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FORT PECK FISHERY HABITAT EVALUATION AND IMPROVEMENT STUDY

Annual Milestone

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INTRODUCTION

The tailwater area and Missouri River immediately downstream from Fort Peck Dam provide a valuable fisheries resource in eastern Montana. This area contains a variety of habitat features and a mixture of both warm and cold water fish which create an important and somewhat unique fishery.

Fort Peck Dam is the upstream most dam in a series of dams on the Missouri River operated by the U.S. Army Corps of Engineers (COE), Missouri River Division (MRD). The COE develops, controls, maintains, and conserves water resources in the Missouri River to fulfill authorized project purposes such as flood control, water quality, navigation, power generation, recreation, and fish and wildlife conservation. In the past, fish and wildlife have received little consideration in the operation of the Fort Peck Project. Within the constraints of available water, Fort Peck Dam has been operated to produce peaking power. This pattern of operation results in large daily fluctuations in water levels below the dam. Recent studies have identified a number of adverse impacts on the downstream fishery associated with these water level fluctuations (Frazer 1985). These problems and a limited amount of quality habitat have prevented the fishery below Fort Peck Dam from reaching its maximum potential.

The Montana Department of Fish, Wildlife and Parks (FWP) is currently working to improve the fishery below Fort Peck Dam by introducing new forage species that should be better adapted to the conditions found below the dam and by stocking chinook salmon to try and develop a tailwater chinook fishery. The rainbow trout limit below Fort Peck Dam was also recently reduced from 10 to 2 fish daily to protect the adult rainbow population in light of increased public interest in this fishery.

The Corps of Engineers, MRD is interested in working with the state to improve the fishery below Fort Peck Dam. The COE has funded a study to identify and evaluate the impacts of the current operation of the Fort Peck Project on the downstream fishery and to develop plans to reduce or eliminate these problems through a combination of water management alterations and habitat improvement.

This milestone presents the results of the first year of this study and outlines work to be conducted during the second year. The major objectives of the first year of this study were:

1. Gather additional baseline data on the fishery downstream from Fort Peck Dam and the impacts of water level fluctuations on this fishery with major emphasis on the reproduction of rainbow trout, walleye, sauger, and forage fish.

2. Develop a better understanding of the stage-flow-discharge relationship downstream from Fort Peck Dam.

3. Work with the COE to initiate changes in water management below Fort Peck Dam to benefit the fishery; evaluate the effectiveness of these changes.

4. Initiate habitat improvement work in selected areas below the dam, evaluate the effectiveness of these projects where possible, and outline plans to continue evaluation in the second year of the study.

5. Identify potential long-term plans involving water level management and habitat modifications for improving the fishery potential of the downstream area.

DESCRIPTION OF STUDY AREA

The study area extends from Fort Peck Dam downstream approximately 10 miles to the mouth of the Milk River.

Fort Peck Dam is a large, earth-filled dam located at river mile 1771.6 on the Missouri River in northeast Montana. The dam was closed in 1937 and backs water 134 miles upstream to near Zortman, Montana. Four large penstock tubes withdraw water 185.5 feet below the top of the dam. Two penstocks are used for power generation and have a maximum discharge capacity of about 17,000 cfs. The generating capacity of the two powerhouses is 185 megawatts. The total discharge capacity through all four penstocks is 45,000 cfs. A separate spillway system located on a bay west of the main dam has a discharge capacity of 230,000 cfs.

Fort Peck Dam is presently operated as a combined base load and peaking plant. The amount of power peaking depends on water availability and power demand. Fort Peck Dam has altered the natural temperature and discharge patterns of the Missouri River downstream.

Habitat

The study area below the dam contains several habitat features (Figure 1). The tailrace area immediately below the dam consists of a shallow shelf of large boulders dropping off into a pool approximately 40 feet deep. Numerous large boulders have been placed in the channel to dissipate energy from the dam discharge. The spaces between the boulders in the center of the channel have filled in with gravel and silt. Boulders along the edges of the current are not silted in and provide fish habitat. The banks just downstream of the dam have been riprapped. The banks in the remainder of the study section are predominately steep vertical sand and silt banks that are very unstable. The bottom in the tailpool area is composed of sand and silt. Most of the tailpool is less than 10 feet deep with a number of shallow mud flats. There are a couple of 30 to 40-feet deep holes 3 to 4 miles below the dam. Approximately 0.9 miles below the dam the tailpool is split by a series of large islands; the main flow going down the west channel. Near the upstream end of Duck Island, the current velocity in the west channel increases as the river passes through a narrow, rocky chute. Downstream from this point there are numerous gravel bars and small gravel points intermixed with a sand and silt bottom.

The east side channel behind Duck and Scout Islands provides critical habitat for rainbow trout spawning, incubation, and rearing. This side channel is about 2.5 miles long; it passes about 1 to 10% of the water discharged from the dam. The bottom in the upper end of the side channel begins as sand and silt, then turns to more gravel and cobble progressively downstream. Two large riffle areas in the lower 0.25 mile of the side channel provide the major spawning and rearing habitat for rainbow.

A unique habitat feature is the dredge cut ponds. These are areas that were excavated to provide fill during construction of the dam. They are connected directly to the main river. The water levels in these ponds are influenced by the discharge from the dam.

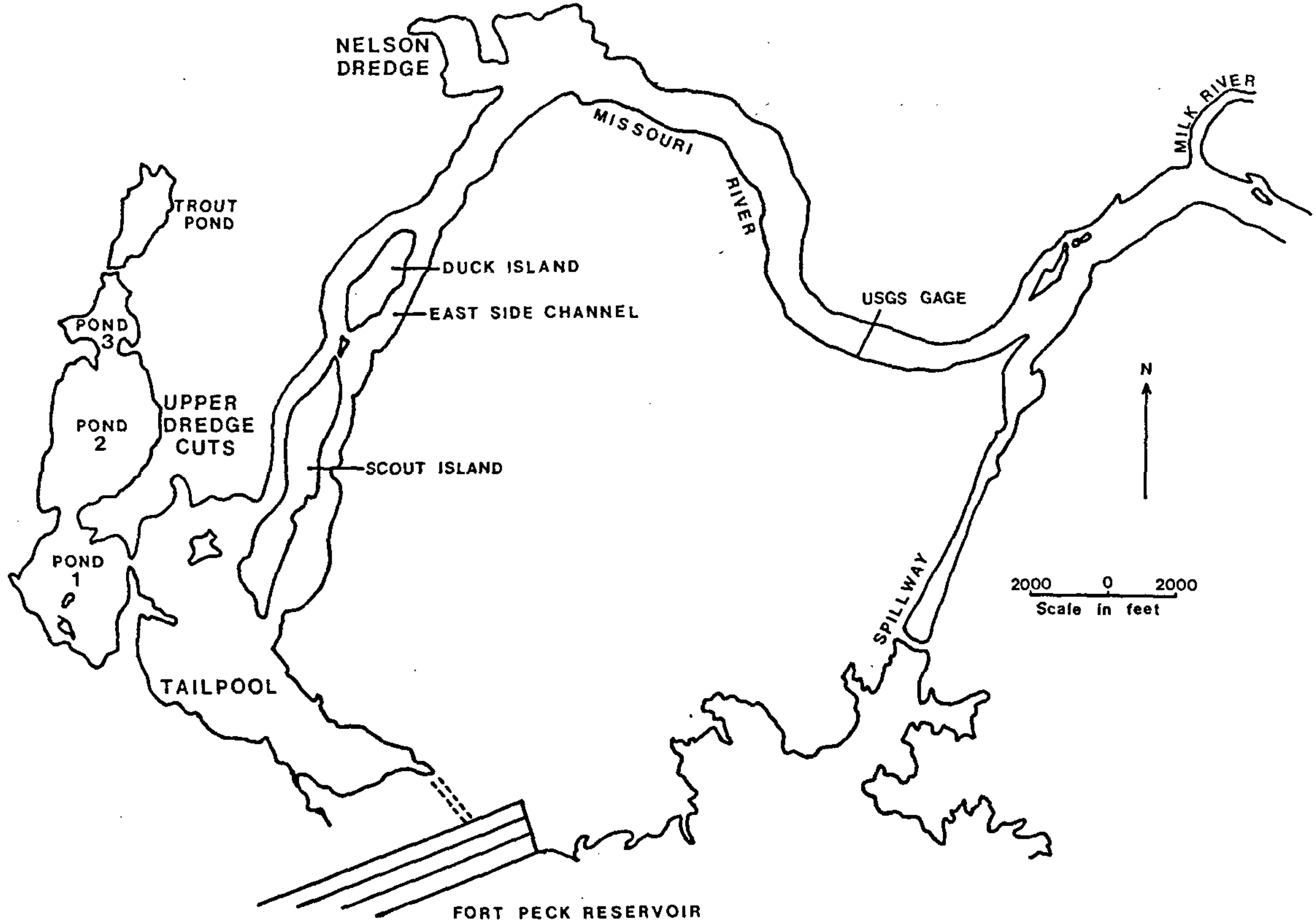

Figure 1. Study Area.

There are two dredge cut areas. The upper dredge cut is located approximately 1.6 miles downstream from the dam and consists of a series of three interconnected ponds (Figure 1) with a single connection to the river. These ponds have a total surface area of approximately 650 acres and a maximum depth of approximately 31 feet. Average depth for the whole area is 15 to 20 feet. The banks and bottom in these ponds are composed of sand and silt. The banks are steep and very unstable with little shoreline cover. There are two gravel points which provide spawning habitat for walleye and sauger.

The Nelson dredge cut is located approximately 6 miles downstream and consists of one 66-acre pond with an approximate maximum depth of 28 feet. The opening to Nelson dredge is larger than the opening to the upper dredge cuts, facilitating exchange of water with the river. The main river channel just downstream of Nelson dredge has been enlarged by dredging, creating a large bay. The bottom and banks in these areas are similar to the upper dredge cut area.

Fisheries

The variety of habitat found in the study area has resulted in the development of a diverse fishery in this area. A total of 39 species of fish representing 14 families has been collected while sampling or are otherwise known to occur in the study area (Table 1). Several other species have been reported from the Missouri River or its tributaries between Fort Peck and Garrison Reservoirs, but have not been collected in the study area (Brown 1971, Stewart 1982).

Table 1. Fish species found in the Fort Peck Tailwater/Dredge Cut Study Area.

