REEDY BRANCH
STREAM RESTORATION
MONITORING YEAR 1 REPORT
AUGUST 2005

DESIGN BID BUILD PROJECT

CONSULTANT: ECOLOGIC

MY1 (2005) Reedy Branch Monitoring Report

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Tables, Photos and Figures

Introduction

Reedy Branch was restored through the North Carolina Wetlands Restoration Program (NCWRP), now known as the North Carolina Ecosystem Enhancement Program (NCEEP). The goals and objectives of this project are as follows:

1. Improve water quality by reducing the sediment load generated by eroding banks and by restoring a riparian buffer;
2. Reestablish stable channel dimension, pattern, and profile;
3. Restore a functioning floodplain;
4. Enhance aquatic and terrestrial habitats in the stream corridor; and
5. Assist the landowner to dedicate the entire floodplain as a wildlife area.
6. Provide at least one stable cattle crossing across the main channel.

This is the 1st year of the required 5-year monitoring period for Reedy Branch.

Table 1. Background Information

Project Name	Reedy Branch			
Designer's Name	EcoLogic Associates, P.C. 4321-A South Elm-Eugene Street, Greensboro, NC 27406 336-335-1108			
Contractor's Name	Phillips and Jordan, Inc. 8245 Chapel Hill Road Cary, NC 27513 919-388-4222			
Project County	Alamance County			
Directions to Project Site	The site can be accessed from Quackenbush Road (SR 2354), which crosses Reedy Branch at the northern end of the project. The landowners for this project are Deborah and Sam Kiser (1957 Quackenbush Road, Snow Camp, NC, 27349). The project starts at the property line southeast of the landowners' house, at the point where the creek enters their property, and ends where the creek passes under Quackenbush Road.			
Drainage Area	1.6 sq. mi.			
USGS Hydro Unit	03030002			
NCDWQ Subbasin	030604			
Project Length	3,155 linear feet (Restoration)			
Restoration Approach	3,155 linear feet of dimension, pattern, and profile			
	14.5 acres of floodplain in conservation easement			
Date of Completion	Construction: Nov 2003		Planting: Jan 2005	
Monitoring Date	Feb 2005			

Table 2. Summary of Channel Conditions						
DIMENSION	Reedy Branch					
	Riffle		Pool			
	As-built	MY1 2005	As-built	MY1 2005		
Bankfull Cross-sectional Area	22.5	26.25	63	65		
Bankfull Width	18.5	20.5	33	25		
Bankfull Mean Depth	.9	.75	1.4	1.4		
Bankfull Max Depth	2.4	2.7	4.6	5.1		
PATTERN	Reedy Branch					
	As-built	MY1 2005				
Meander Wave Length	120	120				
Radius of Curvature	43	43				
Belt width	34	35				
PROFILE		Reedy Branch			Reedy Branch	
	As-built			MY1 2005		
	Minimum	Maximum	Median	Minimum	Maximum	Median
Riffle Length	7	35	16	8	38	17
Riffle Slope	.0011	.041	.010	.0011	.05	.015
Pool Length	16	41	29.2	16	40	29
Pool to Pool Spacing	29	150	59	27	152	59
SUBSTRATE	Reedy Branch					
	Riffle		Pool			
	As-built	2005	As-built	2005		
d50	0.8mm	1.0mm	0.8mm	0.4mm		
d85	7mm	17mm	6mm	9mm		
VEGETATION						
The woody trees and shrubs were only planted about 2 months before the first year monitoring survey.						
No vegetation monitoring was done at this time.						

Overview of Results

The Reedy Branch stream restoration was conducted for the North Carolina Ecosystem Enhancement Program on the Kiser Farm in Snow Camp, NC. The landowner was and continues to be interested in the process and the results. It was his original intent to exclude the cattle from the floodplain and allow the area to become home to wildlife that initiated this project.. Prior to the restoration, the creek had steep failing banks, completely cattle trampled aquatic habitat, heavily browsed riparian and floodplain vegetation, and several areas of planform instability, bank erosion and frequent log and debris jams.

The restoration adjusted the channel dimension and planform to effect more bank stability and in-stream aquatic habitat. The cattle were excluded from the entire valley with the exception of two cattle crossings. A conservation easement was placed on the entire floodplain through the farm. There are some small ponds on the upland areas and limited alternative watering, so it does not appear that the cattle are using the crossings for drinking access. The profile of the creek was adjusted within the limits set by bedrock and rock outcrops that occur throughout the Kiser Farm floodplain. As can be seen by the longitudinal profiles, there is a relatively flat section at the head of the reach, then a steep drop through a bedrock and boulder dominated area (referred to as the "boulder field"), and then a lower section of flatter slope. The majority of stream restoration work occurred in the two flatter sections, with some isolated bank repairs and riparian replanting in the boulder field.

The restoration goals included improving bank stability and in-stream feature morphology, all while saving as much of the native forest vegetation as possible. In some cases, minor changes to the proposed planform were made to save large trees or avoid bedrock that was discovered during channel digging. In addition, there are several small wetlands that occur adjacent to the proposed channel and these were all protected and enhanced during the construction phase. Our monitoring visit in February 2005 found that many of these wetland pools were being used by amphibians, and several types of egg masses were noted over the spring months.

The site is located in the Carolina Slate belt, a region known for shallow soils and high levels of run-off during storm events. The creeks in this area often dry up during the summer months. The landowner tells us that Reedy Branch had been essentially dry with only standing pools of water during the entire three years of drought that preceded restoration. During the initial site survey and the subsequent design period, the creek was completely dry. During construction, a few rain storms occurred and ultimately the project was impacted by the remnants of several hurricanes during the fall of 2004. With the exception of the stream crossing fencing catching a lot of debris and pulling down a section of cattle exclusion fence, there has been no damage resulting from the high flows. Only one section of run-on erosion and one leaking cross vane needed warranty repair. The landowner fixed the cattle crossing fence on his own with help from the local County Extension office.

