouri River. Since the test flow is of a magnitude which is met or exceeded by normal flows in a period of 2 to 3 years, average erosion rates within the Missouri River are anticipated during the test; however, site-specific erosion locations may vary.

Erosion Across from the Spillway

Erosion is normally not a problem across from the spillway outlet due to the infrequent use of the spillway. However, erosion could occur in this area as a result of spillway discharge. Because the spillway flows would not be accompanied by full powerhouse releases (as would occur during a flood event), the erosion in the immediate vicinity of the spillway could vary from erosion associated with a spillway discharge during a flood event. This could create an adverse impact to irrigation water intakes and pump sites located on land directly across from the spillway. To avoid potential adverse impacts, the water intakes could be moved or modified in such a manner as to allow their continued use during the test. The Corps evaluated alternative methods of protecting these intakes, including bank stabilization and intake relocation. Any modification to the site would be done only with landowners' consent and associated easements.

A site visit was conducted in November, 2000 and field data was collected and recorded including soil conditions and properties, pump site locations, and physical properties of the river. An estimated erosion rate was calculated by assuming that spillway flows would remove the toe[19] material from the bank. Bank failure would occur at the rate required to replace the eroded toe material. Based on this analysis, approximately 70 feet of bank loss (approximately 5 acres) could occur during the mini test (USACE, 2001c).

If a bank stabilization structure would be constructed, erosion would be prevented during the mini test, as well as for the full test (and potential future operational changes involving spillway flows).

Another option to the landowner would be to request that a sloughing easement be purchased by the Corps prior to the erosion. This would not prevent the erosion from

[19] supporting base

occurring, but would compensate the landowner in advance for the risk and likelihood of erosion due to the mini test.

Regardless if the potential erosion problem is resolved or not, the amount of erosion and the potential loss of irrigation pump sites (and associated economic impacts) are not considered to be an impact of regional significance, although the impacts may be locally important to the landowner.

Erosion downstream from the Spillway

Numerous studies of Missouri River bank erosion downstream from Fort Peck Dam have been conducted. One recent study was prepared for the Coordinated Resource Management Group - Lower Missouri River CRM (USDA, 1999). A second recent study was prepared as part of the Missouri River Master Water Control Manual review and update study (U.S. Army Corps of Engineers, 1998). The two studies present many conclusions regarding historic and future Missouri River bank erosion trends. Analysis conclusions regarding bank erosion causes and future trends are conflicting between the two studies. The studies and available data demonstrate that existing conditions are unstable and that erosion is occurring in the pre-test condition.

Assuming that the annual erosion rate is directly correlated with the annual flow volume, then the proposed test release would have no impact on the average annual erosion rate.

Because the volume of water discharged during the mini test would be "corrected" by the discharge of lesser volumes of water during the fall, the net annual discharge of water from Fort Peck Dam should still remain constant. As such, annual erosion of riverbanks below Fort Peck Dam (with the exception of "force" erosion across from the spillway) should also remain within the annual average within the reach.

Missouri River erosion processes are complex, and the mechanisms that cause erosion are often site-specific. If only the test flow time period is considered, erosion impacts of the test flow are difficult to quantify. The recommended approach is to perform monitoring during the test as described in the Bank Erosion Monitoring section found in Appendix E.

Since the annual erosion rate for the reach is expected to remain the same, erosion is not considered a significant impact of the mini test.

Irrigation*

Missouri River intakes

Water intakes are currently subject to periodic high and low flows and subsequent problems. Generally, the discharge from the dam for the mini test is within the range of normal periodic high flows, occurring on the average every 2 or 3 years. This document discloses the increase of river elevation of approximately 1.5 feet during the month of June (should a test occur) which allows the landowners time to make accommodations, if needed. No problems to downstream irrigation are anticipated as a result of the test.

The Roosevelt County Conservation District (RCCD), under contract to the Omaha District Corps of Engineers, gathered a variety of data on intakes along the Missouri River from Fort Peck Dam to the Montana-North Dakota border. The RCCD completed a report entitled "Inventory of Pumps and Intakes on the Missouri River Between the Fort Peck Dam and the North Dakota Border", February 19, 2002. Participation by pump owners in the inventory was very strong. The 143 pumps surveyed are believed to comprise the vast majority of pumps being used in the project area. Of the 143 pumps, 55 pumps were on the north side of the river and 87 pumps were on the south side. These pumps are used to irrigate 56,415 acres of cropland. The deliverables from this report include the data input forms used in the inventory as well as related photographs, AutoCAD products, and maps. The RCCD also provided an estimate of the number of pumps/intakes impacted at river discharges of 15,000 cfs to 70,000 cfs in 5,000 cfs increments. This estimate was not a deliverable required by the contract and did not include a detailed explanation of the criteria for determining impacts. Since a Fort Peck Dam release of 15,000 cfs is within the limits of the current water control plan, and since the maximum discharge for the mini test is 15,000 cfs, there is no evidence to indicate mini test impacts beyond normal operations. Therefore, these estimates of impacts were not considered relevant to this EA.

Directly across from the spillway

The water discharged from the spillway would enter the river at a different location than that normally discharged through the powerplant. Due to the direction and magnitude of this discharge, erosion is likely to occur directly across from the spillway which could impact water intakes servicing approximately 1,200 acres of irrigated farmland. The magnitude of the problem would be dependent on the extent of the erosion and the likelihood of temporarily or permanently relocating the water intakes. Although a potentially major loss to the landowner, the loss of irrigation at this site is not considered to be a significant impact on a regional or National basis.

* An issue raised during public scoping

Water Supply*

Missouri River intakes

The discharge required by the test is within normal flow levels experienced or exceeded every two or three years in this reach of the Missouri River. For this reason no abnormal impacts to existing or proposed municipal, rural water district, irrigation district, or to any individual irrigator or domestic intakes are anticipated as a result of the flow test. Turbidity levels are not expected to exceed normal levels, therefore treatment costs are not expected to increase significantly. With regard to the reduced amount of water stored at the reservoir, because of the limitations placed on the availability of water for discharge, no loss of water required for domestic water supply is anticipated.

Immediately downstream from the spillway

If the mini test proceeds without the construction of a preventative bank stabilization project (under the Corps' Section 33 program), then the erosion of up to 5 acres of land directly across from the spillway could temporarily increase turbidity levels in the vicinity of the spillway and immediately downstream from the spillway. There are irrigation intakes in the vicinity of the spillway (one across from the spillway, and two downstream from the Milk River), but no water supply intakes near the spillway or immediately downstream from the spillway. The temporary, localized increase in turbidity is not considered significant.

Environmental Justice Determination

The areas most impacted by the flow test are directly downstream from the spillway. The closest concentration of minority and low-income groups that could potentially be impacted by the proposed action are on the Fort Peck Reservation. This reservation is located on the left bank of the Missouri River, which serves as its southern boundary. The reservation starts approximately 5 miles below the dam and extends along the river a distance of about 80 miles. To the extent the reservation has a greater concentration of Native Americans than the state as a whole, the potential for disproportionate impacts to this minority group was evaluated. However, because no adverse bank erosion impacts are anticipated this far downstream as a result of the test, there would be no disproportionate impacts to minority or low-income groups.

The area most impacted by the flow test is directly across from the spillway. These impacts do not affect Roosevelt County or the Fort Peck Reservation. Since there are no adverse impacts in that county or on the Reservation, no disproportionate impacts to minority or low-income groups are anticipated.

Cultural Resources Impact Analysis

The Missouri River meanders considerably below Fort Peck Dam. High cutbanks exist on the outside bends of the river, and erosion in these areas is active. Assuming that the

Table 9 - Cultural Site Analysis

Site Number(s)	Site Description	NHRP	NHRP eligible	State	Not Impacted	Monitoring Recommended	Comments
24DW287 24RL204 24RL300 32MZ1174	Lower Yellowstone Irrigation Project		X	MT	X		
24MC1	bison processing site		X	MT	X		
24MC97	remnant of the Great Northern Wiota to Fort PEck railroad		X	MT	X		located 49 feet above water level
24MC29 24VL590	Fort Peck Dam	X		MT	X	spillway monitoring	includes powerhouse, spillway, intake tunnels, and gatehouses
24RL246	Carlisle bison processing site		X	MT	X		site already documented, but not relocated during 1992 inventory.
24RL247	Gallinger Ditch			MT	X		not eligible for NHRP
24RL248	two hearths, bison processing, foundation		X	MT	X		stabilized for erosion control
24RL86 24RL211	Snowden Bridge	X		MT	X		bridge is no longer in use
24RV50 32WI17	Fort Union Trading Post	X		MT	X		
24RV438	Lewis and Clark Bridge	X		MT	X		a.k.a. Wolf Point Bridge or Macon Bridge. Still in use.
24VL1345	historic material scatter and terraces			MT	X		not eligible for NHRP
24VL1686	barge and slipway structure		X	MT	X		
24MC401	Barge		X	MT	X		
24MC402	prehistoric site		X	MT	X	X	
24MC403	prehistoric site		X	MT	X		
32MZ58	Mondrian Tree Site		X	ND	X		Impacted by pipeline construction
	Fort Buford		X	ND	X		
32WI156	Buford-Trenton irrigation canal and pumping station		X	ND	X		
32WI904	House and associated outbuildings				X		House dates from 1908-1918 but not on original location. Moved.

annual erosion rate is directly correlated with annual flow volumes, then the proposed test releases would have no impact on the average annual erosion rate. Therefore, no increase in annual erosion rates is anticipated as a result of the mini test. Areas currently experiencing erosion would continue to have erosion with or without the mini test. Impacts of altered Missouri River flows on bank erosion rates are discussed in the "Cumulative Erosion Impacts Analysis" (U.S. Army Corps of Engineers, 1998 a, 1998 b and 1998 c).

Without additional erosion, there would be no anticipated impact to cultural sites along the riverbank (see Table 10). Therefore, no impacts to cultural sites or TCP's is expected as a result of the mini test. Concurrence letters from the Montana State Historical Preservation Officer (SHPO) and the North Dakota SHPO are included in Appendix D.

Tribal Issues Impact Analysis

The following are issues/concerns raised by the Fort Peck Tribes during the consultation process. The Fort Peck Tribe concerns address the full spectrum of the "mini test," "full-test," and "implementation." The issues/concerns mainly deal with the "full-test" and "implementation" but are listed as an indication of their concerns.

1. The Fort Peck Tribe states there has been no substantive consultation nor coordination on the "Fort Peck mini test" or the "Fort Peck full-test."

Corps update: The Omaha District of the Corps of Engineers' understanding of this issue is that the Corps has not provided "plans" of action for the issues the Tribe has raised. The Corps has met, listened, and addressed the concerns with the Tribe. The Corps has not decided on the appropriate plan for these concerns at this time. However, actions have been taken to investigate or address the Tribe's concerns.

2. The Corps of Engineers must provide the Tribe with a plan for protection of the intake site including related facilities in the flood plain of the Missouri River, a plan for mitigation and/or replacement of facilities stemming from the full-test, and any proposed change in operating procedures at Fort Peck Dam to accommodate a future, artificial spring rise. The plan for mitigation and/or replacement of facilities must address a mechanism for financing repairs and/or replacement of the intake and related facilities through funds available from the Corps of Engineers or Federal entities other than the entity established for the operation, maintenance, and replacement of the Fort Peck Reservation Rural Water System.

Corps update: Regarding protection of the intake for the Fort Peck Reservation Rural Water System, it is the Corps understanding that the details of the design for the intake are not available at this time, so an analysis of damage is not possible. However, based on our current knowledge, no overall damages to Tribe facilities from any of the flows is foreseen to be greater than the current operating plan.

3. The Corps of Engineers must likewise provide the Tribes with a plan for funding the additional costs of treating Missouri River water to remove enhanced levels of suspended solids at the water treatment plant for the Fort Peck Reservation Rural Water System.

Corps update: At this time, it is not known that treatment cost above the cost associated with the current river operating plan exist. The Fort Peck Tribes Total Sediment Transport Monitoring plan will be submitted to the Corps Strategic Planning Committee for consideration.

4. The Corps of Engineers must provide the Tribes with a plan for protection/mitigation/replacement/funding of existing intake sites along the north bank of the Missouri River for the Fort Peck Irrigation Project and for other intakes for irrigation or other purposes, including new tribally-proposed irrigation intakes, within the boundaries of the Reservation.

Corps update: The need to protect sites has not been established. The Corps has contracted for an inventory of pumps and intakes on the Missouri River below Fort Peck Dam with the Roosevelt County Conservation District. As a part of the "mini test" and "full-test," it is anticipated that revised river profiles will be established.

5. The Corps of Engineers must provide an analysis of the impact of the mini test, full-test, and any future operational changes at Fort Peck Dam on the erosion of the north or left bank of the Missouri River. The analysis should include the impact of future operations on the mechanisms of accretion and avulsion and the impact of future operations on changes in ownership that might be caused by movement of the banks or channels of the Missouri River. The analysis should also include the impact of future operations of the elevation of the bed of the River as a result of aggradation or degradation. The analysis should provide maps of the Missouri River Valley between the east and west boundaries of the Fort Peck Indian Reservation outlining the soil types, geologic anomalies and any other factors that will permit definition of areas more susceptible to erosion and areas less susceptible to erosion. The analysis must provide conclusions with respect to means of compensating landowners within the Fort Peck Indian Reservation for loss of land whether those landowners are the Tribes, allottees, or private owners.

Corps update: The Corps does not have knowledge of any overall long-term changes to the erosion on the Missouri River caused by the mini test. To address continued local interest groups and Tribe concerns, the Corps has added three erosion monitoring sites in addition to the existing system for evaluating erosion. A new aerial photograph of the Fort Peck reach of the Missouri River was taken in the fall of 2001. The U.S. Department of Agriculture (USDA), Agriculture Research Service (ARS) has performed some independent work and to our understanding has recently provided a report to the local Coordinated Resource Management Group (CRM). In regard to compensating landowners, the only known method of compensation is the Missouri River between Fort

Peck and Gavins Point Project (Section 33). Section 33 has provisions which may limit its applicability to the Tribe's concerns.

6. The Corps of Engineers must provide a plan for review by the governing body for assurances of safety during testing and future operations. The plan should address, among other things, the methods of notification and warning before and during testing or operating procedures to artificially produce a spring rise. The plan should acknowledge and address warning and safety procedures for cultural and spiritual ceremonialists, recreationists, landowners, wood gatherers, hunters, fishermen, and others, that would normally occupy the River, its banks, and its flood plain. The plan should also address the potential for rainfall and/or snow melt events in the Missouri River Basin above Fort Peck Dam, such as the 1948, 1952, and 1964 events, and a loss of flood control capability due to revised operational procedures to maintain reservoir levels at or near spillway elevations in the May/June period in order to accomplish the release of water from the spillway for an enhanced spring rise. The plan should also address any known concerns with regard to the capability of the spillway to perform properly during the mini test, the full-test, or during future operations.

Corps update: The Corps appreciates and acknowledges the concern for those people who are using the river during the "mini test." The releases will increase gradually. An outline for the draft safety plan has been developed and will be completed prior to the mini test. This safety plan will be finalized prior to implementation of the "mini test." The spillway is completely safe for all actions associated with the "mini test" and "full-test." To assess long term effects of future operations, an engineering consultant has completed preliminary instrument installation in the spillway. The consultant will do additional preliminary analysis and additional testing during the mini test and full-test.

7. The Corps of Engineers must provide a plan for review by the governing body for the protection of human remains, cultural, historical, and archeological resources known to exist in the Missouri River Valley and that may in the future be exposed by testing and/or future operating procedures.

Corps update: At this time, the Corps has no knowledge of any change to the impacts on human remains, cultural, historical, and archeological resources as a result of mini test actions. The Corps contracted with the Fort Peck Tribes for a Cultural Resources Inventory and Traditional Cultural Properties Inventory. Given the mini test will not be performed until June 2005 at the earliest, additional information may be available to determine the amount of monitoring of possible erosion of potential cultural sites necessary.

8. The Corps of Engineers must clearly present a report to the governing body on the benefits to the Tribes, their lands, and their resources of the proposed revisions in operations of Fort Peck Dam. The report must address economic, environmental, and cultural benefits.

Corps update: A report which addresses the benefits to the Tribe has not been provided, but the following are some of the benefits the Tribes can expect to receive:

Economic Benefits
The Tribes have a contract with the Corps to conduct Cultural Resources Inventory, Traditional Cultural Properties, and cottonwood forest surveys.

Environmental Benefits
The Tribes and public in general benefit from the protection to the pallid sturgeon, the least tern, and piping plover resulting from the Endangered Species Act (ESA). This protection may also benefit other native fish.

Cultural Benefits
Additional information will be available to the Tribe regarding Cultural Resources Inventory, Traditional Cultural Properties, and cottonwood forests surveys.

9. The report must also address the impact of the mini test, full-test, and any future operational changes on aquatic habitat, riparian habitat (with special attention on our cottonwood forest), endangered or threatened species and upon species that are not threatened or endangered.

Corps update: The Corps contracted with the Fort Peck Tribes to perform an initial cottonwood forest survey as a part of the Cultural Resources Inventory.

10. The report must address the impact of changes in operation of Fort Peck Dam on hydropower resources of the Eastern Division of Pick-Sloan and, more specifically, on the resource pool which the Fort Peck Assiniboine and Sioux Tribes will receive Federal power at preference rates beginning January 1, 2001. The report should provide the Tribes with an assessment of the financial impact of operational changes on the Tribes' hydropower allocation as well as the financial impact on the Tribes from any other positive or negative changes.

Corps update: This EA addresses general hydropower impacts associated with the mini test. It is our understanding that the mini test would not impact the Tribes' hydropower allotment, since Pick-Sloane allocations are generally based on firm kilowatt hours, not a percentage of the total produced.

11. The Corps of Engineers must prepare and present a detailed plan to establish field baseline conditions and thereafter to monitor changes in the field to the river banks, the river bed, suspended sediments, bedload, aquatic habitat, riparian habitat, and other resources and facilities. The plan should describe how changes caused by revised operating procedures will be determined (relative to historic operating procedures) and how those determinations of marginal changes will be used to define damages, mitigation requirements, and compensation. Independent investigations have been undertaken by the tribes on the increase in suspended sediments that may be expected as a result of the spring rise. Those investigations

conclude that a 7 percent increase in suspended sediment can be expected with a change in flows from the historic pattern to the proposed pattern with spring rise. This is of significant concern and interrelates with aggradation, degradation, bank erosion, riparian habitat, and other resources. The Tribes are willing to share this analysis with the Corps of Engineers given a showing of attention to our concerns.

Corps update: The Corps acknowledges the Tribal concern for the river and the associated environments. The Fort Peck Tribe's Total Sediment Transport Monitoring Plan proposal will be submitted to the Corps Strategic Planning Committee for consideration. New aerial photography of the Fort Peck reach of the Missouri River was taken in the fall of 2001. Other monitoring and data collection plans (e.g., fisheries, erosion, etc.) can be found in Appendix E.

Relationship between Short-term Uses and Long-term Productivity

The short-term use of 256,000 acre-feet of water from Fort Peck Lake for a mini test would have a temporary and insignificant effect on hydropower productivity. Water in the lake is a renewable resource dependent on precipitation. The effect of the mini test on long term productivity is insignificant.

Irreversible and Irretrievable Commitments of Resources

The impact analysis resulting from the commitment of water resources for the test is described above and is insignificant. The use of water for the mini test would be irretrievable for this water season, but is retrievable over time through precipitation.

In the absence of a bank stabilization structure across from the spillway, the potential for the direct erosion of up to 5 acres of farmland across from the spillway would be irretrievable for that site. If that site contains sands and other heavier materials, those could form islands or accretion lands at some unknown point downstream. Even so, the erosion would not be significant for the region.

Cumulative Impacts

This section discusses the cumulative or additive impacts and benefits of this mini test with reasonably foreseeable future actions, as well as past actions within the same general area.

There is a likelihood that a full test of flows involving a Fort Peck spillway discharge could occur in the near future, since the full test, like the mini test, is identified in the Opinion as a needed task. It is currently unknown on how these tests would influence future flow management out of Fort Peck Dam. The Master Manual addresses flow alternatives based on the data known to date, and future flow changes, if any, would be addressed through annual AOP meetings and coordination.

The cumulative effect of these actions, in addition to the mini test, could result in warmer Missouri River water during the month of June (and possibly continuing into the summer) during years with flow modifications. This could positively benefit the pallid sturgeon and potentially lead to natural spawning in the Missouri River below Fort Peck.

The cumulative effect of these same actions on native paddlefish, however, was an expressed concern and is unknown. Paddlefish have been tagged and will be monitored for movement to determine if the warmer water compels them to abandon the Yellowstone River (where they successfully spawn) and enter the Missouri River. The incremental temperature increase of the mini test is the smallest of the three actions, and it is not likely to alter paddlefish movement.

The cumulative effect of the flow modification actions on erosion rates is expected to be within the ranges of annual erosion. Erosion across from the spillway (in the absence of bank stabilization) could be locally important, but not a significant impact at the regional scale.

The cumulative effects of flow modification actions and the potential to affect recreation, especially that associated with the Lewis and Clark Bicentennial from 2004 - 2006, would depend on the timing of the flow modification actions. The mini test is scheduled in June of 2005 if sufficient water is available in Fort Peck Lake. However, if the drought continues, the mini test may not occur until after the bicentennial celebration. Prior to implementing the mini test, notice of the higher water would be given to boaters. The additional water could be a benefit for early summer river recreation.

Consistency with Other Public Plans and Documents

This section discloses the consistency of this mini test action with other existing plans and /or NEPA documents within the same general vicinity. In addition, and Environmental Checklist of compliance with State and Federal laws and Executive Orders can be found in Appendix G.

Document	Consistent	Not Consistent
Draft Master Manual	X	
Opinion	X	
Section 33 Bank Stabilization	X	
Annual Operation Plan 2003	X	
Fort Peck Master Plan	X	
Fort Peck Fish Hatchery Report	X	
Fort Peck Visitor Center	X	
Regional Water System for Fort Peck Tribes	X	

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APPENDIX A
FORT PECK SPILLWAY
MAJOR REHABILITATION STUDY

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Ft. Peck Spillway

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Major Rehabilitation Study

August 2000

US Army Corps
of Engineers
Omaha District

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FT. PECK DAM – FT. PECK LAKE
MISSOURI RIVER, MONTANA

SPILLWAY MAJOR REHABILITATION STUDY

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FT. PECK DAM – FT. PECK LAKE
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SPILLWAY MAJOR REHABILITATION STUDY

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Fort Peck Spillway Preliminary Major Rehabilitation Study

1. Fort Peck Project Background. Flow releases from the Fort Peck project are possible through the power plant, outlet works, and spillway. A preliminary investigation was conducted to determine the reliability of the spillway during operation and to assess potential damage as a result of operation. The Fort Peck spillway contains no provision for energy dissipation at the spillway exit channel. The downstream spillway chute has experienced pronounced movement since monitoring of the structure began in 1940. Using information provided within the reconnaissance study, estimates of failure mechanisms and the flow rate at which failure occurs were performed.

An estimation of damage which may result during spillway flows at Fort Peck was performed. The *Fort Peck Dam Spillway, Engineering Reconnaissance Study, August 1996*, addressed operating deficiencies with the spillway. Damage estimates for various flow rates are based on the findings within the reconnaissance study prepared by R.W. Beck.

2. Release Mechanisms. Releases from the Fort Peck project are possible through the power tunnels, outlet works, spillway and spillway gate overtopping during unregulated release.

2.1. Power Tunnels. Normal releases are through the 2 power tunnels (5 generating units) with a capacity of approximately 15,000 cfs at the rated head. At the maximum operating pool elevation of 2250, the power tunnels total discharge capacity is 17,820 cfs.

2.2. Flood Tunnels. The 2 flood tunnels are each regulated with a ring gate with a capacity of approximately 22,500 cfs per tunnel at a pool elevation of 2250. The *Major Rehabilitation Evaluation Report, Outlet Works Modifications, March 1994*, addressed operating deficiencies with the outlet works.

2.3. Spillway. The spillway is regulated with 16 stoney vertical lift gates each 40 feet wide by 25 feet in height. For a pool elevation of 2250.2, the discharge through a single gate with a 1-foot opening is 1040 cfs or 16,640 through all 16 gates. The spillway crest elevation is 2225 feet.

2.4. Spillway Gate Overtopping Flow. Due to operational constraints, overtopping of the Fort Peck spillway gates may occur. Flow over the top of the gates may be roughly approximated as weir flow. With 16 gates, each 40 foot wide (total length of 640 feet) and a weir coefficient of 3.0, the total overtopping flow rate is 1900 cfs for 1 foot of head, 5400 cfs for 2 foot of head, and 10,000 cfs for 3 foot of head.

3. Operating Concerns. Operating concerns during high pools consist of overtopping the spillway gates and the procedure to safely release flows in excess of power capacity from the project.

3.1. Gate Overtopping. If gate overtopping above a certain height must be prevented, raising all the gates 1 foot releases a much higher flow (16,640 cfs compared to only approximately 2000 cfs if all the gates overtop by 1 foot). Therefore, increasing releases prior to overtopping of the gates is preferred to prevent having to raise all the gates simultaneously.

3.2. Outlet Works Release. Past operating experience has indicated that gate damage has occurred as a result of releasing flow. Gate vibration and fatigue are concerns. Previous operation has required periodic maintenance and inspection. The ring gate in tunnel 3 was improved in the 1960's. However, tests conducted by WES and operation in 1975 indicate that the ring gate is still damaged during flow. No data is available which conclusively indicates that a preferred flow range is available which results in the least damaging condition. Studies do indicate that cavitation is the least in the fully vented condition.

3.3. Spillway Releases. The spillway engineering recon study identified concerns with the spillway. Damage due to cavitation, uplift on spillway slabs, and scour at the spillway exit were evaluated.

4. Description of Spillway Features. The Fort Peck spillway is located remotely from the project, approximately 3 miles east of the main embankment, in the right abutment. The spillway consists of a partially lined approach channel, a gated control structure, and a partially lined discharge channel which enters the Missouri River approximately 9 miles below the dam. The spillway was constructed within an outcrop of Bearpaw shale. Near the surface, the shale has weathered extensively. Numerous faults have been identified in the spillway area. Immediately downstream of the lined spillway exit channel, the un-lined channel has been enlarged and deepened by erosion. Provisions for energy dissipation downstream of the concrete lined channel were not included within the constructed project.

4.1. Spillway Location. Four possible spillway sites on the right bluff of the Missouri River were originally studied. The selection of the present site was based on the distance of the gate structure from the dam, the location of the outlet channel with respect to the downstream toe of the dam, and the long approach channel giving an additional factor of safety in the event of failure of the gate structure.

4.2. Control Structure and Approach Channel. The approach channel is nearly 2000 feet in length and is composed of a lined channel for 360 feet upstream of the control gates and 1600 feet of unlined channel. Flow within the spillway channel is regulated by 16 vertical lift gates which are each 25 feet in height by 40 feet in width. The gates are electrically operated and can be individually operated. A 10-foot wide by 30-foot deep concrete cutoff wall lies beneath the upstream edge of the control gate foundation.

4.3. Downstream Spillway Chute. The downstream spillway channel includes a concrete lined channel for a length of 5030 feet. The floor slab of the concrete lined discharge channel varies from 2.33 to 4.0 feet thick. Floor slab sections are 20 feet wide in the longitudinal channel direction and generally 30-40 feet wide in the transverse direction. Downstream of the gate structure, the channel converges from a width of 800 feet at the gate structure to a bottom width of 120 feet at the spillway exit. The overall vertical drop from the crest at the gate structure to the spillway channel exit is 214 feet. For the lower approximately 4000 feet of the lined spillway exit channel, the bottom slope is a constant .0523 ft/ft.

4.4. Cutoff Wall. The lined channel terminates at elevation 2011.0 feet msl with a cutoff wall. The cutoff wall structure is cellular, extends to a depth of 70 feet below the spillway channel invert to elevation 1941.0 feet msl, and also includes wingwalls. The main section of the cutoff structure which spans the channel is 229 feet wide. The wingwalls extend 260 feet at an angle of 45 degrees (185 feet in the direction perpendicular to flow). Total cutoff wall span, measured perpendicular to the direction of flow, is 600 feet. Cellular cutoff wall length, measured in the direction of flow, is 95 feet.

4.5. Downstream Unlined Channel. Downstream of the spillway channel chute and cutoff wall, an unlined discharge channel continues for a length of approximately 2700 feet to the Missouri River. Original construction included excavation through the shale bluffs to the Missouri River floodplain. Channel excavation consisted of a bottom width of 130 feet, side slopes of 2H on 1V, and a flat gradient at an elevation of 2010. After exiting the shale bluff, a 12-foot wide pilot channel was excavated through the river floodplain to the Missouri River. Following construction, spillway flows have altered the channel section and grade within the unlined exit channel.

4.6. Energy Dissipation Structures. Preliminary design of energy dissipation structures which could be employed at the Fort Peck spillway channel exit were performed by the Omaha District Hydraulic Section in the 1960's. Energy dissipation structures considered included a conventional stilling basin and a flip bucket. Available data in Hydraulic Section files indicates that design of an energy dissipation structure was not finalized. Due to the limited detail provided within the design, a cost estimate was not performed. However, either a flip bucket or conventional stilling basin should be regarded as an effective alternative of dissipating energy downstream of the spillway exit and limiting scour depth to an acceptable level.

5. Geology and Foundation. A through discussion of spillway area geology including boring logs and geologic sections are provided in Design Memorandum MFP-118 (Omaha COE, 1973). General information from the report is summarized in this section. Assessment of the rock strength is a necessary parameter in determining scour depth below the spillway. Bedrock in the Fort Peck area is the Bearpaw shale. This is a compaction type shale consisting of dark gray to black clay shale made up of marine sediments. It is comparatively thin bedded and beds of bentonite occur at different intervals. Weathering disintegrates the shale considerably.

As discussed in Design Memorandum MFP-118, 1973, a number of holes were drilled through the slab for the primary propose of determining the condition of the shale immediately under the slab. Extreme fracturing was detected in the first two feet below the slab. Some fracturing accompanied by extensive jointing occur in the shale to a depth of 8 to 10 feet and fairly abundant jointing but no fracturing to a depth of approximately 30 feet.

6. Spillway Flow Parameters. Regulation of the probable maximum flood results in a peak spillway discharge in excess of 250,000 cfs for a duration of approximately 4 days. The spillway flow computations performed within the spillway recon study were used to estimate flow depth and velocity. Due to the changing slope and converging bottom width, the flow velocity and depth vary for different spillway locations at a constant discharge.

6.1. Computed Flow Parameters. The lower portion of the spillway channel has a fairly constant geometry. Within the recon study, computations were performed employing a rugosity or roughness height of .002 and .007 feet. During the 1946 spillway observations, the velocity between stations 40+00 and 45+00 was determined to be about 62.5 feet per second (fps) at a discharge of 27,000 cfs. The measured velocity corresponds fairly well with computed velocities. A summary of computed flow parameters is shown in Table 1. The computed flow parameters illustrates that the spillway flow velocity for the lower 3000 feet of spillway exceeds 40 ft/sec for all flows which were computed (25,000 - 265,000 cfs).

Table 1.
Spillway Flow Computations
Minimum Roughness Height = .002 feet

	Station 20+00		**Station 52+20 Spillway Exit**	
Flow (cfs)	Depth (ft)	Velocity (ft/sec)	Depth (ft)	Velocity (ft/sec)
25,000	3.1	38	3.7	55
75,000	7.2	45	4.6	65
125,000	11.5	48	11.5	83
175,000	15.2	49	14.2	89
265,000	22	50	20	94

6.2. Release Duration Relationship. When flood control releases are required in excess of the power plant capacity (approximately 15,000 cfs) due to reservoir operating criteria, releases may be made through either the spillway or the outlet works. Table 2 lists the number of days the spillway flow would equal or exceed the given value for conditions without releases through the outlet works.

Table 2. Number of Days Spillway Flow Exceeds Given Value		
Spillway Flow (cfs)	**Standard Project Flood (days)**	**Spillway Design Flood (days)**
20,000	22	33
50,000	17	30
100,000	6	21
200,000	0	10

The data listed in Table 2 provide a general assessment of the duration of spillway discharges. For the purposes of this study, the outlet works were considered inoperable due to operational constraints imposed by the Missouri River Region office.

7. Spillway Damage Mechanisms. The spillway engineering recon study identified several different mechanisms by which spillway damage may occur. Damage due to cavitation, uplift of the spillway slabs, and scour at the spillway exit were evaluated. The flow rate at which spillway damage begins and the type of damage which occurs varies with the different damage methods.

7.1. Scour. Below a spillway flow of 60,000 cfs, the cut-off wall and wingwalls are expected to be safe. In the range of 60,000 cfs to 125,000 cfs, the project may function as designed. Above 125,000 cfs, the wingwalls at the spillway exit are expected to fail and the lower end of the spillway will be damaged.

7.2. Cavitation. Major cavitation damage is not expected to occur for the offsets which were measured in the existing condition.

7.3. Slab Uplift. Due to the prolonged period expected for spillway flows and the movement which the spillway has experienced since construction, the spillway is not considered to be watertight. Slab uplift pressure may be expressed as a percentage of the velocity head based on the vertical offset and joint width opening. The downward force resisting uplift consists of the slab weight and weight of the water. The spillway drains relieve the uplift pressure. If the spillway drains are inoperable, the slab has a safety factor less than 1 for the lower 2000 feet of spillway at a flow rate of 25,000 cfs. For a safety factor of 1, the estimated required spillway drain efficiency is between 50 and 80%.

8. Spillway Damage Estimate. Estimating damage to the cutoff wall is extremely difficult given the unknowns of the cutoff wall strength. Forces acting on the wall during flow are nearly impossible to determine. Preliminary damage estimates to the cutoff wall and spillway chute channel were made based on an erosion depth. A detailed analysis of the durability of the wall with respect to scour hole formation was beyond the scope of this study. Plans of the cutoff wall illustrate that it is a massive structure. Damage was determined assuming the wall should be fairly resistant to breakup as the protecting rock layer is scoured away from the front wall face and from battering by loose rock during the scouring process. Based on engineering judgement, damage was broken into four categories of none, minor, major, and replacement. Costs were computed for each damage level based on the damage category. Factors which affect the damage include the high spillway flow velocity for all flows, the observed upheaval areas in the spillway chute, and the poor quality material beneath the spillway slab. These factors all indicate that a single slab failure could quickly propagate upstream and affect a significant portion of the spillway.

8.1. No Damage. For minimal erosion depths, the cutoff wall may suffer some superficial, exterior damage that will not require repair.

8.2 Minor Damage. Minor damage to the cutoff wall and lower end of the spillway chute may occur during lower flow events. Damage costs for this range of scour depth was based on assuming that, although the majority of the cutoff wall remains intact and functional, portions of the wingwall or spillway chute may require reinforcement or replacement. The minor damage scenario would consist of an assumed 20% damage to spillway slabs (10' x 20') which translates into 501 slabs damaged. The damage is assumed to be random. The concrete slabs would be removed from the site and the new slabs constructed and anchors installed.

8.3 Major Damage. Major damage to the cutoff wall and lower end of the spillway chute may occur during medium flow events. Damage was based on the assumption that the cutoff wall would retain enough strength to prevent complete destruction of the spillway channel. However, damage to the cutoff and wingwall structure would be severe. The major damage scenario would consist of loss of all slabs from Station 20+00 to end of spillway, and loss of wingwalls. The failed structural concrete would be removed from the site, new slabs installed, anchors installed, a slab drain system installed, and the wingwalls reconstructed.

8.4 Total Failure. Failure of the wingwall and cutoff wall structure was determined to be probable for large flow events. In this case, the wall would no longer serve to protect the spillway chute channel from erosive forces and undermining. Previous studies have determined that the shale immediately under the spillway slabs is highly deteriorated. Much like a headcut, the erosion may progress upstream fairly rapidly and fail the entire spillway chute channel.

The total failure *scenario #1* would consist of loss of entire spillway from Station 20+00 to the end of the spillway (slabs, wingwalls, cutoff walls). The failed structural concrete would be removed from the site, scour hole soil regraded, new slabs installed, wingwalls and cutoff wall reconstructed, drain system added, slab anchors installed.

The total failure *scenario #2* would consist of loss of entire spillway from Station 20+00 to the end of the spillway (slabs, wingwalls, cutoff walls). The repair would consist of failed structural concrete removed from the spillway, new slabs installed, anchors installed, a slab drain system installed, and stilling basin constructed.

The total failure *scenario #3* would consist of loss of entire spillway from Station 20+00 to the end of the spillway. The repair would consist of failed structural concrete removed from the site, existing slab removal for flip bucket construction, and flip bucket and wingwalls and cutoff wall constructed.

8.5 Rehabilitation - Concept #1. The rehabilitation concept #1 of the spillway will consist of a fix to the existing spillway to alleviate problems as detailed in the scenarios stated above. The rehab scope would consist of slab anchors installed and stilling basin constructed.

8.6 Rehabilitation - Concept #2. The rehabilitation concept #2 of the spillway will consist of a fix to the existing spillway to alleviate problems as detailed in the scenarios stated above. The rehab scope would consist of slab anchors installed and flip bucket constructed.

8.7 Rehabilitation - Concept #3. The rehabilitation concept #3 of the spillway will consist of a fix to the existing spillway to alleviate problems as detailed in the scenarios stated above. The rehab scope would consist of joint sealing system installed and flip bucket constructed.

8.8 Quantities. The following are the major quantities that were calculated for the various damage and rehabilitation schemes.

Minor:
Replace slabs- 501,000 SF x 20% = 100,200 SF
(10' x 20' slabs, 200 SF)
100,200 SF/200 SF = 501 slabs - <u>8,660 CY</u> of Reinforced Concrete
<u>6012</u> new anchors, (12 per slab)

Major:
501,000 SF of slabs 2'-4" thick- 10' x20'
501,000 SF x 2.33' = 1,168,833 CF = <u>43,290 CY</u> of concrete
Anchors- 501,000/16 SF spacing = <u>31,312</u> anchors
Drains-<u>9600 LF of 18"</u> mains, <u>27,000 LF of 8"</u> laterals
gravel- 3' x 3' x 27,000' = 243,000 CF = 9,000 CY = <u>15,300 Tons</u>
(4'+14'/2)x5"= 432,000 CF = 16,000 CY = <u>27,200 Tons</u>
Wingwalls-<u>56,450 CY</u> of concrete
<u>30,000 CY</u> of excavation & backfill
Cleanup- <u>99,740 CY</u> of concrete from above
<u>64,000 CY</u> of scour hole soil

Total Failure:

Scenario #1:

Slabs-43,290 CY of concrete

anchors- 31,312

drain system- 9,600 LF of 18" main, 27,000 LF of 8" laterals, gravel- 42,500 Tons

Wingwalls- 56,450 CY of concrete

Cutoff walls- 28,000 CY of concrete

Excavation & Backfill- 30,000 CY of excavation & backfill

Cleanup- 127,740 CY of concrete

127,134 CY of scour hole soil

Scenario #2:

Slabs- same as scenario #1

Stilling Basin- provided previously

Excavation- 600,000 CY, Backfill- 50,000 CY, Waste- 50,000 CY

Dewatering

Riprap- 12,850 Tons

Bedding- 5,150 Tons

Cleanup- same as scenario #1

Scenario #3:

Slab Removal- 100' x 220' x 2.33' = 51,260 CF = 1,898 CY

Flip Bucket- 4,678 CY of reinforced concrete

Cutoff Wall & Wingwalls- 42,225 CY of reinforced concrete

7,000 CY of excavation and backfill

Cleanup- same as scenario #1 & #2

Rehabilitation:

Concept #1

Anchors- 31,312

Stilling Basin- same as TOTAL FAILURE Scenario #2 excluding cleanup costs.

Concept #2

Anchors- 31,312

Flip Bucket- same as TOTAL FAILURE Scenario #3 excluding cleanup costs.

Includes 2/3 of Cutoff Wall & Wingwall Damage and ½ of Excavation & Backfill of TOTAL FAILURE Scenario #3

Concept #3

No anchors

Seal Joints

Flip Bucket- same as TOTAL FAILURE Scenario #3 excluding cleanup costs.

Includes 2/3 of Cutoff Wall & Wingwall Damage and ½ of Excavation & Backfill of TOTAL FAILURE Scenario #3

9. Description of Major Components. The major components included in the above rehabilitation scenarios are stilling basin, flip bucket, slab anchors and joint sealing system. These components are described in detail below.

9.1 Stilling Basin. The conceptual concrete stilling basin would start at the end of the existing spillway and terminate 467 feet downstream. The basin would be a uniform 110 feet wide. The basin invert would begin at existing elevation 2011 and drop on an elliptical slope to invert elevation 1950, it then continue for 250 feet at that same elevation. The last 17 feet would consist of an end sill at elevation 1957. The wingwalls would slope down from the existing 2070 to 2050 at 200 feet downstream, then continue at elevation 2050 for the last 267 feet. The wingwalls would be A-shaped have a maximum height of 100 feet. The construction work would involve dewatering the existing scour hole and excavating to desired grade and backfilling. The channel downstream would be provided with stone protection.

9.2 Flip Bucket. The conceptual concrete flip bucket would be located at the end of the existing spillway and have a vertical radius of 210 feet. The bucket would have a base length of 76.2 feet, be 14.7 feet high the end of the flip, and cover the entire 110 feet spillway width. The exit angle of the flip would be 18.4 degrees. The existing concrete slab would be removed and the flip bucket doweled to the concrete.

9.3 Slab Anchors. The anchors consist of a 1 3/8 inch diameter steel rods 17 feet long. The existing slab would be cut and jack-hammered, then bored and the boring continued into the shale foundation. The rod installed and grouted, a plate and tightener added at the slab end and the area covered with concrete. The anchor bar would embedded in at least 10 feet of competent shale. Each anchor would cover an area of 16 square feet.

9.4 Joint Sealing System. The spillway slab is not expected to be watertight since aging of the spillway has probably reduced the effectiveness of the water stops. A joint sealing system able to withstand 10 psi at a spillway flow of 125,000 cfs is required to prevent uplifting of the slabs. The following system is the best choice but it will have to be field or laboratory tested to verify. The manufacturer indicated it has been used in storage tanks with this and greater head (static condition). The system is described in the following paragraphs.

9.4.1 Description. EMSEAL Joint Systems, Ltd. is the manufacturer of 20H SYSTEM. 20H is a preformed expanding foam sealant produced by impregnating permanently elastic, high-density, open-cell polyurethane foam with water-based, polymer-modified asphalt. Partially filling the open-cells with the impregnation and then compressing the material results in levels of sealing depending on the degree of compression. Typically, approximately 5-times compression is required for water-tightness in below-grade and horizontal deck applications. The 20H foam is packaged precompressed in shrink-wrapped lengths. It is supplied precompressed to less than the nominal material size for easy insertion into the joint. Sealing between the foam and substrate is achieved through a combination of the effects of foam backpressure and epoxy adhesive applied to the substrates and into which the 20H foam is installed. The exposed outer surface of the installed 20H is further treated with TOPCOAT, supplied to suit the application. The complete 20H SYSTEM comprised three elements: 1) the 20H foam, 2) the epoxy adhesive, and 3) the TOPCOAT.

9.4.2 Joint Seal Characteristics. Below-grade and horizontal deck applications generally require compression to approximately 20% of the material's original uncompressed dimension (i.e. 5-times compression). The 20H is rated for joint movement of +25%, -25% (total 50%) of nominal material width. The following Table 3 gives the physical properties of 20H:

Table 3
Joint Seal Physical Properties

Property	Value	Test Method
Density (uncompressed)	9-10 lb/ft.^{3}	
Density (compressed to 20% of uncompressed width)	45-50 lb/ft.^{3}	
Tensile Strength	21 psi min.	ASTM D3574
Elongation – ultimate	150% min.	ASTM D3574
Temperature range		ASTM C711
High – permanent	185°F	
High – short term	203°F	
Low	-40°F	
Softening Point	140°F min.	ASTM D816
UV resistance	Excellent	
Resistance to aging	Excellent	
Low temperature flexibility 32°F to -10°F	No cracking or splitting	ASTM C711

10. Cost Estimate. MCACES estimates of minor, major and total failure scenarios, and rehabilitation concepts. Tabulated cost values are highly subjective and are based on engineering judgement regarding the extent of damage. The MCACES estimate is enclosed as Appendix B; the rehabilitation total cost is $75,642,000 for concept #1, $55,054,000 for concept #2 and $17,572,000 for concept #3. The total damage costs are shown in Table 4.

11. Monte Carlo Model Input. The final product of the spillway damage analysis was provided as input to the Monte Carlo model analysis. Input to the Monte Carlo model was provided in the format of damage for a given spillway flow rate. Four separate spillway flow ranges and associated costs were specified. Damage and flow was determined based on the results of the computed scour depth and damage estimates described in the spillway recon study. Spillway flow is determined within the Monte Carlo model based on pool level and the reservoir operating rule curve. Input provided to the Monte Carlo model is shown in Table 4.

Table 4 Fort Peck Spillway Monte Carlo Model Input Flow vs. Cost			
Spillway Peak Flow Range (cfs)	**Damage Category**	**Damage Probability**	**Damage Cost ($)**
0 - 60,000	None	1.0	3,000
	Minor	0	10,159,000
	Major	0	84,302,000
	Total Failure	0	101,073,000*
60,000 - 80,000	None	0.5	3,000
	Minor	0.5	10,159,000
	Major	0	84,302,000
	Total Failure	0	101,073,000*
80,000 - 100,000	None	0.1	3,000
	Minor	0.5	10,159,000
	Major	0.4	84,302,000
	Total Failure	0	101,073,000*
100,000 - 125,000	None	0	3,000
	Minor	0.4	10,159,000
	Major	0.5	84,302,000
	Total Failure	0.1	101,073,000*
> 125,000	None	0	3,000
	Minor	0	10,159,000
	Major	0.1	84,302,000
	Total Failure	0.9	101,073,000*

*The same Damage Cost was used for Total Failure Scenario's #1, #2 and #3.

12. Risk Based Analysis

12.1 Introduction. As part of the risk based analysis of the overall Fort Peck Project, the frequency and consequences of spillway uses were required to determine the economic effectiveness of any spillway rehabilitation measures. In order to estimate and combine the frequency of spillway uses with the damages to the spillway, a Monte Carlo simulation of the operation of the reservoir was required.

12.2 Monte Carlo Simulation. Monte Carlo simulation, in general, is a method to determine the probability distribution of the output of a system given the probability distribution of the inputs to the system. The three steps usually required in a Monte Carlo simulation are: determination of the input probability distribution, transforming the input into an output distribution, and analyzing the output. The Monte Carlo simulation for Fort Peck is required to determine the probability distribution of reservoir damage costs given the probability distribution of driving variables (reservoir pool levels, reservoir inflows, reservoir operating uncertainties, etc.). The simulation model developed for Fort Peck allows for both stochastic and deterministic elements of the reservoir system to be modeled. The stochastic elements involve the random variables of the system such as reservoir pool levels and reservoir inflows. The deterministic components of the system are operating uncertainties such as determining required release rates and methods of releases. A summary of the Fort Peck Monte Carlo Simulation Model is given below.

a. The model selects the annual maximum pool level by using a simple autoregressive model based on historical maximum annual pool levels.

b. The model selects the annual maximum daily inflow by selecting a uniform random number between 0 and 1 to represent the inflow probability of occurrence and applies that random number to the inflow-probability cumulative distribution function.

c. For the specified pool and inflow, the required release rate is determined by the model from existing reservoir operating rule curves.

d. For the given pool stage and release rate, the model utilizes an event tree to determine which release mechanism (power plant, outlet works, and spillway) will be used, the consequences of use, and the damage costs associated with the releases.

e. The model repeats for a specified number of years of simulation. The specified period of simulation is broken down into 50-year periods. Within each 50-year period, the damage costs are converted to present value. The average present value damage cost is calculated by averaging the present value damage costs for all 50-year periods.

f. The model is run for with and without project conditions. The reduction in average present value damage costs for with and without project conditions is divided by the project cost to determine the benefit-cost ratio.

12.3 Reservoir Pool Levels. The first step in the Monte-Carlo simulation was generating the time series of annual maximum pool levels for Fort Peck. Due to carry-over storage in the reservoir, the pool levels in Fort Peck are not independent. Because of the annual dependency of pool levels, a simple first order auto regressive model was used to simulate the time series of pool levels. The first order autoregressive model uses the following relationships (Salas, 1980):

$$X_t = X_m + Z_t$$

where:

X_t = generated pool level

X_m = historic mean pool level

$Z_t = r_1 Z_{t-1} + \Phi_{>} >_t$

Definitions:

A. r_1 - lag-1 serial correlation coefficient. Is a measure of the degree of linear dependence among successive values of a series (Salas, 1993).

$r_1 = C_1/Co$

where:

$c_k = (l/N)3(x_{t+k}-x_m)(x_t-x_m)$ *where* k=O,1 *N=number of samples*

The serial correlation coefficient is biased and can be corrected by using:

$r_1 = (1 + Nr_1) / (N-4)$

B. Variance of normal random variable

$\Phi^2_{>}$ - variance of normal random variable

$\Phi^2_{>} = \Phi^2 (1 - r_1^2)$

where Φ^2 = variance of the annual maximum pool levels.

C. $>_t$ - <u>random standardized normal variable</u>

Allows for random or noise element to the generated data.

Twenty-five years of data (1968-1992) since the Mainstem Missouri River Reservoir system has operated as a complete system were used in the development of the autoregressive model. The twenty-five years of data result in a mean pool level of 2240 ft msl, a biased lag1 serial correlation coefficient of 0.78, and an unbiased lag-1 serial correlation coefficient of 0.98. The model works by first selecting a uniform random number between O and 1. This number represents the cumulative probability of the standard normal distribution. A polynomial was used to approximate the standard normal variable (t,) associated with the randomly selected cumulative probability. The initial z, was set at zero so that the model will start at the historic mean maximum annual pool level. The model can then begin generating a series of pool levels that are dependent on the previous year's pool level. A correction factor was applied to the generated pool levels to insure that the generated pool level probability curve would match the historic pool level probability curve.

12.4 Reservoir Inflows. The model generates the annual maximum daily inflow into Fort Peck using the probability integral transform (Benjamin and Cornell, 1970). This involves selecting a uniform random number between O and 1 to represent the cumulative probability distribution quartile value. The randomly selected number is applied to the inflow-probability curve to generate the maximum daily inflow. The model also develops a generated inflow-probability relationship based upon Weibull plotting positions for comparison with the historic inflow-probability curve to insure that the relationship is not biased.

12.5 Reservoir Releases. The required releases for the generated pool levels and inflows were modeled according to the Emergency Regulation Curves - Late Spring Flood Season. The model rounds the generated pool level to the nearest foot and then interpolates between the inflow values to determine the release rate.

12.6 Event Tree. For the given required release rate for each year, the model selects the release system (power plant, outlet works, and spillway), consequences of the use, and damage costs associated with the release. The Monte Carlo simulation model essentially runs through the event tree for the worst flood event for each year and totals up the damage costs for that flood event. The event tree first determines whether there is a normal operating condition or whether there is an emergency condition which requires a rapid drawdown of the pool. For emergency conditions, all release mechanisms are modeled as being fully opened. The spillway flows for the emergency conditions, consequently, are the spillway capacity for the given pool elevation. For normal operating conditions, the method of release is prioritized in that for the given release rate, the model will first use the power plants if they are available. If the power plants are not available, the model will go directly to the spillway or outlet works for releases, depending on pool elevations and user specified release preference. If the required release rate exceeds the power plant release capacity for the particular pool level, the residual required release rate above the powerplants' capacity is sent to either the spillway or outlet works depending on the pool level and user specified priority. If the residual release rate is sent to the outlet works first, the residual release rate above the outlet works capacity for the particular pool level is then sent to the spillway. The spillway branch of the event tree from the Ft. Peck Project, Outlet Works Modification, Major Rehabilitation Evaluation Report was used in this analysis, and is enclosed as Appendix A.

12.7 Economics. The model repeats for a specified number of years of simulation. The specified period of simulation is divided into fifty-year periods. Within each fifty-year period, the damage costs are converted to present value. If a dam failure cost is incurred during any given year, the damage costs the next year and until the end of the fifty-year period are set a pre-described damage cost. If the outlet works are stuck open and result in a loss of pool, the rest of the fifty-year period is also set at a pre-described damage cost. The average present value damage cost is calculated by averaging present value damage costs for all 50-year periods.

12.8 Model Verification. Due to the complexity of the simulation model, verification of the model results were based on the different levels listed below.

a. **Time Series Plotting.** The simulation model automatically plots the generated time series of inflows, pool levels, releases, and damage costs as a quick means of examining the model results. The time series data can be examined for any unexplained trends or shifts in the basic generated data. The time series data can also be examined for interdependence between different time series variables. For example, periods of high releases should correspond to periods of high pool stages and large inflows. Correspondingly, periods of high damage costs should correspond to periods of high releases.

b. **Generated Data Probability Analysis.** The simulation model automatically calculates and plots pool-probability curves and inflow-probability curves for the generated data. The generated data pool-probability curve is plotted along side the pool-probability curve derived from historic data. Likewise, the inflow-probability curves are plotted for both generated and historic data. Plotting the curves insures that the generated data has the same statistical properties as the parent population.

c. **Reservoir Operations.** The simulation model accounts for all release mechanisms and combinations of release mechanisms that are used in the simulation.

Table 5 **Release Summary**	
Ratio of Time Just PP Used	0.81965
Ratio of Time PP and SP Used	0.17760
Ratio of Time Just SP Used	0.00255
Ratio of Time Just Outlet Works Used	0.00010
Ratio of Time PP and Outlet Works Used	0.00000
Ratio of Time Outlet Works and SP Used	0.00000
Ratio of Time PP, OW, and SP Used	0.00000
Ratio of Time Emergency Drawdown	0.00001
TOTAL	1.00000
Where: PP – Power Plant SP – Spillway OW – Outlet Works	

The summary table is useful in verification of the model because it can be compared against historic release records. For the twenty-five years the mainstem system has been operated as a complete system, the maximum annual required release rate has been able to be passed through power plant twenty-two of the twenty-five years or 88% of the years. This compares favorably with the model's 82%. Overall, the summary table allows for quick checks of where the releases are being made.

12.9 Model Sensitivity. Because of the complexity of the model, several sensitivity analyses have been performed on the model. The sensitivity analyses perform two functions; one is to determine if the model gives results which may be rationally supported, and the other is to determine which parameters are most sensitive in affecting the results of the model.

12.9.1 Number of Years of Simulation. The number of years in the model simulation is an important parameter because two counteracting statistical processes are occurring in the model. The number of years determine when an equilibrium or stochastic convergence is attained in the simulation. The first statistical process is the random component of the model may come up with a "hit" or a high damage cost-low probability occurrence after only a few year of simulation. This artificially skews the Benefit-cost ratio on the high side. The countering statistical process is that after a sustained period of simulation, the effect these high damage costs are diminished or diluted by the longer time period. These two countering processes eventually balance out each other and reach a stable solution.

12.9.2 Random Number Generator Seed Number. The random number generator requires a seed number to begin generating a series of uniform random numbers. The sequence of generated random numbers will influence damage costs and the benefit-cost ratio until a certain number of years of simulation until stochastic convergence is reached. The sequence of generated numbers, consequently, is affected by the beginning number or seed number. Sensitivity runs reveal that after 100,000 years of simulation, all sequences of generated values converge to approximately the same number.

12.10 Spillway Damage Probabilities. The probabilities of the particular damage categories occurring during any given year are shown below for a range of spillway flows for the base or existing conditions and the three rehabilitation alternatives.

In general, the damage probabilities reflect that for large flows, there is a corresponding higher probability of sustaining damage to the spillway. The probability of damage decreases with more efficient means of rehabilitation of the spillway.

Table 6
Spillway Damage Probabilities

Spillway Peak Flow Range (cfs)	Damage Category	Damage Probability: Base Condition	Rehab Concept #1*	Rehab Concept #2**	Rehab Concept #3***
0-60,000	None	1.0	1.0	1.0	1.0
	Minor	0.0	0.0	0.0	0.0
	Major	0.0	0.0	0.0	0.0
	Tot. Failure	0.0	0.0	0.0	0.0
60,000-90,000	None	0.5	1.0	1.0	1.0
	Minor	0.5	0.0	0.0	0.0
	Major	0.0	0.0	0.0	0.0
	Tot. Failure	0.0	0.0	0.0	0.0
90,000-120,000	None	0.1	1.0	1.0	0.6
	Minor	0.5	0.0	0.0	0.4
	Major	0.4	0.0	0.0	0.0
	Tot. Failure	0.0	0.0	0.0	0.0
120,000-150,000	None	0.0	1.0	1.0	0.5
	Minor	0.4	0.0	0.0	0.3
	Major	0.5	0.0	0.0	0.2
	Tot. Failure	0.1	0.0	0.0	0.0
>150,000	None	0.0	0.8	0.8	0.4
	Minor	0.0	0.1	0.1	0.3
	Major	0.1	0.1	0.1	0.2
	Tot. Failure	0.9	0.0	0.0	0.1

* -Stilling Basin, Slab Anchors
** -Flip Bucket, Slab Anchors, Cutoff Walls + Wingwalls
*** -Flip Bucket, Seal Joints, Cutoff Walls + Wingwalls

12.11 Results of Monte-Carlo Simulation. The results of the Monte-Carlo simulations are shown below for an array of total failure costs and for the base conditions and the three design alternatives: stilling basin and anchors, flip bucket and anchors, and flip bucket and joint sealing.

Table 7
Monte Carlo Simulation Results

Total Failure Damage Cost	Alternative	Average Present-Value Cost ($)	Rehab Cost ($)	Net Benefit ($)	B/C Ratio
101,073,000[1]	Base Cond.	22,019,000	na	na	na
94,487,000[2]	Base Cond.	21,745,000	na	na	na
34,449,000[3]	Base Cond.	19,250,000	na	na	na
101,073,000[1]	Stilling Basin and Anchors	455,000	75,642,000	21,564,000	0.29
94,487,000[2]		455,000	75,642,000	21,290,000	0.28
34,449,000[3]		455,000	75,642,000	18,795,000	0.25
101,073,000[1]	Flip Bucket and Anchors	544,000	55,054,000	21,475,000	0.39
94,487,000[2]		544,000	55,054,000	21,201,000	0.39
34,449,000[3]		544,000	55,054,000	18,706,000	0.34
101,073,000[1]	Flip Bucket and Sealing	4,039,000	17,572,000	17,980,000	1.02
94,487,000[2]		4.007,000	17,572,000	17,738,000	1.01
34,449,000[3]		3,719,000	17,572,000	15,531,000	0.88

[1] Total Failure Scenario #1.
[2] Total Failure Scenario #2.
[3] Total Failure Scenario #3.

The first two alternatives have the same average present value damage cost for all total failure damages. This is because the spillway rehab is extensive enough, that there is not any total failure, consequently the damages are constant.

The third alternative, the flip bucket and joint sealing, have higher damage costs, but are more than offset by the considerably lower rehab costs. The benefit to cost ratio for two of the total failure costs reflect that rehabbing the spillway would be economically feasible.

13. Recommended Release Strategy. In order to minimize project risk, a release strategy for flows in excess of power tunnel capacity was developed. The release strategy was developed based on operational issues with both the spillway and outlet works. Assuming the power tunnels release 15,000 cfs, additional flow release of 5,000 to 15,000 cfs for 2-3 months may be required. Employment of a risk minimizing release strategy is recommended until structural modifications are made. Development of release strategy is based on the following:

a. The outlet works have not been operated since 1975. In 1975, considerable inspection and maintenance was performed to insure the integrity of the ring gate during operation.

b. The spillway was successfully operated at a maximum flow rate of 20,000 cfs in the 1970's.

c. After the Engineering Reconnaissance Study was completed by R.W. Beck in August 1997, the spillway was operated in November 1997 with a flow rate from 3,000 to 7,500 cfs for 4 months and the peak flow of 7,500 for 3 weeks in that time span.

d. Spillway failure will be confined to the lower end of the spillway. The worst case scenario destroys most of the spillway but does not result in uncontrolled flow release or threatening the integrity of the dam. The spillway gates and upper section of the spillway should be protected by the low flow velocities and a cutoff wall.

e. Outlet works failure may be catastrophic. The worst case scenario destroys the ring gate(s) and damages the downstream tunnel. Closure of the emergency gate under flow is unsuccessful. Flow release is uncontrolled through the outlet works. Tunnel damage caused by ring gate failure is severe and flowing water is not confined to the lined tunnel. The earthen embankment is eroded and the safety of the dam is threatened.

Above the power tunnel capacity, a list was developed which specifies the release mechanism versus increasing for a flow range. Revision of the flow levels within each bracket may be necessary as operating experience dictates. The following release strategy is recommended.

0-10,000 cfs: Utilize the spillway.

10,000-23,000 cfs: Utilize the spillway. Verify that the drains are functioning and monitor during operation.

20,000-60,000 cfs: Utilize the spillway. Verify drains are functioning, monitor during operation, and perform detailed inspections of the spillway and scour hole after operation.

Above 60,000 cfs: Incorporate the use of flood tunnels when damage to the spillway appears eminent. Operate tunnel number 3 first to maximum capacity before tunnel 4. If objectionable flood tunnel operation results switch back to the spillway and accept the damage which occurs. Perform inspections of the spillway and flood tunnels as necessary after operation.

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APPENDIX B
BIOLOGICAL BACKGROUND INFORMATION

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Missouri
River
Natural
Resources
Committee

September 5, 1997

Mr. Larry Cieslik
Reservoir Control Center
Missouri River Division
Corps of Engineers
12565 West Center Road
Omaha, NE 68144-3869

Dear ~~Mr. Cielsik~~ Larry:

On behalf of the Missouri River Natural Resources Committee (MRNRC), I would like to welcome you to your new position as Chief of the Reservoir Control Center. We have enjoyed working with you on the Missouri River Master Manual and expect to continue making positive strides with you and your staff in addressing a myriad of complex issues facing the Missouri River system.

The following are recommendations of the MRNRC for operation of the Missouri River system during the 1998 water year. These recommendations were adopted by the MRNRC during our annual summer meeting held in Bismarck.

- We continue to endorse an emphasis on physical habitat modification as an interim measure for terns, plovers and native fish. We encourage the Corps to pursue these habitat enhancement projects throughout the system. Also, we continue to support efforts by the Corps to evaluate changes in habitat availability within and between years throughout the system. (Note: The MRNRC will be proposing a new approach to address tern and plover conservation needs to the Deputy Commander by separate letter. The Deputy Commander should receive this letter shortly).

- We continue to encourage the Corps to monitor the extent of any flooding or habitat changes associated with high flows during this record-setting water year of run-off. We suggest the use of videography to document flooding and habitat changes. This will prove to be very valuable as discussions on these subjects continue.

- The date that summer flows are returned to full navigation support levels should remain flexible. The actual date should be based on the status of fledgling terns and plovers.

- We are aware of the positive impacts high flows have had on tern and plover habitat the past few years. The high flows have formed sandbar habitats at a much higher elevation than a few years ago. These "new" sandbars should eventually provide nesting and brood habitat for least terns and piping plovers. In addition, there appears to have been better recruitment of native fish during recent years of higher flows. Relatively high spring-early summer flows coupled with lower mid to late summer releases would be helpful for the above species. Regardless of the magnitude of flows adopted in next years Annual Operation Plan, every effort should be made to eliminate any increases in discharge during the tern/plover nesting season. A flow scenario (based on inflow conditions equal to or less than upper quartile) as proposed last year below Garrison Dam was a good first step. Spiking of water releases should also be eliminated.

- High reservoir levels the past few years have inundated vast expanses of vegetation, which in turn, has provided tremendous spawning and rearing habitat for numerous fish species. Most of this vegetation grew during the 1987-92 drought as the reservoirs receded. However, because of the record or near record elevations of these reservoirs the past few years there is again a need to allow for revegetation of some of the shorelines. The MRNRC has promoted the concept of unbalancing Fort Peck, Lake Sakakawea and/or Lake Oahe to maximize fish production in past years; however, other than slight adjustments made for Fort Peck (as proposed below) there is a need to create habitat (i.e. terrestrial vegetation) in all three reservoirs. For this reason, we recommend storage in these reservoirs be relatively balanced for the 1998 water year.

- For runoff projections between median and the upper quartile, operations for Fort Peck should be as follows: between May 15 and June 15 releases from Fort Peck should be 25 kcfs with approximately 50% of these flows originating through the traditional power plant and the remaining 50% from the Spillway. The purpose for this release is two-fold. First, field personnel will monitor movements of native fish in relationship to flows. Secondly, habitat changes due to a month of relatively high flows will be documented. Further justification and reasoning for this release scenario was established last year by the Montana-North Dakota pallid sturgeon work group (refer to Chris Hunter to Col. Richard Craig letter dated February 13, 1997).

- Minimum flow releases should be maintained below all dams to maintain a wetted perimeter necessary to sustain fish populations. These recommendations will be examined and refined on a case by case basis as new data becomes available. Specifically, we recommend the following minimum instantaneous flows;

Fort Peck	4 kcfs
Fort Randall	15-20 kcfs
Gavins Point	9 kcfs
All Others	7.5 kcfs

Last year we requested a written response from the Corps outlining which of our Annual Operating Plan recommendations were implemented, which were not and why. This request was an effort for us to effectively evaluate our recommendations. I understand internal matters such as regional reorganization and appointing a permanent Reservoir Control Chief were issues that received the highest attention during the past year and may be the reason as to why we did not receive a formal response from the Corps. Once again it would greatly assist our efforts if you could provide the following:

- A letter identifying which recommendations were included in the final Annual Operating Plan prior to our Spring meeting. This meeting is typically held in late February or March.
- A letter evaluating implementation of these recommendations prior to our annual meeting. Our annual meeting is usually held in July or August.

On behalf of the MRNRC, I want to again congratulate you and wish you the best of luck as the Chief of Reservoir Control. We would also like to thank all of the Corps staff who have participated at past MRNRC meetings and their efforts to keep us informed of the ongoing operational status of the Missouri River system. If you have any questions concerning these recommendations, please contact me or any other member of the MRNRC.

Sincerely,

Greg Power
Outgoing Chair
Missouri River Natural Resources Committee

c.f. MRNRC representatives and chairperson
MRNRC ex-officio members
MRBA executive director

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MRNRC
MISSOURI RIVER
NATURAL RESOURCES
COMMITTEE

1434 316th Lane • Missouri Valley, Iowa 51555 • 712-642-4121 • Fax 712-642-2460

September 1, 2000

Colonel Michael Meuleners
Northwestern Division, Corps of Engineers
12565 W. Center Road
Omaha, NE 68144-3869

Dear Colonel Meuleners:

I am pleased to submit the following recommendations of the Missouri River Natural Resources Committee (MRNRC) for operation of the Missouri River system during 2000/2001. These recommendations were developed with input from our Fish, Wildlife, and Tern and Plover Technical Sections and adopted by our official MRNRC state delegates.

For the past several years the MRNRC has provided comprehensive recommendations regarding seasonal dam releases, reservoir elevations, and operations for interior least terns and piping plovers. The recommendations regarding Fort Peck and Gavins Point Dam releases, minimum flows below the dams, minimum lake elevations in Lake Sakakawea and Lake Oahe, stable discharges below Oahe Dam and Fort Randall Dam, and spiking of water releases and operations for interior least terns and piping plovers cited in our August 26, 1999 letter remain valid and are incorporated herein by reference.

We appreciate the efforts made this year to maintain Lake Sakakawea elevations during rainbow smelt spawning and to maintain more stable discharges from Oahe Dam during walleye spawning. Biologists have already detected substantial numbers of young-of-the-year (YOY) smelt in Lake Sakakawea while low numbers were found in Lake Oahe. The remainder of this letter will concentrate on specific recommendations for the 2000/2001 AOP which pertain to test flows from Fort Peck Dam and unbalancing of storage in Fort Peck Lake, Lake Sakakawea, and Lake Oahe.

It is our understanding that beginning in mid-May 2001, test flows ("the mini-test") will be released through the Fort Peck Dam spillway to test the structural integrity and performance of the spillway. Various combinations of flow from the spillway and powerhouse will be tested up to a maximum combined release of 15,000 cubic-feet-per-second. These combinations will be tested over a 3-4 day period followed by several days of monitoring prior to another test. The testing is to be completed in 25 days. In 2002, larger test flows will be released and accompanied by an unbalancing of storage in Fort Peck Lake, Lake Sakakawea, and Lake Oahe.

The MRNRC supports these preliminary tests as we view them as initial steps in adaptive management of the river. Spring releases from the dams and unbalancing of reservoir storage should be decided annually, and be dependent on storage conditions in the reservoirs and projected basin runoff. In anticipation of the 2002 full Fort Peck test and reservoir unbalancing, MRNRC members are developing elevation triggers and runoff guidelines for Fort Peck Lake, Lake Sakakawea, and Lake Oahe to guide future release and unbalancing efforts. We intend to discuss these guidelines with your staff and the U.S. Fish and Wildlife Service during our annual meeting in September.

Our specific recommendations for 2001 are:

Exhibit 1

- Owing to the current low storage in Fort Peck Lake, Lake Sakakawea, and Lake Oahe, storage should be balanced ;
- Minimum storage in all lakes should be maintained as close as possible to the conservation pool (base of the annual flood control pool);
- Lake Oahe elevations should not fall between April 8 and May 15 for smelt and walleye spawning; levels in Lake Sakakawea should not fall between April 20 and May 20. Smelt spawn in the top six inches to one foot of the water column on reservoir shorelines. Lake Oahe levels dropped approximately one foot this year immediately after the smelt spawned. Stable reservoir levels are necessary during and immediately following spawning to prevent dessication and loss of eggs. Because of its current low smelt numbers, Lake Oahe is the priority for the coming spring and the following spring if this recommendation cannot be implemented in both lakes.
- It is our understanding that the Fort Peck mini-test will not be implemented unless reservoir elevations exceed 2225 and runoff is expected to be above lower quartile. Stable to rising lake levels should be maintained during the test to preserve reservoir fish spawning and nursery habitat. The tests should be delayed until early June. This will make it more likely that inflows would match or exceed the test outflows even during a low runoff year, thus preserving lake levels. Also, in May, reservoir surface temperatures are not likely to be high enough to produce the desired downstream temperature increases from spillway releases.
- Preliminary reports are that interior least terns and piping plovers had a successful nesting year owing to the continued availability of habitat created by the high flows in 1997 and the lower flows that occurred throughout the nesting season. However, vegetation is beginning to significantly encroach on nesting bars, especially in the river reach between Fort Randall Dam and Lewis and Clark Lake. Flow management measures should be instituted next year if water is available to scour and push up new bars.

I trust these recommendations will be helpful to your staff in developing the Annual Operating Plan for next year. If you have any questions concerning these recommendations, please contact me at 402-471-5555 or Tom Gengerke, incoming MRNRC Chair at 712-336-1714.

Sincerely,

Gene Zuerlein
MRNRC Chair
Nebraska Game and Parks Commission

MRNRC Delegates
MRNRC Ex-Officio Members and
Cooperating Agencies
MRNRC Technical Section Chairs
MRBA Executive Director
FWS Missouri River Coordinator (Olson)

MRNRC
MISSOURI RIVER
NATURAL RESOURCES
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September 21, 2000

Colonel Michael Meuleners
Northwestern Division, Corps of Engineers
12565 W. Center Road
Omaha, NE 68144-3869

Dear Colonel Meuleners:

This is a follow-up to our Annual Operating Plan recommendations of September 1, 2000. After the presentation by your staff on September 13 at our annual meeting and follow-up discussion, we have a better understanding of the plans proposed for the Fort Peck test flows and unbalancing of reservoir storage in 2001 and 2002.

The Missouri River Natural Resources Committee has supported the concept of unbalancing for many years, but only under the right circumstances. This past year has been one of below normal runoff in the Upper Basin. Your staff predicts runoff to be approximately 17.1 million acre-feet which is below Lower Quartile (i.e. occurred in 15 years during the 100-year period from 1898 to 1997). The elevations predicted for Fort Peck Lake, Lake Sakakawea, and Lake Oahe under the basic forecast for next March 1 are below normal for that time of year and infrequently occur under current operations. Since 1968 when the reservoir system was completed, these elevations have been exceeded in roughly 4 out of 5 years. **Therefore, we are concerned that the plans proposed for unbalancing in the next several years may further lower already low reservoirs if a prolonged drought ensues.** For this reason, we believe that the conditions for implementing unbalancing need to be specified to minimize unintended impacts to reservoir fisheries in the event the drought persists.

We agreed at the meeting to provide reservoir elevation guidelines for Fort Peck Lake, Lake Sakakawea, and Lake Oahe for implementing unbalancing. The elevation guidelines are as follows:

1) **Fort Peck Lake:** If the March 1 elevation is greater than the base of the annual flood control pool (2234 ft. msl), implement unbalancing. If the March 1 elevation is between 2227 and 2234 feet msl, implement unbalancing if runoff is projected to raise the reservoir elevation more than three (3) feet after March 1. Unbalancing should not cause lake levels to decline during the important spawning period for forage fish which ranges from April 15-May 30.

2) **Lake Sakakawea:** If the March 1 elevation is greater than the base of the annual flood control pool (1837.5 feet msl), implement unbalancing. If the March 1 elevation is between 1827 feet msl and 1837.5 feet msl, implement unbalancing if runoff is projected to raise the reservoir elevation more than three (3) feet after March 1. Unbalancing should not be implemented until after the critical rainbow smelt and walleye spawning period of April 20-May 20.

3) **Lake Oahe:** If the March 1 elevation is greater than the base of the annual flood control pool (1607.5 feet msl), implement unbalancing. If the March 1 elevation is between 1600 feet msl and 1607.5 feet msl, implement unbalancing if runoff is projected to raise the reservoir elevation more than three (3) feet after March 1. Unbalancing should not be implemented until after the critical rainbow smelt and walleye

Exhibit 2

spawning period of April 8-May 15.

Under the criteria listed above, it would have been possible to implement unbalancing in the reservoirs in the majority of years since 1968. Our analysis of actual end-of-month storage data for the reservoirs indicate that unbalancing would have occurred in 24 of 32 years in Oahe, 24 of 32 years in Sakakawea, and 26 years out of 32 in Fort Peck.

Even with these conditions, it will still be possible to implement the Fort Peck test flows over the next several years without unbalancing Lake Sakakawea. If the drought persists, Sakakawea elevations will continue to decline thereby exposing shoreline habitat and allowing regrowth of vegetation already exposed this year.

I hope these guidelines are helpful to your staff in developing the Annual Operating Plan for next year and the plans for the Fort Peck test flows. If you have any questions concerning these recommendations, please contact me at 402-471-5555 or Tom Gengerke, incoming MRNRC Chair at 712-336-1714.

Sincerely,

Gene Zuerlein
Immediate Past MRNRC Chair
Nebraska Game and Parks Commission

MRNRC Delegates
MRNRC Ex-Officio Members and
Cooperating Agencies
MRNRC Technical Section Chairs
MRBA Executive Director
FWS Missouri River Coordinator (Olson)

BIOLOGICAL OPINION

ON THE

OPERATION OF THE MISSOURI RIVER MAIN STEM RESERVOIR SYSTEM,

OPERATION AND MAINTENANCE OF THE MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT,

AND

OPERATION OF THE KANSAS RIVER RESERVOIR SYSTEM

(November 30, 2000)

Prepared by:

U.S. Fish and Wildlife Service
Region 6, Denver, Colorado
Region 3, Fort Snelling, Minnesota

EXECUTIVE SUMMARY

U.S. FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION
ON THE
OPERATION OF THE MISSOURI RIVER MAIN STEM RESERVOIR SYSTEM,
OPERATION AND MAINTENANCE OF THE MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT,
AND
OPERATION OF THE KANSAS RIVER RESERVOIR SYSTEM

The Corps of Engineers provides the primary operational management of the Missouri River and is responsible under the Endangered Species Act to take actions within its authorities to conserve listed species. On April 3, 2000, the Corps asked the Fish and Wildlife Service to formally consult under the Endangered Species Act on the Operations of the Missouri River Main Stem System, and related Operations of the Kansas River Tributary Reservoirs, and the Operations and Maintenance of the Missouri River Bank Stabilization and Navigation Project. The Corps of Engineers prepared biological assessments for each of these projects and determined that their operations may affect listed species. The species covered under this consultation are the endangered pallid sturgeon, the endangered least tern, the threatened piping plover, and the threatened bald eagle. Current river operations on the Missouri and Kansas Rivers, as well as the continued maintenance of the Bank Stabilization and Navigation Project, are expected to perpetuate habitat loss, nest failure, reduction in forage base, reduction of spawning cues, and overall reductions in reproductive success of these species.

The Fish and Wildlife Service has reviewed project plans and determined that the operation of the three Missouri River projects under past and present operating criteria and annual plans have severely altered, and continue to alter under present operating plans, the natural hydrology and the riverine, wetland, and terrestrial flood plain habitats and fish and wildlife resources of the Missouri River and lower Kansas River ecosystems. Current operations, if continued without significant alterations, likely will cause further declines in other native species and likely will result in additional species listed as threatened or endangered. If more Missouri River species are listed in the future, operational conflicts and constraints will increase, while flexibility to manage the system will decrease.

After reviewing the current condition of the bald eagle, least tern, piping plover, and pallid sturgeon, the environmental baseline for the action area, the effects of the Corps' proposed operation of the Missouri River Main Stem Reservoir System, the operation and maintenance of the Bank Stabilization and Navigation Project, and operation of the Kansas River Reservoir System, and the cumulative effects, it is the Fish and Wildlife Service's opinion that the referenced actions, as proposed, are likely to jeopardize the continued existence of the least tern, piping plover, and pallid sturgeon, but are not likely to jeopardize the continued existence of the bald eagle.

To avoid jeopardizing the continued existence of the tern, plover, and sturgeon, it is necessary to (A) restore a portion of suitable riverine aquatic habitats and hydrologic conditions necessary for successful reproduction and recruitment of the three species, and (B) provide culturing and population augmentation (in the near-term) for the pallid sturgeon to ensure genetic viability of the species until the necessary habitat and hydrologic conditions are restored. To achieve that while continuing Missouri and Kansas River operations and maintenance of the BSNP, it is necessary to: (a) implement flow (i.e., variability, volume, timing, and temperature) enhancement with the goal of providing the hydrologic conditions necessary for species reproduction and recruitment; (b) implement a concurrent habitat restoration program with the goal of restoring habitat quality, quantity, and diversity so that the benefits of adequate dynamic natural river processes are restored; (c) conduct a comprehensive endangered species habitat and monitoring program to better characterize habitat use (by all life stages), longevity, and availability in the Missouri River to facilitate and guide habitat restoration and flow modification; and (d) establish an adaptive management framework to implement, evaluate, and modify the actions in response to variable river conditions, species responses, and increasing knowledge base. The Service believes that those actions will assist in restoring and maintaining the functional ecosystem, and will ensure that the likelihood of survival and recovery of the pallid sturgeon, interior least tern, and the piping plover are not appreciably reduced.

The Service, working with the Corps, has developed a Reasonable and Prudent Alternative (RPA), that includes actions for the least tern, piping plover, and the pallid sturgeon, and the ecosystem in general, that we believe will avoid the likelihood of jeopardizing the continued existence of the three species. This alternative is designed to return some semblance of practical "form and function" of a river system to appropriate sections of the Missouri and Kansas Rivers. It is the combination of all parts of the alternative, working in concert, that will eliminate jeopardy to the species. The primary actions of the RPA include four parts that apply to the least tern, the piping plover, and the pallid sturgeon. A fifth action is designed for the pallid sturgeon. These actions can generally be described as follows:

1. Flow enhancement: The Service has determined that a spring rise and summer drawdown must be implemented from Gavins Point Dam to restore, in part, spawning cues for fish, maintain and develop sandbar habitat for birds and fish, enhance aquatic habitat through connection of the main channel to backwaters and side channels, and improve habitat conditions for summer nesting terns and plovers, forage availability, and fish productivity. A spring release from Fort Peck Dam will provide spawning cues and increase the amount of warm water habitat available to pallid sturgeon and native river fish.

2. Habitat restoration/creation/acquisition: The Service has determined that a portion of the historic habitat base must be restored, enhanced, and conserved in riverine sections that will benefit the listed birds and fish. Habitat restoration goals are 20-30 acres of shallow water

(<5 feet deep, < 2.5 ft/sec. velocity) per mile. Similarly, variable goals by river segment for emergent interchannel sandbar habitat are also identified.

3. Unbalanced system regulation: Unbalancing of the upper three reservoirs when runoff conditions permit, by holding one reservoir low, one at average levels, and one rising on a 3-year rotation will benefit spawning fish and increase forage, increase the availability of tern and plover habitat in reservoirs in drawndown years, create tern and plover sandbar habitat in riverine segments below Fort Peck or Garrison Dams in years of higher releases due to reservoir drawdown, and increase availability of tern and plover sandbar habitat in riverine segments below Fort Peck and Garrison in years of steady or rising reservoir levels.

4. Adaptive Management/Monitoring: The Corps should embrace an adaptive management process that allows efficient modification/implementation of management actions in response to new information and to changing environmental conditions to benefit the species. The two components of this process will be the establishment of an interagency coordination team that will coordinate and guide development and implementation of measures to benefit the species; and development and implementation of a robust monitoring program to better understand baseline conditions, analyze actions, and identify modification to improve results.

5. Propagation/Augmentation: The Corps and the Service will work together to increase pallid sturgeon propagation and augmentation efforts, while habitat and hydrology improvements are being implemented. This short-term action will ensure genetic integrity and prevent extinction of existing pallid sturgeon populations.

Details of the primary actions of the Reasonable and Prudent Alternative described above and the complementary actions are described in the biological opinion text.

and summer flows likely would be reduced to conserve water without implementing special flow modifications. Therefore, the recommended flows from Gavins Point are not expected to contribute to effects of floods during high water years, nor exacerbate drought conditions during low flows. While full implementation of modified flows should occur by 2003, the Corps should move expeditiously to implement components of recommended flows (e.g., spring rise only, summer low flow only, modified rise or low flow) as quickly as possible.

2. In 2001 and 2002, as well as years when the recommended flows are infeasible, the Corps and other agencies in ACT, shall examine expedited implementation of other elements of the RPA to ensure adequate progress towards avoiding jeopardy of the least tern, piping plover, and pallid sturgeon. While in many cases this may involve increasing the pace of alternative methods of habitat creation, such alternatives do not offset the need for hydrologic changes necessary for successful pallid sturgeon spawning, and production of forage for nesting terns and plovers. Therefore, such measures could not be used in-lieu of hydrologic improvements over the long-term.

B. Fort Peck: In the 200-mi (322 km) reach of the Missouri River below Ft. Peck (Segment 2), higher spring flows and warmer water temperatures during the open water period are needed to improve environmental conditions for the pallid sturgeon, least tern, and piping plover. The higher and warmer flows will provide the hydrologic cue for pallid sturgeon and other native fish to spawn. The increased water temperature will help normalize the temperature of the river, provide the temperature cue more suitable for pallid sturgeon egg maturation and spawning (as well as spawning of other native fish), and improve recruitment success for these species. The higher flows will restructure the channel and increase/ improve the available riverine habitat by partially restoring the environmental conditions that listed species evolved with, by redistributing sand for summer flow sand bars, inundating side-channels, and connecting backwater areas to increase primary production which will, in turn, provide additional nutrients, forage fish, and macroinvertebrates needed for larval fish or terns and plovers production and recruitment.

Criteria for the improved spring flows and warm water releases from Fort Peck have been jointly developed through coordination between the Service, Corps, U.S. Geologic Survey, WAPA, and Montana and North Dakota game and fish departments. Through adaptive management, modifications to these criteria may occur through the ACT.

The higher flows and warm-water releases are needed, on average, once every 3 years (33 percent frequency occurrence) and should be incorporated into the unbalancing strategy for the upper three reservoirs (discussed in Section III which follows). A combined release from the spillway and powerhouse is needed to increase water temperature. To provide adequate head for warm-water release from spillway gates (2225 msl), the minimum elevation of Fort Peck Reservoir should be 2230 msl. The Fort Peck releases should only be conducted in years of sufficient runoff (i.e., Median, Upper Quartile, or Upper Decile years) and be timed to avoid lowering the lake during the forage fish spawn (approximately mid-April to mid-May). Initiation of higher discharge shall emulate the timing of the natural inflow into the lake and occur 2-3 days after the rising stage at the Landusky, MT, gauge, but not before May 15 because of cold water temperatures. The peak discharge will range between 20 Kcfs and 25 Kcfs (approximately 19 Kcfs from the spillway and 4 Kcfs from the powerhouse) and persist for a minimum of 3 days. Warm-water releases should continue for at least 30 days. The combination of releases from the spillway and powerhouse should be mixed to achieve a minimum target temperature of 64.4° F (18° C) at Frazer Rapids (RM 1746).

1. In spring 2001, or the first year reservoir elevation and runoff criteria can be met, the Corps shall implement a "mini-test" out of Fort Peck Reservoir to gain sufficient data on combinations of spillway and powerhouse discharges and water temperatures to develop a model for relationships. The mini-test generally should follow the criteria addressed above for reservoir elevation, runoff year, and initiation, but will last only about 3 weeks as flows are varied from 7 Kcfs to 15 Kcfs as various combinations of spillway and powerhouse releases are monitored.

2. In spring 2002, or the first year following the "mini-test" that reservoir elevation and runoff criteria can be met, the Corp shall implement a "full test" of improved flows and warm-water releases out of Fort Peck Reservoir based on the criteria addressed above or as modified through coordination between ACT and the other parties involved in the development of the criteria.

3. In spring 2003, or the first year following the "full test" that reservoir elevation and runoff criteria can be met, the Corps shall implement full flow enhancement releases out of Fort Peck Reservoir based on the criteria addressed above or modified, as appropriate, by the ACT from the 2002 "full test" results.

The pallid sturgeon population remaining below Fort Peck Dam and above Lake Sakakawea represent an important portion of the total population. The adult pallid sturgeon within this reach are nearing the end of their life expectancy and individual female pallid sturgeon may only attempt reproduction during one or two more spawning events. Necessary actions, including baseline monitoring of the habitat conditions, the response of pallid sturgeon to enhanced flows, and coordination of actions, shall be conducted so that a full test of the improve improved flow regime can be implemented by 2002, if appropriate runoff and reservoir conditions occur. In cooperation with the Service, USGS, WAPA, North Dakota Game and Fish Department, Montana Department of Fish, Wildlife, and Parks, and other partners, the Corps shall establish a protocol for monitoring prior to the 2001 test.

C. **Other Segments:** Through adaptive management, the Corps shall investigate the applicability of flow enhancement at Garrison by 2005 and implement, if appropriate.

III. Unbalanced Instrasystem Regulation

Currently, the Corps "balances" the amount of water in storage in the three largest Upper Missouri River main stem system lakes, i.e., Fort Peck Lake (Segment 1), Lake Sakakawea

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

FEB 2 8 2001

Colonel Mark Tillotson
District Engineer, Omaha District
Attn: Mr. William D. Miller
U.S. Army Corps of Engineers
215 North 17th Street
Omaha, Nebraska 68102-4978

Dear Colonel Tillotson:

This letter is in response to questions directed to Mike Olson, Missouri River Coordinator, by Bill Miller, Project Manager, Fort Peck Flow Modification Project, and members of the Fort Peck Assiniboine and Sioux Tribes during a February 16th meeting in Poplar, Montana. Of primary concern was the relationship of Milk River flows to the Fish and Wildlife Service's (Service) recommendations for flows in the Missouri River below Fort Peck Dam which we provided in our biological opinion.

The objectives identified in the biological opinion include both a warming of the water and an increase in stage sufficient to trigger a positive response by native river fish species like the pallid sturgeon. The Corps has indicated that, at this time, the final implementation plan would include a spring rise of 20-25 kcfs (probably 23 kcfs) below Fort Peck Dam. The rise in water will accompany a temperature target of 18 degrees Celsius at Frazer Rapids. The exact flow amounts, timing, temperature, and location requirements will be finalized following the mini and full tests.

The Service would like to clarify the description of the flow enhancement identified in the biological opinion. Our recommendations for flows in the Missouri River should include those flows coming from the Milk River. The Milk provides important temperature and sediment to the Missouri below Fort Peck and these flows will greatly assist native river fish species. Therefore, if the Milk is flowing at 5 kcfs and the final flow implementation plan calls for 23 kcfs, the difference of 18 kcfs should be provided by the combined spillway and powerhouse releases from Fort Peck Dam to meet the flow and temperature targets.

If you have any questions, please contact Mike Olson at 701-250-4481 or Roger Collins at 701-250-4492.

Sincerely,

Allyn J. Sapa
Field Supervisor
North Dakota Field Office

cc: Mike Olson, MR Coordinator, Bismarck
Tom Escarcega, Natural Res. Director, Assiniboine and Sioux Tribes of Fort Peck, Poplar
Arlyn Headdress, Chairman Assiniboine and Sioux Tribes of Fort Peck, Poplar

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
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MAY 4 2001

Colonel Mark Tillotson
District Engineer, Omaha District
Attn: Mr. William D. Miller
U.S. Army Corps of Engineers
215 North 17th Street
Omaha, Nebraska 68102-4978

Dear Colonel Tillotson:

During the past 2 months, Fish and Wildlife Service (Service) and Corps of Engineers (Corps) staff have discussed various aspects of the Reasonable and Prudent Alternative of the Missouri River Biological Opinion related to the Fort Peck Flow Enhancement. In response to a March 23, 2001, verbal request from the Service to the Corps for issues needing clarification or apparent conflicts in the Biological Opinion regarding the Fort Peck Flow Modification, Bill Miller of your staff provided the Service with a draft list of comments and questions. The Corps' list and the Service's response to each of the issues is provided below to further clarify the issues for use in the development of the Environmental Assessment for the Fort Peck Flow Modification and incorporation into the Biological Opinion (BO) Implementation Plan. Relative to the Biological Opinion, these issues will be corrected/clarified on an errata sheet the Service has been developing.

1. **COE Comment:** Full flow enhancement coincides with an unbalancing cycle of Fort Peck Lake being high and Lake Sakakawea being low. Please verify?

   FWS Response: The Service indicated on page 235 of the BO that the Fort Peck flow enhancement should be incorporated into the unbalancing strategy for the upper three reservoirs. This would logically be accomplished when Peck is high enough to meet the threshold elevation to conduct the flows and could be drawn down the 3 feet for unbalancing and when Sakakawea could support the additional water. However, the absolute statement above might preclude other acceptable reservoir storage scenarios and the adaptive management philosophy promoted by the Service. Therefore, we believe this is the type of issue we envision the Agency Coordination Team (ACT) would evaluate and make recommendations on how best to incorporate unbalancing and Fort Peck flow enhancement.

2. **COE Comment:** If other factors prevent full flow enhancement, the Corps will wait until next cycle unless conditions have Fort Peck Lake high and Lake Sakakawea low, then implement. Please verify?

FWS Response: Although unbalancing of the upper three reservoirs ideally is based on a 3-year cycle and Fort Peck flows are needed, on average, once every 3 years, based on operational experience storage and runoff conditions likely would not allow such a regimented schedule for actual implementation. Therefore, through ACT recommendations, the Corps should be opportunistic and implement Fort Peck flows and unbalancing of the upper three reservoirs in any given year that storage and runoff conditions are favorable and not wait for the "beginning" of a new 3-year cycle.

3. **COE Comment:** In response to public concerns, can flow enhancement initiation start 7 days after rising stage at Ulm, Montana, gauge. Please verify?

   FWS Response: We understand the public, especially irrigators, would like as much advance notice of initiation of Fort Peck flow enhancement as possible. On pages 235 and 236 of the BO, the Service indicated the initiation of flow enhancement shall emulate the timing of the natural inflow into the lake, but not before May 15 because of cold water temperatures. We suggested the Landusky gauge be used as the reference gauge and the flow enhancement begin 2-3 days after the rising stage to coincide with travel time to the dam.

   We reviewed USGS data for dates of peak spring flows from both the Landusky and Ulm gauges to determine if the peak at Ulm, on average, occurs earlier than Landusky and has about a 7-day travel time to the dam. In general, we found the peaks at both gauges occur at approximately the same dates, with the peak at Landusky occurring earlier than Ulm in just over 50 percent of the years. Therefore, we suggest the Landusky gauge continue to be the reference point, but have no objection to changing the start date to 7 days after detection of a rising hydrograph at that gauge. We will modify this section of the BO via the errata sheet.

4. Questions regarding peak discharge:

   a. **COE Comment:** Page 236 states "between 20 Kcfs and 25 Kcfs while summary on page 273 states 20-30 Kcfs." Which is correct?

      FWS Response: The discussion between the Service, Corps, States, and MRNRC has focused on a discharge between 20 and 25 Kcfs, with a target of approximately 23 Kcfs. The range of 20-25 Kcfs on page 236 is correct. Page 273 will be corrected in an errata sheet to reflect 20-25 Kcfs.

   b. **COE Comment:** Page 236 talks about the Fort Peck discharge only in terms of spillway and powerhouse discharges, while the letter to the Omaha District, dated February 28, 2001, also includes Milk River flows. Please verify letter?

FWS Response: The February 28, 2001, letter accurately reflects the Service's position on the combination of spillway, powerhouse, and Milk River flows to achieve the target spring rise flows and warm water temperature.

c. **COE Comment:** Page 236 states peak discharge will persist for a minimum of 3 days and warm water releases should continue for at least 30 days. The summary on page 273 addresses a spring release for a minimum of 3 weeks. Does this address the peak discharge minimum of 3 days versus minimum of 3 weeks or the total release at least 30 days versus minimum of 3 weeks? Please clarify both issues?

FWS Response: In general, the spring rise component of the Fort Peck Flow Enhancement (i.e., combination of spillway and powerhouse discharges, as well as input from the Milk River) should emulate the natural inflow into the lake and last approximately 30 days. The rise should be characterized by a gradual ramping up to the peak discharge, hold the peak for a minimum of 3 days, and a gradual ramping down to normal flow management for that year. The warm water release component (i.e., integrated release from the spillway and powerhouse, and including Milk River flows) to meet the temperature target at Frazer Rapids should occur for a minimum of 30 days during the spring rise and integrated spillway releases should continue up to 60 days from initiation, as needed, to achieve the temperature target. In any given year, specifics may need to be addressed by the ACT.

5. **COE Comment:** Page 236 states "The combination of releases from the spillway and powerhouse should be mixed to achieve a minimum target temperature of 64.4 degrees F (18 degrees C) at Frazer Rapids (RM 1746)." Although no time period is included in the requirement stated above, conversations between the Service and Corps staff indicate the target temperature of 64.4 degrees F is to be maintained at Frazer Rapids by use of spillway discharges after the "30-day warm water release" period until natural warming of the river waters occurs. Please clarify? Please provide a limit on the spillway releases in total number of days from initiation.

   FWS Response: Please see the Service response to Number 4 © above regarding the warm water release component.

6. **COE Comment:** Page 273, Summary. The implementation objective column does not include the availability of water limitation.

   FWS Response: Table 24 is merely a summary of the narrative from the BO and does not include a total replication on information in the BO. The Implementation Objective highlights the objective, i.e., to implement the Fort Peck Flow Enhancement on average once every 3 years, but does not include all the constraints or sideboards. This is addressed in the narrative portion of the BO.

7. **COE Comment:** The Summary, page 273, addresses a spring release between "May and the end of June," while page 236 states initiation of the spring release is tied to a rising stage in a gauge, but not before May 15. Please clarify in coordination with comment number 3 above.

   FWS Response: The information on page 236 and number 3 above more accurately reflects the spring rise than the generic bullet statement in Table 24. The Service will modify this statement in Table 24 in the errata sheet to be more specific.

8. **COE Comment:** If the forage fish spawn is still occurring on May 15, does the Corps delay the start of the spring releases? Please clarify (reference page 236).

   FWS Response: As stated on page 235 of the BO, the Fort Peck releases should be timed to avoid lowering the lake during the forage fish spawn (approximately mid-April to mid-May). If the trigger for the spring rise (i.e., rising stage at a selected gauge, but not before May 15) coincides with the May 15 date and the forage fish spawn is still occurring, the ACT should be consulted to assess the status of the forage fish spawn and natural inflows and determine if a delay in the spring rise is appropriate.

9. **COE Comment:** On page 236, the full flow enhancement release is to be "the first year following the full test." Please clarify what is to happen if "this-first-year-following" does not match the proper unbalancing strategy year (see comment number 2 above)?

   FWS Response: The BO states that the full flow enhancement releases shall be implemented the first year following the "full test" that reservoir elevation and runoff criteria can be met. The unbalancing strategy also considers elevation and runoff criteria. Again, this type of issue will be addressed by the ACT to take advantage of the opportunities in any given year and not wait to try and hit the beginning of a "new" cycle.

10. **COE Comment:** Stop protocols are being developed which address issues (cultural resources, erosion, etc.) not addressed by the Biological Opinion. Does the FWS concur with temporary stops in the flow enhancement to address these issues?

    FWS Response: These type of protocols were not addressed in the BO because they are not biological in nature. The Corps must assess these issues in light of its agency responsibilities and consult with the ACT to determine how such protocols will affect the ability of the Corps to meet the RPA and RPM elements of the BO. Dependent upon the nature of the stop protocols, the Service may or may not concur with temporary stops. However, the burden of responsibility for development of stop protocols lies with the Corps.

11. **COE Comment:** Some conversations have implied that the full test would serve as the first full flow enhancement. Please clarify.

    FWS Response: No, this is not the case. The full test is a test that will provide additional information to use in the development of full implementation criteria which may or not be the same from the full test. Hopefully, monitoring and evaluation will provide sound biological information and the basis for any modifications to the criteria, timing, and flows used in the full test.

12. **COE Comment:** Page 231 states the ACT should involve additional agencies or groups. Will the Upper Missouri River Coordinated Resource Management Group (MT) have members on the ACT when the ACT is addressing Fort Peck Flow Modification issues.

    FWS Response: As stated on page 231 of the BO, the agency coordination team (ACT) will serve to guide development and implementation of river management measures to benefit threatened and endangered species. Thus, ACT is comprised of those agencies with biologic or engineering expertise related to elements of the RPA and RPMs and will focus on formulating the best recommendations possible to implement the RPA and RPMs and benefit the listed species. We envision this group as a dynamic group of biologic or engineering expertise comprised of varying representatives of the Corps, Service, MRNRC, MRBA, Tribes, etc, dependent upon the specific issue. If the Corps, in coordination with the Service, believes this group has such expertise to offer to meet these needs, the participation of the group may be warranted. Otherwise, participation of this group and most stakeholders in the basin might best be served through a basinwide Recovery and Implementation Program, which would be much broader in scope.

If you have any questions, please contact Roger Collins at 701-250-4492.

Sincerely,

Allyn J. Sapa
Field Supervisor
North Dakota Field Office

cc: Mike Olson, MR Coordinator, Bismarck

ɔcc: Susan Linner, ES, R-6, Denver, CO
Mike Stempel, Fisheries, R-6, Denver, CO
David Redhorse, R-6, Denver, CO
Mark Wilson, ES Field Supervisor, Helena, MT
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DEPARTMENT OF THE ARMY
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25 OCT 2001

Division Engineer

Dr. Ralph Morgenweck
Regional Director, Mountain-Prairie Region
U.S. Fish and Wildlife Service
PO Box 25486
Denver Federal Center
Denver, CO 80225-0486

Dear Dr. Morgenweck:

This is in reply to your letter of November 30, 2000, transmitting to BG Carl Strock the Missouri River Final Biological Opinion (Biological Opinion) of the same date. That Biological Opinion covered the operation of the Missouri River Mainstem Reservoir System (Mainstem System), the operation and maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP), and the operation of the Kansas River Reservoir System (Kansas River System). The Biological Opinion finds that current operation and maintenance activities of the three projects would jeopardize the continued existence of three Federally listed threatened and endangered (T&E) species: the interior least tern, the piping plover, and the pallid sturgeon. The Biological Opinion also concludes that there will be an incidental take of bald eagles, interior least terns, piping plovers, and pallid sturgeon.

The Biological Opinion presents your recommendation for a Reasonable and Prudent Alternative (RPA), with numerous elements, to avoid jeopardy for these species. Main elements of the RPA are:

- unbalanced system operation
- adaptive management
- flow-related operational changes from Fort Peck and Gavins Point Dams
- T&E species habitat restoration/creation/acquisition
- T&E species-specific measures to avoid jeopardy.

This letter documents our current plan to respond to the Biological Opinion.

Unbalanced System Operation. This flow-related element of your recommendations is being pursued through our Mainstem Annual Operating Plan process. The current dry conditions in the upper Missouri River Basin precluded implementation of this element in 2001; however, we plan to implement it as soon as runoff conditions permit.

Adaptive Management. We have established an Agency Coordination Team (ACT) to initiate the adaptive management process, and we hosted the first ACT meeting in Denver, Colorado, on March 28, 2001. The ACT will guide development and implementation of future river management measures to benefit Federally listed species consistent with the Corps' statutory responsibilities. The first ACT meeting was attended by representatives from our two agencies, the Western Area Power Administration, the Environmental Protection Agency, the Missouri River Basin Association (MRBA), the Missouri River Natural Resources Committee (MRNRC) and the Mni Sose Tribal Water Rights Coalition. Our staffs are also working with the MRBA and MRNRC to develop a proposal to improve the exchange of scientific information pertaining to adaptive management with Tribes, state agencies, interest groups, and individual stakeholders in the basin. We are currently preparing a comprehensive monitoring and evaluation (M&E) plan. Portions of the comprehensive M&E plan have been implemented in past years since the first T&E listings in the late 1980's. We will begin to implement the remainder of the comprehensive M&E plan in calendar year 2002. We will also prepare an annual report that documents Corps actions to implement the Biological Opinion, beginning with actions that took place in calendar year 2001. The annual report will also present Biological Opinion implementation elements planned for the upcoming year.

Ft. Peck Flows. We are analyzing the other flow-related recommendations in the Biological Opinion in two National Environmental Policy Act (NEPA) processes. First, a proposal for a one-year "mini-test" of the flow-related Fort Peck recommendations is the subject of an ongoing NEPA environmental assessment. Assuming a Finding of No Significant Impact, this NEPA process will be completed in time to allow the mini-test to proceed in the spring of 2002. As you know, the mini-test would involve higher than normal spring releases from Fort Peck, including releases from the emergency spillway to effect warmer water in the downstream river reach. We are pursuing the mini-test to help answer questions regarding potential negative impacts to the spillway and the river channel downstream of Fort Peck Dam, and to begin monitoring positive impacts to the native river fishery. We had planned to conduct the mini-test this year, assuming the completion of the NEPA process. Unfortunately, low Fort Peck Lake levels, below that needed to release water over the emergency spillway, prevented the execution of the mini-test. We will continue to pursue the mini-test, and a full test in the subsequent year after the mini-test, when lake levels allow.

Gavins Point Flows. We are analyzing the flow-related recommendations relating to changes to the Gavins Point Dam operation in the NEPA process as part of the ongoing Missouri River Master Manual Review and Update effort. That process is scheduled for completion in early 2003. We have released the Revised Draft Environmental Impact Statement (RDEIS) for the Review and Update that includes the following six water control plan alternatives: the current water control plan, a modified conservation plan, and four alternatives which address the full range of changes in water releases from Gavins Point Dam covered in the Biological Opinion. Water control plan alternatives also include the recommendations on changes to Fort Peck releases. We will take comments on the RDEIS until the end of February 2002. At that time, we will consult with you as we evaluate the results of the NEPA process and select a preferred alternative. A final EIS for the Review and Update is scheduled for completion in May 2002, with a Record of Decision anticipated in October 2002. The final EIS will identify a preferred alternative and state a comprehensive explanation for its' selection. Implementation of any changes to the current Water Control Plan will begin in March 2003, after the preparation and circulation of the 2003 Annual Operating Plan.

Habitat. A significant amount of shallow water habitat has been restored, created, and acquired for the benefit of native river fish under the BSNP Missouri River Fish and Wildlife Mitigation Project, by Section 1135 environmental restoration projects, and through modifications to existing river structures. However, the Biological Opinion recommends a significant increase in shallow water habitat to benefit the pallid sturgeon and sandbar habitat to benefit the terns and plovers, 2,000 acres by 2005 and 19,565 acres by 2020. Sandbar habitat acreage goals vary by year and river reach.

We intend to pursue the restoration or creation of shallow water habitat for native river fish (less than 5 feet deep with a velocity of less than 2 feet per second) consistent with your recommendations. To the extent we need additional authorities, we will actively pursue them; we will also seek whatever appropriations are needed to allow that restoration and creation of habitat. The non-flow related recommendations may need to be evaluated in accordance with NEPA. Decisions regarding the timing and scope of NEPA processes will be made to provide timely implementation of those recommendations. The annual report on Biological Opinion implementation will include discussions of any anticipated NEPA processes. We will continue to create, enhance and maintain emergent sandbar habitat by mechanical manipulation. This may include construction of islands in reservoir headwaters and river reaches, diking and island construction in secondary bays, peninsula cutoffs, overburden removal and fencing of peninsula habitat, dewatering, and vegetation removal. The results of these efforts will be monitored to ensure the most effective methods are being used, and will be included in the annual Biological Opinion implementation report.

T&E Specific Measures. Regarding your species-specific recommendations, we will continue to monitor least tern and piping plover fledge ratios as we have for the last 15 years on the Missouri River and 5 years on the Kansas River. The Great Plains piping plover forage ecology study was scoped in 2000 and commenced during the 2001 nesting season. We remain committed to working with the pallid sturgeon recovery working groups to develop and implement an effective population assessment program similar to the ongoing efforts for the least tern and piping plover. As stated in the Biological Opinion, these efforts are designed to obtain additional scientific information on pallid sturgeon necessary to inform decisions on habitat restoration and flow regulation through an adaptive management process. We will work with your staff and other scientists to develop a monitoring and evaluation framework to gather this scientific information on sturgeon spawning and rearing habitats. We will also pursue near-term assistance for maintaining viable pallid sturgeon genetic stocks through population augmentation with hatchery-reared fish.

We will continue to evaluate historic and potential future take for the current operation, and any potential changes to the operation of the Missouri River and Kansas River Reservoir Systems. We will evaluate and improve management methods that have the potential to minimize take, such as captive rearing and predator aversion, through adaptive management. Evaluation of operational impacts to pallid sturgeon will continue as basic knowledge of the species status, population trends, habitat condition and distribution is gained through population monitoring and evaluation activities. We will pursue a comprehensive public outreach program to increase public awareness and support conservation measures.

We look forward to working with you and your staff as we respond to the Biological Opinion. It remains the intent of the U.S. Army Corps of Engineers to complete the public comment period on the RDEIS addressing the flow-related components of the Biological Opinion on February 28, 2002. Following this public review, a Final Environmental Impact Statement is scheduled for May 2002. I will continue to work with the Service in a cooperative manner to ensure that future actions in response to the Biological Opinion are based upon the best science and engineering available.

David A. Fastabend
Colonel, Corps of Engineers
Division Engineer

January 25, 2002

Planning, Programs, and Project Management

Mr. Al Sapa, Supervisor
U.S. Fish and Wildlife Service
3425 Miriam Avenue
Bismarck, North Dakota 58501

Dear Mr. Sapa:

The Omaha District Corps of Engineers (Corps) is preparing to release a draft Environmental Assessment (EA) for a mini test flow modification out of Fort Peck Dam. The mini test is a component of the Reasonable and Prudent Alternative elements for Multiple Species, item II B (1) for Fort Peck Dam, which is found within the November 30, 2000 Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System.

The implementation of the mini test (discharge 15,000 cfs) would likely increase river surface elevations by approximately 1.5 feet during the month of June 2001. . This increase is in comparison to the average June river elevation in the absence of such a test (discharge 10,500 cfs).

The EA currently discusses how the Corps would monitor for early-nesting least terns and piping plovers and, if needed, relocate these nests to higher elevations or to the hatchery facility at Gavins Point Dam. Both options are available under the Corps' endangered species collection permit for least terns and piping plovers. However, a Biological Assessment (BA) has not been accomplished in conjunction with the mini test, because the mini test action itself is the implementation of an RPA resulting from an earlier Endangered Species Act (ESA) consultation effort.

Please provide our office with written response affirming that a BA is not needed, and that all ESA obligations for the mini test are met by the above actions. Point of contact for this office is Becky Latka (402) 221-4602.

Sincerely,

Candace Gorton
Chief, Environmental, Economic, and
Cultural Resources Section
Planning Branch

Copy Furnished:

Mr. Mark Wilson
U.S. Fish and Wildlife Service
Federal Building, 100 N. Park
P.O. Box 10023
Helena, Montana 59601

CENWO-PM-C (George / Miller)
CENWO-OD-GP (Kruse)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

FEB 2 0 2002

Ms. Candace Gorton
Chief, Environmental, Economic, and
Cultural Resources Section
Planning Branch
U.S. Army Corps of Engineers
Omaha District
106 South 15th Street
Omaha, NE 68102-1618

Dear Ms. Gorton:

This letter responds to your letter, dated January 25, 2002, regarding the need for a Biological Assessment (BA) for the mini-test flow modification out of Fort Peck Dam.

The primary purpose of a BA is for the action agency to determine if a proposed Federal action is likely to adversely affect listed or proposed species. The Fish and Wildlife Service (Service) has already considered the effects of the mini-test in the development of the Reasonable and Prudent Alternative for the November 2000 Missouri River Biological Opinion and determined that it is an integral component of the Fort Peck flow modifications to avoid jeopardy to listed species. In addition, the Corps of Engineers (Corps) is not required to prepare a BA for actions that are not major construction actions; and the assessment on endangered species may be undertaken as part of the Corps' compliance with the requirements of Section 102 of the National Environmental Policy Act for an Environmental Assessment (EA).

Therefore, if the Corps summarizes in the EA the effects/benefits of the Fort Peck flow modifications on the least tern, piping plover, and pallid sturgeon, as documented in the biological opinion, the Service believes that a separate BA is not needed for the Fort Peck mini-test.

The Service looks forward to reviewing the draft EA. If you have any questions regarding this letter, please contact Roger Collins (701-250-4492).

Sincerely,

Allyn N Sapa
Field Supervisor
North Dakota Field Office

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APPENDIX C
FORT PECK DAM OPERATIONS

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FORT PECK

HISTORICAL RECORDS

Historical records for Fort Peck pool elevations and releases date back to 1937, when the dam was first closed. It was not until the main stem system filled in June of 1967 that the records reflected normal system operation. During the period of 1967 through 1997, the pool elevation has ranged from a low of 2208.7 ft msl in April of 1991 to a maximum of 2251.6 ft msl in July of 1975, a range of almost 43 feet. The average annual pool elevation since 1967 is 2234.9 ft msl with a standard deviation of the annual means being 9.8 feet. Daily releases from Fort Peck have ranged from a low of zero cfs for one day in April of 1978 to a high of 35,400 cfs in July of 1975. Daily release has averaged 10,100 cfs since 1967 with a standard deviation in the annual mean discharge of 3,900 cfs. Figure 2 shows the ovserved daily pool elevations and releases from Fort Peck for the period since the main stem system was first filled. Daily maximum, minimum and mean values of pool elevation and releases for each month are listed in Table 2.

Table 2
Fort Peck Pool & Release Historical Records (06/1967-12/1997)

Month	Pool Elevation (ft msl)			Daily Release (cfs)		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Jan	2245.1	2209.3	2233.0	15,600	6,500	11,600
Feb	2244.4	2208.8	2231.9	15,500	4,800	12,200
Mar	2246.2	2208.8	2232.0	15,600	1,000	9,000
Apr	2247.3	2208.7	2233.2	25,100	0	8,100
May	2247.7	2209.3	2234.5	28,900	2,800	9,600
Jun	2250.0	2212.5	2236.9	35,100	3,000	10,600
Jul	2251.6	2212.5	2238.5	35,400	3,000	10,900
Aug	2250.1	2211.4	2237.8	35,200	3,800	10,800
Sep	2248.5	2211.4	2236.8	20,500	2,700	9,900
Oct	2248.0	2211.4	2236.1	21,800	2,700	9,300
Nov	2246.3	2210.9	2235.3	22,300	2,700	9,600
Dec	2245.4	2209.6	2234.2	16,000	4,500	10,200
Annual	2251.6	2208.7	2234.9	35,400	0	10,100

POOL & RELEASE DURATION

Pool duration and release duration relationships were developed using the DRM which used data from 1898 to 1997. Figure 3 shows the pool duration relationship for Fort Peck, while Figure 4 shows the release duration relationship. Both Figure 3 and Figure 4 show the DRM data along with the observed data. Table 3 shows the pool elevation and release for various percentages of time in which the values are equaled or exceeded.

Table 3
Fort Peck Pool & Release Duration Characteristics

Percent of Time Equaled or Exceeded	Pool Elevation (ft msl) DRM	Release (cfs) DRM
Maximum	2250.0	35,000
1	2245.5	22,000
5	2243.2	17,500
10	2242.1	15,000
20	2238.0	12,500
50	2234.9	9,500
80	2219.9	3,500
90	2201.9	3,100
95	2177.6	3,000
99	2165.7	2,800
100	2160.4	2,400

POOL PROBABILITY

In 1975, the maximum pool elevation of 2251.6 feet msl was recorded at Fort Peck. Results of the DRM indicate that the peak daily pool for 1975 would be 2248.3 feet msl which would rank as the sixth highest out of the 100 years of simulated record. DRM results also indicate that the maximum daily pool elevation of 2250.0 feet msl during the simulation period would occur during 1997. Extrapolation of the eye-fit curve between the observed and simulated data based on the shape of the curve from the observed data indicates a reasonable pool-probability relationship. Therefore, this curve was adopted for the Fort Peck Pool Probability relationship. Results are shown in Table 4 and on Figure 5.

Table 4
Fort Peck Pool Probability Relationship
Pool Elevations in Feet MSL

Percent Chance Exceedance	1976 Study	Observed (1967-1997)	Simulated (1898-1997)	Adopted
50	2240.0	2242.0	2240.0	2241.5
20	2246.5	2246.5	2244.9	2246.5
10	2249.0	2249.0	2247.5	2249.0
2	2251.0	2252.7*	2249.5	2251.0
1	2252.0	2254.0*	2250.0	2252.0
0.2	2253.0	2256.5*	2251.0*	2253.0

* extrapolated: Max Observed is 2251.6

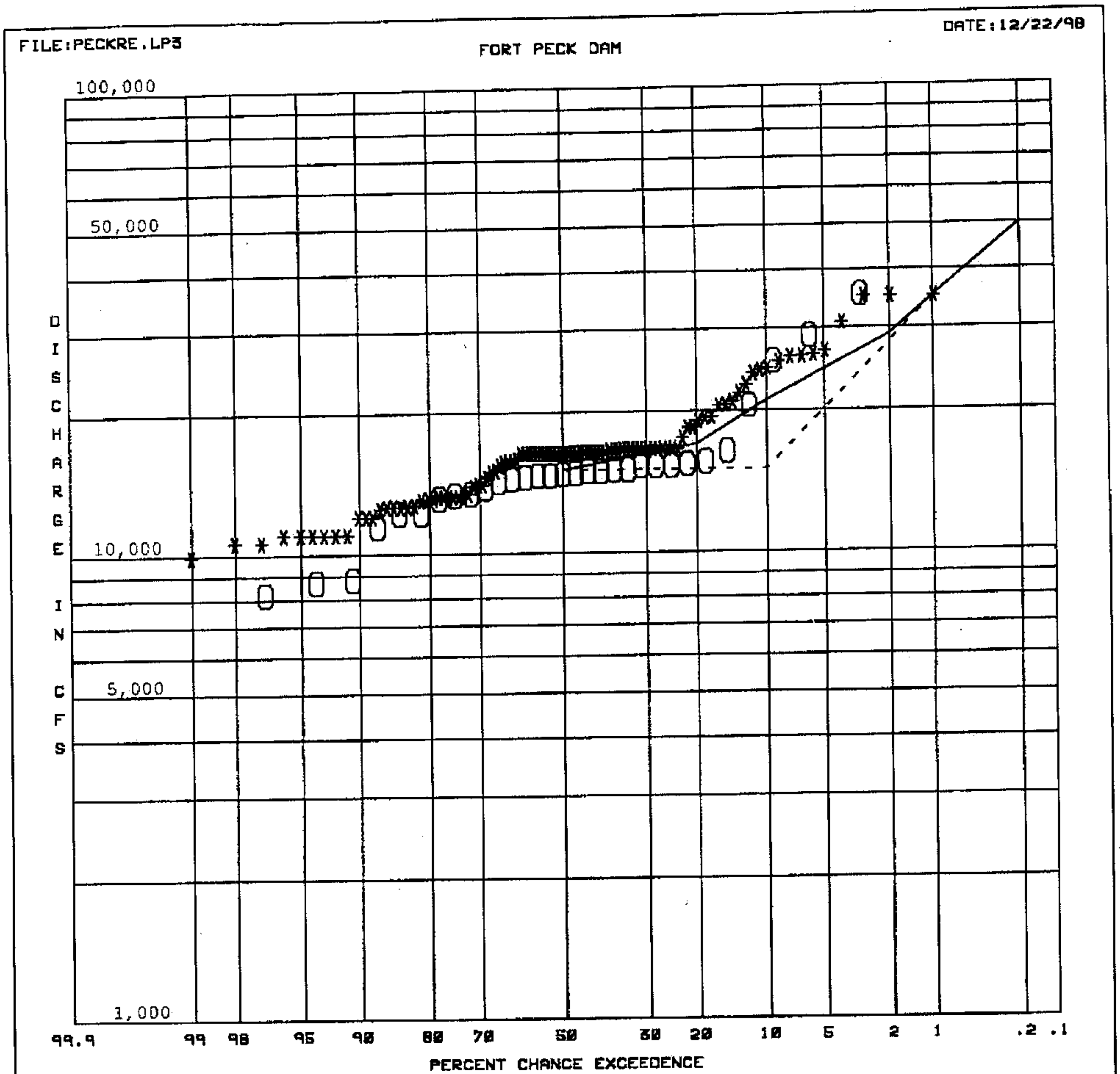
RELEASE PROBABILITY

The maximum observed release from Fort Peck was 35,400 cfs in 1975. Results of the DRM indicate that the maximum daily outflow of 35,000 cfs would be reached during eleven years, 1898, 1908, 1909, 1913, 1916, 1917, 1927, 1948, 1953, 1975, and 1997. The actual maximum for 1997 was 22,300 cfs. The difference stems from the lack of runoff forecasting by the DRM and as a result cannot prerelease water. Both the observed and simulated curves indicated a relatively flat curve with a discharge near 15,000 cfs (near power plant capacity) from the 70 percent chance exceedance to the 20 percent chance exceedance range. The observed remained flat until the 20 percent chance exceedance while the simulated moved to the 30,000 cfs range in a somewhat linear fashion. For events less frequent, both curves showed an abrupt breakpoint at 10 percent value. Values of 35,000 cfs occurred near the 3 percent chance of exceedance for the observed, and 10 percent for the simulated data. A straight line was assumed from the 20 percent to the 0.2 percent and slope steepened between the 2 and 0.2. This curve was used to define the adopted release-probability relationship. Results are shown in Table 5 and on Figure 6.

Table 5
Fort Peck Release Probability Relationship
Discharges in CFS

Percent Chance Exceedance	1976 Study	Observed (1967-1997)	Simulated (1898-1997)	Adopted
50	15,000	14,700	16,300	15,000
20	15,000	15,400	18,400	17,000
10	15,000	24,000	24,400	22,000
2	28,000	40,000*	34,800	29,000
1	35,000	50,000*	34,900	35,000
0.2	50,000	70,000*	35,000*	50,000

* extrapolated: Max Observed is 35,200



LEGEND:

- O OBSERVED
- * SIMULATED
- ——— ADOPTED
- - - - - 1976 STUDY

POWER PLANT CAPACITY - 16,000
OUTLET CAPACITY - 45,000
SPILLWAY CAPACITY - 275,000

MISSOURI RIVER MAIN STEM RESERVOIRS
RELEASE-PROBABILITY RELATIONSHIP

FORT PECK

RESERVOIR CONTROL CENTER
MISSOURI RIVER REGION
U.S. ARMY CORPS OF ENGINEERS
FEBRUARY 1999

FIGURE 6

FORT PECK DAM

RELEASE DURATION RELATIONSHIP

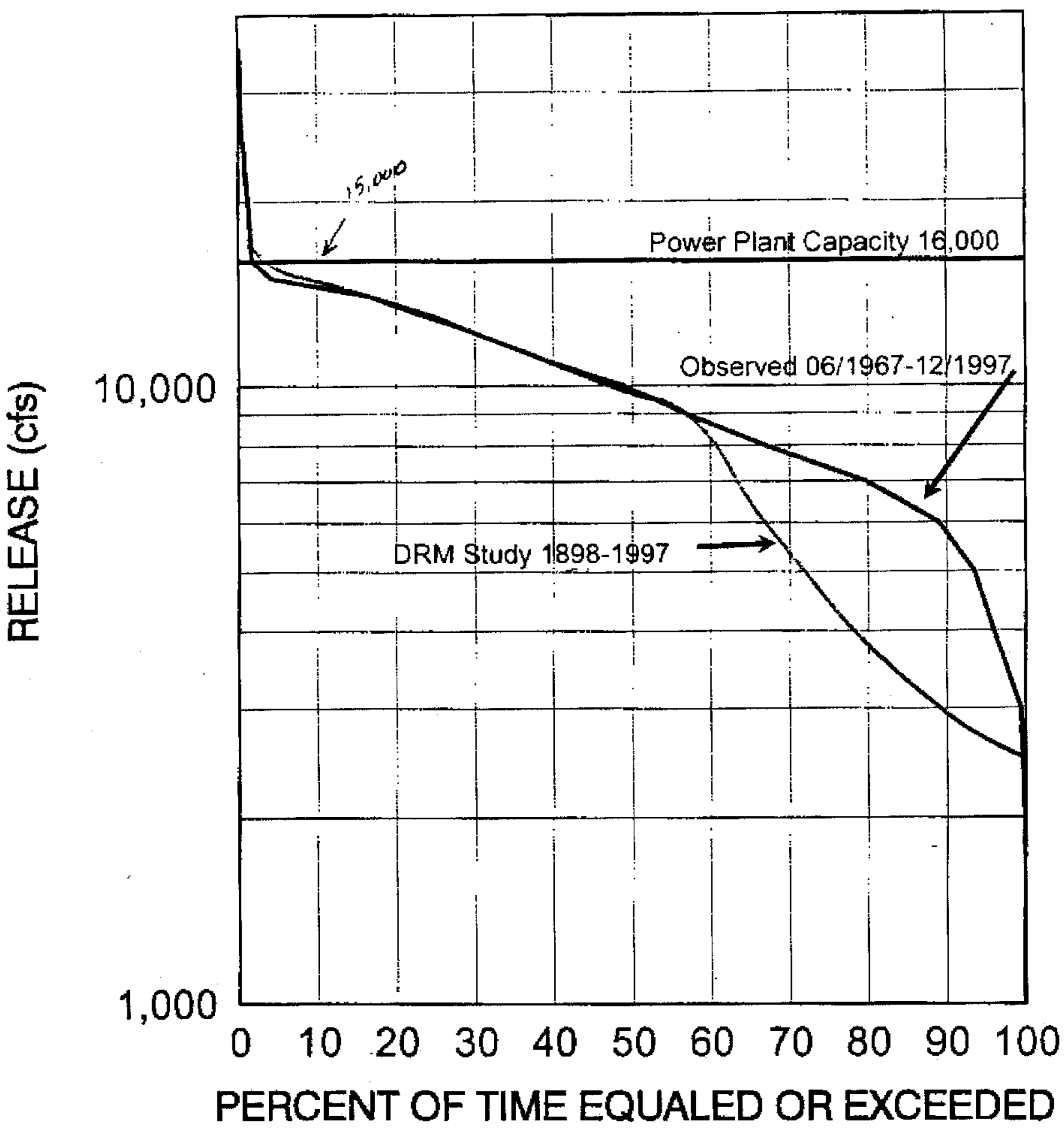
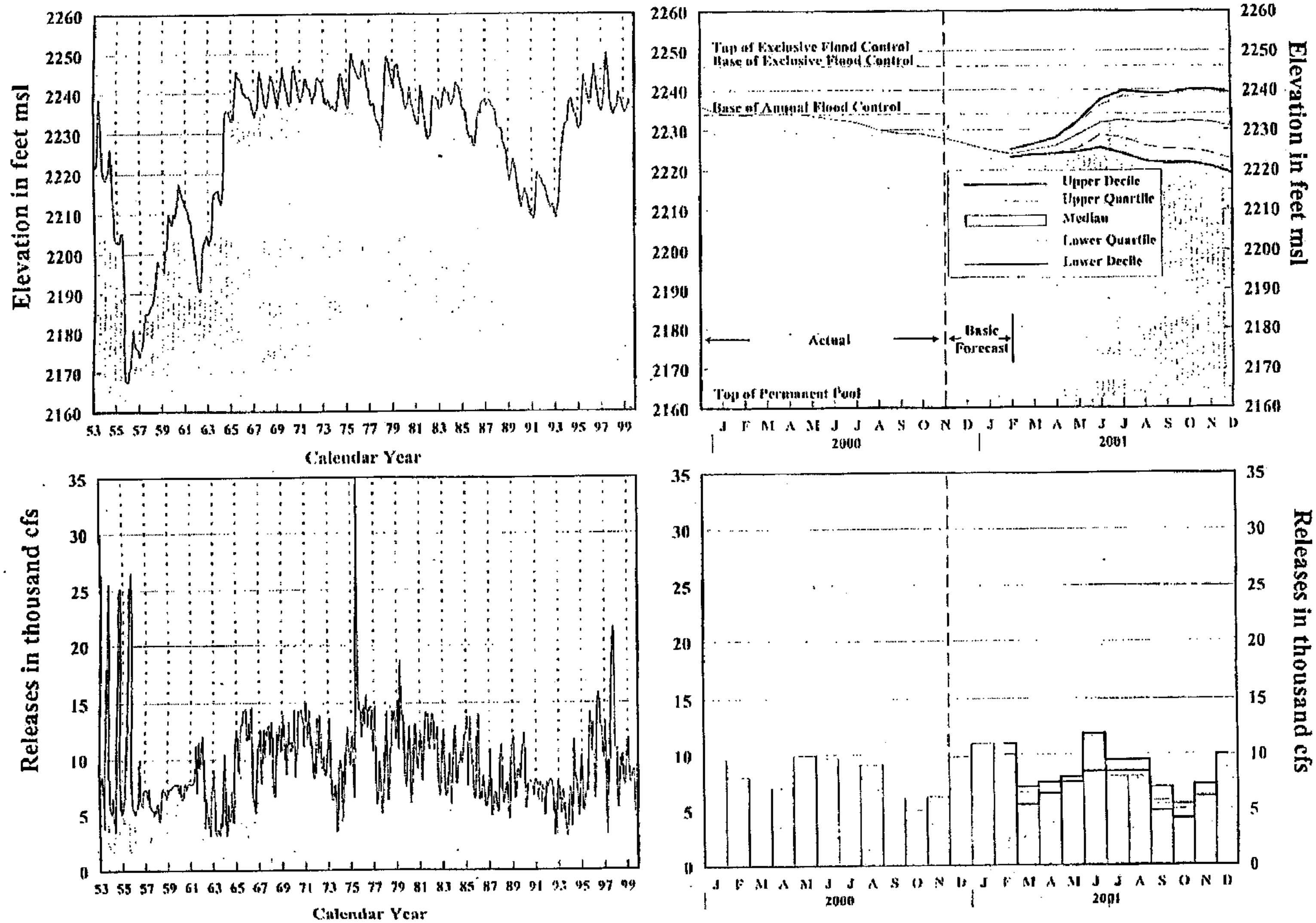


FIGURE 4

Fort Peck
Elevations and Releases



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APPENDIX D
NATIONAL HISTORIC PRESERVATION ACT COMPLIANCE

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Scope of Work for the Cultural Resources Inventory for the Fort Peck Flow Modification Missouri River Downstream from Fort Peck, Montana Valley, Roosevelt, McCone, and Richland Counties, Montana

Revised 14 Jun 01

Introduction

The Corps of Engineers, Omaha District, is planning to release warm water from Fort Peck Lake when there is sufficient water for a release. The purpose of this release is to change the flow pattern, increase turbidity, and warm the water in the Missouri River downstream of the dam in order to stimulate the pallid sturgeon to spawn. The pallid sturgeon is an endangered species.

To accomplish this release, there will be both a mini-test (possibly spring 2002) and a test (a larger release of water through the spillway later, possibly in the spring of 2003). The inventory of cultural resources downstream of the dam is to locate, identify, and evaluate the resources which may be impacted by the proposed mini-test and test.

Methodology

The purpose of this inventory is to locate, identify, and make a recommendation concerning the significance of cultural resources. The inventory will consist of a pedestrian survey of a strip of land 150 feet wide on both sides of the Missouri River. National Register testing will be conducted at any site determined to have the potential to be significant under the National Register criteria. The location of the inventory is from River Mile marker 1763 (the end of the spillway from Fort Peck Dam) to the Highway 85 bridge (River Mile marker 1553), or 210 river miles in length. Cultural resources, for this work, are defined as above or below surface cultural occupation areas, where people lived, worked, or hunted and left material remains which are defined as sites. Cultural resources can include historic sites, historic buildings, prehistoric sites, river crossings or fords, processing areas, trails, roads, bridges, and any other parts of the landscape which have been modified by humans. (Traditional Cultural Properties, areas where traditional items are collected or where worship occurs or visions are sought, will be identified under another Scope of Work.) The work shall consist of three parts, the literature and records search, the field work/pedestrian survey/National Register testing, and writing the report.

I. The literature and records search shall consist of a thorough review of the available records. This search shall include, but shall not be limited to: Tribal records, the Tribal Museum, the Archeological Records office at the University of Montana at Missoula, the State Historical Society, the county courthouses, the local and regional libraries, interviews with individuals knowledgeable in local and regional history, and other individuals who may be helpful in obtaining information about the history and prehistory of the survey area.

II. The field work shall be conducted by pedestrian survey. Crew members are to maintain a survey interval of no greater than 30 meters while conducting this survey. Once a site is located, all artifacts visible on the surface will be pin-flagged and recorded. Diagnostic artifacts will be plotted and collected. Shovel test pits or probes shall be dug to determine the areal extent of the site, unless the crew chief can determine approximate boundaries in another manner. If a site appears to have the potential to be eligible for the National Register of Historic Places, sufficient documentation to support this assessment will be collected.

The field work portion of this contract shall consist of the following.

a. Incorporate relevant research questions into the existing project whenever possible. Use recovered data to address research questions. Develop or amend research questions if appropriate, based on recovered information. These discussions will be included in the final project report.

b. Undertake the following activities as part of site inventory and evaluation actions.

1. Include daily entries in field notes (i.e. project map and field notebooks) on the amount of work accomplished and test results.

2. Map all known and newly discovered sites and isolated finds. Use shovel test pits or soil proves to determine the probable boundaries of the site, unless the crew chief can determine the site boundaries by another method. Make recommendations concerning significance to the National Register of Historic Places. If available to the contractor, at least one (1) Global Positioning Station (GPS) reading will be taken at each site.

3. Indicate all shovel test pits and/or soil probes on the site maps. Map any special findings such as artifact concentrations, features, and diagnostics. Map all erosional and man-made (e.g. illegal excavations) impacts.

4. Employ current archeological standards and methods for the pedestrian survey, shovel tests, and significance determinations.

5. An inventory of cottonwood trees shall be conducted as part of the contract. The trees shall be counted and inventoried. A very brief (one or two sentences) description of the general health of the population shall be included with this inventory.

NOTE: The following policies shall be adhered to during fieldwork:

1. Human remains: If human remains are discovered, they shall not be disturbed but protected in place. The contractor shall immediately notify the Tribes and the Corps of Engineers (Curley Youpee at 406-768-5155, ext. 392, Carl Fourstar, at 406-768-5719,

or Becky Otto at 402-221-3070). The Corps and the Tribe will follow identified internal procedures to address the situation. (This will include notifying the appropriate Indian Tribes, law enforcement, and coroner's offices.) If the remains are determined to be Native American, the Corps shall comply with the terms set forth in the Native American Graves Protection and Repatriation Act (NAGPRA) and the Montana State Law.

2. Artifacts: If, in the opinion of the contractor, diagnostic artifacts/features located outside the area of evaluation are in immediate danger of loss or damage for whatever reason(s), those artifacts shall be collected but only after all readily available and pertinent provenience data on each item is recorded. The reason(s) for collection shall be noted as part of the data accompanying each artifact.

The Contractor shall arrange a mutually acceptable date and time to either meet or have a conference call with the Corps' archeologist and contract specialists to review the Government Statement of Work and Contractor Proposal. The purpose of the meeting or conference call will be to clarify tasks and methods and to minimize misunderstandings that might arise over the course of the contract.

Government-furnished materials shall consist of the following: four sets of maps from the end of the spillway near Fort Peck Dam, Montana to the Highway 85 bridge near Williston, North Dakota. These maps will consist of a base map of 7.5 minute USGS topographical quadrangles with an overlay of infared photographic coverage along the river (1998 data). An additional set of these maps will be provided to the Water Resources office of the Fort Peck Tribes.

III. The Final Report

The final report shall provide an overall discussion of the project, data analyses, and results. This shall include a brief summary of the environment and culture history (i.e. prehistory, ethnohistory, and history) as well as suggestions on research questions and approaches. The sites shall be discussed in terms of site type, location, National Register significance, and the contractor's recommendation concerning impacts to the site.

The contractor will:

a. Prepare a final comprehensive project report summarizing the field work, site data, significance determinations, and results of the inventory. The report shall be prepared according to American Antiquity standards.

b. The report shall include but not be limited to a title page, executive summary, introduction, table of contents, text addressing the results of the Missouri River downstream assessment, and a bibliography. The executive summary shall include results, major findings, statements of significance, and management recommendations.

The title page shall note that the report was done in partial fulfillment of the Corps' contract.

c. Text materials shall be typed on good quality bond paper 8.5 by 11 inches with a 1.25-inch binding margin on the left side, .75 inch on the right side, 1 inch at the top, and 1 inch at the bottom.

d. All pages, figures, and tables shall be of professional quality and shall be consecutively numbered throughout the report. Where applicable, they shall have titles and appropriate explanatory notes.

e. Two copies of the draft report of findings shall be submitted by July 30, 2001. The Government shall review the document and provide comments within 15 days after receipt of the draft report. The Government reserves the right to have the report reviewed by other qualified archeologists and to include their comments as part of the Government's.

f. Three bound copies of the final report plus one unbound, camera ready copy incorporating the government's comments shall be submitted no later than 15 September, 2001.

g. All deliverables shall be submitted in a timely fashion to the following address:

US Army Corps of Engineers
106 South 15th Street
Omaha, NE 68102

ATTN: Becky Otto
CENWO-PM-AE

IV. Conditions

a. The Contractor shall be able to demonstrate the capabilities of key project personnel (e.g. principal investigator, field and laboratory directors, etc.) to successfully complete all phases of identified work. (The Secretary of the Interior's "Standards and Guidelines for Archeological and Historic Preservation" shall be followed in determining qualifications.) The Contractor shall submit the names and resumes of key personnel (i.e. principal investigator, field directory, etc.) to be used on this project. To the maximum extent possible, the Contractor will use students from the Fort Peck Community College as crew. These people will be trained by the Contractor to recognize artifacts and features in the field.

b. All collected and generated project materials (e.g. artifacts, field notes, maps, photographs, slides, etc.) shall be the property of the landowner. The Contractor shall properly clean, label, and box all such materials. The Corps will arrange for the curation of the project collection. If the landowner is agreeable, the artifacts can be curated with the Fort Peck Tribes. If this is the case, the Contractor shall insure the collection meets the standards outlined in 36 CFR Part 79 prior to submitting them for curation. If the landowner wishes to retain the artifacts, they must be returned to the appropriate landowner.

c. Prior to completion of the project, the Contractor shall submit a listing (inventory sheet) of all project data, artifacts, and materials. This shall include an estimate in cubic feet of the total volume of the project collection.

d. All work (i.e. both field and laboratory/office) shall be subject to inspection by representatives of the Corps. Inspections will be done to track contractor progress, verify that identified tasks are being preformed as stated, and identify any problems or issues impeding the successful completion of the contract. If inspections indicated that the work is not being performed in accordance with applicable laws and regulations and the approved proposal/research design, the contractor shall, at no additional cost to the Government, suspend work and immediately develop and undertake appropriate corrective actions approved by the Government.

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Fort Peck Flow Modification
Traditional Cultural Properties Inventory
Along the
Southern Boundary of the Fort Peck Reservation

I. BACKGROUND

A. The Corps of Engineers, Omaha District, is planning to release warm water from Fort Peck Lake during the spring of 2001. The purpose of this release is to warm the water in the Missouri River downstream of the dam in order to stimulate the pallid sturgeon to spawn. The pallid sturgeon is an endangered species.

In order to consider this release idea, there will be both a mini-test (spring 2001) and a test (a larger release of water through the spillway in spring of 2002). The inventory of Traditional Cultural Properties downstream of the dam is to locate, identify, and evaluate the resources, which may be impacted by the proposed mini-test and test.

B. In recent years, regulations for cultural resources protection have been enacted that require the consideration of Traditional Cultural Properties (TCP) when Federal agencies evaluate the effects of their actions. The proposed work will consist of an inventory of all Traditional Cultural Properties (such as sacred sites, traditional gathering areas, or other important places) within the area affected by the proposed tests.

II. PROJECT DESCRIPTION

A. The work to be accomplished by the Contractor shall consist of Phase II of a cultural resources preliminary survey of all TCP sites within sight of the Missouri River.

B. The objectives and purpose of the preliminary investigation are to identify, record, and locate through the use of GPS all TCP sites in the specified area. For the purpose of this contract cultural resources are defined as prehistoric and historic traditional cultural properties. This inventory can include prehistoric or historic sites, areas where there are identifiable features, or areas where no features are visible.

C. The work will consist of the following:

1. Literature and Records Search: A comprehensive literature and records search for the project area to be conducted prior to field investigations. This will include interviews with tribal elders, a review of the available literature, and consultation with anyone else knowledgeable in this area.

2. A CRP Locational Survey, which will consist of the following:

a. Pedestrian surface surveys with a maximum of 30 meter intervals and 30 meter transects. This interval may vary depending upon field conditions, site density, or site size.

b. The location of each cultural resource through the use of GPS equipment, and the entering of such information into a mapping database.

c. Should human remains be discovered, the Contractor must immediately contact the Omaha District to comply with the Montana State Burial law and any agreements with area Tribes. Any required documentation shall be provided to the District.

3. A Preliminary Survey Report which explains the approach, methods, and results of the investigation, and makes recommendations for further work, will include the following:

a. The contractor must keep standard records that include field notes and maps, site survey forms, and GPS data.

b. Specific Traditional Cultural Properties and archeological site locations will be included in an appendix, to be submitted only to the Fort Peck Tribes, and to the Corps, as federal agencies are subject to Title 16 USC § 470hh, concerning confidentiality of information with regard to Traditional Cultural Properties and archaeological resources. Reports for general distribution (if any) will not contain specific maps.

III. CONTRACTOR, INSTITUTIONAL, OR CORPORATION QUALIFICATIONS

As part of the documentation, the contract proposal must include documentation for the main supervisory personnel to support their qualifications for the project.

IV. REPORT SPECIFICATIONS

A. The report shall include the following:

1. A brief summary of the findings, conclusions, and recommendations of the report.

2. Table of Contents.

3. Introduction, which shall include the Government's purpose for the preliminary location survey, as delineated in I.B.

4. An updated regional cultural history of the project area based on the data recovered and a summary of the environmental setting and its relationship to the prehistory of the region.

5. Previous work, as revealed in the literature and records search.

6. Results of the investigation shall include:

a. Description of field methods.

b. GIS data in meta-format, maps, and any photographs or drawings of landscape or artifacts.

7. Bibliography

8. Appendices

B. The report will be divided into easily discernible chapters, with appropriate page separations and headings. The report text will be typed, single-spaced on good quality bond paper, 8.5 inches by 11.0 inches, with 1.5 inch left and bottom margins and 1 inch top and right margins.

C. The report will use correct English grammar, and there will be no typographical errors.

D. All pages will be numbered consecutively, including the bibliography and attachments.

E. Any illustrations that might be done must be clear, legible, self-explanatory, and of sufficiently high quality to be reproduced easily by standard photocopy equipment. All photographs or drawings should be clear, distinct prints or copies with captions and a bar scale.

F. Maps shall be clean, clear, and easily reproducible. Maps must be labeled with a caption/description, north-oriented to the top of the page, and will contain a scale, north arrow, legend, township and range, map size and date, and map source (USGS quad name or published source). The features to be illustrated, such as site locations, shall stand out clearly against the other features on the map.

G. The report shall be organized in such a way that sensitive maps and information are contained in the appendix and can be removed from the report for review by the general public.

H. The final report shall include all Smithsonian Trinomial system site numbers.

I. Any photographs that might be taken shall be of good composition and free of extraneous material. Original prints (not machine copies) shall be in each copy of the report, securely bound into the report and identified as to subject, location, and date.

V. DELIVERABLES AND PERFORMANCE

A. Work Schedule

1. The Contractor is expected to pursue the study in a professional manner to meet the target dates. Six copies of the completed draft report shall be submitted to the Omaha District office. The draft report will be edited by the Contractor for spelling and grammatical errors prior to submittal.

2. The draft report will be completed by 30 July 2001. The Contractor shall include the review comments into the final report and submit the final report to the Government no later than 15 September 2001.

3. The Contractor shall complete the entire work and service to the Government's satisfaction by 15 September 2001.

4. The Contractor shall produce an original and six copies of the report for submission to the Omaha District office at the following address:

U.S. Army Corps of Engineers, Omaha District
ATTN: CEMRO-PM-AE
106 South 15th Street
Omaha, Nebraska 68102

B. Method of Payment

Payment for services rendered will be made as follows: Fifty percent (50%) of the contract price is payable upon the completion of the fieldwork. Twenty-five percent (25%) of the contract amount is payable upon receipt of the draft report by the Government. The remaining 25% will be paid upon the Government's acceptance of the final report.

