

# Morgan Creek Mitigation Report

McDowell County, North Carolina

USGS HUC: 03050105040040

Project ID No. 16-D06027



Prepared for:



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## **Executive Summary**

The Morgan Creek stream restoration site is located on a single parcel approximately 8 miles south of Marion, North Carolina in McDowell County (see **Figure 1**). The project streams lie within the Broad River Basin (Hydrologic Unit Code **03050105040040**) and the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-02.

Defined by the conservation easement surrounding the stream and riparian buffers, the 36.6-acre site contains Morgan Creek and nine unnamed tributaries to Morgan Creek (UT1 through UT9). The land adjacent to the site (outside of the conservation easement) is being used for cattle grazing and also includes portions of undisturbed forest. Morgan Creek lies within a relatively flat valley with UT1, UT2, UT3, UT5, UT8, and UT9 originating in the mountain adjacent to the Morgan Creek valley. UT5 and UT7 originate off-site and are included in the project easement where they flow into the property. The watershed is predominately forest and agricultural land. The site consisted of restoration, enhancement, and preservation stream reaches.

The restoration reaches include all of Morgan Creek and the sections of the tributaries located in the valley of Morgan Creek. Prior to construction, these reaches had minimal woody riparian buffers, failed culvert crossings, and livestock access. In addition, the reaches had been physically altered (straightened) in the past. These impairments created unstable bed and banks and excess sediment, nutrients, and biochemical demand (BOD). These problems combined with the lack of sufficient re-oxygenating riffle features, reduced dissolved oxygen within the water column. Water quality also was diminished due to raised turbidity from bank erosion and elevated water temperatures caused by the lack of tree shading. Habitat potential was reduced by the diminished water quality and loss of physical habitat such as bed features, woody debris, and a well developed vegetative community.

The enhancement reaches of the unnamed tributaries are upstream of the restoration section on the edge of the valley and have a slightly steeper slope than the restoration reaches. Prior to construction, these reaches were mainly affected by lack of a woody riparian buffer, livestock access, and adjacent eroding dirt roads. The enhancement reaches did not exhibit the steep, eroding banks that were observed in the restoration reaches. The enhancement reaches were aggrading, causing a lack of diversity, habitat, and degraded water quality.

The preservation reaches include headwater streams that flow into Morgan Creek. These reaches were (are) stable and have a mature woody riparian buffer. Erosion from the logging trails is being filtered through the buffer, and steep slopes prevent livestock from accessing the reaches.

## Goals and Objectives

Based on the above site conditions, the goals and objectives achieved by this project include:

### **Goals achieved:**

- Provided an ecological uplift by improving water quality, and
- Provided an ecological uplift by re-establishing and improving terrestrial and aquatic habitat and diversity.

### **Objectives achieved:**

- Removed excess nutrients and sediment through the use of vegetative buffers,
- Increased dissolved oxygen concentrations through the use of in-stream structures and the turbulence they produce in pools,
- Stabilized stream banks using bioengineering and/or natural channel design techniques,
- Improved substrate through the use of structures and the elimination of major on-site sediment sources,
- Created habitat diversity by introducing woody structures such as log vanes and rootwads,
- Reduced temperature by restoring canopy in the buffer areas,
- Controlled the invasive exotics by removing them during construction,
- Preserved stable on-site streams and riparian buffers draining into the enhancement/restoration reaches,
- Excluded livestock through fencing,
- Improved crossings by replacing pipes and/or stabilizing outfalls,
- Created vernal pools and oxbow lakes, and
- Protected site assets through the recordation of a conservation easement.

A Rosgen Priority 1 restoration approach was used on sections of Morgan Creek and the lower/downstream sections of UTs 1 through 7. Priority 1 was employed to re-establish an appropriate stream cross section, bed form, and pattern for improved habitat and ecosystem functions. The restored sections also were connected to their historic floodplains, which will re-establish more natural riparian conditions. A section of UT8 was restored by removing a failed culvert that was creating a backwater effect. A new culvert was installed and the stream was restored in that reach to eliminate the upstream backwater condition.

