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. This is a fifth year post-restoration monitoring report and summarizes the pre- and post-restoration conditions within the Hawlings River project area.

Figure 3.1.1 – Hawlings River Stream Restoration 2009

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 mainly characterized by low-density single-family residential use with agricultural use interspersed.

Figure 3.1.2 – Hawlings River Stream Restoration 2005

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.

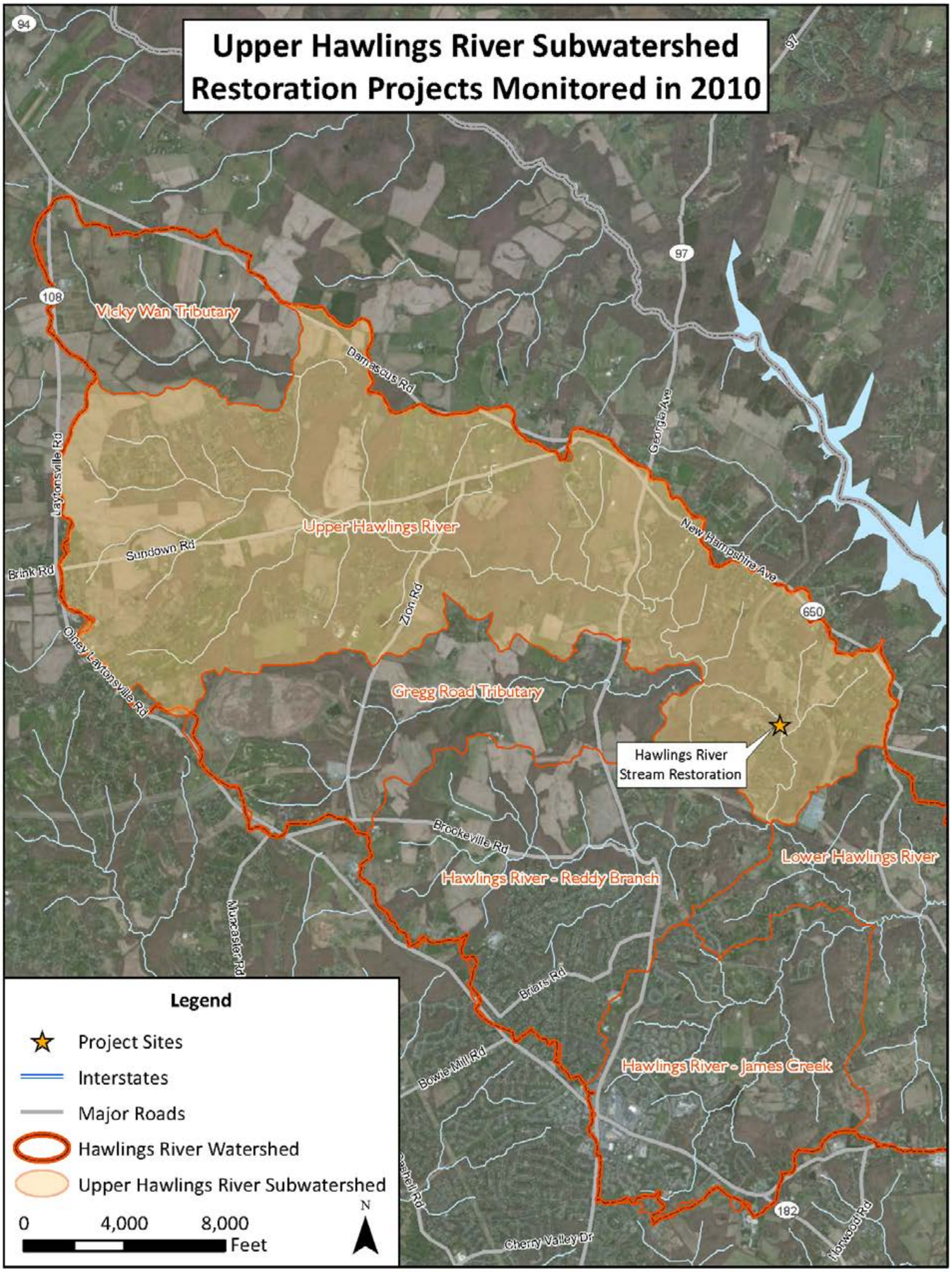


Figure 3.1.3 – Vicinity Map – Hawlings River Stream Restoration

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 fifth and final year post-restoration monitoring report and summarizes the pre- and post-restoration conditions within the Hawlings River project area. The quantitative habitat monitoring was delayed and will be included in a 2011 update report. ***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, 2009 and 2010 (post)	HWHW314D
• Reduce stream erosion and sedimentation • Reduce erosive stream flows	• Quantitative habitat (stream morphology surveys)	2004 (pre) 2006 and 2011[1] (post)	HWHW314D
• Reforest riparian zone	• Botanical survey	2006, 2009 and 2010 (post)	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 2011. The 2011 report will include an update 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 in-situ water chemistry within Hawlings River were monitored both prior to and after restoration occurred at site HWHW314D. Botanical reforestation areas were also assessed at this site. 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***).

