As-Built Mitigation Plan

ROCKY BRANCH STREAM RESTORATION

Yadkin County, North Carolina
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EXECUTIVE SUMMARY

The Rocky Branch Stream Restoration Site (RBSRS) project drains approximately 3.1 square miles (1,984 acres) within the Yadkin-Pee Dee River Basin. The project is located immediately adjacent to Interstate 77 (I-77) with a large portion of the original stream occurring within the I-77 right-of-way. This pre-existing location of the Rocky Branch stream channel is a product of roadway construction completed in 1967. Over the last three decades, the channel relocation has resulted in severe erosion at the base of this roadway slope. In addition, excessive cattle grazing on the adjacent pastureland has resulted in stream bank erosion, mass wasting of banks, reduction in the riparian vegetation, and degraded water quality. To protect the roadway and to restore the Rocky Branch stream channel a new stream channel was constructed through the adjacent pastureland.

The original Rocky Branch channel totaled 2,901 linear feet within the proposed conservation easement. This pre-existing Rocky Branch channel classified as predominantly a degraded C4 channel according to the Rosgen stream classification system (Rosgen, 1994). The two existing tributaries located within the proposed conservation easement totaled 873 linear feet. The original Tributary 1 classified as a C5 stream channel and Tributary 2 was not classified due to its severely degraded nature.

The proposed stream classification for Rocky Branch was a C4 channel. A combination of Priority 1, 2, and 4 restoration levels were implemented on the Rocky Branch channel. The restored Rocky Branch channel located within the conservation easement totaled 3,820 linear feet. Tributary 1 was relocated and shortened and Tributary 2 was converted to a pond due to landowner agreements. The restoration of Tributary 1 resulted in 172 linear feet of a new E4 stream channel utilizing Priority 1 restoration. A total of 3,992 linear feet of stream channel was restored at the RBSRS within the conservation easement.

A conservation easement totaling 24.095 acres was established to perpetually protect the stream restoration project. Approximately 17.6 acres of riparian and 3.9 acres of upland buffer were planted within the conservation easement to reestablish a native plant community. Additionally, cattle drinkers, wells, and shadehouse were installed as a farm management component of the project. An inactive waste storage pond upslope of the project site was decommissioned prior to the stream restoration activities.

This report describes the pre-existing conditions, the proposed restoration plan, and the post construction conditions. The report also outlines the protocols by which the channel stability and vegetation survivability will be evaluated. More specifically, the success of channel restoration, erosion control methods, vegetative plantings, and the long-term stability of the project. This will be accomplished by monitoring and reviewing the following items.

- Permanent Cross Sections: A total of 8 cross sections (4 riffles, 4 pools) will be surveyed for the following 5 years at the specified locations.

- Longitudinal Profiles: Longitudinal profiles will be surveyed for Rocky Branch from Stations (1+77 to 31+77) and for Tributary 1 from Stations (0+00 to 1+72).

- Particle Size Analysis: Pebble counts will be conducted for the following for 5 years at each of the 8 permanent cross section locations.

- Reference Photos: Photos will be taken at locations specified in this document to document and to visualize changes at the site over the 5 years.

- Vegetation Plots: A total of 11 vegetation plots have been established within the riparian buffer and stream banks throughout the site to evaluate the success of the vegetation.

- Crest Gage: A single crest gage has been established to evaluate the number of bankfull events that occur at the site.

Mulkey completed the as-built drawings in August 2007 and will also be responsible for the 1st year (2008) of monitoring at the site. Subsequent monitoring years 2 - 5 will be conducted by a consultant specified by the Ecosystem Enhancement Program (EEP).

1.0 Introduction

1.1 Project Goals and Objectives

The goals of this stream restoration project were to:

- To improve the overall water quality and aquatic habitat in and around the stream channels by reducing sediment and waste inputs into the stream caused by bank erosion, mass-wasting, and livestock influences.
- To improve the richness and diversity of the plant species within the conservation easement.
- To facilitate on-going livestock operations through farm management improvements.
- To provide perpetual protection for the restored stream channels and associated riparian and upland buffers.

These goals will be met through the following objectives:

- By using natural channel design to restore stable dimension, pattern, and profile for the project stream reaches.
- By establishing a native plant community to match the endemic plant species at the site.
- By reducing the quantities of exotic invasive species at the site through mechanical and chemical methods.
- By decommissioning a dairy waste storage pond to eliminate future risks to the Rocky Branch channel and the watershed.
- By installing watering facilities and a shadehouse to manage livestock previously using the restoration site.
- By establishing a conservation easement and permanent fencing to provide long-term protection for the site.

1.2 Project Location

The Rocky Branch Stream Restoration Site (RBSRS) is situated in the southwest corner of Yadkin County, North Carolina. Specifically, it is located on the east side of I-77 between SR 1120 and SR 1122, approximately three miles east of Hamptonville and two miles south of the US 421/I-77 interchange (Figure 1). The restored reaches lie within a 24.095 acre conservation easement. Three individual landowners currently make up the land contained within this conservation easement. The acreage within the easement is divided amongst Mr. Bill Allen (13.469 acres), Mr. Joe Allen (6.985 acres), and Mrs. Texie Owens (3.641 acres).

2.0 Summary of Pre-Construction Conditions

2.1 Rocky Branch Watershed

Rocky Branch and its two unnamed tributaries are situated within the Yadkin-Pee Dee River Basin. The site is specifically within the US Geological Survey (USGS) hydrological unit code (HUC) 03040102 and the NC Division of Water Quality (NCDWQ) sub-basin 03-07-

06. This sub-basin is known as the South Yadkin River Watershed and covers 907 square miles (580,480 acres). Forests and agricultural operations account for approximately 95% of the land use within the sub-basin.

Rocky Branch arises near the Town of Marler, north of US 421, and flows east, crossing portions of the US 421/I-77 interchange, before turning south. The stream passes through the project area en route to its ultimate confluence with Hunting Creek, located approximately 1,600 feet south of the RBSRS.

Rocky Branch collects its surface hydrology from four unnamed tributaries prior to entering the RBSRS. Within the site, Rocky Branch receives hydrologic inputs from Tributary 1, which contains a drainage area of approximately 0.2 square miles (128 acres) and Tributary 2 (natural spring), originating immediately outside of the project area (Figure 2). Hydrological inputs to Rocky Branch, south of Deacon's Hill Road (SR 1120) are limited to flows from drainage ditches, small seeps and sheet flows across the landscape. The drainage area associated with the Rocky Branch watershed is approximately 3.1 square miles (1,984 acres) (Figure 3).

The dominant land use within the Rocky Branch watershed is primarily agriculture, which occupies approximately 75 percent of all land area within the watershed (Figure 4). Rural residences are included within the agricultural land use category, where they comprise a small subset of the agricultural land use. Agriculture in this area is primarily field crops and livestock production. Corn and small grains are the chief agricultural crops grown in the area. Other agricultural land areas are used as pastures for dairy and beef cattle. Forest lands within the watershed are limited to small, narrow areas that account for approximately 20 percent of the land use. Impervious surfaces and intensely maintained areas lying adjacent to these areas account for the remaining 5 percent of the land area. This large area of impervious surface can be attributed to the close proximity of two major multi-lane highways (US 421 and I-77), as well as the presence of three secondary roadways in the immediate watershed area. Three corrugated metal pipes empty stormwater from I-77 directly into the stream channel.

It is reasonable to predict that future land use trends in the watershed area may gradually shift from pure agriculture to rural homesites and small businesses. Agricultural demands in the area will remain high; however, the growth and expansion of nearby urban areas coupled with the proximity of the I-77/US 421 corridors will likely have a tremendous effect on the area.

2.2 Streams

The original location of the Rocky Branch stream channel (along the east toe of the I-77 roadway fill) is a product of the I-77 roadway construction completed in 1967. Prior to the construction of I-77, a segment of the stream channel, which presently flows through the RBSRS, originally flowed southwesterly at the present location of the I-77 corridor, before looping back into the present RBSRS. This channel reach was relocated to the base of the I-77 fill slope to avoid the need for two culverts. Over the last three decades, this realignment

of the Rocky Branch channel has given rise to areas of erosion along the base of the fill slope, which, if ignored, may eventually compromise the integrity of the roadway. Rocky Branch is currently being impacted by cattle grazing. This damage includes stream bank erosion, mass wasting of banks, and reduction in the riparian vegetation. Grazing of cattle without adequate fencing has resulted in significant damage to the Rocky Branch channel and its water quality. The lack of vegetation and the steep topography surrounding Rocky Branch has also caused additional degradation due to the increased overland flow.

2.2.1 Rocky Branch

Mulkey surveyed the existing streams and project site by using total station survey equipment with GPS survey grade receivers. Surveys included 2,901 linear feet of Rocky Branch stream channel within the proposed conservation easement and 1,064 linear feet of channel located within the I-77 right-of-way. Two tributaries totaling 873 linear feet were also surveyed for a total of 4,838 linear feet of stream surveys at the site. Topographic data from the NCDOT were merged with the survey data collected by Mulkey. Existing condition surveys included longitudinal profiles, cross sections, pebble counts, and bar samples to determine the current state of the stream channels. Existing longitudinal profiles were conducted by identifying each stream feature (riffle, run, pool, or glide) and surveying specific points at those features. These specific locations included top of bank, bankfull, waters edge or surface, and thalweg. In addition, 14 cross sections were identified at representative stream features throughout the project to fully characterize the dimension of the existing channels associated with Rocky Branch and Tributary 1 (Table 1). Following the completion of the existing channel surveys, pebble counts were conducted at specific cross section locations as well as a bar sample analysis. Data pertaining to each stream channel are discussed in the following sections.

The existing Rocky Branch channels total approximately 3,774 linear feet within the proposed conservation easement. The existing channel slope ranges from 0.0155 ft/ft in its upper reaches and maintains an average slope of 0.0044 ft/ft throughout the remainder of the project area. Rocky Branch is classified as a B4/1c channel in the upper portions of the project according to the Rosgen stream classification system (Rosgen, 1994). As the slope of the channel changes, the channel morphs initially into a degraded C4 channel and then to a degraded E4 channel before reaching the bridge at SR 1120.

The composition of the stream bed and banks is an important facet of stream character, influencing channel form and hydraulics, erosion rates and sediment supply. The stream bed along Rocky Branch was characterized using two protocols, the modified Wolman Pebble Count (Rosgen, 1993) and the bar sample analysis. The bar sample analysis provides data for both comparison purposes and sediment transport validations.

According to the modified Wolman Pebble Count procedure, the average d_{50} (50% of the sampled population is equal to or finer than the representative particle diameter) is approximately 11.0 mm for Rocky Branch, which falls into the medium gravel size category. Pebble counts were conducted at representative riffle and pool locations throughout the reach.

The stability rating of the existing Rocky Branch channel was determined by using the Pfankuch Channel Stability and Bank Erosion Hazard Index (BEHI) Forms. The Rocky Branch channel was surveyed on sections which predominantly classify as a C4 Rosgen stream type for these two evaluations. The Pfankuch rating for the Rocky Branch channel was estimated to be 115, which ranks as "Poor" according to the rating system established for a C4 Rosgen stream type. The BEHI rating ranged from "Very High" for the upper and middle reaches to "High" for the lower reach.

2.2.2 Tributary 1

Tributary 1 contains approximately 595 linear feet of existing channel within the project area and is classified as a degraded C5 stream. The average slope of this channel is 0.0135 ft/ft. The stream channel and banks associated with this tributary have been principally altered through channelization, which is evident from its linear characteristics. Tributary 1 was likely relocated to the edge of the property to increase the size of the pasture areas.

According to the modified Wolman Pebble Count procedure, the average d_{50} for the stream classification was approximately 1.3 mm, which falls into the very coarse sand size category. The d_{50} for the wetted perimeter was approximately 1.5 mm. The wetted perimeter data were utilized for entrainment and velocity calculations, since no bar sample was taken for Tributary 1. The Pfankuch Channel Stability rating for Tributary 1 was estimated to be 59, which is considered "Good" for a C5 Rosgen stream type. The BEHI evaluation conducted on Tributary 1 determined that the channel has "Moderate" bank erosion potential.

2.2.3 Tributary 2

Tributary 2 emanates from a natural spring and totals approximately 250 linear feet before emptying into the Rocky Branch channel. No stream morphology classification was assigned to this channel due to its degraded condition and its ultimate fate as a pond. The channel area associated with Tributary 2 has been modified for use as a watering area for cattle. As a result, the stream banks and channel have been heavily damaged from cattle use. This tributary currently contributes a large quantity of sediment to the Rocky Branch channel when cattle are actively watering. No Pfankuch Channel Stability or BEHI evaluations were conducted for Tributary 2.

2.3 Jurisdictional Wetlands

Jurisdictional wetland determinations were performed using the three-parameter approach as prescribed in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987). Three jurisdictional wetlands (Wetlands A, B, and C) exist, mostly within the boundaries of the RBSRS. These wetland areas total approximately 1.98 acres; however, only 1.44 acres are completely contained within the permanent conservation easement (Appendix A). Wetland A and C are contained within the conservation easement, but Wetland B extends beyond the easement boundaries. These wetlands will be protected

on a temporary basis by erosion control measures (silt fence) and on a permanent basis through fencing of the entire periphery of the conservation easement.

Wetland A comprises 0.35 acre and is characterized as a narrow, linear swale in which seepage from the adjacent landscape provides its hydrology. The wetland is dominated by herbaceous species which have been heavily damaged by foraging cattle. The wetland provides only modest habitat, very limited water storage capacity, and based on low opportunity, plays a minor role in improving water quality at the site.

Wetland B is the largest wetland (1.49 acres) and is best characterized as a Piedmont Bottomland Forest by Schafale and Weakley (1990). However, only 0.95 acres of the total wetland acreage is completely contained within the conservation easement. The vegetative community has been altered by logging activities, resulting in a patchwork of early to mid-successional vegetation. Surface drainage patterns reflect repeated disturbances at the site from both logging and cattle operations. Original portions of this wetland forest may have been eliminated through ditching/draining over the years to increase pastureland for livestock

Wetland C is the smallest wetland present at the project site with a total acreage of 0.14 acre. This wetland is characterized as an emergent wetland that has formed due to the presence of a natural seepage. The plant species found in this wetland are primarily herbaceous with several tree species on its perimeter. This wetland area is located immediately adjacent to the original Tributary 1, where it drains into the channel.

2.4 Plant Communities

The vegetative communities found within the project area can be characterized by three major groupings. These groupings include Pastureland, Piedmont Bottomland Forest, and Dry Oak—Hickory Forest. Each plant community with its distinct assemblage of plants arose in response to diverse topography and the influences of changing land uses over time. Scientific names are presented along with the common names the first time the species is cited, but subsequent textual references to the same species will be limited only to its common name.

The pastureland is the most dominant vegetative community, where it accounts for approximately 80% of the total land area within the RBSRS. The pasture areas consist mainly of grasses such as fescue (*Festuca* spp.). A large number of weed species were identified including white clover (*Trifolium repens*), dog fennel (*Eupatorium capillifolium*), horsenettle (*Solanum carolinense*), bittercress (*Cardamine hirsuta*), roundleaf plantain (*Plantago rugelii*), pokeweed (*Phytolacca americana*), chickweed (*Stellaria media*), henbit (*Lamium purpureum*), and broadleaf dock (*Rumex obtusifolius*). Most of the pasture is located within the Rocky Branch floodplain, with small portions located along the side slopes of the project area. Intensive browsing by cattle and the constant exposure of disturbed soil by cattle hooves, particularly during wet weather, has resulted in a dynamic influx of weedy species, where seeds of varied species are indiscriminately dispersed to the

disturbed soils in the pasture. This results in a constantly changing pattern of succession in the pasture.

Vegetation found in this community is consistent with the Schafale and Weakley's (1990) Piedmont Bottomland Forest classification. This vegetative community exists along the wooded portion of the project site currently owned by Mrs. Texie Owens. Dominant species found within this vegetative community include red maple (*Acer rubrum*), river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), tulip poplar (*Liriodendron tulipifera*), American holly (*Ilex opaca*) and Chinese privet (*Ligustrum sinense*). Piedmont Bottomland Forests are generally situated on floodplain ridges and terraces other than active levees adjacent to the stream channel. They are underlain by various alluvial soils, including the Chewacla and Congaree series. These communities are flooded; however, they are seldom disturbed by flowing water. Bottomland forests are believed to form a stable climax forest, having an un-even aged canopy with primarily gap phase regeneration, although the possibility of unusually deep and prolonged flooding may make widespread mortality more likely than in uplands (Schafale and Weakley, 1990).

This vegetative community contains species and characteristics commonly associated with the Dry Oak—Hickory Forest described by Schafale and Weakley (1990). The community occupies an upland area of the project site where the highest elevations are found. The dominant species found at the site include red maple, mockernut hickory (*Carya tomentosa*), white oak (*Quercus alba*), scarlet oak (*Quercus coccinea*), tulip poplar, American holly, post oak (*Quercus stellata*), Southern red oak (*Quercus falcata*), black cherry (*Prunus serotina*), and American beech (*Fagus grandifolia).* Other less dominant species found within this vegetative community were Virginia pine (*Pinus virginiana),* Eastern red cedar (*Juniperus virginiana),* sourwood (*Oxydendrum arboreum*), black walnut (*Juglans nigra*), and white pine (*Pinus strobus*). Species found on the fringe of this community include mountain laurel (*Kalmia latifolia*), blackberry (*Rubus* spp.), and Chinese privet.

2.5 Farm Management Issues

This section includes management activities that fall outside of the stream restoration tasks, but are directly linked to the overall quality of the project. The tasks have arisen as a result of the proposed stream restoration project or are a part of the conservation easement agreement. The following sections briefly describe the proposed farm management plans.

2.5.1 Livestock

As a result of the proposed stream restoration activities, livestock currently utilizing the Rocky Branch channels for water will no longer have access to shade or watering areas along the stream and immediate riparian areas. Due to the lack of vegetation in the pastures, a source of shade will also be needed for the cattle.

2.5.2 Waste Storage Pond

An inactive dairy waste storage pond currently occupies approximately 0.5 acre of land found on Mr. Bill Allen's property, which is upslope of proposed stream restoration activities (Appendix A, Sheet 11).

3.0 Proposed Restoration

3.1 Streams

Design methodologies are based on natural channel design concepts outlined by Rosgen (1994, 1996, 1998). These methodologies include existing and reference reach channel surveys, data interpretations and geomorphological comparisons of all channel features. Based on field observations and preliminary ideas, the project will attempt to implement Priority I and II Restoration and Priority IV Stabilization. The restoration of Rocky Branch will follow Priority Level I, II, and IV protocols. The Priority Level I Restoration will result in a new stream channel adjacent to the existing channel that exhibits a bank height ratio (ratio of the low bank height divided by the bankfull height) of 1.0. The sinuosities of the new channels with range around 1.2. The Priority Level II Restoration involves construction of a new channel with a floodplain bench at the bankfull elevation. The Priority Level IV Stabilization will involve the placement of structures to alter the dimension of the channel, without constructing a new channel. A summary of the existing and proposed streams at RBSRS is outlined in Table 2.

This segment of Rocky Branch was selected for the excellent opportunity it presented to restore natural stream functions, to establish effective riparian buffers and to restore healthy floodplain stability. Much of the land within RBSRS is dominated by open pasture without fencing. Since cattle have had relatively unrestricted access to the creek channel for watering, the channels at the RBSRS have been severely impacted. Stream restoration will be implemented on the Rocky Branch channel and one of its two unnamed tributaries (Tributary 1). A pond will be created in place of the other unnamed tributary (Tributary 2), which is fed by a natural spring. Approximately 24.095 acres of conservation easement will provide large riparian and upland buffers to protect the restored stream channels. The project will also provide a shade house and watering structures for approximately 75 beef cattle. In addition, the project will provide assistance in decommissioning a dairy waste storage pond. The entire conservation easement will be fenced to restrict access to the restored areas and the I-77 right-of-way. A permanent crossing will be established within the conservation easement. Access to the site will be limited to gated entry points.

3.1.1 Rocky Branch

It is anticipated that Priority Level II Restoration design measures will be applied to approximately 320 linear feet of Rocky Branch (Station 0+00 to 3+20). This upper reach area will serve as a transition from the existing channel to the newly constructed channel. The slope in the upper reach averages 0.0109 ft/ft, which is the steepest portion of the entire project. Cross vanes will be the primary structures used in this section in order to provide

stability and grade control for this area of transition. Bankfull cross sectional areas found in this portion of the project average 30.0 square feet for riffles and 38.5 square feet for pools. The upper reach stream channel will contain floodplain benches, which will help reduce stream velocities and provide a transitional tool to link the Priority I stream restoration area starting at Station 3+20.

