3 Individual Restoration Projects

Patuxent River

Rocky Gorge Dam

Hawlings River

3.1 Hawlings River Stream Restoration

3.1.1 Introduction

The Hawlings River is part of the Patuxent River watershed and drains directly to the Rocky Gorge Reservoir. This restoration project site was identified by the Hawlings River Watershed Restoration Study (2003) as having highly eroded banks, limited aquatic habitat for stream biota, and a sparsely vegetated stream buffer with a dense groundcover of invasive herbaceous species. The restoration was completed in 2005 and intended to reduce erosion, thereby reducing sedimentation and nutrient inputs to the downstream reservoir, and to improve in-stream aquatic habitat and water quality. The riparian area was also planted with native tree species to improve the stream buffer. ***Figures 3.1.1*** and ***3.1.2*** display examples of the restoration associated with the project.

Figure 3.1.1 – Hawlings River Restoration 2009

Figure 3.1.2 – Hawlings River Stream Restoration 2005

Subwatershed Facts

Subwatershed Drainage Area: 10,240 acres (16 square miles)
Subwatershed Imperviousness: Approximately 15 Percent

Project Facts

Project Area: The Montgomery County Department of Environmental Protection (MCDEP) performed a stream restoration project along the Lower Hawlings River mainstem. The project, located just upstream of Brighton Dam Road, stabilized a 2,800 foot degraded stream channel that flows through County parkland (***Figure 3.1.3***). The Hawlings River is a tributary to the Rocky Gorge Reservoir, a Washington Suburban Sanitary Commission (WSSC) drinking water supply reservoir located in the Patuxent River watershed. The contributing drainage area is characterized by mainly low-density single-family residential use with agricultural use interspersed.

Costs: Structural ($432,293), Reforestation ($47,000), funded in part through the Maryland Department of Natural Resources.
Completion Date: September 2005
Property Ownership: Maryland-National Capital Park and Planning Commission

Project Selection

This stream restoration project was identified in the County's Hawlings River Watershed Restoration Study (2003). The downstream effects of sediments and nutrients into Rocky Gorge Reservoir increased this project's priority along with overwhelming support from residents who use the Hawlings River Stream Valley Park.

Pre-Restoration Conditions

Steep, vertical, highly erodible streambanks are a common problem in the lower Hawlings River. A majority of the vertical banks had minimal vegetation except for invasive plant species such as mile-a-minute and Japanese stilt grass. The riparian buffer shows signs of intense deer browse/rub and the invasive plants have inhibited the next generation of native trees and shrubs. A majority of the stream reach was lacking stable in-stream aquatic habitat.

Restoration Actions Taken

Vertical streambanks were graded-back along the entire length of the project wherever there were minimal existing trees. In some extreme circumstances where the streambank had severe erosion, a rock toe structure was installed to prevent further streambank loss. A variety of native tree and shrubs were planted by the County along the newly graded streambanks and also within the riparian buffer. Additionally, after the construction portion of the project was complete, two volunteer groups, Trout Unlimited and Isaak Walton League of America's Wildlife Achievement Chapter, planted a variety of native trees on both sides of the stream to help reestablish a riparian buffer.