The middle section of UT1 was enhanced (enhancement level I) through livestock exclusion fencing, supplemental buffer plantings, and the stabilization of an adjacent

eroding logging road. The combination of these mitigating factors met the project goals by enhancing the streams' water quality and habitat. The middle sections of UT2, UT3, and UT5 all were enhanced (enhancement level II) through livestock exclusion fencing. The stable reaches of UT1, UT2, UT3, UT5, UT8, and UT9 as well as their riparian buffers were preserved. All stream reaches (restoration, enhancement, and preservation) are protected with a recorded permanent conservation easement (see **Figure 2**). As shown in **Tables 1** and **2** below, the mitigation work at the site resulted in the restoration, enhancement, and/or preservation of 18,772 linear feet of stream for a total of 11,203 stream mitigation units (SMUs).

**Table 1: Mitigation Summary**

	Stream Restoration	Stream Enhancement Level I	Stream Enhancement Level II	Preservation	Total
<b>Total Site (linear feet)</b>	7,855	1,797	1,629	7,491	18,772
<b>Total Site (SMUs)</b>	7,855	1,198	652	1,498	11,203

**Table 2: Mitigation Units Summary**

Contract Stream Mitigation Units (SMUs)	As-built Stream Mitigation Units (SMUs)	Contract Wetland Mitigation Units (WMUs)	As-built Wetland Mitigation Units (WMUs)
11,118	11,203	-	-

Monitoring in 2008 through 2012 will assess the site's streams to determine restoration success. The monitoring plan has been established based on guidance provided by *Stream Mitigation Guidelines* disseminated by the United States Army Corps of Engineers – Wilmington District (McLendon, Scott, Fox, St. John et al. 2003) and the most current version of the EEP documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports." Streams will be monitored for stability using cross section and longitudinal profile surveys and photo documentation.

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## **Narrative**

The Morgan Creek stream restoration site is located off of Mud Cut Road (SR 1351) approximately 8 miles south of Marion, North Carolina in McDowell County (see **Figure 1**). The project streams are located in the Broad River Basin (Hydrologic Unit Code **03050105040040**) and the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-02. The site is defined by the conservation easement surrounding the stream and riparian buffers that cover approximately 36.6 acres.

Located on a single parcel owned by Mr. Lester Kemick, the site contains Morgan Creek and nine unnamed tributaries to Morgan Creek (UT1 through UT9). The land adjacent to the site (outside of the conservation easement) is being used for cattle grazing and timber production. It also includes portions of undisturbed forest. Morgan Creek lies within a relatively flat valley with UT1, UT2, UT3, UT5, UT8, and UT9 originating in the adjacent mountain. UT5 and UT7 originate off-site and are included into the project easement where they reach the Kemick property. The watershed is predominately forest and agricultural land.

Prior to restoration, the stream was altered, had steep, severely eroding banks, and lacked a woody riparian buffer. The unstable banks, lack of a woody buffer, hoof-shear, and surrounding logging roads contributed to excess sediment on-site that caused high turbidity, especially during rain events. Additionally, livestock access resulted in excess nutrients and biochemical oxygen demand (BOD). This, combined with the lack of sufficient re-oxygenating riffle features, reduced dissolved oxygen within the water column. Water quality also was diminished due to raised turbidity from bank erosion and elevated water temperatures caused by the lack of tree shading. Habitat potential was reduced by the diminished water quality and loss of physical habitat such as bed features, woody debris, and a well developed vegetative community.

Based on the above site conditions, the goals and objectives achieved by this project include:

Goals achieved:

- Improved water quality, and
- Re-established and improved terrestrial and aquatic habitat and diversity.

