The Stonebridge Stream Mitigation Project is located on an 1,196-acre site five miles north of Carthage in northeastern Moore County, NC. Three unnamed streams that traverse the site exhibit diminished habitat value as a result of past and on-going agricultural activities. The site was identified by EBX-Neuse I, LLC, as having potential to help meet the compensatory mitigation requirements of the NC Department of Transportation (DOT) for impacts in hydrologic unit 03030003 of the Cape Fear River Basin. The mitigation units would be accomplished through the restoration of stream and riparian habitats as defined in the inter-agency Stream Mitigation Guidelines (USACE, 2003).The proposed project will improve physical habitat and water quality by establishing more natural hydraulic geometry to previously impacted stream segments and by restoring riparian forest buffers by means of cattle exclusion.

A natural channel design approach has been applied to identify stable morphometric parameters. A reference reach located approximately two miles southwest of the site was used in the development of design pattern, cross-sections, and profiles. The reference reach approach was verified using analytical tools in Stable channel Analytical Model (SAM). This included analyses of sediment transport functions, shear stress, and velocity, all of which basically supported the morphometric parameters developed from reference reach data. The proposed design calls for filling the existing stream with material excavated from proposed channel and floodplain areas. Several segments of the channel will be only partially filled, to support vernal pools and other wetland habitats.

Riparian forest buffers will be established throughout the project at widths of at least fifty feet on both sides of all restored streams. Cattle shall be excluded from all stream and buffer restoration areas by fences. A native riparian plant community will be established to include multiple strata and a diverse mix of species. The proposed stream and buffer restoration will arrest the bank erosion and mass wasting that are both active and locally severe.

The proposed restoration practices will result in the restoration of approximately 6,240 linear feet for stream. In addition to channel restoration, 15.6 acres of conservation easements will be provided. The total proposed improvements constitute 6,240 stream mitigation units (SMU's).

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PROJECT DESCRIPTION

This report supports the stream mitigation design to restore portions of three unnamed streams in Moore County, North Carolina. The project is being developed to provide full delivery stream mitigation to the North Carolina Department of Transportation (DOT) for impacts in hydrologic unit 03030003 of the Cape Fear River Basin. The proposed project involves the restoration of 6,240 linear feet of stream channel that has been disturbed by historic agricultural activities and active cattle grazing. The conceptual design presented herein demonstrates that 6,240 feet of stream can be restored, which should generate an equal number of Stream Mitigation Units (SMU).

The Stonebridge Site has an extensive history of agriculture and timber production. The project area was most recently clear-cut in 1982 and converted to hay and pasture. The site currently supports a cow/calf operation, and up until a few years ago also produced hogs. The cattle have severely degraded riparian buffers along Crawley Creek and its tributaries, and prohibit the growth of a natural riparian plant community. Hoof shear has caused extensive stream bank collapse, and the abundance of fine sediment is an impairment to benthic habitat. Additionally, water quality is impacted from animal waste. The proposed project will improve in-stream habitat by restoring the streams to more natural stable geometry, and will benefit water quality by restoring riparian forest buffers and excluding cattle from the restoration area.

PROJECT SITE

The project site is located approximately five miles north of Carthage in northeastern Moore County, NC (Figure 1). The property comprises about 1196 acres of fields and woods. The surrounding area is entirely rural and only sparsely inhabited.

The area of detailed study is depicted on the Existing Conditions Map in Appendix A, which includes stream locations, topography, plant communities, soil boring locations and locations of stream measurements. Field run topographic survey was completed in the fall of 2003 with NAVD 1988 as vertical datum and NC state plane coordinates as the horizontal datum.

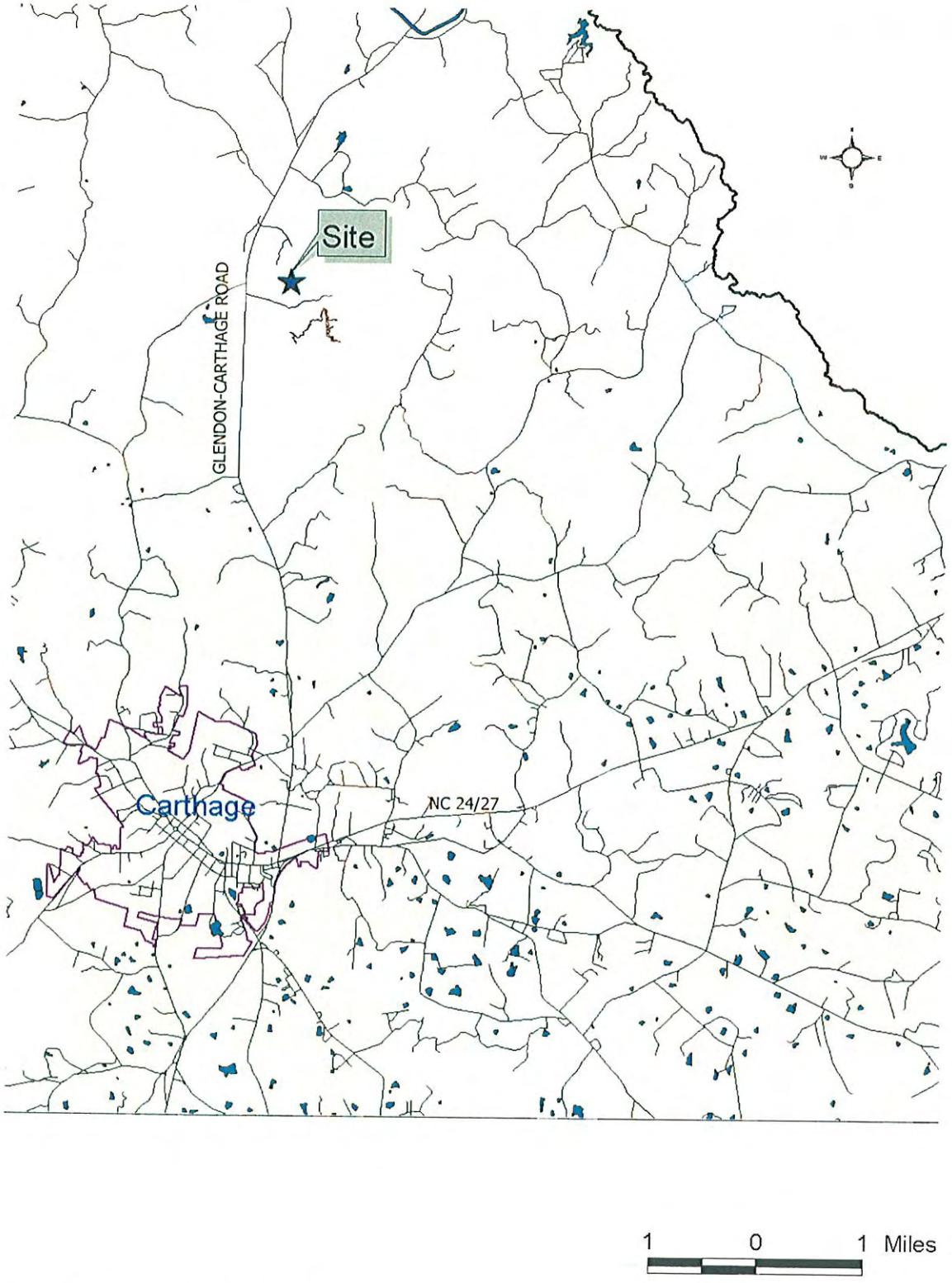


Figure 1. Stonebridge Stream Mitigation Site Location

PHYSIOGRAPHY, TOPOGRAPHY AND DRAINAGE

The Stonebridge Site is in the Piedmont Physiographic Province and the Triassic basins geologic belt. It is underlain by sandstones and mudstones of the Chatham group, which occasionally crop out along the subject streams and on a few hillslopes. Diabase dikes of Jurassic age also cross the site, generally trending northwest to southeast. Gently rolling topography on the property is punctuated by several steep slopes which tend to be associated with exfoliated diabase float. Elevations range from 250 in the Crawley Creek valley to approximately 400 feet.

The primary drainage features on the property are UT-1, UT-2, UT-3 and Crawley Creek, which drain in east and north-east direction as shown in Figure 2. Crawley Creek discharges into Governors Creek, which in turn flows into the Deep River. The NC Division of Water Quality (DWQ) stream classification for Crawley Creek is 'C'.

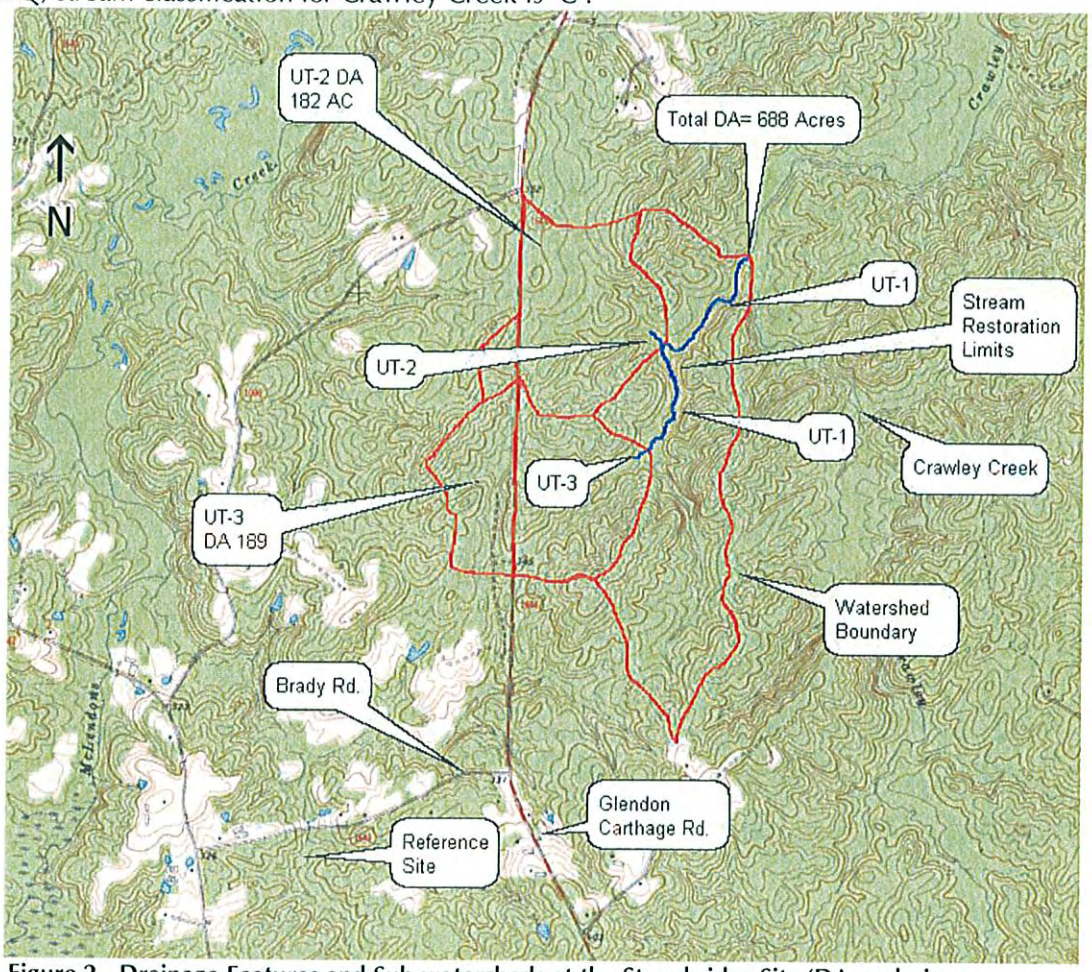


Figure 2. Drainage Features and Sub-watersheds at the Stonebridge Site (DA = drainage area in acres)

The UT1 catchment has a drainage area of 688 acres (1.1 square miles) to its confluence with Crawley Creek. It is a perennial stream represented as a blue line on USGS maps. Field investigations by a DWQ biologist in June 2003 identified benthic fauna characteristic of perennial flow conditions in all sections of UT1, UT2 and UT3 proposed for restoration. Land cover is approximately 60% pasture and 40% woods. At the present time, this area of Moore County is experiencing very limited development growth a large increase in development is not anticipated.

