Biological Responses to Stream Habitat Restoration in the Sligo Creek Watershed, Maryland

Results of the Phase II (1992-93) Program

Benthic Macroinvertebrate Surveys and Fisheries Re-Introductions

James D. Cummins
Interstate Commission on the Potomac River Basin
Suite 300, 6110 Executive Blvd.
Rockville, MD 20852-3903

and

James B. Stribling
Tetra Tech, Inc.
10045 Red Run Blvd., Suite 110
Owings Mills, MD 21117

Contract No. 93-006
Metropolitan Washington Council of Governments
ICPRB Report # 95-5

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

We would like to recognize John Galli of the Washington Area Council of Governments, for his leadership and foresight on this project as well as his contributions to field work and report review. Special acknowledgements extend to Scott Gibbons and Jan Ducnuigeen, of ICPRB, for their contributions to this project, both in the field and at the desk. Those same sentiments are directed to Betsy Weisengoff, Project Manager from the Maryland Department of the Environment, for her support and patience and to Daniel Boward, also of MD MDE, for his help in the review of this document. We greatly appreciate the support of the Maryland-National Capital Park and Planning Commission, Parks Department and the Montgomery County Department of Environmental Protection, Water Resources Management Division. We would also like to thank Christiana Gerardi, Mike Barbour, Erik Leppo and Abby Markowitz, all of Tetra Tech, Owings Mills, for their assistance with and discussions on various aspects of this project. Catherine Burd, also of Tetra Tech, performed much of the clerical work on the benthic macroinvertebrate sections.

EXECUTIVE SUMMARY

This report covers the second phase (1992-1993) of the biomonitoring component of a multi-phase, multi-agency effort to restore upper portions of Sligo Creek, a highly suburbanized watershed of the Anacostia river. The restoration consists of a variety of stormwater quantity and quality controls in combination with stream and riparian habitat rehabilitation. Re-introductions of native fish species have also been an integral part of this effort due to prior extirpations caused by insufficient stormwater controls and probable pollution events in the watershed.

Biomonitoring was based upon U.S. Environmental Protection Agency bioassessment protocols for benthic macroinvertebrates and fish communities. Analysis of the monitoring data showed an increase in the number of species, lower percentage contributions of dominant taxa, and improved habitat conditions at the four sites restored since Phase I (1990) monitoring. Six of the nine fish species re-introduced as part of Phase II were recaptured at the end of the study period. While there were ecological improvements, environmental stress was still in evidence in the relatively low biological metric scores of all studied sites compared to a regional reference site's conditions. However, compared to the very poor biological and habitat conditions of the sites before restoration, the improvements should be considered encouraging and to reflect well upon the restoration effort to date.

I. INTRODUCTION

Typically, the two features of urbanization that have the greatest effect on stream habitat are the removal or disturbance of riparian vegetation and the installation of impervious surfaces, such as asphalt and cement, in the watershed. The detrimental effects on streams associated with increased impervious surfaces and loss of riparian vegetation include:

- substantial habitat alteration,
- thermal regime alteration,
- increased inputs of non-point source pollutants such as chemicals, oil and grease,
- increased flashiness of stormflows,
- decreased woody materials and leaf litter on which many benthic macroinvertebrates feed, and
- accelerated erosion of stream channels.

When combined with point sources or dumping, the ecological health of these streams can be severely impaired.

This project is part of a comprehensive multi-agency effort to restore the Anacostia River basin. Participating agencies include the Montgomery County Department of Environmental Protection (DEP), Maryland Department of the Environment (MOE), the Maryland National Capital Park and Planning Commission (NCPPC), the Metropolitan Washington Council of Governments (COG), and the Interstate Commission on Potomac River Basin (ICPRB).

The long-term objectives of the overall project are to replace, through restoration, a dynamic stability to the physical habitat structure and flow regime of the Anacostia; to demonstrate the positive (or negative) biological response to restoration activities based on benthic macroinvertebrate community structure; and, when appropriate, to reintroduce fish species native to the region for this size stream.

This report presents the second year results (1992-1993) of biological monitoring in Wheaton Branch and mainstem Sligo Creek, tributaries of the Anacostia. It is part of a three phase biological monitoring project documenting changes in the benthic macroinvertebrate and fish assemblages of Wheaton Branch, during and after restoration.

In June of 1990, a stormwater management pond retrofit was completed for Wheaton Branch, a tributary of the Sligo Creek sub-watershed. This pond was designed to help provide control of Wheaton Branch's stormwater quantity and quality, thereby reducing the effects of urbanization on Sligo Creek. In addition, major physical habitat restoration was completed for Wheaton Branch in April 1991. Habitat complexity for fish and benthic macroinvertebrates was restored via streambank stabilization and revegetation and the creation of instream structures to control scour and erosion of the stream bottom. These activities concluded Phase I restoration.

The restoration activities that occurred during Phase II involved creation of wetlands, reforestation of riparian zones, and re-creation of fish habitat in the Sligo Creek mainstem, Wheaton Branch, and the Flora Lane tributary.

II. OVERVIEW OF PHASE I (1990-1991) SAMPLING RESULTS

In a previous survey of Wheaton Branch and Sligo Creek (Cummins and Stribling 1992), the mainstem of the latter produced biological assessments indicative of what was seen in other reaches of Sligo Creek (Stribling et al. 1989, Stribling and Thaler 1990). That is, even within sections with good habitat structure, the taxonomic diversity and levels of abundance of fish and benthic macroinvertebrates were usually low. Exceptions in the upper Sligo Creek drainage were located within Wheaton Branch, where samples usually had the greatest numbers of macroinvertebrates and were dominated by Hydropsyche or Chironomidae. It was determined that, for a brief period of time, there was organic loading into Wheaton Branch from a sewer line leak, and possibly, non-retention of organic particulates by the installed basins. These conditions likely contributed to the extreme dominance of the net-spinning (i.e., filter-feeding) caddisflies (Hydropsyche and Cheumatopsyche) and the relatively low number of benthic macroinvertebrate taxa.[1] Generally low density and taxonomic diversity in Sligo Creek mainstem has been attributed to a combination of scouring stormflows, general urban runoff such as oil and grease, and the possibility of unknown toxicants (Stribling et al. 1989).

The results of Phase I fisheries surveys were similar to earlier studies (Cummins 1990) of this portion of Sligo Creek in that Wheaton Branch and upper Sligo Creek sites had only three species of fish; blacknose dace, northern creek chub, and goldfish. These species are all highly pollution tolerant (Plafkin et. al. 1989). The blacknose dace accounted for 77% of all individuals captured. An indication of environmental stress was that 11% (20 of 182) of the northern creek chubs collected had either fin erosions, skin lesions, external fungal infections or combinations of these external symptoms. These symptoms are associated with environmental degradations such as chronic, sublethal exposure to contaminants, low dissolved oxygen, or high levels of suspended solids (Wedemeyer et al. 1990).

Improvements in the habitat complexity of Wheaton Branch were completed in April of 1991 and are scheduled for the upper Sligo Creek mainstem in 1993. Due to a recently completed stormwater retrofit facility upstream from the study area, water quality benefits and improved flow regime stability in both Wheaton Branch and upper Sligo Creek were expected.[2] Based on the Phase I findings, these streams should support a greater diversity of fish species. Unfortunately, downstream blockages to fish migration prevented the natural re-establishment of a more diverse fish community in Wheaton Branch. Therefore, Phase I recommended experimental transplant stocking of selected local fish species into Wheaton Branch to augment the recovery of fish populations in Sligo Creek.

---

[1]Typically, there is a large increase in filter-feeders, such as Hydropsyche below ponds and reservoirs.

[2]The University Boulevard stormwater retrofit pond became operational in July 1993.

III. PHASE II

A. SAMPLING SITES

Fish and benthic macroinvertebrate surveys at a total of eight sites were conducted between August 21, 1992 and October 5, 1993 for the purpose of monitoring restoration effects upon Sligo Creek's aquatic communities (see Appendix I for a list of Phase I and Phase II sampling dates). Of the eight selected sites, four were established in the Sligo Creek mainstem, two were located in a feeder tributary which flows next to Flora Lane south of Interstate 495, and two sites were re-evaluations of Phase I sites within the existing restoration area of Wheaton Branch. The sampling sites are mapped on Figure 1 (page 8), illustrated (pages 20-35), and described below.

Sligo Creek mainstem

SL1 *Above University Ave. (Rte. 193)* - The downstream boundary of this site is approximately 14 meters upstream from a hiker/biker bridge at the Kemp Mill Shopping Center. This site is in a park surrounded by a heavily urbanized area and, likely, with a higher percentage of impervious surface and less control over stormwater discharges than most of the downstream sites.[3] Due to an apparently high frequency of scouring stormflows, habitat is less than optimal with an unstable bottom and moderate bank erosion. Riffles are relatively infrequent in the sampling area.

SL2 *Upstream of confluence with Wheaton Branch (= WB3 of Cummins and Stribling [1992])* - This site is located on Sligo Creek approximately 90 meters upstream from the confluence with Wheaton Branch. The substrate particle size within riffles ranged from sand to gravel and medium cobble and is not heavily embedded. The right bank is reinforced with rip-rap of placed boulders; the left is a sand and gravel point bar on the inside bend. There is adequate shading even though mowing of the park grass occurred close to the eastern edge of the stream until 1992. Since that time a no-mow area has been maintained in this location and new riparian vegetation has been established.

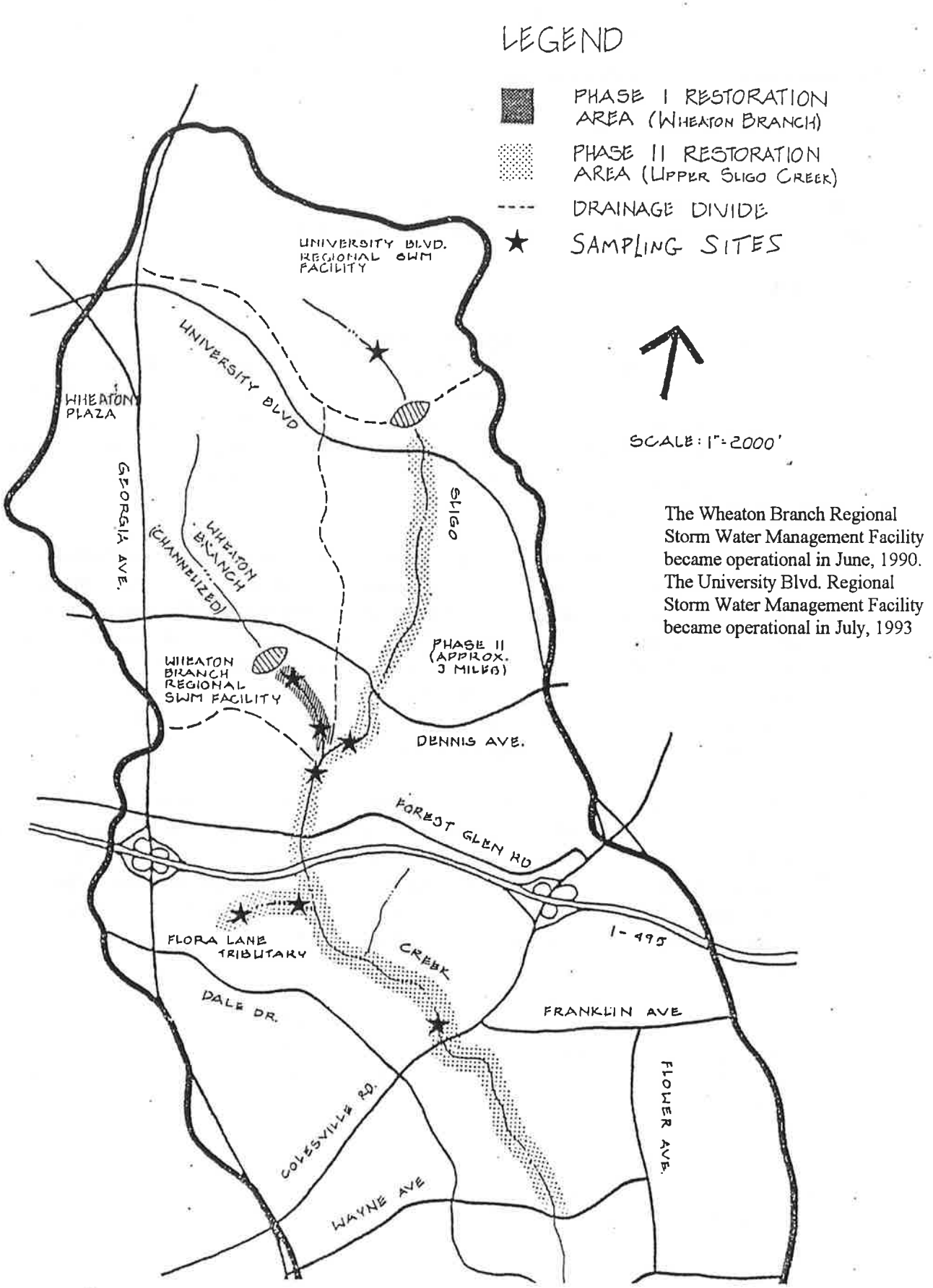
SL3 *Downstream of confluence with Wheaton Branch (= WB4 of Cummins and Stribling [1992])* - This site is very similar in habitat to that of SL2, although the additional flow from Wheaton Branch has caused it to be wider than upstream (SL2). The site is located about 30 meters downstream of the confluence. The range of substrate particle size in the riffle is similar to that of SL2, with very little embeddedness and adequate shading. Both banks are stable; some undercutting is occurring on the right bank, adding habitat dimension not found at SL2.

SL4 *At Colesville Road (Rte. 29)* - The downstream boundary of this site is about 50 meters upstream from Colesville Road and is close to Sligo Creek Parkway and the hiker/biker trail. The site contains large sections of riffle habitat with low embeddedness and good bottom substrate.

---

[3]The upstream drainage area of this site is 30% impervious with no stormwater management controls.

Map 1. Biological Sampling Stations



The Wheaton Branch Regional Storm Water Management Facility became operational in June, 1990. The University Blvd. Regional Storm Water Management Facility became operational in July, 1993

Wheaton Branch

The two Wheaton Branch sites are downstream from a large stormwater management pond which was retrofitted in 1990. The section of Wheaton Branch being studied also underwent extensive bank stabilization (imbricated rip-rap, root wads) and instream habitat restoration (boulder placement, wing deflectors) following the Phase I study.

WB1 *Downstream from Woodman Avenue* - This site is approximately 130 meters downstream from Woodman Avenue, immediately downstream of a small feeder stream and the beginning of park property.

WB2 *Above Sligo Creek confluence* - Designated as Wheaton Branch #3 (WB3) in the Phase I study. The downstream edge of the sampling area is approximately 25 meters upstream of the Sligo Creek Park's hiker/biker bridge (approximately 130 meters upstream from the Wheaton\Sligo confluence).

Flora Lane Tributary

A second order tributary of Sligo Creek, this channel is south of, and runs parallel to, the beltway (Interstate 495).

FL1 *Upstream end of tributary* - The downstream edge of this station is an old concrete weir (purpose of weir is unknown to researchers). The upstream boundary is approximately 15 meters downstream from a recently (1994) constructed weir and flow splitter (part of a new parallel pipe system designed to help reduce stream channel erosion). The straight nature of the main stream channel and its rather uniform 2 meter stream banks are probably due to channelization during development of the adjacent neighborhood. However, the baseflow of this tributary meanders considerably as a result of over 40 years of natural channel adjustment, as well as woody debris deposited in the stream (much of which appears to be from local dumping).

FL2 *Downstream end of tributary* - The site's downstream boundary was just upstream from the confluence with Sligo Creek and the upstream boundary was 21 meters downstream from the Sligo Creek Parkway footbridge. The 21 meter unmonitored section consisted of a large plunge-pool area resulting from a hiker/biker bridge culvert. It was felt this section of the stream was atypical and therefore it was excluded from the sampled area. The southern edge of this site had several areas with steep and eroded banks. Most of the fish were captured in a pool near the middle of the sample area.

B. METHODS

Methods followed the same procedures as were used and documented in the 1990-1991 monitoring year (Cummins and Stribling, 1992) with the exception of habitat assessments as described below:

1. Benthic Macroinvertebrates

A square foot Surber sampler was used for sampling riffles. The pools and root wads were sampled with a long-handled D-frame net. All nets used were U. S. Standard No. 30 (595 micron net openings). For each sampling event, three surber samples (riffles) and a single D-frame sample were taken. All samples were field processed, with specimens removed and placed in approximately 70% ethanol. The samples were kept in separate containers, and identified individually.

