Potomac Direct

Little Falls

3.17 Little Falls I Mainstem Stream Restoration

3.17.1 Introduction

The Little Falls I Mainstem Stream Restoration project was constructed in 2001. The project site is located along Little Falls Branch in Bethesda, Maryland. The project site begins downstream of Massachusetts Avenue and continues to the pedestrian bridge stream crossing within the Little Falls Branch Park in Bethesda, Maryland (***Figure 3.17.2***). The Little Falls Mainstem has been classified by the Code of Maryland Regulations (COMAR) as Use I-P, for water contact recreation and protection of aquatic life. Prior to restoration, this site had severely eroded stream banks, which exposed a sewer line and undermined a pedestrian trail. The goal of the project was to address infrastructure conflicts and severely degraded conditions along the Little Falls Mainstem through stream channel restoration, stabilization, and reforestation; and to provide improved aquatic insect and fish populations and densities. ***Figure 3.17.1*** depicts the site following restoration in 2002.

Figure 3.17.1 – Little Falls I Mainstem Stream Restoration in 2002

Subwatershed facts

Project Drainage Area: 2,828 acres
Project Imperviousness: 27 Percent

Project Facts

Project Area: The stream restoration begins on the mainstem of Little Falls Branch downstream of Massachusetts Avenue and continues to the pedestrian bridge stream crossing within the Little Falls Branch Park. The project included stabilizing approximately 2,376 linear feet of stream and planting native vegetation.

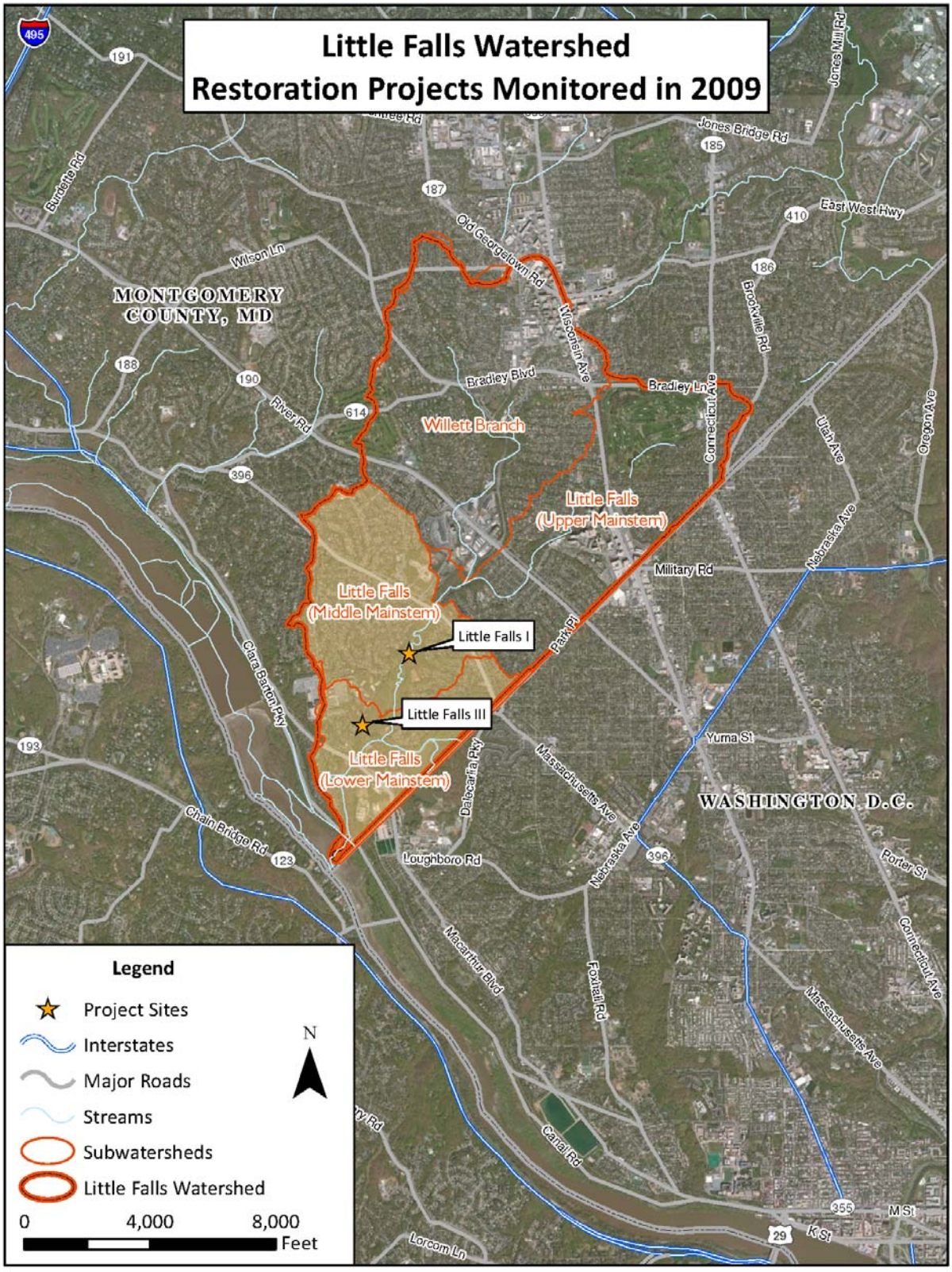


Figure 3.17.2 – Little Falls Watershed Including Little Falls I Mainstem Stream Restoration

Costs: Structural and Reforestation ($412,721), Funded in part through a Maryland Department of the Environment (MDE) grant.
Completion Date: November 2001 with repair work completed on April 2007
Property Ownership: Maryland-National Capital Park and Planning Commission (M-NCPPC)

Project Selection

The Little Falls I stream restoration project was identified by Montgomery County residents who were concerned about the exposed sewer line and stream erosion threatening two sections of the pedestrian footpath. Due to the severity of the erosion and sewer line exposure, the project was identified as high priority.