The middle reach of the proposed channel is the beginning of Priority I restoration activities. The middle reach which contains a slope of 0.0069 ft/ft, will provide a gradual transition between the upper and the lower reaches. Bankfull cross sectional areas associated with the middle reach average 35.0 square feet for riffles to 46.0 square feet for pools. Bankfull associated with the middle reach will lie at or very close to the top of bank. By positioning the bankfull elevation at the top of bank, the stream channel with be able to fully utilize its floodplain. This utilization of the floodplain should significantly reduce bank erosion. Structures used in this section will include cross vanes, j-hook vanes, and single arm rock vanes. Rootwads will be installed at specific areas to relieve stress from outside bends and to provide natural habitat for aquatic life.

The lower reach of Rocky Branch begins at Station 11+80, where it continues to follow Priority I stream restoration methods. This section contains slopes averaging 0.0034 ft/ft, which are the lowest throughout the project. Bankfull cross sectional areas associated with the lower reach average 45.0 square feet for riffles and 52.5 square feet for pools. This reach will also utilize cross vanes, j-hooks, single arm vanes, and rootwads structures. Any existing drainage tiles within the conservation easement will be removed or destroyed during the channel construction. A 25 foot-wide permanent ford crossing will be established within proposed Rocky Branch channel between Stations 14+99 and 15+24.

Beginning at Station 37+10, where the new channel connects back to the existing channel, stream restoration methods will follow Priority IV stabilization methods. This section will use a minimal number of cross vane structures to achieve the appropriate channel dimensions. Stream banks will be sloped and tapered into the floodplain, which will reduce the current bank erosion induced by cattle grazing. A boulder, which is located outside of the easement, will be removed to allow unimpeded flow of the stream.

3.1.2 Tributary 1

Stream restoration associated with Tributary 1 will be exclusively Priority Level I Restoration. The proposed restoration will reduce the linear footage of the stream channel, but provide a more natural configuration and alignment with the Rocky Branch channel. The newly constructed channel will likely classify as an E4. Bankfull cross sectional areas proposed for this stream channel are 4.5 square feet for riffles and 5.25 square feet for pools. Cross vanes will be installed to provide grade control within this newly constructed channel. Spoil material removed from the newly excavated channel will be placed in the abandoned channel of Tributary 1 following the placement of clay plug at the new connection point.

3.1.3 Tributary 2

Tributary 2 will be converted to a spring-fed pond as a result of landowner negotiations pertaining to the conservation easement.

3.2 Wetlands

Wetland A is likely to be impacted by the relocation of the Rocky Branch channel. Several areas will likely receive clay plugs to facilitate the new stream channel location. However, the remaining portions of the wetland will be enhanced through native wetland plantings and natural seeding.

Wetland B is expected to expand as a result of the stream restoration project. The removal of several drain tiles during the construction of the new stream channel will facilitate the expansion of the wetland. The relocation of the stream channel closer to this wetland will also reconnect hydrology and natural floodplain.

Wetland C is also expected to expand as a result of the stream restoration project. The original location of Tributary 1 will be filled, which will allow Wetland C to gradually expand toward the new Rocky Branch channel. The natural seep providing hydrology for this wetland will no longer be able to drain into the original Tributary 1 channel, which will likely result in a larger wetland.

Vernal pools are proposed for the restoration plan to provide additional habitat and water storage for overbank flooding. These vernal pools will be installed after the stream channels have been restored to finalize their size and placement.

The original Rocky Branch channel will be partially filled in specific areas during construction to provide a balanced cut/fill quantity. Specific areas along the I-77 right-of-way will not be filled to facilitate the three corrugated metal pipe flows emanating from the adjacent roadway median. These surface water areas will provide water storage for stormwater runoff and additional wildlife and aquatic habitat for the site.

3.3 Planting Plan

The planting plan for the riparian and upland buffers of the Rocky Branch site will provide post-construction erosion control and riparian habitat enhancement. The planting plan will also attempt to blend existing vegetative communities into recently restored areas. Plantings in the buffer areas will include native species appropriate for the Piedmont physiographic province and the RBSRS. Plants within the floodplain will be flood tolerant species, which can accommodate periodic flooding events throughout the year. A variety of trees and shrubs will be planted to provide cover and habitat for wildlife as well as soil stabilization.

Tree and shrub species will be planted in specific planting zones. These planting zones will accommodate plant species which have specific requirements for growth. Hydrology and topography are main factors that dictate a plant's ability to survive and to thrive following

planting. These planting zones will be created around these requirements and will include the following zones: Zone 1 (Stream Banks), Zone 2 (Riparian Buffer), Zone 3 (Wetlands), Zone 4 (Vernal Pools), and Zone 5 (Upland Buffers. Shrubs and trees with extensive, deep rooting systems will assist in stabilizing the banks in the long term. Native grasses, transplants, and live stakes will be utilized at the site for immediate stabilization as well as erosion control matting along the newly created stream banks. Vegetation will be planted in a random fashion in an effort to mimic natural plant communities. Colonization of local herbaceous vegetation will inevitably occur, which will provide additional soil stability. Tree species will be planted as bare root stock on random eight-foot centers at a frequency of 680 stems per acre. Shrub species will be dispersed among these tree species also on random eight-foot centers. Planting stock will be culled to remove inferior specimens, so only healthy, viable stock will be planted at the RBSRS. Planting of species will utilize dormant plant stock and will be performed to the extent practicable between December 1st and March 15th. A list of species proposed for each Zone can be found in Table 3.

3.4 Farm Management Plan

Mulkey will provide a set of design sheets for the implementation of the proposed farm management plan. Components of the plan include the following section: the installation of watering structures, the drilling of wells, the construction of a cattle shadehouse, and the decommissioning of a waste storage pond. Mulkey will also provide construction oversight during the implementation of the plan.

3.4.1 Livestock

To provide adequate water and shade for the cattle affected by the stream restoration activities, the following best management practices will be provided to the landowners: five drinking stations, two wells, and one shade house will be installed at designated locations outside of the conservation easement.

In order to provide water for approximately seventy-five head of beef cattle, four drinking stations and a well will be installed on Mr. Joe Allen's property. Also, an existing well on the same property will be connected to two of the drinking stations, while the remaining two stations will be connected via a newly drilled well. In addition, one well and one drinker will be established on Mr. Bill Allen's property as part of the conservation easement agreement.

To provide shade for the cattle, a shadehouse will be installed on Mr. Joe Allen's property to provide artificial shade for the livestock. According to specifications outlined by Weaver (2004), each cow requires approximately 64 square feet of floor space to adequately coexist within the shade house. A structure will be built to provide a minimum 5,000 square feet of floor space for 75 head of beef cattle. It is recommended that horizontal structural beams be used to reduce the number of internal supports and that the floor of the structure be made of concrete. The use of structural beams and concrete flooring will expedite daily maintenance processes and provide a higher level of sanitation within the shade house.

3.4.2 Waste Storage Pond

To reduce future risks to stream water quality in the Rocky Branch channel and to protect the stream restoration investment, the waste storage pond will be eliminated through a decommissioning process. The State of North Carolina requires a waste storage pond closure plan to be written by the local NRCS before any waste can be removed or land applied. As a part of the waste storage closure plan, sludge and liquid waste samples were taken to determine their current nutrient content. Soil samples from adjacent farmland were also taken to determine their current nutrient levels and respective soil properties. These samples were taken to the North Carolina Department of Agriculture (NCDA) laboratory in Raleigh, NC for analyses.

Following the completion of a waste storage pond closure plan, a contractor will be hired to follow the specifications contained within the plan. Solid and liquid waste will be removed and land applied to Mr. Bill Allen's farmland directly across SR 1120, currently being leased by Myers Farms, Inc. Each year a waste management plan is prepared for their farming operation and the decommissioning of the dairy waste storage pond will be incorporated into their 2005 waste management plan. All land application activities will be coordinated with Myers Farms to ensure that an active crop will be growing or will be planted within 30 days of application of the waste. Once the waste has been completely removed from the storage pond and the excavated site passes a required inspection, the pit will be filled with suitable earthen material and graded into the surrounding topography.

4.0 Post Construction Site Conditions

Construction at the RBSRS began on May 15, 2006 and was completed during the last week of September 2006. Following construction, the site has experienced at least 3 large bankfull events, which caused some bank erosion due to the lack of vegetation and heavy sand deposits located throughout the floodplain. A large clay berm was installed at Rocky Branch STA 1+77/Right-of-Way Fence to prevent future erosion and to prevent channel migration. In addition, portions of the right-of-way fence were removed to prevent debris jams and replaced with single strands of wire. The NCDOT approved this alteration to the I-77 right-of-way fence. The final walk-through was completed at the site on June 15, 2007.

4.1 Streams

The longitudinal profiles of the newly constructed stream channels at the site were surveyed using total station survey equipment. Cross sections selected for monitoring were surveyed using a rod and laser level. Existing longitudinal profiles were conducted by identifying each stream feature (riffle, run, pool, or glide) and surveying specific points at those features. These specific locations included top of bank, bankfull, waters edge or surface, and thalweg). A summary of the restored stream channels and their proposed Stream Mitigation Units (SMUs) are outlined in Table 2. A complete set of As-Built Drawings including an as-built plan view, longitudinal profiles for the restored channels, and a proposed versus as-built plan view can be found in Appendix A. The cross section data and photos for the 8 permanent cross sections can be found in Appendix B and C respectively.

4.2 Wetlands

Wetlands at the site were not disturbed, except for Wetland A, which received clay plugs as proposed in the design. These plugs were installed to facilitate the location of the new stream channel. Following construction, there was a noticeable increase in wetness at the site. Vernal pools were installed as proposed in the design, with minor adjustments in location and size.

Additionally, surface waters created as a result of the abandoned channel and pond have provided stormwater retention and improved aquatic and wildlife habitat at the site. Appendix A shows all of the features discussed in this section.

4.3 Planted Vegetation

All plant material was installed by December 20th, 2006. Vegetation plots were installed in August 2007 to evaluate the contents of each plot. During this time, a more detailed evaluation of the quantity and quality of the plantings was determined. The site plantings have grown extremely well during 2007, considering the extreme drought and competition from residual pasture weeds and fescue.

4.4 Farm Management

The farm management plan was successfully completed in February 2006, prior to the onset of stream restoration activities. All components were installed or completed as shown in Appendix A, Sheet 11. Specific GPS coordinates for these components are listed in Table 5.

5.0 Monitoring Plan

Utilizing the June 4, 2004 Scope of Services and the March 2005 Rocky Branch Restoration Plan guidelines for monitoring, Mulkey has made an effort to utilize the current protocols set forth by the September, 2005 As-built and monitoring guidelines. This will allow future monitoring at the site to utilize the most recent protocols outlined by EEP. This report will outline the protocols by which the channel stability and vegetation survivability will be evaluated. More specifically, the success of channel restoration, erosion control methods, vegetative plantings, and the long-term stability of the project. To establish baseline data for the monitoring report, longitudinal profiles, permanent cross sections, photo reference points, and vegetation plots were established during August 2007.

5.1 Success Criteria for Streams

Success criteria for stream mitigation sites are based on guidelines established by the USACE, US Environmental Protection Agency (USEPA), NC Wildlife Resources Commission (NCWRC) and the NCDWQ (USACE *et. al,* 2003). These guidelines establish criteria for both hydrologic conditions and vegetation survival.

Stream channel monitoring will determine the degree of success a mitigation project has achieved in meeting the objectives of providing proper channel function and increased habitat quality. Monitoring will be performed each year for the 5-year monitoring period and no less than two bankfull flow events must be documented through the monitoring period. A crest gage will be used to determine the occurrence of these bankfull events. The bankfull events must occur during separate monitoring years. In the event that the required bankfull events do not occur during the 5-year period, consultation with EEP and other resource agencies will be conducted. The monitoring will include reference photos and channel stability analyses, as specified in the latest version of the Ecosystem Enhancement Program "Content, Format and Data Requirements for EEP Monitoring Reports.

The restored sections of the RBSRS will be evaluated with regard to overall channel stability. Since streams are considered as "active" or "dynamic" systems, restoration is achieved by allowing the channel to develop a stable dimension, pattern, and profile such that, over time, the stream features (riffle, run, pool, and glide) are maintained and the channel does not aggrade or degrade. Minor morphologic adjustments from the design stream are anticipated based on the correlation of reference reach data, excessive sediment deposition from upstream sources, and on-going changes in land use within the watershed.

Monitoring of the RBSRS will be performed until success criteria are met up to a period of five years. Monitoring is proposed for hydrology and vegetation. The monitoring plan will be designed in accordance with Stream Mitigation Guidelines (USACE *et. al.* 2003) and in coordination with EEP. Results will be documented on an annual basis, with the associated reports submitted to EEP as evidence that goals are being achieved.

5.2 Success Criteria for Vegetation

Vegetation success at the RBSRS will be measured by survivability over a five year monitoring period. Survivability will be based on achieving at least 320 stems per acre after three years and 260 stems per acre after five years. A survey of vegetation during the growing season (mid-March to early November) will be conducted annually over the five year monitoring period in order to verify survivability of the installed plantings. This survey will track the total mortality on an annual basis and be used to calculate survivability at the end of three and five years. If the planted species do not meet the required number of stems per acre at the end of Year 3 (320) and Year 5 (260), the installation of additional plantings may be necessary. A remedial planting plan will be developed in the event that survivability is not met.

5.3 Methods

5.3.1 Photo Documentation

Photo documentation is essential to monitoring the success of a restoration site. Photos provide a visual assessment of the stream and vegetation conditions. Photos will be taken at the permanent cross section locations and reference photo point locations on a yearly basis. Photos should be taken at the same location as described in the captions of the photos in Appendix C, D, and E of this report.

5.3.2 Vegetation Plots

Planted vegetation will be evaluated using vegetation plots and stem counts. Following the September 16, 2005 guidance on vegetation monitoring, Mulkey installed 11 vegetation plots. The plots were installed randomly throughout the site and have a total area of approximately 100 square meters. An iron pipe was installed at each plot corner along with a polyvinyl chloride (PVC) pipe. During the establishment of these plots, stems were identified, counted, and flagged on lateral branches. A summary of each vegetation plot's contents can be found in Table 4. In addition, photos will be taken from the same location as described in the captions found in Appendix F. GPS coordinates for the vegetation plot corners can be found in Table 5.

Vegetative monitoring will be conducted in July and August of each monitoring year using the latest version of the CVS-EEP vegetation protocol. Vegetation success requirements state that 320 stems/acre must survive after 3 years of monitoring (2010). After 5 years of monitoring (2012), 260 stem/acre must have survived within each plot (USACE et al., 2003). Should the performance criteria outlined above not be met during the monitoring period, a remediation proposal, detailing corrective actions and/or maintenance actions proposed, and an implementation schedule should be developed.

5.3.3 Streams

As-built surveys were conducted in August 2007 to produce drawings that represent the actual implementation of the design plans. These drawings provided documentation of the dimension, pattern, and profile of the restored channel and will serve as a baseline for the monitoring reports. The following sections describe the methods utilized to collect the stream data.

5.3.4 Dimension

A total of 7 permanent cross sections were established at a frequency of less than 500 linear feet apart on the Rocky Branch channel. These cross sections represent 3 riffles and 4 pools. Tributary 1 contains a single riffle cross section due to its small size. The permanent cross section locations are shown in Appendix A and their GPS coordinates are listed in Table 5. Cross section data can be found in Appendix B.

Cross section measurements begin at the left pin and move across the channel to the right pin. The left pin and right pin are oriented with the viewer facing downstream. Specific features that should be collected during the cross section survey include left pin, breaks in slope, top of bank, bankfull, waters edge/surface, stream bed, thalweg, structure arms/footers, and the right pin. To provide a detailed survey, it is recommended that large distance increments not be used when surveying the cross section.

Cross sections may change slightly from year to year and changes in these dimensions should be evaluated on a yearly basis and documented in the monitoring report. In the event that the cross section dimension changes dramatically, a remediation proposal, detailing

corrective actions and/or maintenance actions proposed, and an implementation schedule should be developed.

5.3.5 Pattern and Profile

As a part of the As-built drawings, a longitudinal profile was conducted for the entire lengths of the restored channels. Appendix A depicts these longitudinal profiles for both Rocky Branch and Tributary 1.

The restored portion of Rocky Branch and Tributary 1 will be evaluated yearly to determine overall channel stability. Since streams are considered as "active" or "dynamic" systems, restoration is achieved by allowing the channel to develop a stable dimension, pattern, and profile such that, over time, the stream features (riffle, run, pool, and glide) are maintained and the channel does not aggrade or degrade. Minor morphologic adjustments from the design stream are anticipated based on the correlation of reference reach data, excessive sediment deposition from upstream sources, on-going changes in land use within the watershed, and the effects of extraordinary meteorological events.

Longitudinal profiles will be surveyed for Rocky Branch from Stations (1+77 to 31+77) and for Tributary 1 from Stations (0+00 to 1+72) for inclusion into the monitoring reports. Each longitudinal profile will conducted as to note specific stream features (riffle, run, pool, and glide).

A plan view should be generated following the completion of the longitudinal profiles to facilitate pattern measurements of the restored channels.

5.3.6 Bed Material Analysis

During the As-built surveys, Modified Wolman pebble counts were conducted at each permanent cross section location. Data collected for each reach is presented in Appendix G.

These Modified Wolman pebble counts were completed at each permanent cross section. Each permanent cross section was sampled from bankfull to bankfull. A total of 50 samples were collected at each permanent cross section location along the Rocky Branch reach. A total of 25 samples were collected at the riffle cross section located at Tributary 1. Future sampling should follow the methods outlined above in order to be consistent.

5.3.7 Hydrology

A crest gage will be used to determine the occurrence of bankfull flow events. Monitoring will be performed each year for the 5-year monitoring period and no less than two bankfull flow events must be documented through the monitoring period. The bankfull events must occur during separate monitoring years. In the event that the required bankfull events do not occur during the 5-year period, consultation with EEP and other resource agencies will be conducted.

5.4 Wetland Performance Criteria

Baseline wetland determinations were performed to quantify the existing wetlands at the RBSRS. Currently, a total of 1.44 acres of wetlands are located within the conservation easement. An actual acreage of these wetlands will be determined during the fifth-year of monitoring by a new jurisdictional determination. Each wetland category (creation, restoration, enhancement, and preservation) will be determined by jurisdictional determinations. Wetlands derived as a result of the project will be determined by subtracting the original wetland acreage (2005) from the total wetland acreage found at the site at the end of monitoring year five (2012).

5.5 Reporting

The monitoring reports will follow the methods outlined by the latest version of the EEP Guidance document guidance for monitoring report content, format, and data requirements. Mulkey will conduct the 1st year (2008) of monitoring at the site with subsequent monitoring years (2 - 5) being conducted by a consultant specified by the Ecosystem Enhancement Program (EEP).

Monitoring reports will be submitted to the EEP's designated project representative for coordination with the appropriate regulatory agencies on an annual basis. It is understood that the EEP will coordinate any necessary monitoring report submittals with the regulatory agencies. If monitoring reports indicate any deficiencies in achieving the success criteria on schedule, a remedial action plan will be included in the annual monitoring reports.

6.0 Maintenance and Contingency Plan

Mulkey will reassess the condition of the stream channels, structures, vegetation, and overall bank stability during the 1st year of monitoring (2008). In the event, there is significant problem or concern at the site, a meeting with should be scheduled to discuss the problem and to determine the appropriate remediation.

During the walk-through conducted on June 15, 2007, specific areas were noted as "Areas of Concern". At that time, Mulkey recommended that vegetation should be allowed to grow for one season before any actions were taken. This recommendation was developed to reduce or to minimize damage that may occur from reentering the site with heavy equipment. During the As-built surveys, the site had become well vegetated, but specific areas of concern were still present, that should be mentioned in this baseline document. These areas were photographed and documented in Appendix H. Large quantities of invasive species previously covering the site have been significantly reduced following construction and the alteration of the hydrologic regime.

