

IMPLEMENTATION OF NATURAL CHANNEL DESIGN ON TWO GEORGIA POWER STREAM RESTORATION PROJECTS

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Abstract. A natural channel design approach was implemented to restore Sawmill Creek in Rabun County, Georgia, and an unnamed tributary of the Etowah River in Dawson County. Both properties are owned by Georgia Power Company. After five years the Sawmill Creek restoration reach has successfully endured multiple bankfull events with no failures of structures. The implemented design has successfully met the objective of providing aquatic habitat while restoring the sediment transport competence of the stream and reducing shear stress on the channel banks.

The unnamed tributary of the Etowah River contained the Cherokee Darter downstream and upstream of the 350-foot restoration reach but not within the degraded reach. The objectives of the natural channel design were to reconnect the stream with the floodplain (priority 1 restoration); to restore the proper pattern, profile and dimension; and to restore darter habitat. An aquatic assessment three years after the restoration confirmed that the Cherokee Darter has inhabited the restoration reach.

INTRODUCTION

Georgia Power has implemented a natural channel design approach to restore two stream reaches in northern Georgia. An 1100-foot reach was restored on Sawmill Creek in Rabun County in December 1999. The goal of the project was to restore the reach to a stable form which is defined as the capacity to transport the sediment bedload and maintain the proper pattern, profile and dimension. In addition, the creek is a trout fishery and the purpose of the restoration was to improve and provide trout habitat. The restoration reach has successfully endured several major storm events including the tropical storms in the fall of 2004.

A 250-foot reach was restored in 2001 on an unnamed tributary of the Etowah River in Dawson County. The purpose of the restoration was to reconnect the stream with the floodplain (priority 1 restoration); to restore the proper channel geometry; and to improve darter habitat. Previous to the restoration, aquatic assessments documented that the Cherokee Darter was known to occur upstream and

downstream of the restoration reach but not in the degraded reach. In the summer of 2004, findings of an aquatic assessment confirmed that the Cherokee Darter has inhabited the restoration reach.

SAWMILL CREEK, RABUN COUNTY

Background

The 1100-foot reach of Sawmill Creek was targeted for restoration by Georgia Power due to failing banks and excessive accumulation of sediment bedload material in the channel. These conditions were a direct result of check dam structures that were installed 10 to 15 years ago to create pools for trout habitat. The channel was in an unstable form due to the check dam structures.

Sawmill Creek was classified as a B4c stream type prior to restoration (Rosgen 1996), and the watershed area is 3.3 square miles. The restoration reach is a riffle and pool channel with a channel slope of 1.2 percent. The valley type is a fault-line valley which is structurally controlled and dominated by colluvial slope building processes. The pre-restoration channel had a low sinuosity of 1.1 and an entrenchment ratio of 1.3. The mean width/depth ratio was 19.0. The D50 channel bed materials were 4mm.

Methods

Regional curves for channel dimensions at bankfull discharge have not been published for the Georgia Blue Ridge Mountain Province. Channel dimension data were collected and analyzed for a USGS gaging station on the Tallulah River above Lake Burton. The bankfull discharge (2300 cfs) was field calibrated to the gage using bankfull indicators. Using the published gage height/discharge rating table, flood frequency data, and stream discharge notes for the Tallulah River gage station (#02178400), an annual peak flow frequency analysis determined that the return interval for bankfull discharge is 1.37 years for the Tallulah River gage station. This assessment allows prediction of probable channel dimensions (width, depth, and cross-sectional area) of the Sawmill Creek restoration reach without gage station discharge data specifically for Sawmill Creek.

A 500-foot reach of nearby Moccasin Creek was identified as a suitable reference reach located in the same hydro-physiographic province and is a similar stream type. The Moccasin Creek reach has a 6.6 square mile watershed and is a B3c stream type. Dimensionless ratios, calibrated to bankfull, were calculated for reference conditions for the Moccasin Creek reference reach. The dimensionless ratios were then used to calculate stable channel dimensions and profile characteristics for Sawmill Creek.