Pre-Restoration Conditions

As mentioned above, the mainstem of Little Falls below Massachusetts Avenue was severely degraded and a large amount of streambank erosion was present. Due to this erosion, a large sewer line was uncovered and its vulnerable pipe joints were exposed to the damaging stormwater flows of Little Falls. Approximately 750 feet south of Massachusetts Avenue on the Little Falls, the severe stream bank erosion began to undermine the pedestrian trail that paralleled the stream. The erosion was severe enough that there was a concern the trail may need to close permanently. Approximately 1,100 feet further south along the stream, a pedestrian footbridge that crosses Little Falls was also threatened by the severe erosion. In addition, the aquatic habitat was found to be deficient and there was a lack of riparian buffer along portions of Little Falls.

Restoration Actions Taken

The primary focus of the stream restoration project was to stabilize and protect both the exposed sewer and the two areas of the threatened pedestrian trail. At the upper end of the project, large rip rap stone was used to cover the exposed sewer line while a large step pool system was installed just downstream of the sewer line to ensure the infrastructure would not be exposed again.

Large cross vanes and stone toe protection were installed to center and deflect the erosive stormwater flows away from the streambanks to keep erosion from endangering the pedestrian trail again. At the lower end of the project, M-NCPPC replaced the threatened pedestrian footbridge with a longer spanned footbridge to help ensure the abutments of the footbridge would not be exposed again. A cross vane was installed just upstream of this footbridge to help center the flow of water toward the center of the stream and under the highest portion of the new footbridge.

Establishing improved aquatic habitat was achieved by installing large vanes and cross vanes to create both riffles and pools. The pools were a particularly desirable aspect of the project for fish and other aquatic life that could seek refuge in them during high and intense stormwater flows.

Various native plants were established by volunteers and also as part of the construction of the stream restoration project to reestablish and increase the riparian buffer along Little Falls. M-NCPPC will be continually removing the non-native plants that have threatened the native forest and floodplain. Figure 3.17.3 shows ground-level images before and after restoration.

Figure 3.17.3 – Little Falls I Mainstem Stream Restoration Before (2000) and After Restoration (2002)

3.17.2 Restoration Goals

Restoration goals were defined during the planning and implementation of the Little Falls I Mainstem Stream Restoration project. Pre- and post-restoration monitoring was conducted within the stream and in the riparian area to evaluate each goal's degree of success. ***Table 3.17.1*** below presents the restoration goals, monitoring performed to evaluate the success of the goals, and when and where the monitoring occurred.

Table 3.17.1 – Summary of Restoration Project Goals and Associated Monitoring

Why: Restoration Goals	What: Monitoring Done to Evaluate Goal	When: Years Monitored	Where: Station or Location Monitored
• Improve aquatic habitat conditions • Improve quality and density of aquatic communities	• Qualitative habitat • Aquatic communities: ▪ Benthic macroinvertebrates ▪ Fish • In-situ water chemistry	1999 (pre – fish only) 2002, 2005, and 2009 (post)	LFLF301B
• Reduce stream erosion • Reduce erosive stream flows	• Quantitative habitat (stream morphology surveys)	2011(post) [1]	LFLF301B
• Reforest riparian zone	• Botanical survey	2009	LFLF301B

[1]Quantitative habitat surveys were scheduled for 2009, but were delayed due to missing benchmarks. These benchmarks were located and survey work was performed in 2011. The 2011 report will include updates for this monitoring.

3.17.3 Methods to Measure Project Goals

The basic sampling design for the Little Falls I Mainstem Stream Restoration project was pre-restoration (before) and post-restoration (after) monitoring. However, pre-restoration data are only available for the fish community (1999), thus no comparisons will be made to baseline conditions for benthic macroinvertebrate communities, qualitative habitat, in-situ water chemistry, and quantitative habitat. Post-restoration, the County monitored the aquatic communities (benthic macroinvertebrate and fish), performed rapid habitat assessments (RHAB), took in-situ water chemistry measurements, and conducted a riparian botanical survey at one biological monitoring site (LFLF301B) to evaluate the aquatic habitat conditions, water quality, and botanical reforestation during the post-restoration period (***Figure 3.17.4***). This site was sampled in 2002, 2005, 2007, and 2009. All data collected prior to 2001 are considered pre-restoration data and all subsequent data are considered post-restoration.