2. Fishes

As part of this project, selected native fish species were re-introduced into Wheaton Branch and Flora Lane. Periodic monitoring of the eight selected sites was then conducted to help determine which species were surviving and how these species were dispersing into the mainstem of upper Sligo Creek. Only select fish species which are indigenous to small streams and native to the area were stocked, following the recommendations of the Phase I Study. These fish were collected from the Northwest Branch (another sub-watershed of the Anacostia River immediately to the east of the Sligo Creek sub-watershed) with the help of local citizen volunteers (see Volunteer Flier, Appendix II) and then re-introduced into the Sligo Creek study area. The following ten species were selected as target introductions;

Swallowtail Shiner (Notropis procne)	Cutlips Minnow (Exoglossum maxillinqua)
Satinfin Shiner (Notropis analostanus)	Longnose Dace (Rhinichthys cataractae)
White Sucker (Catostomus commersoni)	Tessellated Darter (Etheostoma olmstedi)
Bluntnose Minnow (Pimephales notatus)	Silverjaw Minnow (Ericymba buccata)
Common Shiner (Notropis cornutus)	Rosyside Dace (Clinostomus funduloides)

We did not stock any sunfish species into the study area because of expected problems with sunfish predation on the establishing minnow populations and, from our experience, sunfish tend to be introduced all too rapidly by local anglers.

Stocking was phased in order to permit less prolific species to establish themselves prior to the introduction of more prolific species, thereby reducing inter-species competition pressures. The first phase of stocking consisted of moderately pollution-tolerant/moderately-prolific species; the bluntnose minnow, white sucker, longnose dace and the tessellated darter. If the prolific species were introduced concurrently with the other species, they might prevent the successful recolonization of the less prolific species into Wheaton Branch.

If the water quality of Wheaton Branch showed a marked improvement over pre-restoration conditions and this first-phase stocking proved successful by the establishment of viable populations of these species, a second-phase stocking of more pollution-intolerant/less-prolific species such as the common and rosyside shiners was to be attempted.

If this stocking also proved successful, a third stocking consisting of cutlips minnows, swallowtail shiners and satinfin shiners was recommended. These are the moderately pollution-tolerant/prolific species which should be the last species stocked. If they were stocked in earlier events they may out-compete the developing populations of the non-prolific species.

An alternative stocking scenario was also recommended in the event that the first stocking is successful but the water quality of Wheaton Branch did not show an improvement from pre-restoration conditions. In this case, the pollution-intolerant species would not be stocked during the second phase of stocking. Instead, the moderately pollution-tolerant/prolific species would be stocked following the first-round stocking effort. There is very limited information regarding restocking of non-game (forage-base) species into urban impacted streams. Therefore, we relied upon our best professional judgement coupled with the availability of the two general habitat types found in Wheaton Branch; pools and riffles, to develop stocking rates. We attempted to stock approximately 10-20 individuals of each species into each pool or riffle, depending on species habitat preference and size and depth of individual pools or riffles.

The preferred stocking time was early spring, when most species are in preparation for spawning. The strategy was that these fish would subsequently spawn in Wheaton Branch and further increase the chances of establishing viable fish populations during the first year. Monitoring of each phase of stocking occurred both during the proceeding fall and prior to any subsequent stocking the following spring.

Fish monitoring was conducted by first setting a block seine of 1/4" mesh across the downstream boundary of the sampling site. Fifty meters directly upstream a second block seine was set across the upstream boundary, serving to impound the fish in that section of the stream during sampling. Three backpack electrofishing passes were then made in the sampling area moving in an upstream direction. The duration of electrofishing time on an individual pass was approximately ten minutes with phased indirect current of 60 hertz frequency and 500 volts. Stunned fish collected from each pass were individually identified, counted, measured, and separated from the other collections and then released at the end of sampling. Fish population estimates were based upon a three pass depletion model (Zippin, 1956).

3. Habitat:

Habitat assessments followed the approach developed by Plafkin et al. (1989) and modified (Barbour and Stribling 1991) to include new parameters described below. The condition of each site under study was rated as a function of its capacity to support a healthy biological community. Appendix III contains the twelve habitat parameters used for this survey. These twelve parameters include three new ones added by EPA protocols since the Phase I study. The new parameters were: canopy cover (#4), lower bank channel capacity (#8), and riparian vegetation zone width (#12).

C. RESULTS AND DISCUSSION:

This section is separated into 1) benthic macroinvertebrates and 2) fishes and habitat. Each of these sections presents the Phase II results followed by a comparison of changes relative to the Phase I results.

1. Benthic Macroinvertebrates

Phase 2. The benthic macroinvertebrate taxa identified in the 96 total samples are shown in Appendix IV along with enumerations of each. These samples loosely cover four seasons (Table 1); although somewhat sporadic, the sampling dates do provide a database from which changes in conditions can be inferred. Benthic macroinvertebrate site labels, locations, and dates sampled are given in Appendix I.

Table 1

Parameters calculated on benthic macroinvertebrate samples. Each value represents a composite of three samples (Sligo Phase II monitoring results)

	Sligo Creek				Wheaton Branch		Flora Lane	
Sampling Stations	SL1	SL2	SL3	SL4	WB1	WB2	FL1	FL2
Summer 1992								
total no. individuals *	16	**	**	162	**	**	133	57
no. taxa	6	**	**	7	**	**	5	6
EPT	0	**	**	2	**	**	0	0
% cont. dominant taxon	31.2	**	**	56.8	**	**	57.1	71.9
Fall 1992								
total no. individuals *	96	277	1137	52	2008	734	131	39
no. taxa	10	15	13	8	12	12	5	7
EPT	0	2	2	2	2	2	0	0
% cont. dominant taxon	43.8	40	55.3	51.9	64	38.4	27.5	27
Spring 1993								
total no. individuals *	499	179	193	157	885	245	162	28
no. taxa	10	7	9	9	12	13	4	2
EPT	2	2	3	2	2	2	0	0
% cont. dominant taxon	72.5	38	45.6	50.9	35	39.1	56.2	93
Summer 1993								
total no. individuals *	10	**	**	216	**	**	42	10
no. taxa	6	**	**	11	**	**	5	3
EPT	3	**	**	2	**	**	0	0
% cont. dominant taxon	40	**	**	62.9	**	**	47.6	40

* surber samples only
** no samples taken

The four metrics calculated on the sample results and their hypothesized direction of change in the presence of stressors:

- total number of individuals generally will decrease in the presence of severe degradation,
- total number of taxa decreases in the presence of most stressors; may artificially increase with organic enrichment,
- number of EPT taxa decreases in the presence of stressors, and
- percent contribution of dominant taxon usually increases in the presence of stressors.

Samples taken are similar to those seen in other urbanized streams of the Anacostia watershed (Stribling et al. 1989, Stribling and Thaler 1990).

The total number of individuals in a sample is not typically a metric used in evaluating streams using benthos. From all samples, the total number of individuals from all samples and all sites ranged from 10-2008 (Table 1). Even with compositing three Surbers, four of the eight sites had at least one sampling event that produced fewer than 100 individuals (Figure 2). Often a problem in urbanized, stormwater-affected streams, low sample abundance would suggest some impairment regardless of what other metrics might indicate. Numbers of taxa ranged from a low of 2 at the downstream Flora Lane site to a high of 15 at the second site in the Sligo Creek mainstem.

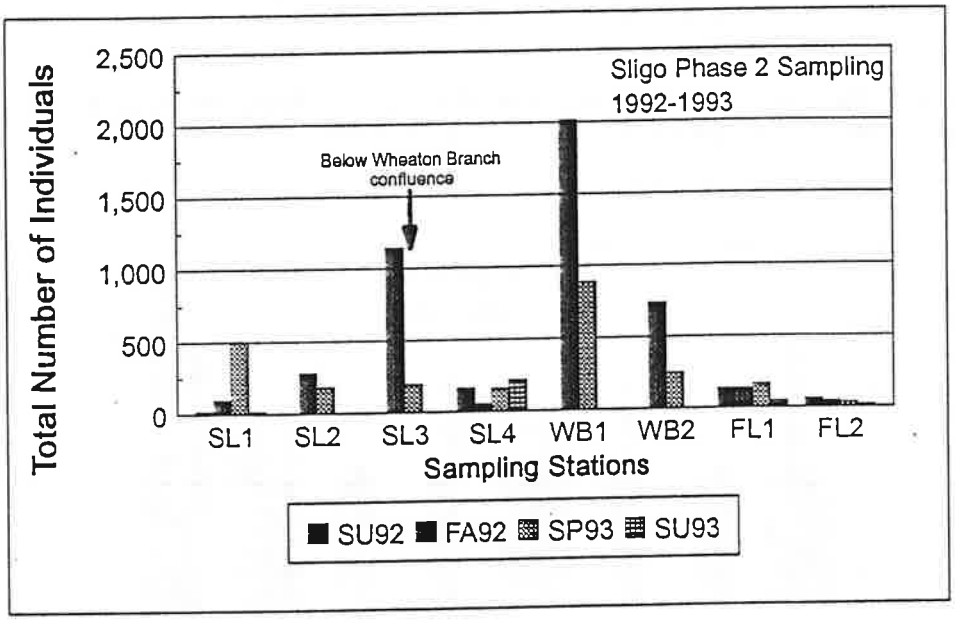


Figure 2. Total number of benthic macroinvertebrates collected at sampling stations in Sligo Creek (SL), Wheaton Branch (WB), and Flora Lane tributary (FL).

Fall samples had the highest numbers of taxa at the three upstream Sligo mainstem sites (SL1-3) and both Wheaton Branch sites (WB1-2) (Figure 3); the lowest numbers of taxa were consistently seen at the Flora Lane sites (FL1-2). Generally, when there is a low number of taxa at a site, there is simultaneously a high "percent contribution of dominant taxon" (Figure 4), an indication that one or a few taxa are:

- exploiting increased energy sources (nutrient enrichment), and/or
- able to exist and become more numerous due to a greater pollution tolerance than the majority of resident species.

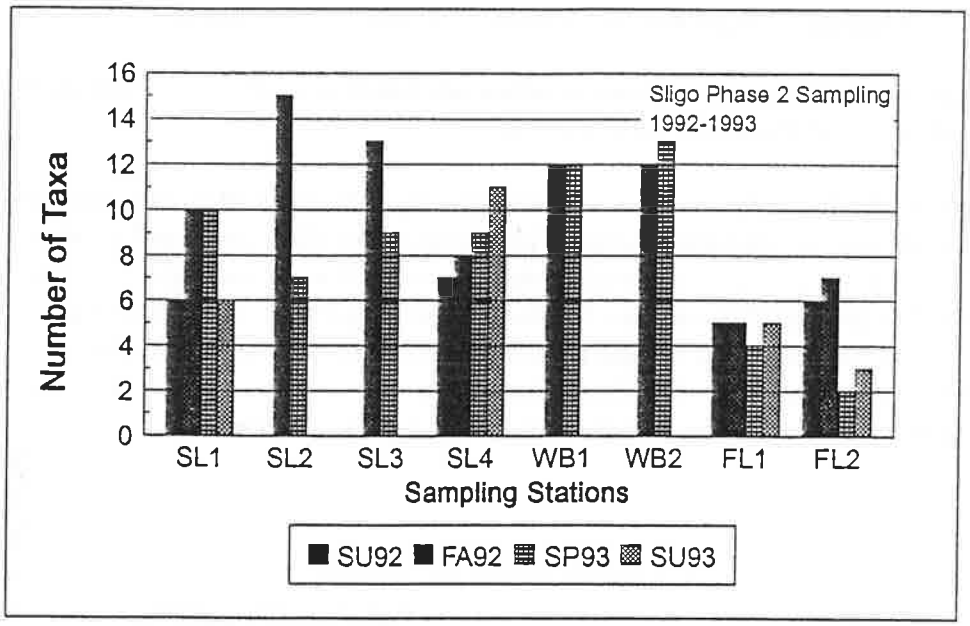


Figure 3. Numbers of benthic macroinvertebrate taxa collected by surbers in Sligo Creek (SL), Wheaton Branch (WB), and Flora Lane tributary (FL).

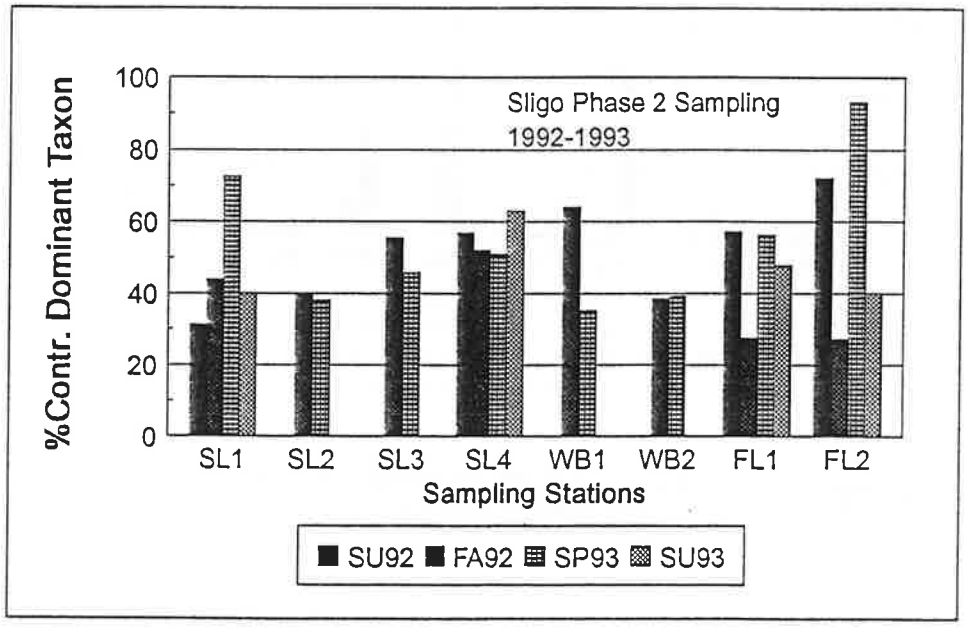


Figure 4. "Percent contribution of dominant taxon" to composited surber samples from Sligo Creek (SL), Wheaton Branch (WB), and Flora Lane tributary (FL).

At all sites, values for percent contribution of dominant taxon (= percent dominance) were never below 35% except at SL1 in the Summer 1992 samples and at both Flora Lane sites in Fall 1992 . These sites also had the highest values for this metric during different seasons, SL1 with 72% in Spring 1993 (Chironomidae: midges), and FL2 with 72% and 93% in Summer 1992 (midges) and Spring 1993 (midges), respectively. A stream sample of benthic macroinvertebrates that is dominated by midges is generally interpreted as a response to stressed conditions. Stribling and Thaler (1990) found that unimpaired streams in the Maryland piedmont region of the Anacostia watershed generally showed a percent dominance of less than 18%. However, every sample at the downstream Flora Lane site (FL2) contained less than 60 organisms, making meaningful calculation and interpretation of this metric difficult. For those samples having 96 specimens or greater (16 out of 24 composite samples [Table 1]), "percent contribution of dominant taxon" averaged 49%, indicating an imbalance in benthic assemblage structure and stressed conditions in general over the study area.

Biological conditions from Phase I to Phase II. The sites for which changes between the two phases can be examined are both on Wheaton Branch (WB1-2) and Sligo Creek mainstem just upstream (WB3/SL2) and downstream (WB4/SL3) of their confluence. For collections in both spring (1990, 1993) and fall (1990, 1992), changes in numbers of individuals were generally much greater than 50% from Phase I to Phase II (Figures 5-6), as were numbers of taxa. For the latter, the spring samples changed from number of taxa ranging from 4-7 (1990) to 7-13 (1993); similarly, fall samples ranged from 5-7 taxa in 1990 to 12-15 in 1992 (Figures 7-8).

Although, in themselves, high numbers of species or other taxa should not be the ultimate indicator of improving ecological conditions, these changes do signal a general improvement in habitat conditions in Wheaton Branch and Sligo Creek since completion of construction. Often, improving conditions are reflected in benthic macroinvertebrate assemblages by one or a few taxa not being overly dominant (Cummins and Stribling, 1992). This characteristic is in part described by the metric "percent contribution of dominant taxon". Thus, when conditions improve, there are typically lower values for this metric. In the spring samples (Figure 9), there was a change from 50-80% dominance (1990) to approximately 37-45% (1993).

Percent dominance changed from a range of approximately 67-93% (1990) to 39-63% in 1992 (Figure 10). As in numbers of individuals and in numbers of taxa, these changes suggest improving conditions in both Wheaton Branch and Sligo Creek.

The metric EPT is probably not useful; it came out as only 2 or 3 in both 1992 and 1993 and the maximum was only 5 in the Phase I sampling. Such low values do not allow sufficient variation between impaired and non-impaired conditions. Another problem with this data set is that it is sporadic among the seasons (Appendix I). The "spring 1993" samples were actually taken in late spring/early summer (May-June); the "summer 1993" sampling occurred at a single site in July and the remainder in early October. In the former case, it is likely that the three June 7 samples can be thought of as the same as the remaining May samples. In the latter, although represented as the summer 1993 results, one should remember that they are primarily fall and should not be used as representative of summer conditions (with the exception of the site farthest downstream on Sligo Creek, SL4). Therefore, the interpretation of changes would be more meaningful with greater standardization of sample timing. Nonetheless, Phases I and II do support an interpretation of ecological improvement in Wheaton Branch following restoration activities.

