WATER QUALITY DEMONSTRATION STUDY

SANDY CREEK AND TRIBUTARY
CAMP HILL, ALABAMA
1989,1990,1991, AND 1992

SPECIAL STUDIES SECTION
FIELD OPERATIONS DIVISION
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

WATER QUALITY DEMONSTRATION STUDY
SANDY CREEK AND TRIBUTARY - CAMP HILL, ALABAMA

INTRODUCTION

The Town of Camp Hill, Alabama utilizes a tributary to Sandy Creek as a receiving stream for the treated effluent from its municipal wastewater treatment facility (WWTP). During the period from August 1989 to October 1990, the WWTP of the Town of Camp Hill underwent construction to upgrade the old disposal plant. Staff members of the Special Studies Section, Field Operations Division of the Alabama Department of Environmental Management (ADEM), at the request of the Municipal Branch of the Water Division of ADEM, conducted a water quality demonstration study to assess the effects of the new treatment facility on Sandy Creek and its tributary.

EPA CONSTRUCTION GRANTS PROGRAM

Since 1972, approximately $550 million dollars in EPA grant funds have been expended toward construction of municipal wastewater treatment works in Alabama. One recipient of EPA funding was the Town of Camp Hill in Tallapoosa county.

The construction, which was completed in October 1990, upgraded the existing 0.12 million gallons per day (mgd), four acre single cell lagoon to 0.15 mgd by adding a second pond and utilizing aquaculture (water hyacinth) technology. The proposed treatment process was considered innovative technology and allowed Camp Hill to recieve a 20% bonus in grant funds. A total of 75% of the eligible costs for the facility was funded by EPA.

The total project cost was approximately $857,000. Of this total, approximately $578,500 was funded by EPA. The project engineer was Goodwyn, Mills, & Cawood, Inc. of Montgomery and the contractor was John Plott Company, Inc. of Tuscaloosa. The new construction included bar screens, four floating aerators, a 200 gallon per minute (gpm) pump station, a two acre hyacinth pond, two greenhouses, flow measuring equipment, a cascade aerator, and a twelve inch diameter gravity outfall.

The new system replaced a non-aerated, four acre, single-cell lagoon discharging secondary quality effluent into a tributary of Sandy Creek. A wasteload allocation study performed by ADEM in 1987 indicated that more stringent limits would be required to maintain the Fish and Wildlife water use classification standard at the existing discharge point. However, by relocating the discharge point to Sandy Creek and employing seasonal limits, Camp Hill would be able to meet proposed new limits by utilizing the cost-effective aquaculture treatment process.

The objective of aquaculture treatment is the removal of nutrients (nitrogen, phosphorus), and suspended solids and the reduction of BOD. During the active growth phase, water hyacinths are capable of absorbing organics, heavy metals, pesticides and other contaminants. The hyacinths uptake nutrients for growth and physically filter solids with their extensive root systems. The

root system also supports an active mass of microorganisms which assist in breaking down and removing pollutants from the wastewater. Another benefit is that algae in the pond effluent is reduced due to the hyacinths limiting the light available to the algae for photosynthesis.

The water hyacinth is very sensitive to temperature and grows most rapidly when the water temperature is 70 to 86 degrees Farenheit. Growth ceases at water temperatures below 50 degrees Farenheit and above 104 degrees Farenheit. Exposure to temperatures of 23 degrees Farenheit or below will kill the plants. The Camp Hill aquaculture system will provide maximum treatment during the summer low flow months when the permit limits are most stringent. In the winter, when cold weather reduces hyacinths to a dormant state, the permit limits are relaxed to secondary levels and compliance should be achieved by conventional lagoon processes.

The Town of Camp Hill, Alabama now discharges treated wastewater to Sandy Creek. Monthly seasonal NPDES permit limits for the WWTP are as follows:

	May-Oct	Nov-Apr
BOD_5	20 mg/L	30 mg/L
TSS	30 mg/L	90 mg/L
NH_3-N	8 mg/L	N/A
D.O.	5 mg/L	N/A

Since initiation of operation in October 1990, the Camp Hill WWTP has experienced some problems in consistently meeting all NPDES permit limits. Possible causes of the facility's non-compliance include the following:

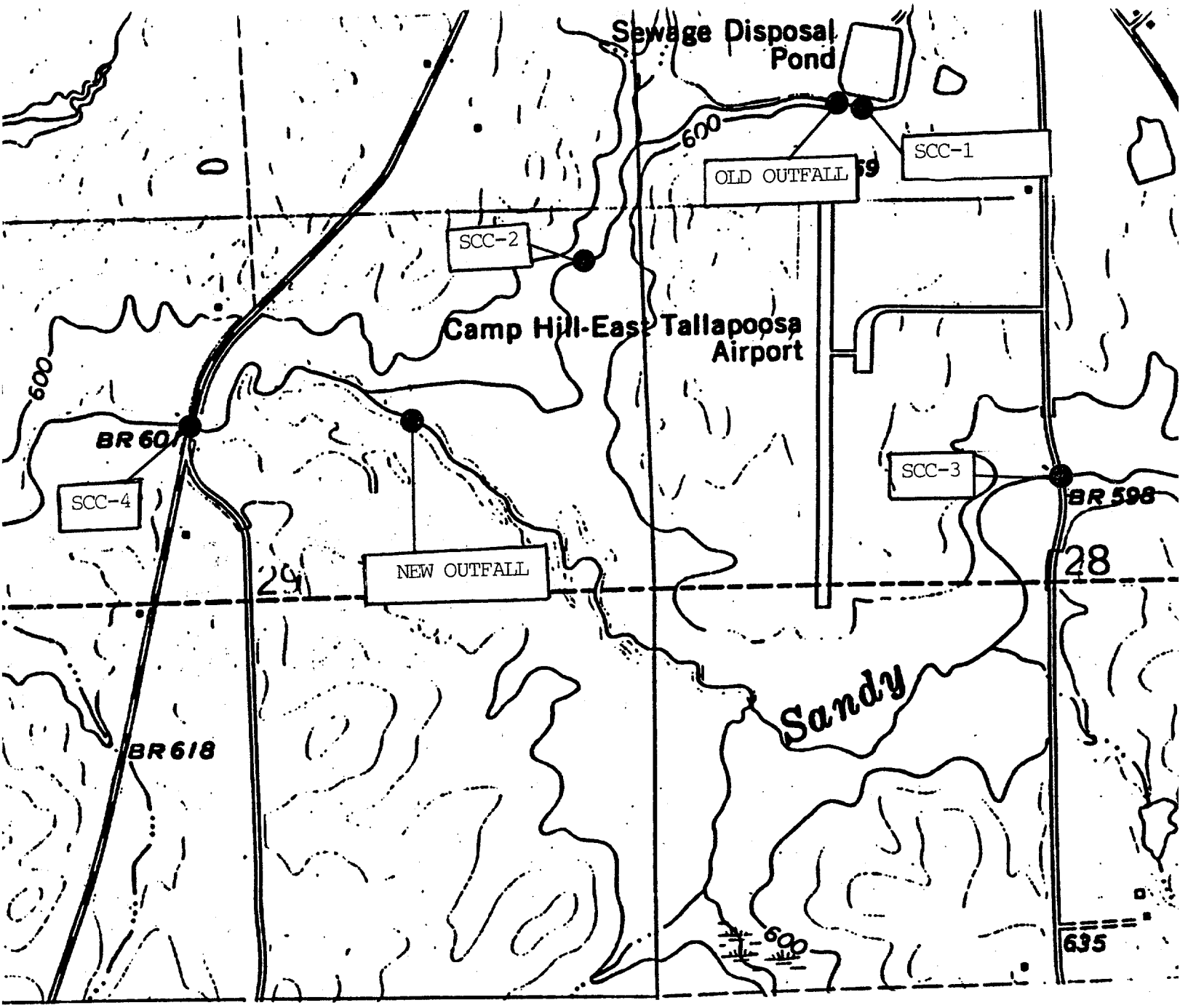
1). Infestation of the hyacinths with spider mites.
2). Growth of duckweed on the primary lagoon.
3). Improper harvesting of the water hyacinths.
4). Improper operation of aeration equipment.