The woody live stakes and bare root trees were just been planted in January 2005. In most locations of the new construction, there is significant growth of herbaceous vegetation and adjacent mature trees, which do a good job of stabilizing the site. In some locations, the herbaceous vegetation might actually outcompete the newly planted woody vegetation. During one site visit, we noted that the live stakes had not been properly planted, in most cases only 2-3 inches of a stake was in the ground and more than a foot was sticking up untrimmed. We found a few in a cursory inspection that were installed upside-down.

Photographs

Photo 1. This is the reference riffle cross section (Station 1+05).

The low flow channel has good depth and width throughout the reach with patches of gravel starting to occur on the riffles. Good pool depth but much of the channel bottom is covered in fine silt that causes a milky cloud when disturbed. At medium flows the channel runs white like milk. At low flows the water is tannic brown.

Photo 2. Pool cross section (Station 26+80).

The outside of this bend is where one of the most stable pools occurs, other than the plunge pool below each cross vane. The low flow depth is over 1.5 feet, just off the coir matting in the bank; bankfull depth is consistent with the design d_{max} of 3.5 feet.

Photo 3. Cross vane with center section shifted and piping at several locations.

At high flows the arms of the cross vane accumulate sediment and protect the banks. This was corrected as a warranty repair.

Photo 4. Storm damage to cattle crossing fence.

The landowner fixed this, at his own expense, by resetting and bracing the posts and replacing most of the horizontal wire with swinging cattle panel.

Photo 5 Reedy Branch in winter.

Note the good, thick, herbaceous riparian vegetation and general wooded valley.

Photo 6 Reedy Branch in summer.

Note the lush herbaceous vegetation that averages 1 meter tall and the frequently closed canopy of mature trees left in place during the restoration.

1.0 BACKGROUND INFORMATION

1.1 Goals and Objectives

The goals and objectives of this project are as follows:

1. Improve water quality by reducing the sediment load generated by eroding banks and by restoring a riparian buffer
2. Reestablish stable channel dimension, pattern, and profile
3. Restore a functioning floodplain
4. Enhance aquatic and terrestrial habitat in the stream corridor
5. Provide at least one stable cattle crossing across the main channel.

1.2 Project Location

Reedy Branch is in south-central Alamance County, directly east of the town of Snow Camp. The site can be accessed from Quackenbush Road (SR 2354), which crosses Reedy Branch at the northern end of the project. The landowners for this project are Deborah and Sam Kiser (1957 Quackenbush Road, Snow Camp, NC, 27349). The project starts at the property line southeast of the landowners' house, at the point where the creek enters their property, and ends where the creek passes under Quackenbush Road.

Reedy Branch is a tributary of Cane Creek and the Haw River in the Cape Fear River Basin. The Reedy Branch watershed above the restoration reach drains about 1.6 square miles. The creek starts about one-half mile south of the Alamance and Chatham County line and flows generally north to its confluence with Cane Creek, about 1.6 miles east of Snow Camp, NC. The watershed consists primarily of woodland and farmland. The agricultural land use is a combination of row crops and animal grazing. The row crops include silage corn, winter wheat, soybeans and a few others. The primary animal grazing is cattle. Historically, this region has been a dairy farming area; however, most of the dairy farms were converted to beef cattle in recent years.

The Kiser farm is a mixture of cattle grazing and chicken production. There are four modern chicken houses within sight of the restoration reach with a population of about 500,000 birds. Some of the chicken litter is land applied to the pastures surrounding the restoration floodplain while some is trucked to adjoining farms nearby.

1.3 Project Description

The entire project is on the property of one landowner. The landowner was willing to donate a conservation easement over the entire floodplain following the restoration work. They have been very helpful and understanding and should be good stewards of this conservation site. The current owners have been on the property for about 15 years. Current land use in the valley

includes pasture and hayfields and a large poultry house on the site above the main channel. The restoration reach runs through a forested but heavily browsed floodplain.

The Reedy Branch restoration site is located in a relatively low-slope Piedmont valley in the Carolina Slate Belt. It is a second order tributary to Cane Creek in the Haw River Basin. In the immediate area of the restoration reach, there are lots of bedrock outcrops and areas mapped in the soil survey as "stony areas". The watershed size and its geology makes the stream very dynamic and flashy. During periods of drought, it has been known to dry up completely. However, even mild rainfall is shed off the shallow rocky soils, which results in a fast rise and fall of the creek in response to storm events. Many areas of the original channel are controlled by bedrock both in elevation and planform. There is also a section just above the middle of the project that is a bedrock and boulder field. It exhibits a steeper slope than the upstream and downstream segments of the project.

Cattle pasture makes up most of the land use on adjacent uplands above the floodplain containing the restoration reach. The cattle historically had access to the entire floodplain and crossed the creek at many locations. Therefore, the creek was essentially a series of muddy pools in an entrenched and eroding channel. Cattle had complete access to the creek and would walk its length in search of water. In most places the banks were shear, undercut and 4-5 feet tall. Because of the heavy cattle traffic, the channel had lost almost all of its in-stream structure and aquatic ecological function.

The cows had also browsed most of the trees and shrubs on the floodplain below 5 feet and had also eliminated most herbaceous species that are edible. This leaves a floodplain dominated by Japanese grass and perilla with a few other species of herbs.