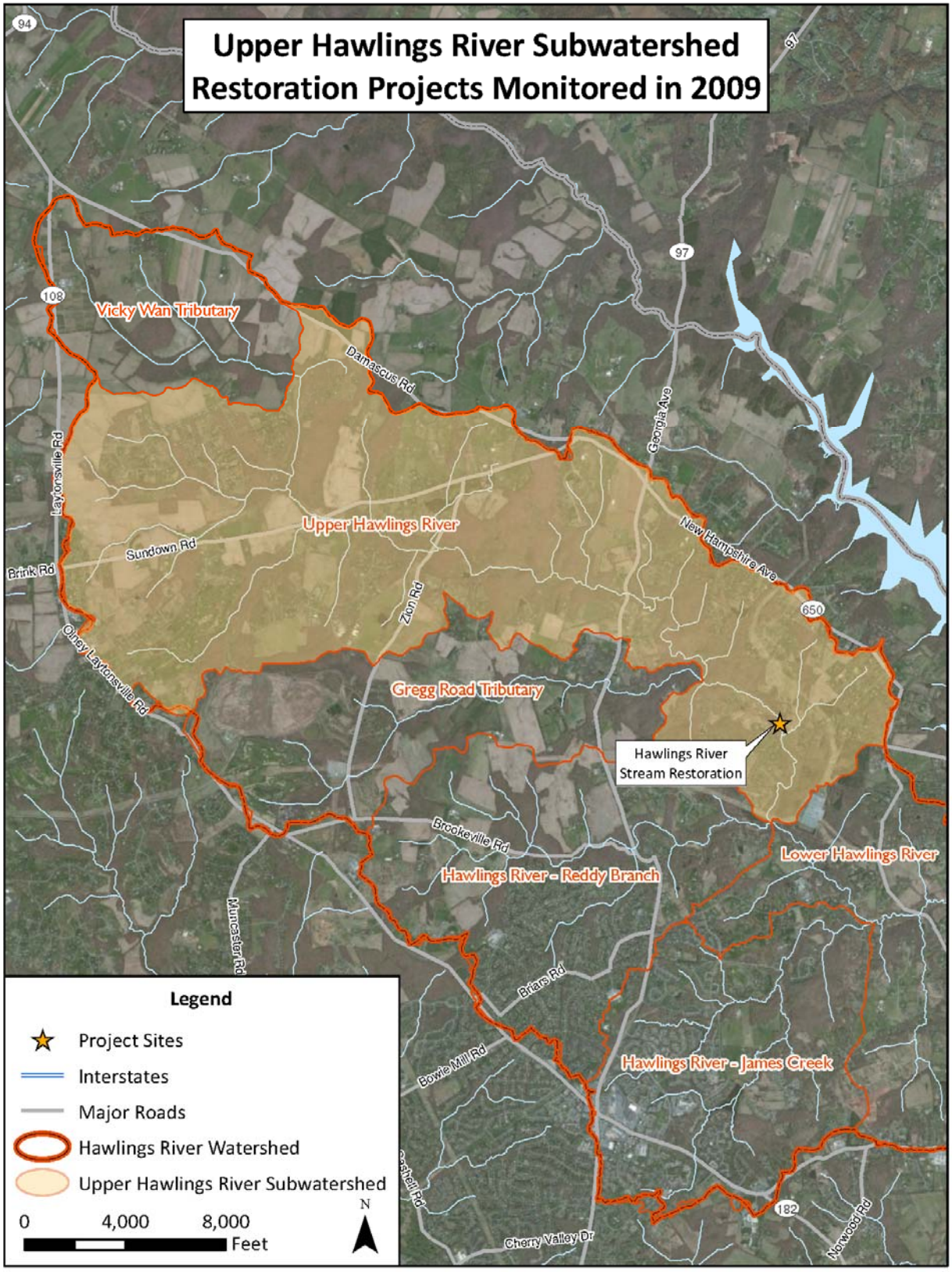


Figure 3.1.3 – Vicinity Map – Hawlings River Stream Restoration

3.1.2 Restoration Goals

Restoration goals were defined during the planning and implementation of the Hawlings River Stream Restoration project. Pre- and post-restoration monitoring was conducted within the stream and in the floodplain of the project area. This is a third year post-restoration monitoring report and summarizes the pre- and post-restoration conditions within the Hawlings River project area. ***Table 3.1.1*** below presents the restoration goals, monitoring performed to evaluate the success of the goals, and when and where the monitoring occurred.

Table 3.1.1 – 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 in Hawlings River • Improve water quality in Hawlings River	• Aquatic Communities: ▪ Benthic macroinvertebrates ▪ Fish ▪ Freshwater mussels • Qualitative Habitat • In-Situ Water Chemistry	2003 and 2004 (pre) 2006 and 2009 (post)	HWHW314D
• Reduce stream erosion and sedimentation • Reduce erosive stream flows	• Quantitative habitat (stream morphology surveys)	2006, 2010[1], 2011 (post)	HWHW314D
• Reforest riparian zone	• Botanical survey	2006 and 2009 (post-restoration)	HWHW314D

[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 2010 and 2011. 2010 and 2011 reports will include updates for this monitoring.

3.1.3 Methods to Measure Project Goals

The basic sampling design for most of the monitoring tasks was pre-restoration (before) and post-restoration (after) monitoring, within the restored reach. Data were collected at one site within the restoration project limits, HWHW314D (***Figure 3.1.4***).

Biological communities (benthic macroinvertebrates, fish, and freshwater mussels), aquatic habitat, and water chemistry within Hawlings River were monitored both prior to and after restoration occurred at site HWHW314D. All data collected prior to 2005 are considered pre-restoration data and all subsequent data are considered post-restoration. Botanical reforestation within the floodplain in the vicinity of the stream restoration was monitored after restoration. These data are presented in the results section below. For more information on how this monitoring is performed and used to measure stream health in the County, see the Methods section above (***Section 2***).