A Corrective Action Report (CAR) has been submitted to ADEM by Camp Hill with a schedule for bringing the facility into compliance. Minor changes in the operation and management of the facility should remedy the permit violation problems.

FIELD OPERATIONS

During the period of May to October 1989 and May to September 1990, staff members of the Special Studies Section collected data to establish conditions and provide a comparative base of information on the tributary to- and Sandy Creek prior to construction and implementation of the new treatment plant. During May 1991 and August 1992, data were collected to demonstrate the improvement, if any, of water quality in the receiving stream attributable to the new plant.

SAMPLING LOCATIONS AND METHODOLOGY



TRIBUTARY TO AND SANDY CREEK
Sampling Locations

MAP 1

The station names and locations were as follows:

STATION	LOCATION:
SCC-1	Tributary to Sandy Creek 50 feet upstream of WWTP.
(control)	T21N,R24E,S21,SW1/4,SE1/4,SW1/4.
	Latitude: 32 47 07.8 Longitude: 086 39 26.0
SCC-2	Tributary to Sandy Creek 0.5 mile downstream of WWTP.
	T21N,R24E,S29,NE1/4,NE1/4,NE1/4.
	Latitude: 32 46 54.1 Longitude: 086 39 11.2
SCC-3	Sandy Creek 1.5 mile upstream of confluence of tributary.
(control)	T21N,R24E,S28,NW1/4,SE1/4,NE1/4.
	Latitude: 32 46 35.1 Longitude: 086 39 11.2
SCC-4	Sandy Creek at Alabama Highway 50.
	T21N,R24E,S29,NW1/4,NE1/4,SE1/4.
	Latitude: 32 46 40.4 Longitude: 086 40 18.4

All physical data, chemical and biological sampling, sample handling techniques, and field parameter analyses utilized in the acquisition of data for this water quality demonstration study were as described in the Field Operations Standard Operating Procedures and Quality Control Assurance Manual (Field Operations Division, ADEM, Volumes 1 and 2), as amended. Chain-of-custody was maintained by locking the samples in a Departmental vehicle when not in sight of a Field Operations employee. The samples requiring laboratory analysis were transported to the ADEM Environmental Laboratory in Montgomery, Alabama. Analysis methodology were as specified in the Federal Register, 40 CFR Part 136, October 1984, as amended. Analysis of the samples yielded the data which are reported in Tables 1 and 2.

DISCUSSION AND RESULTS

A. PHYSICAL

The tributary to Sandy Creek is a first order stream, over the length of the study reach. It drains agricultural, commercial, field/pasture, and forested lands and falls within the Sand Hills sub-Ecoregion. Sandy Creek is a fourth order stream and drains commercial and forested lands. Sandy Creek has canopy cover which varies from mostly open to mostly shaded, has trees and shrubs as the dominant type of streamside vegetation and has moderately stable banks. Bottom structure is largely dominated by gravel, clay, and sand substrates. Flows are usually greater than five cfs, even during low flow conditions. Sandy Creek exhibits signs of erosion to varying degrees, but shows no channel alteration. Multiple habitats suitable for colonization by aquatic macroinvertebrates are abundant and, Habitat Assessments rated this stream as GOOD at both evaluated locations. Sandy Creek lies within the Tallapoosa River drainage basin.

B. CHEMICAL

The Water Use Classification for Sandy Creek is Fish and

Wildlife (F&W). F&W designates the waters to be suitable for fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water contact sports or as a source of water supply for drinking or food processing purposes.

As shown in Table 1, and Figure 1, data collected prior to the upgrade of the treatment plant indicated that the waters in the tributary to Sandy Creek below the Camp Hill WWTP were not meeting the dissolved oxygen standard for the F&W classification (5.0 mg/L). The pH data collected (Table 1, Figure 2) indicated very minor changes in the stream. Biochemical Oxygen Demand (BOD_5), Ammonia (NH_3), Total Kjeldahl Nitrogen (TKN), and Phosphates (PO_4) were all shown to have substantial increases as compared to the upstream stations (Table 1, Figures 3, 4, and 5). In contrast, Sandy Creek, prior to the upgrade of the WWTP, showed very little adverse impact attributable to the effluent.

Chemical data collected on the tributary to Sandy Creek after the upgrade indicated that, when compared to data collected before the upgrade, water quality was improved. Dissolved Oxygen concentrations (Table 2, Figure 1) exhibited a substantial increase. In addition, BOD_5, NH_3, TKN, and PO_4 showed significant reductions in concentration (Table 2, Figures 3, 4, and 5). Conductivity was also shown to decrease downstream of the WWTP (Table 2, Figure 2). Sandy Creek continued to show little adverse impact.

Flow data collected on Sandy Creek (Tables 1 and 2, Figure 2) before and after the upgrade of the WWTP was observed to be approximately the same; between 30 and 36 cubic feet per second (cfs). The 7Q10 low flow for Sandy Creek above the WWTP outfall, however, is 4.6 cfs. This indicates that the stream flows recorded during the study dates were dramatically elevated and may account for the minimal impact from the WWTP.

C. BIOLOGICAL

An assessment of Sandy Creek water quality would be incomplete without considering impacts to the biological communities. The aquatic macroinvertebrate community was sampled using the RBP-Multihabitat method to substantiate the physical, and chemical data and to provide an aspect that reflects pollution response over time.

A complete listing of the taxa collected during this water quality demonstration study has been included in Appendix A. In order to provide results which accurately assess the sampling locations, biological metrics (Tables 3 to 5, Figures 6 to 8) were used to analyze only the raw macroinvertebrate data collected at similar habitats. Table 6 provides a simplified interpretation of these metrics and should be referred to as part of the following discussion.

During the before portion of the water quality demonstration study, a visual assessment was made of the stations associated with the tributary to Sandy Creek. During this visual assessment, SCC-1 was noted to have three types of mayflies, two types of stoneflies, three types of Odonates (Gomphidae, Aeschnidae, Coenagrionidae), Elmid beetles, one Caddisfly, Chironomids, Isopods and Fish (Chubs

or Shiners). In contrast, SCC-2 biological communities were limited to Oligochaetes (dominant organism), Chironomids, one Odonate (Gomphidae), and one large school of fish (Gambusia). In addition, the presence of large amounts of duckweed and filamentous algae were noted. The tributary to Sandy Creek was heavily impacted by the presence of the effluent.