The restoration consisted of the construction of a smaller channel dimension (cross-sectional area) and the restoration of stable planform geometry. Cross vanes, single arm weirs and existing bedrock all were used to control grade at the tops of riffles. Root wads were used to protect the outside of meander bends. In the interest of reducing the bank height ratio, vertical banks were laid back to create a bankfull bench and to establish a more stable growing surface. The planform geometry of the creek also required adjustment to a more stable meander pattern that eliminated some over-sharp, eroding curves in the existing channel. The narrow confines of the valley required that the new channel cross the existing channel at several locations. These crossing points required clay channel plugs to prevent water from seeping into the old channel.

The tie-in to natural grade was done at the upper end using a cross vane located slightly downstream of a bedrock outcrop on the upstream property. The downstream tie-in is at a bedrock outcrop just upstream of the bridge on Quackenbush Road. The natural substrate of the stream was not altered during construction.

Upon completion of the restoration, the cattle were fenced out of the entire floodplain, which was placed under a conservation easement by the landowner. Since the creek bisects the Kiser farm, two cattle crossings were constructed across the restoration. The cattle are allowed to access the crossings by fenced pathways. The crossings had a five-strand barbed wire fence spanning the active channel to keep the cows out of the creek. This fence system suffered

significant damage during a flood when the fencing on the upstream crossing accumulated heavy amounts of drift material and the force of the water pushed over the fence and pulled out the fence posts on either side of the crossing. After consulting with the landowner and the Alamance County NRCS office, it was decided to repair this problem by removing the fencing and hanging cattle panels from a cable stretched across the creek. These panels should offer sufficient resistance to the cattle to keep them in the crossing but swing up during storms to allow the drift and water to pass.

2.0 MY1 (2005) Results and Discussion

2.1 Vegetation

The current existing vegetation is a mixture of the remnant natural alluvial community and introduced agricultural weedy and pasture species, and a few invasive exotics. The riparian vegetation corridor varies in width from zero at the cattle crossings to several hundred feet of successional forest. On average, the buffer width is on the order of 150 feet.

The banks of the creek and the floodplain are vegetated with a medium-aged, mixed hardwood forest typical of this area. The canopy includes Red Maple, Sycamores, several Hickory and Oak species, Boxelders, Green Ash, Tulip Trees, Sweet Gum and Virginia and Shortleaf Pines. The understory species include Ironwood Dogwood, Sourwood, Red Cedar, Slippery Elm, American Holly, Hackberry and juveniles of the canopy tree species. The shrubs include Spicebush, Buckthorn, Multiflora Rose and Strawberry Bush. There are also several areas with thick growths of Japanese Honeysuckle, Greenbrier, Poison Ivy and Blackberry Brambles. There are herbs in areas having few trees including mixtures of native and introduced grasses such as Blue Grass, Orchard Grass, Timothy, Fescue, bromes, vetches, clover, Wingstem, Japanese Stilt Grass, several sedges, Soft rush, Christmas Fern, Grape Ferns, False Nettle, Asters, native Sunflower species and Goldenrods.

The post-construction planting of this project was handled directly by NCEEP and was not supervised or coordinated by EcoLogic. The planting occurred 14 months after the completion of construction. The planted woody riparian species includes live stakes of Black Willow, Silky Dogwood and Elderberry. The bare root woody trees include Green Ash., Tulip Tree, Sycamore, Box Elder, Red Maple, River Birch, Persimmon, Black Gum, Water Oak and Willow Oak.

The live stakes were not planted properly with most of the stakes sticking out of the ground untrimmed and in some cases being installed upside-down. We discovered this during our morphological survey visit (January 2005) and mentioned it to NCEEP's Perry Sugg the following day.

2.2 Morphology

The morphology of the restoration has proven to be very stable in spite of at least 5 bankfull or greater storm events and planting more than a year after the completion of construction. This stability is a result of factors inherent in the site as well as the sensitivity of the design and construction. The site contains a significant amount of bedrock and rock outcrops. These both limited the planform changes that were possible and at the same time were incorporated into the new construction. As a result, there are many areas where native rock forms a portion of the creek bank, was used as a thalweg control structure, functions as grade control, or was built upon as a foundation for a vane or other structure.

The site was constructed in a valley that has a heavy clay soil that is very non-erosive and holds the constructed dimensions well. The valley is almost completely wooded with a range of medium and large trees of several different species, some thick shrubby patches, and a thick growth of native and introduced herbaceous vegetation. The stability of the new channel is also the result of storm flows having access to a wide floodplain of constructed bankfull benches and adjacent low terraces. In many locations, the floodplains have proven to be activated during high flows resulting in the dissipation of storm energy and the deposition of sediments and debris. This takes significant stress off the channel and promotes the stability of the banks and the growth of vegetation. The fact that the landowner is willing to exclude cattle from this wide area of his farm is a testament to his understanding of this project and his good stewardship of the project.

As can be seen by the cross sections, longitudinal profiles, and summary data table, the project is essentially unchanged from as-built to first year monitoring. There is some indication of channel adjustment such as a slight bankfull width increase and subtle changes in riffle and pool geometry and position, but these deviations are likely within the margin of error of the field surveys.

There were three problem areas that needed warranty repairs, which were made in May 2005. One was a small area of run-on erosion down-slope from one of the construction access areas. Another was a cross vane which was leaking, and the third was some storm flow damage to the cattle crossing fences. Two of the repairs were made by Phillips and Jordan, and the cattle crossing was repaired by the landowner.