Family and Scientific Name	Common Name
ACIPENSERIDAE (Sturgeon family)	
Scaphirhynchus platorynchus	Shovelnose sturgeon (A)*
Scaphirhynchus albus	Pallid sturgeon (R)
POLYODONTIDAE (Paddlefish family)	
Polyodon spathula	Paddlefish (A)
LEPISOSTEIDAE (Gar family)	
Lepisosteus platostomus	Shortnose gar (R)
HIDONTIDAE (Mooreye family)	
Hiodon alosoides	Goldeye (A)
SALMONIDAE (Trout family)	
Coregonus artedii[1]	Cisco (R)
Coregonus clupeaformis	Lake whitefish (R)
Salmo gairdneri	Rainbow trout (C)
Salmo trutta	Brown trout (R)
Salvelinus namaycush	Lake trout (C)
Oncorhynchus tshawytscha[2]	Chinook salmon (R)
OSMERIDAE (Smelt family)	
Osmerus mordax	Rainbow smelt (R)

Table 1. (Continued)

Family and Scientific Name	Common Name
ESOCIDAE (Pike family)	
Esox lucius	Northern pike (A)
CYPRINIDAE (Minnow family)	
Phoxinus eos	Northern redbelly dace (R)
Cyprinus carpio	Carp (A)
Hybopsis gracilis	Flathead chub (R)
Couesius plumbeus	Lake chub (C)
Notropis artherinoides	Emerald shiner (C)
Notropis hudsonius[3/]	Spottail shiner (R)
Hybognathus argyritis	Western silvery minnow (C)
Pimephales promelas	Fathead minnow (R)
CATOSTOMIDAE (Sucker family)	
Carpoides carpio	River carpsucker (A)
Cycleptus elongatus	Blue sucker (C)
Ictiobus bubalus	Smallmouth buffalo (A)
Ictiobus cyprinellus	Bigmouth buffalo (A)
Moxostoma macrolepidotum	Shorthead redhorse (A)
Catostomus catostomus	Longnose sucker (A)
Catostomus commersoni	White sucker (A)
ICTALURIDAE (Catfish family)	
Ictaluras melas	Black bullhead (R)
Ictaluras punctatus	Channel catfish (C)
Noturas flavus	Stonecat (R)
GADIDAE (Codfish family)	
Lota lota	Burbot (C)
PERCICHTHYIDAE (Sea bass family)	
Morone chrysops[4/]	White bass (R)
CENTRARCHIDAE (Sunfish family)	
Micropterus dolomieui	Smallmouth bass (R)
Pomoxis annularis	White crappie (R)
PERCIDAE (Perch family)	
Perca flavescens	Yellow perch (C)
Stizostedion canadense	Sauger (C)
Stizostedion vitreum	Walleye (C)
SCIAENIDAE (Drum family)	
Aplodinotus grunniens	Freshwater drum (R)

*(A) = abundant
(C) = common
(R) = rare

[1] First planted in Fort Peck Reservoir in 1983.
[2] First planted in study area in 1983.
[3] First planted in Fort Peck Reservoir in 1982.
[4] Three have been captured in the dredge cuts; two in the spring of 1986.

Walleye and sauger are the most popular game fish in the study area. They are found in all parts of the study area but appear to favor certain habitat areas. It appears that the majority of walleye and sauger in the area are migratory fish from downstream. Some walleye and sauger spawning occurs in the study area.

Northern pike is another popular game fish. They are found predominantly in the dredge cuts, although a few are found in the tailpool and main channel as well. Pike do spawn in the dredge cuts, but their reproductive success appears to be severely impacted by water level fluctuations and the resulting lack of shoreline vegetation.

A population of trophy-sized rainbow trout inhabit the study area and spawn successfully in the east side channel and in the main river. This population of rainbow was first documented in 1979 (Stewart 1980); however, locals report catching rainbow in the area for several years before that. Limited rainbow stocking has occurred in both the study area and in Garrison Reservoir in the past; however, the actual origin of this rainbow population is not known. These rainbow provide an important fishery that is unique to this part of eastern Montana. Sampling efforts indicated that rainbow trout remain in the study area throughout the year.

A population of lake trout is found in the tailpool area below the dam. These fish provide a good fishery, especially in the spring and fall. They also move into the dredge cuts during the winter and are caught by ice fishermen. It is not known if any lake trout spawning occurs below Fort Peck Dam or if the population depends entirely on recruitment from the reservoir.

A population of paddlefish is present in the study area. A mark-and-recapture estimate made in 1978 estimated a population of approximately 3,400 paddlefish in the upper dredge cut during late June and early July. Another 500 paddlefish were thought to be present in Nelson dredge that summer (Needham 1979). Tag return data indicates that these fish are part of a paddlefish population that inhabits Garrison Reservoir and migrates up both the Missouri and the Yellowstone Rivers. Paddlefish in the study area apparently key to the dredge cut areas, especially the upper dredge cuts, but they also use the tailpool on a seasonal basis. It appears that the dredge cuts are vital to maintaining a paddlefish population in the area. Sampling results indicated that part of the paddlefish population remained in the study area for extended periods of time.

Chinook salmon were first planted below Fort Peck Dam in the spring of 1983; annual plants have continued since that time. A ripe male chinook was captured in the dredge cuts in January, 1986. This fish was thought to be a returning fish from the 1983 plant. Other game fish captured in the study area include channel catfish, burbot, shovelnose sturgeon, and an occasional brown trout.

METHODS

Physical Measurements

Three Stevens type F and one Belfort model 5-FW water level recorders were set up in the study area in the spring and maintained on a weekly basis until ice-up in the fall. These recorders were installed as reported in Frazer (1985). Figure 2 shows the locations of these recorders. None of the data from these recorders is summarized in this report since it is currently being used by a consulting firm that has been contracted to work on a long-term flow regulation plan for the area.

All flow measurements made to relate flows to discharge and to measure velocities over redds were made using an AA current meter and top setting wading rod.

Spawning Surveys and Egg Sampling

Rainbow redd counts were made weekly after the first redds were located in late March. All major spawning areas were checked each time. All redds were located on a map and an attempt was made to distinguish old redds from new ones. A running tally was maintained of all known new redds. Rocks were painted and placed in the center of many newly located redds to evaluate disturbance due to current scour and superimposition.

Measurements were made at a number of redds to determine the depth and current velocities fish were selecting for, and the approximate size of redds. Length, width, depth to gravel surface and depth to redd depression were measured. Velocities were measured at the head of the redds proportionally 0.4 of the distance up from the gravel surface.

A 40- x 40-inch drift net constructed of 750 micron nitex netting was used to sample rainbow redds. This net was placed downstream of a redd, then a shovel was used to dig up the redd turning over the gravel to free eggs which were carried downstream into the net. Eggs were sorted and counted in the field and all live eggs were returned to the gravel.

This same drift net and a 7- x 17-inch fine mesh dip net were used to sample for walleye and sauger eggs on a large gravel bar located eight miles below Fort Peck Dam. These nets were placed on the bottom and an area upstream was kicked or fanned with a shovel to dislodge eggs from the surface so they would drift into the net. All samples were sorted and counted in the field.

Ten egg trays were set on two gravel points in the upper dredge cuts to try and collect walleye or sauger eggs. Trays were 12- x 12-inches and constructed of 2- x 1/8-inch steel strap with a fiberglass screen bottom. Each tray was filled with rock substrate, then five trays were placed at varying depths on each point by snorkeling. All trays were left out through the entire spawning period. When pulled, the tray bottoms and all the rocks in the tray were checked for attached eggs.

Rainbow Redd Experiment

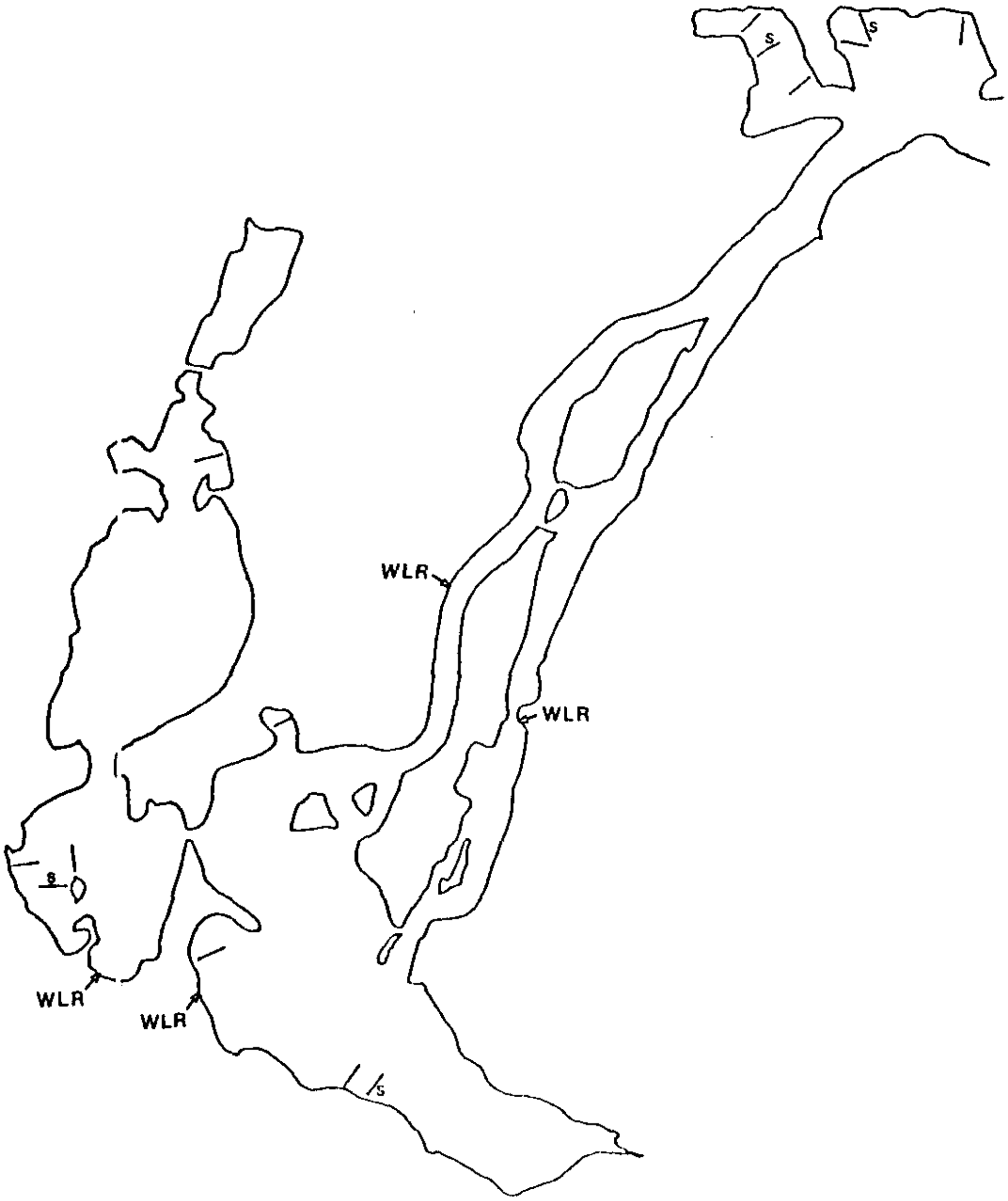

Figure 2. Location of water level recorders (WLR) and gill netting sites. S = "smelt nets" (1/2-inch monofiliment).

Ripe rainbow trout were collected by electrofishing. Eggs were stripped, fertilized and left overnight in a cooler to water harden. The next morning they were counted into groups of 50 and placed with gravel in 4- x 6-inch fiberglass screen bags. Each bag was stapled closed and marked with plastic flagging. Artificial redds were built by fanning the bottom to create a hole. Two bags were placed in each redd and more gravel was fanned from upstream to cover the bags.

Fish Sampling

All game fish and a representative sample of other fish collected during sampling were measured to the nearest 0.1 inches and weighed to the nearest 0.01 pounds. A total count was made of all fish. Most adult rainbow trout collected were tagged with numbered Floy anchor tags.

Two 4- x 6-foot frame traps constructed of 1-inch square mesh and having 50-foot leads were fished in the upper dredge cuts in the spring to monitor walleye, sauger and northern pike spawning. One trap was fished on a gravel point at the south end of pond 1; the second on the west side of the narrows between ponds 1 and 2. These trap nets were set on April 18 and fished until May 6. They were checked every two to three days and all fish were measured and counted.

Gill Nets

Gill nets were set in the upper and lower dredge cuts and tailpool at sites established by Needham in 1979 (Figure 2). A series of 10 125- x 6-foot experimental gill nets with five mesh sizes ranging from 3/4 to 2 inches square mesh and 4 100- x 6-foot monofilament gill nets with 1/2-inch square mesh were fished during the spring, summer, and fall. All nets were set late in the afternoon and fished overnight.

