3.7 Northwood Stream Restoration

3.7.1 Introduction

The Northwood Stream Restoration project was constructed in 2003. The project site is located along the Northwood tributary to Northwest Branch (***Figure 3.7.7***). It begins near the intersection of Hillsboro Drive and Rockbridge Road in the Kemp Mill Estates Subdivision and continued downstream to the mainstem of Northwest Branch (***Figure 3.7.8***). The project included stabilizing approximately 3,749 linear feet of stream and planting native vegetation. The goals of the project were to 1) improve aquatic habitat conditions to increase aquatic insect and fish populations and density in the Northwood tributary, and 2) to reduce stream erosion, sedimentation, and erosive stream flows**.** ***Figure 3.7.1*** depicts the site following restoration in 2009.

Figure 3.7.1 – Northwood Stream Restoration in 2009

Subwatershed facts

Subwatershed Drainage Area: 221 acres
Subwatershed Imperviousness: 25 percent

Project Facts

Project Area: The stream restoration began near the intersection of Hillsboro Drive and Rockbridge Road in the Kemp Mill Estates Subdivision and continued downstream to the mainstem of Northwest Branch. The project included stabilizing approximately 3,749 linear feet of stream and planting native vegetation.

Costs: Structural and Reforestation ($493,072), Funded in part through the Maryland Department of Natural Resources Clean Water Action Plan (CWAP) Grant

Completion Date: March 2003

Property Ownership: Montgomery County and Maryland State Highway Association

Project Selection

The Northwood Stream Restoration Project was identified within Montgomery County's Northwest Branch Watershed Study as a good candidate for a stream restoration project.

Pre-Restoration Conditions

Severe erosion below the concrete flume located at the top of the project limits created a large scour pool that lacked aquatic habitat and the stream banks were actively eroding during every storm event (***Figure 3.7.8***). Washington Suburban Sanitary Commission (WSSC) infrastructure was exposed due to the actively eroding stream bed (***Figure 3.7.2***). Further downstream of the large scour pool there were steep unvegetated streambanks with various non-native vegetation (mostly English Ivy) smothering the native forest. Actively eroding outfall channels were also present along the restoration project where the street runoff from a storm event immediately discharges into the stream (***Figure 3.7.3***). Throughout the project limits, aquatic habitat was limited and mostly consisted of an overwidened stream channel with a shallow water depth that did not provide good aquatic habitat.

Figure 3.7.2 – Exposed WSSC Sewer Line within the Northwood Tributary in 2001 Before Restoration

Figure 3.7.3 – Eroded Outfall to the Northwood Tributary in 2001 Before Restoration

Restoration Actions Taken

At the upper end of the project limits, a large step pool system was installed to provide stability and bring habitat back into the large scour pool that formed immediately below the concrete flume (***Figure 3.7.4***). Imbricated rock was installed along eroding streambank slopes, protecting the stream channel from further damage. The slopes above the imbricated walls were planted with native trees and shrubs to further stabilize the streambanks (***Figure 3.7.5***).

Figure 3.7.4 – Northwood Stream Restoration Before and After Restoration

Figure 3.7.5 – Streambank and Riparian Plantings at Northwood Tributary just after Restoration in 2003

Instream structures included rock and log vanes, which direct water away from unstable streambanks, and form downstream scour pools that provide good habitat for fish. Rock cross vanes also function as grade control, which slow the erosive process of stream down-cutting (***Figure 3.7.6***). Instream structures were also used to protect exposed WSSC infrastructure.

Figure 3.7.6 – Rock Cross Vane at Northwood Tributary in 2010

Undercut and undermined trees were reinforced with supportive rock packing. More seriously damaged trees were flush cut with the stream bank, allowing the root systems to remain in the bank for stabilization. Certain species of trees will send up new trunks from the existing root system and will continue to grow into new mature trees that will protect the streambanks from eroding. ***Figure 3.7.4*** shows ground-level images before restoration in 2000 and after restoration in 2007.