For this reason, the design of the proposed channel is based on hydrology and regional design curves that reflect the existing rural conditions and landuse.

SOILS

According to the Moore County Soil Survey (NRCS, 1995), the subject site is mapped within the Mooshaunee, Hallison, Mayodan, and Pinkston soil association. The three primary soil types found on the site are in the Pinkston, Congaree, and Creedmoor soil series (Figure 3). All soils within the watershed are classified as SCS hydrologic soil groups B and C, which range from fair to well draining soils.

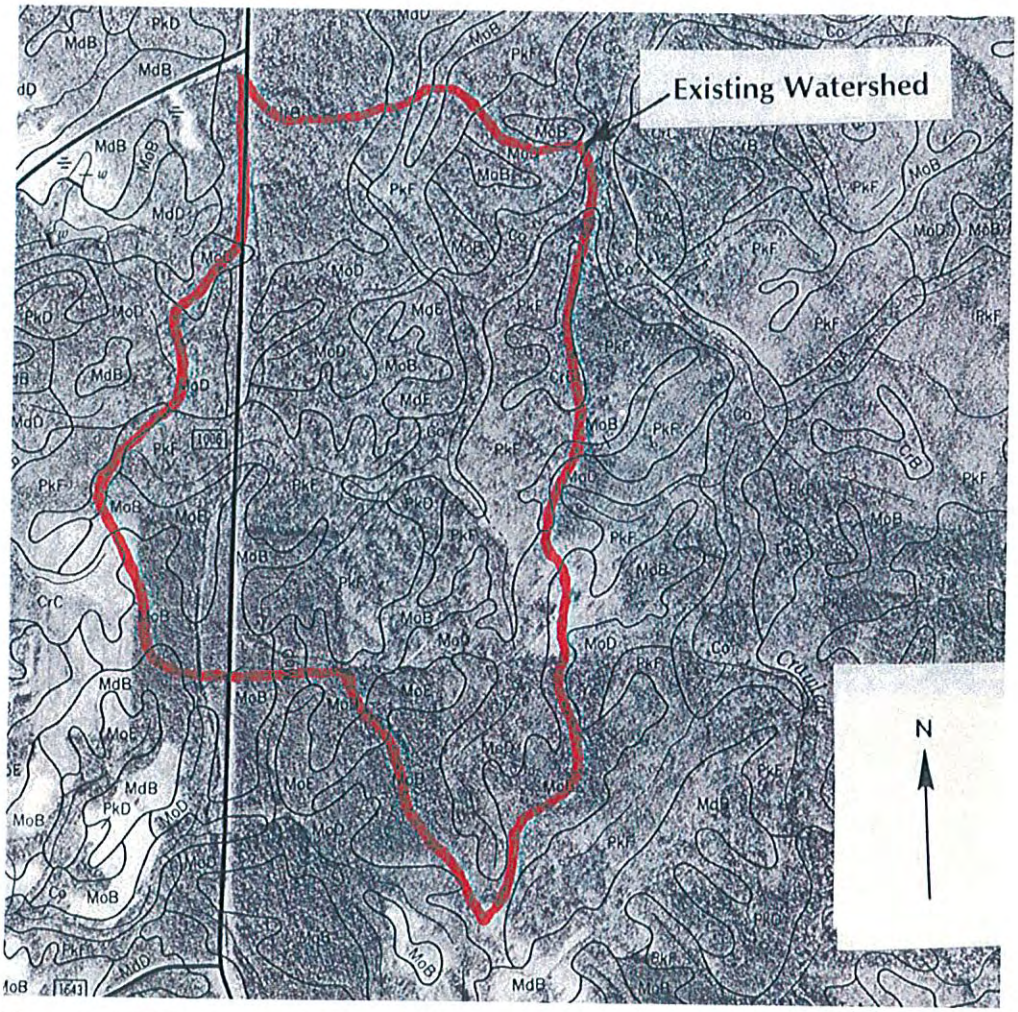


Figure 3. NRCS soils mapping at Stonebridge (Co- Congaree loam; CrB- Creedmoor fine sandy loam; MdE- Mayodan fine sandy loam; MoB, MoD & MoE- Mooshaunee-Hallison complex; PkD & PkF- Pinkston silt loam).

WK Dickson installed a total of nineteen soil borings along UT-1, UT-2 and UT-3 to verify soils mapping and generally evaluate growing conditions, as well as to identify potential design constraints imposed by bedrock. Boring locations are shown on the Existing Conditions Map in Appendix A, and Boring Log descriptions are provided in Appendix B.

The Congaree soil series consists of well-drained and moderately well drained soils on nearly level flood plains along streams in the Piedmont. These soils formed in recent fluvial sediments and range in slopes from zero to two percent. Typically the surface layer is dark yellowish brown loam to ten inches thick. The subsurface extends to seventy inches consisting of yellowish brown loam to silt loam. Soil samples collected from these areas were yellow and reddish-brown in color. The soil texture was comprised of silty, sandy, and blocky-clay, and silt-loam. Some boreholes advanced in this area yielded weathered parent material or saprolite at depths of forty to sixty inches.

The Pinkston soil series is moderately steep and steep, well drained to excessively drained soils. These soils formed in material weathered from coarse-grained Triassic rocks and range in slopes from 15 to 40 percent. They are on strongly dissected uplands from the southern piedmont in the Triassic basin. The surface layer is typically dark brown silt loam to six inches thick. The subsoil extends to a depth of thirty-one inches and is brown fine sandy loam to red brown sandy loam. The underlying material to thirty-six inches is dark reddish gray very fine sandy loam. Hard mudstone and conglomerate bedrock is at a depth of thirty-six inches. Soils observed in this area were of yellow and reddish-brown in color. Soil textures were of silt-loam, silty-clay, and clay-like characteristics.

One borehole advanced along UT-1 lies within the Mayodan series. This series consists of well-drained soils on Piedmont uplands. These soils formed in material weathered from Triassic rocks and range in slopes from two to twenty five percent. Mayodan soils are typically fine sandy loam with the surface layer extending to seven inches thick. The subsurface, consisting of yellowish red silty clay loam to red clay and red silty clay loam, extends to a depth of fifty-one inches where soft bedrock of fine sandy loam is reached. Soil observed from this borehole was yellowish-brown silt-loam and silty-clay.

The soil characteristics observed on the subject site that lies within the Congaree and Pinkston series differ from the Moore County Soil Survey description. These soils exhibited a subsurface trend of brown clays closely related to characteristics of the nearby Creedmoor series. The Creedmoor soil series is commonly found adjacent to Mayodan and Pinkston soils. Creedmoor soils consist of moderately sloping, and well drained to somewhat poorly drained soils. These soils formed in material weathered from fine-grained Triassic rocks. The surface layer is typically silty-loam. Extending further into the subsurface, Creedmoor soils become clay-like and more closely resemble the soils observed in the samples collected along UT-1, UT-2 and UT-3.

The WKD soil borings confirmed that soils at the Stonebridge Site are primarily a silty-loam and will not present any unforeseen problems with identifying native plants to stabilize the riparian areas. A review of this soils evaluation shall be made during the selection of plants for the riparian buffer planting plan.

VEGETATION

Vegetation was surveyed along the designated stream reaches to identify and characterize the existing plant communities along the approximately 100-foot wide riparian corridors of UT-1, UT-2 and UT-3 on November 24, 2003. The Stonebridge Site consists of three different vegetation communities designated as Areas A, B and C on Figure 3.

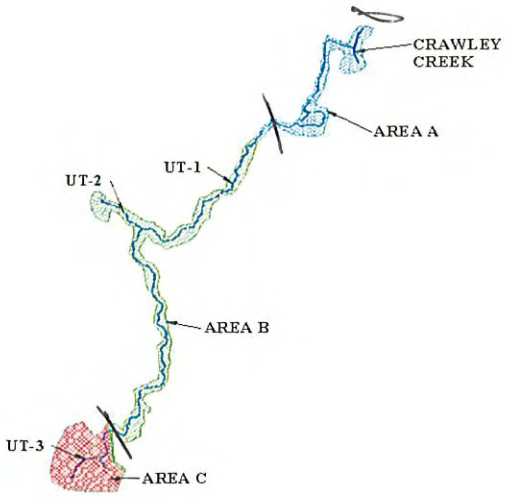


Figure 4. Map of Vegetative Communities

Area A has several mature trees (average 12 inch Diameter Breast Height (DBH)) and a less developed herbaceous layer. Canopy trees include: tulip poplar (Liriodendron tulipifera), water oak (Quercus nigra), river birch (Betula nigra), sweetgum (Liquidambar styraciflua), green ash (Fraxinus pennsylvanica), white oak (Q. alba), Virginia pine (Pinus virginiana), and pignut hickory (Carya glabra). Shrubs and understory plants consists of elderberry (Sambucus canadensis), ironwood (Carpinus caroliniana), flowering dogwood (Cornus florida), and dense patches of autumn olive (Elaeagnus umbellata), as well as, Chinese privet (Ligustrum sinense). The herbaceous community was dominated by Japanese honeysuckle (Lonicera japonica), multiflora rose (Rosa multiflora), Christmas fern (Polystichum acrostichoides), fescue, and soft rush (Juncus effusus). This natural community is a mesic mixed hardwood forest. Cattle and invasive species are currently heavily impacting this community.

The vegetative community in Area B has fewer understory plants than Area A. Dominant species include Chinese privet and ditch willow (Baccharis halimifolia) in adjacent tributaries. These plants are mature and represent a significant seed source that should be eradicated to prevent future out-breaks in newly graded areas. The plant community has similar species to Area A.

Area C is more wooded than Areas A and B. Cattle have not impacted this area to a great extent. This area had many small (3-6 inch DBH) with some larger trees (greater than 12 inch DBH). The trees in Area C include: white oak, willow oak (Quercus phellos), red oak (Q. rubra), and water oak. Understory plants include, red cedar (Juniperus virginiana), flowering dogwood, ironwood, and American holly (Ilex opaca). This area has significantly less invasive plants and a higher potential for the natural recruitment of native hardwoods than Areas A and B.

NATURAL RESOURCES OF SPECIAL CONCERN

A letter was sent on behalf of EBX to the NC Natural Heritage Program requesting information regarding natural heritage areas within and around the Stonebridge Site. In a written reply dated October 21, 2003, the Natural Heritage Program stated that no record of rare species, significant

natural communities, or priority natural areas was found at the Stonebridge Site. A copy of this letter is provided in Appendix C.

UT2 DAM

The dam located just upstream of the proposed UT-2 restoration area was visually inspected by a North Carolina registered professional engineer using the NCDENR Dam Safety form entitled "Dam Safety Inspection Report". The visual inspection was performed according to guidelines described in the "Dam Operation and Inspection Manual", which was prepared by North Carolina Department of Natural Resources and Community Development Division of Land Resources Land Quality Section. In general, the dam is in good condition, appears to be structurally sound, and poses no imminent threat to potential restoration activities. A copy of the completed inspection report for this dam is included in Appendix D.

EXISTING STREAM CONDITIONS

Base data including aerial photography, topography, stream locations, roads and project boundaries were initially evaluated. U.S. Geological Survey (USGS) 1:24000 scale (Putnam 7.5' quadrangle, 1974) topographic map and 1950, 1973, 1993, and 1999/2000 aerial photos were also studied. Drainage areas were determined for several potentially key locations throughout the study area, and anticipated bankfull hydraulic geometry calculated from regional curves.

Aerial imagery of the project area was obtained from USGS for the years 1950, 1973, and 1999/2000 (color-infrared). Coverage for 1993 was obtained from in-house commercial software. A combination of the aerial images and USGS mapping were used to identify changes in landuse and channel location. The three unnamed tributaries were located and compared on the aerial images for the years 1950 and 1973 using imaging software. If the stream or land cover had been altered during that time span, the type of modification and time period were documented. If the stream showed no signs of alteration during that time, the aerials for 1973 and 1993 were compared. This process was repeated for each tributary.