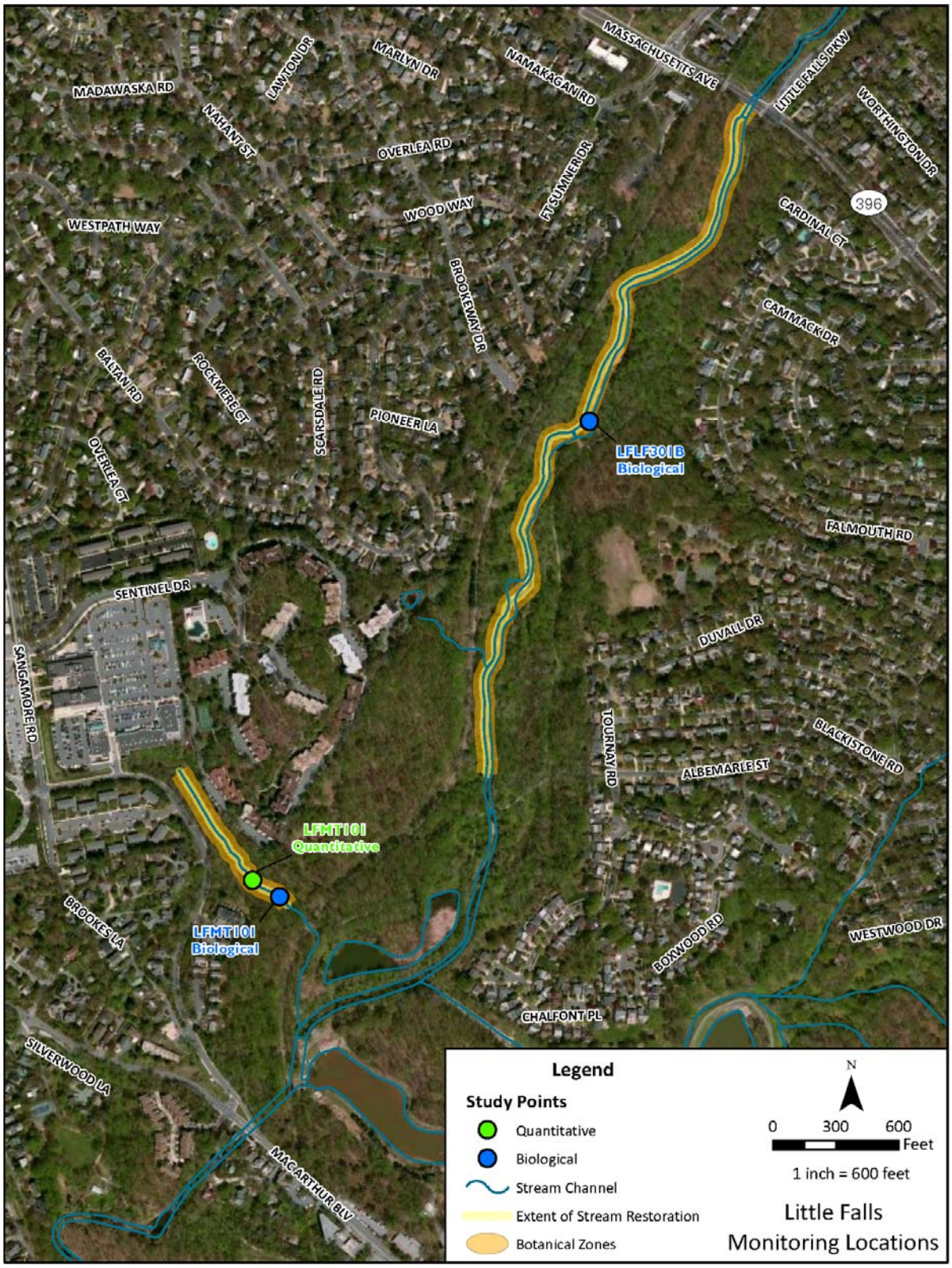


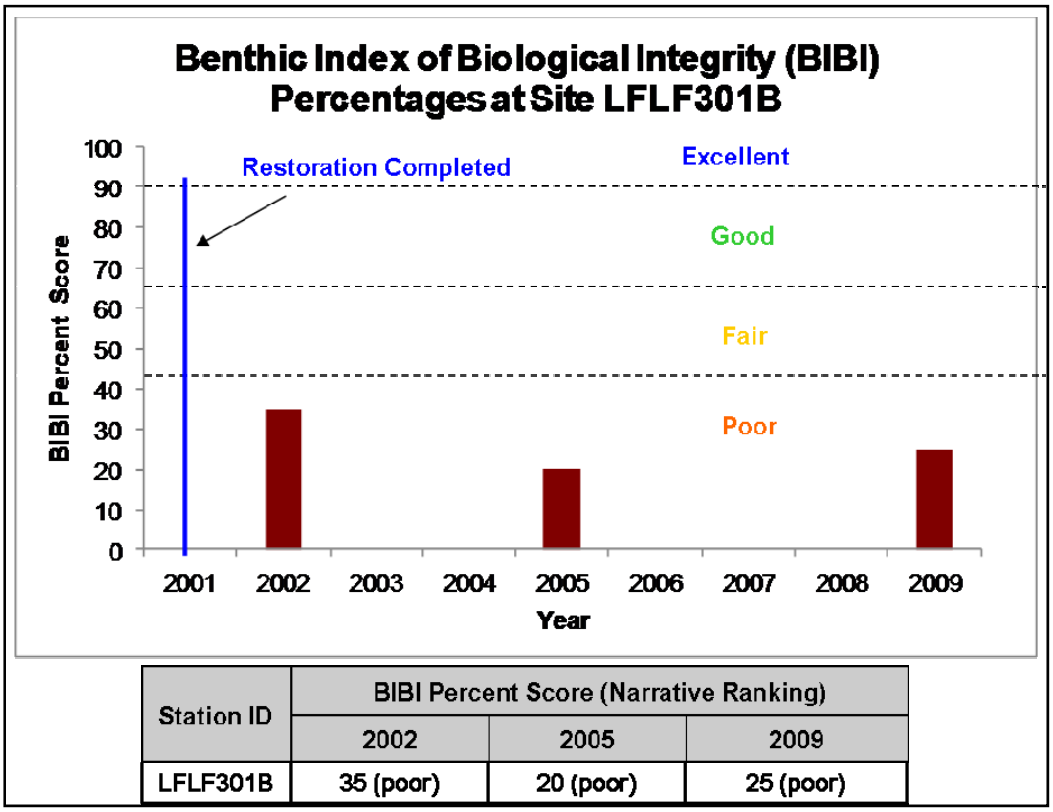
Figure 3.17.4 –Monitoring Location Map for Little Falls I Mainstem Stream Restoration

3.17.4 Results and Analysis

Benthic Macroinvertebrates

BIBI (Benthic Index of Biological Integrity) Scores

The benthic macroinvertebrate community at LFLF301B, as assessed using the MCDEP Benthic Index of Biological Integrity (BIBI), was Poor during each monitoring year in the post-restoration period, with percentages ranging from 20 to 35 (***Figure 3.17.5)***. The highest BIBI percentage was observed in 2002 (35). In 2005, too few individuals were collected to calculate an accurate BIBI, thus this site was given the lowest possible score for that year (20). The decline in BIBI percentage from 2002 to 2009 was due to a decline in the biotic index, a measure of community sensitivity, and a decline in the ratio of scrapers. Field data sheets from 2009 benthic macroinvertebrate monitoring are included in ***Appendix D***.



Station ID	BIBI Percent Score (Narrative Ranking)		
	2002	2005	2009
LFLF301B	35 (poor)	20 (poor)	25 (poor)

Figure 3.17.5 – Pre- and Post-Restoration Benthic Index of Biological Integrity (BIBI) Percentages at LFLF301B

Dominant Taxa

The post-restoration community of benthic macroinvertebrates at LFLF301B was dominated by Chironomidae (midges), which comprised 49 percent of the community after restoration. *Caecidotea* sp. (aquatic sowbugs) was the second most dominant taxon following restoration, representing 15 percent of the community. Both taxa are considered tolerant to stream degradation.