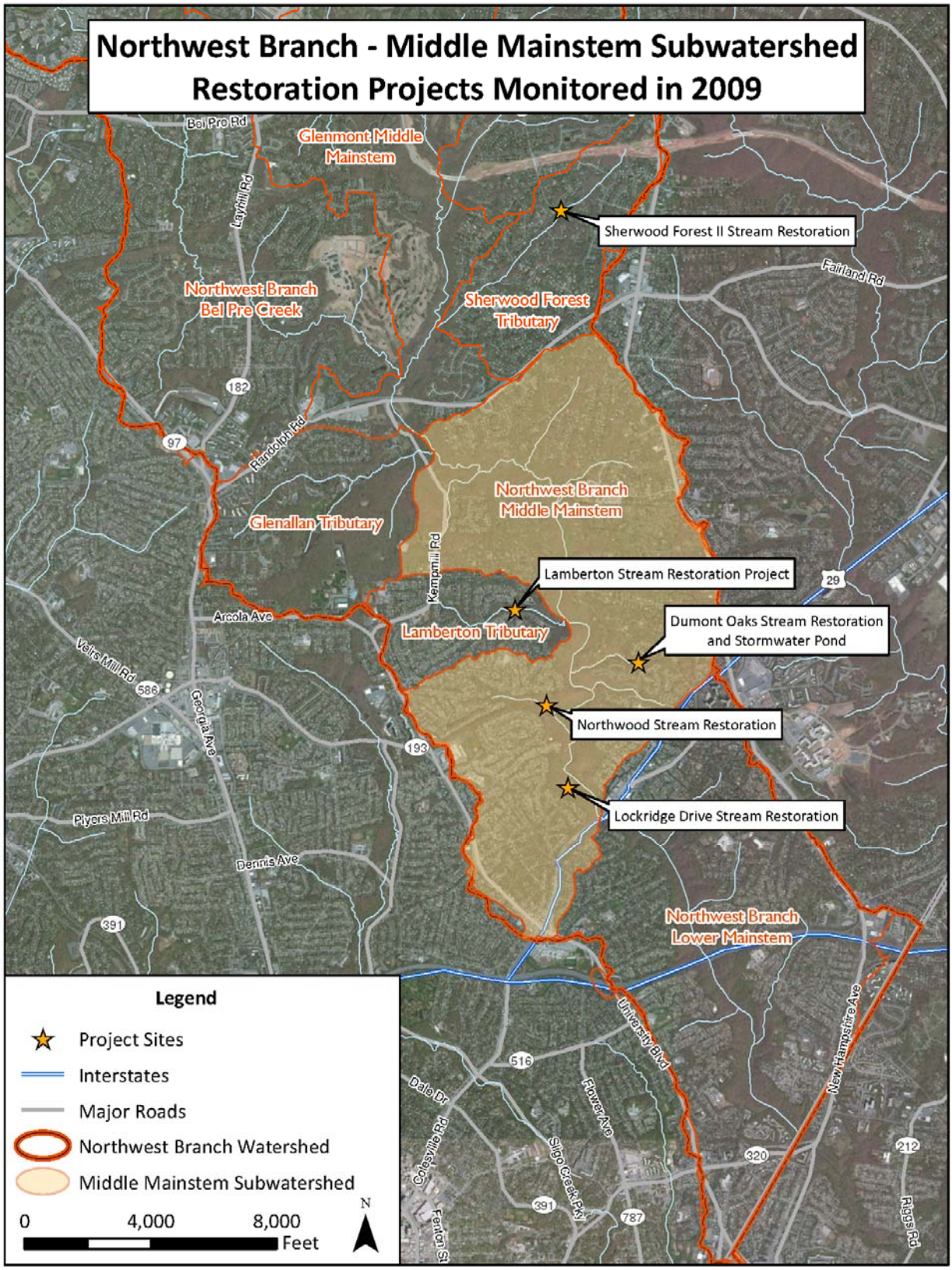


Figure 3.7.7 – Northwest Branch Watershed, Including Northwood Stream Restoration Project

Figure 3.7.8 – Map of 2009 Monitoring Locations for Northwood Stream Restoration Project

3.7.2 Restoration Goals

Restoration goals were defined during the planning and implementation of the Northwood Stream Restoration project. Pre- and post-restoration monitoring was conducted in the stream within the project area. This is a fifth year monitoring report and summarizes the pre- and post-restoration conditions within the Northwood Stream Restoration project area. ***Table 3.7.1*** below presents the restoration goals, monitoring performed to evaluate the success of the goals, and when and where the monitoring occurred.

Table 3.7.1 – 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 water quality, aquatic insect, and fish populations and density in the Northwood tributary	• Qualitative Habitat • Aquatic Communities: ▪ Benthic macroinvertebrates ▪ Fish • In-situ Water Chemistry	2001 and 2002 (pre) 2004, 2005, 2007, and 2009 (post)	NWND101
• Reduce stream erosion and sedimentation • Reduce erosive stream flows	• Quantitative habitat (stream morphology surveys)	2007-2009 (post) [1]	NWND101

[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.