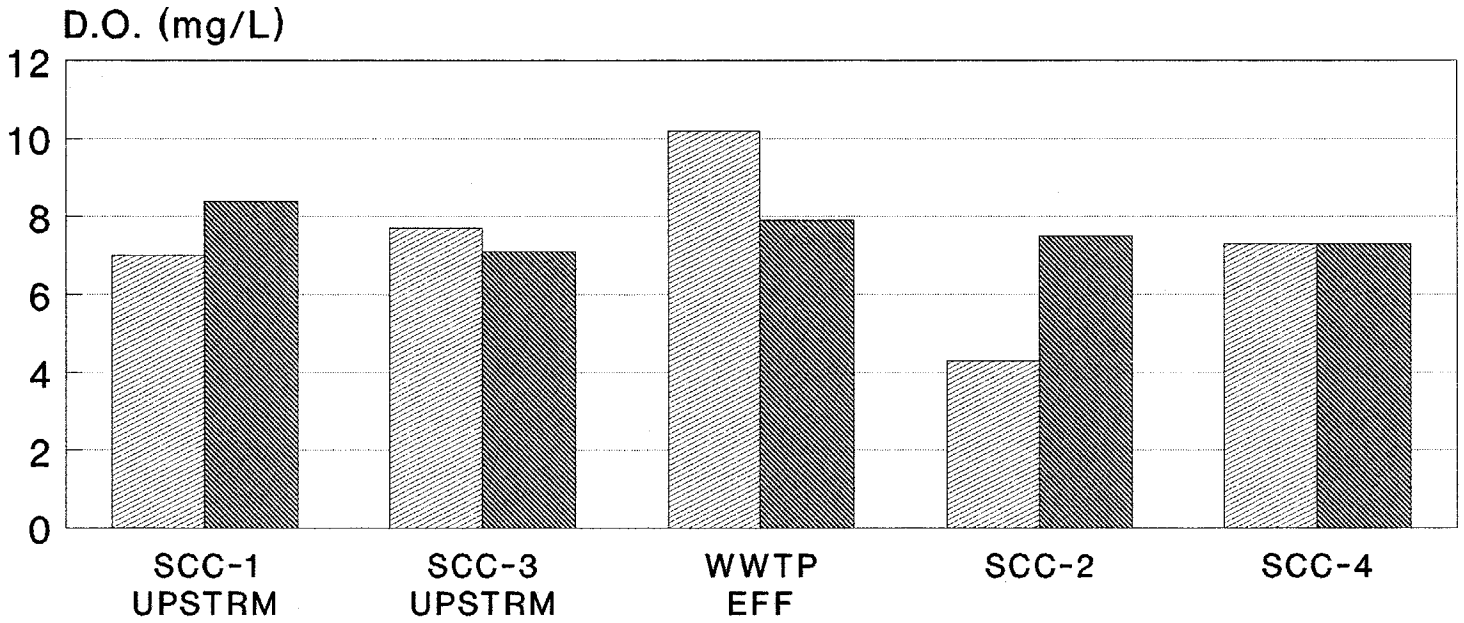
As demonstrated in Tables 3, 4, and 5 and Figures 6, 7, and 8, aquatic macroinvertebrates collected from Sandy Creek before the upgrade of the WWTP, showed little impact from the addition of the effluent bearing waters from the tributary. A slight reduction in the overall number of taxa present, and in the generally pollution intolerant Ephemeroptera, Plecoptera and Trichoptera (EPT) families was noted at SCC-4 (Figure 6, Tables 3 and 4). Community structure (Figure 8) was observed to be well balanced with all major functional feeding groups present. Species Diversity, and Equitability (Figure 7) at SCC-4 also showed a slight decrease as compared to SCC-3. The Similarity Indices (Table 5), indicated that both stations were very similar. The Biotic Index (Table 3 and 4, Figure 6), Shredders to Total ratio, and Scrapers to Scrapers/Collector-Filterers ratio indicated little change as compared to background. The EPT to EPT+Chironomidae ratio also supported the conclusion of acceptable water quality. The biological community of Sandy Creek below the WWTP discharge appears to be minimally affected by the effluent.

Due to the complete removal of the effluent outfall from the tributary to Sandy Creek and the extremely low flow being discharged to Sandy Creek from the new effluent outfall (averaging approximately 1.3% of the total stream flow), a biological assessment during the after portion of this WQDS was regarded as unnecessary to demonstrate an improvement in water quality.

CONCLUSIONS

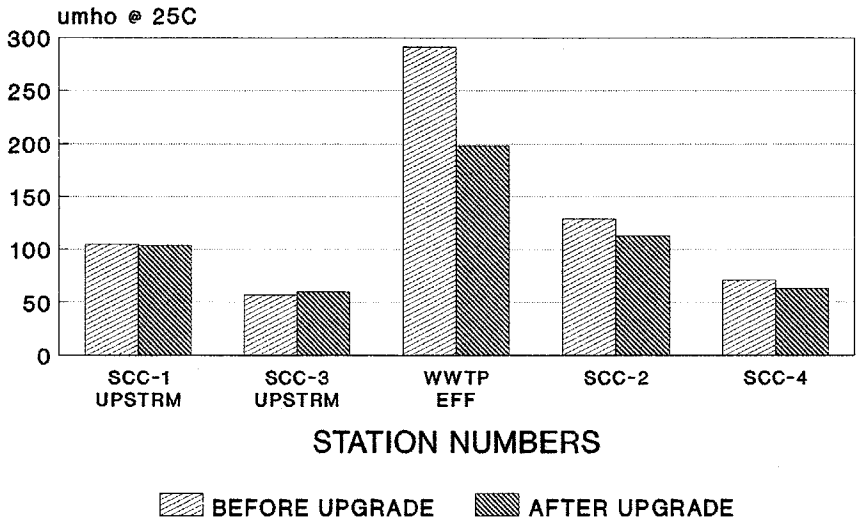
Physical, chemical, and biological data collected before the upgrade, and physical, and chemical data collected after the upgrade of the Camp Hill wastewater treatment plant indicate that the tributary to- and Sandy Creek are meeting their requirements for the Fish and Wildlife Water Use Classification. The tributary to Sandy Creek has experienced an improvement in overall water quality, due to the complete removal of the effluent discharge. Sandy Creek has experienced minimal adverse impact attributable to the Camp Hill WWTP effluent. This may be the result of higher than average stream flows.

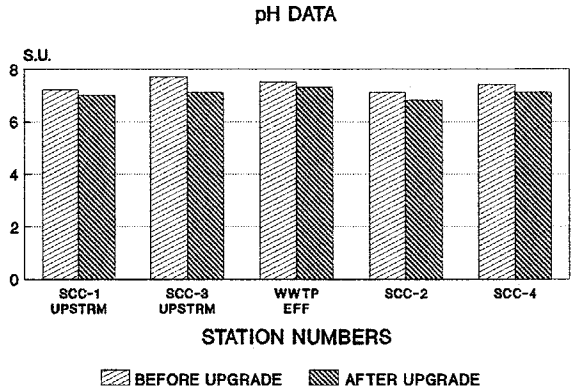
FIGURE 1
TRIBUTARY TO- AND SANDY CREEK
DISSOLVED OXYGEN DATA

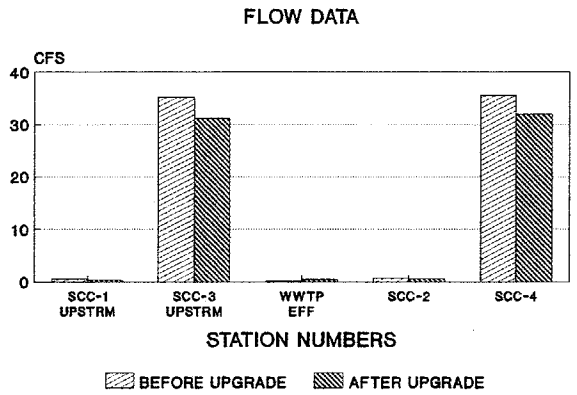


THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS.

FIGURE 2
TRIBUTARY TO- AND SANDY CREEK



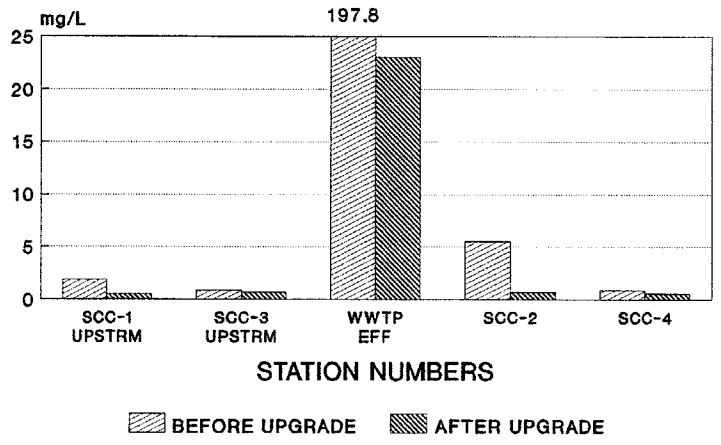




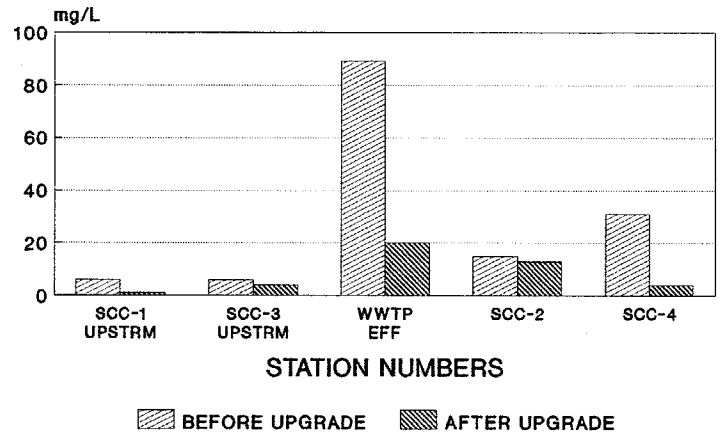
THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS.

