



## **N.C. Division of Forest Resources**

# **Stream Restoration Post-Implementation Annual Monitoring Report: Year 1 - 2009**

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For the N.C. Clean Water Management Trust Fund (CWMTF)  
Project #2004A-411:  
“Rendezvous Mountain Purlear Creek Stream Restoration”

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## **Project Background**

Approximately 2,600 linear feet of Purlear Creek were restored in two phases on Rendezvous Mountain Educational State Forest in Wilkes County, with funding provided by the N.C. CWMTF. The project was implemented in two phases as outlined below:

- Phase 1: 700 linear feet, UT-Purlear, perennial, Priority 1 restoration.
- Phase 2: 1,900 linear feet, mainstem Purlear Creek, perennial, Priority 1 and Priority 2 restoration.

The site was a cattle pasture prior to ownership by the N.C. Division of Forest Resources (DFR). Access to Purlear Creek by the cattle had deteriorated the stream banks and allowed the stream to incise and undercut its banks. There was no functioning riparian buffer along most of the length of stream within the pasture area.

The outcomes of this restoration project include:

- Align the stream into the natural valley of the site;
- Connect the stream to a functional floodplain;
- Create in-stream structures suitable to manage bankflow events and enhance aquatic habitat;
- Establish a permanent forested riparian buffer.

The long-term goal is to create conditions within Purlear Creek that are suitable for the introduction of trout in partnership with the N.C. Wildlife Resources Commission. More detailed background information about the project's scope of work, the site characteristics and restoration implementation is available in the project's Final Report to the CWMTF dated October 31, 2008.

## **Annual Monitoring Narrative**

Additional stream restoration along an estimated 1,600 linear feet of the mainstem of Purlear Creek situated downstream of the end of Phase 2 was accomplished in 2009 with funding from the N.C. Division of Water Resources. This additional restoration is referred to as 'Phase 3'. While this annual monitoring report only addresses Phases 1 and 2 that were funded by the CWMTF, the DFR and its partners at NCSU are also monitoring the work conducted on Phase 3, in a good-faith measure to holistically evaluate the efforts to improve the overall watershed on the State Forest.

The Phase 1 and Phase 2 components of the restoration have largely stabilized and are beginning to exhibit signs of 'naturalizing' with the hydrology of the stream system. Sediment deposition and mobilization is occurring as intended, and the stream's bank structure is holding its integrity, with only a few exceptions.

During 2009, the Division's Remote Automated Weather Station situated on Rendezvous Mountain recorded a total precipitation of 52.25 inches ([http://dfr.nc.gov/fire\\_control/fc\\_raws.htm](http://dfr.nc.gov/fire_control/fc_raws.htm)). This accumulation is notably higher than the total precipitation recorded in 2008 of slightly more than 39 inches, or in 2007 in which slightly less than 33 inches were recorded.

## **Stream Morphology**

Despite some heavy rain events in 2009, the stream's structure, form and stability is well established and intact, with no major failures. In general the whole restoration is in excellent shape. There are some small areas that will require watching to see if they become a problem area, but at the present time there are not significant to be considered a notable problem. Morphologically the stream dimension, pattern and profile appear to be predictably evolving to a stable and mature state. The project has accommodated several bankfull flow events with little or no adjustment. Two minor repairs to the stream's structure are described further in this section.

The attached figures illustrate the elevation profiles and pool/riffle cross-sections within Phase 1 and Phase 2 sections of the creek. The plan sheets/maps of the restored stream are also included with this report. The plan views and cross-sections utilize the actual elevation above mean sea level (MSL) instead of an arbitrary elevation. In each case the upstream cross section is the number 1 cross section for that feature and Phase of restoration. To allow easy comparison of the cross sections within a Phase, the elevations were adjusted by a scaling factor which requires that the actual elevations be artificially adjusted. The cross sections are accurate relative to each other but the elevation numbers would have been incorrect and are not displayed.

Repair work within the UT-Phase 1 were made to a rock cross vane situated downstream from the culvert. As a result of a good-natured attempt by local DFR staff to remove a build-up of sediment resulting from in-stream deposition after restoration was completed, one of the cross vanes began to exhibit piping. The repairs have stabilized and the structure is once again working as designed. The local personnel have been advised that no actions should be taken within the restored stream, without first consulting with NCSU or Forestry NPS Branch staff in Raleigh.