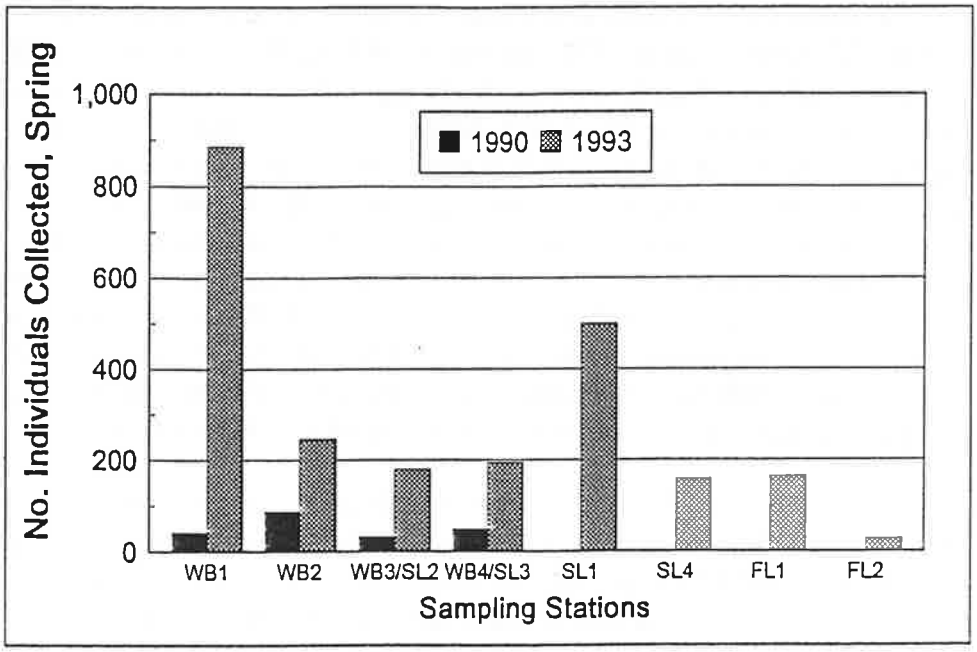


Figure 5. "Number of Individuals" collected by surber sampler during spring 1990 and 1993 sampling in Wheaton Branch (WB), Sligo Creek (SL), and Flora Lane tributary (FL).

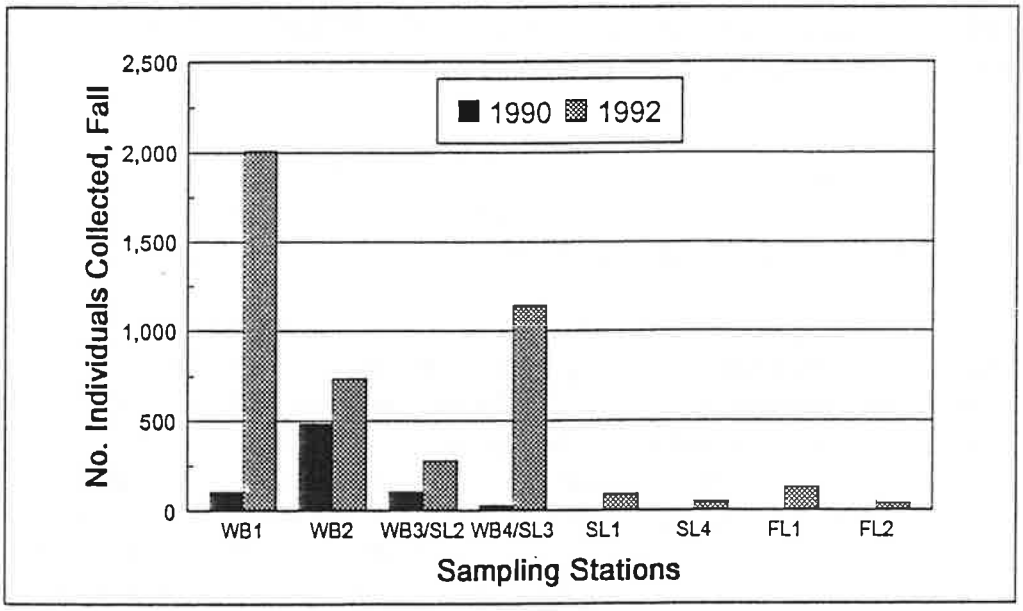


Figure 6. "Number of Individuals" collected by surber sampler during fall 1990 and 1992 sampling in Wheaton Branch (WB), Sligo Creek (SL), and Flora Lane tributary (FL).

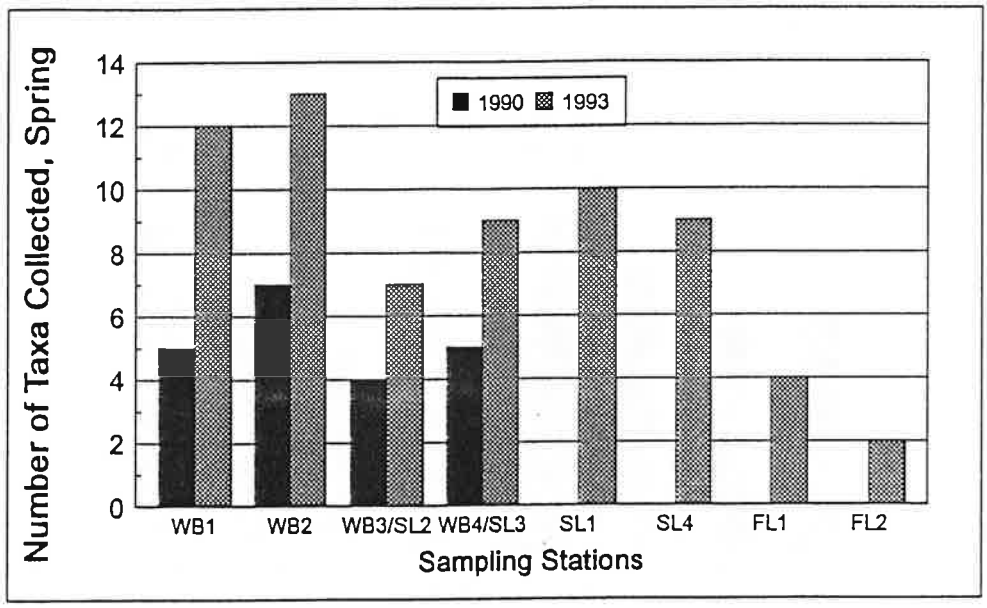


Figure 7. "Number of taxa" collected by surber sampler during spring 1990 (Sligo Phase 1) and 1993 (Phase 2) sampling in Wheaton Branch (WB), Sligo Creek (SL), and Flora Lane tributary (FL).

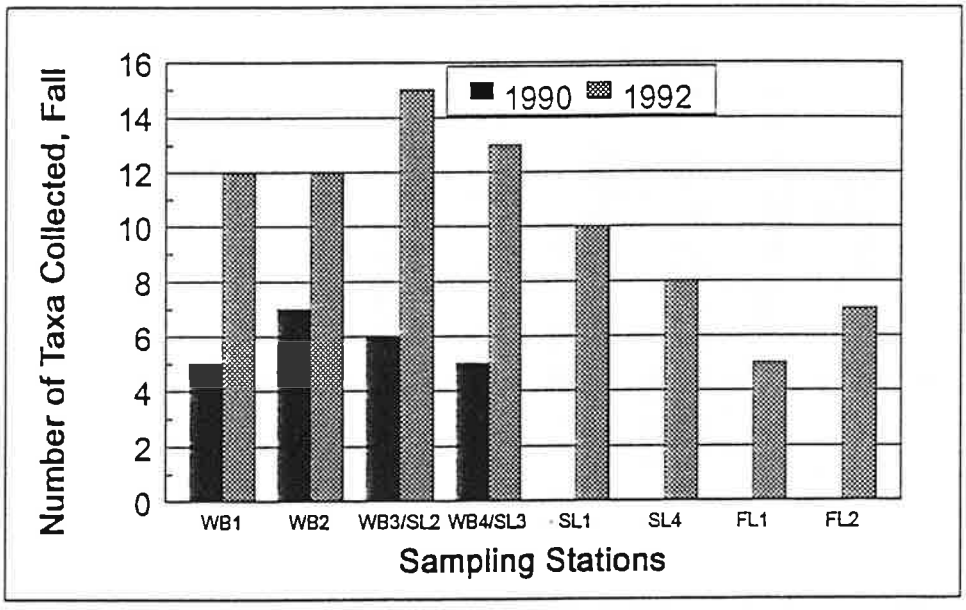


Figure 8. Number of taxa collected by surber sampler during fall 1990 (Sligo Phase 1) and 1992 (Phase 2) sampling in Wheaton Branch (WB), Sligo Creek (SL), and Flora Lane tributary (FL).

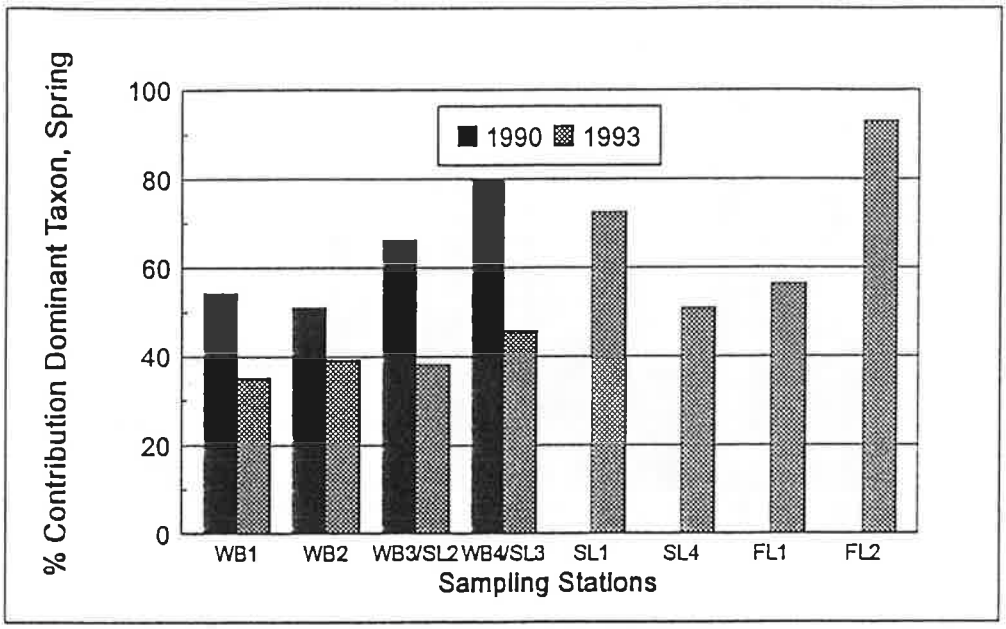


Figure 9. "Percent contribution of dominant taxon" calculated on samples collected by surber sampler during spring 1990 (Sligo Phase 1) and 1993 (Phase 2) sampling in Wheaton Branch (WB), Sligo Creek (SL), and Flora Lane tributary (FL).

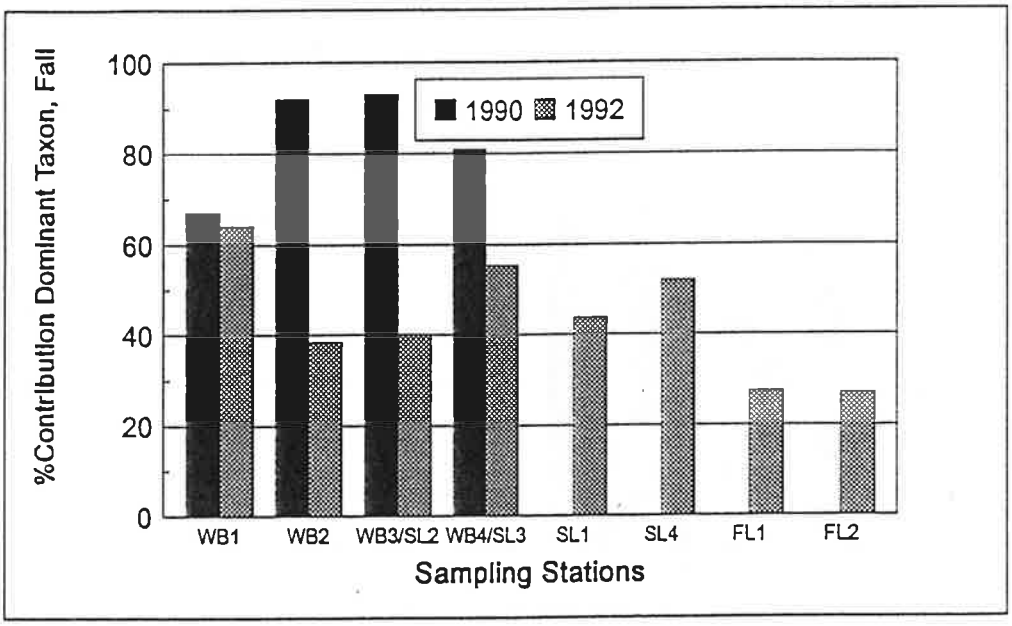


Figure 10. "Percent contribution of dominant taxon" calculated on samples collected by surber sampler during fall 1990 (Sligo Phase 1) and 1992 (Phase 2) in Wheaton Branch (WB), Sligo Creek (SL), and Flora Lane tributary (FL).

2. Fishes and Habitat

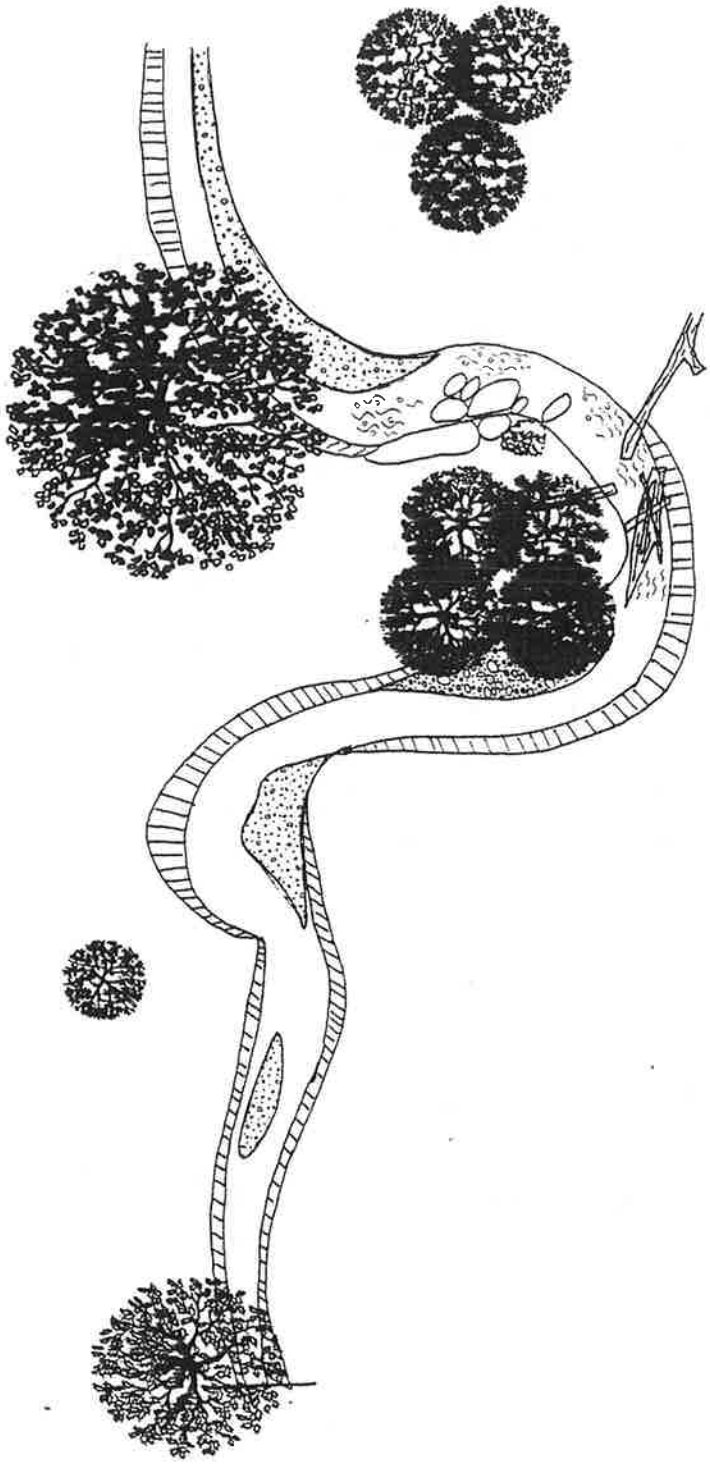
The following section provides a synopsis of the data collected during fish surveys. Fish transplant stockings were provided to the sampling area on three occasions (Table 2). The 1992 and 1993 stockings were part of this project. The first stocking, in 1990, was independent of and prior to this project.

