IOWA CONSERVATION COMMISSION

FISHERIES SECTION

COMMERCIAL FISHERIES INVESTIGATIONS

PROJECT COMPLETION REPORT

Project No. 2-350-R : Wingdam Investigations

Period Covered : 1 July, 1979 - 30 September, 1981

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ABSTRACT

Five hundred ninety-five wing and closing dams bordering Iowa on the Upper Mississippi River were located by reviewing U. S. Army Corps of Engineers' (COE) records. Field surveys showed that 36 percent (217 structures) had been either eroded, covered, or removed by the COE. Total length at original construction was 117,870 m of which 66,737 m (57 percent) remained in 1979. Mean water depth (corrected to operating pool levels) over structures was 1.7 m. Mean maximum depth 30.5 m above and below the structure was 4.2 m and 5.1 m, respectively. Maximum depth occurred below wing and closing dams significantly more often than above. Mean maximum depth at structures located on outside river bends was 6.3 m and was significantly deeper than at dams located on inside river bends (4.6 m). Sand and silt were the dominant substrates associated with wing and closing dams, contributing 77.5 percent and 15.1 percent respectively. Percent sand generally decreased in a downstream direction, being more abundant in upper pools. Silt, gravel, rock, and boulder generally increased in a downstream direction. Mean current velocity on all structures was 0.50 m/sec. Mean current velocity 30.5 m above and below the structures was 0.30 m/sec and 0.28 m/sec, respectively. A wing and closing dam classification system was developed that utilized the geographic location of the structures, water depth over the structures, and the structure location relative to the thalawag as the primary criteria separating structures into identifiable groups. Twenty-four wing and closing dams were sampled for adult fish populations resulting in the capture of 38 fish species totaling nearly 5,500 fish. Commercial fish species were the most abundant with redhorse sp., freshwater drum, carpsucker sp. and shovelnose sturgeon contributing 27 percent, 12 percent, 9 percent, and 6 percent of the total catch respectively. Sport fish included black crappie, sauger, white bass, and walleye with each comprising 4 percent, 4 percent, 4 percent, and 2 percent of the total catch. Commercial fish species were generally more abundant in southern pools (0.44 fish/hr) than in northern pools (0.36 fish/hr) and sport fish were more abundant in northern pools than southern pools with 0.11 fish/hr and 0.04 fish/hr. respectively. More fish were captured during the nighttime period than the daytime period; however, the difference was not significant. Significantly more fish were captured below structures than above. Mean current velocity values collected in conjunction with adult fish sampling were significantly different

between 1980 and 1981 with 1.09 m/sec and 1.54 m/sec, respectively. Overall current velocity during 1980 and 1981 was significantly higher on structures located on outside bends (1.43 m/sec) than those located on inside bends (1.09 m/sec). Overall mean water depth over structures, Secchi disc values, and water temperature values collected in conjunction with adult fish sampling were not significantly different between 1980 and 1981. Water depth over a structure and structure location were the most important parameters affecting adult fish distribution. Structures $\leq$1.52 m in depth had significantly higher catch/effort and species numbers than did structures $>$1.52 m in depth. Structures located on outside river bends had significantly higher catch/effort and species numbers than those located on inside river bends. Over 300 gravid or freshly-spent females and ripe males representing 15 species were collected from structures during the 1980 and 1981 spring sampling period. White bass, mooneye, and redhorse sp. were the most abundant with males more numerous than females for most species. Experimental egg samplers placed on a wing dam collected over 200 fish eggs of which about 12 percent were viable. Fish eggs were hatched in the laboratory and all larva were identified as mooneye (*Hiodon tergisus*). Frame nets, trammel nets, and electrofishing were the most effective gears and accounted for 81 percent of the total fish numbers and 100 percent of the species numbers. Monofilament small mesh gill nets had significantly higher catch/effort values than multifilament small mesh gill nets. Ninety-one percent of the interviewed commercial fishermen fished wing and closing dams. Catfish sp. and buffalo sp. were the dominant fish sought or captured by commercial fishermen with 38 percent and 32 percent respectively. Seventy-one percent of the commercial fishermen preferred to fish wing and closing dams in the spring and fall; however, 19 percent indicated that water level was more important than season. Hoop nets, trammel nets, and box traps were the dominant gear used on structures by commercial fishermen with each comprising 31 percent, 30 percent, and 25 percent respectively. Nearly one-half of the interviewed fishermen spent between 21 to 60 percent of their total fishing effort on wing and closing dams. Seventy-nine percent of the commercial fishermen indicated that overall catch was better from wing and closing dam habitat. The mean depth of water over structures fished by commercial fishermen was 1.52 m and 70 percent of the structures they fished had less than 1.83 m of water over the structure. Commercial fishermen indicated they preferred to fish structures with deep scour holes above or below the structure and those with cuts or notches in them.

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INTRODUCTION

The Mississippi River bordering Iowa contains approximately 190,000 surface acres of water, of which nearly one-half is located in Iowa. The river, with its intricate network of diverse aquatic habitats, is an important part of Iowa's renewable fishery resource.

Since the construction of navigational locks and dams, the Mississippi River has become less dynamic than an unregulated riverine system. Backwater and off-channel areas that were once flushed and scoured by an ever-changing main channel are now subject to siltation and fill at alarming rates; in some areas 132 acre-feet of sediment is deposited annually (Ackerman, 1977). Sloughs, ponds, and backwater lakes are important fish spawning and nursery areas, but many have been destroyed by siltation or placement of spoil materials dredged to maintain commercial navigation on the Upper Mississippi River (Fish and Wildlife Work Group Appendix, GREAT II, 1980). Current modification structures (wing and closing dams) have been impacted continuously since original construction by intentional modification, siltation, and erosion; while others were covered with dredge spoil (Fish and Wildlife Work Group Appendix, II, 1980). This loss, degredation, and manipulation of aquatic habitats on the Upper Mississippi River has resulted in a need to assess the importance of various riverine environments and their use by fish populations.

The main channel border habitat, including most areas in which current modification structures occur, is considered to be excellent habitat for a variety of fish species (Robinson, 1969; and Fremling, 1963). However, there has been little quantitative or qualitative work that addresses the importance of current modification structures to the fishery. Such information is important if resource planners are to make effective and intelligent decisions regarding river management.

This study was designed to inventory, describe, and classify the physical properties of approximately 125 Mississippi River current modification structures by determination of those characteristics important to fish and develop a strategic plan to recommend wing and closing dam construction and modification which is compatible with the integrity of the fishery. Investigations were initiated July 1, 1979 in cooperation with National Marine Fisheries Service and the Iowa Conservation Commission under authority of PL 88:309. The contract was valid through September 30, 1983; however, funding cuts terminated the contract. This is the final report that covers the time period from July 1, 1979 through September 30, 1981.

CURRENT MODIFICATION STRUCTURE INVENTORY AND CLASSIFICATION

Review of Construction Records

Review of existing United States Army Corps of Engineers' (COE) records indicate current modification structures were constructed in a variety of configurations and locations. Structures extending across the mouth of backwater cuts or sloughs are commonly called closing dams. Structures extending to or near the main channel are designated as wing dams. Most wing dams were constructed perpendicular to the current, however several angle slightly upstream. The majority of wing dams are constructed in linear fashion, but a few were constructed in "L" or "T" shapes. Unless otherwise noted, references in this narrative to dams or structures includes all current modification structures except the larger lock and dam system used to regulate river stage. A history of wing and closing dam development, construction material, and construction methodology on the Upper Mississippi River was reported by Boland (1980).

Initial inventories were conducted using COE records obtained from the Rock Island and St. Paul Districts. Records indicated 558 dams were originally constructed along Iowa's border and were numbered according to stream segment and construction date. The COE numbering system was replaced by an identification system which separated dams by navigation pool with the most upstream dam in each pool designated as Dam 1. The remaining dams in each pool were then numbered in sequential order proceeding downstream. As an example, the most upstream dam in Pool 9 was numbered 9-1.

Over the years, a number of structures were cleaved by sedimentation or dredge spoil placement such as when the middle section of the dam was covered by an exposed island, while both ends remain intact. These structures were inventoried as separate structures, resulting in the addition of 37 dams to the original COE number. Many structures were reworked since original construction. These works included removal, repair, and changes in length and elevation of dams.

Information tabulated from COE records for the 595 dams included location by river mile, construction date, length, elevation, depth of dam at operating pool level, and restructured dates and type of repair (Appendix Table A). Structure type (straight, L-shaped, or closing) and location with reference to river thalawag (inside bend, outside bend, or straight section) were also recorded.

Data Collection Chronology

On-site data were collected in Pools 9, 10, 12, 13, 14, 17, 18, and 19 by the Fisheries Management Branch, Iowa Conservation Commission under funding provided by the Fish and Wildlife Management Work Group, Great River Environmental Action Team II (GREAT II). The Fisheries Research Branch inventoried dams in Pools 11, 15, and 16 under separate funding from the National Marine Fisheries Service. Data was collected between August 27 and November 5, 1979. Data from both studies were combined for analysis.

Sampling Procedures

On-site data was collected for all current modification structures. Dams were located and a 12-foot marker pole placed at the shore end. The outer end was located with a Raytheon Model DE 719B recording fathometer, and dam length was determined with a Rangematic 1000 rangefinder. Dams which could not be located with a reasonable amount of effort using river mile locations, COE maps, and the recording fathometer were considered eroded, removed, or covered with sediment.

Water depths and bottom contours around each structure were obtained using a recording fathometer. The sample area was established with a series of florescent marker buoys anchored 30.5 m above and below each dam. Three transects were recorded in an upstream direction, perpendicular to the dam at quartiles of the dam length (Figure 1). Three transects were recorded parallel to the structure, starting at the outer end and proceeding toward shore (Figure 1). Transects parallel to the dams were located 30.5 m above, 30.5 m below, and on the dam. A constant boat speed was maintained during measurements.

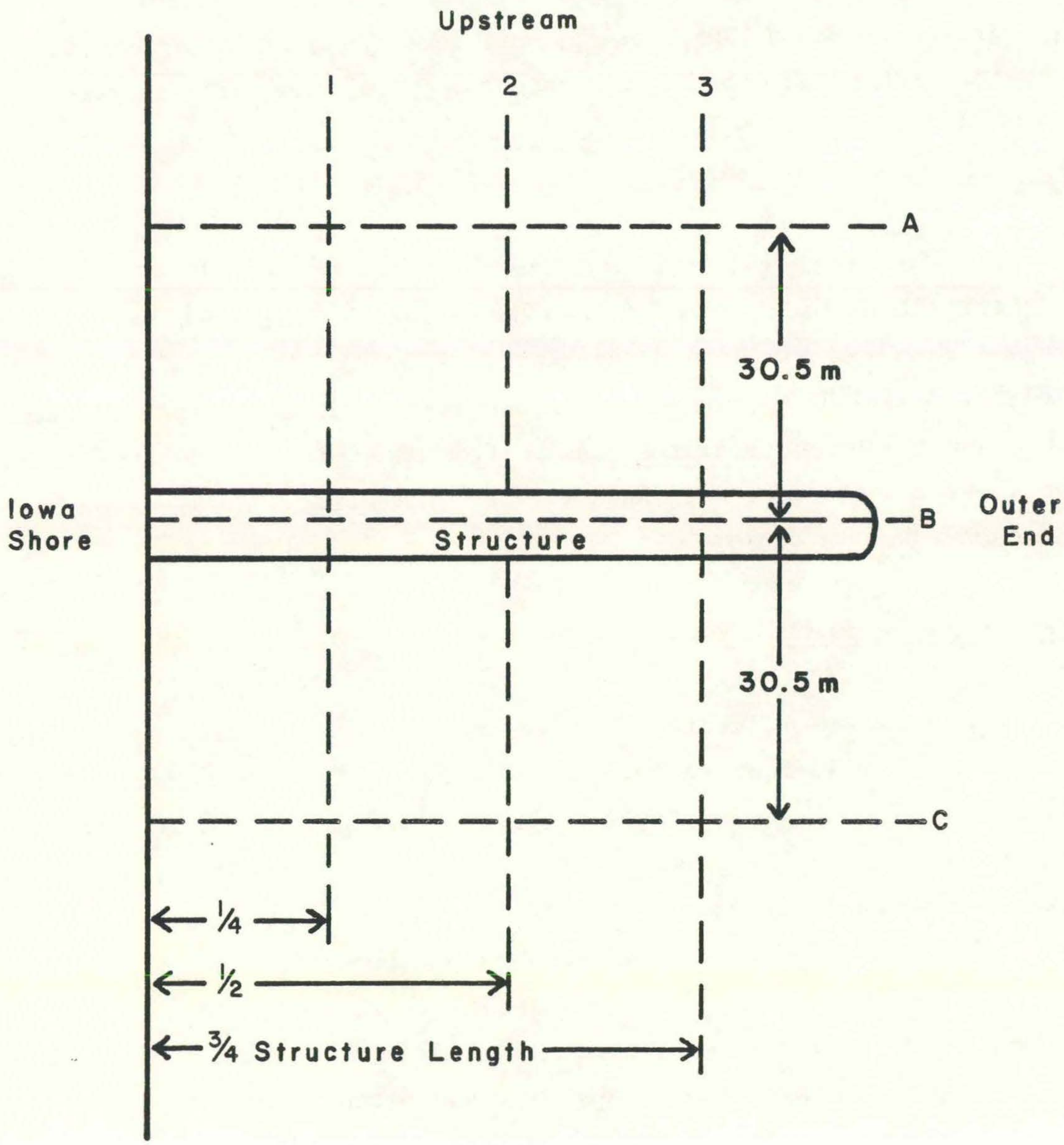


Figure 1 . Transect locations for recording bottom contours associated with Upper Mississippi River current modification structures, 1979.

Water depths associated with each structure were derived from the recording fathometer transects and adjusted to operating pool levels to facilitate comparison among dams. Maximum water depth associated with current modification structures was obtained by combining the six recording transects and selecting the maximum depth. Water depth over structures was determined by averaging the values obtained from three perpendicular transects.

Current velocity was measured for each structure using a Gurley Model 665-E direct reading current meter. Readings were obtained at .6 the water depth, 30.5 m above, 30.5 m below, and on the dam at two-thirds the dam length from shore (Figure 2).

Substrate composition samples were collected using a nine-inch Ponar dredge. Two samples were collected 30.5 m above the structure at one-third and two-thirds the dam length (Figure 3). Two samples were collected below the structure at similar distances. Particle size was determined visually by estimating the percent silt, sand, gravel, rock, and boulder for each sample.

Physical Characteristics of Current Modification Structures

Three hundred seventy-eight structures were surveyed. The remaining 217 (36 percent) had been eroded, covered, or removed by the COE (Table 1). Current modification structures constructed by pool ranged from 92 in Pool 11 to 15 in Pool 15 (Table 1). Structure loss varied considerably by pool, ranging from 80 percent in Pool 15 to 15 percent in Pool 17 (Table 1).

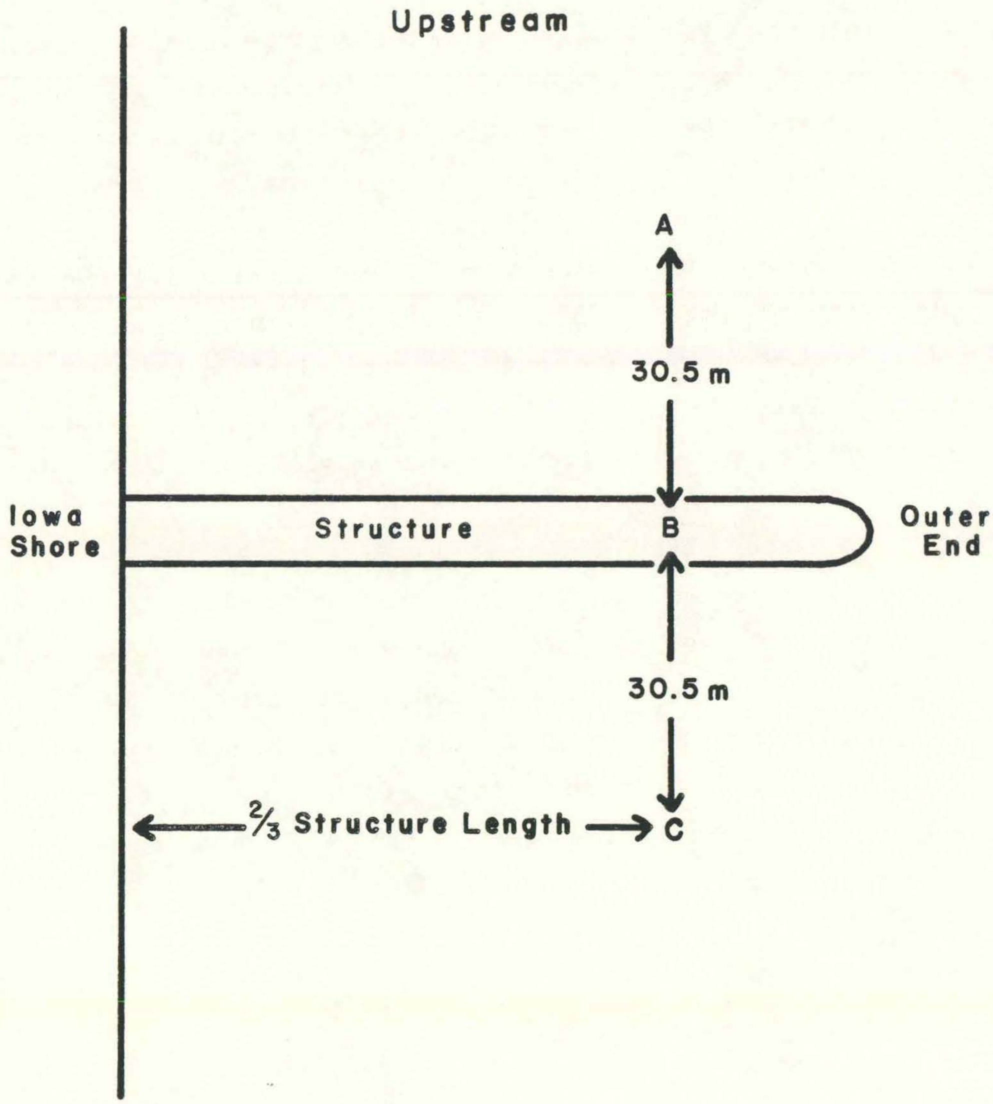


Figure 2. Sample locations (A, B, and C) for measuring current velocities associated with Upper Mississippi River current modification structures, 1979.

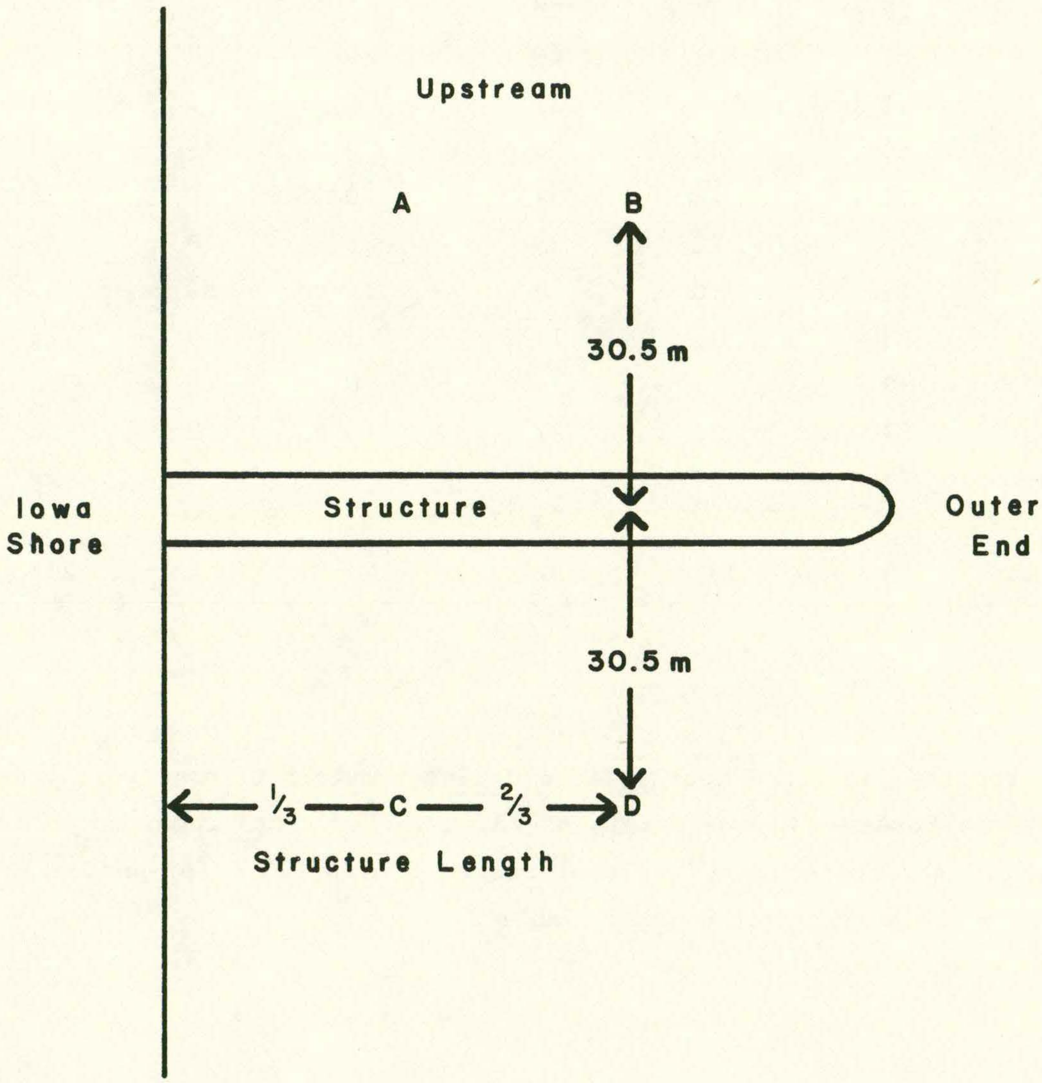


Figure 3. Locations (A, B, C, and D) for collecting substrate material associated with Upper Mississippi River current modification structures, 1979.

Table 1. The present status of 595 current modification structures originally constructed by the U. S. Army Corps of Engineers along the Iowa border of the Upper Mississippi River.

Pool No.	Number Constructed	Covered or Eroded		Removed		Total Removed, Eroded, or Covered	
		Number	Percent	Number	Percent	Number	Percent
9	29	11	38	1	3	12	41
10	67	31	46	0	0	31	46
11	92	21	23	0	0	21	23
12	50	15	30	4	8	19	38
13	72	28	39	0	0	28	39
14	48	12	25	3	6	15	31
15	15	0	0	12	80	12	80
16	63	11	17	3	5	14	22
17	33	5	15	0	0	5	15
18	87	32	37	0	0	32	37
19	39	27	69	1	3	28	72
TOTAL:	595	193	32	24	4	217	36

COE records indicated nearly 117,870 linear meters of dams were constructed along the Iowa border. Approximately 66,737 m (57 percent) remained in 1979 (Table 2). Loss of structure length by pool ranged from 6,920 m (67 percent) in Pool 19 to 2,739 m (24 percent) in Pool 16 (Table 2).

Table 2. Length (in meters) of current modification structures originally constructed in the Iowa portion of the Upper Mississippi River by the U. S. Army Corps of Engineers and the length present in 1979.

Pool No.	Length at Construction	Length in 1979	Percent Remaining
9	3,922	1,744	44
10	11,762	6,125	52
11	15,426	9,240	60
12	8,929	5,526	62
13	13,467	9,857	73
14	10,205	7,517	74
15	1,785	960	54
16	11,585	8,846	76
17	7,474	5,066	68
18	22,943	8,402	37
19	10,373	3,453	33
TOTAL:	117,870	66,737	57

Mean water depth over all structures was 1.7 m and generally increased in the downstream direction (Table 3). Mean water depth over dams varied by pool, ranging from 1.2 m in Pool 14 to 2.6 m in Pool 19 (Table 3). Differences in mean water depth over dams due to location in relation to the thalawag was not significant ($p > .05$), averaging 1.5 m for dams on inside bends to 1.7 m for dams on straight sections (Table 4).

Table 3. Water depth associated with current modification structures in the Iowa portion of the Upper Mississippi River, 1979. Depths are in meters and adjusted to operating pool level.

Pool No.	Number in Sample	Mean Depth Over Structure	Mean Maximum Depth Above Structure	Mean Maximum Depth Below Structure
9	17	1.5	3.7	4.7
10	36	1.5	4.5	5.3
11	70	1.5	4.8	5.6
12	30	1.8	3.9	4.6
13	43	1.7	4.4	5.9
14	31	1.2	4.1	4.9
15	3	1.8	2.8	3.1
16	49	1.8	4.0	3.9
17	28	1.8	3.5	4.1
18	52	2.0	4.5	5.7
19	11	2.6	4.2	5.4
WEIGHTED MEAN:		1.7	4.2	5.1

Table 4. Mean water depth over current modification structures in the Iowa portion of the Upper Mississippi River. Data was obtained in 1979 and summarized by location in relation to the thalawag and pool. Depth is in meters and adjusted to operating pool level.

Pool No.	Inside Bend	Structures In Sample	Outside Bend	Structures In Sample	Straight Section	Structures In Sample
9	1.4	9	--	--	1.6	8
10	1.5	11	1.6	8	1.4	17
11	1.1	12	1.5	14	1.6	44
12	1.9	3	1.1	1	1.8	26
13	1.4	12	1.6	15	1.8	15
14	1.1	1	1.0	7	1.3	23
15	--	--	--	--	1.8	3
16	1.6	14	1.7	11	1.9	24
17	1.7	6	--	--	1.9	22
18	1.9	12	2.5	2	2.2	38
19	2.7	2	1.7	3	3.0	6
WEIGHTED MEAN	1.5		1.6		1.7	

The overall mean maximum depth within the sample areas above and below structures was 4.2 m and 5.1 m, respectively (Table 3). Differences in maximum depth above and below a structure were significant at the 95 percent level when tested in a paired "t" distribution (t = 5.84); therefore, it was concluded maximum depths usually occurred downstream of channel modification structures. Structure location in relation to the thalawag had a significant effect on maximum water depth associated with a structure. Mean maximum water depths found at dams located on outside bends was significantly greater (95 percent level, t = 2.49) than water depth found at dams located on inside bends (Table 5). Maximum water depth associated with dams located on inside bends and on straight sections were not significantly different.

Table 5. Mean maximum water depth associated with current modification structures in the Iowa portion of the Upper Mississippi River by location in relation to the thalawag and pool, 1979. Depth is in meters and adjusted to operating pool level.

	MEAN DEPTH					
Pool No.	Inside Bend	Sample Size	Outside Bend	Sample Size	Straight Section	Sample Size
9	5.0	9	--	--	4.7	8
10	5.8	11	7.0	8	4.6	17
11	4.6	11	6.2	14	5.9	44
12	4.8	3	2.7	1	4.8	26
13	5.2	12	7.5	15	5.9	15
14	2.7	1	5.9	7	5.1	23
15	--	--	--	--	3.4	3
16	3.8	14	4.6	11	4.2	24
17	2.8	6	--	--	4.5	22
18	5.2	12	8.7	2	5.8	41
19	4.2	2	6.4	3	5.5	6
WEIGHTED MEAN	4.7		6.3		5.2	

A chi-square test was used to determine if dam location in relation to the thalawag influenced maximum depth location (upstream or downstream). Results indicated a significant difference at the 95 percent level ($X^2 = 8.05$), with all variability attributable to dams located on inside and outside bends. Analysis indicated that maximum depth occurred below the structure more often than expected when the dams were located on outside bends. Similar analysis indicated maximum depth occurred above dams more often than expected when structures were located on inside bends.

Sand and silt were the dominant substrates associated with current modification structures, contributing 77.5 percent and 15.1 percent respectively (Table 6).

Table 6. Percent composition of substrate associated with current modification structures on the Upper Mississippi River bordering Iowa, 1979. Values are means of all samples.

Pool No.	No. of Structures	Substrate Type (In Percent) Sand	Silt	Gravel	Boulder
9	17	91.6	8.9	--	--
10	36	92.8	5.9	1.1	0.2
11	69	87.1	10.2	2.6	--
12	30	80.1	15.9	2.5	1.5
13	44	76.3	16.3	7.0	0.6
14	31	63.0	32.7	3.0	1.2
15	3	100.0	--	--	--
16	49	74.9	11.7	11.8	1.6
17	28	69.9	14.8	7.0	8.4
18	55	65.2	21.0	5.2	8.8
19	11	69.2	18.5	5.9	6.4
WEIGHTED MEAN		77.5	15.1	4.9	2.6

Substrate types associated with structures were highly variable within pools, but some trends were apparent. Sand generally decreased downstream. Silt, gravel, rock, and boulder generally increased downstream (Table 6). Chi-square testing indicated no significant difference in substrate composition when structure type and location in relation to the thalawag were tested (Table 7).

Table 7. Mean percent composition of substrate associated with current modification structures on the Upper Mississippi River bordering Iowa, summarized by structure type and location, 1979.

	Number of Structures	Substrate Type (In Percent)			
		Sand	Silt	Gravel	Boulder
Structure Type					
Straight	311	77.7	15.0	4.9	2.6
L-Shaped	13	70.5	15.0	9.4	5.0
Closing	49	78.0	16.4	3.4	2.1
Structure Location					
Inside Bend	81	82.7	13.9	3.1	0.3
Outside Bend	61	74.2	14.2	8.7	2.9
Straight Section	229	76.6	15.4	4.5	3.4

Current velocity was measured over a three-month period during fluctuations in river stage and discharge rate; therefore, velocity comparisons among structures and pools were impossible. The mean current velocity on dams was 0.50 m/per second (Table 8). Mean velocities 30.5 m above and below the dams were 0.30 m/sec and 0.28 m/sec, respectively (Table 8).

Construction material used for dam surfaces ranged from fist-sized rock to small boulders with no discernible difference in rock sizes between structures. Aquatic vegetation was absent from all structures.

Table 8. Mean current velocity recorded above, below, and on current modification structures in Iowa's portion of the Mississippi River, 1979. Velocity is in meters per second.

Pool No.	Above Structure	Below Structure	On Structure
9	0.23	0.23	0.39
10	0.20	0.20	0.34
11	0.24	0.21	0.37
12	0.41	0.39	0.62
13	0.31	0.28	0.55
14	0.24	0.20	0.35
15	0.45	0.40	0.90
16	0.43	0.42	0.69
17	0.30	0.28	0.50
18	0.29	0.30	0.56
19	0.24	0.20	0.30
MEAN	0.30	0.28	0.50

Classification Methodology

Multivariate analysis was initially utilized in an effort to classify structures with similar physical attributes. Clustering used an unweighted paired procedure and displayed results in a dendograph format; however, these analysis were unsuccessful in the formulation of identifiable groups. As a result, the criteria used to group dams were limited to a few important and controllable characteristics. These criteria included geographical location of the structure, mean water depth over the structure, and structure location relative to the thalawag.

These criteria allowed the classification of 372 current modification structures into 12 groups (Figure 4) (Appendix Table B). Six structures were not surveyed because of low water stage, interference by barge traffic, or construction activity.

The final step in the classification methodology involved the selection of two structures from each of the 12 groups for adult fish sampling. Structures for fish sampling were selected in a manor that would include dams found in tail, mid, and lower waters of each pool. Twenty-four current modification structures in Pools 10, 11, 13, 16, and 18 were selected for fish sampling.

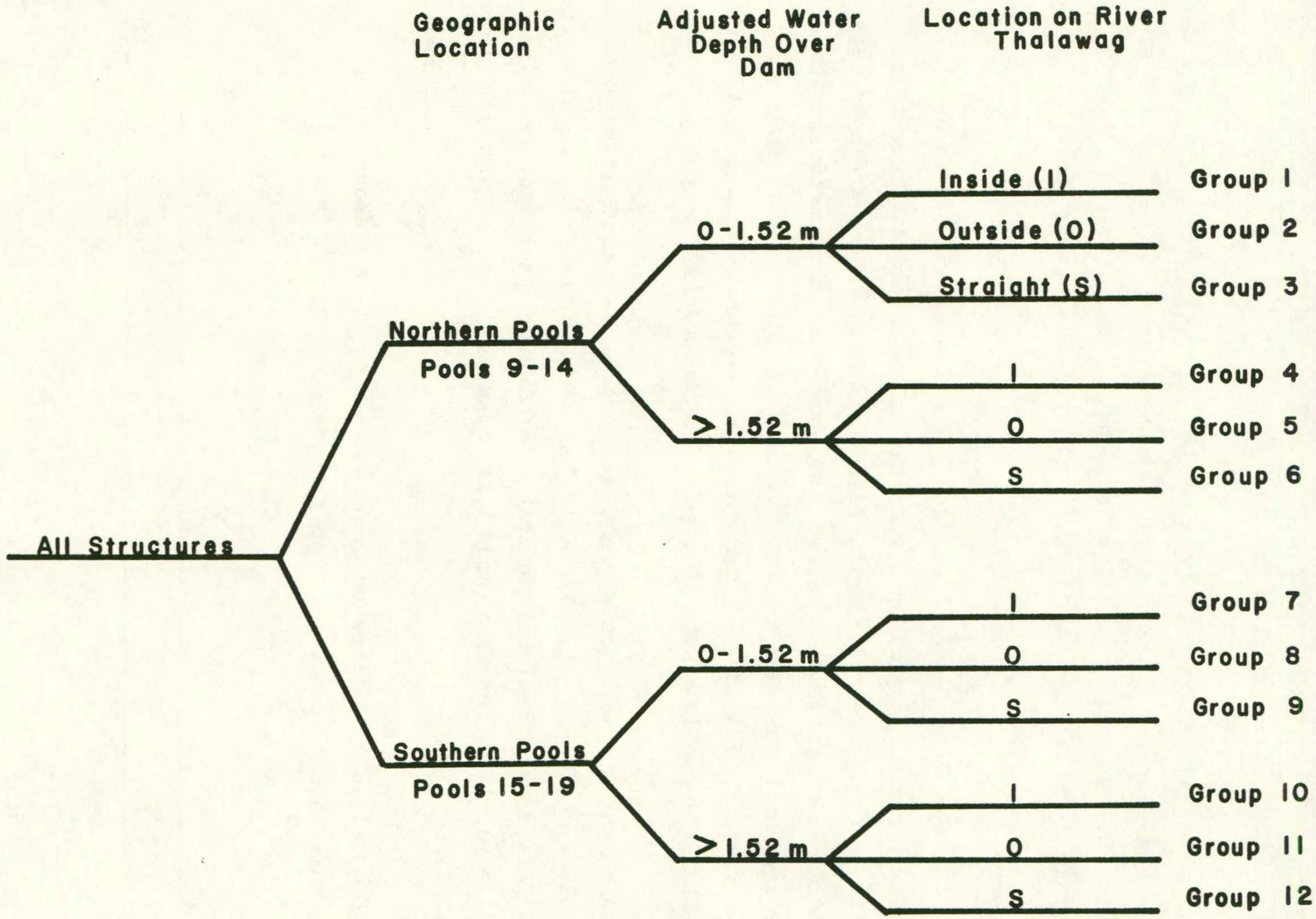


Figure 4. Schematic diagram of the Classification System used to group current modification structures along the Iowa border of the Upper Mississippi River, 1979.

FISH POPULATION CHARACTERISTICS ASSOCIATED WITH CURRENT MODIFICATION STRUCTURES

Experimentation and Development of Sampling Methods

A comprehensive literature review revealed little information regarding fish sampling methods for populations associated with current modification structures. Ideas, but not specific sampling methods, were obtained through personal communications with state and federal fishery biologists familiar with river sampling.

Experimental sampling was initiated during the summer of 1978 to develop adequate collection techniques. Experiments with entanglement and entrapment gear included trammel nets, experimental gill nets, frame nets with leads, and hoop nets without leads. Nets were set above, below, and draped over structures. Experimental electrofishing included sampling against, with, and across river currents and utilized a variety of voltages, currents, and electrode arrangements. Primacord was not used due to problems with storage and inter-county transportation permits.

Experimental sampling with entrapment gear indicated that frame nets captured significantly ($p < .01$, $X^2 = 8.41$) more fish and species of fish than hoop nets (Table 9). Chi-square analysis indicated entrapment gear captured significantly ($p < .05$, $X^2 = 10.52$) more fish and fish species above structures than below structures (Table 9).

Table 9. Comparison of catches by frame and hoop nets set above and below current modification structures, Upper Mississippi River, 1978.

Location	Gear	No. Fish	No. Species	CPE (Fish/Hr.)
Above	Frame	176	16	0.81
Below	Frame	2	2	0.01
Above	Hoop	19	7	0.11
Below	Hoop	3	2	0.02

Although the initial results were not significant, additional experimental sampling with frame nets indicated catch was greater if effort was concentrated from shore to the middle of the structure (Table 10). Catch comparisons of fish obtained utilizing trammel and gill nets set above, below, and draped over structures indicated no significant differences (Table 11); however, this initial sampling did indicate gear selectivity for certain fish species.

Table 10. Comparison of frame net catches when set near shore, middle, and outer tip of current modification structures, Upper Mississippi River, 1978.

	Location		
Parameter	Near Shore	Middle	Outer Tip
Total Fish	117	123	47
No. Species	11	10	10
CPE (Fish/Hr.)	1.63	1.71	0.66

Table 11. Catch comparison for trammel and gill nets set above, below, and draped over current modification structures, Upper Mississippi River, 1978.

Location	Gear	No. Fish	No. Species	CPE (Fish/Hr.)
Above	Gill	7	5	0.05
Below	Gill	10	8	0.07
Draped	Gill	12	11	0.08
Above	Trammel	25	7	0.17
Below	Trammel	31	12	0.22
Draped	Trammel	35	15	0.24

Results of experimental sampling aided development of the final sampling design for adult fish populations inhabiting current modification structures. Trammel and experimental gill nets were set perpendicular to the structure and parallel to current flow. These nets were draped over the dam with one-half of the net fished above the dam and below. Trammel nets were constructed of 12-inch bar mesh outer wall, 1.5-inch bar mesh inner wall, and were 100 feet in length and 8 feet in depth. Two experimental multifilament gill nets were fished at each dam, a small mesh series (panels of 1, 1.5, 2, 2.5-inch bar mesh) and a large mesh series (panels of 3.5, 4, 4.5, and 5-inch bar mesh). Due to extremely low catches, the large mesh gill net was abandoned after the first sampling period and replaced by a small mesh monofilament gill net in the 1981 sampling season. Four mesh sizes were hung in 25-foot panels, 8 feet in depth on all experimental gill nets. Frame nets were staked above the structure with the lead draped over the dam, the throat opening in a downstream direction. Frame nets were rectangular (2.5 feet by 6 feet) with 1-inch bar mesh netting hung over 6 hoops. The lead was 30 feet long and composed of 1¼-inch bar mesh web. Electrofishing was accomplished using pulsed DC current (60-80 pulses per second, 250-300 volts, 6-10 amps). Electrofishing started approximately 50 feet above a structure and proceeded downstream at a rate slightly faster than river velocity and ended just below a structure. The number of runs across each dam varied depending on structure length. The number of runs ranged from 2 to 8 per structure, while fishing effort varied from 4 to 10 minutes per structure.