Electrofishing

An 18-foot boat powered by an 85-Hp outboard jet was used for electrofishing in the main river, side channel and dredge cuts. This boat was equipped with boom mounted positive electrodes and was powered by a 240-volt gas generator attached to a Coffelt VVP-10 voltage regulating box. Pulsed DC current was used for most shocking; however, straight DC was used in some shocking for adult rainbow. Most shocking was done at night.

This same boat, generator and VVP were used with a mobile positive electrode to sample for YOY rainbow in the east side channel and to sample for forage fish along the shorelines of the dredge cuts.

A 35- by 6-foot x 1/4-inch minnow seine was used to sample the shoreline areas of the dredge cuts. This seine was worked through areas of flooded cover by wading.

Habitat Work

Field stone ranging from about 4 inches to 36 inches in diameter were used to construct two rock dikes in the east side channel. Boulders were collected north of Glasgow and hauled to the river. A rubber-tired front-end loader was used to place the boulders in the stream. These boulders were then rolled and placed by hand to build the dikes.

Washed and graded gravel ranging from 3/4- to 2 1/2-inch diameter was purchased from a local gravel pit and delivered to the riverbank. After the dikes were completed, this gravel was placed in the river above and between the dikes by a rubber-tired front-end loader. No attempt was made to spread the gravel evenly through the area. It was felt that high winter flows would move this gravel and distribute it more naturally in relation to the flows.

Dead cottonwood trees from along the riverbank were used to construct rainbow rearing cover in the east side channel. Logs were cut into 6- to 10-foot lengths and skidded to the riverbank. They were then notched and drilled with 1/2-inch holes. Each log was floated out to a desired location, held at an angle to the current and 4-foot lengths of 1/2-inch rebar with a T welded across the top were driven through the log and into the stream bottom to hold the log down. Additional log rearing cover was developed in one area by burying one end of some small trees and logs into a steep riverbank and allowing the other end to extend into the water, pointing slightly downstream.

Christmas tree reefs were placed in the upper dredge cuts with the help of two local sportsmen's groups. Big Muddy Sportsmen put approximately 150 trees in the west bay of pond 3. They stood trees up in cardboard buckets and poured concrete around the trunks. Wolf Point chapter of Walleye Unlimited put approximately 350 trees in the southwest bay of pond 1. They drilled holes through the trunks and roped several trees to a large concrete block. Both reefs were put out on the ice in the spring. The reef in pond 3 sank as the ice melted, but the other reef floated out on an ice flow and the trees had to be hauled back and sunk from a boat.

A 2-inch gas powered water pump, 2-inch diameter fire hose, and a 3-foot long high pressure fire nozzle were used to loosen and flush sediment and fine material out of gravel in two riffle areas in the lower end of the east side channel. The pump was mounted in a small boat and anchored in water deep enough to provide good intake flows. Water pressure was used to work the large nozzle into the gravel at a downstream angle to loosen gravel and float out fines which were then carried downstream by the current. Cleaning started at the top of the riffles and proceeded downstream working back and forth across the riffles. This kept the fines moving downstream until they settled out in a pool below the riffles. After cleaning was complete, a piece of rebar was marked with flagging and driven to the mark in the center of the loose gravel in each area. By checking the gravel levels in relation to these marks at a later date, it was possible to evaluate scouring of this loosened gravel.

RESULTS

Rainbow Trout Abundance and Reproduction

Because of the migratory nature of the mature rainbow spawning in the study area in the spring, it would be impossible to make a good population estimate on these fish by conventional means. Plans were to tag a large number of mature fish by electrofishing, then do an approximate recapture estimate by snorkeling to get some idea of population size. The abnormally high spring discharges in 1985 resulted in poor visibility in the side channel and made snorkeling ineffective. Therefore, little effort was made to shock and tag adult rainbow in 1985.

Thirteen adult rainbow were captured by electrofishing between late April and mid-June. The mean length and weight of these rainbow was 23.1 inches and 4.62 pounds, respectively. Five additional rainbow were captured in late May while trying to collect eggs; no measurements were taken on these fish. Two rainbow over 4.0 pounds were captured between Nelson dredge and the spillway in November while electrofishing for chinook.

Spawning

Rainbow redd counts in 1985 were comparable to counts made the previous two years. General spawning areas selected were the same as previous years, but actual site selection within these general areas was affected by higher spring discharges. The first redds were observed on 18 March when two redds were located in a lower riffle area in the side channel. By mid-April only 19 redds had been located. This contrasts with 1984 when 31 redds were located during the first count on 28 March and 111 redds had been counted by mid-April. Despite this slower start, a total of 291 rainbow redds were counted in the study area in 1985. This compares with final counts of 246 redds in 1984 and 187 redds in 1983 (Frazer 1985). The actual number of redds constructed was probably similar all three years. The major reason for the difference in these counts was the way the redd counts were made. The 1983 count is based on a random count of known spawning areas made during the last couple of weeks of the spawning season. No attempt was made to differentiate between new and old redds or to account for early redds that were no longer visible due to scouring, dewatering, or superimposition of new redds over old ones. In 1984, a total redd count was made in all major spawning areas on a biweekly basis throughout the entire spawning season. All located redds were marked on a map each count and an attempt was made to distinguish new versus old redds so that a running total of new redds could be maintained. Some redds constructed between counts were undoubtedly lost to scouring or superimposition before the next count and never got counted. Toward the end of the spawning run it became very difficult to distinguish new redds from old ones in some of the major spawning areas. Only known new redds were added to the total, so some questionable new redds were not counted. In 1985, complete redd counts were made on a weekly basis and all redds were again located on a map and a running total was maintained. Even weekly was not often enough to get a complete count, especially with the higher spring discharges experienced in 1985. These higher discharges had several impacts on redd locations and on redd counting success. Higher flows made it almost impossible to locate redds in the main river channel; even some areas in the side channel were so deep it was hard to see redds. Higher flows and stronger current velocities had a major influence on spawning area choice and on the distribution of redds within major spawning areas. Three major spawning areas have been identified in the side channel area in past years. In 1985, 78 percent of the redds counted were in the upstream most area; utilization of the two lower areas was reduced considerably. Figures 3, 4 and 5 compare the distribution of redds located in 1983, 1984, and 1985.

The upper side channel spawning area contained a better diversity of spawning habitat than the two lower areas, making it usable at a wider range of flows. At higher discharge levels the major spawning habitat in the two lower areas was subject to strong current velocities and high flow volumes. In 1985, the current and flow in these areas were apparently enough to discourage fish from using them.

These higher discharge levels also affected fish distribution in the upper spawning area by forcing fish out of the center of the channel and concentrating them in limited habitat along the edges. Sixty-six percent of the redds located in the upper spawning area were concentrated in two small areas, one on each side, where current velocities were reduced and some habitat was available. This caused several problems.

The spawning habitat in these areas, especially along the east bank, was of marginal quality, consisting of a thin layer of gravel over a clay base. This area also experienced more siltation problems than the main channel because it was located in a small side channel area.

Since most spawning was concentrated in small areas of habitat, there was considerable superimposition of later redds over earlier ones. Painted rocks were placed in the center of new redds to try to determine how much superimposition was occurring. During the peak spawning period, most of the rocks put out one week in these concentrated spawning areas were moved or buried the following week. Some of this may have been a result of current, but in most cases there were numerous new redds in the area and painted rocks were often found in the tails of these new redds.

Rainbow eggs are extremely sensitive to any kind of disturbance from spawning to eye-up, which takes two to three weeks at temperatures found below Fort Peck. Any eggs disturbed by other fish during this critical period were probably lost. Eggs could also be lost after eye-up if they were excavated by later fish and drifted downstream. It is likely that superimposition had a major impact on overall rainbow egg survival in 1985.

There was also the potential of extremely heavy egg losses in 1985 due to dewatering. The high discharge levels and associated flows forced most rainbow to spawn in shallow shoreline areas, so that even a slight drop in discharge levels during spawning and incubation could have dewatered a large percent of the total redds. This did not occur in 1985, but is a potential problem that should be considered in the future.

Measurements were made on a number of redds to determine the amount of substrate used by a spawning pair of rainbow and to determine what habitat criteria rainbow were selecting for. Table 2 shows the results of these measurements. The average redd covered approximately 16.25 square feet of substrate. The average depth of the redds measured was only 2.0 inches. Most literature and

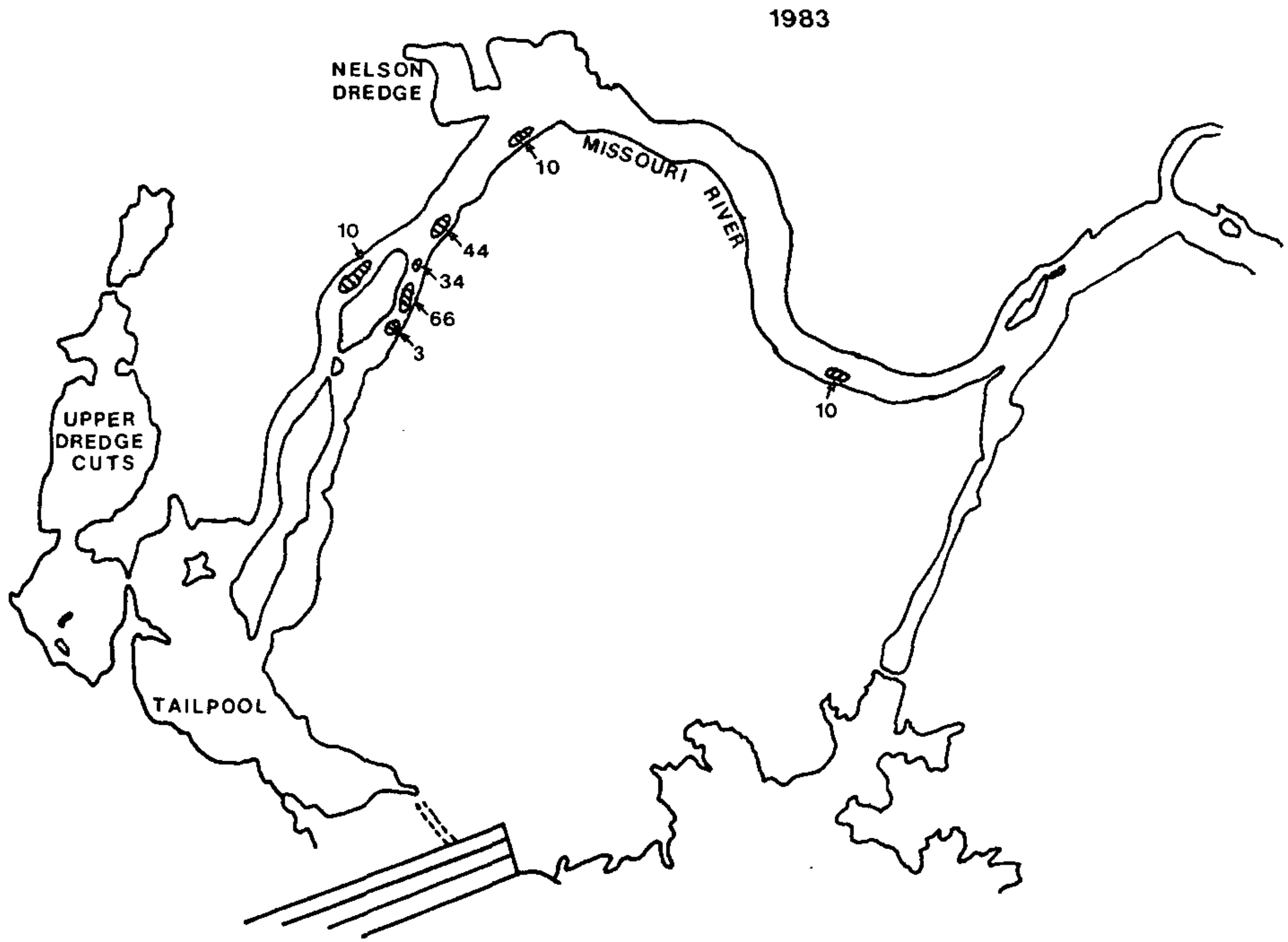

Figure 3. Distribution of rainbow redds located in 1983.