FIGURE 3
TRIBUTARY TO- AND SANDY CREEK
CHEMICAL ANALYSIS DATA

BIOCHEMICAL OXYGEN DEMAND



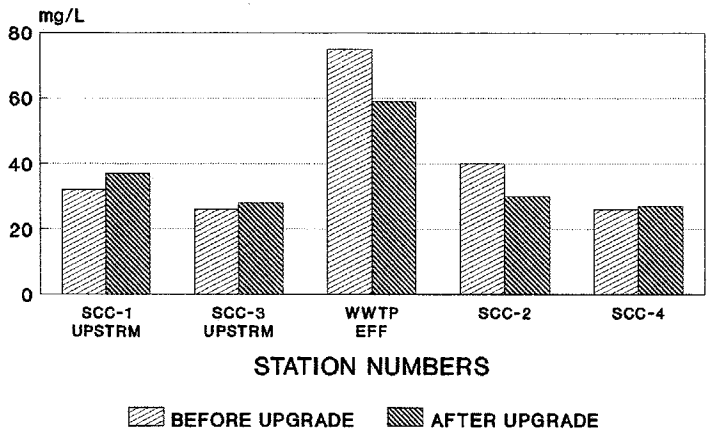
TOTAL SUSPENDED SOLIDS



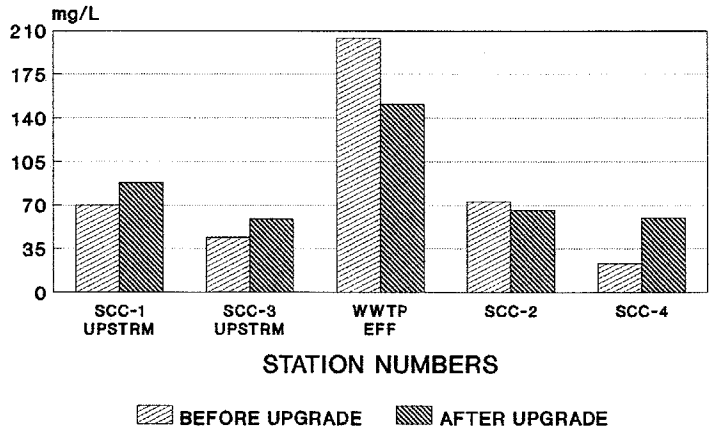
THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS.

FIGURE 4

ALKALINITY



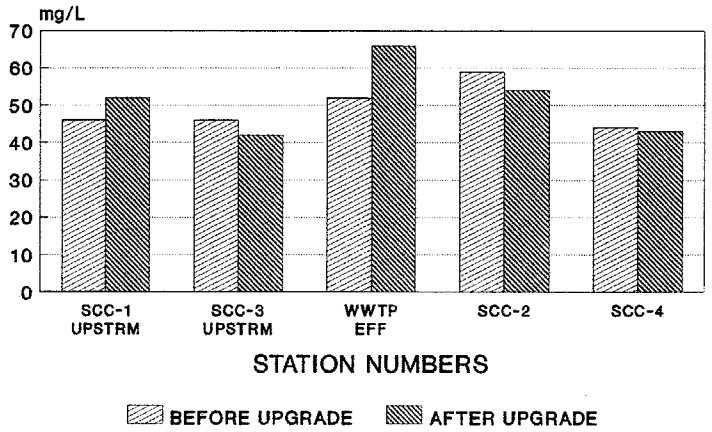
TOTAL DISSOLVED SOLIDS



TRIBUTARY TO- AND SANDY CREEK

THESE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS.

HARDNESS



TURBIDITY

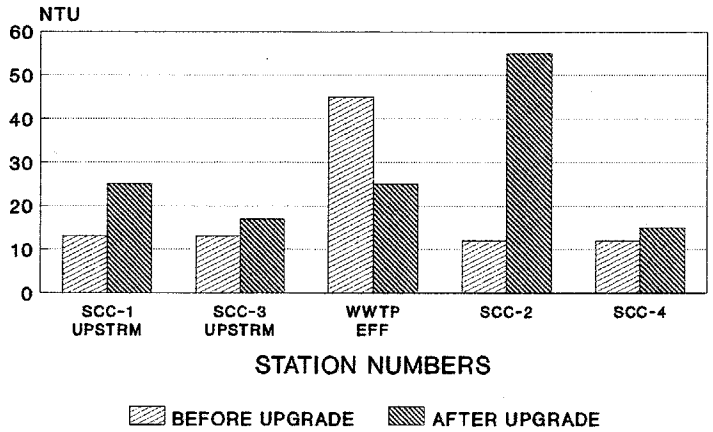
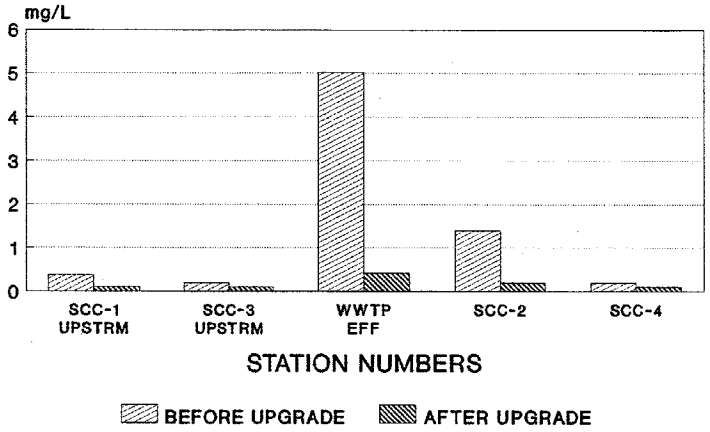
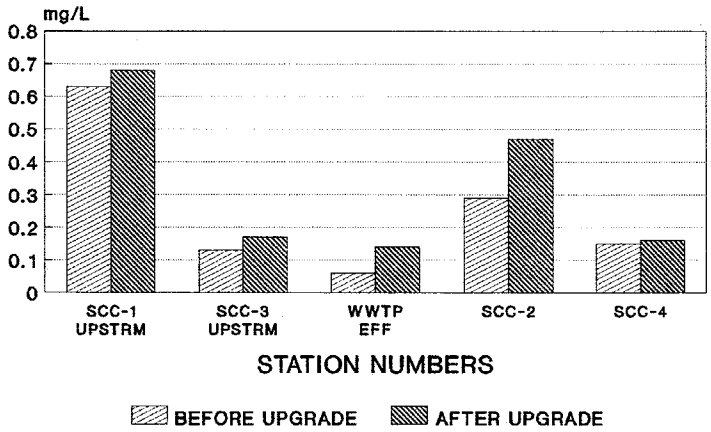


FIGURE 5

AMMONIA



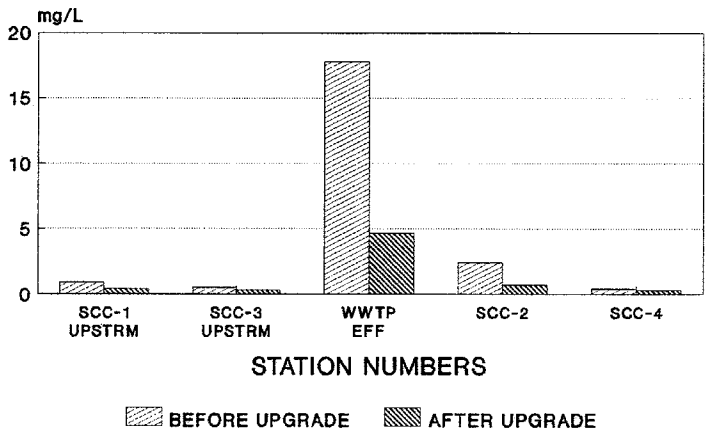
NITRATE



TRIBUTARY TO- AND SANDY CREEK

THESE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS.

