Potomac River Direct

Little Falls

3.4 Little Falls III Mall Tributary Stream Restoration

3.4.1 Introduction

The Little Falls III Mall Tributary Stream Restoration project was constructed in 2005. The project site is located along the Little Falls III Mall Tributary to the Potomac River, between Sangamore Road and Sentinel Drive in Bethesda, Maryland. ***Figure 3.4.3*** depicts the location of the Little Falls III Mall Tributary site. The Little Falls III Mall Tributary 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 streambanks and an exposed sewer line, both caused by stormwater received from a concrete channel at the upper portion of the site. The lower section of the concrete channel was undermined and had fallen apart, causing severe stream erosion. Immediately below the failing concrete channel, there was extreme channel down-cutting (***Figure 3.4.1***).

The goal of the project was to address severely degraded conditions along the Little Falls III Mall Tributary through stream channel restoration, stabilization, and reforestation, while also providing improved or increased aquatic insect and fish communities. ***Figure 3.4.2*** depicts the site following restoration in 2007. This report is the final report for this project and summarizes monitoring results for the fifth year post-construction.

Figure 3.4.1 – Little Falls III Mall Tributary Pre-Restoration in 2005; red arrow indicates exposed sewer line

Figure 3.4.2 – Little Falls III Mall Tributary Post- Restoration in 2009; replaced sewer line protected by stone step pool structures

Subwatershed facts

Subwatershed Drainage Area: 58 acres
Subwatershed Imperviousness: 40 Percent

Project Facts

Project Area: The stream restoration begins near the outfall from the Shops at Summers Place on Sangamore Road and continues downstream to the pedestrian bridge crossing within the Little Falls Branch Park. The project included stabilizing approximately 528 linear feet of stream and planting native vegetation.

Costs: Structural and Reforestation ($352,308), Funded in part through a Maryland Department of the Environment (MDE) Grant.

Completion Date: December 2005
Property Ownership: Maryland-National Capital Park and Planning Commission

Project Selection

The Little Falls Mall Tributary was identified as a priority stream reach within the Metropolitan Washington Council of Governments' (COG) Rapid Stream Assessment Technique (RSAT) Survey of the Little Falls Branch Watershed (1996). In addition to the project site being identified in this Watershed Study, Montgomery County residents contacted the County's Department of the Environmental Protection with concerns over the site's exposed sewer line and severe erosion.