Tolerance Values

Site LFLF301B was dominated by tolerant taxa (86 percent) following restoration, with the remaining 12 percent represented by taxa intermediate in sensitivity (***Figure 3.17.6)***. No sensitive taxa were collected at LFLF301B following restoration. The tolerant taxa were dominated by midges, aquatic sowbugs, and several families of aquatic worms in the Subclass Oligochaeta. Intermediate taxa were dominated by *Hydropsyche* sp. and *Cheumatopsyche* sp. (net spinning caddisflies) and *Simulium* sp. (blackflies).

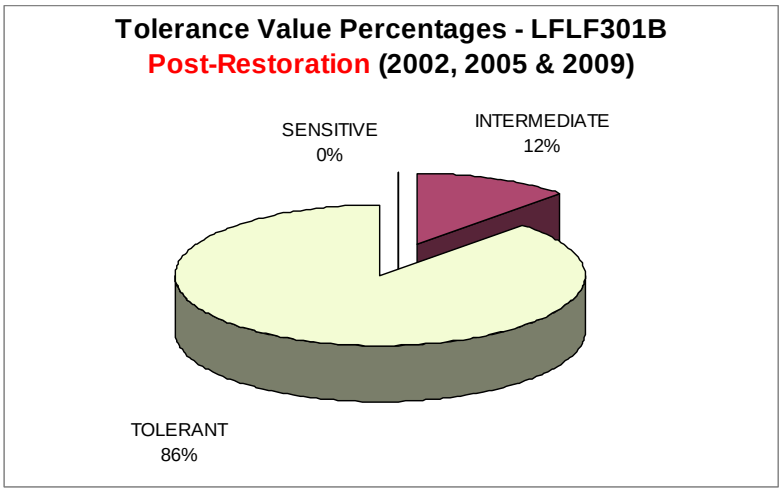


Figure 3.17.6 – Benthic Macroinvertebrate Tolerance Composition at LFLF301B After Restoration

Functional Feeding Groups

Collectors were the most dominant functional feeding group at LFLF301B after restoration, representing 80 percent of the community. Filterers were the second most dominant group, comprising 12 percent of the community. Predators were next most dominant, comprising five percent of the community. More specialized feeders, including scrapers (one percent) and shredders (0.4 percent) that require less degraded stream conditions or specific habitat features were much less abundant (***Figure 3.17.7***).

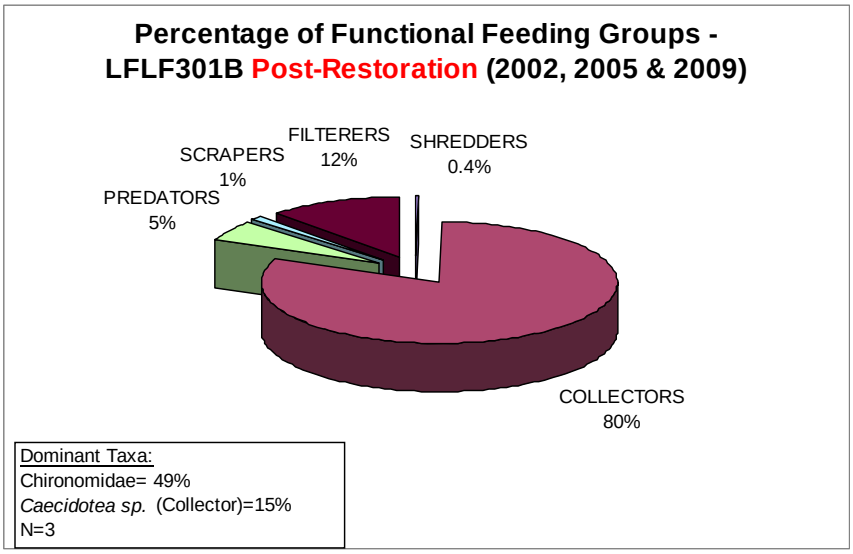
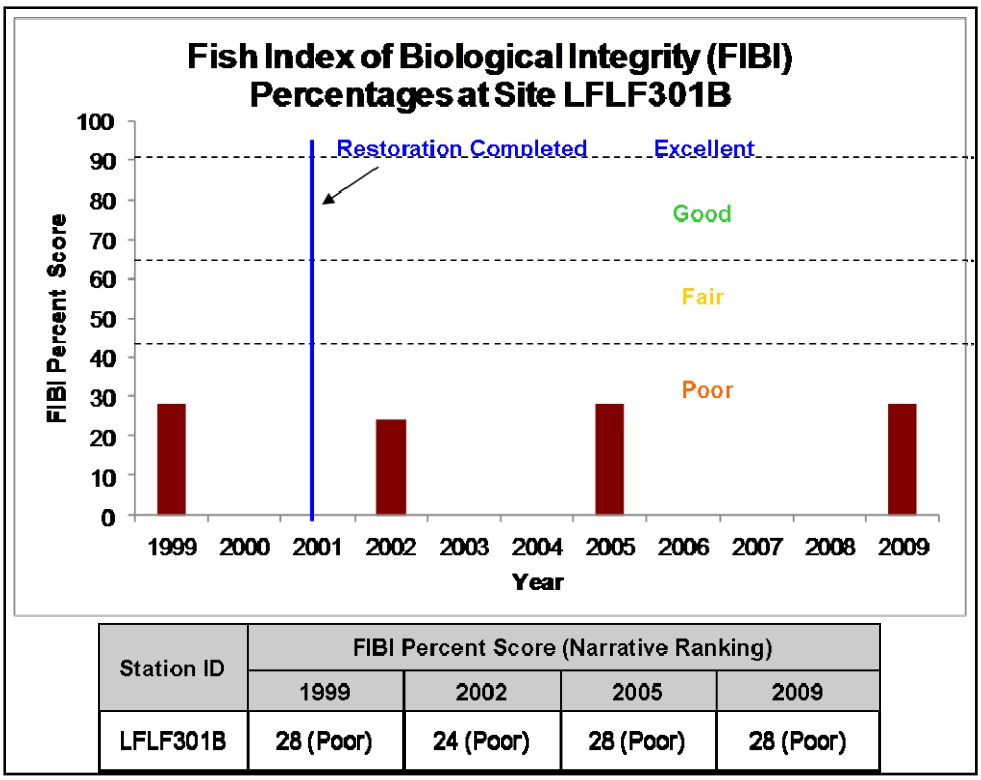