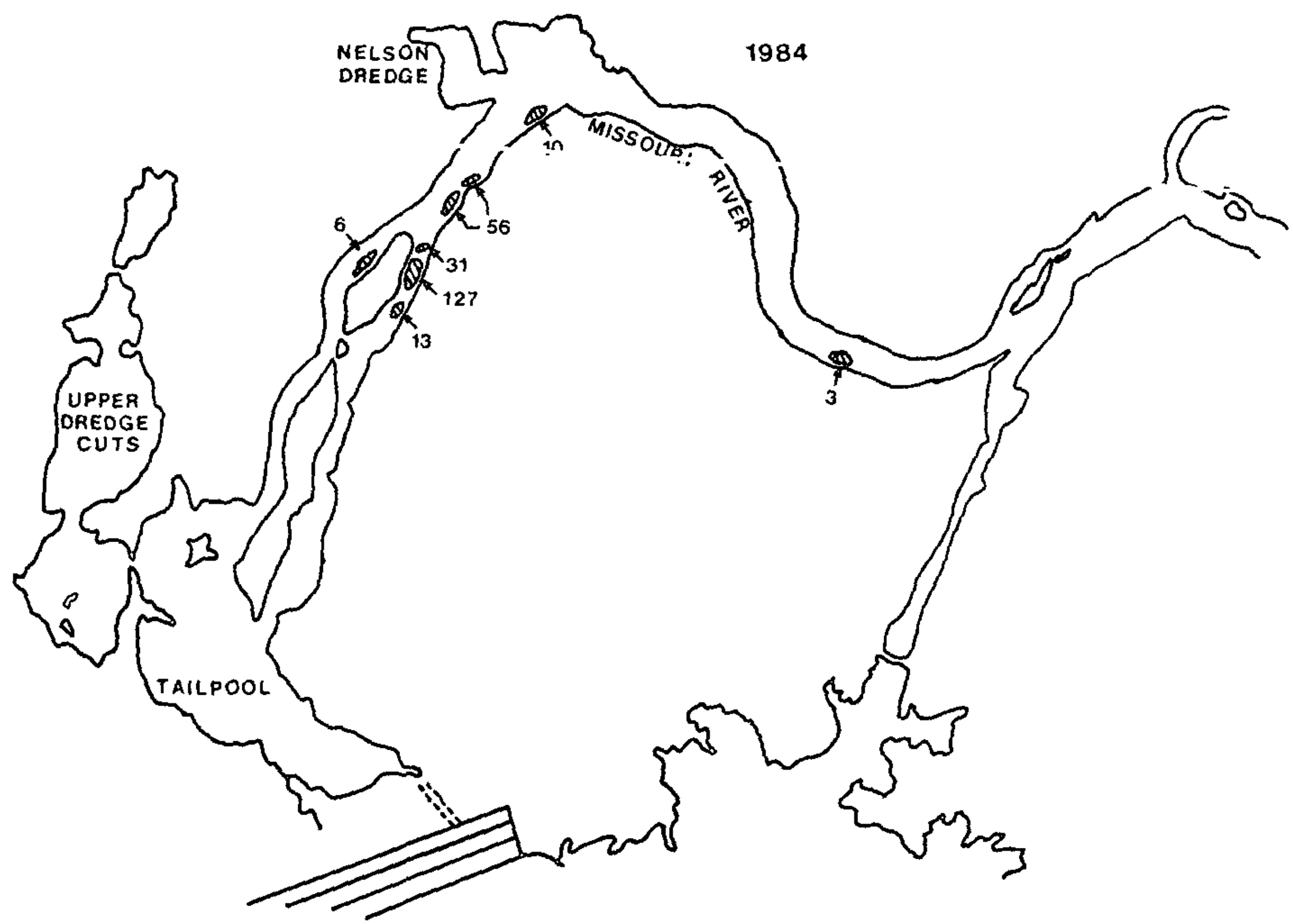

Figure 4. Distribution of rainbow redds located in 1984.

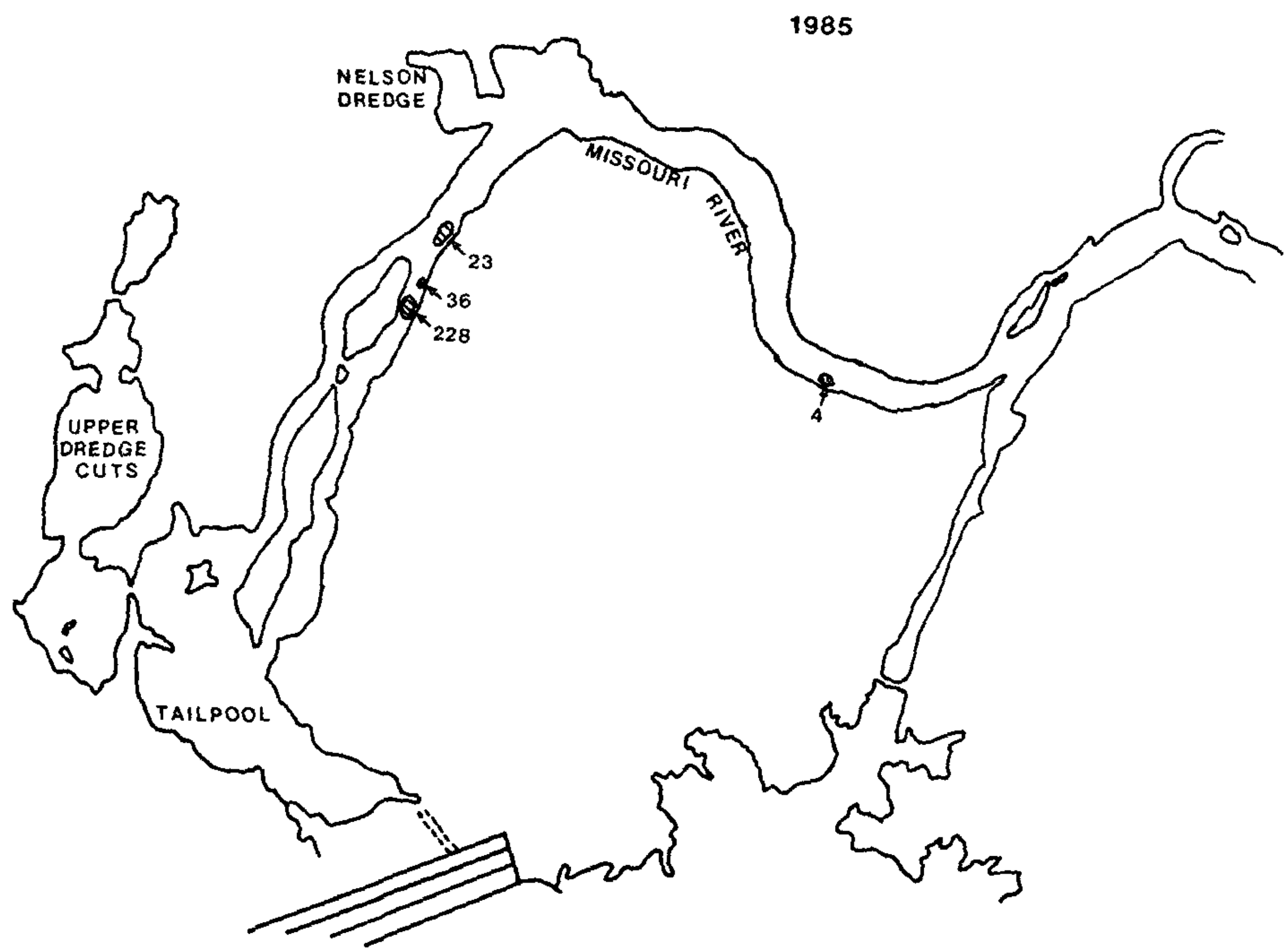

Figure 5. Distribution of rainbow redds located in 1985.

personal experience in other areas have indicated that salmonids normally bury their eggs 6 to 8 inches deep in the gravel. The 2-inch depth found in this study is an indication of the poor quality of the spawning substrate available in the study area. In many areas there is only 2- to 3-inches of gravel over a solid clay base.

Velocity was probably the single greatest factor that determined where rainbow spawned. All measurements shown in Table 2 were made during the day when discharges were about 15,700 cfs. Discharges were dropping to around 10,000 cfs for 5 to 6 hours at night and some of the higher velocity area may have been selected during these lower discharges.

Incubation

A total of 13 rainbow redds was excavated to determine egg survival on 20 June, 1985. This appeared to be about a week too late to get a good survival estimate since many sac fry may have been already emerged from the gravel. Eggs or sac fry were collected in all but one sample, but few of the samples contained many eggs or sac fry. Table 3 presents the results of this redd sampling. Based on these data, it appears that survival to emergence was quite high, especially if it is assumed that most dead eggs and sac fry were collected and that some live sac fry had already emerged. This would appear to be a reasonable assumption based on the small numbers of eggs and fry collected.

An average survival of 34.6% was determined for 10 redd samples made in the same area in 1984 (Frazer 1985). One possible explanation for the apparent higher survival in 1985 may be the better discharge levels that occurred during spawning in 1985. In 1984, minimum daily discharges were dropping to about 2,800 cfs during the peak spawning period in late April and early May. In 1985, minimum daily discharges were maintained above the recommended absolute minimum of 4,500 cfs from early April on, and were above 6,000 cfs for most of the spawning season.

An attempt to make artificial egg plants in 1985 was unsuccessful. No attempt was made to collect rainbow eggs until near the end of the spawning run to reduce the risk of artificial redds being destroyed by superimposition. Only two partially spent females could be collected, which limited the number of eggs. These fish were collected and spawned at night, and the eggs were left until the next morning to be bagged and planted. The eggs looked good in the morning but started to die as they were handled. Six bags of 50 eggs were planted in 4 artificial redds. One bag was checked after two weeks and all but two eggs were dead. The rest of the bags were checked two weeks later and only four live eggs were found. Most of the eggs appeared to have been dead for a long time, and it was assumed that mortality was due to handling before planting and not other factors.

Rearing

A mobile electrofishing unit was used to sample for YOY rainbow in the east side channel on two days in late August. Sampling on the first day was in the afternoon when discharges had stabilized at high levels and water had inundated as much rearing cover as it was going to. The second day was sampled early in the morning as water levels were rising and flooding new habitat. Many of the YOY rainbow seen the second day were right along the edges of the flow in only

Table 2. Size, depth and velocity measurements from rainbow trout redds sampled in 1985.

	Length (ft.)	Width (ft.)	Depth (in.) To Gravel Surface	Depth (in.) To Redd Center	Velocity (cfs)
Number Redds Sampled	31	31	40	40	41
Mean	5.8	2.8	23.0	25.0	2.42
Range	3.8-8.0	1.6-3.6	16.0-36.0	18.0-38.0	1.38-3.45

Table 3. Number of live and dead eggs and sac fry and percent survival in 12 rainbow redds excavated in 1985.