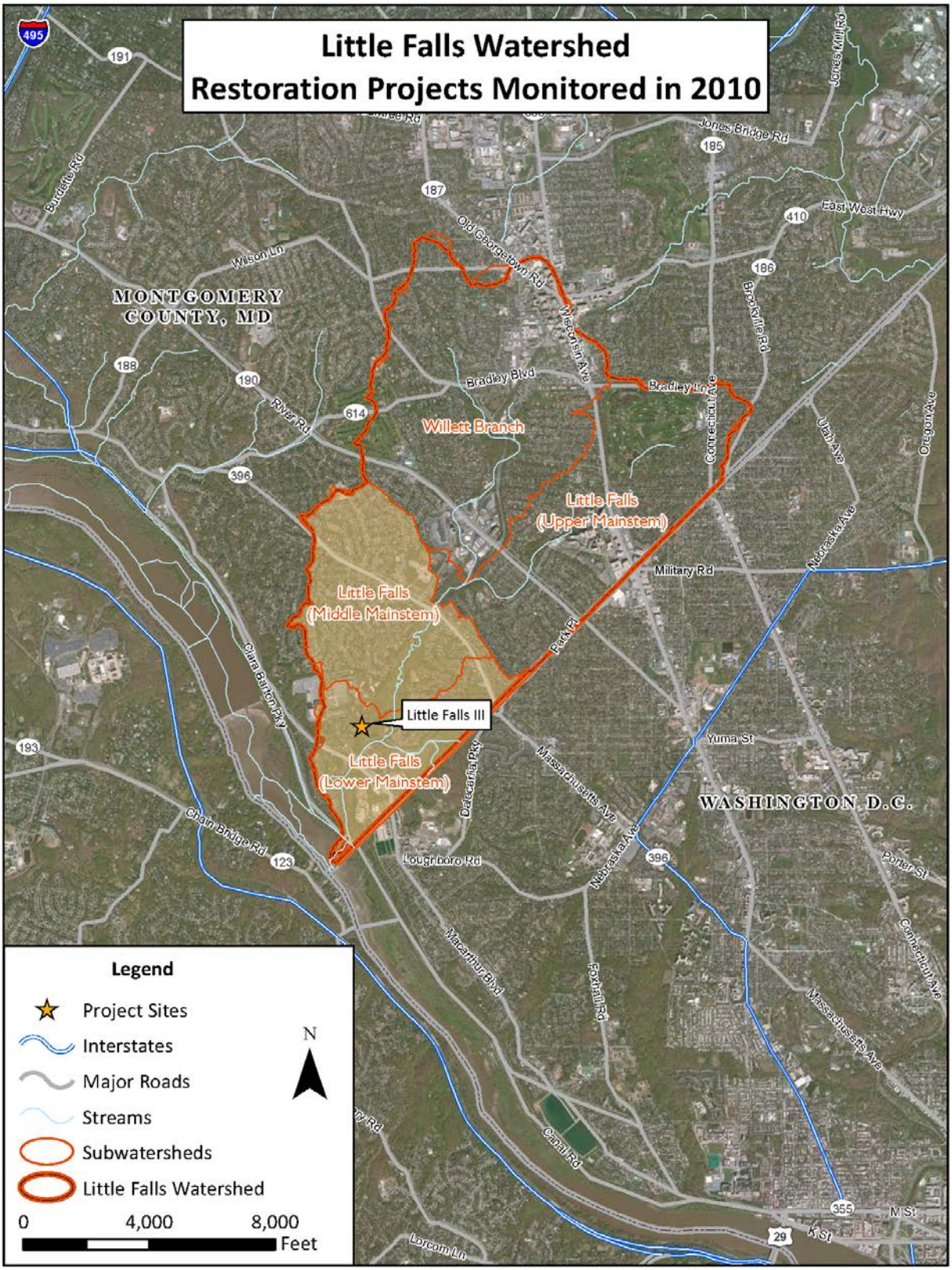


Figure 3.4.3 – Little Falls Watershed Including Little Falls III Mall Tributary (LFMT101) Stream Restoration

Pre-Restoration Conditions

The majority of drainage into the Little Falls Mall Tributary comes from the Shops at Summers Place where the stormwater flows into a "U" shaped concrete channel. The lower section of the concrete channel was undermined and had fallen apart, causing severe stream erosion. Immediately below the failing concrete channel, there was extreme channel down-cutting. On average, the streambank height within the project area was nine feet, with very minimal vegetation for streambank protection. An exposed, leaking sewer line was found toward the upper end of the project limits (***Figure 3.4.1***). Stream erosion was further increased by five storm drain outfalls that had minimal outfall channel protection.

Restoration Actions Taken

Portions of the undermined and unstable "U" shaped concrete channel were removed and replaced with a step pool system to gradually bring the flows from the mall down to the existing grade of the stream. During the step pool construction, WSSC replaced the exposed, leaking sewer line and advised DEP on the placement of the stone step pool structures to ensure their sewer line was protected (***Figure 3.4.2***). Rock pools were constructed at each of the storm drain outfalls to help dissipate the energy associated with the stormwater entering the stream. The vertical eroding streambanks were graded back and planted with native grass seed, ferns, shrubs, and trees (***Figure 3.4.4***). The project attempted to save trees on undercut streambanks with supportive rock packing. Seriously damaged trees were flush cut, allowing root systems to remain in the bank for stabilization.

Figure 3.4.4 – Little Falls III Streambanks Stabilized and Planted with Native Grass, Ferns, Shrubs, and Trees (2009)

Once the stream restoration project was completed, the access road was replanted with various native trees and shrubs. At the access road closer to Sangamore Road, DEP planted twelve white

pine trees to provide a natural screen between the townhouses on Sangamore Court and Sangamore Road. ***Figure 3.4.4*** shows ground-level images before and after restoration.