Standard field methods were used to obtain geomorphic field data from representative stream reaches on the three unnamed tributaries. Measurements included longitudinal profiles and cross-sections at riffles and pools. Calculations of hydraulic geometry based on field indicators of bankfull stage correlated well with regional curve for the rural Piedmont. Bank Erosion Hazard Index (BEHI) values were estimated for each of the reaches to estimate the potential for bank erosion. Reach locations are shown on the Existing Conditions map in Appendix A. All field data are summarized below and presented in greater detail in Appendix A.

Bank Erosion Hazard Index (BEHI) ratings support the need to stabilize stream banks to reduce erosion. Ratio's of bank heights to bankfull heights ranged from 1.8 to 3.3 indicating high to extreme channel incision. Channel banks are primarily composed of silt and fine sand, and due to erosion and cattle grazing had little or no vegetative root systems to provide stability. Table 1 summarizes the channel characteristics found along UT-1, UT-2 and UT-3.

Table 1-Summary of Existing Channel Characteristics

Location	Drainage Area (acres)	Bank Height (ft)	Channel Area (sq. ft.)	Bankfull Area (sq. ft.)	BEHI Rating
UT-1 Reach A	688	4.5-6.0	47.2	23.7	33.75 (High)
UT-1 Reach C	164	3.5-4.0	10	6.8	36.75 (High)
UT-2	182	3.5	12.8	6.2	35.60(High)
UT-3	189	1.0	7.5	7.5	34.7 (High)

Note: Channel area is to top of existing bank

UT1

This stream flows across the property in a northeasterly direction and makes an abrupt turn to the east near its confluence with Crawley Creek. It generally exhibits a very flat gradient and low sinuosity. Measured slopes range from 0.0003 to 0.006, and base flows are backed up over 250 feet upstream of the culvert near Crawley Creek. Portions appear to have been straightened or otherwise relocated. Bedforms are generally indistinct and accumulations of fine sediment are abundant. The stream bed and banks are comprised almost entirely of sand and silt. Most of this stream classifies as an E5, with the upstream-most segment (UT1 Reach C) exhibiting C6 characteristics. However, bank height:bankfull height ratios are typically around 2, indicating significant incision. In addition, as shown in Table 1, the total channel capacity exceeds the bankfull channel capacity by 40 to 99 percent. Field data document degradation and channel enlargement, however, historic air photo analysis could not determine whether these features were natural responses to perturbations or the result of direct channel manipulations.

UT2

UT2 drains about 182 acres in the central portion of the property, flowing southeast and discharging into UT1 in the middle of the project area. The restoration reach is from UT1 upstream to about 120 feet below the pond. The upstream limit of proposed restoration coincides with a potential break between intermittent and perennial flow identified by a DWQ biologist in June 2003. This stream has been relentlessly trampled by cattle along its entire length. Bank erosion is locally severe and riparian buffers are in poor condition. Bed and bank materials are predominantly silt. This stream is similar to UT1 in that its classification is E6 despite high bank height:bankfull height ratios and the total channel capacity suggest degradation and channel enlargement.

UT3

This stream is mapped in the soil survey (Figure 3) but not on the USGS 7.5' topographic quadrangle. However, the stream appears perennial based on observed baseflows, fluvial bedforms and fauna identified by the DWQ biologist. UT3 is largely stable and classifies as a B6c. Much of the riparian zone is forested and cattle impacts are decidedly more localized. The channel exhibits good cross sectional geometry and the existing capacity is appropriate for the drainage area; however, the stream has low sinuosity and often lacks appropriate bedforms.

HYDROLOGIC EVALUATIONS

Hydrologic analyses of the watershed were performed to validate the design channel geometry and bankfull flows. Peak flows and corresponding channel cross sectional areas were determined through standard hydrologic methods for comparison to design parameters. Peak flows in this study were estimated using the following methods:

- NC regional curves
- USACE HEC-1 computer model and SCS hydrology
- USGS regional regression equations for rural conditions in the Piedmont
- Rational method

Evaluations were made at the downstream limits of UT-1, UT-2 and UT-3 and in all cases the bankfull flows found using the regional curve compared well with those determined for the 1-year event in HEC-1 or the 2-year flood event using the USGS regression equations. A summary of the hydrological analysis is shown in Appendix E. The bankfull flows were generally lower than those developed in the HEC-1 model for the 1-year flood event.

Table 2– Summary of Hydrologic Evaluation

Stonebridge Site		**Reach**				
	Methodology	UT1-A	UT1-B	UT1-C	UT-2	UT-3
Drainage Area (mi^2)		1.075	0.941	0.552	0.284	0.295
Drainage Area (ac)		688.0	602.0	353.0	181.8	188.8
Existing Conditions	WKD Surveyed Bankfull Indicator Flow	74.51	139.81	63.24	36.58	33.96
Existing Conditions	Regional Curves	94	73	58	36	37
Existing Conditions	USACE HEC-1 - 1-year Q	160	134	97	37	51
Existing Conditions	USACE HEC-1 - 2-year Q	271	225	168	57	89
Existing Conditions	USACE Reg. Regression Equation- 2-year Q	142	129	89	32	57
Existing Conditions	Rational Method Equation - 2-year Q	179	157	92	45	49
Brady Road Reference Reach		**Location**				
	Methodology	Downstream	Upstream			
Drainage Area (mi^2)		0.478	0.766			
Drainage Area (ac)		305.9	490.2			
Existing Conditions	WKD Surveyed Bankfull Indicator Flow	78.4	65.6			
Stonebridge Site		**Location**				
	Methodology	UT1- A	UT1- B	UT1- C	UT-2	UT-3
Drainage Area (mi^2)		1.075	0.941	0.552	0.284	0.295
Drainage Area (ac)		688.0	602.0	353.0	181.8	188.8
Proposed Conditions	WKD design Bankfull capacity	78.8	NA	64.8	30.6	30.3

Notes: WKD Bankfull flow was determined from field indicators of bankfull stage
Rational method may not be accurate for reaches where DA > 200 acres - shown for comparison only
All flows given are in cubic feet per second (cfs)
WKD Bankfull for proposed conditions was determined at design riffles with Manning's equation

Restoration Summary

Natural channel design methods have been applied to maximize stream potential at the three unnamed tributaries. Design parameters have been developed from reference reach data and applied to the subject streams. The designs presented herein provide for stable cross-sectional geometry, an increase in planform sinuosity, and restoration of riffle-pool sequences and other stream bed diversity to improve benthic habitat. A total of 6,240 linear feet of stream have been designed, most of which will be installed on the existing floodplain. The proposed design will allow flows that exceed the design bankfull stage to spread out over the floodplain. The proposed stream crosses the existing channel in several locations, and some segments of the restoration consist of hydraulic geometry modifications to the existing channel.

As presently envisioned, most of the existing stream will be filled using material excavated from the restoration channel. Native material revetments shall be installed as needed to reduce bank stress, provide grade control and increase habitat diversity. Because the restored stream bed would generally be at a higher elevation than the existing bed, a significant increase in riparian wetland area is anticipated.

Forested riparian buffers shall be established to have widths of at least fifty feet on both sides of all restored streams. After channel construction, riparian buffers shall be ripped to a depth of at least 1.5 feet and/or sub-soiled to ameliorate soil compaction caused by grazing and construction. An appropriate riparian plant community will be established to include multiple strata and a diverse mix of species. Cattle shall be excluded from all stream and buffer restoration areas by fences. Restricting cattle access to these areas will maximize the water quality improvement benefits of the buffers.

The proposed stream and buffer restoration will arrest the bank erosion and mass wasting that are both active and locally severe. By reducing the supply of fine sediments from the banks, restored bedforms will remain stable. Finally, the reductions in nitrogen, biological oxygen demand and other pollutant loadings that will be achieved with the Stonebridge restoration work are substantial benefits to the watershed. Incidental to the stream restoration at the Stonebridge Site, new riparian wetlands will be created. No effort has been made to quantify these wetland areas.

Reference Reach Analysis

Reference reach data were collected from an unnamed stream located about two miles southwest of the Stonebridge site at Brady Road (Figure 2). This unnamed tributary to McLendons Creek was selected as the reference site due to its apparent physical stability, proximity to the mitigation project, and similar hydro-geomorphic setting. The Brady Road reference stream exhibits the following characteristics:

- A geomorphically active floodplain that is hydrologically connected to the stream
- Pronounced riffles, pools, runs and glides
- Sinuosity ranging from 1.45 to 1.67
- Healthy riparian forest buffer
- Location within the same geographical and meteorological region as the Stonebridge Site
- Valley types and slopes are very similar to the Stonebridge Site
- Channel bed and bank materials of fine sand and silt comparable to the Stonebridge Site

The reference stream is classified as an E5 streamtype. Valley slopes at the Stonebridge Site ranged from 0.0044 to 0.008; while the unnamed tributary at Brady Road had a valley slope 0.0066. The

measured longitudinal profile and cross sections are shown in Appendix F. Reference reach data were reduced to dimensionless ratios for design applications to account for differences in catchment size utilizing the NC regional curves that describe relations between hydraulic geometry and drainage area. Table 3 describes the stream restoration design parameters derived from the reference reach.

Table 3 - Summary of Morphometric Design Parameters

	Reference Reach		Design Reach		
Reach Name:	*U/S Brady*	*D/S Brady*	*UT1 - A*	*UT1 - B*	*UT2*
Drainage Area (sqmi):	0.48	0.77	1.08	0.94	0.28
Sinuosity:	1.45	1.67	1.51	1.34	1.51
Beltwidth (ft):	26.6	33.9	55	50	27
Width (ft):	8.1	6.4	12.8	11.6	6.2
Cross Sectional Area (sqft):	12.2	16	26.9	20.7	8.1
Mean Depth (ft):	1.51	2.2	2.1	1.8	1.3
Max Depth (ft):	2.03	2.6	3	2.5	1.7
Width to Depth Ratio:	5.36	2.56	6.1	6.5	4.8
Flood-Prone Width (ft):	50	200	50	50	40
Entrenchment Ratio:	6.17	31.25	4	4	6
Wetted Perimeter (ft):	9.76		15.6	13.9	7.9
Hydraulic Radius (ft):	1.25		1.65	1.45	.97
Valley Slope (ft/ft):	0.0066		0.0044	0.0044	0.013
Water Suface Slope (ft/ft):	0.0025		0.0023	0.0025	0.007
Avg Riffle Slope (ft/ft):	0.00148		0.011	0.011	0.011
Avg Pool Slope (ft/ft):			0.0013	0.0011	0.0014
Pool-Pool spacing (ft):	29.8		65	58	31
Avg Pool depth (ft):	2.0		3.0	2.6	1.8
Pool depth/BF depth (ft):	1.33		1.19	1.20	1.74
Meander Width Ratio:	3.28		4.3	4.3	4.3
Radius of curvature (ft):	17.5	13.5	26	24	13
Channel Materials D50 (mm):	0.75	0.75	.37	.53	1.77
Channel Materials D84 (mm):	0.83	0.83	1.43	1.58	4.33
Classification:	E 5	E 5	E5	E5	E5

Typical Design Sections

Typical cross sections for riffles and pools are shown on the design plan sheets in Appendix G. Two types of typical pool sections were developed to account for pools located on straight reaches and pools on meander bends. Side slopes of channel banks and centerline location of thalweg for the reference reach channel were noted and used as a guide when developing the proposed cross sections. Typical cross sections at riffles were designed using an in-house spreadsheet based on Manning's equation, using roughness "n" values determined from Limerino's equation. NC regional curves were used to confirm hydraulic geometry and channel capacity.

Typical Meander Pattern

The plans showing the design channel alignment are provided in Appendix G. The design meander pattern was developed using both sine generated curves and basic geometry. The initial design was modified in the field using realtime GIS and GPS technologies to minimize loss of large trees and reduce land disturbance. The resulting planform utilizes some existing channel features

and creates additional meander bends that will provide energy dissipation while maintaining sediment transport.

Proposed sinuosity, wavelengths, beltwidths, amplitudes and radii of curvature were generated using commercial spreadsheet software and standard equations. Dimensionless ratios developed from the Brady Road reference site were used as input data. These values have been adjusted by the software to account for the design slopes and bankfull flows calculated for the Stonebridge Site.