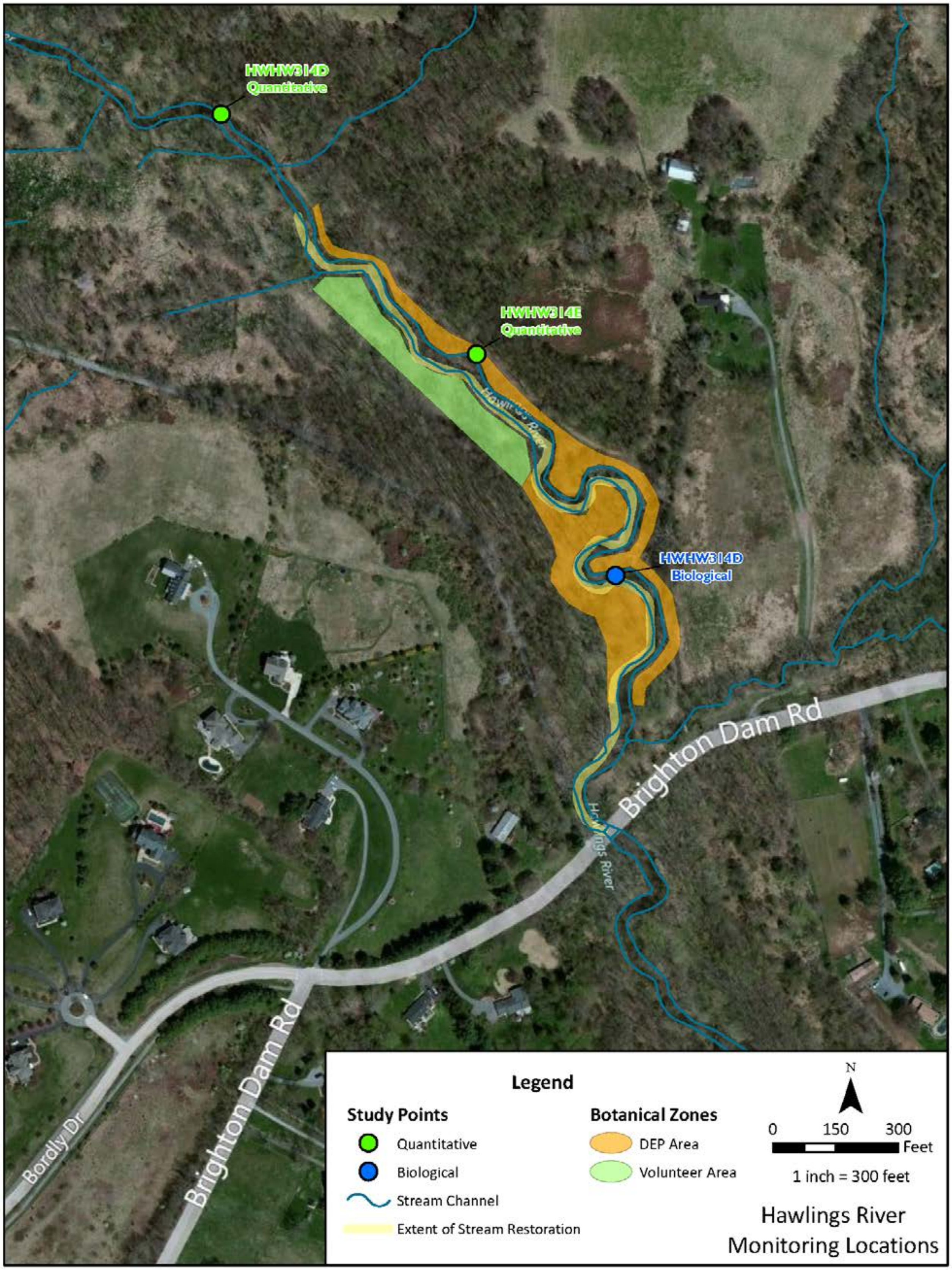


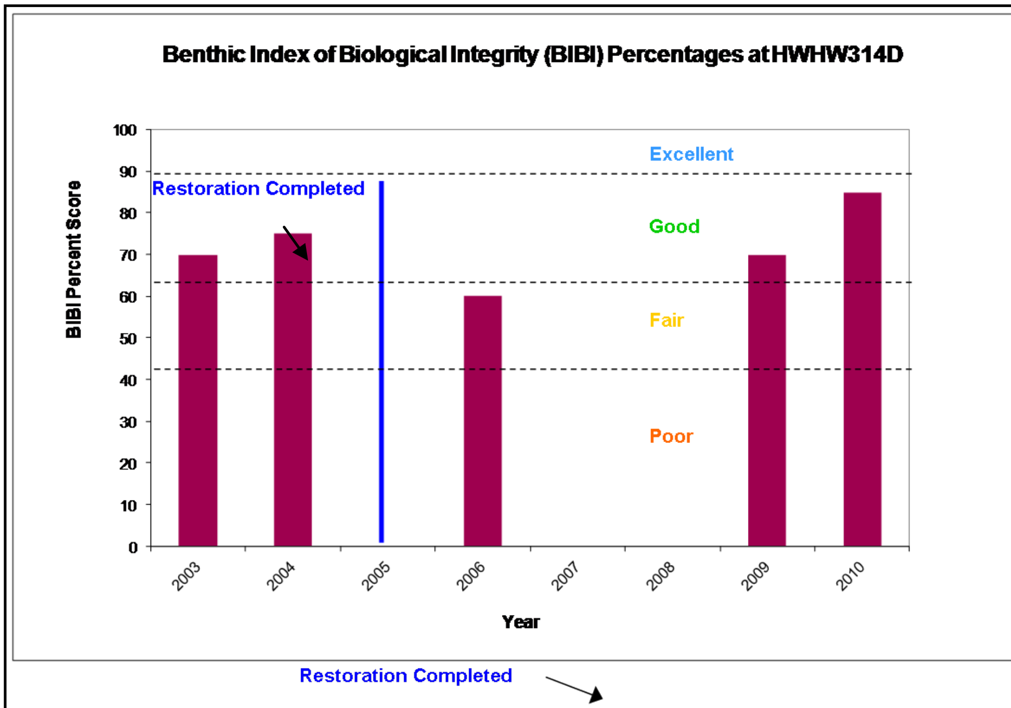
Figure 3.1.4 – Map of Monitoring Locations for Hawlings River Stream Restoration