February 6, 2002

Planning, Programs, and Project Management

Mr. Stan Wilmoth
Montana Historical Society
1410 Eighth Avenue
P. O. Box 201202
Helena, Montana 59620

Dear Mr. Wilmoth:

Due to new information from the engineering analysis of the Fort Peck flow modification mini test (mini test), we are again writing concerning the cultural resources compliance for the mini test.

Engineering analysis estimates that the average annual erosion rate will not be affected by the mini test, with the exception of the land directly across from the spillway. Areas which are currently eroding will continue to erode; areas which are not subject to erosion will not be affected. An archeological inventory has discovered that there are no sites directly across from the spillway. We recommend that the proposed mini text be considered for a No Historic Properties determination. Note: this concerns the mini test only. Full test coverage and compliance for the Missouri River Master Manual is addressed by the staff at our Regional Office.

Because of our commitment to the Fort Peck Tribes, we will continue to fund the cultural resource inventory.

Thank you for your assistance on this matter.

Sincerely,

Candace M. Gorton
Chief, Environmental, Economic and
Cultural Resource Section
Planning Branch

Copy Furnished:
CENWO-SA-NA (Hall)

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cmg 2/26/02
~~1. Larry~~
2. Becky O.

Montana Historical Society

225 North Roberts • P.O. Box 201201 • Helena, MT 59620-1201
• (406) 444-2694 • FAX (406) 444-2696 • www.montanahistoricalsociety.org •

Tuesday, February 19, 2002

Becky Otto
COE Omaha District
106 South 15th Street
Omaha Nebraska 68102-1618

Re: Mini Test Ft. Peck Flow Modification

Dear Becky:

We concur with your finding of No Properties Affected. Please submit a copy of the referenced negative cultural resource inventory when it is complete.

Stan Wilmoth, Ph.D.
State Archaeologist/Deputy SHPO

File COE 2002

State Historic Preservation Office • 1410 8th Ave • P.O. Box 201202 • Helena, MT 59620-1202
• (406) 444-7715 • FAX (406) 444-6575

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RESOLUTION #2262-2001-10

TRIBAL GOVERNMENT
Administrative

WHEREAS, The Fort Peck Tribal Executive Board is the duly elected body representing the Assiniboine and Sioux Tribes of the Fort Peck Reservation and is empowered to act on behalf of the Tribes. All actions shall be adherent to provisions set forth in the 1960 Constitution and By-Laws and Public Law #83-449, and

WHEREAS; the Army Corp of Engineers has proposed a Spring Rise on the Missouri River; and

WHEREAS; the Tribal Executive Board has requested a formal consultation with the Army Corp of Engineers and the Fish & Wildlife Programs; and

WHEREAS; this consultation will be to discuss the Revised Environmental Impact Statement; now

THEREFOR BE IT RESOLVED; that the Tribal Executive Board does hereby request a formal consultation with Army Corp of Engineers and the Fish & Wildlife Programs to discuss the Revised Environmental Impact Statement for the proposed Spring Rise on the Missouri River.

CERTIFICATION

I, the undersigned Secretary Accountant of the Tribal Executive Board of the Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation, hereby certify that the Tribal Executive Board is composed of 12 voting members of whom 11, constituting a quorum were present at a **Special** Board meeting duly called and convened on this 8th, day of **October, 2001** that the foregoing resolution was duly adopted at such meeting by the affirmative vote of 10 for.

APPROVED:

Jackie Miller
Secretary-Accountant\Secretary

Chairman\Vice Chairman
Fort Peck Tribal Executive Board

Superintendent
Fort Peck Agency

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cmy 7/25/03
1. Larry
3. Becky O.

STATE HISTORICAL SOCIETY OF NORTH DAKOTA

July 22, 2003

Candace M. Gorton, Chief
Environmental, Economics and Cultural Resources Section
Planning Branch
Department of the Army
Corps of Engineers, Omaha District
106 South 15th Street
Omaha, NE 68102-1618

ND SHPO Ref.: 90-0208, Fort Peck Flow Modification Project.

Dear Ms. Gorton:

We have reviewed your agency's correspondence of July 8, 2003 for Project: 90-0208, proposed Fort Peck flow modifications to increase the water temperature in the Missouri River downstream from Fort Peck Dam.

We concur that this proposed undertaking will not affect any National Register or National Register eligible sites in North Dakota.

Thank you for the opportunity to review this project. Please include the ND SHPO Reference number listed above in any further correspondence for this specific project. If you have any questions please contact Duane Klinner at (701) 328-3576.

Sincerely,

Merlan E. Paaverud, Jr.
State Historic Preservation Officer
(North Dakota)

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CULTURAL SITE INFORMATION

Cultural Resources Located in Montana

Site 24DW287/24RL204/24RL300/32MZ1174 is the Lower Yellowstone Irrigation Project. It has many site numbers, as it is located in several Montana and North Dakota Counties. Segments of this irrigation system are located within the inventory area. As it helped open up eastern Montana and western North Dakota to farming in the early part of the 1900s, the canal system is recommended as eligible for the National Register of Historic Places. The flow modification (minitest and test) will not impact this site.

Site 24MC1 is a bison processing camp and occupation site, located on an upland terrace on the south side of the Missouri River. This site is also recommended eligible for the National Register, based on its ability to yield additional information concerning communal bison procurement on this part of the plains. This site will not be impacted by the flow modification.

A remnant of the Great Northern Wiota to Fort Peck Railroad has been recorded as 24MC97. This site is eligible for the National Register of Historic Places (NRHP) under Criterion A, having contributed to the broad and sweeping patterns of the history of this country. It was a key element for the successful construction of Fort Peck Dam and Powerhouse, already listed on the NRHP. It is located about 49 feet above the current water levels. It will not be impacted by the Fort Peck Flow modification.

24MC29/24VL590 are the site numbers assigned to Fort Peck Dam, which spans the Missouri River between McCone and Valley Counties. This dam, the first of Franklin D. Roosevelt's New Deal projects, is listed on the NRHP as a National Historic Landmark. Besides the dam itself, there are many other features that contribute to the landmark nomination such as the powerhouse, the spillway, the intake tunnels, and the gatehouses. The dam will not be adversely impacted by the proposed flow modification. A monitoring program will determine if there will be any impacts to the spillway during the minitest.

The Carlisle Site is Site 24RL246, located in Richland County. It is a prehistoric bison-processing site recorded in 1997 by Brumley. The site was first recorded when the Corps was approached by Richland County to help them prevent their county road from being eroded by the Missouri River. At that time, it was exposed in the cutbank. Subsequent testing indicated that is was eligible for the NRHP. The site was not relocated during the recent inventory. The contractor suggested that the site be revisited and re-evaluated.

24RL247 is known as the Gallinger Ditch, an earthen irrigation ditch. It was probably built around the 1924-1935 time frame to provide irrigation for the DT Ranch. The DT Ranch was established by Joshua S. Day, a successful Sidney banker. Day ran large herds of cattle on his ranch, employing up to several dozen cowboys to manage his livestock. The site is not recommended as eligible for the NRHP as it does not meet any of the criteria.

Site 24RL248 was also recorded by Brumley in 1997, while investigating an area to be protected from bank erosion (please see also 24RL246). The site is described as containing two hearths, a bison processing area, and one historic foundation. The historic structure may have been part of a dugout dwelling. The prehistoric component of the site is eligible for the NRHP. This area has been stabilized for erosion control. There will be no impacts as a result of the flow modification.

The Snowden Bridge, Site 24RL86/24RL211, is a Parker through truss vertical lift bridge over the Missouri River. This Great Northern Railway Bridge was built in 1913 by the Waddell and Harrington engineering firm of Kansas City, Missouri. The vertical lift was designed to allow large ship traffic under the bridge. Later converted to accommodate vehicular traffic, a signal system was established and a toll was charged. The bridge is no longer in use. It is listed on the NRHP. The minitest for the flow modification will not impact the Snowden Bridge.

The Fort Union Trading Post National Historic Site (24RV50/32WI17) is the site of one of the most significant fur trading posts on the northern plains. Built in 1828 for the American Fur Company, the fort dominated the fur trade for the next several decades. Many early scientists and explorers visited Fort Union on the journeys along the Missouri. The list of visitors to the fort is a veritable Who's Who of early 19th century frontiersmen including John J. Audubon, Prince Maximillian and Karl Bodmer, George Catlin, Father Pierre DeSmet, Charles Larpenteur, Edwin Denig, and Jim Bridger. The fort is listed on the NRHP as a National Historic Site. It will not be affected by the proposed minitest for the Fort Peck Flow modification.

24RV438 is the Lewis and Clark Bridge, also known as the Wolf Point Bridge or the Macon Bridge. It is a Pennsylvania through truss bridge, built in 1930. It is still in active use and is currently listed on the NRHP. It will not be affected by the Fort Peck flow modification.

24VL1345 consists of a historic material scatter and terraces of the north bank of the Missouri River. It is near the town of Park Grove and may have been associated with individuals living nearby. It is not eligible for the NRHP, nor will it be affected by the flow modification.

Site 24VL1686 is a barge and slipway structure that was built for the construction of Fort Peck Dam. The barge is believed to be the remains of the four dredging units built in the early 1930s to slurry the hydraulic fill for the dam itself. Since it retains integrity of setting location, materials, and association, it is recommended as eligible for the NRHP. The barge remains will not be impacted by the proposed flow modification.

24MC401 is a barge located in the Missouri River. Like 24VL1686, this structure contributed to the New Deal construction of the Fort Peck Dam. With this association and integrity of location, it is recommended as eligible for the NRHP. The Fort Peck Flow Modification will not impact this site.

Site 24MC402 is a prehistoric site with chipped stone debris, pottery, and bone. It is recommended for listing on the NRHP because it has the ability to yield additional information important to the prehistory of the northern plains. This site may be impacted by the proposed flow modification. A monitoring program will be in place during the minitest to determine if there are any impacts.

24MC403 is also a prehistoric site. Located on the southern bank of the Missouri River, it contains considerable bison bone. This may be the location of a bison kill site. The site is recommended for the NRHP, based on the surface observations and interviews with key informants. It will not be impacted by either the minitest or the test for the Fort Peck flow modification.

24MC405/24VL1734 is a set of graded slopes cut into both sides of the river at the former location of a ferry crossing (Government Land Office maps, 1908). No other indications of the ferry remain. It is not recommended as eligible for the NRHP. It will not be impacted by the flow modification.

Site 24MC406 is a historic material scatter approximately 100 feet from the riverbank. Local informants have identified the area as either the remains of the short-lived Fort Charles (a trading post 1861-1864) or an old stockade. It may also be the remains of "Indian log cabins", as identified on the 1895 Missouri River Commission maps. It may be eligible for the NRHP with further testing. At this time the eligibility is unknown. The site is far enough from the river that it will not be impacted, in either case.

24RL254 is a historic house, an associated outhouse, and a collapsed shed. Located on the southern floodplain of the Missouri River, the site is approximately 13 feet from the river cutbank. It does not retain integrity and is not recommended for eligibility to the NRHP.

A historic latrine has been recorded as 24RL301. This wood frame outhouse probably dates to 1916 but is not recommended for NRHP eligibility.

Site 24RL302 is a historic trash scatter. It is not recommended for NRHP eligibility.

24RV597 is a prehistoric cultural material scatter. Bison bone and chipped stone flaking debris were identified on the surface. Based on the density and variety of surface debris, the site is recommended as eligible for the NRHP, with the ability to yield additional information. A cutbank which leads to the Missouri River is located approximately 33 feet to the south of the site. It will not be impacted by the proposed flow modification.

Site 24RV599 is a set of 17 wood pylons, likely the remains of a temporary bridge used to construct the Lewis and Clark Bridge. As this structure has lost its integrity, it is not recommended for NRHP eligibility.

24VL1709 is the Fort Peck Irrigation Project, part of which is located within the inventory area. The irrigation project consists of two units, the Wiota Unit and the Frazer-Wolf Point Unit. The total system has the potential to irrigate approximately 25,000 acres of farmland. The site retains integrity of setting, design, location, materials, workmanship, feeling, and association. It is recommended as eligible under Criterion A. It will not be impacted by the flow modification.

Site 24VL1728 is a prehistoric cultural material scatter along a steep cutbank on the north side of the Missouri River. Knife River Flint and Tongue River Solicified Sediment make op the flaking debris at the site. Fire-cracked rock and bison (?) bone are also present. This may have been a small encampment. This site is recommended as eligible for the NRHP under Criterion D, the ability to yield additional information important to the prehistory of the northern plains. This site may be impacted by the flow modification. A monitoring program will determine if there are any impacts during the minitest.

24VL1729 is a historic trash scatter. It is not recommended as eligible for the NRHP.

Site 24VL1730 is a prehistoric cultural material scatter. The site has already been impacted by a two-track road and cultivation. It is unlikely that this site retains enough integrity for significance. It is not recommended as eligible for the NRHP.

24VL1731 is a historic trash scatter along two terraces of the Missouri River. It is not recommended as eligible for the NRHP.

Site 24VL1732 is a dumping ground for cars. Eight or nine 1930s-1940s abandoned cars and numerous associated car parts comprise the site. Remnants of an old wagon and wagon wheel are also located at the site. The site is not recommended as eligible for the NRHP.

24VL1733 is a historic cultural material scatter, probably associated with an industrial complex located west of the Fort Peck boatyard. Further testing is recommended to determine if the site can be recommended for the NRHP.

24VL1735 consists of wooden pylons and a large historic cultural material scatter located on an island. The pylons measure about 1 foot in diameter and are 18 feet tall. It is likely that these pylons are the remains of a dredge pipe support structure. Additional testing is recommended to determine whether this site can be recommended as eligible for the NRHP.

<u>Cultural Resources Located in North Dakota</u>

The Mondrian Tree Site, 32MZ58, is already listed on the NRHP. It is a multi-component cultural material scatter and has been occupied intermittently for approximately 5000 years. Dennis Toom and Mike Gregg (1983) excavated the site during the construction of the Northern Border pipeline in the early 1980s. Much of the site was impacted by pipeline construction. A gaging station and an irrigation ditch have impacted the rest of the site. It has been impacted by the pipeline but will not be impacted by the proposed flow modification.

Fort Buford, 32WI125, was an Army fort from 1867 to 1895. Originally constructed as a base for the protection of Euroamerican travelers, it was also strategically placed at the confluence of the Missouri and the Yellowstone Rivers. From this vantage point, the soldiers could also try to stem the flow of guns and liquor to the Indians, as well as establishing a staging area for the U.S. military campaigns against the Sioux and Northern Cheyenne. Finally, it was a place where Indian prisoners were assembled before they were transported to Fort Yates. Soldiers from the fort were also given the tasks of preventing cattle rustling and protecting the construction workers who were building the Northern Pacific railroad. The fort is listed on the NRHP. Since no cultural materials were found within the flow modification corridor (150 feet wide), the proposed undertaking will have no effect on the site.

A water-pumping station and a segment of irrigation canal are recorded as 32WI56. This site is part of the Buford-Trenton irrigation project. It is recommended as eligible for the NRHP, having been built in the early 1900s and retains considerable integrity. Irrigation enabled Euroamericans to settle the west and begin farming and ranching. This site will not be impacted by the proposed flow modification.

Site 32WI903 consists of a disturbed human skeleton with associated bison bone along the north bank of the Missouri River. The remains were found near the base of a back-dirt pile that was the result of excavation of a new house foundation. The North Dakota State Historic Preservation Office, the McKenzie County coroner and sheriff were contacted. The remains were given to the State archeologist for repatriation. The NRHP eligibility of this site is unknown. It has been severely disturbed or destroyed by construction activities. If anything remains of the site, it may be recommended as a Traditional Cultural Property.

32WI904 consists of six features: a relocated ~1910 house, a playhouse (circa 1992), a garage (circa 1992), a dog kennel (circa 1992), a tool shed (circa 1992), and a prefab shed (also circa 1992). The house has been moved from Epping, then to Williston, then to it's current location, according to the owner. As such it does not retain integrity of location, design (numerous additions), setting, materials, workmanship, feeling, association, and no longer conveys it's historic character. All the other structures are of recent origin. This site is not eligible for the NRHP as the house does not retain integrity of setting. It will not be impacted by the proposed flow modification.

APPENDIX E
DATA COLLECTION AND MONITORING PLANS

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Summary of Pallid Sturgeon-Related Studies in the Missouri River Below Fort Peck Dam

and

Fort Peck Flow Modification Biological Data Collection Plan
(Draft 6/20/2001)

Pat Braaten
U.S. Geological Survey

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Background

The pallid sturgeon *Scaphirhynchus albus* is a long-lived (> 40 years; Keenlyne and Jenkins 1993) species endemic to the Missouri River, lower Mississippi River, and large tributaries entering these river systems (Bailey and Cross 1954). Extensive habitat alterations have occurred throughout the geographical range of pallid sturgeon, and resulted in the designation of pallid sturgeon as an endangered species in 1990 (Dryer and Sandvol 1993).

One of the few remaining concentrations of pallid sturgeon occurs in the upper Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea, North Dakota. Individuals in this population also inhabit the lower Yellowstone River in Montana and North Dakota (Bramblett 1996). Similar to pallid sturgeon in other regions, long-term viability of the pallid sturgeon population in the Missouri River downstream from Fort Peck Dam is in jeopardy. It is hypothesized that regulated flows from Fort Peck Dam coupled with a suppressed water temperature regime during the spring and early summer spawning period have failed to provide adequate spawning cues for pallid sturgeon. In addition, cold water releases from Fort Peck Dam have limited the amount of riverine habitat suitable for spawning. As a consequence, natural reproduction and recruitment of pallid sturgeon have not occurred for several years as evidenced by a population comprised of large (e.g., > 1200 mm; > 8 kg; Liebelt 1996, 1998) and presumably old individuals.

The U.S. Army Corps of Engineers (USACE) proposes to modify operations of Fort Peck Dam following specifications outlined in the Missouri River Biological Opinion (U.S. Fish and Wildlife Service 2000). Modified dam operations are proposed to increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon and other native fishes. In contrast to "normal" cold water releases through the dam, water from Fort Peck Reservoir will be released over the spillway during flow modifications to enhance water temperature conditions. In 2001, the USACE is proposing to conduct a mini-test of the flow modification plan to evaluate structural integrity of the spillway and other engineering concerns. A full-test of the flow modifications is proposed for 2002 when a maximum of 19,000 cfs will be routed through the spillway. Spillway releases will be accompanied by an additional 4,000 cfs released through the dam. The full-test will be followed by two years (2003, 2004) of "normal" dam operations whereby cold water will be released through the dam. All proposed flows are dependent on adequate inflows to Fort Peck Reservoir and adequate water levels in the reservoir.

The USACE contracted with the U.S. Geological Survey (USGS) to facilitate development of a monitoring program that will be used between 2001 and 2004 to examine the influence of the proposed flow modifications on physical habitat and biological response of pallid sturgeon and other native fish species. Components of the monitoring program include: 1) monitoring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements by pallid sturgeon, 3) examining movements of paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus*, 4) quantifying larval fish, and 5) examining food habits of piscivorous fishes. Several studies have examined various aspects of pallid sturgeon biology and ecology in the Missouri River downstream from Fort Peck Dam and in the lower Yellowstone River (Clancey 1990, 1991,1992, Tews and Clancey 1993; Tews 1994; Bramblett 1996; Liebelt 1996, 1998, 2000a). In addition, the Montana Department of Fish, Wildlife and Parks (MTFWP) implemented a monitoring plan in 2000 (Liebelt 2000b). Information generated by the MTFWP monitoring plan in 2000, in conjunction with results from earlier studies, provides baseline conditions to which biological responses to flow modifications can be compared.

This first portion of this document provides an overview of the study area and summary of pallid sturgeon - related studies in the Missouri River downstream from Fort Peck Dam. The second portion of this document discusses components of the monitoring plan, and provides the rationale and methods for each monitoring component.

Description of the Study Area

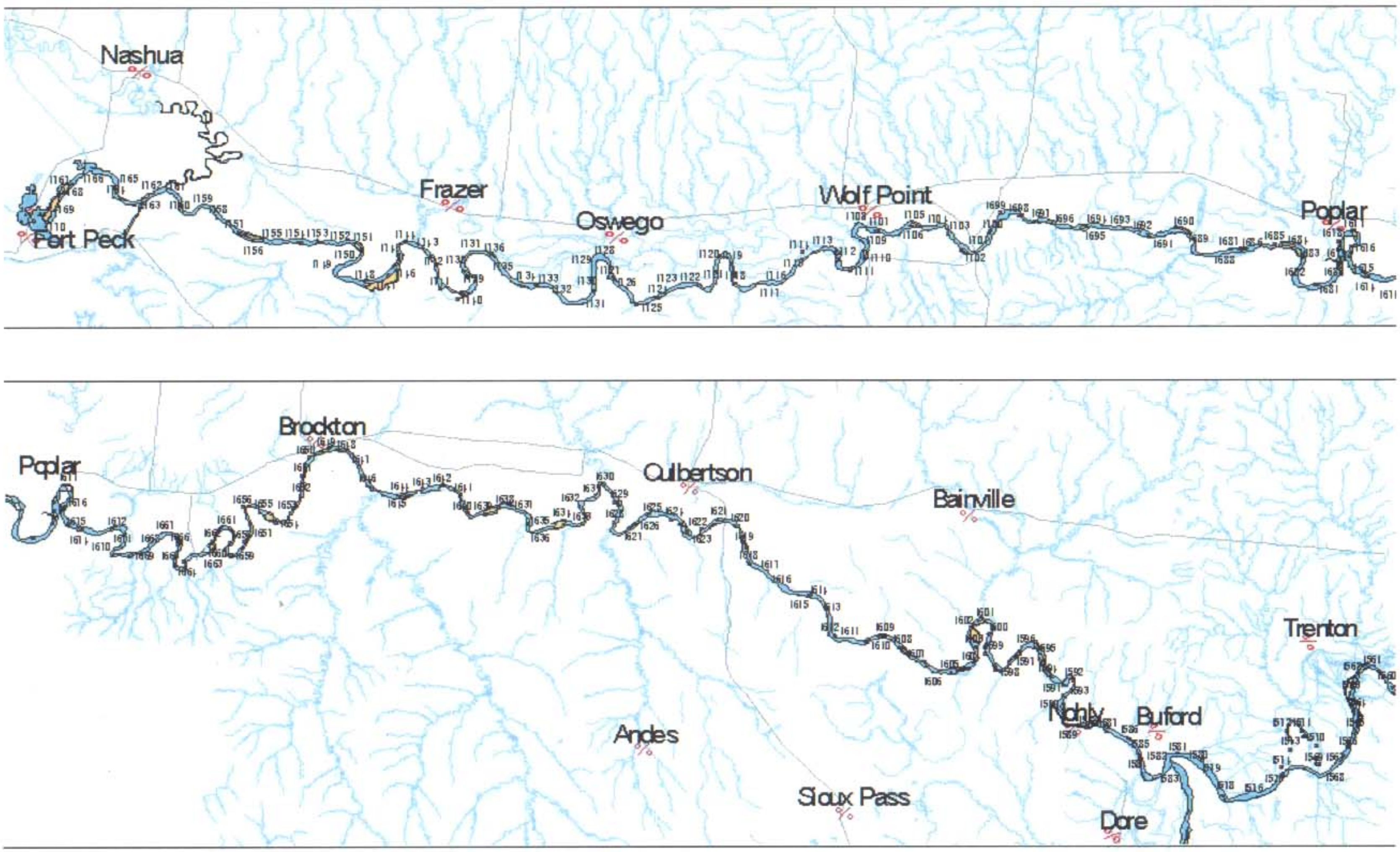
The Missouri River between Fort Peck Dam and the Yellowstone River (Figure 1) was described in detail by Gardner and Stewart (1987) and Tews (1994). Fort Peck Dam is operated as a peaking facility which contributes to daily fluctuations in water levels and atypical seasonal flows (Frazer 1985; Gardner and Stewart 1987; Clancey 1989; Tews 1994). Inputs from tributaries (e.g., Milk River) seasonally augment discharge in the Fort Peck reach. The reach from Fort Peck Dam to Wolf Point is generally characterized as erosional due to altered sediment dynamics. Although this area was likely depositional prior to dam construction (Gardner and Stewart 1987; Bramblett 1996), several areas of gravel and cobble are concentrated between the Milk River and Frazer (Gardner and Stewart 1987; Figure 1). Turbidity is much reduced downstream from the dam, but sediment contributions from the Milk River and other tributaries seasonally elevate turbidity (Gardner and Stewart 1987). The river downstream from Wolf Point is characterized as depositional with numerous shifting sand bars. Despite depositional characteristics, several gravel bars also occur in this reach. For example, Gardner and Stewart (1987) identified 14 gravel areas between Wolf Point and Nohly varying in length from 61 m to 183 m (200 - 600 yards). Liebelt (1996) similarly identified gravel and cobble areas near Nohly.

Hypolimnetic releases (cold water drawn from about 57 m below the surface; Gardner and Stewart 1987) through Fort Peck Dam have significantly altered the thermal regime of the Missouri River downstream from Fort Peck Dam. For example, Gardner and Stewart (1987) found mean water temperature between June and September was 19.4° C in the Missouri River upstream from the reservoir, 11.4° C downstream from the dam, 14.9° C at Wolf Point, and 16.1° C near Culbertson. Thus, although water temperature increases longitudinally downstream from the dam, mean temperature remains suppressed 3.3° C - 8.0 ° C below ambient conditions upstream. The suppressed water temperature regime in the Fort Peck reach provides the primary impetus for the Fort Peck flow modification plan.

The Yellowstone River joins the Missouri River about 200 miles downstream from Fort Peck Dam (Figure 1). In contrast to the Missouri River, the lower 71 miles of Yellowstone River exists in a relatively natural state and is characterized by natural discharge, temperature, and sediment regimes (White and Bramblett 1993). Gravel substrates are common in the upper reaches of the lower Yellowstone River; whereas, sand is more common in the lower reaches (White and Bramblett 1993; Bramblett 1996). A diversion dam is located 71 miles upstream from the mouth.

The Missouri River downstream from the confluence of Yellowstone River regains some semblance of natural conditions due to inputs from the Yellowstone River (Bramblett 1996). Sandbars are common in this reach, and depth can exceed 11 m (Tews 1994). Lotic conditions of the Missouri River downstream from the Yellowstone River are dependent on water levels in

Figure 1. Missouri River below Fort Peck Dam.
The Yellowstone River enters the Missouri River at river mile 1582.



Lake Sakakawea, and vary from about 15 miles at full pool to greater than 31 miles at lower water levels (Tews 1994; Bramblett 1996).

Collections and Sightings of Pallid Sturgeon

Pallid sturgeon have been collected at more than 280 locations in the Fort Peck reach and lower Yellowstone River (Table 1). Capture locations are differentially distributed among three areas representing the Missouri River between Fort Peck Dam and the Yellowstone River (4.5%), the Yellowstone River (24.0 %), and Missouri River downstream from the Yellowstone River confluence (71.5 %). The disproportionate number of pallid sturgeon collected in the three areas is probably attributable to several factors including variations in sampling intensity among areas, differences in habitat suitability among areas, and differences in sampling related to specific study objectives. For example, concentrations of pallid sturgeon in the Yellowstone River confluence area during fall and spring are targeted for brood stock and propagation efforts (Krentz 2000).

Most collections (or sightings) of pallid sturgeon in the Missouri River upstream from the Yellowstone River occurred just below Fort Peck Dam during winter. The number of pallid sturgeon sightings below the dam has varied from year to year (Tews 1994): 1988 (4), 1989 (5), 1990 (2), 1991 (21), 1992 (0), and 1993 (3). The number of different pallid sturgeon observed below the dam during this time period varied from two to three. In recent years, Liebelt (1998) similarly reported three pallid sturgeon were caught by SCUBA below the dam. In addition to collections near the dam, pallid sturgeon have also been sampled or caught by anglers in other areas of the Missouri River between Fort Peck Dam and the Yellowstone River. One pallid sturgeon was caught by an angler near Poplar/Brockton on May 19, 1990 (Table 1). The angler also reported that in past years three other pallid sturgeon were caught in this area during spring (Clancey 1991). Tews and Clancey (1993) reported that a pallid sturgeon was caught by an angler near Culbertson (river mile 1623) in July 1992 (Table 1). A hatchery-reared juvenile pallid sturgeon was recaptured near Nohly in 1999 (river mile 1589.1; Table 1; Liebelt 2000a)

Pallid sturgeon collections in the Yellowstone River occurred primarily during April (28 collections), May (22 collections) and June (10 collections; Table 1). Although pallid sturgeon have been located throughout the lower Yellowstone River, most collections have occurred in the lower 10 miles of the river.

In the Missouri River between the Yellowstone River and Lake Sakakawea, pallid sturgeon have been collected primarily during April (44 collections), September (89 collections), and October (44 collections; Table 1). A total of 25 pallid sturgeon collections have occurred in this area between May and August.

Table 1. Date, location (river mile), length (mm), and weight (kg) of pallid sturgeon collected and observed in the lower Yellowstone River and Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea. River miles delineate collection locations in the Missouri River upstream from the Yellowstone River confluence (river mile 1582-1770), in the Missouri downstream from the Yellowstone River confluence (river mile < 1582), and in the Yellowstone River (river mile 0-86; Y designates Yellowstone River). Collections records are based on field sampling and angler catches compiled from Clancey (1990, 1991, 1992), Tews and Clancey (1993), Tews (1994), Liebelt (1996, 1998, 2000a), and the U.S. Fish and Wildlife Service pallid sturgeon data base (Steve Krentz, personal communication).

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
3	10	89	1769	1483	15.0
3	10	89	1769	1537	24.0
3	21	89	1770	1321	13.2
2	10	90	1770	1494	20.0
5	19	90	Poplar/Brockton	1746	
9	13	90	1577	1379	15.0
9	13	90	1577	1397	15.9
9	14	90	1575	1455	17.7
9	17	90	1575	1448	18.1
1	26	91	1769	1240	12.7
2	2	91	1769	1247	10.4
5	31	91	1577	1356	23.0
6	5	91	1577	1479	19.1
6	11	91	71Y		8.6
7	18	91	86Y	1341	11.4
9	22	91	1564	1320	17.0
9	23	91	1576	1480	22.7
9	23	91	1575	1220	13.4
9	24	91	1546	1465	28.6
9	24	91	1546	1207	10.2
10	10	91	1577	1311	11.8
4	10	92	1574	1567	22.2
6	17	92	2Y	1336	12.7

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
7	14	92	1623		
8	15	92	1560		
9	15	92	1568	1600	24.5
9	30	92	1573	1242	10.6
9	30	92	1573	1478	18.4
9	30	92	1573	1463	
9	30	92	1573	1090	6.8
9	30	92	1573	1524	22.2
9	30	92	1573	1402	15.9
9	30	92	1573	1463	19.7
9	30	92	1573	1481	19.7
10	6	92	1573	1334	12.2
10	6	92	1573	1336	14.7
10	6	92	1573	1539	19.5
10	6	92	1573	1303	12.7
10	7	92	1568	1359	10.8
10	7	92	1570	1359	14.1
10	8	92	1573	1463	19.0
10	8	92	1573	1399	15.8
10	8	92	1573	1338	12.9
10	19	92	1573	1366	16.1
10	19	92	1573	1402	16.6
10	19	92	1573	1308	10.8
10	19	92	1573	1407	13.6
10	19	92	1573	1415	17.0
10	21	92	1566	1486	19.3
10	21	92	1568	1445	14.3
10	21	92	1568	1265	11.6
10	22	92	1574	1359	12.2
10	22	92	1574	1123	8.4

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
10	22	92	1574	1389	13.6
10	27	92	1573	1478	17.9
10	27	92	1573	1341	13.6
10	29	92	1573	1422	15.6
3	20	93	1770	1524	17.4
4	15	93	1566	1385	13.8
4	15	93	1566	1514	20.2
4	22	93	0.5Y	1373	15.0
4	23	93	0.5Y	1566	28.1
4	24	93	2Y	1365	14.5
4	25	93	9Y	320	4252
4	27	93	9.5Y	1317	12.5
5	16	93	3Y		
5	21	93	71Y		
5	30	93	9Y		
9	9	93	1577	1305	12.7
9	10	93	1580	1280	11.3
9	11	93	1580	1525	29.9
9	11	93	1576	1515	23.6
9	12	93	1577	1371	14.1
9	14	93	1580	1379	18.6
9	14	93	1574	1410	17.5
9	14	93	1564	1425	12.4
9	16	93	1580	1292	10.8
9	28	93	1573	1525	20.6
9	28	93	1573	1430	16.8
9	28	93	1573	1325	15.9
9	28	93	1574	1519	18.4
9	29	93	1573	1400	14.5
9	29	93	1573	1275	12.0

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
10	5	93	1569	1143	16.8
4	27	94	1579	1525	
4	29	94	7Y	1295	
4	30	94	10.5Y	1405	17.2
5	15	94	9Y		
5	18	94	67.1Y	1384	18180
5	21	94	71Y		
6	5	94	1580	1294	11.6
6	8	94	69.8Y	1094	8.2
6	14	94	70Y	981	3.8
6	14	94	5.5Y	1450	14.7
6	15	94	5.5Y	1366	12.2
6	15	94	5.5Y	1373	13.8
6	15	94	5.5Y	1240	10.4
6	16	94	7.5Y	1346	11.3
6	16	94	6.5Y	1219	10.0
8	11	94	1521		
8	11	94	1521		
8	11	94	1521		
8	12	94	1521		
9	7	94	1575	1358	12.5
9	7	94	1579	1613	32.0
9	21	94	1580	1638	34.5
9	22	94	1577	1625	
9	22	94	1576	1489	22.7
9	22	94	1577	1409	16.8
9	22	94	1575	1300	10.4
9	22	94	1575	1488	20.0
9	22	94	1575	1388	13.8
9	22	94	1575	1300	14.5

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
9	23	94	1575	1413	20.2
9	23	94	2Y	1222	8.8
9	24	94	1564	1363	20.7
9	24	94	1564		
9	24	94	1564	1425	17.5
9	24	94	1556	1388	14.5
9	25	94	1564	1444	18.2
9	25	94	1564	1456	22.5
9	25	94	1564	1405	12.7
9	25	94	1564	1345	17.0
9	25	94	1564	1310	15.0
9	25	94	1564	1456	22.0
9	26	94	1564	1356	18.2
9	26	94	1564	1275	
9	26	94	1559	1406	21.1
9	26	94	1554	1450	18.2
9	26	94	1554	1350	15.4
9	27	94	1564	1356	13.6
9	27	94	1564	1363	12.7
9	27	94	1564	1245	10.0
9	27	94	1564	1263	11.8
9	27	94	1564	1300	12.7
9	27	94	1564		
9	28	94	1578	1315	12.3
9	28	94	1575	1459	29.7
9	28	94	1575	1325	12.5
9	28	94	1575	1500	23.4
9	28	94	1575		
9	28	94	1575	1381	16.1
9	28	94	1574	1181	12.5

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
10	5	94	1578	1495	23.1
10	5	94	1575	1524	24.9
10	5	94	1575	1312	11.3
10	6	94	1574	1319	13.2
10	6	94	1575	1315	14.1
11	15	94	1564	1280	12.5
11	15	94	1564		
11	15	94	1564		
11	16	94	1575	1375	14.5
4	24	95	3Y	1430	18.1
4	24	95	1579	1475	21.8
4	26	95	4Y	1500	21.3
4	26	95	4Y	1630	26.8
4	27	95	9.5Y	1412	17.5
4	27	95	9Y	1490	22.2
5	18	95	5Y	1353	14.1
5	31	95	10Y	1400	16.3
5	31	95	10Y	1204	10.4
5	31	95	10Y	1475	23.6
8	24	95	1579	1306	14.5
8	24	95	1579	1346	17.0
8	24	95	1579	1477	20.0
9	29	95	1579	1384	14.7
9	29	95	1579	1412	15.4
9	29	95	1578	1365	15.6
10	2	95	1566	1170	14.1
10	10	95	1579	1330	13.6
10	10	95	1579	1340	15.9
10	11	95	1577	1399	18.1
10	11	95	1577	1410	16.6

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
10	12	95	1579	1507	27.2
10	12	95	1579	1550	29.0
2	18	96	1770	1552	23.1
3	19	96	1770	1522	23.1
3	20	96	1770	1319	13.6
5	1	96	5Y	1277	14.1
5	13	96	1577	1503	26.3
5	13	96	5Y	1467	18.6
5	14	96	9.5Y	1450	18.6
5	15	96	9.5Y	1377	15.2
8	28	96	1578	1452	16.3
8	28	96	1578	1320	12.7
8	28	96	1578	1398	16.8
8	28	96	1574	1432	18.1
9	17	96	1577		
9	19	96	1578	1453	
9	20	96	1564.5		
9	20	96	1564.5		
9	24	96	1582	1335	11.8
9	25	96	1577	1356	11.8
10	16	96	1579.5		
9	25	96	1578	1545	24.9
4	22	97	0.5Y	1424	19.4
4	23	97	0.5Y	1527	15.4
4	23	97	0.5Y	1470	24.5
4	24	97	6Y		29.9
4	25	97	6Y		15.4
4	26	97	6Y	1390	17.2
4	26	97	6Y		16.3
4	26	97	6Y	1442	17.7

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
4	27	97	6Y		27.2
4	27	97	6Y		
4	27	97	6Y		18.6
5	30	97	1581.5		
8	3	97	1552.5		16.3
8	17	97	1552.5		29.5
9	16	97	1578		20.9
9	21	97	1556.4		15.9
9	23	97	0Y		27.2
9	23	97	0Y		24.0
9	24	97	1576.5		15.9
9	25	97	0Y	1438	17.0
9	25	97	0Y		23.1
10	15	97	0Y		21.8
10	15	97	0Y		23.6
10	21	97	1581.5	1350	13.2
10	21	97	1581.5	1425	17.4
10	21	97	1581.5	1456	19.1
10	21	97	1581.5	1547	21.4
4	14	98	0Y	1435	15.0
4	15	98	0.5Y	1375	
4	16	98	0.5Y	1450	20.9
4	20	98	1578		
4	20	98	1578		
4	21	98	0Y	1165	11.3
4	22	98	1578		
4	28	98	5Y	1413	21.8
8	6	98	1582		
8	11	98	1581		
8	11	98	1578		

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
9	20	98	1554		
9	22	98	1581.5	1328	12.2
9	29	98	1564		11.4
9	30	98	1573	1600	29.5
10	5	98	1578	1365	14.1
10	6	98	1581.5	1550	29.5
4	12	99	1581.5	1365	14.1
4	13	99	1581.5	1296	13.6
4	13	99	1581.5	1403	14.1
4	13	99	1581.5	1356	17.7
4	13	99	1581.5	1500	23.2
4	14	99	1581.5	1397	15.4
4	14	99	1581.5	1546	22.7
4	14	99	1581.5	1365	16.3
4	14	99	1581.5	1553	23.1
4	15	99	1581.5		21.3
4	15	99	1581.5		13.6
4	15	99	1581.5		
4	15	99	1581.5	1476	23.1
5	4	99	3Y	303	0.0867
5	4	99	3Y		
5	5	99	14.5Y	1450	16.3
5	5	99	11.1Y	337	0.1276
5	19	99	5.2Y	1245	10.0
5	19	99	Fairview bridge in Yellowstone River		
5	20	99	1589.1		
7	7	99	8.5Y	447	0.2783
7	16	99	1552.2		

Month	Day	Year	Location or River mile	Fork length (mm)	Weight (kg)
8	4	99	1554	1429	18.2
8	26	99	1581.5	1445	19.0
4	11	00	1581.5	1580	25.0
4	11	00	1581.5	1521	25.0
4	11	00	1581.5	1352	12.7
4	11	00	1581.5	1515	22.7
4	11	00	1581.5	1367	12.3
4	11	00	1581.5	1520	20.9
4	12	00	1581.5	1448	14.1
4	12	00	1581.5	1308	12.3
4	12	00	1581.5	1468	20.4
4	12	00	1581.5	1444	14.5
4	12	00	1581	1293	11.4
4	13	00	1581.5	1516	25.9
4	13	00	1581.5	1578	24.1
4	13	00	1581.5	1060	5.3
4	13	00	1581.5	1461	17.7
4	13	00	1581.5	1295	15.0
4	17	00	1581.5	1404	16.3
4	18	00	1581.5	1469	19.1
4	18	00	1581.5	1278	12.7
4	18	00	1581.5	1425	20.4
4	18	00	1581.5	1223	13.2
4	18	00	1581.5	1262	10.0
4	18	00	1581.5	1542	27.7
5	3	00	5.4Y	1482	19.5
5	28	00	72Y	1320	13.2

Catch Rates of Pallid Sturgeon

In 1990, the MTFWP initiated standardized sampling of pallid sturgeon in the Missouri River and lower Yellowstone River. Clancey (1992) established nine study sections (Table 2) that have subsequently been used during recent pallid sturgeon studies (e.g., Tews 1994; Liebelt 1996, 1998, 2000a). Sections 1-5 represent sampling areas in the Missouri River between Fort Peck Dam and the Yellowstone River. Sections 6 and 7 represent sampling areas in the Missouri River between the Yellowstone River and Lake Sakakawea. Sections 8 and 9 represent sampling areas in the lower 71 miles of the Yellowstone River.

Table 2. Sections, river miles, and descriptions of study areas for the Missouri River below Fort Peck Dam and the Yellowstone River.

Study section	River miles	Description
1	1770-1761	Fort Peck Dam to Milk River
2	1761-1708	Milk River to Wolf Point
3	1708-1683	Wolf Point to Redwater River
4	1683-1630	Redwater River to Big Muddy River
5	1630-1582	Big Muddy River to Yellowstone River
6	1582-1553	Yellowstone River to Highway 85 bridge
7	1553-1530	Highway 85 bridge to Lake Sakakawea
8	71-30	Yellowstone River from Intake to Highway 23 bridge
9	30-0	Yellowstone River from Highway 23 bridge to mouth

Catch rates of pallid sturgeon at standardized sampling sites varied greatly among different study sections (Table 3). Between 1990 and 1996, highest catch rates occurred in section 6 of the Missouri River downstream from the Yellowstone River (0.3 - 0.9 pallid sturgeon/h) and in sections 8 and 9 of the Yellowstone River (0 - 0.2 pallid sturgeon/h; Table 3). In sections 1-5 of the Missouri River between Fort Peck Dam and the Yellowstone River, no adult pallid sturgeon were reported during standardized sampling. Liebelt (2000a) reported catch rates for 1999 standardized sampling varied between 0.06 pallid sturgeon/net (Yellowstone River sections combined) and 0.12 pallid sturgeon/net (all Missouri River sections combined). Although Liebelt (2000a) reported that all pallid sturgeon in Missouri River sections were captured at river mile 1583.5 (1.5 miles upstream from the Yellowstone River confluence), subsequent examination of the pallid sturgeon data base maintained by the U.S. Fish and

Wildlife Service (Steve Krentz) indicated these individuals were collected at river mile 1581.5 (downstream from the Yellowstone River confluence). Thus, the catch rate of 0.12 pallid sturgeon/net reported for Missouri River sections during 1999 probably represents the catch rate for section 6. For the Yellowstone River and Missouri River downstream from the Yellowstone River, Krentz (2000) reported catch rates of 0.47 pallid sturgeon/h (Fall 1997), 0.62 pallid sturgeon/h (Spring 1998), and 0.41 pallid sturgeon/h (Spring 1999).

Table 3. Catch rates (number/h) of pallid sturgeon sampled in study sections of the Missouri River and lower Yellowstone River. Number of pallid sturgeon sampled, total number of sampling hours, and total number of net drifts are listed in parenthesis. See Table 2 for Study section descriptions.

	Study sections			
Study period	1 - 5	6	8 - 9	Reference
1990-1993	0	0.9	0.15	Tews (1994)
	(0, 41.6, 329)	(46, 52.7, 427)	(4, 26.9, 249)	
1994	0	0.5	0.2	Liebelt (1996)
	(0, 12.9, 91)	(9, 16.5, 106)	(1, 6.1, 41)	
1995	0	0.6	0.1	Liebelt (1996)
	(0, 14.5, 97)	(12, 19.7, 125)	(1, 12.3, 71)	
1996	0	0.3	0	Liebelt (1998)
	(0, 9.2, 218)	(7, 23, 151)	(0, 4, 32)	

Although catch rates of pallid sturgeon vary among study sections, all study sections have not been sampled with the same intensity (Table 3). For example, between 1990 and 1996, sampling intensity averaged 24 net drifts/section/year (sections 1-5), 122 net drifts/section/year (section 6), and 26 net drifts/section/year (sections 8-9). Given the greater length of river encompassed by sections 1-5, these results suggest sections 1-5 have been under-sampled relative to the other study sections.

Movements of Pallid Sturgeon

Movements of pallid sturgeon in the Missouri River and lower Yellowstone River have been examined via telemetry and summarized by several investigators (Clancey 1990; Tews and Clancey 1993; Tews 1994; Bramblett 1996). Pallid sturgeon used in telemetry studies included individuals originally collected and fitted with transmitters in the Fort Peck tailwaters and individuals collected and fitted with transmitters in other downstream areas.

Clancey (1990) reported movements of three pallid sturgeon originally tagged in the Fort Peck tailwaters during March 1989. Two of the three pallid sturgeon tagged in this study exhibited downstream movements after being tagged. For example, one individual was relocated downstream from the Milk River between late March and May. This individual was subsequently relocated at river mile 1736 (river miles are approximate) on June 5 and river mile 1732 on June 14. The second pallid sturgeon exhibiting downstream movement was relocated downstream from the Milk River between late March and April, and also relocated on May 5 (river mile 1749), May 16 (river mile 1722), May 23 (river mile 1694), May 24 (river mile

1689), and June 14 (river mile 1662). Pallid sturgeon moving downstream were located on the north side of the river where turbid inflows from the Milk River increased turbidity in the Missouri River (Clancey 1990). The transmitter on the third pallid sturgeon tagged in the Fort Peck tailwater did not function; however, this individual was subsequently caught twice in the tailrace, once by an angler (April 28) and once by gillnet (August 25).

More comprehensive reports of the spatial and temporal dynamics of pallid sturgeon movements throughout the Missouri River and lower Yellowstone River were provided by Tews and Clancey (1993), Tews (1994), and Bramblett (1996). Bramblett (1996) partitioned the movement periods of pallid sturgeon into four seasons corresponding to spring (March 20 - June 20), summer (June 21 - September 22), Fall (September 23 - December 20), and winter (December 21 - March 19). During spring, 75% of the locations occurred in the lower 28 km of the Yellowstone River and 15% of the locations occurred in the Missouri River downstream from the Yellowstone River confluence. Only one pallid sturgeon originally tagged at the dam was relocated at the dam. Relocations of pallid sturgeon in summer were similar to spring except 39% of the locations occurred in the Missouri River downstream from the Yellowstone River confluence. Four relocations of pallid sturgeon in the Missouri River upstream from the Yellowstone River occurred in summer, and except for the individual that resided at the dam, individuals occurred as far upstream as river mile 1714 (near Wolf Point). During Fall, 96% of all observations occurred in the Missouri River downstream from the Yellowstone River. One pallid sturgeon during Fall was relocated near river mile 1659 (near Brockton). During winter, all observations of pallid sturgeon locations occurred in the Missouri River downstream from the Yellowstone River.

Tews (1994) and Bramblett (1996) provided summaries of the pallid sturgeon movement patterns. For individuals originally tagged near the Yellowstone River confluence, four general movement patterns were identified: 1) movement from the Missouri River to the Yellowstone River in April and May, 2) residency in the Yellowstone River during May, June, and July, 3) movement into the Missouri River/Yellowstone River confluence in late summer, and 4) little movement during winter. In contrast, pallid sturgeon tagged in the Fort Peck tailrace exhibit different movement patterns. These individuals either move downstream in April or reside year-round in the tailrace.

Larval Fish Sampling

Larval fish have been sampled at several sites and areas in the Missouri River downstream from Fort Peck Dam to examine reproductive success of pallid sturgeon and other native fishes. Several studies reported larval sturgeon as *Scaphirynchus sp.*, but positive identifications to date indicate larvae were shovelnose sturgeon (M. Ruggles, MTFWP). In 1978, the MTFWP sampled larval fishes in the Missouri River just upstream from the Milk River confluence, but no larval sturgeon were collected (Needham 1979). Gardner and Stewart (1987) collected 339 samples between 1979 and 1982, but did not find any *Scaphirynchus* larvae. Clancey (1991) sampled larvae in river section 9 (see section descriptions in Table 2), but sampling was unsuccessful. Tews and Clancey (1993) sampled larvae on three dates (June 21, July 15, July 16) in section 9, but no sturgeon eggs or larvae were collected. Liebelt (1996) collected 87 samples in 1995 from three sections (2, 3, 5) on four sampling dates (6/23-6/29, 7/8-7/14, 7/21-7/28, 8/2-8/10); four *Scaphirynchus* larvae were collected in section 5 (near Nohly, river mile 1589). In 1995, 176 larval samples were collected on eight dates (5/18, 5/30-6/1, 6/15-6/16, 6/27-6/29, 7/11-7-13, 7/20, 7/26-7/28, 8/2-8/10) in sections 5, 6, and 9 (Liebelt 1996). Twenty-two *Scaphirynchus* larvae were collected, and distributed among section 6 (12 individuals), section 9 (9 individuals), and section 5 (1 individual). In 1996, 250 larval samples were collected in sections 1-5, 6, and 9 on six sampling dates (5/30-6/6, 6/12-6/21, 6/25-7/2, 7/9-7/12, 7/19-7/26, 7/28-8/7). Three *Scaphirynchus* larvae were collected in section 9 (Liebelt 1998). In 1999, larvae were sampled on eight dates (5/19, 5/20, 6/7, 6/14, 6/29, 6/30, 7/15, 7/16) in section 5 (14 samples), section 6 (4 samples), and section 9 (38 samples; Liebelt 2000a). Only one *Scaphirynchus* larvae was collected during 1999, and this individual was collected in section 5.

Existing Pallid Sturgeon Monitoring Program

In 2000, the MTFWP implemented a monitoring plan supported by the Western Area Power Administration (WAPA) designed to collect baseline information and evaluate the influence of modified flow releases on pallid sturgeon and other native fishes in the Missouri River downstream from Fort Peck Dam (Liebelt 2000b). The WAPA-supported monitoring plan includes larval fish sampling, and sampling and habitat quantification of pallid sturgeon and other native fishes. The monitoring plan includes 8-10 fixed sites located between the Fort Peck tailwaters (river mile 1765.8) and Poplar River (river mile 1679; Figure 1). Larval fish and older life stages of pallid sturgeon and other fishes are sampled 1-2 times/month at each site between May and August. One to three samples are collected at each site during each sampling interval.

Fort Peck Flow Modification Physical and Biological Data Collection Plan

The Fort Peck Flow Modification Physical and Biological Data Collection Plan (presented in the next section) will be implemented during 2001, 2002, 2003 and 2004 to examine the influence of modified dam operations on physical habitat characteristics, and to evaluate biological response by pallid sturgeon and other native fishes to modified dam operations. Components of the Data Collection Plan include: 1) monitoring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements by pallid sturgeon, 3) examining movements of paddlefish, blue suckers, and shovelnose sturgeon, 4) quantifying larval fish, and 5) examining food habits of piscivorous fishes. The Data Collection Plan augments the existing WAPA-supported monitoring plan, and includes several monitoring components not addressed in the WAPA-supported monitoring plan. Information obtained from monitoring activities between 2001 and 2004 will be used to direct future pallid sturgeon monitoring activities.

1. Water temperature and turbidity

Objective: Determine the influence of modified dam operations on water temperature and turbidity in the Missouri River downstream from Fort Peck Dam

Success Criteria: The Missouri River Biological Opinion (USFWS 2000) mandates that a minimum water temperature of 18°C (64.4°F) be established and maintained at Frazer Rapids (river mile 1746) via spillway releases.

Rationale: Spawning by pallid sturgeon is thought to occur as water temperature approaches 18°C (USFWS 2000). In addition to this water temperature requirement, pallid sturgeon larvae require an extensive length of free-flowing riverine habitat to complete their 8-13 day larval drift period (Kynard et al. 1998). Existing conditions in the Missouri River downstream from Fort Peck Dam do not fulfill these requirements. Inadequate water temperatures inhibit spawning, and the length of riverine habitat available for larval drift dynamics is insufficient between spawning areas and the headwaters of Lake Sakakawea. Increasing water temperature to 18°C at Frazer Rapids will not only improve suitability for spawning in the upper reaches of the river, but also significantly increase the length of riverine habitat available to drifting larvae. An assessment of water temperature is needed to characterize the influence of spillway releases and tributary inputs on the longitudinal water temperature regime of the Missouri River downstream from Fort Peck Dam. In addition, water temperature data collected during the study will be used by the USACE to develop water temperature/discharge models for the Missouri River below Fort Peck Dam.

Turbidity is an important water quality variable influencing the distribution and habitat use of pallid sturgeon. Pallid sturgeon are predominantly found in highly turbid waters (Bailey and Cross 1954), and there is evidence suggesting pallid sturgeon prefer areas of high turbidity in the Missouri River (Erickson 1992). In addition to altered discharge and thermal regimes, reduced turbidity in the Missouri River downstream from Fort Peck Dam (Dieterman et al. 1996; Young et al. 1997) may inhibit use of this area by pallid sturgeon. Modified dam operations will likely increase turbidity in the Missouri River downstream from Fort Peck Dam and enhance suitability of this reach for pallid sturgeon. An assessment of turbidity is needed to quantify the influence of modified dam operations on turbidity.

Design and

Analysis: Continuous recording (1-h intervals) water temperature loggers will be installed at several locations in the Missouri River and tributaries during 2001, 2002, and 2003 (Table 4). Data collected in the Missouri River near Landusky (upstream from Fort Peck Reservoir) will characterize the natural thermal regime of the Missouri River, and provide estimates of ambient water temperature conditions that would be expected below Fort Peck Dam under natural conditions. At all mainstem Missouri River sites below the Milk River, a water temperature logger will be positioned near the right and left bank to characterize lateral variations in water temperature across the river channel. This will be most prevalent at locations downstream from tributaries. Water temperature loggers will be positioned in the lower 0.25 m of the water column to maintain consistency with previous monitoring studies. At all Missouri River sites, a water temperature logger will also be positioned in a mid-water column location to characterize vertical variations in water temperature. Water temperature loggers will be installed by April 15 and retrieved October 15. Water temperature data will be downloaded from each logger at monthly intervals. Deployment locations will be recorded with a GPS unit (latitude, longitude).

Continuous recording (1-h intervals) turbidity loggers (turbidity recorded as nephelometric turbidity units; NTU) will be installed during 2001, 2002, and 2003 at four sites. The sites will be located near Frazer Rapids (river mile 1746), Nohly (river mile 1589), in the lower three miles of the Yellowstone River, and at one additional site (to be determined). Turbidity loggers will be positioned mid-stream (where logistically feasible) at a mid-water column location. Turbidity loggers will be deployed by May 1 and retrieved by August 1.

Table 4. Approximate river and tributary locations where water temperature loggers will be deployed during 2001, 2002, and 2003.

River	Location or river mile	River	Location or river mile
Missouri River	Landusky	Missouri River	1724.6
Musselshell River	Mosby	Missouri River	1701.5
Missouri River	1765.2	Redwater Creek[b]	
Spillway[a]		Missouri River	1680.0
Milk River[b]		Poplar River[b]	
Beaver Creek[c]		Missouri River	1653.1
Missouri River	1759.9	Big Muddy Creek[b]	
Missouri River	1757.5	Missouri River	1630.0
Missouri River	1751.5	Missouri River	1620.9
Missouri River	1746.0	Yellowstone River	Lower 3 miles
Missouri River	1741.5	Missouri River	1576.4
Prairie Elk Creek[b]			

a - temperature logger will be placed downstream from plunge pool
b - temperature logger will be placed upstream from any backwater effects of the Missouri River
c - tributary to Milk River

Major equipment needs and specifications:

35 water temperature loggers

(Optic StowAway, -5°C – 37°C, Part No. WTA32-05+37, Onset Computer Corporation)

2 optic shuttles

(Part No. DTA128B, Onset Computer Corporation)

2 optic base stations

(Part No. DSA, Onset Computer Corporation)

3 turbidity loggers "Sondes"

(Part No. 6920 Sonde with self-cleaning turbidity sensor, 6067 attachment cable, YSI Incorporated)

2. Movements of pallid sturgeon

Objective: Examine movements of pallid sturgeon inhabiting the upper Missouri River adjacent to Fort Peck Dam

Rationale: In 2000, the U.S. Fish and Wildlife Service initiated a USACE-supported pallid sturgeon telemetry study designed to evaluate the influence of modified flow releases from Fort Peck Dam on movements of pallid sturgeon. A detailed study plan for this research is presented by the USFWS (2001), and briefly summarized as follows. Ten pallid sturgeon (2 females, 8 males) originally collected from the confluence area of the Missouri River and Yellowstone River were spawned in 2000, surgically implanted with combined acoustic/radio transmitters (CART tags), and released during Fall 2000. Movements of these individuals, in conjunction with additional pallid sturgeon tagged in subsequent years, will be monitored for several years to evaluate the influence of modified flow releases from Fort Peck Dam on movement patterns and behavior. In addition to traditional field-based tracking methods, the USFWS will use shore-based fixed logging stations to monitor movements of pallid sturgeon. Fixed logging stations will be positioned during Spring 2001 at three locations: 1) in the Missouri River downstream from the Yellowstone River (near river mile 1578, 4 miles downstream from the Yellowstone river confluence), 2) in the Missouri River upstream from the Yellowstone River confluence (near river mile 1589, 7 miles upstream from the Yellowstone River confluence), and 3) in the lower 2 miles of the Yellowstone River. If pallid sturgeon movements range upstream to the fixed logging station located at river mile 1589 (Missouri River upstream from the Yellowstone River) during the full-test, the movement will be considered a positive response to the Fort Peck flow modifications (USFWS 2001).

The sample population of pallid sturgeon used in the existing USFWS study does not include individuals currently residing in the Missouri River upstream from the Yellowstone River confluence. Thus, inclusion of individuals from the upper reaches of the river will expand the inference population, and provide a better understanding of pallid sturgeon movements and movement patterns. In addition, use of these individuals will expand the baseline information on use by pallid sturgeon of the upper Missouri River between Fort Peck Dam and the Yellowstone River. Results will be compared to those from Clancey (1990) who found pallid sturgeon tagged near the dam tended to move downstream during spring and early summer.

The locations of fixed logging stations in the USFWS study are concentrated in the lower reaches of the Missouri River and Yellowstone River. Additional fixed logging stations are needed in the upper reaches of the river to better quantify movements of pallid sturgeon between Fort Peck Dam and the Yellowstone River.

***Design and analysis*:** Pallid sturgeon often reside in the tailwaters of Fort Peck Dam during winter, and can be captured by SCUBA. In March 2001, SCUBA will be used to collect a maximum of 10 pallid sturgeon, if available, from the tailwaters of Fort Peck Dam. Individuals will be implanted with CART tags identical to those used in the USFWS study. Movements by these individuals will be monitored by boat every 3-4 days after initial tag implantation, and continue through early July in collaboration with the USFWS study. Two additional fixed logging stations will be acquired in Spring 2001, and positioned in the Missouri River near river mile 1620 (near Culbertson) and river mile 1702 (near Wolf Point). These stations will also be used during the full-test (2002) and subsequent years. Five additional fixed logging stations will be acquired in 2002. Following radio tracking protocols outlined in the USFWS study plan (USFWS 2001), data logging stations will be checked prior to initiation of boat tracking to facilitate detection of riverine reaches or areas where pallid sturgeon are likely to occur. Attributes measured at pallid sturgeon locations will follow those outlined by the USFWS study (USFWS 2001). In addition to relocating pallid sturgeon, drifting trammel nets (22.9 m x 1.8 m, 2.54 cm inner mesh, 15.2 cm outer mesh) will be fished over pallid sturgeon locations to sample for individuals potentially aggregated with radio tagged pallid sturgeon.

Data collected from pallid sturgeon tagged below Fort Peck Dam will be used to determine use of the upper reaches of the Missouri River prior to the full-test. The statistical component of the USFWS study is currently being developed (USFWS 2001), and will be expanded to include pallid sturgeon tagged below the dam if these individuals relocate to the lower reaches of the river.

Major equipment needs:
(all items listed below, except trammel nets, will be acquired through Lotek Wireless Incorporated)
10 CART 32_1s transmitters
3 W7AS data logging receivers
5 ultrasonic upconverters
5 omnidirectional hydrophones
5 baffles
3 antenna switch boxes
1 handheld antenna
5 Yagi antennas
16 50 ohm terminators
2 Environmental enclosure kits

20 B and C connectors
1 Crimp tool for connectors
Coaxial cable (1000 ft)
Trammel nets (22.9 m x 1.8 m, 2.54 cm inner mesh, 15.2 cm outer mesh, several suppliers)

3. Movements of paddlefish, blue sucker, and shovelnose sturgeon

Objective: Examine the influence of Fort Peck Dam operations on directional movements of native Missouri River fishes

Rationale: The reproductive characteristics of several native Missouri River fishes including paddlefish, blue sucker, and shovelnose sturgeon are similar to those exhibited by pallid sturgeon. For example, paddlefish, blue sucker, and shovelnose sturgeon are migratory during the spawning season, respond to discharge and thermal regimes as cues for spawning migrations, and spawn in gravel substrates (Breder and Rosen 1966; Needham 1979; Berg 1981; Penkal 1981; Moss et al. 1983; Hurley et al. 1987; Gardner and Stewart 1987; Bramblett 1996; Pflieger 1997). Collections of larvae and juveniles by Liebelt (1996) indicate that paddlefish, blue sucker, and shovelnose sturgeon exhibit some degree of spawning success under existing operations of Fort Peck Dam; however, there is evidence to suggest that spawning may occur primarily in tributaries (Needham 1979; Needham and Gilge 1983; Gardner and Stewart 1987; Liebelt 1996) where discharge and thermal regimes are more similar to natural conditions. This hypothesis similarly applies to pallid sturgeon for which spawning conditions are more suitable in the Yellowstone River than in the Missouri River. Minimal or lack of spawning by paddlefish, blue sucker, and shovelnose sturgeon in the mainstem Missouri River downstream from Fort Peck Dam probably reflects the decreased suitability of the river resulting from hypolimnetic releases and the unnatural discharge regime. Clancey (1989) hypothesized that high discharges in the Missouri River relative to the Milk River may promote spawning in the Missouri River; whereas, high discharges in the Milk River relative to the Missouri River may promote spawning in the Milk River. Given these considerations, the information gained by examining behavior and movement responses in paddlefish, blue sucker, and shovelnose sturgeon will complement that obtained for pallid sturgeon, and provide a better understanding of how native fishes respond to modified discharge releases. In addition, the use of paddlefish, blue sucker, and shovelnose sturgeon is warranted due to the limited population size of pallid sturgeon in the Missouri River downstream from Fort Peck Dam, and the difficulty of procuring sufficient numbers of pallid sturgeon for research needs.

Design and analysis: Twenty paddlefish, blue suckers, and shovelnose sturgeon will be collected during fall 2001 and 2002, and surgically implanted with CART tags. CART tags used will be fully compatible with shore-mounted data logging stations used for recording movements of pallid sturgeon (described earlier).

Individuals implanted with transmitters will be tracked between May 1 and June 30 during 2002 (full-test) and 2003 (no-test). Implementation of spillway releases during the full-test will likely not occur until late May. Thus, tracking during early May will provide an initial location of individuals prior to spillway releases. Locations will be monitored every 1-4 days to provide detailed information on fish locations and movements prior to and in response to the full-test (2002) or no test releases (2003). Fish tracking will be conducted primarily by boat, and locations determined via triangulation (Winter 1996). Information from shore-mounted logging stations will also be used to supplement movement data collected in the field. Data collected at all locations where individuals are observed will include: date, time of day, latitude, longitude, river mile (or distance up tributary if applicable), water temperature, turbidity, depth, velocity, and substrate type.

Two hypotheses will be tested to evaluate the influence of dam operations on movements of paddlefish, blue sucker, and shovelnose sturgeon:

Hypothesis 1: The frequency of upstream fish movements will be greater during the full-test (2002) than no-test year (2003).
A Chi-square test will be used to compare the proportion of directional movements of individuals (upstream, downstream, none) between years of different dam operations (full-test, no-test). An analysis will also be conducted to compare directional movements before the spillway is operating (early May) and during spillway operation (late May through June).

Hypothesis 2: The frequency of fish observations in the Missouri River will be greater than in the tributaries during the full-test (2002) than no-test year (2003).
A Chi-square test will be used to compare the proportion of observations in different habitats (Missouri River, tributaries) between years of different dam operations (full-test, no-test).

Major equipment needs:
60 CART tags (exact size to be determined, Lotek Wireless Incorporated)
Telemetry receivers and fixed logging stations as described in monitoring component 2 (above)
Trammel nets, experimental gill nets, hoop nets, and boat electrofishing apparatus (several suppliers carry these items)

4. Larval fish sampling

Objective: Examine the influence of Fort Peck Dam operations on spawning success and larval fish abundance

Rationale: The naturalized discharge and temperature regime resulting from the full-test is expected to enhance spawning success of fishes in the Missouri River downstream from the Fort Peck spillway (e.g., Needham 1979; Gardner and Stewart 1987). Therefore, a temporally intensive larval fish sampling regime is necessary to adequately quantify spawning success. Although larval fish are currently sampled under the existing WAPA-supported monitoring plan (Liebelt 2000b; Appendix 1), funding constraints limit the frequency at which larval fish are sampled (e.g., 1-2 times/month). This study will augment the existing larval fish sampling program, and provide a better understanding of spawning dynamics and the temporal distribution of larval fish in response to changes in operations of Fort Peck Dam.

Design and analysis: Larval fish will be collected during 2001, 2002, and 2003 at sites located immediately downstream from the spillway (river mile 1762), immediately downstream from the Milk River (river mile 1761), near Wolf Point (river mile 1701-1711), Nohly (river mile 1583 - 1592), and in the lower Yellowstone River (river mile 0-3). Water contributions from the Milk River and spillway remain closely associated with the north (Milk River) and south (spillway) banks of the river channel for several miles downstream (Gardner and Stewart 1987); therefore, larvae collected from these sites will quantify spawning success specific to each area. Samples will be collected every third day at each site between May 15 and July 31. A minimum of three replicates will be collected at each site. At sites immediately downstream from the Milk River and spillway, each replicate will be comprised of two samples, each sample collected from the right and left sides of the boat. For the Wolf Point, Nohly, and Yellowstone River sites, each replicate will be comprised of four samples: two samples (right and left side of the boat) collected from the left and right shorelines. Drift nets (0.5-m-diameter, 750 μm mesh) will be fished on the bottom for 15 minutes when possible (e.g., when detrital loads are low). Larval drift nets will be fitted with a velocity meter for use in calculating water velocity and volume of water sampled. Larval fish abundance will be expressed as density (number/m^3). Larval sturgeon collected in the samples will be sent to Dr. Darrel Snyder (Larval Fish Laboratory, Colorado State University) for species identification.

A three-way analysis of variance will be used to compare densities of larval fish among years (2001, 2002, 2003), sampling periods (May 15-July 31), and among sites (downstream from spillway, downstream from Milk River, Wolf Point, Nohly). The Yellowstone River site will be analyzed individually using a two-way analysis of variance (year x sampling period) because this site will not be directly influenced by the Fort Peck modified flow releases. Nonetheless, intensive larval sampling in the lower Yellowstone River is needed due to its potential suitability as a spawning area for pallid sturgeon (Bramblett 1996).

Constraint: The temporally intensive larval sampling regime will provide a thorough evaluation of the influence of modified flow regimes on spawning success and larval abundance of most species; however, the limited number of spawning female pallid sturgeon in the Missouri River below Fort Peck Dam significantly reduces the likelihood that pallid sturgeon larvae will be collected. Therefore, the absence of larval pallid sturgeon cannot be used to indicate a "lack of spawning response" by pallid sturgeon to the flow modifications.

Major equipment needs:
(several suppliers carry these components)
4 0.5 meter nets (750 μm mesh)
4 0.5 meter net rings and bridles
4 collecting buckets (3 ½ inch diameter, 750 μm mesh)
3 water velocity meters for nets (Model 2030R, General Oceanics, Incorporated)

5. Food habits of piscivorous fishes

Objective: Examine the food habits of piscivorous fishes in the Missouri River downstream from Fort Peck Dam

Rationale: The USACE held a series of public scoping meetings in Montana during Fall 2000 at which the public was invited to express their thoughts and concerns regarding the proposed flow modifications at Fort Peck Dam. Officials from the USACE were informed by local landowners in the region that young-of-the-year sturgeon have been observed in the stomach contents of sport fish (primarily walleye *Stizostedion vitreum* and northern pike *Esox lucius*) caught in the Missouri River. The observations by local landowners of sturgeon in the diet of large piscivorous fishes occurred during and after observations of "hundreds" of small sturgeon in some tributaries to the Missouri River.

Previous food habit studies on potential predators in the Missouri River below Fort Peck dam have not documented piscivory on young-of-the-year sturgeon. For example, Gardner and Stewart (1987) found the diet of sauger *Stizostedion canadense* included goldeye *Hiodon alosoides*, flathead chub *Platygobio gracilis*, fathead minnow *Pimephales promelas*, white sucker *Catostomus commersoni*, sauger, and freshwater drum *Aplodinotus grunniens*. Food habits of burbot *Lota lota* included fathead minnow, emerald shiner *Notropis atherinoides*, white crappie *Pomoxis annularis*, goldeye, burbot, shorthead redhorse *Moxostoma macrolepidotum*, and sauger (Gardner and Stewart 1987). The diet of shovelnose sturgeon below Fort Peck dam is comprised primarily of aquatic invertebrates (Gardner and Stewart 1987; Liebelt 2000), but may include cyprinids (Liebelt 2000a). Sheik et al. (1998) reported that white crappie in a backwater of the Missouri River in North Dakota consumed fishes. In backwater habitats of the Missouri River downstream from the Yellowstone River, Moon et al. (1998) found goldeye consumed larval fishes; however, larval fish occurred in only 2.5% of the stomach and composed less than 0.1% by number of the total items found in the diet. The opportunistic behavior of predatory fishes poses the possibility that young-of-the-year sturgeon, if available, could be consumed. According to reports received at public scoping meetings, the incidence of sturgeon in the diet is very sporadic which may partially account for the fact that piscivory on sturgeon has not been reported in earlier food habit studies.

Design and analysis: The food habits of potential piscivores including walleye, sauger, northern pike, burbot, goldeye, channel catfish, freshwater drum, and shovelnose sturgeon will be quantified during 2001 and 2002. A minimum of 30 individuals from each species will be collected each month between late June and August. Individuals will be collected from two different areas representing the Missouri River above and below the Yellowstone River confluence. An independent examination of predator food habits in each area is necessary because susceptibility of young-of-the-year sturgeon to predators may vary between areas due to differences in turbidity and abundance of young-of-the-year sturgeon between areas. Predators will be sampled from all available habitats using a variety of gears (e.g., electrofishing, seining, trammel netting, gill netting). Stomach contents of predator fishes will be removed either by dissection (lethal) or by flushing the stomach with a gastric lavage (non-lethal). Young-of-the-year sturgeon found in the diet will be shipped to Dr. Darrel Snyder (Larval Fish Laboratory, Colorado State University) for species identification. The diet of piscivorous fishes will be quantified by the presence/analysis of sturgeon, frequency of occurrence of sturgeon and other taxa, and percent composition by number of sturgeon and other taxa (Bowen 1996).

Major equipment needs:
Trammel nets, experimental gill nets, hoop nets, and boat electrofishing apparatus (several suppliers carry these items)

Contractor Responsibilities and Deliverables

The contractor will purchase all equipment and conduct all tasks in accordance with methods and equipment specified in the five monitoring components listed above. For the water temperature monitoring component, the USACE will purchase 35 water temperature loggers and deliver these to MTFWP for their use in water temperature monitoring. The additional 35 water temperature loggers purchased for the Data Collection Plan will be used as necessary by MTFWP such as to replace loggers damaged by river conditions and to increase the number of water temperature collection sites. The equipment used for tracking movements of pallid sturgeon as listed on page 23 will be furnished to MTFWP by the USFWS.

Progress reports including research data and analyses will be submitted to the USACE and WAPA on a quarterly basis (March 31, June 30, September 30, December 1). In addition, monthly activity reports will be prepared and submitted to the USACE and WAPA. A final project report will be submitted to the USACE and WAPA by March 31, 2005.

Quality assurance representatives from the USACE will periodically accompany MTFWP during monitoring activities to perform quality assurance inspections during the course of the monitoring program. The MTFWP will provide the quality control for their monitoring activities. The MTFWP shall submit, through WAPA to the Omaha District USACE, a quality control plan that includes as a minimum data collection procedures and processes, personnel qualification, training, and safety.

Confidentiality: All data collected, analysis of data, etc. performed under this agreement is the property of the USACE, and is considered provisional until accepted by the Omaha District USACE. Neither WAPA nor the MTFWP will publish, report, or in any way disseminate information generated under this agreement without permission from the Omaha District USACE.

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Montana Department of Fish, Wildlife and Parks

Proposal for Monitoring the Missouri River Fisheries and Habitat Parameters Before, During, and After Fort Peck Spillway Releases (J. E. Liebelt, 2000)

Introduction:

Tentative plans are to release 15,000 cfs to 20,000 cfs from the Fort Peck Spillway into the Missouri River during May/June in 2001. The purpose is to mimic historical natural hydrograph events to some degree. It is surmised releases from the spillway will increase downstream water temperatures, thereby aiding reproduction of warmwater fish species and also increase available habitat by filling side channels and backwater nursery areas. Other possible benefits from increased flows may be scouring of the river channel, establishment of woody vegetation such as cottonwoods along the river bank, and sloughing and erosion of river banks. This provides nutrients and sediments that are important to the overall health of a river system and which would normally occur during a natural hydrograph. Sandbars created or added to by the increased sediment load will provide additional habitat for shorebirds and other wildlife after the water recedes.

Establishment of baseline information prior to spillway releases is necessary in order to determine and measure possible benefits to the fisheries community and river habitats needed by various fish species to survive and prosper. Sustained spillway releases in the past, as in 1975, 1976, and 1997, resulted in major migrations of fish into the spillway and immediate river areas as well as emigration of fish from Fort Peck Reservoir.

A combination of methods designed to sample fish relative to various flow and habitat conditions is needed to collect meaningful baseline data. It is felt a modified Benthic Fish Sampling system would provide the best means of collecting information before, during, and after spillway discharges occur.

Methods:

Seven sites/areas have been selected for monitoring the effects of spillway discharge. A combination of drift nets, stationary gill nets, benthic trawl, bag seine, hoop net, electrofishing, and larval sampling will be used to gather data. Sites selected (see maps) are: Anderson Island (RM 1765.8), Spillway (RM 1762.8), Milk River confluence (RM 1761.0), Nickels rapids (RM 1757.5), Grandchamps/Frazer rapids (RM 1741.5), Wolf Point (RM 1701.5), Poplar/Redwater (RM 1679-1681). Sampling areas were selected based on proximity to the spillway, accessibility, potential influence of spillway discharges, and habitat considerations.

The Anderson Island area is upstream from the spillway confluence and will serve as a control site since this area will not be directly influenced by spillway discharges. The Milk River confluence area is about 1.5 miles downstream across from the spillway confluence and should be monitored in order to compare possible changes in fish species composition and numbers before, during, and after discharges occur. The Milk River attracts large numbers and species of fish during the spring, particularly in "good" water years and may provide comparisons between "natural" river flows and river flows during spillway discharges. The Nickels rapids area, about 5.3 miles below the spillway, has a number of interesting physical features. There is a small rapids area, large boulders, woody snags, a relatively long, deep run and side channels. Also, this area should be strongly affected by the warmer water temperatures from the spillway discharges. The Grandchamps/Frazer rapids area, over 20 miles downstream from the spillway, also has interesting habitat features including a deep, boiling run below the rapids which should concentrate fish and provide comparisons with upstream sampling sites. There are also side channels in the area, which under higher flows, will provide additional habitat for fish. The Wolf Point area, some 60 miles downstream from the spillway, may show subtle changes in fish numbers and composition in response to the increased flows and water temperatures from the spillway. The Poplar/Redwater area, about 83 miles downstream from the spillway, will serve as the lower control site. The spillway discharge should be well mixed by the time the river reaches this area and a more natural state, relative to water temperatures, should prevail.

Temperature loggers have been installed at all proposed sampling sites and are programmed to record water temperatures at one hour intervals. Additional loggers have also been installed in the Spillway Channel (surface, 6-feet, 12-feet depths), the Milk River near the confluence (RM 3), Nohly Bridge (RM 1589), and the lower Yellowstone River (RM 10). This will provide additional support data concerning temperature comparisons among the rivers.

One other consideration regarding spillway releases should be addressed: Emigration of Fort Peck Reservoir fish directly into the Missouri River. It is suspected relatively large numbers of fish including walleye, chinook salmon, lake trout, cisco, and other species, are drawn to the discharge and find their way to the spillway channel and Missouri River. Walleye tagged in the reservoir were caught in the Missouri River after the 1975, 1976, and 1997 spillway releases. After the 1997 releases, adult chinook salmon were observed spawning in a side channel of the Missouri River several miles upstream from the spillway confluence during October. There is little doubt they emigrated from Fort Peck Reservoir. Lake trout and large numbers of cisco were also observed and caught by fishermen in the Aspillway hole≅, immediately below the spillway during and after discharges were terminated in 1997. This emigration could be ignored but would result in a **major** data bias relative to species composition and numbers of fish captured during and after releases.

An electrical grid or other type of barrier system (strobe lights, sonic, or combination) in the reservoir spillway channel should be installed to deter fish emigration from the reservoir. The Corps of Engineers and/or Western Area Power Administration should be responsible for the installation and maintenance of a barrier system. The concrete-lined channel is approximately 1,000 feet wide and about 12 feet deep at the present reservoir level of 2234 msl (end of May, 2000).

Sampling procedure and schedule:

Site 1 - Anderson Island

Sample one to two times per month; May through August

Gear: 3-drift trammel nets
- 3-bottom trawls
- 2-bag seines
- 2-electrofish runs
- 2-hoop nets
- 1-stationary experimental gill net if suitable site found
- 2-larval samples

Site 2 - Spillway Channel and Missouri River (Right Bank)
Sample one to two times per month; May through August

Spillway - pre discharge
Gear: 2-stationary experimental gill nets
2-electrofish runs
2-bag seines

Spillway - discharging:
Gear: 2-stationary experimental gill nets
3-electrofish runs
2-hoop nets
3-drift trammel nets
2-larval samples
Seining and trawling are not possible with spillway discharging

Spillway - post discharge
Gear: Same as pre discharge

Missouri River - Right bank immediately below spillway confluence
Gear: 1-stationary experimental gill net if suitable site found
2-electrofish runs
1-hoop net
2-bag seines
3-drift trammel nets
2-larval samples
3-bottom trawls

Site 3 - Milk River and Missouri River - Left bank below confluence
Sample one to two times per month; May through August
Milk River above confluence:
Gear: 1-stationary experimental gill net
2-electrofish runs

Missouri River below Milk River confluence:
Gear: 1-stationary experimental gill net if suitable site found
2-electrofish runs
1-hoop net
2-bag seines
3-drift trammel nets
2-larval samples
3-bottom trawls

Site 4 - Nickels Rapids

Sample one to two times per month; May through August

Gear: 3-drift trammel nets
3-bottom trawls
2-electrofish runs
1-hoop net
2-bag seines
2-larval samples
1-stationary experimental gill net if suitable site found

Site 5 - Grandchamps/Frazer Rapids

Sample one to two times per month; May through August

Gear: Same as Sites 3 and 4

Site 6 - Wolf Point; Site 7 - Poplar/Redwater

Sample once each month; May through August

Gear: Same as Sites 3,4,5

Sampling protocol and gear:

Protocol

All fish captured by drift netting, stationary experimental gill nets, hoop nets, electrofishing and trawling will be identified, weighed and measured; shovelnose sturgeon and blue sucker will be tagged with numbered cinch tags. Any pallid sturgeon captured will be treated according to guidelines and protocol relative to pallid sturgeon. Electrofishing will not be used to sample fish if concentrations of sturgeon/paddlefish are present in the sampling area in order to avoid possible physical damage to the fish.

Fish captured by seining will be identified and counted. A sample may be weighed and measured if needed.

Larval fish samples will be transferred to glass jars and preserved in 10 percent formalin/phloxine-B dye. Sorting of larval fish, eggs, and aquatic invertebrates will be done later at Fort Peck. Fish will be identified to family/genus/species using larval fish keys and unknown specimens will be sent to the larval fish laboratory at Colorado State University for species ID.

Gear

1. Trammel nets: 75-feet x 6-feet with 1-inch bar inner mesh 6-inch bar outer mesh. Nets will be drifted with the aid of one or two boats, depending on current velocities, for up to 10 minutes. All drifts will be timed using a stopwatch.

2. Stationary experimental gill nets: 125-feet x 6-feet with five 25-foot panels, one each of 3/4-, 1-, 1 1/4-, 1 1/2-, 1 3/4-, 2-inch bar mesh. Nets will be fished for varying times depending on location and river conditions.

3. Hoop nets: 3 1/2-feet mouth diameter, 1-inch bar mesh; will be fished overnight unless location or river conditions require earlier removal.

4. Bottom trawl: 2-feet x 6-feet frame x 15-feet long equipped with rubber rock hopper gear; 1/8-inch outer chafe net and inner liner with 6 1/2-inch cod end diameter. Trawl will be pulled downstream by boat for up to four minutes per trawl.

5. Bag seine: 35- x 6-feet with mud line bottom, 3/16-inch knotless Ace mesh and 6- x 6- x 6-foot bag. Seine will be waded along suitable shoreline for approximately 50 yards and landed on shore for examination of catch.

6. Larval nets: 1/2-meter diameter, 4:1, 750-um Nitex mesh, 11-feet long, equipped with 3 1/2-inch diameter collecting bucket with 750-um screen. Paired nets (one on each side of boat), weighted with 10-or 20-pound lead cannonballs, depending on depth and current velocity, are fished near the bottom for five to 30 minutes, depending on debris load.

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1. **Bank Erosion Monitoring during the Mini-Test.** Monitoring will consist of the following tasks if funds are available:

    a. Bank Erosion. Erosion pins and control points have been established at the three previously established sites. Distances will be measured from the pins to the new bank lines to determine erosion rates. The bank line at each site will be mapped from the established control points to determine the total area lost from the test.

    b. General Downstream Areas. Municipal water and irrigation intakes will be monitored to assure that they will function properly. Other areas identified as critical features will be monitored on an as-needed basis.

    c. Water Surface Elevation Profiles. A water surface profile will be surveyed to identify changes in water surface elevations in the reach.

    d. Spillway Exit. The spillway exit will be surveyed to identify scour and bank erosion.

    e. Aerial Photography. A before and after set of aerial photos will be collected for use in identifying bank erosion.

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Least Tern/Piping Plover
Endangered Species Productivity Work Summary

I. Survey Area

The survey area is the Missouri River from Fort Peck Dam (River Mile 1770.0) to the headwaters of Lake Sakakawea (River Mile 1568.1). Two major tributaries, the Milk and Poplar Rivers, join the Missouri from the north along this reach. Toward the east end of the reach at RM 1582.0, the Missouri's longest tributary, the Yellowstone River, joins the river. Since censusing began in 1988, very few piping plovers have been found on this part of the river, averaging just twelve plovers per year. The Missouri is much more important to least terns with a yearly average of 79 adult terns. In contrast to the plovers farther to the west on Fort Peck Lake, most of the piping plover nests on the river are not initiated until late May and early June. For least terns the majority of nests on the river are initiated during the first three weeks in June.

II. Productivity Surveys

The productivity surveys are conducted on a weekly basis from the last week in May when the plovers first arrive on the nesting grounds through the last week in August when the last of the fledged juvenile terns have departed for the wintering grounds. Surveys to be conducted include nest site surveys, including historically used sites and sites with suitable habitat, surveys for nests, surveys for chicks and fledged juveniles and surveys for banded birds. Nest and chick data will be recorded and inputted into the Threatened & Endangered Species Data Management System (TESDMS). This information will be updated during subsequent site visits throughout the nesting season.

III. Adult Census

A census of adult least terns and adult piping plovers is conducted during the breeding season as a compliance measure for the Biological Opinion. The Adult Census is conducted during the last two weeks in June. All areas of potential habitat need to be censused. This includes areas that were first checked at the beginning of the season that did not yield any birds. The Adult Census is to be conducted in conjunction with the regular productivity survey. The census results will be tabulated into the TESDMS.

IV. Management Actions

Several management actions are undertaken to increase the productivity of the birds. This includes predator control measures, reducing human disturbance, relocating nests and salvaging eggs.

Anti-predation measures include cages put over plover nests, strobe light systems for tern colonies, construction of electrified fences and predator removal. To reduce human disturbance, access to nesting areas can be restricted through the placement of restriction signs and barricades. To prevent loss due to flooding, nests can be relocated to higher elevations by a number of methods. Eggs can be salvaged for captive rearing purposes if nests cannot be relocated to a higher elevation.

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GOVERNMENT ORDER NO. W59XQG01533956
BETWEEN THE U.S. FISH AND WILDLIFE SERVICE AND THE OMAHA DISTRICT U.S. ARMY CORPS OF ENGINEERS

SCOPE OF WORK AND TASK ASSIGNMENTS

Piping Plover and Least Tern Surveys and Productivity Monitoring

PURPOSE AND AUTHORITY

This is a memorandum of understanding (MOU) entered into by and between the U.S. Fish and Wildlife Service (USFWS) and the Omaha District of the U.S. Army Corps of Engineers (Corps). The purpose of this MOU is to establish a scope of work, cost estimate, and responsibilities for the delivery of services to be performed as part of the Corps' responsibilities under the Endangered Species Act of 1973 (ESA), as amended. The accompanying government order purchase request (GO) is to obligate FY 00 funds to finance the continuation of services provided by the USFWS. The GO constitutes an order by the Corps, acting by and through the Contracting Officer, pursuant to the Economy Act, U.S.C. Section 1535, as implemented by the Federal Acquisition Regulation Supplement Subpart 217.5. Each of the parties hereto has the authority and is willing to enter into this MOU and to abide by its terms and conditions.

The Corps received a Biological Opinion (Opinion), concerning the operations of the Missouri River Main Stem System, from the US Fish and Wildlife Service in November 1990. This Opinion concluded that the current operations of the Missouri River would likely jeopardize the continued existence of the interior population of the least tern (*Sterna antillarum*) and the Great Plains population of the piping plover (*Charadrius melodus*). The Opinion provided reasonable and prudent alternatives that, if implemented, would preclude jeopardy to these species. Success of implementing the alternatives and subsequent preclusion of jeopardy, will be based on production, to be measured annually by fledge ratios of both the least terns and piping plovers nesting on the Missouri River. This scope of work for fiscal year 2000 outlines the mission that will be undertaken by the participating agencies to survey populations and enhance and monitor production of both piping plovers and least terns within this region.

SCOPE OF WORK

I. **Objectives**

A. Conduct annual census to estimate number of breeding pairs of least terns and piping plovers within the Fort Peck Reservoir.

B. Monitor production of least terns and piping plovers nesting on Fort Peck Reservoir and document using standardized Corps methods.

C. Implement alternatives which are fiscally and logistically possible for the enhancement of least tern and piping plover productivity and the survival of young-of-the-year juveniles to flight stage.

II. **Participating Agencies or Offices**

USFWS, Charles M. Russell National Wildlife Refuge, Lewistown, MT

III. **Geo-region Study Area**

Fort Peck Reservoir, River Miles 1785.0-1771.0, Reach 1

IV. **Breeding Adult Population Census**

A. Survey total numbers of adult least terns and piping plovers during the last week of June through the first week of July.

B. Record all counts on Corps standardized census record.

V. **Productivity Monitoring**

A. Determine distribution of nesting least terns and piping plovers within the reach and record nest or nesting colony locations on US Army Corps of Engineers aerial mosaics or similar imagery.

B. Determine earliest arrival dates and date of initial nesting or breeding activity within the reach. Determine latest nesting activity and date of last observation of both piping plovers and least terns using the habitat within the reach.

C. Conduct productivity monitoring activities on a 7 to 10 day cycle per site, as per permit conditions, and record all nest site and chick survival data in entirety on Corps standardized data cards.

1. Collect nest data.
    a. Determine number of nests initiated, nest initiation dates, number of eggs laid, and number of eggs hatched.
    b. Determine principle causative factor or factors responsible for nest termination.

2. Collect chick survival data.
    a. Determine number of chicks fledged and estimate date of fledging.
    b. Determine principle causative factor responsible for chick mortality.

VI. **Predator Deterrence**

A. Implement predator exclosure cages on piping plover nests where predation is limiting or has historically limited nest success.

1. Exclosure cage design should be similar to those previously tested on nesting colonies within the Missouri River.
2. All cage designs, nest success, etc. should be discussed in the final report.

B. Test and implement other forms of predator deterrence or experimental removal (in coordination with USDA-Animal Damage Control office) in areas where predation appears to be limiting least tern and piping plover productivity.

VII. **Other Activities**

A. Assist in developing a database, using GIS and GPS equipment, of island geomorphological characters and their relationship to nesting site locations including, nest elevation, distance to nearest water, distance to vegetation, distance to shallow water feeding areas, distance to riverbank, island topology, etc. Data collected will be used to generate weekly nest site location maps plotted on elevation data and also banked in an arc-info database for comparative analysis.

B. Conduct outreach activities to increase public awareness and knowledge about least terns and piping plovers and the role that they play within the Missouri River ecosystem. These activities should include, but not be limited to, press releases, public service announcements, interviews and/or tours with local media, participation in "awareness" days in the local areas, and daily public relations. These activities should be undertaken in such a manner that all participating agencies and designated missions are spoken of and represented to the highest standard.

C. Provide technical assistance to the Corps for development of better management alternatives and to aid in future planning and local recovery efforts of least terns and piping plovers on the Missouri River.

VIII. Reports

A. Status reports on least tern and piping plover survey and monitoring activities will be entered in the Corps online Data Management System after each days survey during the nesting season. Passwords to the system will be forwarded. Reports will be discontinued when all activity is terminated on the study area.

B. Final report will be due no later than October 15, 200 . Report will be sent to Greg Pavelka, Endangered Species Coordinator for Operations Division, Omaha District. Guidelines for final report format will be forwarded.

IX. Agency Contacts

A. US Army Corps of Engineers

Operations Division

FOR TECHNICAL ASSISTANCE
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AGENCY MONITOR
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B. U.S. Fish and Wildlife Service

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CMR National Wildlife Refuge
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Denver Region 6 Office
Jean Dennis
USFWS
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CONTINGENCY PLAN
FOR PROTECTION OF LEAST TERN AND PIPING PLOVER NESTS AND CHICKS

The Corps of Engineers will carry out the following contingency plan for the protection of least tern and piping plover nests and chicks threatened with termination due to natural events or inundation due to poor nest selection under normal system operation, or flood control operations. All efforts will be made to protect nest site viability in the wild prior to collection for captive rearing. Nests will only be collected immediately preceding the inundating release to restrict renesting efforts on unstable habitats. Listed below is a sequential operating plan for nests and chicks threatened by rising water levels. All guidelines are subject to State and Fish and Wildlife Service permit approval and conditions.

NESTS

1. Consult with Reservoir Control Center for water level management options.
   a. Exercise options if available.
   b. If options not available, step 2.

2. Move nest to higher ground that will not be inundated until after the chicks anticipated fledging date.
   a. If successful continue to monitor nest.
   b. If nest cannot be successfully moved, step 3.

3. Elevate nest using a tire or other object if rise in water is expected to be short term.
   a. If successful continue to monitor nest.
   b. If water rise is expected to be long term or if nest cannot be raised, step 4.

4. Evaluate the option of egg removal and captive rearing.
   If option 4 is to be exercised, the US Fish and Wildlife Service and appropriate state agencies will be contacted for coordination and concurrence.

   a. Remove eggs to captive rearing facility to be incubated and raised for release into the wild.
   b. Remove eggs to captive rearing facility to be incubated and raised for research that will aid in meeting the recovery goals of these species.

CHICKS

1. Consult with Reservoir Control Center for water level management options.
   a. Exercise options if available.
   b. If options not available, step 2.
2. Remove chicks and place on adjacent islands within sight of adult birds, if sites unavailable, step 3.

3. Remove chicks to captive rearing facility.
   If option 3 is to be exercised, the US Fish and Wildlife Service and appropriate state agencies will be contacted for coordination and concurrence.

   a. Remove chicks to captive rearing facility to be raised for release into the wild.
   b. Remove chicks to captive rearing facility to be raised for research that will aid in meeting the recovery goals of these species.

CAPTIVE REARING PROTOCOL

CAPTIVE REARING

Captive rearing will be conducted at the Corps of Engineers (Corps) facility at the Gavin's Point Project Office. The facility consists of a main building containing a brooding area, egg handling, incubation, and diet preparation laboratory and an office (see attached facility plans). Outdoor flight pens are attached to the rear of the facility. The building is designed to facilitate the captive rearing of interior least terns and piping plovers in a safe, clean, and healthy environment. The interior walls of the facility are sealed to allow for pressure washing and disinfection of all surfaces. The building and outdoor pens are serviced by raw Missouri River water, treated water, and enclosed sewer.

Visitation protocols are established to limit visitor contact with the birds. Facility technicians are required to wear separate footwear in the brooder area other than that worn outdoors or in the office. Technicians also wear lab coats confined to bird handling areas. Foam alcohol hand creams are used to minimize contamination when handling birds.

Staff from the National Biological Service, Madison Wildlife Health Laboratory were consulted on building design and facility protocols.

COLLECTION

Eggs collected at distances greater than 50 miles from the incubation laboratory at the Gavin's Point Project in Yankton, South Dakota, are placed in a portable incubator to maintain egg viability on route to the lab. Eggs collected within close proximity (less than 50 miles) of the facility, are collected and transported from the field to the laboratory in modified polystyrene or pressed cardboard egg cartons. This allows for the collection operation to be expedited as quickly as possible while maintaining egg viability. Eggs are cleaned, weighed, and candled prior to being placed in the incubator. Any nonviable eggs are removed and sent to the Fish and Wildlife Service (Service) for disposal.

INCUBATION

Viable eggs are placed in a Petersime Model I incubator located in the lab room (see building diagram). Piping plover and least tern eggs are incubated concurrently in the same incubator. The Petersime incubator features a redwood housing, thermostatic thermometer with backup, 150 degree rotational drum egg rack with 2000 egg capacity, paddle fan, and hatcher box. Humidity is controlled by varying the surface exposure of the water pan. Temperature is monitored using the standard dry and wet bulb Fahrenheit thermometers provided by the Petersime Company. Incubator operation settings are set to simultaneously, as closely as possible, meet the requirements of both species.

Dry Bulb Thermometer 99.5 degrees F

Wet Bulb Thermometer 87 degrees F

Relative Humidity 59-60%

Eggs are individually identified by writing a coded number on each shell with a nontoxic felt tipped pen. Eggs are candled and weighed Tuesday, Friday, and Sunday of each week. Weighing allows monitoring of embryo weight loss during the incubation period. Proper humidity regulation should result in 10-10.5 percent fresh egg to hatch weight loss for piping plovers and 11-13 percent fresh egg to hatch weight loss in least terns. Candling enables data to be collected on embryo development and allows observers to accurately determine time to remove eggs from the rotating drum. A second Petersime incubator is used to hatch eggs. Once membrane crowning is observed in the air cell, eggs are to be removed from the incubation incubator and placed in the hatcher incubator. This allows for sufficient time prior to the embryo penetrating the membrane into the air cell, at which time the unhatched chick is susceptible to suffocation if the egg is continually rotated. Humidity within the hatching incubator are to be increased to 65-70 percent. Expected pip to hatch times are 12 to 48 hours for piping plovers and 12-24 hours for least terns. Birds are to be allowed to dry off and then be individually identified with a colored plastic leg band prior to placing them in the brooder box.

BROODING AND FEEDING

After 10 to 12 hours in the hatcher box, or when chicks are completely dried off and are able to stand, the hatchlings will be removed from the hatcher and weighed to determine hatching weight prior to being placed in the brooder box. Every effort will be made to segregate chicks from like broods into individual brooders to prevent any implications that may arise from cross-sibling imprintation. Brooder boxes will be constructed of 7/16ths AC plywood with the smooth side turned in to prevent any injuries from splinters. Box interiors will be sealed with a food grade polyurethane to reduce bacterial contamination and aid in box sanitation. Boxes will be built in 4' X 8' complexes with each individual box being 2' X 2' square and 16 inches high.

Brooder floors will be covered with indoor/outdoor carpeting which will in turn be covered with sand to protect the young birds' feet. Least tern brooders will be provided with a sand simulated nest bowl and an attending adult decoy. Piping plover brooders will have a brood pouch constructed of terry cloth towel for brooding security. Brood boxes will be covered with a fabric top and will be heated with incandescent light bulbs with brooder hoods.

Boxes will be heated to 95-98 degrees F for three to five days with the temperature slowly being decreased as birds began to feather and thermoregulate themselves. Hatchlings will be kept in the brood boxes until their feather tracts are fully feathered (approximately 12-14 days) and they are able to fully thermoregulate. Boxes will be cleaned and disinfected Monday and Thursday of each week using Germacert[tm] nontoxic disinfectant. Chicks will be weighed during the brooder cleaning to track weight gain and adjust diet to ensure proper nutrition.

Recommended Diets:

Piping Plovers 1-3 days old -	mini meal worms, brine shrimp, blood worms, pinhead crickets, black worms, and fly larvae. Supplement with commercial chick starter.
Piping Plovers 3+ days old -	regular meal worms, brine shrimp, blood worms, wax worms, baby crickets, and locally collected insects. Supplement with a poultry starter for filler.
Least Terns 1-3 days old -	locally seined fish fry 1 to 1.5 centimeters in length.
Least Terns 3+ days old -	endemic forage fish, i.e., shiners, mooneye, fathead minnow, freshwater drum, etc., not to exceed 3-5 cm.

Piping plovers will be fed a complete diet containing items above that are available from a local supplier along with insects trapped on-site nightly. Dry food items will initially be sprinkled on the floor of the brooder box to stimulate the young chicks' pecking behavior. Once chicks become accustomed to foraging, all food will be provided in plastic petri dishes to aid in box sanitation. Piping plover chicks will be provided with an unlimited food supply along with a 50-50 mix of $CaCO_3$ and Petamine^{tm} bird vitamins to meet additional nutritional requirements. Diets will be monitored and adjusted according to a nutritional assay of food items obtained for least tern and piping plover forage.

Least terns will be fed several species of endemic forage fish fry until three days of age at which time they will be switched to a variety of locally seined river forage fish and fathead minnows purchased from a local supplier. Available fish species will be analyzed for thiaminase and a variety of fish will be used as feed so thiamin deficiencies can be avoided. When available fishes nutritional composition is insufficient to meet thiamin requirements, a thiamin supplement will be provided. Fish supplied locally from seines or a supplier will be held at Gavin's Point National Fish Hatchery then placed on ice prior to being fed to the birds. While in the brooder boxes forage for the least terns will be hand fed using a white surgical glove and forceps. All feeding will be conducted in complete background darkness to minimize the association between humans and feed. Once the birds become accustomed to grabbing the fish, fish will be provided in a drop in pan filled with water to train the birds to self feed. Least terns will be fed every two hours from 7:00 a.m. to 9:00 p.m. or more frequently as needed.

Both species will be given unlimited water in shallow petri dishes. Brooder boxes will be rolled outside each day for a minimum of two hours. This will ensure vitamin D is metabolized and that bone development deficiencies are avoided.

All feeding utensils and petri dishes will be disinfected after each feeding. The brooder and laboratory will be disinfected at least once per day with a broad spectrum disinfectant. All personnel feeding or handling chicks or otherwise doing general maintenance in the brooder room or lab will apply foamed alcohol hand cream to prevent cross contamination.

When chicks are 12-14 days old and are able to feed and thermoregulate themselves, they will be transferred to the outdoor flight pen. The outdoor pen is 48 feet by 60 feet and contains 6, 20 feet by 20 feet warm release pens. Three of these pens are designed for plovers and contain 15 feet by 20 feet sand pads and 10 feet by 20 feet beach/pool habitats which gently slope from ½ inch to 6 inches deep. The remaining three pens, designed for terns, contain a 10 feet by 20 feet sand pad but the pool habitat slopes from ½ inch to a maximum depth of 1 foot. The pool habitats are individually contained and receive continuous flow of raw river water.

The outdoor pen's exterior walls and dividers are constructed of a four foot high concrete stub wall. Pen floors and pool bottoms are continuous concrete that abuts an elevated center walkway. Eight foot chain link fencing is attached to the stub wall and is lined with shade netting. Eleven foot high exterior walls support a vinyl coated wire mesh roof which rises to 25 feet at the center, providing opportunity for terns to aerially forage over the pool habitat.

Prior to new broods being placed in pens, the pens will be bleached where possible and sand areas raked and exposed to ultraviolet light.

Food will be provided to the pens from the center walkway access until chicks are fully feathered, self-foraging, and are capable of sustained flight. At this time they will be captured with a drop net and banded for release.

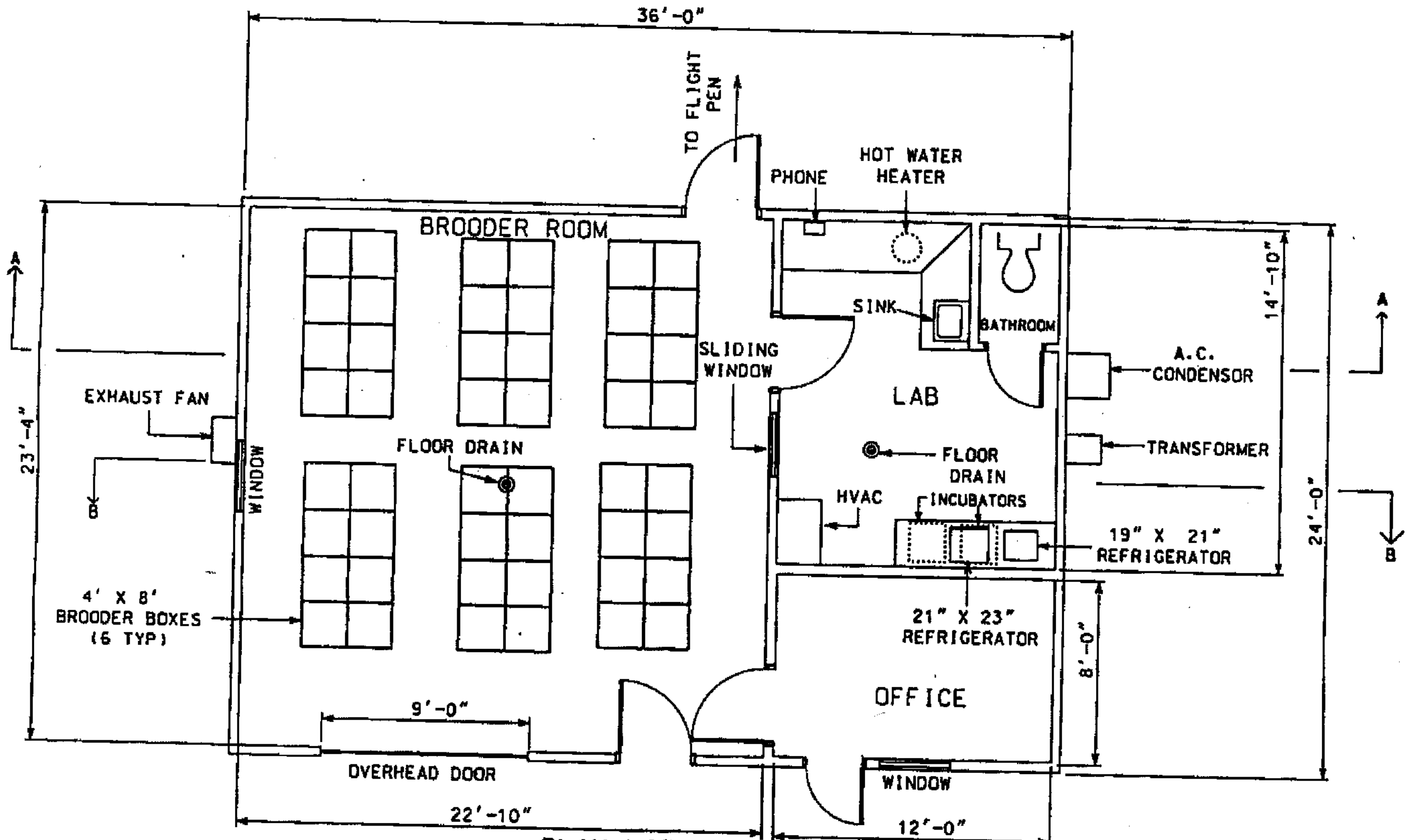
RELEASE AND POST-RELEASE MONITORING

Least terns will be banded with size 1A or 1B steel serially numbered Fish and Wildlife Service bands. Piping plovers will be banded with size 1A or 1B stainless steel serially numbered Service bands. A colored flag (UV stable, Darvic tm plastic manufactured by A.C. Huges) will be applied to the upper leg opposite the Service band.

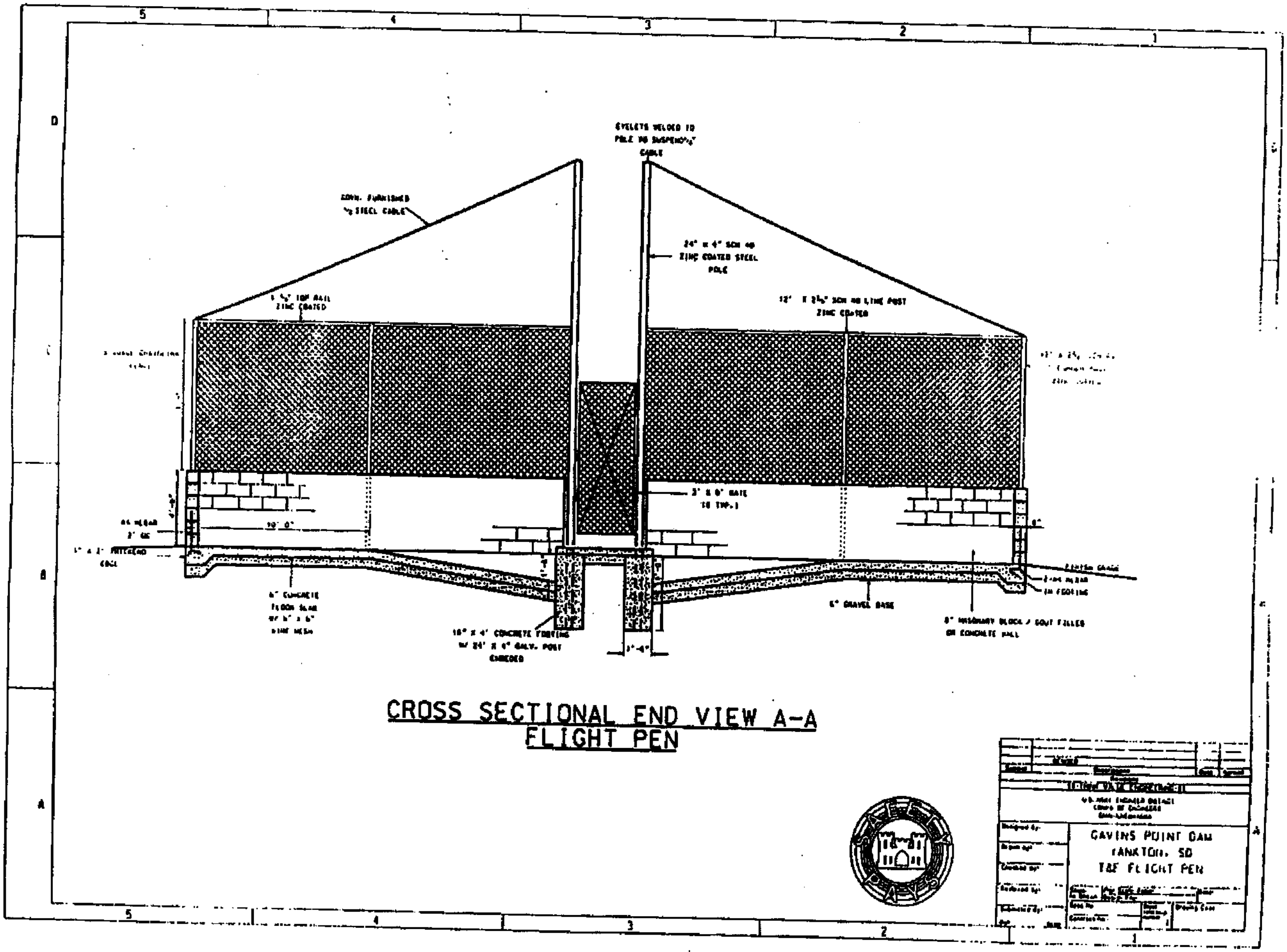
Banded fledglings will be released on sandbar habitat that provides a secure release substrate for a minimum of two weeks post-release. These habitats will be determined to have sufficient elevation to remain exposed during increases in discharges and also will have an available food source for the fledglings. Close coordination with State and other Federal agencies will be undertaken to ensure suitable habitats are located for release sites prior to birds fledging. Many of the constructed sites built by the Corps in previous years below Gavin's Point Dam should provide suitable release substrates.

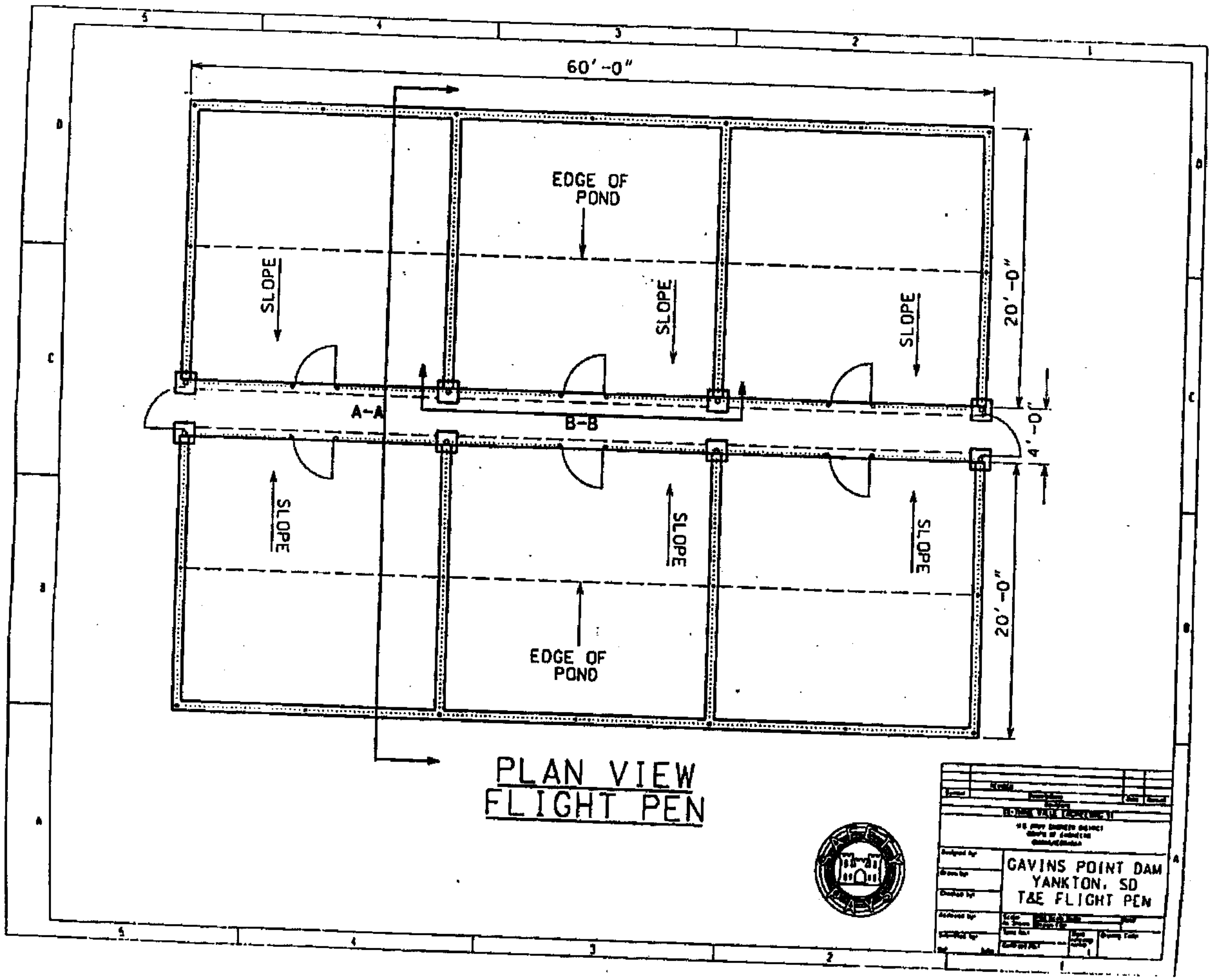
Piping plover chicks of individual broods will be grouped and released onto sandbars with no existing nesting or brooding piping plover adults or released into staging flocks of young-of-the-year flighted piping plover chicks. Least tern chicks of individual broods will be grouped and released near active least tern colonies where young-of-the-year least terns are fledging and beginning to forage for themselves, or released into staging flocks of young-of-the-year flighted least tern chicks.

Least tern and piping plover chicks will be transported to release areas in modified poultry shipping crates. Chicks will be hard-released onto the release areas. Releases will be monitored in conjunction with the Post-Release Survival Study. Efforts will be coordinated through the



PLAN VIEW
CAPTIVE REARING BUILDING


CROSS SECTIONAL END VIEW A-A
FLIGHT PEN
GAVINS POINT DAM
YANKTON, SD
T&E FLIGHT PEN


60'-0"
EDGE OF POND
SLOPE
SLOPE
SLOPE
20'-0"
A-A
B-B
4'-0"
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SLOPE
SLOPE
20'-0"
EDGE OF POND
PLAN VIEW
FLIGHT PEN
GAVINS POINT DAM
YANKTON, SD
T&E FLIGHT PEN

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Scope of Work
Fiscal Year 2004 through Fiscal Year 2008
For the
Fort Peck Flow Modification Biological Data Collection Plan

Background

The U.S. Army Corps of Engineers (USACE) proposes to test operations of Fort Peck Dam following specifications outlined in the Missouri River Biological Opinion (U.S. Fish and Wildlife Service (USFWS 2000). Tests of modified dam operations is proposed to analyze operations which increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon and other native fishes. In contrast to "normal" cold-water releases through Fort Peck Dam, water from Fort Peck Reservoir will be released over the spillway during flow tests to enhance water temperature conditions. The USACE proposes to conduct a mini-test to evaluate structural integrity of the spillway and other engineering concerns (USACE 2002). A full-test will occur the first year with sufficient storage after the mini-test. The full test consists of a maximum of 19,000 cfs over the spillway. Spillway releases will be accompanied by an additional 4,000 cfs released through the dam. Spillway releases during the full-test are targeted to increase water temperature to a minimum of 18°C (64.4°F) at river mile 1746, 24 miles downstream from Fort Peck Reservoir. All proposed flows are dependent on adequate inflows to Fort Peck Reservoir and adequate water levels in the reservoir.

The original schedule of events for conducting the flow tests called for conducting the mini-test during 2001 and the full-test during 2002. However, insufficient water levels in Fort Peck Reservoir during spring 2001, 2002, and 2003 precluded conducting the mini-test and full-test. Pending adequate water levels in Fort Peck Reservoir, the mini-test is targeted to occur in 2006 and the full-test in 2007, but the tests can occur in any year water is available (William D. Miller, USACE, Omaha District, personal communication).

The USFWS 2000 mandated that the USACE develop a monitoring study that would be used to quantitatively evaluate changes in physical habitat and biological responses of pallid sturgeon and other native fishes to modified dam operations. The monitoring study (outlined in the Scope of Work below) entails collecting physical and biological data in years prior to implementation of flow tests (baseline or pre-treatment data), in years during the mini-test and full-test (treatment data), and at least one year following the full-test (post-treatment data). The Montana Department of Fish, Wildlife, and Parks (MTFWP) implemented the monitoring study in 2001, 2002, and 2003 under a separate agreement with the USACE. The proposed Scope of Work augments data collected during the previous 3 years, and will provide continuity in the monitoring study through at least 2008 (pending adequate water levels for the spillway release).

Scope of Work

The Contractor is responsible for providing all labor, equipment, plant, materials, miscellaneous items, and overhead necessary to accomplish the following tasks: (Any meetings, coordination, reviews, conference calls, etc shall be included in the cost of the tasks.)

Monitoring component 1: Measuring water temperature and turbidity in the Missouri River downstream from Fort Peck Dam. Enhancing water temperature in the Missouri River downstream from Fort Peck Dam is an integral outcome of the Fort Peck spillway releases (USFWS 2000). Thus, seasonal and annual water temperature regimes must be evaluated to determine the influence of spillway releases on water temperatures.

The MTFWP (hereafter the Contractor) will monitor water temperature at established sites (see Braaten and Fuller 2002; Braaten and Fuller 2003) from May through October using continuous-recording water temperature loggers. The Contractor will also monitor turbidity at established sites from May through August using continuous-recording turbidity loggers. Water temperature and turbidity will be monitored from FY2004 through FY2008.

Monitoring component 2: Seasonal use, telemetry, and movements of adult pallid sturgeon in the Missouri River downstream from Fort Peck Dam. The majority of sampling effort expended for adult pallid sturgeon occurs in the Yellowstone River and Missouri River downstream from the Yellowstone River confluence. Conversely, minimal sampling effort for adult pallid sturgeon occurs in the Missouri River upstream from the Yellowstone River confluence. Incidental collections of adult pallid sturgeon (Braaten and Fuller 2003) and occasional movements of adult pallid sturgeon in the Missouri River upstream from the Yellowstone River confluence (D. Fuller, MTFWP, personal observation) suggest this reach of the Missouri River may be used by adult pallid sturgeon more than previously anticipated. A sampling program directed specifically towards adult pallid sturgeon in this river reach is required to more thoroughly address this question.

The Contractor will sample for adult pallid sturgeon in the lower 70 miles of the Missouri River upstream from the Yellowstone River confluence, in the Yellowstone River to the Intake Dam, and in other areas that pallid sturgeons become apparent. Sampling will be conducted from April through September, as this time frame spans the period when adult pallid sturgeon have been caught (Braaten and Fuller 2003) or moved into this reach based on telemetry relocations (D. Fuller, MTFWP, personal observation). Adult pallid sturgeon will be sampled in available habitats using trammel nets, otter trawls, and other gears conducive to the habitats. Sampling will occur from FY2004 through FY2008.

The Contractor will surgically implant radio transmitters in adult pallid sturgeon sampled in any reach. The implanting will be coordinated with and approved by the USFWS. However, transmitters will only be implanted during September as water temperature declines to minimize stress to the individuals. The Contractor must use Combined

Acoustic Radio Transmitters (CART tags; Lotek Wireless, Inc.) to maintain consistency with existing technology used by researchers in this reach of the Missouri River. Pallid sturgeon implanted with CART tags will be tracked via boat at weekly intervals from April through July, and at bi-weekly intervals from August through October in conjunction with other telemetry studies (see Monitoring component 3 below). Adult pallid sturgeon implanted with CART tags will be tracked from FY2004 through FY2008.

Monitoring component 3: Examining flow- and temperature-related movements of paddlefish Polyodon spathula, blue suckers Cycleptus elongatus, and shovelnose sturgeon Scaphirhynchus platorynchus. Similar to pallid sturgeon, seasonal migrations and spawning of native Missouri River fishes including paddlefish, blue suckers, and shovelnose sturgeon are influenced by seasonal changes in discharge and water temperature. Enhanced water temperature and flow regimes resulting from modified spillway releases are anticipated to cue spawning migrations into the Missouri River downstream from Fort Peck Dam, and improve spawning conditions. An intensive telemetry study designed to evaluate discharge- and temperature-related movements in relation to spillway releases is necessary to evaluate biological response.

The Contractor will sample for paddlefish, blue suckers, and shovelnose sturgeon in the Missouri River downstream from Fort Peck Dam, and implant a minimum of 20 individuals from each species with CART tags. The Contractor will also sample in the Yellowstone River up to the Intake Dam. The CART tags will be implanted during September in FY2004 and FY2005. Movements and locations of blue suckers, paddlefish, and shovelnose sturgeon will be determined via boat (and air, if necessary) at weekly intervals from April through July, and at bi-weekly intervals from August through October. In addition to manual tracking, the Contractor will deploy, operate, and maintain a series of six continuous-recording telemetry-logging stations (1 in the Milk River, 5 in the Missouri River) from April through October. The species will be tracked from FY2004 through FY2008.

Monitoring component 4: Quantifying larval fish distribution and abundance. Enhanced water temperature and discharge regimes resulting from the spillway releases are expected to increase spawning success for pallid sturgeon and other native fishes in the Missouri River downstream from Fort Peck Dam. An intensive larval fish sampling program is necessary to quantify changes in spawning success and larval fish densities resulting from the spillway releases.

The Contractor will sample larval fish at selected sites in the Missouri River and adjacent habitats, and in the Yellowstone River (see Braaten and Fuller 2002; Braaten and Fuller 2003) from late May through July. Sampling will be conducted at 2-3 day intervals at each site during this time frame. The Contractor will process the larval fish samples, and perform the identification of larvae. Larval sturgeon sampled may be sent to Dr. Darrel Snyder (Colorado State University) to provide expert identification of larval pallid sturgeon and shovelnose sturgeon. Larval fish will be sampled from FY2004 through FY2008.

Monitoring component 5: Quantify the distribution and abundance of young-of-year sturgeon. The USFWS 2000 (p. 98) presented that there is no evidence to suggest that pallid sturgeon have successfully reproduced in the upper Missouri River including the reach downstream from Fort Peck Dam. In September 2002, two young-of-year (YOY) pallid sturgeon and several YOY shovelnose sturgeons were sampled in the Missouri River downstream from the Yellowstone River confluence (Braaten and Fuller 2003). However, it is not known whether these individuals were spawned in the Missouri River or Yellowstone River. These collections provide the first documented evidence of successful reproduction of pallid sturgeon in recent years. An intensive sampling program specifically targeting YOY sturgeon is necessary to further evaluate successful reproduction by pallid sturgeon and shovelnose sturgeon. This monitoring component is complementary to the larval fish sampling (Monitoring component 4) as it provides another method to quantify spawning success of pallid sturgeon and shovelnose sturgeon under existing flow and temperature regimes, and under modified flow and temperature regimes resulting from spillway releases.

The Contractor will sample for YOY sturgeon at selected sites (Braaten and Fuller 2003) in the Missouri River upstream and downstream from the Yellowstone River confluence, and in the Yellowstone River. The sampling regime will target available habitats including but not limited to outside bends, inside bends, and channel crossover areas. Sampling will be conducted with a beam trawl and/or otter trawl pending otter trawl performance tests in these areas. The Contractor will sample all sites at weekly intervals from early August through mid-September. The Contractor will identify larval sturgeon to species, and supplement species identifications with expert identifications provided by Dr. Darrel Snyder (Colorado State University). The YOY sturgeon sampling program will be conducted from FY2004 through FY2008.

Monitoring component 6: Drift rate, drift behavior, and transport of larval sturgeons in the Missouri River downstream from Fort Peck Dam. The early life history of pallid sturgeon and shovelnose sturgeon is poorly understood, and this is particularly true for the larval life stage. Initial results from laboratory studies suggest larval sturgeon migrate downstream for a period of up to 12-13 days, and move a cumulative distance of about 13 km (Kynard et al. 2002). However, these studies were conducted at low velocities in an experimental stream. Higher velocities (e.g., 0.3 – 0.5 m/s), similar to those found in the Missouri River downstream from Fort Peck Dam, may increase the drift rate of larval sturgeon and increase the downstream drift and migration distance. Additional studies were conducted in 2003 to more thoroughly evaluate drift behavior and drift rate of larval sturgeon at higher velocities. These studies were conducted in the laboratory (USGS, Conte Anadromous Fish Research Center, report in preparation) and in a side channel of the Missouri River downstream from Fort Peck Dam (MTFWP, Fort Peck; USGS, Fort Peck; report in preparation). These studies will be expanded in subsequent years to provide an increased understanding of larval sturgeon drift rates and behavior.

The Contractor will conduct larval sturgeon drift studies in the Missouri River downstream from Fort Peck Dam to quantify drift rate as a function of water velocity.

Studies in FY2004 will be conducted in the main stem Missouri River using larval shovelnose sturgeon. In FY2005, the Contractor will conduct a larval drift study in a side channel of the Missouri River (preferably the same side channel used in 2003) using larval pallid sturgeon. Use of larval pallid sturgeon will be dependent upon approval from the USFWS. If results from the side channel in 2005 (larval pallid sturgeon) are similar to those from 2003 (larval shovelnose sturgeon), it will not be necessary to expand the larval pallid sturgeon studies to the main stem Missouri River. Significant differences between studies may warrant additional studies in the main stem. Additional larval sturgeon drift studies will be conducted in the laboratory by the USGS during FY2004 and FY2005. Thus, the Contractor will coordinate and communicate with the participating USGS entities to facilitate exchange of information and ideas resulting from the similar studies. The U.S. Army Engineer Research and Development Center (CEERD) will be conducting flow modeling measurements in the Missouri River and develop models. The Contractor will also coordinate and communicate with the Corps entities to facilitate exchange of information and ideas. The Contractor will perform a site visit during the CEERD fieldwork.

Monitoring component 7: Food habits of piscivorous fishes. The public has expressed concern that piscivorous fishes in the Missouri River downstream from Fort Peck Dam may feed on larval sturgeon. Food habit studies of piscivorous fishes during 2001 (Braaten and Fuller 2002) and 2002 (Braaten and Fuller 2003) showed that several fish species did consume fish prey, but there was no indication that piscivores consumed larval sturgeon. Studies in 2001 and 2002 were conducted under normal dam releases (e.g., spillway releases did not occur).

During 2007 (or the first year the full-test of spillway releases is implemented), the Contractor will conduct a food habit study of potential piscivores in the Missouri River downstream from Fort Peck Dam that is consistent with earlier studies conducted in 2001 and 2002. The contractor will sample walleyes *Stizostedion vitreum*, saugers *S. canadense*, northern pike *Esox lucius*, goldeye *Hiodon alosoides*, channel catfish *Ictalurus punctatus*, freshwater drum *Aplodinotus grunniens*, shovelnose sturgeon, and bubot *Lota lota*. A minimum of 30 individuals from each species will be sampled in July and August from all available habitat types. Stomach contents will be removed, and identified.

Monitoring component 8: Fort Peck fish barrier. Public concern was expressed about potential loss of game fish particularly walleye via the spillway during operation. Additionally, changes in the river fisheries due to changing habitat may be obscured by passage of fish from the reservoir to the river. Both concerns are addressed by placing a fish barrier to prevent fish from passing through the spillway. To document effectiveness of the barrier, fish will be tagged in the vicinity of the spillway from April through July during the years the spillway will be in operation. The fish will be captured with trap nets and merwin traps, and tagged with t-tags. Additional walleye and pike may be tagged during the annual walleye egg-take in the upper Dry Arm of Fort Peck. Survey crews in the river will report any catch of tagged fish.

Monitoring component 9: Assisting with the larval survival test. The Contractor will provide bedding material (substrate) from the transitional area of the Missouri River/Reservoir headwater areas of Lake Sakakawea (delta-silt) and bedding material (substrate) from ideal rearing areas in this reach. This early life food source will be delivered to the Bozeman Fish Technology in Bozeman, Montana (USFWS). The Contractor will provide insight, advise, and provide River Field support to the USFWS larval testing group.

In addition to this laboratory evaluation of survival, the feasibility of evaluating survival of pallid sturgeon utilizing live cribs in the field within these river/reservoir transitional areas will be explored. The USFWS would have to concur with this field experiment as well as the Pallid Sturgeon Recovery Team. If approved, this study would consist of live cribs being placed at various locations in the headwater areas of Lake Sakakawea. Pallid sturgeon fry (pre- and post-yolk sac absorption) will be held in these cribs to evaluate survival in these areas. Additional cribs further upstream in the river would serve as "controls" for the study. A variety of water quality data (e.g., temperature, dissolved oxygen) would be collected throughout the experiment. (The actual work will be added to the Contract by modification, if it proves to be feasible.)

Monitoring component 10: Investigate the development of a scope of work to determine if "imprinting" exists in pallid sturgeon population located in the Fort Peck Reach. The Contractor will perform necessary research into imprinting, coordinate with the appropriate individual parties, and develop possible investigation methods.
(The actual work may be added to this Contract by modification.)

Monitoring component 11: Assist the USFWS with broodstock collection. The Contractor will schedule time to assist the USFWS with broodstock collection in the spring of each year of the contract.

Scope of Work For Possible Future Work (Do Not Include in Proposal) (This work may be added by modification at a later date, additional details would be provided at that time.)

Background

Questions exists regarding if "imprinting" exists in pallid sturgeon population located in the Fort Peck Reach and about the pallid sturgeon larval survival in the transition area of the Missouri River/Reservoir headwaters of Lake Sakakawea (delta-silt).

Additional Monitoring (Tasks 10 -)

The Contractor may be responsible for implementing or supporting:

- Larval survival test

- Pallid sturgeon imprinting testing

Background

In accordance with the 2000 BiOp (RPA element VI A), the Corps is responsible for producing a portion of the pallid sturgeon to meet annual stocking goals. The Corps' responsibility is referred to as the "Average Annual Shortfall" which has been identified as the pallid sturgeon that have not been produced in culture efforts prior to 2000 because of various limitations (e.g., hatchery facilities). The Corps does not possess the essential facilities to culture these fish to accomplish this requirement. A strategy of enhancing propagation levels at a select few facilities possessing the infrastructure and unique knowledge to propagate and stock pallid sturgeon will fulfill this responsibility. Support for these activities with partnering agencies will be handled through long-term contracts.

Pallid Sturgeon Propagation and Augmentation (Tasks 21-).
The contractor will be responsible for a range of tasks, which may include:

- Pallid sturgeon broodstock collection, sexing and transport
- Egg staging and spawning
- Cryopreservation of genetic material
- Pallid sturgeon incubation and fry shipment
- Pallid sturgeon culture
- Pallid sturgeon tagging
- Pallid sturgeon stocking/distribution
- Annual summary report encompassing all activities

The contractor must adhere to all approved protocols for these task activities (e.g., spawning and stocking guidelines, stocking rates, culture densities, etc.)

Background

In accordance with the 2000 BiOp (RPA element VI B), the Corps is required to design a program to monitor pallid sturgeon populations in the high priority river segments of the Missouri River. This RPA element requires the design of the program have the ability to detect improvements in the warm water benthic fishery and collect habitat characteristic data in conjunction with fishery surveys. The Corps and collaborators have developed a plan and protocols for a population assessment program for pallid sturgeon including the associated fish community. The Corps does not possess the necessary skills to implement this program. Long-term contractual agreements will be utilized with the appropriate agencies to implement this program in the Fort Peck Reach.

Pallid Sturgeon Population Assessment (Tasks 31-)

The contractor will be responsible for a variety of tasks which may include:

- Biological surveys for Sturgeon Sampling Season
- Biological surveys for Fish Community Sampling Season
- Habitat characteristic data collection
- Age/Growth data collection
- General data collection (Datasheet submission, QA/QC)
- Annual summary report

All sampling must be in compliance with Long-Term Pallid Sturgeon and Associated Fish Community Assessment for the Missouri River and Standardized Guidelines for Sampling and Data Collection

Timeline and Deliverables

The Contractor will conduct the study components during the timeframes discussed above and summarized in the table below. The Contractor will submit monthly reports of activities and progress to the USACE, and the monthly report can also be submitted to other state and federal agencies that are involved in studies on the Missouri River. An annual report will be prepared and submitted to the USACE by July 1. The annual report can also be circulated to members of the Upper Basin Pallid Sturgeon Work Group.

See Table 1.

References

Braaten, P. J., and D. B. Fuller. 2003. Fort Peck Flow Modification Biological Data Collection Plan – Summary of 2002 Activities. Report prepared for the U. S. Army Corps of Engineers. Montana Department of Fish, Wildlife and Parks, Fort Peck.

Braaten, P. J., and D. B. Fuller. 2002. Fort Peck Flow Modification Biological Data Collection Plan – Summary of 2001 Activities. Report prepared for the U. S. Army Corps of Engineers. Montana Department of Fish, Wildlife and Parks, Fort Peck.

Kynard, B., E. Henyey, and M. Horgan. 2002. Ontogenetic behavior, migration, and social behavior of pallid sturgeon, *Scaphirhynchus albus*, and shovelnose sturgeon *S. platorynchus*, with notes on the adaptive significance of body color. Environmental Biology of Fishes 63:389-403.

USACE. 2002. Draft environmental assessment, Fort Peck flow modification mini-test. U. S. Army Corps of Engineers, Omaha District, Omaha, Nebraska.

USFWS 2000. Biological opinion on the operation of the Missouri River main stem reservoir system, operation and maintenance of the Missouri River bank stabilization and navigation project, and operation of the Kansas River reservoir system. U. S. Fish and Wildlife Service, Region 3 (Fort Snelling, Minnesota) and Region 6 (Denver, Colorado).

The monthly reports can be sent by email or letter. The annual report will be in the format of, detail of, and in content of the Summary of 2001 Activities Report dated June 2002 (attached). The field notes and all data supporting the summary will be electrically maintained by the Contractor in a system that is compatible with the Corps. The field notes and supporting data will be made available to the Corps at any time upon request and at completion of the Contract.

References to established sites in the above tasks are defined as the established sites in the Summary of 2001 Activities Report dated June 2002.

All information, data, and reports are the property of the Corps of Engineers. No report can be published without the permission of the Corps of Engineers. The monthly reports and annual report can be circulated to members of the Upper Basin Pallid Sturgeon Work Group and other state federal agencies that are involved in the studies on the Missouri River, but only after all the Contracted Quality Control tasks have been performed on the data in the reports. The parties that the reports are to be provided to must agree to not publish information from the reports without the permission of the Corps of Engineers.

The Contractor shall develop and provide to the Corps working protocols, and procedures for the tasks in the contract that are similar to those used during the monitoring program performed by the Contractor under a separate agreement performed during 2001 thru 2003. These documents will be subject to Corps inspection and revised when needed to assure the requirements of the contract tasks are met. Due to the nature of data collection for physical responses, a general scope of work is provided without specific details on how to accomplish these tasks. The methods used shall be of sufficient quality to provide defendable data. The Contractor is expected to adjust to changing conditions discovered during the activities and develop revised methods that will maintain the quality of the data. The Government will be in formed of revisions to the established protocols and methods. The Government can specify changes to the protocols and methods.

The Contractor will allow complete inspection/review of all Contractor tasks activities by the Corps and provide all necessity support and equipment to allow the Corps to accompany the Contractor during the accomplishment of the contract tasks.

The Contractor will establish and conduct a Quality Control Program for the contract tasks. The Contractor will submit a detailed Quality Control Plan for approval, which addresses the process for reviewing the protocol for each task at the start of each task session and at monthly intervals during the task. The Quality Control Plan should also include all the Quality Control procedures previously included in the FY01 and FY02 Data Collection Plans.

Payment request will be made monthly by invoice sent to the attention of Mr. Mark Drobish, CENWO-OD-TT.

Contract is for a five year time period from NTP, but the contract may be extended by contract modification depending on the timing of the test flows.

If not stated otherwise in the Contract, the Contractor will follow established MTFWP procedures.

The Contractor shall summit their proposal in the following format to allow cost comparison with the Government. See table enclosed.

The contractor shall submit their proposal in the following format to allow cost comparison with the Government.
Monitoring Component Cost Table.

Monitoring Component										
FY Element/ Tasks	1 Temperature/ turbidity	2 Pallid sturgeon sampling/ telemetry	3 Native species telemetry	4 Larval fish	5 Young-of-year sturgeon	6 Larval drift	7 Food habits	8 Fish barrier	9 Broodstock collection	Totals
2004										
Labor										
Plant										
Equipment										
Overhead										
2005										
Labor										
Plant										
Equipment										
Overhead										
2006										
Labor										
Plant										
Equipment										
Overhead										
2007										
Labor										
Plant										
Equipment										
Overhead										
2008										
Labor										
Plant										
Equipment										
Overhead										

Table 1. Timeline table for conducting monitoring components associated with the Fort Peck Data Collection Project.

	Monitoring Component										
Month	1	2	3	4	5	6	7	8	9	10	11
Jan											
Feb											
Mar											
Apr		X	X					X			X
May	X	X	X	X				X		X	X
Jun	X	X	X	X		X		X	X	X	
Jul	X	X	X	X			X	X	X	X	
Aug	X	X	X		X		X				
Sep	X	X	X		X						
Oct	X	X	X								
Nov											
Dec											
Fiscal Years	2004 – 2008	2004 – 2008	2004 – 2008	2004 – 2008	2004 – 2008	2004, 2005	2006	2005 – 2006	2004 – 2005	2004 – 2005	2004 – 2008

SCOPE OF WORK

Interactions Between River Transport Processes, Drift Behavior, and Habitat Use Of Larval Pallid Sturgeon (*Scaphirhynchus albus*) in the Missouri River Below Fort Peck Dam, Montana
(Draft 1/17/03)

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For the U.S. Army Corps of Engineers

Background

Eggs and larvae of numerous fish species in rivers are transported via water currents from upstream spawning areas to downstream habitats where they settle from the current (Mion et al. 1998; Robinson et al. 1998). Despite recognition of this process, there is a substantial information gap in our knowledge of how hydrologic factors (e.g., river currents) and behavior during the early larval stages interact to influence larval drift rate and distance. An understanding of behavior, drift characteristics, and habitat use of larval pallid sturgeon is recognized as a high priority, immediate research need (Montana-Dakota Pallid Sturgeon Work Group 2000) because the information is critical for identifying potential upstream spawning sites, determining the length of river needed by larval pallid sturgeon, predicting potential settling areas for larvae in downstream areas, and predicting the outcome of pallid sturgeon restoration efforts in the Missouri River.

Results from preliminary studies suggest that the behavior and drift characteristics of larval pallid sturgeon are complex. In laboratory studies, Kynard et al. (1998) and Kynard et al. (2002) found larval pallid sturgeon exhibited an 8-13 day period of downstream migration immediately after hatching. Larvae 0-4 days old predominantly drifted, whereas larvae age-5 and older exhibited directed downstream movements indicative of active downstream migration. In addition, the vertical distribution of larval pallid sturgeon in the water column changed with ontogenetic development. Although results from Kynard et al. (1998) and Kynard et al. (2002) provide an initial understanding of behavior and drift characteristics of larval pallid sturgeon, the studies were conducted under a limited suite of laboratory conditions. For example, mean velocity in the laboratory stream was 15 cm/s, and depth was 20-100 cm deep. Hydraulic conditions (e.g., depth and velocity) in the Missouri River generally exceed the laboratory conditions used by Kynard et al. (Galat et al. 2001); therefore, results on the behaviors and drift characteristics from existing laboratory studies may not be directly extrapolated to natural hydraulic conditions. Higher water velocities (e.g., 50 cm/s) may increase the downstream drift rate of 0-4 day old pallid sturgeon larvae and increase the length of river needed by larval sturgeon to complete their ontogenetic development. Incorporating behavioral data from Kynard et al. (1998) with limited hydraulic data from the Yellowstone River, Krentz (2000a) estimated that the minimum drift distance for larval pallid sturgeon was 55-89 km (23-55 miles). Also based on the preliminary research by Kynard et al. (1998), the USFWS (2000) estimated that larval pallid sturgeon may drift in the water column for 64-643 km (40-399 miles).

One of the few remaining concentrations of pallid sturgeon inhabits the lower 113 km (70 miles) of the lower Yellowstone River and 322 km (200 miles) of the Missouri River between Fort Peck Dam, Montana, and the headwaters of Lake Sakakawea, North Dakota (Figure 1). However, long-term viability of this population is in jeopardy. Recruitment has not occurred for several years as evidenced by a population comprised of large (e.g., > 1200 mm, > 8 kg; Liebelt 1996, 1998) and presumably old individuals. The limited availability of spawning habitat and limited availability of riverine habitat for larval pallid sturgeon are primary factors contributing to the lack of recruitment in the Missouri River-Yellowstone River reach (USFWS 2000). However, it is not specifically known what length of free-flowing river is needed by larval pallid sturgeon. Detailed studies of the interactions between river transport processes and larval pallid sturgeon behavior, drift characteristics, and habitat requirements are necessary to gain a better understanding of factors impeding recruitment in the Missouri River-Yellowstone River reach.

The goal of this study is to gain an understanding of the behavior and habitat requirements of larval pallid sturgeon related to the lack of recruitment in the Missouri River-

Yellowstone River reach. The proposed study is comprised of five components: 1) develop river travel time models based on relationships between discharge and velocity for the Missouri River downstream from Fort Peck Dam, 2) quantify behavior and drift characteristics of larval pallid sturgeon in the laboratory through a range of velocities, 3) examine behavior and drift characteristics of larval sturgeon in the field, 4) model transport of larval pallid sturgeon based on results from study components 1, 2, and 3, and 5) evaluate survival of larval pallid sturgeon under environmental conditions similar to those in river-reservoir transition areas such as the headwaters of Lake Sakakawea, North Dakota. Two examples highlight the relevancy of the proposed research to pallid sturgeon restoration and recovery plans.