Number					Percent	
Live Eggs		Live	Dead	Dead		
Eyed	Uneyed	Sac Fry	Eggs	Sac Fry	Live	Dead
1	--	3	1	1	66.7	33.3
1	--	8	6	1	56.3	63.7
2	--	12	31	1	30.4	69.6
--	--	3	3	-	50	50
--	--	--	--	1	0	100
--	--	--	9	-	0	100
--	2	--	--	-	100	0
--	--	--	1	-	0	100
19	--	2	22	-	48.8	51.2
--	--	--	5	-	0	100
--	--	1	1	-	50	50
4	2	--	7	-	46.1	53.9
27	4	29	86	4	40	60

1.0 to 2.0 inches of water in areas that had just been flooded. This showed that these small fish were moving in and out daily with changing water levels.

A total of 245 YOY rainbow was captured or observed during approximately 3.5 hours of shocking. This catch was up considerably from similar sampling in previous years. Table 4 compares the total catch and sizes of YOY rainbow captured by shocking in the east side channel during August of 1983, 1984, and 1985. The large increase in catch between 1983 and 1984 was a result of changes in discharge patterns as explained in Frazer (1985). It is more difficult to explain the large increase in YOY rainbow seen between 1984 and 1985 since discharge patterns were similar during the rearing season both years. This increase may be a result of better total survival through emergence as explained above. The artificial rearing habitat put out in the spring of 1985 may also have improved total rearing success.

Table 4. Results of electrofishign conducted for YOY rainbow in the east side channel and main river during 1983, 1984, and 1985, total length and length range.

Sampling Dates	No. Fish Caught or Observed	Mean Length[1] (inches)	Length Range (inches)
8-21-83	32	2.0	1.4 - 2.6
8-20 & 8-21-84	140	2.0	1.4 - 3.1
8-22 & 8-23-85	245	2.0	1.3 - 3.1

[1] Only 136 fish were captured and measured in 1985.

The average size of YOY rainbow collected from the side channel in August has remained constant from 1983 through 1985. There was a difference in size between YOY rainbow collected from some artificial rearing cover and from other areas in 1985. This is explained in more detail in the habitat improvement section.

Walleye and Sauger Abundance and Reproduction

Table 5 presents data on walleye and sauger collected in standard spring, summer, and fall gill-net sets in 1985. This table also shows seasonal catches of walleye and sauger for 1984 and 1983. The walleye catch in 1985 was similar to the walleye catch seen the preceding two years. There were no obvious differences in the walleye catch between seasons in 1985.

Table 5. Summary of seasonal walleye and sauger catches in ten 125-foot experimental gill nets fished at standard locations, 1983-1985.

		Spring			Summer			Fall		
Year	Species	No.	Mean Length (in.)	Mean Weight (lbs.)	No.	Mean Length (in.)	Mean Weight (lbs.)	No.	Mean Length (in.)	Mean Weight (lbs.)
1985	Walleye	10	17.4	1.85	6	14.1	0.82	8	17.3	1.82
	Sauger	21	16.4	1.54	41	14.4	0.93	40	16.0	1.27
1984	Walleye	10	17.3	1.64	8	13.6	0.92	4	14.1	0.85
	Sauger	29	13.4	0.63	14	12.6	0.50	44	14.1	0.91
1983	Walleye	11	17.9	2.05	8	17.2	1.58	4	16.7	1.40
	Sauger	1	18.7	1.79	12	14.3	0.92	18	14.1	0.86

In 1984, the spring and fall sauger catch rates were up considerably over previous years. In 1985, the sauger catch rates were up during all three netting periods.

Table 6 summarizes the catch rate of walleye and sauger in 10 summer experimental gill nets set at standard locations from 1979 through 1985. The high catch rates observed in 1980 corresponded to a large run of rainbow smelt that moved into the study area that year (Needham and Gilge 1983). The high sauger catch in 1981 was probably a carry-over from 1980. Other than 1980, the summer walleye catch has remained very constant through 1985. Sauger catch rates, on the other hand, showed a significant increase in 1985 as mentioned above.

Table 6. Summary of walleye and sauger catch from ten 125-foot experimental gill net sets during the summer in Fort Peck dredge cut/tailwater area, 1979-1985.[1]

	Walleye			Sauger		
Year	No.	Mean Length (in.)	Mean Weight (lbs.)	No.	Mean Length (in.)	Mean Weight (lbs.)
1979	8	16.4	1.48	7	15.3	0.96
1980	27	16.8	1.80	67	14.7	1.03
1981	9	17.4	1.86	47	15.0	0.93
1982	7	18.3	1.82	9	16.1	1.06
1983	8	17.2	1.58	12	14.3	0.92
1984	8	13.6	0.92	14	12.6	0.50
1985	6	14.1	0.82	41	14.4	0.93

[1] 1979-1982 data from Needham and Gilge, 1983.

Spawning

The numbers, size, and spawning conditions of walleye and sauger collected by trap netting and electrofishing during the spring of 1985 are presented in Table 7. Trap netting conducted in 1984 indicated there may be some sauger spawning on two gravel points in the upper dredge cuts (Frazer 1985). Frame trap nets were set on these two points in mid-April, 1985 and fished until early May. Water temperatures during this time ranged from 7.5° to 12.5° C, which should have been ideal for walleye and sauger spawning. Koenst and Smith (1976) identified the optimum fertilization temperatures for walleye from 6.0 to 12.0° C and the optimum temperature for sauger as 9° C. No walleye were collected in either trap net in 1985. A total of 15 sauger was captured, but no ripe or spent females were caught. No eggs were collected in the five egg trays placed on each point during the trapping. Despite the higher spring discharges which provided better water levels for spawning, there was no evidence of sauger or walleye spawning in the dredge cuts in 1985.

The number of walleye and sauger spawning in the main river 8 miles below the dam was up significantly in 1985 (Table 7). All but three walleye and one sauger shown were captured in the gravel bar area near the USGS gage house. This area was first electrofished during the day on 1 May. Only four walleye and one sauger were captured. The area was electrofished again the next night; 44 walleye and 10 sauger were captured. These results indicated that night electrofishing was more productive than daylight electrofishing in this shallow, clear water. Two of the walleye captured on 1 May were gravid females, which indicated that a major part of the run should have been present by that time and not just a few early males. None of the females collected the next night were ripe, but they were all close. This again indicated we were still early in the run. There were still a lot of fish in the area four nights later but a lower percent of these were females. One ripe female walleye and one spent female sauger were captured. This was the last night an electrofishing boat was available, so it is not known how much longer this run lasted.

The average weight of both sexes of walleye was almost 3 pounds. Several females over 8 pounds were captured. This run consists mostly of migratory fish from Garrison Reservoir. Normally, most of these fish migrate to this area to spawn and then return immediately downriver (Frazer 1985; Gardner and Stewart 1986). In 1980, when large numbers of smelt migrated up to Fort Peck, many larger walleye and sauger remained in the study area all summer (Needham and Gilge 1981). It is hoped that as the forage base begins to increase below the dam, many of these larger fish will again remain in the area after spawning and eventually become permanent residents.

Kick nets were used to sample for eggs over the gage house gravel bar two days after the last electrofishing run. Eight kick samples were taken at random sites over a small area of the gravel bar. Stizostedion sp. eggs were collected in all but one sample, indicating spawning was quite extensive. No attempt was made to sample for larval fish once they hatched. No YOY walleye or sauger were collected during sampling efforts in 1985.

Table 7. Number, mean size, and spawning condition of walleye and sauger collected by electrofishing in the Missouri River downstream from Fort Peck Dam during the spring of 1983-1985.

					Spawning Condition[1]				
					Male	Female			Unknown
Year	Species	No.	Mean Length (in.)	Mean Weight (lbs.)	Rp	Rp	Gr	Sp	
1985	Walleye	75	19.3	2.96	59	3	13	--	--
	Sauger	13	16.0	1.27	7	--	2	1	3
1984	Walleye	22	20.2	2.87	19	1	2	--	--
	Sauger	4	15.7	1.09	1	--	1	--	2
1983	Walleye	21	18.8	2.25	17	2	1	--	1
	Sauger	5	19.0	1.94	--	--	3	--	2

[1] Rp = ripe, Gr = gravid, Sp = Spent.

Northern Pike Abundance and Reproduction

The number of northern pike handled in 1985 was up from previous years. The greatest increase came in the number of northerns captured in the dredge cuts during spring trap netting. Table 8 presents data on northern pike collected in 1985. The spring gill net catch was similar to past years; summer and fall gill net catches were up slightly. Sizes were similar to previous years.

A total of 58 northern pike was captured in two trap nets fished in the dredge cuts during the spring of 1985; most were ripe and ready to spawn. By the time the trap nets were pulled, the northern catch had dropped off significantly and some of the last northern caught were spent. This indicated that spawning had taken place during the time the trap nets were out.

Previous work has indicated that northern pike spawning does occur in the dredge cuts, but no YOY northerns have ever been captured in the study area. Under normal discharge patterns, the dredge cuts have experienced large daily fluctuations in water levels during the spring spawning period. During spawning, northern pike move into shallow water and deposit their adhesive eggs on flooded vegetation. If spawning occurs during high water levels which are required to flood vegetation around the dredge cuts, then water levels drop, most of the eggs are dewatered and lost.

The higher spring discharge levels accompanied by higher minimum discharges seen in 1985 greatly improved spawning conditions for northerns in the dredge cuts. Higher water levels flooded more shoreline vegetation and more of this vegetation remained under water all the time.

During seining in early July, one 4-inch northern pike was captured in the upper dredge cuts. This was the first YOY northern captured in this area. High water levels made it difficult to effectively seine the dredge cuts since water extended back into the shoreline vegetation and small fish could escape the seine. Shoreline electrofishing was tried as an alternative method to sample this flooded vegetation but proved to be ineffective.

No more YOY northerns were captured, so it could not be determined how successful northern pike spawning was in 1985. Based on the large number of ripe northerns captured in the spring, and the favorable water levels that existed at that time, it is likely that spawning success was quite high.

Table 8. Number, size and spawning condition of northern pike captured in frame traps and gill nets in 1985.

Sampling Method	No.	Mean Length (in.)	Mean Weight (lbs.)	Spawning Condition[2] Male Rp	Male Sp	Female Rp	Female Sp
Frame Traps (Spring)	57[1]	25.6	4.56	35	3	17	2
Gill Nets (Spring)	4	24.3	3.49				
Gill Nets (Summer)	6	26.8	4.16				
Gill Nets (Fall)	11	28.7	6.58				

[1] One northern pike was lost before it was worked.
[2] Rp = ripe; Sp = spent

Forage Fish Abundance and Reproduction

The total number of forage fish collected in the study area in 1985 was low, but there were several important findings concerning the forage fish population. Table 9 shows the numbers and species of forage fish collected by seining, trap netting electrofishing, and gill netting in 1985. Numerous small suckers were observed in the east side channel in August while electrofishing for YOY rainbow. No attempt was made to capture and count these suckers; they are not included in the table.

Suckers and emerald shiners were the most common forage species collected during spring seining. No attempt was made to differentiate between longnose and white suckers. Only six spottail shiners were collected during the spring. Spottails were introduced into Fort Peck Reservoir as a forage fish in 1982 and 1983. Seining results indicated they were well established in the reservoir by the fall of 1983 (Wiedenheft 1984). They were first collected below Fort Peck Dam in the spring of 1984. Large numbers were captured by seining in both the upper and Nelson dredge cuts after they had apparently passed through the dam during the winter and moved into the dredge cuts (Frazer 1985). These spottails ranged in size from 1.3 to 2.6 inches total length. Five of the six spottails caught in the spring of 1985 averaged 3.5 inches total length and were probably survivors from the previous year. The apparent lack of small spottail shiners in the spring of 1985 indicated that recruitment through the dam or from natural reproduction was low in the winter of 1984-85. These results may be somewhat misleading since flooded vegetation due to higher water levels in 1985 made it difficult to effectively seine the dredge cuts.

