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TENNESSEE VALLEY AUTHORITY

Water Resources
Environmental Compliance

SEQUOYAH NUCLEAR PLANT
THERMAL VARIANCE MONITORING PROGRAM

EFFECTS OF THERMAL EFFLUENT FROM SEQUOYAH NUCLEAR PLANT ON FISH POPULATIONS IN CHICKAMAUGA RESERVOIR.

Prepared by

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INTRODUCTION

Thermal discharge of condenser cooling water from the Tennessee Valley Authority's (TVA) Sequoyah Nuclear Plant (SQN) is subject to compliance with the Tennessee Water Quality Act (TWQA) and the Clean Water Act (CWA). Of particular interest to SQN operation is Section 1200-4-.03 of TWQA that states (1) heated water discharges shall not cause the receiving water to exceed 3°C rise relative to an upstream control point nor exceed 30.5°C; and (2) maximum temperature change shall not exceed 2°C per hour. Although an uncommon event, the potential exists for SQN to exceed the 3°C limit during extremely cold weather in November through March. To remain in compliance during these events, SQN must reduce load or operate cooling towers not designed to be used in these conditions which usually results in severe damage to the towers from icing.

Alternative thermal limits are permitted under 316(a) of the CWA provided the owner demonstrates to the regulatory agency that the thermal effluent is within limits to ensure the protection and propagation of a balanced indigenous population of fish and wildlife. In 1992, TVA submitted a request to the Tennessee Division of Water Pollution Control (TDWPC) to modify the temperature change limit in the SQN NPDES permit from 3°C to 5°C from November through March. Support for the alternative thermal limit was presented in a predictive Section 316(a) demonstration (TVA 1989). The new limits were approved by TDWPC and included in the revised NPDES permit TN00226450 for SQN issued in 1993. Part III-C of the new permit requires TVA to conduct field investigations from November 1993 through March 1994 and November 1994 through March 1995 to assess the effects of the 5°C limit on fish populations in Chickamauga Reservoir. The objectives of the field

investigations were to determine if the increased thermal limit at SQN would attract sauger and other predatory fish (e. g., catfish, crappie, white bass) to the thermal plume in November through March and thereby either interfere with normal spawning migration patterns/schedules and/or subject them to increased fishing pressure and harvest.

This report presents (1) plant operational data (load, diffuser flow, and discharge water temperature) from November through March 1993-94 and 1994-95; (2) data on river conditions (water temperature and flow); and (3) fishing pressure and abundance and movement of fish in the vicinity of the SQN diffuser during the same time period. Other recent assessments of the fish community in Chickamauga Reservoir were reported in the TVA reservoir monitoring summary on fish communities (TVA 1993, 1994a, and 1994d) and reports on population dynamics of white bass (TVA 1994b), white crappie (TVA 1990 and McDonough and Buchanan 1991), catfish (TVA 1995), and sauger (Buchanan 1995).

METHODS

Three components were used in evaluating the fishery in the vicinity of the SQN diffuser (Tennessee River Mile 483.6); gillnetting, creel census, and fisherman pressure counts. Field investigations began in November 1993 and continued through March 1994 and were repeated for the same time period in 1994-95. Unless specified otherwise, procedures used in the collection and analysis of samples followed guidelines established in TVA's Field Operations Manual (TVA 1983).

Gillnetting. During November through March 1993-94 and 1994-95, four experimental gillnets were fished two nights per month at two channel locations; (1) Downstream Station (TRM 483.4)-- in the thermal plume near the diffuser and (2) Upstream station (TRM 483.8)--upstream from

the diffuser beyond effects of thermal plume (Figure 1). Data were analyzed to evaluate the attraction of fish to the thermal plume and determine if the heated discharge impeded movement of fish upstream.

Creel Survey. The creel survey was conducted by a roving TVA creel clerk near the SQN diffuser in the approximate area of the mixing zone three days per week (two weekdays and one weekend day). Each weekday survey was for three hours between sunrise and noon or noon and sunset. Weekend surveys consisted of two three-hour periods with an hour break in between. Each survey included (1) instantaneous fishermen pressure counts at the beginning and end of each sampling period and (2) interviews with anglers (recording information on number of each species caught, hours fished, and number of individuals fishing). A computer software program randomly selected sampling dates and times.

Fisherman Pressure Counts. SQN Site Security staff recorded numbers of boats and fishermen in the immediate vicinity of the diffuser four times daily (8:00 AM, 10:00 AM, 1:00 PM, and 4:00 PM) from November 1993 through March 1995.

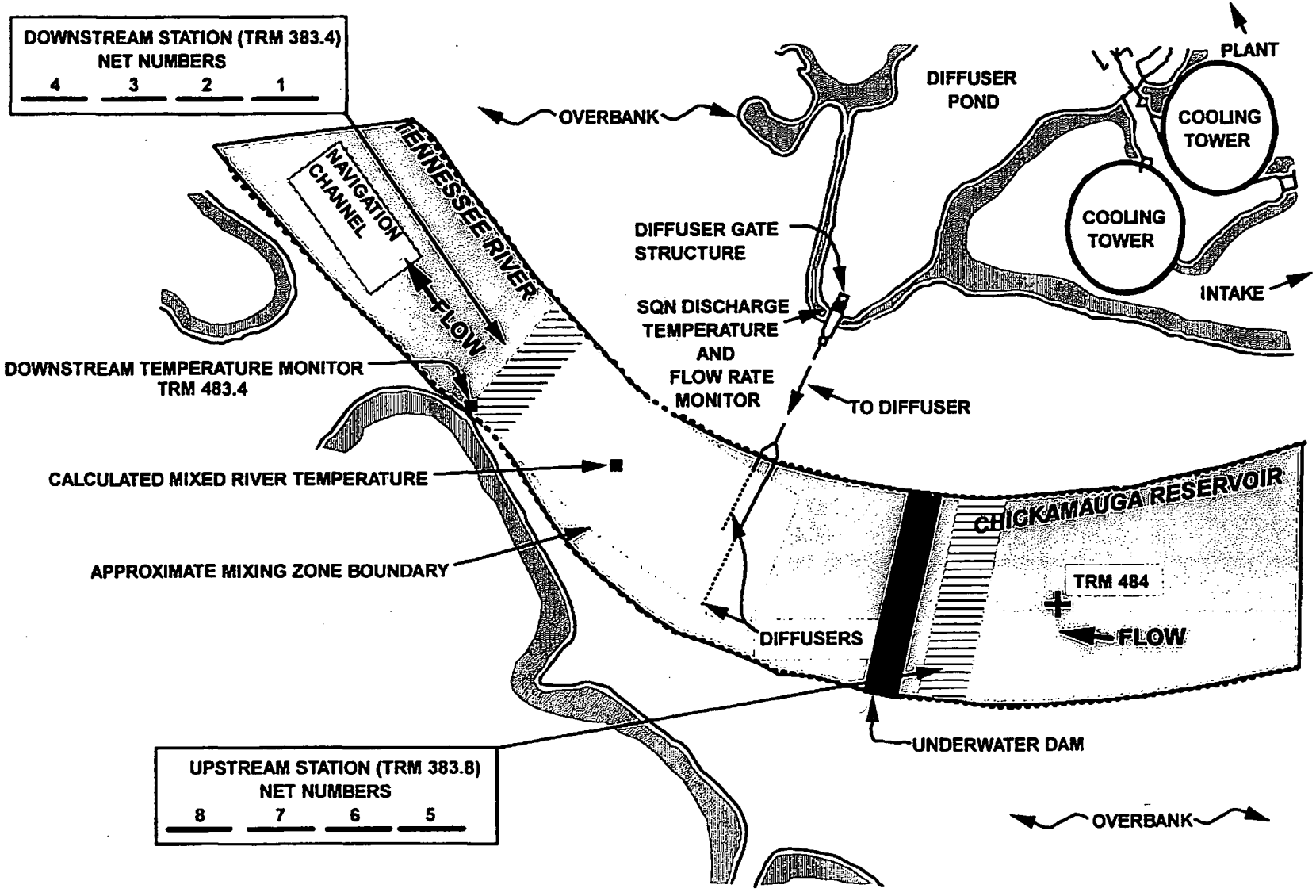

Figure 1. Gillnet stations relative to Sequoyah Nuclear Plant thermal discharge features.

RESULTS AND DISCUSSION

The potential for the SQN discharge temperature to exceed 3°C is a consequence of 1) the plant operating at near maximum load thus increasing discharge temperature and flow; 2) cold weather resulting in low ambient river temperatures; and 3) low river flow past SQN. In a predictive 316(a) demonstration (TVA 1989), thirteen years (1976-1989) of winter river temperature and flow data in the vicinity of SQN were analyzed in a worst-case scenario for potential SQN discharge temperature rise: SQN operating at maximum net load (2,560 MW of electric power with an associated waste heat output of 16.4×10^9 Btu/hr) and with four condenser cooling water (CCW) pumps in operation producing a discharge flowrate of approximately 2,000 cfs. River flowrates primarily depend on dam releases at Watts Bar and Chickamauga hydroelectric plants. Data for hourly dam releases for the 13 winter periods were used to run a finite-difference, unsteady flow model to evaluate the instantaneous river flows at SQN. Based on this simulated computer model, SQN would have exceeded the 3°C temperature rise limit 27 percent of the time (on an hourly basis) and a 4°C limit 4 percent of the time during November through March between 1976 and 1989. However, based on 1993-94 and 1994-95 SQN operational data during the field investigations, a water temperature rise of more than 3°C occurred only once (January 1, 1995).

SQN Operation During Field Investigations

Unit 1 (SEQ1) was not operational during November 1993 through March 1994; Unit 2 (SEQ2) produced an average of 847 MW/hr during this period (Figure 2). Operation was sporadic early in that period, but from mid-December 1993 through March 1994, SEQ2 operated almost continuously, averaging 997 MW/hr. In the winter of 1994-95, SEQ1 and SEQ2 were both on line during the field investigations producing an average of 1,014 and 966 MW/hr, respectively. River flow past SQN was similar during the 1993-94 and 1994-95 field investigations; however, diffuser flow was lower in 1993-94 due to SEQ1 outage (Figure 3). River flows averaged 33,786 cfs (daily average 8,636 to 45,476 cfs) in 1993-94 and 35,178 cfs (range 10,124 to 45,069 cfs) in 1994-95. Daily average diffuser flows ranged from 184 to 2,220 cfs (mean 1,305 cfs) during the 1993-94 and 2,081 to 2,480 cfs (mean 2,325 cfs) in 1994-95.

In accordance with the NPDES permit, the calculated downstream mixed river temperature (computed as a function of river flow at SQN, plant discharge temperature and flowrate, and ambient reservoir thermal structure) is used along with the average measured ambient temperature at 5-foot depth at the intake skimmer wall to determine compliance with the temperature rise (ΔT) limit at SQN. Daily average upstream and downstream water temperatures during the field investigations are presented in Figure 4 and daily average ΔT in Figure 5. Upstream water temperatures were cooler during the 1993-94 sampling period (average 8.9°C, range 2.9 to 15.5°C) than during the 1994-95 period (average 10.5°C, range 4.3 to 18.1°C). The daily average ΔT ranged from 0 to 2.3°C during the 1993-94 field investigations and 0.4 to 3°C in 1994-95. Daily average ΔT exceeded 3°C only one day (January 1, 1995) during the 1993-94 and 1994-95 field investigations. On this date, both units were in operation, water temperature averaged 9.5°C, and river flow past SQN was estimated to be only 10,124 cfs.

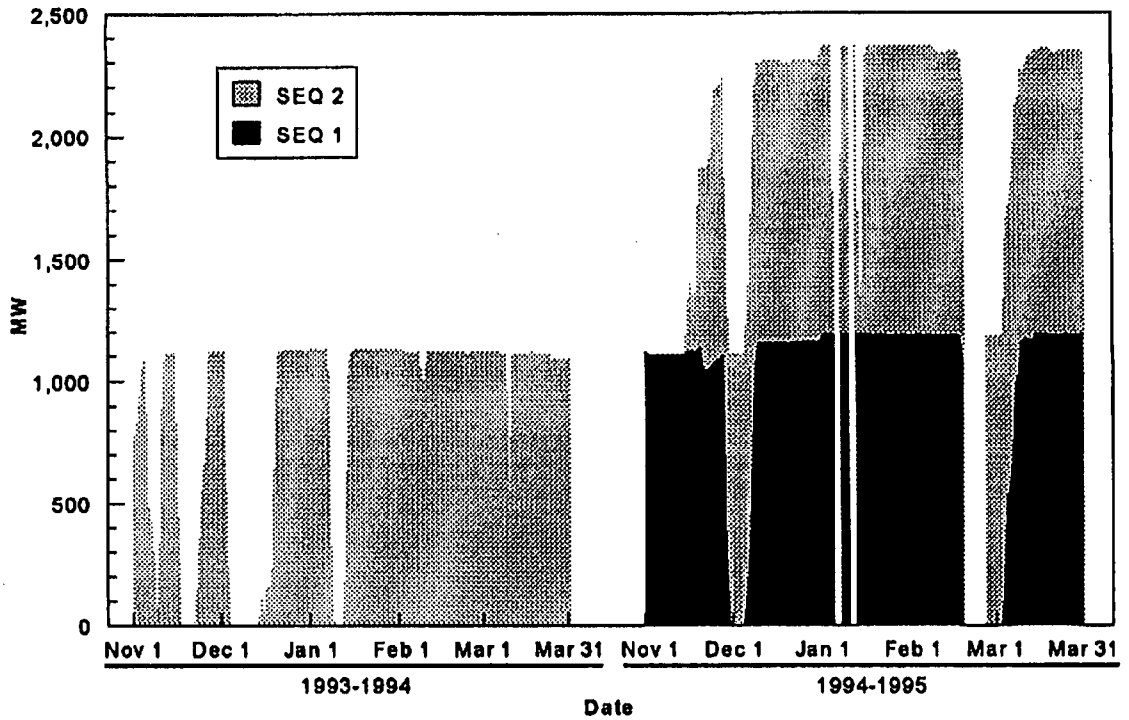

Figure 2. Sequoyah Nuclear Plant load during November through March 1993-94 and 1994-95.

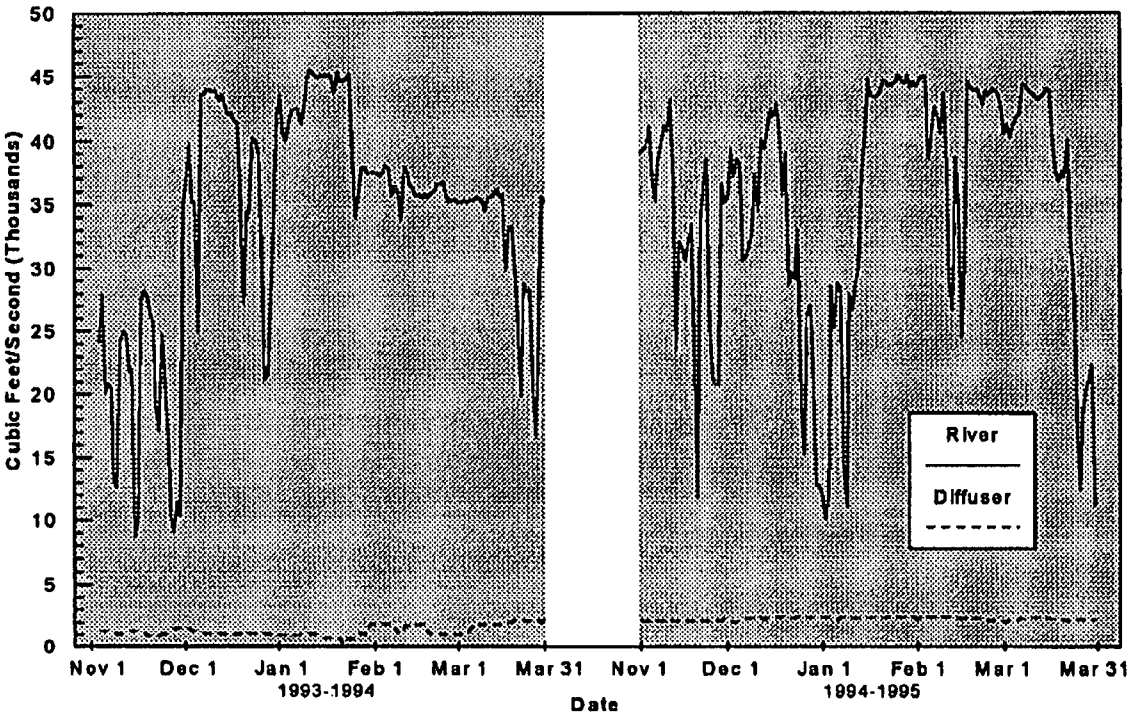

Figure 3. Daily average Sequoyah Nuclear Plant diffuser flow and river flow past the plant during November through March 1993-94 and 1994-95.

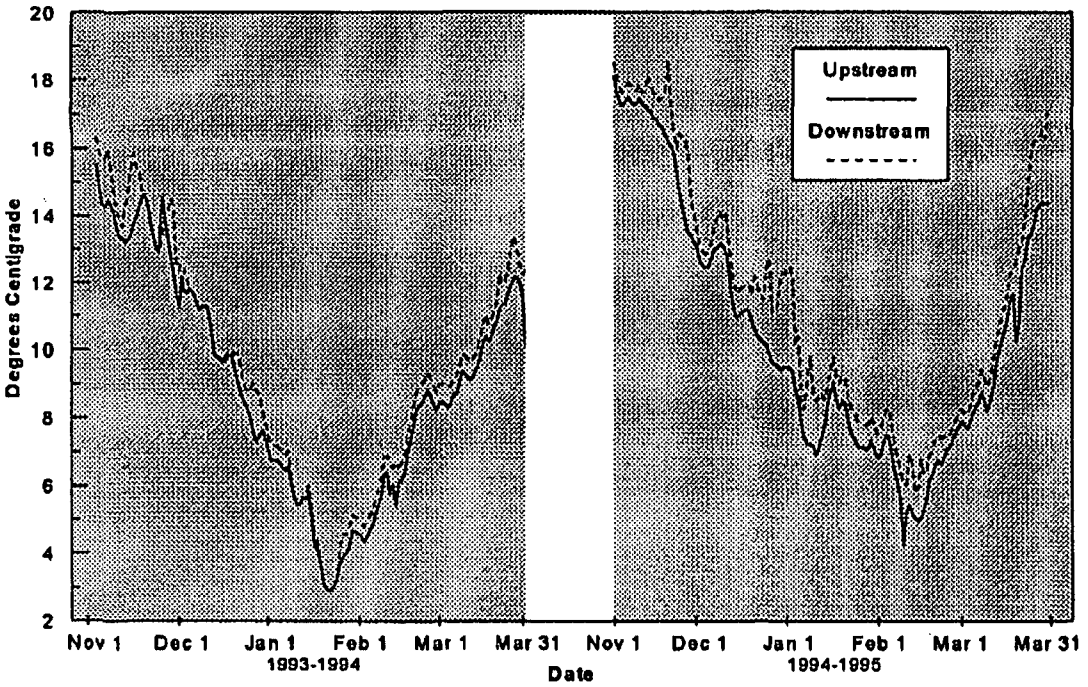

Figure 4. Daily average water temperatures upstream and downstream of the Sequoyah Nuclear Plant diffusers during November 1993 through March 1994 and November 1994 through March 1995.

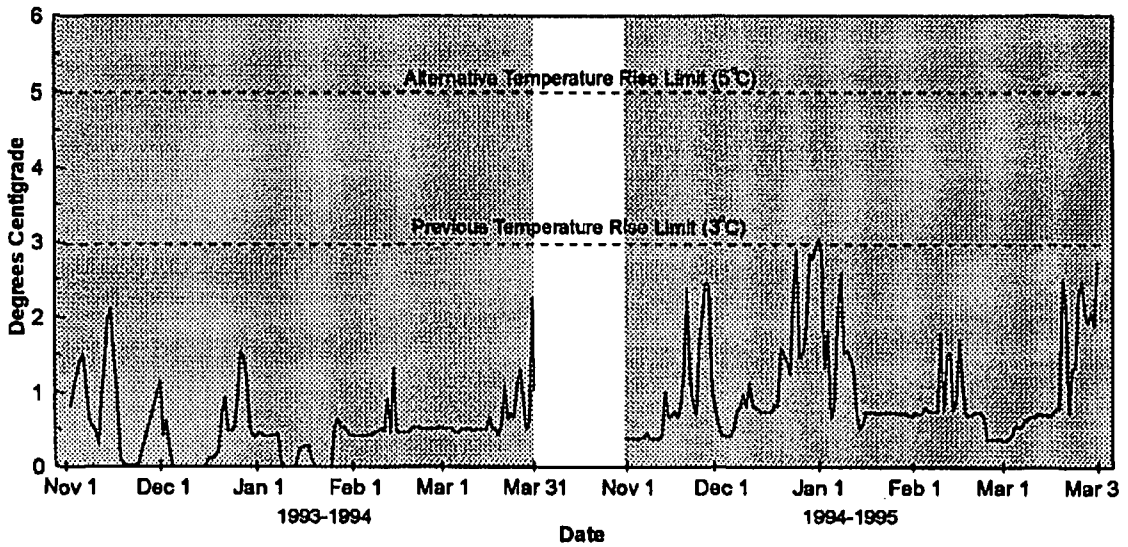

Figure 5. Daily average temperature rise (ΔT) resulting from Sequoyah Nuclear Plant heated water discharges during November 1993 through March 1994 and November 1994 through March 1995.

Fishery Investigations

Gillnets. Fifteen species representing 8 families were collected in the winters (November through March) of 1993-94 and 1994-95 at gillnet stations located near the SQN diffuser (Table 1). Diversity was similar at the station located upstream from the diffuser (13 species) and the downstream station (14 species). Three species occurred at only one station; striped and white bass at the downstream station and spotted sucker at the upstream station (Table 2).

A total of 335 fish were collected during the two-year field investigation; 161 fish at the downstream station and 174 at the upstream station. Numerically, blue catfish was the dominant species followed by sauger, skipjack herring, and channel catfish, respectively. These species were collected in similar numbers at both stations (Figure 6).

Table 1. Common and scientific names of fish collected in gillnets near the Sequoyah Nuclear Plant Diffuser from November through March in 1993-94 and 1994-95.

	Common Name	Scientific Name
Game		
	Striped bass	*Morone saxatilis*
	White bass	*Morone chrysops*
	Yellow bass	*Morone mississippiensis*
	Bluegill	*Lepomis macrochirus*
	Redear sunfish	*Lepomis microlophus*
	Spotted bass	*Micropterus punctulatus*
	Sauger	*Stizostedion canadense*
Rough		
	Skipjack herring	*Alosa chrysochloris*
	Common carp	*Cyprinus carpio*
	Spotted sucker	*Minytrema melanops*
	Blue catfish	*Ictalurus furcatus*
	Channel catfish	*Ictalurus punctatus*
	Flathead catfish	*Pylodictis olivaris*
	Freshwater drum	*Aplodinotus grunniens*
Forage		
	Gizzard shad	*Dorosoma cepedianum*

Table 2. Total number of fish collected in gillnets near the Sequoyah Nuclear Plant Diffuser from November through March in 1993-94 and 1994-95.

Category	Common Name	Sample Location Relative to SQN Diffuser: Downstream	Upstream
Game			
	Striped bass	2	-
	White bass	7	-
	Yellow bass	7	10
	Bluegill	2	7
	Redear sunfish	3	8
	Spotted bass	4	5
	Sauger	29	21
	Subtotal	**54**	**51**
Rough			
	Skipjack herring	12	17
	Common carp	4	1
	Spotted sucker	-	2
	Blue catfish	64	77
	Channel catfish	12	9
	Flathead catfish	3	4
	Freshwater drum	8	9
	Subtotal	**103**	**119**
Forage			
	Gizzard shad	4	4
	Subtotal	**4**	**4**
	Grand Total	**161**	**174**

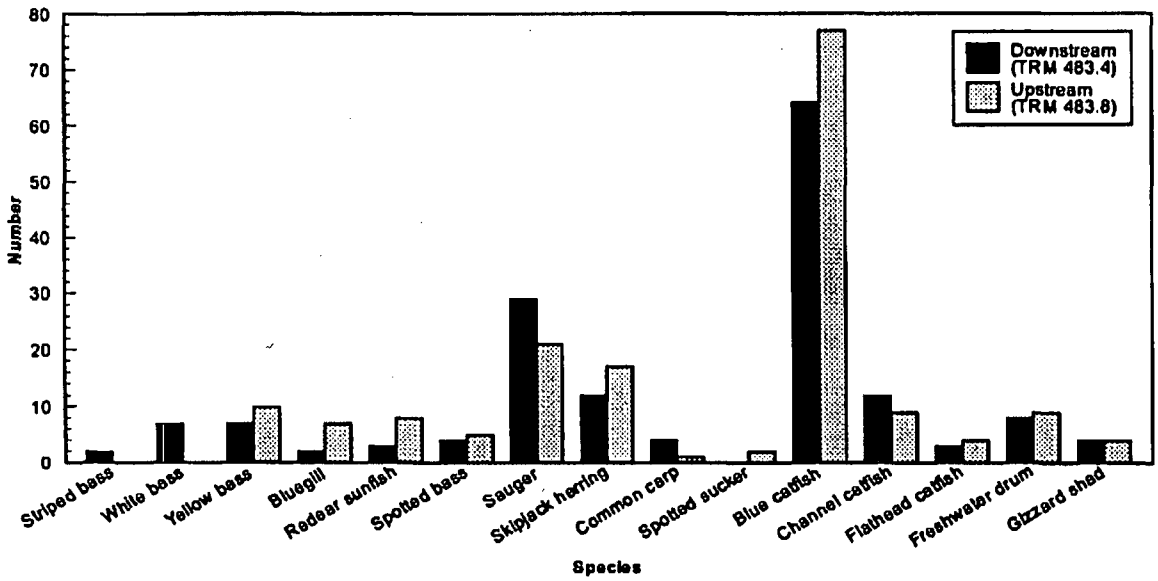

Figure 6. Total number of each species of fish collected in gillnets at the downstream (TRM 483.4) and upstream (TRM 483.8) stations from November through March, 1993-94 and 1994-95.

Creel Census and Fishermen Pressure Counts. A total of 89 three-hour and 40 six-hour creel surveys were conducted near the SQN diffuser in the winters of 1993-94 and 1994-95. From November 1993 to March 1994, 258 man-hours (44 three-hour and 21 six-hour time blocks) were spent conducting surveys and 249 man-hours (45 three-hour and 19 six-hour time blocks) in 1994-95.

Thirty-six boats were observed during the pressure counts including 13 boats with 22 anglers in 1993-94 and 23 boats with 35 anglers in 1994-95. In 1993-94, 14 interviews were conducted with 27 boat fishermen and 23 interviews with 38 anglers in 1994-95 (Table 3). Catfish (3 species) were the target taxa for most fishermen; other responses were bass, sauger, crappie, and any species. During both years combined, anglers caught 67 fish in approximately 65 hours at a catch rate of 1 fish/hr. Species caught were blue catfish (46), channel catfish (14), crappie (3), largemouth bass (2), and sauger (2).

SQN Site Security staff conducted fishermen pressure counts four times daily, seven days a week, from November 1993 through March 1995. Fishing pressure was low; often no anglers were observed in the diffuser area during several pressure counts resulting in weekly averages of less than one angler per count. Peak fishing pressure occurred in the summer and fall, June through October, and minimum levels occurred November through January (Figure 7).

Table 3. Summary of angler interviews conducted near Sequoyah Nuclear Plant diffuser, November 1993 through March 1994 and November 1994 through March 1995.

Date	Number of Anglers	Hours Fished	Angler Hours	Target Species	Species Caught: Blue catfish	Channel catfish	Largemouth bass	Crappie	Sauger
11/03/93	2	6.0	12.0	catfish	24	1			
11/18/93	1	3.0	3.0	catfish		1			
11/26/93	2	1.0	2.0	catfish	3				
02/06/94	2	4.3	8.6	catfish	2	1			
02/06/94	1	1.1	1.1	catfish/crappie	1				
02/06/94	1	2.0	2.0	catfish/crappie	2				
02/19/94	3	0.5	1.5	any species					
02/19/94	2	0.5	1.0	crappie					
02/25/94	1	1.0	1.0	catfish/sauger					1
03/05/95	3	4.0	12.0	bass					
03/05/94	2	4.5	9.0	any species					
03/11/94	3	5.0	15.0	catfish/sauger					
03/13/94	2	2.5	5.0	crappie				1	
03/19/94	2	3.0	6.0	crappie				2	
11/03/94	2	2.0	4.0	bass			1		
11/08/94	2	0.3	0.6	bass	1				
11/12/94	3	1.0	3.0	anything					
11/12/94	1	1.0	1.0	bass					
11/12/94	1	2.0	2.0	catfish/bass		2			
11/12/94	1	2.2	2.2	catfish	4				
11/12/94	1	1.0	1.0	catfish	1				
11/12/94	3	0.5	1.5	catfish					
11/16/94	1	1.1	1.1	catfish	3	3			
11/19/94	2	1.0	2.0	catfish	1				
11/19/94	3	1.0	3.0	anything					
12/03/95	3	3.0	9.0	anything	1				
12/03/94	1	1.0	1.0	bass			1		
12/18/94	1	1.0	1.0	catfish	1	1			
12/26/94	2	1.0	2.0	catfish	2				
12/26/94	1	1.2	1.2	sauger					
12/26/94	2	0.5	1.0	catfish		1			
01/07/95	1	0.8	0.8			2			
01/22/95	1	0.5	0.5	catfish					
02/25/95	1	1.0	1.0	catfish					
02/25/95	2	1.0	2.0	sauger					1
03/11/95	1	1.0	1.0	catfish/sauger					
03/13/95	2	1.1	2.2	catfish		2			
Totals	**65**		**123.2**		**46**	**14**	**2**	**3**	**2**

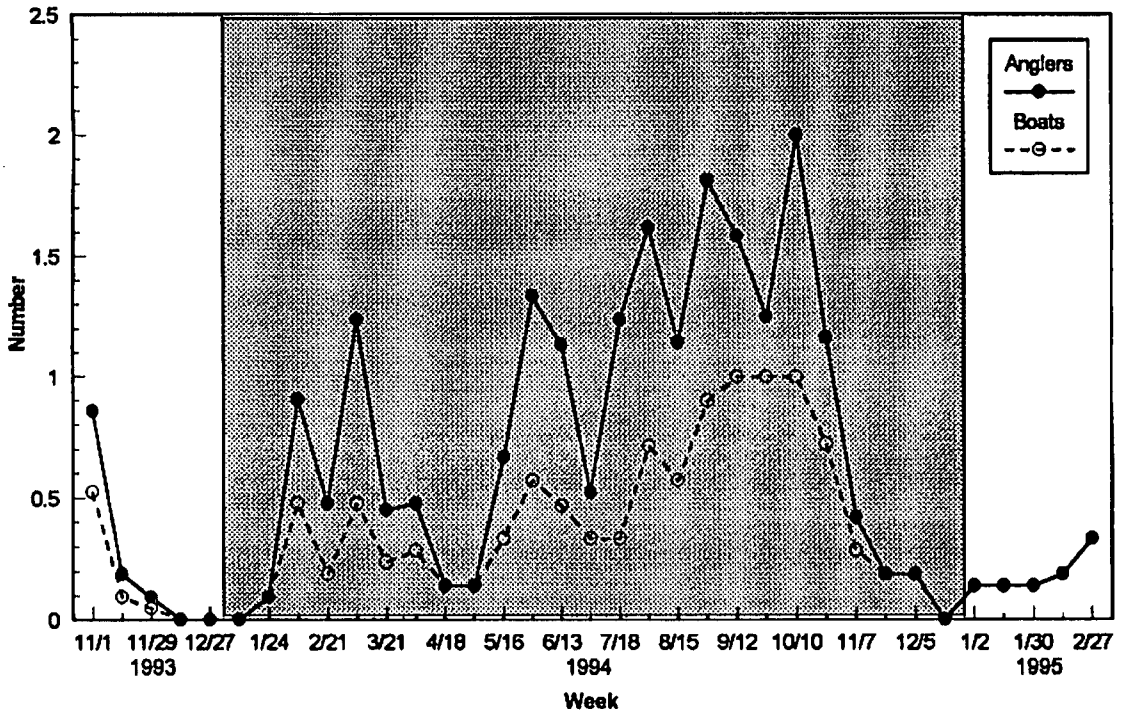

Figure 7. Weekly average of fishing pressure counts made by site security staff at the Sequoyah Nuclear Plant diffuser, November 1993 through March 1995 (28 counts per week).

Important Species

Sauger. Sauger is considered a cool water species and is the focal point of a thermal variance monitoring program (TVA 1994) at TVA's Browns Ferry Nuclear Plant (BFN) on Wheeler Reservoir and an investigation on Chickamauga Reservoir with respect to potential effects of Watts Bar Nuclear Plant (WBN) and SQN (Buchanan, 1995). Areas of concern for the present study are: (1) the effect of the elevated thermal plume on movement past SQN to spawning locations upstream and (2) attraction to heated water thus increasing susceptibility to fishing pressure. Sauger were collected in similar numbers from the downstream

(29)and upstream (21) gillnet stations; this shows movement past SQN and no long-term attraction to the thermal plume. This hypothesis is supported by the creel census (anglers reported only 2 sauger caught in thermal plume) and the similar results reported in the SQN 316(a) demonstration (TVA 1989) and BFN Thermal Variance Monitoring Report (TVA 1994c).

Catfish. Based on creel census, catfish are the target species for most fishing activity in the vicinity of SQN diffuser. Fifty-one percent of anglers interviewed were fishing for catfish. Blue catfish was the dominant species in the gillnet samples and the species most frequently caught by anglers near the diffuser; however, numbers from gillnets were greater at the upstream station. Low numbers of channel and flathead catfish were collected at both gillnet stations (Figure 6). Similarly low numbers were caught by anglers.

Temperate basses. Striped, white, and yellow bass were collected in low numbers at both the downstream and upstream gillnet stations. Striped and white bass at the downstream station and primarily yellow bass at upstream station (Figure 6).

Conclusions

Both SQN operational data and biological data collected near the diffuser during this field investigation support the 5°C temperature rise limit. SQN operational data during the 1993-94 and 1994-95 field investigations indicate a water temperature rise of more than 3°C is an uncommon event for SQN discharges. Based on data collected near the SQN diffuser from gillnets, creel census, and fishermen pressure counts during cold weather (November through March) of 1993-94 and 1994-95, fish are neither attracted to nor avoid the thermal plume. Sauger, theoretically the species most likely to be affected by the temperature rise, were not concentrated in the thermal plume in winter nor inhibited from movement past SQN. Other taxa (catfishes, temperate basses, and centrarchids) were collected in similar numbers above and below the diffuser. Angler fishing pressure was not significant with no apparent attraction or overharvesting of fish. Therefore, results of this investigation indicate the increased temperature rise limit of 5°C due to SQN discharges from November through March is having no demonstrable impact on the fish populations in Chickamauga Reservoir.

REFERENCES

American Fisheries Society. 1980. A list of common and scientific names of fishes from the United States and Canada. American Fisheries Society Special Publication 12, Bethesda, Maryland.

Buchanan, J. P. 1995. Chickamauga Reservoir sauger investigation, 1993-1994. Tennessee Valley Authority, Division of Water Management, Norris, Tennessee.

McDonough, T. A. and J.P. Buchanan. 1991. Factors affecting abundance of white crappies in Chickamauga Reservoir, Tennessee, 1970-1989. North American Journal of Fisheries Management 11:513-524.

Tennessee Valley Authority. 1983. Field Operations Biological Resources Procedures Manual. Division of Natural Resources Operations.

Tennessee Valley Authority. 1989. A predictive section 316(a) demonstration for an alternative thermal discharge limit for Sequoyah Nuclear Plant, Chickamauga Reservoir, Tennessee.

Tennessee Valley Authority. 1990. Status of the white crappie population in Chickamauga Reservoir: final project report.

Tennessee Valley Authority. 1993. Reservoir monitoring - 1992- summary of fish community assessment results.

Tennessee Valley Authority. 1994a. Reservoir monitoring - 1993- summary of fish community assessment results.

Tennessee Valley Authority. 1994b. Chickamauga white bass study 1990-1992: final project report.

Tennessee Valley Authority. 1994c. Thermal variance monitoring for Browns Ferry Nuclear Plant, March 1985-February 1993.

Tennessee Valley Authority. 1994d. Chickamauga Reservoir 1993 fisheries monitoring; cove rotenone results.

Tennessee Valley Authority. 1995. Status of the channel catfish population in Chickamauga Reservoir: final report.

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TENNESSEE VALLEY AUTHORITY

Resource Group
Water Management

CHICKAMAUGA RESERVOIR SAUGER INVESTIGATION

1993-1995

FINAL PROJECT REPORT

Prepared by

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INTRODUCTION

The Tennessee Valley Authority (TVA), in cooperation with the Tennessee Wildlife Resources Agency (TWRA), initiated in 1986 an intensive program to determine the status of the sauger (*Stizostedion canadense)* population in upper Chickamauga Reservoir and to identify potential impacts of operation of Sequoyah (SQN) and Watts Bar (WBN) Nuclear Plants on this important sport fish. This initial investigation (1986 through 1991) documented annual population densities, spawning location, spawning habitat characteristics, pre- and post-spawn movement patterns, year-class strengths, and growth rates (Hevel 1988, Hickman et al. 1989, Hickman et al. 1990, and Hevel and Hickman 1991). A major conclusion was that poor reproductive success resulted in an extreme decline in the number of sauger in Chickamauga Reservoir. Low flows and unstable water temperatures during the sauger spawning period were determined to be the limiting factors. As a result, TWRA stocked 191,000 sauger fingerlings in Chickamauga Reservoir during May of 1990 to supplement the population.

A separate modeling study (Yeager and Shiao 1992), based on the results of the initial investigation, addressed flow levels necessary to enhance sauger reproductive success. It was proposed that optimum sustained instantaneous minimum flow releases of 8,000 cfs from Watts Bar Dam, coinciding with the documented sauger spawning period (April) in

the reservoir, would enhance the sauger population in Chickamauga Reservoir. It was further suggested that instantaneous minimum flow releases of 4,000 cfs would provide for at least a maintenance level of sauger spawning success in the tailwater. During April 1992 a minimum flow of 4,000 cfs was maintained through special releases. In April of 1993 and 1994, rainfall was adequate to maintain 8,000 cfs minimum flow without the need for special releases.

In a separate issue, TVA requested an alternative thermal limit for SQN discharges in 1989 (Wrenn et. al. 1989). Beginning in 1993, the allowable ΔT increase from SQN discharges during November through March was changed from a maximum instantaneous 3°C to a maximum instantaneous 5°C. Kay and Buchanan (1995) reported results of sampling in the vicinity of the SQN diffuser (Tennessee River Mile 483.6) during 1993-1994 while the plant was operating under the new thermal variance. They found no attraction or avoidance by sauger (or any other species) to the thermal plume, and concluded no demonstrable impact from the thermal variance on Chickamauga Reservoir fish populations in the vicinity of SQN.

The Tennessee Division of Water Pollution Control (TDWPC) requested, along with the permit modification, a resumption of sauger population monitoring during 1993-1994. The objectives of the renewal of the Chickamauga Reservoir sauger investigation (during the 1993 and 1994 spawning seasons) were to evaluate the impact of the special release regime on sauger spawning success, assess contribution of the TWRA stocking of juvenile

sauger in 1990, and determine effects of the modified winter thermal variance for SQN on the overall Chickamauga Reservoir sauger population. To meet these objectives, mark and recapture field sampling for sauger was conducted below Watts Bar Dam during February through April in 1993 and 1994 for the following specific purposes: 1) to estimate number of adult sauger in the spawning population below Watts Bar Dam; 2) to evaluate relative strengths of 1990, 1991, and 1992 year-classes to estimate success and contribution of the 1990 stocking by TWRA and effects of improved April releases from Watts Bar Dam on sauger spawning success; 3) to estimate inter-reservoir movement of sauger as well as exploitation rate by fishermen.

METHODS

Sampling in 1993 began on February 16 and continued until May 6 below Watts Bar Dam located at Tennessee River Mile (TRM) 529.9 using both standard 38.1 mm (1 1/2 inch) and experimental bar mesh gill nets. Experimental nets consist of five 6.1 meter panels (25.4, 38.1, 50.8, 63.5, and 76.2 mm bar mesh size). Nets were set in the Watts Bar Dam spilling basin perpendicular to the dam or lock walls. When river levels dictated spilling water through the flood gates, nets were set in the navigation lock approach channel to avoid high flow conditions. When sauger were judged ready to spawn, netting was initiated at the Hunter Shoals spawning area (TRM 521), unless high flows prohibited effective sampling. Nets were fished at night when sauger are typically most active.

