DYNAMAC
CORPORATION
Environmental Services

FINAL REPORT

IMPACTS OF SEDIMENTATION BASIN DISCHARGES FROM THE DALECARLIA AND GEORGETOWN RESERVOIRS ON THE POTOMAC RIVER

Prepared for:

Planning Division
U.S. Army Corps of Engineers Baltimore District
111 Market Street
Baltimore, Maryland 21203

Prepared by:

DYNAMAC CORPORATION
2275 Research Blvd, Suite 500
Rockville, Maryland 20850

February 2, 1993

FINAL REPORT

IMPACTS OF SEDIMENTATION BASIN DISCHARGES FROM THE DALECARLIA AND GEORGETOWN RESERVOIRS ON THE POTOMAC RIVER

Prepared for:

Planning Division
U.S. Army Corps of Engineers Baltimore District
111 Market Street
Baltimore, Maryland 21203

Prepared by:

DYNAMAC CORPORATION
2275 Research Blvd, Suite 500
Rockville, Maryland 20850

February 2, 1993

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Concluded)

LIST OF TABLES

PAGE

LIST OF FIGURES

LIST OF FIGURES (Concluded)

EXECUTIVE SUMMARY

In accordance with the Clean Water Act (CWA) (Federal Water Pollution Control Act of 1972) as amended, the Washington Aqueduct Division of the Baltimore District COE is currently under permit to discharge into the Potomac River water and sediment from two basins at Dalecarlia Reservoir and two basins at Georgetown Reservoir. Discharge to the river occurs at three outfalls (Figure E-1): Outfall 002 (Dalecarlia), Outfall 003 (Georgetown), and Outfall 004 (Georgetown). The discharge must comply with effluent limitations, monitoring requirements, and special conditions mandated in the U.S. Environmental Protection Agency's (U.S. EPA's) National Pollutant Discharge Elimination System (NPDES), Parts I-III. The Dalecarlia WTP discharges are authorized by NPDES Permit No. DC0000019, which was issued on 3 May 1989 and expires on 2 May 1994.

This study was undertaken to comply with Part III (Special Conditions) of the NPDES permit, which requires that the Washington Aqueduct implement a study to determine the impacts of discharges from the sedimentation basins on the Potomac River. The special conditions requirement was added to the NPDES permit to ensure compliance with the CWA. EPA will use the results of this study to determine whether effluent limitations in the current permit need to be modified.

The impact study had the following objectives:

- Characterize the aquatic habitat conditions within the study area.
- Determine the composition, abundance, richness, and diversity of macroinvertebrates of the receiving river in the study area prior to and following discharge.
- Characterize the physical and chemical characteristics of the receiving water in the study area prior to and following discharge.
- Determine the concentrations of iron and aluminum in the river bottom sediments and in the discharge from the sedimentation basins into the receiving waters.
- Determine, by bioassay, the toxicity of the discharges on fathead minnow larvae.

Field sampling occurred during baseline and post-discharge events conducted between October, 1991 and March, 1992. Data collection included in situ water quality measurements, water quality sampling in the river, sediment sampling in the river and sedimentation basins, benthic invertebrate sampling in the river, and sludge and effluent toxicity testing at each of the basins. Sampling in the river was conducted along a series of 6 transects that were located in the area from immediately above Little Falls Dam to just below Key Bridge.

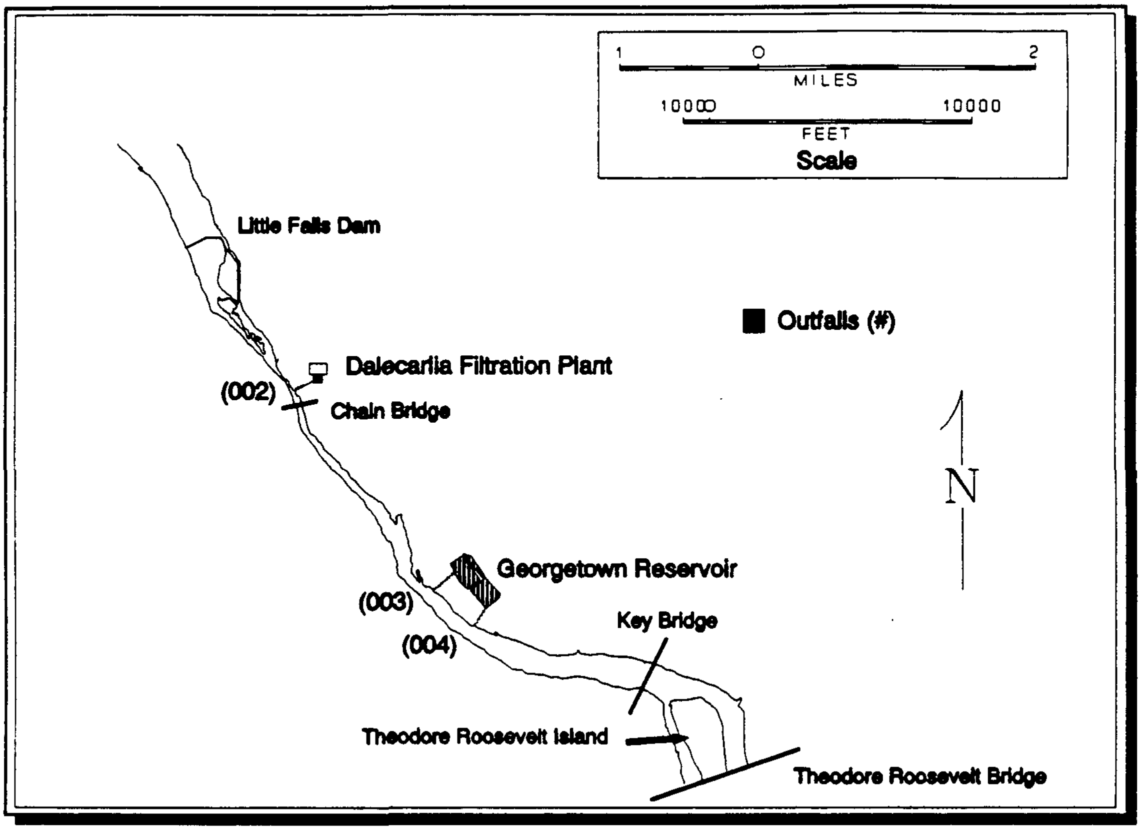


Figure E-1. **Location of the reservoirs and discharge points (Outfall 002, Outfall 003, and Outfall 004).**

Water quality, sediment chemistry, benthic invertebrate, and laboratory toxicity test results were evaluated to identify effects of effluent and sludge discharges on the Potomac River. The data indicate that the study area is extremely heterogeneous, both spatially and temporally. It appears that the river bottom in this area is subject to constant disturbance by high flows and resulting scour. Water quality sampling data (i.e., dissolved oxygen concentration, water temperature, pH, and conductivity) from the river appeared to be driven primarily by rainfall events. Benthic communities were characteristic of disturbed, poor-quality systems. Sediment chemistry in the sedimentation basins, as reflected in aluminum and iron concentrations, was generally similar to that of the river under baseline conditions; aluminum was in the same concentration range, while iron concentrations in the basins were one-half to one-third those in the river. There was no evidence of toxicity from either the effluent or the sludge on fathead minnow larvae. In summary, there were no observed impacts from the sedimentation basin discharges on the water quality, sediment chemistry, benthic biota, or representative fishes of the Potomac River.

SECTION 1. INTRODUCTION

1.1 BACKGROUND

The Dalecarlia Water Treatment Plant (WTP), operated by the Washington Aqueduct Division of the Baltimore District Corps of Engineers (COE), is located in the Georgetown area of Washington, DC. The WTP has two reservoirs, Dalecarlia Reservoir and Georgetown Reservoir, located approximately 2 miles apart. Each reservoir has two operational sedimentation basins. The phases of the water treatment process are described as follows (Degugmen, 1992, personal communication):

- Water is collected from the Potomac River through an intake located at Little Falls Dam.

- The water is routed to either the Dalecarlia or Georgetown Reservoir where it is allowed to settle for a period of approximately 24 to 48 hours.

- Water is routed to the sedimentation basins after being treated with aluminum sulfate (alum), which removes nutrients, silt, organic matter, and turbidity from the water. Aluminum sulfate added to water with carbonate alkalinity creates aluminum hydroxide in the form of a visible floc that settles to the bottom of the basins. Nutrients, silt, and organic matter sorb to the aluminum hydroxide, and hydrogen ions are produced. This process tends to lower the pH of the water. The degree to which pH moves toward the acid range is dependent upon the alkalinity of the water. If the pH falls below 6.0, toxic forms of aluminum will be more abundant; however, if the pH remains in the range of 6-8, the nontoxic forms of aluminum will remain (Cooke and Carlson, 1989).

- Water is directed from the sedimentation basins through a filter consisting of charcoal, sand, and gravel.

- The pH of the water is measured and subsequently adjusted to approximately 7.9-8.2 by the addition of lime (calcium oxide).

- The water is treated with chlorine at a concentration of 2.1-2.5 mg/L resulting in residual chlorine concentration of 0.5-0.6 mg/L. At this point, the water is also treated with fluoride (hydrosluosilic acid) at a concentration of 1.0 mg/L ± 20%.

- The water is distributed for potable use.

In accordance with the Clean Water Act (CWA) (Federal Water Pollution Control Act of 1972) as amended, the Washington Aqueduct Division of the Baltimore District COE is currently under permit to discharge water and sediment into the Potomac River from two basins at Dalecarlia Reservoir and two basins at Georgetown Reservoir. Discharge to the river occurs at three outfalls (Figure 1-1): Outfall 002 (Dalecarlia), Outfall 003 (Georgetown), and Outfall 004 (Georgetown). The discharge must comply with effluent limitations, monitoring requirements, and special conditions mandated in the U.S. Environmental Protection Agency's (U.S. EPA) National Pollutant Discharge Elimination System (NPDES), Parts I-III. The Dalecarlia WTP discharges are authorized by NPDES permit No. DC0000019, which was issued on 3 May 1989 and expires on 2 May 1994. The limitations set forth in this permit are summarized in Table 1-1. These limitations define the environmental conditions required for discharges to occur.

1.2 PURPOSE

Table 1-1. Conditions required for discharges in accordance with the terms of the Dalecarlia WTP NPDES permit.

Parameter	Critical Lower Value
River Flow (MGD)	3,500
Turbidity (NTU)	100

This study was undertaken to comply with Part III (Special Conditions) of the NPDES permit, which requires that the Washington Aqueduct implement a study to determine the impacts of discharges from the sedimentation basins on the Potomac River. The special conditions requirement was added to the NPDES permit to ensure compliance with the CWA. EPA will use the results of this study to determine whether effluent limitations in the current permit need to be modified.

The impact study had the following objectives:

- Characterize the aquatic habitat conditions within the study area.
- Determine the composition, abundance, richness, and diversity of macroinvertebrates of the receiving river in the study area prior to and following discharge.
- Characterize the physical and chemical characteristics of the receiving water in the study area prior to and following discharge.
- Determine the concentrations of iron and aluminum in the river bottom sediments and in the discharge from the sedimentation basins into the receiving waters.
- Determine, by bioassay, the toxicity of the discharges on fathead minnow larvae.

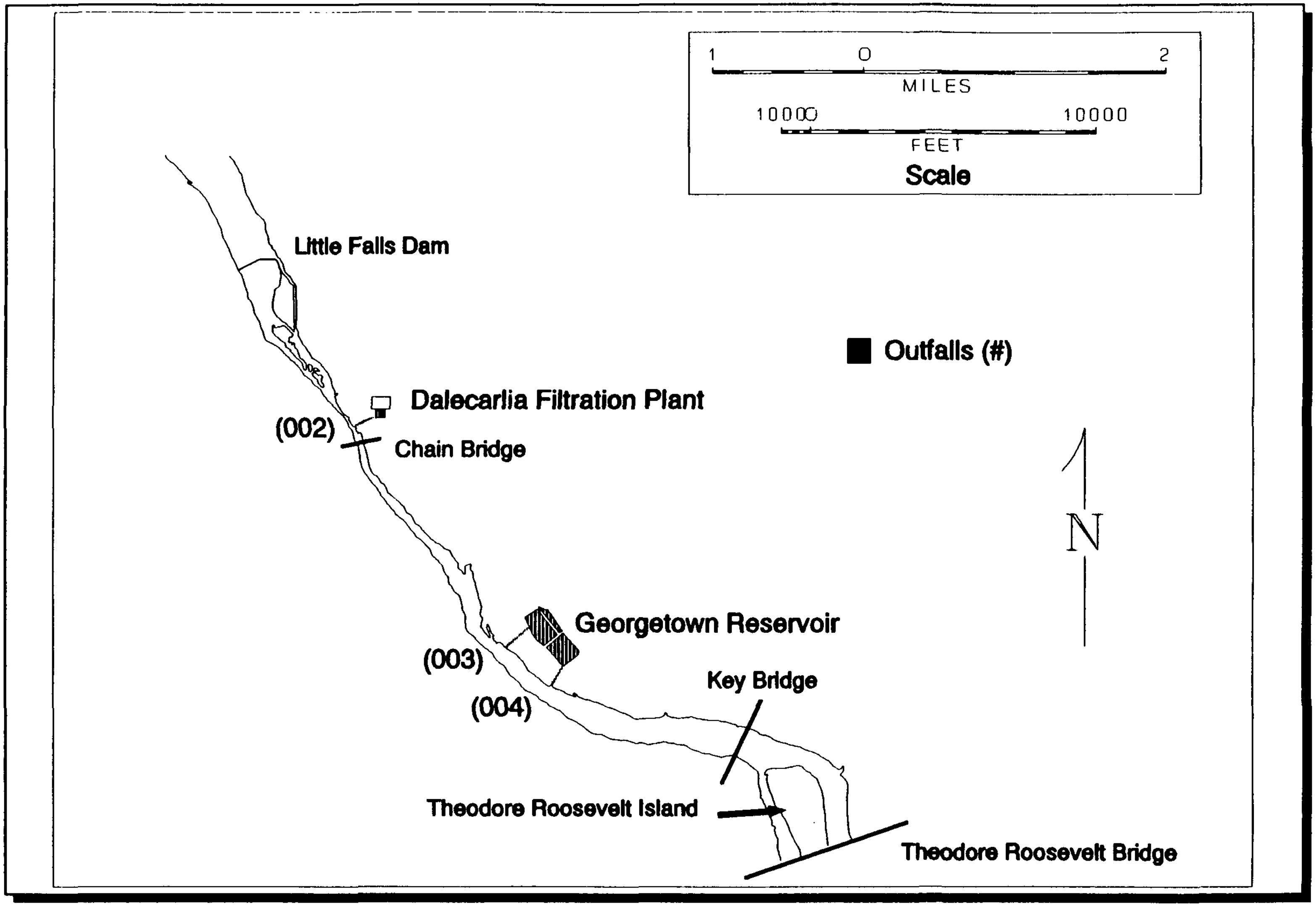


Figure 1-1. Location of the reservoirs and discharge points (Outfall 002, Outfall 003, and Outfall 004).

This page left intentionally blank.

SECTION 2. METHODS

The methods utilized for the collection of water, sediment, and benthic macroinvertebrate samples are described in this section. In addition, the techniques employed in the toxicity bioassay are described.

2.1 SAMPLING DESIGN

Prior to sampling, the original study plan was reviewed by Dynamac personnel and the COE. Modifications were made to the sampling methodology based on knowledge of conditions of the Potomac River in the study area. These modifications were coordinated with relevant personnel (i.e., Mr. James Green) at the U.S. EPA via the COE. A reconnaissance survey of the study area was conducted, prior to sampling, by Dynamac personnel and COE. Modifications were made, as necessary, to the locations of the sampling stations based on the conditions in the river. These modifications were approved by the U.S. EPA via the COE. The layout of the selected sampling stations and the methodology of the sampling schedule are discussed below.

2.1.1 Sampling Station Locations

The locations of the field sampling stations were selected by Dynamac staff in consultation with the COE. A total of six stations were identified, ranging in distance from just upstream of Little Falls Dam to just downstream of the Francis Scott Key Bridge in Georgetown (Figure 2-1). Two of these stations (Transects 1 and 4) were employed as controls (each located directly upstream of the outfall locations).

Each station consisted of a transect running perpendicular to the centerline of the river. Three sampling locations were selected along each transect (i.e., a discrete left, center, and right sampling location). To eliminate confusion and maintain consistency, the upstream direction was arbitrarily designated as *north*; therefore, when facing upstream, the left sampling location was *west* and the right sampling location was *east*. The 6 transects, each with 3 sampling locations, represent a total of 18 sampling locations.

2.1.2 Sampling Schedule

The sampling design was based on two types of sampling events: baseline and post-discharge. One baseline survey and four post-discharge surveys (one following the discharge event from each of the sedimentation basins) were to be conducted. The purpose of the baseline sampling was to characterize the ambient conditions in the river prior to any discharge impacts. Each of the six transects was included in the baseline survey. Sludge samples were also collected from each of the four sedimentation basins during the initial baseline survey. The purpose of the post-discharge sampling was to characterize water quality and macroinvertebrate communities in the river following discharge of the sedimentation basins.

Five transects were sampled following discharge of each of the Dalecarlia Reservoir basins: Transect 1 served as the control station, and Transects 2, 3, 4, and 6 served as treatment stations. Three of the transects were sampled following discharge of each of the Georgetown Reservoir basins: Transect 4 served as the control station, and Transects 5 and 6 served as treatment stations. In addition, bottom sludge and effluent samples were collected from the appropriate basin during each discharge event for use in the toxicity bioassay. Based on the assumption that the contents of the two sedimentation basins at each reservoir would be identical, the original plan required that the toxicity bioassay be conducted on only one basin from each of the reservoirs. To verify this assumption, an attempt was made to conduct the bioassay on all four basins. However, effluent samples were not collected from one sedimentation due to an equipment failure, and subsequently toxicity bioassays were conducted for only three sedimentation basins.

The sampling schedule for this study was highly dependent on river flow and river turbidity. Release from each of the basins was contingent upon receiving adequate rainfall to raise river flow and ensure turbidity to the levels mandated by the NPDES permit.

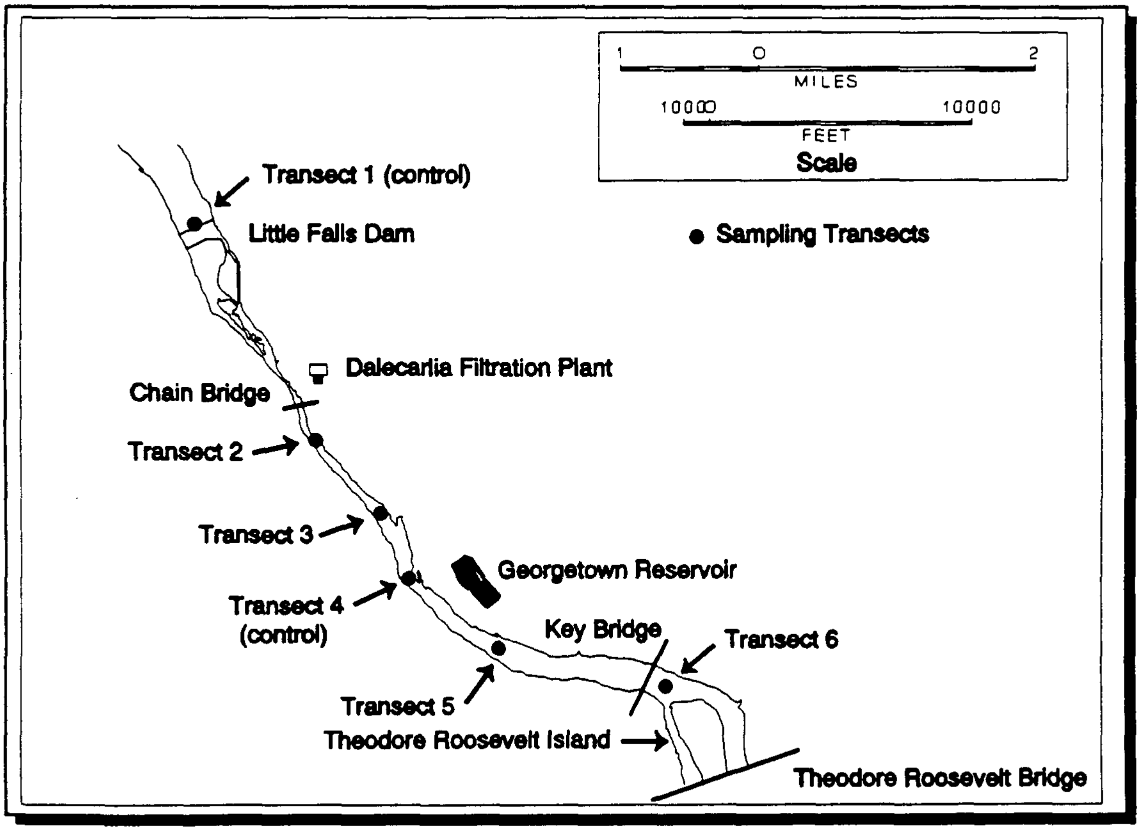


Figure 2-1. **Locations of the sampling stations.**

2.2 WATER QUALITY

Water quality samples were collected at the appropriate transects during the baseline surveys and each of the post-discharge surveys. Water samples were collected at mid-depth at the center location of each transect. Water samples were analyzed by Martel Laboratory Services, Inc. (Martel), Baltimore, MD, for turbidity, 5-day biochemical oxygen demand (BOD_5), total suspended solids, total aluminum, total iron, and alkalinity. Table 2-1 lists the analytical methods used for water quality and sediment analyses. In addition, in situ water quality parameters were measured at 1-meter intervals from water surface to bottom at each water sample collection location using a Hydrolab Surveyor II instrument. In situ parameters included water temperature, pH, dissolved oxygen concentration, and conductivity.

Table 2-1. Methods used in the analysis of water quality and sediment samples.

Parameter	**Method**
Water Quality:	
Turbidity	EPA 180.1
BOD	EPA 405.1
Total suspended solids	EPA 160.2
Total aluminum	EPA 200.7
Total iron	EPA 200.7
Total alkalinity	EPA 310.1
Sediments:	
Total aluminum	EPA 200.7
Total iron	EPA 200.7
Particle size	ASTM D422-63

2.3 SEDIMENT CHEMISTRY

Three sediment samples were collected from each of the four sedimentation basins during the initial baseline survey. Each sample consisted of at least two grabs with a 9- by 9-inch Ponar dredge. The number of grabs was dictated by the number required to yield at least 700 cm^3 of sediment. The basins were not sampled during subsequent baseline surveys because it was assumed that the nature of the sediments would not have changed.

During each sampling event, two bottom sediment samples were collected at each of the three sampling locations along every transect in the river. Each sample consisted of at least two grabs with the Ponar dredge. Again, the number of grabs was dictated by the number required to yield at least 700 cm^3 of sediment.

All sediment samples were placed in laboratory-provided 8-oz (237 mL) containers and shipped to Martel for analysis. Sediment samples were analyzed for total aluminum and total iron. In addition, a portion of the sediment samples (one each from the west, center, and east locations at each of the six transects) collected during the initial baseline survey was analyzed for particle size distribution.

2.4 BENTHIC MACROINVERTEBRATES

During each river sampling event, two benthic macroinvertebrate samples were collected at each of the three sampling locations on each stream transect using a Ponar grab dredge (resulting in six samples per transect). The quantity of sediment retrieved in each grab sample was very variable. This variability required a method for standardizing the volume of sediment associated with the benthic invertebrate samples. The depth of total collected sediment in a 5-gallon bucket was recorded as a means of quantifying sediment volume associated with each sample.

Macroinvertebrate samples were sieved through a Nitex mesh with 560-micron mesh openings to remove small sediment particles and debris. The sieved macroinvertebrate samples were then placed in containers, preserved with 10% formalin, and stained with rose-bengal dye.

Macroinvertebrate samples were shipped to Cove Corporation (Cove), Lusby, MD, where they were sorted, identified to the lowest practicable taxon, enumerated, and preserved in 70% alcohol for long-term storage. Family level was determined to be the lowest practicable taxon for benthic macroinvertebrate identification.

Macroinvertebrate data were evaluated for abundance, composition, richness, and diversity of organisms. Measures of species diversity were calculated using the Shannon Diversity Index (SDI)(Washington, 1984):

$$Shannon's\ H = -\sum_{i=1}^{s} p_i \log p_i$$

where:

p_i = n_i/n.
n_i = total number of individuals in the i^{th} taxon.
n = total number of individuals.
s = total number of taxa.

SDI was calculated with macroinvertebrate data identified to the family level. In general, all specimens used to calculate SDI should all be identified to the same taxonomic level. However, not all specimens collected in this study were identified to the family level because some specimens were either damaged or too small to identify, or were of taxa that are not typically identified to family level. Approximately 17% of the benthic macroinvertebrates fell into this category. As a result, some specimens were only identified to the order or class level. To address this limitation of the data, the SDI calculations were conducted using individuals identified only to order or class under the following assumptions:

1. If there was only 1 individual that was identified to any given order or class in a particular sample, then it was assumed to represent only one family and was used directly as a single member of a single unknown family in calculating the SDI.

2. For situations in which there was more than 1 individual identified to an order or a class and therefore possibly more than one family in the sample, a series of SDI values were calculated representing the different possible combinations of number of families and individuals within each. For example, if there were only 2 individuals, the SDI was calculated as if they were both in the same family and then as if they were in different families. In situations in which there were more than 2 specimens in an order or class the SDI was calculated for the highest number of possible taxa and the lowest number of possible taxa to develop the range of SDI's. The data are presented as high and low SDI values.

3. The possibility of new unidentified families was not considered in the SDI calculations. All specimens not identified to family were considered to be in a family previously identified in the study.

Hilsenhoff's (1988) Family Biotic Index (FBI) was calculated as an indicator of water quality conditions:

$$FBI = \frac{\sum_{i=1}^{s} (n_i \, t_i)}{n}$$

where:

t_i = tolerance value of the i^{th} taxon.

s = total number of families.

Tolerance values were assigned according to tolerance values developed by Hilsenhoff (1988) and Bode (1988). Tolerance values that were unavailable for certain families were determined using best professional judgment and other references, including Barnes (1987) and McCafferty (1981). FBI tolerance values can range from 0 to 10. A value of 0 is assigned to taxa found only in unaltered streams (i.e., high water quality), and a value of 10 is assigned to taxa found in disturbed or severely polluted streams (i.e., poor water quality). The water quality classifications corresponding to FBI values 0-10 are presented in Table 2-2.

The family-level biotic index tends to underestimate levels of pollution in polluted streams and overestimate levels of pollution in unpolluted streams because tolerance values assigned to families are less precise. A family may consist of a number of species with a wide range of tolerance values; however, when a tolerance value is assigned at the family level, the variation in tolerances of the species

Table 2-2. Water quality classifications associated with Hilsenhoff's (1988) FBI.

FBI Value	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

Source: Hilsenhoff (1988).

is minimized. Thus, the family-level biotic index may not be as accurate as a biotic index based on genus/species tolerance levels. The resulting data should be viewed accordingly (Hilsenhoff, 1988).

2.5 SEDIMENT TOXICITY

Bioassays consisting of chronic 7-day sediment toxicity tests were conducted using effluent and sludge samples collected from each basin.

2.5.1 Effluent and Sludge Sample Collection

Two types of samples were collected in association with the sedimentation pond discharges: effluent water and sludge. Effluent samples were collected during the draining of each pond from the drainage system manholes. These samples were collected using submersible pumps and automated samplers. Sludge samples were collected directly from each basin after the draining was completed and before the rinsing process began. The effluent samples did not include basin rinse water; however, the sludge samples were considered to represent worst case discharge conditions. Following collection, effluent and sludge samples were shipped on ice to the University Center for Environmental and Hazardous Materials Studies (Department of Biology) at Virginia Polytechnic Institute and State University, where the 7-day chronic bioassays were conducted.

2.5.2 Bioassay

Potential survival and impairment effects of effluent and sludge (from each basin) to fathead minnows (*Pimephales promelas*) were tested using U.S. EPA (1989) guidelines in a static renewal, 7-day chronic bioassay. The methodology used in the 7-day chronic bioassays is described in full detail in the report titled "Chronic Impairment of Testing of Fathead Minnow (*Pimephales promelas*) to Dalecarlia and

Georgetown Water Treatment Plant Effluents, Washington, DC" (Cherry et al., 1992), which is presented in Appendix C.

2.6 HABITAT ASSESSMENT

Information to support the assessment of habitat in the study area was collected from existing sources and observations during the reconnaissance and field sampling activities. Existing data on habitat types, water quality, fish and wildlife resources, and aquatic vegetation were sought through a literature search, and interviews were conducted with representatives of the Metropolitan Washington Council of Governments, the U.S. Geological Survey, the Interstate Commission on the Potomac River Basin, and others. Observational information was collected during the field activities in the form of field notes and photographs.

2.7 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The reliability and validity of the data were monitored using the standard quality assurance/quality control (QA/QC) methods practiced by Martel Laboratory Services, Inc. and Cove Corporation. These methods are described in the following subsections.

2.7.1 Water Quality and Sediment Chemistry

Martel participates in several QA/QC programs including the following: State of Maryland and EPA wastewater, drinking water, and microbiology programs; U.S. Geological Survey (USGS) multi-matrix program; and U.S. Department of Agriculture (USDA) certification program (Martel, 1991).

QA/QC checks for analytical laboratory analysis consisted of analysis of blanks, replicates, standards, and "spiked" control samples. For each parameter, blanks, standards, replicates, and spikes were performed for every ten samples in each batch of samples.

Following completion of analyses, data and associated calculations were inspected by a designated QA officer, and results of QA/QC samples were verified against established quality control criteria (Martel, 1991). The QA officer determines whether a QA/QC failure has occurred and corrective actions are implemented.

Field replicate sediment samples were also collected from all sample stations at each of the transects. These samples were collected to ensure that sediment composition was adequately represented at each station.

2.7.2 Benthic Macroinvertebrates

Replicate benthic macroinvertebrate samples were collected from all sample locations at each of the transects.

QA/QC checks of macroinvertebrate samples consisted of re-enumeration and re-identification of randomly selected samples. At least 10% of the samples underwent QA/QC evaluations. All samples sorted by each technician were divided into batches of 10 samples, and 1 randomly selected sample from each batch was checked. To pass a QA/QC evaluation for sorting, at least 95% of the organisms had to be removed from the sample. If a sample failed the QA/QC check, all remaining samples from the batch of samples were re-sorted, and the QA/QC procedure was repeated until the batch of samples satisfied the QA/QC criteria. For identification, 95% accuracy was required to pass QA/QC evaluation. If a sample failed to meet the criteria, all samples in the batch were re-identified.

SECTION 3. RESULTS AND DISCUSSION

The results and discussion of the sampling methodology, river flow, habitat assessment, water quality data, sediment chemistry data, particle size distribution data, and benthic macroinvertebrate data are presented in this section.

3.1 RIVER FLOW AND DISCHARGES

Two types of river flow data are recorded or calculated for this section of the Potomac River: river flow-by rate (after WTP withdrawals occur) is gaged at Little Falls Dam, and total river flow is calculated (using the flow-by rate and the withdrawal). The total river flow data would be more representative of river flow at Transect 1 because this transect is located upstream of the WTP water intake. The Little Falls Dam flow-by data would apply to Transects 2 through 6 because they are downstream of Little Falls Dam where the WTP intake is located. River flow data for Little Falls Dam for the dates of the sampling surveys are presented in Table 3-1. River flow was higher during most of the post-discharge surveys than during the baseline surveys, reflecting the fact that each of the post-discharge surveys followed a rainfall. Flows were especially high following the Georgetown #2 discharge.

Table 3-1. River conditions surrounding each of the sampling events.

Event	Date	River Flow (MGD)*
Baseline #1	10 October 1991	950
Baseline #2	5 December 1991	9,187
Dalecarlia #4	10 December 1991	4,052
Baseline #3	20 December 1991	2,042
Dalecarlia #3	10 January 1992	6,528
Georgetown #1	24 February 1992	4,725
Georgetown #2	3 March 1992	9,436

* At Little Falls Dam

Table 3-2 presents flow and discharge information associated with each of the discharge events.

Table 3-2. Summary of river flows and effluent volumes associated with each discharge event.

Discharge Event	Date	Volume of Effluent Discharged (MG)	Volume of Sludge Discharged (MG)	River Flow During Discharge (MGD)
Dalecarlia #4	5 December 1991	14	0.772	9,187
Dalecarlia #3	6 January 1992	14	0.439	9,695
Georgetown #1	20 February 1992	20	0.407	1,823
Georgetown #2	26 February 1992	110	1.066	4,557

3.2 SAMPLING DESIGN

The original sampling schedule allowed for an initial baseline survey prior to the first basin discharge, followed by four post-discharge sampling surveys, 2 to 3 days following completion of each basin discharge. However, the initial baseline survey was followed by a protracted period of low river flows, undermining an accurate comparison of pre- and post-discharge conditions. As a result, a second baseline study was conducted. However, the river flows were extremely high during this survey and this condition prevented collection of certain samples because the Ponar sampler streamed behind the boat rather than sinking to the bottom. As a result, a third baseline survey was subsequently conducted under low-flow conditions, following the first discharge event. Additionally, two post-discharge surveys were conducted following the Georgetown #2 sedimentation basin discharge event because high flows prevented collection of sediment and benthic macroinvertebrate samples at several locations during the first survey. A schedule of the survey types and dates of occurrence is presented in Table 3-3.

Collection of sediment and benthic macroinvertebrate samples was limited at several of the sampling locations because of the rocky bottom and hydrology of the Potomac River in the study area. A single sample often required several grabs with the Ponar dredge to acquire enough sediment to fill a sample container. Some sampling locations yielded no sediment after several collection attempts with the Ponar dredge. These sampling locations were noted.

3.3 HABITAT ASSESSMENT

Habitat in the study area was characterized in terms of major aquatic habitat types (e.g., pool, riffle, or run), as well as fish and wildlife resources, and critical habitat (i.e., wetlands, submerged aquatic vegetation, riparian zone).

Table 3-3. **Description of dates, survey types, and sites at which samples were collected.**

Date	Survey Type	Transect Number	Sediment & Macroinvertebrate Samples Collected [1]	Water Samples & Hydrolab Profiles[1]
10,11 October 1991	Baseline #1[2]	1	E,C,W	C
		2	E,C	C
		3	E,C,W	C
		4	E,C,W	C
		5	E,C,W	C
		6	C,W	C
5 December 1991	Baseline #2	1	E,C,W	C
		2	NA	C
		3	NA	C
		4	C,W	C
		5	E,C,W	C
		6	NA	C
10 December 1991	Post-Discharge Dalecarlia #4[3]	1	C,W	C
		2	NA	C
		3	E,C,W	C
		4	C,W	C
		6	E,C,W	C
20 December 1991	Baseline #3	1	C,W	C
		2	E	C
		3	E,C,W	C
		4	C,W	C
		5	E,C,W	C
		6	C,W	C
10 January 1992	Post-Discharge Dalecarlia #3[4]	1	C,W	C
		2	E	C
		3	E,W	C
		4	W	C
		6	C,W	C
24 February 1992	Post-Discharge Georgetown #1[5]	4	W	C
		5	E,C,W	C
		6	E,C,W	C
29 February 1992	Post-Discharge Georgetown #2[6]	4	NA	C
		5	E	C
		6	E,C,W	C
3 March 1992	Post-Discharge Georgetown #2[7]	4	W	-
		5	E,C,W	-
		6	C,W	-

[1] E = East, C = Center, W = West, NA = sampling attempted, but no samples collected.

[2] Baseline sludge samples were collected from all four basins on 11 October 1991.

[3] Discharge sludge and water samples were collected from Dalecarlia basin #4 on 5 December 1991.

[4] Discharge sludge and water samples were collected from Dalecarlia basin #3 on 6 January 1992.

[5] Equipment failure prevented collection of Georgetown basin #1 discharge samples on 20 February 1992.

[6] Discharge sludge and water samples were collected from Georgetown basin #2 on 26 February 1992.

[7] Required because of difficulty in collecting sediment samples during the 29 February sampling event.

3.3.1 Habitat Types

Descriptions of the physical conditions and habitats observed at each of the sampling transects are presented in the following paragraphs. Figures 3-1 through 3-6 illustrate the location of each transect.

3.3.1.1 Transect 1

This transect was approximately 500 feet upstream of Little Falls Dam. The water was pooled from the dam, but there was sufficient volume and current for the river to flow over the dam (Figure 3-1).

The surrounding land in this area consisted of flat banks near the river that sloped to steep, wooded hills on both sides of the river.

3.3.1.2 Transect 2

Transect 2 was in a section of the river where the channel was very narrow and the river bed mainly consisted of boulders (Figure 3-2). With the exception of the initial baseline sampling event, the river current at this transect was extremely swift during all sampling activities.

The land on the west side of the river at this transect consisted of a steep "cliff-like" hill covered with rocks and trees. The east bank was relatively flat and wooded.

3.3.1.3 Transect 3

Transect 3 was relatively narrow and had a swift current (Figure 3-3). The east side of the river was an eddied area.

The banks on either side of this transect were flat. The west bank extended to a steep, wooded hill. The east bank and surrounding land remained flat and wooded.

3.3.1.4 Transect 4

This transect had a strong current in the river channel and on the east side where a point of rocks jutted into the river (Figure 3-4). The river bed on the east side consisted of boulder. The west side of this transect had a more subdued current.

The land on the west side of Transect 4 formed a large wooded hill with a gradual slope. The east bank was fairly flat immediately adjacent to the river, but began to form a gradual slope away from the river. The area on the east side of river was grassy (in the area of Fletcher's Boathouse) and wooded.

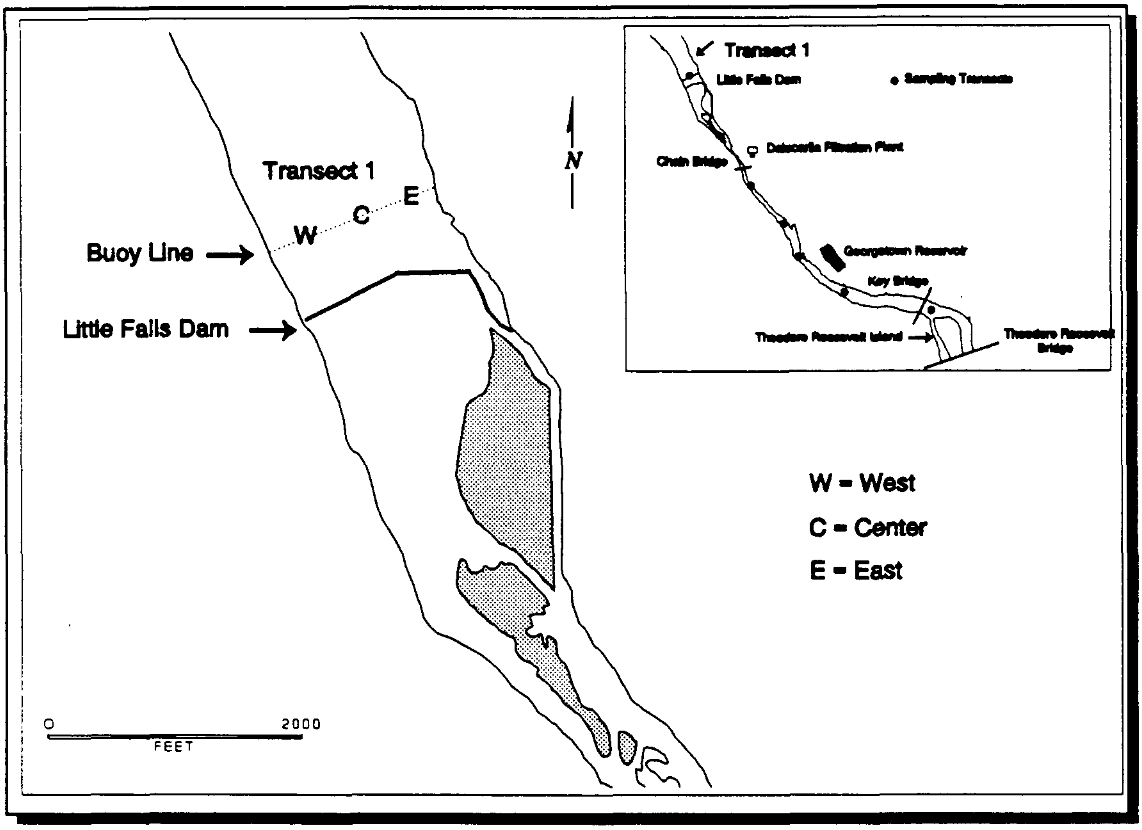


Figure 3-1. Location of Transect 1.

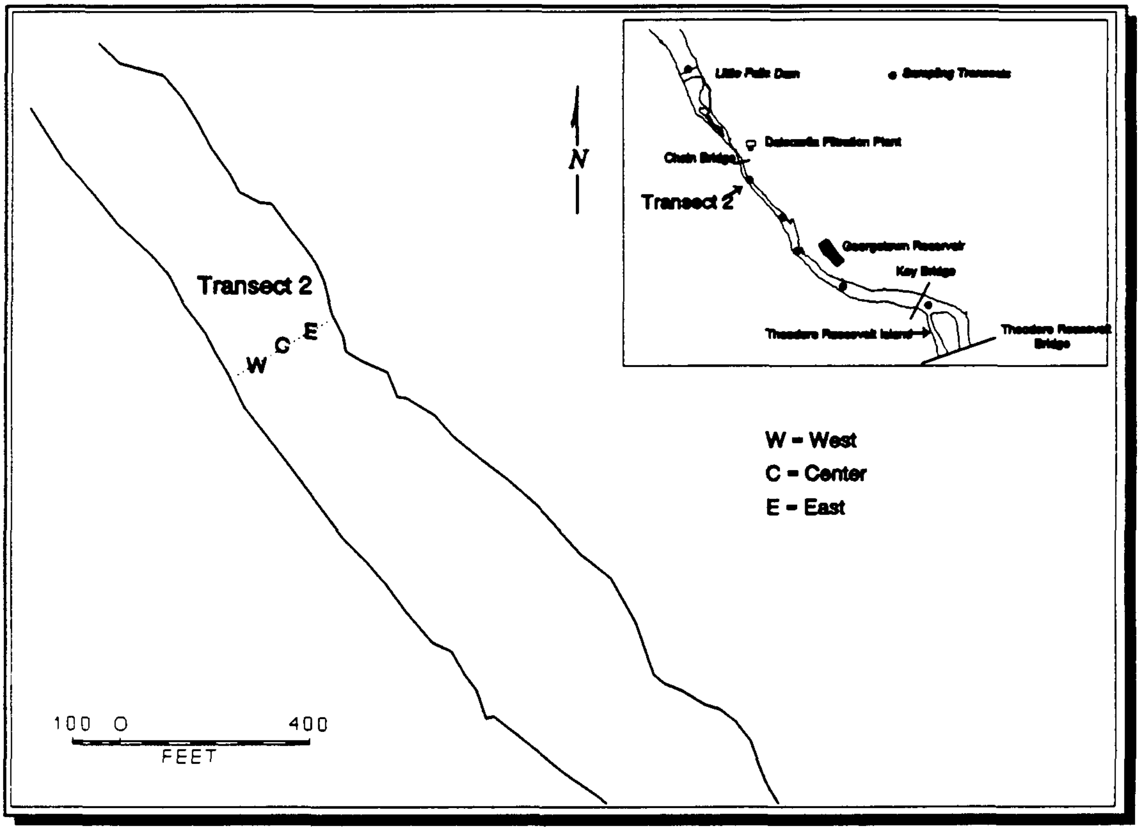


Figure 3-2. Location of Transect 2.

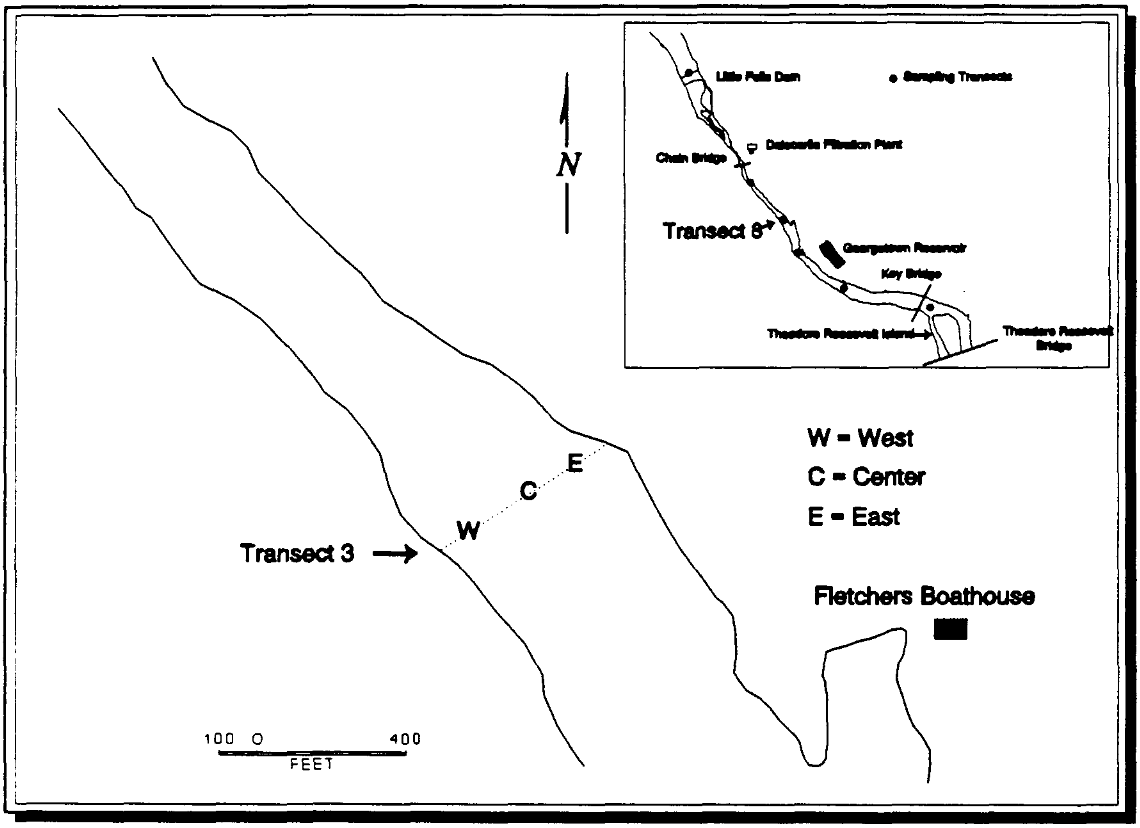


Figure 3-3. **Location of Transect 3.**

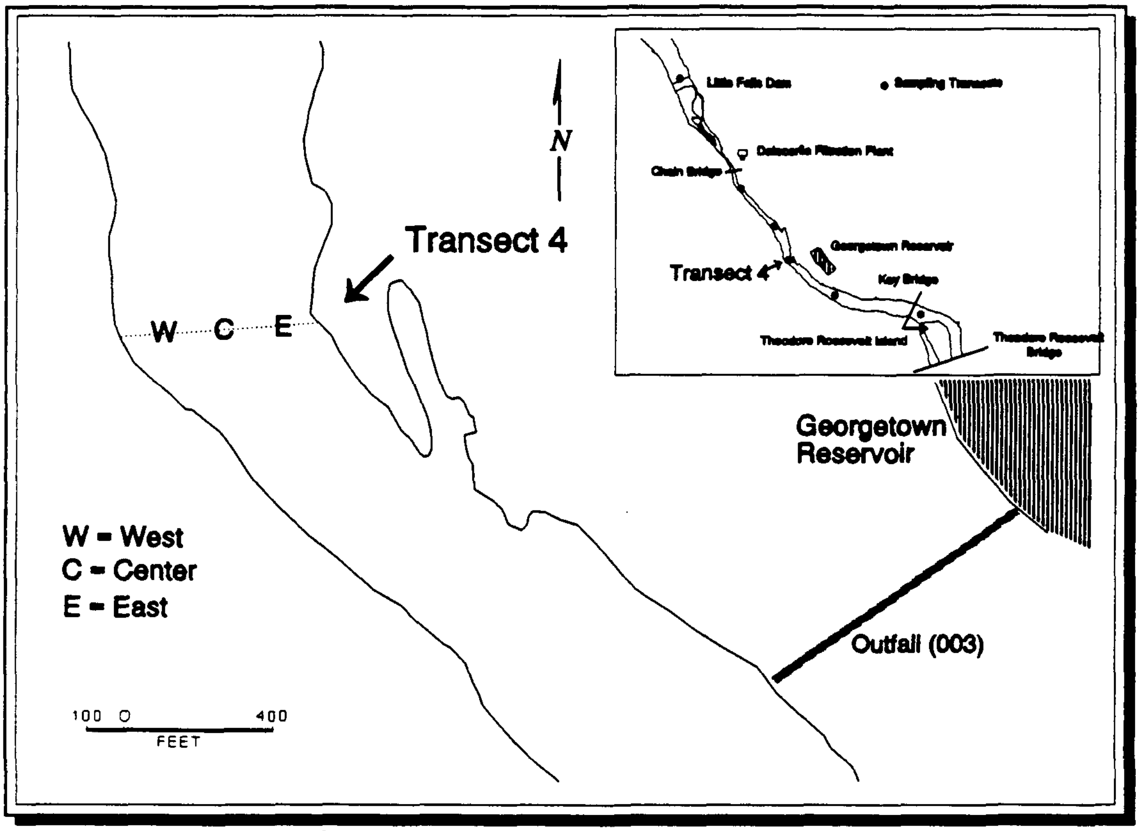


Figure 3-4. Location of Transect 4.

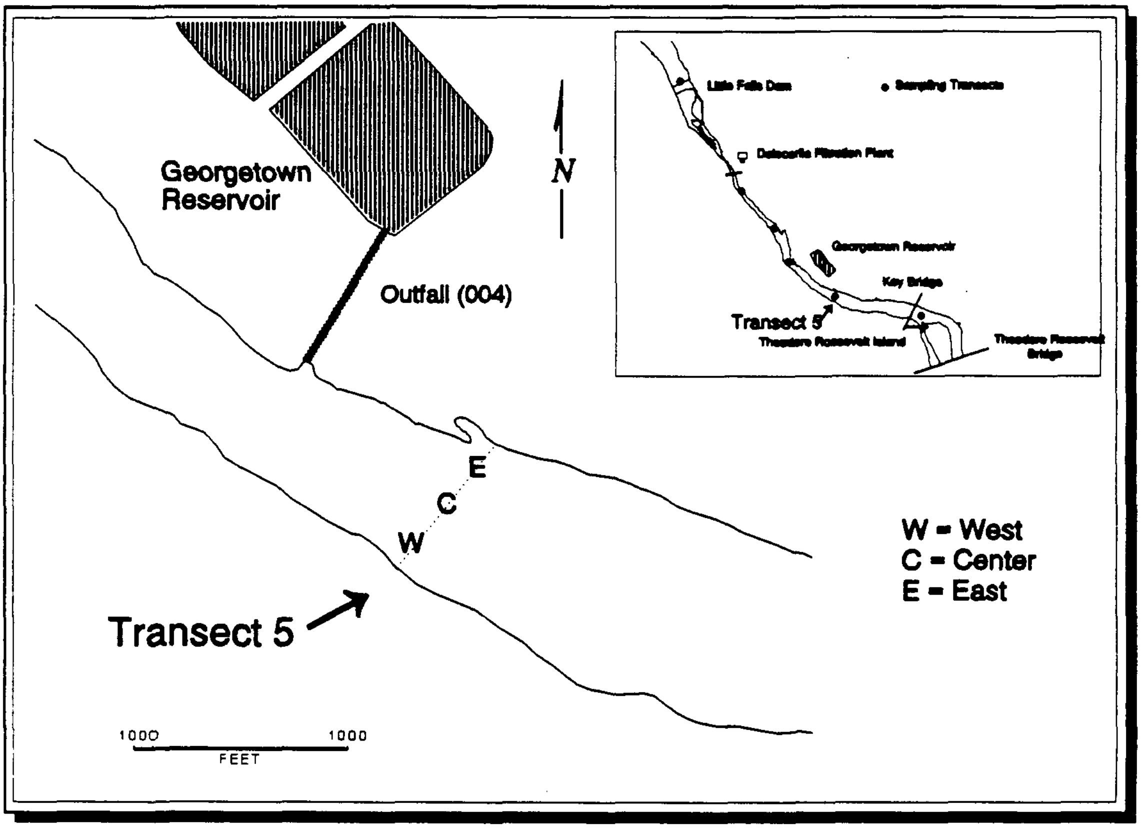


Figure 3-5. **Location of Transect 5.**

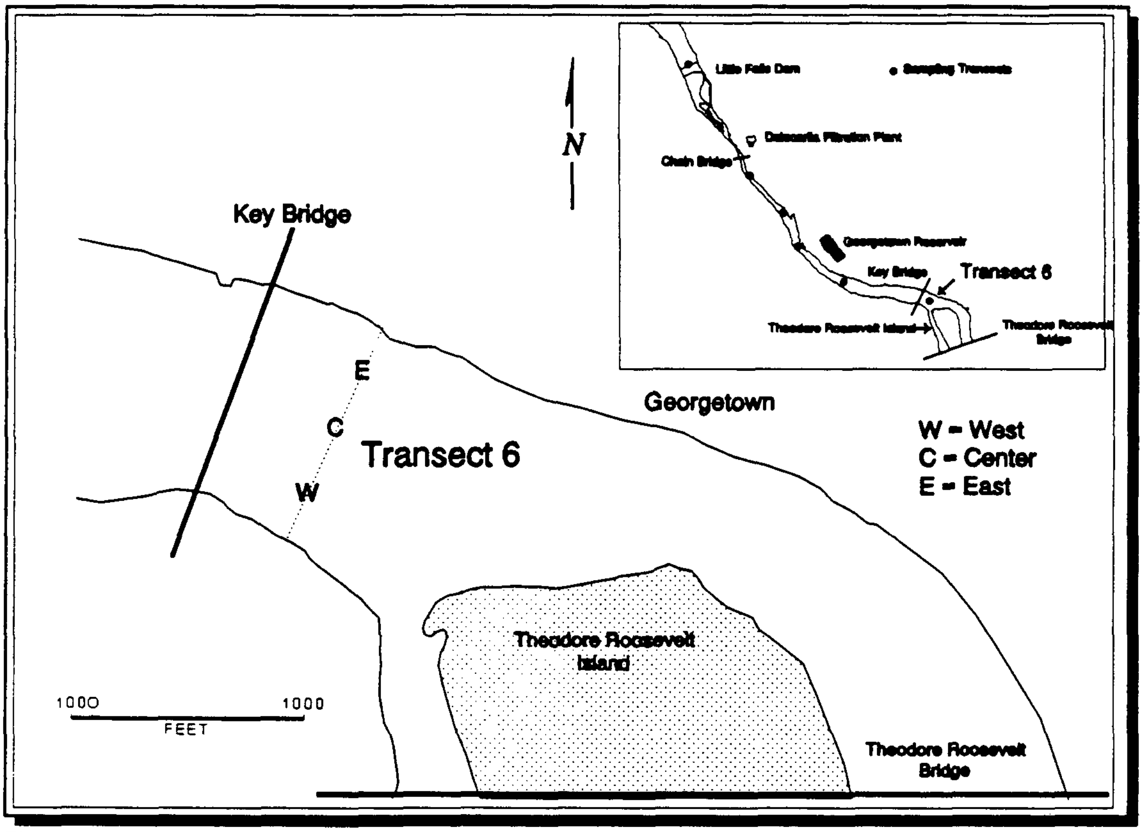


Figure 3-6. **Location of Transect 6.**

3.3.1.5 Transect 5

Transect 5 had a more consistent flow across the transect than the four upstream transects (Figure 3-5). The flow at this transect was also not as strong as the upstream transects because the river widened in this area.

The surrounding land on the west side of Transect 5 consisted of small sandy beach at the river's edge that gradually sloped into a wooded hill. The land on the east side was flat and wooded.

3.3.1.6 Transect 6

The flow at Transect 6 was consistent across the entire transect (Figure 3-6). The river was quite wide and open in this area. Boulders were not visible in the river in this area; however, the river bed consisted of boulders on its east side.

The land on the west side of this transect was flat and wooded. The east bank consisted of a sea wall, with buildings and parking lots immediately adjacent to the river.

3.3.2 Fish and Wildlife

A fisheries survey conducted in 1984 (Cummins, 1985) included shore seining stations near Fletcher's Boathouse (within the current study area) and at the southeastern point of Roosevelt Island (just downstream of the current study area). The following species were collected at the Fletcher's Boathouse station or at both stations (five species collected at the Roosevelt Island station, but not at the Fletcher's Boathouse station are not listed): white perch (*Morone americana*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), white crappie (*Pomoxis annularis*), yellow perch (*Perca flavescens*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), longear sunfish (*Lepomis megalotis*), green sunfish (*Lepomis cyanellus*), channel catfish (*Ictalurus punctatus*), gizzard shad (*Dorosoma cepedianum*), carp (*Cyprinus carpio*), quillback (*Carpiodes cyprinus*), white sucker (*Catostomus commersoni*), common shiner (*Notropis cornutus*), spotfin shiner (*Notropis spilopterus*), spottail shiner (*Notropis hudsonius*), rosyface shiner (*Notropis rubellus*), golden shiner (*Notemigonus crysoleucas*), silvery minnow (*Hybognathus nuchalis*), inland silversides (*Menidia beryllina*), bay anchovy (*Engraulis sp.*), banded killifish (*Fundulus diaphanus*), bluntnose minnow (*Pimephales notatus*), and creek chub (*Semotilus corporalis*). White perch, gizzard shad, and bluntnose minnow were most abundant at the Fletcher's Boathouse station. White perch, spottail shiner, and silvery minnow were the abundant species at the Roosevelt Island station. White perch were most abundant from the end of March through mid-July.