Longitudinal Profiles

The design profiles for UT-1 and UT-2 are shown in Appendix G. These profiles extend throughout the entire project for the proposed conditions channel alignment. The profiles were designed using the reference reach bed features with adjustments made for changes in drainage area and design bankfull energy gradient. Longitudinal geometry for riffles, runs, pools and glides were developed from reference reach dimensionless ratios and applied to the proposed profile at the Stonebridge Site. Log structures, and possibly rock structures, will be utilized in the design to control grade and provide additional habitat diversity and stability.

Riparian Buffer Restoration

Two riparian buffer planting areas are identified: the flat, reconnected floodplain, and the adjacent hillslopes. Species to be planted in each area are listed below, and are intended to restore communities comparable to the Basic Mesic Forest (Piedmont Subtype) and Piedmont/Low Mountain Alluvial Forest as described by Schafale and Weakley (1990). Species selection was based on reference reach vegetation and reference literature. Plant materials will be a mixture of containerized stock, bare-root whips, seedlings, live stakes and cuttings. After channel construction, riparian buffers shall be ripped to a depth of at least 1.5 feet and/or subsoiled to ameliorate soil compaction caused by decades of intense grazing. The floodplain species mix shall be planted on an approximately 8' x 8' spacing to establish 688 trees and shrubs per acre. Upland plants will be installed on 8' x 9' spacing for 622 plants per acre. Riparian habitat plantings will be augmented with transplants, cutting bundles and live stakes installed for stream bank stability.

Table 4 – Riparian Buffer Species

Floodplain Species		Upland Species	
Winged Elm	*Ulmus alata*	Red Oak	*Quercus rubra*
River Birch	*Betula nigra*	Green Ash	*Fraxinus pennsylvanica*
Red Maple	*Acer rubrum*	Yellow Poplar	*Liriodendron tulipifera*
Sycamore	*Platanus occidentalis*	White Oak	*Q. alba*
Blue Beach	*Carpinus caroliniana*	Black Locust	*Robinia pseudoacacia*
Water Oak	*Quercus nigra*	Gray Dogwood	*Cornus racemosa*
Sweet Bay Magnolia	*Magnolia virginiana*	Redbud	*Cercis canadensis*
Elderberry	*Sambucus canadensis*	Loblolly Pine	*Pinus taeda*
Silky Dogwood	*Cornus amomum*		

Stream Crossings

An existing culvert on UT-1 near Crawley Creek is in reasonably good condition and will remain in place. Locations for six additional crossings along UT-1 are identified on the plans. These locations were selected based on the restored channel location, adjacent valley morphology and discussions with the landowner.

The landowner has requested a crossing that would meet road design requirements to support development that may occur in the future. One crossing along UT-1 (STA 39+50) was sized and evaluated according to Moore County and NC DOT design requirements. The hydrologic and hydraulic analyses performed for the crossing design are presented below. In addition, a plan view and cross-section detail of the crossing and the associated right-of-way are presented in Figure 5. The remaining five crossings along UT-1 are either culvert crossings sized to convey bankfull discharge or are ford crossings.

Hydrology

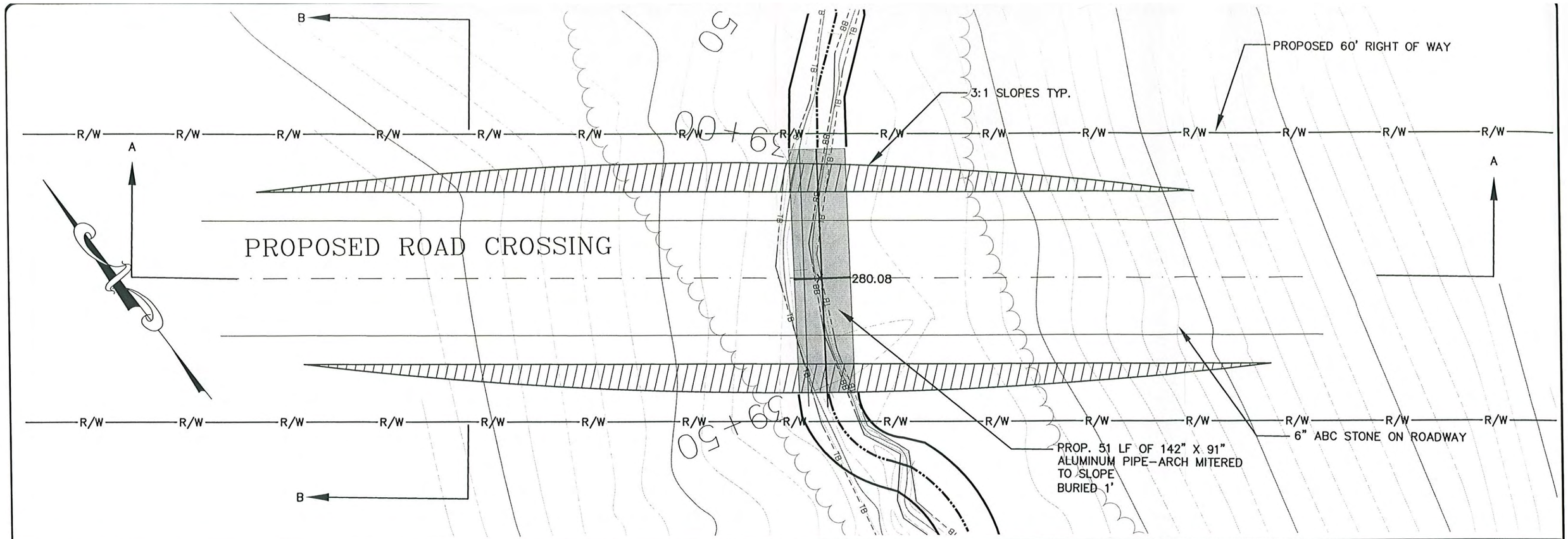
The hydrological analysis phase involves the determination of discharge rates of runoff that the drainage structure will be required to convey. The two methods utilized for the peak discharge are as shown in the North Carolina Division of Highways Guidelines for Drainage Studies and Hydraulic Design. The first method is presented in U.S. Geological Survey Report 87-4096 (4) and is used for watersheds exceeding one square mile. The second method is the hydrological procedure and charts presented in Appendix C, N.C. Division of Highways Hydrological Charts. The drainage areas for each method were obtained by using the latest U.S. Geological Survey maps. The percent impervious area was calculated to be less than three percent. This, combined with observations of current landuse, validated the original assumption to use the rural classification versus the urban classification. The entire project site is zoned as agricultural; therefore, it is assumed that the proposed conditions and runoff values will be similar to the existing conditions.

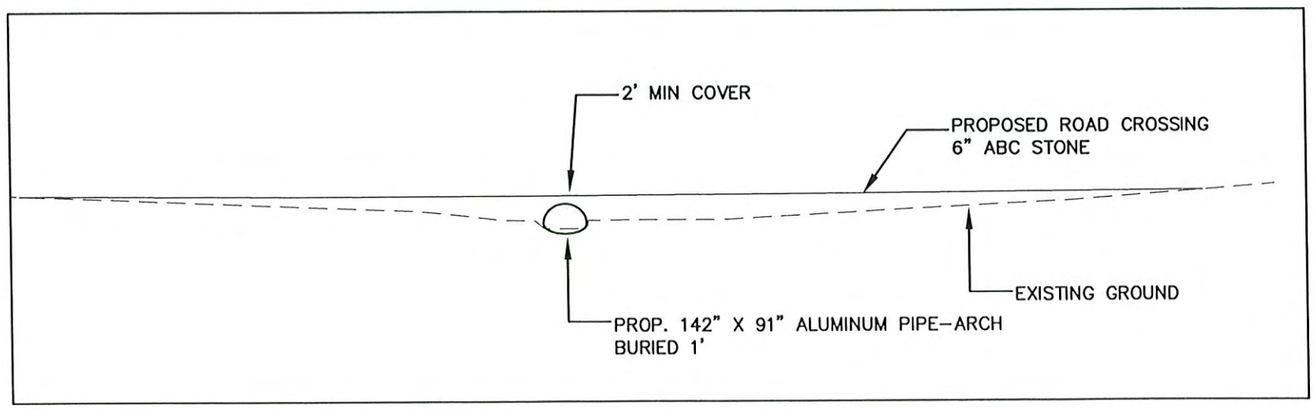
Hydraulics

The hydraulic analysis of UT-1 was performed using the US Army Corps of Engineers' HEC-RAS computer program. The option chosen within the program calculates the water surface profile for steady, gradually varied flow in channels and floodplains. Cross-sections for the HEC-RAS model were created and input automatically by extraction software along with the previously described topographic mapping (DTM). The Cross-sections were developed from the 2-foot contour interval topographic mapping generated from field-surveyed data collection. As part of the Quality Control for this project, a field visit was made by WKD personnel to verify the surveyed data and to determine other various stream characteristics.

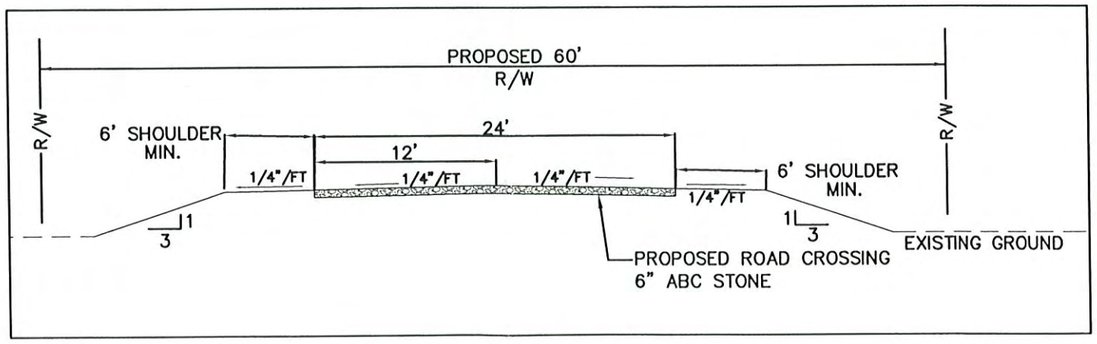
The HEC-RAS model calculates water surface profiles for steady, gradually varied flow, both sub-critical and supercritical, for user-specified discharges. The standard step backwater analysis for sub-critical flow was modeled for UT-1. The model calculates the effect of obstructions, such as culverts, and building structures in the channel and floodplain on the water surface profile. The hydraulic computations are based on the solution of a one-dimensional energy equation with energy loss due to friction evaluated by Manning's equation. Input data for the HEC-RAS computer model include the following:

- Cross-section geometry of the channel and floodplain
- Roughness coefficients to describe the characteristics of the channel and floodplain
- Size, shape, and characteristics of culverts and roadways along the stream reach
- Energy loss coefficients for flow in the channel and at roadway crossings





SECTION A–A
NTS



SECTION B–B
NTS

FIGURE 5

PROJECT MANAGER	MSE
DRAWN BY	AMH
APPROVED BY	SAS
FILE NAME	
DRAWING SCALE	1"=20'
PROJECT DATE	
PROJECT NUMBER	30246.00.RA
PLOT DATE	

STONEBRIDGE STREAM MITIGATION PROJECT

PREPARED FOR

ENVIRONMENTAL BANC & EXCHANGE, LLC

EBX

PROPOSED ROAD CROSSING UT–1 AT STA. 39+25

WK DICKSON
community infrastructure consultants

3101 JOHN HUMPHRIES WYND
RALEIGH, NC 27612
(919) 782-0495

Office Locations:
North Carolina
South Carolina
Georgia
Florida

Design Requirements

The culvert design includes the following requirements: Roadways with culverts larger than 3 feet in diameter have 1.0 foot of freeboard during the 25-year storm event; Headwater depth to culvert depth ratio shall be less that 1.2; and water surface elevations do not flood habitable structures for elevations equal to the 100-year storm event + 1.0-foot elevation. Alternatives were identified through an iterative process of modifying culvert sizes, and lowering culvert and channel inverts.

STRUCTURES

Structures will be incorporated into the channel design to provide additional bank stability. Native materials and vegetation will be used for revetments and grade control structures when applicable. During construction, new stream banks will be stabilized with sod mats harvested onsite. Other bank stability measures include the installation of cuttings bundles at three to five foot intervals along the tops of banks. Typical details for proposed structures and revetments are in Appendix H.