Example 1 – Yellowstone River

The Yellowstone River is characterized by relatively natural discharge, water temperature, and sediment regimes (White and Bramblett 1993). Pallid sturgeon migrate into the lower Yellowstone River during spring and early summer presumably in response to spawning cues provided by the natural discharge and water temperature regimes (Bramblett and White 2001). There is some indication that spawning may occur in the lower 14 km (9 miles) of the Yellowstone River (Krentz 2000b; USFWS 2000; Bramblett and White 2001). However, lack of naturally reproduced young-of-year and juvenile pallid sturgeon in monitoring surveys (Liebelt 1996, 1998) despite successful spawning suggests a recruitment bottleneck during the early larval life stages of pallid sturgeon. About 64 km (40 miles) to 97 km (60 miles) of free-flowing riverine habitat for larval drift dynamics exists between suspected spawning areas in the lower Yellowstone River and the headwaters of Lake Sakakawea. It has been hypothesized that larval pallid sturgeon cannot survive in silty, depositional habitats such as those found in the river-reservoir transition areas of Lake Sakakawea (Krentz 2000b; USFWS 2000). Therefore, the recruitment bottleneck for pallid sturgeon is likely related to the insufficient length of continuous free-flowing river needed by larvae to complete their ontogenetic development. Results from the proposed study will address this hypothesis.

Example 2 – Missouri River below Fort Peck Dam

As outlined in the Missouri River Biological Opinion (USFWS 2000), operations of Fort Peck Dam will be modified in the future (pending the availability of adequate water levels in Fort Peck Reservoir) to enhance water temperature, increase flows, and provide more suitable spawning conditions for pallid sturgeon in a 322 km (200 mile) reach of the Missouri River downstream from Fort Peck Dam. However, limited information is available to determine how increased channel velocities associated with elevated discharges interact with larval drift behavior to influence larval drift distance. For example, if enhanced discharge and water temperature regimes promote spawning by pallid sturgeon in the Missouri River below Fort Peck Dam, will the length of free-flowing river downstream from the spawning site(s) provide sufficient habitat for ontogenetic development? Detailed knowledge of larval drift behavior and hydraulic forces (e.g., water velocity) that serve as the transport mechanism are needed to thoroughly evaluate this and other related questions.

Scope of Work

Study Component 1 – Development of river travel time models based on relationships between discharge and water velocity (Principal Investigators: Dr. Pat Braaten, U.S. Geological Survey, Biological Resources Division, Fort Peck Project Office, Fort Peck, Montana; John French, U. S. Geological Survey, Water Resources Division, Fort Peck, Montana; Dave Fuller, Montana Department of Fish, Wildlife, and Parks, Fort Peck, Montana; John Remus, U. S. Army Corps of Engineers, Omaha, Nebraska).

River discharge and hydraulic data (depth and velocity) for the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea will be compiled from existing sources (e.g., U.S. Geological Survey, U.S. Army Corps of Engineers, Montana Department of Fish, Wildlife, and Parks, North Dakota Game and Fish Department) and from additional data collected as part of the study. Relations between discharge (independent variable) and velocity (dependent variable) will be constructed from existing data to estimate changes in mean velocity as a function of discharge (Figure 2). From this information, it will be possible to estimate travel time (e.g., hours, days) from Fort Peck Dam to selected downstream points in the Missouri River. Based on relations between discharge and velocity, a range of velocities likely encountered by larval pallid sturgeon during drift stages in the Missouri River will serve as treatments for testing larval behavior through a range of velocities (see Component 2 below). Travel time for a range of discharges will also be estimated by measuring the downstream progression of discharge "peaks" or "troughs" between successive USGS gauging stations that correspond to increases or decreases in discharge releases through Fort Peck Dam (Figure 2). Existing gauging stations are located downstream from Fort Peck Dam (06132000), near Wolf Point (06177000), and near Culbertson (06185500).

Existing discharge and velocity data will be augmented by additional data collected during the 2003 field season. Five 16.1 km (10 mile) river reaches will be established at the following locations: 1) downstream from the Milk River (river mile, RM 1751.5 to 1761.5), 2) near Wolf Point (RM 1701-1711), 3) near Poplar (RM 1680-1690), 4) near Culbertson (RM 1620-1630), and 5) near Nohly (RM 1588-1598). Within each reach, one inside-outside bend complex (IOBC; described below) will be randomly selected from all IOBC available in the 16.1 km reach. An IOBC longitudinally progresses from one channel crossover (CHXO; point where the thalweg crosses from one side of the river to the other side of the river) to the next downstream CHXO, and includes the outside bend (OSB) erosional zone and inside bend (ISB) depositional zone (e.g., sand bars, side channels). Four permanent transects will be established within each randomly selected IOBC. The transects will be positioned perpendicular to the flow at the upstream CHXO, between the CHXO and apex of the bend, at the apex of the bend, and between the apex of the bend and the next downstream CHXO. Hydraulic data (cross-sectional area, depth, velocity, discharge) will be measured on each transect using an Acoustic Doppler Current Profiler (ADCP) linked to a differentially corrected GPS unit. Hydraulic measurements will be obtained at a minimum of three discharge levels spanning extremes that occur in 2003.

Study Component 2 – Laboratory quantification of behavior and drift characteristics of larval pallid sturgeon through a range of velocities (Principal Investigator: Dr. Boyd Kynard, Erika Henyey Parker, U.S. Geological Survey, Conte Anadromous Fish Research Center, Turner Falls, Massachusetts).

The drift characteristics and distance drifted of migrant pallid sturgeon ELS (early life stages = free embryo and larvae) depends on the river environment (particularly, water discharge and velocity), and also on behavior of the fish. Recent laboratory studies show that much of migrant ELS behavior in response to physical environmental factors (and habitat) is innate (i.e., illumination intensity, substrate color, and water depth selection; Kynard et al. 2002). Thus, understanding early behavior is critical to predicting and understanding drift characteristics and movement rate of ELS.

The primary objective of the present study is to determine if ELS have a genetic preference to remain in the fastest available velocity. If this is the case, then predicting drift rate of fish in the river will be straightforward. However, if fish prefer to remain in fast flow sometime and in slow flow at other times, predicting their ultimate drift rate from a laboratory study cannot be done because drift rate in the river will vary depending on the actual amount of time fish spend in fast and slow habitat. Thus, drift rate can only be done by in situ monitoring of fish in the river under natural conditions. Objectives of the present study are to 1) determine if migrants drift at the same rate as the fastest water movement in slow, moderate, and fast velocity flows, 2) determine the daily diel drift rate (distance per hour) at the three velocity environments, and 3) determine the diel swimming height above the bottom during day and night.

Drift Rate: The behavior and drift characteristics of ELS during ontogenetic development will be studied through a range of velocities in experimental channels to at least day-14 of the larval interval (cessation of migration). Velocities used in tests will be based on velocity results obtained in Study Component 1 (above). For example, if available mean velocities in the Missouri River downstream from Fort Peck Dam vary from 0.1 m/s to 1.3 m/s through a range of discharges, then ELS behavior and drift characteristics will be examined at a selected subset of velocities within the velocity range. Experience observing ELS indicates that distinguishing the small fish from detritus with video may be impossible at high velocities (e.g., > 0.5 m/s). Given this limitation to experimental tests, we will likely use three velocity environments with maximum velocities of 0.1 m/s, 0.25 m/s, and 0.5 m/s). Obtaining information on drift rate of ELS at higher velocities (e.g., 1.0 m/s) is preferred, but not possible due to limitations observing fish. Using short tests (introducing a fish and following it for a short time) is not an alternative mainly because fish would have to be introduced periodically through the day and night of each day to account for the know difference in diel drift rate during ontogenetic development (Kynard et al. 2002) and fish would have to be kept in separate tanks to test the same fish through time. We do not have the capability to do this. We believe that doubling the drift results of fish at 0.5 m/s to estimate drift at 1.0 m/s would be biologically preferable to extrapolating the results of a series of short drift tests. No information suggests a velocity threshold is needed for migration, instead all evidence indicates ELS have an innate behavior to swim-up above the bottom into the water column regardless of current velocity. The result of this active swimming is that fish move into the current and move downstream in a river. No evidence suggests there is a threshold velocity above which fish cannot resist the current; they do not resist current. However, they may not prefer to use the fastest current during the entire migratory period.

To determine the average movement rate of fish at each of three velocity environments, we need observations on multiple fish at each velocity condition. However, it is impossible to test fish in a group because each individual is small and cannot be distinguished by video from other individuals each time it makes a loop around the tank. Thus, individual movement rates cannot be determined using video observations of a group. We will determine individual movement rates using two fish of different size in each test tank. We will use three tanks at each velocity environment (total, 9 tanks). We will introduce one hatchling embryo into each tank, and then after 4-5 days (beginning of larval period), introduce a second smaller fish (hatchling embryo from another rearing tank with cooler water that has retarded hatching date). With one large and one small fish in each tank, we can distinguish each individual using video, and thus, determine the movement rate (time to move one loop around the tank) of each fish. Data will be collected on six fish at each velocity level (two fish per tank x 3 tanks at each velocity level) and the mean movement rate of the six fish in each velocity environment will be calculated. If a fish dies, it will be replaced immediately by another fish from the appropriate rearing tank (normal or chilled temperature), so data will not be lost.

Fish movement will be studied using nine circular tanks (5-ft diameter) with a 2.5 ft. diameter circular insert inside the large tank to create a channel. Water depth will be about 16 in; channel color is light blue. The insert will be positioned off-center in the 5 ft. tank to create a 9 in. wide channel at the closest point and a 21 in. wide channel at the opposite end of the channel. This will create a channel with fast velocity along the narrow width and along the entire outside wall, a decreasing velocity in the wide part of the channel away from the outside wall, and a slow-water, eddy along the inside wall of the wide channel. This tank configuration creates the habitat complexity present in a river (but on a smaller scale), and will give fish a choice of velocity habitats.

Our previous research in a similar shallow channel of uniform width and velocity found migrants use the entire water column, bottom to surface, by actively swimming up, stopping swimming and drifting motionless down to or near the bottom, then resuming swim up. Thus, the mean velocity of the fast velocity zone around the channel periphery best reflects the fastest migration route. We will characterize this fast water route in each tank by determining the mean velocity at .2 and .8 depth at 12 equidistant stations around the channel, each station 4.5 in from the outside wall. We will also determine the drift rate of a float (vertical quill float that extends from surface to mid-depth) floated around the tank margin in the fastest water. Mean movement rate of the float will be determined by averaging the results of three float tests in each tank (9 float tests per velocity environment).

The appropriate maximum water velocity environment for the three groups of tanks will be provided by a submersible pump located underneath a bottom plastic ramp (20 in long x 8 in high) placed in the narrow channel. The ramp will create shallow water (8 in deep) and provides the best site to observe passing larvae with video. Past studies indicate day-8 and older larvae will move mostly at night, so we will use IR light to observe migrants at night during the entire study. The bottom and sides of the viewing area will be covered with reflective tape to facilitate seeing fish at night.

Data collected from video observations of migrants will be the number of passes by each fish up- and downstream for 5 min each hour of the 24-h day. The daily downstream movement speed and distance traveled by each migrant in the slow, moderate, and fast velocity test groups will be determined by enumerating the number of passes per 5 min (loops per 5 min). Then, using the distance traveled per loop, we will determine the total distance traveled and movement rate (distance moved/5 min) for each fish. The cumulative distance moved per hour will be determined by extrapolating the movement rate of each fish for each 5 min period to the entire 60 min period. The data from individual fish of each test group will be analyzed to produce a daily mean distance and movement rate with error bars. Day and night variation in distance and movement rate will be examined for significant differences. Mean movement rates of fish (n=6 per velocity group) in each of the three test groups (slow, medium, fast velocity) for each day during day and night will be compared to the mean movement rate of the passive float in the three test groups to determine if fish move at the same rate, faster, or slower than the mean rate of the fastest water flow in the three flow conditions.

Swimming height: Preference of ELS for swimming height above the bottom was investigated in a 150-cm high vertical stream tube which had uniform velocity top to bottom (picture and description in Kynard et al. 2002, the methods of which are provided at the end of this section). During studies in the vertical stream tube, day-7 and older larvae swam to the top of the tube, suggesting they would swim higher, possibly to the water surface, if possible. If larvae swim to the surface and remain there, then any model to predict drift rate should account for the vertical distribution. This knowledge is also useful for directing sampling for ELS in the river.

We will conduct swimming height tests of ELS in a 12-foot high (360 cm) stream tube much like the shorter 150-cm high tube used successfully earlier. This length tube was selected after discussion with Pat Braaten on river depths available to migrating ELS. A small paddlewheel turning at the center of the cylinder creates the same velocity top to bottom of the tube. Fish are introduced to the bottom of the tube via a small introduction tube along the paddlewheel. The paddlewheel will stop 30 cm from the surface and bottom of the tube so as to not interfere with fish preferring to remain at these two areas.

Test procedures follow: each day beginning on day-0 (hatching), 8 fish will be introduced into the stream tube and their swimming distance above the bottom determined for 14-15 min after introduction. Previous results in the 150-cm high tube found observations at 5-6 min were adequate to describe fish behavior. Because the tube in the present study is 2.4 times higher than the original tube, we will observe fish at 14-15 min instead of at 5-6 min. The mean daily swimming height will be calculated from the 8 individual fish and daily means determined for all days. Every other day, tests will also be done at night to determine if fish swimming height is similar day and night.

Methods for holding, rearing, observing migrants, and analysis of data will generally follow those presented in Kynard et al. (2002), which have been used to study the behavior of 13 species of sturgeon. A summary of methods from Kynard et al. (2002) is shown below, although not all of the methods are applicable to the present study. Laboratory studies on pallid sturgeon ELS will be used to generate a water velocity-larval behavior matrix that includes age-related larval drift characteristics (Figure 2).

Methods (from Kynard et al. 2002 for pallid and shovelnose sturgeon)

We conducted tests with 500 Missouri River pallid sturgeon that hatched on 25 June 1997 and 400 day-2 pallid sturgeon received the following year on 16 June 1998. Tests were conducted during 2 years with shovelnose sturgeon of Yellowstone River stock: in 1997, 200 fish that hatched on 18 June and 350 fish that hatched on 20 June; and in 1998, 400 fish that hatched on 24 June. The shovelnose sturgeon tested in 1997 and 1998 were from different parents. Eggs were fertilized at a federal hatchery (see Acknowledgements) then shipped to us.

The number of days after hatching was used to characterize age of fish, not the number of days after fertilization, because early rearing varied unknownly before we received eggs. Fish hatching in the first 24 h were termed day-0 fish, i.e., in 1997 pallid sturgeon were day-0 on 25 June and day-1 on 26 June. We reared fertilized eggs in hatching jars that passed embryos in overflow water into 18 or 30-l circular rearing tanks. Temperature of dechlorinated city water from Montague, MA, was similar in rearing and experimental tanks. Water temperature in the oval migration channel in 1997 was 19.0-21.0°C for pallid sturgeon and 18.0-20.0°C for shovelnose sturgeon; and in 1998, temperature was 16-18°C for pallid sturgeon and 18-18.5°C for shovelnose sturgeon. All test and rearing water temperatures were within the range of temperatures experienced by wild fish (USGS data). The natural photoperiod for the Turners Falls location was maintained at all time. Early larvae were fed 6-8 times daily using a timed feeder and four times daily with live Artemia nauplii. In 1998, larvae were fed a sturgeon starter diet (see Acknowledgements), whereas 1997 larvae were fed commercial BioKyowa.

Illumination, substrate color, height above bottom, and cover.– The year and test (species and test in parentheses) were: 1997 (both species - illumination, substrate color, and use of cover); 1998 (pallid sturgeon - height above bottom; shovelnose sturgeon - illumination, substrate color, height above bottom, and cover).

Aquaria used in illumination and substrate choice were 20-l rectangular glass tanks with black plastic covering the four vertical sides to exclude outside light. Two 0.3 m long, 20 watt fluorescent lights were placed 0.3 m above the test tanks, and with barrier partitions underneath the lights, provided the final light intensity for test aquaria. A black cover over one-half of the illumination aquarium's top divided the tank into almost equal areas of illumination (8.2-5.0 lx), dark (0.7-0 lx), and transition in the center (5.5-2.2 lx). The bottom of the illumination aquarium was clear glass and the aquarium sat on a tan table. The bottom of the substrate color aquarium was also clear, but underneath the bottom, the area was divided equally between black and white by two square pieces of white and black plastic. Illumination intensity above the substrate was: white (4.3-2.6 lx) and black (3.3-3.0 lx). During illumination and substrate tests, aquarium position was reversed after each fish to prevent recording side bias of fish. Water was replaced in aquaria between tests to keep water temperature within 1°C of rearing water.

Five pallid sturgeon and four to ten shovelnose sturgeon were tested daily for preference of illumination intensity and substrate color. Before each test, actively swimming fish were removed from a rearing tank using beaker brailing and placed together in a 1-3 l bucket. During each test, a single fish was removed from the bucket by beaker brailing and placed at the water surface in the center of the aquarium. Without acclimation, fish movement was visually recorded as a continuous time series relative to habitat (illumination test - dark, transition, and illuminated; substrate test - white or black bottom). We used an arcsine-transformation of percent data and the percentage of time sturgeon occurred on white substrate or on the illuminated side in all data analyses and calculated 95% confidence intervals to find differences from 50% (no preference).

In 1998 we daily tested 8 pallid and shovelnose sturgeon for swimming height above the bottom in an artificial stream tube that simulated a vertical section of stream (Figure 1). The stream tube was a clear plexiglass cylinder 153 cm long x 15 cm inside diameter with water 150 cm deep. A clockwise rotating paddlewheel that extended down the center of the tube created a horizontal water flow circling the tube at a velocity of 2 cm s^{-1}. A tan cloth was placed on the opposite side of the stream tube from the viewer to provide a uniform background and contrast to see the small fish. During tests, illumination level measured inside the water-filled tube (top to bottom) was 300-50 lx to 30-5 lx depending on time of day. The tube was drained after each test to remove fish and replace water and maintain water temperature within 1°C of rearing tanks.

Sturgeon for stream tube tests were obtained after mixing rearing tank fish by stirring and using beaker brailing to remove fish. Test fish for each replicate were held in a 2 l bucket, and during tests, a single fish was beaker brailed and poured into the top of the introduction tube, which carried fish to the bottom (Figure 1). Only, upward swimming and cover seeking were noted for the first 60 s (acclimation period). At 1-2 min, 5-6 min, and 9-10 min, we continuously recorded up and down movements and the vertical distance of each move. Height of fish off the bottom was determined visually using a depth scale (5 cm marks with 0 = bottom) inscribed around the outside circumference of the tube. We calculated means of high and low values for each period for each fish and presented the grand means for eight fish as a daily time series.

One-half of the stream tube bottom was covered with two layers of grey rocks (5-cm diameter) to create cover habitat and the other one-half of the bottom was open (without cover). Use of cover was recorded only when fish stopped under or by rocks.

In all substrate, illumination or stream tube tests, fish were randomly selected from hundreds of fish, and after testing, all were returned to rearing tanks. While the probability of selecting any fish a second time increased with the number of days tested, we believe the haphazard selection process should provide a group of fish with a set of random tests.

Migration and diel activity.-Migration was observed in an oval endless channel of green-blue color whose linear margin was divided into 12 sections each 62 cm long (see Figure 1, Kynard & Horgan 2001). A continuous flow-through water system supplied 1 l min $^{-1}$ of city water. The channel was 7.3 m in circumference, 32 cm wide, with water 20 cm deep. In all tests, a small submerged pump created a clockwise flow around the channel. During the brief tests with shovelnose sturgeon in 1997, velocities were fast (mean velocity, range 5-12 cm s $^{-1}$), but for all other tests, velocity was slower with a mean velocity of 5-9 cm s $^{-1}$ in sections 6-7 near the pump and a mean velocity of 4-5 cm s $^{-1}$ in the other sections. The mean velocity for each section was determined by measuring velocity at mid-length of each section on both sides and in the center. We measured velocity 3 cm above the bottom with an electronic meter. Three large rocks (each, 10-15 cm diameter) at the two 180° turns of the tank provided cover and reduced water velocity.

We observed both species in 1997 (10 fish per species) and shovelnose sturgeon was tested again in 1998 (15 fish) because observations in 1997 were terminated after only four days to begin testing pallid sturgeon. If a fish died, it was replaced with another from the rearing tank.

We installed a Cohu video camera with infrared light over the oval channel to observe migrants during the day and night in section 1. Silver reflective tape was placed on the channel bottom and sides in the video field of view to enhance seeing the small fish at night. The video system recorded fish for 5 min per hour for 24 h. Because fish could not be marked individually, we recorded the total number of fish moving down- or upstream. These data were used to determine the net number of downstream migrants (number downstream minus number upstream migrants). Mean number of day vs night migrants was compared using t-tests. Also, each day we visually counted the numbers of downstream migrants, upstream migrants, and non-migrants. We evaluated daily downstream movement speed of migrants by determining the time (seconds) for 3-5 fish to move one loop around the channel (1997) or to move 2 m (1998), which we adjusted for total distance (7.3 m) to estimate loop time by age during the day and night. Loop time of only water was measured using a small foam float. Using the hourly video observations of each species, we estimated the average number of downstream loops per fish per day and the cumulative distance moved using the following: (1) number of fish (10 pallid and 10 shovelnose sturgeon in 1997, and 15 shovelnose sturgeon in 1998, (2) net number of downstream migrants (downstream minus upstream number of migrants), (3) twice as many day as night hours for the calendar period, and (4) 7.3 m distance for one loop.

We determined the spatial distribution of fish in the 12 channel sections to determine if fish were randomly distributed. Five times each day, we made an instantaneous count of the number of fish in each section. We analyzed the number of sturgeon in each section for the following periods: pallid sturgeon, late migrants (days 9-12, n = 7 observations) and early residents (days 13-16, n = 14 observations); shovelnose sturgeon, migrants (days 4-8, n = 11 observations), late migrants (days 9-13, n = 32 observations), and residents (days 21-33, n = 28 observations). We used Monte Carlo simulation, n = 10 000, to find the expected distribution of sturgeon numbers in the 12 channel sections if sturgeon selected their location randomly and independently. Simulations were done for 15 fish per channel (shovelnose) and 10 fish per channel (pallid and resident shovelnose). The 10 resident shovelnose were new fish introduced from the rearing tank, not the original fish, which died on day 18. In all observations used in the analysis for pallid migrants, 12 fish were counted even though there were only 10 fish in the tank (i.e. two double counts). Double counting occurs because some fish are moving during observation; we assume that the location of moving fish is random relative to the spatial distribution of stationary fish.

To link behavior to development, we scaled sturgeon development to age and cumulative temperature. Water temperature was recorded daily and these data were used to calculate daily thermal units and cumulative temperature units (CTU) in degree-days after hatching. Cumulative degree-days were calculated to mid-day of each day when behavioral observations were made and reflected temperature during the first 12 h of the current day and the second 12 h of the previous day. For example, day-0 fish accumulated 0 degree days and day-1 fish accumulated 0.5 x temperature °C on day 0 plus 0.5 x temperature °C of day 1.

Study Component 3 – Field examination of behavior and drift characteristics of larval sturgeon (Principal Investigators: Dr. Pat Braaten, Dave Fuller).

This study component will expand on study component 2 (above), but provide a field examination of behavior and drift characteristics of sturgeon in natural habitats of the Missouri River. However, larval shovelnose sturgeon will be used in the field studies because use of larval pallid sturgeon at this time would compromise the existing pallid sturgeon stocking and propagation program in the Missouri River downstream from Fort Peck Dam (Steve Krentz, U. S. Fish and Wildlife Service, personal communication). Although larval shovelnose sturgeon and larval pallid sturgeon exhibit several behavioral similarities (i.e., timing of migration, migration distance, life interval when most distance was moved; Kynard et al. 2002), larval behavior of both species differs with respect to movement characteristics (i.e., peak rate of movement for pallid sturgeon is one-half that of shovelnose sturgeon but pallid sturgeon continue movements twice as long) and diel behavior (i.e., pallid sturgeon are diurnal whereas shovelnose sturgeon are nocturnal). Thus, results of field studies using larval shovelnose sturgeon may not be identical to results that would have been obtained if larval pallid sturgeon had been used. It may be possible in 2004 to repeat Study Component 2 (above) using larval shovelnose sturgeon to more rigorously test for behavioral differences between species.

Field studies will be conducted in side channels and mainstem habitats of the Missouri River. For side channels, five distance markers will be established along the length of a side channel corresponding to point 0 (upstream end of the side channel), point 50 (50 m downstream from the upstream end), point 100 (100 m downstream from the upstream end), point 150 (150 m downstream from the upstream end), and point 200 (200 m downstream from the upstream end). Depth and velocity will be measured at intervals along a transect at each distance marker to obtain an estimate of the average depth and velocity in the side channel. Substrate will be visually assessed as silt, sand, gravel, cobble, and bedrock from grab samples. A larval fish sampling apparatus consisting of two nets (surface net, bottom net; 750 μm mesh) will be positioned mid-channel at the 50 m, 100 m, 150 m, and 200 m distance markers. Five hundred larval shovelnose sturgeon (0 – 4 days old) will be released near the substrate at point 0 in the side channel, and be serially sampled at 20-second intervals at each distance marker following release of larvae. Sampling will occur for 2 minutes beyond the estimated travel time from point 0 to point 200 (based on estimated mean velocity). This study will be conducted in a minimum of three side channels. Bottom profiles of the side channels will be graphed with a chart recorder to identify contours (e.g., dunes) that could influence larval drift and retention. We will explore the possibility of blocking the lower end of the side channels with nets to collect larvae not sampled by the larval sampling devices.

A similar procedure will be used to examine larval drift in the mainstem Missouri River. The study area will extend from the mid-point of one IOBC, through the next CHXO, through the next IOBC, through the next CHXO, and terminate at the mid-point of the next IOBC. Thus, drifting larval sturgeon will be exposed to a variety of natural habitat elements (side channels, sand bars, sand dunes, etc.). Distance markers will be established along the length of the channel corresponding to point 0 (starting point at the IOBC), point 50 (50 m downstream from the start point), point 150 (150 m downstream from the start point), point MID (mid-point of the site; exact distance dependent on total length of the site), and point END (end point; exact distance dependent on total length of the site). Larval drift studies will be conducted at three mainstem sites following the same sampling methodology as in side channels; however, the number of larval sturgeon released at point 0 will be increased to 3,000.

Data generated from field studies of larval drift will be compared to results obtained in the laboratory. For example, the Table 1 below presents hypothetical results from a single side channel that had an average velocity of 0.5 m/s. If larval sturgeon age-0 to age-4 days in natural habitats drift at the rate of average velocity, one would expect centroids of abundance at 100 seconds post-release at the 50-m marker; 200 seconds post-release at the 100–m marker, 300 seconds post-release at the 150-m marker, and 400 seconds post-release at the 200-m marker. Slight differences in timing may occur depending on whether individuals drifted predominantly near the surface or near the bottom (e.g., time to reach a distance marker may increase if individuals drifted along the bottom where velocities are reduced). Summary statistics including mean, minimum and maximum larval drift speed will be determined and compared to laboratory results.

Table 1. Hypothetical results from field studies of larval sturgeon drift characteristics in a single side channel with a mean velocity of 0.5 m/s.

Seconds after release	No. of larvae sampled at 50 m		No. of larvae sampled at 100 m		No. of larvae sampled at 150 m		No. of larvae sampled at 200 m	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
20								
40								
60	1							
80	3							
100	11	6						
120	2	1						
140	1							
160								
180		1	2	1				
200			6	3				
220			1	1				
240			1	1				
260					1			
280								
300					10		2	
320					4	3		
340					2	1		
360						1		
380							1	
400							7	
420							4	2
440								5
460								

Study Component 4 - Model transport of larval pallid sturgeon based on results from Study Components 1, 2, and 3 (Principal Investigators: Dr. Pat Braaten, Dave Fuller, Dr. Boyd Kynard, John Remus).

The information generated from study components 1, 2 and 3 (above) will be used to construct models of downstream transport and drift characteristics of larval pallid sturgeon in the Missouri River downstream from Fort Peck Dam. For initial modeling purposes, seven locations separated by 48.3 km (30 river miles) will be designated as sturgeon spawning areas: 1) immediately downstream from Fort Peck Dam (RM 1770), 2) near Frazer Rapids (RM 1740), 3) near Wolf Point (RM 1710), 4) near Poplar (RM 1680), 5) near Brockton (RM 1650), 6) near Culbertson (RM 1620), and 7) near Nohly (RM 1590). Although sturgeon spawning areas are not known in the Missouri River downstream from Fort Peck Dam, the locations listed above serve as starting points to which additional simulations of larval sturgeon travel time and dispersal rates could be made if accurate spawning locations are identified in future studies. Output from these models will include larval drift duration (hours, days) between river location as a function of discharge, water velocity, drift velocity, and larval behavior, and estimated lengths of river needed by larval pallid sturgeon. Several models will likely be generated (Figure 2). For example, if behavioral studies in the laboratory and field indicate that larval drift rate (m/s) is directly proportional (i.e., 1:1 relationship) to current velocity (m/s), a "Proportional Drift Rate Model" would quantify larval drift travel time between selected points in the river and provide estimates of continuous river length needed by larval pallid sturgeon. Behavioral studies may indicate that the drift rate of larval pallid sturgeon is dependent on current velocity but not directly proportional (e.g., drift rate increases with current velocity, but drift rate is always slower than current velocity). These results would yield a "Modified Proportional Drift Rate Model," whereby travel time between selected points in the river and the length of river needed by larval pallid sturgeon would be based on the drift rate as a function of current velocity. Behavioral studies may indicate that larval drift rate is completely independent of current velocity and that larval pallid sturgeon migrate downstream at a constant rate. Given this scenario, a "Constant Drift Rate Model" could be developed whereby travel time between selected points in the river and length of river needed by pallid sturgeon would be based on the constant rate of larval migration. Additional models that include potential ontogenetic changes in drift rate as a function of current velocity will also be developed pending results from behavioral studies.

Component 5 - Evaluate survival of larval pallid sturgeon in depositional substrates similar to habitat conditions found in the river-reservoir transition area of Lake Sakakawea, North Dakota (Principal Investigator: Dr. Pat Braaten).

It is hypothesized that larval pallid sturgeon cannot survive in silty, depositional habitats such as those found in the river-reservoir transition areas of Lake Sakakawea (Krentz 2000b; USFWS 2000). However, this hypothesis has not been critically evaluated. In this study component, survival of larval pallid sturgeon will be evaluated in the laboratory under different substrate and sediment inflow treatments emulating silt and sand substrate characteristics found in the river-reservoir transition area. Although the spatial and temporal characteristics of substrate in the river-reservoir transition area of Lake Sakakawea are dynamic and dependent on river discharge, river stage and wind (Fred Ryckman, North Dakota Game and Fish Department, personal communication), the laboratory study will isolate substrate type and inflows as causative factors.

In the laboratory, 162 plexiglass tubes (approximate size: 10-liter volume, 15-cm diameter) will be randomly divided into three groups of 54 tubes. Each group of 54 tubes will serve as a turbidity treatment in the experiment (i.e., increasing levels of total dissolved solids; 0 NTU, 75 NTU, 750 NTU). The 54 tubes in each turbidity treatment will be further divided into three groups of 18 tubes with different substrate characteristics (i.e., no substrate, sand, silt; Figure 3). The bottom 10 cm of each vertical tube will be filled with the appropriate substrate as defined by the treatment. Each tube will have a trickle inflow and outflow, but differences in turbidity inflow as described by the treatments. All tubes will be fitted with an air stone and thermometer. Water temperature will be maintained at 22-24°C during the course of the experiment. This temperature range is similar to water temperatures that occur in the Missouri River downstream from the Yellowstone River confluence during late June and July (Braaten and Fuller 2002). Twenty newly hatched (age-0 days old) pallid sturgeon will be added to each tube at the onset of the experiment. Assessments of survival will be initiated on day 1 (first day after larvae are added), and continue on day 3, day 6, day 9, day 12, and day 15. Thus, the survival-assessment period will encompass the complete time period when larval pallid sturgeon are drifting in the water column (e.g., days 0-4) and when larvae have settled to the river bottom (days 5-13).

The following protocol will be used to evaluate survival. On each day, water and sediments will be drained from three randomly selected tubes from each treatment and the number of dead and live larvae will be recorded. Prior to draining tubes, sediments in the bottom of each tube will be measured (mm) to quantify sediment deposition changes throughout the duration of the experiment (mm/hr).

Although included in the current study proposal, this study component will not be conducted under the Scope of Work at this time. Initiation of this study component will be considered for spring and summer 2004.

Contractor Responsibilities and Deliverables

Research activities associated with Study Components 1, 2, 3, and 4 (Study Component 5 has been delayed until 2004) will be partitioned to the following agencies as follows. For Study Component 1 (Development of river travel time models based on relationships between discharge and water velocity), compilation of existing hydrologic data for the Missouri River downstream from Fort Peck Dam will be conducted by the MTFWP (Dave Fuller) and the USGS-BRD (Pat Braaten) with assistance from the USACE (John Remus). Study Component 1 also includes field activities for quantifying changes in depth, velocity, and travel time as a function of discharge. These field activities will be jointly conducted by the MTFWP (Dave Fuller), USGS-BRD (Pat Braaten), and USGS-WRD (John French). Results from Study Component 1 will be summarized as an individual report.

Study Component 2 (Laboratory quantification of behavior and drift characteristics of larval pallid sturgeon through a range of velocities) will be conducted exclusively by the USGS-BRD (Boyd Kynard and Erika Henyey-Parker). Results from Study Component 2 will be summarized as an individual report.

Research activities associated with Study Component 3 (Field examination of behavior and drift characteristics of larval sturgeon) will be conducted by the MTFWP (Dave Fuller) and USGS-BRD (Pat Braaten), and results will be summarized as an individual report.

Study Component 4 (Model transport of larval pallid sturgeon based on results from Study Components 1, 2, and 3) will entail a synthesis of all research activities. Thus, all participating agencies (MTFWP, USGS-BRD, USGS-WRD, USACE) will be involved. Study Component 4 will be summarized as an individual final report, and be completed by March 31, 2004 (see Timeline listed below). All reports will be sent to the Omaha District USACE.

Contractors involved in the study will purchase equipment and conduct tasks in accordance with methods specified in the four study components listed above. Quality assurance representatives from the USACE will periodically accompany contractors in laboratory and field activities to perform quality assurance inspections during the course of the study.

Confidentiality: All data collected, analysis of data, etc. performed during the study is the property of the USACE, and is considered provisional until accepted by the Omaha District USACE. Participating agencies will not publish, report, or in any way disseminate information generated from the studies under this agreement without permission from the Omaha District USACE.

Timeline

Activity	Month 2002		Month 2003												Month 2004		
	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Component 1			X	X	X	X											
Component 2								X	X	X							
Component 3							X	X	X	X							
Component 4										X	X	X	X	X			
Component 5	Initiation delayed until spring/summer 2004																
Final Report															X	X	X

Fiscal Year 2003 Budget

Agency	Contact person	Study component participation	Item	Amount
USGS–BRD, Columbia Environmental Research Center	Pat Braaten	1, 3, 4	Technician salary	$21,710
			Equipment	$31,000
			Travel	$8,550
			Subtotal	$61,260
			Overhead (26%)	$15,928
			Total	$77,188
USGS-WRD, Fort Peck	John French	1	Technician salary	$13,061
			Equipment	$10,686
			Travel	$4,400
			Subtotal	$28,147
			Overhead (40%)	$11,259
			Total	$39,406
MT Fish, Wildlife and Parks	Dave Fuller	1, 3, 4	Technician salary	$48,760
			Equipment	$20,500
			Travel	$3,000
			Subtotal	$72,260
			Overhead (19.1%)	$13,802
			Total	$86,062
USGS – BRD Conte Anadromous Fish Research Center	Boyd Kynard	2, 4	Salary	$23,000
			Equipment	$47,600
			Travel	0
			Subtotal	$70,600
			Overhead(28.5%)	$20,100
			Total	$90,700
			Project Total	$293,356

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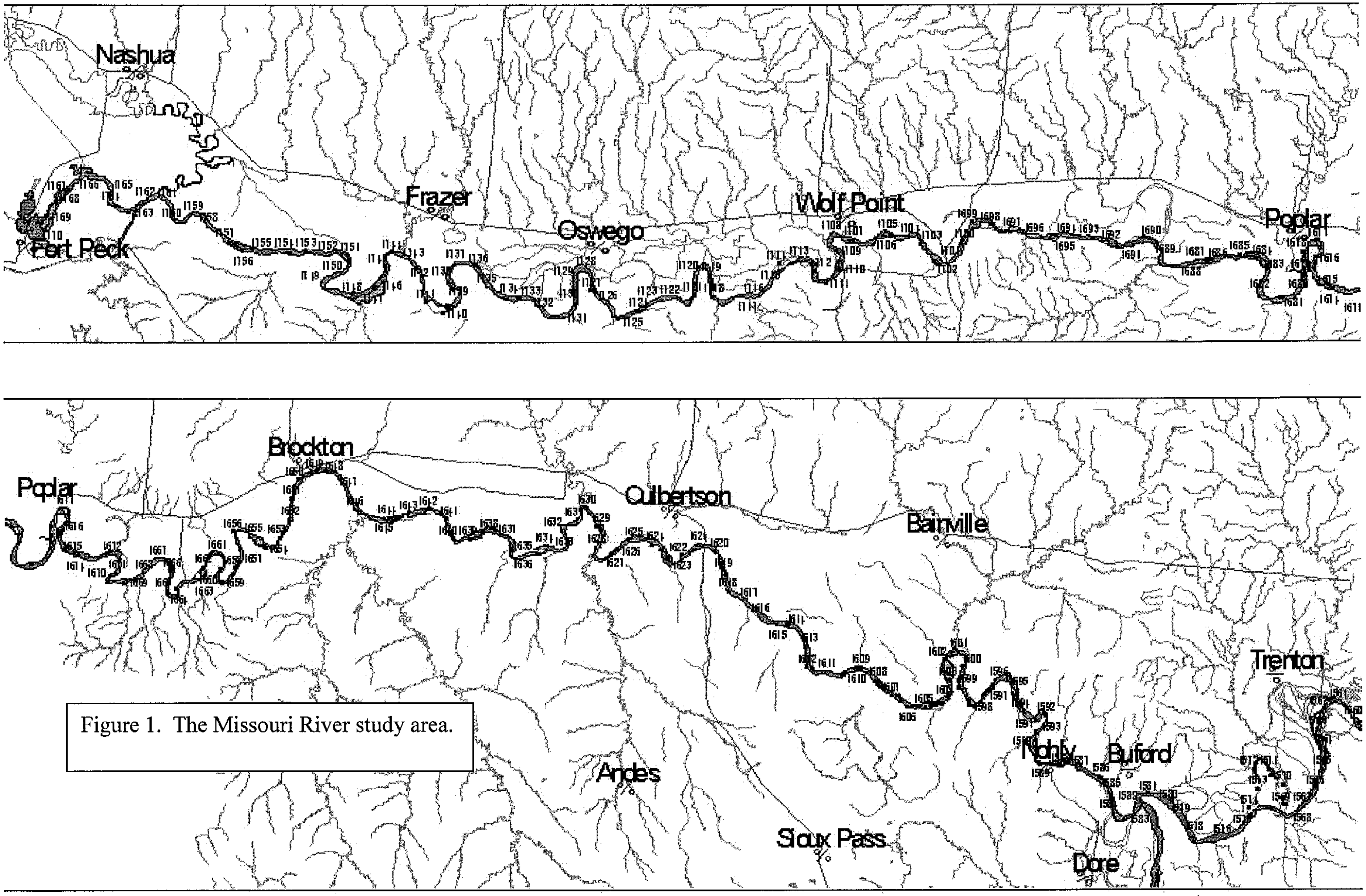
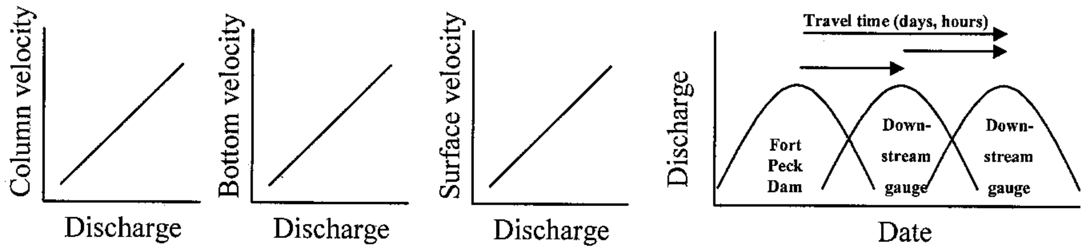


Figure 1. The Missouri River study area.

Conceptual Model Illustrating Research and Modeling Activities and Hypothetical Results for Larval Pallid Sturgeon

Study component 1

Existing hydraulic data



Outputs

a. Range of available velocities

b. Velocity profiles and travel time in the Missouri River

Study component 2

Larval behavior and drift characteristics

Larval age X (days, for ages 0-14)	Treatment velocity (cm/s)	Larval drift velocity (cm/s)	Vertical drift location (cm above bottom)
X	0.1 0.4 0.7 1.0 1.3		

Outputs

Study component 4

Model larval transport and length of river needed

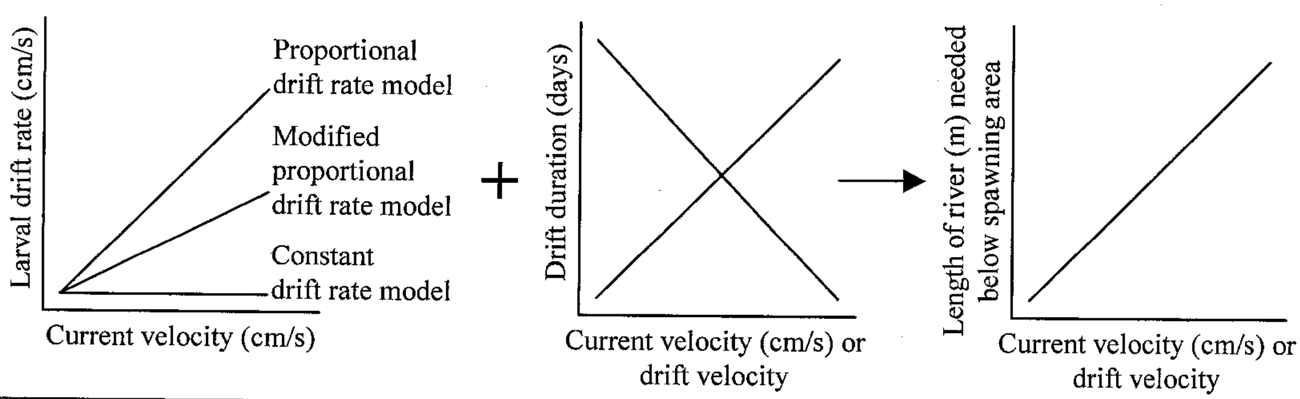


Figure 2. Conceptual model.

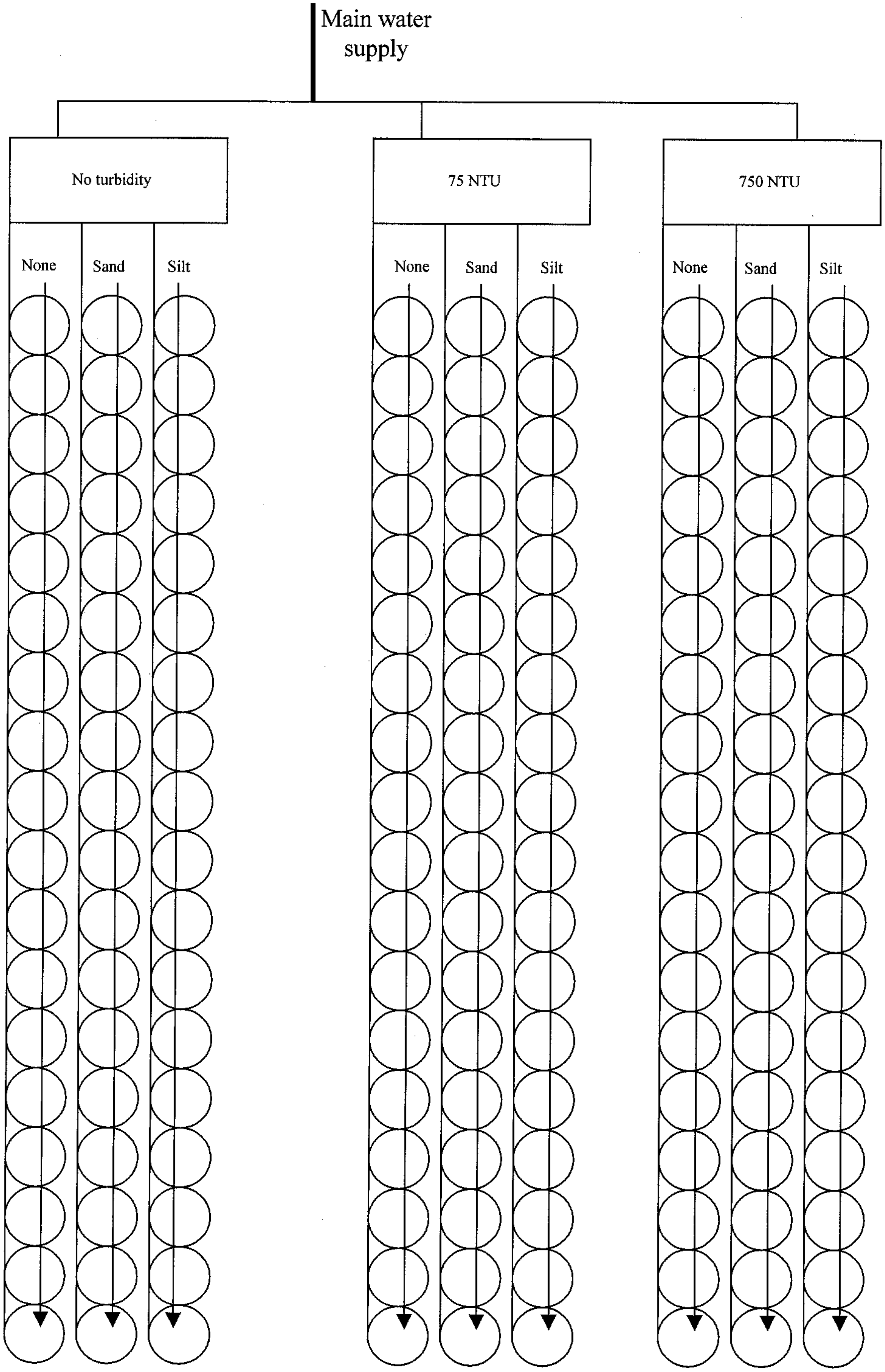


Figure 3. Lab design for survival experiments.

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SCOPE OF SERVICES
FOR
SPILLWAY INVESTIGATION DURING TEST FLOW
AT FT. PECK DAM, MONTANA
30 JULY 2002
REVISION 2 (9 AUGUST 2002)

1. INVESTIGATION AND FLOW TEST GENERAL DESCRIPTION

1.1. Location and General Description.

Fort Peck Dam is located in northeastern Montana on the Missouri River, approximately eight miles upstream from the junction of the Milk and Missouri Rivers. The spillway is located in a pass through the rough, hilly rim of the reservoir basin, about three miles easterly of the main embankment across the Missouri. Montana State Highway No. 24 passes over the spillway and the main embankment of the dam. It joins with U.S. Highway No. 2 at Glasgow, approximately twenty road miles to the northwest of Fort Peck and with State Highway No. 18 to the south.

The spillway is designed to discharge a maximum of 250,000 c.f.s. and consists of an approach channel, a reinforced concrete gate structure, a reinforced concrete discharge channel, and an earth-lined channel to the Missouri River. The approach channel is approximately 2,000 feet long and composed of a lined channel 360 feet long and an unlined channel 1,600 feet long. The reinforced gate control structure is 820 feet long and is set on a curved line. It consists of 17 piers set on a curved line between which are suspended 16 electrically operated vertical-lift steel gates, each 25 feet high and 40 feet long. The piers support the highway bridge, service bridge, walkways, and gate operating platform. The vertical lift gates can be used singly or they can be operated in combinations to achieve the desired flow release. The gate structure also includes 16 stop logs that are each about 43.5 feet long and 3.75 feet high that are used to dewater and allow gate repair. One to seven logs per bay are needed depending upon the reservoir elevation. As many as seven units may be necessary to close one bay at maximum reservoir elevation. The 5,030-foot concrete-lined channel varies in width from 800 to 130 feet and drops 214 feet from the crest of the gate structure to the invert of concrete channel in the cellular cutoff structure. An unlined discharge channel, 2,760 feet long, continuing from the end of the concrete-lined discharge channel, carries spillway flow to the main channel of the Missouri River.

1.2. Study Objectives.

The proposed study objectives are to evaluate the spillway slab stability for a range of flow rates, evaluate scour hole geometry for a range of flow conditions, evaluate the scour hole effect on spillway stability, and perform a preliminary design of spillway rehab alternatives. Described in detail within the following scope, the final report prepared by the A/E shall include conclusions which clearly state:

1. Data collected during the spillway mini-test and full-test flow periods.
2. Determine the spillway slab safety factor for a range of flow rates and identify the flow rate at which slab failure occurs. Impacts of slab doming, drain efficiency, and slab offset shall be clearly stated.
3. Determine the scour hole geometry for a range of flow rates and the spillway flow at which cutoff wall failure occurs. Impacts on the analysis of critical parameters such as tailwater depth, material strength, material weathering and repetitive spillway use, and scour hole geometry shall be clearly stated.
4. A preliminary design of spillway rehab options shall be performed. The reconnaissance level design will evaluate the feasibility of installing a riprap lined plunge pool or spillway flip bucket to provide energy dissipation.
5. Prepare an interim report following the mini-test that describes collected data and performed analysis. Prepare a final report following the full-test that describes collected data and performed analysis for the entire investigation.

1.3. Spillway Function.
The primary function of the Fort Peck spillway is to release surplus water from the reservoir in order to prevent overtopping and possible failure of the dam. The safety of the dam and the downstream developments is dependent upon proper functioning of the spillway under the most adverse conditions.

1.4. General Policy for Operation.
If it becomes necessary to lower the reservoir level by flood control discharge, then it is advisable to let the water run through the spillway gates whenever possible rather than discharge through the flood control tunnels, thereby saving wear and tear on tunnel lining and control shaft gate lip. If the desired discharge is greater than the amount of water discharging through the power units and the reservoir is above elevation 2,225, the excess discharge above that of the power units will be spilled through the spillway gates whenever possible.

1.5. Spillway Scour Hole.
The lined spillway channel terminates at elevation 2011.0 feet m.s.l. with a cutoff wall. At the spillway terminus, a scour hole has formed as a result of spillway operation. The cutoff wall structure is cellular, extends to a depth of 70 feet below the spillway channel invert to elevation 1941.0 feet m.s.l., and also includes wingwalls. A geophysical survey of the scour hole was conducted in May 1996. The survey determined existing scour hole geometry and included a subsurface evaluation of deposited sediments. Significant spillway flows have occurred since the survey date. Measurements are required to define the scour hole geometry. Scour hole measurements are required before the spillway flow tests begin and during the flow test period. A hydraulic analysis was performed to evaluate predicted scour hole geometry for various spillway flows (*Fort Peck Dam Spillway Engineering Reconnaissance Study, August 1997*). The analysis determined estimated scour depth, length, and width for spillway flows as follows:

Discharge (c.f.s.)	Elevation (ft)	Depth (ft)	Length (ft)	Width (ft)
25,000	1981.8	29.2	560	400
125,000	1929.2	81.8	1230	890

1.6. Spillway Exit Channel.
The unlined spillway exit channel continues from the spillway channel chute and cutoff wall for a length of approximately 2700 feet to the Missouri River. Original construction included excavation through the shale bluffs to the Missouri River floodplain. Channel excavation consisted of a bottom width of 130 feet, side slopes of 1V on 2H, and a flat gradient at an elevation of 2010. After exiting the shale bluff, a 12 foot wide pilot channel was excavated through the river floodplain to the Missouri River. Following construction, spillway flows have altered the channel section and grade within the unlined exit channel. Measurements and analysis are required to determine channel degradation during spillway flows and the tailwater rating curve at the spillway exit.

1.7. Slab Drain System.
The drainage system consists of 6- and 8-inch lateral spillway drains which flow into an 18-inch longitudinal collector which extends the full length of the spillway chute slab centerline. All pipes are vitrified clay and are installed beneath the spillway slab. The laterals are present only from the crest structure (approximately station 2+00) down to station 46+00. The 8-inch drains are spaced at 120 foot intervals and are embedded in gravel beneath 5-foot deep concrete collars. The 8-inch lines extend extend from the slab centerline out under the sloping side walls. The 6-inch drains are spaced between the 8-inch pipes at 20 foot centers, and they are embedded in gravel beneath 2-foot-deep concrete collars located at each transverse joint. The 8-inch lines collect seepage water from under the side walls and slab; the 6-inch lines collect seepage water from under the slab and toe of the side walls.

The R.W. Beck study for the Omaha District titled "Ft. Peck Dam Spillway Engineering Reconnaissance Study" concluded "*The slab is not expected to be watertight since aging of the spillway has probably reduced the effectiveness of the water stops. This condition is highly probable* *where a slab displacement of 3/8 inch or greater has occurred. In addition, the spillway flow durations are probably several weeks to months, increasing the chance afor entrance of water and induced uplift. It is assumed induced uplifts will occur and the drains are not effective. Assuming that the induced uplift is 40% of the velocity head, for flows of 25,000 c.f.s. and 125,000 c.f.s., the chute slab safety factor downstream of Station 25+00 is less than 30+00 is less than 1.0. This would result in the slabs lifting off and unraveling, exposing the highly erodible Bearpaw Shale to scour and potential undermining of the upstream slabs and the gated spillway control structure.*

Another way of looking at this condition is to determine what drain efficiency is required to keep the chute slab stable. Drain efficiency is defined as the ratio of the net uplift (after considering the uplift resisting capability of the slab) to the maximum uplift. For a flow of 125,000 c.f.s., the drains will have to be at least 82% efficient, downstream of Station 35+00, if uplift is taken as 100% of velocity head and 55% efficient for an uplift of 40% of the velocity head."

A steel water stop was designed into each joint in an effort to prevent the creation of uplift forces below the slabs due to infiltration of water through the joint. As stated above, due to slab rebound over the years and the observed offsets at some joints, competency of the water stops and the drains are now in question. In an effort to monitor the effectiveness of the drains, vibrating wire pressure transducers were placed in the drain system

Concern has been expressed on the existing condition and water tightness of the slab joints and subdrain pipe because of the rebound movement that the spillway has experienced since construction in the 1930's. Rebound movement of the slabs of up to 3.5 feet has been documented by surveys. A visual inspection in 1995 of the 18" diameter pipe revealed it was partially plugged with soft and loose silt material.

1.8. Spillway Flow Mini-Test.

A spillway flow test is planned to be conducted by the U.S. Army Corps of Engineers, Omaha District, Operations and Engineering Divisions. The test start date is dependent upon Fort Peck pool and downstream channel conditions but is expected to be between 15 May 2003 and 15 June 2003. The specifics are as follows:

Flow Test Scenarios			
Duration (days)	Spillway Flow (1000 c.f.s.)	Power Tunnel (1000 c.f.s.)[2]	Combine Flow Total (1000 c.f.s.)[2]
Adjustment: Initial power flow at 8K, reduce to 4K while increasing spillway flow from 0 to 4K.			
4	4	4	8
Adjustment: Increase power flow from 4 to 8K while reducing spillway flow from 4 to 0K.			
1[1]	0[1]	8	8
Adjustment: Increase power flow from 8 to 11K. Reduce power flow from 11 to 7K while increasing spillway flow from 0 to 4K.			
4	4	7	11
Adjustment: Increase power flow from 7 to 14 K while reducing spillway flow from 4 to 0K.			
4	0	14	14
Adjustment: Reduce power flow from 14 to 11K while increasing spillway flow from 0 to 4K.			
4	4	11	15
Adjustment: Reduce power flow from 11 to 7K while increasing spillway flow from 4 to 8K (maintain a maximum total of 15K). Further reduce power flow from 7 to 4K.			
4	8	4	12
Adjustment: Increase power flow from 4 to 7K.			
4	8	7	15
Adjustment: Reduce power flow from 7 to 4K while increasing spillway flow from 8 to 11K (maintain a maximum total of 15K).			
4[3]	11[3]	4[3]	15[3]
1[4]	11 (no fish barrier)[4]	4[4]	15[4]
Adjustment: Day 1- Reduce spillway flow from 11 to 5K while increasing power flow from 4 to 7K. Day 2 - Reduce spillway flow from 5 to 0K while increasing power flow from 7 to 9K. Day 3 - Further reduce power flow from 9K to the desired flow (7 or 8K).			
NA	0[1]	Normal	Normal

1 Monitoring Period. Spillway flow will be stopped during a 4-12 hour period to perform scour hole and exit channel surveys. The monitoring is scheduled to start at approximately 0830 after the listed spillway flows are stopped. After completion of monitoring, the spillway and power flows will be adjusted to the next flow combination.
2 Approximate power flow will vary depending upon pool elevation.
3 Flow combination duration may vary from 4-9 days depending upon monitoring results.
4 Flow combination duration as required may vary to provide data without the fish barrier.

1.9. Spillway Flow Full-Test.

The Omaha District intends to perform the spillway full-test the calendar year following the mini-test. A full-test protocol will be developed following the mini-test. At this time, the anticipated maximum spillway flow during the full-test is 25,000 c.f.s., (the target flow out of the spillway is 19,000 c.f.s.)

2. WORK TO BE PERFORMED BEFORE MINI-TEST

2.1. Install Fish Barrier. One option the Corps is considering for maintaining fish populations in Fort Peck Reservoir during proposed spillway flow testing is the installation of a temporary fish barrier. The proposed location for this barrier is in the upstream approach channel, with the intent of preventing the movement of fish downstream.

Based on information collected by the Corps, the Corps evaluated various options and determined there are only two viable options for this barrier. The Corps has obtained detailed design and cost information on an electric fish barrier and desires to obtain the same for a net system, which has been identified by fishery agencies, Fort Peck operations personnel, and other Corps personnel as a possible alternative. Debris is not considered to be a significant factor. To that end, the A/E shall develop a design for the Corps-selected netting system, incorporating the following components:

a. Within 8 weeks from award, the contractor shall provide to the Corps for review the installation details of the fish net barrier system.

b. The fish net barrier design will include the anticipated structural support, methods of installation and removal, a method for manual cleaning, and storage requirements for the net. Design calculations and operational considerations will be provided with the design.

c. A budgeting level detailed cost estimate for installation, operation, removal, and storage of the fish net system is required to accompany the design for comparison to the dollar figures generated for the electric fish barrier. The A/E will estimate cost based on A/E contracted personnel performing all required task and the storage facilities being a non-heated government warehouse within 6 miles of the approach channel.

d. It is anticipated that this contract will be modified to install the structure support system for the net during the fall of 2002. The modification is also anticipated to address the purchase and operation of the net system.

2.1.1 Fish Net System. The fish net system is to impair the lake fish greater in length than 4 inches from going over the spillway. As a minimum, the following types of fish are to be impaired from going over the spillway by the net system: Cisco, Walleye, Northern Pike, Buffalo, Small Mouth Bass, Lake trout, Salmon, Catfish, Paddlefish, Shovelnose Sturgeon, Carp, Yellow Perch, Sauger, Burbot (ling), and other related types of fish. Fish Net Design Parameters determined by input from the various stakeholder and regulatory groups are as follows:

a. Use 3/8-inch nylon mesh multi filament net

b. The contractor shall determine the average channel flow velocity for flow rates of 11,000 cfs and 19,000 cfs combined with a range of pool elevations from 2230 to 2245 at 5 foot increments. Average velocities will be determined using an assumed channel bed elevation of 2219 feet (1 foot below the concrete slab in front of the gates at 2220). Channel width shall be determined by scaling from existing plans at the net location. The contractor shall identify flow/depth combinations at which fish impingement occurs. Impingement shall be assumed to occur at an average velocity of 3 ft/sec.

c. The net barrier system design will include the identification of a method for removal and replacement of the net, which allows for removal of a portion of the net (with immediate replacement with another) and manual cleaning. The A/E will consider a system where only half the net system is required to be in use at any one time (allowing for access to the other half for debris removal). The design shall incorporate the requirement to maintain the net barrier within the flow area during the cleaning process.

d. The net barrier system must be functional during the mini tests at pool levels from 2230 to 2245 feet, and may be made up of multiple nets.

e. The contractor shall provide detailed calculations of the loads/force being applied to the net under the flow conditions and the 5 ft depth increments within the pool range given above. A maximum net blockage factor of 30% shall be included in the force computation. The contractor shall identify the factor of safety for both the net and the support system. The contractor shall design the support system to provide a minimum factor of safety of 3.0 at the maximum net loading. The contractor shall design the system such that the net fails prior to failure of the support system. The cost estimates for operating the net system will include the assumption that A/E contracted personnel will check the barrier installation twice daily during the mini-test. The estimate will also include removal and cleaning of the net once every four-days by an A/E contracted cleaning crew with A/E furnished equipment. Impingement will not be concerned as a problem.

f. The net system is to be designed for use a minimum of three times for durations of between 21 and 60 days; the preferred life of the components will be five years. If replacement of any components is anticipated to be required due to degradation of materials during this time frame, these will need to be identified and replacement costs factored into the operational costs.

g. The Corps will be responsible for obtaining any permits required in connection with the fish net system.

h. Backup measures shall consist of a duplicate net. The contractor shall include the cost of the duplicate net in the prepared cost estimate.

2.2. Scour Hole and Exit Channel Survey.
The A/E shall conduct scour hole surveys at the specified times. Scour hole measurements are required before spillway flow tests begin and at specified times during the flow test period. All surveys shall be performed in the same coordinate system that shall be furnished by the government.

2.2.1. Scour Hole Below Water Survey. An accoustical subbottom profiling system or equivalent is required to estimate the thickness of deposited sediments in the scour hole. The profiling equipment shall consist of a sound source, energy source, receiver and recorder. A suitable survey boat is required. A minimum of 5 lines parallel to the spillway and 8 lines perpendicular to the spillway shall be profiled and spaced at 50 feet. Horizontal control of the profiling shall be performed by a laser tracking system. The position of the boat shall be recorded approximately 2 times a second on a navigation computer. The navigation computer shall also be capable of sending a fiducial mark to the subbottom profiler graphic recorder every 10 seconds. Vertical control shall be performed by determining the water surface elevation and using it as a reference. Survey results should clearly identify the extent of deposited material and firm shale within the existing scour hole.

2.2.2. Scour Hole Above Water Survey. In addition to the scour hole below water survey, a land survey is required from the water line to the top of slope. The survey shall be performed in a cross section format. Five perpendicular cross sections shall be used. The approximate location of the cross sections will be furnished on an aerial photograph. The end points of the center cross section shall be marked with a rebar/concrete marker. The government shall furnish a typical section marker detail.

2.2.3. Spillway Exit Channel Survey. Cross section surveys and a centerline profile survey are required of the spillway exit channel. Four perpendicular cross sections are required. The end points of each cross section shall be marked with a rebar/concrete marker. Cross sections shall extend to the top of slope. A centerline profile from the scour hole to the Missouri River is also required. Profile length is approximately 2700 feet. Profile points are required at approximately a 100 foot spacing with additional points as required to identify breakpoints.

2.2.4. Survey Data Format. All surveys shall be performed in a like manner for comparison purposes. All surveys shall utilize the same coordinate system. The horizontal geometry and cross sections shall be plotted in a microstation .dgn file format. Ascii XYZ points and CADD contour mapping shall be provided for each survey.

2.2.5. Additional Surveys. Additional scour hole surveys are required during the spillway flow test period. Survey data collection and analysis shall be performed while considering the requirement to incorporate future survey data for comparison purposes. Surveys shall be performed according to the following schedule:

Approximate Schedule - Spillway Scour Hole and Exit Channel Surveys			
Survey Date	Scour Hole Below Water Subbottom Profile	Scour Hole Above Water	Exit Channel
Just prior to Mini -Test (May 2003)	X	X	X
During Mini-Test 2003	X		
After Mini-Test or Prior to Full-Test [1]	X	X	
During Full-Test 2004[1]	X		
After Full-Test 2004[1]	X	X	X

1 The full-test survey requirements will be further evaluated after the mini-flow test. Survey requirements between the Mini-Test and Full-Test will be dependent upon the time elapsed and the requirement for spillway releases in addition to the proposed test releases.

For scope and estimating purposes, the A/E shall consider the number of surveys in the above table. Additional surveys may be incorporated based on observed response to spillway flows.

2.3. Slope Stability Analyses.

A slope stability analysis shall be performed in the scour hole area for the two scour hole geometries. The wedge method shall be used to analyse the slopes for deep seated failures and infinite slope analyses used to analyze shallow failures. The deep seated failure analysis is necessary for determination of higher spillway flows and anticipated greater erosional extent. The shallow analysis is necessary for determination of sliding of weathered shale at the surface of the slopes at lower spillway flows. The slope stability analysis shall be performed on two cross sections on each side of the spillway centerline and shall be selected by the engineer as judged as potentially the one most unstable. The computer program UTEXAS3 will be used to perform the stabilities. A factor of safety of less than 1.2 will be considered as unstable for the deep seated analysis and 1.0 for the shallow analysis. No subsurface investigations will be performed and all soil strength parameters will be obtained from the report "Fort Peck Lake, Montana, Design Memorandum No. MFP-118, Spillway Slope Excavation, September 1973" and "Design Memorandum No. MFP-109, Spillway Rehabilitation, Revised September 1966". CADD generated drawings for the stability analyses will include drawings showing the four cross sections for each geometry and critical failure surface for each. One of the drawings will be prepared showing a plan view with the section cut locations and the resulting estimated failure outlined.

The results of the stability analyses will be used as a tool for the design of stone or other protection alternative designs in the spillway terminus area for protection of the wingwalls. Refer to section 6 for a discussion of spillway rehab alternative analysis. The stability analysis shall be performed prior to the Mini-Test. At the conclusion of the stability analyses, the A/E shall submit a report including all computations, drawings, and results.

2.4. Develop Mini-Test Spillway Monitoring Plan.

The A/E shall coordinate the Mini-Test data collection and monitoring program with the Omaha District. At a minimum of 25 days prior to the commencement of the Mini-Test, the A/E shall submit a spillway monitoring plan that summarizes data collection in the period before, during, and after the test. The plan shall also detail all personnel that will be involved in the data collection effort and the time(s) that those personnel will be at the Fort Peck project.

3. WORK PERFORMED DURING MINI-TEST

3.1. Spillway Slab Data Collection and Monitoring.

During the mini-flow test period, measured data shall be collected using the previously installed spillway monitoring equipment. Measurement equipment shall be monitored during the test period.

3.2. Spillway Scour Hole Measurements.

Scour hole geometry survey is required prior to the Mini-Test. Following the initial spillway flow period (refer to the spillway mini-test flow schedule, section 1.8), an additional sub-bottom profile measurement is required. All surveys shall be performed as previously described in section *2.2 Scour Hole and Exit Channel Survey*.

4. WORK AFTER MINI-FLOW TEST

Following the Mini-Test, data collection and analysis tasks are required. Analysis performed between the Mini-Test and Full-Test shall be of limited detail. Analysis shall be performed according to the following objectives:

1. Determine the adequacy of collected data and evaluate whether data collection methods require refinement for the Full-Test.
2. Limited detail analysis shall be performed to evaluate spillway slab safety for the proposed Full-Test.
3. Limited detail analysis shall be performed to evaluate potential scour hole erosion during the Full-Test and determine potential project impact.
4. Prepare an interim report to state Full-Test recommendations and allow for government review of methodology and collected data.

4.1. Data Collection and Development.

The A/E shall collect the data obtained during the mini-flow test. Analysis of data shall be performed as required. Collected data shall be provided to the Omaha District as ascii data files on CD-ROM media.

4.2. Scour Hole Survey Data Analysis.

The A/E shall utilize the scour hole survey data collected during the flow test period to present scour hole geometry change. Scour hole geometric change shall be provided for both cross section and plan view in a CADD format.

4.3. Scour Hole Geometry Evaluation.

Computation of scour hole geometry at the spillway shall be performed using the exit flow parameters as determined from evaluation of the concrete lined spillway chute and geologic parameters representative of material within the scour hole area. Scour geometry computation shall incorporate the effects of spillway channel flow distribution and turbulence, flow duration, variable material erosion resistance, flow distribution within the scour hole, downstream tailwater, etc. Determined scour hole geometry shall be calibrated to the extent possible with available prototype measurements. The developed model shall be capable of computing scour geometry for a single flow event or several events in succession. The geometric enlargement of the scour hole after a specified number of flow cycles shall be identified. A flow cycle is defined as a long duration release followed by shale weathering. Scour hole geometry shall be performed in conjunction with identifying potential damage to the spillway cutoff wall, chute, and control structure.

Major tasks consist of the following:

(1) Utilize prototype data to calibrate scour model(s).
(2) Determine peak discharge which causes spillway failure.
(3) Determine spillway scour hole geometry for 4 different conditions.
   A. 10 cycles of 25,000 c.f.s. flow with 30 day minimum flow duration.
   B. 50 cycles of 25,000 c.f.s. flow with 30 day minimum flow duration.
   C. 10 cycles of 40,000 c.f.s. flow with 30 day minimum flow duration.
   D.50 cycles of 40,000 c.f.s. flow with 30 day minimum flow duration.
(4) Interim Report.

4.3.1. Scour Hole Geometry Computation. Computation is required as follows:

General. Computation of scour hole geometries shall be performed by the A/E within the general framework of the following guidelines. The A/E shall review existing reports, the original model study data and reports, measured and computed flow parameters and air entrainment, previous scour hole survey data, and new survey data to aid in the calculation of scour hole geometry progression. The data shall be incorporated into predictive models that calculate the scour hole geometry at various flows. The predictive models shall be capable of determining scour hole geometry (width, depth, and extent) from the input data consisting of flow and geotechnical parameters. During the scour hole geometry computation procedure, coordination is required between hydraulic, geotechnical, and structural disciplines to interpret, evaluate, and direct further computations.

Scour Depth. Two predictive models to determine scour depth shall be utilized. One model shall use the spreadsheet developed during the *Fort Peck Dam Spillway Engineering Reconnaissance Study (R.W. Beck, 1997)*. The model shall be revised as necessary to incorporate measured data from the mini and full test flows. A second model shall be based upon available plunge pool scour guidance using the erodibility index approach as described within the final draft chapter for the second edition of the American Society of Civil Engineers= Sedimentation Engineering Manual #54. The erodibility index method is also available within an existing computer model.

Scour Geometry. Scour hole geometry shall be computed assuming average geologic parameters for the scoured material supplemented with measured data. Spillway channel exit flow parameters shall be determined from the computed model data as described in the Evaluate Spillway Chute section. Geometric shape of the scour hole shall be determined including the length, width, and depth for each peak discharge. The scour hole geometry (depth, width, and length) shall be related to the peak spillway discharge which causes failure of the spillway terminus structure (either the cutoff wall or the wing walls).

Scour hole geometry shall be illustrated for 4 different scenarios. The 4 scenarios consist of a 30 day peak flow rate of 25,000 and 40,000 c.f.s. combined with a repetition of 10 or 50 cycles. In between each flow cycle, the A/E shall assume that the shale is weathered to the maximum deterioration possible. Illustration of scour hole geometry shall require establishing 5 foot contours within the scoured area for a given flow event. A CADD drawing file (Intergraph dgn file format) of the scour hole geometry shall be created in a state plane coordinate system to allow overlaying of the scour hole with existing topography. Although not necessarily a part of the computer model, the A/E shall provide documentation explaining the specified durations.

The A/E shall select the computational method to evaluate scour hole geometry. The elliptical shape method employed in the *Fort Peck Dam Spillway Engineering Reconnaissance Study (R.W. Beck, 1997)* shall be evaluated as well as other suitable methods. The scour hole geometry computational method shall be validated with prototype data. Scour hole geometry is of critical importance since the identified failure mode for the cutoff wall and wingwalls is due to lateral scour.

4.3.2. Tailwater Depth Computation. The government shall furnish the A/E three tailwater rating curves for use with determining scour hole formation. Rating curves shall consist of a normal, maximum, and minimum tailwater elevation. The normal tailwater curve shall be used in conjunction with determining scour hole geometry for the interim report. The maximum and minimum tailwater curves shall be used during the sensitivity analysis performed for the final report. Tailwater rating curves will be revised following the mini-test and full-test based on measured data.

4.3.3. Air Entrainment.
Computations shall be performed to determine spillway flow air entrainment for use with the scour predictive model. Computational analysis shall use the measured spillway flow data to provide flow parameters for use with available literature that provides methods of estimating air entrainment. Computational analysis may be of limited detail and utilize the available procedures and charts such as those described within *EM 1110-2-1603 Hydraulic Design of Spillways* or similar.

4.3.4. Sensitivity Analysis.
For parameters which cannot be identified with a high degree of accuracy or which dramatically affect results, a sensitivity analysis shall be performed. Between geotechnical and hydraulic parameters such as tailwater depth and rock erosion resistance, the A/E shall compute scour hole geometry while adjusting various parameters. Sensitivity analysis shall be performed for the 25,000 and 40,000 c.f.s. flow rates while varying a maximum of 4 parameters. The bulk of the sensitivity analysis shall be performed following the full-test.

4.3.5. Interim Report Requirements.
A report section shall be prepared which describes the basis for the scour hole geometry models and all associated tasks. The report shall briefly describe the computational methods and preliminary results, and survey data collected during the mini-test. Limited detail and calibration is required for the interim report. The report shall be of draft quality. Comments provided by Omaha District shall be used to evaluate full-test data collection protocol and incorporated in the final report. The interim report shall be prepared according to the structure described in the report format section.

<u>A-E Interim Report Products</u>

- Preliminary scour hole maximum depth (2 computation methods)
- Preliminary scour hole geometry computer model which relates scour to hydraulic and geotechnical parameters
- Preliminary scour hole estimate for the full-test flow period
- Interim Report documentation

4.4. Evaluate Spillway Chute
Following construction of the spillway channel, significant upheaval has occurred which has produced discontinuities in the spillway channel and walls. Flow within the spillway channel is extremely high velocity and generally varies from 40-70 ft/sec. An evaluation of the potential for spillway damage to occur during or following various flow conditions was conducted in the *Fort Peck Dam Spillway Engineering Reconnaissance Study (R.W. Beck, 1997)*.

4.4.1. Flow Parameter Computation

The A/E shall use the spillway flow model developed in the previous study to compute spillway flow parameters (R.W. Beck, 1997). The A/E shall determine spillway flow velocity, depth, and distribution for a range of flow rates. The A/E shall calibrate the flow model using measured data. Computations shall be performed for a range of spillway flows with a maximum of 5 flow rates shall be evaluated. Flow bulking due to air entrainment shall be included in the evaluation using measured data and available published data. The computational model shall begin downstream of the gates and piers based upon flow depths determined in the physical model and prototype testing.

NOTE: Work performed for the interim report shall consist of calibrating the model to the mini-test data and using the model to predict full-test flow parameters.

4.4.2. Sensitivity Analysis

Spillway flow parameters shall be determined for calibrated values. Based on the range of measured data, minimum and maximum loss conditions shall be determined. Sensitivity analysis shall be restricted to two discharge rates selected by the A/E which correspond to critical minimum and maximum flow rates with respect to spillway damage. The A/E shall identify the sensitivity parameters for the interim report. The bulk of the sensitivity analysis shall be performed following the full-test.

4.4.3. Chute Damage Evaluation

The A/E shall use measured data to evaluate pressure fluctuations and/or uplift pressures on the spillway chute slabs to identify slab stability. The A/E shall determine the minimum pressure fluctuation which will cause chute uplift and/or major slab damage. Using the measured and computed data, the A/E shall correlate the minimum allowable pressure fluctuation to a maximum allowable flow rate. The A/E shall address uncertainties in the analysis and employ an appropriate safety factor. The effect on flow parameters caused by spillway channel irregularities shall be fully investigated. Flow acceleration and concentration due to slab uplift areas shall be included in the analysis.

In addition to the failure analysis, the A/E shall determine the safety factor for a range of flow rates. A maximum of 5 five flow rates will be considered. Flow rates shall be determined in coordination with Omaha District and will vary from 10,000 c.f.s. to 75,000 c.f.s..

NOTE: Work performed for the interim report shall consist of calibrating the model to the mini-test data and using the model to evaluate potential damage for the full-test flow period. The A/E shall develop stop-test criteria based on the spillway instrumentation to prevent any potential damage during the full-test.

4.4.4. Interim Report

A report section shall be prepared which describes the chute evaluation model and all associated tasks. The interim report shall include all measured data and the results of any preliminary computations. The report shall be prepared according to the structure described in the report format section. CADD drawings illustrating existing spillway details are not required for this item.

<u>A-E Interim Report Products</u>

- Presentation of Measured Data
- Preliminary Model Calibration
- Full-test stop criteria
- Interim Report documentation

4.5. Develop Full-Test Spillway Monitoring Plan.

The A/E shall coordinate the Full-Test data collection and monitoring program with the Omaha District. At a minimum of 25 days prior to the commencement of the Full-Test, the A/E shall submit a spillway monitoring plan that summarizes data collection in the period before, during, and after the test. The plan shall also detail all personnel that will be involved in the data collection effort and the time(s) that those personnel will be at the Fort Peck project.

4.6. Data Collection Evaluation

The A/E will determine the adequacy of collected data and evaluate wheteher data collection methods require refinement. The A/E shall include a summary of data collection efforts, evaluation of data collection methods, and an a summary of recommendations for the Full-Test within the interim report.

4.7. Interim Report Submittal and Review

An interim report shall be submitted to the government following the Mini-Test data collection and data evaluation with the products previously stated. Following interim report submittal, a review will be conducted by the Omaha District. Written comments will be furnished to the A/E within 30 calendar days of receiving the interim report. Incorporation of review comments will be performed during preparation of the final report.

5. WORK DURING SPILLWAY FULL-FLOW TEST

NOTE: SECTION 5 ITEMS FOR WORK DURING THE FULL-FLOW TEST ARE INCLUDED FOR INFORMATIONAL PURPOSES PERTAINING TO A FUTURE WORK EFFORT. THESE ITEMS SHOULD NOT BE INCLUDED IN THE CURRENT COST ESTIMATE.

5.1. Spillway Slab Data Collection and Monitoring.

During the full-flow test period, measured data shall be collected using the previously installed spillway monitoring equipment. Measurement equipment shall be monitored during the test period.

5.2. Spillway Scour Hole Measurements.

During the spillway flow period, a sub-bottom profile measurement is required. At the conclusion of the spillway test period, scour hole geometry above water, exit channel surveys, and a sub-bottom profile survey is required. All surveys shall be performed as previously described in section *2.2 Scour Hole and Exit Channel Survey.*

6. WORK AFTER SPILLWAY FULL-FLOW TEST

NOTE: SECTION 6 ITEMS FOR WORK AFTER THE FULL-FLOW TEST ARE INCLUDED FOR INFORMATIONAL PURPOSES PERTAINING TO A FUTURE WORK EFFORT. THESE ITEMS SHOULD NOT BE INCLUDED IN THE CURRENT COST ESTIMATE.

The A/E shall use all data collected during the full-flow test to update all computational models prepared following the mini-flow test. Work after the full-test shall complete all tasks previously described in *Section 4 Work After Mini-Test.*

6.1. Data Collection and Development.

The A/E shall collect the spillway instrumentation data and scour hole survey data obtained before, during, and following the full-flow test. Analysis of data shall be performed as required. Collected data shall be provided to the Omaha District as ascii data files on CD-ROM media. In addition, the collected data shall be presented within an appendix of the final report. Data presentation shall include a listing of data collection times, data collection locations, and relevant spillway flow data. Data analysis shall be presented in the chute evaluation section. Data collection format shall be summarized.

<u>Collected Data Final Report</u>

Present spillway collection data including location, data collection times, and spillway flow history. Collected data may be presented within an appendice of the final report.

6.2. Scour Hole Survey Data Analysis.

The A/E shall utilize the scour hole survey data collected during the flow test period to present scour hole geometry change. Scour hole geometric change shall be provided for both cross section and plan view in a CADD format. Data presentation shall include a listing of data collection times, locations, and spillway flow history. Data analysis shall be presented in the scour hole geometry section. The actual data may be presented in CD format and included within the report.

Survey Data Final Report

Collected scour hole and exit channel survey data shall be presented in plan view, cross section, and tabulated format within an appendice of the final report.

6.3. Scour Hole Geometry.

Computation of scour hole geometry at the spillway shall be performed to complete all tasks previously described in section 4.3. Analysis shall be updated to revise scour hole depth and geometry for the full-test measured data. Revised tailwater depth, air entrainment, and a sensitivity analysis shall be performed.

Scour Hole Analysis Final Report Requirements.

A report section shall be prepared which describes the basis for the scour hole geometry model and all associated tasks. The report shall describe the computational methods, modifications performed to calibrate to measured data, model accuracy, and conclusions. The report conclusions shall clearly state:

(1) The spillway flow at which cutoff wall failure occurs and the failure mode.
(2) The scour hole maximum length, depth, and width for the 25,000 and 40,000 c.f.s. flow rates.
(3) Impact of flow cycles on scour hole geometry.

The final report shall be prepared according to the structure described in the report format section. CADD drawings consisting of scour hole geometries for the 25,000 and 40,000 c.f.s. flow rates shall be prepared.

A-E Work Products

- Scour hole maximum depth models (2 computation methods)
- Scour hole geometry computer model which relates scour to hydraulic and geotechnical parameters
- CADD dgn file(s) of scour hole contours
- Final Report documentation

6.4. Evaluate Spillway Chute

Computation of scour hole geometry and spillway chute stability at the spillway shall be performed to complete all tasks previously described in section 4.3. Analysis shall be updated to revise the spillway flow model calibration, the chute damage analysis, the sensitivity analysis, and etc.

Spillway Chute Final Report Requirements.

A report section shall be prepared which describes the chute evaluation model and all associated tasks. The final report shall describe the computational methods, modifications performed to calibrate to measured data, model accuracy, and conclusions. The report conclusions shall clearly state:

(1) The spillway flow at which initial chute damage occurs.
(2) The factor of safety for 5 separate flow rates.
(3) Impact of flow cycles on chute slab stability

The final report shall be prepared according to the structure described in the report format section.

A-E Work Products

- Presentation of Measured Data
- Calibrated Spillway Flow Model and Calibration Results
- Identification of Minimum Flow for Chute Damage
- Safety Factors for Various Flows
- Final Report documentation

6.5. Preliminary Design of Spillway Rehab Alternatives.
The A-E shall develop preliminary design data and a cost estimate for energy dissipation devices applicable to the Fort Peck spillway. Energy dissipation devices shall be designed which reduce the scour at the existing cutoff wall to an acceptable level by altering flow parameters or moving the location of the scour hole. The preliminary design analysis shall be of sufficient detail to allow screening of alternatives.

Energy dissipation structures including a flip bucket modification to the spillway chute and a lined plunge pool are standard options that shall be evaluated. The feasibility for other options for dissipating energy such as a conventional stilling basin, installing roughness elements on the spillway chute, inducing a hydraulic jump, and etc. shall be briefly discussed. Within the preliminary analysis, the A/E shall discuss the advantages and disadvantages the identified energy dissipation alternatives. Analysis shall compare the energy dissipation capability for each type of device. This level of analysis shall provide an initial assessment of various types of energy dissipation structures. Potential impacts of the energy dissipation device during flows that exceed design capacity shall also be discussed. The preliminary design and analysis shall include the results of the previous slope stability analysis. The A/E shall anticipate evaluating a minimum of 5 separate alternatives. The level of detail for each alternative may vary. Some alternatives may be eliminated from further consideration as the design progresses.

Energy Dissipator design shall be performed in accordance with criteria presented within EM 1110-2-1603, Hydraulic Design of Spillways, Engineering Monograph No. 25, Hydraulic Design of Stilling Basins and Energy Dissipators, and other applicable design criteria. Design of the energy dissipator shall be evaluated for 2 flow rates as furnished by Omaha District. The design tailwater elevation shall also be furnished by Omaha District. A limited detail (non-MCASES) cost estimate shall be performed for a single energy dissipation structure.

Preliminary design of the energy dissipation structure shall include a brief assessment of structural compatibility with the existing spillway structure. Modifications to the existing structure shall be roughly identified. A maximum of 3 separate CADD drawings to illustrate the design of the energy dissipation structure shall be prepared.

Spillway Rehab Alternatives Final Report Requirements.
A report section shall be prepared which describes the analysis and all associated tasks. The report shall describe the computational methods, limitations, impacts to the existing structure, cost estimate, and recommendations for a selected alternative for detailed design. The report conclusions shall clearly state:

(1) The spillway rehab alternatives considered and design data for each alternative.
(2) The cost estimate for each alternative.
(3) Impact of flow cycles on scour hole geometry.

The final report shall be prepared according to the structure described in the report format section. CADD drawings consisting of scour hole geometries for the 25,000 and 40,000 c.f.s. flow rates shall be prepared.

A-E Work Products

- Initial assessment of various energy dissipation structures

- Reconnaissance level evaluation of constructing a flip bucket and riprap lined plunge pool
- Developed computational models, spreadsheets, and hand calculations
- Cost estimate for a single energy dissipation structure
- Preliminary design CADD drawings

6.6. Draft Report Submittal and Review. The A-E shall submit a draft final report for review. The A-E shall be approximately 95 percent complete at this time. The draft report shall include all major items as discussed within all sections of this scope. The Omaha District shall review the draft report and provide comments for inclusion within the final report. Written comments will be provided to the A-E within 30 calendar days from the time that the draft report is received.

6.7. Final Report Submittal.
Following draft report submittal and receipt of Omaha District review comments, the A-E will have 30 calendar days to resolve all comments and submit the final report.

7. QUALITY CONTROL PLAN.

Quality control review shall be conducted by the Contractor for the entire work effort. The contractor (referred to as Architect-Engineer or Architect-Engineering Firm in this paragraph) shall submit, for evaluation and concurrence, a Quality Control Plan to be used for projects in private industry. The Architect-Engineer is totally responsible for the product being developed, and any review performed by the Corps of Engineers, Omaha District does not relieve the A-E from their professional design liability. Therefore, the A-E will have a Quality Control Plan in place before work begins. The Omaha District is responsible for evaluating the A-E's Quality Control Plan, evaluating the acceptability of the products delivered, and facilitationg the resolution of policy, regulation, and design related issues. The A-E will be informed of problems with the products, the Quality Control Plan or the processes being used for product development.

7.1. Acceptability Criteria. This should include a listing of design, regulatory, and customer critieria for the project and products being delivered.

7.2. Quality Control Procedures. The A-E will outline the procedures to be used for interfacing with any of their subcontractors. This plan should note when key reviews will occur during design development, how lessons learned are incorporated, and how deficiencies are tracked and handled.

7.3. Quality Control Organization. The plan shall describe a quality control organization with names of individuals, responsibilities, and chains of authority. It shall describe who is responsible for internal quality control reporting, and the quality control reporting to the Government.

7.4. Quality Control Documentation. The A-E firm shall provide written documentation signed and dated by the primary A-E firm and their consultants that states "The products included with this deliverable were completed and reviewed in accordance with our Company's Quality Control Plan that is on file with the Omaha District's Project Manager. All applicable design checks, interdisciplinary checks and quality control reviews have been completed by the designated designers and reviewers as stated in the Quality Control Plan. "Our company believes this product is in compliance with all applicable criterai and the stated scope of work. Incomplete work will be added to this product at no additional cost to the government." The A-E firm shall provide a separate Design Quality Review Document which shall be devoted to the findings of all Design Quality Control Reviews and shall be submitted with each design submittal. This document, which should include Quality Control Review comments, summaries fo reviewer's evaluation of the design, signatures of reviewers, etc., provides an indication that the Quality Control Plan was implemented and the results thereof. The completed Quality Control Report shall be included as an appendix within the final report. While quality control procedures will be implemented throughout the project, a completed Quality Control Report is not required as part of the interim report submittal.

8. GOVERNMENT FURNISHED MATERIALS.

Reference materials listed in the Slope Statility Analysis section will be provided by the Government. No additional materials will be provided in support of this effort. The access to the scour hole pool is limited and any special effort such as a crane to place a boat in the scour hole pool are the contractor's responsibility.

9. COORDINATION AND MEETINGS.

Coordination and meetings with the Government are required during this effort. Appropriate coordination will occur during the contract to assure clear communication between both parties.

9.1. The contractor will partake in a minimum of the following formal coordination meetings:

a. One 4-hour start-up meeting conference call with all contractor team members available for their portion of the meeting.

b. One all day site-visit and coordination meeting at Fort Peck Dam, Montana to continue start-up discussion, to verify field conditions and measurements by the contractor, and to discuss initial design conceptions for the fish net design. This meeting will take place within the first two weeks after award of the contract. A minimum of two contractor personnel will attend this meeting.

c. One two-hour conference call after the Corps review of the contractor's fish net design.

d. One two-hour conference call after the contractor submits his plans of action for the final contractor of the fish net system. (This meeting and the following meetings are dependent on the Corps ability to add the fish net system to this contract by modification).

e. One all day site visit in March or April just prior to the mini-test. Meeting at Fort Peck Dam, with a minimum of two contractor personnel attending.

f. Two two-hour conference calls after Corps review of the contractor's interim report following the mini-test.

g. One all day site visit in March or April just prior to the full-test. Meeting at Fort Peck Dam with a minimum of two contractor personnel attending. **(FUTURE EFFORT)**

h. Two two-hour conference calls after the completion of the full-test.**(FUTURE EFFORT)**

i. One all day meeting at Omaha, Nebraska after Corps review of the final report documents.**(FUTURE EFFORT)**

9.2. The above meetings are in addition to normal coordination and informal conference calls which will occur during the course of the contract. If the contractor proposes additional personnel at the site visits, they should be included in the proposal.

9.3. Additional meetings may be necessary; the Corps will visit the contractor's office for those meetings.

9.4 Monthly status reports of approximately one page in length will be provided to the Corps. During periods of non-activity between spillway tests, a report stating such is sufficient.

10. WATER AVAILABILITY.

The Mini-Test and Full-Test will only occur if there is sufficient water available to fully complete the test. Water depth above the spillway crest sufficient to provide the test releases is necessary. There is a possibility that water will not be available in year 2003. Delays due to non-availability of water will be addressed by contract modification. The Government shall inform the A/E regarding water availability and a decision regarding test status in the spring of each year by a date not later than 30 calendar days prior to starting the test (approximately 15 April).

11. FY02 WORK ITEMS.

T he scope requires completion of identified work items during FY 2002 (fiscal year ending 30 Sep 2002). The contractor shall complete all the following work items prior to the end of FY 2002.

11.1. Complete initial portion of the design and budget estimate for fish net system..

12. OMAHA TECHNICAL POINT OF CONTACT.

The Omaha District has designated a technical point of contact (POC). The contractor shall designate a person to function as project engineer (PE) on the study and will be responsible for all coordination with the Omaha District POC. The POC and PE will serve as the liaison for the transfer of all data files and shall coordinate communication between the Corps and the contractor.

CORPS TECHNICAL POC:
Terry Matuska, (402) 221-4485
terry.j.matuska@usace.army.mil

Alternate:
Daniel Pridal, (402) 221-4419

U.S. Army Engineer District, Omaha
CENWO-ED-HD
106 South 15th Street
Omaha, NE 68102

13. SCHEDULE.

Due to the limitations imposed by water availability, schedule adjustments may be necessary. Assuming water is available, the following project schedule for the major project milestones applies:

PROJECT COMPLETION SCHEDULE	
Task	Completion Date
Contractor Submits Initial Proposal, by noon CDT	15 August 2002
Negotiations Complete	20 August 2002
Notice of Award	22 August 2002
Submit Fish Net System Design	17 Oct 2002
Work Prior to Mini-Test	15 May 2003
Mini-Test Data Collection	15 May – 15 June 2003
Work After Mini-Test, Interim Report	30 Sep 2003
Full-Flow Test Data Collection	15 May – 15 June 2004
Work After Full-Flow Test, Draft Final Report	30 January 2004
Final Report Submittal	15 April 2005

14. CONFIDENTIALITY.

All data collected, analysis preformed and any other information generated as part of this delivery order is the property of the Corps of Engineers. The contractor shall not publish, distribute or in anyway disseminate any data, reports or other information generated by the delivery order, or as a direct result of this delivery order, without written permission from the Omaha District.

15. REPORT SUBMITTAL AND FORMAT.

Report submittals shall include the products described above and adhere to the following requirements:

a. All reports as described above and any supporting technical appendices in both hard copy (10 bound and 1 unbound) and in Microsoft Word format.

b. A completed Quality Control Plan.

c. Computer files of all models used during the analysis along with any documentation needed to run the models. This includes input and output files.

d. Microsoft Excel format (or similar) and ASCII data files used to produce all graphs, charts etc.

e. All charts graphs, calculation sheets, references, etc., utilized during the project.

f. All government furnished items.

g. A complete photocopy of the project file. This file shall be well organized and annotated where necessary to avoid confusion. This file shall include meaningful telephone conversation logs, a copy of each cited article or book (excluding government furnished items), calculations, listing of computer files, etc.

h. All computer files shall be submitted electronically. Computer files submitted for the final report shall also be submitted on a recordable compact disc (CD).

i. The report shall be presented in a "reader friendly" style and include the components as follows:

Report Appendices
The report appendices shall be separated by sheets with identifying tabs, and each appendix shall have its own table of contents.

Report Consistency
The main text of the report and the report appendices shall have the same type of print, and the report appendices shall have organizational formats consistent with each other.

Drawings, Sketches, Graphs, and Photographs
All parts of the report, both the main text and the appendices, shall have an abundance of drawings, sketches, graphs, and photographs close to the text which they explicate. They shall be of high quality (photographs in color), easily understood, and be tailored to match the message being conveyed by the text.

Report Components
The A/E shall organize the report to present the performed data collection and analysis in an orderly format. The report requirements for each analysis item are discussed in the individual item scope. Report components shall include, as a minimum, the following items:

Executive Summary
Index
Project Data, Location, History, and Description
Design and Analysis
Appendices (computations, drawings, photos, correspondence, collected data, personnel, quality control report, etc.)

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APPENDIX F
WATER TEMPERATURE STANDARDS AND COORDINATION

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THE STATE OF MONTANA'S WATER QUALITY LAWS AND REGULATIONS

The following laws and regulations were taken from Montana Code Annotated (MCA) or from state rule (ARM) at Environmental Quality, Chapter 30 – Water Quality, Sub-Chapter 6 – Surface Water Quality Standards and Procedures.

Classification of the Missouri River below Fort Peck Dam

- 17.30.610(6) [ARM] Missouri River drainage from Ft. Peck dam to Milk River...B-2
- 17.30.610(9)(a) [ARM] Missouri River (mainstem) from Milk River to North Dakota boundary...B-3

Classification Standards for Temperature

- 17.30.624 [ARM] B-2 CLASSIFICATION STANDARDS (1) Waters classified B-2 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

  (2) No person may violate the following specific water quality standards for waters classified B-2:

  (e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in temperature is 0.5°F. A 2°F per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

- 17.30.625 [ARM] B-3 CLASSIFICATION STANDARDS (1) Waters classified B-3 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

  (2) No person may violate the following specific water quality standards for waters classified B-3:

  (e) A 3°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 77°F; within the naturally occurring range of 77°F to 79.5°F, no thermal discharge is allowed which will cause the water temperature to exceed 80°F; and where the naturally occurring water temperature is 79.5°F or greater, the maximum allowable increase in temperature is 0.5°F. A 2°F per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

Note: The Fort Peck spillway enters the Missouri River approximately one mile upstream from the confluence of the Milk River. The approximate one-mile distance from the spillway to the Milk River is classified as B-2. The remaining portion of the Missouri River from the confluence of the Milk River to the North Dakota state line is classified as B-3.

Natural Conditions

- 75-5-306 [MCA] Purer than natural unnecessary – dams. (1) It is not necessary that wastes be treated to a purer condition than the natural condition of the receiving stream as long as the minimum treatment requirements established under this chapter are met.
  (2) "Natural" refers to conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied. Conditions resulting from the reasonable operations of dams at July 1, 1971, are natural.

Other Water Quality Regulatory Provisions

- 17.30.636 [ARM] GENERAL OPERATION STANDARDS
  (1) Owners and operators of water impoundments that cause conditions harmful to prescribed beneficial uses of state water shall demonstrate to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects. New water impoundments must be designed to provide temperature variations in discharging water that maintain or enhance the existing propagating fishery and associated aquatic life. As a guide, the following temperature variations are recommended: continuously less than 40°F during the months of January and February, and continuously greater than 44°F during the months of June through September.

- 17.30.637 [ARM] GENERAL PROHIBITIONS
  (2) No wastes may be discharged and no activities conducted such that the wastes or activities, either alone or in combination with other wastes or activities, will violate, or can reasonably be expected to violate, any of the standards.

THE FORT PECK TRIBE'S WATER QUALITY REGULATIONS

A copy of the Fort Peck Tribes water quality standards regulations, sent to the Corps' Omaha District Office September 20, 2001 by the Fort Peck Tribes. The following regulations were taken from the provided copy of the Tribes water quality standards.

Classification of the Missouri River below Fort Peck Dam within the Tribal Jurisdiction

- <u>Appendix B, Table 1</u>
  Missouri River
  1. Southern border of Reservation to center of River
     Public Water Supply (Goal)
     Class 1 Cool Water Aquatic Life
     Primary Contact Recreation
     Industrial
     Navigation
     Agriculture

Description of Class 1 Cool Water Aquatic Life Designated Use

- VIII. DESIGNATED USES
  (1) Designated Uses
  d) Class 1 Cool Water Aquatic Life – provides for protection and propagation of nonsalmonid fishes, marginal growth of salmonid fishes, growth and propagation of aquatic life normally found in water where the summer temperature does not often exceed 23° Celsius.

Temperature Water Quality Standards for Class 1 Cool Water Aquatic Life

- <u>Appendix C, Table 2</u>
  PHYSICAL
  Temperature (maximum values)
  Class 1 Cool Water Biota -- 23°C

  REFERENCES FOR TABLE 2: PHYSICAL AND BIOLOGICAL CRITERIA
  2. For those streams designated as Class 1 & Class 2 Cool Water, a 0.5°C increase above naturally occurring water temperature is allowed within the range of 0°C to 18.9°C; within the naturally occurring range of 18.9°C to 19.2°C, no discharge is allowed which will cause the water temperature to exceed 19.4°C; and where the naturally occurring water temperature is 19.2°C or greater, the maximum allowable increase in water temperature is 0.3°C. A 1.1°C-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 12.8°C, and a 1.1°C maximum decrease below naturally occurring water temperature is allowed within the range Of 12.8°C to 0°C.

Naturally Occurring

A definition of "naturally occurring" was not found in the provided copy of the Fort Peck Tribes' water quality standards. "Existing uses" is defined as follows:

III. DEFINITIONS

an) Existing uses are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards.

Other Tribal Water Quality Standards Provisions

- XI. STANDARDS IMPLEMENTATION
  1) All discharges from point sources, all instream activities, and all activities that generate nonpoint source pollution are to be conducted so as to achieve these water quality standards. The Tribes' anticipate that both regulatory and voluntary pollution control programs will be needed to address all current and future water quality problems on the Fort Peck Reservation.
  6) These water quality standards apply to all waters affected by nonpoint source pollution. At this time, the Tribes intend to rely on voluntary compliance for activities which result in nonpoint sources of pollution but do not require a federal license or permit. All appropriate combinations of individual best management practices should be applied to avoid violation of water quality standards.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
106 SOUTH 15TH STREET
OMAHA, NEBRASKA 68102-1618

DEC 2 0 2001

REPLY TO
ATTENTION OF:
District Engineer

Ms. Jan Sensibaugh, Director
Montana Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620-0901

Dear Ms. Sensibaugh:

As you may be aware, the U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (Opinion) to the U.S. Army Corps of Engineers (Corps) on compliance with the Federal Endangered Species Act regarding the operation of the Missouri River main stem reservoir system. In particular, the Opinion stated that the current operation of the Corps' Fort Peck project has adversely impacted the endangered pallid sturgeon. The USFWS believes that regulated flows from the Fort Peck Dam coupled with a suppressed water temperature regime during the spring and early summer spawning period have failed to provide adequate spawning cues for pallid sturgeon. In addition, cold-water releases from Fort Peck Dam are believed to have limited the amount of riverine habitat suitable for pallid sturgeon spawning. The Corps has proposed to modify operations of the Fort Peck Dam following specifications outlined in the Opinion. Modified dam operations are proposed to increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon and other native fish species. The USFWS has targeted a water temperature of 18°C (64.4°F) for the Missouri River at Frazier Rapids (approximately 25 miles downstream from the dam). In contrast to "normal" cold-water releases through the dam, it is proposed to release warmer surface water from Fort Peck Reservoir down the spillway to increase water temperatures in the Missouri River below the dam.

As a precursor to a full implementation of the proposed discharge modification to the operation of the Fort Peck project, the Corps plans to implement a "mini-test" this spring to evaluate the proposed modified operation of the project. The mini-test proposes to release up to 11,000 c.f.s. down the spillway for up to four weeks during the month of June, and is contingent upon there being sufficient water available in Fort Peck Lake. At least 4,000 c.f.s would be simultaneously released from the powerhouse, with a total discharge not to exceed 15,.000 c.f.s. The primary benefits of the mini-test will be: a) collection of data about the spillway integrity at various spillway discharges; b) collection of temperature information at various combinations of spillway/powerhouse discharges for use in future water temperature modeling; c) temporary increase in Missouri River water temperatures within a limited area to enhance pallid sturgeon habitat; and d) testing and standardization of methodologies to be used for monitoring conditions during full implementation.

As part of developing an Environmental Assessment for the proposed mini-test, the Corps briefly reviewed the State of Montana's water quality regulations and is seeking clarification on the state's application of the following provisions:

- The water-use classifications for the Missouri River downstream of the Fort Peck Dam are B-2 for the approximate one-mile distance from the spillway to the Milk River, and B-3 for the remaining portion of the river from the confluence of the Milk River to the Montana/North Dakota state line [17.30.610 (ARM)].

- Classification standards for temperature at 17.30.624 (ARM) and 17.30.625 (ARM) limit increases in water temperature above naturally occurring water temperatures to a maximum of 1°F for B-2 waters within the range of 32°F to 66°F, and a maximum of 3°F for B-3 waters within the range of 32°F to 77°F

- ARM 17.30.602 defines "Naturally occurring" as conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied. Conditions resulting from the reasonable operation of dams in existence as of July 1, 1971 are natural.

- General prohibitions at 17.30.637 (ARM) state that no wastes may be discharged and no activities conducted such that the wastes or activities, either alone or in combination with other wastes or activities, will violate, or can reasonably be expected to violate, any of the standards.

In view of ARM 17.30.602, the Corps considers the release of warmer water through the spillway, in order to positively influence the pallid sturgeons' spawning and overall environment, to be consistent with the reasonable operation of Fort Peck Dam. Please advise me as to whether this interpretation of the State's water temperature standards is appropriate in this matter of a test release of water through the spillway.

The collection of data from this test will be important as we make future decisions about the operation of Fort Peck Dam. If there is any additional information to further coordinate the proposed mini-test, please let me know.

Thank you for your assistance in this matter. If you have any mini-test questions, please contact Mr. Bill Miller at (402) 221-4022.

Sincerely,

Kenneth S. Cooper
Deputy District Engineer

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
106 SOUTH 15TH STREET
OMAHA, NEBRASKA 68102-1618
December 21, 2001

REPLY TO
ATTENTION OF:
District Engineer

Mr. Arlyn Headdress, Chairman
Fort Peck Tribes
P.O. Box 1027
Poplar, Montana 59255

Dear Mr. Headdress:

As you may be aware, the U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (Opinion) to the U.S. Army Corps of Engineers (Corps) on compliance with the Federal Endangered Species Act regarding the operation of the Missouri River main stem reservoir system. In particular, the Opinion stated that the current operation of the Corps' Fort Peck project has adversely impacted the endangered pallid sturgeon. The USFWS believes that regulated flows from the Fort Peck Dam coupled with a suppressed water temperature regime during the spring and early summer spawning period have failed to provide adequate spawning cues for pallid sturgeon. In addition, cold-water releases from Fort Peck Dam are believed to have limited the amount of riverine habitat suitable for pallid sturgeon spawning. The Corps has proposed to modify operations of the Fort Peck Dam following specifications outlined in the Opinion. Modified dam operations are proposed to increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon and other native fish species. The USFWS has targeted a water temperature of 18°C (64.4°F) for the Missouri River at Frazier Rapids (approximately 25 miles downstream from the dam). In contrast to "normal" cold-water releases through the dam, it is proposed to release warmer surface water from Fort Peck Reservoir down the spillway to increase water temperatures in the Missouri River below the dam.

As a precursor to a full implementation of the proposed discharge modification to the operation of the Fort Peck project, the Corps plans to implement a "mini-test" this spring to evaluate the proposed modified operation of the project. The mini-test proposes to release up to 11,000 c.f.s. down the spillway for up to four weeks during the month of June and is contingent upon there being sufficient water available in Fort Peck Lake. At least 4,000 c.f.s. would be simultaneously released from the powerhouse, with a total discharge not to exceed 15,000 c.f.s.. The primary benefits of the mini-test will be: a) collection of data about the spillway integrity at various spillway discharges; b) collection of temperature information at various combinations of spillway/powerhouse discharges for use in future water temperature modeling; c) temporary increase in Missouri River water temperatures within a limited area to enhance pallid sturgeon habitat; and d) testing and standardization of methodologies to be used for monitoring conditions during full implementation.

As part of developing an Environmental Assessment for the proposed mini-test, the Corps briefly reviewed the Fort Peck Tribes' water quality standards and is seeking clarification on the application of the following provisions:

- A water-use classification for the north half of the Missouri River on the southern border of the Reservation is Class 1 Cool Water Aquatic (Appendix B, Table 1).
- For those streams designated as Class 1 and Class 2 Cool Water, a 0.5°C increase above naturally occurring water temperature is allowed within the range of 0°C to 18.9°C (Appendix C, References for Table 2: Physical and Biological Criteria).
- In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act (Antidegradation Policy and Review Process).

Please advise me as to the Tribes' interpretation of the above provisions concerning a test release of water from the spillway. The collection of data from this test will be important as we make future decisions about the operation of Fort Peck Dam. If there is any additional information to further coordinate the proposed mini-test,, please let us know.

Thank you for your assistance in this matter. If you have any mini-test questions, please contact Mr. Bill Miller at (402) 221-4022.

Sincerely,

Kurt F. Ubbelohde
Colonel, Corps of Engineers
District Engineer

Montana Department of
ENVIRONMENTAL QUALITY

Judy Martz, Governor

P.O. Box 200901 • Helena, MT 59620-0901 • (406) 444-2544 • Website: www.deq.state.mt.us

February 1, 2002

Mr. Kenneth S. Cooper
Deputy District Engineer
Department of the Army
Corps of Engineers, Omaha District
106 South 15th Street
Omaha, Nebraska 68102-1618

Dear Mr. Cooper:

To respond to your concerns about how specific sections of the Administrative Rules of Montana (ARM) may effect the proposed mini-test of the "spring rise" flow regime from the Fort Peck Dam, each item will be addressed in the order they were asked.

1) The Missouri River, from just below the Fort Peck Dam to the Milk River, is classified B-2 (ARM 17.30.610(6)), and the river from the Milk River confluence to the North Dakota Border is classified B-3 (ARM 17.30.610(9)(a)). The B-2 reach of the Missouri River is about 10 miles long.

In general, there are two differences between the classifications. The B-2 classification is considered a transition between a salmonid fishery (growth and marginal propagation), with a small temperature change allowed, and a warm water fishery (B-3), with a slightly larger allowed temperature change. The "mini-test" spill will be affecting the transition reach, and the expected conditions in the river (temperature and suspended sediment) will be more like those that existed before construction of the dam.

2) The thermal limits you sited are correct.

3) Dams on large rivers have negative affects on downstream beneficial uses (see §303(d) listings). The ARM 17.30.636(1) expands on the requirement of "reasonable operation" in the definition of naturally occurring. If the operation of a dam impairs downstream uses, the operator of the dam must demonstrate to the department that continued operation will be done in a way that minimizes harmful effects. The rule also requires new facilities to provide temperature variations that maintain or enhance the existing fishery (i.e., pre-dam), which should be the goal of "reasonable operation" of an existing dam.

4) The general prohibition 17.30.637(2) ARM is a narrative standard protecting state waters from the cumulative effects of one or more activities. A dam operated in such a manner as to minimize re-suspension of reservoir sediment, shore erosion and downstream bank erosion, and promote stable riparian conditions, would meet, (at least in part), the general prohibition.

Because the spill test is a necessary part of the demonstration called for by ARM 17.30.636 (1), it will not cause a violation of state water quality standards.

If you have further questions about the meaning or interpretation of Montana's water quality standards, you should contact Abe Horpestad at 406-444-2459 or ahorpestad@state.mt.us.

Sincerely,

Jan P. Sensibaugh
Director

cc: Art Compton

WATER TEMPERATURE CALCULATIONS FOR MINI TEST

Definitions

T1 = Missouri River temperature below Fort Peck Dam tailwaters (RM 1766)
T2 = Temperature of water going down spillway ≈ average upper lake temperature (see A)
T3 = Milk River average June temperature (see B)
T4 = Missouri River temperature at Nickels (RM 1757.5), average June or calculated (see B)
T5 = Missouri River temperature at Frazier Rapids (RM 1744), average June or calculated (see B)
Q1 = Discharge from Fort Peck Dam
Q2 = Discharge down the spillway (see C)
Q3 = Discharge from the Milk River in June (see D)

all discharges are in cfs
all temperatures are in degrees F

A Estimated Spillway Temperature

To calculate spillway temperature, we assume that spillway temperature = upper (top 5 meters) average lake temperature. To determine average upper lake temperature, lake temperature profile data from 1990 - 1997 were used.

{[(∑lake temp 0.1 m 1990 + lake temp 0.1 m 1991 + ...+ lake temp 0.1 m 1997) / 8] 0.1 + (∑lake temp 2.0 m 1990 + lake temp 2.0 m 1991 + ...+ lake temp 2.0 m 1997) / 8] 2 + (∑lake temp 5.0 m 1990 + lake temp 5.0 m 1991 + ...+ lake temp 5.0 m 1997) / 8] 5} / 5 = average lake temp, upper 5 m

n = 3 temp depths x 8 years = 24

assumption: average June lake temperature during the mini test ≈ 1990 - 1997 average

assumption: spillway discharge will consist of a mixture of water from the upper 5 m (≈15 feet) of the lake, depending on lake elevation

B Average June Missouri River Temperatures

Average June Missouri River temperatures were determined from actual temperature measurements at identified locations during 2000 and 2001. Data was collected hourly by automated thermometers and downloaded for analysis. Some locations have data files for the left bank and the right bank, and if so, both were used.

[(day 1, left bank / ∑hourly temps + day 2, left bank / ∑hourly temps + ...+ day 30, left bank / / ∑hourly temps) + (day 1, right bank / ∑hourly temps + day 2, right bank / ∑hourly temps + ...+ day 30, right bank / / ∑hourly temps)] / 30 = average June river temp, by site

n = (24 hourly readings) (30 days) (1 bank) = 1440 or
n = (24 hourly readings) (30 days) (2 banks) = 2880

assumption: average June river temperatures during the mini test $\approx$ temperatures during 2000 and 2001

C Average June Discharge from Fort Peck Dam

Average June discharge data from Fort Peck dam = [$\sum$ June 1 daily average + June 2 daily average....June 30 daily average / 30 for a given year] / n years

D Average Milk River June Discharge

Average June discharge = $\sum$ USGS average monthly discharge data for June, for the year / n years

Temperature projections do <u>not</u> take into account the effects of the following potential variables:

a) air temperature
b) wind speed
c) groundwater temperatures
d) shade along the banks
e) cloud cover
f) lack of lake ice (can result in a colder lake)

EQUATION TEST - 2000 DATA

T1 = 54.1
T2 = N/A
T3 = 66.4
T4 = 55.7
T5 = 55.5

Q1 = 9700
Q2 = 0
Q3 = 420

$$\frac{Q1T1 + Q2T2 + Q3T3}{Q1 + Q2 + Q3} = T4$$

$$\frac{(9700)(54.1) + (0) + (420)(66.4)}{9700 + 0 + 420} = \frac{524,770 + 0 + 27,888}{10,120} = \frac{552,658}{10,120} = 54.6 \approx 55$$

calculated temperature at Nickels = 54.6 ≈ 55
actual temperature at Nickels = 55.7 ≈ 56

T4 £ = T5
55.7 £ = 55.5
£ = 55.5 / 55.7
£ ≈ 1
T4 ≈ T5

EQUATION TEST - 2001 DATA

T1 = 53.9
T2 = N/A
T3 = 65.1
T4 = 55.0
T5 = 55.5

Q1 = 5,900
Q2 = 0
Q3 = 600

$$\frac{Q1T1 + Q2T2 + Q3T3}{Q1 + Q2 + Q3} = T4$$

$$\frac{(5900)(53.9) + 0 + (600)(65.1)}{5900 + 0 + 600} = \frac{318,010 + 0 + 39,000}{6500} = \frac{357,070}{6500} = 54.9 \approx 55$$

calculated temperature at Nickels = 54.9 ≈ 55
actual temperature at Nickels = 55

T4 £ = T5
55£ = 55.5
£ = 55.5 / 55
£ ≈ 1
T4 ≈ T5

MINI TEST TEMPERATURE PROJECTIONS - MAXIMUM AVERAGE (during 11 KCFS)

T1 = 54[1]	Q1 = 4,000[2]
T2 = 60[3]	Q2 = 11,000[4]
T3 = 65[5]	Q3 = 960[6]
T4 = calculated	
T5 = calculated	

$$\frac{Q1T1 + Q2T2 + Q3T3}{Q1 + Q2 + Q3} = T4 \approx T5$$

$$\frac{(54)(4000) + (60)(11,000) + (65)(960)}{4000 + 11,000 + 960} = \frac{216,000 + 660,000 + 62,400}{15,960} = \frac{938,400}{15,960} = 58.8 \approx 59$$

T5 = calculated temperature at Frazier Rapids ≈ 59

Δ T during mini test = T5 - June average at Frazier Rapids during 2000, 2001
Δ T during mini test = 59 - 55

Δ T during mini test (maximum) = 4° F

---

1 assumes same temp for this location as in 2000, 2001
2 predicted discharge from the dam during this combination ofthe mini test
3 June average lake temp, top 5 meters
4 predicted discharge down spillway during this combination of the mini test
5 assumes same temp for this location as in 2000, 2001
6 1940 - 2000 June average for the Milk

MINI TEST TEMPERATURE PROJECTIONS - MINIMUM AVERAGE (during 4 KCFS)

T1 = 54[7]	Q1 = 11,000[8]
T2 = 60[9]	Q2 = 4,000[10]
T3 = 65[11]	Q3 = 960[12]
T4 = calculated	
T5 = calculated	

$$\frac{Q1T1 + Q2T2 + Q3T3}{Q1 + Q2 + Q3} = T4 \approx T5$$

$$\frac{(54)(11{,}000) + (60)(4{,}000) + (65)(960)}{11{,}000 + 4{,}000 + 960} = \frac{594{,}000 + 240{,}000 + 62{,}400}{15{,}960} = \frac{896{,}400}{15{,}960} = 56.2 \approx 56$$

T5 = calculated temperature at Frazier Rapids ≈ 56

Δ T during mini test = T5 - June average at Frazier Rapids during 2000, 2001
Δ T during mini test = 56 - 55

Δ T during mini test (minimum) = 1° F

[7] assumes same temp for this location as in 2000, 2001
[8] predicted discharge from the dam during this combination ofthe mini test
[9] June average lake temp, top 5 meters
[10] predicted discharge down spillway during this combination of the mini test
[11] assumes same temp for this location as in 2000, 2001
[12] 1940 - 2000 June average for the Milk

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APPENDIX G
CHECKLIST OF ENVIRONMENTAL LAWS

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ENVIRONMENTAL CHECKLIST
FORT PECK MINI TEST
January, 2002

Clean Air Act, as amended, 42 U.S.C 1857h-7, et seq. In compliance. Because of the limited scope of the proposed activity, individual and cumulative effects on air quality will be insignificant.

Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq. In compliance. Dam operations are considered "natural" with regard to temperature alterations. No Section 404 or 401 permit is needed for the mini test.

Comprehensive Environmental Response, Compensation, and Liability Act. In compliance. The potential to disturb or encounter hazardous and toxic materials is unlikely.

Endangered Species Act, as amended, 16 U.S.C. 1531, et seq. In compliance. The mini test action would be an implementation of a Biological Opinion task which would result in compliance with the Endangered Species Act. Potential adverse effects to other federally listed species would be avoided.

Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661, et seq. Not applicable. The mini test is not a construction action involving water resources.

National Environmental Policy Act (NEPA), as amended, 42 U.S.C. 4321, et seq. In compliance. This environmental assessment (EA) has been prepared for the proposed action. An Environmental Impact Statement is not required.

National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq. Ongoing coordination. The State Historical Society of Montana has been contacted with regard to the proposed mini test. We are awaiting a response, and will coordinate further with the SHPO as additional information on cultural resource sites becomes available from the ongoing survey information. If significant cultural sites are found, and if those sites are located in areas with increased risk of erosion, then those sites would be monitored during the mini test.

Protection of Wetlands (E.O.11990). In compliance. The project would not affect any special aquatic sites or wetlands.

Floodplain Management (E.O. 11988). In compliance. The project will not significantly affect the flow carrying capacity of the channel and implementation of these measures would not cause a violation of this executive order. The project action, a spillway discharge, must be located in the floodplain to fulfill its purpose.

Watershed Protection and Flood Prevention Act, 16 U.S.C. 1101, et seq. Not applicable. This act does not impose requirements on Corps projects.

Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1(12), et seq. Not applicable. No coordinated use with existing or planned Federal, state or local public recreation development has been considered for this project and recreational use will neither increase nor decrease with these temporary actions.

Land and Water Conservation Fund Act (LWCFA), as amended, 16 U.S.C. 4601-4601-11, et seq. In compliance. The mini test would not affect any property or lands developed for recreational use or wildlife areas funded under the Land and Water Conservation Fund.

Farmland Protection Policy Act (Subtitle I of Title XV of the Agriculture and Food Act of 1981), effective 6 August 1984. In compliance. The potential erosion of up to 5 acres of lands across from the spillway would not be regionally significant. Compliance with this act will also satisfy the requirements set forth in CEQ Memorandum of 11 August 1980, Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA.

CEQ Memorandum, August 10, 1980, Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory. In compliance. The activities undertaken will not preclude a wild, scenic, or recreational river designation and, as such, will not adversely affect this river.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-income Populations. In compliance. The mini test would not disproportionally affect minority or low-income populations downstream from the spillway.

Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq. Not applicable. The area in which the project will occur has not been designated as a wild, scenic, or recreational river.

APPENDIX H
SECTION 33 BANK STABILIZATION PROJECT

2. Becki

US Army Corps of Engineers
Omaha District

PUBLIC NOTICE

Application No: **200190439**
Applicant: U.S. Army Corps of Engineers
Waterway: Missouri River mile 1761.9
Issue Date: July 20, 2001
Expiration Date: August 20, 2001

30 DAY NOTICE

Regulatory Branch 106 South 15th Street Omaha, Nebraska 68102-1618

JOINT PUBLIC NOTICE FOR PERMIT APPLICATION SUBMITTED TO U.S. ARMY CORPS OF ENGINEERS AND MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Under the provisions of Federal regulations 33 C.F.R. 335-337 and instructions from the Office, Chief of Engineers, Washington, D.C., relative to Federal projects involving the discharge of dredged or fill material in waters of the United States, notice is hereby issued to advise interested parties of a proposed project consisting of construction of flow modification dikes on the Missouri River at mile 1761.9 near Fort Peck in Valley County, Montana.

Sections 313 and 404 of the Clean Water Act (33 U.S.C. 1323 and 1344) require each agency of the Federal Government engaged in any activity resulting in, or which may result in the discharge or runoff of pollutants, to comply with Federal, State, or interstate and local requirements respecting the control and abatement of water pollution to the same extent as any person or entity is subject to such requirements. In accordance with 33 C.F.R. 335-337, activities involving the discharge of dredged or fill material to be performed by the Corps of Engineers will be subject to public review procedures that are followed in processing applications for Section 404 permits.

The proposed project is located along the left bank of the Missouri River (mile 1761.9) across from the spillway exit in Section 32, Township 27 North, Range 42 East, Valley County, Montana. An engineering analysis indicates that 2 existing irrigation sites may incur erosion due to flow modifications from Fort Peck Dam and may be damaged beyond repair or totally lost. The proposed project consists of placing three spur dikes at the upstream end of the problem area as shown on the attached drawings. A spur dike can be defined as an elongated structure having one end on the bank of a stream and other end projecting towards the river. Spur dikes have been widely used to direct current away from an eroding bank and cause deposition of sediment on the downstream side of the structure. Dike #1 is 50 feet long and requires a 150-foot long refusal key. Dikes #2 and #3 are 150 feet long and require 25-foot long refusals. A refusal key is stone or concrete rubble placed in a trench excavated landward from the riverbank approximately

perpendicular to the streamflow at the upstream end of the revetment. The refusal prevents the stream from flanking the spur dike structure. Rock quantities were estimated using 1.55 tons/cubic yard. The estimated quantity of rock is 2520 tons, the estimated excavation is 700 cubic yards and the estimated fill is 185 cubic yards. The excavated material will be used to backfill the dike refusals. (See attached drawings for dike dimensions and stone quantities).

The purpose of the project is to protect the irrigation intakes from erosion due to flow modifications from Fort Peck Dam.

Several alternatives were considered as a means to solve the irrigation intake erosion problem. The following alternatives were evaluated.

a. Take no Federal Action
b. Rock spur dikes
c. Water intake relocation
d. Real estate acquisition

Taking no Federal action will result in damage to or loss of the irrigation sites and does not meet the project purpose.

The rock spur dike alternative consists of placing a series of three rock dikes in the vicinity of the pump sites. This alternative protects the site from erosion and is the least costly alternative. Therefore, the rock spur dike alternative is the recommended plan for construction.

Relocating the water intakes consists of relocating both pump sites a safe distance from the river. This alternative is not the least costly method of protection.

Acquiring real estate consists of purchasing an interest in the affected areas. This alternative is not the least costly method of protection.

The Montana Department of Environmental Quality, P.O. Box 200901, 1520 East Sixth Avenue, Helena, Montana 59626-0014, will review the proposed project with the intent to certify in accordance with the provisions of Section 401 of the Clean Water Act. The certification, if issued, will express the State's opinion that the operations undertaken by the applicant will not result in a violation of applicable water quality standards. The Montana Department of Environmental Quality hereby incorporates this public notice as its own public notice and procedures by reference thereto.

The Corps of Engineers, Omaha District will comply with the National Historic Preservation Act of 1966. We have checked the National Register of Historic Places and its current supplements, and there are no known National Register sites in the vicinity. This area will be surveyed by the Fort Peck Tribes for the Fort Peck Flow Modification Mini Test and Test. Results of the inventory will be provided to the Montana State Historic Preservation Officer as soon as they are available.

This project is in the known range of the endangered **Pallid Sturgeon** (*Scaphirhynchus albus*), and **Interior Least Tern** (*Sterna antillarum athalassos*); and the threatened **Piping Plover** (*Charadrius melodus*), and **Bald Eagle** (*Haliaeetus leucocephalus*). In compliance with the Endangered Species Act, a preliminary "no effect" determination has been made. Coordination with the U.S. Fish and Wildlife Service and other interested agencies will be completed to determine the effects on these species or their critical habitat.

The decision whether to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposed activity must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, and, in general the needs and welfare of the people. In addition, the evaluation of the impact of work on the public interest will include application of the guidelines promulgated by the Administrator, Environmental Protection Agency, under authority of Section 404(b) of the Clean Water Act (40 C.F.R.; Part 230).

The Corps of Engineers is soliciting comments from the public; Federal, state, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

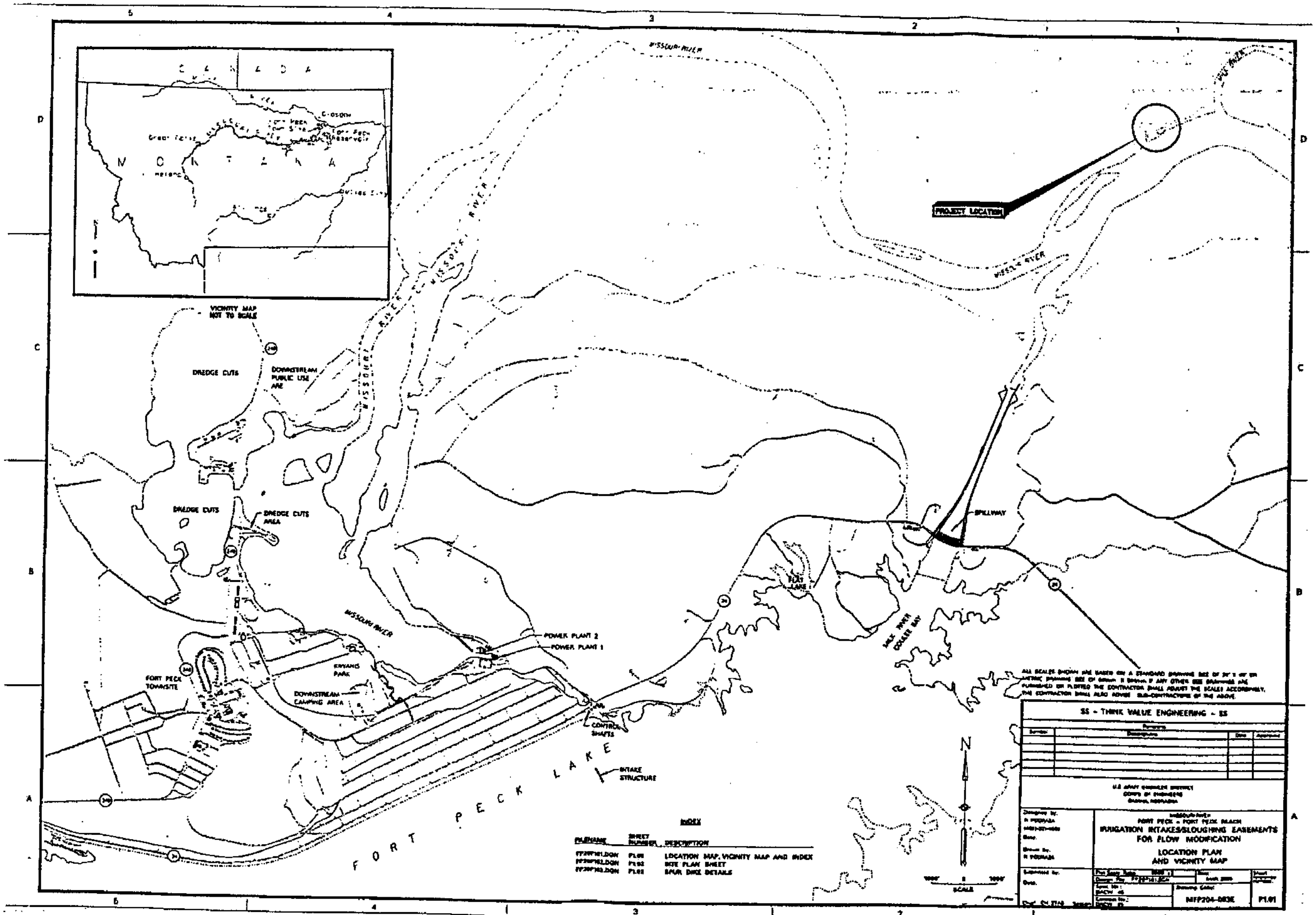
Any person may request, in writing and within the comment period specified in this notice, that a public hearing be held for the purpose of gathering additional information. Requests for public hearings shall be identified as such and shall state specifically the reasons for holding a public hearing and what additional information would be obtained. Requests should be submitted to the District Engineer, Omaha District, Corps of Engineers, 106 South 15th Street, Omaha, Nebraska 68102-1618. Should the District Engineer decide that additional information is required and a public hearing should be held, interested parties will be notified of the date, time and location.

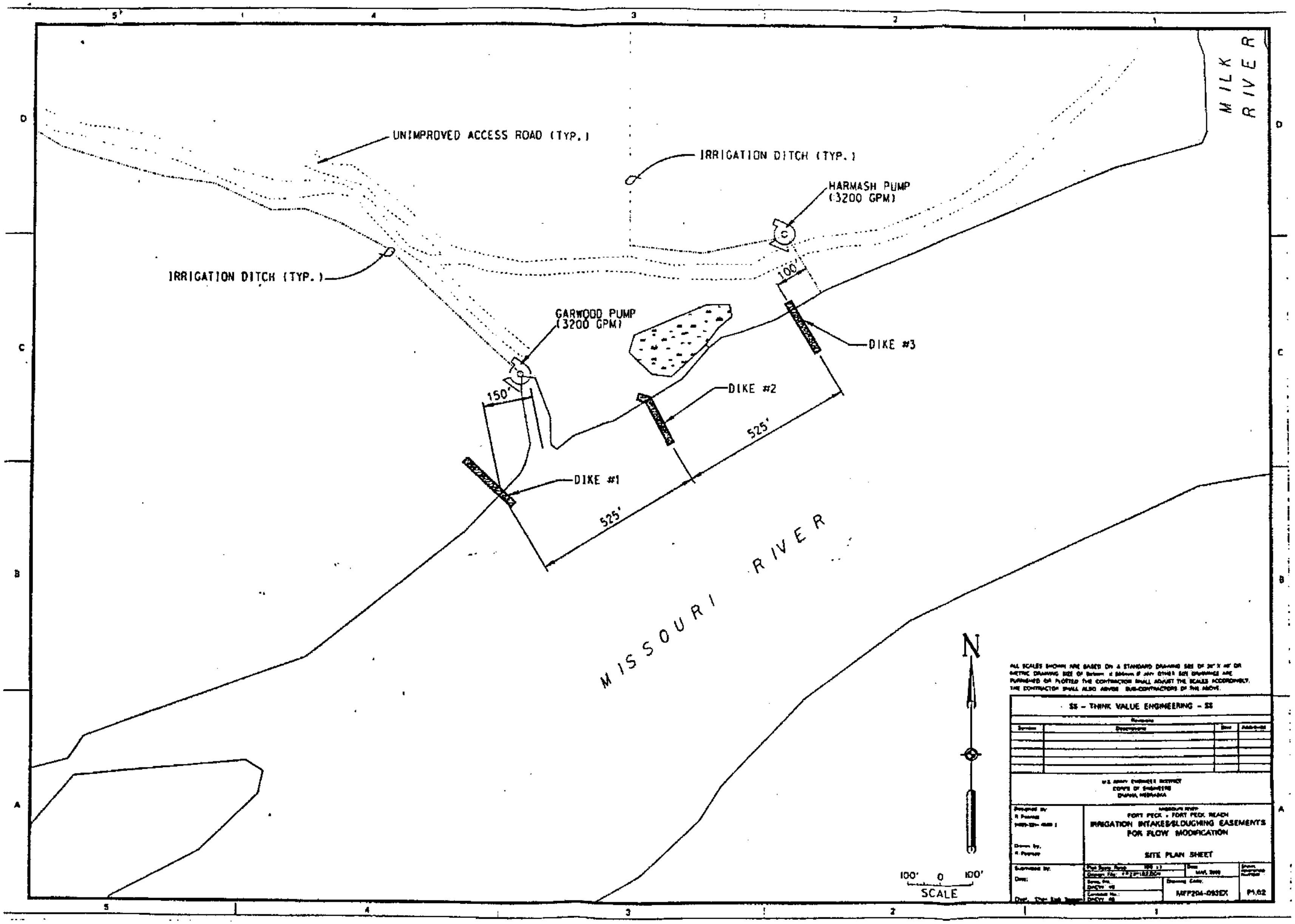
Any interested party (particularly officials of any town, county, state or Federal agency; Indian Tribe; or local association, whose interests may be affected by the work) is invited to submit to this office written facts, arguments, or objections on or before the expiration date listed on the front of this notice. Any agency or individual having an objection to the work should identify their concern or interest with clear and specific reasons. Comments, both favorable and unfavorable, will be accepted, made a part of the record and will receive full consideration in subsequent actions on this application. All replies to the public notice should be addressed to the District Engineer at the address listed in the previous paragraph. Ms. Kathy Iske, telephone number (402) 221-3055, may be contacted for additional information. You may also fax your comments to (402) 221-4939 or e-mail them to: Kathy.L.Iske@usace.army.mil.

Comments received after the close of business on the expiration date of this public notice will not be considered.

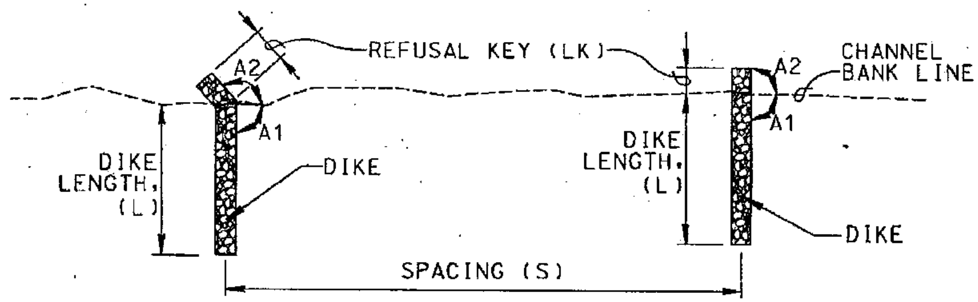
A permit, if issued, will be under the provisions of Section 404 of the Clean Water Act.

Drawings showing the location and extent of the project are attached to this notice.


CANADA
MONTANA
VICINITY MAP NOT TO SCALE
DREDGE CUTS
DOWNSTREAM PUBLIC USE ARE
DREDGE CUTS
DREDGE CUTS AREA
MISSOURI RIVER
PROJECT LOCATION
SPILLWAY
FLAT LAKE
POWER PLANT 2
POWER PLANT 1
KIWANIS PARK
DOWNSTREAM CAMPING AREA
FORT PECK TOWNSITE
CONTROL SHAFTS
INTAKE STRUCTURE
FORT PECK LAKE
N
SCALE
INDEX
FILENAME
SHEET NUMBER
DESCRIPTION
LOCATION MAP, VICINITY MAP AND INDEX
SITE PLAN SHEET
SPUR DIKE DETAILS
SS - THINK VALUE ENGINEERING - SS
IRRIGATION INTAKES/SLOUGHING EASEMENTS
FOR FLOW MODIFICATION
LOCATION PLAN
AND VICINITY MAP
P1.01

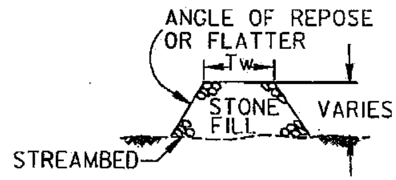


MILK RIVER
UNIMPROVED ACCESS ROAD (TYP.)
IRRIGATION DITCH (TYP.)
HARMASH PUMP (3200 GPM)
100'
IRRIGATION DITCH (TYP.)
GARWOOD PUMP (3200 GPM)
DIKE #3
150'
DIKE #2
525'
DIKE #1
525'
MISSOURI RIVER
N
100' 0 100'
SCALE
SS - THINK VALUE ENGINEERING - SS
FORT PECK - FORT PECK REACH
IRRIGATION INTAKES/SLOUGHING EASEMENTS FOR FLOW MODIFICATION
SITE PLAN SHEET
MFP204-093EX
P1.02



SPUR DIKE TYPICAL PLAN VIEW

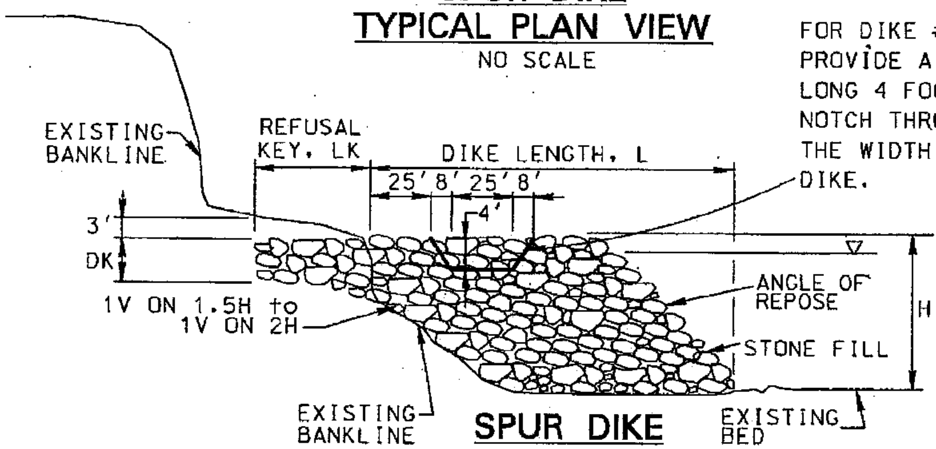
NO SCALE



SPUR DIKE TYPICAL SECTION

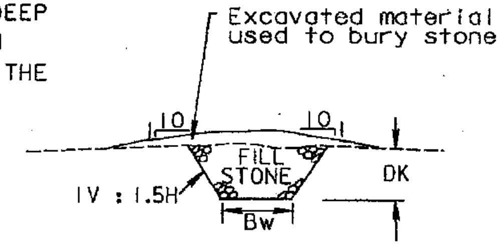
NO SCALE

FOR DIKE #3 ONLY, PROVIDE A 25 FOOT LONG 4 FOOT DEEP NOTCH THROUGH THE WIDTH OF THE DIKE.



SPUR DIKE TYPICAL SECTION

NO SCALE



REFUSAL KEY TYPICAL SECTION

NO SCALE

STRUCTURE	LENGTH, L**	SPACING, S	HEIGHT, H	A1	A2	WIDTH, Tw	REFUSAL KEY, LK ***	WIDTH, Bw	REFUSAL KEY, DK	STONE, tons
DIKE 1	50'	525'	6'	90°	90°	5'	150'	5'	6.5'	700
DIKE 2	150'		8'	90°	135°	5'	36'	5'	6.5'	730
DIKE 3	150'		4'	90°	90°	5'	25'	5'	6.5'	730

** See site plan sheet for layout alignment of each dike.

*** Refusal Key, with additional random fill material to connect to high bank

$$ – THINK VALUE ENGINEERING – $$

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

MISSOURI RIVER
FORT PECK – FORT PECK REACH
IRRIGATION INTAKES/SLOUGHING EASEMENTS
FOR FLOW MODIFICATION

SPUR DIKES DETAILS

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cmq 7/25/03
Becky L.

July 23, 2003

Civil Works Project Management Branch

Mr. James D. Rector
Rector Law Office, P.C.
Attorney at Law
635 First Avenue North
P.O. Box 1360
Glasgow, Montana 59230

Dear Mr. Rector:

Reference your May 12, 2003 letter, via e-mail, regarding the Robert Harmash easements.

At the time the Corps of Engineers received your letter, the date for the Corps to receive signed easements from all the parties involved had passed. However, the Corps was continuing to work with Mr. Harmash; and if the Corps could have received the signed easements immediately, the project could have moved forward. The second paragraph of your letter which conveyed Mr. Harmash's second concern made it clear that the Corps would not be receiving a signed easement immediately; therefore, the project was cancelled.

Mr. Harmash can make another request to be considered for the Section 33 program by mailing a letter to Ms. Laura Timp, Section 33 Project Manager.

If you have any questions, you may contact Mr. Thomas Tracy, an attorney on our staff, at (402) 221-3746.

Sincerely,

SIGNED

William D. Miller
Project Manager

CF:
CENWO-OC (Tom Tracy)
CENWO-RE (Gary Blair)
CENWO-ED-HF (John Remus)
CENWO-PM-AE (Becky Latka)

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RECTOR LAW OFFICE, P.C.
ATTORNEY AT LAW
635 1ST AVENUE NORTH
P.O. BOX 1360
GLASGOW, MONTANA 59230

JAMES D. RECTOR

TELEPHONE
(406) 228-4385
FACSIMILE
(406) 228-4387

VIA E-MAIL

May 12, 2003

Mr. William D. Miller
Project Manager
U.S. Army Corps of Engineers
Omaha District
Civil Works Branch
106 South 15th Street
Omaha, Nebraska 68102-1618

Mr. Timothy D. Kolke
Realty Specialist
U.S. Army Corps of Engineers
Omaha District
Riverdale Real Estate Office
Riverdale, North Dakota 58565

RE: Robert Harmash Easements

Gentlemen:

Mr. Harmash has asked me to review the easement that you prepared for the roadway and channel improvement easements for the project at his farm. Mr. Harmash has a couple of concerns that I don't believe are adequately addressed. The first is that the road easement is his existing road that he uses year round on the farm. The road has some gravel on it, but it is certainly not an all-weather road for heavy equipment. After heavy rains heavy equipment using that road will damage it severely. He is concerned that when you finish this project he is going to be left with a large expenditure to repair the road to its present condition, including adding gravel and/or compaction.

His second concern has to do with making certain that the pump intake structure functions properly after the completion of this project. He is concerned that this project may have a detrimental effect to his pump site, either causing severe erosion or sedimentation. He would request some assurances from the Corps that in the event the design is inadequate to maintain proper functioning, that they will assist him by correcting any deficiencies that occur either by erosion or siltation.

Therefore we would propose that you add a paragraph 14 and 15 to page 2A of your existing easement document. Paragraph 14 should provide acknowledgement that this is a shared easement with the Grantor and the Corps of Engineers and the Corps of Engineers' contractors. That the contractor will maintain the road during the construction period so as to allow normal use of farm equipment during the construction period, and that the road will be repaired at the end of the construction and brought up to its present standards, including gravel and compaction. The contractor should also provide dust control during the construction period.

Paragraph 15 should provide that the Corps of Engineers agrees that the pump site will be maintained so that it continues to function normally, and in the event that the design is inadequate to prevent further erosion to the point of destroying the pump site, or causes abnormal siltation, that the Corps will agree to maintain, repair and alter, if necessary, the dike systems so as to allow continued use of the irrigation pumps.

I have been assured by Mr. Harmash that once the requested paragraphs are added to page 2A of said Agreement that he and the other affected property owners are willing to execute the easement agreement and will do so expeditiously.