Design considerations

The restoration reach at Sawmill Creek had deviated from a stable form with respect to several channel parameters. Most substantially, the channel dimension and profile were adversely affected by the rock check dam structures. Sawmill Creek is confined by the adjacent slopes. As a result, the channel pattern had not been altered; therefore, adjustment of the natural plan form was not necessary. The project was permitted by the Corps of engineers under a Nationwide Permit 27.

Channel dimension. The target riffle bankfull width was 25 feet and the target riffle bankfull mean depth was 1.3 feet. The target width/depth ratio was 19 which was less than the reference of 27 but within the acceptable range of B4 stream types (Rosgen 1996). The bankfull width was typically wider than target. The target bankfull width and depth were adjusted by the installation of rock cross vanes. The constructed design required eight rock vane structures to be installed

The existing mean pool depth was 2.2 feet with a pool maximum depth to riffle mean depth ratio of 1.7. Due to the resultant loss of stream power upstream of the check dam structures, the pool maximum depth was only 0.3 feet deeper than the riffle maximum depth. Reference data indicated that the pool maximum depth to riffle mean depth ratio should be 2.6. Using the dimensionless ratio of 2.6, the target pool maximum depth was designed at 3.4 feet.

Channel profile. Originally, Georgia Power had installed 16 rock check dam structures to create pool habitat for trout. These structures were installed over a distance of 600 feet, which resulted in a pool-to-pool spacing of 38 feet or a dimensionless ratio of pool spacing to bankfull width of 1.5. The channel profile was adjusted by first removing the rock check dam structures. The target pool-to-pool spacing based on reference conditions was designed at 2 to 2.5 times bankfull width. This resulted in a pool spacing of 50 to 65 feet.

Based on reference conditions the riffle slope to channel slope ratio was found to be 2.0. The average existing riffle slope was 0.008 feet/feet. The flat riffle slopes were due to the loss of the ability of the channel to transport the

sediment bedload which resulted in excessive sediment accumulation and formation of mid-channel bars. Based on the reference dimensionless ratio of 2.0, the designed riffle slope was 0.024 feet/feet.

Revegetation. Native species were used for revegetation on the channel banks. Living mats of dog-hobble (*Leucothoe axillaris*) were mechanically removed with a skid-steer from the floodplain upstream of the restoration reach. These mats were relocated to the restoration reach. In addition, live stakes of alder (*Alnus serrulata*) were installed.

Conclusions

In the four years since construction there have been no substantial deviations from the target conditions constructed in December 2000. A minor adjustment was needed to one cross vane structure soon after construction. There have been numerous bankfull events including several major tropical storms. One of the biggest events was a tropical storm on September 18, 2004. At nearby Rabun Gap, 14 inches of rain were recorded at a peak rate of 7.5 inches per hour. After this event, no maintenance on the structures, the channel features, or channel banks was necessary within the restoration reach. The channel has been successfully restored to a stable form and the stream has maintained the capacity to transport the sediment bedload.

TRIBUTARY OF THE ETOWAH RIVER, DAWSON COUNTY

Background

A 650-foot reach of a direct tributary of the Etowah River was targeted for restoration by Georgia Power in May 2001. The stream reach had been relocated and channelized at some unknown time in the past and was in an unstable form. These conditions resulted in low quality habitat for the Cherokee Darter. The objectives of the natural channel design were to reconnect the stream with the floodplain (priority 1 restoration); to restore the proper pattern, profile and dimension; and to improve darter habitat.

The tributary was classified as a G4c stream type prior to restoration (Rosgen 1996), and the watershed area is 0.74 square miles. The restoration reach was a riffle and pool channel with a channel slope of 1.1 percent. The valley type is a fault-line valley which is structurally controlled and dominated by colluvial slope building processes. The pre-restoration channel had a high sinuosity (1.6) due to unstable banks and accelerated lateral migration. The mean width/depth ratio was 8.6 and in some areas was as low as 5.0. The D50 channel bed materials were 8mm.