TOTAL KJELDAHL NITROGEN



PHOSPHATES

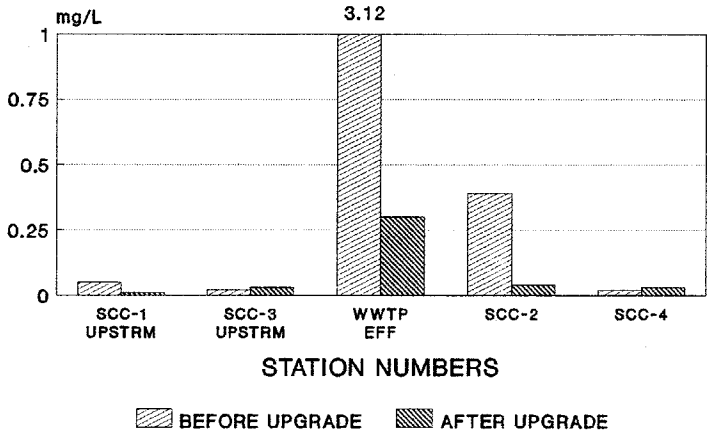
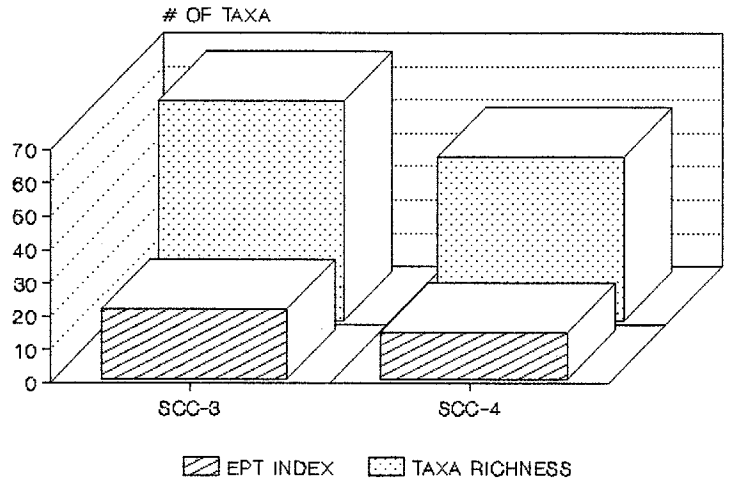


FIGURE 6
BIOMETRIC INDICES

BEFORE UPGRADE



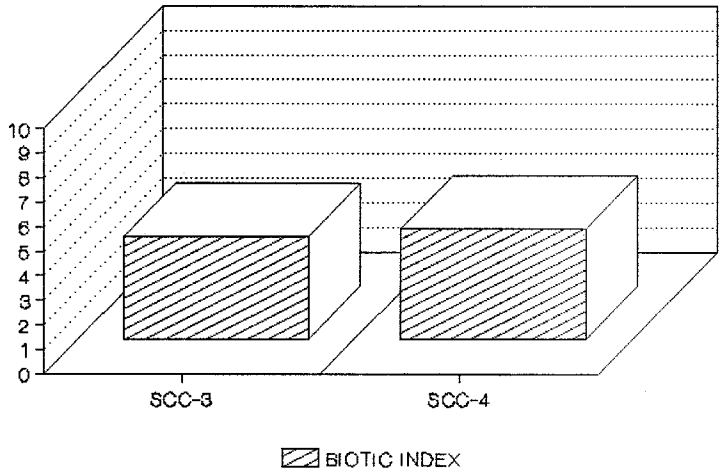
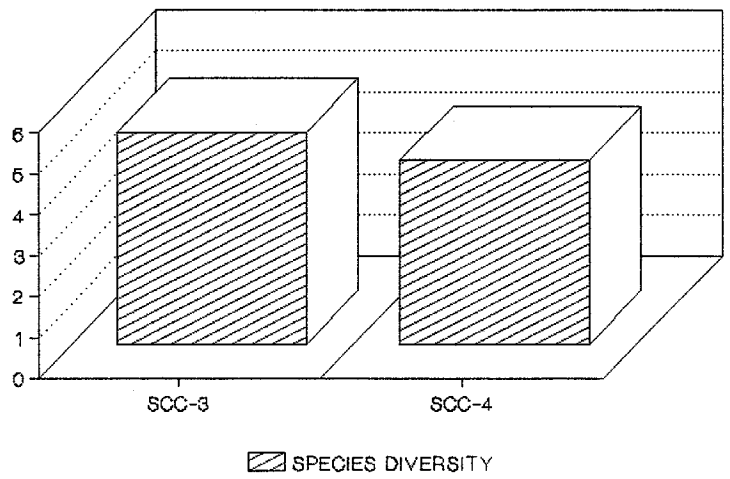


FIGURE 7
BIOMETRIC INDICES

BEFORE UPGRADE



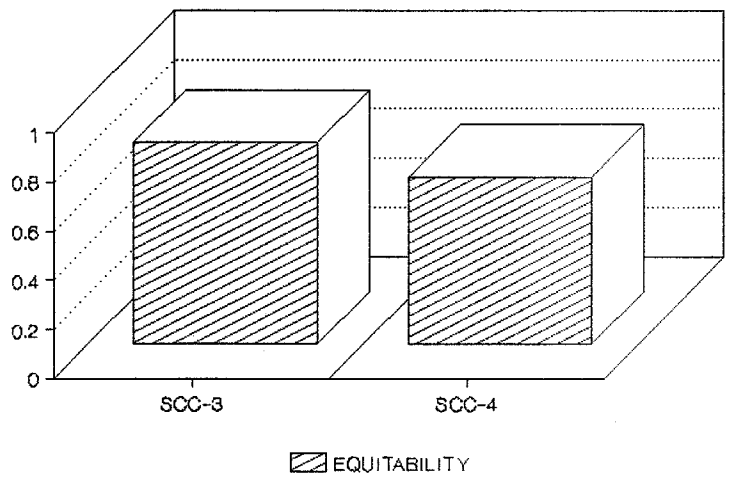
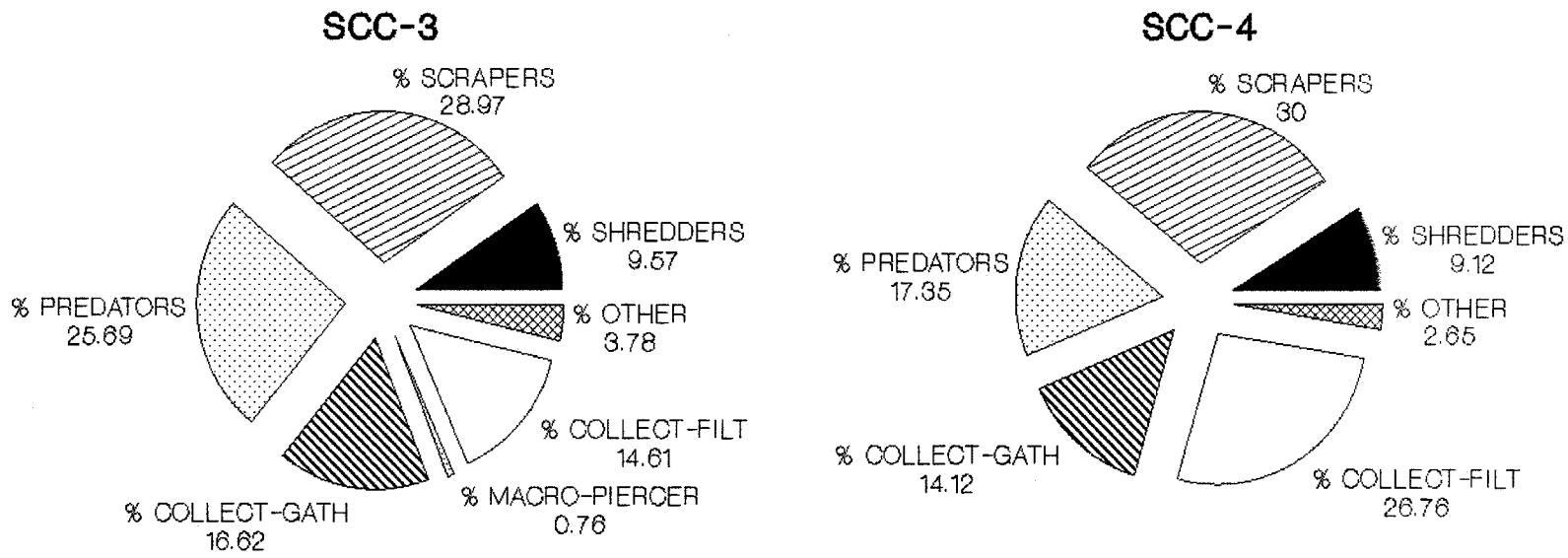