Sampling frequency was from two to four nights per week depending on flow conditions. During 1994, sampling was conducted from March 14 through May 5.

Each sauger captured that was not in a weakened condition was tagged with a numbered reward tag. Data recorded from each fish included total length (mm), weight (g), sex, tag number, and if the fish was a recaptured individual. Spawning condition (e.g., "free flowing", "spent", etc.) was also noted for each fish when possible. Other species of fish captured in gill nets were counted and recorded. Scales and otoliths from any sauger killed or injured were collected for age determination and to supplement length-frequency data used in measuring year-class strength.

Creel data from Chickamauga Reservoir collected by TWRA from 1986 through 1995 were made available for comparison of fisherman catch rates among years. These data were used in conjunction with population estimates to monitor size of year classes produced under various conditions during the spawning period each year.

DATA ANALYSIS

Scale and otolith data were analyzed using the Lee method to back-calculate total lengths at each age prior to capture. Sauger population estimates were calculated using the Thompson and Juday mark and recapture census method (Lackey 1974). This estimate of sauger densities in Chickamauga Reservoir provided the best available measure of

abundance although one assumption required for this method (i.e., a closed system) was not met. This multiple census method of estimation is based on the formula:

$$N = \frac{\Sigma C_t m_t}{\Sigma r_t}$$

where N = estimated population size,
C_t = total fish captured on day t,
m_t = total number of marked fish at the start of day t, and
r_t = number of recaptures in the sample C_t.

RESULTS AND DISCUSSION

Netting/Tagging

A total of 4,053 fish (10.5 per net-hour) including 22 species and two hybrids (Table 1) was captured during 386.4 hours of gill netting from February 16 to May 6, 1993, in upper Chickamauga Reservoir. Channel catfish (2.36/hr), sauger (2.27/hr), and white bass (1.48/hr) were the most abundant species captured. A total of 876 sauger was collected, of which 819 were measured, weighed, tagged, and released. The remainder were either dead or appeared stressed upon removal from the nets.

During 1994 (March 14 through May 5), 4,348 fish including 25 species and two hybrids were captured for a catch rate of 11.58/hr (total effort of 375.6 hours). Sauger (2.41/hr), blue catfish (2.02/hr), and yellow bass (1.84/hr) were most abundant in the catch. A total of 905 sauger was collected of which 786 were tagged and released. Tagged sauger recaptured during netting totaled 144 and 26 during 1993 and 1994, respectively.

Length Frequency/Age-Class Composition

Length frequency for sauger collected during 1993 (Figure 1) indicated only 1.7% (15) of the population were yearlings, suggesting another poor year class was produced during 1992. The percentage of yearling sauger collected during 1986 through 1990 was also extremely low, varying from 0.8% of the population in 1989 to 15.0% in 1990 (Hevel 1988, Hickman et. al. 1989, Hickman et. al. 1990). The percentage of yearling sauger collected in 1991 increased to 71%; however, this was most likely a result of the stocking of 191,000 fingerling sauger by TWRA in 1990 (Hevel and Hickman 1991). Yearling sauger participate in the annual spawning migration, but females and most males are not sexually mature until age two.

If water flow and temperature requirements during the spawning period were suitable, it was anticipated that fingerling sauger stocked during 1990 would produce a strong year class during 1992, the first year the released fish would be sexually mature. But 1993 sampling results were cause for concern as few yearlings were collected. An instantaneous minimum discharge from Watts Bar Dam of 4,000 cfs was maintained during April, 1992 and, as required for optimum spawning conditions, the water temperature increased gradually during the 1992 spawning period. It is apparent from 1993 sampling results that an instantaneous minimum discharge rate of 4,000 cfs may be insufficient to meet sauger spawning requirements at the Hunter Shoals site.

During 1994, the percentage of sauger yearlings collected increased to 89.5% (810 individuals, also an increase) indicating a successful spawn and survival during 1993 (Figure 1). Numbers of adult sauger two years and older were much lower in 1994 (95) than 1993 (860). This is indicative of the relatively short life span of sauger in Tennessee River reservoirs (maximum of 4 or 5 years with most surviving for only 3 years) as noted by Hackney and Holbrook (1971) and Hickman et. al. (1989). The high percentage of yearlings observed in 1994 could likely be attributed to enhanced spawning success and survival due to the instantaneous minimum discharge of 8,000 cfs from Watts Bar Dam during April 1993 (optimum reported by Yeager and Shiao, 1992).

Population Estimate

Populations estimates of sauger in Chickamauga Reservoir declined progressively (Figure 2) over the period 1986 through 1990 but increased in 1991 (Hevel and Hickman, 1991). The previously mentioned TWRA stocking of 191,000 fingerling sauger in 1990 was probably responsible for the 1991 increase. Sampling was not conducted during 1992. Based on 1993 tagging/recapture data, the estimated number of adult sauger in Chickamauga Reservoir was 2,241. Only 37 yearling sauger (1992 year class) were estimated to be in the reservoir in spring 1993. Data collected during 1994 provided an estimate of 13,833 sauger, over six times the number estimated during 1993. The majority of these fish (89.5%) were yearlings from the 1993 year class.

Creel Results

Estimated hours spent fishing for sauger from 1986 through 1995 (TWRA 1987 - 1996) generally follow sauger population estimates (Table 2). Effort expended was high in 1986 when the population estimate was over 18,000 catchable fish. Effort declined through 1989 along with the population. Fishing pressure increased slightly in 1990 even though the population was estimated to be at its lowest point during the sample period. Sauger fishing effort rebounded in 1991 as the population increased to approximately 8,000 individuals. In 1993, effort again declined somewhat along with the sauger population, but established a new high in 1994 as numbers of catchable sauger increased. Fishing pressure for sauger again increased in 1995; however, comparison with densities was not possible as population sampling was not conducted during 1995.

Catch rate of sauger (per hour of fishing) also generally followed population estimates, except for a relatively high catch rate for 1990 (Table 2). Poor conditions (unusually high water releases) during the winter-spring 1990 sampling period resulted in only 34 sauger tagged and 9 recaptured. Hevel and Hickman (1991) suggested that the abnormal flow conditions reduced sauger sampling efficiency and may have altered typical distribution patterns of sauger. The population estimate of only 78 individuals was likely inaccurate. Based on the 1991 estimated population of adult sauger in Chickamauga Reservoir of 2,036, it is evident sauger densities were higher than reported in 1990, but remained low compared to the 1986 estimated adult population of 17,058.

The high fishermen catch rate of sauger in 1995 (0.98 fish/hour), in conjunction with high fishing pressure estimates that year (Table 2), indicates a significant year class was produced in 1994. Harvest rate was low suggesting the majority of the catch was made up of juvenile sauger. Water releases through Watts Bar Dam during April 1994 were in excess of the 8,000 cfs target instantaneous minimum flow necessary to maximize suitable conditions for sauger spawning. The 1995 creel catch rate indicates a large 1994 year class was produced.

Exploitation Rate and Movement

Recaptures by fishermen of sauger tagged below Watts Bar Dam revealed an exploitation rate of 9% in 1993 and 11% in 1994. Exploitation rate estimates were not adjusted for tag loss or non-reporting. These results are somewhat higher than those obtained during the earlier years of the study which ranged from 5% to 8% of the population being harvested each year from 1986-1992. These rates of harvest are far below the normal annual exploitation of walleye in Michigan reported by Schneider (1978). Snow (1978) suggested an exploitation rate of 55% would not adversely impact northern pike populations in Wisconsin, and Anderson (1974), Graham (1974), and Ming (1974) considered an exploitation rate of up to 40% allowable to maintain a quality fishery for largemouth bass. It is evident that fishing mortality has very little impact on the sauger population in Chickamauga Reservoir.

Based on tag returns by fishermen, movement of sauger through the upstream dam was again documented during 1993 and 1994. Seven of the 77 tagged sauger (9%) returned

by fishermen with location of capture information were caught above Watts Bar Dam in 1993. In 1994, only 2 of 65 tagged sauger (3%) returned by fishermen with location of capture were recaptured from Watts Bar Reservoir. These rates fall within the range previously observed (3 to 15%) from 1986-1989 (Hevel 1988, Hickman et. al. 1989, and Hickman et. al. 1990). Other researchers have also noted the occurrence of sauger traversing TVA locks (Cobb 1960, St. John 1990, and Pegg 1994). Hevel (1988), Hickman et. al. (1989), and St. John (1990) suggested that this inter-reservoir movement of sauger indicates spawning sites located in one reservoir contribute to sauger populations in other reservoirs throughout the Tennessee River. Pegg et. al. (1996) concluded that impoundments on the Tennessee River are only partial barriers to migration, and the interdependence of these populations is unknown.

There was no evidence of sauger or fishermen concentration in the vicinity of SQN based on fishermen recaptures or on the special thermal variance creel study done at SQN from 1993-1994 (Kay and Buchanan 1995). No tagged sauger were reported from this area of Chickamauga Reservoir in 1993, and only 2 of 65 recaptured sauger (3%) with catch location information were taken there in 1994. As concluded by Kay and Buchanan (1995), the thermal variance for SQN allowing a 5°C ΔT during November through March 1993 and 1994 had no impact on sauger distribution or migration.

Conclusions

Comparison of 1993 and 1994 sauger population sampling results with the special water releases through Watts Bar Dam revealed that an instantaneous minimum discharge of 8,000 cfs was sufficient to provide conditions for successful reproduction of sauger. The high 1995 fishermen catch rate of juvenile sauger, following a year when instantaneous minimum releases during April through Watts Bar Dam exceeded 8,000 cfs, support this conclusion. However, it is apparent that an instantaneous minimum discharge rate of 4,000 cfs may be inadequate to maintain a viable sauger population. The release of 191,000 fingerling sauger in 1990 by TWRA for an approximate cost of $30,000.00 (Mike Smith, TWRA Eagle Bend Fish Hatchery, personal communication) proved to be very effective in establishing a year class. It is apparent that in years when adequate flows can not be maintained during the sauger spawning period, supplemental stocking could substitute for natural reproduction.

The thermal variance from 3°C to 5°C ΔT during November through March at SQN was determined to have no adverse impact on the sauger population in Chickamauga Reservoir. The sauger population was at a low density in 1993 prior to implementation of the thermal variance. In 1994, after the variance was implemented in November 1993, the resident sauger population was estimated at its highest level since 1986. No attraction to, or avoidance of, the SQN diffuser area was documented for fishermen or sauger based on a SQN creel survey and tags returned during 1993 and 1994. Sauger exploitation rate also remained low after the variance was implemented.

During the nine year history of the Chickamauga sauger project, numerous objectives were realized. The spawning site for sauger was identified, annual sauger population estimates were developed, instantaneous minimum flow of 8,000 cfs and gradually increasing water temperatures during the spawning period were found to be critical factors in sauger reproductive success, stocking of fingerlings was determined to be an effective means of producing a good year class when conditions are unsuitable for natural reproduction, and determination of no impacts from a thermal variance at SQN was accomplished.

Literature Cited

Anderson, R. O. 1974. Influence of mortality rates on production and potential sustained harvest of largemouth bass populations. *In* J. L. Funk, editor. Symposium on overharvest and management of largemouth bass in small impoundments. North Central Division, American Fisheries Society, Special Publication Number 3, Washington, D. C. 18-28.

Cobb, E. S. 1960. The sauger fishery in the lower Tennessee River. Final Report (Dingell-Johnson Project F-12-R), Tennessee Wildlife Resources Agency, Nashville, TN. 16 pp.

Graham, L. K. 1974. Effects of four harvest rates on pond fish populations. *In* J. L. Funk, editor. Symposium on overharvest and management of largemouth bass in small impoundments. North Central Division, American Fisheries Society, Special Publication Number 3, Washington, D. C. 29-38.

Hackney, P. A. and J. A. Holbrook II. 1978. Sauger, walleye and yellow perch in the United States. *In* R. L. Kendall, editor. Selected coolwater fishes of North America. American Fisheries Society Special Publication Number 11, Washington, D. C. 74-81.

Hevel, K. W. 1988. Survey of the population dynamics of sauger (Stizostedion canadense) in Chickamauga Reservoir - 1986 and 1987. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 44 pp.

Hevel, K. W. and G. D. Hickman. 1991. Population survey of sauger in Chickamauga Reservoir 1990-1991. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 13 pp.

Hickman, G. D., K. W. Hevel, and E. M. Scott. 1989. Density, movement patterns, and spawning characteristics of sauger (Stizostedion canadense) in Chickamauga Reservoir - 1988. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 53 pp.

Hickman, G. D., K. W. Hevel, and E. M. Scott. 1990. Population survey of sauger (Stizostedion canadense) in Chickamauga Reservoir - 1989. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 26 pp.

Kay, L. K. and J. P. Buchanan. 1995. Sequoyah Nuclear Plant thermal variance monitoring program - effects of thermal effluent from Sequoyah Nuclear Plant on fish populations in Chickamauga Reservoir. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 16 pp.

Lackey, R. T. 1974. Introductory fisheries science. Sea Grant, Department of Commerce, Under Grant 04-4-158-40, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Ming. A. 1974. Regulation of largemouth bass harvest with a quota. *In* J. L. Funk, editor. Symposium on overharvest and management of largemouth bass in small impoundments. North Central Division, American Fisheries Society, Special Publication Number 3, Washington, D. C. 39-53.

Pegg, M. A. 1994. Angler exploitation and movements of sauger in the lower Tennessee River. Master's Thesis. Tennessee Technological University, Crossville, TN. 43 pp.

Pegg, M. A., J. B. Layzer, and P. W. Bettoli. 1996. Angler exploitation of anchor-tagged saugers in the lower Tennessee River. North American Journal of Fisheries Management. 16:218-222.

Schneider, J. C. 1978. Selection of minimum size limits for walleye fishing in Michigan. *In* R. L. Kendall, editor. Selected coolwater fishes of North America. American Fisheries Society Special Publication 11:398-407.

Snow, H. E. 1978. Responses of northern pike to exploitation in Murphy Flowage, Wisconsin. *In* R. L. Kendall, editor. Selected coolwater fishes of North America. American Fisheries Society Special Publication 11:320-327.

St. John, R. T. 1990. Sauger (Stizostedion canadense) abundance and spawning movements in the Fort Loudoun Tailwaters, Tennessee. Master's Thesis. Tennessee Technological University, Crossville, TN. 92 pp.

Tennessee Wildlife Resources Agency (TWRA). 1987. Tennessee sport fishing creel survey - 1986. Tennessee Wildlife Resources Agency, Nashville, TN.

Tennessee Wildlife Resources Agency (TWRA). 1988. Tennessee sport fishing creel survey - 1987. Tennessee Wildlife Resources Agency, Nashville, TN.

Tennessee Wildlife Resources Agency (TWRA). 1989. Tennessee sport fishing creel survey - 1988. Tennessee Wildlife Resources Agency, Nashville, TN.

Tennessee Wildlife Resources Agency (TWRA). 1990. Tennessee sport fishing creel survey - 1989. Tennessee Wildlife Resources Agency, Nashville, TN.

Tennessee Wildlife Resources Agency (TWRA). 1991. Tennessee sport fishing creel survey - 1990. Tennessee Wildlife Resources Agency, Nashville, TN.

Tennessee Wildlife Resources Agency (TWRA). 1992. 1991 TWRA creel survey. Tennessee Wildlife Resources Agency, Nashville, TN. Fisheries Report 92-9. 265 pp.

Tennessee Wildlife Resources Agency (TWRA). 1993. 1992 TWRA creel survey. Tennessee Wildlife Resources Agency, Nashville, TN. Fisheries Report 93-14. 218 pp.

Tennessee Wildlife Resources Agency (TWRA). 1994. 1993 TWRA creel survey. Tennessee Wildlife Resources Agency, Nashville, TN. Fisheries Report 94-18. 282 pp.

Tennessee Wildlife Resources Agency (TWRA). 1995. 1994 TWRA creel survey. Tennessee Wildlife Resources Agency, Nashville, TN. Fisheries Report 95-29. 317 pp.

Tennessee Wildlife Resources Agency (TWRA). 1996. 1995 TWRA creel survey. Tennessee Wildlife Resources Agency, Nashville, TN. Fisheries Report 96.

Wrenn, W. B., N. W. Woomer, P. Ostrowski, Jr., W. L. Harper, and E. B. Robertson, Jr. 1989. A predictive section 316(a) demonstration for an alternative winter thermal discharge limit for Sequoyah Nuclear Plant, Chickamauga Reservoir, TN. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 87 pp.

Yeager, B. and M. Shiao. 1992. Recommendation and implementation of special seasonal flow releases to enhance sauger spawning in Watts Bar Tailwater. Tennessee Valley Authority, Water Resources, Chattanooga, TN. 57 pp.

Table 1. Species list, number collected, and catch per hour during winter-spring gill netting in Chickamauga Reservoir, 1993 (total effort of 386.4 hours) and 1994 (total effort of 375.6 hours).

Common Name	1993		1994	
	Number Collected	Catch/hour	Number Collected	Catch/hour
Paddlefish	6	0.02	-	-
Longnose gar	4	0.01	48	0.13
Mooneye	17	0.04	5	0.01
Skipjack herring	378	0.98	554	1.48
Alewife	-	-	4	0.01
Gizzard shad	298	0.77	217	0.58
Threadfin shad	3	0.01	2	0.01
Common carp	1	0.01	9	0.02
Quillback	1	0.01	2	0.01
Northern hog sucker	6	0.02	-	-
Smallmouth buffalo	-	-	4	0.01
Spotted sucker	48	0.12	20	0.05
Silver redhorse	-	-	1	0.01
Golden redhorse	4	0.01	2	0.01
Shorthead redhorse	-	-	1	0.01
Blue catfish	216	0.56	760	2.02
Channel catfish	911	2.36	497	1.32
Flathead catfish	2	0.01	6	0.02
White bass	571	1.48	188	0.50
Yellow bass	487	1.26	690	1.84
Striped bass	23	0.06	51	0.14
Hybrid striped x white bass	60	0.16	24	0.06
Green sunfish	1	0.01	-	-
Warmouth	-	-	1	0.01
Bluegill	-	-	7	0.02
Redear sunfish	1	0.01	15	0.04
Sauger	876	2.27	905	2.41
Walleye	58	0.15	8	0.02
Hybrid walleye x sauger	30	0.08	15	0.04
Freshwater drum	51	0.13	312	0.83
Totals	4,053	10.50	4,348	11.58

Table 2. Estimated fishing pressure and catch rate for sauger from Chickamauga Reservoir, during the period 1986-1995.

Year	Population Estimate	Estimated Fishing Pressure (Hours)	Catch Rate (Number/Hour)
1986	18,381	30,422	0.52*
1987	2,861	17,439	0.59*
1988	1,251	11,201	0.00
1989	1,173	3,098	0.00
1990	78	5,938	0.96
1991	7,024	24,746	0.70
1992	No estimate	13,976	0.47
1993	2,241	12,990	0.63
1994	13,833	42,135	1.05
1995	No estimate	52,281	0.98

* Harvest/hour

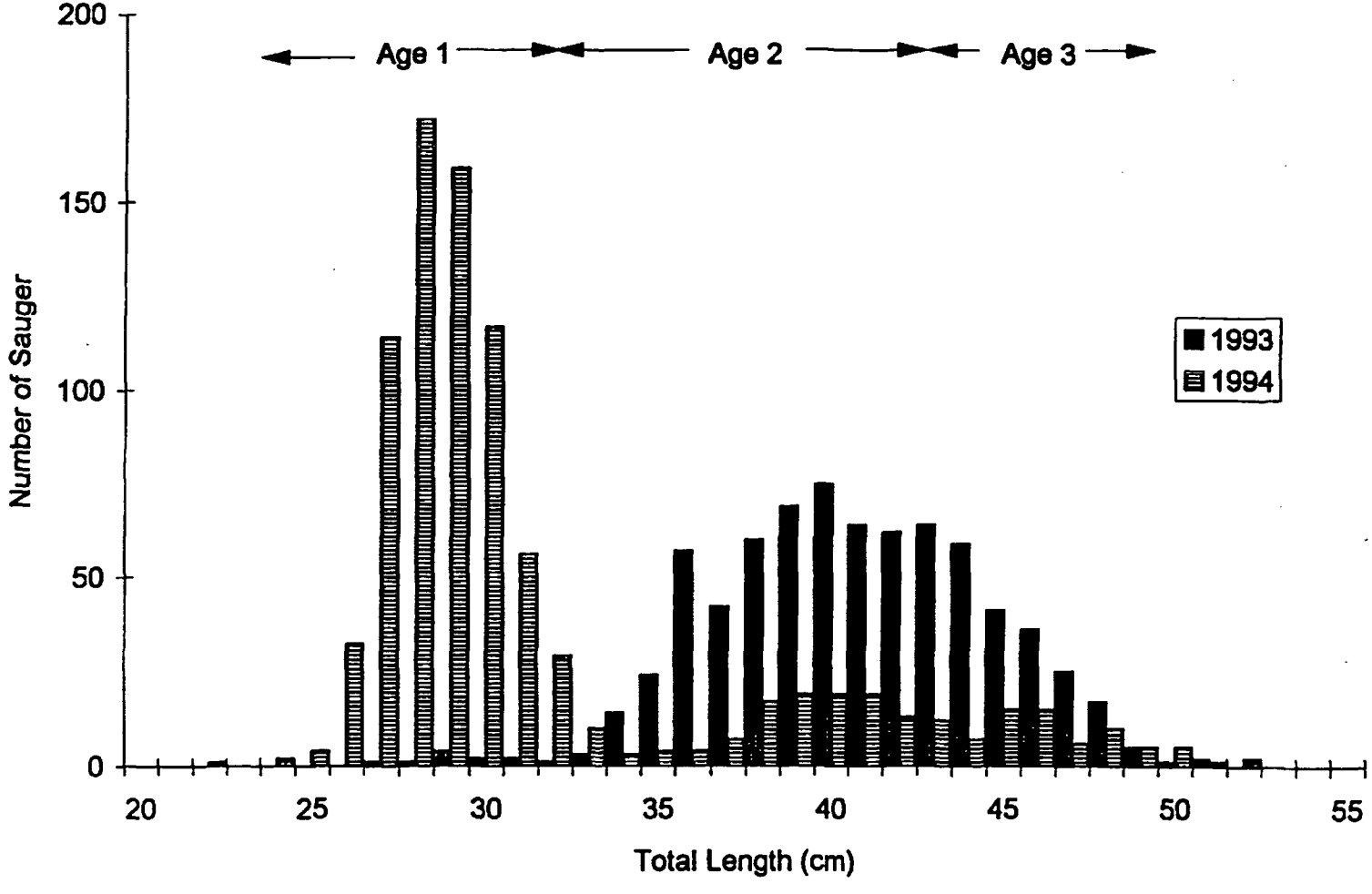


Figure 1. Length frequency/age composition of sauger collected from Chickamauga Reservoir during winter-spring, 1993 and 1994.

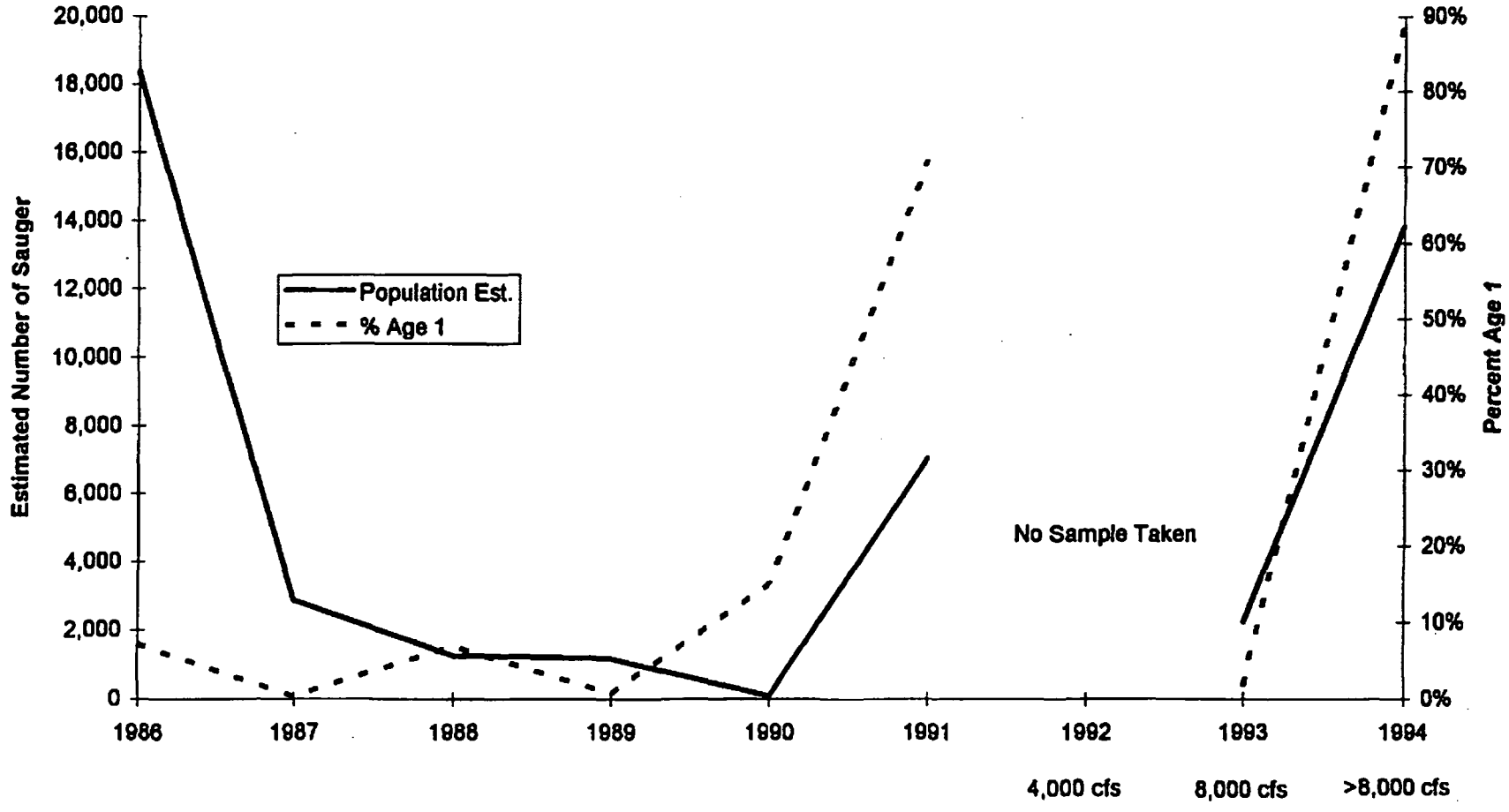
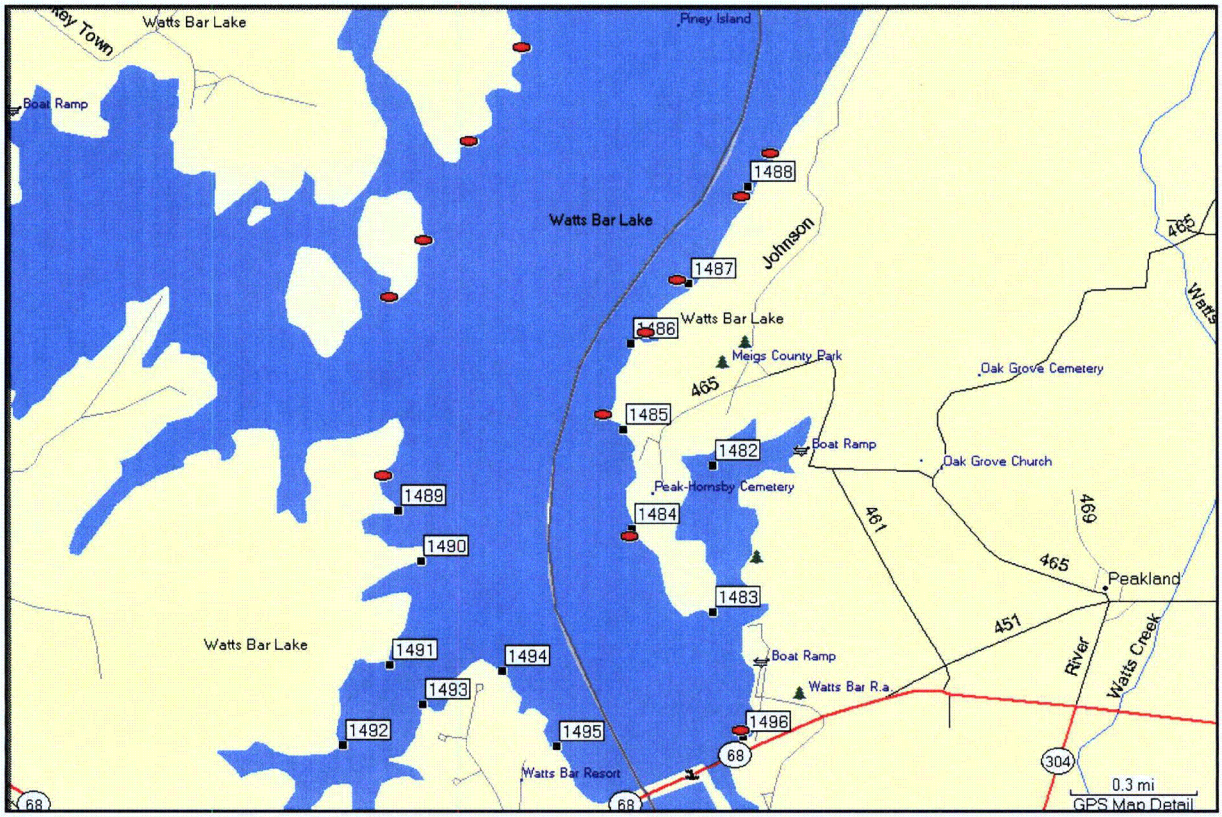


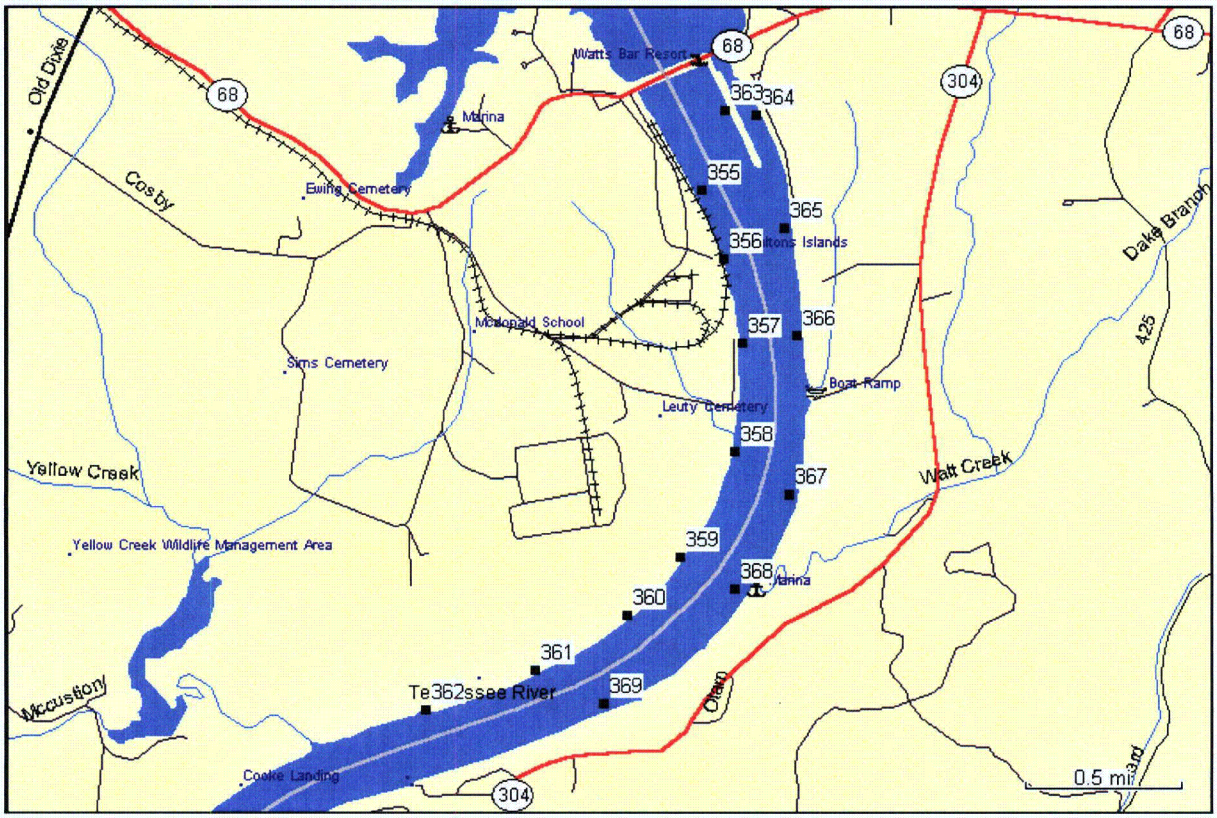
Figure 2. Estimated number of adult sauger and the percent of Age 1 sauger in Chickamauga Reservoir 1986-1994. Minimum discharge rates from Watts Bar Dam during April 1992-1994.

Figure 1. Location of benthic macroinvertebrate sampling transects above (Tennessee River Mile 533.3) and below (Tennessee River Mile 527.4) Watts Bar Nuclear Plant, depicted by red lines from right to left bank. Ten equally spaced samples are collected across each transect.



	Electrofishing locations			Gill net locations	
1482	N35 37.948	W84 46.772		N35 37.800	W84 46.983
1483	N35 37.640	W84 46.772		N35 38.053	W84 47.053
1484	N35 37.815	W84 46.978		N35 38.225	W84 46.943
1485	N35 38.022	W84 47.000		N35 38.337	W84 46.863
1486	N35 38.203	W84 46.980		N35 38.513	W84 46.698
1487	N35 38.329	W84 46.835		N35 38.603	W84 46.627
1488	N35 38.533	W84 46.683		N35 38.828	W84 47.257
1489	N35 37.854	W84 47.570		N35 38.629	W84 47.390
1490	N35 37.748	W84 47.512		N35 38.421	W84 47.505
1491	N35 37.528	W84 47.592		N35 38.302	W84 47.593
1492	N35 37.359	W84 47.710		N35 37.927	W84 47.609
1493	N35 37.446	W84 47.508		N35 37.390	W84 46.702
1494	N35 37.515	W84 47.306			
1495	N35 37.356	W84 47.170			
1496	N35 37.376	W84 46.696			

Figure 2. Electro-fishing and gill net sampling locations in Watts Bar Reservoir Forebay (Tennessee River Miles 530 to 532.2) upstream from Watts Bar Nuclear Plant. Black squares represent electro-fishing locations; red circles represent gill net locations.



Electrofishing locations		
355	N35 36.927	W84 46.819
356	N35 36.734	W84 46.743
357	N35 36.488	W84 46.682
358	N35 36.184	W84 46.709
359	N35 35.881	W84 46.891
360	N35 35.716	W84 47.073
361	N35 35.562	W84 47.391
362	N35 35.451	W84 47.765
363	N35 37.152	W84 46.738
364	N35 37.142	W84 46.631
365	N35 36.818	W84 46.537
366	N35 36.510	W84 46.491
367	N35 36.060	W84 46.518
368	N35 35.791	W84 46.708
369	N35 35.467	W84 47.156

Figure 3. Electro-fishing locations in Chickamauga Reservoir Inflow (Tennessee River Miles 527 to 529.8) near Watts Bar Nuclear Plant, represented by black squares. Gill nets are not set in inflow areas due to high flows which greatly diminish effectiveness.

Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir before and after Watts Bar Nuclear Plant Unit 1 Operation

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Introduction

Section 316(a) of the Clean Water Act (CWA) is intended to regulate facilities with a thermal discharge from a point source to assure the protection of Balanced Indigenous Populations (BIP) of aquatic life. TVA uses its existing Vital Signs (VS) monitoring program, supplemented with additional fish community monitoring upstream and downstream of fossil and nuclear power plants, to evaluate effects of thermal discharges to aquatic communities in the receiving water body. The VS monitoring program began in 1990 in the Tennessee River System. This program was implemented to evaluate ecological health conditions in major reservoirs as part of TVA's stewardship role. One of the 5 indicators used in the VS program to evaluate reservoir health is the Reservoir Fish Assemblage Index (RFAI) methodology which was implemented beginning in 1993. RFAI has been thoroughly tested on TVA and other reservoirs and published in peer-reviewed literature (Jennings, et al., 1995; Hickman and McDonough, 1996; McDonough and Hickman, 1999). Fish communities are used to evaluate ecological conditions because of their importance in the aquatic food web and because fish life cycles are long enough to integrate conditions over time.

This report is in response to "Petitioner's Amended Contention 7 Regarding TVA Aquatic Study, Section 5d." which states: "The Aquatic Study is now 12 years old. The overall health of the aquatic community of Chickamauga Reservoir and the Tennessee River has continued to decline. There has been a decline in Reservoir Fish Assemblage Index (RFAI) values, a decline in the number of fish species captured in sampling,...."

The purpose of this report is to: (1) provide a detailed explanation of the RFAI methodology and its application to fish community evaluation in relation to thermal discharges as specified by 316(a) of the Clean Water Act; (2) compare fish community structure of Chickamauga Reservoir before (1993-1995) and after (1996-2008) Watts Bar Nuclear Plant (WBN) Unit 1 became operational using existing TVA RFAI data; and (3) compare temporal differences in RFAI scores at the site within the WBN thermal discharge and at other monitoring sites within Chickamauga Reservoir from 1993 to 2008.

Plant Description

Watts Bar Nuclear Plant is located on the right descending (west) bank of upper Chickamauga Reservoir near Tennessee River Mile (TRM) 528, approximately two miles downstream of Watts Bar Dam (TRM 529.9) (Figure 1). This one-unit nuclear generating plant went into commercial operation on May 27, 1996.

In the original design, nearly all the waste heat created by the plant was dissipated in the atmosphere by the cooling towers. A small fraction of the waste heat was dissipated in the Tennessee River by the cooling tower blowdown. Blowdown from the cooling tower is discharged through multi-port diffusers located in the main river channel at TRM 527.9. Makeup water and other water supply requirements are obtained from an intake channel and pumping station at TRM 528. Intake pumping flow rate is 80 cfs, and maximum diffuser discharge is about 135 cfs. Long-term average flow past WBN is 27,100 cfs.

The WBN Supplemental Condenser Cooling Water System (SCCW) system became operational in July, 1999. The SCCW system withdraws water from the intake structure located immediately upstream of Watts Bar Dam at TRM 529.9, which formerly served WBF. The temperature of the water in the SCCW system is usually lower than that provided by the Unit 1 cooling tower, so the SCCW flow reduces the temperature of the Unit 1 condenser flow and enhances the performance of the steam cycle. The SCCW is designed to provide a maximum of 365 cfs. Water from the SCCW system is discharged through the old WBF discharge structure located on the Tennessee River approximately 1.1 miles upstream of the nuclear plant intake.

The SCCW system was designed and constructed as a discretionary system. The SCCW system has no significant impact on the original blowdown system, allowing the plant to operate with or without the SCCW system in service. When the SCCW system is in service, the fraction of waste heat dissipated in the Tennessee River can be higher than that of the original full closed-mode operation.

Methods

Fish Sample Locations Upstream and Downstream of WBN

Reservoirs are typically divided into three zones for VS monitoring – inflow, transition, and forebay. The inflow zone is generally in the upper reaches of the reservoir and is riverine in nature; the transition zone or mid-reservoir is the area where water velocity decreases due to increased cross-sectional area; and the forebay is the lacustrine area near the dam. The Chickamauga Reservoir inflow RFAI sample site is located at TRM 529.0 below Watts Bar Dam and extends downstream to TRM 526.3. This station is used to provide downstream fish community data in the vicinity of the WBN thermal discharge. Since the WBN discharge is located within Chickamauga Reservoir inflow zone, no upstream control site data are available for comparison. Watts Bar Reservoir RFAI forebay site (TRM 531) is used to document any notable changes in Tennessee River ecological conditions above the WBN discharge but is not used for upstream/downstream comparisons of RFAI scores.