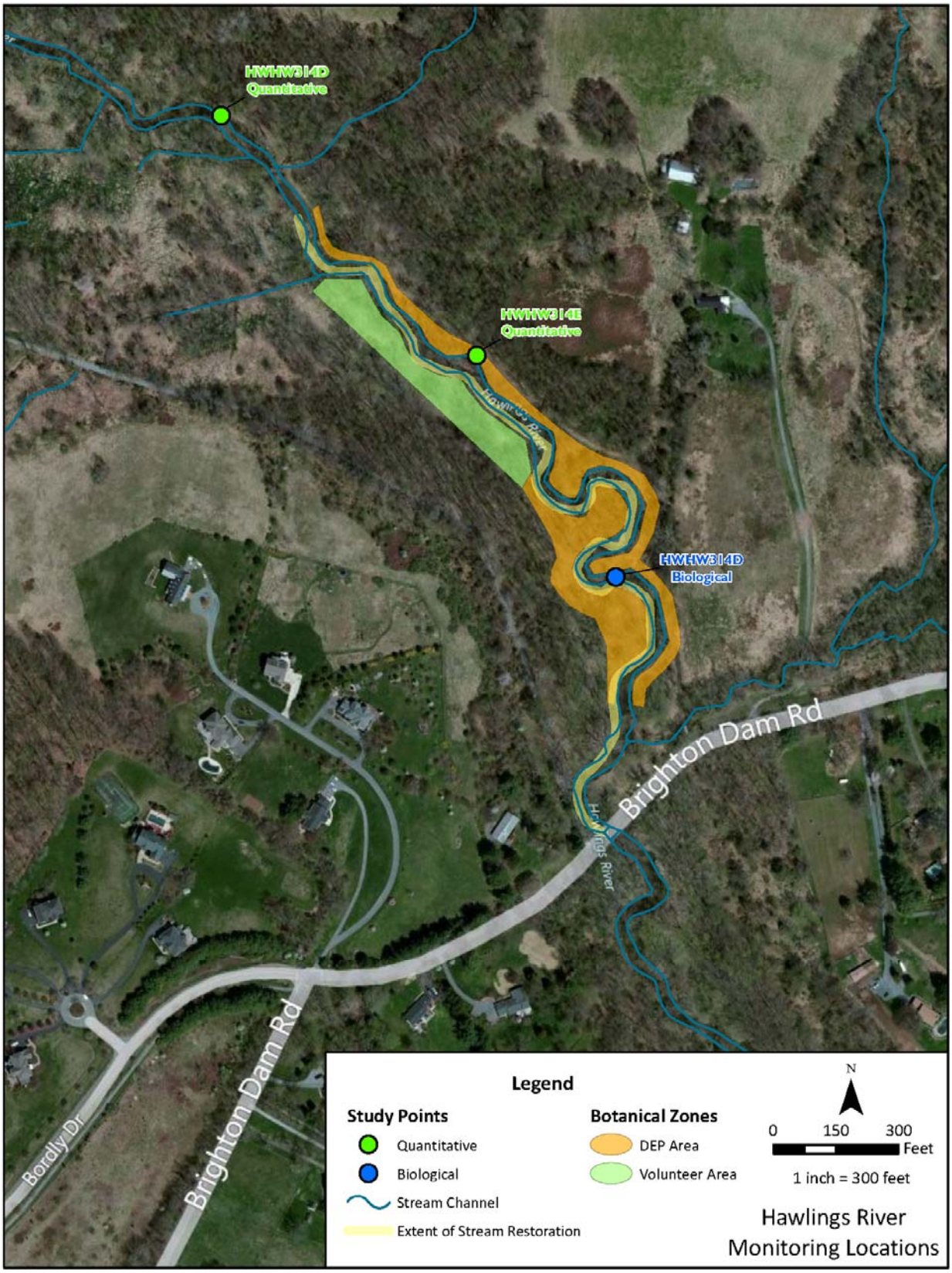


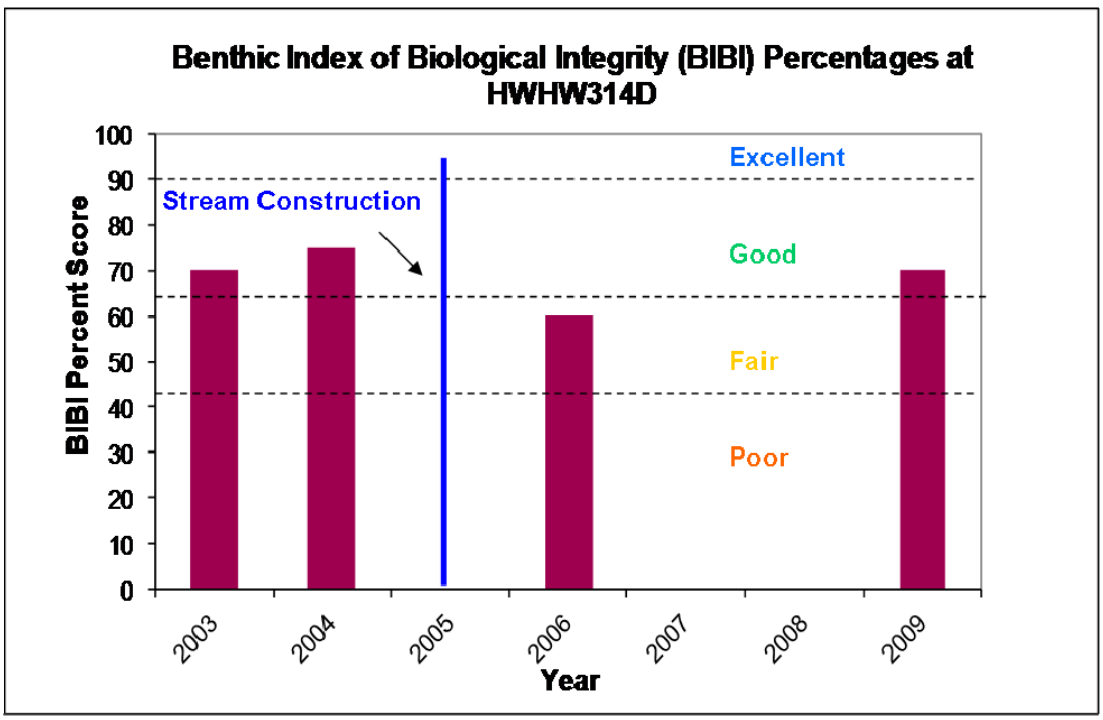
Figure 3.1.4 – Map of Monitoring Locations for Hawlings River Stream Restoration

3.1.4 Results and Analysis

Benthic Macroinvertebrates

BIBI (Benthic Index of Biological Integrity) Scores

The BIBI percentage at this site was in the Good range during the pre-restoration period (***Figure 3.1.5***). In the first year post-restoration, the BIBI percentage declined to the Fair range, but in 2009 improved slightly to the Good range. The decline in the post-restoration period was generally due to a decline in the percentage of shredders in the community as well as a decline in the proportion of EPT individuals. However, the most taxa-rich benthic macroinvertebrate community at this site was found in 2009, consisting of seven or more taxa than collected in any other year. Field data sheets for the benthic macroinvertebrate task in 2009 are included in ***Appendix D***.



Stream Construction

Year	2003	2004	2006	2009
BIBI Percentage	70	75	60	70
(Narrative Ranking)	(Good)	(Good)	(Fair)	(Good)

Figure 3.1.5 – Pre- and Post-Restoration Benthic Index of Biological Integrity (BIBI) Percentages at HWHW314D

Dominant Taxa

The pre-restoration benthic community was dominated by Chironomidae (midges), which comprised 55 percent of the community. *Acentrella* sp., a genus of mayfly, was the second most dominant taxa, occupying 12 percent of the pre-restoration community. The post-restoration

community was also dominated by midges; however the percentage of dominance declined to 34 percent. *Simulium sp.* (blackfly larvae) was the second most dominant taxa in the post-restoration period; this genus is intermediate in sensitivity, as is the *Acentrella* sp., the second most dominant taxa in the pre-restoration period. Other less dominant taxa common in the post-restoration period were similar to those found in the pre-restoration period.

Tolerance Values

Prior to restoration, individuals tolerant to disturbance dominated the benthic macroinvertebrate community, individuals intermediate in sensitivity were second most dominant, and lastly, sensitive individuals comprised the smallest portion of the community (***Figures 3.1.6 and 3.1.7***). After restoration, intermediate individuals were the most dominant tolerance group sensitivity, while the percentage of individuals sensitive to disturbance increased after restoration from 18 to 23 percent. Additionally, tolerant individuals declined after restoration from 57 to 39 percent of the community.