Figures 4-6 illustrate the particle analysis, cross-section and longitudinal profile comparisons of the as-built survey in 2004 and the first year monitoring survey in 2005. Based on this data and field observations, it is easy to conclude that the restoration is stable and has not changed measurably during this period of observation. Some indications of slight bankfull width increase, pool depth decrease and particle size increase will need to be confirmed in subsequent surveys to confirm their statistical validity.

2.3 Wildlife Habitat

Prior to construction, the creek's aquatic habitat was in very poor shape as a result of the stream instability and the cattle impact. We noted essentially no macroinvertibrates or fish, only one

species of frog in the pools, and some crayfish burrows in the lower banks. The landowner also commented on the lack of aquatic and associated riparian wildlife and expressed his desire that the project improve the habitat for wildlife of all kinds.

After restoration, there was evidence of spring amphibian breeding in the floodplain wetlands (some constructed from the old channel), and more species of frogs and salamanders in the creek. Increased populations of crayfish and new populations of small fish were also noted by the survey staff and the landowner. In addition, the survey staff found otter scat and noted evidence of beaver activity. The landowner stated that he sees birds he has not seen before in the easement area.

2.4 Areas of Concern

There are two areas of continuing concern for this project. One is the poor condition of the live stakes, which resulted from their improper planting. As noted in the field, most of the live stakes were not inserted deep enough into the ground to produce a viable root system. They were also not trimmed so they stick up 12-18 inches and will surely produce more shoots than the new roots can support. We also found a significant number that were inserted in the ground upside-down, which makes their growth and survival even more unlikely. On a related note, the viability of the new bare root seedlings appears satisfactory, but the competition from herbaceous vegetation and remnant canopy trees is fierce. It has yet to be determined if this will be a significant problem, but is worth monitoring.

The other area of concern is the cattle crossing fencing. There are two cattle crossings, each bounded by an upstream and downstream fence. The upper crossing suffered significant damage from storm flows, while the lower crossing was undamaged. The high storm flows of last winter caused lots of drift to accumulate on the wires and the force of the water and weight of the accumulation caused the upstream fence to fail. The failure, shown in photo 4, resulted when the storm flow and ground saturation caused the fence posts to fall. The fence wire stayed intact and remained attached to the posts. Since the movement of cattle is an almost daily requirement, the landowner could not wait until the state approved a repair plan, so he fixed it himself after consulting with the designer and Alamance County Cooperative extension.

The agreed fix was to reinstall the fence posts and remove the horizontal wires crossing the channel. In place of the wires, a single cable was stretched from the top of the creekside posts and a heavy wire cattle panel was hung from the cable. The plan is that the panel will deter cattle from accessing the stream, but will swing up during high flows. On a visit to the site after the repairs were made, it was noted that the landowner did not remove all the horizontal wire from the original installation when he hung the cattle panels. When asked about this, he said he was concerned that there needed to be some resistance if the cattle pushed on the panel and he therefore left some wires in place. It will take more storm events to determine if this is a suitable and permanent fix.

