

**As-built report for the Barnhill  
Mitigation Site, Little Ivy Creek,  
Madison County**

**North Carolina Wildlife Resources Commission**

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## **Project Objectives**

The objectives at this mitigation site were to improve water quality, fisheries habitat, riparian quality and stability of Little Ivy Creek. These objectives were met using a number of practices. At eroding sections, the stream banks were reshaped to a more stable cross-sectional profile. J-hook vanes were used to reduce high bank stress and to improve habitat through pool creation. A vegetated floodplain was constructed at the foot of two high, vertical banks in order to reduce erosion at these sites. Disturbed sections of the riparian zone were seeded with a native vegetation mix for long-term stability and a cover crop of millet for short-term stability. During the coming dormant winter season, bare rooted and live stakes of tolerant woody species will be planted extensively from the bankfull elevation, up-slope to the easement line.

Specific objectives at the Barnhill mitigation site were the following:

1. Protect the stream and riparian zone through placing them in a conservation easement.
2. Install J-hook vanes along the eroding bend in the river to reduce erosion and provide fish habitat.
3. Stabilize eroding, vertical bank by constructing a floodplain bench at the toe of the slope.
4. Plant native trees, bushes and ground cover that will stabilize the creek banks, shade the stream, and provide wildlife cover and food.

## **General Construction Narrative**

Construction at this site was carried out through an informal contract with Forga Contracting, Incorporated. Equipment work began on June 12, 2000 and was completed on June 21, 2000. For a total of seven days worked at this site. The contractor provided one track-hoe, one rubber tired loader and two dump trucks as needed. Access to the site was gained from Beech Glen Road, SR-1540 and across the landowner's property at an old ford of the stream. Work began by hauling approximately 30 truckloads of rock to the site from the A10 highway project. Rock was stock piled on the state road right-of-way and moved to structural sites with the rubber tired loader. Due to having only one access point at the old ford, construction of vanes began at the top and continued downstream to the ford. Then the work downstream of the ford was completed from the end of the project back to the ford. Eroding banks at or below vane sites were sloped, vegetated and erosion control materials installed. Banks were sloped by pushing down the bank and protecting the toe of the bank with stone or logs. This allowed sloping without producing excess soil. Building floodplain benches to the bankfull elevation protected two vertical banks. These benches were built out of boulders and covered with soil. The soil was applied over an erosion control fabric that was then wrapped around the soil and pinned in place. All bare ground areas were vegetated with a native riparian seed mix and a cover crop. The cover crop developed well and stabilized the ground surface. Trees have been ordered for this site and will be planted during the coming dormant season, winter 2001. We will also be collecting live stake material during the dormant season and planting it at this site. At this site, this project has resulted in the restoration and protection of 1200 linear feet of stream and riparian area.

### **Preconstruction Site Conditions:**

The Taylor Barnhill site is located in the Little Ivy Creek watershed on Little Ivy Creek approximately 1.2 miles upstream of its junction with Ivy Creek. The watershed is developed with a medium to low density of homes. The primary land disturbing activity in the watershed is agriculture. Most of the flatter valleys are used to raise tobacco and cattle are grazed on steeper pastureland. Forestland in the watershed was converted to agricultural land during the 1800's and early 1900's. A significant portion of the watershed remains in secondary growth forest. At the present time, there is some conversion of agricultural land to single family home sites. The construction of a major interstate through the county should increase this trend. Little Ivy Creek has suffered from land disturbing activities within the watershed. Much of the creek has been channelized or moved at some time in the past. Sedimentation of the creek has continued for many years as soil from fields, pastures and gravel roads has eroded into the creek.

The channel at this site is confined by a narrow valley and is primarily a large bend in the creek, over which the stream drops approximately 8 feet in a 1200-foot reach. The channel is primarily a single thread along the bend; however, there is an old cutoff channel on the inside of the bend. The majority of the water flows down the primary channel with higher flows using the cutoff. Where erosion of the bank is minimal the channel has a vegetated interberm. Excessive erosion is a problem along most of the right bank in the bend and along the lower right, high bank. An entrenchment ratio of approximately 2.0 and a width/depth ratio of 18.1, indicate that this is a B type stream channel. Small cobble (72 mm) is the D50 of the bed material in the project reach. Water surface slope across the project reach is .0085, which is more indicative of a C type stream. When taken together these criteria indicate that the project reach is a B3c, according to the Rosgen stream classification system.

Pool habitat at this site was limited, with only one large pool present in the upper third of the site. The remaining pools were small scour pools of limited length and depth. This condition resulted in a limited number of quality pools for aquatic organisms. The D<sub>50</sub> of the bed was small cobble; however, the size distribution of bed material sampled during pebble counts indicates a bimodal distribution. The first mode was made up of small sand and finer material, and the second mode was centered on large cobble (180 mm). Inspection of the bed indicates one composed primarily of cobble with some boulders. The cobble is embedded in finer material and silt deposits were present in areas of low velocity. The absence of high quality pools and the presence of embedded substrate had resulted in limited spawning areas for fish, particularly gravel spawning species such as trout.