Table 2: Transfer Stockings of Fishes into Upper Sligo Creek

COMMON NAME	SCIENTIFIC NAME	1990[1]	1992[2]	1993[2]	TOTAL
1. Silverjaw Minnow	Ericymba buccata	123			123
2. Cutlips Minnow	Exoglossum maxillingua	9		5	14
3. Swallowtail Shiner	Notropis procne	2071		36	2107
4. Satinfin Shiner	Notropis spilopterus	1064			1064
5. Common Shiner	Notropis cornutus	65		11	76
6. Spottailed Shiner	Notropis hudsonius	82			82
7. Bluntnose Minnow	Pimephales notatus	40	171	46	257
8. Rosyside Dace	Clinostomus funduloides	10		45	55
9. Longnose Dace	Rhinichythys cataractae	9	14	10	33
10. White Sucker	Catostomus commersoni	11	97		108
11. Northern Hog Sucker	Hypentelium nigricans	13		6	19
12. Bluegill Sunfish	Lepomis macrochirus	2			2
13. Redbreast Sunfish	Lepomis auritus	2			2
14. Pumpkinseed Sunfish	Lepomis gibbosus	2			2
15. Largemouth Bass	Micropterus salmoides	(yoy) 3			3
16. Tessellated Darter	Etheostoma olmstedi	57	133	30	220
17. Banded Killifish	Fundulus diaphanus	39			39
	GRAND TOTALS	3602	415	189	4206

[1]Introduced into Sligo Creek mainstem near SL-4; [2]Introduced into Wheaton Branch, tributary of Sligo Creek

Provided on the next fourteen pages are overhead views of each site which were transcribed from field sketches made during sampling. These are accompanied by 1) habitat assessment scores for that site, 2) the lists of fish species and number of individuals captured, 3) water quality parameters, and 4) general weather conditions for each sampling date. Information on the reference site in N.W. Branch can be found in Appendix V.



Site SLC1: Sligo Creek x University Blvd.

Habitat Assessment 10/15/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Marginal	7	10-30% Mix of Rubble, Gravel, or other stable habitat.
Embedded-ness	Poor	5	Gravel, cobble and boulder particles are over 75% surrounded by fine sediment
Velocity/ Depth	Marginal	7	Only 2 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Optimal	16	Some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light.
Channel Alteration	Marginal	4	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks.
Scouring/ Deposition	Sub-Optimal	8	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.
Pool/Riffle Ratio	Sub-Optimal	8	7-15. Infrequent repeat pattern. Variety of microhabitats less than optimal.
Lower Bank Stability	Sub-Optimal	8	Overbank (lower) flows occasional. W/D ratio 8-15.
Upper Bank	Marginal	4	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow.
Bank Vegetative Protection	Poor	2	Less than 50% of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Optimal	10	>18 meters.
TOTAL		87	

Sligo Creek Phase II, 1992-1993 Fisheries Survey

Site SLC1: Sligo Creek x University Blvd.

Species Captured	10/15/92	6/7/93	10/5/93
1. Blacknose Dace	4	8	39
# of Species	1	1	1
# of Individuals	4	8	39
Estimate of total population	6	12	42
$\pm$ 2 SE	9	11	6

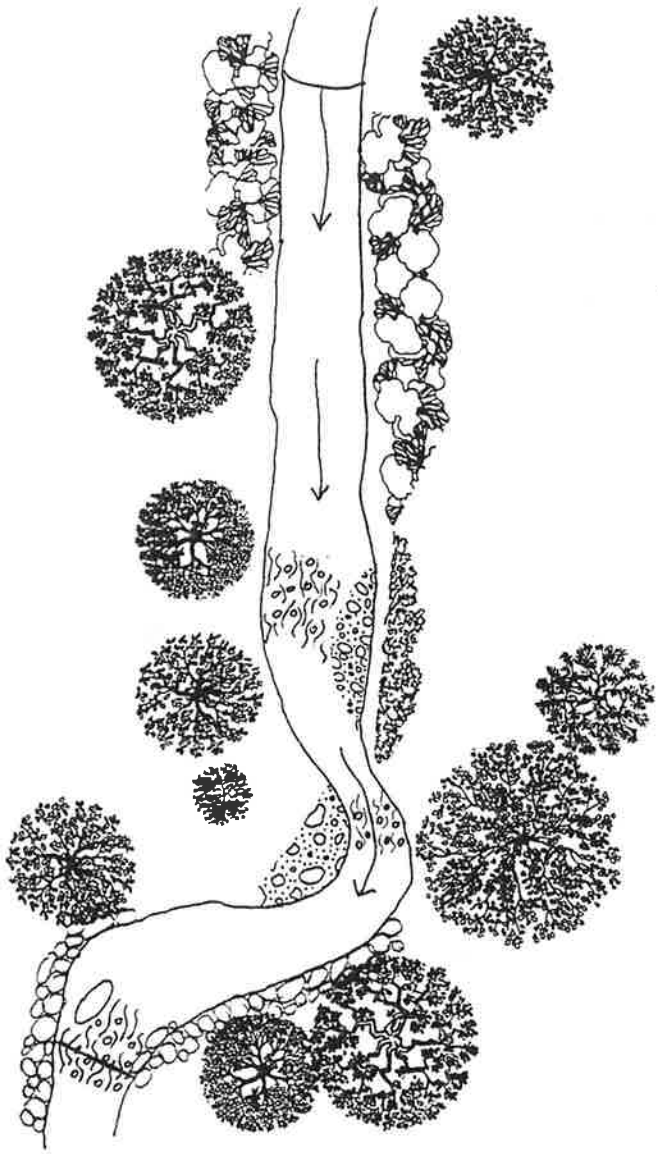
Water Quality Conditions:
10/15/93 Temp: 11.0 Turbidity: clear

Weather Conditions
10/15/93 Air Temp: 70's Wind: light Cloud Cover: clear

Water Quality Conditions:
6/7/93 Temp: 17.15 pH: 7.4 DO: 5.72 Cond: 245

Water Quality Conditions:
10/5/93 Temp: 12.5

Weather Conditions:
10/5/93 Air Temp: High 60's Wind: light Cloud Cover: moderate



Site SLC2: Sligo Creek x Wheaton Branch (upstream)

Habitat Assessment 10/20/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Sub-Optimal	11	30-50% Mix of Rubble, Gravel, or other stable habitat. Adequate Habitat
Embedded-ness	Marginal	8	Gravel, cobble and boulder particles between 50-75% surrounded by fine sediment
Velocity/ Depth	Optimal	16	Slow shallow, Slow deep, Fast Shallow and Fast deep habitats all present
Canopy Cover	Optimal	17	Some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light.
Channel Alteration	Sub-Optimal	9	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present
Scouring/ Deposition	Sub-Optimal	8	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.
Pool/Riffle Ratio	Optimal	12	Ratio 5-7. Variety of habitat. repeat pattern relatively frequent.
Lower Bank Stability	Sub-Optimal	12	Overbank (lower) flows occasional. W/D ratio 8-15.
Upper Bank	Sub-Optimal	9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.
Bank Vegetative Protection	Marginal	3	50-79% of the streambank surfaces covered by vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Marginal	4	Between 6-12 meters.
TOTAL		117	

Sligo Creek Phase II, 1992-1993 Fisheries Survey

Site SLC2: Sligo Creek x Wheaton Branch, Upstream

Species Captured	10/20/92	5/28/93	7/29/93
1. Swallowtail Shiner	1		
2. Blacknose Dace	221	97	161
3. Northern Creek Chub	36	33	27
4. Green Sunfish	2	2	1
5. Tessellated Darter	2		1
6. Rosysided Dace			1
7. White Sucker			1
# of Species	5	3	6
# of Individuals	262	132	192
Estimate of total population	273	155	209
± 2 SE	10	19	16

Length of game fish in millimeters: Sligo Creek x Wheaton Branch, upstream. (10/20/92)

Northern Creek Chub: 170.
Green Sunfish: 60,68.

Water Quality Conditions:
10/20/92 Temp: 7.0 Turb: clear

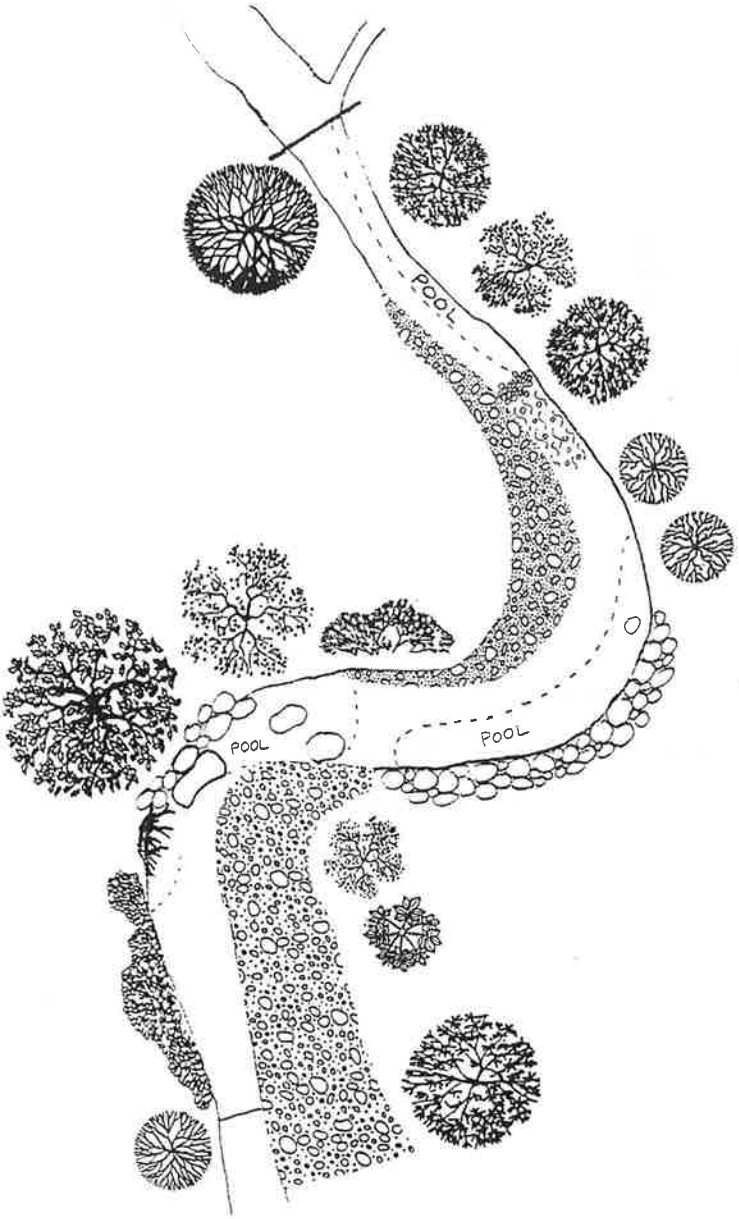
Weather Conditions:
10/20/92 Air Temp. 7.0 Wind: light Cloud Cover: clear

Water Quality Conditions:
5/28/93 Temp: 18.3 pH: 7.39 DO: 7.05 Cond: 236 Turb: clear

Length of game fish in millimeters: Sligo Creek x Wheaton Branch, upstream. (7/29/93)

Green Sunfish: 95.
White Sucker: 50.

Weather Conditions:
7/29/93 Air temp: 90's Wind: light Cloud Cover: clear



Site WB1: Upper Wheaton Branch.

Habitat Assessment 09/16/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Sub-Optimal	12	30-50% Mix of rubble, gravel, or other stable habitat.
Embedded-ness	Sub-Optimal	11	Gravel, cobble and boulder particles between 25-50% surrounded by fine sediment
Velocity/ Depth	Sub-Optimal	14	Only 3 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Optimal	17	Some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light.
Channel Alteration	Optimal	13	Little or no enlargement of islands or point bars, and/or no channelization
Scouring/ Deposition	Sub-Optimal	10	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.
Pool/Riffle Ratio	Sub-Optimal	11	7-15. Infrequent repeat pattern. Variety of microhabitats less than optimal.
Lower Bank Stability	Sub-Optimal	8	Overbank (lower) flows occasional. W/D ratio 8-15.
Upper Bank	Sub-Optimal	7	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.
Bank Vegetative Protection	Marginal	5	50-79% of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Optimal	9	>18 meters.
TOTAL		125	

TABLE 5: Sligo Creek Phase II, 1992 Fisheries Survey

Site WB1: Upper Wheaton Branch

Species Captured	9/16/92	6/7/93	7/30/93
1. Goldfish	42	15	14
2. Rosyside Dace		1	
3. Common Shiner		2	
4. Blacknose Dace	93	110	66
5. Longnose Dace		1	
6. Northern Creek Chub	19	32	25
7. White Sucker	14	12	1
8. Brown Bullhead	1		
9. Green Sunfish	44	14	43
10. Bluegill Sunfish	3	9	
11. Tessellated Darter		3	
# of species	7	10	5
# of individuals	216	199	149
Estimate of total population	309	293	180
± 2 SE	35	35	25

Length of game fish in millimeters. Wheaton Branch Upstream (9/16/92)

White Sucker 173,202,188,218,163,257,185,160,212,210,192,183,170,182.
Brown Bullhead 68.
Green Sunfish 72,65,73,55,67,65,52,85,62,50,58,60,80,74,45, 65,70,48,47,55,68,45,45,45,45,58.

Water Quality Conditions:
9/16/92 Temp: 21.2 pH: 7.5 DO: 7.5 Cond: 258

Length of game fish in millimeters. Wheaton Branch Upstream (6/7/93)

White Sucker 205,223,206,225,211.

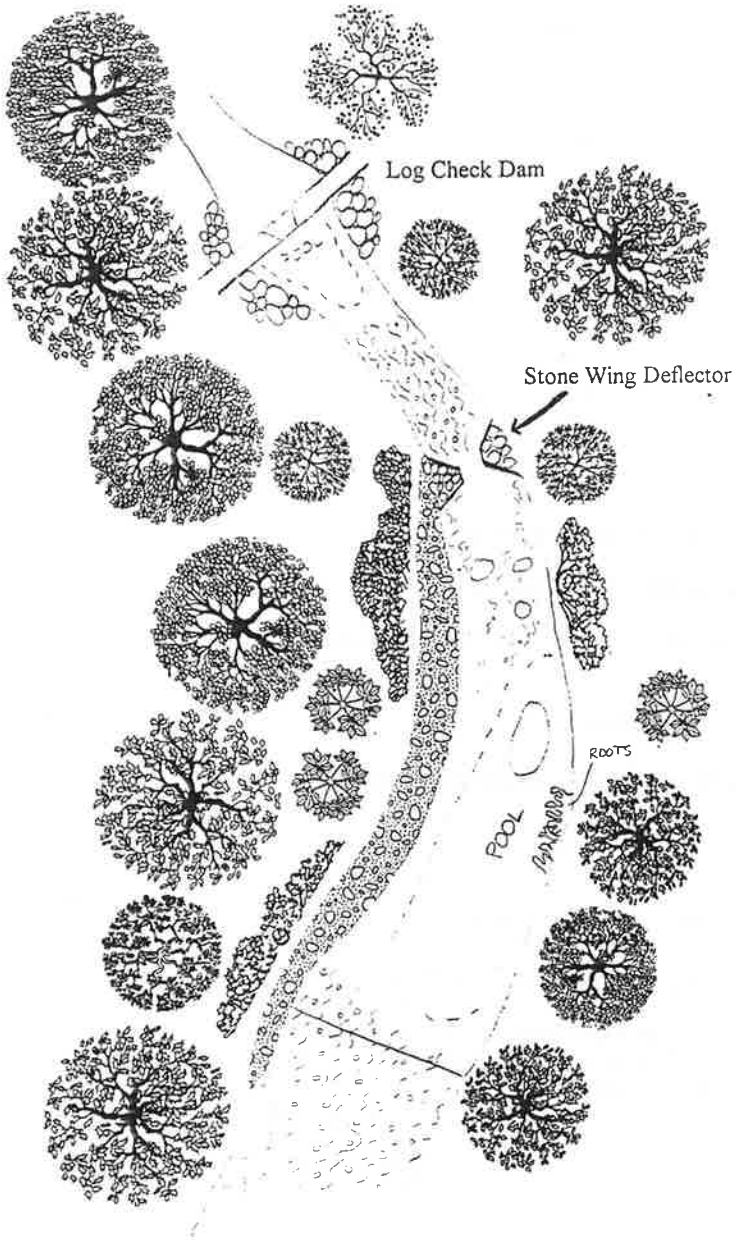
Water Quality Conditions:
6/7/93 Temp: 16.8 pH: 7.28 DO: 4.67 Cond: 239 Turb: 7.0 ntu

Length of game fish in millimeters. Wheaton Branch Upstream (7/30/93)

Green Sunfish 95,90,88,55,50,33,28,80,80,58,65,65,35,80,81,90,74,82,75,35,50,30,50,30,85,30,85, 30,70,88,85,78,60,58,65,88,35,35,30,32,28,88,85,37,38,35,65.
(comments: one with badly eroded tail, one with tail injury)
White Sucker 128.