3.7.3 Methods to Measure Project Goals

The basic sampling design for the Northwood Stream Restoration project was pre-restoration (before) and post-restoration (after) monitoring. The County monitored the biological communities (benthic macroinvertebrates and fish), performed rapid habitat assessments (RHAB), and took in-situ water chemistry measurements at one biological monitoring site (NWND101) to evaluate the aquatic habitat conditions and water quality during the pre- and post-restoration periods. All data collected prior to 2003 are considered pre-restoration data and all subsequent data are considered post-restoration.

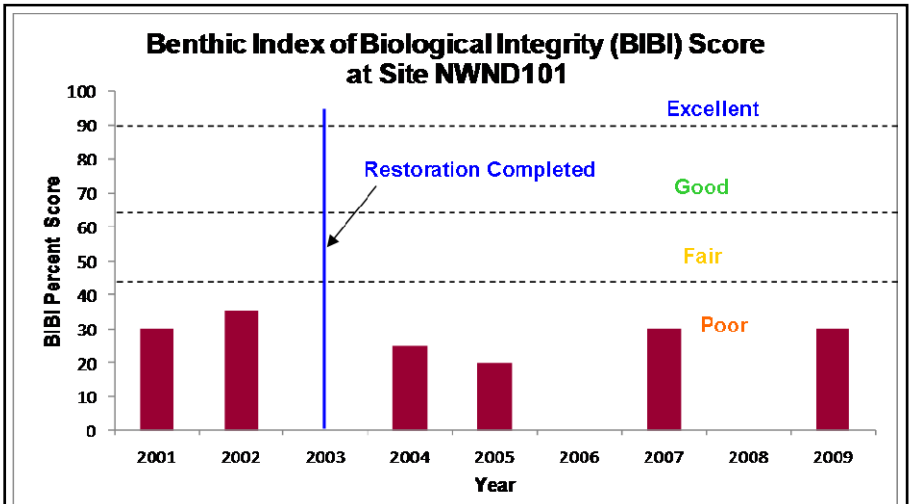
3.7.4 Results and Analysis

Benthic Macroinvertebrates

BIBI (Benthic Index of Biological Integrity) Scores

The benthic macroinvertebrate community at NWND101, as assessed using the MCDEP Benthic Index of Biological Integrity (BIBI), was Poor in all years in both the pre- and post-restoration periods (***Figure 3.7.9***). The baseline BIBI percentage prior to restoration was 30 in 2001 and 35 in 2002. Following restoration, the BIBI percentages declined ranging from 20 to 30, and not exceeding pre-restoration conditions. The highest BIBI percentage was observed prior to

restoration in 2002 (35). Field data sheets from 2009 benthic macroinvertebrate monitoring are included in ***Appendix D***.



Year	2001	2002	2004	2005	2007	2009
BIBI Percentage	30	35	25	20	30	30
Narrative Ranking	poor	poor	poor	poor	poor	poor

Figure 3.7.9 – Pre- and Post-Restoration Benthic Index of Biological Integrity (BIBI) Percentages at NWND101

Dominant Taxa

Both pre-and post-restoration communities of benthic macroinvertebrates at NWND101 were dominated by Chironomidae (non-biting midges), which comprised of 89 percent of the community prior to restoration and 75 percent after restoration. *Dolophilodes* sp. (fingernet caddisflies), was the second most dominant taxon prior to restoration, representing three percent of individuals collected. Following restoration, the second most dominant taxon collected was Lumbriculidae, a family of aquatic worms, making 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, 92 and 83 percent respectively, as were the most dominant two taxa.

Tolerance Values

Site NWND101 was dominated by tolerant taxa (93 percent) prior to restoration, with three percent of the community represented by sensitive taxa, and the remaining four percent represented by taxa intermediate in sensitivity (***Figures 3.7.10 and 3.7.11***). Following restoration, the proportion of tolerant taxa was similar, but there was a decrease in the proportion of sensitive taxa and an increase in the proportion of intermediate taxa.