TVA has four additional monitoring sites on Chickamauga Reservoir. A site in the transition zone is located at TRM 490.5, two sites in the forebay are located at TRM 482 and 472.3, and a site on the Hiwassee River embayment of Chickamauga Reservoir is located at Hiwassee River mile (HiRM) 8.5.

Fish Community Sampling Methods and Data Analysis for Sites Upstream and Downstream of WBN

Fish sampling immediately downstream of WBN was conducted by boat electro-fishing (Reynolds, 1996). Fish sampling in Watts Bar Reservoir forebay (upstream of WBN) and at all other Chickamauga Reservoir sites were conducted by boat electro-fishing and gill netting (Hubert, 1996; Reynolds, 1996). Electro-fishing methodology consisted of fifteen electro-fishing boat runs near the shoreline, each 300 meters long with a duration of approximately 10 minutes each. The total near-shore area sampled is approximately 4,500 meters (15,000 feet). Experimental gill nets (so called because of their use for research as opposed to commercial fishing) are used as an additional gear type to collect fish from deeper habitats not effectively sampled by electro-fishing. Each experimental gill net consists of five-6.1 meter panels for a total length of 30.5 meters (100.1 feet). The distinguishing characteristic of experimental gill

nets is mesh size that varies between panels. For this application, each net has panels with mesh sizes of 2.5, 5.1, 7.6, 10.2, and 12.7 cm. Experimental gill nets are typically set perpendicular to river flow extending from near-shore to the main channel of the reservoir. Ten overnight experimental gill net sets were used at all sampling stations in Chickamauga Reservoir, with the exception of the inflow site downstream of the WBN discharge. Flows prevent effective use of gill nets at the site located just downstream of WBN in the inflow zone of Chickamauga Reservoir (TRM 529).

Fish collected were identified by species, counted, and examined for anomalies (such as disease, deformations, or hybridization). The resulting data were analyzed using RFAI methodology.

The RFAI uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health. Individual species can be utilized for more than one metric. Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

1. **Total number of species** -- Greater numbers of species are considered representative of healthier aquatic ecosystems. As conditions degrade, numbers of species at an area decline.
2. **Number of centrarchid species** -- Sunfish species (excluding black basses) are invertivores and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.
3. **Number of benthic invertivore species** -- Due to the special dietary requirements of this species group and the limitations of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.
4. **Number of intolerant species** -- This group is made up of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.

5. **Percentage of tolerant individuals** (excluding Young-of-Year) -- This metric signifies poorer water quality with increasing proportions of individuals tolerant of degraded conditions.
6. **Percentage dominance by one species** -- Ecological quality is considered reduced if one species inordinately dominates the resident fish community.
7. **Percentage of non-native species** -- Based on the assumption that non-native species reduce the quality of resident fish communities.
8. **Number of top carnivore species** -- Higher diversity of piscivores is indicative of the availability of diverse and plentiful forage species and the presence of suitable habitat.

Trophic Composition

9. **Percent of individuals as top carnivores** -- A measure of the functional aspect of top carnivores which feed on major planktivore populations.
10. **Percentage of individuals as omnivores** -- Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline while opportunistic omnivorous species increase in relative abundance.

Abundance

11. **Average number per run** -- (number of individuals) -- This metric is based upon the assumption that high quality fish assemblages support large numbers of individuals.

Fish Health

12. **Percentage individuals with anomalies** -- Incidence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization are noted for all fish measured, with higher incidence indicating less favorable environmental conditions.

RFAI methodology addresses all four attributes or characteristics of a "balanced indigenous population" defined by the CWA, as described below:

A biotic community characterized by diversity appropriate to the ecoregion: Diversity is addressed by the metrics in the Species Richness and Composition category, especially metric 1: Total number of species. Determination of reference conditions based on the inflow zones of lower mainstem Tennessee River reservoirs (as described below) ensures appropriate species expectations for the ecoregion.

The capacity for the community to sustain itself through cyclic seasonal change: TVA uses an autumn data collection period for biological indicators, both VS and upstream/downstream monitoring. Autumn monitoring is used to document condition or health after being subjected to the wide variety of stressors throughout the year.

One of the main benefits of using biological indicators is their ability to integrate stressors through time. Examining the condition or health of a community at the end of the "biological year" (i.e., autumn) provides insights into how well the community has dealt with the stresses through an annual seasonal cycle. Likewise, evaluation of the condition of individuals in the community (in this case, individual fish as reflected in Metric 12) provides insights into how well the community can be expected to withstand stressors through winter. Further, multiple sampling years during the permit renewal cycle adds to the evidence of whether or not the autumn monitoring approach has correctly demonstrated the ability of the community to sustain itself through repeated seasonal changes.

The presence of necessary food chain species: Integrity of the food chain is measured by the Trophic Composition metrics, with support from the Abundance metric and Species Richness and Composition metrics. Existence of a healthy fish community indicates presence of necessary food chain species because the fish community is comprised of species that utilize multiple feeding mechanisms that transcend various levels in the aquatic food web. Basing evaluations on a sound multi-metric system such as the RFAI enhances the ability to discern alterations in the aquatic food chain.

A lack of domination by pollution-tolerant species: Domination by pollution-tolerant species is measured by metrics 3 (Number of benthic invertivore species), 4 (Number of intolerant species), 5 (Percentage of tolerant individuals), 6 (Percentage dominance by one species), and 10 (Percentage of individuals as omnivores).

Scoring categories are based on "expected" fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical fish assemblage data representative of inflow, transition, and forebay zones from upper mainstem Tennessee River reservoirs (Hickman and McDonough, 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent relative degrees of degradation: least degraded (5); intermediate degraded (3); and greatest degraded (1). Scoring criteria for upper mainstem Tennessee River reservoirs are shown in Table 1. The Hiwassee River embayment site is scored with RFAI transition zone scoring criteria.

If a metric was calculated as a percentage (e.g., Percent tolerance individuals), the data from electro-fishing and gill netting were scored separately and allotted half the total score for that individual metric. Inflow areas are scored only using electro-fishing data and scoring criteria were developed to account for the lack of gill net data. Individual metric scores for a sampling area are summed to obtain the RFAI score for the area.

TVA uses RFAI results to determine maintenance of BIP using 2 approaches. One is "absolute" in that it compares the RFAI scores and individual metrics to predetermined values. The other is "relative" in that it compares RFAI scores attained downstream to the upstream control site. The "relative" approach does not apply to WBN since the upstream site is located upstream of Watts Bar Dam. The "absolute" approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the attained RFAI score from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure a conservative screening of BIP. First, if an RFAI score reaches 70% of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if

fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then normal community structure and function would be present indicating that BIP had been maintained, thus no further evaluation would be needed.

RFAI scores range from 12 to 60. As discussed in detail below, the average variation for RFAI scores in TVA reservoirs is 6 ($\pm$ 3). Therefore, any location that attains an RFAI score of 45 (42 plus the upward sample variation of 3) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level; i.e., any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level would require a more in-depth look to determine if BIP exists. An inspection of individual RFAI metric results and species of fish used in each metric would be an initial step to help identify if operation of WBN is a contributing factor. This approach is appropriate because a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

The Quality Assurance (QA) component of VS monitoring deals with how well the RFAI scores can be repeated and is accomplished by collecting a second set of samples at 15%-20% of the sites each year. Previous statistical analyses with the QA component of VS has shown that the comparison of RFAI index scores from 54 paired sample sets collected over a seven year period ranged from 0 to 18 points. Based on these findings, the 75th percentile is 6 and the 90th percentile is 12. The mean difference between these 54 paired scores is 4.6 points with 95 percent confidence limits of 3.4 and 5.8. Therefore, a difference of 6 points or less was the value selected for defining "similar" scores between years sampled at the downstream site. That is, if the downstream RFAI score is within 6 points compared to prior years score then the fish communities will be considered similar. It is important to bear in mind that differences greater than 6 points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). When this occurs, a metric-by-metric examination will be conducted to determine what caused the difference in scores and the potential for the difference to be thermally related.

RFAI scores have an intrinsic variability of ±3 points. This variability comes from various sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured (TWRC, 2006). Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population. As long as the score is within the 6-point range, there is no certainty that any real change has taken place beyond method variability.

Results and Discussion

Fish Species Occurrence Analysis

During RFAI sampling from 1993 to 2008 at the Chickamauga Reservoir inflow station (TRM 529), located within the thermal discharge of WBN Plant, 48 fish species were collected (Table 2). Prior to WBN operation (1993 to 1995), 39 fish species were collected. During initial WBN operation (1996 to 1997), 34 fish species were encountered. Sampling during subsequent years (1999 to 2008) has resulted in 45 species at this site.

Skipjack herring is the only species that has not been encountered at this site that was encountered prior to operation of WBN. This species was never collected in large numbers at this site; 25 individuals in 1993, 10 individuals in 1994, and 1 individual in 1995. It is commonly collected at other sites throughout Chickamauga Reservoir (Appendix 1).

In recent years (1999 to 2008), six native species (bullhead minnow, river redhorse, rock bass, smallmouth redhorse, spotted gar, and walleye) and one non-native species (inland silverside) have been collected at this site that were not encountered in WBN pre-operational samples (Table 2, Appendix 1).

Chestnut lamprey (1 individual) and mooneye (1 individual) were collected in samples at this site during monitoring during initial operation (1997) but were not collected in pre-operational samples or samples during subsequent years (Table 2). Chestnut lamprey is a parasitic fish that

feeds on larger bodied fishes. It has been sporadically collected throughout Chickamauga Reservoir during 1993 to 2008 RFAI samples (Appendix1). Only 7 mooneye, including the 1 individual collected at this site in 1997 have been collected in Chickamauga Reservoir during 1993 to 2008 (Appendix).

During RFAI sampling from 1993 to 2008 at all sampling sites in Chickamauga Reservoir, 58 fish species have been collected (Table 3). Prior to WBN operation (1993 to 1995), 47 fish species were collected. During initial WBN operation (1996 to 1997), 43 fish species were encountered. Sampling during subsequent years (1999 to 2008) has resulted in collection of 55 species in Chickamauga Reservoir.

Two native species (highfin carpsucker and river carpsucker) and one non-native species (grass carp) were collected in Chickamauga Reservoir prior to WBN operation that have not been collected post WBN operation (Table 3). Both of these native species were represented by 1 individual at the Chickamauga transition zone site (TRM 490.5) in 1994 (Appendix 1). This site is located ~38 river miles downstream of WBN which precludes any possible thermal impact from WBN to the known occurrence of these species in Chickamauga Reservoir.

Seven native species (black buffalo, lake sturgeon, mooneye, river redhorse, rock bass, smallmouth redhorse, and western mosquitofish) and three non-native species (alewife, Atlantic needlefish, and inland silverside) have been collected in recent RFAI samples (1999 to 2008) that were not collected before WBN operation in Chickamauga Reservoir (Table 3, Appendix 1).

In conclusion, there has not been a decline in the number of species or overall fish community composition at the site located within the thermal discharge of WBN or within Chickamauga Reservoir.

RFAI Analysis

RFAI scores for the inflow site (TRM 529) downstream from the WBN thermal discharge have averaged a score of 45 during the 15 sample years from 1993 to 2008 (Table 4). Scores from every sample year were ≥ 70% of the highest attainable score of 60 indicating that BIP had been

maintained. Individual metric scores and overall RFAI scores for all sites in Chickamauga Reservoir and the Watts Bar Reservoir forebay site upstream of WBN are listed in Appendix 2-A to Appendix 2-P.

The greatest score difference between consecutive sample years at this site was six points, which has been observed twice throughout the duration of RFAI sampling at this site (Table 4). This site received a score of 48 in 1995 and dropped to a 42 the following year. An evaluation of individual metrics showed that the 1996 sample scored 2 points lower for 3 metrics (percent dominance by one species, percent top carnivores, and percent omnivores) (Appendices 2-M, 2-N). Collection of 3,577 gizzard shad during 1996, compared to 790 during 1995 was predominantly responsible for these score differences (Appendix 1). Species composition and abundance of top carnivore species was similar between years but collection of such a large number of gizzard shad reduced the overall percentage of top carnivores present in the sample and subsequently increased the percent dominance by one species and the percentage of omnivores in the overall sample. Metrics that indicate degradation such as "number of benthic invertivores" and "number of intolerant species" received the same score during both sample years.

The second occurrence of a score difference of six points was during 2003 (score of 48) and 2004 (score of 42). An evaluation of individual metrics showed that the 2004 sample scored 2 points lower for 4 metrics (percent tolerant individuals, percent dominance by one species, percent omnivores, and number of intolerant species), while the 2003 sample received a 2 point lower score for the metric "percent top carnivores" (Appendices 2-E, 2-F). Once again, collection of large numbers of gizzard shad during 2004 was the primary the reason for lower metric scores. During 2004, 750 gizzard shad were collected compared to 178 during 2003 (Appendix 1). This resulted in lower scores for "percent tolerant individuals", "percent dominance by one species", and "percent omnivores". Although the 2003 sample received a higher score for the metric "percent tolerant individuals", observed values were similar (57.7% in 2003 compared to 64.8% in 2004). The lower score for the metric "number of intolerant species" during 2004 was the result of collection of 1 less intolerant species. The same intolerant species were collected during both sample years with the exception of 6 black redhorse during

2003 (Appendix 1). Although less intolerant species were collected during 2004, 69 intolerant individuals were collected compared to 25 individuals during 2003.

Other RFAI samples in Chickamauga Reservoir (transition, forebay {2 sites}, and embayment) have averaged scores ≥ 42 from 1993 to 2008 which are $\geq 70\%$ of the highest attainable score of 60 indicating that BIP had been maintained throughout Chickamauga Reservoir (Table 4). Lower scores at some sites have been observed in recent years, most notably during 2007 and 2008. This period was a severe drought period which may have stressed fish communities at sites within the transition and forebay zones of the reservoir. This was also observed in Watts Bar Reservoir forebay which is upstream of the WBN thermal discharge (Table 4). RFAI scores at the Chickamauga Reservoir inflow site in the vicinity of WBN did not noticeably change during this drought period. Long term trends in RFAI scores do not indicate that overall fish community health, diversity, and structure has declined in the vicinity of WBN or throughout Chickamauga Reservoir.

Literature Cited

Hickman, G. D. and T. A. McDonough. 1996. Assessing the Reservoir Fish Assemblage Index-A potential measure of reservoir quality. *In*: D. DeVries (Ed.) Reservoir symposium-Multidimensional approaches to reservoir fisheries management. Reservoir Committee, Southern Division, American Fisheries Society, Bethesda, MD. pp 85-97.

Hubert, W. A., 1996. Passive capture techniques, entanglement gears. Pages 160-165 in B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society Bethesda, Maryland, USA.

Jennings, M. J., L. S. Fore, and J. R. Karr. 1995. Biological monitoring of fish assemblages in the Tennessee Valley reservoirs. Regulated Rivers 11:263-274.

McDonough, T.A. and G.D. Hickman. 1999. Reservoir Fish Assemblage Index development: A tool for assessing ecological health in Tennessee Valley Authority impoundments. *In*: Assessing the sustainability and biological integrity of water resources using fish communities. Simon, T. (Ed.) CRC Press, Boca Raton, pp 523-540.

Reynolds, J. B., 1996. Electrofishing. Pages 221-251 in B. R. Murphy and D. W. Willis,editors. Fisheries techniques, 2nd edition. American Fisheries Society Bethesda, Maryland, USA.

Tennessee Wildlife Resources Commission (TWRC). 2006. Strategic Plan, 2006-2012. Tennessee Wildlife Resources Commission, Nashville, TN. pp. 124-125. http://tennessee.gov/twra/pdfs/StratPlan06-12.pdf

Table 1. Scoring criteria for forebay, transition, and inflow sections of upper mainstream Tennessee River reservoirs. Upper mainstream reservoirs include Chickamauga, Fort Loudoun, Melton Hill, Nickajack, Tellico, and Watts Bar.

		Scoring Criteria								
		Forebay			Transition			Inflow		
Metric	Gear	1	3	5	1	3	5	1	3	5
1. Total species	Combined	<14	14-27	>27	<15	15-29	>29	<14	14-27	>27
2. Total Centrarchid species	Combined	<2	2-4	>4	<2	2-4	>4	<3	3-4	>4
3. Total benthic invertivores	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
4. Total intolerant species	Combined	<2	2-4	>4	<2	2-4	>4	<2	2-4	>4
5. Percent tolerant individuals	Electrofishing	>62%	31-62%	<31%	>62%	31-62%	<31%	>58%	29-58%	<29%
	Gill netting	>28%	14-28%	<14%	>32%	16-32%	<16%			
6. Percent dominance by 1 species	Electrofishing	>50%	25-50%	<25%	>40%	20-40%	<20%	>46%	23-46%	<23%
	Gill netting	>29%	15-29%	<15%	>28%	14-28%	<14%			
7. Percent non-native species	Electrofishing	>4%	2-4%	<2%	>6%	3-6%	<3%	>17%	8-17%	<8%
	Gill netting	>16%	8-16%	<8%	>9%	5-9%	<5%			
8. Total top carnivore species	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
9. Percent top carnivores	Electrofishing	<5%	5-10%	>10%	<6%	6-11%	>11%	<11%	11-22%	>22%
	Gill netting	<25%	25-50%	>50%	<26%	26-52%	>52%			
10. Percent omnivores	Electrofishing	>49%	24-49%	<24%	>44%	22-44%	<22%	>55%	27-55%	<27%
	Gill netting	>34%	17-34%	<17%	>46%	23-46%	<23%			
11. Average number per run	Electrofishing	<121	121-241	>241	<105	105-210	>210	<51	51-102	>102
	Gill netting	<12	12-24	>24	<12	12-24	>24			
12. Percent anomalies	Electrofishing	>5%	2-5%	<2%	>5%	2-5%	<2%	>5%	2-5%	<2%
	Gill netting	>5%	2-5%	<2%	>5%	2-5%	<2%			

Table 2. Comparison of fish species collected during autumn RFAI sampling at the Chickamauga Reservoir inflow site located within the WBN thermal discharge (TRM 529) pre-operation (1993-1995), during initial operation (1996-1997), and in subsequent years (1999-2008) during operation of WBN Unit 1. Species are listed in alphabetical order by common name.

Common Name	Scientific Name	1993-1995	1996-1997	1999-2008
Black crappie	*Pomoxis nigromaculatus*	X	X	X
Black redhorse	*Moxostoma duquesnei*	X	X	X
Blue catfish	*Ictalurus furcatus*	X	---	X
Bluegill	*Lepomis macrochirus*	X	X	X
Bluntnose minnow	*Pimephales notatus*	X	X	X
Brook silverside	*Labidesthes sicculus*	X	---	X
Bullhead minnow	*Pimephales vigilax*	---	---	X
Channel catfish	*Ictalurus punctatus*	X	X	X
Chestnut lamprey	*Ichthyomyzon castaneus*	---	X	---
Common carp	*Cyprinus carpio*	X	X	X
Emerald shiner	*Notropis atherinoides*	X	X	X
Flathead catfish	*Pylodictis olivaris*	X	X	X
Freshwater drum	*Aplodinotus grunniens*	X	X	X
Gizzard shad	*Dorosoma cepedianum*	X	X	X
Golden redhorse	*Moxostoma erythrurum*	X	X	X
Golden shiner	*Notemigonus crysoleucas*	X	X	X
Green sunfish	*Lepomis cyanellus*	X	X	X
Hybrid stripped x white bass	*Morone saxatilis x chrysops*	---	X	---
Hybrid sunfish	*Lepomis sp*	X	X	X
Inland silverside	*Menidia beryllina*	---	---	X
Largemouth bass	*Micropterus salmoides*	X	X	X
Largescale stoneroller	*Campostoma oligolepis*	X	---	X
Logperch	*Percina caprodes*	X	X	X
Longear sunfish	*Lepomis megalotis*	X	X	X
Longnose gar	*Lepisosteus osseus*	X	X	X
Mooneye	*Hiodon tergisus*	---	X	---
Northern hog sucker	*Hypentelium nigricans*	X	X	X
Redbreast sunfish	*Lepomis auritus*	X	X	X
Redear sunfish	*Lepomis microlophus*	X	X	X
River redhorse	*Moxostoma carinatum*	---	X	X
Rock bass	*Ambloplites rupestris*	---	---	X
Sauger	*Sander canadensis*	X	X	X
Skipjack herring	*Alosa chrysochloris*	X	---	---
Smallmouth bass	*Micropterus dolomieu*	X	X	X
Smallmouth buffalo	*Ictiobus bubalus*	X	---	X
Smallmouth redhorse	*Moxostoma breviceps*	---	---	X
Spotfin shiner	*Cyprinella spiloptera*	X	X	X
Spotted bass	*Micropterus punctulatus*	X	X	X
Spotted gar	*Lepisosteus oculatus*	---	---	X
Spotted sucker	*Minytrema melanops*	X	X	X
Steelcolor shiner	*Cyprinella whipplei*	X	---	X
Striped bass	*Morone saxatilis*	X	---	X
Striped shiner	*Luxilus chrysocephalus*	X	---	X
Threadfin shad	*Dorosoma petenense*	X	X	X
Walleye	*Sander vitreus*	---	---	X
Warmouth	*Lepomis gulosus*	X	X	X
White bass	*Morone chrysops*	X	X	X
White crappie	*Pomoxis annularis*	X	X	X
Yellow bass	*Morone mississippiensis*	X	X	X
Yellow perch	*Perca flavescens*	X	X	X
Total number of species (excluding hybrids)		**39**	**34**	**45**

Table 3. Comparison of fish species collected during autumn RFAI sampling at all sites in Chickamauga Reservoir pre-operation (1993-1995), during initial operation (1996-1997), and in subsequent years (1999-2008) during operation of WBN Unit 1. Species are listed in alphabetical order by common name.

Common Name	Scientific Name	1993-1995	1996-1997	1999-2008
Alewife	*Alosa pseudoharengus*	---	---	X
Atlantic needlefish	*Strongylura marina*	---	---	X
Black buffalo	*Ictiobus niger*	---	---	X
Black crappie	*Pomoxis nigromaculatus*	X	X	X
Black redhorse	*Moxostoma duquesnei*	X	X	X
Blue catfish	*Ictalurus furcatus*	X	X	X
Bluegill	*Lepomis macrochirus*	X	X	X
Bluntnose minnow	*Pimephales notatus*	X	X	X
Brook silverside	*Labidesthes sicculus*	X	X	X
Bullhead minnow	*Pimephales vigilax*	X	X	X
Channel catfish	*Ictalurus punctatus*	X	X	X
Chestnut lamprey	*Ichthyomyzon castaneus*	X	X	X
Common carp	*Cyprinus carpio*	X	X	X
Emerald shiner	*Notropis atherinoides*	X	X	X
Flathead catfish	*Pylodictis olivaris*	X	X	X
Freshwater drum	*Aplodinotus grunniens*	X	X	X
Gizzard shad	*Dorosoma cepedianum*	X	X	X
Golden redhorse	*Moxostoma erythrurum*	X	X	X
Golden shiner	*Notemigonus crysoleucas*	X	X	X
Grass carp	*Ctenopharyngodon idella*	X	---	---
Green sunfish	*Lepomis cyanellus*	X	X	X
Highfin Carpsucker	*Carpiodes velifer*	X	---	---
Hybrid bass	*Micropterus sp.*	---	---	X
Hybrid shad	*Dorosoma sp*	X	X	X
Hybrid stripped x white bass	*Morone saxatilis x chrysops*	X	X	X
Hybrid sunfish	*Lepomis sp*	X	X	X
Hybrid walleye x sauger	*Sander vitreus x canadensis*	---	---	X
Inland silverside	*Menidia beryllina*	---	---	X
Lake sturgeon	*Acipenser fulvescens*	---	---	X
Largemouth bass	*Micropterus salmoides*	X	X	X
Largescale stoneroller	*Campostoma oligolepis*	X	---	X
Logperch	*Percina caprodes*	X	X	X
Longear sunfish	*Lepomis megalotis*	X	X	X
Longnose gar	*Lepisosteus osseus*	X	X	X
Mooneye	*Hiodon tergisus*	---	X	X
Northern hog sucker	*Hypentelium nigricans*	X	X	X
Redbreast sunfish	*Lepomis auritus*	X	X	X
Redear sunfish	*Lepomis microlophus*	X	X	X
River carpsucker	*Carpiodes carpio*	X	---	---
River redhorse	*Moxostoma carinatum*	---	X	X
Rock bass	*Ambloplites rupestris*	---	---	X
Sauger	*Sander canadensis*	X	X	X
Skipjack herring	*Alosa chrysochloris*	X	X	X
Silver redhorse	*Moxostoma anisurum*	X	---	X

Table 3. (Continued)

Common Name	Scientific Name	1993-1995	1996-1997	1999-2008
Smallmouth bass	*Micropterus dolomieu*	'X	X	X
Smallmouth buffalo	*Ictiobus bubalus*	X	X	X
Smallmouth redhorse	*Moxostoma breviceps*	---	---	X
Spotfin shiner	*Cyprinella spiloptera*	X	X	X
Spotted bass	*Micropterus punctulatus*	X	X	X
Spotted gar	*Lepisosteus oculatus*	X	X	X
Spotted sucker	*Minytrema melanops*	X	X	X
Steelcolor shiner	*Cyprinella whipplei*	X	---	X
Striped bass	*Morone saxatilis*	X	X	X
Striped shiner	*Luxilus chrysocephalus*	X	---	X
Threadfin shad	*Dorosoma petenense*	X	X	X
Walleye	*Sander vitreus*	X	X	X
Warmouth	*Lepomis gulosus*	X	X	X
Western mosquitofish	*Gambusia affinis*	---	---	X
White bass	*Morone chrysops*	X	X	X
White crappie	*Pomoxis annularis*	X	X	X
Yellow bass	*Morone mississippiensis*	X	X	X
Yellow bullhead	*Ameiurus natalis*	---	X	X
Yellow perch	*Perca flavescens*	X	X	X
Total number of species (excluding hybrids):		**47**	**43**	**55**

Table 4. Summary of RFAI scores from sites located directly upstream and downstream of Watts Bar Nuclear Plant as well as scores from sampling conducted during 1993-2008 as part of the Vital Signs Monitoring Program in Chickamauga Reservoir.

Station	Location	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
WBN Upstream Forebay	TRM 531.0	44	48	---	43	---	41	36	44	39	39	45	43	46	42	36	36	42
WBN Downstream Inflow	TRM 529.0	52	52	48	42	46	---	42	44	46	48	48	42	42	42	42	44	45
Transition	TRM 490.5	51	40	48	43	39	---	45	46	45	51	42	49	46	47	44	34	45
Forebay	TRM 482.0	---	---	---	47	---	---	41	48	46	43	45	41	39	35	38	38	42
Forebay	TRM 472.3	43	44	47	---	40	---	45	45	48	46	43	43	46	43	41	41	44
Hiwassee River Embayment	HiRM 8.5	46	39	39	---	38	---	43	43	47	---	36	42	45	---	41	---	42

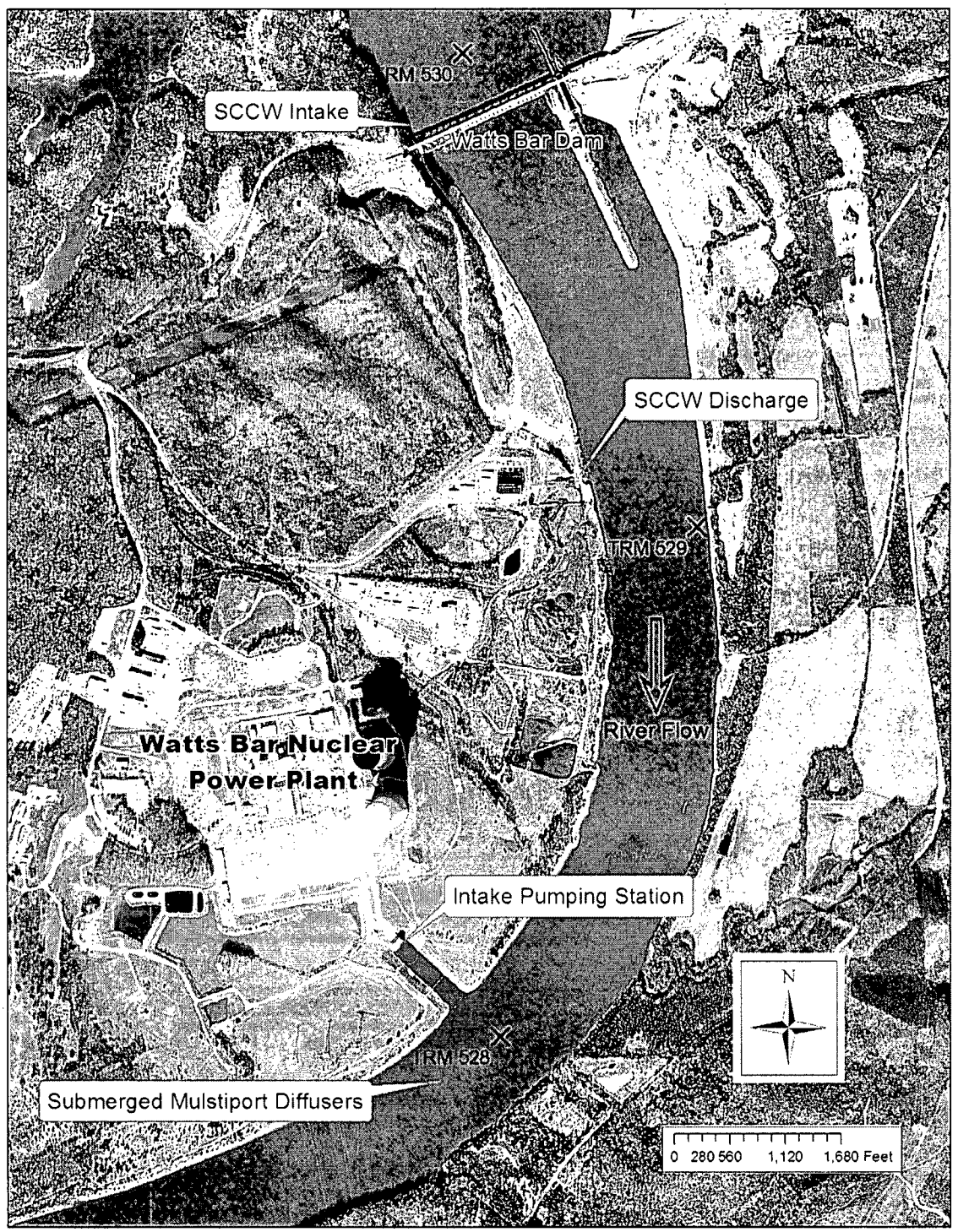

Figure 1. Map of WBN showing location of SCCW intake and discharge.

Appendix 1. Species list and number of fish collected by year and Tennessee River mile (TRM) in Chickamauga Reservoir (TRM 529, 490.5, 482, 472.2, and Hiwassee River mile 8.4) and Watts Bar Reservoir forebay (TRM 531) during autumn RFAI sampling (electro-fishing {EF} and gill netting), 1993 to 2008. Species are listed in alphabetical order by common name.

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Alewife	*Alosa pseudoharengus*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Alewife	*Alosa pseudoharengus*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Atlantic needlefish	*Strongylura marina*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Atlantic needlefish	*Strongylura marina*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Black buffalo	*Ictiobus niger*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	1	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	3	---	3
			482.0	---	---	---
			472.3	1	---	1
			HIRM 8.5	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Black buffalo	*Ictiobus niger*					
		2002	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	1	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	12	---	12
		2004	531.0	2	---	2
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	6	---	6
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	2	3	5
		2006	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	2	1	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Black crappie	*Pomoxis nigromaculatus*					
		1993	531.0	3	4	7
			529.0	15	---	15
			490.5	19	14	33
			472.3	---	14	14
			HIRM 8.5	1	47	48
		1994	531.0	1	---	1
			529.0	7	---	7
			490.5	3	---	3
			472.3	1	2	3
			HIRM 8.5	7	---	7
		1995	529.0	6	---	6
			490.5	10	1	11
			472.3	7	16	23
			HIRM 8.5	1	1	2
		1996	531.0	---	---	---
			529.0	16	---	16
			490.5	---	---	---
			482.0	---	18	18
		1997	529.0	12	---	12
			490.5	---	---	---
			472.3	---	2	2
			HiRM 8.5	1	---	1
		1998	531.0	---	1	1
		1999	531.0	---	1	1
			529.0	4	---	4
			490.5	1	1	2
			482.0	---	---	---
			472.3	1	4	5
			HIRM 8.5	6	3	9
		2000	531.0	7	2	9
			529.0	43	---	43
			490.5	18	9	27
			482.0	2	2	4
			472.3	---	4	4
			HIRM 8.5	14	5	19
		2001	531.0	2	34	36
			529.0	---	---	---
			490.5	6	5	11
			482.0	---	32	32
			472.3	1	41	42
			HIRM 8.5	12	15	27

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Black crappie	*Pomoxis nigromaculatus*					
		2002	531.0	1	25	26
			529.0	18	---	18
			490.5	17	8	25
			482.0	3	1	4
			472.3	1	23	24
		2003	531.0	6	7	13
			529.0	13	---	13
			490.5	19	8	27
			482.0	4	1	5
			472.3	---	8	8
			HIRM 8.5	12	---	12
		2004	531.0	---	13	13
			529.0	23	---	23
			490.5	23	10	33
			482.0	5	4	9
			472.3	5	14	19
			HIRM 8.5	25	7	32
		2005	531.0	1	52	53
			529.0	26	---	26
			490.5	3	4	7
			482.0	6	2	8
			472.3	2	8	10
			HIRM 8.5	14	3	17
		2006	531.0	3	29	32
			529.0	5	---	5
			490.5	12	18	30
			482.0	2	13	15
			472.3	1	47	48
		2007	531.0	---	44	44
			529.0	4	---	4
			490.5	2	56	58
			482.0	1	21	22
			472.3	1	57	58
			HIRM 8.5	18	1	19
		2008	531.0	---	7	7
			529.0	5	---	5
			490.5	8	22	30
			482.0	3	20	23
			472.3	1	30	31

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Black redhorse	*Moxostoma duquesnei*					
		1993	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	6	---	6
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	4	---	4
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	4	---	4
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	5	---	5
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	---	---
			529.0	2	---	2
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Black redhorse	*Moxostoma duquesnei*					
		2003	531.0	---	---	---
			529.0	6	---	6
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	2	---	2
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2006	531.0	---	---	---
			529.0	6	---	6
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	2	---	2
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	6	---	6
		2008	531.0	---	---	---
			529.0	3	---	3
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Blue catfish	*Ictalurus furcatus*					
		1993	531.0	---	10	10
			529.0	1	---	1
			490.5	1	8	9
			472.3	1	4	5
			HIRM 8.5	---	1	1
		1994	531.0	---	4	4
			529.0	1	---	1
			490.5	---	4	4
			472.3	---	7	7
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	6	6
			472.3	---	9	9
			HIRM 8.5	1	7	8
		1996	531.0	---	6	6
			529.0	---	---	---
			490.5	---	7	7
			482.0	---	2	2
		1997	529.0	---	---	---
			490.5	---	6	6
			472.3	---	---	---
			HiRM 8.5	---	3	3
		1998	531.0	---	7	7
		1999	531.0	---	37	37
			529.0	---	---	---
			490.5	---	4	4
			482.0	---	15	15
			472.3	---	18	18
			HIRM 8.5	---	3	3
		2000	531.0	---	8	8
			529.0	1	---	1
			490.5	---	---	---
			482.0	10	8	18
			472.3	---	22	22
			HIRM 8.5	---	---	---
		2001	531.0	---	5	5
			529.0	11	---	11
			490.5	---	17	17
			482.0	2	18	20
			472.3	---	38	38
			HIRM 8.5	---	1	1
		2002	531.0	---	11	11
			529.0	---	---	---
			490.5	---	---	---
			482.0	8	2	10
			472.3	---	5	5

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Blue catfish	*Ictalurus furcatus*					
		2003	531.0	---	3	3
			529.0	2	---	2
			490.5	---	26	26
			482.0	---	12	12
			472.3	---	16	16
			HIRM 8.5	---	1	1
		2004	531.0	---	3	3
			529.0	---	---	---
			490.5	---	15	15
			482.0	---	8	8
			472.3	---	14	14
			HIRM 8.5	---	---	---
		2005	531.0	---	4	4
			529.0	2	---	2
			490.5	---	17	17
			482.0	---	23	23
			472.3	---	29	29
			HIRM 8.5	---	---	---
		2006	531.0	---	2	2
			529.0	1	---	1
			490.5	---	1	1
			482.0	---	15	15
			472.3	---	5	5
		2007	531.0	---	3	3
			529.0	---	---	---
			490.5	---	7	7
			482.0	1	32	33
			472.3	---	11	11
			HIRM 8.5	2	2	4
		2008	531.0	---	9	9
			529.0	2	---	2
			490.5	---	7	7
			482.0	4	12	16
			472.3	---	14	14

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Bluegill	*Lepomis macrochirus*					
		1993	531.0	102	2	104
			529.0	460	---	460
			490.5	372	3	375
			472.3	160	3	163
			HIRM 8.5	361	6	367
		1994	531.0	348	3	351
			529.0	483	---	483
			490.5	217	1	218
			472.3	382	3	385
			HIRM 8.5	321	1	322
		1995	529.0	306	---	306
			490.5	148	2	150
			472.3	82	4	86
			HIRM 8.5	103	2	105
		1996	531.0	136	1	137
			529.0	459	---	459
			490.5	115	1	116
			482.0	442	1	443
		1997	529.0	222	---	222
			490.5	---	1	1
			472.3	52	2	54
			HiRM 8.5	27	---	27
		1998	531.0	156	1	157
		1999	531.0	46	1	47
			529.0	52	---	52
			490.5	29	1	30
			482.0	25	3	28
			472.3	14	1	15
			HIRM 8.5	159	1	160
		2000	531.0	329	1	330
			529.0	355	---	355
			490.5	83	4	87
			482.0	311	3	314
			472.3	126	1	127
			HIRM 8.5	148	6	154
		2001	531.0	264	5	269
			529.0	166	---	166
			490.5	97	23	120
			482.0	405	3	408
			472.3	36	2	38
			HIRM 8.5	262	4	266

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Bluegill	*Lepomis macrochirus*					
		2002	531.0	254	---	254
			529.0	244	---	244
			490.5	361	---	361
			482.0	178	---	178
			472.3	184	2	186
		2003	531.0	419	---	419
			529.0	354	---	354
			490.5	193	---	193
			482.0	170	4	174
			472.3	144	7	151
			HIRM 8.5	272	---	272
		2004	531.0	368	---	368
			529.0	89	---	89
			490.5	219	2	221
			482.0	277	5	282
			472.3	112	2	114
			HIRM 8.5	449	2	451
		2005	531.0	540	---	540
			529.0	177	---	177
			490.5	247	5	252
			482.0	220	2	222
			472.3	236	6	242
			HIRM 8.5	190	2	192
		2006	531.0	485	1	486
			529.0	250	---	250
			490.5	171	8	179
			482.0	307	5	312
			472.3	309	1	310
		2007	531.0	281	2	283
			529.0	402	---	402
			490.5	228	3	231
			482.0	203	8	211
			472.3	376	7	383
			HIRM 8.5	322	1	323
		2008	531.0	935	2	937
			529.0	892	---	892
			490.5	698	---	698
			482.0	695	---	695
			472.3	1306	5	1311