Repair work was undertaken on a segment of Phase 2. Soon after the conclusion of restoration along Phase 2, approximately 150 feet of the restored stream bank began to undercut and lose its integrity. It was determined that there were not sufficient structures in the stream to accommodate the water flow and that perhaps the stream's layout was too straight. This segment of stream in question was situated along the last 150-foot stretch of stream on the downstream end of the project between Phase 2 and Phase 3. During the Phase 3 restoration work in 2009, the contractor re-configured and completely rebuilt this failing segment of Phase 2, to incorporate additional structures and sinuosity, thus providing a smooth transition between the Phase 2 and Phase 3 components of restoration.

### **Vegetation**

Woody vegetation appears to be well-established within the riparian corridor. In addition, growth of naturally-germinated tree seedlings ("volunteers") from the nearby forested area have contributed to the overall species diversity of the restoration area. Several observations and visual monitoring of the vegetation growth have been performed, but no plots or seedling survival counts have yet been conducted. This decision is due to the extreme planting conditions encountered during this project. During that period (2006, 2007 & 2008), a prolonged drought coupled with intense deer browse of newly-planted seedlings was thought to have a negative effect on the long-term survival of planted seedlings and shrubs. With 1 to 2 growing seasons now concluded, we feel that enough time has lapsed to obtain a reliable estimate of the density and species of woody vegetation on the project site.

While fescue grass has re-grown alongside the stream, we feel that the woody vegetation has established itself and the trees and shrubs should be able to compete with the fescue. As we continue to monitor the site, it may be warranted to make spot applications of herbicide that would control the fescue and other un-wanted vegetation. Some encroachment by nearby populations of invasive plant species (*Ailanthus altissima*, Tree of Heaven and *Microstegium vimineum*, Japanese stiltgrass) has been observed within portions of the restoration area. Invasive species control should prove an ongoing challenge.



Figure 1: Overview of vegetation along Phase 1, shown here May 2009.



Figure 2: Wild strawberry volunteer growth along Phase 1, shown here May 2009.



Figure 3: Swamp chestnut oak seedling along Phase 2: Planted February 2008, shown here May 2009.



Figure 4: Yellow-poplar seedling along Phase 2: Planted February 2008, shown here May 2009.

## Aquatic Insects

An assessment of aquatic insects was performed in the spring of 2009 by Dave Penrose, on behalf of the NCSU Department of Biological & Agricultural Engineering. The results of the monitoring report are provided below.

### Benthic Macroinvertebrate Summary from Rendezvous Mountain (NCDNR Purlear Creek)

#### Stream Restoration Project: April, 2009

Benthic macroinvertebrates have been collected from 5 locations as part of a monitoring project at Rendezvous Mountain ESF. Phase 1 of this project was the restoration of a small UT of Purlear Creek in July-August 2006, and Phase 2 on the mainstem of Purlear Creek in July-August 2007. Benthic data were collected each spring from 2005 through 2009. The 2005 and 2006 surveys were conducted prior to any restoration activities. Site A is a small headwater reach of Purlear Creek located above a large waterfall and was selected as reference conditions for the restoration work on the UT (Site D). These two sites are approximately the same size. Table 1 compares the data from these two locations only. Biological samples were also collected from a reach of Purlear Creek below the waterfall (Site B) and from within an inactive pasture (Site C or Phase 2 of this project).

**Table 1. "Phase 1" summary statistics from the stream restoration project at Rendezvous Mountain. Site A is the reference for the restored reach (similar size features)**

Month/Year of Survey	Site A, above falls (REFERENCE)					Site D, UT (PHASE-1 REACH)				
	4/05	4/06	5/07	4/08	4/09	4/05	4/06	5/07	4/08	4/09
Total taxa richness	44	39	53	45	42	42	37	44	52	48
EPT taxa richness	28	27	32	27	30	28	29	29	29	33
EPT abundance	112	140	167	90	138	112	122	173	114	104
Dominant in Common Taxa*	-	-	-	-	-	59%	59%	51%	50%	62%
# Indicator species	24	21	24	22	20	23	24	13	26	23