Thank you.

Sincerely,

James D. Rector

JDR/cj

cc by fax: Sharon Peterson of Senator Max Baucus, Billings
Pam Chrisafulli of Senator Conrad Burns, Glendive

APPENDIX I
LEAST TERN & PIPING PLOVER NESTING SITES
MISSOURI RIVER BELOW FORT PECK DAM

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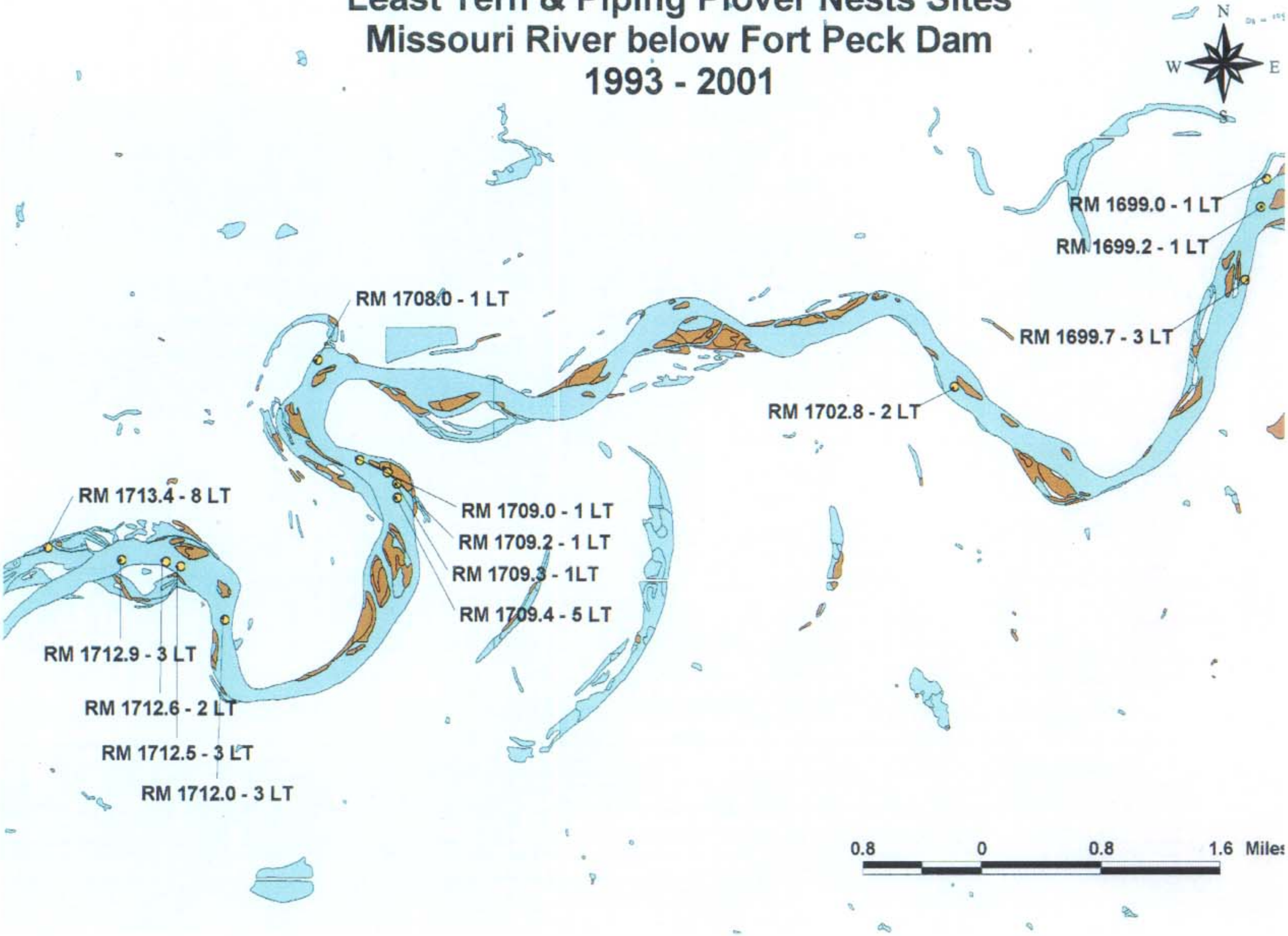
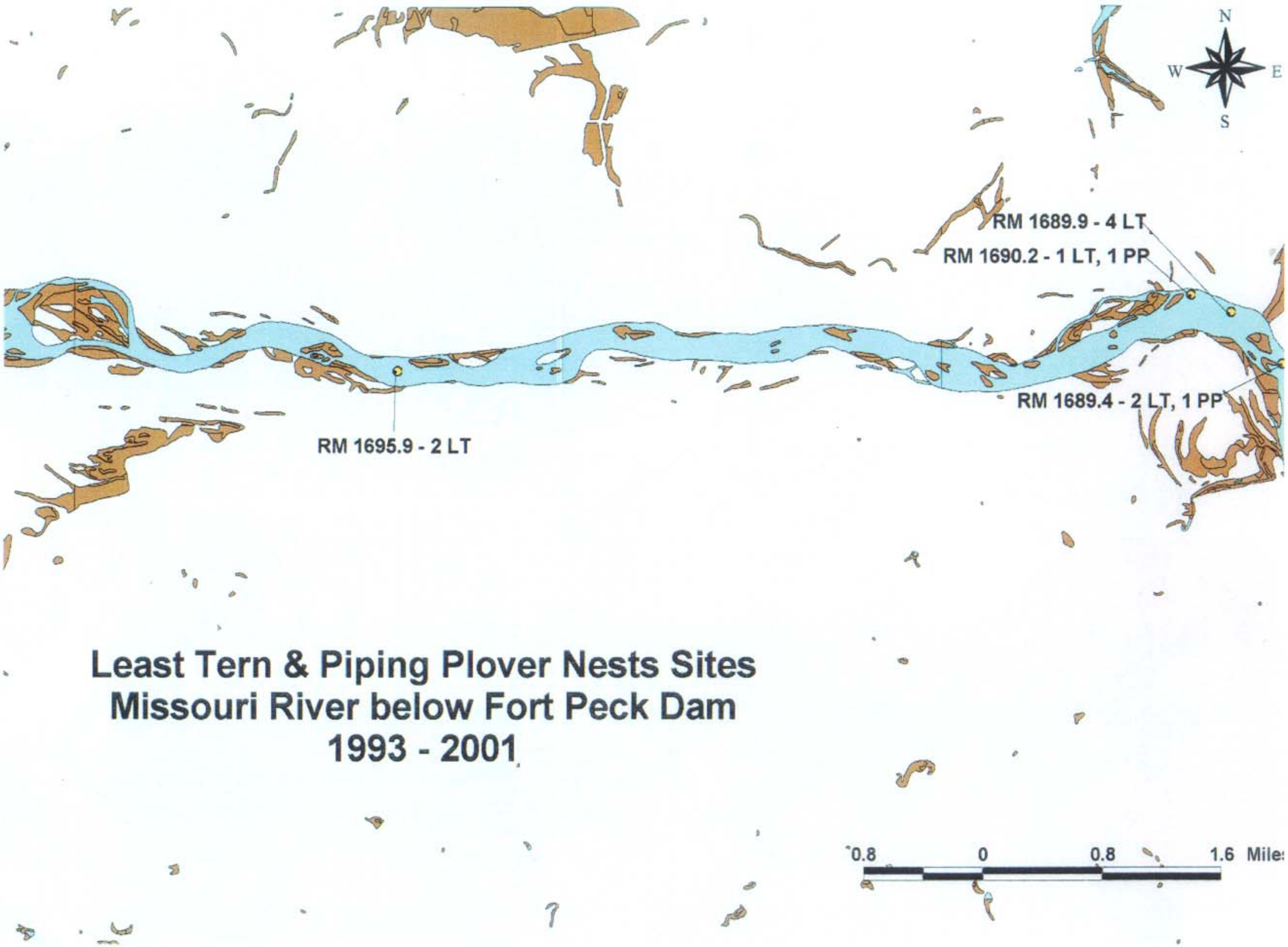
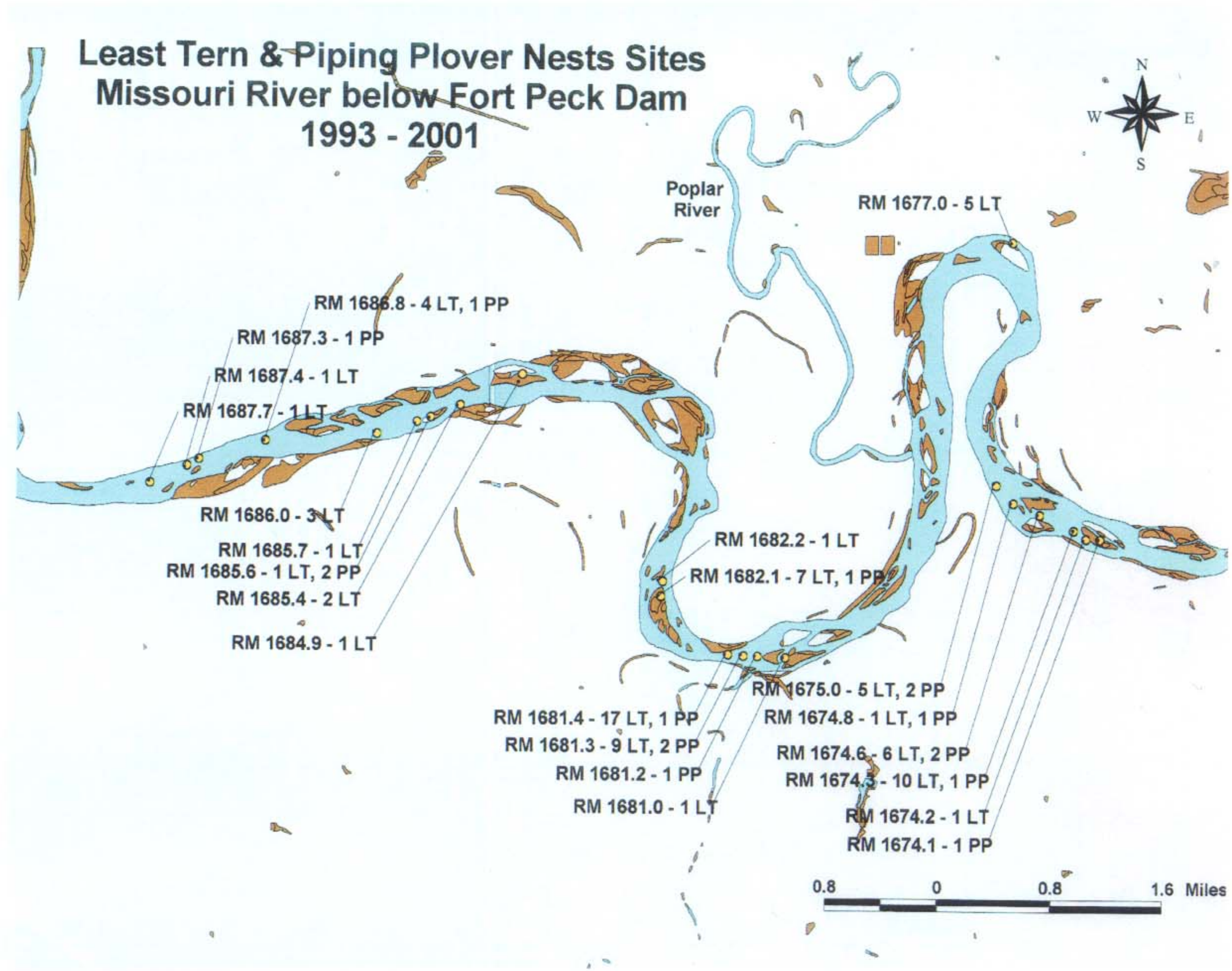
Least Tern & Piping Plover Nests Sites
Missouri River below Fort Peck Dam
1993 - 2001





Least Tern & Piping Plover Nests Sites
Missouri River below Fort Peck Dam
1993 - 2001


Least Tern & Piping Plover Nests Sites
Missouri River below Fort Peck Dam
1993 - 2001
N
W
E
S
Poplar River
RM 1677.0 - 5 LT
RM 1686.8 - 4 LT, 1 PP
RM 1687.3 - 1 PP
RM 1687.4 - 1 LT
RM 1687.7 - 1 LT
RM 1686.0 - 3 LT
RM 1685.7 - 1 LT
RM 1685.6 - 1 LT, 2 PP
RM 1685.4 - 2 LT
RM 1684.9 - 1 LT
RM 1682.2 - 1 LT
RM 1682.1 - 7 LT, 1 PP
RM 1681.4 - 17 LT, 1 PP
RM 1681.3 - 9 LT, 2 PP
RM 1681.2 - 1 PP
RM 1681.0 - 1 LT
RM 1675.0 - 5 LT, 2 PP
RM 1674.8 - 1 LT, 1 PP
RM 1674.6 - 6 LT, 2 PP
RM 1674.3 - 10 LT, 1 PP
RM 1674.2 - 1 LT
RM 1674.1 - 1 PP
0.8
0
0.8
1.6 Miles

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APPENDIX J
PALLID STURGEON SIGHTING MAPS

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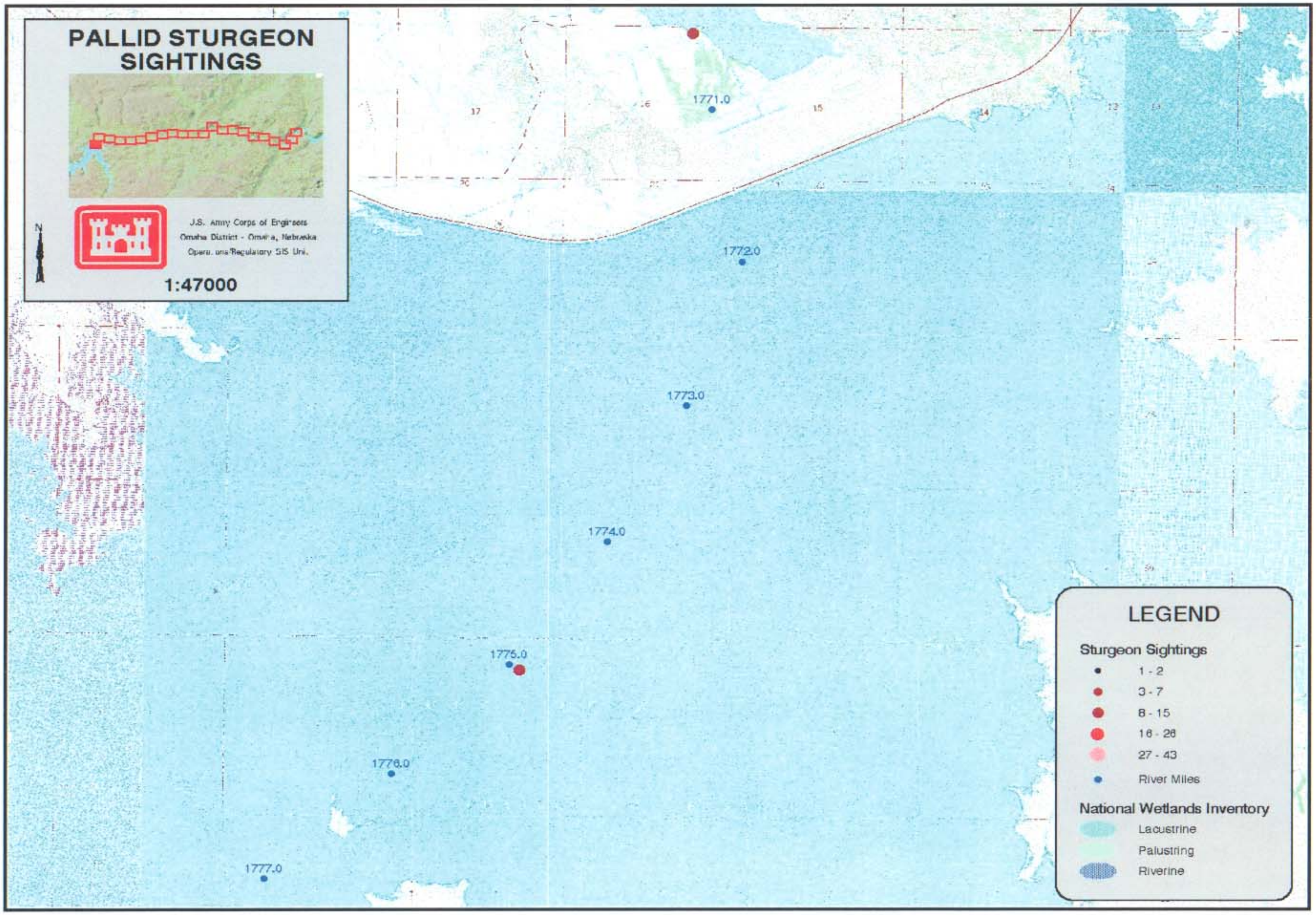
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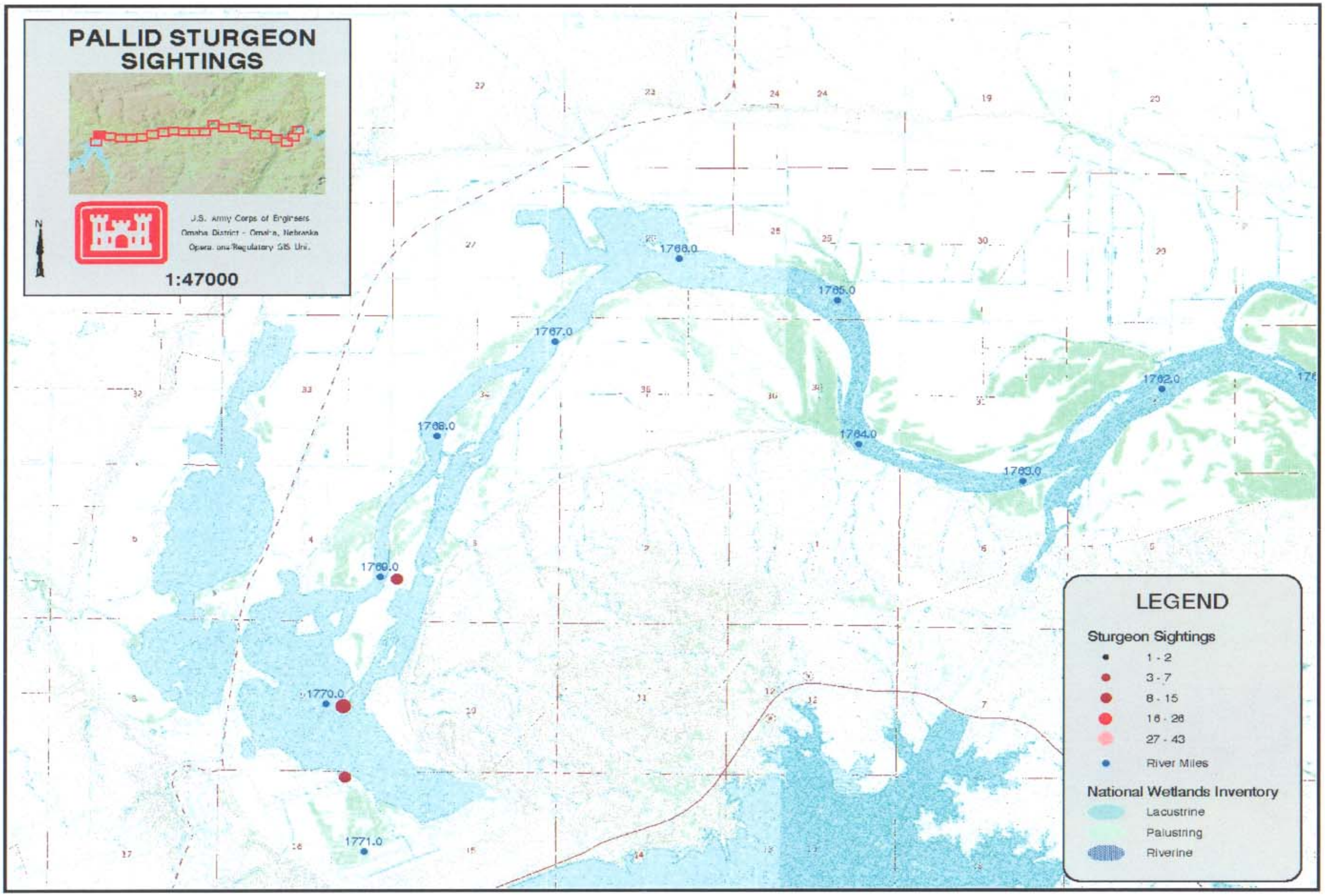
U.S. Army Corps of Engineers
Omaha District - Omaha, Nebraska
1:47000
1771.0
1772.0
1773.0
1774.0
1775.0
1776.0
1777.0
LEGEND
Sturgeon Sightings
1 - 2
3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
Lacustrine
Palustring
Riverine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Operations/Regulatory GIS Unit
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1764.0
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LEGEND
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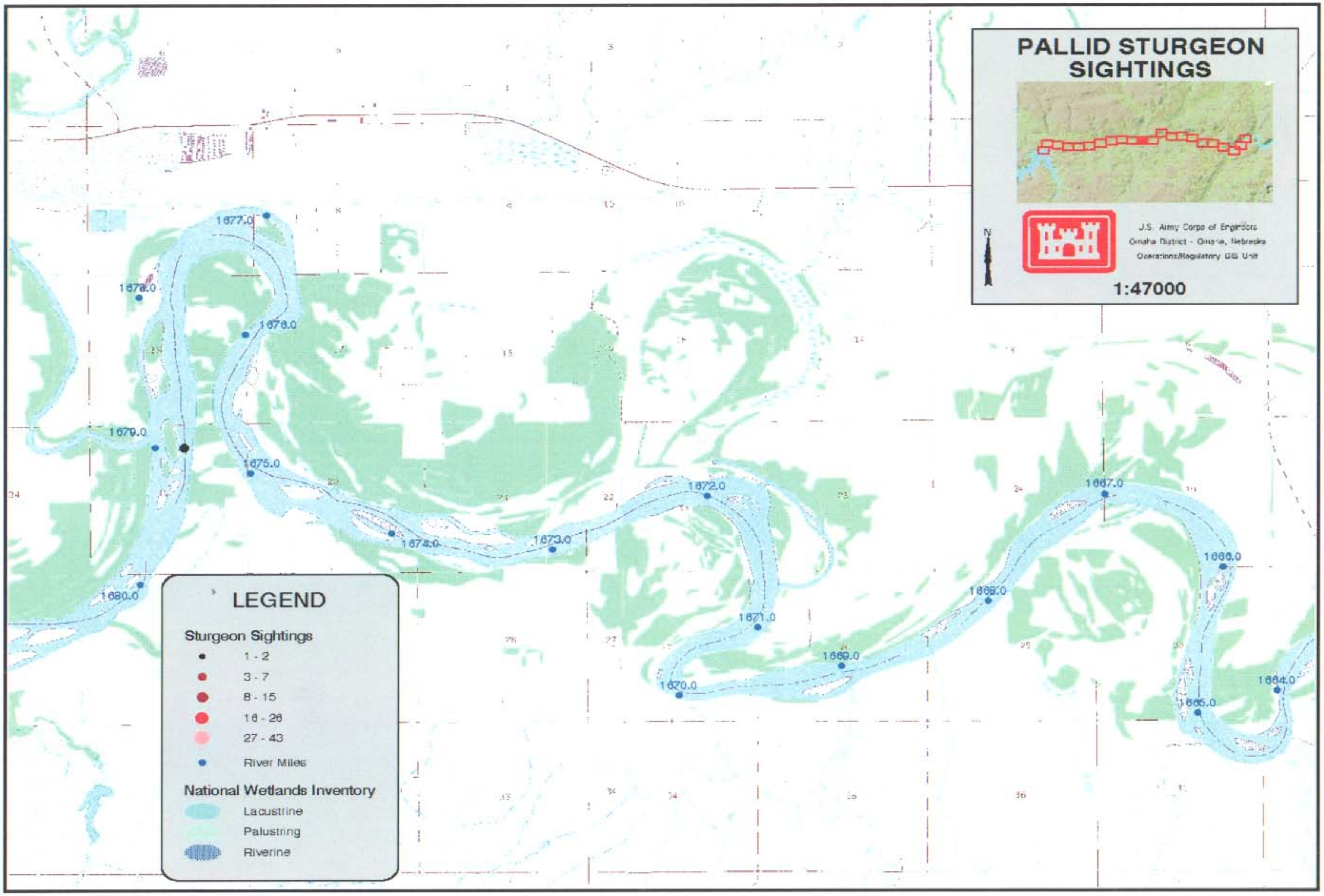
1 - 2
3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
Lacustrine
Palustrine
Riverine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SIGHTINGS
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Omaha District - Omaha, Nebraska
Operations/Regulatory GIS Unit
N
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LEGEND
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1 - 2
3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
Lacustrine
Palustrine
Riverine
1677.0
1678.0
1676.0
1679.0
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1674.0
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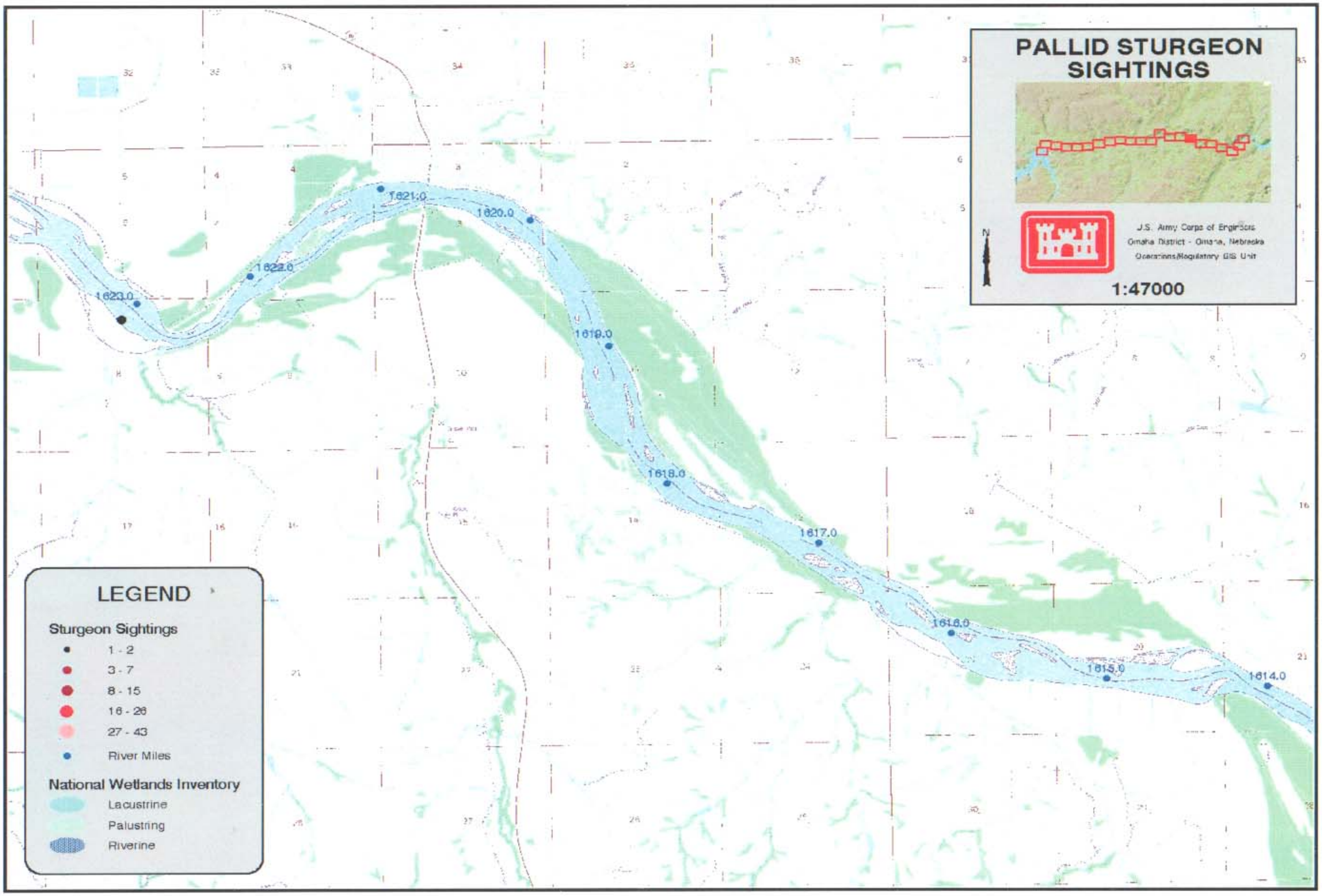
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SIGHTINGS
U.S. Army Corps of Engineers
Omaha District - Omaha, Nebraska
Operations/Regulatory GIS Unit
1:47000
LEGEND
Sturgeon Sightings
1 - 2
3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
Lacustrine
Palustring
Riverine
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1617.0
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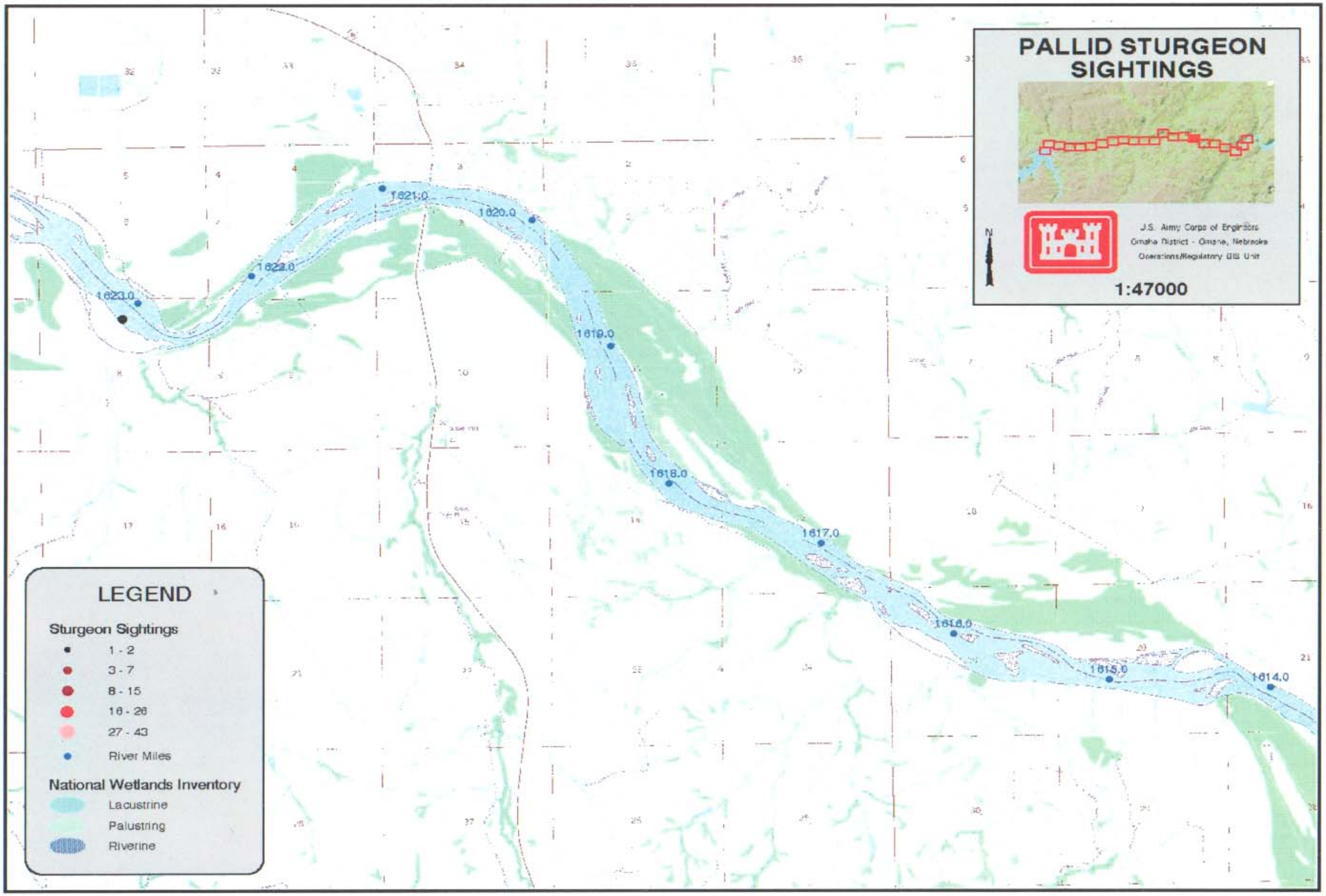
1614.0



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Omaha District - Omaha, Nebraska
Operations/Regulatory GIS Unit
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LEGEND
Sturgeon Sightings
1 - 2
3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
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Palustrine
Riverine
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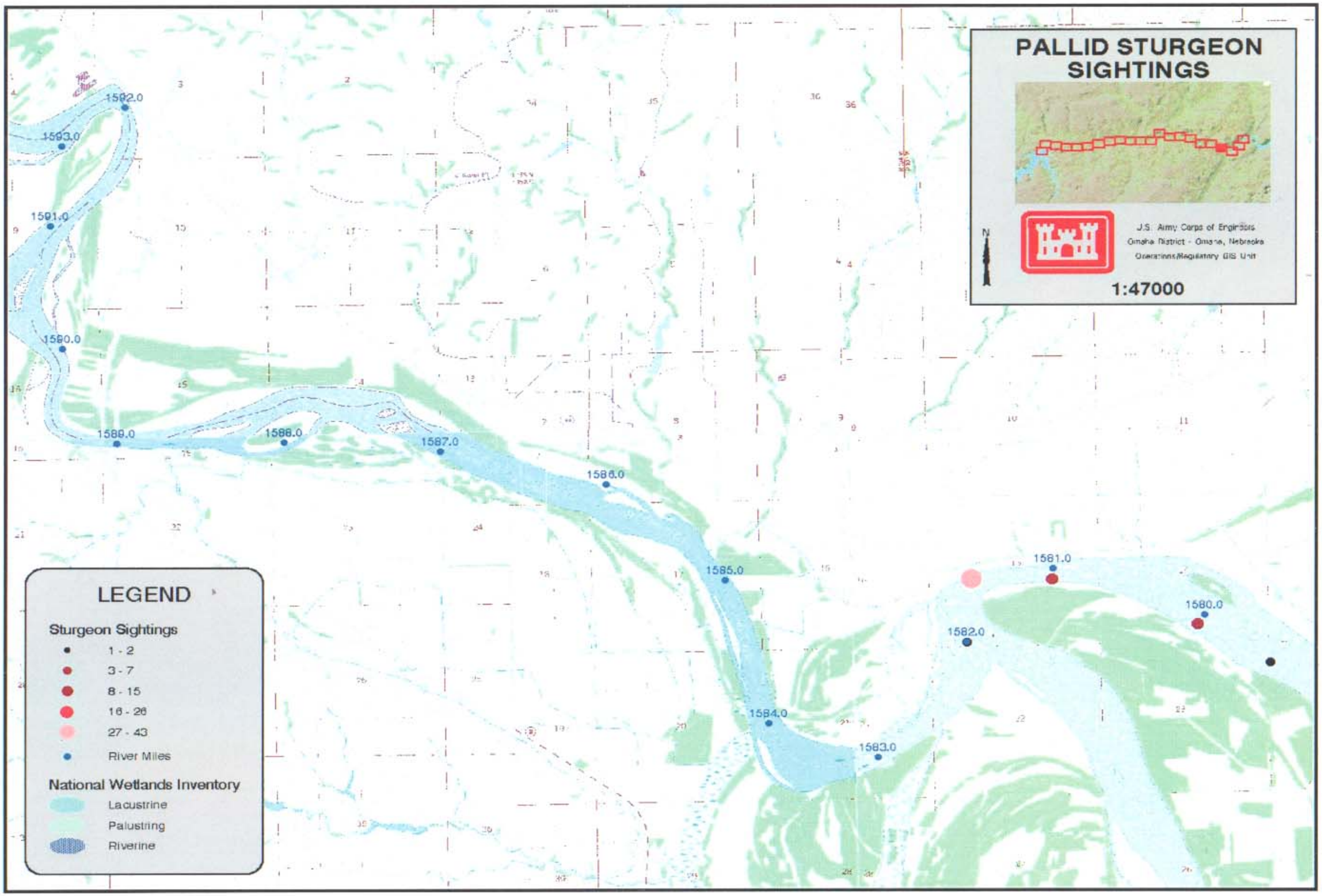
1614.0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Omaha District - Omaha, Nebraska
Operations/Regulatory GIS Unit
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1 - 2
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8 - 15
16 - 26
27 - 43
River Miles
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Riverine
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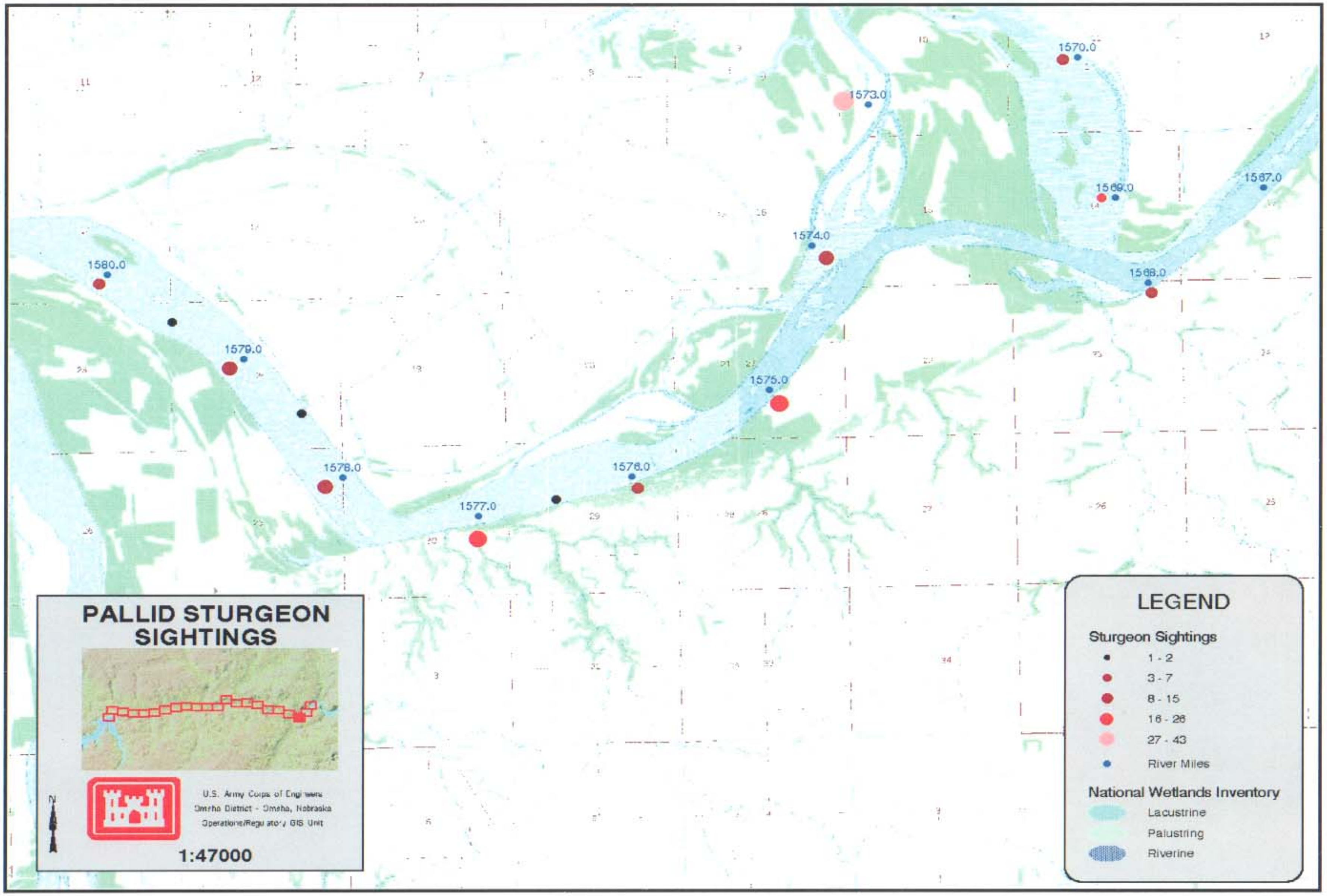
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Omaha District - Omaha, Nebraska
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Sturgeon Sightings
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8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
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Riverine
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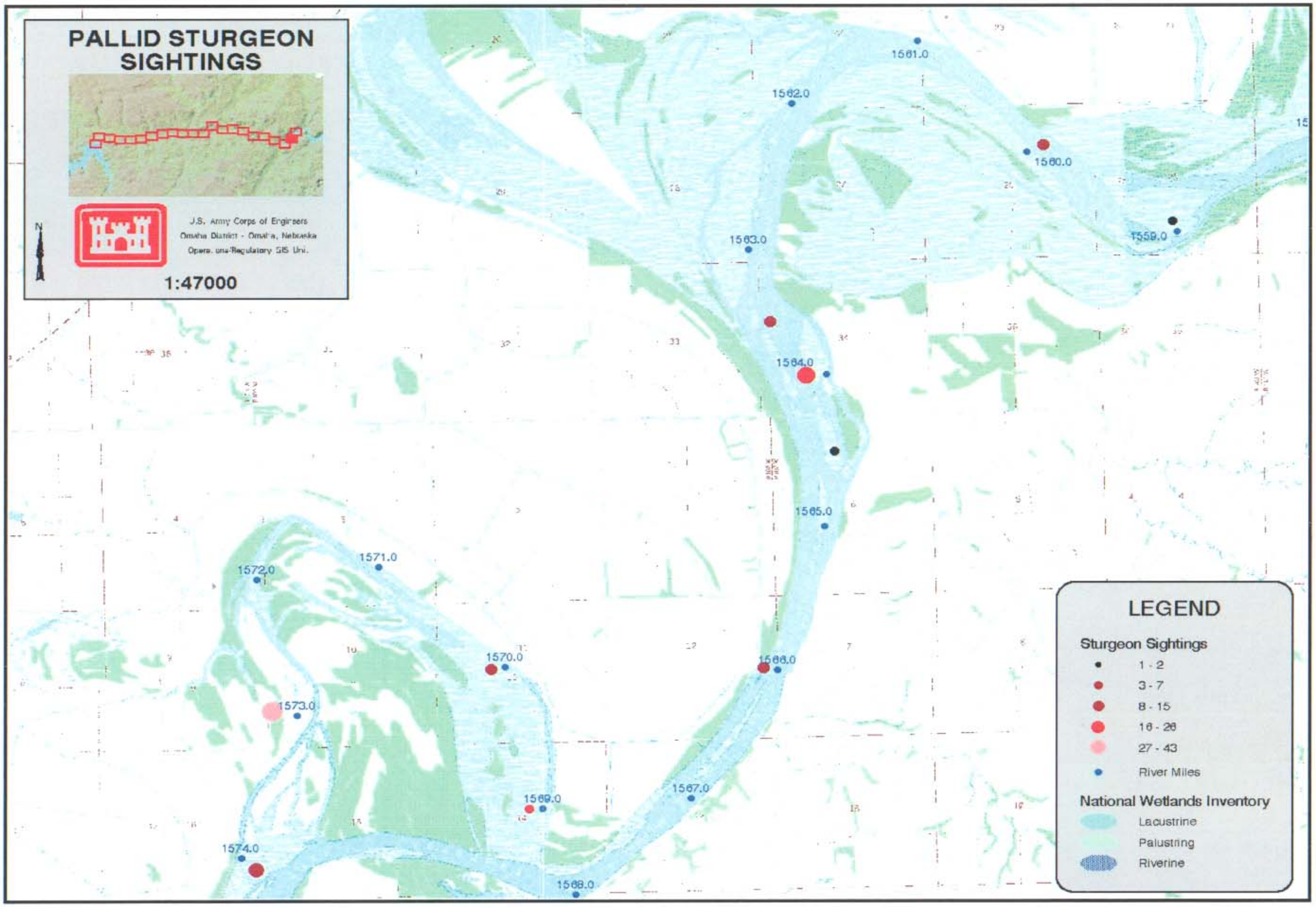

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Omaha District - Omaha, Nebraska
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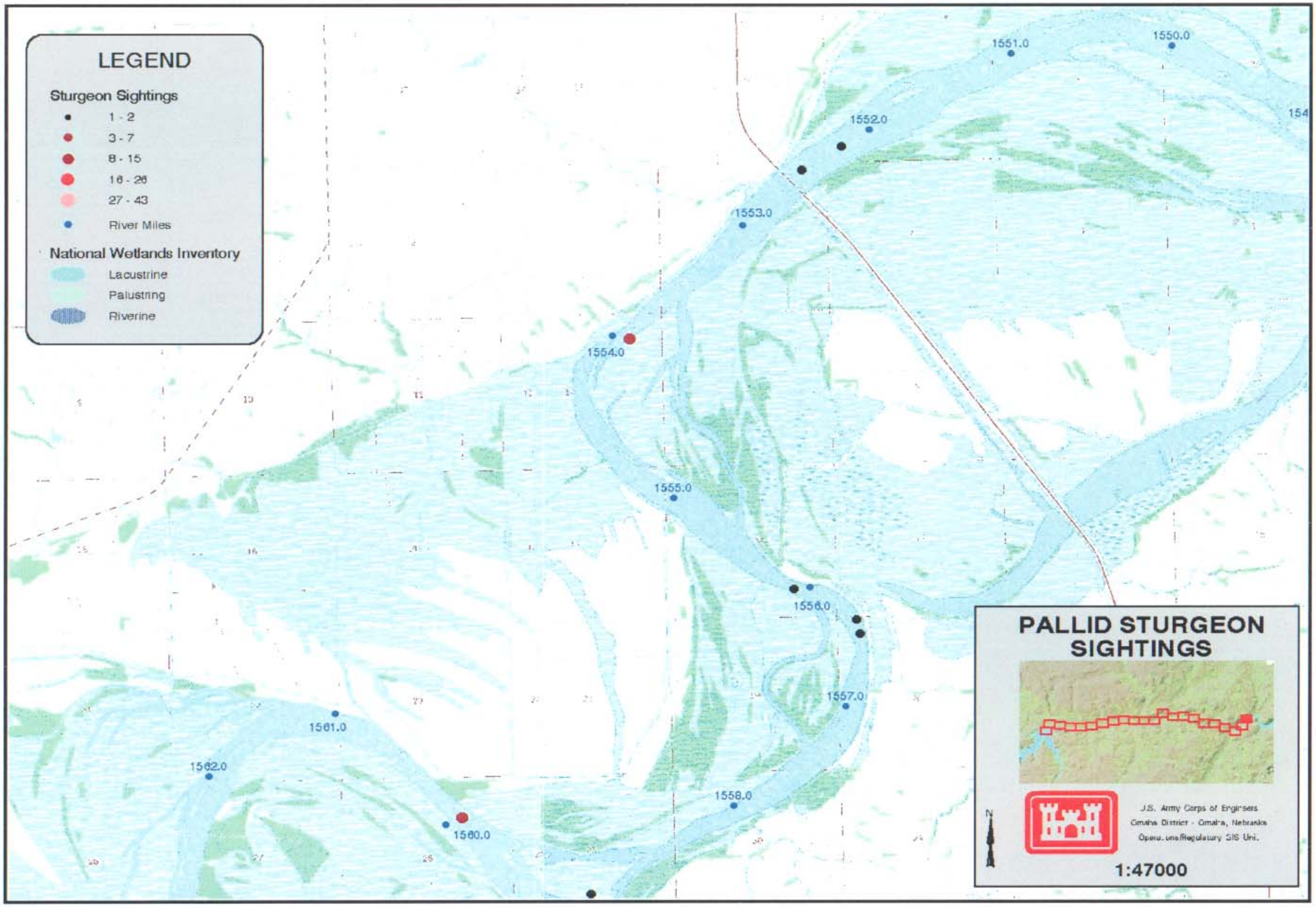
1568.0
LEGEND
Sturgeon Sightings
1 - 2
3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
Lacustrine
Palustrine
Riverine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3 - 7
8 - 15
16 - 26
27 - 43
River Miles
National Wetlands Inventory
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Palustring
Riverine
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1551.0
1552.0
1553.0
1554.0
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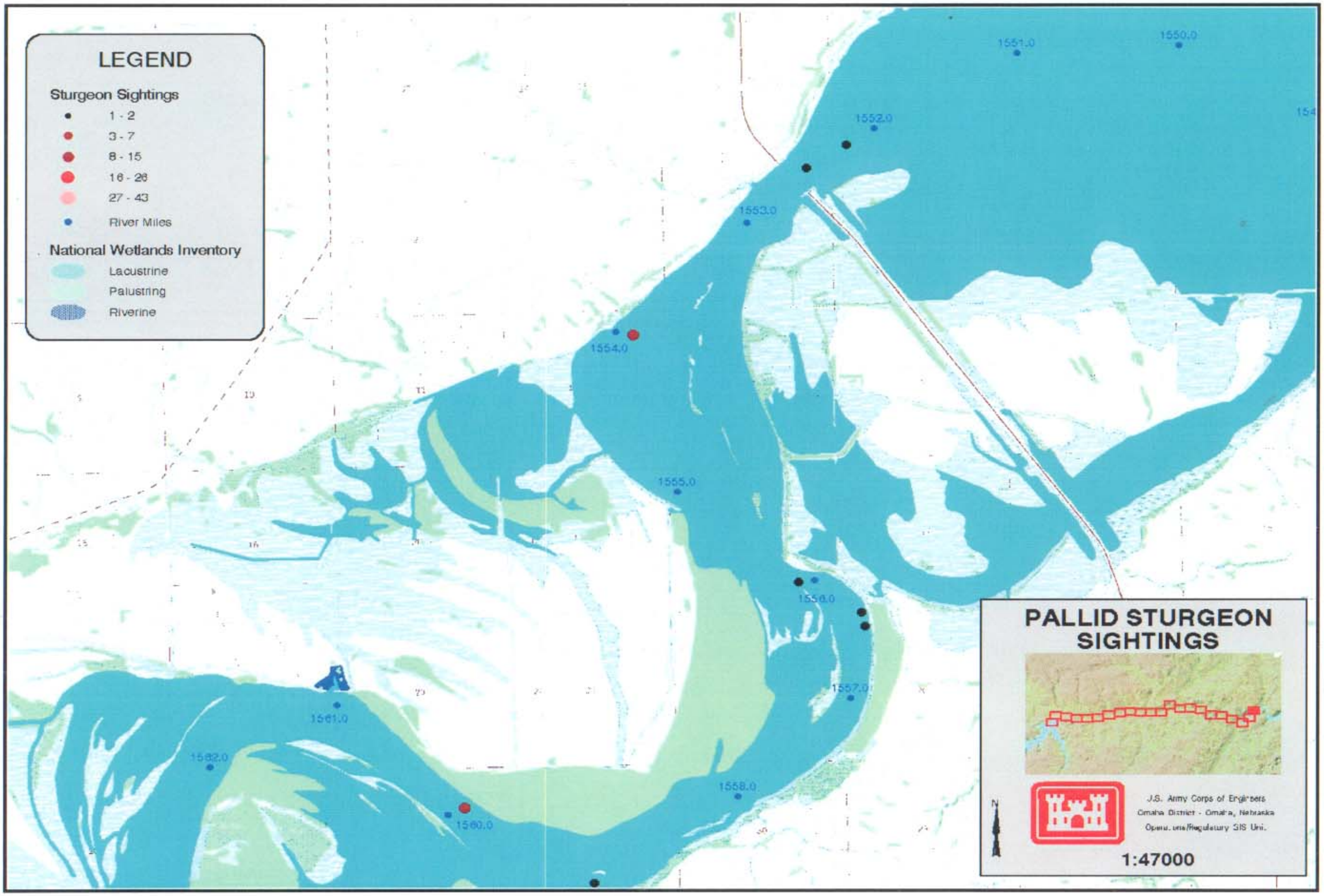
PALLID STURGEON
SIGHTINGS
1:47000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River Miles
National Wetlands Inventory
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Riverine
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PALLID STURGEON SIGHTINGS
U.S. Army Corps of Engineers
Omaha District - Omaha, Nebraska
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APPENDIX K
MISSOURI RIVER INTAKE LOCATIONS AND ELEVATIONS

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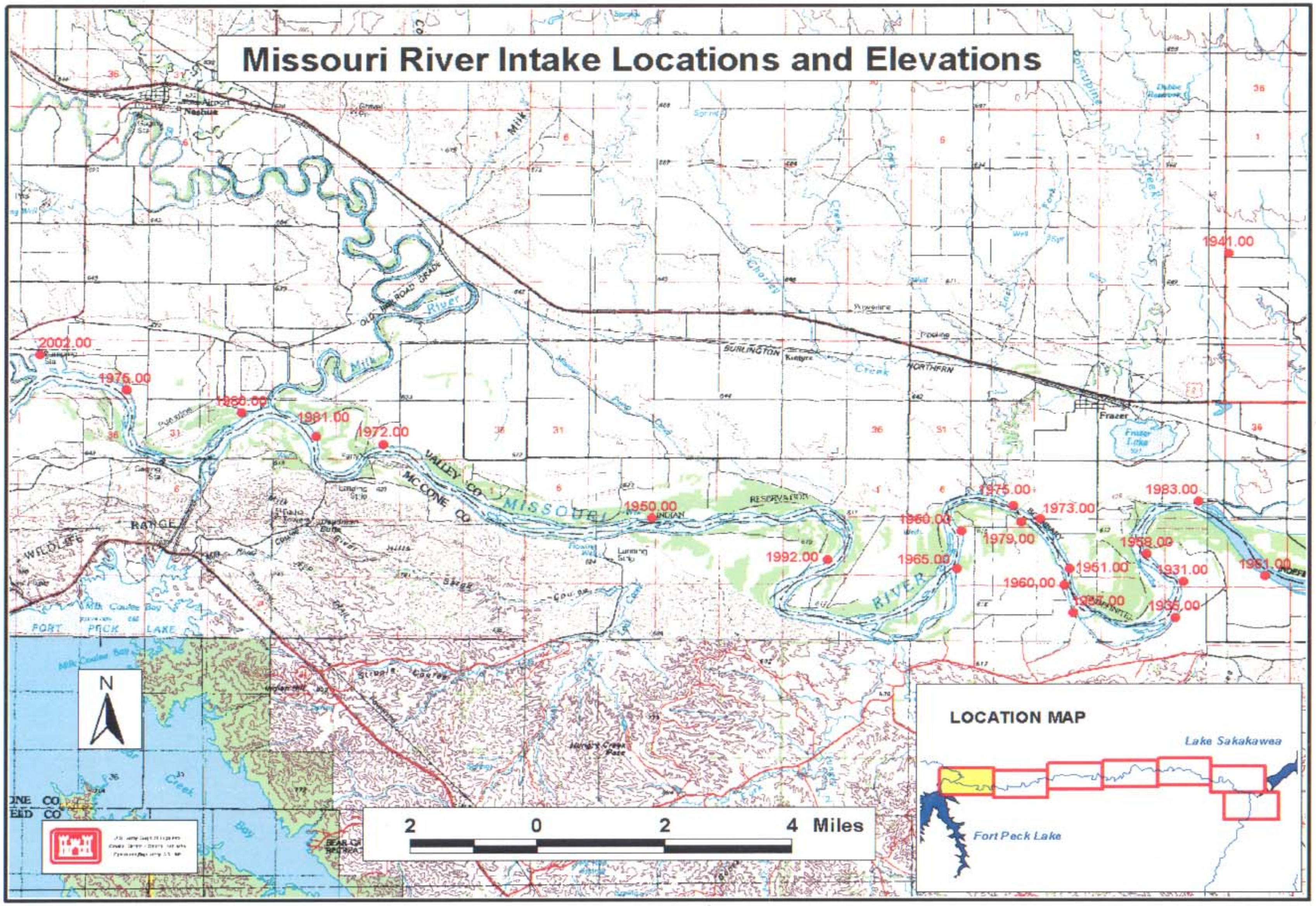
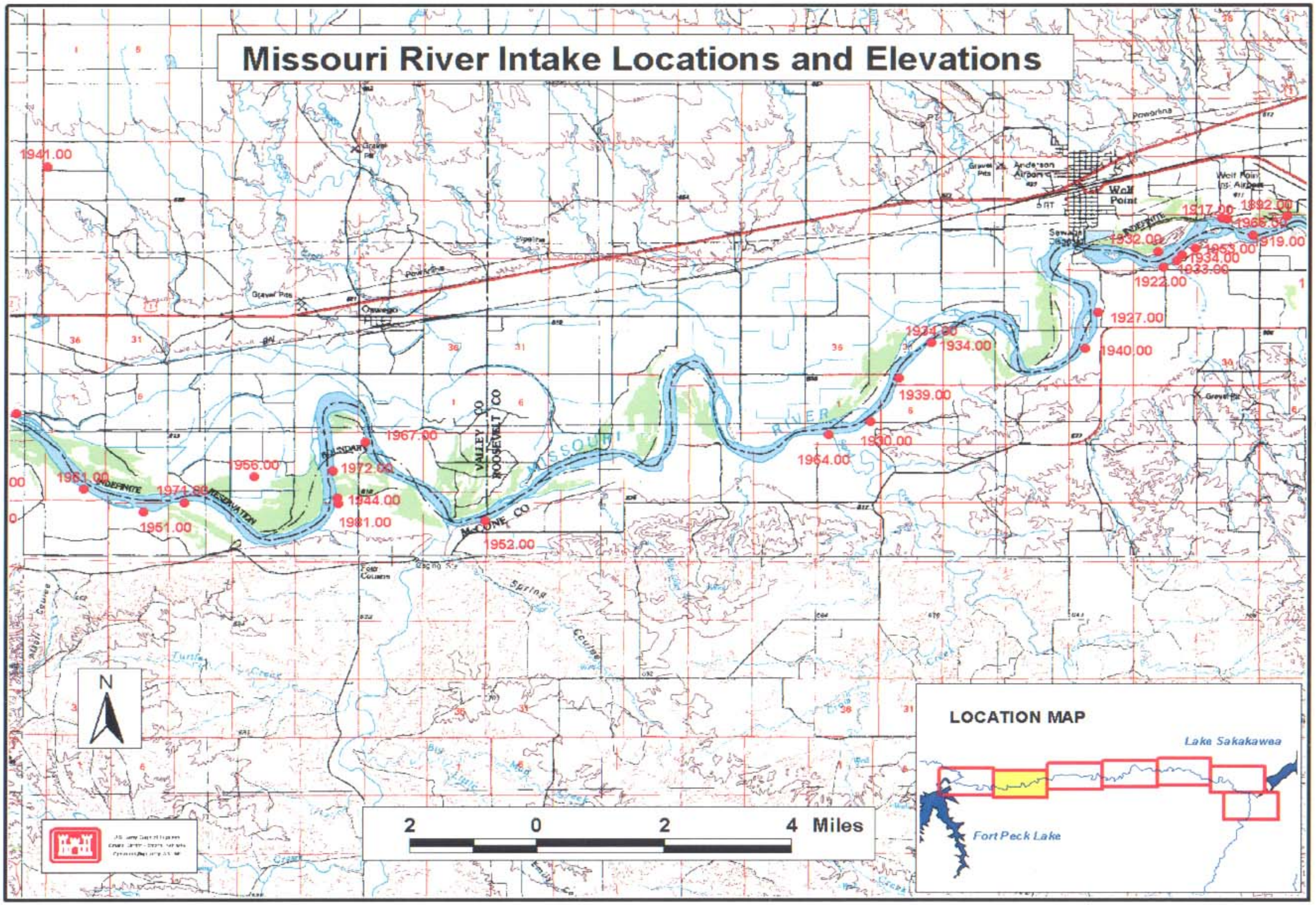
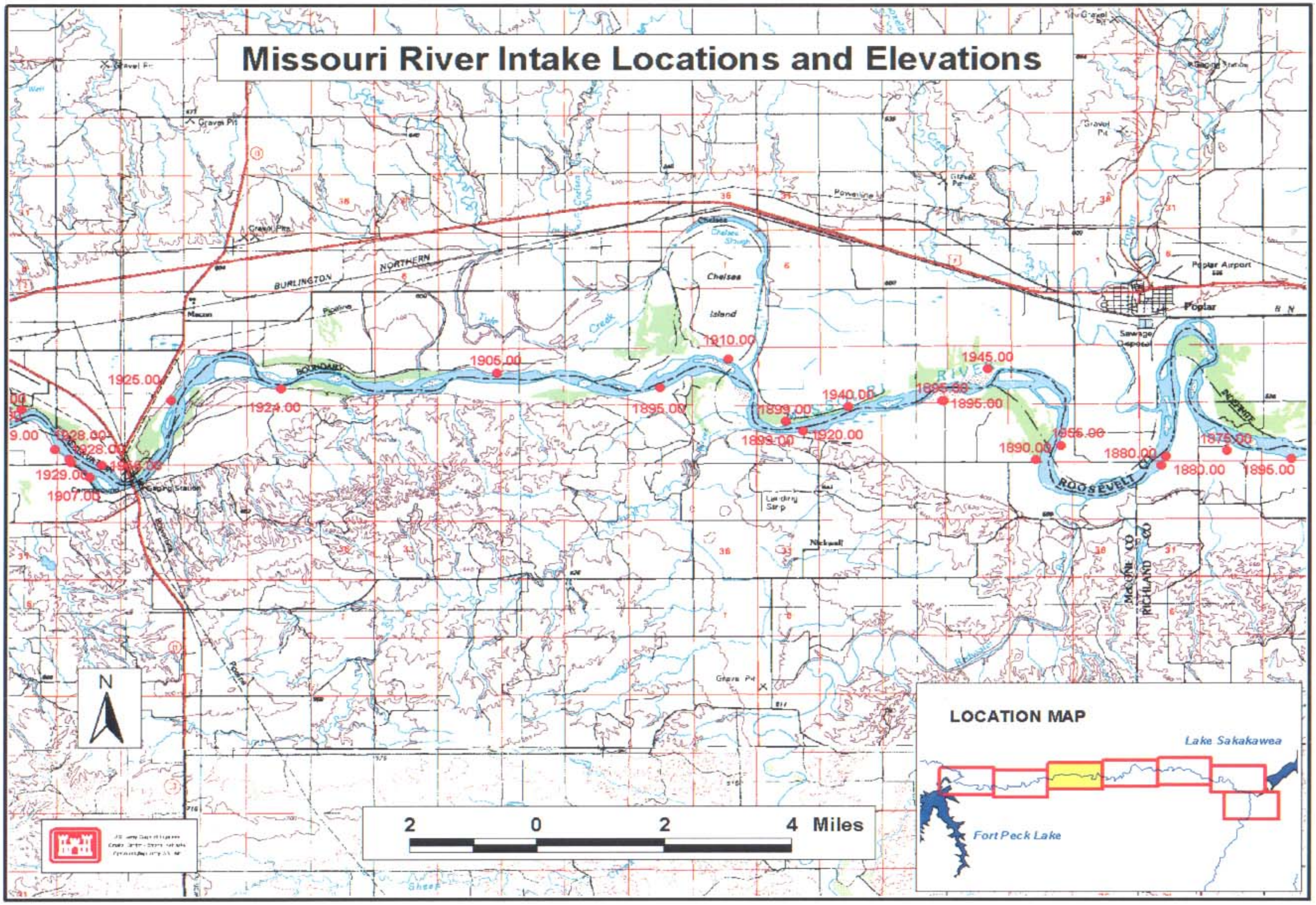
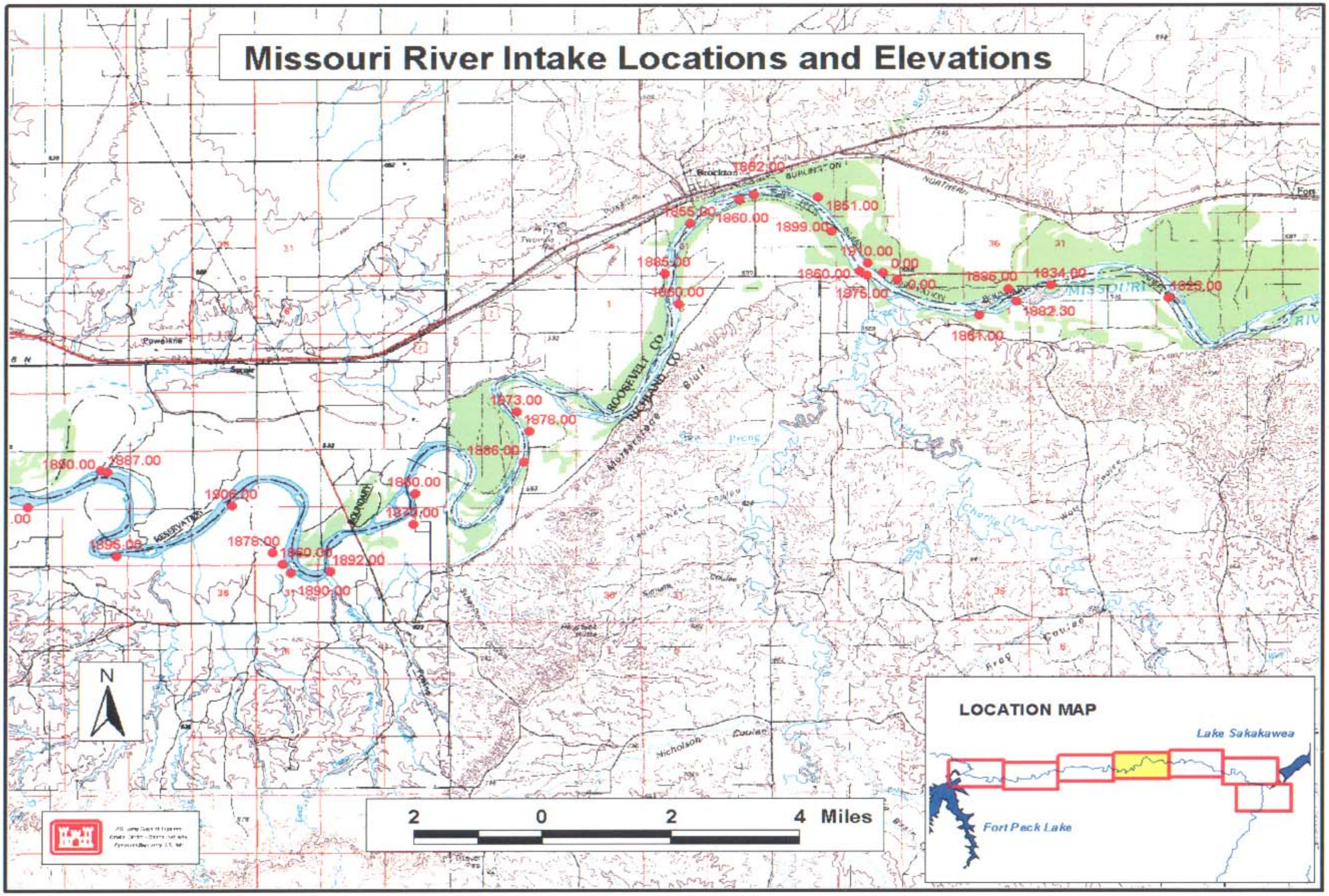

Missouri River Intake Locations and Elevations
2002.00
1976.00
1980.00
1981.00
1972.00
1950.00
1992.00
1965.00
1960.00
1975.00
1973.00
1979.00
1951.00
1960.00
1983.00
1958.00
1931.00
1935.00
1961.00
1941.00
MISSOURI
RIVER
Milk River
BURLINGTON NORTHERN
Fraser
VALLEY CO
McCONE CO
FORT PECK LAKE
N
2 0 2 4 Miles
LOCATION MAP
Lake Sakakawea
Fort Peck Lake



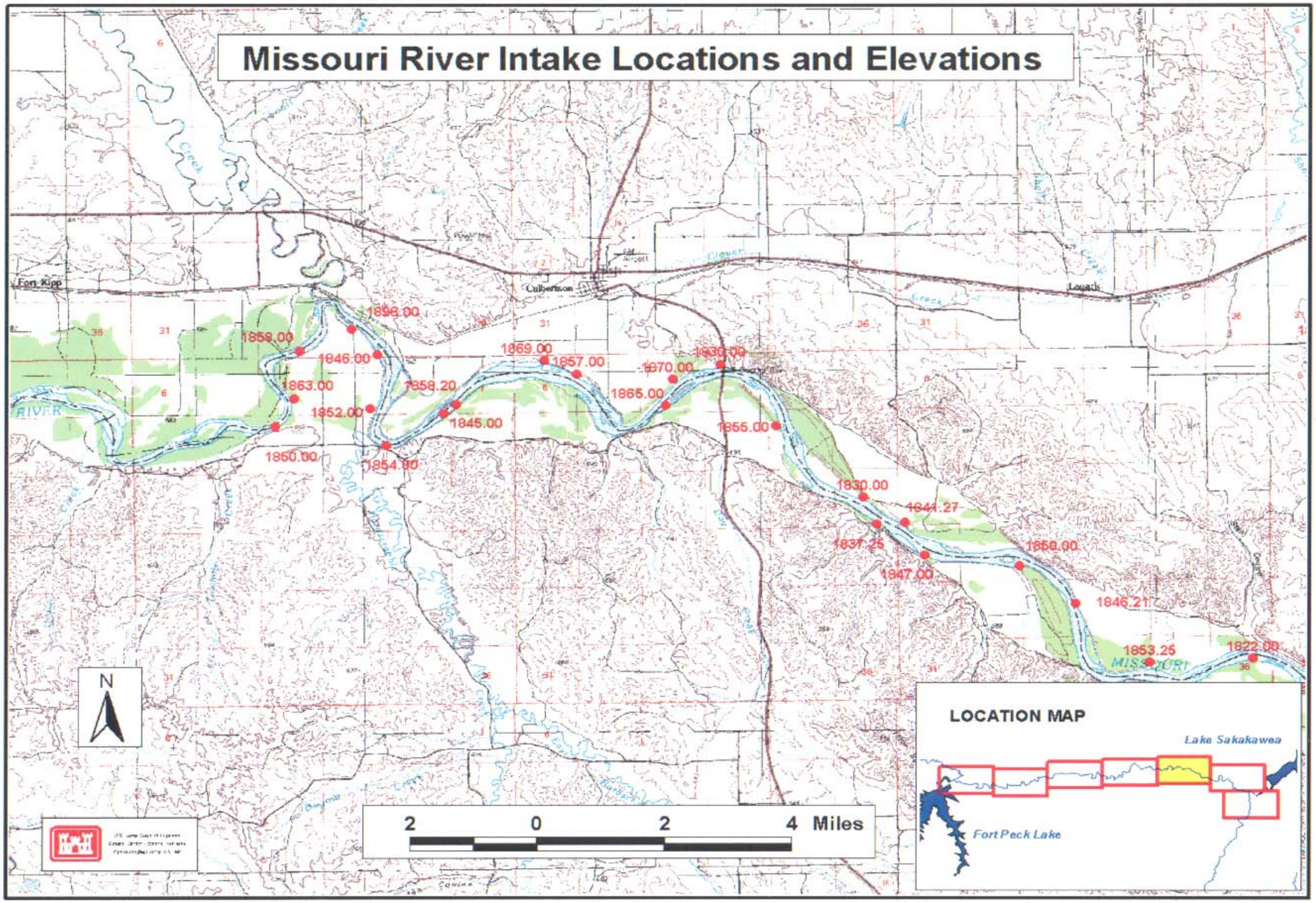
Missouri River Intake Locations and Elevations
1941.00
1917.00
1892.00
1932.00
1919.00
1922.00
1927.00
1934.00
1940.00
1939.00
1930.00
1964.00
1967.00
1956.00
1972.00
1944.00
1981.00
1951.00
1952.00
Wolf Point
MISSOURI
RIVER
VALLEY CO
ROOSEVELT CO
McCONE CO
N
2
0
2
4 Miles
LOCATION MAP
Lake Sakakawea
Fort Peck Lake



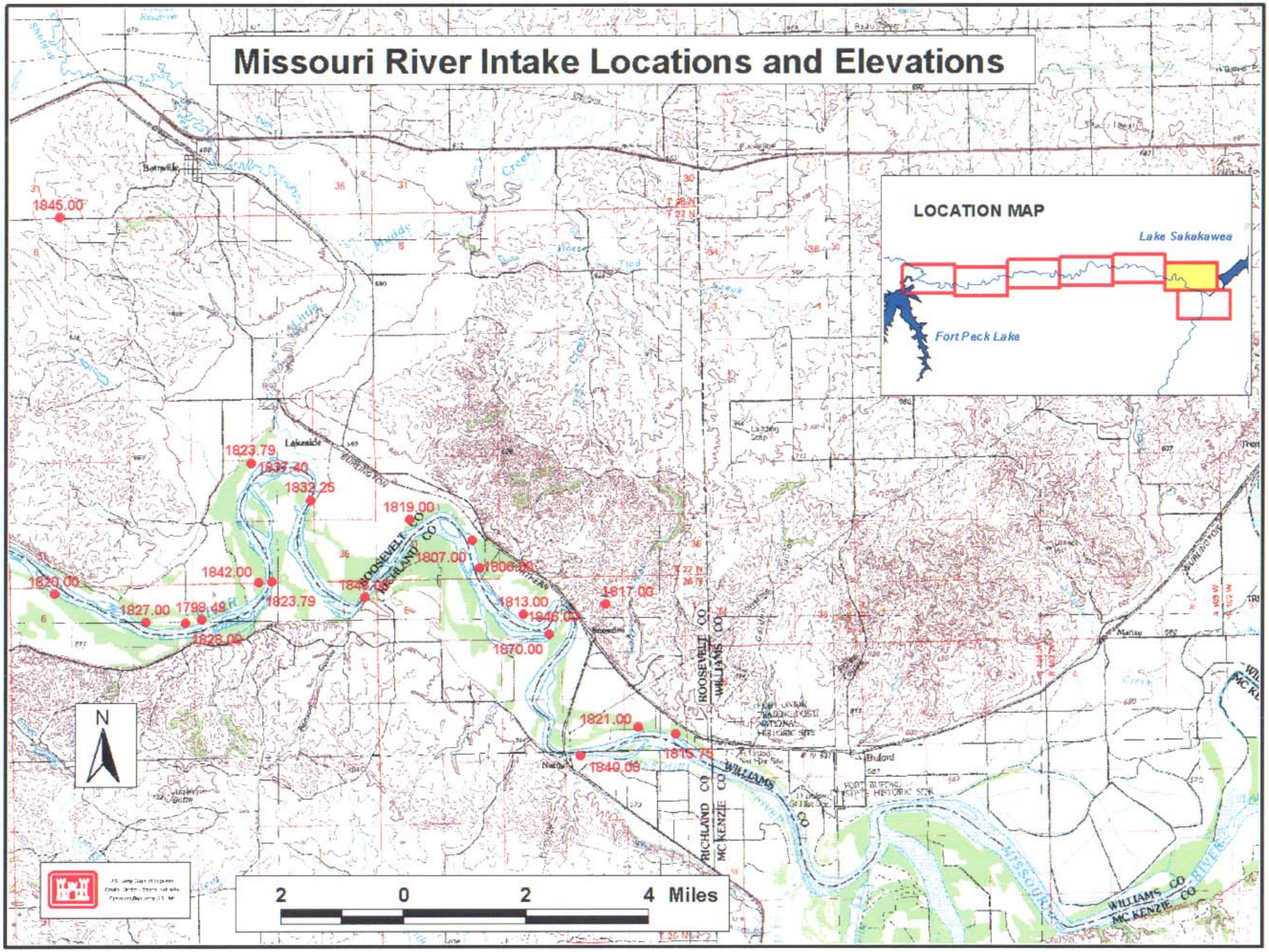
Missouri River Intake Locations and Elevations
1925.00
1924.00
1905.00
1895.00
1910.00
1899.00
1940.00
1920.00
1945.00
1895.00
1890.00
1956.00
1880.00
1875.00
1896.00
1929.00
1907.00
BURLINGTON
NORTHERN
Chelsea
Island
Poplar
Poplar Airport
ROOSEVELT
RICHLAND CO
N
2
0
2
4 Miles
LOCATION MAP
Lake Sakakawea
Fort Peck Lake



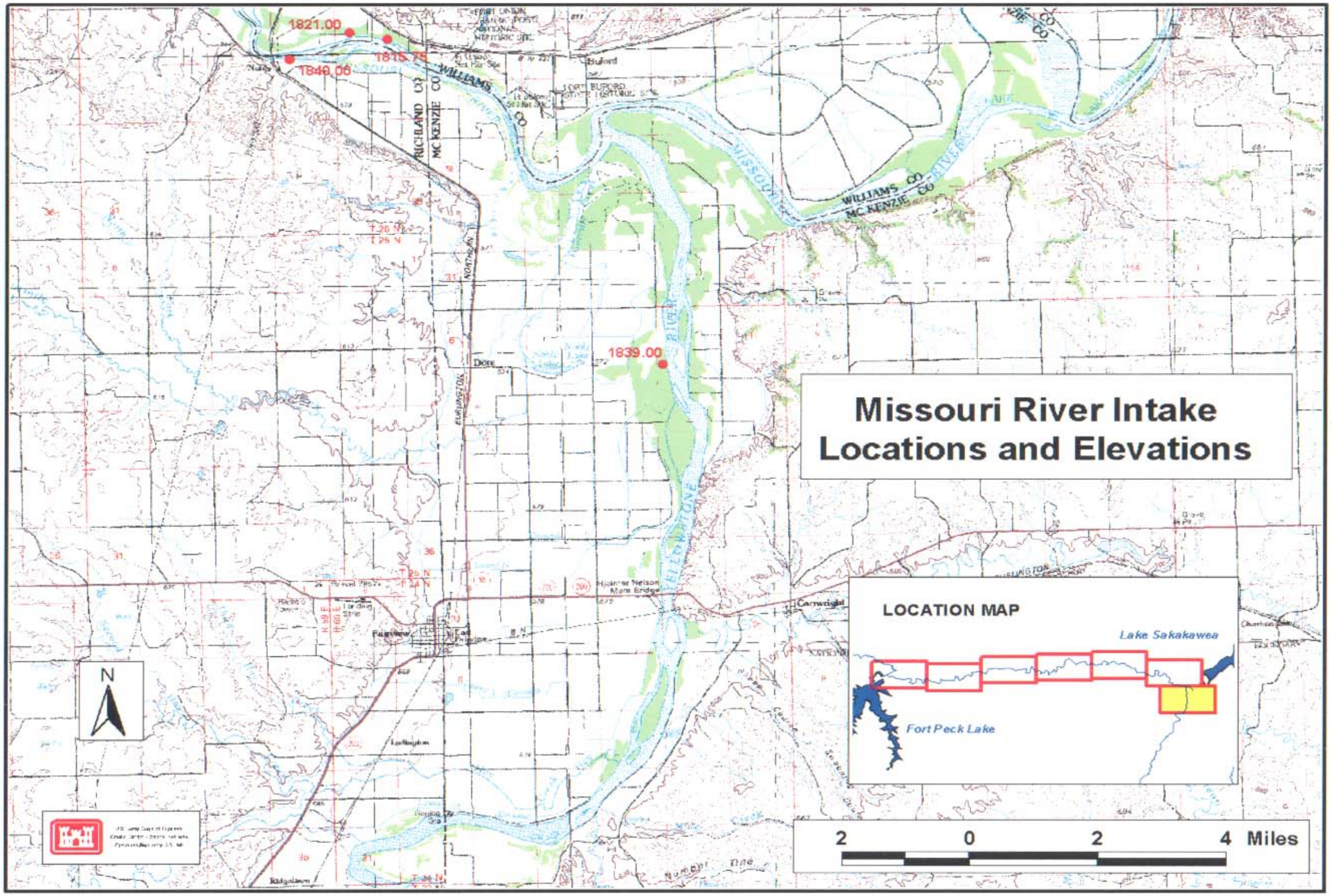
Missouri River Intake Locations and Elevations
LOCATION MAP
Lake Sakakawea
Fort Peck Lake
2 0 2 4 Miles
N



Missouri River Intake Locations and Elevations
Fort Kipp
Culbertson
Loads
RIVER
MISSOURI
1898.00
1859.00
1846.00
1863.00
1852.00
1858.20
1845.00
1860.00
1854.00
1869.00
1857.00
1870.00
1930.00
1865.00
1855.00
1830.00
1841.27
1837.25
1847.00
1850.00
1846.21
1853.25
1822.00
N
2
0
2
4 Miles
LOCATION MAP
Lake Sakakawea
Fort Peck Lake



Missouri River Intake Locations and Elevations
LOCATION MAP
Lake Sakakawea
Fort Peck Lake
1845.00
1823.79
1837.40
1832.25
1819.00
1807.00
1806.00
1842.00
1820.00
1823.79
1827.00
1799.49
1826.00
1813.00
1846.00
1870.00
1817.00
1821.00
1815.75
1840.00
Lakeside
Bainville
Buford
ROOSEVELT CO
RICHLAND CO
WILLIAMS CO
MC KENZIE CO
FORT BUFORD STATE HISTORIC SITE
2 0 2 4 Miles
N


Missouri River Intake
Locations and Elevations
1821.00
1815.75
1840.00
1839.00
LOCATION MAP
Lake Sakakawea
Fort Peck Lake
2
0
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4 Miles
N
WILLIAMS CO
MC KENZIE CO
RICHLAND CO
MC KENZIE CO
MISSOURI RIVER
Buford
Dore
Cartwright
Fairview
Ridgelawn

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APPENDIX L
FORT PECK BIOLOGICAL MONITORING DATA

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Movements and Habitat Preferences of Adult Post Spawn Pallid Sturgeon
Pallid Sturgeon Telemetry Study

2001 Progress Report

by

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Introduction

This progress report summarizes telemetry research field activities conducted in the 2001 field season in accordance with the US Fish and Wildlife Service's (USFWS), Post Spawn Pallid Sturgeon Telemetry Study. Funding for this project has been provided by Western Area Power Administration (WAPA), the US Army Corps of Engineers (USACE) and the USFWS.

Due to limited amounts of data concerning post spawn movements of pallid sturgeon, the USFWS initiated a long term study in an attempt to answer some of the unresolved questions about these unique, native river fish.

The main goals of this study are to monitor post spawn migrational movements to help identify pallid sturgeon spawning areas, determine pallid sturgeon response to " Spring Test Flows " out of Fort Peck Dam to see if mimicking natural flows will expand pallid use and habitat into the Missouri River above the confluence of the Yellowstone River, and to evaluate reproductive stages of known post spawn females. We also hope telemetered pallid sturgeon will serve as an important tool for future broodstock capture by utilizing and netting possible aggregations in relation to telemetered fish as Tews (1993) demonstrated during fall tagging. Netting additional fish and marking them with Passive Integrated Transponder (PIT) tags will also serve to help strengthen current population estimates.

Study Area

The pallid sturgeon study area (See Figure 1, for core study area), for the most part, is a semi-confined stretch of approximately 290 river miles encompassing the Missouri River from Fort Peck Dam to the head waters of Lake Sakakawea and from the Yellowstone River confluence (~ RM 1582.0) up the Yellowstone River to the Intake Diversion Dam, Intake, Montana.

Within our study core area, we placed three fixed data logging stations to shorten tracking zones into more manageable reaches. This served dual purposes because it aided researchers in tracking fish and gives us continual movement data within this area.

As suggested in the Post Spawn Telemetry Study Plan, fixed data logging station locations had to be adjusted due to a variety of factors, but eventually all three stations were placed in well suited areas that met the criteria needed to work effectively. Our first station initially was placed up the mouth of the Yellowstone River a few hundred yards (576506 E, 5314283 N) adjacent to or above the confluence on the west river bank below the high water line. Later in the summer, it was moved to the east bank on private property, due to low water conditions. The second station, which is identified as the Fort Union Station (586880 E, 5315030 N), is approximately five river miles up the Missouri River above the confluence, and as its name suggests, lies due east of Fort Union State Park on the north shore of the Missouri River on State owned land . The third station was located down the lower Missouri River approximately 11 river miles below the confluence and is adjacent to the Erickson Island State Game Production Area. The Erickson Island Station is located on the north shore of the management area (572089 E, 5316011 N).

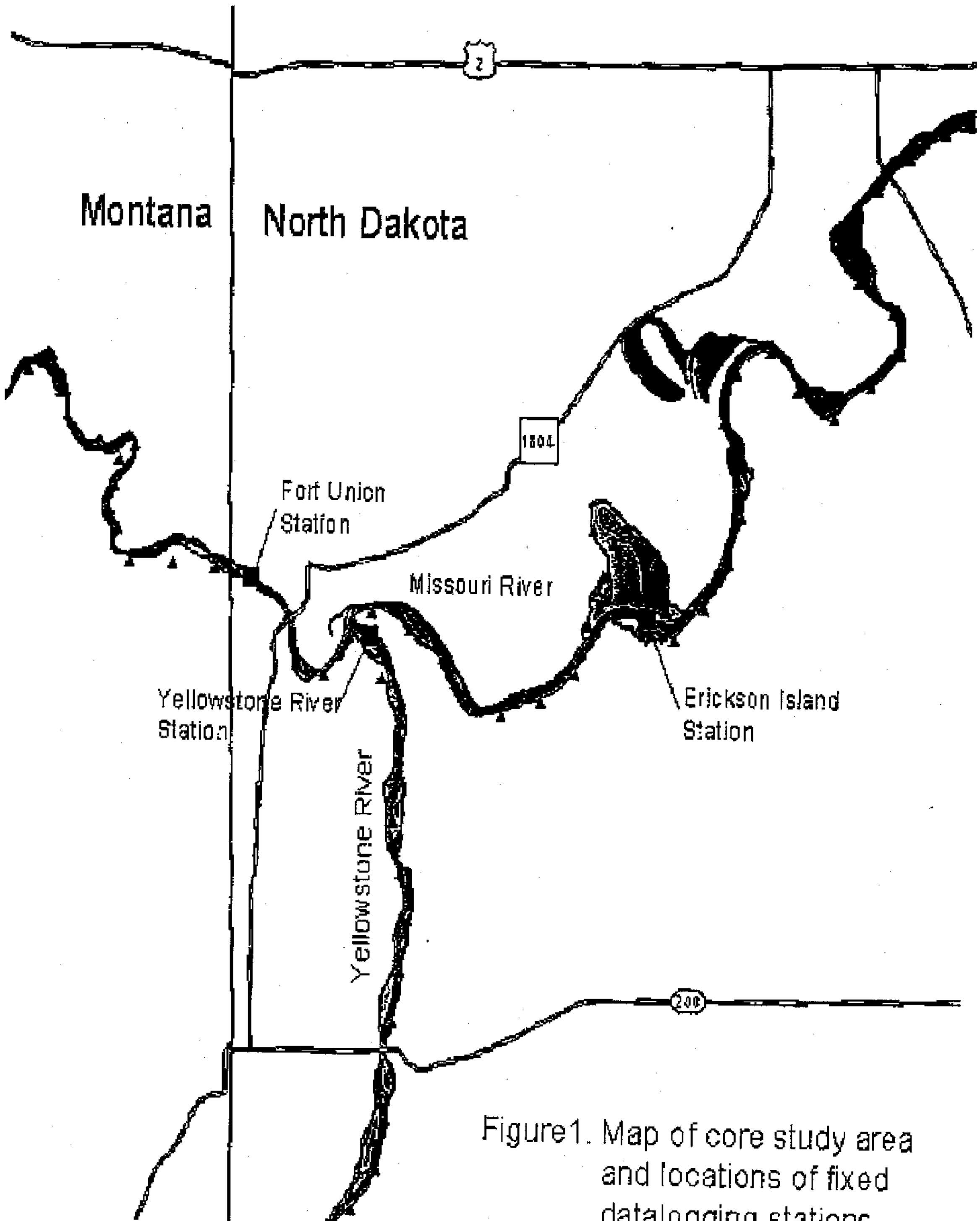

Figure1. Map of core study area and locations of fixed datalogging stations.

Methods

Adult pallid sturgeon used for our telemetry study are products of the 2000 and 2001 spawning activities performed at Garrison Dam National Fish Hatchery (GDNFH 2000), Riverdale, North Dakota, and the Miles City State Fish Hatchery (2001) at Miles City, Montana.

Crews from Montana Fish, Wildlife and Parks (MTFWP), Fort Peck Field Office, and the USFWS, Bismarck, North Dakota, worked cooperatively to provide hatcheries with gravid broodstock pallid sturgeon. Fish were collected by drifting 150' long by 6' high trammel nets with two panels (6" inside panel and 10" outside panel) along the bottom of the river with one end connected to the boat and the other end free floating. Predominantly, most pallid sturgeon were caught within the true confluence of the two rivers or directly downstream in the lower Missouri within a few hundred yards of the confluence, as well as a few hundred yards up the Yellowstone River.

Once a fish was netted, the pallid sturgeon was brought back to the boat ramp where morphometric and meristic data were taken. In addition, the fish was staged by hatchery personnel (Rob Holm, GDNFH) to assess if it was a male or female, gravid or nongravid, and whether the fish would be transported to the hatchery for propagation purposes. If found to be a candidate for propagation, the fish was vaccinated with an antibiotic (Biomyocin) and loaded on a fifth wheel distribution trailer and transported to the appropriate hatchery.

The "Class of 2000" fish were spawned at GDNFH on June 14, 2000, and telemetry transmitters were surgically fitted at the hatchery on August 28. Ten fish, two females and eight males were tagged with transmitters (Table 1). These fish were kept at the hatchery to recover from the induced stress caused by handling at spawning time, as well as the surgical procedures used to deploy tags. The pallids were returned to the confluence on October 10 through the 12, 2000.

Due to the virus issues associated with GDNFH, the Upper Basin Pallid Workgroup decided that 2001 pallid sturgeon spawning would take place at the Miles City State Hatchery in Miles City, Montana. Six fish (Class of 2001, Table 2) were spawned at Miles City hatchery on June 26th, 2001. Due to room shortage at the hatchery, fish were surgically tagged on July 3 and were returned to the confluence on July 9 and 10, 2001. Unfortunately, one of the female pallid sturgeon died after tagging, thus leaving one female and four males to return back to the river for study purposes. (A total of 15 were tracked during the study).

Pallid sturgeon were surgically implanted with Combined Acoustic Radio Transmitters (CART), manufactured by Lotek Engineering Inc. of New Market, Ontario. The transmitter utilized in the study, Model CART 32_1S, is an internal tag with an external antennae (~ 18 inches) with a listed longevity rate of five years, based on a five second burst rate. Diameter of the tag is 32 mm in length, and weighs 61.0 grams (weight in water).

We chose to employ CART tags to utilize the dual aspect of the tags, using the radio aspect in wide shallow reaches of the river or in and around island complexes, and using the sonic aspect in deep, highly turbid areas where radio telemetry would be compromised.

Name	Code	Sex	PIT tag #	Weight in Pounds	Weight in Kilograms	Fork Length in Inches	Fork Length in Millimeters
Art	18	M	1F4849755B	33	14982	51	1295
Al	22	M	1F4A004552	26	11793	52	1335
Annie	25	F	1F47715752	55	24970	62 +	1580
Andre	26	M	7F7B081579	32	14528	56	1444
Alex	34	M	115525534A	36	16344	55	1404
Aaron	38	M	1F477B3A65	45	20430	57+	1468
Arnie	44	M	2202236E31	61	27694	60+	1542
Archie	46	M	1F4A33194B	45	20340	57+	1468
Andrew	50	M	1F4A143350	28	12712	53+	1352
Amber	62	F	115713555A	57	25878	59+	1516

Table 1. Class of 2000. Pallid sturgeon tagged and spawned in 2000 at the Confluence of the Yellowstone and Missouri Rivers. Name, code, sex, Pit tag numbers, weight, and lengths are listed.

Name	Code	Sex	PIT tag #	Weight in Pounds	Weight in Kilograms	Fork Length in Inches	Fork Length in Millimeters
Butch	2	M	1F4A27214F	50	22657	61	1541
Bridget	10	F	220E345E09	61	27971	63+	1615
Bart	14	M	115631222A	29	13257	52+	1340
Bob	116	M	7F7D3C5708	30	13714	55+	1405
Ben	144	M	1F4A111C6A	43	19657	55	1394

Table 2. Class of 2001. Pallid sturgeon tagged and spawned in 2001 at the Confluence of the Yellowstone and Missouri Rivers. Name, code, sex, Pit tag numbers, weight, and lengths are listed.

CART tags also work exclusively with Lotek receivers and fixed data logging stations, allowing researchers to download movement and direction data of individual fish to support manual tracking.

CART tags were surgically implanted using a combination of methods of Bramblett (1996), Clancey (1992), and procedures implemented by researcher's listed in the Hatchery Manual for the White Sturgeon (Conte et al.1988). The only deviation from past researchers methods was the addition of anesthetizing the incision with a local anesthetic (lidocaine), to lesson stress. In addition, an application of SuperGlue was applied to incisions and sutures to help seal tissue together and strengthen suture knots. The use of the local anesthetic seemed to have a positive effect on pallid sturgeon, as most fish seemed to be more docile during the initial incision and insertion of tags.

To ensure CART tags were operating properly, tags were tested on three different occasions with the accompanying SRX_400 W5 Lotek receiver. All tags were tested and cycled upon arrival of shipment in Bismarck, ND, tested upon insertion into the fish at the previously mentioned fish hatcheries, and finally retested again at the boat ramp before fish were released back into the wild at the Confluence of the Yellowstone and Missouri Rivers. All fifteen tags performed perfectly on all occasions and hopefully will continue to do so long-term.

We tracked fish from April until October at two different tracking intensities. In April, May, and June, we tracked fish extensively five days per week throughout the entire three month time span to try to maximize locations per fish during spring flows and suspected spawning periods. Beginning in July, we went to a less aggressive tracking regime consisting of tracking for five days every three weeks throughout the rest of the field season until October 8, when fixed data logging stations were removed from the river.

Typical tracking protocol consisted of traveling daily to all three fixed datalogging stations to download movement data which assisted in ascertaining directions of individual fish. This helped determine the section of river to be sampled. For the majority of the tracking season, the acoustic aspect was utilized exclusively for relocating tagged fish. Relocation of fish was accomplished by lowering the 360 degree hydrophone beneath the bottom of the boat, floating for approximately two minutes, then raising the hydrophone and powering down river 300 meters, and repeating this process until we found a fish or finished sampling a study section.

Upon receiving signals from a fish, a handheld baffled 180 degree directional hydrophone was used to home in on the coded pallid sturgeon. Several drifts were then made to get directly above the fish and to obtain a power signal from our SRX_400 receiver of 200 or above with a gain reading of zero percent. Once a power rating of 200 or above was achieved and maintained, we anchored above the fish and started recording data.

Relocation data included fish name, code number, date and military time of location. A Global Positioning System (GPS) waypoint was taken with a Rockwell Precision Lightweight PLGR+96. Waypoint numbers, as well as their corresponding Easting and Northing values were recorded into a field logbook in case PLGR+96 data was lost or erased before it could be downloaded.

A fish's physical location also was noted in the field logbook. Two different categories were used: 1) main channel or side channel, main channel inside bend, and main channel outside bend, and 2) whether the fish was associated with main or side channel island, main or side channel upstream of island, and main or side channel downstream of island.

Additionally, depth, water temperature, and turbidity were also recorded. Turbidity was measured with a handheld Hach 2100P Portable Turbidimeter and data was recorded in NTU's. A laminated field map also was utilized to record rivermiles which were used to backup GPS values and provide quick reference of past locations. Flow data downloaded weekly from the United States Geological Survey's (USGS) Sidney and Culbertson gauging stations was also added to the logs.

Finally, a small, rough map was sketched in the field logbook to help document yardage values to islands, sandbars, nearest shore, far shore, and total distance of river width. Yardages were determined with a Bushnell Laser Rangefinder, model Yardage Pro 1000. All data collected in the field was later entered into an EXCEL spreadsheet which is compatible for exporting files into various statistical programs.

Results and Discussion

Due to different unanswered questions concerning the feasibility of the long term Pallid Sturgeon Telemetry Study, the 2001 field season was converted into a "pilot phase" for upcoming research. Concerns were raised about effectiveness of equipment at the Fort Peck coordination meeting, as fixed data logging stations are somewhat of a new concept for this part of the region and our water quality parameters. Contingent on effectiveness of Lotek's telemetry equipment, another profound concern was whether biologists could relocate individual fish effectively, or enough times to provide adequate samples for statistical analysis. For these reasons, coupled with the fact that USACE warm water flow tests have been delayed due to low water conditions until 2003, a pilot phase at this juncture afforded us time to answer questions and collect important baseline movement data.

An important aspect of the pilot study phase of this project was to evaluate the functionality of the fixed datalogging stations, assess their proper placement to fragment study zones, and to measure overall usefulness in remotely collecting large amounts of data during times of the year when biologists are not on the river. On April 17 and 18, fixed datalogging stations were installed with the help of a multi-agency effort on the Missouri and Yellowstone Rivers. Personnel from MTFWP, USGS, and the North Dakota Game and Fish Department (NDGFD) all played roles in the deployment of stations. WAPA provided funding to our telemetry project by covering expenses for technological representatives from Advanced Biotelemetrics Inc. (ABI) from New Market, Ontario, to help in the initial setup of the telemetry station equipment. Doctor Richard Booth and Eric Bombardier of ABI spent four days aiding in fixed datalogging station setup, assisting in the calibration of station receivers, providing technical support concerning trouble shooting problems, and rendering much useful information on tips and techniques pertaining to our project.

The Fort Union and the Yellowstone Stations were set up to monitor both acoustic and radio frequencies, while the Erickson Island Station was set up experimentally to monitor acoustic only. Overall, all three stations performed to our satisfaction and much valuable movement data was collected throughout the course of the tracking field season. The Erickson Island Station proved to be our most consistent and trouble-free unit throughout the field season, most likely because of its location and single frequency scanning. The other two stations performed well, except for a couple of different time spans when we experienced technical difficulties with power sources and receivers shutting down. Unfortunately, during one of the time spans, both of the stations shut down simultaneously, resulting in the loss of valuable directional and movement data for a few fish over a 60 to 90-day period. We believe we have resolved the power source issue for the upcoming field season and will monitor it closely.

As mentioned previously in the report, our tracking regime primarily used the acoustic aspect for relocating tagged pallid sturgeon, with the exception of a brief period in October when water quality parameters were conducive to using radio frequency. Although the dual combined acoustic/radio aspect is supposed to be the strong point of Lotek's CART tag; unfortunately, we were unable to utilize the radio frequency most of the time due to water quality factors. This was most prevalent in the Yellowstone River where turbidity, total dissolved solids, and conductivity levels proved to be too high for optimum efficiency, therefore, we questioned the effectiveness of this aspect to locate fish.

However, within a short window of time this past fall we had varied success using the radio frequency to locate pallids by use of a boat under power (3000 rpm's). We ran the Missouri River from the confluence down to the Highway 85 bridge and found eight pallids using radio only. Using buoys to mark transmitters, we conducted some distance/depth tests to get a better grasp on the pros and cons of these tags. Relative to range, upstream detection of the tags was relatively poor, around 50 to 80 yards, while approaching the fish from downstream resulted in detection ranges of 150 to 330 yards. The most likely explanation might be that the fish were pointed upstream, thus blocking the signal with the body, versus coming from behind the fish and getting a better signal from the more exposed dangling antenna. Favorable water quality parameters were probably responsible for the limited success at that time; conditions were definitely more favorable than they had been all season.

All radio observed fish were found in eight feet of water or less, turbidity averaged around 20 NTU's, and the conductivity hovered around 560 to 590. Unfortunately, we don't see these kind of physical characteristics very often. Although the radio aspect has limitations, there are definitely applications when it could prove to be useful, especially during low flow and low turbidity conditions. Another useful application of the radio aspect is for diel movement information once we are on top of a fish. Using it for close range telemetry should not be a problem.

Manual tracking acoustically is more labor and time intensive, but proved to be highly effective for relocating fish in both river systems. Typically, we could start detecting signals of fish 300 to 400 yards away, and have occasionally picked up signals as far away as 600 yards. With these types of ranges, we felt highly confident about our method of acoustic sampling.

Two hundred thirty seven observations were made during the 2001 pilot study field season, 72 relocations by boat and 165 observations at fixed datalogging stations. This number of observations probably is a fairly low representative of relocation numbers that should be achieved in the future, based on the fact our manual tracking didn't officially start until May and we had several problems with our boat and hydrophones late in the summer.

Fourteen of 15 fish surgically implanted with internal CART tags were relocated during the pilot study. The only fish unable to be located was Aaron (# 38), a 27-pound male from the class of fish released in 2000. Upon his release in the fall of 2000, he was followed for a couple of days along with the rest of the study group and exhibited the same behavior as other tagged and released pallid sturgeon. A few possible explanations for the absence of #38 in 2001 exist. The fish may have moved out of the study area into reaches of the Upper Missouri River or the head waters of Lake Sakakawea or, simply the CART 32_1S tag may have stopped working after the fall of 2000. Another theory existing may be that the tag was expelled from the fish and buried in sediment or sand.

A large majority of the study group stayed within the confines of the lower nine miles of the Yellowstone River. Most spent considerable amounts of time around the confluence, and ranged down the lower Missouri River to the Highway 85 Bridge near Williston, North Dakota. Although Annie (# 25), was never located by boat in the Yellowstone River, she roamed extensively and set the upper limits for a boat relocated fish furthest up the Upper Missouri River (RM 1592.3) and the lower limits for a fish below the confluence, down the Lower Missouri River (RM 1551.4). We located two different males at RM's 9.5 and 9.6 on the Yellowstone River which marks the farthest point up the Yellowstone for boat relocations. However, during the periods when our stations shut down we are fairly confident two males went up the Yellowstone River above Sidney, Montana. We did not relocate them until late summer when they returned back to the confluence area.

One anomaly worth mentioning from this season's field notes was the behavior of the study's three females, Annie (# 25), Amber (# 62), and Bridget (# 10). Throughout the tracking season, a total of ten observations occurred in the upper Missouri River above the confluence; nine of the ten observations were by the above mentioned females. One male (# 34) selected the upper Missouri for a day and returned back to the confluence.

Data collected in 2001 provides baseline information for our long term study, but is insufficient for any statistical or correlation analysis. Data collected in the 2002 field season will be added to this years data and will be preliminarily analyzed for the 2002 progress report submitted to all agencies providing funding, including: USACE, WAPA, Upper Basin Pallid Workgroup, as well as the Bureau of Reclamation and the NDGFD which will be providing funding in 2002. Northern Prairie Wildlife Research Center will assist in data analysis, development and critical review of models, and aid in future project design and assessment of discrepancies.

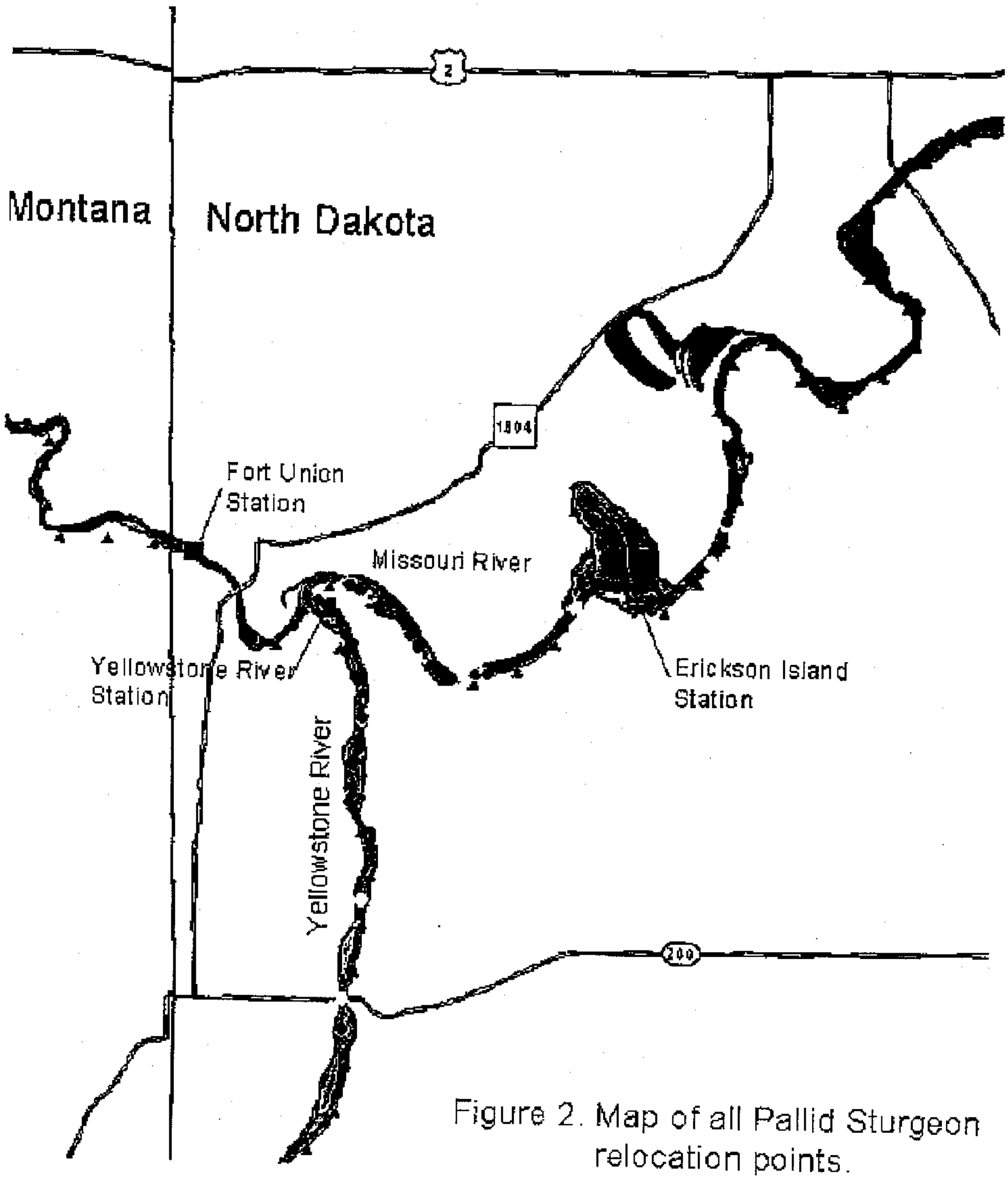

Figure 2. Map of all Pallid Sturgeon relocation points.

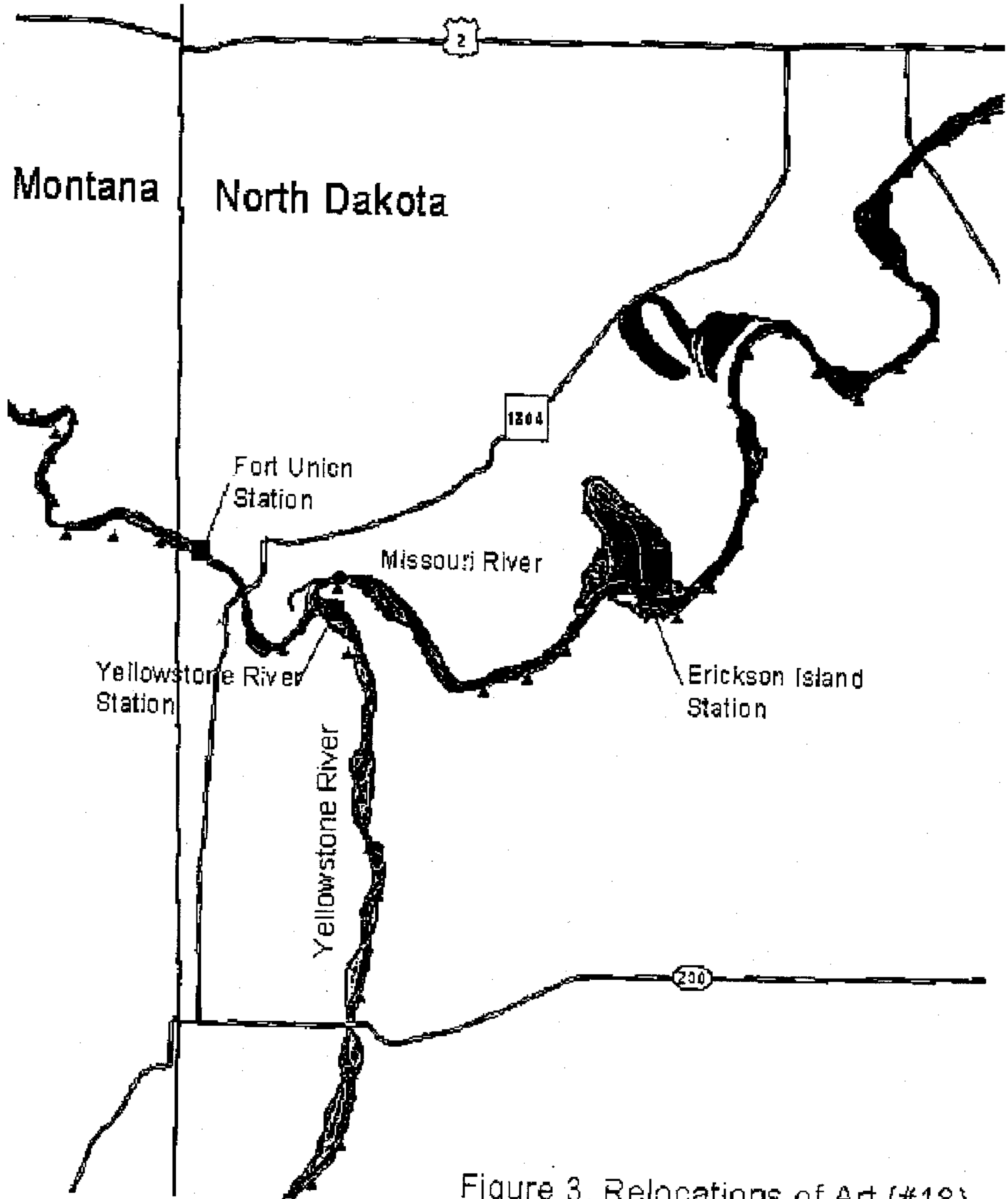

Figure 3. Relocations of Art (#18)

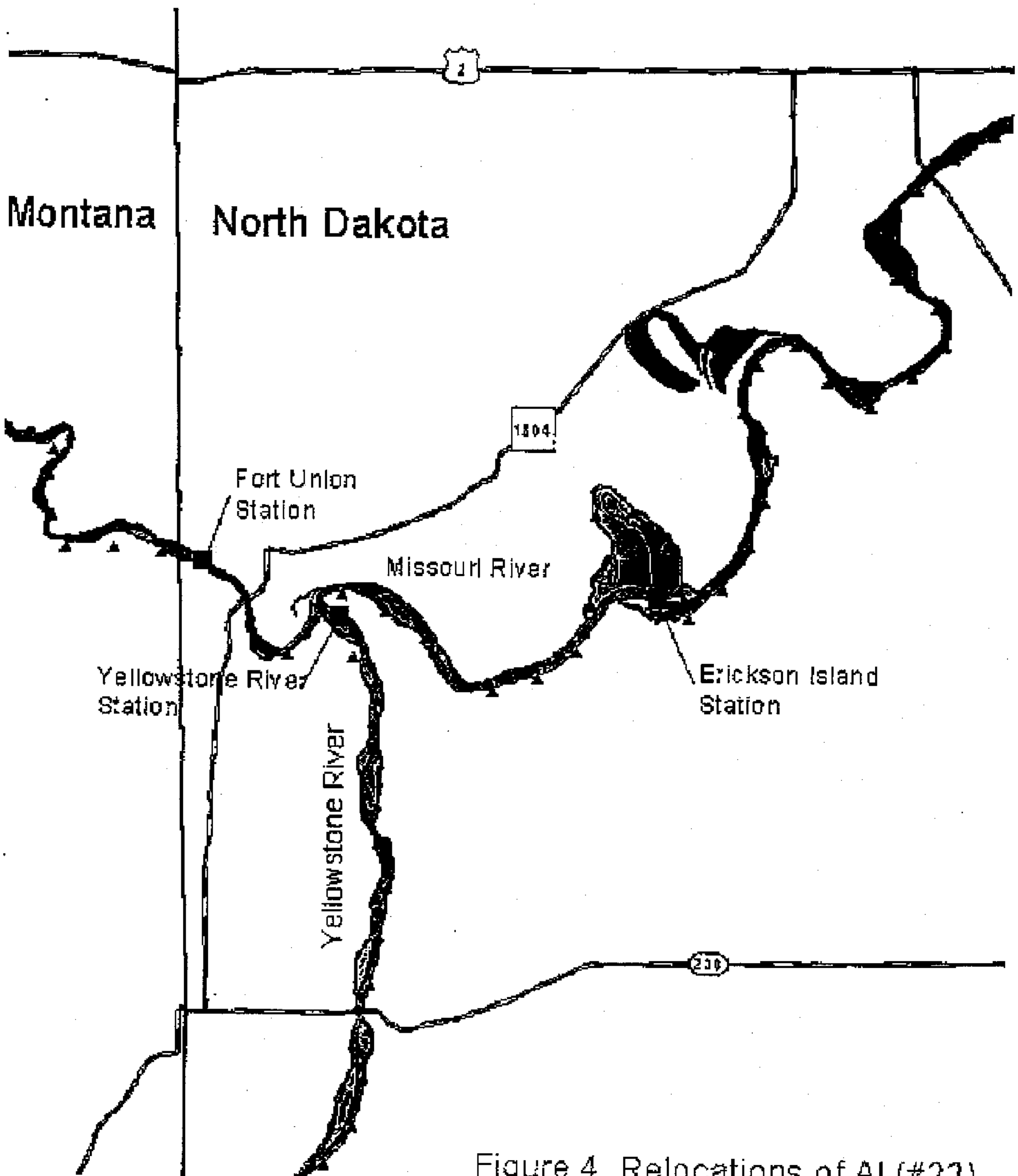

Figure 4. Relocations of Al (#22)

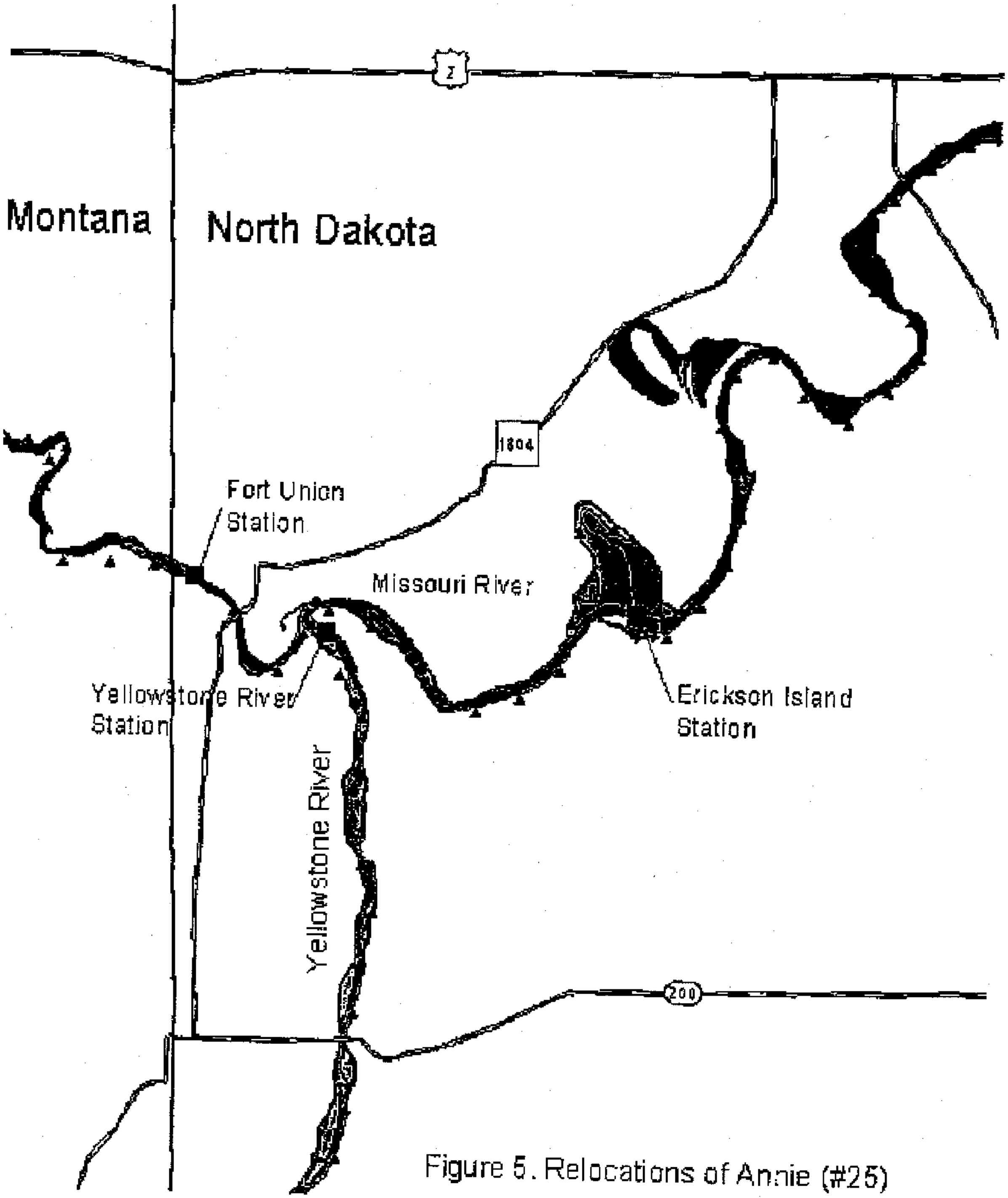

Figure 5. Relocations of Annie (#25)

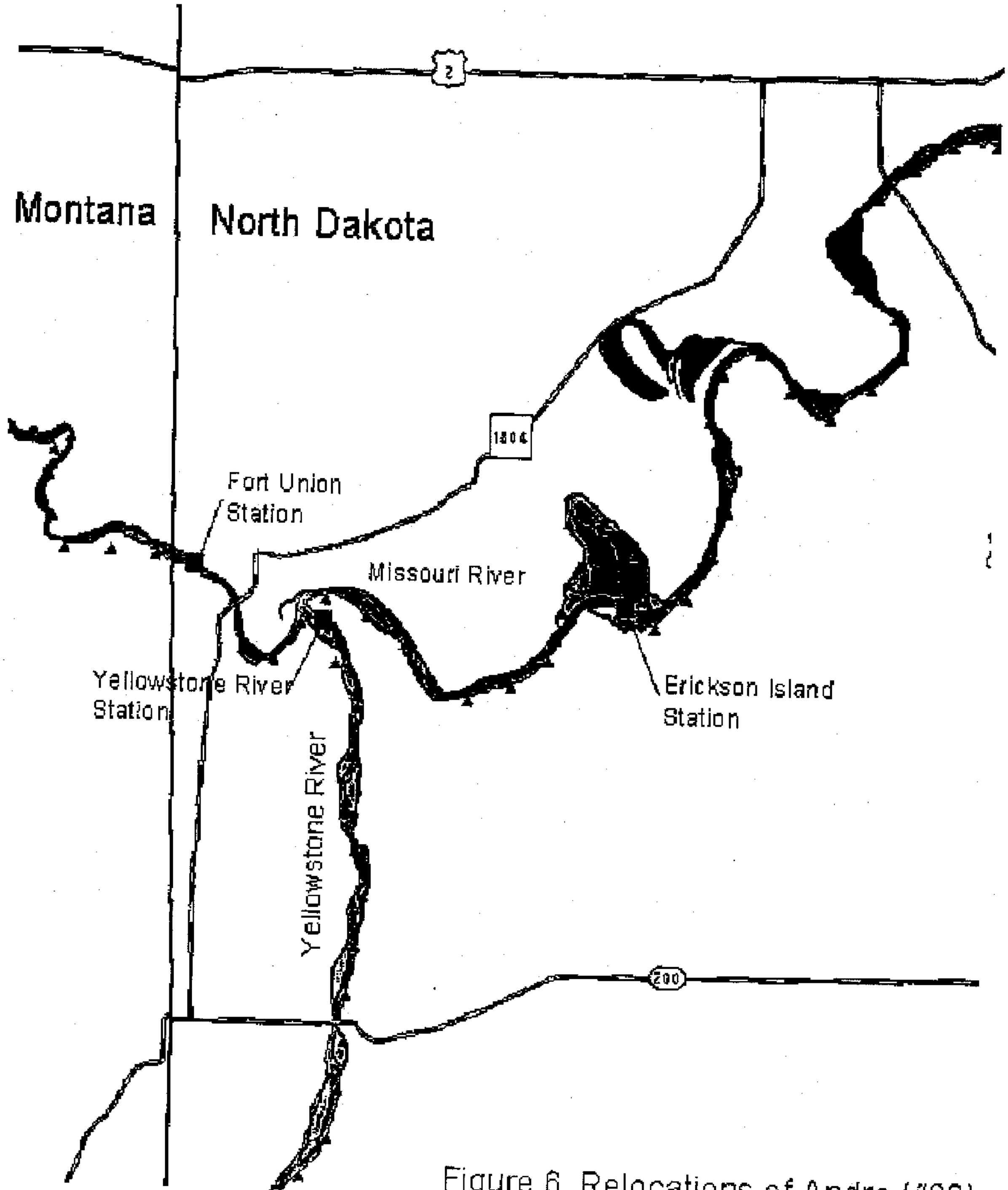

Figure 6. Relocations of Andre (#26)

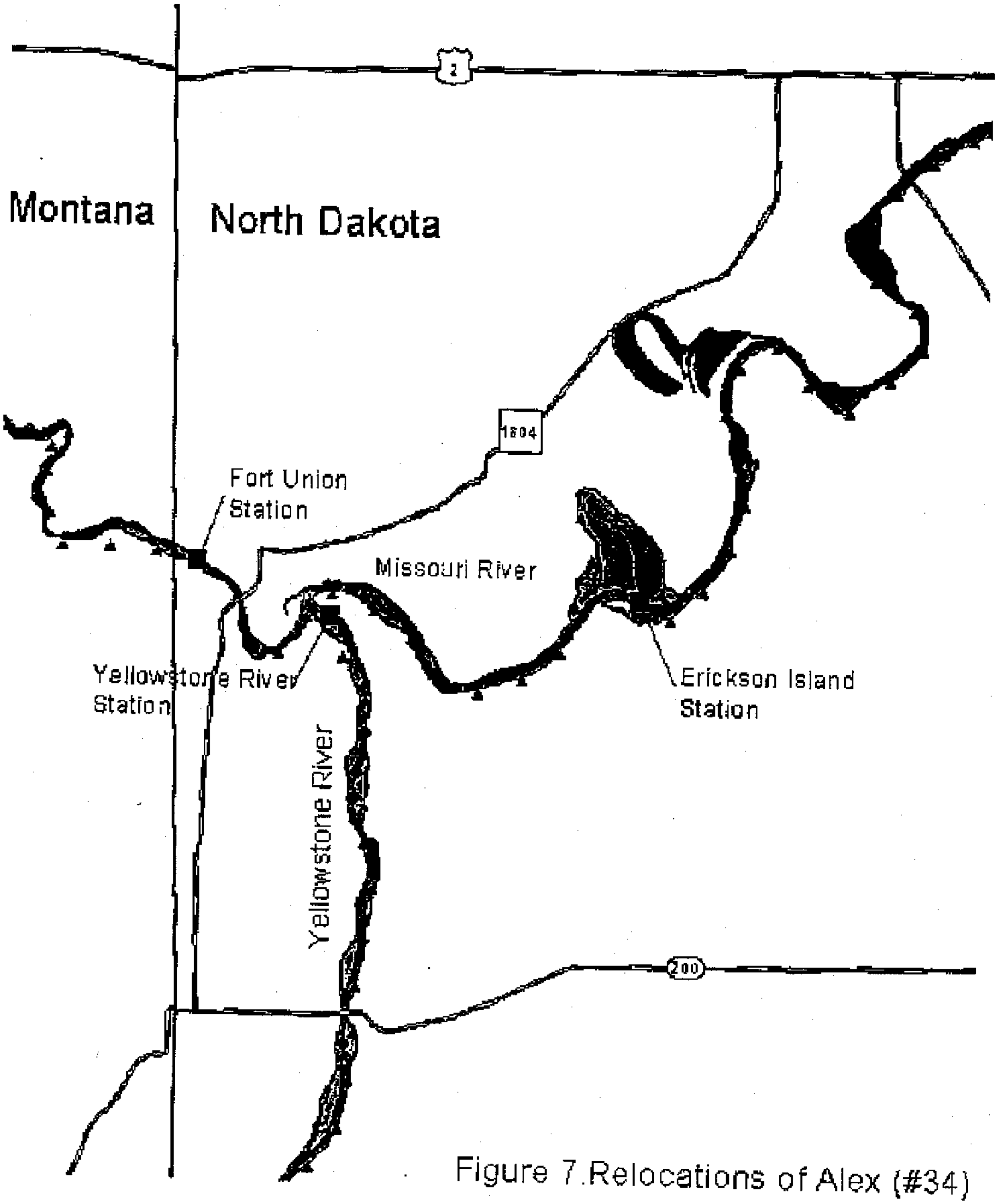

Figure 7.Relocations of Alex (#34)

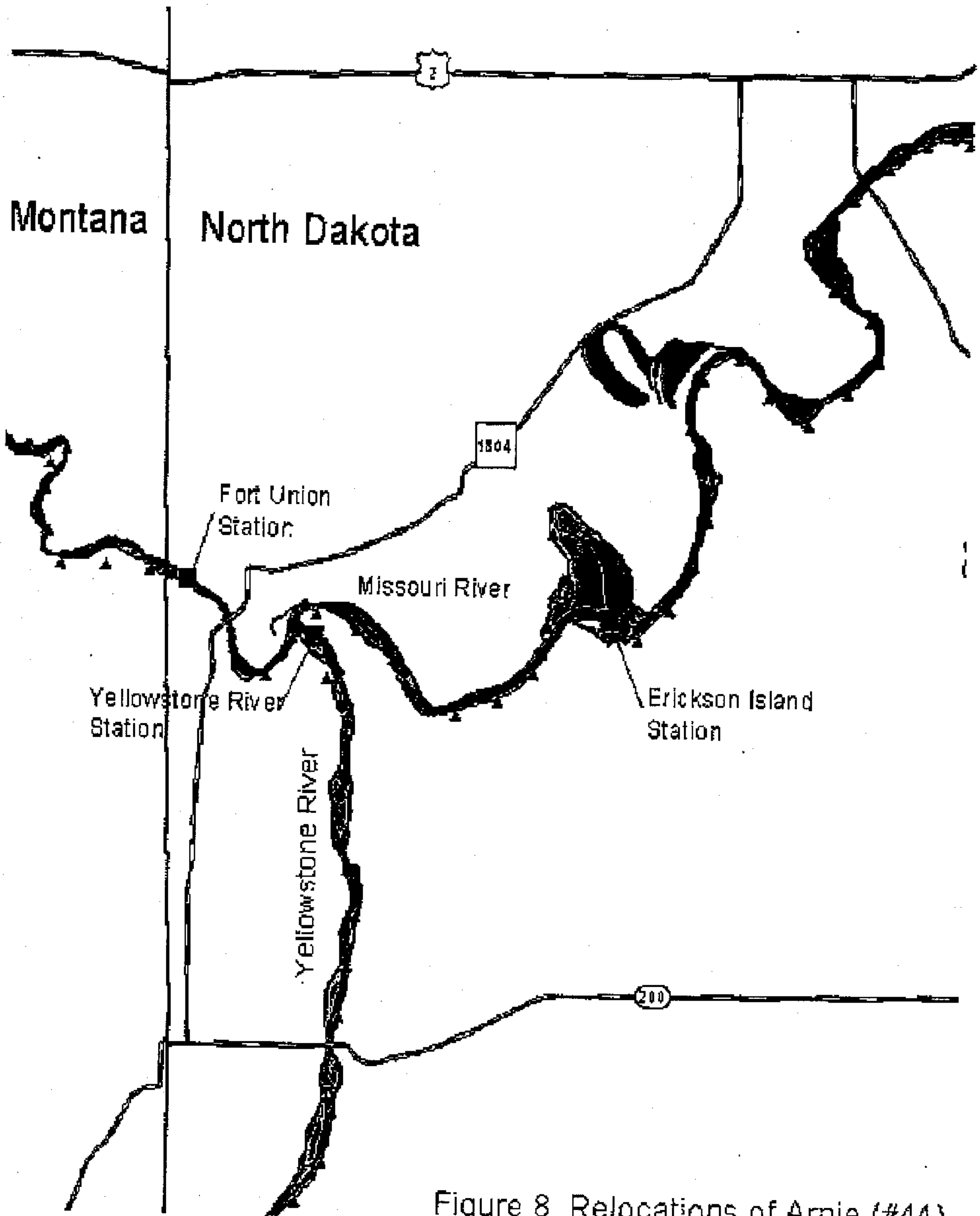

Figure 8. Relocations of Arnie (#44)

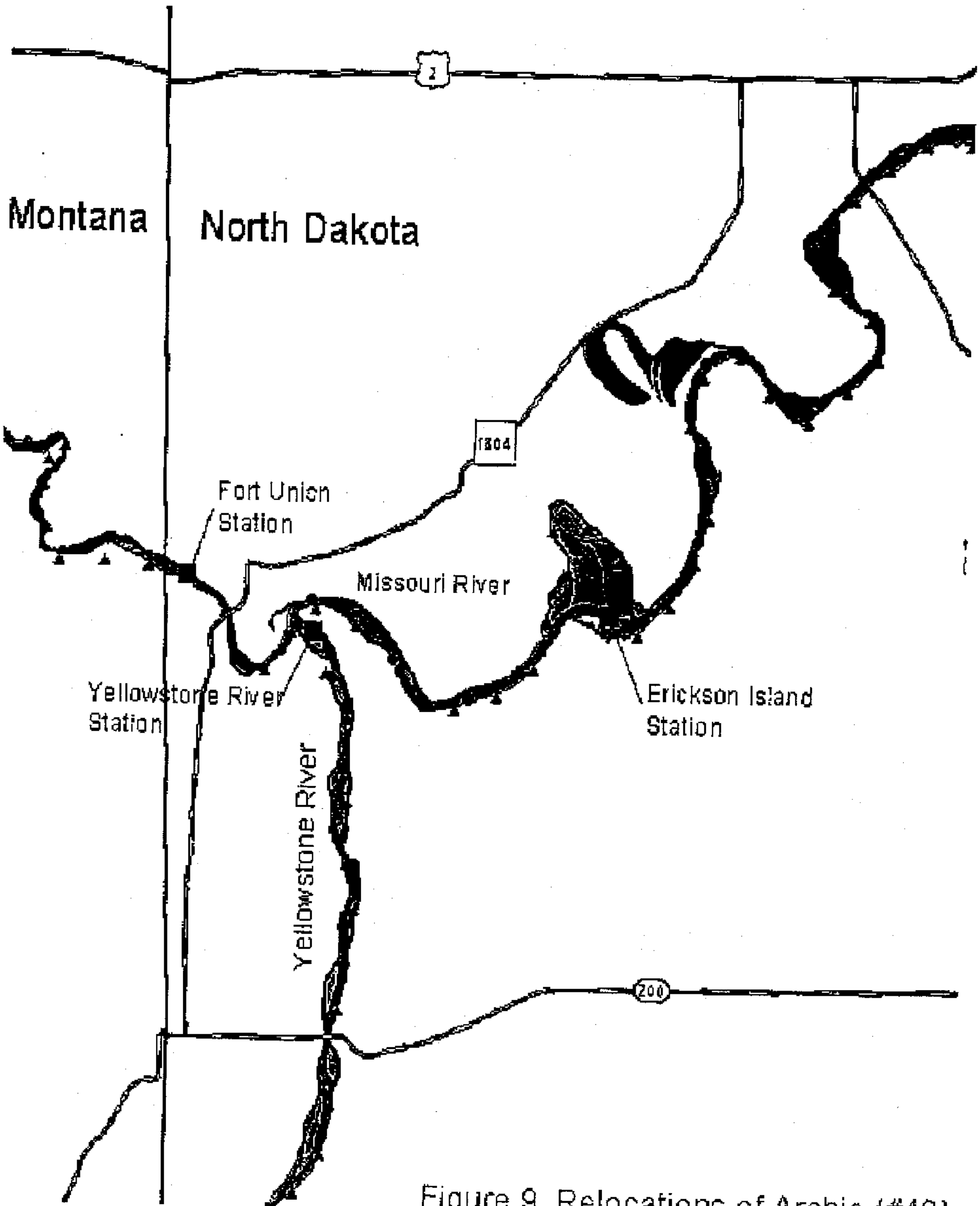

Figure 9. Relocations of Archie (#46)

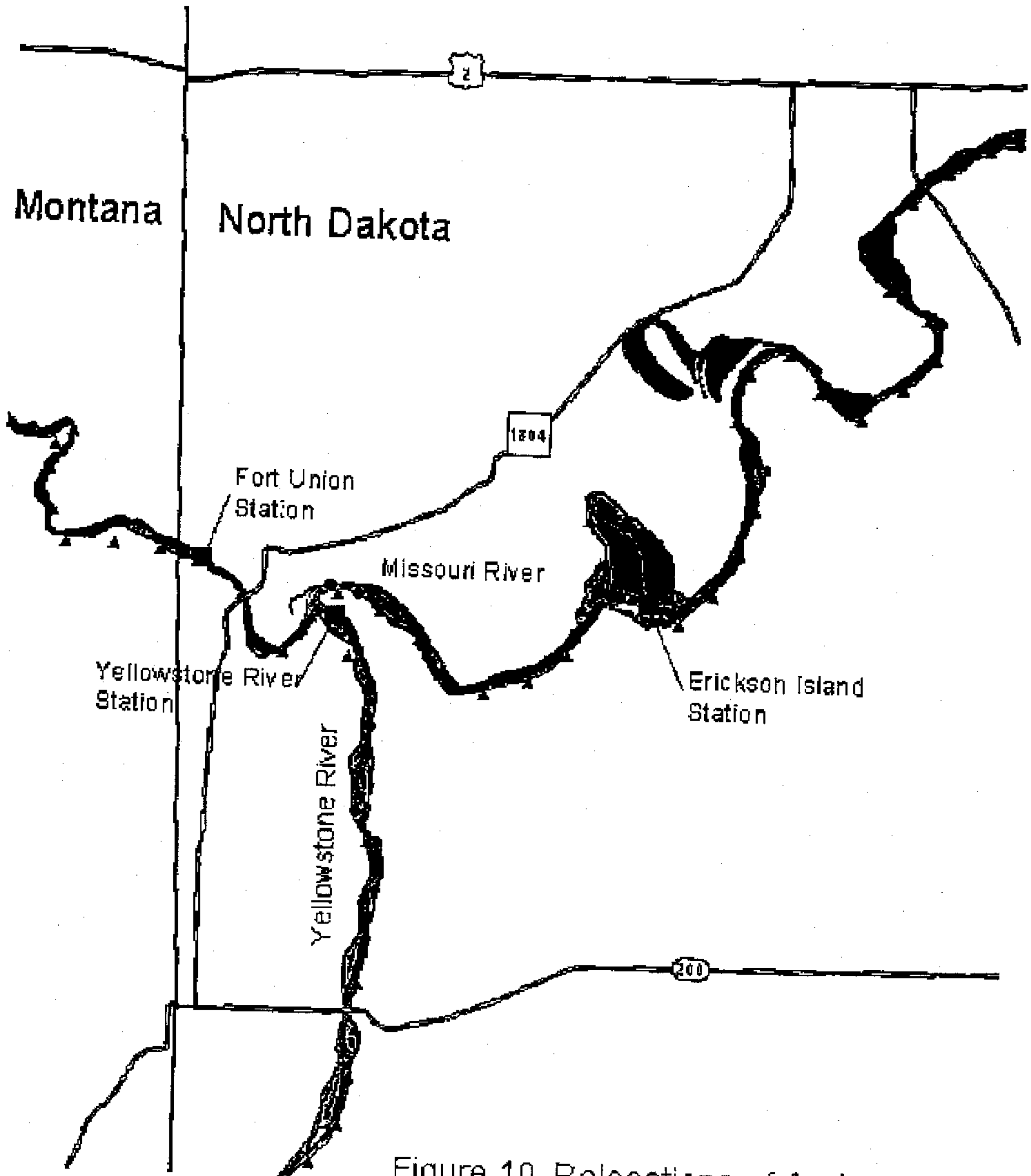

Figure 10. Relocations of Andrew (#50)

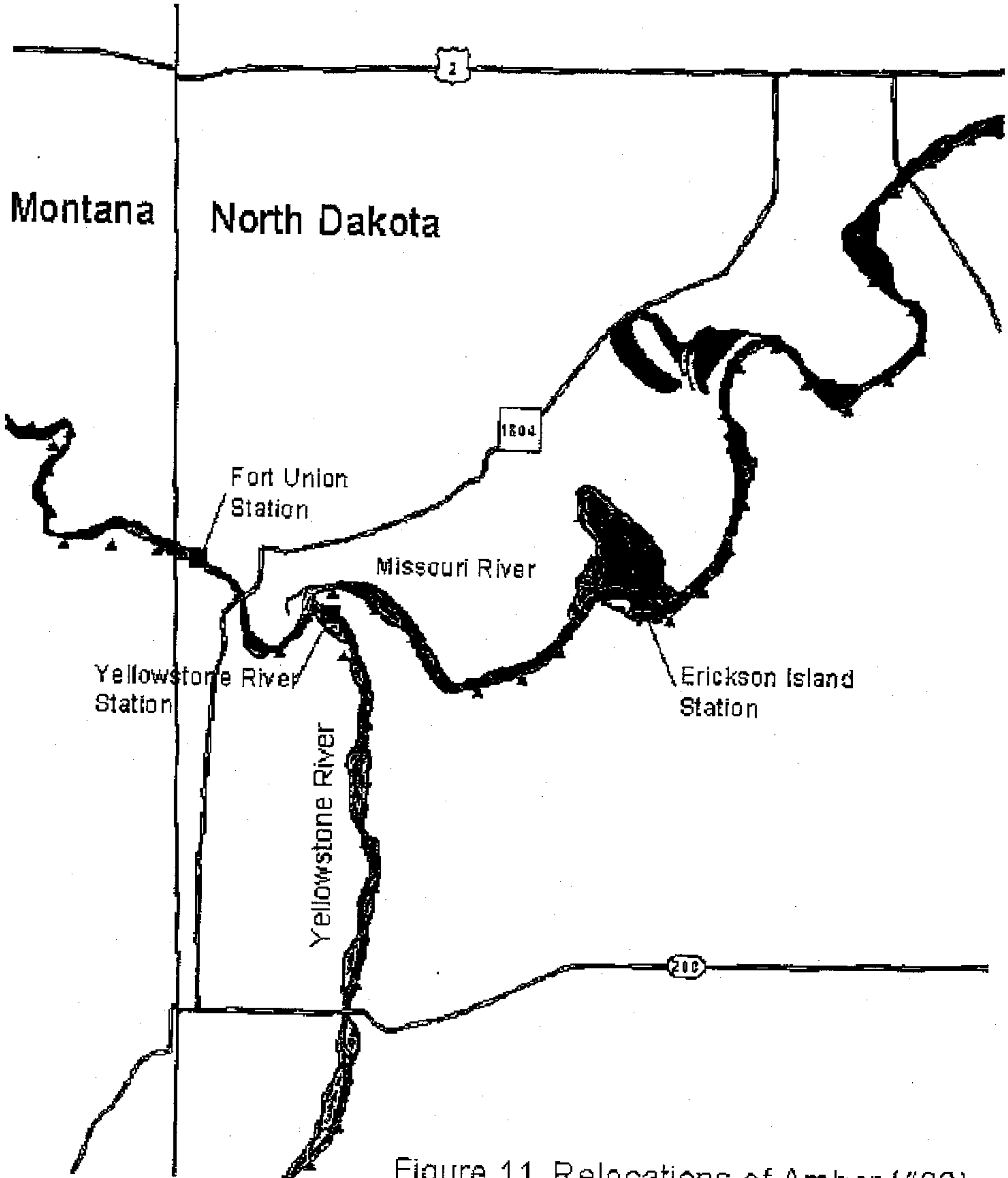

Figure 11. Relocations of Amber (#62)

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Fort Peck Flow Modification Biological Data Collection Plan

Summary of 2001 Activities

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U. S. Army Corps of Engineers
Contract Number 00-UGPR-34

Abstract

The Missouri River Biological Opinion developed by the U. S. Fish and Wildlife Service formally identified that seasonally atypical discharge and water temperature regimes resulting from operations of Fort Peck Dam have precluded successful spawning and recruitment of pallid sturgeon *Scaphirhynchus albus* in the Missouri River below Fort Peck Dam. In response, the U. S. Army Corps of Engineers (USACE) proposes to modify operations of Fort Peck Dam to enhance environmental conditions for spawning and recruitment of pallid sturgeon. In 2001, the Fort Peck Flow Modification Biological Data Collection Plan (hereafter Fort Peck Data Collection Plan) was implemented to evaluate the influence of proposed flow and temperature modifications on physical habitat and biological response of pallid sturgeon and other native fishes. The 4-year Fort Peck Data Collection Plan is comprised of five monitoring components: 1) measuring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements by pallid sturgeon that inhabit areas immediately downstream from Fort Peck Dam, 3) examining flow- and temperature-related movements of paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus*, 4) quantifying larval fish distribution and abundance, and 5) examining food habits of piscivorous fishes. The Fort Peck Data Collection Plan is supported by the USACE, and implemented by the Montana Department of Fish, Wildlife, and Parks (MTFWP) and the U. S. Geological Survey Columbia Environmental Research Center. Proposed flow modifications were not implemented in 2001 due to inadequate precipitation and insufficient reservoir levels.