Figure 3.17.7 – Benthic Macroinvertebrate Functional Feeding Group Composition and Dominant Species at LFLF301B After Restoration

Fish

FIBI (Fish Index of Biological Integrity) Scores

The fish community, as assessed by the MCDEP Fish Index of Biological Integrity (FIBI), was Poor in all years prior to and after restoration (***Figure 3.17.8***). During the 1999 pre-restoration monitoring, this site had a FIBI percentage of 28. In 2002, following restoration, the FIBI percentage decreased to 24 but increased to the pre-restoration percentage of 28 in 2005 and 2009. Although the FIBI did not improve over time, both fish density and species diversity increased at this site after restoration (***Figure 3.17.9***). A total of 35 individuals representing one species were collected in 1999 prior to restoration. Following restoration, fish density and diversity increased each year to 95 individuals of three species in 2002, 478 individuals of four species in 2005, and 2,309 individuals of four species in 2009. Field data sheets from the 2009 fish monitoring are included in ***Appendix D***.



Station ID	FIBI Percent Score (Narrative Ranking)			
	1999	2002	2005	2009
LFLF301B	28 (Poor)	24 (Poor)	28 (Poor)	28 (Poor)

Figure 3.17.8 – Pre- and Post-Restoration Fish Index of Biological Integrity (FIBI) Percentages at LFLF301B

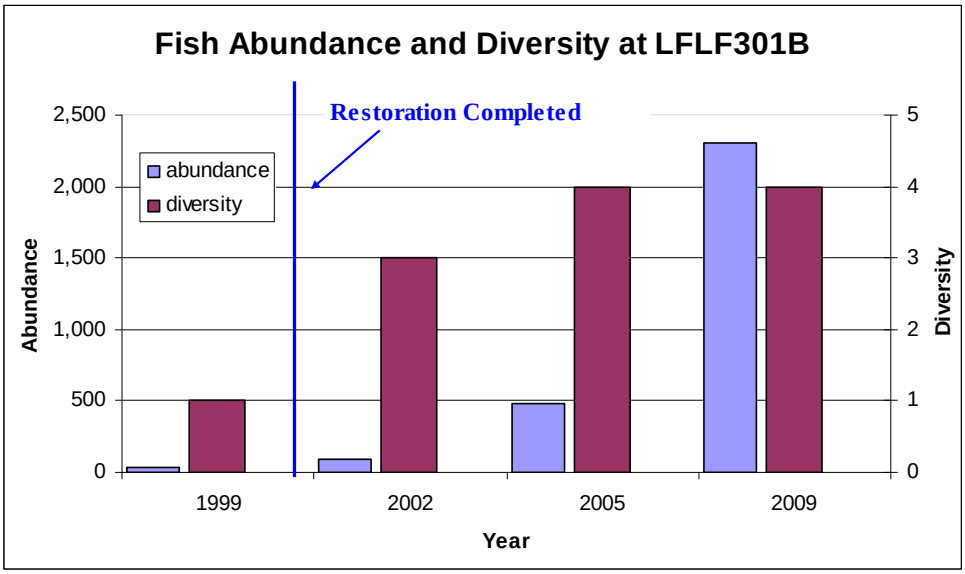


Figure 3.17.9 – Pre- and Post-Restoration Fish Abundance and Diversity at LFLF301B

Dominant Species

The most dominant fish species at LFLF301B, *Rhinichthys atratulus* (blacknose dace), remained similar between the pre- and post-restoration periods. Prior to restoration, blacknose dace was the only species collected. Following restoration, blacknose dace

remained the most dominant species, but was slightly less dominant than before restoration, making up 95.5 percent of the community, rather than 100 percent pre-restoration. Fathead minnow (*Pimephales promelas*) was second most dominant after restoration, comprising two percent of the community. The remainder of the community consisted of redbreast sunfish (*Lepomis auritus*), creek chub (*Semotilus atromaculatus*), central stoneroller (*Campostoma anomalum*), largemouth bass (*Micropterus salmoides*), and bluegill (*L. macrochirus*).

Tolerance Values

Tolerant fish species heavily dominated LFLF301B prior to and following restoration. Site LFLF301B was represented by 100 percent tolerant species (blacknose dace) prior to restoration. Following restoration, the proportion of tolerant species decreased slightly to 99 percent. The only fish species collected that is not considered tolerant to stressors was central stoneroller, which is considered intermediate in sensitivity. ***Figures 3.17.10*** and ***3.17.11*** show the differences in percentages of tolerance values between pre- and post-restoration sampling periods at LFLF301B.