Figure 3.4.5 – Little Falls III Mall Tributary Stream Restoration Before (2005) and After Restoration (2007)

3.4.2 Restoration Goals

Restoration goals were defined during the planning and implementation of the Little Falls III Mall Tributary Stream Restoration project. Pre- and post-restoration monitoring was conducted within the stream and in the riparian area. ***Table 3.4.1*** below presents the restoration goals, monitoring performed to evaluate the success of the goals, and when and where the monitoring occurred.

Table 3.4.1 – 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 benthic macroinvertebrate community in the Little Falls III Mall Tributary • Help establish a fish community	• Qualitative habitat • Aquatic communities: ▪ Benthic macroinvertebrates ▪ Fish • Water chemistry	2002 (pre) 2009 and 2010 (post)	LFMT101
• Reduce stream erosion • Reduce erosive stream flows	• Quantitative habitat (stream morphology surveys)	2011(post) [1]	LFMT101
• Reforest riparian zone	• Botanical survey	2009 and 2010 (post)	LFMT101

[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.

3.4.3 Methods to Measure Project Goals

The basic sampling design for the Little Falls III Mall Tributary Stream Restoration project was pre-restoration (before) and post-restoration (after) monitoring. However, pre-restoration data are not available for the fish community, thus no comparisons will be made to baseline conditions for fish. The County monitored the biological communities (benthic macroinvertebrate and fish), took in-situ water chemistry measurements performed rapid habitat assessments (RHAB), and conducted a botanical survey, at one biological monitoring site (LFMT101) within the restoration project to evaluate the aquatic habitat conditions, water quality, and botanical reforestation during the post-restoration period in 2010. Pre-restoration data were collected at this site in 2002 and post-restoration data were collected at this site in 2009 and 2010. ***Figure 3.4.6*** depicts the location of the LFMT101 monitoring site.

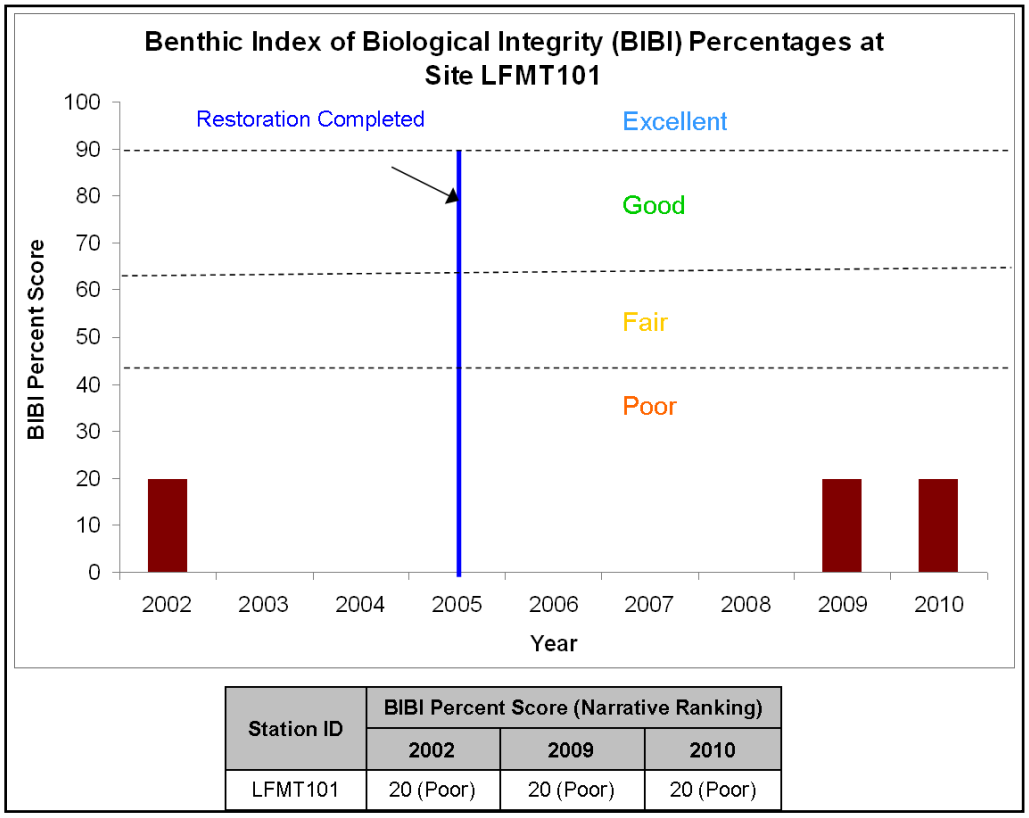
Figure 3.4.6 –Monitoring Location Map for Little Falls III Mall Tributary (LFMT101) Stream Restoration