Monitoring data collected in 2001 were representative of moderately low flow conditions. Continuous-recording water temperature loggers positioned at 17 locations provided baseline water temperature profiles to which changes in water temperatures resulting from modified dam operations could be compared. For example, in the absence of modified dam operations, mean water temperature between mid-May and mid-October was 6.3°C cooler at Frazer Rapids (mean = 13.8°C) downstream from Fort Peck Dam than in the free-flowing Missouri River upstream from Fort Peck Dam (mean = 20.1°C). Turbidity increased longitudinally downstream from Fort Peck Dam, and generally increased during periods of elevated discharge. No pallid sturgeon were found or implanted with radio transmitters. Sixteen blue suckers, 19 paddlefish, and 29 shovelnose sturgeon were surgically implanted with radio/acoustic transmitters during September. These individuals will be intensively tracked beginning in April 2002 to examine discharge and temperature-related movement patterns. A total of 10,744 larvae fishes were sampled at six sites on the mainstem Missouri River and adjacent habitats. Larval sturgeon (*Scaphirhynchus* sp.) were sampled at Wolf Point (N = 6), Nohly (N = 10), and in the Yellowstone River (N = 8). Larval catostomids (suckers) were the dominant taxon sampled, and comprised 40-90% of the larval fishes sampled at all sites; however, taxa composition varied significantly among sites. Food habit data for burbot *Lota lota*, channel catfish *Ictalurus punctatus*, freshwater drum *Aplodinotus grunniens*, goldeye *Hiodon alosoides*, northern pike *Esox lucius*, sauger *Stizostedion canadense*, shovelnose sturgeon, and walleye *Stizostedion vitreum* were obtained during July and August 2001. Although each species exhibited piscivory, there was no evidence that sturgeon larvae or juveniles were consumed. In addition to field results, analyses and results of precision and accuracy of water temperature loggers deployed during 2001 are presented.

Introduction

The pallid sturgeon *Scaphirhynchus albus* is a long-lived (> 40 years; Keenlyne and Jenkins 1993) species endemic to the Missouri River, lower Mississippi River, and large tributaries entering these river systems (Bailey and Cross 1954). Extensive habitat alterations throughout the geographical range of pallid sturgeon have negatively impacted populations. As a consequence, pallid sturgeon were designated as an endangered species in 1990 (Dryer and Sandvol 1993).

One of the few remaining concentrations of pallid sturgeon occurs in the upper Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea, North Dakota. Individuals in this population also inhabit the lower Yellowstone River in Montana and North Dakota (Bramblett and White 2001). Similar to pallid sturgeon in other regions, long-term viability of the pallid sturgeon population in the Missouri River downstream from Fort Peck Dam is in jeopardy. It is hypothesized that regulated flows from Fort Peck Dam coupled with a suppressed water temperature regime during the spring and early summer spawning period have failed to provide adequate spawning cues for pallid sturgeon. In addition, cold water releases from Fort Peck Dam have limited the amount of riverine habitat suitable for spawning. As a consequence, natural reproduction and recruitment of pallid sturgeon have not occurred for several years as evidenced by a population comprised of large (e.g., > 1200 mm; > 8 kg; Liebelt 1996, 1998) and presumably old individuals.

The U.S. Army Corps of Engineers (USACE) proposes to modify operations of Fort Peck Dam following specifications outlined in the Missouri River Biological Opinion (U.S. Fish and Wildlife Service 2000). Modified dam operations are proposed to increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon and other native fishes. In contrast to "normal" cold water releases through Fort Peck Dam, water from Fort Peck Reservoir will be released over the spillway during flow modifications to enhance water temperature conditions. The USACE proposes to conduct a mini-test of the flow modification plan to evaluate structural integrity of the spillway and other engineering concerns. A full-test of the flow modifications will occur when a maximum of 19,000 cfs will be routed through the spillway. Spillway releases will be accompanied by an additional 4,000 cfs released through the dam. Pending results from the full-test, modified flow releases from Fort Peck Dam in subsequent years will be implemented in an adaptive management framework. All proposed flows are dependent on adequate inflows to Fort Peck Reservoir and adequate water levels in the reservoir.

The original schedule of events for conducting the flow modifications called for conducting the mini-test during 2001 and conducting the full-test in 2002. However, insufficient water levels in Fort Peck Reservoir during spring 2001 and 2002 precluded conducting the mini-test and full-test. Thus, pending favorable precipitation and adequate reservoir water levels in early Spring 2003, the mini-test may be conducted in 2003 and the full-test conducted in 2004.

The Fort Peck Flow Modification Biological Data Collection Plan (hereafter referred to as the Fort Peck Data Collection Plan) is a monitoring program designed to examine the influence of proposed flow modifications from Fort Peck Dam on physical habitat and biological response of pallid sturgeon and other native fishes. Components of the monitoring program include: 1) measuring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements by pallid sturgeon that inhabit areas immediately downstream from Fort Peck Dam, 3) examining flow- and temperature-related movements of paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus*, 4) quantifying larval fish distribution and abundance, and 5) examining food habits of piscivorous fishes. The Fort Peck Data Collection Plan is supported by the USACE, and implemented by the Montana Department of Fish, Wildlife, and Parks (MTFWP) and the U. S. Geological Survey Columbia Environmental Research Center – Fort Peck Project Office. Western Area Power Administration serves as the contractual liaison between the USACE and MTFWP.

Study Area

The study area encompasses the Missouri River between river kilometer (rkm) 2,850 (river mile, RM 1,770) at Fort Peck Dam and rkm 2,523 (RM 1,567) downstream from the Yellowstone River confluence (Figure 1). The study area also includes the lower 5 km (3 miles) of the Yellowstone River (Figure 1). See Gardner and Stewart (1987), White and Bramblett (1993), Tews (1994), and Bramblett and White (2001) for a complete description of physical and hydrological characteristics of the study area.

Methods

Monitoring Component 1 - Water temperature and turbidity.

Water temperature logger deployment. Water temperature loggers (Optic StowAway, -5°C – +37°C, 4 min response time, accuracy $\pm$ 0.2°C from 0 - 21°C) were deployed during late April and early May at 17 sites in the Missouri River, Yellowstone River, selected tributaries, and off-channel areas (Table 1). Duplicate loggers were placed near the left and right bank (as viewed looking upstream) at most mainstem Missouri River sites to assess lateral variations in water temperature. Water temperature loggers were positioned near the bottom of the river channel. At two locations (Nickels Ferry, Frazer Pump), additional loggers were stratified in the water column. Water temperature loggers were programmed to record water temperature at 1-hr intervals, and periodically downloaded during the deployment period.

Statistical analysis of water temperature. Paired t-tests were used to compare mean daily water temperature between left and right bank locations at sites where duplicate loggers were deployed. Analysis of variance was used to compare mean daily water temperature among all logger locations.

Assessment of water temperature logger precision and accuracy. Following retrievel from the field, all water temperature loggers (except the logger deployed at Robinson Bridge) were subjected to a series of 11 common water bath treatments to evaluate precision and accuracy among loggers (Table 2). During water bath treatments, water temperature was also measured with a YSI Model 85 meter (accuracy $\pm$ 0.1°C) and a hand-held alcohol thermometer (accuracy $\pm$ 1.0°C) at specific times. Thus, the YSI meter and alcohol thermometer provided two independent methods of measuring the "true" water temperature of the water baths. The same YSI meter and alcohol thermometer were used in all field activities during 2001. All loggers did not record water temperature at the exact time temperature was measured with the YSI or alcohol thermometer; therefore, either a single temperature recorded within about 15 minutes of the actual measurement time was used or two temperatures spanning the actual measurement time period were averaged. In addition to post-deployment comparisons involving water bath

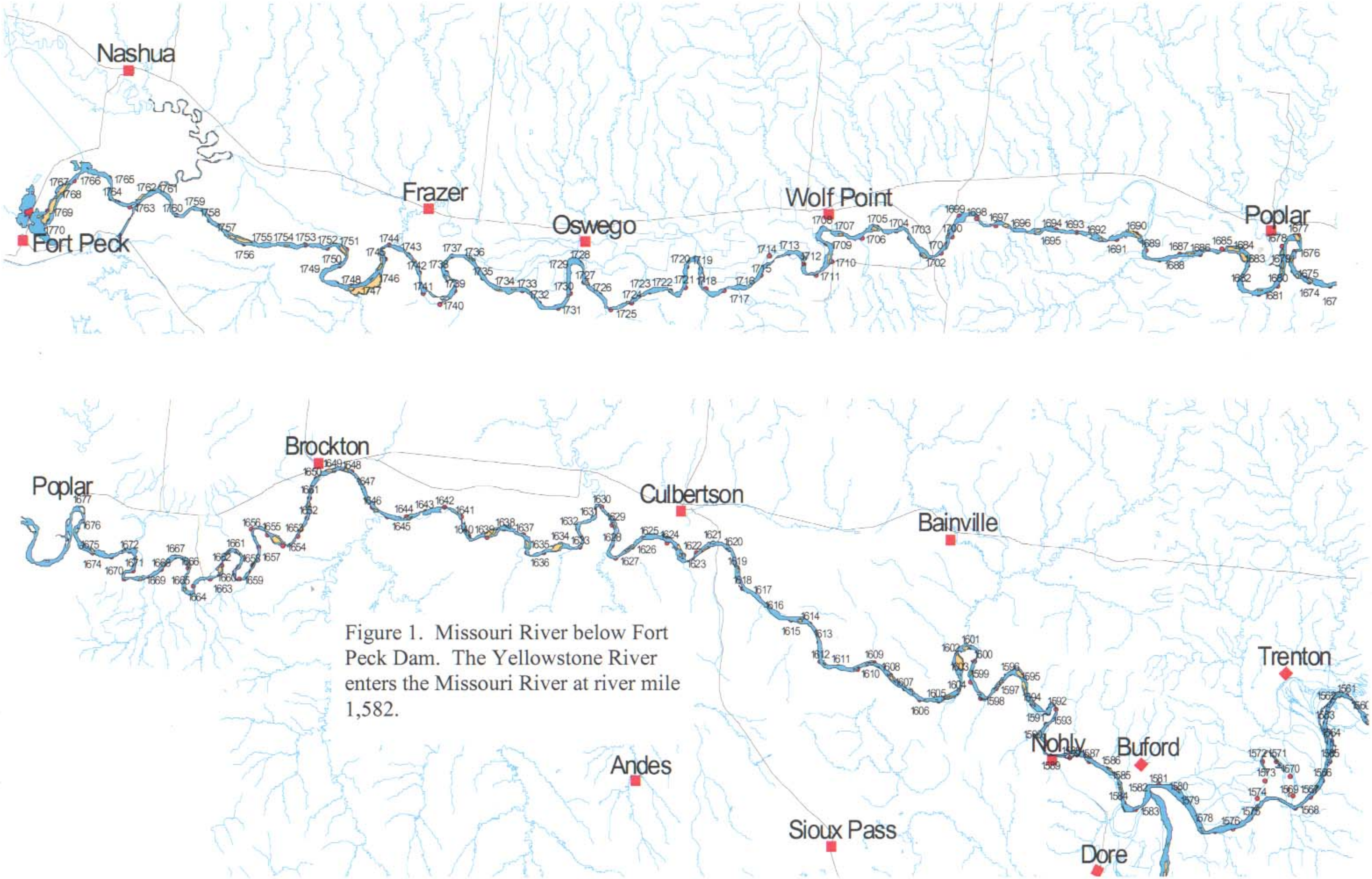

Figure 1. Missouri River below Fort Peck Dam. The Yellowstone River enters the Missouri River at river mile 1,582.

Table 1. Sites, approximate river mile (RM; distance upstream from the Missouri River-Mississippi River confluence or distance upstream in a specified tributary), latitude (° North), longitude (° west), bank locations (left or right when looking upstream; strat = stratified in the water column), serial numbers, and dates of deployment for water temperature loggers deployed in the Missouri River and adjacent areas during 2001.

Site	RM	Latitude	Longitude	Bank location	Logger serial no.	Deploy date	Retrieval date
Above Fort Peck Lake (Robinson Bridge)	1,921.2	47 37.51	108 41.13	left		4/13/01	10/09/01
Downstream from Fort Peck Dam	1,765.2	48 03.345	106 21.874	right	389503	4/30/01	11/13/01
				left	389561		
Spillway		48 02.395	106 20.457	right	389574	4/30/01	11/13/01
Milk River	4.0	48 04.016	106 18.182	left	389560	4/30/01	11/13/01
Nickels Rapids	1,757.5	48 02.068	106 14.902	right	389563	5/2/01	11/13/01
		48 02.008	106 15.110	left	389571		
Nickels Ferry	1,759.9	48 02.662	106 17.300	right	389495	4/30/01	11/13/01
		44 02.390	106 17.448	left	389504		
		48 02.662	106 17.300	strat	394819		
Frazer Pump	1,751.5	48 01.897	106 07.547	right	389565	5/2/01	11/13/01
		48 01.800	106 07.522	left	389489		
				strat	389556	5/17/01	
Frazer Rapids	1,746.0	48 00.405	106 06.595	right	389501	5/2/01	11/13/01
		48 00.453	106 05.989	left	389490		
Grand Champs	1,741.5	48 00.300	106 01.873	right	389479	5/2/01	11/13/01
		48 00.215	106 01.855	left	389575		
Wolf Point	1,701.5	48 04.539	105 31.479	right	389500	5/3/01	11/14/01
		48 04.779	105 31.202	left	389493		
Redwater River	0.1	48 03.665	105 12.653	mid-channel	389502	5/3/01	11/15/01
Poplar	1,680	48 03.968	105 12.425	right	389558	5/3/01	11/15/01
		48 03.957	105 12.127	left	389491		
Poplar River	0.4	48 05.029	105 11.696	left	389488	5/3/01	11/15/01
Culbertson	1,620.9	48 07.471	104 28.433	right	389567	5/8/01	11/16/01
		104 28.59	104 28.590	left	389572		
Nohly	1,591.2	48 01.126	104 06.012	right	389498	4/19/01	11/16/01
		48 00.838	104 06.441	left	389496		
Yellowstone River	3.5	47 56.082	103 57.725	right	389562	5/8/01	11/16/01
Below Yellowstone River	1,576.5	47 57.650	103 53.751	right	389564	4/26/01	11/16/01
		48 57.511	103 53.835	left	389566		

Table 2. Post-deployment protocols for evaluating precision and accuracy of water temperature loggers.

Sample	Date	Procedure	Temperature recording time
1	11/19/01	Logger put in water bath at 1550	1550
2	11/20/01	Same water bath as sample 1 – room temperature	0820
3	11/20/01	Same water bath as sample 2 – room temperature	0900
4	11/20/01	Same water bath as sample 3 – room temperature	2100
5	11/21/01	Same water bath as sample 4 – room temperature	0900
6	11/21/01	Same water bath as sample 5 – room temperature	1400
7	11/21/01	Same water bath as sample 6 – room temperature	1600
8	11/23/01	Water bath moved outdoors at 1030	1200
9	11/23/01	Same water bath as sample 8	1300
10	11/26/01	Water bath moved outdoors at 0830	1000
11	11/26/01	Water bath from sample 10 brought indoors at 1000	1100

treatments, water temperature measured with the YSI Model 85 meter during the course of larval fish sampling (late May through July, see below) provided an additional data set to which accuracy and precision of the loggers could be evaluated. Larval fish sampling sites were generally within 1.6-3.2 km (1-2 miles) of a water temperature logger. Similar to water bath trials, either a single time-specific temperature recording from the logger or two recordings (averaged) corresponding to time-specific temperature measurements obtained while larval fish sampling were used. Water temperature at the larval fish sampling sites was measured in the upper 1-m of the water column.

Statistical analysis of water temperature logger precision and accuracy. A suite of analysis was used to evaluate precision and accuracy of water temperature loggers. First, water temperature between the YSI and alcohol thermometer was compared with paired t-tests for the water bath trials. Second, water temperature precision of loggers for each water bath treatment was evaluated with univariate statistics (mean, standard deviation, minimum, maximum, and range) computed over all loggers. The mean, minimum, maximum, and range were screened for precision. If precision was low (e.g., broad range of temperature for an individual water bath trial), logger data were scrutinized to determine which logger(s) was contributing to the extreme values. After identifying and deleting the "suspect" logger(s), univarite statistics were computed again to assess precision. Third, paired t-tests were used to compare mean water temperature between the YSI and logger at larval fish sampling stations.

Field measurements of turbidity. Turbidity (nephelometric turbidity units; NTU) was measured during the larval fish sampling period (see below) using a Hach Model 2100P portable turbidimeter (serial number 950500007962, measurement range 0 – 1000 NTU, accuracy $\pm$ 2%). During August and September, continuous-recording turbidity data loggers (Hydrolab Datasonde 4a, serial numbers 39046, 39047, 39048, measurement range 0 – 1000 NTU, accuracy $\pm$ 2%) were deployed at three sites. Sites were located in the Missouri River at Frazer Rapids (rkm 2,811; RM 1,746), near Nohly (rkm 2,558; RM 1589), and in the Yellowstone River 0.81 km (0.5 miles) upstream from the confluence. Turbidity data loggers were programmed to record turbidity at 1-hr intervals.

Monitoring Component 2 – Movements by pallid sturgeon.

Diving in areas immediately downstream from Fort Peck Dam was conducted periodically during a 6-week period in February and March 2001. Pallid sturgeon collected were to be implanted with transmitters and tracked during spring and summer 2001.

Monitoring Component 3 - Movements of paddlefish, blue suckers, and shovelnose sturgeon.

Sampling for paddlefish, blue suckers, and shovelnose sturgeon for transmitter implantation was initiated in September 2001 and completed in early October. Species were sampled using drifted trammel nets, hoop nets (primarily targeting blue suckers), and surface-drifted gill nets (primarily targeting paddlefish). A minimum of 20 suitable-sized individuals of each species were targeted for transmitter implantation. Our goal was to extend flow- and temperature-related movement inferences to all areas of the Missouri River below Fort Peck Dam and Lake Sakakawea. Therefore, species were collected in several areas between rkm 2,842 (RM 1,765) and rkm 2,523 (RM 1,567; Figure 1).

Transmitters varied in type and spanned a range of size, longevity, and frequency to accommodate differences in fish size among species and study objectives (Table 3). All species were implanted with combined acoustic/radio tags (CART) tags. Estimated life expectancy of the CART tags varied from about 1,049 days to 4,725 days to accommodate multiple spawning episodes. In addition to the CART tags, two types of radio transmitters were used on an experimental basis for blue suckers and shovelnose sturgeon. All transmitters were pre-programmed with unique codes to facilitate identification of individual fish (Table 3).

Table 3. Transmitter specifications and target species (BUSK = blue sucker, SNSG = shovelnose sturgeon, PDFH = paddlefish). Frequency-specific transmitter codes are as follows: CART 16-2S (2, 6, 8, 10, 14, 17, 18, 22, 25, 26, 30, 34, 38, 43, 44, 46, 50, 56, 62, 69, 70, 73, 74, 82, 86, 93, 94, 96, 98, 106, 110, 116, 119, 120, 128, 132, 143, 144, 145, 146); CART 32-1S (3, 4, 5, 7, 9, 11, 12, 13, 15, 16, 19, 20, 21, 69, 82, 93, 106, 119, 132, 145); MCFT-3A (1, 3, 4, 5, 7); MCFT-7A (9, 11, 12, 13, 15).

Lotek transmitter type and model	Radio frequency	Acoustic frequency	Longevity (days)	Weight Water (g)	Weight Air (g)	Target species
CART 16-2S	149.62	76.8	1,049	18.0	31.5	BUSK, SNSG
CART 32-1S	149.76	65.5	4,725	61.0	114	PDFH
MCFT-3A	149.62		1,139	6.7	16.0	BUSK, SNSG
MCFT-7A	149.62		494	12.8	29.0	BUSK, SNSG

Surgical implantation of transmitters was conducted after 1-6 individuals were captured at a sampling location. After being sampled, fish were placed in streamside live cars. Individuals were placed in a partially submerged V-shaped trough during surgical implantation of transmitters, and water was continually flushed water over the gills using a bilge pump apparatus. After making an abdominal incision about midway between the pectoral fin and pelvic fin, a shielded needle technique (Ross and Kleiner 1982) was used to extrude the transmitter antennae through the body cavity. The transmitter was then inserted into the body cavity, and the incision was closed with silk sutures. Most blue suckers and shovelnose sturgeon were held overnight in streamside live cars, and released the following morning. A 5-10 minute period of facilitated acclimation following surgical procedures was used to stabilize paddlefish prior to release. Water temperature during the surgical implantation period was 13.5°C to 17.1°C.

Monitoring Component 4 – Larval Fish

Sampling protocols. Larval fish were sampled at about 3-4 day intervals from late May through July at six sites (Table 4). Sites on the mainstem Missouri River were located just downstream from Fort Peck Dam, near Wolf Point, and near Nohly. Sites located off the mainstem Missouri River included the spillway channel, the Milk River, and the Yellowstone River. Due to the lack of spillway releases during 2001, the spillway channel was narrow and consisted of two lentic pools connected to the mainstem Missouri River at the lowermost pool. Larval fish at all sites were sampled with 0.5-m-diameter nets (750 μm mesh) fitted with a General Oceanics Model 2030R velocity meter.

Table 4. Larval fish sampling locations, number of replicates, samples, and net locations for 2001. Abbreviations for net location are as follows: B = bottom, M = mid-water column, S = surface (0.5 - 1.0 m below the surface).

Site	Approximate river mile	Replicates	Samples per replicate	Net location
Missouri River below Fort Peck Dam	1,763.5-1,765.3	2	4	B/M
Spillway	1,762.8	2	4	S
Milk River	0.5-4.0	3	4	S
Missouri River near Wolf Point	1,701.0-1,708.0	3	4	B/M
Missouri River near Nohly	1,582.5-1,590.2	3	4	B/M
Yellowstone River	0.1-3.0	3	4	B/M

Specific larval fish sampling protocols varied among sites and were dependent on site characteristics (Table 4). Two to three replicates were collected at the sites, where one replicate was comprised of four subsamples (two subsamples simultaneously collected on the right and left side of the boat at sampling locations near the left and right shorelines). At all sites except the spillway site, the left and right sampling locations corresponded to inside bend and outside bend locations at the mid-point of a river bend. The spillway channel had minimal sinuosity; therefore, samples did not reflect inside and outside bend locations. Only two replicates were available in the spillway channel (one replicate in both of the spillway channel pools). Similarly, only two well-defined bends were available for sampling at the site just downstream from Fort Peck Dam. The full compliment of three replicates was available at the other sites. At sites exclusive of the spillway and Milk River, paired subsamples near the left and right bank locations were comprised of one net fished on the bottom and one net fished in the middle of the water column. Thus, each replicate was comprised of two bottom subsamples and two mid-water column subsamples. Nets were maintained at the target sampling location by affixing a 9.1 kg (bottom sample) and 4.5 kg (mid-water column sample) lead weight to the net. Larval nets were fished for a maximum of 15 minutes (depending on detrital loads). The boat was anchored during net deployment (e.g., "passive" sampling). In the Milk River and spillway channel, irregular bottom contours, shallow depths, and silt substrates were not conducive to bottom sampling. In addition, minimal current velocity in these two locations required an "active" larval fish sampling approach. Therefore, larval fish in the Milk River and spillway channel were sampled in the upper 1-m of the water column as the boat was powered upstream for a maximum of 15 min. Larval fish samples were placed in a 5-10% formalin solution containing phloxine-B dye and stored.

Larval fish were sampled at the same replicate and subsample locations throughout the sampling period except when changes in discharge necessitated minor adjustments in the sampling location. For example, an attempt was made to sample larval fish at total water column depths between 1.5 m and 3.0 m. This protocol was used to minimize variations in larval fish density associated with vertical stratification of larvae in the water column. When river discharge decreased (or increased), water depth in a previously sampled location exceeded the required range. Therefore, the specific sampling location changed but was always near ($\pm$ 300 m) the general vicinity of the earlier samples.

Laboratory methods. Larval fish were extracted from samples and placed in vials containing 70% alcohol. Larvae were identified to family when possible and enumerated. Individuals tentatively identified to Polyodontidae and Acipenseridae were sent to Dr. Darrel Snyder (Larval Fish Laboratory, Colorado State University) for species identification and confirmation.

Monitoring Component 5 – Food habits of piscivorous fishes

Potential piscivores including walleye *Stizostedion vitreum*, sauger *S. canadense*, northern pike *Esox lucius*, burbot *Lota lota*, goldeye *Hiodon alosoides*, channel catfish *Ictalurus punctatus*, freshwater drum *Aploninotus grunniens*, and shovelnose sturgeon were sampled in the Missouri River between Wolf Point and Nohly (Figure 1). Fishes were sampled during July and August in off-channel habitats (e.g., tributaries, tributary confluences, backwaters, side channels) and main channel habitats (e.g., outside bend shoreline and thalweg, inside bend shoreline and channel border, channel crossovers) using stationary gill nets, drifting trammel nets, hoop nets, and electrofishing. Gill nets and hoop nets were usually set in late afternoon or evening and checked the following morning, but in some instances both gear types were left in a location throughout the day and periodically checked. Fishes were identified, weighed (g), and measured (mm).

Stomach samples were obtained in one of two ways. First, the entire stomach was removed via dissection and placed in a 10% formalin solution for storage. In the case of large stomachs, a slit was made in the stomach wall to facilitate formalin seepage into the stomach. The second method of stomach sampling involved the use of gastric lavage. The lavage apparatus consisted of a 12-V bilge pump connected to plastic hose. With the bilge pump operating and the fish held in a slightly inverted position, the hose was inserted down the esophagus of the fish and into the fish stomach. Running water flushed contents of the stomach into a sieve held under the fish mouth and gills. Stomach contents were rinsed from the sieve into a 10% formalin solution and stored. The lavage was used on about 50% of the sauger sampled to minimize mortality because sauger are listed as a species of special concern in Montana.

In the laboratory, stomach contents were initially identified to Class. Diet organisms were subsequently identified to Order (for Insecta) and to species (for Osteichthyes) when possible. Diet items that could not be identified beyond Insecta and Osteichthyes were designated as unknown for the Class. Diet items were also classified as detritus (e.g., woody debris, algae) and miscellaneous (e.g., sand, rocks). Diet items were enumerated and weighed for the lowest taxon identified. Wet weights (0.1 g) were measured after the diet items were blotted on paper towels to remove excess water. Body fragments were used to enumerate organisms. For example, the presence of a head capsule or partial body fragment was treated as indicative of a whole organism. For Osteichthyes, fish scales, bones or the presence of other body parts was treated as indicative that a whole organism was ingested.

Food habits data were summarized by three indices. Frequency of occurrence (%) was calculated as the number of individuals containing the specific food item/number of stomachs containing food. Numerical frequency (%) was computed as the total number of taxon-specific food items/total number of all food items. Weight frequency (%) was computed as the total weight of a taxon-specific food item/total weight of all food items.

Results

Monitoring Component 1 - Water temperature and turbidity

General comments on water temperature loggers. At the time of logger retrieval, observations on logger characteristics that could influence accuracy of water temperature data were recorded. All water temperature loggers were retrieved in October and November 2001 except for the left bank logger (as delineated when looking upstream) located near Nohly (serial number 389496). This logger had been downloaded earlier during the deployment period; therefore, only a partial water temperature data set was available. However, the Nohly logger located on the right bank (serial number 389498) was retrieved and provided a complete data set for this site throughout the duration of the deployment period. The Culbertson logger located near the right bank (serial number 389567) was on shore when retrieved. The left bank logger at this site (serial number 389572) was retrieved, and provided a complete data set for the deployment period. An examination of data from the right bank logger suggested this logger had been pulled out of the water in early August. Therefore, data logged after early August is suspect.

Precision and accuracy of water temperature loggers. Precision of water temperature loggers varied among water bath sample treatment temperatures. At water bath sample treatment temperatures exceeding 20.0°C (as indicated by the YSI and alcohol thermometer), precision of all water temperature loggers was moderate as indicated by the moderate range (0.4 to 3.5°C) of water temperatures (Table 5). Precision of all water temperatures loggers declined at cooler water temperature treatments (e.g., < 15°C) as indicated by an increase in the range (7.4 – 12.6°C) of water temperatures (Table 5). The decrease in precision at cooler water temperatures suggested that one or more loggers was recording erroneous water temperatures. Further examination of individual loggers suggested that three loggers (Frazer Pump stratified, Serial Number 389556; Poplar River, Serial Number 389488; Redwater Creek, Serial Number 389502) exhibited extreme values at cool water bath treatment samples (e.g., < 15°C). Exclusion of these three loggers from the analysis increased precision (e.g., decreased the range, especially the maximum) of water temperature measurements primarily in the cool water bath treatment samples (Table 5). After "suspect" loggers were identified omitted from the comparisons, water temperature loggers had a relatively high level of precision (0.4 to 1.2 °C) at warmer water temperatures and a reduced level of precision at cooler temperatures (1.4 to 5.2°C).

Water temperatures measured with the YSI and alcohol thermometers (Table 5) provided a means to which accuracy of water temperature loggers could be evaluated. The maximum deviation in water temperature between the YSI and alcohol thermometer was 0.6°C, but there was no significant difference in water temperature between the two measurement instruments (t-test, t = 0.57, df = 6, P = 0.59). Thus, this result suggests the "true" water temperature of the

Table 5. Summary statistics for water temperature comparisons among YSI Model 85 meter (YSI), hand-held alcohol thermometer (Alcohol), and water temperature loggers in 11 water bath samples. The first set of summary statistics (mean; number of loggers, N; standard deviation, SD; minimum, maximum, range) for each water bath sample included all loggers. The second set of summary statistics for water temperature loggers excluded data from three loggers that exhibited extreme values.

			Water temperature loggers					
Sample	YSI (°C)	Alcohol (°C)	Mean (°C)	N	SD	Minimum	Maximum	Range
1	22.4	23.0	23.4	27	0.7	20.5	24.0	3.5
			23.4	24	0.3	22.8	24.0	1.2
2	20.3		20.2	27	0.2	20.0	21.0	1.0
			20.2	24	0.1	20.0	20.4	0.4
3	20.4	20.0	20.3	27	0.2	20.1	21.0	1.0
			20.2	24	0.1	20.1	20.5	0.4
4	20.7		20.6	27	0.1	20.4	20.9	0.5
			20.6	24	0.1	20.4	20.9	0.5
5	20.6	20.0	20.5	27	0.1	20.3	20.8	0.5
			20.5	24	0.1	20.3	20.8	0.5
6	20.8	21.0	20.8	27	0.1	20.6	21.0	0.4
			20.8	24	0.1	20.6	21.0	0.4
7	20.9		20.8	27	0.1	20.6	21.0	0.4
			20.8	24	0.1	20.6	21.0	0.4
8	13.3	13.0	14.9	27	2.1	13.2	20.6	7.4
			14.2	24	0.6	13.2	15.7	2.5
9	11.1		12.9	27	2.3	11.2	20.2	9.0
			12.1	24	0.3	11.2	12.6	1.4
10	7.5	7.0	9.7	26	3.1	7.5	20.1	12.6
			8.8	24	0.7	7.5	10.4	2.9
11	10.7	11.0	11.6	26	1.9	8.6	16.3	7.7
			11.2	24	1.5	8.6	13.8	5.2

water bath sample treatments was reasonably approximated with the YSI and alcohol thermometers. In water bath treatment comparisons between the YSI and loggers, the maximum deviation in temperature was 2.2°C, and there was a significant difference in water temperature (t-test, t = -2.35, df = 10, P = 0.04). However, deviations in water temperature between the YSI and loggers were minimal (0-1.0 °C) at warm water temperatures, but greater (0.9-2.2 °C at lower water temperatures. Omission of the three "suspect" loggers mentioned above resulted in a maximum deviation of 1.3°C, and there was no significant difference in temperature (t-test, t = -

2.15, df = 10, P = 0.06). Deviations in water temperature between the YSI and loggers were generally greater at lower than higher water temperatures.

Comparisons of date- and time-specific water temperatures measured at larval fish sampling stations to those recorded by water temperature loggers adjacent to larval fish sampling sites provided an additional means to evaluate accuracy of the water temperature loggers. Mean time-specific water temperature did not differ significantly at five of six sites (Table 6), and deviations in mean water temperature were minimal (0.1 - 1.5°C). There was a significant difference in water temperature between the water temperature logger and YSI meter at the site below Fort Peck Dam (Table 6). At this site, the difference in mean temperature was 1.8 °C.

Table 6. Summary statistics and t-tests for comparisons of water temperature recorded from loggers and YSI Model 85 meter (YSI) at six larval fish sampling sites.

Site	Method	Mean (°C)	N	SD	t-value	P-value
Missouri River below Fort Peck Dam	Logger	14.1	15	2.0	2.83	0.008
	YSI	12.3	15	1.3		
Milk River	Logger	20.9	17	3.5	0.94	0.357
	YSI	22.2	17	4.2		
Spillway	Logger	20.2	17	3.6	0.09	0.932
	YSI	20.3	17	3.1		
Missouri River near Wolf Point	Logger	18.0	16	4.2	0.78	0.442
	YSI	17.0	16	3.3		
Missouri River near Nohly	Logger	20.9	15	3.6	0.06	0.953
	YSI	20.8	15	3.2		
Yellowstone River	Logger	20.9	16	4.4	0.96	0.343
	YSI	22.4	16	3.9		

Lateral comparisons of water temperature. Water temperature did not differ significantly between right and left back locations at the nine locations where paired loggers were deployed (Table 7). Deviations between bank locations were small and varied from 0.1 °C to 0.9 °C.

Longitudinal water temperature patterns. Daily water temperature was averaged between left and right bank locations at nine sites where paired loggers were deployed due to the lack of significant differences in water temperature between bank locations (Table 7). Water temperature at the 13 Missouri River mainstem sites and 5 off-channel locations differed significantly among locations (ANOVA, F = 107.6, df = 17, 2610, P < 0.0001; Table 8, Figure 2). For the period spanning 5/17/01-10/09/01 (common deployment period for all loggers), mean daily water temperature for Missouri River mainstem sites was greatest (20.1°C) at the Robinson Bridge site located in the free-flowing reach of the Missouri River upstream from Fort Peck Lake. Mean daily water temperature was lowest at the site just downstream from Fort Peck Dam (13.0°C), but gradually increased to 18.9°C at Nohly (the most downstream Missouri River site upstream from the Yellowstone River). Daily water temperature at the Missouri River mainstem locations was most variable in the Missouri River below the Yellowstone River confluence (coefficient of variation, CV = 20.9) and least variable just downstream from Fort Peck Dam (CV = 11.6; Table 8). The USFWS (2001) mandated that a minimum water temperature of 18°C be established and maintained at Frazer Rapids (rkm 2,811; RM 1,746) via spillway releases. Mean daily water temperature did not reach 18°C at Frazer Rapids during 2001 (Figure 2).

Mean daily water temperature between 5/17/01-10/09/01 for off-channel locations was highest in the Yellowstone River (19.3 °C) and Poplar River (19.4 °C; Table 8). The Redwater River exhibited the highest variability in daily water temperatures (CV = 22.3) during the time interval.

Table 7. Summary statistics and t-tests for comparisons of water temperature between water temperature loggers located on opposite banks of the river (looking upstream) during 2001.

Site	Bank location	Dates	N	Mean (°C)	SD	t-value	P-value
Missouri River below Fort	Right	5/1-10/31	184	12.4	2.1	0.41	0.68
Peck Dam	Left	5/1-10/31	184	12.3	2.1		
Nickels Rapids	Right	5/2-10/31	183	12.9	2.3	1.43	0.15
	Left	5/2-10/31	183	12.5	2.2		
Frazer Pump	Right	5/3-10/31	182	13.2	2.6	1.56	0.11
	Left	5/3-10/31	182	12.8	2.4		
Frazer Rapids	Right	5/2-10/31	183	12.8	2.4	1.09	0.28
	Left	5/2-10/31	183	13.1	2.5		
Grand Champs	Right	5/2-10/31	183	13.3	2.7	0.52	0.61
	Left	5/2-10/31	183	13.5	2.7		
Wolf Point	Right	5/3-10/31	182	14.3	3.9	0.99	0.32
	Left	5/3-10/31	182	14.7	4.1		
Culbertson	Right	5/8-7/31	85	18.5	3.8	0.24	0.81
	Left	5/8-7/31	85	18.4	3.6		
Nohly	Right	5/1-6/22	53	14.7	2.1	1.51	0.13
	Left	5/1-6/22	53	15.3	2.1		
Below Yellowstone River	Right	5/1-10/31	184	17.1	5.3	1.60	0.11
	Left	5/1-10/31	184	18.0	5.7		

Table 8. Daily water temperature summary statistics (mean; standard deviation, SD; coefficient of variation, CV) for Missouri River mainstem locations and off-channel locations in 2001. Summary statistics for all sites were calculated for dates spanning 5/17/01-10/09/01 (N = 146) to standardize comparisons among all loggers. See Figure 2 for a graphical representation of daily water temperatures.

Location	Site	Mean (°C)	SD	CV
Missouri River mainstem	Robinson Bridge	20.1	3.7	18.4
	Below Fort Peck Dam	13.0	1.52	11.6
	Nickel Ferry (stratified)	13.4	1.82	13.6
	Nickels Rapids	13.5	1.68	12.5
	Frazer Pump (stratified)	13.8	1.76	12.8
	Frazer Rapids	13.8	1.84	13.3
	Frazer Pump	13.9	1.86	13.4
	Grand Champs	14.4	2.03	14.1
	Wolf Point	16.5	3.07	18.7
	Poplar	16.8	2.83	16.8
	Culbertson	17.9	3.46	19.3
	Nohly	18.9	3.76	20.0
	Below Yellowstone River	19.4	4.05	20.9
Off-channel or tributary	Spillway	18.4	3.04	16.6
	Milk River	19.1	3.76	19.6
	Redwater River	19.0	4.23	22.3
	Poplar River	19.4	3.86	19.9
	Yellowstone River	19.3	4.19	21.7

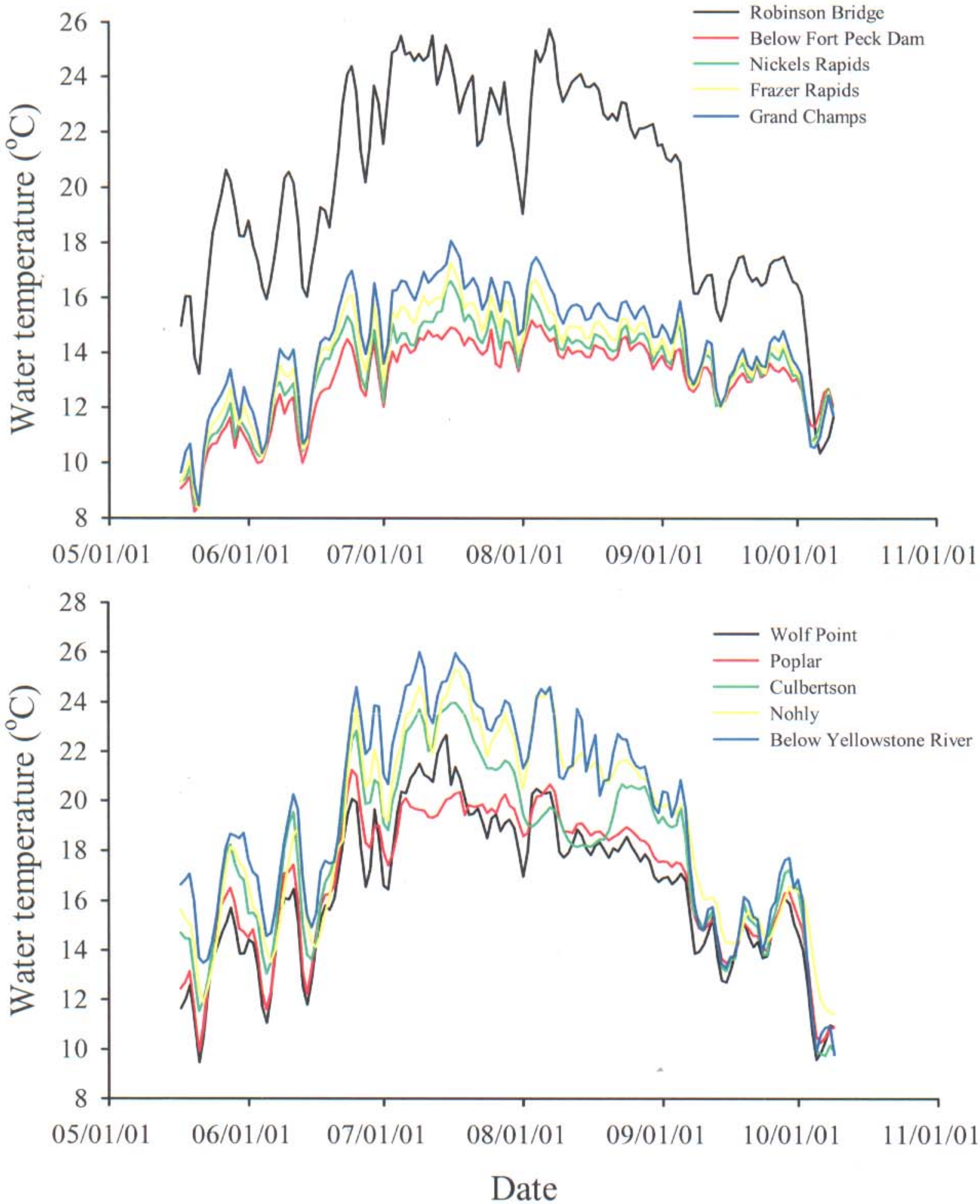

Figure 2. Mean daily water temperature (°C) at 10 sites on the mainstem Missouri River during 2001.

Field turbidity measurements. Turbidity during the late-May through July larval fish sampling period exceeded the maximum turbidity limit (1000 NTU) of the turbidity logger at four of six sites on specific dates (Figure 3, 4). Because water samples were not diluted to measurable values on all dates when turbidity exceeded 1000 NTU, values exceeding 1000 NTU were truncated to 1000 NTU. Lack of accurate turbidity for these time periods precluded statistical spatial and temporal comparisons; nonetheless, qualitative comparisons facilitate interpretation of spatial and temporal trends. Turbidity was lowest at the larval fish sampling station just downstream from Fort Peck Dam, and did not exceed 10 NTU (Figure 3). Turbidity was also low in the spillway channel, and varied between 11 NTU and 73 NTU. In the Milk River, turbidity exceeded 1000 NTU on three occasions and varied between 45 NTU and 833 NTU on other sampling dates. Turbidity at Wolf Point varied between 20 NTU and 550 NTU during most sampling intervals, but exceeded 1000 NTU on three sampling dates (Figure 4). At the larval fish sampling station near Nohly, turbidity exceeded 1000 NTU on one sampling date, but varied between 40 NTU and 844 NTU during the other sampling dates. Among all locations, turbidity was generally greatest in the Yellowstone River. Turbidity in the Yellowstone River exceeded 1000 NTU on five of the 17 sampling dates, and varied between 100 NTU and 817 NTU on the other 12 sampling dates.

Temporal variations in discharge had differential influences on turbidity among sites (Figure 3, 4). Discharge from Fort Peck Dam had little influence on turbidity at the site downstream from Fort Peck Dam. Conversely, turbidity tended to increase or decrease with increases or decreases in discharge in the Milk River, and at Wolf Point and Nohly. Relations between discharge and turbidity were less defined in the Yellowstone River where increases in turbidity were not always associated with an increase in discharge.

Turbidity loggers. Turbidity loggers deployed in late summer 2001 provided a continuous, short-term assessment of spatial and temporal variations in turbidity at two of three sites. The turbidity logger deployed at Frazer Rapids failed to record data; therefore, no data was available from this site. Mean daily turbidity near Nohly was relatively low (15 - 103 NTU) during the recording period (Figure 5). Turbidity at Nohly increased during early September concomitant with a 2,250 cfs decrease in discharge. Turbidity in the Yellowstone River was relatively stable (23-40 NTU) from mid-August to early September. An abrupt increase in Yellowstone River turbidity occurred between early- and mid-September as discharge increased from 1,270 cfs to 4,500 cfs. During this time period, turbidity exceeded 1000 NTU on six dates.

Precision and accuracy of turbidity loggers. Periodic measurements of turbidity near the Nohly turbidity logger during the course of this and other projects (Dave Yerk, Montana Department of Fish,Wildlife, and Parks, pers. comm.) facilitated an evaluation of turbidity logger performance. Eight field tubidity measurements (7 measurements on day 1 of logger deployment, 1 measurement immediately preceding logger retrieval) were compared to turbidity values recorded by the Nohly turbidity logger. There was no significant difference (t-test, $t = -0.35$, $P = 0.78$, $df = 7$) between field turbidity measurements (mean = 52.9 NTU, SD = 15.2, N = 8) and logger turbidity measurements (mean = 56.2 NTU, SD = 21.4, N = 8).

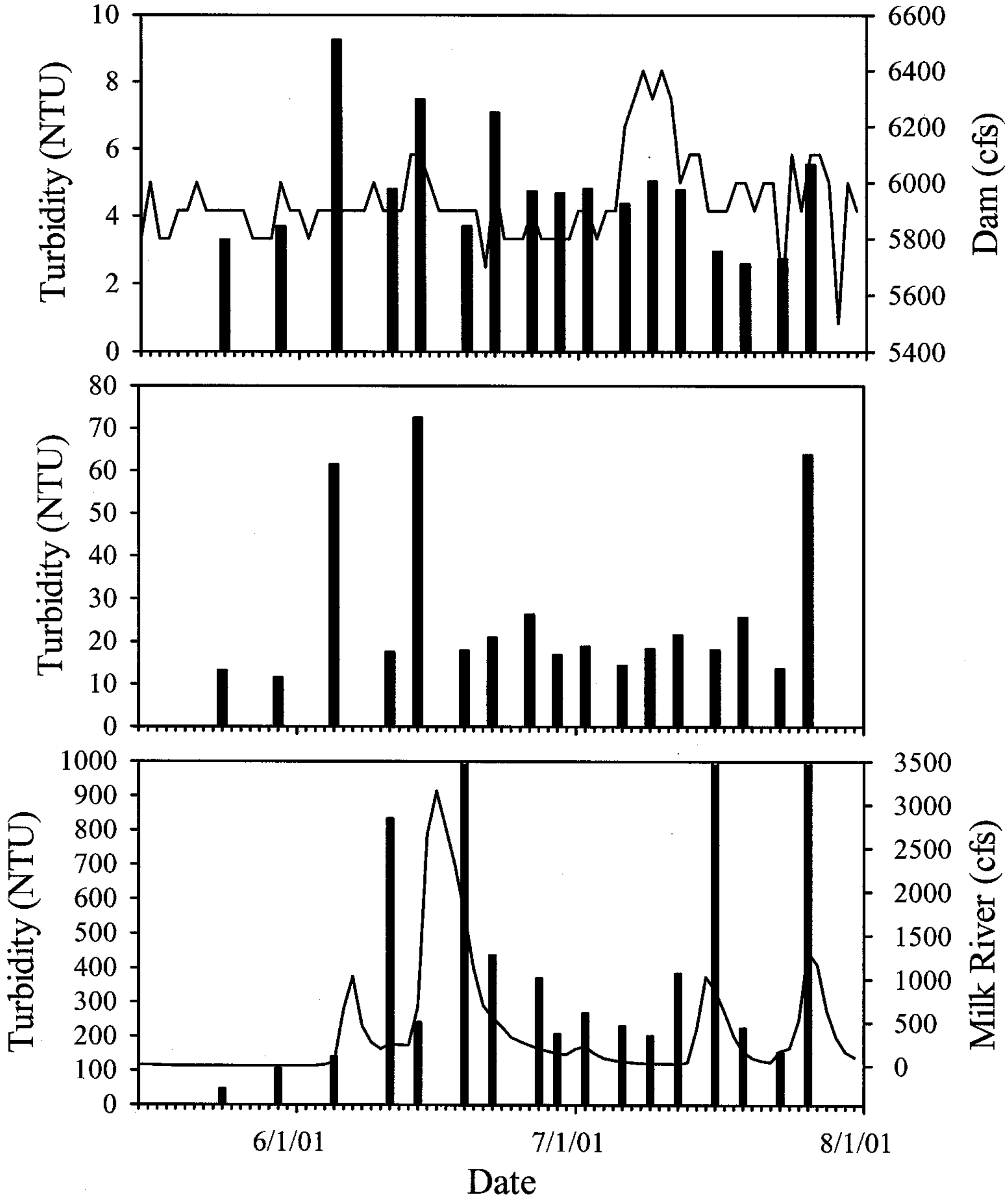

Figure 3. Turbidity (NTU; vertical bars) and discharge (cfs; solid line) at larval fish sampling sites located downstream from Fort Peck Dam (top panel), in the spillway channel (middle panel), and in the Milk River (lower panel) during 2001.

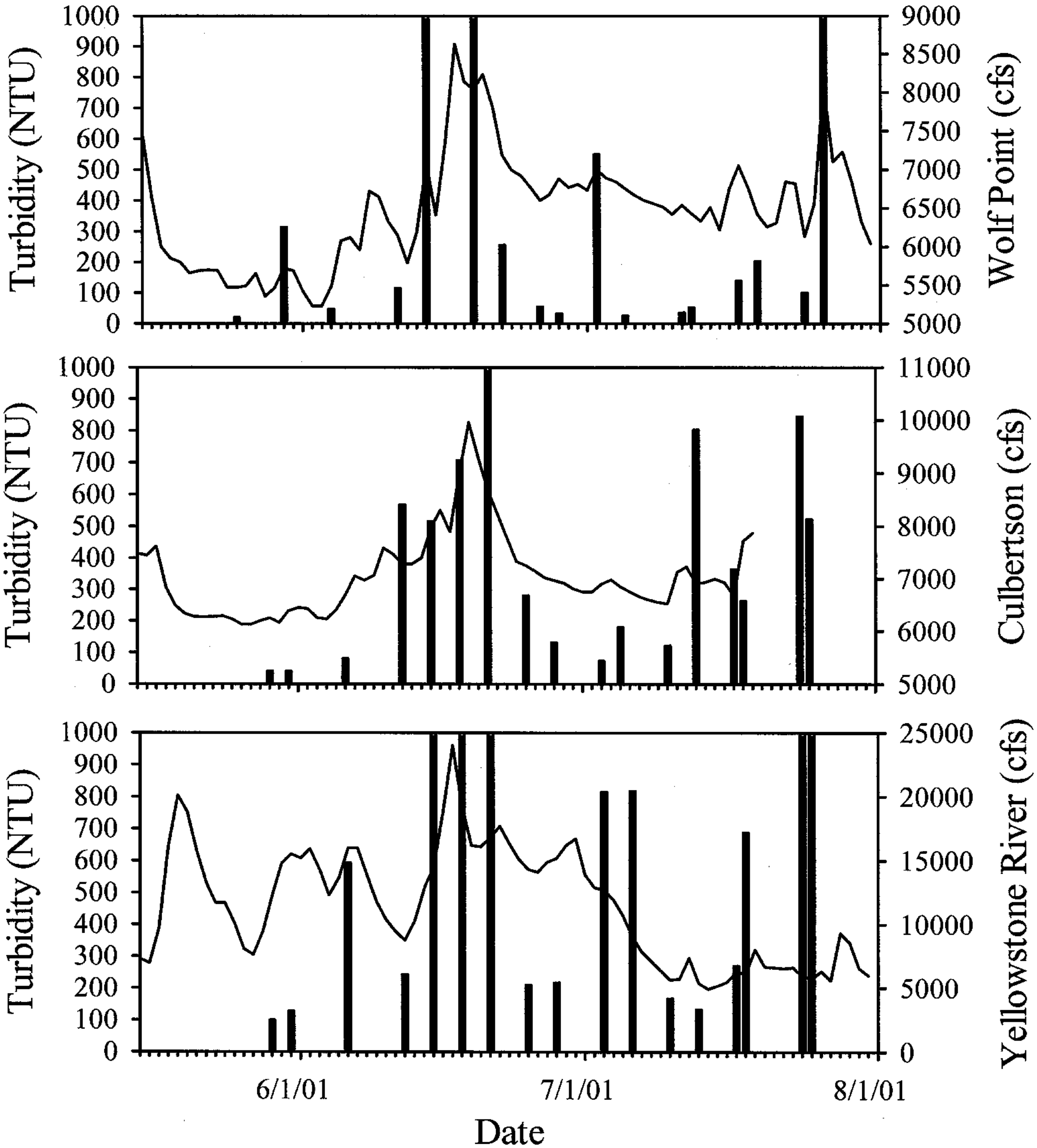

Figure 4. Turbidity (NTU; vertical bars) and discharge (cfs; solid line) at larval fish sampling sites located at Wolf Point (top panel), at Nohly (middle panel), and in the Yellowstone River (lower panel) during 2001.

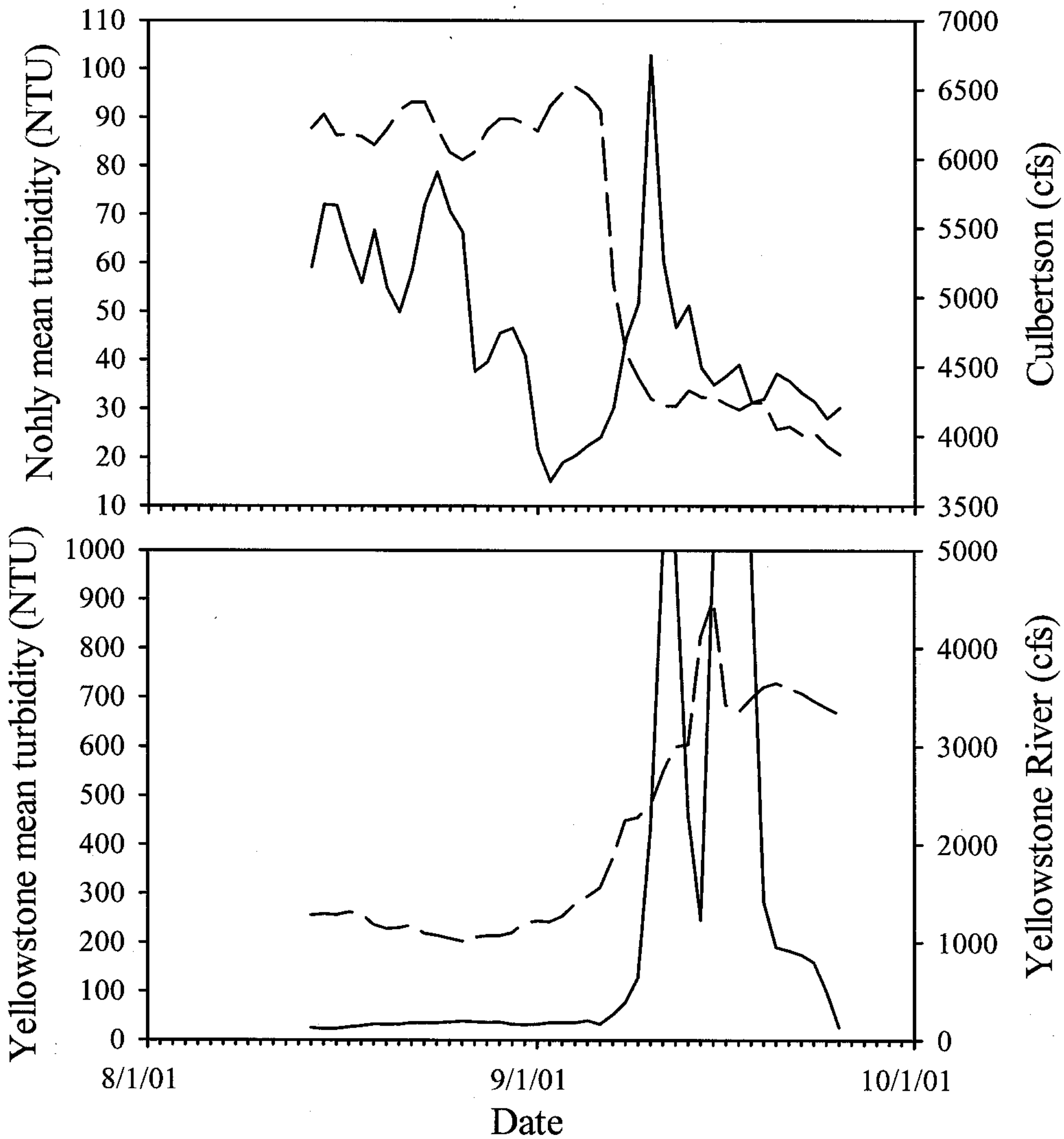

Figure 5. Mean daily turbidity (NTU; solid line) from turbidity loggers and discharge (cfs; dashed line) in the Missouri River at Nohly (top panel) and in the Yellowstone River (lower panel) during 2001.

Monitoring Component 2 – Movements by pallid sturgeon

No pallid sturgeon were found in areas immediately downstream from Fort Peck Dam. As a consequence, no pallid sturgeon were implanted with transmitters.

Monitoring Component 3 - Movements of paddlefish, blue suckers, and shovelnose sturgeon

Extensive sampling throughout the study area resulted in capturing 16 suitable-sized blue suckers for transmitter implantation. Blue suckers were collected just downstream from the Milk River (3 individuals), near Culbertson (9 individuals), and in the Missouri River near the Yellowstone River confluence (4 individuals). Mean length and weight of blue suckers was 669 mm and 2,336 g, respectively (Table 9). Seven individuals were identified as males, three were females, and the sex of seven blue suckers was not positively determined. Blue suckers were implanted exclusively with CART16-2S transmitters.

A total of 19 paddlefish were sampled for transmitter implantation, and all were netted in the Missouri River below the Yellowstone River confluence. Although extensive netting was conducted in other areas of the Missouri River between Fort Peck Dam and the Yellowstone River, only one other paddlefish was observed. This individual was caught just downstream from Wolf Point, but escaped from the net while being retrieved. Paddlefish were implanted exclusively with CART 32-1S transmitters, and averaged 996 mm and 15,732 g (Table 9). Of the 19 paddlefish implanted with transmitters, 14 individuals were identified as males, 1 individual was female, and the sex of four individuals was not determined.

Twenty-nine shovelnose sturgeon suitable for transmitter implantation were collected throughout the study area (4 individuals just downstream from the Milk River, 3 individuals near Wolf Point, 7 individuals near Culbertson, 7 individuals near Nohly, and 6 individuals in the Missouri River near the Yellowstone River confluence). Shovelnose sturgeon implanted with transmitters averaged 746 mm and 1,947 g (Table 9). Seven individuals were identified as male, 18 individuals as female, and the sex of 4 individuals was not determined. The CART16-2S transmitters were implanted in 21 shovelnose sturgeon, and an additional 8 individuals were implanted with either the MCFT-3A or MCFT-7A radio transmitters.

Table 9. Number, sex ratio (male:female:undetermined), and length (mm) and weight (g) metrics for blue suckers, paddlefish, and shovelnose sturgeon implanted with transmitters during September and early October 2001.

Species	Number	Sex ratio	Metric	Mean	Minimum	Maximum
Blue sucker	16	6:3:7	Length	669	596	738
			Weight	2,336	1,625	3,500
Paddlefish	19	14:1:4	Length	996	918	1,185
			Weight	15,732	11,339	32,205
Shovelnose sturgeon	29	7:18:4	Length	746	655	850
			Weight	1,947	1,100	3,250

Radio tracking was conducted during November 2001 in selected areas of the river to obtain initial information on post-implantation movements. Three blue suckers and two shovelnose sturgeon were relocated in a reach of the Missouri River spanning from rkm 2,842 (RM 1,765) to rkm 2,829 (RM 1,757). Both shovelnose sturgeon and two of the three blue suckers relocated were originally implanted and released in the same reach. The third blue sucker was originally implanted with a transmitter and released near Culbertson indicating that this individual had migrated upstream about 211 km (131 miles) in a 2-month period. Tracking throughout a 39-km (24-mile) reach of the Missouri River between Wolf Point and Poplar provided relocation information on one shovelnose sturgeon. This individual was initially implanted and released near Culbertson, and had migrated about 109 km (68 miles) upstream in a 2-month period. In addition to manual tracking, a data logging station operated by the USFWS detected movements of paddlefish in the Missouri River downstream from the Yellowstone River confluence (Wade King, USFWS, personal communication).

Monitoring Component 4 – Larval Fish

The late-May through July sampling period resulted in a total of 1,078 larval fish samples (136 samples at the site just downstream from Fort Peck Dam, 136 samples in the spillway, 204 samples in the Milk River, 198 samples at Wolf Point, 200 samples at Nohly, 204 samples in the Yellowstone River). The full compliment of four subsamples per replicate was collected at all sites except on five occasions (Nohly, 7/5/01, replicate 2 and 3; Wolf Point, 7/19/01, replicate 1, 2, and 3) when only two subsamples per replicate were collected due to inclement weather. Mean volume of water sampled per subsample was 77.7 m^3 at the site downstream from Fort Peck Dam (total = 10,564 m^3), 21.2 m^3 in the spillway (total = 2,882 m^3), 90.7 m^3 in the Milk River (total = 18,510 m^3), 102.8 m^3 at Wolf Point (total = 20,364 m^3), 65.4 m^3 at Nohly (total = 13,086 m^3), and 47.9 m^3 in the Yellowstone River (total = 9,771 m^3).

Relative abundance of fishes and eggs. Ten families cumulatively represented by 10,744 fish sampled during 2001 comprised the larval fish collections at all sites (Table 10). Representatives of Catostomidae (suckers) and Cyprinidae (minnows and carps) were sampled at all sites, and two families (Hiodontidae, exclusively goldeye; Percidae, perches) were sampled at all sites except the site downstream from Fort Peck Dam. Representatives of Polyodontidae (exclusively paddlefish) and Salmonidae (salmonids) were sampled at four of six sites. Representatives from Sciaenidae (exclusively freshwater drum), Ictaluridae (catfishes), and Acipenseridae (sturgeons) were sampled at three of six sites. Centrarchids (sunfishes) were sampled at only two sites (spillway channel, Yellowstone River). Excluding larvae that could not be definitively identified, the greatest number of families occurred in the Missouri River at Wolf Point (9). Eight families were identified from samples collected in the Milk River, at Nohly, and in the Yellowstone River. The site downstream from Fort Peck Dam yielded the fewest families (3).

The proportion of the community comprised of various taxa varied among sites. Catostomidae was the dominant taxon sampled, and comprised greater than 40% of the fishes sampled at all sites (Table 10). Although catostomids comprised greater than 70% of the fish community at sites located downstream from Fort Peck Dam, in the spillway channel, and at Wolf Point, the proportion of the community comprised of catostomids decreased in the Milk River, at Nohly, and in the Yellowstone River as other taxa (primarily Cyprinidae and Hiodontidae) increased in abundance. Individuals identified as common carp *Cyprinus carpio* dominated the Cyprinidae at several sites. Common carp represented 71.5% of the cyprinids in the Milk River, 68.8% at Wolf Point, 50.0% at Nohly, and 15.8% in the Yellowstone River. Percids (primarily *Stizostedion* sp.) comprised 7.4-14.9% of the larval fishes sampled at Wolf Point and Nohly, respectively, but had minimal representation in the spillway (3.3%), Milk River (trace), and in the Yellowstone River (1%). The Milk River had the greatest proportion of freshwater drum (11.7%); whereas, freshwater drum comprised only 2.5-2.6% of the fish sampled at Wolf Point and Nohly. Larvae of Acipenseridae comprised 0.8%, 3.6%, and 2.6% of the individuals sampled at Wolf Point, Nohly, and in the Yellowstone River, respectively. It should be noted that final confirmation of Acipenseridae larvae and Polyodontidae larvae sampled in 2001 is in progress. Therefore, results presented for Acipenseridae and Polyodontidae are contingent on final family/species determinations. Paddlefish comprised less than 0.1% of the larvae sampled in the Milk River, 0.1% at Wolf Point, 0.7% at Nohly, and 7.7% of the larvae sampled in the Yellowstone River. In addition to larval fishes, a total of 7,435 eggs were sampled across all sites during 2001. Of these, nine eggs identified as sturgeon and/or paddlefish eggs were sampled Wolf Point, Nohly, and in the Yellowstone River.

Table 10. Number (N) and frequency (%) of larval fishes, and numbers of eggs sampled at six sites in the Missouri River during 2001. T = less than 0.1%.

	Below Fort Peck Dam		Spillway		Milk River		Wolf Point		Nohly		Yellowstone River	
Taxon	N	%	N	%	N	%	N	%	N	%	N	%
Acipenseridae							6	0.8	10	3.6	8	2.6
Catastomidae	81	90.0	399	81.4	4624	52.4	546	72.2	111	40.2	139	44.6
Centrarchidae			15	3.1							2	0.6
Cyprinidae	3	3.3	52	10.6	2240	25.4	64	8.5	40	14.5	57	18.3
Hiodontidae			1	0.2	879	10.0	10	1.3	40	14.5	45	14.4
Ictaluridae					23	0.3	1	0.1			13	4.2
Percidae			16	3.3	2	T	56	7.4	41	14.9	3	1.0
Polyodontidae					1	T	8	1.1	4	1.4	24	7.7
Salmonidae	2	2.2			2	T	1	0.1	2	0.7		
Sciaenidae					1029	11.7	20	2.6	7	2.5		
Unknown	4	4.4	7	1.4	20	0.2	44	5.8	21	7.6	21	6.7
Total	90		490		8,820		756		276		312	
Eggs												
Sturgeon/paddlefish							1		1			7
Unknown	687		13		3455		829		546			1887

Spatial and temporal periodicity and densities of Acipenseridae and Polyodontidae larvae. In the Milk River, one larval paddlefish was sampled on July 2, but no sturgeon larvae were collected. At Wolf Point, six sturgeon larvae and eight paddlefish larvae were sampled (Table 11). Larval sturgeon were sampled on July 17, July 19, and July 26, and mean density on these dates was 0.08 - 0.40 larvae/100 m^3 (Table 11). Larval paddlefish at Wolf Point were sampled on five dates (Table 11). Mean density of larval paddlefish on the five dates was 0.08 - 0.16 larvae/100 m^3.

Table 11. Total number (number), mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of Acipenseridae and Polyodontidae larvae sampled by date in the Missouri River at Wolf Point.

	Date 2001																
	May					June								July			
Metric	25	30	4	11	14	19	22	26	28	2	5	11	12	17	19	24	26
Acipenseridae																	
Number														1	2	3	
Mean														0.08	0.40	0.18	
Median														0	0	0.19	
Min.														0	0	0	
Max.														0.25	1.19	0.35	
Polyodontidae																	
Number						2	1	2	2			1					
Mean						0.16	0.08	0.15	0.15			0.11					
Median						0.22	0	0	0.18			0					
Min.						0	0	0	0			0					
Max.						0.26	0.25	0.46	0.27			0.33					

Ten sturgeon larvae and four paddlefish larvae were sampled at Nohly (Table 12). Larval sturgeon were first sampled on June 21, and subsequently sampled on June 28, July 10, July 13, July 18, July 24, and July 25. Mean density of larval sturgeon on the six dates was 0.07 - 0.23 larvae/100 m^3. Larval paddlefish at Nohly were sampled on only two dates (June 28 and July 25), and densities did not exceed 0.19 larvae/100 m^3 (Table 12).

Table 12. Total number (number), mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of Acipenseridae and Polyodontidae larvae sampled by date in the Missouri River at Nohly.

	Date 2001																
	May					June								July			
Metric	29	31	6	12	15	18	21	25	28	3	5	10	13	17	18	24	25
Acipenseridae																	
Number							1		1			2	2		1	1	2
Mean							0.08		0.07			0.21	0.16		0.23	0.20	0.22
Median							0		0			0	0		0	0	0
Min.							0		0			0	0		0	0	0
Max.							0.25		0.20			0.65	0.49		0.70	0.59	0.67
Polyodontidae																	
Number									3								1
Mean									0.18								0.19
Median									0.20								0
Min.									0								0
Max.									0.36								0.57

In the Yellowstone River, eight sturgeon larvae and 24 paddlefish larvae were sampled (Table 13). Larval sturgeon were sampled on 6 dates (June 25, June 28, July 3, July 6, July 17, and July 25), and mean densities were less than 0.44 larvae/100 m^3 (Table 13). Larval paddlefish were sampled on eight dates between May 29 and July 25. On those dates when larval paddlefish were collected in the Yellowstone River, mean densities varied from 0.08 larvae/100 m^3 to 2.1 larvae/100 m^3.

Table 13. Total number (number), mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of Acipenseridae and Polyodontidae larvae sampled by date in the Yellowstone River.

	Date 2001																
	May		June							July							
Metric	29	31	6	12	15	18	21	25	28	3	6	10	13	17	18	24	25
								Acipenseridae									
Number								2	1	1	2			1			1
Mean								0.44	0.22	0.13	0.23			0.15			0.20
Median								0	0	0	0			0			0
Min.								0	0	0	0			0			0
Max.								1.32	0.67	0.39	0.70			0.44			0.60
								Polyodontidae									
Number	4	2		2	2	1	1	10									1
Mean	0.43	0.20		0.44	0.47	0.28	0.28	2.1									0.08
Median	0.53	0.28		0.64	0	0	0	0.59									0
Min.	0	0		0	0	0	0	0.44									0
Max.	0.76	0.31		0.68	1.41	0.85	0.83	5.28									0.24

Larval nets fished on the bottom tended to collect a greater number of larval sturgeon and larval paddlefish. For example, of the 24 larval sturgeon sampled during 2001, 17 larvae (70.8%) were sampled in larval nets fished on the bottom. Of the 37 larval paddlefish sampled, 23 larvae (62.2%) were sampled in larval nets fished on the bottom. In addition to larvae, sturgeon/paddlefish eggs were collected during 2001 at Wolf Point (June 19, N = 1), at Nohly (July 13, N = 1), and in the Yellowstone River (June 18, N = 1; June 21, N = 1; June 25, N = 2; July 3, N = 2; July 6, N = 1).

Spatial and temporal periodicity and densities of larval fishes exclusive of Acipenseridae and Polyodontidae. At the site downstream from Fort Peck Dam, mean density of larval fishes varied between 0 and 3.8 larvae/100 m^3 during the sampling period (Figure 6). Catostomids comprised the majority (90%) of the larval fishes below Fort Peck Dam, and exhibited highest densities on the June 19, June 22, and June 29 sampling dates. Salmonids were sampled on the initial sampling date (May 24), and had a mean density of 0.22 larvae/100 m^3. Cyprinids were sampled only on two dates (July 16, July 23), but at low densities (mean $\leq$ 0.23 larvae/100 m^3).

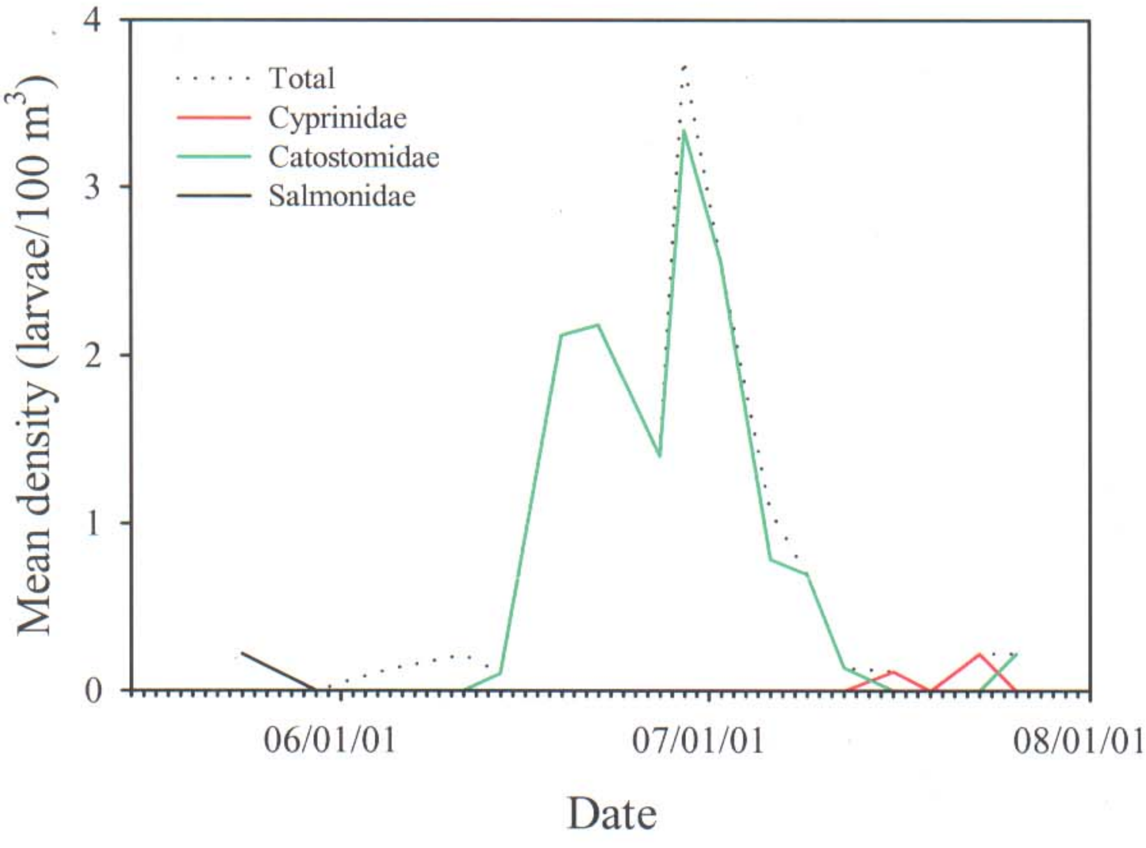

Figure 6. Mean density (number/100 m^3) by date of all larval fishes (Total), Cyprinidae, Catostomidae, and Salmonidae sampled at the site just downstream from Fort Peck Dam during 2001.

In the spillway channel, mean density of larval fishes varied from 0 larvae/100 m^3 on June 11 to a maximum of 74 larvae/100 m^3 on July 26 (Figure 7). Samples through June 14 were comprised predominantly of percids, centrarchids, and cyprinids (mean density ≤ 5.3 larvae/100 m^3). After June 14, catostomids increased in abundance and mean density exceeded 40 larvae/100 m^3 on three sampling dates (July 2, July 9, July 26).

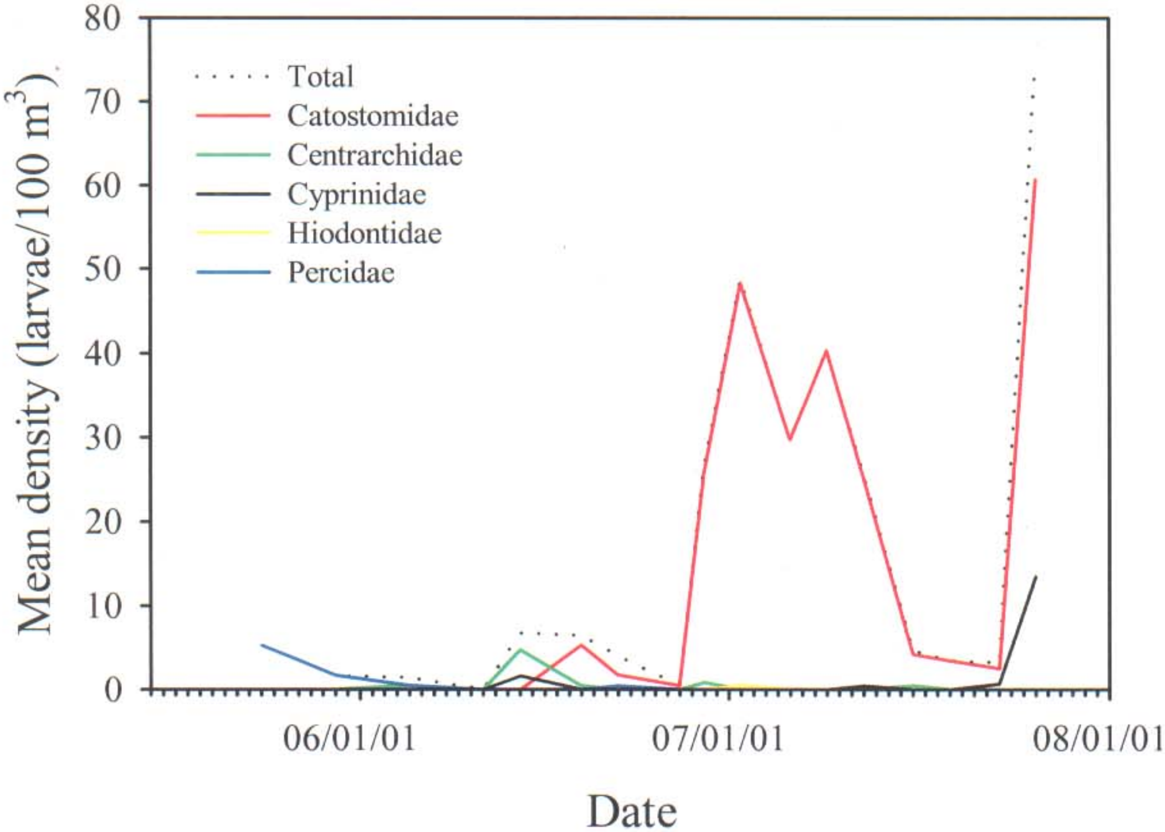

Figure 7. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Centrarchidae, Cyprinidae, Hiodontidae, and Percidae sampled in the spillway during 2001.

The larval fish community in the Milk River exhibited pronounced temporal variations in composition and density (0 – 180 larvae/100 m^3) that were associated with spawning periodicity of different taxa (Figure 8). Cyprinids (primarily common carp) exhibited maximum density (mean = 82 larvae/100 m^3) on June 19, and continued to be present in the community through July 26 but at reduced densities (mean < 22 larvae/100 m^3). A second peak in larval fish density occurred on June 27 (mean density = 76 larvae/100 m^3) as catostomids (mean density = 43 larvae/100 m^3), and to a lesser extent sciaenids (mean density = 15.4 larvae/100 m3) and hiodontids (mean density = 9.8 larvae/100 m3), increased in abundance. The greatest density of larval fishes in the Milk River occurred on July 9 (mean density = 180 larvae/100 m^3) when the density of catostomids was greatest (mean = 130 larvae/100 m^3). Cyprinids also exhibited a secondary peak in density on July 9 (mean = 22 larvae/100 m^3). Salmonids were sampled only on May 24 and May 30 at low densities (mean < 0.08 larvae/100 m^3). Ictalurids were represented during late samples (July 16 and July 26), but at low densities (mean < 3.1 larvae/100 m^3).

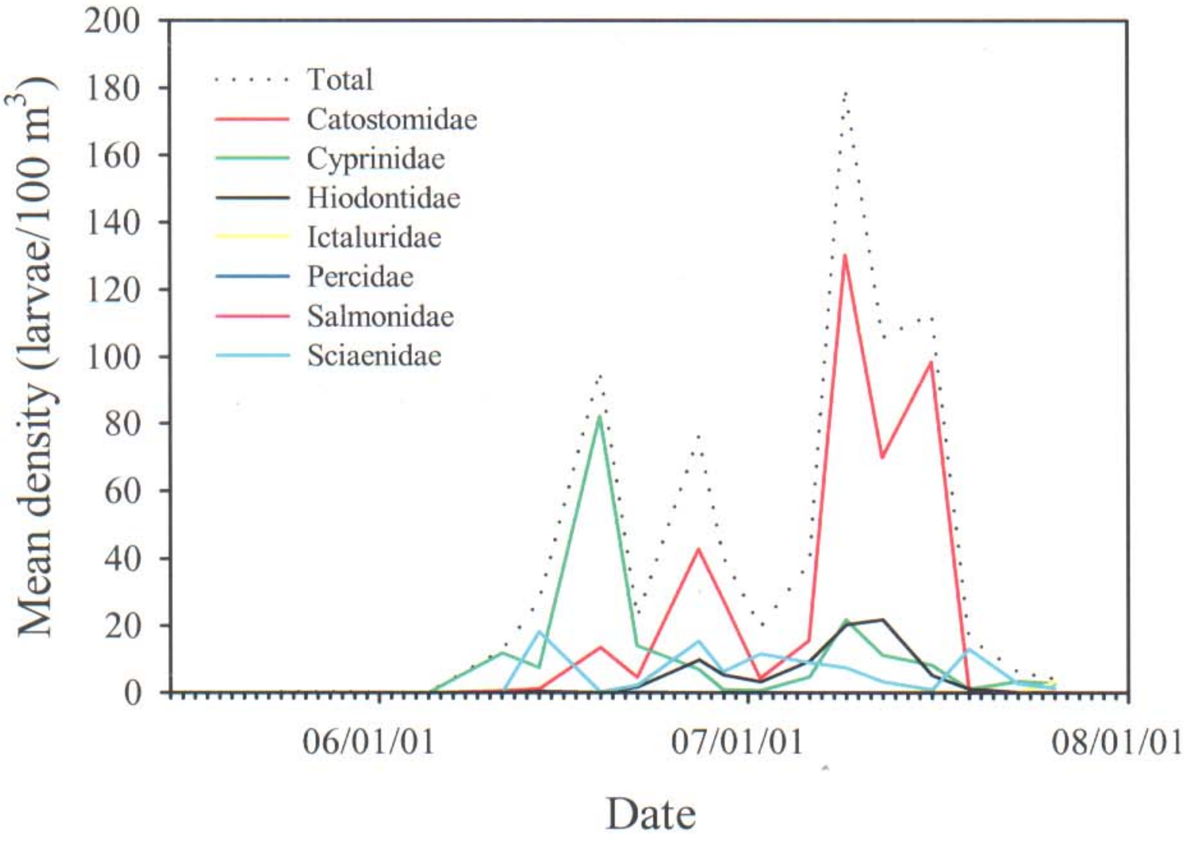

Figure 8. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Ictaluridae, Percidae, Salmonidae, and Sciaenidae sampled in the Milk River during 2001.

Temporal variations in the density of larval fishes at Wolf Point (mean 0.3 – 13.0 larvae/100 m^3) were primarily attributed to temporal changes in the abundance of catostomids and to a lesser extent percids and cyprinids (Figure 9). In early samples (May 25, May 29), percid (primarily *Stizostedion* sp.) densities averaged 0.9 – 1.2 larvae/100 m^3 and comprised 75 – 91% of the total density of larval fish. The second period of elevated densities occurred on June 11 as the density of catostomids increased to 2.8 larvae/100 m^3. The third peak in larval fish densities on June 19 (7.2 larvae/100 m^3) was associated with a continued increase in the density of catostomids (3.8 larvae/100 m^3) and a maximum density of cyprinids (2.9 larvae/100 m^3). After the June 19, densities of catostomids accounted for the majority of the larval fish sampled. Mean density of other taxa (i.e., Sciaenidae, Salmonidae, Ictaluridae, and Hiodontidae) did not exceed 0.71 larvae/100 m^3 on any sampling date.

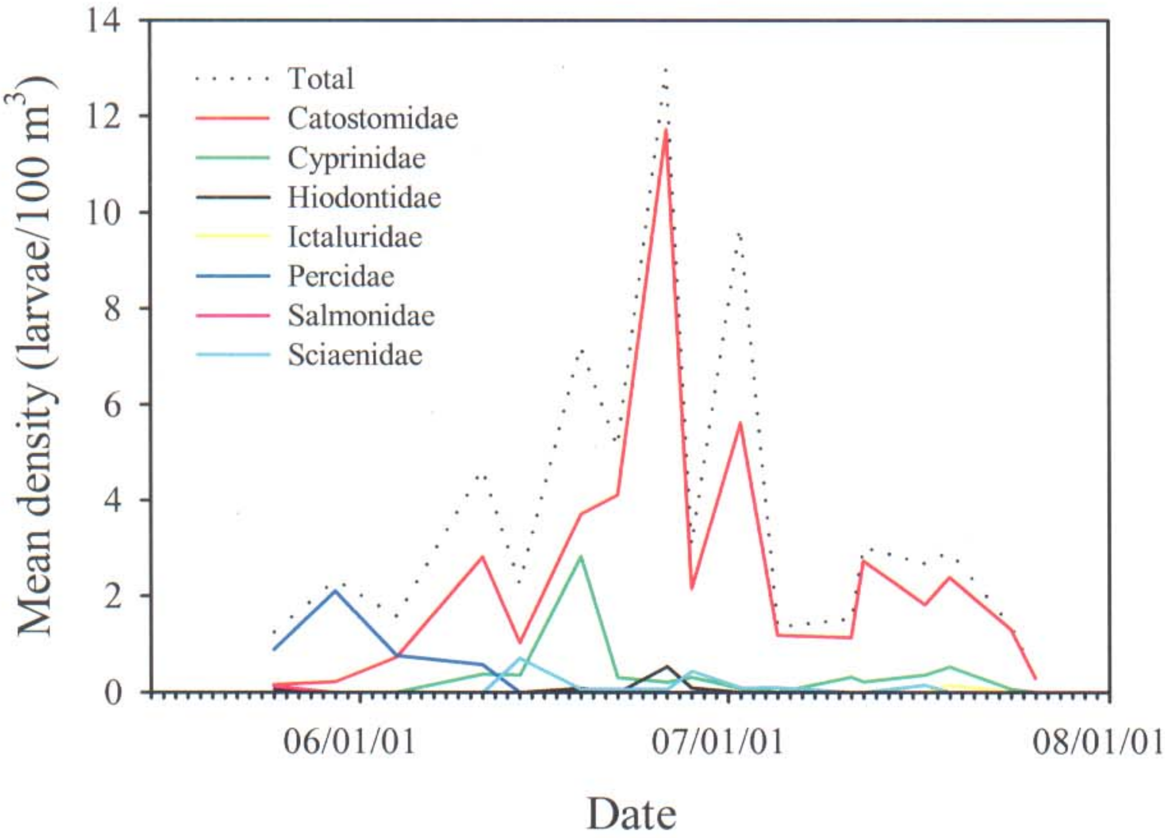

Figure 9. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Ictaluridae, Percidae, Salmonidae, and Sciaenidae sampled in the Missouri River at Wolf Point during 2001.

Mean density of larval fish at Nohly varied from 0 to 31.2 larvae/100 m^3 during the larval sampling period; however, two distinct modes in larval fish density characterized the periodicity and occurrence of larval fishes in the samples (Figure 10). On May 31, the larval fish community was comprised exclusively of percids (mean density = 26.8 larvae/100 m^3). Total density remained relatively low through June 21, then increased substantially on June 25 as catostomids (mean density = 13.5 larvae/100 m^3), cyprinids (12.0 larvae/100 m^3), and hiodontids (5.0 larvae/100 m^3) exhibited peak abundance. Densities of larval fish were low after June 25.

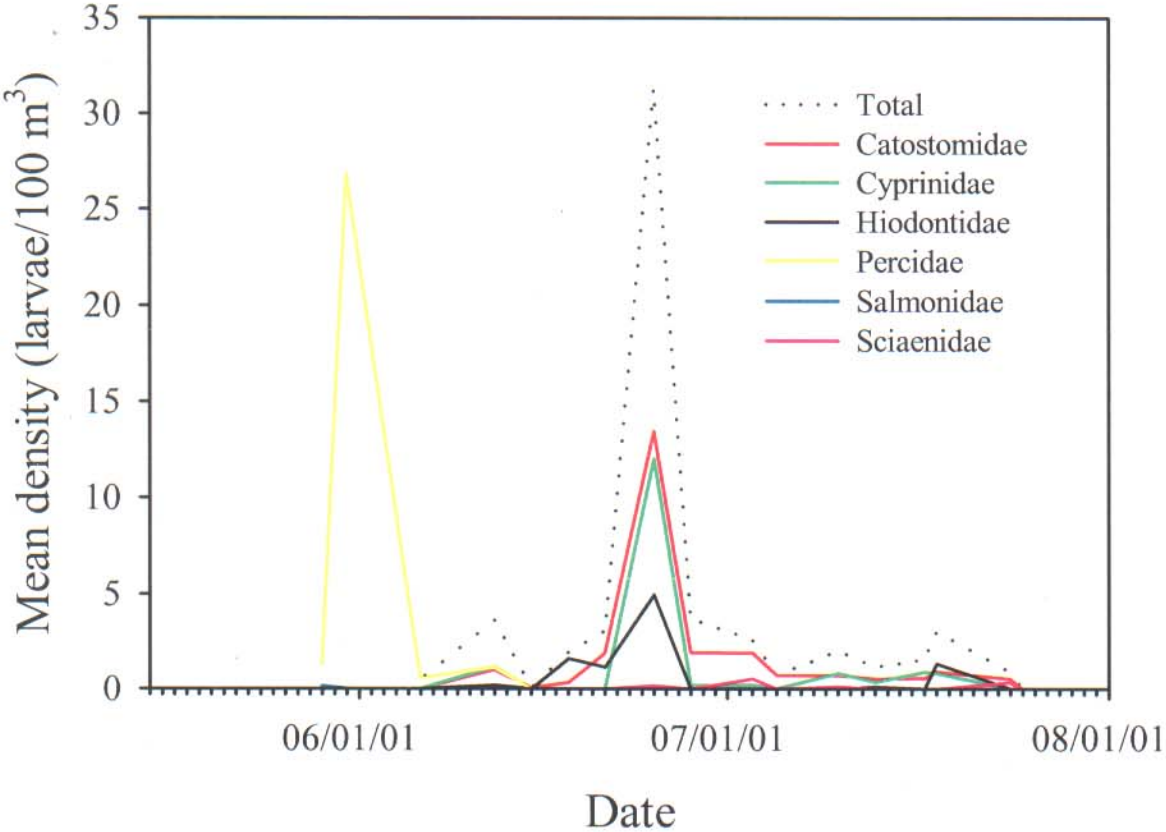

Figure 10. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Percidae, Salmonidae, and Sciaenidae sampled in the Missouri River at Nohly during 2001.

Mean density of larvae fishes in the Yellowstone River varied from 0.6 larvae/100 m^3 on May 29 to 6.9 larvae/100 m^3 on July 10; however, temporal variations in larval density were primarily influenced by three taxa (Catostomidae, Hiodontidae, Cyprinidae) that exhibited cyclical periodicity in occurrence (Figure 11). Densities of Hiodonitidae and Catostomidae varied inversely on most sampling dates, and comprised 52-100% of the total densities through July 6. A shift in taxa composition occurred after July 6 when densities of catostomids peaked on July 10 (mean density = 5.9 larvae/100 m^3) and cyprinids exhibited a significant increase in density on July 13 (mean density = 2.4 larvae/100 m^3). Densities of other taxa (Centrarchidae, Percidae, Ictaluridae) in the Yellowstone River were low (≤ 0.5 larvae/100 m^3) throughout the sampling period.

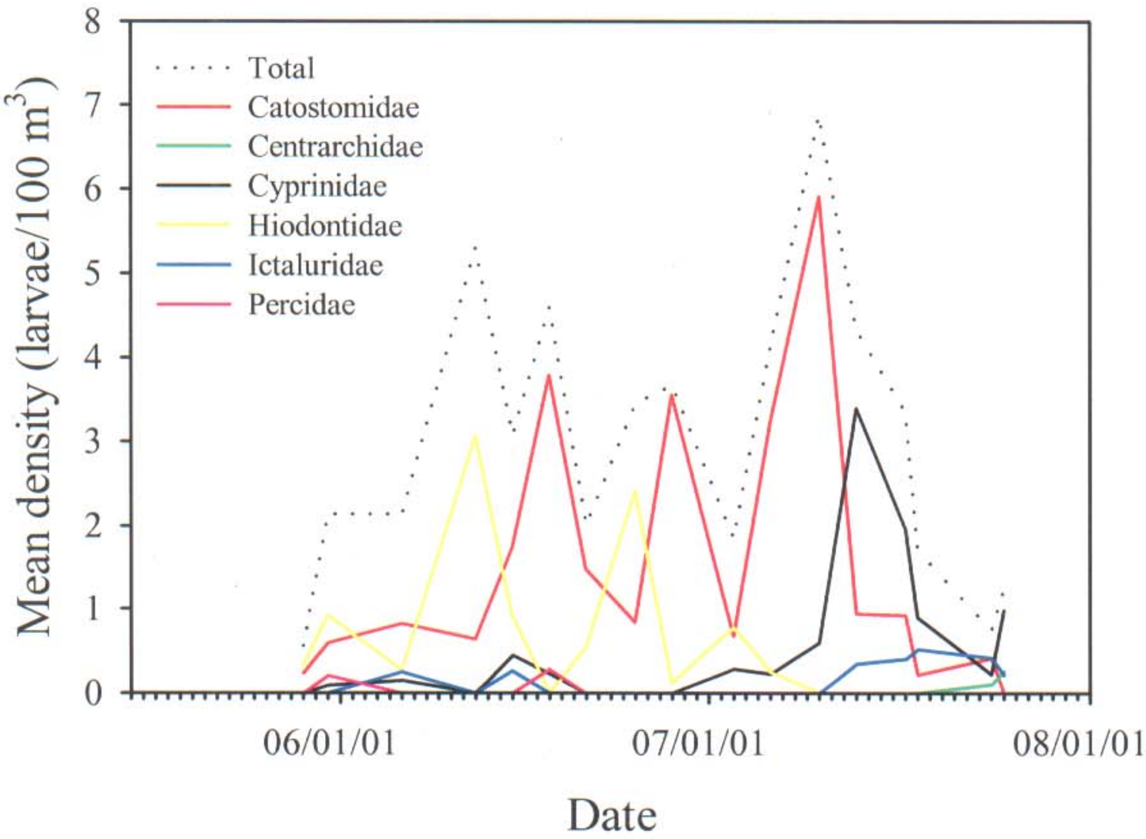

Figure 11. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Centrarchidae, Cyprinidae, Hiodontidae, Ictaluridae, and Percidae sampled in the Yellowstone River at Nohly during 2001.

Monitoring Component 5 – Food habits of piscivorous fishes

Five burbot were sampled during July and August. Individuals varied from 335 mm to 456 mm (mean = 369 mm) and from 200 g to 425 g (mean = 247 mm). All five stomachs were empty; thus, no information on food habits was obtained.

Channel catfish were frequently sampled, and stomachs from 76 individuals were retained for diet analysis (Table 14). The sample of channel catfish covered a broad size distribution (mean length = 387 mm, 222 mm - 655 mm; mean weight = 550 g, 82 g – 3,000 g). Of the 76 stomachs obtained, 11 (14%) were empty. Diet material identifiable as fish (osteichthyes) or fish fragments (e.g., scales, bones) was found in 71% of channel catfish stomachs. Other organisms including orthopterans (e.g., grasshoppers), trichopterans (caddisflies), coleopterans (beetles), dipterans (true flies) and horsehair worms (Gordioida) were founded in greater than 10% of all stomachs. Representatives of ephemeroptera (mayflies), hymenoptera (ants, wasps), plecoptera (stoneflies), and decapoda (crayfishes) were found in less than 10% of the stomach samples. Detritus (e.g., algae, wood fragments) and miscellaneous material (e.g., sand, rocks) were found in 46% of all stomachs. Trichopterans and fish comprised greater than 20% of all ingested organisms on a numerical basis. On a weight basis, fish dominated the diet and comprised 63.4% of ingested material.

Table 14. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for channel catfish sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	23	13.8	0.4
	Diptera	11	6.7	0.3
	Ephemeroptera	9	2.8	0.1
	Hymenoptera	2	0.4	T
	Orthoptera	38	11.5	4.6
	Plecoptera	2	0.4	0.2
	Trichoptera	25	26.9	0.3
	Unknown	6	7.1	0.1
Crustacea	Decapoda	6	1.6	8.7
Osteichthyes	Unknown	71	20.6	63.4
Gordioida		11	8.3	0.1
Detritus		46		9.0
Miscellaneous		46		12.8
			Total number of organisms = 253	Total weight = 62.1 g

Stomach samples were obtained from 10 freshwater drum (Table 15). Freshwater drum varied from 290 mm to 450 mm (mean length = 372 mm) and 304 g to 1,400 g (mean weight = 780 g). All 10 stomachs from freshwater drum contained diet material. Seventy percent of the stomachs from freshwater drum contained fish or fish fragments. Of these, 20% of the stomachs contained identifiable common carp. Unknown fishes were found in 50% of the stomachs. Other diet components were found in 10-30% of the stomachs. Unknown fish or fish fragments comprised the greatest frequency (52.0%) on a numerical basis. Similarly, common carp and unknown fish and fish fragments cumulatively comprised about 80% of ingested material by weight.

Table 15. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for freshwater drum sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Diptera	10	8.0	T
	Hemiptera	10	12.0	T
	Trichoptera	20	8.0	T
Crustacea	Decapoda	30	12.0	19.5
Osteichthyes	(all)	70		
	Common carp	20	8.0	40.2
	Unknown	50	52.0	39.6
Detritus		20		T
Miscellaneous		20		0.6
			Total number of organisms = 25	Total weight = 51.8 g

Stomachs from 91goldeye (mean length = 268 mm, 152 mm – 362 mm; mean weight = 171 g, 25 g – 339 g) were obtained for diet analysis (Table 16). Of the 91 stomachs obtained, 84 (92%) contained food items. Goldeye ingested a broad range of food items, but fish and fish fragments (58%), orthopterans (57%), and coleopterans (33%) had the greatest frequency of occurrence. The greatest number of individuals ingested included representatives from trichoptera (40.4%) and coleoptera (28.9%); however, orthoptera (55.9%) and fishes (23.5%) comprised the greatest proportion of food ingested based on weight.

Table 16. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for goldeye sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	33	28.9	6.2
	Diptera	15	3.7	0.3
	Ephemeroptera	4	1.1	T
	Hemiptera	1	0.1	T
	Hymenoptera	5	0.8	0.1
	Odonata	2	0.3	0.6
	Orthoptera	57	14.3	55.9
	Trichoptera	18	40.4	4.2
	Unknown	17	1.7	2.8
Osteichthyes	Unknown	58	6.5	23.5
Gordioida		7	2.2	0.1
Detritus		11		1.3
Miscellaneous		21		5.0
			Total number of organisms = 757	Total weight = 64.9 g

A total of 59 stomachs was obtained from northern pike. The size distribution of northern pike included individuals varying from 285 mm to 1,140 mm (mean length = 642 mm) and 142 g to 8,550 g (mean weight = 2,055 g). Of the 59 stomachs obtained, 36 (61%) were empty. Northern pike were primarily piscivorous as indicated by the high frequency of occurrence (91%) of fish and fish fragments in the stomachs (Table 17). Of the prey fish ingested, common carp were found in 27% of the stomachs. Emerald shiners, flathead chubs, and northern pike were found 4% of the stomachs. Decapods and amphibians were found in 4% of the stomachs. On a numerical basis, common carp (38.6%) and unknown fish and fish fragments (48.6%) were the most common diet components consumed. Nearly 99% of the weight of food items ingested was comprised of fish. However, this proportion was strongly influenced by one 800-g northern pike that was found in the stomach of a 1,032 mm (7,000 g) northern pike.

Table 17. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for northern pike sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Unknown	4	1.4	T
Crustacea	Decapoda	9	2.9	0.8
Osteichthyes	(all)	91		
	Common carp	27	38.6	18.6
	Emerald shiner	4	4.3	0.6
	Flathead chub	4	1.4	1.0
	Northern pike	4	1.4	64.5
	Unknown	83	48.6	14.1
Amphibia		4	1.4	0.4
Detritus		4		T
			Total number of organisms = 70	Total weight = 1240.5 g

Sauger sampled for diet analysis averaged 364 mm (178 mm – 511 mm) and 428 g (40 g-1,150 g). A sample of 47 sauger stomachs was obtained, and 14 (30%) stomachs were empty. Sauger were primarily piscivorous as 94% of the stomachs contained fish and fish fragments (Table 18). Of the fish consumed, common carp, emerald shiners, and goldeye were found in 3-6% of the stomachs. Unknown fish and fish fragments were found in 85% of the stomachs. The occurrence of coleopterans and emphemropterans in the diet was 3-6%. Numerically, unknown fish comprised 89.1% of all items ingested. Fish and fish fragments comprised 100% of the diet by weight of sauger, excluding trace contributions of other items.

Table 18. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for sauger sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	3	1.6	T
	Ephemeroptera	6	3.1	T
Osteichthyes	(all)	94		
	Common carp	6	3.1	4.2
	Emerald shiner	3	1.6	3.0
	Goldeye	3	1.6	0.9
	Unknown	85	89.1	91.9
Detritus		3		T
Miscellaneous		3		T
			Total number of organisms = 64	Total weight = 156.2 g

A sample of 29 stomachs was obtained for shovelnose sturgeon, and 1 stomach (3%) was empty. Shovelnose sturgeon averaged 551 mm (340 mm – 718 mm) and 771 g (114 – 1,850). Dipterans had the highest frequency of occurrence, and were found in 86% of all stomachs (Table 19). Other insect groups (ephemeroptera, orthoptera, trichoptera) were found in 7-36% of the stomachs. Fish and fish fragments occurred in 43% of the stomach samples. Similar to frequency of occurrence, dipterans comprised greater than 78% of the diet by number and weight. Ephemeroptera comprised 7.6-10.3% of the diet by number and weight. The high frequency of occurrence by number for shovelnose sturgeon was attributed to four individuals that had 945-2,538 larval dipterans in their stomach.

Table 19. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for shovelnose sturgeon sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Diptera	86	92.0	78.1
	Ephemeroptera	36	7.6	10.3
	Orthoptera	7	T	0.1
	Trichoptera	29	0.3	0.3
	Unknown	11	T	0.8
Osteichthyes	Unknown	43	0.1	5.9
Detritus		32		1.7
Miscellaneous		36		2.7
			Total number of organisms = 9,769	Total weight = 27.8 g

A total of 34 stomachs was obtained from walleye. Walleye varied from 205 mm to 705 mm (mean length = 447 mm) and from 25 g to 2,450 g (mean weight = 942 g). Of the 34 stomachs obtained, 13 stomachs (38%) were empty. Walleye were primarily piscivorous (frequency of occurrence of fishes in the diet = 100%; Table 20). Insects (i.e. dipterans and ephemeropterans) were found in 5% of the stomachs. Of the fish consumed, common carp were identified in 19% of the stomachs. Common carp and fish cumulatively comprised 96.4% of all organisms in the stomach by number and 100% (excluding trace amounts) of all organisms by weight.

Table 20. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for walleye sampled in the Missouri River during July and August 2001. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Diptera	5	1.8	T
	Ephemeroptera	5	1.8	T
Osteichthyes	(all)	100		
	Common carp	19	10.7	42.7
	Unknown	100	85.7	57.3
Detritus		5		T
			Total number of organisms = 56	Total weight = 181.9 g

Related Activities

Juvenile pallid sturgeon. Three hatchery-raised juvenile pallid sturgeon were sampled during 2001 in conjunction with monitoring activities. Juvenile pallid sturgeon were sampled near Wolf Point on September 12 (431 mm, 245 g, PIT tag number 424E2C054C), near Nohly on September 24 (440 mm, 255 g, PIT tag number 424E3F352E, and just downstream from the Yellowstone River confluence (370 mm, 151 g, PIT tag number 411D15473C).

Young-of-year sturgeon sampling. Benthic trawling was conducted on September 6 and 7 to sample young-of-year (YOY) pallid sturgeon and shovelnose sturgeon. Seven trawls were conducted between Nohly and the Yellowstone River confluence, and 37 trawls were conducted in the Missouri River from the Yellowstone River confluence to below the Highway 85 bridge rkm 2,500 (RM 1,553) in North Dakota. No YOY sturgeon were sampled upstream from the Yellowstone River confluence. Three YOY shovelnose sturgeon were sampled near rkm 2,541 (RM 1,578; 63 mm, 46 mm, 49 mm) and two YOY shovelnose sturgeon were sampled at the Highway 85 bridge (43 mm, 44 mm).

Discussion

Physical and biological data collected under the Fort Peck Data Collection Plan during 2001 provides baseline information that will be used to evaluate physical and biological changes resulting from modified flow releases. In addition to this information, baseline information collected by the Montana Department of Fish, Wildlife and Parks and the U. S. Fish and Wildlife Service will also be used to examine the influence of modified flow releases on pallid sturgeon and other native fishes.

Monitoring Component 1 - Water temperature and turbidity

Water temperature loggers deployed during 2001generally had a good level of precision and accuracy during water bath comparisons with the exception of the three aforementioned "suspect" loggers. However, accuracy and precision were generally greater at warm water bath treatment temperatures (e.g., > 20°C) than at cooler treatment temperatures (< 15°C). Warm water bath treatments were conducted at relatively stable room temperatures that created homeothermal conditions in the water bath; therefore, recorded values represented temperature in a minimally changing, homeothermal environment. When the water bath was moved outside into cooler conditions, it is possible that the water did not cool at the same rate throughout the water bath. As a consequence, loggers positioned near the edge of the water bath may have recorded a different temperature than loggers positioned near the middle of the water bath. Water temperature was measured with the YSI and alcohol thermometer near the middle of the water bath. Because the position of each logger was not recorded, it was not possible to more thoroughly address position-related variations in water temperature. In 2002, water temperature loggers will be subjected to additional pre- and post-deployment tests to examine precision and accuracy through a range of water temperatures.

Comparisons between water temperature collected during larval fish sampling and water temperature recorded by loggers near the larval fish sampling sites provided an extended (> 2 months) in situ assessment of logger accuracy. No significant differences in water temperature were found at five of six sites despite differences in measurement location (i.e., loggers recorded water temperature near the bottom, water temperature during larval fish sampling was measured in the upper 1-m of the water column). These results suggest the loggers maintained a high level of accuracy during the deployment period and that the water column was homeothermal. In contrast, water temperature differed between the logger and YSI at the site just downstream from Fort Peck Dam. A clear explanation for this difference is not known. Similar to 2001, water temperature measured during larval fish sampling in 2002 will be compared to logger data.

The good level of precision and accuracy exhibited by water temperature loggers (with the exception of the three suspect loggers) facilitates a discussion of lateral and longitudinal water temperatures recorded in 2001. Mean daily water temperature at nine sites did not differ significantly between left and right bank locations during the period when data from duplicate loggers were available (Table 7). These results suggest that the Missouri River was laterally homeothermal and that tributary inputs had minimal influence on lateral variations in water temperature during 2001. These conclusions are based on comparisons spanning the entire period from early May through October (at most sites); however, there were specific instances within the entire time period when lateral variations in water temperature occurred. For example, downstream from the Milk River at the Nickels Rapids site, water temperature near the right (north) bank on June 18 and July 16 was 1.9 - 2.3°C warmer than near the left (south) bank.

Increased discharges of warm water from the Milk River elevated water temperatures on the north bank due to incomplete lateral mixing of Milk River-Missouri River water at Nickels Rapids. Earlier studies have also shown that inputs from the Milk River differentially affect water temperature at downstream sites, but the effects are most prevalent in spring and early summer when the Milk River exhibits greatest flows (Gardner and Stewart 1987; Yerk and Baxter 2001).

Longitudinal water temperature profiles obtained during 2001 provided baseline data that will be used to evaluate the influence of Fort Peck flow modifications on water temperature. Between mid-May and mid-October, water temperature in the Missouri River upstream from Fort Peck Lake averaged 7.1°C greater than directly downstream from Fort Peck Dam, and 1.2°C greater than at Nohly. Given natural increases in water temperatures from upstream to downstream that would be expected in the unmodified Missouri River (Galat et al. 2001) and other rivers (Allan 1995), water temperature should be greater at Nohly than upstream from Fort Peck Dam. However, despite 303 km (188 miles) of free-flowing river downstream from the dam, water temperature remained suppressed below ambient conditions upstream from the reservoir. Gardner and Stewart (1987) similarly found that June – September water temperatures below the dam, at Wolf Point, and at Culbertson were 8.0°C, 4.5°C, and 3.3°C lower, respectively, than water temperatures upstream from the reservoir. Specifically related to the Missouri River Biological Opinion (USFWS 2000), a primary goal of the Fort Peck Flow Modification project is to establish and maintain a minimum water temperature of 18°C at Frazer Rapids (rkm 2,811, RM 1746) during May and June. The maximum mean daily water temperature recorded at Frazer Rapids during 2001 was 17.2°C on July 16 and 17.4°C on July 17. In 2000, Yerk and Baxter (2001) similarly showed that the maximum mean daily water temperature at Frazer Rapids slightly exceeded 17.0°C in mid-July.

Turbidity measurements from late May through mid September provided a baseline assessment of spatial and temporal turbidity patterns. Fort Peck Lake serves as a sediment trap; therefore, turbidity was lowest at the site directly downstream from the dam. Inputs from the Milk River and other tributaries elevated turbidity at sites further downstream from Fort Peck Dam similar to conditions described by Gardner and Stewart (1987). On a temporal scale, changes in river discharge influenced turbidity at all sites except the site directly downstream from the dam. Elevated turbidities typically occurred on the ascending limb, peak, or descending limb of the hydrograph. Hourly turbidity measurements recorded by the turbidity loggers provided a more refined examination of relations between discharge and turbidity. For example, mean daily turbidity in the Yellowstone River increased rapidly as discharge increased; whereas, mean daily turbidity at Nohly increased as discharge declined by about 2,000 cfs. Declines in discharge flush organic material and organisms from dewatered backwaters and side channels into the main channel (Modde and Schmulbach 1977). This process may partially explain the turbidity increase at Nohly concomitant with the declining hydrograph. It should be noted that the increase in turbidity that occurred at Nohly in early September (15 – 103 NTU) was small in comparison to discharge-related variations in turbidity that occurred between late May and August (e.g., 40 – >1000 NTU).

Limited comparisons of turbidity measured with the Hach turbidimeter and turbidity loggers suggested accuracy of the turbidity loggers was good during the limited deployment period. However, periodic field observations indicated the turbidity loggers accumulated debris in their flowing water locations that could influence the accuracy of turbidity measurements.

Turbidity loggers deployed in 2002 – 2004 will be cleaned on a weekly basis to maintain measurement accuracy. In addition, pre- and post-deployment calibrations will be conducted.

Monitoring Component 2 – Movements by pallid sturgeon

Pallid sturgeon were not found in the Fort Peck tailwaters in winter 2001. The last recorded observation of pallid sturgeon in the tailwaters occurred in 1996 (Liebelt 1998) when three individuals were captured by SCUBA. However, anecdotal information from an independent diver reported that pallid sturgeon were observed in the tailwaters in winter 1997. Attempts to locate and capture pallid sturgeon for transmitter implantation will continue in the tailwaters throughout the duration of the study. Information on seasonal movements of pallid sturgeon from the tailwaters would be complimentary to existing movement-related studies being conducted by the USFWS in the Missouri River-Yellowstone River confluence area.

Monitoring Component 3 - Movements of paddlefish, blue suckers, and shovelnose sturgeon

Similar to pallid sturgeon, paddlefish, blue suckers, and shovelnose sturgeon are migratory during the spawning season, respond to discharge and thermal cues for spawning migrations, and spawn in gravel substrates (Breder and Rosen 1966; Needham 1979; Berg 1981; Penkal 1981; Moss et al. 1983; Hurley et al. 1987; Gardner and Stewart 1987; Pflieger 1997; Bramblett and White 2001). Successful implantation of transmitters in paddlefish, blue suckers, and shovelnose sturgeon was a critical first-step towards examining biological response of native Missouri River fishes to changes in the operations of Fort Peck Dam. Beginning in late April or early May 2002, individuals will be manually tracked at 1 – 4 day intervals through June and perhaps longer. Manually tracking efforts will be complimented by a network of seven fixed logging stations that will continuously monitor fish movements in the Missouri River between Fort Peck Dam and the confluence of the Yellowstone River. Additional logging stations operated by the USFWS in the lower Missouri River and Yellowstone River may also be used to record discharge- and temperature-related movements.

Monitoring Component 4 – Larval Fish

The number of larval sturgeon sampled during 2001 (Wolf Point = 6; Nohly = 10; Yellowstone River = 8) generally exceeded numbers reported in earlier studies, but the number of larval paddlefish sampled during 2001 (Milk River = 1; Wolf Point = 8; Nohly = 4; Yellowstone River = 24) was generally similar to earlier investigations. For example, in samples conducted during 1994, Liebelt (1996) reported that no larval sturgeon were sampled at Wolf Point and only four sturgeon were sampled near Nohly. The Yellowstone River was not sampled in 1994. Samples conducted during 1995 resulted in one larval sturgeon near Nohly and nine larval sturgeon in the Yellowstone River (Liebelt 1996). In 1996, three larval sturgeon were sampled in the Yellowstone River, but none were sampled at Wolf Point or Nohly (Liebelt 1998). Liebelt (2000) sampled one larval sturgeon at Nohly during 1999, but did not sample any sturgeon at Wolf Point or in the Yellowstone River. Larval fish sampling was not conducted at Nohly or in the Yellowstone River during 2000, and only one larval sturgeon was sampled at Wolf Point in 2000 (Yerk and Baxter 2001). For paddlefish, Liebelt (1996) sampled three individuals at Nohly during 1994, but did not sample any larval paddlefish in the Milk River or at Wolf Point. Liebelt (1996) sampled 47 larval paddlefish (15 at Nohly, 32 in the Yellowstone

River) during 1995. In 1996, two larval paddlefish were sampled in the Yellowstone River, seven larval paddlefish were sampled upstream from the Yellowstone River confluence (presumably in the Wolf Point, Culbertson, and Nohly areas), and no larval paddlefish were sampled in the Milk River (Liebelt 1998). Samples conducted during 1999 resulted in the collection of one larval paddlefish in the Milk River, three in the Yellowstone River, but no larval paddlefish were sampled at Nohly (Liebelt 2000). In 2000, one larval paddlefish was sampled at Wolf Point, but no larval paddlefish were sampled in the Milk River (Yerk and Baxter 2001). Differences in the number of larval sturgeon and larval paddlefish collected among studies may be due to several factors including differences in sample number and sample intensity among studies, and annual variations in spawning success related to inter-annual variations in discharge and water temperature regimes.

The temporal periodicity of larval sturgeon and paddlefish observed in 2001 was consistent with species-specific spawning characteristics. Because paddlefish spawn at lower water temperatures than sturgeon (Wallus 1990; Yeager and Wallus 1990), concentrations of paddlefish generally occurred earlier during the larval fish sampling period as evidenced by results from Wolf Point and the Yellowstone River. Although there were similarities in the periodicity of larval paddlefish and larval sturgeon between sites, concentrations of sturgeon larvae typically appeared earlier in the Yellowstone River than at sites in the Missouri River. Concentrations of larval sturgeon were sampled in the Yellowstone River from late June through July; whereas, concentrations of larval sturgeon did not occur until early July at Nohly and mid July at Wolf Point. In earlier studies, larval sturgeon were first sampled upstream from the Yellowstone River confluence on July 16, 1999 (Liebelt 2000), on July 18 – 19, 2000 at Wolf Point (Yerk and Baxter 2001), at Nohly on July 8 – 14, 1994 (Liebelt 1996), in the Yellowstone River on June 15 –16, 1995 (Liebelt 1996), and in the Yellowstone River on July 9 – 12, 1996 (Liebelt 1998). Warmer water in the Yellowstone River likely promotes earlier spawning by sturgeon in comparison to the Missouri River at Nohly and Wolf Point where water temperature increases are delayed. Larval fish sampling in subsequent years will more thoroughly investigate this hypothesis especially in regard to modified flow releases from Fort Peck Dam.

Statistical analyses examining spatial and temporal patterns in taxa composition and larval density will be conducted following fieldwork in 2002, 2003, and 2004. However, larval fish data collected in 2001 provides preliminary information that can be evaluated in the context of earlier studies. Similar to our results, earlier studies have also found that the least number of larval fish taxa typically occurs in the coldwater reaches directly downstream from Fort Peck Dam and that taxon composition increases in mainstem or tributary locations with warmer water temperatures (Gardner and Stewart 1987; Liebelt 2000; Yerk and Baxter 2001). Pooled among sampling periods, catostomids dominated the larval fish community at all sites and comprised 40% (Nohly) to 90% (downstream from Fort Peck Dam) of the larval fishes sampled. Gardner and Stewart (1987) similarly reported that catostomids comprised 100% of the larval fishes just below Fort Peck Dam, and 39% of the larval fishes sampled near Culbertson (their sampling station closest to Nohly). Stewart (1983) also found that catostomids comprised about 90% of the larval fish sampled at 25 sites in the mainstem Missouri River downstream from Fort Peck Dam.

Earlier larval fish studies did not sample at the same intensity as was conducted during this study; therefore, it is not appropriate to directly compare densities of larval fish obtained in this study with densities obtained in earlier studies. Nonetheless, qualitative comparisons can be made. In this study, greatest densities of larval fishes occurred in mid to late June at sites downstream from the dam, at Wolf Point, and at Nohly (with the exception of Percidae). Maximum densities in the Milk River and spillway occurred in early to mid July. Maximum density of larval fish in the Yellowstone River occurred in early July, but earlier samples also had high densities. Gardner and Stewart (1987) found highest densities of larval fish occurred during June in three of four years. Averaged across sampling periods, Gardner and Stewart (1987) reported average densities of larval fish in 1979 were 0 larvae/100 m^3 below Fort Peck Dam, 8.7 larvae/100 m^3 in the Milk River, and 0.2 larvae/100 m^3 at Wolf Point and Culbertson. In larval fish sampling conducted in 2000, Yerk and Baxter (2001) reported mean densities of 0.3 fish/100 m^3 below Fort Peck Dam, 11.5 larvae/100 m3 in the Milk River (only one date), and 2.1 larvae/100 m^3 at Wolf Point. Trends in larval fish densities during 2001 were similar as mean density across sampling periods was lowest downstream from the dam (0.9 larvae/100m^3), increased in the Milk River (44.6 larvae/100 m^3), then declined at Wolf Point (3.7 larvae/100 m^3) and Nohly (4.9 larvae/100 m^3). The annually consistent larval fish sampling protocols outlined in the Fort Peck Data Collection Plan, in conjunction with larval fish information generated from the existing WAPA-supported monitoring program, will provide a comprehensive understanding of how changes in Fort Peck Dam operations influence spawning success of sturgeon, paddlefish, and other native Missouri River fishes. These studies will more stringently address the hypothesis that reproductive success and densities of larval fishes are directly related to river discharge (Gardner and Stewart 1987). In addition, we have initiated a power analysis of the 2001 larval fish data set to guide larval fish sampling activities in 2002, 2003, and 2004. For example, the analysis will help determine whether the existing effort (e.g., subsamples, replicates) in the context of sample variance provides sufficient power to detect inter-annual differences in larval fish density. Results from this analysis will be prepared by May 15, 2002.

Monitoring Component 5 – Food habits of piscivorous fishes

The primary impetus for this monitoring component was to determine whether sturgeon larvae and juveniles are consumed by the piscivore fish assemblage in the Missouri River. In 2001, stomach contents from all species except burbot contained identifiable fish or miscellaneous fish body parts; however, there was no evidence of piscivory on sturgeon. Fish parts were primarily scales and ossified bone – skeletal features not characteristic of sturgeon.

Variations in the diet of species sampled in this study were evident. Fish comprised greater than greater than 63% of the biomass of ingested items in channel catfish, freshwater drum, northern pike, sauger, and walleye; whereas, orthopterans comprised nearly 60% of the diet biomass in goldeyes. Dipterans comprised about 78% of the diet biomass in shovelnose sturgeon. In a Missouri River backwater downstream from the Yellowstone River, Fisher et al. (2001) found fishes comprised 49 – 100% of the wet mass diet in sauger, northern pike, and walleye during July. Contrary to our findings, Fisher et al. reported that corixids and coleopterans were the dominant food item in goldeyes, and that chironomids comprised 36 – 58% of the diet in freshwater drum. For channel catfish, Fisher et al. (2001) found that individuals 400 – 549 mm fed predominantly (44%) on coleopterans, but individuals greater than 549 mm fed predominantly (47.1%) on fish. Similar to our study, Stewart (1983) and Gardner and Stewart (1987) found sauger in the Missouri River downstream from Fort Peck Dam fed predominantly on fishes during the summer. For shovelnose sturgeon, Gardner and Stewart (1987) found individuals fed predominantly on dipterans. Piscivores will be sampled in late June, July, and August of 2002. A more complete analysis and discussion of piscivore food habits will be presented following completion of 2002 field activities.

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MISSOURI RIVER COTTONWOOD STUDY
FORT PECK RESERVATION, MONTANA

September 2001

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INTRODUCTION

The Fort Peck Assiniboine and Sioux Tribes (Tribes) are concerned that Great Plains cottonwood (*Populus deltoides*) woodlands, along the Missouri River on the Fort Peck Reservation (Reservation), in eastern Montana are dying out (i.e., declining in spatial extent and vigor and may not be regenerating young trees to replace older trees that are dying). The riparian cottonwood woodlands along the Missouri River on the Reservation are of cultural, aesthetic, spiritual, and biological importance to the Tribes.

Cottonwood woodlands are declining due to several factors. Construction and operation of the Fort Peck Dam, upstream from the western boundary of the Reservation, has altered flow regimes of the Missouri River, channel morphology, and vegetation on the floodplain of the river. Fires have killed stands of cottonwood and agricultural operations have replaced cottonwood communities with hay fields and crops. Livestock grazing and trampling has degraded the vegetation on some sites.

An indirect effect of historic operation of the Fort Peck Dam on cottonwoods might be the proliferation of beavers along the Missouri River. High densities of beavers are causing substantial mortality to cottonwoods along the river.

In response to concerns expressed by the Tribes, the Army Corps of Engineers funded this study to document the status of riparian cottonwood woodlands along 141 miles of Missouri River shoreline on the Reservation. The purpose of the study is to establish baseline conditions concerning the demography, seral ecology, volume and growth rates, species composition, and structural features of cottonwood communities along the Missouri River. These studies establish baseline conditions so that effects of future operations of the Fort Peck Dam can be assessed and a management plan prepared for regeneration of cottonwoods on a sustained basis.

This report presents results of the cottonwood study conducted by Joe C. Elliott, Ecological Consultant, under contract to the Tribes This report also presents a literature review of riparian cottonwood ecology and beaver-cottonwood interactions and suggests measures to mitigate resource losses associated with the decline of cottonwood woodlands on the Reservation.

REVIEW OF COTTONWOOD ECOLOGY

The following is a review of scientific studies of cottonwood ecology in the western United States and Canada. This review documents the interaction of seasonal hydrology, sediment deposition, and other factors that affect reproduction of riparian cottonwood communities. The following studies provide information on aspects of riparian plant ecology that are relevant to assessing the status of cottonwood communities on the reservation.

Riparian Vegetation

Riparian vegetation is comprised of plant communities that occur in transitional zones between aquatic and terrestrial ecosystems. These plant communities are "pulse-stabilized" systems maintained in continual ecological transition (disclimax) through the pulse of periodic flooding. Scouring by floodwaters and deposition of water-borne sediment (alluvium) creates optimum habitat for seedlings of cottonwood and willow species. Seeds of these species germinate almost exclusively on recently deposited, fully exposed alluvium.

According to Mahoney and Rood (1993), the following factors are important for cottonwood seedling establishment: 1) peak flows to prepare germination sites; 2) receding flows at the time of seed release to expose new germination sites; 3) gradually declining water table to limit seedling drought stress and promote root growth; 4) adequate summer flows to meet high water demands; and 5) adequate autumn flows to maintain water balance and over-winter survival. A detailed discussion of life history, ecology, and conservation of North American cottonwood forests is presented by Braatne and others (1996), Johnson (1992), and Hansen and Suchomel (1990). Fluvial processes associated with establishment and maintenance of riparian forests are discussed by Scott and others (1996)

Construction and operation of dams can affect riparian ecology by altering the seasonal timing and magnitude of stream flows, sediment transport potential of downstream waters, and ice formation. These influences of dams on hydrology can affect amounts of water available to vegetation; meandering rate of streams; formation and erosion of stream banks, bars, and islands; establishment of cottonwood and willow species; and regeneration of senescent riparian plant communities.

Studies of riparian vegetation on the Reservation were conducted by Miles et al (1993) and Hansen et al (1995). These researchers studied three plots along the Missouri River and suggested that altered flows from damming the Missouri River have drastically reduced Great Plains cottonwood regeneration. Using 1979 aerial photographs, these researchers mapped riparian plant communities on the Reservation.

Ecology of riparian forests on the St. Mary, Waterton, and Belly rivers in Alberta were studied by Rood and Heinze-Milne (1989). They found that riparian forests downstream from the St. Mary and Waterton dams declined by 48 and 23 percent, respectively. There was negligible reduction in cottonwood forests on the undammed Belly River, downstream from an irrigation diversion. The decline in cottonwood forests was attributed to low summer flows, resulting from dam operation that led to drought-induced mortality.

Rood and others (1995) also addressed cottonwood decline on the St. Mary River. Analyses of historical stream flows indicated that cottonwood mortality was drought-induced as a result of insufficient flows during the hot dry, summer periods and abrupt flow reductions following the high-flow period in spring.

The collapse of riparian poplar forests downstream from dams in western North American prairies was investigated by Rood and Mahoney (1990). They reviewed literature that reported vegetation impacts, downstream from dams on the Missouri, Big Horn, South Platte, Milk, St. Mary, Waterton, and Belly rivers and concluded that dams contribute to forest failure by: reducing downstream flows, altering flow patterns to attenuate spring flooding, and stabilizing summer flows. Reduced downstream flows can cause drought stress. Moderation of spring flooding can inhibit formation of seedbeds essential for germination and growth of riparian species.

Flooding patterns associated with ecological succession of riparian vegetation along the Red Deer River in southern Alberta were studied by Cordes and others (1997). They found that cottonwood regeneration was initiated on the floodplain by major floods (recurrence interval greater than 1 in 50 year events). Construction of the Dickson Dam has led to attenuation of floods, reduced the occurrence of extensive floods, and lowered potential for cottonwood forests downstream from the dam to be regenerated.

Impacts of the Fresno Dam on the Milk River in northern Montana and southern Alberta were studied by Bradley and Smith (1984 and 1985). They found that cottonwood densities on the Milk River floodplain were reduced 25 kilometers downstream from the dam in Montana. Cottonwood densities upstream from the dam in Alberta were significantly higher. They interpreted the results of their studies to suggest that cottonwood decline is due to a marked reduction in flood magnitude and frequency, rates of sedimentation, and channel meandering.

Impacts on cottonwoods, along the Marias River in Montana, downstream from the Tiber Dam, were reported by Rood and Mahoney (1995). Their studies found that: 1) reduced flooding allowed dense growth of grass, shrubs, and sedges to compete with cottonwood seedlings; 2) hydrological patterns of spring flooding and subsequent gradual flow decline required for seedling establishment is lacking; 3) formation of point bars and lateral bars, necessary for seedling establishment, has been inhibited; and 4) suspended sediment settles out in the reservoir, which may contribute to channel entrenchment.

Lesica and Miles (1998) also studied the ecology of cottonwoods along the Marias River downstream from the Tiber Dam. They observed that cottonwood recruitment that once occurred over large areas of the floodplain is now confined to a narrow zone along the channel. Seventy-seven percent of cottonwood trees in all age classes were damaged by beavers, effectively preventing cottonwoods from developing close to the river. They found that preference of beavers for cottonwood over the exotic invader species, Russian olive, is leading to replacement of cottonwood on some areas of the floodplain by Russian olive.

Flood dependency of cottonwoods along the Missouri River in Montana was studied by Scott and others (1997). They found that 72 percent of cottonwood trees established following floods with recurrence intervals greater than 9 years. Flows of this magnitude are necessary to create moist alluvium at elevations high enough to allow cottonwoods to survive subsequent floods and ice jams. Almost all cottonwoods that have survived recent floods were established higher than 1.2 meters above the lower limit of perennial vegetation (active channel shelf).

Studies of the Platte River in Nebraska (Johnson 1994) found that cottonwood forests have colonized formerly active channels of the Platte River as a result of lowering of stream flows for irrigation and to fill dams. This finding differs from results reported by researchers in Montana and Alberta. Accordingly, Johnson (1994) observed that responses of the Platte River differed from responses of other rivers. He states that the divergent response observed, despite similar disturbances, indicates complex relationships among plants and geomorphic processes operating on floodplains and the difficulties in understanding, generalizing, and predicting the impacts of modification of stream flow on natural ecosystems.

Beaver Ecology

Studies on beaver ecology and field observations on the Reservation indicate that beaver depredation on cottonwood is a major factor in declines of cottonwood forest on the Fort Peck Reservation. It is probable that historic operation of the Fort Peck Dam has influenced beaver population densities, distribution, and effects on cottonwoods.

General information on life history, behavior, and ecology of beavers is presented Olson and Hubert (1994) and Jenkins and Busher (1979). Beavers generally breed in January or February and give birth in May or June in lodges, constructed of mud and sticks, or in burrows excavated into riverbanks. Typically, bank burrows have underwater entrances that deter predators such as coyote and wolves and remain free of ice in winter.

Beavers live in family groups called colonies. Each colony of beavers occupies a reach of stream in common, uses a common food supply, and lives in the same burrows or lodges. Each colony is territorial and marks its territory with scent posts to deter use of space and food by neighboring colonies. Density of colonies and numbers of individuals varies depending on food supply, availability of sites suitable for winter burrows, history of flooding, and levels of mortality (e.g., from starvation, predation, trapping, and disease). Bergerud and Miller (1977) found that territorial behavior spaces colonies, dispersing populations within limits of food and water resources. However, territorial behavior does not prevent overutilization of food resources and population declines from reduced reproduction and increased mortality.

Beavers eat relatively large amounts of herbaceous vegetation in summer, but rely on trees and shrubs for critical winter nutrition. In order of preference, beavers eat aspen, willow, cottonwood, alder, and red-osier dogwood most frequently (Olson and Hubert 1995).

Dams can influence beaver populations by converting riparian areas to reservoir pools. Reservoir pools typically provide poor habitat for beavers because: shoreline vegetation is sparse, often lacking in favored food plants; reservoirs typically have unstable banks unsuitable for construction of burrows because wave action erodes banks and formation of winter ice separates beaver from water (burrows and security from predation) and food (Brown 1989, Bissell and Brown 1987).

Mack and others (1990) studied how Kerr Dam on the Flathead River has affected beaver and other wildlife. They found that stream flow fluctuations caused by Kerr Dam caused winter colony sites to be de-watered, flooded, and subjected to extreme shoreline icing. Heavy icing followed by rising water levels dislodged beaver food caches.

Lesica and Miles (1998) found that high beaver populations on the Marias River of Montana greatly affect riparian ecology by destroying cottonwoods and allowing proliferation of Russian olive. They speculate that the Tiber Dam that increases the number of potential den sites safe from flooding and severe drawdown may have enhanced beaver populations through flow regulation. This effect on population is supported by studies of Collins (1976), which found dramatic population movements occurred when beavers abandoned dwelling sites (lodges and burrows) due to seasonally high and low stream flows.

Beaver populations are controlled largely by dispersal (Olson and Hubert 1994). Two-year old beavers leave the colony in late spring in search of mates. Dispersing two-year old beavers usually move 5 to 10 miles with moves of over 100 miles being reported. Mortality during dispersal is usually substantial.

METHODS

Data on cottonwoods were collected at 30 randomly located circular plots, 0.1-acre in size, located on tribal or allotted lands. Sample plots were located on floodplain terraces, usually about 10-15 feet above the surface of the river at the time of sampling (i.e., September). Major floods that occurred prior to construction of the Fort Peck Dam periodically inundated these terraces. Map of plot locations are included in Appendix A.

Data was collected for number of trees, tree height, tree diameter, age, crown condition, and reproduction of seedlings and saplings. Tree ages were estimated by coring trees with an increment borer. Appendix B includes the field forms and data collected for each plot. Trees that were dead or damaged by beavers were also recorded. Joe Elliott and Drake Barton collected data during the week of September 10-14, 2001. Access to randomly located plots was by gained by working from a canoe.

Mark Teply of Larix Systems, Inc. generated random plot locations and statistically analyzed the data collected in this study. Tree data were summarized on a plot basis for the following parameters: average diameter at breast height (DBH), trees per acre, basal area, and cubic volume. With the exception of volume, parameters were summarized for both live and dead trees. Volume estimates were calculated for live trees only and were based on gross volume tables prepared by Edminster et al. (1997) for plains cottonwood. Log-linear diameter-height relationships were developed from these data to support volume estimation. Live tree data were also summarized based on stocking classes described by Meyer and Buchman (1984) by way of descriptive statistics for each parameter of interest and DBH class distributions.

RESULTS

Relatively open stands of Great Plains cottonwood (*Populus deltoides*) are the dominant forest community on upper floodplain terraces (10-15 above the level of the river during low-flow periods) along the Missouri River. Although the spatial extent of cottonwood woodlands have been reduced by clearing of land for agriculture and other factors, cottonwood woodlands still are present on substantial areas of the Missouri River floodplain, often extending a mile or more from the river.

Riparian communities along the Missouri River, on the Reservation, typically consist of an overstory dominated by Great Plains cottonwoods (40-80 percent canopy cover). Cottonwood stands tend to be even-aged with relatively consistent diameters ranging from 12-40 inches in diameter. Although it was not possible to accurately determine tree ages because most mature trees have heart rot, it appears that nearly all the trees are more than 70 years old with many trees being over 100 years old. Most cottonwoods are declining in vigor as evidenced by numerous dead tops, many missing branches, and numerous cavities in the boles. No cottonwood reproduction (i.e., no seedlings or saplings) was recorded for any of the sites sampled. Photographs of sites in the study area are included as Appendix C.

Table 1 presents plot summaries for live and dead trees sampled along the Missouri River. Figure 1 presents graphically live tree stand structure results reported in Table 1 where plot number increases with distance traveled down river. Live tree stand structure was predominated by cottonwoods. On a basal area basis, percent contribution by cottonwoods ranged between 89 and 100 percent. About three-quarters of these plots would be considered overstocked according to basal area and trees per acre guidelines presented in Meyers and Buchman (1984). Remaining plots were mostly fully stocked with few plots that would be considered understocked. Though there is an evident periodic trend in parameter data over distance down river, the lack of ancillary data makes it difficult to interpret.

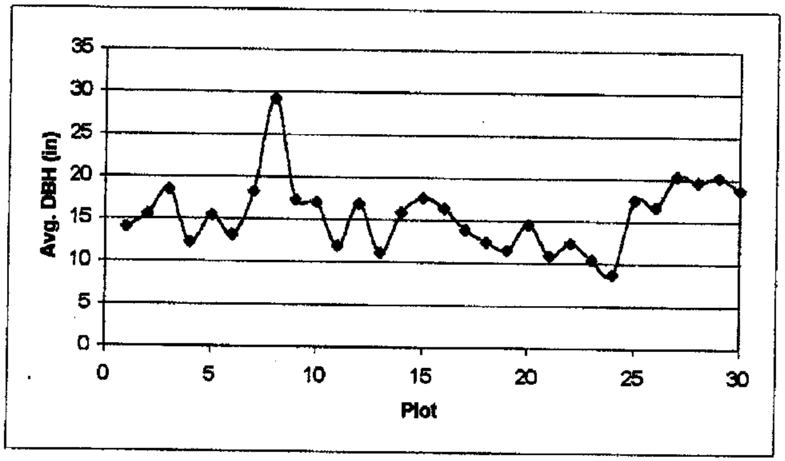
Table 2 summarizes live tree data by stocking class and Figure 2 presents diameter at breast height (DBH) class distributions for each stocking class. Generally, average DBH among stocking classes did not vary; however, there were expectedly increases in trees per acre, basal area, and cubic volume as stocking class increased. The most apparent distinguishing feature among these stocking classes was DBH class distribution. Fully stocked plots are closest in exhibiting a "J"-shaped DBH class distribution. Highest contribution was coming from trees 5 to 10 inches DBH and stocking levels generally decrease through to the 35-inch and greater DBH class. Understocked plots were predominated by mid-sized trees (15 to 20 inches DBH) and almost no trees 20 inches and greater are represented. Overstocked plots differ from fully stocked plots by higher numbers of trees 5 to 20 inches DBH, represented in greater proportion by shade tolerant species such as green ash.

Table 1. Plot Data Summaries, Riparian Cottonwood Study, Missouri River, Fort Peck Reservation, Montana.

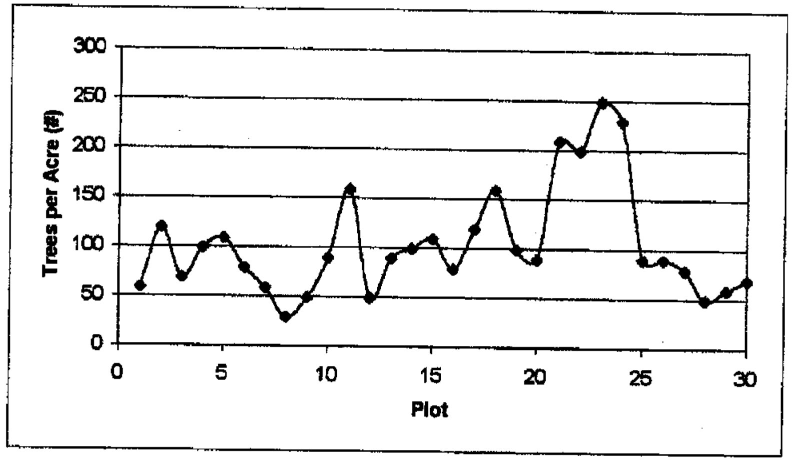
		Live Trees				Dead Trees (3)		
Plot	Stocking Class (1)	Average DBH (in)	Tree per Acre (#)	Basal Area (sqft/ac)	Cubic Vol. (2) (cuft/ac)	Average DBH (in)	Tree per Acre (#)	Basal Area (sqft/ac)
01	Fully Stocked	14.2	60	104.8	3,431			
02	Overstocked	15.7	120	172.1	6,237			
03	Overstocked	18.6	70	144.6	6,070			
04	Overstocked	12.4	100	163.6	7,759	26.0	10	36.9
05	Overstocked	15.5	110	148.4	5,282			
06	Fully Stocked	13.3	80	88.1	3,002	18.0	10	17.7
07	Fully Stocked	18.3	60	117.2	4,916	17.0	20	32.5
08	Overstocked	29.3	30	143.4	6,007			
09	Understocked	17.4	50	83.4	3,302	17.5	20	33.7
10	Overstocked	17.1	90	146.5	5,496			
11	Overstocked	12.0	160	140.8	4,621	7.0	10	2.7
12	Understocked	17.0	50	79.6	2,872			
13	Understocked	11.2	90	79.2	2,780	25.0	10	34.1
14	Overstocked	16.0	100	151.0	5,665	11.0	10	6.6
15	Overstocked	17.7	110	205.5	8,139	8.7	30	13.0
16	Overstocked	16.5	80	129.8	4,960			
17	Overstocked	14.0	120	131.2	4,407			
18	Overstocked	12.6	160	153.0	5,140			
19	Fully Stocked	11.7	100	89.8	3,061	7.0	30	8.3
20	Overstocked	14.7	90	123.2	4,631			
21	Overstocked	11.0	210	154.3	4,415	7.4	100	31.3
22	Overstocked	12.6	200	187.1	6,242			
23	Overstocked	10.6	250	168.4	5,133			
24	Overstocked	8.9	230	109.2	3,059	7.0	10	2.7
25	Overstocked	17.7	90	191.3	7,844			
26	Overstocked	16.8	90	153.9	6,048			
27	Overstocked	20.5	80	221.9	9,850			
28	Fully Stocked	19.8	50	122.3	5,130			
29	Overstocked	20.3	60	138.0	5,714			
30	Overstocked	18.9	70	138.8	5,417			

Notes:
(1) - Based on trees per acre and basal area per acre as described in Myers and Buchman (1984).
(2) - Based on gross volume tables for plains cottonwood in Edminster et al. (1977).
(3) - Includes standing dead trees (snags) and recent downed dead trees due to beaver kill.

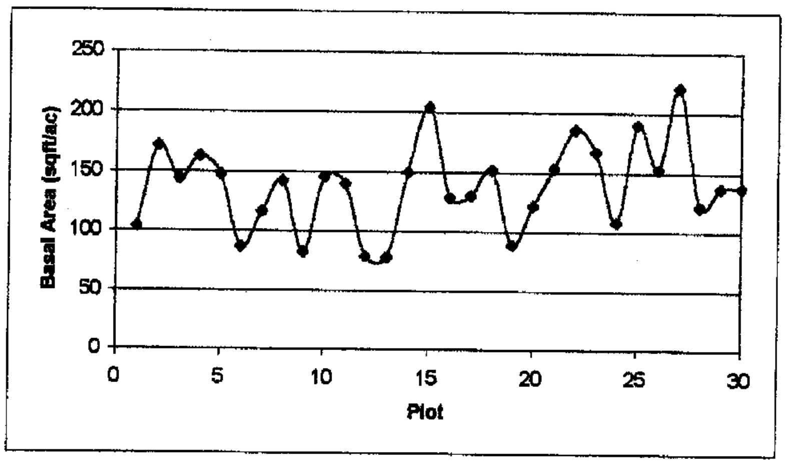
Figure 1. Live Tree Stand Structure, Riparian Cottonwood Study, Missouri River, Fort Peck Reservation, Montana.



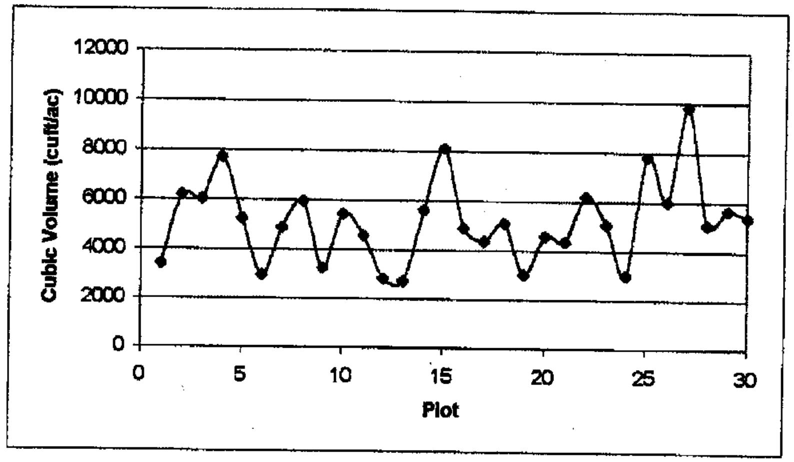
1a. Average DBH



1b. Trees per Acre



1c. Basal Area



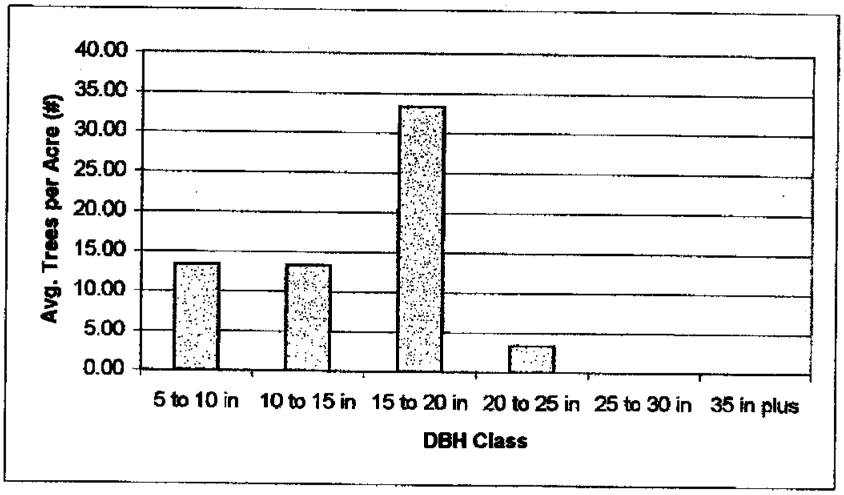
1d. Cubic Volume

Table 2. Live Tree Summary Statistics by Stocking Class, Riparian Cottonwood Study, Missouri River, Fort Peck Reservation, Montana.