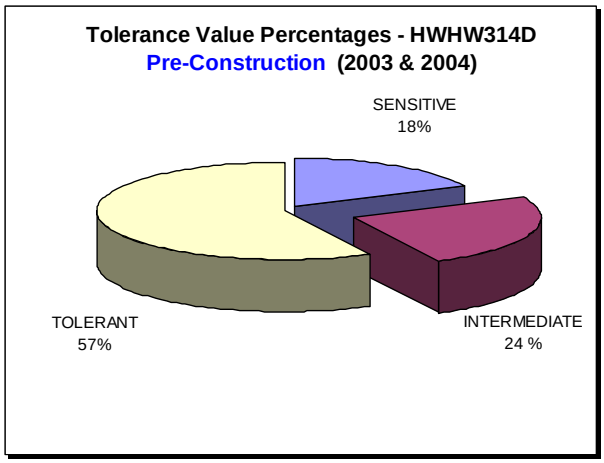


Figure 3.1.6 – Benthic Macroinvertebrate Tolerance Composition at HWHW314D Prior Restoration

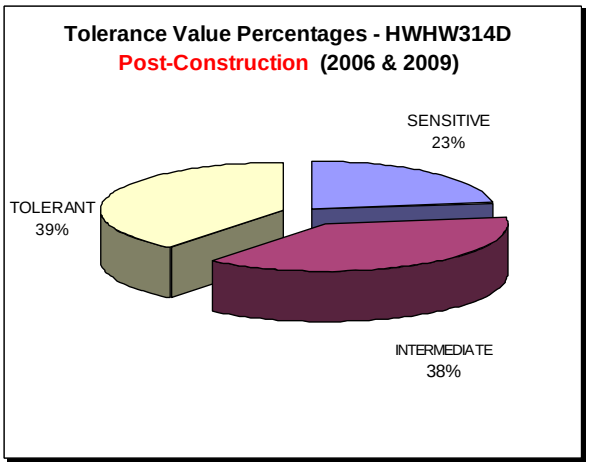


Figure 3.1.7 – Benthic Macroinvertebrate Tolerance Composition at HWHW314D After Restoration

Functional Feeding Groups

Functional feeding groups of benthic macroinvertebrates are helpful in describing the condition, habitat, and food availability in a stream. More specialized feeders, including scrapers and shredders, often require less degraded stream conditions or specific habitat features. Benthic macroinvertebrates classified as generalist feeders, such as collectors and filterers, can often persist in more impacted streams (EPA 2010). In all years, this site had a diverse assemblage of functional feeding groups. Prior to and after restoration, collectors were the most dominant feeding group; however the proportion of collectors decreased from the pre- to post-restoration period (***Figures 3.1.8 and 3.1.9***). Predators were the second most dominant feeding group in the pre-restoration period but were replaced by filterers as second most dominant after restoration. The proportion of shredders and scrapers, increased slightly from the pre- to post-restoration period by one and two percent, respectively.

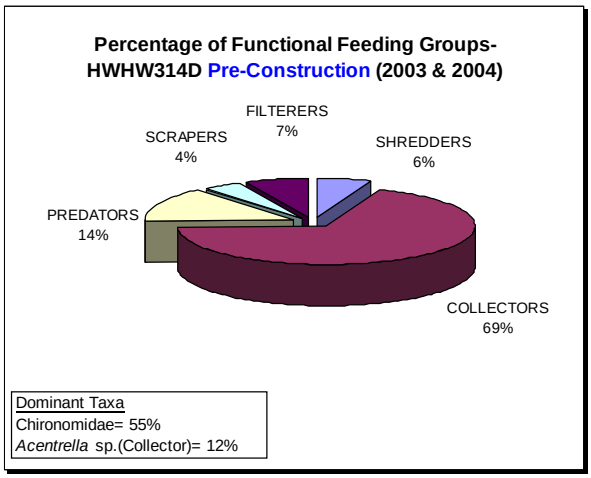


Figure 3.1.8 – Benthic Macroinvertebrate Functional Feeding Group Composition at HWHW314D Prior to Restoration

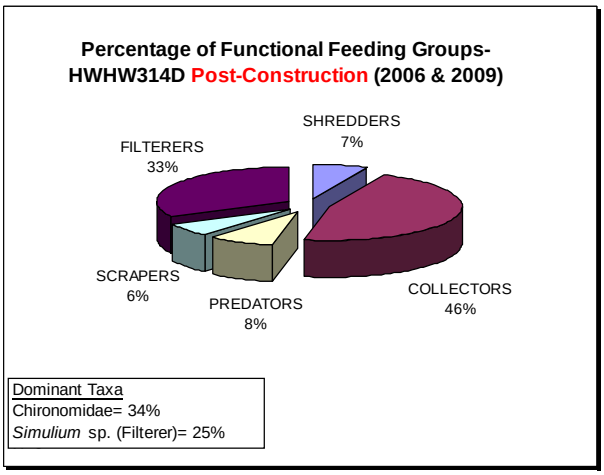
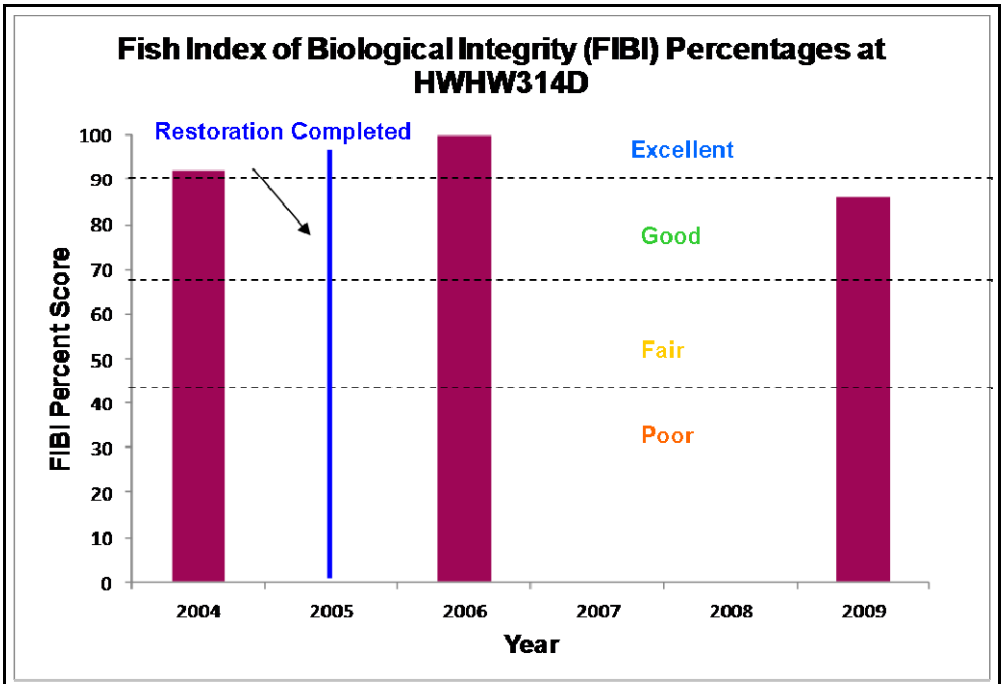