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 to the Good range, with further improvements in the Good category in 2010. The decline in 2006 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. The improvement in BIBI percentage in 2009 was due to an increase in benthic macroinvertebrate diversity, which in 2010 remained improved from the pre-restoration period. The additional improvement in 2010 was due to an increase in the proportion of both shredders and EPT individuals. Field data sheets for the benthic macroinvertebrate task in 2010 are included in ***Appendix D***.



Year	2003	2004	2006	2009	2010
BIBI Percentage	70	75	60	70	85
(Narrative Ranking)	(Good)	(Good)	(Fair)	(Good)	(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 39 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 (57 percent) and intermediate individuals were second most dominant (24 percent). After restoration, individuals intermediate in sensitivity dominated the community (44 percent) and sensitive (25 percent) and tolerant (24 percent) individuals were relatively equal in dominance (***Figures 3.1.6 and 3.1.7***).

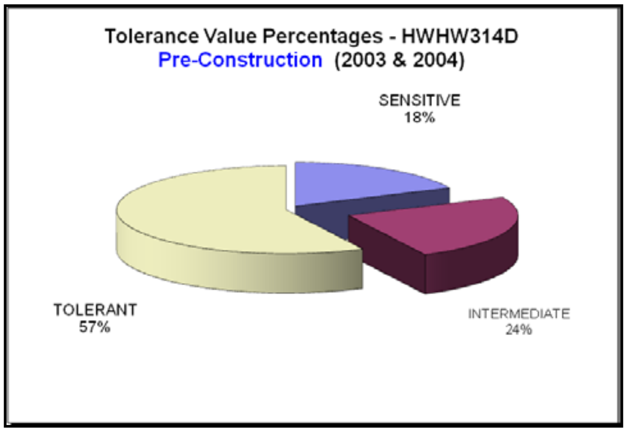


Figure 3.1.6 – Benthic Macroinvertebrate Tolerance Composition at HWHW314D Prior to Restoration

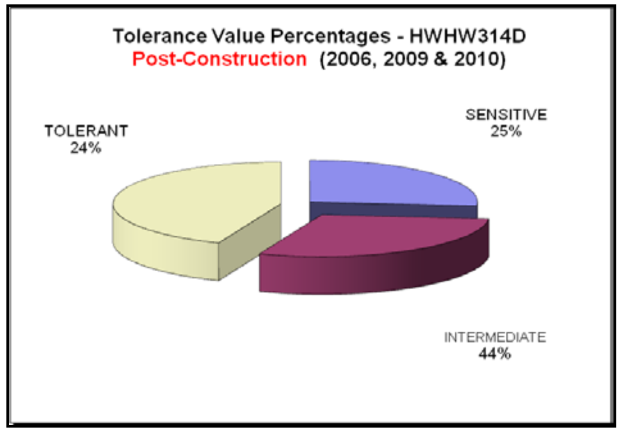


Figure 3.1.7 – Benthic Macroinvertebrate Tolerance Composition at HWHW314D After Restoration

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, from 69 to 51 percent (***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 scrapers and shredders, increased slightly from the pre- to post-restoration period by one percent.

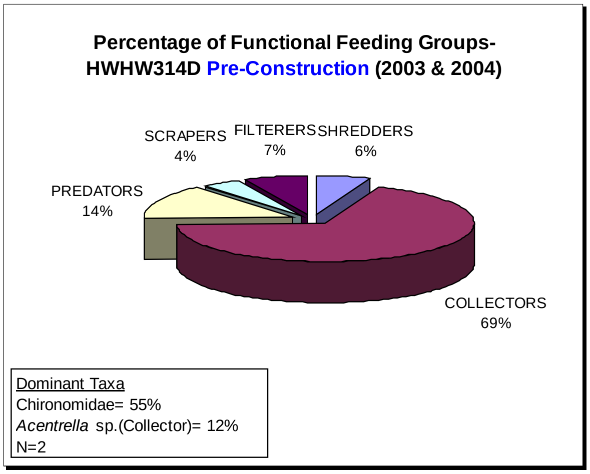


Figure 3.1.8 – Benthic Macroinvertebrate Functional Feeding Group Composition at HWHW314D Prior to Restoration