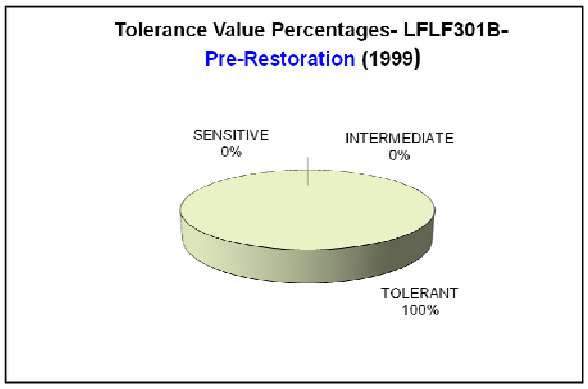


Figure 3.17.10 – Fish Tolerance Composition at LFLF301B Prior to Restoration

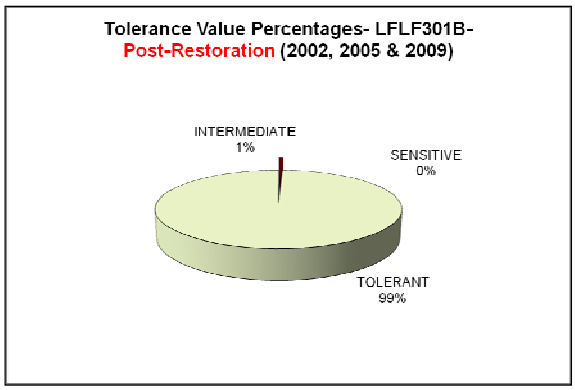


Figure 3.17.11 – Fish Tolerance Composition at LFLF301B After Restoration

Functional Feeding Groups

Prior to restoration, omnivores (blacknose dace) comprised 100 percent of the fish community. Following restoration, the proportion of omnivores (blacknose dace and fathead minnow) decreased to 97 percent. Generalists (creek chub and redbreast sunfish) were the second most dominant group, comprising two percent of the community. The remainder of the community was made up of more specialized feeding groups that were not observed prior to restoration. These included algavores (central stoneroller), invertivores (bluegill), and predators (largemouth bass), which comprised 0.6, 0.4, and 0.2 percent of the community, respectively. ***Figures 3.17.12*** and ***3.17.13*** show the percentages of each functional feeding group at LFLF301B for the pre- and post-restoration monitoring periods, respectively.

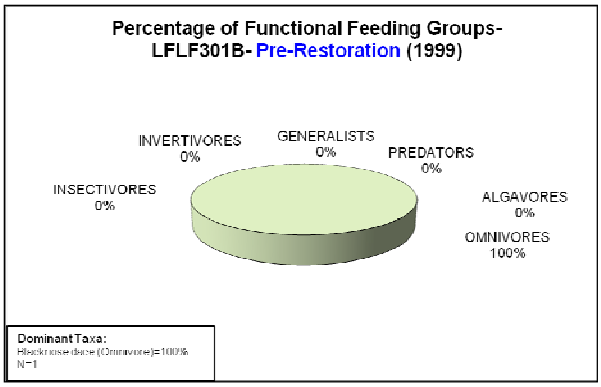


Figure 3.17.12 – Fish Functional Feeding Group Composition and Dominant Species at LFLF301B Prior to Restoration

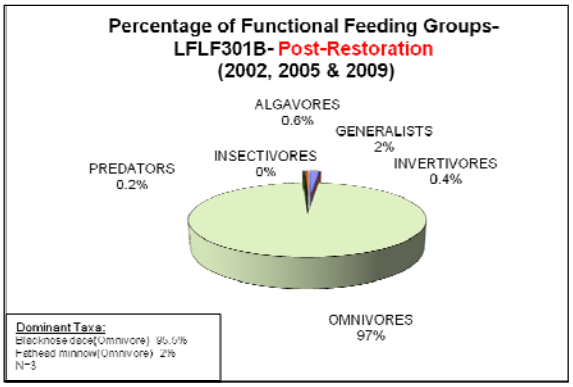


Figure 3.17.13 – Fish Functional Feeding Group Composition and Dominant Species at LFLF301B After Restoration

Pioneering Species

Non-pioneer fish were absent from the Little Falls mainstem site prior to restoration and increased every year after restoration (***Figure 3.17.14***). Species that are considered non-pioneers are generally more sensitive to urbanized aquatic habitats than pioneer species. The most drastic increase in non-pioneer fish occurred in 2002 when over 60 percent of the community was comprised of non-pioneer fish. *Pimephales promelas* (fathead minnow) was the dominant non-pioneer species present in this year and was absent from this site in all other years. In the other years post-restoration, less than three percent of the community was comprised of non-pioneer fish.

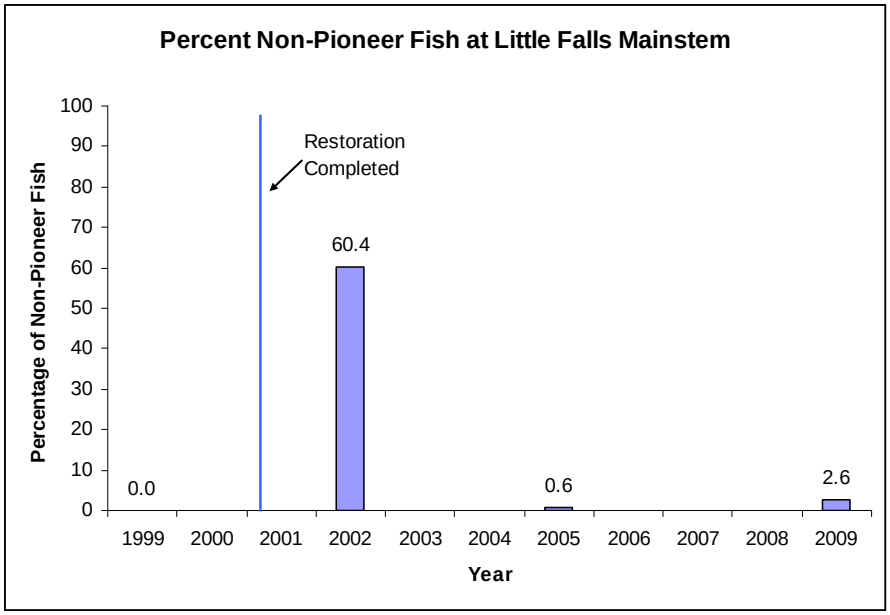
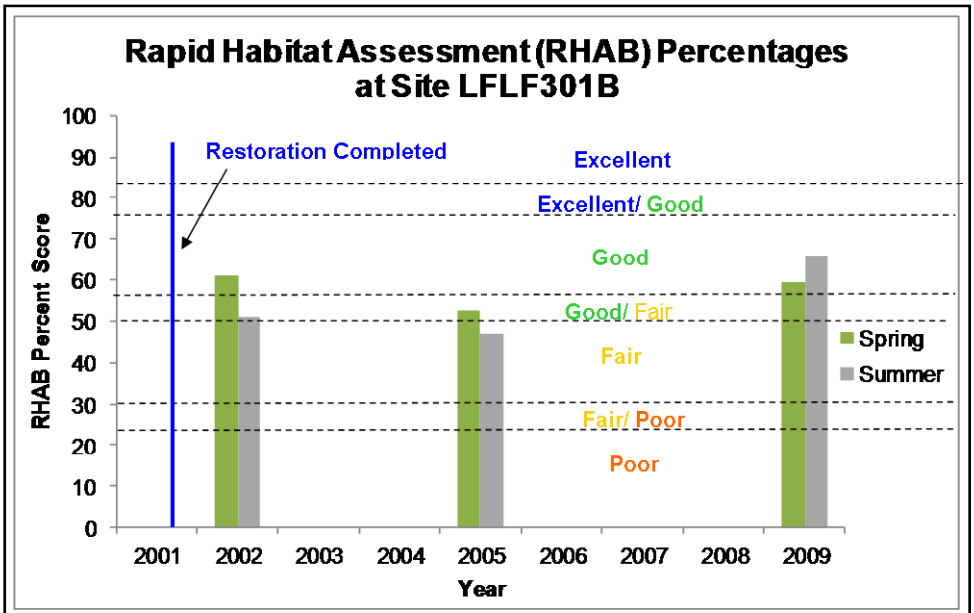