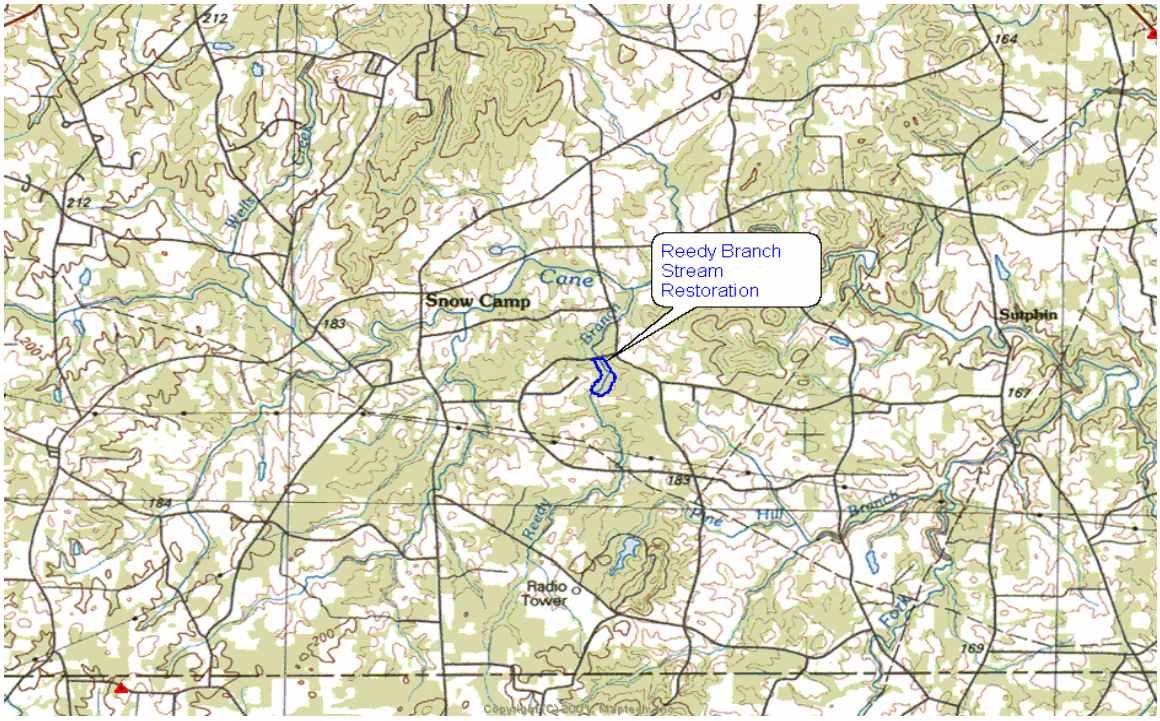


Figure 1 Map of Project Location

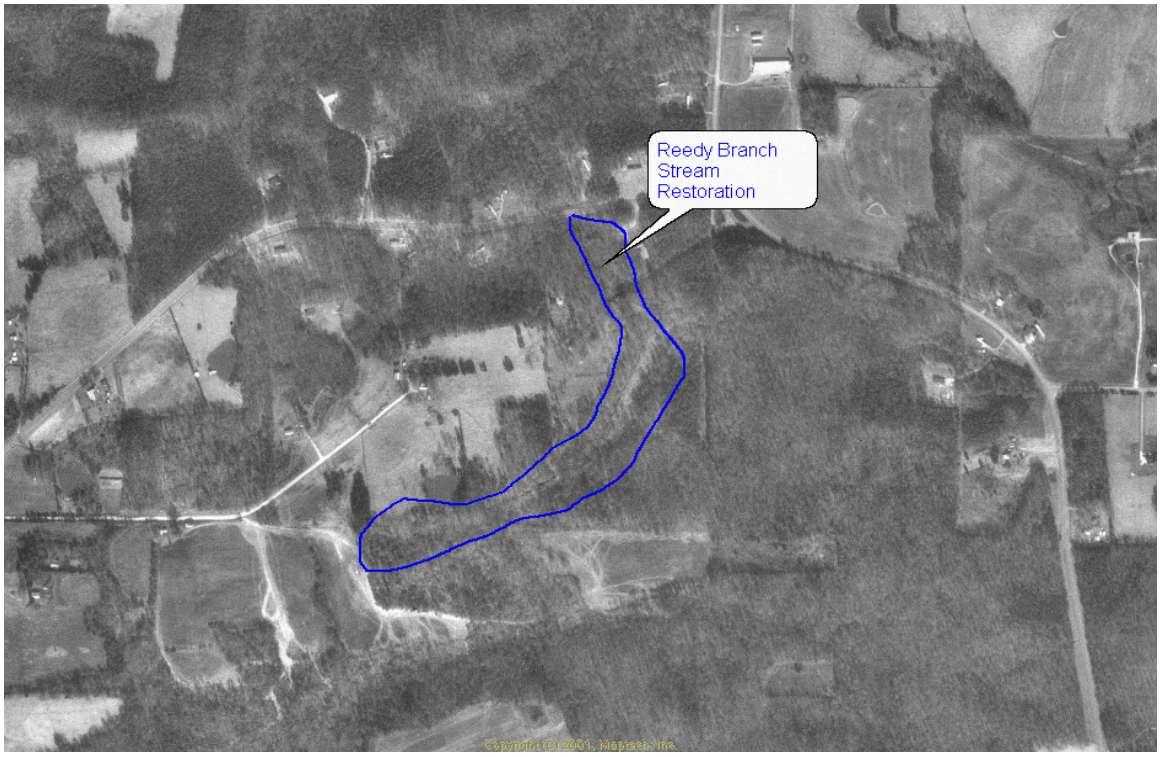


Figure 2 Ortho-photo of the Reedy Branch Restoration Reach

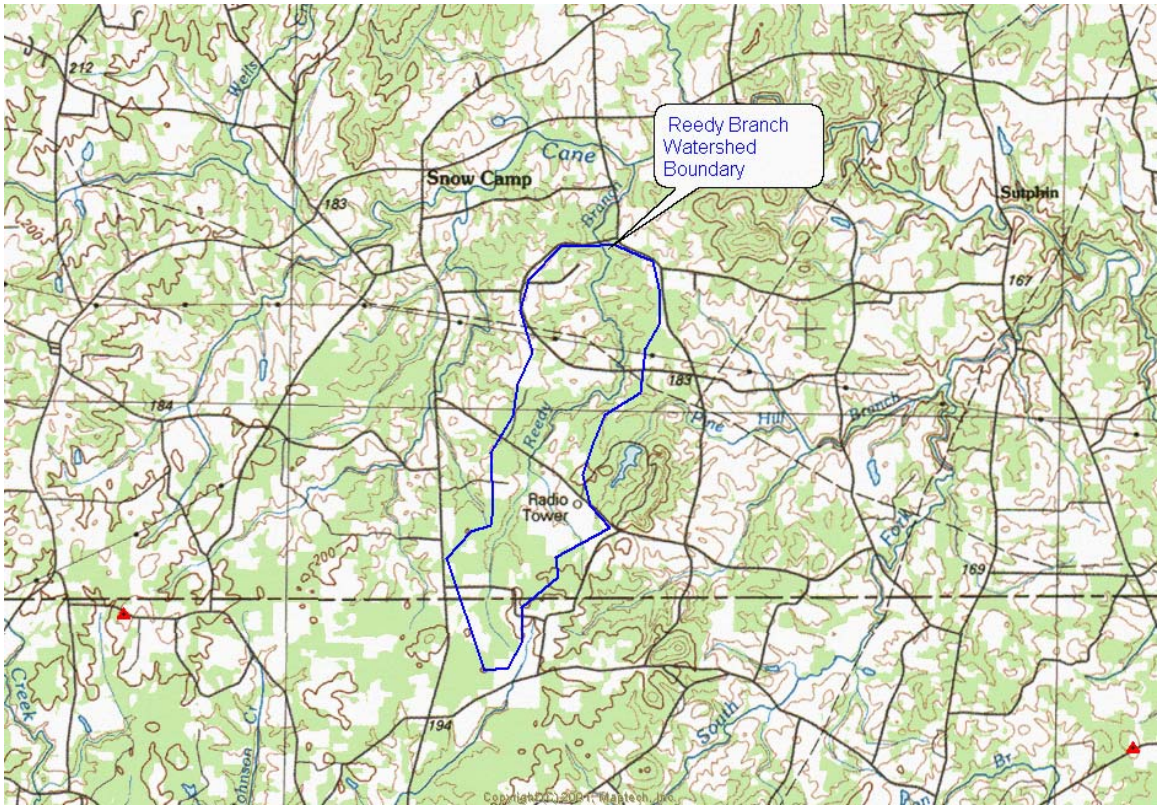