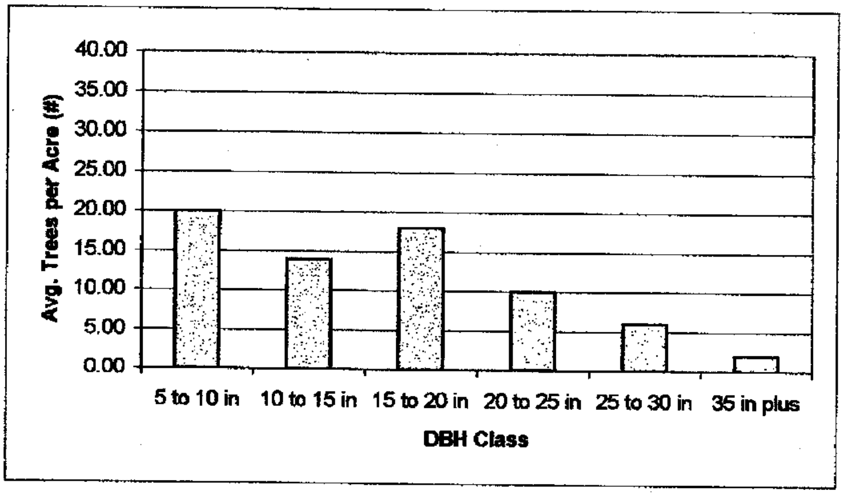
Parameter	Statistic	Stocking Class: Understocked	Fully Stocked	Overstocked	All Plots
Number of Plots	n	3	5	22	30
Average DBH (in)	min	11.2	11.7	8.9	8.9
	max	17.4	19.8	29.3	29.3
	avg.	15.2	15.5	15.9	15.7
	sd	3.5	3.5	4.4	4.1
Trees per Acre (#)	min	50	50	30	30
	max	90	100	250	250
	avg.	63	70	119	105
	sd	23	20	58	56
Basal Area (sqft/ac)	min	79.2	88.1	109.2	79.2
	max	83.4	122.3	221.9	221.9
	avg.	80.7	104.4	155.3	139.3
	sd	2.3	15.5	27.0	36.3
Cubic Volume (cuft/ac)	min	2780	3002	3059	2780
	max	3302	5130	9850	9850
	avg.	2985	3908	5824	5221
	sd	279	1034	1491	1689

Figure 2. Live Tree DBH Class Distribution by Stocking Class, Riparian Cottonwood Study, Missouri River, Fort Peck Reservation, Montana.

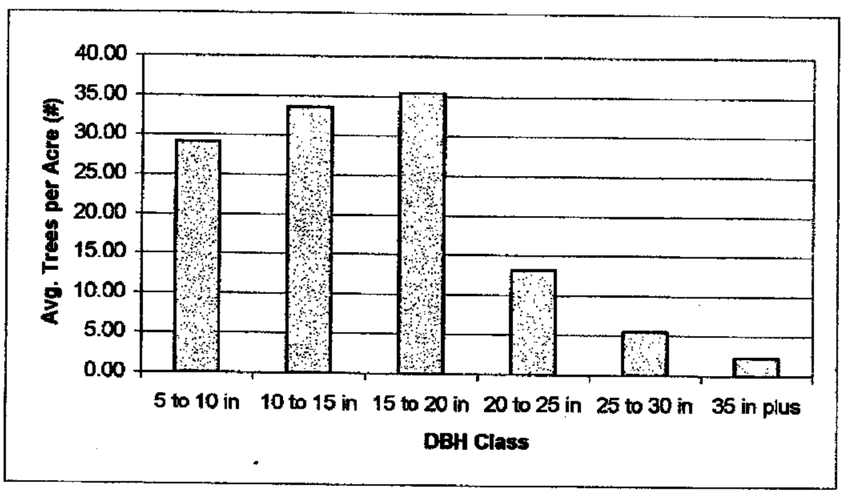
2a. Understocked



2b. Fully Stocked



2c. Overstocked



Cottonwoods are relatively short-lived trees. The average live expectancy of a Great Plains cottonwood is 125 years (Miles et al 1993, Hansen et al 1995, and Wilson 1970). After about 125 years, green ash, box elder, and Russian olive replace cottonwoods if cottonwood regeneration is not initiated by flooding and sediment deposition.

Hanson et al (1995) classified the plant communities sampled in this study as the Great Plains cottonwood/western snowberry community type. Common understory shrubs and trees in this community include green ash *(Fraxinus pennsylvanica)*, silver buffaloberry (*Sheperdia argentea*), chokecherry (*Prunus virginiana*), snowberry (*Symphoricarpos occidentalis*), poison ivy (*Toxicodendron rydbergii*), and Wood's rose (*Rosa woodsii*). Several stands sampled had dense stands of the exotic small tree, Russian olive (*Eleagnus angustifolia*) forming a secondary canopy from 25-30 feet in height, under taller cottonwoods (mostly from 85 to 95 feet in height). Common herbaceous species include smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), wildrye (*Elymus canadensis*), wild licorice (*Glycerrhiza lepidota*), western needlegrass (*Stipa occidentalis*), and western wheatgrass (*Agropyron smithii*).

Green ash and Russian olive are the only trees reproducing on the higher river terraces of the study area. At some sites, green ash and Russian olive form a canopy layer under an aging, decadent canopy of cottonwoods. Unlike cottonwoods, neither green ash nor Russian olive requires periodic flooding to reproduce.

Where fire or beavers have killed cottonwoods, green ash and Russian olive increase in density. These two species respond to fire or cutting by sprouting from root crowns or stumps whereas older cottonwoods are usually killed and often do not sprout from roots or severed trunks.

Beavers also show a marked preference for cottonwoods over green ash and Russian olive. Lesica and Miles (2001), in studies on the Marias and Yellowstone rivers in Montana found that beavers were far more likely to kill cottonwoods than Russian olive. The preferential selection of beavers for cottonwoods over Russian olive increases the rate of conversion of cottonwood communities to Russian olive communities.

Green ash is a native species common in riparian areas of eastern Montana. Russian olive is an exotic, invasive species that is rapidly spreading in many riparian plant communities on the northern Great Plains. There is concern that Russian olive will replace native riparian forests, resulting in a loss of biological diversity (Lesica and Miles 2001, Knopf and Olson 1984).

Large populations of beavers are having a substantial effect on cottonwood trees in the study area. Many trees within 50 meters of the river have been gnawed or felled by beavers. Beaver populations have increased throughout most of Montana because trapping has declined due to low fur prices. Large beaver populations below the Fort Peck Dam may also be due to the release of controlled flows from the Dam. With control of large floods, beaver dens are at reduced risk of being flooded or removed by bank erosion. Ice formation, which can also adversely affect beavers, has also been influenced by discharge of relatively constant temperature water from the Fort Peck Dam.

DISCUSSION

Cottonwood woodlands on the higher terraces along the Missouri River are declining because reproduction is not replacing trees that are dying or being killed by beavers and fire. The average life span of a Great Plains cottonwood is about 125 years or less. Most cottonwoods on floodplain terraces are older than 80 years. Within 20-50 years the cottonwood woodlands that often extend a mile or more from the Missouri River will be replaced by woodlands dominated by green ash, Russian olive, and shrubs such as choke cherry, silver buffaloberry and silver sagebrush (*Artemisia cana*).

Cottonwoods are not reproducing because overbank flooding of the higher stream terraces along the Missouri River has been eliminated by containment of major floods by the Fort Peck Dam. Also, the rate at which lateral channel migrations take place has been greatly reduced due to operation of the Fort Peck Dam. Reduced rates of channel migration reduce the potential for cottonwood regeneration on sandbars, islands and stream banks.

Another influence of the Fort Peck Dam on vegetation concerns downcutting (degradation) of the channel downstream from the Dam. Sediment normally carried suspended in the Missouri River settles out in the reservoir behind the dam. Water discharged from the dam has very low suspended sediment loads; consequently, the river tends to downcut the channel, thereby increasing the elevation of the floodplain terraces above the river level. Increased height of the floodplain terraces above the channel decreases soil moisture levels in terraces causing moisture stress in cottonwoods especially during the late summer and fall when river levels are lowest.

Although cottonwood reproduction is not taking place on higher floodplain terraces, cottonwoods are reproducing on recent sand bars, islands, and lower terraces that are periodically inundated with current operation of the Fort Peck Dam. Numerous sand bars and islands, within a few feet of the water surface during the low-flow period (i.e., September) have dense stands of cottonwood seedlings. A few higher sites (5-7 feet above the river level during the base-flow period), that are not flooded and scoured every year by high flows, have developed stands of young cottonwood trees and saplings.

Cottonwood reproduction is occurring only along a very narrow zone where fluctuations of river flows periodically inundate low floodplain terraces immediately adjacent to the river or on instream sandbars and islands that are unstable and shift due to erosion and deposition that accompany changing river flows. Although young seedlings and saplings often form dense stands on alluvial deposits close to the river, these young colonies of cottonwood experience high levels of mortality from frequent flooding, erosion, and ice scouring

As the more extensive, mature and decadent cottonwood forests on the upper river terraces gradually decline and are replaced by green ash and Russian olive, beavers, will concentrate their foraging on the cottonwoods that are reproducing on lower terraces, islands, and sand bars. Because cottonwood reproduction is taking place on only a narrow zone along the river, these young cottonwoods will become extremely vulnerable to beaver-caused mortality.

Areas on higher terraces, where beavers are now killing cottonwoods will be devoid of cottonwoods in the future, forcing beaver populations to concentrate on a smaller food supply. The result will likely be that beavers decimate cottonwood reproduction before trees can reach maturity.

RECCOMMENDATIONS

The current study established that extensive cottonwood stands on river terraces are not reproducing and will likely be largely gone in 20-50 years. Since it is not feasible or desirable to allow the Missouri River to flow unimpeded by the Fort Peck Dam, regenerating cottonwoods through flooding, scouring, and sediment deposition is not an option. Artificial regeneration of cottonwoods could be initiated on sites where maintaining cottonwood forests is desirable from an ecological, cultural, or spiritual perspective.

Manipulation of diameter classes would provide limited improvement in the cottonwood component. In overstocked stands, thinning of trees 20 inches and less could yield DBH class distributions that approximate those in fully stocked stands. However, residual trees in these would be either tolerant species, such as green ash, or cottonwoods that have been suppressed and would therefore be unlikely to respond to thinning. Improvements in the cottonwood component would likely only occur through artificial establishment of cottonwoods as noted above.

Because beavers are having a substantial influence on cottonwood mortality and will likely limit future cottonwood regeneration (which is occurring on a limited area), reductions of beaver populations may be desirable. Alternatively, protecting cottonwood stands with mesh or fencing could also reduce beaver damage.

Sites where cottonwoods are regenerating are limited to low terraces, sand bars, and low islands. These areas are limited in size and may be too unstable with regard to erosion and deposition dynamics to support cottonwood communities until the communities develop into mature stands. Mapping the spatial extent of areas where cottonwoods are regenerating and monitoring changes of these sites would provide information on the future probability that some cottonwood stands might reach maturity.

To accurately map areas of cottonwood regeneration, aerial photographs (scale 1: 24,000 or larger) taken in late summer, would be necessary. Interpretation of aerial photographs, combined with on-the-ground reconnaissance, would be needed to delineate areas with viable cottonwood stands. Comparison of aerial photography of the Reservation, taken in

1979, with new photography for the Reservation would allow comparisons to be made concerning changes in the spatial extent of various seral stages of riparian communities. Rates of channel migration, sand bar and island formation, and losses of cottonwoods due to fire and beavers could be determined by comparison of recent aerial photographs with historic aerial photographs.

Monitoring changes of cottonwood mortality, reproduction, and growth could be conducted through establishment of continuous forest inventory (CFI) plots randomly located in the forest. Tree measurements would be similar to that conducted for this study, but trees would be numbered and tracked through time. Parameter summaries would also be similar to that conducted for this study and, additionally, the following components of growth could be evaluated upon remeasurement: survivor growth, mortality, ingrowth, and removal. Overall, these data would support trend analysis explaining and predicting the change in cottonwood stand conditions over time.

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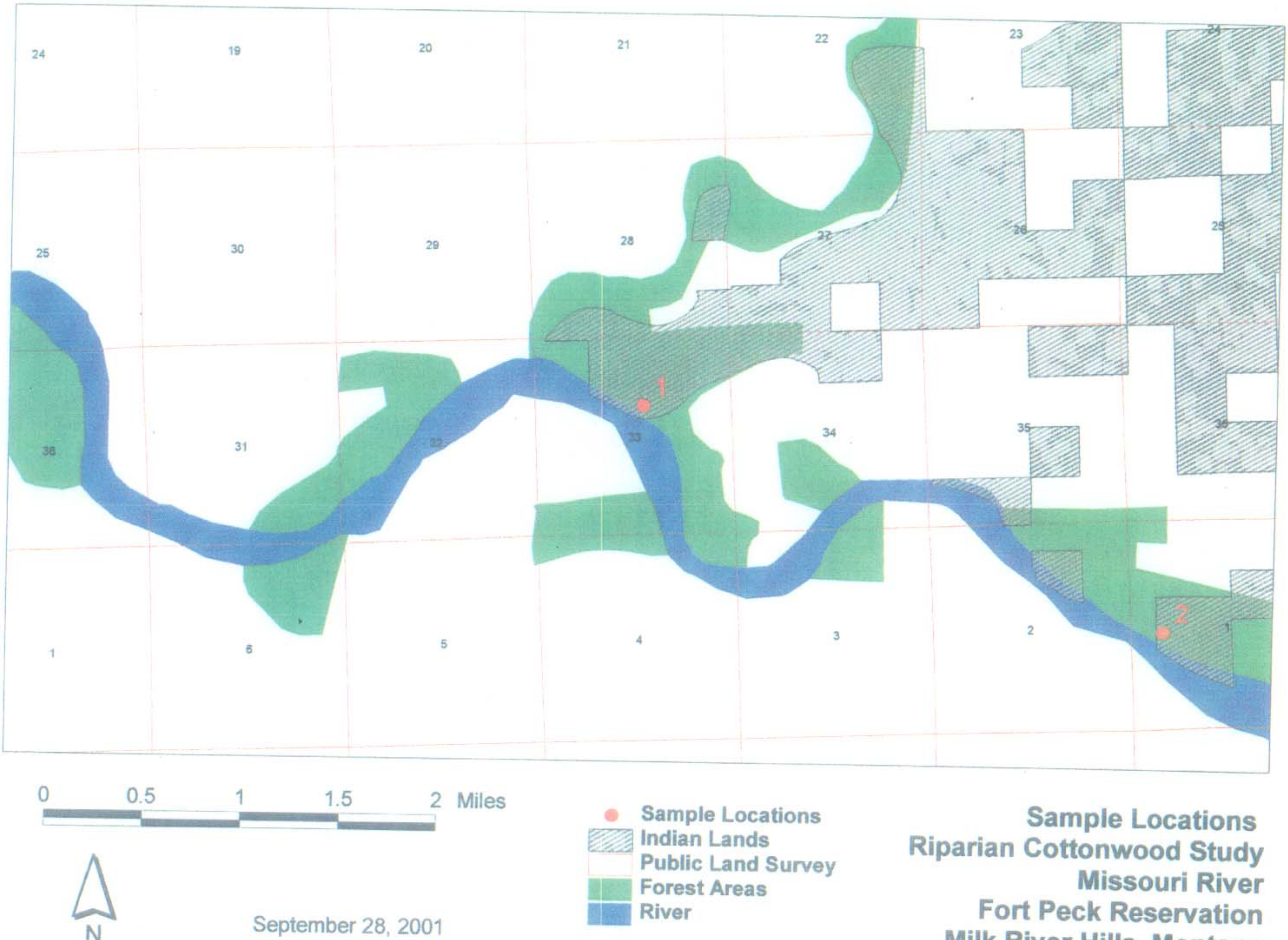
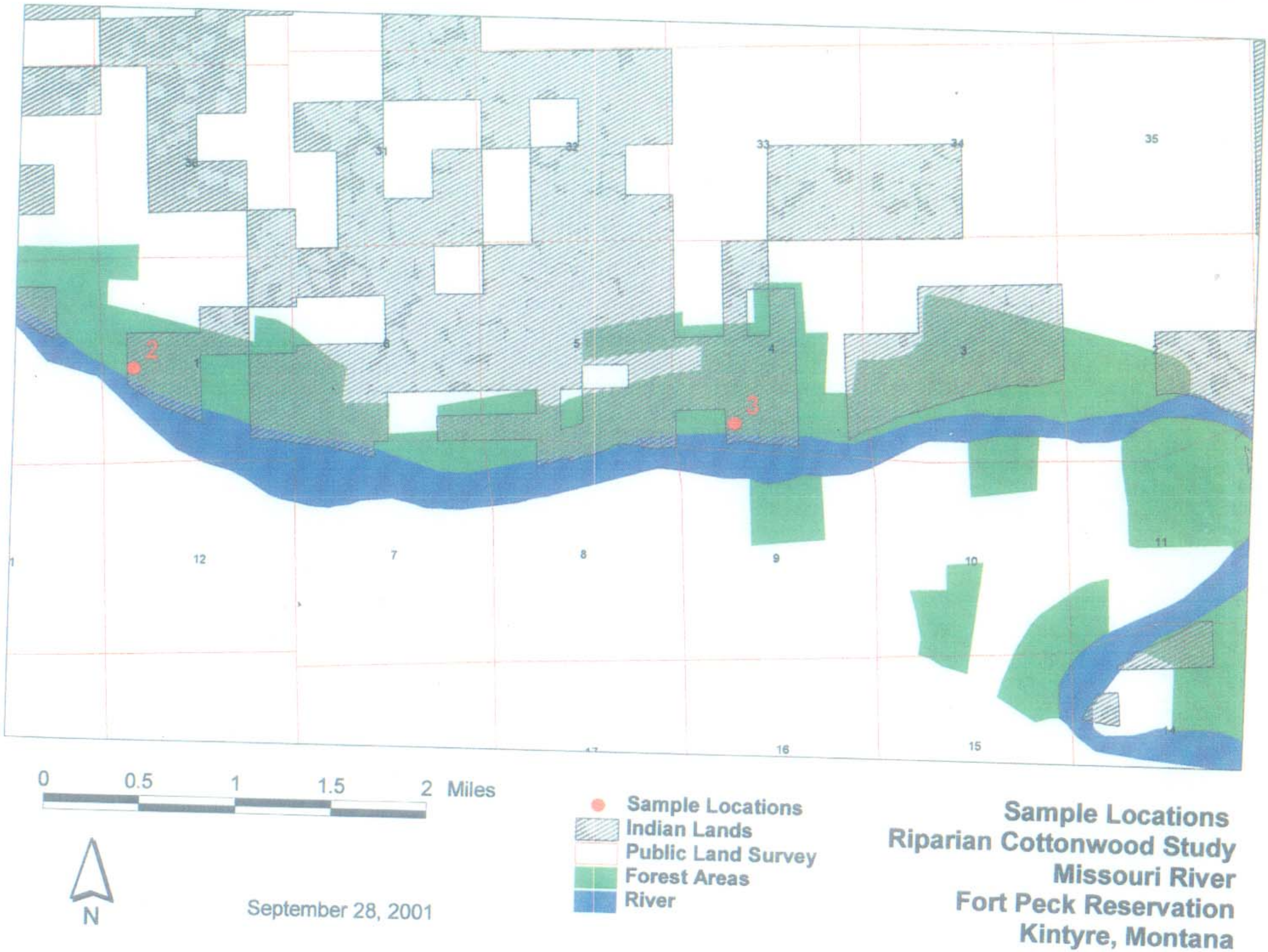
APPENDIX A

MAPS OF SAMPLE SITES



September 28, 2001

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Milk River Hills, Montana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10
11
16
15
14
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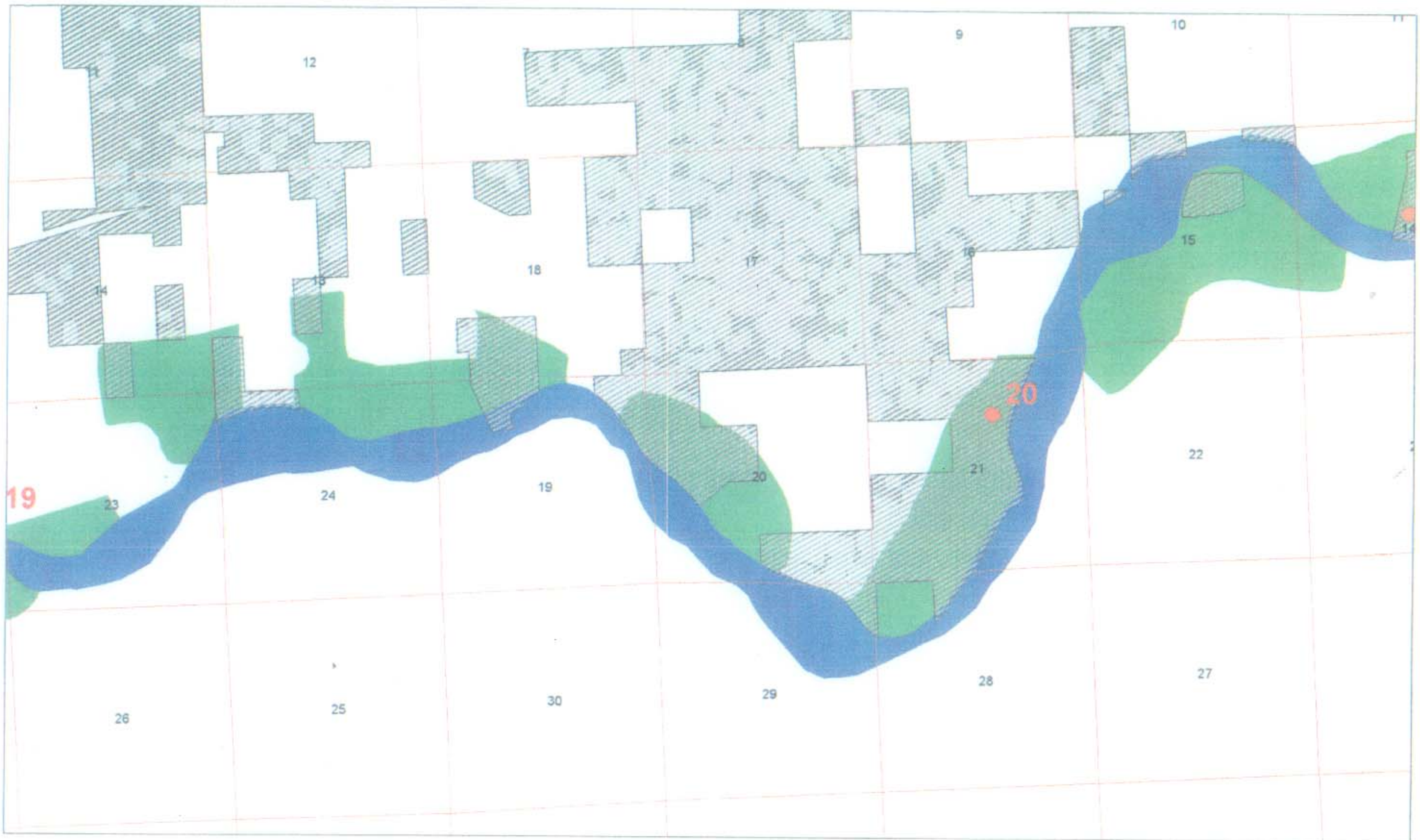
2 Miles
N
September 28, 2001
Sample Locations
Indian Lands
Public Land Survey
Forest Areas
River
Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Kintyre, Montana



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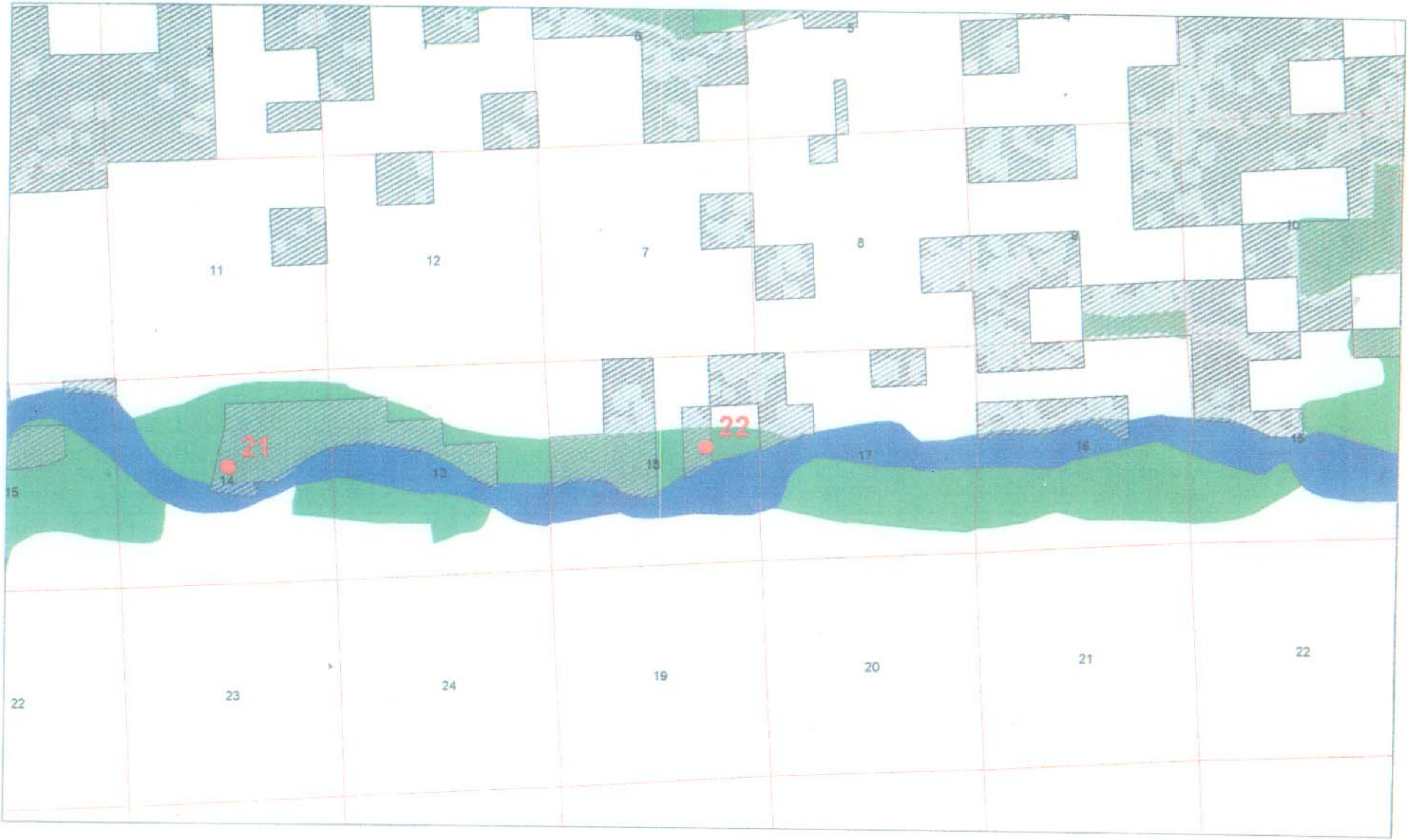
September 28, 2001

- Sample Locations
- Indian Lands
- Public Land Survey
- Forest Areas
- River

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Macon, Montana



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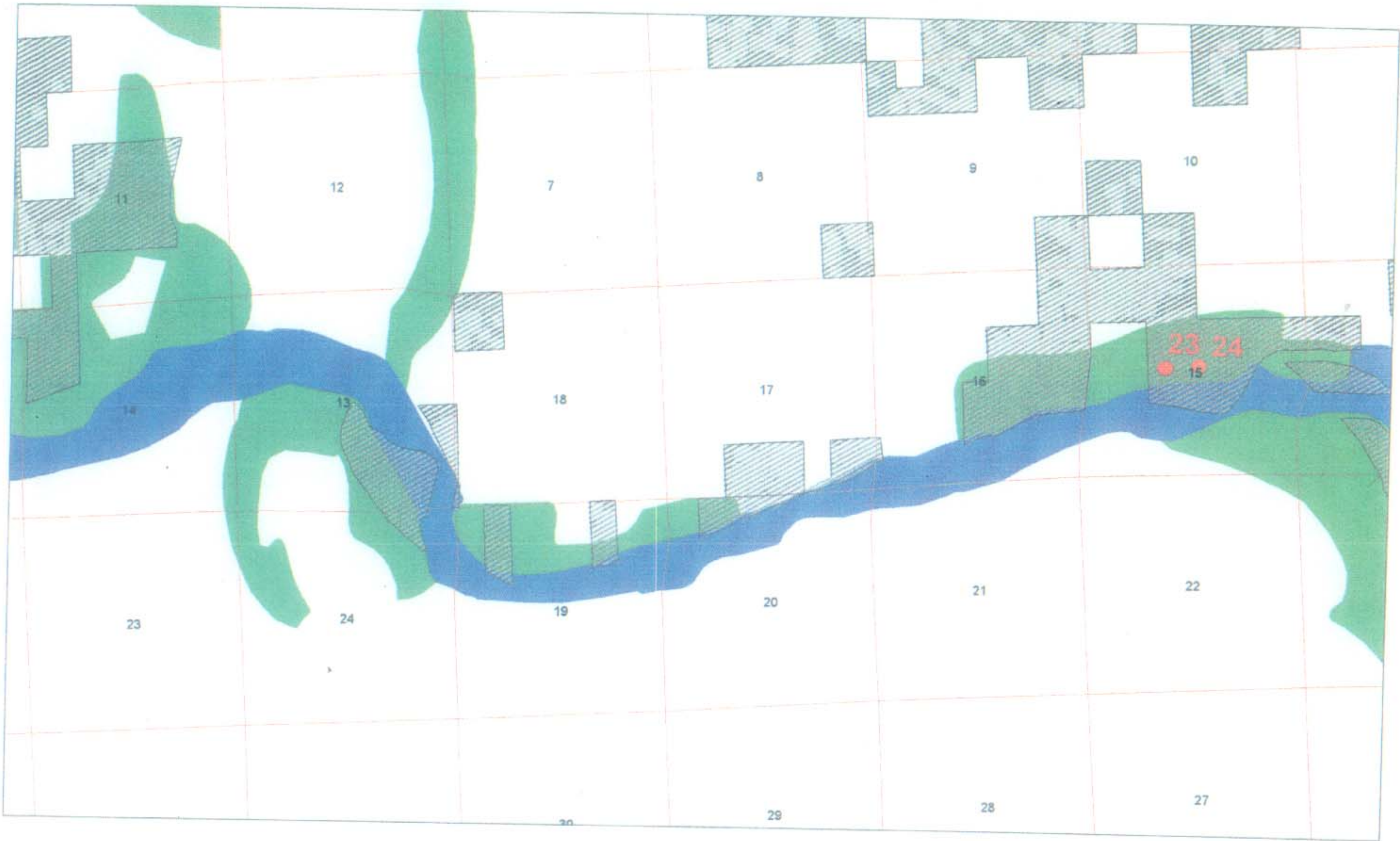
September 28, 2001

- Sample Locations
- Indian Lands
- Public Land Survey
- Forest Areas
- River

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Chelsea SW, Montana



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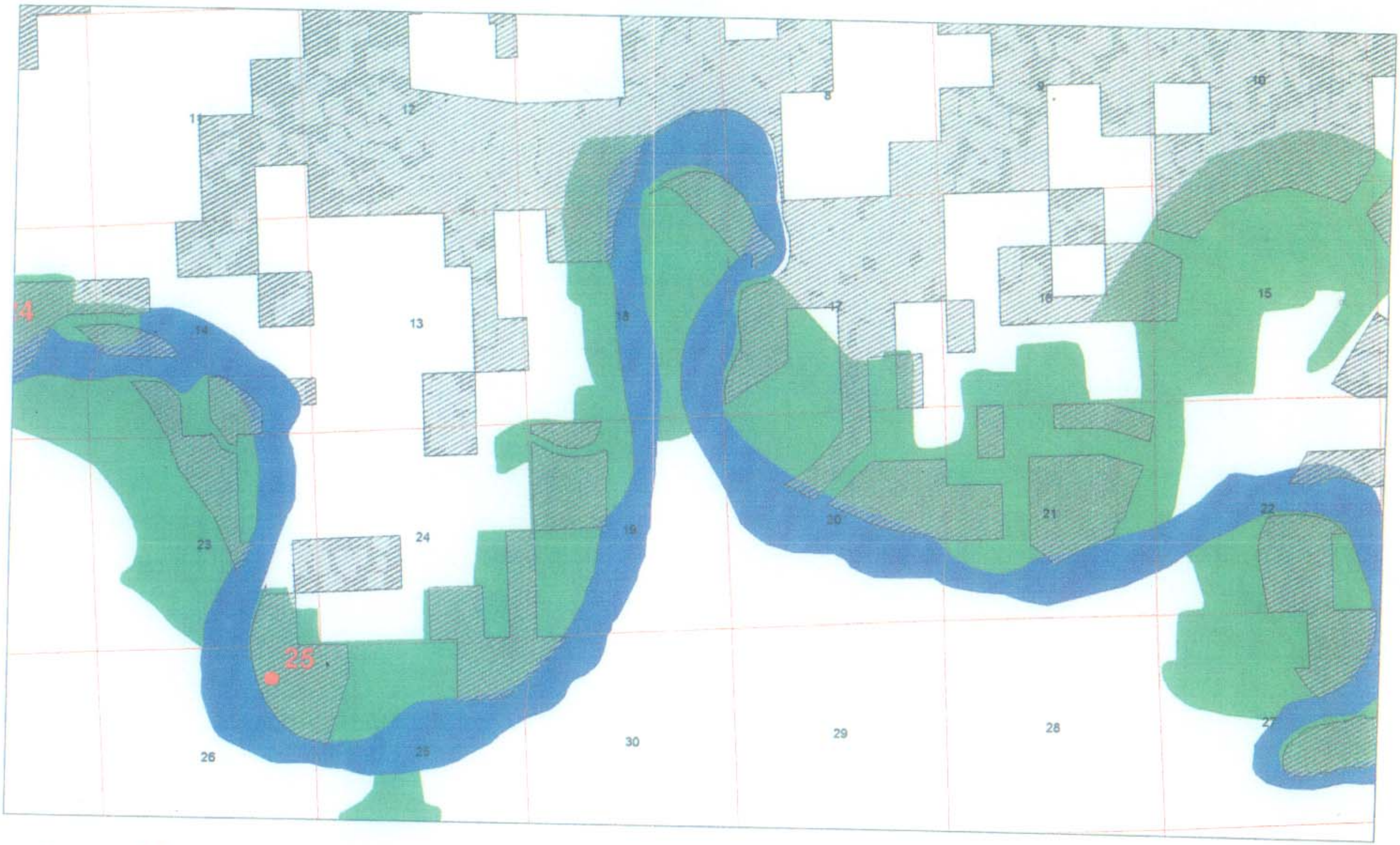
September 28, 2001

- Sample Locations
- Indian Lands
- Public Land Survey
- Forest Areas
- River

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Nickwall, Montana



0 0.5 1 1.5 2 Miles

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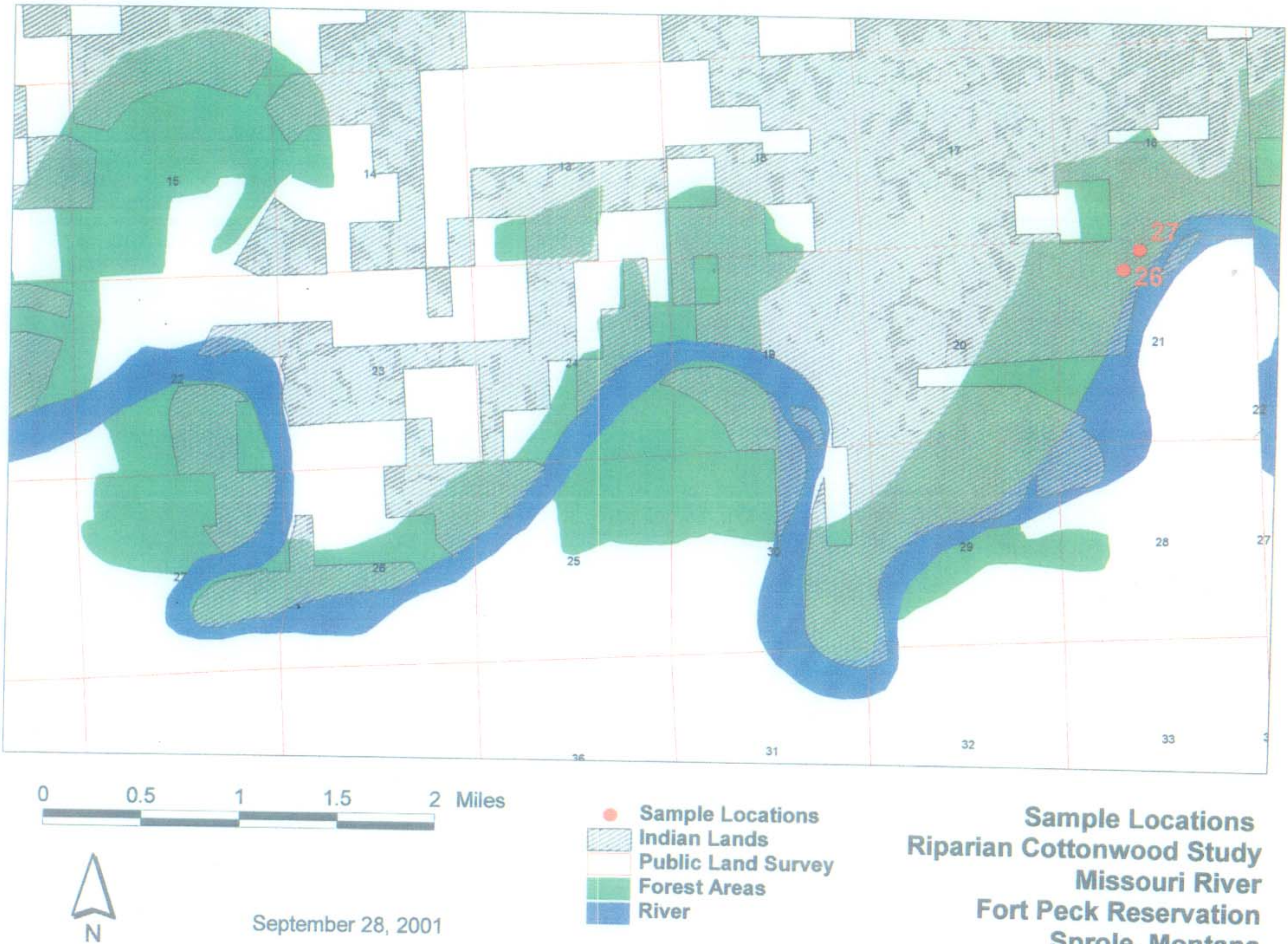
September 28, 2001

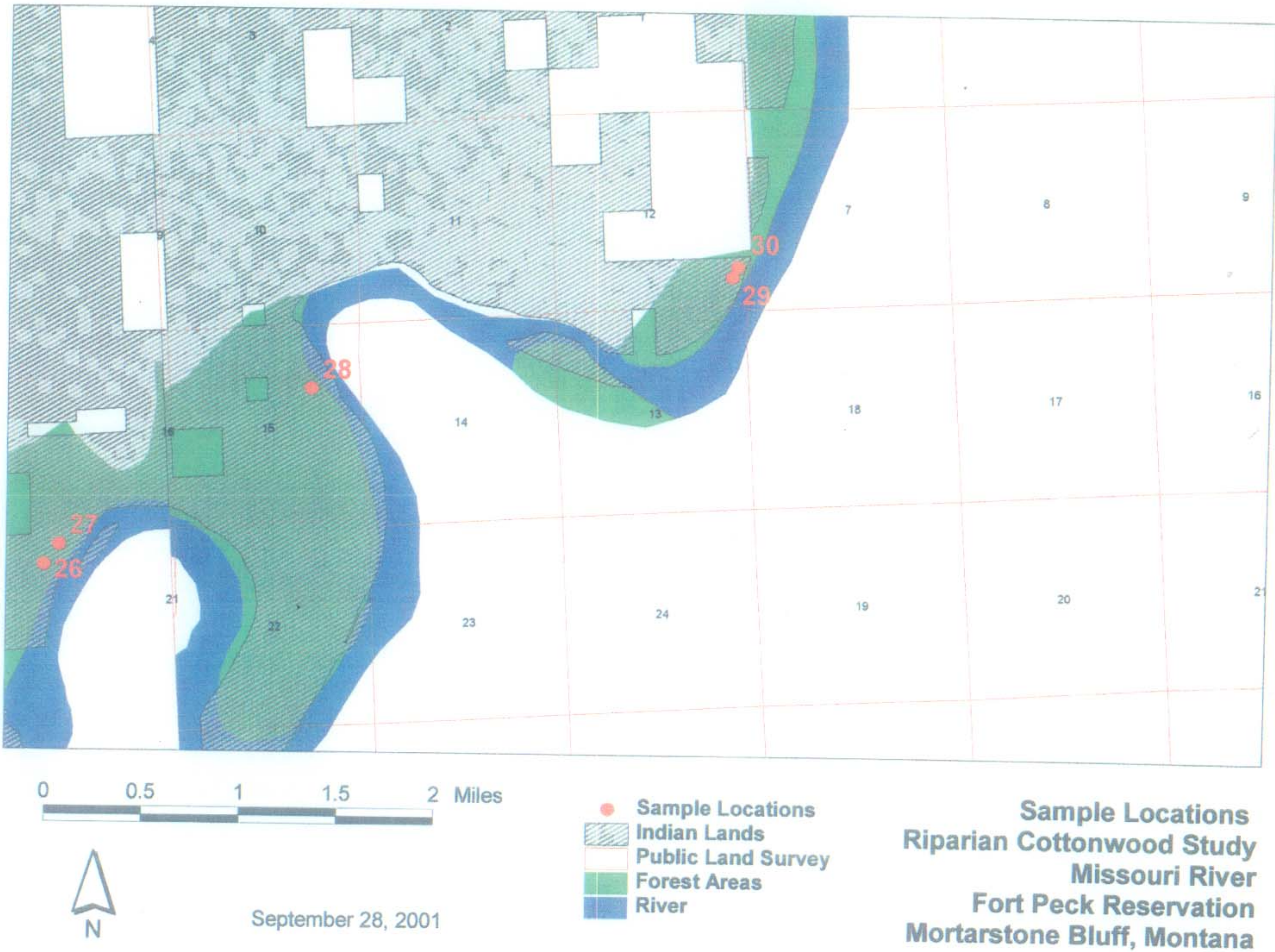
- Sample Locations
- Indian Lands
- Public Land Survey
- Forest Areas
- River

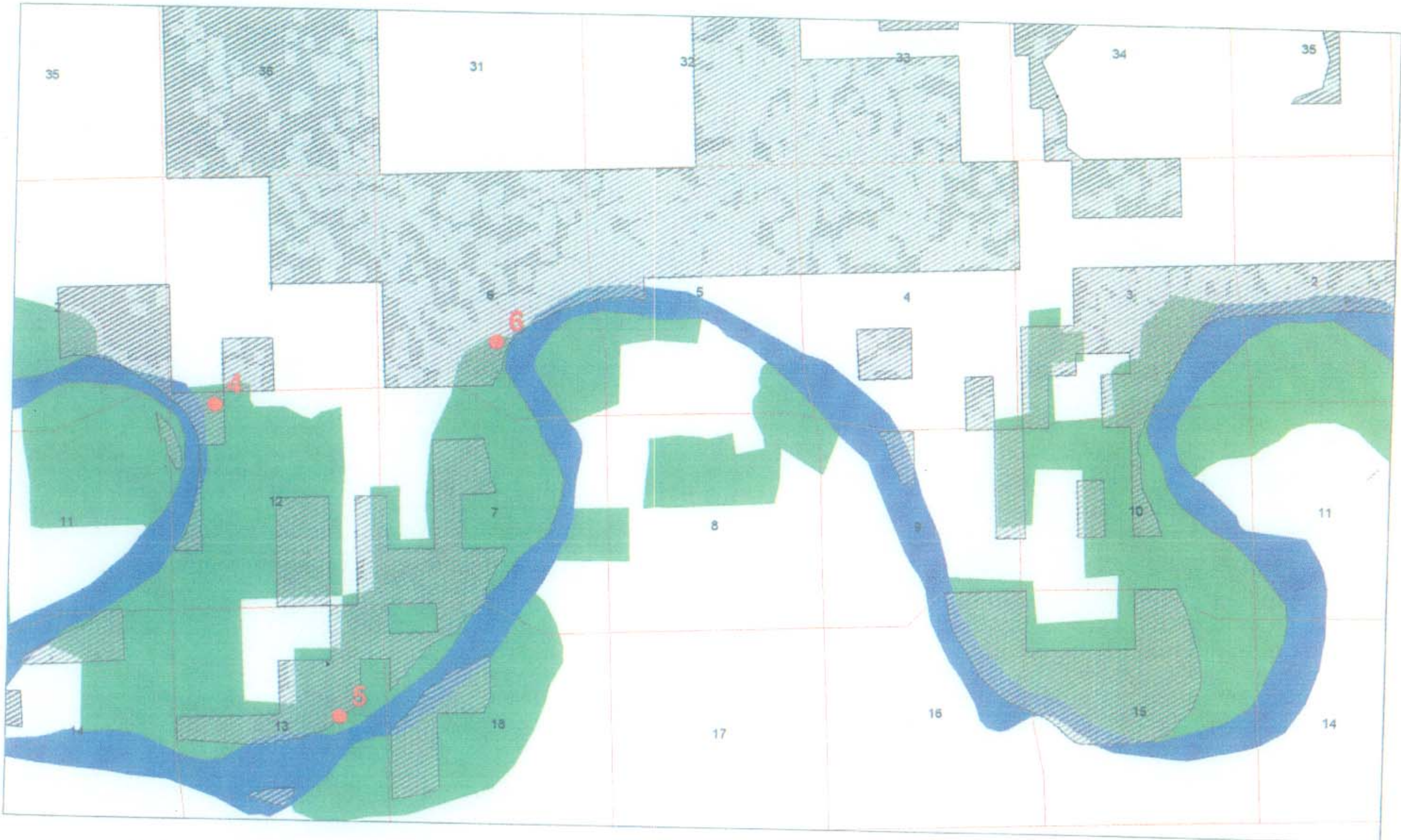
Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Poplar, Montana



September 28, 2001

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Sprole, Montana


30
29
28
27
26
0 0.5 1 1.5 2 Miles
N
September 28, 2001
Sample Locations
Indian Lands
Public Land Survey
Forest Areas
River
Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Mortarstone Bluff, Montana



0 0.5 1 1.5 2 Miles

N

September 28, 2001

- Sample Locations
- Indian Lands
- Public Land Survey
- Forest Areas
- River

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Frazer, Montana

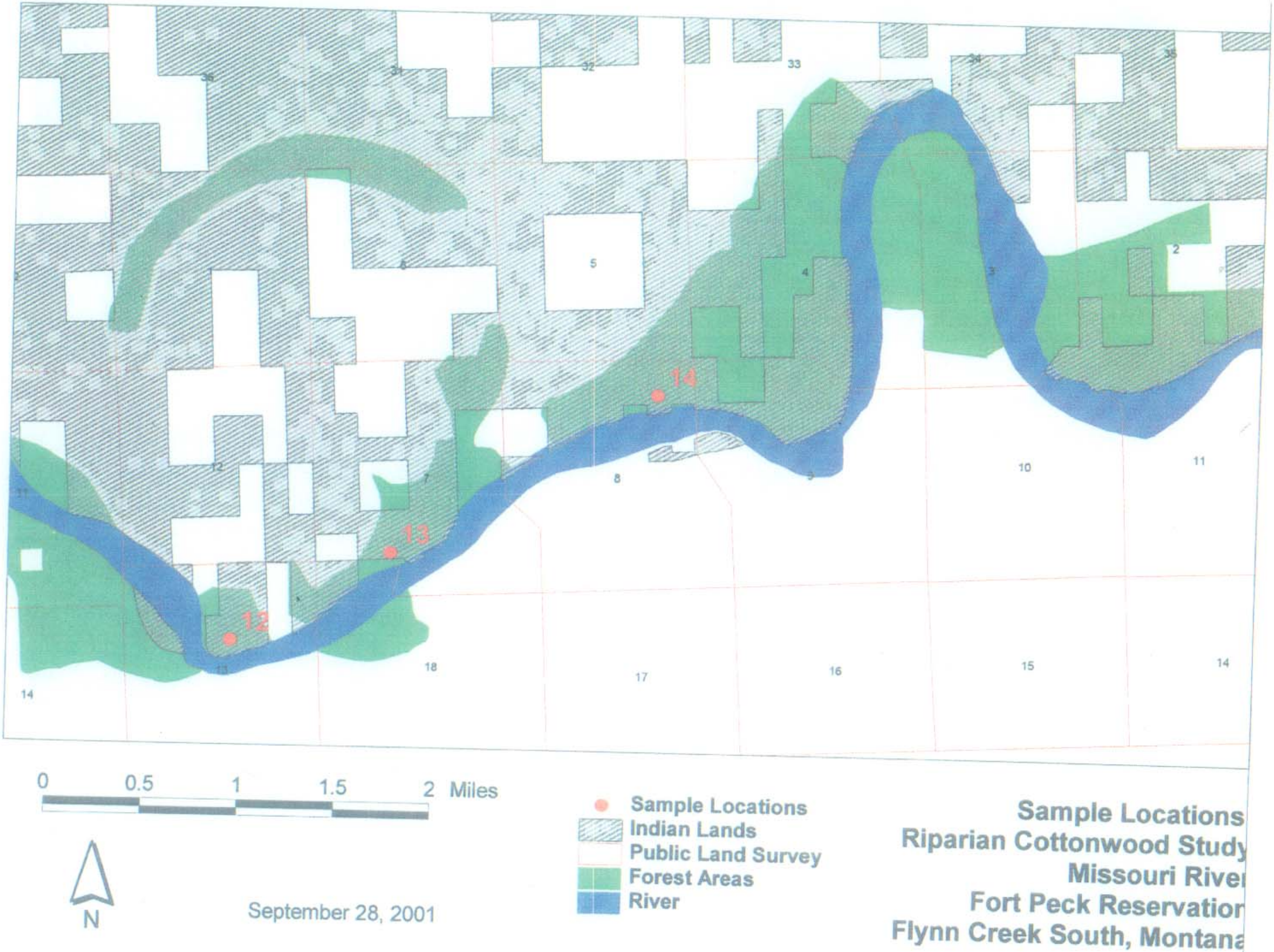
0 0.5 1 1.5 2 Miles

Sample Locations
Indian Lands
Public Land Survey
Forest Areas
River

N

September 28, 2001

Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Oswego, Montana



14
13
12
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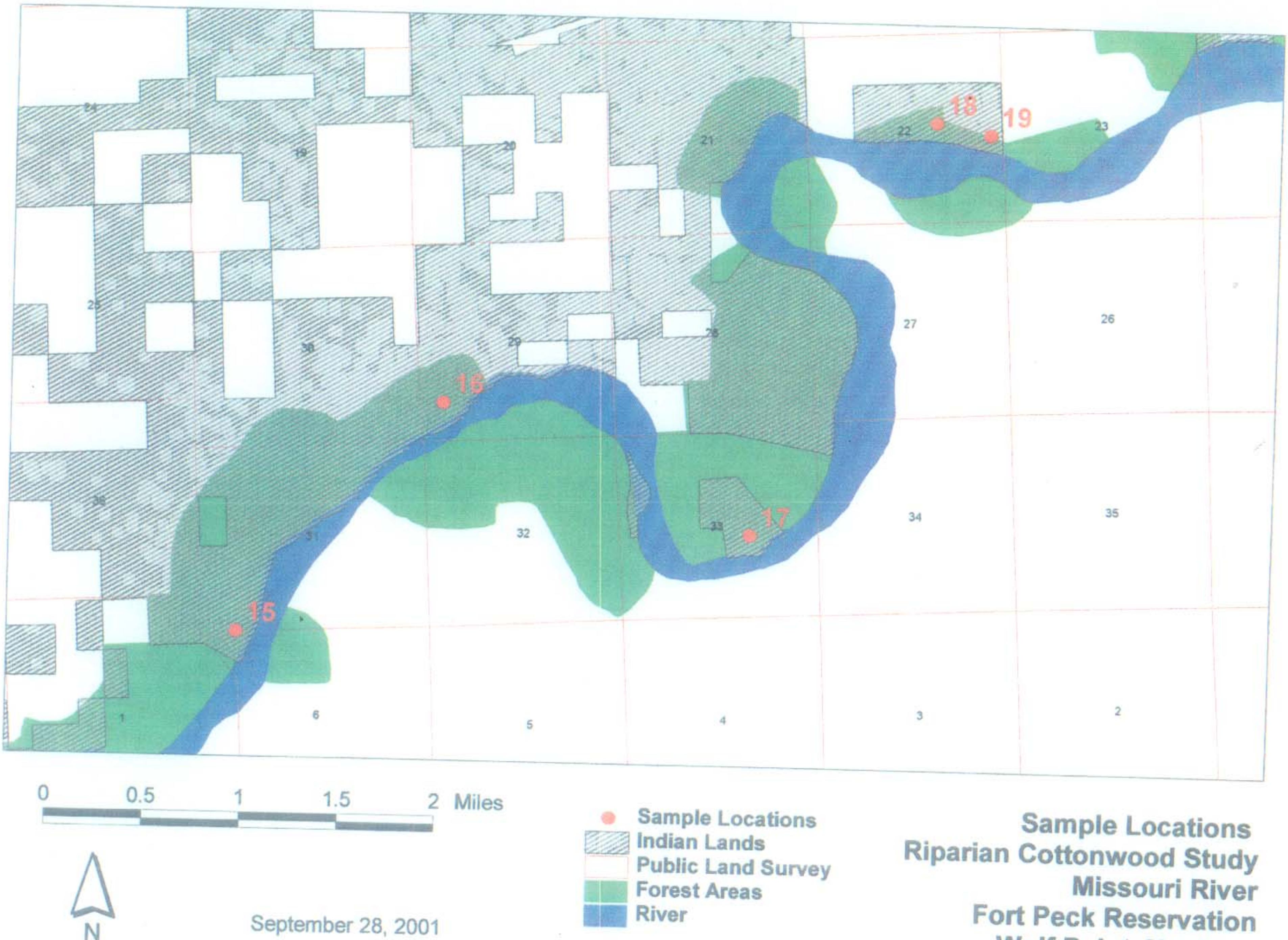
2 Miles
N
September 28, 2001
Sample Locations
Indian Lands
Public Land Survey
Forest Areas
River
Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Flynn Creek South, Montana



Sample Locations
Riparian Cottonwood Study
Missouri River
Fort Peck Reservation
Wolf Point, Montana

APPENDIX B

DATA FIELD FORMS

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: #1
Subplot:

Crew: [illegible]E/DB

Date: 9/10/01

Subplot Location: GRAZED TERRACE ~15' ABOVE RIVER
STIOCC 15% POAPRA 40% AGRTRA 5 SYMOCC
PHOTO #1 1/10 ACRE PLOT ELYVIR 15% ARTCAN T RODWOO 2

Forest Type: POP DEL
Percent Slope: 0
Aspect: 0
Physiography: TERRACE

Soil Group:
Soil Texture: SANDY
Soil Erosion: NONE
Litter Depth: 0-2"
Humus Depth:

Stand Structure: 2-STORY
Crown Cover: 40%
Ground Cover: 70%
Browsing Intensity: HIGH
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
FRAPEN	1	5	21	1	22								
FRAPEN	1	6	25	2	—								
FRAPEN	1	5	22	2	—								
POPDEL	1	11	65	2	39								
POPDEL	1	25	65	2	ROT.								
POPDEL	1	33	65	2	ROT.								

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

Rev. 8/25/01

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 2
Subplot:

Crew: JEI DB

Date: 9/10/01

Subplot Location: AGRSMI ELYVIR
POAPRA STLOCC PHOTO # 3 (AFTER GRAVEL BAR W/ CANOE PHOTO
SYMOCC BRDINE

Forest Type: POPDEC
Percent Slope: 0
Aspect: 0
Physiography: TERRACE 15' ABOVE RIVER

Soil Group: CLAY
Soil Texture: CLAY
Soil Erosion: 0
Litter Depth: 2
Humus Depth:

Stand Structure: 1 STORY
Crown Cover: 70%
Ground Cover: 90%
Browsing Intensity: MODERATE
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	9		2									
POPDEL	1	9		2	~40								
POPDEL	1	18		2									
POPDEL	1	17		2									
POPDEL	1	15		2									
POPDEL	1	19		2	ROT								
POPDEL	1	12		2									
POPDEL	1	19		2									
POPDEL	1	21	71	2	ROT.								
POPDEL	1	13		2									
POPDEL	1	14		2									
POPDEL	1	22		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 3
Subplot:

Crew: SE/DB

Date: 9/10/0

Subplot Location: TERRACE ~15' ABOVE RIVER
ELYTOX GLYLEP SYMOCC
BROINE PRUVIR SOLCAN

Forest Type: POP DEL
Percent Slope: 0
Aspect: 0
Physiography: TERRACE

Soil Group: SANDY LOAM
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 60%
Ground Cover: 100%
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Deca Soundr
POPDEL	1	21	85	2	—								
POPDEL	1	16	80	2	—								
POPDEL	1	28	85	2	ROT.								
POPDEL	1	7	75	1	40								
POPDEL	1	20	80	1	—								
POPDEL	1	19	80	2	—								
POPDEL	1	19	80	2	—								

80

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	3'	—	10					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 4
Subplot:

Crew: JE/DB

Date: 9/11/0

Subplot Location: TERRACE ~15 ABOVE RIVER
SYMOCC PRUVIR GLYCAN
RHUTOX BROINE ROSWOO

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography: TERRACE

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2-STORY
Crown Cover: 60
Ground Cover: 98
Browsing Intensity: UNGRAZE
Other Disturbance: BEAVER

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Deca Soundn
POPDEL	1	38		3		ROTTEN							
POPDEL	2	26	69	5		"							
FRAPEN	1	7		1									
FRAPEN	1	7		1	52								
FRAPEN	1	6		2									
FRAPEN	1	6		2									
FRAPEN	1	6		2									
FRAPEN	1	5		2									
POPDEL	1	35		3									
FRAPEN	1	6		2									
FRAPEN	1	8		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	3	—	2					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 5
Subplot:

Crew: JE/DB

Date: 9/11/01

Subplot Location: TERRACE 12-15 FEET ABOVE RIVER
SYMOCC RHUTOX STIOCC LINPER
ELYCAN POAPRA PARQUI

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography: TERRACE

Soil Group: SANDY LOAM
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 50%
Ground Cover: 85%
Browsing Intensity: LOW
Other Disturbance: BEAVER

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	13	69	2									
"	1	15	MULT	2									
"	1	13	TRUNK	2									
"	1	13	MULT	2									
"	1	14	TRUNK	2									
"	1	17	MULT	2									
"	1	15	TRUNK	2									
"	1	17	MULT	2									
"	1	21	TRUNK	2									
"	1	15	MULT	2									
"	1	18	TRUNK	2	70								

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	1.5'	—	3					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 6
Subplot:

Crew: JE/DB

Date: 9/11/01

Subplot Location: TERRACE AMEALN BROINE SYMOCC CORSTO PRUVIR RHUTOX
SPIRITUAL SITE PRAYER FLAGS ON COTTONWOOD
NO PHOTO

Forest Type: POPDEL/FRAPEN
Percent Slope: 0
Aspect: 0
Physiography: TERRACE (10')

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2-STORY
Crown Cover: 50
Ground Cover: 60
Browsing Intensity: NONE
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	7	58	1	49								
POPDEL	1	18	62	2	—	ROTTEN							
POPDEL	1	12		1	—								
POPDEL	1	18		1	—								
FRAPEN	1	5	25	2	50								
POPDEL	2	18	15	5	—	ROTTEN							
POPDEL	1	19		3	—								
POPDEL	1	17		2	—								
POPDEL	1	10			—								

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
FRAPEN	1	1	10'	1		NONE							
FRAPEN	1	1	8'	1									
FRAPEN	1	1	12'	1									

Seedling Data (trees less than 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 7

Crew: JE/DB

Date: 9/11/0

Subplot Location: TERRACE 10-15' ABOVE RIVER
SYMOCC ELEANG (1-small tree)
OSMGE
SHEARG RHUTOX

Forest Type: POP DEL
Percent Slope: 0
Aspect: 0
Physiography: TERRACE

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 50
Ground Cover: 90
Browsing Intensity: NONE
Other Disturbance: DEER

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POP DEL	1	23	99	2		ROTTEN							
"	1	14		2									
"	1	17		2									
"	1	11		2									
"	2	14	12	5									
"	1	23		2									
"	2	20	35	5									
"	1	22		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 8
Subplot:

Crew: JE/DB

Date: 9/11/01

Subplot Location: TERRACE 12-15'
SYMOCC 60% ELYCAN
RHUTOX SHEARG
NO PHOTO

Forest Type: POPDEL / FRAPEN
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2-STORY
Crown Cover: 50
Ground Cover: 75
Browsing Intensity: NONE
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Deca Soundn
POPDEL	r	26		2		ROTTEN							
POPDEL	1	27		2		"							
POPDEL	1	35	71	3		"							
FRAPEN	1	5	25	1									
FRAPEN	1	8	35	1	60+	ROTTEN							
FRAPEN	1	5		2									
FRAPEN	1	7	25	1									
FRAPEN	1	5	20	1									
FRAPEN	1	5	22	1									
FRAPEN	1	6	22	1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 9
Subplot:

Crew: JE/DB

Date: 9/11/01

Subplot Location: TERRACE 12-15' ABOVE RIVER
BROINE GLYLEP PRUVIR
SYMOCC SHEARG ELYCAN

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 50 %
Ground Cover: 95 %
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	19	96	1		ROTTEN							
POPDEL	1	14		2									
POPDEL	1	18		2									
POPDEL	1	18		2									
POPDEL	2	19	10	5									
POPDEL	2	16	55	5									
POPDEL	1	18		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
FRAPEN	1	1	12	1									
FRAPEN	1	2	14	1									

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 10

Crew: JE/DB

Date: 9/11/01

Subplot Location: TERRACE ABOVE RIVER
SAME AS #9

Forest Type: POP DEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 50 %
Ground Cover: 90 %
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	18	82	2									
POPDEL	1	17	MULT.	2									
POPDEL	1	17	TRUNK	2									
POPDEL	1	18		2									
POPDEL	1	16		2									
POPDEL	1	19		2									
POPDEL	1	19		2									
POPDEL	1	19		2									
POPDEL	1	11		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	5		1					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 11

Crew: JE/DB

Date: 9/11/01

Subplot Location:

TERRACE ABOVE RIVER (10-15')

NO PHOTO

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 80
Ground Cover: 40
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	12		2	~60								
POPDEL	1	12		2									
POPDEL	1	15		1									
POPDEL	1	14	65	1									
POPDEL	1	19		1									
POPDEL	1	7		1									
FRAPEN	1	5	42	1									
POPDEL	1	14	MULT	1									
POPDEL	1	13	TRUNK	1									
POPDEL	1	12		1									
POPDEL	1	11		1									
FRAPEN	1	6		2									
POPDEL	1	17		1									
POPDEL	1	13	MULT	1									
POPDEL	1	17	TRUNK	1									
FRAPEN	1	5		1									
POPDEL	2	7		5									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 12

Crew: JEIDB

Date: 9/12/0

Subplot Location: TERRACE
STIOCC ELYCAN RHUTOX
SYMOCC SHEARG

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1-STORY
Crown Cover: 45%
Ground Cover: 90%
Browsing Intensity: LOW
Other Disturbance:

84
80
6720

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	18		3		ROTTEN							
POPDEL	1	17	MULT	2									
POPDEL	1	17	TRUNK	2									
POPDEL	1	14		2									
POPDEL	1	19	72	2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 13

Crew: JE/JB

Date: 9/12/01

Subplot Location: TERRACE
SYMOCC AMEALN ELYCAN
RHUTOX PRUVIR

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2-STORY
Crown Cover: 70 %
Ground Cover: 60 %
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	2	25	32	5									
FRAPEN	1	7	36	2									
FRAPEN	1	5	35	2									
POPDEL	1	16		2									
POPDEL	1	23		3									
POPDEL	1	5		4									
POPDEL	1	16		2									
FRAPEN	1	5		2									
POPDEL	1	12		2									
POPDEL	1	12		2									
POPDEL	1	43	86	3									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
FRAPEN	1	2	14										

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	2'	—	1					

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Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: Stand Unit: Subplot: 14	Crew: JE/DB	Date: 9/12/10

Subplot Location: TERRACE
GLYLEP ELYCAN
RHUTOX POAPRA

Forest Type: POPDEL Percent Slope: Aspect: Physiography:	Soil Group: Soil Texture: Soil Erosion: Litter Depth: Humus Depth:	Stand Structure: 1 STORY Crown Cover: 60 Ground Cover: 70 Browsing Intensity: LOW Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	17		2		ROTTEN							
POPDEL	1	6		3									
POPDEL	1	14		1									
POPDEL	1	11		2									
POPDEL	1	18	78	2									
POPDEL	1	14		2									
POPDEL	1	18		2									
POPDEL	1	20		2									
POPDEL	2	11	17	5									
POPDEL	1	21		2									
POPDEL	1	21											

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	1		1					

Movements and Habitat Preferences of Adult Post Spawn Pallid Sturgeon

2002 Progress Report

March 17, 2003

Wade L. King
Project Biologist

And

Ryan H. Wilson
Project Technician

U.S. Fish and Wildlife Service
Missouri River FWMAO
Bismarck, North Dakota

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID: ✓
Stand Unit: 15
Subplot:
Crew: JE/DB
Date: 9/12/01

Subplot Location: TERRACE 10' ABOVE RIVER

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1 STORY
Crown Cover: 60
Ground Cover: 50
Browsing Intensity: HEAVY
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	16		2									
POPDEL	1	20		2									
POPDEL	1	19		2									
POPDEL	2	9	15	5									
POPDEL	2	11	50	5									
POPDEL	1	8		2									
POPDEL	1	15		2									
POPDEL	1	13		2									
POPDEL	2	6		5									
POPDEL	1	16		1									
POPDEL	1	21		1									
POPDEL	1	29	87	2									
POPDEL	1	23		1									
POPDEL	1	15		1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: Stand Unit: 16 Subplot:	Crew: JE/DB	Date: 9/12/01

Subplot Location: TERRACE

Forest Type: POPDEL/FRAPEN Percent Slope: Aspect: Physiography:	Soil Group: Soil Texture: Soil Erosion: Litter Depth: Humus Depth:	Stand Structure: 2-STORY Crown Cover: 50 Ground Cover: 80 Browsing Intensity: LOW Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	18		2									
POPDEL	1	16		2									
POPDEL	1	15		2									
POPDEL	1	22	82	2									
POPDEL	1	21		2									
POPDEL	1	15		1									
POPDEL	1	20		2									
FRAPEN	1	5	38	1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	1		4					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 17
Subplot:

Crew: JE/DB

Date: 9/12/0

Subplot Location: TERRACE ROSWOO
SYMOCC PRUVIR PARQUI
ELYCAN POAPRA SHEARG
RHUTOX

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture: 80
Soil Erosion: 80
Litter Depth: 6 ½ ⁰
Humus Depth:

Stand Structure: 1 STORY
Crown Cover: 55
Ground Cover: 30
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	12		2		ROTTEN							
"	1	13	MULT	2									
"	1	14	TRUNK	2									
"	1	15		2									
"	1	12		2									
"	1	15		2									
"	1	13		2									
"	1	10		3									
"	1	17		2									
"	1	14	MULT	1									
"	1	15	TRUNK	1									
"	1	18	75	2		ROTTEN							

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	3		2					

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Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: Stand Unit: 18 Subplot:	Crew: JE/DB	Date: 9/12/01

Subplot Location: TERRACE
ELEANG-30%

Forest Type: POPDEL/ELEANG	Soil Group:	Stand Structure: 2-STORY
Percent Slope: 0	Soil Texture:	Crown Cover: 70
Aspect: 0	Soil Erosion:	Ground Cover: 30
Physiography:	Litter Depth:	Browsing Intensity: LOW
	Humus Depth:	Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	15		2	ROT	ROT							
POPDEL	1	15		2									
POPDEL	1	7		4									
POPDEL	1	13		2									
POPDEL	1	11		2									
ELEANG	1	5	26	1									
ELEANG	1	5	28	1									
POPDEL	1	16		1									
ELEANG	1	7	27	1	35								
POPDEL	1	19	86	2									
POPDEL	1	16		2									
POPDEL	1	16		2									
POPDEL	1	13		2									
POPDEL	1	15		2									
POPDEL	1	13		2									
POPDEL	1	15		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
ELEANG	1	4	22	1									

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
ELEANG	1	10		4					

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 19
Subplot:

Crew: JE/DB

Date: 9/12/01

Subplot Location:
RHUTOX
POAPRA

Forest Type: POPDEC/ELEANG
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2 STORY
Crown Cover: 85
Ground Cover: 20
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
ELEANG	1	5	16	1	—								
ELEANG	2	8	22	3									
ELEANG	2	8	16	3									
ELEANG	1	6	14	1									
POPDEC	1	21	88	2									
ELEANG	1	7	16	3									
POPDEC	1	15		2									
POPDEC	1	15		2									
POPDEC	1	14		2									
POPDEC	1	13											
ELEANG	1	5		2									
POPDEC	2	5	60	5									
POPDEC	1	16											

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
ELEANG	1	2	18	1									
ELEANG	1	3	20										
ELEANG	1	3	19										
ELEANG	1	2											
ELEANG	1	3											

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: Stand Unit: Subplot: 20	Crew: JE/DB	Date: 9/13/01

Subplot Location: TERRACE
DENSE SHRUB CANOPY - SALAMG, PRUVIR ROSWOO FRAPEN
RHUTOX ELYCAN GLYLEP

Forest Type: POPDEL/ Percent Slope: 0 Aspect: 0 Physiography:	Soil Group: Soil Texture: Soil Erosion: Litter Depth: Humus Depth:	Stand Structure: 1-story Crown Cover: 50 Ground Cover: 60 Browsing Intensity: LOW Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	14	—	1									
POPDEL	1	5	30	1									
POPDEL	1	25	85	2									
POPDEL	1	15	—	1									
POPDEL	1	15	—	2									
POPDEL	1	18	—	2									
SALAMG	1	5	18	4									
POPDEL	1	17	—	2									
POPDEL	1	8	—	1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
SALAMG	1	4	15	3									

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 21
Subplot:

Crew: JE/DB

Date: 9/13/01

Subplot Location: TERRACE 5-10' ABOVE RIVER
UNDERSTORY OF ELEANG YOUNG STAND ON LOWER TERRACE

Forest Type: POPDEL
Percent Slope:
Aspect:
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2 STORY
Crown Cover: 50
Ground Cover: 40
Browsing Intensity: LOW/NONE
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	10		2			POPDEL	1	17		1		
POPDEL	1	15		2			POPDEL	1	20	79	1		
ELEANG	1	5	22	1			POPDEL	1	12				
POPDEL	1	7		1			POPDEL	2	6	—	BEAVER CUT		
POPDEL	1	11		1			POPDEL	2	7	—	BEAVER CUT		
POPDEL	1	7		1			POPDEL	1	10		1		
POPDEL	1	12		1			POPDEL	1	10		4		
POPDEL	1	8		2			POPDEL	1	6		1		
POPDEL	1	12		1	42		POPDEL	1	12		1		
POPDEL	2	8	—	—	BEAVER		POPDEL	1	11		1		
POPDEL	2	5	—	—		CUT	POPDEL	2	8	— BEAVER CUT			
ELEANG	1	6	24	1	16								
ELEANG	1	5	22	1									
POPDEL	2	7			BEAVER								
POPDEL	2	9				CUT							
POPDEL	2	6											
POPDEL	1	12											
POPDEL	1	13											
POPDEL	1	7			—	BEAVER							
POPDEL	1	11				CUT							

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
ELEANG	1	1	8	1									
ELEANG	1	1	8	1									

Seedling Data (trees less than 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
ELEANG	1	2	—	1					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 22
Subplot:

Crew: JE/DB

Date: 9/13/01

Subplot Location: TERRACE

ELEANG
FRAPEN

Forest Type: POPDEL
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 1 STORY
Crown Cover: 60
Ground Cover: 75
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	16	MULT	2									
"	1	15	TRUNK	2									
"	1	14		2									
"	1	9		2									
"	1	20	MULT	2									
"	1	15	TRUNK	2									
"	1	14		2									
"	1	6		2									
"	1	14	MULT	2									
"	1	16	TRUNK	2									
"	1	16		2									
"	1	10		2									
"	1	10		2									
"	1	15	MULT	2									
"	1	9		2									
"	1	8		2									
"	1	12		2									
"	1	15		2									
ELEANG	1	5		3									
POPDEL	1	12	75	3									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	1		4					

Rev. 8/25/01

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 23

Crew: JG/DB

Date: 9/13/0

Subplot Location: TERRACE ~ 5-10' FEET ABOVE RIVER
SHEARG BROINE
GLYLEP

Forest Type: POPDEL/ELEANG
Percent Slope: 0
Aspect:
Physiography: 0

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2 STORY
Crown Cover: 70
Ground Cover: 80
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	9		1			POPDEL	1	17	1			
"	1	12	} multi	1			"	1	8	2			
"	1	13	stem	1			"	1	11	2			
"	1	11		1			"	1	12	1			
"	1	8	} multi	1			"	1	10				
"	1	13		1									
"	1	16	72	1									
"	1	6		1									
"	1	12		1									
"	1	5		1									
"	1	7		1									
"	1	11		2									
"	1	14		1									
"	1	8		1									
"	1	12		1									
"	1	16		1									
"	1	6		2									
"	1	13		2									
"	1	10		1									
ELEANG	1	5	28	1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 24
Subplot:

Crew: JE/DB

Date: 9/13/01

Subplot Location: TERRACE ~ 5-10' ABOVE RIVER

Forest Type: POPDEL/ELEANG
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2 STORY
Crown Cover: 60
Ground Cover: 50
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	11	mult.	2			POPDEL	1	9		1		
"	1	7	stem	2			"	1	9		1		
"	1	12	mult	1			"	1	10		2		
"	1	12	stem	1			"	1	8		2		
"	1	11		2									
"	1	7		1									
"	1	5		1									
"	1	5		1									
"	1	13		1									
"	1	5		1									
"	1	12		1									
"	1	5		2									
"	1	12	68	1									
"	1	6		1									
"	1	15		2									
"	1	7		2									
"	2	7		5									
"	1	8		3									
"	1	6		2									
"	1	9											

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
ELEANG	1	1		3					

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit: 25
Subplot:

Crew: JE/DB

Date: 9/14/01

Subplot Location: TERRACE

LOTS OF BROKEN TOPS ON POPDEL

Forest Type: POPDEL/ELEANG
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2 STORY
Crown Cover: 50
Ground Cover: 70
Browsing Intensity: MODERATE
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
ELEANG	1	5	18	1									
POPDEL	1	27		2									
ELEANG	1	5		1									
POPDEL	1	21		2									
POPDEL	1	22		2									
POPDEL	1	20		3									
FRAPEN	1	7	32	1									
POPDEL	1	25		2									
POPDEL	1	27	76	2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count

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Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 26 (D)
Crew: JE/OB
Date: 9/14/01

Subplot Location: TERRACE
ROSA SP. 30%   RHUTOX
CORSTO   GLYLEP

Forest Type: POPDEL	Soil Group:	Stand Structure: 1 STORY
Percent Slope: 0	Soil Texture:	Crown Cover: 65
Aspect: 0	Soil Erosion:	Ground Cover: 80
Physiography:	Litter Depth:	Browsing Intensity:
	Humus Depth:	Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundne
POPDEL	1	21	90	2									
"	1	16		3									
"	1	18		2									
"	1	22		3									
"	1	20		3									
"	1	25		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	10		4					

Rev. 8/25/01

Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: Stand Unit: Subplot: 27(E)	Crew: SE/DB	Date: 9/14/01

Subplot Location: TERRACE ROSA

Forest Type: POPDEL	Soil Group:	Stand Structure: 1 STORY
Percent Slope: 0	Soil Texture:	Crown Cover: 50
Aspect: 0	Soil Erosion:	Ground Cover: 85
Physiography:	Litter Depth:	Browsing Intensity: LOW/NONE
	Humus Depth:	Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	14		2									
"	1	19		2									
"	1	21		2									
"	1	20		2									
"	1	23	82	2									
"	1	19		2									
"	1	16		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	4		1					

Rev. 8/25/01

Vegetation Data Collection Sheet
Cottonwood Stand Reconnaissance
Fort Peck Indian Reservation, Montana

Stand ID:
Stand Unit:
Subplot: 28 (A)

Crew: JE/DB

Date: 9/14/01

Subplot Location: SYMOCC
RHUTOX

Forest Type: POPDEL/FRAPEN
Percent Slope: 0
Aspect: 0
Physiography:

Soil Group:
Soil Texture:
Soil Erosion:
Litter Depth:
Humus Depth:

Stand Structure: 2 STRATA
Crown Cover: 70
Ground Cover: 50
Browsing Intensity: LOW
Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundness
POPDEL	1	20	MULT STEM	2									
POPDEL	1	19		2									
POPDEL	1	16		2									
POPDEL	1	12	MULT STEM	2									
POPDEL	1	20		2									
POPDEL	1	21		2									
POPDEL	1	13		2									
POPDEL	1	25	87	2									
FRAPEN	1	5	34	1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
FRAPEN	1	1	11	1									
FRAPEN	1	4	20										

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	3		1					

Rev 8/25/01

Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: 29 Stand Unit: (B) Subplot:	Crew: JE/DB	Date: 9/14/01

Subplot Location: TERRACE

Forest Type: POPDEL / FRAPEN	Soil Group:	Stand Structure: 2 STORY
Percent Slope: 0	Soil Texture:	Crown Cover:
Aspect: 0	Soil Erosion:	Ground Cover:
Physiography:	Litter Depth:	Browsing Intensity:
	Humus Depth:	Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness
POPDEL	1	19		2									
FRAPEN	1	5	36	1									
POPDEL	1	30		3									
POPDEL	1	31	88	2									
POPDEL	1	22		2									
POPDEL	1	25		2									
POPDEL	1	26		2									
FRAPEN	1	6		1									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
FRAPEN	1	2	15	1									
FRAPEN	1	2	15	1									
FRAPEN	1	3	18	1									

Seedling Data (trees less than 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	2		5					

Rev. 8/25/01

Vegetation Data Collection Sheet Cottonwood Stand Reconnaissance Fort Peck Indian Reservation, Montana	Stand ID: Stand Unit: 30 Subplot: (C)	Crew: JE/DB	Date: 9/14/01

Subplot Location: TERRACE

Forest Type: POPDEL/FRAPEN	Soil Group:	Stand Structure: 2 STORY
Percent Slope: 0	Soil Texture:	Crown Cover: 70
Aspect: 0	Soil Erosion:	Ground Cover: 30
Physiography:	Litter Depth:	Browsing Intensity: LOW/MOD.
	Humus Depth:	Other Disturbance:

Tree Data (trees greater than or equal to 5.0" DBH are sampled within a 1/24th acre subplot (24.0 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay / Soundness	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Soundne
POPDEL	1	25	80	2									
"	1	23		2									
"	1	27		2									
FRAPEN	1	6	32	1									
POPDEL	1	18		2									

Sapling Data (trees less than 5.0" DBH and greater than or equal to 1.0" DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class	Spp. Code	Status Code	DBH / DRC	Total Height	Crown Class	Age at Diam.	Decay Class
FRAPEN	1	2	18	1									
FRAPEN	1	1	16	1									
FRAPEN	1	2	16	1									
FRAPEN	7	2	16	1									

Seedling Data (trees less than 1.0"DBH are sampled within a 1/300th acre microplot (6.8 ft. radius))

Spp. Code	Status Code	Average Height	Average Age	Seedling Count	Spp. Code	Status Code	Average Height	Average Age	Seedling Count
FRAPEN	1	4		5					

Rev. 8/25/01

APPENDIX C

PHOTOGRAPHS OF STUDY AREA

Typical stand of Great Plains cottonwood with understory of smooth brome

Typical stand of mature cottonwood

Cottonwood stand on river terrace

Cottonwood stand with understory of green ash

Cottonwood stand with understory of Russian olive

Cottonwoods gnawed by beavers

Cottonwood stand destroyed by fire

Cottonwood seedlings growing on recently formed sand bar

This report submitted to:

Cooperators

Bureau of Reclamation

Garrison Dam National Fish Hatchery

Montana Fish, Wildlife and Parks
Fort Peck Field Office

North Dakota Game and Fish Department

Upper Pallid Sturgeon Workgroup

US Army Corps of Engineers

US Geological Survey
Fort Peck Field Office

Western Area Power Administration

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Introduction

This report summarizes the research and field activities conducted in April through October of the 2002 field season. The main goals of this study are to monitor post spawn migrational movements to help identify pallid sturgeon spawning areas, determine pallid sturgeon response to " Spring Test Flows " out of Fort Peck Dam to see if mimicking natural flows will expand pallid use and habitat into the Missouri River above the confluence of the Yellowstone River, and to evaluate reproductive stages of known post spawn females. We also hope telemetered pallid sturgeon will serve as an important tool for future broodstock capture by utilizing and netting possible aggregations in relation to telemetered fish. Netting additional fish and marking them with Passive Integrated Transponder (PIT) tags will also serve to help strengthen current population estimates.

Study Area

The pallid sturgeon study area (See Figure 1, for study area), for the most part, is a semi-confined stretch of approximately 290 river miles encompassing the Missouri River from Fort Peck Dam to the headwaters of Lake Sakakawea and from the Yellowstone River confluence (~ RM 1582.0) up the Yellowstone River to the Intake Diversion Dam, Intake, Montana.

As suggested in the Post Spawn Telemetry Study Plan, datalogging station locations had to be adjusted due to a variety of factors, but eventually all stations were placed in well-suited areas that met the criteria needed to work effectively. Our first station initially was placed up the mouth of the Yellowstone River, a few hundred yards adjacent to or above the confluence on the west riverbank below the high water line. Later in the summer, it was moved to the east bank on private property, due to low water conditions. The second station, which is identified as the Fort Union Station, is approximately 5 river miles up the Missouri River above the confluence, and as its name suggests, lies due east of Fort Union State Park on the north shore of the Missouri River on State-owned land. The third station was located approximately 11 miles down the Missouri River on the Erickson Island State Game Production Area and is located on the north shore of the river.

Two additional logging stations were funded for the 2002 field season by the Bureau of Reclamation (BOR) and the North Dakota Game and Fish Department (NDGFD), which brings the total of stations to five. The BOR station was positioned on Montana Dakota Utilities property outside of Sidney, Montana, (RM 30.1) on the Yellowstone River. The NDGFD funded station was placed downstream of the Ducks Unlimited Pumphouse (RM 1557) on the lower Missouri River. The addition of the two new stations benefited the project, helping to expand the study area into more manageable reaches and providing more movement data.

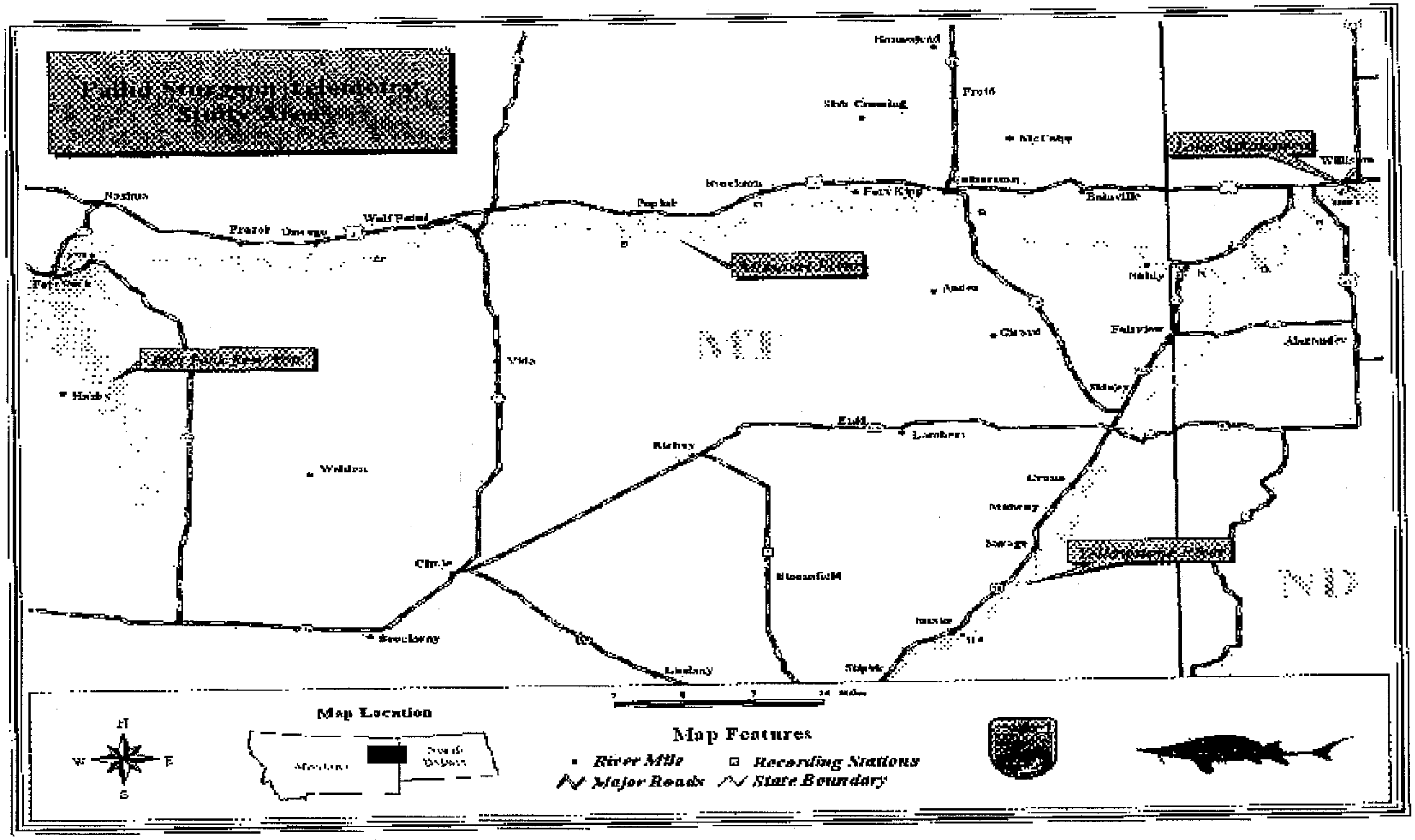

Figure 1: Map of study area

Methods

Pallid sturgeon telemetry tracking started in the second week of May 2002, and manual tracking resumed throughout the month and continued until the end of June. During the month of July, we started a less stringent tracking regime, only tracking every third week, which was continued through October, when fixed datalogging stations were taken out of the river.

Tracking methodology, as well as other methods, has been described in last year's progress report and the USFWS's draft proposal plan, so rather than describe them here, one can refer to the previous year's literature.

One addition utilized in this past field season's tracking, was the implementation of using a cell phone link to the Sidney fixed datalogging station. This system allowed us to download the station data from a hotel or office, with the aid of a computer. The remote system also allowed us to check settings and change them, call the station to see if it is still operating properly, and most importantly, check the data to determine if one of our study fish has moved into another study reach.

Due to the number of paddlefish on the 149.760 pallid frequency, the addition of two more cell phone links and three more W31 receivers will be utilized to ensure data can be downloaded before memory banks fill up and data is lost. This became a problem on a few different occasions in the 2002 tracking season and should be resolved with the upgraded receivers and technology.

No pallid sturgeon were tagged after the spring 2002 spawn, due to a number of mortalities of the broodstock adults in the hatchery. Although only one mortality (which possibly was the result of cumulative stress from spawning, as well as tagging,) has been associated with the telemetry project; surgically implanting telemetry tags was suspended for a year until the mortality issue in the hatchery could be addressed.

For further clarification of tables and figures listed in this report, fish spawned in the spring of 2000 were named starting with the letter "A," and fish spawned in the spring of 2001 were given names with the letter "B." Because no fish were tagged in the spring of 2002, C will be skipped and fish spawned and tagged in 2003 will all be designated with names starting with "D."

Results and Discussion

During the 2002 spring broodstock capture, a male pallid sturgeon with rather suspicious scar tissue was netted. After referencing the pallid sturgeon database for passive integrated transponder (PIT) tag matches, it was conclusive this fish was a previous telemetry study fish. Aaron, fish # 38, had been tracked in the fall of 2000 when he was released back to the river and beginning in the spring of the 2001 field season, was unable to be located till present. His tag incision had healed perfectly and no signs of stress or infection were observed.

Consequently, we saw this happen at least two more times in the 2002 field season. Amber, fish # 62, lost her tag approximately at river mile (RM) 1558 above the Ducks Unlimited Pumphouse. In mid-April, she was observed crossing the Erickson Island Station and staging downstream below the Confluence Station for a brief period of time. She then was located by boat at RM 1567 in May. Somewhere after that time period, she shed her tag in about 7 feet of water adjacent to an island. We continued to pick up here tag throughout the summer at the same location without it ever moving. Attempts were made to net the fish on different occasions, but no movements were ever monitored. Water levels never reached shallow enough depths to attempt retrieval.

Al, fish # 22, also departed from our study this field season. This tag was apparently shed in the early spring of 2002. Montana, Fish, Wildlife and Parks crews' picked up his signal at Big Sky Bend (~RM 17), where it remained for the rest of the year. In late August, attempts to retrieve the tag were conducted. The tag was located in approximately 2 to 3 feet of water and maximum signal output was picked up on our receivers helping us isolate the tag within a couple foot radius, unfortunately after digging for a couple of hours, the tag could not be retrieved.

Bridget, fish # 10, has also been unable to be located since she was returned back to the river. The loss of this fish, as well as Amber, has definitely hurt one of the objectives of the study and has left us with only one female study fish.

Name	Code	Sex	Pit tag #	Weight in Pounds	Weight in Kilograms	Fork Length in Inches	Fork Length in Millimeters
Art	18	M	1F4849755B	33	14982	51	1295
Annie	25	F	1F47715752	55	24970	62	1580
Andre	26	M	7F7B081579	32	14528	56	1444
Alex	34	M	115525534A	36	16344	55	1404
Arnie	44	M	2202236E31	61	27694	60	1542
Archie	46	M	1F4A33194B	45	20340	57	1468
Andrew	50	M	115713555A	28	12712	53	1352

Table 1: List of the class of 2000 remaining in the study, as of October 2002.

Name	Code	Sex	Pit tag #	Weight in Pounds	Weight in Kilograms	Fork Length in Inches	Fork Length in Millimeters
Butch	2	M	1F4A27214F	50	22857	61	1541
Bart	14	M	115631222A	29	13257	52	1340
Bob	116	M	7F7D3C5708	30	13714	55	1405
Ben	144	M	1F4A111C6A	43	19657	55	1394

Table: 2. List of the class of 2001 remaining in the study, as of October 2002.

A primary objective of this study was to establish the time between spawns for adult pallid sturgeon and to learn more about the reproductive physiology of these native river fish. Past spawning records from a female sturgeon suggests they may spawn between 2 and 7 years, as well as physical evidence displayed by two, small pallid/pallid hybrid females at GDNFH. Once a female was identified with gravid eggs, it was hoped that tracking her would lead to pallid sturgeon spawning grounds and give us an idea on the stage periods between spawns.

Fish # 25 was located in the lower Missouri River on April 24th, and subsequent netting drifts were made to capture this female on two different days. Unfortunately, she was located in a deep trough along the shore and was unable to be captured. On two separate occasions (June 19-21 and June 30 to July 8th), she proceeded to migrate up the Missouri River to the USGS's Culbertson datalogging station (RM 1619). Unfortunately, we were unaware of her location and she eluded us until mid-August, when she was found in the lower Missouri River around RM 1556.5.

Upon relocation of the Annie on August 22 at RM 1664.7, Garrison Dam National Fish Hatchery Manager, Rob Holm, was contacted immediately and met us at the highway 85 boatramp 3 hours later. We then drift-netted for the female and captured her on the third drift, at which time we went to shore and prepared to tube her. Rob used a ¼-inch diameter, 30-inch section of clear, plastic tubing to perform the procedure.

Upon tubing the female, no small white eggs or black shriveled, larger eggs were found. Two subsequent attempts were made to extract eggs off the ovary, but no eggs were present. Annie was released and remained present in the lower Missouri throughout the rest of the summer and into the end of the tracking season. Although we can't be positive, due to the lack of any eggs present, two possible scenarios could exist. One, she spawned her eggs in the spring of 2002 and is in the process of regeneration; and, if this theory is true, she should have small, white eggs present on her ovaries in the spring of 2003. Two, if no sign of eggs are found on the ovary in the spring of 2003, it will be safe to assume that it will take a longer duration for her to attempt another spawn.

Diel movements were also recorded and compared for the 2002 fish by using data from individual fish passing fixed datalogging stations. The stations list the time the fish enters and leaves the range of station hydrophones. Times from boat relocations were not considered.

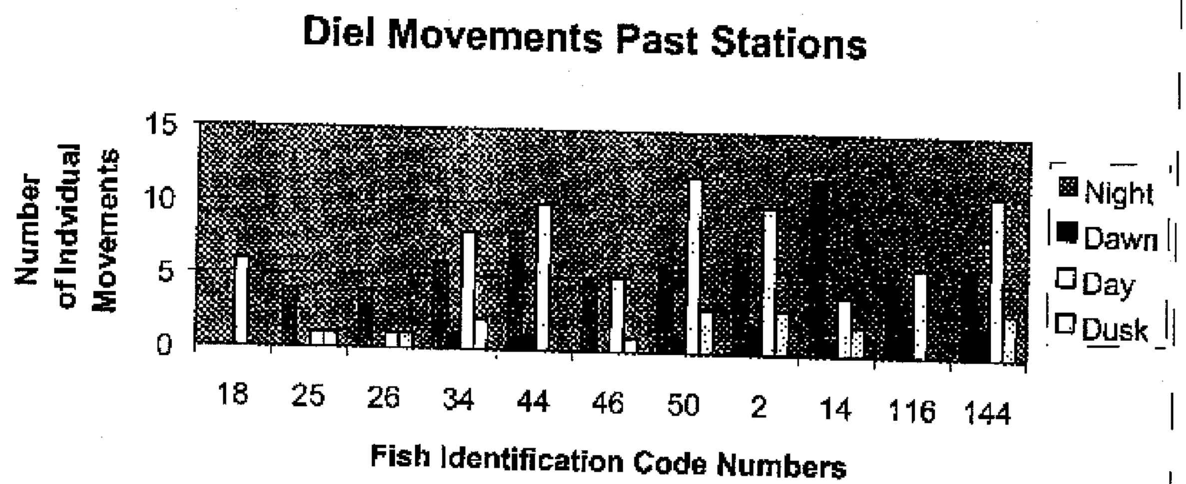

Table 3: Diel movements of the11fish remaining in study for the 2002 field season.
Night = 1 hour after sundown to 1 hour before sunrise.
Dawn = 1 hour before sunrise to 1 hour after sunrise.
Day = 1 hour after sunrise to 1 hour before sunset.
Dusk = 1 hour before sundown to 1 hour after sundown.

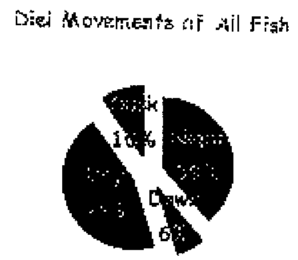

Figure 2: Diel movements for all fish in 2002.

Although diel movements differed significantly between some fish, there seems to be only a marginal difference between the higher percentages of daytime movements from the nighttime movements recorded.

A total of 331 observations were recorded in the 2002 field season, with 139 of them coming from boat relocations. A portion of the boat relocations came from Montana Fish, Wildlife and Park's fishery crews tracking paddlefish in the same confines of the river. This added information helped fill the gaps in data when fish sometimes slipped past stations and were not recorded.

With the addition of the USFWS's two stations and the deployment of the Montana based USGS stations on the upper Missouri River to Fort Peck Dam, fish movement was recorded both higher in terms of RM's traveled up in the upper Missouri and Yellowstone Rivers. Fish # 144 traveled up the Missouri River to the Wolf Point, Montana, Station (RM 1717), from May 20 to June 8 and ranged as low as RM 1555.4 in the lower Missouri in mid-July to the last boat relocation on November 8, 2002. From lower to upper river reaches, he spanned over 161 river miles in the Missouri and also made a couple of appearances 4 to 5 miles up the Yellowstone. In the Yellowstone River, a male pallid sturgeon was relocated 50 miles above the confluence, marking it as the highest a fish has been observed in that reach.

Although we saw greater distances traveled from a few individual pallids, overall fish movement seemed to decrease in 2002 compared to 2001. In 2001, only three fixed datalogging stations were active in the study and they recorded a total of 165 observations of fish passing them. For the 2002 field season, the USFWS deployed five stations and the USGS deployed at least five additional stations from Culbertson, MT, to Fort Peck Dam, Montana. In all, there were over three times the stations deployed and activated, and they accounted for 192 station observations, only 27 more than last year.

A large proportion of movement mimicked behavior from last year's observations. In April, May, and June, fish reacted to the rising and falling hydrographs daily; later in the summer to early fall, response was usually limited.

The study pallids are definitely exhibiting some unique behavior that has carried over from 2001 to 2002. Two males, Art (18) and Andre (26), have consecutively passed the Yellowstone Station and have spent almost the entire summer around or above Sidney, Montana. Andre passed the Yellowstone Station on May 19 in 2001 and on May 17 in 2002 to spend most of the summer above Sidney, and then returned in August and September. Art basically followed the same behavior and traveled up the Yellowstone on May 25 and also spent his summer ranging above the Highway 200, Fairview Bridge to about 10 miles above Sidney, MT.

For 2 consecutive years, Annie, the sole female left in the telemetry study has selected to stay in the Missouri River, this past year ranging from RM 1557 in the lower Missouri to RM 1619, at Culbertson, MT, on the upper Missouri. Although on both years she was recorded staging around the Yellowstone Station, she has never been relocated by boat up the Yellowstone River.

This was also the case for Butch, a male from the class of the 2001 spawners. He was captured four times in one week during the broodstock capture in mid-April at the confluence, and finally dropped down into the lower Missouri, where he stayed for the rest of the summer. This fish didn't seem to exhibit any urge to follow the hydrograph and spent most of the season between the Erickson Island and the Williston Stations. In fact, he never did migrate up to the confluence or show up on the Yellowstone Station. Although, I suspect some of his behavior may have stemmed from the stress induced with being caught four times in April, it's possible his home range may be that small considering all the movement he displayed within the small area.

As mentioned above, many of the telemetry study fish were either captured or monitored in the confluence area during the April broodstock capture. Besides Butch, Arnie was captured three times and three other fish were at least captured once. Radio-transmittered fish aided in the capture of non-tagged sturgeon on a couple different occasions, including a large female caught up the Yellowstone River adjacent to where Archie, fish # 46, was netted previously.

On three occasions during the field season, we relocated pallid sturgeon using slow, shallow side channels, which was interesting, considering we did not see this happen in 2001. In two of the cases, the side channel was shallow, with about 3 feet of water and we saw the pallids moving around continually, possibly feeding.

Plans for the 2003 field season include the same tracking schedule and protocol, hopefully with the addition of more study fish in the spring. Baseline data will continue to be taken to compare against fish movement associated with USACE proposed test flows slated for the future.

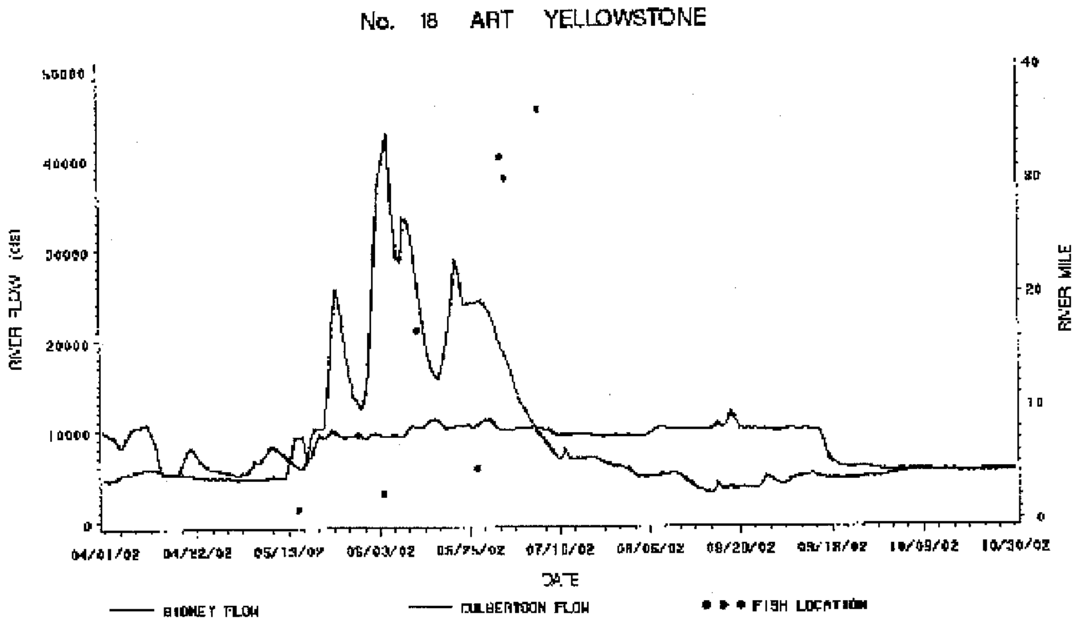

Figure 3: Relocations for Art, fish # 18, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

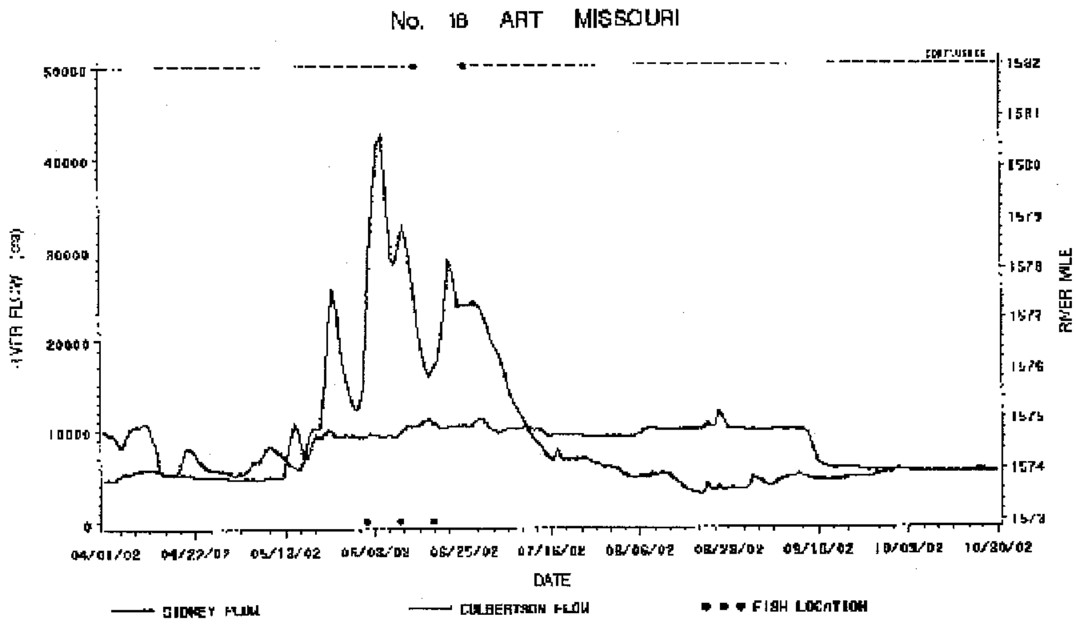

Figure 4: Relocations for Art, fish # 18, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

No. 25 ANNIE MISSOURI

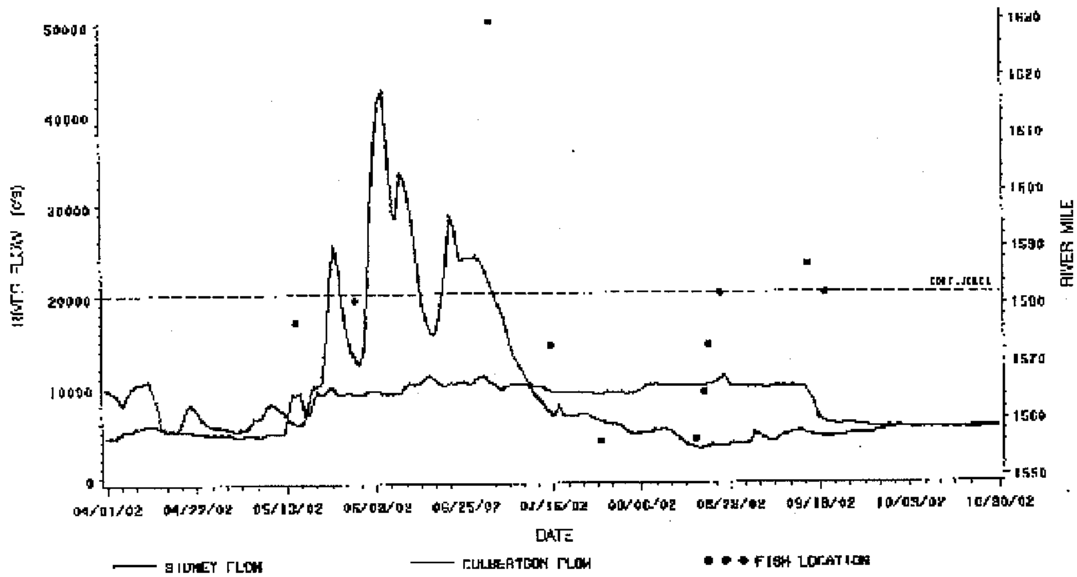

Figure 5: Relocations for Annie, fish # 25, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

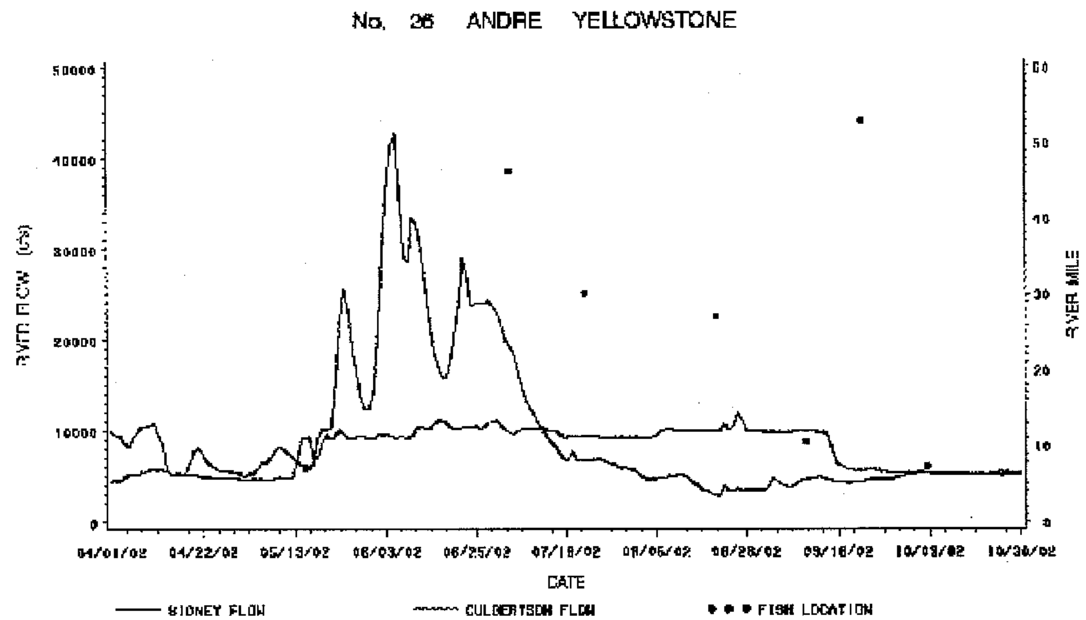

Figure 6: Relocations for Andre, fish # 26, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

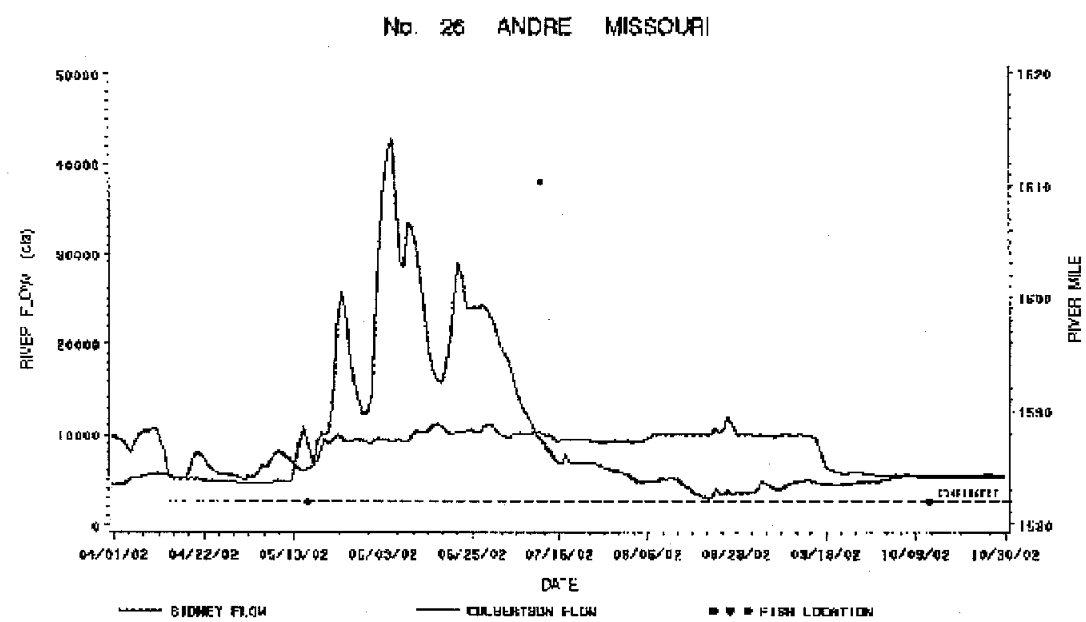

Figure 7: Relocations for Andre, fish # 26, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

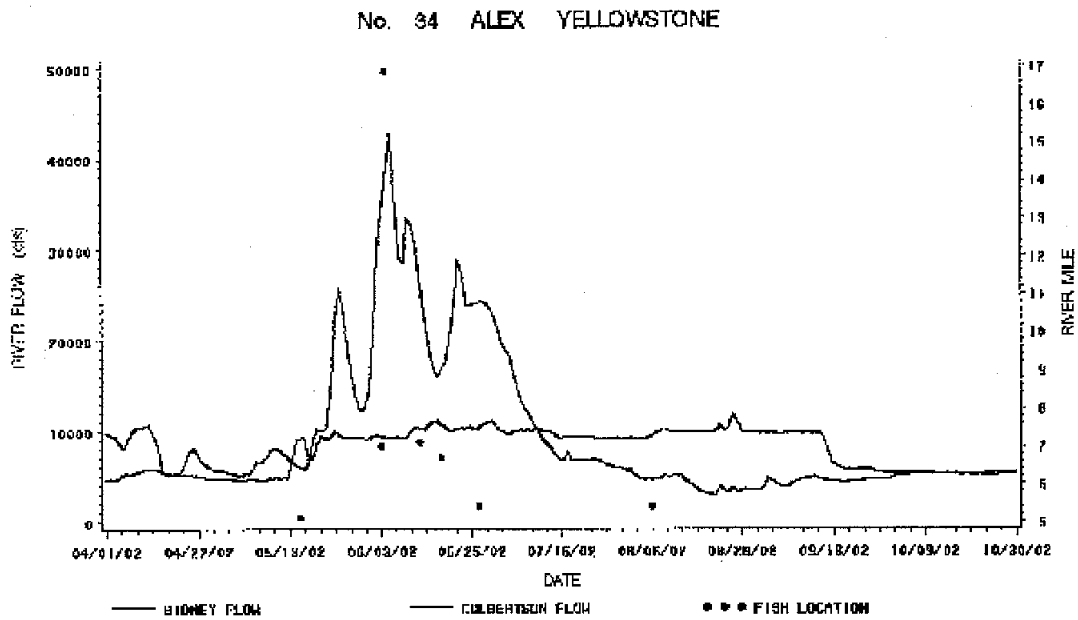

Figure 8: Relocations for Alex, fish # 34, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

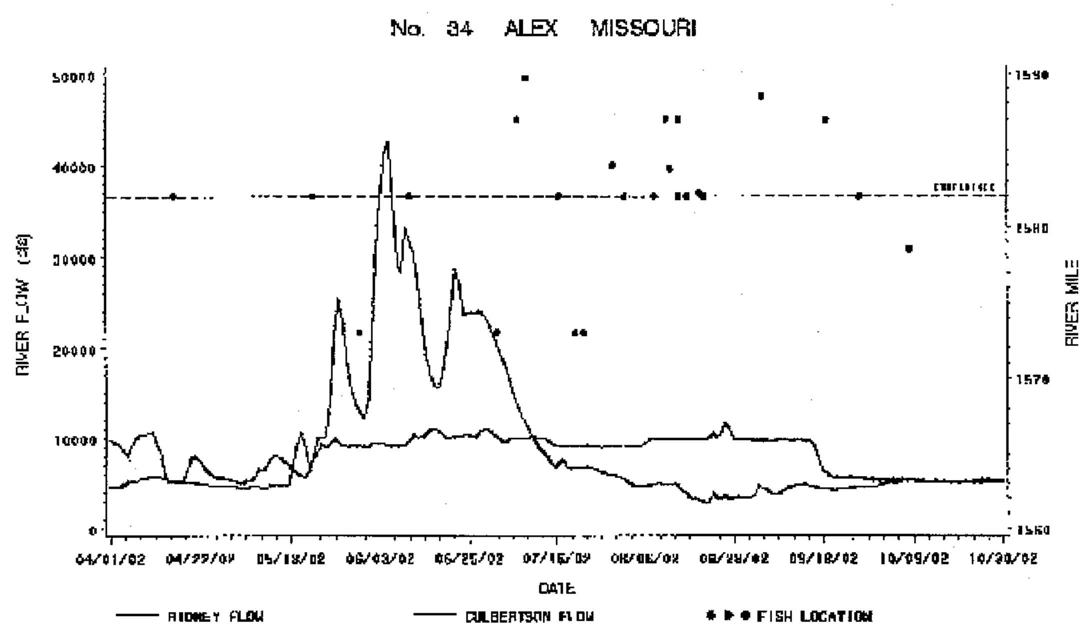

Figure 9: Relocations for Alex, fish # 34, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

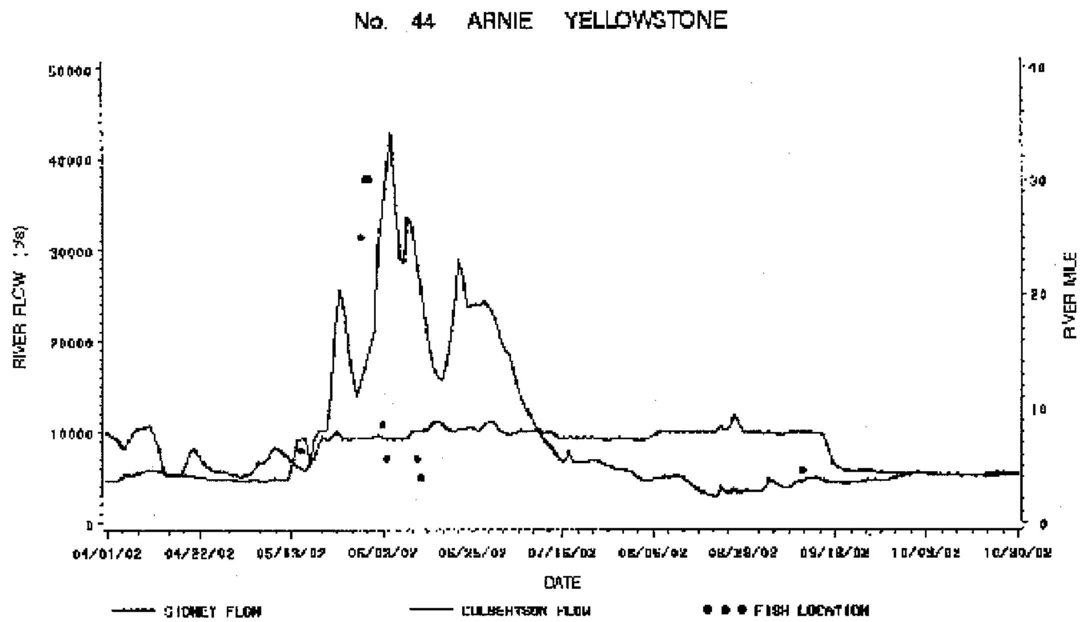

Figure 10: Relocations for Arnie, fish # 44, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

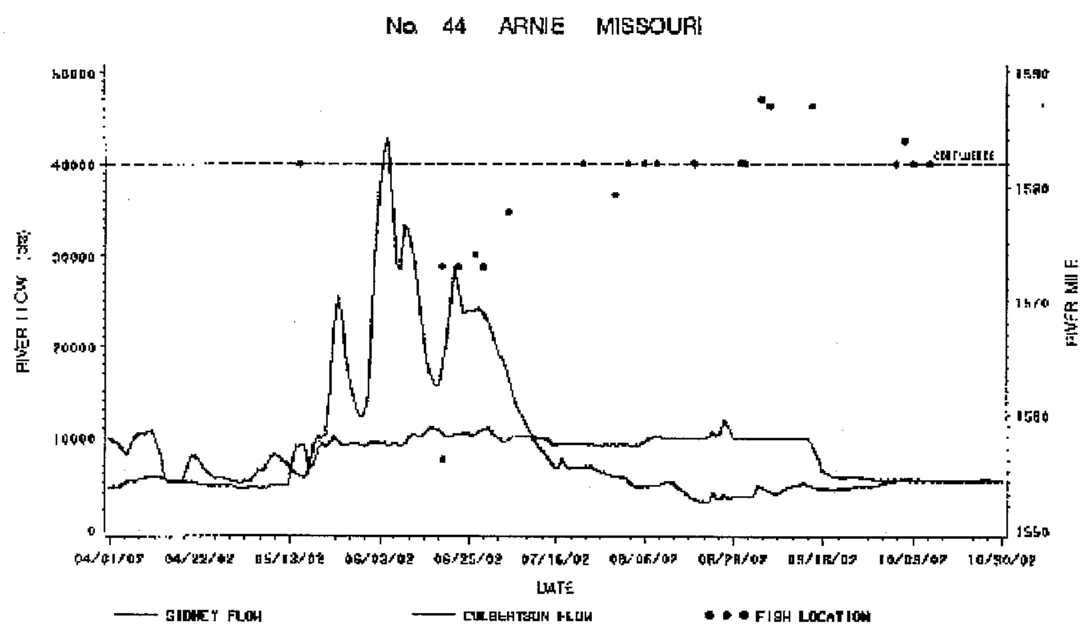

Figure 11: Relocations for Arnie, fish # 44, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

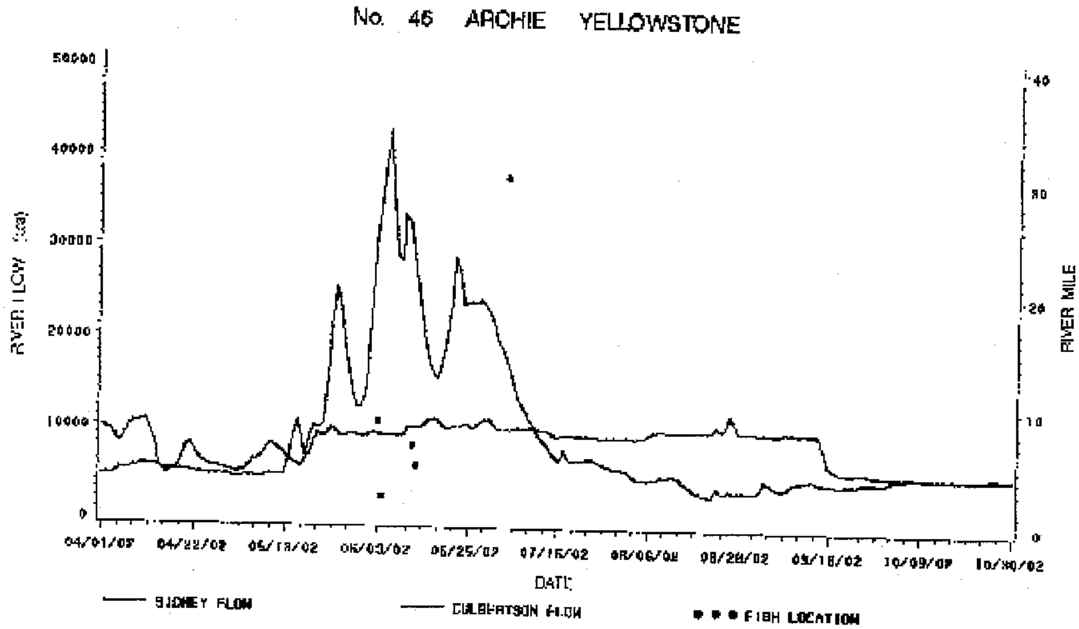

Figure 12: Relocations for Archie, fish # 46, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

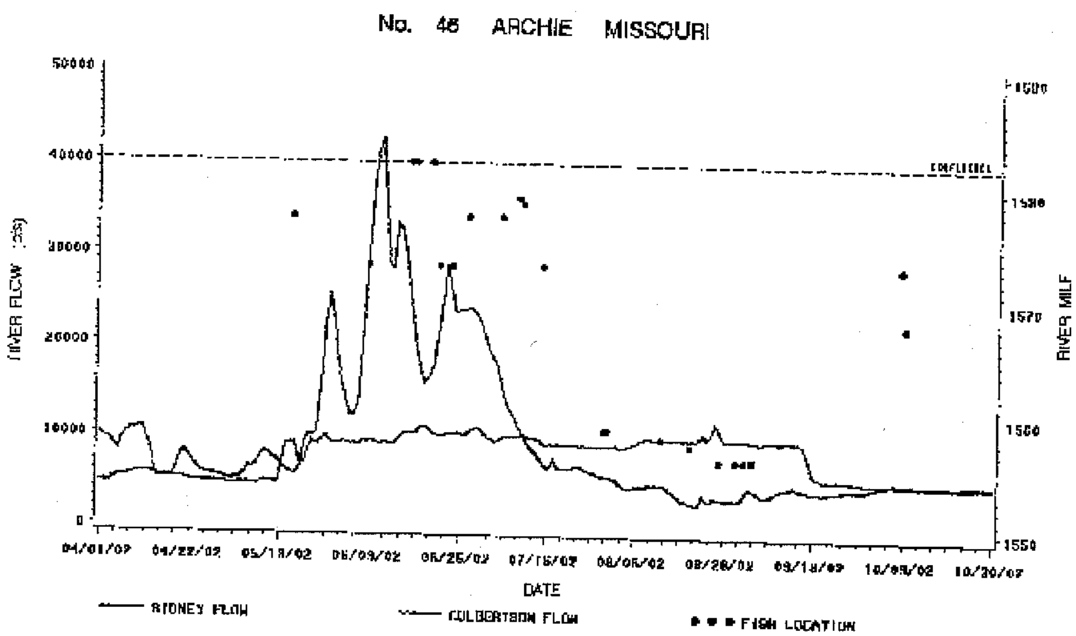

Figure 13: Relocations for Archie, fish # 46, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

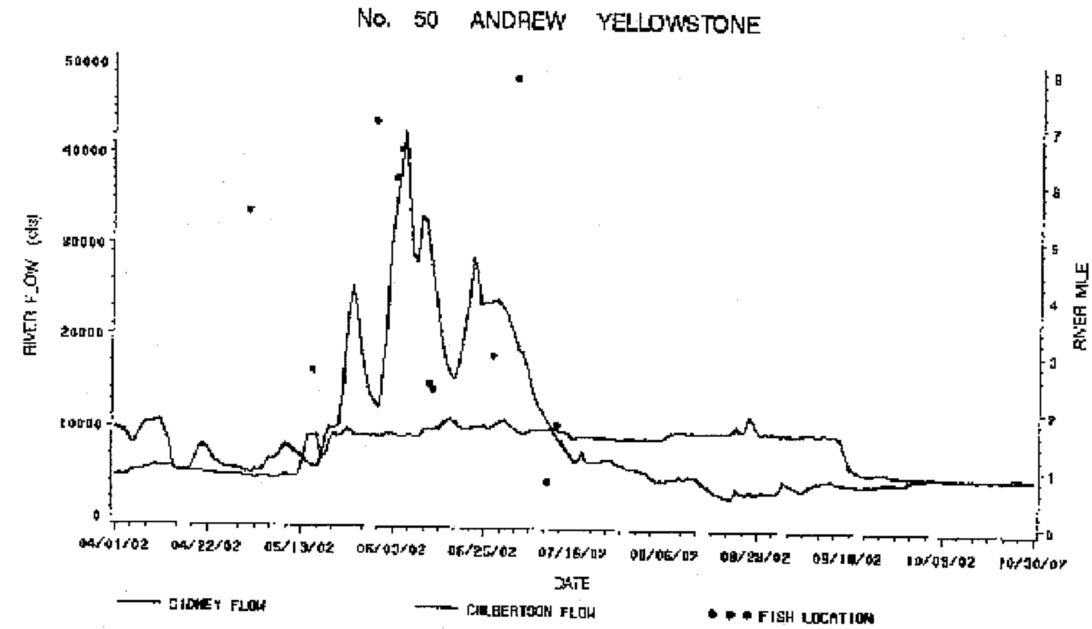

Figure 14: Relocations for Andrew, fish # 50, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

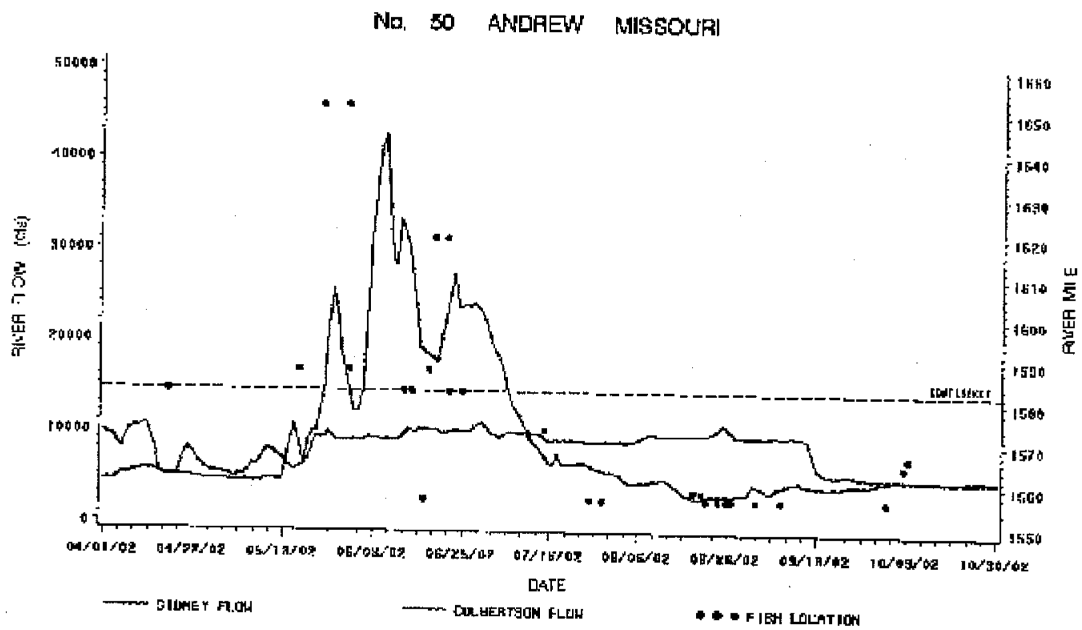

Figure 15: Relocations for Andrew, fish # 50, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

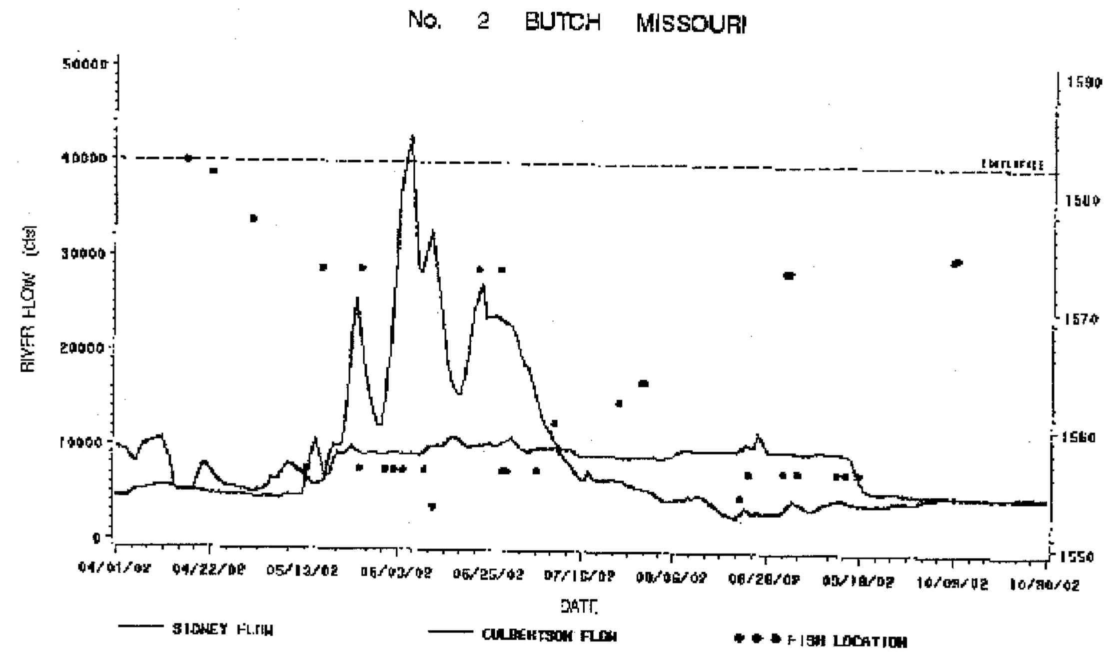

Figure 16: Relocations for Butch, fish # 2, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

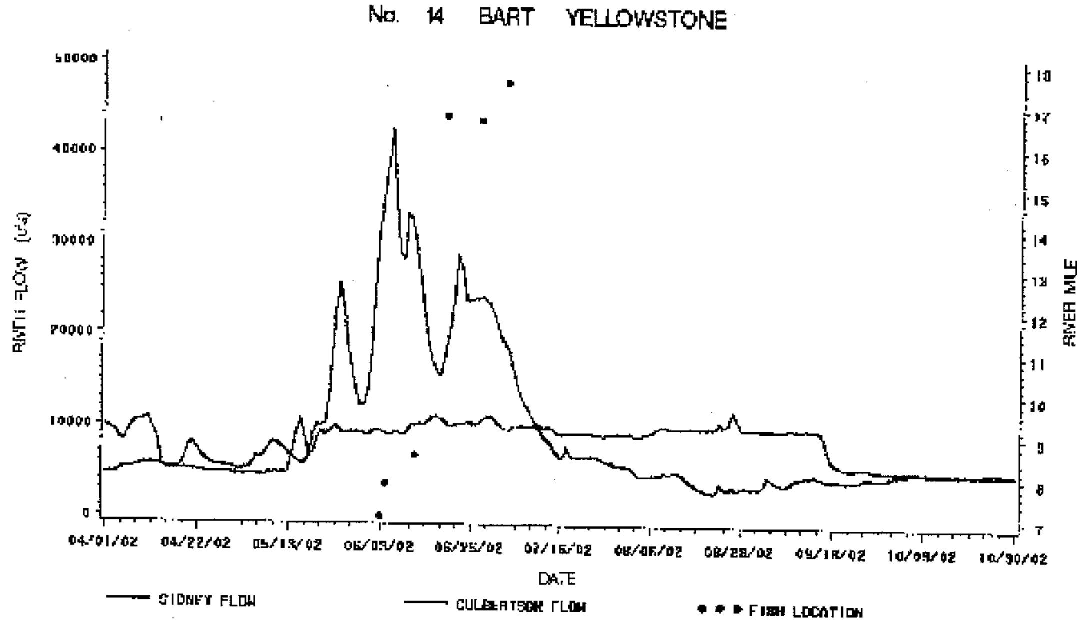

Figure 17: Relocations for Bart, fish # 14, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

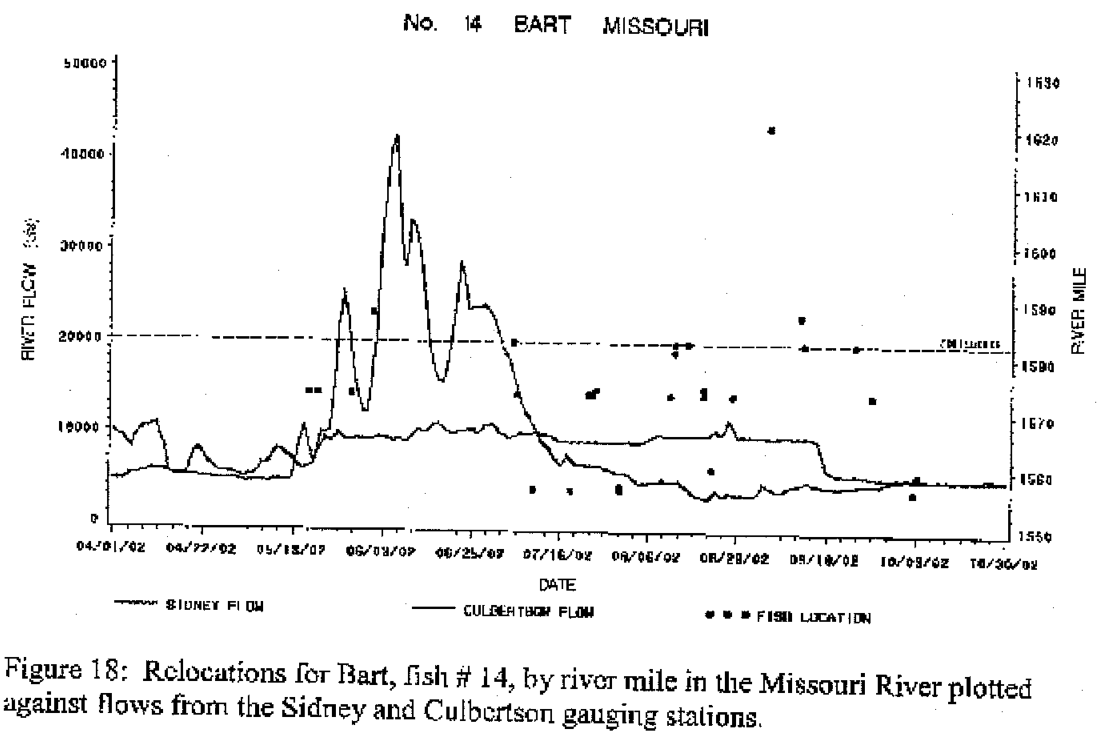

Figure 18: Relocations for Bart, fish # 14, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

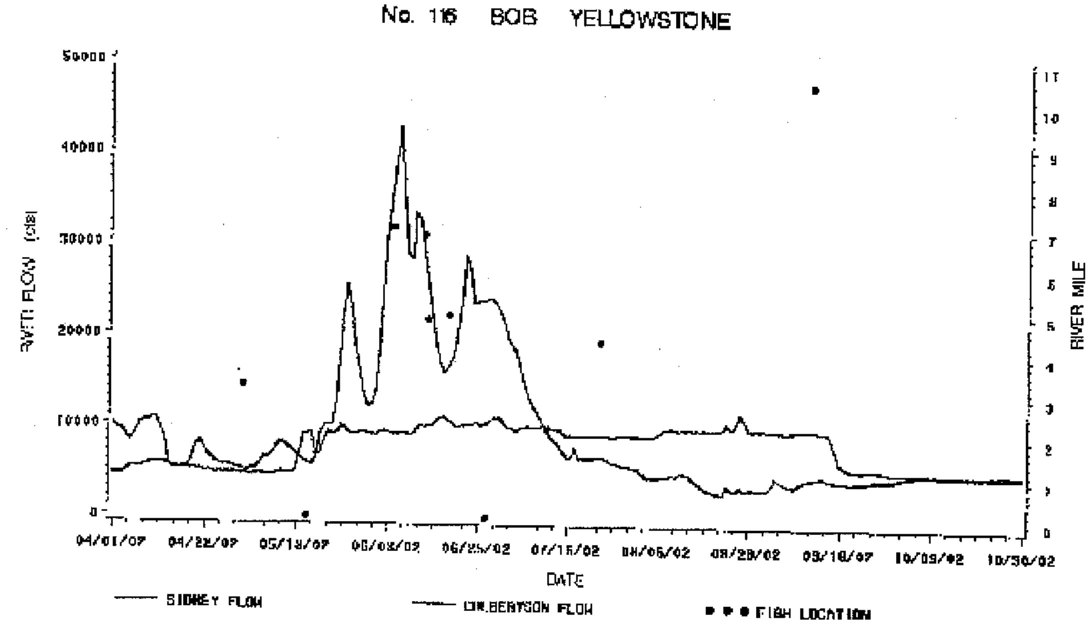

Figure 19: Relocations for Bob, fish # 116, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

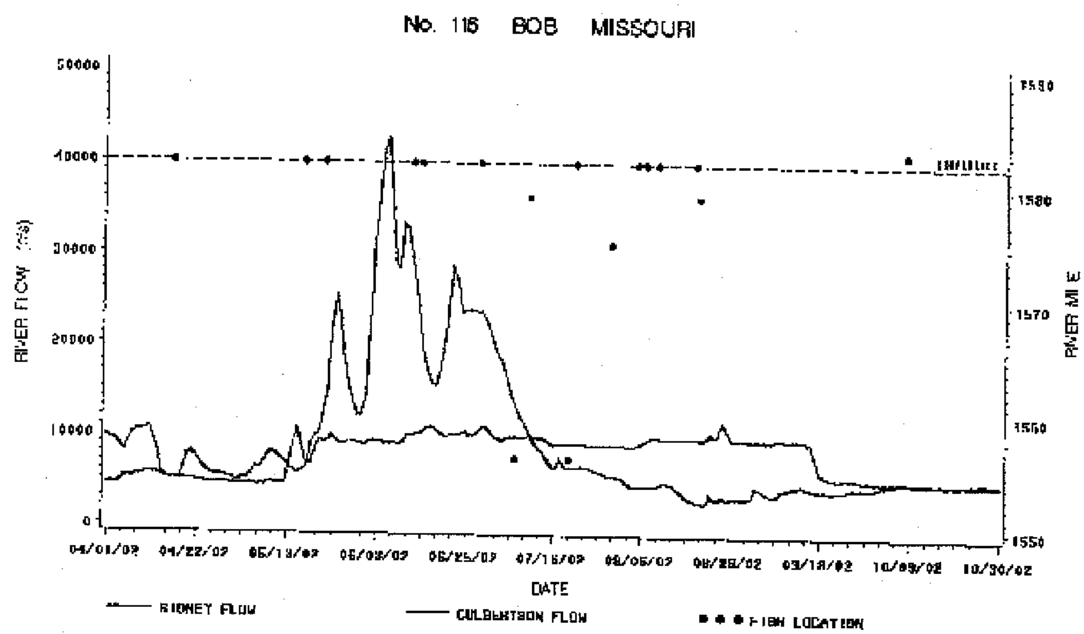

Figure 20: Relocations for Bob, fish # 116, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

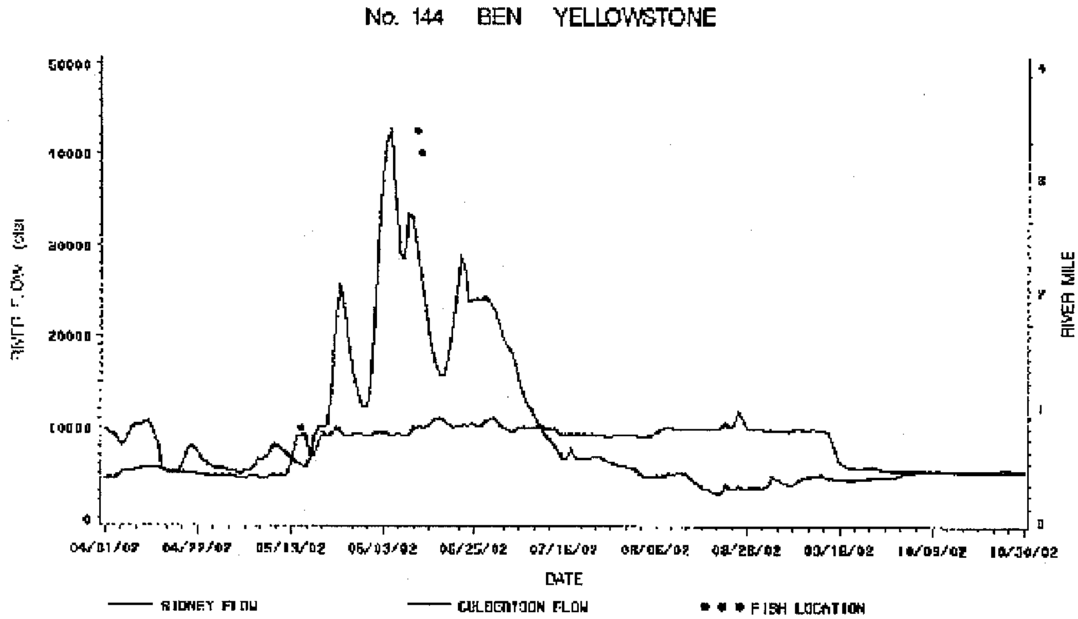

Figure 21: Relocations for Ben, fish # 144, by river mile in the Yellowstone River plotted against flows from the Sidney and Culbertson gauging stations.