Figure 3.17.14 – Non-Pioneering Fish Present at Little Falls Mainstem Site (LFLF301B) Before and After Restoration LFLF301B

Qualitative Habitat

Post-restoration aquatic habitat was evaluated at LFLF301B in the spring and summer in 2002, 2005, and 2009. During these years, aquatic habitat percentages were Fair to Good, ranging from 47 to 66. This site generally had sub-optimal habitat for fish and benthic macroinvertebrates, moderate to heavy sediment deposition, and greater than 50 percent embeddedness. Aquatic habitat improved between 2005 and 2009, due to an increase in sediment deposition and bank stability. ***Figure 3.17.15*** shows aquatic habitat scores after restoration at LFLF301B.



RHAB Percent Score						
Year	2002		2005		2009	
Period	spring	summer	spring	summer	spring	summer
RHAB Percentage	61	51	52.5	47	59.5	66
Narrative Ranking	Good	Good/Fair	Good/Fair	Fair	Good	Good

Figure 3.17.15 – Pre- and Post-Restoration Rapid Habitat Assessment (RHAB) Percentages at LFLF301B

Quantitative Habitat

Quantitative monitoring was scheduled to occur at LFLF301B in 2009, but was delayed due to problems locating the benchmarks. Data were collected in 2011 and will be presented in the 2011 report.

Water Chemistry

With the exception of one pH reading taken during the summer of 2009, in-situ water quality parameters measured at LFLF301B were in compliance with COMAR standards for Use I-P streams during the post-restoration period (***Table 3.17.2***). During the summer of 2009, pH was 8.85, which is above the upper instantaneous State standard of 8.5.

Table 3.17.2 – Post-restoration in-situ Water Chemistry Data at LFLF301B

Water Quality Parameter	2002		2005		2009	
	spring	summer	spring	summer	spring	summer
Dissolved Oxygen (mg/L)	9.88	7.76	16.22	7.11	-	6.95
Dissolved Oxygen (% Saturation)	92	96	-	86	-	74
pH	7.28	7.78	8.26	7.61	8.85	7.45
Conductivity (µmhos)	503	747	700	773	615	803
Water Temperature (ºF)	53.6	78.6	55.2	75.7	74.9	64.8

Botanical Reforestation

In 2007, approximately 230 trees and shrubs were planted at this site including 12 species. In 2009, the botanical zone at this site contained four species of planted trees, six species of planted shrubs and several volunteer species. Planted tree species found onsite included *Platanus occidentalis* (American sycamore), *Acer rubrum* (red maple), *Liriodendron tulipifera* (tulip poplar), and *Salix nigra* (black willow) (***Figure 3.17.16***). *Carpinus caroliniana* (American hornbeam) was the only species of tree that was planted in 2007 that was absent from the 2009 survey. Overall planting survival at this site was poor, with 33 percent of the planted trees and 27 percent of the planted shrubs surviving to 2009 ***Table 3.17.3***. However, when adding the volunteer trees found onsite to the survival percentage, there was over 100 percent success at this site. The most common species of volunteer found at this site was black willow, which comprised over 80 percent of the trees. Sixty-four percent of the individuals encountered in the 2009 survey appeared healthy and fifteen stems were dead. None of the trees appeared to be browsed by deer, but many showed evidence of rubbing. All of the planted trees appeared to have grown since being planted; ranging from 1 to 1.5 inch caliper at the time of planting to between 1.25 and 2.9 caliper in 2009 (***Table 3.17.4***). Volunteer American sycamores were also observed, which were mostly larger than those planted.

Figure 3.17.16 – Botanical Zone at LFLF301B along the Little Falls Mainstem (2009)

Table 3.17.3 – 2009 Botanical Reforestation Summary for Trees at LFLF301B

Scientific Name	Common Name	Number Planted	Number Observed (2009)	Percent Survival
Platanus occidentalis	American sycamore	51	13	25
Acer rubrum	red maple	38	13	34
Liriodendron tulipifera	tulip poplar	13	7	54
Salix nigra	black willow	6	>6	100
Carpinus caroliniana	American hornbeam	12	0	0
Total		**120**	**39**	**33**

Six species of planted shrubs (23 individuals) were identified at this site, including *Viburnum dentatum* (southern arrowwood), *Aronia arbutifolia* (red chokeberry), *Viburnum prunifolium* (blackhaw), *Alnus serrulata* (hazel alder), *Cornus amomum* (silky dogwood), and *Cephalanthus occidentalis* (buttonbush). *Lindera benzoin* (spicebush) was the only species of shrub planted at this site that was not observed in 2009. Of the 27 percent shrub survival, 70 percent were considered healthy. Volunteer *Hamamelis virginiana* (witch hazel) were also observed in 2009. Several species of invasive plants were observed at this site, some of which were rather abundant across the site. Those observed included *Ampelopsis brevipedunculata* (porcelainberry), *Polygonum cespitosum* (Oriental ladysthumb), *Polygonum cuspidatum* (Japanese knotweed), *Polygonum perfoliatum* (Asiatic tearthumb), *Microstegium vimineum* (Nepalese browntop), *Lonicera japonica* (Japanese honeysuckle), *Glechoma hederacea* (gill over the ground), and *Ipomoea* sp. (unknown morning glory).