7.0 Points of Contact

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State Construction Office:
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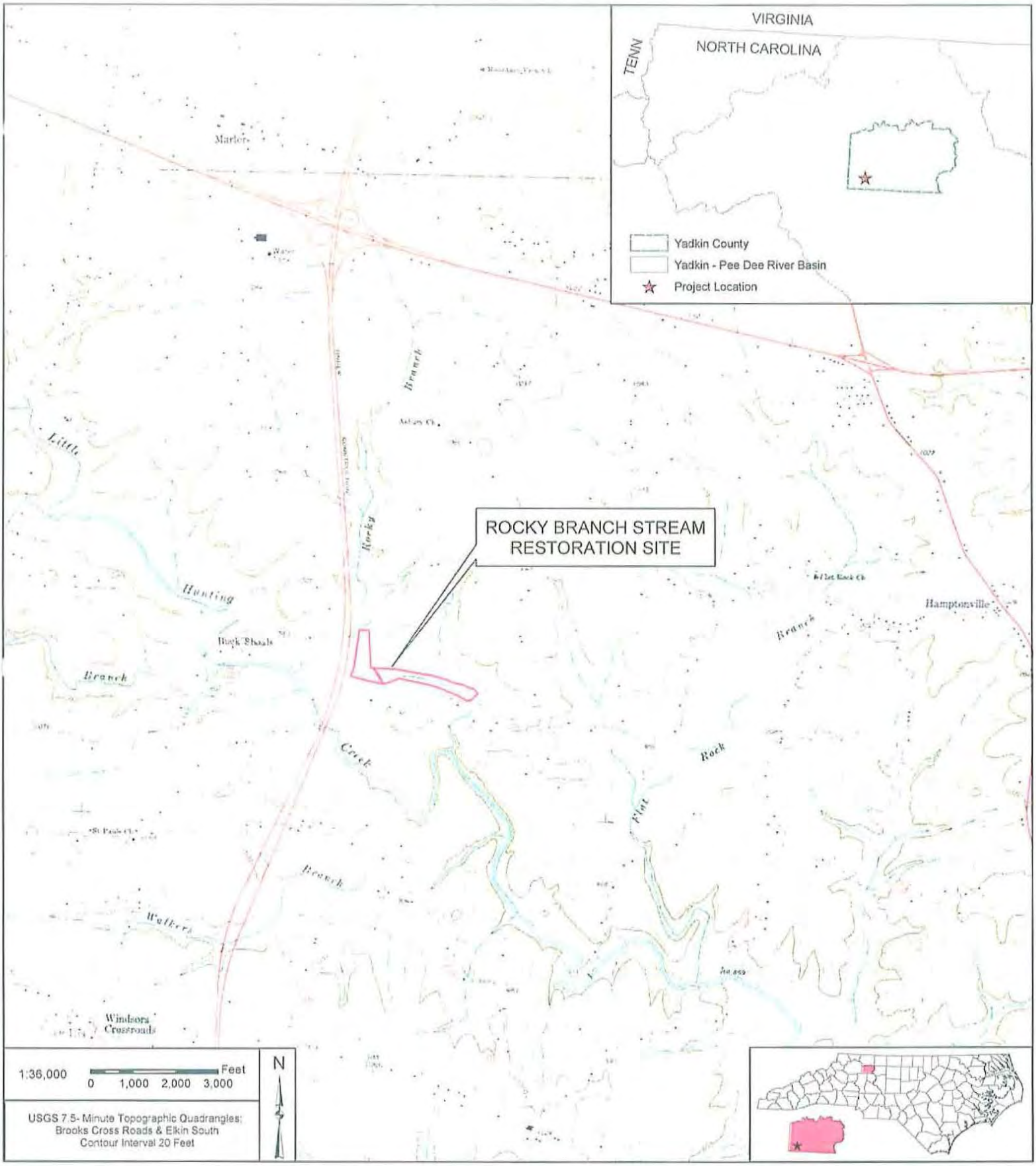
FIGURES

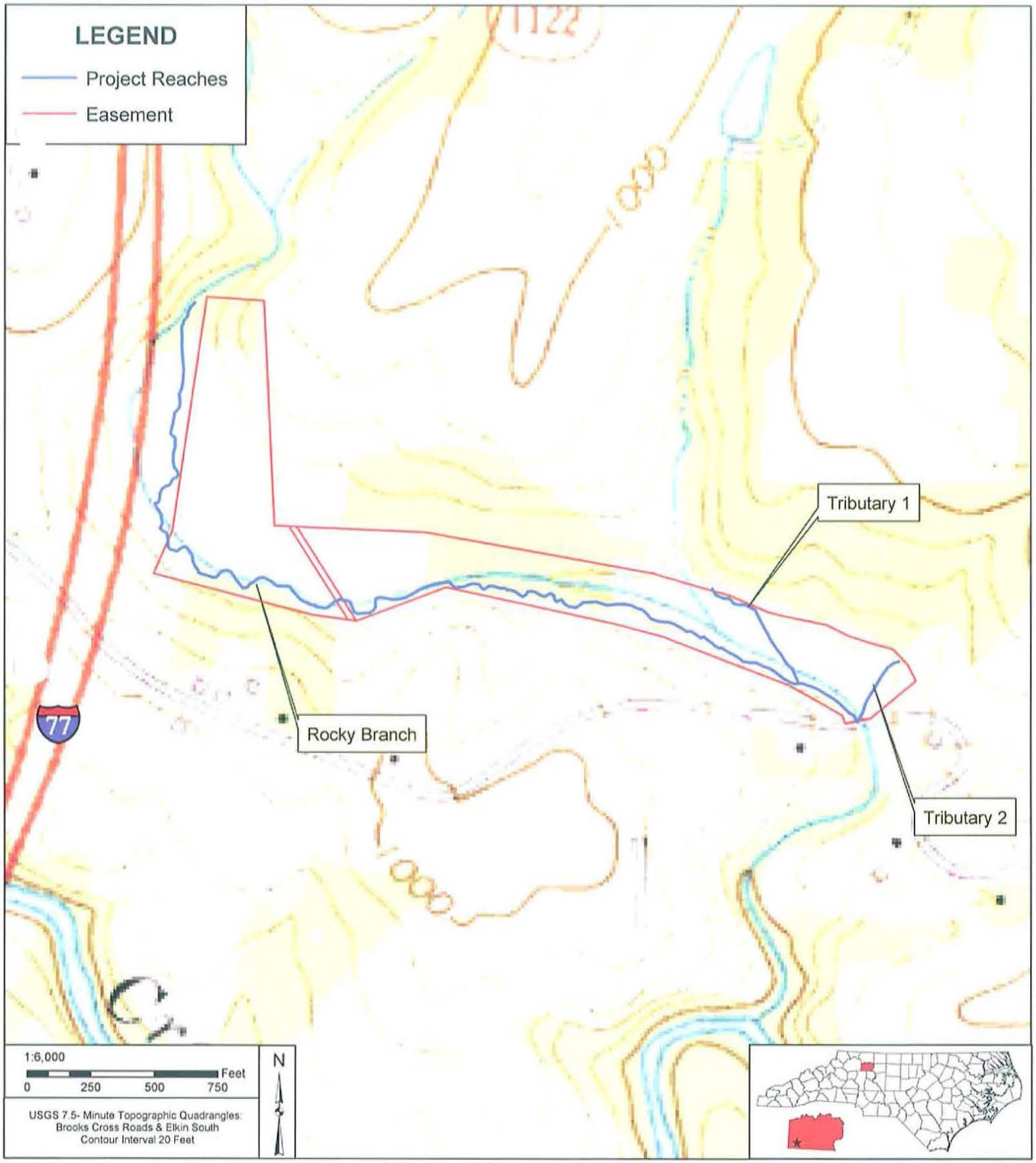


VICINITY MAP

ROCKY BRANCH STREAM RESTORATION

YADKIN COUNTY, NORTH CAROLINA

Figure 1



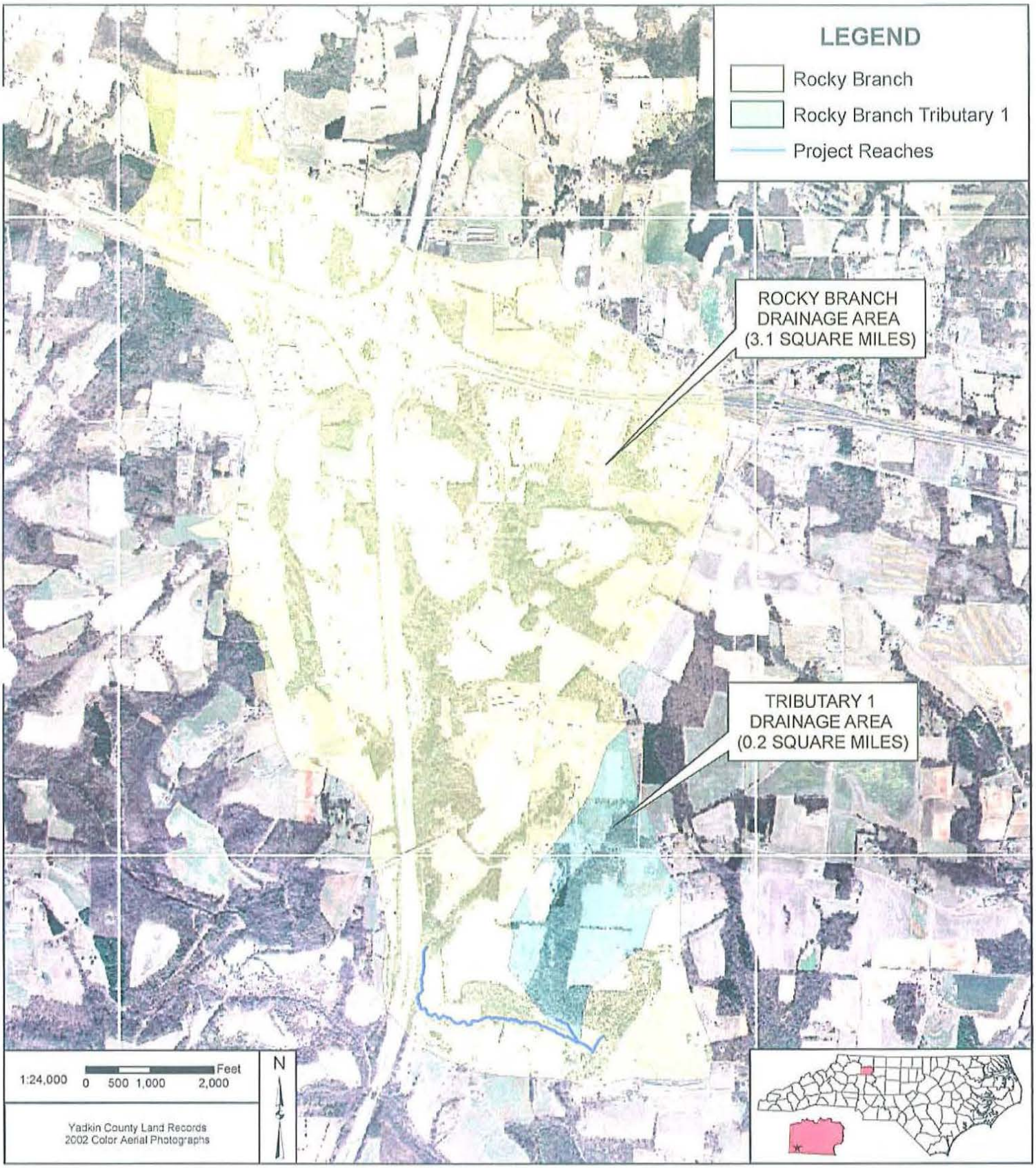
Ecosystem Enhancement Program

LOCATION MAP

ROCKY BRANCH STREAM RESTORATION

YADKIN COUNTY, NORTH CAROLINA

Figure 2



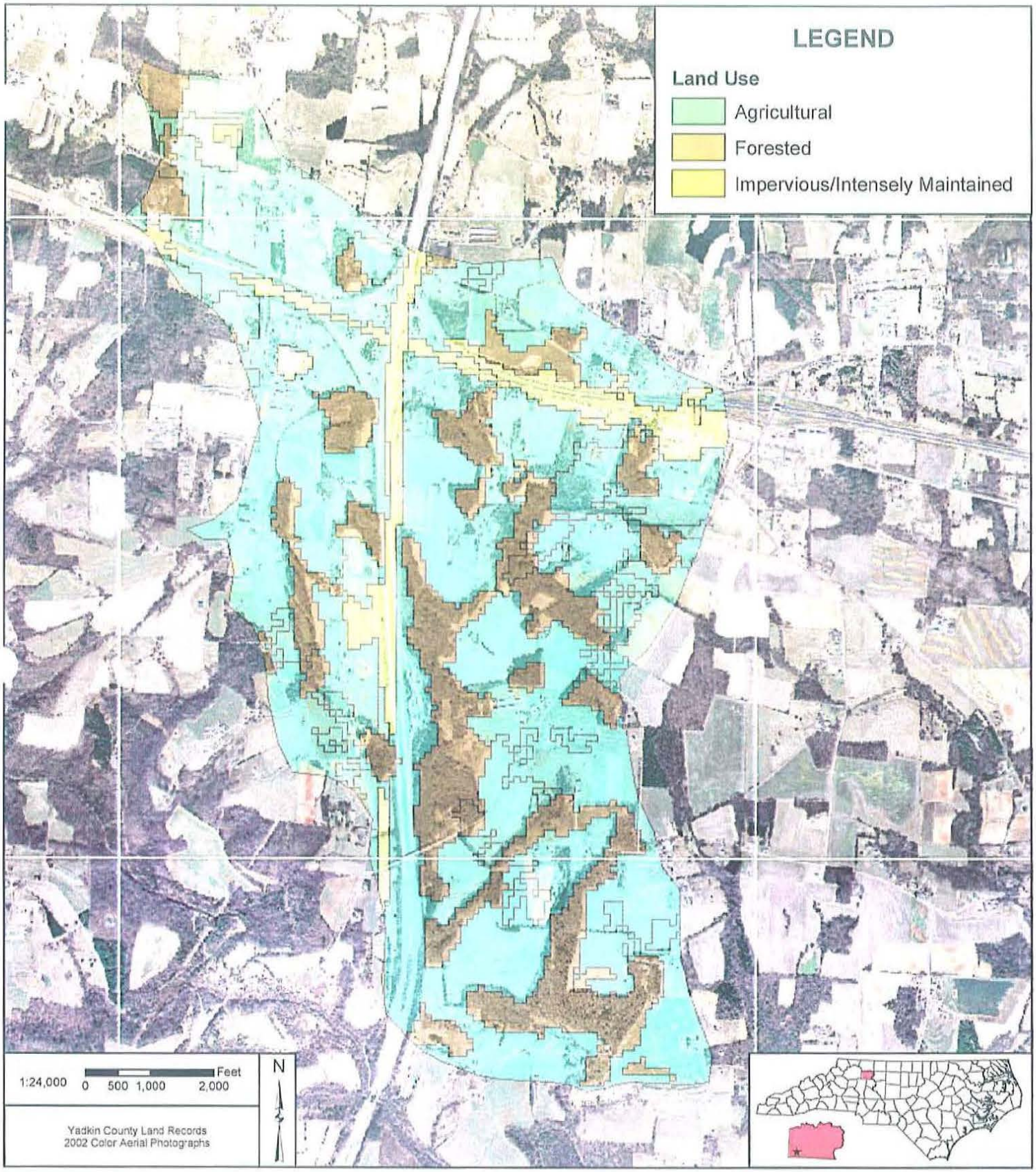
WATERSHED MAP

ROCKY BRANCH STREAM RESTORATION

YADKIN COUNTY, NORTH CAROLINA

Ecosystem Enhancement Program

Figure 3



Ecosystem Program

LAND USE MAP

ROCKY BRANCH STREAM RESTORATION

YADKIN COUNTY, NORTH CAROLINA

Figure 4

TABLES

Table 1. Summary of Existing Cross Sections – Rocky Branch and Tributary 1

Cross Section	Station No.	Morph. Feature	Bankfull Area (ft^2)	Ent. Ratio *	W/D Ratio*	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Stream Class.*
1	2+33	Pool	35.7	1.9	10.9	23.4	1.5	--
2	4+45	Riffle	27.5	1.5	13.2	21.9	1.3	B4/1c
3	6+00	Run	34.4	1.6	11.8	23.5	1.5	--
4	7+43	Pool	37.4	4.4	7.43	21.0	1.8	--
5	8+83	Glide	34.6	1.5	17.3	27.3	1.3	--
6	11+37	Riffle	35.7	2.3	17.7	27.9	1.3	C4
7	16+97	Riffle	35.0	3.7	18.9	28.5	1.2	C4
8	23+12	Run	40.5	1.8	11.8	25.6	1.6	--
9	26+30	Pool	45.1	>5	13.1	28.0	1.6	--
10	26+43	Glide	35.1	1.7	12.2	24.1	1.5	--
11[A]	28+09	Riffle	45.2	>5	11.1	23.9	1.9	E4
12	35+39	Riffle	43.5	>5	11.8	26.5	1.6	E4
13	44+30	Riffle	27.3	1.8	25.6	28.6	0.9	B4/1c
Trib. 1	3+84	Riffle	3.1	1.6	33.6	10.8	0.3	C5

*Notes: Ent. Ratio is "Entrenchment Ratio"
W/D Ratio is "Width/Depth Ratio"
Stream classification is only viable along riffle sections.
[A] Bar Sample Location

Table 2. Rocky Branch Stream Restoration Summary

Stream Channel Summary					
Stream	**Priority Level**	**Type**	**Original Channel Length (lf)** [A]	**Restored Channel Length (lf)** [A]	**Stream Mitigation Units (SMU)**
Rocky Branch	I & II	Restoration	2,901	3,614	3,614
	IV	Enhancement I		206	137
Tributary #1	I	Restoration	593	172	172
Tributary #2			280	Pond	
		Totals	3,774	3,992	3,923

[A] Portion of original channel contained within proposed conservation easement.

Table 3. Recommended Plant Species and Planting Zones.

Planting Zone	Zone Description	Recommended Plant Species [A]	
		Scientific Name	Common Name
1	Stream Banks	*Alnus serrulata*	Tag alder
		Betula nigra	River birch
		Cephalanthus occidentalis	Buttonbush
		Cornus amomum	Silky dogwood
		Hibiscus mosheutos	Marsh mallow
		Lindera benzoin	Spicebush
		Salix nigra	Black willow
		Salix sericea	Silky willow
		Sambucus canadensis	Elderberry
2	Riparian Buffer	*Betula nigra*	River birch
		Fraxinus pennsylvanica	Green ash
		Lindera benzoin	Spicebush
		Plantanus occidentalis	Sycamore
		Quercus nigra	Water oak
		Quercus phellos	Willow oak
		Sambucus canadensis	Elderberry
3	Wetlands	*Alnus serrulata*	Tag alder
		Cephalanthus occidentalis	Buttonbush
		Cornus amomum	Silky dogwood
		Fraxinus pennsylvanica	Green ash
		Hibiscus mosheutos	Marsh mallow
		Salix nigra	Black willow
		Salix sericea	Silky willow
4	Vernal Pools	*Boehmeria cylindrica*	False nettle
		Carex lurida	Lurid sedge
		Carex intumescens	Bladder sedge
		Cyperus strigosus	Umbrella sedge
		Eleocharis obtusa	Blunt spike-rush
		Eupatorium fistulosum	Joe-pye weed
		Juncus coriaceus	Leathery rush
		Juncus effuses	Soft rush
		Saururus cernuus	Lizard's tail
5	Upland Buffer	*Carya tomentosa*	Mockernut hickory
		Cornus florida	Flowering dogwood
		Diospryos virginiana	Persimmon
		Ilex opaca	American holly
		Juniperus virginiana	Eastern red cedar
		Pinus echinata	Shortleaf pine
		Pinus strobus	White pine
		Pinus virginiana	Virginia pine
		Prunus serotina	Black cherry
		Quercus alba	White oak
		Quercus falcata	Southern red oak

[A] List is alphabetized by scientific name within each planting zone.

Table 4. Vegetation Plot Information.

Vegetation Plot	Zone Description	Actual Plot Size, sq. meters (sq. feet)	Identified Species Common Name
1	Stream Banks & Riparian Buffer	91.8 (988.1)	Black willow [A] (18) Buttonbush (1) Silky dogwood [A] (6) Marsh mallow (6) Virginia sweetspire [B] (1) Sycamore (2) Water Oak (4) Total (38)
2	Riparian Buffer	99.5 (1,070.5)	Buttonbush (1) Chokeberry [B] (2) Green ash (6) Water Oak (1) Sycamore (1) Willow oak (2) Total (13)
3	Riparian Buffer	100.0 (1,076.4)	Green ash (4) Water Oak (1) Sycamore (6) Water oak (3) Total (14)
4	Riparian Buffer	99.7 (1,073.9)	Elderberry (1) Green ash (4) Sycamore (2) Willow oak (4) Total (11)
5	Riparian Buffer	100.6 (1,082.6)	Buttonbush (4) Green ash (5) Willow oak (4) Total (13)
6	Riparian Buffer	99.16 (1,067.4)	Buttonbush (6) Chokeberry [B] (1) Elderberry (1) Green ash (5) River birch (1) Total (14)

( ) Denotes the number of species found within a particular vegetation plot (bareroot or live stake)
[A] Species designated for live staking at 2,723 stakes/acre equivalent to a 4 x 4 spacing.
[B] Represents a plant species that was substituted during the project due to availability.
Note: All bareroot species were planted at 680 stems/acre equivalent to an 8 x 8 spacing.