Figure 3.1.9 – Benthic Macroinvertebrate Functional Feeding Group Composition at HWHW314D After Restoration

Fish

FIBI (Fish Index of Biological Integrity) Scores

Prior to restoration the Hawlings River site was rated as Excellent by the MCDEP Fish Index of Biological Integrity (FIBI) (***Figure 3.1.10***). In the first year post-restoration, this site was in the Excellent FIBI range and had the highest possible score. In 2009, this site declined to the Good range. The decline in FIBI percentage in 2009 was due to a decline in the number of riffle benthic insectivorous individuals, as well as a decline in the percentage of tolerant individuals and the total number of individuals, but the latter two metrics were within the same range as in 2006. Shield darter, a species of particular importance, due to its State watch listing, was collected at this site in all years. Additionally, one brook trout individual, a Greatest Conservation Need coldwater stream species, was collected at this site in 2006. Field data sheets for the fish task performed in 2009 are included in ***Appendix D***.



Restoration Completed

Year	2004	2006	2009
FIBI Percentage	92	100	86
(Narrative Ranking)	(Excellent)	(Excellent)	(Good)

Figure 3.1.10 – Pre- and Post-Restoration Fish Index of Biological Integrity (FIBI) Percentages at HWHW314D

Dominant Species

The most dominant fish species present in the pre-restoration period was *Campostoma anomalum* (central stoneroller), with *Catostomus commersoni* (white sucker) as the second most dominant. Collectively, these species made up 40 percent of the fish community prior to restoration. In the post-restoration period the most dominant fish species was *Etheostoma olmstedi* (tessellated darter), followed by central stoneroller as second most dominant; these two species made up 35 percent of the post-restoration fish community.

Tolerance Values

Fish species intermediate in sensitivity dominated the community both prior to and after restoration at HWHW314D (***Figures 3.1.11 and 3.1.12***). The proportion of sensitive fish species remained similar before and after restoration, comprising three percent of the community. In the post-restoration period, the percentage of tolerant fish species declined from 48 to 41 percent, while the percentage of intermediate fish species increased from 49 to 56 percent.

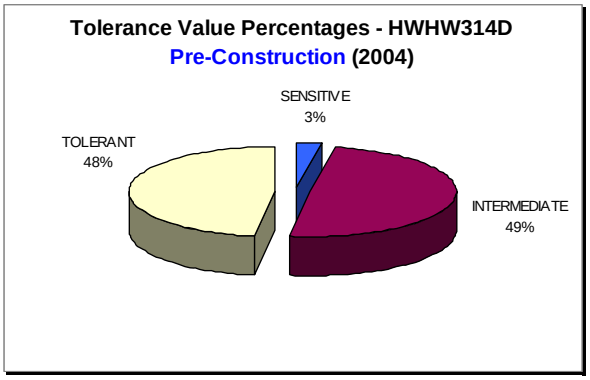


Figure 3.1.11 – Fish Tolerance Value Composition at HWHW314D Prior to Restoration

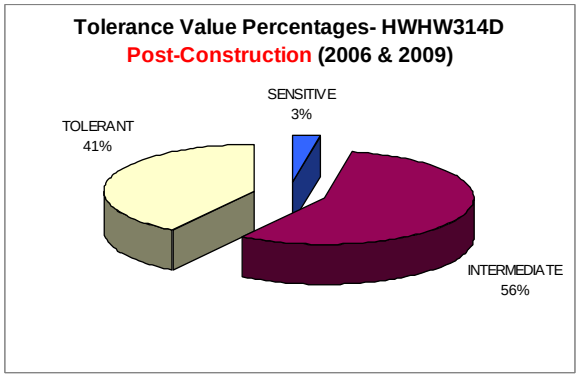


Figure 3.1.12 – Fish Tolerance Value Composition at HWHW314D After Restoration

Functional Feeding Groups

Fish classified as specialist feeders, including invertivores, algavores, and insectivores often require less degraded stream conditions, more sensitive prey, or specific resources for feeding. The proportion of these specialist feeders increased from comprising 50 percent of the community in the pre-restoration period, to comprising 56 percent after restoration (***Figures 3.1.13 and 3.1.14***). The percentage of invertivores increased the most out of all specialized feeding groups. All invertivore species found after restoration were also present prior to restoration, but were found in greater percentages after restoration.