Gill, trammel, and frame nets were raised near sunrise and sunset each 24-hour period to determine diurnal catch. All fish were identified to species, counted, measured for total length (to the nearest mm), and body condition noted (especially during reproduction). Catch statistics included relative abundance, catch per effort, species abundance, species composition, and length frequency. Electrofishing was accomplished during daylight hours within two weeks of the netting samples. Less than one-fourth of the fish stunned and observed during electrofishing could be netted. Fish identified but lost were included in catch statistics.

Effort was made to obtain spring (April-May), summer (July-August), and fall (September-October) adult fish samples from each structure. Dams sampled for fish use were also sampled to determine water temperature, turbidity, and current velocity. Current velocity was measured on each dam at 0.6 the water depth.

Fish Population Statistics

Six sampling periods were scheduled during the 1980 and 1981 field seasons. Two of these samples were partially incomplete. The spring 1980 electrofishing sample was missed because of equipment failure, and the 1981 summer netting and electrofishing samples in Pools 16 and 18 were not obtained due to high water levels.

Abundance Composition, and Size Structure

Adult fish sampling on current modification structures over the two-year period resulted in the capture of 38 fish species (Table 12), totaling nearly 5,500 fish (Table 13). *Cyprinid* sp. were not enumerated except for carp. Redhorse sp., freshwater drum, and carpsucker sp. dominated the catch with 27 percent, 12 percent, and 9 percent respectively (Table 13). Other commercial species included shovelnose sturgeon (6 percent), longnose gar (5 percent), smallmouth buffalo (3 percent), carp (3 percent), channel catfish (2 percent), and flathead catfish (2 percent). Important sport fishes included black crappie, sauger, white bass, and walleye with each comprising 4 percent, 4 percent, 4 percent, and 2 percent of the total catch respectively (Table 13).

Table 12. Fish species captured on current modification structures during the study period, Upper Mississippi River, 1980 and 1981.

Shorthead Redhorse (*Moxostoma breviceps*)[a]
Golden Redhorse (*Moxostoma erythrurum*)[a]
Silver Redhorse (*Moxostoma anisurum*)[a]
Freshwater Drum (*Aplodinotus grunniens*)
River Carpsucker (*Carpoides carpio*)[b]
Quillback Carpsucker (*Carpoides cyprinus*)[b]
Highfin Carpsucker (*Carpoides velifer*)[b]
Mooneye (*Hiodon tergisus*)
Shovelnose Sturgeon (*Schaphirhynchus platorynchus*
Gizzard Shad (*Dorosoma cepedianum*)
Longnose Gar (*Lepisosteus osseus*)
Carp (*Cyprinus carpio*)
Smallmouth Buffalofish (*Ictiobus bubalus*)
Channel Catfish (*Ictalurus punctatus*)
Flathead Catfish (*Pylodictis olivaris*)
Bigmouth Buffalofish (*Ictiobus cyprinellus*)
Blue Sucker (*Cycleptus elongatus*)
Shortnose Gar (*Lepisosteus platostomus*)
Spotted Sucker (*Minytrema melanops*)[c]
Northern Hogsucker (*Hypenteluim nigricans*)[c]
White Sucker (*Catostomus commesoni*)[c]
Goldeye (*Hiodon alosoides*)
Paddlefish (*Polydon spathula*)
Bowfin (*Amia calva*)
American Eel (*Anguilla rostrata*)
Black Crappie (*Pomoxis nigromaculatus*)
Sauger (*Stizostedion canadense*)
White Bass (*Morone chrysops*)
Walleye (*Stizostedion vitreum*)
Bluegill (*Lepomis macrochirus*)
Northern Pike (*Esox lucius*)
White Crappie (*Pomoxis annularis*)
Smallmouth Bass (*Micropterus dolomieui*)
Black Bullhead (*Ictalurus melas*)
Largemouth Bass (*Micropterus salmoides*)
Rock Bass (*Amploplites repestris*)
Pumpkinseed (*Lepomis gibbosus*)
Yellow Perch (*Perca flavescens*)

[a] Collectively referred to as Redhorse sp. in remainder of narrative.

[b] Collectively referred to as Carpsucker sp. in remainder of narrative.

[c] Collectively referred to as Sucker sp. in remainder of narrative.

Table 13. Species and numbers of fish collected by gear during the 1980 and 1981 field seasons, Upper Mississippi River bordering Iowa.

			SMALL MESH GILL NETS				
Species	Frame	Trammel	Multi	Mono	Shocking	Total	Percent
Redhorse sp.	254	459	94	89	563	1,459	27
Freshwater Drum	486	50	22	42	28	628	12
Carpsucker sp.	373	67	18	5	38	501	9
Mooneye	156	25	22	51	98	352	7
Shovelnose Sturgeon	21	144	121	34	2	322	6
Gizzard Shad	5	50	27	23	141	246	5
Longnose Gar	11	80	66	84	22	263	5
Carp	29	12	7	26	84	158	3
Smallmouth Buffalo	54	16	9	13	54	146	3
Cannel Catfish	35	39	21	9	25	129	2
Flathead Catfish	54	10	2	5	13	84	2
Bigmouth Buffalo	1	2	0	1	33	37	1
Blue Sucker	5	14	14	18	9	60	1
Shortnose Gar	11	25	15	16	5	72	1
Sucker sp.	7	8	1	1	2	19	1
Goldeye	0	1	0	2	0	3	1
Paddlefish	0	1	1	0	1	3	1
Bowfin	1	0	0	0	0	1	1
American Eel	1	0	0	0	0	1	1
Black Crappie	212	16	0	0	2	230	4
Sauger	54	58	74	27	19	232	4
White Bass	173	16	5	11	19	224	4
Walleye	49	16	14	9	28	116	2
Bluegill	42	12	3	1	6	64	1
Northern Pike	18	16	2	1	0	37	1
White Crappie	17	4	0	0	0	21	1
Smallmouth Bass	0	3	0	0	6	9	1
Black Bullhead	0	4	0	0	0	4	1
Largemouth Bass	0	1	0	0	2	3	1
Rock Bass	1	0	1	0	0	2	1
Pumpkinseed	1	0	0	0	0	1	1
Yellow Perch	0	0	0	0	1	1	1
TOTAL:	2,071	1,149	539	468	1,202	5,428	
PERCENT OF TOTAL:	38%	21%	10%	9%	22%		

Length frequency tables were constructed for species that were represented by 50 or more individuals. Figures 5 through 15 show north-south variations in length frequency distributions for 18 species of fish. Appendix Tables C though S show length frequency distribution by gear and capture location.

Relative abundance as determined by catch per effort (C/E) values indicate commercially-harvested fish (redhorse sp., freshwater drum, carpsucker sp., mooneye, shovelnose sturgeon, carp, channel and flathead catfish, smallmouth and bigmouth buffalo, blue sucker, longnose and shortnose gar, sucker sp., paddlefish, bowfin, and American eel) are more abundant on current modification structures than sport fish (black crappie, sauger, white bass, walleye, bluegill, northern pike, white crappie, smallmouth and largemouth bass, black bullhead, rock bass, pumpkinseed, and yellow perch). Channel and flathead catfish, freshwater drum, and paddlefish make significant contributions to both the commercial and sport fishery; however, for purposes of this report these species are grouped with commercially-harvested fish. Overall mean C/E was 0.40 and 0.07 fish/hr. for commercial and sport fish, respectively (Table 14). Commercially-harvested fish are generally more abundant on structures in southern pools compared to northern pools with 0.44 and 0.36 fish/hr., respectively (Table 14). Catch per effort indices show that sport fish are more abundant on structures in northern pools (0.11 fish/hr.) compared to southern pools (0.04 fish/hr.).

Catch data for netting and electrofishing were evaluated separately because (1) electrofishing is an active gear while netting is passive, (2) large differences in C/E values, and (3) electrofishing data exhibited higher variability than the netting data.

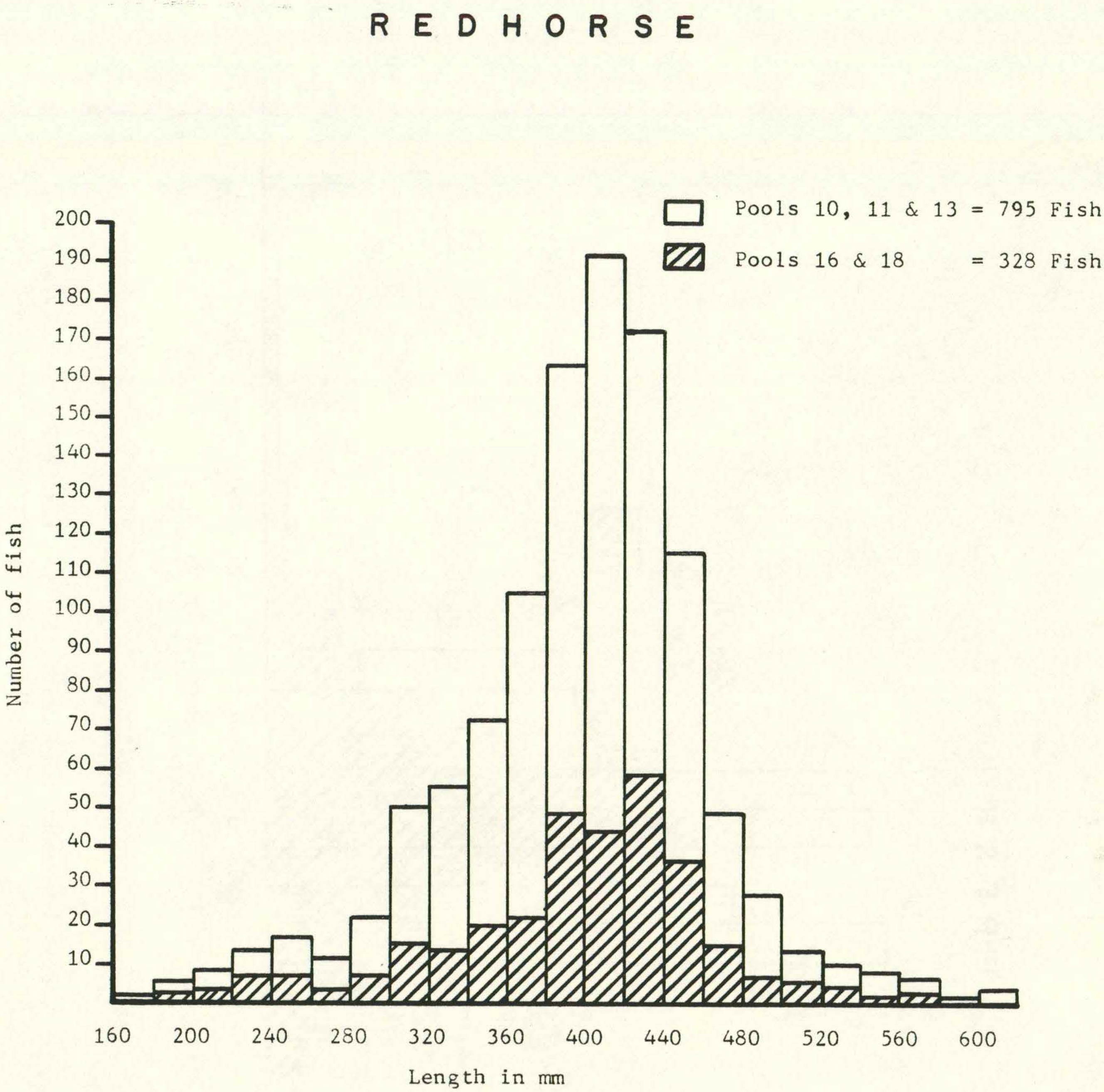


Figure 5. Length frequency for Redhorse collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.

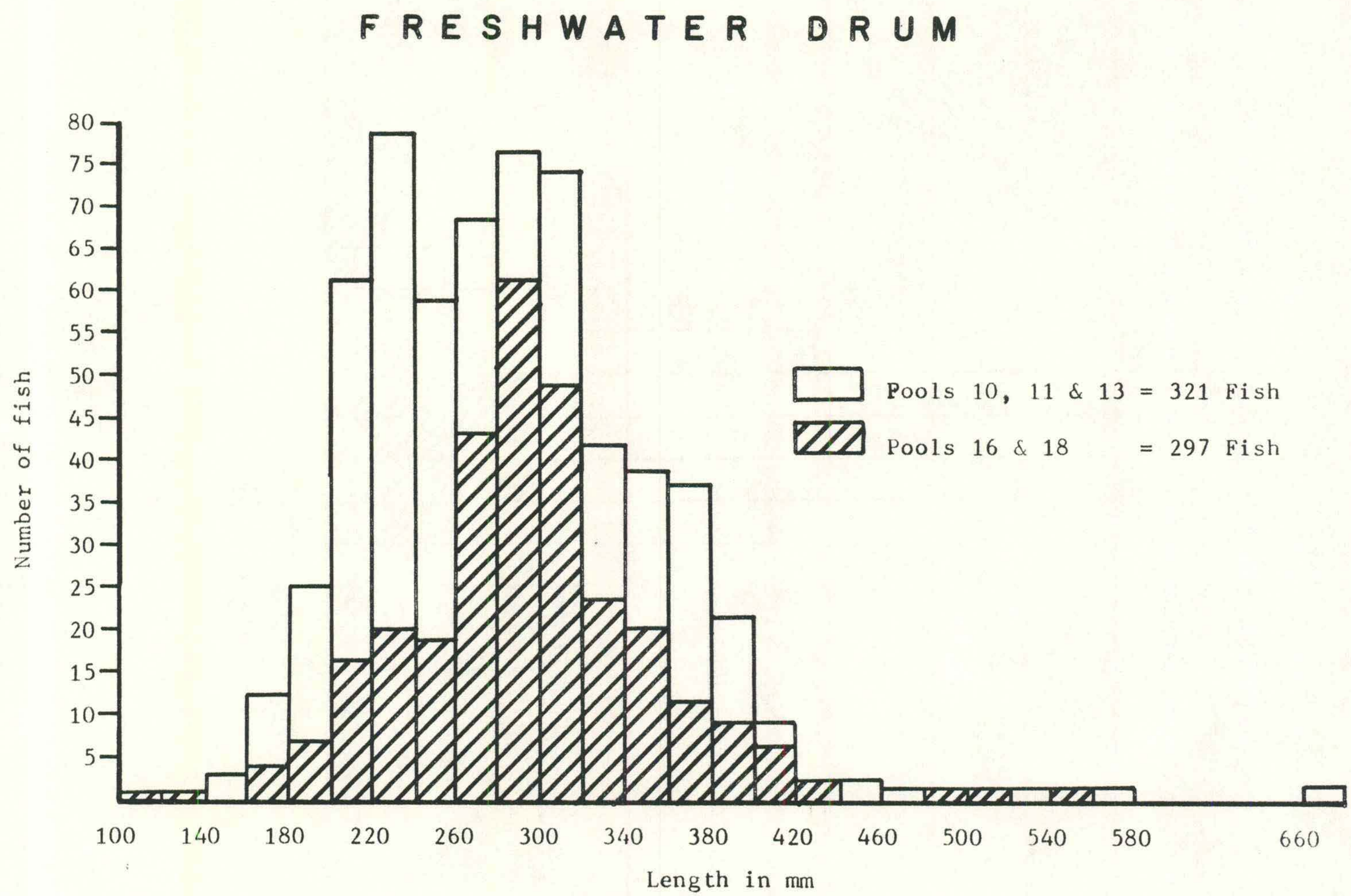


Figure 6. Length frequency for Freshwater Drum collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.

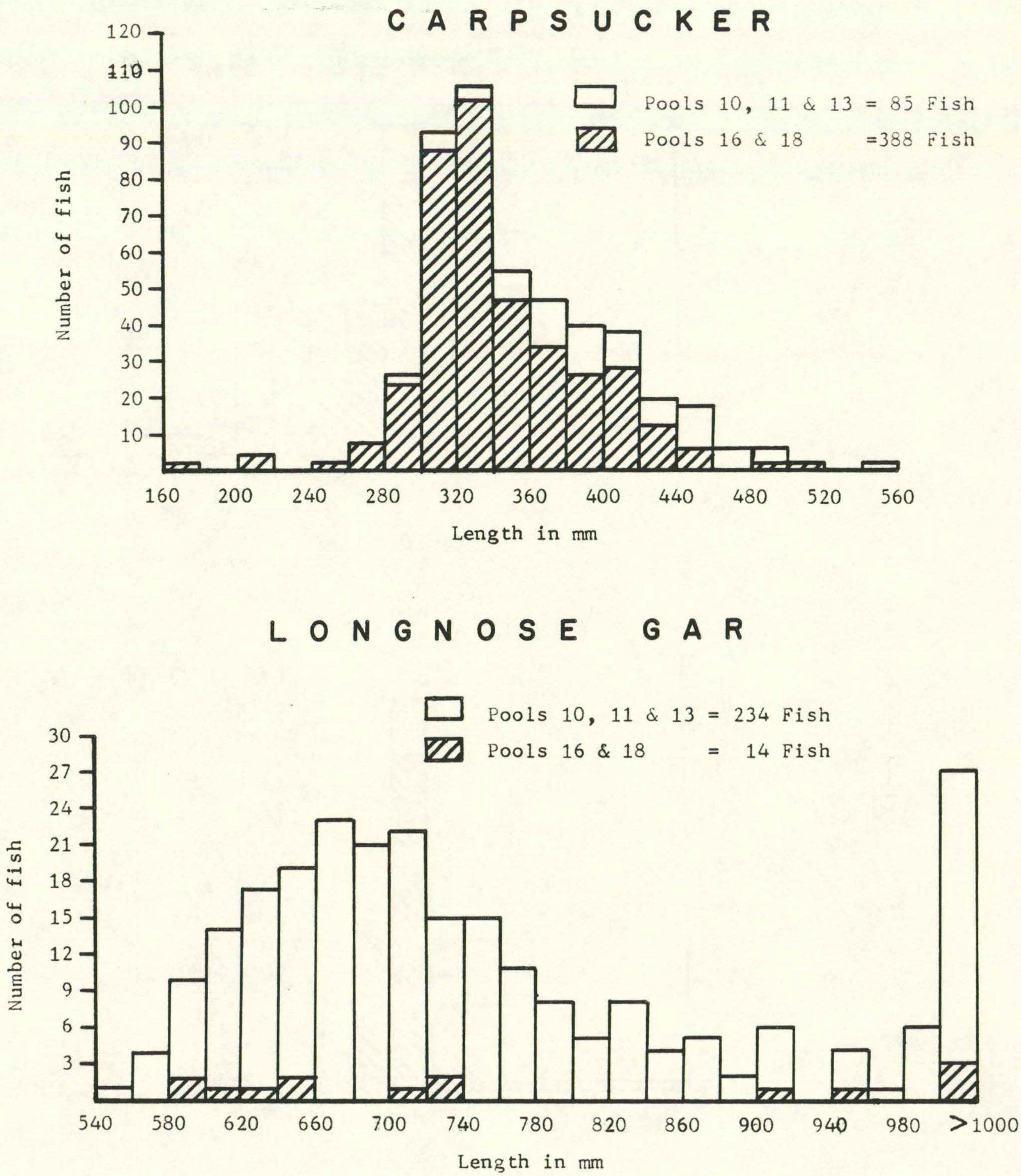
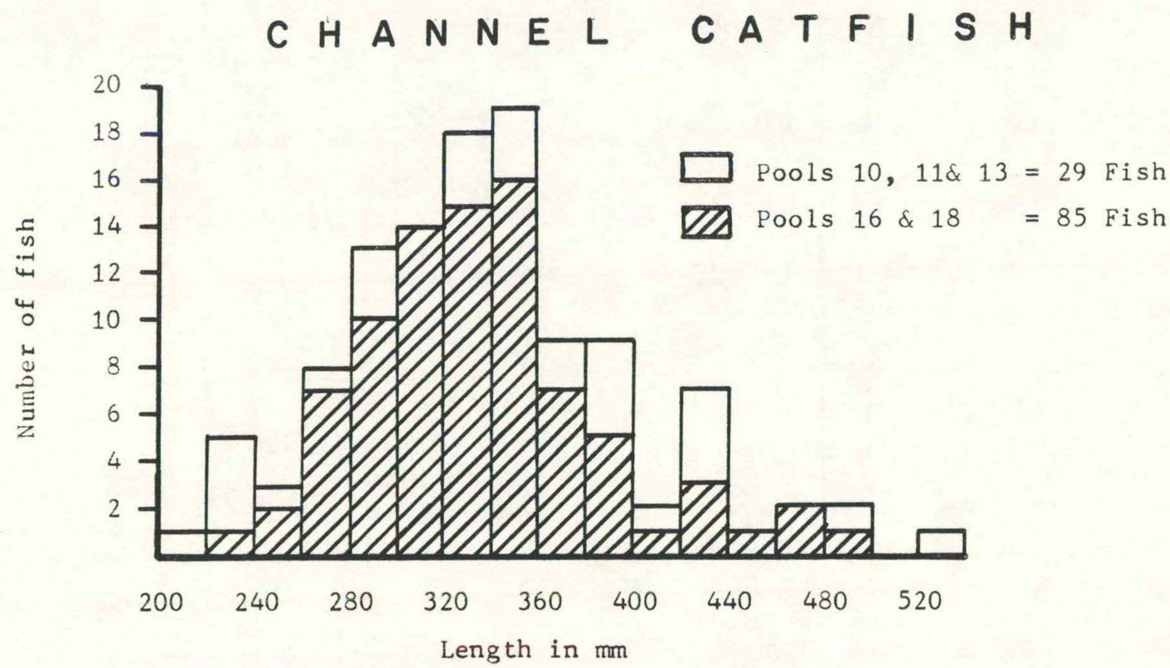


Figure 7. Length frequency for Carpsucker and Longnose Gar collected from current modification structures, Upper Mississippi River, bordering Iowa, 1980 and 1981.



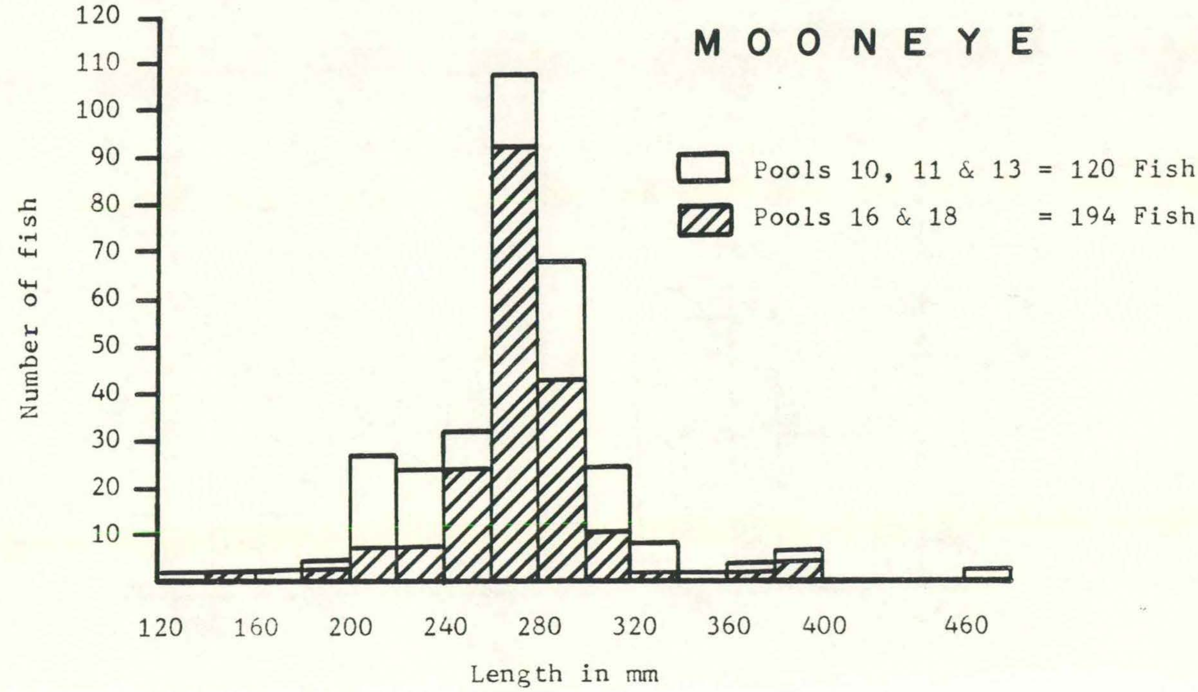


Figure 8 . Length frequency for Channel Catfish and Mooneye collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.

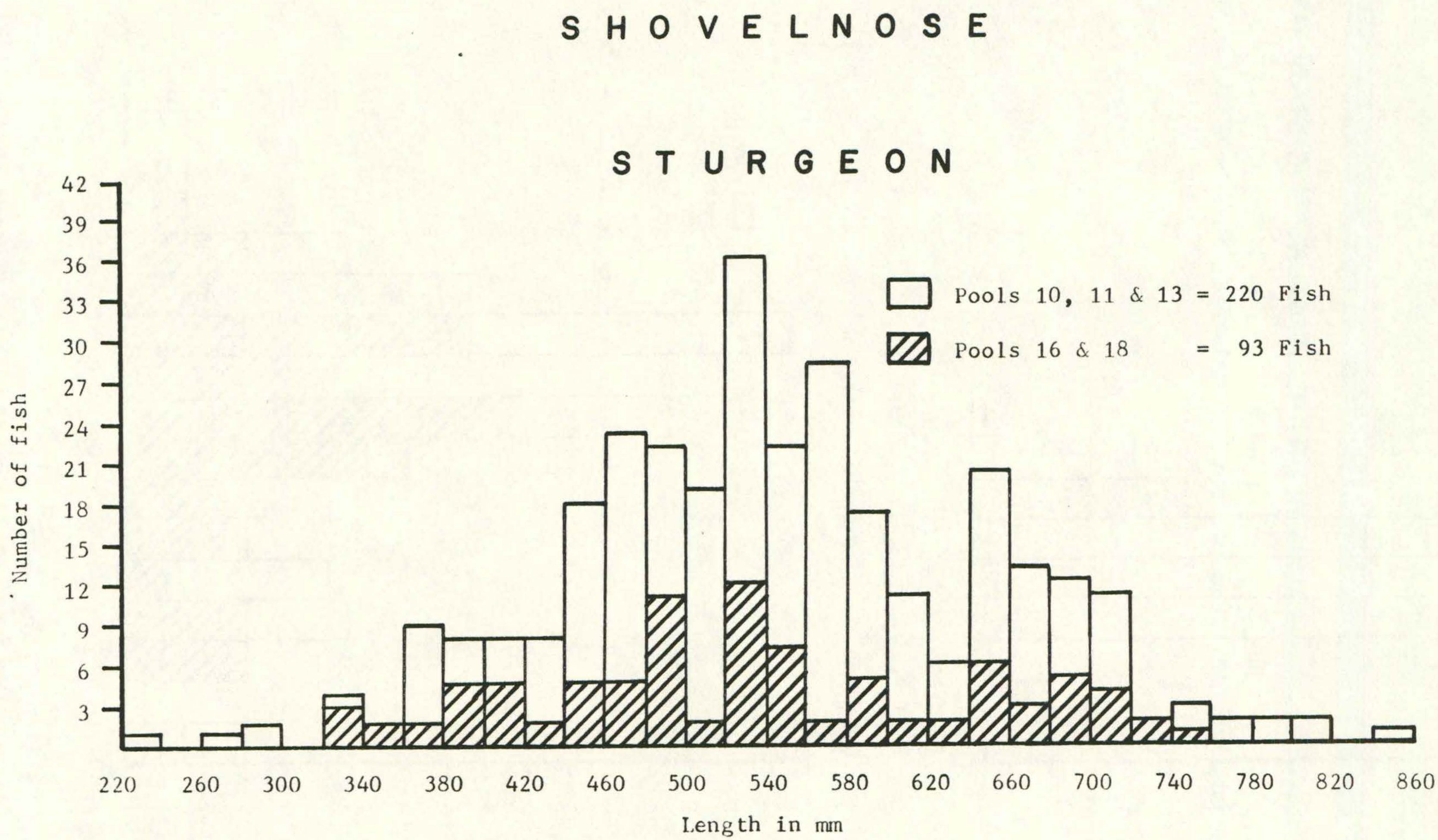
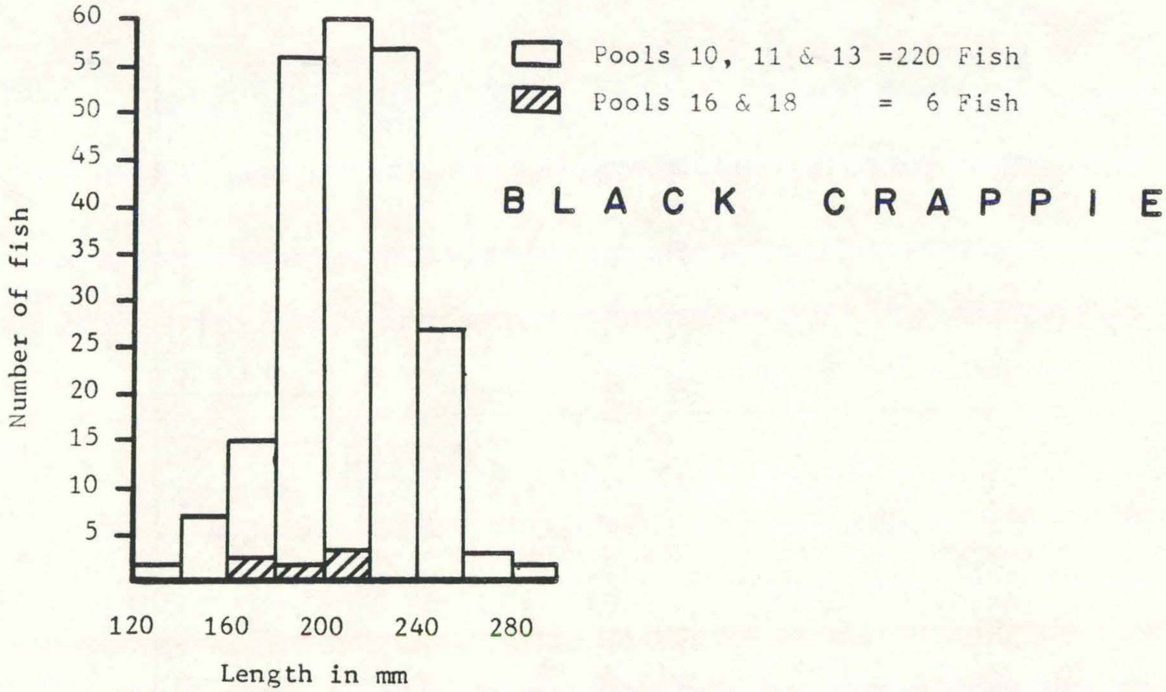


Figure 9 . Length frequency for Shovelnose Sturgeon collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.



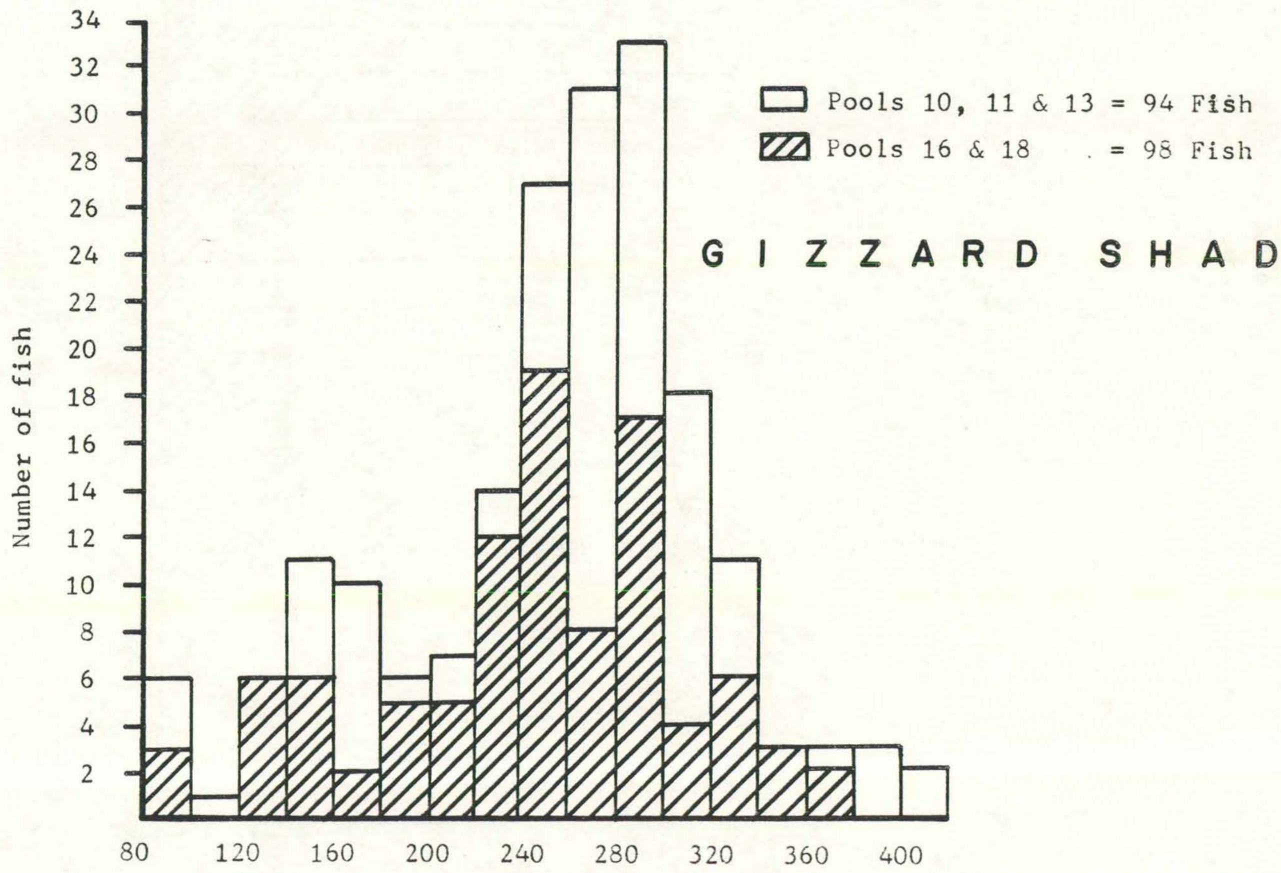
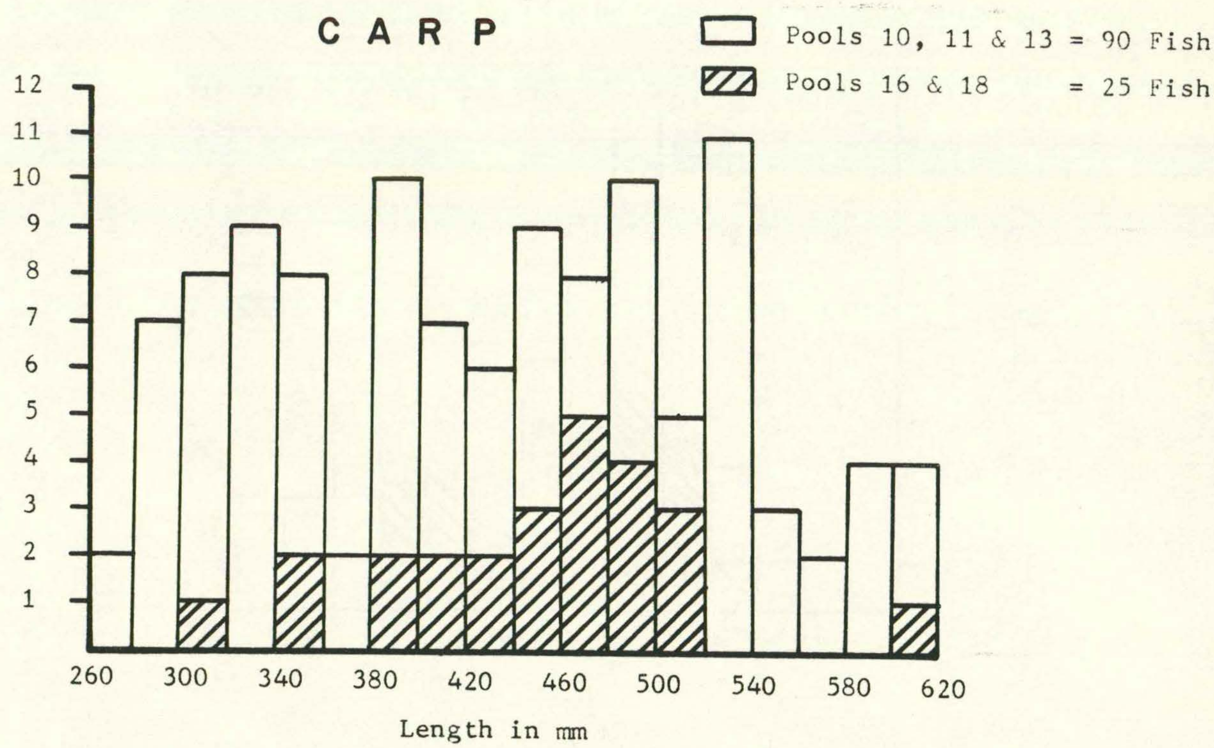


Figure 10. Length frequency for Black Crappie and Gizzard Shad collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.



