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TIER 1 SCREENING LEVEL FISH/SEDIMENT SAMPLING RESULTS NCBC GULFPORT MS

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NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

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SOUTHERN DIVISION
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NORTH CHARLESTON, SOUTH CAROLINA
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NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

Unit Identification No.: N62604

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November 1999

FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Installation Restoration (IR) program. This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act as amended by the Superfund Amendments and Reauthorization Act, the Resource Conservation and Recovery Act (RCRA), and the Hazardous and Solid Waste Amendments (HSWA) of 1984. These acts establish the means to assess and clean up hazardous waste sites for both private-sector and Federal facilities.

The program that has been adopted to address present hazardous material management is RCRA and the HSWA (RCRA/HSWA) corrective action program. RCRA ensures that solid and hazardous wastes are managed in an environmentally sound manner. The law applies to facilities generating or handling hazardous waste. The HSWA corrective action program is designed to identify and clean up releases of hazardous substances at RCRA-permitted facilities.

The Southern Division, Naval Facilities Engineering Command manages and the U.S. Environmental Protection Agency and the Mississippi Department of Environmental Quality oversee the Navy environmental program at Naval Construction Battalion Center (NCBC), Gulfport, Mississippi. All aspects of the program are conducted in compliance with State and Federal regulations, as ensured by the participation of these regulatory agencies.

Questions regarding the delisting petition at NCBC Gulfport should be addressed to Mr. Art Conrad, Code 1865, at (843) 820-5520.

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Naval Construction Battalion Center
Gulfport, Mississippi

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GLOSSARY

AO	Agreed Order
BMP	Biological Monitoring Plan
DO	dissolved oxygen
NCBC	Naval Construction Battalion Center
PeCDD	pentachloro-p-dibenzodioxin
ppt	parts per trillion
TCDD	tetrachloro-p-dibenzodioxin
TEF	toxicity equivalency factor
TEQ	toxicity equivalency quotients
USEPA	U.S. Environmental Protection Agency

CHAPTER 1.0

1.0 INTRODUCTION

This report provides the results of the Tier 1 screening level fish and sediment sampling event conducted at the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi, on March 15-19, 1999. As previously discussed in the Biological Monitoring Plan (BMP) (Harding Lawson Associates, Inc., 1998), two screening-level sampling events are to be conducted during pre- and post-spawn periods. The rationale for collecting fish tissue during both pre- and post-spawn periods is that the lipid content of many species, which represents an important reservoir for organic pollutants such as dioxin, is generally highest during pre-spawn periods. The data reported herein represent the results of fish and sediment collected during the pre-spawn sampling period. It is anticipated that the post-spawn sampling effort will be completed in August or September 1999.

1.1 HISTORY. NCBC Gulfport is currently operating under an Agreed Order (AO) (No. 319396) with the Mississippi Department of Environmental Quality. The AO establishes a comprehensive strategy to delineate and, if warranted, remediate dioxin contamination due to prior storage and handling of herbicide orange on the base. The AO requires that NCBC Gulfport conduct a phased BMP to evaluate the risks to humans and ecological species due to potential contact with dioxin. The extent of risks for both humans and the environment is a function of how much of the dioxin contamination from the sediment has been accumulated in the aquatic food chain (i.e., fish and shellfish). Therefore, the BMP requires collection of fish tissue and sediment for dioxin analysis in order to provide a measure of chemical exposures for ecological and human receptors in the risk assessment.

1.2 PURPOSE. The primary objectives of the fish/sediment sampling and analysis biomonitoring program include (1) collection of whole fish tissue, fish fillet tissue, shellfish tissue, and sediment samples from on-site ditches, Turkey Creek, Brickyard Creek, Bernard Bayou, and a reference area; (2) evaluation of the relationship between fish tissue residue levels and sediment concentrations of dioxins and furans; (3) measurement of site-specific exposures to humans and higher trophic level ecological receptors; and (4) use of a tiered monitoring strategy to determine if dioxin levels in fish and shellfish tissue pose a risk to human health and ecological receptors.

Human receptors that may potentially be at risk include subsistence fisherman who consume fish and/or shellfish that are caught from on- and off-site aquatic habitats. Concentrations of dioxins and furans detected in fish fillet and shellfish will be used to support the human health evaluation.

Potential risks for ecological receptors exposed to dioxin in the on- and off-site aquatic habitats include reduced reproductive success in high trophic level fish-eating mammals and birds that use the contaminated aquatic system as foraging habitat and reduced egg development in populations of

forage fish that inhabit the on- and off-site aquatic habitats. Concentrations of dioxins and furans in whole fish tissue will be used to support the ecological evaluation.

The purpose of this letter report is to present the results of the first tier of the screening-level fish and sediment sampling program. The methodology used to collect the biological samples and sediment is described in Chapter 2.0, and the results of the fish tissue sampling and fish tissue/sediment analytical data are presented in Chapter 3.0.

CHAPTER 2.0

2.0 METHODOLOGY

The methodology for collection of fish/shellfish and sediment for the pre-spawn Tier 1 screening study is discussed in the following sections: site selection (Section 2.1), sample collection (Section 2.2), sample processing and packaging (Section 2.3), and target analyte selection (Section 2.4).

2.1 SITE SELECTION. Previous investigations of surface water and sediment collected from the base and off-site locations indicate that dioxin is present in the sediment of the on-site ditches as well as downstream locations in Turkey Creek and Brickyard Creek. The sampling locations were chosen to represent extremes of the bioaccumulation spectrum, ranging from an undisturbed reference site to sites where existing basewide and off-site sediment data suggest substantial dioxin accumulation. Other factors that were considered in the selection of the sampling locations include the following: intensity of subsistence, sport, or commercial fishing; foraging areas for piscivorous mammals or birds; proximity to historical water and/or sediment sampling sites; availability of data on fish and shellfish community structure; bottom condition; type of sampling equipment; site accessibility; and input from State fisheries biologists.

A total of eight sampling locations (BIO-1 through BIO-8), which are depicted on Figure 2-1, were identified based on the factors described above. Two of the sites are located in on-site drainage ditches (BIO-1 and BIO-2), two sites are located in Turkey Creek downstream of the base (BIO-4 and BIO-5), two sites are located in Brickyard Creek downstream of the base (BIO-7 and BIO-8), one site is located in Bernard Bayou (BIO-6), and one site, which is located in the upper reaches of Turkey Creek upstream of the site, was chosen as the reference location (BIO-3).

2.2 SAMPLE COLLECTION. As specified in the BMP, sediment, fish tissue, and shellfish were to be collected at each of the eight sampling locations. Collection of sediment, fish tissue, and shellfish is discussed separately in Subsections 2.2.1, 2.2.2, and 2.2.3, respectively.

2.2.1 Sediment Collection Sediment was collected at each of the eight sampling locations using a petite ponar dredge. At each location, several sediment grabs were collected and placed into a stainless-steel bowl. All debris including sticks, shells, and rocks were removed from the sample. The sediment was then homogenized or mixed together using a stainless-steel spoon prior to being transferred to the sampling container. Each of the sampling containers was labeled with the sample location, time, date, required analysis, and initials of the sampler(s). Field observations including grain size, organic content, and depositional environment were also recorded.

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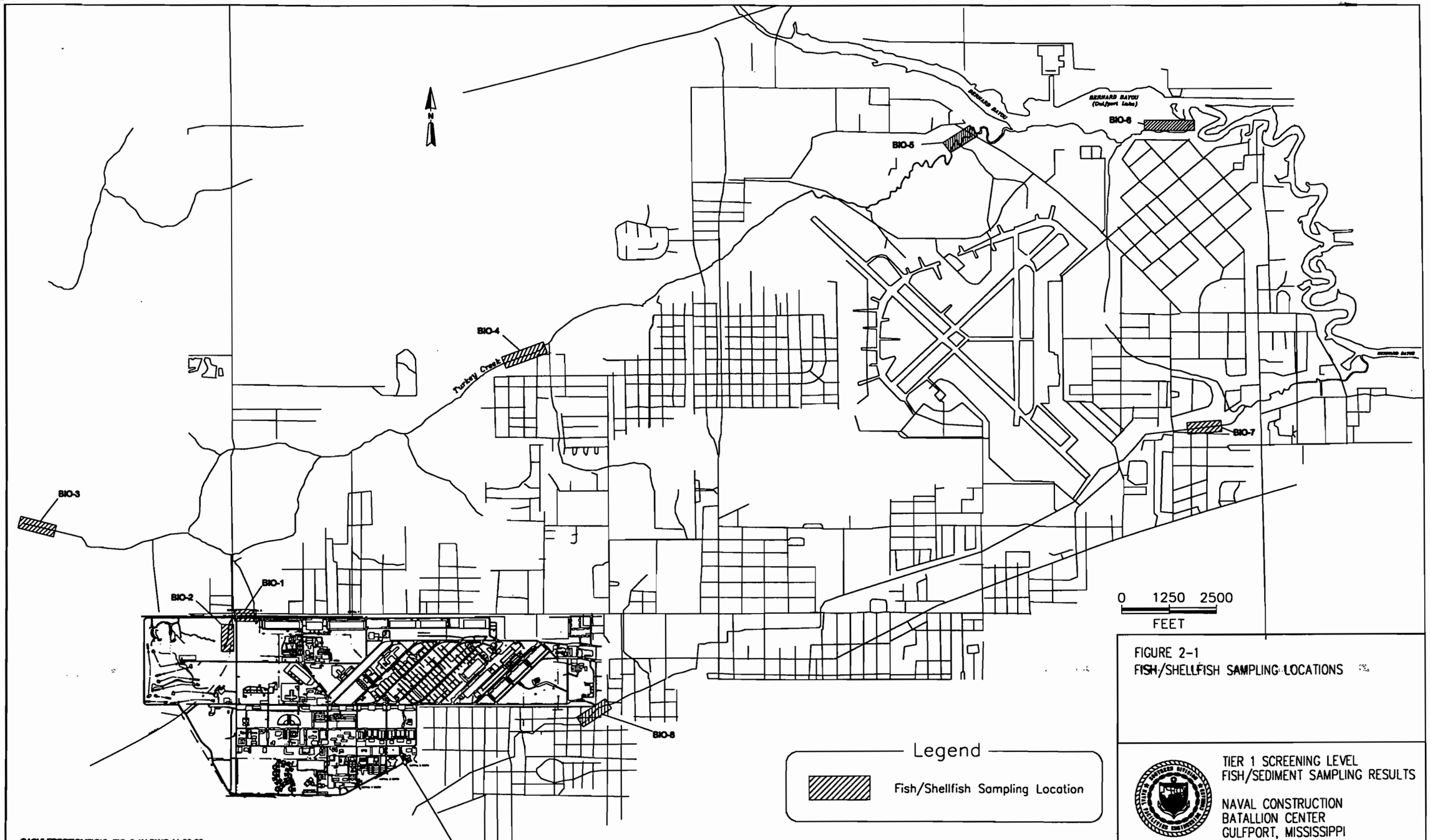

FIGURE 2-1
FISH/SHELLFISH SAMPLING LOCATIONS

TIER 1 SCREENING LEVEL
FISH/SEDIMENT SAMPLING RESULTS

NAVAL CONSTRUCTION
BATALLION CENTER
GULFPORT, MISSISSIPPI

2.2.2 Fish Tissue Collection Fish samples for tissue analysis were collected at each of the eight locations by C^2 Environmental Services Inc. using boat and backpack electrofishers, seines, trot lines, and hoop nets. Trot lines and hoop nets were baited with several different cheese-based baits and chicken and beef livers. Further information on the types of equipment used to collect fish is described in the Ecological Sampling Services report (C^2 Environmental Services Inc., 1999), which is included as Appendix A. During the fish sampling, water-level data and water quality information including pH, temperature, salinity, dissolved oxygen, and conductivity were also measured at each of the eight locations.

As specified in the BMP, fish fillets were collected to evaluate typical human exposures, and whole fish were collected to evaluate typical exposures for ecological receptors. The volume of fish required for each fish sample was approximately 100 grams per fish sample. An attempt was made to collect composite samples (homogeneous mixtures of samples from two or more organisms of the same species collected at a particular site and analyzed as one sample) for each target species from each location per U.S. Environmental Protection Agency (USEPA) guidance (1995). Two duplicate samples were collected to represent the fish fillet and whole fish tissue samples.

Target species were chosen based on the criteria listed in the BMP, input from State fisheries biologists, and the results of the creel survey, which is included as Appendix B. Two different trophic levels of fish were selected to support the human health evaluation and three different trophic levels were selected to support the ecological evaluation. The target species identified for the human health and ecological evaluations are described below in Paragraphs 2.2.2.1 and 2.2.2.2, respectively.

2.2.2.1 Human Health Target Species USEPA guidance (1995) recommends collection of one bottom feeder and one predator fish as target species for inland fresh waters. Target species for the human health evaluation included the bottom-feeding channel catfish (*Ictalurus punctatus*) and the predator largemouth bass (*Micropterus salmoides*). Bluegill (*Lepomis macrochirus*) was identified as a substitute target species for the largemouth bass. Collection was focused on the larger individuals, as the larger (older) individuals within a population are more likely to be consumed by humans and are generally the most contaminated when persistent chlorinated organic chemicals are of concern (Philips, 1980). As previously mentioned, all fish collected as human health target species were filleted prior to chemical analysis.

2.2.2.2 Ecological Target Species Whole body fish samples were collected to measure the extent of contamination to which ecological receptors may be exposed. An attempt was made to collect whole body samples for three different feeding guilds (primary/secondary consumer, omnivorous bottom feeder, and tertiary consumer) at seven of the eight sampling locations (BIO-2 through BIO-8). It was determined that whole body samples would not be collected at sampling location BIO-1, which is located in an on-site drainage ditch. Fish-eating mammals and birds are not likely to forage at this location due to the lack of ecological habitat and proximity to the road. Target species chosen for the ecological evaluation include striped mullet (*Mugil cephalus*)

as the primary/secondary consumer, channel catfish as the bottom feeder, and largemouth bass as the tertiary consumer. Alternate target species for primary/secondary consumer trophic level included gizzard shad (*Dorosoma petenense*) and blacktail shiner (*Cyprinella venusta*); alternate target species for the tertiary consumer included chain pickerel (*Esox niger*). Collection was focused on the smaller to medium-sized individuals, as they are more likely to be consumed by piscivorous mammals and birds.

2.2.3 Shellfish Collection As specified in the BMP, shellfish (i.e., crayfish) were to be collected at each of the eight sampling locations in order to evaluate potential exposures to humans. Although an effort was made to collect crayfish at each of the locations using crayfish traps baited with beef liver, no crayfish were collected using this method. An effort was also made to collect crayfish using dip nets in the swampy area east of Canal Street and south of Turkey Creek. Although crayfish were collected via the dip net method, their body size was too small to provide the necessary 300-gram composite sample required for chemical analysis. Therefore, chemical analysis of shellfish tissue was not completed as part of the pre-spawn Tier 1 sampling effort. The results of the creel survey (Appendix B) indicate that there is no evidence of significant population of these animals present nor was there evidence of human consumption. It is recommended that crayfish be removed as one of the target species for human health.

2.3 SAMPLE PROCESSING AND PACKAGING. Collected target fish were identified to species, measured for total length and weight, sexed (if possible from external examination), and examined carefully for external anomalies including fin erosion, skin ulcers, skeletal anomalies, and neoplasms (i.e., ulcers). Stainless-steel knives were used to fillet the fish. Catfish were filleted by gutting (removing organ tissue) and removing the head and skin. Largemouth bass and bluegill were filleted by removing the head, internal organs, and scales. All tissue extraction equipment (e.g., knives, gloves, etc.) was decontaminated between the processing of each sample. Whole fish and fillet samples were grouped by species and trophic level and composited for each sample location. Each sample was wrapped in aluminum foil and placed in a Ziplock® plastic bag. Both the foiled samples and plastic bags were labeled, and chain-of-custody labels were attached to each bag. Copies of all labels and chain-of-custody forms are included in Appendix A. Whenever possible, composite samples from each site were placed into a single, labeled bag. Samples were preserved on wet ice and shipped within 2 days of processing.

2.4 TARGET ANALYTE SELECTION. Dioxin and furans are included as the target analyte because they have been detected in sediment samples collected at NCBC Gulfport in both on- and off-site sampling locations. The seventeen 2,3,7,8-substituted tetra- through octa-chlorinated dioxin and dibenzofuran congeners are included as target analytes for fish tissue residue and sediment samples. USEPA Method 8290 was used to detected tetra- through octa-chlorinated dioxin and furan congeners with chlorine substitutions at molecular positions 2, 3, 7, and 8. In addition, percent lipid content was measured in whole fish and fish fillet tissue samples.

3.0 RESULTS

The results of the fish tissue sampling, fish tissue analytical data, and sediment analytical data are discussed separately in Sections 3.1, 3.2, and 3.3, respectively.

3.1 FISH TISSUE SAMPLING. As previously discussed, the fish tissue sampling effort was conducted on March 15-19, 1999. The sampling locations, types of equipment used to collect fish, water quality measurements, and types of fish collected are discussed in Subsections 3.1.1 through 3.1.4, respectively.

3.1.1 Sampling Locations A number of the proposed sampling locations including BIO-3, BIO-4, BIO-5, and BIO-7 were relocated due to accessibility problems and physical restrictions including water depth and current. Sites BIO-4, BIO-5, and BIO-7 were moved slightly downstream from their originally planned locations, while BIO-3 (the background location) was moved upstream from its original site. Although these locations were moved, the new sites were selected to be as close to the original locations as possible. The sampling locations are presented in Figure 3-1. Descriptions of each of the sampling locations including water depth, substrate type, presence of vegetation, riparian characteristics, water flow and turbidity, and canopy cover are provided in Appendix A.

3.1.2 Types of Sampling Equipment Boat and backpack electrofishers, seines, trot lines, and hoop nets were used to collect fish, and traps and dip nets were used in an attempt to collect crayfish. As previously mentioned, no crayfish were collected. A summary of the sampling methods used to collect fish tissue at each of the locations is presented in Table 3-1.

Table 3-1
Summary of Sampling Equipment Used to Collect Fish Tissue

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sampling Location	Electrofisher	Trot Line	Hoop Net	Seine
BIO-1	X	X	X	
BIO-2	X	X	X	
BIO-3	X	X	X	
BIO-4		X	X	
BIO-5	X	X	X	X
BIO-6	X	X	X	
BIO-7	X			
BIO-8	X	X	X	

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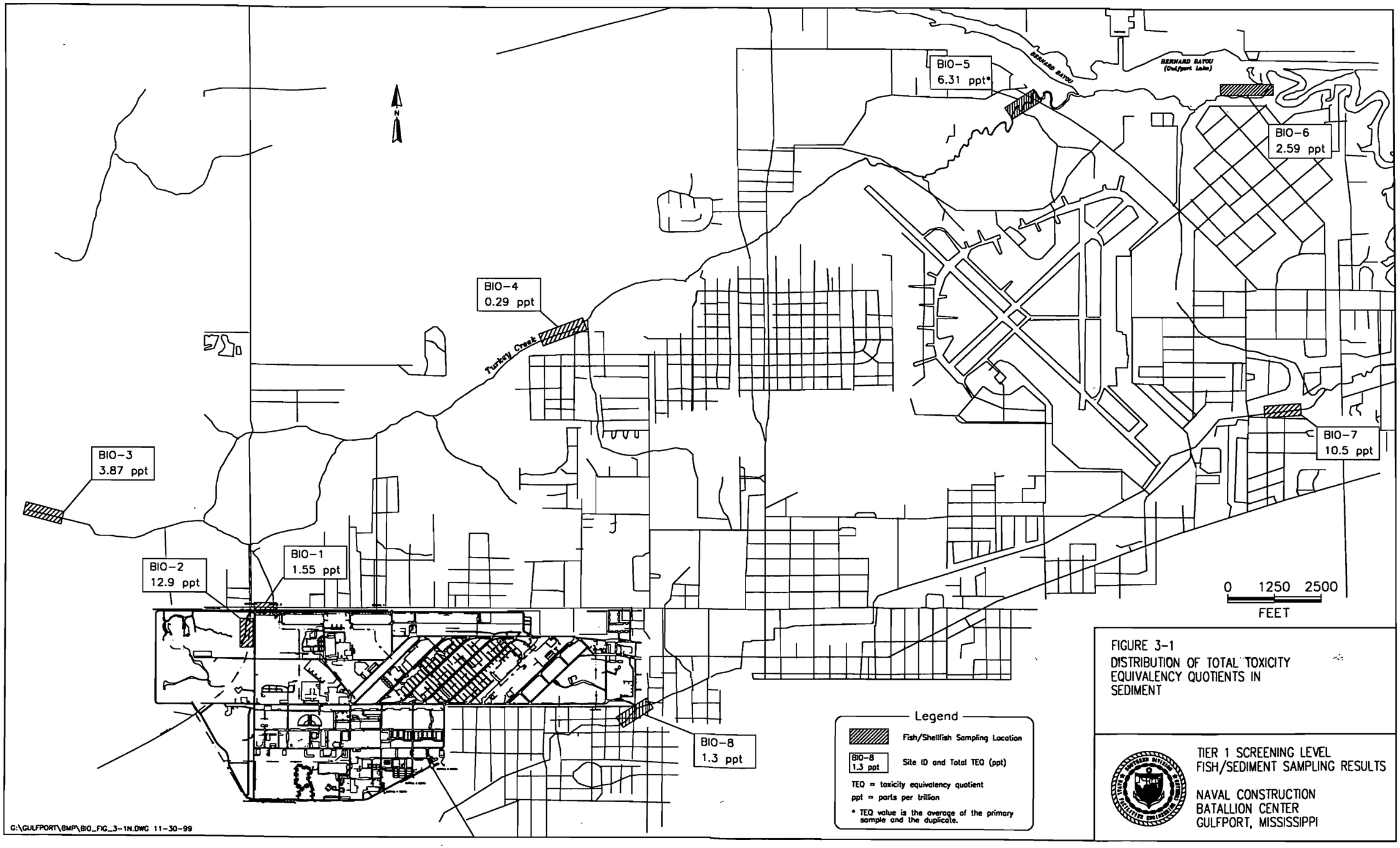

FIGURE 3-1
DISTRIBUTION OF TOTAL TOXICITY EQUIVALENCY QUOTIENTS IN SEDIMENT

TIER 1 SCREENING LEVEL
FISH/SEDIMENT SAMPLING RESULTS

NAVAL CONSTRUCTION
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3.1.3 Water Quality Measurements A summary of the water quality parameters including pH, water temperature, salinity, dissolved oxygen (DO), and conductivity measured at each of the sampling locations during the fish sampling effort is presented in Table 3-2. In general, the *in situ* water quality parameters measured at the sampling locations were within acceptable levels for protection of aquatic biota (USEPA, 1986). Water temperature ranged from 13.6 to 22.2 degrees Celsius, DO from 5.35 to 9.65 milligrams per liter, pH from 4.96 to 7.53, conductivity from 41/6 to 633 microohms per centimeter, and salinity from 0 to 0.3 parts per trillion (ppt). The pH levels were lower at the Turkey Creek locations BIO-3, BIO-4, and BIO-5 because "blackwater" systems such as Turkey Creek have an abundance of naturally occurring tannic acid, resulting in lower pH values. The observed variance in conductivity is common in freshwater systems, where the proportion of different ions is highly dependant on climatic and edaphic factors (Boyd, 1990). In general, elevated conductivity values are associated with increased salinity at sampling locations BIO-6 and BIO-7. Although it had rained prior to the field sampling event, no rain occurred during the sampling period, and water levels appeared to be representative of normal, base flow conditions.