Electrofishing was tried as an alternative method to sample small fish hiding in this flooded vegetation, but did not appear to be very effective. The same areas of the upper dredge cut were shocked in the morning as water was just beginning to flood vegetation and again in the afternoon after water was well back in the vegetation. Large numbers of carp were present in the flooded cover, but only two small fish were seen; neither was caught. The large number of carp moving in the shallow areas may have driven most of the small fish out. These carp also made it difficult to see, because they created turbidity in the shallow water. Nelson dredge cut was shocked mid-afternoon between the two sampling periods in the upper dredge cut. There were fewer carp present and all of the fish reported under electrofishing in Table 9 were captured in Nelson dredge. Suckers were again the predominant species captured.

In the spring of 1985, Big Muddy Sportsmen Club seined approximately 15,000 5- to 6-inch yellow perch from the Dredge Cut Trout Pond and planted them in the upper dredge cuts. The perch caught during the seasonal gill netting were probably from this plant.

Only two rainbow smelt were captured in 1985, one each in a spring and a summer gill net. Cisco were collected for the first time below Fort Peck Dam in 1985. Cisco (Coregonus artedii) were first introduced into Fort Peck Reservoir in the spring of 1984 when approximately 9.4 million fry were planted in an attempt to establish a new forage fish population. An additional 10 million fry were planted in the reservoir in the spring of 1985. In January of 1985, three cisco were found floating in the tailrace below Fort Peck Dam. Four more were collected from the same area in early March. These fish ranged from 6.5 to 7.7

Table 9. Total catch of forage fish by various methods during 1985.

Species	Trap Nets	Gill Nets	Spring Seining	Fall Seining	Electrofishing
Spottail Shiners			5	14	
Cisco		5			
Suckers (White & longnose)			26		11
Yellow Perch	4	12		2	
Rainbow Smelt		2			
Western Silvery Minnows		2	6		
Emerald Shiners			24	3	
Fathead Minnows			1	1	1
Flathead Chub				1	1

inches total length and were from the 1984 plant. The first live cisco were captured from the study area during summer gill netting in 1985. Two were captured in gill nets in the upper tailpool and two more from Nelson dredge. One additional cisco was captured in the tailpool during fall gill netting. All of these fish were around 10.5 inches long. This showed that cisco were successfully passing through the dam.

Reproduction

The capture of gravid females and YOY forage fish in the study area in 1985 showed there was some forage fish reproduction occurring. Gravid emerald shiners, western silvery minnows, and spottail shiners were captured in the dredge cuts while seining in early July. Numerous adult suckers were observed in the riffle areas of the east side channel while shocking for adult rainbow in the spring. Sucker eggs were recovered in the side channel while sampling for rainbow eggs, and numerous small suckers were seen while shocking for YOY rainbow in August, indicating that sucker spawning was successful.

Based on size, all of the forage fish captured in the dredge cuts during fall seining were YOY fish. The most important find was the capture of 14 YOY spottail shiners. This was the first time that YOY spottail were captured below Fort Peck Dam. Young-of-the-year spottail were captured in three of eleven seine hauls and in all three ponds of the upper dredge cuts indicating that spottail reproduction was probably quite extensive throughout the dredge cuts.

Cisco are doing very well in Fort Peck Reservoir and matured sooner than expected. Large numbers of sexually mature cisco were captured in Fort Peck Reservoir in the fall of 1984 indicating that spawning probably occurred (Wiedenheft 1986). As the cisco population increases in the reservoir, the number of cisco passing through the dam should also increase. None of the cisco captured below Fort Peck Dam in 1985 looked like they would mature that fall, but cisco should be able to mature and reproduce below the dam, and could make a tremendous contribution to the forage base in the study area in the near future.

Chinook Salmon

The Montana Department FWP has been stocking chinook salmon in the Missouri River below Fort Peck Dam in an attempt to develop a natural spawning run. The first plant occurred in the spring of 1983 when 45,000 3- to 5-inch pre-smolt chinook were released in the Fort Peck tailwaters. Approximately 216,000 chinook fingerlings were planted in the spring of 1984 and 105,000 in 1985. Plans are to continue this stocking program in hopes of establishing a self-reproducing salmon run below Fort Peck Dam to benefit the sport fishery. It is hoped that these chinook fingerlings will migrate to Garrison Reservoir to grow and mature, then return to the Fort Peck tailwaters to spawn.

Chinook normally spawn as four-year-olds; however, some males may run at three. Chinook planted in 1983 were three years old in the fall of 1985. The tailrace, the east side channel, and the main river down to the spillway were electrofished in mid-November to determine if any of the males from this first plant returned to the study area in 1985. Two adult rainbow were captured, but no salmon were seen.

On 13 January 1986, an ice fisherman brought in a ripe male chinook salmon he had captured in the upper dredge cuts. This fish weighed just over 3.0 pounds and was in very good condition. Scale analysis showed it was three years old. There was not way to tell if this fish was a returning male from the 1983 plant in the tailpool or if it had remained in the tailwater area for three years and never migrated downstream. He may have even passed through the dam from plants made in the reservoir. More effort should be devoted to looking for chinook in the study area to try and determine if some of them remain in the area after planting. Approximately 500 chinook planted below the dam in the spring of 1985 were marked with small numbered tags to determine if these fish actually do migrate downstream to Garrison Reservoir. Chinook planted in Fort Peck Reservoir in 1986 will be marked with tetracycline before planting making it possible to differentiate between river and reservoir fish in the future.

Almost five times as many chinook were planted below Fort Peck Dam in 1984 compared to 1983. These fish were also in much better condition when planted. It is anticipated that there could be a good run of three-year-old males from this plant in the fall of 1986. There should also be a run of four-year-old fish from the 1983 plant. Considerable effort will be spent in cooperation with regional fisheries personnel trying to determine if and when chinook start to return to the Fort Peck area and to identify where these fish congregate. Spawning habitat will be monitored to determine if any spawning does occur.

Habitat Improvement Work

Several habitat improvement projects were initiated in 1985; only a limited amount of evaluation has been possible to date. Much of this work has been done to benefit rainbow trout in the study area, but should also benefit chinook salmon if they start returning to the area to spawn.

Rock Dikes and Spawning Gravel

The major habitat improvement work implemented in 1985 involved the construction of two large rock dikes and the addition of spawning gravel at a major rainbow spawning riffle in the east side channel. Figure 6 shows the approximate location of this work and diagrammatic sketch of the project. Each dike was approximately 50 yards long, 24 to 36 inches high, and built diagonal to the flow. Anderson, Ruediger, and Hudson (1984) compared several different designs for instream habitat structure and found the diagonal to be the best design. They also found that structures constructed of boulders worked as well as rock-filled gabions in large streams. Our dikes are a modification of Anderson's design since our dikes do not connect to the banks.

These dikes were designed with several purposes in mind: 1) They were to act as partial dams to reduce current velocities in the center of the channel. This allowed spawning gravel to deposit and remain in the channel and allowed spawning fish to use these areas even at high flows. A major part of these dikes will remain flooded at low flows; at high flows they will act as current breaks. 2) They should provide the same kind of rearing cover as provided by the logs, but the dikes should be more permanent. 3) These dikes should also provide excellent habitat for aquatic invertebrates which would increase the food supply available for rearing fish. 4) These dikes were designed to force more water over the large gravel flat at their downstream end (Figure 6). This area contained good spawning gravel that was usually too shallow to be used by spawning fish under normal flow conditions. By increasing water depth over the gravel with the help of the dikes, this flat should become available to spawning fish over a wide range of flows. Many of the larger boulders embedded in this gravel flat were dug up and placed on top of the gravel to help reduce bottom armoring and to provide additional rearing cover.

Approximately 80 cubic yards of washed 3/4- to 2 1/2-inch spawning gravel was placed in the channel above and between these dikes, and left to be distributed by the current. Since the greatest discharges from Fort Peck Dam normally occur during the winter, it was hoped that this gravel would be distributed and somewhat stable before rainbow started to move into the area in the spring of 1986.

Once the gravel was in place, boulders ranging from about 12- to 24-inches in diameter were placed individually and in groups between the dikes. These boulders will provide cover for adult fish that move into the area to spawn. Anderson, et al., (1984) found that spawning fish avoided open gravel bars created by structures when hiding cover was insufficient. These boulders should also provide additional rearing cover for YOY rainbow.

This new habitat will be intensively evaluated during the spring and summer of 1986. The new spawning gravel will be monitored to determine how much it is

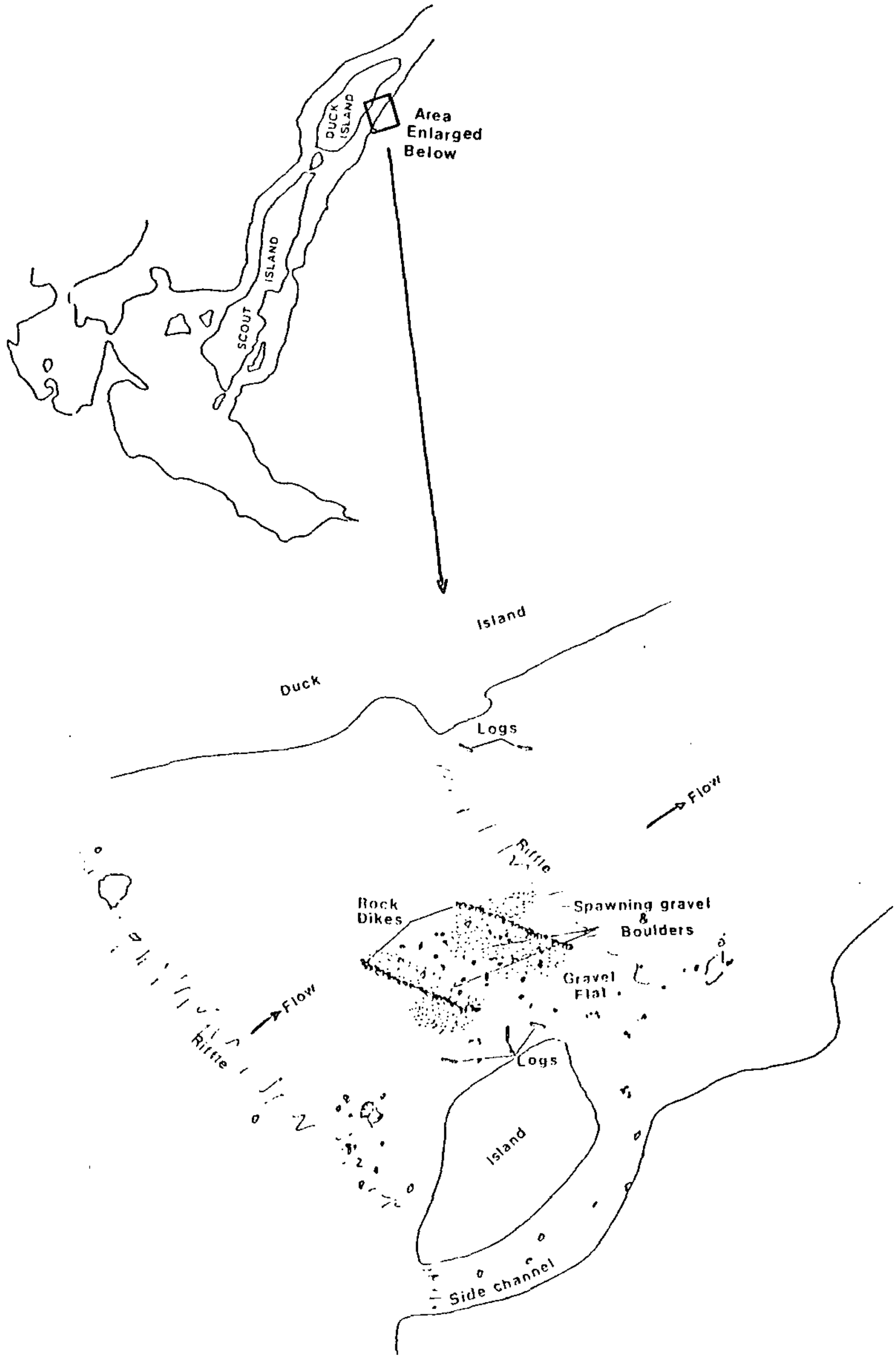

Figure 6. Location and diagramatic sketch of major habitat improvement work completed in the study area in 1985.

used by spawning rainbow. Artificial egg plants will be used to evaluate egg survival in the new gravel and compare it to natural spawning gravel. Fry emergence traps will be used to monitor fry survival. Electrofishing and snorkeling will be used to evaluate use of the dikes and boulders. The whole area will be monitored in the fall to determine if any returning chinook salmon use the new habitat for spawning or staging.