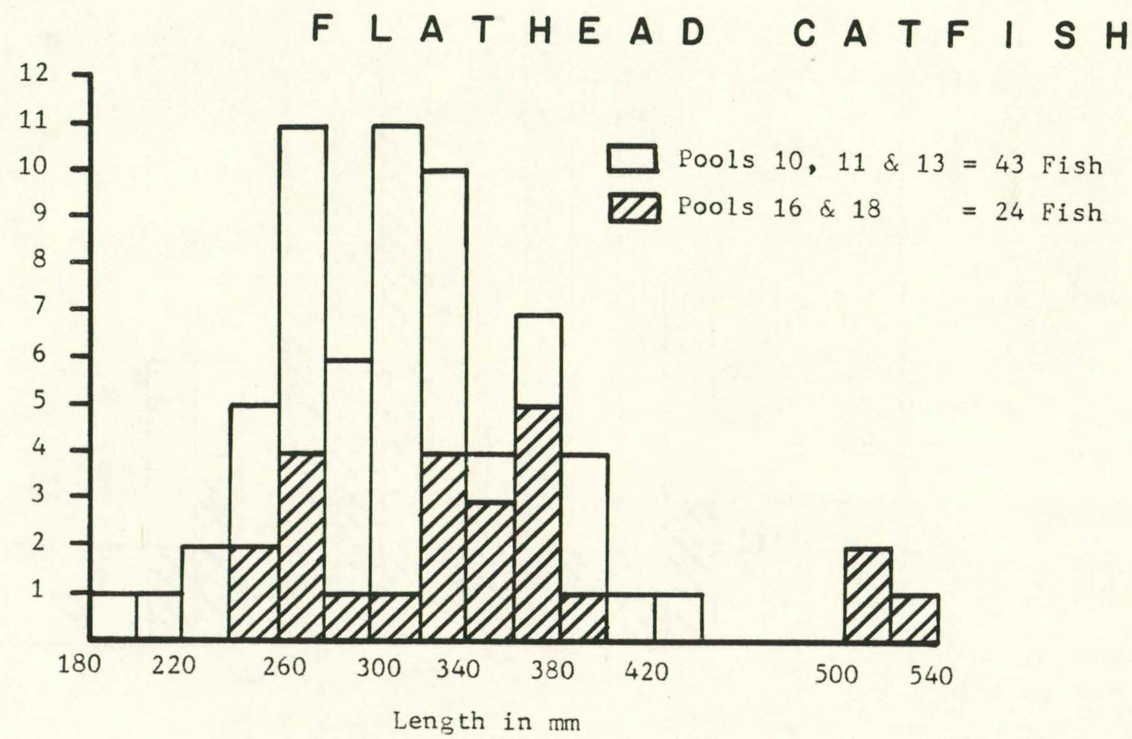


Figure 11 . Length frequency for Carp and Flathead Catfish collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 & 1981.

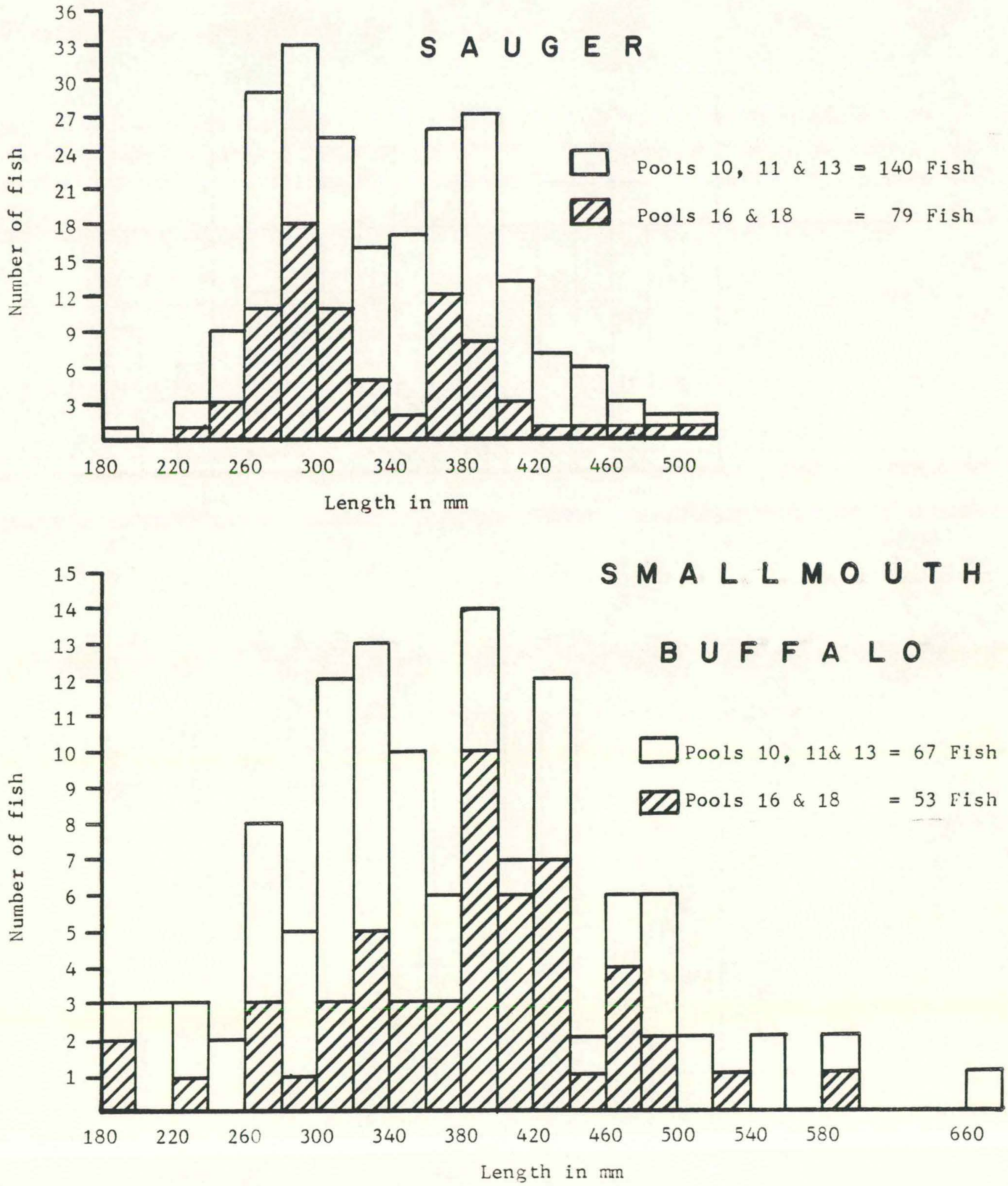


Figure 12 . Length frequency for Saúger and Smallmouth Buffalo collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.

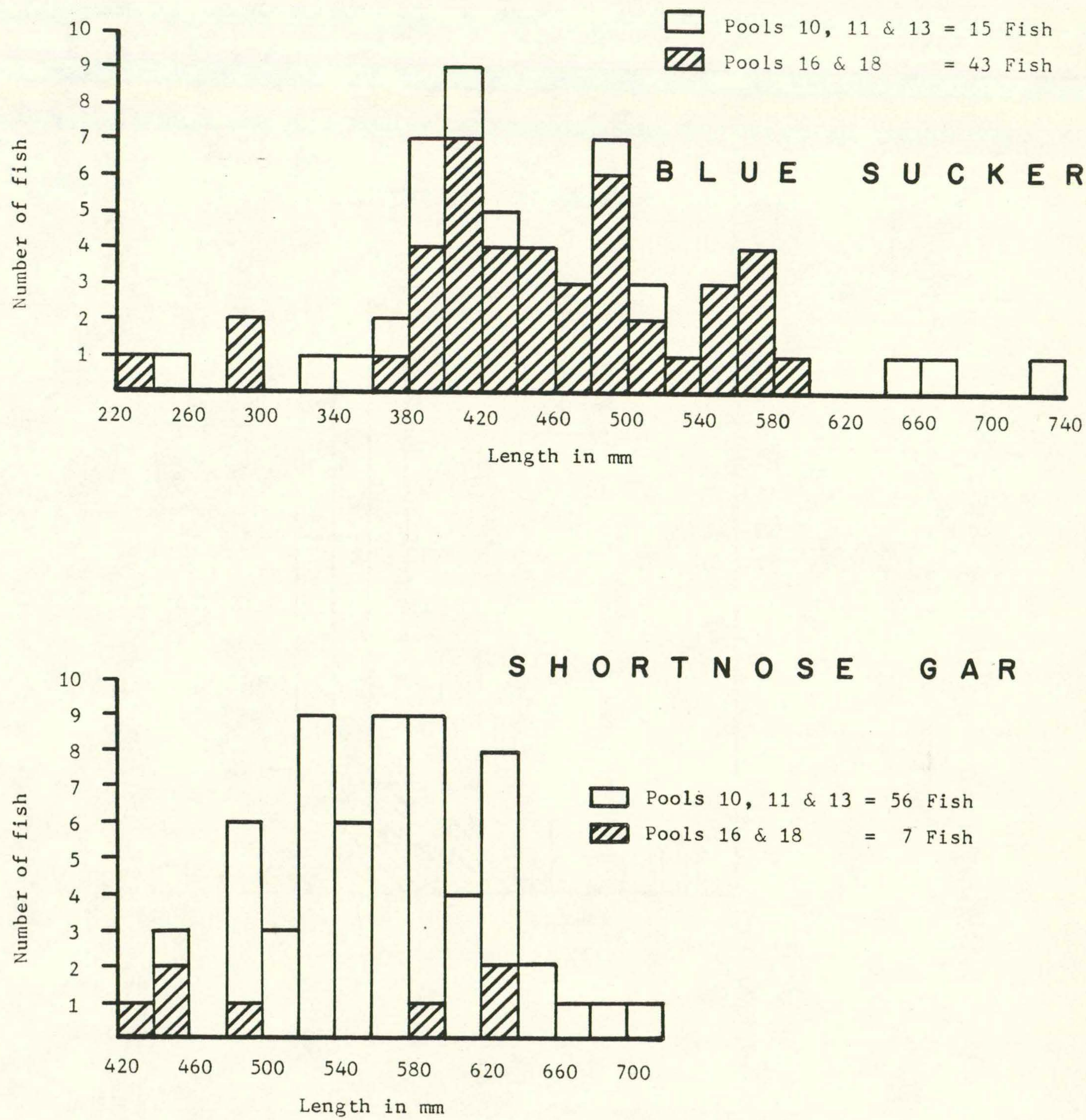


Figure 13 . Length frequency for Blue Sucker and Shortnose Gar collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 and 1981.

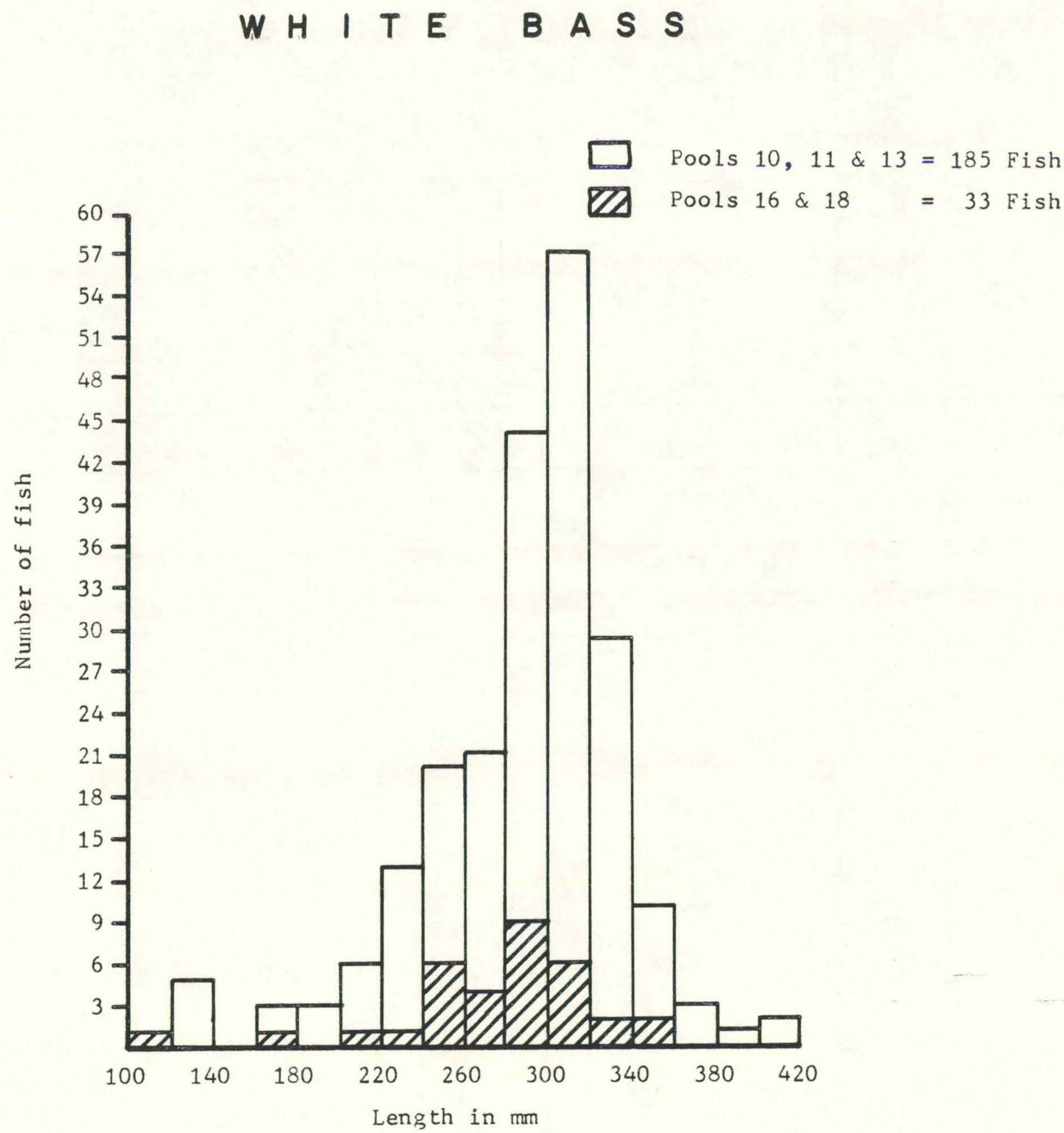
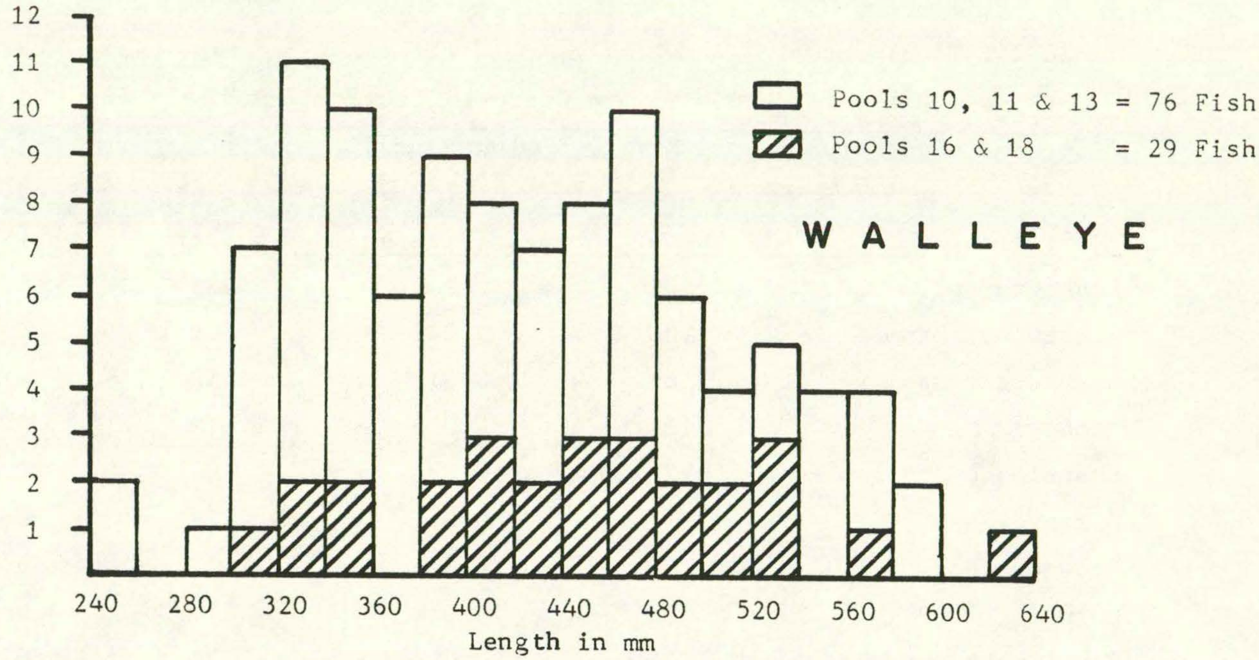


Figure 14 . Length frequency for White Bass collected from current modification structures, Upper Mississippi River bordering Iowa 1980 and 1981.



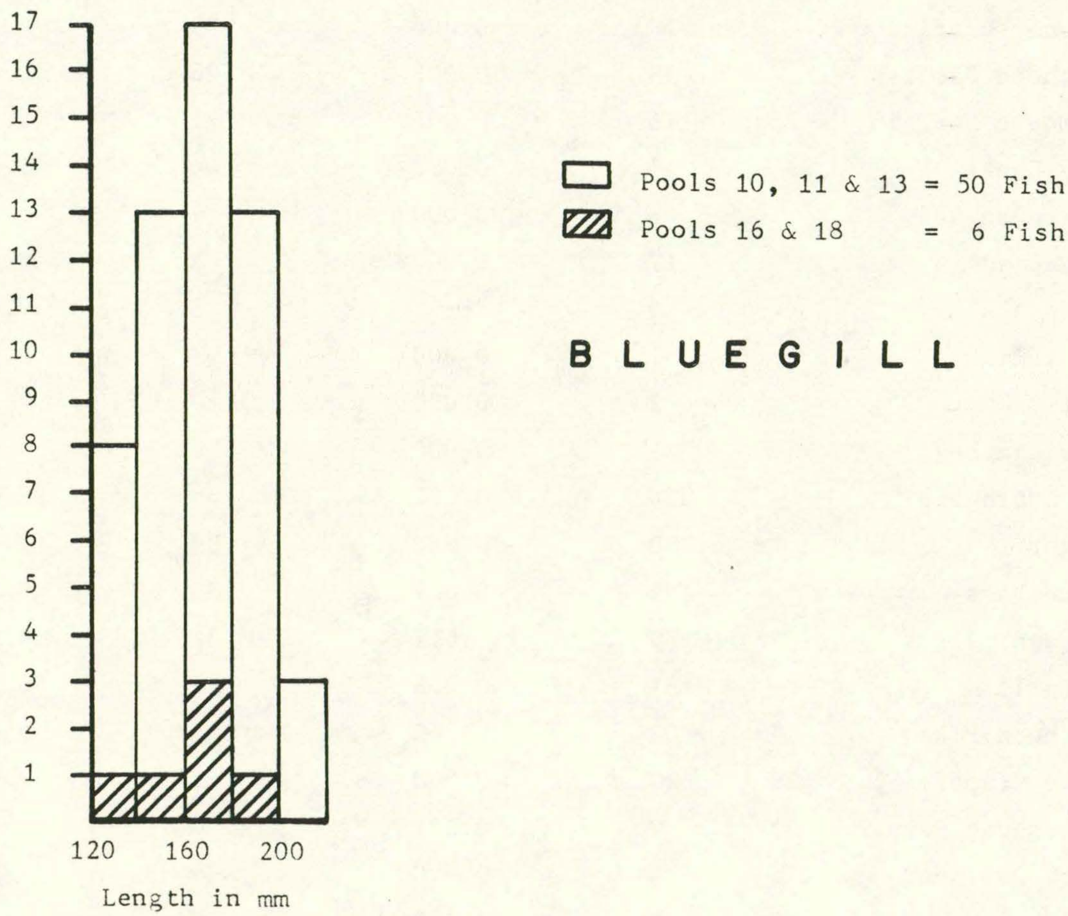


Figure 15. Length frequency for Walleye and Bluegill collected from current modification structures, Upper Mississippi River bordering Iowa, 1980 & 1981.

Table 14. Total number and catch per effort for fish sampled from current modification structures bordering Iowa by northern and southern pools, Upper Mississippi River, 1980 and 1981.

Species	North (Pools 10, 11, 13) Number	North (Pools 10, 11, 13) C/E (Fish/Hr.)	South (Pools 16, 18) Number	South (Pools 16, 18) C/E (Fish/Hr.)
Redhorse sp.	1,000	0.145	459	0.104
Freshwater Drum	328	0.047	300	0.068
Carpsucker sp.	89	0.013	412	0.093
Mooneye	133	0.019	219	0.050
Shovelnose Sturgeon	227	0.033	95	0.022
Gizzard Shad	117	0.017	129	0.029
Longnose Gar	246	0.036	17	0.004
Carp	111	0.016	47	0.011
Smallmouth Buffalo	74	0.011	72	0.016
Channel Catfish	30	0.004	99	0.022
Flathead Catfish	58	0.008	26	0.006
Bigmouth Buffalo	16	0.002	21	0.005
Blue Sucker	16	0.002	44	0.010
Shortnose Gar	63	0.009	9	0.002
Sucker sp.	17	0.002	2	0.0004
Goldeye	0	--	3	0.0006
Paddlefish	1	0.0001	2	0.0004
Bowfin	1	0.0001	0	--
American Eel	1	0.0001	0	--
Black Crappie	224	0.032	6	0.001
Sauger	150	0.022	82	0.019
White Bass	189	0.027	35	0.008
Walleye	79	0.011	37	0.008
Bluegill	57	0.008	7	0.002
Northern Pike	35	0.005	2	0.0005
White Crappie	20	0.003	1	0.0002
Smallmouth Bass	9	0.001	0	--
Black Bullhead	4	0.0006	0	--
Largemouth Bass	3	0.0004	0	--
Rock Bass	2	0.0003	0	--
Pumpkinseed	1	0.0001	0	--
Yellow Perch	1	0.0001	0	--
TOTAL:	3,302	0.4748	2,126	0.4821

Ninety-five percent confidence intervals around mean electrofishing and netting C/E values indicated no significant difference between the 1980 and 1981 sample years or between the spring, summer, and fall sample periods (Figure 16).

Evaluation of Diurnal and Catch Location

Data obtained from diurnal netting activities indicated more fish were captured during nighttime hours than daytime hours (Table 15); however, the difference was not significant. Mean C/E for day and night periods was 0.35 and 0.41 fish/hr., respectively. Forty-five percent or 4,972 hours of fishing effort was exerted during the day, and 55 percent or 5,827 hours of fishing was exerted at night (Table 15).

Initial sampling with trammel and gill nets draped over structures indicated considerable variation in fish numbers captured above and below structures; therefore, data was recorded to evaluate this difference. Chi-square analysis of fish numbers indicated significantly ($p < .01$, $X^2 = 13.36$) more fish were captured below structures (Table 16).

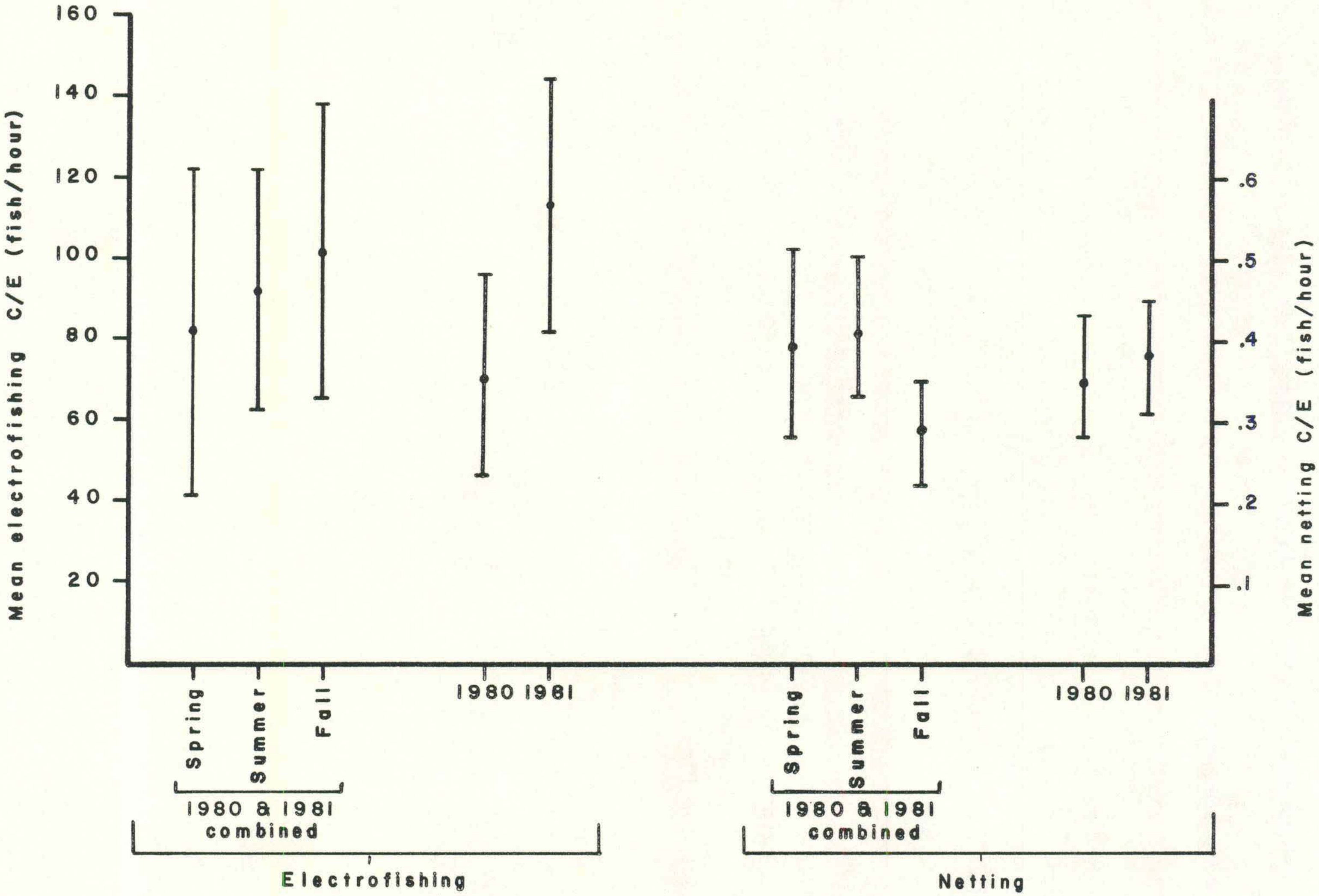


Figure 16. Ninety-five percent confidence intervals around mean electrofishing and netting catch per effort values by years and seasons for current modification structures bordering Iowa, Upper Mississippi River.

Table 15. Comparison of daytime and nighttime catch taken from current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

Species	Frame Day	Frame Night	Trammel Day	Trammel Night	Small Mesh Multi Gill Day	Small Mesh Multi Gill Night	Small Mesh Mone Gill Day	Small Mesh Mone Gill Night	Total Day	Total Night
Redhorse sp.	106	139	154	304	40	53	55	34	355	530
Freshwater Drum	167	314	11	39	8	14	23	19	209	386
Carpsucker sp.	203	152	22	45	11	7	4	1	240	205
Mooneye	82	73	8	17	7	14	30	21	127	125
Shovelnose Sturgeon	4	16	24	119	31	82	3	31	62	248
Gizzard Shad	1	4	16	34	4	21	11	12	32	71
Longnose Gar	1	10	30	49	27	39	13	70	71	168
Carp	19	10	5	6	2	5	19	7	45	28
Smallmouth Buffalo	14	39	4	12	1	8	7	6	26	65
Channel Catfish	15	20	15	24	6	15	4	5	40	64
Flathead Catfish	13	40	2	8	1	1	2	3	18	52
Blue Sucker	1	4	5	8	4	9	9	9	19	30
Shortnose Gar	3	8	8	17	10	5	6	10	27	40
Sucker sp.	4	0	3	4	0	1	0	1	7	6
Black Crappie	94	114	6	10	0	0	0	0	100	124
Sauger	21	32	11	47	22	49	15	12	69	140
White Bass	112	60	7	9	0	5	8	3	127	77
Walleye	26	24	4	12	7	6	5	4	42	46
Bluegill	36	6	8	4	2	1	1	0	47	11
Northern Pike	9	9	13	3	2	0	1	0	25	12
TOTAL FISH:	931	1,074	356	771	185	335	216	248	1,688	2,428
PERCENT:	22%	26%	8%	18%	4%	8%	5%	6%	41%	59%
TOTAL NET HOURS	1,541	1,890	1,203	1,458	1,429	1,734	619	745	4,792	5,827
FISH/NET HOUR	.60	.57	.29	.53	.13	.19	.35	.33	.35	.41

Table 16. Comparison of fish numbers captured above and below current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

			Small Mesh Gill Net					
	Trammel		Multi		Mono		Total	
Species	Above	Below	Above	Below	Above	Below	Above	Below
Redhorse sp.	179	272	29	53	35	50	243	375
Freshwater Drum	5	40	5	15	10	25	20	80
Carpsucker sp.	31	32	1	7	1	4	33	43
Shovelnose Sturgeon	47	100	36	80	19	16	102	196
Mooneye	4	19	3	11	8	43	15	74
Longnose Gar	26	44	12	46	3	80	41	170
Gizzard Shad	12	35	5	18	3	20	20	73
Smallmouth Buffalo	6	9	2	4	5	7	13	20
Carp	7	4	1	3	18	6	26	13
Channet Catfish	13	26	3	14	1	6	17	46
Flathead Catfish	5	5	0	2	3	1	8	8
Shortnose Gar	6	19	4	11	3	8	13	38
Blue Sucker	4	10	2	12	4	13	10	35
Sucker sp.	4	2	0	1	0	1	4	4
Sauger	19	37	27	43	6	19	52	99
White Bass	7	8	3	4	2	10	12	22
Black Crappie	5	8	0	0	0	0	5	8
Walleye	2	12	2	10	2	7	6	29
Northern Pike	6	7	0	2	0	1	6	10
Bluegill	4	6	2	1	0	1	6	8
TOTAL:	392	695	137	337	123	318	652	1,350
FISH/NET HR.	.29	.52	.09	.21	.18	.47	.18	.38

Physical Characteristics of Structures During Adult Fish Sampling Periods

Each time a wing or closing dam was sampled for adult fish, several physical measurements of water depth on the structure, current velocity on the structure, water temperature, and Secchi disc depth were also taken. Values for these parameters on individual sample days during the 1980 and 1981 field seasons are shown in Appendix Tables T through EE. The overall mean depth on structures for 1980 and 1981 was 1.68 m and 1.80 m, respectively ($p > .05$, Table 17). The overall mean velocity was 1.09 m/sec during 1980 and 1.54 m/sec in 1981 ($p < .05$). Mean Secchi depth values were 34.3 cm and 37.6 cm for 1980 and 1981 (Table 18). Mean water temperature was 17.7° C. during 1980 and 18.3° C. during 1981 (Table 18). Secchi disc and water temperature values were not significantly different between the two study years (Figure 17).

Wing and closing dam physical characteristics that were collected during the initial inventory were the primary criteria used to develop the wing and closing dam classification system. To ascertain whether the various components of the classification system retained their differences during the two-year study period, the physical parameters (water depth, current velocity, and Secchi depth) collected in conjunction with adult fish sampling were tested against the three major components of the classification system (geographic location, water depth over the structure, and structure location). Mean water depth over shallow and deep structures was 1.37 m and 2.10 m respectively which were significantly different at the 99 percent level (Table 19).

Table 17. Mean depth and velocity on current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

Pool No.	Wing Dam No.	Mean Depth (meters) 1980	Mean Depth (meters) 1981	Mean Velocity (m/sec) 1980	Mean Velocity (m/sec) 1981
10	27	1.68	1.86	.84	1.51
	36	1.19	1.01	.99	1.65
	40	2.01	2.07	.98	1.80
	42	1.01	1.16	.86	1.49
11	45	2.10	2.10	1.17	1.54
	49	1.83	1.86	.59	.95
	50	2.13	2.41	.95	1.38
	52	2.50	2.59	.62	.94
13	4	.82	1.22	1.04	1.24
	11	1.22	1.43	.86	1.27
	14	1.28	1.58	.94	1.51
	22	.79	1.43	1.40	2.08
16	1	1.55	1.46	1.43	1.64
	2	.88	.88	1.98	1.99
	4	2.04	2.07	1.55	1.82
	7	1.31	1.25	1.24	1.51
16	41	2.38	2.53	1.22	1.49
	45	2.32	2.32	.97	1.37
	51	2.50	2.59	.79	1.23
	53	2.96	3.05	.89	.98
18	4	1.65	1.86	.81	1.47
	15	.91	1.07	1.33	2.11
	16	1.22	1.46	1.49	2.14
	36	1.92	1.95	1.24	1.84
Overall Mean		1.68	1.80	1.09	1.54

Table 18. Mean Secchi disk depth and water temperature on current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

Pool No.	Wing Dam No.	Mean Secchi Depth (cm) 1980	Mean Secchi Depth (cm) 1981	Mean Temperature (° C) 1980	Mean Temperature (° C) 1981
10	27	40.1	51.6	17.9	20.0
	36	40.1	51.6	17.9	20.0
	40	40.1	51.6	17.9	20.0
	42	40.1	51.6	17.9	20.0
11	45	36.8	44.2	18.8	19.7
	49	36.8	44.2	18.8	19.7
	50	36.8	44.2	18.8	19.7
	52	36.8	44.2	18.8	19.7
13	4	36.3	37.6	18.8	19.3
	11	36.3	37.6	18.8	19.3
	14	36.3	37.6	18.8	19.3
	22	36.3	37.6	18.8	19.3
16	1	31.0	31.5	17.0	16.9
	2	31.0	31.5	17.0	16.9
	4	31.0	31.5	17.0	16.9
	7	31.0	31.5	17.0	16.9
16	41	32.0	33.3	16.9	17.1
	45	32.0	33.3	16.9	17.1
	51	32.0	33.3	16.9	17.1
	53	32.0	33.3	16.9	17.1
18	4	30.5	30.0	17.2	16.9
	15	29.0	26.2	17.1	16.9
	16	29.0	26.2	17.1	16.9
	36	29.0	26.2	17.1	16.9
Overall Mean		34.3	37.6	17.8	18.3

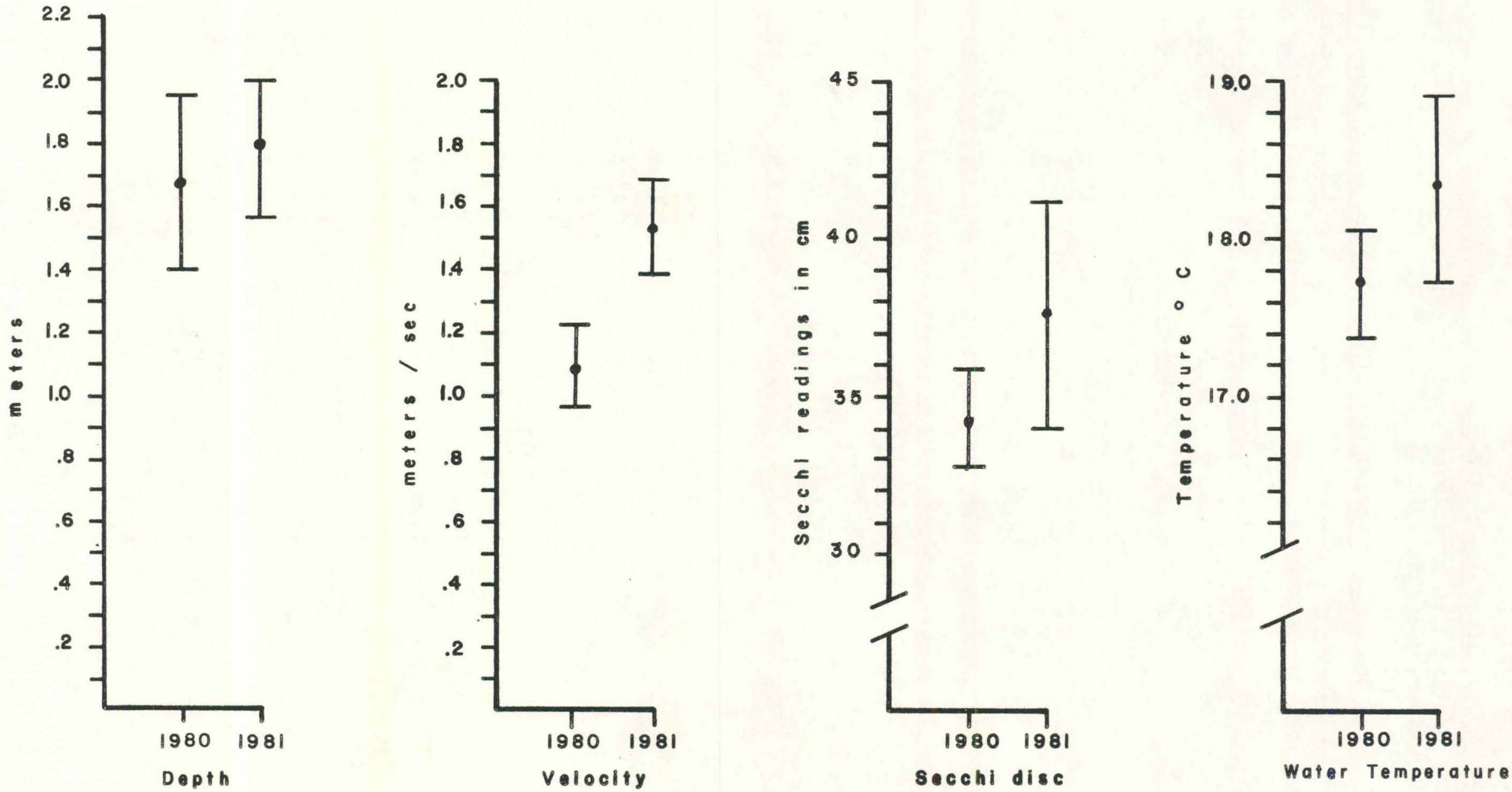


Figure 17 . Mean water depth, water velocity, secchi disc depth, water temperature values for the 1980 and 1981 sample years collected on current modification structures bordering Iowa, with 95% confidence intervals around means.

Table 19. Physical characteristics collected from current modification structures bordering Iowa compared to major components of the wing and closing dam classification system.

	CLASSIFICATION SYSTEM COMPONENTS		
Parameter	≤ 1.52 m/ > 1.52 m	Inside/Outside/Straight	North/South
Depth	**	ns	ns
Velocity	ns	*	ns
Secchi	ns	ns	**

** Significant at the .01 level of probability
 * Significant at the .05 level of probability
ns No significant difference ($p > .05$)

Current velocity varied significantly only with structure location in relation to thalawag. Structures located on outside bends had significantly higher current velocity than those located on inside bends. Current volocity for structures located on straight river sections was not significantly different from structures located on inside and outside bends. Mean current velocity for structures located on inside bends, outside bends, and straight river sections were 1.09, 1.43, and 1.31 m/sec., respectively.

Differences in Secchi disc transparency were significantly different due to the geographical location of the structures. Structures located in northern pools had higher water transparencies ($\overline{X}$ = 41.2 cm) than structures located in southern pools ($\overline{X}$ = 30.7 cm).