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Bluntnose minnow	*Pimephales notatus*					
		1993	531.0	19	---	19
			529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1994	531.0	1	---	1
			529.0	24	---	24
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1996	531.0	1	---	1
			529.0	1	---	1
			490.5	1	---	1
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	4	---	4
		1998	531.0	19	---	19
		1999	531.0	---	---	---
			529.0	2	---	2
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2000	531.0	9	---	9
			529.0	---	---	---
			490.5	---	---	---
			482.0	12	---	12
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2001	531.0	3	---	3
			529.0	1	---	1
			490.5	21	---	21
			482.0	4	---	4
			472.3	---	---	---
			HIRM 8.5	13	---	13
		2002	531.0	2	---	2
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Bluntnose minnow	*Pimephales notatus*					
		2003	531.0	2	---	2
			529.0	2	---	2
			490.5	12	---	12
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	20	---	20
		2004	531.0	---	---	---
			529.0	1	---	1
			490.5	5	---	5
			482.0	3	---	3
			472.3	---	---	---
			HIRM 8.5	3	---	3
		2005	531.0	1	---	1
			529.0	---	---	---
			490.5	2	---	2
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2006	531.0	21	---	21
			529.0	---	---	---
			490.5	1	---	1
			482.0	30	---	30
			472.3	---	---	---
		2007	531.0	1	---	1
			529.0	---	---	---
			490.5	3	---	3
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	14	---	14
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Brook silverside	*Labidesthes sicculus*					
		1993	531.0	94	---	94
			529.0	12	---	12
			490.5	130	---	130
			472.3	127	---	127
			HIRM 8.5	1	---	1
		1994	531.0	6	---	6
			529.0	28	---	28
			490.5	---	---	---
			472.3	234	---	234
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	624	---	624
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1996	531.0	16	---	16
			529.0	---	---	---
			490.5	10	---	10
			482.0	16	---	16
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	4	---	4
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	9	---	9
			HIRM 8.5	---	---	---
		2000	531.0	24	---	24
			529.0	---	---	---
			490.5	1	---	1
			482.0	2	---	2
			472.3	152	---	152
			HIRM 8.5	3	---	3
		2001	531.0	14	---	14
			529.0	19	---	19
			490.5	7	---	7
			482.0	6	---	6
			472.3	4	---	4
			HIRM 8.5	12	---	12

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Brook silverside	*Labidesthes sicculus*					
		2002	531.0	4	---	4
			529.0	20	---	20
			490.5	13	---	13
			482.0	11	---	11
			472.3	51	---	51
		2003	531.0	70	---	70
			529.0	2	---	2
			490.5	10	---	10
			482.0	14	---	14
			472.3	11	---	11
			HIRM 8.5	12	---	12
		2004	531.0	36	---	36
			529.0	8	---	8
			490.5	13	---	13
			482.0	10	---	10
			472.3	41	---	41
			HIRM 8.5	2	---	2
		2005	531.0	52	---	52
			529.0	1	---	1
			490.5	5	---	5
			482.0	6	---	6
			472.3	10	---	10
			HIRM 8.5	7	---	7
		2006	531.0	3	---	3
			529.0	15	---	15
			490.5	---	---	---
			482.0	---	---	---
			472.3	3	---	3
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	2	---	2
			HIRM 8.5	---	---	---
		2008	531.0	2	---	2
			529.0	2	---	2
			490.5	---	---	---
			482.0	1	---	1
			472.3	2	---	2

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Bullhead minnow	*Pimephales vigilax*					
		1993	531.0	10	---	10
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	2	---	2
			HIRM 8.5	3	---	3
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	---	---
			529.0	6	---	6
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Bullhead minnow	*Pimephales vigilax*					
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	2	---	2
			472.3	---	---	---
		2007	531.0	1	---	1
			529.0	---	---	---
			490.5	1	---	1
			482.0	3	---	3
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	6	---	6
			529.0	1	---	1
			490.5	9	---	9
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Channel catfish	*Ictalurus punctatus*					
		1993	531.0	1	11	12
			529.0	10	---	10
			490.5	---	11	11
			472.3	---	3	3
			HIRM 8.5	---	5	5
		1994	531.0	1	3	4
			529.0	10	---	10
			490.5	---	4	4
			472.3	1	7	8
			HIRM 8.5	---	6	6
		1995	529.0	28	---	28
			490.5	4	9	13
			472.3	15	8	23
			HIRM 8.5	---	---	---
		1996	531.0	1	3	4
			529.0	7	---	7
			490.5	3	7	10
			482.0	7	4	11
		1997	529.0	1	---	1
			490.5	4	2	6
			472.3	---	---	---
			HiRM 8.5	---	11	11
		1998	531.0	---	6	6
		1999	531.0	---	11	11
			529.0	4	---	4
			490.5	2	3	5
			482.0	4	16	20
			472.3	---	4	4
			HIRM 8.5	---	5	5
		2000	531.0	2	8	10
			529.0	3	---	3
			490.5	21	---	21
			482.0	8	1	9
			472.3	---	4	4
			HIRM 8.5	---	8	8
		2001	531.0	1	10	11
			529.0	11	---	11
			490.5	17	11	28
			482.0	8	4	12
			472.3	2	6	8
			HIRM 8.5	1	11	12
		2002	531.0	1	5	6
			529.0	22	---	22
			490.5	17	3	20
			482.0	13	9	22
			472.3	1	2	3

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Channel catfish	*Ictalurus punctatus*					
		2003	531.0	5	5	10
			529.0	5	---	5
			490.5	2	14	16
			482.0	6	15	21
			472.3	---	10	10
			HIRM 8.5	1	5	6
		2004	531.0	2	8	10
			529.0	9	---	9
			490.5	10	7	17
			482.0	15	7	22
			472.3	11	12	23
			HIRM 8.5	2	6	8
		2005	531.0	10	2	12
			529.0	15	---	15
			490.5	---	6	6
			482.0	6	13	19
			472.3	---	5	5
			HIRM 8.5	---	5	5
		2006	531.0	4	1	5
			529.0	20	---	20
			490.5	4	4	8
			482.0	3	14	17
			472.3	5	2	7
		2007	531.0	4	2	6
			529.0	12	---	12
			490.5	1	2	3
			482.0	12	8	20
			472.3	3	6	9
			HIRM 8.5	5	6	11
		2008	531.0	3	3	6
			529.0	16	---	16
			490.5	3	2	5
			482.0	18	5	23
			472.3	2	5	7

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Chestnut lamprey	*Ichthyomyzon castaneus*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	4	---	4
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	3	---	3
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	1	---	1
			490.5	4	---	4
			472.3	2	---	2
			HiRM 8.5	1	---	1
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	4	---	4
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Chestnut lamprey	*Ichthyomyzon castaneus*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	3	---	3
			482.0	---	---	---
			472.3	1	---	1
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	2	---	2
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Common Carp	*Cyprinus carpio*					
		1993	531.0	4	6	10
			529.0	23	---	23
			490.5	16	1	17
			472.3	4	---	4
			HIRM 8.5	19	2	21
		1994	531.0	28	---	28
			529.0	13	---	13
			490.5	21	---	21
			472.3	15	1	16
			HIRM 8.5	31	5	36
		1995	529.0	7	---	7
			490.5	7	---	7
			472.3	4	---	4
			HIRM 8.5	30	2	32
		1996	531.0	10	5	15
			529.0	10	---	10
			490.5	7	1	8
			482.0	12	---	12
		1997	529.0	49	---	49
			490.5	12	---	12
			472.3	4	---	4
			HiRM 8.5	---	---	---
		1998	531.0	16	4	20
		1999	531.0	13	6	19
			529.0	4	---	4
			490.5	3	---	3
			482.0	11	---	11
			472.3	---	---	---
			HIRM 8.5	4	1	5
		2000	531.0	11	---	9
			529.0	38	---	38
			490.5	13	---	13
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	5	2	7
		2001	531.0	8	2	10
			529.0	2	---	2
			490.5	11	---	11
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2002	531.0	7	3	10
			529.0	7	---	7
			490.5	7	---	7
			482.0	3	---	3
			472.3	3	1	4

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Common carp	*Cyprinus carpio*					
		2003	531.0	8	4	12
			529.0	6	---	6
			490.5	6	---	6
			482.0	2	1	3
			472.3	5	---	5
			HIRM 8.5	3	---	3
		2004	531.0	7	1	8
			529.0	6	---	6
			490.5	4	---	4
			482.0	8	---	8
			472.3	3	---	3
			HIRM 8.5	4	---	4
		2005	531.0	7	3	10
			529.0	6	---	6
			490.5	1	---	1
			482.0	2	---	2
			472.3	---	1	1
			HIRM 8.5	5	1	6
		2006	531.0	9	4	13
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	4	1	5
		2007	531.0	7	1	8
			529.0	1	---	1
			490.5	4	---	4
			482.0	1	---	1
			472.3	---	1	1
			HIRM 8.5	6	---	6
		2008	531.0	2	4	6
			529.0	---	---	---
			490.5	---	---	---
			482.0	2	---	2
			472.3	1	1	2

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Emerald shiner	*Notropis atherinoides*					
		1993	531.0	10	---	10
			529.0	885	---	885
			490.5	901	---	901
			472.3	754	---	754
			HIRM 8.5	193	---	193
		1994	531.0	1638	---	1638
			529.0	60	---	60
			490.5	87	---	87
			472.3	94	---	94
			HIRM 8.5	37	---	37
		1995	529.0	---	---	---
			490.5	868	---	868
			472.3	705	---	705
			HIRM 8.5	352	---	352
		1996	531.0	19	---	19
			529.0	3	---	3
			490.5	325	---	325
			482.0	1015	---	1015
		1997	529.0	21	---	21
			490.5	1	---	1
			472.3	20	---	20
			HIRM 8.5	117	---	117
		1998	531.0	1428	---	1428
		1999	531.0	6	---	6
			529.0	6	---	6
			490.5	27	---	27
			482.0	48	---	48
			472.3	15	---	15
			HIRM 8.5	46	---	46
		2000	531.0	---	---	---
			529.0	4	---	4
			490.5	26	---	26
			482.0	83	---	83
			472.3	164	---	164
			HIRM 8.5	65	---	65
		2001	531.0	---	---	---
			529.0	33	---	33
			490.5	69	---	69
			482.0	98	---	98
			472.3	20	---	20
			HIRM 8.5	59	---	59
		2002	531.0	---	---	---
			529.0	2	---	2
			490.5	54	---	54
			482.0	19	---	19
			472.3	64	---	64

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Emerald shiner	*Notropis atherinoides*					
		2003	531.0	---	---	---
			529.0	3	---	3
			490.5	15	---	15
			482.0	93	---	93
			472.3	95	---	95
			HIRM 8.5	4	---	4
		2004	531.0	11	---	11
			529.0	9	---	9
			490.5	62	---	62
			482.0	183	---	183
			472.3	260	---	260
			HIRM 8.5	55	---	55
		2005	531.0	2	---	2
			529.0	44	---	44
			490.5	21	---	21
			482.0	71	---	71
			472.3	51	---	51
			HIRM 8.5	8	---	8
		2006	531.0	---	---	---
			529.0	19	---	19
			490.5	23	---	23
			482.0	26	---	26
			472.3	10	---	10
		2007	531.0	---	---	---
			529.0	6	---	6
			490.5	36	---	36
			482.0	40	---	40
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	5	---	5
			490.5	3	---	3
			482.0	4	---	4
			472.3	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Flathead catfish	*Pylodictis olivaris*					
		1993	531.0	1	9	10
			529.0	10	---	10
			490.5	1	6	7
			472.3	1	2	3
			HIRM 8.5	1	3	4
		1994	531.0	3	7	10
			529.0	7	---	7
			490.5	1	5	6
			472.3	4	3	7
			HIRM 8.5	---	4	4
		1995	529.0	4	---	4
			490.5	7	2	9
			472.3	1	2	3
			HIRM 8.5	---	1	1
		1996	531.0	3	6	9
			529.0	9	---	9
			490.5	1	5	6
			482.0	1	3	4
		1997	529.0	4	---	4
			490.5	1	4	5
			472.3	---	2	2
			HIRM 8.5	---	1	1
		1998	531.0	3	5	8
		1999	531.0	5	4	9
			529.0	6	---	6
			490.5	1	---	1
			482.0	---	1	1
			472.3	---	2	2
			HIRM 8.5	1	2	3
		2000	531.0	6	15	21
			529.0	5	---	5
			490.5	---	1	1
			482.0	---	1	1
			472.3	10	2	12
			HIRM 8.5	---	1	1
		2001	531.0	3	8	11
			529.0	8	---	8
			490.5	3	3	6
			482.0	1	---	1
			472.3	---	3	3
			HIRM 8.5	2	---	2
		2002	531.0	10	18	28
			529.0	6	---	6
			490.5	2	3	5
			482.0	3	3	6
			472.3	---	1	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Flathead catfish	*Pylodictis olivaris*					
		2003	531.0	4	17	21
			529.0	5	---	5
			490.5	5	4	9
			482.0	2	3	5
			472.3	5	2	7
			HIRM 8.5	---	5	5
		2004	531.0	5	3	8
			529.0	9	---	9
			490.5	6	4	10
			482.0	---	2	2
			472.3	6	5	11
			HIRM 8.5	5	---	5
		2005	531.0	17	11	28
			529.0	17	---	17
			490.5	3	2	5
			482.0	5	8	13
			472.3	1	5	6
			HIRM 8.5	2	5	7
		2006	531.0	5	10	15
			529.0	7	---	7
			490.5	3	---	3
			482.0	2	1	3
			472.3	1	4	5
		2007	531.0	7	14	21
			529.0	28	---	28
			490.5	16	1	17
			482.0	1	4	5
			472.3	7	3	10
			HIRM 8.5	2	1	3
		2008	531.0	5	9	14
			529.0	10	---	10
			490.5	8	4	12
			482.0	---	2	2
			472.3	7	8	15

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Freshwater drum	*Aplodinotus grunniens*					
		1993	531.0	3	5	8
			529.0	4	---	4
			490.5	6	7	13
			472.3	1	9	10
			HIRM 8.5	4	7	11
		1994	531.0	4	1	5
			529.0	7	---	7
			490.5	4	5	9
			472.3	10	9	19
			HIRM 8.5	7	2	9
		1995	529.0	4	---	4
			490.5	4	6	10
			472.3	7	1	8
			HIRM 8.5	6	16	22
		1996	531.0	7	5	12
			529.0	9	---	9
			490.5	7	6	13
			482.0	1	8	9
		1997	529.0	6	---	6
			490.5	3	1	4
			472.3	1	8	9
			HIRM 8.5	1	19	20
		1998	531.0	1	2	3
		1999	531.0	7	22	29
			529.0	3	---	3
			490.5	7	13	20
			482.0	4	5	9
			472.3	2	12	14
			HIRM 8.5	4	13	17
		2000	531.0	5	18	23
			529.0	1	---	1
			490.5	3	1	4
			482.0	---	2	2
			472.3	1	13	14
			HIRM 8.5	3	8	11
		2001	531.0	6	11	17
			529.0	6	---	6
			490.5	2	13	15
			482.0	1	1	2
			472.3	1	6	7
			HIRM 8.5	5	18	23

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Freshwater drum	*Aplodinotus grunniens*					
		2002	531.0	4	10	14
			529.0	6	---	6
			490.5	7	3	10
			482.0	2	6	8
			472.3	1	4	5
		2003	531.0	5	1	6
			529.0	3	---	3
			490.5	5	7	12
			482.0	5	10	15
			472.3	4	5	9
			HIRM 8.5	5	10	15
		2004	531.0	10	2	12
			529.0	17	---	17
			490.5	19	5	24
			482.0	13	5	18
			472.3	19	7	26
			HIRM 8.5	4	13	17
		2005	531.0	12	3	15
			529.0	3	---	3
			490.5	2	6	8
			482.0	3	5	8
			472.3	5	9	14
			HIRM 8.5	---	4	4
		2006	531.0	1	6	7
			529.0	19	---	19
			490.5	3	6	9
			482.0	2	3	5
			472.3	6	5	11
		2007	531.0	3	5	8
			529.0	3	---	3
			490.5	9	14	23
			482.0	---	6	6
			472.3	6	6	12
			HIRM 8.5	2	4	6
		2008	531.0	2	3	5
			529.0	---	---	---
			490.5	2	6	8
			482.0	6	7	13
			472.3	10	7	17

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Gizzard shad	*Dorosoma cepedianum*					
		1993	531.0	388	57	445
			529.0	570	---	570
			490.5	399	45	444
			472.3	37	53	90
			HIRM 8.5	361	62	423
		1994	531.0	81	15	96
			529.0	184	---	184
			490.5	151	28	179
			472.3	61	56	117
			HIRM 8.5	64	8	72
		1995	529.0	790	---	790
			490.5	330	58	388
			472.3	31	18	49
			HIRM 8.5	829	30	859
		1996	531.0	271	46	317
			529.0	3577	---	3577
			490.5	274	36	310
			482.0	253	48	301
		1997	529.0	85	---	85
			490.5	82	16	98
			472.3	53	7	60
			HIRM 8.5	43	24	67
		1998	531.0	133	47	180
		1999	531.0	25	260	285
			529.0	46	---	46
			490.5	28	118	146
			482.0	14	76	90
			472.3	28	67	95
			HIRM 8.5	28	58	86
		2000	531.0	79	105	184
			529.0	91	---	91
			490.5	34	60	94
			482.0	135	---	135
			472.3	33	75	108
			HIRM 8.5	87	2	89
		2001	531.0	25	91	116
			529.0	44	---	44
			490.5	93	115	208
			482.0	76	83	159
			472.3	7	80	87
			HIRM 8.5	130	57	187
		2002	531.0	27	61	88
			529.0	138	---	138
			490.5	163	12	175
			482.0	170	3	173
			472.3	49	12	61

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Gizzard shad	*Dorosoma cepedianum*					
		2003	531.0	149	40	189
			529.0	178	---	178
			490.5	5	7	12
			482.0	5	10	15
			472.3	41	42	83
			HIRM 8.5	146	33	179
		2004	531.0	331	36	367
			529.0	750	---	750
			490.5	86	39	125
			482.0	147	47	194
			472.3	47	50	97
			HIRM 8.5	183	3	186
		2005	531.0	191	12	203
			529.0	307	---	307
			490.5	121	24	145
			482.0	203	87	290
			472.3	36	74	110
			HIRM 8.5	42	44	86
		2006	531.0	353	42	395
			529.0	269	---	269
			490.5	260	63	323
			482.0	188	32	220
			472.3	52	65	117
		2007	531.0	103	122	225
			529.0	111	---	111
			490.5	245	77	322
			482.0	109	72	181
			472.3	69	59	128
			HIRM 8.5	182	16	198
		2008	531.0	125	105	230
			529.0	180	---	180
			490.5	357	80	437
			482.0	108	73	181
			472.3	67	46	113

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Golden redhorse	*Moxostoma erythrurum*					
		1993	531.0	---	---	---
			529.0	8	---	8
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	7	---	7
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	4	4
		1995	529.0	10	---	10
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1996	531.0	---	---	---
			529.0	7	---	7
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	10	---	10
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	1	---	1
			529.0	7	---	7
			490.5	5	---	5
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	2	2
		2000	531.0	---	---	---
			529.0	4	---	4
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	1	1
			529.0	8	---	8
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2002	531.0	---	---	---
			529.0	7	---	7
			490.5	1	1	2
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Golden redhorse	*Moxostoma erythrurum*					
		2003	531.0	---	---	---
			529.0	6	---	6
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	1	2
		2004	531.0	---	1	1
			529.0	2	---	2
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2005	531.0	---	---	---
			529.0	8	---	8
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	3	3
		2006	531.0	---	---	---
			529.0	12	---	12
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	4	---	4
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	9	---	9
		2008	531.0	---	---	---
			529.0	7	---	7
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Golden shiner	*Notemigonus crysoleucas*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	42	1	43
			472.3	---	9	9
			HIRM 8.5	6	10	16
		1994	531.0	13	---	13
			529.0	6	---	6
			490.5	1	1	2
			472.3	---	5	5
			HIRM 8.5	43	---	43
		1995	529.0	10	---	10
			490.5	4	1	5
			472.3	---	---	---
			HIRM 8.5	10	---	10
		1996	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	3	---	3
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	3	---	3
			490.5	11	2	13
			482.0	11	8	19
			472.3	4	1	5
			HIRM 8.5	16	5	21
		2002	531.0	---	---	---
			529.0	3	---	3
			490.5	16	---	16
			482.0	1	---	1
			472.3	17	1	18

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Golden shiner	*Notemigonus crysoleucas*					
		2003	531.0	6	---	6
			529.0	3	---	3
			490.5	25	---	25
			482.0	6	1	7
			472.3	8	1	9
			HIRM 8.5	19	5	24
		2004	531.0	---	---	---
			529.0	1	---	1
			490.5	6	1	7
			482.0	3	---	15
			472.3	12	1	13
			HIRM 8.5	9	---	9
		2005	531.0	1	---	1
			529.0	3	---	3
			490.5	1	---	1
			482.0	16	---	16
			472.3	26	---	26
			HIRM 8.5	2	---	2
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	9	---	9
			482.0	4	2	6
			472.3	8	5	13
		2007	531.0	---	---	---
			529.0	1	---	1
			490.5	25	2	27
			482.0	---	1	1
			472.3	2	---	2
			HIRM 8.5	5	---	5
		2008	531.0	---	---	---
			529.0	8	---	8
			490.5	14	---	14
			482.0	11	---	11
			472.3	15	2	17

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Grass carp	*Ctenopharyngodon idella*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Grass carp	*Ctenopharyngodon idella*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Green sunfish	*Lepomis cyanellus*					
		1993	531.0	4	---	4
			529.0	1	---	1
			490.5	---	---	---
			472.3	3	---	3
			HIRM 8.5	---	---	---
		1994	531.0	4	---	4
			529.0	7	---	7
			490.5	1	---	1
			472.3	10	---	10
			HIRM 8.5	---	---	---
		1995	529.0	1	---	1
			490.5	1	---	1
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1996	531.0	6	---	6
			529.0	3	---	3
			490.5	---	---	---
			482.0	7	---	7
		1997	529.0	1	---	1
			490.5	---	---	---
			472.3	1	---	1
			HiRM 8.5	---	---	---
		1998	531.0	16	---	16
		1999	531.0	2	---	2
			529.0	5	---	5
			490.5	1	---	1
			482.0	1	---	1
			472.3	1	---	1
			HIRM 8.5	---	---	---
		2000	531.0	21	---	21
			529.0	4	---	4
			490.5	---	---	---
			482.0	2	---	2
			472.3	8	---	8
			HIRM 8.5	2	---	2
		2001	531.0	8	---	8
			529.0	11	---	11
			490.5	10	---	10
			482.0	1	---	1
			472.3	1	---	1
			HIRM 8.5	2	---	2

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Green sunfish	*Lepomis cyanellus*					
		2002	531.0	7	---	7
			529.0	4	---	4
			490.5	4	---	4
			482.0	---	---	---
			472.3	5	---	5
		2003	531.0	16	---	16
			529.0	3	---	3
			490.5	3	---	3
			482.0	---	---	---
			472.3	4	---	4
			HIRM 8.5	---	---	---
		2004	531.0	11	---	11
			529.0	5	---	5
			490.5	1	---	1
			482.0	---	---	---
			472.3	5	---	5
			HIRM 8.5	3	---	3
		2005	531.0	35	---	35
			529.0	30	---	30
			490.5	5	---	5
			482.0	2	---	2
			472.3	10	---	10
			HIRM 8.5	---	---	---
		2006	531.0	24	---	24
			529.0	3	---	3
			490.5	1	---	1
			482.0	1	---	1
			472.3	7	---	7
		2007	531.0	5	---	5
			529.0	3	---	3
			490.5	5	---	5
			482.0	3	---	3
			472.3	7	---	7
			HIRM 8.5	---	---	---
		2008	531.0	8	---	8
			529.0	26	---	26
			490.5	2	---	2
			482.0	---	---	---
			472.3	7	---	7

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Highfin carpsucker	*Carpiodes velifer*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Highfin carpsucker	*Carpiodes velifer*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid bass	*Micropterus sp.*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid bass	*Micropterus sp.*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	2	---	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid shad	*Dorosoma sp.*					
		1993	531.0	---	7	7
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	3	3
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	4	4
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	1	1
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid shad	*Dorosoma sp.*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	5	5
			472.3	---	4	4
		2007	531.0	---	14	14
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	3	3
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	2	2
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid striped x white bass	*Morone saxatilis x chrysops*					
		1993	531.0	---	1	1
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	4	4
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	3	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	3	3
		1997	529.0	1	---	1
			490.5	---	1	1
			472.3	---	5	5
			HIRM 8.5	---	2	2
		1998	531.0	1	---	1
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid striped x white bass	*Morone saxatilis x chrysops*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid sunfish	*Lepomis sp.*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1994	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1996	531.0	1	---	1
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	3	---	3
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	2	---	2
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	1	---	1
			490.5	7	---	7
			482.0	3	---	3
			472.3	1	---	1
			HIRM 8.5	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid sunfish	*Lepomis sp.*					
		2002	531.0	3	---	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		2004	531.0	7	---	7
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	2	---	2
			529.0	---	---	---
			490.5	2	---	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	2	---	2
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid walleye x sauger	*Sander vitreus x canadensis*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Hybrid walleye x sauger	*Sander vitreus x canadensis*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Inland silverside	*Menidia beryllina*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Inland silverside	*Menidia beryllina*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	10	---	10
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2005	531.0	13	---	13
			529.0	---	---	---
			490.5	4	---	4
			482.0	2	---	2
			472.3	1	---	1
			HIRM 8.5	---	---	---
		2006	531.0	48	---	48
			529.0	30	---	30
			490.5	6	---	6
			482.0	38	---	38
			472.3	18	---	18
		2007	531.0	7	---	7
			529.0	---	---	---
			490.5	3	---	3
			482.0	2	---	2
			472.3	22	---	22
			HIRM 8.5	35	---	35
		2008	531.0	---	---	---
			529.0	45	---	45
			490.5	51	---	51
			482.0	23	---	23
			472.3	105	---	105

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Lake sturgeon	*Acipenser fulvescens*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Lake sturgeon	*Acipenser fulvescens*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Largemouth bass	*Micropterus salmoides*					
		1993	531.0	28	12	40
			529.0	120	---	120
			490.5	99	2	101
			472.3	19	2	21
			HIRM 8.5	169	---	169
		1994	531.0	42	1	43
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	118	---	118
			490.5	15	1	16
			472.3	16	2	18
			HIRM 8.5	27	---	27
		1996	531.0	25	2	27
			529.0	45	---	45
			490.5	7	3	10
			482.0	19	2	21
		1997	529.0	58	---	58
			490.5	7	---	7
			472.3	---	3	3
			HIRM 8.5	18	1	19
		1998	531.0	10	---	10
		1999	531.0	11	3	14
			529.0	8	---	8
			490.5	5	1	6
			482.0	3	3	6
			472.3	6	3	9
			HIRM 8.5	45	---	45
		2000	531.0	15	13	28
			529.0	47	---	47
			490.5	38	---	38
			482.0	31	---	31
			472.3	35	3	38
			HIRM 8.5	73	---	73
		2001	531.0	12	5	17
			529.0	17	---	17
			490.5	31	---	31
			482.0	29	3	32
			472.3	24	2	26
			HIRM 8.5	36	---	36

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Largemouth bass	*Micropterus salmoides*					
		2002	531.0	13	---	10
			529.0	39	---	39
			490.5	56	---	56
			482.0	32	---	32
			472.3	29	12	41
		2003	531.0	13	8	21
			529.0	30	---	30
			490.5	15	3	18
			482.0	22	2	24
			472.3	14	2	16
			HIRM 8.5	21	---	21
		2004	531.0	26	1	27
			529.0	65	---	65
			490.5	40	---	40
			482.0	41	4	45
			472.3	36	2	38
			HIRM 8.5	55	---	55
		2005	531.0	14	7	21
			529.0	30	---	30
			490.5	35	---	35
			482.0	20	2	22
			472.3	10	2	12
			HIRM 8.5	31	1	32
		2006	531.0	30	4	34
			529.0	16	---	16
			490.5	4	4	8
			482.0	23	1	24
			472.3	15	3	18
		2007	531.0	36	---	10
			529.0	17	---	17
			490.5	17	9	26
			482.0	20	2	22
			472.3	16	9	25
			HIRM 8.5	28	2	30
		2008	531.0	20	12	32
			529.0	15	---	15
			490.5	21	5	26
			482.0	21	4	25
			472.3	19	7	26

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Largescale stoneroller	*Campostoma oligolepis*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	6	---	6
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Largescale stoneroller	*Campostoma oligolepis*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Logperch	*Percina caprodes*					
		1993	531.0	1	---	1
			529.0	7	---	7
			490.5	79	---	79
			472.3	3	---	3
			HIRM 8.5	9	---	9
		1994	531.0	3	---	3
			529.0	67	---	67
			490.5	---	---	---
			472.3	25	---	25
			HIRM 8.5	1	---	1
		1995	529.0	7	---	7
			490.5	12	---	12
			472.3	12	---	12
			HIRM 8.5	4	---	4
		1996	531.0	4	---	4
			529.0	19	---	19
			490.5	10	---	10
			482.0	13	---	13
		1997	529.0	1	---	1
			490.5	1	---	1
			472.3	5	---	5
			HiRM 8.5	---	---	---
		1998	531.0	7	---	7
		1999	531.0	---	---	---
			529.0	19	---	19
			490.5	1	---	1
			482.0	9	---	9
			472.3	3	---	3
			HIRM 8.5	9	---	9
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	4	---	4
			HIRM 8.5	---	---	---
		2001	531.0	4	---	4
			529.0	3	---	3
			490.5	23	---	23
			482.0	5	---	5
			472.3	4	---	4
			HIRM 8.5	7	---	7

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Logperch	*Percina caprodes*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	2	---	2
			472.3	4	---	4
		2003	531.0	2	---	2
			529.0	1	---	1
			490.5	4	---	4
			482.0	9	---	9
			472.3	---	---	---
			HIRM 8.5	3	---	3
		2004	531.0	---	---	---
			529.0	18	---	18
			490.5	3	---	3
			482.0	1	---	1
			472.3	6	---	6
			HIRM 8.5	---	---	---
		2005	531.0	3	---	3
			529.0	4	---	4
			490.5	3	---	3
			482.0	6	---	6
			472.3	5	---	5
			HIRM 8.5	2	---	2
		2006	531.0	7	---	7
			529.0	22	---	22
			490.5	4	---	4
			482.0	15	---	15
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	5	---	5
			490.5	7	---	7
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2008	531.0	3	---	3
			529.0	4	---	4
			490.5	4	---	4
			482.0	4	---	4
			472.3	4	---	4

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Longear sunfish	*Lepomis megalotis*					
		1993	531.0	---	---	---
			529.0	3	---	3
			490.5	7	---	7
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	1	---	1
			490.5	1	---	1
			472.3	3	---	3
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	7	---	7
			472.3	3	---	3
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	3	---	3
			490.5	4	---	4
			482.0	12	---	12
		1997	529.0	1	---	1
			490.5	3	---	3
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	1	---	1
			529.0	---	---	---
			490.5	4	---	4
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	9	---	9
			490.5	7	---	7
			482.0	45	---	45
			472.3	16	---	16
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	2	---	2
			490.5	8	---	8
			482.0	47	2	49
			472.3	1	---	1
			HIRM 8.5	4	---	4

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Longear sunfish	*Lepomis megalotis*					
		2002	531.0	---	---	---
			529.0	8	---	8
			490.5	14	---	14
			482.0	8	---	8
			472.3	16	---	16
		2003	531.0	2	---	2
			529.0	3	---	3
			490.5	27	---	27
			482.0	29	---	29
			472.3	6	---	6
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	32	---	32
			490.5	13	---	13
			482.0	7	---	7
			472.3	4	---	4
			HIRM 8.5	3	---	3
		2005	531.0	5	---	5
			529.0	46	---	46
			490.5	12	---	12
			482.0	12	---	12
			472.3	8	---	8
			HIRM 8.5	---	---	---
		2006	531.0	6	---	6
			529.0	25	---	25
			490.5	15	---	15
			482.0	11	---	11
			472.3	10	---	10
		2007	531.0	1	---	1
			529.0	9	---	9
			490.5	13	---	13
			482.0	9	---	9
			472.3	6	---	6
			HIRM 8.5	1	---	1
		2008	531.0	8	---	8
			529.0	19	---	19
			490.5	1	---	1
			482.0	19	---	19
			472.3	19	---	19

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Longnose gar	*Lepisosteus osseus*					
		1993	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1996	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	1	---	1
		1999	531.0	---	1	1
			529.0	2	---	2
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	3	3
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	3	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Longnose gar	*Lepisosteus osseus*					
		2003	531.0	---	---	---
			529.0	3	---	3
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	1	---	1
			529.0	18	---	18
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	1	1
			472.3	1	---	1
			HIRM 8.5	---	1	1
		2006	531.0	---	---	---
			529.0	2	---	2
			490.5	---	---	---
			482.0	---	2	2
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	1	---	1
			490.5	---	1	1
			482.0	---	1	1
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	1	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Mooneye	*Hiodon tergisus*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	1	1
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	2	2
			482.0	---	1	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Mooneye	*Hiodon tergisus*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	1	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Northern hogsucker	*Hypentelium nigricans*					
		1993	531.0	1	---	1
			529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	7	---	7
			529.0	1	---	1
			490.5	---	---	---
			472.3	3	---	3
			HIRM 8.5	---	---	---
		1995	529.0	1	---	1
			490.5	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	2	2
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	4	---	4
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Northern hogsucker	*Hypentelium nigricans*					
		2002	531.0	1	---	1
			529.0	1	---	1
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	2	---	2
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Redbreast sunfish	*Lepomis auritus*					
		1993	531.0	10	---	10
			529.0	4	---	4
			490.5	15	---	15
			472.3	25	---	25
			HIRM 8.5	---	---	---
		1994	531.0	7	---	7
			529.0	45	---	45
			490.5	7	---	7
			472.3	30	---	30
			HIRM 8.5	3	---	3
		1995	529.0	1	---	1
			490.5	3	---	3
			472.3	7	---	7
			HIRM 8.5	---	---	---
		1996	531.0	4	---	4
			529.0	4	---	4
			490.5	12	3	15
			482.0	15	---	15
		1997	529.0	3	---	3
			490.5	3	---	3
			472.3	2	---	2
			HiRM 8.5	---	---	---
		1998	531.0	37	---	37
		1999	531.0	7	---	7
			529.0	6	---	6
			490.5	11	---	11
			482.0	10	---	10
			472.3	26	---	26
			HIRM 8.5	1	---	1
		2000	531.0	35	---	35
			529.0	16	---	16
			490.5	12	---	12
			482.0	30	---	30
			472.3	53	1	54
			HIRM 8.5	4	---	4
		2001	531.0	36	---	36
			529.0	15	---	15
			490.5	38	---	38
			482.0	37	2	39
			472.3	36	---	36
			HIRM 8.5	3	---	3

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Redbreast sunfish	*Lepomis auritus*					
		2002	531.0	14	---	14
			529.0	19	---	19
			490.5	40	---	40
			482.0	25	---	25
			472.3	70	1	71
		2003	531.0	18	---	18
			529.0	7	---	7
			490.5	58	---	58
			482.0	29	---	29
			472.3	50	---	50
			HIRM 8.5	3	---	3
		2004	531.0	57	---	57
			529.0	19	---	19
			490.5	43	---	43
			482.0	56	---	56
			472.3	68	---	68
			HIRM 8.5	2	---	2
		2005	531.0	25	---	25
			529.0	29	---	29
			490.5	65	---	65
			482.0	152	---	152
			472.3	78	---	78
			HIRM 8.5	3	---	3
		2006	531.0	83	---	83
			529.0	19	---	19
			490.5	65	---	65
			482.0	70	---	70
			472.3	215	---	215
		2007	531.0	8	---	8
			529.0	22	---	22
			490.5	94	---	94
			482.0	68	1	69
			472.3	115	---	115
			HIRM 8.5	4	---	4
		2008	531.0	38	---	38
			529.0	26	---	26
			490.5	24	---	24
			482.0	93	1	94
			472.3	179	---	179

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Redear sunfish	*Lepomis microlophus*					
		1993	531.0	27	2	29
			529.0	150	---	150
			490.5	66	26	92
			472.3	27	8	35
			HIRM 8.5	298	22	320
		1994	531.0	46	2	48
			529.0	274	---	274
			490.5	55	10	65
			472.3	79	2	81
			HIRM 8.5	109	8	117
		1995	529.0	124	---	124
			490.5	19	19	38
			472.3	43	10	53
			HIRM 8.5	31	17	48
		1996	531.0	34	1	35
			529.0	91	---	91
			490.5	16	15	31
			482.0	213	20	233
		1997	529.0	105	---	105
			490.5	19	17	36
			472.3	3	2	5
			HiRM 8.5	133	8	141
		1998	531.0	46	---	46
		1999	531.0	17	1	18
			529.0	63	---	63
			490.5	34	8	42
			482.0	51	6	57
			472.3	7	3	10
			HIRM 8.5	99	6	105
		2000	531.0	44	---	44
			529.0	137	---	137
			490.5	35	8	43
			482.0	60	3	63
			472.3	19	4	23
			HIRM 8.5	179	7	186
		2001	531.0	56	---	56
			529.0	139	---	139
			490.5	25	39	64
			482.0	77	20	97
			472.3	25	6	31
			HIRM 8.5	71	7	78

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Redear sunfish	*Lepomis microlophus*					
		2002	531.0	36	---	36
			529.0	221	---	221
			490.5	71	6	77
			482.0	50	2	52
			472.3	29	5	34
		2003	531.0	50	---	50
			529.0	61	---	61
			490.5	45	47	92
			482.0	96	16	115
			472.3	55	10	65
			HIRM 8.5	66	2	68
		2004	531.0	42	1	43
			529.0	64	---	64
			490.5	76	19	95
			482.0	76	8	84
			472.3	32	4	36
			HIRM 8.5	87	9	96
		2005	531.0	35	---	35
			529.0	85	---	85
			490.5	32	8	40
			482.0	81	9	90
			472.3	28	5	33
			HIRM 8.5	65	16	81
		2006	531.0	55	---	55
			529.0	83	---	83
			490.5	42	37	79
			482.0	112	7	119
			472.3	33	9	42
		2007	531.0	31	---	31
			529.0	54	---	54
			490.5	44	12	56
			482.0	40	3	43
			472.3	22	3	25
			HIRM 8.5	47	---	47
		2008	531.0	33	1	34
			529.0	93	---	93
			490.5	42	13	55
			482.0	86	---	86
			472.3	36	5	41

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
River carpsucker	*Carpiodes carpio*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
River carpsucker	*Carpiodes carpio*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
River redhorse	*Moxostoma carinatum*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
River redhorse	*Moxostoma carinatum*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	1	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Rock bass	*Ambloplites rupestris*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Rock bass	*Ambloplites rupestris*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Sauger	*Sander canadensis*					
		1993	531.0	---	1	1
			529.0	---	---	---
			490.5	---	1	1
			472.3	1	1	2
			HIRM 8.5	---	8	8
		1994	531.0	---	6	6
			529.0	1	---	1
			490.5	---	5	5
			472.3	---	2	2
			HIRM 8.5	1	15	16
		1995	529.0	4	---	4
			490.5	---	14	14
			472.3	---	12	12
			HIRM 8.5	1	7	8
		1996	531.0	---	5	5
			529.0	4	---	4
			490.5	1	10	11
			482.0	---	6	6
		1997	529.0	1	---	1
			490.5	1	25	26
			472.3	---	7	7
			HiRM 8.5	1	10	11
		1998	531.0	1	3	4
		1999	531.0	---	2	2
			529.0	1	---	1
			490.5	1	2	3
			482.0	---	4	4
			472.3	---	1	1
			HIRM 8.5	---	5	5
		2000	531.0	---	4	4
			529.0	---	---	---
			490.5	---	5	5
			482.0	---	3	3
			472.3	---	4	4
			HIRM 8.5	2	2	4
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	1	1
			HIRM 8.5	---	2	2

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Sauger	*Sander canadensis*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	1	4	5
			482.0	---	6	6
			472.3	---	1	1
		2003	531.0	---	1	1
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	2	2
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2004	531.0	---	1	1
			529.0	---	---	---
			490.5	---	2	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	1	1
			HIRM 8.5	---	2	2
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	1	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Skipjack herring	*Alosa chrysochloris*					
		1993	531.0	---	13	13
			529.0	25	---	25
			490.5	---	54	54
			472.3	---	40	40
			HIRM 8.5	---	2	2
		1994	531.0	1	65	66
			529.0	10	---	10
			490.5	---	8	8
			472.3	1	17	18
			HIRM 8.5	---	---	---
		1995	529.0	1	---	1
			490.5	---	81	81
			472.3	---	34	34
			HIRM 8.5	---	10	10
		1996	531.0	---	44	44
			529.0	---	---	---
			490.5	---	43	43
			482.0	---	20	20
		1997	529.0	---	---	---
			490.5	---	25	25
			472.3	---	19	19
			HiRM 8.5	---	3	3
		1998	531.0	1	34	35
		1999	531.0	---	13	13
			529.0	---	---	---
			490.5	---	35	35
			482.0	1	19	20
			472.3	1	38	39
			HIRM 8.5	---	4	4
		2000	531.0	---	5	5
			529.0	---	---	---
			490.5	---	8	8
			482.0	---	3	3
			472.3	---	66	66
			HIRM 8.5	---	3	3
		2001	531.0	---	2	2
			529.0	---	---	---
			490.5	---	39	39
			482.0	---	6	6
			472.3	---	44	44
			HIRM 8.5	---	13	13
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	15	15
			482.0	---	3	3
			472.3	---	24	24