3.4.4 Results and Analysis

Benthic Macroinvertebrates

BIBI (Benthic Index of Biological Integrity) Scores

The benthic macroinvertebrate community at LFMT101, as assessed using the MCDEP Benthic Index of Biological Integrity (BIBI), was Poor in both the pre- and post-restoration periods (***Figure 3.4.7***). The baseline BIBI percentage prior to restoration was 20, which is the lowest possible BIBI percentage. Note that prior to restoration, the number of individuals collected was 29, which is below the threshold for calculating the BIBI, thus the lowest possible BIBI score was assigned at this site in 2002. Following restoration in 2009 and 2010, the number of individuals increased above the BIBI threshold, but the BIBI percentage remained at 20. Field data sheets from 2010 benthic macroinvertebrate monitoring are included in ***Appendix D***.



Station ID	BIBI Percent Score (Narrative Ranking)		
	2002	2009	2010
LFMT101	20 (Poor)	20 (Poor)	20 (Poor)

Figure 3.4.7 – Pre- and Post-Restoration Benthic Index of Biological Integrity (BIBI) Percentages at LFMT101

Dominant Taxa

Both pre- and post-restoration communities of benthic macroinvertebrates at LFMT101 were dominated by Chironomidae (non-biting midges), which comprised 82 percent of the community prior to restoration and 87 percent after restoration. *Gammarus* sp. (scuds) was the second most dominant taxon prior to restoration, representing 14 percent of individuals collected. Following restoration, the second most dominant taxa collected was Enchytraeidae (a family of aquatic worms), which made up eight percent of the community. Overall, the percentage of dominance

of the top two taxa was similar between the pre- and post-restoration periods, comprising 96 and 95 percent of the community, respectively.

Tolerance Values

Site LFMT101 was dominated by tolerant taxa (83 percent) prior to restoration, with the remaining 14 percent represented by taxa intermediate in sensitivity (***Figures 3.4.8 and 3.4.8***). Following restoration, the site experienced an increase in the proportion of tolerant benthic macroinvertebrate taxa to 99 percent, and a decrease in the proportion of taxa intermediate in sensitivity to one percent.

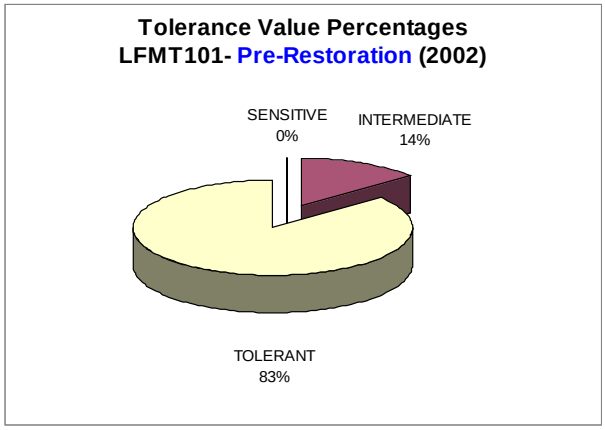


Figure 3.4.8 – Benthic Macroinvertebrate Tolerance Composition at LFMT101 Prior to Restoration