Overall, the riparian zone at this site was in good shape. The easement area contains 90% of the riparian zone at this project site and there are only two small areas at each end that are excluded because the landowner owns one side of the stream. At spots along the channel the stream has developed a narrow floodplain. This benefits channel conditions by slowing water velocity during high water events. This in turn reduces the amount of erosion occurring on the stream banks. The left bank or inside of the bend along this reach is in good shape with little or no erosion on the island. A high, vertical bank on the cutoff channel was degrading due to minimal erosion. The landowner's house is on this side of the stream and he maintains a well-vegetated buffer between grassed areas and the creek. The right bank is stable over the upper 1/3 of the site but becomes unstable as the creek enters the bend. Above this eroding bank is a well vegetated terrace that gives way on the lower end of the site to a high (8-10 feet) vertical bank. The terrace is vegetated with large and small trees and has an extensive growth of bamboo. The existing vegetated buffer varies between 10 and 50 feet in width and provides the shade that the

stream needs to maintain the cold water trout require. The primary threat to the existing riparian zone is the erosion along the right bank of the creek and the erosion occurring on the high, vertical banks.

### **Channel Modifications:**

Three J-hook vanes were installed along the right bank and through the upper bend at this site (see the map showing all structure locations). Large boulders (500 to 1000 pounds) were used to construct these vanes. This was shot rock hauled from disposal areas on the A10 project. Vanes started with two or three offset boulders (J-hook) to create a scour pool and rose to the bankfull elevation on the bank. Large footer rocks supported all top rocks in the vanes. Holes were dug at the convergence points of the water vortices to accelerate pool formation. Excess bed material was placed near the bank, upstream of the vanes where natural deposition is expected. The second and third vanes were positioned relative to the water flow off of the vane upstream of them. The third vane was significantly longer and at a lower slope than vanes 1 and 2 because we attempted to cross the confluence with a tributary that enters at this point. This was done to capture the sediment that had been moving down this stream and accelerate its movement over the vane. The placement of this series of vanes was designed to reduce erosion in the upper bend and to create pool habitat below the vanes. The attached longitudinal profile shows how vane construction has increased the deep-water habitat at this site. The elevation of the front rocks in the vane were not measured in this profile, or it would show a shallow point where the water was spilling into the scour holes, but the scour action of these vanes can be observed from this profile. The attached pebble count information shows the decrease in fines below these vanes and the increase in smaller cobbles. To some extent this data reflects constructed conditions and not hydraulic influences; however, the site has had some high water over it since project completion, so direct alterations during construction do not account for all observed improved conditions. The vanes are creating the desired deep-water habitat and sorting bed material in a way that will provide needed spawning gravel. In addition, no further erosion has been observed at this site. The attached cross-sections show conditions at the end of construction and will be used to monitor channel stability. At least two additional cross-sections will be added to these.

At two locations along this reach the stream was flowing against the toe of high (10-12 foot), clay banks. One of these sites was on the right bank of the main channel at the lower end of the project, the other site was along the left bank of the cutoff channel. Erosion was occurring along the toe of these steep slopes causing the upper banks to fail and fall into the stream. We addressed this problem by constructing floodplain benches at the base of the two banks. Large boulders were used to construct the bench and to bring it to within a few inches of the bankfull elevation. The top of the rock bench was then filled with soil excavated from a high ground source. At the lower site on the main channel, the soil was laid down over an erosion control fabric that was pulled back over the top of the soil, wrapping it in the fabric. This created a soil lift that had greater stability than the soil would have had alone. We felt that this was needed at this larger channel site because it would be exposed to high flows. In the cutoff channel we did not create a lift but we did cover the soil with an erosion control material. To date these sites have proven stable and are capturing soil that erodes from above the bench. Long-term stability will be assessed beginning next year, by implementing our monitoring protocol.

### **Riparian Improvements:**

Bank sloping was not done extensively at this site because the riparian zone was in fair to good condition above the eroding areas. The stream bank below the second and third vanes was sloped by pushing the soil down to a more stable angle. This approach to bank sloping did not create waste soil that would have had to be removed. Placing smaller boulders and a log at the slope toe stabilized the bank in these two areas. These sloped banks and the created floodplain was fertilized, limed and seeded. After seeding, either an eight-foot wide, coir/straw blanket or coir "net" type blanket was used to cover the area above the log. Above these erosion control blankets a 4-foot width of jute fabric was also laid down. All of these erosion control materials were pinned using landscape staples. Two types of blankets were used to test which blanket would be better for this application on future projects.