Fisheries seine data collected by the DC Department of Consumer and Regulatory Affairs, Environmental

Control Division (DCRA, ECD) in 1985 indicated the presence of the following species at the Fletcher's Boathouse sampling station (near Transect 4 of the current study): gizzard shad, white perch, spotfin shiner, alewife (*Alosa pseudoharengus*), bluegill, and pumpkinseed (MWCOG, 1987).

Additional fisheries data has been collected outside the current study area. Electrofishing was conducted in Potomac River backwater by the Maryland Office of Environmental Programs in 1980 at a site upstream of Little Falls Dam (just above Old Anglers Inn). Species collected include the following: rosyside dace (*Clinostomus funduloides*), swallowtail shiner (*Notropis procne*), spotfin shiner, bluntnose minnow, shorthead redhorse (*Moxostoma macrolepidotum*), yellow bullhead (*Ictalurus natalis*), redbreast sunfish (*Lepomis auritus*), pumpkinseed, longear sunfish, bluegill, and largemouth bass (MOEP, 1980).

Cummins' (1985) fisheries survey also included seining, gill netting, and otter trawling at sampling stations downstream of the current study area. The following species were collected: striped bass (*Morone saxatilis*), white perch, largemouth bass, smallmouth bass, yellow perch, walleye (*Stizostedion vitreum*) pumpkinseed, bluegill, longear sunfish, green sunfish, channel catfish, black bullhead (*Ictalurus melas*), brown bullhead (*Ictalurus nebulosus*), alewife, blueback herring (*Alosa aestivalis*) gizzard shad, carp, quillback, white sucker, American eel (*Anguilla rostrata*), longnose gar (*Lepisosteus osseus*), spot (*Leiostomus xanthurus*), tessellated darter (*Etheostoma olmstedi*), common shiner, spotfin shiner, spottail shiner, rosyface shiner, golden shiner, silvery minnow, inland silversides, bay anchovy, banded killifish, striped killifish (*Fundulus majalis*), mummichog (*Fundulus heteroclitus*), bluntnose minnow, and creek chub.

Waterfowl in the tidal Potomac River consists of a variety of swimming birds, shore birds, wading birds, and raptors (MWCOG, 1987). White-tailed deer, red fox, and raccoon are also found in the study area (personal communication, Lea, 1992).

3.3.3 Riparian Vegetation

Vegetation in the study area consists of floodplain or bottomland vegetation. The canopy vegetation consists of sycamore (*Platanus occidentalis*), silver maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), common cottonwood (*Populus deltoides*), box elder (*Acer negundo*), river birch (*Betula nigra*), black willow (*Salix nigra*), American elm (*Ulmus americana*), and black walnut (*Juglans nigra*). Disturbed areas along nearby roads and the canal towpath have been invaded by non-native species including the tree-of-heaven (*Ailanthus altissima*) and the black locust (*Robinia pseudo-acacia*). The understory consists of poison ivy (*Rhus radicans*), Virginia creeper (*Parthenocissus quinquefolia*), wild grape (*Vitis sp.*), Japanese honeysuckle (*Lonicera japonica*), stinging nettle (*Urtica dioica*), garlic mustard (*Alliaria officinalis*), and English ivy (*Hedera helix*). Herbaceous vegetation consists primarily of spring wildflowers (personal communication, Lea, 1992).

The "Chain Bridge Flats" is a unique area located between Little Falls Dam and approximately 200 yards downstream of Chain Bridge. This area is subject to scouring and supports a somewhat different vegetation community than the portion of the river directly downstream. Stunted trees, including sycamore, common cottonwood, and Bur oak (*Quercus macrocarpa*), are typical of this segment of land. Herbaceous vegetation common in this area includes some threatened species (e.g., wild false indigo, *Baptisia australis*; riverbank goldenrod, *Solidago spathalata*; redroot, *Ceanothus ovatus*; and Bur oak, *Quercus macrocarpa*: personal communication, Lea, 1992).

3.3.4 Submerged Aquatic Vegetation

The Metropolitan Washington Council of Governments (MWCOG) conducted a survey of submerged aquatic vegetation (SAV) in the Potomac River during September 1991 (personal communication, Berstein, 1992). No SAV was observed within the area included in the current study. Submerged aquatic vegetation, consisting mainly of hydrilla (*Hydrilla verticillata*) and water star grass (*Heteranthera dubia*), exists sporadically downstream of the study area (personal communication, Whiting, 1992).

3.4 WATER QUALITY

The results of the laboratory analyses of the water quality samples are presented in Figure 3-7 for the baseline surveys and Figure 3-8 for the post-discharge surveys (along with the second baseline survey for comparison purposes). Parameters evaluated include alkalinity, 5-day biochemical oxygen demand, total suspended solids, turbidity, total aluminum, and total iron. National water quality criteria are presented in the discussion where appropriate. These criteria are intended to present scientific data and/or guidance regarding the impact of pollutants on water quality, which could be used in formulating regulatory requirements (U.S. EPA, 1986). Water quality data are presented in Appendix A.

3.4.1 Alkalinity

Alkalinity was lowest during the Dalecarlia #3 post-discharge survey (60 mg/L) and highest during the initial baseline survey (130 mg/L). The alkalinity concentrations were consistent from transect to transect for each baseline survey. The first baseline survey had the highest alkalinity concentrations at an average of 120 mg/L. The alkalinity concentrations ranged between 91 and 95 mg/L during the third baseline survey. Alkalinity concentration during the second baseline survey was 110 mg/L at each transect. Alkalinity concentrations were lower during all of the post-discharge surveys than the baseline surveys. This may be a result of the introduction of low-alkalinity rainwater to the river (each post-discharge survey followed a rain event). Alkalinity concentrations were higher during the Dalecarlia #4 post-discharge survey than the Dalecarlia #3 post-discharge survey, and higher during the Georgetown #1 post-discharge survey than during the Georgetown #2 post-discharge survey. Flow, as a result of recent rainfall, was greater during the Dalecarlia and Georgetown post-discharge surveys that had the lowest

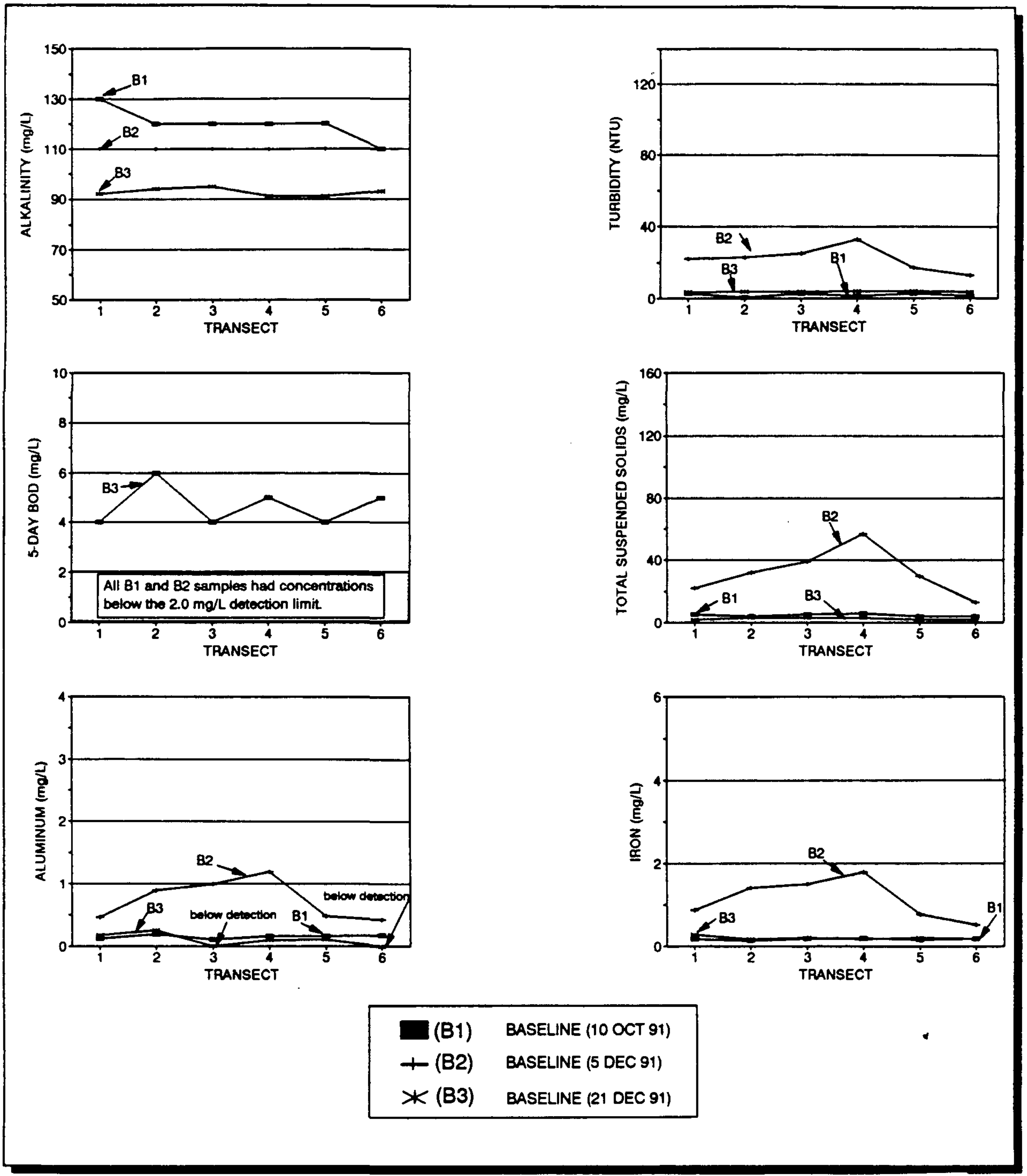


Figure 3-7. Results of laboratory analyses of water quality samples collected during the baseline surveys (detection limit of aluminum is 0.1 mg/L).

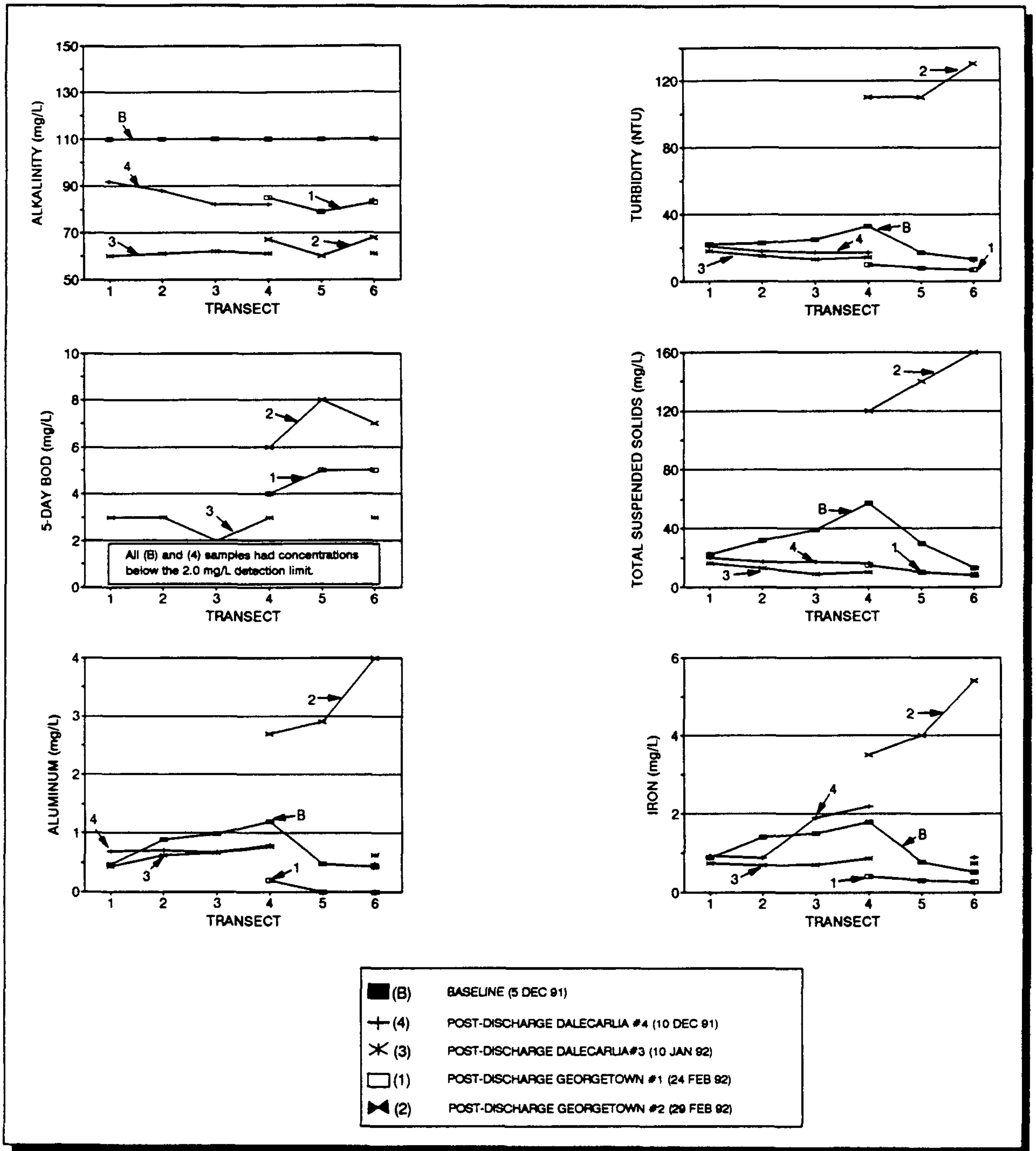


Figure 3-8. **Results of laboratory analyses of water quality samples collected during the second baseline survey and the post-discharge surveys.**

alkalinity concentrations (compared to the other basin at the same reservoir). There was little variability between transects during each given survey. The control transects for each survey did not differ greatly from the other transects sampled during the survey.

The U.S. EPA has designated a water quality criterion for alkalinity of 20 mg/L or greater for protection of freshwater aquatic life. Concentrations obtained during the entire survey met the specified criteria.

3.4.2 Biochemical Oxygen Demand

Five-day biochemical oxygen demand (BOD_5) is a measure of the oxygen required for biochemical breakdown of organic material, as well as the oxygen required to oxidize inorganic material (APHA, 1985). The first and second baseline survey samples had BOD_5 values that were less than the 2.0-mg/L detection limit, as did the Dalecarlia #4 post-discharge survey. The Georgetown #2 post-discharge survey had the highest BOD_5 values, ranging from 6 mg/L to 8 mg/L. The third baseline survey and the Georgetown #1 post-discharge survey had comparable BOD_5 values falling between the detection limit and the Georgetown #2 values.

These values are similar to values reported by MWCOG (1987). It is characteristic for BOD_5 values to rise in association with high flows.

3.4.3 Total Suspended Solids

The concentration of total suspended solids was low for the first (4 to 6 mg/L) and third (2 to 3 mg/L) baseline surveys; the minimum concentration was 2 mg/L. The concentrations increased during the second baseline survey, probably as a result of significantly higher flows from a recent rainfall event. The concentrations were also low for the Dalecarlia #3 (9 to 16 mg/L) and #4 (13 to 20 mg/L) and Georgetown #1 (8 to 15 mg/L) post-discharge surveys, although slightly higher than the first and third baseline surveys. TSS concentrations were exceptionally high during the Georgetown #2 post-discharge survey, reaching a peak of 160 mg/L. These elevated TSS concentrations were probably due to particles introduced to the river from runoff and bank erosion, as well as bottom sediment resuspended by high flows in the river from recent heavy rainstorms. In most cases, the TSS concentrations were lower at the downstream stations, reflecting a decrease in river velocity and settling of suspended particulate material.

The observed TSS concentrations are within the range previously reported for this segment of the Potomac River (MWCOG, 1987). TSS concentrations are variable in this segment of the Potomac River and reflect the relationship between flow and the amount of solids in the water column.

3.4.4 Turbidity

Corresponding with the TSS concentrations, the turbidity values for the first (0.66 to 2.9 NTU) and third (3.5 to 4.0 NTU) baseline surveys were quite low, with a minimum value of 0.66 NTU. Turbidity data collected during the Dalecarlia #3 and #4 and the Georgetown #1 post-discharge surveys fell between values for the first and third baseline surveys and the second baseline survey. The turbidity values were highest for the Georgetown #2 post-discharge survey; the maximum value was 130.0 NTU. The elevated turbidity can be attributed to increased suspended matter in the water from a recent heavy rainfall.

No specific criteria are available for turbidity.

3.4.5 Total Aluminum

The lowest total aluminum concentrations of all the surveys were obtained during the first and third baseline surveys, ranging from concentrations less than the 0.10-mg/L detection limit to 0.25 mg/L. Concentrations obtained during the second baseline survey were higher, ranging from 0.43 mg/L to 1.2 mg/L. The post-discharge surveys for Dalecarlia #3 and #4 and Georgetown #1 had concentrations that were lower than the second baseline survey. Aluminum concentrations were greatest during the Georgetown #2 post-discharge survey, ranging from 2.70 mg/L to 4.00 mg/L. Flows were extremely high during this survey, and the strong current most likely was scouring the river bottom and mixing sediments into the water column. Although aluminum concentrations increased during the post-discharge surveys, because of the high flows it was impossible to determine whether the increases may be attributed more to introduction of aluminum-bound particles to the water column from runoff and resuspension of the bottom sediments (resulting from the recent excessive rainfall), or to discharge of the effluent from the basins. Figure 3-9 illustrates the correlation between the concentrations of total aluminum and total suspended solids for all water samples collected during the entire study. The strength of the relationship shown in this figure ($R^2 = 0.896$) suggests that water column aluminum concentrations are associated with suspended particulate material.

In the pH range between 6.5 and 9.0, aluminum occurs in freshwaters as monomeric, dimeric, and polymeric hydroxides; and as complexes with humic acids, phosphate, sulfate, and other anions. The national criteria, as derived from *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, indicate that freshwater aquatic life would be protected when pH ranges between 6.5 and 9.0, if the 4-day average concentration of aluminum does not exceed 87 µg/L (0.087 mg/L) more than once every 3 years on the average, and if the 1-hour average concentration does not exceed 750 µg/L (0.75 mg/L) more than once every 3 years on the average. Some site-specific exceptions occur when an especially sensitive aquatic organism is present (U.S. EPA, 1988). Although the sampling schedule for this study did not allow for examining a 4-day, 3-year average or a 1-hour, 3-year average of aluminum concentrations, it was assumed that the single samples collected

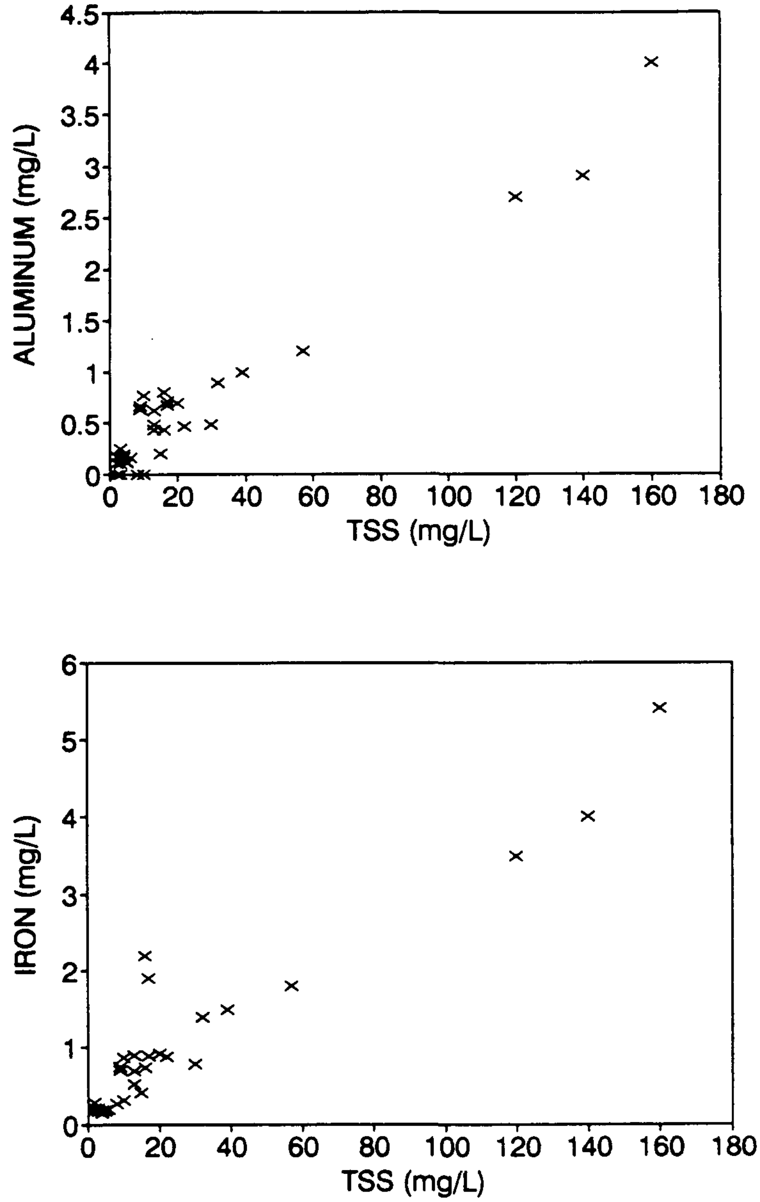


Figure 3-9. **Relationship between total aluminum and total suspended solids, and total iron and total suspended solids for water samples collected during this study.**

during the current study would be similar in composition to the average of several samples collected (at one location) over a 1-hour period. Therefore, the 750-µg/L criterion was used for evaluation of aluminum concentrations. The criterion was exceeded during four of the study surveys. The total aluminum concentration at Transect 4 slightly exceeded 750 µg/L during both of the Dalecarlia post-discharge surveys. Total aluminum concentrations during the second baseline survey exceeded 750 µg/L at Transects 2, 3, and 4. Total aluminum concentrations during the Georgetown #2 post-discharge survey were much higher than 750 µg/L. All of these surveys were immediately following a rainfall event. The elevated aluminum concentrations were probably a result of the introduction of aluminum-bound particles in stormwater runoff to the water column.

No analytical methodology is accepted as ideal for defining aquatic life criteria for aluminum. As previously mentioned, numerous species of aluminum occur in surface waters, and definitive information is scarce regarding the toxicity of aluminum species to freshwater aquatic life (U.S. EPA, 1988). The method employed in this investigation involves a digestion procedure. The digestion results in the dissolution of all aluminum fractions, some of which are not toxic. Measurements of total aluminum may thus include a significant fraction that is neither biologically available nor toxic in the environment. This phenomenon can be especially problematic with waters containing suspended clay (U.S. EPA, 1988). As a result, aluminum criteria may be overprotective in some instances when aluminum is measured as total recoverable aluminum.

3.4.6 Total Iron

Total iron concentrations exhibited a pattern similar to that of total aluminum during all of the surveys, although iron concentrations were somewhat higher. Again, the first and third baseline surveys had the lowest concentrations, ranging from 0.14 mg/L to 0.28 mg/L. The second baseline survey had somewhat higher total iron concentrations, ranging from 0.52 mg/L to 1.8 mg/L. The iron concentrations observed during the Dalecarlia #3 and #4 and Georgetown #1 post-discharge surveys were between the second baseline survey and the first and third baseline surveys. However, concentrations at Transects 3, 4, and 6 of the Dalecarlia #4 post-discharge survey were slightly greater than those in the second baseline survey. As with aluminum, the total iron concentrations from the Georgetown #2 survey were highest of all the surveys, ranging from 3.50 mg/L to 5.40 mg/L.

The observed elevated total iron concentrations associated with the Georgetown #2 post-discharge survey were probably a reflection of sediment particles suspended in the river from high flows. Heavy rainstorms preceded the Georgetown #2 survey. Iron is naturally slightly enriched in District of Columbia waters because soils in the area consist largely of clays in which iron is abundant (personal communication, Karimi, 1992). A strong correlation ($R^2 = 0.948$) was observed between the concentrations of total iron and total suspended solids for water samples collected during the entire survey, as shown in Figure 3-9.

The District of Columbia has established a total iron limit of 1.0 mg/L for secondary contact recreation and aesthetic enjoyment (DCMR, Title 21, Chapter 11). The U.S. EPA has established the same criteria for protection of freshwater aquatic life (U.S. EPA, 1986). Total iron concentrations exceeded this limit during the second baseline survey, and the Dalecarlia #4 and Georgetown #2 post-discharge surveys.

3.4.7 Water Temperature

Water temperature data are shown in Figure 3-10. The data exhibit normal seasonal variances for each of the surveys. Water temperature was fairly consistent from transect to transect during any given survey. The nearly vertical temperature profiles are typical of a well-mixed, swift-flowing river system such as the study area of the Potomac River. Temperatures were highest in October, reached a low in December, and increased slightly with the January surveys.

All water temperatures were below the upper limit of 32.2 °C set by District of Columbia Municipal Regulations (DCMR, Title 21, Chapter 11 - Water Quality Standards).

3.4.8 pH

The pH values were consistent among the three baseline surveys, ranging from 8.20 to 8.73 (Figure 3-11). Lower pH values were observed during all of the post-discharge surveys. The decreased pH values associated with the post-discharge surveys may be attributed to low-pH rainwater from storms that preceded each of the surveys.

Several of the observed pH values slightly exceeded the upper limit of the 6.0-8.5 range specified by DCMR, Title 21, Chapter 11, for the protection of aquatic life, waterfowl, shore birds, and water-oriented wildlife. All observed pH values were within the range of 6.5-9.0 for protection of freshwater aquatic life, as specified by U.S. EPA (1986). The pH values did not fall below the 6.0 level at which more toxic species of aluminum are formed (Cooke and Carlson, 1989).

3.4.9 Dissolved Oxygen

Dissolved oxygen concentrations, as presented in Figure 3-12, showed typical seasonal variances in conjunction with changes in water temperature. Dissolved oxygen concentrations increased with decreasing water temperatures, as oxygen is more soluble in cold water than in warm water. No apparent trend was seen between surveys in the concentrations of dissolved oxygen at the transects. Dissolved oxygen concentrations appeared to be primarily a function of water temperature during the post-discharge surveys as compared with other factors. All concentrations obtained for the post-discharge surveys were within the limits set by the range of the baseline surveys.

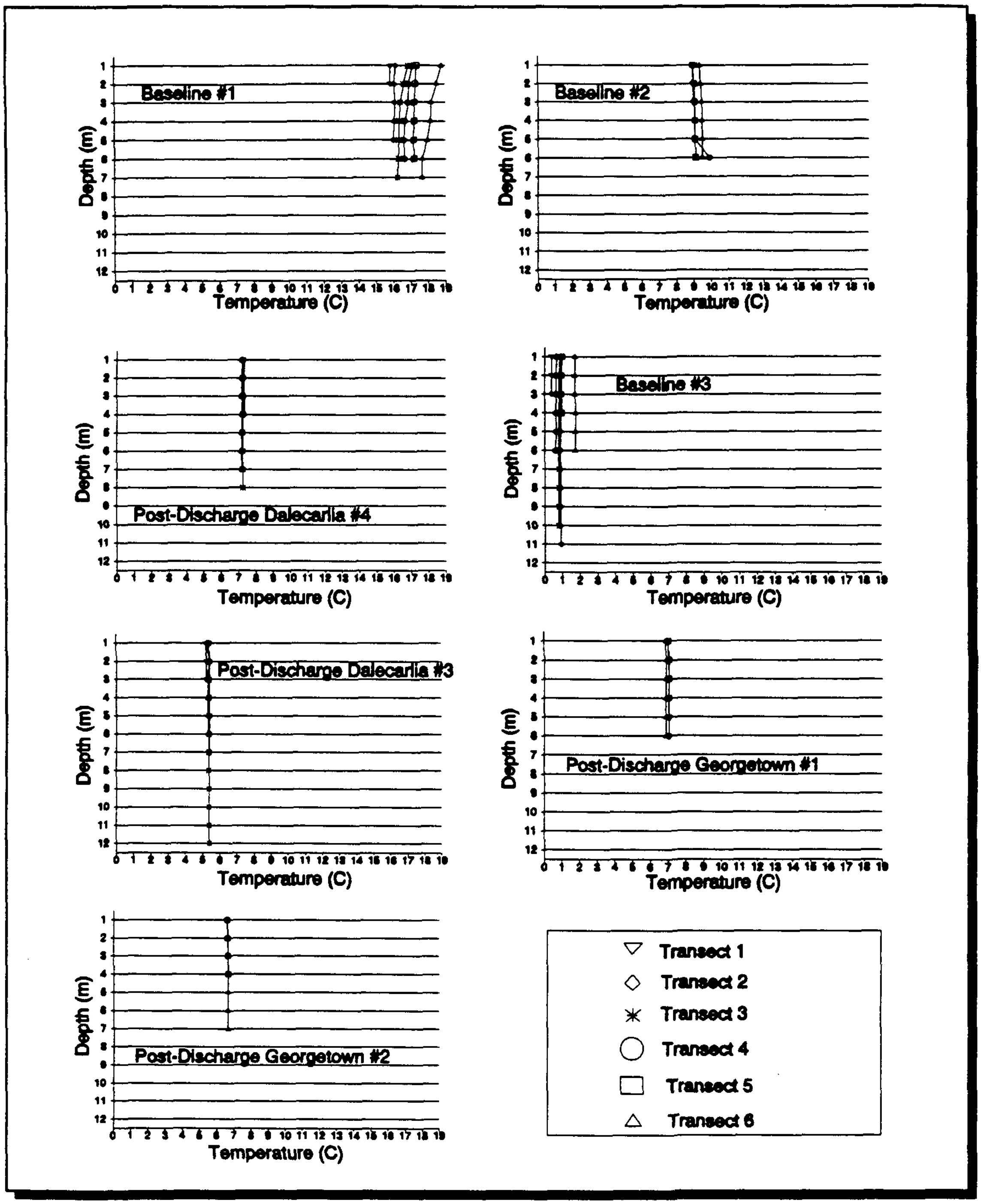


Figure 3-10. In situ surface-to-bottom profiles of water temperature for each survey.

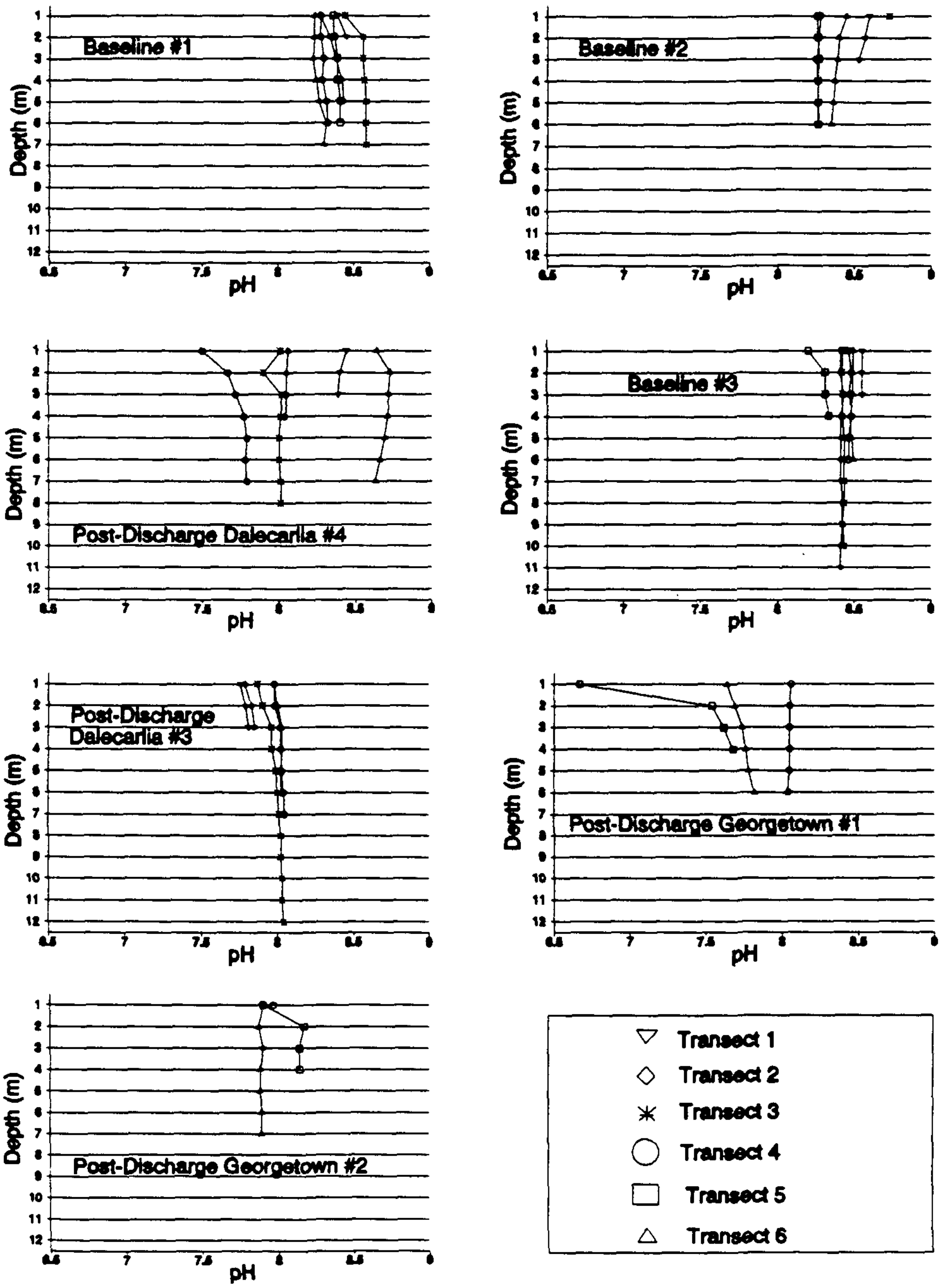


Figure 3-11. In situ surface-to-bottom profiles of pH for each survey.

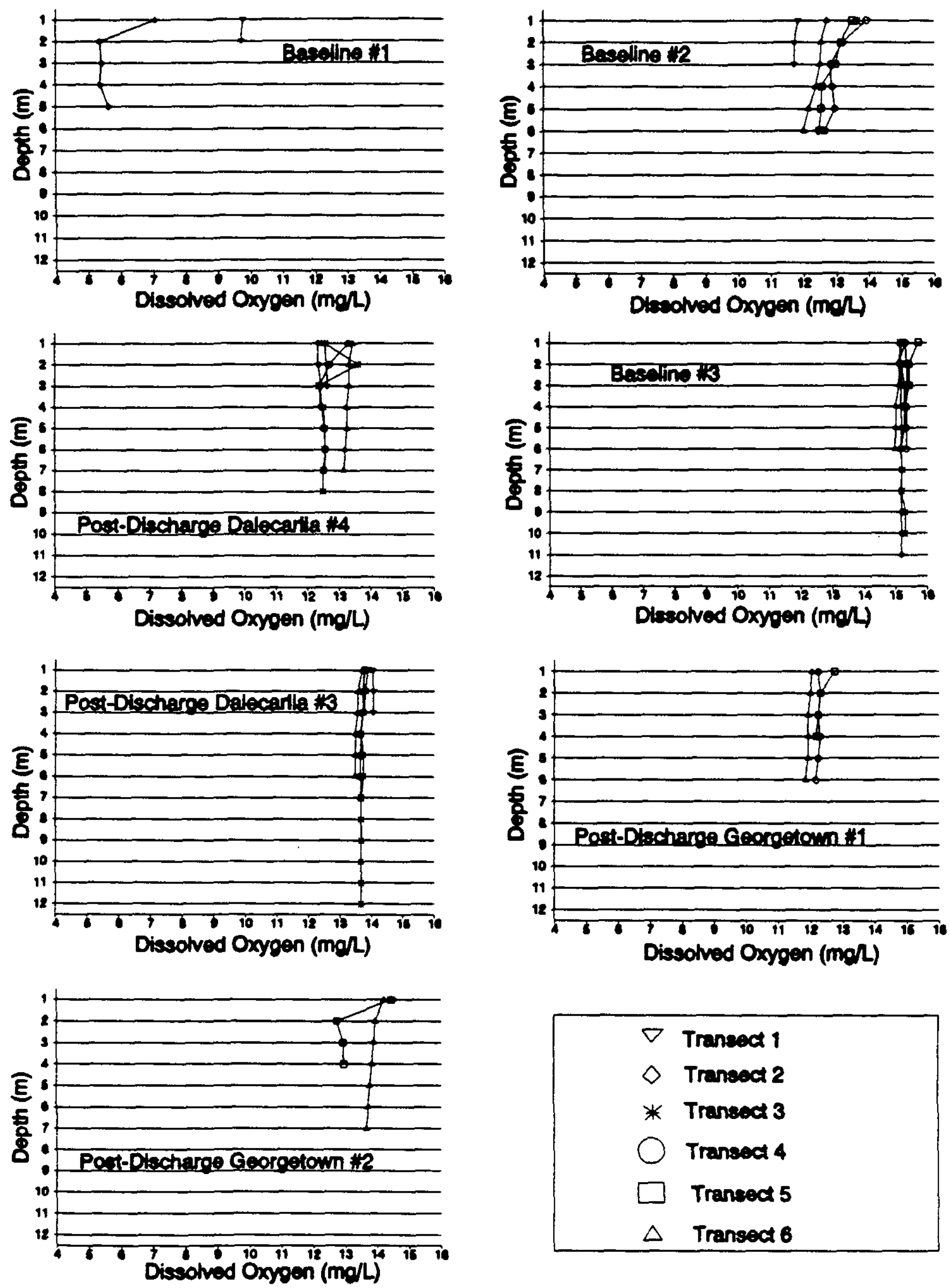


Figure 3-12. In situ surface-to-bottom profiles of dissolved oxygen concentration for each survey.

Dissolved oxygen concentrations were above the instantaneous minimum of 4.0 mg/L designated by DCMR, Title 21, Chapter 11. The same 4.0-mg/L minimum is set as a water quality criterion for freshwater aquatic life by the U.S. EPA (1986). In addition, the U.S. EPA has specified an instantaneous minimum criterion of 8.0 mg/L in the water column to achieve an intergravel concentration of 5.0 mg/L for protection of early aquatic life stages, including embryonic and larval stages and juvenile forms up to 30 days after hatching. This criterion was not met at Transect 2 during the first baseline survey. However, it is unlikely that any early life stages would be affected at that time of the year.

3.4.10 Conductivity

Conductivity is a measure of the flow of electrons through water (the reciprocal of resistance to electron flow through water) and is used as an indicator of total dissolved solids (TDS) in aquatic systems (Cole, 1983). As shown in Figure 3-13, conductivity values ranged from 312 µS/cm to 362 µS/cm during the first and second baseline surveys. Conductivity values were significantly lower during the third baseline survey, ranging from 286 µS/cm to 289 µS/cm.

Conductivity values observed during the post-discharge surveys were generally lower than those observed during the baseline surveys. Conductivity ranged from a low of 239 µS/cm during the Dalecarlia #3 post-discharge survey to a high of 322 µS/cm during the Georgetown #1 post-discharge survey. This reduction in conductivity may be a reflection of the high river flows associated with the rainfall events that preceded each post-discharge survey. The additional volume of water from direct precipitation and runoff may have served to dilute the system, reducing the concentration of TDS in the river and lowering the conductivity.

Generally, conductivity in the United States ranges from 50 to 1500 µS/cm for potable waters (APHA et al., 1985). The observed values are well within the normal range encountered in this section of the Potomac River (MWCOG, 1985 and 1987).

3.5 SEDIMENT ANALYSES

The following sections present the results of the sediment sampling and analyses. Physical analyses (i.e., particle size distributions) were conducted only on river sediment samples collected during the first baseline survey. Chemical analyses were performed on both river and sedimentation basin samples.

3.5.1 Particle Size Distribution

A summary of particle size distribution results for the sediment samples collected from the river during the first baseline survey is presented as a series of pie charts in Figures 3-14 and 3-15. The size classifications used in the analyses are presented in Table 3-4. Summaries of the observations at each transect are presented in the following paragraphs.

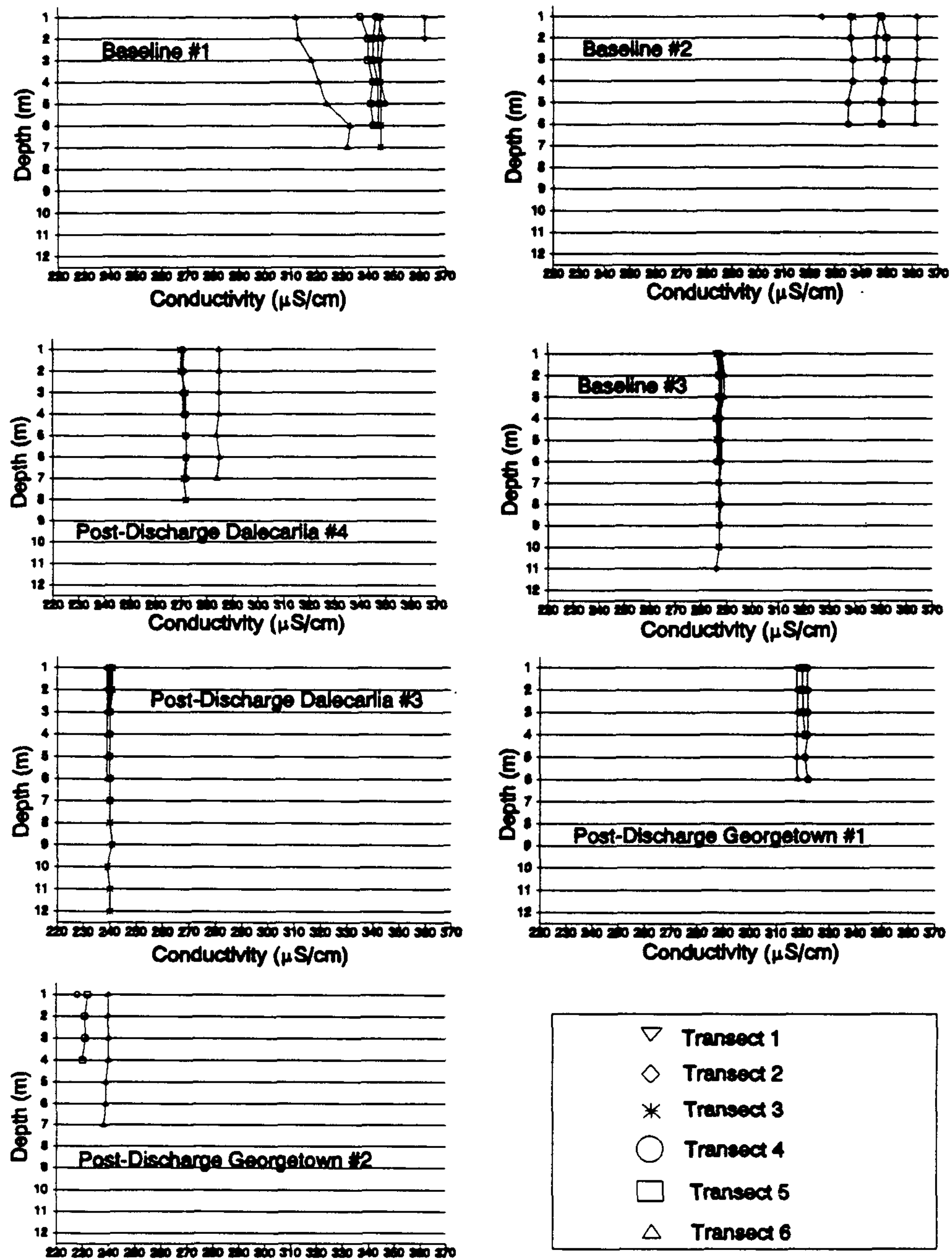


Figure 3-13. In situ surface-to-bottom profiles of conductivity for each survey.

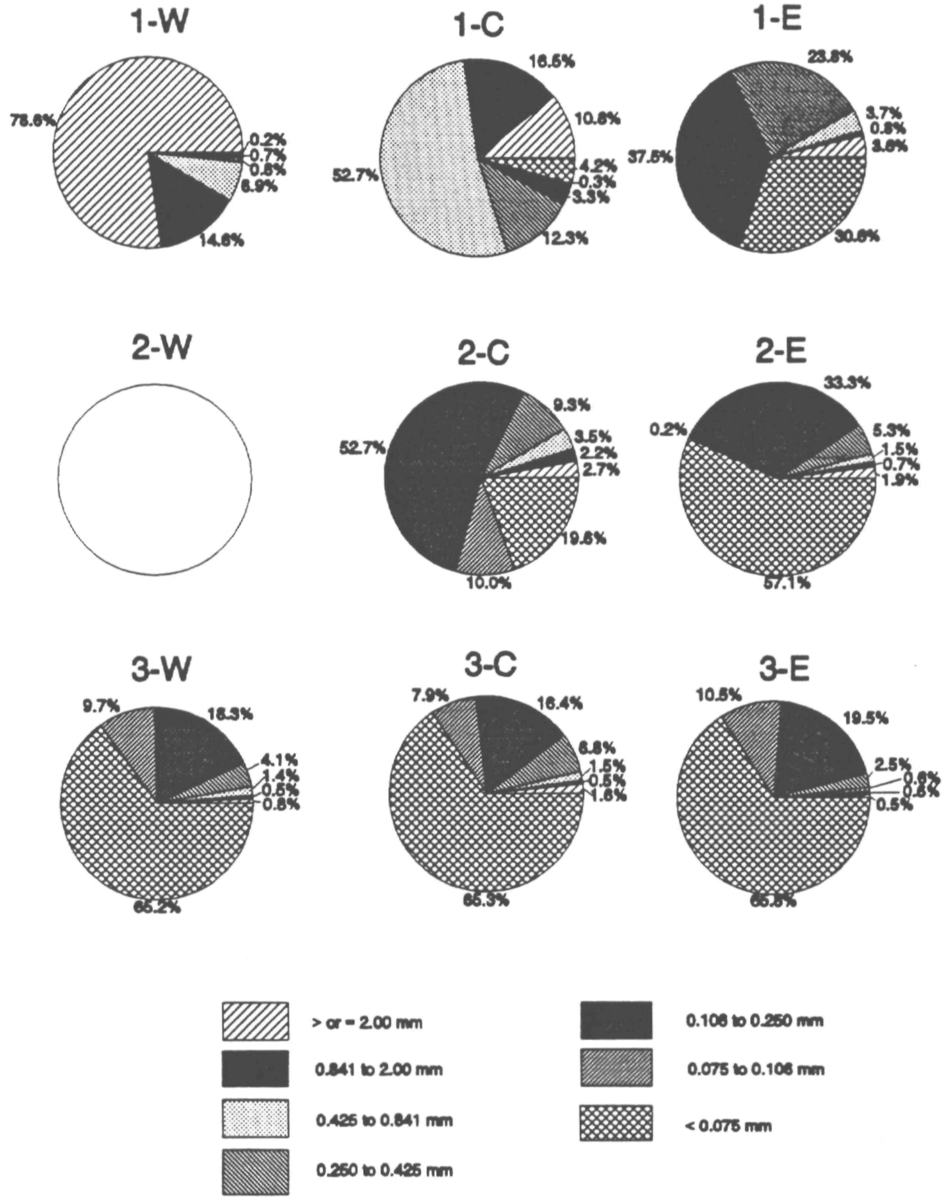


Figure 3-14. **Particle size distribution of sediment samples collected at Transects 1, 2, and 3.**

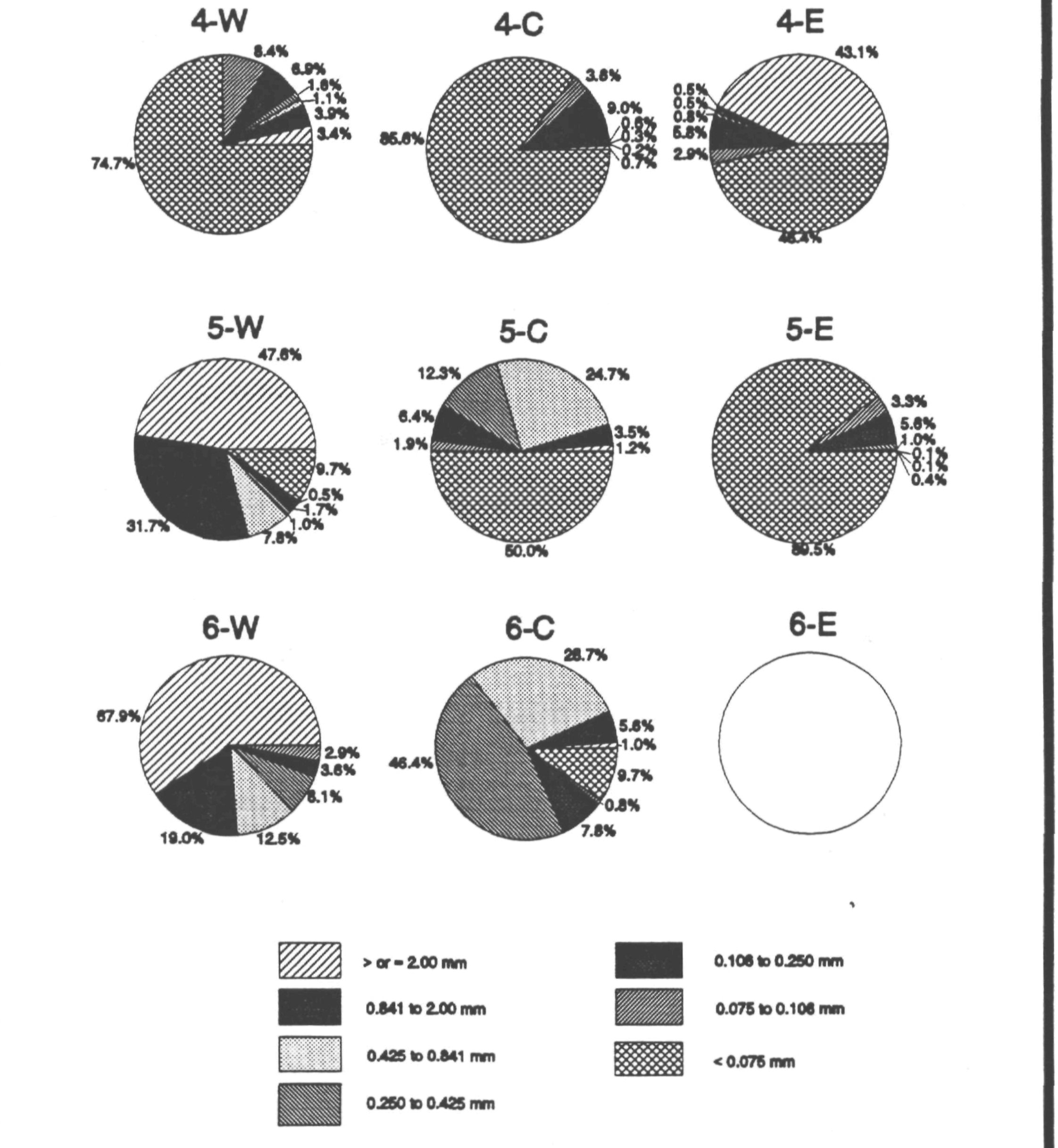


Figure 3-15. **Particle size distribution of sediment samples collected at Transects 4, 5, and 6.**

3.5.1.1 Transect 1

The distributions of sediment particle sizes at this transect were quite variable. In general, the dominant particle sizes decreased from west to east along the transect.

3.5.1.2 Transect 2

The west location was characterized by boulders, preventing the collection of a sediment sample. Approximately half of the center sample consisted of fine sand and very fine sand or smaller-sized particles. The east sample was primarily fine to very fine sand or silt.

Table 3-4. Classifications used in the analysis of particle size distribution.

Size (mm)	Classification
≥ 2.00	Gravel
0.841 - 1.99	Very coarse sand
0.426 - 0.840	Coarse sand
0.251 - 0.425	Medium sand
0.106 - 0.250	Fine sand
0.075 - 0.105	Very fine sand
≤ 0.075	Silt

3.5.1.3 Transect 3

All three samples (west, center, and east) were relatively uniform, consisting predominantly of silt.

3.5.1.4 Transect 4

The west and center samples at this transect were quite similar in composition and consisted primarily of silt. The east sample was almost evenly distributed between gravel and silt, with very small percentages of other size particles present. It should be noted that in later surveys, it was not possible to collect a sample from the east location because boulders were present in the river bed.

3.5.1.5 Transect 5

The particle size distributions across this transect were variable, with a general trend of decreasing particle size from west to east. Approximately half of the west sample was gravel, followed closely in percentage by coarse to very coarse sand. This contrasts strongly with the center sample where half of the sediment consisted of very fine sand or smaller-sized particles, and the east sample which consisted almost entirely of silt.

3.5.1.6 Transect 6

More than half of the west sample consisted of gravel, followed by coarse to very coarse sand. The center sample consisted mainly of medium to coarse sand. The bottom on the east side of the transect was covered with boulders, making it impossible to collect sediment samples during the baseline and most of the subsequent surveys.

The data presented in the preceding figures and discussion represent sediment conditions at a single point in time (i.e., the first baseline survey) and space. Qualitative observations made during the collection of subsequent baseline and post-discharge benthic samples suggest that the river bottom in the study area is highly variable, both spatially and temporally. Examination of the particle size distributions shows that the bottom was generally quite variable from site to site along each transect. In many cases, the dredge had to be deployed several times to obtain an adequate volume of sediment because of the very rocky nature of the bottom, yet the resulting sample may have been dominated by relatively fine particles. The impression among the sampling crew was that these samples were being collected from pockets of sediment located in and among the rocks and boulders that appear to cover the river bed in the study area. Moreover, because the river narrows significantly immediately upstream of the study area, and high-flow conditions are accompanied by extreme turbulence, it is very likely that this portion of the Potomac River is highly dynamic, with constant scouring and redistribution of the sediment on the river bottom. This would certainly explain why locations where sediment samples were collected during the initial baseline survey did not necessarily yield a benthic sample during subsequent sampling events.

These observations have significant implications to the objectives of this investigation. The bedload portion of sediment transport tends to eliminate suitable habitat for many forms of aquatic life (Novotny and Chesters, 1981). If a significant bedload exists in the study area, then the resident benthic communities may be expected to be limited to those hardy and/or mobile organisms that are adapted to a very dynamic substrate. As a result, the benthic communities at any location may be as variable as the substrate, moving on to more suitable habitat as local conditions change. With a large bedload, sediment sampling at any given point in space and time will be representative of only the surficial sediments that happen to be passing through the sampling location at that moment. This condition would be reflected in a high degree of variability in physical, chemical, and biological measurements in sediment samples collected over any period of time.

3.5.2 Total Aluminum

Figure 3-16 presents the results of the total aluminum analyses for samples collected from the four sedimentation basins and during the three baseline surveys as high-low plots; a vertical line shows the range of concentrations observed at each site, and the horizontal "tick" indicates the mean concentration. Locations where sampling was attempted but no sediment was found are denoted with "N/S." Figure 3-17 contains similar representations of sediment aluminum concentrations observed during the post-discharge events. A summary of the river sediment aluminum data is presented by sampling event and transect number in Table 3-5. For clarity, shaded cells in the table indicate transects where samples were not collected during a given sampling event, and heavy vertical lines are used to indicate the location of each discharge relative to the transects. The results for the sedimentation basin and river samples are discussed in the following subsections. Total aluminum data are presented in Appendix A.

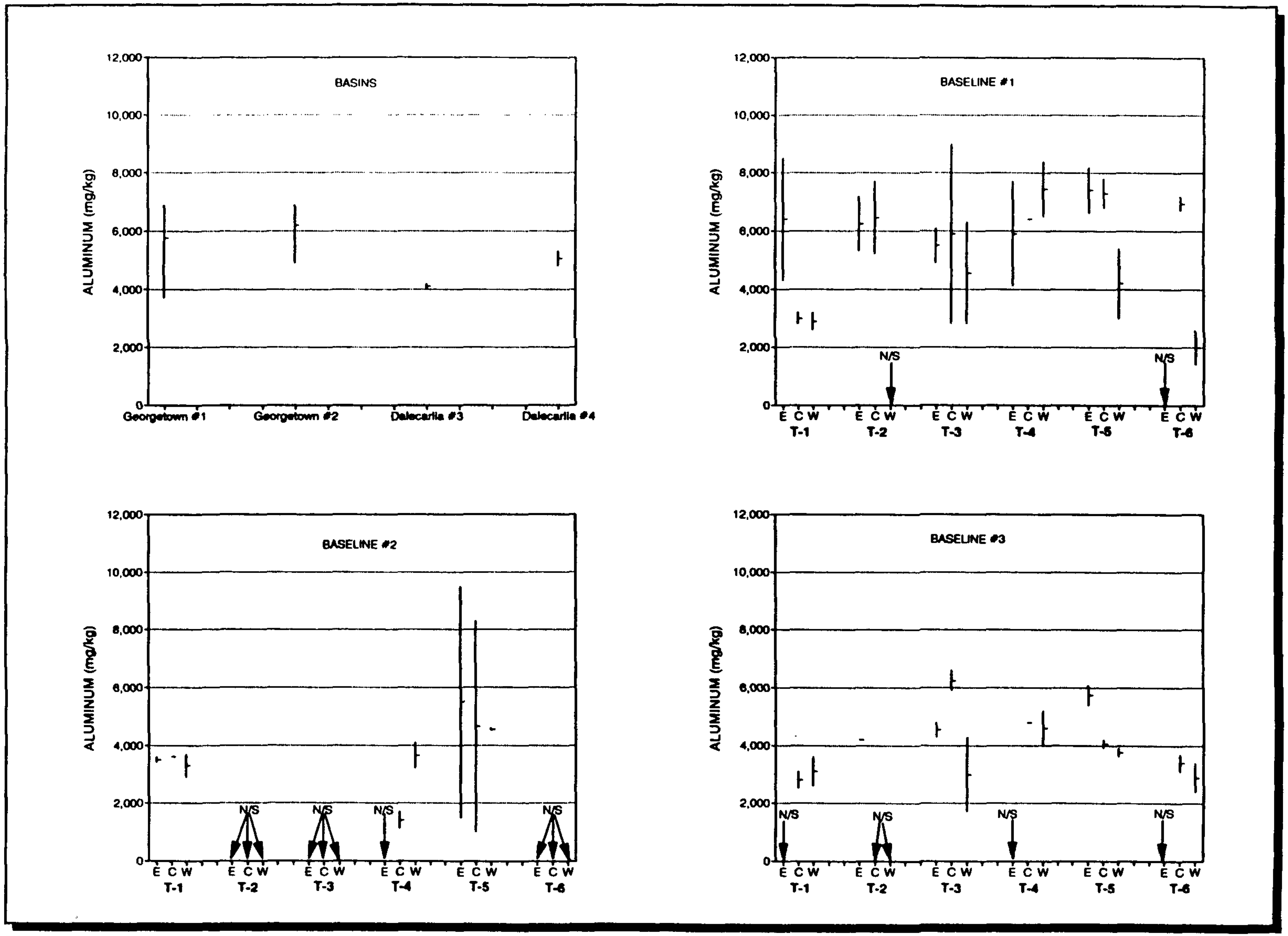


Figure 3-16. Total aluminum concentrations in the sediment samples collected from the sedimentation basins and during the baseline river surveys.