Objectives achieved:

- Removed excess nutrients and sediment through the use of vegetative buffers,
- Increased dissolved oxygen concentrations through the use of in-stream structures and the turbulence they produce in pools,
- Stabilized stream banks using bioengineering and/or natural channel design techniques,

- Improved substrate through the use of structures and the elimination of major on-site sediment sources,
- Created habitat diversity by introducing woody structures such as log vanes and rootwads,
- Reduced temperature by restoring canopy in the buffer areas,
- Controlled the invasive exotics by removing them during construction,
- Preserved stable on-site streams and riparian buffers draining into the enhancement/restoration reaches,
- Excluded livestock through fencing,
- Improved crossings by replacing pipes and/or stabilizing outfalls,
- Created vernal pools and oxbow lakes, and
- Protected site assets through the recordation of a conservation easement.

The design of the restoration reaches at the site employed a Rosgen Priority 1 restoration approach. Morgan Creek and the downstream sections of UTs 1 through 7 were restored using this technique (see **Figure 2**). Morphological data from the reference reach, piedmont rural regional curves, regime equations, and the existing channel morphology were used to determine the proper dimension, pattern, and profile of the proposed channels. Morgan Creek and the downstream reaches of UT1 through UT7 were designed as Rosgen C type channels. Reaches in the steep valleys were designed as Rosgen B or Bc type channels.

The middle section of UT1 was enhanced (enhancement level I) through livestock exclusion fencing, supplemental buffer plantings, and the stabilization of a severely eroding logging road. The eroding logging trails adjacent to the easement were stabilized through standard forestry best management practice (BMP) techniques such as water bars, sediment check dams, erosion control fabric, straw wattles, and seeding and straw. Livestock was excluded through fencing to minimize stream impacts.

The middle sections of UT2, UT3, and UT5 were all enhanced (enhancement level II) through livestock exclusion fencing.

Stable reaches of UT1, UT2, UT3, UT5, UT8, and UT9 and their riparian buffers were preserved. All stream reaches (restoration, enhancement, and preservation) are protected with a recorded permanent conservation easement (see **Figure 2**).

The riparian buffer of the entire easement was planted in five zones. Zone 1, the stream bank zone, consists of planted tree and shrub species and seeded native herbaceous species typically found along stream banks in the region. Zone 2, a forested riparian area, consists of selected tree and shrub species that are tolerant of inundation and saturation. Zone 3, an upland zone, was planted with tree and shrub species less tolerant of inundation and saturation. Zone 4 is a transitional zone between the other zones and the conservation easement. It includes a mixture of light-tolerant, canopy, and understory

species. Zone 5 includes areas that already had appropriate native forest vegetation. In these areas, supplemental tree and shrub species were planted as needed. Zone 1 was planted with live stakes, and Zones 2 through 5 were planted with bare root seedlings. Plant spacing was determined according to planting type.

Inspection of the vegetation plots during the baseline monitoring phase showed that the planting density matched the density prescribed in the planting plan. It should be noted that Zone 5 plantings in currently forested areas are supplemental. As a result, the actual densities may reflect the spacing of mature forested areas.

**Table 3: Mitigation Summary by Reach**

<b>Project Stream</b>	<b>Stream Restoration (linear feet)</b>	<b>Stream Enhancement Level I (linear feet)</b>	<b>Stream Enhancement Level II (linear feet)</b>	<b>Preservation (linear feet)</b>	<b>Total</b>
Morgan Creek	4,821	-	-	-	4,821
UT1	507	1,797	0	1,569	3,873
UT2	162	-	120	928	1,210
UT3	583	-	807	559	1,949
UT4	192	-	-	-	192
UT5	275	-	703	0	978
UT5	0	-	700	454	1,154
UT6	460	-	-	-	460
UT7	692	-	-	-	692
UT8	163	-	-	1,693	1,856
UT9	0	-	-	2,288	2,288
<b>Total Site</b>	<b>7,855</b>	<b>1,797</b>	<b>1,629</b>	<b>7,491</b>	<b>18,772</b>
<b>Total SMUs</b>	<b>7,855</b>	<b>1,198</b>	<b>652</b>	<b>1,498</b>	<b>11,203</b>