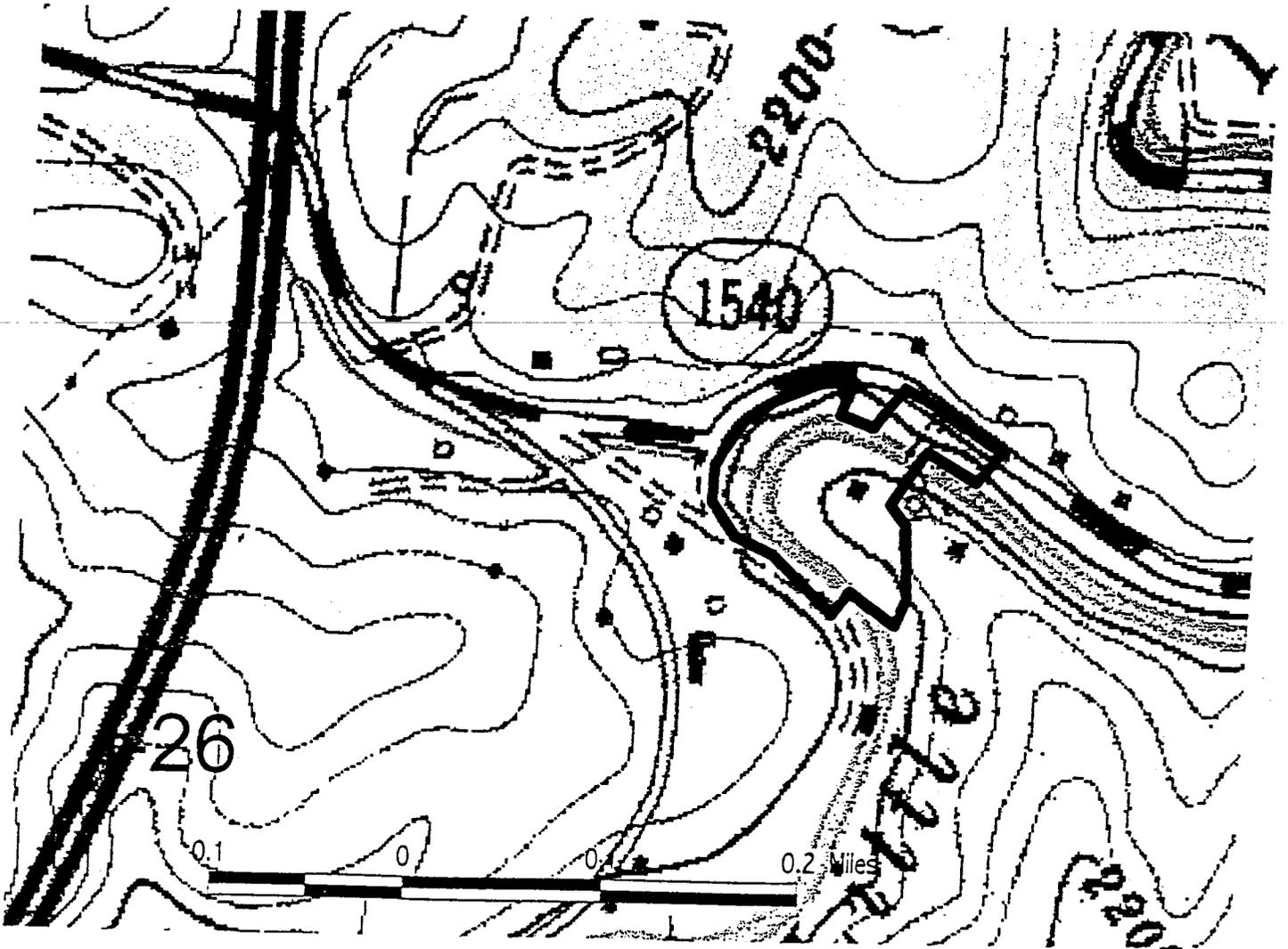
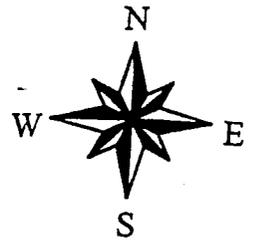
Seeding was done with a native riparian mix and a cover crop of millet. The millet germinated very quickly with the afternoon showers that occurred during construction, and grew through the erosion control materials. This provided a very stable ground surface. Frost usually kills millet so we may sow a cold hardy cover crop if needed for winter protection. It may take 2 to 3 years for the perennial seed mix to become established with dense coverage. We will monitor the growth of this mix and do supplemental seeding as needed. We plan to extensively plant the sloped banks with live stakes of black willow, silky willow, and silky dogwood during this coming dormant season. We will also plant a number of bare rooted trees during the late winter. These plantings will consist in part of black willow, red-osier dogwood, river birch, persimmon, green ash, sycamore and red maple. Total numbers of live stakes and bare rooted trees were not determined, but densities will be approximately 350-500/acre.

During site visits conducted since construction ended we found the riparian zone to be stable and vegetation in excellent condition. We will be developing plots to access survival of vegetation as the woody species are planted. Vegetative plots, tree survival and riparian stability will be evaluated this spring.

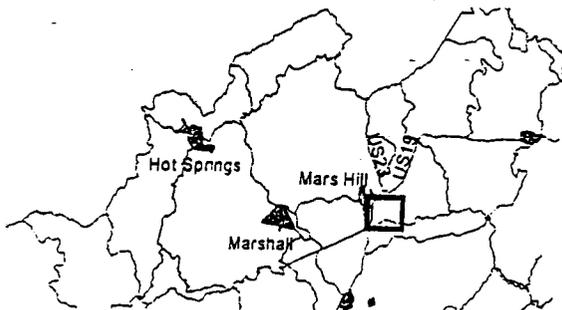
### **Livestock Management:**

The fact that the present landowner manages his property in a natural state and has no plans to ever have livestock made fencing of this easement area unnecessary. The easement line was demarcated using 4x4 treated posts that supported a sign indicating the presence of the conservation easement area. The aesthetics of these posts was enhanced by adding a blue bird house to them. The easement along the state road right-of-way was marked using carsonite posts supplied by the NCDOT. If future land uses on the adjoining field jeopardize the restored riparian zone, the easement agreement reserves the right of the WRC to install a fence to protect the easement.