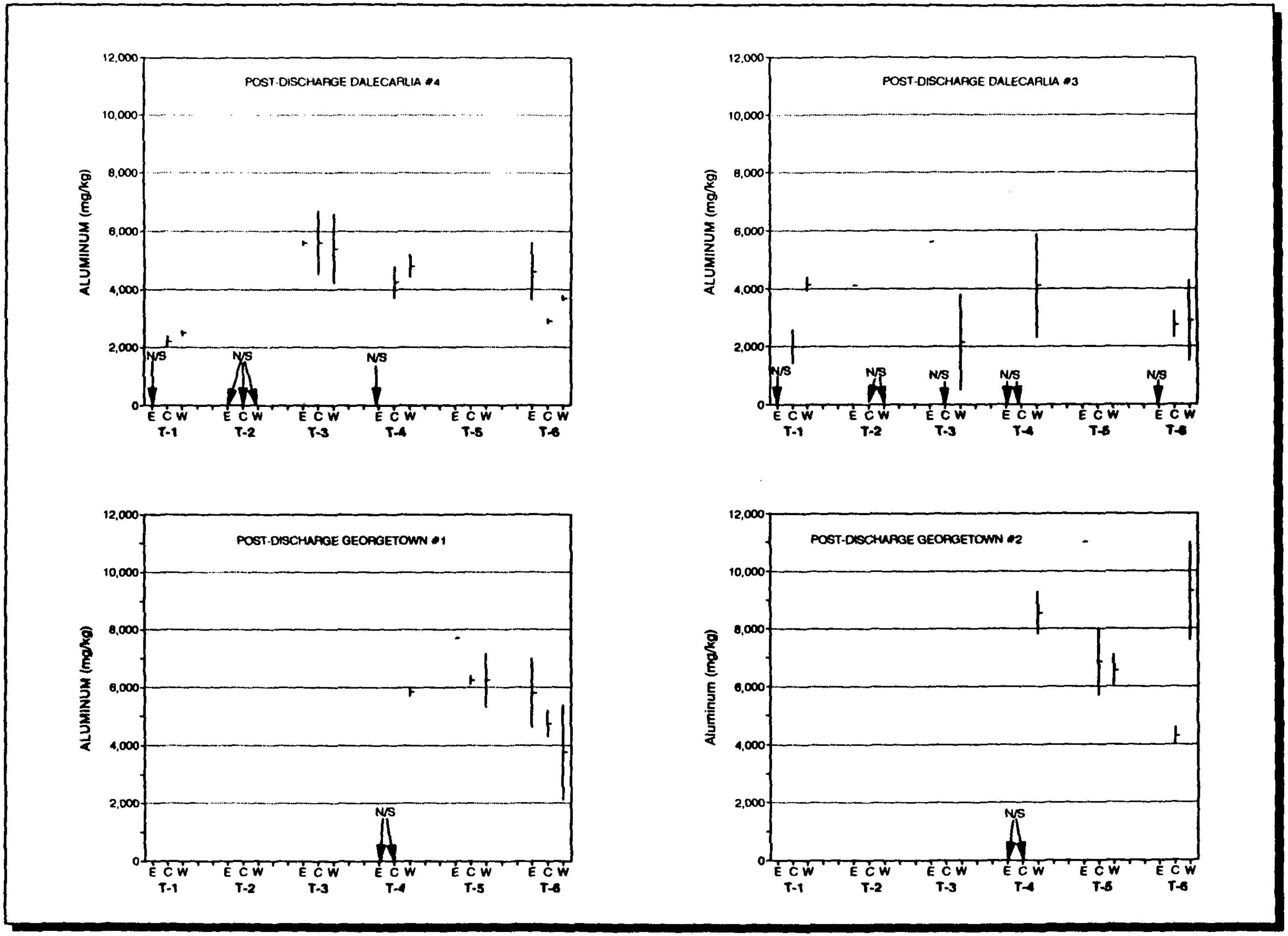


Figure 3-17. Total aluminum concentrations in the sediment samples collected during the post-discharge river surveys.

Table 3-5. Summary of total aluminum data from river sediment samples.

Event	Transect Number					
	1	2	3	4	5	6
Baseline #1	Mean =4100 sd = 2234 n = (6)	6350 1287 (4)	5316 2365 (6)	6583 1469 (6)	6300 1892 (6)	4475 2907 (4)
Baseline #2	3440 321 (5)	▨	▨	2525 1372 (4)	4900 3457 (6)	▨
Dalecarlia #4	2350 252 (4)	▨	5533 1037 (6)	4525 640 (4)	▨	3733 993 (6)
Baseline #3	2950 507 (4)	4200 na (1)	4600 1692 (6)	4667 611 (3)	4516 999 (6)	3150 557 (4)
Dalecarlia #3	3075 1350 (4)	4100 0 (2)	3297 2592 (3)	4100 2546 (2)	▨	2825 1203 (4)
Georgetown #1	▨	▨	▨	6150 636 (2)	6540 940 (5)	4767 1608 (6)
Georgetown #2	▨	▨	▨	8550 1061 (2)	7960 1942 (5)	6800 3212 (4)

Notes: Shading indicates transects where no samples were collected.
Heavy vertical lines indicate the location of discharge points relative to the transects.
Mean concentrations are expressed in units of mg/kg.

3.5.2.1 Sedimentation Basins

The mean aluminum concentrations of the sedimentation basins during the initial baseline survey ranged from 4,100 mg/kg at Dalecarlia #3 to 6,200 mg/kg at Georgetown #2. Mean concentrations at the Dalecarlia #4 and Georgetown #1 basins were 5,067 mg/kg and 5,767 mg/kg, respectively. Because the sediments in these basins are a product of the same treatment process, it would be expected that the chemical composition of the sediments would be similar. An examination of Figure 3-16 suggests that the sediment from the Georgetown basins had higher mean aluminum concentrations than those from the Dalecarlia basins. However, the variability within replicate samples from each basin was substantial; both the highest (6,900 mg/kg) and lowest (3,700 mg/kg) concentrations were observed in the samples from the same basin (i.e., Georgetown #1). Using Tukey's HSD multiple comparison test (Tukey, 1977), no statistically significant difference was noted among the aluminum concentrations in the sediments from the four sedimentation basins. It should be noted that the power of the statistical test was undermined somewhat by the small number of samples from each basin (i.e., 3).

3.5.2.2 Baseline River Samples

Several observations result from a review of the baseline data presented in Figure 3-16 and Table 3-5. These may be summarized as follows:

- There is a great deal of variability within and among transects under baseline conditions. This variability may potentially be attributed to the wide variety of flows observed among the different events.

- With the exception of the east station during Baseline #1, the average sediment aluminum concentrations at Transect 1 appear to be consistently the lowest observed. Although this could potentially be attributed to residual aluminum in the sediments from past discharges, determination of this is undermined by the inconsistent availability of sediment at the upstream sites, especially Transect 2.

- Average aluminum concentrations at each of the transects decreased between Baseline #1 and Baseline #3. The only obvious reason for this trend is the deposition of sediments from elevated river flows occurring between the baseline events.

- Most (i.e., 71.9%) of the river sediment samples collected during the Baseline #1 event fell within or above the range of aluminum concentrations observed in the sediments from the four sedimentation basins (i.e., 3,700 - 6,900 mg/kg). If Transect #1, which is in a relatively wide and slow-moving area of the river, is eliminated from consideration, this percentage increases to 80.8.

The last observation has very important implications in that the material discharged into the river from the basins appears to have had aluminum concentrations in the same range as the unimpacted sediments in the river. In fact, 25% of the sediment samples collected during Baseline #1 showed aluminum concentrations greater than any of those observed in the samples from the sedimentation basins.

3.5.2.3 Post-Discharge River Samples

The Dalecarlia post-discharge data show aluminum concentrations similar to and only slightly greater than, in some cases, the concentrations in the sedimentation basins. The aluminum concentrations following the discharge of the Georgetown basin samples showed the same pattern. Aluminum concentrations in the samples collected following the discharge of the Georgetown #2 basin were the highest concentrations observed (excluding Transect 5-center and Transect 6-center) throughout the entire study.

Data analyses were conducted to detect statistically significant changes in sediment aluminum concentrations between successive sampling events. The premise behind these tests was that impacts of the discharges would result in significant changes in sediment aluminum concentrations at downstream transects. Comparison of upstream transects provides the opportunity to check for effects that are independent of the discharges. The analyses consisted of using the t-test for equal mean concentrations at each of the transects for paired events. Table 3-6 presents a summary of the results of these analyses. Probability values (p) shown in the table indicate the probability of incorrectly rejecting the null hypothesis (i.e., equal means). Asterisks are used to indicate significance at the 90 and 99% confidence levels. The discussion regarding these data is presented by discharge event.

Table 3-6. Summary of t-tests comparing sediment aluminum concentrations at each transect between paired sampling events.

Paired Events	Transect Number					
	1	2	3	4	5	6
Baseline #1 versus Baseline #2	t = -0.649 p = 0.532			t = -4.386 p = 0.002**	t = -0.870 p = 0.405	
Baseline #1 versus Dalecarlia #4	t = -1.529 p = 0.165		t = -0.205 p = 0.841	t = -2.602 p = 0.032*		t = -0.591 p = 0.571
Baseline #2 versus Dalecarlia #4	t = -5.541 p = 0.001**			t = -2.642 p = 0.038*		
Baseline #3 versus Dalecarlia #4	t = -2.121 P = 0.078*		t = -1.152 P = 0.276	t = -0.295 p = 0.780		t = -1.056 p = 0.322
Baseline #3 versus Dalecarlia #3	t = -0.173 p = 0.868		t = -0.926 p = 0.385	t = -0.400 p = 0.716		t = -0.490 p = 0.641
Dalecarlia #3 versus Georgetown #1				t = -1.105 p = 0.384		t = -2.047 p = 0.075*
Georgetown #1 versus Georgetown #2				t = 2.744 p = 0.111	t = -1.472 p = 0.179	t = -1.345 p = 0.216

Notes:
* Indicates significance at the 90% confidence level.
** Indicates significance at the 99% confidence level.
Heavy vertical lines indicate position of discharge relative to location of transects.

Dalecarlia #4. Transect 1 was established as the upstream control site for the post-discharge surveys following release of the Dalecarlia sedimentation basins. There was a statistically significant decrease in the mean aluminum concentrations at Transect 1 after the Dalecarlia #4 discharge. Examination of the plots in Figure 3-17 suggests that this significance is entirely the result of the somewhat anomalous concentrations observed at Transect 1-E.

Both the Baseline #1 and Baseline #2 sampling events were available for use as a control against which to compare the Dalecarlia #4 post-discharge data. Although Baseline #2 was temporally closer to the Dalecarlia #4 sampling, the extremely high flows and resulting limited number of samples that were collected raise issues regarding the representativeness of the data. Comparisons of the mean aluminum concentrations at each transect show decreases at all transects. The decrease was statistically significant at Transect #4, where mean concentrations declined from 6,583 mg/kg for the Baseline #1 sample to 2,525 mg/kg for Baseline #2. For these reasons, the Baseline #2 data should be considered suspect.

No significant differences in mean aluminum concentrations were observed between Baseline #1 and the Dalecarlia #4 discharge at Transects 3 and 6. However, statistically significant differences were observed for the sediment samples collected at Transect 4. Comparison of the post-discharge data for this transect with the Baseline #1 data indicates a significant decrease in mean aluminum concentration from 6,583 mg/kg to 4,525 mg/kg. Conversely, comparison with the Baseline #2 data suggests an increase from 2,525 mg/kg to 4,525 mg/kg. In summary, the evidence suggests that the discharge from the Dalecarlia #4 basin did not have a significant impact on the sediment aluminum concentrations in the Potomac River.

Dalecarlia #3. Baseline #3 was conducted between the Dalecarlia #4 and #3 discharges, and provides a reference against which to gage the impacts of the Dalecarlia #3 discharge. No statistically significant differences between these two events were observed at any of the transects. The mean aluminum concentrations were lower at all downstream stations after the discharge.

It might be noted that Baseline #3 was also compared to Dalecarlia #4 to examine differences between events where no discharge had occurred. The only significant difference detected was at Transect 1, where an increase in sediment aluminum concentrations of approximately 600 mg/kg was noted.

Georgetown #1. The Dalecarlia #3 event served as the control for the Georgetown #1 post-discharge survey. Although the concentrations at Transect 4, upstream of the discharge, increased from 4,100 mg/kg to 6,150 mg/kg, this difference was not statistically significant. A similar increase of approximately 2,000 mg/kg at Transect 6 was, however, statistically significant at the 90% confidence level. A comparison of data for Transect 5 from the Dalecarlia #3 post-discharge sampling also shows a similar statistically significant increase in mean aluminum concentration of approximately 2,000 mg/kg. Although the statistical significance of the observed increases in downstream concentrations would suggest an impact from the Georgetown #1 discharge, the fact that the upstream station experienced a similar, albeit not statistically significant, increase indicates that some other environmental factor is probably responsible for the observed changes.

Georgetown #2. The Georgetown #1 post-discharge sampling data served as the control for the Georgetown #2 post-discharge event. All of the transects showed an increase in aluminum concentrations; the highest mean transect concentration (i.e., 8,554 mg/kg) was observed at Transect 4, upstream of the

Georgetown discharges. The highest individual aluminum concentration observed during the study (i.e., 11,000 mg/kg) was associated with the sample collected at Transect 6-W. Because of the large variability at each transect, the increases were not statistically significant.

3.5.3 Total Iron

Figure 3-18 presents the results of the total iron analyses for samples collected from the four sedimentation basins and during the three baseline surveys as high-low plots; a vertical line shows the range of concentrations observed at each site, and a horizontal "tick" indicates the mean concentration. Locations where sampling was attempted but no sediment was found are denoted with "N/S." Figure 3-19 contains similar representations of sediment aluminum concentrations observed during the post-discharge events. A summary of the river sediment aluminum data is presented by sampling event and transect number in Table 3-7. For clarity, shaded cells in the table indicate transects where samples were not collected during a given sampling event, and heavy vertical lines are used to indicate the location of each

Table 3-7. Summary of total iron data from river sediment samples.

Event	Transect Number					
	1	2	3	4	5	6
Baseline #1	Mean = 8300 sd = 2764 n = (6)	8775 1631 (4)	6450 3320 (6)	7583 1447 (6)	9700 1325 (6)	8925 3063 (4)
Baseline #2	8720 898 (5)	▨	▨	3008 3403 (4)	8020 6566 (6)	▨
Dalecarlia #4	7475 750 (4)	▨	9067 1942 (6)	8375 2225 (4)	▨	8033 922 (6)
Baseline #3	7400 796 (4)	7700 na (1)	7833 2938 (6)	7267 1484 (3)	8500 1055 (6)	7400 993 (4)
Dalecarlia #3	7500 1679 (4)	6800 283 (2)	5550 4592 (3)	8050 2758 (2)	▨	6650 2213 (4)
Georgetown #1	▨	▨	▨	8200 1697 (2)	9960 1335 (5)	9167 1728 (6)
Georgetown #2	▨	▨	▨	8550 1626 (2)	11380 1540 (5)	11325 3500 (4)

Notes: Shading indicates transects where no samples were collected.
Heavy vertical lines indicate the location of discharge points relative to the transects.
Mean concentrations are expressed in units of mg/kg.

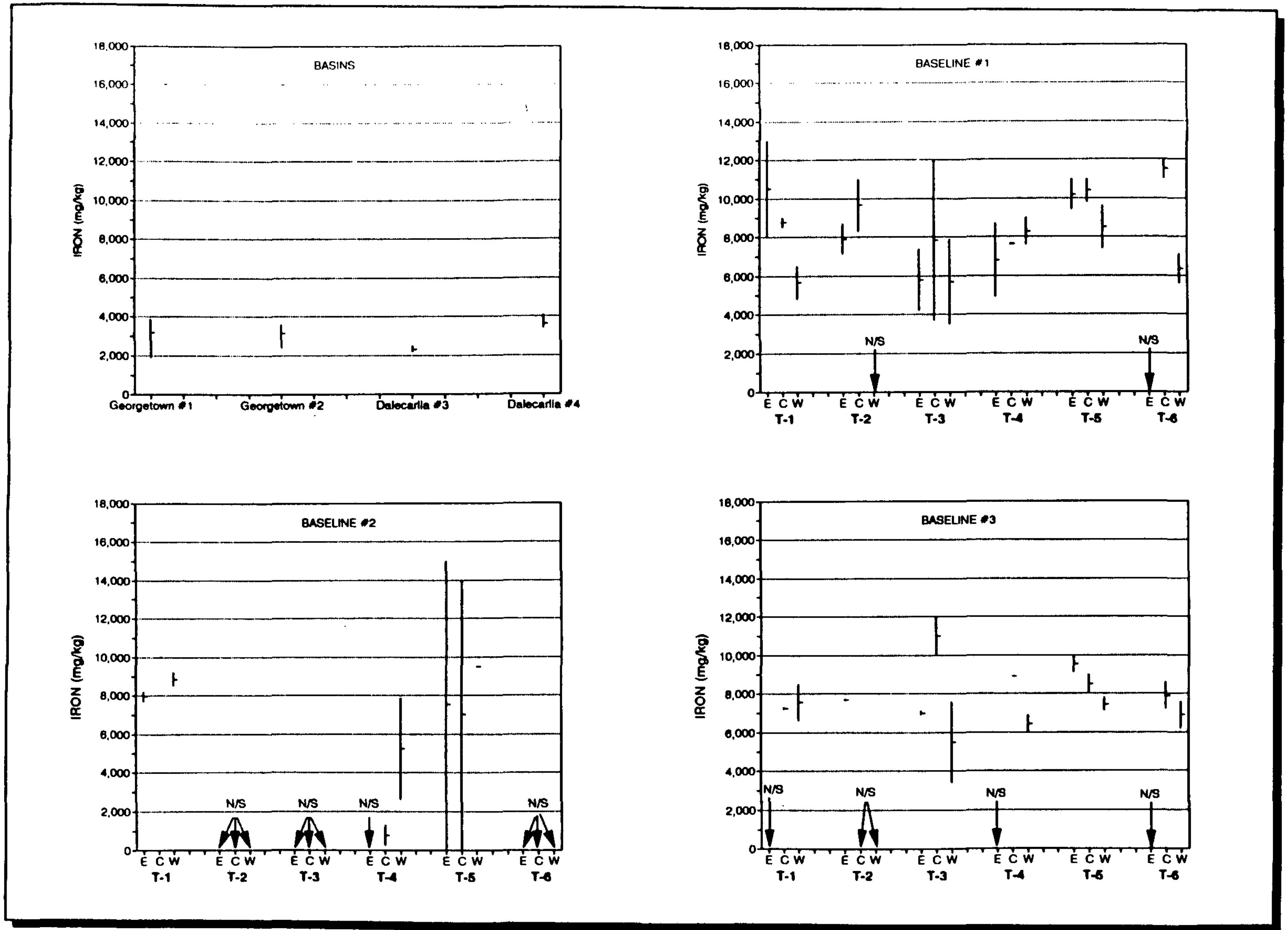


Figure 3-18. **Total iron concentrations in the sediment samples collected from the sedimentation basins and during the baseline river surveys.**

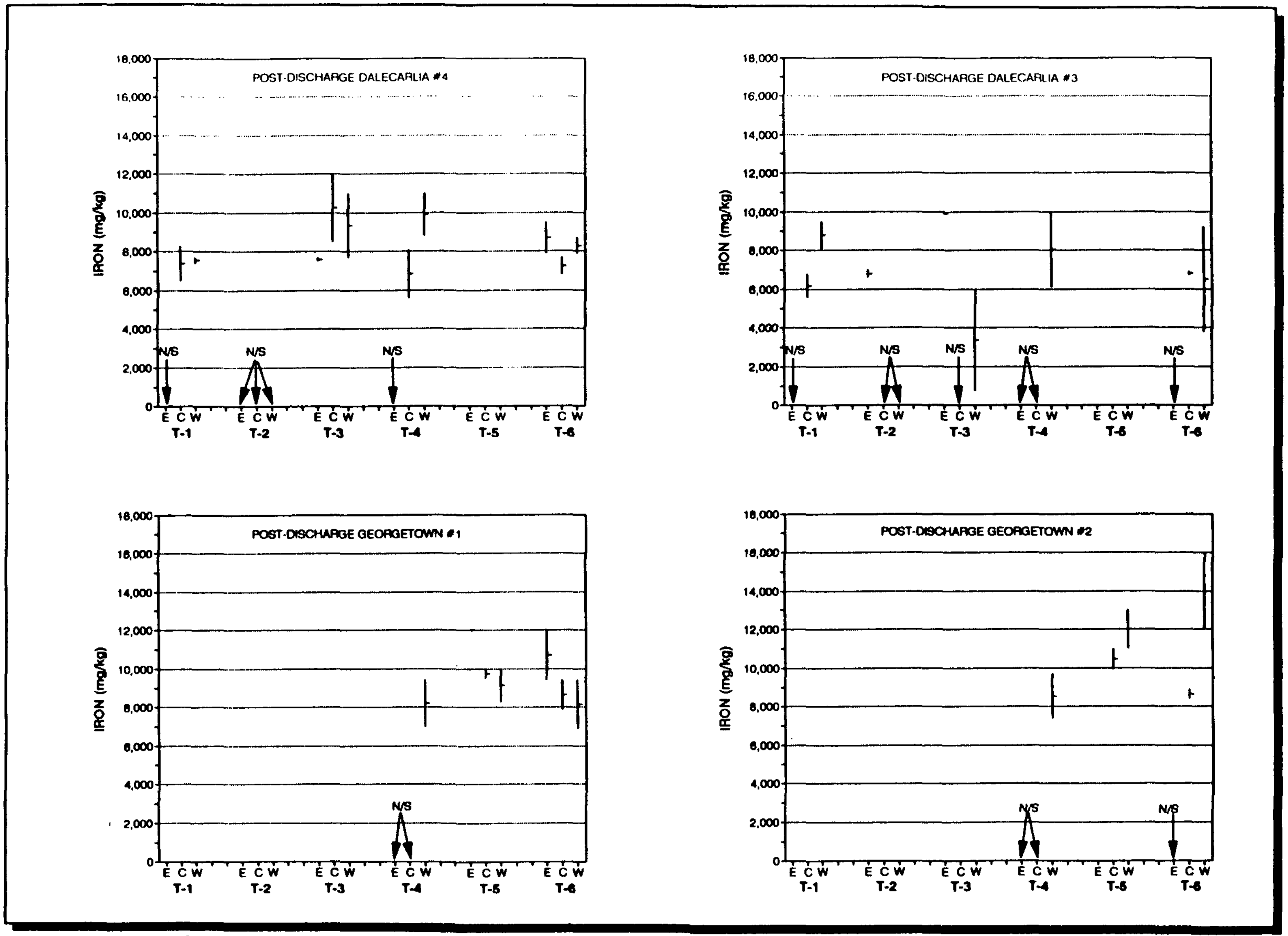


Figure 3-19. Total iron concentrations in the sediment samples collected during the post-discharge river surveys.

discharge relative to the transects. The results for the sedimentation basin and river samples are discussed in the following subsections. Total iron data are presented in Appendix A.

3.5.3.1 Sedimentation Basins

The mean iron concentrations in samples collected from the sedimentation basins during the initial baseline survey ranged from 2,300 mg/kg at Dalecarlia #3 to 3,633 mg/kg at Dalecarlia #4. The mean concentrations for Georgetown #1 and Georgetown #2 showed less variation with concentrations of 3,200 mg/kg and 3,233 mg/kg, respectively. No statistically significant difference was observed in the mean iron concentrations of the four basins.

3.5.3.2 Baseline River Samples

A review of the iron concentration data presented in Figure 3-18 and Table 3-7 yielded the following relevant observations regarding the baseline samples:

- Although a great deal of variability in the observed concentrations was noted at each transect, the mean transect concentrations were relatively consistent. No statistically significant difference was seen among the transects for either Baseline #1 or Baseline #3.

- In general, the iron concentrations in the baseline river samples were substantially (i.e., by a factor of 2) higher than those from the sedimentation basins. The only exception consisted of the data from Transect 4 collected during Baseline #2.

- The iron concentrations observed during Baseline #1 at Transects 5 and 6 were among the highest observed during the entire survey.

3.5.3.3 Post-Discharge River Samples

The post-discharge monitoring data are characterized by total iron concentrations that are consistently higher, by a factor of 2 or more, than the concentrations observed in the sedimentation basin samples. The basin concentrations ranged from 2,300 mg/kg to 3,633 mg/kg, only exceeding river sample concentrations of 765 mg/kg (Transect 4-center) from the Baseline #2 survey and a concentration of 3,375 mg/kg (Transect 3-west) from the Dalecarlia #3 post-discharge survey. Based on this observation, it can be concluded that the discharge of sediment from the Dalecarlia and Georgetown sedimentation basins would not result in an increase in iron concentrations in the sediments of the study area of the Potomac River.

It should be noted that iron concentrations at the downstream stations did increase over the duration of the investigation. Transects 5 and 6 showed especially large increases. This trend does not appear to have been a result of the alum discharges. Soils (certain clays) in the vicinity of the District of Columbia are slightly enriched with iron, and as a result, iron is abundant in the waters of the District of Columbia. Iron is relatively insoluble in oxygenated water and settles to the bottom of the river. This insoluble iron adds to the concentration of iron already contained in the sediments. Higher sediment iron concentrations during the post-discharge surveys may thus be attributed to extra iron being introduced to the river from runoff and soil erosion.

Overview. The mean iron concentrations in the samples from the sedimentation basins were, in most cases, lower than the lowest mean iron concentration for each survey.

Although Transect 1 was the control site for the Dalecarlia sedimentation basin releases, the iron concentrations were not dramatically lower for this transect than for the other transects. The concentrations were slightly lower following the release of Dalecarlia #4 and quite similar to those of the other transects following the release of Dalecarlia #3. Mean iron concentrations at Transects 3 and 4 were higher during the Dalecarlia #4 post-discharge survey than during the two previous baseline surveys. Of the locations where samples were collected on Transect 6 during the Dalecarlia #4 post-discharge survey, the center location's iron concentration decreased and the west location's iron concentration increased compared to the baseline concentrations. The mean iron concentrations from the Dalecarlia #3 post-discharge survey were lower than baseline concentrations for most locations, excluding Transect 3-east and Transect 4-west, both of which increased.

Transect 4 was the control site for the Georgetown sedimentation basin releases. Transect 4 had nearly the lowest mean iron concentration of the locations sampled following the discharge of Georgetown #1; however, samples could be collected from only one location at Transect 4 as opposed to all locations at Transects 5 and 6. The mean iron concentration at Transect 4-west was similar to the concentrations at Transect 5-west and Transect 6-west. Overall, the mean iron concentrations from the Georgetown #1 post-discharge survey were greater than or very similar to the mean iron concentrations at corresponding locations during the baseline surveys. Following the discharge of Georgetown #2, Transect 4 (control) had the lowest mean iron concentration of the transects sampled. The remainder of the sampling locations, excluding Transect 6-center, had the highest mean iron concentrations of the entire study.

3.6 BENTHIC MACROINVERTEBRATES

The following subsections present the results of the macroinvertebrate sampling analysis. The evaluation of the macroinvertebrate data was based upon calculations of taxa composition, abundance, family richness, diversity, and a family-level biotic index. Macroinvertebrate data are presented in Appendix B.

3.6.1 Taxa Composition

Taxa composition describes the types of taxa collected in a particular habitat or sample. A comprehensive taxa composition list for all transects is presented in Table 3-8.

All of the transects were dominated by same three families: Tubificidae, Chironomidae, and Corbiculidae. These families together constituted between 88% and 97% of the organisms collected at each transect. Tubificidae represented more than 50% of the organisms for all transects except for Transect 4, where it was found in equal numbers to Chironomidae, at 43% each. Chironomidae constituted from 13% to 43% of the organisms at each transect. Corbiculidae represented from 6% to 12% of the organisms collected at each transect. The remaining organisms constituted 3% and 18% of the organisms collected at each transect.

3.6.2 Taxa Richness

Richness is defined by the number of taxa or families present. Generally, a relatively higher richness value indicates a healthier environment in terms of increased water quality, habitat diversity, and habitat suitability. Accordingly, the variability of richness due to current velocity and substrate type is decreased when similar habitats are sampled (Plafkin et al., 1989).

Richness values for this study were based on family-level identification, and taxa not identified to family were not included in the calculation of richness. This procedure will not negatively impact the results of richness because evaluation is based on a relative scale that makes a comparison between transects during a single event, or between same transects during different events (rather than a comparison of the richness value against an arbitrary scale). Because non-family-level taxa were eliminated consistently from each sample for richness calculation, the actual richness value is different than it would have been had these taxa been included; however, the relationship between the richness values of the samples is not altered.

Figures 3-20 and 3-21 present the family richness results for the baseline and post-discharge sampling events, respectively. The data are presented as high-low plots, where the vertical line is defined by the high and low values observed at each location, and a horizontal "tick" mark indicates the mean value. A tabulated statistical summary of these data is presented by transect and event in Table 3-9.

There was no apparent negative impact on richness from the discharges. In fact, mean richness often increased at test transects (or was greater at test transects than control transects) following a discharge. Transect 3 appeared to have the highest richness values of all the transects during baseline and discharge surveys. Richness varied between transects within the surveys (including baseline surveys), and no survey appeared to have substantially greater richness values than the other surveys. Similarly, richness varied at transects from survey to survey. However, there was no obvious trend in this observation. Application

Table 3-8. Summary of macroinvertebrate species collected at each of the transects.

PHYLUM	CLASS	ORDER	FAMILY	T-1	T-2	T-3	T-4	T-5	T-6
Annelida	Oligochaeta	Tubificida	Tubificidae	●	●	●	●	●	●
			Naididae	●	●	●	●	●	●
	Polychaeta		Sabellidae		●	●	●	●	
	Hirudinea	Rhynchobdellida	Glossiphoniidae	●	●	●		●	●
Platyhelminthes	Turbellaria	Tricladida	Planariidae	●			●		
			Turbellaria (ind)	●	●	●	●	●	●
Rhynchocoela			Rhynchocoela (ind)		●		●	●	●
Arthropoda	Chelicerata	Acarina			●	●	●	●	●
	Crustacea	Amphipoda	Crangonyctidae		●	●	●	●	
		Amphipoda	Gammaridae	●	●	●	●	●	●
		Isopoda	Asellidae		●	●	●	●	
	Insecta	Coleoptera	Elmidae	●		●	●	●	●
		Collembola	Entomobryidae			●	●		●
			Collembola (ind)		●				
		Diptera	Ceratopogonidae	●	●	●		●	●
			Chaoboridae	●				●	●
			Chironomidae	●	●	●	●	●	●
			Diptera (non-Chironomidae)		●	●	●	●	●
			Diptera family A			●	●	●	
			Diptera family B			●			
			Diptera family C			●			
			Diptera family D	●	●	●	●		
			Empididae					●	
			Psychodidae		●				
			Thaumaleidae				●		

(cont.)

Table 3-8. (Concluded).

PHYLUM	CLASS	ORDER	FAMILY	T-1	T-2	T-3	T-4	T-5	T-6
		Ephemeroptera	Caenidae		●	●	●		
			Ephemeridae	●	●	●		●	●
			Tricorythidae			●			
			Ephemeroptera (ind)	●	●	●		●	●
		Hemiptera	Hemiptera (ind)				●		
		Lepidoptera	Arctiidae			●			●
			Pyralidae			●			
		Odonata	Gomphidae	●	●	●	●		●
			Macromiidae		●				
			Odonata (ind)			●			●
		Plecoptera	Taeniopterygidae			●	●		
			Plecoptera (ind)	●		●			
			Helicopsychidae	●			●		
			Hydropsychidae			●	●	●	
			Hydroptilidae	●		●			●
			Leptoceridae	●	●	●	●	●	●
			Polycentropodidae	●		●	●	●	●
			Trichoptera (ind)		●	●	●	●	
Mollusca	Bivalvia	Unionacea	Unionidae	●	●			●	●
			Unionacea (ind)				●	●	
		Sphaeriacea	Corbiculidae	●	●	●	●	●	●
			Sphaeriidae	●	●	●	●	●	●
			Sphaeriacea (ind)			●	●	●	
	Gastropoda		Ancylidae	●	●	●	●	●	●
			Hydrobiidae				●	●	●
			Planorbidae			●		●	
			Physidae			●	●	●	
			Pleuroceridae		●	●	●	●	
			Gastropoda (ind)	●	●	●	●	●	●

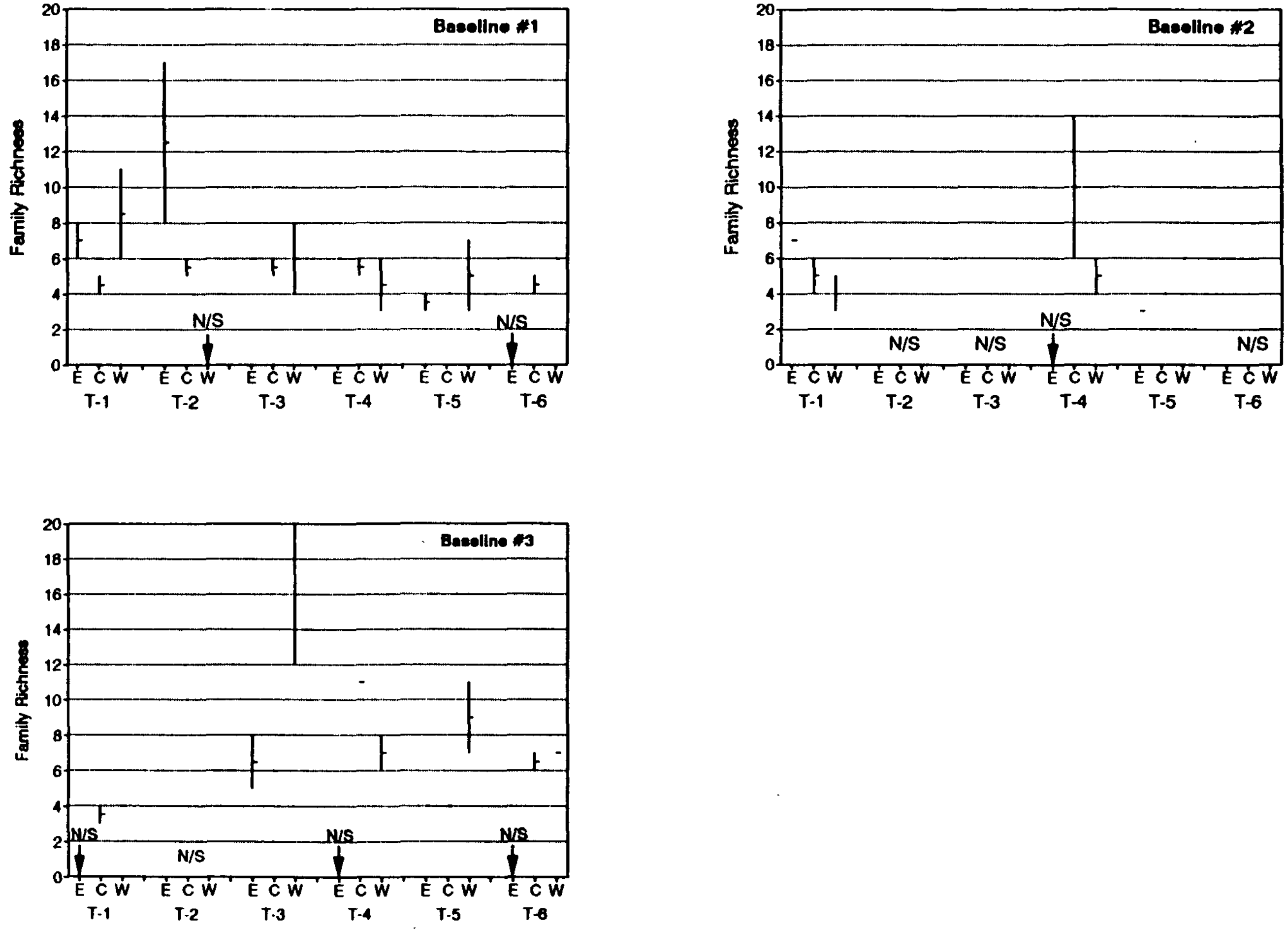


Figure 3-20. **Benthic invertebrate family richness in samples collected during the baseline surveys.**

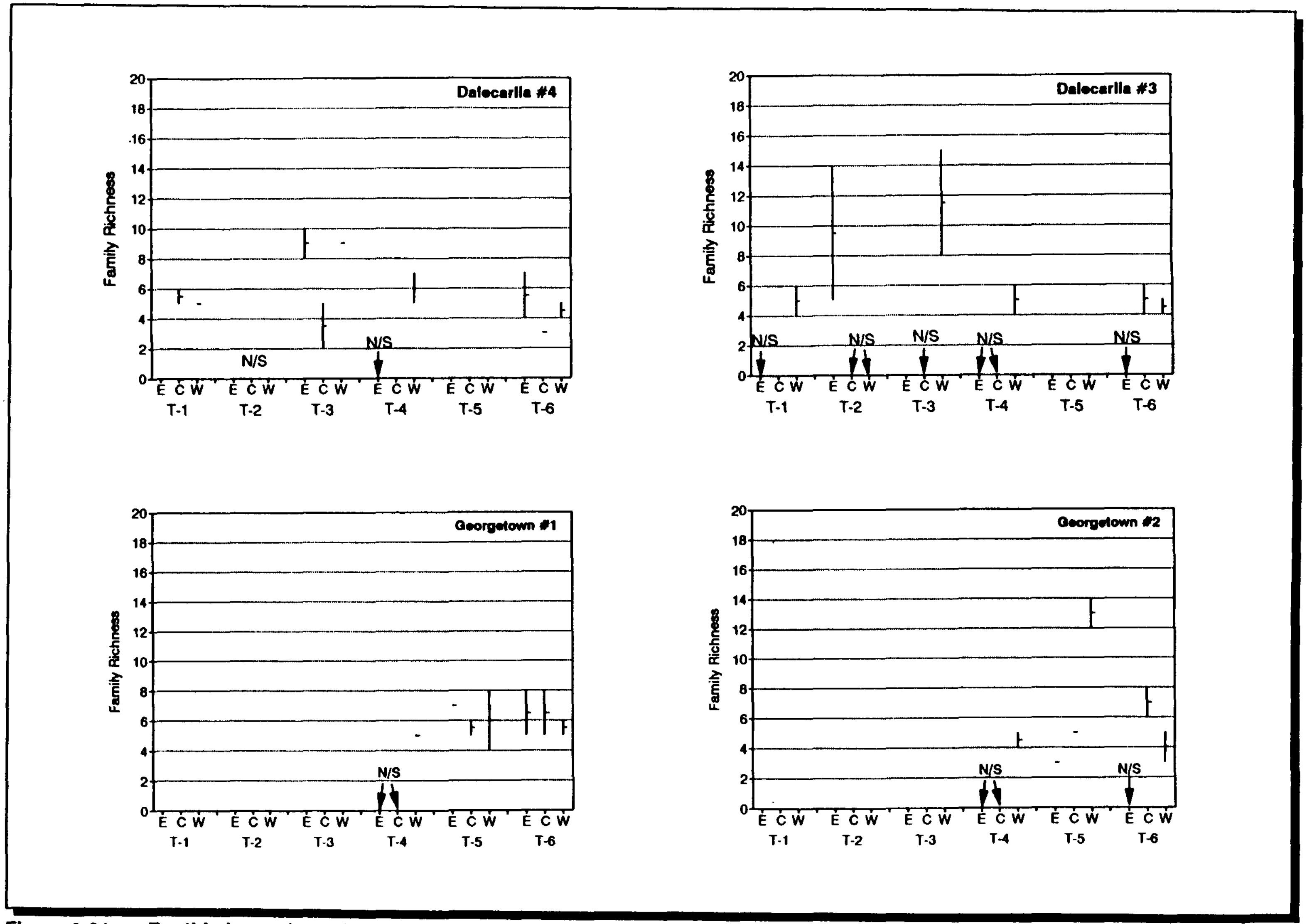


Figure 3-21. Benthic invertebrate family richness in samples collected during the post-discharge surveys.

Table 3-9. Summary of macroinvertebrate richness data.

Event	Transect Number					
	1	2	3	4	5	6
Baseline #1	Mean = 6.67 sd = 2.50 n = 6	9.00 5.48 4	5.80 1.48 5	5.33 1.21 6	4.17 1.47 6	5.00 1.00 3
Baseline #2	5.00 1.58 5			7.50 4.44 4	4.33 1.37 6	
Dalecarlia #4	5.25 0.50 4		6.80 3.27 5	6.67 1.53 3		4.33 1.51 6
Baseline #3	3.75 0.50 4		9.50 5.72 6	8.33 2.52 3	5.67 2.88 6	6.75 0.50 4
Dalecarlia #3	5.50 1.00 4	9.50 6.36 2	9.67 4.73 3	5.00 1.41 2		4.75 0.96 4
Georgetown #1				5.00 0.00 2	6.00 1.58 5	6.17 1.47 6
Georgetown #2				4.50 0.71 2	7.80 4.87 5	5.50 2.08 4

of a paired comparison of transect means, as was used in the analysis of sediment chemistry data (Section 3.5.2.1), revealed no significant difference between average richness values observed at transects before and after discharges. The family richness values obtained do not indicate a difference in water quality between the transects or surveys.

3.6.3 Abundance

Figures 3-22 and 3-23 present the abundance results for the baseline and post-discharge sampling events, respectively. A tabulated statistical summary of these data is presented by transect and event in Table 3-10.

The abundance data were somewhat variable within and between transects. Mean abundance ranged from 27.1 to 382.2/1000 cm^3. The most obvious trend in the data was that abundance of organisms for Transects 1 through 3 was consistently greater than the abundance for Transects 4 through 6. It is interesting to note that the abundance consistently decreased for each subsequent baseline survey at Transect 1, and increased consistently at Transect 4. No obvious trend was seen in the discharge data for the Dalecarlia #3 and #4 post-discharge events. An interesting trend was observed in the Georgetown #1 and #2 post-discharge data -- the abundance of organisms increased from Transects 4 through 6 for

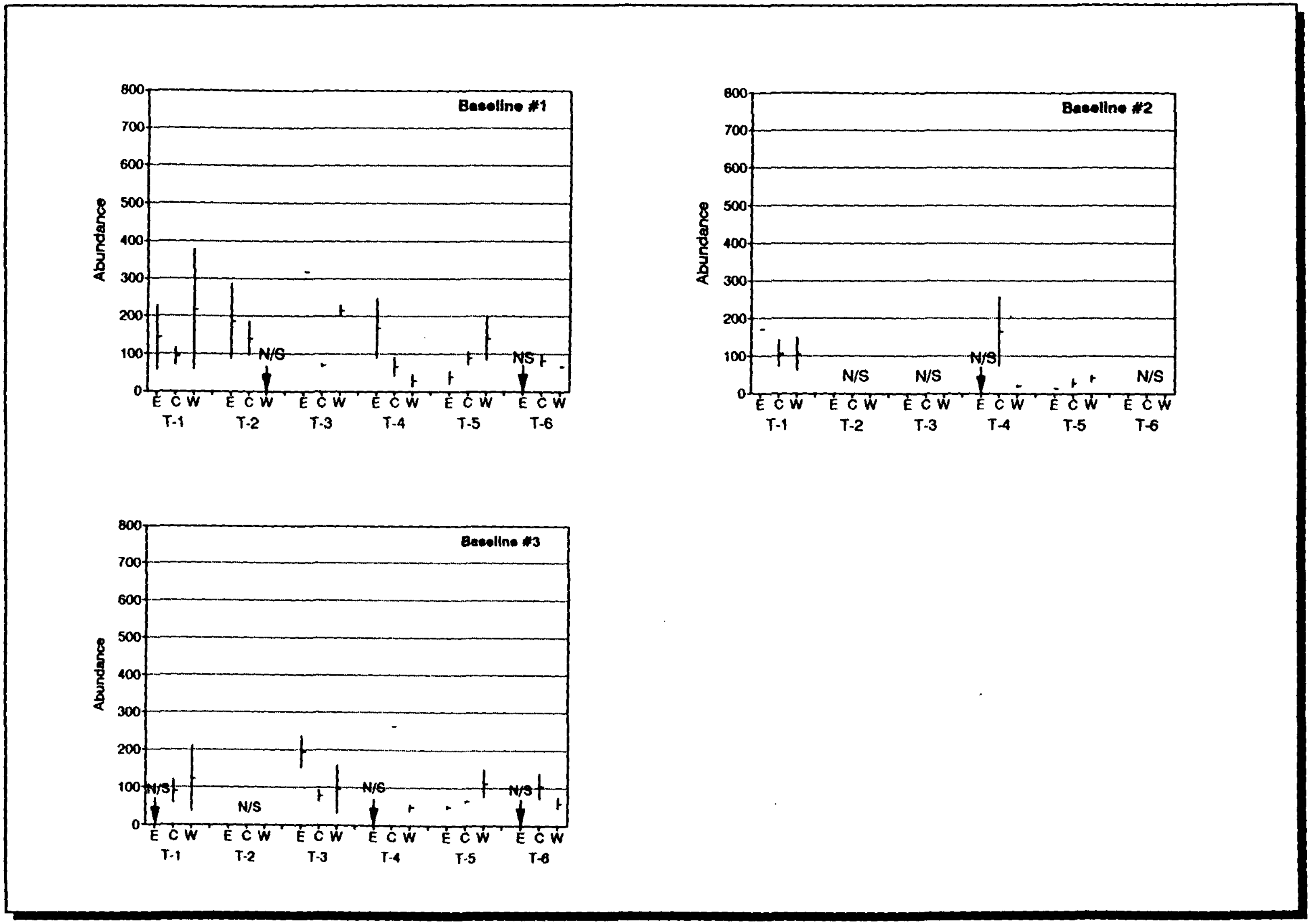


Figure 3-22. Benthic invertebrate abundance in samples collected during the baseline surveys.

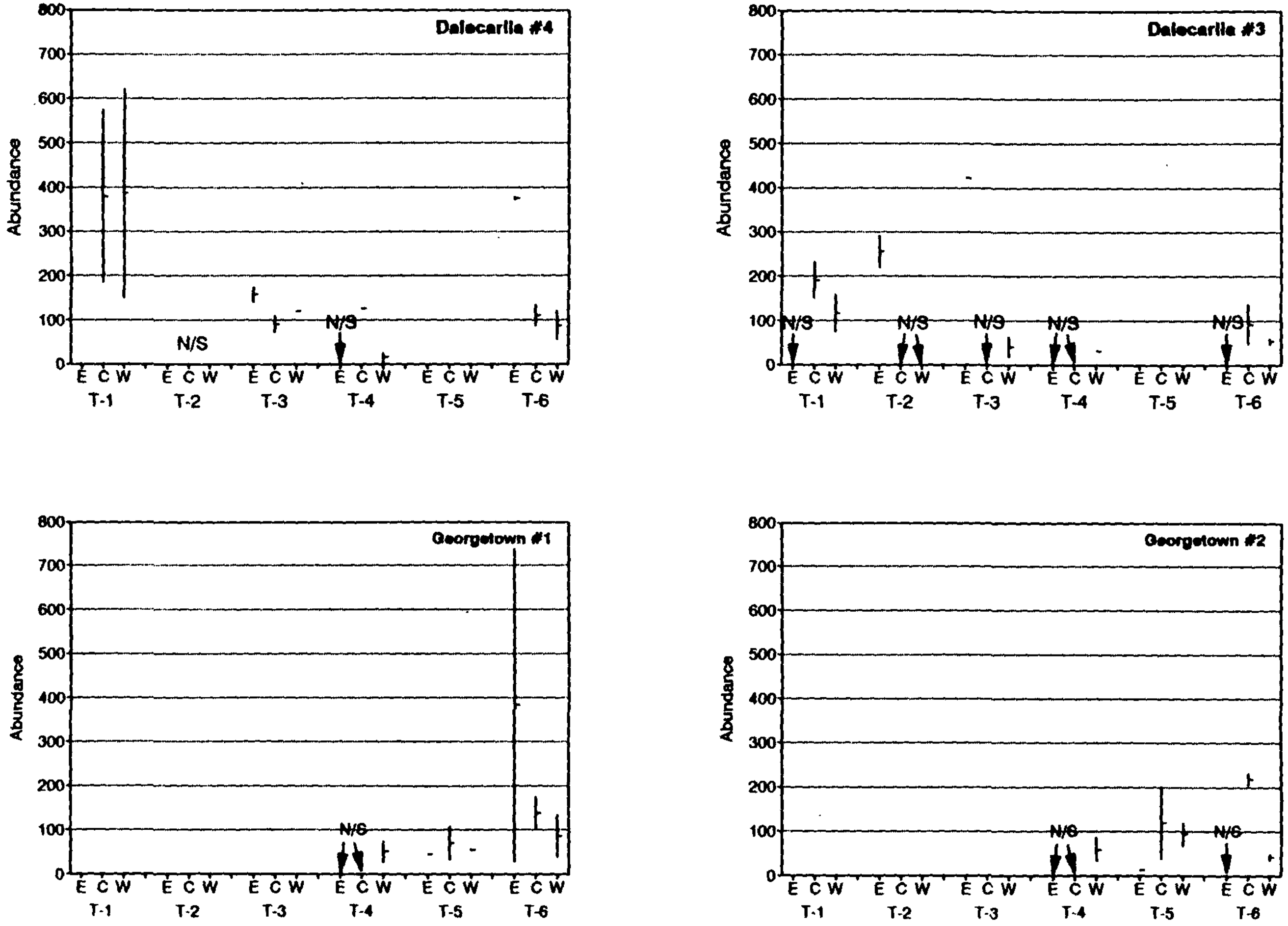


Figure 3-23. Benthic invertebrate abundance in samples collected during the post-discharge surveys.

Table 3-10. Summary of macroinvertebrate abundance data.

Event	Transect Number					
	1	2	3	4	5	6
Baseline #1	Mean = 151.7 sd = 129.2 n = 6	164.3 93.4 4	178.0 107.6 5	87.8 84.8 6	89.1 61.3 6	76.9 18.9 3
Baseline #2	118.9 49.4 5			92.4 113.1 4	27.1 15.2 6	
Dalecarlia #4	382.2 251.1 4		123.2 38.2 5	52.0 64.4 3		191.1 145.0 6
Baseline #3	106.3 78.4 4		122.7 74.4 6	119.1 124.0 3	75.9 37.8 6	82.0 40.2 4
Dalecarlia #3	153.9 65.5 4	256.0 52.2 2	167.6 222.3 3	32.0 0.2 2		72.4 44.4 4
Georgetown #1				50.2 34.0 2	58.7 29.4 5	202.1 269.0 6
Georgetown #2				58.6 38.4 2	88.0 75.8 5	130.2 103.2 4

both basin discharges. Comparison of paired mean transect values failed to show any statistically significant difference between events.

3.6.4 Shannon's Diversity Index (SDI)

Figures 3-24 and 3-25 present the SDI results for the baseline and post-discharge sampling events, respectively. Where individuals could not be identified to the family level, the highest of the possible SDI values has been shown. A tabulated statistical summary of these data is presented by transect and event in Table 3-11. Where individuals could not be identified to family, the range of possible SDI values is represented by showing high and low SDI values. It can be seen from this table that relatively little uncertainty was introduced into the SDI calculations by the inability to fully enumerate a few individuals. Diversity is an expression of community structure. A high diversity value indicates that all species are nearly equal in abundance. High species diversity reflects a more stable, complex, and mature community with an array of species interaction. Low species diversity is characteristic of communities with only a few species, or communities where only few species are abundant. Such communities are less complex and relatively unstable. The more stable the community, the better it can withstand disturbance. Therefore, diversity provides a basis for assessing the potential impact of disturbances.

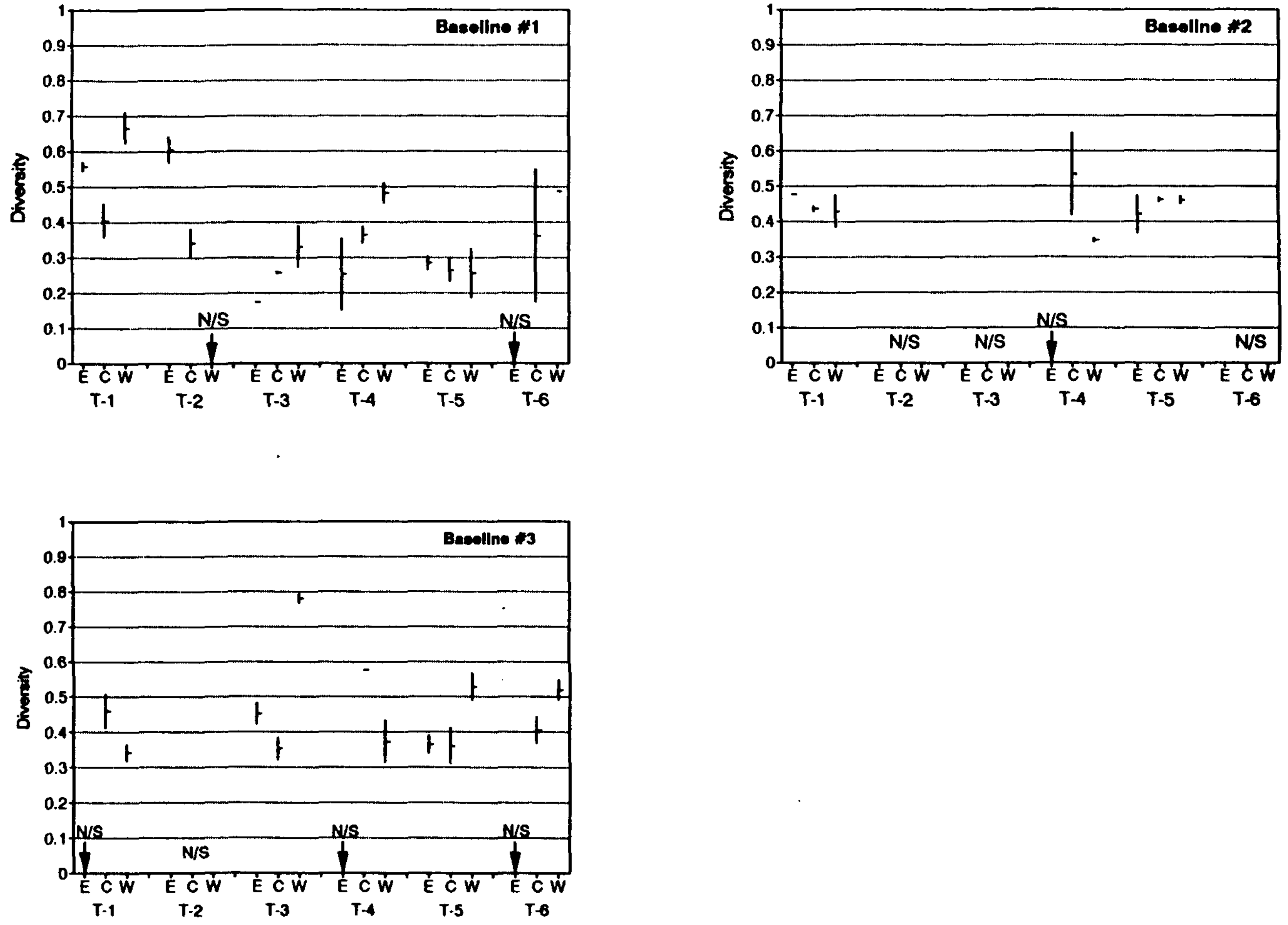


Figure 3-24. Shannon's Diversity Index (SDI) values for benthic invertebrate samples collected during the baseline surveys.