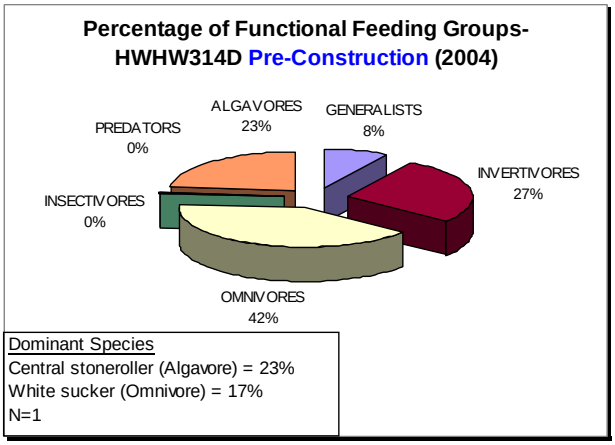


Figure 3.1.13 – Fish Functional Feeding Group Composition at HWHW314D Prior to Restoration

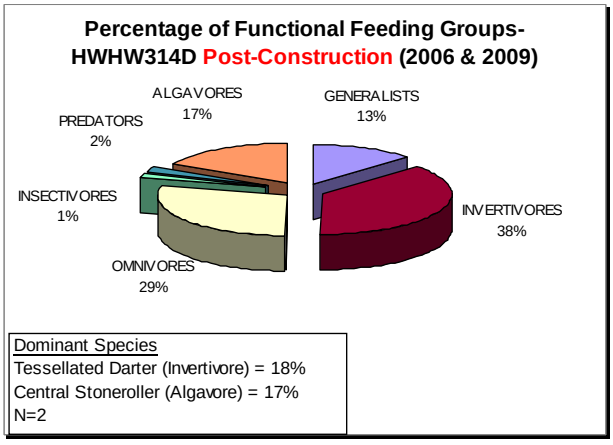


Figure 3.1.14 – Fish Functional Feeding Group Composition at HWHW314D After Restoration

Pioneer Fish Analysis

Non-pioneer fish individuals comprised 70 percent of the community prior to restoration. After restoration the percentage of non-pioneering individuals increased to 73 percent.

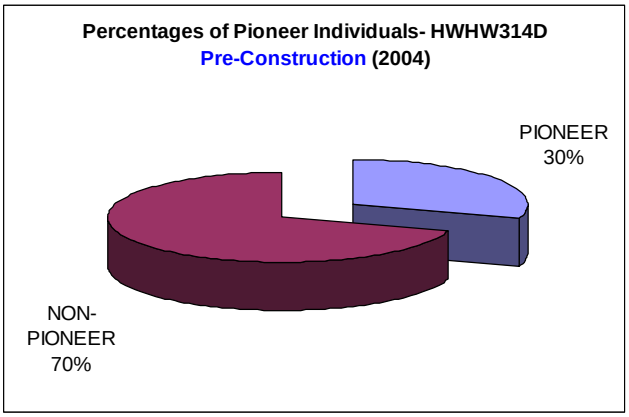


Figure 3.1.15 – Pioneer Fish Composition at HWHW314D Prior to Restoration

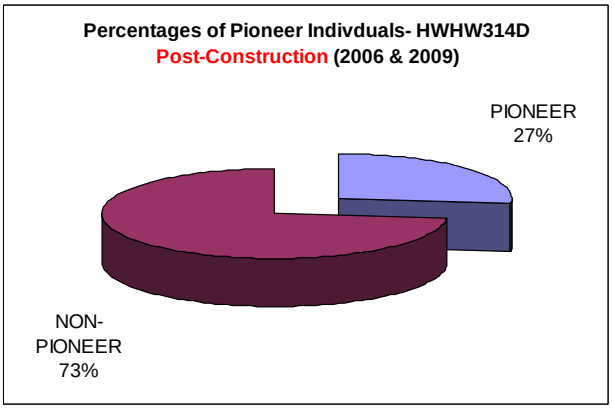


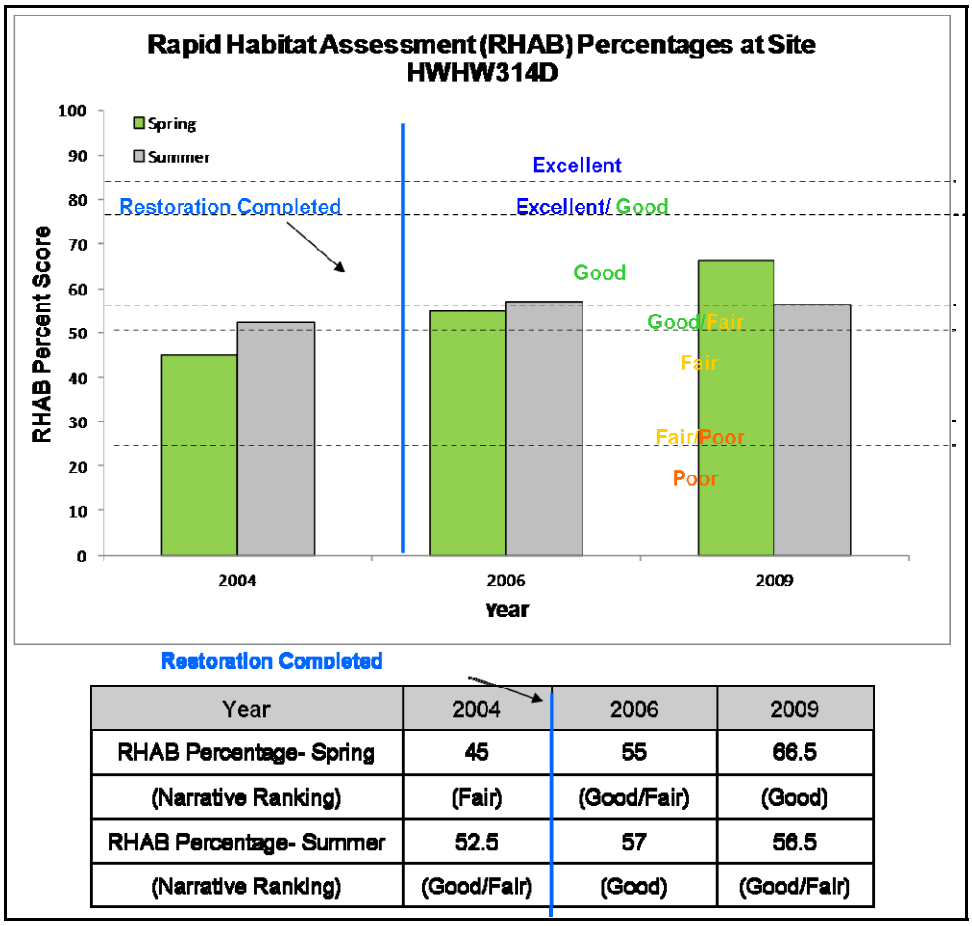
Figure 3.1.16 – Pioneer Fish Composition at HWHW314D After Restoration