Comparisons Between Fish Populations and Structure Characteristics

One of the primary objectives of this study was to determine wing and closing dam characteristics that were important to adult fish populations. Table 20 shows the total catch, effort, and catch per effort for each structure sampled during the two-year study. Total catch ranged from 41 fish on Dam 16-45 to 700 fish on Dam 13-22. Catch/effort for all gears combined on individual dams ranged from 0.10 fish/hr. on Dam 16-45 to 1.27 fish/hr. on Dam 16-2 (Table 20).

Table 20. Total fish collected by all gear from individual current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

	Northern Pools												Southern Pools												
	Pool 10				Pool 11				Pool 13				Pool 16								Pool 18				
Species	10-27	10-36	10-40	10-42	11-45	11-49	11-50	11-52	13-4	13-11	13-14	13-22	16-1	16-2	16-4	16-7	16-41	16-45	16-51	16-53	18-4	18-15	18-16	18-36	Total
Redhorse sp.	48	55	45	111	120	92	98	105	60	63	43	160	27	138	21	47	20	15	16	20	35	53	43	24	1459
Freshwater Drum	10	5	25	9	64	14	19	53	37	3	15	74	32	33	79	31	8	6	14	3	52	20	14	8	628
Carpsucker sp.	3	7	3	10	6	13	6	8	16	1	7	9	61	156	15	42	10	9	10	8	32	20	36	13	501
Mooneye	3	13	12	6	8	4	13	7	15	13	12	27	23	94	18	28	2	0	2	0	9	17	10	16	352
Shovelnose Sturgeon	5	5	2	0	11	2	54	12	43	44	22	27	13	9	28	12	3	1	0	4	5	2	12	6	322
Gizzard Shad	3	3	3	6	10	5	7	2	33	11	25	9	2	11	7	20	3	0	1	1	65	12	6	1	246
Longnose Gar	7	8	0	1	24	8	7	4	29	23	22	113	6	2	3	2	0	0	1	0	3	0	0	0	263
Carp	0	2	3	3	23	15	4	14	7	4	2	34	3	1	2	13	0	0	1	0	8	11	7	1	158
Smallmouth Buffalo	2	2	4	1	8	9	3	4	9	7	13	12	10	11	18	13	4	3	1	2	2	4	2	2	146
Channel Catfish	1	0	1	1	3	4	3	2	2	3	0	10	8	14	4	15	3	2	7	8	2	13	21	2	129
Flathead Catfish	7	2	6	6	9	5	6	2	4	4	5	2	0	1	2	0	0	2	1	1	3	5	5	6	84
Bigmouth Buffalo	2	0	0	0	2	0	1	1	0	2	6	2	10	0	1	5	1	0	0	0	0	2	0	2	37
Blue Sucker	1	3	2	0	1	0	1	0	0	0	4	4	12	16	6	7	0	0	0	0	0	0	2	1	60
Shortnose Gar	0	1	0	0	4	0	2	1	9	3	26	17	1	1	2	0	0	0	2	0	2	0	1	0	72
Sucker sp.	1	2	1	0	4	1	5	2	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	19
Goldeye	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	3
Paddlefish	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	3
Bowfin	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
American Eel	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Black Crappie	5	2	11	22	4	4	1	3	27	12	17	116	2	1	1	0	0	0	0	0	1	1	0	0	230
Sauger	5	20	10	31	16	5	11	10	13	5	8	16	8	9	9	7	4	2	5	13	8	9	6	2	232
White Bass	5	2	0	7	5	1	3	6	115	10	15	20	2	10	15	1	0	0	0	0	2	3	1	1	224
Walleye	1	4	3	7	8	1	7	1	8	17	6	16	7	9	2	8	1	1	0	0	7	1	1	0	116
Bluegill	7	2	2	10	2	2	0	6	13	1	5	7	0	1	0	1	0	0	0	0	3	1	0	1	64
Northern Pike	0	0	0	0	0	0	1	0	17	2	4	11	0	Ø1	0	0	0	0	0	0	0	1	0	0	37
White Crappie	0	0	0	0	1	0	0	1	6	3	1	8	0	0	0	0	0	0	0	0	1	0	0	0	21
Smallmouth Bass	0	2	2	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Black Bullhead	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
Largemouth Bass	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Rock Bass	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Pumpkinseed	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Yellow Perch	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	116	141	136	237	334	186	253	244	464	233	258	700	227	521	234	254	59	41	61	60	241	175	167	86	5428
Total Effort (Hours)	572.7	574.7	575.4	579.8	580.5	546.6	578.6	576.6	574.8	578.7	584.7	591.8	409.4	409.6	398.4	414.4	405.4	412.3	409.3	386.1	360.4	202.1	318.1	289.3	11,339.4
Catch/hour	.20	.25	.24	.41	.58	.34	.44	.42	.81	.40	.44	1.18	.55	1.27	.59	.61	.15	.10	.15	.16	.67	.87	.53	.30	.48

Structures were grouped according to the schematic outlined in the Classification Methodology Section (Table 21). Total catch ranged from 944 fish for Group 2 (shallow structures located on outside bends in northern pools) to 121 fish in Group 10 (deep structures located on inside bends in southern pools) (Table 21). Mean netting C/E ranged from 0.69 fish/hr. for Group 8 to 0.15 fish/hr. for Group 10 (Table 21). Mean electrofishing C/E ranged from 202.61 to 3.21 fish/hr. for Groups 8 and 10, respectively. Species numbers ranged from 23 for Groups 2, 4, and 6 to 12 in Group 10 (Table 21).

Statistical analysis consisted of catch/effort and species numbers comparisons between structures located in northern and southern pools, between shallow (≤ 1.52 m) and deep (> 1.52 m) structures and between structures located on inside bends, outside bends, and straight river sections. Netting and electrofishing data were evaluated separately and data transformed to $\log_{10}$ (C/E) for netting and $\log_{10}$ (C/E + 1) for electrofishing. Species numbers data were transformed to $\log_{10}$ (# species + 1) for electrofishing and was not transformed for netting data.

Analysis of variance indicated depth and location were the parameters most important to adult fish populations. Structures that were ≤ 1.52 m deep had significantly higher C/E and species numbers that did structures that were >1.52 m below the surface (Table 22).

Table 21 . Comparison of fish numbers, catch per effort and species numbers for current modification structures bordering Iowa, grouped according to the classification system by geographical location, depth and location to the thalawag.

Group	Structures in Groups	Geographical Location	Depth Classification	Location to Thalawag	Total Fish	Mean Netting C/E(fish/hr)	Mean Electrfishing C/E(fish/hr)	Total No. Species
1	10-42, 11-49	N[a]	0-5 feet	I[b]	423	0.29	77.45	19
2	11-52, 13-22	N	0-5 feet	O	944	0.65	120.27	23
3	10-36, 13-4	N	0-5 feet	S	605	0.42	92.02	22
4	10-27, 13-11	N	over 5 feet	I	349	0.33	80.01	23
5	11-45, 13-14	N	over 5 feet	O	592	0.39	94.80	22
6	10-40, 11-50	N	over 5 feet	S	389	0.28	25.91	23
7	16-7 , 18-36	S	0-5 feet	I	340	0.29	147.40	18
8	16-1 , 16-2	S	0-5 feet	O	748	0.69	202.61	22
9	18-15, 18-16	S	0-5 feet	S	342	0.45	187.18	17
10	16-51, 16-53	S	over 5 feet	I	121	0.15	3.21	12
11	16-4 , 16-41	S	over 5 feet	O	293	0.29	64.90	18
12	16-45, 18-4	S	over 5 feet	S	282	0.29	45.45	18

a, N= Northern pools (10, 11 & 13), S= Southern pools (16 & 18)

b, I= Inside river bend, O= Outside river bend, and S= Straight river section

Table 22. Analysis of variance for netting and electrofishing samples taken from Upper Mississippi River current modification structures bordering Iowa, 1980 and 1981.

Parameter	Net Sampling C/E	Net Sampling Species	Electrofishing Samples C/E	Electrofishing Samples Species
North/South	ns	ns	ns	ns
Depth	22.416	8.29**	31.562**	24.163**
Location	9.177**	6.085**	3.662*	3.218*
Depth X Location	ns	ns	ns	ns
N/S X Location	ns	ns	4.619*	3.27*
N/S X Depth	5.786*	ns	14.327**	11.89**
Third Order Interactions	ns	ns	ns	ns

** Significant at the .01 level of probability

* Significant at the .05 level of probability

ns Not significant (p > .05)

This relationship was significant for both net and electrofishing samples. Structure location in relation to the thalawag had a significant influence on C/E and species numbers obtained by both electrofishing and netting (Table 22). Structures located on outside river bends had significantly higher C/E and species numbers than those located on inside river bends. In most cases, no significant difference was noted between structures located on outside bends and straight river sections.

The north/south by location interaction was significant only for electrofishing C/E and species numbers (Table 22). Plots of mean values for the interaction indicate that C/E and species numbers by structure location differ considerably more for southern pools than for northern pools (Figure 18).

The north/south by depth interaction was significant for netting C/E and for electrofishing C/E and species numbers (Table 22). Plots of mean values indicate that for shallow dams, C/E and species numbers were similar between northern and southern pools; but for deep dams, C/E and species numbers were considerably lower in southern pools (Figures 19 and 20).

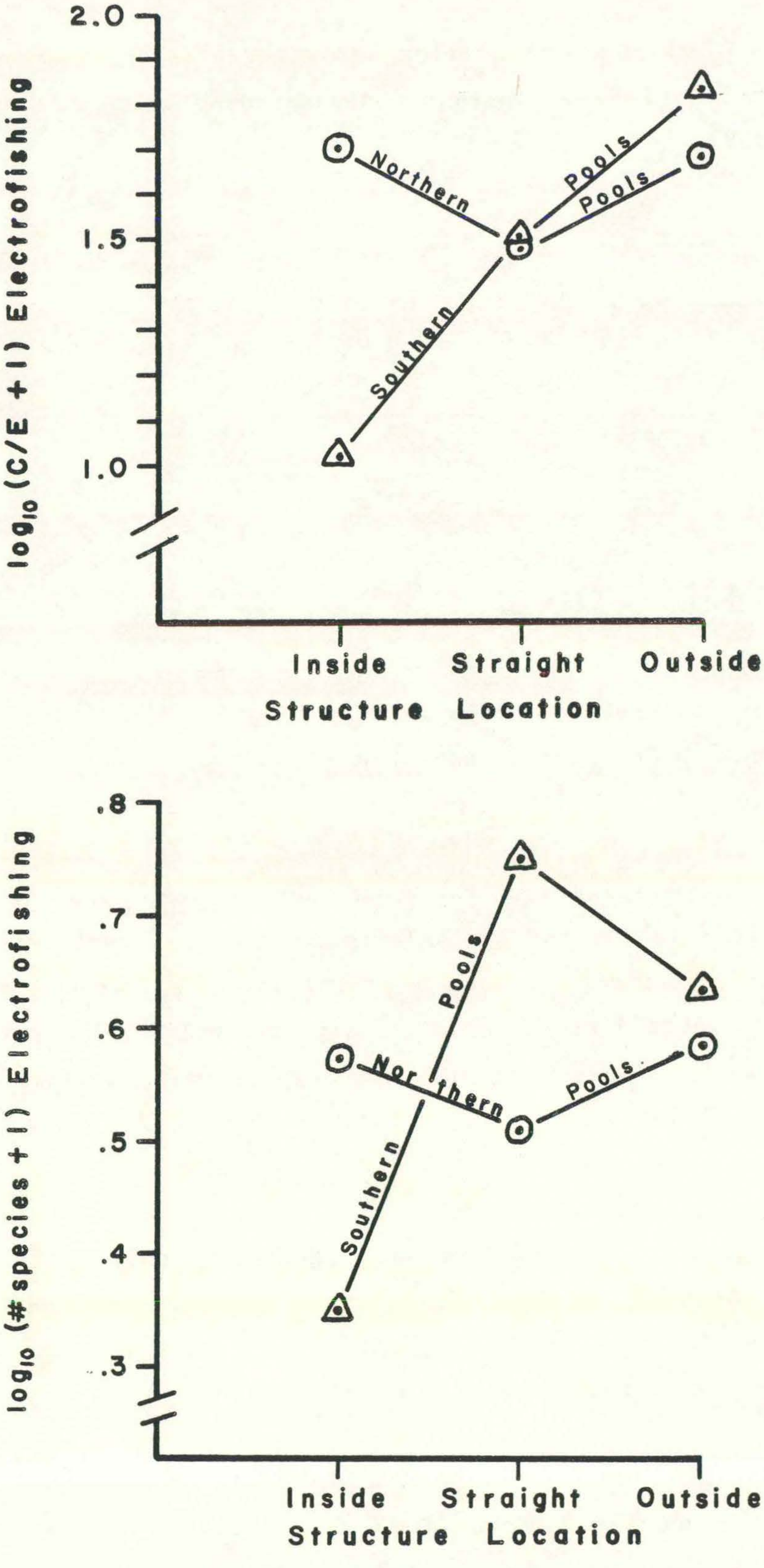


Figure 18 . Electrofishing catch/effort and species numbers comparisons between structure and pool location.

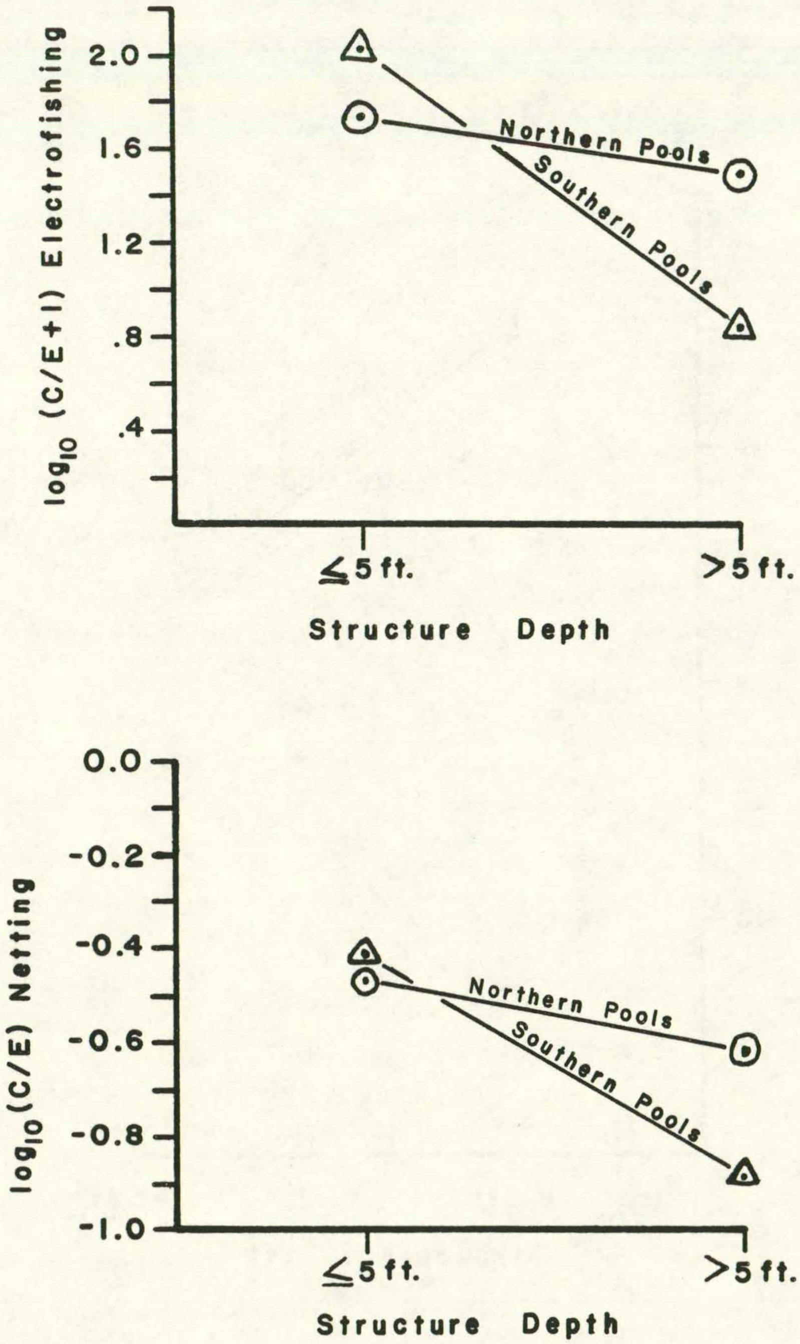


Figure 19. Electrofishing and netting catch/effort comparisons by depth and pool location.

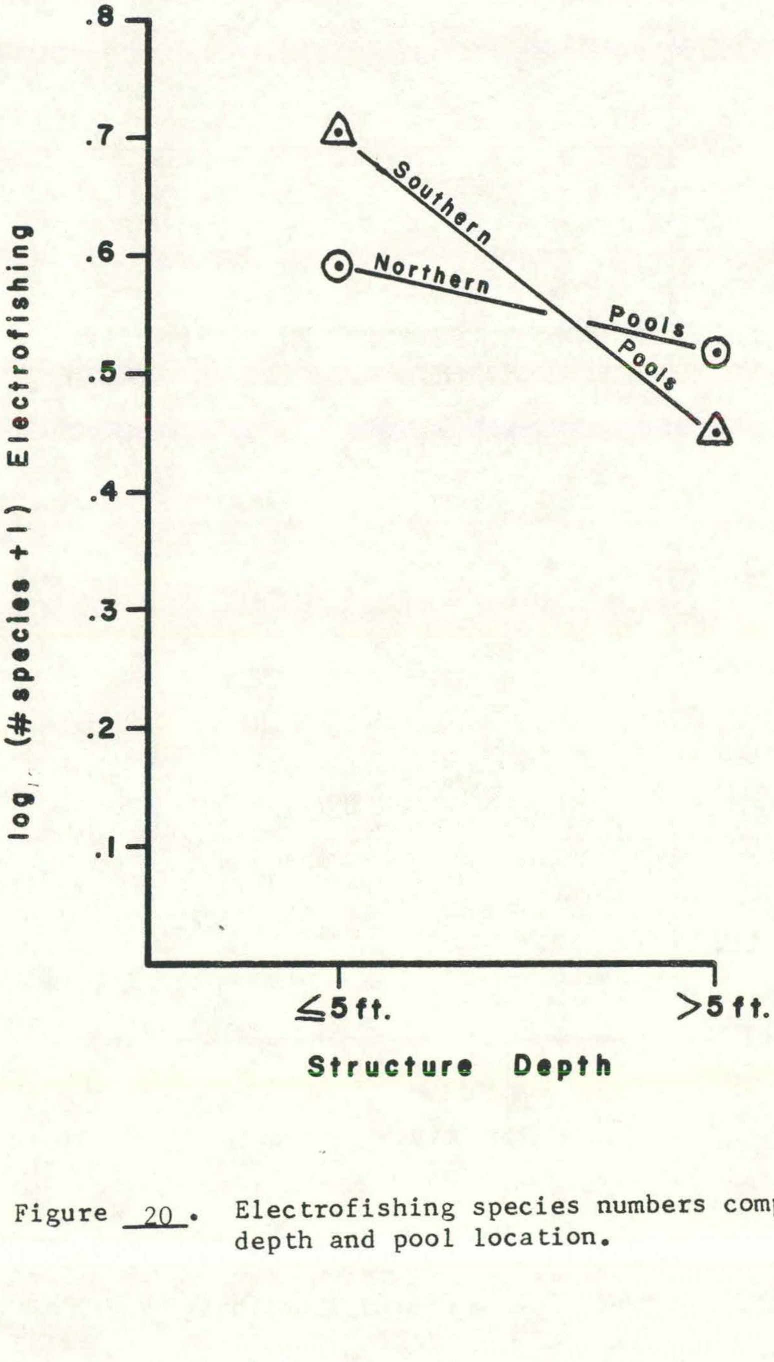


Figure 20. Electrofishing species numbers comparisons by structure, depth and pool location.

Additional analysis was performed to test seasonal and depth relationships. Table 23 shows significant F-test values for netting C/E and species number. This analysis was not performed for electrofishing data because of the missed spring sample in 1980 and summer sample in Pools 16 and 18 during 1981.

Table 23. Analysis of variance values for net catches of fish taken from current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

	NETTING	
Parameter	C/E	Species
Season	ns	3.673*
Depth	22.416**	7.945**
Season X Depth	ns	ns

** .01 level of probability

* .05 level of probability

ns Not significant

The number of species captured by netting gear was significantly different by season. The mean species numbers captured were 8.7, 8.0, and 6.7 for spring, summer, and fall respectively. The spring and summer catch was significantly higher than the fall.

Linear regression analysis was used to determine for individual samples, relationships between C/E, species number, depth of dam, and water velocity over the dam. Analysis yielded the following model for netting data:

$$\log_{10} Y = -2.0711 + 0.1152 X_1 - 0.0733 X_2 + 0.3406 \log_{10} X_3$$

Where Y = C/E, data transformed ($\log_{10} X_1$)

X_1 = Number of species

X_2 = Depth

X_3 = Velocity ($\log_{10} X_3$)

The model was significant at the 99 percent confidence level [$F_{(3;111)} = 9.10$; $R = .444$).

Intraclass correlation values for all regression parameters are given on Table 24.

Table 24. Intraclass correlation for catch/effort, number of species, depth, and velocity calculated for individual netting samples collected from current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

	PARTIAL CORRELATIONS (r)			
Parameter	C/E	No. Species	Depth	Velocity
C/E	1.00	0.284*	-0.197^{ns}	0.2789**
No. Species	--	1.00	-0.421**	-0.155^{ns}
Depth	--	--	1.00	0.102^{ns}
Velocity	--	--	--	1.00

** Significant at the .01 level of probability

* Significant at the .05 level of probability

ns Not significant ($p > .05$)

Significant relationships indicated by the analysis included -- as the number of species increase in an individual sample, so does catch/effort; higher current velocities result in higher catch/effort; and as depth over the structure increases, the number of species that are captured decreases.

The linear regression analysis for electrofishing data yielded the following model:

$$\log_{10} Y = 0.720 + 2.352 \log_{10} X_1 - 0.04 X_2 - 0.229 \log_{10} X_3$$

where: Y = C/E, data transformed, $\log_{10} (X + 1)$

X_1 = Number of species captured $[\log_{10} (X + 1)]$

X_2 = Depth

X_3 = Velocity $[\log_{10} (X + 1)]$

The model was significant at the 99 percent confidence level ($F = 243.3$; $R = .948$). Intraclass values are given in Table 25.

Table 25. Intraclass correlation coefficients for catch/effort, species number, depth, and velocity for individual electrofishing samples collected from current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

	PARTIAL CORRELATIONS (r)			
Parameter	C/E	No. Species	Depth	Velocity
C/E	1.00	0.943**	-0.613**	-0.056 ns
No. Species	--	1.00	-0.579**	-0.006 ns
Depth	--	--	1.00	0.030 ns
Velocity	--	--	--	1.00

** Significant at the .01 probability level

* Significant at the .05 probability level

ns Not significant (p > .05)

As with the netting data, electrofishing C/E and species numbers were positively correlated; as the species numbers in an individual sample increased, so did C/E. The overriding variable influencing both electrofishing C/E and number of species was water depth over a structure (Table 25). As water depth increased, both C/E and species numbers decreased.

Current Modification Structure Use For Reproduction By Fishes

During the 1980 and 1981 spring sample periods, data was recorded to determine the numbers of gravid or freshly-spent females and ripe males that were captured from wing and closing dams. Three hundred eleven sexually-mature fish were captured, of which 52 were females and 259 were males (Table 26).

Table 26. Numbers of gravid or freshly-spent females and ripe males collected from current modification structures during the 1980 and 1981 spring sample period, Upper Mississippi River.

Species	Males	Females	Total
Redhorse sp.	14	26	40
Freshwater Drum	12	--	12
Carpsucker sp.	15	7	22
Mooneye	40	8	48
Gizzard Shad	1	1	2
Longnose Gar	1	--	1
Carp	13	2	15
Channel Catfish	--	1	1
Smallmouth Buffalo	3	1	4
Bigmouth Buffalo	2	--	2
Sucker sp.	1	3	4
Black Crappie	2	1	3
Sauger	3	--	3
White Bass	147	1	148
Bluegill	5	1	6
TOTALS:	259	52	311

The most abundant species was white bass with 148 fish followed by mooneye (48) and redhorse sp. (40). Males were more numerous for all species except redhorse sp. and sucker sp. (Table 26). Due to small sample size and high variability in the data, no statistical analysis were performed; however, mean number of reproductively-mature fish per sample reflects trends that are similar to the adult fish analysis. Shallower dams had higher mean number of reproductively-active fish per sample than did deeper dams (Table 27). Structures located on outside bends and straight river sections had more reproductively-active fish than did structures located on inside bends (Table 27).

Table 27. Total fish numbers and mean number of reproductively-mature fish per sample captured from Upper Mississippi River current modification structures bordering Iowa, 1980 and 1981.

Parameter	Total Number Of Fish	Mean Number Of Fish/Sample
Northern Pools	175	7.25
Southern Pools	136	5.67
≤1.52 m	222	9.21
>1.52 m	89	3.70
Inside Bend	46	2.88
Outside Bend	131	8.13
Straight Section	134	8.38

In order to develop methods for collecting fish eggs from wing and closing dams for the next study segment, experimental egg samplers were constructed and placed on a wing dam during the spring of 1981. Experimental egg samplers were constructed of one-half inch reinforcement rod shaped into a one-half meter square and covered with one-fourth inch hardward cloth. Either rock, window screening, or furnace air filters were sandwiched between the hardware cloth. Samplers were placed on the upstream face, top, and downstream side of a structure. Samplers were placed near the shore end, the middle, and the outer tip of the wing dam. Over 200 fish eggs were collected, while samplers located on top and downstream side and placed near the middle and outer tip of the structure collected over 80 percent of the eggs. Rock-filled samplers collected the largest number of fish eggs. Furnace air filters became plugged with silt rendering them ineffective. Window screening captured only a few eggs that became trapped along the frame edge between the screen and the reinforcement rod. Approximately 12 percent of the eggs collected were viable. These eggs were returned to the laboratory for hatching and aiding in identification. Eggs were placed in a hatchery battery jar and air bubbled through the water to keep the eggs in suspension. Fish eggs hatched within three to five days of collection and were identified as mooneye (Hiodon tergisus) larva. No other fish species were identified from egg collections.

Gear Evaluation

Since a comprehensive literature review revealed little information regarding sampling methods and gear for collecting fish associated with current modification structures, gear performance and evaluation was an important component of the study. Table 28 summarizes total fish, C/E, and number of species captured by each gear during the two-year study period. Electrofishing had the highest catch per effort with 96.94 fish/hr. while large mesh multifilament gill nets exhibited the lowest catch/effort with 0.01 fish/hr. (Table 28). Frame and trammel nets together captured nearly 60 percent of the fish and 97 percent of the species (Tables 28 and 13).

Table 28. Total fish, species, and catch per effort (fish/hr.) by gear from current modification structures bordering Iowa, Upper Mississippi River, 1980 and 1981.

Gear	Total Fish	Percent Of Total	Total Effort (Hr.)	C/E Fish/Hr.	No. Species	Percent Of Total Species
Frame Nets	2,071	38	3,467	0.60	31	82
Trammel Nets	1,148	21	2,733	0.42	33	87
Small Mesh Multi Nets	539	10	3,211	0.17	25	66
Small Mesh Mono Nets[a]	467	9	1,364	0.34	25	66
Large Mesh Multi Nets[b]	4	1	552	0.01	2	5
Electrofishing	1,202	22	12.4	96.94	28	74
TOTALS:	5,428		11,339.4	0.48	38	

a Small mesh monofilament nets used only during the 1981 field season.

b Large mesh multifilament nets used only during the spring, 1980 sample period.

Catch effort data showed a skewed distribution and values were transformed [$\log_e (X + 1)$] to obtain normality. Analysis of the 1980 and 1981 mean C/E for frame, trammel, and small mesh multifilament gill nets indicated a significant difference in gear (Table 29).

Table 29. Analysis of variance for mean catch/effort in frame, trammel, and small mesh multifilament gill nets, 1980 and 1981, with seasons as replication, Upper Mississippi River.

Source	dF	SS	MS	F
(A) Gear	2	.1354	.0677	27.01**
(B) Day/Night	1	.0071	.0071	2.83 ns
A x B	2	.0120	.0060	2.40 ns
Error	34	.0852	.0025	--
TOTAL:	39	.2397	--	--

** 99 percent confidence level

ns Not significant ($p > .05$)

Confidence intervals around mean C/E indicated that small mesh multifilament gill nets had significantly lower catch than frame and trammel nets (Figure 21). Mean C/E for monofilament and multifilament small mesh gill nets were also analyzed. Analysis of variance for mean catch/effort for monofilament and multifilament small mesh gill nets indicated a significant difference (99 percent level) in C/E (Table 30).

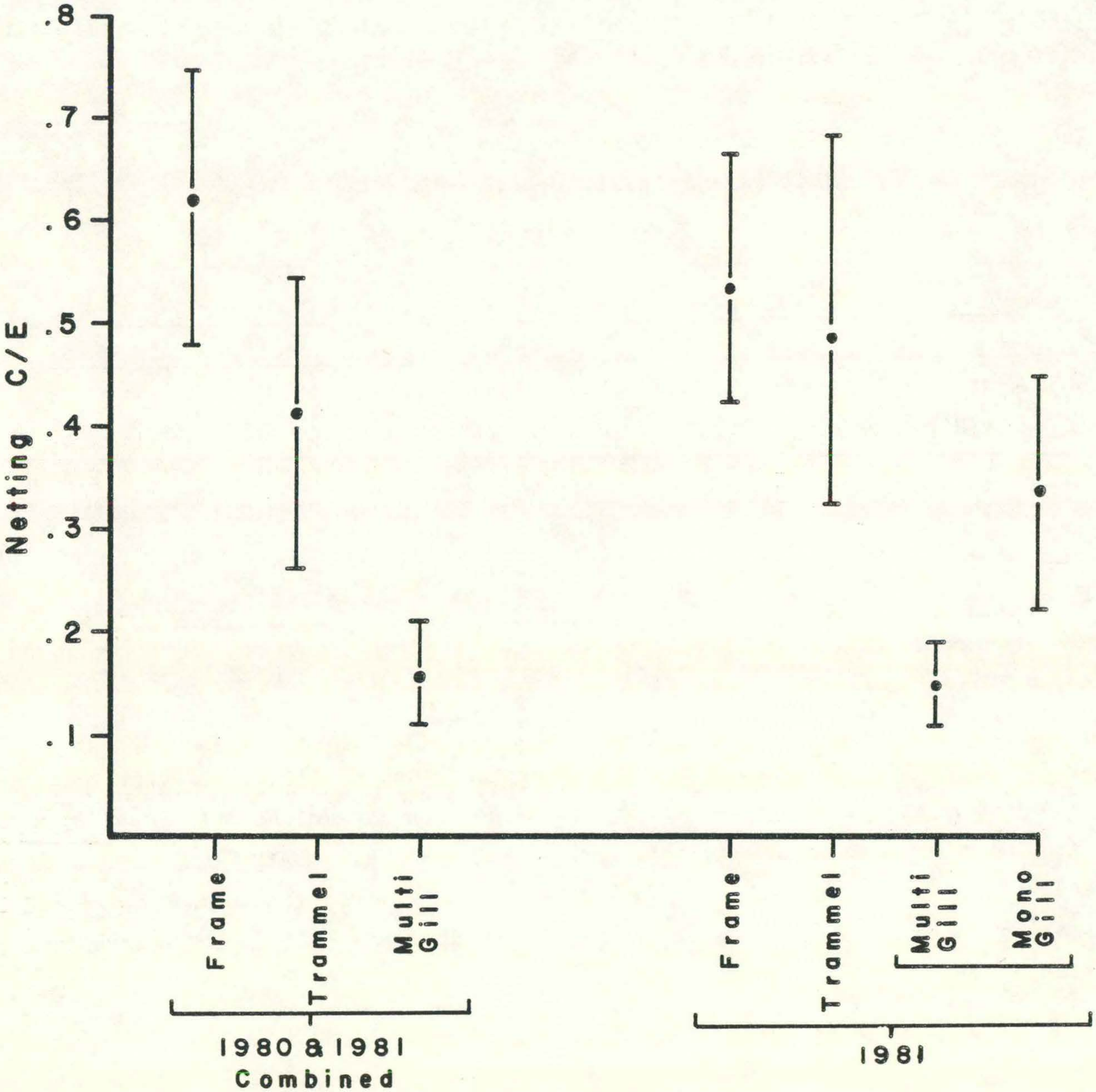


Figure 21. Mean catch/effort values for frame, trammel, and multifilament gill net samples in 1980-81. Brackets denote confidence intervals at the 95% level.

Table 30. Analysis of variance for seasonal and diurnal differences in mean catch/effort obtained using monofilament and multifilament small mesh gill nets.

Source	dF	SS	MS	F
(A) Multi/Mono	1	.0187	.0187	169.82**
(B) Day/Night	1	.0009	.0009	8.49 ns
(C) Season	2	.0036	.0018	16.33 ns
A x B	1	.0001	.0001	0.98 ns
A x C	2	.0009	.0005	4.11 ns
B x C	2	.0004	.0002	1.66 ns
Error	2	.0002	.0002	
TOTAL:	11	.0249		

** .01 level of probability

ns Not significant ($p > .05$)

Confidence intervals around mean C/E indicated multifilament small mesh gill nets had a significantly lower catch rate than monofilament gill nets. There were no significant differences between C/E obtained using monofilament gill nets, trammel nets, and frame nets during 1981 (Figure 21).

Previous analysis of mean C/E for all netting gear combined showed no significant difference between day and night samples; however, mean day/night C/E for individual netting gears indicated some unique trends and significant differences. Mean C/E for frame and monofilament small mesh gill nets were slightly higher during the day than during the night, while mean C/E for trammel and multifilament small mesh gill nets were considerably lower during the day than during the night (Figure 22). Ninety-five percent confidence intervals around mean day/night C/E for individual gear indicate frame net C/E was significantly higher than multifilament gill nets during both day and night periods and significantly higher than trammel nets during the day (Figure 22).

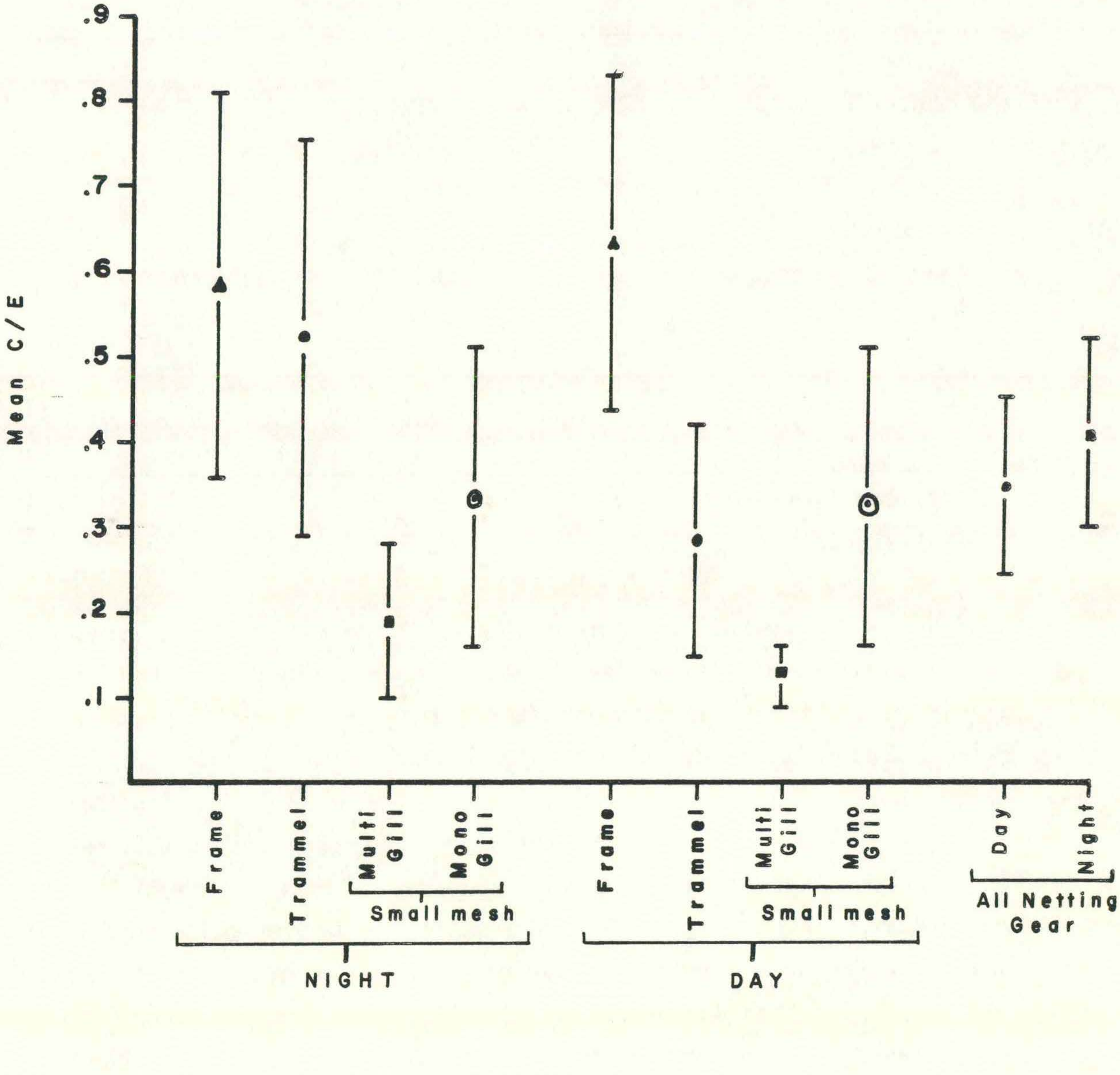


Figure 22. Mean catch/effort for nighttime and daytime samples with frame, trammel, and small mesh gill nets in 1980 and 1981. Brackets denote confidence intervals at the 95% level.

Although electrofishing had the highest C/E, it captured five fewer species than trammel nets and three fewer species than frame nets (Table 28). Additional analysis of electrofishing information showed this data to be more variable than netting gear data. The coefficient of variation for the sample means [CV (X)] averaged 18 percent for electrofishing and 11 percent for netting.

A large trammel net was constructed to be fished below structures during the 1981 field season as recommended by Pitlo (1980). The net was to be set stationary, oblique to the current and fish driven into the net with the electroshocker or a noisemaker. Due to high water levels and the regular sampling schedule, this method of experimental sampling was not used during the 1981 sample period.