Water Quality Conditions:
7/30/93 Temp: 21 Turb: moderate

Weather Conditions:
7/30/93 Air temp: 80's Wind: none Cloud Cover: none



Site WB2: Lower Wheaton Branch.

Habitat Assessment 09/16/95

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Sub-Optimal	11	30-50% Mix of rubble, gravel, or other stable habitat.
Embedded-ness	Sub-Optimal	12	Gravel, cobble and boulder particles between 25-50% surrounded by fine sediment
Velocity/ Depth	Sub-Optimal	14	Only 3 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Optimal	18	Some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light.
Channel Alteration	Sub-Optimal	10	Some new increase in bar formation mostly from coarse gravel; and/or some channelization present.
Scouring/ Deposition	Sub-Optimal	10	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.
Pool/Riffle Ratio	Optimal	13	Ratio 5-7. Variety of habitats. Repeat pattern of sequence relatively frequently.
Lower Bank Stability	Sub-Optimal	9	Overbank (lower) flows occasional. W/D ratio 8-15.
Upper Bank	Sub-Optimal	8	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.
Bank Vegetative Protection	Marginal	7	50-79% of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Optimal	9	>18 meters.
TOTAL		129	

TABLE 6: Sligo Creek Phase II, 1992 Fisheries Survey

Site WB2: Lower Wheaton Branch

Species Captured	9/16/92	6/7/93	7/30/93
1. Goldfish	35	39	55
2. Golden Shiner	1	2	
3. Rosyside Dace		1	
4. Swallowtail Shiner	16	9	
5. Satinfin Shiner	1		5
6. Spottailed Shiner	6		2
7. Blacknose Dace	64	270	135
8. Bluntnose Minnow		3	
9. Northern Creek Chub	21	31	32
10. White Sucker	9	1	3
11. Brown Bullhead	1	3	3
12. Green Sunfish	12	35	33
13. Bluegill Sunfish	15	5	
14. Largemouth Bass	1		
15. Tessellated Darter	2	5	3
# of species	13	12	9
# of individuals	184	404	271
Estimate of total population	252	479	346
± 2 SE	*	*	58

* Standard error too large

Length of game fish in millimeters. Wheaton Branch Downstream (9/16/92)

Largemouth Bass	182.
Brown Bullhead	92.
Tessellated Darter	58,62.
White Sucker	172,155,168,160,138,148,280,125,130.
Bluegill	44,40,40,48,40,48,48,42,38.

Water Quality Conditions:
9/16/92 Temp: 21.7 pH: 7.6 DO: 7.0 Cond: 256

Length of game fish in millimeters. Wheaton Branch Downstream (6/7/93)

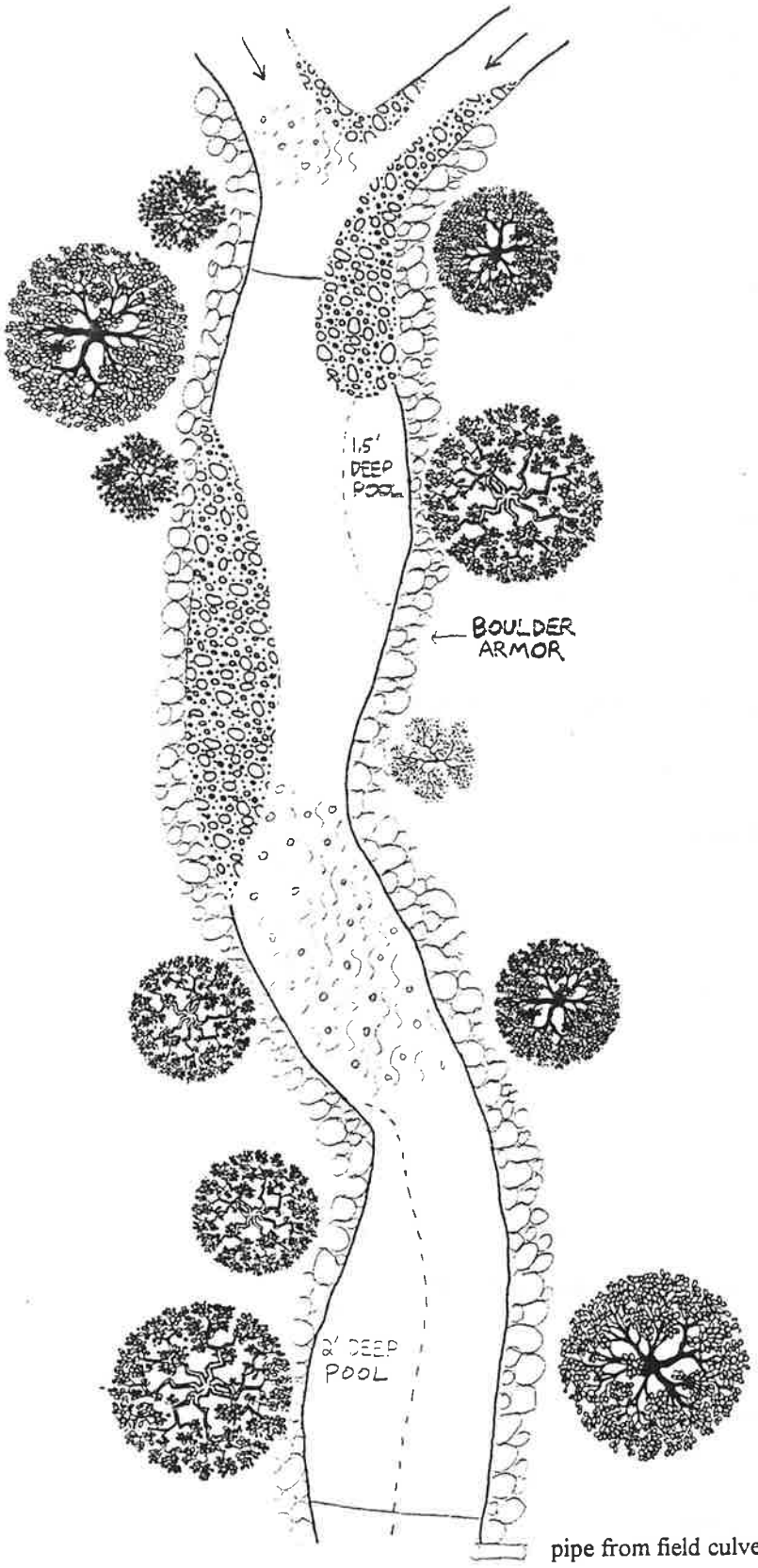
White Sucker	172,155,168,160,138,148,280,125,130.
Brown Bullhead	92.
Bluegill Hybrid	44,40,40,48,40,48,48,42,38.
Largemouth Bass	182.
Tessellated Darter	58,62.

Water Quality Conditions:
6/7/93 Temp: 19.0 pH: 7.46 DO: 5.86 Cond: 242 Turb: 8 ntu

Length of game fish in millimeters. Wheaton Branch Downstream (7/30/93)

White Sucker	200,228,45,45,165,48,53,50.
Brown Bullhead	122,135,165. (comments: two with eroded tails)
Green Sunfish	60,76,65,65,73,80,62,63,63,66,70,86,32,111,101,87,78,66,78,63. (comments: enlarged eyes in two fish)

Water Quality Conditions:
7/30/93 Temp: 21 Turb: moderate
Air temp: 80's Wind: none Cloud Cover: none



pipe from field culvert

Site SLC3: Sligo Creek x Wheaton Branch (downstream)

Habitat Assessment 10/20/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Sub-Optimal	11	30-50% Mix of rubble, gravel, or other stable habitat.
Embedded-ness	Sub-Optimal	13	Gravel, cobble and boulder particles between 25-50% surrounded by fine sediment
Velocity/ Depth	Sub-Optimal	9	Only 3 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Optimal	16	Some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light.
Channel Alteration	Sub-Optimal	11	Some new increase in bar formation mostly from coarse gravel; and/or some channelization present.
Scouring/ Deposition	Sub-Optimal	11	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.
Pool/Riffle Ratio	Marginal	6	Ratio 15-25. Occasional riffle or bend. Bottom contours provide some habitat.
Lower Bank Stability	Sub-Optimal	11	Overbank (lower) flows occasional. W/D ratio 8-15.
Upper Bank	Sub-Optimal	8	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.
Bank Vegetative Protection	Sub-Optimal	8	70-89% of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Marginal	4	Between 6 and 12 meters.
TOTAL		116	

Sligo Creek Phase II, 1992-1993 Fisheries Survey

Site SLC3: Sligo below Wheaton Branch

Species Captured	10/20/92	5/28/93	7/29/93
1. American Eel			3
2. Goldfish	2	3	3
3. Swallowtail Shiner	33	36	8
4. Satinfin Shiner		6	2
5. Spottailed Shiner	5		12
6. Blacknose Dace	268	150	243
7. Longnose Dace		1	2
8. Northern Creek Chub	58	34	15
9. White Sucker	2		4
10. Spotfin Shiner	5		
11. Brown Bullhead	1		2
12. Green Sunfish		4	5
13. Tessellated Darter	3	7	10
# of Species	9	8	12
# of Individuals	377	241	309
Total population estimate	529	252	383
$\pm$ 2 SE	*	8	*

* Standard error too large

Length of game fish in millimeters. Sligo creek at Wheaton Branch, Downstream (10/20/92)

White Sucker	246,288.
Green Sunfish	50.
Northern Creek Chub	190.
Brown Bullhead	110.

Water Quality Conditions:
10/20/92 Temp: 6.0 Turb: clear

Weather Conditions:
10/20/92 Air Temp: 4.0 Wind: light Cloud Cover: clear

Water Quality Conditions:
5/28/93 Temp: 19.5 pH: 7.53 DO: 7.15 Cond: 276 Turb: clear

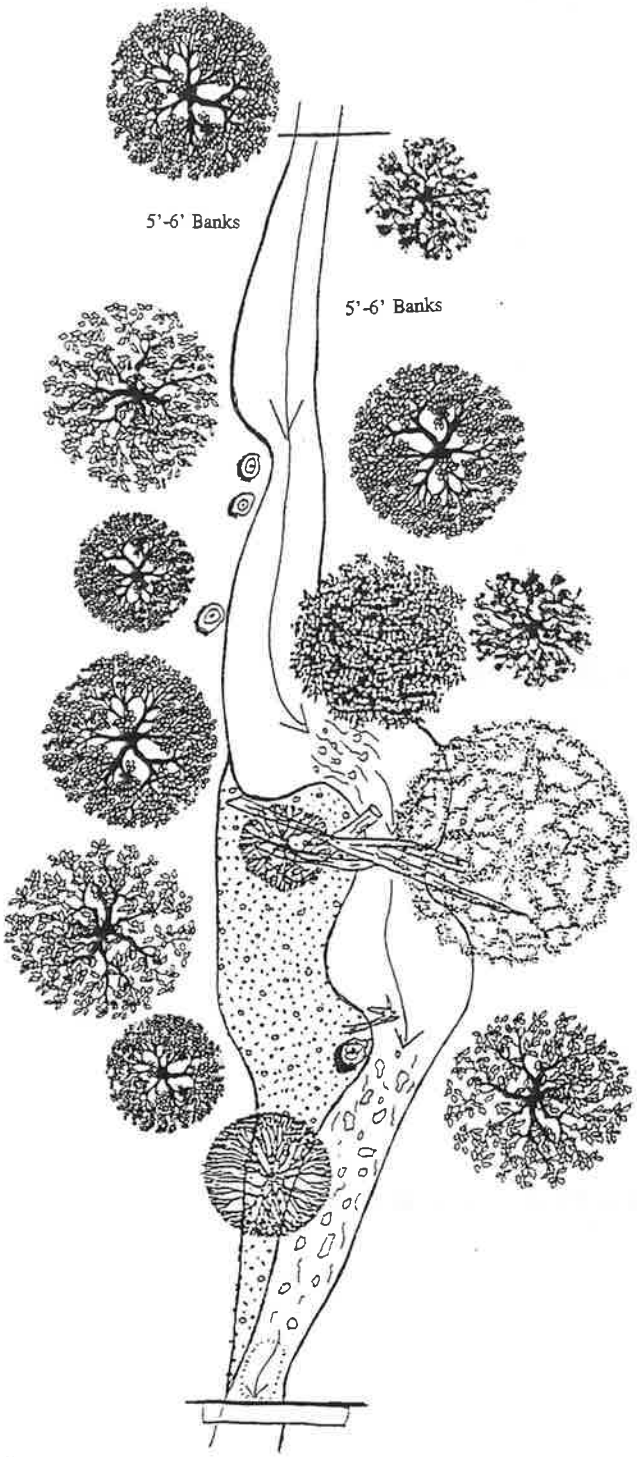
Weather Conditions:
5/28/93 Air Temp: 80's Wind: light Cloud Cover: clear

Length of game fish in millimeters. Sligo Creek at Wheaton Branch, Downstream (7/29/93)

Green Sunfish	90,75,88,23,73.
American Eel	605,387,735.
White Sucker	148,150,50,43.
Brown Bullhead	148,48,43,50.

Water Quality Conditions:
7/29/93 Temp: 21 Turb: clear

Weather Conditions:
7/29/93 Air Temp: 90's Wind: none Cloud Cover: clear



Site FL1: Upper Flora Lane.

Habitat Assessment 10/15/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Sub-Optimal	14	30-50% mix of rubble, gravel, or other stable habitat. Adequate habitat.
Embedded-ness	Marginal	6	Gravel, cobble and boulder particles between 50-75% surrounded by fine sediment
Velocity/ Depth	Sub-Optimal	15	Only 3 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Marginal	10	Completely covered by dense canopy; water surface completely shaded OR nearly full sunlight reaching water surface. Shading limited to <3 hours per day.
Channel Alteration	Marginal	7	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks.
Scouring/ Deposition	Marginal	7	30-50% affected. Deposits and/or scour at obstructions, constrictions, and bends. Filling in pools prevalent.
Pool/Riffle Ratio	Marginal	7	15-25. Occasional riffle or bend. Bottom contours provide some habitat.
Lower Bank Stability	Optimal	12	Overbank flows rare. W/D ratio <7.
Upper Bank	Sub-Optimal	8	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.
Bank Vegetative Protection	Marginal	5	50-79% of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	7	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Poor	2	< 6 meters.
TOTAL		100	

Sligo Creek Phase II, 1992-1993 Fisheries Survey

Site FL1: Upper Flora Lane

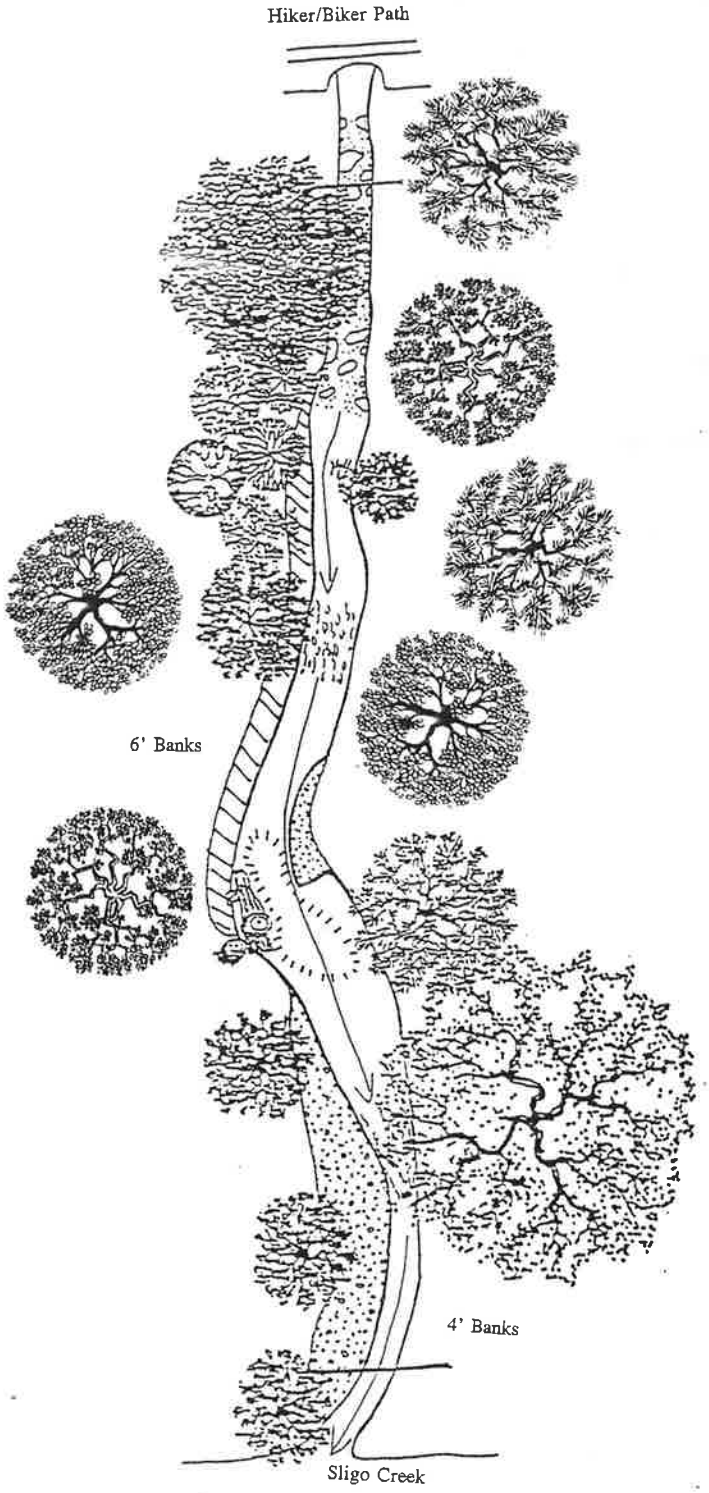
Species Captured	10/15/92	5/28/93	10/5/93
1. Blacknose Dace	13	5	35
2. Green Sunfish			3
# of Species	1	1	2
# of Individuals	13	5	38
Total population estimate	14	6	46
± 2 SE	3	4	13

Water Quality Conditions:
5/28/93 Temp: 18.3 pH: 7.39 DO: 7.05 Cond: 236 Turb: clear

Weather Conditions:
5/28/93 Air Temp: 80's Wind: light Cloud Cover: clear

Water Quality Conditions:
10/5/93 Temp: 12.5 Turb: very turbid (water appeared grey)

Weather Conditions:
10/5/93 Air Temp: 70's Wind: none Cloud Cover: clear



Site FL2: Lower Flora Lane.