**Table 4: Mitigation Summary**

<b>Contract Stream Mitigation Units (SMUs)</b>	<b>As-built Stream Mitigation Units (SMUs)</b>	<b>Contract Wetland Mitigation Units (WMUs)</b>	<b>As-built Wetland Mitigation Units (WMUs)</b>
11,118	11,203	-	-

### Modifications to the Restoration Plan and Construction Plan Summary

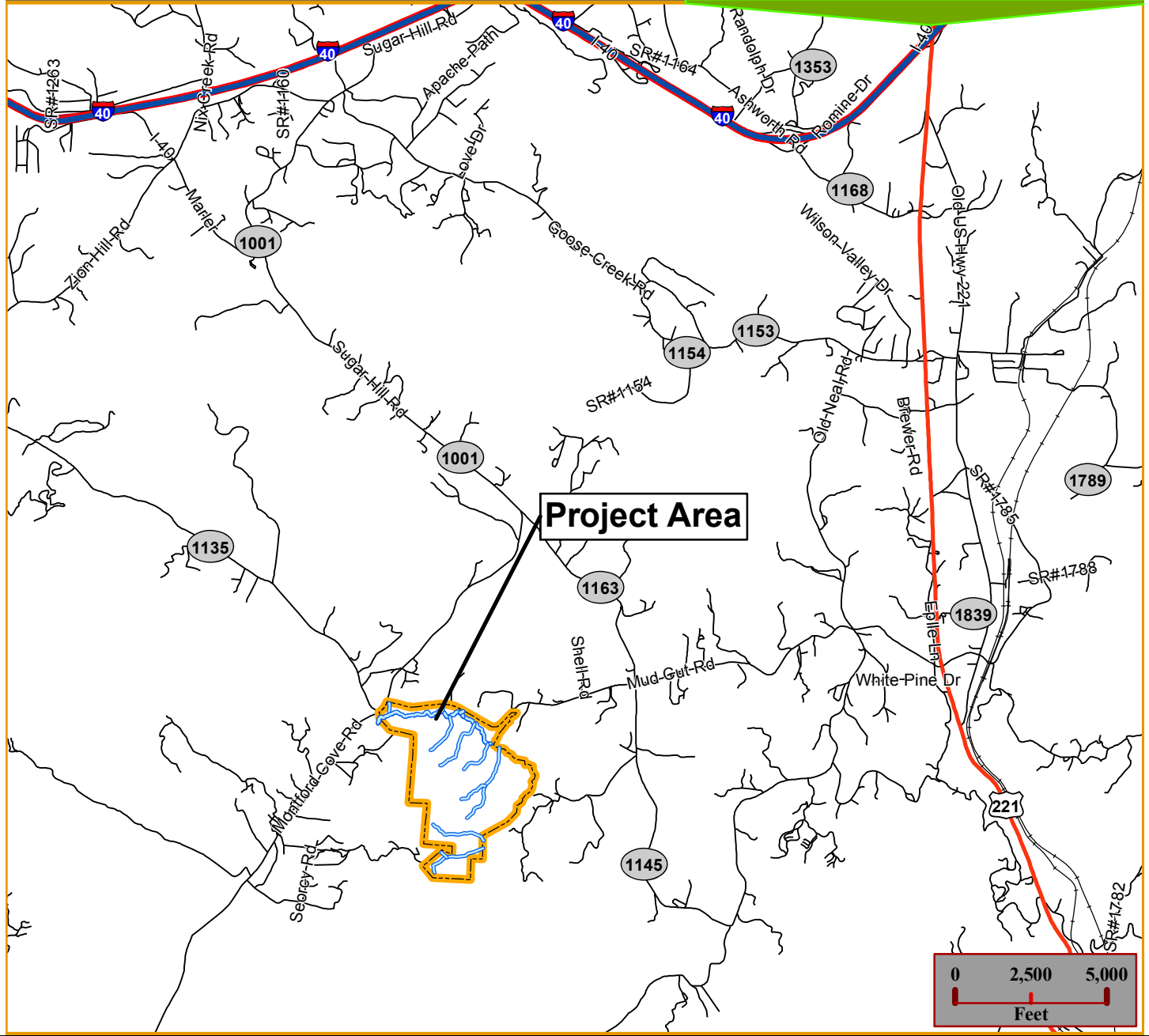