COMMERCIAL FISHERMEN USE AND CATCH FROM CURRENT MODIFICATION STRUCTURES

Forty-seven Iowa commercial fishermen were interviewed to determine the importance of wing and closing dam habitat to commercial fishing operations. Commercial fishermen were asked if they fished wing and closing dams, specific dams they fished, species sought or captured, if there appeared to be seasonal trends for structures or fish, amount of effort, and gear types used. They were also asked to compare catch from wing and closing dam habitat to other habitats.

Species Sought, Seasonal Trends, Gear Used, and Amount of Effort

Forty-three of the interviewed fishermen (91 percent) indicated they fished wing and closing dams. Catfish and buffalo were the dominant species sought or captured with 38 percent and 32 percent respectively (Table 31). Other species included carp (12 percent) and freshwater drum (12 percent). Seventy-three percent of the commercial fishermen preferred to fish wing and closing dams in the spring and fall (Table 31); however, 19 percent indicated that water levels were more important than season. Low water levels were preferred as nets were ineffective during high flow periods. Hoop nets, trammel nets, and box traps comprised 86 percent of the gear used by commercial fishermen around current modification structures. Hoop nets and box traps were usually baited with cheese or soybean cake. Trammel nets were usually dead set for 24 hours, drifted above or below structures, or dead set and fish driven into the net by pounding the water surface with a noisemaker. Forty-five percent of the fishermen interviewed spent between 21 and 60 percent of their total fishing effort in wing and closing dam habitat (Table 31). Nearly 20 percent of the fishermen spent between 81 to 100 percent of their efforts in this habitat. Some fishermen that spent less effort in wing and closing dam habitat indicated that they would like to fish this habitat more, but there was too much competition around "good" wing and closing dams and "good" structures were limited. Nearly 80 percent of the commercial fishermen indicated that catch was better from wing and closing dam habitat compared to other habitats (Table 31).

Table 31. Summary of responses received from commercial fishermen interviewed to determine the importance of wing and closing dam habitat to their fishing operations.

1. Fishermen that did or did not fish wing and closing dams:

Yes	43
No	4

2. Fish species sought or captured:

Channel or flathead catfish	38 percent
Smallmouth or bigmouth buffalo	32 percent
Carp	12 percent
Freshwater drum	12 percent
Paddlefish	3 percent
Gar	1.5 percent
Shovelnose sturgeon	1.5 percent

3. Time of year when wing and closing dams were fished:

Fall	38 percent
Spring	35 percent
Summer	5 percent
Winter	3 percent
Water level more important than season	19 percent

4. What gears were used:

Hoop nets (baited)	31 percent
Trammel nets	30 percent
Box traps (baited)	25 percent
Set lines	11 percent
Seines	3 percent

5. Amount of effort (as a percent of their total fishing effort):

1 - 20 percent	34 percent
21 - 40 percent	24 percent
41 - 60 percent	21 percent
61 - 80 percent	5 percent
81 -100 percent	18 percent

6. Compare catch on wing and closing dam habitat to other habitats:

Better	79 percent
Same	12 percent
Worse	9 percent

<u>Physical Characteristics of Current Modification Structures Fished by Commercial Fishermen</u>

Commercial fishermen named 93 wing and closing dams that they fished on a regular basis. Seventeen of the 93 structures were referred to twice and four were referred to three times. Data from the initial wing and closing dam inventory was used to derive the physical characteristics of structures fished by commercial operators.

The overall mean water depth (corrected to operating pool level) over structures fished by commercial fishermen was 1.52 m. Commercial fishermen generally used the shallower structures since 70 percent had less than 1.83 m of water over the top (Figure 23). The mean maximum water depth upstream and downstream of structures selected by commercial fishermen was 4.57 m and 6.46 m respectively. Selection for structures by location in relation to the thalawag was 11 percent, 27 percent, and 62 percent respectively for inside bend, outside bend, and straight river sections.

Most commercial fishermen indicated they preferred to fish structures with deep scour holes above or below the dam and those with cuts or notches in them. A number of wing and closing dams were identified by commercial fishermen as having been "good" dams at one time, but have been sanded in over the years, and they no longer catch fish from these structures.

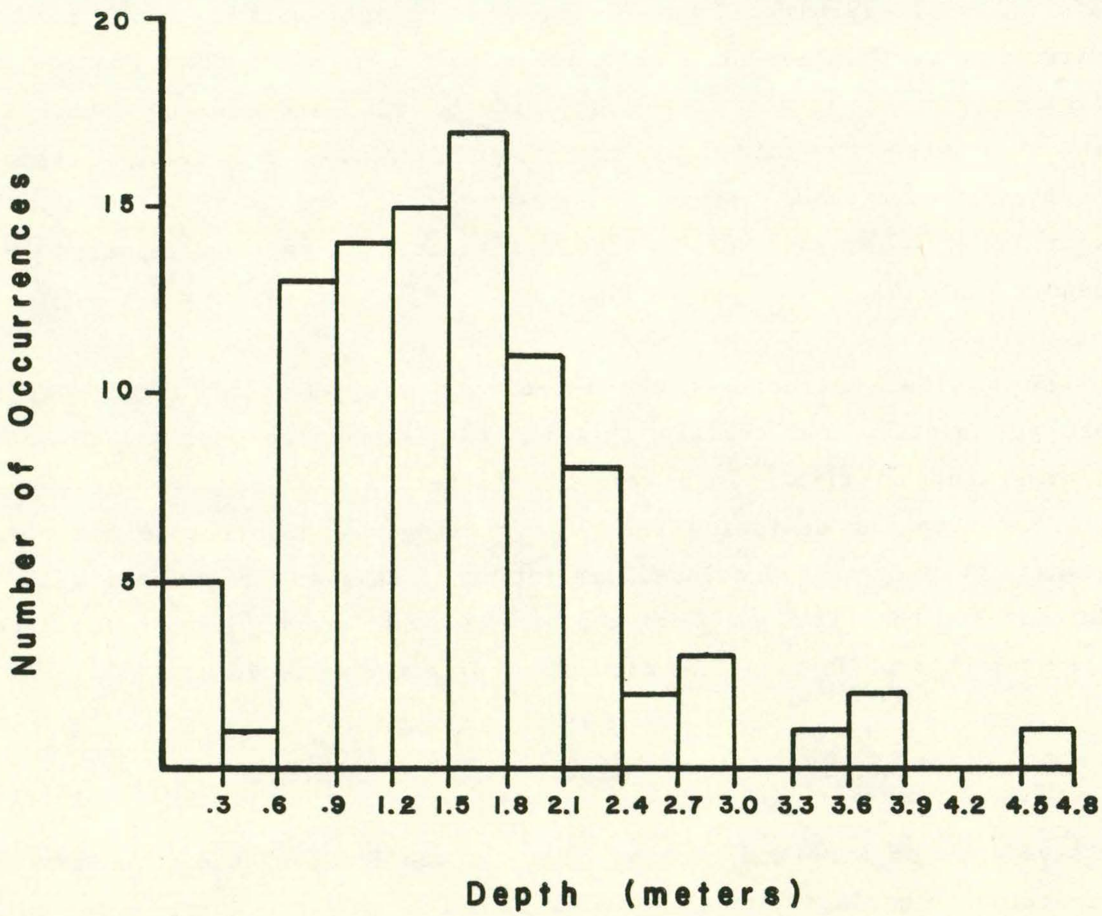


Figure 23 . Depth frequency of current modification structures bordering Iowa, fished by Iowa commercial fishermen. Depth is water depth over the structure and corrected to operating pool level.

DISCUSSION

Wing and closing dams on the Upper Mississippi River were constructed to maintain 4½ feet and 6 feet navigation channel depths during the late 1800's and early 1900's (Tweet, 1975) and were exposed except during high flow periods. Construction of the present lock and dam system in the 1930's to obtain a 9 foot navigation channel inundated the majority of wing and closing dams. Erosion of these structures by ice flows and river currents, and sedimentation by sand necessitates continuous repair and maintenance. Since 1895 and continuing to present, over 46 percent (266) of the structures have been repaired or replaced (Appendix Table A).

Fish use of these structures was relatively unknown. This study was the first effort to quantify and qualify this habitat, and those physical characteristics most important to fish. This work should help answer environmental concerns of hydraulic engineers designing wing and closing dam maintenance and construction programs. Funding cuts precluded completion of this entire project with PL 88.309 funds and only the first two segments of the study are reported here; however, the entire project will be completed with the assistance of DJ funding.

Wing and Closing Dam Inventory and Physical Characteristics

Extensive loss of wing and closing dams was confirmed by the inventory. Original construction records indicate nearly 73 miles of structures were built along Iowa's border (Appendix Table A); presently only 42 miles remain. The loss of the majority of structure length was due to sedimentation by sand. Generally, sedimentation by sand does not result in the buildup of dry land below the structure; rather, the entire area around or between adjacent structures fill in with sand resulting in large, shallow sand flats. Structure location appears to be one of the critical factors that determines if a structure will be sanded in. The probability of a structure sanding in appears higher for dams constructed in a series or dike field (Simon et al., 1975), for dams located in the lower sections of a pool (Table 32) and for those located below the mouths of tributary streams that carry heavy sediment loads (Appendix Table A).

Table 32. Comparison of wing and closing dams that have been sanded in or eroded by location in a pool, Upper Mississippi River.

Location	Total Number Constructed	Total Number Sanded In Or Eroded	Percent
Upper Half Of All Pools[a]	335	99	29.6
Lower Half Of all Pools	259	93	35.9

[a] Determined by dividing pool length into half according to river miles.

Structures located on inside bends and closing dams also appear to experience higher rates of sedimentation (Table 33).

Table 33. Comparison of sanded-in or eroded structures by location in relation to the thalawag and structure type, Upper Mississippi River bordering Iowa.

Parameter	Percent Occurance in Original Inventory[a]	Percent Occurance for Sanded-In or Eroded Structures[b]
Structure Location		
Inside	26	34
Outside	15	11
Straight	59	54
Structure Type		
Straight	77	64
L-Shaped	4	4
Closing	19	32

a 563 structures, including sanded-in or eroded structures but excluding those removed by the COE

b 193 structures sanded-in or eroded

Tweet (1975) stated that 336 miles of wing and closing dams had been constructed on the Upper Mississippi River by 1907. If wing and closing dam loss on other sections of the river are similar to those bordering Iowa, about 145 miles of this valuable habitat has been lost since original construction. The continued degredation and loss of wing and closing dam habitat due to sedimentation, erosion, removal, or coverage by dredge spoil remains a major concern to resource managers, commercial fishermen, and sport fishermen.

Initially multivariate analysis techniques were used to group structures into a classification system according to measured differences in physical characteristics. These analyses were unsuccessful in the formulation of a classification system because: (1) unmanageable number of groups and when group numbers were reduced, many of the physical characteristics were obscured, (2) clustering did not group dams with respect to significant differences noted in the individual analysis or these differences were masked by other characteristics, and (3) in some instances the selection criteria of an individual cluster remained undetermined.

The second attempt to classify current modification structures utilized important characteristics determined by analysis of individual characteristics and those which could be directly affected by construction and maintenance activities.

The final criteria used to develop the classification system included: (1) geographical location of the structure (north/south), (2) mean water depth over the structure (≤ 1.52 m and > 1.52 m), and (3) structure location relative to the thalawag (inside bend, outside bend, or straight river section). Geographical stratification of structures (northern pools and southern pools) was necessary because substrate composition, water quality, and fish species abundance and composition varied north to south. Mean water depth over structures was an important characteristic because the amount of water moving over a structure affected current patterns, velocity, and scouring action. Maximum depths associated with structure and current velocities varied significantly with location of structures in respect to the thalawag; therefore, structure locations were divided into those located on inside bends, outside bends, and straight river sections.

These criteria allowed development of a workable classification system and the repetition within groups required for analysis of fish associated with various structures. In addition, physical characteristics (water depth over structures, current velocities, and Secchi disc depths) collected in conjunction with adult fish sampling remained significantly different within the classification system (Table 19). Thus, the classification system was valid throughout the study period and C/E comparisons among components of the classification were valid.

Fish Populations Associated With Wing and Closing Dam Habitat

Fisheries literature pertaining to sampling methods and estimating reliable population indices for fish associated with current modification structures was limited. Holzer (1978) compared fish populations inhabiting wing dams, sand flats, and riprapped banks in Pool 8; and Pierce (1980) compared fish inhabiting six wing dams and a side channel in Pool 13. In general, it was difficult to make comparisons of fish populations sampled in the two studies because of differences in gear used. Holzer (1978) used only pulsed DC night electrofishing, and Pierce (1980) used baited and unbaited hoop nets and AC night electrofishing. In the present study, hoop nets and AC electrofishing were not used because experimental sampling showed frame nets and pulsed DC electrofishing captured more fish. These studies, allow only general comparisons of gear, gear efficiency, and fish species numbers and occurrence (Table 34). In general, 16 to 40 fish species utilize wing and closing dam habitat on the Upper Mississippi River (Table 35).

Table 34. Comparisons of gear, effort, fish numbers and catch per effort for various studies that have sampled fish populations associated with current modification structures.

Source	Hoop nets[a] Unbaited	Hoop nets[a] Baited	Frame Net	Electrofishing Pulsed DC	Electrofishing AC	Trammel net Straight	Exp. Gill Net Multi	Exp. Gill Net Mono	Total
Holzer (1978)									
Total fish	nu[b]	nu	nu	276	nu	nu	nu	nu	276
No. species				20					20
Effort (Hrs.)				1.03					1.03
C/E				270					270
Pierce (1980)									
Total fish	235	540	nu	nu	737	nu	nu	nu	1,512
No. species	20	17			30				38
Effort	4,960	3,464			17.5				8,441.5
C/E	0.047	0.156			42.11				0.179
Present Study									
Total fish	nu	nu	2,071	1,202	nu	1,149	539	468	5,428
No. species			32	28		33	25	25	38
Effort			3,467	12.4		2,733	3,211	1,364	10,787.4 [c]
C/E			0.60	96.9		0.42	0.17	0.34	0.503

a Pierce (1980) used 1 inch bar mesh
b nu indicates gear not used
c excluding large mesh gill nets used only during the spring 1980 sample

Table 35. Comparison of fish population statistics from studies that have focused on current modification structures and their use by fish population. Numbers in parenthesis are species totals.

Source	Study Area	No. Structures Studied	No. Fish	No. Species	No. Species Represented By One Or Two Individuals	Most Abundant Commercial Sp.		Most Abundant Sport Sp.	
Holzer (1978)	UMR[a]	2	278	20	4	Redhorse sp.	(113)	Bluegill	(59)
						Carp	(23)	Smallmouth Bass	(25)
						Flathead Catfish	(7)	Walleye	(11)
Pierce (1980)	UMR	6	1,512	38[b]	6	Freshwater Drum	(263)	Bluegill	(196)
						Smallmouth Buffalo	(253)	Black Crappie	(67)
						Channel Catfish	(205)	Sauger	(50)
Present Study	UMR	24	5,428	38[c]	5	Redhorse sp.	(1,459)	Sauger	(232)
						Freshwater Drum	(628)	Black Crappie	(230)
						Carpsucker sp.	(501)	White Bass	(224)

[a]Upper Mississippi River

[b]Includes 6 *Cyprinid* sp.

[c]Excludes *Cyprinid* sp. except carp

Commercial fish such as redhorse sp., freshwater drum, carp, carpsucker sp., smallmouth buffalo, and catfish are more abundant in wing and closing dam habitat on the Upper Mississippi River than sport fishes (Table 35). Differences in species composition and abundance between studies are partially due to gear differences. For example, Pierce (1980) captured 96 percent of the smallmouth bass, 80 percent of the buffalo, and 10 percent of the channel catfish and freshwater drum in baited hoop nets. Baited nets were not used in the present study because bait draws fish into nets from considerable distances downstream, and catch results would be misleading. Major sport fish collected from wing and closing dams on the Upper Mississippi River include sauger, black crappie, bluegill, white bass, smallmouth bass, and walleye (Table 35).

Weighted mean length comparisons were made from fish captured in wing and closing dam habitat in the present study to fish captured by Boland (1979) in Brown's Lake, a large, shallow backwater in Pool 13 of the Upper Mississippi River. Both the upper and lower length groups in the length frequency distribution have been included to aid in comparisons since in a number of instances there are little differences in the weighted mean lengths (Table 36). Both large and small specimens of redhorse sp., mooneye, channel catfish, and sauger were captured from wing and closing dam habitat compared to the backwaters (Table 36). The largest specimens of freshwater drum, carpsucker sp., gizzard shad, longnose and shortnose gar, smallmouth buffalo, and walleye were captured from wing and closing dam habitat. The largest specimens of carp, black crappie, and bluegill were captured in the backwater complex. Holzer (1978) indicated wing dam habitats produced the largest specimens of smallmouth bass, bluegill, black crappie, walleye, sauger, and gizzard shad when compared to samples taken from sand flats and riprapped banks.

Table 36. Comparisons of weighted mean length of selected species captured by Boland (1979) in a large backwater lake complex in Pool 13 of the Upper Mississippi River to fish captured from current modification structures in the present study. Lengths are in mm, and the lower and upper length groups in the length frequency distribution are in parenthesis.

	Boland (1979)			Present Study		
	Weight	Length Group		Weight	Length Group	
Species	Mean	Lower	Upper	Mean	Lower	Upper
Redhorse sp.	383.6	(241-260)	(481-500)	396.6	(161-180)	(601-620)
Freshwater Drum	274.6	(41- 60)	(481-500)	282.5	(101-120)	(721-740)
Carpsucker sp.	334.0	(41- 60)	(441-460)	351.5	(161-180)	(541-560)
Mooneye	280.9	(221-240)	(381-400)	272.2	(121-140)	(461-480)
Gizzard Shad	126.4	(41- 60)	(401-420)	253.4	(81-100)	(401-420)
Longnose Gar	631.4	(461-480)	(781-800)	761.8	(541-560)	(1,000)
Carp	458.3	(261-280)	(661-680)	418.6	(261-280)	(601-620)
Smallmouth Buffalo	295.0	(141-160)	(421-440)	369.8	(181-200)	(661-680)
Channel Catfish	330.0	(281-300)	(441-460)	333.4	(201-220)	(521-540)
Shortnose Gar	549.5	(301-320)	(681-700)	565.2	(421-440)	(701-720)
Black Crappie	211.3	(81-100)	(301-320)	211.6	(121-140)	(281-300)
Sauger	319.5	(221-240)	(421-440)	338.4	(181-200)	(501-520)
	207.6[a]					
	331.4[b]					
White Bass	278.3	(201-220)	(381-400)	287.1	(101-120)	(401-420)
Walleye	342.5	(221-240)	(481-500)	422.2	(241-260)	(621-640)
	357.3[a]					
	349.9[b]					
Bluegill	165.9	(61- 80)	(221-240)	160.4	(121-140)	(201-220)

[a] Means from electroshocking in Lock and Dam 10 tailwaters, Spring 1980, unpublished data, Iowa Conservation Commission.

[b] Means from electroshocking in Lock and Dam 12 tailwaters, Spring 1980, unpublished data, Iowa Conservation Commission.

Only three paddlefish were captured in the present study, but Peter Southall (personal communications), in a radiotelemetry study on paddlefish movement and behavior, located these fish in areas between wing dams on numerous occasions. Paddlefish were also found in deep scour holes located behind wing dams, rock piles, and bridge abutments. Gengerke (1978) also observed paddlefish over a submerged wing dam exhibiting what appeared to be spawning behavior. It is possible that the netting and electrofishing sampling gear used in this and other studies does not adequately sample some fish species that utilize wing and closing dam habitat.

Use of current modification structures by fishes for reproduction has not been previously documented. Since collection techniques and methods were being developed and only one wing dam was sampled, it remains unknown how extensive this use is. Rock-filled samplers most closely duplicated wing and closing dam substrate and also captured the greatest number of fish eggs. Fifteen fish species were captured from structures in spawning condition (gravid or freshly-spent females and males with flowing milt). Generally, 1980 and 1981 spring samples were late for cold-water spawners (sauger and walleye) and early for warm-water spawners (freshwater drum and channel catfish). The large number of male white bass that were sampled in wing and closing dam habitat may indicate white bass utilize this as spawning habitat since in many fish species the males arrive at the spawning areas before females. Redhorse species were often congregated near the outer tip of the structure, and on a number of occasions gravid and freshly-spent females and ripe males were captured together indicating spawning activity.

Gear Evaluation

Fishery science has not developed sampling methods and techniques for large lotic environments to the proficiency achieved in lentic environments. As such, gear performance and evaluation results from this and other studies that focus on a single habitat can aid in the development of adequate sampling methods for the variety of habitats found in large riverine systems.

The highest mean C/E ranging from 42 to 270 fish/hr. was obtained by electrofishing (Table 34). Electrofishing captured between 74 to 81 percent of the total species that were collected. Although mean C/E was highest with electrofishing, results from this study indicate that electrofishing C/E data was variable, making it difficult to detect significant differences between parameters being tested. Calculations of sample size for electrofishing C/E values in the present study indicated that sampling effort for individual dams should have been increased from five samples per dam to eleven samples per dam to obtain the desired variance levels to allow testing of parameters at the 95 percent confidence level. Pulsed DC electrofishing appears to outperform AC electrofishing for sampling fish populations associated with current modification structures on the Upper Mississippi River.

Baited and unbaited hoop nets and unbaited frame nets were the only entrapment gear used. Mean C/E values for hoop nets ranged from 0.047 to 0.156 fish/hr. (Table 34). Mean hoop net C/E values were the lowest of all gears; although for certain species such as catfish and smallmouth buffalo, they performed well (Pierce 1980). Hoop nets captured from 38 to 76 percent of the total species. Mean frame net C/E was 0.60 fish/hr. and frame nets captured 84 percent of the total species (Table 34). Frame nets appear to outperform baited and unbaited hoop nets for collecting fish from current modification structures.

Trammel nets and experimental small mesh gill nets were used only in the present study. Trammel net mean C/E was 0.42 fish/hr. and captured 87 percent of the species sampled in this study (Table 34). Trammel nets outperformed monofilament and multifilament small mesh gill nets and monofilament small mesh gill nets outperformed multifilament small mesh gill nets in the present study (Table 34). Pierce (1980) indicated electrofishing outperformed hoop nets in terms of C/E and number of species captured on wing dams in the Upper Mississippi River. In the present study, frame nets, trammel nets, and electrofishing were the most effective gear and 81 percent of the total number and 100 percent of the species could have been captured with a 40 percent reduction in total effort if only these gears had been employed.

There is evidence for gear selectivity for species and fish size (Table 13 and Appendix Tables C to S); however, this topic has been adequately addressed by numerous authors (FAO, Technical Paper 33, 1980) and will not be discussed here.

During the present study, some gear limitations were noted, especially during high flow periods when trammel and gill nets were ineffective and became plugged with debris. In addition, late fall netting with trammel and gill nets was ineffective because nets became plugged with leaf litter, regardless of river stage.

Wing and Closing Dam Physical Characteristics and Fish Population Statistics

Evaluation of C/E data within the wing and closing dam classification system showed water depth over each structure and structure location in relation to the thalawag were the two most important physical characteristics affecting fish populations associated with current modificaton structures. These findings were supported by the regression analysis results performed independent of the wing and closing dam classification system. Overall mean C/E and species number values were higher for shallow structures and structures located on outside bends and straight river sections (Figure 24).

Maximum depth is significantly greater around structures located on outside river bends (Table 5) as is current velocity over the top of the structure (Table 19). Wing and closing dams narrow the area through which water can flow by decreasing the depth from the river bed to the water surface. Some of the water volume is directed toward the main channel, the remaining water volume must increase in velocity in order to pass through the restriction. Current velocity nearly doubles over the top of the structure compared to upstream or downstream velocities (Table 8). The higher current velocity increases scouring action resulting in deeper scour holes, especially for structures located on outside river bends. Since maximum depth is usually located below structures (Table 3), and more fish were captured below structures than above (Table 16), the quality and diversity of the aquatic habitat appears to be enhanced by dams with shallow water depth over the top and deep scour holes downstream. Fish populations respond by being more diverse around structures that possess those characteristics. Hynes (1970) reported that current velocity decreases logrithmically with increasing depth and such a relationship would make scour holes below current modification structures attractive to fish as shelter from river currents. Kallemeyn and Novotney (1977), Hickman (1975), and Robinson (1980) have all indicated that diverse cover and shelter attract fish.

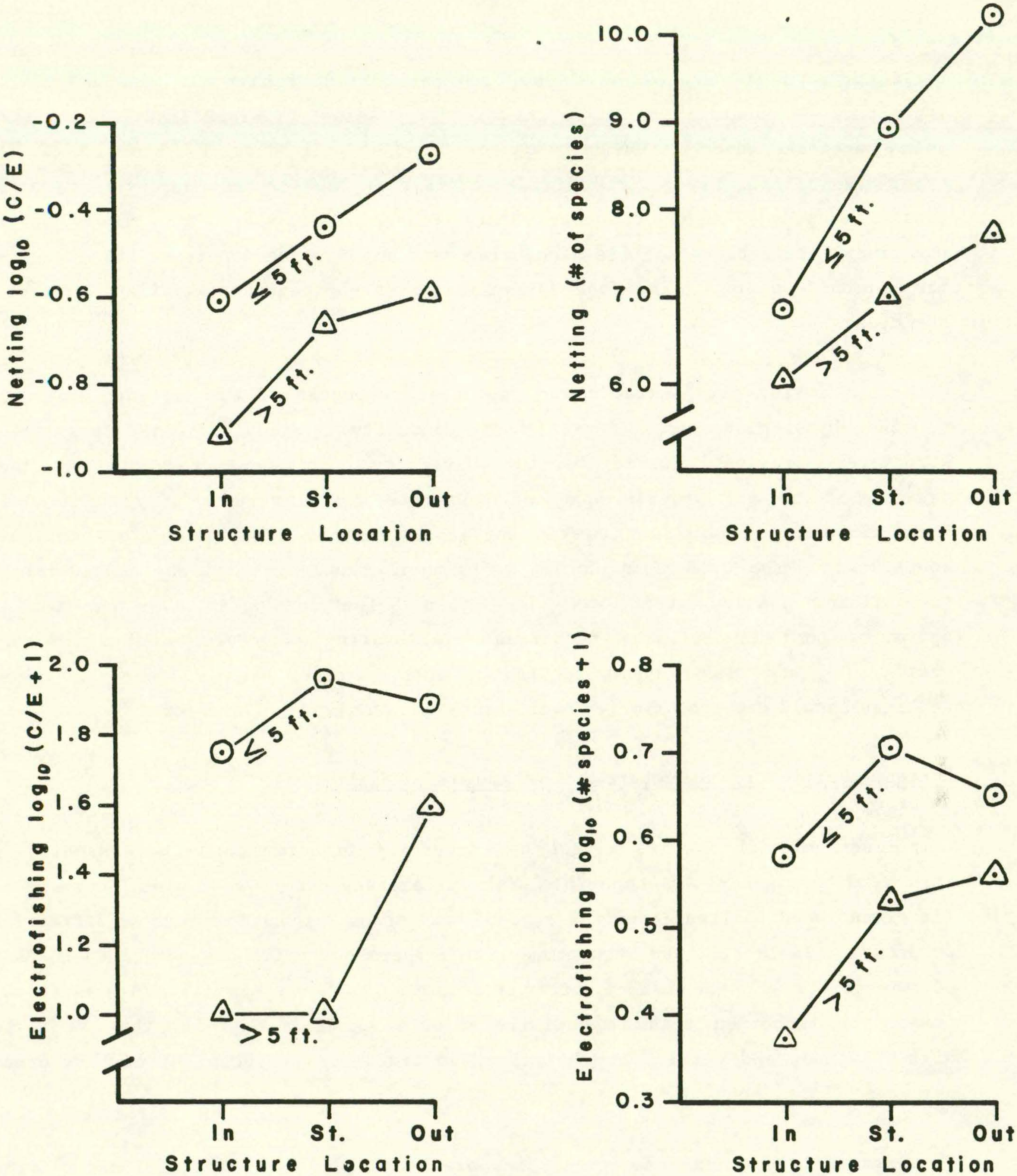


Figure 24. Comparison of netting and elecrofishing catch/effort and species numbers between structure depth and location parameters. Where In = inside river bend, St. = straight river section, and Out = outside river bend.

Carlander et al (1959), Jude (1968), and Rathum (1969) have all reported on the importance of aquatic insects to the diet of Mississippi River fish. Hall (1980) found aquatic insects abundant on or around wing dams in Pool 13 of the Upper Mississippi River, colonizing artificial substrates on wing dams at densities up to 80,000 per square meter. Pierce (1980) stated that since much of the river substrate is sterile sand, wing dams may provide important substrate for the production of fish food organisms, thereby attracting fish to these structures.

Wing and closing dam habitat is an important component of the habitats available to the Upper Mississippi River fish community. Study results show these structures provide aquatic habitat diversity, shelter, produce fish food organisms, and may provide spawning substrate for a variety of fish species. Every effort must be made to stop the losses that have occurred since original constructon. The U. S. Army Corps of Engineers should give strong consideration to building shallow structures (less than 5 feet of water over the top at operating pool levels) when repairing deteriorating structures or building new ones. Wing and closing dams located on outside river bends or straight river sections should receive priority over structures on inside river bends.

Current Modification Structure Use By Commercial Fishermen

Comparison of fish species caught by commercial fishermen and those sampled in this study are generally comparible with differences due to gear used. Commercial fishermen used baited hoop nets and box traps around current modification structures (Table 31), and when commercial fishermen's catch was compaired to that of Pierce (1980) who used similar gear, results were similar. In addition, commercial fishermen tend to maximize efforts for those species that have the highest value, and catfish and buffalo have traditionally been the highest price per pound (Rasmussen, 1979).

When structure physical characteristics are compared between the wing and closing dam inventory and those selected by commercial fishermen, three preferences were noted: (1) commercial fishermen generally select shallower structures, (2) they select to fish structures with deep scour holes upstream and downstream, and (3) commercial fishermen select for structures located on outside river bends and select against structures located on inside river bends (Table 37).

Table 37. Comparison of physical characteristics between structures selected by commercial fishermen and the wing and closing dam inventory. Depths are in meters.

	No. of Structures	Mean Water Depth Over[a]	Mean Maximum Depth[a] Upstream	Mean Maximum Depth[a] Downstream	Percent By Location In.	Percent By Location Out.	Percent By Location Str.
Wing & Closing Dam Inventory	372	1.7	4.2	5.1	22	16	62
Fished By Comm. Fishermen	93	1.5	4.6	6.5	11	27	62

[a] Corrected to operating pool.

Structure preferenced by commercial fishermen are identical to those structures preferred by commercial fish species as determined by the present study. Wing and closing dams provide important and preferred fishing grounds to commercial fishing operations.

Commercial fishermen indicated catch was better from wing and closing dam habitat compared to other habitats, and over 40 percent of the interviewed fishermen spent nearly two-thirds of their total effort in this habitat.

STUDY RECOMMENDATIONS

1. Study results show that current modification structures with less than five feet of water over the top (at operating pool levels) and located on outside river bends create the most diverse aquatic habitats and attract the greatest fish numbers and species. Structures less than five feet in depth and located on inside river bends should receive the lowest priority or be completely avoided, if possible. Results from this and other studies give hydraulic engineers the needed data base to develop and modify the wing and closing dam building and maintenance program so that aquatic habitat can be improved, created, and maintained.

2. Frame nets, trammel nets, and pulsed DC electrofishing were the most effective sampling gears used during this study. Trammel nets do have some limitations, especially during high flow periods and in late fall after tree leaves have fallen.

3. Although reproductive use of a current modification structure was documented for one fish species in this study, additional work is needed to more fully understand the use of these structures as spawning substrate by other fish species.

4. Netting and electrofishing data indicated that fish were present at the time of capture but did not determine if fish were transient or used the area for extended time periods. Since wing and closing dam habitat usually comprise only one to two percent of the total habitat available in a pool, a study that measures percent of time spent in wing and closing dam habitat relative to other available habitats is important. This could best be accomplished by a radio telemetry study on selected species. Selected commercial species should include shovelnose sturgeon, freshwater drum, smallmouth buffalo, and channel catfish because they are more valuable to the commercial fishery than are redhorse sp. or carpsucker species. Sport fishes should include sauger, walleye, white bass, and black crappie.

5. Various state and federal agencies have conducted surveys to compile catch statistics for entire pool, backwater, or tailwater fisheries. No information exists that documents sport fishermen use of wing and closing dams, species sought or captured, and the amount of effort expended on these structures. Information is needed to determine the importance of these structures to the sport fishery.

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APPENDIX

KEY TO APPENDIX TABLE A

IA WD N	Wing dam number assigned for this study - first number is the pool in which dam is located, second number is the dam number which is numbered consecutively from north to south in each pool.
COE N	Wing dam numbers from Corps of Enginners records - first number is sheet number from original Corps maps, second number is dam number which was assigned in consecutive order by date of constructions. Asterisk (*) indicates sub-divided dams which are considered as individual dams in this study.
RIVER MILE	Location of dam by river mile to closest tenth mile.
DT	Dam type. S indicates a straight dam, C is a closing dam and L is an L-shaped dam, T is a T-shaped dam.
DATE CONS	Year the dam was constructed.
REWORK YEAR	Year the dam was reworked.
REWORK TYPE	Type of work done on dam - RP indicates repair, a number that follows the RP designation is the dam length in feet that was repaired; EX indicates extension of the dam, a number that follows is the length of the extension in feet; RM without a number following indicates the entire dam was removed, a number following the RM designation is the length of dam in feet that was removed; RS indicates the dam was raised in elevation, a number following indicates the length of dam in feet that was raised; NT indicates notched and the number following is the length of the notch in feet; PD indicates the top of the dam was paved; RT indicates the top of the dam was removed; RE indicates the end of the dam was removed, WD indicates the dam was widened.
DL	The length of the dam in feet as recorded in Corps of Engineers' records.
ELEV	Elevation of the dam in feet above sea level as shown in Corps of Engineers' records.
DEPTH OP	Depth on dam top at operating pool level, (+) number indicates height emerged to nearest tenth foot, (-) number is the depth submerged to the closest tenth foot.
SD	Month and day the dam was surveyed in 1979 by the study team - E/C indicates the dam was completely eroded or covered by bottom sediments, RM indicates the dam was completely removed.

ML	Total length of dam in feet measured by the study team.
ADJ DEPTH	Depth of water on dam measured by study team, adjusted to flat pool stage. (-) number is amount submerged in feet, (+) number indicates vertical height emerged.
LC	Location of dam in relation to river meander - S is on straight section, I is dam located on inside bend, O indicates outside bend location.
PF	Physical feature of river bottom near dam - 1 indicates no scour hole, 2 indicates scour upstream, 3 indicates scour downstream, 4 indicates scour upstream and downstream, 5 indicates silted in, 6 indicates notched with scour channel, 7 indicates scour or fill.
SUBSTRATE	Percent of substrate that is: SL - silt, SD - sand, GR - gravel, BD - boulder.
MAX DEPTH	Maximum water depth in feet - U indicates within 100 feet upstream from dam centerline, D indicates within 100 feet downstream from dam centerline.
CURRENT VELOCITY	Current velocity in feet per second - UP is 100 feet upstream of dam centerline, ON is on dam centerline, DOWN is 100 feet downstream from dam centerline.

Appendix Table A. Information tabulated from Army Corps of Engineers'records, columns 2 through 9. On site data collected by the study team for individual dams, columns 10-23.