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Skipjack herring	*Alosa chrysochloris*					
		2003	531.0	---	2	2
			529.0	---	---	---
			490.5	---	21	21
			482.0	---	7	7
			472.3	---	33	33
			HIRM 8.5	1	---	1
		2004	531.0	---	34	34
			529.0	---	---	---
			490.5	---	28	28
			482.0	---	15	15
			472.3	---	33	33
			HIRM 8.5	---	1	1
		2005	531.0	---	9	9
			529.0	---	---	---
			490.5	---	7	7
			482.0	---	17	17
			472.3	---	82	82
			HIRM 8.5	---	10	10
		2006	531.0	---	2	2
			529.0	---	---	---
			490.5	---	31	31
			482.0	---	21	21
			472.3	---	39	39
		2007	531.0	---	4	4
			529.0	---	---	---
			490.5	---	32	32
			482.0	---	18	18
			472.3	---	24	24
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Silver redhorse	*Moxostoma anisurum*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Silver redhorse	*Moxostoma anisurum*					
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	2	2
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Smallmouth bass	*Micropterus dolomieu*					
		1993	531.0	19	---	19
			529.0	34	---	34
			490.5	6	1	7
			472.3	10	2	12
			HIRM 8.5	---	3	3
		1994	531.0	19	3	22
			529.0	36	---	36
			490.5	7	1	8
			472.3	16	---	16
			HIRM 8.5	---	---	---
		1995	529.0	10	---	10
			490.5	4	---	4
			472.3	15	4	19
			HIRM 8.5	---	---	---
		1996	531.0	31	---	31
			529.0	19	---	19
			490.5	10	---	10
			482.0	7	---	7
		1997	529.0	33	---	33
			490.5	9	6	15
			472.3	4	---	4
			HiRM 8.5	---	---	---
		1998	531.0	19	---	19
		1999	531.0	5	---	5
			529.0	3	---	3
			490.5	13	---	13
			482.0	1	---	1
			472.3	1	---	1
			HIRM 8.5	---	---	---
		2000	531.0	17	---	17
			529.0	19	---	19
			490.5	4	6	10
			482.0	7	1	8
			472.3	4	2	6
			HIRM 8.5	---	---	---
		2001	531.0	6	1	7
			529.0	2	---	2
			490.5	8	1	9
			482.0	4	---	4
			472.3	1	---	1
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Smallmouth bass	*Micropterus dolomieu*					
		2002	531.0	6	2	8
			529.0	16	---	16
			490.5	29	2	31
			482.0	8	2	10
			472.3	7	3	10
		2003	531.0	11	2	13
			529.0	10	---	10
			490.5	12	---	12
			482.0	2	12	14
			472.3	3	1	4
			HIRM 8.5	---	---	---
		2004	531.0	26	1	27
			529.0	25	---	25
			490.5	18	---	18
			482.0	5	---	5
			472.3	5	---	5
			HIRM 8.5	---	---	---
		2005	531.0	12	1	13
			529.0	25	---	25
			490.5	24	---	24
			482.0	1	---	1
			472.3	4	---	4
			HIRM 8.5	---	---	---
		2006	531.0	11	---	11
			529.0	10	---	10
			490.5	17	1	---
			482.0	---	---	---
			472.3	15	---	15
		2007	531.0	2	2	4
			529.0	4	---	4
			490.5	5	---	5
			482.0	1	1	2
			472.3	3	1	4
			HIRM 8.5	---	---	---
		2008	531.0	6	1	7
			529.0	2	---	2
			490.5	8	---	8
			482.0	2	---	2
			472.3	7	---	7

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Smallmouth buffalo	*Ictiobus bubalus*					
		1993	531.0	---	4	4
			529.0	---	---	---
			490.5	3	1	4
			472.3	1	---	1
			HIRM 8.5	---	6	6
		1994	531.0	1	---	1
			529.0	4	---	4
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		1995	529.0	---	---	---
			490.5	3	2	5
			472.3	---	1	1
			HIRM 8.5	7	6	13
		1996	531.0	1	1	2
			529.0	---	---	---
			490.5	1	---	1
			482.0	7	4	11
		1997	529.0	---	---	---
			490.5	---	1	1
			472.3	---	---	---
			HIRM 8.5	1	5	6
		1998	531.0	1	4	5
		1999	531.0	2	4	6
			529.0	---	---	---
			490.5	2	---	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	19	14	33
		2000	531.0	1	3	4
			529.0	---	---	---
			490.5	---	---	---
			482.0	9	1	10
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2001	531.0	2	1	3
			529.0	---	---	---
			490.5	3	---	3
			482.0	1	1	2
			472.3	1	---	1
			HIRM 8.5	21	3	24

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Smallmouth buffalo	*Ictiobus bubalus*					
		2002	531.0	5	3	8
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	3	9	12
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	8	3	11
		2004	531.0	9	1	10
			529.0	1	---	1
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	3	2	5
		2005	531.0	2	1	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	---	1
			HIRM 8.5	4	---	4
		2006	531.0	3	4	7
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	4	5	9
			529.0	---	---	---
			490.5	1	1	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	37	---	37
		2008	531.0	2	7	9
			529.0	1	---	1
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	1	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Smallmouth redhorse	*Moxostoma breviceps*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Smallmouth redhorse	*Moxostoma breviceps*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotfin shiner	*Cyprinella spiloptera*					
		1993	531.0	43	---	43
			529.0	13	---	13
			490.5	13	---	13
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1994	531.0	57	---	57
			529.0	12	---	12
			490.5	28	---	28
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1995	529.0	4	---	4
			490.5	52	---	52
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1996	531.0	49	---	49
			529.0	7	---	7
			490.5	4	---	4
			482.0	13	---	13
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	3	---	3
			HIRM 8.5	1	---	1
		1998	531.0	103	---	103
		1999	531.0	6	---	6
			529.0	9	---	9
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	66	---	66
			529.0	23	---	23
			490.5	---	---	---
			482.0	18	---	18
			472.3	2	---	2
			HIRM 8.5	1	---	1
		2001	531.0	92	---	92
			529.0	31	---	31
			490.5	21	---	21
			482.0	41	---	41
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2002	531.0	6	---	6
			529.0	28	---	28
			490.5	7	---	7
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotfin shiner	*Cyprinella spiloptera*					
		2003	531.0	50	---	50
			529.0	11	---	11
			490.5	19	---	19
			482.0	20	---	20
			472.3	2	---	2
			HIRM 8.5	5	---	5
		2004	531.0	16	---	16
			529.0	11	---	11
			490.5	2	---	2
			482.0	1	---	1
			472.3	3	---	3
			HIRM 8.5	1	---	1
		2005	531.0	102	---	102
			529.0	4	---	4
			490.5	1	---	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	86	---	86
			529.0	44	---	44
			490.5	6	---	6
			482.0	38	---	38
			472.3	7	---	7
		2007	531.0	16	---	16
			529.0	27	---	27
			490.5	9	---	9
			482.0	20	---	20
			472.3	4	---	4
			HIRM 8.5	2	---	2
		2008	531.0	79	---	79
			529.0	17	---	17
			490.5	6	---	6
			482.0	20	---	20
			472.3	4	---	4

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotted bass	*Micropterus punctulatus*					
		1993	531.0	3	1	4
			529.0	82	---	82
			490.5	82	23	105
			472.3	43	28	71
			HIRM 8.5	7	1	8
		1994	531.0	7	3	10
			529.0	52	---	52
			490.5	49	13	62
			472.3	115	2	117
			HIRM 8.5	10	5	15
		1995	529.0	9	---	9
			490.5	36	1	37
			472.3	22	15	37
			HIRM 8.5	4	4	8
		1996	531.0	1	4	5
			529.0	40	---	40
			490.5	16	10	26
			482.0	25	35	60
		1997	529.0	7	---	7
			490.5	10	15	25
			472.3	1	2	3
			HiRM 8.5	4	2	6
		1998	531.0	YOY	---	YOY
		1999	531.0	1	---	1
			529.0	11	---	11
			490.5	13	1	14
			482.0	12	5	17
			472.3	7	4	11
			HIRM 8.5	3	2	5
		2000	531.0	16	---	16
			529.0	35	---	35
			490.5	13	35	48
			482.0	47	14	61
			472.3	19	22	41
			HIRM 8.5	7	---	7
		2001	531.0	1	2	3
			529.0	16	---	16
			490.5	22	27	49
			482.0	26	70	96
			472.3	21	43	64
			HIRM 8.5	7	5	12

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotted bass	*Micropterus punctulatus*					
		2002	531.0	9	4	13
			529.0	31	---	31
			490.5	61	21	82
			482.0	35	34	69
			472.3	18	49	67
		2003	531.0	12	4	16
			529.0	24	---	24
			490.5	21	7	28
			482.0	42	8	50
			472.3	19	25	44
			HIRM 8.5	9	---	9
		2004	531.0	3	---	9
			529.0	49	---	49
			490.5	49	18	67
			482.0	29	18	47
			472.3	31	5	36
			HIRM 8.5	12	3	15
		2005	531.0	2	---	2
			529.0	56	---	56
			490.5	22	18	40
			482.0	30	21	51
			472.3	16	25	41
			HIRM 8.5	11	4	15
		2006	531.0	3	---	3
			529.0	32	---	32
			490.5	24	10	34
			482.0	30	9	39
			472.3	17	41	58
		2007	531.0	4	---	4
			529.0	30	---	30
			490.5	19	7	26
			482.0	9	12	21
			472.3	13	19	32
			HIRM 8.5	22	---	22
		2008	531.0	1	2	3
			529.0	13	---	13
			490.5	14	2	16
			482.0	20	44	64
			472.3	5	27	32

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotted gar	*Lepisosteus oculatus*					
		1993	531.0	1	---	1
			529.0	---	---	---
			490.5	---	1	1
			472.3	---	---	---
			HIRM 8.5	1	2	3
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	3	---	3
		1995	529.0	---	---	---
			490.5	---	1	1
			472.3	---	---	---
			HIRM 8.5	4	---	4
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	1	1
			482.0	10	4	14
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	1	---	1
		1998	531.0	1	---	1
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	2	---	2
			482.0	6	---	6
			472.3	---	---	---
			HIRM 8.5	8	2	10
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	2	---	2
			529.0	1	---	1
			490.5	4	4	8
			482.0	1	---	1
			472.3	2	---	2
			HIRM 8.5	---	---	---
		2002	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotted gar	*Lepisosteus oculatus*					
		2003	531.0	2	---	2
			529.0	---	---	---
			490.5	1	---	1
			482.0	3	---	3
			472.3	4	---	4
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	1	---	1
			490.5	8	---	8
			482.0	8	---	8
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2005	531.0	5	---	5
			529.0	---	---	---
			490.5	2	---	2
			482.0	---	---	---
			472.3	2	---	2
			HIRM 8.5	1	---	1
		2006	531.0	2	---	2
			529.0	2	---	2
			490.5	1	---	1
			482.0	2	---	2
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	25	1	26
			482.0	4	1	5
			472.3	1	1	2
			HIRM 8.5	2	---	2
		2008	531.0	2	---	2
			529.0	7	---	7
			490.5	11	---	11
			482.0	9	---	9
			472.3	5	---	5

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotted sucker	*Minytrema melanops*					
		1993	531.0	1	1	2
			529.0	16	---	16
			490.5	15	4	19
			472.3	---	---	---
			HIRM 8.5	16	5	21
		1994	531.0	1	---	1
			529.0	28	---	28
			490.5	4	5	9
			472.3	6	---	6
			HIRM 8.5	34	13	47
		1995	529.0	28	---	28
			490.5	16	1	17
			472.3	13	5	18
			HIRM 8.5	64	4	68
		1996	531.0	4	1	5
			529.0	13	---	13
			490.5	3	1	4
			482.0	4	3	7
		1997	529.0	16	---	16
			490.5	4	12	16
			472.3	---	3	3
			HiRM 8.5	---	28	28
		1998	531.0	4	4	8
		1999	531.0	---	2	2
			529.0	9	---	9
			490.5	4	---	4
			482.0	8	4	12
			472.3	1	---	1
			HIRM 8.5	56	14	70
		2000	531.0	6	10	16
			529.0	5	---	5
			490.5	5	10	15
			482.0	1	8	9
			472.3	---	9	9
			HIRM 8.5	13	26	39
		2001	531.0	7	12	19
			529.0	6	---	6
			490.5	9	1	10
			482.0	2	8	10
			472.3	3	3	6
			HIRM 8.5	64	21	85
		2002	531.0	6	7	13
			529.0	8	---	8
			490.5	4	---	4
			482.0	5	3	8
			472.3	4	8	12

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Spotted sucker	*Minytrema melanops*					
		2003	531.0	6	14	20
			529.0	4	---	4
			490.5	6	3	9
			482.0	4	5	9
			472.3	3	6	9
			HIRM 8.5	26	11	37
		2004	531.0	14	13	27
			529.0	4	---	4
			490.5	3	2	5
			482.0	6	1	7
			472.3	6	2	8
			HIRM 8.5	30	11	41
		2005	531.0	4	17	21
			529.0	8	---	8
			490.5	5	2	7
			482.0	3	1	4
			472.3	3	1	4
			HIRM 8.5	28	18	46
		2006	531.0	8	8	16
			529.0	3	---	3
			490.5	5	1	6
			482.0	2	1	3
			472.3	3	2	5
		2007	531.0	3	5	8
			529.0	5	---	5
			490.5	2	3	5
			482.0	8	---	8
			472.3	---	---	---
			HIRM 8.5	21	2	23
		2008	531.0	2	3	5
			529.0	1	---	1
			490.5	2	---	2
			482.0	5	1	6
			472.3	5	1	6

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Steelcolor shiner	*Cyprinella whipplei*					
		1993	531.0	48	---	48
			529.0	39	---	39
			490.5	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1994	531.0	34	---	34
			529.0	93	---	93
			490.5	---	---	---
			472.3	1	---	1
			HIRM 8.5	---	---	---
		1995	529.0	7	---	7
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	31	---	31
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Steelcolor shiner	*Cyprinella whipplei*					
		2003	531.0	---	---	---
			529.0	4	---	4
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Striped bass	*Morone saxatilis*					
		1993	531.0	---	---	---
			529.0	7	---	6
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	1	1	2
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	1	1
			HIRM 8.5	---	---	---
		1995	529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	4	4
			HiRM 8.5	YOY	---	YOY
		1998	531.0	---	5	5
		1999	531.0	---	3	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	4	4
		2000	531.0	---	4	4
			529.0	1	---	1
			490.5	---	5	5
			482.0	---	1	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	4	4
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	5	5
			529.0	1	---	1
			490.5	---	2	2
			482.0	---	3	3
			472.3	---	3	3

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Striped bass	*Morone saxatilis*					
		2003	531.0	1	6	7
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2004	531.0	2	1	3
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	1	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	1	2	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	2	---	2
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	9	9
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	7	7
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Striped shiner	*Luxilus chrysocephalus*					
		1993	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	1	---	1
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Striped shiner	*Luxilus chrysocephalus*					
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	2	---	2
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Threadfin shad	*Dorosoma petenense*					
		1993	531.0	---	6	6
			529.0	YOY	---	YOY
			490.5	YOY	---	YOY
			472.3	YOY	---	YOY
			HIRM 8.5	YOY	---	YOY
		1994	531.0	YOY	---	YOY
			529.0	YOY	---	YOY
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	YOY	---	YOY
			490.5	YOY	---	YOY
			472.3	YOY	---	YOY
			HIRM 8.5	YOY	---	YOY
		1996	531.0	YOY	---	YOY
			529.0	YOY	---	YOY
			490.5	YOY	---	YOY
			482.0	YOY	---	YOY
		1997	529.0	YOY	---	YOY
			490.5	---	1	1
			472.3	---	---	---
			HIRM 8.5	YOY	---	YOY
		1998	531.0	---	18	18
		1999	531.0	---	17	17
			529.0	261	---	261
			490.5	10	2	12
			482.0	15	5	20
			472.3	---	3	3
			HIRM 8.5	177	---	177
		2000	531.0	---	1	1
			529.0	27	---	27
			490.5	YOY	---	YOY
			482.0	YOY	---	YOY
			472.3	---	3	3
			HIRM 8.5	48	---	48
		2001	531.0	---	3	---
			529.0	YOY	---	YOY
			490.5	2	2	4
			482.0	1	2	3
			472.3	---	3	3
			HIRM 8.5	3	---	3
		2002	531.0	---	1	1
			529.0	378	---	378
			490.5	134	---	134
			482.0	---	---	---
			472.3	125	1	126

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Threadfin shad	*Dorosoma petenense*					
		2003	531.0	1	5	6
			529.0	265	---	265
			490.5	17	1	18
			482.0	---	---	---
			472.3	3	1	4
			HIRM 8.5	---	---	---
		2004	531.0	1	---	1
			529.0	196	---	196
			490.5	5	---	5
			482.0	16	---	16
			472.3	51	---	51
			HIRM 8.5	1	---	1
		2005	531.0	5	---	5
			529.0	56	---	56
			490.5	7	---	7
			482.0	26	---	26
			472.3	23	---	23
			HIRM 8.5	---	---	---
		2006	531.0	1	5	6
			529.0	1	---	1
			490.5	58	1	59
			482.0	5	---	5
			472.3	83	---	83
		2007	531.0	6	---	6
			529.0	1	---	1
			490.5	1	---	1
			482.0	2	1	3
			472.3	2	---	2
			HIRM 8.5	4	---	4
		2008	531.0	2	---	2
			529.0	---	---	---
			490.5	3	---	3
			482.0	22	1	23
			472.3	13	---	13

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Walleye	*Sander vitreus*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	29	29
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	15	15
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	4	4
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	10	10
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Walleye	*Sander vitreus*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	1	---	1
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	2	2
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	1	1
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Warmouth	*Lepomis gulosus*					
		1993	531.0	1	---	1
			529.0	16	---	16
			490.5	10	1	11
			472.3	1	---	1
			HIRM 8.5	10	---	10
		1994	531.0	---	---	---
			529.0	9	---	9
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	1	---	1
		1995	529.0	1	---	1
			490.5	3	---	3
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	1	---	1
			529.0	1	---	1
			490.5	1	---	1
			482.0	1	---	1
		1997	529.0	1	---	1
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	6	---	6
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	---	1
			HIRM 8.5	1	---	1
		2000	531.0	3	---	3
			529.0	9	---	9
			490.5	8	1	9
			482.0	4	1	5
			472.3	1	---	1
			HIRM 8.5	6	---	6
		2001	531.0	---	1	1
			529.0	1	---	1
			490.5	2	---	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2002	531.0	4	---	4
			529.0	5	---	5
			490.5	24	---	24
			482.0	4	1	5
			472.3	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Warmouth	*Lepomis gulosus*					
		2003	531.0	---	---	---
			529.0	1	---	1
			490.5	14	---	14
			482.0	---	---	---
			472.3	4	---	4
			HIRM 8.5	11	---	11
		2004	531.0	5	---	5
			529.0	8	2	10
			490.5	---	---	---
			482.0	---	---	---
			472.3	5	---	5
			HIRM 8.5	26	---	26
		2005	531.0	8	---	8
			529.0	---	---	---
			490.5	1	---	1
			482.0	2	---	2
			472.3	---	---	---
			HIRM 8.5	9	---	9
		2006	531.0	2	1	3
			529.0	---	---	---
			490.5	1	---	1
			482.0	---	---	---
			472.3	4	---	4
		2007	531.0	2	---	2
			529.0	6	---	6
			490.5	4	---	4
			482.0	---	---	---
			472.3	3	---	3
			HIRM 8.5	14	---	14
		2008	531.0	1	---	1
			529.0	12	---	12
			490.5	1	---	1
			482.0	1	---	1
			472.3	1	1	2

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Western mosquitofish	*Gambusia affinis*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HiRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Western mosquitofish	*Gambusia affinis*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
White bass	*Morone chrysops*					
		1993	531.0	4	16	20
			529.0	10	---	10
			490.5	---	104	104
			472.3	1	11	12
			HIRM 8.5	12	9	21
		1994	531.0	3	11	14
			529.0	6	---	6
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	3	3
		1995	529.0	61	---	61
			490.5	9	4	13
			472.3	1	7	8
			HIRM 8.5	1	2	3
		1996	531.0	1	9	10
			529.0	13	---	13
			490.5	---	2	2
			482.0	---	8	8
		1997	529.0	15	---	15
			490.5	---	2	2
			472.3	---	3	3
			HIRM 8.5	3	---	3
		1998	531.0	---	4	4
		1999	531.0	---	10	10
			529.0	3	---	3
			490.5	---	3	3
			482.0	1	1	2
			472.3	---	1	1
			HIRM 8.5	---	2	2
		2000	531.0	---	2	2
			529.0	6	---	6
			490.5	---	3	3
			482.0	---	1	1
			472.3	---	4	4
			HIRM 8.5	---	4	4
		2001	531.0	---	2	2
			529.0	6	---	6
			490.5	---	3	3
			482.0	---	1	1
			472.3	---	4	4
			HIRM 8.5	---	4	4
		2002	531.0	1	18	19
			529.0	9	---	9
			490.5	---	4	4
			482.0	1	---	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
White bass	*Morone chrysops*					
		2003	531.0	2	6	8
			529.0	2	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	1	1
			HIRM 8.5	---	---	---
		2004	531.0	1	17	18
			529.0	32	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	1	1	2
			HIRM 8.5	---	---	---
		2005	531.0	4	14	18
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	3	3
			472.3	---	2	2
			HIRM 8.5	1	9	10
		2006	531.0	21	11	32
			529.0	---	8	8
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	1	3	4
			529.0	---	---	---
			490.5	---	2	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	1	6	7
			529.0	---	---	---
			490.5	---	3	3
			482.0	---	---	---
			472.3	---	1	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
White crappie	*Pomoxis annularis*					
		1993	531.0	---	5	5
			529.0	4	---	4
			490.5	1	3	4
			472.3	---	6	6
			HIRM 8.5	9	1	10
		1994	531.0	---	---	---
			529.0	1	---	1
			490.5	1	2	3
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	3	---	3
			490.5	---	1	1
			472.3	---	2	2
			HIRM 8.5	---	---	---
		1996	531.0	---	4	4
			529.0	6	---	6
			490.5	---	2	2
			482.0	---	2	2
		1997	529.0	1	---	1
			490.5	1	---	1
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	2	2
		1999	531.0	---	2	2
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	2	2
			HIRM 8.5	2	1	3
		2000	531.0	---	20	20
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	4	4
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	1	---	1
			490.5	---	10	10
			482.0	1	2	3
			472.3	---	5	5
			HIRM 8.5	1	---	1

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
White crappie	*Pomoxis annularis*					
		2002	531.0	---	2	2
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	2	2
			472.3	---	---	---
		2003	531.0	---	1	1
			529.0	1	---	1
			490.5	---	1	1
			482.0	---	1	1
			472.3	---	1	1
			HIRM 8.5	2	---	2
		2004	531.0	---	3	3
			529.0	6	---	6
			490.5	2	---	2
			482.0	---	2	2
			472.3	---	---	---
			HIRM 8.5	1	---	1
		2005	531.0	---	4	4
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	1	1
			HIRM 8.5	---	---	---
		2006	531.0	---	5	5
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	1	1
		2007	531.0	1	3	4
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	1	2	3
		2008	531.0	---	1	1
			529.0	---	---	---
			490.5	---	1	1
			482.0	---	1	1
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Yellow bass	*Morone chrysops*					
		1993	531.0	---	66	66
			529.0	79	---	79
			490.5	1	69	70
			472.3	---	33	33
			HIRM 8.5	46	24	70
		1994	531.0	---	8	8
			529.0	54	---	54
			490.5	4	62	66
			472.3	---	14	14
			HIRM 8.5	10	12	22
		1995	529.0	22	---	22
			490.5	1	83	84
			472.3	---	33	33
			HIRM 8.5	7	35	42
		1996	531.0	---	59	59
			529.0	52	---	52
			490.5	1	39	40
			482.0	1	25	26
		1997	529.0	82	---	82
			490.5	---	28	28
			472.3	---	5	5
			HiRM 8.5	34	11	45
		1998	531.0	---	8	8
		1999	531.0	---	45	45
			529.0	6	6	12
			490.5	---	50	50
			482.0	---	16	16
			472.3	1	13	14
			HIRM 8.5	21	7	28
		2000	531.0	---	108	108
			529.0	34	---	34
			490.5	4	34	38
			482.0	6	9	15
			472.3	1	40	41
			HIRM 8.5	117	28	145
		2001	531.0	---	71	71
			529.0	1	---	1
			490.5	---	124	124
			482.0	---	80	80
			472.3	1	80	81
			HIRM 8.5	2	159	161
		2002	531.0	---	42	42
			529.0	35	---	35
			490.5	18	---	46
			482.0	1	---	1
			472.3	17	---	17

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Yellow bass	*Morone chrysops*					
		2003	531.0	---	54	54
			529.0	17	---	17
			490.5	---	33	33
			482.0	2	18	20
			472.3	1	24	25
			HIRM 8.5	15	10	25
		2004	531.0	1	5	6
			529.0	26	---	26
			490.5	1	31	32
			482.0	---	17	17
			472.3	---	28	28
			HIRM 8.5	19	50	69
		2005	531.0	---	76	76
			529.0	13	---	13
			490.5	---	25	25
			482.0	2	18	20
			472.3	---	13	13
			HIRM 8.5	1	35	36
		2006	531.0	21	11	33
			529.0	8	---	8
			490.5	---	55	55
			482.0	---	9	9
			472.3	---	32	32
		2007	531.0	---	46	46
			529.0	7	---	7
			490.5	2	89	91
			482.0	---	32	32
			472.3	---	---	---
			HIRM 8.5	8	86	94
		2008	531.0	---	26	26
			529.0	1	---	1
			490.5	---	37	37
			482.0	---	14	14
			472.3	---	24	24

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Yellow bullhead	*Ameiurus natalis*					
		1993	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1994	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1995	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1996	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	1	1
		1997	529.0	---	---	---
			490.5	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	4	---	4
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2001	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Yellow bullhead	*Ameiurus natalis*					
		2002	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2004	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2005	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2006	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Yellow perch	*Perca flavescens*					
		1993	531.0	1	---	1
			529.0	1	---	1
			490.5	10	8	18
			472.3	1	1	2
			HIRM 8.5	43	---	43
		1994	531.0	4	---	4
			529.0	3	---	3
			490.5	4	---	4
			472.3	1	---	1
			HIRM 8.5	28	---	28
		1995	529.0	---	---	---
			490.5	3	3	6
			472.3	---	---	---
			HIRM 8.5	4	---	4
		1996	531.0	1	---	1
			529.0	1	---	1
			490.5	3	1	4
			482.0	1	---	1
		1997	529.0	7	---	7
			490.5	7	---	7
			472.3	---	---	---
			HIRM 8.5	19	---	19
		1998	531.0	---	---	---
		1999	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	7	---	7
			472.3	2	---	2
			HIRM 8.5	8	---	8
		2000	531.0	---	---	---
			529.0	---	---	---
			490.5	2	---	2
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	2	---	2
		2001	531.0	5	---	5
			529.0	---	---	---
			490.5	---	---	---
			482.0	1	---	1
			472.3	---	---	---
			HIRM 8.5	1	1	2

Appendix 1. (Continued)

Common Name	Scientific Name	Year	River Mile	Total Fish EF	Total Gill Net Fish	Total Fish Combined
Yellow perch	*Perca flavescens*					
		2002	531.0	---	---	---
			529.0	2	---	2
			490.5	2	---	2
			482.0	---	---	---
			472.3	---	---	---
		2003	531.0	---	---	---
			529.0	---	---	---
			490.5	1	3	4
			482.0	---	---	---
			472.3	---	1	1
			HIRM 8.5	---	---	---
		2004	531.0	5	---	5
			529.0	1	---	1
			490.5	2	---	2
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	5	---	5
		2005	531.0	1	---	1
			529.0	4	---	4
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
			HIRM 8.5	10	---	10
		2006	531.0	3	---	3
			529.0	---	---	---
			490.5	---	---	---
			482.0	---	---	---
			472.3	---	---	---
		2007	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	2	---	2
			472.3	---	---	---
			HIRM 8.5	---	---	---
		2008	531.0	---	---	---
			529.0	---	---	---
			490.5	1	---	1
			482.0	2	---	2
			472.3	1	---	1

Appendix 2-A. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2008.

Autumn 2008		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition											
1. Number of species		28	5	27	3	30	5	27	3	27	3
2. Number of centrarchid species		7	5	8	5	7	5	8	5	8	5
3. Number of benthic invertivores		5	3	3	1	3	1	3	1	3	1
4. Number of intolerant species		6	5	3	3	5	5	3	3	4	3
5. Percent tolerant individuals	Electrofishing	82.3	1	86.7	0.5	80.7	0.5	86.7	0.5	93.8	0.5
	Gill Netting	---	---	47.5	0.5	41.9	0.5	47.5	0.5	58.8	0.5
6. Percent dominance by 1 species	Electrofishing	63	1	53.9	0.5	58.2	0.5	53.9	0.5	72.6	0.5
	Gill Netting	---	---	44.2	0.5	38.2	0.5	44.2	0.5	49.8	0.5
7. Percent non-native species	Electrofishing	32.5	5	4	1.5	2.3	1.5	4	1.5	0.2	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	5.2	2.5
8. Number of top carnivore species		7	5	9	5	11	5	9	5	9	5
B. Trophic composition											
9. Percent top carnivores	Electrofishing	3.7	1	5.4	0.5	4.7	0.5	5.4	0.5	2.7	0.5
	Gill Netting	---	---	40.3	1.5	47.1	1.5	40.3	1.5	33.6	1.5
10. Percent omnivores	Electrofishing	14.6	5	29	1.5	13.1	2.5	29	1.5	10.3	2.5
	Gill Netting	---	---	49.2	0.5	47.1	0.5	49.2	0.5	61.6	0.5
C. Fish abundance and health											
11. Average number per run	Electrofishing	94.3	3	86.3	0.5	79.7	0.5	86.3	0.5	85.8	0.5
	Gill Netting	---	---	18.1	1.5	19.1	1.5	18.1	1.5	21.1	1.5
12. Percent anomalies	Electrofishing	0.9	5	1.1	2.5	2.1	1.5	1.1	2.5	0.4	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	0.9	2.5
Overall RFAI Score			**44**		**34**		**38**		**41**		**36**

Appendix 2-B. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2007.

Autumn 2007		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		27	3	31	5	26	3	22	3	26	3	26	3
2. Number of centrarchid species		7	5	8	5	6	5	7	5	7	5	8	5
3. Number of benthic invertivores		6	3	3	1	3	1	1	1	5	3	2	1
4. Number of intolerant species		6	5	4	3	4	3	4	3	3	3	4	3
5. Percent tolerant individuals	Electrofishing	75.6	1	76.5	0.5	75.7	0.5	86.6	0.5	70.3	0.5	85.1	0.5
	Gill Netting	---	---	29	1.5	37.7	0.5	27.1	1.5	17.1	1.5	46.8	0.5
6. Percent dominance by 1 species	Electrofishing	51.9	1	29.7	1.5	36.3	1.5	55.3	0.5	41.1	0.5	52.2	0.5
	Gill Netting	---	---	27.7	1.5	31.6	0.5	26.1	1.5	69.9	0.5	41.4	0.5
7. Percent non-native species	Electrofishing	0.3	5	1	2.5	0.7	2.5	3.2	1.5	5.2	1.5	2.6	1.5
	Gill Netting	---	---	0	2.5	0.4	2.5	0.4	2.5	0	2.5	3.4	2.5
8. Number of top carnivore species		8	5	11	5	9	5	8	5	8	5	9	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	12	3	10.7	1.5	6.4	1.5	6	1.5	10.5	1.5	9.5	1.5
	Gill Netting	---	---	62	2.5	40.4	1.5	66.8	2.5	74.8	2.5	45.8	1.5
10. Percent omnivores	Electrofishing	16.1	5	33.9	1.5	22	2.5	10.9	2.5	30.2	1.5	22.5	2.5
	Gill Netting	---	---	27.7	1.5	51.3	0.5	27.5	1.5	19.5	2.5	50.2	0.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	51.6	3	54.9	0.5	37.3	0.5	45.3	0.5	52.3	0.5	35.9	0.5
	Gill Netting	---	---	32.1	2.5	22.8	1.5	28	2.5	12.3	1.5	29.5	2.5
12. Percent anomalies	Electrofishing	3.2	3	1.6	2.5	1.4	2.5	0.6	2.5	1.5	2.5	1.3	2.5
	Gill Netting	---	---	0.6	2.5	1.3	2.5	0.4	2.5	0	2.5	4.7	1.5
Overall RFAI Score			**42**		**44**		**38**		**41**		**41**		**36**

Appendix 2-C. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2006.

Autumn 2006		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition											
1. Number of species		26	3	30	5	26	3	24	3	28	5
2. Number of centrarchid species		6	5	7	5	6	5	8	5	8	5
3. Number of benthic invertivores		5	3	4	3	3	1	2	1	3	1
4. Number of intolerant species		6	5	5	5	3	3	5	5	5	5
5. Percent tolerant individuals	Electrofishing	65.3	1	70.1	0.5	72.4	0.5	74.6	0.5	85.2	0.5
	Gill Netting	---	---	30	1.5	29.6	0.5	28.6	0.5	34.8	0.5
6. Percent dominance by 1 species	Electrofishing	29.1	3	35.3	1.5	33.6	1.5	37.4	1.5	37.9	1.5
	Gill Netting	---	---	25.2	1.5	22.5	1.5	24.4	1.5	26.1	1.5
7. Percent non-native species	Electrofishing	3.4	5	0.8	2.5	4.2	0.5	2.7	1.5	4.8	0.5
	Gill Netting	---	---	0	2.5	0	2.5	0.4	2.5	2.5	2.5
8. Number of top carnivore species		9	5	10	5	8	5	8	5	10	5
B. Trophic composition											
9. Percent top carnivores	Electrofishing	9	1	8.3	1.5	6.5	1.5	5.9	1.5	6	1.5
	Gill Netting	---	---	51.2	1.5	40.8	1.5	62.8	2.5	54	2.5
10. Percent omnivores	Electrofishing	31.5	3	37.2	1.5	24.6	1.5	8.3	2.5	30.5	1.5
	Gill Netting	---	---	27.2	1.5	47.9	0.5	30.8	1.5	32.9	1.5
C. Fish abundance and health											
11. Average number per run	Electrofishing	61.7	3	49.1	0.5	60.9	0.5	55.1	0.5	85.3	0.5
	Gill Netting	---	---	25	2.5	14.2	1.5	26.6	2.5	16.1	1.5
12. Percent anomalies	Electrofishing	1.5	5	0.3	2.5	0.4	2.5	0.7	2.5	0.2	2.5
	Gill Netting	---	---	0.4	2.5	3.5	1.5	1.9	2.5	0	2.5
Overall RFAI Score			**42**		**47**		**35**		**43**		**42**

Appendix 2-D. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2005.

Autumn 2005		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		27	3	29	3	26	3	29	5	31	5	30	5
2. Number of centrarchid species		6	5	7	5	7	5	7	5	5	5	8	5
3. Number of benthic invertivores		6	3	4	3	3	1	4	3	6	3	3	1
4. Number of intolerant species		6	5	7	5	5	5	6	5	4	3	5	5
5. Percent tolerant individuals	Electrofishing	58.6	1	76.2	0.5	70.2	0.5	71	0.5	62	1.5	81.9	0.5
	Gill Netting	---	---	23	1.5	43.4	0.5	31.2	0.5	28.7	1.5	11.9	2.5
6. Percent dominance by 1 species	Electrofishing	30.5	3	39.4	1.5	25.1	1.5	42.2	1.5	43	0.5	48.3	1.5
	Gill Netting	---	---	19.8	1.5	41	0.5	30.5	0.5	25.7	1.5	34.9	0.5
7. Percent non-native species	Electrofishing	1	5	0.8	2.5	0.5	2.5	0.2	2.5	3.4	1.5	2	1.5
	Gill Netting	---	---	0	2.5	0	2.5	0.4	2.5	0.6	2.5	2.3	2.5
8. Number of top carnivore species		7	5	9	5	9	5	12	5	11	5	10	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	16.7	3	14.2	2.5	7.3	1.5	6.4	1.5	13.8	2.5	5	1.5
	Gill Netting	---	---	45.2	1.5	34	1.5	51.7	2.5	41.5	1.5	80.7	2.5
10. Percent omnivores	Electrofishing	33.3	3	19.9	2.5	26	1.5	11.3	2.5	12.7	2.5	19.5	2.5
	Gill Netting	---	---	37.3	1.5	58	0.5	40.5	0.5	32.2	1.5	10.1	2.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	67	3	41.8	0.5	58.5	0.5	37.3	0.5	29.5	0.5	74.5	0.5
	Gill Netting	---	---	12.6	1.5	21.2	1.5	26.9	2.5	17.1	1.5	21.8	1.5
12. Percent anomalies	Electrofishing	2.2	3	0.8	2.5	0.9	2.5	0.5	2.5	0.7	2.5	0.8	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	0	2.5	0	2.5
Overall RFAI Score			**42**		**46**		**39**		**46**		**45**		**46**

Appendix 2-E. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2004.

Autumn 2004		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		29	5	31	5	27	3	25	3	28	3	28	5
2. Number of centrarchid species		7	5	8	5	6	5	7	5	8	5	7	5
3. Number of benthic invertivores		4	3	4	3	3	1	3	1	3	1	3	1
4. Number of intolerant species		4	3	5	5	5	5	5	5	4	3	4	3
5. Percent tolerant individuals	Electrofishing	64.8	1	55.1	1.5	58.8	1.5	37.2	1.5	71.5	0.5	81.8	0.5
	Gill Netting	---	---	22.9	1.5	45.9	0.5	30.6	0.5	4.6	2.5	26.6	1.5
6. Percent dominance by 1 species	Electrofishing	50	1	29.6	1.5	30.4	1.5	33.8	1.5	45.2	0.5	36.8	1.5
	Gill Netting	---	---	20.7	1.5	29.6	0.5	27.8	1.5	45.9	0.5	23.4	1.5
7. Percent non-native species	Electrofishing	0.5	5	2.2	2.5	0.9	2.5	0.4	2.5	1.1	2.5	1.4	2.5
	Gill Netting	---	---	0.5	2.5	0.6	2.5	0	2.5	0	2.5	1.3	2.5
8. Number of top carnivore species		10	5	11	5	9	5	8	5	9	5	11	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	16.9	3	19.9	2.5	9.6	1.5	10.9	2.5	11.9	2.5	6.5	1.5
	Gill Netting	---	---	50.5	1.5	39.6	1.5	48.9	1.5	56.9	2.5	57.1	2.5
10. Percent omnivores	Electrofishing	51.2	3	15	2.5	19.4	2.5	9.5	2.5	20.5	2.5	35.1	1.5
	Gill Netting	---	---	33	1.5	48.4	0.5	42.8	0.5	11	2.5	31.8	1.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	99.9	3	49.3	0.5	60.8	0.5	51.3	0.5	66.2	0.5	66.6	0.5
	Gill Netting	---	---	18.8	1.5	15.9	1.5	18	1.5	10.9	0.5	15.4	1.5
12. Percent anomalies	Electrofishing	1.3	5	1.2	2.5	1.5	2.5	1	2.5	0.9	2.5	1.6	2.5
	Gill Netting	---	---	0.5	2.5	0	2.5	0	2.5	0	2.5	0	2.5
Overall RFAI Score			**42**		**49**		**41**		**43**		**42**		**43**

Appendix 2-F. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2003.