Table 3-2
Summary of *In Situ* Water Quality Measurements

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sampling Location	pH	Water Temperature (degrees Celsius)	Salinity (parts per trillion)	Dissolved Oxygen (milligrams per liter)	Conductivity (uS/cm)
BIO -1	7.53	22.2	0.1	9.65	159.3
BIO-2	6.55	21.5	0.1	8.86	175.4
BIO-3	4.96	14.9	0	5.35	42.3
BIO-4	5.81	16.3	0	7.32	52.1
BIO-5	5.31	13.6	0	6.86	41.6
BIO-6	5.89	14.3	0.2	7.10	465.2
BIO-7	7.32	18.2	0.3	6.33	633.0
BIO-8	7.17	18.4	0.1	7.87	227.3

Note: uS/cm = micro-Siemens per centimeter.

3.1.4 Fish Collection A total of 29 species of fish were collected at the various sampling locations. Sunfish (Family *Centrarchidae*) were the dominant taxa; 9 of the 29 species of fish collected during the sampling effort were sunfish. A complete list of all fish species collected during the sampling effort is presented in Table 3-3.

Although every effort was made to collect all of the target species from each of the sampling locations, not all target species were obtained. Tables 3-4 and 3-5 provide respective summaries of all the fish fillet (for the human

Table 3-3
Fish Collected During the March 1999 Sampling Event

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Family	Common Name	Scientific Name
Amiidae	Bowfin	*Amia calva*
Aphredoderidae	Pirate perch	*Aphredoderus sayanus*
Atherinidae	Brook silverside	*Labidesthes sicculus*
Catostomidae	Lake chubsucker	*Erimyzon sucetta*
Centrarchidae	Bluegill	*Lepomis macrochirus*
	Green sunfish	*Lepomis cyanellus*
	Longear sunfish	*Lepomis megalotis*
	Redbreast sunfish	*Lepomis auritus*
	Redear sunfish	*Lepomis microlophus*
	Spotted sunfish	*Lepomis punctatus*
	Warmouth	*Lepomis gulosus*
	White crappie	*Pomoxis annularis*
	Largemouth bass	*Micropterus salmoides*
Clupeidae	Gizzard shad	*Dorosoma cepedianum*
Cyprinidae	Common carp	*Cyprinus carpio*
	Unidentified shiner	*Notropis* sp.
Engraulidae	Bay anchovy	*Anchoa mitchilli*
Cyprinodontidae	Golden topminnow	*Fundulus chrysotus*
	Gulf killifish	*Fundulus grandis*
Gobiidae	Darter goby	*Gobionellus boleosoma*
Ictaluridae	Brown bullhead	*Ameiurus nebulosus*
	Yellow bullhead	*Ameiurus natalis*
	Black bullhead	*Ameiurus melas*
	Channel catfish	*Ictalurus punctatus*
Lepisostidae	Spotted gar	*Lepisosteus oculatus*
Mugilidae	Striped mullet	*Mugil cephalus*
Poeciliidae	Mosquitofish	*Gambusia* sp.
	Sailfin molly	*Poecilia latipinna*
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*

Table 3-4
Summary of Fish Fillet Tissue Submitted for Analysis

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sample Location	Sample Identification	Species	Trophic Level[1]	Length (mm)[2]	Weight (g)[3]	Presence of Eggs[4]	Anomalies
BIO-1	BIO-1-FF-CF	Yellow bullhead	BF	238	204	None	None
		Yellow bullhead	BF	300	460	Yes	None
	BIO-1-FF-RE	Redear sunfish	PF	154	74	Yes	None
		Redear sunfish	PF	150	65	Yes	None
		Redear sunfish	PF	150	68	Yes	None
		Redear sunfish	PF	140	50	None	None
		Redear sunfish	PF	135	48	Yes	None
		Redear sunfish	PF	130	44	None	None
BIO-2	BIO-2-FF-CF	Brown bullhead	BF	425	1330	None	None
		Brown bullhead	BF	425	1190	None	Mouth damaged by trot line
		Brown bullhead	BF	430	1250	None	None
	BIO-2-FF-LB	Largemouth bass	PF	430	1440	Yes	None
		Largemouth bass	PF	260	246	None	None
BIO-3	BIO-3-FF-BG	Bluegill	PF	147	53	None	None
		Bluegill	PF	152	62	None	None
		Bluegill	PF	131	43	None	None
		Bluegill	PF	125	36	None	None
BIO-4	BIO-4-FF-CF	Channel catfish	BF	435	1100	Yes	None
	BIO-4-FF-BG	Bluegill	PF	162	80	None	None
		Bluegill	PF	168	92	None	None
BIO-5	BIO-5-FF-CF	Yellow bullhead	BF	260	278	None	None
	BIO-5-FF-LB	Largemouth bass	PF	355	755	Yes	Slight deformity of caudal fin
BIO-6	BIO-6-FF-CF	Channel catfish	BF	450	1250	Yes	None
	BIO-6-FF-CFR (Replicate)	Channel catfish	BF	550	2500	Yes	None
	BIO-6-FF-LB	Largemouth bass	PF	300	450	None	None
		Largemouth bass	PF	345	660	Yes	None
BIO-7	BIO-7-FF-LB	Largemouth bass	PF	262	255	None	None
		Largemouth bass	PF	253	210	None	None
BIO-8	BIO-8-FF-CF	Black bullhead	BF	275	330	None	Deformed dorsal spine
		Black bullhead	BF	220	158	None	None
	BIO-8-FF-LB	Largemouth bass	PF	288	345	None	None
		Largemouth bass	PF	265	270	Yes	None

[1] Indicates the trophic level; BF = bottom feeder and PF = predator fish.
[2] The reported fish length represents the distance from the snout to the caudal fin and was measured prior to filleting.
[3] The reported fish weight was measured prior to filleting.
[4] Indicates that the fish was a female with eggs.

Notes: mm = millimeters.
g = grams.
FF = fish fillet.
CF = catfish.
RE = redear sunfish.
LB = largemouth bass.
BG = bluegill.
CFR = catfish replicate.

Table 3-5
Summary of Whole Fish Tissue Submitted for Analysis

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sample Location	Sample Identification	Species	Trophic Level[1]	Length (mm)[2]	Weight (g)	Anomalies
BIO-2	BIO-2-WF-GS	Gizzard shad	P/S Cons.	110	13	None
		Gizzard shad	P/S Cons.	150	34	None
		Gizzard shad	P/S Cons.	160	41	None
		Gizzard shad	P/S Cons.	170	57	None
	BIO-2-WF-CF	Brown bullhead	BF	373	775	None
	BIO-2-WF-LB	Largemouth bass	Tert. Cons.	233	156	None
BIO-3	BIO-3-WF-CS	Lake chubsucker	P/S Cons.	155	56	Eroded caudal fin
		Lake chubsucker	P/S Cons.	162	63	None
	BIO-3-WF-BG	Bluegill	Tert. Cons.	88	14	None
		Bluegill	Tert. Cons.	80	9	None
		Bluegill	Tert. Cons.	90	12	None
		Bluegill	Tert. Cons.	88	11	None
		Bluegill	Tert. Cons.	68	6	None
		Bluegill	Tert. Cons.	80	8	None
		Bluegill	Tert. Cons.	70	6	None
		Bluegill	Tert. Cons.	70	6	None
		Bluegill	Tert. Cons.	73	6	None
		Bluegill	Tert. Cons.	80	8	None
		Bluegill	Tert. Cons.	72	6	None
		Bluegill	Tert. Cons.	66	5	None
BIO-4	BIO-4-WF-CF	Channel catfish	BF	300	440	Abrasion near dorsal fin
	BIO-4-WF-BG	Bluegill	Tert. Cons.	135	52	None
BIO-5	BIO-5-WF-SS	Brook silverside	P/S Cons.	7 @ 80	7 @ 19	None
		Shiner	P/S Cons.	9 @ 60	9 @ 21	None
	BIO-5-WF-LB	Largemouth bass	Tert. Cons.	265	242	None
BIO-6	BIO-6-WF-SM	Striped mullet	P/S Cons.	172	60	None
		Striped mullet	P/S Cons.	180	64	None
		Striped mullet	P/S Cons.	175	62	None
		Striped mullet	P/S Cons.	163	52	None
	BIO-6-WF-CF	Channel catfish	BF	280	210	None
		Channel catfish	BF	395	700	None
	BIO-6-WF-LB	Largemouth bass	Tert. Cons.	258	252	None
		Largemouth bass	Tert. Cons.	230	152	None
	BIO-6-WF-LBR (replicate)	Largemouth bass	Tert. Cons.	310	490	Contusion from electrode
BIO-7	BIO-7-WF-SM	Striped mullet	P/S Cons.	178	50	None
		Striped mullet	P/S Cons.	163	48	None
	BIO-7-WF-LB	Largemouth bass	Tert. Cons.	188	80	None
		Largemouth bass	Tert. Cons.	225	162	None
BIO-8	BIO-8-WF-CF	Black bullhead	BF	175	95	None
		Black bullhead	BF	198	112	None
	BIO-8-WF-LB	Largemouth bass	Tert. Cons.	260	254	None
		Largemouth bass	Tert. Cons.	230	170	None

[1] Indicates the trophic level; P/S Cons. = primary/secondary consumer, BF = bottom feeder, and tert. cons. = tertiary consumer.
[2] The fish length represents the distance between the snout and the caudal fin.

Notes:
mm = millimeters.
g = grams.
WF = whole fish.
GS = gizzard shad.
CF = catfish.
LB = largemouth bass.
CS = lake chubsucker.
BG = bluegill.
SS = brook silverside and shiner.
SM = striped mullet.

health evaluation) and whole fish (for the ecological evaluation) tissue samples that were collected at each of the sampling locations. The types of fish collected for the human health and ecological evaluations are described below in Paragraphs 3.1.4.1 and 3.1.4.2, respectively.

3.1.4.1 Fish Collected for Human Health Evaluation With the exception of sampling locations BIO-3 and BIO-7 where no bottom feeder fish species were found, both trophic levels of fish were collected at the other eight sampling locations. A total of 11 bottom feeders including channel catfish, yellow bullhead, brown bullhead, and black bullhead were collected and filleted; eggs were observed in 4 of the 11 fish during processing. A total of 21 predator fish including largemouth bass, bluegill, and redear sunfish were collected and filleted; 8 of the 21 predator fish were identified as females with eggs. Deformities not associated with the injuries due to the sampling equipment were observed in two fish; one largemouth bass collected from location BIO-5 had a slight deformity of the caudal fin, and one black bullhead collected from location BIO-8 had a deformed dorsal spine.

3.1.4.2 Fish Collected for Ecological Evaluation As previously mentioned, whole fish were collected from seven locations (BIO-2 through BIO-8) to support the ecological evaluation. A total of 28 fish representing the primary/secondary consumer trophic level including gizzard shad, lake chubsucker, brook silverside, shiner, and striped mullet were collected from five of the seven locations (none were found at locations BIO-4 and BIO-8). In order to meet the minimum 100 gram volume requirement, it was necessary to combine two different species (seven brook silverside and nine shiners) collected from location BIO-5 into one composite sample. Six bottom feeders including brown bullhead, channel catfish, and black bullhead were collected from four of the seven locations (none were found at locations BIO-3, BIO-5, and BIO-7). A total of 22 fish representing the tertiary consumer trophic level including largemouth bass and bluegill were collected from all seven of the sampling locations. Deformities not associated with injuries due to the sampling equipment were noted in two fish; one lake chubsucker collected from location BIO-3 had an eroded caudal fin and one channel catfish collected from BIO-4 had an abrasion near the dorsal fin.

3.2 FISH TISSUE ANALYTICAL DATA. The analytical data for fish fillet tissue (to support the human health evaluation) and whole fish tissue are discussed separately in Subsections 3.2.1 and 3.2.2, respectively. Although fish tissue was analyzed for the group of 17 closely related 2,3,7,8-chlorosubstituted dioxins and furans, the discussion and summary tables in Subsections 3.2.1 and 3.2.2 focus on detected concentrations of 2,3,7,8-tetrachloro-p-dibenzodioxin (TCDD) and 1,2,3,7,8-pentachloro-p-dibenzodioxin (PeCDD). These two congeners represent the largest component of herbicide orange. In addition, the total toxicity equivalency quotients (TEQs) are presented for each sample. TEQs are calculated using USEPA-derived toxicity equivalency factors (TEFs) assigned to each of the 2,3,7,8-chlorosubstituted dioxins and furans (USEPA, 1989). Applying the TEF to the analytical results of the various dioxin and furan congeners provides an expression of an equivalent amount of 2,3,7,8-TCDD, which is the most toxic of all the different congeners. The TEQ is determined for each sample in which a group of dioxin congeners is

detected by multiplying each congener concentration by its TEF. The sum of all these calculations is the TEQ for that sample (USEPA, 1989). Percent lipid for each fish sample is also discussed. The analytical data for all 17 congeners is included as Appendix C.

3.2.1 Fish Fillet Analytical Data A summary of the total TEQs, percent lipid data, and concentrations of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD detected in fish fillet tissue are presented in Table 3-6. The most toxic of the 17 congeners, 2,3,7,8-TCDD, was detected in only one of the fish fillet samples. 2,3,7,8-TCDD was detected at a concentration of 2.59 ppt in redear sunfish fillets collected from sampling location BIO-1 in an on-site drainage ditch south of 28th Street. The total TEQ for sample BIO-1-FF-RE was also 2.59 ppt, indicating that only 2,3,7,8-TCDD was detected in this sample. With the exception of sample BIO-1-FF-RE and BIO-4-FF-CF4, where the TEQ was 0.07 ppt, none of the 17 dioxin and furan congeners were detected in any of the other fish fillet tissue.

Table 3-6
Analytical Data for Fish Fillet Tissue

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sample Identification	2,3,7,8-TCDD (ppt)	1,2,3,7,8-PeCDD (ppt)	Total TEQ (ppt)	Percent Lipid (%)
BIO-1-FF-CF	0.6 U	0.74 U	0	0.76
BIO-1-FF-RE	2.59	0.72 U	2.59	0.84
BIO-2-FF-CF	0.9 U	0.53 U	0	0.49
BIO-2-FF-LB	0.86 U	0.59 U	0	0.53
BIO-3-FF-BG	0.37 U	0.79 U	0	0.70
BIO-4-FF-CF	0.38 U	0.57 U	0.07	3.31
BIO-4-FF-BG	0.81 U	0.86 U	0	1.54
BIO-5-FF-CF	0.67 U	0.52 U	0	0.80
BIO-5-FF-LB	0.78 U	0.85 U	0	0.50
BIO-6-FF-CF	0.3 U	0.76 U	0	8.81
BIO-6-FF-CFR	0.84 U	0.51 U	0	5.98
BIO-6-FF-LB	0.97 U	0.99 U	0	0.57
BIO-7-FF-LB	0.57 U	0.89 U	0	0.89
BIO-8-FF-CF	0.45 U	0.84 U	0	1.04
BIO-8-FF-LB	11.3 U	6.54 U	0	0.98

Notes:
TCDD = tetrachloro-p-dibenzodioxin.
ppt = parts per trillion.
PeCDD = pentachloro-p-dibenzodioxin.
TEQ = toxicity equivalent quotient.
% = percent.
FF = fish fillet.
CF = catfish.
U = undetected.
RE = redear sunfish.
LB = largemouth bass.
BG = bluegill.
CFR = catfish replicate.

Percent lipid values ranged from 0.53 to 8.81 percent. In general, catfish fillets collected from Bernard Bayou (sampling location BIO-6) contained the highest percentage of lipids.

3.2.2 Whole Fish Analytical Data A summary of the total TEQs, percent lipid data, and concentrations of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD detected in whole fish tissue are presented in Table 3-7. The TCDD and/or PeCDD

congeners were detected in catfish collected from locations BIO-4, BIO-6, and BIO-8 and largemouth bass collected from locations BIO-2, BIO-5, and BIO-8. TEQ values greater than 1 ppt were reported for catfish collected from BIO-6 (TEQ = 2.14 ppt) and BIO-8 (TEQ = 2.30 ppt) and largemouth bass collected from BIO-2 (TEQ = 3.12 ppt) and BIO-8 (TEQ = 2.1 ppt). The variability in TEQ values observed between sample BIO-6-WF-LB (2 fish/sample) and its duplicate BIO-6-WF-LBR (1 fish/sample) may be due to differences in the number of fish included in each sample.

Table 3-7
Analytical Data for Whole Fish Tissue

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sample Identification	2,3,7,8-TCDD (ppt)	1,2,3,7,8-PeCDD (ppt)	Total TEQ (ppt)	Percent Lipid (%)
BIO-2-WF-GS	0.24 U	0.45 U	0.18	7.72
BIO-2-WF-CF	0.78 U	0.89 U	0	1.29
BIO-2-WF-LB	3.08	1.44 U	3.12	1.80
BIO-3-WF-CS	0.72 U	0.8 U	0.01	1.78
BIO-3-WF-BG	0.72 U	0.8 U	0.02	2.92
BIO-4-WF-CF	2.15 EMP	0.85 U	0.06	0.95
BIO-4-WF-BG	0.38 U	1 U	0.01	4.52
BIO-5-WF-SS	1.17 U	2.42 U	0.07	3.00
BIO-5-WF-LB	1.94 EMP	2.11 EMP	0.36	1.47
BIO-6-WF-SM	0.73 U	0.75 U	0.11	7.15
BIO-6-WF-CF	0.18 U	3.2 EMP	2.14	9.65
BIO-6-WF-LB	0.19 U	0.71 U	0	1.6
BIO-6-WF-LBR	0.97 U	0.76 U	0.30	2.28
BIO-7-WF-SM	0.12 U	1.08 U	0.21	4.51
BIO-7-WF-LB	0.9 U	0.7 U	0.37	1.36
BIO-8-WF-CF	0.88 U	4.48	2.30	4.18
BIO-8-WF-LB	2.1	2.67 EMP	2.1	3.32

Notes:
TCDD = tetrachloro-p-dibenzodioxin.
ppt = parts per trillion.
PeCDD = pentachloro-p-dibenzodioxin.
TEQ = toxicity equivalent quotient.
% = percent.
WF = whole fish.
GS = gizzard shad.
U = undetected.
CF = catfish.
LB = largemouth bass.
CS = lake chubsucker.
BG = bluegill.
SS = brook silverside and shiner.
SM = striped mullet.
LBR = largemouth bass replicate.
EMP = estimated maximum possible concentration.

Percent lipid values measured in whole fish were generally much higher than those reported for the fish fillet tissues. The lipid content of whole fish is expected to be higher because the entire fish including the gonads contains a higher percentage of fat, especially during the pre-spawn period. Lipid values ranged from 0.95 to 9.65 percent in whole fish tissues. Catfish and striped mullet collected from Bernard Bayou (sampling location BIO-6) contained the highest percentage of lipids.

3.3 SEDIMENT ANALYTICAL DATA. A summary of the total TEQs and concentrations of 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD detected in sediment are presented in Table 3-8. As previously discussed, the TCDD and PeCDD congeners are presented because they are most representative of the contaminants present in herbicide orange. In addition, field observations are also summarized in Table 3-8. Figure 3-1 depicts the spatial distribution of TEQ values at each of the eight sampling locations. TEQ values ranged from 0.29 ppt at location BIO-SD-4 to 12.9 ppt at location BIO-2, which is located on site in Canal No. 1. The TEQ value and organic content of the sediment at location BIO-SD-2 in the on-site canal were highest relative to the other sampling locations. In general, it appears that higher TEQ values may be associated with the organic content of the sediment. Sediment samples with high organic content, including locations BIO-SD-2, BIO-SD-5, and BIO-SD-7 had TEQ values ranging from 6.31 to 12.9 ppt.