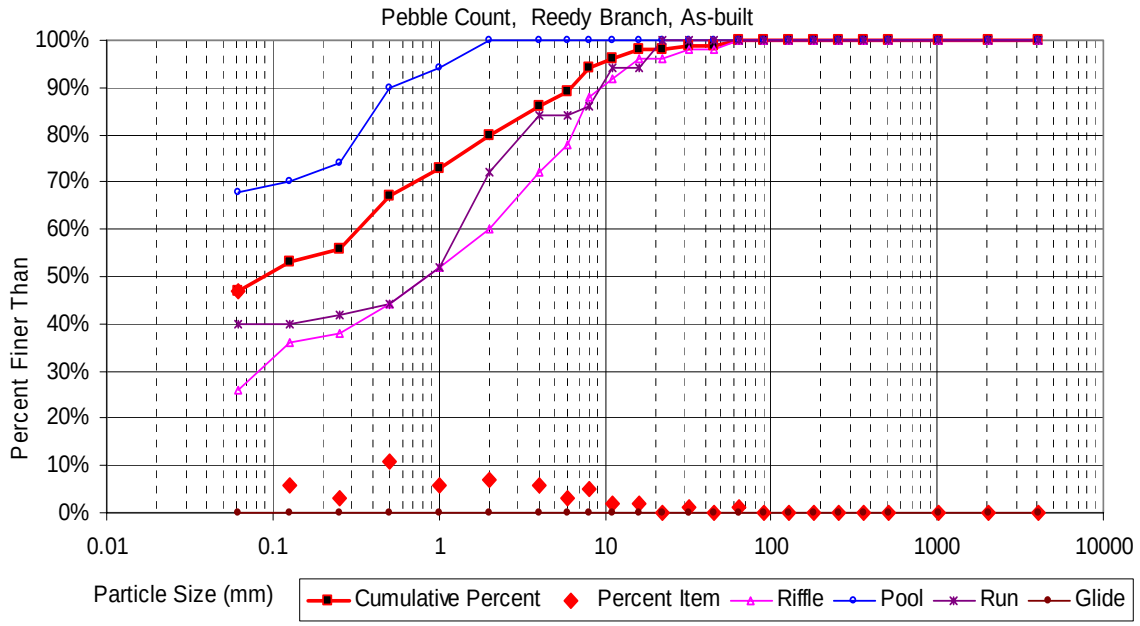


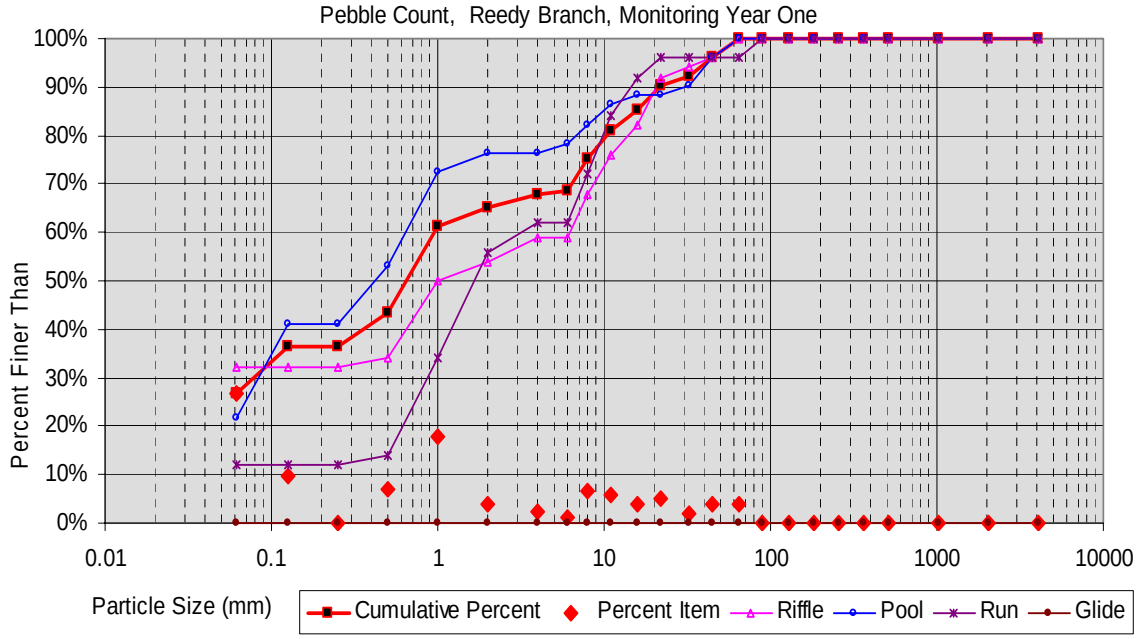
Figure 3 Approximate Watershed Boundary

This watershed covers about 7.8 square miles starting in Chatham County and flowing generally north into Alamance County.