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
9-1	-	672.4	C	--	--	--	--	--	--	E/C													
9-2	3-1	670.5	C	1894	1914	Ex 162 Add 162	475	--	--	E/C													
9-3	4-13	668.2	S	1918	--	--	230	--	--	9/25	225	-5.66	S	4	5	95	0	0	16.9	27.7	.95	2.01	.84
9-4	4-8	667.9	S	1918	--	--	675	--	--	9/25	540	-5.20	S	2	5	95	0	0	14.9	12.5	1.13	2.23	.77
9-5	4-9	667.7	S	1918	--	--	575	--	--	9/25	420	-4.53	I	6	5	95	0	0	12.1	16.2	.70	1.45	1.06
9-6	4-14	667.4	S	1918	1927	RP	280	--	--	9/25	250	-2.46	I	6	5	95	0	0	9.5	10.3	.84	1.48	.77
9-7	4-20	667.1	S	1918	1927	RP	350	--	--	9/17	50	-4.15	I	5	5	95	0	0	8.2	7.1	.95	.84	.59
9-8	5-15	666.8	S	1918	1927	RP	360	--	--	9/17	340	-6.25	I	6	5	95	0	0	20.2	33.8	.40	1.91	.22
9-9	5-16	666.6	S	1918	--	--	230	--	--	9/17	230	-5.55	I	1	5	95	0	0	10.5	13.2	.40	.81	.45
9-10	5-8	665.9	S	1918	1918	RP	310	--	--	9/17	150	-6.18	S	1	5	95	0	0	13.2	11.7	1.13	1.48	.66
9-11	5-9*	665.7	S	1914	1918	RP	420	--	--	9/17	200	-5.78	S	4	5	95	0	0	13.4	17.8	1.02	1.02	.81
9-12	5-9	665.7	C	--	--	--	--	--	--	RM													
9-13	5-10	665.5	S	1914	--	--	535	--	--	9/17	240	-5.65	S	1	5	95	0	0	12.0	10.8	.88	1.94	1.17
9-14	5-12	665.3	S	1914	1927	RP	425	--	--	E/C													
9-15	6-25	661.1	S	1919	1927	RP	375	--	--	10/12	350	-4.16	S	3	5	95	0	0	15.2	15.2	.77	1.45	.91
9-16	6-24	661.0	S	1919	1927	RP	500	--	--	10/12	300	-3.36	I	6	5	95	0	0	10.7	10.4	.57	1.45	.91
9-17	7-23	660.8	S	1919	1927	RP	825	--	--	9/25	600	-4.00	I	3	27	73	0	0	8.7	12.0	.62	.73	.62
9-18	7-22	660.6	S	1919	1927	RP	900	--	--	E/C													
9-19	7-21	660.4	S	1919	--	--	1000	--	--	9/19	360	-4.82	I	5	5	95	0	0	8.7	11.7	.84	.70	.41
9-20	9-6	655.2	S	1918	1927	RP	410	--	--	9/21	300	-4.55	S	7	20	80	0	0	12.9	10.0	.62	.73	.59
9-21	9-7	655.0	S	1919	1920 1927	Ex 640	1090	--	--	9/21	480	-5.25	S	1	10	90	0	0	10.3	10.3	.59	.66	.59
9-22	9-1	654.5	C	1886	1927	RP	860	--	--	9/18	686	-5.49	I	3	20	80	0	0	12.2	32.0	.57	1.02	.62
9-23	10-44	653.0	C	1932	--	--	750	--	--	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
9-24	10-8	652.7	C	1889	1900	Ex 140	140	--	--	E/C													
9-25	10-5	652.3	C	1886	1927	RP	75	--	--	E/C													
9-26	10-12	652.0	S	1915	--	--	370	--	--	E/C													
9-27	10-11	652.0	S	1915	--	--	442	--	--	E/C													
9-28	10-14	652.0	S	1915	--	--	75	--	--	E/C													
9-29	10-13	651.9	C	1915	--	--	190	--	--	E/C													
10-1	1-10	647.5	C	1894	1900	Ex 400	650	--	--	9/12	240	-4.88	S	4	2	96	2	0	13.5	16.4	.22	.23	.23
10-2	1-33	646.6	S	1922	--	--	380	--	--	9/12	270	-4.42	0	7	1	99	0	0	15.6	19.9	.99	1.87	.23
10-3	1-9*	646.5	C	1894	1900 1918	RP Ex 40	600	--	--	9/12	480	-5.72	0	4	2	98	0	0	18.0	40.6	1.20	1.34	1.06
10-4	1-9	645.7	S	1926	--	--	200	--	--	9/12	120	-4.12	0	1	2	98	0	0	15.0	18.2	.43	.99	.30
10-5	1-10	645.6	S	1926	--	--	210	--	--	E/C													
10-6	1-11	645.4	S	1926	--	--	240	--	--	E/C													
10-7	2-15	643.2	S	1926	--	--	200	--	--	E/C													
10-8	2-24	643.0	S	1927	--	--	285	--	--	E/C													
10-9	2-16	642.8	S	1926	--	--	300	--	--	E/C													
10-10	2-17	642.6	S	1927	--	--	280	--	--	9/12	250	-4.68	I	4	26	74	0	0	19.6	24.1	.58	.84	.40
10-11	3-23	642.5	S	1927	--	--	300	--	--	E/C													
10-12	3-19	641.7	S	1927	--	--	200	--	--	E/C													
10-13	3-20	641.6	S	1927	--	--	395	--	--	10/9	285	-5.18	S	5	4	96	0	0	9.0	9.0	.88	.77	.70
10-14	3-21	641.5	S	1927	--	--	290	--	--	E/C													
10-15	3-22	641.3	S	1927	--	--	180	--	--	10/9	120	-3.28	S	3	6	87	2	5	6.6	12.0	.42	.84	.32
10-16	3-18	641.3- 641.6	S	1927	--	--	2400	--	--	10/9	2400	-1.74	S	5	23	74	1	2	5.5	5.4	.41	.41	.40

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
10-17	7-31	630.4	S	--	--	--	260	--	--	8/31	250	-6.33	I	2	2	98	0	0	34.1	38.9	.42	.77	.59
10-18	7-32	630.3	S	--	--	--	460	--	--	8/31	400	-5.43	I	3	2	98	0	0	37.8	29.8	.58	1.06	.70
10-19	7-33	630.1	S	--	--	--	825	--	--	8/31	800	-5.03	O	3	5	95	0	0	19.4	25.8	.41	1.38	.77
10-20	7-34	630.0	S	--	--	--	1235	--	--	8/30	1200	-3.96	O	3	2	98	0	0	18.3	18.1	.66	1.17	1.24
10-21	7-27	629.6	S	--	--	--	1100	--	--	8/30	1100	-6.30	O	6	2	98	0	0	12.3	30.6	.77	1.80	.99
10-22	8-2	629.5	S	--	--	--	1100	--	--	8/30	1000	-3.83	S	6	1	99	0	0	15.1	20.0	.88	1.91	1.02
10-23	8-28	629.3	S	--	--	--	1225	--	--	8/29	1200	-4.06	S	6	1	99	0	0	11.4	28.5	.84	1.76	1.06
10-24	8-3*	629.1	S	--	--	--	1200	--	--	E/C													
10-25	8-3	629.1	C	--	--	--	300	--	--	8/29	300	-3.86	S	6	2	98	0	0	17.1	17.2	.77	1.48	.95
10-26	8-35	628.8	S	--	--	--	1275	--	--	8/29	705	-4.56	I	2	2	98	0	0	13.0	12.0	.99	1.98	1.06
10-27	8-37	628.7	S	--	--	--	1000	--	--	8/29	300	-6.56	I	5	2	98	0	0	14.9	13.1	.84	1.13	.73
10-28	8-8	628.5	S	--	--	--	800	--	--	8/29	280	-5.53	S	2	2	98	0	0	13.4	11.6	.62	.91	.73
10-29	8-4*	628.2	S	--	--	--	250	--	--	E/C													
10-30	8-4	628.2	C	--	--	--	500	--	--	E/C													
10-31	8-1	628.0	S	--	--	--	700	--	--	8/29	700	-4.86	S	5	2	98	0	0	10.4	10.1	.42	.81	.84
10-32	8-7*	627.8	S	--	--	--	175	--	--	E/C													
10-33	8-7	627.8	C	--	--	--	500	--	--	E/C													
10-34	9-25	626.7	S	--	--	--	300	--	--	E/C													
10-35	9-24	626.7	S	--	--	--	600	--	--	9/11	150	-7.23	S	4	16	81	3	0	15.8	15.8	.77	1.13	.44
10-36	9-23	626.4	C	--	--	--	625	--	--	9/11	375	-3.83	S	1	2	98	0	0	11.1	11.7	1.02	1.20	.50
10-37	9-22	626.2	S	--	--	--	550	--	--	9/11	525	-2.83	S	1	1	99	0	0	12.6	11.1	.70	1.68	.81
10-38	9-16*	626.0	C	--	--	--	800	--	--	E/C													
10-39	9-16	626.0	S	--	--	--	--	--	--	E/C													
10-40	10-44	622.2	S	--	--	--	200	--	--	9/11	150	-7.06	S	4	2	96	2	0	15.0	16.8	1.06	1.84	.81

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
10-41	10-41	622.0	S	--	--	--	400	--	--	9/11	180	-4.99	I	1	1	99	0	0	10.3	10.3	1.09	1.72	.95
10-42	10-42	621.8	S	--	--	--	600	--	--	9/11	400	-4.59	I	4	2	98	0	0	14.1	16.1	.70	.88	.62
10-43	10-43	621.6	S	--	--	--	1100	--	--	9/11	900	-2.73	I	4	1	99	0	0	14.3	19.7	.84	1.24	.40
10-44	10-29	621.4	S	--	--	--	1275	--	--	E/C													
10-45	10-45	621.2	S	--	--	--	--	--	--	9/11	1200	-4.53	I	1	1	99	0	0	11.8	13.0	.77	1.06	.66
10-46	10-30	621.0	S	--	--	--	1425	--	--	9/4	1300	-4.79	I	5	37	57	6	0	9.9	10.7	.59	.62	.77
10-47	11-10	620.8	S	--	--	--	875	--	--	9/4	630	-5.52	O	7	22	78	0	0	10.2	21.2	.66	1.17	.56
10-48	11-36	619.0	S	--	--	--	875	--	--	9/4	450	-3.76	S	1	2	98	0	0	10.5	9.0	1.02	1.41	.59
10-49	11-3	618.8	C	--	--	--	450	--	--	E/C													
10-50	11-49	618.4	S	--	--	--	300	--	--	E/C													
10-51	11-37	618.3	S	--	--	--	400	--	--	E/C													
10-52	11-38	618.1	S	--	--	--	175	--	--	E/C													
10-53	12-39*	617.9	S	--	--	--	200	--	--	E/C													
10-54	12-39	617.9	C	--	--	--	200	--	--	E/C													
10-55	12-40	617.7	S	--	--	--	400	--	--	E/C													
10-56	12-45	617.6	S	--	--	--	300	--	--	E/C													
10-57	12-46	617.5	S	--	--	--	175	--	--	E/C													
10-58	12-50	617.4	S	--	--	--	500	--	--	E/C													
10-59	12-51	617.3	S	--	--	--	200	--	--	9/4	180	-5.52	O	5	4	89	7	0	9.0	8.7	.77	.95	.77
10-60	12-60	616.4	S	--	--	--	400	--	--	8/28	380	-6.15	S	3	2	88	10	0	26.1	24.1	.77	1.13	.59
10-61	12-13	616.3	S	--	--	--	550	--	--	8/28	550	-4.78	I	5	13	80	7	0	9.2	9.0	.40	.40	.40
10-62	12-66	616.1	S	--	--	--	975	--	--	8/28	165	-3.85	S	1	9	91	0	0	13.2	12.3	.40	.56	.56
10-63	12-67	615.9	S	--	--	--	900	--	--	8/28	160	-7.38	S	5	5	95	0	0	15.9	17.5	.40	.40	.40
10-64	12-68	615.7	S	--	--	--	875	--	--	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
10-65	12-32	615.6	S	--	--	--	650	--	--	E/C													
10-66	12-31	615.3	S	--	--	--	125	--	--	E/C													
10-67	12-30	615.4	L	--	--	--	1175	--	--	E/C													
11-1	32-63	614.5	S	1914	1925 1937	Ex 200 Rm 100	1100	603.8	+0.8	10/12	540	-5.06	0	6	0	100	0	0	13.0	25.3	1.00	1.40	.40
11-2	32-64	614.4	S	1914	1925 1937	Ex 200 Rm 250	433	602.7	-0.3	10/12	540	-9.06	0	4	0	100	0	0	25.1	25.6	1.05	1.90	.70
11-3	32-65	614.3	S	1915	1929	RP	575	604.2	+1.2	10/12	600	- .52	S	4	0	100	0	0	20.8	30.2	.80	1.80	1.00
11-4	32-70	614.1	S	1914	1929	RP	682	603.6	+0.6	10/12	540	- .52	S	7	0	100	0	0	21.4	13.9	.40	1.00	.70
11-5	32-73	613.8	S	1929	1933	RP	665	601.5	-1.5	10/11	240	- .22	S	2	0	100	0	0	11.4	8.5	.70	.90	.20
11-6	32-69	613.7	S	1914	1976	RP	682	603.0	0.0	10/11	270	- .85	I	4	0	100	0	0	15.6	13.4	.70	1.00	.20
11-7	32-61	613.6	S	1914	1976	RP	514	603.3	+0.3	10/11	246	- .69	I	2	0	100	0	0	12.0	11.6	.80	.60	.50
11-8	32-54*	613.4	S	1913	1976	RP	250	603.0	0.0	10/11	150	- .69	I	7	0	100	0	0	9.1	11.7	.50	1.20	.25
11-9	32-54	613.4	C	1913	1976	RP	800	603.0	0.0	10/11	--	EM	I	5	--	--	--	--	--	--	--	--	--
11-10	32-55	613.3	S	1913	1976	RP	445	603.0	0.0	10/11	225	-1.49	I	6	0	100	0	0	13.4	18.5	.90	1.40	.50
11-11	32-56	613.2	S	1913	1976	RP	250	603.0	0.0	10/11	297	-1.72	I	4	0	100	0	0	11.2	11.9	.30	1.40	.70
11-12	32-28	612.5	S	1913	1976	RP	581	603.2	+0.2	10/9	615	-1.01	0	3	0	93	7	0	13.5	23.9	.80	1.20	.60
11-13	32-29	612.4	S	1913	1976	RP	408	603.6	+0.6	10/9	285	- .24	0	7	25	75	0	0	11.7	19.2	.40	1.00	.70
11-14	32-35	612.3	S	1913	--	--	270	607.6	+4.6	10/9	85	-10.24	0	2	0	100	0	0	30.3	30.2	1.00	.90	.65
11-15	32-34	612.2	S	1913	1938	Rm 120	--	602.8	-0.2	E/C													
11-16	32-33	612.1	S	1913	1938	Rm 140	--	602.3	-0.7	10/9	58	-6.99	S	1	0	25	75	0	7.9	8.0	.80	1.00	.40
11-17	33-25	611.2	S	1906	1933	RP	540	602.0	-1.0	10/9	645	- .84	S	4	0	100	0	0	6.1	5.1	.60	1.60	.30
11-18	33-19*	611.1	S	1900	1933	RP	430	602.1	-0.9	10/9	363	-1.37	S	1	0	100	0	0	6.5	4.3	.50	1.30	1.00
11-19	33-19	611.1	C	1900	1933	RP	430	602.1	-0.9	10/9	330	-1.71	S	1	0	100	0	0	4.6	5.0	.40	1.30	.60
11-20	33-18*	611.0	S	1900	1933	RP	400	602.5	-0.5	10/9	303	-1.64	S	7	0	100	0	0	6.0	4.0	.60	1.40	.70

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-21	33-18	611.0	C	1900	1933	RP	200	602.5	-0.5	10/9	345	-1.74	S	4	0	100	0	0	6.1	6.9	.65	1.10	.25
11-22	33-17	610.8	S	1900	1933	RP	735	602.0	-1.0	10/8	270	-2.74	O	7	0	100	0	0	7.3	11.9	1.00	1.40	.50
11-23	33-16	610.8	C	1900	1915	RP	445	600.5	-2.5	E/C													
11-24	33-23	610.6	S	1903	1976	RP	690	603.0	0.0	10/8	339	-1.40	O	4	0	100	0	0	14.5	16.5	.70	1.60	.60
11-25	33-22*	610.4	S	1903	1976	RP	250	600.6	-2.4	10/8	315	-2.87	S	7	0	100	0	0	17.5	34.9	1.20	2.00	1.00
11-26	33-22	610.4	C	1903	1976	RP	250	600.6	-2.4	E/C													
11-27	33-21	610.2	S	1903	1933	RP	635	601.0	-2.0	E/C													
11-28	33-29	610.0	S	1906	1933	RP	620	602.3	-0.7	E/C													
11-29	33-30	609.9	C	1906	1928	RP	761	601.8	-1.2	E/C													
11-30	33-20	609.8	S	1900	1933	RP	632	600.6	-2.4	E/C													
11-31	33-7	609.6	C	1898	1933	RP	880	601.3	-1.7	E/C													
11-32	33-41	609.5	S	1915	1933	RP	124	601.6	-1.4	10/8	174	-1.67	S	7	0	100	0	0	8.1	18.9	.60	.90	.60
11-33	33-40	609.4	S	1915	1933	RP	300	604.7	+1.7	10/8	130	-2.00	S	7	0	100	0	0	7.4	17.6	.50	.60	.40
11-34	33-8	609.2	C	1898	1933	RP	1022	600.5	-2.5	10/8	1350	-2.27	S	7	0	100	0	0	8.1	10.6	.60	.50	.50
11-35	33-11	609.1	S	1898	1933	RP	800	599.6	-3.4	10/8	900	-2.80	S	7	0	100	0	0	9.4	17.4	.50	1.10	.20
11-36	33-12	608.9	S	1900	1933	RP	507	600.5	-2.5	10/5	630	-3.49	O	1	0	98	2	0	7.1	7.1	1.00	1.20	.80
11-37	33-34	608.1	L	1911	1925	RP	1115	598.3	-4.7	E/C													
11-38	33-35	607.8	S	1911	--	--	--	600.2	-2.8	E/C													
11-39	33-38	607.2	S	1914	1927	Ex 100'	130	599.9	-3.1	10/5	165	-14.62	S	3	25	45	30	0	19.1	19.1	1.00	1.10	1.20
11-40	33-54	607.0	S	1927	--	--	270	599.8	-3.2	10/5	275	-12.26	S	7	0	65	35	0	23.1	25.0	1.10	1.30	.70
11-41	33-55	606.9	S	1927	1928	Ex 350'	450	599.2	-3.8	10/5	315	-2.12	S	7	0	100	0	0	23.8	30.4	.60	.70	.50
11-42	33-36	606.7	S	1914	1925 1926 1934	> Ex 345 RP	983	601.2	-1.8	Barge Fleeting Area - Unable to Map													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-43	33-60	606.6	S	1928	--	--	603	599.2	-3.8	Barge Fleeting Area - WD E/C													
11-44	33-59	606.3	S	1928	--	--	417	599.0	-4.0	Barge Fleeting Area - WD E/C													
11-45	33-48	605.2	S	1915	1925	RP	473	597.6	-5.4	10/5	570	-6.06	O	7	0	100	0	0	19.7	22.1	1.30	2.20	.80
11-46	33-6	604.8	C	1898	1929	RP	730	597.8	-5.2	10/4	690	-5.78	O	4	0	100	0	0	22.0	32.9	.90	2.80	1.80
11-47	33-49	604.7	S	1915	1925	RP	327	597.3	-5.7	10/4	309	-10.15	S	7	0	100	0	0	14.8	16.8	1.60	2.70	1.20
11-48	33-50	604.5	S	1915	1976	RP 285	394	598.9	-4.1	10/4	186	-3.65	S	1	0	100	0	0	14.6	13.8	.90	2.00	.60
11-49	33-51	604.3	S	1915	1976	RP 285 RP 165	400	598.2	-4.8	10/4	210	-4.35	I	6	0	100	0	0	8.2	9.0	.90	1.10	1.00
11-50	33-52	604.0	S	1923	1927	RP	800	597.3	-5.7	10/4	840	-5.95	S	6	0	100	0	0	14.8	14.8	.50	1.60	.80
11-51	34-25	603.2	S	1926	1929	RP	229	596.0	-7.0	10/4	245	-7.17	O	3	25	75	0	0	21.5	23.5	.90	1.00	.70
11-52	34-26	603.1	L	1926	--	--	621	597.6	-5.4	10/2	296	-4.24	O	6	12	88	0	0	10.3	11.2	.65	1.00	.80
11-53	34-24*	602.9	C	1926	--	--	600	597.0	-6.0	10/2	510	-5.28	S	6	0	100	0	0	11.4	33.8	.90	1.20	1.00
11-54	34-24	602.9	S	1926	--	--	400	597.0	-6.0	10/2	525	-7.04	O	3	0	100	0	0	15.0	13.0	1.30	1.90	1.20
11-55	34-11*	602.8	C	1908	1926	RP	200	597.4	-5.6	10/2	225	-4.51	O	6	0	100	0	0	11.0	19.2	1.00	1.10	1.10
11-56	34-11	602.8	S	1908	1976	RP 210	495	597.4	-5.6	10/2	540	-6.48	S	6	0	100	0	0	15.9	15.6	1.30	2.00	1.10
11-57	34-27*	602.4	C	1927	--	--	500	596.8	-6.2	10/2	570	-6.01	S	6	0	100	0	0	10.4	11.8	.70	1.10	.50
11-58	34-27	602.4	S	1927	1976	RP 230	254	596.8	-6.2	10/2	234	-10.68	S	4	0	100	0	0	23.7	33.6	1.50	1.60	.70
11-59	34-1	602.2	C	1887	1927	RP	627	599.8	-3.5	10/2	675	-4.61	S	6	0	100	0	0	14.1	42.8	.80	1.20	.70
11-60	34-28*	602.1	C	1927	--	--	750	596.9	-6.1	10/1	750	-5.04	S	2	0	100	0	0	9.0	7.3	.75	.75	.75
11-61	34-28	602.1	S	1927	1976	RP 190	200	596.9	-6.1	10/1	180	-5.87	I	3	12	88	0	0	14.2	14.6	.90	1.20	1.00
11-62	34-29	601.9	S	1927	1929	Ex 275	360	596.8	-6.2	E/C													
11-63	34-30	601.9	C	1927	1928	Ex 270	270	597.8	-5.2	10/1	285	-5.27	I	6	37	63	0	0	17.0	34.0	.60	1.30	.60
11-64	34-40	601.6	S	1928	--	--	455	599.5	-3.5	10/1	285	-3.67	I	7	50	50	0	0	6.8	6.4	.60	.80	.60
11-65	34-13	600.7	S	1914	1976	RP	663	596.0	-7.0	10/1	600	-5.14	S	2	12	88	0	0	22.2	22.7	.40	1.00	.65

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-66	34-14	600.6	S	1914	1976	RP	400	596.7	-6.3	10/1	375	-3.90	S	2	0	100	0	0	18.5	18.0	.65	.80	.70
11-67	34-19	596.1	S	1915	1928	RP	445	596.5	-6.5	9/28	420	-6.82	S	3	15	85	0	0	15.1	15.7	.70	.80	.60
11-68	34-18	595.9	S	1915	1928	RP	540	598.3	-4.7	9/28	330	-5.18	S	7	27	73	0	0	16.0	20.0	.75	.90	.60
11-69	35-43	595.4	S	1928	--	--	226	599.1	-3.9	9/28	255	-4.48	S	4	7	86	7	0	15.4	20.8	.90	1.10	.70
11-70	35-10	595.2	S	1900	1928	EX 75	415	595.7	-7.3	9/28	390	-6.85	S	4	40	60	0	0	20.1	22.4	.80	.90	.70
11-71	35-11	595.1	S	1900	1928	EX 200	678	597.4	-5.6	9/28	540	-6.28	S	4	42	58	0	0	17.4	21.9	.60	.80	.90
11-72	35-16	594.9	S	1900	1928	EX 125	685	596.8	-6.2	9/28	570	-6.12	S	6	40	60	0	0	12.4	11.4	.70	1.00	.70
11-73	35-12	594.7	S	1900	1928	RP	600	596.5	-6.5	9/28	225	-6.32	S	4	55	45	0	0	12.9	14.7	.70	.90	.40
11-74	35-13	594.5	S	1900	1928	EX 90	751	596.5	-6.5	9/28	675	-4.95	S	1	32	68	0	0	15.6	16.6	.50	.80	.60
11-57	35-14	594.3	S	1900	1928	RP	842	596.6	-6.4	9/27	750	-4.67	S	1	19	81	0	0	15.1	15.0	.65	.85	.75
11-76	35-35	594.1	S	1926	1927	EX 550	735	593.2	-9.8	9/27	600	-5.63	S	1	45	55	0	0	14.2	15.2	.65	.80	.60
11-77	35-36	593.9	S	1927	--	--	613	594.2	-8.8	9/27	255	-9.23	S	6	26	74	0	0	13.0	13.6	.95	1.05	.80
11-78	35-30	593.7	S	1915	1925	RP	455	594.3	-8.7	9/27	450	-8.10	S	6	32	68	0	0	15.1	16.9	.85	1.10	.75
11-79	35-38	591.3	S	1928	--	--	383	596.5	-6.5	9/27	360	-8.03	S	7	0	100	0	0	19.9	33.1	.70	1.20	.50
11-80	35-39	591.2	S	1928	--	--	613	594.6	-8.4	9/27	645	-8.57	S	4	0	100	0	0	21.0	22.0	.70	1.25	.50
11-81	35-26	591.0	S	1911	1928	EX 260	850	592.8	-10.2	9/27	900	-9.53	I	7	0	100	0	0	18.0	14.8	.70	.95	.60
11-81	35-21	590.8	S	1911	1928	EX 100	1025	594.2	-8.8	9/26	1050	-8.22	I	1	0	100	0	0	13.8	11.1	1.00	1.20	.90
11-83	35-22	590.5	S	1911	1929	RP	1145	594.6	-8.4	E/C													
11-84	35-23	590.2	S	1911	1929	RP	1166	595.0	-8.0	E/C													
11-85	35-24	590.0	S	1911	1929	RP	775	594.4	-8.6	E/C													
11-86	36-22	584.8	S	1915	--	--	1276	592.3	-10.7	E/C													
11-87	36-23	584.6	S	1915	--	--	1020	589.4	-13.6	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
11-88	36-24	584.4	S	1915	--	--	660	590.1	-12.9	E/C													
11-89	36-2	584.3	S	1893	1918	RP	530	589.9	-13.1	E/C													
11-90	36-1	583.9	S	1893	1936	RM 45	980	587.0	-16.0	9/26	750	-13.82	S	3	57	43	0	0	24.3	46.3	1.00	1.40	.50
11-91	36-25	583.6	S	1915	1936 1938 > 1976	RM 330 RS 125	400	603.0	0.0	9/26	510	-1.31	S	4	69	6	25	0	32.1	35.2	1.00	.80	.50
11-92	36-26	583.4	C	1915	1936 1938	RM 320	380	588.4	-14.6	E/C													
12-1	36-11	581.6	S	1912	1929	RP	562	589.3	- 2.7	10/15	360	- 2.56	S	1	0	95	5	0	12.2	13.3	.84	1.94	.84
12-2	36-12	581.3	S	1912	1929	RP	860	589.8	- 2.2	Bridge Construction- Unable to Map													
12-3	36-18	580.9	S	1914	1915	RP	920	590.0	- 2.0	E/C													
12-4	36-13	580.5	S	1912	--	--	924	588.4	- 3.6	10/15	840	- 3.02	S	6	58	42	0	0	15.7	18.6	.70	.81	.77
12-5	36-14	580.3	S	1912	1928	RP	730	590.3	- 1.7	10/15	975	- 1.46	S	3	61	39	0	0	10.1	25.4	.29	.36	.33
12-6	36-15	580.1	S	1912	1928	RP	660	588.4	- 3.6	10/24	540	- 5.92	S	3	100	0	0	0	16.6	13.0	.26	.84	.62
12-7	37-UN	577.1	S	--	--	--	--	--	--	10/24	180	- 3.59	O	3	0	85	0	15	8.6	8.8	1.56	2.37	1.45
12-8	87-44	575.0	S	1928	--	--	355	--	--	10/24	300	- 4.92	S	4	1	54	20	25	13.8	14.2	1.80	2.70	1.31
12-9	37-34	574.9	S	1926	1928	RP	464	586.8	- 5.2	10/24	1050	- 5.52	S	1	1	78	21	0	9.0	9.8	1.52	2.41	1.72
12-10	37-23	574.5	L	1913	--	--	869	587.2	- 4.8	E/C													
12-11	37-24	574.3	L	1912	--	--	1625	587.5	- 4.5	E/C													
12-12	37-25	574.1	S	1912	--	--	543	586.7	- 5.3	E/C													
12-13	37-UN	573.3	C	1893	--	--	388	587.9	- 4.1	E/C													
12-14	37-2	--	C	--	--	--	--	--	--	E/C													
12-15	37-18	573.3	S	1911	1929	RP	378	586.9	- 5.1	10/25	--	- 5.14	I	6	0	100	0	0	12.9	26.8	1.48	2.09	1.24
12-16	37-17	573.0	S	1911	1929	RP	473	587.4	- 4.6	10/25	480	- 4.24	I	2	0	100	0	0	10.6	8.2	1.31	2.12	1.27
12-17	37-33	572.8	S	1913	--	--	634	588.2	- 3.8	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
12-18	37-14	572.3	C	1911	--	--	798	587.2	- 4.8	E/C													
12-19	37-15	572.1	S	1911	--	--	650	586.5	- 5.5	E/C													
12-20	37-16	571.9	S	1911	1928	RP	350	588.6	- 3.4	E/C													
12-21	38-6	568.9	S	1902	1922	RP	480	585.5	- 6.5	10/29	690	-6.27	S	7	1	99	0	0	10.4	9.4	1.94	3.30	2.05
12-22	38-5	568.7	S	1902	1928	RP	702	587.2	- 4.8	10/29	750	-6.00	S	3	0	100	0	0	9.4	8.6	1.91	3.85	2.05
12-23	38-13	568.5	S	1912	1928	RP	796	588.1	- 3.9	10/29	900	-3.54	S	6	58	42	0	0	6.6	23.3	1.72	2.63	1.56
12-24	38-10	568.3	S	1902	1912 1913 > 1928	Ex 290 RP	854	587.0	- 5.0	E/C													
12-25	38-16	568.1	S	1918	1928	RP	610	587.4	- 4.6	10/29	--	-2.60	S	5	0	100	0	0	6.6	7.4	1.60	1.91	1.56
12-26	38-17	567.3	S	1913	1929	Ex 250	350	584.7	- 7.3	10/29	300	-6.60	S	2	22	78	0	0	7.9	8.5	1.87	2.82	1.45
12-27	38-15	567.1	L	--	1940	RM 496	367	584.4	- 7.6	10/29	300	-4.70	S	3	15	56	24	5	9.1	10.8	1.38	2.41	1.84
12-28	38-14	566.8	C	1914	1940	RM	--	586.1	- 5.9	RM													
12-29	38-20	565.8	S	1913	1940	RM	--	585.7	- 6.3	RM													
12-30	38-18	565.5	S	1913	1940	RM	--	586.4	- 5.6	RM													
12-31	38-21	564.3	S	1922	--	--	500	583.6	- 8.4	10/30	525	-7.65	S	3	10	90	0	0	20.8	25.6	1.64	3.12	1.17
12-32	38-4	564.1	S	1902	1926	RM 160	799	584.3	- 7.7	11/2	750	-7.84	S	7	0	100	0	0	16.8	20.3	1.38	2.30	1.41
12-33	38-3	563.9	S	1902	1922	RP	960	584.3	- 7.7	11/2	975	-7.01	S	6	0	100	0	0	15.6	16.0	1.72	2.37	1.60
12-34	38-22	563.7	S	1929	--	--	778	586.3	- 5.7	11/2	750	-4.57	S	7	32	68	0	0	13.8	12.1	1.48	3.04	1.13
12-35	38-23	563.5	S	1929	--	--	772	585.8	- 6.2	11/2	750	-4.71	S	1	0	100	0	0	9.9	9.1	1.38	2.23	1.17
12-36	38-24	563.3	S	1929	--	--	545	584.9	- 7.1	11/2	525	-5.61	S	4	10	90	0	0	11.4	11.8	1.31	1.48	.70
12-37	39-36	562.4	S	1922	--	--	305	581.5	-10.5	11/2	300	-5.21	S	3	5	95	0	0	19.8	23.8	1.20	2.12	1.27
12-38	39-37	562.2	L	1922	--	--	984	582.6	- 9.4	11/2	1000	-8.67	S	4	27	73	0	0	14.8	14.6	1.60	2.09	1.52
12-39	39-38	562.1	S	1922	--	--	413	584.4	- 7.6	11/2	400	-6.64	S	7	7	93	0	0	11.4	11.6	1.48	2.19	1.72
12-40	39-47	561.8	C	1927	--	--	550	582.8	- 9.2	11/2	500	-7.17	S	6	5	95	0	0	16.2	19.8	1.64	1.87	1.80

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH DEPTH	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
12-41	39-15	560.5	C	1901	1926	RP	608	581.5	-10.5	10/31	600	- 8.97	I	5	0	100	0	0	9.6	7.6	1.52	2.12	1.31
12-42	39-35	560.9	S	1914	--	--	800	583.7	- 8.3	E/C													
12-43	39-14	559.7	C	1901	1926	NT 60	658	582.7	- 9.3	11/5	600	-10.33	S	6	7	93	0	0	15.1	16.7	1.02	1.41	1.45
12-44	39-16	559.4	S	1901	1925	RP	1590	--	--	9/28	2190	- 9.08	S	4	24	73	3	0	17.1	28.9	.72	.88	.75
12-45	39-20	558.9	S	1913	--	--	520	582.0	-10.0	11/5	500	- 8.50	S	1	21	78	1	0	16.5	16.1	1.09	1.72	.99
12-46	39-22	558.8	S	1913	--	--	--	583.0	- 9.0	E/C													
12-47	39-23	558.8	S	1913	--	--	500	582.7	- 9.3	11/5	100	- 9.10	S	7	12	88	0	0	16.4	13.9	1.17	1.56	1.20
12-48	39-24	558.7	S	1913	--	--	469	581.5	-10.5	RM													
12-49	39-26	558.4	S	1913	--	--	748	581.3	-10.7	E/C													
12-50	39-28	558.3	S	1913	--	--	455	581.6	-10.4	E/C													
13-1	39-5	556.0	S	1897	1914	RF	364	582.1	- 0.9	8/27	300	- 4.23	O	4	0	0	75	25	9.7	10.5	1.48	2.01	1.31
13-2	39-7	555.8	S	1897	1914	RP	469	580.7	- 2.3	8/30	525	- 5.81	S	3	70	28	2	0	11.7	16.8	.99	1.68	.81
13-3	39-4	555.6	S	1897	1934	RP	846	581.4	- 1.6	8/28	900	- 5.04	S	4	21	78	1	0	18.0	19.1	.73	2.67	1.02
13-4	39-3	555.4	S	1897	1914	RP	1270	582.6	- 0.4	8/28	1050	- 4.70	S	7	0	99	1	0	9.3	8.9	.91	1.68	1.27
13-5	39-31	555.1	S	1914	1934	RP	560	582.6	- 0.4	8/30	600	- 5.75	S	7	14	86	0	0	14.6	12.8	1.02	2.30	1.27
13-6	39-17	554.9	S	1901	1925 1934	Ex 150 RF	430	582.5	- 0.5	8/28	390	- 5.94	I	7	0	50	50	0	11.6	10.9	1.52	2.86	1.27
13-7	39-17	554.9	C	1901	1934	RP	832	582.5	- 0.5	8/30	750	- 5.58	I	3	0	100	0	0	12.9	14.9	1.06	2.16	.81
13-8	39-18*	554.6	S	1901	1925 1934	Ex 250 RP	600	582.1	- 0.9	8/30	675	- 5.85	I	7	0	100	0	0	11.5	10.1	.73	1.98	1.06
13-9	39-18	554.6	C	1901	1934	RP	713	582.1	- 0.9	8/31	750	- 5.88	I	4	0	100	0	0	12.7	12.6	1.09	1.94	.99
13-10	39-19*	554.4	S	1901	1915 1934	Ex 850	975	581.4	- 1.6	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
13-11	39-19	554.4	C	1901	1934	RP	229	581.4	-1.6	8/31	975	-6.04	I	1	20	70	10	0	10.1	11.0	1.17	1.60	1.17
13-12	40-3	552.6	S	1916	1932	RP	840	581.6	-1.4	8/31	840	-6.21	O	6	0	100	0	0	19.2	18.5	1.60	1.48	1.24
13-13	40-4	552.5	S	1916	1934	RP	807	582.0	-1.0	9/7	1320	-5.57	O	6	0	99	1	0	13.1	23.3	1.24	1.41	1.09
13-14	40-17	552.3	S	1928	1934	RP	939	581.6	-1.4	9/7	1380	-5.31	O	3	0	100	0	0	10.0	9.1	.95	1.60	1.20
13-15	40-18	552.1	C	1928	--	--	750	581.9	-1.1	E/C													
13-16	40-18	552.1	C	1928	--	--	315	581.9	-1.1	9/7	315	-6.21	S	1	0	90	10	0	10.3	9.6	1.24	1.87	1.34
13-17	40-20*	552.0	S	1929	--	--	1113	580.4	-2.6	9/20	285	-2.28	S	3	2	98	0	0	10.8	15.2	1.41	2.34	.94
13-18	40-20	552.0	C	1929	--	--	350	580.4	-2.6	E/C													
13-19	40-5*	551.8	S	1916	1928	RP	500	580.9	-2.1	9/7	351	-6.91	S	3	0	100	0	0	8.8	22.2	.95	1.17	.62
13-20	40-5	551.8	C	1916	1928	RP	703	580.9	-2.1	9/7	705	-6.07	S	6	0	100	0	0	10.0	28.6	.66	1.27	.99
13-21	40-6	551.6	S	1916	1976	RP	736	581.6	-1.4	9/7	1020	-5.37	S	3	0	100	0	0	12.8	26.2	.44	1.17	.66
13-22	40-7	550.7	L	1916	1941	RM 200	736	581.6	-1.4	9/10	1425	-2.98	O	6	0	45	55	0	16.3	36.1	1.17	3.08	.40
13-23	40-21	550.4	S	1929	1976	RP	951	581.7	-1.3	9/10	1200	-4.12	O	6	0	100	0	0	11.4	30.1	.66	1.72	.47
13-24	40-22	550.3	S	1929	1976	RP	1083	581.9	-1.1	9/10	1200	-3.12	O	6	0	100	0	0	10.1	31.2	.70	2.19	.77
13-25	40-23	550.1	S	1929	1976	RP	935	581.8	-1.2	9/10	840	-3.48	O	3	12	88	0	0	9.6	19.6	.91	2.01	.84
13-26	40-13	546.3	S	1924	1978	RP	452	577.9	-5.1	9/10	360	-7.05	S	4	0	99	1	0	18.7	30.1	1.64	3.19	1.41
13-27	40-14	546.2	S	1924	1978	RP	563	577.8	-5.2	9/10	450	-7.05	S	3	2	97	1	0	17.4	19.0	.55	1.94	.99
13-28	40-15	546.0	S	1924	1978	RP	478	579.6	-3.4	9/12	285	-6.24	S	3	1	95	4	0	17.6	23.0	.81	1.98	.70
13-29	40-16	545.9	S	1924	1978	RP	598	579.5	-3.5	9/12	264	-5.91	S	7	0	100	0	0	14.2	10.1	.77	1.56	.84
13-30	40-9	545.1	S	1917	1923	Ex 200	720	578.0	-5.0	E/C													
13-31	40-10	545.0	S	1917	1922	Ex 430	768	578.1	-4.9	E/C													
13-32	40-11	544.8	S	1922	--	--	715	578.0	-5.0	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK		DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE				MAX DEPTH		CURRENT VELOCITY		
					YEAR	TYPE									% SL	% SD	% GR	% BD	U	D	UP	ON	DOWN
13-33	40-12	544.7	S	1923	--	--	485	578.2	-4.8	E/C													
13-34	41-16	543.4	C	1923	1926	RP	630	576.9	-6.1	9/11	900	-7.28	S	6	0	94	6	0	12.1	23.8	2.01	2.01	1.52
13-35	41-2	541.4	S	1887	1892	RP	600	573.8	-9.2	E/C													
13-36	41-1	541.4	C	1887	--	--	336	576.3	-6.7	E/C													
13-37	41-6	540.9	S	1892	1931	RP	360	577.1	-5.9	9/13	360	-7.16	0	2	39	60	1	0	26.7	37.7	.77	1.98	.09
13-38	41-7	540.8	S	1892	1931	RP	717	577.7	-5.3	9/25	975	-6.06	0	3	38	61	1	0	23.9	10.1	.66	2.01	1.24
13-39	41-4	540.7	C	1892	1931	RP	852	578.1	-4.9	9/25	1020	-4.39	0	5	99	1	0	0	9.8	9.9	1.06	1.34	.81
13-40	41-5	540.4	C	1892	--	--	200	576.9	-6.1	E/C													
13-41	41-11	539.5	S	1894	--	--	380	576.9	-6.1	E/C													
13-42	41-10	539.2	S	1894	--	--	955	575.6	-7.4	E/C													
13-43	41-9	538.9	C	1894	--	--	--	--	--	E/C													
13-44	41-2	538.7	C	1894	--	--	--	--	--	E/C													
13-45	42-4	537.1	S	1905	1978	RP	1230	575.0	-8.0	9/25	1800	-6.08	I	2	0	96	4	0	14.7	16.2	1.34	2.34	1.31
13-46	42-5	536.9	S	1906	1928	RP	825	581.0	-2.0	9/25	1020	-4.28	I	6	0	100	0	0	13.3	31.8	1.20	2.34	1.41
13-47	42-40	536.8	S	1927	1928	Ex 225	550	581.5	-1.5	9/25	600	-6.67	I	4	45	55	0	0	30.5	24.1	1.41	1.64	1.02
13-48	42-6	536.3	C	1906	--	--	300	574.5	-8.5	E/C													
13-49	42-43	533.4	S	1928	1929	RP	602	573.7	-9.3	9/25	675	-5.11	0	3	39	61	0	0	14.9	29.0	.62	1.06	.59
13-50	42-17	533.3	L	1917	1929	RP	765	576.0	-7.0	9/25	1200	-6.37	0	7	49	51	0	0	14.1	11.1	.81	.81	.59
13-51	42-15	533.1	C	1917	1962	RS, RP	1045	573.9	-9.1	9/25	1125	-2.37	0	4	11	69	20	0	10.8	36.2	.81	2.74	.47
13-52	42-44	532.8	S	1929	--	--	294	574.8	-8.6	9/25	300	-8.04	I	7	2	98	0	0	23.8	26.8	1.06	2.23	.66
13-53	42-45	532.6	S	1929	--	--	577	577.1	-5-9	9/27	630	-4.88	I	5	20	80	0	0	8.8	7.3	.95	1.24	.91
13-54	42-46	532.4	S	1929	--	--	694	577.4	-5.6	9/25	1050	-4.98	I	4	60	40	0	0	20.9	11.7	1.31	1.98	1.13
13-55	42-47	532.3	S	1929	--	--	532	577.2	-5.8	9/27	450	-4.12	I	5	41	59	0	0	7.6	7.8	1.02	1.24	.91