Table 4 contd. Vegetation Plot Information.

Vegetation Plot	Zone Description	Actual Plot Size, sq. meters (sq. feet)	Identified Species Common Name
7	Riparian Buffer	98.9 (1,064.6)	Buttonbush (2) Elderberry (1) Green ash (5) River birch (2) Willow oak (7) Water Oak (1) Total (18)
8	Riparian Buffer	100.7 (1,084.4)	Buttonbush (4) Elderberry (1) Green ash (6) Sycamore (5) Tag alder (2) Virginia sweetspire [B] (2) Total (20)
9	Riparian Buffer	100.6 (1,082.3)	Green ash (11) Tag alder (1) Willow oak (1) Water Oak (1) Total (14)
10	Stream Banks & Riparian Buffer	91.57 (985.6)	Black willow [A] (18) Green ash (3) River birch (3) Silky dogwood [A] (14) Water oak (1) Water Oak (4) Total (43)
11	Riparian Buffer	100.7 (1,083.4)	Buttonbush (2) Elderberry (1) Green ash (5) River birch (2) Willow oak (7) Water Oak (1) Total (18)

( ) Denotes the number of species found within a particular vegetation plot (bareroot or live stake)
[A] Species designated for live staking at 2,723 stakes/acre equivalent to a 4 x 4 spacing.
[B] Represents a plant species that was substituted during the project due to availability.
Note: All bareroot species were planted at 680 stems/acre equivalent to an 8 x 8 spacing.

Table 5. Site Specific GPS Coordinates.

Permanent Cross Section Locations			
Cross Section	**Pin**	**Northing**	**Easting**
1	East	858170.89359	1464946.89729
1	West	858142.40913	1464790.43990
2	West	857781.82075	1464851.12922
2	East	857764.04218	1464965.72269
3	North	857607.44340	1465127.21077
3	South	857485.69880	1465101.76172
4	Southwest	857541.43253	1465432.50285
4	Northwest	857634.50310	1465521.14063
5	North	857575.76276	1465864.78722
5	South	857473.81958	1465861.27126
6	South	857401.46305	1466197.32514
6	North	857513.83203	1466202.30296
7	Southwest	857358.12558	1466552.27231
7	Northeast	857467.17109	1466625.62703
8	West	857385.59529	1466817.68550
8	East	857398.75469	1466895.76799

Crest Gage Location	
Northing	**Easting**
857409.44222	1466721.42761

Farm Management BMP Locations		
BMP Type	**Northing**	**Easting**
Well 1	856615.39087	1465171.05531
Well 2 (Existing)	856455.03536	1466595.05788
Well 3	857260.98343	1468044.34475
Drinker 1	856914.93614	1465512.69405
Drinker 2	857095.28396	1466490.19729
Drinker 3	856332.37388	1466574.25648
Drinker 4	857510.40992	1468451.88227
Drinker 5	856632.08884	1468172.34936
Shadehouse, SW	857379.59145	1468831.48159
Shadehouse, NW	857431.99583	1468813.83332
Shadehouse, NE	857460.02939	1468911.02705
Shadehouse, SE	857409.07706	1468928.70706

Reference Photo Locations		
Photo Point	**Northing**	**Easting**
1	858305.39856	1464958.44449
2	857481.49342	1464761.56009
3	857644.58764	1465357.57928
4	857449.47382	1466738.05359
5	857166.62472	1466918.73000
6	857271.35679	1467333.00027

Table 5 contd. Site Specific GPS Coordinates.

Vegetation Plots			
Vegetation Plots	**Plot Corner**	**Northing**	**Easting**
1	SE	858171.34000	1464887.27000
2	SE	857832.82000	1464938.13000
3	NW	857953.78000	1464779.04000
4	NW	857632.18000	1465175.26000
5	NW	857496.40000	1465196.13000
6	NW	857494.24000	1465349.51000
7	NW	857586.42000	1465640.52000
8	NW	857460.15000	1466018.59000
9	NW	857421.22000	1466494.90000
10	NW	857438.11000	1466695.12000
11	NW	857357.62000	1466967.62000

APPENDICES

APPENDIX A
AS-BUILT PLAN DRAWINGS

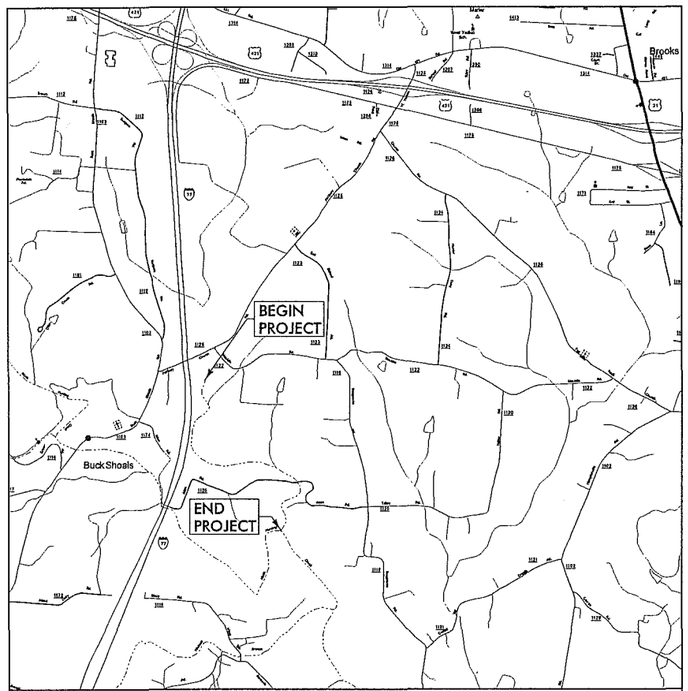
SCO ID NO. 03-06061-01A

YADKIN COUNTY

ROCKY BRANCH STREAM RESTORATION PROJECT

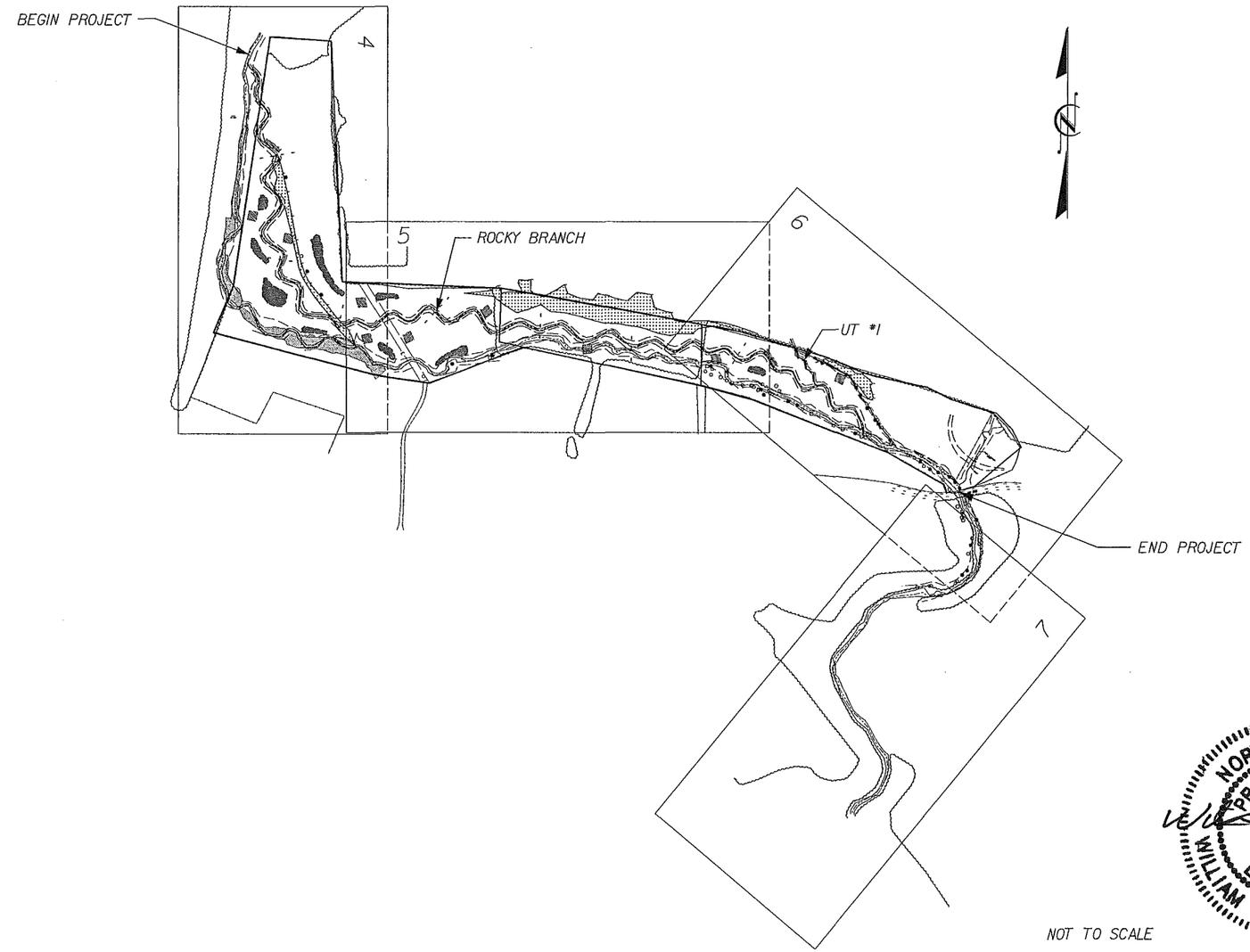
LOCATION: APPROXIMATELY TWO MILES SOUTH OF THE US 421 AND I-77 INTERSECTION

AS-BUILT DRAWINGS



VICINITY MAP

APPROXIMATE SCALE 1 : 30,000



NOT TO SCALE

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 09.10.07

INDEX OF SHEETS

SHEET NUMBER	SHEET
1	TITLE SHEET
2	LEGEND
3 - 10	ASBUILT DRAWINGS
11	FARM MANAGEMENT PLAN VIEW

REVISIONS

DATE	BY	DESCRIPTION
9/6/07	TBB	AS-BUILT DRAWINGS

SCALE AS SHOWN

DATE:	9/6/07
DESIGNED:	TBB
DRAWN:	JTL
CHECKED:	WSH
APPROVED:	WSH

MULKEY PROJECT NUMBER 200424L00

PLANS PREPARED BY:

MULKEY ENGINEERS & CONSULTANTS
PO Box 33127
RALEIGH, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

PROJECT MANAGER
TOM BARRETT, RF

SENIOR ENGINEER
WILLIAM SCOTT HUNT III, PE

SENIOR SCIENTIST
TOM BARRETT, RF

PROJECT ENGINEER

PLANS PREPARED FOR

Ecosystem Enhancement PROGRAM

TITLE SHEET

SHEET OF

NOTE: NOT TO SCALE
Not all symbols used in plans

LEGEND

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III 03.10.07

REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	2

LEGEND

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BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin — EIP
- Property Corner
- Property Monument — ECM
- Existing Fence
- Temporary Fence
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Tree Protection Fence
- Wetland Boundary
- Proposed Oxbow Wetland Boundary — WLB
- Conservation Easement
- Construction Limits
- Limits Of Disturbance
- Proposed Gate — G
- Control Point
- Bench Mark

BUILDINGS AND OTHER CULTURE:

- Sign — S
- Foundation
- Area Outline
- Building
- School
- Church

HYDROLOGY:

- Hydro, Pool or Reservoir
- River Basin Buffer — RBB
- Flow Arrow
- Disappearing Stream
- Spring
- Thalweg
- Top Of Bank
- Swamp Marsh
- Proposed Lateral, Tail, Head Ditch — FLOW
- Bedrock

RAILROADS:

- Standard Guage — CSX TRANSPORTATION
- RR Signal Milepost — MILEPOST 35
- Switch — SWITCH
- RR Abandoned

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Existing Gravel Road
- Existing Metal Guardrail
- Existing Cable Guiderail

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard — Vineyard

EXISTING STRUCTURES:

MAJOR:

- Bridge, Tunnel or Box Culvert — CONC
- Bridge Wing Wall, Head Wall and End Wall — CONC WW

MINOR:

- Head and End Wall — CONC HW
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB — CB
- Paved Ditch Gutter
- Storm Sewer Manhole — S
- Storm Sewer — S

UTILITIES:

POWER:

- Existing Power Pole
- Existing Joint Use Pole
- Power Manhole — P
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole — HH
- H-Frame Pole
- Recorded U/G Power Line — P

GAS:

- Gas Valve
- Gas Meter
- Recorded U/G Gas Line — G
- Above Ground Gas Line — A/G Gas

TELEPHONE:

- Existing Telephone Pole
- Telephone Manhole — T
- Telephone Booth
- Telephone Pedestal — T
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole — HH
- Recorded U/G Telephone Cable — T
- Recorded U/G Telephone Conduit — TC
- Recorded U/G Fiber Optics Cable — T FO

WATER:

- Water Manhole — W
- Water Meter
- Water Valve
- Water Hydrant
- Recorded U/G Water Line — W
- Above Ground Water Line — A/G Water

TV:

- TV Satellite Dish
- TV Pedestal — C
- TV Tower
- U/G TV Cable Hand Hole — HH
- Recorded U/G TV Cable — TV
- Recorded U/G Fiber Optic Cable — TV FO

MISCELLANEOUS:

- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box — S
- Utility Unknown U/G Line — ZUTL
- U/G Tank; Water, Gas, Oil
- A/G Tank; Water, Gas, Oil
- Abandoned According to Utility Records — AATUR
- End of Information — E.O.I.

SANITARY SEWER:

- Sanitary Sewer Manhole — S
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line — SS
- Above Ground Sanitary Sewer — A/G Sanitary Sewer
- Recorded SS Forced Main Line — FSS

PROPOSED STREAM WORK:

STREAM STRUCTURES:

- Rock Crossvane
- Rock Vane
- J Hook Rock Vane
- Modified Rock Vane
- Constructed Riffle
- Root Wad
- Structure Number

STREAM FEATURES:

- Constructed Bankfull/Top Of Bank
- Old Top Of Bank
- Constructed Thalweg
- Proposed Thalweg
- Waters Edge
- Old Waters Edge
- Vernal Pool
- Surface Water
- Staging Area
- Impervious Dike
- Permanent Improved Gravel Road
- Temporary Gravel Road
- Stone Outlet Sediment Trap
- Impervious Stream Channel Plug
- Fill Existing Stream Channel
- Vegetation Plot

MISCELLANEOUS:

- Photo Point — PP #
- Cross Section
- Crest Gauge

REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	3

AS-BUILT DRAWING

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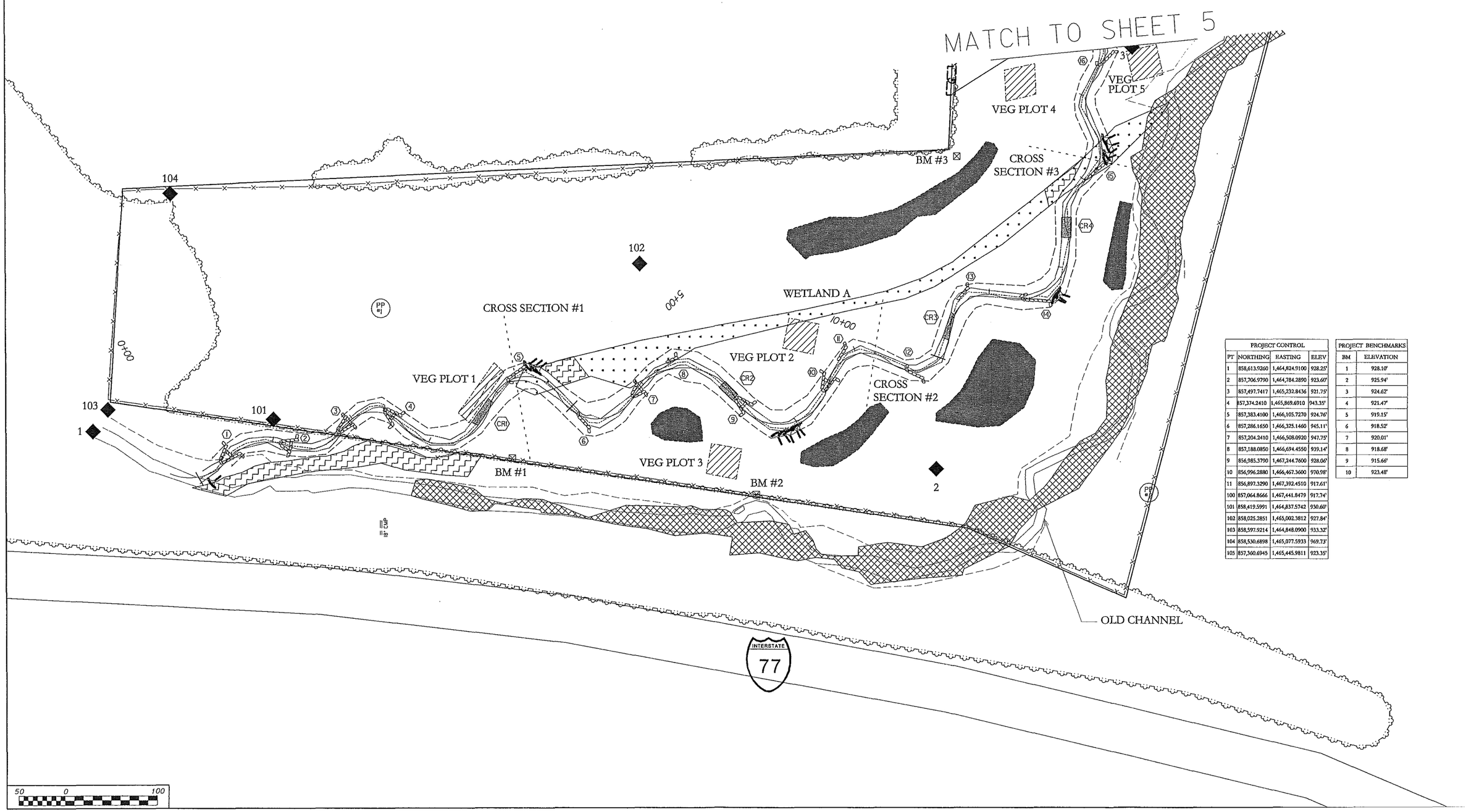
09.10.07



PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
1	858,613.9260	1,464,824.9100	928.25'
2	857,706.9790	1,464,784.2890	923.60'
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4	857,374.2410	1,465,869.6910	943.35'
5	857,383.4100	1,466,105.7270	924.76'
6	857,286.1650	1,466,325.1460	945.11'
7	857,204.2410	1,466,508.0920	947.75'
8	857,188.0850	1,466,694.4550	939.14'
9	856,985.3790	1,467,244.7600	928.06'
10	856,996.2880	1,466,467.3600	970.98'
11	856,897.3290	1,467,392.4510	917.61'
100	857,064.8666	1,467,441.8479	917.74'
101	858,419.5991	1,464,837.5742	930.60'
102	858,025.2851	1,465,002.3812	927.84'
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104	858,530.6898	1,465,077.5933	969.73'
105	857,360.6945	1,465,445.9811	923.35'

PROJECT BENCHMARKS	
BM	ELEVATION
1	928.10'
2	925.94'
3	924.62'
4	921.47'
5	919.15'
6	918.52'
7	920.01'
8	918.68'
9	915.66'
10	923.48'

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REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	4