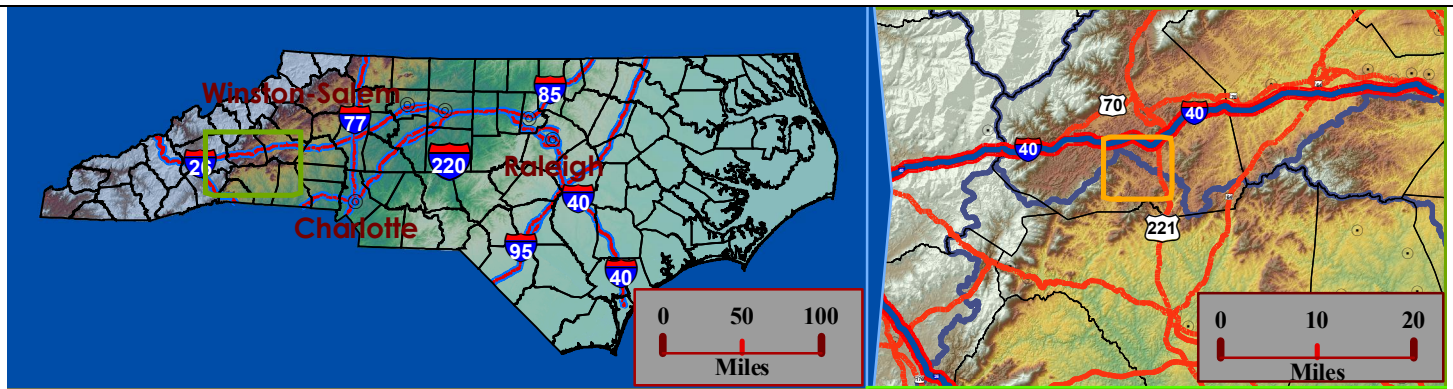
The following paragraphs summarize the changes made after the restoration plan was approved. These changes all were minor in nature and did not affect the overall design approach and restoration intent. They occurred during the creation of the construction drawings or during construction.