Habitat Assessment 10/15/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Marginal	6	10-30% mix of rubble, gravel, or other stable habitat. Habitat availability less than desirable.
Embedded-ness	Poor	4	Gravel, cobble and boulder particles over 75% surrounded by fine sediment
Velocity/ Depth	Marginal	6	Only 2 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Optimal	16	A mixture of conditions where some areas of water surface fully exposed to sunlight and other areas receiving various degrees of filtered light.
Channel Alteration	Marginal	4	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks.
Scouring/ Deposition	Marginal	4	30-50% affected. Deposits and/or scour at obstructions, constrictions, and bends. Filling in pools prevalent.
Pool/Riffle Ratio	Poor	3	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat.
Lower Bank Stability	Sub-Optimal	8	Overbank flows occasional. W/D ratio 8-15.
Upper Bank	Poor	2	Unstable. Many eroded areas. "Raw" areas frequent. Side slopes > 60% common.
Bank Vegetative Protection	Poor	2	Less than 50 of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Marginal	4	Between 6 - 12 meters.
TOTAL		67	

Sligo Creek Phase II, 1992-1993 Fisheries Survey

Site FL2: Lower Flora Lane

Species Captured	10/15/92	5/13/93	10/5/93
1. Blacknose Dace	111	92	262
2. Northern Creek Chub	15	2	15
3. Green Sunfish			4
4. Redbreast Sunfish	1		
# of Species	3	2	3
# of Individuals	127	94	281
Total population estimate	315	96	302
± 2 SE	*	2	14

* Standard error too large

Length of game fish in millimeters. Flora Lane Downstream (10/15/92)

Northern Creek Chub 127,196,154,155,147,140,125,163.
Redbreast 30.

Water Quality Conditions:
10/15/92: Temp: 14 Turb: clear

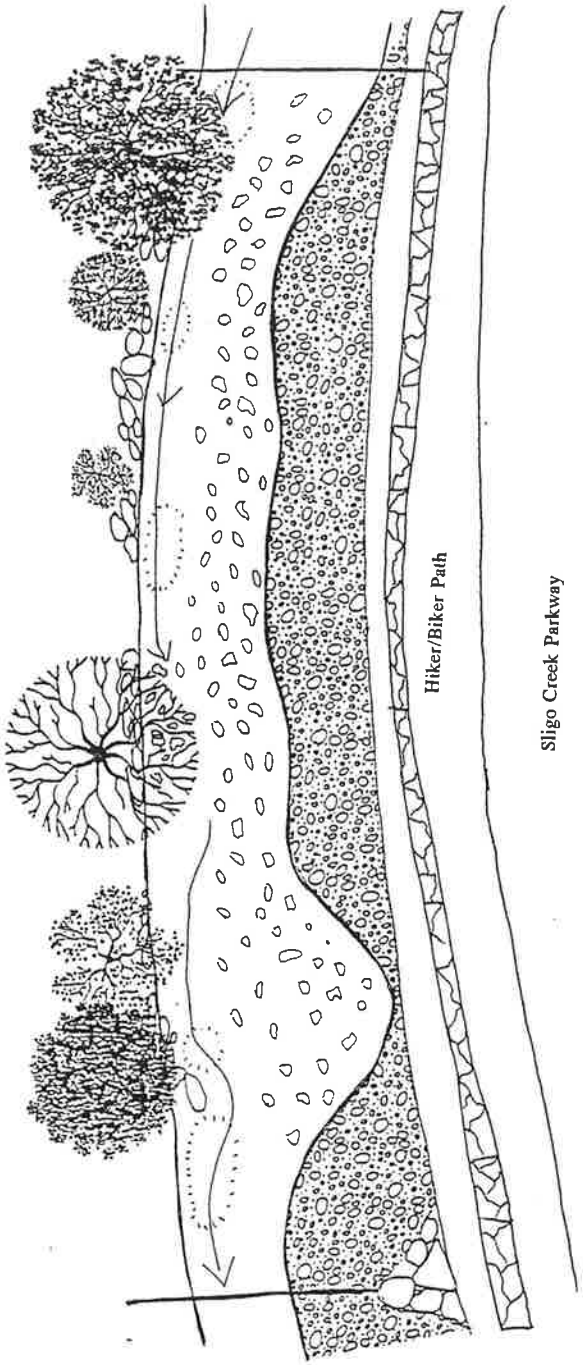
Weather Conditions:
10/15/92: Air Temp: 19.0 Wind: light Cloud Cover: clear

Water Quality Conditions:
5/13/93: Temp: 17.2 pH: 7.45 DO: 852 Cond: .397 Turb: clear

Weather Conditions:
5/13/93: Air Temp: 70.5 Wind: light Cloud Cover: 90%

Water Quality Conditions:
10/5/93 Temp: 12.5 Turb: moderately clear

Weather Conditions:
10/5/93 Air Temp: 70's Wind: moderate Cloud Cover: clear



Site SLC4: Sligo Creek above Colesville Road

Habitat Assessment 10/15/92

Habitat Parameter	Rank	Score	Description
Bottom Substrate	Sub-Optimal	15	30-50% Mix of rubble, gravel, or other stable habitat.
Embedded-ness	Sub-Optimal	13	Gravel, cobble and boulder particles between 25-50% surrounded by fine sediment
Velocity/ Depth	Sub-Optimal	14	Only 3 of the 4 habitat types present (missing riffles/runs get lower score)
Canopy Cover	Optimal	16	Some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light.
Channel Alteration	Sub-Optimal	11	Some new increase in bar formation mostly from coarse gravel; and/or some channelization present.
Scouring/ Deposition	Sub-Optimal	11	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools.
Pool/Riffle Ratio	Sub-Optimal	11	Ratio 7-15. Infrequent repeat pattern. Variety of macrohabitat less than optimal.
Lower Bank Stability	Sub-Optimal	11	Overbank (lower) flows occasional. W/D ratio 8-15.
Upper Bank	Sub-Optimal	8	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods.
Bank Vegetative Protection	Sub-Optimal	6	70-89% of the streambank surfaces covered by protective vegetation.
Streamside Cover	Sub-Optimal	8	Dominant vegetation is of tree form.
Riparian Vegetative Zone	Poor	2	< 6 meters.
TOTAL		126	

Site SLC4: Sligo Creek above Colesville Road

Species Captured	10/15/92	5/28/93	7/29/93
1. Blacknose Dace	166	231	246
2. Northern Creek Chub	3		2
3. Green Sunfish		1	1
4. Tessellated Darter	1		
5. Longnose Dace			3
# of Species	3	2	4
# of Individuals	170	232	252
Estimate of total population	191	255	280
± 2 SE	20	16	20

Water Quality Conditions:
10/15/92 Temp: 13.0 Turb:clear

Weather Conditions:
10/15/92 Air Temp: 15.0 Wind: light Cloud Cover: clear

Water Quality Conditions:
5/28/93 Temp: 18.3 pH: 7.39 DO: 7.05 Cond: 236 Turb:clear

Weather Conditions:
5/28/93 Air Temp: 80's Wind: light Cloud Cover: clear

Weather Conditions:
7/29/93 Air Temp: 90's Wind: light Cloud Cover: clear

Biological conditions from Phase I to Phase II. Total IBI and Habitat Assessment scores, along with the percent of reference for each site, are shown below in Table 3.

Table 3
Phase I and II IBI and Habitat Assessment Scores

	1990				1992			
SITE	IBI raw score	% of reference	habitat assessment	% of reference	IBI raw score	% of reference	habitat assessment	% of reference
REF	27.00	100	88.00	100	27.00	100	120	100
SL2	0.00	0	93.00	106	7.67	28	117	98
SL3	0.00	0	97.00	110	9.67	36	116	97
WB1	0.00	0	43.00	49	10.33	38	125	104
WB2	0.00	0	49.00	56	14.33	53	129	108
FL1					5.33	20	100	83
FL2					5.67	21	67	56
SL1					3.33	12	87	73
SL4					6.00	22	126	105

Note: the increase in the habitat score for the reference site (Layhill Park, Northwest Branch) is due to the addition of three habitat parameters noted in the text

Biological data analysis for fish incorporated eight metrics to arrive at an **I**ndex of **B**iological **I**ntegrity (**IBI**) as modified from Plafkin et al. (1989) by Cummins (1991). "Optimal" metric values are scored as 5, while metric values 3, 1, and 0 respectively represent conditions approximating, deviating slightly below, or deviating greatly below the regional reference site values. Therefore, scoring is meant to establish a hierarchy with the best conditioned streams receiving the highest scores.

Please note that an updated and therefore different habitat assessment sheet was used for the Phase II study. The new "twelve parameter" habitat assessment more accurately characterizes stream habitat conditions than its "nine parameter" predecessor. However, since the new twelve parameter assessments has a greater potential total score than the nine parameter assessment (180 vs 135, respectively) the new assessment will automatically increase the total score of any site previously evaluated with the older nine parameter assessment method[4]. Therefore, direct numeric comparisons between habitat scores of Phase I and Phase II were not made. However, because sites are evaluated by their percent similarities to reference site conditions, comparisons were made by using the differences between the "percent of reference site" scores of the Phase I and Phase II studies.

For example, refer to the habitat scores of site WB1 as seen in Table 3 and the graphic presentation of habitat scores as seen on the following page in Figure 11. In the Phase I study (9 parameter habitat assessment) this site attained a habitat score of 43, which was 49% of the original reference site score of 88. In the Phase II study (12 parameter habitat assessment), after restoration, this site scored 125 habitat points, 104% of the same reference site's new score of 120 (the three new

[4]The updated scores for the Reference Site in the Phase II study for these new parameters were 17, 7, and 8, respectively.

parameters added 32 points to the old score of 88). WB2's relative habitat scores also improved, from 56% of reference conditions to 108% of reference. WB1 and WB2 habitat scores for embeddedness and channel alteration improved considerably between Phase I and Phase II. Many other habitat parameters at these two stations also showed increased scores, indicating improved ability to support aquatic communities. Restoration activities such as stormwater pond construction, streambank stabilization, revegetation, and instream structures reduced stream scouring and erosion, and therefore most likely improved the aquatic communities there. In contrast, at the time of this study, three unrestored sites did not compare favorably with reference site habitat conditions; Upper Sligo Creek above University Boulevard, (SL1), and the two Flora Lane sites (FL1, FL2).

While WB1 and WB2 showed significant increases in habitat score, SL2 and SL3 showed slight decreases between Phase I and II. However, these small decreases are not likely attributable to any significant changes in habitat, but are more likely due to the subjective nature and variance inherent in successive habitat scoring.

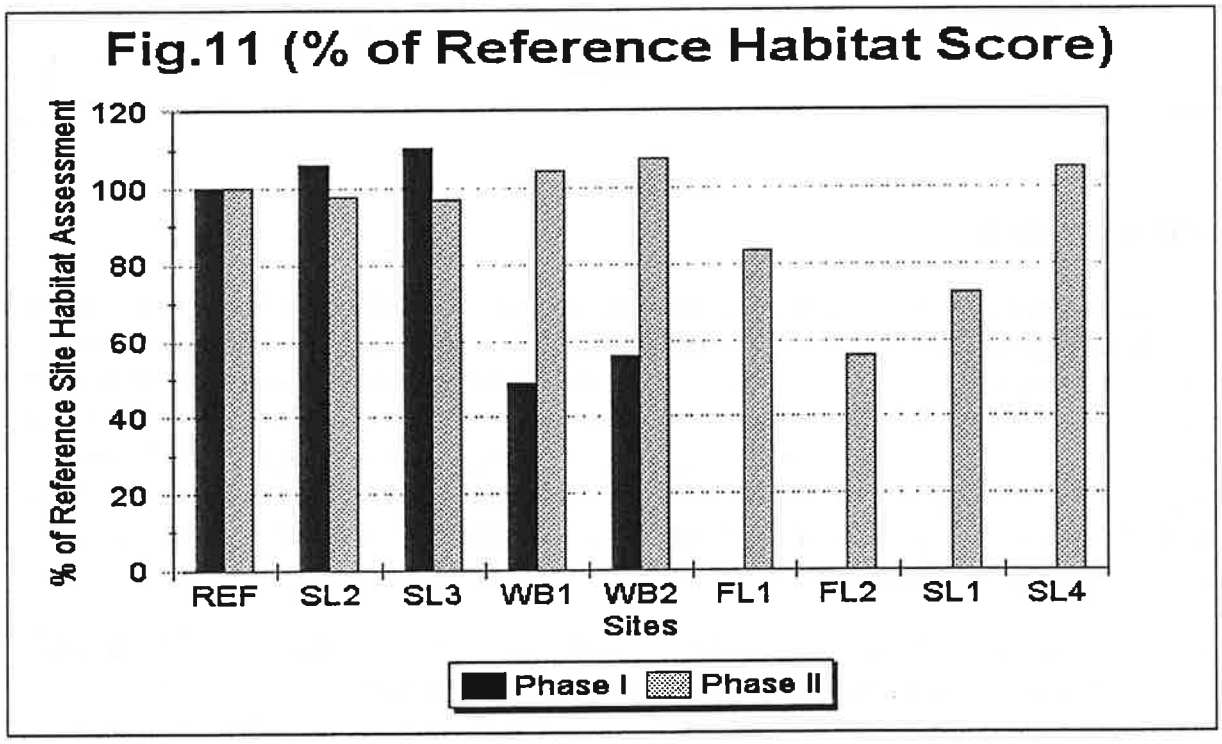
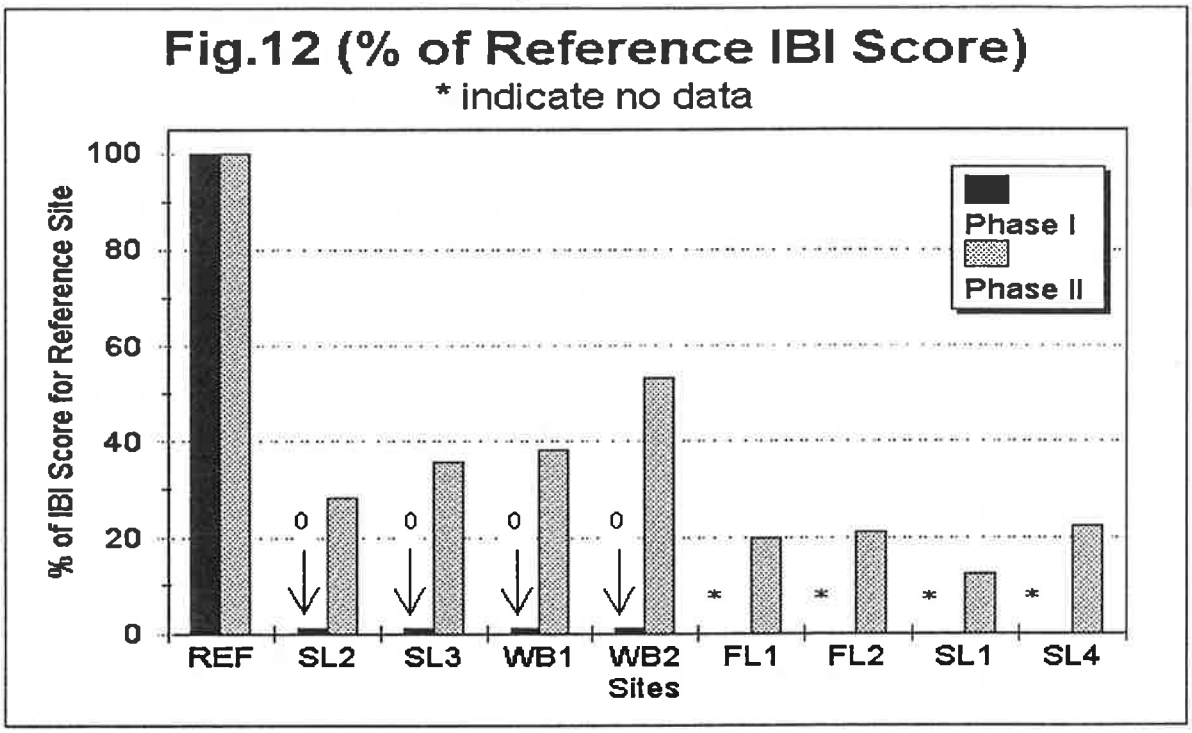


Figure 12, on the following page, shows that there have also been improvements in the biological (IBI) scores at all four sites which were sampled during Phase I when compared to the Northwest Branch reference site. Phase I scores were zero for each of these stations and their biological conditions were extremely poor (there were only three very pollution-tolerant fish species present). After restoration and transplant stockings into Wheaton Branch, the Wheaton Branch and adjacent Sligo Creek sites support 5-13 fish species with IBI scores from 28-53% of reference site conditions.