AS-BUILT DRAWING

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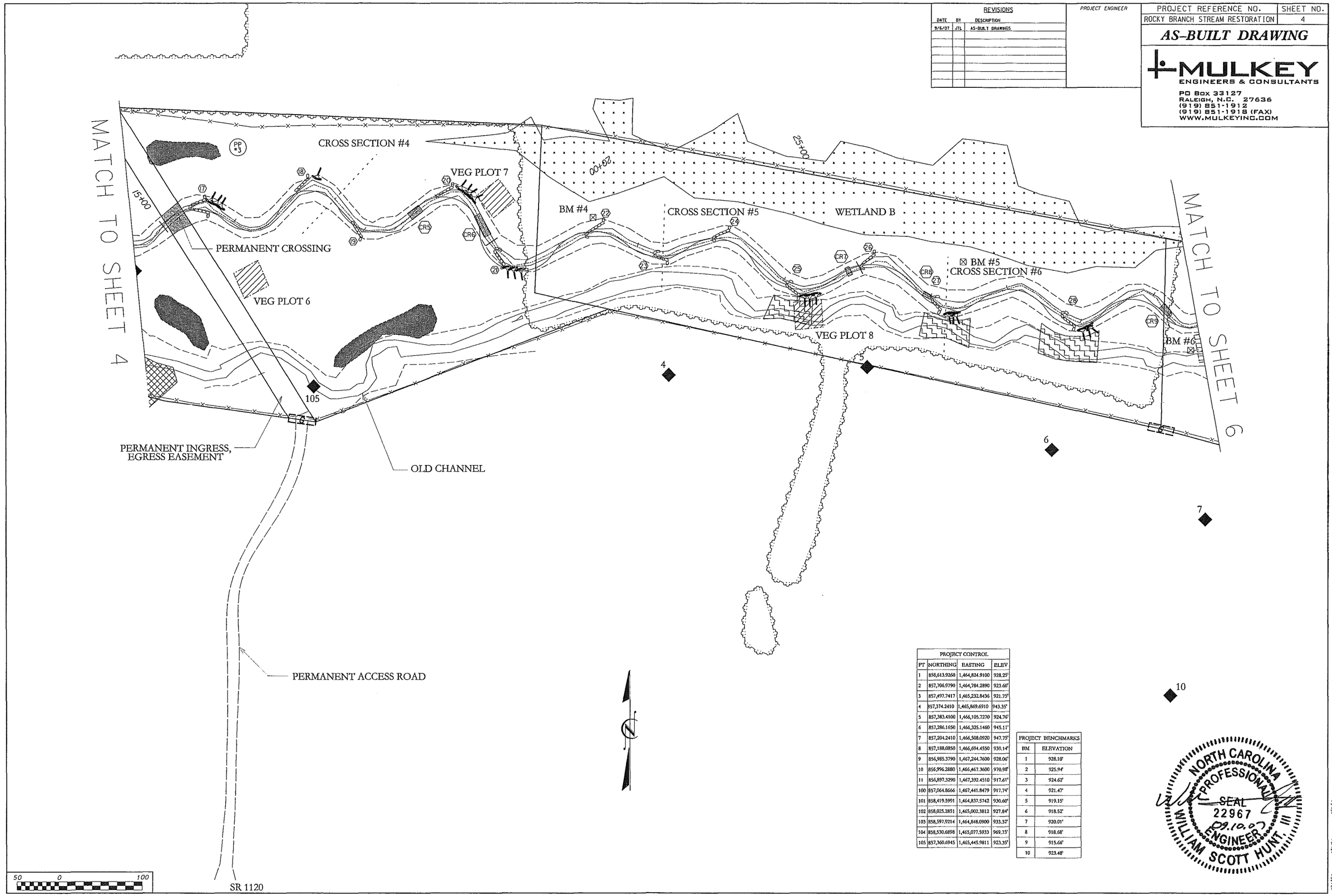

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REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	5

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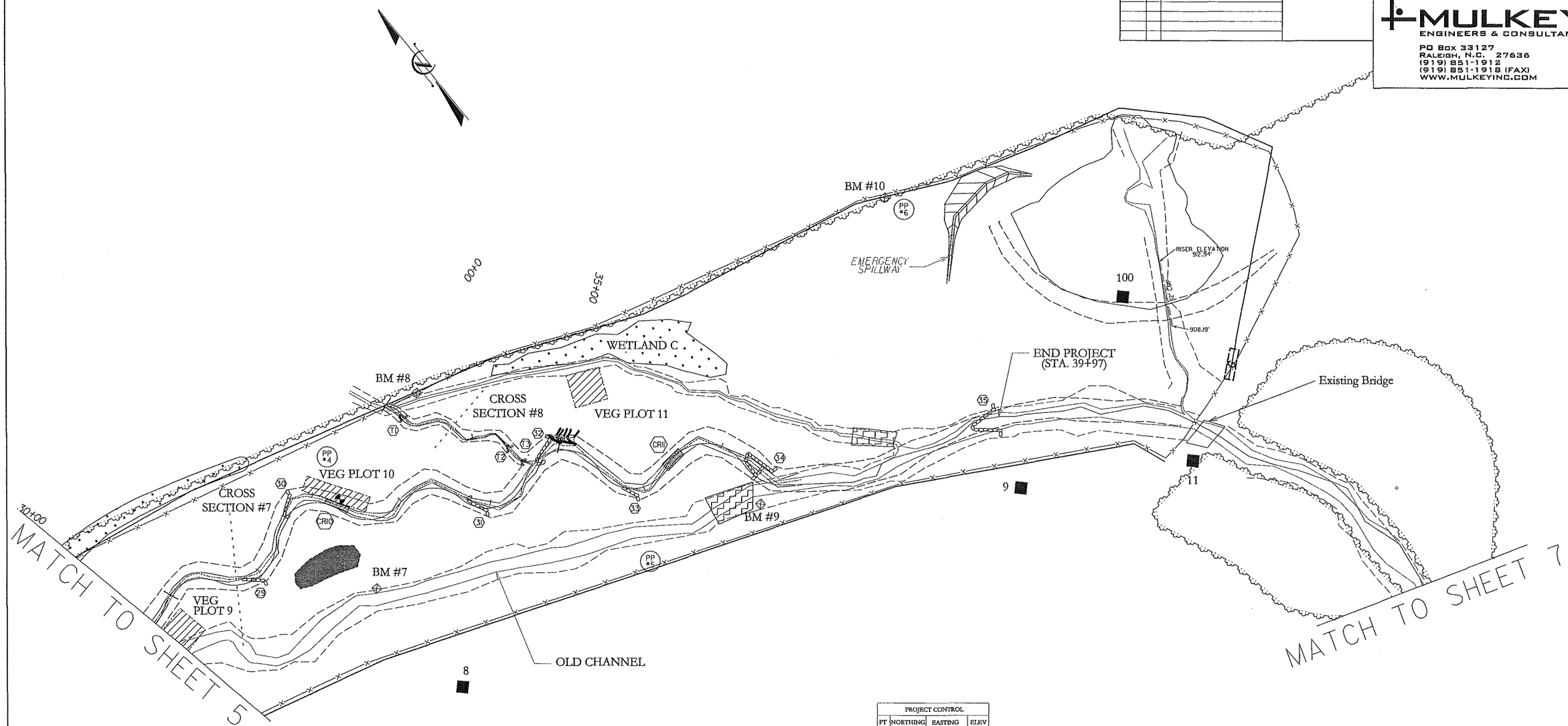

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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
09.10.07

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REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	6

AS-BUILT DRAWING

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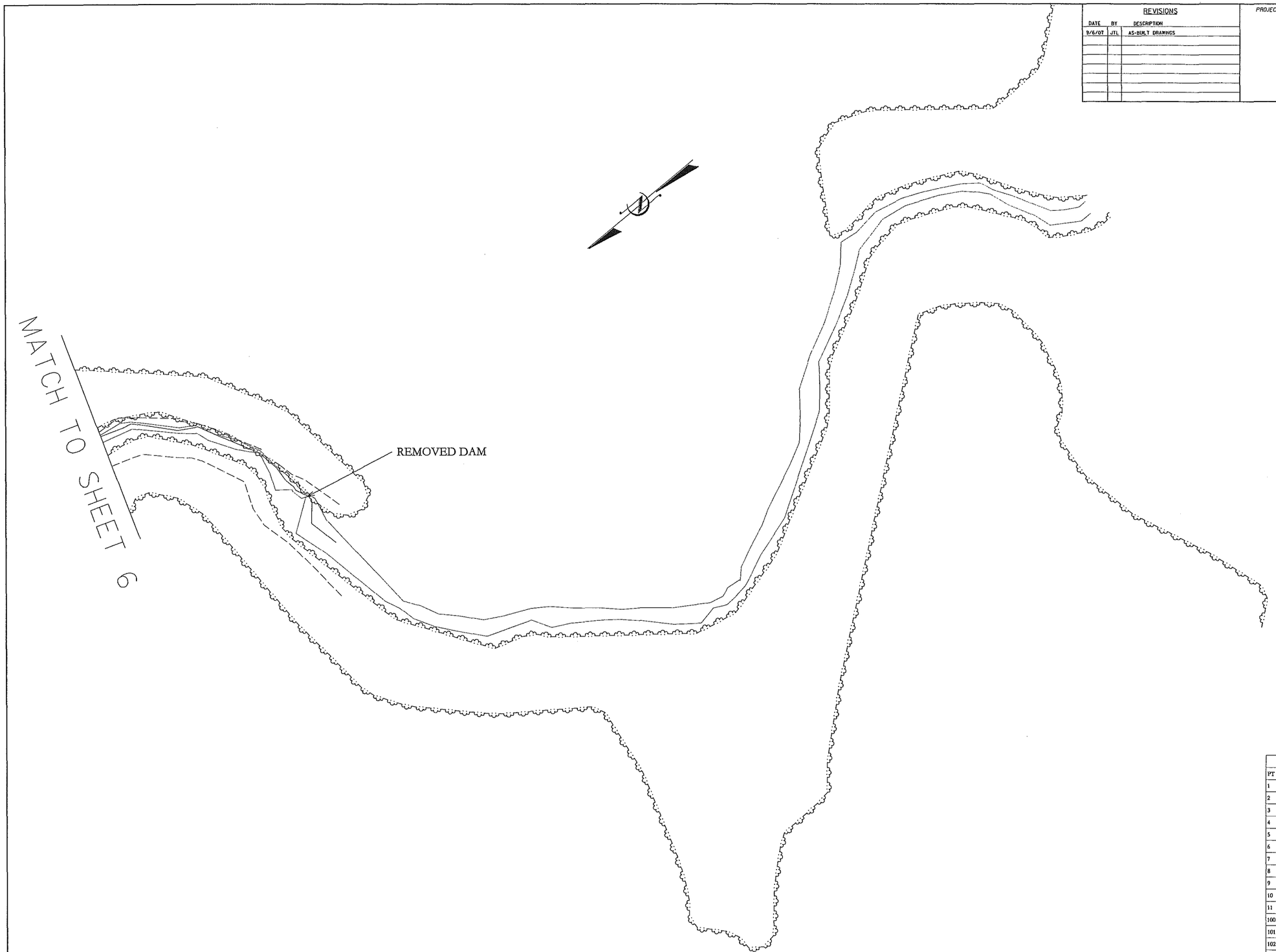

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$DATE$ $TIME$ $FILE$

PROFILES

NORTH CAROLINA PROFESSIONAL SEAL 22961 ENGINEER WILLIAM SCOTT HUNT, III 09.10.07

REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

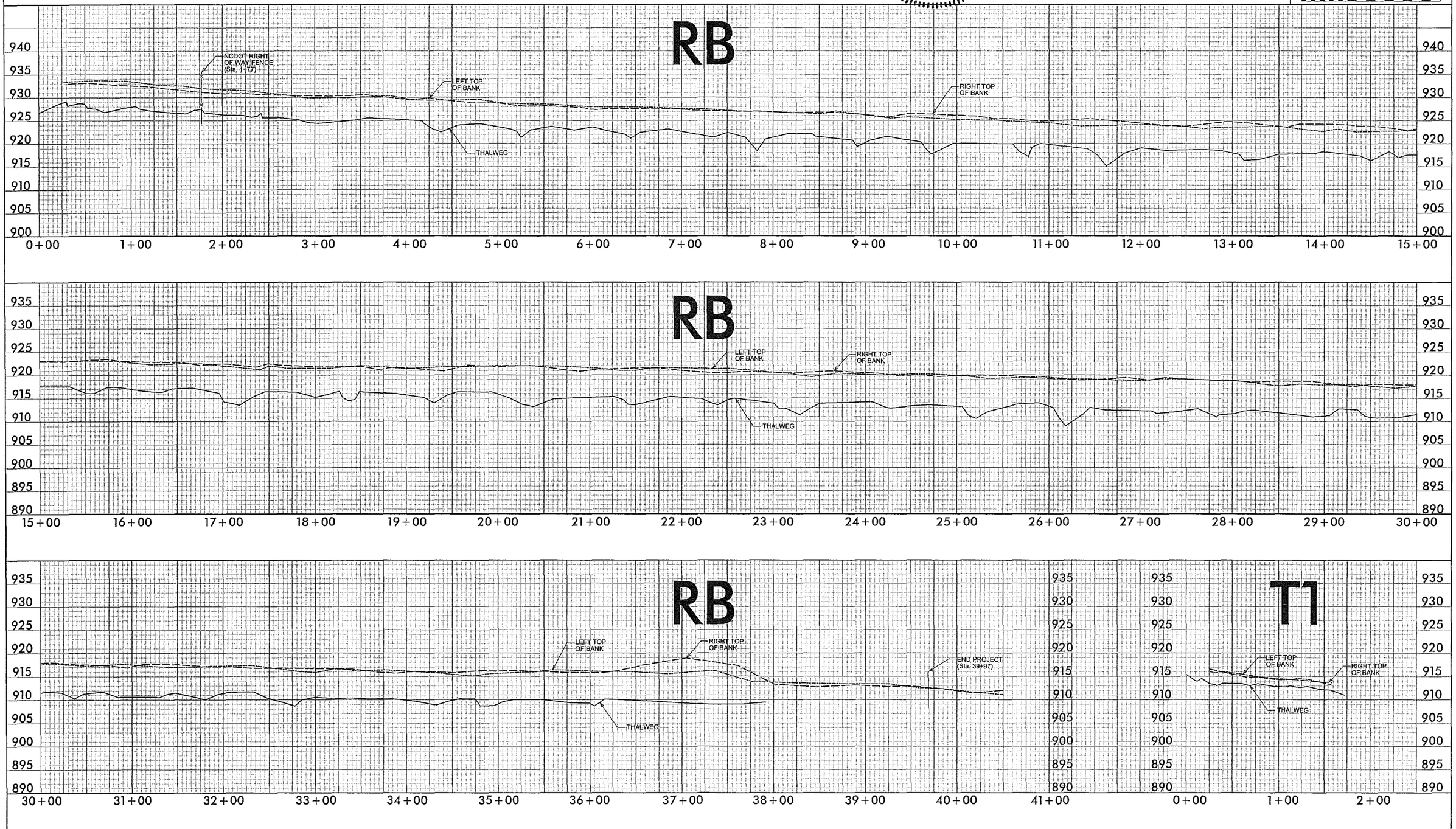
PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	7

AS-BUILT DRAWING

MULKEY ENGINEERS & CONSULTANTS

HORIZONTAL SCALE 50 0 100

VERTICAL SCALE 10 0 20



REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	8

AS-BUILT DRAWING

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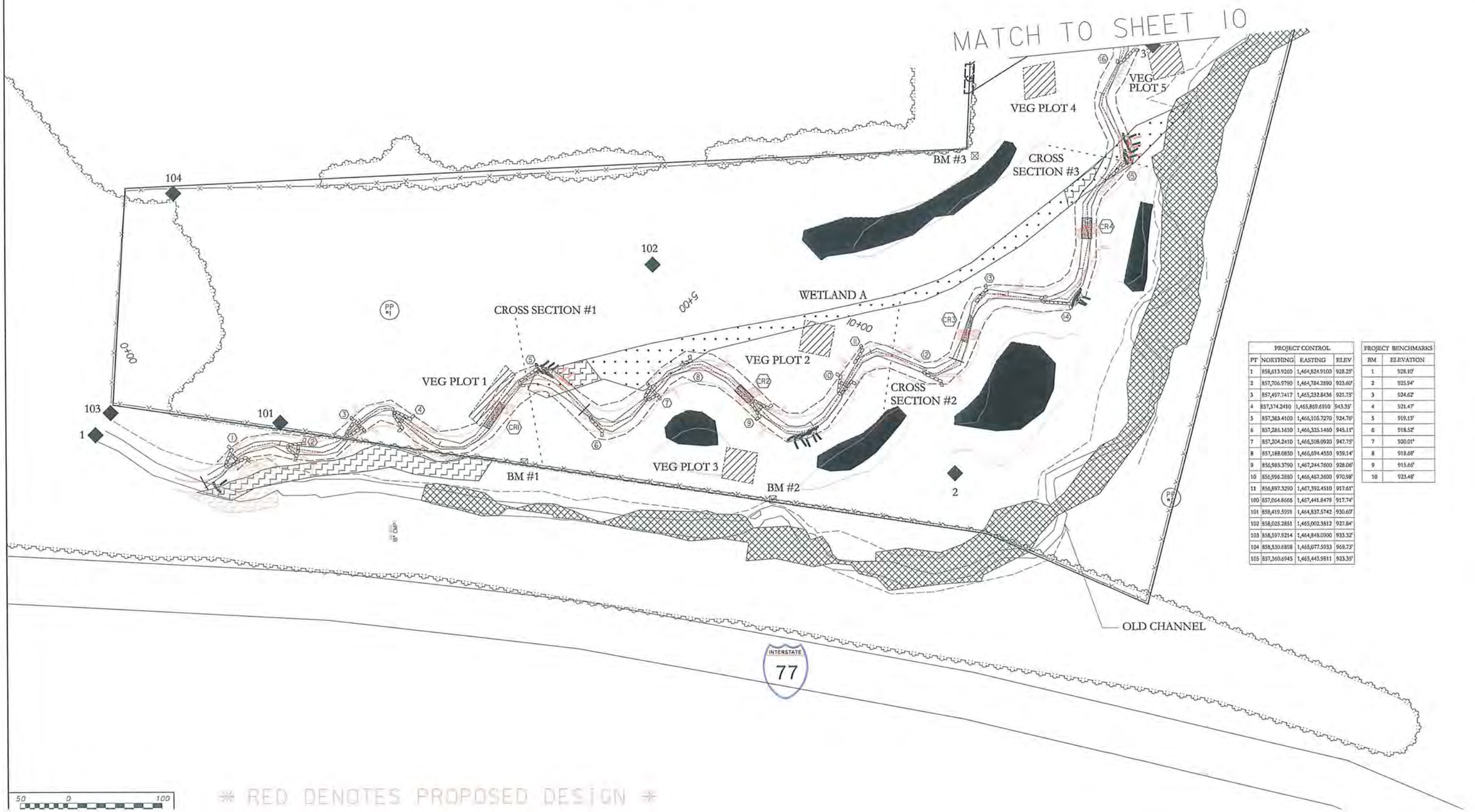
03.10.07



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* RED DENOTES PROPOSED DESIGN *

REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO. | SHEET NO.
ROCKY BRANCH STREAM RESTORATION | 9

AS-BUILT DRAWING

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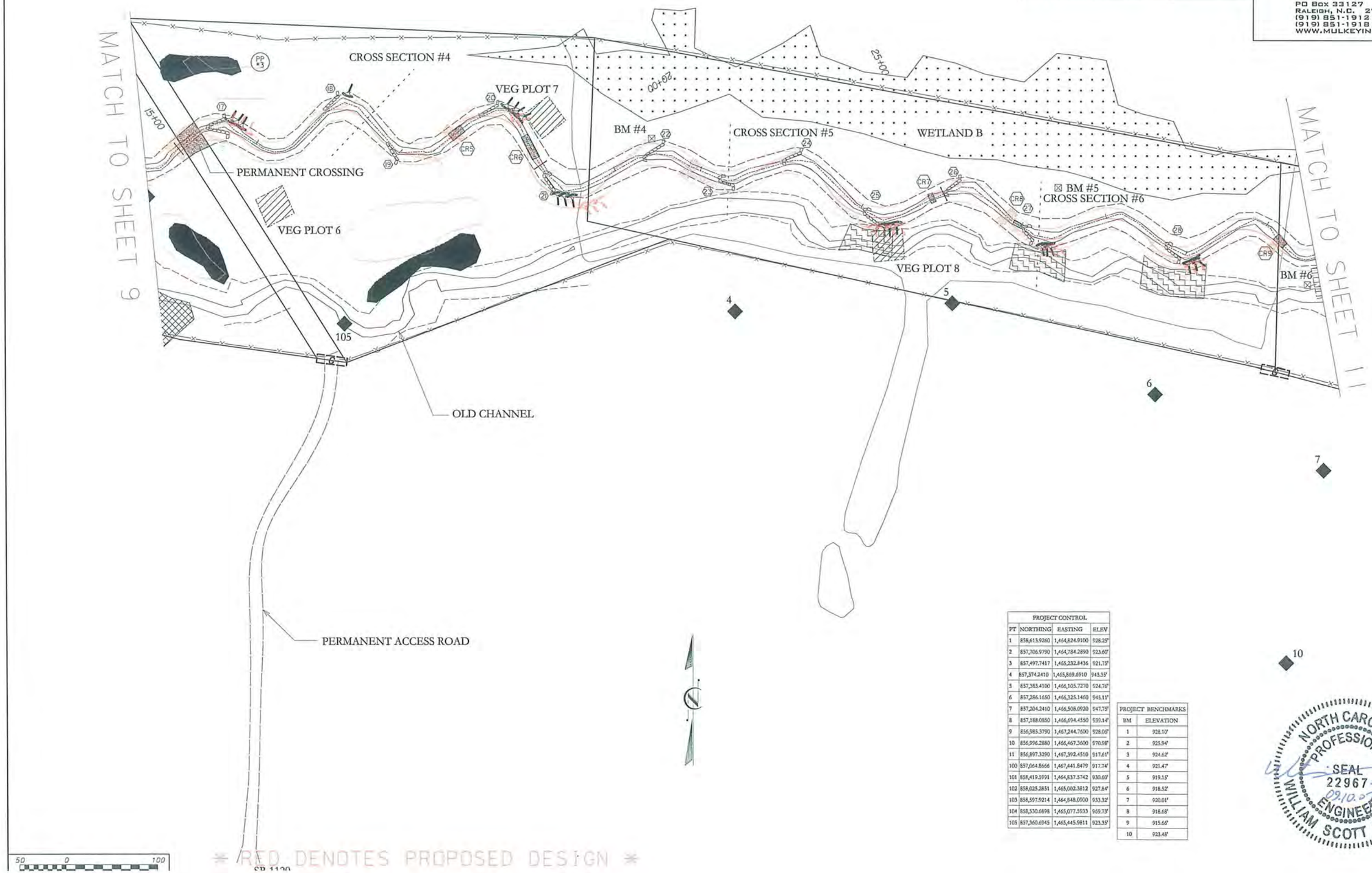

PROJECT CONTROL			
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NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
09.10.07

REVISIONS		
DATE	BY	DESCRIPTION
9/6/07	JTL	AS-BUILT DRAWINGS

PROJECT ENGINEER

PROJECT REFERENCE NO.	SHEET NO.
ROCKY BRANCH STREAM RESTORATION	10

AS-BUILT DRAWING

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PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
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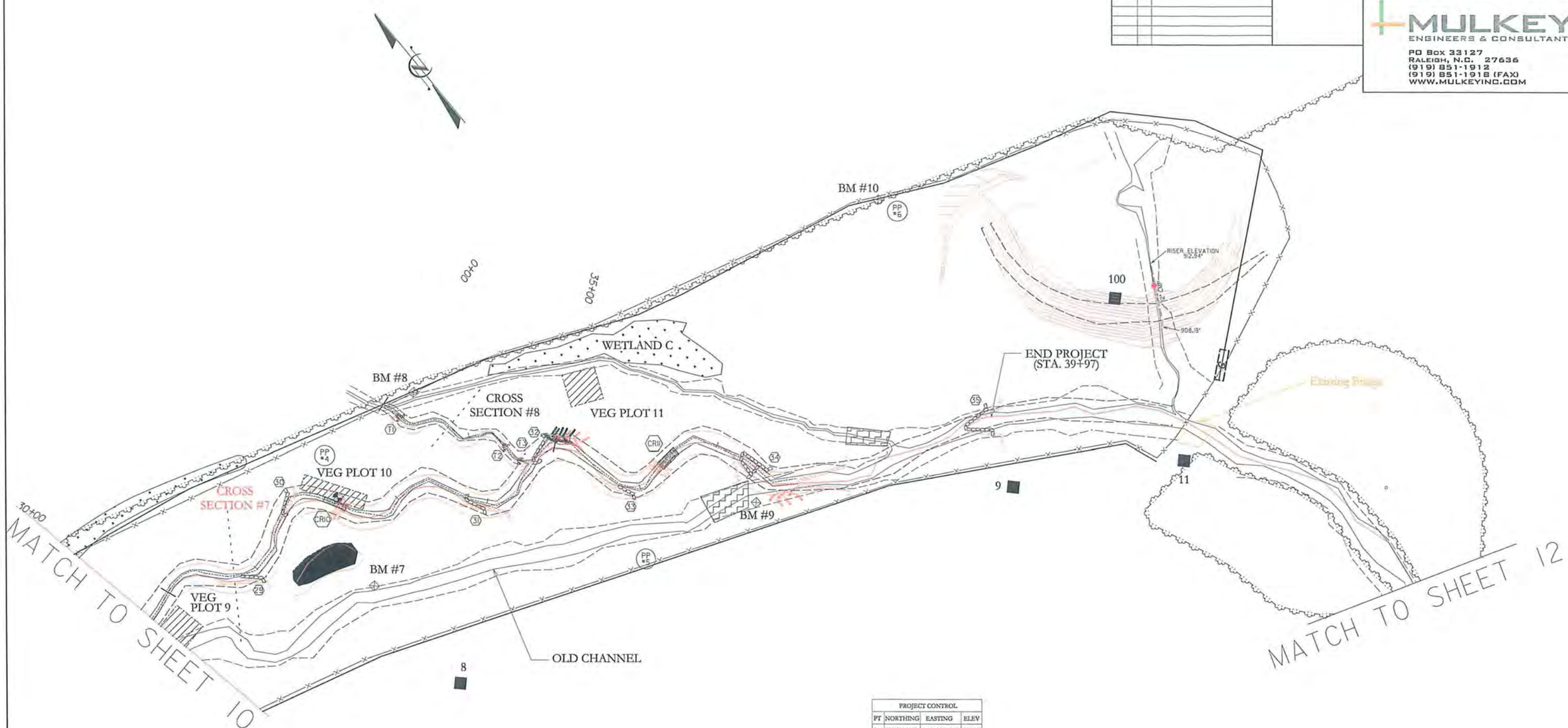

PROJECT CONTROL			
PT	NORTHING	EASTING	ELEV
1	858,613.9260	1,464,824.9100	928.25'
2	857,706.9790	1,464,784.2890	923.60'
3	857,497.7417	1,465,232.8436	921.75'
4	857,374.2410	1,465,869.6910	943.35'
5	857,383.4100	1,466,105.7270	924.76'
6	857,286.1650	1,466,325.1460	945.11'
7	857,204.2410	1,466,508.0920	947.73'
8	857,188.0850	1,466,694.4550	939.14'
9	856,985.3790	1,467,244.7600	928.00'
10	856,996.2860	1,466,467.3600	970.98'
11	856,897.3290	1,467,392.4510	917.61'
100	857,064.8666	1,467,441.8479	917.74'
101	858,419.5991	1,464,837.5742	930.60'
102	858,025.2651	1,465,002.3812	927.84'
103	858,597.9214	1,464,848.0900	933.32'
104	858,330.6898	1,465,077.5933	969.73'
105	857,360.6945	1,465,445.9811	923.35'

PROJECT BENCHMARKS	
BM	ELEVATION
1	928.10'
2	923.94'
3	924.62'
4	921.47'
5	919.15'
6	918.52'
7	920.01'
8	918.68'
9	915.66'
10	923.48'

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III
09.10.07

50 0 100

* RED DENOTES PROPOSED DESIGN *

As-Built Drawings	SHEET NO.
Farm Management Plan View	11
Rocky Branch Stream Restoration	

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

09.10.07

MULKEY ENGINEERS & CONSULTANTS
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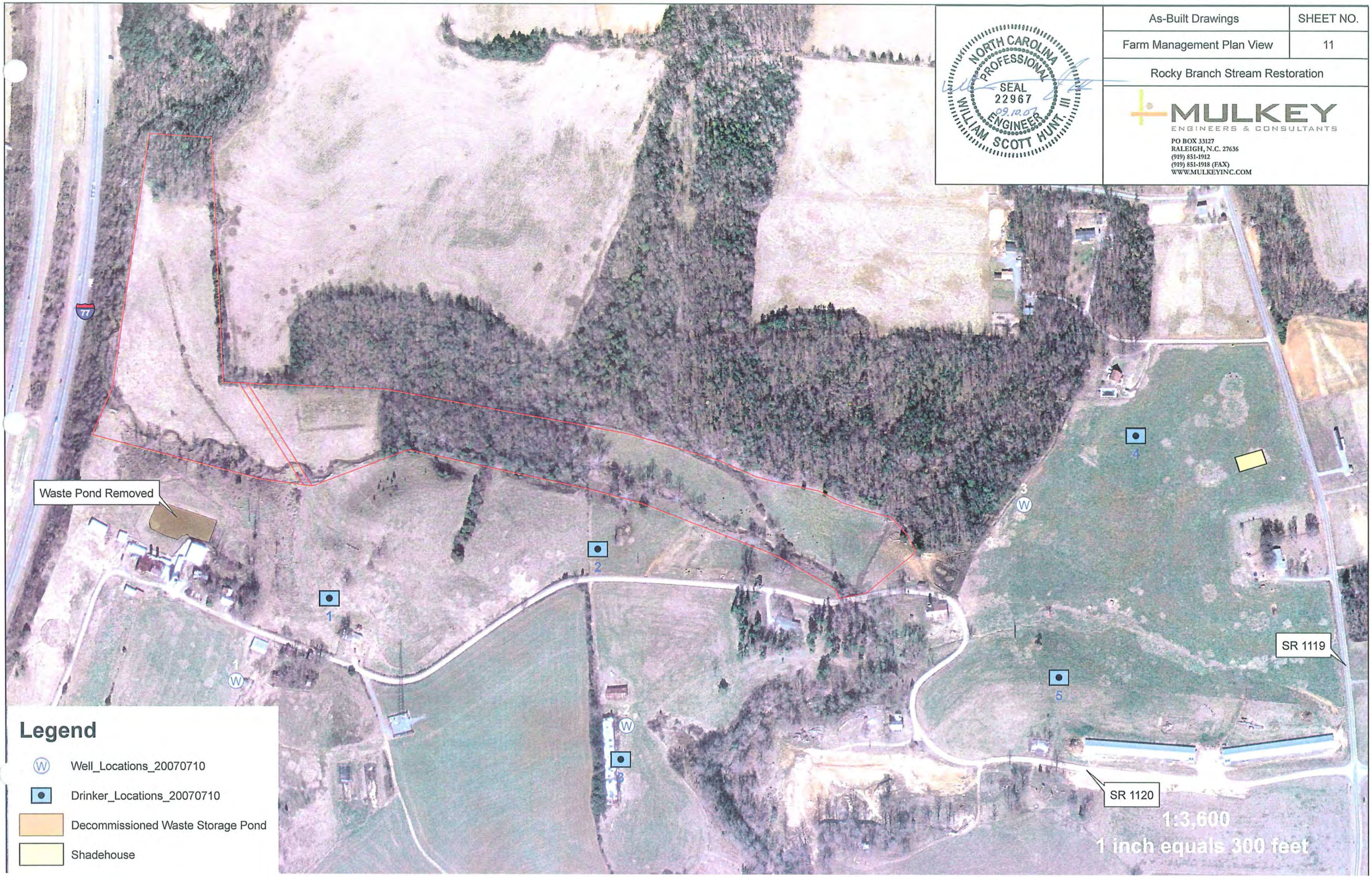
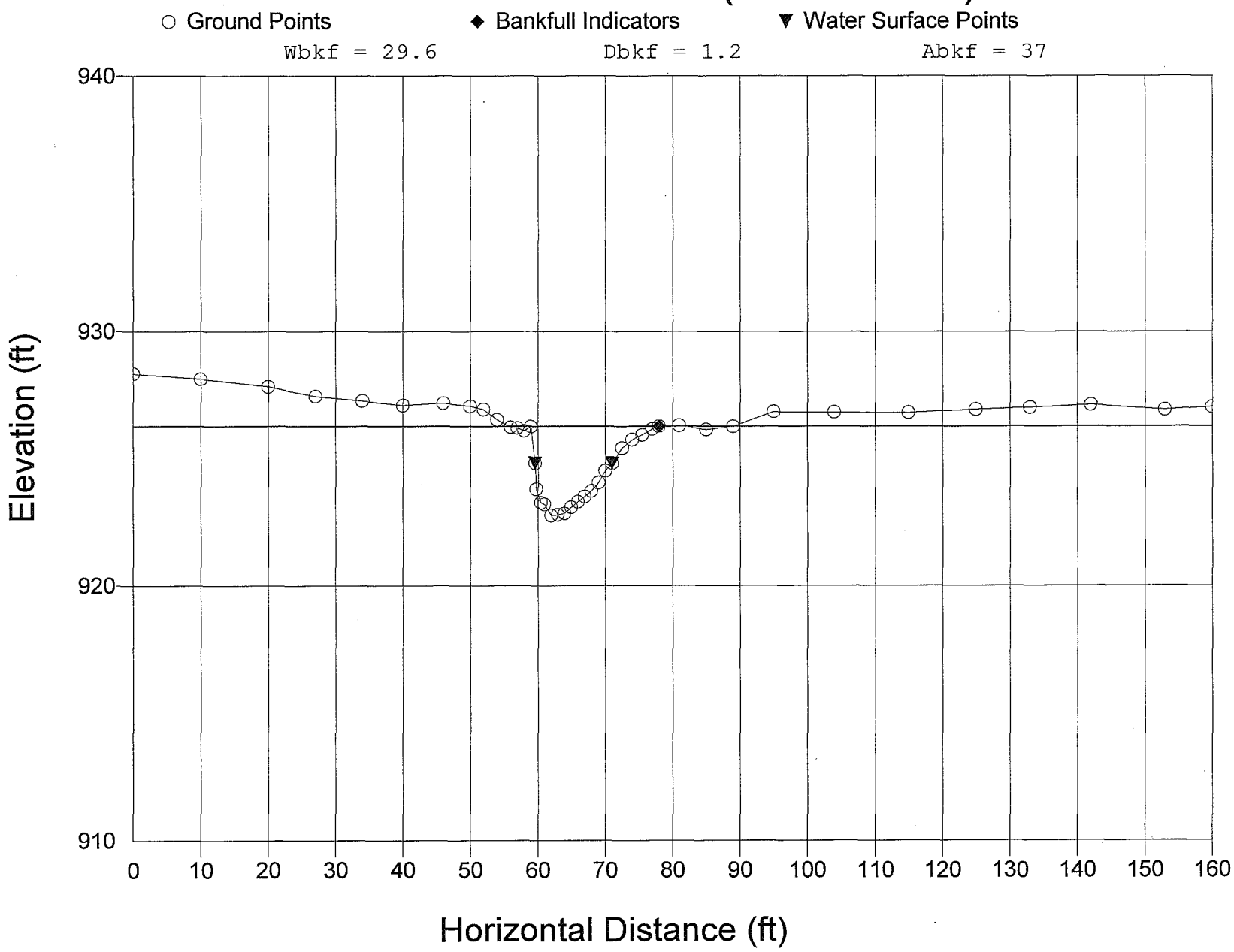
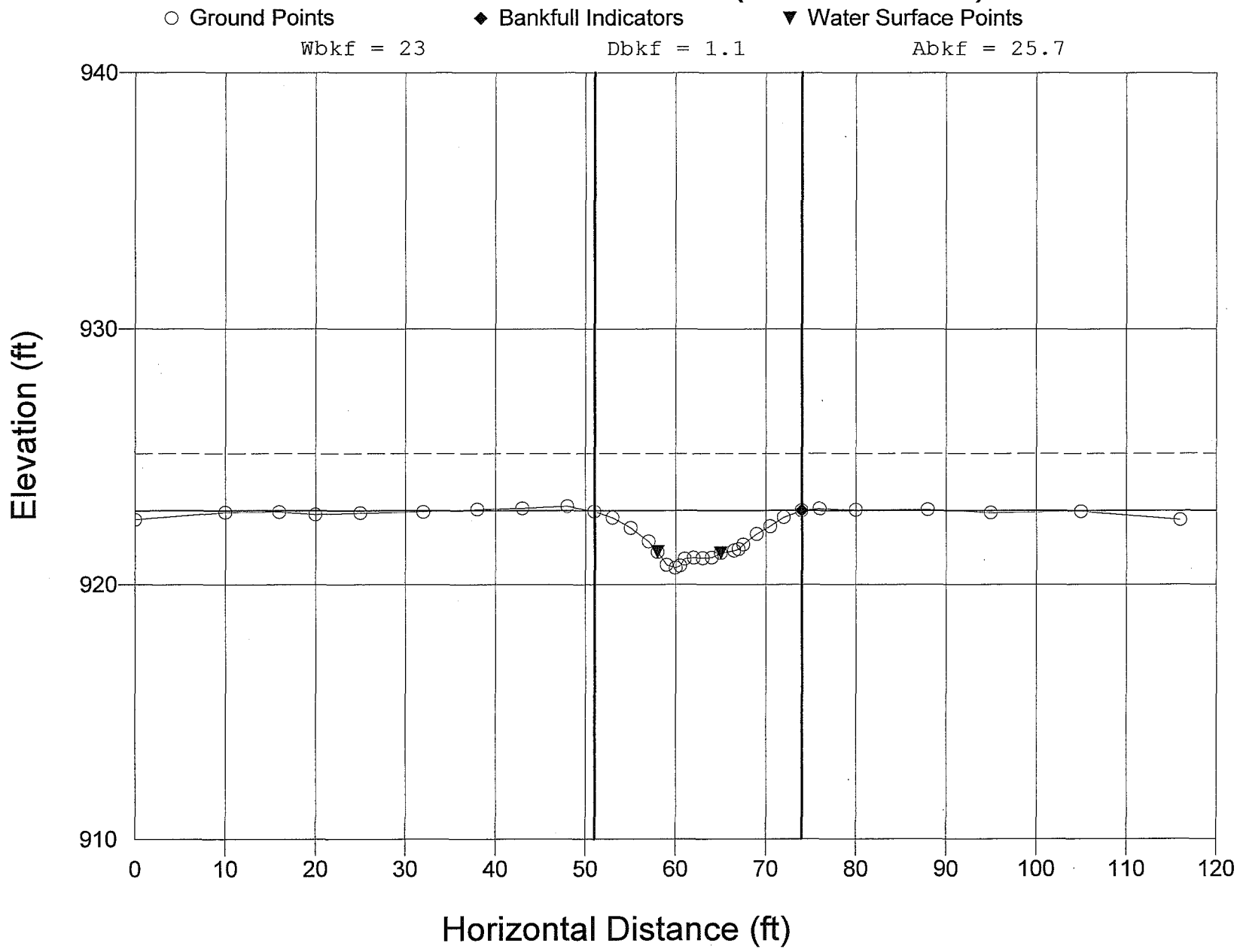


Appendix B
Cross-Sections
(Year 0, 2007)