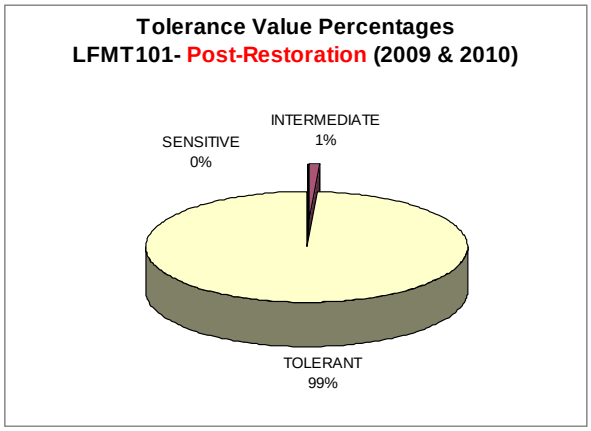


Figure 3.4.9– Benthic Macroinvertebrate Tolerance Composition at LFMT101 After Restoration

Functional Feeding Groups

Collectors were the most dominant functional feeding group at LFMT101 both before and after restoration. Prior to restoration, the community was dominated by collectors (93 percent). Scrapers represented the only other functional feeding group present prior to restoration, comprising three percent of the community (***Figures 3.4.10 and 3.4.11***). After restoration the percentage of collectors decreased to 89 percent. The remainder of the community was represented by predators (10 percent), filterers (0.7 percent), and shredders (0.3 percent). Scrapers, a specialized feeding group that requires less degraded stream conditions or specific habitat features were absent from the benthic macroinvertebrate community following restoration.

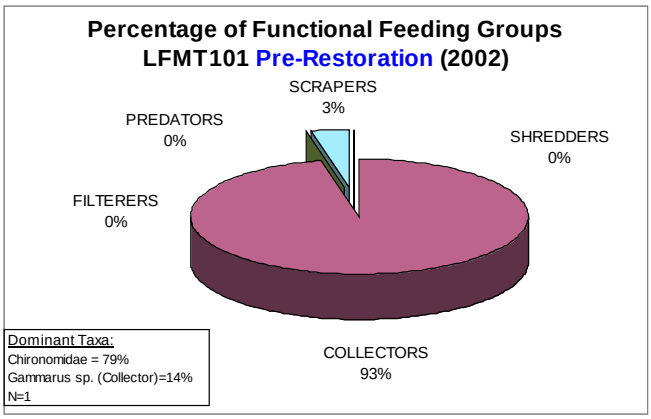


Figure 3.4.10 – Benthic Macroinvertebrate Functional Feeding Group Composition and Dominant Species at LFMT101 Prior to Restoration