FIGURE 8
SANDY CREEK
COMMUNITY STRUCTURE
BEFORE UPGRADE



% OTHER ARE THE ORGANISMS WITHOUT FUNCTIONAL

FEEDING GROUP DESIGNATION.

TABLE 1

WATER QUALITY DEMONSTRATION STUDY
TRIBUTARY TO- AND SANDY CREEK AT CAMP HILL, ALABAMA
DATA COLLECTED PRIOR TO UPGRADE OF WWTP

DATE	STATION	TIME	AIR TEMP	WATER TEMP	D.O.	pH	SPEC COND	TURB	ALK	BOD 5	HARD	TSS	TDS	COD	NO -N 3	NH -N 3	TKN	PHOS TOT	FLOW	BACT
05/24/89	STP	12:12	27	25		7	330	88	92	50	76	115	225	46	0.12	9	27.2	3.2	0.15	---
07/13/89	EFF	10:30	25.5	27		7	193	31	30	23.5	54	44	120	78	<0.04	1.92	4.69	1.64	0.13	---
08/22/89		12:15	24	21		7	282	25	64	43	45	60	181	245	<0.04	0.51	9.79	2.58	0.04	---
10/03/89		11:25	21	22		8.4	255	35	70	48	49	64	154	36	0.1	5.29	12.96	3.1	0.3	---
05/17/90		10:38	26	27	11.1	8.3	289	15	79	23	60	18	236	130	<0.04	4.9	9.7	2.7	0.08	---
09/11/90		09:37	30	27	9.2	7.5	395	74	112	999	28	234	306	70	<0.04	8.5	42.4	5.5	0.02	---
AVERAGE			25.6	24.8	10.2	7.5	291	45	75	197.8	52	89	204	101	---	5.02	17.79	3.12	0.12	---
05/24/89	SCC-1	12:05	27	23	7.5	7.5	94	9	30	0.9	55	6	93	10	0.78	0.5	2.2	0.02	0.58	670
07/13/89		10:25	25.5	23	7.3	7.2	104	11	32	0.4	33	<1	60	12	0.73	<0.2	0.82	0.06	0.89	146.7
08/22/89		10:30	29	22	3.6	6.9	111	8	30	0.5	37	20	68	15	0.77	<0.2	<0.4	0.05	0.43	350
10/03/89		10:55	21	17	8.1	6.9	106	35	28	0.9	39	5	72	12	0.41	1	1	0.11	0.84	40
05/17/90		11:05	26	21	7.7	7.7	108	5	33	1.2	59	3	77	7	0.9	<0.2	0.6	<0.02	0.58	>1280
09/11/90		09:44	30	27	7.5	7.1	106	7	36	7.4	55	1	49	10	0.2	<0.2	<0.4	<0.02	0.07	15
AVERAGE			26.4	22.2	7.0	7.2	105	13	32	1.9	46	---	70	11	0.63	---	---	---	0.57	----
05/24/89	SCC-2	13:35	29	26	1.3	7.2	118	11	46	0.8	150	7	98	24	0.14	2.6	5.2	0.43	0.73	510
07/13/89		11:05	27	24.5	5.5	7.2	101	8	32	1.9	30	6	55	18	0.45	<0.2	0.41	0.15	1.02	3200
08/22/89		10:30	29	22	3.5	6.9	111	8	34	2.9	37	6	75	22	0.23	0.41	0.85	0.18	0.47	260
10/03/89		10:05	22	16	5.8	6.8	132	21	38	3.1	34	15	23	22	0.31	<1	1.1	0.38	1.14	280
05/17/90		10:10	26	22	6.9	7.2	106	10	31	2	51	10	76	15	0.58	0.4	0.8	0.13	0.66	147
09/11/90		09:10	27	24	2.7	7.3	204	13	59	22	53	43	112	64	<0.04	3.8	6.1	1.05	0.09	>600
AVERAGE			26.7	22.4	4.3	7.1	129	12	40	5.5	59	15	73	28	---	---	2.4	0.39	0.68	----
05/17/90	SCC-3	11:35	26	22	7.7	8.2	53	15	22	1.2	42	10	53	7	0.18	<0.2	0.6	<0.02	65.4	97
09/11/90		11:00	29	25	6.2	7.2	60	11	29	0.5	49	1	35	7	0.08	<0.2	<0.4	<0.02	5.02	223
AVERAGE			27.5	23.5	7.0	7.7	57	13	26	0.9	46	6	44	7	0.13	---	---	---	35.21	160
05/17/90	SCC-4	09:10	25	21	7.8	7.5	65	13	21	1.6	38	58	9	10	0.22	<0.2	<0.4	<0.02	66.06	102
09/11/90		08:40	24	24	6.7	7.2	76	11	30	0.2	50	3	37	10	0.08	<0.2	<0.4	<0.02	5.11	41
AVERAGE			24.5	22.5	7.3	7.4	71	12	26	0.9	44	31	23	10	0.15	---	---	---	35.59	72
			C	C	ppm	SU	umho @25C	NTU	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	cfs	org/ 100mL

TABLE 2

WATER QUALITY DEMONSTRATION STUDY
TRIBUTARY TO- AND SANDY CREEK AT CAMP HILL, ALABAMA
DATA COLLECTED AFTER UPGRADE OF WWTP

DATE	STATION	TIME	AIR TEMP	WATER TEMP	D.O.	pH	SPEC COND	TURB	ALK	BOD 5	Cl	HARD	TSS	TDS	NO -N 3	NH -N 3	TKN	TON	COD	PHOS TOT	FLOW	BACT
05/24/91	STP	1105	25	21	8.3	7	130	20	46	9	6.5	55	13	101	<0.04	<0.2	2.6	2.6		0.3	0.16	
08/26/92	EFF	0820	25	27	7.5	7.6	265	29	72	36	35	76	26	200	0.23	0.65	6.7	6.05	80	0.29	0.66	
AVERAGE			25	24	7.9	7.3	198	25	59	23	20.7	66	20	151	---	---	4.65	4.33	80	0.30	0.41	
05/24/91	SCC-1	1055	26	19	8.4	7	107	47	34	0.3	6	54	1	83	0.67	<0.2	0.7	0.7		<0.02	0.44	
08/26/92		1030	28	26	8.4	7	100	2.2	40	0.7	5	49	<1	92	0.68	<0.015	<0.15	0.13	10	0.008	0.26	>60
AVERAGE			27	22.5	8.4	7	104	25	37	0.5	6	52	--	88	0.68	---	---	0.42	10	---	0.35	---
05/24/91	SCC-2	1015	25	19	7.5	6.8	113	55	30	0.7	4.5	54	13	66	0.47	<0.2	0.7	0.7		0.04	0.6	
08/26/92		INACCESSIBLE			INACCESSIBLE			INACCESSIBLE			INACCESSIBLE				INACCESSIBLE			INACCESSIBLE				
AVERAGE			25	19	7.5	6.8	113	55	30	0.7	5	54	13	66	0.47	---	0.70	0.70	---	0.04	0.60	---
05/24/91	SCC-3	1155	25	20	7.2	7	60	27	26	0.8	2.5	45	5	54	0.16	<0.2	<0.4	0		0.03	36.68	
08/26/92		1305	30	25	7	7.1	60	7.6	29	0.5	3	39	3	64	0.18	<0.015	0.207	0.21	2	0.02	25.59	32
AVERAGE			28	23	7.1	7.1	60	17	28	0.7	3	42	4	59	0.17	---	---	0.11	2	0.03	31.14	32
05/24/91	SCC-4	1220	26	20.5	7.2	7	55	23	24	0.4	2.5	46	6	56	0.16	<0.2	<0.4	0		0.04	37.28	
08/26/92		1330	29	27	7.4	7.1	70	6.6	29	0.8	2	40	2	63	0.15	<0.015	0.19	0.19	2	0.01	26.51	2
AVERAGE			28	24	7.3	7.1	63	15	27	0.6	2	43	4	60	0.16	---	---	0.10	2	0.03	31.90	2
			C	C	ppm	SU	umho @25C	NTU	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	cfs	org/ 100 mL