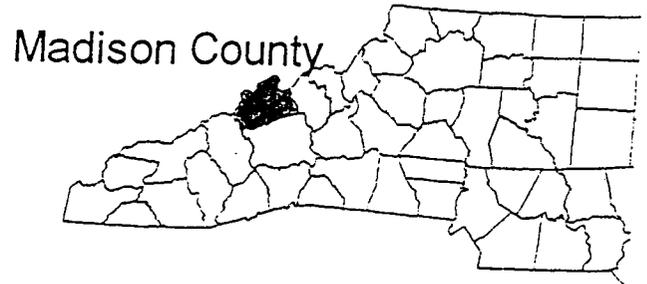
# Barnhill Site

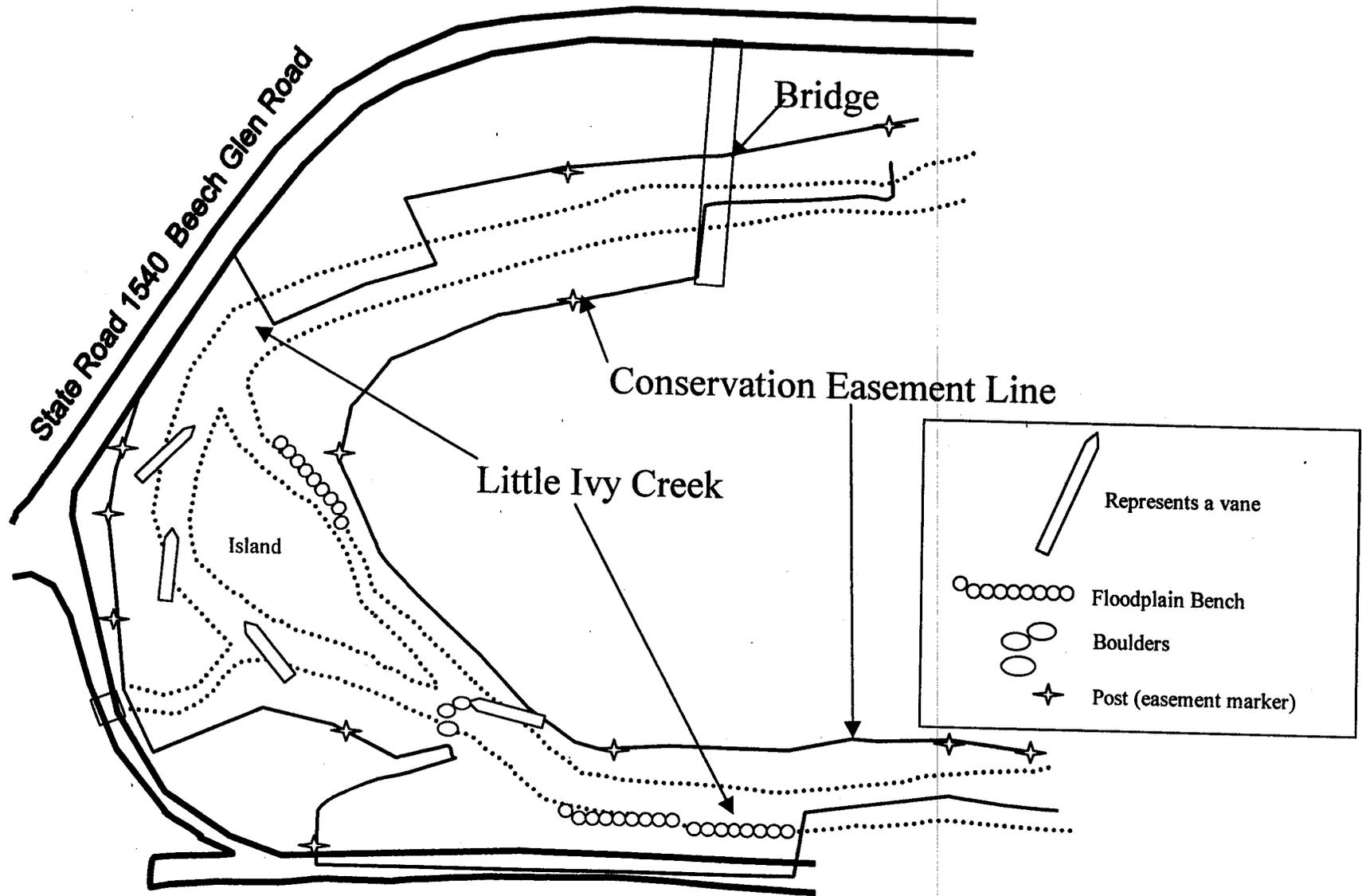


## Madison County

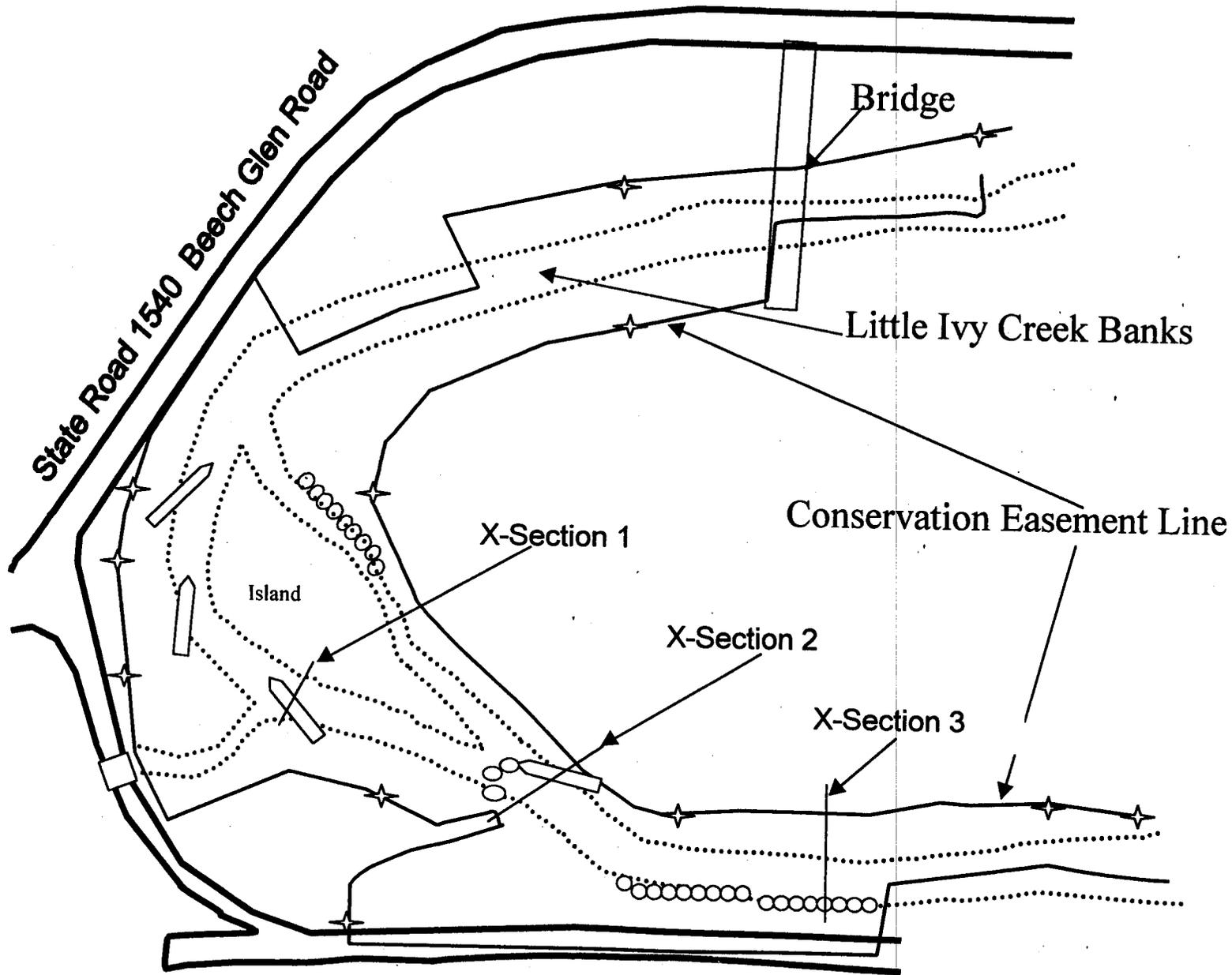


## North Carolina



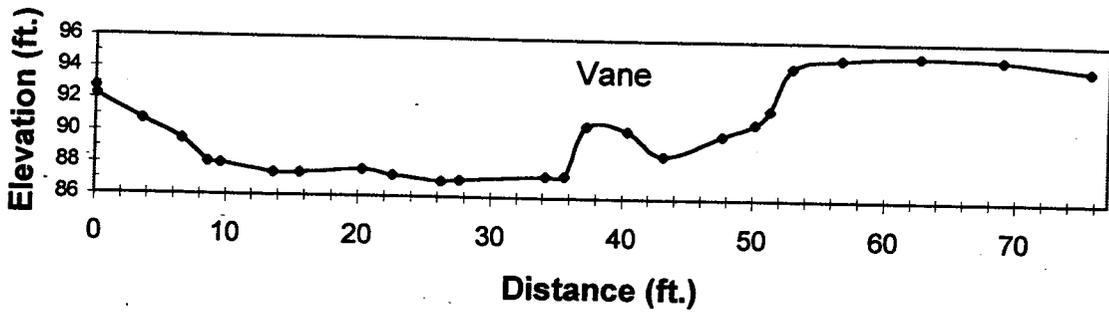