Freshwater Mussels

The Hawlings River is designated by the Maryland Department of Natural Resources (MD-DNR) as a stronghold watershed for freshwater mussels. Pre-restoration freshwater mussel communities were not assessed at HWHW314D and post-restoration freshwater mussel monitoring was only conducted in 2009. During this time, there was no evidence of live or dead freshwater mussels in the vicinity of the stream restoration. The only bivalves observed were *Corbicula* sp., a genus of exotic Asian clam commonly found in Maryland streams.

Qualitative Habitat

Aquatic habitat evaluated at HWHW314D showed an improvement from the pre-restoration period to the post-restoration period from the Fair and Good/Fair ranges to the Good/Fair and Good ranges (***Figure 3.1.17***). The post-restoration aquatic habitat improvements were due to higher ratings for epifaunal substrates for benthic macroinvertebrate communities, less embedded substrates, more frequent riffle habitats, and a decline in erosion severity on one streambank.



Year	2004	2006	2009
RHAB Percentage- Spring	45	55	66.5
(Narrative Ranking)	(Fair)	(Good/Fair)	(Good)
RHAB Percentage- Summer	52.5	57	56.5
(Narrative Ranking)	(Good/Fair)	(Good)	(Good/Fair)

Figure 3.1.17 – Pre- and Post-Restoration Rapid Habitat Assessment (RHAB) Percentages at HWHW314D

Quantitative Habitat

Quantitative monitoring was scheduled to occur at HWHW314D 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 chemistry measurements collected in the pre-restoration period were in compliance with COMAR standards (***Table 2.6***) for Use IV-P streams (***Table 3.1.2***). With the exception of one pH reading exceeding the upper pH limit in the fall of 2006, in-situ water chemistry readings in the post-restoration period were within state standards. However, the pH reading taken in the summer of 2006 was 8.5, which is the upper COMAR limit for this stream use class.

Table 3.1.2 – Pre- and Post-Restoration in-situ Water Chemistry – HWHW314D

Water Quality Parameter	2004		2006			2009	
	Spring	Summer	Spring	Summer	Fall	Spring	Summer
Dissolved oxygen (mg/L)	11.99	8.65	-	7.44	14.37	11.50	8.46
Dissolved oxygen (% saturation)	107	92	-	89	121	120	88
pH	7.58	7.54	-	8.5	9.34	7.33	6.64
Conductivity (µmhos)	116	117	133	131	126	106	127
Water temperature (ºF)	50.5	64.9	43.7	73.2	45.32	67.8	64.9

Botanical Reforestation

The reforestation area at HWHW314D consisted of tree and shrub plantings along the streambank and floodplain of Hawlings River just north of Brighton Dam Road. Botanical plantings were monitored post-restoration in 2006 and 2009. In 2006, this site was monitored using *Procedures for Survival Counts for Forest Mitigation Plantings (2004)*. The plot radius was selected for each site based on the best available information, either from the construction plans or from assumed planting densities. Thirty-three of the plots contained acceptable trees (62 percent). Several trees were knocked over by high stream flows or had flood debris on their trunk or in the branches. There was little understory throughout much of the planted area, but the entire area had a dense carpet of herbaceous growth, making the observation of volunteer seedlings difficult.

In 2009, different methodology was used; each individual planting was located, measured, and notes were taken on the health and problems with its growth, using the planting plan. This site was characterized as having a success rate of 73 percent, with 66 percent of the plantings surviving to 2009 and 7 percent growth from volunteer trees (***Table 3.1.3***). However, many of the trees observed were considered to be unhealthy. One hundred and twenty one stems were counted, but only 10 percent were considered healthy, 31 percent appeared dead, and the remaining 59 percent of trees had invasive species impeding their growth or were damaged by deer or beaver. One species (*Quercus palustris* (pin oak) increased by 80 percent, with volunteer numbers contributing to the overall reforestation goal. *Fraxinus pennsylvanicus* (green ash) was the only species planted that was not observed in 2009. The remaining four planted species were documented on site and included *Platanus occidentalis* (American sycamore), *Acer rubrum* (red maple), pin oak, and *Acer saccharinum* (silver maple). Three volunteer tree species were also found in 2009 including *Pinus strobus* (white pine), *Betula nigra* (river birch), and *Asimina tribola* (pawpaw), one volunteer shrub species *Cornus amomum* (silky dogwood) was found in the planting area. ***Figure 3.1.16*** shows an image of the botanical reforestation site on the day of the 2009 monitoring.

Figure 3.1.18 – HWHW314D in 2009, photo taken on the right bank looking downstream, showing sycamore plantings with a dense groundcover of Nepalese browntop and other herbaceous species

Table 3.1.3 – Botanical Reforestation Data for Site HWHW314D

Common Name	Scientific Name	Number Planted	Number of Trees Observed [1]	Success Rate (%) [2]
sycamore	*Platanus occidentalis*	45	27	60
silver maple	*Acer saccharum*	20	16	80
red maple	*Acer rubrum*	20	16	80
pin oak	*Quercus palustris*	10	18	180
green ash	*Fraxinus pennsylvanicus*	10	0	0
Total		**105**	**84**	**73**

[1] This count includes both planted and volunteer individuals.