SANDY CREEK SCC3-900718 SINGLE STATION METRICS
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	TOTAL
TAXA RICHNESS	17	44	12	34	8	66
# ORGANISMS	90	136	44	119	8	397
EPT TAXA RICHNESS	10	11	6	12	2	21
AVERAGE TOLERANCE VALUE	3.88	4.95	3.58	4.09	5.13	4.68
BIOTIC INDEX	3.59	4.53	4.55	4.10	5.13	4.20
# CHIRONOMIDAE TAXA / TOTAL TAXA	.06	.23	.08	.26	.38	.23
# EPT / # EPT + # CHIRONOMIDAE	.94	.73	.93	.64	.40	.74
# SCRAPERS / # FILTERING COLLECTORS + # SCRAPERS	.69	.63	.94	.52	.67	.66
# SHREDDERS / TOTAL # ORGANISMS	.09	.12	.02	.11	.00	.10
PERCENT SCRAPERS	40.00	11.03	68.18	26.89	25.00	28.97
PERCENT SHREDDERS	8.89	11.76	2.27	10.92	.00	9.57
PERCENT FILTERING COLLECTORS	17.78	6.62	4.55	25.21	12.50	14.61
PERCENT COLLECTOR GATHERERS	26.67	11.76	9.09	15.97	37.50	16.62
PERCENT PREDATORS	5	47	15	19	25	25.69
PERCENT MACROPHYTE PIERCERS	1.11	.74	.00	.84	.00	.76
PERCENT OTHERS	.00	10.29	.00	.84	.00	3.78
# HYDROPTILIDAE / # TRICHOPTERA	.0588	.0556	.0000	.0625	.0000	.0545
SHANNON WEAVER DIVERSITY INDEX	3.46	4.84	2.56	4.35	3.00	5.17
EQUITABILITY	.93	.96	.67	.88	1.41	.82

SANDY CREEK SCC3-900718 SINGLE STATION METRICS
MACROINVERTEBRATE DATA

DOMINANT TAXON AND PERCENT CONTRIBUTION

RIFFLE	ROOT BANK	ROCK LOG	CPOM	SAND	TOTAL
Promoresia	Calopteryx	Elimia	Stenonema	Cryptochironomus	Elimia
21.11	13.24	50.00	15.97	12.50	13.35

SANDY CREEK SCC3-900718 SINGLE STATION METRICS
MACROINVERTEBRATE DATA

FIVE DOMINANT TAXA IN TOTAL COLUMN AND PERCENT CONTRIBUTION

Elimia
13.35

Stenonema
8.82

Promoresia
5.29

Calopteryx
4.79

Cheumatopsyche
4.28

SCC4-900718 SINGLE STATION METRICS
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	TOTAL
TAXA RICHNESS	8	19	22	15	3	49
# ORGANISMS	31	62	188	44	15	340
EPT TAXA RICHNESS	4	3	10	5	0	14
AVERAGE TOLERANCE VALUE	4.75	5.44	3.96	4.07	6.33	4.47
BIOTIC INDEX	4.10	5.06	4.38	4.00	6.40	4.51
# CHIRONOMIDAE TAXA / TOTAL TAXA	.25	.16	.23	.27	.00	.18
# EPT / # EPT + # CHIRONOMIDAE	.85	.62	.81	.79	.00	.80
# SCRAPERS / # FILTERING COLLECTORS + # SCRAPERS	.17	1.00	.61	.44	.57	.53
# SHREDDERS / TOTAL # ORGANISMS	.00	.13	.11	.07	.00	.09
PERCENT SCRAPERS	12.90	4.84	38.83	31.82	53.33	30.00
PERCENT SHREDDERS	.00	12.90	10.64	6.82	.00	9.12
PERCENT FILTERING COLLECTORS	64.52	.00	25.00	40.91	40.00	26.76
PERCENT COLLECTOR GATHERERS	22.58	11.29	15.96	9.09	.00	14.12
PERCENT PREDATORS	0	58	9	9	6	17.35
PERCENT MACROPHYTE PIERCERS	.00	.00	.00	.00	.00	.00
PERCENT OTHERS	.00	12.90	.00	2.27	.00	2.65
# HYDROPTILIDAE / # TRICHOPTERA	.0000	.0000	.0000	.0000	.0000	.0000
SHANNON WEAVER DIVERSITY INDEX	2.26	3.75	3.52	3.29	1.27	4.49
EQUITABILITY	.81	1.02	.75	.93	.98	.68

SCC4-900718 SINGLE STATION METRICS
MACROINVERTEBRATE DATA

DOMINANT TAXON AND PERCENT CONTRIBUTION

RIFFLE	ROOT BANK	ROCK LOG	CPOM	SAND	TOTAL
Ceratopsyche	Sialis	Elimia	Cheumatopsyche	Elimia	Elimia
51.61	20.97	30.85	25.00	53.33	20.59

SCC4-900718 SINGLE STATION METRICS
MACROINVERTEBRATE DATA

FIVE DOMINANT TAXA IN TOTAL COLUMN AND PERCENT CONTRIBUTION

Elimia
20.59

Cheumatopsyche
10.59

Ceratopsyche
10.00

Stenonema
5.00

Nectopsyche
4.12

SANDY CREEK COMPARISON METRICS
MACROINVERTEBRATE DATA

SCC 003 90 07 18
VERSUS
SCC 004 90 07 18

DOMINANTS IN COMMON	Elimia
	Stenonema
	Cheumatopsyche
NUMBER OF DOMINANTS IN COMMON	3
INDICATOR ASSEMBLAGE INDEX	1.14
SORENSON'S COMMUNITY SIMILARITY INDEX	.66
COMMUNITY LOSS INDEX	.57
JACCARD COEFFICIENT OF COMMUNITY	.49
QUANTITATIVE SIMILARITY INDEX	
TAXA	54.98
QUANTITATIVE SIMILARITY INDEX	
FUNCTIONAL FEEDING GROUP	86.82

TABLE 6
BIOMETRIC INTERPRETATION

METRIC	RANGE	INTERPRETATION
HABITAT ASSESSMENT	104-135	EXCELLENT
	71-103	GOOD
	35-70	FAIR
	0-34	POOR
a). TAXA RICHNESS b). EPT INDEX c). SHANNON-WEAVER SPECIES DIVERSITY d). EQUITABILITY		GENERALLY INCREASES WITH INCREASING WATER QUALITY.
a). BIOTIC INDEX b). % DOMINANT TAXA c). TOLERANCE VALUE OF DOM TAXA		GENERALLY INCREASES WITH DECREASING WATER QUALITY.
a). % SHREDDERS b). % SCRAPERS c). % PREDATORS d). % COLLECTOR-GATHERERS e). % COLLECTOR-FILTERERS f). % MACROPHYTE PIERCERS g). % OTHERS		PERCENTAGES AND COMPOSITION SHOULD BE SIMILAR TO BACKGROUND STATION FOR SIMILAR STREAM SIZES AND HABITAT COMPOSITION.
a). SCRAPERS/SCRAPERS+C-F b). SHREDDERS/TOTAL c). HYDROPTILIDAE/TRICHOPTERA		NO SIGNIFICANT CHANGE AS COMPARED TO BACKGROUND.
a). EPT/EPT+CHIRONOMIDAE		GENERALLY INCREASING WATER QUALITY AS APPROACHES 1.0.
SIMILARITY INDICES		
a). INDICATOR ASSEMBLAGE INDEX (IAI) b). JACCARD COMMUNITY SIMILARITY c). SORENSON'S CSI		INCREASING SIMILARITY AS APPROACHES 1.0.
a). DOMINANTS IN COMMON b). QUANTITATIVE SIMILARITY INDEX (QSI)-TAXA c). QSI-FUNCTIONAL FEEDING GROUP (FFG)		GENERALLY INCREASING WITH INCREASING SIMILARITY.
a). COMMUNITY LOSS INDEX		GENERALLY INCREASING WITH INCREASING DISSIMILARITY.