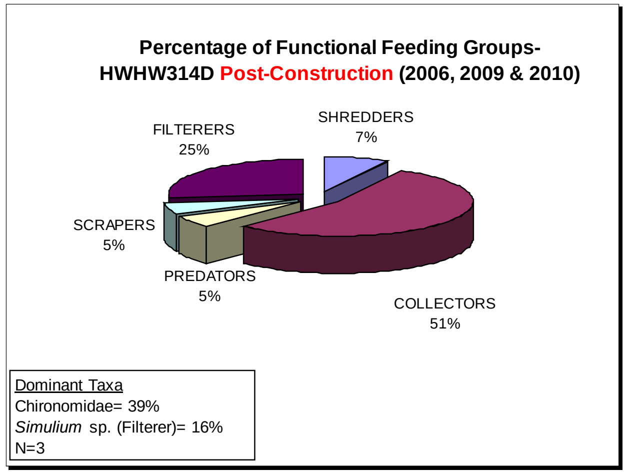


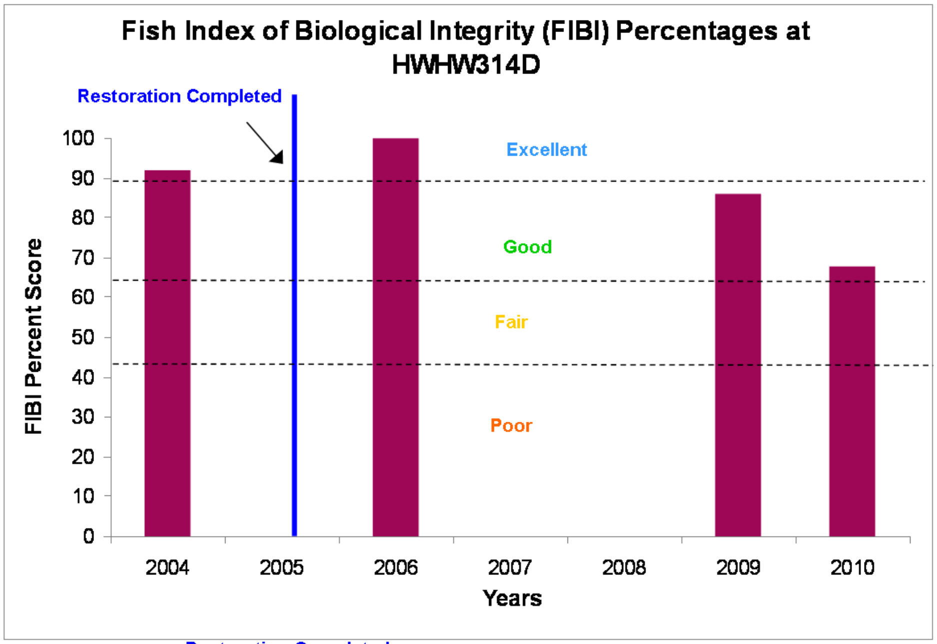
Figure 3.1.9 – Benthic Macroinvertebrate Functional Feeding Group Composition at HWHW314D After Restoration

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 FIBI range, and in 2010 declined further, but remained in the Good range. The decline in FIBI percentages in 2009 and 2010 was due to declines in the number of riffle benthic insectivorous individuals, the percentages of intolerant individuals, and the total number of individuals, as well as an increase in the number of omnivores and generalists. Every year post-restoration the number of fish collected declined from 389 individuals in 2006, to 224 in 2009, and to 159 in 2010 (***Figure 3.1.11***).

One brown trout individual, a Greatest Conservation Need coldwater stream species, was collected at this site in 2006. Shield darter, a species of particular importance, due to its State watch listing, was collected at this site every year except 2010. Additionally, gizzard shad, an anadromous fish species was collected in 2010; this was the only year this species was collected at this site. Field data sheets for the fish task performed in 2010 are included in ***Appendix D***.



Restoration Completed

Year	2004	2006	2009	2010
FIBI Percentage	92	100	86	68
(Narrative Ranking)	(Excellent)	(Excellent)	(Good)	(Good)

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

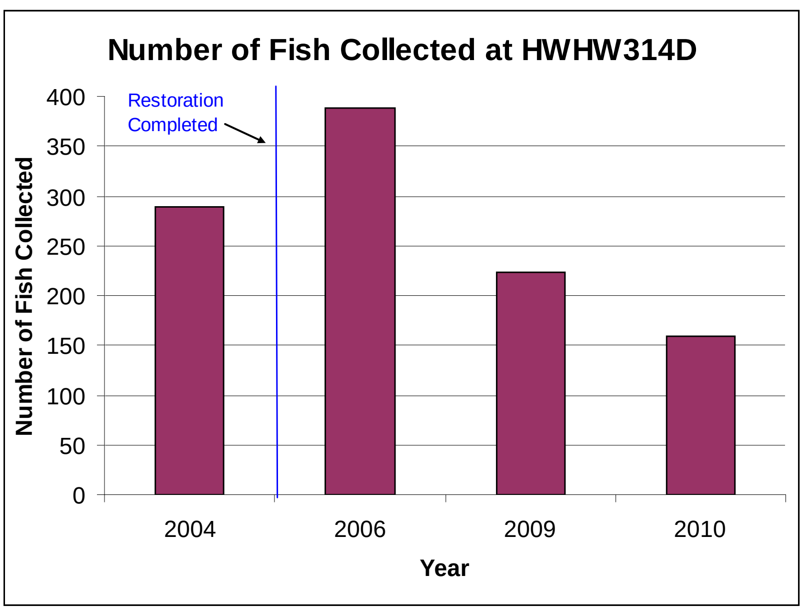


Figure 3.1.11 – Pre- and Post-Restoration Fish Abundance at HWHW314D

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 *Campostoma anomalum* (central stoneroller); these two species made up 32 percent of the post-restoration fish community.