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
13-56	42-36	530.7	S	1925	--	--	139	577.2	-5.8	9/27	90	-12.05	0	4	0	60	40	0	26.2	27.8	1.38	1.24	.73
13-57	42-37	530.6	S	1925	--	--	505	575.5	-7.5	9/27	225	-7.05	0	4	25	53	22	0	14.5	25.5	1.06	1.31	.55
13-58	42-34	530.3	S	1924	1926	RP	885	575.6	-7.4	9/27	510	-6.05	0	7	0	99	1	0	15.1	14.6	1.20	1.64	.88
13-59	42-35	530.1	S	1924	1926	RP	1050	575.0	-8.0	E/C													
13-60	42-28	529.1	C	1924	1929	RP	341	573.5	-9.5	E/C													
13-61	42-27	528.9	C	1924	1926	RP	235	572.5	-10.5	E/C													
13-62	43-17	524.6	C	1904	--	--	277	569.9	-13.1	E/C													
13-63	43-22*	524.1	S	1904	--	--	--	--	--	E/C													
13-64	43-22	524.1	C		--	--	--	--	--	E/C													
13-65	43-21	524.0	S	1904	1924	Ex 195	653	572.8	-10.2	E/C													
13-66	43-27	523.8	S	1924	--	--	775	571.4	-11.6	E/C													
13-67	43-28	523.6	S	1924	--	--	821	572.3	-10.7	E/C													
13-68	43-29	523.4	S	1924	--	--	679	574.1	-8.9	E/C													
13-69	43-30	523.2	S	1924	--	--	693	573.3	-9.7	E/C													
13-70	43-31	523.1	S	1924	--	--	632	574.2	-8.6	E/C													
13-71	43-32	522.8	S	1924	--	--	630	573.3	-9.7	9/27	255	--	--	--	100	0	0	0	--	--	.26	.32	.26
13-72										E/C													
14-1	43-49	522.5	S	1928	1935	RM 275	600	574.5	+2.5	RM													
14-2	43-1	522.3	S	1894	1924	RP	382	570.8	-1.2	10/1	288	-1.34	S	2	5	95	0	0	9.5	5.4	.30	.44	.12
14-3	43-2	522.3	C	1894	1924	RP	300	571.4	-0.6	E/C													
14-4	43-2	522.3	C	1894	1924	RP	300	571.4	-0.6	E/C													
14-5	43-40	522.4	S	1924	--	RM	591	571.4	-0.6	RM													
14-6	43-3	522.2	S	1894	1924	Ex 175	600	568.8	-3.2	10/1	705	-4.54	S	3	0	90	10	0	19.5	23.9	.88	.66	.55

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
14-7	43-38	522.1	C	1924	1928	Ex 50	702	571.1	-0.9	10/1	201	-1.21	S	7	90	10	0	0	8.1	3.6	.18	.22	.08
14-8	43-39	521.9	S	1924	1928	Ex 375	625	574.6	+2.6	E/C													
14-9	43-25	--	S	1907	--	--	509	572.2	+0.2	Removed in bridge construction													
14-10	44-23	520.0	S	1927	--	--	1117	574.6	+2.6	10/4	1410	-4.42	S	4	25	55	20	0	33.4	28.1	1.38	1.38	.55
14-11	44-19	519.9	C	1924	--	--	158	568.8	-3.2	E/C													
14-12	44-24*	519.8	S	1927	--	--	200	573.8	+1.8	10/4	450	-5.39	0	4	19	77	4	0	30.9	23.2	.55	.84	.66
14-13	44-24	519.8	C	1927	--	--	200	573.8	+1.8	E/C													
14-14	44-29	519.6	L	1928	--	--	895	572.0	0.0	E/C													
14-15	44-28	519.4	S	1928	--	--	440	572.8	+0.8	10/4	300	-5.19	S	3	23	56	21	0	13.2	15.5	.88	1.27	.73
14-16	44-18	519.3	C	1924	1952	RS	426	569.1	-2.9	Unable To Map - Flood Wall Built On Top													
14-17	44-9	519.0	S	1900	--	--	220	567.7	-4.3	E/C													
14-18	44-17	517.5	L	1924	1961	EX	1300	569.2	-2.8	10/4		EM	S	--	--	--	--	--	--	--	--	--	--
14-19	44-20	513.8	S	1925	--	--	760	568.4	-3.6	10/5	1320	-3.76	S	4	50	50	0	0	8.3	12.6	.70	1.64	1.09
14-20	44-21	513.6	S	1925	--	--	575	570.1	-1.9	10/5	780	-4.30	S	4	25	75	0	0	10.0	11.1	1.09	1.31	.95
14-21	44-22	513.5	S	1925	--	--	430	569.1	-2.9	10/5	720	-6.66	S	4	23	65	12	0	16.1	13.7	1.31	1.56	.91
14-22	45-2	511.3	S	1898	1925	RP	1359	568.4	-3.6	10/5	720	-5.00	S	2	0	100	0	0	10.8	10.3	1.20	1.87	1.06
14-23	45-3	511.1	C	1899	--	--	580	568.4	-3.6	10/5	252	-3.55	I	4	40	60	0	0	7.8	8.8	.81	1.13	.73
14-24	45-4	511.1	S	1899	1925	RP	857	568.4	-3.6	10/8	1020	-3.08	S	3	2	98	0	0	12.1	13.9	.81	1.06	.36
14-25	45-36	510.5	S	1925	--	--	825	568.6	-3.4	E/C													
14-26	45-10*	510.3	S	1910	1925	RP	300	568.7	-3.3	10/8	222	-2.18	S	3	69	31	0	0	12.3	12.1	.59	.99	.44
14-27	45-10	510.3	C	1910	1925	RP	600	568.7	-3.3	E/C													
14-28	45-11	510.1	S	1910	1925	Ex 285	1215	569.6	-2.4	10/8	1350	-4.28	S	6	12	88	0	0	13.1	22.6	.81	1.34	.84
14-29	45-15*	510.0	S	1919	1925	Ex 625	500	568.7	-3.3	10/8	480	-3.05	0	3	50	49	1	0	15.2	15.1	.70	1.31	.91
14-30	45-15	510.0	C	1919	1925	RP	500	568.7	-3.3	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
14-31	45-37	509.8	S	1925	--	--	1230	568.8	-3.2	10/9	1800	-4.17	O	3	37	63	0	0	16.2	18.3	1.06	1.60	1.80
14-32	45-16*	509.6	C	1919	1925	Ex 980	1000	567.8	-4.2	10/9	1600	-4.00	S	5	0	100	0	0	7.6	9.0	.88	1.09	.95
14-33	45-16	509.6	T	1919	1925	Ex 980	1000	567.8	-4.2	10/9	1350	-4.03	S	4	0	100	0	0	16.5	20.0	.99	1.38	.84
14-34	45-12	509.3	S	1910	--	--	550	566.6	-5.4	10/8	375	-5.75	S	6	11	89	0	0	16.2	20.4	.66	1.24	.84
14-35	45-13	509.2	C	1910	--	--	735	573.8	+1.8	10/9	1650	-6.43	S	4	0	100	0	0	16.2	14.2	.66	1.09	.81
14-36	45-23	507.6	C	1923	--	--	568	567.0	-5.0	10/9	675	-5.20	S	3	0	100	0	0	11.9	23.9	.66	.99	.30
14-37	45-27	506.2	S	1924	--	--	483	568.8	-3.2	10/9	510	-2.67	O	3	95	5	0	0	8.6	19.5	.77	1.02	.30
14-38	45-26	506.0	S	1924	--	--	841	568.9	-3.1	10/9	1050	-3.47	O	6	55	45	0	0	14.6	23.5	.66	1.38	.66
14-39	45-25	505.9	S	1924	--	--	1656	569.5	-2.5	10/9	375	-1.97	O	7	70	30	0	0	5.9	7.8	.62	1.24	.47
14-40	45-17	505.4	C	1921	--	--	700	569.2	-2.8	10/9	1425	-3.33	O	4	22	77	1	0	15.2	20.2	.81	2.09	.88
14-41	45-18	504.6	C	1922	--	--	335	566.7	-5.3	E/C													
14-42	46-12	501.3	S	1927	--	--	335	567.7	-4.3	10/10	365	-3.98	S	4	45	6	19	30	8.5	8.5	.51	.73	.47
14-43	46-13	501.2	S	1927	--	--	451	567.0	-5.0	10/10	870	-5.15	S	4	52	36	6	6	17.3	21.5	.99	.77	.33
14-44	46-14	501.0	S	1927	--	--	900	566.2	-5.8	10/10	1200	-5.81	S	1	39	61	0	0	10.5	11.1	.84	.91	.40
14-45	46-10	500.8	S	1927	--	--	1090	565.4	-6.6	10/10	--	-6.15	S	3	85	15	0	0	9.2	15.5	.84	.91	.70
14-46	46-1	500.4	S	1924	--	--	970	567.7	-4.3	E/C													
14-47	46-2	500.1	L	1924	1925 1927	Ex 1210	1890	566.0	-6.0	10/10	--	-4.61	S	3	26	74	0	0	10.0	12.4	.70	1.09	.62
14-48	46-3	499.8	S	1924	1925	RP	680	565.8	-6.2	10/10	1200	-3.95	S	3	45	55	0	0	13.7	37.0	.62	1.20	.40
15-1	47-3	491.0	S	1891	1895	RS Ex 100 PD	1550	--	--	9/12	1500	-3.30	S	7	0	100	0	0	9.1	7.0	1.00	3.85	2.25
15-2	47-6½	489.9	S	1891	1899	WD	850	--	--	9/12	900	-3.56	S	1	0	100	0	0	9.2	10.0	1.50	2.80	1.10

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
15-3	47-9	488.1	S	1890	1936	RM	535	--	--	RM													
15-4	47-9½	487.9	S	1895	1936	RM	1250	--	--	RM													
15-5	47-10	487.8	S	1892	1936	RM 500	105	--	--	RM													
15-6	47-37	487.7	S	1912	1936	RM	--	--	--	RM													
15-7	47-18	487.6	S	1896	1936	RM	830	--	--	RM													
15-8	47-36	487.5	S	1912	1936	RM	--	--	--	RM													
15-9	47-35	487.5	S	--	1936	RM	--	--	--	RM													
15-10	47-34	487.1	S	1912	1936	RM	--	--	--	RM													
15-11	47-33	486.9	S	1912	1936	RM 290	--	--	--	RM													
15-12	47-32	486.7	S	1894	1936	RM 722	--	--	--	RM													
15-13	47-16	486.5	S	1895	1936	RM 915	735	--	--	9/12	750	-11.13	S	1	0	100	0	0	9.0	13.9	1.95	2.20	1.50
15-14	47-31	486.4	S	1895	1936	RM 839	--	--	--	RM													
15-15	47-30	486.2	S	1912	1936	RM 1025	--	--	--	RM													
16-1	48-33	481.2	S	1929	--	--	990	544.7	-0.3	9/13	1350	-4.69	0	2	0	100	0	0	12.3	10.6	2.20	2.70	2.20
16-2	48-35	481.0	S	1929	--	--	1426	546.3	+1.3	9/13	1350	-2.92	0	7	0	100	0	0	10.6	12.7	2.00	4.40	1.80
16-3	48-34	480.7	S	1929	--	--	760	543.7	-1.3	9/13	660	-6.15	0	6	0	63	37	0	13.5	14.9	1.50	3.80	2.40
16-4	48-36	480.4	S	1929	--	--	690	544.0	-1.0	9/13	660	-7.25	0	3	0	51	49	0	13.6	18.8	2.30	4.10	2.00
16-5	48-37	480.2	S	1929	--	--	515	542.0	-3.0	9/14	570	-6.92	I	3	0	81	19	0	19.2	20.8	1.60	3.60	1.70
16-6	48-38	479.9	S	1929	--	--	720	542.5	-2.5	9/14	675	-6.49	I	2	0	100	0	0	14.0	12.7	1.80	2.80	1.90
16-7	48-4	479.6	S	1896	1939	RM 290	790	541.5	-0.5	9/14	750	-4.29	I	4	0	100	0	0	12.0	11.4	1.50	1.90	1.20
16-8	48-2	479.4	S	1896	1936 1939 1967	RM 790	400	546.2	+1.2	9/14	570	-2.89	I	3	0	93	7	0	9.9	9.1	.90	3.40	1.00

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
16-9	48-3	479.2	S	1896	1936 1939 1967	RM 865	217	546.4	+1.4	9/14	675	-2.52	I	3	0	88	12	0	11.0	9.9	1.30	3.50	1.30
16-10	48-5	479.0	S	1896	1936 1939 1967	RM 720	463	546.2	+1.2	9/17	870	-1.45	I	7	37	63	0	0	9.8	8.3	1.40	2.90	.80
16-11	48-6	478.7	S	1896	1939 1967	RM 390	500	541.9	-3.1	9/17	630	-5.29	I	3	17	83	0	0	8.1	8.3	1.20	1.70	1.30
16-12	48-7	478.6	L	1896	1967	RM 170	460	541.4	-3.6	9/17	1295	-5.15	S	7	2	79	19	0	11.9	10.3	1.60	1.75	1.55
16-13	48-8	478.6	S	1896	--	--	1500	543.0	-2.0	E/C													
16-14	48-12	478.1	S	1897	1926	RP	480	542.5	-2.5	9/17	600	-5.32	S	4	0	45	30	25	12.6	11.0	2.00	3.25	1.75
16-15	48-13	477.3	C	1901	1931	RP	1545	548.2	+3.2	E/C													
16-16	48-17	477.2	S	1901	1967	RM 170	170	543.4	-1.6	9/18	375	-9.59	0	3	0	27	73	0	15.5	14.1	1.70	2.80	2.20
16-17	48-23	477.0	S	1901	1967	RM 200	190	542.5	-2.5	9/18	156	-2.36	0	1	0	0	50	50	10.3	10.5	2.60	3.00	2.20
16-18	48-24	476.8	S	1901	1967	RM 210	80	542.6	-2.4	9/18	80	-3.53	S	7	0	4	94	2	7.9	5.9	1.80	2.20	1.60
16-19	48-20	476.3	S	1901	--	--	760	543.2	-1.8	9/18	600	-3.06	I	6	98	1	1	0	8.0	3.3	.50	.50	.50
16-20	48-21	476.1	S	1901	1968	RM 530	530	541.4	-3.6	RM - Commercial Loading Area													
16-21	48-22	475.9	S	1901	--	--	320	542.6	-2.4	9/18	435	-13.19	S	1	0	80	20	0	15.6	15.1	2.20	2.40	2.20
16-22	49-10	474.5	S	1907	1912	RP	120	542.2	-2.8	9/18	300	-5.16	I	7	45	55	0	0	12.6	10.1	1.40	2.30	1.50
16-23	49-15	474.3	S	1907	1912	RP	430	542.6	-2.4	9/18	600	-4.16	I	4	25	75	0	0	11.7	9.0	1.70	2.50	1.80
16-24	49-17	474.1	S	1907	1912	RP	570	542.4	-2.6	9/19	540	-3.18	S	3	18	80	2	0	8.5	9.8	1.20	2.40	1.00
16-25	49-19	473.9	S	1908	1912	RP	630	543.1	-1.9	9/19	420	-2.54	S	7	0	56	44	0	7.2	14.3	1.50	2.70	1.80
16-26	49-24	473.6	S	1912	--	--	310	541.7	-3.3	9/19	210	-4.98	S	3	50	50	0	0	14.8	14.7	.50	1.10	.40
16-27	49-25	473.5	S	1912	--	--	330	542.8	-2.2	9/19	291	-4.24	S	7	34	66	0	0	13.5	12.2	.60	1.50	.80
16-28	49-29	472.8	S	1912	--	--	550	540.6	-4.4	9/19	525	-6.71	S	6	37	63	0	0	13.5	14.0	1.50	2.80	1.60

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
16-29	49-28	472.6	S	1912	--	--	1080	541.3	-3.7	9/19	1095	-5.84	S	6	0	100	0	0	13.1	12.6	1.50	3.20	1.40
16-30	49-30	472.0	S	1912	--	--	550	537.5	-7.5	E/C													
16-31	49-42	470.8	S	1913	--	--	375	539.7	-5.3	9/19	309	-5.21	S	1	5	95	0	0	9.9	9.6	1.10	1.50	1.00
16-32	49-41	470.6	S	1913	--	--	330	540.3	-4.7	9/20	465	-7.21	S	1	0	75	25	0	14.8	14.8	1.90	2.70	1.60
16-33	49-40	470.4	S	1913	1938	RM 250	80	537.6	-7.4	9/20	360	-7.62	S	1	0	100	0	0	15.8	15.1	1.20	2.20	1.30
16-34	49-37	470.2	S	1913	1938	RM 200	265	539.2	-5.8	9/20	510	-7.18	S	1	0	88	12	0	16.5	16.8	1.00	1.50	.80
16-35	49-36	470.1	S	1913	--	--	400	539.0	-6.0	9/20	450	-7.85	S	6	0	88	12	0	15.8	13.6	1.00	2.10	1.20
16-36	50-34	467.0	S	1914	1928	RP	470	539.5	-5.5	E/C													
16-37	50-35	466.8	S	1914	1928	RP	578	547.2	+2.2	9/20	480	-8.22	S	7	0	100	0	0	16.5	15.8	1.50	2.20	1.60
16-38	50-31	466.6	S	1914	--	--	605	539.2	-6.0	9/20	285	-2.48	O	3	0	75	25	0	13.8	17.5	1.10	1.50	.60
16-39	50-30	466.4	S	1914	--	--	580	542.4	-2.6	9/21	240	-6.09	O	7	12	68	20	0	15.0	16.3	1.50	1.20	1.20
16-40	50-29	466.2	S	1914	--	--	650	537.6	-7.4	9/21	690	-5.55	O	2	25	60	15	0	15.3	14.4	1.40	2.30	1.30
16-41	50-16	466.0	S	1910	--	--	840	538.6	-6.4	9/21	870	-6.95	O	1	12	88	0	0	15.6	13.3	1.20	2.30	1.70
16-42	50-17	465.8	S	1910	--	--	990	538.5	-6.5	9/24	975	-6.28	S	1	37	63	0	0	14.2	13.7	1.30	2.50	1.50
16-43	50-33	465.6	S	1914	--	--	410	536.3	-8.7	9/24	291	-9.11	S	6	0	100	0	0	15.1	13.5	.80	2.40	1.60
16-44	50-18	465.4	S	1911	--	--	740	538.2	-6.8	9/24	900	-5.15	S	4	55	45	0	0	16.5	15.8	1.50	2.10	1.20
16-45	50-19	465.2	S	1911	--	--	540	538.1	-6.9	9/24	675	-6.65	S	7	12	88	0	0	13.3	12.2	1.20	1.80	1.40
16-46	50-22	464.9	S	1912	--	--	810	537.5	-7.5	E/C													
16-47	50-23	464.7	S	1912	--	--	540	537.3	-7.7	E/C													
16-48	50-41	464.5	S	1915	--	--	835	538.2	-6.8	E/C													
16-49	50-42	464.2	S	1915	--	--	1100	537.1	-7.9	9/24	570	-6.25	S	1	0	100	0	0	8.8	8.5	1.20	1.30	1.20
16-50	50-45	464.0	S	1915	--	--	800	539.2	-5.8	9/24	456	-5.91	S	2	0	100	0	0	12.0	10.9	1.20	1.40	1.30
16-51	50-3	463.0	S	1895	--	--	560	535.3	-9.7	9/25	585	-7.68	I	7	0	90	10	0	16.4	13.3	1.20	1.50	1.00
16-52	50-4	462.8	L	1895	1939	RM 210	750	537.0	-8.0	9/25	720	-7.04	I	4	0	96	4	0	12.1	12.0	1.75	2.25	1.25

IA WD	COE	RIVER		DATE	REWORK				DEPTH			ADJ			SUBSTRATE %				MAX DEPTH		CURRENT VELOCITY		
N	N	MILE	DT	CONS	YEAR	TYPE	DL	ELEV	OP	SD	ML	DEPTH	LC	PF	SL	SD	GR	BD	U	D	UP	ON	DOWN
16-53	51-12	462.1	S	1897	--	--	1780	536.3	-8.7	9/25	1650	-8.31	I	6	0	100	0	0	17.1	14.5	1.10	1.40	1.15
16-54	51-19	461.5	S	1913	--	--	650	535.0	-10.0	9/25	465	-8.41	I	2	0	100	0	0	12.6	10.9	1.70	1.80	1.60
16-55	51-23	460.9	S	1914	--	--	580	537.1	-7.9	E/C													
16-56	51-28	460.7	S	1924	--	--	920	534.9	-10.1	E/C													
16-57	51-22	460.5	S	1914	1924	RP	610	537.6	-7.4	E/C													
16-58	51-32	460.3	S	1927	--	--	325	545.5	+0.5	9/25	180	-1.81	S	4	58	42	0	0	11.9	8.1	.75	1.35	.30
16-59	51-13	458.1	S	1897	1928	RP	325	539.4	-5.6	9/25	195	-8.11	O	2	0	100	0	0	12.6	16.1	1.10	1.25	1.10
16-60	51-14	458.0	S	1897	1928	RP	133	536.8	-8.2	E/C													
16-61	51-24	457.6	S	1924	--	--	435	533.2	-11.8	9/25	420	-11.31	S	4	0	100	0	0	22.6	25.0	.85	2.00	1.00
16-62	51-25	457.4	S	1924	1935	RM	500	--	--	RM													
16-63	51-27	457.2	S	1924	1935	RM	425	--	--	RM													
17-1	51-7	456.4	S	1896	--	--	1110	532.8	-3.2	8/27	840	-4.49	S	6	0	100	0	0	8.6	9.4	.88	.91	.77
17-2	51-8	456.3	S	1896	--	--	1000	531.2	-4.8	8/28	975	-11.23	S	2	0	50	5	45	13.5	12.3	1.06	.97	.77
17-3	51-9	456.1	S	1896	--	--	750	532.5	-3.5	8/28	705	-7.07	S	1	0	53	5	42	12.1	12.3	.58	1.38	.99
17-4	52-5	448.0	L	1916	--	--	1070	531.4	-4.6	8/29	825	-6.42	S	2	0	91	9	0	11.5	11.8	1.05	1.68	.86
17-5	52-6	447.8	C	1917	--	--	792	533.2	-2.8	8/29	390	-6.42	S	3	0	75	25	0	13.6	11.7	1.38	2.97	1.10
17-6	52-6	447.8	C	1917	--	--	1190	533.2	-2.8	8/29	435	-5.52	I	1	0	83	17	0	9.1	9.3	1.10	2.23	1.11
17-7	52-7*	447.3	C	1916	--	--	600	532.7	-3.3	8/29	375	-5.72	I	1	0	78	22	0	7.6	8.4	1.07	1.44	1.05
17-8	52-7	447.3	C	1916	--	--	270	532.7	-3.3	E/C													
17-9	52-8	447.5	S	1918	--	--	1560	530.7	-5.3	E/C													
17-10	52-9*	447.0	S	1925	--	--	250	531.1	-4.9	8/30	285	-5.37	S	2	4	95	1	0	12.4	9.2	.88	1.53	.39
17-11	52-9	447.0	C	1925	--	--	500	531.0	-5.0	8/30	420	-3.47	S	5	25	75	0	0	11.4	20.7	2.27	2.38	2.27
17-12	53-26	446.7	S	1925	--	--	620	--	--	8/30	330	-6.77	I	1	7	93	0	0	9.5	9.9	2.38	2.50	2.00

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
17-13	53-24	446.4	S	1925	--	--	490	--	--	8/30	315	-8.00	I	1	0	89	11	0	13.2	12.7	.52	.99	.57
17-14	53-33	446.1	S	1925	1935	RT	1120	--	--	8/31	1350	-4.51	I	1	40	59	1	0	7.7	6.7	.68	1.72	.93
17-15	53-25	445.9	S	1925	--	--	525	--	--	8/30	381	-3.88	S	1	0	98	2	0	6.5	7.7	.49	1.01	.56
17-16	53-5	444.8	S	1899	1934	RP	555	533.1	-2.9	9/18	675	-7.23	S	3	0	50	12	38	20.2	19.8	.99	1.99	.43
17-17	53-6	444.6	S	1899	1934	RP	850	533.3	-2.7	9/18	765	-5.06	S	3	1	50	11	38	13.7	15.2	.56	1.72	.58
17-18	53-7	444.4	S	1899	1924 1934	Ex 200 RP	855	533.0	-3.0	9/18	1080	-6.50	S	2	1	91	8	0	19.5	18.0	.57	1.38	.43
17-19	53-21	444.1	S	1924	1935	RT,RE	850	--	--	9/27	900	-3.96	S	6	18	81	1	0	9.7	15.3	.85	1.87	.73
17-20	53-22	443.8	S	1924	1935	RT,RE	945	--	--	9/27	1025	-3.83	S	3	2	94	4	0	8.2	9.7	.81	1.72	.81
17-21	53-16	443.6	S	1917	1934	RP	1080	--	--	9/18	435	-4.76	S	6	0	100	0	0	10.2	15.5	.61	.99	.57
17-22	53-43	443.2	C	1928	--	--	700	--	--	9/18	750	-2.06	S	6	63	20	17	0	15.5	20.6	.48	1.01	.95
17-23	53-45	443.0	S	1928	--	--	710	--	--	9/18	750	-2.06	S	3	41	35	20	4	13.0	19.8	.31	1.50	.63
17-24	53-44	442.8	S	1928	--	--	409	--	--	8/31	360	-2.99	S	6	77	23	0	0	5.9	14.9	.24	.27	.40
17-25	53-33	439.8	S	1926	--	--	255	--	--	E/C													
17-26	53-38	439.5	S	1926	--	--	840	--	--	9/7	510	-3.86	I	1	19	69	12	0	6.5	6.6	.60	1.07	.59
17-27	53-8	439.2	S	1901	--	--	920	528.6	-7.4	E/C													
17-28	53-40	439.2	S	1926	1928	RP	881	--	--	9/7	435	-9.42	S	4	10	90	0	0	19.2	21.5	.97	1.35	.82
17-29	53-39	439.0	S	1926	--	--	878	--	--	10/8	222	-13.97	S	3	10	15	8	67	21.7	24.7	1.16	1.41	1.10
17-30	53-18	438.0	C	1917	1927	RP	100	--	--	E/C													
17-31	53-19	437.8	S	1917	1927	RP	450	--	--	9/7	135	-5.56	S	1	60	40	0	0	9.2	10.0	.69	.86	.57
17-32	53-20	437.6	S	1917	1927	Ex 325	720	--	--	9/7	705	-6.92	S	2	0	99	1	0	9.0	9.0	.53	.91	.54
17-33	54-4	437.4	S	1917	1927	RP	675	--	--	9/7	249	-4.66	S	2	35	60	5	0	7.7	8.7	.57	1.10	.50
18-1	54-32	437.0	S	1927	1935	RM 141	459	--	--	9/10	360	-15.8	S	3	0	53	47	0	26.6	28.8	1.13	1.68	1.07

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-2	54-34	436.7	S	1927	--	--	460	--	--	9/10	555	-5.47	S	3	25	75	0	0	16.4	26.2	.77	2.53	.99
18-3	54-10	436.0	S	1924	--	--	400	--	--	E/C													
18-4	54-5	435.8	S	1917	--	--	720	--	--	9/10	285	-11.40	S	3	69	31	0	0	21.6	25.8	1.72	1.72	1.92
18-5	54-6	435.6	S	1918	--	--	500	--	--	9/10	375	-8.03	S	3	37	63	0	0	16.5	17.9	.64	1.79	.59
18-6	54-3	435.3	C	1916	--	--	580	--	--	9/10	540	-7.30	S	3	75	5	19	1	15.3	27.8	.89	1.14	1.06
18-7	54-17	434.2	C	1927	1947	Rm 500	1300	--	--	E/C													
18-8	54-16	433.8	S	1927	1978	RP	500	--	--	9/11	900	-7.48	O	3	0	50	12	38	22.0	28.1	1.47	3.39	.98
18-9	54-15	433.5	S	1927	--	--	1400	--	--	9/11	1500	-10.61	I	1	0	96	4	0	19.0	19.4	1.01	1.87	1.32
18-10	54-18	433.0	S	1927	--	--	1155	--	--	9/11	825	-6.38	I	7	0	99	1	0	13.0	13.4	1.05	2.78	1.13
18-11	54-29	432.6	S	1927	--	--	1050	--	--	9/11	660	-10.28	I	3	0	97	3	0	19.4	20.1	.82	2.33	1.44
18-12	54-27*	432.1	S	1927	--	--	400	--	--	9/11	204	-3.05	I	5	0	100	0	0	7.3	7.4	.64	.86	1.03
18-13	54-27	432.1	C	1927	--	--	380	--	--	E/C													
18-14	54-27	432.1	C	1927	--	--	400	--	--	E/C													
18-15	54-26	431.8	S	1927	--	--	798	--	--	9/11	192	-4.18	S	4	23	25	2	50	15.1	19.1	1.44	1.95	.61
18-16	54-25	431.5	S	1927	1932	RM 65	495	--	--	9/11	285	-5.55	S	4	0	84	8	8	14.2	13.9	1.35	1.79	1.56
18-17	54-24	431.3	S	1927	1932	RM 215	829	--	--	9/11	120	-6.68	S	4	25	25	0	50	16.8	19.1	1.13	2.18	1.05
18-18	54-23*	431.1	S	1927	1932	Rm 335	500	--	--	9/11	150	-5.05	S	7	6	69	0	25	18.3	18.6	.91	2.78	.41
18-19	54-23	431.1	C	1927	--	--	800	--	--	9/11	120	-2.55	I	3	100	0	0	0	8.5	11.9	2.5	2.94	1.72
18-20	54-21	430.8	S	1927	1932	RM 150	1735	--	--	9/14	465	-5.92	S	4	0	50	1	49	23.9	23.5	.79	3.18	1.16
18-21	54-20	430.5	S	1927	--	--	1930	--	--	9/14	420	-11.95	S	3	0	0	12	88	17.6	23.0	1.21	2.28	.93
18-22	54-35	430.1	C	1928	--	--	1800	--	--	9/14	40	EP	S	4	50	0	0	50	18.0	20.5	1.51	2.08	1.75
18-23	54-38*	429.8	S	1928	--	--	450	--	--	9/14	360	-12.25	S	6	0	100	0	0	22.1	23.9	1.28	2.08	2.03
18-24	54-38	429.8	C	1928	--	--	500	--	--	9/14	330	-3.39	S	6	39	61	0	0	18.5	23.1	1.12	1.82	1.59
18-25	54-36	429.4	S	1928	--	--	1430	--	--	9/14	540	-7.09	S	6	29	70	1	0	16.9	22.5	1.13	1.72	.56

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-26	54-39*	429.1	S	1928	--	--	350	--	--	E/C													
18-27	54-39	429.1	C	1928	--	--	850	--	--	E/C													
18-28	54-37	428.8	S	1928	--	--	1110	--	--	9/20	420	-2.82	S	2	0	100	0	0	6.2	6.5	.90	1.79	1.25
18-29	54-1	428.9	C	1904	1954	RS	1130	--	--	9/14	900	-3.95	S	6	12	88	0	0	18.7	41.0	.85	5.56	1.21
18-30	55-19	428.6	S	1916	1919	EX	580	526.4	-1.6	9/20	150	-2.05	S	1	0	100	0	0	6.3	6.9	.73	1.47	.18
18-31	55-20	428.4	S	1918	--	--	1100	524.3	-3.7	E/C													
18-32	55-10	428.2	S	1904	1919	Ex 370	1225	524.8	-3.2	E/C													
18-33	55-12	428.0	S	1905	1919	Ex 200	1105	525.1	-2.9	9/19	1050	-4.60	S	2	1	99	0	0	10.3	9.0	1.10	1.56	1.35
18-34	55-22	427.7	S	1923	--	--	940	524.8	-3.2	9/19	750	-4.83	S	4	25	74	1	0	11.2	10.3	.99	2.08	1.19
18-35	55-24	427.4	S	1923	--	--	1020	526.1	-1.9	9/19	930	-5.00	S	2	0	90	10	0	10.1	8.4	1.07	2.53	1.05
18-36	55-23	427.2	S	1923	--	--	1000	524.8	-3.2	9/19	420	-5.00	I	5	0	100	0	0	9.9	9.6	1.25	2.08	1.13
18-37	55-21	426.9	C	1923	--	--	290	524.3	-3.7	E/C													
18-38	55-25	426.9	S	1923	--	--	685	524.0	-4.0	9/20	360	-5.38	I	1	0	75	25	0	10.4	8.8	1.72	1.72	1.60
18-39	55-27	426.6	S	1925	--	--	670	523.6	-4.4	E/C													
18-40	55-26	426.3	L	1925	--	--	1545	523.1	-4.9	E/C													
18-41	55-28*	426.0	S	1925	--	--	1240	522.2	-5.8	9/20	315	-5.82	S	3	50	49	1	0	13.6	14.4	.33	.80	.53
18-42	55-28	426.0	C	1925	--	--	620	522.2	-5.8	E/C													
18-43	55-29	425.7	S	1925	--	--	580	523.7	-4.3	9/25	450	-6.35	S	6	0	37	38	25	16.7	23.4	.54	1.23	.18
18-44	55-18	425.2	C	1889	1953	RS,RP	555	519.8	-8.2	9/25	480	-2.71	I	4	0	99	1	0	14.1	35.9	1.07	4.05	1.29
18-45	55-30	424.7	S	1925	--	--	800	523.3	-4.7	9/21	495	-6.30	I	7	48	50	2	0	12.0	15.8	.49	.52	.43
18-46	55-33	424.4	S	1928	--	--	615	527.9	-0.1	9/21	540	-4.66	S	2	0	75	25	0	14.2	13.4	.95	1.72	1.23
18-47	55-35*	424.1	S	1928	--	--	900	524.4	-3.6	9/21	435	-3.53	S	3	30	63	7	0	11.0	13.3	.93	1.53	1.05
18-48	55-35	424.1	C	1928	--	--	350	524.4	-3.6	9/25	135	--	S	5	21	70	9	0	4.0	3.3	.17	.91	.20
18-49	55-5	423.8	S	1899	1928	RP	1420	523.2	-4.8	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-50	55-4	423.7	C	1899	--	--	445	522.3	-5.7	E/C													
18-51	55-32	423.4	S	1928	--	--	1260	522.4	-5.6	E/C													
18-52	55-34	423.1	S	1928	--	--	1320	523.3	-4.7	E/C													
18-53	55-8	422.7	S	1903	1929	Ex 750	1490	527.8	-0.2	9/25	375	-1.55	S	3	17	82	1	0	9.6	11.9	.55	.79	.32
18-54	55-9	422.5	S	1903	1979	Ex 440	1475	528.7	+0.7	9/21	1650	-1.60	S	7	21	79	0	0	9.3	12.9	.43	.79	.16
18-55	56-3	421.9	C	1895	1963	RP	900	519.8	-8.2	9/25	840	--	S	6	14	60	1	25	11.1	37.2	.46	2.43	--
18-56	56-8	421.9	S	1905	1924	EX	910	523.3	-4.7	E/C													
18-57	56-9	421.8	S	1905	1924	EX	860	523.1	-4.9	E/C													
18-58	56-7	421.5	C	1903	1963	RP	400	522.3	-5.7	9/25	395	--	S	3	35	65	0	0	6.5	23.2	--	--	--
18-59	56-19	421.5	S	1926	--	--	450	521.4	-6.6	10/1	675	-7.63	S	7	1	99	0	0	15.8	15.6	1.13	1.28	.95
18-60	56-20	421.3	S	1926	--	--	450	519.1	-8.9	10/1	570	-8.49	S	2	20	77	3	0	17.8	17.5	.79	1.42	.75
18-61	56-21	421.1	S	1926	--	--	450	524.1	-3.9	9/25	390	-12.05	S	1	12	62	1	25	19.7	18.9	.93	1.40	1.01
18-62	56-22	420.9	S	1926	--	--	600	522.9	-5.1	9/25	540	-9.51	S	6	40	60	0	0	16.4	21.2	1.01	1.36	1.17
18-63	56-23	420.9	S	1926	--	--	600	522.2	-5.8	10/1	585	-7.83	S	3	5	93	2	0	14.9	21.6	1.04	1.53	1.05
18-64	56-24	420.4	L	1926	--	--	950	521.3	-6.7	10/1	960	-7.06	S	6	15	75	10	0	12.5	13.5	1.01	1.60	.94
18-65	56-2	420.3	L	1895	--	--	1400	523.7	-4.3	E/C													
18-66	56-10	419.5	L	1918	--	--	1717	520.1	-7.9	9/13	330	-9.78	I	4	16	59	0	25	21.3	25.4	.54	.83	.49
18-67	56-12	419.4	S	1918	--	--	600	520.0	-8.0	9/13	345	-8.62	S	7	30	67	3	0	17.9	21.4	.69	1.44	.65
18-68	56-13	419.2	S	1918	--	--	320	519.0	-9.0	E/C													
18-69	56-11	419.1	S	1918	--	--	100	521.2	-6.8	E/C													
18-70	56-18	418.9	S	1924	--	--	700	519.4	-8.6	9/13	195	-9.12	O	4	34	40	1	25	14.4	29.0	.65	1.15	.70
18-71	56-25	417.4	S	1927	--	--	425	521.5	-6.5	9/13	168	-6.82	I	3	50	50	0	0	17.0	20.6	.48	1.10	.22
18-72	56-4	417.2	S	1897	1927	RP	1180	519.9	-8.1	9/13	1185	-7.12	I	7	24	70	6	0	15.0	16.0	1.16	1.68	1.03
18-73	56-5	417.0	S	1897	1927	EX	1480	520.5	-7.5	E/C													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
18-74	56-6	416.7	S	1897	1927	EX	1960	521.4	-6.6	E/C													
18-75	57-3	416.3	S	1900	--	--	1140	521.0	-7.0	E/C													
18-76	57-11	415.9	L	1927	--	--	1425	520.1	-7.9	E/C													
18-77	57-2	415.8	S	1897	1931	RP	1400	521.0	-7.0	10/4	795	-7.14	S	7	24	75	1	0	17.2	21.1	.49	1.32	.72
18-78	57-1	415.8	S	1897	1927	EX 200	870	520.6	-7.4	E/C													
18-79	57-12	415.7	S	1927	--	--	550	517.7	-10.3	10/4	225	-5.36	S	7	27	71	2	0	10.2	9.5	1.07	1.19	.93
18-80	57-15	415.3	S	1927	--	--	700	520.0	-8.0	E/C													
18-81	57-14	415.0	S	1927	--	--	835	521.8	-6.2	E/C													
18-82	57-17	414.2	S	1927	--	--	980	518.5	-9.5	E/C													
18-83	57-18	414.0	S	1927	--	--	504	522.9	-5.1	E/C													
18-84	57-19	413.4	S	1927	--	--	425	522.2	-5.8	9/13	285	-7.32	S	2	64	35	1	0	12.7	16.8	.85	1.79	1.41
18-85	57-8	413.2	S	1915	1929	RP	820	518.8	-9.2	9/13	--	-9.28	S	4	40	35	25	0	14.5	25.3	.68	1.13	.73
18-86	57-9	413.0	S	1915	1938	RM 150	810	522.0	-6.0	E/C													
18-87	57-10	412.8	S	1915	1929	EX 225	720	515.5	-12.5	E/C													
19-1	57-4	410.4	C	1905	--	--	370	513.7	-4.5	E/C													
19-2	58-23	408.8	C	1948	--	--	1800	--	--	9/26	2100	EP	O	6	0	75	0	25	15.3	27.8	.23	--	.16
19-3	58-15	408.4	C	1897	--	--	486	--	--	E/C													
19-4	58-21	407.5	C	1905	--	--	450	--	--	9/26	435	-5.98	S	7	0	96	4	0	7.8	10.9	.28	.30	.28
19-5	58-1	407.0	C	1877	1897	RP	--	--	--	E/C													
19-6	58-4	406.9	C	1889	1900	RP	830	--	--	9/26	900	-7.44	O	6	17	82	1	0	17.9	17.8	.28	.22	.29
19-7	58-12	406.8	S	1891	1900	RP	945	--	--	9/26	975	-5.08	I	3	23	60	17	0	9.9	9.6	1.03	1.10	1.05
19-8	58-9	406.3	S	1891	1900	RP	810	--	--	9/26	465	-6.28	S	1	0	99	1	0	10.8	11.0	1.13	2.23	.86
19-9	58-16	405.5	S	1897	1935	RM	2080	--	--	RM													