Methods

Regional curves for the Piedmont developed by North Carolina State University were used to assist in the modeling of the hydraulic geometry. Channel dimension data were collected and analyzed for a USGS gaging station on Fausett Creek near Talking Rock (#02381600). The bankfull discharge (399 cfs) was field calibrated to the gage using bankfull indicators. Using the published gage height/discharge rating table, flood frequency data, and stream discharge notes, an annual peak flow frequency analysis determined that the return interval for bankfull discharge is 1.3 years for the Fausett Creek gage station. This assessment allows prediction of probable channel dimensions (width, depth, and cross-sectional area) of the restoration reach. A 325-foot reach of a nearby unnamed tributary in the Dawson Forest was identified as a suitable reference reach since it is located in the same hydro-physiographic province and is a similar stream type. The reference reach has a 0.55 square-mile watershed and is a B4c stream type. Dimensionless ratios, calibrated to bankfull, were calculated for reference conditions for the Dawson Forest reference reach. The dimensionless ratios were then used to calculate stable channel dimensions and profile characteristics for the restoration reach.

Design considerations

The restoration reach had been relocated at some unknown time in the past by previous landowners and was severely degraded. Over time, the channel had migrated laterally and displayed excessive sinuosity. The restoration reach had deviated from a stable form with respect to several channel parameters. Channel dimension, profile, and pattern were in an unstable form. Consultations with Robyn Goodloe at U.S. Fish and Wildlife Service regarding Cherokee Darter habitat were taken into consideration in the natural channel design. The project was permitted by the Corps of engineers under a Nationwide Permit 27.

Channel Pattern. In some areas of the floodplain it was possible to identify features indicating the location of the original channel. The restored channel was relocated in the original location where feasible. The sinuosity was reduced from 1.66 to 1.16.

Channel dimension. The target riffle bankfull width was 14 feet and the target riffle bankfull mean depth was 1.2 feet. The target width/depth ratio of 12 was similar to the reference of 11.7. The existing bankfull width of 9.8 feet was narrower than the target of 14 feet. The target bankfull width and depth were adjusted by the installation of rock cross vanes. The constructed design required six rock vane structures to be installed.

The reach ended at a road crossing where a series of four pipes were installed. Two pipes were sized for the bankfull discharge cross-sectional area. One of the bankfull discharge pipes was at an invert elevation of 0.5 feet lower than the second bankfull discharge pipe. This allowed fish passage at base flows. Two additional pipes were set with an invert at bankfull discharge elevation. These floodplain pipes were designed for a 25-year storm event. There was also a road crossing above the beginning of the restoration reach. This was a hanging pipe and was not adjusted.

Channel profile. The target pool-to-pool spacing based on reference conditions was designed at three times bankfull width. This resulted in a mean pool spacing of 40 feet. Glides are important features in any channel restoration. Glides serve as grade control for the riffle section and assist in dissipation of energy. With respect to the Cherokee Darter, glides are important habitat features. Piedmont reference data indicate that the glide section should be no less in length than the bankfull width.

Revegetation. Native species were used for revegetation on the channel banks. Banks were stabilized with 700-gm coir mats and seeded with a mix of Virginia wild rye (*Elymus virginicus*), and Canadian wild rye (*Elymus canadensis*). In addition, live stakes of black willow (*Salix nigra*) and silky dogwood (*Cornus amomum*) were installed.

Conclusions

The restoration reach maintained a stable form but was impacted by the September 18 tropical storm event. The first cross vane structure below the existing road crossing pipe was compromised by excessive shear stress because the pipe was undersized for such a large storm event. This is scheduled for repair. In addition, the tropical storm event carried an excessive sediment load from severe erosion upstream. This sediment load filled the lower three pools in the restoration reach. These pools will be adjusted as well.

During the summer of 2004, an aquatic inventory documented that the Cherokee Darter has inhabited the restoration reach.

LITERATURE CITED

Rosgen, D. 1966. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.