Location of vanes, boulders, floodplain benches and conservation easement markers at the Barnhill Site.

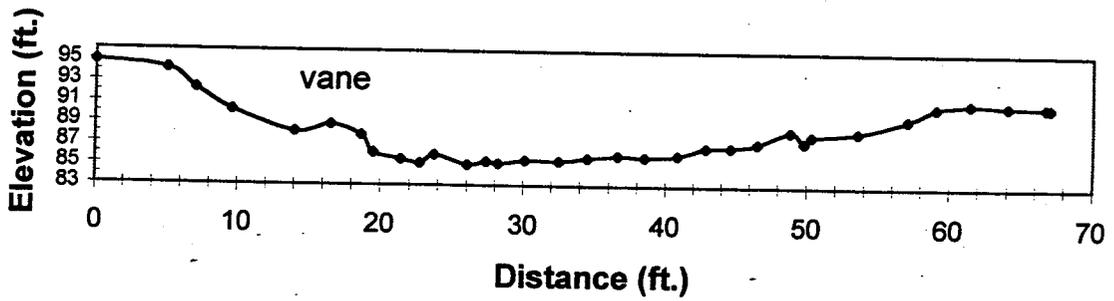


Location of cross-sections taken for monitoring postconstruction channel stability at the Barnhill Site.