Table 3-8
Analytical Data for Sediment

Tier I Screening Level Fish/Sediment Sampling Results
Naval Construction Battalion Center
Gulfport, Mississippi

Sample Location	2,3,7,8-TCDD (ppt)	1,2,3,7,8-PeCDD (ppt)	Total TEQ (ppt)	Field Observations
BIO-SD-1	1.49 EMP	0.74 U	1.55	Tan-brown fine to medium grained sand with brown-black organic material (very fine grained); medium to low organic content; location is onsite upstream of sediment recovery trap.
BIO-SD-2	0.63 U	0.92 U	12.9	Fine brown-black silt; very high organic content; location is onsite in canal.
BIO-SD-3	0.54 U	0.87 U	3.87	Brown-orange clay with silt and fine sand; very low organic content; reference location is offsite in Turkey Creek.
BIO-SD-4	0.4 U	0.28 U	0.29	Tan fine to medium grained sand; very low organic content; location is offsite in Turkey Creek.
BIO-SD-5	0.87 U	0.57 U	6.71	Approximately 1.5 inches of black fine grained organic material on top of tan fine to medium grained sand; high organic content; location is offsite in meandering section of Turkey Creek.
BIO-SD-5D	0.51 U	0.62 U	5.90	See description for BIO-SD-5.
BIO-SD-6	0.32 U	0.22 U	2.59	Tan fine to medium grained sand with brown-black organic material; medium organic content; location is offsite in Bernard Bayou.
BIO-SD-7	0.48 U	1.04 EMP	10.5	Tan-brown fine grained sand with silt and some clay, some black organic sediment (silt); medium organic content; location is offsite in Brickyard Creek south of the airport.
BIO-SD-8	0.57 U	0.65 U	1.31	Brown-black fine grained sand with silt and debris; medium to high organic content; location is offsite in Brickyard Creek downstream of a culvert.

Notes: TCDD = tetrachloro-p-dibenzodioxin
ppt = parts per trillion.
PeCDD = pentachloro-p-dibenzodioxin
SD = sediment sample.
TEQ = toxicity equivalent quotient.
U = undetected.
EMP = estimated maximum possible concentration.

4.0 SUMMARY

During the pre-spawn round of fish sampling conducted at and around NCBC Gulfport, a total of 15 fillet samples and 17 whole fish samples were analyzed. The highest concentration in a fillet sample, a sunfish, was 2.59 ppt TEQ (with 2.59 ppt TCDD). The highest concentration in a whole fish sample, a largemouth bass, was 3.12 ppt TEQ (with 3.08 ppt TCDD). Both fish samples were caught on base but near the boundary of the base.

Screening levels for the presence of dioxin in fish tissue as enforced by the Mississippi Office of Pollution Control are as follows (1) if concentrations of fish tissue samples exceed 5 ppt, consumption is limited, (2) if concentration of fish tissue samples exceed 25 ppt, consumption is not allowed.

Although the screening level for the presence of dioxin in fish tissue was not exceeded, it is recommended that the post-spawn sampling be conducted. It is anticipated that upon further review of the data, one to two sampling locations may be omitted.

Crawfish are not abundant and no evidence exists that the local community catches and eats local crawfish. Therefore, it is recommended that no further attempts to collect crawfish be conducted.

REFERENCES

REFERENCES

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APPENDIX A

APPENDIX A

ECOLOGICAL SAMPLING SERVICES REPORT

ECOLOGICAL SAMPLING SERVICES
NCBC GULFPORT, GULFPORT, MISSISSIPPI
FINAL REPORT

FOR

HARDING LAWSON ASSOCIATES ES, INC.

JUNE, 1999

PREPARED BY:

C^2 ENVIRONMENTAL SERVICES, INC.

CHAMBLEE, GA

INTRODUCTION

C^2 Environmental Services, Inc. was contracted by Harding Lawson Associates ES, Inc. (HLA-ES) to collect various fish and shellfish species for laboratory analyses for dioxins in their tissue. This information is to be used to identify whether these contaminant levels are within acceptable risk levels for human health consumption and are not of ecological concern (human and ecological risk assessments).

METHODOLOGY - WORK PLAN/TECHNICAL APPROACH

The following work plan outlines the original proposed technical scope-of-work and sampling locations for this field effort. The investigation at NCBC Gulfport was scheduled to occur at a total of eight sampling locations: two locations in the on-site drainage ditches (BIO-1 and BIO-2); two locations in Turkey Creek (BIO-4 and BIO-5); two location in Brickyard Creek (BIO-7 and BIO-8); one location in Bernard Bayou (BIO-6); and, one location in an undisturbed reference site (BIO-3).

Sampling in freshwater was scheduled to occur via electrofishing (boat and/or backpack) and/or alternative methods (dependent on electrofishing success), including trot lines, hoop nets, gill nets, seine, or rod and reel. Boat electrofishing was to be conducted in deep water locations from a 14-ft john boat using a Smith-Root 5.0 GPP electrofishing unit, rated for conductivities ranging from 10 to 6,750 µmhos/cm, and was to be conducted by maneuvering the boat along the bank, vegetation, submerged stumps and logs, and other potential sources of cover. Backpack electrofishing (in wadable, shallow sampling locations) was to be conducted using a Smith-Root Model 15-C POW Backpack Electrofisher. During all electrofishing efforts, proper protective gear (e.g., gloves, waders, etc.) was to be worn. Polarized sunglasses were to be worn as weather conditions dictate to reduce glare and improve sampling efficiency. Stunned fish were to be dipnetted and placed in an aerated live well for processing. All types of shoreline habitat were to be sampled. Electrofishing equipment is preferred for collecting predator species, such as largemouth bass and bluegill.

Trot lines and/or hoop nets are the preferred methods for collecting the bottom feeder, i.e., channel catfish. These methods were to be deployed and baited, usually in the evening, and checked the next morning. For brackish water sampling, i.e., Bernard Bayou, alternate collection methods were to include gill netting, seining, cast netting, and rod and reel, if necessary. These methods also were to be used at the freshwater sites, if the preferred methods did not achieve the desired results. If gill netting was utilized, experimental gill nets (different mesh sized panels) were scheduled to be used. Dependent on site conditions and capture success, gill nets were to be set perpendicular to the shore for varying lengths of time (No more than 12-hour, overnight sets are anticipated.).

Crawfish were to be collected using crawfish traps or nets. These were to be baited with locally-available baits.

Water level data and *in situ* water quality measurements (water temperature, pH, dissolved oxygen, salinity, and conductivity) were to be taken at each study location during sampling/ electrofishing. A daily logbook was to be maintained which summarized all field activities, including date and time of each sample collection, instrument calibrations, site conditions, and any pertinent observations or problems encountered during sampling.

Several species of fish and shellfish were to be targeted for collection for human health and ecological risk. For human health, channel catfish (omnivorous bottom feeder), largemouth bass (tertiary consumer of recreational importance), and crawfish (bottom-dwelling, bottom feeding shellfish) were to be targeted. Bluegill was to be substituted for largemouth bass, if this species was not present. For ecological risk assessment, striped mullet (primary/ secondary consumer feeding on planktonic macroinvertebrates and algae), channel catfish, and largemouth bass were to be targeted for collection. Possible alternate species included gizzard shad or blacktail shiner (for striped mullet) and chain pickerel (for largemouth bass).

Collected target individuals were to be identified to species, measured for total length, sexed (if possible from external examination), and examined carefully for external anomalies, including fin erosion, skin ulcers, skeletal anomalies, and neoplasms (i.e., ulcers). Next, target species were to be composited for tissue analysis. Composites are mixtures of two or more individuals of the same species and should include approximately similar sized specimens (smallest no less than 75% of largest) collected at the same time. Samples were to provide a minimum of 100 grams of fish or 300 grams of shellfish (i.e., crawfish) tissue for analysis. Emphasis for samples was to be on larger specimens. Single replicates were to be collected at a minimum of 10 percent of the sampling locations. Whole fish were to be utilized for ecological risk assessment, and fish were to be filleted for human risk assessment.

Protective gloves were to be worn when handling samples; gloves were to be rinsed or changed after processing each sample. Individuals selected for tissue analysis were to be washed in ambient water to remove any foreign material from surface. Targeted species were to be grouped by species and separated to prevent contamination.

All whole fish and shellfish samples were to be individually wrapped in extra heavy duty aluminum foil, labeled, and placed inside plastic zip-lock bags and sealed. Chain-of-Custody labels were to be attached to each bag. If possible, all composite samples were to be kept together in a single large waterproof bag in the same shipping container. Once packaged, all samples were to be cooled with wet or blue ice (with adequate layers of ice between samples) and shipped as soon as possible.

Fish filleting was to be completed in the field. Target fish were to be filleted, and fillets retained for laboratory analysis. Channel catfish were to be processed by gutting the individual and removing its head and skin. Largemouth bass and bluegill were to be processed by removing the head, internal organs, and scales. Processing was to occur as soon as possible after collection and was to be performed on precleaned glass surfaces. The cutting surface was to be cleaned properly between processing. Dissections were to be made

using teflon-coated stainless steel microtome blades.

A report describing field procedures and summarizing fishery data collected in the field were to be produced. HLA-ES was to be provided with four hard copies of the report and an electronic copy on disk. A copy of all field logs also were to be provided.

RESULTS

The sampling effort was conducted on March 15 - 19, 1999. After reviewing the proposed sampling sites (in the field) and methodologies, some changes were effected. First, due to access and other physical restriction (e.g., water depths and currents), some of the sampling locations were moved slightly, including BIO-3, BIO-4, BIO-5, and BIO-7. Sites BIO-4, BIO-5, and BIO-7 were moved downstream somewhat from their originally planned locations, while BIO-3 was moved upstream from its original site. The revised sampling locations/sites are presented on Figure 1. Descriptions of each site are presented in Appendix A. The new sites were selected to be as close as possible to the original locations and allow for similar data/information collection.

Most of the originally planned sampling methods were employed. Boat and backpack electrofishers, seines, trot lines, and hoop nets were used to collect fish, and traps and dip nets/seines were utilized in an attempt to collect crawfish. No gill nets or rod and reels were used for sampling. A summary of sampling methods is presented in Table 1. Trot lines and hoop nets were baited with several different cheese-base baits and chicken and beef livers. Cut fish and fresh shrimp also were used to bait the trot lines. Beef liver was used as bait in the crawfish traps.

Despite extensive sampling efforts, all target species were not collected/present at each site. Additionally, collection of the planned size groupings were not always possible. For human health samples, the largest fish were retained for filleting. For ecological health samples, smaller fish (e.g., capable of being ingested by piscivorous wildlife) were retained as samples. Wherever possible, a minimum of 100 grams of sample was obtained. Some samples, however, had less than this amount. Information on each fish tissue sample submitted to the laboratory for analysis is located in Appendix C.

In general, sample handling, preparation, labeling, and shipping was conducted in accordance with the original work plan. Stainless steel fillet knives were used to fillet the fish. The fish were filleted on a cutting board wrapped in aluminum foil. Tissue extraction equipment (e.g., knives, gloves, etc.) were decontaminated between each sample. Except for catfish, human health fish samples were scaled and filleted with skin on. Catfish were skinned and filleted. Whole fish and fillet samples were grouped by species and trophic level, wrapped in aluminum foil, and placed in a zip-lock plastic bag. The foiled samples and the plastic bags were labeled, and chain-of-custody labels were attached to each bag. Whenever possible (size permitting), composite samples from each site were placed into a single, labeled bag.

Samples were preserved on wet ice and shipped within two days of processing.

A summary of the water quality parameters measured at each site during sampling is presented in Table 2. In general, the *in situ* water quality parameters measured at the survey sites were within acceptable levels for protection of aquatic biota (USEPA, 1986). Water temperature ranged from 13.6 to 22.2°C, DO from 5.35 to 9.65 mg/l, pH from 4.96 to 7.53, specific conductance from 41.6 to 633.0 µS/cm, and salinity from 0.0 to 0.3 ppt. The pH levels were lower at the Turkey Creek sites (BIO-3, -4, and -5), but these levels were within the pH range commonly found in "blackwater" systems such as Turkey Creek (due to abundance of naturally-occuring tannic acid in these waters). Specific conductance levels varied greatly, which is common in freshwater systems, where the proportion of different ions (conductivity) is highly dependent on climatic and edaphic factors (Boyd, 1990). The highest specific conductance levels were measured at BIO-6 and -7, which probably was due to the tidal influence (i.e., highly-conductive saline water) at these sites. BIO-7 also was downstream of considerable residential and commercial development within the City of Gulfport, and Brickyard Creek may have received concentrated levels of dissolved solids and ions from non-point source runoff. Although it had rained prior to initiating field efforts, no rain occurred during the sampling, and water levels appeared to be at normal, base flow conditions.

Field notes were recorded daily in field logs. A copy of these notes is found in Appendix B.

Fish Collected

A complete list of all fish species collected during the sampling effort is presented in Table 3. A total of 29 species of fish were collected at the various study sites. Sunfish (Family Centrarchidae) were the dominant taxa; 9 of the 29 species of fish collected during the sampling effort were centrarchids.

Not all the targeted species were collected at each site. Crayfish traps were set at each study site, and dip netting was conducted in the swampy area south of Turkey Creek just upstream of BIO-4. Although some crayfish were collected, insufficient numbers and small body size (i.e., less than 300 grams composite samples) prevented submittal of any crayfish tissue for laboratory analyses from any of the sites. A summary of fish tissue samples submitted for analysis is presented in Table 4. The following is a summary of the fish sample data collected at each site, and the Field Record Forms (as well as Chain-of-Custody and tissue labels) are located in Appendix C:

BIO-1

As per the work plan, only fish fillets (i.e., no whole fish samples) were obtained at BIO-1 for human health assessment. The bottom feeder trophic level representative from this site was yellow bullhead. The laboratory sample was comprised of two individuals. Length and weight of each fish was 238 millimeters (mm)/204 grams (g) and 300 mm/460 g, respectively. The larger yellow bullhead was a female with eggs.

The tertiary consumer of recreational importance trophic level representative from this site was redear sunfish. A total of 6 fish were filleted. Lengths ranged from 130 to 154 mm, and weights ranged from 44 to 74 g. Eggs were present in 4 of the 6 fish. No external anomalies were observed on any of the fish submitted to the laboratory for analysis.

BIO-2

Both fillets and whole fish (i.e., human and ecological health) were obtained at BIO-2. For human health/fillets, the bottom feeder trophic level representative from this site was brown bullhead. The laboratory sample was comprised of three individuals of this species. Lengths ranged from 425 to 430 mm, and weights ranged from 1190 to 1330 g. The tertiary consumer of recreational importance trophic level representative from this site was largemouth bass. Two individuals of this species comprised the sample, measuring 430 and 260 mm and weighing 1440 and 246 g, respectively. The larger bass was a female with eggs.

For ecological health/whole fish, all three trophic level samples were collected. Gizzard shad was the species representing the primary/secondary consumer from this site. A composite sample of four individuals of this species was assembled. Lengths ranged from 110 to 170 mm, and weights ranged from 13 to 57 g. A single brown bullhead comprised the whole fish bottom feeder sample (length of 373 mm and weight of 775 g). The tertiary consumer of recreational importance trophic level sample consisted of a single largemouth bass, which measured 233 mm and weighed 156 g.

With the exception of some mouth damage to one of the brown bullheads (fillet) caused by the trot line on which it was captured, no external anomalies were observed on any of the fish submitted to the laboratory for analysis.

BIO-3

This site was selected as the study reference station, because of its location upgradient of any site-related contamination. No samples representing the bottom feeder trophic level were collected from this site. Both fillet and whole fish samples were obtained for the tertiary consumer of recreational importance trophic level, however. The fish species which comprised these samples was bluegill. Four bluegill were filleted. Lengths of these individuals ranged from 125 to 152 mm, and weights ranged from 36 to 53 g. A total of 12 small bluegill were composited for the whole fish sample. Lengths of these specimens ranged from 68 to 90 mm and weights from 6 to 14 g. The primary/secondary consumer from this site was represented by lake chubsucker. This whole fish sample was comprised of two individuals, measuring 155 and 162 mm and weighing 56 and 63 g, respectively. The smaller lake chubsucker had an eroded caudal fin; none of the other fish submitted to the laboratory for analysis from this site had any observed external anomalies.

BIO-4

No primary/secondary consumer trophic level sample was collected from this site. Bluegill

represented the tertiary consumer of recreational importance trophic level (both fillet and whole fish samples). A single bluegill comprised the whole fish sample (length of 135 mm and weight of 52 g). A composite fillet sample of two bluegill, 162 mm/80 g and 168 mm/92 g, also was obtained from this site. The fillet sample for bottom feeder trophic level consisted of one female channel catfish with eggs, which measured 435 mm and weighed 1100 g. The bottom feeder trophic level whole fish sample was comprised of a single yellow bullhead. This specimen was 300 mm in length and 440 g in weight, and had an abrasion near the dorsal fin/spine. No other external anomalies were observed on any of the fish submitted to the laboratory for analysis from this site.

BIO-5

Due to insufficient size and numbers of a single species, the primary/secondary consumer trophic level sample from this site consisted of a mixture of brook silversides and shiners (*Notropis* sp.). Seven brook silversides (averaging 80 mm in length and 2.3 g in weight) and 9 shiners (average length of 60 mm and average weight of 2.7 g) were composited for the whole fish sample. Largemouth bass represented the tertiary consumer of recreational importance trophic level. Single specimens comprised both fillet and whole fish samples. The whole fish sample/individual measured 265 mm and weighed 242 g, and the fillet sample fish was 355 mm long and weighed 755 g. The largemouth bass used for the fillet sample was a female with eggs and had a slight deformity on the caudal fin. Only a human health/fillet sample representing the bottom feeder trophic level was collected from this site, i.e., no whole fish for ecological assessment. The fillet sample consisted of a single yellow bullhead, which measured 260 mm and weighed 278 g.

Besides the largemouth bass with the slightly deformed caudal fin, no other external anomalies were observed on any of the fish submitted to the laboratory for analysis from this site.

BIO-6

A complete set of human and ecological fish samples was collected at BIO-6. The primary/secondary consumer trophic level representative species was striped mullet. A total of 4 individuals were composited for this trophic level sample. The 4 striped mullets ranged from 163 to 180 mm in length and 52 to 64 g in weight. Largemouth bass represented the tertiary consumer of recreational importance trophic level. Two specimens were composited for both the fillet and whole fish samples. Both fish in the fillet sample were females, and the larger one had eggs. Their lengths and weights were 300 mm/450 g and 345 mm/ 660 g, respectively. The whole fish sample consisted of specimens measuring 258 and 230 mm and weighing 252 and 152 g, respectively. The smaller fish was a female. The bottom feeder trophic level was represented by channel catfish. The fillet sample consisted of a single female with eggs. The fish measured 450 mm and weighed 1250 g. The whole fish sample also consisted of two specimens, measuring 280 and 395 mm and weighing 210 and 700 g, respectively. No external anomalies were observed on any of the fish submitted to the

laboratory for analysis from this site.

Replicate samples were collected from this site. Both human and ecological health samples were obtained. The human health replicate was a bottom feeder trophic level sample represented by a single channel catfish, which measured 550 mm in length and weighed 2500 g. The ecological/whole fish sample consisted of a largemouth bass. This tertiary consumer of recreational importance trophic level sample measured 310 mm in length and weighed 490 g. This specimen was injured slightly (contusion caused by electrode burn) during collection.

BIO-7

As previously mentioned, this site received considerable runoff from residential and commercial areas in Gulfport and also was located just downstream of the airport. No samples representing the bottom feeder trophic level were collected from this site. The primary/secondary consumer trophic level representative species from this site was striped mullet. Two individuals were composited for this trophic level sample. One fish was 178 mm in length and 50 g in weight, and the other was 163 mm in length and 48 g in weight. The tertiary consumer of recreational importance trophic level species was largemouth bass. The whole fish sample consisted of two individuals, measuring 188 and 225 mm and weighing 80 and 162 g, respectively. The smaller fish was a female with eggs. The tertiary consumer fillet sample also consisted of two largemouth bass. One fish measured 262 mm and weighed 255 g, and the other fish was 253 mm in length and weighed 210 g. No other external anomalies were observed on any of the fish submitted to the laboratory for analysis from this site.

BIO-8

No primary/secondary consumer trophic level sample was collected from this site. Largemouth bass represented the tertiary consumer of recreational importance trophic level (both fillet and whole fish samples). Both samples consisted of two individuals. The fillet sample was a composite of one fish measuring 288 mm in length and weighing 345 g and another fish (female with eggs) 220 mm long and weighing 158 g. The whole fish sample consisted of one fish measuring 260 mm in length and weighing 254 g and another fish measuring 230 mm in length and weighing 170 g. The bottom feeder trophic level was represented by black bullhead. Two specimens were composited for both the fillet and whole fish samples. The fillet sample consisted of fish measuring 275 and 220 mm in length and weighing 330 and 158 g, respectively. The whole fish sample consisted of specimens measuring 175 and 198 mm and weighing 95 and 112 g, respectively. The largest black bullhead (275 mm/330 g; used in fillet sample) had a deformed dorsal spine, but no other external anomalies were observed on any of the fish submitted to the laboratory for analysis from this site.

LITERATURE CITED

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USEPA (U.S. Environmental Protection Agency). 1986. Quality Criteria for Water. EPA 440/5-86-001. Office of Water, Regulations and Standards, Washington, DC.