More gravel is available and will be put out in the fall of 1986 if studies show the present habitat work is benefiting the downstream fishery.

Log Rearing Structures

Two types of log structures were placed in the side channel during the spring to test their effectiveness as rearing cover for rainbow. Five logs were placed in the channel near the upper spawning riffle. These logs ranged from 6 to 10 feet long and 8 to 16 inches in diameter. They were staked in the channel at an angle to the current with rebar driven through the logs and into the stream bottom. The elevation of these logs varied so that two logs remained in the water all the time and the other three became dewatered at different decreasing flows. One additional log was anchored in deep water near a spawning area at the lower end of the side channel. This was an important spawning area, but contained almost no rearing cover. The bank in this area was a very unstable vertical sand bank that provided no cover. A number of small trees and logs were laid along this bank with their bases buried in the bank and trunks and branches extending out into the river and slightly downstream. It was hoped that these trees would provide fish cover and also help stabilize the bank near the spawning area.

The side channel was electrofished in late August for YOY rainbow. At this time daily discharges from the dam were fluctuating between 6,500 cfs and 11,500 cfs. The three shallower logs in the upstream area were being dewatered on a nightly basis. The water level had just reached these logs a short time before they were shocked, yet all three logs held fish. At least one YOY rainbow was collected from each log with a total of six rainbow and several small suckers being collected. It appeared that fish were moving in with rising water levels and moved to the logs as soon as they were flooded.

One of the two deeper logs pulled partly free from the bottom and had turned parallel with the flow. The current along the sides of this log was very strong and the log provided very little protective cover. No fish were found in association with this log. The other deep log remained in place and was providing good cover and a good current break. This log held 10 YOY rainbow and at least 2 suckers. Nine of these rainbow were captured and measured. They were significantly larger than the YOY rainbow captured from other areas. The average total length of the 9 rainbow captured from this one deep log was 2.6 inches; the largest of these fish was 3.1 inches long. In comparison, the average total length of 127 other YOY rainbow captured throughout the rest of the side channel was 1.9 inches. Only 2 of these fish were longer than 2.6 inches and 1 of these was collected from the deep log placed at the lower end of the side channel. It appeared that the rainbow using this deeper log were remaining at this log and not using up energy to move in and out with fluctuating flows. This could account for the faster growth and larger size seen in these rainbow.

Water levels were low enough when the lower habitat area was shocked that most of the logs buried along the bank were dry. One tree had several branches extending out into the water that had collected algae. The one log that had been staked to the bottom was also in water. Eight of the 10 YOY rainbow collected from this area were using this limited artificial habitat as cover. Again, one of the rainbow using the deep log was 3.0 inches long.

Based on these results, it appeared that additional rearing habitat could greatly benefit YOY rainbow rearing in the side channel. This rearing cover should be deep enough to remain wetted at low flows and provide a current break so small fish can use it during high flows. Logs provide a good current break but are hard to keep in place in deeper water. All but one of the instream logs installed in the spring of 1985 had moved or were totally gone by early January, 1986. If additional logs are to be used in the future, a better method should be developed to secure them to the stream bottom.

Artificial Reefs

Lack of spawning and protective cover in the dredge cuts due to continually fluctuating water levels has been identified as a major factor limiting the development of both forage and game fish populations in these areas. In an attempt to help solve this problem two Christmas tree reefs were placed in the upper dredge cuts in the spring of 1985 with the help of local sportsman groups.

Big Muddy Sportsmen's Club placed trees in about 18 to 20 feet of water in pond 3. Wolf Point chapter of Walleyes Unlimited put a reef in a shallow bay in pond 1. This bay is only about 13 feet deep at full pool. The reef in pond 3 will be difficult to evaluate because of its depth, but should provide good deep water cover for both forage and game fish. The reef in pond 1 should be shallow enough to provide some spawning substrate for fish like yellow perch, as well as providing hiding cover for both forage and game fish.

Perch spawn in water depths of 3 to 12 feet, but they require some form of flooded vegetation or other substrate on which to spawn (Krieger, Terrell and Nelson 1983). Very little natural spawning habitat is available for perch in the dredge cuts due to fluctuating water levels. The vegetation that is present is only flooded at high water and is subject to dewatering as water levels drop. If perch do spawn in these areas during high water, their eggs will be dewatered as water levels drop. The reef in pond 1 should provide substrate shallow enough for spawning but deep enough to remain flooded at low water.

In the spring of 1985, Big Muddy Sportsmen's Club seined approximately 15,000 perch from the dredge cut trout pond and moved them to the upper dredge cuts. Most of these perch were ripe and ready to spawn. Plans are to continue moving perch into the dredge cuts on an annual basis if possible. These reefs should be an important factor in the future success of these plants. They will also be very important in the development of other forage populations in the dredge cuts such as spottail and cisco.

The best method to evaluate these reefs would be by direct observation using SCUBA. By the time the ice melted and the reefs sank in the spring of 1985, visibility in the dredge cuts was too poor for diving. Attempts to sample the shallow reef by electrofishing were unsuccessful. An attempt will be made to dive on these reefs earlier in the spring in 1986. It may also be possible to evaluate fish use with a recording fish locator.

Plans are to continue working with local sportsmen to make these reefs an annual club project. The possibility of using other reef structures in the dredge cuts will also be evaluated.

Gravel Cleaning

A high-pressure water pump was used to loosen and clean spawning gravel in two test areas in the east side channel. Under normal discharge patterns these areas appeared to have necessary flow and habitat requirements for rainbow trout spawning, but no spawning had been documented in these areas. The gravel in these areas was very compacted with a high concentration of sediment. A strong jet of water was used to work the test areas and float some of the sediment out. Loosened sediment was carried downstream and settled out below the riffles. This procedure seemed to work very well. There was a large pile of sand and silt deposited at the edge of the current just below each riffle test area, and the gravel remaining in the test area felt very loose. It was easy to feel the difference in gravel compactness walking from an unworked to a worked area. Tests using a marked stake showed that this loosened gravel remained in place even during high flows.

It was not possible to evaluate the effectiveness of this cleaned gravel in attracting spawning rainbow. The higher than normal spring discharges in 1985 completely changed the flow patterns and water depths in the side channel during the spawning period. An area on the same riffle as the cleaned areas that had been a major spawning area in the past received little spawner use in 1985. No spawning occurred over either cleaned area in 1985. This was probably due more to water conditions than to lack of good spawning substrate.

Water Management Program

A combination of higher average spring and summer discharges to benefit the reservoir fishery and higher minimum daily discharges to benefit the downstream fishery resulted in improved production of both forage and game fish below Fort Peck Dam in 1985.

The operational pattern and resulting water management program at Fort Peck Dam affects fisheries in both Fort Peck Reservoir and the tailwater and dredge cut area below the dam. As a result, any water management for the area has to balance the needs of both fisheries which, at times, can be difficult.

In 1985 the Reservoir Control Center was able to provide a water management plan for Fort Peck that benefitted both the reservoir and the downstream fisheries. The COE agreed for the first time in 1985 to try and manage the Missouri River mainstem reservoir system in an unbalanced manner for the benefit of the fishery. The 1985 management plan for Fort Peck Reservoir called for a drawdown of the reservoir during the summer to allow vegetation to establish along the shorelines. To accomplish this, discharge levels from Fort Peck Dam had to be maintained at high levels during the spring and summer. This resulted in higher than normal average flows downstream.

Previous work demonstrated that low instantaneous discharges for even a few hours can have serious impacts on rainbow trout spawning and rearing success below Fort Peck Dam irregardless of average daily discharge levels (Frazer, 1985). As a result, FWP made recommendations to the COE concerning minimum instantaneous discharge levels to be maintained from Fort Peck Dam during rainbow spawning and rearing. The 1985 recommendations called for a recommended minimum instantaneous discharge of 6,700 cfs with an absolute minimum instantaneous discharge of 4,500 cfs from April 1 through September 15.

The Reservoir Control Center tried to stay within these recommendations in 1985. Minimum daily discharge levels were brought above the recommended minimum level of 4,500 cfs on April 8, and minimum hourly discharges did not drop much below 4,500 cfs again until September 18. Minimum discharge levels were maintained above 6,700 cfs during most of the spring spawning season (Figure 7).

The greater average discharge level and the better minimum discharges in 1985 have several impacts on the fishery below Fort Peck Dam. The higher average spring discharges caused some problems during rainbow spawning, but the overall effects of this water management plan were beneficial to the downstream fishery.

As discussed in the section on rainbow trout spawning, the higher average spring discharges affected spawning site selection. Higher discharges resulted in increased flow volumes and water velocities in the east side channel which forced most spawning fish out of the center of the channel. This concentrated most of the spawning activity in a few isolated areas along the edge of the channel which resulted in considerable superimposition of later redds over early ones and probably affected overall egg survival. This was the only problem identified with the 1985 Fort Peck water management plan in regards to the downstream fishery. The habitat work completed in the fall of 1985 should reduce this problem in the future. The dikes and added spawning gravel were