Figure 4 Particle Size Analysis



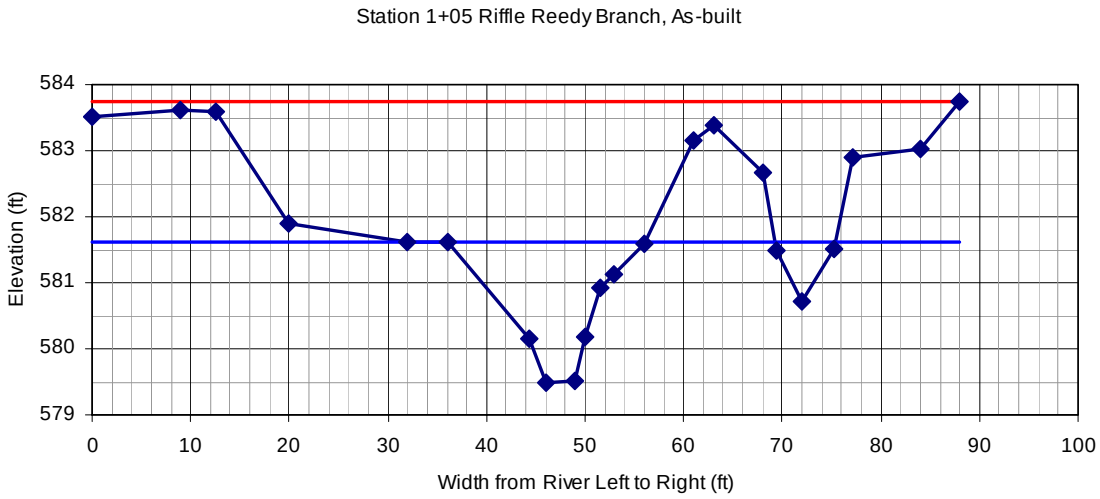
d50 = 0.1mm d84= 3mm

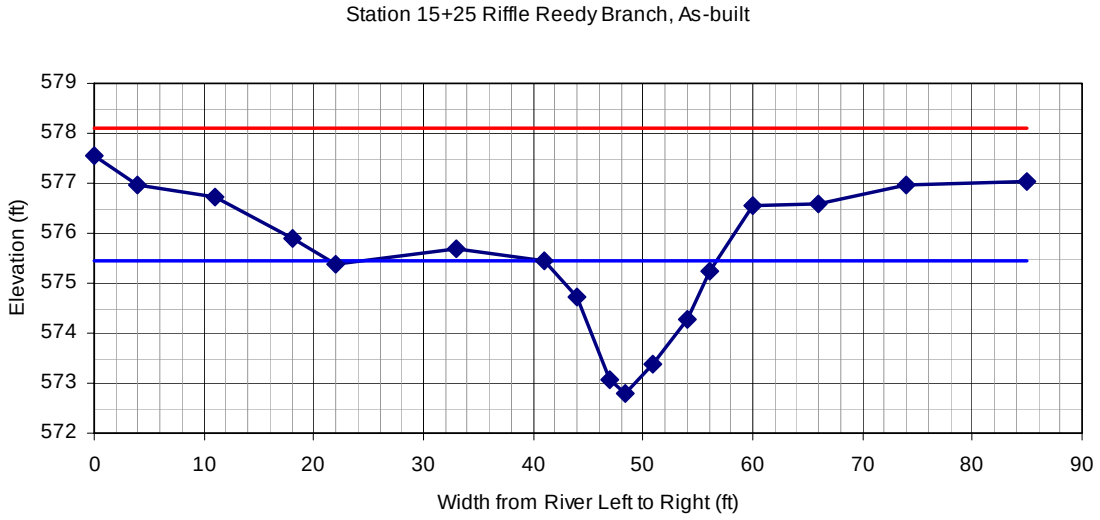


d50 = 0.6mm d84 = 14mm

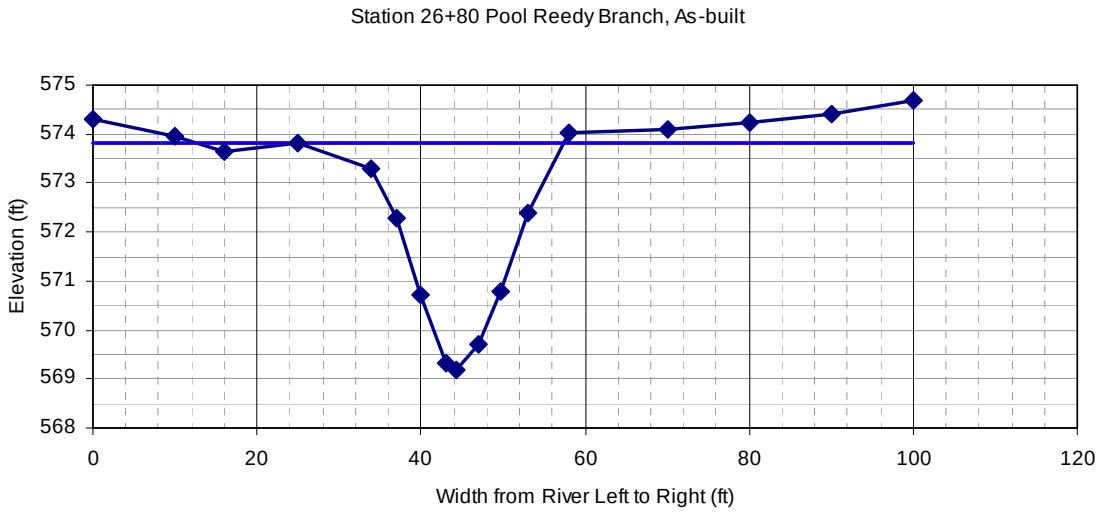
Figure 5 Cross Sections