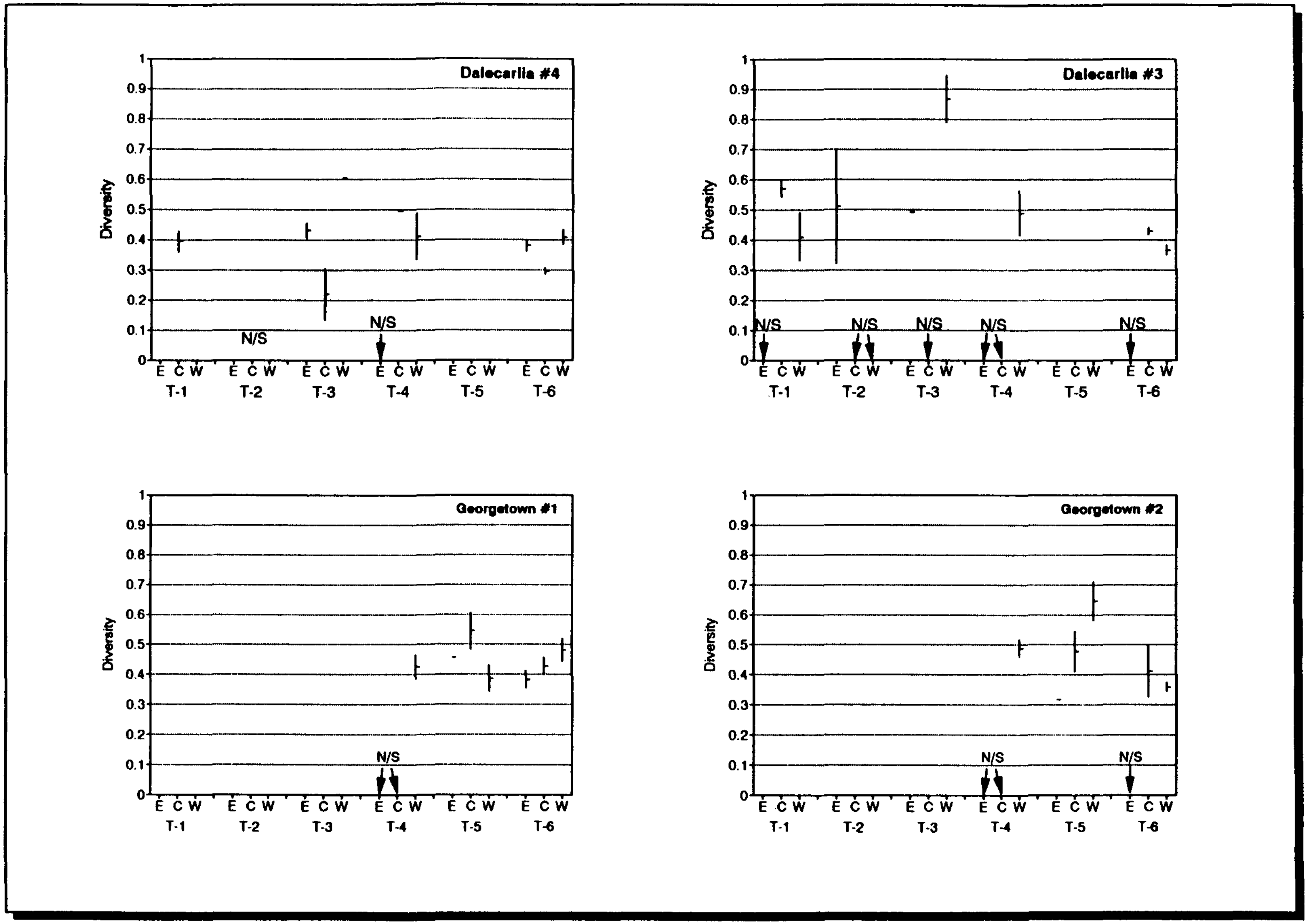


Figure 3-25. Shannon's Diversity Index (SDI) values for benthic invertebrate samples collected during the post-discharge surveys.

Table 3-11. Summary of Shannon's Diversity Index (SDI) data. High and low values are shown where identification of some individuals to the family level was uncertain.

Event	Transect Number					
	1	2	3	4	5	6
Baseline #1	Mean = 0.539/0.543 sd = 0.125/0.125 n = 6	0.472/0.473 0.156/0.158 4	0.269 0.076 5	0.363/0.365 0.124/0.124 6	0.267 0.053 6	0.402 0.201 3
Baseline #2	0.441 0.039 5			0.426/0.440 0.157/0.144 4	0.455/0.477 0.040/0.042 6	
Dalecarlia #4	0.396/0.397 0.031/0.030 4		0.380/0.381 0.174/0.176 5	0.439 0.091 3		0.362 0.057 6
Baseline #3	0.400 0.081 4		0.525/0.528 0.197/0.201 6	0.440 0.131 3	0.418 0.096 6	0.462 0.077 4
Dalecarlia #3	0.490 0.116 4	0.508/0.511 0.267/0.270 2	0.721/0.742 0.217/0.231 3	0.488 0.107 2		0.397 0.041 4
Georgetown #1				0.425 0.058 2	0.460/0.463 0.092/0.096 5	0.430 0.057 6
Georgetown #2				0.488 0.042 2	0.512 0.152 5	0.385 0.079 4

Shannon's Diversity Index (SDI) yields values between 0 and 1; the higher the number, the greater the diversity of the community. Numerical criteria have not been established for evaluating SDI values and interpreting the health of community; the SDI value is based on, and used as, a relative scale.

The majority of SDI values (Table 3-11) were between 0.4 and 0.5. Transect 3 had one of the lowest recorded SDI values (0.27) during Baseline #1 and the highest value (0.74) during Baseline #3. Few consistent trends were noted in the distribution of the SDI values. Transect 1 values consistently declined with each baseline survey, and Transect 3 values consistently increased with each baseline survey. The SDI values for the remaining transects varied inconsistently with each baseline survey. No consistent trends were observed for the post-discharge samples. No statistically significant differences were seen between paired transect means between sampling events.

3.6.5 Family-Level Biotic Index

The Family-Level Biotic Index (FBI) was developed to assess the degree of organic pollution present based on pollution tolerance values assigned to macroinvertebrate taxa at the family level. The FBI value is dependent upon the tolerance value of each family and the abundance of that family relative to total abundance of the entire sample. The degree of organic pollution is determined by comparing the resulting

FBI value to a pre-designated range of FBI values and their associated degrees of pollution (Hilsenhoff, 1988).

Figures 3-26 and 3-27 present the FBI results for the baseline and post-discharge sampling events, respectively. A tabulated statistical summary of these data is presented by transect and event in Table 3-12.

Table 3-12. Summary of Family-Level Biotic Index data.

Event	Transect Number					
	1	2	3	4	5	6
Baseline #1	Mean = 8.71 sd = 0.40 n = 6	8.85 0.25 4	9.16 0.12 5	8.74 0.51 6	8.58 1.25 6	8.91 0.34 3
Baseline #2	8.18 0.45 5			7.55 0.41 4	8.18 0.46 6	
Dalecarlia #4	8.61 0.23 4		8.89 0.31 5	7.95 0.57 3		8.34 0.38 6
Baseline #3	8.00 0.41 4		8.54 0.73 6	7.69 0.52 3	8.50 0.31 6	7.96 0.26 4
Dalecarlia #3	8.25 0.51 4	8.73 0.53 2	7.76 0.65 3	7.68 0.28 2		8.42 0.21 4
Georgetown #1				7.95 0.03 2	8.43 0.31 5	8.25 0.30 6
Georgetown #2				8.39 0.15 2	8.42 0.51 5	8.26 0.35 4

The mean FBI values for the entire study ranged from 7.55 to 9.16, a range that is characteristic of "very poor" water quality (see Table 2-2). This category has a high likelihood of organic pollution. Mean FBI values appear to be consistently highest during Baseline #1, representing the poorest degree of water quality of all the surveys.

The FBI values of the baseline surveys (especially Baseline #1) and the control transects indicate that a high degree of pollution is characteristic of existing (baseline) conditions in the study area. It should be noted that the Hilsenhoff (1988) FBI tends to underestimate the level of pollution in polluted streams, and pollution levels may actually be higher than indicated. With the exception of the FBI values observed at

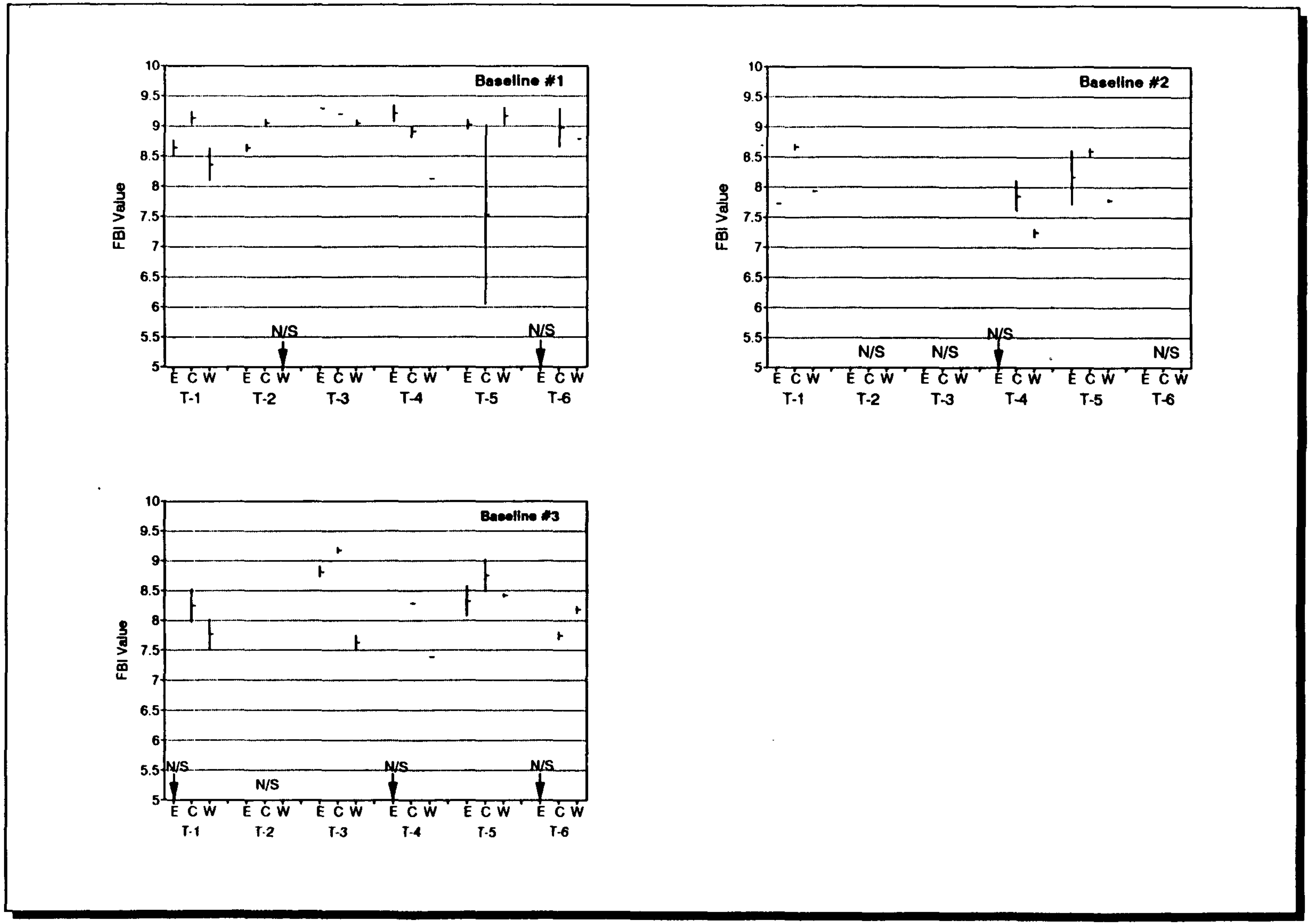


Figure 3-26. Family-Level Biotic Index (FBI) values for benthic invertebrate samples collected during the baseline surveys.

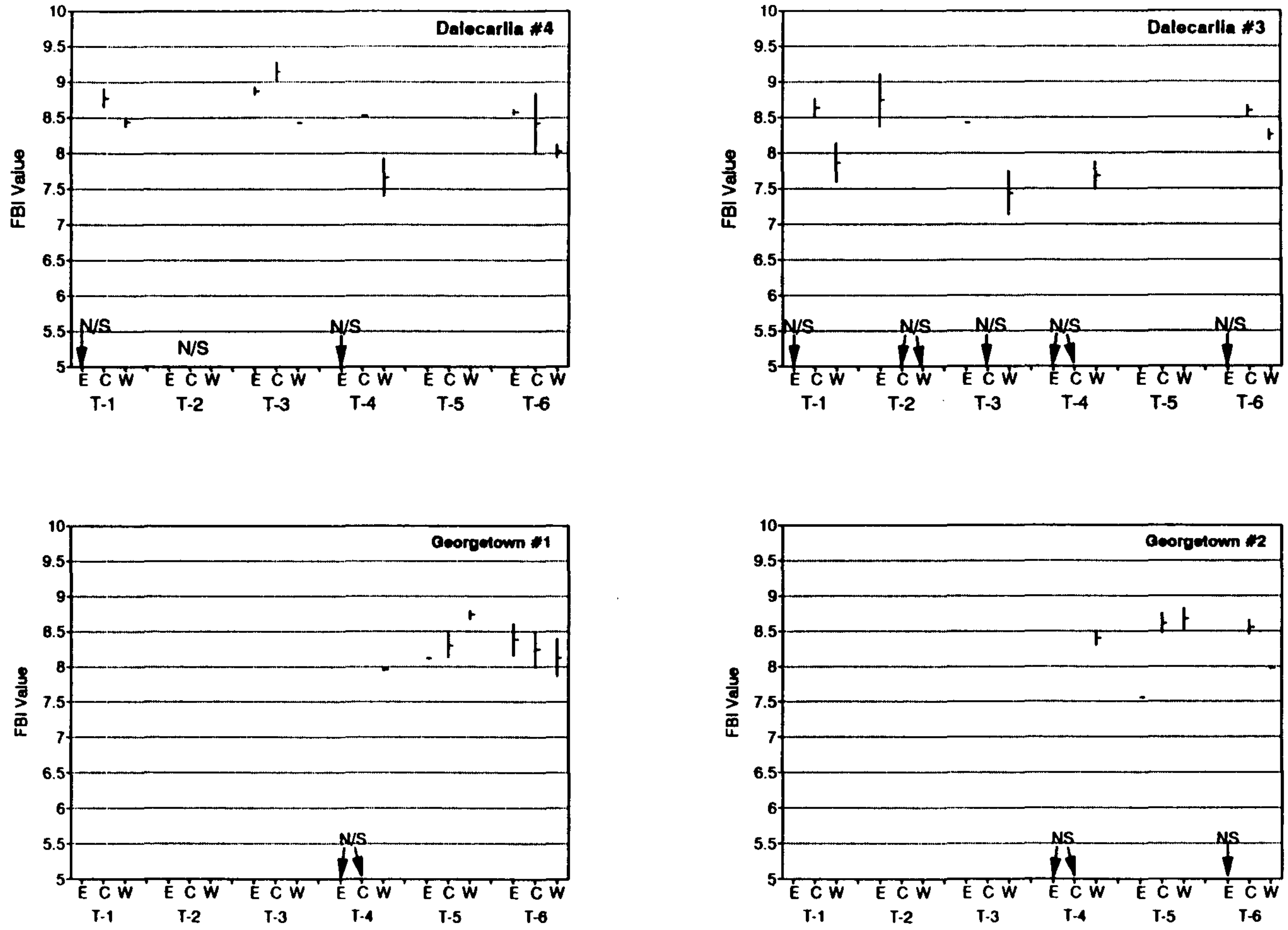


Figure 3-27. Family-Level Biotic Index (FBI) values for benthic invertebrate samples collected during the post-discharge surveys.

Transect 4 during the Baseline #1 and #2 surveys, there were no statistically significant differences in transect means at any of the sites between successive sampling events.

3.6.6 Overview

The study area consists naturally of a hard substrate and is a scour area during storm events. This condition made it difficult to obtain representative and comparable samples using the ponar grab sampler because the ponar sampler is more suited to soft substrates. Often during data collection, sediment could be collected from a particular location during one survey, and none would be collected during the next survey. The macroinvertebrate data displayed a great deal of variability within and between transects for all metrics evaluated in this study. The bottom sediments are apparently being continually redistributed, keeping the benthos in a constant state of disturbance. This disturbance of the macroinvertebrate communities is reflected in the dominance of Tubificid worms and Corbicula at all transects (Petran and Kothe, 1978). These organisms have high tolerance values and are generally the dominant organisms in highly disturbed areas. The results of the macroinvertebrate data reflected signs of disturbance before the basin discharges began.

In summary, no impact on the macroinvertebrate community was observed in association with the discharge of the settling basins. The macroinvertebrate community appears to be characterized by adaptation to a very dynamic environment.

3.7 SEDIMENT TOXICITY

A summary of the bioassay results is presented in the following discussion. A comprehensive presentation of the data associated with the 7-day toxicity bioassays is detailed in the report titled "Chronic Impairment Testing of Fathead Minnow (*Pimephales promelas*) to Dalecarlia and Georgetown Water Treatment Plant Effluents, Washington, DC" (Cherry et al., 1992), which is presented in Appendix C.

3.7.1 Effluent and Sludge Sampling

Effluent from Dalecarlia #4 was collected on 5 December 1991 from a drainage system manhole west of the sedimentation basin using two automated samplers operating in tandem. The two samplers were programmed to pump a total of 1 liter of effluent into a 5-gallon carboy at hourly intervals throughout the 6-hour drainage period. A 2.5-gallon sludge sample was collected directly from the sedimentation basin, which had been drained but not rinsed. The sample was collected with a bucket lowered over the guardrail into the basin and subsequently placed into a 5-gallon carboy for shipment to the analytical laboratory.

Effluent from Dalecarlia #3 was collected on 6 January 1991. The sample was collected by Washington Aqueduct staff who composited hourly grab samples collected from the drainage system over a 6-hour discharge period. The sludge sample was again collected with a bucket lowered over the guardrail into the drained, unrinsed basin and then transferred to a 5-gallon carboy for shipment to the laboratory.

An attempt was made to collect effluent samples at Georgetown #1 on 19 February 1992. Two automated samplers were installed at manhole M.H. #1, located at the southeast corner of the Georgetown reservoir. The samplers were programmed to pump 1 liter of effluent into a 5-gallon carboy at hourly intervals throughout the 6-hour drainage period. A 2.5-gallon sludge sample was collected from the drained, unrinsed basin with a bucket, and then transferred to a 5-gallon carboy for shipment to the laboratory.

Effluent samples were collected at Georgetown #2 on 25 February 1992 from the Blow Off Gate Chamber using a submersible pump. A sample was collected every 2 hours over the 18-hour drainage period. These samples were then combined into a 10-gallon composite sample. A 2.5-gallon sludge sample was collected directly from the drained, unrinsed basin using a bucket and then transferred into a 5-gallon carboy for shipment to the laboratory.

3.7.2 Effluent Bioassay

A total of three chronic 7-day toxicity tests were conducted using effluent from the Dalecarlia and Georgetown sedimentation basins. The results of these tests are summarized in Table 3-13. Observed ranges for pH and dissolved oxygen are provided in the table because these two parameters may affect survival and growth. In general, water quality was observed to be relatively consistent among the different effluent dilutions. Dissolved oxygen concentrations tended to decrease near the 24-hour renewal point of each experiment.

Effluent from Dalecarlia Basin #4 did not significantly affect mortality of fathead minnow larvae at any effluent concentration. No fish died during the 7-day bioassay. The no-observed effects concentration (NOEC) for survival and growth was 100% effluent.

Fathead minnows tested in the Dalecarlia Basin #3 bioassay had 100% survival at all effluent concentrations. No significant difference was observed in growth between the control and each of the effluent concentrations.

Fathead minnow survival ranged from 97.5 to 100% in the 7-day bioassay of Georgetown Basin #2 effluent. Survival was 100% in all concentrations except for the 10% effluent concentration. Mean weights did not vary greatly between effluent concentrations. Fish exposed to 100% effluent exhibited the greatest weight gain.

Table 3-13. Summary of survival and growth results for effluent samples.

Basin	Concentration (%)	Survival (%)	Growth (mg)	D.O. Range (mg/L)	pH Range
Dalecarlia #4	0	100	0.677	4.9 - 8.4	7.12 - 7.66
	1	100	0.798	3.4 - 8.6	7.13 - 7.70
	10	100	0.762	4.4 - 8.7	7.19 - 7.68
	100	100	0.821	4.5 - 10.8	7.08 - 7.43
Dalecarlia #3	0	100	0.446	4.8 - 7.9	7.38 - 8.11
	1	100	0.500	5.7 - 8.4	7.55 - 7.85
	10	100	0.473	5.5 - 8.3	7.21 - 7.58
	100	100	0.413	4.2 - 8.8	6.72 - 7.28
Georgetown #2	0	100	0.477	5.4 - 7.9	7.28 - 8.23
	1	100	0.512	5.2 - 8.0	7.33 - 8.17
	10	97.5	0.449	5.6 - 8.1	7.36 - 7.82
	100	100	0.514	5.0 - 9.2	6.47 - 7.04

No bioassay data were collected for Georgetown Basin #1 effluent because an equipment failure prevented the collection of an effluent sample for use in the bioassay.

3.7.3 Sludge Bioassay

A total of four chronic 7-day sediment toxicity tests were conducted using sludge from the Dalecarlia and Georgetown sedimentation basins. The results of these tests are summarized in Table 3-14. Again, dissolved oxygen and pH ranges are provided.

A screen test was conducted using effluent and sludge from Dalecarlia Basin #4. This test indicated 100% survival of fish that underwent a 48-hour exposure to effluent. However, survival of fish exposed to sludge for 48 hours was dependent upon the degree of dilution. All larvae survived in 1-3% sludge, but survival declined from 65 to 50 to 0% in 10, 30, and 100% sludge, respectively.

Survival of fish exposed to 30 and 100% sludge from Dalecarlia Basin #4 was significantly reduced. Significant weight impairment was also evident at 3, 30, and 100% sludge concentrations. It was determined that fish mortality and growth were significantly impacted by daily declines in DO concentrations rather than sludge toxicity.

Table 3-14. Summary of survival and growth results for sludge samples.

Basin	Concentration (%)	Survival (%)	Growth (mg)	D.O. Range (mg/L)	pH Range
Dalecarlia #4	0	95	0.679	2.7 - 8.3	7.07 - 7.78
	1	80	0.634	2.8 - 8.3	7.16 - 7.74
	3	85	0.551*	3.3 - 8.3	7.21 - 7.73
	10	85	0.625	3.3 - 8.3	7.20 - 7.74
	30	42.5*	0.573*	0.07 - 8.4	7.15 - 7.48
	100	0*	-	-	-
Dalecarlia #3	0	100	0.446	4.8 - 7.9	7.38 - 8.11
	1	100	0.530	4.8 - 7.3	7.18 - 7.49
	3	100	0.499	4.2 - 6.3	7.02 - 7.44
	10	100	0.475	2.1 - 4.8	6.81 - 7.12
	30	0*	-	0.04 - 5.4	6.94 - 7.03
	100	0*	-	-	-
Georgetown #2	0	100	0.477	5.4 - 7.9	7.28 - 8.23
	1	100	0.391*	5.1 - 8.6	7.24 - 7.77
	3	100	0.416	5.0 - 8.2	7.17 - 7.53
	10	100	0.356*	5.2 - 7.5	6.88 - 7.21
	30	100	0.234*	4.8 - 6.2	6.76 - 7.13
	100	0*	-	-	-
Georgetown #1	0	100	0.553	5.2 - 7.7	7.15 - 8.08
	1	100	0.495	5.6 - 7.7	7.08 - 7.78
	3	100	0.555	5.3 - 7.7	6.97 - 7.70
	10	100	0.563	5.0 - 7.1	6.82 - 7.40
	30	100	0.482	5.2 - 6.9	6.77 - 7.18
	100	0*	-	-	-

Note: * Denotes statistically significant difference from the control at the 95% confidence level.

Fish survival in 1, 3, and 10% concentrations of sludge from Dalecarlia Basin #3 was 100%. Survival in 30 and 100% sludge concentrations was 0%. Growth was not significantly impaired in the 1, 3, and 10% sludge concentrations. Because an aeration system was implemented during this bioassay, DO concentrations were higher than for the previous bioassay; however, declines in DO still contributed to increased mortality in the 30% sludge concentration.

Fish survival in sludge from Georgetown Basin #2 was 100% at 1, 3, 10, and 30% concentrations. Survival was 0% at 100% sludge concentration. Weight gain was significantly impaired at 10 and 30% sludge concentrations. A weight impairment was observed in the 1% sludge concentration, however, it was determined to be not ecologically significant because the fish weight at 3% sludge concentration was higher than at 1%, and not significantly different from the control. DO concentrations were higher during this bioassay because of the implementation of aeration during the study.

Fish survival in sludge from Georgetown Basin #1 was 100% at 1, 3, 10, and 30% sludge concentrations. There was no impairment of weight at these concentrations. At 100% sludge concentration, fish survival was 0%. Again, DO concentrations were regulated somewhat by aeration, and large reductions in DO concentration were not observed near the time of each daily renewal.

3.7.4 Overview

The results of the toxicity tests indicate that effluent released from the sampled sedimentation basins had no effect on either mortality or growth of fathead minnows. This conclusion is consistent with observations at the basins, where fish communities were clearly visible.

No significant mortality or impairment of growth was observed in fish exposed to concentrations of sludge in the range of 0 - 10%. There were significant effects observed at the 30% concentration, but these appear to have been related to oxygen demand and resulting suffocation of the fish rather than toxic effects of the sludge. No fish were able to survive in 100% sludge, primarily because of the combined effects of dissolved oxygen deprivation and physical impairment on swimming ability and gill functions.

Instream water calculations (IWCs) were conducted to examine the probable concentrations of effluent and sludge in the river as a result of the sedimentation basin discharges. Based on a minimum river flow of 3,500 MGD, as stipulated in the facility's NPDES permit, IWC concentrations ranged from 0.4 to 3.1% for the effluent discharges and from 0.1 to 0.3% for the sludge discharges. No mortality or growth impairment was observed at these low concentrations of effluent or sludge. Because discharges occurred under significantly higher flows, actual instream concentrations were lower.

3.8 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following section presents a brief summary of the quality assurance/quality control (QA/QC) results obtained during the analyses of water quality and sediment chemistry, benthic macroinvertebrates, and the sediment toxicity bioassay.

3.8.1 Water Quality Data

Martel's standard QA/QC program includes evaluation of blank, replicate, standard, and "spiked" samples during water quality analysis. Martel conducts QA/QC checks on 10% of the samples in a batch. The acceptable limits and ranges of recovery for QA/QC tests are presented in Table 3-15 (Kuyawa, 1992; see Table 2-1 for analytical methods). QA/QC evaluations that fail the specified criteria are re-tested. Repeated failures are "flagged" in the QA/QC report. No "flags" were reported for water quality analysis.

Table 3-15. Summary of QA/QC criteria for water quality and sediment chemistry samples.

QA/QC Test	Limit/Range
Blank (± 10% of parameter detection limit)	Aluminum ± 0.01 ppm Alkalinity ± 0.1 ppm BOD ± 0.2 ppm Iron ± 0.001 ppm TSS ± 0.1 ppm Turbidity ± 0.01 NTU (variable)
Replicate	I-STAT value <0.1
Spike	75-125% recovery
Standard	75-125% recovery

QA/QC tests of standards, replicates, blanks, and spikes satisfied the specified criteria with one exception: a replicate test for total suspended solids was not within the appropriate I-STAT range. Martel did not "flag" this as unacceptable.

Detailed water quality QA/QC results are presented in Appendix D.

3.8.2 Sediment Chemistry

Sediment chemistry analysis was subject to the identical QA/QC program utilized by Martel for water quality (Section 3.8.1). No QA/QC "flags" were reported for sediment chemistry analysis.

Evaluation of standards, replicates, spikes, and blanks for QA/QC checks of sediment chemistry analyses satisfied the specified criteria with one exception: only 52% of a series of blanks evaluated for QA/QC of a large batch of iron samples satisfied the designated criteria (± 0.001 of a 0.01 ppm detection limit). Martel did not "flag" this as an unacceptable QA/QC result. It should be noted that the blank values that did not satisfy criteria ranged from 0.02 ppm to 47 ppm, relatively negligible when sediment iron concentrations were reported in thousands of mg/kgs. The single blank result of 47 ppm may potentially be attributed to the inadvertent substitution of a blank standard for a blank (personal communication, Kuyawa, 1992). Detailed sediment chemistry QA/QC results are presented in Appendix D.

3.8.3 Benthic Invertebrates

Sixteen (12.6%) of the 127 total macroinvertebrate samples were checked for sorting errors. Three of these samples failed the QA/QC criteria, resulting in the re-sorting of 20 samples. The average QA/QC error was 2.0%. The QA/QC error ranged from 0.0% to 6.6%.

Thirteen (10.2%) of the macroinvertebrate samples were checked for identification errors. One of the samples failed the QA/QC criteria, and nine samples were re-identified. The average QA/QC error was 1.3%. The QA/QC error ranged from 0.0% to 5.7%. Detailed macroinvertebrate QA/QC sorting and identification results are presented in Appendix D.

The designated QA/QC protocols were followed in the appropriate manner. The data received are acceptable in accordance with the QA/QC criteria.

3.8.4 Bioassays

QA/QC testing of the chronic 7-day sediment toxicity bioassays consisted of determining LC_{50}s for fathead minnows using a reference toxicant (cadmium atomic absorption spectrophotometry standard, Fisher Scientific SO-C-118, Lot. No. 870113-24) in U.S. EPA reconstituted water. A total of three QA/QC tests were conducted. The dates and results of the tests are presented in Table 3-16.

Additional QA/QC testing included physical and chemical analyses of test waters for water temperature, conductivity, total hardness, total alkalinity, dissolved oxygen concentration, and pH. Method citations and specific QA/QC results are available in the report titled "Chronic Impairment Testing of Fathead Minnow (*Pimephales promelas*) to Dalecarlia and Georgetown Water Treatment Plan Effluents, Washington, DC" (Cherry et al., 1992), which is presented in Appendix C.

Table 3-16. Summary of fathead minnow QA/QC testing.

Date of Test	24-hr LC_{50} ($\mu g/L$)	48-hr LC_{50} ($\mu g/L$)
17-19 December 1991	218.0	61.6
20-22 January 1992	54.4	22.1
20-22 March 1992	122.4	60.6

This page left intentionally blank

SECTION 4. SUMMARY AND CONCLUSIONS

A summary of the results and conclusions of this investigation is presented below, organized by data collection type. In addition, recommendations for sampling strategies for future assessment investigations are provided at the end of this section.

4.1 WATER QUALITY

The laboratory results and in situ measurements showed no apparent water quality effects as a result of the release of effluent and sludge from any of the basins. Because of the strong current and river flow pattern in the study area (especially following recent rainfall), water affected by discharges moves downstream immediately. As a result, the water samples collected from the river during the post-discharge events (2-3 days after the actual discharge) would not be expected to be representative of conditions during or immediately after the discharge. Observed trends or differences between the surveys were probably related to the rainfall that was associated with each of the post-discharge surveys.

4.2 SEDIMENT CHEMISTRY

Statistically significant increases in sediment aluminum concentrations occurred twice: (1) Transect 4 after the Dalecarlia #4 discharge, and (2) Transect 6 after the Georgetown #1 discharge. In the case of the Dalecarlia #4 discharge, the observed mean concentration at Transect 4 fell midway between the mean concentrations observed at that location during Baselines #1 and #2. In the case of the Georgetown #1 discharge, a nearly uniform 2,000-mg/kg increase in aluminum concentration was observed at all transects, regardless of their relative position with reference to the point of discharge. The only other statistically significant changes observed were at Transect #1, upstream of all of the discharge points. It does not appear that the discharges from the Dalecarlia and Georgetown basins had a significant effect on the sediment aluminum concentrations at the study transects.

4.3 BENTHIC INVERTEBRATES

The effluent and sludge discharges had no apparent affect on the benthic communities in the study area. Natural variability among these communities is high, probably a reflection of the continual disturbance of bottom sediments by high river velocities and resulting turbulence. The biological indices examined suggest that ecological quality in the study area is poor and subject to high levels of organic pollution.

4.4 7-DAY TOXICITY BIOASSAY

Effluent discharged from both sedimentation basins at Dalecarlia WTP and from sedimentation basin #2 at the Georgetown WTP had no affect on fathead survival or growth. An effluent bioassay was not conducted using effluent from sedimentation basin #1 because an equipment failure prevented collection of an effluent sample; however, it is assumed that the contents of basins #1 and #2 would be similar.

Exposure to sludge from the basins at higher concentrations (i.e., 10, 30, and 100%) did impact the survival and growth of fathead minnows, but the impact appears to have been related to oxygen starvation and physical impairment rather than to toxic effects. Sludge at 100% concentrations impaired swimming ability and gill functions, and resulted in 100% mortality in all tests. Oxygen demand exerted by 10 and 30% concentrations of sludge resulted in significant mortality in the first two toxicity tests. Use of an aerator in subsequent tests resulted in 100% survival at sludge concentrations up to 30%.

Instream water calculations (IWCs) were conducted to estimate effluent and sludge concentrations that would be likely to occur in the Potomac River during discharges. The minimum river discharge specified by the NPDES permit (i.e., 3,500 MGD) was used as the basis of these calculations. In all instances, concentrations were below 3.5%.

In summary, no apparent toxic effects on fathead minnow larvae resulted from either effluent or sludge from any of the Dalecarlia Water Treatment Plant basins.

4.6 RECOMMENDATIONS

Evaluation of the results of this investigation has led to a number of observations and associated recommendations. These will assist in the planning of similar studies, and may be summarized as follows:

- A reconnaissance-level testing of sediments in the sedimentation basins and the river is recommended to develop some indication of the likely impact of discharges. In the case of this investigation, reconnaissance sampling would have revealed sedimentation basin aluminum concentrations similar to those in the river, and sedimentation basin iron concentrations approximately one-third to one-half those in the river.

- The collection and analysis of water quality samples in the river 2-3 days after the sedimentation basin discharges served no practical purpose in this investigation. As an alternative, it is suggested that the collection of water quality samples in the river be conducted during discharges to provide information on the location and density of the discharge plume.

- The benthic macroinvertebrate sampling may not have been representative of the most sensitive populations within the system, because of the very irregular and dynamic conditions on the river bottom. The ability of the ponar sampler to efficiently sample such a system was limited, making it difficult to obtain representative and comparable samples. In situ artificial substrate samplers are suggested as an alternative to the dredge sampler utilized in this study. The traditional Hester-Dendy samplers may not be well suited to this application because high velocities and many fishermen are present in the area. It is recommended that research into samplers used in high-velocity western streams be conducted to identify a suitable design before a field sampling program is finalized.

- Although the toxicity tests conducted during this investigation represented worst case conditions, it is recommended that in situ exposure testing be considered as a supplement or alternative to laboratory tests in the future. In situ testing may be conducted with fertilized eggs, larvae, or fully developed fish in enclosures placed at various locations in the likely path of the plume.

- The dissolved oxygen sag observed during the toxicity testing raises an issue regarding impacts of sludge discharges on dissolved oxygen in the Potomac River. However, because the discharges occur during high flows and the river is highly mixed, this may not represent a problem. Although this issue was beyond the scope of this investigation, it warrants further analysis.

This page left intentionally blank.

SECTION 5. REFERENCES

APHA, AWWA, and WPCF. 1985. Standard Methods for the Examination of Water and Wastewater. 16th edition. American Public Health Association, American Water Works Association, and Water Pollution Control Federation.

Barnes, R. 1987. Invertebrate Zoology. W.B. Saunders College Publishing. Philadelphia, PA.

Berstein, G. 1992. Metropolitan Washington Council of Governments. Washington, DC. Personal communication.

Bode, R. 1988. Quality assurance work plan for biological stream monitoring in New York State. Stream Biomonitoring Unit, Bureau of Monitoring and Assessment, Division of Water, New York State Department of Environmental Conservation.

Cole, G.A. 1983. Textbook of Limnology. 3rd edition. The C.V. Mosby Company. St. Louis, MO.

Cooke, G. and R. Carlson. 1989. Reservoir management for water quality and THM precursor control. Prepared for the American Water Works Association (AWWA). Denver, CO.

Cummins, J.D. 1985. 1984 Fisheries survey of the Potomac and Anacostia estuaries in Washington, DC. Department of Biology, George Washington University.

Degugmen, M. 1992. Washington Aqueduct Division, Baltimore District Corps of Engineers. Personal communication.

Hilsenhoff, W. 1988. Rapid field assessment of organic pollution with a family-level biotic index. Journal of the North American Benthological Society 7(1):65-68.

IEPA. 1990. Illinois water quality report, 1988-1989. Illinois Environmental Protection Agency. Division of Water Pollution Control. Springfield, IL.

IEPA. 1985. Illinois Environmental Protection Agency field methods manual. Illinois Environmental Protection Agency. Springfield, IL.

Karimi, H. 1992. District of Columbia Department of Consumer and Regulatory Affairs, Environmental Control Division. Personal communication.

Kuyawa, V. 1992. Laboratory Manager. Martel, Inc. Personal communication.

Lea, C. 1992. Resource Manager. C & O National Historic Park. National Park Service, Palisades District. Personal communication.

Martel. 1991. Standard Operating Procedure: Quality Assurance and Quality Control Plan. Martel Laboratory Services, Inc. Baltimore, Maryland.

McCafferty, P. 1981. Aquatic Entomology. Science Books International Publishing. Boston, MA.

MOEP. 1980. Potomac River low flow study - fish collection data. Maryland Department of Health and Mental Hygiene. Office of Environmental Programs. Division of Water Quality Monitoring, Biological Services Section.

MWCOG. 1987. Potomac River water quality - 1985: Conditions and trends in metropolitan Washington. Prepared by Department of Environmental Programs, Metropolitan Washington Council of Governments. Prepared for Washington Metropolitan Water Resources Planning Board.

MWCOG. 1985. Potomac River water quality - 1984: Conditions and trends in metropolitan Washington. Prepared by Department of Environmental Programs, Metropolitan Washington Council of Governments. Prepared for Washington Metropolitan Water Resources Planning Board.

Plafkin, J., M. Barbour, K. Porter, S. Gross, and R. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers - benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water. EPA/444/4-89-001.

U.S. EPA. 1988. Ambient water quality criteria for aluminum - 1988. U.S. Environmental Protection Agency. Office of Water Regulations and Standards, Criteria and Standards Division. Washington, DC. EPA 440/5-86-008.

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

Washington, H. 1984. Diversity, biotic and similarity indices: a review with special relevance to aquatic ecosystems. Water Research 18(6):653-694.

Whiting, J. 1992. Virginia Institute of Marine Science. Gloucester Point, VA. Personal communication.

APPENDIX A: WATER QUALITY AND SEDIMENT CHEMISTRY DATA

WATER QUALITY LABORATORY DATA

TRANSECT	DATE	SURVEY	ALKALINITY (mg/L)	TURBIDITY (NTU)	BOD5 (mg/L)	TSS (mg/L)	ALUMINUM (mg/L)	IRON (mg/L)
1	10-Oct-91	Baseline #1	130	2.7	<2	5	0.12	0.17
2	10-Oct-91	Baseline #1	120	0.66	<2	4	0.19	0.14
3	10-Oct-91	Baseline #1	120	2.9	<2	5	0.11	0.18
4	10-Oct-91	Baseline #1	120	1.4	<2	6	0.16	0.19
5	10-Oct-91	Baseline #1	120	2.8	<2	4	0.16	0.16
6	10-Oct-91	Baseline #1	110	1.4	<2	4	0.17	0.18
1	05-Dec-91	Baseline #2	110	22	<2	22	0.46	0.88
2	05-Dec-91	Baseline #2	110	23	<2	32	0.89	1.4
3	05-Dec-91	Baseline #2	110	25	<2	39	0.99	1.5
4	05-Dec-91	Baseline #2	110	33	<2	57	1.2	1.8
5	05-Dec-91	Baseline #2	110	17	<2	30	0.48	0.78
6	05-Dec-91	Baseline #2	110	13	<2	13	0.43	0.52
1	10-Dec-91	Dalecarlia #4	92	21	<2	20	0.69	0.93
2	10-Dec-91	Dalecarlia #4	88	18	<2	17	0.71	0.89
3	10-Dec-91	Dalecarlia #4	82	17	<2	17	0.67	1.9
4	10-Dec-91	Dalecarlia #4	82	17	<2	16	0.80	2.2
5	10-Dec-91	Dalecarlia #4						
6	10-Dec-91	Dalecarlia #4	84	12	<2	13	0.48	0.90
1	21-Dec-91	Baseline #3	92	3.6	4	2	0.17	0.28
2	21-Dec-91	Baseline #3	94	3.8	6	3	0.25	0.17
3	21-Dec-91	Baseline #3	95	3.7	4	3	<0.10	0.20
4	21-Dec-91	Baseline #3	91	3.9	5	3	0.10	0.17
5	21-Dec-91	Baseline #3	91	4.0	4	2	0.11	0.20
6	21-Dec-91	Baseline #3	93	3.5	5	2	<0.10	0.18
1	10-Jan-92	Dalecarlia #3	60	18.0	3	16	0.43	0.74
2	10-Jan-92	Dalecarlia #3	61	15.0	3	13	0.62	0.70
3	10-Jan-92	Dalecarlia #3	62	13.0	2	9	0.66	0.71
4	10-Jan-92	Dalecarlia #3	61	14.0	3	10	0.77	0.87
5	10-Jan-92	Dalecarlia #3						
6	10-Jan-92	Dalecarlia #3	61	13.0	3	9	0.63	0.75
1	24-Feb-92	Georgetown #1						
2	24-Feb-92	Georgetown #1						
3	24-Feb-92	Georgetown #1						
4	24-Feb-92	Georgetown #1	85	10.0	4	15	0.20	0.41
5	24-Feb-92	Georgetown #1	79	7.6	5	10	<0.10	0.31

WATER QUALITY LABORATORY DATA

TRANSECT	DATE	SURVEY	ALKALINITY (mg/L)	TURBIDITY (NTU)	BOD5 (mg/L)	TSS (mg/L)	ALUMINUM (mg/L)	IRON (mg/L)
6	24-Feb-92	Georgetown #1	83	6.7	5	8	<0.10	0.27
1	29-Feb-92	Georgetown #2						
2	29-Feb-92	Georgetown #2						
3	29-Feb-92	Georgetown #2						
4	29-Feb-92	Georgetown #2	67	110.0	6	120	2.70	3.50
5	29-Feb-92	Georgetown #2	60	110.0	8	140	2.90	4.00
6	29-Feb-92	Georgetown #2	68	130.0	7	160	4.00	5.40

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
BASELINE 1	10-Oct-91	1	0	16.02	8.28	9.85	363	950
BASELINE 1	10-Oct-91		1	15.84	8.39	9.79	362	950
BASELINE 1	10-Oct-91		2	15.82	8.45	9.73	362	950
BASELINE 1	10-Oct-91	2	1	16.15	8.28	7.08	344	950
BASELINE 1	10-Oct-91		2	16.05	8.34	5.35	346	950
BASELINE 1	10-Oct-91		3	16.08	8.38	5.43	345	950
BASELINE 1	10-Oct-91		4	16.02	8.42	5.38	345	950
BASELINE 1	10-Oct-91		5	16.00	8.43	5.65	347	950
BASELINE 1	10-Oct-91	3	1	16.85	8.44	*10.18	345	950
BASELINE 1	10-Oct-91		2	16.59	8.56	*10.30	344	950
BASELINE 1	10-Oct-91		3	16.40	8.56	*	344	950
BASELINE 1	10-Oct-91		4	16.33	8.57	*	345	950
BASELINE 1	10-Oct-91		5	16.31	8.58	*	345	950
BASELINE 1	10-Oct-91		6	16.27	8.58	*	345	950
BASELINE 1	10-Oct-91		6.5	16.23	8.58	*	345	950
BASELINE 1	10-Oct-91	4	1	17.13	8.28	*	343	950
BASELINE 1	10-Oct-91		2	16.90	8.28	*	342	950
BASELINE 1	10-Oct-91		3	16.85	8.30	*	342	950
BASELINE 1	10-Oct-91		4	16.65	8.29	*	344	950
BASELINE 1	10-Oct-91		5	16.62	8.32	*	344	950
BASELINE 1	10-Oct-91		5.5	16.61	8.33	*	344	950
BASELINE 1	10-Oct-91	5	1	17.36	8.36	*	337	950
BASELINE 1	10-Oct-91		2	17.28	8.37	*	340	950
BASELINE 1	10-Oct-91		3	17.21	8.39	*	340	950
BASELINE 1	10-Oct-91		4	17.19	8.39	*	342	950
BASELINE 1	10-Oct-91		5	17.16	8.41	*	341	950
BASELINE 1	10-Oct-91		6	17.17	8.41	*	342	950
BASELINE 1	10-Oct-91	6	1	18.77	8.24	*	312	950
BASELINE 1	10-Oct-91		2	18.50	8.24	*	313	950
BASELINE 1	10-Oct-91		3	18.17	8.23	*	318	950

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
BASELINE 1	10-Oct-91		4	18.11	8.25	*	321	950
BASELINE 1	10-Oct-91		5	17.95	8.27	*	324	950
BASELINE 1	10-Oct-91		6	17.65	8.32	*	333	950
BASELINE 1	10-Oct-91		6.5	17.64	8.30	*	332	950
BASELINE 2	05-Dec-91	1	0	8.93	8.63	11.96	347	9187
BASELINE 2	05-Dec-91		1	8.94	8.60	11.84	347	9187
BASELINE 2	05-Dec-91		2	8.95	8.57	11.71	346	9187
BASELINE 2	05-Dec-91		2.7	8.96	8.53	11.71	346	9187
BASELINE 2	05-Dec-91	2	0.3	9.05	8.25	13.6	325	9187
BASELINE 2	05-Dec-91	3	0.5	9.05	8.73	13.65	337	9187
BASELINE 2	05-Dec-91	4	1	8.96	8.28	13.93	336	9187
BASELINE 2	05-Dec-91		2	9.00	8.27	13.19	336	9187
BASELINE 2	05-Dec-91		3	9.02	8.25	12.83	337	9187
BASELINE 2	05-Dec-91		4	9.03	8.26	12.87	337	9187
BASELINE 2	05-Dec-91		5	9.05	8.26	12.95	335	9187
BASELINE 2	05-Dec-91		5.6	9.86	8.27	12.65	335	9187
BASELINE 2	05-Dec-91	5	1	8.93	8.26	13.49	348	9187
BASELINE 2	05-Dec-91		2	9.02	8.26	13.13	350	9187
BASELINE 2	05-Dec-91		3	9.04	8.27	12.97	350	9187
BASELINE 2	05-Dec-91		4	9.04	8.26	12.55	349	9187
BASELINE 2	05-Dec-91		5	9.04	8.26	12.54	348	9187
BASELINE 2	05-Dec-91		6	9.07	8.26	12.48	348	9187
BASELINE 2	05-Dec-91	6	1	9.34	8.45	12.72	362	9187
BASELINE 2	05-Dec-91		2	9.40	8.40	12.53	362	9187
BASELINE 2	05-Dec-91		3	9.44	8.39	12.51	362	9187
BASELINE 2	05-Dec-91		4	9.45	8.37	12.36	361	9187
BASELINE 2	05-Dec-91		5	9.47	8.36	12.15	361	9187
BASELINE 2	05-Dec-91		6	9.46	8.35	12.00	361	9187

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
DALECARLIA #4	10-Dec-91	1	0	7.28	8.50	12.66	271	4052
DALECARLIA #4	10-Dec-91		1	7.28	8.44	12.55	271	4052
DALECARLIA #4	10-Dec-91		2	7.28	8.40	12.60	271	4052
DALECARLIA #4	10-Dec-91		3	7.28	8.39	12.61	271	4052
DALECARLIA #4	10-Dec-91	2	1	7.35	8.06	12.33	271	4052
DALECARLIA #4	10-Dec-91		2	7.35	8.05	12.33	271	4052
DALECARLIA #4	10-Dec-91		3	7.35	8.05	12.41	271	4052
DALECARLIA #4	10-Dec-91		4	7.34	8.04	12.40	271	4052
DALECARLIA #4	10-Dec-91	3	1	7.26	8.01	12.54	270	4052
DALECARLIA #4	10-Dec-91		2	7.25	7.90	13.59	270	4052
DALECARLIA #4	10-Dec-91		3	7.25	8.02	12.35	272	4052
DALECARLIA #4	10-Dec-91		4	7.25	8.01	12.48	272	4052
DALECARLIA #4	10-Dec-91		5	7.25	8.00	12.54	272	4052
DALECARLIA #4	10-Dec-91		6	7.25	8.00	12.54	272	4052
DALECARLIA #4	10-Dec-91		7	7.25	8.01	12.48	271	4052
DALECARLIA #4	10-Dec-91		7.5	7.25	8.01	12.48	272	4052
DALECARLIA #4	10-Dec-91	4	1	7.22	7.50	13.29	271	4052
DALECARLIA #4	10-Dec-91		2	7.22	7.67	12.69	271	4052
DALECARLIA #4	10-Dec-91		3	7.22	7.72	12.37	271	4052
DALECARLIA #4	10-Dec-91		4	7.22	7.77	12.44	272	4052
DALECARLIA #4	10-Dec-91		5	7.22	7.79	12.50	272	4052
DALECARLIA #4	10-Dec-91		6	7.22	7.78	12.56	272	4052
DALECARLIA #4	10-Dec-91		6.7	7.22	7.79	12.50	272	4052
DALECARLIA #4	10-Dec-91	6	1	7.22	8.64	13.43	285	4052
DALECARLIA #4	10-Dec-91		2	7.19	8.73	13.30	285	4052
DALECARLIA #4	10-Dec-91		3	7.19	8.72	13.30	285	4052
DALECARLIA #4	10-Dec-91		4	7.19	8.71	13.24	285	4052
DALECARLIA #4	10-Dec-91		5	7.19	8.69	13.24	284	4052
DALECARLIA #4	10-Dec-91		6	7.19	8.66	13.18	285	4052
DALECARLIA #4	10-Dec-91		7	7.19	8.63	13.12	284	4052

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
BASELINE 3	20-Dec-91	1	0	0.36	8.56	15.20	286	2042
BASELINE 3	20-Dec-91		1	0.38	8.55	15.30	286	2042
BASELINE 3	20-Dec-91		2	0.38	8.55	15.09	287	2042
BASELINE 3	20-Dec-91		2.5	0.39	8.55	15.17	287	2042
BASELINE 3	20-Dec-91	2	1	0.92	8.41	15.14	288	2042
BASELINE 3	20-Dec-91		2	0.91	8.41	15.16	288	2042
BASELINE 3	20-Dec-91		3	0.90	8.43	15.16	288	2042
BASELINE 3	20-Dec-91		4	0.90	8.41	15.16	288	2042
BASELINE 3	20-Dec-91		5	0.90	8.41	15.17	288	2042
BASELINE 3	20-Dec-91		6	0.91	8.41	15.16	288	2042
BASELINE 3	20-Dec-91		7	0.90	8.41	15.17	287	2042
BASELINE 3	20-Dec-91		8	0.91	8.42	15.16	288	2042
BASELINE 3	20-Dec-91		9	0.91	8.42	15.16	287	2042
BASELINE 3	20-Dec-91		1	0.90	8.41	15.17	287	2042
BASELINE 3	20-Dec-91		11	0.91	8.41	15.16	286	2042
BASELINE 3	20-Dec-91	3	1	0.86	8.42	15.12	286	2042
BASELINE 3	20-Dec-91		2	0.82	8.42	15.15	287	2042
BASELINE 3	20-Dec-91		3	0.81	8.42	15.26	287	2042
BASELINE 3	20-Dec-91		4	0.80	8.42	15.27	287	2042
BASELINE 3	20-Dec-91		5	0.80	8.43	15.27	286	2042
BASELINE 3	20-Dec-91		6	0.79	8.43	15.18	287	2042
BASELINE 3	20-Dec-91		7	0.79	8.43	15.18	287	2042
BASELINE 3	20-Dec-91		8	0.79	8.43	15.18	287	2042
BASELINE 3	20-Dec-91		9	0.79	8.42	15.28	287	2042
BASELINE 3	20-Dec-91		1	0.79	8.43	15.28	287	2042
BASELINE 3	20-Dec-91	4	1	0.67	8.46	15.31	287	2042
BASELINE 3	20-Dec-91		2	0.64	8.48	15.33	287	2042
BASELINE 3	20-Dec-91		3	0.64	8.47	15.34	287	2042
BASELINE 3	20-Dec-91		4	0.63	8.48	15.34	286	2042
BASELINE 3	20-Dec-91		5	0.64	8.46	15.34	287	2042

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
BASELINE 3	20-Dec-91		6	0.63	8.46	15.34	286	2042
BASELINE 3	20-Dec-91	5	1	0.98	8.20	15.71	287	2042
BASELINE 3	20-Dec-91		2	0.95	8.31	15.41	287	2042
BASELINE 3	20-Dec-91		3	0.95	8.31	15.42	287	2042
BASELINE 3	20-Dec-91		4	0.95	8.33	15.31	286	2042
BASELINE 3	20-Dec-91	6	1	1.71	8.49	15.18	288	2042
BASELINE 3	20-Dec-91		2	1.71	8.49	15.09	289	2042
BASELINE 3	20-Dec-91		3	1.72	8.49	15.09	289	2042
BASELINE 3	20-Dec-91		4	1.74	8.47	14.99	287	2042
BASELINE 3	20-Dec-91		5	1.74	8.48	14.99	287	2042
BASELINE 3	20-Dec-91		5.5	1.74	8.49	14.98	287	2042
DALECARLIA #3	10-Jan-92	1	0	5.24	7.74	14.04	239	6528
DALECARLIA #3	10-Jan-92		1	5.23	7.76	14.04	239	6528
DALECARLIA #3	10-Jan-92		2	5.21	7.79	14.05	239	6528
DALECARLIA #3	10-Jan-92		3	5.21	7.81	14.05	239	6528
DALECARLIA #3	10-Jan-92	2	0	5.41	7.55	13.82	240	6528
DALECARLIA #3	10-Jan-92		1	5.37	7.79	13.75	240	6528
DALECARLIA #3	10-Jan-92		2	5.36	7.83	13.76	240	6528
DALECARLIA #3	10-Jan-92		2.5	5.36	7.85	13.77	240	6528
DALECARLIA #3	10-Jan-92	3	0	5.41	7.82	14.25	241	6528
DALECARLIA #3	10-Jan-92		1	5.40	7.87	13.88	241	6528
DALECARLIA #3	10-Jan-92		2	5.40	7.90	13.81	241	6528
DALECARLIA #3	10-Jan-92		3	5.39	7.96	13.74	240	6528
DALECARLIA #3	10-Jan-92		4	5.39	7.96	13.66	240	6528
DALECARLIA #3	10-Jan-92		5	5.39	7.99	13.74	240	6528
DALECARLIA #3	10-Jan-92		6	5.39	8.00	13.74	240	6528
DALECARLIA #3	10-Jan-92		7	5.39	8.01	13.66	240	6528
DALECARLIA #3	10-Jan-92		8	5.39	8.02	13.66	240	6528
DALECARLIA #3	10-Jan-92		9	5.39	8.02	13.66	241	6528

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
DALECARLIA #3	10-Jan-92		1	5.39	8.03	13.66	239	6528
DALECARLIA #3	10-Jan-92		11	5.39	8.03	13.66	240	6528
DALECARLIA #3	10-Jan-92		12	5.39	8.04	13.66	240	6528
DALECARLIA #3	10-Jan-92	4	0	5.43	7.95	14.09	241	6528
DALECARLIA #3	10-Jan-92		1	5.42	7.98	13.79	241	6528
DALECARLIA #3	10-Jan-92		2	5.41	7.98	13.71	240	6528
DALECARLIA #3	10-Jan-92		3	5.41	8.02	13.71	240	6528
DALECARLIA #3	10-Jan-92		4	5.41	8.02	13.64	240	6528
DALECARLIA #3	10-Jan-92		5	5.41	8.03	13.64	240	6528
DALECARLIA #3	10-Jan-92		6	5.41	8.04	13.64	240	6528
DALECARLIA #3	10-Jan-92		7	5.40	8.05	13.65	240	6528
DALECARLIA #3	10-Jan-92	6	0	5.35	7.96	14.24	240	6528
DALECARLIA #3	10-Jan-92		1	5.33	7.98	13.70	239	6528
DALECARLIA #3	10-Jan-92		2	5.34	8.00	13.55	240	6528
DALECARLIA #3	10-Jan-92		3	5.33	8.03	13.55	239	6528
DALECARLIA #3	10-Jan-92		4	5.33	8.03	13.48	239	6528
DALECARLIA #3	10-Jan-92		5	5.32	8.02	13.48	239	6528
DALECARLIA #3	10-Jan-92		6	5.32	8.03	13.48	239	6528
GEORGETOWN #	24-Feb-92	4	1	7.03	8.06	12.24	322	4725
GEORGETOWN #	24-Feb-92		2	7.04	8.05	12.29	322	4725
GEORGETOWN #	24-Feb-92		3	7.05	8.05	12.23	322	4725
GEORGETOWN #	24-Feb-92		4	7.04	8.05	12.29	322	4725
GEORGETOWN #	24-Feb-92		5	7.05	8.05	12.24	321	4725
GEORGETOWN #	24-Feb-92		6	7.04	8.04	12.17	322	4725
GEORGETOWN #	24-Feb-92	5	1	7.03	6.67	12.75	320	4725
GEORGETOWN #	24-Feb-92		2	7.03	7.54	12.30	320	4725
GEORGETOWN #	24-Feb-92		3	7.04	7.62	12.24	320	4725
GEORGETOWN #	24-Feb-92		4	7.04	7.68	12.17	321	4725
GEORGETOWN #	24-Feb-92	6	1	6.88	7.64	12.04	318	4725

HYDROLAB IN-SITU WATER QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	DEPTH (m)	TEMP (C)	pH	DO (mg/L)	COND (uS/cm)	River Flow
GEORGETOWN #	24-Feb-92		2	6.88	7.69	11.98	318	4725
GEORGETOWN #	24-Feb-92		3	6.88	7.74	11.92	318	4725
GEORGETOWN #	24-Feb-92		4	6.88	7.76	11.92	318	4725
GEORGETOWN #	24-Feb-92		5	6.88	7.78	11.92	318	4725
GEORGETOWN #	24-Feb-92		5.3	6.88	7.82	11.85	318	4725
GEORGETOWN #	29-Feb-92	4	1	6.61	7.97	14.50	228	9436
GEORGETOWN #	29-Feb-92	5	1	6.59	7.90	14.43	232	9436
GEORGETOWN #	29-Feb-92		2	6.62	8.17	12.72	231	9436
GEORGETOWN #	29-Feb-92		3	6.65	8.14	12.93	231	9436
GEORGETOWN #	29-Feb-92		3.5	6.65	8.14	12.94	230	9436
GEORGETOWN #	29-Feb-92	6	1	6.63	7.90	14.21	240	9436
GEORGETOWN #	29-Feb-92		2	6.65	7.87	13.93	240	9436
GEORGETOWN #	29-Feb-92		3	6.65	7.90	13.88	240	9436
GEORGETOWN #	29-Feb-92		4	6.65	7.88	13.82	240	9436
GEORGETOWN #	29-Feb-92		5	6.65	7.88	13.76	239	9436
GEORGETOWN #	29-Feb-92		6	6.66	7.89	13.70	239	9436
GEORGETOWN #	29-Feb-92		6.5	6.66	7.89	13.64	238	9436

* D.O. unstable-fluctuated between 8 & 11 mg/l.