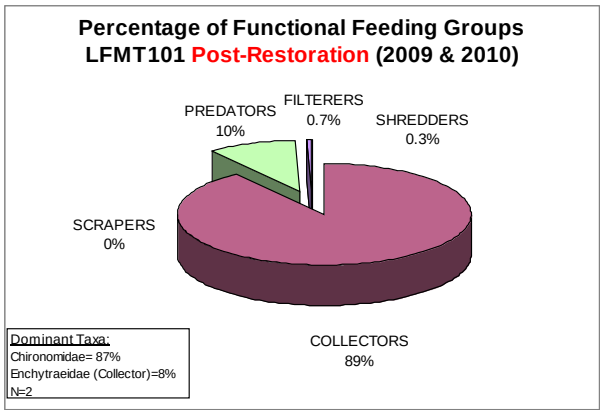


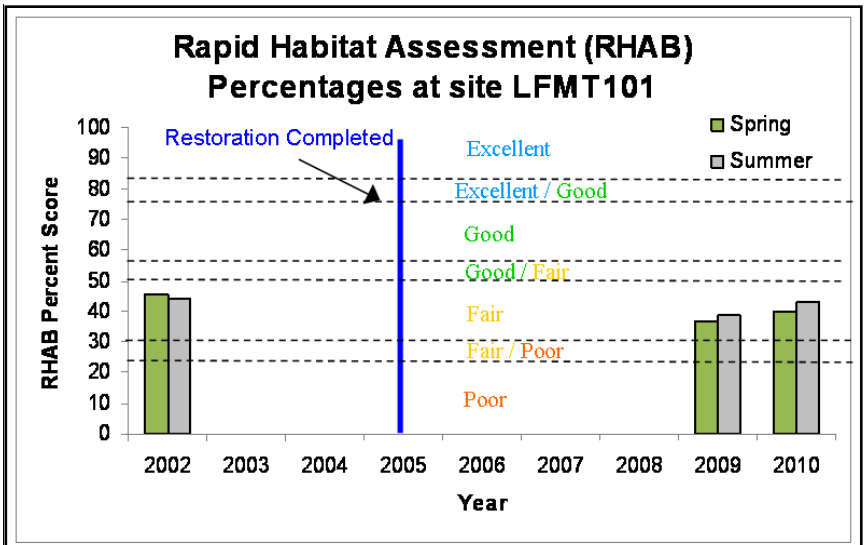
Figure 3.4.11– Benthic Macroinvertebrate Functional Feeding Group Composition and Dominant Species at LFMT101 After Restoration

Fish

Fish data were not available for the pre-restoration period at this site. The post-restoration fish community was sampled at LFMT101 in 2009 and 2010. No fish were documented during these surveys, thus Fish Index of Biotic Integrity (FIBI) scores could not be calculated. The absence of fish at this site is likely due to the size of the stream, as the stream is small and possibly dry during parts of the year, which suggests that fish are not a good indicator for stream condition at this site (***Figure 3.4.14***).

Qualitative Habitat

Pre-restoration aquatic habitat was evaluated at LFMT101 in the spring and summer in 2002. During this period, percentages were in the Fair range with percent scores of 45.5 and 44.0, respectively (***Figure 3.4.12***). Following restoration, aquatic habitat was evaluated in the spring and summer of 2009 and 2010. During this time, aquatic habitat percentages ranged from 36.5 to 43 and remained within the Fair range. Generally, this site scored in the poor range for fish habitat and sediment deposition, had marginal habitat for benthic macroinvertebrates, and moderately stable to moderately unstable streambanks. Field data sheets for this task are located in ***Appendix D***.



Station ID	RHAB Percent Score (Narrative Ranking)					
	2002		2009		2010	
LFMT101	spring	summer	spring	summer	spring	summer
	45.5 (fair)	44 (fair)	36.5 (fair)	39 (fair)	40 (fair)	43 (fair)

Figure 3.4.12 – Pre-Restoration (2002) and Post-Restoration (2009 and 2010) Rapid Habitat Assessment (RHAB) Percentages at LFMT101

Quantitative Habitat

Quantitative monitoring was scheduled to occur at LFMT101 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

All in-situ water quality parameters were in compliance with COMAR standards for Use I-P streams during both pre- and post-restoration periods (***Table 3.4.2***). However, dissolved oxygen was relatively low (5.42 mg/L) in the summer of 2002, but did not go below state standards.

Table 3.4.2– Pre- and Post-restoration in-situ Water Chemistry Data at LFMT101

Water Quality Parameter	2002		2009		2010	
	spring	summer	spring	summer	spring	summer
Dissolved Oxygen (mg/L)	6.64	5.42	-	6.17	15.42	8.95
Dissolved Oxygen (% Saturation)	69	64	-	63	132	101
pH	6.67	6.74	6.85	6.61	7.47	6.96
Conductivity (umhos)	567	644	1022	908	532	793
Water Temperature (°F)	66.2	75.6	72.1	62.4	51.3	70.5