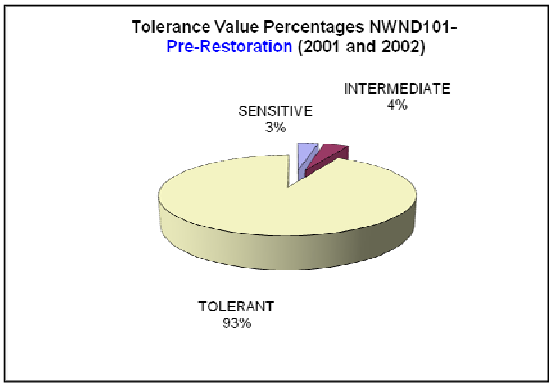


Figure 3.7.10– Benthic Macroinvertebrate Tolerance Composition at NWND101 Prior to Restoration

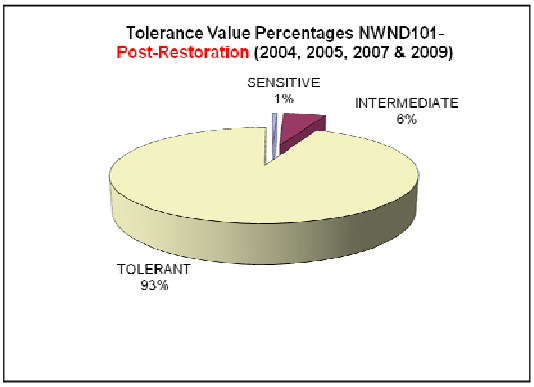


Figure 3.7.11– Benthic Macroinvertebrate Tolerance Composition at NWND101 After Restoration

Functional Feeding Groups

Collectors were the most dominant functional feeding group at NWND101 both before and after restoration. More specialized feeders, including scrapers and shredders that require less degraded stream conditions or specific habitat features, were present in only minor amounts both before restoration and declined slightly after restoration (*Figures 3.7.12 and 3.7.13*). After restoration the percentage of collectors decreased from 90 percent to 84 percent, the percentage of filterers increased from six percent to nine percent, and the percentage of predators increased from one percent to five percent.

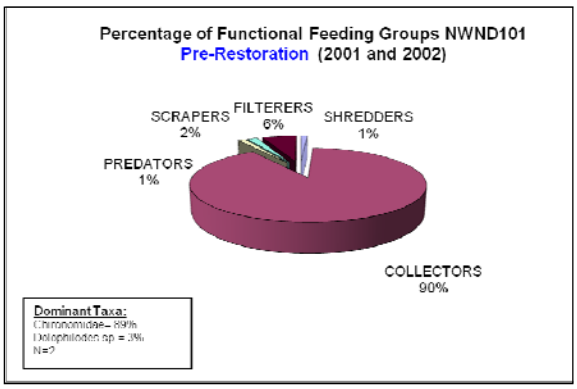


Figure 3.7.12 – Benthic Macroinvertebrate Functional Feeding Group Composition and Dominant Species at NWND101 Prior to Restoration

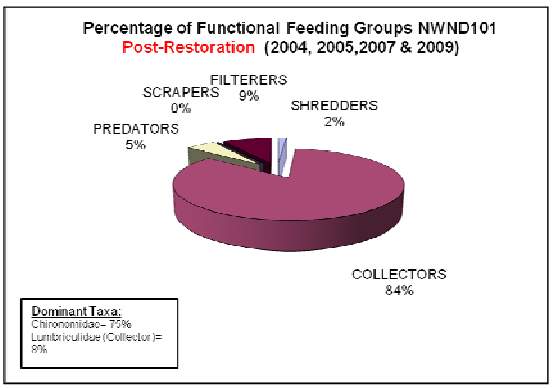


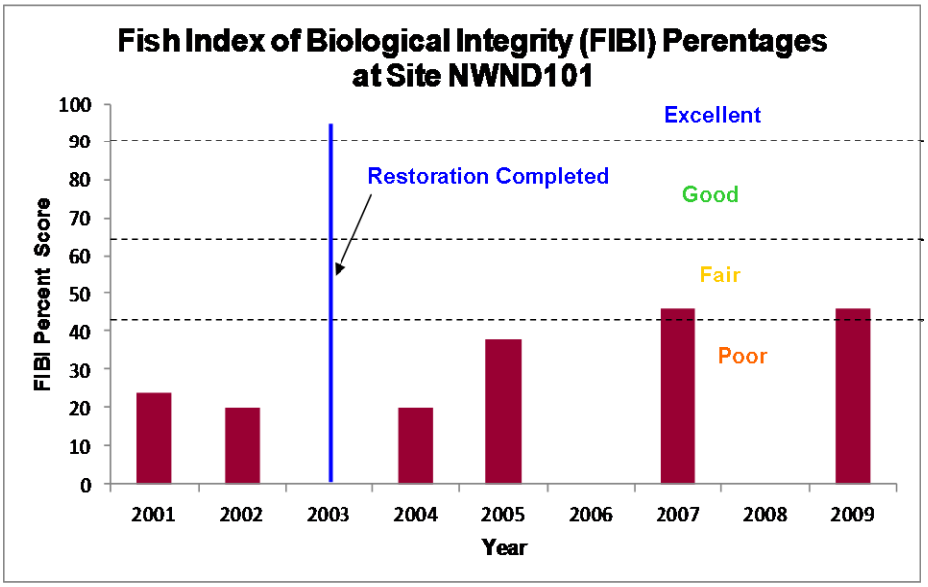
Figure 3.7.13 – Benthic Macroinvertebrate Functional Feeding Group Composition and Dominant Species at NWND101 After Restoration