As-Built

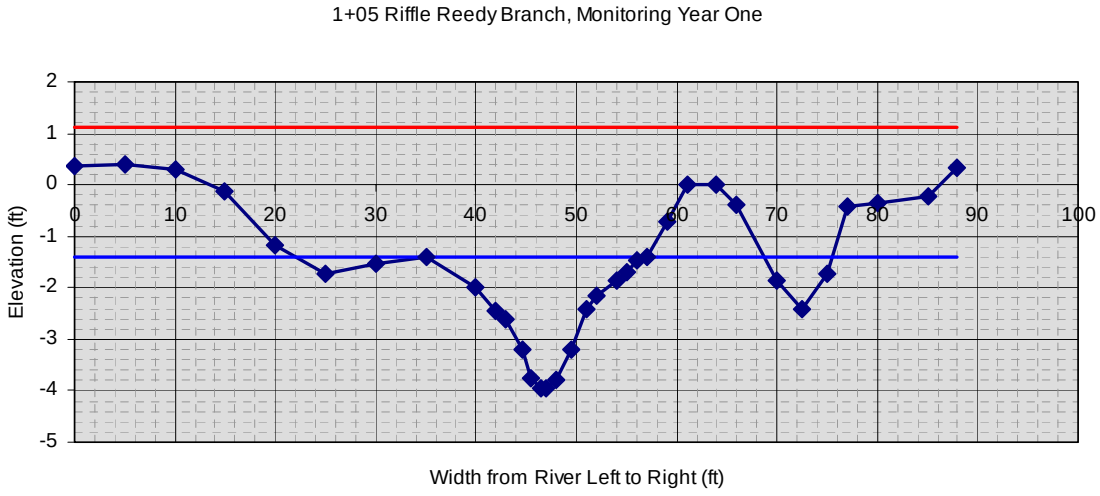




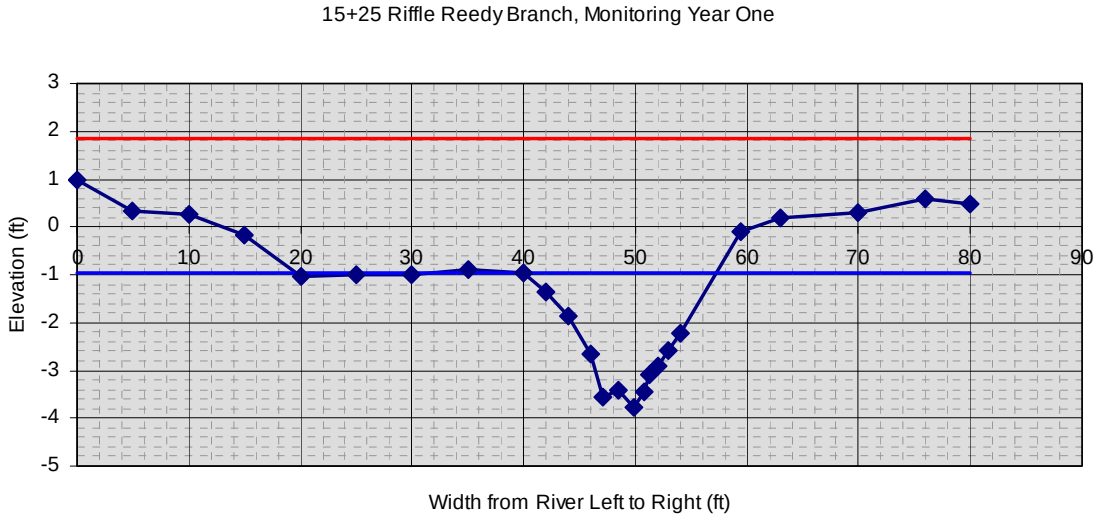
As-Built



MY1 (2005) Monitoring



MY1 (2005) Monitoring



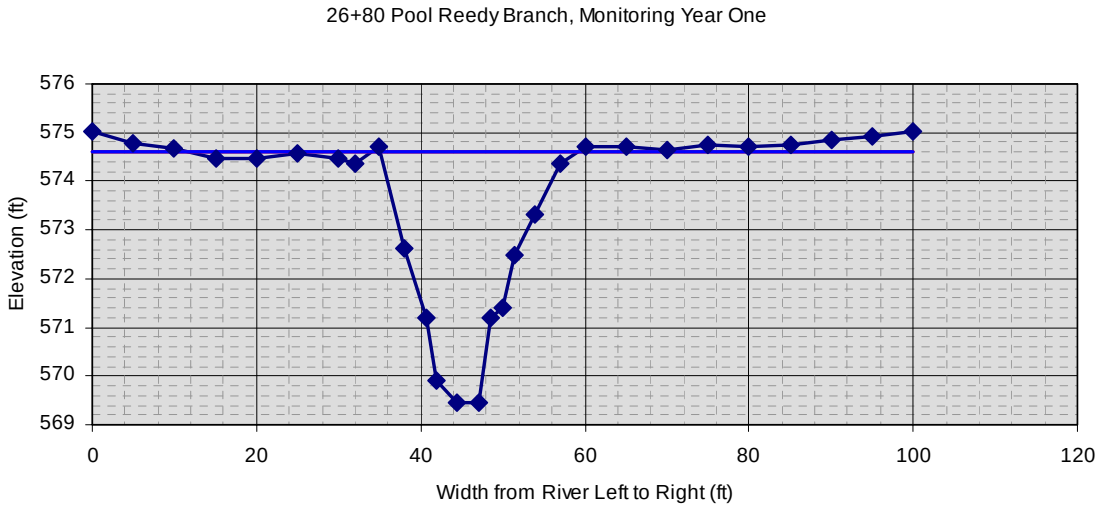


Figure 6 Longitudinal Profiles