Autumn 2003		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		30	5	29	3	25	3	26	3	27	3	29	5
2. Number of centrarchid species		8	5	8	5	6	5	8	5	6	5	7	5
3. Number of benthic invertivores		5	3	3	1	3	1	2	1	4	3	3	1
4. Number of intolerant species		5	5	5	5	5	5	5	5	3	3	5	5
5. Percent tolerant individuals	Electrofishing	57.7	3	67	0.5	54.7	1.5	55.6	1.5	72.5	0.5	78.8	0.5
	Gill Netting	---	---	29.7	1.5	26.4	1.5	27	1.5	41.8	0.5	27.9	1.5
6. Percent dominance by 1 species	Electrofishing	34.2	3	31.2	1.5	24.8	2.5	29.9	1.5	40.2	0.5	48.5	1.5
	Gill Netting	---	---	28.1	0.5	19.6	1.5	21.4	1.5	36.3	0.5	28.4	1.5
7. Percent non-native species	Electrofishing	0.6	5	1.1	2.5	0.3	2.5	1	2.5	0.4	2.5	1	2.5
	Gill Netting	---	---	0.8	2.5	0.7	2.5	0.5	2.5	2.2	2.5	5.3	2.5
8. Number of top carnivore species		10	5	10	5	11	5	10	5	9	5	11	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	10.2	1	11.8	2.5	11.2	2.5	9.5	1.5	8.9	1.5	5.9	1.5
	Gill Netting	---	---	31.3	1.5	37.2	1.5	49.5	1.5	20.9	0.5	56.8	2.5
10. Percent omnivores	Electrofishing	18.7	5	20.8	2.5	20.4	2.5	11.2	2.5	30.9	1.5	20	2.5
	Gill Netting	---	---	44.2	1.5	39.2	0.5	35.2	0.5	51.6	0.5	32.6	1.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	69.1	3	41.3	0.5	45.7	0.5	32.1	0.5	45.1	0.5	57.6	0.5
	Gill Netting	---	---	24.9	2.5	14.8	1.5	19.6	1.5	9.1	0.5	19	1.5
12. Percent anomalies	Electrofishing	0.7	5	1	2.5	0.3	2.5	0.8	2.5	0.4	2.5	0.8	2.5
	Gill Netting	---	---	6.4	0.5	0.7	2.5	0.5	2.5	0	2.5	2.1	1.5
Overall RFAI Score			**48**		**42**		**45**		**43**		**36**		**45**

Appendix 2-G. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2002.

Autumn 2002		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition											
1. Number of species		26	3	30	5	24	3	25	3	27	3
2. Number of centrarchid species		7	5	8	5	7	5	7	5	7	5
3. Number of benthic invertivores		5	3	5	3	3	1	3	1	3	1
4. Number of intolerant species		6	5	6	5	5	5	5	5	4	3
5. Percent tolerant individuals	Electrofishing	37.5	3	57.9	1.5	70.3	0.5	52.5	1.5	78	0.5
	Gill Netting	---	---	9.8	2.5	6.2	2.5	16.6	1.5	33.9	0.5
6. Percent dominance by 1 species	Electrofishing	29.4	3	32	1.5	30.6	1.5	27.1	1.5	60	0.5
	Gill Netting	---	---	34.8	0.5	42	0.5	28	1.5	26.2	1.5
7. Percent non-native species	Electrofishing	0.8	5	0.8	2.5	0.5	2.5	0.4	2.5	1.7	2.5
	Gill Netting	---	---	2.3	2.5	3.7	2.5	2.3	2.5	4.7	2.5
8. Number of top carnivore species		7	5	10	5	10	5	8	5	10	5
B. Trophic composition											
9. Percent top carnivores	Electrofishing	12.1	3	16.3	2.5	14.3	2.5	8.1	1.5	9.7	1.5
	Gill Netting	---	---	81.1	2.5	67.9	2.5	76	2.5	56.7	2.5
10. Percent omnivores	Electrofishing	13.2	5	18	2.5	33.5	1.5	10.3	2.5	10.2	2.5
	Gill Netting	---	---	11.4	2.5	17.3	1.5	12	2.5	35.6	0.5
C. Fish abundance and health											
11. Average number per run	Electrofishing	85.7	3	75.3	0.5	38.8	0.5	45.3	0.5	28.2	0.5
	Gill Netting	---	---	13.2	1.5	8.1	0.5	17.5	1.5	23.3	1.5
12. Percent anomalies	Electrofishing	0.5	5	0.6	2.5	0.9	2.5	1	2.5	0.9	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	0	2.5
Overall RFAI Score			**48**		**51**		**43**		**46**		**39**

Appendix 2-H. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2001.

Autumn 2001		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		29	5	31	5	29	5	28	5	32	5	27	3
2. Number of centrarchid species		7	5	8	5	7	5	7	5	8	5	6	5
3. Number of benthic invertivores		6	3	3	1	3	1	3	1	4	3	4	3
4. Number of intolerant species		6	5	5	5	5	5	5	5	5	5	4	3
5. Percent tolerant individuals	Electrofishing	51.8	3	60	1.5	67.7	0.5	54.5	1.5	62.8	0.5	75.9	0.5
	Gill Netting	---	---	34	0.5	29.5	0.5	24.6	1.5	19.9	1.5	37.5	0.5
6. Percent dominance by 1 species	Electrofishing	29.5	3	17.5	2.5	45.4	1.5	18.2	2.5	35.3	1.5	44.7	1.5
	Gill Netting	---	---	28.1	0.5	23.6	1.5	21.9	1.5	48	0.5	33.1	0.5
7. Percent non-native species	Electrofishing	0.4	5	2	2.5	0.1	2.5	0	2.5	0.3	2.5	2.2	1.5
	Gill Netting	---	---	0.2	2.5	0	2.5	0.3	2.5	0	2.5	2.5	2.5
8. Number of top carnivore species		8	5	10	5	11	5	11	5	9	5	9	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	8.4	1	13.5	2.5	7.4	1.5	25.8	2.5	8.2	1.5	4.7	0.5
	Gill Netting	---	---	49.4	1.5	56.8	2.5	60.4	2.5	61	2.5	48.4	1.5
10. Percent omnivores	Electrofishing	12.8	5	28.6	1.5	11.4	2.5	7.6	2.5	24.8	1.5	6.6	2.5
	Gill Netting	---	---	32.9	1.5	32.4	1.5	34.2	0.5	23.3	1.5	39.6	0.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	37.5	1	37	0.5	59.5	0.5	13.2	0.5	49.5	0.5	39.3	0.5
	Gill Netting	---	---	44.1	2.5	35.2	2.5	36.6	2.5	33.1	2.5	27.5	2.5
12. Percent anomalies	Electrofishing	1.2	5	2.5	1.5	1.5	2.5	2.5	1.5	1.8	2.5	0.7	2.5
	Gill Netting	---	---	0	2.5	1.7	2.5	1.9	2.5	0.6	2.5	0.4	2.5
Overall RFAI Score			**46**		**45**		**46**		**48**		**47**		**39**

Appendix 2-I. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 2000.

Autumn 2000		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		24	3	23	3	28	5	27	3	28	3	31	5
2. Number of centrarchid species		7	5	7	5	7	5	8	5	6	5	7	5
3. Number of benthic invertivores		4	3	2	1	2	1	3	1	2	1	3	1
4. Number of intolerant species		4	3	5	5	5	5	5	5	3	3	5	5
5. Percent tolerant individuals	Electrofishing	62.5	1	54.4	1.5	66.5	0.5	39.5	1.5	42.5	1.5	81	0.5
	Gill Netting	---	---	8	2.5	4.9	2.5	29.7	0.5	9.6	2.5	43.5	0.5
6. Percent dominance by 1 species	Electrofishing	38.5	3	25.1	1.5	37.5	1.5	25.2	1.5	21.9	1.5	46.7	1.5
	Gill Netting	---	---	25.5	1.5	23	1.5	26.5	1.5	26.9	1.5	31.8	0.5
7. Percent non-native species	Electrofishing	4.2	5	4.5	1.5	0.2	2.5	0	2.5	0.9	2.5	1.6	2.5
	Gill Netting	---	---	3.6	2.5	1.6	2.5	0	2.5	1.9	2.5	4.7	2.5
8. Number of top carnivore species		7	5	10	5	9	5	10	5	10	5	10	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	20.6	3	23.3	2.5	11.2	2.5	10.6	2.5	26.8	2.5	8.7	1.5
	Gill Netting	---	---	78.1	2.5	57.4	2.5	53.4	2.5	42.3	1.5	51.8	2.5
10. Percent omnivores	Electrofishing	14.7	5	20.5	2.5	21.4	2.5	5.1	2.5	14.6	2.5	15.3	2.5
	Gill Netting	---	---	4.4	2.5	14.8	2.5	35.7	0.5	12.5	2.5	39.4	0.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	61.5	3	22.1	0.5	55.3	0.5	43.3	0.5	54.5	0.5	47	0.5
	Gill Netting	---	---	13.7	1.5	6.1	0.5	28.3	2.5	10.4	0.5	34	2.5
12. Percent anomalies	Electrofishing	1.1	5	3	1.5	1.7	2.5	1.8	2.5	4.7	1.5	1.4	2.5
	Gill Netting	---	---	1.5	2.5	1.6	2.5	0.7	2.5	0	2.5	0	2.5
Overall RFAI Score			**44**		**46**		**48**		**45**		**43**		**44**

Appendix 2-J. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 1999.

Autumn 1999		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition													
1. Number of species		27	3	28	3	25	3	25	3	31	5	26	3
2. Number of centrarchid species		5	5	6	5	5	5	7	5	6	5	7	5
3. Number of benthic invertivores		7	5	4	3	3	1	4	3	6	3	3	1
4. Number of intolerant species		4	3	5	5	5	5	5	5	2	3	4	3
5. Percent tolerant individuals	Electrofishing	25.1	5	38	1.5	26.3	2.5	59.1	1.5	34.7	1.5	71	0.5
	Gill Netting	---	---	49.2	0.5	45.3	0.5	41.5	0.5	40.8	0.5	61.4	0.5
6. Percent dominance by 1 species	Electrofishing	46.9	1	16.3	2.5	21	2.5	22	2.5	25.2	1.5	29.7	1.5
	Gill Netting	---	---	48.4	0.5	42	0.5	38.1	0.5	38.2	0.5	58	0.5
7. Percent non-native species	Electrofishing	0.7	5	2.4	2.5	7.4	0.5	1.6	2.5	1.7	2.5	8.4	0.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	3.3	2.5	2	2.5
8. Number of top carnivore species		9	5	10	5	9	5	10	5	12	5	11	5
B. Trophic composition													
9. Percent top carnivores	Electrofishing	7.9	1	17.8	2.5	9.9	1.5	13.4	2.5	12.2	2.5	14.2	2.5
	Gill Netting	---	---	38.1	1.5	27.1	1.5	38.6	1.5	22.4	0.5	19.4	0.5
10. Percent omnivores	Electrofishing	11.1	5	17.8	2.5	15.6	2.5	22	2.5	8	2.5	25.8	1.5
	Gill Netting	---	---	51.2	0.5	59.7	0.5	50.6	0.5	53.9	0.5	71	0.5
C. Fish abundance and health													
11. Average number per run	Electrofishing	37.1	1	13.9	0.5	16.2	0.5	8.5	0.5	46.9	0.5	10.3	0.5
	Gill Netting	---	---	24.4	2.5	18.1	1.5	17.6	1.5	15.2	1.5	44.8	2.5
12. Percent anomalies	Electrofishing	2.7	3	2.9	1.5	0.8	2.5	0	2.5	0.6	2.5	1.3	2.5
	Gill Netting	---	---	0	2.5	0.6	2.5	0.6	2.5	0	2.5	0	2.5
Overall RFAI Score			**42**		**45**		**41**		**45**		**43**		**36**

Appendix 2-K. Individual metric scores and overall RFAI scores for Watts Bar Reservoir forebay, Autumn 1998.

Autumn 1998		TRM 531 Watts Bar Forebay	
Metric		Obs	Score
A. Species richness and composition			
1. Number of species		28	5
2. Number of centrarchid species		7	5
3. Number of benthic invertivores		3	1
4. Number of intolerant species		4	3
5. Percent tolerant individuals	Electrofishing	29.5	2.5
	Gill Netting	37.9	0.5
6. Percent dominance by 1 species	Electrofishing	65.5	0.5
	Gill Netting	33.5	0.5
7. Percent non-native species	Electrofishing	0.8	2.5
	Gill Netting	6.8	2.5
8. Number of top carnivore species		11	5
B. Trophic composition			
9. Percent top carnivores	Electrofishing	1.7	0.5
	Gill Netting	36.6	1.5
10. Percent omnivores	Electrofishing	8	2.5
	Gill Netting	48.4	0.5
C. Fish abundance and health			
11. Average number per run	Electrofishing	144.4	1.5
	Gill Netting	16.1	1.5
12. Percent anomalies	Electrofishing	0.3	2.5
	Gill Netting	0.6	2.5
Overall RFAI Score			**41**

Appendix 2-L. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir, Autumn 1997.

Autumn 1997		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition									
1. Number of species		26	3	20	3	22	3	22	3
2. Number of centrarchid species		8	5	5	5	5	5	3	3
3. Number of benthic invertivores		6	3	3	1	4	3	2	1
4. Number of intolerant species		5	5	4	3	4	3	2	3
5. Percent tolerant individuals	Electrofishing	55.6	3	67.3	0.5	64	0.5	23.2	2.5
	Gill Netting	---	---	16.2	1.5	17.2	1.5	18.9	1.5
6. Percent dominance by 1 species	Electrofishing	29.4	3	33.5	1.5	53	0.5	27.8	1.5
	Gill Netting	---	---	18	1.5	23	1.5	18.2	1.5
7. Percent non-native species	Electrofishing	7.8	5	7.8	0.5	4	1.5	9.4	0.5
	Gill Netting	---	---	0.9	2.5	6.9	2.5	9.8	0.5
8. Number of top carnivore species		9	5	8	5	9	5	10	5
B. Trophic composition									
9. Percent top carnivores	Electrofishing	28.7	5	14.7	2.5	5	1.5	16.5	2.5
	Gill Netting	---	---	55	2.5	60.9	2.5	41.7	1.5
10. Percent omnivores	Electrofishing	18	5	39.6	1.5	57	0.5	12.3	2.5
	Gill Netting	---	---	22.5	2.5	13.8	2.5	33.3	1.5
C. Fish abundance and health									
11. Average number per run	Electrofishing	50.4	1	16.3	0.5	6.7	0.5	27.5	0.5
	Gill Netting	---	---	11.1	0.5	8.7	0.5	13.2	1.5
12. Percent anomalies	Electrofishing	2.5	3	3.3	1.5	0	2.5	0.5	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5
Overall RFAI Score			**46**		**39**		**40**		**38**

Appendix 2-M. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 1996.

Autumn 1996		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 482 Chickamauga Forebay		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition									
1. Number of species		30	5	27	3	31	5	27	3
2. Number of centrarchid species		8	5	6	5	8	5	6	5
3. Number of benthic invertivores		6	3	3	1	3	1	3	1
4. Number of intolerant species		6	5	5	5	5	5	5	5
5. Percent tolerant individuals	Electrofishing	92.9	1	49.9	1.5	36.4	1.5	85.4	0.5
	Gill Netting	---	---	23.8	1.5	24.9	1.5	25.7	1.5
6. Percent dominance by 1 species	Electrofishing	80.8	1	38.6	1.5	48.4	1.5	45.3	1.5
	Gill Netting	---	---	22.3	1.5	22.1	1.5	26.1	1.5
7. Percent non-native species	Electrofishing	0.3	5	1.2	2.5	0.6	2.5	1.3	2.5
	Gill Netting	---	---	1	2.5	1.4	2.5	4.4	2.5
8. Number of top carnivore species		10	5	10	5	11	5	9	5
B. Trophic composition									
9. Percent top carnivores	Electrofishing	4.7	1	5.4	0.5	3	0.5	7.3	1.5
	Gill Netting	---	---	59.6	2.5	58.1	2.5	59.3	2.5
10. Percent omnivores	Electrofishing	81.2	1	34	1.5	13.4	2.5	31.1	1.5
	Gill Netting	---	---	26.4	1.5	27.2	1.5	29.6	1.5
C. Fish abundance and health									
11. Average number per run	Electrofishing	295.3	5	56.1	0.5	139.9	1.5	61.3	0.5
	Gill Netting	---	---	19.3	1.5	21.7	1.5	22.6	1.5
12. Percent anomalies	Electrofishing	0	5	0	2.5	0	2.5	0.1	2.5
	Gill Netting	---	---	0	2.5	0	2.5	1.8	2.5
Overall RFAI Score			**42**		**43**		**47**		**43**

Appendix 2-N. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir, Autumn 1995.

Autumn 1995		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition									
1. Number of species		28	5	29	3	27	3	26	3
2. Number of centrarchid species		7	5	8	5	7	5	3	3
3. Number of benthic invertivores		6	3	3	1	4	3	5	3
4. Number of intolerant species		5	5	5	5	6	5	2	3
5. Percent tolerant individuals	Electrofishing	64.7	1	16.8	2.5	14.5	2.5	51.5	1.5
	Gill Netting	---	---	21.3	1.5	14.2	1.5	22.8	1.5
6. Percent dominance by 1 species	Electrofishing	40.9	3	36.3	1.5	58.3	0.5	42.7	0.5
	Gill Netting	---	---	28	1.5	18.6	1.5	23.5	1.5
7. Percent non-native species	Electrofishing	0.5	5	0.3	2.5	0.1	2.5	1.8	2.5
	Gill Netting	---	---	1	2.5	0	2.5	1.3	2.5
8. Number of top carnivore species		11	5	11	5	10	5	11	5
B. Trophic composition									
9. Percent top carnivores	Electrofishing	12.7	3	2.5	0.5	2	0.5	2.6	0.5
	Gill Netting	---	---	63.9	2.5	69.4	2.5	43	1.5
10. Percent omnivores	Electrofishing	43.3	3	10	2.5	1.7	2.5	45.2	0.5
	Gill Netting	---	---	25.7	1.5	19.7	1.5	30.2	1.5
C. Fish abundance and health									
11. Average number per run	Electrofishing	128.7	5	232.6	2.5	206	1.5	129.5	1.5
	Gill Netting	---	---	29.6	2.5	18.3	1.5	14.9	1.5
12. Percent anomalies	Electrofishing	0	5	0	2.5	0	2.5	0	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5
Overall RFAI Score			**48**		**48**		**47**		**39**

Appendix 2-O. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 1994.

Autumn 1994		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition											
1. Number of species		34	5	28	3	24	3	24	3	28	5
2. Number of centrarchid species		8	5	8	5	6	5	5	5	5	5
3. Number of benthic invertivores		6	3	2	1	4	3	4	3	4	3
4. Number of intolerant species		7	5	4	3	6	5	1	1	5	5
5. Percent tolerant individuals	Electrofishing	49.9	3	66	0.5	46.9	1.5	66.8	0.5	24.7	2.5
	Gill Netting	---	---	21.4	1.5	51.1	0.5	15.7	2.5	13.4	2.5
6. Percent dominance by 1 species	Electrofishing	27.1	3	32.1	1.5	33.8	1.5	41.6	0.5	68.4	0.5
	Gill Netting	---	---	40.3	0.5	41.5	0.5	16.9	1.5	45.8	0.5
7. Percent non-native species	Electrofishing	1	5	3.8	1.5	1.4	2.5	7.7	0.5	1.6	2.5
	Gill Netting	---	---	0	2.5	1.5	2.5	5.6	1.5	4.9	2.5
8. Number of top carnivore species		10	5	10	5	8	5	9	5	9	5
B. Trophic composition											
9. Percent top carnivores	Electrofishing	16.9	3	12.4	2.5	15	2.5	11.2	2.5	3.3	0.5
	Gill Netting	---	---	62.3	2.5	33.3	1.5	46.1	1.5	75.4	2.5
10. Percent omnivores	Electrofishing	13.6	5	26.2	1.5	6.9	2.5	18	2.5	5.5	2.5
	Gill Netting	---	---	24	1.5	56.3	0.5	22.5	2.5	19	1.5
C. Fish abundance and health											
11. Average number per run	Electrofishing	120.9	5	45.1	0.5	75.5	0.5	51.4	0.5	159.6	1.5
	Gill Netting	---	---	15.4	1.5	13.5	1.5	8.9	0.5	14.2	1.5
12. Percent anomalies	Electrofishing	0.1	5	0	2.5	0.2	2.5	0	2.5	0	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	2.1	1.5
Overall RFAI Score			**52**		**40**		**44**		**39**		**48**

Appendix 2-P. Individual metric scores and overall RFAI scores for sites sampled in Chickamauga Reservoir and Watts Bar Reservoir forebay, Autumn 1993.

Autumn 1993		TRM 529 Chickamauga Inflow		TRM 490.5 Chickamauga Transition		TRM 472.3 Chickamauga Forebay		HiRM 8.5 Hiwassee Embayment		TRM 531 Watts Bar Forebay	
Metric		Obs	Score	Obs	Score	Obs	Score	Obs	Score	Obs	Score
A. Species richness and composition											
1. Number of species		32	5	30	5	28	5	30	5	31	5
2. Number of centrarchid species		8	5	7	5	8	5	5	5	7	5
3. Number of benthic invertivores		6	3	3	1	2	1	4	3	4	3
4. Number of intolerant species		7	5	6	5	4	3	4	3	5	5
5. Percent tolerant individuals	Electrofishing	45.6	3	41.4	1.5	20.6	2.5	57.3	1.5	73.4	0.5
	Gill Netting	---	---	13.9	2.5	33.2	0.5	29.8	1.5	34.6	0.5
6. Percent dominance by 1 species	Electrofishing	34.2	3	39.7	1.5	62.1	0.5	25.6	1.5	43.4	1.5
	Gill Netting	---	---	26.2	1.5	23.3	1.5	22.2	1.5	23.4	1.5
7. Percent non-native species	Electrofishing	1.3	5	1.2	2.5	0.5	2.5	4.5	1.5	0.6	2.5
	Gill Netting	---	---	2.3	2.5	0.5	2.5	0.8	2.5	2.4	2.5
8. Number of top carnivore species		10	5	11	5	10	5	12	5	11	5
B. Trophic composition											
9. Percent top carnivores	Electrofishing	14.4	3	8.8	1.5	4.8	0.5	17.3	2.5	6.5	1.5
	Gill Netting	---	---	70	2.5	58.9	2.5	51.6	1.5	54.1	2.5
10. Percent omnivores	Electrofishing	23.5	5	20.2	2.5	3.6	2.5	27.6	1.5	46.3	1.5
	Gill Netting	---	---	16.9	2.5	31.2	1.5	31.7	1.5	37.1	0.5
C. Fish abundance and health											
11. Average number per run	Electrofishing	172.2	5	151.5	1.5	80.9	0.5	93.9	0.5	58.1	0.5
	Gill Netting	---	---	39.7	2.5	20.2	1.5	25.2	2.5	20.5	1.5
12. Percent anomalies	Electrofishing	0	5	0	2.5	0	2.5	0.1	2.5	0	2.5
	Gill Netting	---	---	0	2.5	0	2.5	0	2.5	2.4	1.5
Overall RFAI Score			**52**		**51**		**43**		**46**		**44**

Watts Bar Native Mussel Enhancement Project

Preliminary Evaluation of an Artificial Boulder Field for Enhancing Native Mussel Habitat in the Watts Bar Tailwater, Tennessee River Mile 528.5

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Appendix A-1

1. Introduction

The results of several previous studies indicate that native mussels persist in suitable gravel and cobble habitats located in at least the first ten miles downstream from Watts Bar Dam (Tennessee River Mile 529.9 - 519) (Wrenn, *et al.* 1986; Jenkinson 1991; Ahlstedt and McDonough 1997; Baxter, *et al.* 1998). These studies also indicate that the resident mussels are continuing to grow (if only slowly) but are not successfully recruiting juveniles into their populations (Wrenn, *et al.* 1986; Baxter, *et al.* 1998). Less detailed studies downstream from other dams on the Tennessee River suggest similar status for the mussel stocks in those areas, with a few interesting exceptions. Surveys conducted just downstream from Pickwick Landing Dam (Jenkinson 1987), Wilson Dam (Garner and McGregor 2001), and Guntersville Dam (J.T. Garner, Malacologist, Alabama Division of Wildlife and Freshwater Fisheries, personal communication) suggest that substantial mussel recruitment is occurring along some shoreline and backwater areas in those tailwaters. In all three of these tailwater areas, more mussel recruitment is occurring in sheltered habitats than in the main river channel.

One of the most obvious differences between the main river channel and sheltered shoreline or backwater habitats is the difference in bottom water velocities that occurs during floods and other high-flow events. Other studies have indicated that higher density mussel beds are often associated with relatively lower bottom velocities (Salmon and Green 1983; Way, *et al.* 1989; Strayer and Ralley 1993; Layzer and Madison 1995) and, in particular, areas that provide refuge from high bottom velocities during flood events (Vannote and Minshall 1982; Strayer 1999). Similarly, Neves and Widlak (1987) found highest densities of juvenile mussels (ages 0-3 years) behind boulders in runs and riffles. Some studies suggest that exposure to relatively high bottom velocities can depress the health of juvenile mussels, at

least temporarily (Payne and Miller 1987). Other studies suggest that near-bottom shear stresses and other complex hydraulic variables associated with high flows inhibit settlement and subsequent recruitment of juvenile mussels, when high flows coincide with settlement (when early juveniles drop from their fish hosts) (Layzer and Madison 1995; Hardison and Layzer 2001).

If high water velocities along the bottom have some effect on where successful mussel recruitment can occur, it seems logical that small mussels might be swept away from otherwise suitable habitats in the river channel during high velocity spates. To address this topic, we designed an experiment to see if a relatively simple method of reducing high water velocities across otherwise suitable mussel habitat would allow small mussels to remain in place and, perhaps, might eventually enhance successful mussel recruitment in this tailwater.

The Tennessee Valley Authority's (TVA) Watts Bar Nuclear Plant (WBN) commissioned this experiment and report to satisfy a National Pollutant Discharge Elimination System (NPDES) permit requirement set forth by the Division of Water Pollution Control, Tennessee Department of Environment and Conservation (WBN NPDES Permit TN0020168). As stipulated in that permit, the Tennessee Wildlife Resources Agency has previously reviewed and approved a proposal describing this experiment and has agreed that it should satisfy the permit requirements.

2. Methods

2.1 Study Area

This experiment was conducted in the Tennessee River approximately 1 mile (~1.6 km) downstream from Watts Bar Dam, in Rhea County, Tennessee. A location was chosen along the right (descending) margin of the navigation channel, between the loading facility at Watts Bar Fossil Plant and the intake channel for Watts Bar Nuclear Plant (TRM 528.3 - 528.8, see Figure 1). This site is outside of the navigation channel and appeared to contain suitable mussel habitat. Flow throughout this reach of the river is controlled by releases from Watts Bar Dam and the associated Watts Bar Hydroelectric Power Plant (WBH). Seasonal discharge from WBH is generally highest during late summer peaking power generation and fall reservoir drawdown, and lowest during late spring reservoir filling (see Appendix). Spring floods and other periods of high precipitation occasionally result in relatively short spates of high discharges from the dam that deviate from the general seasonal pattern.

At least 14 native mussel species are believed to survive in the Watts Bar tailwater. Native mussel distributions range from very sparse and patchy in the first few miles downstream from WBH (TRM 529.9 - 527), to relatively dense and widespread a few miles farther downstream (e.g. Hunter Shoals, TRM 522) (summarized in Baxter, *et al* 1998). Surveys have found very little evidence of recent mussel recruitment throughout the length of the tailwater (Jenkinson 1991; Ahlstedt and McDonough 1997; Baxter, *et al.* 1998). In contrast, the Asian clam, *Corbicula fluminea* (Muller, 1774) and, recently, the zebra mussel, *Dreisenna polymorpha* (Pallas, 1771), have become abundant throughout the Watts Bar tailwater (Kerley 2001).

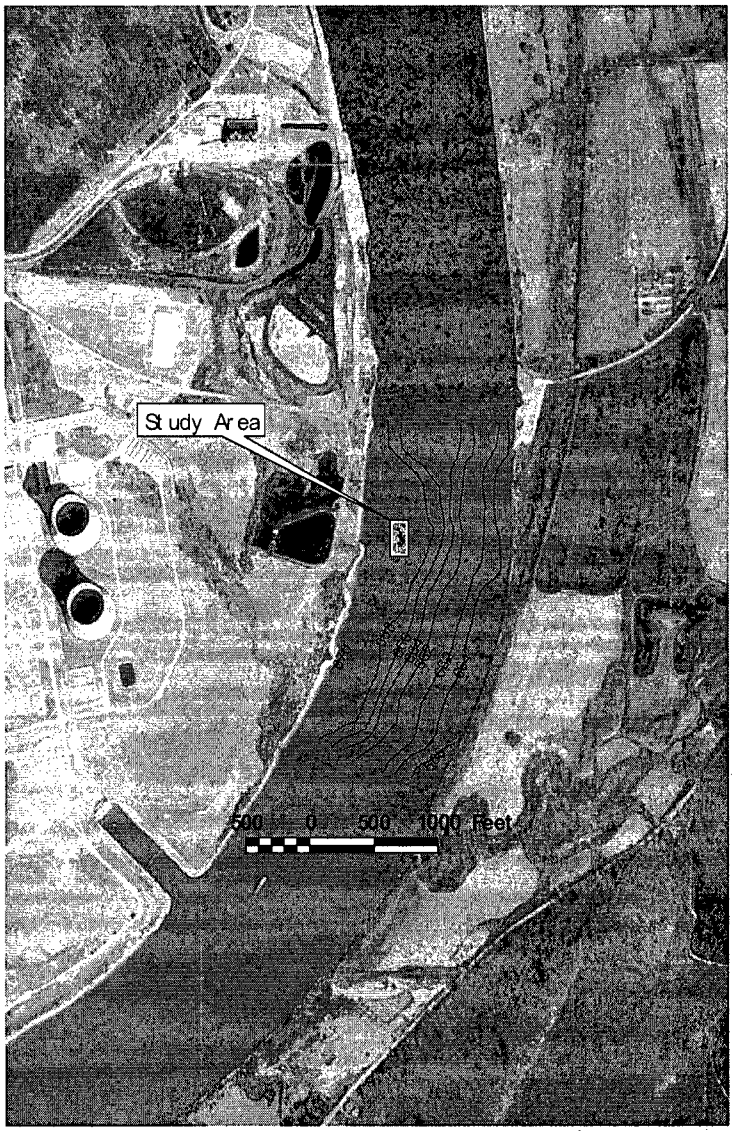


Figure 1. Aerial photograph of Watts Bar tailwater (Tennessee River miles 527.5-529.6) with location of boulder field identified (study area). River bottom elevation contours are given in feet above mean sea level. Watts Bar Dam is just beyond the upper margin of the photograph.

A preliminary reconnaissance indicated that very few live, native mussels occur in this area beyond 20 meters (m) from the right (descending) shore. No live, native mussels were found beyond 50 m from shore, including the area identified for placement of the boulder field. Interestingly, however, three small mussels, each apparently less than 10 years old and representing a different species, were among the 19 mussels collected from the near-shore part of this area. The presence of these individuals indicates that at least three mussel species [fragile paper shell, *Leptodea fragilis* (Rafinesque, 1820), purple wartyback, *Cyclonaias tuberculata* (Rafinesque, 1820), and pink heelsplitter, *Potamilis alatus* (Say, 1817)] are experiencing some successful recruitment in at least part of the Watts Bar tailwater.

The river bottom is relatively uniform throughout the area selected for this experiment. Bottom contours are nearly level to gradually sloping from the toe of the initial bank slope toward mid-channel (3.5-4.5 m mean depth at base flow), then dropping rapidly along the right (descending) edge of the navigation channel. During the initial survey, the substrate was mostly sand for the first 20 m offshore; a mixture of gravel, cobble, sand, and empty Asian clam and zebra mussel shells from 20 to 40m offshore; and moderately scoured cobble and gravel with scattered empty Asian clam and zebra mussel shells from 40 to 100 m offshore.

2.2 Boulder Field Design and Deployment

The limestone boulders used in this experiment to disrupt current velocity along part of the river bottom were generally semi-cubical to prismatic in shape and were from 2 to 4 ft (0.6 to 1.2 m) minimum dimension in any plane. They were transported from a nearby quarry via tractor-trailers and loaded onto a barge. Boulders were placed on the river bottom using a

large track-hoe to either drop or push them from the deck of the barge. The boulder field was placed on September 28, 2000.

The initial concept of the boulder field was to provide a variety of bottom velocity effects across the width and length of an area and during the range of discharge volumes coming from Watts Bar Dam. The presence of the boulders was expected to reduce shear stresses along the bottom across nearly all of the experiment area during most flow velocities. Conversely, parts of the experiment area were expected to be subjected to various amounts of turbulence and likely experience some localized increases in shear stresses and associated complex hydraulic variables during high flows, possibly even greater than would occur in unsheltered areas.

The selected design was a staggered pattern of 6 rows, consisting of 10 boulders each, planned to cover approximately 70 x 100 feet (700 ft^2 or 65 m^2) of river bottom. While every attempt was made to place boulders according to the original design, actual deployment of the boulders resulted in a somewhat different arrangement. The resulting boulder field as deployed is a bit less orderly than originally planned, but generally retains the characteristics desired for the experiment. The approximate relative positions of the boulders are indicated on Figure 2.

2.3 Boulder Field Mapping

Initial mapping of the actual boulder positions on the river bottom was conducted in early November 2000 using a floating, integrated Global Positioning System (GPS) antenna, receiver, and logger (SAM02 Smart Antenna, Axiom Navigation Inc.) tethered to a diver. The SAM02 recorded its position every five seconds as the diver maneuvered through the boulder field. When the diver located a boulder on the river bottom, a technician on the

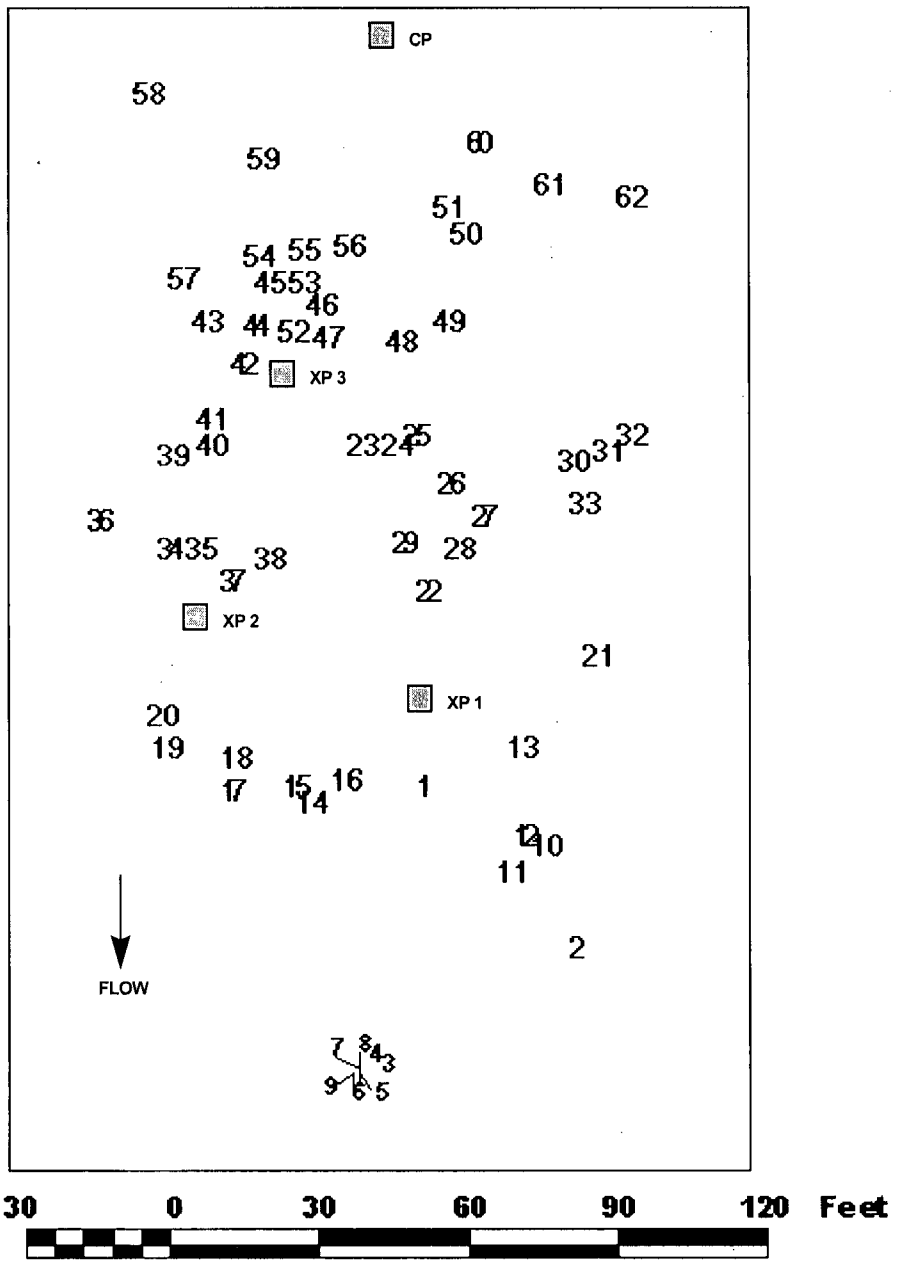


Figure 2. Estimated positions of boulders within study area and relative positions of experimental plots. Numbers (1-62) represent boulders.(CP= control plot, XP= experimental plot)

surface recorded the time and approximate location of the GPS unit. In the laboratory, the positions of individual boulders were estimated by extracting the markers corresponding to the recorded time entries. The boulder mapping effort included five diver deployments over two days.

This mapping procedure proved to be less than ideal for determining the relative position of each boulder due to uncertainties in the positions computed by the GPS unit. Observations made during subsequent dives indicated that, while the overall configuration of the boulder field was generally depicted by this technique, the relative position of each boulder was not always accurately mapped. Nonetheless, this information was sufficient for estimating patterns of flow behavior and determining experimental plot locations within the boulder field.

2.4 Location of Experimental Plots

The map of boulder locations was used to select three areas within the boulder field where mussels would be stocked. The potential for hydrodynamic transport of mussels was the primary criterion for selecting the test plot locations. Each location was chosen based on the different degrees of protection from the effects of high velocity flows that they were predicted to provide. Among the experimental plots, plot 1 was placed in the least sheltered location, plot 3 was placed in the most sheltered location, and plot 2 was placed in a location predicted to provide intermediate shelter from high velocity flows. The control plot was placed outside of the boulder field, in an upstream location virtually identical to the experimental area prior to the addition of the boulders.

All four experimental plots were located approximately 50 m from the right (descending) shore in water approximately 12 to 14 ft. (3.7-4.3 m) deep. Experimental plot 1 was located

within the downstream third of the boulder field, approximately 24 ft. (7.3 m) downstream from a cluster of boulders (Figure 2). Plot 2 was located within the middle third of the boulder field and approximately 15 ft. (4.6 m) downstream from a cluster of boulders. Plot 3 was located in the upstream third of the boulder field and approximately 6 ft (1.8 m) downstream from a relatively dense cluster of boulders. The control plot was located approximately 50 ft. (15 m) upstream from the boulder field, at approximately the same distance from shore and depth as the experimental plots.

Each 3 m^2 plot consisted of three contiguous 1 m^2 sub-plots: two adjacent sub-plots on the upstream side and one downstream, centered between the other two. Plot boundaries were marked with steel pins located at the outside corners of each sub-plot. Pins were 16 in. (40.6 cm) long and were driven into the substrate, leaving approximately 4 in. (10 cm) exposed. Subsequent location of plots was aided by GPS coordinates and by buoys anchored near each plot.

2.5 Mussel Stocking

Mussels to be stocked in the experimental and control plots included both small and large individuals. Small mussels included both juveniles of various species [primarily pimplebacks, *Quadrula pustulosa* (I. Lea, 1831)] and adults of species that are small at maturity [threehorn wartyback, *Obliquaria reflexa* Rafinesque 1820, fawnsfoot, *Truncilla donaciformis* (I. Lea, 1828), and purple lilliput, *Toxolasma lividus* (Rafinesque, 1831)]. With approval and assistance from J. T. Garner, Alabama Division of Wildlife and Freshwater Fisheries, these smaller mussels were collected from an area in the Guntersville Dam tailwater (Tennessee River miles 347.6 and 348), Marshall County, Alabama. The substrate within this area was primarily sand and fine gravel, so a suction dredge was used as an efficient method for collecting these animals (procedure described in Miller *et al.* 1997).

These mussels were transported to the Watts Bar tailwater and held in mesh bags submerged at the experiment site while divers collected adult mussels. Large adult native mussels were collected by hand from the Hunter Shoals area of the Watts Bar tailwater (TRM 522), approximately seven miles downstream from the experiment site.