A sediment transport analysis was performed to ensure that the restoration design creates a stable sand bed channel that neither aggrades nor degrades over time. Channel stability is achieved when the sediment inflow equals the sediment outflow. Various stable channel design functions relating channel dimension, slope, and materials were utilized to calculate appropriate cross-section dimensions to ensure competency.

Sediment transport is typically assessed to determine stream's ability to move a specific grain size at a given flow. Methods include analysis of shear stress, tractive force, and critical dimensionless shear stress. While the corresponding equations are important in estimating entrainment for gravel bed streams, the equations are not as effectively applied to sand bed channels in which all particles are mobile during bankfull flows. The following methods and functions were considered during the sediment transport analysis:

- Stable channel Analytical Model (SAM) -- Copeland Method
- Shear stress
- Velocity

SAM (COPELAND METHOD)

Initial cross-section dimensions were evaluated using the stable channel design functions within the U.S. Army Corps of Engineers (USACE) HEC-RAS Model (Version 3.1.1). These functions are based upon the methods used in the SAM Hydraulic Design Package for Channels developed by the USACE Waterways Experiment Station. The Copeland Method was developed specifically for sand bed channels (median grain size restriction of 0.0625 mm to 2 mm), and was therefore selected for application at the Stonebridge site. The method sizes stable dimensions as a function of slope, discharge, roughness, side slope, bed material gradation, and the inflowing sediment discharge. Results are presented as a range of widths and slopes, and their unique solution for depth, making it easy to adjust channel dimensions to achieve stable channel configurations. See Table 5 below for the HEC-RAS output.

Table 5 – HEC-RAS Stable Channel Design Output

Reach	Bottom Width (ft)	Depth (ft)	Slope (ft/ft)	Shear Stress (lb/ft^2)
UT-1 (D/S of UT-2)	11.0	2.1	0.0023	0.30
UT-1 (U/S of UT-2)	10.0	1.7	0.0025	0.27
UT-2	5.0	1.3	0.007	0.42

VELOCITY APPROACH

Published data are readily available that provide entrainment velocities for different bed and bank materials. A comparison of calculated velocities to these permissible velocities is a simple method to help verify channel stability. The following table compares the proposed velocities calculated using Manning's equation with the allowable velocities presented in the USACE's Hydraulic Design of Flood Control Channels manual (USACE, 1991).

Table 6 – Comparison of Proposed and Allowable Velocities

Reach	Design Velocity (ft/s)	*Allowable Velocity (ft/s)		
		fine sand	coarse sand	fine gravel
UT-1 (D/S of UT-2)	3.6	2.0	4.0	6.0
UT-1 (U/S of UT-2)	3.4	2.0	4.0	6.0
UT-2	3.7	2.0	4.0	6.0

*(USACE, 1991)

Results from HEC-RAS show that the velocities for both UT-1 and UT-2 fall within the acceptable range of 2.0 to 4.0 ft/s for a sand bed channel.

SHEAR STRESS APPROACH

Shear stress is commonly used as a tool for assessing channel stability. Allowable channel shear stresses are a function of bed slope, channel shape, flows, bed material (shape, size and gradation), cohesiveness of bank materials and vegetative cover. The shear stress approach compares calculated shear stresses to those found in the literature. Shear stress is the force exerted on a boundary during the resistance of motion as calculated using the following formula:

$$\tau = \gamma RS \qquad \text{(V-1)}$$

τ = shear stress (lb/ft^2)
γ = specific gravity of water (62.4 lb/ft3)
R = hydraulic radius (ft)
S = average channel slope (ft/ft)

Table 7 – Comparison of Proposed and Allowable Shear Stresses

Reach	Proposed Shear Stress at Bankfull Stage (lb/ft^2)	*Sand/Silt/Clay (lb/ft^2)	**Vegetation (lb/ft^2)
UT-1 (D/S of UT-2)	0.30	0.32 to 0.43	0.4 to 2.5
UT-1 (U/S of UT-2)	0.27	0.32 to 0.43	0.4 to 2.5
UT-2	0.42	0.32 to 0.43	0.4 to 2.5

*(Chow 1959)
** (Fischenich, 2001)

Review of the above table shows that the proposed shear stresses for UT-1 and UT-2 all fall within the permissible limits. The channels are able to withstand shear stresses ordinarily thought to be erosive for sand bed channels due to the cohesive nature of the bank soils. In localized areas of high or excessive shear stresses along the tributaries, additional protection will be provided in the form of structures and/or vegetation.

The stream restoration success criteria for the Stonebridge Site will follow accepted and approved success criteria presented in the site specific mitigation plans developed for the EBXN-I Neu-Con Mitigation Banking sites as well as the Stream Mitigation Guidelines issued on April 2003. Specific success criteria components are presented below.

SUCCESS CRITERIA COMPONENTS

Bankfull Events

Two bankfull flow events must be documented within the 5-year monitoring period. The two bankfull events must occur in separate years. Otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years.

Cross Sections

There should be little change in as-built cross-sections. If changes do take place they should be evaluated to determine if they represent a movement toward a more unstable condition (for example down-cutting or erosion) or are minor changes that represent an increase in stability (for example settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Cross-sections shall be classified using the Rosgen stream classification method and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

Longitudinal Profiles

The longitudinal profiles should show that the bedform features remain generally stable, e.g. they are not aggrading or degrading. The pools should remain deep and the riffles should remain shallower than the pools. Bedforms observed should be consistent with those observed for channels of the design stream type. However, since the Stonebridge tributaries are sand bed channels, all bedforms are expected to be dynamic.

Stream Vegetative Success Criteria

Specific and measurable success criteria for plant density within the riparian buffer on the site will be based on the recommendations found in the WRP Technical Note and correspondence from review agencies on mitigation sites recently approved under the Neu-Con Mitigation Banking Instrument.

The interim measure of vegetative success for the site will be the survival of at least 320 3-year old planted trees per acre at the end of year three of the monitoring period. The final vegetative success criteria will be the survival of 260 5-year old planted trees per acre at the end of year five of the monitoring period.

Up to 20 percent of the site species composition may be comprised of volunteers. Remedial action may be required should these species (that is, loblolly pine, red maple, sweet gum, etc.) present a problem and exceed the 20 percent composition. Beneficial species regeneration should be noted within the monitoring reports.

Photo Reference Stations

Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Longitudinal photos should not indicate the absences of developing bars within the channel or an excessive

increase in channel depth. Lateral photos should not indicate excessive erosion or continuing degradation of the banks over time. A series of photos over time should indicate successional maturation of riparian vegetation.

Reference Site

A reference reach will be identified with a stream order, habitat designation and Rosgen classification similar to the project stream.

METHOD OF REPORTING ON SUCCESS CRITERIA

An as-built report documenting stream restoration will be developed within 60 days of the planting completion on the restored site. The report will include elevations, photographs, sampling plot locations, and a description of initial species composition by community type. The report will also include a list of the species planted and the associated densities.

The monitoring program will be implemented to document system development and progress toward achieving the success criteria. The restored stream morphology will be assessed to determine the success of the mitigation. The monitoring program will be undertaken for 5 years or until the final success criteria are achieved, whichever is longer.

Monitoring reports will be prepared in the fall of each year and submitted to NCDOT. The monitoring reports will include:

1. A detailed narrative summarizing the condition of the restored site and all regular maintenance activities;
2. As-built topographic maps showing location of monitoring gauges, vegetation sampling plots, permanent photo points, and location of transacts;
3. Photographs showing views of the restored site taken from fixed-point stations from a height of approximately five to six feet. Permanent markers will be established to ensure that the same locations (and view directions) on the site are monitored in each monitoring period;
4. Vegetative data, as described below;
5. Identification of any invasion by undesirable plant species, including quantification of the extent of invasion of undesirable plants by either stem counts, percent cover, or area, whichever is appropriate;
6. A description of any damage done by animals;
7. Wildlife observations; and
8. Reference and stream data.

STREAM RESTORATION MONITORING

Bankfull Events

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauges and photographs. The crest gauge will record the highest watermark between site visits, and the gauge will be checked each time there is a site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

Cross Sections

Two permanent cross-sections will be installed per 1,000 linear feet of stream restoration work, with one located at a riffle cross-section and one located at a pool cross-section. Each cross section will be marked on both banks with permanent pins to establish the exact transect used. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year-to-year data. The annual cross section survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross sections will be classified using the Rosgen stream classification system.

Bed Material Analyses

The project stream reach is composed of bedforms in the sand size sediment fraction. Since the median grain size (D50) is similar to the reference reaches studied, it is unexpected that a substantial change will occur. Bulk samples will be collected and analyzed to determine any changes in substrate. Composite samples will be taken across the channel bottom at no less than 6 cross sections.

Longitudinal Profiles

A longitudinal profile will be completed in years one, three, and five of the monitoring period. The profile will be conducted for a representative length of restored channel. Measurements will include thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature, for example, riffle, pool, and the max pool depth. The survey will be tied to a permanent benchmark.

Vegetative Monitoring

In order to determine if the success criteria are achieved, vegetation-monitoring stations will be installed on approximately 2 percent of the restoration site. The size of individual monitoring plots will be 0.1 acre. Vegetation monitoring will occur in spring after leaf-out has occurred. Individual plot data for woody species will be provided. Plot data will not be averaged over the entire site to obtain a single figure for stem density. Permanent plots for the sampling of planted species shall be randomly located in each of the target communities. The enumeration of the density of planted species will equal the number of remaining stems in the plot divided by the plot size in acres. Individual seedlings will be marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living planted seedlings and the current year's living planted seedlings.

At the end of the first growing season, species composition, density, and survival will be evaluated. For each subsequent year, until the final success criteria is achieved, the restored Site will be evaluated between July and November.

Photo Reference Stations

Photographs will be used to visually document restoration success. Reference stations will be photographed before construction and continued for at least five years following construction. Reference photos will be taken once a year. After construction has taken place, reference stations will be marked with wooden stakes.

Lateral reference photos. Reference photo transects will be taken at each permanent cross section. Photographs will be taken of both banks at each cross section. The survey tape will be centered in the photographs of the bank. The water line will be located in the lower edge of the frame and as

much of the bank as possible included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

Structure photos. Photographs will be taken at each grade control structure along the restored stream. Photographers should make every effort to consistently maintain the same area in each photo over time.

Benthic Macroinvertebrates and Fish Sampling

No benthic macro-invertebrate or fish sampling is required on the restored site at this time. Should sampling eventually be required by the review agencies, appropriate sampling methodologies and success criteria will be implemented and will be based on those accepted and approved by the review agencies for the Neu-Con Mitigation Banking Sites.

REMEDIAL ACTIONS

In the event that the site or a specific component of the site fails to achieve the defined success criteria, EBXN-I will develop necessary adaptive management plans and/or implement appropriate remedial actions for the site in coordination with the review agencies. Remedial action required by the review agencies will be designed to achieve the success criteria specified previously, and shall include a work schedule and monitoring criteria that will take into account physical and climactic conditions.

SUMMARY

The Stonebridge Stream Mitigation Project will improve physical habitat and water quality through the restoration of stream and riparian habitats as defined in the inter-agency Stream Mitigation Guidelines (USACE, 2003). The design plan presented herein provides a total of 6,240 linear feet of stream restoration for the project. Therefore, the resultant SMU's are 6,240 based on the 1:1 mitigation credit ratio received for stream restoration.

CONSERVATION EASEMENT

A conservation easement will be placed over the preservation acreage consisting of a fifty-foot buffer extending out from the beltwidth of the proposed restoration design. The total easement area is 15.6 acres. Livestock and cattle will be excluded from all areas protected by conservation easement. The easement limits will be clearly marked by the use of fencing, marker posts, signage, or other appropriate means. Crossings shown on the plans shall be assets within the easement.

CURRENT OWNERSHIP OF PROPERTY

EBX-Neuse I, LLC ("EBXN-I") acquired an Agreement for Purchase and Sale of Easement from Floyd Strader and wife Mildred Strader who are the current land owners of the Stonebridge site. The Agreement allows EBXN-I to acquire an easement on the portion of the 1200-acre site, which is needed for the Restoration Plan.