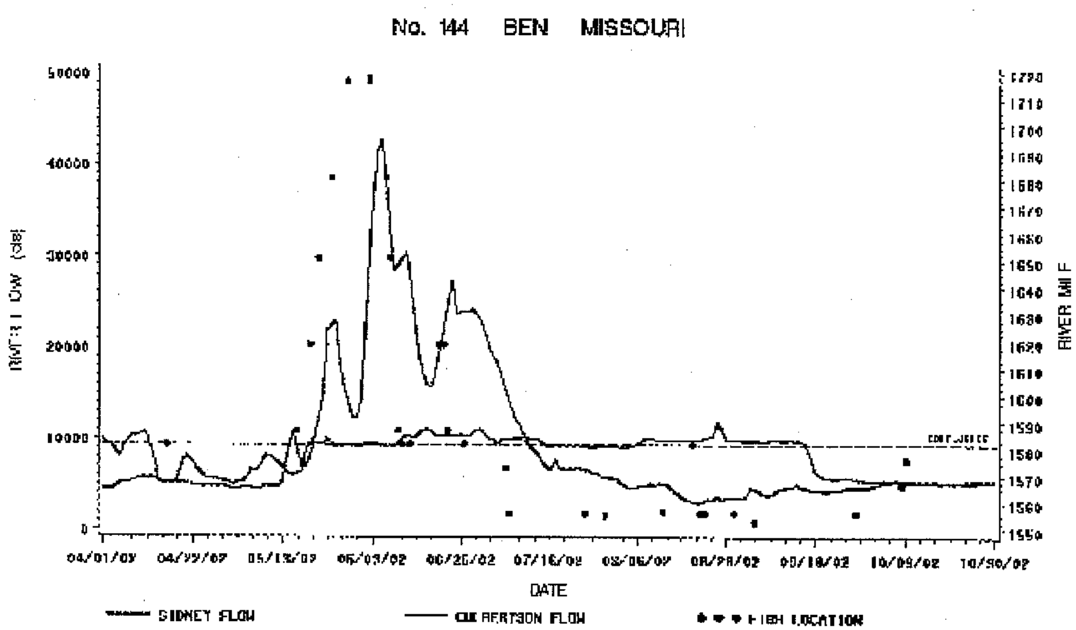

Figure 22: Relocations for Ben, fish # 144, by river mile in the Missouri River plotted against flows from the Sidney and Culbertson gauging stations.

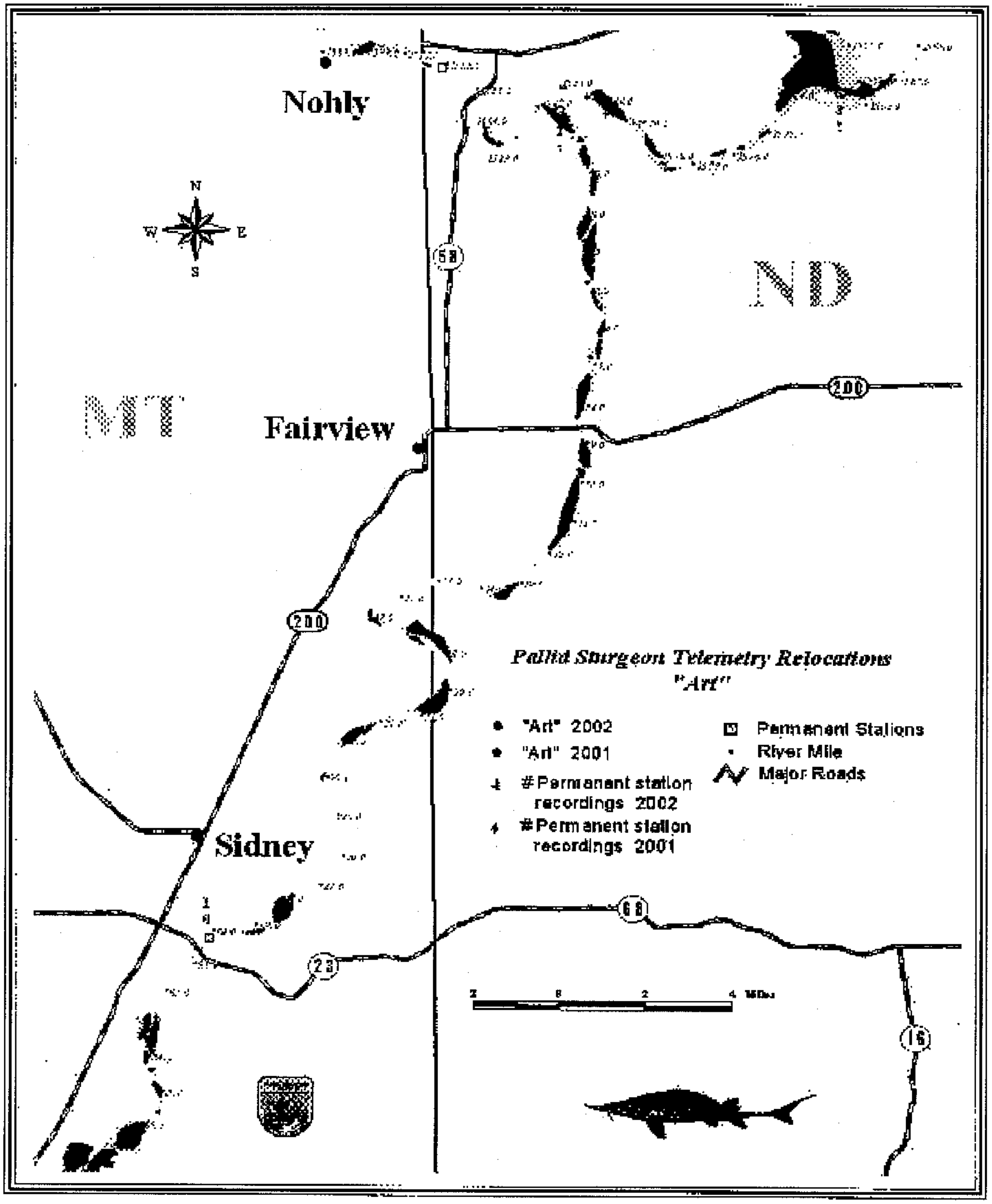

Figure 23: Map of boat relocations and movement frequencies registered for Art passing various fixed datalogging stations for 2001 and 2002.

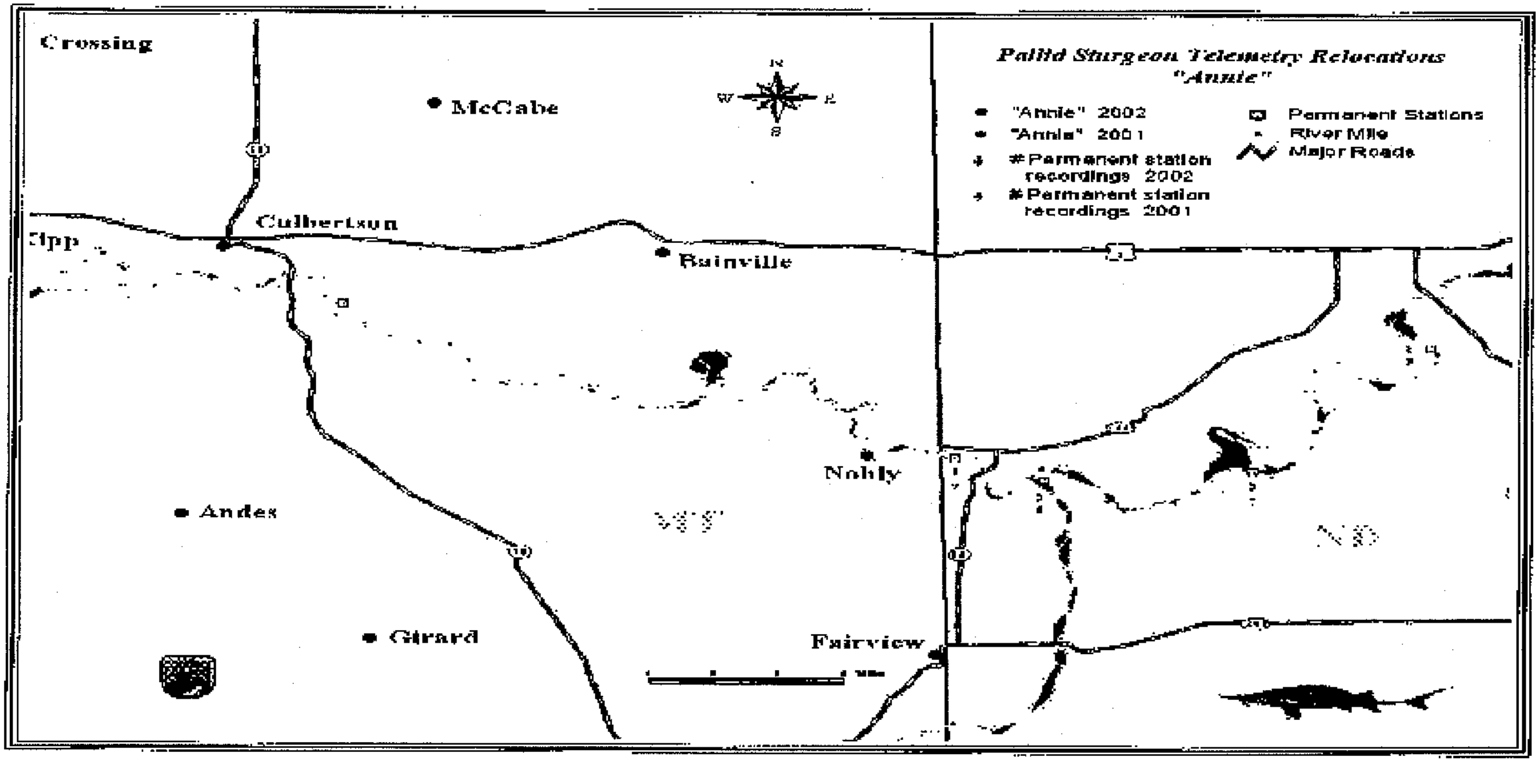

Figure 24: Map of boat relocations and movement frequencies registered for Annie passing various fixed datalogging stations for 2001 and 2002

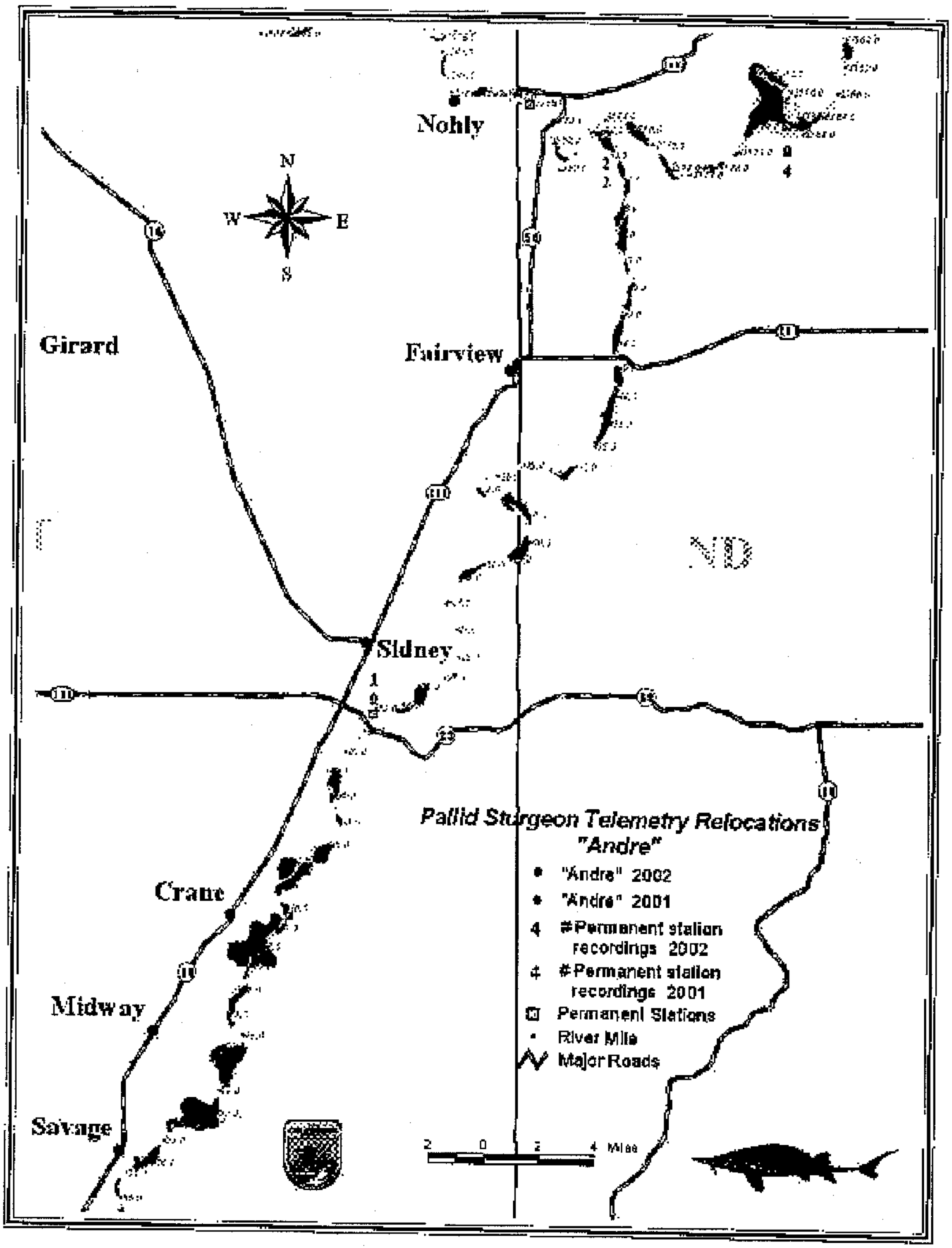

Figure 25: Map of boat relocations and movement frequencies registered for Andre passing various fixed datalogging stations for 2001 and 2002.

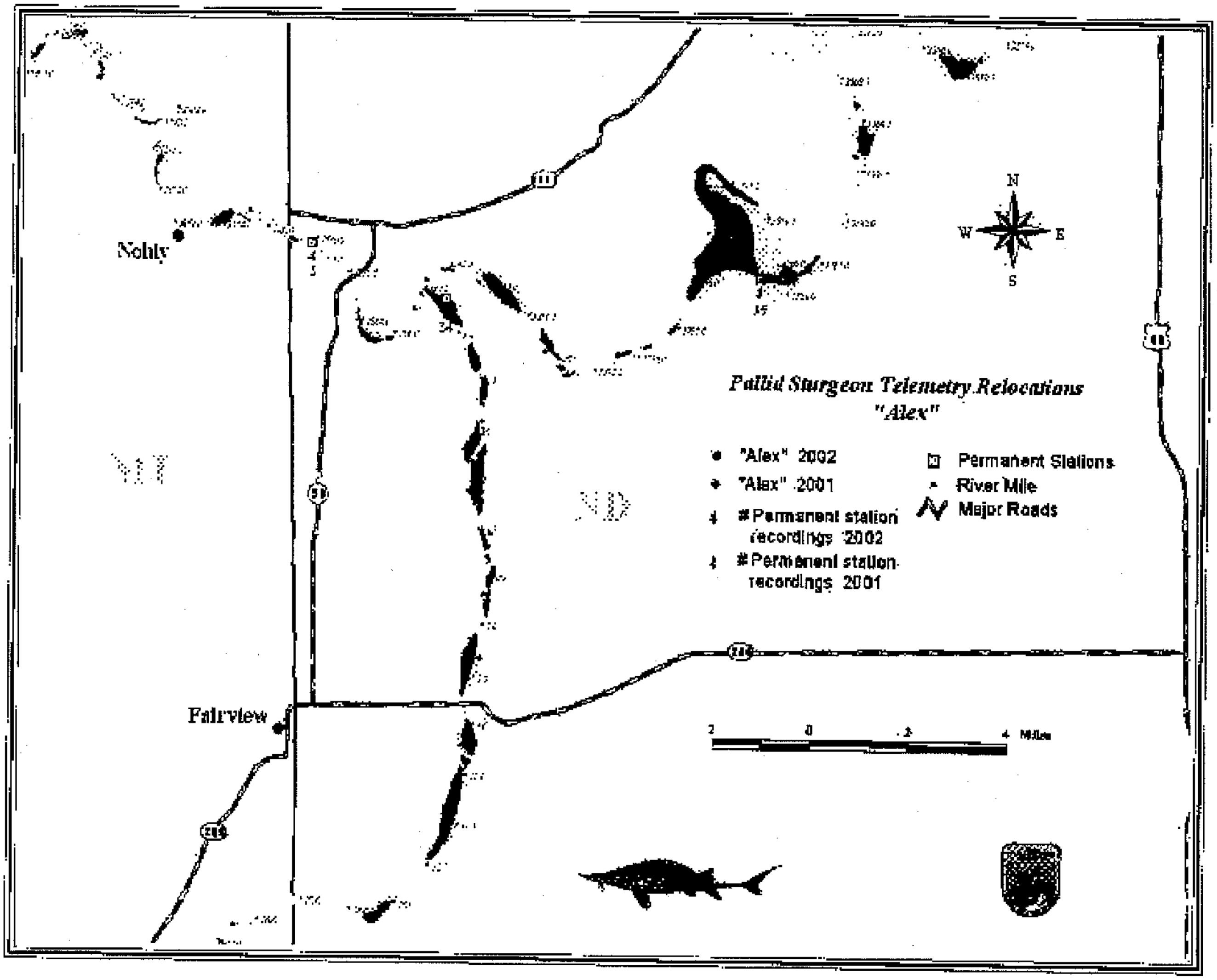

Figure 26: Map of boat relocations and movement frequencies registered for Alex passing various fixed datalogging stations for 2001 and 2002.

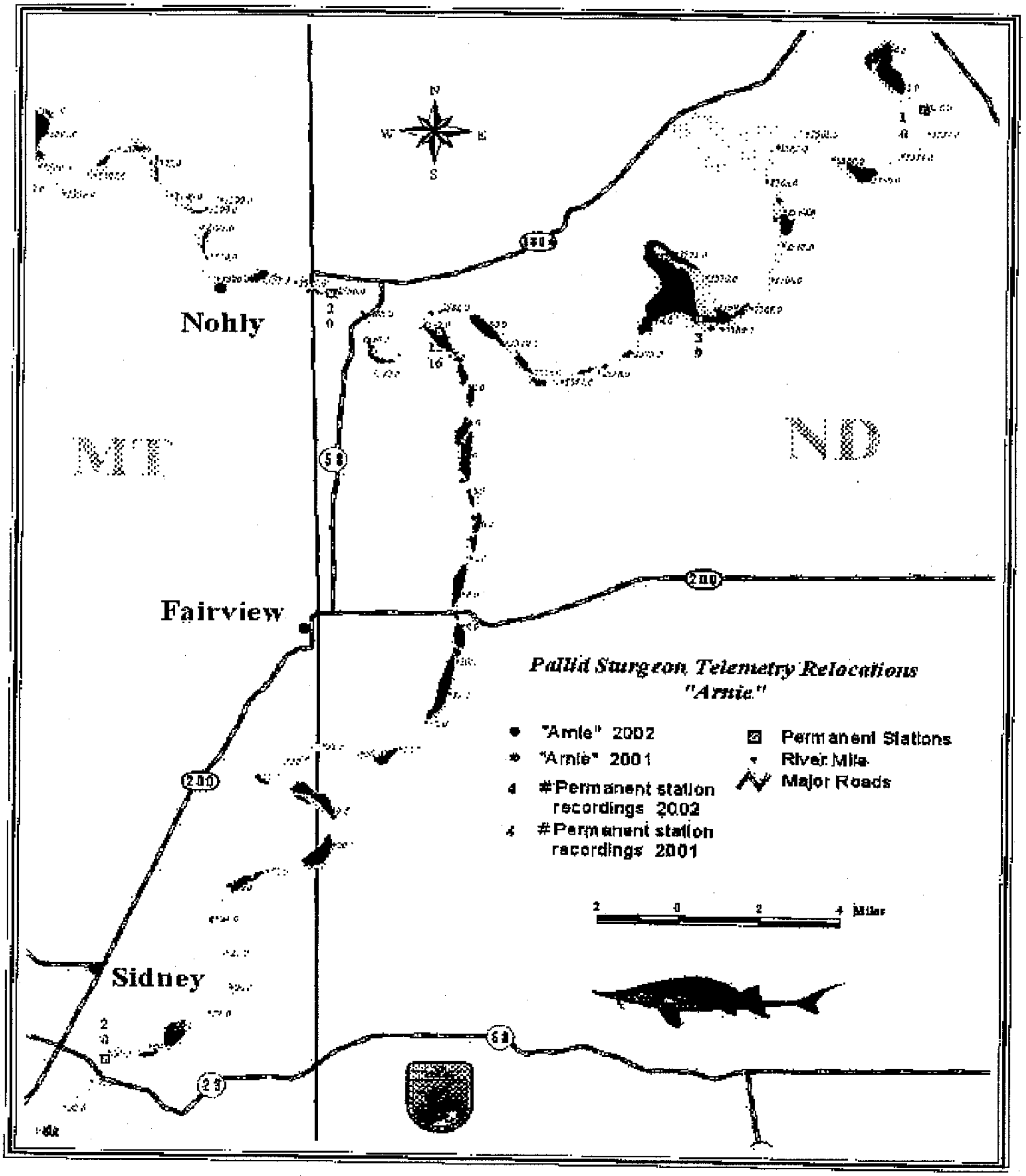

Figure 27: Map of boat relocations and movement frequencies registered for Arnie passing various fixed datalogging stations for 2001 and 2002.

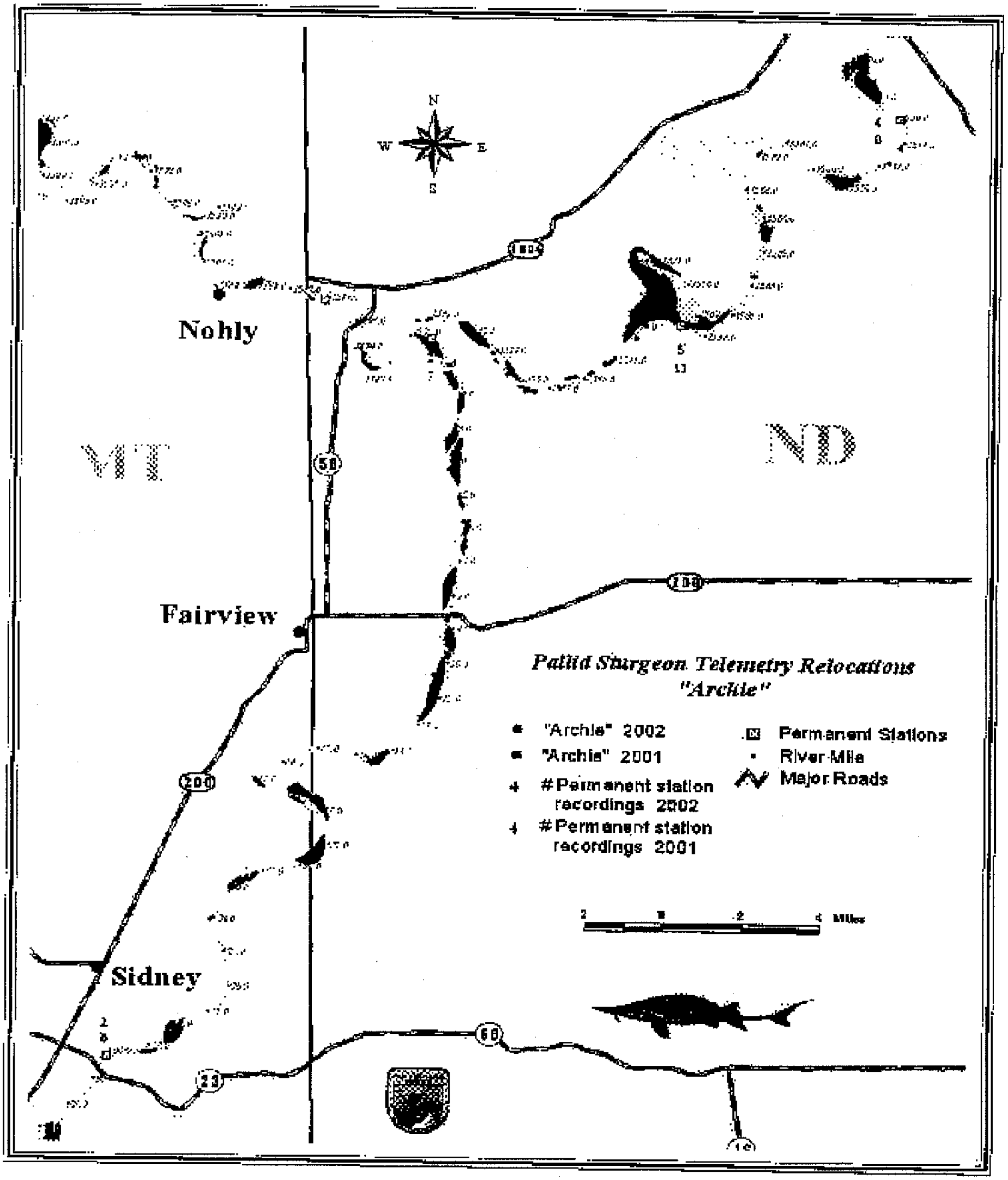

Figure 28: Map of boat relocations and movement frequencies registered for Archie passing various fixed datalogging stations for 2001 and 2002.

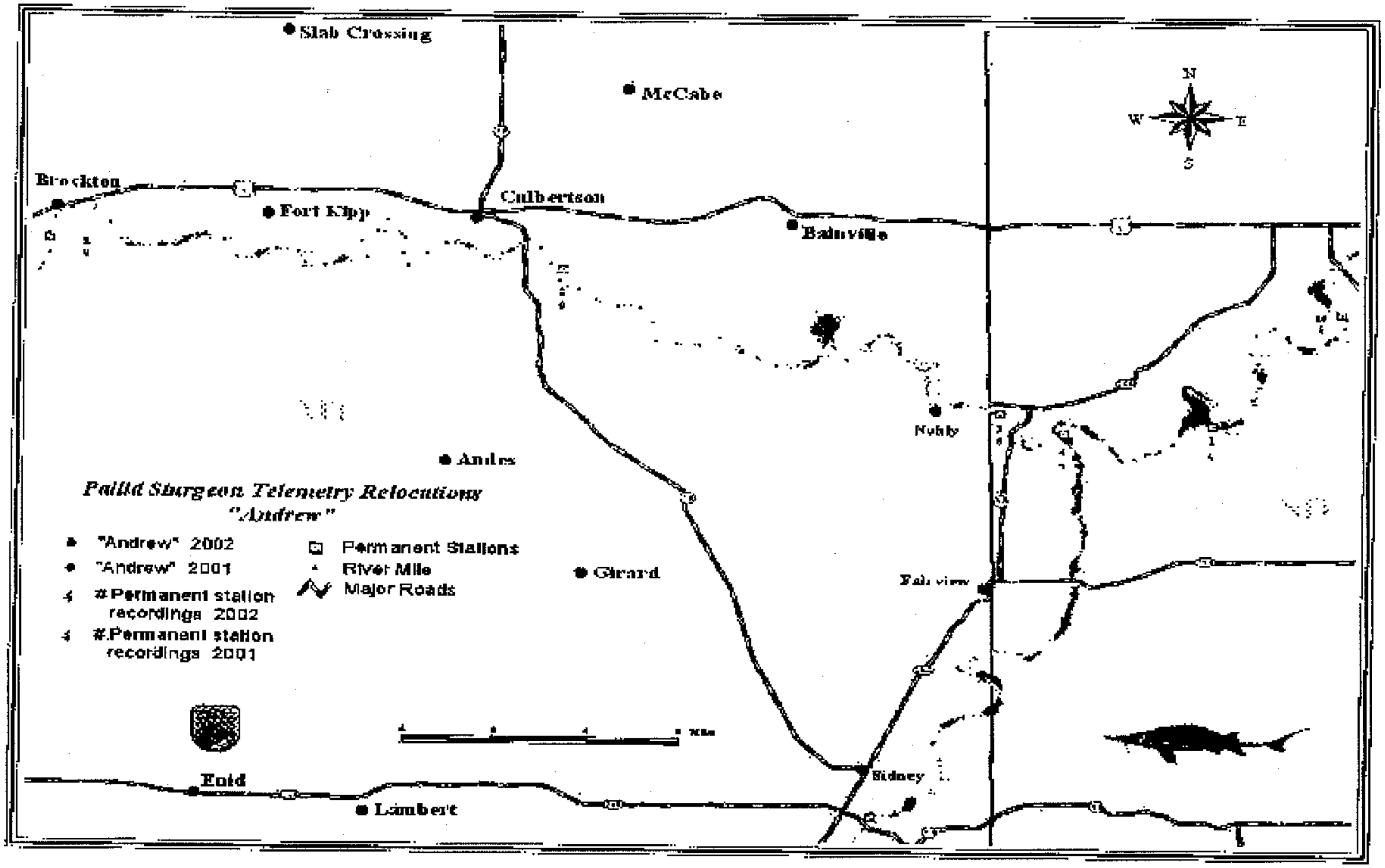

Figure 29: Map of boat relocations and movement frequencies registered for Andrew passing various fixed datalogging stations for 2001 and 2002.

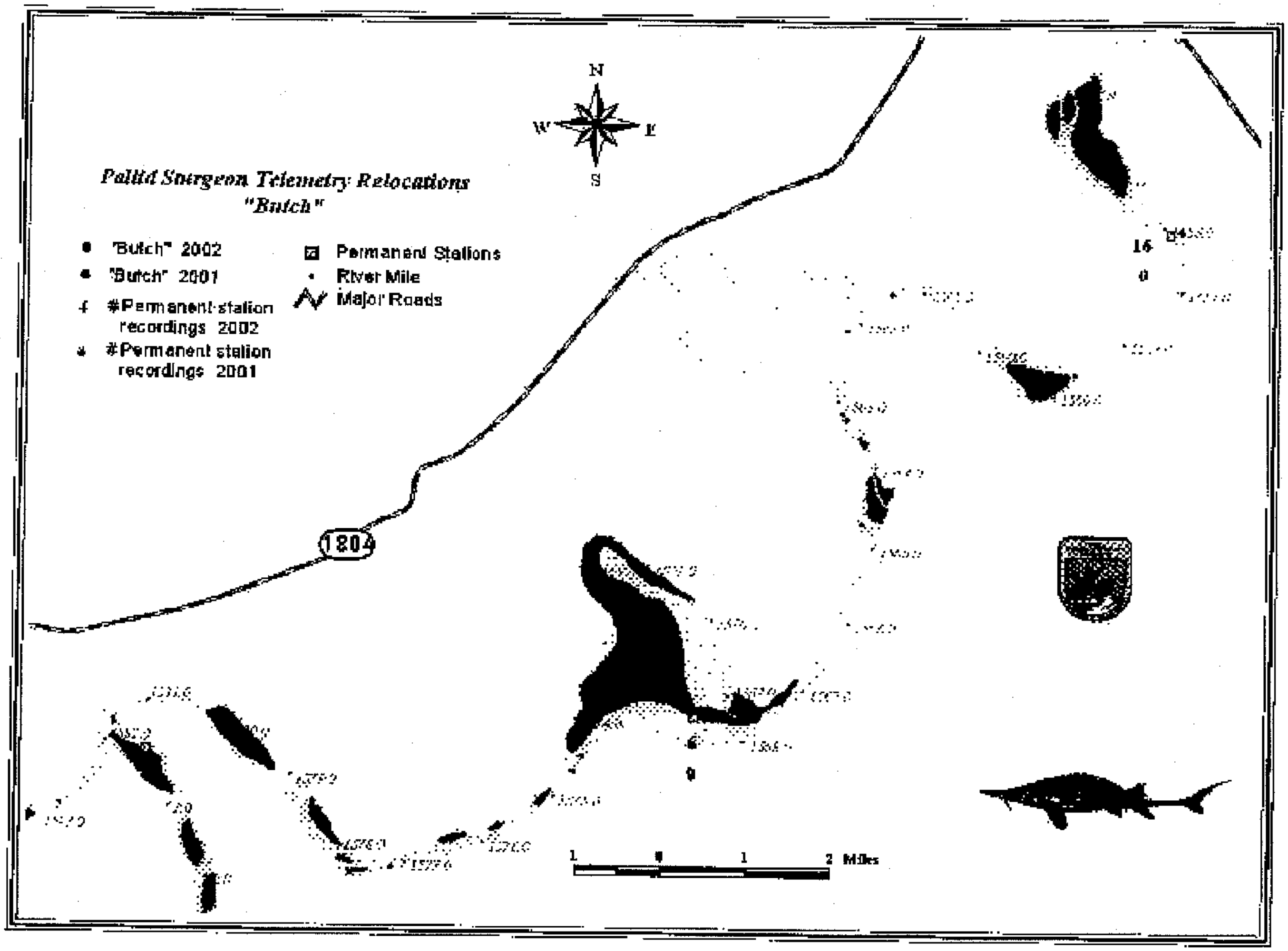

Figure 30: Map of boat relocations and movement frequencies registered for Butch passing various fixed datalogging stations for 2001 and 2002.

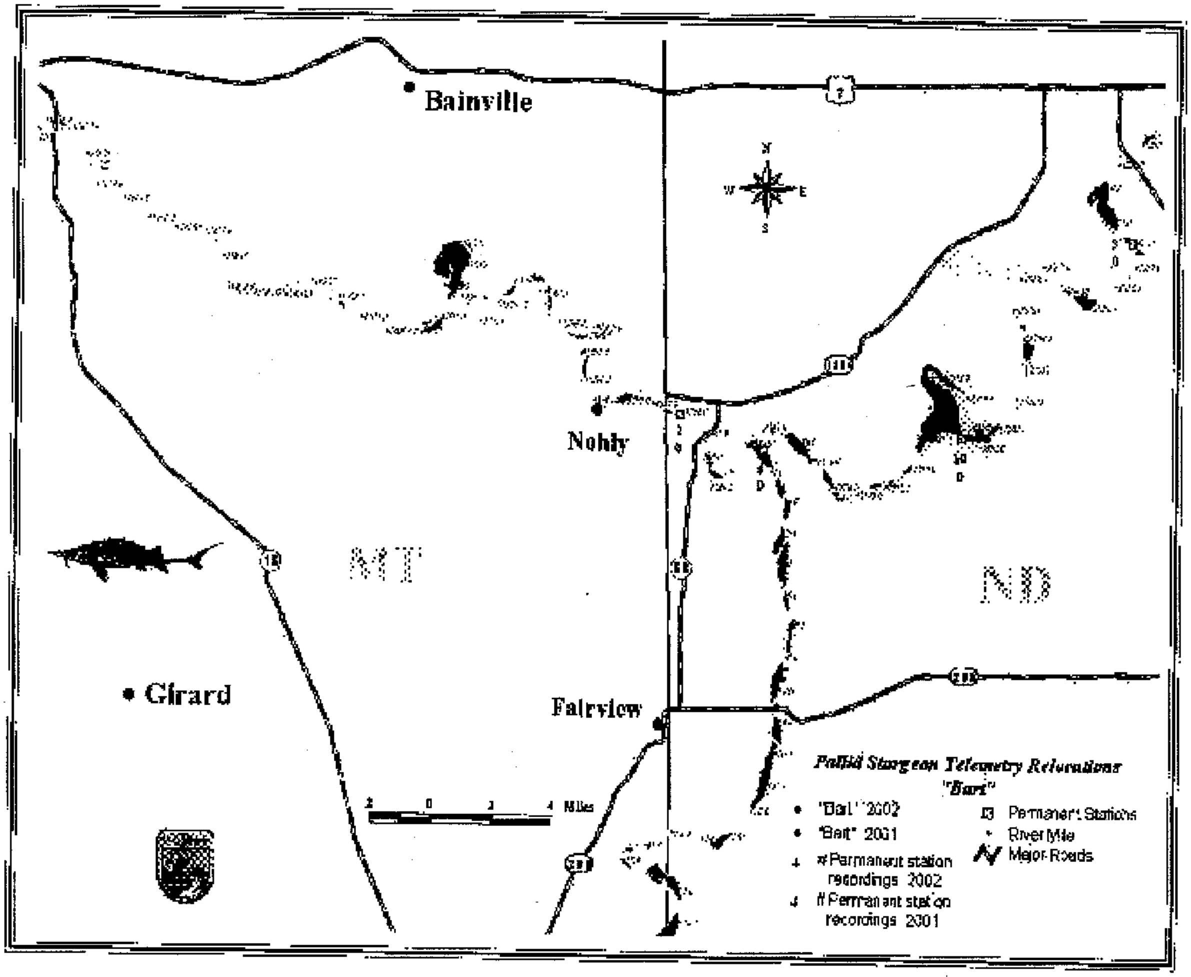

Figure 31: Map of boat relocations and movement frequencies registered for Bart passing various fixed datalogging stations for 2001 and 2002.

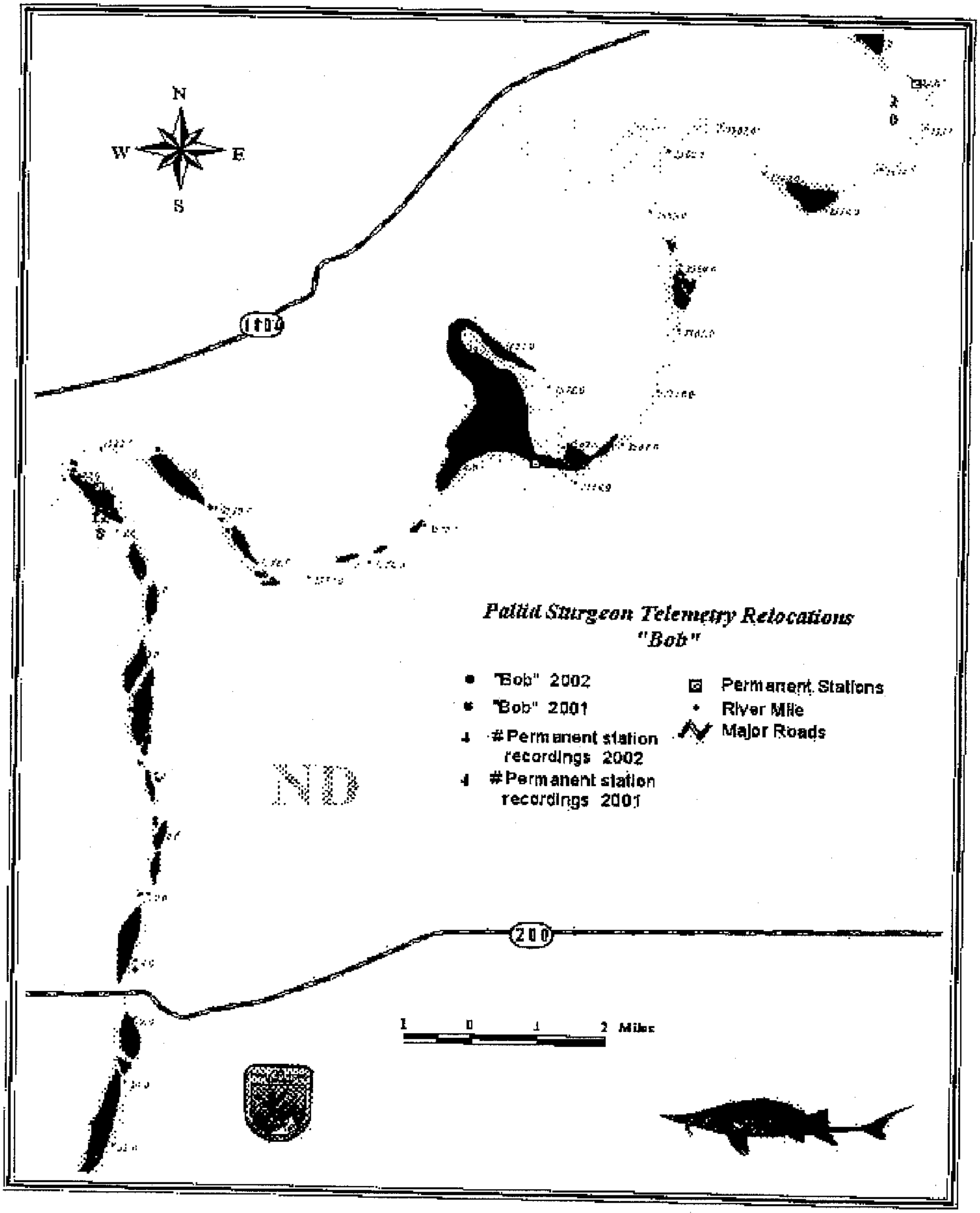

Figure 32: Map of boat relocations and movement frequencies registered for Bob passing various fixed datalogging stations for 2001 and 2002.

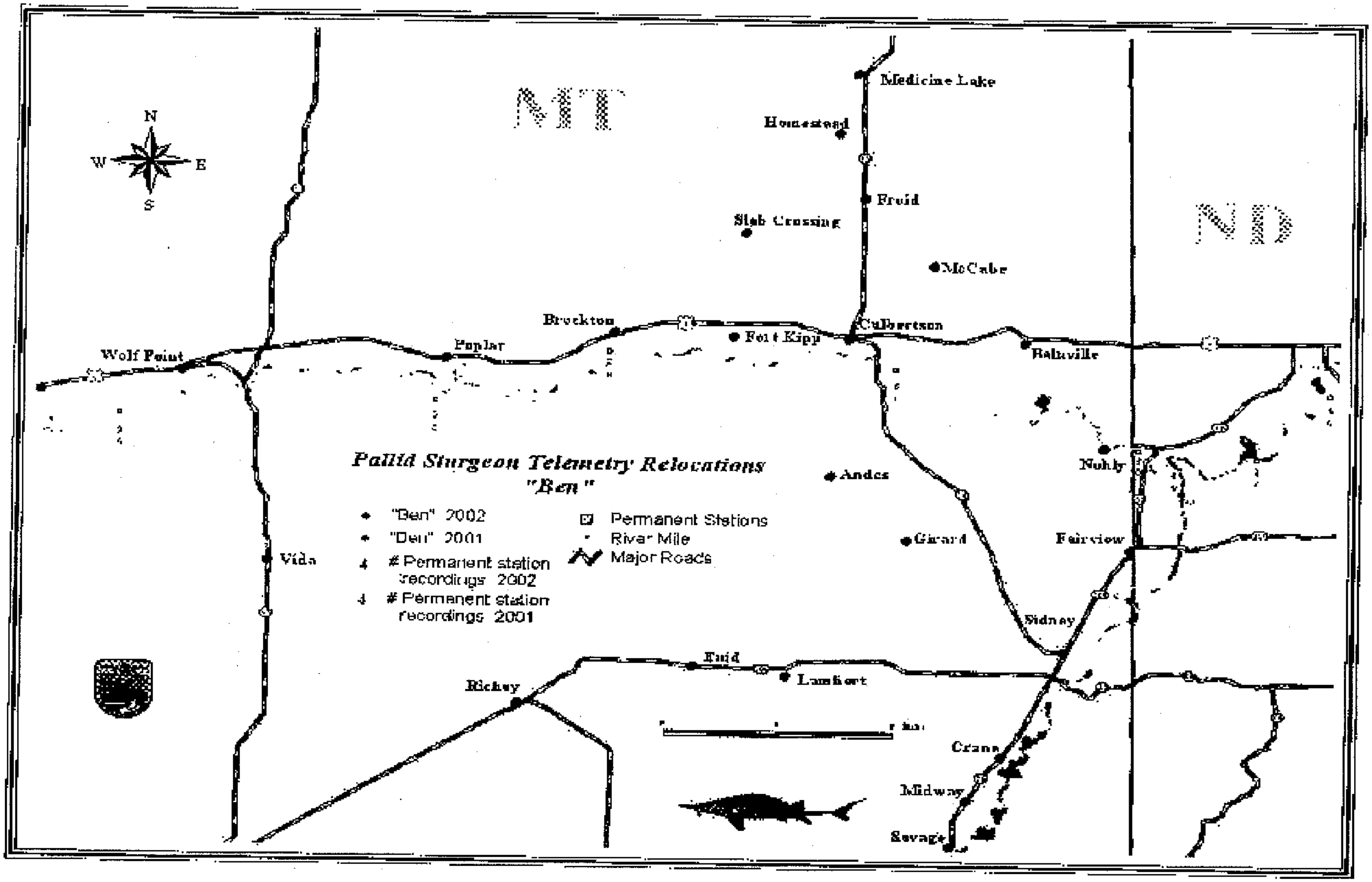

Figure 33: Map of boat relocations and movement frequencies registered for Ben passing various fixed datalogging stations for 2001 and 2002.

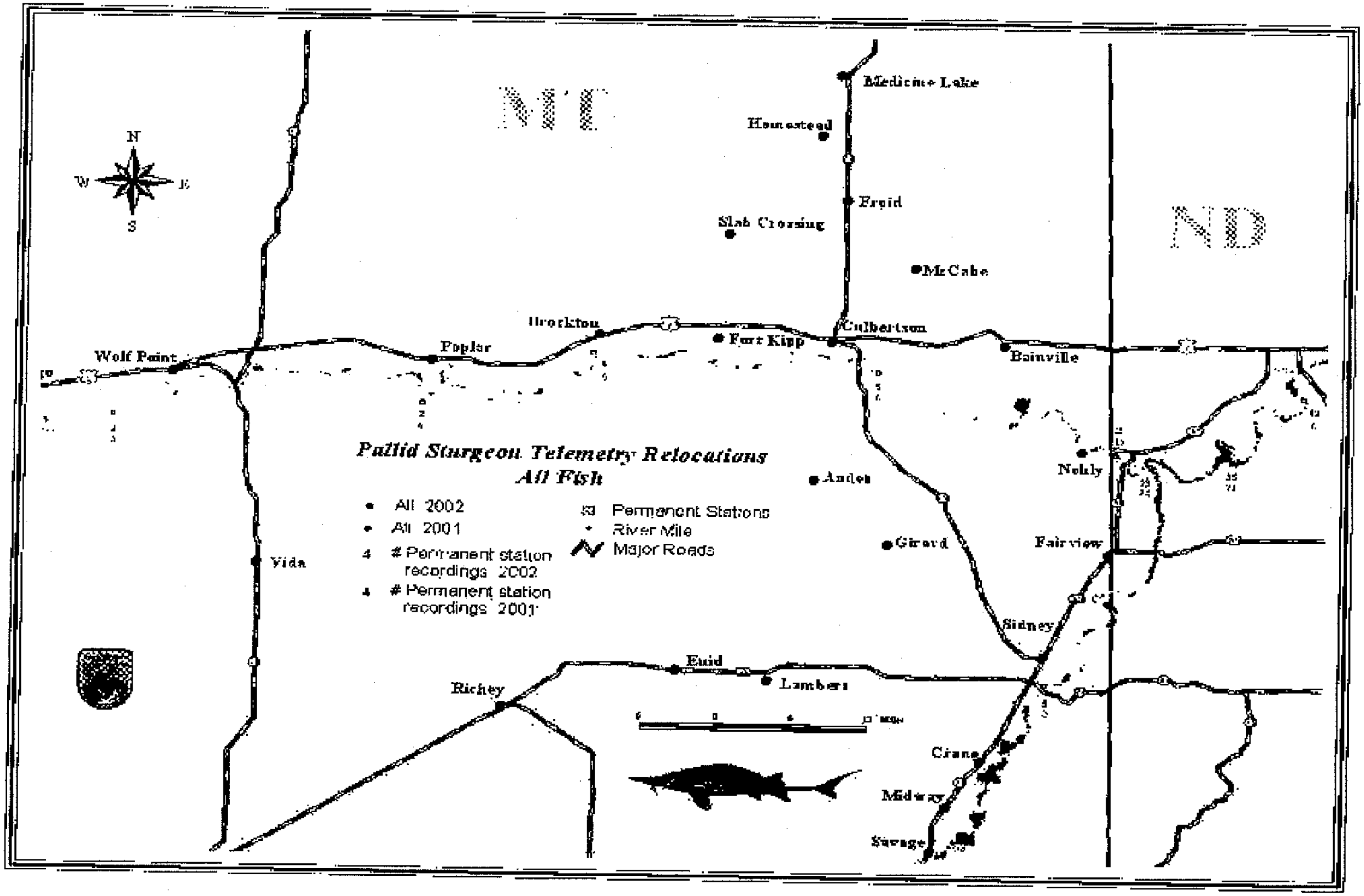

Figure 34: Map of boat relocations and movement frequencies registered for all fish passing various fixed datalogging stations for 2001 and 2002.

Fort Peck Flow Modification Biological Data Collection Plan

Summary of 2002 Activities

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Prepared for:
U. S. Army Corps of Engineers
Contract Number 00-UGPR-34

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Abstract

The Missouri River Biological Opinion developed by the U. S. Fish and Wildlife Service formally identified that seasonally atypical discharge and water temperature regimes resulting from operations of Fort Peck Dam have precluded successful spawning and recruitment of pallid sturgeon *Scaphirhynchus albus* in the Missouri River below Fort Peck Dam. In response, the U. S. Army Corps of Engineers (USACE) proposes to modify operations of Fort Peck Dam to enhance environmental conditions for spawning and recruitment of pallid sturgeon. The Fort Peck Flow Modification Biological Data Collection Plan (hereafter Fort Peck Data Collection Plan) was implemented in 2001 to evaluate the influence of proposed flow and temperature modifications on physical habitat and biological response of pallid sturgeon and other native fishes. Activities continued during 2002, and are summarized below. The multi-year Fort Peck Data Collection Plan is comprised of five monitoring components: 1) measuring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements by pallid sturgeon that inhabit areas immediately downstream from Fort Peck Dam, 3) examining flow- and temperature-related movements of paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus*, 4) quantifying larval fish distribution and abundance, and 5) examining food habits of piscivorous fishes. The Fort Peck Data Collection Plan is supported by the USACE, and implemented by the Montana Department of Fish, Wildlife, and Parks (MTFWP) and the U. S. Geological Survey Columbia Environmental Research Center.

Proposed flow modifications were not implemented in 2002 due to inadequate precipitation and insufficient reservoir levels. Continuous-recording water temperature loggers positioned at 17 locations provided baseline water temperature profiles to which changes in water temperatures resulting from modified dam operations could be compared. In the absence of modified dam operations in 2002, mean water temperature between mid-May and mid-October was 6.0°C cooler immediately downstream from Fort Peck Dam (mean = 11.9°C) than in the free-flowing Missouri River upstream from Fort Peck Dam (mean = 17.9°C). Water temperature 288 km (179 miles) downstream from Fort Peck Dam averaged 1.2°C less than above Fort Peck Dam. Similar to 2001, adult pallid sturgeon were not found in selected areas immediately downstream from Fort Peck Dam. Consequently, pallid sturgeon were not implanted with radio transmitters. Between April and November 2002, telemetry relocations were obtained for 16 blue suckers (160 relocations), 27 shovelnose sturgeon (276 relocations), and 18 paddlefish (134 relocations) in the Missouri River and Yellowstone River. One continuous-recording telemetry logging station positioned in the Milk River and five additional stations positioned at sites between Fort Peck Dam and Culbertson logged an additional 376 contacts of radio-implanted fish. Shovelnose sturgeon and paddlefish were highly migratory, and exhibited seasonal differences in use of the Missouri River and Yellowstone River. Blue suckers tended to be less migratory. In September 2002, an additional 21 shovelnose sturgeon, 21 blue suckers, and 3 paddlefish were implanted with transmitters. These individuals will be tracked during 2003. A total of 41,768 larval fish were sampled at six sites on the mainstem Missouri River and adjacent habitats. Larval sturgeon (*Scaphirhynchus* sp.) were sampled at Wolf Point (N = 5) and in the Yellowstone River (N = 9). Larval catostomids (suckers) were the dominant taxon sampled, and comprised 43-94% of the larval fishes sampled at all sites; however, taxa composition varied significantly among sites. Food habit data for burbot *Lota lota*, channel catfish *Ictalurus punctatus*, freshwater drum *Aplodinotus grunniens*, goldeye

Hiodon alosoides, northern pike *Esox lucius*, sauger *Stizostedion canadense*, shovelnose sturgeon, and walleye *Stizostedion vitreum* were obtained during July and August 2002. All species with the exception of shovelnose sturgeon exhibited piscivory, but there was no evidence that sturgeon larvae or juveniles were consumed. Six hatchery-raised juvenile pallid sturgeon and one adult pallid sturgeon were sampled during September in conjunction with associated field activities. In addition, two larval pallid sturgeon (21.6 mm, 23.1 mm) were sampled on September 4 and 5, 2002, downstream from the Yellowstone River confluence. These findings are the first documented account of larval pallid sturgeon in the Missouri River downstream from Fort Peck Dam, and indicate that successful spawning by pallid sturgeon did occur in 2002. However, it is not known whether spawning occurred in the Yellowstone River or in the Missouri River.

Introduction

The U.S. Army Corps of Engineers (USACE) proposes to modify operations of Fort Peck Dam following specifications outlined in the Missouri River Biological Opinion (U.S. Fish and Wildlife Service 2000). Modified dam operations are proposed to increase discharge and enhance water temperatures during late May and June to provide spawning cues and enhance environmental conditions for pallid sturgeon *Scaphirhynchus albus* and other native fishes. In contrast to "normal" cold water releases through Fort Peck Dam, water from Fort Peck Reservoir will be released over the spillway during flow modifications to enhance water temperature conditions. The USACE proposes to conduct a mini-test of the flow modification plan to evaluate structural integrity of the spillway and other engineering concerns. A full-test of the flow modifications will occur when a maximum of 19,000 cfs will be routed through the spillway. Spillway releases will be accompanied by an additional 4,000 cfs released through the dam. Pending results from the full-test, modified flow releases from Fort Peck Dam in subsequent years will be implemented in an adaptive management framework. All proposed flows are dependent on adequate inflows to Fort Peck Reservoir and adequate water levels in the reservoir.

The original schedule of events for conducting the flow modifications called for conducting the mini-test during 2001 and conducting the full-test in 2002. However, insufficient water levels in Fort Peck Reservoir during spring 2001 and 2002 precluded conducting the mini-test and full-test. Thus, pending favorable precipitation and adequate reservoir water levels in early spring 2003, the mini-test may be conducted in 2003 and the full-test conducted in 2004.

The Fort Peck Flow Modification Biological Data Collection Plan (hereafter referred to as the Fort Peck Data Collection Plan) is a monitoring program designed to examine the influence of proposed flow modifications from Fort Peck Dam on physical habitat and biological response of pallid sturgeon and other native fishes. Components of the monitoring program include: 1) measuring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements by pallid sturgeon that inhabit areas immediately downstream from Fort Peck Dam, 3) examining flow- and temperature-related movements of paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus*, 4) quantifying larval fish distribution and abundance, and 5) examining food habits of piscivorous fishes. The Fort Peck Data Collection Plan is supported by the USACE, and implemented by the Montana Department of Fish, Wildlife, and Parks (MTFWP) and the U. S. Geological Survey Columbia Environmental Research Center – Fort Peck Project Office. Western Area Power Administration serves as the contractual liaison between the USACE and MTFWP.

Study Area

The Missouri River study area extends from Fort Peck Dam located at river kilometer (rkm) 2,850 (river mile, RM 1,770) to the headwaters of Lake Sakakawea near rkm 2,496 (RM 1,550; Figure 1). The study area also includes the lower 113 rkm (70 miles) of the Yellowstone River (Figure 1). See Gardner and Stewart (1987), White and Bramblett (1993), Tews (1994), and Bramblett and White (2001) for a complete description of physical and hydrological characteristics of the study area.

Methods

Monitoring Component 1 - Water temperature and turbidity.

Water temperature logger deployment. Water temperature loggers (Optic StowAway, -5°C – +37°C, 4 min response time, accuracy ± 0.2°C from 0 - 21°C) were deployed during early May at sites in the Missouri River, Yellowstone River, selected tributaries, and off-channel areas (Table 1). Duplicate loggers were secured adjacent to the north and south bank lines at sites in the Missouri River to assess lateral variations in water temperature. Water temperature loggers were positioned near the bottom of the river channel. An additional logger was stratified in the water column at selected sites to assess vertical variations in water temperature. Stratified water temperature loggers were secured to either the north or south bank locations. Water temperature loggers were programmed to record water temperature at 1-hr intervals, and periodically downloaded during the deployment period.

Statistical analysis of water temperature. Analysis of variance and t-tests were used to compare mean daily water temperature among water temperature loggers positioned on the north and south bank locations, and stratified in the water column. Analysis of variance was used to compare mean daily water temperature among all logger locations.

Assessment of water temperature logger precision. Precision of water temperature loggers was assessed prior to and following retrieval from the field. In April 2002, all water temperature loggers (except the logger deployed at Robinson Bridge) were subjected to a series of 15 common water bath treatments to evaluate precision and accuracy among loggers. The 15 water bath treatments were comprised of three temperature ranges (cold, < 10°C; cool, 15-20°C; warm, > 20°C) with five temperature measurements recorded within each temperature range. During water bath treatments, water temperature was also measured with a YSI Model 85 meter (accuracy ± 0.1°C) and a hand-held alcohol thermometer (accuracy ± 1.0°C) at specific times. In late November following retrieval from the field, water temperature loggers were subjected to a similar series of common water bath treatments as conducted in pre-deployment assessments. In addition to pre- and post-deployment comparisons involving water bath treatments, water temperature measured with the YSI Model 85 meter during the course of larval fish sampling (late May through early August, see below) provided an additional data set to which accuracy and precision of the loggers could be evaluated. Larval fish sampling sites were generally within 1.6-3.2 km (1-2 miles) of a water temperature logger. Water temperature at the larval fish sampling sites was measured in the upper 1-m of the water column.

Statistical analysis of water temperature logger precision. Pre- and post-deployment precision of loggers for each water bath treatment was evaluated with univariate statistics (mean, standard deviation, minimum, maximum, and range) computed over all loggers. The mean, minimum, maximum, and range were screened for precision. If precision was low (e.g., broad range of temperature for an individual water bath trial), logger data were scrutinized to determine which logger(s) was contributing to the extreme values. After identifying and deleting the "suspect" logger(s), univarite statistics were computed again to assess precision. In addition to univariate statistics, a two-way analysis of variance was used to compare precision (i.e., temperature range) of water temperature loggers between pre- and post-deployment test and among the three water temperature treatments.

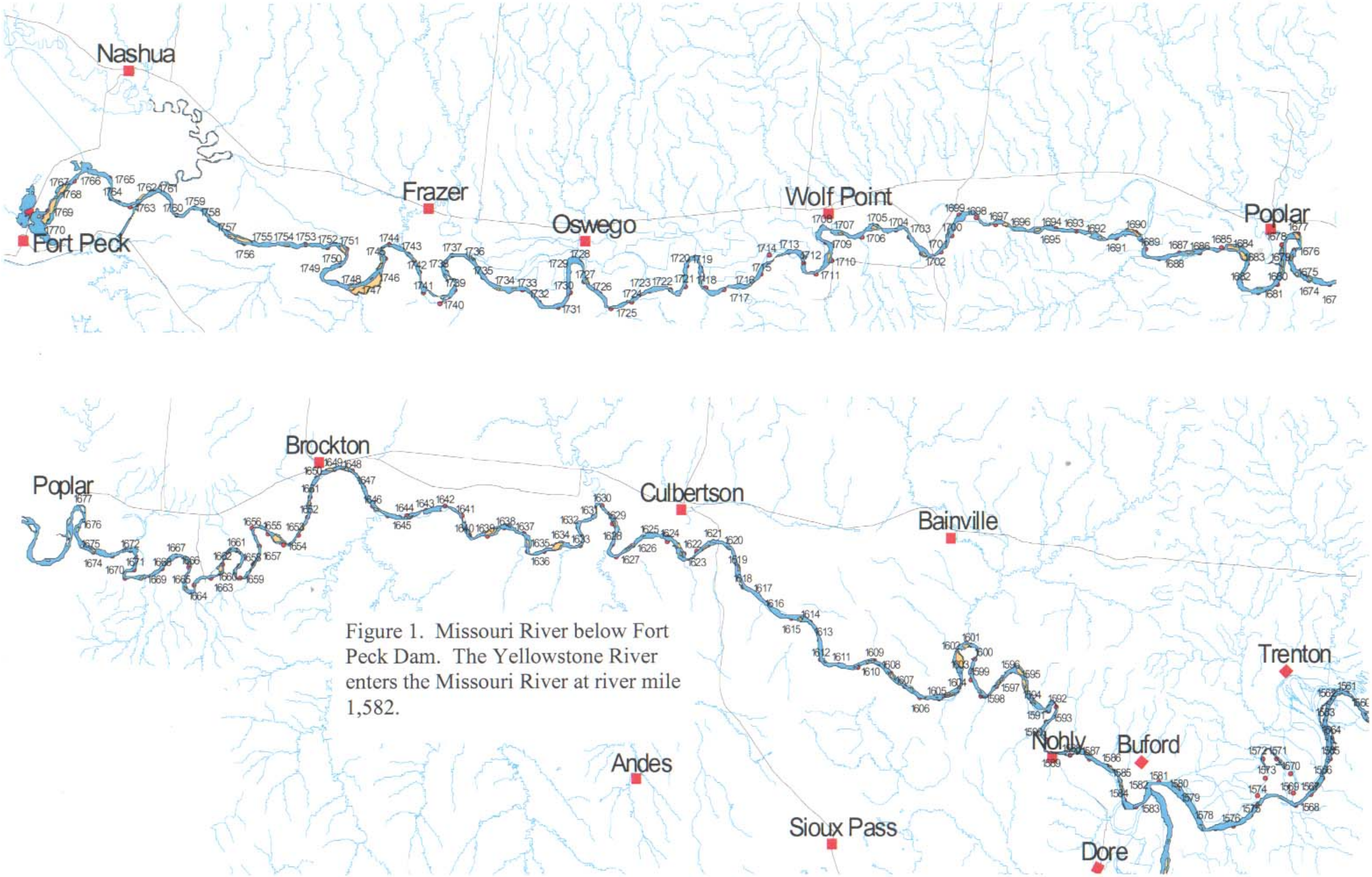

Figure 1. Missouri River below Fort Peck Dam. The Yellowstone River enters the Missouri River at river mile 1,582.

Table 1. Sites, approximate river mile (RM; distance upstream from the Missouri River-Mississippi River confluence or distance upstream in a specified tributary), bank locations (north, south, strat = stratified in the water column), serial numbers, and dates of deployment for water temperature loggers deployed in the Missouri River and adjacent areas during 2002. NR = not recovered at the end of the season.

Site	RM	Bank location	Logger serial no.	Deploy date	Retrieval date
Above Fort Peck Lake	1,921.2	South		4/26/02	11/6/02
Downstream from Fort Peck Dam	1,765.2	North	389503	5/10/02	10/21/02
		South	389561	5/10/02	10/21/02
Spillway			389574	5/10/02	10/21/02
Milk River	4.0		389560	5/9/02	10/21/02
Nickels Ferry	1,759.9	North	389495	5/9/02	10/21/02
		South	389488	5/9/02	10/21/02
		strat	407322	5/9/02	10/21/02
Nickels Rapids	1,757.5	North	389563	5/9/02	11/6/02
		South	389571	5/9/02	11/6/02
		strat	389504	5/9/02	11/6/02
Frazer Pump	1,751.5	North	389565	5/9/02	11/6/02
		South	389489	5/9/02	11/6/02
		Strat	389556	5/9/02	11/6/02
Frazer Rapids	1,746.0	North	389501	5/9/02	11/6/02
		South	389490	5/9/02	11/6/02
		Strat	429705	5/9/02	11/6/02
Grand Champs	1,741.5	North	389497	5/9/02	11/6/02
		South	389575	5/9/02	11/6/02
		Strat	407323	5/9/02	11/6/02
Wolf Point	1,701.5	North	389493	5/9/02	11/6/02
		South	389500	5/9/02	11/6/02
		strat	429703	5/9/02	11/6/02
Redwater River	0.1		389502	5/9/02	NR
Poplar	1,680	North	389491	5/9/02	NR
		South	389492	5/9/02	NR
		strat	429700	5/9/02	NR
Poplar River	0.4		314955		NR
Culbertson	1,620.9	North	389572	5/2/02	10/25/02
		South	389567	5/2/02	NR
		strat	429696	5/2/02	10/25/02
Nohly	1,591.2	North	429697	5/1/02	11/8/02
		South	389498	5/1/02	NR
		strat	429698	5/1/02	NR
Yellowstone River	3.5		389562	5/1/02	11/8/02
Below Yellowstone River	1,576.5	North	389566	5/1/02	11/8/02
		South	389564	5/1/02	11/8/02
		strat	429704	5/1/02	11/8/02

Field measurements of turbidity. Turbidity (nephelometric turbidity units; NTU) was measured from late May through August with continuous-recording (1-hr interval) turbidity data loggers (Hydrolab Datasonde 4a, serial numbers 39046, 39047, 39048, 39049, measurement range 0 – 1000 NTU, accuracy ± 2%). Turbidity loggers were deployed in the Missouri River near Frazer Rapids (rkm 2,811; RM 1,746), near Poplar (rkm 2,708; RM 1,682) and near Nohly (rkm 2,558; RM 1589), and in the Yellowstone River 0.81 km (0.5 miles) upstream from the confluence.

Assessments of turbidity logger precision. Precision of turbidity loggers was assessed during field deployment and following retrieval from the field. Turbidity loggers at Nohly and in the Yellowstone River were located within larval fish sampling stations (see below) where turbidity was also measured at 2-3 day intervals between late May and early August. Turbidity at the larval fish sampling stations was measured using a Hach Model 2100P portable turbidimeter (measurement range 0 – 1000 NTU, accuracy ± 2%). Thus, time- and date-specific turbidity measurements logged by the turbidity loggers were compared to turbidities measured during larval fish sampling. After deployment in the field, turbidity loggers were subjected to a common water bath to assess precision of turbidity measurements among the turbidity loggers. The loggers were placed in a water bath to which sediment had been added. Sediments in the bucket were periodically mixed to increase turbidity. After turbidity declined due to particle settling, the sediments were again stirred to increase turbidity. Turbidity loggers were programmed to record turbidity at 15-min intervals during the post-deployment assessments. The 15-min sampling interval resulted in more than 90 individual measurements of turbidity during the post-deployment tests. A subsample of low (< 100 NTU), medium (200-500 NTU), and high (>500 NTU) turbidity measurements was randomly selected from the total number of observations for post-deployment comparisons.

Statistical analysis of turbidity logger precision. Correlation analysis was used to assess the degree of association between turbidities measured by the turbidity loggers and turbidities measured during larval fish sampling at Nohly and in the Yellowstone River. In addition, t-tests were used to compare mean turbidity recorded by the loggers and during larval fish sampling. For post-deployment assessments of turbidity, univariate statistics as calculated for water temperature (discussed above) were screened for precision. Analysis of variance was used to compare the turbidity range (i.e., precision) among low, medium, and high turbidity water bath treatments.

Monitoring Component 2 – Movements by pallid sturgeon.

Diving in areas immediately downstream from Fort Peck Dam was conducted periodically during a 6-week period in February and March 2001. Pallid sturgeon collected were to be implanted with transmitters and tracked during spring and summer.

Monitoring Component 3 – Flow- and temperature-related movements of paddlefish, blue suckers, and shovelnose sturgeon.

Transmitter implantation.-Sampling for paddlefish, blue suckers, and shovelnose sturgeon for transmitter implantation was conducted in September 2002. Species were sampled using drifted trammel nets, hoop nets (primarily targeting blue suckers), and surface-drifted gill nets (primarily targeting paddlefish). A minimum of 20 suitable-sized individuals of each species were targeted for transmitter implantation. Our goal was to extend flow- and temperature-related movement inferences to all areas of the Missouri River below Fort Peck

Dam. Therefore, species were collected in several areas between rkm 2,842 (RM 1,765) and rkm 2,547 (RM 1,582; Figure 1).

The three species were implanted with two varieties of combined acoustic/radio tags (CART tags, Lotek Wireless Incorporated, New Market, Ontario). The CART tag emits alternating radio and acoustic coded signals at established time intervals. The coded signal emitted by each CART tag is unique to facilitate identification of individual fish. Blue suckers and shovelnose sturgeon were implanted with the CART 16-2S (16 mm x 68 mm, air weight = 31.5 g, 865-day longevity, 4-second pulse interval, 149.620 Mhz, 76.8 kHz). Paddlefish were implanted with the CART 32-1S (32 mm x 101 mm, air weight = 114 g, 1,095-day longevity, 1 second interval, 149.620 MHz, 76.8 kHz).

Surgical implantation of transmitters was conducted after 1-6 individuals were captured at a sampling location. After being sampled, fish were placed in streamside live cars. Individuals were placed in a partially submerged V-shaped trough during surgical implantation of transmitters, and water was continually flushed over the gills using a bilge pump apparatus. After making an abdominal incision about midway between the pectoral fin and pelvic fin, a shielded needle technique (Ross and Kleiner 1982) was used to extrude the transmitter antennae through the body cavity. The transmitter was then inserted into the body cavity, and the incision was closed with silk sutures. Most blue suckers and shovelnose sturgeon were held overnight in streamside live cars, and released the following morning. A 5-10 minute period of facilitated acclimation following surgical procedures was used to stabilize paddlefish prior to release. Surgical implantation of transmitters was conducted at water temperatures between 10.3°C and 16.4°C.

Stationary telemetry logging stations.- Stationary telemetry logging stations were deployed in late April and early May 2002 at six sites (Milk River, RM 2.0; downstream from the Milk River, RM 1,759; near Wolf Point, RM 1,717; near Poplar, RM 1,681.5; near Brockton, RM 1,651; near Culbertson, RM 1,619). The logging stations (8 ft x 8 ft floating platform) were positioned away from the bankline, and secured to the bankline using cables and an iron arm. Each logging station was equipped with unidirectional hydrophones (one pointing upstream, one pointing downstream), solar panels, and an environmental enclosure kit containing dual 12-volt batteries, a receiver, two ultrasonic upconverters, and an antennae switchbox.

Manual tracking of implanted fish.- Manual tracking of fish implanted with CART tags in September 2001 was initiated in April 2002. The Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea (354 km, 220 miles), and the Yellowstone River from the confluence to Intake Diversion (113 km, 70 miles) were tracked at about weekly intervals. Two radio frequencies (149.760 MHz, 149.620 MHz) were simultaneously monitored during the boat-tracking run. A hydrophone was used to scan acoustic frequencies in deep areas of the two rivers. The entire study area could be tracked in a 3-4 day time interval. Several variables (frequency, code, latitude, longitude, river mile, water depth, habitat type, water temperature, turbidity, time-of-day) were recorded at fish relocations.

Data analysis.-A complete analysis of fish movements and tracking data is not warranted at this time because 2002 was the initial year of the multi-year study. Rather, fish movements and tracking data for 2002 were summarized for the study period as the number of relocations per km by river reach for the three species. Five river reaches were delineated, and included Reach 1 (Fort Peck Dam to Wolf Point, rkm 2,832 – rkm 2,723), Reach 2 (Wolf Point to the Yellowstone River confluence, rkm 2,723 – km 2,691), Reach 3 (Yellowstone River confluence to Highway 85 near Williston, ND, rkm 2,691 – rkm 2,485), Reach 4 (Yellowstone River from the confluence to Sidney, MT, rkm 0 – rkm 48), and Reach 5 (Yellowstone River from Sidney to Intake diversion dam, rkm 48 – rkm 114).

Monitoring Component 4 – Larval Fish

Sampling protocols. Larval fish were sampled at about 3-4 day intervals from late May through early August at six sites (Table 2). Similar to 2001, sites on the mainstem Missouri River were located just downstream from Fort Peck Dam, near Wolf Point, and near Nohly. Sites located off the mainstem Missouri River included the spillway channel, the Milk River, and the Yellowstone River. Larval fish at all sites were sampled with 0.5-m-diameter nets (750 µm mesh) fitted with a General Oceanics Model 2030R velocity meter.

Table 2. Larval fish sampling locations, number of replicates, samples, and net locations for 2002. Abbreviations for net location are as follows: B = bottom, M = mid-water column, S = surface (0.5 - 1.0 m below the surface).

Site	Approximate river mile	Replicates	Samples per replicate	Net location
Missouri River below Fort Peck Dam	1,763.5-1,765.3	3	4	B/M
Spillway	1,762.8	2	4	S
Milk River	0.5-4.0	5	4	S
Missouri River near Wolf Point	1,701.0-1,708.0	5	4	B/M
Missouri River near Nohly	1,584-1,592	5	4	B/M
Yellowstone River	0.1-3.0	5	4	B/M

Specific larval fish sampling protocols varied among sites and were dependent on site characteristics (Table 2). Two to five replicates were collected at the sites, where one replicate was comprised of four subsamples (two subsamples simultaneously collected on the right and left side of the boat at sampling locations near the left and right shorelines). At all sites except the spillway site, the left and right sampling locations corresponded to inside bend and outside bend locations at the mid-point of a river bend. The spillway channel had minimal sinuosity; therefore, samples did not reflect inside and outside bend locations. Only two replicates were available in the spillway channel (one replicate in both of the spillway channel pools), and three replicates were available at the site downstream from Fort Peck Dam. The full compliment of five replicates was available at the other sites. At sites exclusive of the spillway and Milk River, paired subsamples near the left and right bank locations were comprised of one net fished on the bottom and one net fished in the middle of the water column. Thus, each replicate was comprised of two bottom subsamples and two mid-water column subsamples. Nets were maintained at the target sampling location by affixing lead weights to the net. Larval nets were fished for a maximum of 10 minutes (depending on detrital loads). The boat was anchored during net deployment (e.g., "passive" sampling). In the Milk River and spillway channel, irregular bottom contours, shallow depths, and silt substrates were not conducive to bottom sampling. In addition, minimal current velocity in these two locations required an "active" larval fish sampling approach. Therefore, larval fish in the Milk River and spillway channel were sampled in the upper 1-m of the water column as the boat was powered upstream for a maximum of 10 min. Larval fish samples were placed in a 5-10% formalin solution containing phloxine-B dye and stored.

Larval fish were sampled at the same replicate and subsample locations throughout the sampling period except when changes in discharge necessitated minor adjustments in the sampling location. For example, an attempt was made to sample larval fish at total water column depths between 1.5 m and 3.0 m. This protocol was used to minimize variations in larval fish density associated with vertical stratification of larvae in the water column. When river discharge decreased (or increased), water depth in a previously sampled location exceeded the required range. Therefore, the specific sampling location changed but was always near ($\pm$ 300 m) the general vicinity of the earlier samples.

Laboratory methods. Larval fish were extracted from samples and placed in vials containing 70% alcohol. Larvae were identified to family when possible and enumerated. Damaged individuals that could not be identified were classified as unknown.

Changes in larval fish sampling protocols from 2001. Three sampling protocols were changed between 2001 (first year of the project) and 2002. First, the maximum number of replicates was increased from three (2001) to five (2002) for the Milk River, Yellowstone River, and Missouri River sites located near Wolf Point and Nohly. At the site downstream from the dam, the number of replicates was increased from two (2001) to three (2002). The number of replicates in the spillway channel was not increased because there are only two pools. Second, sample duration was decreased from a maximum of 15 min (2001) to 10 min (2002). Thus, although maximum sample duration was reduced in 2002, an increase in the number of replicates actually increased the total sampling time (see Results). Third, larval fish sampling extended to the first week of August in 2002; whereas, larval fish sampling was concluded the last week of July in 2001.

Monitoring Component 5 – Food habits of piscivorous fishes

Potential piscivores including walleye *Stizostedion vitreum*, sauger *S. canadense*, northern pike *Esox lucius*, burbot *Lota lota*, goldeye *Hiodon alosoides*, channel catfish *Ictalurus punctatus*, freshwater drum *Aploninotus grunniens*, and shovelnose sturgeon were sampled in the Missouri River between Wolf Point and Nohly (Figure 1). Fishes were sampled during July and August 2002 in off-channel habitats (e.g., tributaries, tributary confluences, backwaters, side channels) and main channel habitats (e.g., outside bend shoreline and thalweg, inside bend shoreline and channel border, channel crossovers) using stationary gill nets, drifting trammel nets, hoop nets, and electrofishing. Gill nets and hoop nets were usually set in late afternoon or evening and checked the following morning, but in some instances both gear types were left in a location throughout the day and periodically checked. Fishes were identified, weighed (g), and measured (mm).

Stomach samples were obtained in one of two ways. First, the entire stomach was removed via dissection and placed in a 10% formalin solution for storage. In the case of large stomachs, a slit was made in the stomach wall to facilitate formalin seepage into the stomach. The second method of stomach sampling involved the use of gastric lavage. The lavage apparatus consisted of a 12-V bilge pump connected to plastic hose. With the bilge pump operating and the fish held in a slightly inverted position, the hose was inserted down the esophagus of the fish and into the fish stomach. Running water flushed contents of the stomach into a sieve held under the fish mouth and gills. Stomach contents were rinsed from the sieve into a 10% formalin solution and stored. The lavage was used on sauger sampled to minimize mortality because sauger are listed as a species of special concern in Montana.

In the laboratory, stomach contents were initially identified to Class. Diet organisms were subsequently identified to Order (for Insecta) and to species (for Osteichthyes) when possible. Diet items that could not be identified beyond Insecta and Osteichthyes were designated as unknown for the Class. Diet items were also classified as detritus (e.g., woody debris, algae) and miscellaneous (e.g., sand, rocks). Diet items were enumerated and weighed for the lowest taxon identified. Wet weights (0.001 g) were measured after the diet items were blotted on paper towels to remove excess water. Body fragments were used to enumerate organisms. For example, the presence of a head capsule or partial body fragment was treated as indicative of a whole organism. For Osteichthyes, fish scales, bones or the presence of other body parts was treated as indicative that a whole organism was ingested.

Food habits data were summarized by three indices. Frequency of occurrence (%) was calculated as the number of individuals containing the specific food item/number of stomachs containing food. Numerical frequency (%) was computed as the total number of taxon-specific food items/total number of all food items. Weight frequency (%) was computed as the total weight of a taxon-specific food item/total weight of all food items.

Results and Discussion

Monitoring Component 1 - Water temperature and turbidity

General comments on water temperature loggers. Of the 38 water temperature loggers deployed during 2002, eight (21%) were not recovered. These included all three loggers deployed at Poplar, single loggers deployed in the Poplar River and Redwater River, one logger deployed at Culbertson, and two loggers deployed at Nohly. Excessive sedimentation and accumulation of woody debris prevented these loggers from being retrieved. With the exception of the Poplar site, at least one logger was recovered from Culbertson and Nohly thereby providing water temperature data at these sites. On September 5, it was observed that the water temperature logger in the Yellowstone River was in less than 15 cm of water. Subsequent checks of the data indicated large diel variations in water temperature during August and the first few days of September. These large diel variations most likely resulted from diel variations in air temperature rather than water temperature. Data for August was "corrected" by replacing the suspect temperature logger data with hourly water temperature data recorded by the Yellowstone turbidity logger located just downstream from the temperature logger.

Pre- and post-deployment assessments of water temperature logger precision. A total of 36 loggers was assessed for precision during the pre-deployment tests (Table 3). For all water temperature treatments during pre-deployment tests, the temperature range (i.e., maximum recorded temperature minus minimum recorded temperature) was narrow ($\leq 0.66^{o}C$; Table 3) indicating that precision of the loggers was good. For the post-deployment tests, only 26 loggers were screened for precision due to exclusion of loggers that were not recovered at the end of the deployment period. Post-deployment assessments of precision indicated that precision of the water temperature loggers remained good as evidenced by a narrow temperature range ($\leq 0.71^{o}C$) for all treatment temperatures (Table 3). Pre- and post-deployment comparisons indicated there was no significant difference ($F = 0.46$, $P = 0.64$, $df = 2, 24$) in water temperature range (i.e., precision) among the cold (mean = $0.53^{o}C$), cool (mean = $0.51^{o}C$), and warm

(0.55°C) water temperature treatments. Thus, pre- and post-deployment precision was consistent among the different water temperature treatments. However, the range differed significantly between the pre- and post-deployment tests ($F = 4.86$, $P = 0.04$, $df = 1, 24$). Pooled across water temperature treatments, the range was significantly greater for the post-deployment tests (mean = 0.56°C) than the pre-deployment tests (mean = 0.50°C). These results suggest some "drift" of precision following deployment in the field. However, the difference in precision between pre- and post-deployment tests was minimal (0.06°C) suggesting that the quality of water temperature data recorded by the loggers was still good. There was no significant ANOVA interaction term ($P = 0.39$). Results from the pre- and post-deployment tests suggest that the water temperature data recorded by the loggers at all sites during 2002 accurately depicted thermal conditions in the riverine areas.

Lateral and vertical comparisons of water temperature. There were 11 sites where water temperature loggers were positioned on the north and south banks, and stratified in the water column (Table 1). However, comparisons of water temperature among north bank, south bank, and stratified locations could only be conducted at nine sites due to the loss of loggers at the Poplar and Nohly. At the site located just downstream from Fort Peck Dam, there was no significant difference in water temperature between the north and south bank locations (Table 4). At the Nickels Ferry site, water temperature was significantly greater on the north bank and stratified location than on the south bank. The stratified logger at Nickels Ferry was positioned on the north bank along with the north bank logger. Lack of a significant difference between stratified and north bank logger indicates homeothermal conditions through the water column. Significant differences in water temperature occurred at the Nickels Rapids site where water temperature was greatest on the north bank and stratified location and least on the south bank. At the Nickels Rapids site, the stratified logger was positioned on the south bank along with the south bank logger. Lack of a significant difference between stratified and south bank logger indicates homeothermal conditions through the water column. No significant differences in water temperature among logger locations occurred at the Frazer Pump site, Frazer Rapids site, Grand Champs site, or Culbertson Site (Table 4). Similar to the Nickels Ferry and Nickels Rapids site, lack of significant differences in water temperature between stratified and either north or south bank locations at these sites indicate homeothermal conditions in the water column. At the site located downstream from the Yellowstone River, water temperature was significantly greater at the stratified and south bank locations than at the north bank location. However, there is some indication that water temperatures recorded by the north bank logger at this site were not representative of "true" water temperatures. For example, mean water temperature was higher at Nohly than at the north bank logger located downstream from the Yellowstone River. One would expect that water temperature at this site should be at least equal to or greater than water temperatures recorded at Nohly. Based on this consideration, the logger located on the north bank downstream from the Yellowstone River was likely recording slightly cooler ground water seepage than ambient river temperatures. Similar to the other sites, there was no significant difference between the stratified logger positioned on the south bank and the south bank logger located at the site downstream from the Yellowstone River.

Table 3. Pre- and post-deployment summary statistics for water temperature comparisons among YSI Model 85 meter (YSI), hand-held alcohol thermometer (Alcohol), and water temperature loggers in common water bath treatments.

Sample	YSI	Alcohol	Logger mean	Logger minimum	Logger maximum	Logger range	Logger SD	Number of loggers
				Pre-deployment				
1	17.8	18.0	17.6	17.3	17.8	0.45	0.10	36
2	17.9	18.0	17.7	17.5	17.9	0.44	0.10	36
3	18.0	18.0	17.7	17.5	17.9	0.45	0.10	36
4	18.0	18.0	17.8	17.6	18.1	0.49	0.10	36
5	18.0	18.0	17.9	17.6	18.1	0.44	0.09	36
6	3.1	3.0	3.0	2.8	3.2	0.41	0.10	36
7	3.2	3.0	3.1	2.8	3.4	0.55	0.11	36
8	3.3	3.0	3.3	3.0	3.6	0.55	0.11	36
9	3.3	3.0	3.2	3.0	3.6	0.55	0.11	36
10	3.4	3.0	3.4	3.2	3.6	0.43	0.10	36
11	25.0	24.0	25.1	24.8	25.4	0.66	0.13	36
12	23.8	23.0	23.9	23.6	24.2	0.65	0.13	36
13	22.9	23.0	22.9	22.7	23.2	0.46	0.10	36
14	21.9	22.0	22.1	21.9	22.3	0.47	0.11	36
15	21.4	21.0	21.5	21.2	21.7	0.46	0.11	36
				Post-deployment				
1			7.2	6.9	7.5	0.55	0.11	26
2			7.2	6.9	7.5	0.55	0.10	26
3			7.3	7.1	7.6	0.55	0.12	26
4			7.5	7.2	7.6	0.43	0.09	26
5	8.1	8.0	7.6	7.2	7.9	0.71	0.16	26
6	20.9	22.0	21.7	21.4	22.0	0.64	0.13	26
7			21.2	20.9	21.5	0.63	0.12	26
8			20.8	20.6	21.0	0.46	0.12	26
9			20.4	20.1	20.7	0.61	0.13	26
10			20.2	19.9	20.4	0.45	0.12	26
11			18.5	18.3	18.7	0.45	0.12	26
12			18.5	18.1	18.7	0.61	0.13	26
13			18.5	18.1	18.7	0.61	0.13	26
14			18.5	18.1	18.7	0.60	0.13	26
15	18.6	18.0	18.5	18.1	18.7	0.60	0.13	26

Table 4. Summary statistics and probability values (P, from ANOVA or t-tests) for comparisons of mean daily water temperature (°C) among water temperature loggers located on the north bank and south bank, and stratified in the water column during 2002. Means with the same superscript within sites are not significantly different (P > 0.05). Inclusive dates for comparisons at all sites are 5/11/02-10/20/02 (163 days).

Site	Logger location	Mean	SD	Minimum	Maximum	P
Below Fort Peck Dam	North	12.0^{a}	2.3	5.8	15.5	0.53
	South	11.8^{a}	2.2	5.8	15.3	
Nickels Ferry	North	13.2^{a}	3.0	6.1	21.7	0.0007
	South	12.2^{b}	2.3	6.1	15.8	
	Stratified	13.2^{a}	3.0	6.1	21.8	
Nickels Rapids	North	13.0^{a}	2.7	6.4	19.7	0.02
	South	12.3^{b}	2.3	6.3	16.0	
	Stratified	$12.4^{a,b}$	2.3	6.3	16.1	
Frazer Pump	North	13.1^{a}	2.7	7.0	18.9	0.11
	South	12.6^{a}	2.4	6.7	16.5	
	Stratified	13.1^{a}	2.7	6.9	18.9	
Frazer Rapids	North	12.7^{a}	2.6	6.6	18.0	0.53
	South	12.8^{a}	2.4	6.8	16.7	
Grand Champs	North	13.0^{a}	2.5	7.1	18.0	0.94
	South	13.1^{a}	2.5	7.4	17.0	
	Stratified	13.1^{a}	2.5	7.4	16.9	
Wolf Point	North	14.4^{a}	2.9	9.1	19.2	0.75
	South	14.6^{a}	3.3	7.9	19.8	
Culbertson	North	16.2^{a}	4.1	8.1	23.4	0.80
	Stratified	16.3^{a}	4.6	7.1	24.5	
Nohly	North	16.7	4.8	6.7	25.4	
Below Yellowstone River	North	15.8^{b}	3.8	6.5	21.6	0.0001
	South	17.8^{a}	5.1	6.7	27.2	
	Stratified	17.9^{a}	5.2	6.7	27.3	

Influence of tributary inflows on water temperature. Lateral differences in water temperature at some sites suggested that tributary inflows differentially influenced water temperatures on north and south bank locations due to incomplete lateral mixing. During 2002, the Milk River exhibited periods of increasing and decreasing flows between mid- and late-June, and during late August. During these time frames, water temperatures on the north bank of the river at Nickels Ferry, Nickels Rapids, Frazer Pump, Frazer Rapids, and Grand Champs increased and decreased with Milk River flows; whereas, water temperatures on the south bank of the river remained relatively stable (Figures 2, 3, 4). The influence of Milk River discharge on lateral differences in water temperature is also demonstrated by significant positive correlations between the difference in mean daily water temperature between the north and south banks (north bank minus south bank) and Milk River discharge at Nickels Ferry ($r = 0.85$, $P < 0.0001$, $N = 90$), Nickels Rapids ($r = 0.83$, $P < 0.0001$, $N = 90$), Frazer Pump ($r = 0.79$, $P < 0.0001$, $N = 90$), Frazer Rapids ($r = 0.81$, $P < 0.0001$, $N = 90$), and Grand Champs ($r = 0.84$, $P < 0.0001$, $N = 90$). The maximum difference in water temperature between the north and south banks decreased from upstream to downstream and was 8.1°C at Nickels Ferry, 5.5°C at Nickels Rapids, 3.5°C at Frazer Pump, 1.8°C at Frazer Rapids, and 1.1°C at Grand Champs (Figures 2, 3, 4). Thus, lateral mixing of Milk River water and Missouri River water discharged through Fort Peck Dam was nearly complete at the Grand Champs site.

Earlier studies in the Missouri River downstream from Fort Peck have evaluated lateral variations in water temperature resulting from Milk River discharge inputs. Braaten and Fuller (2002) found that mean daily water temperature did not differ significantly between north and south bank locations for the time period spanning early May through October; however, there were specific instances when bank locations deviated in water temperature as a result of warm discharge inputs from the Milk River. Gardner and Stewart (1987) and Yerk and Baxter (2001) similarly showed that warm inputs from the Milk River differentially affected lateral water temperatures, but the effects are most pronounced in spring and early summer when Milk River discharge is high.

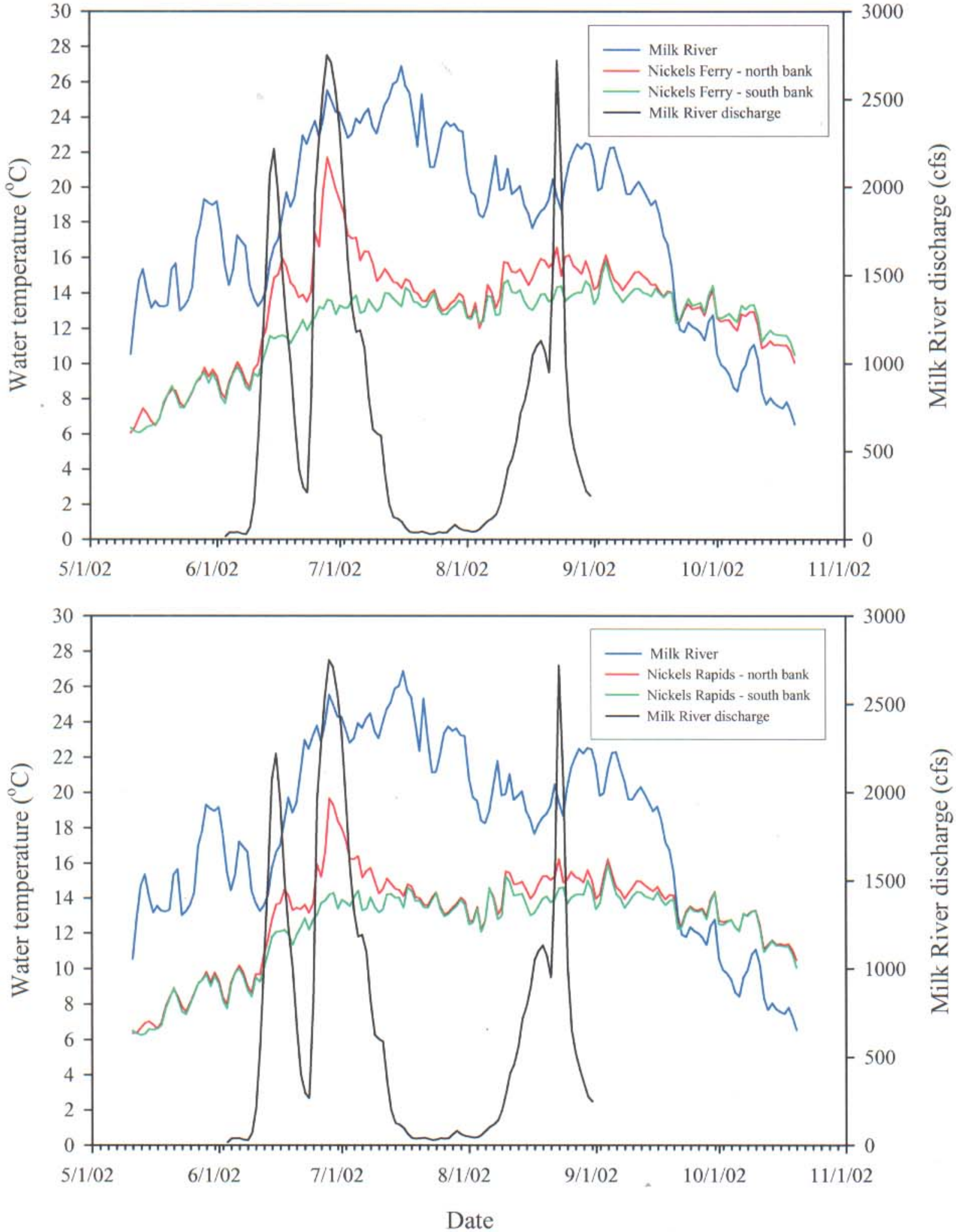

Figure 2. Water temperature profiles and discharge for the Milk River, and water temperatures profiles for the Missouri River at Nickels Ferry and Nickels Rapids during 2002.

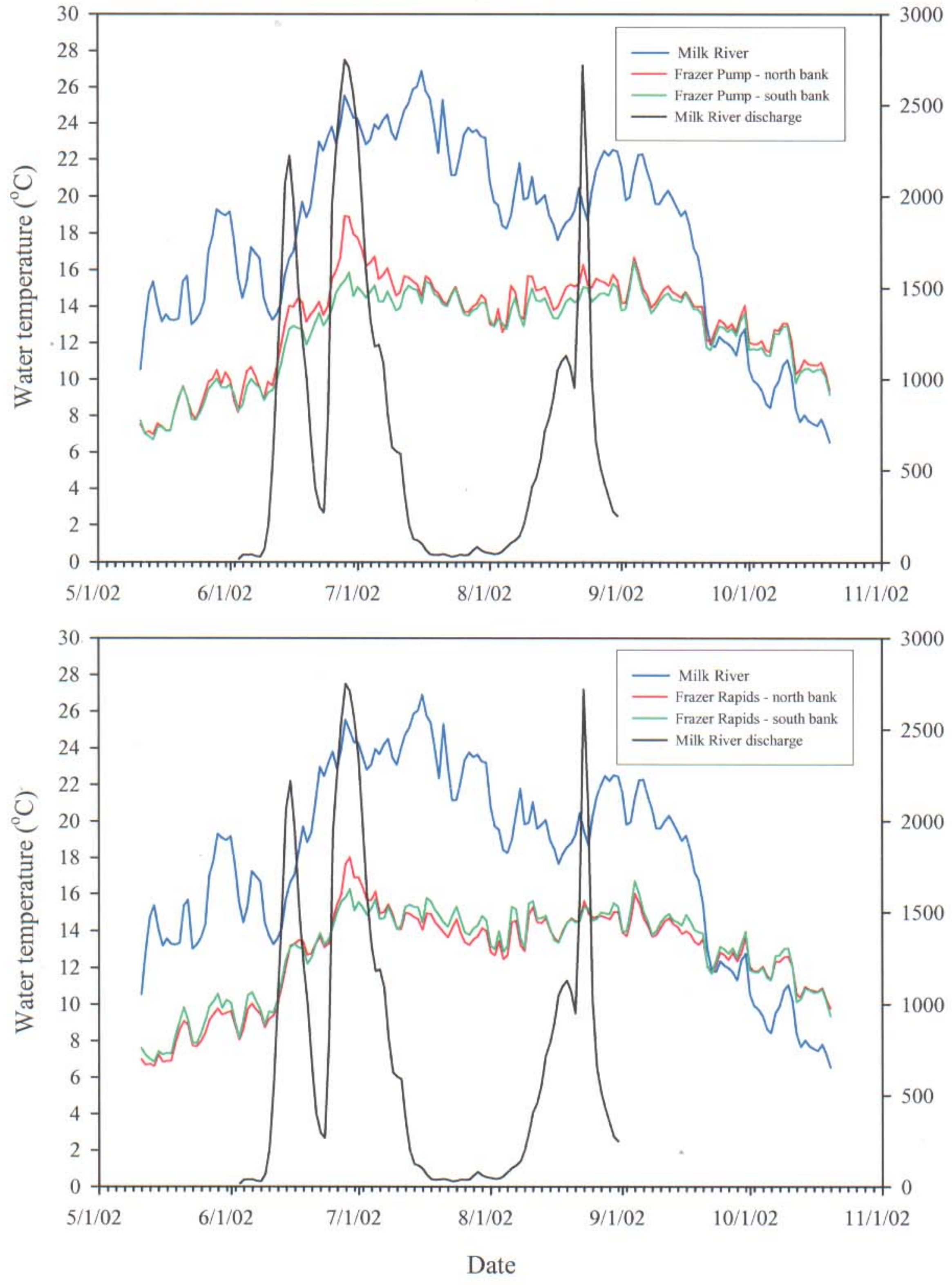

Figure 3. Water temperature profiles and discharge for the Milk River, and water temperatures profiles for the Missouri River at Frazer Pump and Frazer Rapids during 2002.

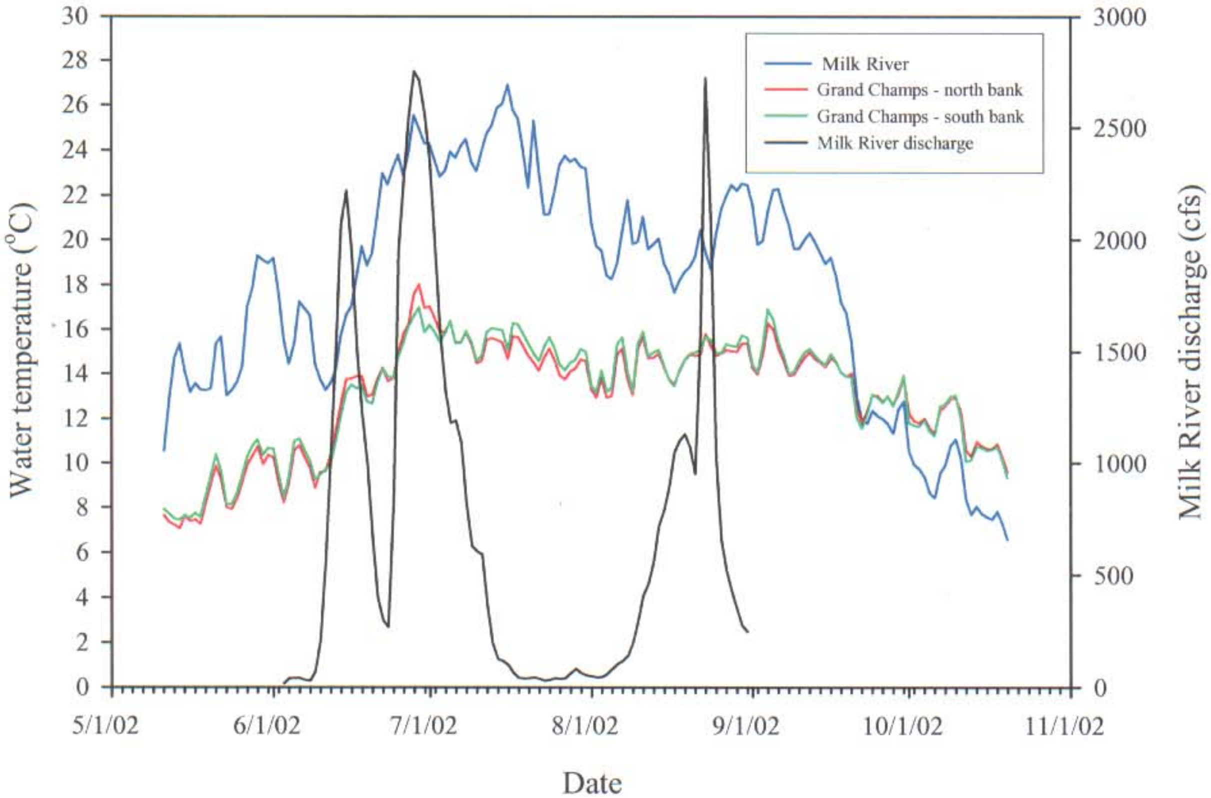

Figure 4. Water temperature profiles and discharge for the Milk River, and water temperatures profiles for the Missouri River at Grand Champs during 2002.

Longitudinal water temperature patterns. Daily water temperature for all sites was averaged across north bank, south bank, and stratified locations to depict average thermal conditions in the river. Mean water temperature for the common deployment period (5/11/02-10/20/02) differed significantly among the 11 Missouri River mainstem sites and three off-channel locations (ANOVA, $F = 64.35$, $df = 13, 2{,}268$, $P < 0.0001$; Table 5, Figure 5). Mean daily water temperature for Missouri River mainstem sites was greatest at the Robinson Bridge site (17.9°C) located in the free-flowing reach of the Missouri River upstream from Fort Peck Lake and in the Missouri River downstream from the Yellowstone River (17.9°C). The lowest mean daily water temperature occurred at the site just downstream from Fort Peck Dam (11.9°C). Mean daily water temperature increased downstream from Fort Peck Dam, and was 16.7°C at the Nohly site. Daily water temperature at the Missouri River mainstem locations was most variable in the Missouri River below the Yellowstone River confluence (CV = 28.8) and at Nohly (CV = 28.7), but least variable just downstream from Fort Peck Dam (CV = 11.9; Table 5). The USFWS (2000) mandated that a minimum water temperature of 18°C be established and maintained at Frazer Rapids (rkm 2,811; RM 1,746) via the spillway releases. During 2002, a mean daily water temperature of 18.0°C occurred on one date (June 29) on the north bank of the river at Frazer Rapids (Table 4). However, mean daily water temperature for the site on June 29 was 17.1°C when cooler water on the south bank of the river was included in the mean daily temperature calculations (Figure 5). In the absence of spillway releases, water temperature in 2001 did not reach 18°C at Frazer Rapids (Braaten and Fuller 2002). In 2000, Yerk and Baxter (2001) similarly showed that the maximum mean daily water temperature at Frazer Rapids slightly exceeded 17.0°C in mid-July.

For off-channel locations, mean daily water temperature between 5/11/02-10/20/02 was highest in the Yellowstone River (18.4 °C) and Milk River (18.0 °C; Table 5). The Yellowstone River exhibited the highest variability in daily water temperatures (CV = 29.3) during the time interval.

Inter-annual comparisons of mean daily water temperature within sites. Comparisons of mean daily water temperature between 2001 and 2002 for dates spanning 5/17-10/9 indicated that 2002 was significantly cooler than 2001 at most sites (Table 6). In the free-flowing Missouri River upstream from Fort Peck Lake, water temperature averaged 1.4°C warmer in 2001. Eight of nine mainstem Missouri River sites between Fort Peck Dam and the Yellowstone River confluence averaged 0.6-1.5°C warmer in 2001 than 2002. The Nickels Ferry site (located just downstream from the Milk River confluence) was the only site between Fort Peck Dam and the Yellowstone River where water temperature was not statistically different between years (Table 6). Water temperature in the Milk River did not differ significantly between 2001. No significant differences in mean daily water temperatures were found between years in the Yellowstone River or in the Missouri River downstream from the Yellowstone River confluence (Table 6).

Mean daily air temperatures were obtained from the National Weather Service in Glasgow, MT to assess water temperature regimes during 2001 and 2002 in the context of air temperatures. For dates spanning May 1 through October 31 ($N = 184$ days), mean daily air temperature was significantly higher (t-test, $t = 2.54$, $P = 0.01$) in 2001 (mean = 16.5°C) than 2002 (mean = 14.5°C). These results corroborate findings from the water temperature analysis; however, between-year differences in air temperature (2.0°C) were slightly greater than between-differences in water temperature (0.6-1.5°C).

Table 5. Daily water temperature (°C) summary statistics (mean; minimum; maximum; standard deviation, SD; coefficient of variation, CV) for Missouri River mainstem locations and off-channel locations in 2002. Summary statistics for all sites were calculated for common deployment dates (5/11/02-10/20/02, N = 163 days) to standardize comparisons among all loggers. See Figure 5 for a graphical representation of daily water temperatures. Means with the same superscript are not significantly different ($P > 0.05$).

Location	Site	Mean	Minimum	Maximum	SD	CV
Missouri River mainstem	Robinson Bridge	$17.9^{a,b}$	8.5	26.7	4.7	26.5
	Below Fort Peck Dam	11.9^{g}	5.8	15.4	2.3	18.9
	Nickel Ferry	12.9^{g}	6.2	19.1	2.7	20.9
	Nickels Rapids	12.6^{g}	6.4	16.1	2.4	19.2
	Frazer Pump	12.9^{g}	6.9	17.9	2.6	19.9
	Frazer Rapids	12.8^{g}	6.7	17.1	2.5	19.5
	Grand Champs	$13.1^{f,g}$	7.3	17.3	2.5	19.3
	Wolf Point	$14.5^{e,f}$	9.0	19.4	3.1	21.3
	Culbertson	$16.3^{c,d}$	7.6	23.9	4.3	26.6
	Nohly	$16.7^{b,c}$	6.7	25.4	4.8	28.7
	Below Yellowstone River	$17.9^{a,b}$	6.7	27.3	5.2	28.8
Off-channel or tributary	Spillway	$15.1^{d,e}$	7.4	20.0	3.1	20.6
	Milk River	$18.0^{a,b}$	6.5	26.9	5.1	28.5
	Yellowstone River	18.4^{a}	6.9	27.9	5.4	29.3

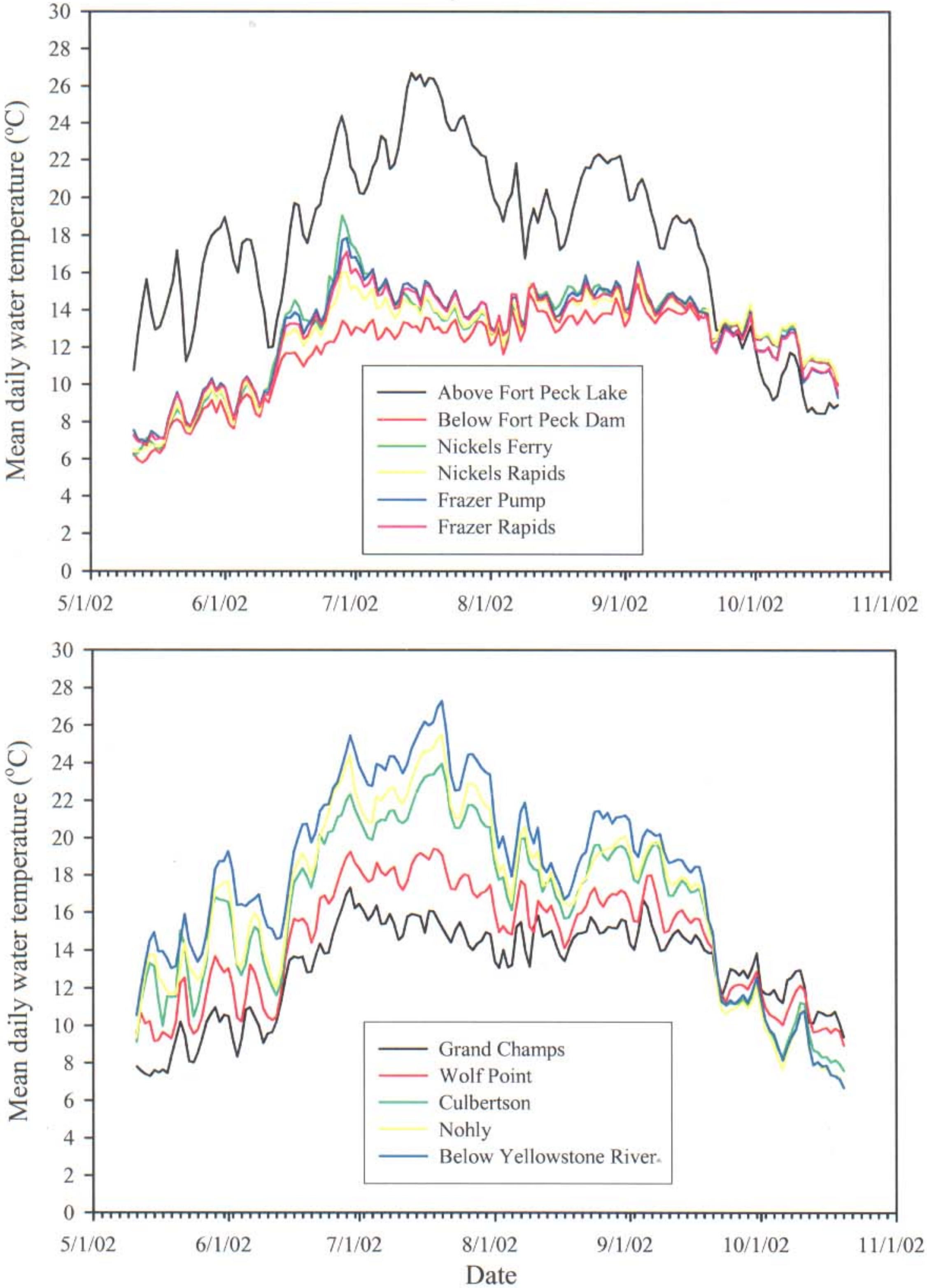

Figure 5. Mean daily water temperature (°C) at 11 sites on the mainstem Missouri River during 2002.

Table 6. Summary statistics (mean, °C; standard deviation, SD; number of days, N; Probability value, P) for comparisons of mean daily water temperature between 2001 and 2002 at mainstem Missouri River sites and off-channel sites. Common dates for both years are 5/17-10/9. P-values denoted by an asterisk indicate t-test comparisons based on unequal variances.

Site	Year	Mean	SD	N	P
Missouri River above Fort Peck Lake	2001	20.1	3.7	146	0.002
	2002	18.7	4.2	146	
Below Fort Peck Dam	2001	13.0	1.5	146	< 0.0001*
	2002	12.2	2.0	146	
Spillway	2001	18.4	3.0	146	< 0.0001
	2002	15.7	2.7	146	
Milk River	2001	19.1	3.8	146	0.59*
	2002	18.9	4.5	146	
Nickels Ferry	2001	13.4	1.8	146	0.55*
	2002	13.2	2.5	146	
Nickels Rapids	2001	13.5	1.7	146	0.02*
	2002	12.9	2.2	146	
Frazer Pump	2001	13.9	1.8	146	0.03*
	2002	13.3	2.3	146	
Frazer Rapids	2001	13.8	1.84	146	0.005*
	2002	13.1	2.3	146	
Grand Champs	2001	14.4	2.0	146	0.0006
	2002	13.5	2.3	146	
Wolf Point	2001	16.5	3.1	146	< 0.0001
	2002	15.0	2.8	146	
Culbertson	2001	17.9	3.5	146	0.04
	2002	17.0	3.9	146	
Nohly	2001	18.9	3.8	146	0.005
	2002	17.5	4.3	146	
Yellowstone River	2001	19.3	4.2	146	0.96
	2002	19.3	4.8	146	
Below Yellowstone River	2001	19.4	4.1	146	0.22
	2002	18.8	4.5	146	

General comments on turbidity loggers. Two of four turbidity loggers deployed during 2002 malfunctioned during the deployment period. The turbidity logger deployed at Frazer Rapids functioned only between 5/28/02 and 6/3/02. The turbidity logger deployed near Poplar functioned only between 5/14/02 and 5/27/02. Thus, these loggers provided minimal turbidity data. However, turbidity loggers deployed in the Missouri River near Nohly (5/29/02-8/28/02) and in the Yellowstone River (5/31/02-8/31/02) functioned properly and logged hourly turbidity throughout the deployment period.

Precision of turbidity loggers. Measurements of turbidity obtained near the Nohly turbidity logger and Yellowstone turbidity logger during larval fish sampling facilitated an evaluation of turbidity logger performance during the deployment period. Mean turbidity from the turbidity loggers and larval fish sampling sites did not differ significantly at Nohly (t-test, $t = 0.30$, $P = 0.77$, $df = 36$) and in the Yellowstone River (t-test, $t = 0.43$, $P = 0.67$, $df = 34$; Table 7). Measurements of turbidity obtained from the turbidity loggers and larval fish sampling sites were highly correlated at Nohly ($r = 0.98$, $P < 0.0001$, $N = 19$) and in the Yellowstone River ($r = 0.98$, $P < 0.0001$, $N = 18$; Figure 6).

Table 7. Statistical comparisons and summary statistics (mean; standard deviation, SD.; minimum; maximum) for turbidity (NTU) measured at larval fish sampling locations (Hach meter) and by the turbidity loggers at Nohly and in the Yellowstone River. Probability values (P) are results from t-tests between instruments within sites.

Site	Instrument	N	Mean	SD	Minimum	Maximum	P
Nohly	Hach	19	325	337	72	1000	0.77
	Logger	19	294	303	14	972	
Yellowstone	Hach	18	380	338	61	1000	0.67
	Logger	18	333	311	15	1000	

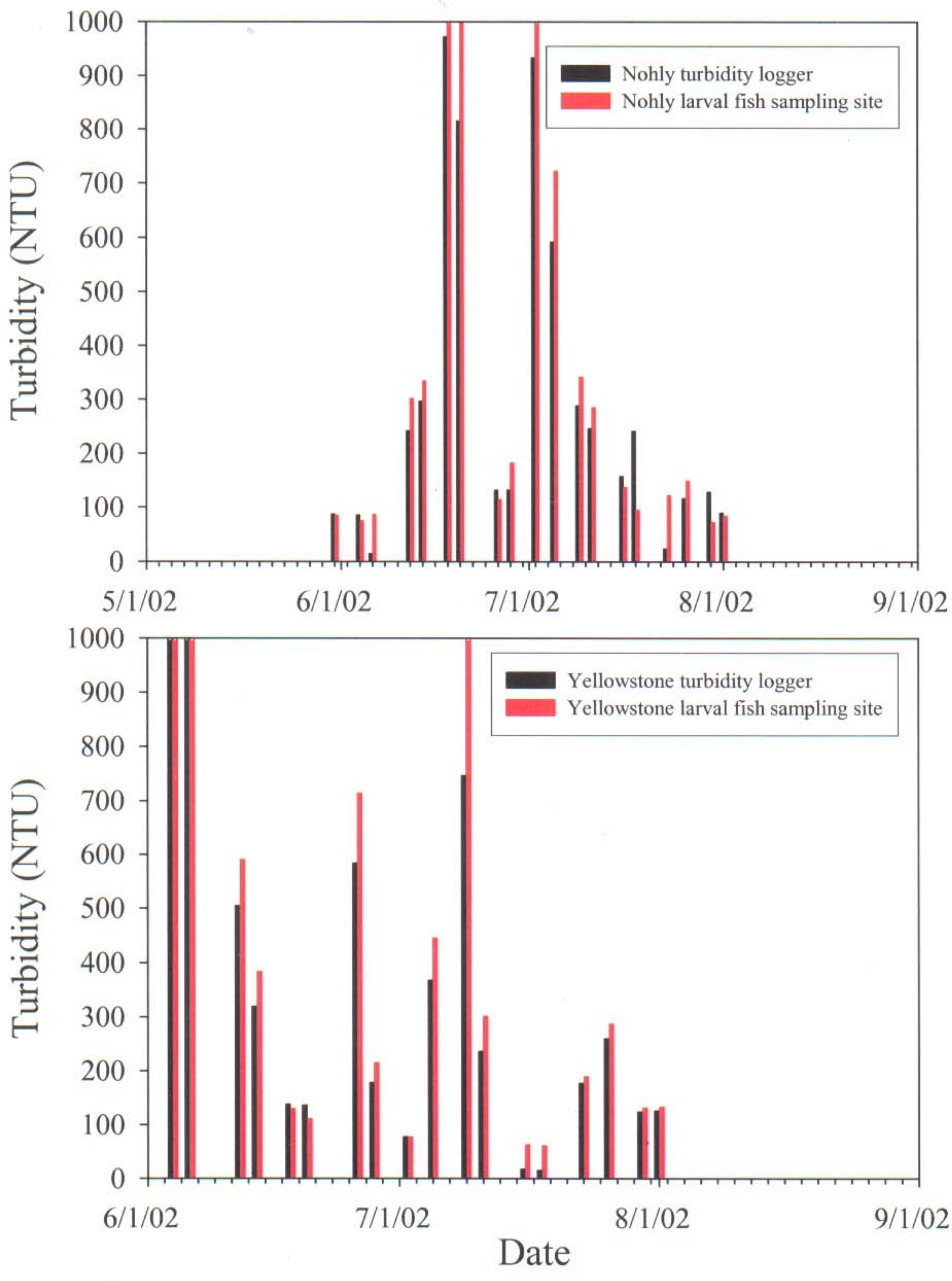

Figure 6. Mean daily turbidity (NTU) by date for Nohly (upper panel) and the Yellowstone River (lower panel).

Turbidity precision, as indexed by the range of turbidity, differed significantly (F = 3.77, P = 0.04, df = 2, 26) among the post-deployment turbidity levels for the Nohly and Yellowstone turbidity loggers (Table 8). Turbidity range was significantly greater (P < 0.05) in the high turbidity treatments (mean = 46.2 NTU) and intermediate turbidity treatments (mean = 33.2 NTU) than in the low turbidity treatments (mean = 9.2 NTU). These results indicate that turbidity range was not consistent among different turbidity levels. However, minimum turbidity and maximum turbidity differed by an average of 6% for the high turbidity treatment, 8% for the intermediate turbidity treatment, and 20% for the low turbidity treatment. Thus, although the range differed, the two turbidity loggers exhibited relatively high precision at intermediate and high turbidity levels.

Table 8. Post-deployment summary statistics for turbidity (NTU; mean, range, minimum, maximum) for the Nohly and Yellowstone River turbidity loggers in common turbidity bath samples.

Sample	Mean	Range	Minimum	Maximum
1	17.1	15.9	9.1	25.0
2	26.1	24.6	13.8	38.4
3	33.1	2.8	31.7	34.5
4	35.8	2.8	34.4	37.2
5	38.5	1.7	37.6	39.3
6	41.8	2.3	40.6	42.9
7	44.7	3.4	43.0	46.4
8	46.3	1.5	45.5	47.0
9	59.6	24.2	47.5	71.7
10	80.2	10.5	74.9	85.4
11	92.4	10.9	86.9	97.8
12	273.4	24.2	261.3	285.5
13	278.2	15.8	270.3	286.1
14	287.2	17.2	278.6	295.8
15	317.7	11.3	312.0	323.3
16	324.8	46.1	301.2	347.8
17	356.6	5.2	354.0	359.2
18	381.3	41.6	360.5	402.1
19	410.6	59.8	380.7	440.5
20	451.5	56.0	423.5	479.5
21	470.6	54.8	443.2	498.0
22	651.5	70.4	616.3	686.7
23	708.8	76.4	670.6	747.0
24	834.2	97.5	785.4	882.9
25	884.4	125.1	821.8	946.9
26	1000	0	1000	1000
27	1000	0	1000	1000
28	1000	0	1000	1000
29	1000	0	1000	1000

Field turbidity measurements. Hourly turbidity recorded by the turbidity loggers at Nohly and in the Yellowstone River varied greatly during late-May through August deployment period. At Nohly, hourly turbidity measurements exceeded 1000 NTU (maximum value of logger) on the following dates and number of times in a 24-hr period (in parenthesis): 6/17 (9), 6/18 (4), 6/19 (2), 6/26 (3), 6/30 (19), 7/1 (24), 7/2 (4), 8/21 (9), 8/23 (3), 8/24 (13), 8/25 (3), and 8/27 (7). In the Yellowstone River, turbidity exceeded 1000 NTU on the following dates and number of times in a 24-hr period (in parenthesis): 6/4 (18), 6/5 (24), 6/6 (23), 6/7 (1), 6/10 (7), 7/9 (5), 7/19 (11), 7/20 (16), and 7/21 (10). Because 1000 NTU was exceeded on specific dates, turbidity readings that exceeded 1000 NTU were truncated to 1000 NTU for estimations of mean daily turbidity. Truncation of turbidity data reduced the accuracy of mean daily estimates, resulted in conservative estimates of mean daily turbidity, and precluded quantitative statistical comparisons of spatial and temporal differences in mean daily turbidity. Nonetheless, qualitative comparisons based on conservative turbidity estimates facilitated interpretation of spatial and temporal turbidity trends. Spatially, mean daily turbidity between 5/31/02 and 8/27/02 was similar in the Missouri River at Nohly (mean = 261.6, SD = 238.3, N = 89 days) and in the Yellowstone River (mean = 255.7, SD = 244.5, N = 89 days).

Temporal patterns in mean daily turbidity varied between the Missouri River at Nohly and in the Yellowstone River. At Nohly, daily changes in turbidity generally followed increases or decreases in Missouri River discharge (Figure 7). The three periods of maximum turbidity (6/18, 7/1, 8/24) occurred 1-2 days following elevated discharges at Culberston. In the Yellowstone River, periods of elevated turbidity early in the deployment period (e.g., 6/1-7/1) generally followed periods of elevated discharge (Figure 7); however, turbidity late in the deployment period (7/1-8/31) exhibited elevated levels in the absence of significant increases in discharge.

Monitoring Component 2 – Movements by pallid sturgeon

No pallid sturgeon were found in areas immediately downstream from Fort Peck Dam. As a consequence, no pallid sturgeon were implanted with transmitters.

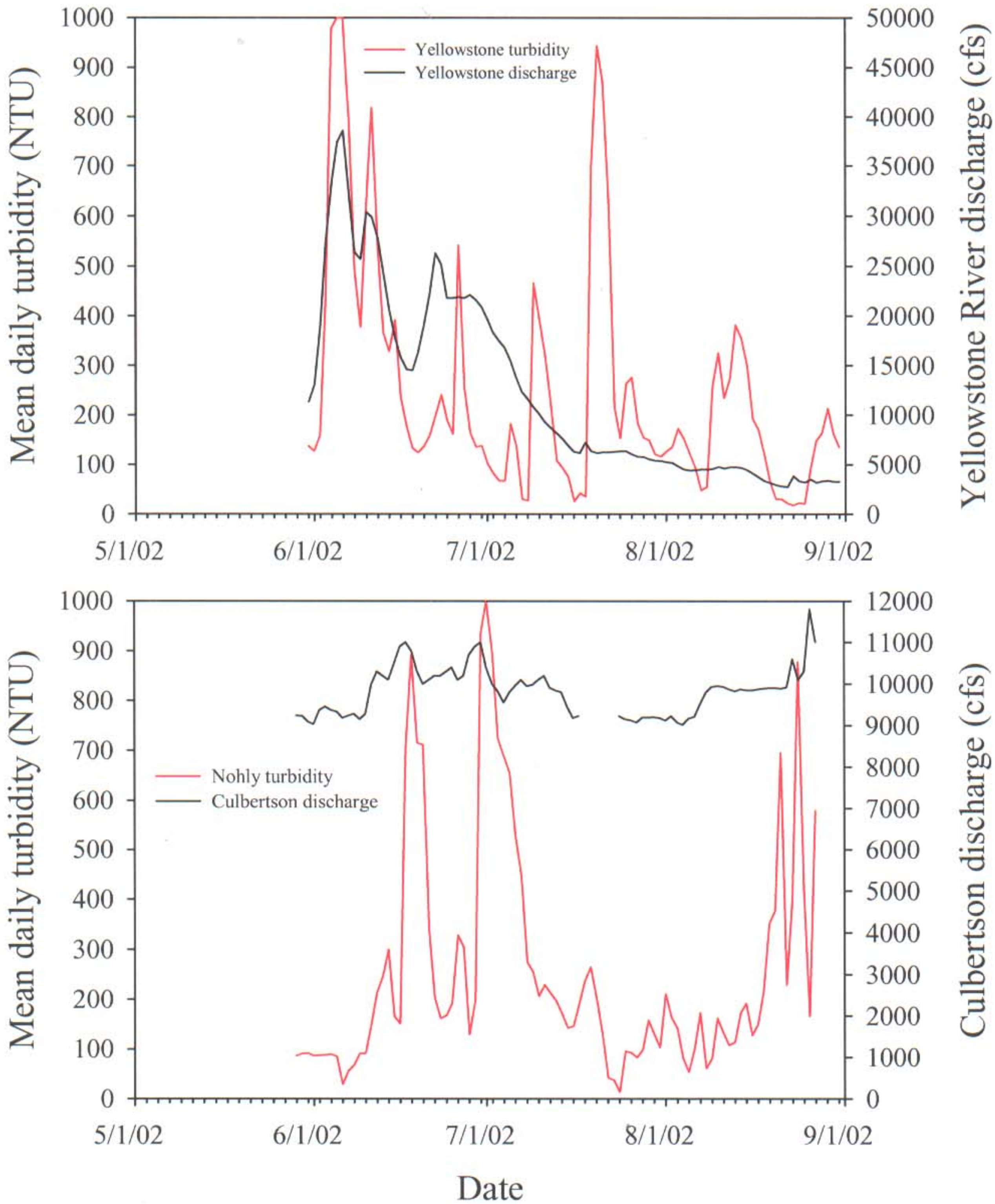

Figure 7. Mean daily turbidity (NTU; solid line) from turbidity loggers and discharge (cfs; dashed line) in the Yellowstone River (upper panel) in the Missouri River at Nohly (lower panel) during 2002.

Monitoring Component 3 – Flow- and temperature-related movements of paddlefish, blue suckers, and shovelnose sturgeon

Transmitter implantation.- Sampling throughout the study area in September 2002 resulted in the capture of 21 shovelnose sturgeon, 21 blue suckers, and 3 paddlefish suitable for transmitter implantation (Table 9). The blue suckers and shovelnose sturgeon sampled were captured throughout the study area spanning from near the Milk River to the Yellowstone River confluence. The three paddlefish captured were sampled at one location downstream from Wolf Point. Although paddlefish during fall are common in the Missouri River downstream from the Yellowstone River confluence, the Fort Peck Project was not granted permission to implant transmitters in paddlefish in this area. However, an additional 20 paddlefish (10 males, 10 females) were implanted with CART-32 transmitters in the Missouri River downstream from the confluence in fall 2002 by Dr. Dennis Scarnecchia (University if Idaho). Permission has been granted to use tracking and movement information from these individuals to augment the Fort Peck telemetry project. Individuals implanted with transmitters in 2002 will be tracked during 2003 in conjunction with fish that were implanted with transmitters in 2001.

Table 9. Number, sex ratio (male:female:undetermined), and length (mm) and weight (g) metrics for blue suckers, paddlefish, and shovelnose sturgeon implanted with transmitters during September 2002.

Species	Number	Sex ratio	Metric	Mean	Minimum	Maximum
Shovelnose sturgeon	21	2:18:1	Length	787	702	912
			Weight	2,280	1,550	3,650
Blue sucker	21	7:9:5	Length	702	637	789
			Weight	2,894	1,875	3,925
Paddlefish	3	2:0:1	Length	951	954	977
			Weight	11,833	8,900	14,050

Shovelnose sturgeon.- Of the 28 shovelnose implanted in 2001, 27 individuals were relocated in 2002. However, one individual shed the transmitter near Wolf Point in early July after swimming upstream approximately 125 kilometers. The remaining 26 fish were manually relocated five to 15 times (mean =11) throughout the season. The number of manual relocations of shovelnose sturgeon during the April to November tracking season varied from 18 to 62 among months (Table 10). Manual relocations for shovelnose sturgeon during this timeframe were augmented by 69 contacts at the logging stations (Table 10). Total movement of shovelnose sturgeon varied between 54 km and 885 km (mean = 241 km).

The number of relocations of shovelnose sturgeon varied greatly among reaches and months (Figure 8). In reach 1 (Fort Peck Dam to Wolf Point), the mean number of relocations per km was similar among months. There were five fish that resided in the reach 1 for the entire season. All these fish were implanted between Wolf Point and the Milk River. There were only three other fish that were implanted in this reach, and all eventually migrated to the Yellowstone River, one by early June, one by late June, and the other in early September. One of these fish returned to reach 1 in the fall after traveling twenty miles up the Yellowstone River. The other two remained in the Yellowstone River for the remainder of the season. Three other shovelnose sturgeon were found in this reach that had not been not implanted in reach 1. These included two fish that were implanted near Culbertson.

Table 10. Monthly totals of manual relocations and telemetry logging station contacts for shovelnose sturgeon, blue suckers, and paddlefish during 2002.

Species	Month	Manual relocations	Logging station contacts	Total contacts
Shovelnose sturgeon	April	27		27
	May	58	14	72
	June	62	15	77
	July	57	11	68
	August	19	21	40
	September	15	8	23
	October	20		20
	November	18		18
Blue sucker	April	13		13
	May	30	16	46
	June	30	17	47
	July	42	11	53
	August	11	9	20
	September	10	14	24
	October	12	5	17
	November	12		12
Paddlefish	April	27		27
	May	30	71	101
	June	42	58	100
	July	10	30	40
	August	3	34	37
	September	2	29	31
	October	10	13	23
	November	10		10

Use of reach 2 (Wolf Point to the Yellowstone River confluence) was low throughout the study period, and there was a trend of decreasing use of reach 2 from May through July (Figure 8). Nineteen shovelnose sturgeon were originally implanted in reach 2. Nine of these fish were found in the Yellowstone River on the first tracking run in April. Six additional shovelnose sturgeon were in the Yellowstone River between late April and early July. Three shovelnose sturgeon were mentioned earlier to have moved into reach 1 before migrating to the Yellowstone, and one shovelnose sturgeon shed the transmitter. Other than these early relocations, the only fish found in reach 2 were migrants passing through the reach. Bramblett and White (2001) reported the return of shovelnose that were in the Yellowstone River to this area above the confluence in the fall; however, this event did not occur in 2002. Rather, these individuals primarily stayed in the lower Yellowstone River (e.g., reach 4).

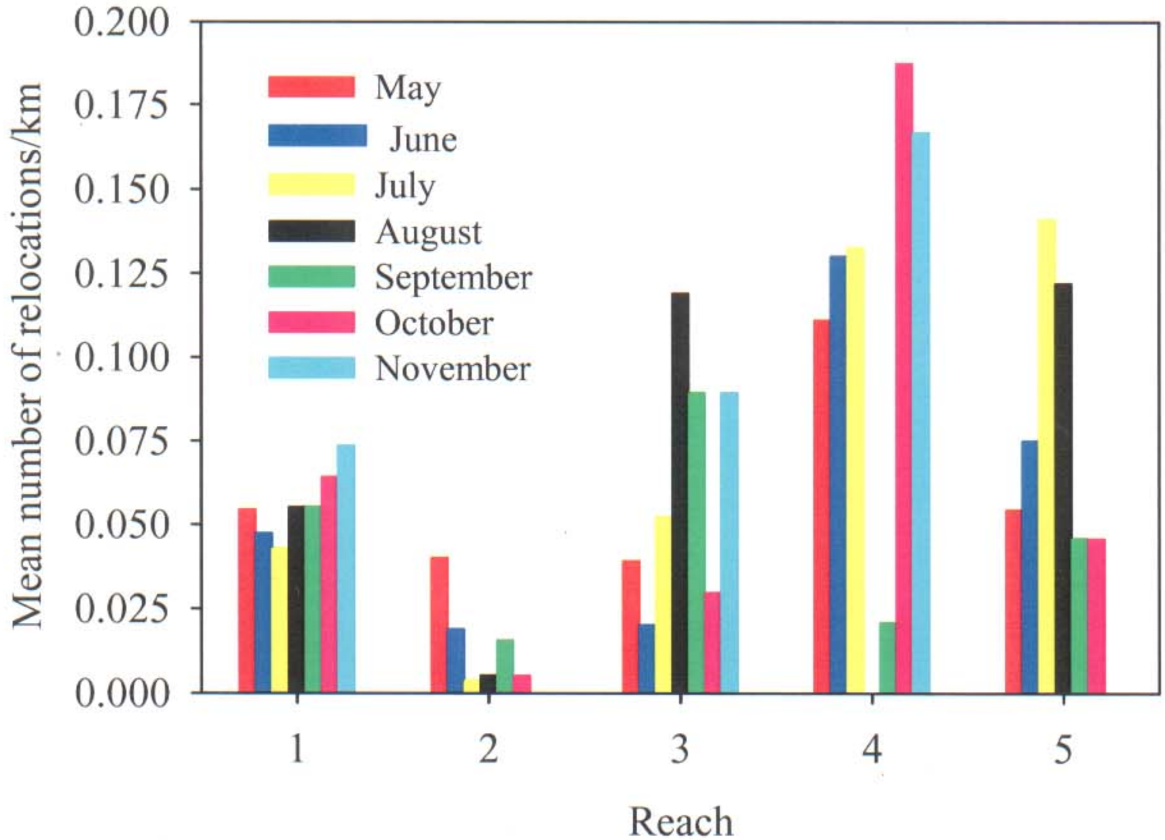

Figure 8. Mean number of shovelnose sturgeon relocations per km by month in five riverine reaches (Reach 1 = Missouri River between Fort Peck Dam and Wolf Point, Reach 2 = Missouri River between Wolf Point and the Yellowstone River confluence, Reach 3 = Missouri River from the Yellowstone River confluence to the headwaters of Lake Sakakawea, Reach 4 = Yellowstone River from the confluence to Sidney, MT, Reach 5 = Yellowstone River from Sidney, MT to Intake diversion dam).

There were relatively few relocations of shovelnose sturgeon in reach 3 (Yellowstone River confluence to Highway 85). Reach 3 is only 33.6 km; therefore, a single relocation accentuates the mean number of fish per km estimates relative to the other river reaches. The mean number of shovelnose sturgeon per km in reach 3 increased from a minimum in June to a maximum in August when four individual fish were found during one tracking run. However, three of these were found immediately below the confluence (< 1km). Only one shovelnose was found greater than 5 km downstream of the confluence.

The two reaches of the Yellowstone River generally had the highest concentration of shovelnose sturgeon; however, the mean number of shovelnose sturgeon per km varied among months within reaches. For example, the mean number of shovelnose sturgeon per km in reach 4 (Yellowstone River confluence to Sidney) minimally increased between May and July; whereas, the mean number of shovelnose sturgeon per km in reach 5 (Sidney to Intake diversion dam) greatly increased between May and July. In September, conductivities were unusually high, making the signals difficult to locate. Also of interest is the decline in the number of shovelnose sturgeon per km during August. Some of those fish moved downstream to just below the Yellowstone River confluence, and some moved above Sidney into reach 5. Although there is not an increase shown in reach 5 for August, we suspect that four individuals passed over the Intake diversion dam during the period from July to August. In addition, it is likely that one shovelnose sturgeon passed over the diversion in August. One of these fish was found later in the fall in the Yellowstone River, one was found below intake in April 2003, and three others have not been found. It should be mentioned that no tracking was conducted above Intake diversion dam to confirm passage over Intake; however, the last documented locations were at or near the diversion dam. No tracking was conducted in reach 5 during November.

Blue suckers.- Sixteen of 17 blue suckers were relocated in 2002. However, one individual shed its tag soon after being implanted, and one shed its tag near Fairview (Yellowstone River) in mid July after swimming over 300 km. The remaining 14 blue suckers were manually relocated one to 15 times (mean = 12) throughout the tracking season. A total of 160 manual relocations were obtained for blue suckers between April and November, and an additional 72 contacts were obtained from the logging stations (Table 10). Total movement of individuals varied from 5 km to 409 km (mean = 201.5 km).

Blue suckers did not exhibit large seasonal migrations as they tended to remain close to the riverine area in which they were implanted with transmitters. In reach 1, there was a slight increase in the mean number of relocations per km between June and September (Figure 9). Three fish were originally implanted with transmitters near the Milk River, and two of these fish did not leave this reach. One blue sucker was recorded on the Milk River logging station in July. The third fish went down to reach 2 for the month of July, but returned to reach 1 for the remainder of the season. One fish that was implanted near Culbertson area moved upstream to reach 1 soon after being implanted.

There was a slight decreasing trend in the number of blue suckers per km in reach 2 between May and September (Figure 9). Of the eight blue suckers implanted near Culbertson (reach 2), one individual was mentioned earlier to have moved upstream, and one was found near Williston in April and was never relocated again. We suspect this individual moved downstream into Lake Sakakawea. One blue sucker was found in reach 3 early in the year, moved to reach 2 for a month, and moved into reach 4 prior to shedding the transmitter near Fairview. The remaining five blue suckers implanted in reach 2 exhibited very little movement, and did not leave the reach.

Use of the Yellowstone River (reach 4, reach 5) by blue suckers varied among months (Figure 9). Three of the four blue suckers that were implanted at the confluence used the Yellowstone River. Use of the Yellowstone River did not appear to be related to a spawning migration because one fish moved up in April, one in May, and one in late June. Only one individual was relocated in reach 5 of the Yellowstone River, and this occurred from June through August. One blue sucker returned to reach 2 in early July while the other moved downstream to reach 3 in the fall. The other blue sucker that was implanted at the confluence spent the majority of time in reach 3 near Williston.

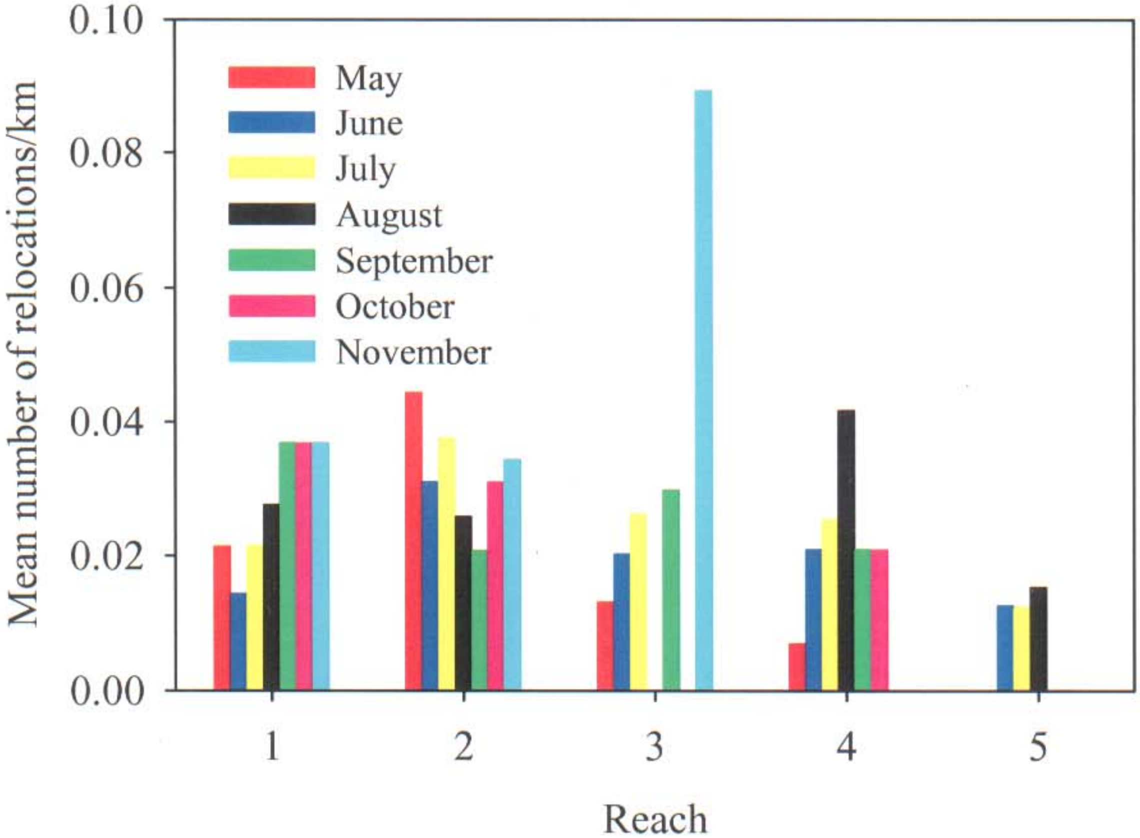

Figure 9. Mean number of blue sucker relocations per km by month in five riverine reaches (Reach 1 = Missouri River between Fort Peck Dam and Wolf Point, Reach 2 = Missouri River between Wolf Point and the Yellowstone River confluence, Reach 3 = Missouri River from the Yellowstone River confluence to the headwaters of Lake Sakakawea, Reach 4 = Yellowstone River from the confluence to Sidney, MT, Reach 5 = Yellowstone River from Sidney, MT to Intake diversion dam).

Paddlefish.-Transmitters from all nineteen paddlefish implanted in 2001 were relocated in 2002. The transmitter from one paddlefish was shed near Erickson Island soon after implantation occurred. Another paddlefish shed the transmitter in mid July near Oswego after swimming over 450 km. These 18 fish were manually relocated four to 14 times (mean = 8). Between April and November, a total of 134 manual relocations of paddlefish were obtained (Table 10). An additional 235 contacts were obtained by the telemetry logging stations. Total movement varied from 45 km to 820 km (mean = 332 km).