Central stoneroller, a species intermediate in sensitivity, declined in abundance over the post-restoration period. It was the most dominant species collected in 2006, the third most dominant in 2009 and was only represented by six individuals in 2010. Tessellated darter, a tolerant fish species, was the third most dominant species in 2006, and rose to the second most dominant in both 2009 and 2010.

Tolerance Values

The composition of fish tolerance at HWHW314D remained similar prior to and after restoration. Fish species intermediate in sensitivity dominated the community both prior to and after restoration at HWHW314D (***Figures 3.1.12 and 3.1.13***). The proportion of sensitive fish species remained the same before and after restoration, comprising three percent of the community. In the post-restoration period, the percentage of tolerant fish species declined slightly from 48 to 45 percent, while the percentage of intermediate fish species increased from 49 to 50 percent.

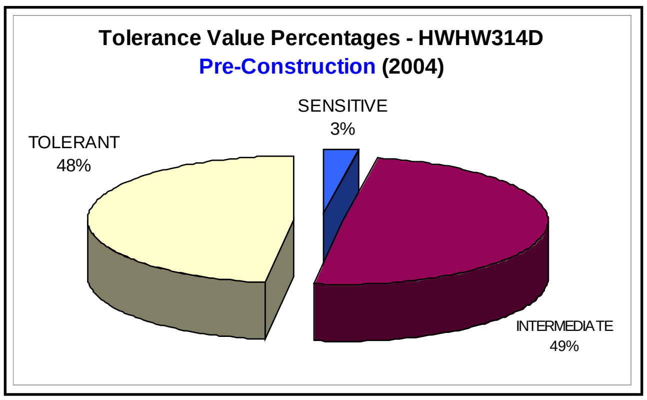


Figure 3.1.12 – Fish Tolerance Value Composition at HWHW314D Prior to Restoration

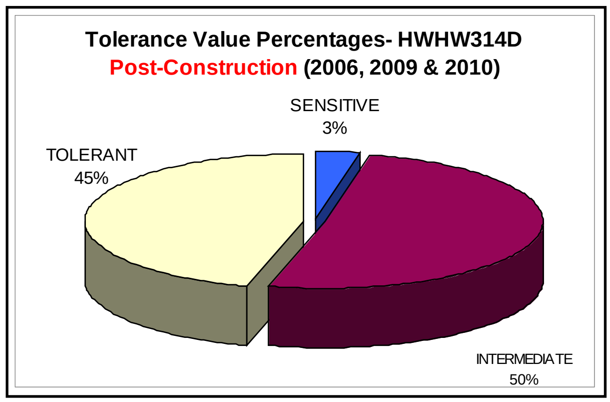


Figure 3.1.13 – Fish Tolerance Value Composition at HWHW314D After Restoration

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 52 percent after restoration (***Figures 3.1.14 and 3.1.15***). The percentage of invertivores increased the most out of all specialized feeding groups, while the percentage of algavores decreased. All invertivore species found after restoration were present prior to restoration, but were found in greater percentages after restoration. Tessellated darter was the most common invertivore found and central stoneroller was the only algavore species at this site.

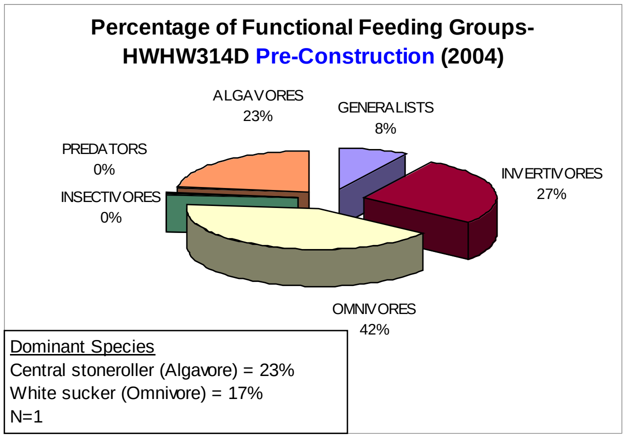


Figure 3.1.14 – Fish Functional Feeding Group Composition at HWHW314D Prior to Restoration

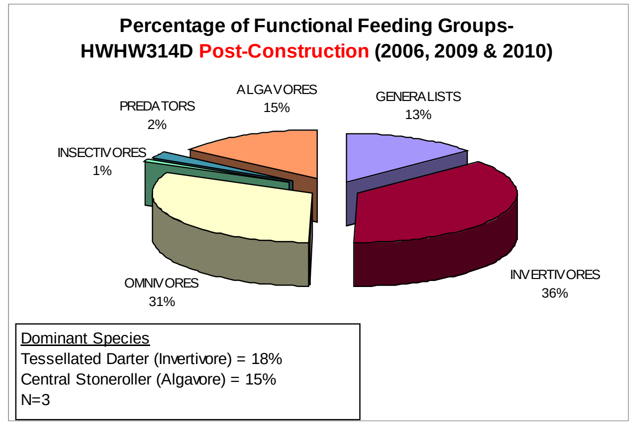


Figure 3.1.15 – Fish Functional Feeding Group Composition at HWHW314D After Restoration

Pioneer Fish Analysis

Non-pioneer fish comprised 70 percent of the community prior to restoration. After restoration the percentage of non-pioneering individuals increased to 75 percent (***Figures 3.1.16 and 3.1.17***).