Fish

FIBI (Fish Index of Biological Integrity) Scores

The fish community, as assessed using the MCDEP Fish Index of Biological Integrity (FIBI), was Poor during the pre-restoration monitoring period, with a percent score of 24 in 2001 and 20 in 2002 (***Figure 3.7.14***). Following restoration, the FIBI exceeded the pre-restoration percentages, with percentages ranging from 20 (Poor) to 46 (Fair). The highest FIBI percentage was observed following restoration in 2007 and 2009 (46). The increase in FIBI percentages following restoration was due to an increase the total number of individuals, an increase in the

number of benthic insectivorous individuals, and an increase in the number of minnow species. In addition to an increase in FIBI percentages, fish density increased from an average of 102 individuals per year before restoration to an average of 223 individuals per year following restoration. Field data sheets from the 2009 fish monitoring are included in ***Appendix D***.



Year	2001	2002	2004	2005	2007	2009
FIBI Percent Score	24	20	20	38	46	46
Narrative Score	poor	poor	poor	poor	fair	fair

Figure 3.7.14 – Pre- and Post-Restoration Fish Index of Biological Integrity (FIBI) Percentages at NWND101

Dominant Fish Species and Pioneer Fish

The most dominant fish species at NWND101 remained similar between the pre- and post-restoration periods, with the pioneer species *Rhinichthys atratulus* (blacknose dace) representing the majority of the individuals collected. Prior to restoration, blacknose dace comprised of 96 percent of individuals collected and *Rhinichthys cataractae* (longnose dace) made up two percent of the community. *Etheostoma flabellare* (fantail darter) and *Etheostoma blennioides* (greenside darter) were also collected prior to restoration in minor amounts, but were only collected in 2002. Following restoration, blacknose dace, although still the most dominant species collected, was less dominant than before restoration, comprising only 76 percent of the community. Longnose dace, a non-pioneer species, was second most dominant after restoration and increased in dominance to 12 percent. The remainder of individuals collected following restoration included tessellated darter, *Semotilus atromaculatus* (creek chub), *Catostomus commersonii* (white sucker), *Clinostomus funduloides* (rosyside dace), and fantail darter. Overall, the percent of pioneer fish individuals decreased by 10 percent following restoration (***Figures 3.7.15 and 3.7.16***).