TABLE 1

SUMMARY OF FISH SAMPLING METHODOLOGIES

SAMPLING SITES	ELECTROFISHER	TROT LINE	HOOP NET	SEINE
BIO-1	x	x	x	
BIO-2	x	x	x	
BIO-3	x	x	x	
BIO-4		x	x	
BIO-5	x	x	x	x
BIO-6	x	x	x	
BIO-7	x			
BIO-8	x	x	x	

TABLE 2

SUMMARY OF *IN SITU* WATER QUALITY MEASUREMENTS

SAMPLING SITES	pH (s.u.)	WATER TEMPERATURE (° C)	SALINITY (ppt)	DISSOLVED OXYGEN (mg/l)	SPECIFIC CONDUCTANCE (µS/cm)
BIO-1	7.53	22.2	0.1	9.65	159.3
BIO-2	6.55	21.5	0.1	8.86	175.4
BIO-3	4.96	14.9	0.0	5.35	42.3
BIO-4	5.81	16.3	0.0	7.32	52.1
BIO-5	5.31	13.6	0.0	6.86	41.6
BIO-6	5.89	14.3	0.2	7.10	465.2
BIO-7	7.32	18.2	0.3	6.33	633.0
BIO-8	7.17	18.4	0.1	7.87	227.3

s.u. = standard units
° C = degrees Celcius
ppt = parts per thousand
mg/l = milligrams per liter
µS/cm = micro-Siemens per centimeter

TABLE 3

FISH COLLECTED FROM STUDY SITES
NCBC GULFPORT, MISSISSIPPI

Amiidae
Bowfin, *Amia calva*

Aphredoderidae
Pirate perch, *Aphredoderus sayanus*

Atherinidae
Brook silverside, *Labidesthes sicculus*

Catostomidae -
Lake chubsucker, *Erimyzon sucetta*

Centrarchidae -
Bluegill, *Lepomis macrochirus*
Green sunfish, *Lepomis cyanellus*
Longear sunfish, *Lepomis megalotis*
Redbreast sunfish, *Lepomis auritus*
Redear sunfish, *Lepomis microlophus*
Spotted sunfish, *Lepomis punctatus*
Warmouth, *Lepomis gulosus*
White crappie, *Pomoxis annularis*
Largemouth bass, *Micropterus salmoides*

Clupeidae -
Gizzard shad, *Dorosoma cepedianum*

Cyprinidae -
Common carp, *Cyprinus carpio*
Unidentified shiner, *Notropis* sp.

Engraulidae
Bay anchovy, *Anchoa mitchilli*

Cyprinodontidae -
Golden topminnow, *Fundulus chrysotus*
Gulf killifish, *Fundulus grandis*

Gobiidae
Darter goby, *Gobionellus boleosoma*

Ictaluridae -
Brown bullhead, *Ameiurus nebulosus*
Yellow bullhead, *Ameiurus natalis*
Black bullhead, *Ameiurus melas*

Channel catfish, *Ictalurus punctatus*

Lepisostidae -
Spotted gar, *Lepisosteus oculatus*

Mugilidae -
Striped mullet, *Mugil cephalus*

Poeciliidae -
Mosquitofish, *Gambusia sp.*
Sailfin molly, *Poecilia latipinna*

Sciaenidae -
Freshwater drum, *Aplodinotus grunniens*

TABLE 4

SUMMARY OF FISH SAMPLES SUBMITTED FOR ANALYSIS

SAMPLING SITE	SPECIES	FILLET (F)/ WHOLE BODY (W)	LENGTH (mm)	WEIGHT (g)	PRESENCE OF EGGS	ANOMALIES
BIO-1	Yellow bullhead	F	238	204	---	---
	Yellow bullhead	F	300	460	X	---
	Redear sunfish	F	154	74	X	---
	Redear sunfish	F	150	65	X	---
	Redear sunfish	F	150	68	X	---
	Redear sunfish	F	140	50	---	---
	Redear sunfish	F	135	48	X	---
	Redear sunfish	F	130	44	---	---
BIO-2	Brown bullhead	W	373	775	---	---
	Brown bullhead	F	425	1330	---	---
	Brown bullhead	F	425	1190	---	Mouth damaged by trot line
	Brown bullhead	F	430	1250	---	---
	Largemouth bass	F	430	1440	X	---

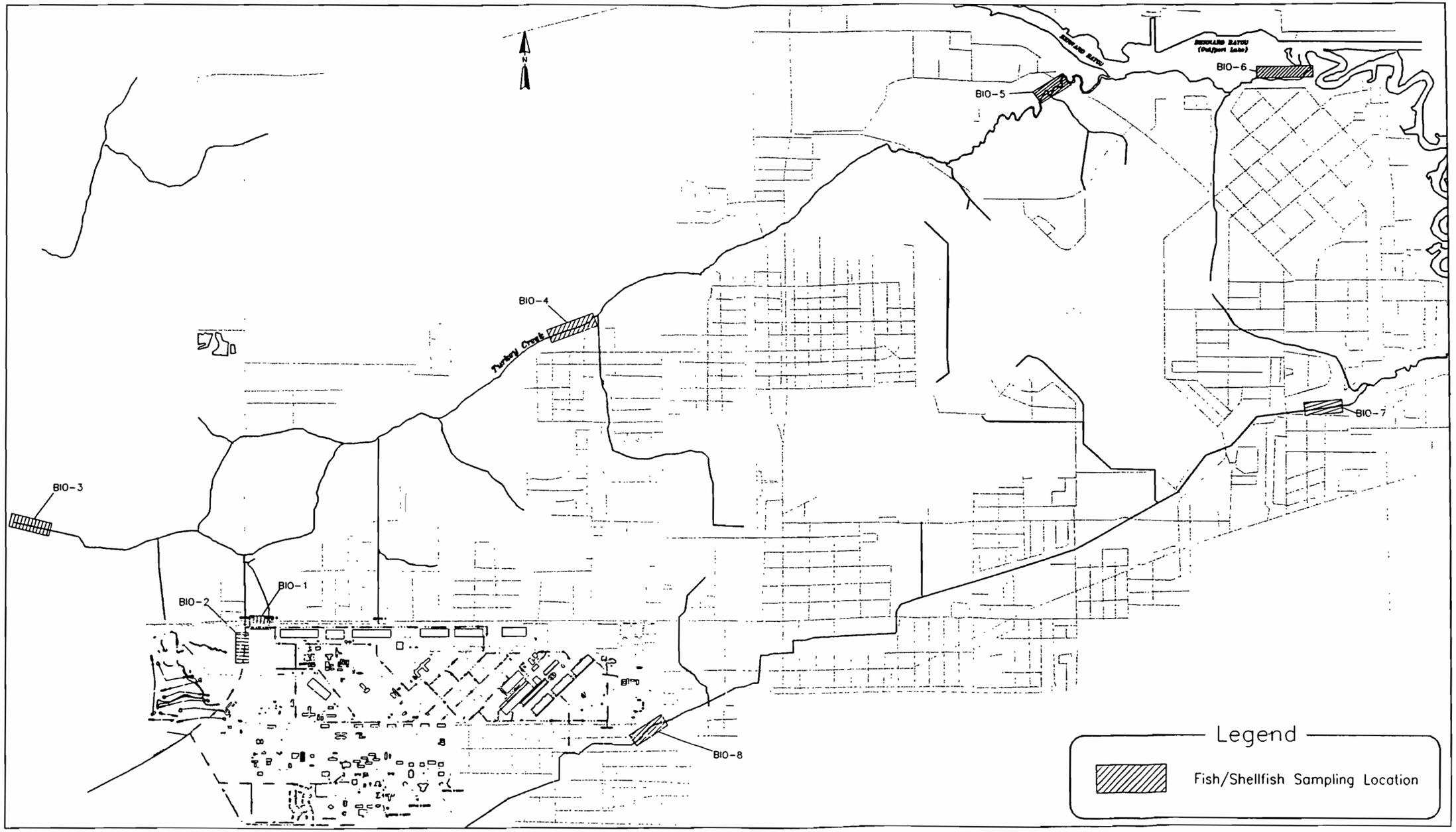
SAMPLING SITE	SPECIES	FILLET (F)/ WHOLE BODY (W)	LENGTH (mm)	WEIGHT (g)	PRESENCE OF EGGS	ANOMALIES
	Largemouth bass	F	260	246	---	---
	Largemouth bass	W	233	156	---	---
	Gizzard shad	W	110	13	---	---
	Gizzard shad	W	150	34	---	---
	Gizzard shad	W	160	41	---	---
	Gizzard shad	W	170	57	---	---
BIO-3	Bluegill	W	88	14	---	---
	Bluegill	W	80	9	---	---
	Bluegill	W	90	12	---	---
	Bluegill	W	88	11	---	---
	Bluegill	W	68	6	---	---
	Bluegill	W	80	8	---	---
	Bluegill	W	70	6	---	---
	Bluegill	W	70	6	---	---
	Bluegill	W	73	6	---	---
	Bluegill	W	80	8	---	---
	Bluegill	W	72	6	---	---

SAMPLING SITE	SPECIES	FILLET (F)/ WHOLE BODY (W)	LENGTH (mm)	WEIGHT (g)	PRESENCE OF EGGS	ANOMALIES
	Bluegill	W	66	5	---	---
	Bluegill	F	147	53	---	---
	Bluegill	F	152	62	---	---
	Bluegill	F	131	43	---	---
	Bluegill	F	125	36	---	---
	Lake chubsucker	W	155	56	---	Eroded caudal fin
	Lake chubsucker	W	162	63	---	---
BIO-4	Channel catfish	F	435	1100	X	---
	Channel catfish	W	300	440	---	Abrasion near dorsal fin
	Bluegill	W	135	52	---	---
	Bluegill	F	162	80	---	---
	Bluegill	F	168	92	---	---
BIO-5	Brook silverside	W	7 @ 80	7 @ 19	---	---
	Shiner	W	9 @ 60	9 @ 21	---	---
	Largemouth bass	W	265	242	---	---
	Largemouth bass	F	355	755	X	Slight deformity of caudal fin

SAMPLING SITE	SPECIES	FILLET (F)/ WHOLE BODY (W)	LENGTH (mm)	WEIGHT (g)	PRESENCE OF EGGS	ANOMALIES
	Yellow bullhead	F	260	278	---	---
BIO-6	Channel catfish	W	280	210	---	---
	Channel catfish	W	395	700	---	---
	Channel catfish	F	450	1250	X	---
	Channel catfish	F (replicate)	550	2500	X	---
	Largemouth bass	W	258	252	---	---
	Largemouth bass	W	230	152	---	---
	Largemouth bass	W (replicate)	310	490	---	Contusion from electrode
	Largemouth bass	F	300	450	---	---
	Largemouth bass	F	345	660	X	---
	Striped mullet	W	172	60	---	---
	Striped mullet	W	180	64	---	---
	Striped mullet	W	175	62	---	---
	Striped mullet	W	163	52	---	---
BIO-7	Largemouth bass	W	188	80	X	---
	Largemouth bass	W	225	162	---	---

SAMPLING SITE	SPECIES	FILLET (F)/ WHOLE BODY (W)	LENGTH (mm)	WEIGHT (g)	PRESENCE OF EGGS	ANOMALIES
	Largemouth bass	F	262	255	---	---
	Largemouth bass	F	253	210	---	---
	Striped mullet	W	178	50	---	---
	Striped mullet	W	163	48	---	---
BIO-8	Black bullhead	W	175	95	---	---
	Black bullhead	W	198	112	---	---
	Black bullhead	F	275	330	---	Deformed dorsal spine
	Black bullhead	F	220	158	---	---
	Largemouth bass	W	260	254	---	---
	Largemouth bass	W	230	170	---	---
	Largemouth bass	F	288	345	---	---
	Largemouth bass	F	265	270	X	---

mm = millimeters
g = grams



HARDING LAWSON ASSOCIATES

TITLE. Naval Construction Battallion Center
Fish/Shellfish Sampling Locations
Gulfport, MS

0 1250 2500
FEET

DWN: JRF	DES.:	PROJECT NO.:
CHKD:	APPD:	FIGURE NO 1
DATE.	REV.:	

APPENDIX B

APPENDIX A

SITE DESCRIPTIONS

BIO-1

This study station was located on-site, south of 28th St. and upstream of a sediment recovery trap. This site was a small pool (15 feet by 50 feet) in a drainage ditch. The average depth was approximately two feet, and substrate was primarily mud. Some emergent and submergent vegetation was observed in shallow littoral areas. No flow was observed, and the water was fairly turbid.

BIO-2

This study station was located on-site in Canal No. 1. Depths generally ranged from 2 to 4 feet, and the canal width was about 20 feet. Substrate was primarily mud. Considerable emergent and submergent vegetation were located in the shallow littoral areas. Although some flow was observed, the water was stagnant and turbid.

BIO-3

This site was located in the upper section of Turkey Creek. This site was considered to be relatively undisturbed (i.e., reference site) because of its location up-gradient from NCBC Gulfport. A roadway (Turner Road) crossed Turkey Creek at this location, and sampling was conducted upstream and downstream of the road crossing. The stream upstream of the roadway was pooled with little observed flow. Depths generally ranged from 2 to 4 feet, and the width was about 5 to 8 feet. Substrate was primarily mud and hardpan (clay). Small areas of emergent vegetation was located in the shallow littoral areas. Canopy cover was 50 to 80%, and the surrounding riparian area was forested. Numerous snags and overhanging branches were present. The water was turbid.

Downstream of the roadway, the stream was flowing (< 1 cubic feet per second [cfs]). The channel appeared to have been dredged and straightened in the past (not recent). Water depths were generally less than 1 to 2 feet, and average stream width was about 4 feet. Substrate was primarily hardpan. Canopy cover was nearly 100%. The surrounding riparian area was forested to the north, and some single family dwellings were located south of the stream. Some instream cover (e.g., snags, limbs) was present.

BIO-4

This site was located on Turkey Creek just downstream from NCBC Gulfport. The stream appeared channelized in this area. The channel was deeply incised, and the stream banks were steep. The current was swift in this area, and little instream cover was present (some overhanging branches). Water depths generally were greater than 4 feet, and the stream was about 15 to 20 feet wide. Substrate was primarily hardpan. The water was turbid.

BIO-5

This site was located on Turkey Creek downstream of the airport and about half a mile upstream of the confluence with Bernard Bayou. The area appeared relatively undisturbed and natural. The stream exhibited good sinuosity at this site, and the riparian zone was densely forested and relatively undisturbed for several hundred feet in most areas. Canopy cover was about 80% to 90%. Stream width was about 20 to 30 feet, and depths were

generally greater than 4 feet. The substrate was a mixture of sand, mud, and detritus. Numerous stumps, limbs, and snags were present, often extending nearly across the stream; downed trees completely blocked passage at the upstream-most section of this site. Swift current was present in the main stream channel, and the water was fairly turbid.

BIO-6

This site was in the eastern side of Bernard Bayou and was lacustrine in nature. Some tidal influence was observed; however, water was principally fresh. There was a mixture of residential and industrial development along much of the shoreline at this site; however, relatively undisturbed, natural areas also were present. Docks were common in the developed areas, and stumps and snags were frequently encountered along the more undisturbed shoreline. Substrate consisted of a mixture of firm sand and mud in most areas. Depths varied but were generally less than 5 feet within about hundred feet of the shore in most areas.

BIO-7

This site was the downstream-most location on Brickyard Creek and was downstream of the airport. The stream was channelized in this area and may have been somewhat tidally influenced. No noticeable flow was observed during sampling. The site was surrounded by residential development, but the immediate riparian area predominantly was forested (forested riparian zone generally 20 feet to greater than 100 feet. Canopy cover was approximately 50% to 80%. Stream width was about 30 to 40 feet, and depths were generally greater than 4 feet. Substrate appeared to be primarily mud. A moderate amount of instream cover was present, primarily snags and overhanging limbs. Water was turbid.

BIO-8

This site was the uptream-most location on Brickyard Creek, immediately downstream of the base. The area was completely surrounded by residential development, and riparian zone often had little or no vegetation (i.e., structures or impervious surface). The stream was highly impacted by anthropogenic activities and contained large amounts of refuse. The creek was channelized, and little canopy (0% to 30%) was present. The stream was relatively small in the sampling area, with stream widths generally ranging from 5 to 10 feet and depths of 2 inches to about 4 feet. Substrate consisted primarily of mud, sand, and rubble (rip rap).

APPENDIX B

COPIES OF FIELD NOTES

2

3/15

NCBC Gilfpt

→ reviewed all sites

BIO 2 - 207 m from road / pm

3 crawfish traps, hoop net
↳ varying depth, avg 30 apart

BIO 7 - @ sediment trap
3 crawfish traps; trotline

BIO 8 - just off base site 3 pm
3 crawfish traps, trotline

BIO 6 - Bernard Bayou 4 pm
3 crawfish traps, trotline, hoop net

BIO 7 - end of runway site 5 pm
3 crawfish traps; trotline

3/16 7 am

BIO 1, 8, 6 & 7 - no crawfish or fish on trotlines (hoop net @ BIO 2 not checked)
Crawfish traps rebait @ all, ~~rebait~~ (trotlines not rebaited)

BIO 2 - 1 yellow bullhead; trotline + crawfish traps rebaited

#63 calibrated - 4.7 pH
DO @ 13.6°C - 13.76 → 10.37

BIO 6 - 9 AM

DO - ~~7.7~~ 7.10 pH - 5.89 Sal - 0.2
temp - 14.3 cond - ~~767~~ 465.2 µS/cm ppt

- trotline - 2 channel catfish (GBH attacking one of the c
hoop net - 1 small bluegill
→ reset trotline + added another; reset hoop net

electro - DC, low, 50%, 60 PPS
amps - 6-9 amps time 669
a few hundred feet of shoreline
collected - LMB, bluegill, redear, striped mullet, 1 ~~croaker~~ freshwater drum, jvr

Habitat - lacustrine w/ some tidal influence; mixture of a few resid, industrial (northshore); shoreline - shrubs, plants, trees, stumps
(sal in stem)
- reset trotline + hoop net

BIO 5 - bottom station on Turkey Cr
DO - 6.86 pH - 5.31 Sal - 0
temp - 13.6 cond - 41.6
electro - DC, high, 100%, 120 PPS, amp - 4-6
time - 733 + 604 = 1337 sec
- started @ end + drift down to bridge, then walked down
collected - LMB, bluegill, redear, spotted shiner, silversides, jvr
whole sediment sampling, collected flounder
(left - yet?)

BIO 3 - set hoop net + trotline
BIO 4 - set trotline
BIO 2 - set trotline

Turney Rd

3/17 sunny, warm
- checked trotlines, traps

BIO 2 - 3 brown bullhead on trotline
BIO 1 - nothing; rebaited crawfish traps
BIO 3 - nothing on trotline
hoop net - redbreast; bluegill, chubsucker; hoop net reset
BIO 4 - set hoop net - 1 large channel cat

BIO 6 - 2 large channel cat on 2nd trotline 2pm
none on 1st; trotline + hoop net pulled
BIO 5 - no catfish on trotline; hoop net - nothing; pulled

collected minnows

→ worked up fish collected - freezer - whole fish, complete, decon between each site
- ~~wash tro~~ new gloves, foil, new bait, fish +
Decon → soap, DI rinse, alcohol, DI rinse
- set trotlines @ BIO 3, 4, 1 + 2 in AM

3/18 - foggy, warm
- meters calibrated
pH - 4 + 7; DO - 9.84 → 100% @ 14.3

BIO 2 - checked trotline; - none
BIO 1 - " ; - 1 yellow bullhead
BIO 3 - " ; hoopnet - 1 bluegill + redeare, pulled
nothing; pulled

electro (backpack) - numerous bluegill, redbreast, ginger, green, spotted, mosquitofish, orange, bluegill, crawfish
DO - 5.35 pH - 4.96 Sal - 0.0
temp - 14.9 cond - ~~54.2~~ 42.3
Pics 1-3 -

Setting - 7 - 5, Volts = 500, time 10:30
- also some seine pulls - a few crawfish, Gambusia

Habitat - water tracked (Blackwell?)
Down - small flowing stream (flow < 1cfs), wid - 3-5', depth - 1"-2'; sub - hardpan; canopy - 100%, channelized, med. to sparse
up - pool, depth - 2-4', no flow; wid - 5-8'; sub - mud, hardpan, gravel; canopy - 50-90%, roots

BIO 4 - trotline - 1 bullhead, hoopnet - none
Pics 4+5
DO - 7.32 pH - 5.81 Sal - 0
temp - 16.0 cond - 52.1

6

Pics 6 & 7 flow - 50-75 cfs water turbid

Habitat - channelized; deep - >4'; wid - 15-20'; sub - hardpan; canopy - 100%; little cover, straight

1193
1022
1715

BIO 8 - 11 AM

DO - 7.87 pH - 7.12 Sal - 0.1
temp - 18.4 cond - 227.3

electro - I-5 volts 200-300, time - 1719

fish - LMB, bullhead, bluegill, redspotted sunfish, warmouth, green sunfish, silverside, mosquitofish, goldfish (V), minnows (V), golden shiner (V), fathead minnow (V), pumpkinseed (V), 2 toed amphibians; crawfish, shrimp

Habitat - turbid small stream highly impacted; large amounts of trash, rubble, fencing, etc; flow - 1-2 cfs; wid - 5-10'; depth - 2"-4'; sub - mud, sand, rubble; can - 0-30%; straight, channelized

Pics 8 & 9

BIO 2 1 PM

Pics 10 & 11

DO - 8.86 pH - 6.55 Sal - 0.1
temp 21.5 cond - ~~[illegible]~~ 175.4 cc

Pics 10 & 11

electro - DC, 50%, High, 120 PPS, 8-10 amps, time 733

fish - numerous sunfish (bluegill, redspotted, green?) gizzard shad, bowfin, gar; carp;

Habitat - canal; 20' wid; depth - 2-4'; sub - mud, gravel emergent & submerg, deep edge, no canopy

BIO 11 -

Pic 12

DO - 9.65 pH - 7.53 Sal - 0.1
temp - 22.2 cond - 159.3

electro - DC, 50%, High, 120 PPS, 8-10 amp, time - 387

fish - 1° bluegill, redear

Habitat - pool caused by 1 cleaned dam; wid - 15-20'; depth - 1-4'; sub - mud, some emergent & subm, no canopy

BIO 5 - Pics 13 & 14 4 pm

set cradle trotline - relocated off turbid

- Habitat = riverine gravel & invasive/natural, 4'-thick, fenced; wid - 20-30'; depth - 1->5'; sub - sand, mud, debris; canopy 90% in places; snags, limbs, stumps, [illegible]

BIO 7 (?) - runway site

Pics 14 & 15

DO - 7.65 pH - 7.27 Sal. - 0.3
temp - 20.4 cond - 573

- too deep to back pack shock - boat [illegible]

BIO 4

- pulled trot line - hoopnet

↳ 3 bluegill

03/15

7:30 AM

B105 - checked + pulled both trot lines
(yellow bullhead

B107 - electrofished 9 AM

DO - 6.33 pH - 7.32 sal 0.3
temp - 18.2 cond - 633

settings - DC, 120 pps, Low-High, 50%
time - 1110 sec + 200-300 m
@ Washington/Simpson Rd bridge

fish - carp (1 large); gizzard shad, striped mullet, LMB, redear, bluegill, spotted, cyprinids (anchovies?)