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
BASELINE 1	10-Oct-91	1	E	1	8500	13000
BASELINE 1	10-Oct-91	1	E	2	4300	8000
BASELINE 1	10-Oct-91	1	C	1	2800	9000
BASELINE 1	10-Oct-91	1	C	2	3200	8500
BASELINE 1	10-Oct-91	1	W	1	2600	6500
BASELINE 1	10-Oct-91	1	W	2	3200	4800
BASELINE 1	10-Oct-91	2	E	1	7200	8700
BASELINE 1	10-Oct-91	2	E	2	5300	7100
BASELINE 1	10-Oct-91	2	C	1	7700	11000
BASELINE 1	10-Oct-91	2	C	2	5200	8300
BASELINE 1	10-Oct-91	2	W	1		
BASELINE 1	10-Oct-91	2	W	2		
BASELINE 1	10-Oct-91	3	E	1	6100	7400
BASELINE 1	10-Oct-91	3	E	2	4900	4200
BASELINE 1	10-Oct-91	3	C	1	9000	12000
BASELINE 1	10-Oct-91	3	C	2	2800	3700
BASELINE 1	10-Oct-91	3	W	1	6300	7900
BASELINE 1	10-Oct-91	3	W	2	2800	3500
BASELINE 1	10-Oct-91	4	E	1	7700	8700
BASELINE 1	10-Oct-91	4	E	2	4100	4900
BASELINE 1	10-Oct-91	4	C	1	6400	7600
BASELINE 1	10-Oct-91	4	C	2	6400	7700
BASELINE 1	10-Oct-91	4	W	1	8400	9000
BASELINE 1	10-Oct-91	4	W	2	6500	7600
BASELINE 1	10-Oct-91	5	E	1	8200	11000
BASELINE 1	10-Oct-91	5	E	2	6600	9400
BASELINE 1	10-Oct-91	5	C	1	7800	11000
BASELINE 1	10-Oct-91	5	C	2	6800	9800
BASELINE 1	10-Oct-91	5	W	1	5400	9600
BASELINE 1	10-Oct-91	5	W	2	3000	7400
BASELINE 1	10-Oct-91	6	E	1		
BASELINE 1	10-Oct-91	6	E	2		
BASELINE 1	10-Oct-91	6	C	1	6700	12000
BASELINE 1	10-Oct-91	6	C	2	7200	11000
BASELINE 1	10-Oct-91	6	W	1	2600	7100
BASELINE 1	10-Oct-91	6	W	2	1400	5600
BASELINE 2	05-Dec-91	1	E	1	3400	7700
BASELINE 2	05-Dec-91	1	E	2	3600	8200

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
BASELINE 2	05-Dec-91	1	C	1	3600	10000
BASELINE 2	05-Dec-91	1	C	2		
BASELINE 2	05-Dec-91	1	W	1	2900	8500
BASELINE 2	05-Dec-91	1	W	2	3700	9200
BASELINE 2	05-Dec-91	2	E	1		
BASELINE 2	05-Dec-91	2	E	2		
BASELINE 2	05-Dec-91	2	C	1		
BASELINE 2	05-Dec-91	2	C	2		
BASELINE 2	05-Dec-91	2	W	1		
BASELINE 2	05-Dec-91	2	W	2		
BASELINE 2	05-Dec-91	3	E	1		
BASELINE 2	05-Dec-91	3	E	2		
BASELINE 2	05-Dec-91	3	C	1		
BASELINE 2	05-Dec-91	3	C	2		
BASELINE 2	05-Dec-91	3	W	1		
BASELINE 2	05-Dec-91	3	W	2		
BASELINE 2	05-Dec-91	4	E	1		
BASELINE 2	05-Dec-91	4	E	2		
BASELINE 2	05-Dec-91	4	C	1	1100	230
BASELINE 2	05-Dec-91	4	C	2	1700	1300
BASELINE 2	05-Dec-91	4	W	1	3200	2600
BASELINE 2	05-Dec-91	4	W	2	4100	7900
BASELINE 2	05-Dec-91	5	E	1	9500	15000
BASELINE 2	05-Dec-91	5	E	2	1500	50
BASELINE 2	05-Dec-91	5	C	1	8300	14000
BASELINE 2	05-Dec-91	5	C	2	1000	70
BASELINE 2	05-Dec-91	5	W	1	4500	9500
BASELINE 2	05-Dec-91	5	W	2	4600	9500
BASELINE 2	05-Dec-91	6	E	1		
BASELINE 2	05-Dec-91	6	E	2		
BASELINE 2	05-Dec-91	6	C	1		
BASELINE 2	05-Dec-91	6	C	2		
BASELINE 2	05-Dec-91	6	W	1		
BASELINE 2	05-Dec-91	6	W	2		
DALECARLIA #4	10-Dec-91	1	E	1		
DALECARLIA #4	10-Dec-91	1	E	2		
DALECARLIA #4	10-Dec-91	1	C	1	2400	8300
DALECARLIA #4	10-Dec-91	1	C	2	2000	6500

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
DALECARLIA #4	10-Dec-91	1	W	1	2600	7700
DALECARLIA #4	10-Dec-91	1	W	2	2400	7400
DALECARLIA #4	10-Dec-91	2	E	1		
DALECARLIA #4	10-Dec-91	2	E	2		
DALECARLIA #4	10-Dec-91	2	C	1		
DALECARLIA #4	10-Dec-91	2	C	2		
DALECARLIA #4	10-Dec-91	2	W	1		
DALECARLIA #4	10-Dec-91	2	W	2		
DALECARLIA #4	10-Dec-91	3	E	1	5700	7700
DALECARLIA #4	10-Dec-91	3	E	2	5500	7500
DALECARLIA #4	10-Dec-91	3	C	1	6700	12000
DALECARLIA #4	10-Dec-91	3	C	2	4500	8500
DALECARLIA #4	10-Dec-91	3	W	1	4200	7700
DALECARLIA #4	10-Dec-91	3	W	2	6600	11000
DALECARLIA #4	10-Dec-91	4	E	1		
DALECARLIA #4	10-Dec-91	4	E	2		
DALECARLIA #4	10-Dec-91	4	C	1	4800	8100
DALECARLIA #4	10-Dec-91	4	C	2	3700	5600
DALECARLIA #4	10-Dec-91	4	W	1	4400	8800
DALECARLIA #4	10-Dec-91	4	W	2	5200	11000
DALECARLIA #4	10-Dec-91	5	E	1		
DALECARLIA #4	10-Dec-91	5	E	2		
DALECARLIA #4	10-Dec-91	5	C	1		
DALECARLIA #4	10-Dec-91	5	C	2		
DALECARLIA #4	10-Dec-91	5	W	1		
DALECARLIA #4	10-Dec-91	5	W	2		
DALECARLIA #4	10-Dec-91	6	E	1	5600	9500
DALECARLIA #4	10-Dec-91	6	E	2	3600	7900
DALECARLIA #4	10-Dec-91	6	C	1	3000	7700
DALECARLIA #4	10-Dec-91	6	C	2	2800	6800
DALECARLIA #4	10-Dec-91	6	W	1	3600	7900
DALECARLIA #4	10-Dec-91	6	W	2	3800	8700
BASELINE 3	21-Dec-91	1	E	1		
BASELINE 3	21-Dec-91	1	E	2		
BASELINE 3	21-Dec-91	1	C	1	2500	7200
BASELINE 3	21-Dec-91	1	C	2	3100	7300
BASELINE 3	21-Dec-91	1	W	1	2600	6600
BASELINE 3	21-Dec-91	1	W	2	3600	8500

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
BASELINE 3	21-Dec-91	2	E	1	4200	7700
BASELINE 3	21-Dec-91	2	E	2		
BASELINE 3	21-Dec-91	2	C	1		
BASELINE 3	21-Dec-91	2	C	2		
BASELINE 3	21-Dec-91	2	W	1		
BASELINE 3	21-Dec-91	2	W	2		
BASELINE 3	21-Dec-91	3	E	1	4800	6900
BASELINE 3	21-Dec-91	3	E	2	4300	7100
BASELINE 3	21-Dec-91	3	C	1	5900	10000
BASELINE 3	21-Dec-91	3	C	2	6600	12000
BASELINE 3	21-Dec-91	3	W	1	1700	3400
BASELINE 3	21-Dec-91	3	W	2	4300	7600
BASELINE 3	21-Dec-91	4	E	1		
BASELINE 3	21-Dec-91	4	E	2		
BASELINE 3	21-Dec-91	4	C	1	4800	8900
BASELINE 3	21-Dec-91	4	C	2		
BASELINE 3	21-Dec-91	4	W	1	4000	6900
BASELINE 3	21-Dec-91	4	W	2	5200	6000
BASELINE 3	21-Dec-91	5	E	1	6100	9100
BASELINE 3	21-Dec-91	5	E	2	5400	10000
BASELINE 3	21-Dec-91	5	C	1	4200	9000
BASELINE 3	21-Dec-91	5	C	2	3900	8000
BASELINE 3	21-Dec-91	5	W	1	3600	7100
BASELINE 3	21-Dec-91	5	W	2	3900	7800
BASELINE 3	21-Dec-91	6	E	1		
BASELINE 3	21-Dec-91	6	E	2		
BASELINE 3	21-Dec-91	6	C	1	3100	7200
BASELINE 3	21-Dec-91	6	C	2	3700	8600
BASELINE 3	21-Dec-91	6	W	1	3400	7600
BASELINE 3	21-Dec-91	6	W	2	2400	6200
DALECARLIA #3	10-Jan-92	1	E	1		
DALECARLIA #3	10-Jan-92	1	E	2		
DALECARLIA #3	10-Jan-92	1	C	1	2600	6800
DALECARLIA #3	10-Jan-92	1	C	2	1400	5600
DALECARLIA #3	10-Jan-92	1	W	1	4400	8100
DALECARLIA #3	10-Jan-92	1	W	2	3900	9500
DALECARLIA #3	10-Jan-92	2	E	1	4100	7000

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
DALECARLIA #3	10-Jan-92	2	E	2	4100	6600
DALECARLIA #3	10-Jan-92	2	C	1		
DALECARLIA #3	10-Jan-92	2	C	2		
DALECARLIA #3	10-Jan-92	2	W	1		
DALECARLIA #3	10-Jan-92	2	W	2		
DALECARLIA #3	10-Jan-92	3	E	1	5600	9900
DALECARLIA #3	10-Jan-92	3	E	2		
DALECARLIA #3	10-Jan-92	3	C	1		
DALECARLIA #3	10-Jan-92	3	C	2		
DALECARLIA #3	10-Jan-92	3	W	1	3800	6000
DALECARLIA #3	10-Jan-92	3	W	2	490	750
DALECARLIA #3	10-Jan-92	4	E	1		
DALECARLIA #3	10-Jan-92	4	E	2		
DALECARLIA #3	10-Jan-92	4	C	1		
DALECARLIA #3	10-Jan-92	4	C	2		
DALECARLIA #3	10-Jan-92	4	W	1	2300	6100
DALECARLIA #3	10-Jan-92	4	W	2	5900	10000
DALECARLIA #3	10-Jan-92	5	E	1		
DALECARLIA #3	10-Jan-92	5	E	2		
DALECARLIA #3	10-Jan-92	5	C	1		
DALECARLIA #3	10-Jan-92	5	C	2		
DALECARLIA #3	10-Jan-92	5	W	1		
DALECARLIA #3	10-Jan-92	5	W	2		
DALECARLIA #3	10-Jan-92	6	E	1		
DALECARLIA #3	10-Jan-92	6	E	2		
DALECARLIA #3	10-Jan-92	6	C	1	3200	6900
DALECARLIA #3	10-Jan-92	6	C	2	2300	6700
DALECARLIA #3	10-Jan-92	6	W	1	4300	9200
DALECARLIA #3	10-Jan-92	6	W	2	1500	3800
GEORGETOWN #1	24-Feb-92	1	E	1		
GEORGETOWN #1	24-Feb-92	1	E	2		
GEORGETOWN #1	24-Feb-92	1	C	1		
GEORGETOWN #1	24-Feb-92	1	C	2		
GEORGETOWN #1	24-Feb-92	1	W	1		
GEORGETOWN #1	24-Feb-92	1	W	2		
GEORGETOWN #1						
GEORGETOWN #1	24-Feb-92	2	E	1		
GEORGETOWN #1	24-Feb-92	2	E	2		
GEORGETOWN #1	24-Feb-92	2	C	1		

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
GEORGETOWN #1	24-Feb-92	2	C	2		
GEORGETOWN #1	24-Feb-92	2	W	1		
GEORGETOWN #1	24-Feb-92	2	W	2		
GEORGETOWN #1	24-Feb-92	3	E	1		
GEORGETOWN #1	24-Feb-92	3	E	2		
GEORGETOWN #1	24-Feb-92	3	C	1		
GEORGETOWN #1	24-Feb-92	3	C	2		
GEORGETOWN #1	24-Feb-92	3	W	1		
GEORGETOWN #1	24-Feb-92	3	W	2		
GEORGETOWN #1	24-Feb-92	4	E	1		
GEORGETOWN #1	24-Feb-92	4	E	2		
GEORGETOWN #1	24-Feb-92	4	C	1		
GEORGETOWN #1	24-Feb-92	4	C	2		
GEORGETOWN #1	24-Feb-92	4	W	1	6600	9400
GEORGETOWN #1	24-Feb-92	4	W	2	5700	7000
GEORGETOWN #1	24-Feb-92	5	E	1	7700	12000
GEORGETOWN #1	24-Feb-92	5	E	2		
GEORGETOWN #1	24-Feb-92	5	C	1	6100	9500
GEORGETOWN #1	24-Feb-92	5	C	2	6400	10000
GEORGETOWN #1	24-Feb-92	5	W	1	5300	8300
GEORGETOWN #1	24-Feb-92	5	W	2	7200	10000
GEORGETOWN #1	24-Feb-92	6	E	1	7000	12000
GEORGETOWN #1	24-Feb-92	6	E	2	4600	9400
GEORGETOWN #1	24-Feb-92	6	C	1	4300	7900
GEORGETOWN #1	24-Feb-92	6	C	2	5200	9400
GEORGETOWN #1	24-Feb-92	6	W	1	5400	9400
GEORGETOWN #1	24-Feb-92		W	2	2100	6900
GEORGETOWN #2	03-Mar-92	1	E	1		
GEORGETOWN #2	03-Mar-92	1	E	2		
GEORGETOWN #2	03-Mar-92	1	C	1		
GEORGETOWN #2	03-Mar-92	1	C	2		
GEORGETOWN #2	03-Mar-92	1	W	1		
GEORGETOWN #2	03-Mar-92	1	W	2		
GEORGETOWN #2	03-Mar-92	2	E	1		
GEORGETOWN #2	03-Mar-92	2	E	2		
GEORGETOWN #2	03-Mar-92	2	C	1		
GEORGETOWN #2	03-Mar-92	2	C	2		
GEORGETOWN #2	03-Mar-92	2	W	1		

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
GEORGETOWN #2	03-Mar-92	2	W	2		
GEORGETOWN #2	03-Mar-92	3	E	1		
GEORGETOWN #2	03-Mar-92	3	E	2		
GEORGETOWN #2	03-Mar-92	3	C	1		
GEORGETOWN #2	03-Mar-92	3	C	2		
GEORGETOWN #2	03-Mar-92	3	W	1		
GEORGETOWN #2	03-Mar-92	3	W	2		
GEORGETOWN #2	03-Mar-92	4	E	1		
GEORGETOWN #2	03-Mar-92	4	E	2		
GEORGETOWN #2	03-Mar-92	4	C	1		
GEORGETOWN #2	03-Mar-92	4	C	2		
GEORGETOWN #2	03-Mar-92	4	W	1	7800	7400
GEORGETOWN #2	03-Mar-92	4	W	2	9300	9700
GEORGETOWN #2	03-Mar-92	5	E	1	11000	14000
GEORGETOWN #2	03-Mar-92	5	E	2		
GEORGETOWN #2	03-Mar-92	5	C	1	5700	9900
GEORGETOWN #2	03-Mar-92	5	C	2	8000	11000
GEORGETOWN #2	03-Mar-92	5	W	1	7100	11000
GEORGETOWN #2	03-Mar-92	5	W	2	6000	13000
GEORGETOWN #2	03-Mar-92	6	E	1		
GEORGETOWN #2	03-Mar-92	6	E	2		
GEORGETOWN #2	03-Mar-92	6	C	1	4600	8900
GEORGETOWN #2	03-Mar-92	6	C	2	4000	8400
GEORGETOWN #2	03-Mar-92	6	W	1	11000	16000
GEORGETOWN #2	03-Mar-92	6	W	2	7600	12000
BASELINE 1	10-Oct-91	Georgetown #1	A	1	6700	3900
BASELINE 1	10-Oct-91	Georgetown #1	B	1	6900	3800
BASELINE 1	10-Oct-91	Georgetown #1	C	1	3700	1900
BASELINE 1	10-Oct-91	Georgetown #2	A	1	6900	3600
BASELINE 1	10-Oct-91	Georgetown #2	B	1	4900	2400
BASELINE 1	10-Oct-91	Georgetown #2	C	1	6800	3400
BASELINE 1	10-Oct-91	Dalecarlia #3	A	1	4100	2200
BASELINE 1	10-Oct-91	Dalecarlia #3	B	1	4000	2200
BASELINE 1	10-Oct-91	Dalecarlia #3	C	1	4200	2500
BASELINE 1	10-Oct-91	Dalecarlia #4	A	1	5300	4100
BASELINE 1	10-Oct-91	Dalecarlia #4	B	1	5100	3400

SEDIMENT QUALITY DATA

SURVEY TYPE	DATE	TRANSECT	LOCATION	REPLICATE	ALUMINUM (mg/kg)	IRON (mg/kg)
BASELINE 1	10-Oct-91	Dalecarlia #4	C	1	4800	3400

APPENDIX B: BENTHIC MACROINVERTEBRATE DATA

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Oct-91	1	Center	1	Annelida	Oligochaeta		Naididae		2
10-Oct-91	1	Center	1	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
10-Oct-91	1	Center	1	Arthropoda	Insecta	Diptera	Chironomidae		8
10-Oct-91	1	Center	1	Annelida	Hirudinea		Glossiphoniidae		1
10-Oct-91	1	Center	1	Turbellaria					1
10-Oct-91	1	Center	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	44
10-Oct-91	1	Center	1	Annelida	Oligochaeta		Tubificidae		146
10-Oct-91	1	Center	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	36
10-Oct-91	1	Center	2	Annelida	Oligochaeta		Tubificidae		70
10-Oct-91	1	Center	2	Arthropoda	Insecta	Diptera	Chironomidae		11
10-Oct-91	1	Center	2	Annelida	Oligochaeta		Naididae		6
10-Oct-91	1	East	1	Annelida	Oligochaeta		Naididae		1
10-Oct-91	1	East	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		2
10-Oct-91	1	East	1	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
10-Oct-91	1	East	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Oct-91	1	East	1	Annelida	Oligochaeta		Tubificidae		50
10-Oct-91	1	East	1	Arthropoda	Insecta	Diptera	Chironomidae		23
10-Oct-91	1	East	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	1	East	1	Turbellaria					1
10-Oct-91	1	East	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	20
10-Oct-91	1	East	2	Annelida	Oligochaeta		Tubificidae		84
10-Oct-91	1	East	2	Arthropoda	Insecta	Diptera	Chironomidae		29
10-Oct-91	1	East	2	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
10-Oct-91	1	East	2	Arthropoda	Insecta	Ephemeroptera	(inderterminate)		5
10-Oct-91	1	East	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	39
10-Oct-91	1	East	2	Arthropoda	Insecta	Coleoptera	Elmidae		3
10-Oct-91	1	WEST	1	Mollusca	Bivalvia	Unionacea	Unionidae		2
10-Oct-91	1	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
10-Oct-91	1	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		155
10-Oct-91	1	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		74
10-Oct-91	1	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	41
10-Oct-91	1	West	1	Arthropoda	Insecta	Diptera	Chironomidae		45
10-Oct-91	1	West	1	Arthropoda	Insecta	Ephemeroptera	Emphemeriidae		1
10-Oct-91	1	West	1	Arthropoda	Insecta	Diptera	Ceratopogonidae		1
10-Oct-91	1	West	1	Annelida	Oligochaeta		Tubificidae		70
10-Oct-91	1	West	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	1	West	1	Mollusca	Gastropoda		(indeterminate)		1
10-Oct-91	1	West	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	4
10-Oct-91	2	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Oct-91	2	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		24
10-Oct-91	2	CENTER	1	Arthropoda	Insecta	Collembola	(indeterminate)		1
10-Oct-91	2	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		320
10-Oct-91	2	CENTER	1	Platyhelminthes	Turbellaria				2
10-Oct-91	2	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		39
10-Oct-91	2	CENTER	1	Arthropoda	Crustacea	Amphipoda	Asellidae		1
10-Oct-91	2	CENTER	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
10-Oct-91	2	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		200
10-Oct-91	2	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		19
10-Oct-91	2	CENTER	2	Platyhelminthes	Insecta	Coleoptera	Elmidae		2
10-Oct-91	2	CENTER	2	Arthropoda	Insecta	Diptera	Diptera family D		1
10-Oct-91	2	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		36
10-Oct-91	2	CENTER	2	Arthropoda	Chelicerata	Acarina			1
10-Oct-91	2	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
10-Oct-91	2	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		27
10-Oct-91	2	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		14

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Oct-91	2	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		113
10-Oct-91	2	EAST	1	Mollusca	Gastropoda		Pleuroceridae		4
10-Oct-91	2	EAST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	2	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
10-Oct-91	2	EAST	1	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
10-Oct-91	2	EAST	1	Platyhelminthes	Turbellaria				2
10-Oct-91	2	EAST	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		6
10-Oct-91	2	EAST	1	Arthropoda	Chelicerata	Acarina			1
10-Oct-91	2	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		300
10-Oct-91	2	EAST	2	Mollusca	Bivalvia	Unionacea	Unionidae		1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Coleoptera	Elmidae		7
10-Oct-91	2	EAST	2	Mollusca	Gastropoda		Pleuroceridae		1
10-Oct-91	2	EAST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		4
10-Oct-91	2	EAST	2	Arthropoda	Crustacea	Isopoda	Asellidae		1
10-Oct-91	2	EAST	2	Mollusca	Gastropoda				1
10-Oct-91	2	EAST	2	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	2
10-Oct-91	2	EAST	2	Platyhelminthes	Turbellaria				38
10-Oct-91	2	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	40
10-Oct-91	2	EAST	2	Mollusca	Gastropoda		Ancylidae		2
10-Oct-91	2	EAST	2	Arthropoda	Chelicerata	Acarina			2
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Odonata	Macromiidae		1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Ephemeroptera	Ephemeriidae		1
10-Oct-91	2	EAST	2	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Collembola (ind)			1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Diptera	Psychodidae		1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		52
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		1
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		2
10-Oct-91	2	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		41
10-Oct-91	2	EAST	2	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
10-Oct-91	2	West	2	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		6
10-Oct-91	2	West	2	Arthropoda	Insecta	Trichoptera	Elmidae		4
10-Oct-91	2	West	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		1
10-Oct-91	2	West	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	23
10-Oct-91	2	West	2	Arthropoda	Insecta	Trichoptera	(indeterminate)		1
10-Oct-91	2	West	2	Arthropoda	Insecta	Coleoptera	Leptoceridae		1
10-Oct-91	2	West	2	Annelida	Oligichaeta		Tubificidae		45
10-Oct-91	2	West	2	Mollusca	Gastropoda		(indeterminate)		1
10-Oct-91	2	West	2	Arthropoda	Insecta	Diptera	Chironomidae		57
10-Oct-91	3	CENTER	1	Arthropoda	Crustacea	Amphipoda	Asellidae		1
10-Oct-91	3	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	4
10-Oct-91	3	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		181
10-Oct-91	3	CENTER	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	3	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		14
10-Oct-91	3	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		10
10-Oct-91	3	CENTER	2	Arthropoda	Insecta	Diptera	Diptera family D		1
10-Oct-91	3	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
10-Oct-91	3	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		154
10-Oct-91	3	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		6
10-Oct-91	3	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	3	CENTER	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		1
10-Oct-91	3	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		14
10-Oct-91	3	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	4
10-Oct-91	3	EAST	2	Mollusca	Gastropoda		Pleuroceridae		1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Oct-91	3	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		12
10-Oct-91	3	EAST	2	Platyhelminthes	Turbellaria				1
10-Oct-91	3	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		506
10-Oct-91	3	EAST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	3	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		31
10-Oct-91	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Oct-91	3	WEST	1	Platyhelminthes	Turbellaria				2
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera family D		1
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Trichoptera	(indeterminate)		2
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		5
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Lepidoptera	Gomphidae		1
10-Oct-91	3	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		265
10-Oct-91	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	12
10-Oct-91	3	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		10
10-Oct-91	3	WEST	1	Arthropoda	Chelicerata	Acarina			1
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
10-Oct-91	3	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		39
10-Oct-91	3	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		6
10-Oct-91	3	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		58
10-Oct-91	3	WEST	2	Arthropoda	Insecta	Diptera	Diptera family D		3
10-Oct-91	3	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	8
10-Oct-91	3	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		327
10-Oct-91	4	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
10-Oct-91	4	CENTER	1	Mollusca	Gastropoda		Ancylidae		1
10-Oct-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		2
10-Oct-91	4	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		16
10-Oct-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		48
10-Oct-91	4	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		123
10-Oct-91	4	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		24
10-Oct-91	4	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		6
10-Oct-91	4	CENTER	2	Mollusca	Gastropoda		Pleuroceridae		1
10-Oct-91	4	CENTER	2	Platyhelminthes	Turbellaria	Tricladida	Planariidae	Dugesia sp.	1
10-Oct-91	4	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Oct-91	4	EAST	1	Mollusca	Bivalvia	Unionacea			1
10-Oct-91	4	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		8
10-Oct-91	4	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		173
10-Oct-91	4	EAST	1	Mollusca	Gastropoda		Ancylidae		1
10-Oct-91	4	EAST	1	Mollusca	Gastropoda		Pleuroceridae		1
10-Oct-91	4	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	1
10-Oct-91	4	EAST	1	Mollusca	Gastropoda		Hydrobiidae		1
10-Oct-91	4	EAST	2	Arthropoda	Insecta	Trichoptera	Elmidae		3
10-Oct-91	4	EAST	2	Mollusca	Gastropoda		Pleuroceridae		18
10-Oct-91	4	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
10-Oct-91	4	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		275
10-Oct-91	4	EAST	2	Arthropoda	Insecta				2
10-Oct-91	4	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		36
10-Oct-91	4	EAST	2	Platyhelminthes	Turbellaria	Tricladida	Planariidae	Dugesia sp.	3
10-Oct-91	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		4
10-Oct-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
10-Oct-91	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		2
10-Oct-91	4	WEST	2	Arthropoda	Insecta	Trichoptera	(indeterminate)		1
10-Oct-91	4	WEST	2	Arthropoda	Chelicerata	Acarina			2
10-Oct-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
10-Oct-91	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		47

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Oct-91	4	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		62
10-Oct-91	4	WEST	2	Mollusca	Gastropoda		Pleuroceridae		1
10-Oct-91	4	WEST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Oct-91	5	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		26
10-Oct-91	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		190
10-Oct-91	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Oct-91	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
10-Oct-91	5	CENTER	2	Arthropoda	Insecta	Acarina			1
10-Oct-91	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		96
10-Oct-91	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		3
10-Oct-91	5	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		20
10-Oct-91	5	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
10-Oct-91	5	EAST	1	Arthropoda	Insecta	Trichoptera	(indeterminate)		1
10-Oct-91	5	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Oct-91	5	EAST	1	Mollusca	Bivalvia	Unionacea			1
10-Oct-91	5	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		142
10-Oct-91	5	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		25
10-Oct-91	5	EAST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	5	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		43
10-Oct-91	5	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		10
10-Oct-91	5	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
10-Oct-91	5	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		104
10-Oct-91	5	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Oct-91	5	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		8
10-Oct-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15
10-Oct-91	5	WEST	2	Arthropoda	Insecta	Acarina			1
10-Oct-91	5	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		54
10-Oct-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		5
10-Oct-91	5	WEST	2	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
10-Oct-91	5	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		271
10-Oct-91	5	WEST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Oct-91	5	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	6	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		28
10-Oct-91	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		3
10-Oct-91	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		342
10-Oct-91	6	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	7
10-Oct-91	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		24
10-Oct-91	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	20
10-Oct-91	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Oct-91	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		71
10-Oct-91	6	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		24
10-Oct-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	33
10-Oct-91	6	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Oct-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
10-Oct-91	6	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		89
10-Oct-91	6	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		33
10-Oct-91	6	WEST	1	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		2
04-Dec-91	1	CENTER	1	Mollusca	Gastropoda				1
04-Dec-91	1	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		64
04-Dec-91	1	CENTER	1	Arthropoda	Insecta	Trichoptera	Helicopsychidae		1
04-Dec-91	1	CENTER	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
04-Dec-91	1	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	9
04-Dec-91	1	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		23
04-Dec-91	1	CENTER	1	Platyhelminthes	Turbellaria	Tricladida	Planariidae	Dugesia sp.	1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
04-Dec-91	1	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		2
04-Dec-91	1	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		58
04-Dec-91	1	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
04-Dec-91	1	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		29
04-Dec-91	1	EAST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
04-Dec-91	1	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae		26
04-Dec-91	1	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		70
04-Dec-91	1	EAST	1	Arthropoda	Insecta	Lepidoptera	Gomphidae		1
04-Dec-91	1	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		19
04-Dec-91	1	EAST	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
04-Dec-91	1	EAST	1	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
04-Dec-91	1	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	57
04-Dec-91	1	WEST	1	Platyhelminthes	Turbellaria				1
04-Dec-91	1	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		77
04-Dec-91	1	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		2
04-Dec-91	1	WEST	1	Arthropoda	Insecta	Odonata	Gomphidae		1
04-Dec-91	1	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		19
04-Dec-91	1	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		25
04-Dec-91	1	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	8
04-Dec-91	1	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		53
04-Dec-91	4	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		107
04-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
04-Dec-91	4	CENTER	1	Mollusca	Gastropoda		Pleuroceridae		1
04-Dec-91	4	CENTER	1	Mollusca	Gastropoda		Ancylidae		2
04-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Unionacea			1
04-Dec-91	4	CENTER	1	Arthropoda	Insecta	Diptera	Diptera family D		1
04-Dec-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		24
04-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15
04-Dec-91	4	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	9
04-Dec-91	4	CENTER	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		2
04-Dec-91	4	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		10
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		126
04-Dec-91	4	CENTER	2	Arthropoda	Chelicerata	Acarina			1
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Trichoptera	(indeterminate)		1
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Collembola	Entomobryidae		5
04-Dec-91	4	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		168
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Trichoptera	Hydropsychidae		3
04-Dec-91	4	CENTER	2	Mollusca	Gastropoda				5
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		2
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
04-Dec-91	4	CENTER	2	Mollusca	Gastropoda		Physidae		1
04-Dec-91	4	CENTER	2	Arthropoda	Crustacea	Amphipoda	Crangonyctidae		1
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Diptera	Diptera family D		2
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Diptera	Thaumaleidae		1
04-Dec-91	4	CENTER	2	Arthropoda	Insecta				2
04-Dec-91	4	CENTER	2	Annelida	Insecta	Hemiptera	(indeterminate)		1
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		3
04-Dec-91	4	CENTER	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
04-Dec-91	4	CENTER	2	Mollusca	Gastropoda		Ancylidae		16
04-Dec-91	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		6
04-Dec-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
04-Dec-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea			5
04-Dec-91	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		53
04-Dec-91	4	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
04-Dec-91	4	WEST	2	Arthropoda	Insecta	Ephemeroptera	Caenidae		1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
04-Dec-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea			7
04-Dec-91	4	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
04-Dec-91	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		53
04-Dec-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	1
04-Dec-91	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		2
04-Dec-91	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15
04-Dec-91	5	CENTER	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
04-Dec-91	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		40
04-Dec-91	5	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		27
04-Dec-91	5	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
04-Dec-91	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		47
04-Dec-91	5	CENTER	2	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
04-Dec-91	5	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		25
04-Dec-91	5	CENTER	2	Arthropoda	Crustacea	Amphipoda	Crangonyctidae		1
04-Dec-91	5	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		48
04-Dec-91	5	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		11
04-Dec-91	5	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	11
04-Dec-91	5	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	12
04-Dec-91	5	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		15
04-Dec-91	5	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		11
04-Dec-91	5	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		38
04-Dec-91	5	WEST	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
04-Dec-91	5	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		91
04-Dec-91	5	WEST	1	Arthropoda	Insecta	Ephemeroptera (ind)			1
04-Dec-91	5	WEST	1	Mollusca	Gastropoda		Pleuroceridae		1
04-Dec-91	5	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
04-Dec-91	5	WEST	1	Arthropoda	Insecta	Diptera	Ceratopogonidae		2
04-Dec-91	5	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
04-Dec-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	16
04-Dec-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
04-Dec-91	5	WEST	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		2
04-Dec-91	5	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		60
04-Dec-91	5	WEST	2	Arthropoda	Chelicerata	Acarina			2
04-Dec-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea			10
04-Dec-91	5	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		185
10-Dec-91	1	CENTER	1	Platyhelminthes	Turbellaria				1
10-Dec-91	1	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15
10-Dec-91	1	CENTER	1	Mollusca	Gastropoda				1
10-Dec-91	1	CENTER	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
10-Dec-91	1	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		56
10-Dec-91	1	CENTER	1	Mollusca	Gastropoda		Ancylidae		2
10-Dec-91	1	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		117
10-Dec-91	1	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		446
10-Dec-91	1	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		9
10-Dec-91	1	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Dec-91	1	CENTER	2	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		4
10-Dec-91	1	CENTER	2	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
10-Dec-91	1	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	17
10-Dec-91	1	CENTER	2	Platyhelminthes	Turbellaria				8
10-Dec-91	1	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		117
10-Dec-91	1	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		254
10-Dec-91	1	WEST	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		2
10-Dec-91	1	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		156
10-Dec-91	1	WEST	1	Platyhelminthes	Turbellaria				4
10-Dec-91	1	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		5

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Dec-91	1	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15
10-Dec-91	1	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		88
10-Dec-91	1	WEST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Dec-91	1	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	12
10-Dec-91	1	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		1
10-Dec-91	1	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		105
10-Dec-91	3	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		49
10-Dec-91	3	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	7
10-Dec-91	3	CENTER	1	Arthropoda	Insecta	Ephemeroptera	Tricorythidae		1
10-Dec-91	3	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		233
10-Dec-91	3	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		9
10-Dec-91	3	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		70
10-Dec-91	3	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		7
10-Dec-91	3	EAST	1	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
10-Dec-91	3	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		4
10-Dec-91	3	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		486
10-Dec-91	3	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	52
10-Dec-91	3	EAST	1	Arthropoda	Chelicerata	Acarina			1
10-Dec-91	3	EAST	1	Mollusca	Gastropoda		Physidae		1
10-Dec-91	3	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		178
10-Dec-91	3	EAST	1	Platyhelminthes	Turbellaria				1
10-Dec-91	3	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		8
10-Dec-91	3	EAST	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
10-Dec-91	3	EAST	1	Arthropoda	Insecta	Trichoptera			1
10-Dec-91	3	EAST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		3
10-Dec-91	3	EAST	2	Mollusca	Gastropoda		Pleuroceridae		2
10-Dec-91	3	EAST	2	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	1
10-Dec-91	3	EAST	2	Mollusca	Gastropoda		Ancylidae		1
10-Dec-91	3	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		107
10-Dec-91	3	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		497
10-Dec-91	3	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		24
10-Dec-91	3	EAST	2	Arthropoda	Insecta	Coleoptera	Elmidae		2
10-Dec-91	3	EAST	2	Mollusca	Gastropoda				1
10-Dec-91	3	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	91
10-Dec-91	3	EAST	2	Rhynchocoelea					5
10-Dec-91	3	EAST	2	Mollusca	Gastropoda		Physidae		2
10-Dec-91	3	WEST	1	Rhynchocoelea					12
10-Dec-91	3	WEST	1	Mollusca	Gastropoda				2
10-Dec-91	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	87
10-Dec-91	3	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		30
10-Dec-91	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
10-Dec-91	3	WEST	1	Mollusca	Gastropoda		Ancylidae		2
10-Dec-91	3	WEST	1	Arthropoda	Insecta	Collembola	Entomobryidae		1
10-Dec-91	3	WEST	1	Mollusca	Gastropoda		Physidae		1
10-Dec-91	3	WEST	1	Arthropoda	Insecta	Trichoptera	(indeterminate)		1
10-Dec-91	3	WEST	1	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	5
10-Dec-91	3	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		267
10-Dec-91	3	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		174
10-Dec-91	3	WEST	1	Arthropoda	Chelicerata	Acarina			2
10-Dec-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		7
10-Dec-91	4	CENTER	1	Platyhelminthes	Turbellaria	Tricladida	Planariidae	Dugesia sp.	1
10-Dec-91	4	CENTER	1	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		1
10-Dec-91	4	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		174
10-Dec-91	4	CENTER	1	Mollusca	Gastropoda		Ancylidae		3
10-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	71

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Dec-91	4	CENTER	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Dec-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		266
10-Dec-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae	Branchiura sowerbyi	1
10-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Unionacea			1
10-Dec-91	4	CENTER	1	Mollusca	Gastropoda				1
10-Dec-91	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		83
10-Dec-91	4	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		1
10-Dec-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Dec-91	4	WEST	1	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
10-Dec-91	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		13
10-Dec-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Dec-91	4	WEST	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Dec-91	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		11
10-Dec-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
10-Dec-91	4	WEST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Dec-91	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		18
10-Dec-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Dec-91	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		147
10-Dec-91	6	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
10-Dec-91	6	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		229
10-Dec-91	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
10-Dec-91	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		133
10-Dec-91	6	CENTER	2	Mollusca	Gastropoda				1
10-Dec-91	6	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		46
10-Dec-91	6	EAST	1	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
10-Dec-91	6	EAST	1	Arthropoda	Chelicerata	Acarina			2
10-Dec-91	6	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae	Branchiura sowerbyi	1
10-Dec-91	6	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		258
10-Dec-91	6	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		492
10-Dec-91	6	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	7
10-Dec-91	6	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		16
10-Dec-91	6	EAST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Dec-91	6	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Dec-91	6	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		153
10-Dec-91	6	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
10-Dec-91	6	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		93
10-Dec-91	6	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		9
10-Dec-91	6	WEST	1	Arthropoda	Insecta	Trichoptera	Hydroptilidae		1
10-Dec-91	6	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		63
10-Dec-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	17
10-Dec-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Chironomidae		87
10-Dec-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Dec-91	6	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		62
10-Dec-91	6	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		115
10-Dec-91	6	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Dec-91	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	13
20-Dec-91	1	CENTER	1	Platyhelminthes	Turbellaria				1
20-Dec-91	1	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		56
20-Dec-91	1	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	32
20-Dec-91	1	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		3
20-Dec-91	1	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		77
20-Dec-91	1	CENTER	1	Arthropoda	Insecta	Plecoptera	(indeterminate)		1
20-Dec-91	1	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		83
20-Dec-91	1	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		43
20-Dec-91	1	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
20-Dec-91	1	CENTER	2	Platyhelminthes	Turbellaria				1
20-Dec-91	1	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	9
20-Dec-91	1	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		82
20-Dec-91	1	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		1
20-Dec-91	1	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		129
20-Dec-91	1	WEST	2	Platyhelminthes	Turbellaria				1
20-Dec-91	1	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		65
20-Dec-91	1	WEST	2	Arthropoda	Insecta	Trichoptera	Hydroptilidae		1
20-Dec-91	1	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
20-Dec-91	1	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		18
20-Dec-91	3	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		1
20-Dec-91	3	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
20-Dec-91	3	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		30
20-Dec-91	3	CENTER	1	Mollusca	Gastropoda				1
20-Dec-91	3	CENTER	1	Arthropoda	Chelicerata	Acarina			1
20-Dec-91	3	CENTER	1	Rhynchocoelea					1
20-Dec-91	3	CENTER	1	Mollusca	Gastropoda		Ancylidae		3
20-Dec-91	3	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	56
20-Dec-91	3	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		236
20-Dec-91	3	CENTER	2	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	1
20-Dec-91	3	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		208
20-Dec-91	3	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		17
20-Dec-91	3	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		1
20-Dec-91	3	CENTER	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		2
20-Dec-91	3	CENTER	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		1
20-Dec-91	3	CENTER	2	Mollusca	Gastropoda				1
20-Dec-91	3	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	32
20-Dec-91	3	EAST	1	Mollusca	Gastropoda				1
20-Dec-91	3	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		13
20-Dec-91	3	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	47
20-Dec-91	3	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		289
20-Dec-91	3	EAST	1	Arthropoda	Chelicerata	Acarina			1
20-Dec-91	3	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		118
20-Dec-91	3	EAST	1	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	3
20-Dec-91	3	EAST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
20-Dec-91	3	EAST	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		3
20-Dec-91	3	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
20-Dec-91	3	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		4
20-Dec-91	3	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		216
20-Dec-91	3	EAST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
20-Dec-91	3	EAST	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		1
20-Dec-91	3	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		65
20-Dec-91	3	EAST	2	Arthropoda	Chelicerata	Acarina			1
20-Dec-91	3	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	43
20-Dec-91	3	WEST	1	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Diptera	Ceratopogonidae		1
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		2
20-Dec-91	3	WEST	1	Mollusca	Gastropoda		Ancylidae		4
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Plecoptera	Taeniopterygidae		1
20-Dec-91	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	8
20-Dec-91	3	WEST	1	Arthropoda	Crustacea	Isopoda	Asellidae		1
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Trichoptera	Hydroptilidae		1
20-Dec-91	3	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		35
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera family C		1
20-Dec-91	3	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		2

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
20-Dec-91	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea			18
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Trichoptera	(indeterminate)		1
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		56
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera family A		1
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		1
20-Dec-91	3	WEST	1	Arthropoda	Insecta	Lepidoptera	Arctiidae	Estigmene sp.	2
20-Dec-91	3	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		13
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Collembola	Entomobryidae		1
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
20-Dec-91	3	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		72
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		210
20-Dec-91	3	WEST	2	Rhynchocolea					4
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		20
20-Dec-91	3	WEST	2	Mollusca	Gastropoda		Physidae		1
20-Dec-91	3	WEST	2	Mollusca	Gastropoda				1
20-Dec-91	3	WEST	2	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
20-Dec-91	3	WEST	2	Mollusca	Gastropoda		Planorbidae		5
20-Dec-91	3	WEST	2	Arthropoda	Crustacea	Amphipoda	Crangonyctidae		8
20-Dec-91	3	WEST	2	Arthropoda	Crustacea	Isopoda	Asellidae		2
20-Dec-91	3	WEST	2	Mollusca	Gastropoda		Ancylidae		6
20-Dec-91	3	WEST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		6
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Trichoptera	Hydroptilidae		1
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Trichoptera	(indeterminate)		3
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Plecoptera	(indeterminate)		1
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Plecoptera	Taeniopterygidae		5
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Trichoptera	Hydropsychidae		1
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		1
20-Dec-91	3	WEST	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		2
20-Dec-91	3	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
20-Dec-91	3	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	70
20-Dec-91	3	WEST	2	Arthropoda	Chelicerata	Acarina			9
20-Dec-91	4	CENTER	1	Mollusca	Gastropoda		Ancylidae		4
20-Dec-91	4	CENTER	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
20-Dec-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		100
20-Dec-91	4	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		2
20-Dec-91	4	CENTER	1	Rhynchocolea					1
20-Dec-91	4	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		101
20-Dec-91	4	CENTER	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
20-Dec-91	4	CENTER	1	Arthropoda	Insecta	Plecoptera	Taeniopterygidae		1
20-Dec-91	4	CENTER	1	Arthropoda	Crustacea	Isopoda	Asellidae		1
20-Dec-91	4	CENTER	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		2
20-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	60
20-Dec-91	4	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
20-Dec-91	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		26
20-Dec-91	4	WEST	1	Arthropoda	Insecta	Odonata	Gomphidae		1
20-Dec-91	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		189
20-Dec-91	4	WEST	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
20-Dec-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
20-Dec-91	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	19
20-Dec-91	4	WEST	1	Rhynchocolea					1
20-Dec-91	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		110
20-Dec-91	4	WEST	2	Arthropoda	Insecta	Trichoptera	Helicopsychidae		2
20-Dec-91	4	WEST	2	Arthropoda	Chelicerata	Acarina			3
20-Dec-91	4	WEST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
20-Dec-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
20-Dec-91	4	WEST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
20-Dec-91	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	7
20-Dec-91	4	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		4
20-Dec-91	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		19
20-Dec-91	4	WEST	2	Platyhelminthes	Turbellaria				1
20-Dec-91	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
20-Dec-91	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		153
20-Dec-91	5	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		29
20-Dec-91	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		9
20-Dec-91	5	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
20-Dec-91	5	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		46
20-Dec-91	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		64
20-Dec-91	5	CENTER	2	Mollusca	Gastropoda		Ancylidae		1
20-Dec-91	5	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
20-Dec-91	5	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae	Branchiura sowerbyi	1
20-Dec-91	5	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		55
20-Dec-91	5	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		68
20-Dec-91	5	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
20-Dec-91	5	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		1
20-Dec-91	5	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		110
20-Dec-91	5	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		80
20-Dec-91	5	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		3
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		68
20-Dec-91	5	WEST	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Trichoptera	Hydropsychidae		1
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
20-Dec-91	5	WEST	1	Arthropoda	Chelicerata	Acarina			2
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Diptera	Empididae		1
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Diptera	Diptera family A		1
20-Dec-91	5	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		103
20-Dec-91	5	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
20-Dec-91	5	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	24
20-Dec-91	5	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
20-Dec-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
20-Dec-91	5	WEST	2	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
20-Dec-91	5	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		102
20-Dec-91	5	WEST	2	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
20-Dec-91	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	33
20-Dec-91	5	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		5
20-Dec-91	5	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		118
20-Dec-91	6	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
20-Dec-91	6	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		307
20-Dec-91	6	CENTER	1	Arthropoda	Chelicerata	Acarina			2
20-Dec-91	6	CENTER	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
20-Dec-91	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		1
20-Dec-91	6	CENTER	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
20-Dec-91	6	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	31
20-Dec-91	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		93
20-Dec-91	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
20-Dec-91	6	CENTER	2	Arthropoda	Insecta	Trichoptera	Hydroptilidae		1
20-Dec-91	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	19
20-Dec-91	6	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
20-Dec-91	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		49
20-Dec-91	6	CENTER	2	Arthropoda	Insecta	Odonata			1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
20-Dec-91	6	CENTER	2	Arthropoda	Chelicerata	Acarina			1
20-Dec-91	6	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		123
20-Dec-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
20-Dec-91	6	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
20-Dec-91	6	WEST	1	Annelida	Hirudinea	Rhynchobdellida	Glossiphonidae		1
20-Dec-91	6	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		133
20-Dec-91	6	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		1
20-Dec-91	6	WEST	1	Arthropoda	Chelicerata	Acarina			5
20-Dec-91	6	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		114
20-Dec-91	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	32
20-Dec-91	6	WEST	2	Mollusca	Bivalvia	Unionacea	Unionidae		1
20-Dec-91	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	23
20-Dec-91	6	WEST	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		2
20-Dec-91	6	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
20-Dec-91	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
20-Dec-91	6	WEST	2	Arthropoda	Chelicerata	Acarina			1
20-Dec-91	6	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		48
20-Dec-91	6	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		74
20-Dec-91	6	WEST	2	Mollusca	Gastropoda		Hydrobiidae		1
10-Jan-92	1	CENTER	1	Arthropoda	Insecta	Coleoptera	Elmidae		2
10-Jan-92	1	CENTER	1	Platyhelminthes	Turbellaria	Tricladida	Planariidae	Dugesia sp.	1
10-Jan-92	1	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		3
10-Jan-92	1	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		45
10-Jan-92	1	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		54
10-Jan-92	1	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	58
10-Jan-92	1	CENTER	2	Arthropoda	Insecta	Ephemeroptera			2
10-Jan-92	1	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		17
10-Jan-92	1	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		6
10-Jan-92	1	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		49
10-Jan-92	1	CENTER	2	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
10-Jan-92	1	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	28
10-Jan-92	1	CENTER	2	Arthropoda	Insecta	Diptera	Diptera family D		1
10-Jan-92	1	CENTER	2	Mollusca	Gastropoda		Ancylidae		1
10-Jan-92	1	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	6
10-Jan-92	1	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Jan-92	1	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		75
10-Jan-92	1	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		20
10-Jan-92	1	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		38
10-Jan-92	1	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		54
10-Jan-92	1	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Jan-92	1	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	17
10-Jan-92	1	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Jan-92	1	WEST	2	Arthropoda	Insecta	Diptera	Chaoboridae		1
10-Jan-92	2	EAST	1	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	1
10-Jan-92	2	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		3
10-Jan-92	2	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		179
10-Jan-92	2	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	18
10-Jan-92	2	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		29
10-Jan-92	2	EAST	2	Rhynchocoela					1
10-Jan-92	2	EAST	2	Arthropoda	Insecta	Odonata	Gomphidae		1
10-Jan-92	2	EAST	2	Mollusca	Gastropoda				4
10-Jan-92	2	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
10-Jan-92	2	EAST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		55
10-Jan-92	2	EAST	2	Arthropoda	Crustacea	Isopoda	Asellidae		2
10-Jan-92	2	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		100

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Jan-92	2	EAST	2	Platyhelminthes	Turbellaria				1
10-Jan-92	2	EAST	2	Mollusca	Gastropoda		Ancylidae		18
10-Jan-92	2	EAST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
10-Jan-92	2	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		8
10-Jan-92	2	EAST	2	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
10-Jan-92	2	EAST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	131
10-Jan-92	2	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		273
10-Jan-92	2	EAST	2	Arthropoda	Crustacea	Amphipoda	Crangonyctidae		1
10-Jan-92	2	EAST	2	Arthropoda	Insecta	Ephemeroptera	Caenidae		6
10-Jan-92	2	EAST	2	Arthropoda	Insecta	Coleoptera	Elmidae		10
10-Jan-92	3	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		3
10-Jan-92	3	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		3
10-Jan-92	3	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		54
10-Jan-92	3	EAST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Jan-92	3	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		75
10-Jan-92	3	EAST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	11
10-Jan-92	3	EAST	1	Platyhelminthes	Turbellaria				1
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera family B		1
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Diptera	Ceratopogonidae		2
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Lepidoptera	Pyralidae	Petrophila sp.	1
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		2
10-Jan-92	3	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		2
10-Jan-92	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea			9
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera family A		1
10-Jan-92	3	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	1
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Diptera	Diptera family D		4
10-Jan-92	3	WEST	1	Mollusca	Gastropoda				2
10-Jan-92	3	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		22
10-Jan-92	3	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		35
10-Jan-92	3	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		28
10-Jan-92	3	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		3
10-Jan-92	3	WEST	2	Mollusca	Bivalvia	Sphaeriacea			13
10-Jan-92	3	WEST	2	Platyhelminthes	Turbellaria				1
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Odonata	(indeterminate)		1
10-Jan-92	3	WEST	2	Mollusca	Gastropoda		Pleuroceridae		1
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		2
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
10-Jan-92	3	WEST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		4
10-Jan-92	3	WEST	2	Arthropoda	Crustacea	Amphipoda	Crangonyctidae		4
10-Jan-92	3	WEST	2	Mollusca	Gastropoda				2
10-Jan-92	3	WEST	2	Mollusca	Gastropoda		Ancylidae		10
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Ephemeroptera	Caenidae		1
10-Jan-92	3	WEST	2	Rhynchocolea					1
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		2
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae	13	13
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		75
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Plecoptera	(indeterminate)		1
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Trichoptera	Hydropsychidae		1
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		2
10-Jan-92	3	WEST	2	Arthropoda	Insecta	Sphaeriacea			1
10-Jan-92	3	WEST	2	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	3
10-Jan-92	3	WEST	2	Arthropoda	Chelicerata	Acarina			3
10-Jan-92	3	WEST	2	Arthropoda	Crustacea	Isopoda	Asellidae		3
10-Jan-92	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		11

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
10-Jan-92	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea			2
10-Jan-92	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		4
10-Jan-92	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
10-Jan-92	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		24
10-Jan-92	4	WEST	1	Mollusca	Gastropoda				1
10-Jan-92	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	3
10-Jan-92	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		29
10-Jan-92	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		112
10-Jan-92	4	WEST	2	Arthropoda	Insecta	Trichoptera	(indeterminate)		2
10-Jan-92	4	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
10-Jan-92	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		4
10-Jan-92	4	WEST	2	Arthropoda	Insecta	Diptera	Diptera family A		1
10-Jan-92	4	WEST	2	Arthropoda	Insecta	Collembola	Entomobryidae		3
10-Jan-92	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea			1
10-Jan-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		1
10-Jan-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae	Branchiura sowerbyi	1
10-Jan-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		150
10-Jan-92	6	CENTER	1	Arthropoda	Insecta	Diptera	Chaoboridae		1
10-Jan-92	6	CENTER	1	Arthropoda	Chelicerata	Acarina			1
10-Jan-92	6	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		107
10-Jan-92	6	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	29
10-Jan-92	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
10-Jan-92	6	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		40
10-Jan-92	6	CENTER	2	Arthropoda	Chelicerata	Acarina			1
10-Jan-92	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		1
10-Jan-92	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		74
10-Jan-92	6	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		137
10-Jan-92	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
10-Jan-92	6	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		153
10-Jan-92	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
10-Jan-92	6	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		112
10-Jan-92	6	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		2
10-Jan-92	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
10-Jan-92	6	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		132
10-Jan-92	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	9
24-Feb-92	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		30
24-Feb-92	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		1
24-Feb-92	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		14
24-Feb-92	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	6
24-Feb-92	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
24-Feb-92	4	WEST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
24-Feb-92	4	WEST	2	Rhynchocolea					1
24-Feb-92	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		41
24-Feb-92	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		64
24-Feb-92	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		2
24-Feb-92	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		70
24-Feb-92	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		2
24-Feb-92	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea			5
24-Feb-92	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
24-Feb-92	5	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		95
24-Feb-92	5	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
24-Feb-92	5	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		4
24-Feb-92	5	CENTER	2	Mollusca	Bivalvia	Sphaeriacea			6

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
24-Feb-92	5	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		48
24-Feb-92	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		65
24-Feb-92	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		2
24-Feb-92	5	CENTER	2	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	25
24-Feb-92	5	CENTER	2	Arthropoda	Insecta	Ephemeroptera			1
24-Feb-92	5	EAST	1	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
24-Feb-92	5	EAST	1	Molluaca	Bivalvia	Sphaeriacea	Sphaeriidae		5
24-Feb-92	5	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		156
24-Feb-92	5	EAST	1	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	19
24-Feb-92	5	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		2
24-Feb-92	5	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		126
24-Feb-92	5	EAST	1	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	1
24-Feb-92	5	EAST	1	Arthropoda	Insecta	Coleoptera	Elmidae		2
24-Feb-92	5	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		2
24-Feb-92	5	WEST	1	Arthropoda	Insecta	Coleoptera	Elmidae		1
24-Feb-92	5	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		160
24-Feb-92	5	WEST	1	Molluaca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	5	WEST	1	Rhynchocolea					1
24-Feb-92	5	WEST	1	Arthropoda	Insecta	Diptera	Ceratopogonidae		1
24-Feb-92	5	WEST	1	Arthropoda	Insecta	Diptera	Chaoboridae		1
24-Feb-92	5	WEST	1	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	15
24-Feb-92	5	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		75
24-Feb-92	5	WEST	1	Arthropoda	Insecta	Ephemeroptera			1
24-Feb-92	5	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		107
24-Feb-92	5	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		1
24-Feb-92	5	WEST	2	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	7
24-Feb-92	5	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		42
24-Feb-92	6	CENTER	1	Molluaca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	6	CENTER	1	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	5
24-Feb-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		53
24-Feb-92	6	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		79
24-Feb-92	6	CENTER	1	Arthropoda	Insecta	Odonata	Gomphidae		1
24-Feb-92	6	CENTER	1	Molluaca	Gastropoda				1
24-Feb-92	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		2
24-Feb-92	6	CENTER	2	Molluaca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	6	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		63
24-Feb-92	6	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
24-Feb-92	6	CENTER	2	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
24-Feb-92	6	CENTER	2	Arthropoda	Insecta	Lepidoptera	Arctiidae	Estigmene sp.	1
24-Feb-92	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		102
24-Feb-92	6	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae	91	91
24-Feb-92	6	EAST	1	Molluaca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	6	EAST	1	Annelida	Oligochaeta	Tubificida	Naididae		1
24-Feb-92	6	EAST	1	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	12
24-Feb-92	6	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		70
24-Feb-92	6	EAST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		326
24-Feb-92	6	EAST	2	Arthropoda	Insecta	Trichoptera	Leptoceridae		1
24-Feb-92	6	EAST	2	Annelida	Oligochaeta	Tubificida	Naididae		2
24-Feb-92	6	EAST	2	Arthropoda	Insecta	Diptera	Chironomidae		174
24-Feb-92	6	EAST	2	Arthropoda	Insecta	Lepidoptera	Arctiidae	Estigmene sp.	1
24-Feb-92	6	EAST	2	Arthropoda	Insecta	Coleoptera	Elmidae		1
24-Feb-92	6	EAST	2	Molluaca	Bivalvia	Sphaeriacea	Sphaeriidae		2
24-Feb-92	6	EAST	2	Molluaca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	10
24-Feb-92	6	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		144
24-Feb-92	6	WEST	1	Arthropoda	Chelicerata	Acarina			1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
24-Feb-92	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	39
24-Feb-92	6	WEST	1	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
24-Feb-92	6	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		1
24-Feb-92	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
24-Feb-92	6	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		48
24-Feb-92	6	WEST	2	Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae		1
24-Feb-92	6	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		24
24-Feb-92	6	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		25
24-Feb-92	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	14
24-Feb-92	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		1
03-Mar-92	4	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	11
03-Mar-92	4	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		37
03-Mar-92	4	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		28
03-Mar-92	4	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		1
03-Mar-92	4	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	31
03-Mar-92	4	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		67
03-Mar-92	4	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		7
03-Mar-92	4	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		74
03-Mar-92	4	WEST	2	Annelida	Polychaeta		Sabellidae	Manayunkia aestuarina	1
03-Mar-92	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		22
03-Mar-92	5	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		1
03-Mar-92	5	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	29
03-Mar-92	5	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		24
03-Mar-92	5	CENTER	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
03-Mar-92	5	CENTER	1	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
03-Mar-92	5	CENTER	2	Mollusca	Gastropoda				1
03-Mar-92	5	CENTER	2	Platyhelminthes	Turbellaria				2
03-Mar-92	5	CENTER	2	Mollusca	Bivalvia	Unionacea	Unionidae		2
03-Mar-92	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Naididae		1
03-Mar-92	5	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		182
03-Mar-92	5	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		74
03-Mar-92	5	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	22
03-Mar-92	5	EAST	1	Arthropoda	Insecta	Diptera	Chironomidae		18
03-Mar-92	5	EAST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		7
03-Mar-92	5	EAST	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
03-Mar-92	5	WEST	1	Arthropoda	Crustacea	Amphipoda	Crangonyctidae		1
03-Mar-92	5	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		8
03-Mar-92	5	WEST	1	Platyhelminthes	Turbellaria				6
03-Mar-92	5	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		18
03-Mar-92	5	WEST	1	Mollusca	Bivalvia	Unionacea	Unionidae		1
03-Mar-92	5	WEST	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		4
03-Mar-92	5	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	202
03-Mar-92	5	WEST	1	Mollusca	Gastropoda		Ancylidae		54
03-Mar-92	5	WEST	1	Arthropoda	Insecta	Diptera	Diptera (non-Chironomidae)		2
03-Mar-92	5	WEST	1	Mollusca	Gastropoda		Hydrobiidae		3
03-Mar-92	5	WEST	1	Rhynchocolea					6
03-Mar-92	5	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		165
03-Mar-92	5	WEST	1	Annelida	Oligochaeta	Tubificida	Naididae		7
03-Mar-92	5	WEST	1	Mollusca	Gastropoda		Planorbidae		16
03-Mar-92	5	WEST	1	Mollusca	Gastropoda		Physidae		12
03-Mar-92	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	72
03-Mar-92	5	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		35
03-Mar-92	5	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		1
03-Mar-92	5	WEST	2	Arthropoda	Insecta	Trichoptera	Polycentropodidae		1
03-Mar-92	5	WEST	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		1

DATE	STATION	LOCATION	REPL. #	PHYLUM	CLASS	ORDER	FAMILY	GENUS/SPECIES	QUAN.
03-Mar-92	5	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		4
03-Mar-92	5	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		226
03-Mar-92	5	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Sphaeriidae		6
03-Mar-92	5	WEST	2	Arthropoda	Crustacea	Isopoda	Asellidae		1
03-Mar-92	5	WEST	2	Platyhelminthes	Turbellaria				8
03-Mar-92	5	WEST	2	Annelida	Polychaeta		Sabellidae		2
03-Mar-92	5	WEST	2	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
03-Mar-92	5	WEST	2	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		2
03-Mar-92	5	WEST	2	Mollusca	Gastropoda		Ancylidae		14
03-Mar-92	5	WEST	2	Mollusca	Gastropoda		Planorbidae		3
03-Mar-92	6	CENTER	1	Platyhelminthes	Turbellaria				3
03-Mar-92	6	CENTER	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	18
03-Mar-92	6	CENTER	1	Arthropoda	Insecta	Diptera	Chironomidae		97
03-Mar-92	6	CENTER	1	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		2
03-Mar-92	6	CENTER	1	Rhynchocolea					2
03-Mar-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Naididae		8
03-Mar-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae	Branchiura sowerbyi	1
03-Mar-92	6	CENTER	1	Annelida	Oligochaeta	Tubificida	Tubificidae		155
03-Mar-92	6	CENTER	1	Arthropoda	Crustacea	Amphipoda	Gammaridae		1
03-Mar-92	6	CENTER	1	Mollusca	Gastropoda		Ancylidae		1
03-Mar-92	6	CENTER	2	Arthropoda	Insecta	Diptera	Chironomidae		100
03-Mar-92	6	CENTER	2	Annelida	Oligochaeta	Tubificida	Tubificidae		218
03-Mar-92	6	CENTER	2	Platyhelminthes	Turbellaria				1
03-Mar-92	6	CENTER	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
03-Mar-92	6	CENTER	2	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		1
03-Mar-92	6	CENTER	2	Arthropoda	Insecta	Coleoptera	Elmidae		2
03-Mar-92	6	CENTER	2	Arthropoda	Insecta	Diptera	Ceratopogonidae		1
03-Mar-92	6	WEST	1	Annelida	Oligochaeta	Tubificida	Tubificidae		67
03-Mar-92	6	WEST	1	Arthropoda	Insecta	Diptera	Chironomidae		117
03-Mar-92	6	WEST	1	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	7
03-Mar-92	6	WEST	2	Mollusca	Bivalvia	Sphaeriacea	Corbiculidae	Corbicula fluminea	2
03-Mar-92	6	WEST	2	Arthropoda	Insecta	Ephemeroptera	(indeterminate)		1
03-Mar-92	6	WEST	2	Annelida	Oligochaeta	Tubificida	Tubificidae		119
03-Mar-92	6	WEST	2	Annelida	Oligochaeta	Tubificida	Naididae		9
03-Mar-92	6	WEST	2	Arthropoda	Insecta	Diptera	Entomobryidae		1
03-Mar-92	6	WEST	2	Arthropoda	Insecta	Diptera	Chironomidae		175

APPENDIX C: CHRONIC IMPAIRMENT TESTING OF FATHEAD MINNOW (PIMEPHALES PROMELAS) TO DALECARLIA AND GEORGETOWN WATER TREATMENT PLANT EFFLUENTS, WASHINGTON, DC

Chronic Impairment Testing of Fathead Minnow (*Pimephales promelas*) to Dalecarlia and Georgetown Water Treatment Plant Effluents, Washington, D. C.