\*Abundant and Common taxa were used for this evaluation

The restoration activities at Site D appear to have minimally impacted the ecological condition of the stream following the Phase 1 restoration in 2006. Taxa richness and the abundance of EPT taxa are slightly higher following restoration (2007 and 2008) and DIC values were only slightly lower. This initial surge in taxa richness is common following restoration and has been noted in numerous investigations. However, many fewer indicator species were found at this site in 2007 and it appears caddisfly taxa (most notably *Rhyacophila*, *Neophylax* and *Nyctiophylax*) were eliminated or reduced in abundance. However many of these taxa re-appeared during the survey in 2008. Despite slightly lower total taxa richness and EPT abundance in 2009, the dominant taxa in common with the reference site increased to 62%. These data suggests that the benthic fauna are still evolving in this UT reach and that the conditions are similar to pre-restoration conditions. Shredder taxa often decline following restoration, as much less LPOM is found in newly restored features. However the shredder community in this tributary is healthy (*Lepidostoma*, *Tallaperla*, *Tipula* were all common or abundant during both post-construction surveys). This is most likely due to the abundance of overstory, mature trees within the riparian corridor along the UT-Phase 1.

**Table 2. "Phase 2" summary statistics from the stream restoration project at Rendezvous Mountain. Site B will be used for reference for all mainstem locations.**

Month/Year of Survey	Site B, below falls (REFERENCE)					Site C, pasture (PHASE-2 REACH)				
	4/05	4/06	5/07	4/08	4/09	4/05	4/06	5/07	4/08	4/09
Total taxa richness	55	45	57	43	44	64	58	59	49	51
EPT taxa richness	36	31	34	27	29	41	34	34	31	37
EPT abundance	159	122	189	90	111	170	143	165	113	118
Dominant in Common Taxa*	-	-	-	-	-	63%	74%	62%	48%	65%
# Indicator species	33	27	25	24	22	33	26	27	23	26

\*Abundant and Common taxa were used for this evaluation.

Table 2 summarizes the benthic data from the mainstem of “Phase 2” on Purlear Creek at Rendezvous Mountain. Site B is above the confluence with the restored UT, but below the falls and was selected as the reference for this portion of the project. Site C (pasture location) is below this UT and was restored in the summer of 2007 during “Phase 2” of the project. The survey in 2008 was the first post-restoration investigation at this location.

Taxa richness and EPT abundance values were significantly lower at both reference locations (Sites A and B) in 2008. This may be a response to watershed wide conditions or the negative impacts of very low flow. These values improve at both locations in 2009. Following Phase 2 restoration in 2007, moderately lower taxa richness and EPT abundance values were seen. It is difficult to conclude that these lower numbers were due to the restoration activities or the negative effects of very low flow. However conditions appear to have rebounded quickly at this location. All summary metrics were higher during the 2009 investigation. These data indicate that the restoration activities in this reach of Purlear Creek had very little negative impacts to the benthic fauna. Recovery of the fauna at this reach is likely due to the nearby sources of recolonization and refuge.

### **Outreach/Education/Training**

During the restoration site work for Phase 3 in spring of 2009, the NCSU project managers hosted a field workshop for students enrolled with the Department of Biological and Agricultural Engineering. This workshop included a walking tour and examination of Phase 1 and Phase 2, to illustrate for the students the successive progress of a stream restoration, over a period of time. Approximately 15 individuals participated.

### **Goals for Continuing Management**

In addition to the monitoring, there are other project goals that the DFR intends to pursue during 2010:

- Continue to support and direct the joint Division of Forest Resources / Division of Prisons *Young Offenders Forest Conservation Program* (known as the BRIDGE Program) in their work to remove excessive legacy sediment from the upper-most headwater reach of Purlear Creek.
- Identify and control sources of sediment from the upstream reach beyond the Phase 1-UT, which is mobilizing significant sediment since the restoration was completed.
- Cooperate with N.C. Division of Water Quality’s request to install shallow groundwater piezometers within the restoration area.
- Develop signage that promotes the restoration, and its partners. Install the sign in a location that will be visible from the bridge on Mozelles Road.

### **Attachments**

- A. Plan sheets (8pp)
- B. Elevation Profiles and Cross-Sections (4pp)
- C. Photograph pages (10pp)

Additional 2009 site photographs are available at the “Picasa” website:

Photos of Phase 1: <http://picasaweb.google.com/stream.restore/RMESFPhase1#>

Photos of Phase 2: <http://picasaweb.google.com/stream.restore/RMESFPhase2#>