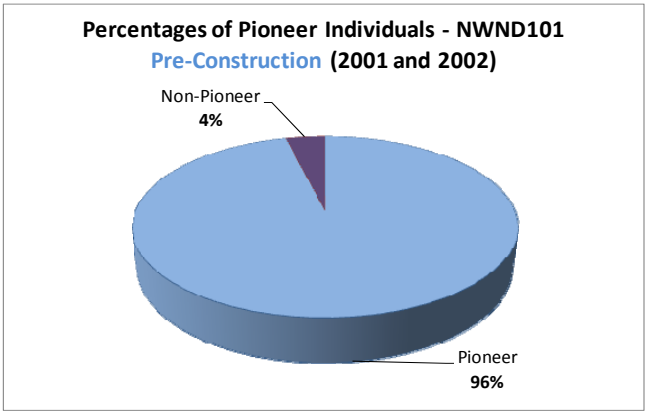


Figure 3.7.15 – Pioneer Fish Composition at NWND101 Prior to Restoration

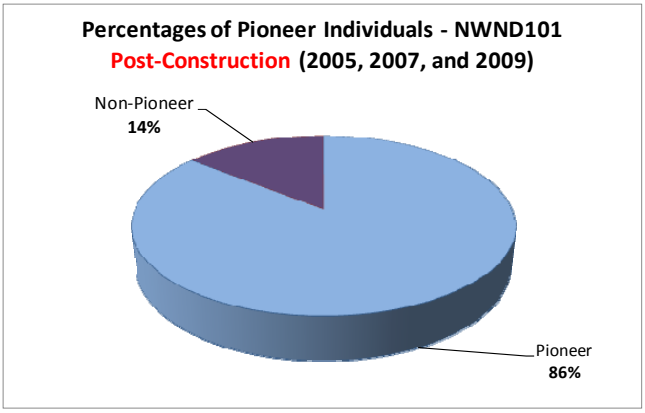


Figure 3.7.16 – Pioneer Fish Composition at NWND101 After Restoration

Tolerance Values

Tolerant fish species heavily dominated NWND101 prior to and following restoration. Site NWND101 was represented by 96 percent tolerant species prior to restoration, including blacknose dace and creek chub. The remainder of individuals collected were fantail darter and greenside darter, which have intermediate tolerance levels, but were only present in minor amounts. Following restoration, the proportion of tolerant species decreased to 87 percent, including creek chub, blacknose dace, white sucker, and tessellated darter. The remainder of individuals collected were rosyside dace, longnose dace, and fantail darter, which have intermediate tolerance levels, but were only present in minor amounts. ***Figures 3.7.17*** and ***3.7.18*** show the differences in tolerant fish species between pre- and post-restoration sampling periods at NWND101.

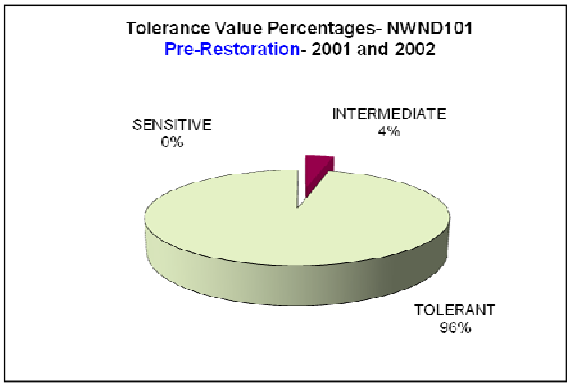


Figure 3.7.17 – Fish Tolerance Composition at NWND101 Prior to Restoration

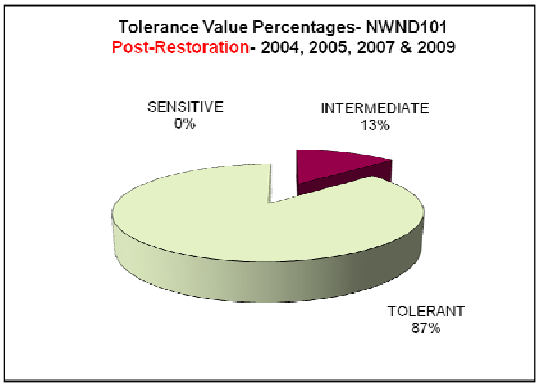


Figure 3.7.18 – Fish Tolerance Composition at NWND101 After Restoration

Functional Feeding Groups

Site NWND101 was dominated by omnivorous fish species both pre- and post-restoration. Prior to restoration, omnivores (i.e., blacknose dace and longnose dace) comprised 98 percent of the fish community, and the remaining two percent were insectivores and generalists. Following restoration, the proportion of omnivores decreased to 89 percent and the percentage of invertivores, a more specialized feeding group that was not observed prior to restoration, occupied six percent of the community. The percentage of insectivores declined slightly after

construction to one percent. ***Figures 3.7.19*** and ***3.7.20*** show the percentages of each functional feeding group at NWND101 for pre- and post-restoration monitoring periods, respectively.

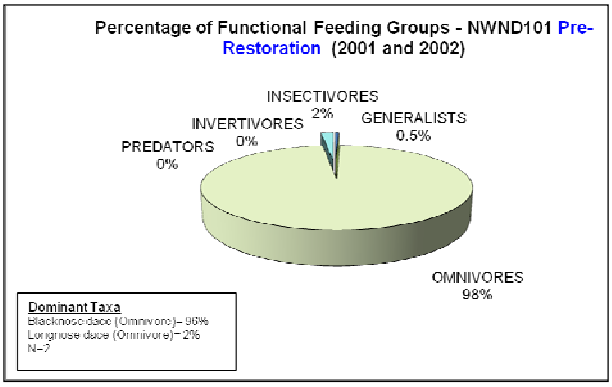


Figure 3.7.19 – Fish Functional Feeding Group Composition and Dominant Species at NWND101 Prior to Restoration