All of the project restoration reaches were designed with a Rosgen Priority 1 technique. Overall, the design patterns of these reaches were constructed as designed, except for small sections of UT3 and UT4. The pattern on these two sections was adjusted slightly to avoid large hardwood trees.

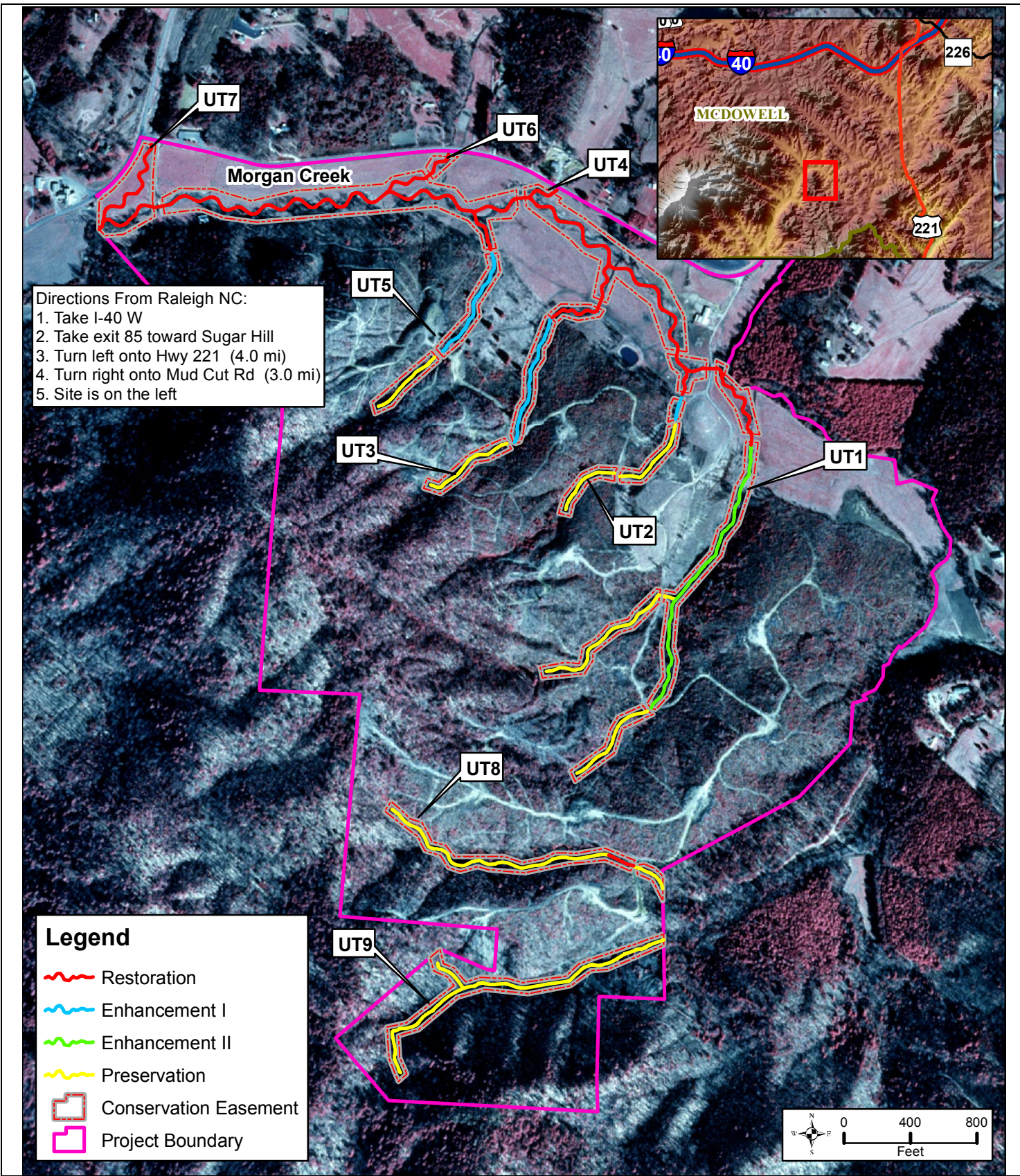
Five vernal pools/oxbow lakes were created along Morgan Creek, and one was created near UT3. These features all are contained within the conservation easement and were constructed to help balance earthwork and further enhance habitat. These features also will provide additional off-line habitat. Inlet and outlets were constructed on each of these oxbow features at the half bankfull elevation to allow fresh water and aquatic species to enter during rain events.

A few in-stream structures were moved on-location or were not constructed due to site conditions. There were no modifications to the structure types listed in the restoration plan (e.g., rock cross vanes, A-vanes, step-pools, boulder sills, constructed riffles, log vanes, and rootwads). Several of the step-pools (UT1, UT2, UT3, and UT7) were modified from a series of A-vanes to a rock cross vane in conjunction with a series of boulder sills. The purpose of this modification was to preserve the intent of a Priority 1 restoration upstream and to allow a maximum drop of one-half foot between the structures.