D. CONCLUSIONS

Wheaton Branch's stream habitat and fish communities recovered considerably from Phase I to Phase II. It's fish appear healthier, i.e., the percentage of fishes with external anomalies such as tumors or infections decreased from common to negligible levels. Fish community structure also improved in the Sligo Creek mainstem in the vicinity of its confluence with Wheaton Branch. There are more types of fishes, including gamefish such as sunfish, largemouth bass and catfish. While anecdotal, perhaps the greatest measure of success observed during the course of this study were the young people that were fishing again along a stream which was once severely eroded, biologically depauperate, and a trash laden eyesore.

At the same time, there remains room for improvement. At the end of Phase II, even the best of the sites studied was well below the reference site conditions and the upper Sligo Creek mainstem fish communities have not yet recovered except in the immediate vicinity of Wheaton Branch. The gamefish present were small. Nonetheless, the recovery thus far is encouraging. Additional stormwater and habitat improvements are included in Phase III for Sligo Creek. Based upon the fish species survival of Phase II work, additional stocking of the more pollution intolerant fish species, such as common shiners, rosysided dace, northern hog suckers and mottled sculpins, is recommended for the upper Sligo Creek watershed.

LITERATURE CITED

Barbour, M.T., and J.B. Stribling. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. Pp. 25-38 *in* Biological Criteria: Research and Regulation. Proceedings of a Symposium. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA-440/5-91-005. July 1991.

Cummins, J. D. and J. B. Stribling. 1992. Wheaton Branch retrofit project. 1990-91 Biomonitoring Program. ICPRB Report 92-1. Interstate Commission on the Potomac River Basin, Rockville, MD. 39 pp.

Stribling, J. B., M. G. Finn, P. D. Thaler, and D. M. Spoon. 1989. Nineteen eighty nine Maryland Anacostia River study. Part 1: Habitat. Macrobenthic invertebrate communities and water quality assessment. ICPRB Report 90-1. Interstate Commission on the Potomac River Basin, Rockville, MD.

Stribling, J. B. and P. D. Thaler. 1990. Nineteen ninety Maryland Anacostia River Basin study. Part 1: Habitat, macrobenthic invertebrate communities and water quality. ICPRB Report 91-2. Interstate Commission on the Potomac River Basin, Rockville, MD.

Cummins, J.D. 1989. 1988 Survey and Inventory of the Fishes in the Anacostia River Basin. Interstate Commission on the Potomac River Basin, Report #89-2. Suite 300, 6110 Executive Blvd., Rockville, Maryland.

Cummins, J.D. 1990. 1989 Anacostia River Basin Study, Part II: Fisheries. Interstate Commission on the Potomac River Basin, Report #90-1. Suite 300, 6110 Executive Blvd., Rockville, Maryland.

Ohio Environmental Protection Agency. 1987. Biological Criteria for the Protection of Aquatic Life: Volume II. User's Manual for Biological Assessment of Ohio Surface Waters. Ohio Environmental Protection Agency, Columbus, Ohio.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. U.S. EPA, Office of Water. EPA/444/4-89-001. 128pp. + appendices.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for Evaluating Stream, Riparian, and biotic Conditions. General Technical Report INT-138. U.S. Department of Agriculture, U.S. Forest Service, Ogden, Utah.

Zippin, C. 1956. An evaluation of the removal method of estimating animal population. Biometrics 12:163-189

Appendix I. Benthic Macroinvertebrate Site Labels, Locations, and Dates Sampled.

Site Labels*		Stream	General Location	Sampling Dates	
Phase I 1990-91	Phase II 1992-93			Phase I 1990-91	Phase II 1992-93
WB1	WB1	Wheaton Branch	below Woodman Ave.	3/26, 5/14, 7/28, 11/03, 4/06	12/15, 6/7
WB2	WB2	Wheaton Branch	approx. 100 m downstream of WB1	3/26, 5/14, 7/28, 11/03, 4/06	12/15, 6/7
WB3	SL2	Sligo Creek	upstream of WB confluence	3/26, 5/14, 7/28, 11/03, 4/06	12/15, 5/28
WB4	SL3	Sligo Creek	downstream of WB confluence	3/26, 5/14, 7/28, 11/03, 4/06	12/15, 5/28
	SL1	Sligo Creek	above University Ave.		8/21, 12/15, 6/7, 10/5
	SL4	Sligo Creek	just upstream of Colesville Rd.		8/25, 12/14, 5/28, 7/29
	FL1	Flora Lane Tributary	upstream site		8/25, 12/14, 5/13, 10/5
	FL2	Flora Lane Tributary	downstream site		8/25, 12/14, 5/13, 10/5

* Note that two of the duplicated sites changed identifying labels from Phase I sampling to Phase II sampling; WB3 changed to SL2, and WB4 changed to SL3

Wheaton Branch Reintroduction Day

Thursday, April 23, 1992

Come Rain or Shine!

Come help us restore the native fish community of Wheaton Branch! We need your help in transplanting hundreds of darters, suckers and various minnows back into this urban stream. Volunteers are welcome for each of the following scheduled activities:

MORNING:

9:00 am (Departure at 9:10 am)

Activity:
Fish Capture Expedition to Northwest Branch (at University Blvd.)
Meeting Place:
Sligo Creek Park Community Center Parking Lot

AFTERNOON:

1:00 - 3:00 pm

Activity:
Fish Release into Wheaton Branch
Meeting Place:
Wheaton Branch Park Entrance at Woodman Ave.

See Map on Back for Meeting Place Locations

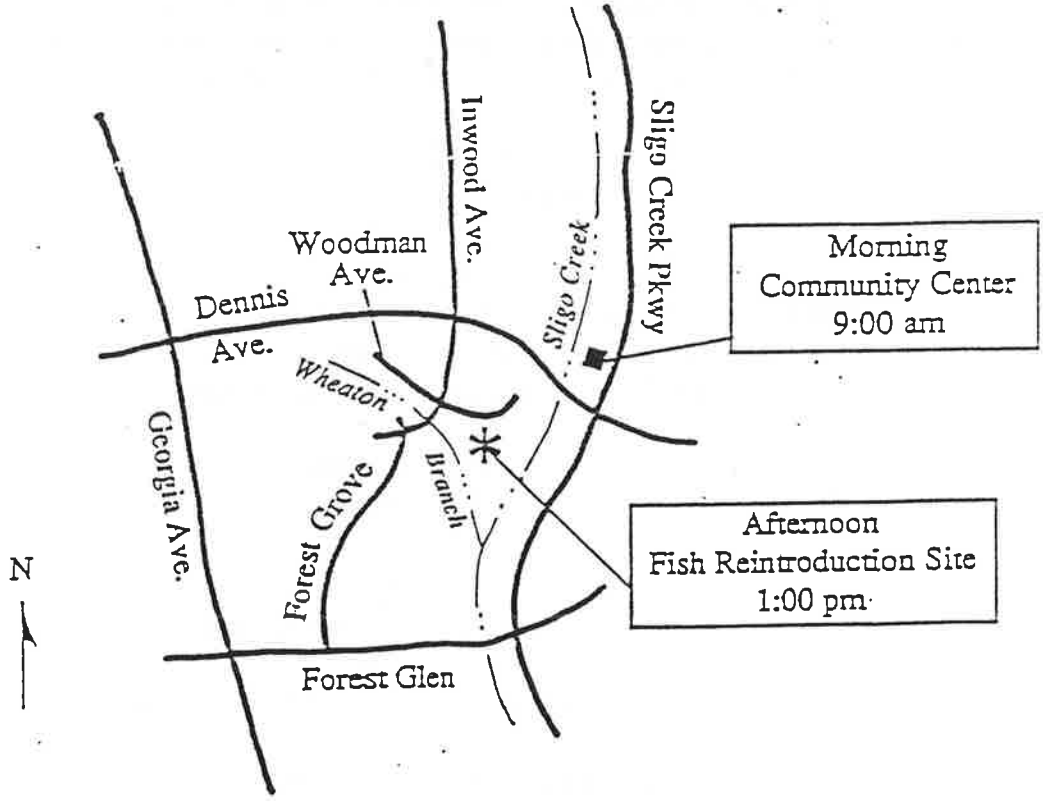
BE PREPARED!

- Carpool with a friend (no public transportation available to Northwest Branch).
- Wear appropriate shoes and clothing (rubber boots or waders are recommended).
- Bring your own food and water.
- No restrooms or wash facilities present at Wheaton Branch.

We'll Provide the Nets, Buckets and Fish

For further information please call:
John Galli at MWCOG
202-962-3348

Meeting Locations



Not to Scale

APPENDIX III

REVISED 25 SEPTEMBER 1990
HABITAT ASSESSMENT FIELD DATA SHEET
RIFFLE/RUN PREVALENCE

Habitat Parameter	Category			
	Optimal	Sub-Optimal	Marginal	Poor
1. Bottom substrate/ instream cover (a)	Greater than 50% mix of rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% mix of rubble, gravel, or other stable habitat. Adequate habitat. 11-15	10-30% mix of rubble, gravel, or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble, gravel, or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness (b)	Gravel, cobble, and boulder particles are between 0-25% surrounded by fine sediment. 16-20	Gravel, cobble, and boulder particles are between 25-50% surrounded by fine sediment. 11-15	Gravel, cobble, and boulder particles are between 50-75% surrounded by fine sediment. 6-10	Gravel, cobble, and boulder particles are over 75% surrounded by fine sediment. 0-5
3. <0.15 cms (5 cfs)→ Flow at rep. low	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 16-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
OR >0.15 cms (5 cfs)→ velocity/depth	Slow (<0.3 m/s), deep (>0.5 m): slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles or runs receive lower score). 6-10	Dominated by 1 velocity/ depth category (usually pools). 0-5
4. Canopy cover (shading) (c)(d)(g)	A mixture of conditions where some areas of water surface fully exposed to sunlight, and other receiving various degrees of filtered light. 16-20	Covered by sparse canopy; entire water surface receiving filtered light. 11-15	Completely covered by dense canopy; water surface completely shaded **OR** nearly full sunlight reaching water surface. Shading limited to <3 hours per day. 6-10	Lack of canopy, full sunlight reaching water surface. 0-5
5. Channel alteration (a)	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; and/or extensive channelization. 0-3

APPENDIX III (CONT.)

RIFFLE/RUN PREVALENCE

Habitat Parameter	Category			
	Optimal	Sub-Optimal	Marginal	Poor
6. Bottom scouring and deposition (a)	Less than 5% of the bottom affected by scouring and/or deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and/or scour at obstructions, constrictions, and bends. Filling of pools prevalent. 4-7	More than 50% of the bottom changing frequently. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3
7. Pool/riffle, run/bend ratio (a) (distance between riffles divided by stream width)	Ratio: 5-7. Variety of habitat. Repeat pattern of sequence relatively frequent. 12-15	7-15. Infrequent repeat pattern. Variety of macrohabitat less than optimal. 8-11	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
8. Lower bank channel capacity (b)	Overbank (lower) flows rare. Lower bank W/D ratio <7. (Channel width divided by depth or height of lower bank.) 12-15	Overbank (lower) flows occasional. W/D ratio 8-15. 8-11	Overbank (lower) flows common. W/D ratio 15-25. 4-7	Peak flows not contained or contained through channelization. W/D ratio >25. 0-3
9. Upper bank stability (a)	Upper bank stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problems. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. "Raw" areas frequent along straight sections and bends. Side slopes >60% common. 0-2
10. Bank vegetative protection (d)	Over 90% of the streambank surfaces covered by vegetation. 9-10	70-89% of the streambank surfaces covered by vegetation. 6-8	50-79% of the streambank surfaces covered by vegetation. 3-5	Less than 50% of the streambank surfaces covered by vegetation. 0-2
OR Grazing or other disruptive pressure (b)	Vegetative disruption minimal or not evident. Almost all potential plant biomass at present stage of development remains. 9-10	Disruption evident but not affecting community vigor. Vegetative use is moderate, and at least one-half of the potential plant biomass remains. 6-8	Disruption obvious; some patches of bare soil or closely cropped vegetation present. Less than one-half of the potential plant biomass remains. 3-5	Disruption of streambank vegetation is very high. Vegetation has been removed to 2 inches or less in average stubble height. 0-2

APPENDIX III (CONT.)

RIFFLE/RUN PREVALENCE

Habitat Parameter	Category			
	Optimal	Sub-Optimal	Marginal	Poor
11.Streamside cover (b)	Dominant vegetation is shrub.	Dominant vegetation is of tree form.	Dominant vegetation is grass or forbes.	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings.
	9-10	6-8	3-5	0-2
12.Riparian vegetative zone width (least buffered side) (e)(f)(g)	>18 meters.	Between 12 and 18 meters.	Between 6 and 12 meters.	<6 meters.
	9-10	6-8	3-5	0-2
Column Totals	____	____	____	____

Score _____

(a) From Ball 1982.
(b) From Platts et al. 1983.
(c) From EPA 1983.
(d) From Hamilton and Bergersen 1984.
(e) From Lafferty 1987.
(f) From Schueler 1987.
(g) From Bartholow 1989.