Habitat - straight/canal; no noticeable flow (tidally influenced?); wid - 30-40'; dep > 4'; sub-mud; canopy - 50-80%; cover - snags, limbs; rip + residential/forested

10:45 AM

Working fish (same methods/decon as previous)
- finished all processing by 12:30 PM

Vouchers - 2 - black bullheads
1 - lake chubsucker
4 - brook silversides
1 - golden topminnow
1 - sailfin molly
1 - gulf killifish
4 - darter gobies

APPENDIX C

APPENDIX C

COPIES OF FIELD RECORD FORMS

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-16-99 - AM
3-18-99 - AM, PM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Drainage Ditch

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name: Yellow Bullhead

Composite Sample No.: Bio-1-FF-CF Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	258 (204g)	F	006		
002	300 (460g)	F (w/eggs)	007		
003			008		
004			009		
005			010		

Minimum size ____ x 100 = ____ >75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies):

Predator—Species Name: Bio-1-FF-RE

Composite Sample No.: Redear Sunfish Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	154 (74g)	F (with eggs)	006	130 (44)	
002	150 (65g)	F (with eggs)	007		
003	150 (68g)	F (w/eggs)	008		
004	140 (50)		009		
005	135 (48)	F (w/eggs)	010		

Minimum size ____ x 100 = ____ ≥75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies):

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-17-99 AM 3-18-99 - PM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Drainage ditch

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name: Brown Bullhead

Composite Sample No.: Bio-2-WF-CF Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	373 (775 g)		006	425 (1380 g)	
002			007	425 (1190 g)	
003			008	430 (1250)	
004			009		
005			010		

Minimum size x 100 = >75% Composite mean length mm

Maximum size

Bio-2-FF-CF

Notes (e.g., morphological anomalies): (607) Mouth damaged by trout line

Predator—Species Name: Largemouth Bass

Composite Sample No.: Bio-2-FF-LB Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	430 - (1440 g)	F (w/ eggs)	006	233 (156 g)	
002	260 (246)		007		
003			008		
004			009		
005			010		

Minimum size x 100 = ≥75% Composite mean length mm

Bio-2-WF-LB

Maximum size

Notes (e.g., morphological anomalies)

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-18-99 - PM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Drainage Ditch

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name:

Composite Sample No.: Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001			006		
002			007		
003			008		
004			009		
005			010		

Minimum size x 100 = >75% Composite mean length mm

Maximum size

Notes (e.g., morphological anomalies):

~~Predator Species Name:~~ Primary Gizzard Shad

Composite Sample No.: B10-2-WF-GS Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	110 (13 g)		006		
002	150 (34 g)		007		
003	160 (41)		008		
004	170 (57)		009		
005			010		

Minimum size x 100 = ≥75% Composite mean length mm

Maximum size

Notes (e.g., morphological anomalies)

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30

Sampling Date and Time: 3-18-99 - AM
3-18-99 - AM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County

Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Creek

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency:

Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

~~Bottom Feeder Species Name:~~ Secondary Blue Gill

Composite Sample No.: 810-3-WF-BG

Number of Individuals:

Fish #	Length (mm)	Sex	MM	g	Fish #	Length (mm)	Sex
001	88 (14 g)	0011	72	6	006	80 (8)	
002	80 (9 g)	0012	66	5	007	70 (6)	
003	90 (12)				008	70 (6)	
004	88 (11)				009	73 (6)	
005	68 (6)				010	80 (8)	

Minimum size ____ × 100 = ____ >75%

Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies)

~~Predator Species Name:~~ Primary Chub Sucker

Composite Sample No.: 810-3-WF-CS

Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	155 (56)		006		
002	162 (63g)		007		
003			008		
004			009		
005			010		

Minimum size ____ × 100 = ____ ≥75%

Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies)

(001) Eroded Caudal Fin

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: _____

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.: _____

Waterbody Name/Segment Number: _____

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Creek

Site Description _____

Collection Method: _____

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: _____ Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED: _____

Bottom Feeder—Species Name: _____

Composite Sample No.: _____ Number of Individuals: _____

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001			006		
002			007		
003			008		
004			009		
005			010		

Minimum size ____ x 100 = ____ >75% Composite mean length _____ mm

Maximum size

Notes (e.g., morphological anomalies): _____

Secondary Predator—Species Name: Bluegill

Composite Sample No.: Bio-3-FF-BG Number of Individuals: _____

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	147 (53)		006		
002	152 (62)		007		
003	131 (43)		008		
004	125 (36)		009		
005			010		

Minimum size ____ x 100 = ____ ≥75% Composite mean length _____ mm

Maximum size

Notes (e.g., morphological anomalies) _____

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-17-99 AM 3-18-99 PM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Creek

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name: Channel Catfish, (Yellow Bullhead for whole fish)

Composite Sample No.: Bio-04-FF-CF Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	435 (1100g)	F (with eggs)	006	300 (440)	
002			007		
003			008		
004			009		
005			010		

Minimum size × 100 = >75% Composite mean length BO-4-WF-CF mm

Maximum size

Notes (e.g., morphological anomalies): Abrasion near dorsal fin

~~Predator Species Name~~ Secondary: Bluegill

Composite Sample No.: Bio-4-WF-B6 Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	135 (52)		006	162 (80)	
002			007	168 (92)	
003			008		
004			009		
005			010		

Minimum size × 100 = ≥75% Composite mean length Bio-4-FF-B6 mm

Maximum size

Notes (e.g., morphological anomalies)

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-16-99 PM 3-17-99 PM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Creek

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

~~Bottom Feeder~~ Primary Secondary Consumer Species Name: Brook Silver side, Spottail Shiner

Composite Sample No.: Bio-S-WF-SS Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	(9-21g) 60-Avg Length		006		
002	(7-19g) 80-Avg Length		007		
003			008		
004			009		
005			010		

Minimum size x 100 = ≥75% Composite mean length mm

Maximum size

Notes (e.g., morphological anomalies):

Predator—Species Name: Largemouth Bass

Composite Sample No.: Bio-S-WF-LB Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	265 (242g)		006	355 (755g)	F (with eggs)
002			007		
003			008		
004			009		
005			010		

Minimum size x 100 = ≥75% Composite mean length mm

Maximum size Bio-S-FF-LB

Notes (e.g., morphological anomalies): Slight deformity on Caudal Fin (006)

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

page 1 of 1

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-19-99 AM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY Creek

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name: Yellow Bullhead

Composite Sample No.: Bio-5-FF-CF Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	260 (278)		006		
002			007		
003			008		
004			009		
005			010		

Minimum size × 100 = ____ >75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies):

Predator—Species Name:

Composite Sample No.: Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001			006		
002			007		
003			008		
004			009		
005			010		

Minimum size × 100 = ____ ≥75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies)

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-16-99 AM
3-17-99 AM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☒ LAKE ☐ ESTUARY

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name: Channel Catfish

Composite Sample No.: Bio-6-WF-CF Number of Individuals: 2

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	280 (210g)		006	450 (1250g)	F (with eggs)
002	395 (700g)		007		
003			008	550 (2500)	F (with eggs)
004			009		
005			010		

Replicate

Minimum size ____ × 100 = ____ >75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies) Bio-6-FF-CF

Predator—Species Name: Largemouth Bass

Composite Sample No.: Bio-6-WF-LB Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	258 (252g)		006	300 (450g)	F
002	230 (152g)	F	007	346 (660)	F (with eggs)
003			008		
004	310 (490g)	Replicate	009		
005			010		

Minimum size ____ × 100 = ____ ≥75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies) Bio-6-FF-LB
004 - Injured during collection

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 2-16-99 AM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☒ LAKE ☐ ESTUARY

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED: Primary Secondary Consumer

~~Bottom Feeder~~ Species Name: Striped Mullet

Composite Sample No.: B10-6-WF-SM Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	172 (60g)		006		
002	180 (64)		007		
003	175 (62)		008		
004	163 (52		009		
005			010		

Minimum size × 100 = ____ >75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies).

Predator—Species Name:

Composite Sample No.: Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001			006		
002			007		
003			008		
004			009		
005			010		

Minimum size × 100 = ____ ≥75% Composite mean length ____ mm

Maximum size

Notes (e.g., morphological anomalies).

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-19-99 - AM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-9092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

~~Bottom Feeder Species Name:~~ Secondary Largemouth Bass

Composite Sample No.: Bio-7-WF-LB Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	188 (80)	F (w/eggs)	006	262 (265g)	
002	225 (162)		007	253 (210)	
003			008		
004			009		
005			010		

Minimum size × 100 = ____ >75% Composite mean length Bio-7-FF-LB mm

Maximum size

Notes (e.g., morphological anomalies):

Predator ~~Species Name:~~ Primary Striped Mullet

Composite Sample No.: Bio-7-WF-SM Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	178 (50g)		006		
002	163 (48)		007		
003			008		
004			009		
005			010		

Minimum size × 100 = ____ ≥75% Composite mean length mm

Maximum size

Notes (e.g., morphological anomalies)

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Field Record for Fish Contaminant Monitoring Program — Screening Study

Project Number: 02540.30 Sampling Date and Time: 3-18-99 AM

SITE LOCATION:

Site Name/Number: NCBC Gulfport

County/Parish: Harrison County Lat/Long.:

Waterbody Name/Segment Number:

Waterbody Type: ☐ RIVER ☐ LAKE ☐ ESTUARY

Site Description

Collection Method:

Collector Name: C² Environmental Services, Inc
(print and sign)

Agency: Phone: 770 986-8092

Address: 4122 Admiral Dr., Atlanta, GA 30341

FISH COLLECTED:

Bottom Feeder—Species Name: Black Bullhead

Composite Sample No.: Bio-8-WF-OF Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	175 (95)		006	275 (330) g	
002	198 (112)		007	220 (158)	
003			008		
004			009		
005			010		

Minimum size × 100 = ____ >75% Composite mean length Bio-8-FF-CF mm

Maximum size

Notes (e.g., morphological anomalies): 006 (Deformed Dorsal Spine)

Predator—Species Name: Largemouth Bass

Composite Sample No.: Bio-8-WF-LB Number of Individuals:

Fish #	Length (mm)	Sex	Fish #	Length (mm)	Sex
001	260 (254) g		006	288 (345) g	
002	230 (170)		007	265 (270)	F (w/ eggs)
003			008		
004			009		
005			010		

Minimum size × 100 = ____ ≥75% Composite mean length Bio-8-FF-LB mm

Maximum size

Notes (e.g., morphological anomalies):

Figure A-2 Example of a Field Record for Fish Contaminant Monitoring Program—Screening Study

Analytical Laboratories Ltd.
50 Bathurst Drive, Unit 12
Waterloo, Ontario N2V 2C5
FAX (519) 747-3806
Phone (519) 747-2575

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CLIENT PROJECT NUMBER: 0254020

CANVIRO QUOTATION NUMBER:

COMPANY NAME: Jordan Lawson Associates

CLIENT PURCHASE ORDER NUMBER:

PROJECT MANAGER: Penny Lexier

PHONE NUMBER: (423) 531-1922

Requested Completion Date:

REGULATIONS: REG 347 [ ] MISA [ ] ODWO [ ] OTHER ____

Sample Disposal: Dispose [X] Return [ ]

FOR LAB USE ONLY: LOT NO. 2 3 ; ENTERED BY: ; DATE ENTERED:

SAMPLING Date	Time	Type COMP.	Type GRAB	Matrix WATER	Matrix SOIL	Matrix OTHER	SAMPLE DESCRIPTION (This Description Will Appear On The Report)	NUMBER OF CONTAINERS	Dioxin 3290	SAMPLE REMARKS
1/17/99		X				X	BIO-6-WF-CF	2	X	tissue
1/10/99		X				X	BIO-6-WF-SM	1	X	tissue
1/16/99		X				X	BIO-6-WF-LB	2	X	tissue
1/16/99		X				X	BIO-6-WF-LBR	1	X	tissue replicate
1/17/99		X				X	BIO-6-FF-CF	1	X	tissue
1/17/99		X				X	BIO-6-FF-CFR	1	X	tissue - replicate
1/16/99		X				X	BIO-6-FF-LB	1	X	tissue
1/17/99		X				X	BIO-4-FF-CF	1	X	tissue
1/16/99		X				X	BIO-1-FF-CF	1	X	tissue
1/17/99		X				X	BIO-2-FF-CF	1	X	tissue
1/17/99		X				X	BIO-2-WF-CF	1	X	tissue
1/18/99		X				X	BIO-1-FF-RE	1	X	tissue
1/18/99		X				X	BIO-2-WF-GS	1	X	tissue

SAMPLED BY: (SIGNATURE) [signature] DATE 3/19/99 TIME 1640

RECEIVED BY: (SIGNATURE) DATE TIME

RECEIVED BY: (SIGNATURE) DATE TIME

RECEIVED BY: (SIGNATURE) DATE TIME

COMMENTS:

SHIPPED BY: UPS [ ] HAND DELIVERED [ ] FED-EX [ ] PUROLATOR [ ] OTHER ____

SHIPPING NUMBER

RECEIVED AT LAB: (SIGNATURE) DATE TIME

DISTRIBUTION: ORIGINAL - LAB, Yellow - LAB, Pink - Client

REV 9/93

CANVIRO
Analytical Laboratories Ltd.
50 Bathurst Drive, Unit 12
Waterloo, Ontario N2V 2C5
FAX (519) 747-3806
Phone (519) 747-2575

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CLIENT PROJECT NUMBER: 02540.30

CANVIRO QUOTATION NUMBER:

COMPANY NAME: Harding Lawson Associates

CLIENT PURCHASE ORDER NUMBER:

PROJECT MANAGER: MR [ ] MS [X] DR [ ] Penny Baxter

PHONE NUMBER: (423) 531-1922

Requested Completion Date: Standard TAT

REGULATIONS: REG 347 [ ] MISA [ ] ODWO [ ] OTHER ___

Sample Disposal: Dispose [ ] Return [ ]

FOR LAB USE ONLY

LOT NO. ___

ENTERED BY: ___

DATE ENTERED:

SAMPLING Date	SAMPLING Time	Type COMP.	Type GRAB	Matrix WATER	Matrix SOIL	Matrix OTHER	SAMPLE DESCRIPTION (This Description Will Appear On The Report)	NUMBER OF CONTAINERS	ANALYSES REQUESTED: 8240 (Dioxin)	SAMPLE REMARKS
3/16/99	1435		X		X		BIO-SD-5	1	X	Sediment
3/16/99	1435		X		X		BIO-SD-5D (duplicate)	1	X	
3/16/99	1500		X		X		BIO-SD-6	1	X	
3/16/99	1700		X		X		BIO-SD-2	1	X	
3/17/99	0900		X		X		BIO-SD-1	1	X	
3/17/99	1000		X		X		BIO-SD-3	1	X	
3/17/99	1245		X		X		BIO-SD-8	1	X	
3/17/99	1315		X		X		BIO-SD-4	1	X	
3/17/99	1400		X		X		BIO-SD-7	1	X	
3/18/99	0940		X	X			BIO-FB-1	1	X	potable water
3/18/99	0945		X	X			BIO-RB-1	1	X	rinseate

SAMPLED BY: (SIGNATURE) [signature] DATE 3/18/99 TIME 1330

RECEIVED BY: (SIGNATURE) DATE TIME

RECEIVED BY: (SIGNATURE) DATE TIME

RECEIVED BY: (SIGNATURE) DATE TIME

COMMENTS:

SHIPPED BY: UPS [ ] HAND DELIVERED [ ] FED-EX [ ] PUROLATOR [ ] OTHER ___

SHIPPING NUMBER

RECEIVED AT LAB: (SIGNATURE) DATE TIME

Analytical Laboratories Ltd.
50 Bathurst Drive, Unit 12
Waterloo, Ontario N2V 2C5
FAX (519) 747-3806
Phone (519) 747-2575

BIO-5

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CLIENT PROJECT NUMBER: 02540.30

CANVIRO QUOTATION NUMBER:

COMPANY NAME: Harding Lawson Associates

CLIENT PURCHASE ORDER NUMBER:

PROJECT MANAGER: MR [ ] MS [X] DR [ ] Penny Pickler

PHONE NUMBER: (413) 521-1922

Requested Completion Date:

REGULATIONS: REG 347 [ ] MISA [ ] ODWO [ ] OTHER ____

Sample Disposal: Dispose [X] Return [ ]

FOR LAB USE ONLY: LOT NO. ____ ENTERED BY: ____ DATE ENTERED: ____

SAMPLING Date	Time	Type: COMP.	GRAB	Matrix: WATER	SOIL	OTHER	SAMPLE DESCRIPTION (This Description Will Appear On The Report)	NUMBER OF CONTAINERS	ANALYSES REQUESTED: Dioxins										SAMPLE REMARKS
3/16/99		X				X	BIO-5-FF-LB	1	X										tissue
3/16/99		X				X	BIO-5-VIF-SS	2	X										tissue - 2 composited
3/16/99		X				X	BIO-5-VIF-LB	1	X										tissue
3/18/99		X				X	BIO-2-FF-LB	1	X										tissue
3/18/99		X				X	BIO-2-WF-LB	1	X										tissue
3/18/99		X				X	BIO-3-WF-BG	1	X										tissue
3/18/99		X				X	BIO-3-FF-BG	1	X										tissue
3/17/99		X				X	BIO-3-WF-CS	1	X										tissue
3/18/99		X				X	BIO-4-FF-BG	1	X										tissue
3/18/99		X				X	BIO-4-WF-CF	1	X										tissue
3/18/99		X				X	BIO-4-WF-BG	1	X										tissue
3/19/99		X				X	BIO-5-FF-CF	1	X										tissue
3/19/99		X				X	BIO-7-WF-LB	1	X										tissue

SAMPLED BY: (SIGNATURE) [signature] DATE 3/19/99 TIME 1640

RECEIVED BY: (SIGNATURE) DATE TIME

RECEIVED BY: (SIGNATURE) DATE TIME

RECEIVED BY: (SIGNATURE) DATE TIME

COMMENTS:

SHIPPED BY: UPS [ ] HAND DELIVERED [ ] FED-EX [ ] PUROLATOR [ ] OTHER ____

SHIPPING NUMBER

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REV 9/93

CANVIRO
Analytical Laboratories Ltd.
50 Bathurst Drive, Unit 12
Waterloo, Ontario N2V 2C5
FAX (519) 747-3806
Phone (519) 747-2575

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CLIENT PROJECT NUMBER

CANVIRO QUOTATION NUMBER

COMPANY NAME: Harding Lawson Associates

CLIENT PURCHASE ORDER NUMBER

PROJECT MANAGER: Penny Baxter

PHONE NUMBER: (423) 531-1922

Requested Completion Date: Standard TAT

REGULATIONS: REG 347 ☐ MISA ☐ ODWO ☐ OTHER ____

Sample Disposal: Dispose ☒ Return ☐

FOR LAB USE ONLY

LOT NO. ____

ENTERED BY: ____

DATE ENTERED: ____

SAMPLING Date	SAMPLING Time	Type COMP.	Type GRAB	Matrix WATER	Matrix SOIL	Matrix OTHER	SAMPLE DESCRIPTION (This Description Will Appear On The Report)	NUMBER OF CONTAINERS	ANALYSES REQUESTED: Dioxin 8290	SAMPLE REMARKS
3/19/99		X				X	BIO-7-FF-LB	1	X	tissue
3/19/99		X				X	BIO-7-WF-SM	1	X	tissue
3/19/99		X				X	BIO-8-FF-CF	1	X	tissue
3/19/99		X				X	BIO-8-WF-LB	1	X	tissue
3/18/99		X				X	BIO-8-WF-CF	1	X	tissue
3/18/99		X				X	BIO-8-FF-LB	1	X	tissue

[signature] 3/19/99

SAMPLED BY: (SIGNATURE) [signature] DATE 3/19/99 TIME 1640

RECEIVED BY: (SIGNATURE) DATE TIME

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COMMENTS:

SHIPPED BY: UPS ☐ HAND DELIVERED ☐ FED-EX ☐ PUROLATOR ☐ OTHER ____

SHIPPING NUMBER

RECEIVED AT LAB: (SIGNATURE) DATE TIME

REV 9/97

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-1-FF-CF	Chris Crow

Composite Number.Specimen Number(s)	Chemical Analyses	Study Type
1 Fish	Dioxin 8290	NA

Sampling Date (d/m/yr).Time (24-hr clock)	☐ All target analytes ☐ Others (specify) _____	Screening	Intensive
3/16/99		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Yellow Bullhead Catfish (CF)	Whole Body	Resection	Wet	Dry
Comments: ♀ fish 60g sample		X	X	