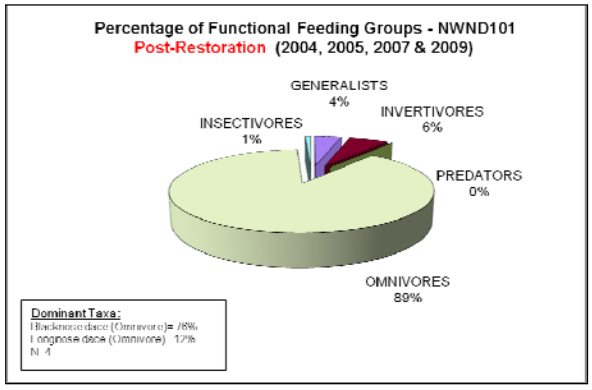
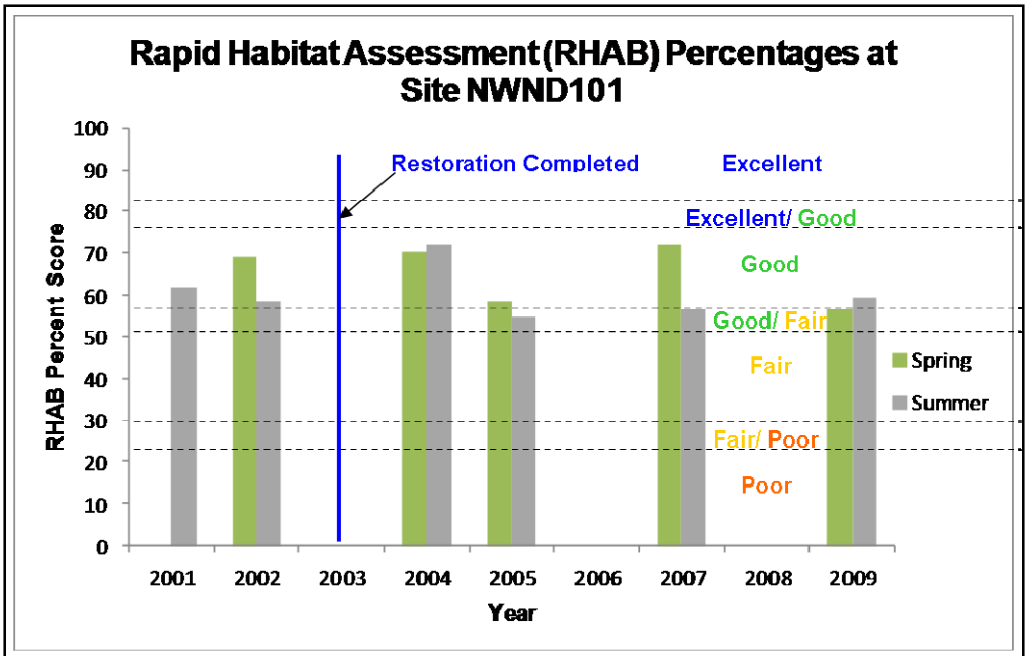


Figure 3.7.20 – Fish Functional Feeding Group Composition and Dominant Species at NWND101 After Restoration

Qualitative Habitat

Pre-restoration aquatic habitat was evaluated at NWND101 in the spring in 2001 and in the spring and summer in 2002. During this period, pre-restoration percentages were in the Good range with scores ranging from 58.5 to 69.0 and an overall average score of 62.8 percent. ***Figure 3.7.21*** shows aquatic habitat scores before and after restoration at NWND101.

Following restoration, aquatic habitat was evaluated in the spring and summer of 2004, 2005, 2007, and 2009. During these years, aquatic habitat percentages were mostly Good, ranging from 55.0 to 72.0, with an overall average score of 62.5 percent. Instream cover for fish was in the marginal/suboptimal ranges and epifaunal substrates for benthic macroinvertebrates were generally rated as suboptimal.



Year	2001	2002	2004	2005	2007	2009
RHAB Percentage-Spring	-	69	70.5	58.5	72	56.5
(Narrative Ranking)	-	(good)	(good)	(good)	(good)	(good)
RHAB Percentage- Summer	62	58.5	72	55	56.5	59.5
(Narrative Ranking)	(good)	(good)	(good)	(good/fair)	(good)	(good)

Figure 3.7.21 – Pre- and Post-Restoration Rapid Habitat Assessment (RHAB) Percentages at NWND101

Quantitative Habitat

Quantitative monitoring was scheduled to occur at NWND101 in 2009, but was delayed due to problems locating the benchmarks. Data were collected in 2010 and will be presented in the 2010 report.