Botanical Reforestation

This site was planted in 2005 with 78 trees representing five species *Platanus occidentalis* (American sycamore), *Acer rubrum* (red maple), *Pinus strobus* (white pine), *Ilex opaca* (American holly), and *Liriodendron tulipifera* (tuliptree). In 2010, all five species of planted trees were observed in addition to three species of volunteer trees *Carpinus caroliniana* (American hornbeam), *Betula nigra* (river birch) and *Cercis canadensis* (eastern redbud). Overall, the success rate of planted trees in this botanical zone was 69 percent (***Table 3.4.3***). When including the volunteers found at this site, the reforestation success rate increased to 76 percent. White pine and red maple had the two best survival rates and tuliptree had the lowest survival rate. Of the trees observed in 2010, 65 percent appeared healthy. A few individuals were experiencing tip dieback and were rubbed by deer. Only four stems were dead at the time of the vegetation survey and included three American sycamores and one red maple. The tree species that grew the most since being planted in 2005 were white pine and tuliptree. The species that grew the least were American holly and American sycamore.

Table 3.4.3 – Botanical Reforestation Tree Data for Site LFMT101

Scientific Name	Common Name	Number Planted (2005)	Number Observed (2009)	Number Observed (2010)	2009 Success Rate (%)	2010 Success Rate (%)	Caliper Range (2010)
Platanus occidentalis	American sycamore	15	10	9	67	60	1.4
Acer rubrum	red maple	24	17	17	71	71	1-1.8
Liriodendron tulipifera	tuliptree	17	11	10	65	59	1-3
Pinus strobus	white pine	12	12	12	100	100	2.75-3.5
Ilex opaca	American holly	10	5	6	50	60	1
Total		**78**	**55**	**54**	**71**	**69**	

[1] All trees ranged from 1 to 1.5 inch caliper when planted in 2005

In 2005, 169 shrubs representing four species were planted including *Viburnum prunifolium* (blackhaw), *Lindera benzoin* (northern spicebush), *Cephalanthus occidentalis* (buttonbush), and *Sambucus nigra canadensis* (American black elderberry). With the exception of American black elderberry, all other shrub species that were planted at this site were observed in 2010. In addition, two volunteer species were found including *Cornus amomum* (silky dogwood) and *Hamamelis virginiana* (American witchhazel). Overall, the success rate of shrubs was lower than trees at this site, with 21 percent of the individuals surviving from 2005 to 2010. When including the volunteers the success rate increased to 25 percent. Blackhaw had the highest survival rate (39 percent) among the planted species observed in 2010, and buttonbush had the lowest survival rate (22 percent) (***Table 3.4.4***). However, buttonbush individuals grew the most, having the greatest difference in height since being planted in 2005.

Forty-four stems were counted in the botanical zone, 70 percent of which appeared healthy. Most individuals that were deemed unhealthy appeared to be affected either by deer browse or rub or invasive plants. Only one shrub was dead at the time of the survey. Several species of

invasive plants were observed, some of which were rather abundant across the site. Those observed included *Rubus phoenicolasius* (wineberry), *Celastrus orbiculatus* (Oriental bittersweet), *Alliaria petiolata* (garlic mustard), *Lonicera japonica* (Japanese honeysuckle), *Wisteria sinensis* (Chinese wisteria), *Microstegium vimineum* (Nepalese browntop), and *Rosa multiflora* (multiflora rose). ***Figure 3.4.13*** shows the reforestation area following restoration in 2010.

Table 3.4.4 – Botanical Reforestation Shrub Data for Site LFMT101

Scientific Name	Common Name	Number Planted (2005)	Number Observed (2009)	Number Observed (2010)	2009 Success Rate (%)	2010 Success Rate (%)	2010 Average Height (ft)
Lindera benzoin	northern spicebush	76	20	19	26	25	3.5
Viburnum prunifolium	blackhaw	76	23	14	30	39	4
Sambucus canadensis	American black elderberry	8	2	0	25	0	
Cephalanthus occidentalis	buttonbush	9	4	2	44	22	4.5
Total		**169**	**49**	**35**	**29**	**21**	

[1]The height of all planted shrubs was approximately three to four feet in 2005

Figure 3.4.13 – Botanical Zone at LFMT101 along the Little Falls III Mall Tributary (2010) showing American sycamore plantings and dense invasive herbaceous coverage

3.4.5 Discussion

Table 3.4.3 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 partially met by the restoration actions, one restoration goal was successfully met, and one project goal could not be evaluated in 2010.