	Sampling Date (d/mo/yr)
48 grams fillet ♀ w/eggs	18/3/99
	Time (24-h clock) AM

Species Name	
Yellow Bullhead Catfish	
Total Length or Size (cm) 1 Fish 60g	Sampling Site (name/number) BIO-1-FF-CF
Specimen Number	Sampling Date (d/mo/yr) 3/16/99
	Time (24-h clock) AM

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-1-FF-RE	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
6 fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
18/3/99 pm		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Red Ear (RE)	Whole Body	Resection	Wet	Dry
Comments: 136 grams 4-♀ w/eggs		X	X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and or ID number)	Sampler (name and signature)
BIO-2-WF-GS	Chris. Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
4 fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
18/3/99 pm		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Gizzard Shad (GS)	Whole Body	Resection	Wet	Dry
Comments: 4 fish	X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-2-WF-LB	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
1 fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)		Screening	Intensive
18/3/99 PM	☒ All target analytes ☐ Others (specify) _____	X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
	Whole Body	Resection	Wet	Dry
Largemouth Bass (LB)	X		X	

Comments: 233 mm - 156 g

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-2-FF-LB	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
1 fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)		Screening	Intensive
18/3/99 PM	☐ All target analytes ☐ Others (specify) _____	X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
	Whole Body	Resection	Wet	Dry
Largemouth Bass (LB)		X	X	

Comments: ♀ w/eggs

Project Number	Collecting Agency (name, address, phone)
02540.30	C² Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BI0.2-FF-CF	Chris Crow

Sample/Site Number/Specimen Number(s)	Chemical Analyses	Study Type
fish composite	Dioxin 8290	NA

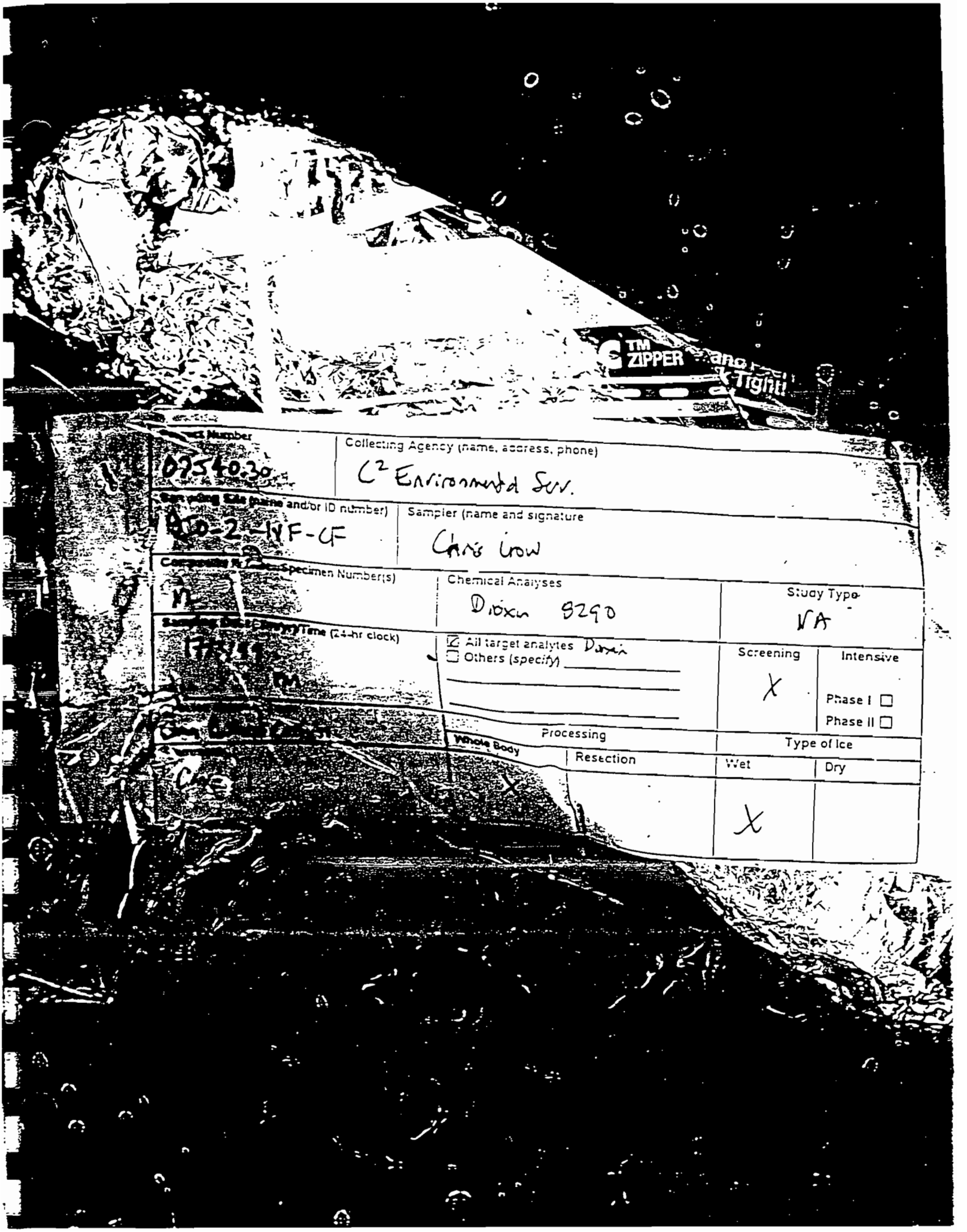
Sampling Date (d/m/y) Time (24-hr clock)	☐ All target analytes ☐ Others (specify) _____	Screening	Intensive
3/17/99		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Brown Bullhead Catfish (CF)	Whole Body	Resection	Wet	Dry
Comments		X	X	

Species Name or Code	Sample Type
Catfish (CF)	Fish Fillet

Sampling Site (name/number)

BI0.2-FF-CF



Collecting Agency (name, address, phone)	
C^2 Environmental Serv.	

Sampling Site (name and/or ID number)	Sampler (name and signature)
050-2-WF-CF	Chris Crow

Composite Specimen Number(s)	Chemical Analyses	Study Type
N	Dioxin 8290	NA

Sampling Date (mo/day/yr) Time (24-hr clock)		Screening	Intensive
[illegible]	☑ All target analytes Dioxin ☐ Others (specify)	X	Phase I ☐ Phase II ☐

Processing		Type of Ice	
Whole Body	Resection	Wet	Dry
X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-3-WF-CS	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
2 fish	Dioxin 8290	NA

Sampling Date (d/m/yr);Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
17/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Chub Sucker (CS)	Whole Body	Resection	Wet	Dry
Comments: one has eroded caudle fin	X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and or ID number)	Sampler (name and signature
BIO-3-FF-BG	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
4 fish	Dioxin 8290	NA

Sampling Date (d/m/yr);Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
18/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Blue Gill (BG)	Whole Body	Resection	Wet	Dry
Comments: Total wt. filleted = 76g		X	X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-3-WF-BG	Chris Crow

Composite Number, Specimen Number(s)	Chemical Analyses	Study Type
12 fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	All target analytes / Others (specify)	Screening	Intensive
18/3/99 AM	☒ All target analytes ☐ Others (specify)	X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
	Whole Body	Resection	Wet	Dry
Blue Gill - (BG)	X		X	

Comments

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-4-WF-BG	Chris Crow

Composite Number, Specimen Number(s)	Chemical Analyses	Study Type
1 fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	All target analytes / Others (specify)	Screening	Intensive
18/3/99 pm	☒ All target analytes ☐ Others (specify)	X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
	Whole Body	Resection	Wet	Dry
Blue gill (BG)	X		X	

Comments

135 mm - 52g

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-4-WF-CF	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
1 fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
18/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
catfish (CF)	Whole Body	Resection	Wet	Dry
Comments: 380mm - 440g	X		X	

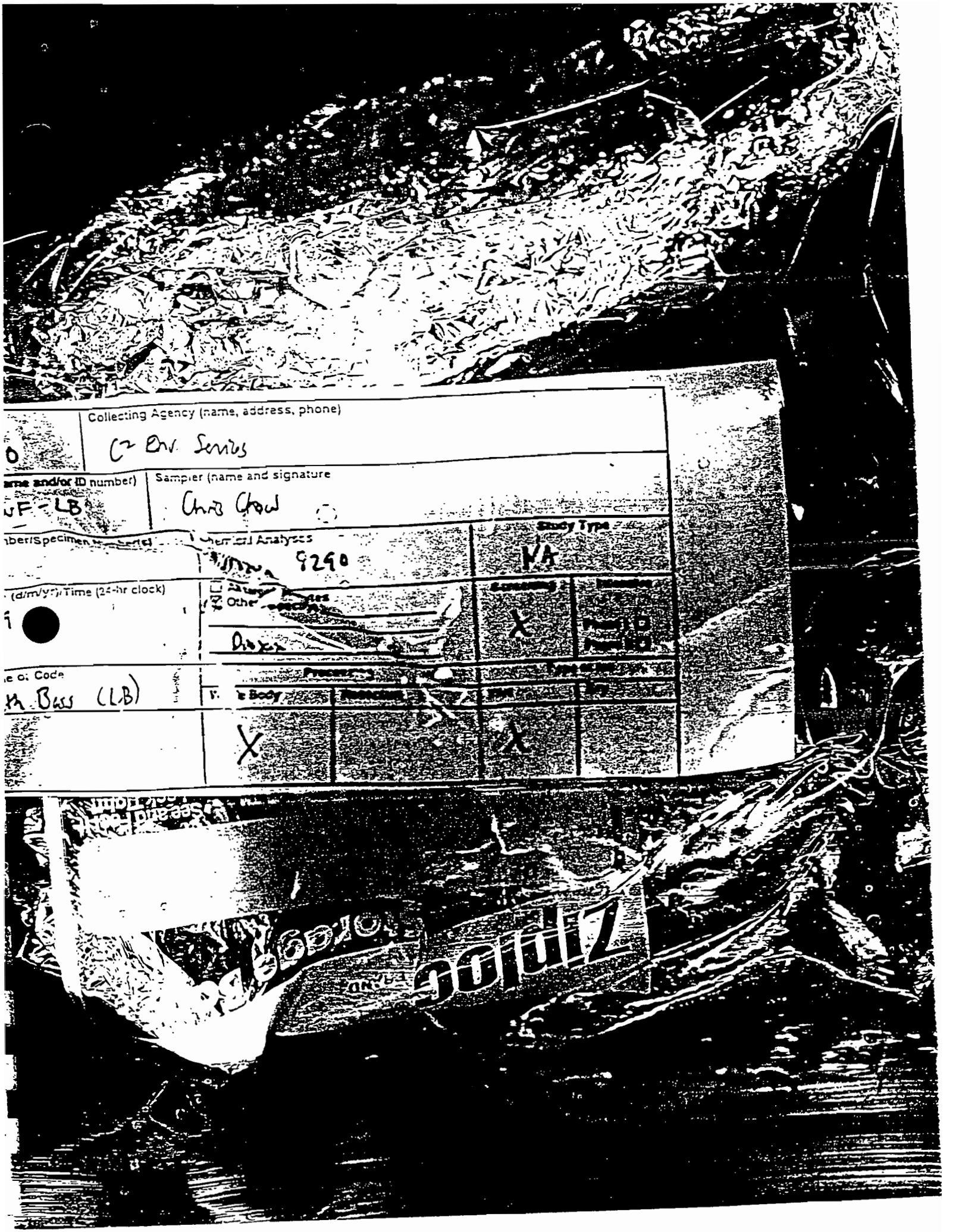
Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

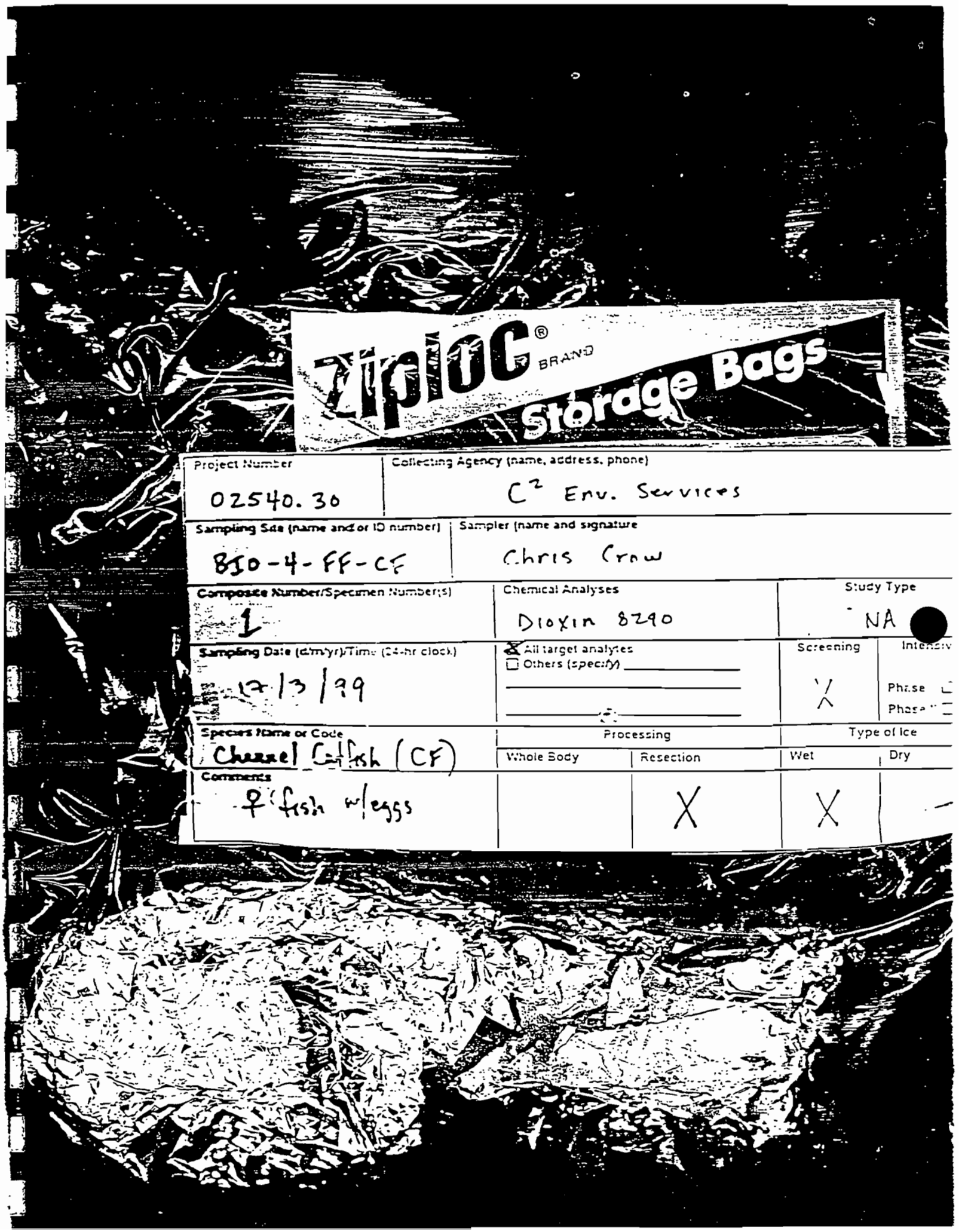
Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-4-FF-BG	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
2 - fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
18/3/99 PM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Blue gill (BG)	Whole Body	Resection	Wet	Dry
Comments: Total wt. filleted = 78 grams		X	X	


Collecting Agency (name, address, phone)
Sampler (name and signature
Chris Chow
Study Type
9290
Dioxin
Time (24-hr clock)
Code
Bass (LB)
X
X



Project Number	Collecting Agency (name, address, phone)
02540.30	C² Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-4-FF-CF	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
1	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening	Intensiv
17/3/99		X	Phase Phase

Species Name or Code	Processing		Type of Ice	
Channel Catfish (CF)	Whole Body	Resection	Wet	Dry
Comments: ♀ fish w/eggs		X	X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-5-FF-CF	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
1 fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
19/3/99 Am		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Catfish (CF)	Whole Body	Resection	Wet	Dry
Comments: 260mm - 278g fillet wt. 72g		X	X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
	Chris Crow.

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
~~Largemouth Bass (L~~	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☐ All target analytes ☐ Others (specify) _____	Screening	Intensive
		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
	Whole Body	Resection	Wet	Dry
Comments			X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-5-FF-LB	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
1	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
16/3/99		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ce	
Large mouth Bass (LB)	Whole Body	Resection	Wet	Dry
Comments: f w/ eggs		X	X	

Sampling Site (name and/or code): BIO-5-FF-LB
Sample Type: Fish
Sampling Site (name/number): C2-FF-LB
Number: 585
Size (cm):

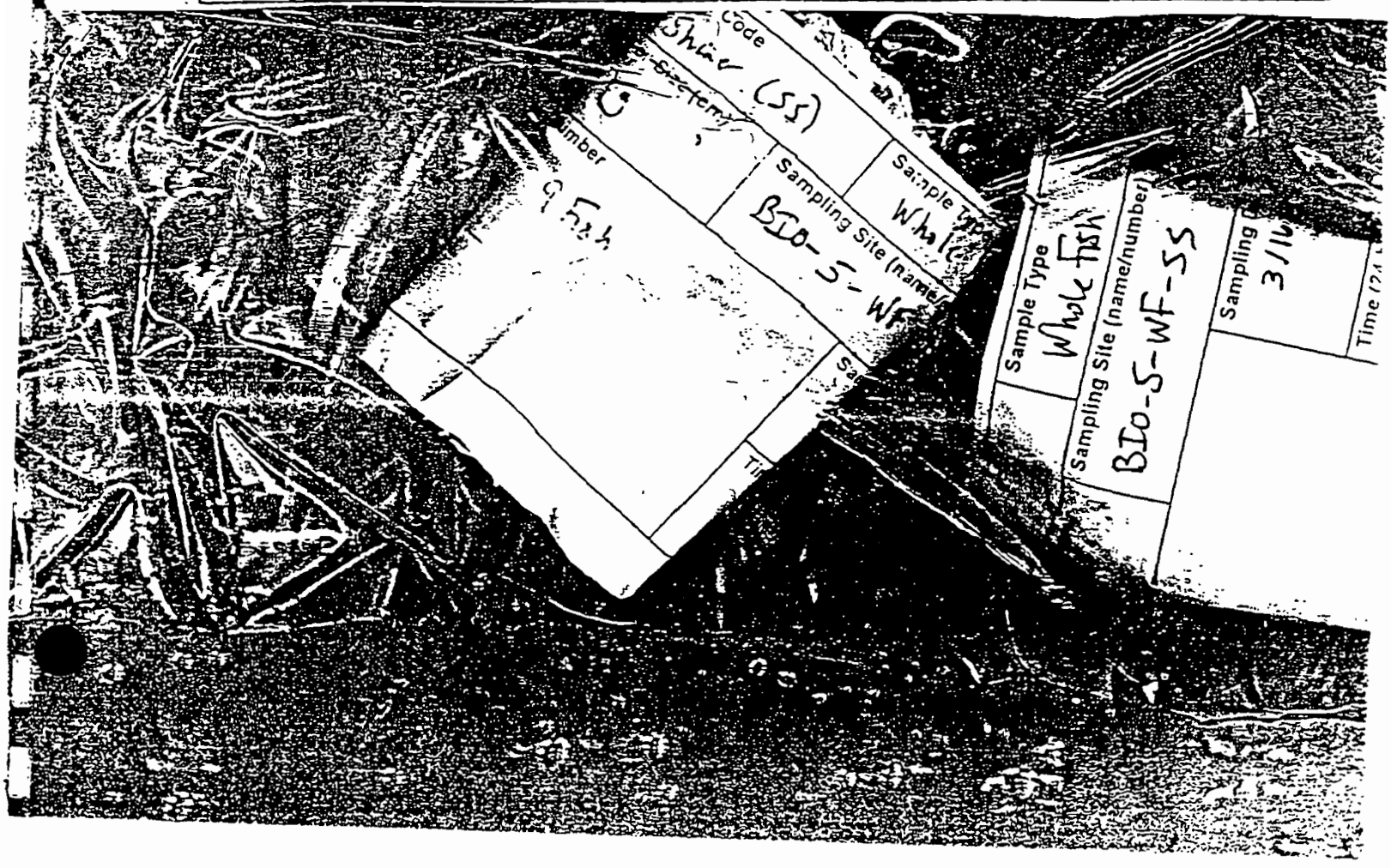
Project Number	Collecting Agency (name, address, phone)
02540.30	C² Env. Services, Inc.