Paddlefish exhibited migratory patterns during the seasonal cycle (Figure 10). Ten of the eighteen paddlefish migrated up the Yellowstone River between May 16 and June 12. Four of these fish were relocated upstream from Sidney (reach 5) as determined from manual tracking and contacts at the Sidney logging station (operated by the USFWS). The maximum relocation distance upstream in the Yellowstone River was 99 km. All of these fish returned to reach 4 between June 5 and July 11. One paddlefish utilized the Missouri River and Yellowstone River, two paddlefish remained in reach 3, and the remaining five paddlefish migrated upstream the Missouri River into reaches 1 and 2. These individuals initiated migrations up the Missouri River between May 6 and June 14. Two of the five paddlefish migrated into the Milk River in mid- to late-June, and re-entered the Missouri River on July 6 and 8. Four fish returned to reach 3 between June 13 and August 16. One paddlefish shed the transmitter around July 15 near Oswego (within reach 1; Figure 1).

After the spring migrations, 11 paddlefish returned to the Erickson Island area (reach 3). These individuals were subsequently relocated several times during the fall in this area. The four paddlefish fish that used reach 1 and reach 2 of the Missouri River were not relocated in the Erickson Island area. Rather, logging stations data indicated that these individuals moved downstream below Williston.

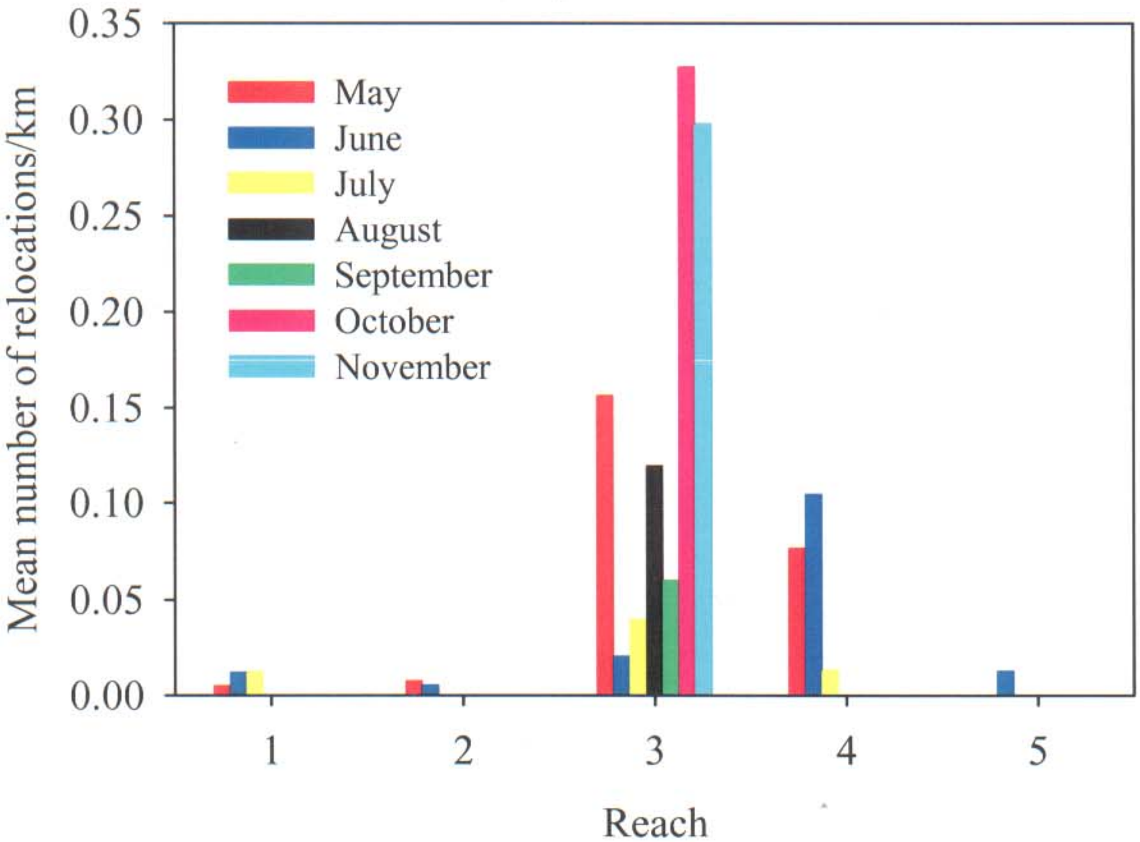

Figure 10. Mean number of paddlefish relocations per km by month in five riverine reaches (Reach 1 = Missouri River between Fort Peck Dam and Wolf Point, Reach 2 = Missouri River between Wolf Point and the Yellowstone River confluence, Reach 3 = Missouri River from the Yellowstone River confluence to the headwaters of Lake Sakakawea, Reach 4 = Yellowstone River from the confluence to Sidney, MT, Reach 5 = Yellowstone River from Sidney, MT to Intake diversion dam).

Monitoring Component 4 – Larval Fish

Larval fish were sampled on 21 individual sampling events between May 21 and August 2. However, three sites (spillway channel, Milk River, site downstream from the dam) were not sampled during one sampling event (May 31) due to equipment breakdown. The larval fish sampling regime resulted in a total of 1,965 larval fish subsamples (222 samples at the site just downstream from Fort Peck Dam, 156 samples in the spillway, 368 samples in the Milk River, 409 samples at Wolf Point, 414 samples at Nohly, 396 samples in the Yellowstone River). The volume of water sampled could not be estimated for six samples. Mean volume of water sampled per subsample was 61.9 m^3 at the site downstream from Fort Peck Dam (total = 13,740 m^3), 21.4 m^3 in the spillway (total = 3,342 m^3), 73.8 m^3 in the Milk River (total = 27,164 m^3), 74.3 m^3 at Wolf Point (total = 30,406 m^3), 63.5 m^3 at Nohly (total = 26,034 m^3), and 45.4 m^3 in the Yellowstone River (total = 17,887 m^3).

Relative abundance of larval fishes and eggs. A total of 41,768 larvae representing ten families were sampled from all sites during 2002, and nearly 77% of the larvae were sampled in the Milk River (Table 11). Catostomidae (suckers) and Cyprinidae (minnows and carps) were sampled at all sites. Two families (Hiodontidae, exclusively goldeye; Percidae, perches) were sampled at all sites except the site downstream from Fort Peck Dam. Polyodontidae (exclusively paddlefish) were sampled in the Milk River, Yellowstone River, and in the Missouri River

Table 11. Number (N) and frequency (%) of larval fishes, and numbers of juveniles, adults, and eggs sampled at six sites during 2002. T = less than 0.1%.

	Below Fort Peck Dam		Spillway		Milk River		Wolf Point		Nohly		Yellowstone River	
Taxon	N	%	N	%	N	%	N	%	N	%	N	%
Acipenseridae							5	T			9	0.7
Catostomidae	158	93.5	291	87.9	25,601	79.9	5915	87.8	476	43.1	605	44.0
Centrarchidae									2	0.2		
Cyprinidae	4	2.4	12	3.6	4,447	13.9	363	5.4	118	10.7	469	34.1
Hiodontidae			3	0.9	818	2.6	67	1.0	101	9.1	175	12.7
Ictaluridae					8	T					3	0.2
Percidae			2	0.6	1	T	240	3.6	326	29.5	22	1.6
Polyodontidae					7	T	27	0.4	14	1.3	34	2.5
Salmonidae	3	1.8					14	0.2	35	3.2		
Sciaenidae			4	1.2	1,142	3.6	93	1.4	23	2.1		
Unknown	4	2.4	19	5.7	27	T	13	0.2	9	0.8	59	4.3
Total larvae	169		331		32,051		6,737		1,104		1,376	
Juveniles			3		413				12		5	
Adults	4		9		347		2		2		1	
Sturgeon/ paddlefish eggs							1					4
Unknown eggs	333		33		4,461		2,425		1,965			5,838

at Wolf Point and Nohly. Sciaenidae (exclusively freshwater drum) were identified from four sites (spillway, Milk River, Wolf Point, Nohly). Salmonidae were sampled at Wolf Point, Nohly, and at the site downstream from Fort Peck Dam. Families minimally represented in the samples included Ictaluridae (catfishes) that were sampled only in the Milk River and Yellowstone River, and Acipenseridae (sturgeons) that were found only at Wolf Point and in the Yellowstone River. Centrarchidae (sunfishes) were sampled only at Nohly. Excluding larvae that could not be definitively identified, the greatest number of families occurred in the Missouri River at Wolf Point (8 families) and Nohly (8 families). Seven families were identified from samples in the Milk River and Yellowstone River. The least number of families occurred in the spillway (5 families) and at the site downstream from Fort Peck Dam (3).

Composition of the larval fishes sampled in 2002 varied among taxa and sites (Table 11). Nearly 98% of larval fishes sampled were represented by Catostomidae (79.1%), Cyprinidae (13.0%), Sciaenidae (3.0%), and Hiodontidae (2.8%). Whereas Catostomidae was the dominant taxon sampled, the proportion of catostomids varied among sites. Catostomids comprised greater than 79% of the fish community at the site downstream from Fort Peck Dam, in the spillway channel, in the Milk River, and at Wolf Point, but the proportion of the community comprised of catostomids decreased to 43% at Nohly and 44% in the Yellowstone River. The majority of larval cyprinids (primarily common carp *Cyprinus carpio*) were sampled in the Milk River (82.2%) and at Wolf Point (6.7%). Similarly, of the 1,262 larval freshwater drum sampled, 90.5% were sampled in the Milk River and 7.4% at Wolf Point. The majority of larval goldeye (70.3%) were sampled in the Milk River, but goldeye were also common in the Yellowstone River (15.0%) and at Nohly (8.7%). The majority of larval percids (primarily *Stizostedion* sp.) were sampled at Nohly (55.2%) and Wolf Point (40.6%). Of the 82 larval paddlefish sampled, 41.5% were sampled in the Yellowstone River, 32.9% at Wolf Point, 17.1% at Nohly, and 8.5% in the Milk River. The 14 larval sturgeon sampled in 2002 were distributed between Wolf Point (35.7%) and the Yellowstone River (64.3%).

Spatial and temporal periodicity and densities of Acipenseridae and Polyodontidae larvae. Larval sturgeon were not sampled in the Milk River during 2002, but seven larval paddlefish were collected (Table 12). Collections of larval paddlefish in the drift occurred on June 25 and July 8, and mean densities were less than 0.50 larvae/100 m^3 (Table 12). No larval sturgeon were sampled from the Milk River in 2001, and only one paddlefish larvae was sampled from the Milk River in 2001 (July 2; Braaten and Fuller 2002).

Table 12. Number sampled, mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of paddlefish larvae sampled by date in the Milk River.

	Date 2002																				
	May						June								July						Aug
Metric	21	28	3	6	10	13	17	20	25	28	1	3	8	12	15	19	22	26	29	2	
Number sampled									2				5								
Mean									0.50				0.29								
Median									0				0.31								
Min									0				0								
Max									1.35				0.57								

Samples of larval fishes at Wolf Point included sturgeon and paddlefish (Table 13). First collections of larval sturgeon at Wolf Point occurred on July 15 (mean density = 0.06 larvae/100 m^3). Larval sturgeon were also sampled on July 18 and August 2, but mean density was low (< 0.20 sturgeon/100 m^3). Collections of larval paddlefish (27 total) were distributed between early and late sampling dates. Mean density varied from 0.13 larvae/100 m^3 to 0.46 larvae/100 m^3 during June 24-July 5, and from 0.20 larvae/100 m^3 to 0.35 larvae/100 m^3 during July 15-July 25. Braaten and Fuller (2002) found six larval sturgeon at Wolf Point in 2001, and these were sampled on July 17 (1), July 19 (2), and July 24 (3). A total of eight larval paddlefish were sampled in 2001, and these were collected on June 19 (2), June 22 (1), June 26 (2), June 28 (2), and July 11 (1).

Table 13. Number sampled, mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of larval sturgeon (*Scaphirhynchus* sp.) and larval paddlefish sampled by date in the Missouri River at Wolf Point.

	Date 2002																				
	May			June								July									Aug
Metric	21	28	31	3	7	10	14	18	21	24	27	1	5	8	11	15	18	22	25	29	2
Scaphirhynchus sp.																					
Number sampled																1	1				3
Mean																0.06	0.07				0.19
Median																0	0				0
Min																0	0				0
Max																0.32	0.35				0.60
Paddlefish																					
Number sampled										2	6	6	2			4	3		4		
Mean										0.13	0.43	0.46	0.17			0.27	0.20		0.35		
Median										0	0.31	0.37	0			0.28	0		0		
Min										0	0	0	0			0	0		0		
Max										0.35	1.44	1.11	0.83			0.71	1.02		1.39		

Larval sturgeon were not sampled in the Missouri River at Nohly during 2002, but 14 paddlefish larval were sampled between July 2 and July 16 (Table 14). Mean density varied from 0.14 larvae/100 m^3 to 0.35 larvae/100 m^3. During 2001, Braaten and Fuller (2002) sampled ten larval sturgeon at Nohly on June 21 (1), June 28 (1), July 10 (2), July 13 (2), July 18 (1), July 24 (1), and July 25 (2). Only four larval paddlefish were sampled in 2001 and these were collected on June 28 (3) and July 25 (1).

Table 14. Total number (number), mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of paddlefish larvae sampled by date in the Missouri River at Nohly.

	Date 2002																				
	May			June								July									Aug
Metric	22	29	31	4	6	12	14	18	20	26	28	2	5	9	11	16	18	23	26	30	1
Paddlefish																					
Number sampled												4	4	2	2	2					
Mean												0.35	0.34	0.19	0.14	0.14					
Median												0.38	0	0	0	0					
Min												0	0	0	0	0					
Max												0.99	0.90	0.93	0.69	0.68					

Larval fish samples from the Yellowstone River yielded a total of 9 larval sturgeon and 34 larval paddlefish (Table 15). Sturgeon larvae were sampled on three dates (June 28, July 5, July 9), and mean density varied from 0.09 larvae/100 m^3 to 0.64 larvae/100 m^3. Larval paddlefish were sampled nearly continuously from their first occurrence in the drift on June 6 to the last occurrence in the drift on July 5. Mean densities of larval paddlefish varied from 0.19 larvae/100 m^3 (June 28) to 1.48 larvae/100 m^3 (June 20). A total of eight larval sturgeon were sampled in the Yellowstone River during 2002 (Braaten and Fuller 2002), and these were found on June 25 (2), June 28 (1), July 3 (1), July 6 (2), July 17 (1), and July 25 (1). Twenty-three paddlefish were sampled from the Yellowstone River during 2001 (Braaten and Fuller 2002). Individuals during 2001 were sampled on May 29 (4), May 31 (2), June 12 (2), June 15 (2), June 18 (1), June 21 (1), June 25 (10), and July 25 (1).

Table 15. Total number (number), mean density (mean; number/100 m^3), median density (median), minimum density (min.), and maximum density (max.) of larval sturgeon (*Scaphirhynchus* sp.) and larval paddlefish sampled by date in the Yellowstone River.

	Date 2002																				
	May			June								July									Aug
Metric	22	29	31	4	6	12	14	18	20	26	28	2	5	9	11	16	18	23	26	30	1
	Scaphirhynchus sp.																				
Number sampled											2		6	1							
Mean											0.14		0.64	0.09							
Median											0		0.66	0							
Min											0		0	0							
Max											0.40		1.37	0.47							
	Paddlefish																				
Number sampled					1	3	3	5	11	3	3		5								
Mean					0.25	0.55	0.33	0.79	1.48	0.41	0.19		0.46								
Median					0	0	0	0.70	1.59	0.54	0.30		0								
Min					0	0	0	0	0.60	0	0		0								
Max					1.24	2.77	1.63	2.21	1.92	0.80	0.34		1.82								

Larval nets fished on the bottom tended to sample a greater number of larval sturgeon and larval paddlefish than nets fished in the mid-water column. Of the 14 larval sturgeon sampled during 2002, 9 larvae (64.3%) were sampled in larval nets fished on the bottom. Excluding Milk River samples that were fished exclusively on the surface, 47 larval paddlefish (62.7%) were sampled in larval nets fished on the bottom. In addition to larvae, five sturgeon/paddlefish eggs were sampled during 2002; these were collected at Wolf Point (July 18, N = 1) and in the Yellowstone River (June 12, N = 1; June 18, N = 1; June 26, N = 1; July 2, N = 1). Braaten and Fuller (2002) reported that 70.8% of the larval sturgeon sampled in 2001 were collected in bottom samples. About 62% of the larval paddlefish sampled in 2001 were obtained from bottom samples.

Spatial and temporal periodicity and densities of larval fishes exclusive of Acipenseridae and Polyodontidae. Mean density of larval fishes at the site downstream from Fort Peck Dam varied between 0 and 4.7 larvae/100 m^3 among sampling periods (Figure 11). Maximum densities of larvae occurred on July 3 (mean = 4.27 larvae/100 m^3) and July 12 (mean = 4.7 larvae/100 m^3) when catostomids averaged greater than 94% of the larvae densities. Salmonids comprised 100% of the larval fish densities on May 21 (mean 1.07 larvae/100 m^3) and June 6 (mean = 0.12 larvae/100 m^3). Cyprinids (exclusively common carp) were sampled on two dates (July 15, July 22), but at low densities (mean ≤ 0.44 larvae/100 m^3).

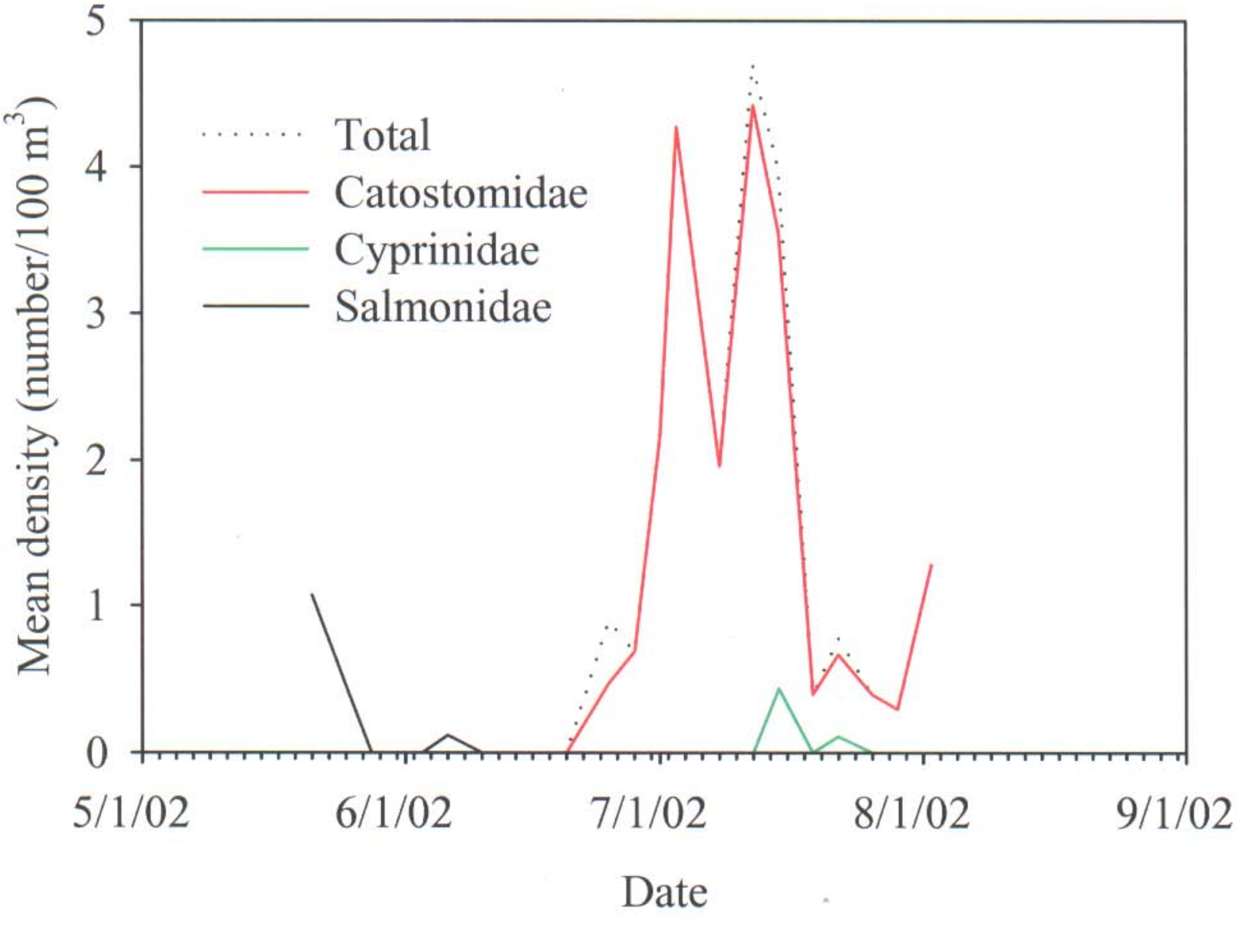

Figure 11. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, and Salmonidae sampled in the Missouri River at the site downstream from Fort Peck Dam during 2002.

In the spillway channel, mean density of larval fishes varied from 0 larvae/100 m^3 to 74 larvae/100 m^3 (Figure 12). Mean density was low through late June (< 18 larvae/100 m^3), peaked on July 1 as catostomids comprised greater than 98% of the larval fishes sampled, then declined through the beginning of August. Mean density of larval Cyprinidae, Hiodontidae, Percidae , and Sciaenidae were low (≤ 4.0 larvae/100 m^3) throughout the sampling period.

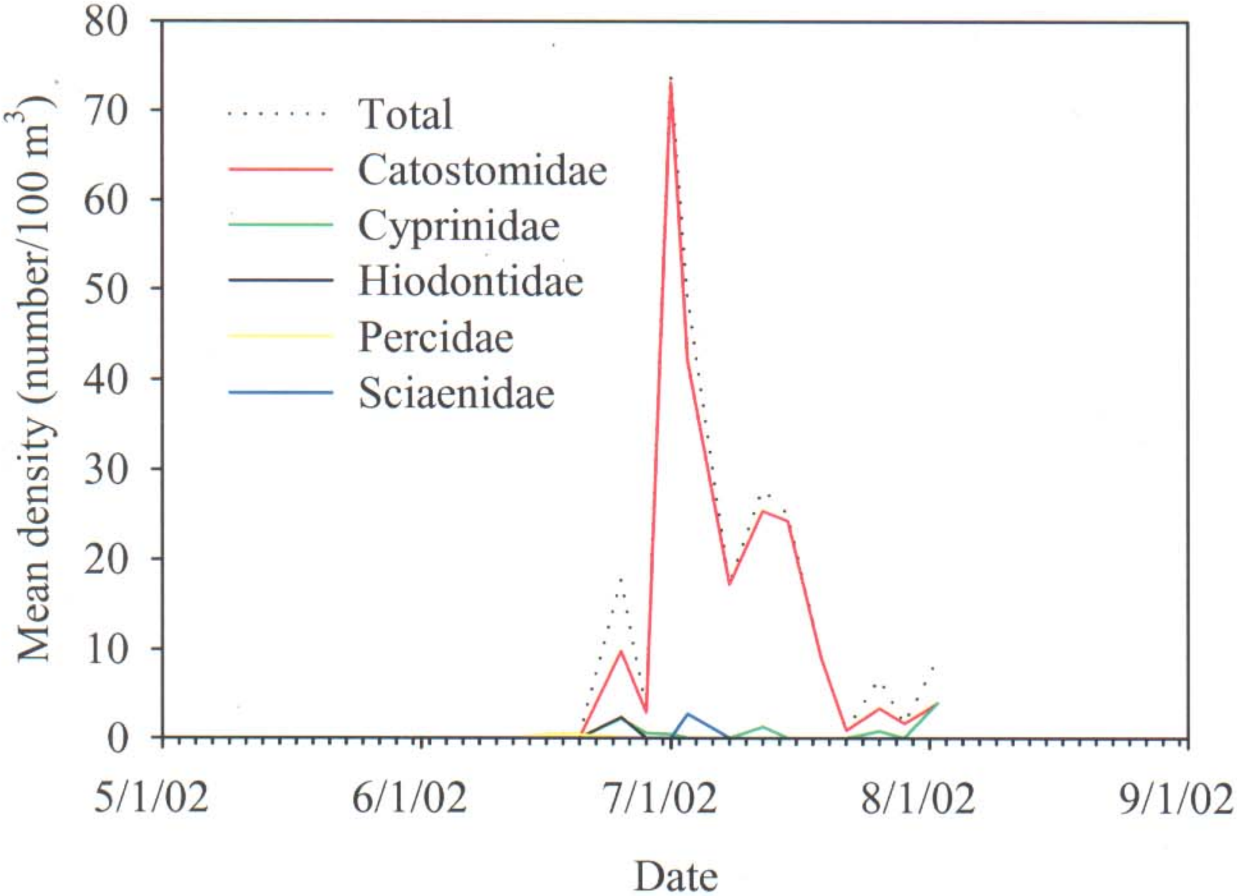

Figure 12. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Percidae, and Sciaenidae sampled in the Fort Peck spillway channel during 2002.

Composition and densities of larval fishes in the Milk River exhibited pronounced temporal variations (Figure 13). Densities of all taxa were low (< 27 larvae/100 m^3) through June 20. Mean density increased substantially to 3,673 larvae/100 m^3 on June 25 when catostomids (mean density = 3,205 larvae/100 m^3) comprised 87% of the larvae, cyprinids (mean density = 348 larvae/100 m^3) comprised 9.5% of the larvae, and hiodontidae (mean density = 105/100 m^3) comprised 2.9% of the larvae. Density of larval freshwater drum (Sciaenidae) peaked on June 28 (mean = 57.8 larvae/100 m^3) as densities of other taxa declined through late July. Whereas common carp larvae comprised 95-100% of the cyprinids sampled from June 13 to July 12, larval cyprinids exclusive of common carp comprised 100% of the cyprinid larvae from the July 19 through August 2 sampling periods.

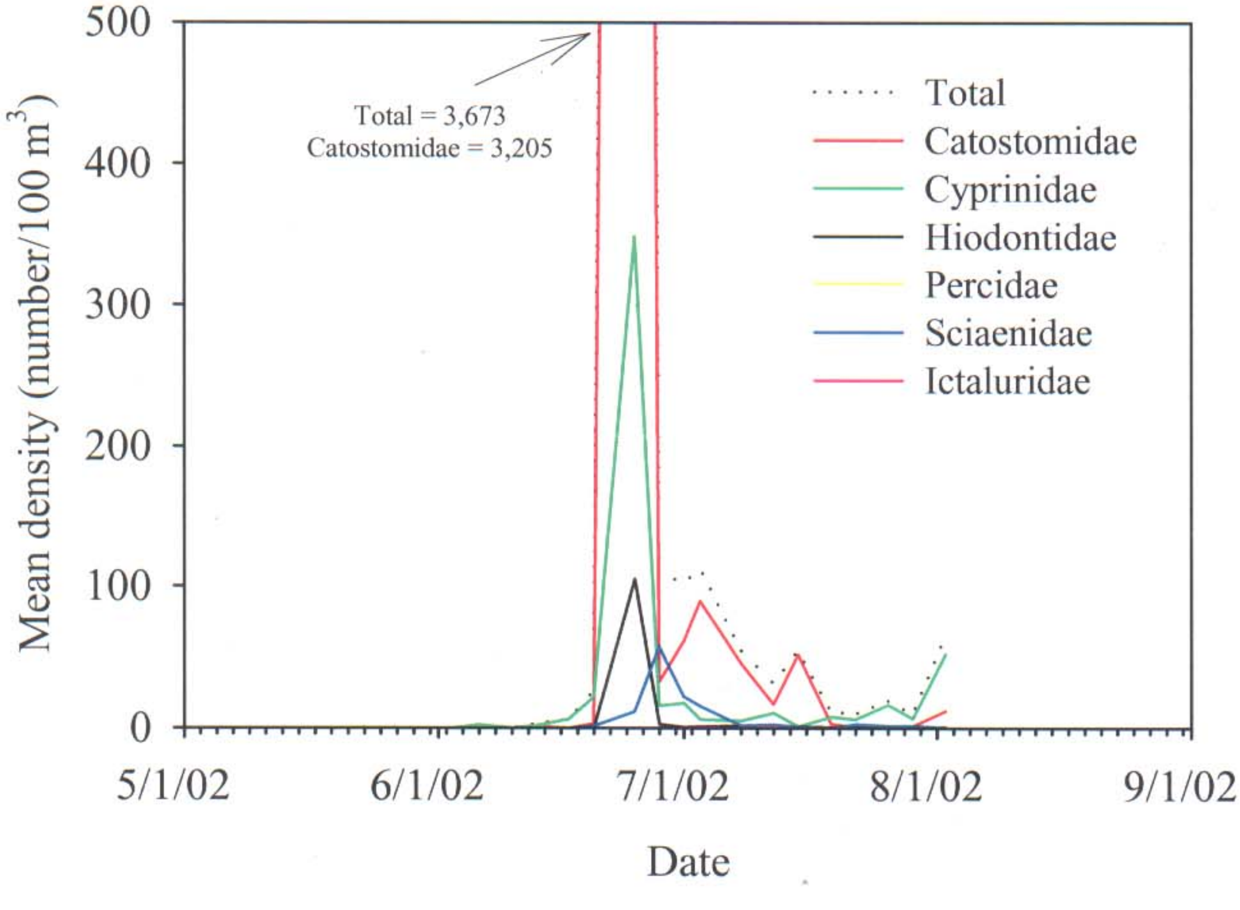

Figure 13. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Percidae, Sciaenidae, and Ictaluridae sampled in the Milk River during 2002.

Larval fishes sampled at Wolf Point exhibited temporal variations in taxon composition and density among sampling periods (Figure 14). Between May 28 and June 18, larval densities were low (< 4.4 larvae/100 m^3) and were dominated by larval percids (primarily *Stizostedion* sp.). Mean density increased to a maximum of 338.4 larvae/100 m^3 on June 27 primarily as a result of an increase in density of catostomids (mean density = 316 larvae/100 m^3) and cyprinids (mean density = 18.1 larvae/100 m^3). Hiodontidae also exhibited maximum density on June 27 (mean density = 3.45 larvae/100 m^3). Mean density of catostomidae and cyprinidae decreased after June 27; whereas, density of Sciaenidae increased on July 1 (mean = 2.13 larvae/100 m^3) and July 5 (mean = 2.38 larvae/100 m^3). Between June 14 and July 1, common carp comprised 67-100% of the larval cyprinids sampled at Wolf Point.

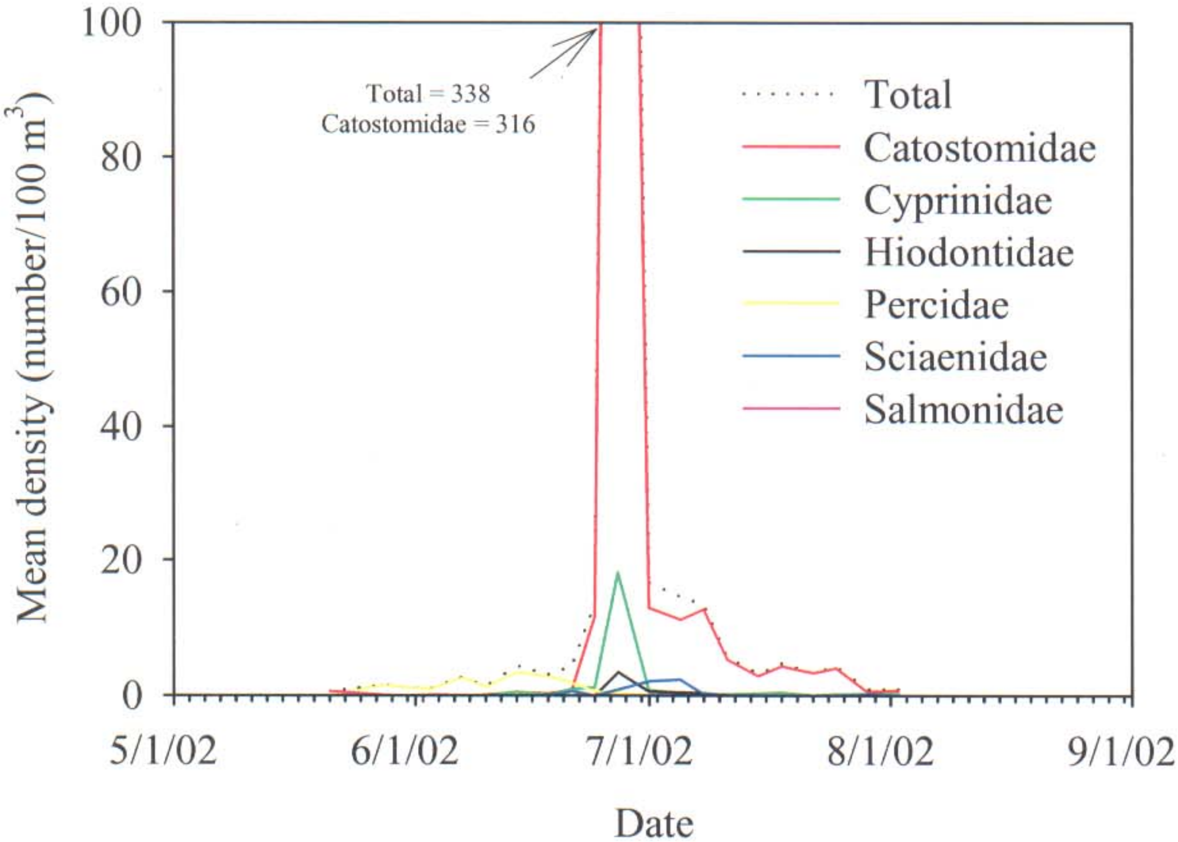

Figure 14. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Percidae, Sciaenidae, and Salmonidae sampled in the Missouri River at Wolf Point during 2002.

Mean total density of larval fishes sampled at Nohly varied from 0.30 larvae/100 m^3 to 16.6 larvae/100 m^3 throughout the sampling period (Figure 15). Larval percids (primarily *Stizostedion* sp.) were the dominant taxon sampled between May 29 and June 20 (mean densities 1.31-5.8 larvae/100 m^3). Total density of larvae increased on June 28 as catostomids exhibited maximum density (mean = 9.44 larvae/100 m^3). Total density continued to increase through July 2 with contributions from catostomids (mean = 7.83 larvae/100 m^3), hiodontidae (mean = 5.0 larvae/100 m^3), cyprinidae (2.2 larvae/100 m^3), and sciaenids (1.2 larvae/100 m^3). Common carp comprised 40-100% of the cyprinidae sampled between June 12 and July 11. Total density declined after early July, and the larval community was composed exclusively of catostomids and cyprinid (non-common carp) larvae.

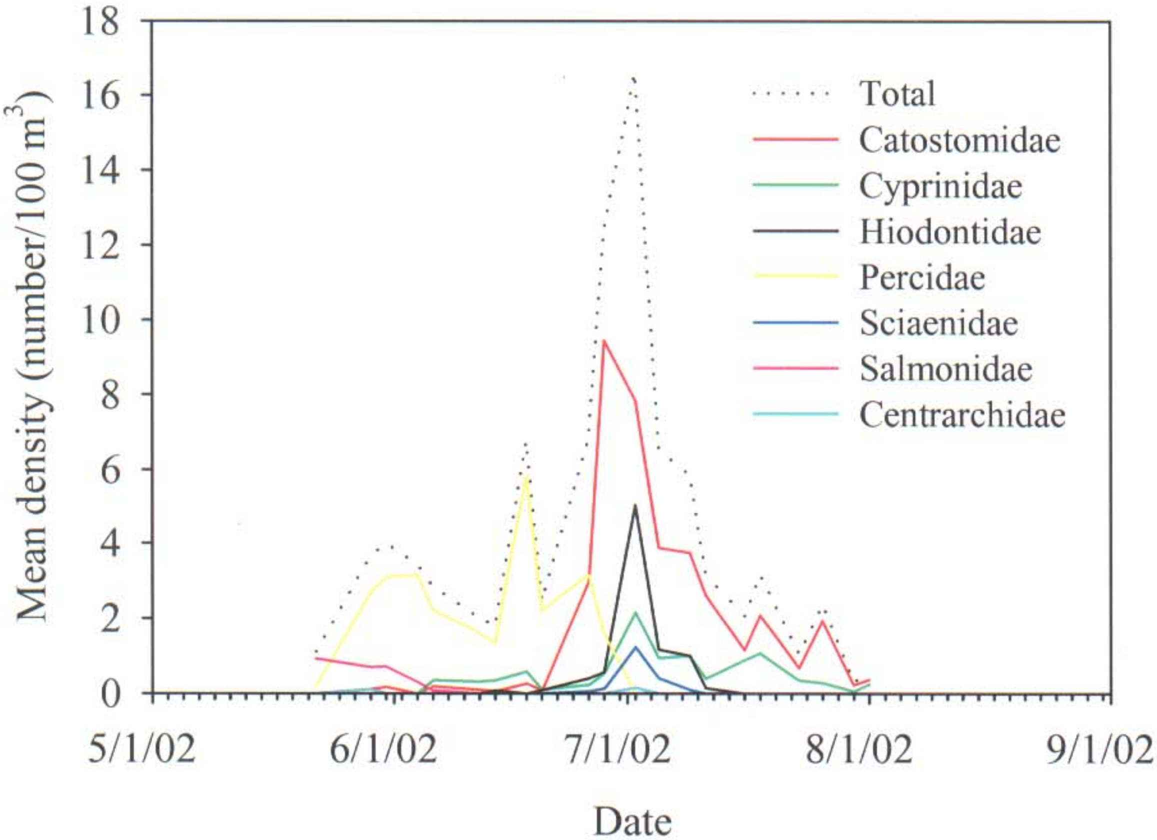

Figure 15. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Percidae, Sciaenidae, Salmonidae, and Centrarchidae sampled in the Missouri River near Nohly during 2002.

Mean total density of larval fishes in the Yellowstone River varied between 0.3 larvae/100 m^3 and 45.9 larvae/100 m^3 during the late-May through early August sampling periods (Figure 16). Larval fish samples from late May through late June were composed predominately of larval goldeyes (mean density 0.3 - 5.7 larvae/100 m^3) and to a lesser extent catostomids (mean density = 0 – 2.5 larvae/100 m^3) and cyprinids (mean density = 0 – 2.9 larvae/100 m^3). Larval common carp comprised 62-100% of the cyprinid larvae sampled from late May through late June. The initial peak in total density occurred on July 9 when catostomids comprised 94% of the larval fish density. The second period of high larval densities occurred on July 16 and July 18 as cyprinds (non-common carp) comprised 86-93% of the larval fish densities.

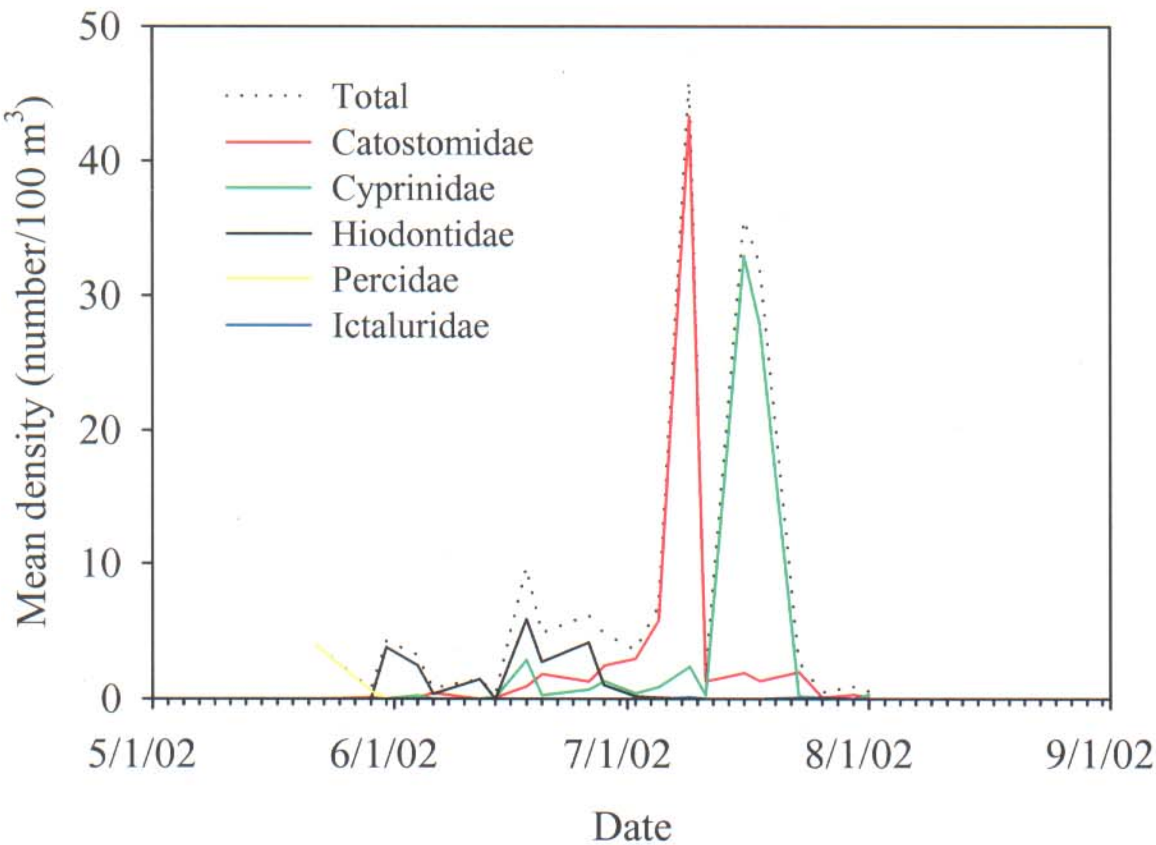

Figure 16. Mean density (number/100 m^3) by date of all larval fishes (Total), Catostomidae, Cyprinidae, Hiodontidae, Percidae, and Ictaluridae sampled in the Yellowstone River during 2002.

Inter-annual trends in larval fish densities.-A complete analysis of spatial and temporal changes in larval fish densities resulting from the Fort Peck spillway releases will be conducted after completion of the project. However, summary statistics from the 2001 and 2002 larval fish data sets were computed to illustrate inter-annual trends. Pooled across late-May through late July sampling dates (common dates for both years), larval fish densities (all taxa) were generally greater during 2002 than 2001 in the Milk River and in the Missouri River at Wolf Point (Figure 17). Mean densities were generally similar between years at the site downstream from the dam (2001 mean = 1.06 larvae/100 m^3; 2002 mean = 1.26 larvae/100 m^3), in the spillway channel (2001 mean = 19.79 larvae/100 m^3; 2002 mean = 13.66 larvae/100 m^3), at Nohly (2001 mean = 5.89 larvae/100 m^3; 2002 mean = 4.91 larvae/100 m^3), and in the Yellowstone River (2001 mean = 3.58 larvae/100 m^3; 2002 mean = 9.55 larvae/100 m^3). Elevated discharge in the Milk River during 2002 may have enhanced spawning success, and there is evidence to suggest that the increased density of larval fishes at Wolf Point was influenced by the higher densities originating from the Milk River during 2002. For example, peak densities at Wolf Point in 2002 occurred on June 27 (Figure 14), two days after peak densities were observed in the Milk River (Figure 13). Milk River discharge increased substantially during this time period (Figure 2) and likely transported larval fish downstream to Wolf Point. The benefit of enhanced larval production in

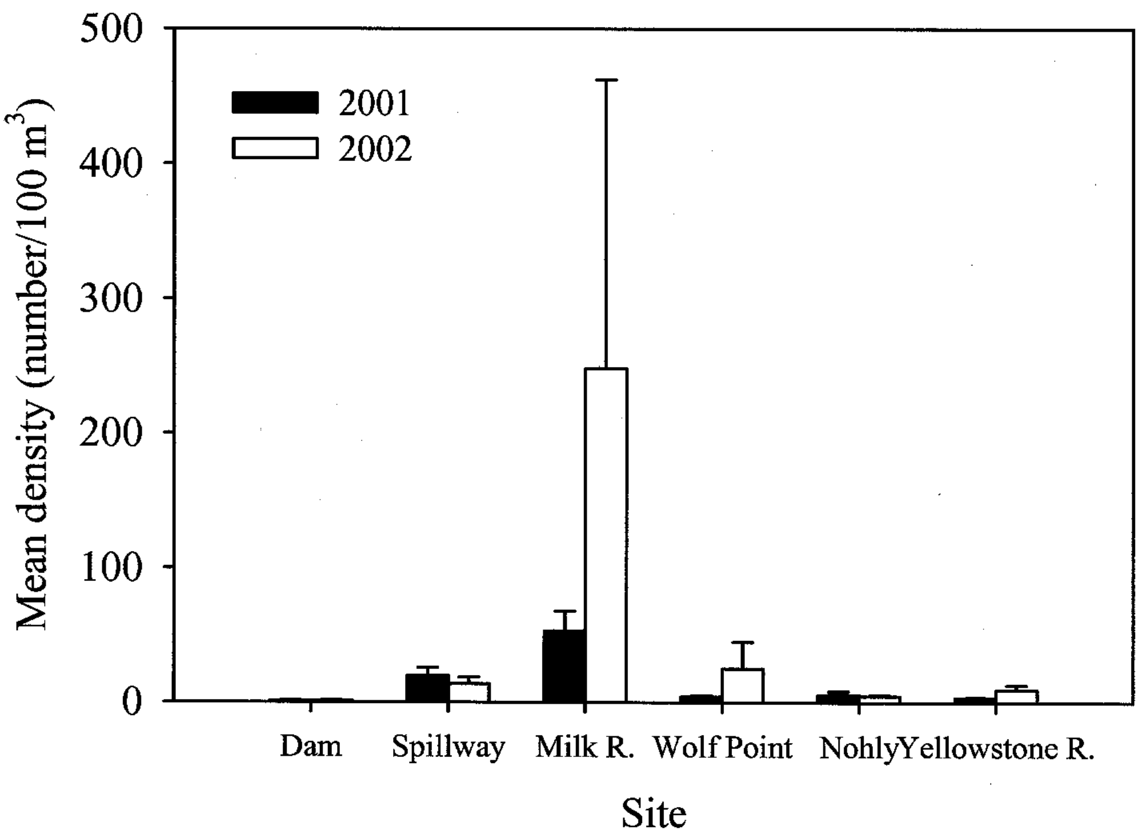

Figure 17. Mean total density (number/100 m^3; lines denote 1 standard error) of larval fishes sampled at six sites in 2001 and 2002.

the Milk River was not evident at the Nohly site suggesting that the larval fish either settled to benthic habitats upstream from Nohly or experienced high mortality levels during the drift-transport process to Nohly.

Monitoring Component 5 – Food habits of piscivorous fishes

Four burbot were sampled during July and August 2002. Individuals varied from 237 mm to 306 mm (mean = 286 mm), and from 50 g to 175 g (mean = 129 mm). The four stomachs were empty; thus, no information on food habits was obtained.

Stomachs from 62 channel catfish (mean length = 387 mm, 212 - 630 mm; mean weight = 610 g, 50 - 2,525 g) were obtained during July and August 2002. Five stomachs (8.1%) were empty. A variety of prey organisms was found in the stomach contents of channel catfish, but orthopterans (e.g., grasshoppers) represented the highest frequency of occurrence (43.9% of the stomachs) and frequency by number (66.2%) of food items ingested (Table 14). Fish (Class Osteichthyes) were found in 31.6% of the channel catfish, and identifiable fish in the diet included goldeyes and ictalurids (i.e., catfishes). Five diet components (miscellaneous material, orthopterans, unknown fish, goldeye, and mammals) comprised 81.7% of the diet weight.

Table 14. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for channel catfish sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	19.3	7.4	0.3
	Ephemeroptera	3.5	0.6	T
	Hemiptera	3.5	1.3	T
	Lepidoptera	3.5	1.0	0.7
	Odonata	1.8	0.3	T
	Orthoptera	43.9	66.2	17.0
	Trichoptera	17.5	5.5	0.1
	Unknown	14.0	7.4	0.3
Crustacea	Decapoda	5.3	1.0	1.2
Gordoida	Nematomorpha	5.5	1.6	T
Mammalia		1.8	0.3	14.2
Osteichthyes		31.6		
	Goldeye	1.8	0.3	15.6
	Ictaluridae	3.5	0.6	6.7
	Unknown	26.3	4.8	16.1
Aves		3.5	0.6	1.0
Arachnida	Araneae	1.8	0.3	T
Fungi		1.8	0.3	3.7
Unknown		1.8	0.3	T
Detritus		28.1		4.1
Miscellaneous		42.1		18.8
			Total organisms = 311	Total weight = 423.99 g

Eight freshwater drum (mean length = 385 mm, 317 – 469 mm; mean weight = 797 g, 400 – 1,300 g) were sampled in July and August 2002, and all eight stomachs contained food items (Table 15). Fish represented the highest frequency of occurrence (75% of the stomachs), but insects and crustaceans were also present in the diet. Ephemeropterans (e.g., mayflies) represented the highest frequency by number (34.8%); whereas, decapods (e.g., crayfish) dominated the diet on a weight basis (88.3%).

Table 15. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for freshwater drum sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Diptera	12.5	4.3	T
	Ephemeroptera	12.5	34.8	0.7
	Unknown	37.5	34.8	1.1
Crustacea	Decapoda	37.5	13.0	88.3
Osteichthyes	(all)	75.0		
	Unknown	75.0	13.0	0.7
Detritus		37.5		0.8
Miscellaneous		50.0		8.3
			Total organisms = 46	Total weight = 39.3 g

Stomachs were obtained from 93 goldeye (mean length = 260 mm, 146 – 353 mm; mean weight = 157 g, 25 – 325 g), and only one stomach (1.1%) was empty. Orthopterans were found in 71.7% of the stomachs, and comprised 86.1% of the ingested organisms (Table 16). Six additional insect orders (Coleoptera, Hemiptera, Lepidoptera, Odonata, Plecoptera, Trichoptera) were also found in the diet (frequency of occurrence = 1.1 – 18.5%), but these cumulatively comprised less than 9.0% of the ingested organisms. Fish, horsehair worms (Class Gordoida, Order Nematomorpha), and mammals were found in 1.1 – 14.1% of the stomachs. Orthopterans comprised 90.8% of the weight of ingested organisms

Table 16. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for goldeye sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	18.5	5.3	0.8
	Hemiptera	8.7	1.1	0.5
	Lepidoptera	2.2	0.2	0.3
	Odonata	1.1	0.1	T
	Orthoptera	71.7	86.1	90.8
	Plecoptera	1.1	0.1	T
	Trichoptera	12.0	2.1	T
	Unknown	14.1	2.0	1.9
Gordioda	Nematomorpha	1.1	0.1	T
Mammalia		1.1	0.1	1.4
Osteichthyes	(all)	14.1		
	Unknown	14.1	2.6	1.8
Detritus		7.6		0.1
Miscellaneous		19.6		2.3
			Total organisms = 808	Total weight = 492.23 g

Stomachs were acquired from 47 northern pike (mean length = 573 mm, 406 – 835 mm; mean weight = 1,180 g, 450 – 3,525 g), but 16 stomachs (34.0%) were empty. Fish were found in 64.5% of the stomachs (Table 17). Identifiable fish prey included centrarchids (i.e., sunfishes), ictalurids (i.e., catfishes), sauger, and Stizostedion sp. (i.e., walleye or sauger). Northern pike also consumed decapods (12.9% of the stomachs) and orthopterans (3.2% of the stomachs). Unknown fish had the highest frequency by number (75% of organisms ingested). Fish comprised 92% of the weight of ingested organisms, but the high percentage was largely due to one ingested sauger that comprised 78.5% of the total weight.

Table 17. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for northern pike sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Crustacea	Decapoda	12.9	8.3	7.5
Insecta	Orthoptera	3.2	6.3	0.2
Osteichthyes	(all)	64.5		
	Centrarchidae	3.2	2.1	0.2
	Ictaluridae	3.2	2.1	0.1
	Sauger	6.5	4.2	78.5
	Stizostedion	3.2	2.1	0.1
	Unknown	54.8	75.0	13.1
Detritus		12.9		0.1
Miscellaneous		29.0		0.3
			Total organisms = 48	Total weight = 349.23 g

Stomachs from 102 sauger (mean length = 368 mm, 206-526 mm; mean weight = 404 g, 50 – 1,275 g) were obtained, and 40 stomachs (39.2%) were empty. Fish represented the highest frequency of occurrence (93.5% of all stomachs); whereas, identifiable insects and crustaceans were found in only 1.6% to 3.2% of the stomachs (Table 18). Identifiable fish in the diet included common carp, emerald shiner, flathead chub, goldeye, *Hybognathus* sp., and ictalurids. Identifiable fish and unknown fish cumulatively comprised 85.7% of the total number of organisms found in the stomachs, and 98.5% of the total weight of organisms.

Table 18. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for sauger sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	1.6	1.1	T
	Ephemeroptera	1.6	1.1	T
	Hemiptera	1.6	1.1	T
	Odonata	1.6	1.1	T
	Orthoptera	3.2	2.2	T
	Trichoptera	1.6	1.1	T
	Unknown	9.7	5.5	T
Crustacea	Argulus	1.6	1.1	T
Osteichthyes	(all)	93.5		
	Common carp	1.6	1.1	1.1
	Emerald shiner	6.5	4.4	12.3
	Flathead chub	4.8	3.3	50.2
	Goldeye	1.6	2.2	0.3
	Hybognathus	6.5	6.6	16.1
	Ictaluridae	1.6	1.1	5.8
	Unknown	82.3	67.0	12.7
	Eggs	1.6		T
Detritus		62.9		1.0
Miscellaneous		16.1		0.3
			Total organisms = 91	Total weight = 123.86 g

Stomachs from 64 shovelnose sturgeon (mean length = 563 mm, 162-722 mm; mean weight = 743 g, 100 – 1,350 g) were obtained. Of these, 5 stomachs (7.8%) were empty. The diet of shovelnose sturgeon was comprised primarily of insects (Table 19). Dipterans were the dominant insects consumed, and were found in 89.8% of the stomachs. Dipterans comprised 99.9% of the organisms consumed, and 87% of the weight of organisms in the stomachs.

Table 19. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for shovelnose sturgeon sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Coleoptera	1.7	T	T
	Diptera	89.8	99.9	87.2
	Ephemeroptera	3.4	T	0.1
	Odonata	3.4	T	0.1
	Orthoptera	13.6	T	3.2
	Trichoptera	6.8	T	0.1
	Unknown	8.5	T	2.0
Crustacea	Decapoda	1.7	T	T
Detritus		5.1		T
Miscellaneous		11.9		7.1
			Total organisms = 85,965	Total weight = 249.20 g

Stomachs from 14 walleyes (mean length = 395 mm, 255 – 532 mm; mean weight = 609 g, 100 – 1,600 g) were obtained. Of these, 4 stomachs (28.6%) were empty. Fish were found in 80% of the stomachs, but fish prey could not be identified to species (Table 20). Although insects were present in the diet, fish comprised 84.6% of the total number of organisms and 98.6% of the weight of organisms in the stomachs.

Table 20. Frequency of occurrence (%, number of individuals containing the specific food item/ number of stomachs containing food), numerical frequency (%, total number of taxon-specific food items/total number of all food items), and weight frequency (%, total weight of a taxon-specific food item/total weight of all food items) of diet components for walleye sampled in the Missouri River during July and August 2002. T = less than 0.1%.

Diet component		Frequency of occurrence (%)	Frequency by number (%)	Frequency by weight (%)
Insecta	Ephemeroptera	10.0	7.7	0.1
	Odonata	10.0	7.7	0.5
Osteichthyes	(all)	80.0		
	Unknown	80.0	84.6	98.6
Detritus		40.0		0.5
Unknown		10.0		0.3
			Total organisms = 13	Total weight = 7.86 g

Related Activities

Incidental captures of adult and hatchery-raised juvenile pallid sturgeon.-Incidental captures of pallid sturgeon occurred in 2002 while conducting activities associated with the Fort Peck Data Collection Plan. First, an adult pallid sturgeon (1,362 mm, 12,150 g, PIT tag number 7F7D364B62) was sampled with a trammel net at rkm 2,600 (RM 1,615) on September 25. Second, a total of six hatchery-raised juvenile pallid sturgeon were sampled. Individuals were captured with trammel nets near Wolf Point on September 12 (231 mm, 38.9 g, PIT tag number 435E1D160C) and September 17 (245 mm, 44.1 g, PIT tag number 435D675A10), near Culberston on September 19 (416 mm, 211.7 g, PIT tag number 424F0D0226; 603 mm, 642.3 g, PIT Tag number 411D0B513C) and September 26 (369 mm, 176.5 g, no PIT tag, green and yellow elastomere implants), and at the Yellowstone River confluence on September 25 (430 mm, 243.0 g, PIT tag number 424F377447).

Young-of-year sturgeon sampling.-Benthic trawling was conducted between August 7 and September 5, 2002, to sample for young-of-year (YOY) sturgeon. Three riverine areas were sampled including the Missouri River above the Yellowstone River confluence (ATC; rkm 2,549-2,563, RM 1,583-1,592), the Yellowstone River (rkm 0-3.2, RM 0-2.0), and the Missouri River below the Yellowstone River confluence (BTC; rkm 2,497-2,547, RM 1,551-1,582). Young-of-year sturgeon (e.g., designated as less than 100 mm) sampled were measured in the field, preserved in a 10% formalin solution, and were tentatively identified as pallid sturgeon or shovelnose sturgeon in the laboratory using criteria established by Dr. Darrel Snyder (Colorado State University, Larval Fish Laboratory). If individuals were initially identified as pallid sturgeon, then they were sent to Dr. Darrel Snyder for expert identification.

A total of 116 benthic trawl samples was conducted among the three sampling areas resulting in a total of 475.5 minutes of sampling effort (Table 21). Three YOY sturgeon tentatively identified as shovelnose sturgeon were sampled in the Missouri River ATC on August 7, August 21, and September 4 (Table 21). These individuals varied from 20 – 58 mm. No YOY sturgeon were sampled from the Yellowstone River; however, sampling effort in the Yellowstone River was low in comparison to the other sites. A total of 30 YOY sturgeon was sampled in the Missouri River BTC (Table 21). The number of YOY sturgeon sampled was low ($\leq$ 3 individuals) from August 13 to September 4, but increased to 20 on September 5. Two YOY sturgeon sampled from the Missouri River BTC exhibited characteristics specific to pallid sturgeon, and were tentatively identified as pallid sturgeon. These individuals were sampled on September 4 at rkm 2,537 (RM 1,576) and September 5 at rkm 2,500 (RM 1,553). The two individuals were sent to Dr. Darrel Snyder for species confirmation. The following quoted text from Dr. Snyder (dated 17 March 2003) highlights the results from his examination of the two YOY sturgeon:

"Based on my analyses, I have designated both specimens as tentative pallid sturgeon (*Scaphirhynchus albus*?). If these are pure pallid sturgeon, they display some characters observed only for shovelnose sturgeon in my comparison of hatchery reared larvae. However, I suspect they are impure pallid sturgeon or possibly F1 hybrids displaying mostly pallid sturgeon traits.

Both specimens were developmentally at or very near transition from the protolarval phase (without yolk) to the mesolarval phase and were therefore analyzed using criteria for both developmental phases; greater weight was given to criteria for protolarvae without yolk. The smaller specimen (21.6 mm TL, collected on 9/5/02 at H-85 site) has a torn caudal fin with a few rather indistinct or questionable caudal fin rays and no dorsal or anal fin rays. The larger specimen (23.1 mm TL, collected on 9/4/02 at US Erickson site) has a few "almost" distinct dorsal (but not caudal or anal) fin rays, depending on lighting and angle of view. Treated as protolarvae, both specimens matched pallid sturgeon criteria for all but one primary taxonomic character and about half of the secondary taxonomic characters. Treated as mesolarvae, criteria for all but one secondary character for both specimens and one primary character for the smaller specimen matched pallid sturgeon or both species. Had I analyzed the specimens only as mesolarvae, I would have designated the larger specimen positively as pallid sturgeon and the smaller specimen as unknown (probably a hybrid). Both specimens had fewer dorsal-fin pterygiophores than previously observed for larvae of either species. Considering the late date of capture relative to developmental state, it is possible that this and perhaps other meristic characters were affected by substantially warmer incubation and rearing temperatures than used for the developmental series I described. Results of the analyses are detailed on the following pages."

Table 21. Benthic trawl sampling locations, effort, dates, and number and lengths (minimum and maximum length in parentheses) of young-of-year sturgeon sampled in 2002. Asterisks denote that a pallid sturgeon was sampled. ATC = Missouri River upstream from the Yellowstone River confluence, BTC = Missouri River downstream from the Yellowstone River confluence.

		Date							
Location	Metric	8/7	8/13	8/21	8/22	8/27	8/28	9/4	9/5
Missouri River ATC	Effort (trawls)	8		12			9	5	
	Effort (minutes)	31		48			31	28	
	Number of sturgeon	1		1			0	1	
	Mean length	38		58				20	
Missouri River BTC	Effort (trawls)		21		22	18		10	6
	Effort (minutes)		81.5		85.5	69		50	32
	Number of sturgeon		1		3	3		3*	20*
	Mean length		58		49 (22-81)	29 (15-55)		24 (22-25)	21 (17-25)
Yellowstone River	Effort (trawls)				5				
	Effort (minutes)				19.5				
	Number of sturgeon				0				
	Mean length								

Other researchers have sampled larval pallid sturgeon in the Mississippi River (R. Hrabik, Missouri Department of Conservation, Jackson, MO, personal communication) and the lower channelized Missouri River (L. Mauldin, USFWS, Columbia, MO, personal communication). The two larval pallid sturgeon sampled in September 2002 provide the first documented account of larval pallid sturgeon in the Missouri River downstream from Fort Peck Dam, and indicate that successful spawning by pallid sturgeon did occur in 2002. However, it is not known whether spawning occurred in the Yellowstone River or in the Missouri River. Additional analyses will be conducted on the two larval pallid sturgeon to estimate age, hatch date, and spawning date.

Activities for 2003

All monitoring activities associated with the Fort Peck Data Collection Plan will continue through the 2003 field season with the exception of the piscivore food habit studies. The piscivore food habit studies will be initiated again when the full-test of the spillway releases is implemented. In addition to the monitoring activities, we will continue to sample for YOY pallid sturgeon and shovelnose sturgeon during August and September. Funding for the Fort Peck Data Collection Plan was expanded for 2003 to conduct a larval sturgeon drift study in the Missouri River downstream from Fort Peck Dam. This is a collaborative study involving the MTFWP (Dave Fuller), USGS Columbia Environmental Research Center, Fort Peck Project Office (Pat Braaten), and the USGS Conte Anadromous Fish Research Center (Boyd Kynard) designed to evaluate drift rates, drift distance, and drift behavior of larval pallid sturgeon and larval shovelnose sturgeon through a range of water velocities and environmental conditions. Results from this study will be presented at the annual Upper Basin meeting in December 2003.

Acknowledgments

Funding for this project was provided by the U. S. Army Corps of Engineers (William Miller, Project Manager). Western Area Power Administration (Ted Anderson) served as the contractual liaison between the Corps of Engineers and the Montana Department of Fish, Wildlife and Parks. Nathan McClenning, William Waller, Heidi Wiedenheft, and Drew Henry assisted in the field sampling, data entry, and laboratory activities. Dave Yerk, Matt Baxter, and Kevin Kapucinski from the Montana Department of Fish, Wildlife and Parks provided logistical support. Wade King and Ryan Wilson from the U.S. Fish and Wildlife Service provided a portion of the telemetry logging station data.

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APPENDIX M
COMMENTS AND RESPONSES ON THE DRAFT EA

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SUMMARY OF COMMENTS[1]
DRAFT EA - FORT PECK MINI TEST

1. Commenting Agencies

- State of Missouri Department of Natural Resources
- North Dakota State Water Commission
- Montana Fish, Wildlife, and Parks (two letters)
- Montana Department of Natural Resources and Conservation
- Richland County
- McCone County

2. Commenting Municipalities

- no written comments on draft EA

3. Commenting Public Groups

- BOMMM Joint Water Resource Board
- Missouri Levee & Drainage District
- McCone Conservation District

4. Commenting Tribes

- no written comments on draft EA

5. Public Comments

Sent From	Form 1[2]	Form 2[3]	Form 3[4]	Letter	Form 4[5]
Cartwright, ND				X	
Langdon, ND	X				
Lakota, ND	X				
Hampsclew, ND	X				
Bainville, MT		X			
Culbertson, MT			X		
Mandan, ND	X				
Fairfield, ND	X				
Brocket, ND	X				
Langdon, ND	X				
Thief River Falls, MN	X				
Sidney, MT		X			

[1] requests for additional copies of the document are not considered comments
[2] form beginning "Comment Questionnaire"
[3] form beginning "It is VERY important...."
[4] form beginning "I am requesting an extension....."
[5] form beginning "I, along with others of the Fort Peck area..."

Brockton, MT			X	
Fairview, MT	X			
Richy, MT	X			
Richy, MT	X			
Fairview, MT	X			
Fairview, MT	X			
Nashua, MT			X	
Nashua, MT			X	
Fairview, MT			X	
Fairview, MT			X	
Fairview, MT			X[6]	
Culbertson, MT		X		
Culbertson, MT		X		
Culbertson, MT		X		
Culbertson, MT		X		
Culbertson, MT			X	
Glasgow, MT			X	
Fairview, MT			X	
Sidney, MT				X
Fairview, MT (4 sigs[7])				X
Fairview, MT (2 sigs)				X
Wolf Point, MT (2 sigs)				X
Poplar, MT (2 sigs)				X
Fairview, MT (5 sigs)				X
Sidney, MT				X
Froid, MT				X
Dagmar, MT (2 sigs)				X
Sidney, MT				X
Nashua, MT (4 sigs)				X
Sidney, MT (2 sigs)				X
Sidney / Fairview MT (4 sigs)				X
Williston, ND				X
Fairview, MT (2 sigs)				X
Burlington, ND	X			
Bakersfield, CA				X
Brockton, MT (2 sigs)				X
Williston, ND (5 sigs)				X
Sidney, MT				X
Williston, ND (2 sigs)				X
Williston, ND	X			
Santa Rosa, CA				X
Fairview, MT (25 sigs)				X
Fairview, MT (2 sigs)				X
Wolf Point, MT (2 sigs)				X

[6] on old yellow scoping comment form
[7] indicates number of signatures on form

Froid, MT		X
Williston, ND (2 sigs)		X
Williston, ND (2 sigs)		X
Fort Peck, MT	X	
Williston, ND (2 sigs)		X
Wolf Point, MT (4 sigs)		X
Wolf Point, MT (3 sigs)		X
Wolf Point, MT (3 sigs)		X
Williston, ND (2 sigs)		X
Idaho Falls, ID; Rigby, ID; Pasco, WA (4 sigs)		X
Idaho Falls, ID; Pasco, WA (4 sigs)		X
Idaho Falls, ID (4 sigs)		X
Fairview, MT; Sidney, MT (41 sigs)		X
Fairview, MT; Cartwright, ND (28 sigs)		X
Williston, ND		X
Wolf Point, MT; Vick, MT (4 sigs)		X
Williston, ND (3 sigs)		X
Williston, ND (3 sigs)		X
Williston, ND (2 sigs)		X
Brockton, MT (2 sigs)		X
Williston, ND (2 sigs)		X
Brockton, MT; Poplar, MT; Lambert, MT (9 sigs)		X
Williston, ND (2 sigs)		X
Wolf Point, MT (4 sigs)		X
Logan, MT (2 sigs)		X
Poplar, MT (2 sigs)		X
Nashua, MT (2 sigs)		X
Bainville, MT (5 sigs)		X
Brockton, MT		X
Williston, ND		X
Wolf Point, MT (2 sigs)		X
Williston, ND (2 sigs)		X
Williston, ND (2 sigs)		X
Williston, ND (2 sigs)		X
Williston, ND (5 sigs)		X
Fairview, MT		X
Fairview, MT		X
Circle, MT (4 sigs)		X
Lambert, MT		X
Nashua, MT (4 sigs)		X
Wolf Point, MT (4 sigs)		X
Fairview, MT (2 sigs)		X
Fairview, MT (2 sigs)		X
Wolf Point, MT		X
Wolf Point, MT		X
Brockton, MT (2 sigs)		X

North Dakota State Water Commission

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May 10, 2002

Ms. Rebecca Latka
U.S. Army Corps of Engineers, Omaha District
CENWO-PM-AE
106 South 15th Street
Omaha, NE 68102-1618

Dear Ms. Latka:

The State Water Commission continues to be interested in the Fort Peck Flow Modification Tests and their possible effects on the North Dakota portion of the Fort Peck Reach. We have received and reviewed the *Draft Environmental Assessment, Fort Peck Flow Modification, Mini-Test* and wish to offer the following comments.

Page 10:
The *Bismarck Tribune* is listed twice, but one lists the location as Valley City, North Dakota. If it actually was the Valley City Times Record, why was a notice posted so far from Missouri River? The television station listed as KBOM in Bismarck, North Dakota, should probably be KXMB. 1

Page 36, Map 3: Proposed Critical Habitat – Missouri River Below Fort Peck Dam
Unable to determine those areas marked as "Critical Habitat." Perhaps indicator arrows pointing out the critical habitat would help clarify. 2

Page 42, Water Supply Paragraph:
Notes that a municipal or rural water intake is located at Williston, Montana. It should be listed as Williston, North Dakota. 3

Page 42, Socioeconomic Section:
Notes the population and racial composition of the affected Montana counties, but not for the North Dakota counties. 4.

Page 43, Cultural Resources:
Again discussions are made of eastern Montana sites, but nothing for North Dakota. 5

Page 50 - 51, Changes in Water Temperature:
The fourth paragraph in this section states, "Using the mass balance equation…, calculated June water temperatures would be 59 degrees F at Frazier Rapids." It should be clarified that the Mini-Test will not cause the water temperature to reach the desired 64.4 degrees Fahrenheit. 6

FORT PECK MINI TEST COMMENT RESPONSES

1 Change made; comment noted.

2 Comment noted.

3 Change made.

4. The population and racial composition of Richland County, Montana and McKenzie and Williams counties in North Dakota have been added to the socioeconomic analysis errata sheet, distributed for public review shortly after the Draft EA.

5 Changes made.

6 The mini-test will not likely cause the water temperature to reach 64.4 degrees. However, the purpose of the mini-test is NOT to achieve the 64.4 degree target identified in the Biological Opinion, but rather to gather temperature data during the combined flows, to test data collection methodology, and to test the spillway integrity. Therefore, no change to the EA text is needed.

Page 60, Missouri River Intakes:
Once again the North Dakota reach has been overlooked as is evident by the fact that only a single pump site on the Yellowstone River is shown on the maps in Appendix K. For the Corps' reference I have included a list of water permit holders, obtained from the North Dakota State Water Commission's water permit database, on either the Missouri or Yellowstone River in the area in question. It is imperative to contact each of these water permit holders to have their pump site location(s) logged and mapped for inclusion in the report. 7

Page 61:
The Environmental Assessment assumes annual erosion rates are directly related to annual flow volumes and the flow rate fluctuations will not increase erosion as long as the total annual flow volume is not changed. I disagree with this statement. Fluctuating flows which are repeatedly wetting and drying the bank material cause an increased rate of erosion due to sloughing. The higher flows themselves will also increase the amount of erosion. 8

Although the Environmental Assessment gives a generalized overview of how the Mini-Test will be conducted as well as the testing/monitoring to be done in conjunction with the test, it seems to ignore the North Dakota portion of the Fort Peck Reach. There appears to have been no determination of those factors listed as "Socioeconomic Baseline & Existing Conditions" or "Cultural Resources" for North Dakota as there was for the Montana portion of the reach. It is imperative that the Corps not overlook the North Dakota reach for the Environmental Assessment, the Mini-Test, the Full-Test, or during proposed operational changes. 9

Sincerely,

Dale L. Frink
State Engineer

DF:JP:cg/1392
Enclosure

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

7 Thank you for the information on pump sites and owners. Public notice of the mini test will be given in advance.

8 The wetting and drying of the banks will be no more than that which occurs under existing operations. Further, the peak flows are within the range of flows that could be expected from normal operations. Therefore, it is reasonable to assume that the mini-test will not affect the short or long-term erosion rates.

9 Once we realized that the North Dakota information was not included, we mailed an errata sheet with this information to those on the mailing list (letter dated May 8, 2002) and extended the comment period until August 9 in order to allow for comment on this additional information. The contents of the errata sheet have been added into the text of the Final EA.

COUNTY OF RICHLAND

Office Of
COUNTY COMMISSIONERS
201 West Main -Sidney, Montana 59270
406-433-1706 FAX 406-433-3731
Chairman-Mark Rehbein Vice-Chairman-Henry T. Johnson Member-Don Steppler

Rebecca J. Latka
U.S. Army Corps of Engineers
Atten: CENWO-PM-AE
106 South 15th ST.
Omaha, NE 68102-1618

To whom it may concern;

The Richland County Commissioners would like to express our concern and opposition to the so-called "mini test" scheduled for June 2003. This discharge of water could be very detrimental to many of the Farmers, Ranchers and Taxpayers of Richland County located along or near the Missouri River below Fort Peck Dam. The loss of private and public land to erosion, accompanied by flooding could be very costly to Richland County and its taxpayers. Also the cost to the public in general would be very detrimental to our economy. 10

Thank-you for listening to our concerns.

Respectfully;
Richland County Commissioners

Mark Rehbein, Chairman

Henry Johnson

Don Steppler

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

10 The long-term erosion rate will not be affected by the mini-test and water discharge elevations will not be greater than the elevations the river reach has experienced within the last 10 years. Accordingly there will be no significant loss of land, no flooding due to the test, no appreciable impact on the Richland County tax base, and no impact to the area economy.

DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

JUDY H. MARTZ, GOVERNOR
1625 ELEVENTH AVENUE
STATE OF MONTANA
DIRECTOR'S OFFICE (406) 444-2074
TELEFAX NUMBER (406) 444-2684
PO BOX 201601
HELENA, MONTANA 59620-1601

July 30, 2002

Ms. Rebecca Latka
U.S. Army Corps of Engineers, Omaha District
CENWO-PM-AE/Rebecca Latka
106 South 15th Street
Omaha, NE 68102-1618

Dear Ms. Latka:

On behalf of the Montana Department of Natural Resources and Conservation, I am pleased to provide our comments regarding the Draft Environmental Assessment for the proposed Fort Peck Flow Modification Mini-Test. We are submitting some general comments that reflect our concerns about the Mini-Test; these are similar to those regarding the Full Test that were included in our comments on the Revised Draft EIS for the Master Manual. We are also providing some specific observations on items contained in the Draft E.A. document.

Montana has supported the idea of testing a spring rise below Fort Peck subject to certain conditions. Public safety must be given first priority in implementing the Mini- and Full Tests and any modified flow regimes that may follow. We trust that the Corps will take adequate measures to warn the public in advance of the increase in releases. These warnings should be well in advance of the releases and should take the form of announcements through local media, meetings with organizations and governmental agencies, as well as contacts with irrigators, recreators and other river users before and during the Mini-Test. 11

Prior to conducting the Mini-Test, it will be essential to establish "stop criteria" that reduce the likelihood that higher releases from Fort Peck will endanger people and property. The stop criteria listed in the Draft E.A. will need elaboration and should include consideration of high runoff events on tributaries below Fort Peck. 12

Consideration must be given to minimizing damage to property and avoiding exacerbating erosion problems along the river--particularly in the vicinity of the spillway. We recommend that the Corps' monitoring efforts include impacts to the channel and banks. With funding from the Corps, the Roosevelt Conservation District conducted an inventory of pumps and intakes along the river during the summer of 2001. This inventory will be useful as baseline information in assessing the impacts of the flow modification exercises. We expect that the Corps will include this information in any such assessment. 13

The Draft E.A estimates the impact to the lake level to be a drop of 1.2 feet and characterizes that as a negligible impact to lake interests. If the Mini-Test is being implemented in conjunction with the proposed intrasystem unbalancing scheme, then the lake level would be expected to drop more than 1.2 feet. If the unbalancing scheme is not planned during the same year as the 14

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

11 The Corps will take adequate measures to inform all interested parties in advance of flow test releases. The procedure and process for the notification will be included in the Fort Peck Flow Test plan

12 At the time of the flow test release, the "stop protocol" will be reviewed by the Corps to ensure all appropriate elaborations are included. The potential for high runoff events on tributaries below Fort Peck was considered and is addressed in the "stop protocol."

13 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives, and therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the Current Water Control Plan. The report prepared for the Corps of Engineers by the Roosevelt County Conservation District (RCCD) provided a great deal of information and provided an estimate of the number of pumps that may be impacted by a high discharge. The report did not however, provide any details into the extent or nature of the impacts, nor was it intended to. The data collected by the RCCD is part of the mini-test plan and will be used to design data collection and assessment efforts for both the mini-test and full test.

14 The forecasted end of June Fort Peck Lake elevation is 1.2 feet lower as a result of the higher mini-test releases than would occur without a mini-test. June runoff into Fort Peck is normally the highest runoff month of the year, and the lake would be expected to rise during the month with or without the mini-test. Total drawdown is dependent on an array of conditions.

Mini-Test, then we urge the Corps to store the volume of water associated with the higher releases in advance of the Mini-Test. This will preserve lake levels at Fort Peck as well as head lost for hydropower production.

Some specific comments pertaining to the document follow:

--page 2. "Pregus" County should read "Fergus" County.

--page 19, footnote 12. NEPA refers to National Environmental Policy Act. 15

--page 41, Table 5. Does this table refer to the 1994 survey of water intakes?

--page 42. The intake for the Fort Peck Rural County Water District may be in the vicinity of the dam.

--page 56. With regard to fishing below the dam, the trout fishery in the river between the dam and the spillway is likely to be affected by reduced flows. 16

--page 57, Table 8. Where did the data in the price column come from? Do these prices reflect springtime market conditions when adequate water would be in the system to allow for the Mini-Test? 17

--page 59. How does the Corps define a "region"? 18

While we recognize that the modified flow releases proposed in the Mini-Test are relatively modest in magnitude and within the range of the historical record, we consider the Mini-Test a precedent for subsequent flow modification exercises that are likely to include releases of significantly greater volume. Accordingly, we strongly urge the Corps to work with local interests to ensure and that the goals and procedures for the flow modifications are well understood and that a consistent pattern is established for conducting subsequent flow modifications. 19

Sincerely,

BUD CLINCH
Director

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

15 Changes made.

16 During the mini test, a minimum of 4,000 cfs will be released from the powerplant to ensure the trout fishery is unaffected.

17 The market prices of energy shown in Table 8 were obtained from the Western Area Power Administration's Watertown, South Dakota Operations Office. They are futures prices from some of the major energy hubs in the Midwest.

18 In this instance, the region of influence is described in the socioeconomic section. Initially it included McCone, Roosevelt, and Valley counties in Montana. It was expanded to also include Richland County in Montana and McKenzie and Williams counties in North Dakota.

19 The Corps has been working, and will continue to work, with local interests to ensure the goals and procedures for the flow tests are well understood. Any subsequent flow tests will have the same high level of coordination that the Corps has shown to date.

McCone County

Circle, Montana

– 59215 –

Becky L

August 6, 2002

U.S. Army Corps of Engineers, Omaha District
CENWO-PM-AE/Rebecca Latka
106 South 15th Street
Omaha, NE 68102-1618

TO WHOM IT MAY CONCERN:

For the record, the following comments are those of the McCone County, Montana Board of County Commissioners.

As a point of order, McCone County's northern border consists of a portion of the Missouri River segment discussed in the Fort Peck Flow Modification Mini-Test Draft Environmental Assessment. That said, we also note for the record that neither the McCone County Conservation District nor the county commissioners were aware of the public scoping meetings, the draft environmental assessment, or the comment period until contacted by a concerned taxpayer from another county in May, one week from the original deadline for comment! Notice was not published in our local newspaper, nor were press releases sent to the radio and television stations serving the majority of McCone County from Glendive and Miles City. 20

We question the need for the mini-test and/or the full test. We also question the scientific basis as discussed and illustrated by the USFWS, given the recent discoveries of examples of their "flawed science" in listing the lynx and as they have promoted in Oregon and elsewhere. We firmly believe that independent, outside scientific review should be required to be conducted and included in this environmental assessment, given the current reputation of the USFWS "expertise". 21

As far as we can determine, this assessment does not contemplate damages to our agricultural taxpayers. There is no plan for compensation, 22

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

20 The Miles City Star is on our press release list, however the printing of press releases is a voluntary action based on anticipated local interest. Based on your input, we have added additional media outlets for Miles City to our press release list.

21 The Corps will not respond on behalf of the U.S. Fish and Wildlife Service. The Corps agrees that management decisions should be based on the best available science. Both agencies are in Endangered Species Act consultation on the Corps' operation of the Missouri River projects.

22 The EA deals solely with the mini-test and issues raised regarding compensation for potential damages due to a full test are not considered. The long-term erosion rate will not be affected by the mini test and water discharge elevations will not be greater than the elevations the river reach has experienced in the last 10 years. Currently the Missouri River reach below Fort Peck Dam experience flows of this magnitude or greater on the average of every two to three years. Accordingly, there will be no significant impacts to municipal or irrigation water intakes beyond those already periodically experienced. See also responses to comments 48 and 58.

rehabilitation, or mitigation for losses sustained to their operations due to the mini or full tests. There is neither study of nor plan for protection of pump sites or water intakes along the river for landowners or community municipal water projects and the possible costs incurred due to this proposed action.

McCone County enjoys a relatively mild infestation of noxious weeds except along the Missouri River. A year of extremely high water in the dam and the current drought and actions by the Corps lowering the dam have exacerbated the spread of noxious weeds on the extended shoreline. The draft environmental assessment doesn't address the spread of noxious weeds on the riverbanks or any control measures preventing the spread onto private land along the river due to the testing sequence. 23

McCone County's residents are dependent on a rural electric cooperative for electric power. The REC's ability to deliver affordable rates of electricity to this area is dependent on the blending of the low cost hydropower produced at Fort Peck with other higher cost electricity. This environmental assessment does not cover compensation for the higher costs of power demanded by our RECs due to flooding from the spillway or lowering of the Missouri River. 24

The impacts to recreation on Fort Peck Lake are of extreme concern to us. With the advent of privatization of the cabin sites, the price asked for and received for cabins has quadrupled in the last two years. Fort Peck Lake is being discovered, bringing out-of-state recreaters and fishermen to the lake in an ever-increasing number. All of the economic progress because the dam is there, and which is desperately needed by this area, could become a dream of the past if the lake levels become subject to a primary obligation to run these tests. Certainly the tests have, in effect, already taken place many times due to the proceeding years of the operation of the dam, focused on keeping the barge industry on the lower Missouri in business. 25

On behalf of the McCone County Commissioners,

Connie Eissinger, Chairman

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

23 The timeframe associated with the mini test is considerably shorter than that experienced during drought and other natural low-flow periods. The implementation of the mini test is not possible during the current drought, since the water needs to be at an elevation 5 feet above the spillway. During the test, the water will be lowered an estimated 1.2 feet for a period of approximately 1 month. Along the riverbanks, the water level will be increased by up to 1.5 feet for less than a month. Both the lake elevation changes and the river elevation changes are well within "normal" fluctuations along these water bodies; therefore, no change in noxious weed coverage is anticipated.

24 The diversion of flow through the Fort Peck spillway for the mini test, thereby making the water unavailable to the turbines for hydropower production, would reduce project annual hydropower output by about one percent. During periods of normal demand the Western Area Power Authority (WAPA), which is the governmental entity responsible for marketing the power, can readily make up this loss from other sources on the power grid. To the extent this energy could be more costly, there would be a small impact to WAPA customers, including rural power cooperatives. Because the test would be discontinued in the event of an energy shortage, no significant impact is foreseen to area rural electric cooperatives.

25 The mini test would lower the lake level by approximately 1.2 feet. This is well within normal limits of operation and should not impact cabin prices or recreational activity at the lake. Regarding past operation, high flows in and of themselves are not sufficient to evaluate the effects of a controlled spillway discharge on downstream water temperatures. The mini test would include the collection of primary data on a variety of changes resulting from the controlled discharge through the spillway.

Cedar.Salt Cedar is a highly invasive and water hogging shrub. Salt Cedar not only displaces native plants in floodplains and riparian areas, but it also displaces wildlife, impairs stream flows and contributes to wild fires. 30

4. **Recreation** – Lowering Fort Peck Dam would have great economical impact on the local businesses in our areas. Our businesses look forward to the recreational income from fishermen and boaters. 31

5. **Threatened and Endangered Species** – the Piping Plover and the Pallid Sturgeon. The Missouri River has never been a place where the Pallid Sturgeon has spawned. There has not been any Pallid Sturgeon in Fort Peck since the 30's. They are found mostly in the Yellowstone River. As for the Piping Plover, there needs to be more thorough studies done on the subject. There have been reports from area farmers of several Piping Plover in their haystacks. 32

Another great concern is "how can you take only one year's worth of data on the river, combine it with a theory and run a mini-test and a full-test. There is a need for a thorough assessment to enable one to weigh all the factors involved—the economic losses in both agricultural production and agricultural operations that directly affect all of the agricultural and local businesses; loss of pump sites to landowners; loss of tax dollars to our county; and the millions of dollars lost from electricity each time the river is flooded. What about loss of wildlife and livestock? 33

We strongly feel that your proposed management plan puts all involved at great risk, as it is based primarily on theory.

Sincerely,

Jeanne Rae Kirkegard

Jeanne Rae Kirkegard
District Administrator
For the Board of Supervisors

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

30 Since we do not anticipate an increased annual erosion rate associated with the mini test, we also do not anticipate that noxious weeds will increase as a result of the mini test.

31 A temporary reduction in the level of Fort Peck Lake of 1.2 feet as a result of the mini test is well within normal lake level fluctuations and would not have a significant adverse impact on lake recreation. Accordingly, no adverse impacts to area businesses or to the economy are likely.

32 The Missouri River downstream from Fort Peck Dam is considered a Recovery Priority Area for the pallid sturgeon, and supports a nominal population of sturgeon. As part of the pre-test monitoring for the mini-test, pallid sturgeon have been fitted with sonic tags to allow us to follow their movement within the Missouri River and the Yellowstone River. Portions of the Missouri River below Fort Peck Dam have been identified as Critical Habitat for the piping plover. Field surveys of the river have documented both the least tern and the piping plover on islands within the Missouri River below Fort Peck Dam. Annual monitoring is being done for pallid sturgeon, least tern, and piping plover within the Missouri River, including the Missouri River below Fort Peck Dam.

33 The purpose of the mini test is to obtain the necessary data to better understand and evaluate the need for a larger test. Prior to additional flow testing another environmental analysis, identifying and evaluating potential impacts would be conducted. This EA deals solely with the mini test. The long-term erosion rate would not be affected by the mini test. Currently the Missouri River reach below Fort Peck Dam experiences flows of the magnitude proposed for the mini test or greater on the average of every 2 to 3 years. Accordingly, the impacts to agricultural production, agricultural operations, pump sites, local tax revenue, irrigation intakes, livestock, wildlife, and county business activity would be similar to that which would be experienced during one of these frequent high flow years. Regarding lost electrical production see comment response number 24.

STATE OF MISSOURI
Bob Holden, Governor • Stephen M. Mahfood, Director
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF THE DIRECTOR
P.O. Box 176 Jefferson City, MO 65102-0176

May 9, 2002

Brigadier General David A. Fastabend
Commander, Northwestern Division
U.S. Army Corps of Engineers
P. O. Box 2870
Portland, OR 97208-2870

Colonel Kurt F. Ubbelohde
District Engineer, Omaha District
U.S. Army Corps of Engineers
106 South 15th Street
Omaha, NE 68102-4978

U.S. Army Corps of Engineers, Omaha District
Becky Latka, CENWO-PM-AE
106 South 15th Street
Omaha, NE 68102-1618

Dear General Fastabend, Lieutenant Colonel Ubbelohde and Ms. Latka:

Thank-you for providing the Missouri Department of Natural Resources with the opportunity to comment on the Draft Environmental Assessment, Fort Peck Flow Modification Mini-Test, April 2002 (Draft EA). Please consider the following comments.

According to the document, the Draft EA covers only the mini test. Lessons learned from the mini test, as well as the full test would likely be applied to future reservoir operational changes (presumably through the revised Master Manual). According to the Corps' schedule, the Final Environmental Impact Statement on the Master Manual will be released this summer, prior to conducting the mini test. However, until the mini and full tests are complete it will be difficult for the Corps to adequately present specific details concerning the final operational design or the potential impacts. This appears to create a timing issue between the mini test, the full test, the public input into the review and update of the Master Manual. The Corps should afford the public ample opportunity to comment on any recommended changes in future operations of the Reservoir System. 34.

The Draft EA indicates that the drawdown of Ft. Peck Reservoir would have beneficial impacts on tern and plover nesting around the reservoir. It also indicates that the Reservoir shoreline is proposed critical habitat for the plover, and that both terns and plovers nest in the reach below Ft. 35

RECYCLED PAPER

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

34. Appropriate documentation and coordination with the public will occur for all aspects of any release changes from Fort Peck Dam. At this time, the mini test is the first change to occur, and this Environmental Assessment (EA) has been prepared accordingly. A second EA is anticipated for the full test, which could occur as early as the year following the mini test.

35 The Corps and the U.S. Fish and Wildlife Service are in Endangered Species Act consultation. Flow tests from Fort Peck are being considered in that consultation.

Peck. The Draft EA only presents a brief discussion of impacts on terns and plovers, which included possible flooding of nests, moving eggs and wetted-sand preventing re-nesting. This brief discussion may be adequate for a mini-test; however, a more comprehensive evaluation of impacts to terns and plovers needs to be presented before a full test or operational changes are implemented.

The Corps has included a study of the food habits of piscivorous fish. According to the Draft EA, local landowners in Montana observed sturgeon in the diet of piscivorous fish. This was after observing "hundreds" of small sturgeon in some tributaries to the Missouri River. If sturgeon are found in the stomachs of predator fish, the study will confirm what the locals have observed. However, if sturgeon are not found, the study is inadequate to confidently dispute what the locals have observed. It does not appear that the study will include sampling for the presence of "small sturgeon". This sampling is needed to confirm that small sturgeon are available as a food source. The Draft EA notes that during 2001 and 2002 a minimum of 30 individuals from each fish species (including walleye, sauger, northern pike, etc.) will be collected at two locations during each month, June, July and August, and stomach contents determined. This is a very small sample size. Since pallid sturgeon recovery efforts might be negated by predator fish, study results on the impact of predator fish must be conclusive. Questions such as sample size, presence of young sturgeon, and other related issues such as competition should be evaluated. 36

We understand that the full test and implementation of operational changes are beyond the scope of the Draft EA; however, the Corps needs to clearly articulate to the public the relationship between the mini test, the full test, and future operational changes. The Corps' effort to resolve local concerns about the feeding habits of predator fish with regards to them eating small sturgeon could be critical to future recovery efforts. Two-way communication and building trust with local landowners is extremely important. We hope these comments are useful. Please feel free to contact Mike Wells, Chief of Water Resources at 573-751-2867 if you have any questions regarding the Department's comments. Thank you again for this opportunity to comment. 37

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Stephen Mahfood
Director

SM:jm

c: Bill Bryan, Deputy Chief Counsel, Missouri Attorney General's Office
David Conrad, National Wildlife Federation
Ken Midkiff, Clean Water Campaign, Sierra Club
Dan Beard, National Audubon Society

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

36 See Appendix M Data Results from 2001 – 2002.

37 The Corps is in consultation with the U.S. Fish and Wildlife Service regarding releases from Fort Peck Dam. All flow tests are part of an adaptive management strategy, which is currently being implemented.

Montana Fish, Wildlife & Parks

P.O. Box 200701
Helena, MT 59620
406-444-2449

May 2, 2002

U.S. Army Corps of Engineers, Omaha District
CENWO-PM-AE/Rebecca Latka
106 South 15th Street
Omaha, NE 68102-1618

Dear Rebecca:

Thank you for the opportunity to comment on the draft EA titled *Fort Peck Flow Modification Mini-Test*. Montana Fish, Wildlife and Parks has reviewed the EA and supports the proposal. Because of the dire condition that the remaining pallid sturgeon populations are in, it is critical that this mini-test be completed as soon as there is available water, in order to proceed with the full test. We concur with your conclusion that this mini-test is within the range normally experienced or exceeded every two to three years, and therefore, impacts should be minimal. We strongly support the monitoring associated with the test, and encourage the Corps. to continue those monitoring efforts even if the mini-test has to be postponed due to low water since those data will provide valuable baseline information. Montana Fish, Wildlife and Parks has been assisting with collection of baseline fisheries and water temperature data, and will continue to do so, as well. 38

We appreciate that the mini-test cannot occur until reservoir levels reach 2230 feet msl, and encourage the Corps to conduct the mini-test according to the proposal once the reservoir reaches that level.

Please feel free to contact me if you require additional information.

Sincerely,

Chris Hunter
Fisheries Division Administrator

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

38 Comments noted. Due to the continuing drought, it may be a while before elevation 2230 is attained.

GREENBERG

ATTORNEYS AT LAW

TRAURIG

Robert Vincze
303-572-6552

May 10, 2002

VIA CERTIFIED MAIL
RETURN RECEIPT REQUESTED
AND U.S. MAIL

U.S. Army Corps of Engineers, Omaha District
CENWO-PM-AE/Rebecca Latka
106 South 15th Street
Omaha, NE 68102-1618

Re: Draft Environmental Assessment (EA) for the Fort Peck Flow Modification Mini-Test, Fort Peck, Montana

Dear Ms. Latka:

The MO-ARK Association offers the following comments on the above-referenced EA. The MO-ARK Association respectively requests the U.S. Army Corps of Engineers further evaluate the effects of site-feeding predator fish such as the Walleye, Smallmouth Bass and Northern Pike on the Pallid Sturgeon fry and year-of-young. In accordance with the Pallid Sturgeon Recovery Plan issued by the U.S. Fish and Wildlife Serviced dated November 7, 1993, predation by such site-feeding predator fish is one of the reasons for the decline of the Pallid Sturgeon (at p. 12). In fact, Section 2.62 of the recovery outline in the Recovery Plan calls for study of the "degree of competition and predation by introduced fishes." Through legislation and appropriations, the Federal Government has authorized hundreds of millions of dollars for habitat restoration in major part to recover the Pallid Sturgeon. These expenditures must be weighed against the continued value of stocking non-native fish, when such fish compete with and prey upon the Pallid Sturgeon. "[T]he decline of the pallid sturgeon has probably occurred in . . . a large number of other, more recent impacts, including continuing harvest, contaminants, hybridization, decline of prey, competitors, and others." (Tyus Report, "Reasons for Decline", ¶ 4, p. 9). 39

Respectfully submitted,

Robert Vincze /bl

Robert J. Vincze
Attorney for the MO-ARK Association and
the Missouri Levee & Drainage District
Association

RV/bt

39 We acknowledge that there are many other factors related to pallid sturgeon decline and recovery than the flows from Fort Peck Dam. This EA relies primarily on existing information, supplemented with specific studies to address scooping concerns where information from literature was not readily available. See Appendix M for monitoring data from 2001-2002.

B • O • M • M • M
JOINT WATER RESOURCE BOARD

Dedicated to Protect the Banks and Riparian Land along the Missouri River

June 19, 2002

Col Kurt S. Ubbelohde
Corps of Engineers
106 South 15th Street
Omaha, NE 68102

Dear Col. Ubbelohde:

I am addressing this very important complaint to you and request that you refer it to whomever in your "family" you consider most appropriate to study and reply.

I am very troubled by two recent statements by the COE in the RDEIS of the Missouri River Master Manual dated August 2001 and the Environmental Assessment of the Ft. Peck Flow Modification dated April 2002. The pages containing these statements are attached to this letter.

The statements in effect say that the amount of bank erosion on the Missouri River is a function of the total volume of water released and not the manner in which it is released. This assertion, if true, would mean that the Corps of Engineers could release water at Ft. Peck, Garrison and other dams in any manner they wish and not affect the total amount of downstream bank erosion. 40

I have polled ten civil engineers (PE's) concerning your assertion and they either entirely disagree or at least wish to examine the COE studies which led to this conclusion.

P.O. Box 2599 • Bismarck, ND 58502 • 701-223-4615 • Fax: 701-223-4645
BURLEIGH • OLIVER • MCLEAN • MERCER • MORTON COUNTY WATER RESOURCE DISTRICTS

40 See attached Jul 15, 2002 letter to B.O.M.M.M. Board, which addresses the comments within this letter.

We believe the erosion rate is an exponential function (the exact exponent will vary) and not a direct function of the rate of flows. For example, doubling the rate of flow could cause four times the bank erosion and will greatly increase the total bank erosion for a given amount of water. Those of us in the water business know of the downstream erosion of smaller streams that have been eliminated by installing dams with appropriate outlets. The same amount of water flowed with little or no erosion! In larger rivers, such as the Missouri, increasing rate of flows increases the velocity. Any engineer knows that the energy is an expression of the square of the velocity! The increased velocity also increases the centrifugal force (also a square function) of the water against the curves of the river channel. Also when operated at higher levels the river banks are much more vulnerable to wave erosion caused by wind and power boats.

All the above contradicts the COE statements enclosed. I wonder if the COE have published these statements as a self-serving excuse to permit the experimental high flows downstream from Ft. Peck which will cause higher bank erosion than otherwise would have been, and the unequal levels proposed for the Oahe and Garrison dams. This would result in higher flows and greatly increased bank erosion in the Garrison to Oahe reach (and a larger increase in the Oahe delta) then otherwise would have been. Also there would be lower flows (than otherwise would have been) in other years, which is also highly undesirable to all the river users of this reach.

I, too, am very interested in learning what kind of research led the COE to conclude that the release rates have no relation to total bank erosion. This conclusion certainly would not stand up in a hydraulics laboratory.

The BOMMM Joint Board was organized in 1983 for the purpose of preventing the loss of more high riparian land by the bank erosion of the Missouri River. We advocate the rip-rap of only those reaches needed. To date 30% of the 160 miles of bank have been stabilized. A 1997 North Dakota Water Commission study concluded that only 10% more needed protection, leaving 60% or 96 miles untouched. A FEMA restudy to be

District Engineer

Mr. Andy Mork, Chairman
BOMM Joint Water Resource Board
P.O. Box 2599
Bismarck, North Dakota 58502

Dear Mr. Mork:

Thank you for bringing your concerns on the Fort Peck Mini-Test Environmental Assessment (EA) to our attention. We hope the explanations below, provided by our engineering staff, will help explain how we arrived at the conclusions with regard to erosion during the higher-flow events. Any comments regarding the Master Water Control Manual Environmental Impact Statement should be directed to our Northwestern Division office at 12565 West Center Road, Omaha, Nebraska 68144.

Higher flows are proportionally more erosive than lower flows, and the Corps has never claimed differently. However, when analyzing the alternatives presented in the EA for the Fort Peck mini-test, the Corps considered the entire flow-duration curve and how it would be changed by the various alternatives, not a single discharge. This is where the volume of water is considered. If a particular flow scenarios calls for an increase in the number of high flow days, then there must be a corresponding increase in the number of low flow days, or a decrease number of median flow days, etc. because there is a set volume of water.

On a river such as the Missouri, the alluvial processes (erosion, deposition, etc.) are controlled by the dominant discharge or dominate discharge class. This dominant discharge class is the discharge range that moves the majority of the bed material sediment through the reach. To change the discharge class would require a significant change in the shape of the flow-duration curve for the river reach. Examination of the flow-duration curves for the various alternatives indicates that the distribution of flows is very similar and that the dominant discharge class remains the same. Therefore, there is no reason to expect a change in the long-term erosion/deposition patterns.

In any given year the erosion/deposition will be more or less than the long-term average depending on the run-off for that year, and the system management objectives. However, over the long-term, high flow years and low flow years (natural or man-made) will be balanced out.

Page Three

released in late 2002 of the south Bismarck reach indicates a one foot rise in the river bottom in the last 10 years. This adds urgency to the necessity of completing upstream bank protection and it another reason BOMMM Joint Board is so concerned with river bank losses.

I am interested in your response to this complaint. A meeting with your engineers would be desirable.

Sincerely,

Andy Mork

Andy Mork, Chairman
1-701-663-3840

cc: BOMMM Board
Dale Frink, State Engineer
Todd Sando, Assistant State Engineer
Ron Sando, Morton Cnty WRB Engineer
Mike Dwyer
Bonne Whitmere

Regarding your request for a meeting, the Corps will be in Bismarck on July 31, 2002 to discuss bank stabilization issues with the Missouri River Vision Group, of which the BOMMM Joint Water Resource Board is a member.

If you have additional comments, please contact me; or Mr. William Miller, the project manager, at (402) 221-4022; or Ms. Becky Latka, our National Environmental Policy Act specialist at (402) 221-4602.

Sincerely,

SIGNED
COL KURT F. UBBELOHDE
Kurt F. Ubbelohde
Colonel, Corps of Engineers
District Engineer

CF:
CENWD-CM-W-M (Hargrave/Farhat)
CENWO-ED-H (Remus)
CENWO-PM-C (Timp)
CENWO-PM-AE (Latka)

"FORT PECK STOW"

U.S. Army Corps of Engineers
ATT. Rebecca J. Latka

I believe Two Things are Needed before The mini Test is started.

1. A Full Environmental Impact Study Needs To be completed befor Test. We need To get The feel and concerns of All involved. 41

2. A full Economic Impact Studies. To See what is lost or what is gained. As I read Through The Draft: There are To many issues not addressed And Need To be addressed befor The Test start. 42

2002 JUL 22 AM

- [signature]
Eldon Ekren
Cartwright North Dakota
P.O. Box 29 - 58838

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

41 One purpose of an EA is to determine if an EIS is needed. Based on the predicted environmental impacts in the EA, and the similarity between the mini test and natural flow variations, the impacts associated with the mini test are not considered "significant" for NEPA purposes. Therefore an EIS is not needed.

42 The impacted reach of river is subjected to periodic flows of this magnitude every two to three years. No unusual impacts to agricultural production, recreation, or damages to land are anticipated. The production of electrical energy will be affected due to spilling water through the spillway, but impacts to the cost of electricity in the area will be minor. Because these items are not significantly impacted, no secondary impacts to the economy are considered, and a detailed economic impact study is not warranted.

Tom Ruffatto
HC 80 Box 440
Brockton, MT 59213

Bucky L.

Ms Gatka

After reading the Draft Environmental Assessment for the Fort Peck Flow modification mini test, I feel that my property rights are not ~~being~~ being protected. I also feel that 43
the Mini Test, even though it is for a short period of time, will have a long lasting effect on the banks of the river. This is a project that may change the action of the river forever. 44

Thank You

Tom Ruffatto

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

43 Through the implementation of the mini test at Fort Peck, the Corps will not divest any rights of private property owners. Those holding rights who believe that they are negatively impacted will have the same rights to seek compensation for alleged damages as they currently hold with regards to the operation of Fort Peck Dam within the Missouri River Reservoir System under the existing Missouri River Master Water Control Manual. See also responses to comments 48 and 58.

44 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives; therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the Current Water Control Plan.

Post-it® Fax Note 7671	Date 8/9/02 # of pages ▸ 2
To Rebecca J. LATKA	From SKIP Erickson
Co./Dept.	Co.
Phone #	Phone #
Fax # 402-221-4886	Fax # 406-228-4823

August 9, 2002

Skip Erickson
P.O. Box 351
Glasgow, Mt 59230

Rebecca J. Latka
U.S. Army Corp of Engineers
Atten: CENWO-PM-AE
106 south 15th St.
Omaha, Nebraska 68102-1618

Re: "mini test"

Dear Ms Latka:

The reference to "mini test" would infer that there might be a "maxi-test, or at least one with greater possibility for potential economic loss to downstream property owners, primarily irrigators such as myself. 45

I am one of three owners of an irrigated farm a few miles downstream from the spillway at Fort Peck Reservoir. We have two irrigation pump sites, one of which we had to recently move at substantial expense because it was washed away with normal water discharges. The other pump site requires work every spring in order to make it useable.

I'm sympathetic with the plight of the pallid sturgeon, but as stated in the newspapers, I'm not sure the mini-test is **required** in order to comply with the Endangered Species Act; rather, it appears to be a grand experiment to test someone's theory that increased water flows in the spring will enhance the spawning of the pallid sturgeon. 46

The increased flows will certainly affect irrigators, both in terms of additional dirt-work to maintain or protect the pump sites, field erosion, and in lost revenues due to the inability to irrigate the crops when they need it most. At this juncture, it appears the "cost" of this experiment will be borne by the irrigators with no mention of mitigation for assuming this burden. 47 But the experiment is going to happen regardless of negative impact and we apparently have no choice in the matter. My question is, if I suffer economic loss, will I be compensated? In other circumstances when the government participates in a "taking" of one's property or property rights, it reimburses the property owner. Has the government considered mitigation for damages caused by this test? What if it proves to be successful so as to be conducted every year – does the property owner 48

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

45 As described in the Draft EA, the mini test would likely be followed by a full test. So yes, there is the potential for larger tests in the future. See response to comment 35.

46 See response to comment 35. To some extent, the mini test (and the full test) is an experiment to test the hypothesis that pallid sturgeon need higher spring flows and warmer river temperatures to successfully spawn. Through the "adaptive management" process, information collected through monitoring during the tests can be used to determine the effectiveness of the test.

47 The impacted reach of river is subjected to periodic flows of this magnitude every 2 to 3 years. No unusual impacts to agricultural production, recreation, or damages to land are anticipated. Accordingly, no unusual operating costs would be imposed on irrigators along the affected reach.

48 If the mini test is implemented, it is not anticipated that the release of up to 15,000 cubic feet per second (cfs) of water from Fort Peck Dam, including up to 11,000 cfs down the spillway, for approximately 4 weeks, would result in the categorical destruction of all economic beneficial use of any property, in violation of the prohibition of the Fifth Amendment to the United States Constitution against Governmental taking without just compensation. However, the Corps will examine any allegations or claims from property owners for compensation allegedly owed due to the mini-test.

have to suffer the loss indefinitely? It appears to me that the burden of protecting endangered species should be the obligation of every American, not just a select few who happen to live in the area. The fact that I own a farm on the Missouri River shouldn't imply that I've participated in the demise of certain species, nor does it mean that I need to share an inordinate share of the cost of saving those same species. I'm only asking for a little fairness and reasonable consideration. 49

Another thought is that this experiment certainly might delay the long over-due revision of the Master Manual. That delay, in of itself, has the possibility of negatively impacting many species that aren't yet endangered, and at a potentially huge cost. Money could be better spent by raising pallid sturgeon in the new fish hatchery at Fort Peck. We know that the planting process does work and could ultimately be the logical solution to saving the pallid sturgeon without causing controversy and grief to downstream landowners. 50

Respectfully submitted,

Skip Erickson

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

49 See response to comment 35.

50 The stocking of hatchery-raised pallid sturgeon is also a part of the Biological Opinion and a component of pallid sturgeon recovery. The current plan is to stock pallid sturgeon "in addition to" tests, not "instead of" tests. Implementation of the mini test is unrelated to the Master Manual schedule.

Virgil and Marlene Toavs
P O Box 2
Fort Peck, MT 59201

August 12, 2001

Rebecca J Latka
U S Army Corps of Engineers
Attentions CENWO-PM-AE,
106 South 15 th ST
Omaha, NE 68102-1618
Fax 402-221-4886

Dear Corp:

Please consider this a protest regarding the proposed discharge of additional water down the Missouri River below the dam.

We are one of many irrigators who need stable water levels to prevent bank washing and destruction of bank stability. Fluctuating water is not in the interest of irrigators but is also degrading to the river banks making the water muddy and unnatural causing further erosion and contamination of the water. 51

Please keep water levels steady to keep river banks stable.

Sincerely,

Virgil and Marlene Toavs

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

51. Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives; therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the Current Water Control Plan.

8-05-02

Rebecca J. Latka
U.S. Army Corps of Engineers
Att: ~~CENWO~~-P.M. A.E.
106 S. 15th St.
Omaha, N.E. 68102-1618

To take more water out of an already low Ft. Peck Lake just for a test is assinine. 52

yours truly
Don Ligon
P.O. Box 231
Lambert, Mt. 59243

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

52 A minimum elevation of 2230 feet in Lake Peck is needed to run the test; therefore, the test will not occur during the current drought.

8-5-02

U.S. Army Corps of Engineers
CENWD-PM-AE/REBECCA LATKA
1?0 SOUTH 15TH STREET
OMAHA, NE 68102

Becky L

Dear Sirs & Ladys
I have been opposed to the mini tests from the
start. It could maybe wash my pump site out, The
orps have proposed some Spur Dykes to keep pump 53
site from washing out.
I was under the impression that the Fort
Peck Damm was made for flood control, but this
mini Test is the exact opposit. They are going
to create a flood, it could wash out the River 54
banks and pump sites. The higher water
evels in the river could cause the river banks
- slough more rapidly and it will be harder to
maintain the pump sites, and they will need
more maintenence.
The money lost from running the water
hrough the Spillway is a big factor, This could 55
ause the price of Electricity to rise even more.
I remember when President Roosevelt came
y our place in a special train on the tracks
our farm. He was going to Fort Peck to talk
bout the dam. Dad said we must go up and hear
im talk. He spoke from the upper end of the long
rass lawn in Fort Peck just west of the A.D.
uilding and accross the street north of the
rt Peck Hotel
He said we have achieved succes, there will 56
no more floods from the Missouri River. It makes
e wonder what he would say, if he were alive
oday and hear that we are going to create a
pring rise or maybe a flood from the dam he had
made while he was president.
I must ask for the No Action Alternative

Sincerely,
Edgar O. Garwood
Box 212

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

53 Comment noted.

54 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives; therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the Current Water Control Plan. The flows in the mini test are no higher than under normal operations and are not expected to cause flooding. Downstream inflow will be monitored and the test suspended if downstream inflows threaten flooding.

The level of flow, projected for the mini test is currently experienced on the average of every 2 to 3 years; therefore, no additional operation and maintenance cost for irrigation pumps, beyond those already frequently experienced are foreseen.

55 Western Area Power Administration (WAPA) would have a projected $2.3 million expense as a result of the mini test. This expense would not have a large impact on rates.

56 Comment noted.

Please Be Specific -

Shirley J Hardy
Rt Box 740
Fairview Mt. 59221

? Comments on flooding Fort Peck Test

QUESTIONS CONSERNING FLOODING AND DRY UP THE MISSOURI RIVER BELOW FORT PECK DAM.

- How many cubic feet per second will be allowed down the Missouri River after the flood so we can irrigate? — 57
- How much money is dedicated to the riverbank erosion of private property along the river? 58
- How much money will be allocated to landowners for crop damage?
- How much money will be put aside for pump site damage?
- Please show in detail how private property owners below Ft. Peck Dam can prove damage without costing a fortune and be compensated in as fast a time frame as it did to do the damage.
- Will we be guaranteed electricity each year? 59
- Will we always be guaranteed irrigation water? 60
- Why doesn't the Corp of Engineers have to obey Montana Stream Bank Preservation Act of 1975? 61
- Where did this idea originate and what does each test cost? 62
- Don't irrigators below the dam have the same interest as barge owners? 63
- How do you flood the Missouri River and waste water a month every year and keep water in Montana? 64
- Montana was declared a disaster area this summer from drought, this fall for loss of electricity-now we will have a permanent disaster when the Missouri River is flooded. At what point would we have our water cut off entirely for an endangered species? 65
- Is man creating another disaster area? 66
- It is criminal to waste water in dry Eastern Montana with a man made flood!

How much Loss of electricity each time a Surge (flood) is going to Cost? 67

FORT PECK MINI TEST COMMENT RESPONSES (continued)

57 Summer releases following the mini test would most likely be in the 7,500- to 8,000-cfs range for a median (average) runoff scenario. Every effort would be made to provide flows adequate to support irrigation flows should less than median runoff occur.

58 The Corps does not believe that the mini test at Fort Peck, if implemented, would result in appreciable and compensable losses. The Corps will examine every allegation or claim from property owners for compensation of alleged damages.

59 See response to comment 24.

60 It is not within the authority provided to it by Congress for the Corps to define, quantify, adjudicate, and allocate water rights to which Tribes and private property owners in the Missouri River Basin may be entitled under law or treaty. Rather, the Corps regulates the water within the Missouri River Mainstem Reservoir System, consistent with the dominant navigational servitude that the United States has to water within the Missouri River. Thus, the Corps is not in a position to guarantee any property owner's right to have irrigation water.

61 The Attorney General of Montana has provided an opinion stating that the Montana Natural Streambed and Land Preservation Act does not apply to federal projects unless Congress agrees to the regulation.

Please be specific - Shirley J Hardy
Rt 1 Box 740
Fairview Mt. 59221

comments on flushing flows at Ft Peck Test

QUESTIONS CONSERNING FLOODING AND DRY UP THE MISSOURI RIVER BELOW FORT PECK DAM.

- How many cubic feet per second will be allowed down the Missouri River after the flood so we can irrigate? — 57
- How much money is dedicated to the riverbank erosion of private property along the river? 58
- How much money will be allocated to landowners for crop damage?
- How much money will be put aside for pump site damage?
- Please show in detail how private property owners below Ft. Peck Dam can prove damage without costing a fortune and be compensated in as fast a time frame as it did to do the damage.
- Will we be guaranteed electricity each year? 59
- Will we always be guaranteed irrigation water? 60
- Why doesn't the Corp of Engineers have to obey Montana Stream Bank Preservation Act of 1975? 61
- Where did this idea originate and what does each test cost? 62
- Don't irrigators below the dam have the same interest as barge owners? 63
- How do you flood the Missouri River and waste water a month every year and keep water in Montana? 64
- Montana was declared a disaster area this summer from drought, this fall for loss of electricity-now we will have a permanent disaster when the Missouri River is flooded. At what point would we have our water cut off entirely for an endangered species? 65
- Is man creating another disaster area? 66
- It is criminal to waste water in dry Eastern Montana with a man made flood!

How much Loss of electricity each time a Surge (Flood) is going to Cost? 67

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

62 The underlying Federal purpose is to comply with the Endangered Species Act and the pallid sturgeon recommendation in the U.S. Fish and Wildlife Service's November 2000 Biological Opinion on the Current Operations of the Missouri River, Kansas River, and Bank Stabilization and Navigation Project.

The cost for the testing activities and data collection for FY01 through FY08 are estimated to be in excess of $10 million. The estimated loss of energy revenues due to water passing over the spillway and not through the powerhouse is $2.3 million for the mini –test, based on current cost data.

63 The Corps cannot speak for barge owners regarding whether they have the same interests as do the irrigators located below the Fort Peck Dam

64 The overall flow of water out of Fort Peck on a yearly average will not change due to the mini test.

65 The Corps does not foresee a situation where all water would ever be cut off entirely. The Endangered Species Act is a law that applies to the Corps of Engineers.

66 Effects of the mini test on hydropower generation are shown in Table 8. The actual expense to the Western Area Power Administration will depend on the value of energy at the time the mini test is conducted.

67 The Corps needs to balance the needs of the species with the operational authorities for the dam. This document is addressing only the mini test, which would result in a loss of Fort Peck powerhouse generation at an estimated cost of $2.3 million.

Rebecca J. Latka

None of The Concerns I voiced 2 yrs ago have been answered so I am Totally against Surges on Missouri. We have 8-10 mi. of River front with our Ranch on South Side of Missouri Approx 10 mi above Nohly. I am Completely dumbfounded That This much damage and cost could be Caused To support The Pallid Sturgeon (I had never heard of This fish) + experiment with warmer water being a better Spawning enviroment. This is done even Though it may be detrimental To Least Tern, Piping Plover, water quality, irrigators (56,000 ac) Lost power generating revenue, Cold water species, etc 68

It seems no matter how many Locals object your main concern is To Push This Through. The hearings were a joke. Schedual once during our Sugarbeet harvest + now writing Letters when we should be branding. I Think Klamath Falls debacle was Terrible as well as Spotted owl both of which The National Academy of Science say was not justified. 69

What is so honorable about accomplishing your goals at Someone else's expense??

Private property + free enterprise is the backbone of this great nation don't destroy it!!!

Sincerely,

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

68 The Corps' goal is to comply with the Endangered Species Act with as little impact on landowners as possible.

69 The wetting and drying of the banks will be no more than that which occurs under existing operations, therefore the affect to those factors listed are anticipated to range from very minor to no affect.

Body L 1

May 7 2002

Army Corps of engineers:

I'm writting this letter in opposition of the Fort Peck Flow Modification Mini-test. I pump water along side Edgar Garwood directly across river from the spillway. I'm concerned about bank erosion or change of water main-stream acess to my pump site. I'm worried the proposed Spur Dike will not effectively do it's intended job. Butting the spur dike to the sand bank may cause it to become an island or it may fill in downstream side with sediment cutting off my water supply. I Feel for the cost of the intended Spur dikes an acess for floating pump or Something could be used in conjunction with maybe one or two dikes so I could maintain a sold pump site with "normal" changes in river flow, the banks soak water on high flow then when river elevation goes down, water pours out of the banks pushing sand with it Causing serious erosion problems. With the proposed flow modifications this will only compound the problem. This is not only my problem but every pump site down river. 70

70 Two potential solutions were identified to address this concern during the mini test. The first was to excavate a channel to allow operation of the irrigation pumps. The intake channel would have provided flow to the existing pumps. Periodic maintenance could be required. The second alternative was to rent a portable pump for the duration of the irrigation season to allow continued flow access during the mini test. To date, the landowners have not pursued these options.

2

I also have a pump site upstream at the Lowest end of the dredge cuts. Here with the changes in flow from the power house my pumps would have to be raised and lowered accordingly. This can be a big problem when its haying and irrigating season. Ronald Garwood will also have this problem at a site about 1 mile below me. We do allready have problems with current flow modification at these sites but this will also compound the trouble at these sites.

I also question the purpose of trying to raise river temp with water from the Lake. Being a swimmer, the Lake water is awful cold going into July. Many times the top few inches may be to your figures but below that is Cold. I wonder how much a warming effect this will have on river water. 71.

The Pallid Sturgeon has been here for 60 yrs. Why do we now think we can help them become more plentyful by expirmenting with such complicated matters. What happend to the spotted Plover? Won't this release drown out their nesting spots at this time of year? The Least tern would also have to be affected? 72

I don't know of anything in this world that will last forever.

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

71. The effect spillway discharges would have on the river water temperature is largely dependent upon the temperature difference in the "spillway water" and receiving river water and the quantity of water discharged. The larger the temperature difference and volume discharged the greater the potential for raising water temperature in the river. If temperature differences and discharge volume in relation to river volume were small, the spillway discharge would have minimal effect on raising the water temperature of the river.

72 The pallid sturgeon is an ancient fish that has survived since dinosaur times, but is currently not reproducing in the Missouri River. One of the reasons for the lack of reproduction may be the lack of a warm water pulse thought to trigger the spawning process. Unless a species can successfully reproduce, it will go extinct. The mini test, full test, and any potential operational changes, should they happen, together with pallid sturgeon monitoring could provide information on whether this warmer pulse helps the pallid sturgeon successfully spawn.

Although there is some risk to a few nesting least terns and piping plovers, this risk can be avoided by relocating eggs and nests if needed. Few birds nest along the Missouri River islands below Fort Peck Dam, and the U.S. Fish and Wildlife Service has determined that the greater good would be for the pallid sturgeon to spawn. Historically, before Fort Peck Dam, flooding occasionally overlapped the nesting season for the least tern and piping plover. The floods also helped restore high elevation sandbar islands for these birds, even if eggs were lost during the actual flood, so the overall effect was beneficial was for these birds and fish.

3

Changing habitat for one thing goes down the line and effects everything. What happens to Sauger? This fish used to be caught readily at mouth of Milk river but now is not so common. Rainbow trout gravel bars have been developed up stream for spawning sites. Don't these fish do better in cold water? Again when sauger fishing was good at the Mouth of the Milk river Rainbow trout were very seldomly caught if ever, at least by me. Do you give up one for the other? Who picks what to save and what to flounder? 73

I'm not against saving our enviroment or any of mother natures creations but at what cost? I have to bring up the Wolf program? Was this worth the money and trouble to create more impacts on wildlife? 74

Please continue to send and more information on any regarding issues to

David Anderson
HC 81 Box 212
Nashua Mt.
59248

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

73 The sauger is a native fish that would have acclimated to the warmer pre-dam spring rise flows, so would not be negatively affected by the mini test. Most native fish may find some long-term benefit in a warmer and higher flow during the late spring or early summer. Rainbow trout are not native to the Missouri River, and, while most trout prefer cold water, rainbow trout are quite flexible in their life requirements and can even survive in some warm Nebraska ponds if sufficiently aerated. The cold-water fishery between Fort Peck Dam and the spillway would not be influenced by the warm spillway discharge, because the warmer spillway discharge would flow downstream from the trout waters.

74 Cost is ultimately a factor in wildlife restoration programs, because while most people are in favor of "saving the environment," there is often a limit to that support, based on the cost for implementing the program. Unlike the endangered salmon, the pallid sturgeon has no commercial value, which makes the cost for its recovery more of an issue. Many people would support some changes and inconvenience if there is a good monitoring program in place to detect if such changes were working or not.

Ronald Garwood
HC 87 Box 215
Nashua MT 59248

Dear sirs.

I am an irrigated farmer 6 mile south of Nashua on
The Missouri River below Fort Peck Dam. I maintain a
pump site on The river above The spillway and share
a site with my Father, Edgar Garwood. These sites are
2½ miles apart. I am deeply concerned by The
"Spring Rise Proposal" by The Fish and Wildlife service
and The Corps of Engineers. This action could cause
severe damage To our pump site below The spillway by
inundation of The pump site or erosion under The pump
and we might have To move The pump at a critical Time 75
in our irrigation season. The other pump site above
The spillway would only receive 4000 CFS which
wouldn't be enough To irrigate. I need To have at least
6000 CFS To irrigate without losing its prime & To
irrigate day & Night. This pumpsite is on The outside 76
bend of The river, very shallow, & prone To
erosion at high water. I Feel The Corps and The
Fish and wildlife service should be responsible
For Losses To my crops For loss of income at This
critical irrigating Time. I Feel There should be a 77
special disaster payment made To The irrigating Farmers if
They can't get water on Their crops. We have a large
investment in irrigation pumps, sites, ditches and
Leveled Land.

I Feel This proposal To Try To stimulate spawning
of The pallid sturgeon in This cold water The 78

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

75 Spur dikes could have been constructed under the Section 33 authority, however agreement was never reached between the landowner and the government.

76 Two potential solutions were identified to address this concern during the mini test. The first was to excavate a channel to allow operation of the irrigation pumps. The intake channel would have provided flow to the existing pumps. Periodic maintenance could be required. The second alternative was to rent a portable pump for the duration of the irrigation season to allow continued flow access during the mini test. To date, no landowners have pursued this option.

77 The Corps cannot speak for the U.S. Fish and Wildlife Service regarding its responsibility or liability for alleged losses of crop income that could result if its proposed "spring rise" of the Missouri River is implemented by the Corps within the Master Water Control Manual. With regards to the mini test, which is the subject of the Environmental Assessment, the amount of water released for the numbers of days specified would not result in the categorical destruction of all economic beneficial use of any property, in violation of the prohibition of the Fifth Amendment to the United States Constitution against Governmental taking without just compensation.

You provided a suggestion that a special disaster payment be made to farmers who rely on irrigation intake from the Missouri River to get water to their crops. The Corps cannot institute such payments without prior Congressional action in authorizing and appropriating the funds.

78 See response to comment 72.

Corps has created, by The buildding of Fort Peck
dam, is very Foolish and espensive proposal. I believe
The inundation of The river by "The Spring Rise" would
hurt many species of birds including ducks, geese,
plover and Terns That are on The river. Some Thing That
hasn't been Taken in To The consideration is The large
numbers of predatory Fish, birds and mammals That
are on The river now That wasn't here in The 50's. I've 79
irrigated, hunted, Fished, Trapped, Back packed and boated This
river For years. In The 50's + 60 we Caught many large
sturgeon which had To have been pallid sturgeon up To
5 Foot long. I also caught + released one in 1997. We
didn't have Northern pike, walleye, Lake Trout and muskies
Then like we have Now in numbers. We had raccoons
migrate here about '60 + They catch large numbers in
shallow areas or pools. We have large numbers of Cormorants
gulls, pellicans and loons. We also have bald eagles
and ospreys which Feed on Fish. I believe all of
These predators have had a detrimental effect on all
Native species of our Fish. This spring rise proposal
would cause Millions of dollars due To loss of generation
crops, disaster payments, erosion, damage To pumpsites and
inundation of habitat For many species of birds and animals.

I believe money spent on The warm water Fishery at
Fort Peck when it comes on line will provide numerous
Fingerlings of pallid sturgeon and Native Fish is a better use
of our money. This hatchery would help Keep The pallid oFF The
endangered list and wouldn't cause other environmental 80
problems That The Spring Rise would.

Sincerely
Ronald Harwood

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

79 While it's true that many other species have been introduced into the Missouri River since the closing of Fort Peck Dam, these species are flexible enough to not be affected by the mini test. Remember that the mini test is within the types of flows already seen periodically on the river, but the higher flow would be coming from warmer upper lake water instead of through the outlet works of the dam. The introduced coldwater trout fishery downstream from Fort Peck Dam would be upstream from the warmer spillway discharge, so would not be affected by the warmer water.

80 Comment noted.

peckyL

COMMENT QUESTIONNAIRE

Draft Environmental Assessment Fort Peck Flow Modification Mini-Test

Complete this form by circling any answer with which you agree.
Feel free to make copies and ask friends to send comments.
EACH family member should comment on a separate sheet.
You are encouraged to add personal comments at the end or between each question.
Return forms by Friday, August 9th to:
US Army Corps of Engineers, Omaha District
CENWO-PM-AE / Rebecca Latka
106 South 15th Street
Omaha NE 68102-1618

****

Your Name (please print): Robert Lebrun Date: 7-14-2002

Your Signature: [signature]

Complete Address: 513 8th Ave, Langdon, ND 58249

1. The assessment should include statements recognizing land rights, mineral rights and water rights and show a plan of how those rights will be upheld. 81
   (I Agree) I Disagree I Don't Know
2. There should be a full environmental assessment of the proposed mini-test or of a full-test before either procedure is carried out. 82
   (I Agree) I Disagree I Don't Know
3. The assessment should include a plan for compensation, mitigation, repair or replacement of any agriculture-related operations if any type of damage is incurred. 83
   (I Agree) I Disagree I Don't Know
4. The assessment should include compensation for revenue lost because electrical generation was interrupted due to Corps induced flood or drought. 84
   (I Agree) I Disagree I Don't Know
5. The assessment should include a plan to handle the increased silt deposit, which will likely increase under this proposal, thereby causing additional flooding. 85
   (I Agree) I Disagree I Don't Know
6. The plan should recognize the normal spring rise of the Yellowstone River or other tributaries which join the Missouri River and indicate how the Corps intends to handle this annual event. 86
   (I Agree) I Disagree I Don't Know
7. The assessment should address the Corps' plan for handling any increase in suspended particulates, metals and chemicals if turbidity is increased by this plan. 87
   (I Agree) I Disagree I Don't Know
8. The assessment should include a plan for non-endangered species which may be threatened as a result of man-made flooding. 88
   (I Agree) I Disagree I Don't Know

Continued on back

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

81 No adverse taking of property rights is foreseen as a result of the mini test. The level of flow proposed is within the normal range of flow on the reach and historically is met or exceeded on the average of every 2 or 3 years.

82 Full assessments of the environmental impacts of the mini test have been completed. The Fort Peck Flow Modification Mini Test Environmental Assessment provides National Environmental Policy Act (NEPA) coverage for the mini test. Appropriate NEPA documentation and coordination with the public will be accomplished under separate processes for any future actions.

83 See responses to comments 48 and 58.

84 Western Area Power Administration has no avenue for reimbursing customers for lost or reduced generation. The amount of reduced hydropower generation during the mini test would be insignificant compared to the daily generation in the upper midwestern region, and the effect of additional energy purchases on rates would be negligible.

85 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows; therefore, the erosion/deposition patterns would be similar. Although, an increase in suspended sediment can be calculated it is within the error band of the measurements and is not considered a significant contributor to either the alluvial processes or water quality.

86 Actual and forecasted Missouri and Yellowstone River flows will be closely monitored before any increase in releases is made for the mini test. The Corps of Engineers has a "stop protocol" for termination of mini test releases if flooding is imminent.

87 Increases in turbidity are not anticipated during the mini test. Turbidity monitoring would be conducted to verify this.

88 The EA did consider the effects of the mini test on non-endangered species and their habitats. The mini test is within the range of lake and river elevation fluctuation already being experienced by species within the lake and the river. Wetland and cottonwood habitats were specifically addressed, as well as lake and river fisheries.

9. The assessment should include a plan to protect or minimize damage to pump sites or other water intakes along the river for both private landowners and community water systems and the projected cost. 89
(I Agree) I Disagree I Don't Know

10. Upstream landowners and states, who have given up land in order to provide flood protection, energy generation and irrigation, should at least receive equal treatment as downstream landowners and states whenever the Corps considers policy changes. 90
(I Agree) I Disagree I Don't Know

OTHER COMMENTS:

-------------Fold in half, tape closed and mail by August 9th-------------

US Army Corps of Engineers, Omaha District
CENWO-PM-AE / Rebecca Latka
106 South 15th Street
Omaha NE 68102-1618

68102#1618

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

89 The Missouri River between Fort Peck Dam, Montana, and Gavins Point Dam, South Dakota and Nebraska, project was authorized by Section 33 of the Water Resources Development Act (WRDA) of 1988 (Public Law 100-676). In this authorization the Secretary of the Army is directed to undertake such measures, including maintenance and rehabilitation of existing structures, acquisition of real property and associated improvements (from willing sellers), and monetary compensation to affected landowners which the Secretary determines are needed to alleviate bank erosion and related problems associated with reservoir releases along the Missouri River. In lieu of structural measures, the Secretary may acquire interests in the affected areas from willing sellers.

The Section 33 authority also considers water intake relocation as a means of alleviating bank erosion and related problems associated with reservoir releases. The intake must be evaluated comparing the cost of acquiring an interest in the affected areas to the cost of water intake relocation. In some cases, it may cost less to use conventional structural methods to correct the problem. In those cases, conventional structures would be designed and built by the Corps.

Little damage is anticipated beyond that resulting during normal high flows experienced on the average of every 2 to 3 years. However, the above referenced legislation provides the Corps with adequate authority to meet any problems that might arise unexpectedly.

90 Although the physical condition at different sites may result in different approaches both upstream and downstream, landowners are treated the same.

4/3/02 orig Becky L

It is VERY important that the Corps of Engineers hear from you. You must comment on the "Draft Environmental Assessment Fort Peck Flow Modification Mini-Test. The deadline for comments is August 9, 2002.

These are samples of comments given by concerned individuals. Comments given by **you** must be **hand written** by you and signed. Please feel free to use these examples and add your own as there are several issues involved.

The assessment does not address an environmental impact statement for the mini or full test for this section of the Missouri River. 91

The assessment does not address means of compensation for the mini test, full test, or a continued modification for the Missouri River. 92

The assessment does not show a plan for compensation, mitigation, repair or replacement of any agriculture related operations. 93

The assessment does not compensate for the lost revenue generated for electricity each time there is flooding or drying of the Missouri River. 94

The assessment does not allow for non endangered species in the path of the water that could become threatened as a result of the flooding. 95

The assessment does not show a plan to protect any pump sites, water intakes along the river for landowners or community municipal water projects. 96

The assessment does not show a plan for the confluence of the Missouri and Yellowstone Rivers where there is an existing silt deposit that will increase, causing additional flooding. 97

There is no plan allowing for the spring rise of the Yellowstone River joining the Missouri River or other tributaries into the Missouri River. 98

The assessment does not address the increase in suspended chemicals and metals and particulates due to increased turbidity nor a plan to handle this increase. 99

Makes Comments Here or Use a Separate Sheet of Paper.

Stop The Flooding or Fix all Damage Done. pay For each Pump site + Land Caved IN - Do Environment Statement of Ft Peck Master Manual 100

Merle Hardy
R2 Box 2272
Fairview MT 59221

Please fold and mail.

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

91 Full assessments of the environmental impacts of the mini test have been completed. The Fort Peck Flow Modification Mini Test Environmental Assessment provides National Environmental Policy Act (NEPA) coverage for the mini test. Appropriate NEPA documentation and coordination with the public will be accomplished under separate processes for future actions.

92 See responses to comments 48 and 58.

93 See responses to comments 48 and 58

94 See response to comment 55.

95 See response to comment 88.

96 See response to comments 58 and 89.

97 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives, and therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the Current Water Control Plan.

98 See response to comment 86.

99 Increases in turbidity are not anticipated during the mini test. Turbidity monitoring would be conducted to verify this.

100 Comment noted.

P.O. Box 410
Culbertson, Montana 59218
May 6, 2002

U.S. Army Corps of Engineers, Omaha District
CENWO-PM-AE/REBECCA LATKA
106 South 15th Street
Omaha, NE 68102-1618

Re: Mini Flow Test on the Upper Missouri River.

Dear Rebecca,

I am requesting an extension the comment period for the following reasons:

1. Richland County residents were excluded from notification and our farm is in Richland County. 101
2. We need time to analyze the document.
3. We're unable to understand how these tests are to improve the situation of an endangered species in one remote area of rural America but not on any other stretch of the river.
4. We're unable to comprehend why an endangered species such as the paddlefish can be legally harvested and the proceeds from caviar sales be given to neighboring communities. Yet the landowners and the holders of the water rights are being forced to give up property rights on the major flow without being compensated. 102
5. Why can a bureaucracy promote their business at the expense of others and disguise the whole process as protection of an endangered species?
6. Shouldn't all fishing and leisure floating of the Missouri River be halted to protect all of the endangered species?

Please extend the comment period for at least 90 days.

Sincerely,

[signature]

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

101 Press release information was sent to media outlets in Wolf Point, MT and in Williston, ND, which are two larger cities on either side of Richland County. We also had many Richland County residents on our original mailing list and have been adding names as they were forwarded to us for inclusion.

102 As requested, the comment period was extended by 90 days.

The mini test is one part of a much larger effort being conducted by the Corps of Engineers along the Missouri River.

Many individual actions throughout the nation are needed in order to recover the pallid sturgeon.

The paddlefish is not an endangered species, which is why it can be legally harvested.

Protection of endangered species is a national law supported by the people, acting through their elected officials.

Leisure floating would not affect endangered species. Fishing actions that follow state regulations would not affect endangered species.

Becky L

I, along with others of the Fort Peck area, **strongly object** to a flexible flow management plan for the Missouri River, including the Mini Test, implementation of the Master Manual and any other man-made floods on the river. Following are some reasons why:

1. Flexible flow means catastrophic flooding, washed out pump sites, loss of land sloughed off into the river, and loss of the mineral rights on those lands. 103
2. The proposed 25,000 CFS for a month or more is billions of gallons of wasted water. This is a criminal waste in the dry areas of the Missouri watershed. 104
3. The economic impact of flooding and then drying up the river will be catastrophic to farmers, ranchers, barge owners, businesses and cities along the Missouri. 105
4. The EPA is violating it's own regulations by flooding the nesting sites of endangered birds. The plan to gather the eggs of the birds, hatch them and then return them to the wild makes no sense at all, especially given the fact that with very small expense, existing fish hatcheries can adequately take care of the problem with the endangered fish. 106
5. The Fort Peck Dam has been a multiple use dam for the past 68 years. We strongly object to the proposed changes that would sacrifice agriculture, commerce, energy production, cities and recreation. 107
6. Once water is released from the dam it cannot be controlled. Existing flooding will be made worse by summer storms along the watershed. 108
7. The Missouri/Yellowstone confluence area will be adversely impacted as flexible flow will exacerbate an already severe silting problem. 109
8. Economic, Environmental and Social Impact Studies need to be done before any decisions are made. 110
9. Any plan needs to include compensation to property owners along the river. 111
10. This is an area of "Family Farms" - another endangered species in need of protection. Don't wash the land away. 112
11. There is no sound scientific research which indicates that flexible flow will accomplish the purpose for which it is being done. It is a bad idea. 113
12. We are **true** environmentalists. We love this land, we live on this land, and we want to make certain that it is preserved for future generations, intact with birds, fish, animals and people. 114

Name: Ray Hansen Address: 4333 Mt. Hwy 13 Wolf Point, Montana 59201

Name:__________ Address:__________

Name:__________ Address:__________

Name:__________ Address:__________

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

103 The wetting and drying of the banks will be no more than that which occurs under existing operations. Further, the peak flows are within the range of flows that could be expected from normal operations. Therefore, it is reasonable to assume that the mini test would not affect the long-term erosion rates.

104 The mini test would require a spillway discharge of 11,000 cubic feet per second. The remaining 4,000 cubic feet per second would be discharged through the powerhouse. The water would flow into Lake Sakakawea, where it can be controlled for use within the Missouri River mainstem system for purposes, such as hydropower production; industrial, municipal and agricultural water supply; irrigation, recreation, navigation, and fish and wildlife. To the extent it will be lost to the Fort Peck project will not greatly affect water users.

105 The mini test does not include a proposal for flooding or drying up the Missouri River. It is simply testing the effect of different Fort Peck Dam release regimes on water temperatures, thereby improving the suitability of the river below Fort Peck Dam as habitat for the endangered pallid sturgeon. The proposed test flow of 15,000 cubic feet per second is currently experienced in the test reach every 2 or 3 years without major harm to area farmers, ranchers, businesses and cities along the river. To the extent water would be spilled from Fort Peck Dam, it will be recaptured at Garrison Dam and available for down stream uses. In the event of the threat of flooding due to high flows from tributaries of the test reach (streams below Fort Peck, but above Lake Sakakawea), the test will be curtailed.

106 See response to comment 72.

107 The Fort Peck Dam Project is still a multiple use project. The actions being taken continue to support all project purposes.

108 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives; therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the CWCP. The flows in the mini test are no higher than under normal operations and are not expected to cause flooding. Downstream inflow would be monitored and the test suspended if downstream inflows increase the threat of flooding.

109 Assessment of the flow duration data for Fort Peck Dam indicates very little change in the overall distribution of flows for all the alternatives; therefore, long-term channel conditions below Fort Peck Dam are considered to be similar to those associated with the Current Water Control Plan.

Becky L

I, along with others of the Fort Peck area, **strongly object** to a flexible flow management plan for the Missouri River, including the Mini Test, implementation of the Master Manual and any other man-made floods on the river. Following are some reasons why:

1. Flexible flow means catastrophic flooding, washed out pump sites, loss of land sloughed off into the river, and loss of the mineral rights on those lands. | 103
2. The proposed 25,000 CFS for a month or more is billions of gallons of wasted water. This is a criminal waste in the dry areas of the Missouri watershed. | 104
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Name: Ray Hanson Address: 4333 Mt. Hwy 13 Wolf Point, Montana 59201

Name:__________ Address:__________

Name:__________ Address:__________

Name:__________ Address:__________

110 The purpose of the EA is to consider relevant impacts to the human environment and to provide a mechanism for their consideration in the decision-making process. The EA primarily addresses the natural environment because those are resources most likely to be impacted. The study reach of river is already subjected to periodic flows of the proposed magnitude every 2 to 3 years. Indirect impacts to area residents and to the economy would be the result of direct impacts to activities generating economic activity; namely agricultural production and recreation. Since no unusual impacts to these factors are anticipated, no significant social or economic impacts are likely.

111 See responses to comments 48 and 58.

112 Comment noted.

113 Since higher, warmer spring flows existed prior to the closure of Fort Peck Dam and have been replaced by colder fairly static flows, the link between warm flows and spawning is a logical hypothesis worth testing.

114 The proposed approach is a compromise approach in which the flows are not as large as historically present and are for a shorter duration. Many people would support some changes in flows and some inconvenience if needed to preserve our natural heritage as long as there is in place a good monitoring program to detect if such changes were working or not.

PO Box 410
Culbertson, Mont. 59218
April 19, 2002

US Army Corps of Engineers, Omaha District
Attn: Ms. Rebecca J. Latka
106 S. 15th St. Omaha
Nebraska 68102-1618

Re: Proposed Mini Test on Missouri River below Fort Peck Dam.

Dear Ms. Latka:

Of the issues involved with the mini-flow test below the Fort Peck Dam in Montana, the proponents and opponents of the proposition have more in common than they have in disagreement. We would all agree that if there were a fishery problem, that it is caused by the construction of the dam and not the individual landowners living along the river. In this case the Fort Peck Dam's very existence environmentally affects a specific population of fish and therefore becomes Montana's environmental version of the leaking "Exxon Valdez". How should we all proceed?

As in every other environmental issue, the government agencies always have taken a look at the problem involved and identified the individual responsible for the environmental problem. It has always been the responsibility of the individual who caused the problem to resolve the issue both physically and financially. In this case it should be the Corps of Engineers that accepts these responsibilities. This is the issue that separates the individual Montana landowners and farmers from the Corps of engineers and environmentalists.

If the flow tests are conducted in June, these tests will interfere with the property rights and water rights of individual farmers. A recent study of some 140 irrigation-pump sites shows that 90 of them will be impacted negatively. This means that pumps and pump sites may have to be moved and modified. Of the remaining 60 pump sites, many of them will have to move pumps, electrical boxes, pipe lines, meter poles, and fuel tanks away from the bank. During this period of time most of these same farms will be unable to irrigate, and occur additional costs. Farmers can't afford to receive 1930 prices for their commodities and assume the extravagant remedies of environmental issues as suggested by others. These hidden costs have to be addressed by the Corps. 115

Montana citizens can ill afford the costs to be incurred by this test. Let the Army Corps of Engineers and the environmentalists vote on this issue with their own checkbooks!

Sincerely,

James D. Carlisle

FORT PECK MINI TEST COMMENT RESPONSES
(continued)

115 See response to comments 77 and 99.

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