EBXN-I is prepared to convey an easement to the NCDOT on the acreage necessary to achieve the restoration objectives outlined in the Restoration Plan.

CATEGORICAL EXCLUSION

The Categorical Exclusion Action Classification Form for the Stonebridge site is provided in Appendix C.

Chow, Ven Te. (1959). Open-Channel Hydraulics, McGraw-Hill, New York.

Fischenich, C. (2001). "Stability Thresholds for Stream Restoration Materials," EMRRP Technical Notes Collection (ERDC TNEMRRP-SR-29), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Harrelson, Cheryl C., C.L. Rawlins, John P. Potyondy. (1994). Stream channel reference sites: an illustrated guide to field technique. USDA Forest Service, Fort Collins, CO.

NRCS, (1995). Soil Survey of Moore County, North Carolina. USDA Natural Resources Conservation Service.

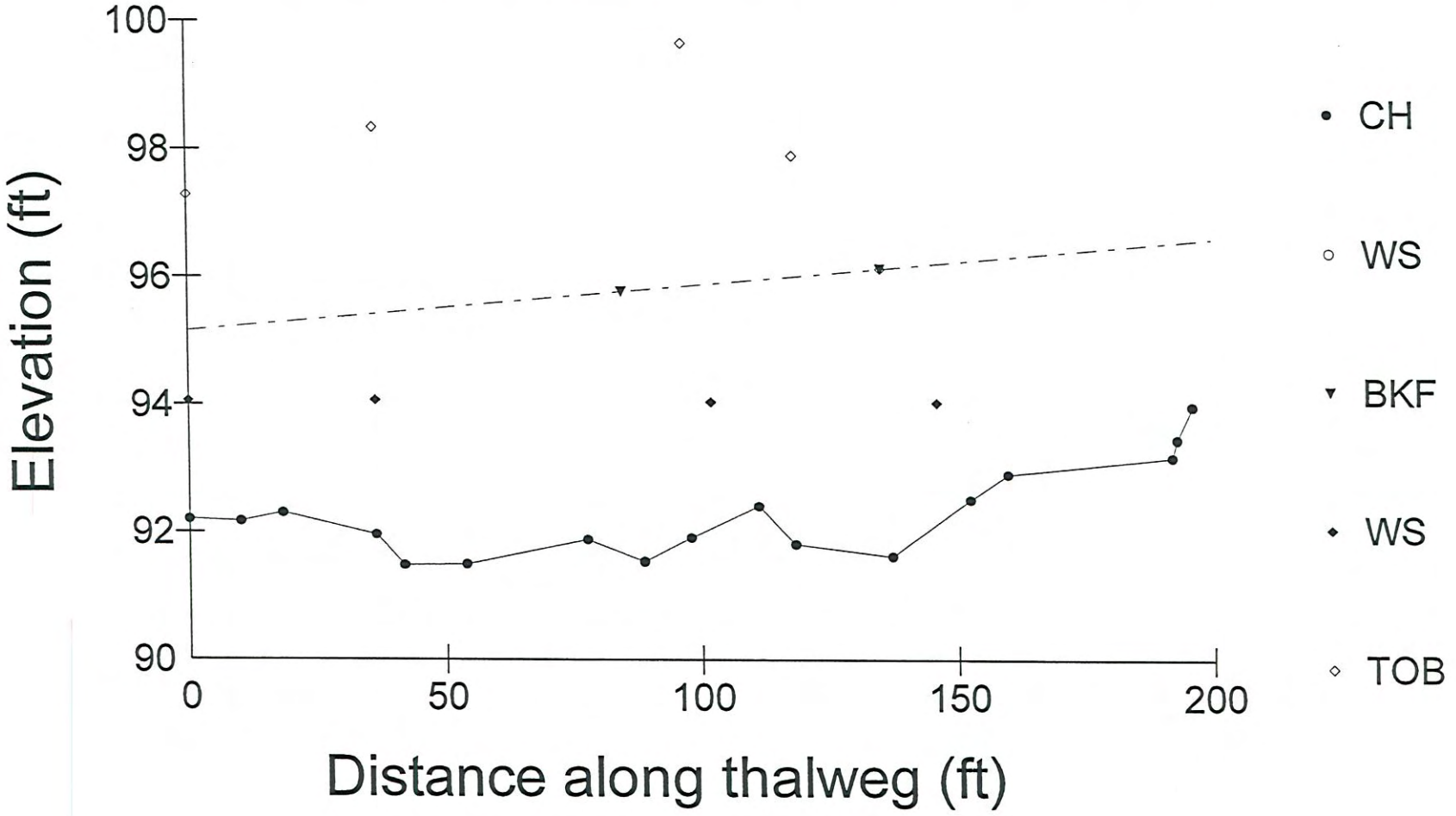
Shafale, M.P. and A.S. Weakley, 1990. *Classification of the Natural Communities of North Carolina: Third Approximation*. North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health, and Natural Resources. 325 pp.

U.S. Army Corps of Engineers (USACE). (1991) (change 1, 1994). "Engineering and Design - Hydraulic Design of Flood Control Channels," EM 1110-2-1601, Washington, DC.