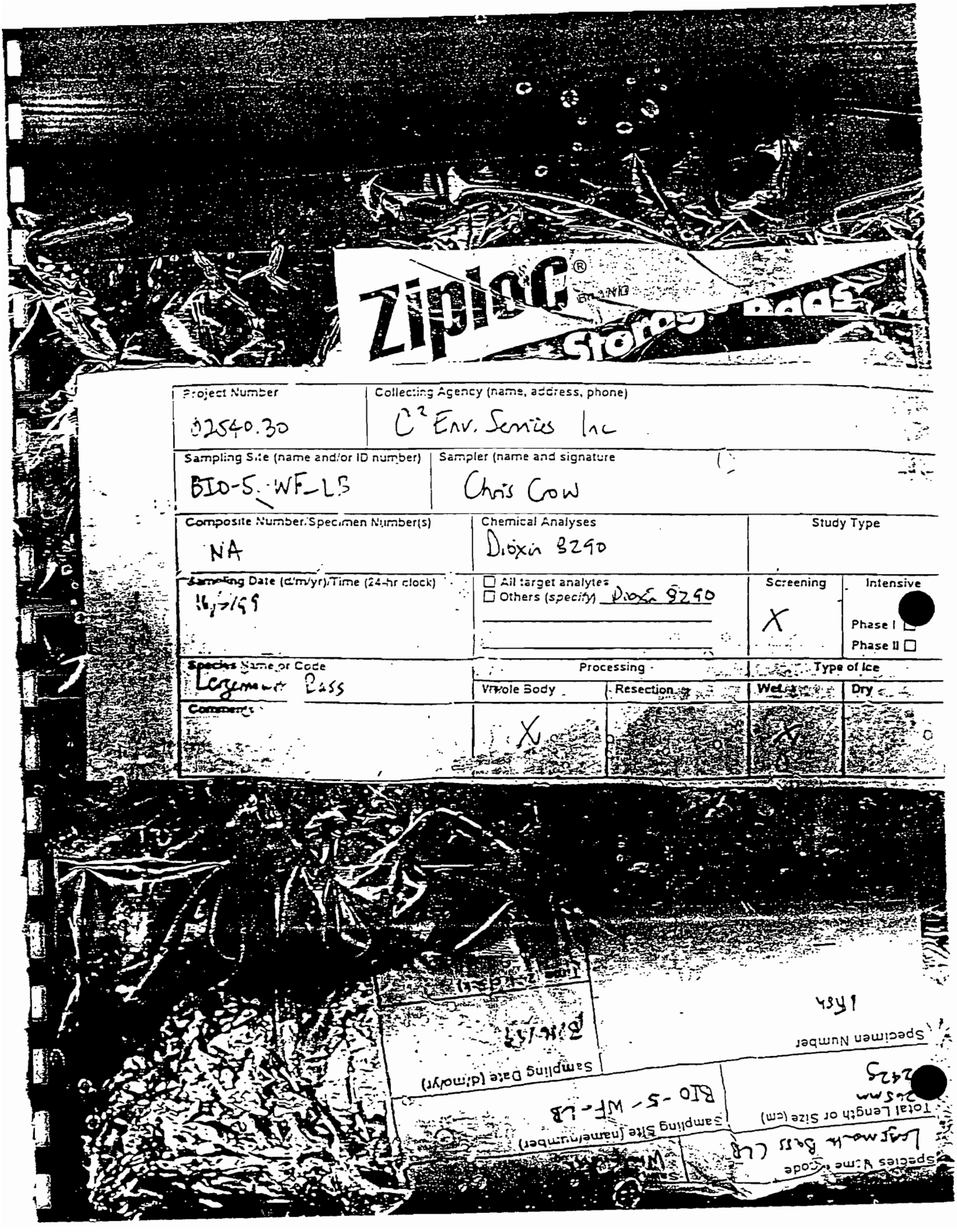
Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-5-WF-SS	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
NA	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☐ All target analytes ☐ Others (specify) Dioxin	Screening	Intensive
16/3/99 17/3/99		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
see comments	Whole Body	Resection	Wet	Dry
Comments 2 species included Spottail shiner & silverside ~40g in 2 composite samples	X		X	





Project Number	Collecting Agency (name, address, phone)
02540.30	C² Env. Services Inc

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-5-WF-LB	Chris Cow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
NA	Dioxin 8290	

Sampling Date (d/m/yr)/Time (24-hr clock)	☐ All target analytes ☐ Others (specify) Dioxin 8290	Screening	Intensive
16/7/99		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Largemouth Bass	Whole Body	Resection	Wet	Dry
Comments:	X		X	

Species Name or Code	Sampling Site (name/number)	Sampling Date (d/m/yr)	Specimen Number
Largemouth Bass CLB	BIO-5-WF-LB	16/7/99	1fish
Total Length or Size (cm) 245mm		Time (24-hr clock)	

[illegible]	Chris Cri..
Number(s) 1	Chemical Analyses
Sampling Date (d/m/yr)/Time (24-hr clock) 16/3/99 AM	☐ All target analytes ☒ Others (specify) Dioxin Dioxin 8290
Species Name or Code Large mouth Bass (LB)	
Comments replicate	

Study Type	
NA	
Screening X	Intensive Phase I ☐ Phase II ☐

Processing		Type of [illegible]	
Whole Body X	Resection	Wet X	Dry

Project Number	Collecting Agency (name, address, phone)
02540.30	E2 Environmental Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-6-WF-SM	Chris Cow

Composite Number/Specimen Number(s)	Chemical Analyses
#1	Dioxin 8290

Sampling Date (Day/yr)/Time (24-hr clock)	All target analytes / Other (specify)
10/21/99 AM	Dioxin

Species Name or Code	Processing	
Striped Mullet (SM)	Whole Body	Research
Comments	X	

Study Type		
NA		
Screening	Baseline	
X	Pre ☐ Post ☐	
Tissue		
Wet	Dry	
X		

Composite of 4 fish

3/15/99

Time (24-h clock)

AM

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-6-FF-LB	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analysis	Study Type	
1 Fish	Dioxin 8290	NA	
Sampling Date (dd/mo/yr) Time (24-hr clock) 3/16/99	☐ All target analytes ☐ Others (specify)	Screening X	Intensive Phase I ☐ Phase II ☑

Species Name or Code	Processing		Type of Ice	
Largemouth Bass	Whole Body	Resection	Wet	Dry
Comments: 2 f w/ eggs		X	X	

Species Name or Code	Sample Type
Largemouth Bass (LB)	Filet
Total Length or Size: 1 fish	Sampling Site (name/number): BIO-6-FF-LB
life	
Specimen Number: fish	Sampling Date (d/mo/yr): 3/16/99
	Time:

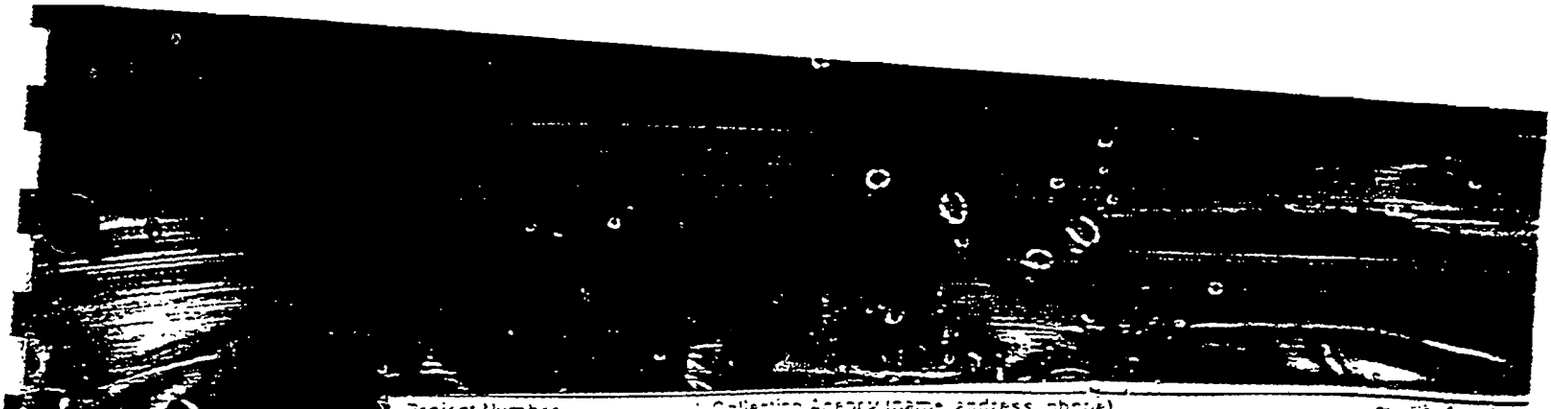
Project Number	Collecting Agency
D2543.30	ϕ^2 Environmental

Sampling Site (name and/or ID number)	Sampler (name and
BIO-6-WF-CF	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses
#1	Dioxin 8290

Sampling Date (d/m/yr) Time (24-hr clock)	
16/3/99-AM 17/3/99-PM	☐ All target analytes ☐ Others (specify) Dioxin

Species Name or Code	Processing		
Channel Catfish (CF)	Whole Body	Resection	Wet
Comments Bernard Bayou	X		X



Project Number	Collecting Agency (name, address, phone)
02540.30	C² Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-6-FF-CF	Chris Crow

Composite Number, Specimen Number(s)	Chemical Analyses	Study Ty
1	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening
17/3/99 PM		X

Species Name or Code	Processing		Type
Channel Catfish (CF)	Whole Body	Resection	Wet
Comments: ♀ fish w/eggs		X	X

Species	Fillet
Channel Catfish (CF)	

Total Length or Size (cm)	Sampling Site (name/number)
1 fish 250g	BIO-6-FF-CF

Specimen Number	Sampling Date (d/mo/yr)	Time (24-h clock)
—	3/17/99	PM

♀ fish w/ eggs

Storage

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and or ID number)	Sampler (name and signature
BIO-6-FF-CFR	Chris Crow

Composite Number.Specimen Number(s)	Chemical Analyses	Study Type
1 fish	Dioxin 8290	NA

Sampling Date (d/mo/yr)Time (24-hr clock)	All target analytes / Others (specify)	Screening	Intensive
17/3/99 PM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Channel Catfish (CF)	Whole Body	Resection	Wet	Dry
Comments: ♀ fish w/eggs		X	X	

Sampling Site (name/number)	Specimen Number	Sampling Date (d/mo/yr)	Time (24-h clock)
BIO-6-FF-CFR	1305	3/17/99	PM

Replicate for Fillet

Fish Fillet

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-7-WF-SM	Chris Crow

Composite Number, Specimen Number(s)	Chemical Analyses	Study Type
2-fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify) _____	Screening	Intensive
19/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Stripped Mullet (SM)	Whole Body	Resection	Wet	Dry
Comments 178 mm - 50g 163 mm - 48g	X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and or ID number)	Sampler (name and signature
BIO-7-WF-LB	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
2 fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☐ All target analytes ☐ Others (specify) _____	Screening	Intensive
19/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Largemouth Bass (LB)	Whole Body	Resection	Wet	Dry
Comments 188 mm - 80g 225 mm - 162g	X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-7-FF-LB	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
2X fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening	Intensive
19/3/99		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Largemouth Bass (LB)	Whole Body	Resection	Wet	Dry
Comments 1 - ♀ w/eggs Total wt. 132g		X	X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☐ All target analytes ☐ Others (specify)	Screening	Intensive
		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
	Whole Body	Resection	Wet	Dry
Comments			X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-8-WF-CF	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
2-fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening	Intensive
18/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Catfish (CF) Black Bullhead	Whole Body	Resection	Wet	Dry
Comments: 175 mm - 95 g 198 mm - 112 g	X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature)
BIO-8-FF-CF	Chris Crow

Composite Number/Specimen Number(s)	Chemical Analyses	Study Type
2-fish	Dioxin 8290	NA

Sampling Date (d/m/yr)/Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening	Intensive
18/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Catfish (CF) Black Bullhead	Whole Body	Resection	Wet	Dry
Comments: 1-deformed dorsal spine 1-♀ w/eggs Total Wt. 112 g		X	X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and/or ID number)	Sampler (name and signature
BIO-8-WF-LB	Chris Crow

Composite Number, Specimen Number(s)	Chemical Analyses	Study Type
2 - fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening	Intensive
18/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Largemouth Bass (LB)	Whole Body	Resection	Wet	Dry
Comments 260 mm - 254 g 230 mm - 170 g	X		X	

Project Number	Collecting Agency (name, address, phone)
02540.30	C^2 Env. Services

Sampling Site (name and or ID number)	Sampler (name and signature
BIO-8-FF-LB	Chris Crow

Composite Number, Specimen Number(s)	Chemical Analyses	Study Type
2 - fish	Dioxin 8290	NA

Sampling Date (d/m/yr), Time (24-hr clock)	☒ All target analytes ☐ Others (specify)	Screening	Intensive
18/3/99 AM		X	Phase I ☐ Phase II ☐

Species Name or Code	Processing		Type of Ice	
Largemouth Bass (LB)	Whole Body	Resection	Wet	Dry
Comments fillet wt. 223 g		X	X	

APPENDIX B

CREEL SURVEY

Creel Survey
January – April 1999

1.0 INTRODUCTION

This report provides the results of the Creel study conducted at the Naval Construction Battalion Center Gulfport (NCBC) in Gulfport, Mississippi, during the period January through April 1999. This study was conducted to determine the species most likely consumed by the fishing population on and around the base. The study results also will help guide fish collection conducted as part of the *Biological Monitoring Plan* of the base.

1.1 HISTORY. The NCBC in Gulfport, Mississippi, is currently operating under an Agreed Order (No. 319396) with the Mississippi Department of Environmental Quality (MSDEQ). The Agreed Order (AO) establishes a comprehensive strategy to delineate and, if warranted, remediate dioxin contamination due to prior storage and handling of herbicide orange on the base. The AO requires that NCBC Gulfport conduct a Human Health Exposure Assessment and a phased Biological Monitoring Plan (BMP) to evaluate the risks to human and ecological species due to potential contact with dioxin.

The Human Health Exposure Assessment, called the NCBC Gulfport Community Survey and Exposure Assessment (CSEA), was completed in May 1997 (HLA, 1997). The survey confirmed consumption of fish caught from the ditch system around the base, but it also reported that "people were reluctant to admit they fished from the ditch." Further, the CSEA recommended a Creel-type study to better evaluate this human exposure pathway. This document provides the results of the Creel study conducted at NCBC Gulfport.

1.2 PURPOSE. The first step in the BMP is to describe all the ways that humans can come into contact with the dioxin in the ditch system (HLA, 1998). Dioxin has a bioaccumulation factor of 23,000, indicating a significant potential for dioxin to move from sediments up the food chain into fish (Air Force, 1989). Humans can then consume these fish. Thus, a potentially important exposure pathway is consumption of dioxin-containing fish by humans.

However, not all the fish in the ditch system are likely to be consumed by humans. Some species may be too small or may not be present. Also, sustenance fishermen, who fish from the bank, may not easily catch other species. To accurately address the potential risks to the fishing population at NCBC Gulfport, it is important to identify the species caught and consumed.

2.0 STUDY METHODOLOGY

The Creel study was conducted in two phases. In the first phase, literature on fresh water fishing activity in south Mississippi was consulted. Mississippi Department of Fish, Wildlife, and Parks and the

Mississippi Gulf Coast Research Laboratory personnel were also contacted for additional information on species caught and consumed in the area around the base.

The second phase consisted of four site visits to the base during the period of January through April 1999. Fishermen observed in the area were interviewed to determine both the species caught and the species consumed by the human population.

3.0 STUDY RESULTS

The literature review of south Mississippi fresh water fishing was considerably assisted by several internet sites supported by the Mississippi Department of Fish, Wildlife, and Parks and the State of Mississippi. In addition, two experts in fresh water fishing activity in the Gulfport area were interviewed: Dennis Riecke of the Mississippi Department of Fish, Wildlife, and Parks and Larry Nicholson of the Mississippi Gulf Coast Research Laboratory.

3.1 FISH SPECIES. Many different fish species may be present in the NCBC Gulfport ditch system; however, the most likely caught and consumed fish at NCBC Gulfport come from only four entomological families. These families are the Sunfish (*Centrarchidae*), the Catfish (*Ictaluridae*), the Perch (*Percidae*), and the Temperate bass (*Percichthyidae*). The most common fish species at NCBC Gulfport are in the Sunfish and the Catfish families.

3.1.1 Sunfish The members of the Sunfish family directly observed or identified by fishermen in the area include the largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochiris*), and the sunfish (*Lepomis cyanellus*). Other species possibly present include smallmouth bass (*Micropterus dolomieu*), spotted bass (*Micropterus punctulatus*), white crappie (*Pomoxis annularis*), redear sunfish (*Lepomis microlophus*), warmouth (*Lepomis gulosus*), green sunfish (*Lepomis cyanellus*), longear sunfish (*Lepomis megalotis*), redbreast sunfish (*Lepomis auritus*) and shadow bass (*Ambloplites ariommus*).

3.1.2 Catfish The members of the Catfish family directly observed or identified by fishermen in the area include the channel catfish (*Ictalurus punctatus*), the blue catfish (*Ictalurus furcatus*), and the flathead catfish (*Pylodictus olivaris*). Other species possibly present include the yellow bullhead (*Ameiurus natalis*), the black bullhead (*Ameiurus melas*), and the brown bullhead (*Ameiurus nebulosus*).

3.1.3 Perch The member of the Perch family directly observed or identified by fishermen in the area is the yellow perch (*Perca flavescens*). Other species possibly present include the walleye (*Stizostedion vitreum*), and sauger (*Stizostedion canadense*).

3.1.4 Temperate Bass Seabee Lake at NCBC Gulfport is stocked with the hybrid striped bass (*Morone chrysops x Morone saxatilis* and/or *Morone saxatilis x Morone chrysops*). Other members of the Temperate bass family possibly present include the yellow bass (*Morone mississippiensis*) and the striped bass (*Morone saxatilis*).

3.1.5 Other Fish Species Several other fish species may be present in the ditch system around NCBC Gulfport. An American eel (*Anguilla rostrata*) was found during construction activities in Canal No. 1 at Canal Road. The spotted gar (*Lepisosteus oculatus*), longnose gar (*Lepisosteus osseus*), shortnose gar (*Lepisosteus platostomus*), and alligator gar (*Lepisosteus spatula*) are likely in areas of deeper water. The common carp (*Cyprinus carpio*) is also likely in most areas of the base. The smallmouth buffalo (*Ictiobus bubalus*), bigmouth buffalo (*Ictiobus cyprinellus*), black buffalo (*Ictiobus niger*) and the freshwater drum (*Aplodinotus grunniens*) may be present in Bernard Bayou.

3.2 SITE VISITS. Four site visits were conducted as part of this study. An unusually dry winter, combined with cold weather, made it difficult to identify and interview fishermen.

3.2.1 Fishermen Interviews Only two fishermen were identified and interviewed during the four site visits. One fisherman was identified during the February site visit and another during the April visit. The fishermen were located under the bridge near the intersection of Polk and Ohio Streets and next to Turkey Creek near the airport runway, respectively.

Both fishermen described catching and consuming bass, crappie, catfish and "bream." The bass described are likely the largemouth bass (*Micropterus salmoides*). The fish described as "bream" are probably bluegill (*Lepomis macrochiris*), sunfish (*Lepomis cyanellus*), or yellow perch (*Perca flavescens*). The crappie was clearly the black crappie (*Pomoxis nigromaculatus*).

Both were in possession of blue catfish (*Ictalurus furcatus*), but also described catching channel catfish (*Ictalurus punctatus*), and the flathead catfish (*Pylodictus olivaris*) when water levels were high.

3.2.2 CSEA Results Three non-fish species were also considered in the Creel study. During the 1997 CSEA, an NCBC worker indicated that he commonly consumed frogs (*Rana sp.*) collected from the ditches at NCBC Gulfport (HLA, 1997). This activity was not witnessed during the site visits, but it may represent an unusual consumption exposure pathway that may need further evaluation.

4.0 STUDY CONCLUSIONS

This Creel study confirms the earlier CSEA results that humans are consuming fish collected from the ditch system around NCBC Gulfport. While there may be numerous species present in the area, only a few entomological families are represented. This study recommends the fish collection portion of the BMP attempt to collect representatives from each family. Emphasis should be placed on obtaining several members of the Sunfish (*Centrarchidae*) and Catfish (*Ictaluridae*) families. Additional families sampled may include Perch (*Percidae*), and Temperate bass (*Percichthyidae*).

At this time, there is no evidence of consumption of crayfish (*Procambrus sp.*) collected from the ditch system. It is recommended that this species not be further evaluated in the fish collection portion of the BMP.

5.0 REFERENCES

Harding Lawson Associates (HLA). 1997. Results of Community Survey and Exposure Assessment, Naval Construction Battalion Center Gulfport, Mississippi. Unit Identification Code N62604, May 1997.

HLA. 1998. Biological Monitoring Plan Workplan for Naval Construction Battalion Center Gulfport, Mississippi. May 1998.

Air Force. 1989. U.S. Air Force Installation Restoration Program Toxicology Guide. Volume 4, Chapter 63. 2,3,7,8-Tetrachlorodibenzo-p-dioxin. July 1989.