Donald S. Cherry, Ph.D., Annick Mikailoff and John R. Lauth, Ph.D.

Department of Biology and

University Center for Environmental and Hazardous Materials Studies

Virginia Polytechnic Institute and State University

Blacksburg, VA 24061

June 5, 1992

Table of Contents

Executive Summary

Fathead minnow

- Fathead minnow larvae were exposed to effluent from three basins of Dalecarlia and Georgetown water treatment plants and sludge from all four in 7-day survival/chronic weight impairment tests.
- Effluent from the three water treatment basins had no negative effect upon fish survival and growth.
- Fish could not survive in 100% sludge from the 4 basins tested, hence weight data could not exist.
- The dissolved oxygen (DO) sag at the end of each daily renewal adversely influenced fish survival in the tests where DO sagged to levels ≤2.5 mg/L.
- Fish weight was variable in concentrations from 3 through 30% sludge depending upon the basin sampled and DO sag measured during the tests.

1.0 Introduction

1.1 Toxicity Testing Requirements

Biomonitoring of the Dalecarlia and Georgetown water treatment plant effluents were required under special conditions as set forth by the United States Environmental Protection Agency's (US EPA) National Pollutant Discharge Elimination System (NPDES). When the water treatment basins become full, a scheduled release is coordinated with a higher flow condition in the Potomac River. A special study was developed whereby the effluent from four basins would be periodically collected during the effluent release effort and tested for potential survival/impairment effects to fish. The species tested was fathead minnow (*Pimephales promelas*) using the US EPA (1989) guidelines in a static renewal, 7-day chronic bioassay. Other studies were carried out in the river (benthic macroinvertebrate communities) by personnel of Dynamac Corporation, Rockville, Maryland.

Testing was initiated in this laboratory on December 10-17, 1991 and concluded on March 2-9, 1992. Procedures for these tests have been outlined in US EPA (1985) as Test Method 1000.0 (7-day survival and growth of fathead minnow). Since then, the US EPA has published a newer version in 1989. Specific details of test methodologies are detailed later in this report.

We used three effluent concentrations 1, 10 and 100% plus a control of Potomac River water as diluent. We also expanded the testing to include the sludge in the basins since it was released after the effluent. It had a thick, dark consistency, sometimes granular in nature but usually comprised of fine, mud-like particulates. Special testing protocol was developed to address fish interaction in the sludge.

The 7Q10 was given as 388 million gallons/day (MGD). The total time and volume of effluent sludge release varied from 6-10 hrs (14-110 million gallons) and on a daily basin comprised 3.5-45.9 MGD. Effluent samples consisted of composite samples during the time of release, packed on ice in coolers and shipped overnight to the laboratory.

1.2 Plant Location

The plants are located adjacent to the Potomac River in or near the Georgetown area of Washington, D.C.

1.3 Receiving Water Body

The plants discharge into the Potomac River.

1.4 Testing Laboratory

Fathead Minnow:

Dr. Donald S. Cherry
Department of Biology and University Center for
Environmental and Hazardous Materials Studies
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061
(703) 231-6766

2.0 Plant Operations

2.1 *Products*

Municipal water treatment effluent.

2.2 *Raw Materials*

Not applicable.

2.3 *Operating Schedule*

Intermittently during the year when the basins are full.

2.4 *Description of Water Treatment Systems*

Not available.

2.5 *Retention Time*

Not applicable.

2.6 *Volume of Effluent Flow*

Georgetown basin #1 - 20 million gal/6 hr release time = 80 million gal/day
(if the release occurred for 24 hr)
Georgetown basin #2 - 110 million gal/18 hr release time = 137.5 million gal
(per 24 hr of continual release)
Dalecarlia basin #3 - 14 million gal/6 hr release time = 56 million gal/day
(per 24 hr of continual release)
Dalecarlia basin #4 - 14 million gal/6 hr release time = 56 million gal/day
(per 24 hr of continual release)

3.0 Source of Effluent and Dilution Water

3.1 Effluent Samples

1. Sampling point at skimmer wall of each basin
2. Collection Dates and Times (APPENDIX I)

   12-5-92 Basin 4 effluent and sludge
   1-6-92 Basin 3 effluent and sludge
   2-20-92 Georgetown 1 sludge
   2-26-92 Georgetown 2 (effluent and sludge)

3. Sample Collection Method

   Composite sampler

3.2 Surface Water Samples

1. Sampling Point above Dalecarlia Plant
2. Collection Date and Time

   October 8, 1991 at 3:00 P.M.

3. Sample Collection Method

   Single grab sample by pail and rope.

4. Streamflow at 7Q10

   Not applicable.

5. For chronic testing, river water was used.

4.0 Test Methods

4.1 Fathead Minnow (Pimephales promelas) Culturing

4.1.1 Age

12-24 hr old at test initiation.

4.1.2 Life Stage

Larval, prior to complete yolk-sac absorption.

4.1.3 Mean Weight

0.07-0.09 mg/fish; n=20.

4.1.4 Source

In-house cultures originally from Kurtz's Fish Hatchery, Elverson, Pennsylvania (June 1985). New stock was brought in from the Virginia Tech Fisheries Department on 12-17-91 and completely integrated into the system on 1-9-92.

4.1.5 Diseases and Treatment

Disease free stock and test animals.

4.2 Fathead Minnow Survival and Growth for Effluent Testing

4.2.1 Test Method Used

US EPA Method 1000.0, Fathead Minnow Survival and Growth Test.

4.2.2 End Points of Test

Seven-day survival and growth of the test organisms and measured as mg/surviving fish (APPENDIX II).

4.2.3 Further Description of Testing Protocol

At several points, the US EPA test (1989) method offers a choice among various options. The options chosen for the tests are set forth below. In addition, Virginia Tech employs certain standard improvements to the US EPA protocol which were used here. These are set forth below.

6.1 Fathead minnow larvae are cultured from in-house stock at Virginia Tech. The condition of eggs and newly hatched larvae are optimally controlled only from in-house stock cultures. Newly hatched larvae can be shipped in well oxygenated water in insulated containers; however, potential stress from temperature and oxygen shifts during transportation can occur. Also, knowledge of pathogenic stress from fungi and other diseases may not be available from hatchery stock. Hence, the most vigorous stock of test fish are those kept completely in-house.

6.8 The test vessels used were 500 mL (solution depth of 3.6 cm, surface diameter of 9.6 cm) instead of 1.0 L to enhance feeding efficiencies by fish larvae on brine shrimp without unnecessary overcrowding.

7.11 The US EPA protocol recommends the use of larvae that are less than 24 hr old. A toxicological concern is that no specific procedure is allotted for the removal of approximately 0-11 hr old larvae versus those that are 12-24 hr old. Having an in-house stock collected where thousands of eggs are available daily, allows selection of more vigorous larvae that are closer to 12-24 hr old and not 0-11 hr old. Therefore, the bias of natural post-hatch mortality during the first several hours of life is reduced.

11.7.1 Test solutions were 250 mL instead of 500 mL. The smaller volume allows greater contact time for fish larvae with their food source. The US EPA (1989) protocol allows for using test beakers from 220 to 1,000 mL.

4.2.4 Date and Time Test Began

Dalecarlia Basin #4 - December 10, 1991 (effluent) and December 16, 1991 (sludge)

Dalecarlia Basin #3 - January 18, 1991 (effluent and sludge)

Georgetown Basin #2 - March 2, 1992 (effluent and sludge)

Georgetown Basin #1 - March 10, 1992 (sludge only)

* Pump malfunctioned preventing effluent from being collected.

4.2.5 Date and Time Test Ended

Dalecarlia Basin #4 - December 17, 1991 (effluent) and December 23, 1991 (sludge)

Dalecarlia Basin #2 - January 25, 1991 (effluent and sludge)

Georgetown Basin #2 - March 9, 1992 (effluent and sludge)

Georgetown Basin #1 - March 17, 1992 (sludge only)

4.2.6 Type of Test Chambers

500 mL Pyrex.

4.2.7 Volume of Test Solution per Chamber

250 mL.

4.2.8 Number of Test Organisms per Chamber

Ten.

4.2.9 Number of Replicate Test Chambers per Treatment

Four.

4.2.10 Test Temperature

25 ± 1 C.

4.3 Fathead Minnow Survival and Growth for Sludge Testing

4.3.1 Test Method

Not officially defined.

4.3.2 End Points of Test

Seven-day survival and growth of the test organisms and measured as mg/surviving fish (APPENDIX III).

4.3.3 Details of Test

Sludge handling presents many difficulties which have been addressed in the course of this series of chronic tests. Although no official EPA standard procedure for handling sludge is available, a method has been developed in this laboratory which may prove to be applicable to sludges of different composition and thickness. The basic concept was the same as for fathead minnow effluent testing except for adjustments in handling sludge dilution, monitoring DO sags, and daily renewals of sludge/diluent concentrations. Initially, Basin #4 sludge was fairly smooth and of a relatively lesser particulate content than subsequent sludge samples. Basin #4 sludge was handled as any other type of effluent and mixed with Potomac River water as a diluent at the following concentrations: 1, 3, 10 and 30%. However, it became clear that maintaining a proper DO level in the solutions was crucial, especially in view of sudden and extreme DO sags at the 30% concentration.

In the following chronic test using Basin 3 sludge, the test solutions were constantly aerated with a gentle stream of air. It became apparent that fish were stressed when they were transferred from a higher DO level to solutions which had not been aerated for as long a period of time and had a lower dissolved oxygen content. It also appeared that aerating constantly would deprive the test solutions of any toxic volatile component and thereby be very unrepresentative of real life conditions.

A better method was thus developed and used for the two remaining tests. The test solutions were aerated prior to renewal until they reached a fairly stable DO level and did not exhibit any tendency toward DO sag any longer. The length of this aeration period may be determined for each sludge sample in particular. A 2 to 3-hr aeration time proves to be quite sufficient to maintain an adequate DO level over a 24-hr test period.

Another problem encountered in this type of testing had to do with the transfer of the organisms at renewal time. Quite early on a method was developed and applied to all four tests. At renewal time, the solid portion of the test solutions which had settled at the bottom was siphoned out with a siphon of appropriate diameter for each test solution. The siphon had to be wide enough to allow removal of particulate matter but not so wide that the fish were siphoned out too. This was relatively easy for the 1, 3 and 10% concentrations. Siphoning the solid matter allowed a stress-free renewal and also accurate counting of the fish.

The highest concentration tested (30%) was handled differently, since the amount of particulate matter was too high and the siphon opening was too small to allow for convenient drainage. The reverse process was used: first, the liquid portion was drained, then the remaining liquid portion with the fish in it was drained and transferred to a small beaker. The fish were then counted and fresh solutions were placed in the test containers to which the fish were then returned. This gentle handling of the fish accounts for the greater survival rate as the tests proceeded.

4.3.4 Summary Steps of Sludge Test

The entire procedure for sludge tests is summarized below.

1. Sludge test solutions were prepared at the concentrations being tested.
2. Tests solutions were aerated for a maximum period of 3 hours and a minimum of one 1/2 hour as needed.
3. Water chemistry was then performed on the test solutions and DO was closely monitored at intervals on the first day to determine that no DO sag occurs.
4. If DO could not be maintained at a satisfactory level (≥4.4 mg/L), constant aeration would be introduced.
5. Daily renewal was done using an appropriate size siphon for solutions containing lesser amounts of particulate matter.
6. When large amounts of particulate matter were present, the fish themselves were transferred to new solutions.

7. Post-renewal water chemistry was done on combined samples including liquid and solid portions. However, DO was monitored using the liquid portion where the fish were located.

5.0 Statistical Analysis

Survival-impairment was analyzed statistically using the Kruskal-Wallis Test, a non-parametric one-way analysis of variance rank analogue (Hollander and Wolfe, 1973). Significantly different means for chronic survival and impairment growth were determined by a rank-sign least significant differences procedure ($\alpha = 0.05$). Other statistical tests used included the Dunnett's Procedure and Steel's Many-One Rank Test for fathead minnow impairment analysis (US EPA 1989 and Rogers 1986).

6.0 Quality Assurance

6.1 Fathead Minnow

6.1.1 Standard Toxicant

Cadmium atomic absorption spectrophotometry standard, Fisher Scientific SO-C-118

Lot No. 870113-24.

6.1.2 Date and Time of Test

December 17-19, 1991 at 11:00 A.M.
January 20-22, 1992 at 1:30 P.M.
March 20-22, 1992 at 3:30 P.M.

6.1.3 Dilution Water Used

US EPA reconstituted water.

6.1.4 Reference Toxicant Results

In US EPA reconstituted water, the 24 and 48-hr LC_{60}s for Cd to fathead minnow larvae were 218.0 and 61.6 µg/L (Table 3A), 54.4 and 22.1 µg/L (Table 3B), and 122.4 and 60.6 µg/L (Table 3C). The organisms were fit and testable relative to the historical data base in the laboratory (APPENDIX III).

6.1.5 Physical and Chemical Methods Used

Fathead minnow testing included standard physical and chemical analyses of test waters by the following methods (method citation by US EPA [1983] follows in parentheses): temperature (thermometric Method 170.1), conductivity (specific conductance Method 120.1, YSI Model 33), total hardness (EDTA titrimetric Method 120.2), total alkalinity (titrimetric Method 310.1), dissolved oxygen (membrane electrode Method 360.1, YSI Model 57), and pH (electrometric Method 150.1, Fisher Accumet Model 805).

7.0 Results

7.1 Fathead Minnow Effluent Testing

Fathead minnow larvae exposed to Dalecarlia Basin #4 effluent for seven days had no significantly different mortality at any effluent concentration compared to the controls, that is, no fish died in the test (Table 1).

Final mean weight of fish in the control treatment was 0.677 mg/fish and at all effluent concentrations, fish weights were higher (Table 1). Mean weight was highest at 100% effluent concentration. Summarily, the NOEC (no observed effects concentration) for survival and growth was 100% effluent.

With respect to water chemistry from Dalecarlia Basin #4 effluent, temperature was constant at 25°C. In general, hardness, alkalinity, pH and conductivity were consistently the same between effluent concentrations (Table 2). Dissolved oxygen, however, did decrease to levels of 3.4-4.9 mg/L after each 24-hr renewal. Water chemistry of sludge data in Table 3 will be presented in the next section.

Survival of fathead minnows exposed to Dalecarlia Basin 3 effluent was 100% at all effluent concentrations (Table 4). Growth was not significantly different from the control at any concentration including 100%. Fish growth was highest in laboratory culture water (0.525 mg) and lower in Potomac River diluent (0.446 mg) although differences were not significant.

Water chemistry was consistently the same between different effluent dilution for all parameters except dissolved oxygen (Table 5). The sag in dissolved oxygen before each daily renewal was less than in basins 4 effluent. Dissolved oxygen sags dropped to 5.7-4.2 mg/L after the initial setup of 7.4-8.8 mg/L. Water chemistry of sludge data in Table 6 will be presented in the next section.

Fathead minnow survival to Georgetown Basin 2 effluent was consistently high at every test concentration (97.5-100%), and no fish died in the control or 100% effluent (Table 7). Fish weight were similar between effluent concentrations and the greatest weight gain occurred in 100% effluent.

Water chemistry was consistently the same for all parameters at each effluent concentration except DO (Table 8). The DO levels sagged to 5.0-6.0 mg/L prior to each 24-hr renewal after starting at 7.4-9.2 mg/L.

No data are available for testing Georgetown Basin 1 effluent. The pump failed to work preventing composite sampling of the effluent (Personal Communication, Dynamac Corp).

7.2 *Fathead Minnow Sludge Testing*

Screen test data from effluent and sludge from Dalecarlia Basin 4 indicated that fish would survive in the effluent in 48-hr exposures but not in the sludge (APPENDIX I, Table 1). Survival in sludge was dose-dependent in that all larvae survived in 1 and 3% sludge, but survival declined to 65, 50 and 0% in 10, 30 and 100% sludge.

Fathead minnow survival in sludge from Dalecarlia Basin 4 was significantly reduced in 30 and 100% sludge (Table 1). Fish weight was also impaired significantly in 30 and 100% sludge concentrations. It appeared that weight gain was significantly reduced at 3% but not 10% sludge. Hardness, alkalinity and conductivity increased between control water river and 30% sludge (Table 3). Dissolved oxygen concentration dropped very low before each daily renewal. DO levels dropped to 2.7-3.3 mg/L in 1 to 10% sludge while in 30%, DO declined to 0.07 mg/L. These daily sags in DO significantly influenced both fish mortality and growth impairment.

Fish survival in sludge from Dalecarlia Basin 3 was significantly reduced (0% survival) in 30 and 100% sludge concentration (Table 4). Growth was not significantly reduced in 1, 3 and 10% sludge exposures.

Water chemistry from the Basin 3 sludge of Dalécarlia was difficult to access for hardness and alkalinity as measurements in 30% sludge were marred with interference (Table 6). Since the test was aerated, dissolved oxygen measurements were much higher before each daily renewal in this test than in sludge from Basin 4. However, when DO sagged to 0.04 mg/L in 30% sludge, fish mortality was 100%.

Fish survival in sludge taken from Basin 2 of the Georgetown plant was not adversely affected through 30%, except all fish in 100% sludge died (Table 7). Fish weight was significantly impaired in 10 and 30% sludge relative to the controls. Fish weight gain was basically the same between laboratory culture and Potomac River water. The weight impairment suggested in 1% sludge is not considered to be ecologically significant when fish weight in 3% sludge was higher and not significantly different from the control.

Water chemistry from Basin 2 sludge of the Georgetown Plant was not measurably different for conductivity and pH (Table 9). Dissolved oxygen concentration before each daily renewal were much higher (6.0-4.8 mg/L) between control to 30% concentration of sludge compared to the two previous tests with Dalecarlia sludge. Likewise, fish mortality did not occur in the test other than at 100% sludge.

Fish survival in sludge sampled from Georgetown Basin 1 was not affected at any sludge concentration through 30% (Table 10). Fish weight was not impaired through 30% concentration of sludge. Fish mortality and, hence, weight were negatively affected in 100% sludge.

Water chemistry was generally consistent for conductivity and pH between low and higher sludge concentrations from Georgetown Basin 1 (Table 11). Dissolved oxygen concentrations were more consistent between the beginning and end of each day. The DO ranged between 7.7-6.0 mg/L at the start to 5.2-5.6 mg/L just prior to renewal. The lack of fish mortality from 0-30% sludge concentrations coincided with the minimization in daily DO sag.

8.0 Data Tables

Table 1. Survival and growth of fathead minnow (*Pimephales promelas*) larvae exposed to effluent and sludge collected from the Dalecarlia Treatment Plant Basin #4 on 12/5/91. Dilution water was Potomac River water collected upstream from the plant. Sample size was 4 replicates of 10 fish each. Treatments significantly different from the control are indicated by an asterisk (*) ($\alpha = 0.05$).

Effluent Conc (%)	Survival (%)	Growth (mg/)	(Stan. Dev.)	Range
0	100	0.677	(±0.105)	0.542-0.774
1	100	0.798	(±0.060)	0.735-0.848
10	100	0.762	(±0.086)	0.669-0.838
100	100	0.821	(±0.047)	0.757-0.859
Sludge Conc (%)				
0	95	0.679	(±0.081)	0.574-0.762
1	80	0.634	(±0.073)	0.572-0.734
3	85	0.551*	(±0.071)	0.463-0.636
10	85	0.625	(±0.016)	0.606-0.646
30	42.5*	0.573*	(±0.033)	0.542-0.606
100	0*	—	—	

Table 2. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Dalecarlia Treatment Plant Basin #4 effluent from December 10 to 17, 1991. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Effluent Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0	3-6	25.0 (25.0)	6.6 (4.9-8.4)	7.40 (7.12-7.66)	140	104	372 (371-376)
1	3-6	25.0 (25.0)	6.5 (3.4-8.6)	7.42 (7.13-7.70)	--	--	379 (368-400)
10	3-6	25.0 (25.0)	6.8 (4.4-8.7)	7.39 (7.19-7.68)	--	--	384 (372-406)
100	3-6	25.0 (25.0)	7.8 (4.5-10.8)	7.30 (7.08-7.43)	150	113	419 (417-421)

Table 3. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Dalecarlia Treatment Plant Basin #4 Sludge from December 16 to 23, 1991. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Sludge Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0	3-6	25.0 (25.0)	6.9 (2.7-8.3)	7.47 (7.07-7.78)	140	104	393 (362-401)
1	3-6	25.0 (25.0)	7.0 (2.8-8.3)	7.47 (7.16-7.74)	--	--	368 (363-370)
3	3-6	25.0 (25.0)	6.9 (3.3-8.3)	7.47 (7.21-7.73)	--	--	365 (355-371)
10	3-6	25.0 (25.0)	6.7 (3.3-8.3)	7.43 (7.20-7.74)	--	--	385 (354-400)
30	3-6	25.0 (25.0)	5.3 (0.07-8.4)	7.32 (7.15-7.48)	220 (220)	449 (384-448)	427 (410-453)

Table 4. Survival and growth of fathead minnow (*Pimephales promelas*) larvae exposed to effluent and sludge collected from the Dalecarlia Treatment Plant Basin #3 on 1/15/92. Dilution water was Potomac River water collected upstream from the plant. Sample size was 4 replicates of 10 fish each.

Effluent Conc (%)	Survival (%)	Growth (mg/)	(Stan. Dev.)	Range
0 (lab)	100	0.525	(±0.034)	0.478-0.556
0 (Potomac)	100	0.446	(±0.080)	0.338-0.516
1	100	0.500	(±0.067)	0.418-0.557
10	100	0.473	(±0.052)	0.405-0.519
100	100	0.413	(±0.064)	0.328-0.462
Sludge Conc (%)				
0 (lab)	100	0.525	(±0.034)	0.478-0.556
0 (Potomac)	100	0.446	(±0.080)	0.338-0.516
1	100	0.530	(±0.083)	0.440-0.640
3	100	0.499	(±0.031)	0.463-0.517
10	100	0.475	(±0.047)	0.422-0.521
30	0*	—	(—)	(—)
100	0*	—	(—)	(—)

Table 5. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Dalecarlia Treatment Plant Basin #3 effluent from January 18 to 25, 1992. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Effluent Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0 (Lab)	3-6	25.0 (24.9-25.0)	6.7 (5.6-7.4)	6.86 (6.71-7.08)	100	65	683 (678-692)
0 (Potomac)	3-6	25.0 (24.9-25.0)	6.8 (4.8-7.9)	7.82 (7.38-8.11)	150	108	381 (379-385)
1	3-6	25.0 (24.9-25.0)	7.0 (5.7-8.4)	7.69 (7.55-7.85)	--	--	382 (378-387)
10	3-6	25.0 (24.9-25.0)	6.8 (5.5-8.3)	7.47 (7.21-7.58)	--	--	384 (381-389)
100	3-6	25.0 (24.9-25.0)	6.4 (4.2-8.8)	7.04 (6.72-7.28)	190	115	435 (426-450)

Table 6. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Dalecarlia Treatment Plant Basin #3 sludge from January 18 to 25, 1992. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Sludge Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0 (Lab)	3-6	25.0 (24.9-25.0)	6.7 (5.6-7.4)	6.86 (6.71-7.08)	100	65	683 (678-692)
0 (Potomac)	3-6	25.0 (24.9-25.0)	6.8 (4.8-7.9)	7.82 (7.38-8.11)	150	108	381 (379-385)
1	3-6	25.0 (24.9-25.0)	6.2 (4.8-7.3)	7.38 (7.18-7.49)	--	--	384 (382-388)
3	3-6	25.0 (24.9-25.0)	5.4 (4.2-6.3)	7.24 (7.02-744)	--	--	389 (386-392)
10	3-6	25.0 (24.9-25.0)	3.3 (2.1-4.8)	7.04 (6.81-712)	--	--	420 (411-438)
30	3-6	25.0 (24.9-25.0)	1.7 (0.04-5.4)	6.99 (6.94-7.03)	ND	ND	476 (471-482)

Table 7. Survival and growth of fathead minnow (*Pimephales promelas*) larvae exposed to effluent and sludge collected from the Georgetown Treatment Plant Basin #2 on February 26, 1992. Sample size was 4 replicates of 10 fish each. Treatments significantly different from the control are indicated by an asterisk (*) ($\alpha = 0.05$). Dilution water was Potomac River water collected upstream from the plant.

Effluent Concentration (%)	Survival (%)	Weight (mg/fish)		
		Mean	S.D.	Range
0 (Lab)	100	0.479	0.041	0.464-0539
0 (Potomac)	100	0.477	0.009	0.468-0.488
1	100	0.512	0.084	0.435-0.591
10	97.5	0.449	0.049	0.414-0520
100	100	0.514	0.025	0.484-0.543

Sludge Concentration (%)	Survival (%)	Weight (mg/fish)		
		Mean	S.D.	Range
0 (Lab)	100	0.479	0.041	0.464-0.539
0 (Potomac)	100	0.477	0.009	0.468-0.488
1	100	0.391*	0.037	0.344-0.434
3	100	0.416	0.025	0.390-0.450
10	100	0.356*	0.061	0.288-0.419
30	100	0.234*	0.036	0.198-0.283

Table 8. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Georgetown Basin #2 effluent from March 2 to 9, 1992. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Effluent Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0 (Lab)	3-6	24.9	6.8	6.77	100	65	628
		(24.9)	(6.0-7.4)	(6.54-7.12)			(625-630)
0 (Potomac)	3-6	24.9	6.8	7.74	150	108	377
		(24.9)	(5.4-7.9)	(7.28-8.23)			(375-380
1	3.6	24.9	6.8	7.74	--	--	376
		(24.9)	(5.2-8.0)	(7.33-8.17)			(374-379)
10	3.6	24.9	6.9	7.56	--	--	373
		(24.9)	(5.6-8.1)	(7.36-7.82)			(370-376)
100	3.6	24.9	7.2	6.78	120	65	350
		(24.9)	(5.0-9.2)	(6.47-7.04)			(348-351)

Table 9. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Georgetown Basin #2 sludge from March 2 to 9, 1992. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Sludge Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0 (Lab)	3-6	24.9	6.8	6.77	100	65	628
		(24.9)	(6.0-7.4)	(6.54-7.12)			(625-630)
0 (Potomac)	3-6	24.9	6.8	7.74	150	108	377
		(24.9)	(5.4-7.9)	(7.28-8.23)			(375-380)
1	3.6	24.9	7.0	7.47	--	--	362
		(24.9)	(5.1-8.6)	(7.24-7.77)			(360-363)
3	3.6	24.9	6.7	7.31	--	--	360
		(24.9)	(5.0-8.2)	(7.17-7.53)			(353-365)
10	3.6	24.9	6.0	7.10	--	--	336
		(24.9)	(5.2-7.5)	(6.88-7.21)			(328-348)
30	3.6	24.9	5.3	6.92	ND	ND	315
		(24.9)	(4.8-6.2)	(6.76-7.13)			(300-338)

Table 10. Survival and growth of fathead minnow (*Pimephales promelas*) larvae exposed to sludge collected from the Georgetown Plant Basin #1. Sample size was 4 replicates of 10 fish each. Treatments significantly different from the control are indicated by an asterisk (*) ($\alpha = 0.05$). Dilution water was Potomac River water collected upstream from the plant.

Sludge Concentration (%)	Survival (%)	Weight (mg/fish)		
		Mean	S.D.	Range
0	100	0.553	0.039	0.495-0.578
3	100	0.495	0.060	0.427-0.558
10	100	0.555	0.028	0.525-0.581
100	100	0.563	0.056	0.504-0.635
30	100	0.482	0.030	0.438-0.503
100	0*	—	—	—

Table 11. Summary means and ranges for water chemistry for the fathead minnow chronic survival and reproduction test with Georgetown Basin #1 sludge from March 10 to 17, 1992. Ranges (below in parentheses) and means are for combined new and 24-hr old test solutions.

Sludge Conc. (%)	n	Temperature (°C)	Diss. Oxygen (mg/L)	pH (SU)	Total Hardness (mg/L)	Total Alkalinity (mg/L)	Conductivity (umhos/cm)
0	3-6	24.9 (24.9-25.0)	6.5 (5.2-7.7)	7.63 (7.15-8.08)	150	108	386 (385-387)
1	3-6	24.9 (24.9-25.0)	6.7 (5.6-7.7)	7.43 (7.08-7.78)	--	--	382 (379-384)
3	3-6	24.9 (24.9-25.0)	6.5 (5.3-7.7)	7.38 (6.97-7.70)	--	--	373 (367-378)
10	3-6	24.9 (24.9-25.0)	6.0 (5.0-7.1)	7.11 (6.82-7.40)	--	--	362 (362-363)
30	3-6	24.9 (24.9-25.0)	6.0 (5.2-6.9)	6.93 (6.77-7.18)	ND	ND	380 (373-389)

9.0 Discussion

The data indicate that effluent released from the three water treatment basins has no effect upon fathead minnow survival or growth. The lowest response for survival was 2.5% mortality (95.5% survival) at 10% effluent concentration in one test which represented 1 out of 40 test organisms that died at this single concentration. Effluent from one basin at Georgetown was not tested since it was not collected during the release process. It should be noted that fish fared as well, if not better in the effluent relative to fish weight at the end of the test compared to the control. This was true in two of the three effluents when 100% effluent concentration results were compared to the controls.

Sludge, however, affected both fish survival and impaired growth to a degree depending upon the dissolved oxygen sag between daily renewals. Fish could not survive in 100% sludge from all four basins. The thickness and/or semi-viscous nature of the sludge at 100% was inhospitable for fathead minnow swimming ability and survival based upon its mud-like constituency. At lesser sludge concentrations, the degree of DO sag was the problem that influenced fish survival and/or impaired growth.

When DO sag was not controlled with gentle aeration, fish survival and growth could be affected at concentrations to 10% or 30% sludge. The DO concentrations could drop to <1.0 mg/L which was 4 times lower than normal testing limits at 40% saturation. When this happened, fish survival was low and the remaining fish were impaired in weight gained. Sludge testing was not a test parameter initially negotiated for testing until arrival at the Dalecarlia treatment plant site in October 1991 since it was not clear that sludge was part of the discharge process. Therefore, we had to develop the testing technology as the test progressed, and in all cases, we had just enough sludge to complete each test. It was apparent in the third and fourth sludge tests that when DO sag was minimized, fish survival and growth were encouraged.

An instream water calculation (IWC) may be calculated for each basin depending upon the volume of effluent or sludge released and how it is calculated per 24-hr period.

Assuming the 7Q10 is 388 MGD for the Potomac River, effluent volumes can be broad depending upon how one calculated or addresses the IWC. The IWC may be calculated as the total gallons released and would range from 3.6 (14/388) to 28.4% (110/388). If one calculated the IWC based upon a continuous effluent release time of 24 hr, the IWC's per basin would be higher (14.4 to 35.4%). A discharge is considered stressful if fish impairment data coincide with the IWC. There obviously is no effect from the effluent since 100% concentration did not impair fish growth nor did any fish die. It should be emphasized, however, that the discharge is an intermittent (<1 day) rather than a continuous one that is released throughout the year. If based upon the actual river flow, during the time of release (3500 MGD), the calculated IWC's would be substantially lowered (ie, 0.4 [14/3500] to 3.1% [110/3500]).

Some interpretation is needed for the sludge release and if an IWC can be developed for it. One way for analysis is to use the total wet volume of sludge released per basin which were 0.772 (Dalecarlia #3), 0.439 (Dalecarlia #4), 0.407 (Georgetown #1) and 1.066 million gallons (Georgetown #2). The above values were personal communication from DYNAMAC personnel. Based upon the conservative 7Q10 of 388 MGD, the IWC calculation would be 0.1 to 0.3% which is very low.

Another concern is how to interpret the DO sag data below 40% saturation in the laboratory tests and those where DO was maintained. It was obvious that DO sag was the contributing factor to fish mortality in the sludge tests. One concern is if the sludge release caused a DO sag in the Potomac River. We cannot address this issue since our responsibilities only related to the laboratory testing.

One way in evaluating this dilemma is to take the weighted data approach by considering all the information (field and laboratory) available. The potential negative connotations of 10-100% sludge concentrations into the Potomac River from the fathead minnow tests may be addressed by comparing them with results obtained from the in-river benthic macroinvertebrate surveys conducted. It is recommended that more dialogue be developed in attempting to discuss the potential environmental ramifications of the sludge tests.

10.0 Literature Cited

Hollander, M. and D. A. Wolfe. 1973. Nonparametric Statistical Methods. John Wiley & Sons, New York, N.Y.

Rogers, J. W. 1986. Alternative guidelines for statistical analysis and interpretation of chronic bioassay data. Wisconsin Dept. Nat. Resour., Bur. Water Resour. Managem., August, 1986. Madison, WI.

United States Environmental Protection Agency. 1985. Short-term methods for estimating the chronic toxicity of effluent and receiving waters to freshwater organisms. Horning, W. B. and C. I. Weber, Eds. EPA-600/4-85/014. Cincinnati, OH.

United States Environmental Protection Agency. 1989. Short-term methods for estimating the chronic toxicity of effluent and recovery water to freshwater organisms. C. I. Weber et al. EPA/600/4-89/001. Cincinnati, OH.

Appendices

Appendix I

Check in Sheets and Fathead Minnow Screening Tests

Appendix II

Fathead Minnow Chronic Toxicity Data and Water Quality Analyses

Appendix III

Reference Toxicity Test Data for Fathead Minnows

Appendices

Appendix I

Check in Sheets and Fathead Minnow Screening Tests

Table 1, Appendix I. Screen tests performed on Effluent and Sludge from the Dalecarlia Treatment Plant Basin #4 on December 9 to December 11 and December 10 to December 14, 1991. Dilution water was Potomac River water collected upstream from the plant.

Effluent Conc (%)	Survival (48 hr)	24 hr LC50	48 hr LC50
0	100	—	—
0.1	100	—	—
0.1	100	—	—
1.0	100	—	—
10	100	—	—
100	100	—	—
Sludge Conc %	Survival (48 hr)		
0	100	Probit	Probit
1	100	30.393	20.345
3	100		
10	65	Spearman	Spearman
30	50	31.320	20.585
100	0		

SAMPLE CHECK IN

Fill out this information with each effluent or river water sample coming in for testing. Keep completed sheets with test data or file with lab coordinator.

Date: 12-10-91 Sampling Date: 12-5-91 Arrival Time: noon

Sample Identification: Dalecarlia Basin 4 effluent

Shipper: Fed. Ex.____ Burlington____ other(specify) UPS

Drop Off Location: ESL____ 1020 Derring ✓ Don Cherry's____

other(specify)____

Storage While Shipped: on ice

Water Chemistry Analysis:

Sample taken by: R. Dotson Sample analysis by: Amick Mikailsky

temperature: 5 °C Dissolved O_2: 12.6 mgO_2/l

conductivity: 414 µmhos pH: 6.98

alkalinity: 113 mgCaCO$_3$/l hardness: 150 mgCaCO$_3$/l

Metal analysis:

Done by:____ date:____

Qual. Assur.

	yes	no	initials	date
chain of custody complete		✓	AM	12-10-91
refrigeration at 4°C	✓		AM	12-10-91
field record received		✓	AM	12-10-91
sample label affixed properly	✓		AM	12-10-91
project leader informed	✓		AM	12-10-91

Additional Comments

Effluent beyond allowed time allotted for testing.

SAMPLE CHECK IN

ill out this information with each effluent or river water sample oming in for testing. Keep completed sheets with test data or file ith lab coordinator.

ate: 1-9-92 Sampling Date: 1-6-92 Arrival Time: 1400

ample Identification: Dalecarlia - Basin 3 - Effluent

hipper: Fed. Ex.____ Burlington____ other(specify) UPS

rop Off Location: ESL____ 1020 Derring____ Don Cherry's____

other(specify) Biology Dept

torage While Shipped: ____________

ater Chemistry Analysis:

ample taken by: R. Dotson Sample analysis by: A Mikailoff

temperature: 3.6 °C Dissolved O₂: 8.6 mgO₂/l

conductivity: 879 µmhos pH: 6.90

alkalinity: 115 mgCaCO₃/l hardness: 190 mgCaCO₃/l

etal analysis:

one by: ____________ date: ____________

ual. Assur.

	yes	no	initials	date
chain of custody complete		✓	AM	1-9-92
refrigeration at 4°C	✓		↓	↓
field record received		✓	↓	↓
sample label affixed properly	✓		↓	
project leader informed	✓		AM	1-9-92

ditional Comments

SAMPLE CHECK IN

Fill out this information with each effluent or river water sample coming in for testing. Keep completed sheets with test data or file with lab coordinator.

Date: 1-9-92 Sampling Date: 1-6-92 Arrival Time: 1400

Sample Identification: Dalecarlia - Basin 3 - Sludge -

Shipper: Fed. Ex.____ Burlington____ other(specify) UPS

Drop Off Location: ESL_____ 1020 Derring____ Don Cherry's____

other(specify) Biology Dept.

Storage While Shipped:

Water Chemistry Analysis:

Sample taken by: L. Dotson Sample analysis by: A. Mikailsft

temperature: 6 °C Dissolved O_2: NC mgO_2/l

conductivity: NC µmhos pH: NC

alkalinity: ND $mgCaCO_3/l$ hardness: ND $mgCaCO_3/l$

Metal analysis:

ND = not determined - too dark for colorimetric titrations

NC : too thick - coats probes -

Done by: date:

Qual. Assur.

	yes	no	initials	date
chain of custody complete		✓	AM	1-9-92
refrigeration at 4°C	✓		AM	↓
field record received		✓	AM	
sample label affixed properly	✓		AM	
project leader informed	✓		AM	1-9-92

Additional Comments

SAMPLE CHECK IN

ill out this information with each effluent or river water sample coming in for testing. Keep completed sheets with test data or file with lab coordinator.

Date: 2-28-92 Sampling Date: 2-26-92 Arrival Time: 1245
Sample Identification: Effluent - Basin 2 - Composite 2 am to 9 am -

Shipper: Fed. Ex. ✓ Burlington____ other(specify)____
Drop Off Location: ESL____ 1020 Derring ✓ Don Cherry's____
other(specify)____
Storage While Shipped: On ice

Water Chemistry Analysis:
Sample taken by: R. Dotson Sample analysis by: Annick Mikailoff
temperature: 0.6 °C Dissolved O₂: 8.9 mgO₂/l
conductivity: 348 µmhos pH: 6.47
alkalinity: 65 mgCaCO₃/l hardness: 120 mgCaCO₃/l

etal analysis: used for test

one by:____ date:____

ual. Assur.

	yes	no	initials	date
chain of custody complete		✓	AM	
refrigeration at 4°C	✓		AM	
field record received		✓	AM	
sample label affixed properly	✓		AM	
project leader informed	✓		AM	

dditional Comments

SAMPLE CHECK IN

.ill out this information with each effluent or river water sample coming in for testing. Keep completed sheets with test data or file with lab coordinator.

Date: 28[illegible] Feb 92 Sampling Date: 25-26 Feb 92 Arrival Time: 1245
Sample Identification: Effluent - Basin 2 -
Composite From 2-25-92 (3 pm)
TO 2-26-92 (3 am)

Shipper: Fed. Ex. ✓ Burlington____ other(specify)____________
Drop Off Location: ESL_____ 1020 Derring ✓ Don Cherry's_____
other(specify)____________
Storage While Shipped: On ice

Water Chemistry Analysis:
Sample taken by: R. Dotzon Sample analysis by: Annick Mikaïlsh
temperature: 16 °C Dissolved O₂: ____________ mgO_2/l
conductivity: ____________ µmhos pH: ____________
alkalinity: ____________ $mgCaCO_3/l$ hardness: ____________ $mgCaCO_3/l$

Metal analysis: not used for testing

Done by:______________________________ date:______________

Qual. Assur.

	yes	no	initials	date
chain of custody complete				
refrigeration at 4°C				
field record received				
sample label affixed properly				
project leader informed				

Additional Comments

SAMPLE CHECK IN

ill out this information with each effluent or river water sample oming in for testing. Keep completed sheets with test data or file ith lab coordinator.

ate: 2-28-92 Sampling Date: 2-26-92 Arrival Time: 1200 pm
ample Identification: Sludge (tag) - Georgetown 2 -

hipper: Fed. Ex.____ Burlington____ other(specify) UPS
rop Off Location: ESL_____ 1020 Derring ✓ Don Cherry's____
other(specify)________
torage While Shipped: on ice

ater Chemistry Analysis:
ample taken by: R. Dotson Sample analysis by: A. Mitailwtt
temperature: 2.0 °C Dissolved O₂: ND mgO₂/l
conductivity: ND µmhos pH: ND
alkalinity: ND mgCaCO₃/l hardness: ND mgCaCO₃/l

etal analysis: ND = not determined because sludge was too thick, clogged the probes & did not allow for colorimetric titrations

one by:________ date:________

ual. Assur.

	yes	no	initials	date
chain of custody complete		✓	AM	2-28-92
refrigeration at 4°C	✓		AM	↓
field record received		✓	AM	
sample label affixed properly	✓		AM	
project leader informed	✓		AM	2-28-92

ditional Comments

SAMPLE CHECK IN

Fill out this information with each effluent or river water sample coming in for testing. Keep completed sheets with test data or file with lab coordinator.

Date: 2-28-92 Sampling Date: 2-20-92 Arrival Time: 1200 pm
Sample Identification: Sludge (no tag)
Georgetown 1

Shipper: Fed. Ex.____ Burlington____ other(specify) UPS
Drop Off Location: ESL____ 1020 Derring ✓ Don Cherry's____
other(specify)____
Storage While Shipped: on ice

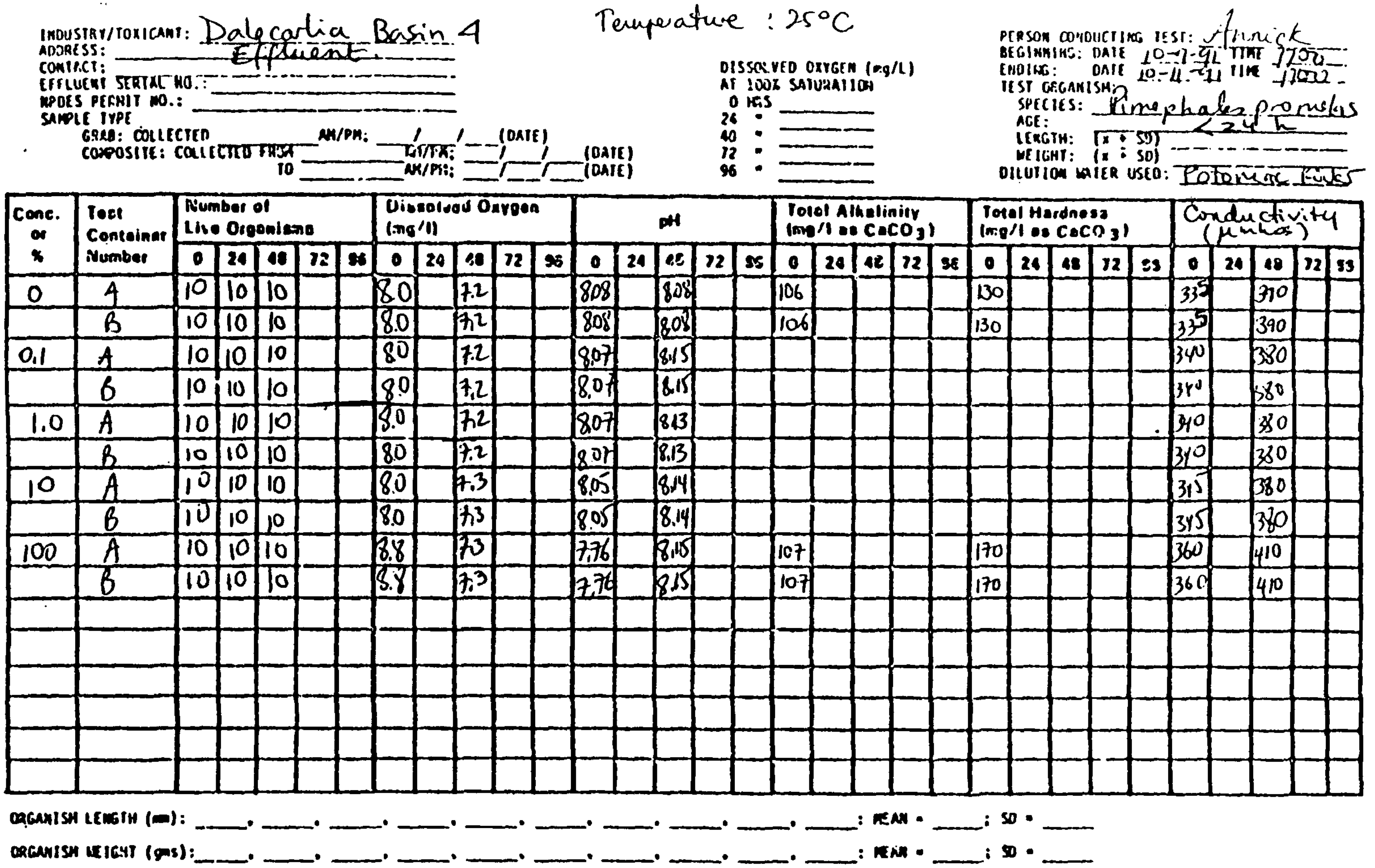
Water Chemistry Analysis:
Sample taken by: R. Dotson Sample analysis by: A Mikaili
temperature: 6.0 °C Dissolved O_2: ND mgO_2/l
conductivity: ND µmhos pH: ND
alkalinity: ND $mgCaCO_3/l$ hardness: ND $mgCaCO_3/l$
ND: not determined because sludge was too thick, clogged the probes & did not allow for colorimetric titrations
Metal analysis:

Done by:____ date:____

Qual. Assur.

	yes	no	initials	date
chain of custody complete		✓	AM	2-28-92
refrigeration at 4°C	✓		AM	↓
field record received		✓	AM	
sample label affixed properly	✓		AM	
project leader informed	✓		AM	2-28-92

Additional Comments



INDUSTRY/TOXICANT: Dalecarlia Basin 4 Effluent.
ADDRESS: ______
CONTACT: ______
EFFLUENT SERIAL NO.: ______
NPDES PERMIT NO.: ______
SAMPLE TYPE
GRAB: COLLECTED ______ AM/PM: ___/___/___ (DATE)
COMPOSITE: COLLECTED FROM ______ AM/PM: ___/___/___ (DATE)
TO ______ AM/PM: ___/___/___ (DATE)

Temperature : 25°C

DISSOLVED OXYGEN (mg/L)
AT 100% SATURATION
0 HRS ______
24 " ______
48 " ______
72 " ______
96 " ______

PERSON CONDUCTING TEST: Annick
BEGINNING: DATE 10-7-91 TIME 1700
ENDING: DATE 10-11-91 TIME 1700
TEST ORGANISM:
SPECIES: Pimephales promelas
AGE: <24 h
LENGTH: (x ± SD) ______
WEIGHT: (x ± SD) ______
DILUTION WATER USED: Potomac River

Conc. or %	Test Container Number	Number of Live Organisms					Dissolved Oxygen (mg/l)					pH					Total Alkalinity (mg/l as $CaCO_3$)					Total Hardness (mg/l as $CaCO_3$)					Conductivity (μmhos)				
		0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96
0	A	10	10	10			8.0		7.2			808		8.08			106					130					335		390		
	B	10	10	10			8.0		7.2			808		8.08			106					130					335		390		
0.1	A	10	10	10			80		7.2			8.07		8.15													340		380		
	B	10	10	10			8.0		7.2			8.07		8.15													340		380		
1.0	A	10	10	10			8.0		7.2			8.07		8.13													340		380		
	B	10	10	10			80		7.2			8.07		8.13													340		380		
10	A	10	10	10			8.0		7.3			8.05		8.14													345		380		
	B	10	10	10			8.0		7.3			8.05		8.14													345		380		
100	A	10	10	10			8.8		7.3			7.76		8.15			107					170					360		410		
	B	10	10	10			8.8		7.3			7.76		8.15			107					170					360		410		

ORGANISM LENGTH (mm): ____, ____, ____, ____, ____, ____, ____, ____, ____, ____: MEAN = ____; SD = ____

ORGANISM WEIGHT (gms): ____, ____, ____, ____, ____, ____, ____, ____, ____, ____: MEAN = ____; SD = ____

Figure 5. Data sheet for effluent toxicity tests.