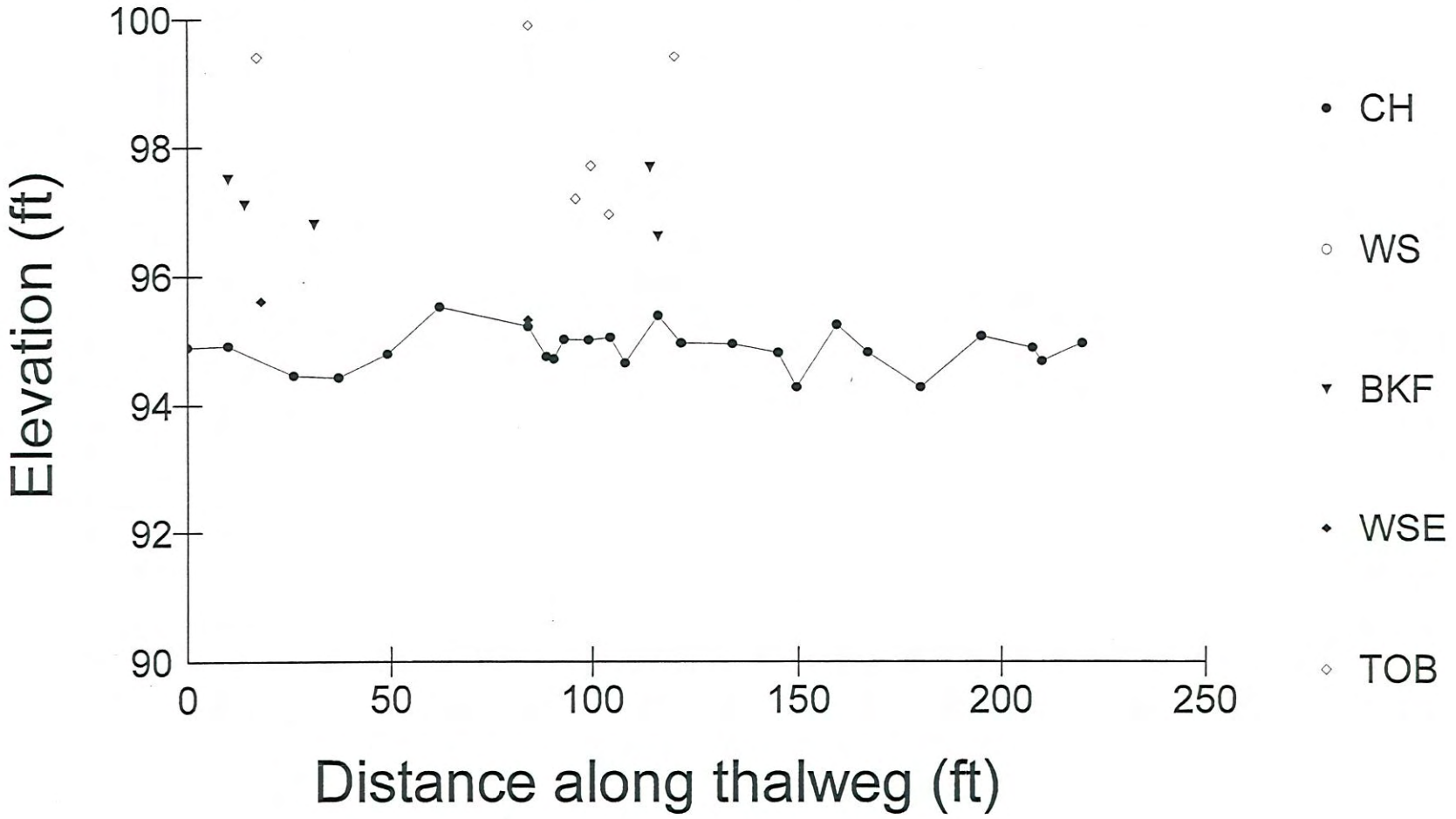
APPENDICES

APPENDIX A

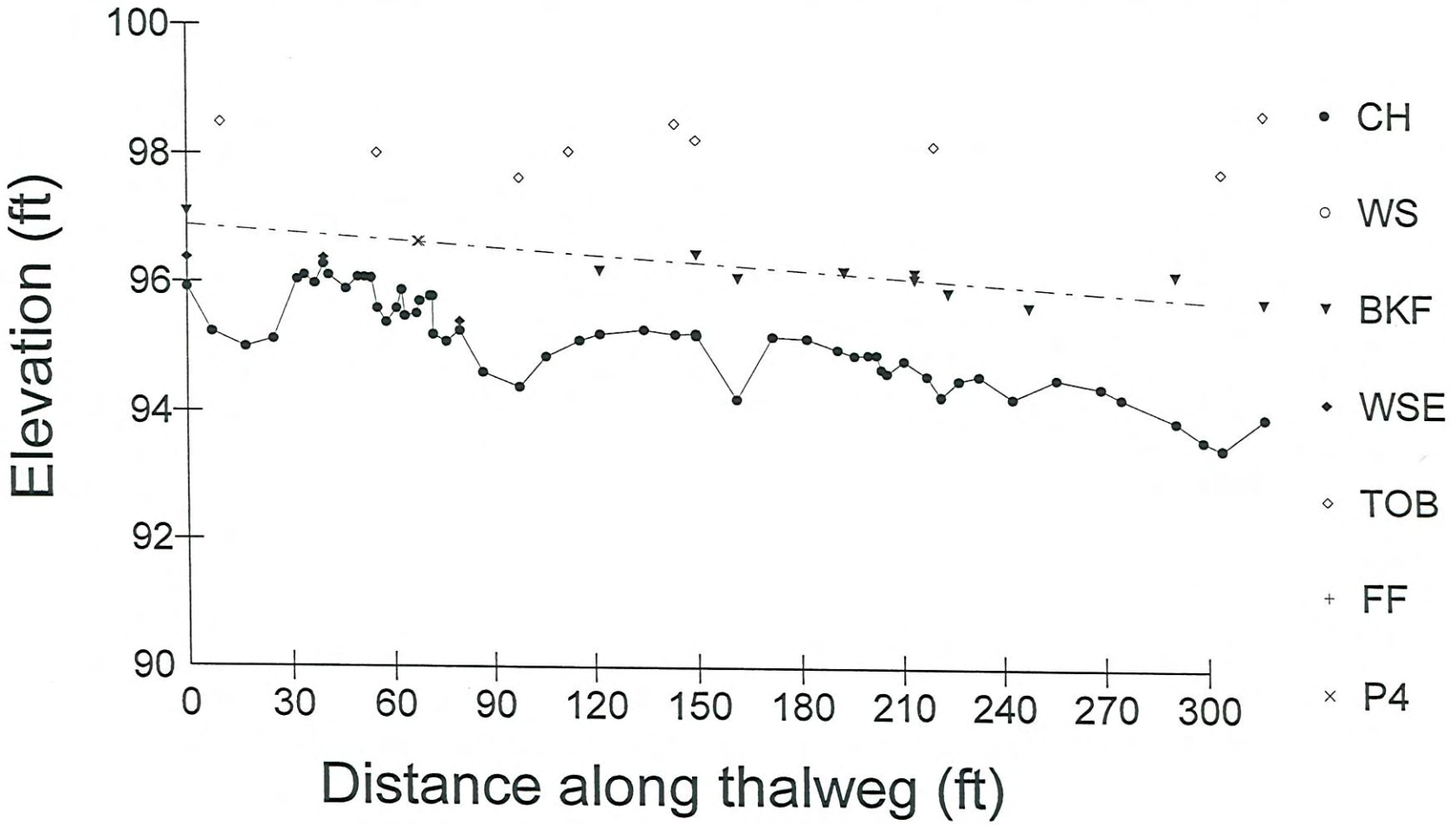
UT-1 PROFILE AT REACH A



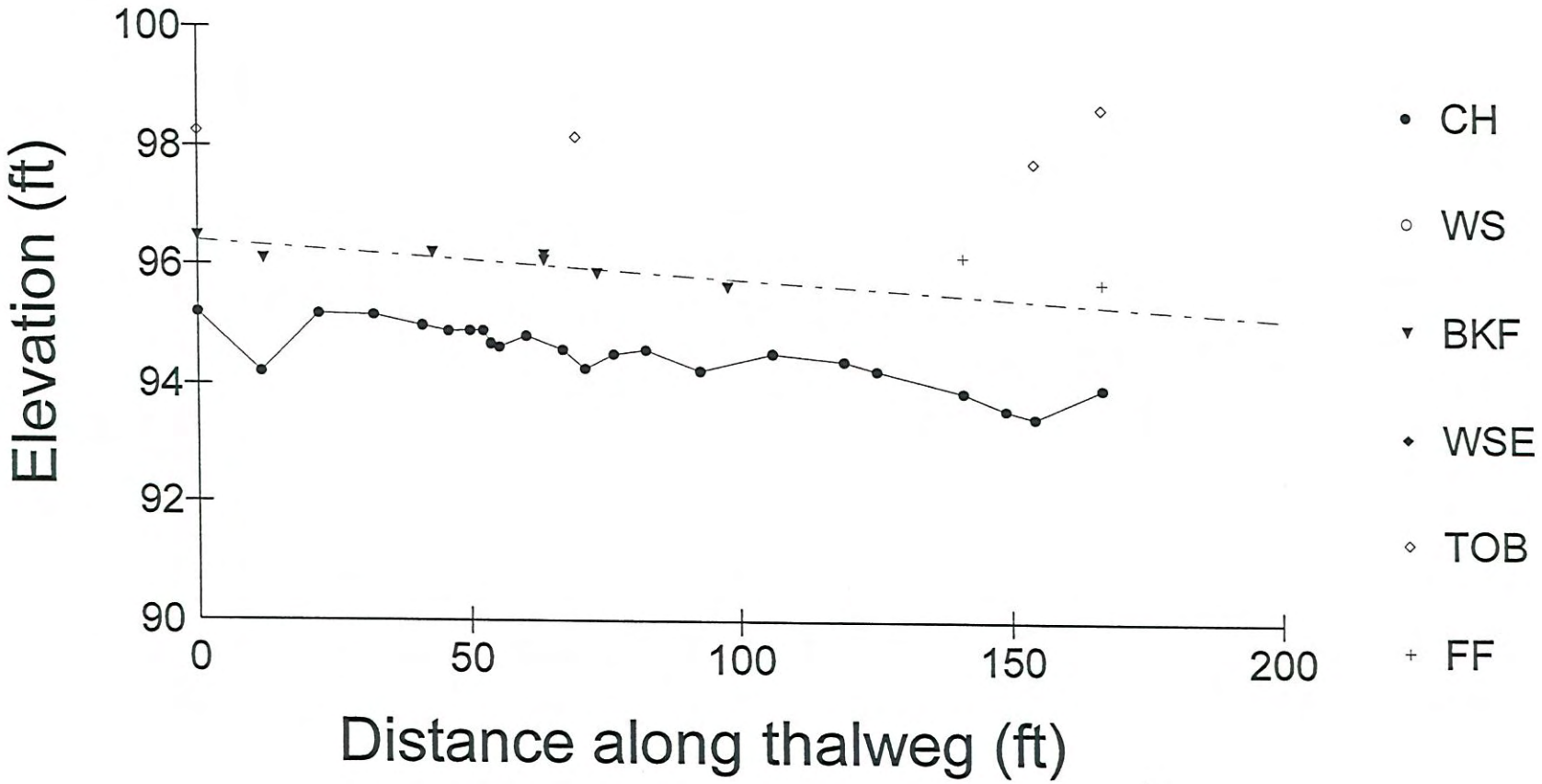
UT- 1 PROFILE REACH B



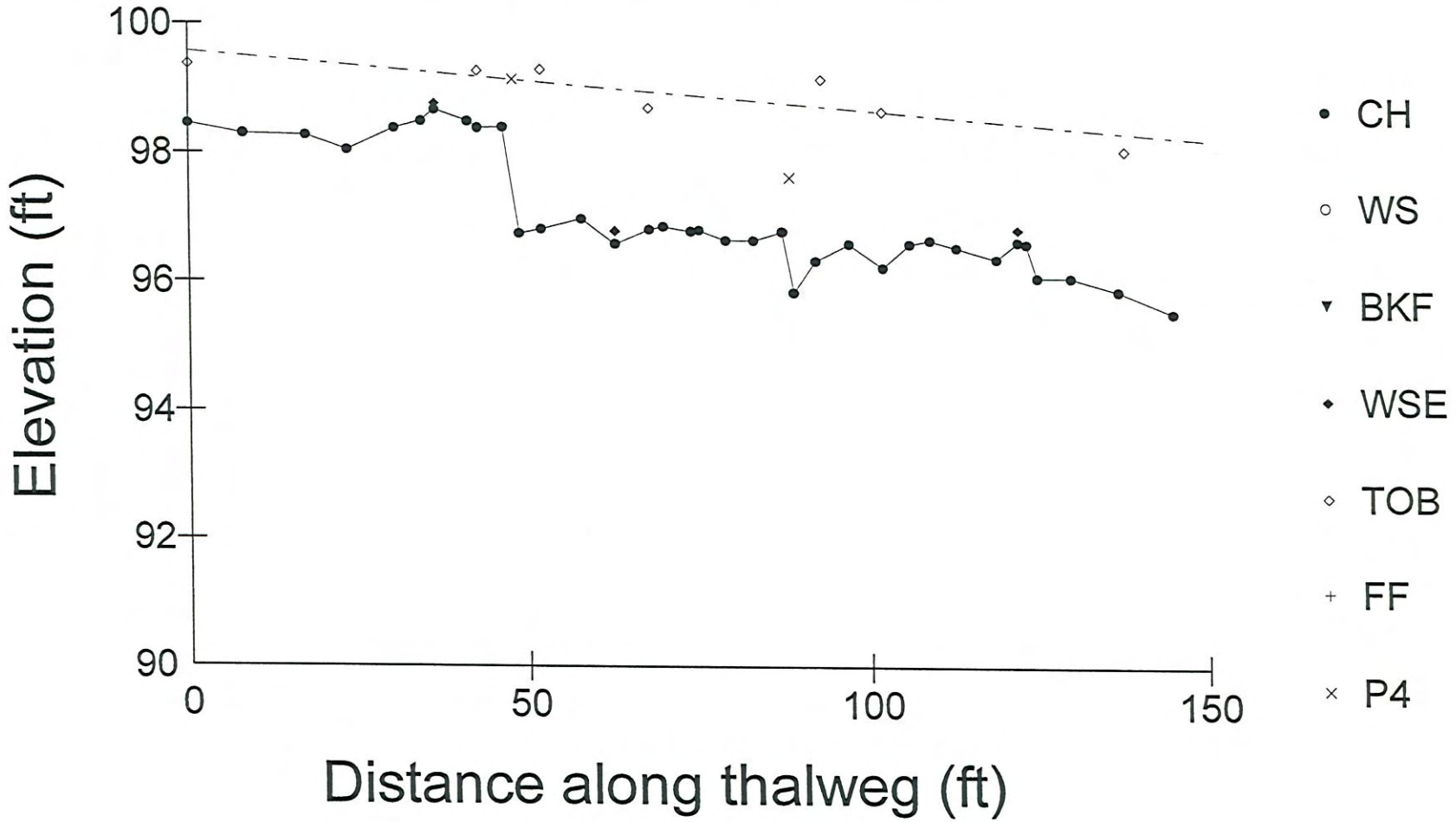
UT3 & UT-1 REACH C PROFILE



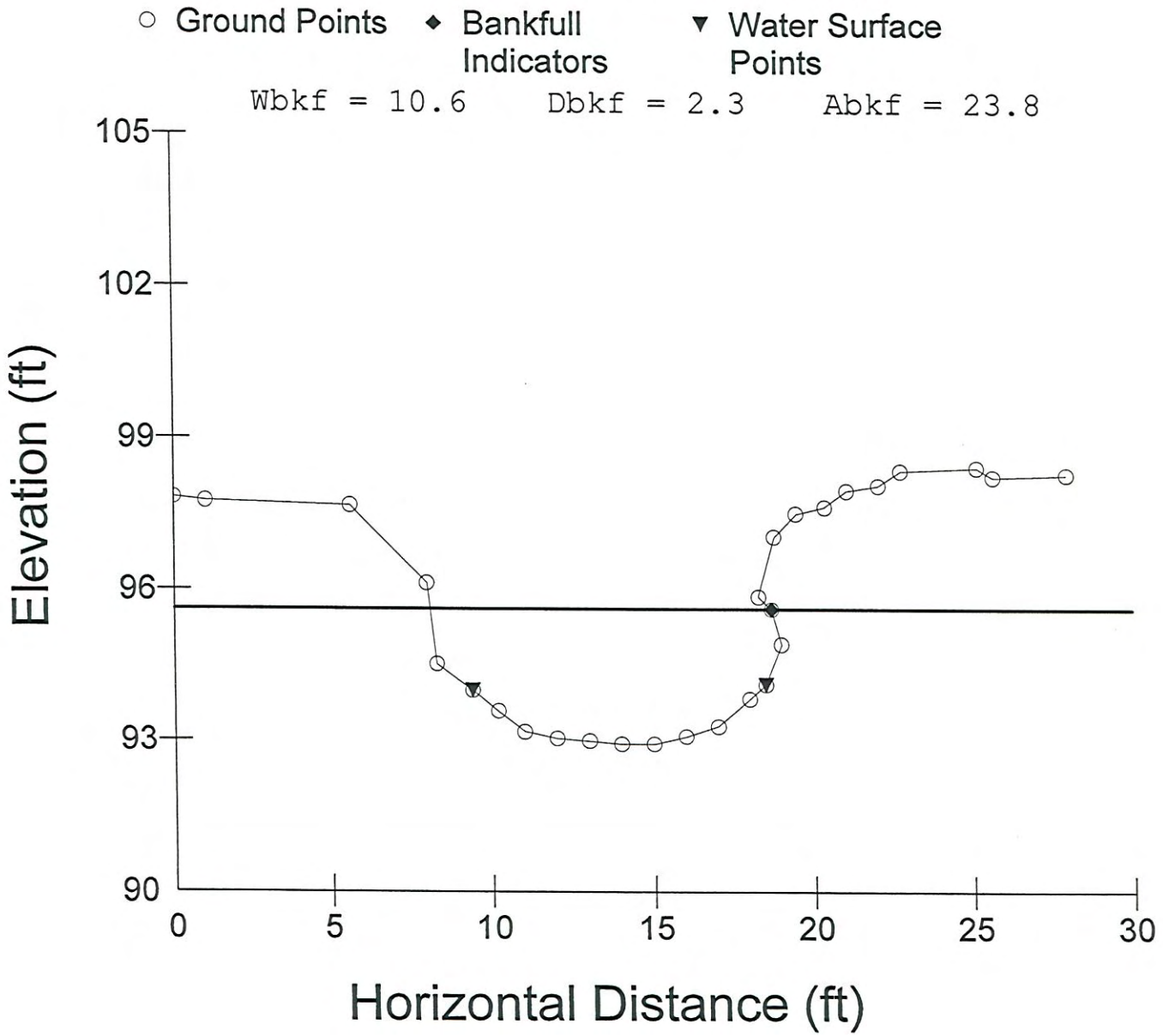
UT-1 PROFILE UPSTREAM OF UT-3



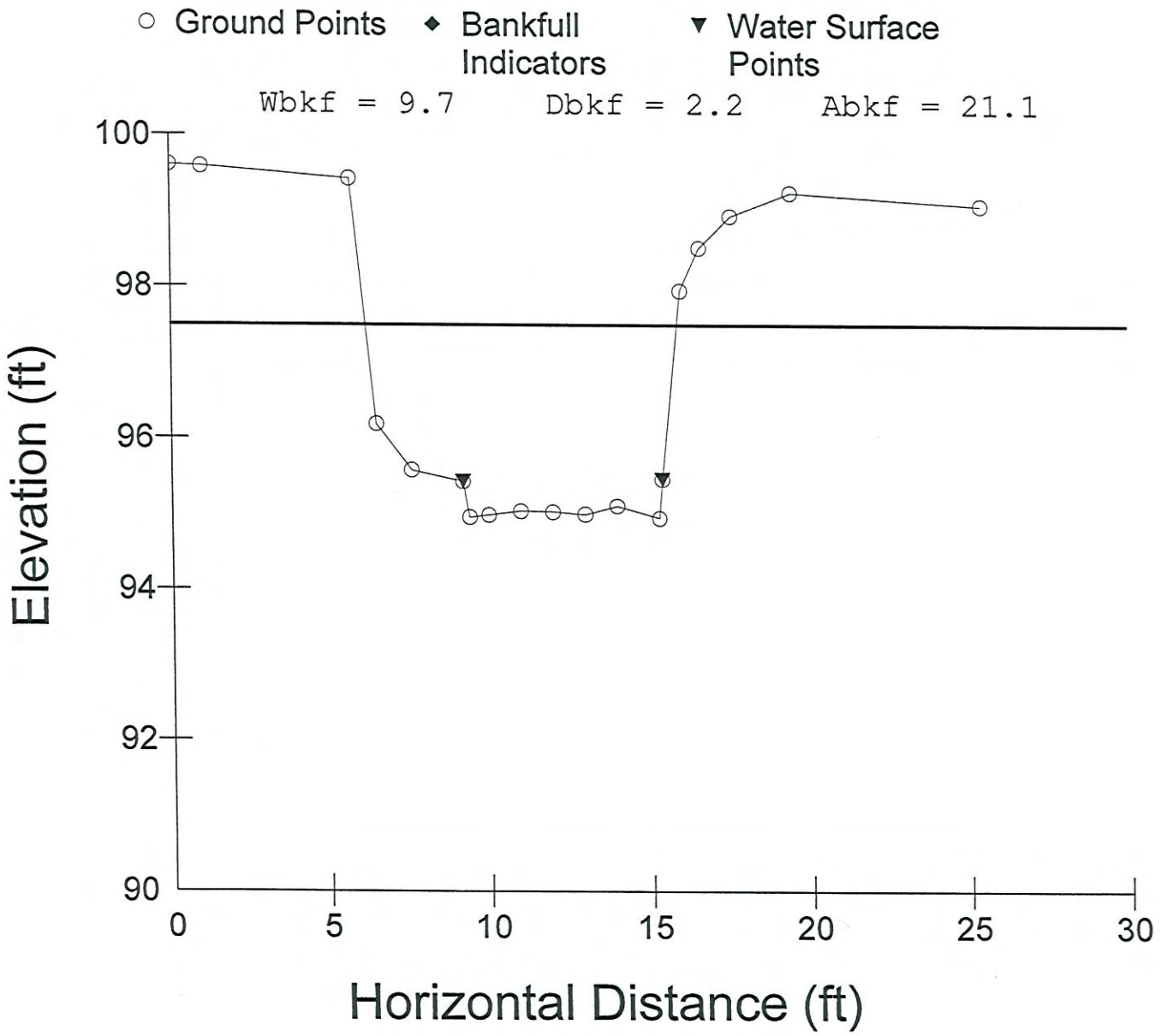
UT-2 PROFILE


100
98
96
94
92
90
Elevation (ft)
0
50
100
150
Distance along thalweg (ft)