APPENDIX C

COMPREHENSIVE DATA TABLES

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-1	BIO-1	BIO-1	BIO-2	BIO-2	BIO-2
	SAMPLE ID	BIO-1-FF-CF	BIO-SD-1	BIO-1-FF-RE	BIO-SD-2	BIO-2-FF-CF	BIO-2-WF-CF
	DATE	03/16/99	03/17/99	03/18/99	03/16/99	03/17/99	03/17/99
	DEPTH (ft)	-1.00	0.00	-1.10	0.00	-1.00	-1.20
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.6 U	1.49 EMP	2.59	0.63 U	0.9 U	0.78 U
1,2,3,7,8-PeCDD		0.74 U	0.74 U	0.72 U	0.92 U	0.53 U	0.89 U
1,2,3,4,7,8-HxCDD		0.63 U	3.61 U	0.39 U	3.61 EMP	0.56 U	0.81 U
1,2,3,6,7,8-HxCDD		0.53 U	1.74 U	0.32 U	10.3	0.47 U	0.68 U
1,2,3,7,8,9-HxCDD		0.59 U	0.89 U	0.37 U	9.76	0.53 U	0.76 U
1,2,3,4,6,7,8-HpCDD		1.23 U	68.6	0.53 U	465	0.86 U	1.35 U
1,2,3,4,6,7,8,9-OCDD		1.38 U	711	0.69 U	4790	1.51 U	9.83 EMP
2,3,7,8-TCDF		0.1 U	0.53 U	0.56 U	0.84 U	0.48 U	0.98 U
1,2,3,7,8-PeCDF		0.97 U	0.27 U	0.83 U	0.54 U	0.91 U	0.61 U
2,3,4,7,8-PeCDF		0.56 U	0.32 U	0.96 U	0.62 U	0.57 U	0.71 U
1,2,3,4,7,8-HxCDF		0.43 U	0.41 U	0.32 U	3.64	1.66 U	0.47 U
1,2,3,6,7,8-HxCDF		0.37 U	0.34 U	0.28 U	3.77 EMP	0.35 U	0.41 U
2,3,4,6,7,8-HxCDF		0.45 U	0.55 U	0.34 U	4.5 EMP	0.42 U	0.5 U
1,2,3,7,8,9-HxCDF		0.57 U	0.27 U	0.43 U	0.66 U	0.53 U	0.63 U
1,2,3,4,6,7,8-HpCDF		0.7 U	12	0.4 U	84.8	0.15 U	0.98 U
1,2,3,4,7,8,9-HpCDF		1.07 U	0.46 U	0.62 U	5.04	0.82 U	1.5 U
1,2,3,4,6,7,8,9-OCDF		2.25 U	38.3	1.36 U	219	2.28 U	2.78 U
Total TCDD		ND U	ND U	2.59	ND U	ND U	ND U
Total PeCDD		ND U	ND U	ND U	ND U	ND U	ND U
Total HxCDD		ND U	5.01	ND U	76.9	ND U	ND U
Total HpCDD		ND U	336	ND U	1060	ND U	ND U
Total TCDF		ND U	ND U	ND U	ND U	5	ND U
Total PeCDF		ND U	3.84	ND U	ND U	9.33	ND U
Total HxCDF		ND U	4.29	ND U	65.3	13.5	ND U
Total HpCDF		ND U	32.2	ND U	213	ND U	ND U
Total TEQ		0	1.5553	2.59	12.9274	0	0

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
ND = Not Detected

For RCL DIOX

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-2	BIO-2	BIO-2	BIO-3	BIO-3	BIO-3
	SAMPLE ID	BIO-2-FF-LB	BIO-2-WF-GS	BIO-2-WF-LB	BIO-SD-3	BIO-3-WF-CS	BIO-3-FF-BG
	DATE	03/18/99	03/18/99	03/18/99	03/17/99	03/17/99	03/18/99
	DEPTH (ft)	-1.10	-1.30	-1.40	0.00	-1.20	-1.00
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.86 U	0.24 U	3.08	0.54 U	0.72 U	0.37 U
1,2,3,7,8-PeCDD		0.59 U	0.45 U	1.44 U	0.87 U	0.8 U	0.79 U
1,2,3,4,7,8-HxCDD		0.5 U	0.83 U	0.62 U	0.42 U	0.61 U	0.46 U
1,2,3,6,7,8-HxCDD		0.42 U	2.59 EMP	0.95 U	0.61 U	0.51 U	0.38 U
1,2,3,7,8,9-HxCDD		0.47 U	1.6 U	0.58 U	7.05	0.57 U	0.43 U
1,2,3,4,6,7,8-HpCDD		0.73 U	10.7	2.97	78.8	1.86 U	0.67 U
1,2,3,4,6,7,8,9-OCDD		1.19 U	68.9	8.8	2380	10.4	0.88 U
2,3,7,8-TCDF		0.57 U	2.14 EMP	0.69 U	0.34 U	0.65 U	0.41 U
1,2,3,7,8-PeCDF		0.58 U	0.79 U	0.72 U	0.39 U	0.4 U	0.57 U
2,3,4,7,8-PeCDF		0.67 U	0.92 U	0.83 U	0.46 U	0.47 U	0.66 U
1,2,3,4,7,8-HxCDF		0.33 U	0.52 U	2.44 U	0.27 U	0.36 U	0.33 U
1,2,3,6,7,8-HxCDF		0.29 U	0.44 U	0.37 U	0.24 U	0.31 U	0.29 U
2,3,4,6,7,8-HxCDF		0.35 U	0.54 U	0.46 U	0.29 U	0.38 U	0.35 U
1,2,3,7,8,9-HxCDF		0.44 U	0.68 U	0.57 U	0.36 U	0.47 U	0.44 U
1,2,3,4,6,7,8-HpCDF		0.39 U	0.9 U	0.14 U	2.42 U	0.45 U	0.44 U
1,2,3,4,7,8,9-HpCDF		0.6 U	0.93 U	0.98 U	0.51 U	0.69 U	0.67 U
1,2,3,4,6,7,8,9-OCDF		1.91 U	3.51 U	2.44 U	4.75 U	2.03 U	1.57 U
Total TCDD		ND U	ND U	3.08	ND U	ND U	ND U
Total PeCDD		ND U	ND U	ND U	ND U	ND U	ND U
Total HxCDD		ND U	ND U	ND U	15.4	ND U	ND U
Total HpCDD		ND U	17	2.97	176	ND U	ND U
Total TCDF		ND U	ND U	13.8	ND U	ND U	ND U
Total PeCDF		ND U	ND U	14.1	ND U	ND U	ND U
Total HxCDF		ND U	ND U	ND U	ND U	ND U	ND U
Total HpCDF		ND U	ND U	ND U	ND U	ND U	ND U
Total TEQ		0	0.1759	3.1185	3.873	0.0104	0

Values represent total concentrations unless noted < =Not detected at indicated reporting limit --- =Not analyzed
ND = Not Detected
For RCL DIO

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-3	BIO-4	BIO-4	BIO-4	BIO-4	BIO-4
	SAMPLE ID	BIO-3-WF-BG	BIO-SD-4	BIO-4-FF-CF	BIO-4-FF-BG	BIO-4-WF-BG	BIO-4-WF-CF
	DATE	03/18/99	03/17/99	03/17/99	03/18/99	03/18/99	03/18/99
	DEPTH (ft)	-1.10	0.00	-1.10	-1.00	-1.20	-1.30
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.72 U	0.4 U	0.38 U	0.81 U	0.38 U	2.15 EMP
1,2,3,7,8-PeCDD		0.8 U	0.28 U	0.57 U	0.86 U	1 U	0.85 U
1,2,3,4,7,8-HxCDD		0.43 U	0.53 U	0.001 U	0.51 U	0.71 U	0.65 U
1,2,3,6,7,8-HxCDD		0.36 U	0.44 U	2.33 U	0.42 U	0.53 U	0.48 U
1,2,3,7,8,9-HxCDD		0.41 U	1.2 U	1.05 U	0.48 U	0.64 U	0.58 U
1,2,3,4,6,7,8-HpCDD		0.58 U	10.9	6.24	0.63 U	1.08 U	4.94
1,2,3,4,6,7,8,9-OCDD		16.4	181	5.02	0.98 U	9.93	13.6
2,3,7,8-TCDF		0.32 U	0.29 U	0.59 U	0.64 U	0.52 U	0.44 U
1,2,3,7,8-PeCDF		0.43 U	0.3 U	0.37 U	0.75 U	0.052 U	0.73 U
2,3,4,7,8-PeCDF		0.5 U	0.35 U	0.39 U	0.87 U	0.55 U	0.76 U
1,2,3,4,7,8-HxCDF		0.25 U	0.27 U	0.35 U	0.31 U	0.34 U	0.32 U
1,2,3,6,7,8-HxCDF		0.21 U	0.23 U	0.27 U	0.27 U	0.27 U	0.25 U
2,3,4,6,7,8-HxCDF		0.26 U	0.28 U	0.36 U	0.32 U	0.35 U	0.33 U
1,2,3,7,8,9-HxCDF		0.33 U	0.36 U	0.43 U	0.41 U	0.42 U	0.4 U
1,2,3,4,6,7,8-HpCDF		0.4 U	0.94 U	1.47 U	0.55 U	0.49 U	0.44 U
1,2,3,4,7,8,9-HpCDF		0.62 U	0.52 U	0.55 U	0.84 U	0.73 U	0.67 U
1,2,3,4,6,7,8,9-OCDF		1.36 U	2.74 U	2.68 U	1.84 U	2.61 U	2.25 U
Total TCDD		ND U	1.19	ND U	ND U	ND U	ND U
Total PeCDD		ND U	ND U	ND U	ND U	ND U	ND U
Total HxCDD		ND U	9.35 U	ND U	ND U	ND U	ND U
Total HpCDD		ND U	28.7	6.24	ND U	ND U	4.94
Total TCDF		ND U	ND U	ND U	ND U	ND U	ND U
Total PeCDF		ND U	ND U	ND U	ND U	ND U	ND U
Total HxCDF		ND U	ND U	ND U	ND U	ND U	ND U
Total HpCDF		ND U	ND U	ND U	ND U	ND U	ND U
Total TEQ		0.0164	0.29	0.06742	0	0.00993	0.063

Values represent total concentrations unless noted < =Not detected at indicated reporting limit --- =Not analyzed
ND = Not Detected
For RCL DIOX

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-5	BIO-5	BIO-5	BIO-5	BIO-5	BIO-5
	SAMPLE ID	BIO-SD-5	BIO-SD-5D	BIO-5-FF-LB	BIO-5-WF-LB	BIO-5-WF-SS	BIO-5-FF-CF
	DATE	03/16/99	03/16/99	03/16/99	03/16/99	03/16/99	03/19/99
	DEPTH (ft)	0.00	0.00	-1.10	-1.20	-1.30	-1.00
	RESULT TYPE	Primary	Duplicate 1	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.87 U	0.51 U	0.78 U	1.94 EMP	1.17 U	0.67 U
1,2,3,7,8-PeCDD		0.57 U	0.62 U	0.85 U	2.11 EMP	2.42 U	0.52 U
1,2,3,4,7,8-HxCDD		0.31 U	0.98 U	0.5 U	0.61 U	1.04 U	0.98 U
1,2,3,6,7,8-HxCDD		5.12	3.91 EMP	1.06 U	2.99	0.87 U	0.73 U
1,2,3,7,8,9-HxCDD		6.37	5.16	0.47 U	0.54 U	0.98 U	0.88 U
1,2,3,4,6,7,8-HpCDD		207	211	1.69 U	4.7	4.52	1.05 U
1,2,3,4,6,7,8,9-OCDD		2920	2750	3.45 U	10.9	28.9	1.66 U
2,3,7,8-TCDF		0.55 U	0.33 U	0.47 U	0.35 U	1.39 U	0.46 U
1,2,3,7,8-PeCDF		0.54 U	0.36 U	0.44 U	0.75 U	0.96 U	0.76 U
2,3,4,7,8-PeCDF		0.62 U	0.38 U	0.51 U	0.87 U	1.11 U	0.8 U
1,2,3,4,7,8-HxCDF		2.33 U	0.9 U	2.36 U	0.82 U	3.32 EMP	0.35 U
1,2,3,6,7,8-HxCDF		1.35 U	1.41 U	0.24 U	0.45 U	0.57 U	0.27 U
2,3,4,6,7,8-HxCDF		0.001 U	0.26 U	0.29 U	0.55 U	0.69 U	0.36 U
1,2,3,7,8,9-HxCDF		0.33 U	0.33 U	0.37 U	0.69 U	0.87 U	0.43 U
1,2,3,4,6,7,8-HpCDF		41.7	37.3	0.67 U	0.63 U	1.62 U	0.42 U
1,2,3,4,7,8,9-HpCDF		2.61	2 U	0.46 U	0.96 U	1.28 U	0.64 U
1,2,3,4,6,7,8,9-OCDF		123	116	1.46 U	2.97 U	2.08 U	2.42 U
Total TCDD		11.5	ND U	ND U	ND U	ND U	ND U
Total PeCDD		ND U	ND U	ND U	ND U	ND U	ND U
Total HxCDD		56.5	49.4	ND U	ND U	ND U	ND U
Total HpCDD		437	441	ND U	4.7	4.52	ND U
Total TCDF		ND U	ND U	3.69	8.01	10.8	ND U
Total PeCDF		4.15	1.9	5.35	5.93	12	ND U
Total HxCDF		31.9	23.8	ND U	9.05	ND U	ND U
Total HpCDF		107	102	ND U	ND U	ND U	ND U
Total TEQ		6.7051	5.9	0	0.3569	0.0741	0

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

ND = Not Detected

For RCL DIO

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-6	BIO-6	BIO-6	BIO-6	BIO-6	BIO-6
	SAMPLE ID	BIO-SD-6	BIO-6-FF-LB	BIO-6-WF-CF	BIO-6-WF-LB	BIO-6-WF-LBR	BIO-6-WF-SM
	DATE	03/16/99	03/16/99	03/16/99	03/16/99	03/16/99	03/16/99
	DEPTH (ft)	0.00	-1.20	-1.30	-1.40	-1.50	-1.60
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.32 U	0.97 U	0.18 U	0.19 U	0.97 U	0.73 U
1,2,3,7,8-PeCDD		0.22 U	0.99 U	3.2 EMP	0.71 U	0.76 U	0.75 U
1,2,3,4,7,8-HxCDD		0.32 U	0.8 U	1.37 U	1.12 U	0.78 U	0.82 U
1,2,3,6,7,8-HxCDD		1.64 U	0.66 U	5.16	0.93 U	1.56 U	0.68 U
1,2,3,7,8,9-HxCDD		1.36 U	0.76 U	1.56 U	1.06 U	0.74 U	0.78 U
1,2,3,4,6,7,8-HpCDD		93.6	1.52 U	5.3 EMP	1.84 U	3.34	5.51
1,2,3,4,6,7,8,9-OCDD		1430	2.16 U	19.9	3.32 U	12	54
2,3,7,8-TCDF		0.34 U	0.69 U	0.98 U	0.32 U	0.77 U	0.95 U
1,2,3,7,8-PeCDF		0.27 U	0.95 U	0.99 U	0.88 U	0.49 U	0.79 U
2,3,4,7,8-PeCDF		0.31 U	0.51 U	3.19	0.93 U	0.52 U	0.84 U
1,2,3,4,7,8-HxCDF		0.74 U	1.5 U	1.82 U	0.86 U	2.53	0.88 U
1,2,3,6,7,8-HxCDF		0.34 U	0.75 U	0.8 U	0.5 U	0.26 U	0.52 U
2,3,4,6,7,8-HxCDF		0.32 U	0.6 U	0.67 U	0.63 U	0.51 U	0.65 U
1,2,3,7,8,9-HxCDF		0.25 U	0.73 U	0.82 U	0.77 U	0.62 U	0.79 U
1,2,3,4,6,7,8-HpCDF		16.1	0.73 U	0.26 U	0.95 U	2.44 U	1.28 U
1,2,3,4,7,8,9-HpCDF		1.35 U	1 U	1.35 U	1.29 U	0.87 U	0.7 U
1,2,3,4,6,7,8,9-OCDF		63.3	2.7 U	3.1 U	2.1 U	1.91 U	3.03 U
Total TCDD		12.3	ND U	ND U	ND U	ND U	ND U
Total PeCDD		ND U	ND U	ND U	ND U	ND U	ND U
Total HxCDD		12.8	ND U	5.16	ND U	ND U	ND U
Total HpCDD		256	ND U	ND U	ND U	3.35	11.7
Total TCDF		ND U	8.75	9.2	ND U	14.7	ND U
Total PeCDF		ND U	ND U	3.19	ND U	8.98	ND U
Total HxCDF		10.9	ND U	ND U	3.5	25.3	7.03
Total HpCDF		53	ND U	ND U	ND U	5.78	ND U
Total TEQ		2.5903	0	2.1359	0	0.2985	0.1091

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
ND = Not Detected
For RCL DIOX

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-6	BIO-6	BIO-7	BIO-7	BIO-7	BIO-7
	SAMPLE ID	BIO-6-FF-CF	BIO-6-FF-CFR	BIO-SD-7	BIO-7-FF-LB	BIO-7-WF-LB	BIO-7-WF-SM
	DATE	03/17/99	03/17/99	03/17/99	03/19/99	03/19/99	03/19/99
	DEPTH (ft)	-1.00	-1.10	0.00	-1.00	-1.10	-1.20
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.3 U	0.84 U	0.48 U	0.57 U	0.9 U	0.12 U
1,2,3,7,8-PeCDD		0.76 U	0.51 U	1.04 EMP	0.89 U	0.7 U	1.08 U
1,2,3,4,7,8-HxCDD		1.18 U	0.74 U	1 U	0.61 U	0.7 U	0.9 U
1,2,3,6,7,8-HxCDD		3.86 EMP	0.61 U	11	0.46 U	0.52 U	0.68 U
1,2,3,7,8,9-HxCDD		0.72 U	0.7 U	12.1	0.56 U	0.63 U	0.82 U
1,2,3,4,6,7,8-HpCDD		4.7 EMP	1.5 U	258	0.99 U	0.9 U	10.5
1,2,3,4,6,7,8,9-OCDD		8.02 EMP	2.35 U	5300	1.45 U	1.46 U	108
2,3,7,8-TCDF		0.89 U	0.69 U	0.52 U	0.36 U	0.63 U	0.66 U
1,2,3,7,8-PeCDF		0.64 U	0.86 U	0.2 U	0.61 U	0.43 U	0.55 U
2,3,4,7,8-PeCDF		0.68 U	0.91 U	0.7 U	0.64 U	0.46 U	0.57 U
1,2,3,4,7,8-HxCDF		4.54 (EMPC)	0.48 U	2.19 U	0.4 U	3.7	1.44 U
1,2,3,6,7,8-HxCDF		0.28 U	0.4 U	1.08 U	0.31 U	0.32 U	0.29 U
2,3,4,6,7,8-HxCDF		0.88 U	0.5 U	1.7 U	0.41 U	0.42 U	0.38 U
1,2,3,7,8,9-HxCDF		1.08 U	0.61 U	0.22 U	0.49 U	0.51 U	0.46 U
1,2,3,4,6,7,8-HpCDF		0.83 U	0.81 U	27.2	0.4 U	0.1 U	2.29 U
1,2,3,4,7,8,9-HpCDF		1.13 U	1.1 U	0.44 U	0.61 U	0.56 U	0.91 U
1,2,3,4,6,7,8,9-OCDF		2.19 U	2.27 U	33.3	3.15 U	3.11 U	6.01 EMP
Total TCDD		ND U	ND U	2.81	ND U	ND U	ND U
Total PeCDD		ND U	ND U	6.01	ND U	ND U	ND U
Total HxCDD		ND U	ND U	129	ND U	ND U	ND U
Total HpCDD		4.76	ND U	586	ND U	ND U	22.6
Total TCDF		ND U	3.32	ND U	ND U	5.48	6.3
Total PeCDF		29.4	ND U	14.7	ND U	7.63	5.3
Total HxCDF		65	ND U	23.4	ND U	3.7	ND U
Total HpCDF		9.46	ND U	51.9	ND U	3.95	ND U
Total TEQ		0	0	10.4953	0	0.37	0.213

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
ND = Not Detected
For RCL DIO

PRELIMINARY DIOXIN/FURAN RESULTS
MARCH 1999
BIOLOGICAL MONITORING PLAN
NCBC GULFPORT, MS.

CONSTITUENT (Units in ng/kg)	SITE	BIO-8	BIO-8	BIO-8	BIO-8	BIO-8
	SAMPLE ID	BIO-SD-8	BIO-8-FF-LB	BIO-8-WF-CF	BIO-8-FF-CF	BIO-8-WF-LB
	DATE	03/17/99	03/18/99	03/18/99	03/19/99	03/19/99
	DEPTH (ft)	0.00	-1.10	-1.20	-1.00	-1.30
	RESULT TYPE	Primary	Primary	Primary	Primary	Primary
2,3,7,8-TCDD		0.57 U	11.3 U	0.88 U	0.45 U	2.1
1,2,3,7,8-PeCDD		0.65 U	6.54 U	4.48	0.84 U	2.67 EMP
1,2,3,4,7,8-HxCDD		0.57 U	0.87 U	0.78 U	0.7 U	0.001 U
1,2,3,6,7,8-HxCDD		1.64 U	0.72 U	2.26 U	0.52 U	1.78 U
1,2,3,7,8,9-HxCDD		1.51 U	0.83 U	1.03 U	0.63 U	0.64 U
1,2,3,4,6,7,8-HpCDD		57.1	0.58 U	4.92	1.04 U	1.68 U
1,2,3,4,6,7,8,9-OCDD		582	1.14 U	7.86	1.17 U	2.2 U
2,3,7,8-TCDF		0.57 U	0.8 U	0.66 U	0.48 U	0.58 U
1,2,3,7,8-PeCDF		0.5 U	27.5 U	0.46 U	0.65 U	0.81 U
2,3,4,7,8-PeCDF		0.58 U	29.2 U	0.49 U	0.68 U	0.86 U
1,2,3,4,7,8-HxCDF		0.63 U	19.1 U	0.37 U	0.31 U	0.65 U
1,2,3,6,7,8-HxCDF		0.42 U	15.8 U	0.4 U	0.25 U	0.26 U
2,3,4,6,7,8-HxCDF		0.81 U	19.8 U	0.38 U	0.32 U	0.33 U
1,2,3,7,8,9-HxCDF		0.35 U	24.2 U	0.46 U	0.39 U	0.4 U
1,2,3,4,6,7,8-HpCDF		12.9	4.72 U	1.01 U	0.38 U	0.4 U
1,2,3,4,7,8,9-HpCDF		0.72 U	6.43 U	0.6 U	0.56 U	0.54 U
1,2,3,4,6,7,8,9-OCDF		26.1	1.28 U	0.95 U	2.77 U	1.15 U
Total TCDD		ND U	ND U	ND U	ND U	2.1
Total PeCDD		ND U	ND U	ND U	ND U	ND U
Total HxCDD		4.79	ND U	ND U	ND U	ND U
Total HpCDD		131	ND U	4.92	ND U	ND U
Total TCDF		ND U	ND U	2.16	ND U	1.41
Total PeCDF		ND U	ND U	ND U	ND U	3.73
Total HxCDF		8.57	ND U	ND U	ND U	3.16
Total HpCDF		27.1	ND U	ND U	ND U	ND U
Total TEQ		1.3081	0	2.29706	0	2.1

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

ND = Not Detected The following qualifier(s) exist: U, E, M, P

For RCL DIOX