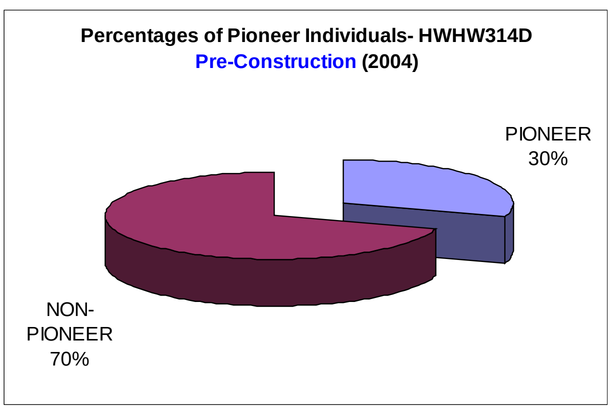


Figure 3.1.16 – Pioneer Fish Composition at HWHW314D Prior to Restoration

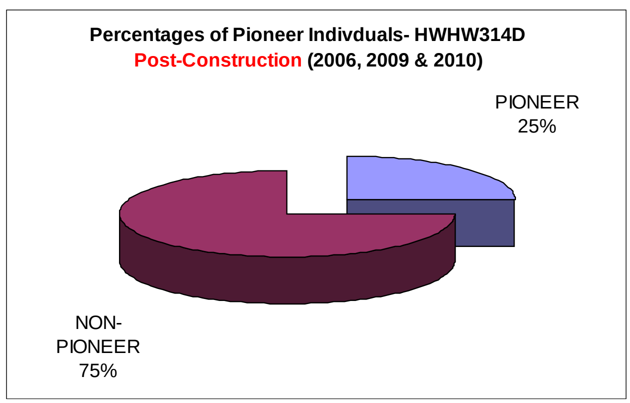


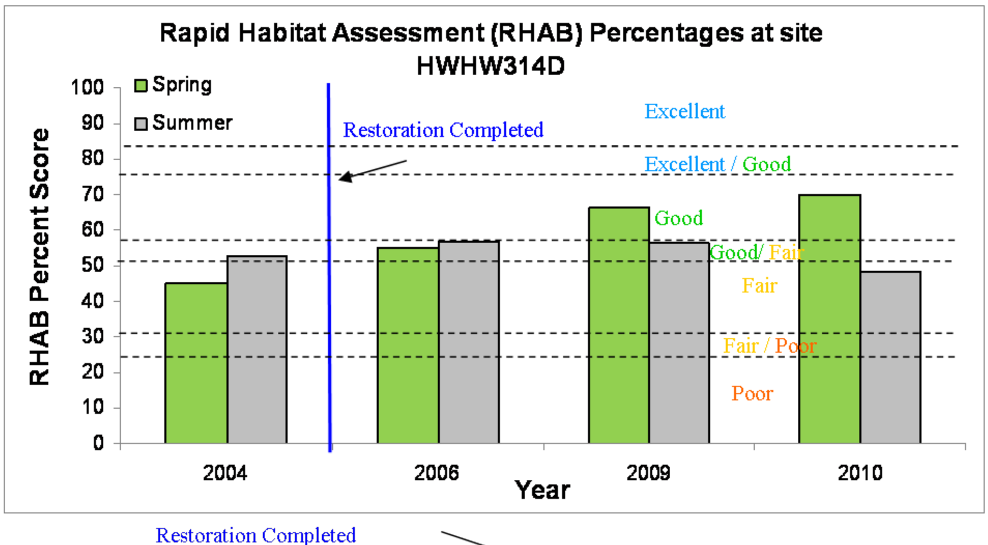
Figure 3.1.17 – Pioneer Fish Composition at HWHW314D After Restoration

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 conducted in 2009 and 2010. During this time, there was no evidence of live or dead freshwater mussels in the vicinity of the stream restoration. The only bivalves observed in both monitoring years were *Corbicula* sp., a genus of exotic Asian clam commonly found in Maryland streams.

Qualitative Habitat

Aquatic habitat evaluated at HWHW314D generally showed an improvement from the pre-restoration period to 2010. During this time, overall narratives ranged from the Fair and Good/Fair ranges to the Good/Fair and Good ranges (***Figure 3.1.18***). The post-restoration aquatic habitat improvements were due to higher ratings of epifaunal substrates for benthic macroinvertebrate communities, less embedded substrates, more frequent riffle habitats, and a decline in erosion severity on one streambank. Conversely, the summer habitat assessment in 2010 showed a decrease from the other post-restoration assessments to the Fair range. This decrease was due to lower estimates of in-stream cover for fish, and an increase in sedimentation and embeddedness estimates. ***Figure 3.1.19*** shows the sedimentation that was present in 2010.