Water Chemistry

With the exception of one pH reading taken during the summer of 2002, in-situ water quality parameters were in compliance with COMAR standards for Use IV streams during both pre- and post-restoration periods (***Table 3.7.2***). During the summer of 2002, pH was 6.45, which is slightly below the lower instantaneous State standard of 6.5. All post-restoration in-situ water chemistry readings were in compliance with COMAR standards.

Table 3.7.2– Pre- and Post-restoration in-situ Water Chemistry Data at NWND101

Water Quality Parameter	2001	2002		2004		2005		2007		2009	
	summer	spring	summer	spring	summer	spring	summer	spring	summer	spring	summer
Dissolved Oxygen (mg/L)	7.15	9.50	5.88	11.30	7.72	12.59	11.99	12.66	7.97	9.94	7.70
Dissolved Oxygen (% Saturation)	77	104	65	100	84	113	130	114	88	95	82
pH	7.08	7.11	6.45	7.25	7.34	7.86	7.85	8.45	8.00	7.02	7.23
Conductivity (µmhos)	-	138	147	175	148	160	206	207	207	200	199
Water Temperature (ºF)	66.7	68.0	69.6	50.0	67.1	51.1	66.7	51.3	68.0	52.9	65.8

3.7.5 Discussion

Table 3.7.3 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 following restoration, one project goal was not met, and one project goal could not be evaluated in 2009, but will be assessed in 2010.

Table 3.7.3 – Summary of Project Goal Results

Goal	Result
• Improve aquatic habitat conditions • Improve water quality, aquatic insect community, and fish populations and density in the Northwood tributary	Partially successful – aquatic habitat scores did not show improvement following restoration. However, comparison of pre- and post-restoration photos show habitat improvement in areas outside of the monitoring reach; improvement in the fish community (10 percent decrease in pioneer fish), but little improvement in the benthic community
Reduce stream erosion, sedimentation, and erosive stream flows	Unable to determine – quantitative stream survey data from 2010 will suggest if these goals have been met

Partially Successful – Improve aquatic habitat and water quality conditions in the Northwood tributary

Aquatic habitat scores along the Northwood tributary were largely similar following restoration. The habitat assessments fluctuated year to year while the overall average score from pre- to post-restoration went from 62.8 percent to 62.5 percent. In other words, there is not much difference between the pre- and post-restoration assessments in the specific area of the restoration reach where aquatic habitat was evaluated. However, photographic comparisons of the entire project area pre- versus post-restoration indicate there was an improvement in aquatic habitat from restoration activities that have provided stream stability (***Figure 3.7.4***). Many of the most degraded areas have been remediated, including the concrete flume leading to the large scour pool, the exposed sewer pipe, and some of the most highly unstable and eroded streambanks.

These areas were not located within the monitoring reach and were therefore not included in the aquatic habitat assessments.

Overall, the benthic macroinvertebrate community remained Poor during both pre- and post-restoration periods, and showed little improvement following restoration.

Although NWND101 continues to be dominated by tolerant fish species, the site has experienced an increase in fish density, a decrease in pioneer fish, and an improvement in FIBI percentages following restoration. The fish community was represented by a greater diversity of functional feeding groups and a lower percentage of tolerant fish species after restoration, suggesting the fish community has improved following the restoration of this site. A 10 percent increase in non-pioneer fish after restoration may also indicate that more stable habitat is available to colonize.

In-situ water chemistry remained similar prior to and after restoration. With the exception of the pH reading taken during the summer of 2002, in-situ water quality parameters were in compliance with COMAR standards for Use IV streams during both pre- and post-restoration periods.

3.7.6 Conclusions

The Northwood Stream Restoration project has partially met the goal of improving aquatic habitat conditions and improving aquatic insect and fish communities in the Northwood tributary. Despite apparent improvements shown in photographic comparisons, aquatic habitat assessments within the monitoring reach have remained within the Good to Good/Fair range showing no improvement to the aquatic habitat. Benthic macroinvertebrate communities have remained similar overtime, showing a slight decline in some community measures. The benthic macroinvertebrate community may be limited by water quality or by barriers to colonization. The watershed in which the Northwood mainstem flows is urbanized and 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. However, the fish community has improved following restoration and all in-situ water chemistry measurements were in compliance with COMAR standards since the completion of this restoration project.