TOXICANT/EFFLUENT: Valecarlia Basin 4 Alum Sludge
SPONSOR:
CONTACT:
[✓ Screening] / Definitive Test (circle one)
Dilution Water: Patomic River Water
Storage Method: Refrigeration 4°c

Beginning Date: 12-10-91 Time:
Ending Date: 12-14-91 Time:
Test Organism: Fathead minnow
Organism Source: ESL

Conc. or %		Number alive			Temperature (C)			D.O. (mg/L)			pH			Conductivity		
		0	24	48	96h	24	48	0	24	48	0	24	48	0	24	48
0	A	10	10	10	10	25	25			7.6			7.94			415
	B	10	10	10	10	25	25									
1	A	10	10	10	9	25	25			7.6			8.02			401
	B	10	10	10	10	25	25									
3	A	10	10	10	9	25	25			7.6			7.82			397
	B	10	10	10	7	25	25									
10	A	10	8	8	7	25	25			7.5			7.56			407
	B	10	10	5	5	25	25									
30	A	10	~~4~~ 7	6	0	25	25			7.3			7.49			433
	B	10	~~7~~ 4	4	3	25	25									
100	A	10	0	0	0	25	25			4.9			7.14			772
	B	10	1	0	0	25	25									

88

Due to high Turbidity, there will be difficulty

JRL 12-14-91

```
-----------------------------------------------------------------------------
                              SPEARMAN-KARBER
                           TRIM:             5.00%
                           LC50:            31.320
               95% LOWER CONFIDENCE:        22.564
               95% UPPER CONFIDENCE:        43.473
-----------------------------------------------------------------------------
  CONC.      NUMBER     NUMBER   PERCENT    BINOMIAL
  % sludge   EXPOSED    DEAD     DEAD       PROB.(%)
    1.00       20.        0.         .00     .9537D-04
    3.00       20.        0.         .00     .9537D-04
   10.00       20.        2.       10.00     .2012D-01
   30.00       20.        9.       45.00     .4119D+02
  100.00       20.       19.       95.00     .2003D-02
HE BINOMIAL TEST SHOWS THAT   10.00 AND  100.00 CAN BE USED AS STATISTICALLY
UND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS SINCE THE ACTUAL CONFIDENCE
VEL ASSOCIATED WITH THESE LIMITS IS  99.9779 PERCENT.
 APPROXIMATE LC50 FOR THIS DATA SET IS   33.205
-----------------------------------------------------------------------------
    RESULTS USING MOVING AVERAGE
PAN        G       LC50    95% CONFIDENCE LIMIT
 3        .066    29.99    21.36    45.50
-----------------------------------------------------------------------------
 ***** RESULTS CALCULATED BY PROBIT METHOD
RATIONS      G             H          GOODNESS OF FIT
6           .143          1.00          .94
OPE =  2.93
% CONFIDENCE LIMITS:     1.83 AND    4.04

50=   30.39
% CONFIDENCE LIMITS:   21.86 AND   42.99

 =     4.90
% CONFIDENCE LIMITS:     1.55 AND    8.54
-----------------------------------------------------------------------------
ATE: 12-91                      TEST NUMBER: 1         DURATION:    24 Hours
PLE: Daleciaria lagoon #4 alumSPECIES: Pimephales promelas

THOD          LC50          CONFIDENCE LIMITS
                        LOWER      UPPER     SPAN
NOMIAL       33.205    10.000    100.000    90.000
A            29.995    21.364     45.495    24.132
OBIT         30.393    21.865     42.988    21.124
EARMAN       31.320    22.564     43.473    20.909
** = LIMIT DOES NOT EXIST
-----------------------------------------------------------------------------
```

Dalecarlia Basin #4
Alum Sludge
24 - LC_{50} - for Fat Lead Minnow
12-19-91
JRL

```
                                   SPEARMAN-KARBER
                                     TRIM:               .00%
                                     LC50:             20.585
                    95% LOWER CONFIDENCE:              14.423
                    95% UPPER CONFIDENCE:              29.382
--------------------------------------------------------------------------------
    CONC.      NUMBER     NUMBER   PERCENT     BINOMIAL
    % sludge  EXPOSED     DEAD     DEAD        PROB.(%)
      1.00       20.        0.         .00       .9537D-04
      3.00       20.        0.         .00       .9537D-04
     10.00       20.        7.       35.00       .1316D+02
     30.00       20.       10.       50.00       .5881D+02
    100.00       20.       20.      100.00       .9537D-04
 THE BINOMIAL TEST SHOWS THAT    3.00 AND  100.00 CAN BE USED AS STATISTICALLY
SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS SINCE THE ACTUAL CONFIDENCE
LEVEL ASSOCIATED WITH THESE LIMITS IS  99.9998 PERCENT.
 AN APPROXIMATE LC50 FOR THIS DATA SET IS   30.000
--------------------------------------------------------------------------------
      RESULTS USING MOVING AVERAGE
  SPAN        G        LC50   95% CONFIDENCE LIMIT
    3       .051     19.64     14.57     26.84
--------------------------------------------------------------------------------
  ****** RESULTS CALCULATED BY PROBIT METHOD
ITERATIONS      G            H          GOODNESS OF FIT
   6          .121         1.00           .14
 SLOPE =  2.47
 95% CONFIDENCE LIMITS:     1.61 AND    3.33

 LC50=   20.34
 95% CONFIDENCE LIMITS:   14.23 AND   29.42

 LC1 =     2.32
 95% CONFIDENCE LIMITS:      .69 AND    4.33

--------------------------------------------------------------------------------
  DATE: 12-91                        TEST NUMBER: 1        DURATION:    48 Hours
SAMPLE: Daleclaria lagoon #4 alumSPECIES: Pimephales promelas

METHOD          LC50            CONFIDENCE LIMITS
                            LOWER      UPPER     SPAN
BINOMIAL        30.000       3.000   100.000    97.000
MAA             19.637      14.566    26.835    12.269
PROBIT          20.345      14.225    29.423    15.197
SPEARMAN        20.585      14.423    29.382    14.959
**** = LIMIT DOES NOT EXIST
--------------------------------------------------------------------------------
```

Dalecarlia Basin #4
Alum Sludge
48 hr LC50 for
Fathead Minnow
12-19-91
JRL

```
                               SPEARMAN-KARBER
                              TRIM:              5.00%
                              LC50:             10.154
               95% LOWER CONFIDENCE:             6.711
               95% UPPER CONFIDENCE:            15.364
----------------------------------------------------------------------
  CONC.       NUMBER     NUMBER   PERCENT    BINOMIAL
  % sludge  EXPOSED     DEAD     DEAD       PROB.(%)
    1.00        20.        1.        5.00     .2003D-02
    3.00        20.        4.       20.00     .5909D+00
   10.00        20.        8.       40.00     .2517D+02
   30.00        20.       17.       85.00     .1288D+00
  100.00        20.       20.      100.00     .9537D-04
HE BINOMIAL TEST SHOWS THAT    3.00 AND   30.00 CAN BE USED AS STATISTICALLY
UND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS SINCE THE ACTUAL CONFIDENCE
VEL ASSOCIATED WITH THESE LIMITS IS  99.2803 PERCENT.
N APPROXIMATE LC50 FOR THIS DATA SET IS   12.564
----------------------------------------------------------------------
    RESULTS USING MOVING AVERAGE
SPAN       G      LC50   95% CONFIDENCE LIMIT
 4       .066     9.34     6.22    13.95
----------------------------------------------------------------------
 ***** RESULTS CALCULATED BY PROBIT METHOD
ERATIONS     G           H          GOODNESS OF FIT
 5         .099        1.00          .56
LOPE =  1.92
 % CONFIDENCE LIMITS:     1.32 AND    2.53

 50=    9.44
 % CONFIDENCE LIMITS:     6.27 AND   14.20

 1 =      .58
 % CONFIDENCE LIMITS:      .15 AND    1.23

----------------------------------------------------------------------
 ATE: 12-91                     TEST NUMBER: 1        DURATION:    96 Hours
 PLE: Daleclaria lagoon #4 alumSPECIES: Pimephales promelas

 THOD        LC50         CONFIDENCE LIMITS
                       LOWER      UPPER     SPAN
 NOMIAL      12.564     3.000     30.000    27.000
 A            9.339     6.216     13.949     7.733
 OBIT         9.440     6.275     14.198     7.923
 EARMAN      10.154     6.711     15.364     8.652
 ** = LIMIT DOES NOT EXIST
----------------------------------------------------------------------
```

Dalecarlia Basin #4
Alum Sludge
96-hr LC50 for Fathead Minnow
12-19-91
JRL

```
                                  SPEARMAN-KARBER

                                  TRIM:               5.00%
                                  LC50:              10.154
                   95% LOWER CONFIDENCE:              6.711
                   95% UPPER CONFIDENCE:             15.364
```

```
   CONC.      NUMBER     NUMBER    PERCENT    BINOMIAL
   % ~~EFFLUE~~ Sludge EXPOSED    DEAD      DEAD       PROB.(%)
    1.00       20.        1.        5.00      .2003D-02
    3.00       20.        4.       20.00      .5909D-00
   10.00       20.        8.       40.00      .2517D+02
   30.00       20.       17.       85.00      .1288D+00
  100.00       20.       20.      100.00      .9537D-04

 THE BINOMIAL TEST SHOWS THAT    3.00 AND   30.00 CAN BE USED AS STATISTICALLY
SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS SINCE THE ACTUAL CONFIDENCE
LEVEL ASSOCIATED WITH THESE LIMITS IS  99.2803 PERCENT.
 AN APPROXIMATE LC50 FOR THIS DATA SET IS   12.564
```

```
     RESULTS USING MOVING AVERAGE
  SPAN       G       LC50   95% CONFIDENCE LIMIT
   4        .066     9.34     6.22     13.95
```

```
  ****** RESULTS CALCULATED BY PROBIT METHOD
ITERATIONS     G           H          GOODNESS OF FIT
   5         .099        1.00           .56

 SLOPE =  1.92
 95% CONFIDENCE LIMITS:     1.32 AND    2.53

 LC50=    9.44
 95% CONFIDENCE LIMITS:     6.27 AND   14.20

 LC1 =     .58
 95% CONFIDENCE LIMITS:      .15 AND    1.23
```

```
 DATE: 12/10-14/91           TEST NUMBER: 1        DURATION:    96 HOURS

SAMPLE: DALECARLIA BASIN #4          SPECIES: FATHEAD MINNOW

 METHOD         LC50               CONFIDENCE LIMITS
                               LOWER      UPPER     SPAN
 BINOMIAL      12.564          3.000     30.000    27.000
 MAA            9.339          6.216     13.949     7.733
 PROBIT         9.440          6.275     14.198     7.923
 SPEARMAN      10.154          6.711     15.364     8.652

 **** = LIMIT DOES NOT EXIST
```

- Washington 96 HR LC50

Appendix II

Fathead Minnow Chronic Toxicity Data and Water Quality Analyses

Fathead Minnow / Midge Larvae Weight Data Sheet

Work Order #: Dalecarlia

Date: 12-20-91

Oven:

ID #: 26615 - Effluent

Time: 1100 Temp: 67°C

Balance:

ID #: 38100044

Calibrated: [✓] yes [] no

Sample	Sample Size (n)	Combined Weight (mg)	Boat weight (mg)	Sample Weight (mg)	Mean Weight (mg)
0A	10	109.138	101.395	7.743	0.774
0B	10	108.097	101.606	6.491	0.649
0C	10	119.667	112.222	7.445	0.744
0D	10	105.116	99.699	5.417	0.542
1A	10	105.436	96.955	8.481	0.848
1B	10	131.704	123.196	8.508	0.851
1C	10	104.644	97.295	7.349	0.735
1D	10	110.951	103.382	7.569	0.757
10A	10	115.598	107.279	8.319	0.832
10B	10	99.176	92.107	7.069	0.707
10C	9	94.553	88.532	6.021	0.669
10D	10	108.514	100.131	8.383	0.838
100A	10	121.020	113.453	7.567	0.757
100B	10	114.099	105.509	8.590	0.859
100C	10	108.544	100.023	8.521	0.852
100D	10	104.616	96.459	8.157	0.816

Analyst: Annick Mikailoff

Page 1 of 1

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Chronic Test Data Sheet

Work Order #: Dalecarlia

Beginning Date: 12-10-91 Time: 2300

Project #: Effluent Basin 4

Ending Date: 12-17-91 Time: 2300

Test Type: [] Static

[✓] Static/Renewal

[] Flow Through

Test Location: [] Inc. 1 Temp: ____

[✓] Inc. 2 Temp: 25.0 °C

[] Other Temp: ____

Dilution Water: Potomac River

Test Organism: Pimephales promelas age: <24 hrs old

Toxicant/Effluent: Dalecarlia effluent Basin 4

Source: BMI

Conc. or % Eff	No. Exp.	Mortality / Neonates Produced						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
0A	10	0	0	0	0	0	0	0
0B	10	0	0	0	0	0	0	0
0C	10	0	0	0	0	0	0	0
0D	10	0	0	0	0	0	0	0
1A	10	0	0	0	0	0	0	0
1B	10	0	0	0	0	0	0	0
1C	10	0	0	0	0	0	0	0
1D	10	0	0	0	0	0	0	0
10A	10	0	0	0	0	0	0	0
10B	10	0	0	0	0	0	0	0
10C	10	0	0	0	1	1	1	1
10D	10	0	0	0	0	0	0	0
100 A	10	0	0	0	0	0	0	0
100 B	10	0	0	0	0	0	0	0
100 C	10	0	0	0	0	0	0	0
100 D	10	0	0	0	0	0	0	0
Ini.	AM	AM	AM	AM	AM	AM	AM	AM

Analyst: Annick Mikailoff

Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 12-10-91/2300

Day of Test: 1

Page 1 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	25	373/353	8.4	5.8	7.49	7.66	104	140	NC
1	25	400/370	8.3	5.8	7.51	7.70			NC
10	25	406/38	8.1	6.3	7.41	7.68			NC
100	25	420/424	9.8	5.6	7.17	7.43	113	150	NC
Inst. #	B	C	A	A	A	A			—
Cal. by Initials	AM	AM	AM	AM	AM	AM			—

Combined Samples: [✓] yes [] no

Comments:

Analyst: Annick Mikaïloff

Supervisor: ______

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 12-14-91 / 1215

Day of Test: 4

Page 2 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	25	371/422	8.1	4.2	7.36	7.12	104	140	NC
1	25	369/412	8.0	3.4	7.37	7.13			NC
10	25	373/404	8.2	4.4	7.30	7.19			NC
100	25	421/449	10.8	4.5	7.08	7.15	113	150	NC
Inst. #									
Cal. by Initials									

Combined Samples: [] yes [] no

Comments:

Analyst: Annick Mikaï

Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 12-16-91/1415

Day of Test: 7

Page 3 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	25	376/393	8.4	4.9	7.62	7.17			NC
1	25	368/395	8.6	4.8	7.61	7.19			NC
10	25	372/400	8.7	5.3	7.48	7.28			NC
100	25	417/447	10.6	5.6	7.18	7.22			NC
Inst. #	6								
Cal. by Initials	AM								

Combined Samples: ☑ yes ☐ no

Comments:

Analyst:

Supervisor:

```
DALECARLIA E4
Fathead Minnow survival

      0       1       10      100
    -----   -----   -----   -----
 1)  1       1       1       1
 2)  1       1       1       1
 3)  1       1       1       1
 4)  1       1       1       1


Fathead minnow larval survival and growth test
Fathead Minnow survival

Enter the maximum number of replicates per treatment:  4

Fathead minnow larval survival and growth test

DALECARLIA E4

Survival

           -----------------------------------------------------------------------
  1.0000 :  +XX                 +XX                 +XX                 +XX         :
  0.9938 :                                                                          :
  0.9755 :                                                                          :
  0.9455 :                                                                          :
  0.9045 :                                                                          :
  0.8536 :                                                                          :
  0.7939 :                                                                          :
  0.7270 :                                                                          :
  0.6545 :                                                                          :
  0.5782 :                                                                          :
  0.5000 :                                                                          :
  0.4218 :                                                                          :
  0.3455 :                                                                          :
  0.2730 :                                                                          :
  0.2061 :                                                                          :
  0.1464 :                                                                          :
  0.0955 :                                                                          :
  0.0545 :                                                                          :
  0.0245 :                                                                          :
  0.0062 :                                                                          :
  0.0000 :  D                   D                   D                   D           :
           -----------------------------------------------------------------------
            1                   2                   3                   4
                      Coded Concnetration, 1 = Control

+ = mean, * = mean, significant using Steel's test
D = Dunnett's (or Fisher's) critical level
X / = Data (# = data not used in the analysis)


Fathead minnow larval survival and growth test
DALECARLIA E4
Fathead Minnow Growth

      0       1       10      100
    -----   -----   -----   -----
 1) .774    .848    .832    .757
 2) .649    .851    .707    .859
 3) .744    .735    .669    .852
 4) .542    .757    .838    .816
```

```
No TRANSFORMATION

                                    Dunnetts  significant ?
%Effluent    N    Mean        Std   Critical Dunnetts Steels
                                    value
     0.000   4    0.677    0.105    0.551
     1.000   4    0.798    0.060    0.551
    10.000   4    0.762    0.086    0.551
   100.000   4    0.821    0.047    0.551

Press ENTER to continue ?

Pooled root mean square error =    0.078  DF = 12

Dunnett's critical T =    2.290

Bartlett's test, B =    1.928  Df = 3
 (Critical 1% value =  11.34 )

For this data, the minimum difference that can be detected as
statistically significant is a   18.615
 % reduction in the mean response from the control

NOEC = 100.000 %effluent

Biologically Significant Level =    0.542

Analysis at  on

Press ENTER to continue ?


Fathead minnow larval survival and growth test

DALECARLIA E4

Average weight
           --------------------------------------------------------------
   0.9000 :                                                               :
   0.8887 :                                                               :
   0.8775 :                                                               :
   0.8663 :                                                               :
   0.8550 :                     /                                  X      :
   0.8438 :                     /                                         :
   0.8325 :                                      X                        :
   0.8212 :                                                       +/      :
   0.8100 :                                                               :
   0.7987 :                    +                                          :
   0.7875 :                                                               :
   0.7763 :    /                                                          :
   0.7650 :                                     +                         :
   0.7537 :                     /                                  /      :
   0.7425 :    /                                                          :
   0.7313 :                     /                                         :
   0.7200 :                                                               :
   0.7088 :                                      /                        :
   0.6975 :                                                               :
   0.6863 :                                                               :
   0.6750 :   +                                                           :
   0.6638 :                                      /                        :
   0.6525 :    /                                                          :
   0.6413 :                                                               :
   0.6300 :                                                               :
```

Fathead Minnow / Midge Larvae Weight Data Sheet

Work Order #: Dalecarlia

Date: 12-29-91

Oven:

ID #: 26615 - Sludge

Time: 1204 Temp: 65°C

Balance:

ID #: 381 000 44

Calibrated: ☒ yes ☐ no

Sample	Sample Size (n)	Combined Weight (mg)	Boat weight (mg)	Sample Weight (mg)	Mean Weight (mg)
0A	9	108.280	102.310	5.970	0.663
0B	10	118.202	112.463	5.739	0.574
0C	10	120.871	113.248	7.623	0.762
0D	9	130.976	124.522	6.454	0.717
1A	8	118.967	113.094	5.873	0.734
1B	9	113.812	108.667	5.145	0.572
1C	7	112.489	108.374	4.115	0.588
1D	8	119.793	114.651	5.142	0.643
3A	8	119.687	114.601	5.086	0.636
3B	6	103.761	100.369	3.392	0.565
3C	9	116.334	111.477	4.857	0.540
3D	10	99.424	94.772	4.652	0.465
10A	10	147.189	140.917	6.272	0.627
10B	7	136.814	132.459	4.355	0.622
10C	8	135.297	130.449	4.848	0.606
10D	9	132.289	126.474	5.815	0.646
30A	3	125.620	123.801	1.819	0.606
30B	4	112.102	109.933	2.169	0.542
30C	4	108.802	106.419	2.383	0.596
30D	6	98.934	95.658	3.276	0.546

Analyst: Amick Mikailoff

Page 1 of 1

CHRONIC/SUBCHRONIC TEST SOLUTION SET UP

Project: Dalecarlia
Sponsor:
Description of test: Sludgetest Chronic Fathead minnow Study

Sample ID: Dalecarlia Alum Sludge Basin #4
Dilution ID:

Test Concentration	Volume Test Material (mL)	Final Volume Dilute with Potomic RW
0	0 ml	800 ml
1	8 ml	800 ml
3	24 ml	800 ml
10	80 ml	800 ml
30	240 ml	800 ml

Initial Actions:

Date/Time	Activity	Investigator
12/16/91 800	Dilutions Made	John R Fauth
12/16/91 8:30	Test Vessels Filled	John R Fauth
12/16/91 9:00	Organisms Transferred and Counted	John R Fauth

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Chronic Test Data Sheet

Work Order #: Dalecarlia
Beginning Date: 12/16/91 Time: 8:00 P.M.
Project #: ______
Ending Date: ______ Time: ______

Test Type: [] Static
☑ Static/Renewal
[] Flow Through

Test Location: [] Inc. 1 Temp: ______
☑ Inc. 2 Temp: 24.9
[] Other Temp: ______

Dilution Water: Patomic RW
Test Organism: Fathead Minnow Age: <24h
Toxicant/Effluent: Dalecarlia Alum Sludge
Source: Basin 4 / ESL(AM)

Conc. or % Eff	No. Exp.	# Survivors* ~~Mortality / Neonates Produced~~						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Control A	10	10	10	9	9	9	9	9
B	10	10	10	10	10	10	10	10
C	10	10	10	10	10	10	10	10
D	10	10	10	10	10	9	9	9
1 A	10	10	10	8	8	8	8	8
B	10	10	10	10	10	10	9	9
C	10	10	9	8	8	8	7	7
D	10	10	9	9	9	8	8	8
3 A	10	10	10	9	8	8	8	8
B	10	10	8	7	6	6	6	6
C	10	10'	9	9	9	9	9	9
D	10	10	10	10	11*	10	10	10
10 A	10	10	10	9	9	9	9	10
B	10	10	9	7	7	7	7	7
C	10	10	10	9	8	8	8	8
D	10	10	10	10	10	10	9	9
30 A	10	9	9	7	4	4	4	3
B	10	8	8	5	4	4	4	4
C	10	9	8	5	5	4	4	4
D	10	9	7	4	5	5	5	6
Ini.					AM	AM	AM	AM

(?) 1 mo

1 less 2
surpri
1 more

* Note - due to high turbidity, it is best to do a count of survivors each day

Supervisor:

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 12-16-91 9:00 PM

Day of Test: Day 1 begin (start) End

Page 1 of ____

Sample % Sludge	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			~~AM~~ Start	~~PM~~ End	~~AM~~ Start	~~PM~~ End			
0	25	362	8.3	7.4	7.38	7.78	104	140	—
1	25	370	8.3	7.4	7.38	7.69			—
3	25	371	8.3	7.3	7.39	7.71			—
10	25	400	8.3	7.1	7.41	7.74			—
30	25	410	8.4	6.5	7.38	7.39	384	220	—
Inst. #		C	A	B	B				
Cal. by Initials	JRL	JRL	JRL	JRL	JRL	JRL	JRL	JRL	

Combined Samples: ☑ yes ☐ no

Comments:

Analyst: John R [illegible]

Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 12/19/91 8:00 PM

Day of Test:

Page 2 of

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
% Sludge			AM	PM	AM	PM			
0	25	368	8.2	7.4	7.50	7.69	104	140	—
1	25	370	8.2	7.3	7.48	7.74			—
3	25	369	8.2	7.1	7.48	7.73			—
10	25	400	8.3	6.8	7.48	7.54			—
30	25	453	8.4	5.4	7.33	7.48	~~3~~449	220	—
~~75~~									
Inst. #		C	A	A	B	B			
Cal. by Initials	JRL	JRL	JRL	JRL	JRL	JRL	NA	NA	

Combined Samples: ☑ yes ☐ no

Comments:

Analyst: John R. Lauth

Supervisor:

Water Chemistry Bench Sheet

Work order: Dalecarlia

Date/Time: 12/21/91

Day of Test: 5

Page 3 of 3

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	25	401	7.4	2.7	7.38	7.07	104	140	NC
1	25	363	7.7	2.8	7.38	7.16			NC
3	25	355	7.5	3.2	7.32	7.21			NC
10	25	354	6.2	3.3	7.22	7.20			NC
30	25	417	2.8*	0.07	7.19	7.15	394	220	NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [] no

Comments: * aerated to 5.2 - Mortality at 30% is probably due to the low D.O. Final D.O after aeration was 2.7 at 30 (day 6). D.O in the upper liquid was 3.8.

Analyst: Annick Mikailoff

Supervisor: ______________

```
DALECARLIA S4
Fathead Minnow survival

      0      1      3      10     30
     -----  -----  -----  -----  -----
 1)  .9     .8     .8     1      .3
 2)  1      .9     .6     .7     .4
 3)  1      .7     .9     .8     .4
 4)  .9     .8     1      .9     .6

DALECARLIA S4
Fathead Minnow survival
Arc Sine Square Root TRANSFORMATION

                     TRANSFORMED         Dunnetts   significant ?     untransformed
%Effluent     N     Mean         Std     Critical  Dunnetts Steels    Mean     Critical
                                         value                                 VALUE
     0.000    4      1.410     0.186      1.070                       0.974    0.770
     1.000    4      1.114     0.106      1.070                       0.805    0.770
     3.000    4      1.203     0.287      1.070                       0.871    0.770
    10.000    4      1.230     0.251      1.070                       0.888    0.770
    30.000    4      0.709     0.128      1.070   at 5%    at 5%      0.424    0.770

Press ENTER to continue ?

Pooled root mean square error =    0.204   DF = 15

Dunnett's critical T =    2.360

Bartlett's test, B =    3.497   Df = 4
 (Critical 1% value =   13.28 )

For this data, the minimum difference that can be detected as
statistically significant is a   21.014
 % reduction in the mean response from the control

NOEC =  10.000 LOEC =  30.000 Chronic value =  17.321 %effluent

Analysis at 01:10:05 on 01-01-1980

Press ENTER to continue ?


Fathead minnow larval survival and growth test

DALECARLIA S4

Survival

           ------------------------------------------------------------
   1.0000 :    X                       /            /                   :
   0.9938 :                                                             :
   0.9755 :   +                                                         :
   0.9455 :                                                             :
   0.9045 :    X           /           /           +/                   :
   0.8536 :                           +                                 :
   0.7939 :   D           DX          D/           D/           D       :
   0.7270 :                /                        /                   :
   0.6545 :                                                             :
   0.5782 :                            /                         /      :
   0.5000 :                        .                                    :
   0.4218 :                                                     *X      :
   0.3455 :                                                             :
   0.2730 :                                                      /      :
   0.2061 :                                                             :
```

```
Fathead minnow larval survival and growth test
DALECARLIA S4
Fathead Minnow Growth

      0       1       3       10      30
     -----   -----   -----   -----   -----
 1)  .663    .734    .636    .627    .606
 2)  .574    .572    .565    .622    .542
 3)  .762    .588    .540    .606    .596
 4)  .717    .643    .465    .646    .546

DALECARLIA S4
Fathead Minnow Growth
No TRANSFORMATION

                                           Dunnetts  significant ?
%Effluent     N    Mean       Std     Critical  Dunnetts Steels
                                           value
     0.000    4    0.679     0.081     0.578
     1.000    4    0.634     0.073     0.578
     3.000    4    0.551     0.071     0.578    at  5%
    10.000    4    0.625     0.016     0.578
    30.000    4    0.573     0.033     0.578    at  5%

Press ENTER to continue ?

Pooled root mean square error =    0.060   DF =  15

Dunnett's critical T =    2.360

Bartlett's test, B =    6.663   Df = 4
 (Critical 1% value =   13.28 )

For this data, the minimum difference that can be detected as
statistically significant is a    14.843
 % reduction in the mean response from the control

NOEC =    1.000 LOEC =    3.000 Chronic value =    1.732 %effluent

Biologically Significant Level =    0.543

Analysis at 01:10:05 on 01-01-1980

Press ENTER to continue ?


Fathead minnow larval survival and growth test

DALECARLIA S4

Average weight
           ----------------------------------------------------------
   0.7750 :                                                           :
   0.7669 :                                                           :
   0.7587 :    /                                                      :
   0.7506 :                                                           :
   0.7425 :                                                           :
   0.7344 :                /                                          :
   0.7262 :                                                           :
   0.7181 :    /                                                      :
   0.7100 :                                                           :
   0.7019 :                                                           :
   0.6937 :                                                           :
```

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Effluent + Sludge Tests run concurrently
Second Test - Basin 3 Samples were aerated

Fathead Minnow / Midge Larvae Weight Data Sheet

Work Order #: Dalecarlia

Date: 1-27-92

Oven:
ID #: Effluent (0,1,10,100%) Sludge(0,1,3,10,30%)

Time: 0930 Temp: 66

Balance:
ID #: 381 000 44

Calibrated: [✓] yes [] no

Sample	Sample Size (n)	Combined Weight (mg)	Boat weight (mg)	Sample Weight (mg)	Mean Weight (mg)
LAB A	10	115.435	109.872	5.563	0.556
B	10	105.190	99.761	5.429	0.543
C	10	118.412	113.179	5.233	0.523
D	10	116.729	111.954	4.775	0.478
0 A	10	108.406	103.468	4.938	0.494
B	10	106.762	102.398	4.364	0.436
C	10	87.949	84.564	3.385	0.338
D	10	94.486	89.328	5.158	0.516
1 A	10	107.488	101.956	5.532	0.553
B	10	111.949	107.235	4.714	0.471
C	10	101.917	97.740	4.177	0.418
D	10	126.726	121.158	5.568	0.557
10 A	10	101.455	96.267	5.188	0.519
B	10	94.450	89.363	5.087	0.509
C	10	102.419	98.373	4.046	0.405
D	10	108.995	104.409	4.586	0.459
100 A	9	110.625	107.670	2.955	0.328
B	10	92.231	87.624	4.607	0.461
C	10	110.698	106.082	4.616	0.462
D	10	105.127	101.123	4.004	0.400
1 A	10	108.583	103.291	5.292	0.529
B	10	94.989	89.894	5.095	0.510
C	10	127.327	120.926	6.401	0.640
D	10	106.988	102.593	4.395	0.440
3 A	10	112.143	107.283	4.860	0.486
B	10	107.027	102.393	4.634	0.463
C	10	116.641	111.331	5.310	0.531
D	10	101.317	96.150	5.167	0.517
10 A	10	98.809	94.584	4225	0.422
B	10	110.087	105.611	4.476	0.448
C	10	102.723	97.509	5.214	0.521
D	10	110.177	105.093	5.084	0.508

Analyst: A. Mikailoff

Page 1 of 1

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Chronic Test Data Sheet

Work Order #: Dalecarlia
Beginning Date: 1-18-92 Time: 1330
Project #: Effluent
Ending Date: 1-25-92 Time: 1330

Test Type: [] Static
[✓] Static/Renewal
[] Flow Through

Test Location: [] Inc. 1 Temp: ____
[✓] Inc. 2 Temp: 25.0 ±1°C
[] Other Temp: ____

Dilution Water: Potomac River
Test Organism: P. promelas age: 30 hours
Toxicant/Effluent: Basin 3 Effluent
Source: ESL

Conc. or % Eff	No. Exp.	Mortality / Neonates Produced						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
LAB A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
0 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
1 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
10 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
100 A	10	0	0	0	0	0	0	1
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
Ini.	AM	AM	AM	AM	AM	AM	AM	AM

Analyst: Annick [illegible]
Supervisor: __________

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Chronic Test Data Sheet

Work Order #: Dalecarlia
Beginning Date: 1-18-92 Time: 1330
Project #: Sludge
Ending Date: 1-25-92 Time: 1330
Test Type: [] Static
[✓] Static/Renewal
[] Flow Through
Test Location: [] Inc. 1 Temp: ____
[✓] Inc. 2 Temp: 25.0
[] Other Temp: ____

Dilution Water: Potomac River
Test Organism: P. promelas age: 30 hours
Toxicant/Effluent: Basin 3 Sludge
Source: FSL

Conc. or % Eff	No. Exp.	Mortality / Neonates Produced						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
3 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
10 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
30 A	10	0	2	2	4 *	8	9	10
B	10	1	3	3	4 *	7	8	10
C	10	3	6	6	10 *	10	10	10
D	10	0	0	0	3 *	7	8	10
Ini.	AM	AM	AM	AM	AM	AM	AM	AM

[DO at 30 is 6.4 in liquid]

Analyst:
Supervisor: __________

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 1-18-92 / 1230

Day of Test: 1

Page 1 of 3

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
LAB	25.0	678	7.0	5.6	7.01	6.73			NC
0	25.0	380	7.6 *	6.6	8.03	7.91			NC
1	25.0	378	7.6	6.5	7.72	7.85			NC
10	25.0	381	7.6	6.2	7.46	7.58			NC
100	25.0	426	7.3	5.7	6.94	7.15			NC
1 S	25.0	382	6.5	5.4	7.36	7.43			NC
3 S	25.0	388	5.4	5.1	7.19	7.23			NC
10 S	25.0	411	3.2	4.8	7.05	7.11			NC
30 S	25.0	4.82	0.04	6.4 **	6.98	7.03			NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [] no

Comments: * 7.6 after 48h aeration

** DO in liquid portion only (0.07 overall)

The effluent concentration at 100% corresponds to 20% sludge

Analyst: Annick Mikaïl

Supervisor: __________

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 1-20-92/0905

Day of Test: 3

Page 2 of 3

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
LAB	25.0	680	7.4	6.2	6.86	6.80			NC
0	25.0	379	7.9	6.4	8.11	7.66			NC
1	25.0	380	8.4	5.8	7.83	7.56			NC
10	25.0	382	8.3	5.5	7.46	7.58			NC
100	25.0	428	8.1	4.4	6.93	7.22			NC
1	25.0	383	7.3	5.2	7.51	7.30			NC
3	25.0	386	6.3	4.9	7.29	7.24			NC
10	25.0	411	3.2	4.3	7.08	7.10			NC
30	25.0	471	0.04	1.5	7.01	6.94			NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [] no

Comments: DOs are combined top + bottom layers

sludge can't be that toxic! lots of little snails showed up in my containers today!

Analyst: Annick Mekoui/SA

Supervisor: ____________

Note: Fish at 30% sludge die because they are transferred from a liquid with hi DO to a liquid with low DO (maybe 30% would have to be aerated prior to renewal for several hrs to attain DO similar to DO in test vessels. But this would change its chemistry.

Water Chemistry Bench Sheet

Work Order: Dalecarlia

Date/Time: 1-24-92/ 1150

Day of Test: 7

Page 3 of 3

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
LAB	24.9	692	7.2	6.7	6.71	7.08			NC
0	24.9	385	7.7	4.8	7.88	7.38			NC
1	24.9	387	7.8	5.7	7.62	7.55			NC
10	24.9	389	7.9	5.5	7.21	7.52			NC
100	24.9	450	8.8	4.2	6.72	7.28			NC
1S	24.9	388	6.8	4.8	7.18	7.49			NC
3S	24.9	392	6.2	4.2	7.02	7.44			NC
10 S	24.9	438	2.1	21	6.81	7.12			NC
Inst. #	B		A		A				
Cal. by Initials	AM		AM		AM				

Combined Samples: [X] yes [] no

Comments:

Analyst: Annick Mikailoff

Supervisor: ____________

```
DALECARLIA E3
Fathead Minnow survival

       0        0.1      1        10       100
     -----    -----    -----    -----    -----
 1)    1        1        1        1        1
 2)    1        1        1        1        1
 3)    1        1        1        1        1
 4)    1        1        1        1        1


Fathead minnow larval survival and growth test
Fathead Minnow survival

Enter the maximum number of replicates per treatment:  4

Fathead minnow larval survival and growth test

DALECARLIA E3

Survival
            ----------------------------------------------------------------------
  1.0000 :  +XX          +XX           +XX          +XX          +XX          :
  0.9938 :                                                                    :
  0.9755 :                                                                    :
  0.9455 :                                                                    :
  0.9045 :                                                                    :
  0.8536 :                                                                    :
  0.7939 :                                                                    :
  0.7270 :                                                                    :
  0.6545 :                                                                    :
  0.5782 :                                                                    :
  0.5000 :                                                                    :
  0.4218 :                                                                    :
  0.3455 :                                                                    :
  0.2730 :                                                                    :
  0.2061 :                                                                    :
  0.1464 :                                                                    :
  0.0955 :                                                                    :
  0.0545 :                                                                    :
  0.0245 :                                                                    :
  0.0062 :                                                                    :
  0.0000 :  D            D             D            D            D            :
            ----------------------------------------------------------------------
            1            2             3            4            5
                     Coded Concnetration, 1 = Control

+ = mean, * = mean, significant using Steel's test
D = Dunnett's (or Fisher's) critical level
X = Data (# = data not used in the analysis)
```

```
Fathead minnow larval survival and growth test
DALECARLIA E3
Fathead Minnow Growth
  Lab control  Filter Control   % Effluent
      0      0.1      1        10      100
    -----  -----  -----  -----  -----
 1)  .556   .494   .553   .519   .328
 2)  .543   .436   .471   .509   .461
 3)  .523   .338   .418   .405   .462
 4)  .478   .516   .557   .459   .400
```

DALECARLIA E3

```
                                Dunnetts  significant ?
%Effluent    N  Mean      Std   Critical Dunnetts Steels
                                value
   0.000     4   0.525   0.034   0.423
   0.100     4   0.446   0.080   0.423
   1.000     4   0.500   0.067   0.423
  10.000     4   0.473   0.052   0.423
 100.000     4   0.413   0.064   0.423  at 5%   at 5%

Press ENTER to continue ?

Pooled root mean square error =   0.061  DF = 15

Dunnett's critical T =   2.360

Bartlett's test, B =   1.877  Df = 4
 (Critical 1% value =  13.28 )

For this data, the minimum difference that can be detected as
statistically significant is a   19.494
 % reduction in the mean response from the control

NOEC =  10.000 LOEC = 100.000 Chronic value =  31.623 %effluent

Biologically Significant Level =   0.420
Concentration at Biologically Significant Level =  75.800 %Effluent

Analysis at  on

Press ENTER to continue ?


Fathead minnow larval survival and growth test

DALECARLIA E3

Average weight
           ------------------------------------------------------------


   0.5625 :
   0.5562 :   /                         /


   0.5375 :
   0.5312 :


   0.5125 :
   0.5062 :                                          /


   0.4875 :
   0.4812 :
   0.4750 :   /                                     +
   0.4687 :                              /
   0.4625 :                                                      X
   0.4562 :                                          /
   0.4500 :
   0.4437 :               +
   0.4375 :                /
   0.4313 :
   0.4250 :  D            D             D           D            D
   0.4187 : ----------------------------/--------------------------
```

```
Fatneac minnow larval survival and growtn test

DALECARLIA E3

Average weight
           ------------------------------------------------------------

   0.5625 :
   0.5562 :   /                          /

   0.5375 :
   0.5312 :

   0.5125 :
   0.5062 :                                          /

   0.4875 :
   0.4812 :
   0.4750 :   /                                     +
   0.4687 :                              /
   0.4625 :                                                       X
   0.4562 :                                          /
   0.4500 :
   0.4437 :               +
   0.4375 :                /
   0.4313 :
   0.4250 :  D            D             D           D            D
   0.4187 : -----------------------------/--------------------------
   0.4125 :                                                      *
   0.4062 :                                          /
   0.4000 :                                                       /
   0.3937 :
   0.3875 :
   0.3812 :
   0.3750 :
   0.3687 :
   0.3625 :
   0.3563 :
   0.3500 :
   0.3438 :
   0.3375 :                /
   0.3312 :
   0.3250 :                                                       /
           ------------------------------------------------------------
             1            2             3           4            5
                    Coded Concnetration, 1 = Control

+ = mean, * = mean, significant using Steel's test
D = Dunnett's (or Fisher's) critical level
--- = Biologically significant level
X / = Data (# = data not used in the analysis)
```

```
Fathead minnow larval survival and growth test
DALECARLIA S3
Fathead Minnow survival

    0     0.1   1     3     10    30
    ----- ----- ----- ----- ----- -----
 1) 1     1     1     1     1     0
 2) 1     1     1     1     1     0
 3) 1     1     1     1     1     0
 4) 1     1     1     1     1     0


Fathead minnow larval survival and growth test
Fathead Minnow survival

Enter the maximum number of replicates per treatment:  4

Fathead minnow larval survival and growth test

DALECARLIA S3

Survival

           ------------------------------------------------------------
   1.0000 :  +XX            +XX           +XX    +XX     +XX              :
   0.9938 :                                                               :
   0.9755 :                                                               :
   0.9455 :                                                               .
   0.9045 :                                                               :
   0.8536 :                                                               :
   0.7939 :                                                               :
   0.7270 :                                                               :
   0.6545 :                                                               :
   0.5782 :                                                               :
   0.5000 :                                                               :
   0.4218 :                                                               :
   0.3455 :                                                               :
   0.2730 :                                                               :
   0.2061 :                                                               :
   0.1464 :                                                               :
   0.0955 :                                                               :
   0.0545 :                                                               :
   0.0245 :                                                               :
   0.0062 :                                                               .
   0.0000 :  D              D             D      D       D     DXX        .
           ------------------------------------------------------------
             1              2             3      4       5     6
                    Coded Concnetration, 1 = Control

+ = mean, * = mean, significant using Steel's test
D = Dunnett's (or Fisher's) critical level
X / = Data (# = data not used in the analysis)


Fathead minnow larval survival and growth test
DALECARLIA S3
Fathead Minnow Growth
```

lab control | river control | % Sludge

```
    0     0.1   1     3     10    30
    ----- ----- ----- ----- ----- -----
 1) .556  .494  .529  .486  .422
 2) .543  .436  .510  .463  .448
 3) .523  .338  .640  .531  .521
 4) .478  .516  .440  .517  .508
```

```
      0.0955 :                                                                    :
      0.0545 :                                                                    :
      0.0245 :                                                                    :
      0.0062 :                                                                    :
      0.0000 :  D                D               D       D        D       DXX     :
              -----------------------------------------------------------------
                1                2               3       4        5       6
                            Coded Concnetration, 1 = Control

  + = mean, * = mean, significant using Steel's test
  D = Dunnett's (or Fisher's) critical level
  X / = Data (# = data not used in the analysis)



  Fathead minnow larval survival and growth test
  DALECARLIA S3
  Fathead Minnow Growth

        0      0.1    1      3      10     30
       -----  -----  -----  -----  -----  -----
   1)  .556   .494   .529   .486   .422
   2)  .543   .436   .510   .463   .448
   3)  .523   .338   .640   .531   .521
   4)  .478   .516   .440   .517   .508

  DALECARLIA S3
  Fathead Minnow Growth
  No TRANSFORMATION

                                         Dunnetts  significant ?
  %Effluent     N    Mean        Std     Critical Dunnetts Steels
                                         value
        0.000    4    0.525    0.034    0.426
        0.100    4    0.446    0.080    0.426
        1.000    4    0.530    0.083    0.426
        3.000    4    0.499    0.031    0.426
       10.000    4    0.475    0.047    0.426

  Press ENTER to continue ?

  Pooled root mean square error =   0.059  DF = 15

  Dunnett's critical T =   2.360

  Bartlett's test, B =   4.250  Df = 4
   (Critical 1% value =   13.28 )

  For this data, the minimum difference that can be detected as
  statistically significant is a   18.827
   % reduction in the mean response from the control

  NOEC =  10.000 %effluent

  Biologically Significant Level =   0.420

  Analysis at  on

  Press ENTER to continue ?

  Subscript out of range in 6220█

  Ok█
```

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Fathead Minnow / Midge Larvae Weight Data Sheet

Work Order #: Georgetown 2 - Effluent.

Date: 3-11-92

Oven:

ID #: 26615

Time: 1130 Temp: 66°C

Balance:

ID #: 381 00044

Calibrated: [✓] yes [ ] no

Sample	Number Exposed	Number Recovered (n)	Combined Weight (mg)	Boat weight (mg)	Sample Weight (mg)	Mean Weight (mg)
LAB OA	10	9	119.303	114.668	4.635	0.464
OB	10	10	100.635	96.185	4.450	0.445
OC	10	10	97.778	92.387	5.391	0.539
OD	10	10	103.538	98.865	4.673	0.467
0 A	10	10	108.303	103.424	4.879	0.488
0 B	10	10	113.600	108.922	4.678	0.468
0 C	10	10	112.175	107.373	4.802	0.480
0 D	10	10	134.204	129.483	4.721	0.472
1 A	10	10	123.777	117.865	5.912	0.591
1 B	10	10	124.666	120.220	4.446	0.445
1 C	10	10	124.343	118.568	5.775	0.578
1 D	10	10	126.361	122.015	4.346	0.435
10 A	10	10	115.124	110.956	4.168	0.417
10 B	10	10	101.108	96.972	4.136	0.414
10 C	10	10	114.916	109.711	5.205	0.520
10 D	10	9	108.457	104.449	4.008	0.445
100 A	10	10	135.588	130.748	4.840	0.484
100 B	10	10	139.633	134.207	5.426	0.543
100 C	10	10	140.775	135.556	5.219	0.522
100 D	10	10	132.818	127.734	5.084	0.508

Analyst: A.

Page 1 of 2

Fathead Minnow / Midge Larvae Weight Data Sheet

Work Order #: Georgetown 2- Sludge - Date: 3-11-92

Oven: Balance:

ID #: 26615 ID #: 381 000 44

Time: 1130 Temp: 66°C Calibrated: [✓ yes] [] no

Sample	Number Exposed	Number Recovered (n)	Combined Weight (mg)	Boat weight (mg)	Sample Weight (mg)	Mean Weight (mg)
1 A	10	10	121.931	118.491	3.440	0.344
B	10	10	122.558	118.220	4.338	0.434
C	10	10	126.607	122.608	3.999	0.400
D	10	10	149.787	145.932	3.855	0.386
3 A	10	10	143.015	138.897	4.118	0.412
B	10	10	138.847	134.351	4.496	0.450
C	10	10	127.702	123.797	3.905	0.390
D	10	10	129.517	125.399	4.118	0.412
10 A	10	10	122.425	119.205	3.220	0.322
B	10	10	136.386	132.445	3.941	0.394
C	10	10	138.760	135.878	2.882	0.288
D	10	10	150.346	146.155	4.191	0.419
30 A	10	10	139.580	136.751	2.829	0.283
B	10	10	136.762	134.521	2.241	0.224
C	10	10	135.011	133.031	1.980	0.198
D	10	10	141.514	139.219	2.295	0.230

Analyst: A Mikailoff Page 2 of 2

Chronic Test Data Sheet

Work Order #: Dalecarlia
Beginning Date: 3-2-92 Time: 1345
Project #: Basin 2 - Effluent
Ending Date: 3-9-92 Time: 1345
Test Type: ☐ Static
☑ Static/Renewal
☐ Flow Through
Test Location: ☐ Inc. 1 Temp:
☒ Inc. 2 Temp: 25.0±1°C
☐ Other Temp:

Dilution Water: Potomac River
Test Organism: P. promelas age: <24h
Toxicant/Effluent: Basin 2 - Effluent
Source: ESL

Conc. or % Eff	No. Exp.	Mortality / Neonates Produced						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
LAB A	10	0	0	1	1	1	1	1
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
0 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
1 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
10 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	1
100 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
Ini.	AM	AM	AM	AM	AM	AM	AM	AM

Analyst: A Mikail
Supervisor:

VPI & SU University Center for Environmental and Hazardous Materials Studies, Aquatic Ecotoxicology Laboratory

Chronic Test Data Sheet

Work Order #: Dalecarlia
Project #: Georgetown 2
Test Type: ☐ Static
☑ Static/Renewal
☐ Flow Through

Beginning Date: 3-2-92 Time: 1345
Ending Date: 3-9-92 Time: 1345
Test Location: ☐ Inc. 1 Temp: ____
☑ Inc. 2 Temp: 25±1°C
☐ Other Temp: ____

Dilution Water: Potomac River
Test Organism: P. promelas age: <24h
Toxicant/Effluent: Georgetown2 Alum Sludge
Source: ESL

Conc. or % Eff	No. Exp.	Mortality / Neonates Produced						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
3 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
10 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
30 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
Ini.	AM	AM	AM	AM	AM	AM	AM	AM

Analyst: Annick Mikailoff
Supervisor: ____________

VPI & SU University Center for Environmental and Hazardous Material Studies Aquatic Ecotoxicology Laboratory

Water Chemistry Bench Sheet

Work Order: Dalecarlia - Basin 2 .   Date/Time: 3-2-92 / 1345

Day of Test: 1   Page 1 of 3

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
LAB 0	24.9	630	7.3	6.4	7.12	6.79	65	100	NC
0	24.9	375	7.7	6.3	8.23	7.53	108	150	NC
1	24.9	374	7.8	6.2	8.17	7.66			NC
10	24.9	370	7.9	6.2	7.82	7.61			NC
100	24.9	348	8.9	5.8	6.47	7.04	65	120	NC
1S	24.9	360	7.8	5.1	7.45	7.41			NC
3S	24.9	362	7.6	5.0	7.17	7.23			NC
10S	24.9	333	7.4	5.3	6.88	7.08			NC
30 S	24.9	338	5.1	4.8	6.76	6.99			NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [ ] no

Comments: Aerated sludge samples for 30 minutes.
End of day DOs are measured in liquid upper portion (combined samples)

Analyst: Annick Mikail   Supervisor: ______________

Water Chemistry Bench Sheet

Work Order: Dalecarlia-Basin 2 Date/Time: 3-4-92 / 1315

Day of Test: 3 Page 2 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
LAB 0	24.9	628	7.4	6.0	6.93	6.54	65	100	0
0	24.9	377	7.9	5.4	8.04	7.28	108	150	NC
1	24.9	376	8.0	5.2	7.97	7.33			NC
10	24.9	374	8.1	5.6	7.61	7.36			NC
100	24.9	350	8.9	5.0	6.61	6.91	65	120	NC
1S	24.9	362	8.6	6.0	7.67	7.24			NC
3S	24.9	353	8.2	5.9	7.53	7.22			NC
10S	24.9	348	6.4	5.5	7.10	7.12			NC
30S	24.9	300	6.2	5.0	6.70	7.03			NC
Inst. #	B	C	A	A	A	A			A
Cal. by Initials	AM	AM	AM	AM	AM	AM			AM

Combined Samples: [✓] yes [] no

Comments:

Analyst: Annick Supervisor: ____________

VPI & SU University Center for Environmental and Hazardous Material Studies Aquatic Ecotoxicology Laboratory

Water Chemistry Bench Sheet

Work Order: Dalecarlia - Basin 2

Date/Time: 3-6-92 / 1245

Day of Test: 5

Page 3 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
LAB	24.9	625	7.0	6.4	6.62	6.64	65	100	0
0	24.9	380	7.6	5.9	7.96	7.38	108	150	NC
1	24.9	379	7.6	5.9	7.88	7.45			NC
10	24.9	376	7.7	6.0	7.53	7.41			NC
100	24.9	351	9,2	5.6	6.63	7,00	65	120	NC
1	24.9	363	8,2	6,2	7,77	7,29			NC
3	24.9	365	7,5	5.8	7,43	7,27			NC
10	24.9	328	6.0	5,2	7,21	7,19			NC
30	24.9	306	5,8	4.8	6,91	7,13			NC
Inst. #	B	C	A	A	A	A			A
Cal. by Initials	AM	AM	AM	AM	AM	AM			AM

Combined Samples: [✓] yes [] no

Comments:

Analyst:

Supervisor: ______________

```
[illegible]

Press ENTER to continue
CHRONIC TOXICITY ANALYSIS PROGRAM

[illegible]

[illegible]
[illegible] Data To a File
[illegible] Data
[illegible]
[illegible]
[illegible] Analyze Selected Data
[illegible]
[illegible]

[illegible] FOLLOWED BY RETURN:

Fathead minnow larval survival and growth test
Georgetown EE
Fathead Minnow survival

     0     1     10    100
     ----- ----- ----- -----
 1)  1     1     1     1
 2)  1     1     1     1
 3)  1     1     1     1
 4)  1     1     .9    1
Division by zero

Georgetown EE
Fathead Minnow survival
Arc Sine Square Root TRANSFORMATION

                       TRANSFORMED        Dunnetts  significant ?    untransformed
%Effluent     N    Mean         Std    Critical  Dunnetts Steels    Mean     Critical
                                       value                                 VALUE
*     0.000    4    1.571   0.000    1.571                          1.000    1.000
*     1.000    4    1.571   0.000    1.571   at 5%                  1.000    1.000
     10.000    4    1.490   0.161    1.571   at 5%                  0.994    1.000
*   100.000    4    1.571   0.000    1.571   at 5%                  1.000    1.000

Press ENTER to continue ?

Pooled root mean square error =   0.161  DF = 3

Dunnett's critical T =   0.000

Bartlett's test, B =   0.000  Df = 0
 (Critical 1% value =  0 )

++ one-sided 2.5% T test used in place of Dunnett's test, results are approxima
e
For this data, the minimum difference that can be detected as
statistically significant is a     0.000
 % reduction in the mean response from the control

NOEC =    0.000 LOEC =    1.000 Chronic value =   0.000 %effluent

*  This concentration not used for pooled error or Bartlett's test.

Unusual value: conc = 10  data =   0.900 ratio =  -1.210 is >1 or <-1
Analysis at 00:31:30 on 01-01-1980
```

```
e-sided 2.5% test used in place of Dunnett's test, results are approximat

or this data, the minimum difference that can be detected as
atistically significant is a    0.000
% reduction in the mean response from the control

OEC =    0.000 LOEC =    1.000 Chronic value =    0.000 %effluent

  This concentration not used for pooled error or Bartlett's test.

nusual value: conc = 10  data =    0.900 ratio =  -1.210 is >1 or (-1
alysis at 00:31:30 on 01-01-1980

ess ENTER to continue ?

athead m nnow larval survival and growth test

orgetown 2E

urvival
             ------------------------------------------------------------------------------
  1.0000 :   DXX                  DXX                  DX/                  DXX         :
  0.9938 :                                             +                                :
  0.9755 :                                                                              :
  0.9455 :                                                                              :
  0.9045 :                                              /                               :
  0.8536 :                                                                              :
  0.7939 :                                                                              :
  0.7270 :                                                                              :
  0.6545 :                                                                              :
  0.5782 :                                                                              :
  0.5000 :                                                                              :
  0.4218 :                                                                              :
  0.3455 :                                                                              :
  0.2730 :                                                                              :
  0.2061 :                                                                              :
  0.1464 :                                                                              :
  0.0955 :                                                                              :
  0.0545 :                                                                              :
  0.0245 :                                                                              :
  0.0062 :                                                                              :
  0.0000 :                                                                              :
             ------------------------------------------------------------------------------
              1                     2                    3                    4
                        Coded Concnetration, 1 = Control

= mean, * = mean, significant using Steel's test
 = Dunnett's (or Fisher's) critical level
/ = Data (# = data not used in the analysis)


thead minnow larval survival and growth test
orgetown 2E
thead Minnow Growth

   0       1       10      100
 -----   -----   -----   -----
  .458    .591    .417    .484
  .468    .445    .414    .543
  .480    .578    .520    .522
  .472    .435    .445    .508

        --
```

```
Turn the printer OFF using Ctrl-PrtSc if desired

Press ENTER to continue ?

Fathead minnow larval survival and growth test
Georgetown 2 S
Fathead Minnow survival

      0      1      3      10     30
    -----  -----  -----  -----  -----
 1)   1      1      1      1      1
 2)   1      1      1      1      1
 3)   1      1      1      1      1
 4)   1      1      1      1      1


Fathead minnow larval survival and growth test
Fathead Minnow survival

Enter the maximum number of replicates per treatment:  4                     ?

Fathead minnow larval survival and growth test

Georgetown 2 S

Survival

               ------------------------------------------------------------
   1.0000 :   +XX          +XX          +XX           +XX           +XX        :
   0.9938 :                                                                    :
   0.9755 :                                                                    :
   0.9455 :                                                                    :
   0.9045 :                                                                    :
   0.8536 :                                                                    :
   0.7939 :                                                                    :
   0.7270 :                                                                    :
   0.6545 :                                                                    :
   0.5782 :                                                                    :
   0.5000 :                                                                    :
   0.4218 :                                                                    :
   0.3455 :                                                                    :
   0.2730 :                                                                    :
   0.2061 :                                                                    :
   0.1464 :                                                                    :
   0.0955 :                                                                    :
   0.0545 :                                                                    :
   0.0245 :                                                                    :
   0.0062 :                                                                    :
   0.0000 :   D            D            D             D             D          :
               ------------------------------------------------------------
              1            2            3             4             5
                      Coded Concnetration, 1 = Control

+ = mean, * = mean, significant using Steel's test
D = Dunnett's (or Fisher's) critical level
X / = Data (# = data not used in the analysis)


Fathead minnow larval survival and growth test
Georgetown 2 S
Fathead Minnow Growth

      0      1      3      10     30
    -----  -----  -----  -----  -----
```

```
thead Minnow Growth

    0      1      3      10     30
    -----  -----  -----  -----  -----
)   .488   .344   .412   .322   .283
)   .468   .434   .450   .394   .224
)   .480   .400   .390   .288   .198
)   .472   .386   .412   .419   .230

orgetown 2 S
thead Minnow Growth
 TRANSFORMATION

                                    Dunnetts  significant ?
ffluent    N    Mean        Std     Critical Dunnetts Steels
                                    value
   0.000   4    0.477     0.009     0.414
   1.000   4    0.391     0.037     0.414   at 5%    at 5%
   3.000   4    0.416     0.025     0.414            at 5%
  10.000   4    0.356     0.061     0.414   at 5%    at 5%
  30.000   4    0.234     0.036     0.414   at 5%    at 5%

ess ENTER to continue ?

oled root mean square error =   0.038  DF = 15

nnett's critical T =    2.360

rtlett's test, B =    7.624  Df = 4
Critical 1% value =  13.28 )

r this data, the minimum difference that can be detected as
atistically significant is a   13.174
 reduction in the mean response from the control

EC =    0.000 LOEC =    1.000 Chronic value =    0.000 %effluent

ologically Significant Level =   0.382
ncentration at Biologically Significant Level =   5.966 %Effluent

alysis at   on

ess ENTER to continue ?


thead minnow larval survival and growth test

orgetown 2 S

erage weight
            --------------------------------------------------------------
 0.5000 :                                                               :
 0.4919 :    /                                                          :
 0.4837 :    /                                                          :
 0.4756 :   +/                                                          :
 0.4675 :    /                                                          :
 0.4594 :                                                               :
 0.4513 :                             /                                 :
 0.4431 :                                                               :
 0.4350 :                 /                                             :
 0.4269 :                                                               :
 0.4188 :                            *              /                   :
 0.4106 :   D            D           DX           D            D        :
 -  ---                                                                 :
```

Fathead Minnow / Midge Larvae Weight Data Sheet

Work Order #: Georgetown I

Date: 3-19-92

Oven:

ID #: 26655

Time: 0930 Temp: 67°C

Balance:

ID #: 38100044

Calibrated: [✓] yes [] no

Sample	Number *Exposed*	Number *Recovered* (n)	Combined *Weight* (mg)	Boat weight *(mg)*	Sample *Weight* (mg)	Mean Weight (mg)
0 A	10	10	121.402	115.692	5.710	0.571
B	10	10	113.627	108.680	4.947	0.495
C	10	10	119.700	114.014	5.686	0.569
D	10	10	120.563	114.785	5.778	0.578
1 A	10	10	130.189	124.621	5.579	0.558
B	10	10	129.682	124.374	5.308	0.531
C	10	10	129.186	124.565	4.621	0.462
D	10	10	121.438	117.164	4.274	0.427
3 A	10	10	118.125	112.369	5.756	0.576
B	10	10	118.078	112.826	5.252	0.525
C	10	10	119.604	113.795	5.809	0.581
D	10	10	123.999	118.633	5.366	0.537
10 A	10	10	125.871	120.117	5.754	0.575
B	10	10	124.679	119.299	5.380	0.538
C	10	10	124.486	119.447	5.039	0.504
D	10	10	123.789	117.442	6.347	0.635
30A	10	10	118.913	113.899	5.014	0.501
B	10	10	112.187	107.812	4.375	0.438
C	10	10	121.261	116.419	4.842	0.484
D	10	10	117.094	112.061	5.033	0.503

Analyst: Annick Mikailoff

Page 1 of 1

Chronic Test Data Sheet

Work Order #: Georgetown I
Beginning Date: 3-10-92 Time: 1400
Project #: Alum Sludge
Ending Date: 3-17-92 Time: 1400
Test Type: [ ] Static
[✓] Static/Renewal
[ ] Flow Through
Test Location: [ ] Inc. 1 Temp: ____
[✓] Inc. 2 Temp: 24.9
[ ] Other Temp: ____

Dilution Water: Potomac River
Test Organism: P. promelas age: <24h
Toxicant/Effluent: Alum sludge
Source: ESL

Conc. or % Eff	No. Exp.	Mortality / Neonates Produced						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
0 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
1 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
3 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
10 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
30 A	10	0	0	0	0	0	0	0
B	10	0	0	0	0	0	0	0
C	10	0	0	0	0	0	0	0
D	10	0	0	0	0	0	0	0
Ini.	AM	AM	AM	AM	AM	AM	AM	AM

Analyst: A. Mikailoff
Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: Georgetown 1 (Alum sludge)   Date/Time: 3-10-92 / 1400

Day of Test: 1   Page 1 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	25	387	7.6	5.2	8.08	7.15	108	150	NC
1	25	379	7.7	5.9	7.78	7.24			NC
3	25	367	7.7	5.4	7.70	7.20			NC
10	25	362	7.1	5.3	7.40	7.07			NC
30	25	373	6.8	5.2	6.88	7.05	ND	ND	NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [] no

Comments:
Aerated samples for 1 hour prior to adding fish.