All mussels to be used in this experiment were identified, measured for maximum length using digital calipers (to the nearest millimeter), and sorted by size and species. All mussels included in the experiment were sorted into four size ranges by dividing the total size range into fourths (10-43, 43-76, 76-109, and >109 mm). An individually-numbered plastic tag (Floy Tag, Inc., Seattle, WA) was attached to the left valve of each mussel with cyanoacrylate glue. Mussels were divided as evenly as possible among each of the four plots: first by number per size class, then by species. A total of 668 mussels were stocked into the four plots (166-168 mussels per plot) (see Table 1). Divers manually placed mussels into each plot, with each size class evenly distributed across the total area of each plot. Small mussels (10-76 mm) were inserted at least 3 in. (7.6 cm) into the substrate. Larger mussels (>76 mm) were placed so that at least 2/3 of the shell was beneath the surface of the substrate. Stocking was completed on November 30, 2000.

Species		Plot				Total	Size Range (mm)	%< 76 mm
Common Name	**Scientific Name**	**XP 1**	**XP 2**	**XP 3**	**CP**			
Threehorn wartyback	*Obliquaria reflexa*	68	70	72	72	282	14-55	100
Pimpleback	*Quadrula pustulosa*	52	50	51	49	202	11-72	100
Elephantear	*Elliptio crassidens*	18	25	22	19	84	39-126	5
Fawnsfoot	*Truncilla donaciformis*	9	9	8	10	36	12-27	100
Threeridge	*Amblema plicata*	7	1	3	2	13	15-58	100
Purple wartyback	*Cyclonaias tuberculata*	3	-	6	4	13	16-96	54
Ohio pigtoe	*Pleurobema cordatum*	3	1	3	3	10	91-107	0
Pink heelsplitter	*Potamilus alatus*	4	2	-	4	10	46-176	10
Fragile papershell	*Leptodea fragilis*	-	5	-	1	6	34-84	83
Purple liliput	*Toxolasma lividus*	2	2	2	1	7	21-38	100
Butterfly	*Ellipsaria lineolata*	-	1	1	2	4	32-87	50
Monkeyface	*Quadrula metanevra*	-	-	-	1	1	85	0
	Total	166	166	168	168	668	11-176	
	Density per square meter	55.3	55.3	56	56			

Table 1. Number of mussels per species stocked into each plot (XP = experimental plot, CP = control plot.)

2.6 Monitoring and Assessment

Divers performed a brief visual reconnaissance on July 3, 2001, to determine if the plots were still intact and to document that at least some of the larger mussels were still in place. Divers quantitatively sampled the plots on September 20-21, 2001, generally following techniques described by Miller *et al.* (1993). Three samples were taken from each plot by placing a 0.25 m^2 quadrat frame at some random point within each 1m^2 sub-plot. Within each quadrat, divers removed any mussels visible at the substrate surface then excavated the substrate to approximately 10 cm depth, putting the material in a 20-liter bucket. Each bucket was hauled to the surface, where the substrate was screened through two nested sieves (25 and 9.5 mm). All mussels from each quadrat were removed from the sample and counted by species. Tag number and length measurements also were recorded from each of these animals. Mussels and the excavated substrate material were carefully replaced in the plot from which they had been removed.

2.7 Data Analysis

Statistical methods used to analyze the data from this experiment generally follow those described by Sokal and Rolf (1981). Analyses were performed with the aid of Excel 7.0 (1996, Excel for Windows 95, Microsoft Corporation) and SAS 8.0 (1998, SAS Institute). Data from each plot were compared for differences in the total number of mussels recovered and the number of mussels in each size class. Observed data were tested for normality (W:Normal and Pr<W) and non-normal distributions were adjusted by log transformation ($\log_{(n+1)}$). Analysis of variance (ANOVA) and Tukey's t-test were performed on the transformed sample data.

3. Results

3.1 Bottom Conditions

In July 2001, all plots were found quickly and appeared to be intact. There was no discernible change in substrate conditions at the control plot. Substrate conditions within the boulder field had changed somewhat. Areas directly downstream from boulders had accumulated additional amounts of Asian clam and zebra mussel shell material, as well as some smaller gravel. Some minor scouring also was evident upstream, along the sides, and between some boulders. Larger mussels were visible at the surface in each experimental plot and in the control plot.

During the September 2001 sampling effort, conditions were generally similar to those observed in July, with one exception. This time, the divers failed to locate experimental plot 1 during over two hours of search time. While there was a discernible increase in the deposition of Asian clam and zebra mussel shell material in the general vicinity of plot 1 over the pre-experiment condition, deposition in that area did not appear to have increased between July and September. The possible fate of plot 1 and the implications of various alternative explanations are covered in the Discussion section.

3.2 Mussel Survival

Results from the quantitative sampling in the three remaining plots are presented in tables 2 and 3. A combined total of 93 mussels representing 6 species was recovered from all plots sampled (Table 2). As indicated in the tables, similar numbers of mussels were recovered overall and per size class from experimental plots 2 and 3 (39 and 40 animals, respectively); however, substantially fewer mussels (14) were recovered from the control plot. Log transformed sample means from plots 2 and 3 were significantly different from the control

plot (p= 0.038). No mussels from the 10-43 mm size class were recovered from the control plot, while 13 were recovered from experimental plot 3 and 15 were found in experimental plot 2. The numbers of small mussels in the experimental plots was significantly different from the control plot (p=0.0007). With regard to each of the other three size classes, the numbers of recovered mussels were not significantly different between the experimental and the control plots (43-76mm, p=0.5; 76-109mm, p=0.8; >109mm, p=0.7)

Species		Plot	XP 2			XP 3			CP			
Common Name	**Scientific Name**	**Sample**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**Total**
Threehorn wartyback	*Obliquaria reflexa*		3	14	4	9	5	6	-	2	1	44
Pimpleback	*Quadrula pustulosa*		-	5	6	2	5	3	2	-	3	26
Elephantear	*Elliptio crassidens*		3	2	1	2	2	2	-	2	1	15
Purple wartyback	*Cyclonaias tuberculata*		-	-	-	-	3	-	-	-	2	5
Pink heelsplitter	*Potamilus alatus*		1	-	-	-	-	-	-	-	1	2
Ohio pigtoe	*Pleurobema cordatum*		-	-	-	1	-	-	-	-	-	1
		Totals: Sample	7	21	11	14	15	11	2	4	8	93
		Plot		39			40			14		
		Sample Mean		13			13.3			4.7		
		SD		7.2			2.1			3.1		
		Estimated Density per Square Meter		52			53.3			18.7		

Table 2. Number of mussels per species recovered in samples from each plot. Experimental plot 2 and 3 log transformed sample means are significantly different from the control plot. (XP= experimental plot, CP= control plot, SD = standard deviation).

The numbers of recovered mussels in each size class from each plot were compared arithmetically to the original stocked density (density per square meter estimated from samples / stocked density per square meter) (Table 3). The results from experimental plots 2 and 3 were very similar, while the control plot was considerably different. The percentages of smaller sized mussels (≤109 mm) recovered from the control plot (0-58%) were consistently lower than those recovered from the experimental plots (61-158%); however, the percentage of mussels >109 mm recovered from the control plot (145%) were comparable to those recovered from the experimental plots (100-133%).

Nearly all of the mussels recovered were found alive. Two individuals were found dead in place: a threehorn wartyback in experimental plot 2 and a pimpleback in the control plot. A dead fragile paper shell, originally stocked into the control plot, was found in the lower third of the boulder field during the search for experimental plot 1. Tag retention was good, with only three mussels recovered without a tag. Two of these three mussels were found in the control plot.

Plot	Size Class (mm)	Total number stocked	Stocked density per square meter	Total number in samples (combined)	Density per square meter estimated from samples	Percentage of stocked density recovered in samples
XP 1	10-43	82	27	-	-	-
	43-76	57	19	-	-	-
	76-109	15	5	-	-	-
	>109	12	4	-	-	-
	Total	166	55	-	-	-
XP 2	10-43	83	28	13	17	63
	43-76	54	18	19	25	141
	76-109	17	6	4	5	94
	>109	12	4	3	4	100
	Total	166	55	39	52	94
XP 3	10-43	99	33	15	20	61
	43-76	43	14	17	23	158
	76-109	11	4	3	4	109
	>109	15	5	5	7	133
	Total	168	56	40	53	95
CP	10-43	86	29	0	0	0
	43-76	55	18	8	11	58
	76-109	16	5	2	3	50
	>109	11	4	4	5	145
	Total	168	56	14	18.7	33

Table 3. Comparison of the initial stocked density of mussels per square meter to the estimated density after 10 months. Data are given by plot and size class (XP = experimental plot, CP = control plot).

3.3 Shell Growth

Assessment of shell growth was difficult due to the relatively small sample sizes, little apparent growth, and an apparent relatively high degree of sampling error. While most mussels showed little or no growth (range= 0-4mm), a few mussels measured ~1 mm shorter than they were at the beginning of the experiment (see Table 4). This difference was most likely due to sampling error rather than an actual reduction in total length. Given these limitations, no statistical analyses were conducted on shell growth; however, some cautious observations were made. Pimplebacks showed the most apparent growth among all species in all plots. This may be have been related more to the relatively young age of these animals than anything else. Nearly all pimplebacks were relatively younger, faster growing individuals and most of the other similar-sized mussels in the samples were of species that mature at a smaller size (e.g. threehorn wartyback). While a good proportion of the overall growth seen in experimental plots 2 and 3 occurred among mussels in the smaller size class (10-43 mm), no mussels ≤ 43 mm were recovered from the control plot. With regard to mussels > 43 mm, there does not appear to have been any difference in growth between the mussels recovered from any of the plots during the 10-month duration of this experiment.

Plot		XP 2			XP 3			CP		
Species		Nov-00	Sep-01	Difference	Nov-00	Sep-01	Difference	Nov-00	Sep-01	Difference
Common Name	**Scientific Name**									
Threehorn wartyback	*Obliquaria reflexa*	54	54	-	55	54	-1	50	50	-
		51	51	-	51	49	-2	45	44	-1
		50	50	-	48	47	-1	48	48	-
		49	49	-	46	46	-			
		47	47	-	46	46	-			
		46	46	-	46	46	-			
		46	46	-	46	46	-			
		46	46	-	44	44	-			
		44	44	-	43	42	-1			
		43	43	-	43	43	-			
		42	42	-	42	42	-			
		41	41	-	42	41	-1			
		41	41	-	42	42	-			
		39	39	-	41	41	-			
		39	39	-	41	41	-			
		38	39	1	40	40	-			
		38	38	-	39	39	-			
		38	38	-	38	38	-			
		32	32	-	37	37	-			
		28	28	-	31	31	-			
Pimpleback	*Quadrula pustulosa*	64	62	-2	64	64	-	46	47	1
		51	51	-	57	57	-	50	50	-
		49	49	-	48	47	-1	59	59	-
		47	49	2	47	48	1	47	48	1
		47	50	3	46	50	4	45	45	-
		47	47	-	46	47	1			
		46	46	-	45	44	-1			
		45	48	3	40	41	1			
		42	44	2	25	28	3			
		41	42	1	17	21	4			
		35	36	1						
Elephantear	*Elliptio crassidens*	123	122	-1	126	125	-1	116	115	-1
		110	110	-	116	116	-	tag lost	118.9	-
		109	109	-	115	115	-	tag lost	111	-
		108	108	-	112	111	-1			
		107	106	-1	111	111	-			
		106	105	-1	108	107	-1			
Purple wartyback	*Cyclonaias tuberculata*	-	-		86	86	-	89	89	-
					75	76	1	92	92	-
					37	43	6			
Ohio pigtoe	*Pleurobema cordatum*	-	-		91	90	-1			
Pink heelsplitter	*Potamilus alatus*	131	133	2		-				
All										
Total positive growth			13			21			3	
Growth per mussel			0.3			0.5			0.3	
>43mm only										
Total positive growth			8			7			-	
Growth per mussel			0.3			0.3			-	

Table 4. Total length (mm) of mussels when stocked (Nov. 2000) and when assessed 10 months later (Sep. 2001) (XP = experimental plot, CP = control plot).

4. Discussion

4.1 Stability of the Boulder Field

When this experiment was conceived, the best or most practical object to use to create the desired hydraulic effects was not immediately clear. Beyond the effects of various shapes and sizes on hydraulic variables, there was a question of stability of the objects themselves. Would they remain in place during high flows? Concrete highway barricades, or "Jersey barriers", were initially considered. After some preliminary analyses, however, it was determined that they could tip over or otherwise be moved by flows within the normal range of discharge from WBH. For reasons of simplicity and utility, boulders were chosen over other materials that were considered. While they were believed to be more stable than the Jersey barriers, there was some doubt as to how stable they would actually be under high flow conditions. Since the boulder field was mapped only at the beginning of the experiment and the precision of the mapping effort was low, direct comparisons of boulder positions over time was not possible. However, observations of the relative positions of boulders in the vicinity of the experimental plots indicate that there was very little, if any, movement over the 10 month period. There was some minor settling and shifting that occurred immediately following their initial placement, but there was no evidence of any movement that occurred between late November 2000 (when plots were stocked) and September 2001. Discharge from WBH over the course of the experiment ranged from 0 to 60,747 cubic feet per second (cfs) [1.7 million liters per second (ls)] (see Appendix).

4.2 Loss of Experimental Plot 1

Within the boulder field, conditions short distances downstream from boulders (experimental plots 2 and 3) appeared to be more favorable than those in areas farther downstream

(experimental plot 1). While smaller mussels were either absent or recovered in lower than expected numbers from the control plot, large adult mussels were still recovered in numbers comparable to experimental sites 2 and 3. Our failure to find neither mussels of any size, nor the metal corner pins at experimental plot 1, suggests that hydraulic disturbance in that area was not only greater than in the areas where plots 2 and 3 were stocked, but apparently greater than just upstream from the boulder field (i.e. the control plot). Flow behavior through the boulder field is complex and to some extent chaotic; however, enough information concerning hydraulic dynamics and bed material transport is available to describe a process that may, at least in part, explain these observations.

Published experimental data and analyses of the flow structure and bed material transport mechanisms behind boulders (essentially prismatic obstructions) are lacking. A better understanding of this interaction would require detailed field and laboratory measurements and analyses, both of which were beyond the scope of this study. In particular, the horizontal extent of disturbed zones behind boulders is difficult to predict. Inferences about the longitudinal and vertical flow structure can be made by assuming that such flows share some features with flow over a backward-facing step (a sudden drop in bed elevation), which is well understood (e.g. Nezu and Nakagawa 1987, Driver et al 1987).

Flow separates as it passes the upstream edges of a boulder, creating a separation zone (i.e., wake) downstream from the boulder. As a result, within and immediately downstream of this separation zone, the tractive force exerted by the flow on the bed material (including mussels) is less than that of the unobstructed flow. Tractive force is a component of shear stress that describes the longitudinal drag force exerted by the stream flow on the stream bed and the resistive force that the stream bed exerts on the flow (Chow 1959). The separation zone extends downstream from a boulder to a region where the flow reattaches

to the bed -- typically for distances equal to several boulder heights. Backward-facing step literature indicates that these distances range from 5 to 7 times the step height. Thus, the extent of a boulder separation zone likely ranges from 10 to 35 ft. (3 to 11 m), depending on specific boulder height. Downstream from the separation zone, in the region where the flow reattaches to the bottom, intensified turbulence (velocity fluctuations above the bed and intensified pressure fluctuations at the bed) increases the potential that material in the stream bed would be dislodged. Therefore, bed material and mussels in a reattachment region are probably more mobile for a given shear stress than those exposed to the unobstructed flow or those in the separation zone.

Plot 1 was located approximately 24 ft. (7 m) downstream from the nearest upstream boulder-- well within the range predicted for increased turbulence and hydrodynamic transport potential. While this seems to reasonably explain our results, the discharge record from WBH presents a problem. Highest flows during the 10-month experimental period occurred in mid-February, 2001, when high rainfall resulted in spilling from Watts Bar Dam. Flows peaked on February 19 when discharge was >60,000 cfs (1.7 million ls) and were continuous at that level for over 24 hours (Appendix). Large mussels were still visible at the surface of the substrate when all of the plots, including plot 1, were checked in early July. It was not until September 20, when we began the assessment sampling, that no trace of plot 1 was found. Clearly, some factor(s) in addition to the highest instantaneous flow contributed to the total loss of plot 1.

The only distinct feature indicated in the discharge record between July and September 20 was a period of consistently high daily maximum and average flows during the late-summer reservoir draw down period. Beginning in late July, daily maximum discharge (~43,000 cfs or 1.2 million ls) and average daily discharge (~25,000 cfs or 700k ls) were almost

consistently elevated for approximately 50 days leading up to September 20. This suggests that these discharge characteristics somehow produced more net hydrodynamic transport potential in the area of plot 1 than the short, but intense, high flow event in February.

Alternatively, the possibility exists that some disturbance, independent of discharge from the dam or WBH, may have caused or contributed to the loss of plot 1. There is a fair amount of both commercial and large recreational boat traffic in the Watts Bar tailwater. While the experimental area is located outside of the marked navigation channel, the water over this area is deep enough for most large vessels. Propeller wash from a large vessel passing near plot 1 might have disturbed the substrate and either directly, or indirectly, lead to the conditions we observed. This seems unlikely, however, given that several buoys were present in and around this area (including one within ~5 meters of plot 1) and none of these buoys were visibly disturbed or moved between July and September. An abundance of snagged fishing line was seen in the experimental area, indicting frequent use of the area by recreational fishers. An anchor dragged through the experimental plot could have disturbed the area and contributed to the loss of plot 1. This too, seems unlikely, but cannot be ruled out.

4.3 Mussel Survival

There were clear differences in the number of mussels recovered from the three remaining plots. Over a relatively short period of time, mussels exposed to bottom conditions and flow regime typical in this area of the upper Watts Bar tailwater (control plot) were less likely to remain in place than those in areas sheltered by boulders (experimental plots 2 and 3). Shear stresses and other complex hydraulic variables associated with high bottom velocities during periods of high-volume discharge from WBH and spills from the dam during flood events are most likely responsible for this phenomenon. Observations and experimental

data indicate that high velocity flows can dislodge mussels from the stream bed (Watters 1994); however little is known about the specific critical velocities necessary to dislodge mussels or the range of variables that may influence this process. Obviously, flood events that cause large-scale bed load movement can dislodge mussels since they are essentially components of the substrate. At lower velocities, the thresholds for hydrodynamic transport are unclear. The potential for hydrodynamic transport of mussels is known to be influenced by taxon-specific adaptations, such as shell morphology (Watters 1994), that can make certain species or forms more vulnerable than others. The degree of influence from other variables, such as mussel behavior, specific gravity, relative size, and position in the substrate, is unknown.

It should be noted that no direct observations were made during this experiment of live mussels that had been dislodged from the substrate. The fate of the lost mussels is uncertain. These mussels may have been passively swept away by high flows, they may have actively moved themselves due to some behavioral reaction to higher bottom velocities, or there may have been some interaction of active behavioral response and passive hydrodynamic transport potential. For example, they may have burrowed deeper into the substrate than we were able to sample or they may have moved, or attempted to move, horizontally beyond the test plot bounds, actively seeking more favorable conditions. Movement near the surface of the substrate, which requires retraction and extension of the animal's foot, may have made them more vulnerable to being swept away.

Many lentic (still water inhabiting) mussel species are known to be relatively motile, moving both vertically and horizontally within and along the surface of the substrate (e.g. Amyot and Downing 1991; Porter and Horn 1983). Recent laboratory experiments and other observations indicate that juveniles (R.J. Neves, VPI, Blacksburg, VA, personal

communication) and adults (Vannote and Minshall 1982; Johnson 1999) of some lotic (flowing water inhabiting) species are also capable of moving in response to unfavorable conditions, while others are not. Seasonal, vertical migration, associated with the reproductive cycle, is reported for adult pimplebacks and threehorn wartybacks (Watters, *et al* 1999); however, reaction to changes in water velocity were not studied. The ability for adult mussels to actively move over substantial distances (>1 m) appears to be related to substrate quality, as well as species. Movement of greater distance and frequency is more often seen in substrates dominated by sand and smaller particles (Johnson 1999). In more blocky substrates, with a relatively high percentage of cobbles and larger particles (such as in the Watts Bar tailwater), adults may be generally limited to relatively short vertical movements. Smaller juvenile mussels may be capable of moving more easily within the interstitial spaces of stream beds containing primarily larger particles. However, given the lack of clear indications from the literature and the absence of more conclusive evidence, it is difficult to determine with certainty the specific cause(s) for the loss of mussels. Whatever the mechanism, it is reasonably clear that exposure to the unobstructed flow regime typical in the study area is the primary factor contributing to their disappearance from the control plot.

4.4 Size Comparison

There were clear differences in the number of mussels recovered among size classes. There was no apparent difference in the persistence of mussels >109mm among plots, but mussels <109mm were recovered from the control plot in lower than expected numbers. In particular, the absence of mussels <44mm from control plot samples indicates greater vulnerability of smaller mussels to flow-related disturbance. Smaller mussels are lighter and may be less dense (lower specific gravity) than larger adult mussels. Intuitively, it seems obvious that smaller mussels would be more susceptible to hydrodynamic transport that

larger mussels, which are heavier and may possess physical and behavioral adaptations that aid in their persistence under high shear stresses.

In attempting to explain the absence of mussel beds from otherwise suitable habitats, Layzer and Madison (1995) and Hardison and Layzer (2001) suggested that settling juveniles were swept away from areas with high shear stresses. Strayer (1999) indicates that this mechanism alone is insufficient to explain the absence of multiple species (17 species included in the Layzer and Madison study) that drop from their fish hosts at different times of the year under presumably different flow conditions and shear stresses. He suggested that disturbance associated with flood events of from 3-30 year occurrence intervals might better explain his observations. Our results support this hypothesis by indicating that some mussels up to ~100 mm may be vulnerable to displacement during flows of relatively short occurrence interval, regardless of conditions at the time of settlement.

Flow conditions at the time of early juvenile settlement undoubtedly influences mussel recruitment. Subsequent short-interval flood events are also likely to influence recruitment. Our results suggest that flow obstructions, such as boulders, can provide refuge sufficient for mussels ≥10mm to maintain position in the substrate during discharges of over 60,000 cfs (1.7 million ls). While these sheltered areas may provide enhanced habitat for early juvenile settlement, this remains untested.

5. Conclusions

The results of this experiment indicate that it is possible to install boulders in an area exposed to flows up to 60,000 cfs and have them remain in place for at least one year. The

experimental results also indicate that such a boulder field can enhance at least the short-term survival of native mussels placed within its limits, especially mussels smaller than 44mm in length. These results suggest that bottom velocity patterns may have a major influence on native mussel distribution and recruitment in the Watts Bar tailwater.

If these conclusions are correct, the boulders represent a relatively simple method for manipulating flow patterns as a way to augment and enhance native mussel habitat in tailwaters without altering the structures or discharge regime being used at the dam. This experiment may be a first step toward designing effective and efficient methods for mitigating some of the detrimental effects on mussel populations which can occur downstream from certain dams.

Literature Cited

Ahlstedt, S.A. and T.A. McDonough. 1997. Summary of preoperational monitoring of the mussel fauna in the upper Chickamauga Reservoir (Tennessee River) in the vicinity of TVA's Watts Bar Nuclear Plant, 1983-1993. Walkerana, 1995-1996, 8(19):107-126.

Amyot, J.P. and J.A. Downing. 1991. Endo- and epibenthic distribution of the unionid mollusc *Elliptio complanata*. Journal of the North American Benthological Society 10(3):280-285.

Baxter, D.S., J.P. Buchanan, G.D. Hickman, J.J. Jenkinson, J.D. Milligan, C.J. O'Bara. 1998. Aquatic environmental conditions in the vicinity of Watts Bar Nuclear Plant during two years of operation, 1996-1997. Tennessee Valley Authority, Water Management, Norris, TN. 259 p.

V. T. Chow. 1959 (reissued 1988). Open Channel Hydraulics. McGraw-Hill, New York, NY. 680 p.

Driver, D. M., H. L. Seegmiller, and J. G. Marvin. 1987. Time dependent behavior of a reattaching shear layer. American Institute of Aeronautics and Astronautics Journal 25:914-919.

Garner, J.T. and S.W. McGregor. 2001. Current status of freshwater mussels (Unionidae, Margaritiferidae) in the Muscle Shoals area of Tennessee River in Alabama (Muscle Shoals revisited again). American Malacological Bulletin 16(1-2): 155-170.

Hardison, B.S. and J.B. Layzer. 2001. Relationships between complex hydraulics and the localized distribution of mussels in three regulated rivers. Regulated Rivers: Research and Management 17:77-84.

Jenkinson, J.J. 1987. Freshwater mussel survey of areas potentially affected by a proposed channel widening project, Tennessee River miles 203-206. Tennessee Valley Authority, Division of Air and Water Resources, Knoxville, TN. 20 p.

Jenkinson, J.J. 1991. Mussel survey at possible impact sites adjacent to the proposed Mead paper mill, Tennessee River Miles 519-525. Tennessee Valley Authority, Water Resources, Aquatic Biology Department, Chattanooga, TN. TVA/WR/ABD 1035R. 9 p.

Johnson, S.L. 1999. Habitat suitability criteria for freshwater mussels: can mussels seek out suitable habitat? (presentation abstract only). Program guide and abstracts, 1st Symposium of the Freshwater Mollusk Conservation Society, March 17-19, 1999, Chattanooga, TN, p. 53.

Kerley, B.L. 2001. Reservoir outlook document for zebra mussels and asiatic clams at TVA's Watts Bar, Sequoyah, and Browns Ferry Nuclear Plants, Tennesse Valley Authority, Aquatic Biology Laboratory, Norris, TN. 11pp.

Layzer, J.B. and L.M. Madison. 1995. Microhabitat use by freshwater mussels and recommendations for determining their instream flow needs. Regulated Rivers: Research and Management 10:329-345.

Miller, A.C. B.S. Payne, D.J. Shafer, and L.T. Neill. 1993. Techniques for monitoring freshwater bivalve communities and populations in large rivers. Pages 147-158 in K.S. Cummings, A.C. Buchanan, and L.M. Koch, eds. Conservation and management of freshwater mussels: Initiatives for the future. Proceedings of a UMRCC symposium, 12-14 October 1992, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Miller, A.C., B.S. Payne, and L.T. Neill. 1997. A diver-operated suction dredge to collect mussels. Pages 146-149 in K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo, eds. Conservation and management of freshwater mussels II: Initiatives for the future. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Neves, R.J. and S.N. Moyer. 1988. Evaluation of techniques for age determination of freshwater mussels (Unionidae). American Malacological Bulletin 6(2):179-188.

Neves, R.J. and J.C. Widlak. 1987. Habitat ecology of juvenile freshwater mussels (Bivalvia: Unionidae). American Malacological Bulletin 5:1-7.

Nezu, I. and H. Nakagawa. 1987. Experimental investigation of turbulent structure of backward-facing step flow in an open channel. Journal of Hydraulic Research 25:67-89.

Payne, B.S. and A.C. Miller. 1987. Effects of current velocity on the freshwater bivalve *Fusconaia ebena*. American Malacological Bulletin 5(2):177-179.

Porter, H.J. and K.J. Horn. 1983. Habitat distribution of sympatric populations of selected Lampsiline species (Bivalvia: Unionoida) in the Waccamaw drainage of Eastern North and South Carolina. American Malacological Bulletin 1: 61-68.

Salmon, A. and R.H. Green. 1983. Environmental determinants of unionid clam distribution in the Middle Thames River, Ontario. Canadian Journal of Zoology 61:832-838.

Sokal, R.R. and F.J. Rolf. 1981. Biometry. W.H. Freeman and Co., San Francisco, CA. 2nd edition. 859 p.

Strayer, D.L. 1999. Use of flow refuges by unionid mussels in rivers. Journal of the North American Benthological Society 18(4):468-476.

Strayer, D.L. and J. Ralley. 1993. Microhabitat use by an assemblage of stream-dwelling unionaceans (Bivalvia), including two rare species of *Alasmidonta*. Journal of the North American Benthological Society 12(3):247-258.

Vannote, R.L. and G.W. Minshall. 1982. Fluvial processes and local lithology controlling abundance, structure, and composition of mussel beds. Proceedings of the National Academy of Science, USA 79:4103-4107.

Vaughn, C.C. and M. Pyron. 1995. Population ecology of the endangered Ouachita rock-pocketbook, *Arkansia wheeleri* (Bivalvia: Unionidae), in the Kiamichi River, Oklahoma. American Malacological Bulletin 11(2): 145-151.

Watters, G.T. 1994. Form and function of unionoidean shell sculpture and shape. American Malacological Bulletin 11: 1-20.

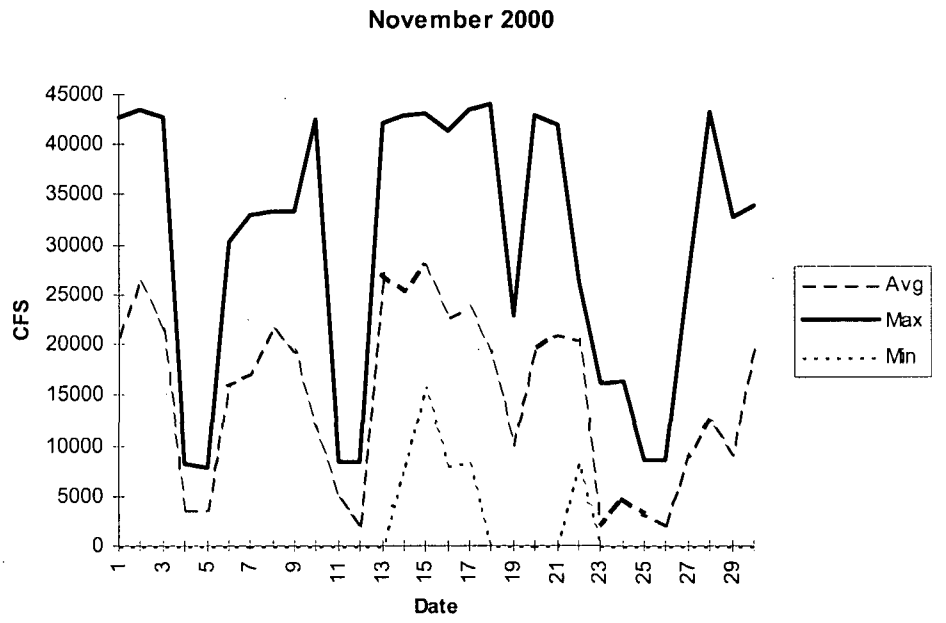
Watters, G.T., S.H. O'Dee, S.W. Chordas, and J. Rieger. 1999. Vertical migration in mussels. Poster presented at the 1st Symposium of the Freshwater Mollusk Conservation Society, March 17-19, 1999, Chattanooga, TN.

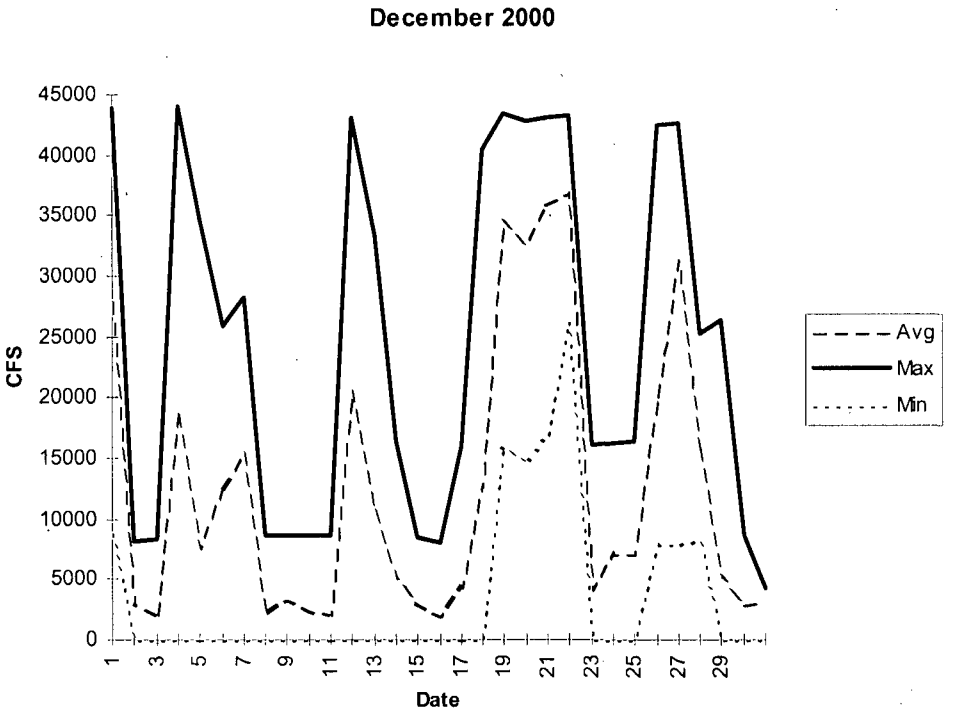
Way, C.M., A.C. Miller, and B.S. Payne. 1989. The influence of physical factors on the distribution and abundance of freshwater mussels (Bivalvia: Unionidae) in the lower Tennessee River. The Nautilus 103(3):96-98.

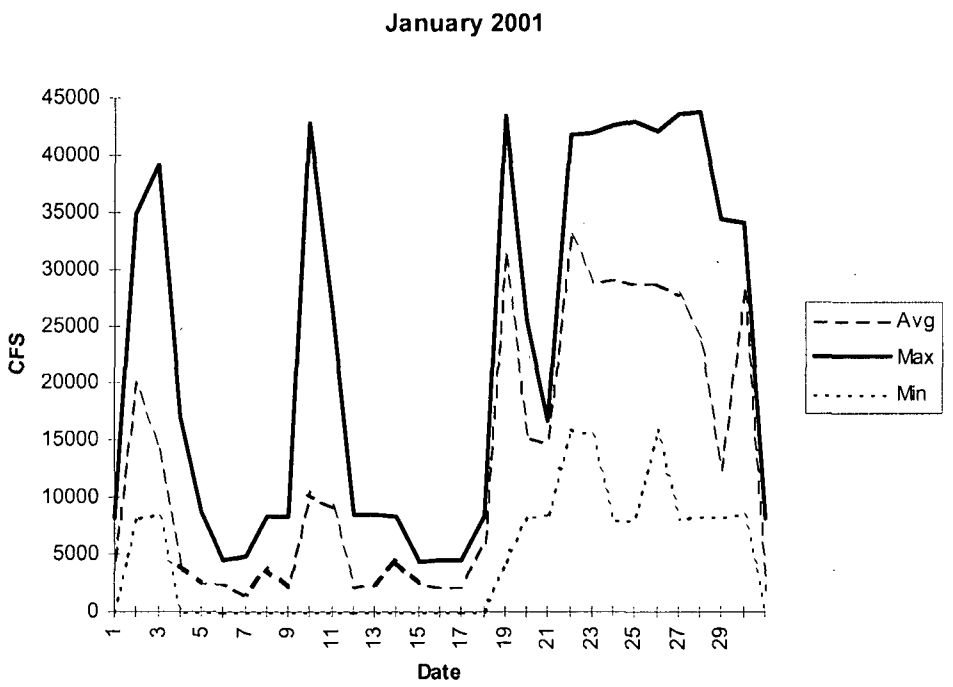
Wrenn, W.B., W.C. Barr, L.M. Beard, D.J. Bruggink, J.P. Buchanan, D.L. Bunting II, D.L. Dycus, T.M. Craven, H.R. Gwinner, J.J. Jenkinson, C.E. Mulkey, A.O. Smith, D.C. Wade, R.H. Wainberg, and W.K. Wilson. 1986. Preoperational assessment of water quality and biological resources of Chickamauga Reservoir, Watts Bar Nuclear Plant, 1973-1985. Tennessee Valley Authority, Office of Natural Resources and Economic Development, Division of Air and Water Resources, Knoxville, TN. TVA/ONRED/WRF-87/1a.