Table 3.4.5 – Summary of Project Goal Results

Goal	Result
Improve aquatic habitat conditions Improve quality and density of aquatic communities	Partially successful – pre-restoration fish data were not available for this site, thus no before/after comparisons can be made. However, fish were absent from the site in 2009 and 2010; therefore, no improvement to the community could have occurred. Qualitative habitat did not improve after restoration. Benthic macroinvertebrate data shows no improvement in the quality of the community, but a greater density was observed following restoration.
Reduce stream erosion and erosive stream flows	Unable to determine – physical data from 2011 will suggest if these goals have been met.
Reforest riparian zone	Successful – most tree plantings appeared healthy; however, several of the shrub plantings have died and invasive species were prevalent.

Partially Successful – Improve Aquatic Habitat Conditions and Quality and Density of Aquatic Communities in the Little Falls Branch

Based on the results of the fifth year of monitoring, the goal of improving aquatic habitat conditions and aquatic community quality and density in the Little Falls III Mall Tributary was partially met by the restoration actions. Although aquatic habitat conditions did not improve following restoration, the benthic macroinvertebrate community showed greater density and a greater diversity of functional feeding groups. However, scrapers, a specialized feeding group that was present prior to restoration was absent from this site after restoration. Fish were not observed at this site post-restoration. Therefore, the goal of helping to establish a fish community was not met by the restoration actions. The absence of fish at this site is likely due to the small size of Little Falls III Mall Tributary and shallow water conditions. The stream channel may have been dry during the year, suggesting that this site may not be a suitable candidate for establishing a viable fish population (***Figure 3.4.14***).

Figure 3.4.14 – Site LFMT101 in 2010 Showing Low Flow Conditions and Poor Fish Habitat

Unable to Determine – Reduce Stream Erosion and Erosive Stream Flow in the Little Falls Branch

Because quantitative monitoring was delayed in 2010, the goal of reducing stream erosion and erosive stream flows was unable to be determined. Data were collected in 2011 and will be presented in the 2011 report.

Successful – Reforest Riparian Zone

2010 monitoring indicated reforestation efforts within LFMT101 have been successful. Overall, the success rate of the planted vegetation, including volunteers was 76 percent for trees and 25 percent for shrubs. The health of persisting planted vegetation was good, with approximately 65 percent of trees and 70 percent of shrubs appearing healthy at the time of the monitoring visit. An abundance of planted Christmas ferns were also found along the upstream portion of the project. However, planting success declined between 2009 and 2010, indicating that some of the plantings may not be stable and success may continue to decline in the future. This may be partially due to the abundance of invasive species across the site, combined with the presence of deer at this site which also appeared to affect many of the planted shrubs and trees. Invasive control measures are recommended for species such as porcelainberry, Oriental bittersweet, and multiflora rose that could potentially suppress the health of the riparian plantings.

3.4.6 Conclusions

The fifth and final year of monitoring for this site indicated that the goals of improving aquatic habitat and reforesting the riparian zone in the Little Falls III Mall Tributary were partially met by the restoration actions. The riparian zone at this site is relatively improved by the restoration efforts with several of the tree and shrubs surviving five years after being planted. However, planting success has decreased over time and invasive species and deer may be limiting growth and overall success of the riparian reforestation.

The goal of improving the quality and density of aquatic communities may not be attainable at this site because the watershed in which the Little Falls III Mall Tributary flows is highly

urbanized. It may not be able to assimilate impacts from impervious surface runoff or treat all of the contaminated stormwater without implementation of watershed-wide stormwater management improvements. Nevertheless, some small improvements in benthic macroinvertebrate density and diversity of functional feeding groups have occurred, and may continue to improve. Functional improvements to benthic communities can take many years, if not decades, in urban restoration projects. Additionally, this small stream may lack the supporting hydrology and associated instream habitat to support a community of resident fish. It is important for future projects to establish attainable restoration goals for biology that factor in necessary improvements to hydrology, geomorphology, and water quality.