Analyst: Annick   Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: Georgetown 1 (Alum Sludge)

Date/Time: 3-13-92/

Day of Test: 3

Page 2 of 3

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	24.9	386	7.7	5.2	8.06	7.31	108	150	NC
1	24.9	382	7.7	5.9	7.71	7.39			NC
3	24.9	374	7.6	5.5	7.59	7.36			NC
10	24.9	362	7.0	5.0	7.23	7.26			NC
30	24.9	378	6.9	5.3	6.85	7.18			NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [] no

Comments:

Analyst: Annick Mikaitoff

Supervisor: ____________

VPI & SU University Center for Environmental and Hazardous Material Studies Aquatic Ecotoxicology Laboratory

Water Chemistry Bench Sheet

Work Order: Georgetown I (Alum sludge)

Date/Time: 3-16-92 / 0945

Day of Test: 6

Page 3 of 3

Sample	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	24.9	385	7.7	5.4	8.02	7.18	108	150	NC
1	24.9	384	7.4	5.6	7.60	7.08			NC
3	24.9	378	7.4	5.3	7.49	6.97			NC
10	24.9	363	6.5	5.1	6.82	6.87			NC
30	24.9	389	6.4	5.5	6.77	6.83			NC
Inst. #	B	C	A	A	A	A			
Cal. by Initials	AM	AM	AM	AM	AM	AM			

Combined Samples: [✓] yes [ ] no

Comments:

Analyst: Annick Mikcaitis

Supervisor: ____________

```
athead minnow larval survival and growth test
eorgetown 1
athead Minnow survival

     0      1      3      10     30
    ----- ----- ----- ----- -----
1)   1      1      1      1      1
2)   1      1      1      1      1
3)   1      1      1      1      1
4)   1      1      1      1      1
```

```
athead minnow larval survival and growth test
athead Minnow survival

nter the maximum number of replicates per treatment:  4
```

```
athead minnow larval survival and growth test

eorgetown 1

urvival
             ----------------------------------------------------------------
   1.0000 :   +XX          +XX          +XX          +XX          +XX          :
   0.9938 :                                                                    :
   0.9755 :                                                                    :
   0.9455 :                                                                    :
   0.9045 :                                                                    :
   0.8536 :                                                                    :
   0.7939 :                                                                    :
   0.7270 :                                                                    :
   0.6545 :                                                                    :
   0.5782 :                                                                    :
   0.5000 :                                                                    :
   0.4218 :                                                                    :
   0.3455 :                                                                    :
   0.2730 :                                                                    :
   0.2061 :                                                                    :
   0.1464 :                                                                    :
   0.0955 :                                                                    :
   0.0545 :                                                                    :
   0.0245 :                                                                    :
   0.0062 :                                                                    :
   0.0000 :   D            D            D            D            D            :
             ----------------------------------------------------------------
              1            2            3            4            5
                     Coded Concnetration, 1 = Control

 = mean, * = mean, significant using Steel's test
 = Dunnett's (or Fisher's) critical level
 / = Data (# = data not used in the analysis)
```

```
athead minnow larval survival and growth test
eorgetown 1
athead Minnow Growth
```

```
Georgetown 1
Fathead Minnow Growth

      0      1      3      10     30
      -----  -----  -----  -----  -----
 1)   .571   .558   .576   .575   .501
 2)   .495   .531   .525   .538   .438
 3)   .569   .462   .581   .504   .484
 4)   .578   .427   .537   .635   .503

Georgetown 1
Fathead Minnow Growth
No TRANSFORMATION

                                      Dunnetts  significant ?
%Effluent    N    Mean        Std     Critical Dunnetts Steels
                                      value
     0.000   4    0.553    0.039    0.479
     1.000   4    0.495    0.060    0.479
     3.000   4    0.555    0.028    0.479
    10.000   4    0.563    0.056    0.479
    30.000   4    0.482    0.030    0.479

Press ENTER to continue ?

Pooled root mean square error =    0.045   DF = 15

Dunnett's critical T =    2.360

Bartlett's test, B =    2.517  Df = 4
 (Critical 1% value =   13.28 )

For this data, the minimum difference that can be detected as
statistically significant is a   13.503
 % reduction in the mean response from the control

NOEC =  30.000 %effluent

Biologically Significant Level =   0.443

Analysis at  on

Press ENTER to continue ?


Fathead minnow larval survival and growth test

Georgetown 1

Average weight
           --------------------------------------------------------------
   0.6500 :                                                              :
   0.6431 :                                                              :
   0.6362 :                                          /                   :
   0.6294 :                                                              :
   0.6225 :                                                              :
   0.6156 :                                                              :
   0.6087 :                                                              :
   0.6019 :                                                              :
   0.5950 :                                                              :
   0.5881 :                                                              :
   0.5812 :     /                       /                                :
   0.5744 :     /                       /            /                   :
   0.5675 :     /                                                        :
```

Appendix III

Reference Toxicity Test Data for Fathead Minnows

Table 3A. Acute (24- and 48-hr) toxicity of cadmium reference toxicant to fathead minnow larvae (12 to 24-hr old) in US EPA (laboratory) water initiated on December 17-19, 1991 (replicates A and B combined, n = 20 fish per treatment).

Nominal Cadmium Concentration (μg/L)	Mortality	
	24 hr	48 hr
0	0	0
10	0	0
20	0	0
40	10	30
80	10	70
160	40	90
320	65	100
LC_{50} (μg/L)	218.02	61.55
95% LCL[a]	157.89	49.21
95% UCL[a]	365.99	77.00

[a] LCL and UCL indicate lower and upper confidence limits, respectively.

Table 3B. Acute (24- and 48-hr) toxicity of cadmium reference toxicant to fathead minnow larvae (12 to 24-hr old) in US EPA (laboratory) water initiated on January 20-22, 1992 (replicates A and B combined, n = 20 fish per treatment).

Nominal Cadmium Concentration (μg/L)	Mortality (%)	
	24 hr	48 hr
0	0	0
10	10	10
20	15	55
40	40	70
80	50	100
160	100	100
LC_{50} (μg/L)	54.37	22.13
95% LCL[a]	42.21	17.03
95% UCL[a]	71.19	28.76

[a] LCL and UCL indicate lower and upper confidence limits, respectively.

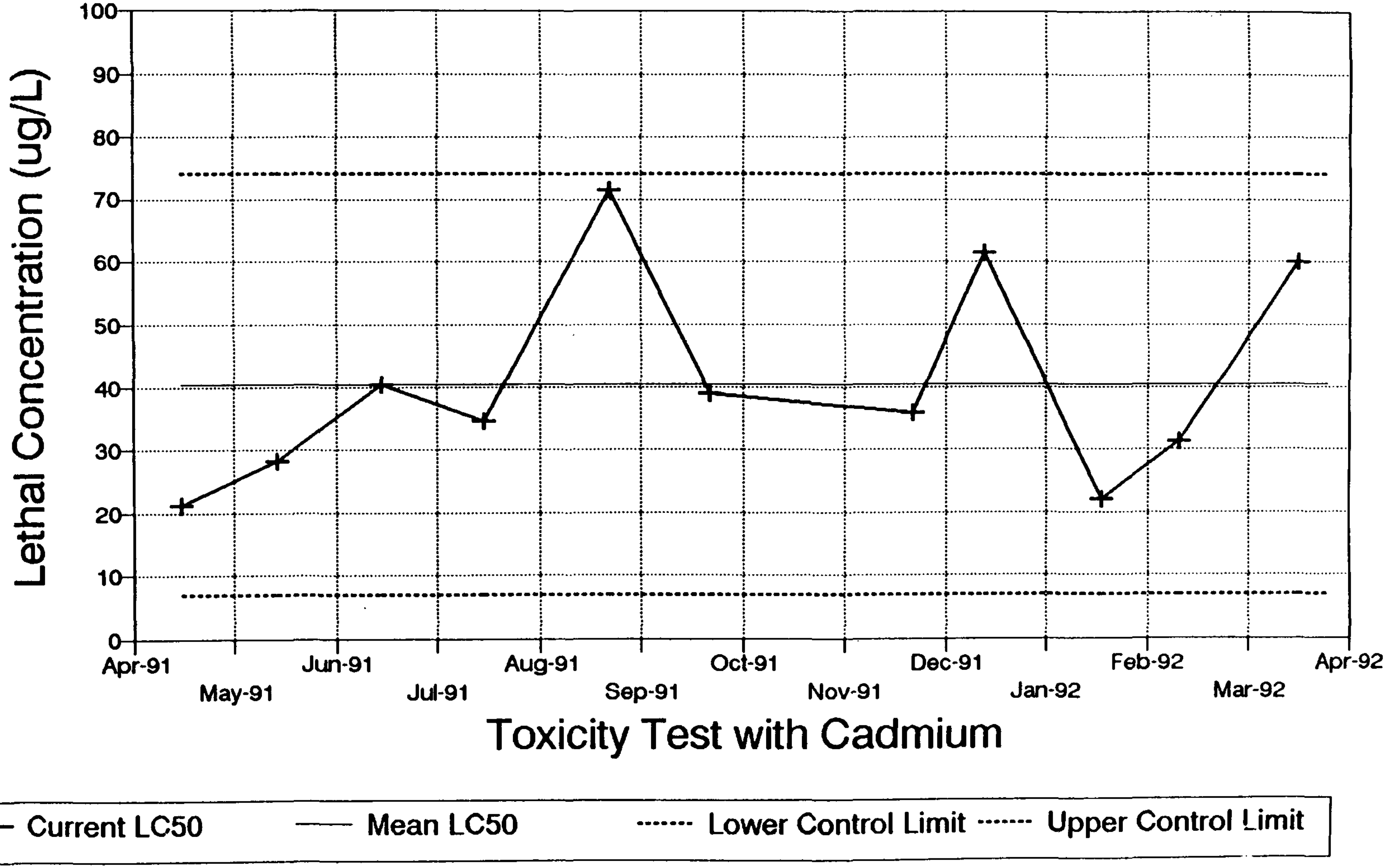
Table 3C. Acute (24- and 48-hr) toxicity of cadmium reference toxicant to fathead minnow larvae (12 to 24-hr old) in US EPA (laboratory) water initiated on March 20-22, 1992 (replicates A and B combined, n = 20 fish per treatment).

Nominal Cadmium Concentration (μg/L)	Mortality	
	24 hr	48 hr
0	0	0
12.5	0	5
25	0	5
50	0	20
50	10	40
100	40	60
200	75	95
400	95	100
LC_{50} (μg/L)	122.41	60.61
95% LCL[a]	95.75	45.91
95% UCL[a]	156.48	80.04

[a] LCL and UCL indicate lower and upper confidence limits, respectively.

Control Chart

Fathead Minnow Larvae (EPA Water)



Biology Department and University Center for Environmental
& Hazardous Materials Studies

Aquatic Ecotoxicology Laboratory Work Order

Client: n/A

Project No. n/A

Work Description: FHM-Cd-Ref-EPA

Work Order Number: 1009

Assigned To: Stuart Cynde

Sample ID No.

Test Conditions:

Organism and Age: FHM ≤ 48 h from BMI

Test Mode: Static Acute

Test Duration: 48 h

Dilution Water: EPA

Concentrations: 320, 160, 80, 40, 20, 10, 0 ug/L

Replicates: 2

Temperature: 25 ± 2

Feeding Regime: None

Special Conditions:

Conducted on Midge Shelf

Initiation Date: 12-17-91

Completion Date: 12-19-91

Assigned By: Stuart Cynde

Date: 12-17-91

Acute Test Data Sheet

Work Order #: 1009

Beginning Date: 12-17-91 Time: 500p

Project #:

Ending Date: 12-19-91 Time: 500p

Test Type: [✓] Static

[] Static/Renewal

[] Flow Through

Test Location: [] Inc. 1 Temp:

[] Inc. 2 Temp:

[✓] Other Temp: 25±1

midge shelf

Dilution Water: EPA - 12-17-91

Test Organism: FHM age: ≤48h

Toxicant/Effluent: Cd

Source: BM1-12-16-91

Conc. or % Eff	No. Exp.	Number Surviving				
		0 h	24 h	48 h	72 h	96 h
0.0 A	10	10	10	10		
B	10	10	10	10		
20.0 A	10	10	10	10		
B	10	10	10	10		
40 A	10	10	10	8		
B	10	10	8	6		
80 A	10	10	9	3		
B	10	10	9	3		
160 A	10	10	4	1		
B	10	10	5	1		
320 A	10	10	5	0		
B	10	10	2	0		
10 A	10	10	10	10		
B	10	10	10	10		
Initial						

Analyst:

Supervisor:

Water Chemistry Bench Sheet

Work Order: 1009

Date/Time: 12-11-91 / 5:00p.

Day of Test: Beg.

Page 1 of 1

Sample ug/L	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0.0	22.1	299.7 ~~256~~ sr		8.15		7.97	55.6	80.0	
10	22.1	301.8 ~~256~~		8.25		7.94			
20	22.1	301.8 ~~256~~		8.15		7.94			
40	22.1	301.8		8.15		7.92			
80	22.1	301.8		8.2		7.84			
160	22.1	303		8.20		7.70			
320	22.1	305		8.10		7.49	53.1	80.0	
Inst. #	QC1	D	N/A	D	N/A	C	N/A	N/A	N/A
Cal. by Initials		MY		MY		MY			

Combined Samples: [✓] yes [ ] no

Comments:

Analyst: Stuart Rlyat

Supervisor: __________

Water Chemistry Bench Sheet

Work Order: 1009

Date/Time: 12-19-91 5:30 p

Day of Test: end

Page 1 of 1

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0.0	23.5	298		7.70		7.89	55	80	
10		298		7.70		7.89			
20		300		7.60		7.89			
40		303		7.60		7.89			
80		303		7.60		7.89			
160		303		7.70		7.89			
320	23.5	303		7.70		7.69	50	80	
Inst. #	QC1	D		D					
Cal. by Initials									

Combined Samples: [✓] yes [] no

Comments:

Analyst:

Supervisor:

```
                     EPA PROBIT ANALYSIS PROGRAM
                   USED FOR CALCULATING EC VALUES
                            Version 1.4


#1009 FHM Cd Ref in EPA (12/17-12/19) SRL (Anal SRL)

                                     Observed        Adjusted        Predicted
             Number       Number     Proportion      Proportion      Proportion
   Conc.     Exposed      Resp.      Responding      Responding      Responding

  10.0000      20           0          0.0000          0.0000          0.0015
  20.0000      20           0          0.0000          0.0000          0.0330
  40.0000      20           6          0.3000          0.3000          0.2405
  80.0000      20          14          0.7000          0.7000          0.6660
 160.0000      20          18          0.9000          0.9000          0.9409
 320.0000      20          20          1.0000          1.0000          0.9965

i - Square Heterogeneity =     1.876

           =      1.789199
gma        =      0.265569

ameter            Estimate     Std. Err.          95% Confidence Limits
------------------------------------------------------------------------------
ercept          -1.737231      1.099925     (    -3.893084,       0.418622)
pe               3.765501      0.606871     (     2.576034,       4.954969)

oretical Spontaneous Response Rate = 0.0000
```

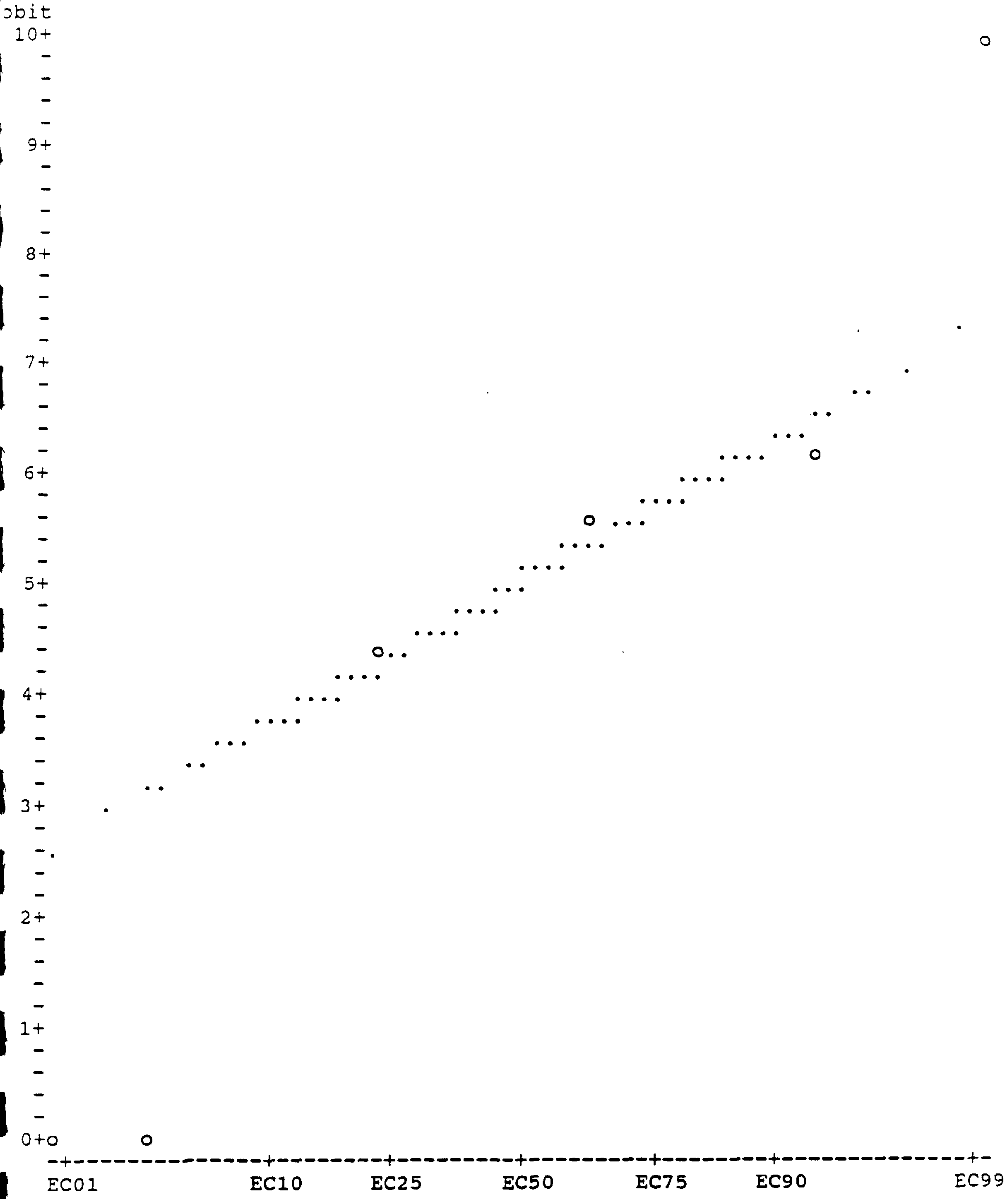
WO#1009 FHM Cd Ref in EPA (12/17-12/19) SRL (Anal SRL)

Estimated EC Values and Confidence Limits

Point	Conc.	Lower 95% Confidence	Upper Limits
EC 1.00	14.8390	7.3371	21.8989
EC 5.00	22.5094	13.2618	30.5760
EC10.00	28.1090	18.0836	36.7323
EC15.00	32.6560	22.2111	41.7286
EC50.00	61.5459	49.2071	76.9953
EC85.00	115.9937	90.7503	170.6599
EC90.00	134.7572	103.0893	209.6220
EC95.00	168.2803	123.8397	285.8520
EC99.00	255.2654	172.9010	516.6995

#1009 FHM Cd Ref in EPA (12/17-12/19) SRL (Anal SRL)

PLOT OF ADJUSTED PROBITS AND PREDICTED REGRESSION LINE



Biology Department and University Center for Environmental
& Hazardous Materials Studies

Aquatic Ecotoxicology Laboratory Work Order

Client: N/A

Project No. N/A

Work Description: FHM Rep Test

Work Order Number: 1017

Assigned To: DoBBS

Sample ID No. AA Cd Rep Sol

Test Conditions:

Organism and Age: FHM ≤ ~~24~~ h rce 1-20-92 48hrs.

Test Mode: Static Acute

Test Duration: 48 h

Dilution Water: EPA - Moderately Hard Water Batch # 1-16-92

Concentrations: Your Discretion

Replicates: 2

Temperature: 25 ± 2

Feeding Regime: None

Special Conditions:

Initiation Date: ASAP

Completion Date: 1-22-92

Assigned By: Don S Cherry

Date: 1-15-92

Acute Test Data Sheet

Work Order #: ~~1016~~ 1017 MO 1-20-92

Beginning Date: 1-20-92 Time: 3:30pm

Project #: NA

Ending Date: 1-22-92 Time: 3:00pm

Test Type: ☒ Static
☐ Static/Renewal
☐ Flow Through

Test Location: ☐ Inc. 1 Temp: ____
☐ Inc. 2 Temp: ____
☒ Other Temp: 25.0 °C
Water Bath in 1027A

Dilution Water: EPA Mod. Hard

Test Organism: Fathead age: ≤48hrs

Toxicant/Effluent: Cd

Source: ESL

ug Cd/L Conc. or ~~% Eff~~	No. Exp.	Number Surviving				
		0 h	24 h	48 h	72 h	96 h
0 A	10	10	10	10	NA	NA
B	10	10	10	10		
10 A	10	10	8	8		
B	10	10	10	10		
20 A	10	10	9	~~3~~ 4 MO 1-22-92		
B	10	10	8	5		
40 A	10	10	5	3		
B	10	10	7	3		
80 A	10	10	~~8~~ 5 MO 1-21-92	0		
B	10	10	5	0		
160 A	10	10	0	0		
B	10	10	0	0		
Initial	MO	MO	MO	MO	MO	MO

Analyst: Michael

Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: 1017

Date/Time: 1-20-92/5pm

Day of Test: 0

Page 3 of 6

Sample µg Cd/L	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	24.9	296/22.6	NA	7.8	NA	7.93	60.0	840	NA
10	NA	NA		7.8		NA	NA	NA	
20				7.7					
40				7.8					
80	↓	↓		7.9		↓	↓	↓	
160	24.7	296/22.6	↓	7.8	↓	7.95	59.5	85.0	↓
Inst. #		D		C		C	C		
Cal. by Initials									

Combined Samples: [✓ yes] [] no

Comments: EPA H_2O

Analyst:

Supervisor:

VPI & SU University Center for Environmental and Hazardous Material Studies Aquatic Ecotoxicology Laboratory

Water Chemistry Bench Sheet

Work Order: 1017

Date/Time: 1/21/92 /

Day of Test: 1

Page 4 of 6

Sample ug Cd/L	Temp (°C)	Cond. (µmhos)	DO (mg/L) AM	DO (mg/L) PM	pH AM	pH PM	Alk mg/L	Hard mg/L	TRC mg/L
0	24.7	NA	NA	7.5	NA	NA	NA	NA	NA
10	NA	↓	↓	7.5	↓	↓	↓	↓	↓
20	↓	↓	↓	7.4	↓	↓	↓	↓	↓
40	↓	↓	↓	7.5	↓	↓	↓	↓	↓
80	↓	↓	↓	7.5	↓	↓	↓	↓	↓
160	247	↓	↓	7.6	↓	↓	↓	↓	↓
Inst. #	NA			C					
Cal. by Initials									

Combined Samples: [ ] yes ☒ no Rep A

Comments: EPA-H2O

Analyst:

Supervisor: ______________

Water Chemistry Bench Sheet

Work Order: 1017

Date/Time: 1/22/92/

Day of Test: 2

Page 5 of 6

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	24.8	NA	NA	7.4	NA	NA	NA	NA	NA
10	NA			NA					
20									
40									
80	↓			↓					
160	24.7	↓	↓	7.5	↓	↓	↓	↓	↓
Inst. #	NA			D					
Cal. by Initials									

Combined Samples: ☒ yes [] no

Comments: EPA H_2O

Analyst:

Supervisor:

```
 CT-TOX:  BINOMIAL, MOVING AVERAGE, PROBIT, AND SPEARMAN METHODS
-----------------------------------------------------------------------------


                                  SPEARMAN-KARBER

                                TRIM:          10.00%
                                LC50:          22.127
                 95% LOWER CONFIDENCE:         17.027
                 95% UPPER CONFIDENCE:         28.756
-----------------------------------------------------------------------------


    CONC.        NUMBER      NUMBER    PERCENT     BINOMIAL
    ug/L         EXPOSED     DEAD      DEAD        PROB.(%)
     10.00         20.         2.       10.00       .2012D-01
     20.00         20.        11.       55.00       .4119D+02
     40.00         20.        14.       70.00       .5766D+01
     80.00         20.        20.      100.00       .9537D-04
    160.00         20.        20.      100.00       .9537D-04

 THE BINOMIAL TEST SHOWS THAT   10.00 AND   80.00 CAN BE USED AS STATISTICALLY
SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS SINCE THE ACTUAL CONFIDENCE
LEVEL ASSOCIATED WITH THESE LIMITS IS  99.9798 PERCENT.
 AN APPROXIMATE LC50 FOR THIS DATA SET IS   18.674
-----------------------------------------------------------------------------

      RESULTS USING MOVING AVERAGE
  SPAN        G       LC50   95% CONFIDENCE LIMIT
    3        .076     22.54    17.53    27.91
-----------------------------------------------------------------------------


  ****** RESULTS CALCULATED BY PROBIT METHOD
ITERATIONS      G           H          GOODNESS OF FIT
   5           .122        1.00          .36

 SLOPE =  3.39
 95% CONFIDENCE LIMITS:     2.20 AND    4.57

 LC50=   21.96
 95% CONFIDENCE LIMITS:   16.89 AND   27.81

 LC1 =     4.52
 95% CONFIDENCE LIMITS:     1.76 AND    7.28

-----------------------------------------------------------------------------


  DATE: 1-22-92                   TEST NUMBER: 1017      DURATION:    48 Hours

SAMPLE: Cd Reference Test         SPECIES: FATHEAD MINNOW


 METHOD          LC50          CONFIDENCE LIMITS
                           LOWER      UPPER     SPAN
 BINOMIAL        18.674    10.000     80.000    70.000
 MAA             22.537    17.533     27.907    10.374
 PROBIT          21.962    16.893     27.807    10.914
 SPEARMAN        22.127    17.027     28.756    11.729

 **** = LIMIT DOES NOT EXIST
-----------------------------------------------------------------------------
```

Virginia Polytechnic Institute & State University
Biology Department and University Center for Environmental
& Hazardous Materials Studies

Aquatic Ecotoxicology Laboratory Work Order

Client: N/a

Project No. N/a

Work Description: FHM - ~~Static~~ Acute - EPA

Work Order Number: 1053

Assigned To: Joe Bidwell

Sample ID No. AA Cd Ref Sol

Test Conditions:

Organism and Age: FHM ≤24h - Record hatch date.

Test Mode: Static, non-renewal

Test Duration: 48h

Dilution Water: EPA - Moderately Hard. record date made

Concentrations: 200, 100, 50, 25, 12.5, 0.0 ug/L Cd.

Replicates: 2

Temperature: 25±1

Feeding Regime: none

Special Conditions:

Initiation Date: 3-2092

Completion Date: 3-2292

Assigned By:

Date: 3-1692

Acute Test Data Sheet

Work Order #: 1053

Project #: N/A

Test Type: [✓] Static

[ ] Static/Renewal

[ ] Flow Through

Beginning Date: 20 March 1992 Time: 1530

Ending Date: 22 March 1992 Time: 1515

Test Location: [ ] Inc. 1 Temp: ____

[ ] Inc. 2 Temp: ____

[ ] Other Temp: ____

Dilution Water: EPA Mod Hard

Toxicant/Effluent: Cd

Test Organism: FHM age: < 24 Hr

Source: In house Culture

Conc. or % Eff	No. Exp.	Number Surviving				
		0 h	24 h	48 h	72 h	96 h
0 A	10	10	10	10		
0 B	10	10	10	10		
125A	10	10	10	9		
12.5 B	10	10	10	10		
25 A	10	10	10	9		
25 B	10	10	10	7		
50 A	10	10	9	4		
50 B	10	10	9	8		
100 A	10	10	5	3		
100 B	10	10	7	4		
200 A	10	10	3	0		
200 B	10	10	2	1		
400 A	10	10	0	0		
400 B	10	10	1	0		
Initial						

Analyst: ____________

Supervisor: ____________

Water Chemistry Bench Sheet

Work Order: 1053

Date/Time: 20 March 1992 1530

Day of Test: Begin Day 1

Page 1 of 1

Sample ug cd/L	Temp (°C)	Cond. (μmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	23.0	385	7.75		7.87		70	150	
12.5			7.80						
25			7.75						
50			7.79						
100			7.80						
200			7.80						
400	23.5	385	7.80		7.64		72	130	
Inst. #		C	A		B				
Cal. by Initials		JRB	JRB		JRB				

Combined Samples: [] yes [✓ no]

Comments:

Analyst: JR Bidwell

Supervisor:

Water Chemistry Bench Sheet

Work Order: 1053

Date/Time: 22 March 1992 1515

Day of Test: END DAY 2

Page 1 of 1

Sample	Temp (°C)	Cond. (µmhos)	DO (mg/L)		pH		Alk mg/L	Hard mg/L	TRC mg/L
			AM	PM	AM	PM			
0	26.0			7.15					
12.5	26.0			7.20					
25	26.0			7.10					
50	26.0			6.91					
100	26.0			7.10					
200	26.0			7.00					
400	26.0			7.24					
Inst. #				A					
Cal. by Initials				NS					

Combined Samples: [] yes [✓] no

Comments:

Analyst:

Supervisor:

```
 CT-TOX:  BINOMIAL, MOVING AVERAGE, PROBIT, AND SPEARMAN METHODS
-----------------------------------------------------------------------------

                                             SPEARMAN-KARBER

                                           TRIM:         5.00%
                                           LC50:       122.405
                          95% LOWER CONFIDENCE:         95.754
                          95% UPPER CONFIDENCE:        156.475
-----------------------------------------------------------------------------

    CONC.      NUMBER     NUMBER    PERCENT     BINOMIAL
    ug/L       EXPOSED    DEAD      DEAD        PROB.(%)
     12.50       20.        0.         .00      .9537D-04
     25.00       20.        0.         .00      .9537D-04
     50.00       20.        2.       10.00      .2012D-01
    100.00       20.        8.       40.00      .2517D+02
    200.00       20.       15.       75.00      .2069D+01
    400.00       20.       19.       95.00      .2003D-02

 THE BINOMIAL TEST SHOWS THAT   50.00 AND  200.00 CAN BE USED AS STATISTICALLY
SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS SINCE THE ACTUAL CONFIDENCE
LEVEL ASSOCIATED WITH THESE LIMITS IS  97.9104 PERCENT.
 AN APPROXIMATE LC50 FOR THIS DATA SET IS  121.292
-----------------------------------------------------------------------------

      RESULTS USING MOVING AVERAGE
  SPAN       G       LC50   95% CONFIDENCE LIMIT
    4       .066    123.28    97.45   160.63
-----------------------------------------------------------------------------

  ****** RESULTS CALCULATED BY PROBIT METHOD
ITERATIONS      G          H         GOODNESS OF FIT
   5          .099       1.00         .99

 SLOPE =  3.36
 95% CONFIDENCE LIMITS:     2.30 AND    4.43

 LC50=  124.08
 95% CONFIDENCE LIMITS:   98.06 AND  158.18

 LC1 =   25.24
 95% CONFIDENCE LIMITS:   11.71 AND   38.56

-----------------------------------------------------------------------------

  DATE: 3-20                     TEST NUMBER: 1053      DURATION:     24 hours

SAMPLE: Cd                       SPECIES: Fathead Minnow


 METHOD         LC50          CONFIDENCE LIMITS
                           LOWER      UPPER     SPAN
 BINOMIAL      121.292     50.000    200.000   150.000
 MAA           123.284     97.447    160.632    63.185
 PROBIT        124.080     98.058    158.177    60.118
 SPEARMAN      122.405     95.754    156.475    60.721

 **** = LIMIT DOES NOT EXIST
-----------------------------------------------------------------------------
```

APPENDIX D: QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) DATA

MARTEL

MARTEL INC.
A [illegible] Company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile (301) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965
Capital Airport Springfield, Illinois 62707 (217) 522-0009

Martel Lab Number: 13179

Log Identification: W-14092

Certificate of Laboratory Analysis

Page No. 1
12/19/91

Company: DYNAMAC

Quality Control Report
Reported by Control Number
Blank Results

Date of Analysis	Analytic Result	Unit of Measure
** Test Code: AL		
12/16/91	0.15	ppm
12/16/91	<0.10	ppm
12/16/91	<0.10	ppm
** Test Code: ALK		
12/16/91	0.4	ml
** Test Code: BOD		
12/11/91	0.3	mg/l
** Test Code: FE		
12/16/91	0.05	ppm
12/16/91	<0.01	ppm
12/16/91	<0.01	ppm
** Test Code: SS		
12/12/91	0.0000	g
** Test Code: TURB		
12/17/91	0.13	NTU

MARTEL

MARTEL INC.
A GEONEX Company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile (301) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965
Capital Airport Springfield, Illinois 62707 (217) 522-0009

Certificate of Laboratory Analysis

Page No. 1
12/19/91

Company: DYNAMAC

Quality Control Report
Reported by Test Code
Standard Results

Date of Analysis	Standard Type	Analytic Result	True Value	% Recover
** Test Code: AL				
12/16/91		9.68	10.0	96.800
12/16/91		9.68	10.0	96.800
** Test Code: ALK				
12/16/91		101	100	101.000
** Test Code: FE				
12/16/91		9.77	10.0	97.700
12/16/91		9.66	10.0	96.600
** Test Code: TURB				
12/17/91		0.45	0.5	90.000
12/17/91		3.8	4.0	95.000
12/17/91		39	40	97.500

MARTEL

MARTEL INC.
A GEONEX Company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile (301) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965
Capital Airport Springfield, Illinois 62707 (217) 522-0009

Certificate of Laboratory Analysis

Page No. 1
12/19/91

Company: DYNAMAC

Quality Control Report
Reported By Control Number
Replicate Results

Date of Analysis	Sample ID	Analytic Result A	Analytic Result B	I STAT
** Test Code: ALK				
* Control No: 14092				
12/16/91	5	84	84	0.000
** Test Code: FE				
* Control No: 13990				
12/16/91	4	0.65	0.66	0.008
** Test Code: SS				
* Control No: 14097				
12/12/91	1	9	10	0.053
** Test Code: TURB				
* Control No: 14092				
12/17/91	2	18	19	0.027
* Control No: 14110				
12/17/91	1	56	54	0.018

MARTEL

MARTEL LABORATORY SERVICES, INC.
A GEONEX Company

1025 Cromwell Bridge Road Baltimore Maryland 21204 301 825-[illegible] [illegible]
5920 North Belt Suite [illegible] Houston Texas 77396 713 [illegible]
Capital Airport Springfield, Illinois 62707 217 [illegible]

Martel Lab Number: 13389

Log Identification: W-14306

Certificate of Laboratory Analysis

Page No. 1
01/03/92

Company: DYNAMAC

Quality Control Report
Reported by Control Number
Blank Results

Date of Analysis	Analytic Result	Unit of Measure
** Test Code: AL		
12/30/91	<0.10	ppm
12/30/91	<0.10	ppm
12/30/91	<0.10	ppm
12/30/91	<0.10	ppm
12/30/91	<9.9	ppm
12/30/91	<0.10	ppm
12/30/91	<0.10	ppm
12/30/91	<0.10	ppm
12/30/91	<0.10	ppm
** Test Code: ALK		
12/27/91	0.3	ml
** Test Code: FE		
12/30/91	0.02	ppm
12/30/91	<0.01	ppm
12/30/91	<0.01	ppm
12/30/91	<0.01	ppm
12/30/91	1.1	ppm
12/30/91	<0.01	ppm
12/30/91	0.01	ppm
12/30/91	<0.01	ppm
12/30/91	<0.01	ppm
** Test Code: SS		
12/23/91	0.0000	mg/l
12/23/91	0.0000	mg/l
** Test Code: TURB		
12/22/91	0.09	NTU

MARTEL

MARTEL LABORATORY SERVICES, INC.

GEONEX [illegible]

1025 Cromwell Bridge Road Baltimore, Maryland 21204 301 825-7790 Facsimile [illegible]
5920 North Belt Suite [illegible] Houston, Texas 77396 713 441-4465
Capital Airport Springfield, Illinois 62707 217 [illegible]

Certificate of Laboratory Analysis

Page No. 1
01/03/92

Company: DYNAMAC

Quality Control Report
Reported by Test Code
Standard Results

Date of Analysis	Standard Type	Analytic Result	True Value	% Recover
** Test Code: AL				
12/30/91		9.50	10.0	95.000
12/30/91		9.85	10.0	98.500
12/30/91		9.75	10.0	97.500
12/30/91		9.88	10.0	98.800
12/30/91		9.90	10.0	99.000
12/30/91		9.86	10.0	98.600
** Test Code: ALK				
12/27/91		98	100	98.000
** Test Code: FE				
12/30/91		9.79	10.0	97.900
12/30/91		9.98	10.0	99.800
12/30/91		9.41	10.0	94.100
12/30/91		10.00	10.0	100.000
12/30/91		9.44	10.0	94.400
12/30/91		9.96	10.0	99.600
** Test Code: TURB				
12/22/91		0.49	0.5	98.000
12/22/91		3.9	4.0	97.500
12/22/91		40	40	100.000

MARTEL

MARTEL LABORATORY SERVICES, INC.
a GEONEX company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile [illegible]
5920 North Belt, Suite [illegible] Houston, Texas 77396 [illegible]
Capital Airport Springfield, Illinois 627[illegible] [illegible]-0009

Certificate of Laboratory Analysis

Page No. 1
01/03/92

Company: DYNAMAC

Quality Control Report
Reported By Control Number
Replicate Results

Date of Analysis	Sample ID	Analytic Result A	Analytic Result B	I STAT
** Test Code: AL				
* Control No: 14027				
12/30/91	1	17	21	0.105
* Control No: 14306				
12/30/91	3	<0.10	<0.10	0.000
** Test Code: ALK				
* Control No: 14232				
12/27/91	7	110	110	0.000
* Control No: 14310				
12/27/91	13	5	6	0.091
** Test Code: FE				
* Control No: 14306				
12/30/91	3	0.20	0.18	0.053
** Test Code: SS				
* Control No: 14229				
12/23/91	1	830	9630	0.841
* Control No: 14306				
12/23/91	5	3	2	0.200
** Test Code: TURB				
* Control No: 14306				
12/22/91	6	3.5	3.4	0.014

MARTEL

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (410) 825-7790 Facsimile (410) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965 Facsimile (713) 872-7916
1438 Sangamon Avenue Springfield, Illinois 62702 (217) 522-0009 Facsimile (217) 522-2119

Certificate of Laboratory Analysis

Page No. 1
04/15/92

Company: DYNAMAC

Quality Control Report
Reported by Control Number
Blank Results

Martel Lab Number: 14909

Log Identification: W-16330

Date of Analysis	Analytic Result	Unit of Measure
** Test Code: AL		
04/13/92	<0.10	ppm
04/13/92	<0.10	ppm
04/13/92	<0.10	ppm
04/14/92	12	ppm
04/14/92	11	ppm
04/14/92	<0.10	ppm
** Test Code: FE		
04/13/92	<0.01	ppm
04/13/92	0.02	ppm
04/14/92	13	ppm
04/14/92	12	ppm
04/14/92	<0.01	ppm

MARTEL

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (410) 825-7790 Facsimile (410) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965 Facsimile (713) 872-7916
1438 Sangamon Avenue Springfield, Illinois 62702 (217) 522-0009 Facsimile (217) 522-2119

Certificate of Laboratory Analysis

Page No. 1
01/15/92

Company: DYNAMAC

Quality Control Report
Reported by Test Code
Standard Results

Date of Analysis	Standard Type	Analytic Result	True Value	% Recover
** Test Code: AL				
01/13/92		10.18	10.0	101.800
01/13/92		99.81	100	99.810
01/14/92		10.21	10.0	102.100
** Test Code: FE				
01/13/92		10.33	10.0	103.300
01/13/92		99.81	100.0	99.810
01/14/92		10.56	10.0	105.600

MARTEL

MARTEL INC.
A GEONIX Company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile (301) 321-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965
Capital Airport Springfield, Illinois 62707 (217) 522-0009

Martel Lab Number: 13564

Log Identification: W-14580

Certificate of Laboratory Analysis

Page No. 1
01/20/92

Company: DYNAMAC

Quality Control Report
Reported by Control Number
Blank Results

Date of Analysis	Analytic Result	Unit of Measure
** Test Code: AL		
01/17/92	<0.10	ppm
01/17/92	<0.10	ppm
01/17/92	0.11	ppm
01/17/92	0.11	ppm
** Test Code: ALK		
01/16/92	0.2	ml
** Test Code: BOD		
01/11/92	0.4	mg/l
** Test Code: FE		
01/17/92	<0.01	ppm
01/17/92	0.01	ppm
01/17/92	0.10	ppm
01/17/92	0.03	ppm
** Test Code: SS		
01/13/92	0.0001	g
** Test Code: TURB		
01/10/92	0.05	NTU

MARTEL

MARTEL INC.
A [illegible] Company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile (301) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965
Capital Airport Springfield, Illinois 62707 (217) 522-0009

Certificate of Laboratory Analysis

Page No. 1
01/20/92

Company: DYNAMAC

Quality Control Report
Reported by Test Code
Standard Results

Date of Analysis	Standard Type	Analytic Result	True Value	% Recover
** Test Code: AL				
01/17/92		10.26	10.0	102.600
01/17/92		11.11	10.0	111.100
01/17/92		10.92	10.0	109.200
** Test Code: ALK				
01/16/92		104	100	104.000
** Test Code: FE				
01/17/92		10.13	10.0	101.300
01/17/92		10.43	10.0	104.300
01/17/92		10.87	10.0	108.700
** Test Code: TURB				
01/10/92		0.57	0.5	114.000
01/10/92		4.2	4.0	105.000
01/10/92		41	40	102.500

MARTEL

MARTEL INC.
A [illegible] Company

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (301) 825-7790 Facsimile (301) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965
Capital Airport Springfield, Illinois 62707 (217) 522-0009

Certificate of Laboratory Analysis

Page No. 1
01/20/92

Company: DYNAMAC

Quality Control Report
Reported By Control Number
Replicate Results

Date of Analysis	Sample ID	Analytic Result A	Analytic Result B	I STAT
** Test Code: ALK				
* Control No: 14580				
01/16/92	1	60	61	0.008
** Test Code: SS				
* Control No: 14577				
01/13/92	6	300	310	0.016
** Test Code: TURB				
* Control No: 14580				
01/10/92	5	13	14	0.037

MARTEL

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (410) 825-7790 Facsimile (410) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965 Facsmile (713) 872-7916
1438 Sangamon Avenue Springfield, Illinois 62702 (217) 522-0009 Facsimile (217) 522-2119

Certificate of Laboratory Analysis

Page No. 1
02/25/92

Company: DYNAMAC

Quality Control Report
Reported by Control Number
Blank Results

Martel Lab Number: 14131

Log Identification: W-14976

Date of Analysis	Analytic Result	Unit of Measure
** Test Code: AL		
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/18/92	<0.10	ppm
02/21/92	18	ppm
02/21/92	<0.10	ppm
02/21/92	<0.10	ppm
02/21/92	<0.10	ppm
02/21/92	<0.10	ppm
** Test Code: FE		
02/18/92	10	ppm
02/18/92	0.04	ppm
02/18/92	0.01	ppm
02/18/92	0.03	ppm
02/18/92	<0.01	ppm
02/18/92	<0.01	ppm
02/18/92	<0.01	ppm
02/18/92	0.06	ppm
02/18/92	<0.01	ppm
02/18/92	<0.01	ppm
02/18/92	0.02	ppm
02/18/92	0.01	ppm
02/18/92	0.07	ppm
02/21/92	<0.02	mg/l
02/21/92	17	ppm
02/21/92	0.06	ppm
02/21/92	0.01	ppm
02/21/92	<0.01	ppm
02/21/92	<0.01	ppm

MARTEL

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (410) 825-7790 Facsimile (410) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965 Facsmile (713) 872-7916
1438 Sangamon Avenue Springfield, Illinois 62702 (217) 522-0009 Facsimile (217) 522-2119

Certificate of Laboratory Analysis

Page No. 1
02/25/92

Company: DYNAMAC

Quality Control Report
Reported by Test Code
Standard Results

Date of Analysis	Standard Type	Analytic Result	True Value	% Recover
** Test Code: AL				
02/18/92		101.06	100	101.060
02/18/92		96.00	100	96.000
02/18/92		97.87	100	97.870
02/18/92		10.08	10.0	100.800
02/18/92		10.20	10.0	102.000
02/18/92		10.18	10.0	101.800
02/18/92		10.12	10.0	101.200
02/18/92		9.58	10.0	95.800
02/18/92		9.85	10.0	98.500
02/18/92		9.38	10.0	93.800
02/18/92		10.07	10.0	100.700
02/18/92		10.37	10.0	103.700
02/21/92		99.65	100	99.650
02/21/92		9.71	10.0	97.100
02/21/92		9.97	10.0	99.700
02/21/92		9.59	10.0	95.900
** Test Code: FE				
02/18/92		98.01	100	98.010
02/18/92		95.01	100	95.010
02/18/92		95.93	100	95.930
02/18/92		9.67	10.0	96.700
02/18/92		9.83	10.0	98.300
02/18/92		9.67	10.0	96.700
02/18/92		10.18	10.0	101.800
02/18/92		10.08	10.0	100.800
02/18/92		9.93	10.0	99.300
02/18/92		9.57	10.0	95.700
02/18/92		9.52	10.0	95.200
02/18/92		10.11	10.0	101.100
02/21/92		97.71	100	97.710
02/21/92		9.33	10.0	93.300
02/21/92		9.96	10.0	99.600
02/21/92		9.71	10.0	97.100
02/21/92		9.91	10.0	99.100
02/21/92		9.93	10.0	99.300

MARTEL
1025 Cromwell Bridge Road Baltimore, Maryland 21204 (410) 825-7790 Facsimile (410) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965 Facsimile (713) 872-7916
1438 Sangamon Avenue Springfield, Illinois 62702 (217) 522-0009 Facsimile (217) 522-2119

Certificate of Laboratory Analysis

Page No. 1
02/25/92

Company: DYNAMAC

Quality Control Report
Reported By Control Number
Replicate Results

Date of Analysis	Sample ID	Analytic Result A	Analytic Result B	I STAT
** Test Code: AL				
* Control No: 14976				
02/18/92	11	1500	1500	0.000
02/18/92	21	5500	5600	0.009
02/18/92	3	3600	3500	0.014
02/18/92	35	3800	3600	0.027
02/18/92	40	1700	1700	0.000
02/18/92	48	5200	5000	0.020
02/18/92	61	1100	1100	0.000
02/21/92	10	9500	8300	0.067
02/21/92	10	9500	9700	0.010
02/21/92	70	5900	6100	0.017
02/21/92	71	2300	1800	0.122
02/21/92	71	2300	2100	0.021
* Control No: 15310				
02/21/92	1	<0.50	<0.50	0.000
** Test Code: FE				
* Control No: 14976				
02/18/92	11	9500	9100	0.005
02/18/92	21	7500	7600	0.007
02/18/92	3	10000	9700	0.015
02/18/92	35	8700	8300	0.024
02/18/92	48	6000	5900	0.008
02/18/92	50	9100	9000	0.006
02/18/92	50	9100	9100	0.000
02/18/92	60	8100	7700	0.025
02/18/92	60	8100	9100	0.071
02/18/92	61	7000	6900	0.007
02/21/92	10	15000	14000	0.034
02/21/92	10	15000	15000	0.000
02/21/92	70	10000	13000	0.130
02/21/92	71	6700	5200	0.126
02/21/92	71	6700	7000	0.022
* Control No: 15310				
02/21/92	1	0.53	0.48	0.050

MARTEL

1025 Cromwell Bridge Road Baltimore, Maryland 21204 (410) 825-7790 Facsimile (410) 821-1054
5920 North Belt, Suite 111 Houston, Texas 77396 (713) 441-4965 Facsmile (713) 872-7916
1438 Sangamon Avenue Springfield, Illinois 62702 (217) 522-0009 Facsimile (217) 522-2119

Certificate of Laboratory Analysis

Page No. 1
02/25/92

Company: DYNAMAC

Quality Control Report
Reported By Test Code
Spike Results

Date of Analysis	Sample Identification	Analytic Result	Spiked Result	Spike Value	% Recovery
** Test Code: AL					
* Control No: 14976					
02/18/92	6	1100	2015.30	1000	91.530
02/18/92	61	3900	4686.35	1000	78.635
02/18/92	12	7198	8589	920	118.587
02/18/92	20	5700	8100	1900	126.316
02/18/92	27	3316	4181	960	121.667
02/18/92	30	5600	8100	2000	125.000
02/18/92	33	2482	3419	980	95.612
02/18/92	40	4200	5900	1900	89.474
02/18/92	42	3918	4968	1100	95.455
02/18/92	50	6100	8400	2000	115.000
02/18/92	55	3481	4365	950	93.053
02/18/92	60	4400	6200	2000	90.000
02/18/92	20	7700	9200	1900	78.947
02/18/92	27	5009	6220	960	126.146
02/24/92	10	9500	14000	5875	76.596
02/24/92	10	8300	14000	5875	97.021
02/24/92	70	5900	11000	5259	96.977
02/24/92	70	6100	11000	5259	93.174
02/24/92	74	2300	5700	3160	107.595
02/24/92	74	1800	5700	3160	123.418
** Test Code: FE					
* Control No: 14976					
02/18/92	50	9100	11318.57	2000	110.929
02/18/92	6	230	1226.13	1000	99.613
02/18/92	60	8100	10319.80	2000	110.990
02/18/92	20	7700	9200	1900	78.947
02/18/92	27	5009	6220	960	126.146
02/18/92	30	9500	12000	2000	125.000
02/18/92	40	7700	9500	1900	94.737
* Control No: 15245					
02/24/92	1dw	<0.02	0.957	1.0	95.700
* Control No: 14976					
02/24/92	10	15000	21000	5875	102.128
02/24/92	10	14000	21000	5875	119.149
02/24/92	70	10000	16000	5259	114.090

Cove Corporation
10200 BREEDEN ROAD, LUSBY, MARYLAND 20657
TELEPHONE: (301) 326-4577
FAX No. (301) 326-4767

May 14,1992

Ms. Chris Cooper
Dynamac Corporation
The Dynamac Building, Suite 500
2275 Research Boulevard
Rockville, MD 20850-3268

Re: QA/QC results for Potomac River macrobenthic samples processed by Cove Corporation.

Dear Ms. Cooper,

QA/QC results for Potomac River sample processing are presented in tables on the following pages. All 127 macrobenthic samples were sorted by Sean Stickell (29.5 samples), Janice Darling (26 samples), Denise Henderson (25.5 samples), Barbara Weems (2[illegible] samples), Rene Sadler (15 samples), and Cindy Statter (9 samples). A total of 12.6% of the samples were checked for unacceptable sorting errors.

All macrobenthic samples were collectively identified by Nancy Mountford (molluscs, insects, and sundry taxa), Sue Arcuri (oligochaetes and chironomids), and Tim Morris (crustaceans and chironomids). A total of 10.2% of the samples were checked for unacceptable identification errors.

I have one additional QA/QC sample processing note to report. Two relatively new technicians (Sean Stickell and Janice Darling) assisted in sample sorting. As a precautionary QA/QC procedure, a number of their initial samples were resorted to determine if training for independent sample sorting was adequate. Thus, they were not immediately placed on the batch system. Due to this special training procedure, seven samples sorted by Sean and Janice were excluded from the batch system in which 10% of the total number are randomly selected for QA/QC purposes.

If you have any questions or comments, please call.

Sincerely,
Tim Morris
C. Timothy Morris
Laboratory Manager

QA/QC SUMMARY RESULTS

Sorting Performance

total number of samples processed	127
total number of QA/QC samples	16
total number of QA/QC failures	3
total number of resorted samples	20
average QA/QC percent error	2.0
range of QA/QC percentages	6.6

Identification Performance

total number of samples processed	127
total number of QA/QC samples	13
total number of QA/QC failures	1
total number of reidentified samples	9
average QA/QC percent error	1.3
range of QA/QC percentages	5.7

Detailed QA/QC Sorting Results

Tech.	Batch Number	Sample Number	Sampling Date	QA/QC Inspection	Number Found	Total Number	Percent Error
SES	1	4-1 Center	04DEC91	DJH 16MAR92	10	151	6.6
SES	1	5-1 Center	09OCT91	DJH 06APR92	1	224	0.5
SES	2	4-2 Center	10DEC91	RMS 14APR92	17	527	3.2
SES	3	3-1 West	10JAN92	RMS 01MAY92	2	32	6.3
SES	3	1-2 Center	10JAN92	DJH 12MAY92	1	105	1.0
JRD	1	1-2 East	10OCT91	DJH 13APR92	6	161	3.7
JRD	2	1-1 West	10JAN92	RMS 30APR92	3	103	0.3
DJH	1	1-2 Center	10DEC91	SLA 27MAR92	0	207	0.0
DJH	2	3-1 West	09OCT91	SLA 17APR92	1	341	0.3
DJH	3	3-1 West	10JAN92	RMS 05MAY92	3	52	5.8
DJH	3	6-2 East	24FEB92	RMS 07MAY92	0	517	0.0
BAW	1	1-1 West	20DEC91	RMS 21APR92	5	221	2.3
BAW	2	4-1 West	24FEB92	RMS 30APR92	0	52	0.0
RMS	1	6-1 West	20DEC91	DJH 21APR92	5	289	1.7
RMS	2	6-2 West	20DEC91	DJH 04MAY92	1	154	0.7
CLS	1	6-1 Center	10JAN92	RMS 30APR92	1	290	0.3

Detailed QA/QC Identification Results

Batch Number	Sample Number	Sampling Date	QA/QC Inspection	Errors	Total Number	Percent Error
1	4-1 Center	09OCT91	CTM & NKM 12MAY92	4	70	5.7
2	5-2 Center	09OCT91	CTM & NKM 12MAY92	3	122	2.5
3	1-1 West	04DEC91	CTM & NKM 12MAY92	2	157	1.3
4	3-1 Center	10DEC91	CTM & NKM 12MAY92	3	299	1.0
5	6-1 East	10DEC91	CTM & NKM 12MAY92	2	779	0.3
6	3-2 East	09OCT91	CTM & NKM 12MAY92	4	556	0.7
7	4-2 West	03MAR92	CTM & NKM 13MAY92	0	180	0.0
8	1-1 Center	20DEC91	CTM & NKM 12MAY92	1	170	0.6
9	3-2 Center	20DEC91	CTM & NKM 12MAY92	0	263	0.0
10	5-1 Center	20DEC91	CTM & NKM 12MAY92	0	196	0.0
11	5-1 West	24FEB92	CTM & NKM 12MAY92	4	258	1.6
12	3-1 East	10JAN92	CTM & NKM 12MAY92	3	148	2.0
13	4-2 West	10JAN92	CTM & NKM 12MAY92	1	156	0.6