Year	2004	2006	2009	2010
RHAB Percentage Spring	45	55	66.5	70
(Narrative Ranking)	(Fair)	(Good/Fair)	(Good)	(Good)
RHAB Percentage Summer	52.5	57	56.5	48
(Narrative Ranking)	(Good/Fair)	(Good)	(Good)	(Fair)

Figure 3.1.18 – Pre- and Post-Restoration Rapid Habitat Assessment (RHAB) Percentages at HWHW314D

Figure 3.1.19 – Hawlings River in Summer 2010, Showing High Sedimentation

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		2010	
	Spring	Summer	Spring	Summer	Fall	Spring	Summer	Spring	Summer
Dissolved oxygen (mg/L)	11.99	8.65	-	7.44	14.37	11.5	8.46	11.89	6.94
Dissolved oxygen (% saturation)	107	92	-	89	121	120	88	114	76
pH	7.58	7.54	-	8.5	9.34	7.33	6.64	7.55	7.10
Conductivity (µmhos)	116	117	133	131	126	106	127	134	142
Water temperature (°F)	50.5	64.9	43.7	73.2	45.32	67.8	64.9	56.1	67.8

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, 2009 and 2010. 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 and 2010, a 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. In 2009, 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. However, many of the trees observed were considered to be unhealthy. ***Figure 3.1.20*** shows an image of the botanical reforestation site on the day of the 2009 monitoring.

Figure 3.1.20 – 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

In 2010, the site was characterized as having a success rate of 64 percent in the fifth and final year of monitoring (***Table 3.1.3***). Ninety nine stems were counted, but only 15 percent were considered healthy, 27 percent appeared dead, and the remaining trees had invasive species impeding their growth or were damaged by deer or beaver. ***Figure 3.1.21*** shows an image of the botanical reforestation site on the day of the 2010 monitoring. All five planted species were identified. The two volunteer tree species that were found in 2009 were also found in 2010 (white pine (*Pinus strobus*) and river birch (*Betula nigra*). This site was in a similar condition to what was observed in 2009, except the number of healthy red maple declined from 2009 to 2010, from 80 to 25 percent. Invasive vines, such as *Polygonum perfoliatum* (Asiatic tearthumb) and *Celastrus orbiculatus* (Oriental bittersweet), and dense growth of *Microstegium vimineum* (Nepalese browntop) were abundant.

Table 3.1.3 – Post-restoration Botanical Reforestation Data for Site HWHW314D Collected in 2010

Common Name	Scientific Name	Number Planted	Number of Healthy Trees Observed[1]	Success Rate (%)[2]
American sycamore	*Platanus occidentalis*	45	29	64
silver maple	*Acer saccharum*	20	16	80
red maple	*Acer rubrum*	20	5	25
pin oak	*Quercus palustris*	10	13	130
green ash	*Fraxinus pennsylvanicus*	10	4	40
Total		**105**	**72**	**64** [1]

[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 2010 were larger than those planted in 2005 and some were larger than they were the previous year. Sycamore showed the most growth of all species since they were planted, and pin oak grew the most since 2009 (***Table 3.1.4***). Green ash (*Fraxinus pennsylvanicus*) were observed in 2010 for the first time since they were planted, but they did not appear to have grown much.

Table 3.1.4 – Site HWHW314D 2005 Botanical Planting Sizes verses 2010 Observed Sizes

Common name	Scientific Name	Planting Size 2005 (inch diameter)	Observed Size 2009 (inch diameter)	Observed Size 2010 (inch diameter)
sycamore	*Platanus occidentalis*	<1 - 1.5	1 - 6.5	1.5 - 5.2
silver maple	*Acer saccharum*	1 -1.5	0.5 - 4	1.5 - 4.5
red maple	*Acer rubrum*	1 - 1.5	0.5 - 2.25	1 - 2
pin oak	*Quercus palustris*	1 - 1.5	1 - 3	1 - 4
green ash	*Fraxinus pennsylvanicus*	<1 - 1.5	-	0.5 - 1

Figure 3.1.21 – HWHW314D in 2010, photo looking at the floodplain showing abundant invasive coverage, including Asiatic tearthumb and Nepalese browntop

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.

3.1.5 Discussion

Three of the four project goals were partially met by the restoration actions. 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 is provided below in ***Table 3.1.5***.

Table 3.1.5 – Summary of Project Goal Results

Goal	Result
Improve aquatic habitat conditions in Hawlings River	Partially successful – epifaunal substrate ratings improved while erosion severity and embeddedness decreased, but riffle frequency severely decreased in 2010 and other habitat improvements may be returning to pre-restoration conditions
Improve water quality in Hawlings River	Partially successful – BIBI percent scores improved while FIBI scores declined. However, when combining the pre-restoration data and comparing it to the post-restoration data some measures of the fish community composition improved
Reduce stream erosion, sedimentation and erosive stream	Unable to determine – quantitative survey data from 2011 will determine if these goals have been met

Table 3.1.5 – Summary of Project Goal Results

Goal	Result
flows	
Reforest riparian zone	Partially successful – trees have been planted and are growing in the restoration area that was previously sparsely vegetated; however, many plantings have died and invasive plants are extensive in most planted areas

Partially Successful – Aquatic Habitat

Aquatic habitat changes were variable at the Hawlings River Stream Restoration site after restoration but generally improved over time. Notable habitat improvements included increases in quality of epifaunal substrates for benthic macroinvertebrate communities, less embedded substrates, and an improvement, at least on one bank, in erosion severity. The last year of monitoring (2010) documented increases in sedimentation and embeddedness. It should be noted that within the post-restoration monitoring period, there were several major flooding events that occurred. The monitoring site is located upstream of Brighton Dam Road, the culvert for which is undersized and causes floodwater to back up and in some cases, to flow over the road. Over time, this repeated flooding may have caused increases in fine sediment deposition.