Appendix

Discharge data from Watts Bar Dam
November 2000 - September 2001


November 2000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
CFS
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
Date
Avg
Max
Min


December 2000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
CFS
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
Date
Avg
Max
Min


January 2001
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40000
35000
30000
25000
20000
15000
10000
5000
0
CFS
1
3
5
7
9
11
13
15
17
19
21
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29
Date
Avg
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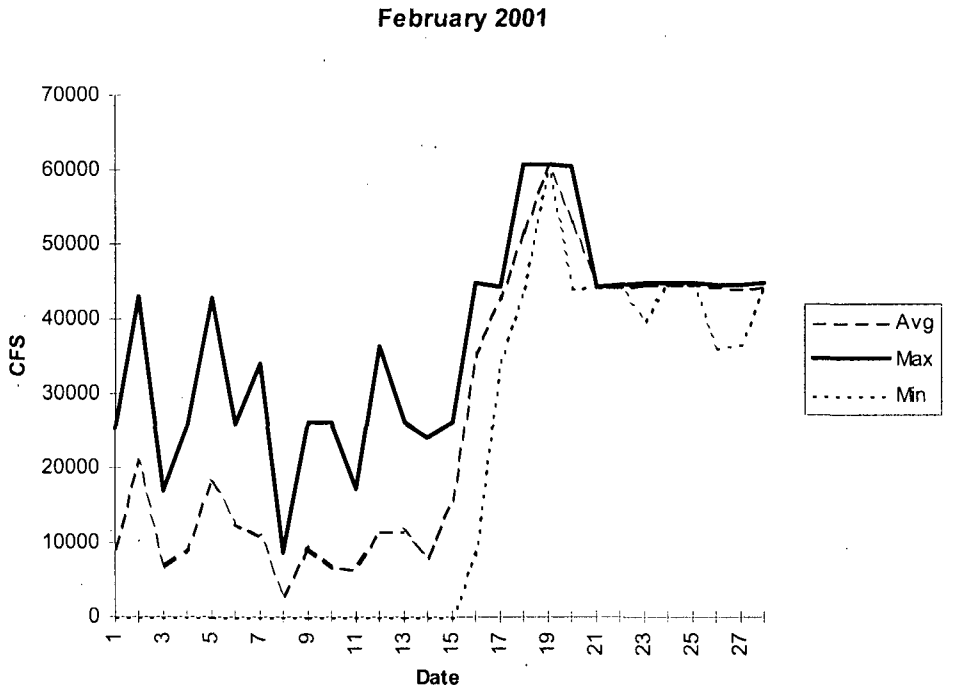
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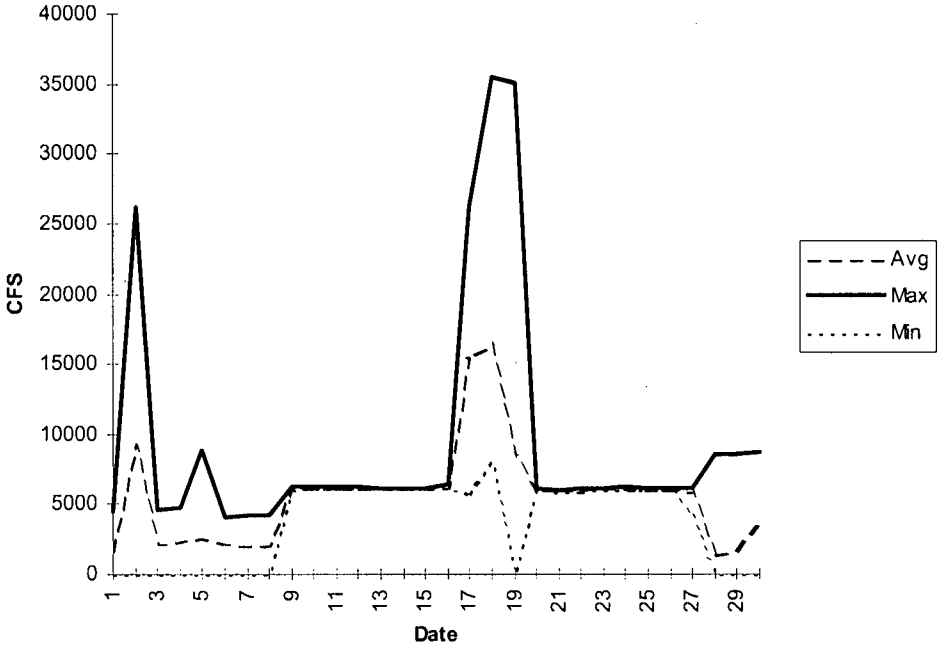

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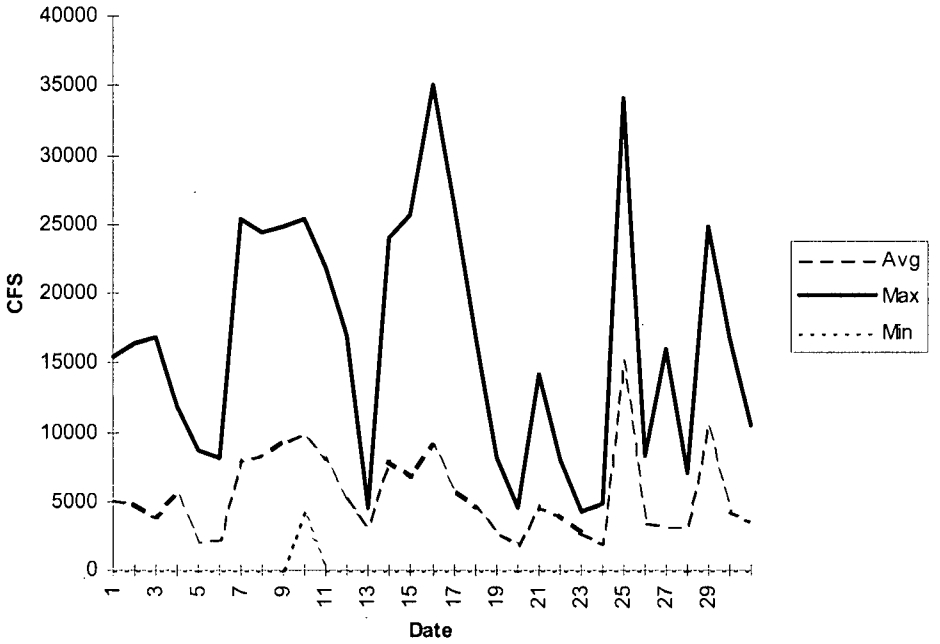

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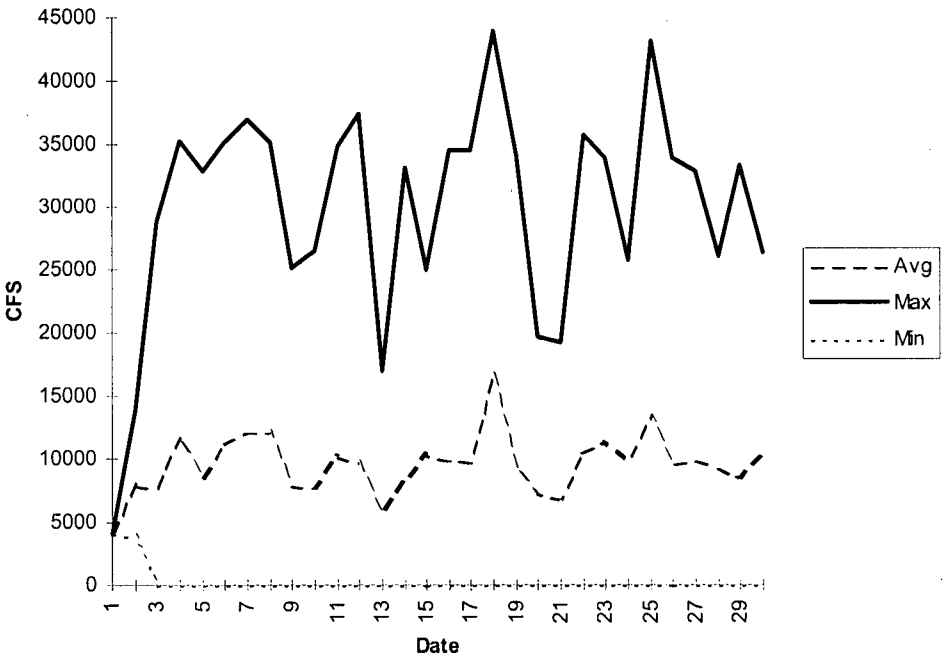

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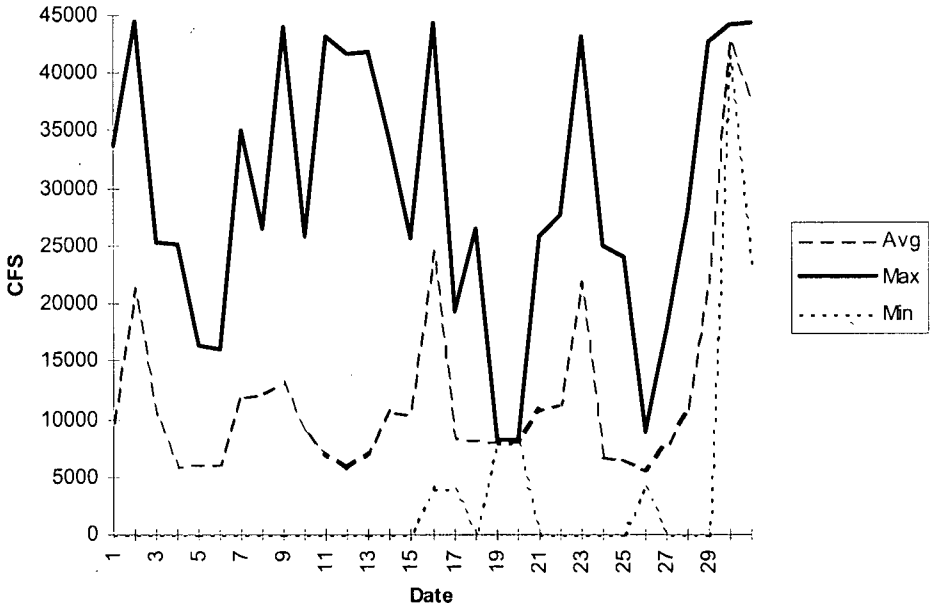

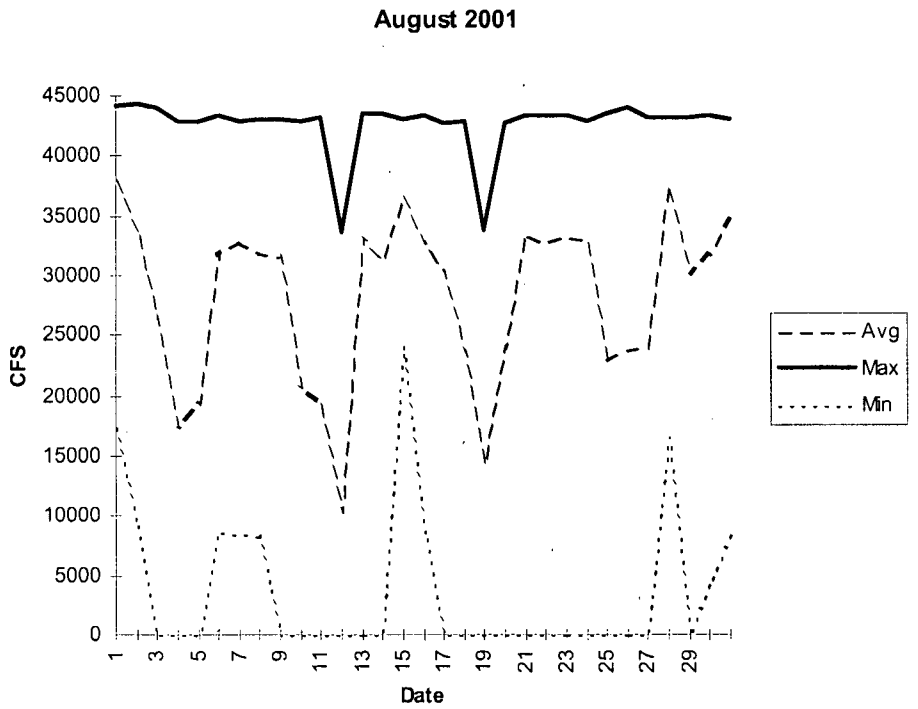
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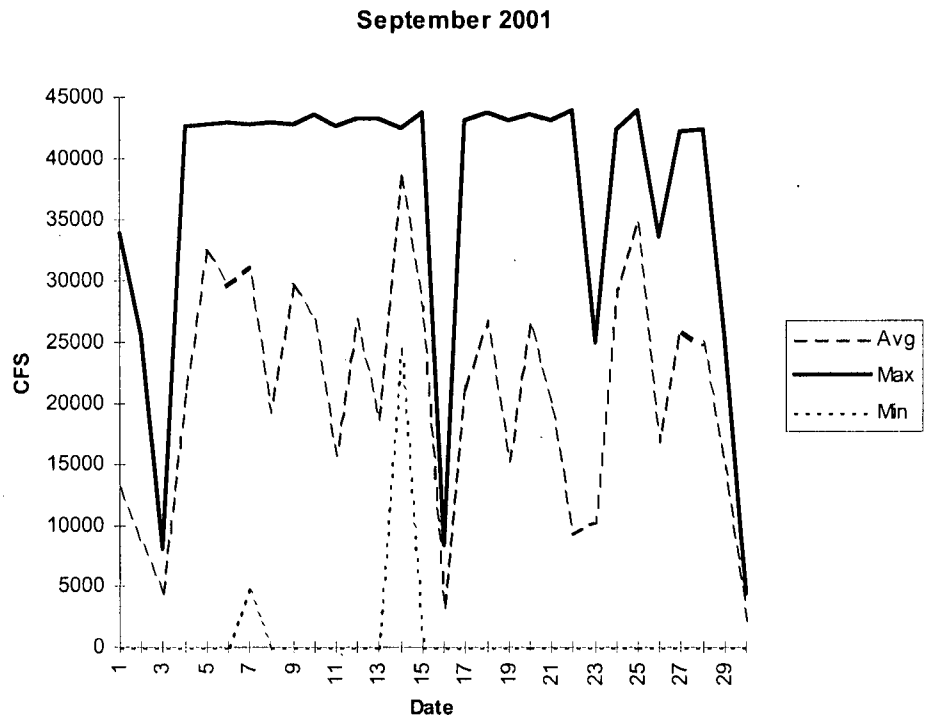
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TPS Standard Processes and Procedures	**TITLE** **TOM Line Maintenance Environmental Management Process**	**TOM-SPP-5.2.001** **Rev. 0000** **Page 1 of 14** Effective Date 9/1/2005

Prepared by: Environmental Program Staff

Concurred by: _____ Aug 5, 2005
Tina I. Broyles, Manager, Environmental Program — Date

Concurred by: _____ 8/5/05
James A. Teague, Manager, Transmission Support Department — Date

Concurred by: _____ 8/5/05
Cleston E. Jones, General Manager, Area Operations — Date

Approved by: _____ 8/8/05
Ronald H. Rogers, Vice President, Transmission Operations & Maintenance — Date

Current Revision Description

Initial issue.

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1.0 PURPOSE

This process describes how environmental review for Transmission Operations and Maintenance (TOM) line maintenance projects is performed and establishes responsibilities for the environmental compliance and support functions.

2.0 SCOPE

The process applies to TOM Area organizations involved in the performance of transmission line maintenance projects which have potential for environmental impact. It implements requirements of the TPS Environmental Management System, TPS-SPP-05.002 and TPS-SPP-05.018, as applied to line maintenance projects.

For TOM line projects led by the Transmission Support Department (TSD), environmental compliance activities are managed according to the TPS EMS documents and are not detailed within this process. The Environmental Program staff provides compliance support for NEPA and permitting as needed. This may include TOM area projects which have broad program implications. Site compliance support is provided by TOM area environmental personnel (e.g., storm water permit inspections, tower painting waste disposals). For other projects where TSD owns the overall project budget, but the work is managed and performed by the Transmission Service Center (TSC), the requirements in this procedure would apply.

3.0 PROCESS

The activity descriptions in the sections below are cross-referenced to a flowchart in Appendix B. Special considerations for implementation of this process include:

- Emergency projects are those in response to storm damage or those where a structure or asset is found to be in immediate threat of failure. Those projects may be subjected to a separate accelerated review and permitting after consultation with regulators.

- When TOM requests completion of TOM projects by Electric System Projects (ESP), environmental requirements in this procedure must be met by TOM personnel as defined or an agreement reached with ESP to complete the designated responsibilities. Sufficient time must be allowed to complete environmental compliance activities before work can begin by ESP crews.

3.1 Roles and Responsibilities

<u>Transmission Service Manager (TSM)</u>

Identifies line maintenance projects, defines scope and location, and provides for environmental review.

Ensures appropriate NEPA documentation and any required environmental permits are obtained prior to starting work.

Ensures changes in work activities or scope (e.g., larger pad disturbance required) are communicated to the Environmental / Easement Technician (E/E Tech) for review before work proceeds.

3.1 Roles and Responsibilities (continued)

Ensures environmental compliance requirements and commitments outlined in the work package are implemented by providing resources to meet responsibilities outlined in this process and any applicable environmental compliance documents.

Signs and certifies construction storm water permit inspection records and permit termination records, as the Duly Authorized Representative for the TOM Vice President. Signs other environmental permit applications and documents when allowed by the signatory requirements.

Ensures all environmental permits are properly closed upon completion of work.

Line Foreman / Crew

Completes TVA Form 17630 Storm Water Inspection Checklist with description of site conditions at time of inspection, expected project scope, and work methods and plan.

Communicates scope changes (e.g., larger pad disturbance required, alternate access) and any changes in site conditions to E/E Tech before work begins for additional evaluation.

Implements environmental compliance requirements and commitments identified in the work package.

E/E Tech

Performs environmental reviews for line maintenance projects, identifies environmental compliance requirements, and ensures that all applicable permits and documents are prepared.

Requests environmental sensitive area reviews by TVA technical specialists when necessary based on scope of activities and established guidelines.

Ensures construction storm water permit inspections are performed according to requirements defined in the construction Storm Water Pollution Prevention Plan (SWPPP), provides completed inspection records to the TSM for certification, and ensures the records are filed according to the TPS Environmental Management System (EMS). Ensures records are submitted to the appropriate regulatory authorities, when required.

Tracks environmental commitments outlined in the NEPA document and closes in the TVA ENTRAC system.

Provides environmental compliance oversight for line maintenance projects and the applicable permit requirements.

Area Environmental Engineer / Program Administrator (AEE / AEPA)

Provides backup compliance support for general permitting and inspections as needed.

When engineering licensing qualifications are met, may provide engineering support, prepare construction SWPPP and certify environmental permits as required. Accordingly, the AEE could take on the Environmental Program Staff Engineer responsibilities outlined throughout this process.

3.1 Roles and Responsibilities (continued)

Environmental Program Staff (EPS)

EPS Engineer provides regulatory technical support and conducts regulatory interface designated by the EMS.

EPS Engineer develops and certifies construction SWPPP for TOM line maintenance projects.

EPS Engineer coordinates review, approval, and submittal of environmental permit applications and associated documentation by the TOM Vice President.

EPS Engineer provides engineering support and PE review and certification, when needed, for other environmental permits and projects (e.g., bank stabilization design, drainage systems, Kentucky Water Quality Certification Application).

TOM Vice President (TOM VP)

Reviews and signs construction storm water permit applications and associated documentation as the Responsible Corporate Official. Signs other environmental permit applications and documents when signatory requirements apply.

3.2 Identify Line Maintenance Projects for Environmental Review

A. Line maintenance projects are identified based on line inspections and/or other management-directed projects. The projects will include but are not limited to the following:

   1. Bank Stabilization

   2. Pole and/or Crossarm Replacement

   3. Insulator Replacement

B. TVA Form 17630, Line Inspection Storm Water Issues Checklist, is the method used to initiate an environmental review and is generated from annual line inspections and from newly identified projects throughout the year (e.g., stream bank stabilization). For each project, the Line Foreman completes the Form 17630 documenting site conditions and expected impacts (e.g., pads required, access points, stream crossings). Foreman forwards the completed document to the E/E Tech. Information must be of sufficient detail for the E/E Tech to assess the environmental impacts and required permits. State and local regulations can differ with regard to when permits are required so any quantity of expected soil disturbance or use of heavy equipment should be documented on the 17630. A sample form 17630 is provided in Appendix B. Line Foremen should ensure they use the latest version from the TVA Forms system.

3.2 Identify Line Maintenance Projects for Environmental Review (continued)

NOTE

Disturbance activities potentially subject to construction storm water permitting will include clearing, grading, filling and excavating, or other similar activities that will result in soil disturbance and a potential for discharge of sediment off the work site. Activities affecting surface water (e.g., stream crossings) may be subject to additional state and/or local environmental permit requirements.

C. TSM and Line Foreman identify proposed schedule for work and document for E/E Tech environmental review prioritization. Those projects considered urgent for start as soon as possible should be flagged with a desired start date. E/E Tech advises TSM of start date feasibility after assessing environmental compliance requirements and includes target dates with applicable milestones completion (e.g., Natural or Cultural Resource Review, Categorical Exclusion Checklist review and signoff, permit application submittal, state or local waiting periods).

3.3 Perform Environmental Review

The E/E Tech performs environmental review by conducting the following activities:

A. Separates and reviews completed TVA Form 17630 Storm Water Checklists according to work priority.

B. Reviews existing sensitive area information for Natural and Cultural Resources through previous assessments and Plan and Profile Drawings. According to established guidelines, determines whether existing sensitive area information is current and relevant, and if not requests new review from TVA technical specialists.

C. Consults with Line Foreman and TSM for additional information when necessary to complete evaluation.

D. Conducts pre-job field inspections as appropriate to determine impacts and to evaluate site conditions.

E. Consults with TVA technical specialists for direction when migratory bird nests are present and when identified sensitive area commitments cannot be met.

F. Conducts and documents NEPA review by evaluating project's applicability under generic Categorical Exclusion Checklist (CEC) 1501 or developing a site-specific CEC in the TVA ENTRAC system for projects requiring environmental permits and evaluation of site-specific commitments to avoid environmental impact.

3.4 Identify & Obtain Permits

TOM projects should be conducted to meet established general permit requirements, as those typically allow for quicker implementation of projects and minimal environmental impact. However, site-specific permits must be obtained when general permit requirements cannot be met or when otherwise required by regulation for potential high environmental impact.

3.4 Identify & Obtain Permits (continued)

A. E/E Tech identifies environmental permit requirements for each project based on federal, state and local requirements and according to the applicable TPS Environmental Protection Procedures. E/E Tech conducts regulatory interface according to the EMS requirements. Interface may include project coordination and approval activities with other state or federal agencies (e.g., United States Forest Service) for site-specific compliance requirements.

B. For General Construction Storm Water Permits, the following additional expectations apply.

1. To determine applicability, E/E Tech includes all qualifying disturbance in a contiguous span and evaluates it as a single project. Access road preparation (or any other disturbance that supports multiple structures) is included in the disturbance calculation, and counts as one project when it supports non-contiguous transmission line spans. Other activities where work is managed under a single work order may be considered a single project by regulation. Some regulations may allow for exemption of minor activities considered maintenance. E/E Tech will make this evaluation based on regulatory requirements as described in step A above.

2. When a General Construction Storm Water Permit is required, the TSM and E/E Tech will perform an additional review to determine whether impacts requiring the permit can be avoided.

3. E/E Tech provides all appropriate site data and environmental review information to EPS Engineer for preparation of the construction SWPPP and permit documentation in 3.6. EPS Engineer and E/E Tech conduct additional field visits as necessary.

C. E/E Tech obtains other environmental permits, including Tennessee Aquatic Resource Alteration Permits (ARAP), Corps of Engineers permits, etc. and consults with EPS Engineer for permit review and preparation when licensing requirements apply. E/E Tech consults EPS Engineer for other engineering technical support when needed.

D. E/E Tech provides fee payment forms to TSM for submittal directly or for inclusion with permit applications, when required.

3.5 Prepare, Certify and Submit General Construction Storm Water Permit Application and Plans

A. EPS Engineer prepares the General Construction Storm Water Permit application, SWPPP, and any other required plans (e.g., Georgia Comprehensive Monitoring Plan) in consultation with TSM and E/E Tech, certifies the documents, and provides to TOM VP for review and approval.

NOTE

State and local environmental regulations typically refer to the construction storm water plan as a Storm Water Pollution Prevention Plan or SWPPP. However, there will be some instances when state and/or local regulation refers to it by another title, such as Erosion and Sediment Control Plan.

3.5 Prepare, Certify and Submit General Construction Storm Water Permit Application and Plans (continued)

B. EPS Engineer provides fee payment forms to TSM for submittal directly or for inclusion with permit application packages, when required.

C. TOM VP reviews permit applications and SWPPP and signs documentation for submittal to regulatory authorities.

D. EPS Engineer forwards completed documentation to E/E Tech for preparation of the work package.

3.6 Compile & Distribute Work Package

A. E/E Tech ensures the environmental requirements are included in the standard work package distributed to the TSM and Line Foreman. This will include the following components, as required:

1. Signed Form 17630
2. Generic CEC 1501 or Site-Specific CEC
3. Best Management Practice (BMP) Requirements
4. Sensitive Species Requirements / Commitments
5. Construction Storm Water General Permit Application, SWPPP, Notice of Coverage
6. Erosion and Sediment Control Plan
7. Tennessee ARAP Permit
8. Grading Permit
9. Corps of Engineers 404 Permits (Wetlands)

B. TSM and Line Foreman review expectations in the package. E/E Tech should assist in review with TSM and Line Foreman of expectations when environmental permits are required or as determined necessary.

3.7 Implement Environmental Work Package Requirements

A. The TSM, Line Foreman and Crew are responsible for implementing environmental requirements outlined in the work package.

B. Storm Water BMPs are required for all projects even when minor disturbance is expected.

3.7 Implement Environmental Work Package Requirements (continued)

C. For projects requiring General Construction Storm Water Permits, installation and periodic maintenance of BMPs is required as defined in the construction SWPPP. Maintenance includes correction of deficiencies identified during permit inspections. The E/E Tech, in consultation with the TSM, determines whether the Line Foreman and crew will be responsible for these requirements or they will be performed by a qualified contractor. BMP maintenance is required through the life of the project until the site is stabilized and permits are closed according to the SWPPP.

D. E/E Tech informs EPS Engineer if there are any problems with implementation of the SWPPP. The EPS Engineer will make any revisions to the SWPPP and re-submit, as required by regulation.

3.8 Perform Storm Water Permit Inspections, Certify and File Records

A. EPS Engineer performs general construction storm water permit inspections, as the licensed professional, when required by the state or local regulation.

B. E/E Tech (or designated certified contractor) performs construction storm water inspections and completes required compliance paperwork.

C. E/E Tech provides permit inspection records to the TSM for review.

D. TSM certifies the inspection records as the Duly Authorized Representative for TOM VP and files the records at the TSC.

E. TSM makes compliance paperwork available for regulators and auditors upon request.

3.9 Stabilize Site

A. Regulations define what conditions must be achieved to consider a site stabilized for permit closure. These conditions will be outlined in the environmental work package.

B. E/E Tech performs a final inspection to verify stabilization and completion of all permit requirements.

3.10 Close Permits & CEC Commitments

A. E/E Tech completes all required compliance documentation, obtains TSM certification as Duly Authorized Representative for permit terminations when required, and forwards completion notices to regulatory authorities.

B. E/E Tech confirms closure of commitments outlined in the CEC and closes the commitments in the TVA ENTRAC system.

3.11 Training

- Linemen must complete the TVA Storm Water Management course number 28868 or the applicable state general course. If the state course is taken, the completion certificate must be submitted to Corporate Environmental Training in order to receive credit.

3.11 Training (continued)

- E/E Techs must take the state-specific training courses for storm water permit inspectors and maintain certifications accordingly. AEE / AEPA must also obtain inspector certification in order to provide backup support.

4.0 RECORDS

4.1 QA Records

None.

4.2 Non-QA Records

Records generated by this process are managed according to the TPS-SPP-05.012 Environmental Records Management Process.

5.0 DEFINITIONS

CEC - Categorical Exclusion Checklist is the documentation used by TVA to document that the federal action does not have a significant effect on the human environment and for which an environmental assessment or environmental impact statement is not required.

Cultural Resources - For TVA purposes, cultural resources are considered the following: archaeological resources, cultural landscapes, historic structures, and historic objects that are listed on, eligible for listing, or potentially eligible for listing on the National Register of Historic Places.

ENTRAC - A TVA computerized system for NEPA records and commitment tracking which must be used to document Categorical Exclusion determinations unless more detailed documentation is required.

General Permit - This references a group of environmental permits that have pre-defined specific conditions that an applicant agrees to meet, without exception, in order to conduct the activity covered by the permit (e.g., stream crossings, wet weather conveyance alterations, work in wetlands, bank stabilizations). Use of these general permits allows projects to proceed without the more time-consuming efforts involved in site-specific permitting and in some cases, work may be conducted without notification to the regulatory authority. Examples that apply to TOM activities include Corps of Engineer Nationwide Permits, Tennessee Aquatic Resource Alterations Permits, and General Construction Storm Water Permits.

Migratory Bird - A migratory bird is a bird that has a seasonal and somewhat predictable pattern of movement. For Executive Order 13186 and the Migratory Bird Treaty Act, migratory birds generally includes all native birds in the U.S. , except those non-migratory species such as quail and turkey that are managed by states.

5.0 DEFINITIONS (continued)

Natural Resources - Resources include endangered, threatened or special status environmental species, wild and scenic rivers, wetlands and other water resources (e.g., streams), unique or important terrestrial and aquatic habitats, migratory birds, ecologically critical areas, federal / state / local park lands, national or state forests, wilderness areas, scenic areas, wildlife management areas, recreational areas, greenways and trails.

NEPA - The National Environmental Policy Act, passed by Congress in 1969 and in effect January 1, 1970. NEPA prescribes environmental protection and a balance between uses and preservation of natural and cultural resources as goals for federal decision-making. It mandates that all federal agencies prepare in-depth studies of impacts of and alternatives to 'major federal actions' and information from those studies be an integral part of agency decision-making.

6.0 REFERENCES

References used to develop this procedure include the following TPS environmental procedures. These documents may be accessed from the TPS Net.

- TPS-SPP-05.002 Environmental Review Process
- TPS-SPP-05.018 Standards and Criteria for Environmental Review
- TPS Environmental Protection Procedures:
    1. Construction Storm Water Permits
    2. Aquatic Resource Alteration Permits
    3. Section 404 Permits -- Dredge & Fill

Appendix A
(Page 1 of 1)

TVA Form 17630 Storm Water Checklist

LINE INSPECTION STORM WATER ISSUES

DATE:_____ LINE NAME:_____ LINE #/ SEGMENT #_____

STRUCTURE #(s)_____ IF WITHIN CITY LIMITS LIST CITY_____

Identify length and width of soil disturbance for access to structure(s):_____feet

Identify length and width of soil disturbance for pad (s):_____feet

Total of continuous soil disturbance for Access, ROW, repair, Pads etc.:_____square feet

Structure Site Characteristics:	Yes	No	Comments/Notes (use additional sheets if necessary)
Pad(s) required?			
Materials require disposal?			Describe:
Fill required?			
Excavation required?			
Is adjacent ROW entirely forested?			If 'No', circle all that apply: Partially Forested, Row Crop, Pasture, Open Field, Industrial, Commercial, Residential
Clearing required?			
Stream located within 300 ft. (football field)?			
Site on Slope?			Check one: less than 10%_____ between 10 to 20% _____ Greater than 20%_____
Pole(s) placed w/in same hole or w/in 5 ft. of existing structure?			
Is the pole change more difficult than usual?			Describe:
Existing structure latitude _____ and longitude _____			

Access and/or ROW Travel to Structure(s)	Yes	No	Comments/Notes (use additional sheets if necessary)
Is area adjacent access/ROW entirely forested?			If 'No', circle all that apply: Partially Forested, Row Crop, Pasture, Open Field, Industrial, Commercial, Residential:
Re-clearing required?			
Fill required?			
Grading required?			
Stream crossed?			
Stream culvert or bridging required?			
BMPs needed?			If yes, include in soil disturbance calculation.
Migrating bird nest present? Latitude _____ and longitude _____ at point of departure from public road			
Access: Existing New	Is there existing soil and/or vegetation disturbance done by others?: Yes No If 'Yes,' by whom?		

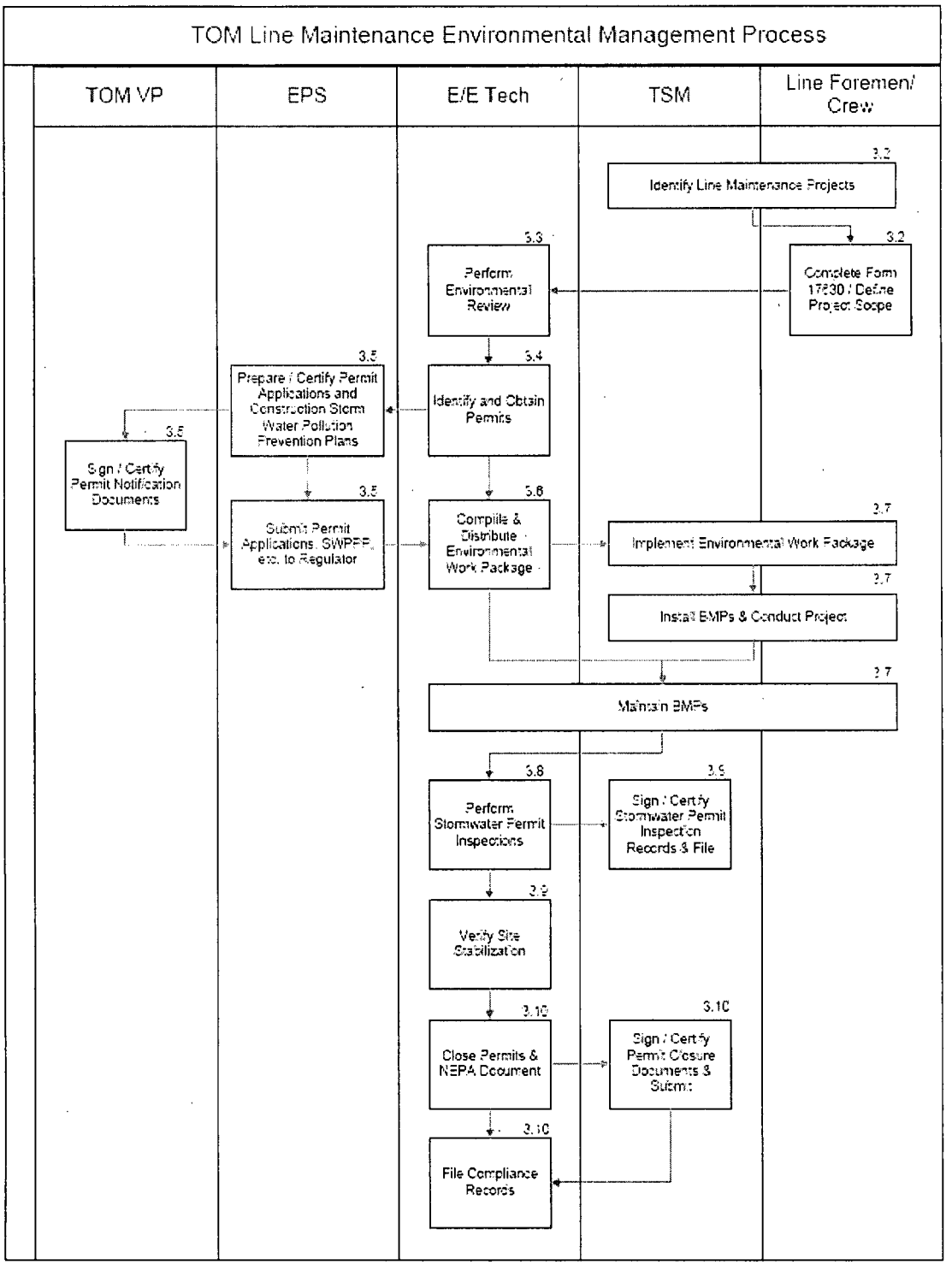
E/E Tech SAR Input(s)	Yes	No	Comments
Known cave, bluff, cedar glade?			
Federal/state managed area?			
Threatened/endangered species/habitat?			
Archeological/historic?			
BMPs needed?			
Wetland or normally wet area crossed?			

Line Inspector Signature Inspection	Date		*Line Inspector Signature Completed*	Date	
E/E Tech Signature/Reviewed	Date		*E/E Tech Signature/Completed*	Date	

CEC 1501 applies? ☐Yes ☐ No Permit required? ☐Yes ☐ No

Appendix B
(Page 1 of 1)

Process Flowchart



WBN
Sewage Usage

Sewage Usage

Meter Read Date	Days Used		Gallons Used	Daily Usage Rate (Gallons/Day)	Cumulative Average Daily Usage (Gallons/Day)
09/16/2008	19		1237900	65153	65153
10/15/2008	29		593100	20452	38146
11/18/2008	34		638300	18774	30113
12/12/2008	24		914200	38092	31920
01/12/2009	31		1179100	38035	33304
02/12/2009	31		897600	28955	32501
03/11/2009	27		741800	27474	31805
04/13/2009	33		1259600	38170	32726
05/12/2009	29		1060300	36562	33159
06/12/2009	31		1004800	32413	33079
07/13/2009	31		805000	25968	32388
08/12/2009	30		877800	29260	32119
09/11/2009	30		894700	29823	31937
10/12/2009	31		1509800	48703	33205
11/12/2009	31		1146200	36974	33470
				#DIV/0!	

WATTS BAR NUCLEAR PLANT
WATERSHED MAP

Legend

- RESERVATION BOUNDARY
- DRAINAGE BOUNDARY
- SUB STORMWATER AREA
- CATCH BASINS
- STORM DRAIN ENDWALLS
- STORMWATER MONITORING POINT
- NPDES MONITORING POINT
- GENERAL YARD FLOW
- DRAINWAY / WATER
- UNDERGROUND PIPE
- NPDES SIGN

N

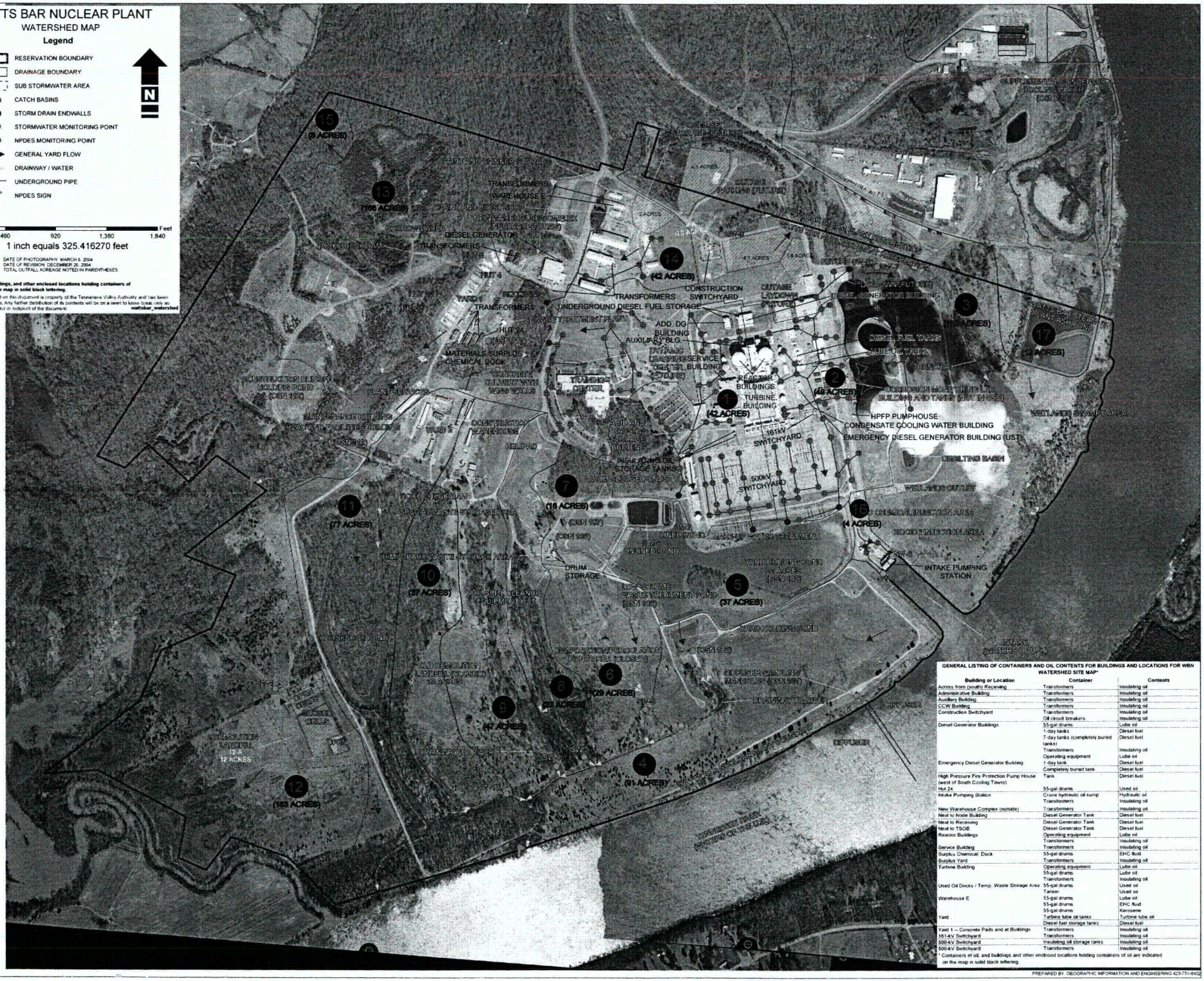
0 230 460 920 1,380 1,840 Feet

1 inch equals 325.416270 feet

DATE OF PHOTOGRAPHY: MARCH 8, 2004
DATE OF REVISION: DECEMBER 20, 2004
TOTAL OUTFALL ACREAGE NOTED IN PARENTHESES

*** Containers of oil, buildings, and other enclosed locations holding containers of oil are indicated on the map in solid black lettering.**

The information contained on this document is property of the Tennessee Valley Authority and has been determined to be sensitive. Any further distribution of its contents will be on a need to know basis, only as determined by the originator or recipient of the document. **wattsbar_watershed**



GENERAL LISTING OF CONTAINERS AND OIL CONTENTS FOR BUILDINGS AND LOCATIONS FOR WBN WATERSHED SITE MAP*

Building or Location	Container	Contents
Across from (south) Receiving	Transformers	Insulating oil
Administrative Building	Transformers	Insulating oil
Auxiliary Building	Transformers	Insulating oil
CCW Building	Transformers	Insulating oil
Construction Switchyard	Transformers	Insulating oil
	Oil circuit breakers	Insulating oil
Diesel Generator Buildings	55-gal drums	Lube oil
	1-day tanks	Diesel fuel
	7-day tanks (completely buried tanks)	Diesel fuel
	Transformers	Insulating oil
	Operating equipment	Lube oil
Emergency Diesel Generator Building	1-day tank	Diesel fuel
	Completely buried tank	Diesel fuel
High Pressure Fire Protection Pump House (west of South Cooling Tower)	Tank	Diesel fuel
Hut 24	55-gal drums	Used oil
Intake Pumping Station	Crane hydraulic oil sump	Hydraulic oil
	Transformers	Insulating oil
New Warehouse Complex (outside)	Transformers	Insulating oil
Next to Node Building	Diesel Generator Tank	Diesel fuel
Next to Receiving	Diesel Generator Tank	Diesel fuel
Next to TSC06	Diesel Generator Tank	Diesel fuel
Reactor Buildings	Operating equipment	Lube oil
	Transformers	Insulating oil
Service Building	Transformers	Insulating oil
Surplus Chemical Dock	55-gal drums	EHC fluid
Surplus Yard	Transformers	Insulating oil
Turbine Building	Operating equipment	Lube oil
	55-gal drums	Lube oil
	Transformers	Insulating oil
Used Oil Docks / Temp. Waste Storage Area	55-gal drums	Used oil
	Tanker	Used oil
Warehouse E	55-gal drums	Lube oil
	55-gal drums	EHC fluid
	55-gal drums	Kerosene
Yard	Turbine lube oil tanks	Turbine lube oil
	Diesel fuel storage tanks	Diesel fuel
Yard 1 -- Concrete Pads and all Buildings	Transformers	Insulating oil
161-kV Switchyard	Transformers	Insulating oil
500-kV Switchyard	Insulating oil storage tanks	Insulating oil
500-kV Switchyard	Transformers	Insulating oil

* Containers of oil, and buildings and other enclosed locations holding containers of oil are indicated on the map in solid black lettering.

PREPARED BY: GEOGRAPHIC INFORMATION AND ENGINEERING 423-751-6402