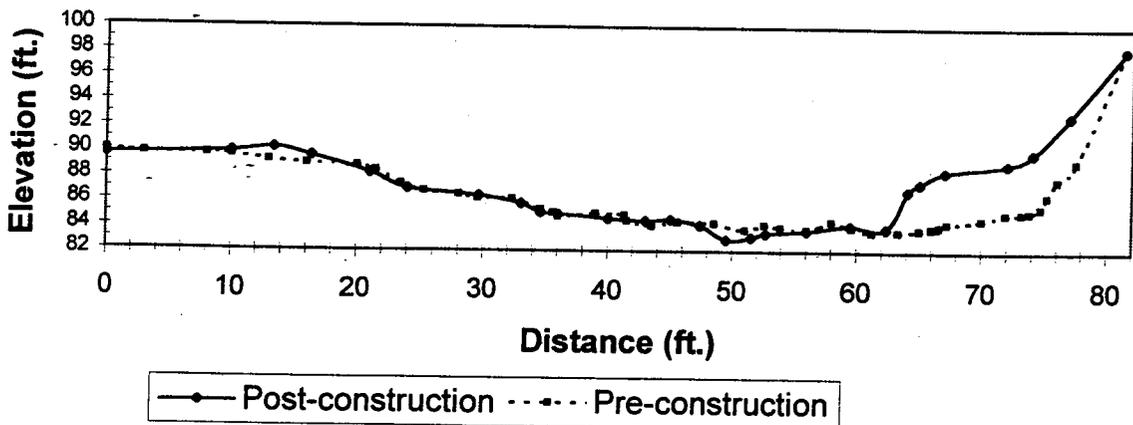
### Cross-section 1, 3rd vane



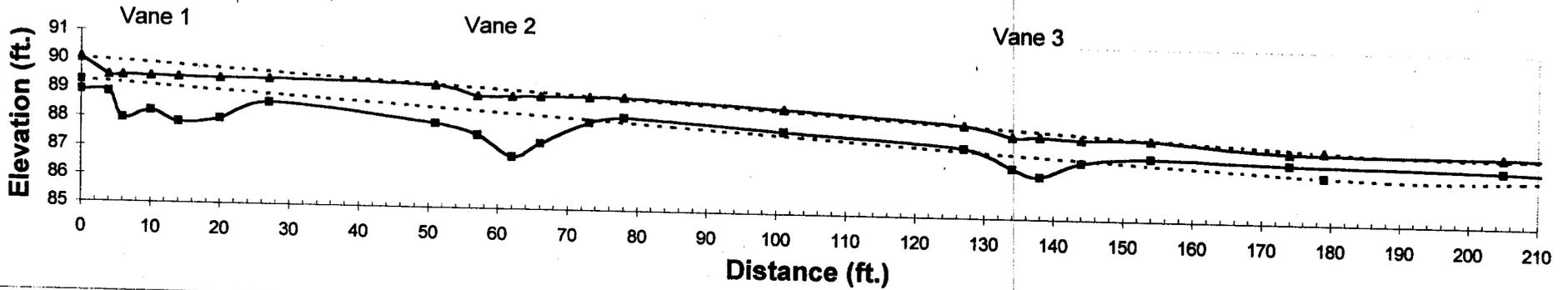
### Cross-section 2, vane at ford



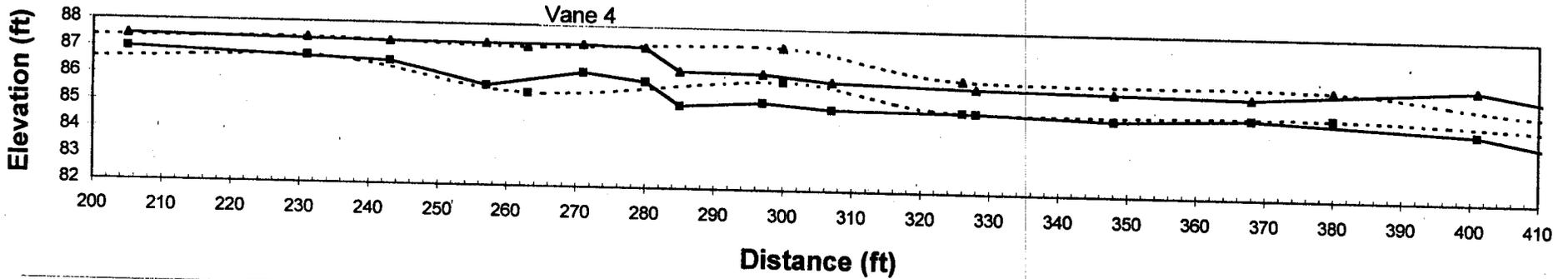
### Cross-section 3, bench on vertical bank