Partially Successful – Water Quality

Benthic macroinvertebrate community changes were variable after restoration but BIBI scores improved from before the restoration occurred. The first year this site was sampled after restoration, the BIBI score was lower than it was prior to restoration. Benthic macroinvertebrate recruitment takes time after a stream disturbance. A disturbance such as stream dewatering that was performed in 2005 for this project may account for the lower score in 2006. However in 2009, the BIBI percentage rebounded to the same BIBI percentage as was documented prior to restoration. The highest recorded BIBI percentage was measured in 2010, demonstrating a positive post-restoration trend. Some measures of benthic macroinvertebrate community composition that showed improvement after restoration included a decrease in the percent dominance of individuals from the generally tolerant midge family, an increase in the percentage of sensitive and intermediate individuals, and a decrease in the percentage of tolerant individuals. Overall, benthic macroinvertebrate conditions improved post-restoration.

When looking at the fish community pre- versus post-restoration periods as a whole, it appears as though slight improvements have occurred. However, when looking at the fish communities each year, it appears as though the community has declined. The FIBI percent scores increased in 2006, the first year after restoration, from the pre-restoration range but declined thereafter, in both 2009 and 2010, to below the pre-restoration percentage. Other measures of fish community composition showed some post-restoration improvements when combining all data from the pre-restoration period and comparing it to all data combined from the post-restoration period. However, the high quality community noted in 2006 may have skewed the post-restoration average. The improvements detected in the post-restoration fish community as whole included a decline in percent dominance of the top two dominant species from the pre- to post-restoration period, a decrease in the percentage of pioneering individuals, and an increase in number of functional feeding groups represented after restoration.

With the exception of the pH reading taken in the fall of 2006 that exceeded the upper pH limit, in-situ water chemistry readings were in compliance with COMAR Use IV-P standards. The pH reading taken in the summer of 2006 was 8.5, which is the uppermost pH limit, but does not exceed State standards.

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.

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. One volunteer tree species was observed in the reforestation area; however, many of the plantings have died and are being out-competed by invasive species. Sixty-four percent of the plantings survived to 2010 (***Figure 3.1.22***).

Figure 3.1.22 – HWHW314D in 2010, photo looking at the floodplain showing plantings and abundant invasive coverage, including Asiatic tearthumb and Nepalese browntop

3.1.6 Conclusions

Overall, the Hawlings River stream restoration has partially met three of four project goals. The restoration has enhanced the stream buffer in an area once dominated by herbaceous vegetation; although, many of the plantings have died or are being out-competed by invasive species. There may be some potential to save the remaining plantings from being overtaken by invasive vines by removing them from the plantings. However, large-scale treatment of invasive species at this site is not recommended, since the entire floodplain of this stream system is covered by the same invasive plants that were observed at this site (Nepalese browntop and Asiatic tearthumb).

Aquatic habitat at this site was relatively improved after restoration. Improved parameters include higher quality epifaunal substrates for benthic macroinvertebrates, less embedded substrates, and more a stable bank on one streambank. Aquatic habitat parameters that did not improve included in-stream habitat for fish and sedimentation. Interestingly, as the parameters that generally measure habitat quality for benthic macroinvertebrates improved, so did the benthic macroinvertebrate communities, and as the parameters that measure habitat quality for fish declined over time, so did the fish communities.

After restoration, benthic macroinvertebrate communities were relatively improved. Benthic communities were generally comprised of fewer generally tolerant midges and other taxa tolerant to disturbance, as well as a greater proportion of individuals sensitive to disturbance. Fish communities only showed improvement in one of the post-restoration years; in all other years, fish communities were represented by a more tolerant and less diverse assemblage than was present prior to restoration. However, when combining all pre-restoration data and comparing it to all post-restoration data, it appears as though fish communities have improved. In one year post-restoration, a very high quality fish community was observed which made the post-restoration community appear better than the pre-restoration community.

The restoration area is a third order stream and fish habitat conditions may be variable due to flashy flows and channel instability. Anecdotally, there were also more frequent above-average flooding events that have occurred within the post-restoration period that may have contributed to sedimentation and channel instability. The results of the 2011 quantitative assessments will assess the stability of the channel to see if that could be having an affect on the fish population.

In addition to declines in habitat and watershed and stream channel changes, another plausible explanation for the decline in the fish community in 2010 could be the abnormally dry summer conditions that occurred in that year (U.S. Drought Monitor 2013). In all other years this site was sampled for fish, no drought conditions existed, but in 2010, at the time of fish sampling, abnormally dry conditions occurred in the Patuxent River watershed potentially causing fish to seek refuge in other parts of the stream environment.