[2] This calculation includes both survival of planted trees and additional volunteer individuals = (# of trees observed /# planted).

The caliper sizes of all four of the planted species measured in 2009 were larger than those planted in 2005; sycamore showed the most growth of all planted species (***Table 3.1.4***). Invasive vines, such as *Polygonum perfoliatum* (Asiatic tearthumb) and *Celastrus orbiculatus* (Oriental bittersweet), and dense growth of *Microstegium vimineum* (Nepalese browntop) will likely inhibit success of trees and shrubs for the foreseeable future.

Table 3.1.4 – Site HWHW314D 2005 Botanical Planting Sizes verses 2009 Observed Sizes

Common name	Scientific Name	Planting Size 2005 (inch diameter)	Observed Size 2009 (inch diameter)
sycamore	*Platanus occidentalis*	<1 - 1.5	1-6.5
silver maple	*Acer saccharum*	1-1.5	0.5-4
red maple	*Acer rubrum*	1-1.5	0.5-2.25
pin oak	*Quercus palustris*	1-1.5	1-3

3.1.5 Discussion

Table 3.1.5 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 third year of post-restoration monitoring. One of the project goals was successfully met, two were partially met, and two project goals could not be evaluated in 2009 and will be assessed in 2011.

Table 3.1.5 – Summary of Project Goal Results

Goal	Result
Improve aquatic habitat conditions in Hawlings River	Successful – frequency of riffles and epifaunal substrate ratings improved, while erosion severity and embeddedness decreased
Improve water quality in Hawlings River	Partially successful – FIBI and BIBI percent scores were variable but some other measures of community composition improved; mussels were not found in the project area; one pH in-situ reading was above COMAR's upper limit
Reduce stream erosion, sedimentation and erosive stream flows	Unable to determine – quantitative survey data from 2011 will determine if these goals have been met
Reforest riparian zone	Partially successful – trees have been planted and successfully grown in the restoration area that was previously sparsely vegetated; however, many plantings have died and most planted areas have extensive invasive species present

Successful – Aquatic Habitat

Aquatic habitat generally improved at the Hawlings River Stream Restoration site after restoration. Notable habitat improvements included increases in epifaunal substrates for benthic macroinvertebrate communities, less embedded substrates, more frequent riffle features, and an improvement, at least on one bank, in erosion severity. Most other aquatic habitat parameters remained similar from the pre- to post-restoration period.

Partially Successful – Water Quality

Benthic macroinvertebrate community changes were variable after the restoration occurred. BIBI scores were slightly lower at HWHW314D the first year it was sampled after restoration, declining from the Good to the Fair range. However in 2009, the BIBI percentage rebounded back to the Good range and had the same BIBI percentage as was documented in 2003. Some measures of benthic macroinvertebrate community health did show improvement after restoration including an increase in the number of taxa represented at the site. In 2009, this site was represented by 24 taxa; at least seven more than were collected in any other year. Additional improvements include a decrease in the percent dominance of tolerant individuals and an increase in the percentage of sensitive individuals. Benthic macroinvertebrate recruitment takes time after a stream disturbance, including disturbances such as stream dewatering that was performed during this restoration project. The County will monitor benthic macroinvertebrate

communities in the restoration area in 2010 to see if conditions are maintained from the pre-restoration period or improved with additional time for benthic macroinvertebrate recruitment.

The fish community, as assessed by the MCDEP FIBI was inconsistent over time, increasing the first year monitored after restoration from the pre-restoration range and decreasing in 2009, to below the pre-restoration FIBI percent score. Other measures of fish community composition showed improvement. The percent dominance of the top two dominant species declined from the pre- to post-restoration period, and the proportion of specialized feeders increased after restoration activities occurred. The fifth year of monitoring in 2010 will add another year to this dataset so the County will be better able to assess changes in the fish community and evaluate the success of the water quality improvement restoration goal.

In-situ water chemistry data were mostly in compliance with COMAR Use IV-P standards, except for the pH reading taken in the fall of 2006 that exceeded the upper pH limit and the pH reading taking in the summer of 2006 that was 8.5, the uppermost pH limit. In-situ water chemistry will continue to be measured in 2010 to determine if pH is an issue at this site.

No freshwater mussels were found at this site, even though the Hawlings River watershed is designated by MD-DNR as a "stronghold" watershed for freshwater mussels, and two species of mussel have been known to inhabit the Patuxent River watershed. Freshwater mussels are the most imperiled group of organisms, at a greater risk of extinction than birds, mammals, and reptiles combined. They are an important indicator of water quality because they are long-lived and cannot escape polluted or disturbed streams. The Hawlings River will continue to be monitored for freshwater mussels as water quality and habitat improvements are made.

Partially Successful – Riparian Reforestation

Many areas that were sparsely vegetated prior to construction have been planted as part of this restoration project and the riparian zone is relatively improved. The planting areas have a success rate of 73 percent, with 66 percent of the planted trees surviving and an additional 7 percent recruitment from volunteer trees. However, only ten percent of the species were considered healthy; many of the plantings have died and are being out-competed by invasive species or rubbed by deer or cut by beaver. With the exception of green ash, which was not observed at all, the caliper sizes of the individuals observed in 2009 were larger than those that were planted in 2005. The increase in size of the planted individuals is a measure of successful growth and a sign that these trees are well established. Planted sycamore individuals showed the greatest increase in growth but had the lowest overall survival of the planted species. Pin oak had the best overall survival of all planted species and some individuals have increased in caliper size since they were planted in 2005. Several volunteer tree species and one volunteer shrub species were observed in the reforestation area. Invasive species control along with more planting is recommended for further success of this goal. However, if additional plantings are installed at this site, it is suggested that each planting be protected, from deer to the extent possible, as a large part of the site's lack of success is likely due to deer browse and rub.