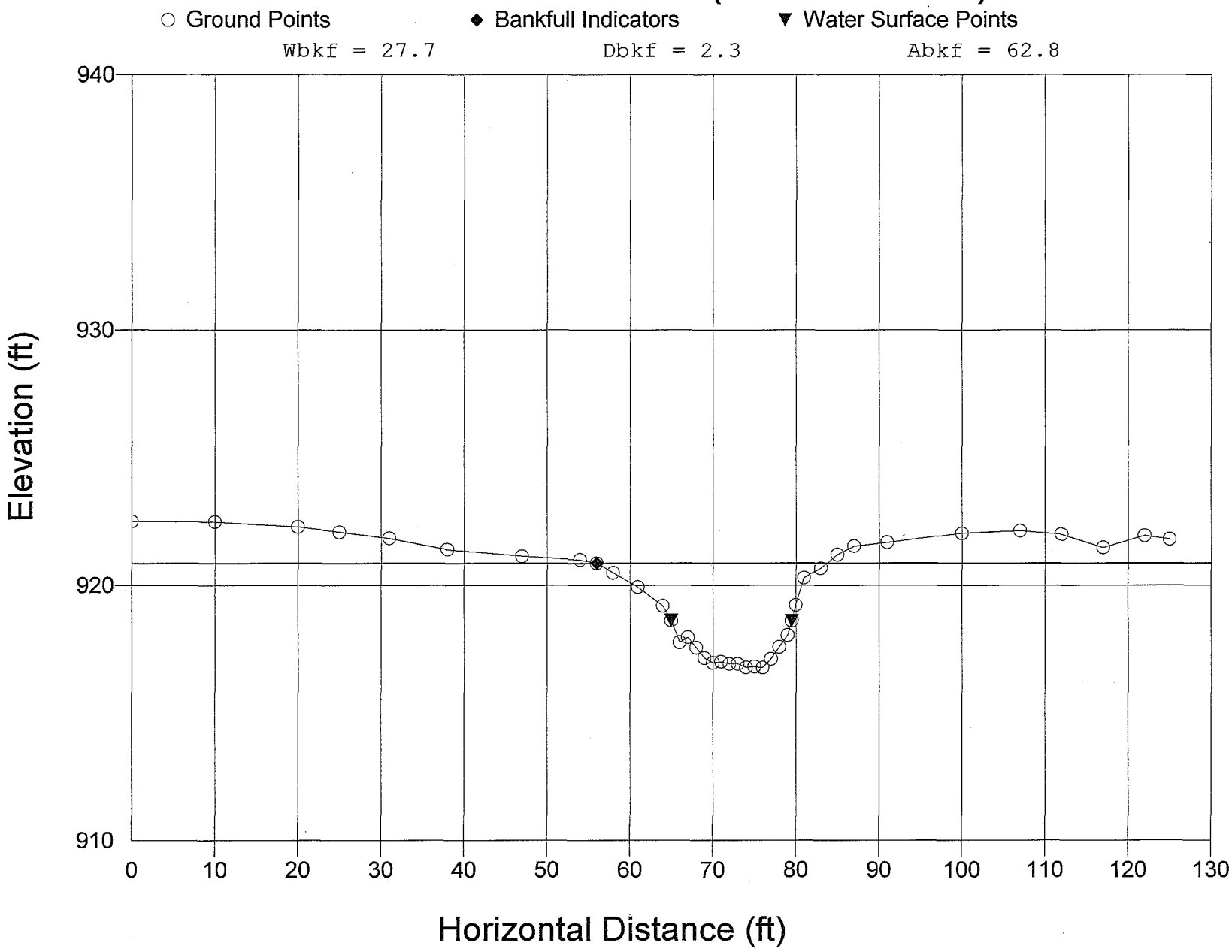
Cross Section 1 - Pool (STA 4 + 25)



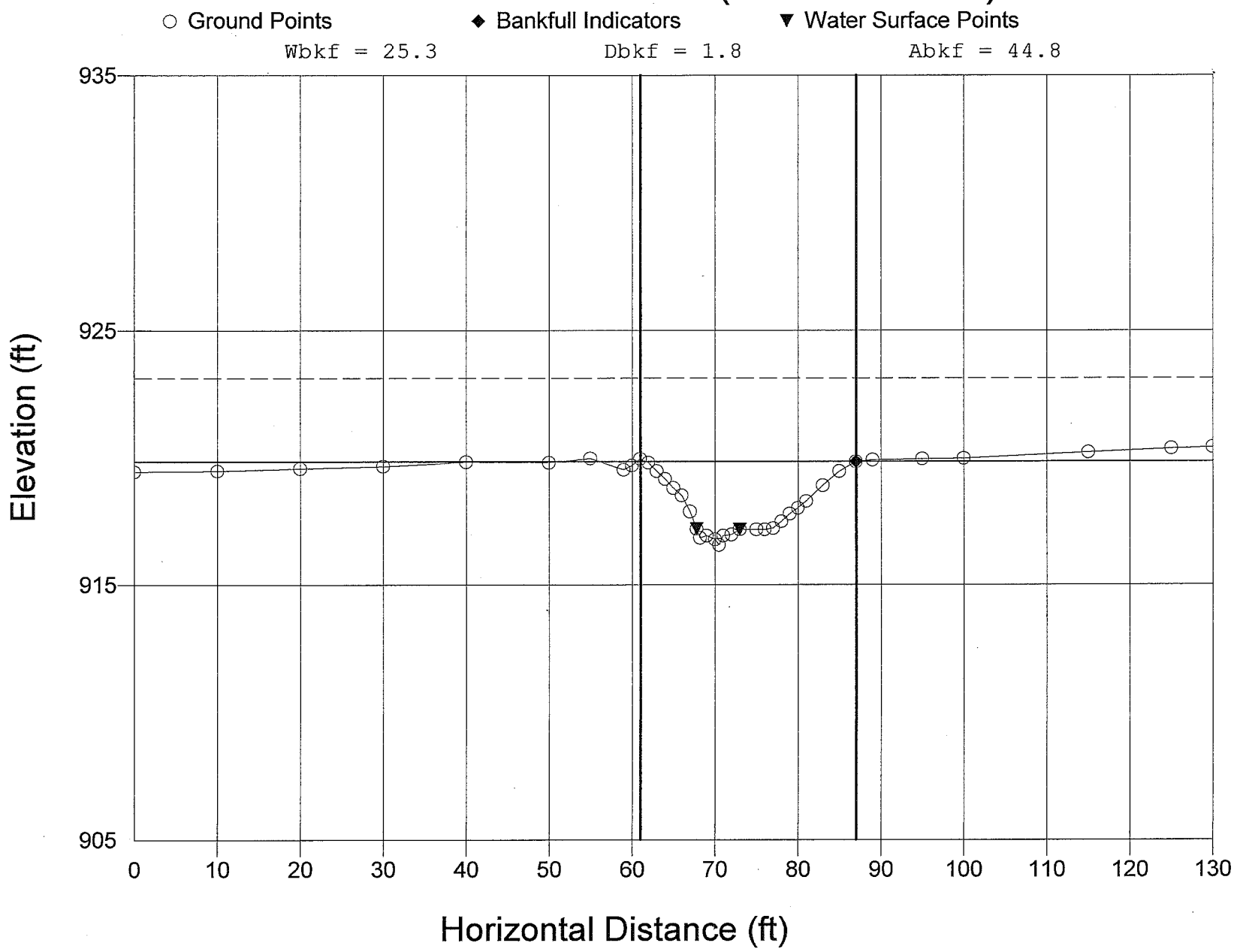
Cross Section 2 - Riffle (STA 9 + 22)



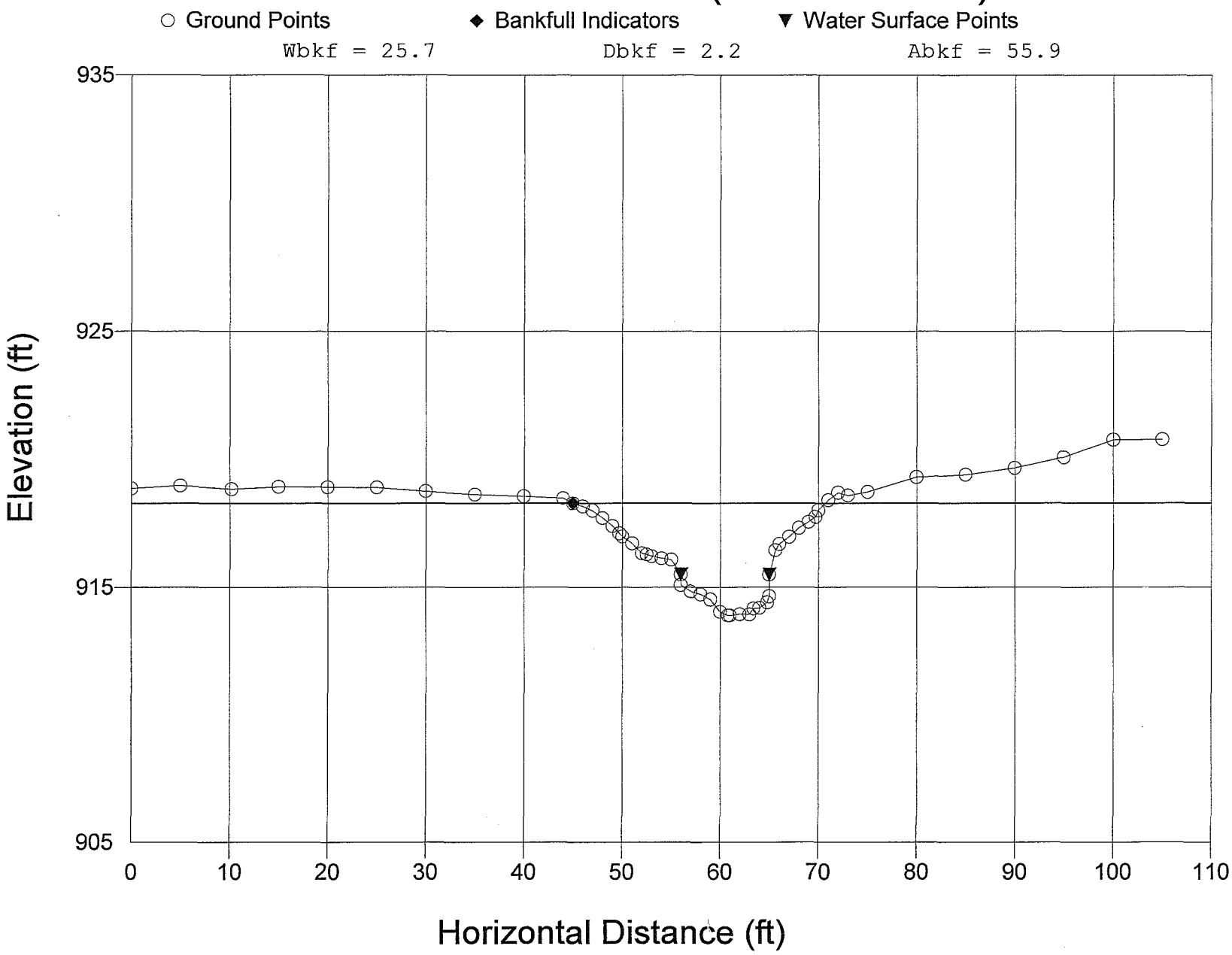
Cross Section 3 - Pool (STA 13 + 25)



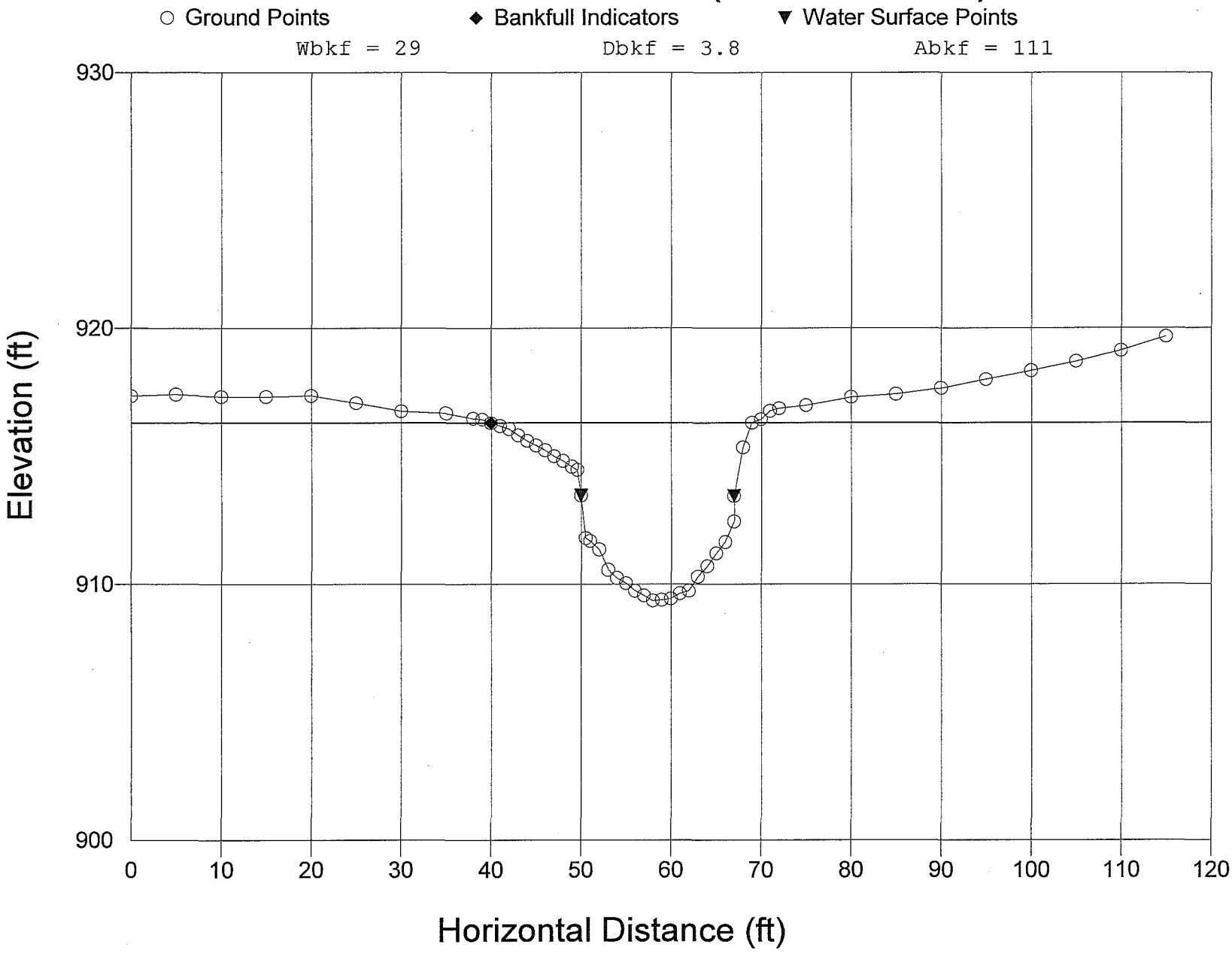
Cross Section 4 - Riffle (STA 17 + 49)



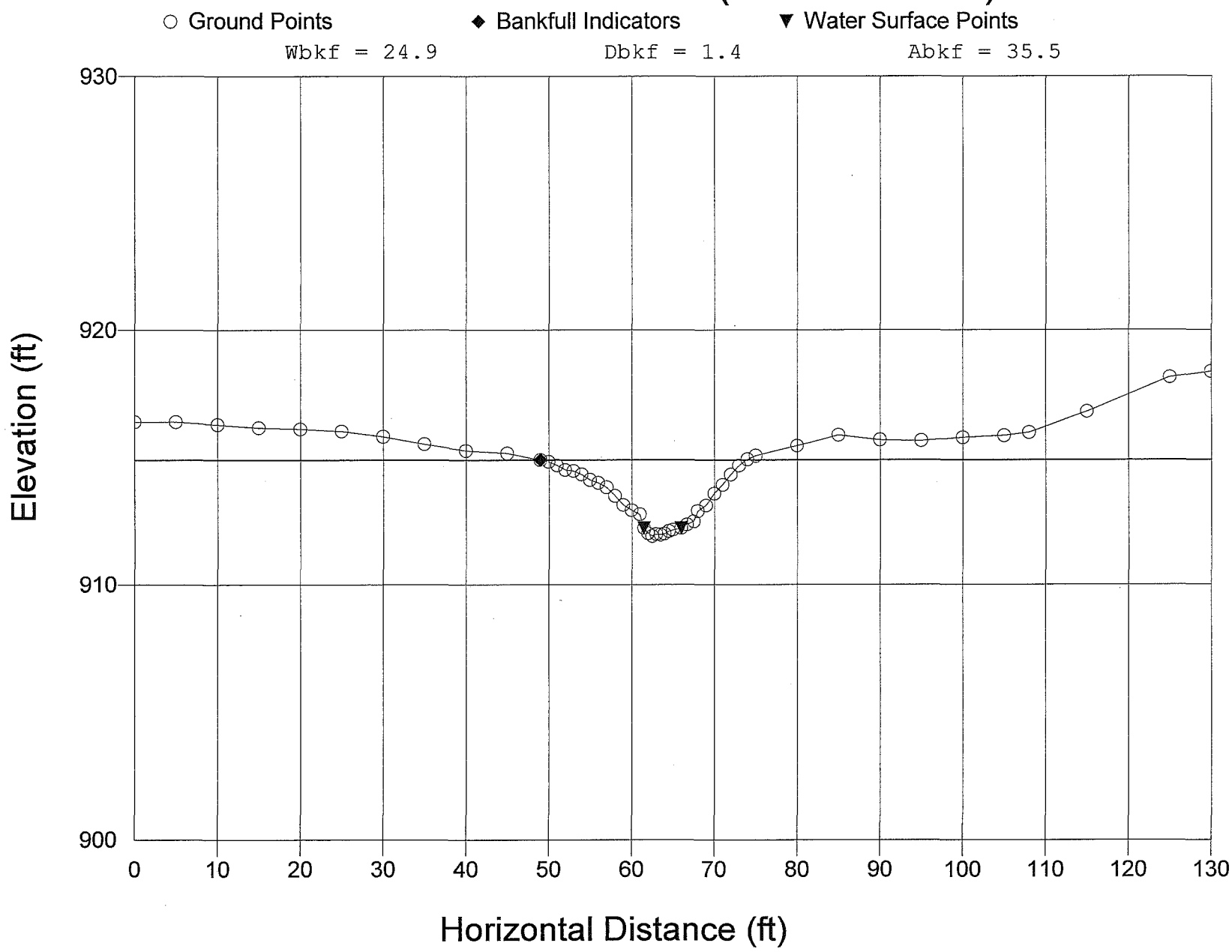
Cross Section 5 - Pool (STA 22 + 32)



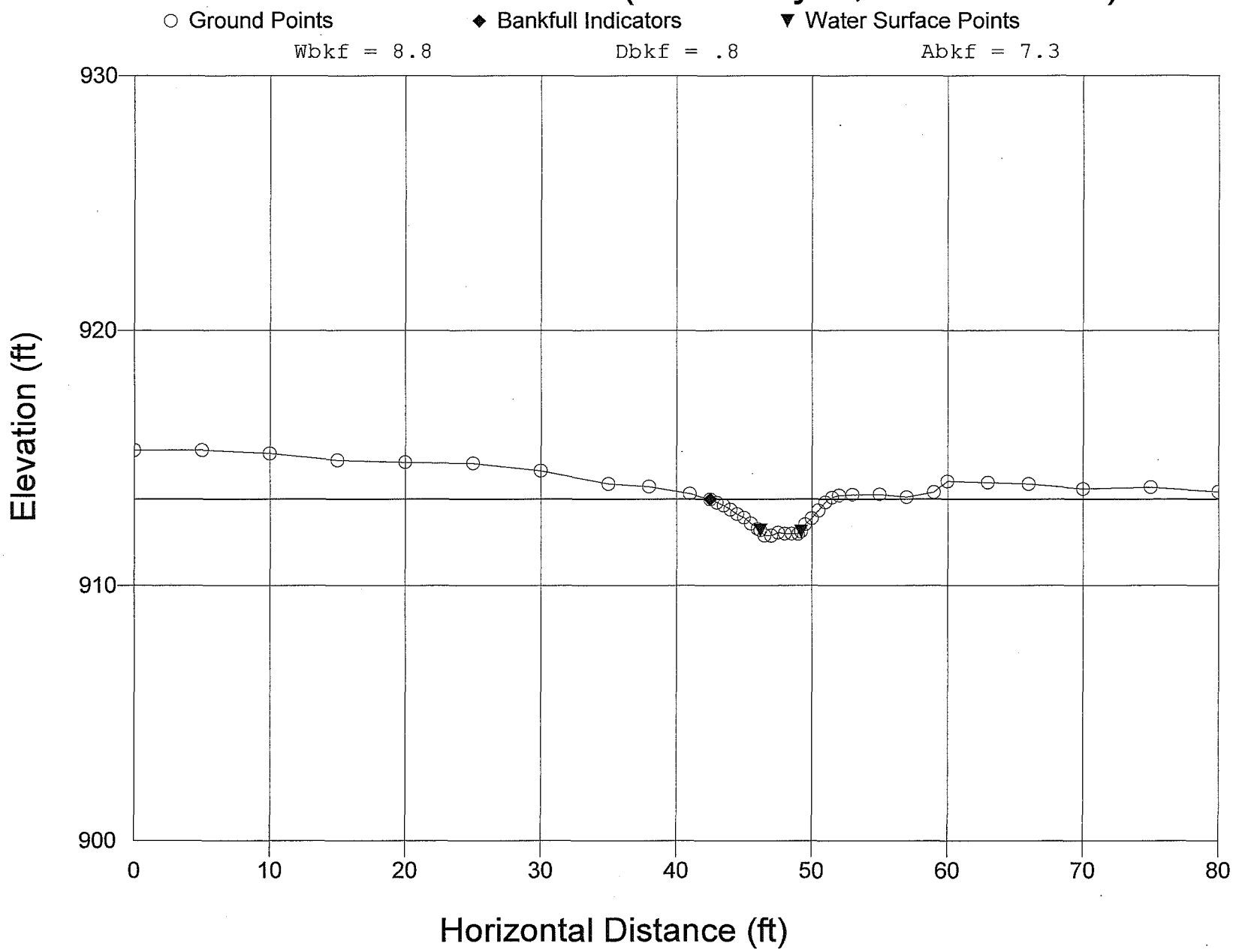
Cross Section 6 - Pool (STA 26 + 22)



Cross Section 7 - Riffle (STA 30 + 75)



Cross Section 1 - Riffle (Tributary 1, STA 0 + 75)



Appendix C
Cross-Section Photos
(Year 0, 2007)

Cross Section 1 - Pool. (Rocky Branch, STA 4 + 25) View looking downstream.