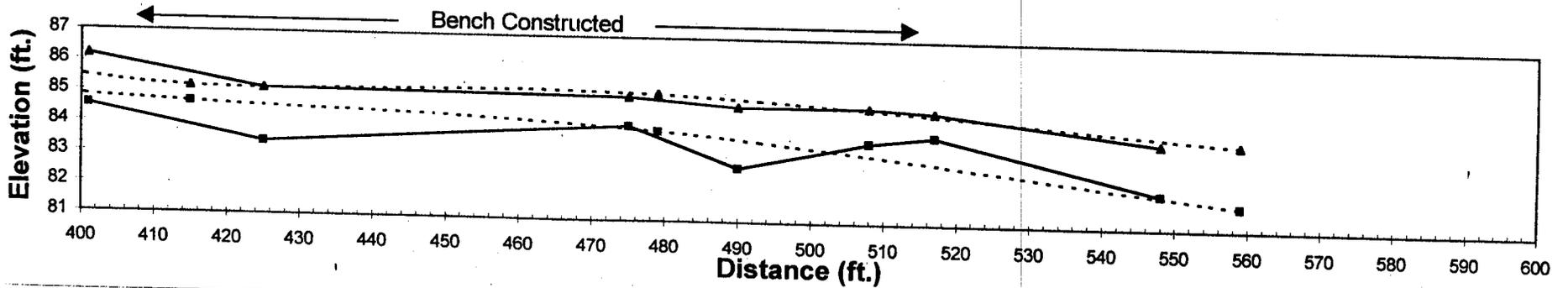
### Longitudinal Profile of Little Ivy Creek, Barnhill Site



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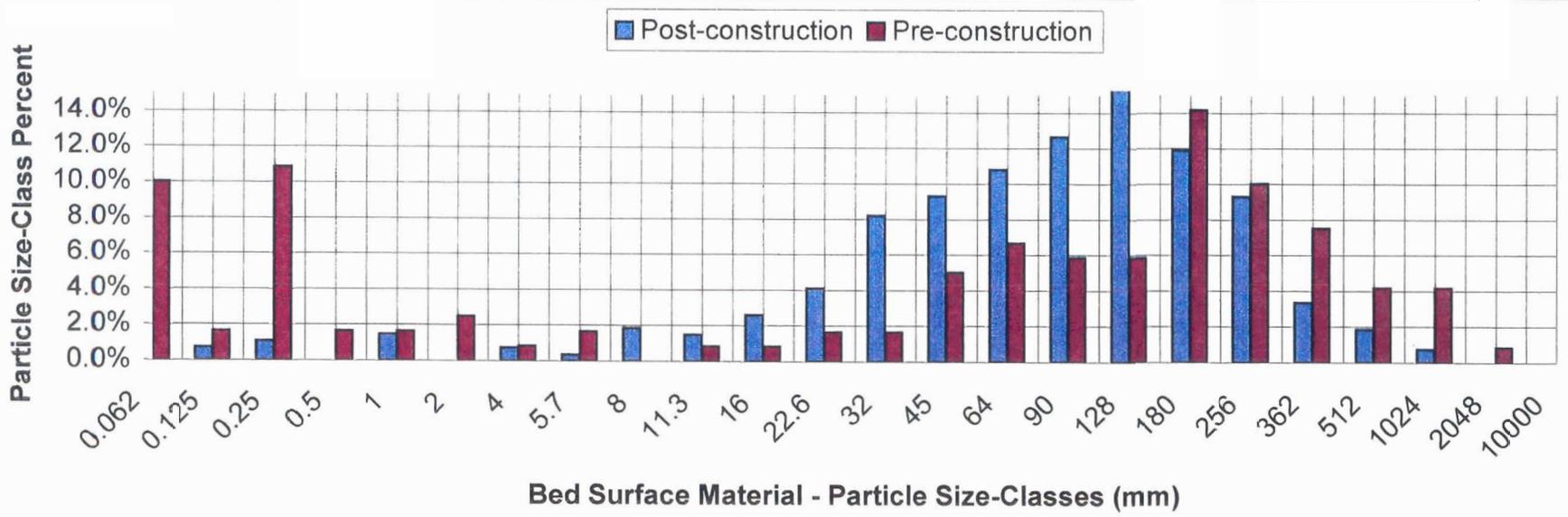
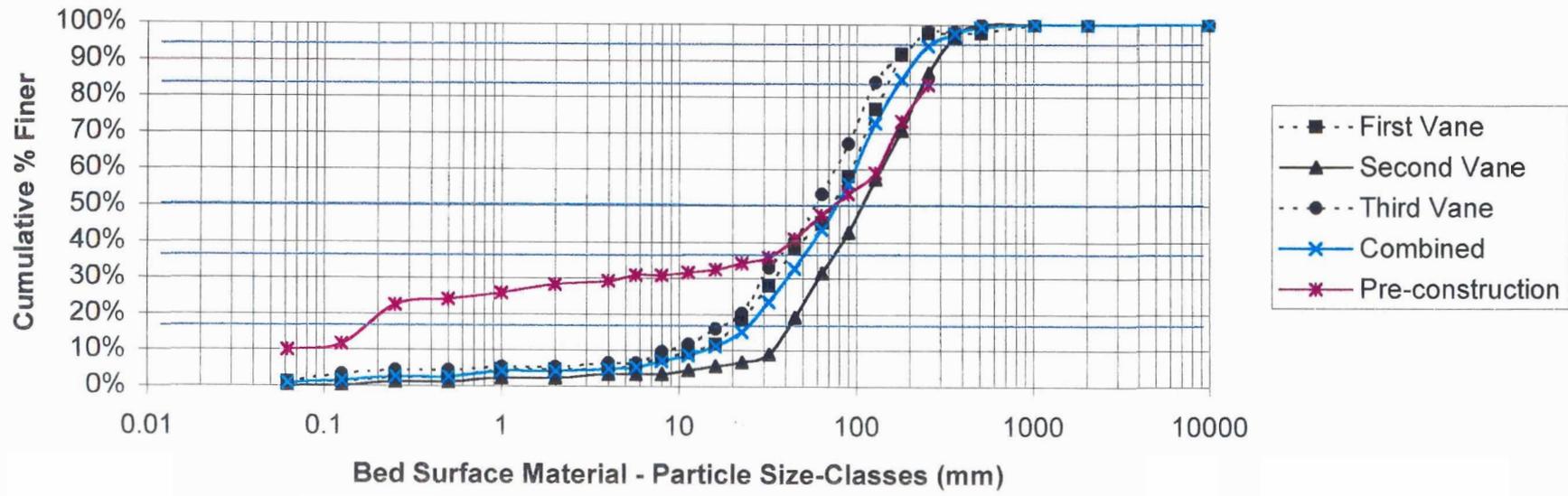