Table 3.17.4 – Size and Condition of Little Falls Mainstem Plantings Observed During 2009 Botanical Monitoring

Scientific Name	Common Name	Size Planted	Average Size Observed (2009)	Percent Healthy
Platanus occidentalis	American sycamore	1-1.5 inch caliper	1.25-2.25 inch caliper	75
Acer rubrum	red maple	1-1.5 inch caliper	1.25-2.25 inch caliper	0
Liriodendron tulipifera	tulip poplar	1-1.5 inch caliper	1.5-2.9 inch caliper	100
Salix nigra	black willow	3-4 feet	12 feet	87
Viburnum dentatum	southern arrowwood	3-4 feet	3.5 feet	100
Alnus serrulata	hazel alder	3-4 feet	3 feet	0
Aronia arbutifolia	red chokeberry	3-4 feet	5 feet	100
Viburnum prunifolium	blackhaw	3-4 feet	3 feet	100
Cornus amomum	silky dogwood	3-4 feet	2.5 feet	75
Cephalanthus occidentalis	buttonbush	3-4 feet	4 feet	100

3.17.5 Discussion

Table 3.17.5 below provides a summary of project goals, the results of post-restoration monitoring, and whether each project goal has been met by the restoration actions as assessed by the fifth year of post-restoration monitoring. Based on the results, one of the project goals was met by the restoration actions, one project goal was partially met, and one project goal could not be evaluated in 2009.

Table 3.17.5 – Summary of Project Goal Results

Goal	Result
• Improve aquatic habitat conditions • Improve quality and density of aquatic communities	Partially successful – pre-restoration data was not available for benthic macroinvertebrates and qualitative habitat, thus no before/after comparisons can be made. However, the benthic macroinvertebrate scores remained consistently poor following restoration. Fish data shows little improvement in health, but greater density and diversity of fish communities was observed following restoration.
Reduce stream erosion and erosive stream flows	Unable to determine – physical data from 2010 will suggest if these goals have been met.
Reforest riparian zone	Successful – most plantings appeared healthy; however, several of the plantings have died and certain areas showed high invasive species coverage.

Unable to Determine – Improve Aquatic Habitat Conditions

Because pre-restoration data were not available for qualitative habitat, the goal of improving habitat conditions could not be determined in 2009. However, qualitative habitat scores have been fairly consistent over the post-restoration period and have not declined or improved over time.

Partially Successful - Improve Quality and Density of Aquatic Communities in the Little Falls Branch

Because pre-restoration data were not available for benthic macroinvertebrates, the goal of improving these communities in the Little Falls I mainstem could not be determined in 2009. Post-restoration benthic macroinvertebrate communities were in the Poor range in all years and declined after the first year of post-restoration monitoring. Fish community health as assessed by the FIBI did not improve following restoration; however, an increase in fish density and diversity was observed, indicating that the goal of improving fish density was met in 2009. Fish numbers increased exponentially, from 35 collected pre-restoration to 95 in 2002, to 478 in 2005, and then to 2,309 sampled in 2009. Fish diversity also improved, increasing from one species found pre-restoration to seven species found post-restoration. Prior to restoration, non-pioneering fish were absent from the community but increased slightly in the post-restoration period to comprise less than three percent in 2005 and 2009 and over 60 percent in 2002. Non-pioneering fish species are usually less tolerant of disturbed conditions than pioneering species; their presence may indicate an improvement in quality of aquatic habitat. Additionally, with the exception of one pH reading taken during the summer of 2009, in-situ water quality parameters were in compliance with COMAR standards for Use I-P streams during the post-restoration period.

Successful – Reforest Riparian Zone

The current year's monitoring effort indicated reforestation efforts within LFLF301B have been successful. Many areas that were sparsely vegetated prior to construction have

been planted for this restoration project, and as a result the riparian zone is relatively improved. Even though only 33 percent of the planted trees and 27 percent of the planted shrubs survived to 2009, more trees and shrubs were observed in the riparian zone than were planted for this project. Overall, the health of persisting planted vegetation was good, with approximately 64 percent of trees and 70 percent of shrubs appearing healthy at the time of the monitoring visit. Additionally, most species have grown since being planted in 2007, another indication of health, with black willow, red chokeberry, and tulip poplar showing the most growth overall. However, several species of invasive plants were observed, some of which were rather abundant across the site. Invasive control measures are recommended for species that could potentially suppress the health of the riparian plantings such as porcelainberry, Japanese knotweed, and Asiatic tearthumb.

3.17.6 Conclusions

Overall, the Little Falls I Mainstem Stream Restoration project has partially met the goal of improving fish population density and has met the goal of riparian reforestation. However, because pre-restoration data was not available for this site, no comparisons can be made to baseline conditions for qualitative habitat, benthic macroinvertebrates, and water quality. Following restoration, aquatic habitat conditions were within the Good/Fair range. The benthic macroinvertebrate and fish communities were rated as Poor. These communities may be limited by the stream water quality at this site since the watershed in which the Little Falls I Mainstem flows is highly urbanized. Despite the overall rating of Poor, the fish community is showing signs of improvement in density and diversity. The total number of species encountered increased from one to seven and the total fish numbers sampled went from 35 to over 2,000 from pre- to post-restoration. However, the species found are predominantly tolerant to degradation, which indicates there may be remaining habitat and/or water quality issues present, or that colonization of more intermediate and sensitive species may be physically limited. In its current state, the basin is likely not able to assimilate impacts from impervious surface runoff or treat all of the contaminated stormwater without implementation of watershed-wide stormwater management improvements.