APPENDIX IV. BENTHIC MACROINVERTEBRATE SAMPLING DATA 1992-1993*

Summer 1992

	SL1				SL2	SL3	SL4				WB1	WB2	FL1				FL2			
Date	Aug 21				not sampled	not sampled	Aug 25				not sampled	not sampled	Aug 25				Aug 25			
Taxon	S1	S2	S3	N			S1	S2	S2	N			S1	S2	S3	N	S1	S2	S3	N
Nematoda																				
Nemertea																				
Prostoma graecense																				
Oligochaeta							12	5	8				13	3	9		3	1		
Hirudinea																				
Pelecypoda				1																
Pisiidae																				
Pisidium																				
Gastropoda																				
Physidae																				
Physella	2		1												1				3	4
Physella heterostropha				15									2				3			
Ancylidae																				
Ferrissia			1					1	2											
Planorbidae																				
Gyraulus																				1
Menetus dilatatus																				
Planorbella																				
Lymnaeidae																				
Pseudosuccinea columella																				
Stagnicola																				
Asellidae																				
Lirceus				1																
Caecidotea																				
Gammaridae																				
Gammarus																				
Cambaridae																				
Procambarus																				
Hydracarina				1																
Entomobryidae																				
Sminthuridae																				
Dicyrtoma																				
Baetidae																				
Baetis																				
Zygoptera																				
Coenagrionidae																				
Enallagma																				
Calopterygidae																				
Calopteryx																				
Aeshnidae																				
Aeshna				1																
Gomphidae																				
Notonectidae																				
Notonecta																				
Veliidae																				
Microvelia	2																			
Corydalidae																				
Nigronia serricornis																				
Hydropsychidae (larvae)								6												
Hydropsyche								88	4											
Cheumatopsyche							2	9	1											
Hydropsychidae (pupae)								3												
Dryopidae (adults)																				
Helichus	2																			
Hydrophilidae																				
Berosus																				
Simuliidae																				
Simulium																				
Muscidae (Lispe?)																				
Chironomidae (larvae)		1	2				1	1	1				16	4	56		2	35	4	2
Tanypodinae (larvae)		3	2	1			1						11	6	2		1	1	1	
Chironomidae (pupae)							1						1		4			1		
Conchapelopia													1							
Zavrelia													1	1						
Cricotopus													1							
Chironominae (pupae)																				
Culicidae																				
Culex																				
Tipulidae																				
Tipula																		1		
Antocha								12	4											
Dicranota																				
Empididae																				
Hemerodromia																		1		
Dolichopodidae														1						
Sciomyzidae																				
Lepidoptera																				
Braconidae																				
Total No. Organisms	6	4	6	20			17	125	20	0			46	15	72	0	9	40	8	7
Surber Totals (3)		16						162						133				57		

8/17/93 QC BY CG

NOTE: Station SL1.N sample contained 1 Salamander
Station FL2.S2 sample contained 1 Minnow
Station FL2.S3 sample contained 1 Fish

* Shaded squares indicate organism not included in number of taxa metric

APPENDIX IV. BENTHIC MACROINVERTEBRATE SAMPLING DATA 1992-1993*

Fall 1992

	SL1				SL2				SL3				SL4				WB1				WB2				FL1				FL2			
Date	Dec 15				Dec 15				Dec 15				Dec 14				Dec 15				Dec 15				Dec 14				Dec 14			
Taxon	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N
Nematoda																																
Nemertea																																
Prostoma graecense					1																											
Oligochaeta	17	2	8		49	4	58		48	3	34	4		13	10	4	5	10	29	4	7	7	62	3	10	18	10	1	1	3	1	
Hirudinea				1							3						48	29	27		9	3	46	2								
Pelecypoda																																
Pisiidae																																
Pisidium											1						22	2		3			6									
Gastropoda																																
Physidae																																
Physella																	2			1	3											
Physella heterostropha	5	2	4	1	2																		4	3	4	6	1			4		
Ancylidae																																
Ferrissia	2		3				2			1	14			1					1					2							
Planorbidae																																
Gyraulus							1													1											
Menetus dilatatus			1																											1		
Planorbella																																
Lymnaeidae																																
Pseudosuccinea columella																	1			2												
Stagnicola																																
Asellidae																																
Lirceus					2									1	1																	
Caecidotea																																
Gammaridae																																
Gammarus					5					1	1																					
Cambaridae															1															1		
Procambarus																																
Hydracarina																																
Entomobryidae																																
Sminthuridae																																
Dicyrtoma																									1							
Baetidae																																
Baetis																																
Zygoptera																																
Coenagrionidae																																
Enallagma			1																			1										
Calopterygidae																																
Calopteryx	1																															
Aeshnidae																																
Aeshna																																
Gomphidae																																
Notonectidae																																
Notonecta																																
Veliidae																																
Microvelia																																
Corydalidae																																
Nigronia serricornis																		1														
Hydropsychidae (larvae)							3			6		9						6	2				7									
Hydropsyche					42	3	53		109	16	404			5	4		393	471	421		2	1	273									
Cheumatopsyche					18		13		168	10	263				9		122	135	206		13	2	267									
Hydropsychidae (pupae)																																
Dryopidae (adults)																																
Helichus																																
Hydrophilidae																																
Berosus																				1												
Simuliidae																																
Simulium											1																					
Muscidae (Lispe?)																				1												
Chironomidae (larvae)	14	4	23	1	5				5		1		1	3			46	1	4	2	2	2			6	7	21	1	6	3		
Tanypodinae (larvae)	2	4	1		8		1		11		10							8	7	1	5		4		19	7	10		1	6	2	
Chironomidae (pupae)																																
Conchapelopia																																
Zavrelia																																
Cricotopus																									1		1		1	1		
Tipulidae																																
Tipula	1				4	1			2		1						1						2		3	6				7	1	
Antocha					1				5		7			1	2								3									
Dicranota																																
Empididae																																
Hemerodromia		1			1				1		2						5	2	2		1	1	1									
Dolichopodidae					1																											
Sciomyzidae ?																				1												
Lepidoptera																																
Braconidae																																
Total No. Organisms	42	13	41	3	138	8	131	0	355	31	751	4	1	24	27	4	645	665	698	18	42	17	675	10	44	44	43	2	9	26	4	0
Surber Total (3)	96				277				1137				52				2008				734				131				39			

8/17/93 QC BY CG

* Shaded squares indicate organism not included in number of taxa metric

APPENDIX IV. BENTHIC MACROINVERTEBRATE SAMPLING DATA 1992-1993*

Spring 1993

	SL1				SL2				SL3				SL4				WB1				WB2				FL1				FL2			
Date	June 7				May 28				May 28				May 28				June 7				June 7				May 13				May 13			
Taxon	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N	S1	S2	S3	N
Nematoda															1				7													
Nemertea																																
Prostoma graecense									2																							
Oligochaeta	22	51	18	1	25	5	4		25	7	27		49	8	23		25	14	49	4	5	2	6	6	35	24	32	3	3	1		1
Hirudinea	1			1													12	5	4		5	1										
Pelecypoda																																
Pisiidae																																
Pisidium																							1									
Gastropoda									1																							
Physidae																																
Physella																																
Physella heterostropha	2	3		24															4		2		1									1
Ancylidae																																
Ferrissia																					1											
Planorbidae																																
Gyraulus																																
Menetus dilatatus																																
Planorbella																	1															
Lymnaeidae																																
Pseudosuccinea columella																							1									
Stagnicola																																1
Asellidae				1																												
Lirceus																																
Caecidotea																											1	2				2
Gammaridae																																
Gammarus	1				2								3																			
Cambaridae																																
Procambarus															1																	
Hydracarina																						1										
Entomobryidae																																
Sminthuridae																																
Dicyrtoma																																
Baetidae																																
Baetis	2	4	3		19	12	17		4	1	5				2		11	8	4													
Zygoptera				6																												
Coenagrionidae																																
Enallagma																																
Calopterygidae																																
Calopteryx																																
Aeshnidae																																
Aeshna																																
Gomphidae				1																												
Notonectidae																																
Notonecta																																
Veliidae																																
Microvelia																																
Corydalidae																																
Nigronia serricornis																																
Hydropsychidae (larvae)	2	1							10					1			16	25	12		8	1	1									
Hydropsyche	1	1			3	1			5				1		8		85	77	91		12	10	8									
Cheumatopsyche									3								113	107	90		39	29	28									
Hydropsychidae (pupae)					7				9																							
Hydrophilidae																																
Berosus																																
Simuliidae																																
Simulium	2	2	2												1		21	27	21			2	4									
Muscidae (Lispe?)																																
Chironomidae (larvae)	107	180	75	87	31	8	29		48	8	30	2	15	18	22		9	23	20	5	10	31	12		29	16	23		15	9		2
Tanypodinae (larvae)	1	3	2			5			1				5				7	1	1		6	8	4				1					1
Chironomidae (pupae)					10				4																		1					2
Cricotopus																																
Conchapelopia		1									1								1		1		2									
Theinemanniella		1																														
Chironominae (pupae)									1														2									
Culicidae																																
Culex																		1														
Tipulidae																																
Tipula	1	5	5						2		1				1								1									1
Antocha																																
Dicranota						1																										
Empididae																																
Hemerodromia																																
Dolichopodidae																																
Sciomyzidae																																
Lepidoptera																																
Braconidae																																
Total No. Organisms	142	252	105	121	97	32	50	0	113	16	64	2	73	27	57	1	300	288	297	9	89	85	71	6	64	40	58	5	18	10	0	11
Surber Total (3)	499				179				193				157				885				245				162				28			

8/17/93 QC BY CG

FL1.N contains one amphibian (salamander)

* Shaded squares indicate organism not included in number of taxa metric

APPENDIX IV. BENTHIC MACROINVERTEBRATE SAMPLING DATA 1992-1993*

Summer 1993

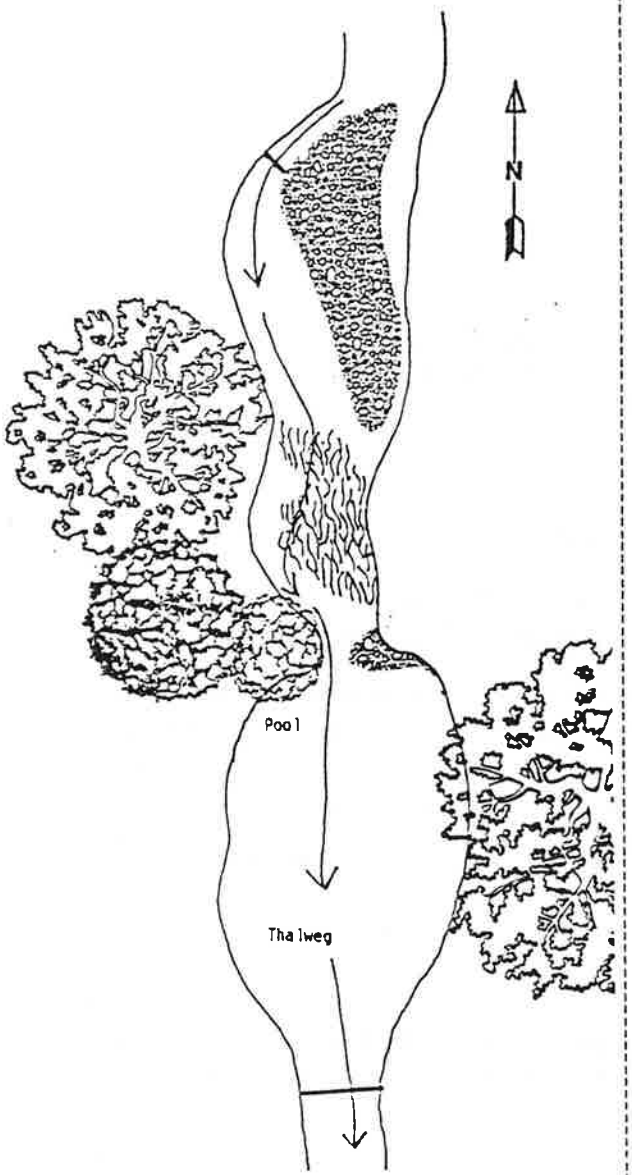
	SL1				SL2	SL3	SL4				WB1	WB2	FL1				FL2			
Date	October 5				not sampled	not sampled	July 29				not sampled	not sampled	October 5				October 5			
Taxon	S1	S2	S3	N			S1	S2	S3	N			S1	S2	S3	N	S1	S2	S3	N
Nematoda																				
Nemertea																				
Prostoma graecense																				
Oligochaeta		1					2	3	6	1			3	9	2		1	1	1	
Hirudinea																				
Pelecypoda																				
Pisiidae																				
Pisidium																				
Gastropoda																				
Physidae																				
Physella	2																			
Physella heterostropha														2	1	1			1	
Ancylidae																				
Ferrissia																				
Planorbidae																				
Gyraulus																				
Menetus dilatatus																				
Planorbella																				
Lymnaeidae																				
Pseudosuccinea columella							1													
Stagnicola																				
Asellidae																				
Lirceus																				
Caecidotea									5											
Gammaridae																				
Gammarus																				
Cambaridae										1										
Procambarus																				
Hydracarina																				
Entomobryidae																	1			
Sminthuridae																				
Dicyrtoma																				
Baetidae																				
Baetis	1	3						1	1											
Zygoptera																				
Coenagrionidae																				
Enallagma																				
Calopterygidae																				
Calopteryx				1																
Aeshnidae																				
Aeshna																				
Gomphidae																				
Notonectidae																				
Notonecta				1																
Veliidae																				
Microvelia																				
Corydalidae																				
Nigronia serricornis																				
Hydropsychidae (larvae)								4	1											
Hydropsyche		1					5	42	89											
Cheumatopsyche		1					14	6	7											
Hydropsychidae (pupae)							1		3											
Dryopidae (adults)																				
Helichus																				
Hydrophilidae																				
Berosus																				
Simuliidae																				
Simulium								1												
Muscidae (Lispe?)																				
Chironomidae (larvae)								6	2				3	7	8	2		1	3	
Tanypodinae (larvae)								3					1	2		1				
Chironomidae (pupae)													1							
Cricotopus																				
Zavrelia																				
Conchapelopia													1	1			1			
Theinemanniella																				
Chironominae (pupae)																				
Culicidae																				
Culex																				
Tipulidae																				
Tipula		1					1	3	2					1						
Antocha							1	5	1											
Dicranota																				
Empididae																				
Hemerodromia																				
Dolichopodidae																				
Sciomyzidae																				
Lepidoptera														1						
Braconidae																				
Total No. Organisms	3	7	0	2			25	74	117	2			9	22	11	4	3	2	5	0
Surber Total (3)		10						216						42				10		

8/17/93 QC BY CG

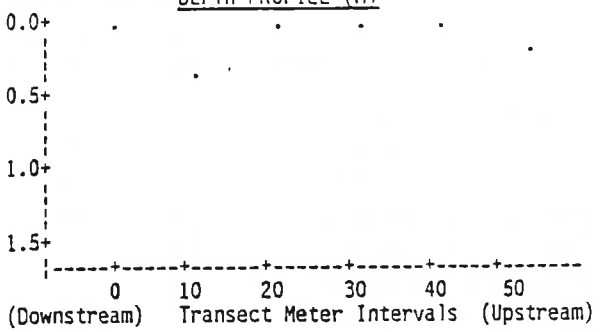
* Shaded squares indicate organism not included in number of taxa metric

APPENDIX V. REFERENCE SITE INFORMATION

SITE #13: N.W. Branch x Layhill Park



DEPTH PROFILE (M)



TEMPS: Spring 14 C Summer 22 C

GRADE: 43.5'/mile (8.4m/km)

HABITAT PARAMETER	RANK	SCORE	DESCRIPTION
Bottom Substrate	excel	18	>50% rubble,gravel, submerged logs undercut banks or other stable hab.
Embedded-ness	good	14	gravel,cobble, and boulder particles >24% & <50% surrounded by fine sediment
Velocity/ Depth	excel	19	all habitat categories present
Channel Alteration	good	11	some new increase in bar formation mostly coarse gravel,some channelazation
Scouring/ Deposition	good	9	5-30% affected scour at constrictions & were grades steepen, some dep. in pools
Pool/Riffle Run/Bend	excel	13	variety of habitat deep riffles and pools
Bank Stability	fair	4	moderately unstable,moderate frequency and size of erosional areas slopes-60%
Bank Veg. Stability	good	7	50-79% of the streambank surfaces covered by veg., gravel or larger materiel
Streamside Cover	good	7	dominant vegetation is of tree form

Total Score 88

Source: ICPRB Report #91-2 1990 Md Anacostia River Basin Study Part II: Fisheries Rapid Bioassessments

APPENDIX V. REFERENCE SITE INFORMATION

Site #13- Northwest Branch x Layhill Park

Species captured	(6/15)	(7/31) / pop. est. / std. error		
1. Silverjaw Minnow	0	1		
2. Cutlips Minnow	2	2		
3. Rosyside Dace	19	5		
4. Swallowtail Shiner	69	24		
5. Satinfin Shiner	6	10		
6. Common Shiner	135	17		
7. Spottail Shiner	12	6		
8. Bluntnose Minnow	129	24		
9. Blacknose Dace	90	40		
10. Longnose Dace	13	8		
11. Northern Creek Chub	1	0		
12. White Sucker	4	6		
13. Northern Hog Sucker	10	4		
14. Margined Madtom	0	1		
15. Bluegill Sunfish	2	0	2.2/N.A.	.8/N.A.
16. Redbreast Sunfish	9	10	9.2/10.2	.6/.53
17. Fantail Darter	4	5		
18. Tessellated Darter	0	2		
# of Species	15	16		
# of Individuals	505	165		
Species Diversity	1.92	2.34	Average = 2.13	

Approximate drainage area above site = 13.2 square miles
Stream surface area = 384.5 square meters (.039 hectares)

Gamefish Density	N/km	N/h	% ≥ stock	% ≥ quality	% ≥ pref.
Bluegill Sunfish	44	56	50	0	0
Redbreast Sunfish	194	249	20	0	0

Riffle/pool ratio = 1:1.8

Anomalies: none

Upstream net was approximately 900 meters (2952.7 ft.) downstream from the confluence of Northwest Branch and Buckhorn Branch

Source: ICPRB Report #91-2 1990 Md Anacostia River Basin Study Part II: Fisheries Rapid Bioassessments