### Longitudinal Profile of Little Ivy Creek, Barnhill Site



- Thalweg Elevation
- Preconstruction Thalweg Elevation
- Bankfull Elevation
- Preconstruction Bankfull Elevation

PEBBLE COUNT INFORMATION

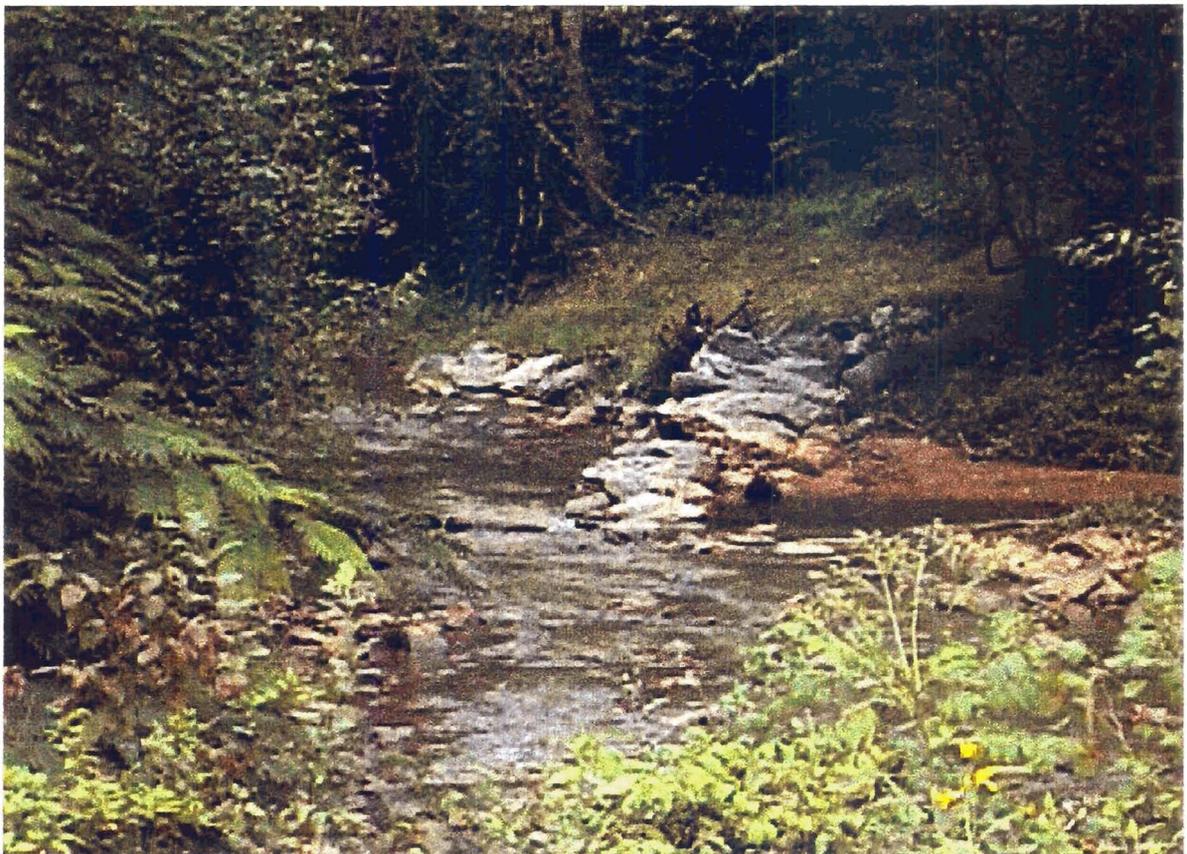




Site of the second vane, taken from the first vane downstream. Top photo shows site before construction, middle photo is the site during construction and bottom photo is three months after construction.



Site of second vane, taken from the third vane upstream. Top photo shows the area before construction and bottom photo shows the same area after construction, with scour hole developed.



Upper photo - the third vane after construction showing high water pooling upstream of the vane and falling toward mid-channel. Bottom photo - shows the same vane with sediment deposited above the vane as water slows and the sloped, vegetated bank.



Bench construction at the lower end of the reach. Top photo shows the condition of the high vertical bank before construction. Middle photo shows construction and bottom photo shows site three months after construction.