**Title** Vicinity Map

Submitted to: 	<b>Project</b>	Morgan Creek Stream Restoration Site McDowell County, North Carolina		
	<b>Date</b>	<b>Project Number</b>	<b>Figure</b>	
	9/25/08	16-D06027	1	



**Title** Project Component/Asset Map

Submitted to: 	<b>Project</b>	Morgan Creek Stream Restoration Site McDowell County, North Carolina		
	<b>Date</b>	<b>Project Number</b>	<b>Figure</b>	
	9/25/08	16-D06027	2	

## **Monitoring Plan**

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by *Stream Mitigation Guidelines* disseminated by the United States Army Corps of Engineers – Wilmington District and recommendations from the North Carolina Ecosystem Enhancement Program (EEP). The collection and summarization of monitoring data will be conducted in accordance with the most current version of the EEP documents entitled “Content, Format, and Data Requirements for EEP Monitoring Reports.”

Monitoring will occur annually for five years and include reference photographs, materials sampling, site survey, visual assessment, and mapping of significant features. The success criteria and assessment methods for the site’s streams and riparian buffer are provided below.

### **Stream Monitoring**

#### **Success Criteria**

The stream geometry will be considered successful if the cross-section geometry, profile, and sinuosity are stable or reach a dynamic equilibrium. It is expected that there will be changes in the designed cross sections, profile, and/or substrate composition. Changes that may occur during the monitoring period will be evaluated to determine whether they represent a movement toward a more unstable condition (e.g., down cutting or bank erosion) or an increase in stability (e.g., settling, vegetative changes, coarsening of bed material, braiding in areas of flatter slopes, etc.).

Deviation from the design ratios will not necessarily denote failure as it is possible to maintain stability and not stay within the design geometry. Changes to the as-built hydraulic geometry may occur due to natural processes of channel adjustment.

#### **Assessment Methods**

Sixteen permanent cross sections have been installed at unique stream segments throughout the project site. The cross sections represent 10 riffles and six pools. Annual photographs showing both banks will be taken for each cross section.

Four longitudinal profile sections have been installed totaling 3,108 linear feet of survey. UT1 consists of 378 linear feet, Morgan Creek (MC)-Upper consists of 1,424 linear feet, MC-Lower consists of 1,054 linear feet, and UT6 consists of 252 linear feet of surveyed profile.

Photo stations were established to capture the condition of the channel and vegetation plots. Seventy permanent photo stations and eight vegetation plot photos have been established.

The restored and enhanced stream reaches will be investigated for channel stability and in-stream structure functionality. Evidence of channel instability will be identified, mapped, and photographed. Structures will be inventoried for functionality.

## Riparian Buffer

### **Success Criteria**

The success of riparian vegetation planting will be gauged by stem counts of planted species. Riparian vegetation will be considered successful with the survival of 260 planted stems per acre at the end of the fifth year of monitoring. Survival of 320 planted stems per acre at the end of the third year of monitoring will serve as an interim success criterion. Photos taken at established photo points should indicate maturation of riparian vegetation community.

### **Assessment Methods**

The success of vegetation plantings will be measured through stem counts. Fourteen permanent plots will be used to sample the riparian buffer and restoration wetlands. Each quadrant covers 100 square meters. During the counts, the health of the vegetation will be noted. The vegetation survey will occur during the growing season. Permanent photo points have been set up for each plot.

## **References**

- McLendon, Scott, Becky Fox, Todd St. John, et al. (2003). Stream Mitigation Guidelines. United States Army Corps of Engineers - Wilmington District, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission, and North Carolina Department of Natural Resources - Division of Water Quality.
- Rosgen, David L. (1995). A Geomorphic Approach to Restoration of Incised Rivers. Management of Landscapes Disturbed by Channel Incision.
- Mathis Jr., Roy L. (1995). Soil Survey of McDowell County, North Carolina. Natural Resources Conservation Service, United States Department of Agriculture.

**Attachment 1**  
Record Drawings

(See Record Set separate from this  
document – dated 09/24/2008)

# **Attachment 2**

## **Baseline Monitoring**

(Equinox Environmental Consulting and Design, Inc.)