SANDY CREEK SCC3-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	MACROPHYTE SWEEP	TOTAL
ANNELIDA		4					4
ARTHROPODA							
MALACOSTRACA							
AMPHIPODA							
Talitridae							
Hyalella		1					1
DECAPODA		4				2	6
ISOPODA							
Asellidae							
Asellus		2					2
Lirceus		1					1
INSECTA							
COLEOPTERA							
Dytiscidae							
Hydroporus		1					1
Elmidae							
Ancyronyx		2					2
Dubiraphia		1		1		2	4
Macronychus		5					5
Promoresia	19		1	1			21
Stenelmis	11	1	1	2		1	16
Gyrinidae							
Dineutus	1	1					2
Hydrophilidae							
Helobata		2		1			3
Psephenidae							
Psephenus		1					1
DIPTERA							
Ceratopogonidae							
Atrichopogon				1			1
Bezzia			1				1
CHIRONOMIDAE							
Chironominae							
Chironomini							

SANDY CREEK SCC3-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	MACROPHYTE SWEEP	TOTAL
Cryptochironomus		1			1		2
Microtendipes				1			1
Nilothauma					1		1
Phaenopsectra		3					3
Polypedilum	2	1		13			16
Stictochironomus		1			1		2
Xenochironomus		1					1
Tanytarsini							
Rheotanytarsus		1		5		1	7
Tanytarsus		1		5			6
Tanytarsini UNID		2					2
Orthocladinae							
Orthocladius				1			1
Rheocricotopus			1	5			6
Tanypodinae							
Ablabesmyia		1		1			2
Natarsia		1		1			2
Labrundinia		1					1
Thienemannimyia Grp				1			1
Simulidae							
Simulium		1		3		1	5
Tabanidae							
Tabanus		4					4
Tipulidae							
Tipula	3	5					8
Dixidae							
Dixella		1		1			2
EPHEMEROPTERA							

SANDY CREEK SCC3-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	MACROPHYTE SWEEP	TOTAL
Baetidae							
Baetis	5		2	4		2	13
Ephemeridae							
Hexagenia		3				4	7
Heptageniidae							
Heptagenia	3		1				4
Stenonema	3	7	6	19		8	43
Heptageniidae UNID		4				2	6
Oligoneuridae							
Isonychia	5			1		1	7
Polymitarcyidae							
Ephoron					1		1
Tricorythidae				1			1
Tricorythodes		1		4		2	7
HEMIPTERA							
Mesoveliidae							
Mesovelia		1					1
Veliidae							
Microvelia						1	1
MEGALOPTERA							
Corydalidae							
Corydalus				1			1
Nigronia				2			2
ODONATA							
Aeshnidae							
Boyeria	1	10	4	1		2	18
Calopterygidae							
Calopteryx		18		1			19
Coenagrionidae							
Argia		8					8
Gomphidae							
Gomphus		9			1	2	12

SANDY CREEK SCC3-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	MACROPHYTE SWEEP	TOTAL
Macromiidae							
Macromia		1		1			2
PLECOPTERA							
Perlidae							
Acroneuria			2	9		3	14
Neoperla		4		3		1	8
Paragnetina	1	1		2			4
Perlidae UNID						1	1
TRICHOPTERA							
Brachycentridae							
Brachycentrus		2		4		2	8
Microsema	3						3
Hydropsychidae							
Ceratopsyche	6			1			7
Cheumatopsyche	5		2	10			17
Hydroptilidae							
Hydroptila	1	1		1			3
Leptoceridae							
Nectopsyche		7	1			3	11
Oecetis	2						2
Limnephilidae							
Pycnopsyche		3					3
Polycentropodidae							
Polycentropus		2					2
Psychomyiidae							
Lype		3			1		4
MOLLUSCA							
GASTROPODA							
MESOGASTROPODA							
Pleuroceridae							
Elimia	19		22	11	1	15	68
PELECYPODA							

SANDY CREEK SCC3-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	MACROPHYTE SWEEP	TOTAL
HETERODONTA							
Corbiculidae							
Corbicula					1		1

SANDY CREEK SCC4-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	TOTAL
ANNELIDA		2				2
OLIGOCHAETA		5				5
ARTHROPODA						
INSECTA						
COLEOPTERA						
Dytiscidae						
Hydroporus		4				4
Elmidae						
Ancyronyx			1			1
Dubiraphia				1		1
Macronychus			6			6
Optioservus			1			1
Promoresia			3			3
Stenelmis	1		3	3		7
Gyrinidae						
Gyretes		1				1
Hydrophilidae						
Helobata				1		1
COLEOPTERA UNID				1		1
DIPTERA						
Athericidae						
Atherix			1			1
Ceratopogonidae						
Bezzia					1	1
CHIRONOMIDAE						
Chironominae						
Chironomini						
Phaenopsectra		2				2
Polypedilum			5	3		8
Stelechomyia			1			1
Stenochironomus			11	2		13
Tanytarsini						
Rheotanytarsus	1		3	1		5

SANDY CREEK SCC4-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	TOTAL
Tanytarsus				1		1
Orthocladinae						
Orthocladius	3		2			5
Tanypodinae						
Ablabesmyia		2				2
Thienemannimyia Grp		1				1
Tabanidae						
Tabanus		4				4
Tipulidae						
Tipula		8				8
EPHEMEROPTERA						
Baetidae						
Baetis	4		7			11
Ephemeridae						
Hexagenia		6				6
Heptageniidae						
Heptagenia			3			3
Stenonema			8	9		17
Oligoneuridae						
Isonychia	1			5		6
HEMIPTERA						
Corixidae						
Corixidae UNID dif		1				1
Mesoveliidae						
Mesovelia		1				1
MEGALOPTERA						
Sialidae						
Sialis		13				13
ODONATA						
Aeshnidae						
Boyeria				2		2
Calopterygidae						
Calopteryx		1				1

SANDY CREEK SCC4-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	TOTAL
Coenagrionidae						
Argia		2				2
Coenagrionidae UNID		1	1			2
Gomphidae						
Gomphus		4				4
Macromiidae						
Macromia		2				2
PLECOPTERA						
Perlidae						
Acroneuria			5	1		6
Paragnetina			11	1		12
TRICHOPTERA						
Brachycentridae						
Brachycentrus			1			1
Hydropsychidae						
Ceratopsyche	16		18			34
Cheumatopsyche	2		23	11		36
Potamyia			2			2
Leptoceridae						
Mystacides		1				1
Nectopsyche			14			14
Psychomyiidae						
Lype		1				1
MOLLUSCA						
GASTROPODA						
LIMNOPHILA						
Ancylidae						
Ferrissia				1		1
MESOGASTROPODA						
Pleuroceridae						
Elimia	3		58	1	8	70
PELECYPODA						
HETERODONTA						

SANDY CREEK SCC4-900718
MACROINVERTEBRATE DATA

	RIFFLE	ROOT/ BANK	ROCK LOG	CPOM	SAND	TOTAL
Corbiculidae						
Corbicula					6	6