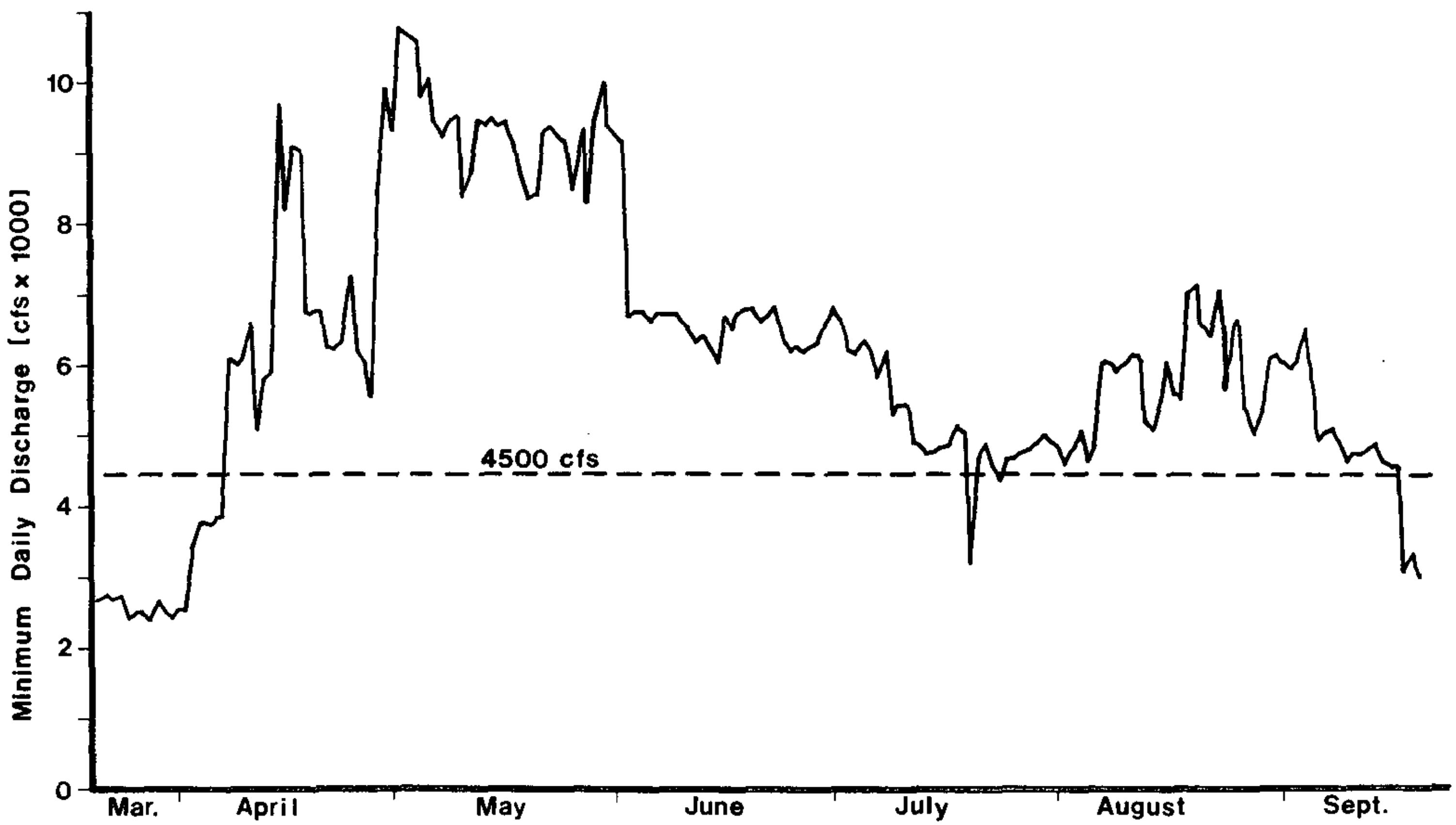

Figure 7. Minimum daily discharge from Fort Peck Dam during rainbow trout spawning and rearing in 1985.

placed to provide good spawning habitat and reduced current velocities in the center of the channel even during higher discharges.

The 1985 discharge pattern had several positive effects on the downstream fishery. The higher average discharge levels resulted in better water levels in the dredge cuts during the spring when both forage and game fish were spawning. Higher water levels flooded more shoreline vegetation and provided better spawning conditions. The higher minimum discharge levels helped maintain more water in vegetation so there was less chance of eggs being dewatered along the shoreline. Successful northern pike, yellow perch, and spottail shiner spawning was documented in the dredge cuts in 1985.

The number of walleye spawning below Fort Peck Dam was up in 1985. This may have been due partially to the better flows in the lower Missouri as a result of higher spring discharges.

Higher minimum daily discharge levels helped maintain better water levels in the side channel during rainbow spawning. Even though most spawning was concentrated along the shoreline in shallow water, the number of redds lost due to dewatering was low. The higher minimum discharge levels also helped maintain a better growth of filamentous algae in the side channel which resulted in better rearing cover for YOY rainbow. The number of YOY rainbow captured in the side channel during late summer in 1985 was up considerably from previous years.

These results showed that water management can be an important tool in maintaining and improving the fishery below Fort Peck Dam. By combining water management with habitat improvement, it should be possible to develop a long-term water management plan for the study area that will fit within the other operational constraints faced by Reservoir Control.

Potential Long Term Plans

The habitat improvement projects being tested as part of this contract are small scale projects designed to evaluate their effectiveness in solving some of the fisheries problems identified below Fort Peck Dam. If these projects prove to be beneficial to the fisheries on a small scale, it is important to begin programming for an expansion of these ideas on a larger scale. The existing habitat work should be expanded and there are several other areas in the east side channel and main river where additional spawning and rearing habitat is needed. There are also numerous areas where natural habitat has been seriously degraded due to siltation. Much of this habitat is no longer usable for spawning because of high concentrations of fines and gravel compaction resulting from these fines. Many of these areas could be reclaimed and expanded.

Siltation is a serious problem in the study area because of unstable, erosive river banks, fluctuating water levels below Fort Peck Dam and the surrounding highly erosive soils. Fines were already starting to accumulate in the new gravel put out in 1985. In order to obtain maximum benefits from habitat work completed in the study area, a long term maintenance program involving periodic cleaning of spawning gravel should be developed.

To make sure that the habitat improvement work planned for the east side channel would not adversely affect existing rainbow spawning, Don Reichmuth was contracted to evaluate the proposed habitat project. Don is a consultant who has done considerable work for FWP in the past. His firm was also asked to look at the general hydrology of the study area in relation to existing fisheries and water management problems. Based on their evaluation, they proposed a plan for regulating water levels in the study area using two weir structures, one in the main west channel and one in the east side channel. Figure 8 shows the general location and a diagramatic sketch of these two weirs.

The weir in the west channel would be about 3 to 5 feet high and would be under water all the time. This weir could be designed level or with a notch in it to facilitate boat passage. The purpose of this weir would be to increase head in the tailpool and river upstream so at low discharge levels more water would be forced down the east channel. This would help maintain necessary minimum spawning and rearing flows in the east side channel during periods of low discharge.

The weir in the east channel would contain a series of culverts to allow all water to pass through during low flows. During high discharge levels the top of this weir above the culverts would act as a dam to force more water back down the west channel. This would help reduce very high flows in the east channel.

Necessary water fluctuation and flow data have been collected. The area has been surveyed and a preliminary design is being developed to determine feasibility and costs of this type of project and to identify potential problems that may occur with a project of this nature. If this plan is feasible, it could solve many of the problems existing in the study area, not only for the fisheries, but also for reservoir control in trying to manage water levels below the dam.

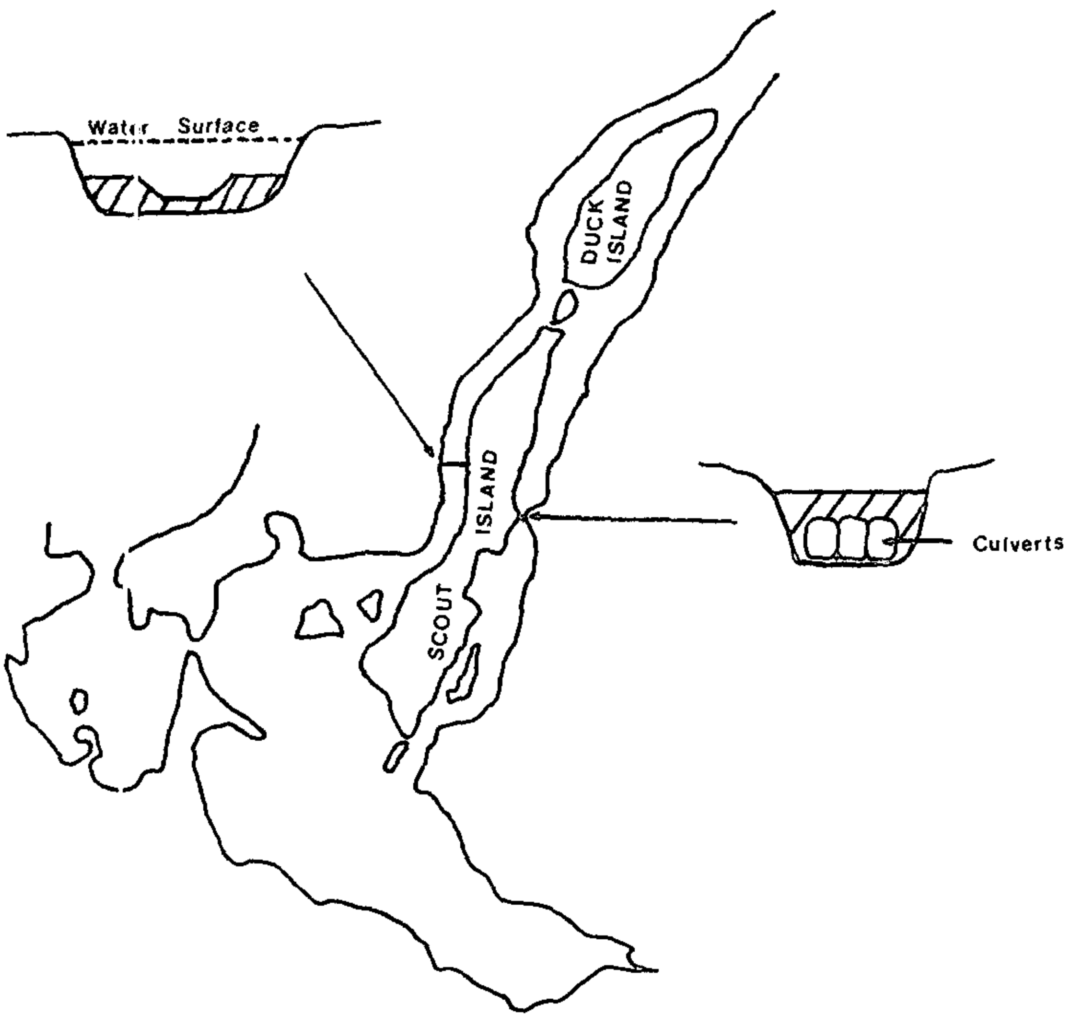

Figure 8. Location and design of weir structures proposed below Fort Peck Dam.

Preliminary indications are that this plan would also greatly reduce or even eliminate water level fluctuations in the upper dredge cuts and tailpool. This could have a very beneficial impact on the downstream fishery. Stabilized water levels would allow vegetation to establish along the shorelines. This would result in an improved forage fish population and in turn a better game fish population in the area.

Improved shoreline vegetation and stabilized water levels would also help solve the serious bank erosion problem that now exists in the dredge cuts and tailpool.

This plan would require additional funding and an expansion of the existing contract, but the potential benefits would greatly outweigh the additional costs. Evaluation of this plan should be a high priority in the future.

SUMMARY

Considerable progress was made in developing a water management plan for the study area below Fort Peck Dam in 1985. Reservoir control made a serious effort to maintain discharges above the minimum levels recommended for rainbow trout spawning and rearing. This provided improved spawning and rearing conditions and resulted in better egg survival and rearing success. Higher average daily discharges in combination with higher minimum discharge levels improved spring spawning conditions in the dredge cuts.

Evaluation of artificial rearing cover installed in the spring showed that YOY rainbow used this cover when available. It appeared that additional rearing cover in the center of the channel may not only result in better rearing success, but may actually improve the growth rate of rearing fish.

Additional rearing cover and spawning substrate were placed in the side channel in the fall of 1985 and will be ready for evaluation in 1986. This habitat work was designed to take into account information learned during spring and summer sampling.

The forage fish situation appeared to be improving in the study area. Young-of-the-year spottail shiner were collected in the dredge cuts for the first time in 1985. Cisco were captured below the dam for the first time indicating they were successfully passing through the dam. It is anticipated they will be able to reproduce successfully in the study area. Yellow perch reproduction apparently occurred in 1985, and the Christmas tree reefs added to the dredge cuts should improve perch spawning success in the future.

The first spawning run of chinook salmon is anticipated below Fort Peck Dam in the fall of 1986. If these fish do return, they should benefit from the habitat work completed for rainbow in 1985.

A long term plan has been proposed and is being evaluated that could solve many of the fisheries and water management problems below Fort Peck Dam.

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