Cross Section 2 - Riffle. (Rocky Branch, STA 9 + 22) View looking downstream.

Cross Section 3 - Pool. (Rocky Branch, STA 13 + 25) View looking downstream.

Cross Section 4 - Riffle. (Rocky Branch, STA 17 + 49) View looking downstream.

Cross Section 5 - Pool. (Rocky Branch, STA 22 + 32) View looking downstream.

Cross Section 6 - Pool. (Rocky Branch, STA 26 + 22) View looking downstream.

Cross Section 7 - Riffle. (Rocky Branch, STA 30 + 75) View looking downstream.

Cross Section 8 - Riffle. (Tributary 1, STA 0 + 75) View looking downstream.

Appendix D
Reference Photo Points
(Existing Conditions, 2005)

Photo Point 1. View looking south toward dairy facility.

Photo Point 2. View looking north across existing Rocky Branch stream channel.

Photo Point 2. View looking northeast across existing Rocky Branch stream channel.

Photo Point 3. View looking west toward the I-77 roadway corridor.

Photo Point 3. View looking south toward homes located along SR 1120.

Photo Point 3. View looking east toward Piedmont Bottomland Forest.

Photo Point 4. View looking west toward the Piedmont Bottomland Forest.

Photo Point 4. View looking south toward SR 1120.

Photo Point 4. View looking east toward existing Tributary 1.

Photo Point 5. View looking northwest across existing Rocky Branch stream channel.

Photo Point 5. View looking northeast toward existing Tributary 1.

Photo Point 6. View looking west toward existing Tributary 1.

Photo Point 6. View looking south toward SR 1120 and Joe Allen residence.

Photo Point 6. View looking east toward existing Tributary 2.

Appendix E
Reference Photo Points
(Year 0, 2007)

Photo Point 1. View looking south toward dairy facility.

Photo Point 2. View looking north across new Rocky Branch stream channel.

Photo Point 2. View looking northeast across new existing Rocky Branch stream channel.

Photo Point 3. View looking west toward the I-77 roadway corridor.

Photo Point 3. View looking south toward homes located along SR 1120.

Photo Point 3. View looking east toward wooded area.

Photo Point 4. View looking west through wooded section.

Photo Point 4. View looking south toward SR 1120.

Photo Point 4. View looking east toward newly constructed Tributary 1 and main channel.

Photo Point 5. View looking northwest across new Rocky Branch stream channel.

Photo Point 5. View looking north toward newly constructed Tributary 1.

Photo Point 5. View looking northeast toward new pond.

Photo Point 6. View looking west toward SR 1120.

Photo Point 6. View looking south toward SR 1120 and Joe Allen residence.

Photo Point 6. View looking east toward new pond.

Appendix F
Vegetation Plot Photos
(Year 0, 2007)

Vegetation Plot 1 – Streambanks (5m x 20m). View from southeast plot corner.

Vegetation Plot 2 – Riparian Buffer (10m x 10m). View from southeast plot corner.

Vegetation Plot 3 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Vegetation Plot 4 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Vegetation Plot 5 – Riparian Buffer (10m x 10m). View from northwest corner.

Vegetation Plot 6 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Vegetation Plot 7 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Vegetation Plot 8 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Vegetation Plot 9 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Vegetation Plot 10 – Stream Banks (5m x 20m). View from northwest plot corner.

Vegetation Plot 11 – Riparian Buffer (10m x 10m). View from northwest plot corner.

Appendix G
Wolman Pebble Count Data
(Year 0, 2007)

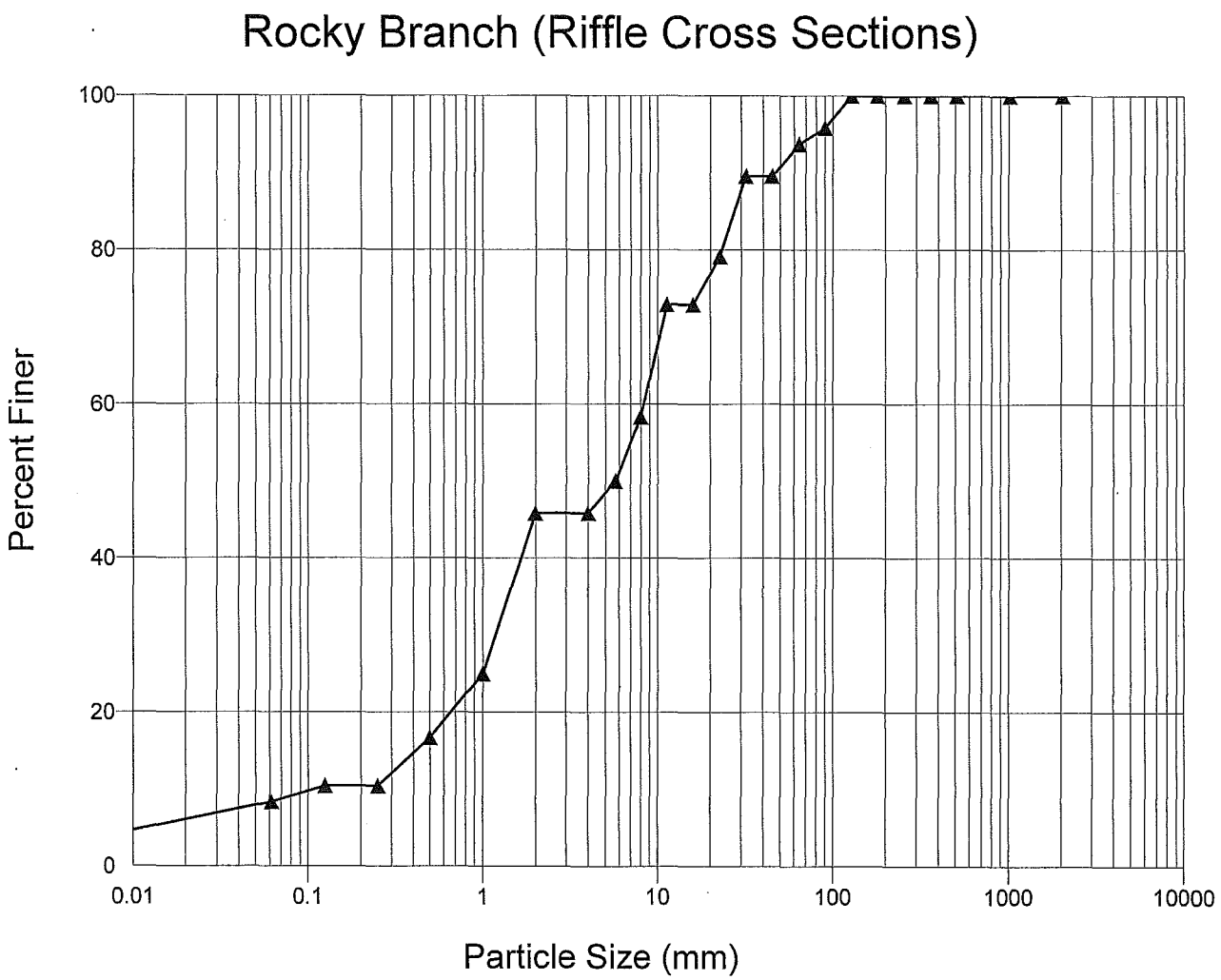
RIVERMORPH PARTICLE SUMMARY

River Name: Rocky Branch
Reach Name: Rocky Branch
Sample Name: Rocky Branch (Riffle Cross Sections)
Survey Date: 08/27/07

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	4	8.33	8.33
0.062 - 0.125	1	2.08	10.42
0.125 - 0.25	0	0.00	10.42
0.25 - 0.50	3	6.25	16.67
0.50 - 1.0	4	8.33	25.00
1.0 - 2.0	10	20.83	45.83
2.0 - 4.0	0	0.00	45.83
4.0 - 5.7	2	4.17	50.00
5.7 - 8.0	4	8.33	58.33
8.0 - 11.3	7	14.58	72.92
11.3 - 16.0	0	0.00	72.92
16.0 - 22.6	3	6.25	79.17
22.6 - 32.0	5	10.42	89.58
32 - 45	0	0.00	89.58
45 - 64	2	4.17	93.75
64 - 90	1	2.08	95.83
90 - 128	2	4.17	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.47
D35 (mm)	1.48
D50 (mm)	5.7
D84 (mm)	26.96
D95 (mm)	79.62
D100 (mm)	128
Silt/Clay (%)	8.33
Sand (%)	37.5
Gravel (%)	47.92
Cobble (%)	6.25
Boulder (%)	0
Bedrock (%)	0

Total Particles = 48 (need at least 60).


Rocky Branch (Riffle Cross Sections)
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

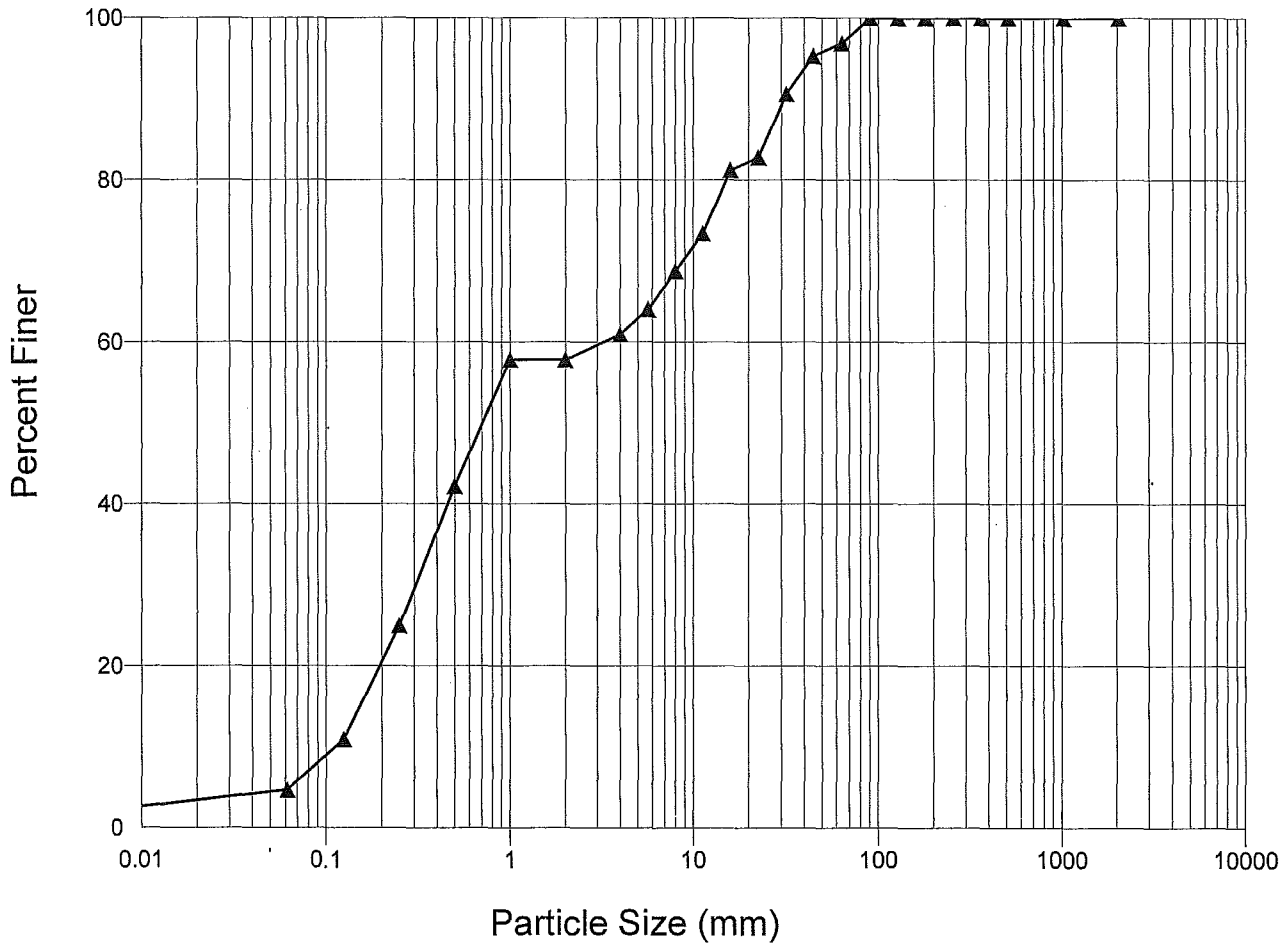
River Name: Rocky Branch
Reach Name: Rocky Branch
Sample Name: Rocky Branch (Pool Cross Sections)
Survey Date: 08/29/07

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	3	4.69	4.69
0.062 - 0.125	4	6.25	10.94
0.125 - 0.25	9	14.06	25.00
0.25 - 0.50	11	17.19	42.19
0.50 - 1.0	10	15.63	57.81
1.0 - 2.0	0	0.00	57.81
2.0 - 4.0	2	3.13	60.94
4.0 - 5.7	2	3.13	64.06
5.7 - 8.0	3	4.69	68.75
8.0 - 11.3	3	4.69	73.44
11.3 - 16.0	5	7.81	81.25
16.0 - 22.6	1	1.56	82.81
22.6 - 32.0	5	7.81	90.63
32 - 45	3	4.69	95.31
45 - 64	1	1.56	96.88
64 - 90	2	3.13	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.17
D35 (mm)	0.4
D50 (mm)	0.75
D84 (mm)	24.03
D95 (mm)	44.14
D100 (mm)	90
Silt/Clay (%)	4.69
Sand (%)	53.12
Gravel (%)	39.07
Cobble (%)	3.12
Boulder (%)	0
Bedrock (%)	0

Total Particles = 64.

Rocky Branch (Pool Cross Sections)



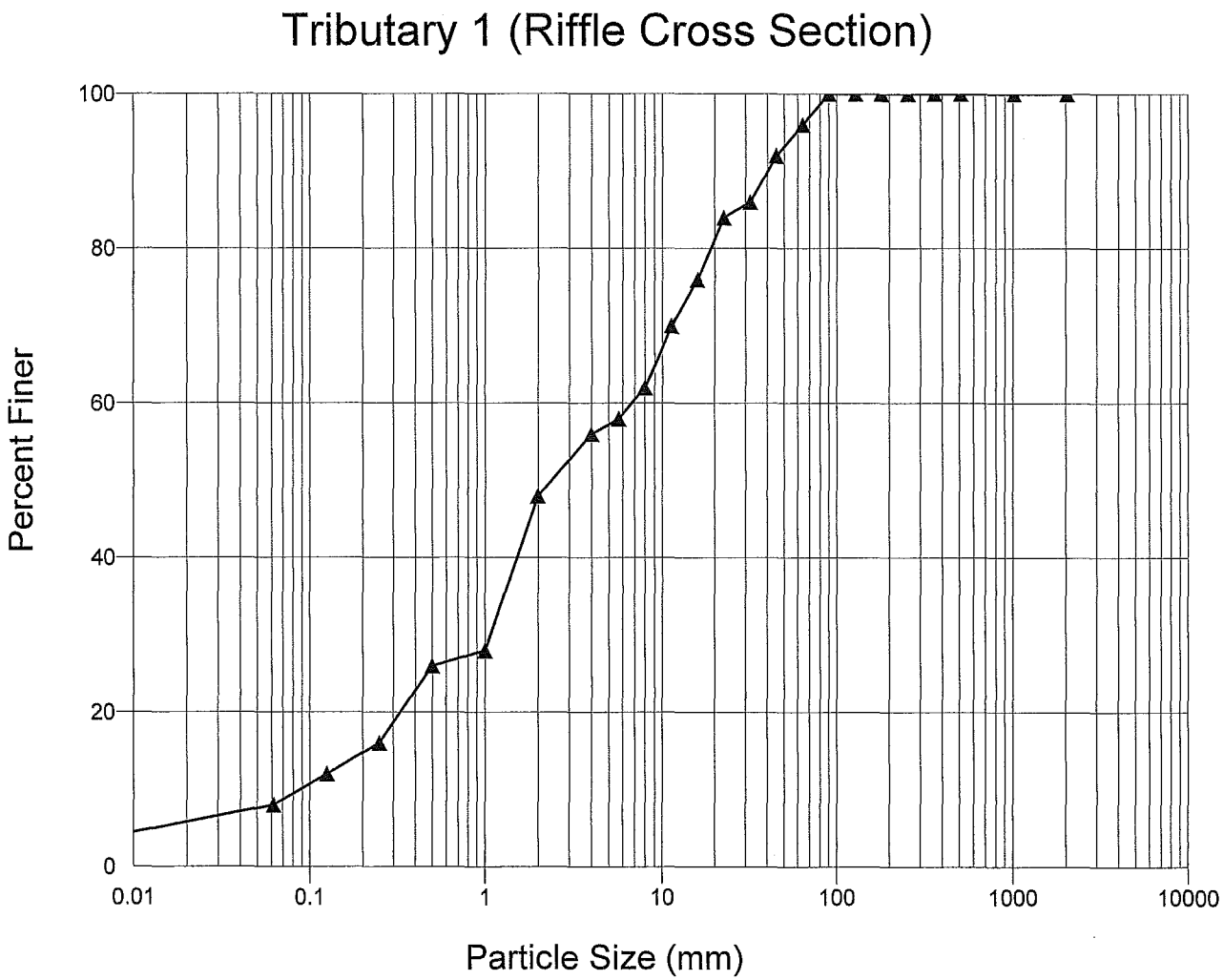
RIVERMORPH PARTICLE SUMMARY

River Name: Tributary 1
Reach Name: Tributary 1
Sample Name: Tributary 1(Riffle Cross Section)
Survey Date: 08/29/07

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	4	8.00	8.00
0.062 - 0.125	2	4.00	12.00
0.125 - 0.25	2	4.00	16.00
0.25 - 0.50	5	10.00	26.00
0.50 - 1.0	1	2.00	28.00
1.0 - 2.0	10	20.00	48.00
2.0 - 4.0	4	8.00	56.00
4.0 - 5.7	1	2.00	58.00
5.7 - 8.0	2	4.00	62.00
8.0 - 11.3	4	8.00	70.00
11.3 - 16.0	3	6.00	76.00
16.0 - 22.6	4	8.00	84.00
22.6 - 32.0	1	2.00	86.00
32 - 45	3	6.00	92.00
45 - 64	2	4.00	96.00
64 - 90	2	4.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.25
D35 (mm)	1.35
D50 (mm)	2.5
D84 (mm)	22.6
D95 (mm)	59.25
D100 (mm)	90
Silt/Clay (%)	8
Sand (%)	40
Gravel (%)	48
Cobble (%)	4
Boulder (%)	0
Bedrock (%)	0

Total Particles = 50 (need at least 60).


Tributary 1 (Riffle Cross Section)
Percent Finer
100
80
60
40
20
0
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)

Appendix H
Areas of Concern

Rocky Branch (Station 1+77) View near I-77 right-of-way fence of eroded area caused by a debris jam. Area is currently vegetated with natural sycamore seedlings.

Rocky Branch (Stations 4+10 – 4+20) Pool with sloughed banks upstream of cross section 4. View looking downstream.

Rocky Branch, (Stations 23+70 – 23+90) Stretch of channel with sloughed banks. View looking across channel from right to left.

Rocky Branch, (Stations 25+70 – 25+80) Stretch of channel with sloughed banks. View looking across channel from right to left.

Rocky Branch (Station 22+32) Cross Section 6 – Pool. Large cross sectional area compared with proposed design.

Rocky Branch (Stations 32+80 – 33+00) Area of sloughing banks. View looking across channel from left to right.

Rocky Branch (Stations 34+00 – 34+30) Area of sloughing banks. View looking across channel from left to right.