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
19-10	58-3	405.2	C	1881	--	--	460	--	--	E/C													
19-11	58-19	404.9	S	1903	1908	RF	3020	513.0	-5.2	9/26	2400	-6.48	S	4	0	62	33	5	18.4	26.4	1.11	1.46	.82
19-12	58-20	404.6	S	1903	1935	RM	450	--	--	E/C													
19-13	59-15	397.3	S	1899	--	--	800	--	--	10/9	270	-8.91	0	7	6	87	7	0	15.8	17.3	1.38	1.68	1.17
19-14	59-5	396.1	S	1895	--	--	764	--	--	E/C													
19-15	59-6	395.5	S	1895	--	--	900	--	--	E/C													
19-16	59-7	395.3	S	1895	--	--	800	--	--	E/C													
19-17	59-8	395.1	S	1895	--	--	1225	--	--	E/C													
19-18	60-10*	394.3	S	1895	1903	EX	400	--	--	E/C													
19-19	60-10	394.3	C	1895	1903	RP	200	--	--	E/C													
19-20	60-10	394.3	C	1895	1903	RP	200	--	--	E/C													
19-21	60-4	392.5	C	1892	1898	RP	660	--	--	E/C													
19-22	60-9	392.4	C	1893	1898	RP	258	--	--	E/C													
19-23	60-6	392.1	S	1893	--	--	940	--	--	10/9	750	-12.05	S	3	34	66	0	0	18.6	17.0	.82	1.10	.80
19-24	60-5	391.7	S	1893	--	--	1050	--	--	E/C													
19-25	60-7	391.4	S	1893	1898	RP	1300	--	--	E/C													
19-26	60-1	391.5	C	1878	--	--	--	--	--	E/C													
19-27	60-2	391.4	C	1878	--	--	--	--	--	E/C													
19-28	60-3	391.5	C	1878	--	--	--	--	--	E/C													
19-29	60-11	389.4	L	1889	1898	EX 800	1200	--	--	10/10	--	-13.46	S	3	33	30	2	35	21.1	22.2	--	--	--
19-30	60-12	389.0	S	1889	1899	RS 4 EX 100	1610	--	--	10/10	1040	-13.96	S	3	15	79	1	5	19.1	17.9	.72	.97	.69
19-31	60-25	388.7	S	1899	--	--	970	--	--	E/C													
19-32	60-13	388.5	S	1889	1892	RS 4	2240	--	--	10/10	1995	-12.56	I	1	75	25	0	0	17.6	17.4	.72	.85	.79

IA WD N	COE N	RIVER MILE	DT	DATE CONS	REWORK YEAR	REWORK TYPE	DL	ELEV	DEPTH OP	SD	ML	ADJ DEPTH	LC	PF	SUBSTRATE % SL	SUBSTRATE % SD	SUBSTRATE % GR	SUBSTRATE % BD	MAX DEPTH U	MAX DEPTH D	CURRENT VELOCITY UP	CURRENT VELOCITY ON	CURRENT VELOCITY DOWN
19-33	60-14	388.1	S	1889	1895	EX 500	2740	--	--	E/C													
19-34	60-20	387.4	S	1895	--	--	800	--	--	E/C													
19-35	60-29*	387.3	C	1909	--	--	230	--	--	E/C													
19-36	60-29	387.3	C	1909	--	--	230	--	--	E/C													
19-37	60-17	387.2	S	1889	1895	EX 150	1550	--	--	E/C													
19-38	60-16	387.0	C	1889	1907	RP	565	--	--	E/C													
19-39	60-18	386.6	S	1889	--	--	700	--	--	E/C													

*Subdivided dams

Appendix Table B. Classification of 372 current modification structures into 12 groups.

Group Number																
1	2	3		4	5	6		7	8	9		10	11	12		
9- 5	10- 2	9-15	11-33	9- 8	10- 3	9- 3	11-80	14-23	14-29	14- 2	17-11	16- 5	14-12	14-15	16-43	18- 3
9- 6	10- 4	9-20	11-34	9- 9	10-19	9- 4	11-90	16- 7	14-31	14- 6	17-15	16- 6	16- 3	14-21	16-44	18- 4
9- 7	10-20	10-15	11-35	9-22	10-21	9-10	12- 6	16- 8	14-37	14- 7	17-19	16-11	16- 4	14-34	16-45	18- 5
9-16	11-12	10-16	11-41	10-17	10-47	9-11	12- 9	16- 9	14-38	14-10	17-20	16-22	16-16	14-35	16-49	18- 6
9-17	11-13	10-22	11-48	10-18	10-59	9-13	12-21	16-10	14-39	14-18	17-21	16-51	16-39	14-36	16-50	18-16
9-19	11-22	10-23	11-59	10-27	11- 1	9-21	12-22	16-19	14-40	14-19	17-22	16-52	16-40	14-43	16-61	18-17
10- 1	11-24	10-25	11-66	11-61	11- 2	10-13	12-26	16-23	16- 1	14-20	17-23	16-53	16-41	14-44	17- 2	18-18
10-10	11-36	10-31	11-69	11-63	11-14	10-28	12-31	17-14	16- 2	14-22	17-24	16-54	16-59	14-45	17- 3	18-20
10-26	11-52	10-36	11-74	11-81	11-45	10-35	12-32	17-26	16-17	14-24	17-33	17- 6	18- 8	15-13	17- 4	18-21
10-41	11-55	10-37	11-75	11-82	11-46	10-40	12-33	18-12	16-38	14-26	18-15	17- 7	18-70	16-12	17- 5	18-23
10-42	12- 7	10-48	11-91	12-15	11-51	10-60	12-37	18-19	19- 2	14-28	18-22	17-12	19- 6	16-14	17-10	18-25
10-43	13- 1	10-62	12- 1	12-41	11-54	10-63	12-38	18-36		14-32	18-24	17-13	19-13	16-21	17-16	18-41
10-45	13-22	11- 3	12- 4	13- 6	13-13	11-16	12-39	18-44		14-33	18-28	18- 9		16-28	17-17	18-43
10-46	13-23	11- 4	12- 5	13- 7	13-37	11-39	12-40			14-42	18-29	18-10		16-29	17-18	18-59
10-61	13-24	11- 5	12- 8	13- 8	13-38	11-40	12-43			14-47	18-30	18-11		16-31	17-28	18-60
11- 6	13-25	11-17	12-23	13- 9	13-49	11-47	12-44			14-48	18-33	18-38		16-32	17-29	18-61
11- 7	13-39	11-18	12-25	13-11	13-50	11-50	12-45			15- 1	18-34	18-45		16-33	17-31	18-62
11- 8	12-51	11-19	12-27	13-45	13-56	11-53	12-47			15- 2	18-35	18-66		16-34	17-32	18-63
11- 9		11-20	12-34	13-47	13-57	11-56	13- 2			16-18	18-46	18-71		16-35	18- 1	18-64
11-10		11-21	12-35	13-52	13-58	11-57	13- 3			16-24	18-47	18-72		16-37	18- 2	18-67
11-11		11-25	13- 4			11-58	13- 5			16-25	18-48	19- 7		16-42		18-77
11-49		11-32	13-17			11-60	13-12			16-26	18-53	19-32				18-79
11-64						11-65	13-14			16-27	18-54					18-84
12-16						11-67	13-16			16-58	18-55					18-85
13-46						11-68	13-19			17- 1	18-58					19- 4
13-53						11-70	13-20									19- 8
13-54						11-71	13-21									19-11
13-55						11-72	13-26									19-23
						11-73	13-27									19-29
						11-76	13-28									19-30
						11-77	13-29									
						11-78	13-34									
						11-79										

Appendix Table C Length frequency distribution by gear and geographical location for Redhorse species, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
161-180									1		1	0
181-200			1		1				1	2	3	2
201-220			1	1	3				2	2	6	3
221-240	1			1	2		1	1	1	6	5	8
241-260	4	3		2				1	5	2	9	8
261-280	3	1		1		1	1		4		8	3
281-300	1	5	5	2	1				6	1	13	8
301-320	8	5	16	5	3		3	1	4	5	34	16
321-340	5	3	29	10	1				6	2	41	15
341-360	14	2	29	14		1		1	9	2	52	20
361-380	22	4	46	14	3	2	2		12	1	85	21
381-400	32	14	46	20	7	2	8	2	21	11	114	49
401-420	27	17	57	9	13	7	15	5	33	8	145	46
421-440	25	12	51	25	5	2	13	7	19	13	113	59
441-460	12	11	27	14	9	2	10	1	20	9	78	37
461-480	3	4	8	4	9	5	7	1	7	1	34	15
481-500	5	1	6	1	3	2	3		4	3	21	7
501-520		2	4	2	2		1		1	1	8	5
521-540	2		1		1	2	2			1	6	4
541-560	1		2			1	2		2		7	1
561-580	2		2			1			1	1	5	2
581-600			2								2	0
601-620	1		2								3	0
621-640											0	0
641-660											0	0
Total	169	84	335	125	63	28	68	20	159	71	794	328

Appendix Table D Length frequency distribution by gear and geographical location for Freshwater Drum, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
101-120										1	0	1
121-140										1	0	1
141-160	2				1						3	0
161-180	2		1	2	5			1		1	8	4
181-200	15	7			1				2		18	7
201-220	44	16	1								45	16
221-240	49	15	7	4	2		1			1	59	20
241-260	31	17	8			1	1	1			40	19
261-280	18	38	4	2	1	1	1	1		1	24	43
281-300	12	52	2	2	1	1		1		5	15	61
301-320	18	40	3	1	1	1	3	2		5	25	49
321-340	8	21	5	1			6			1	19	23
341-360	10	17	1		3		4	1	1	2	19	20
361-380	10	12	2		2		10		1		25	12
381-400	4	8	1		1		6			1	12	9
401-420	3	6									3	6
421-440		2									0	2
441-460	1						1				2	0
461-480	1										1	0
481-500		1									0	1
501-520		1									0	1
521-540	1										1	0
541-560		1									0	1
561-580									1		1	0
581-600											0	0
601-620											0	0
621-640											0	0
641-660											0	0
661-680	1										1	0
681-700											0	0
701-720											0	0
721-740		1									0	1
Total	230	255	35	12	18	4	33	7	5	19	321	297

Appendix Table E Length frequency distribution by gear and geographical location for Carpsucker species, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
161-180					1						1	0
181-200											0	0
201-220		2									0	2
221-240											0	0
241-260		1									0	1
261-280		7		1							0	8
281-300		24	2							1	2	25
301-320	2	79	2	4		3				3	4	89
321-340	1	89	2	6		4				3	3	102
341-360	5	41	2	6		1					7	48
361-380	6	26	4	3	1			1	1	5	12	35
381-400	6	25	4			2	1	1	1		12	28
401-420	5	22	3	4	1	3			1		10	29
421-440	3	9	4	1	1	1				1	8	12
441-460	2	7	10								12	7
461-480			5						2		7	0
481-500	4	2	1								5	2
501-520			1								1	0
521-540											0	0
541-560	1										1	0
Total	35	334	40	25	4	14	1	2	5	13	85	388

Appendix Table F Length frequency distribution by gear and geographical location for Mooneye, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
121-140									2		2	0
141-160									2	1	2	1
161-180									2		2	0
181-200							2		1	2	3	2
201-220	4	1		1	1		14	1	1	4	20	7
221-240	8	4		1			8	2	1	1	17	8
241-260	3	18	1			1	1	1	1	5	6	25
261-280	6	62	3	5	2	4	2	3	4	17	17	91
281-300	7	23	5	5	3		8	4	3	10	26	42
301-320	6	6	4			2	3			2	13	10
321-340	2				1	1	3		1		7	1
341-360	1		1								2	0
361-380		1				2			1		1	3
381-400	1	1				2				1	1	4
401-420											0	0
421-440											0	0
441-460											0	0
461-480									1		1	0
Total	38	116	14	12	7	12	41	11	20	43	120	194

Appendix Table G Length frequency distribution by gear and geographical location for Shovelnose Sturgeon, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
221-240			1								1	0
241-260											0	0
261-280					1						1	0
281-300					2						2	0
301-320											0	0
321-340					1	3					1	3
341-360				1		1					0	2
361-380			2	1	5	1					7	2
381-400			1	3	2	2					3	5
401-420			2	3			1	2			3	5
421-440			6	2							6	2
441-460	2	1	4	1	5	2	2	1			13	5
461-480	2	1	8	3	6		2	1			18	5
481-500	2		7	6	1	4	1	1			11	11
501-520	1		7	1	8	1	1				17	2
521-540	1		16	7	4	4	3	1			24	12
541-560	1		9	3	4	3	1	1			15	7
561-580		1	13		10	1	3				26	2
581-600	1		8	3	2	2	1				12	5
601-620			5		1	2	3				9	2
621-640	1		2	1	1	1					4	2
641-660		1	8	3	5	2	1				14	6
661-680	2		2	1	6	2					10	3
681-700			3	1	3	2	1	2			7	5
701-720			3	1	4	2		1			7	4
721-740						1		1			0	2
741-760					2			1			2	1
761-780					2						2	0
781-800			1		1						2	0
801-820					1		1				2	0
821-840											0	0
841-860					1						1	0
Total	13	4	108	41	78	36	21	12	0	0	220	93

Appendix Table H. Length frequency distribution by gear and geographical location for Gizzard Shad, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
81-100									3	3	3	3
101-120									1		1	0
121-140										6	0	6
141-160			3		2	4		1		1	5	6
161-180			2		4	1	2	1			8	2
181-200				1		2		1	1	1	1	5
201-220					1				1	5	2	5
221-240		1		5					2	6	2	12
241-260	1	1	4	10		1		1	3	6	8	19
261-280			7	3			1	2	15	3	23	8
281-300			5	3	2	1		3	9	10	16	17
301-320	1		1	2	1	1	2	1	9		14	4
321-340			1	3			2	1	2	2	5	6
341-360		1				1		1			0	3
361-380								1	1	1	1	2
381-400					1		2				3	0
401-420					2						2	0
Total	2	3	23	27	13	11	9	13	47	44	94	98

Appendix Table I Length frequency distribution by gear and geographical location for Longnose Gar, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
541-560					1						1	0
561-580			1		2		1				4	0
581-600				1		1	7		1		8	2
601-620	2		2	1	3		4		2		13	1
621-640		1	6		1		8		1		16	1
641-660	2		3		2	1	10	1			17	2
661-680	1		10		3		8		1		23	0
681-700	1		7		4		8		1		21	0
701-720	1		6		8	1	6				21	1
721-740	2		3	1	3	1	5				13	2
741-760			5		4		5		1		15	0
761-780			4		2		5				11	0
781-800			2		3		3				8	0
801-820					2		3				5	0
821-840			3		4		1				8	0
841-860			1		3						4	0
861-880			3				2				5	0
881-900			1		1						2	0
901-920			4	1			1				5	1
921-940											0	0
941-960			2		1	1					3	1
961-980			1								1	0
981-1000	1		2		2		1				6	0
> 1000			11	1	10	2	3				24	3
Total	10	1	77	5	59	7	81	1	7	0	234	14

Appendix Table J Length frequency distribution by gear and geographical location for Carp, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
261-280	2										2	0
281-300	2		1		1		3				7	0
301-320	3		1				3			1	7	1
321-340	4				1		3		1		9	0
341-360	5	1	1	1							6	2
361-380	1						1				2	0
381-400	1					1	1		6	1	8	2
401-420									5	2	5	2
421-440							2		2	2	4	2
441-460	1	1			2		1		2	2	6	3
461-480	1	1		2	1			2	1		3	5
481-500		1		3			2		4		6	4
501-520				1					2	2	2	3
521-540	1				1		1		8		11	0
541-560									3		3	0
561-580									2	0	2	0
581-600									4		4	0
601-620	2	1	1								3	1
Total	23	5	4	7	6	1	17	2	40	10	90	25

Appendix Table K Length frequency distribution by gear and geographical location for Smallmouth Buffalo, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
181-200	1	2									1	2
201-220	2						1				3	0
221-240	2			1							2	1
241-260	1		1								2	0
261-280	3	2	1						1	1	5	3
281-300	3								1	1	4	1
301-320	9							2		1	9	3
321-340	2	2	1	1	2		1	1	2	1	8	5
341-360	3	1	1	1	1		2			1	7	3
361-380	1	3			2						3	3
381-400	1	5			1				2	5	4	10
401-420	1	5				1					1	6
421-440		2	1					1	4	4	5	7
441-460			1							1	1	1
461-480	1			2	1					2	2	4
481-500			1	1			2		1	1	4	2
501-520					1		1				2	0
521-540				1							0	1
541-560									2		2	0
561-580											0	0
581-600				1			1				1	1
601-620											0	0
621-640											0	0
641-660											0	0
661-680			1								1	0
Total	30	22	8	8	8	1	8	4	13	18	67	53

Appendix Table L Length frequency distribution by gear and geographical location for Channel Catfish, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
201-220					1						1	0
221-240	1		1		2	1					4	1
241-260		1		1	1						1	2
261-280	1	3				4					1	7
281-300	3	4		3						3	3	10
301-320		4		2		4		2		2	0	14
321-340		3	1	2	2	4		1		5	3	15
341-360	2	5	1	7		1		1		2	3	16
361-380	1	2		3			1	1		1	2	7
381-400	1		2	5	1						4	5
401-420				1			1				1	1
421-440		1	3	2			1				4	3
441-460				1							0	1
461-480				1		1					0	2
481-500							1			1	1	1
501-520											0	0
521-540							1				1	0
Total	9	23	8	28	7	15	5	5		14	29	85

Appendix Table M Length frequency distribution by gear and geographical location for Flathead Catfish, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
181-200	1										1	0
201-220	1										1	0
221-240	2										2	0
241-260	3	2									3	2
261-280	6	4	1								7	4
281-300	3	1	2								5	1
301-320	8	1	1				1				10	1
321-340	5	2		2			1				6	4
341-360	1	1		2							1	3
361-380	2	2		1		1		1			2	5
381-400	3	1									3	1
401-420	1										1	0
421-440							1				1	0
441-460											0	0
461-480											0	0
481-500											0	0
501-520		1				1					0	2
521-540		1									0	1
Total	36	16	4	5	0	2	3	1	0	0	43	24

<u>Appendix Table N</u> Length frequency distribution by gear and geographical location for Blue Sucker, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
221-240										1	0	1
241-260							1				1	0
261-280											0	0
281-300		1				1					0	2
301-320											0	0
321-340	1										1	0
341-360			1								1	0
361-380						1			1		1	1
381-400				1		1	2	2	1		3	4
401-420		1		3		2			2	1	2	7
421-440	1			1				3			1	4
441-460				1		2		1			0	4
461-480				1		1		1			0	3
481-500				2		2		1	1	1	1	6
501-520					1			2			1	2
521-540								1			0	1
541-560				2		1					0	3
561-580		1				1		2			0	4
581-600						1					0	1
601-620											0	0
621-640											0	0
641-660							1				1	0
661-680							1				1	0
681-700											0	0
701-720											0	0
721-740			1								1	0
Total	2	3	2	11	1	13	5	13	5	3	15	43

Appendix Table O Length frequency distribution by gear and geographical location for Shortnose Gar, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
421-440				1							0	1
441-460						1	1	1			1	2
461-480											0	0
481-500	3			1			1		1		5	1
501-520	1				2						3	0
521-540	4		2		1		2				9	0
541-560	1		1		2		2				6	0
561-580	2		3		3		1				9	0
581-600	1		5		1	1	1				8	1
601-620			1		1		2				4	0
621-640			5	1			1	1			6	2
641-660			1		1						2	0
661-680	1										1	0
681-700							1				1	0
701-720					1						1	0
Total	13	0	18	3	12	2	12	2	1	0	56	7

Appendix Table P Length frequency distribution by gear and geographical location for Walleye, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
241-260					1				1		2	0
261-280											0	0
281-300					1						1	0
301-320	5	1							1		6	1
321-340	4	1	2	1	1				2		9	2
341-360	7			2			1				8	2
361-380	3		1				2				6	0
381-400	5	1	1		1					1	7	2
401-420	2	2	3	1							5	3
421-440	1		2	1					2	1	5	2
441-460	3			1	1	2			1		5	3
461-480	5	3			1				1		7	3
481-500	1		1				1	2	1		4	2
501-520	1	1					1			1	2	2
521-540	1				1					3	2	3
541-560					2		2				4	0
561-580					2	1			1		3	1
581-600		1								1	0	2
601-620											0	0
621-640										1	0	1
Total	38	10	10	6	11	3	7	2	10	8	76	29

Appendix Table Q. Length frequency distribution by gear and geographical location for Black Crappie, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
121-140			1								1	0
141-160	7										7	0
161-180	13	2									13	2
181-200	50	1	5								55	1
201-220	53	3	3						1		57	3
221-240	52		4								56	0
241-260	26		1								27	0
261-280	3										3	0
281-300	1										1	0
Total	205	6	14						1		220	6

Length frequency distribution by gear and geographical location for Bluegill, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
121-140	6		1					1			7	1
141-160	9	1	2						2		13	1
161-180	8	2	6	1							14	3
181-200	11	1	1						1		13	1
201-220	2								1		3	0
Total	36	4	10	1				1	4		50	6

Appendix Table R Length frequency distribution by gear and geographical location for Sauger, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
181-200									1		1	0
201-220											0	0
221-240				1			1		1		2	1
241-260	1		1		4	1				2	6	3
261-280	1		2	3	8	6	6		1	2	18	11
281-300	2	3	4	5	6	9	2	1	1		15	18
301-320	2	4	2	2	7	2	2	3	1		14	11
321-340	4	2		1	5	2	2				11	5
341-360	2	1	8	1	4				1		15	2
361-380	1	4	7	4	3	1	3	2		1	14	12
381-400	8	1	5	5	5	1	1	1			19	8
401-420	4	1	3	2	2		1				10	3
421-440	1	1	1		4						6	1
441-460	3	1			1		1				5	1
461-480	1		1					1			2	1
481-500		1	1								1	1
501-520		1			1						1	1
Total	30	20	35	24	50	22	19	8	6	5	140	79

Appendix Table S Length frequency distribution by gear and geographical location for White Bass, collected from current modification structures, 1980 and 1981.

Length	Frame		Trammel		Multi Gill		Mono Gill		Shock		Total	
Frequency	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.	N.	S.
101-120										1		1
121-140									5		5	
141-160												
161-180					1			1	1		2	1
181-200	2		1								3	
201-220	4	1			1						5	1
221-240	10	1							2		12	1
241-260	11	5	2	1			1				14	6
261-280	13	1	3	2			1			1	17	4
281-300	33	8	1	1					1		35	9
301-320	46	3	1	1	1		3	1		1	51	6
321-340	26	1							1	1	27	2
341-360	4		2			1	1		1	1	8	2
361-380	1						2				3	
381-400	1										1	
401-420			1				1				2	
Total	151	20	11	5	3	1	9	2	11	5	185	33

Appendix Table T Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 10 of the Upper Mississippi River by sampling dates, 1980.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
10	27	5/8	17	NA	40.64	.43
		6/24	26	2.13	30.48	.55
		6/30	24	.91	33.02	.49
		8/5	26	1.52	60.96	.61
		10/23	9	1.83	35.56	1.13
		11/4	6	1.98	40.64	1.83
10	36	5/8	17	NA	40.64	.46
		6/24	26	.91	30.48	.73
		6/30	24	1.83	33.02	.46
		8/5	26	.76	60.96	.69
		10/23	9	2.22	35.56	1.80
		11/4	6	1.52	40.64	1.83
10	40	5/8	17	NA	40.64	.64
		6/24	26	2.13	30.48	.85
		6/30	24	2.13	33.02	.58
		8/5	26	1.83	60.96	.80
		10/23	9	1.83	35.56	1.22
		11/4	6	2.13	40.64	1.83
10	42	5/8	17	NA	40.64	.40
		6/24	26	.91	30.48	.69
		6/30	24	.91	33.02	.52
		8/5	26	1.22	60.96	.61
		10/23	9	.91	35.56	1.34
		11/4	6	1.07	40.64	1.58

Appendix Table U Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 11 of the Upper Mississippi River by sampling dates, 1980.

Pool No.	Structure No.	Date	Temp° C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
11	45	5/6	20	NA	40.64	.67
		6/23	24	2.13	27.94	.76
		6/30	26	2.13	30.48	.70
		8/4	27	1.98	48.26	.59
		10/21	10	2.13	35.56	.18
		11/3	6	2.13	38.10	.24
11	49	5/6	20	NA	40.64	.52
		6/23	24	1.98	27.94	.40
		6/30	26	1.83	30.48	.24
		8/4	27	1.37	48.26	.32
		10/21	10	1.83	35.56	.94
		11/3	6	2.13	38.10	1.14
11	50	5/6	20	NA	40.64	.64
		6/23	24	2.44	27.94	.67
		6/30	26	2.44	30.48	.73
		8/4	27	2.13	48.26	.55
		10/21	10	2.44	35.56	1.31
		11/3	6	2.44	38.10	1.83
11	52	5/6	20	NA	40.64	.30
		6/23	24	2.44	27.94	.40
		6/30	26	2.13	30.48	.20
		8/4	27	2.29	48.26	.43
		10/21	10	2.59	35.56	.91
		11/3	6	3.02	38.10	1.46

Appendix Table V Depth, temperature, velocity and Secchi disk depths on selected current modification structures in Pool 13 of the Upper Mississippi River by sampling dates, 1980.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
13	4	5/5	17	NA	35.56	.52
		6/26	26	.91	30.48	.49
		7/1	26	.61	30.48	.55
		7/30	26	.30	48.26	.42
		10/20	11	.76	35.56	2.74
		11/3	7	1.52	38.10	
13	11	5/5	17	NA	35.56	.61
		6/26	26	1.22	30.48	.46
		7/1	26	1.07	30.48	.49
		7/30	26	.76	48.26	.24
		10/20	11	1.22	35.56	1.77
		11/3	7	1.83	38.10	1.59
13	14	5/5	17	NA	35.56	.73
		6/26	26	1.22	30.48	.66
		7/1	26	1.07	30.48	.55
		7/30	26	.91	48.26	.34
		10/20	11	1.52	35.56	1.38
		11/3	7	1.68	38.10	1.99
13	22	5/5	17	NA	35.56	1.16
		6/26	26	.91	30.48	1.16
		7/1	26	.61	30.48	.91
		7/30	26	.31	48.26	.68
		10/20	11	.91	35.56	1.68
		11/3	7	1.22	38.10	2.84

Appendix Table W   Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 16 of the Upper Mississippi River by sampling dates, 1980.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
16	1	5/12	19	1.22	45.72	.32
		6/23	24	2.13	20.32	NA
		7/7	27	1.37	25.40	.76
		10/27	8	1.52	30.48	2.26
		11/5	7	1.52	33.02	2.38
16	2	5/12	19	.31	45.72	.91
		6/23	24	1.22	20.32	NA
		7/7	27	.61	25.40	1.22
		10/27	8	1.07	30.48	3.05
		11/5	7	1.22	33.02	2.74
16	4	5/12	19	1.52	45.72	.43
		6/23	24	2.13	20.32	NA
		7/7	27	1.83	25.40	.76
		10/27	8	2.14	30.48	2.59
		11/5	7	2.59	33.02	2.50
16	7	5/12	19	1.52	45.72	.38
		6/23	24	1.37	20.32	NA
		7/7	27	.91	25.40	.82
		10/27	8	1.37	30.48	1.52
		11/5	7	1.37	33.02	2.23

Appendix Table X   Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 16 of the Upper Mississippi River by Sampling dates, 1980.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
16	41	5/13	18	2.44	45.72	.30
		6/24	24	1.98	22.86	NA
		7/8	29	2.44	27.94	.55
		10/28	7	2.59	30.48	2.01
		11/5	7	2.44	33.02	2.01
16	45	5/13	18	2.44	45.72	.32
		6/24	24	2.13	22.86	NA
		7/8	29	2.13	27.94	.46
		10/28	7	2.13	30.48	1.65
		11/5	7	2.74	33.02	1.46
16	51	5/13	18	2.74	45.72	.37
		6/24	24	2.44	22.86	NA
		7/8	29	2.44	27.94	.27
		10/28	7	2.13	30.48	1.22
		11/5	7	2.74	33.02	1.31
16	53	5/13	18	3.02	45.72	.30
		6/24	24	2.74	22.86	NA
		7/8	29	3.02	27.94	.37
		10/28	7	3.02	30.48	1.37
		11/5	7	3.02	33.02	1.52

Appendix Table Y   Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 18 of the Upper Mississippi River by sampling dates, 1980.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
18	4	5/15	18	1.52	46.99	.55
		6/25	24	1.98	12.70	NA
		7/10	29	.91	31.75	NA
		10/30	7	1.98	30.48	.55
		11/5	7	1.83	30.48	1.34
18	15	5/15	18	.91	34.29	.73
		6/25	24	.91	12.70	NA
		7/10	29	.00	31.75	NA
		10/30	7	1.83	35.56	1.00
		11/5	7	.91	30.48	2.26
18	16	5/15	18	.91	34.29	1.07
		6/25	24	1.52	12.70	NA
		7/10	29	.61	31.75	NA
		10/30	7	1.52	35.56	1.19
		11/5	7	1.52	30.48	2.23
18	36	5/15	18	1.83	34.29	.58
		6/25	24	1.98	12.70	NA
		7/10	29	1.52	31.75	NA
		10/30	7	2.13	35.56	.98
		11/5	7	2.13	30.48	2.16

Appendix Table Z Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 10 of the Upper Mississippi River by sampling dates, 1981.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
10	27	5/7	14	2.13	35.56	NA
		5/26	18	1.83	40.64	1.10
		8/11	24	1.68	64.77	1.95
		8/18	22	2.13	58.42	2.07
		9/15	21	1.52	58.42	.55
		10/21	NA	1.83	NA	1.86
10	36	5/7	14	1.22	35.56	NA
		5/26	18	.91	40.64	1.52
		8/11	24	1.07	64.77	2.50
		8/18	22	.91	58.42	2.38
		9/15	21	.76	58.42	.73
		10/21	NA	1.22	NA	1.10
10	40	5/7	14	2.13	35.56	NA
		5/26	18	1.98	40.64	1.59
		8/11	24	2.44	64.77	2.50
		8/18	22	2.13	58.42	2.50
		9/15	21	1.83	58.42	.91
		10/21	NA	1.83	NA	1.52
10	42	5/7	14	1.37	35.56	NA
		5/26	18	.91	40.64	1.22
		8/11	24	1.07	64.77	1.65
		8/18	22	1.07	58.42	2.07
		9/15	21	1.52	58.42	.73
		10/21	NA	.91	NA	1.77

Appendix Table AA Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 11 of the Upper Mississippi River by sampling dates, 1981.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
11	45	5/7	14	2.74	43.18	NA
		5/28	21	1.98	43.18	1.46
		8/12	24	2.13	52.07	2.62
		8/18	23	2.13	40.64	1.77
		9/17	19	1.83	40.64	.79
		9/22	18	1.83	45.72	1.07
11	49	5/7	14	2.44	43.18	NA
		5/28	21	1.68	43.18	.73
		8/12	24	1.83	52.07	1.28
		8/18	23	1.83	40.64	1.77
		9/17	19	1.52	40.64	.55
		9/22	18	1.83	45.72	.43
11	50	5/7	14	3.05	43.18	NA
		5/28	21	2.29	43.18	1.13
		8/12	24	2.44	52.07	2.26
		8/18	23	2.74	40.64	1.95
		9/17	19	1.83	40.64	.61
		9/22	18	2.13	45.72	.95
11	52	5/7	14	3.20	43.18	NA
		5/28	21	1.68	43.18	.67
		8/12	24	2.44	52.07	1.77
		8/18	23	1.83	40.64	1.22
		9/17	19	3.05	40.64	.37
		9/22	18	3.35	45.72	.67

Appendix Table BB Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 13 of the Upper Mississippi River by sampling dates, 1981.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
13	4	5/6	13	1.83	33.02	1.52
		5/21	17	1.07	40.64	1.52
		7/30	22	1.07	35.56	1.52
		8/19	23	1.22	30.48	1.22
		9/14	22	.85	40.64	1.07
		9/22	18	1.22	45.72	.61
13	11	5/6	13	2.13	33.02	1.59
		5/21	17	1.37	40.64	1.10
		7/30	22	1.52	35.56	1.37
		8/19	23	1.52	30.48	.98
		9/14	22	1.16	40.64	1.52
		9/22	18	.91	45.72	1.07
13	14	5/6	13	2.13	33.02	1.95
		5/21	17	1.37	40.64	1.52
		7/30	22	1.37	35.56	1.65
		8/19	23	2.13	30.48	1.34
		9/14	22	1.52	40.64	1.52
		9/22	18	.91	45.72	1.07
13	22	5/6	13	1.68	33.02	2.71
		5/21	17	.91	40.64	3.66
		7/30	22	1.22	35.56	2.50
		8/19	23	.91	30.48	2.10
		9/14	22	2.13	40.64	.91
		9/22	18	1.71	45.72	.61

Appendix Table CC Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 16 of the Upper Mississippi River by sampling dates, 1981.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk(cm)	Velocity (m/sec)
16	1	4/30	14	1.68	26.67	2.13
		6/1	23	1.22	43.18	1.71
		9/28	17	1.52	33.02	1.25
		10/12	13	1.37	22.86	1.46
16	2	4/30	14	1.22	26.67	1.95
		6/1	23	.46	43.18	2.50
		9/28	17	.91	33.02	1.77
		10/12	13	.91	22.86	1.74
16	4	4/30	14	2.74	26.67	2.59
		6/1	23	1.52	43.18	1.62
		9/28	17	1.83	33.02	1.46
		10/12	13	2.13	22.86	1.62
16	7	4/30	14	1.52	26.67	1.74
		6/1	23	.91	43.18	1.68
		9/28	17	1.22	33.02	1.07
		10/12	13	1.37	22.86	1.55

Appendix Table DD   Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 16 of the Upper Mississippi River by sampling dates, 1981.

Pool No.	Structure No.	Date	Temp° C	Depth(m)	Secchi Disk	Velocity (m/sec)
16	41	4/30	14	2.74	26.67	2.38
		6/2	23	2.44	53.34	1.52
		9/29	17	2.59	30.48	.91
		10/12	13	2.29	22.86	1.16
16	45	4/30	14	2.44	26.67	1.89
		6/2	23	2.29	53.34	1.46
		9/29	17	2.44	30.48	.88
		10/12	13	2.13	22.86	1.22
16	51	4/30	14	2.74	26.67	1.37
		6/2	23	2.59	53.34	1.46
		9/29	17	2.44	30.48	.98
		10/12	13	2.59	22.86	1.13
16	53	4/30	14	NA	26.67	NA
		6/2	23	3.05	53.34	1.10
		9/29	17	3.05	30.48	.91
		10/12	13	3.05	22.86	.91

Appendix Table EE Depth, temperature, velocity and Secchi disk depths on selected current modification structures on Pool 18 of the Upper Mississippi River by sampling dates, 1981.

Pool No.	Structure No.	Date	Temp °C	Depth(m)	Secchi Disk	Velocity (m/sec)
18	4	5/1	14	2.44	27.94	1.52
		6/4	23	1.52	45.72	NA
		10/1	16	1.68	22.86	.98
		10/13	14	1.83	22.86	1.77
18	15	5/1	14	1.52	27.94	2.13
		6/4	23	.76	45.72	NA
		10/1	16	1.07	22.86	1.77
		10/13	14	.91	22.86	2.44
18	16	5/1	14	1.83	27.94	2.65
		6/4	23	1.22	45.72	NA
		10/1	16	1.52	22.86	1.10
		10/13	14	1.22	22.86	2.68
18	36	5/1	14	2.29	27.94	2.26
		6/4	23	1.83	45.72	3.66
		10/1	16	1.83	22.86	2.74
		10/13	14	1.83	22.86	2.74