CH
WS
BKF
WSE
TOB
FF
P4

C/S 1 @ UT-1


Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 10.6
Dbkf = 2.3
Abkf = 23.8
105
102
99
96
93
90
Elevation (ft)
0
5
10
15
20
25
30
Horizontal Distance (ft)

C/S 2 ALONG UT-1



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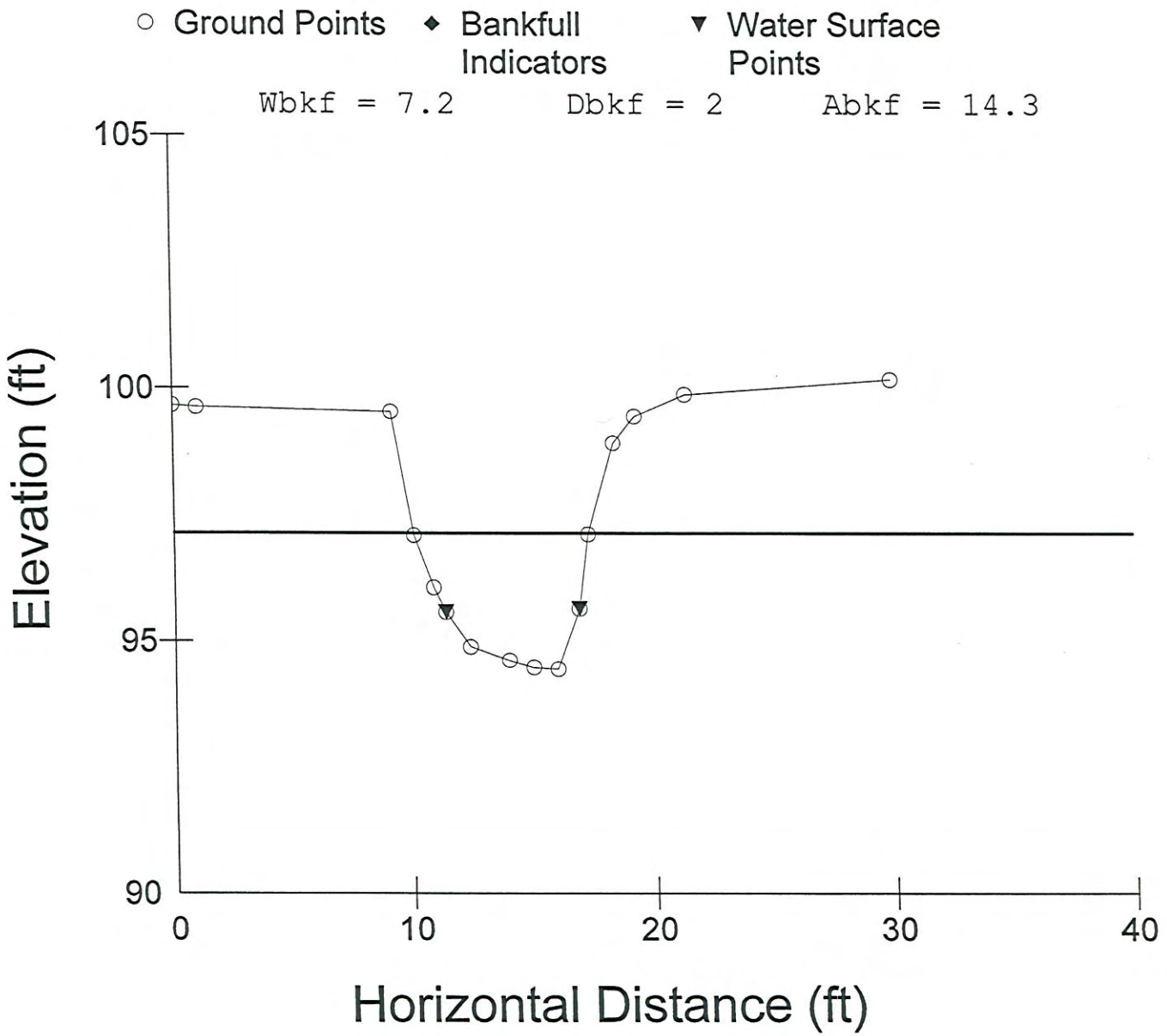

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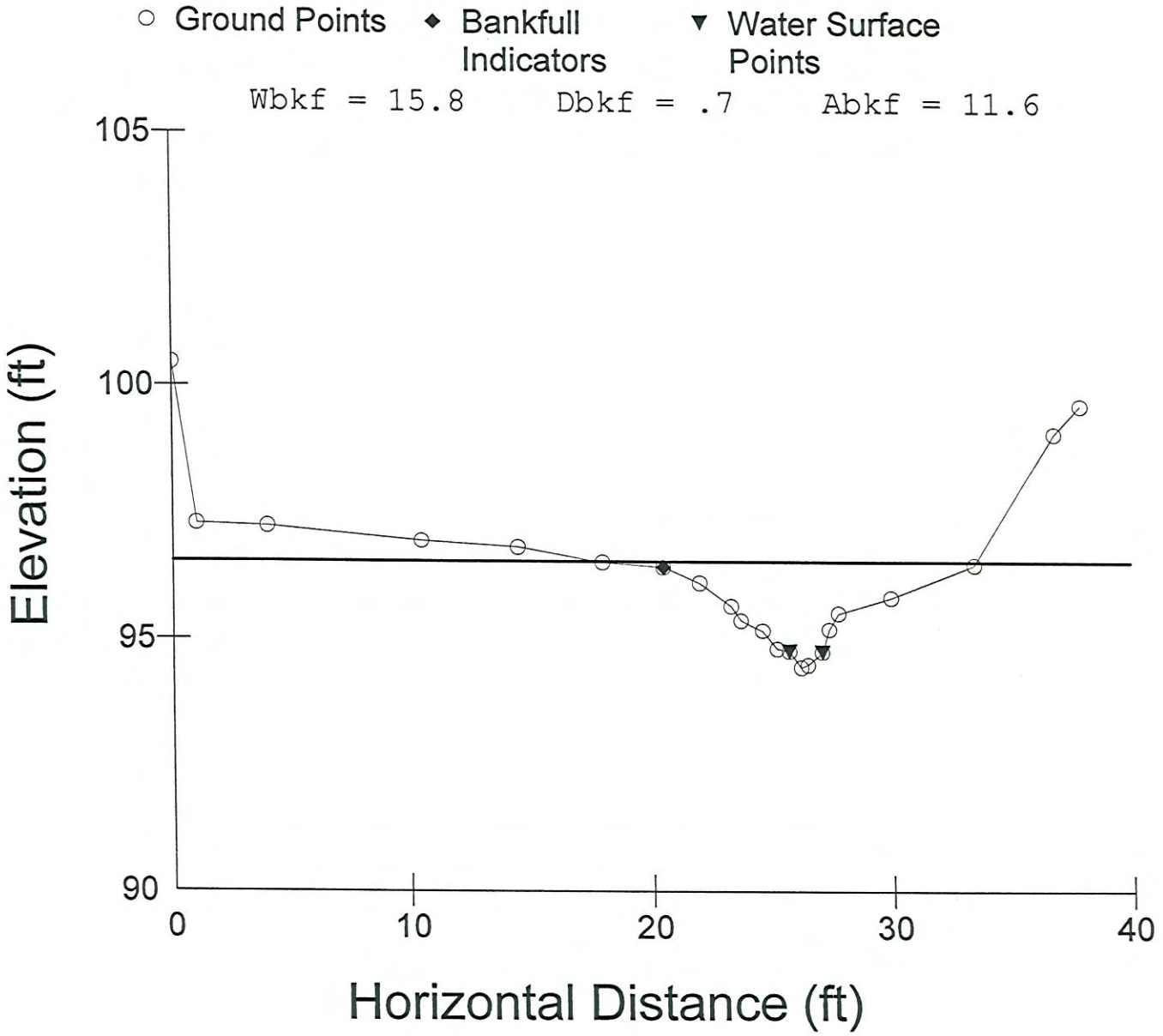

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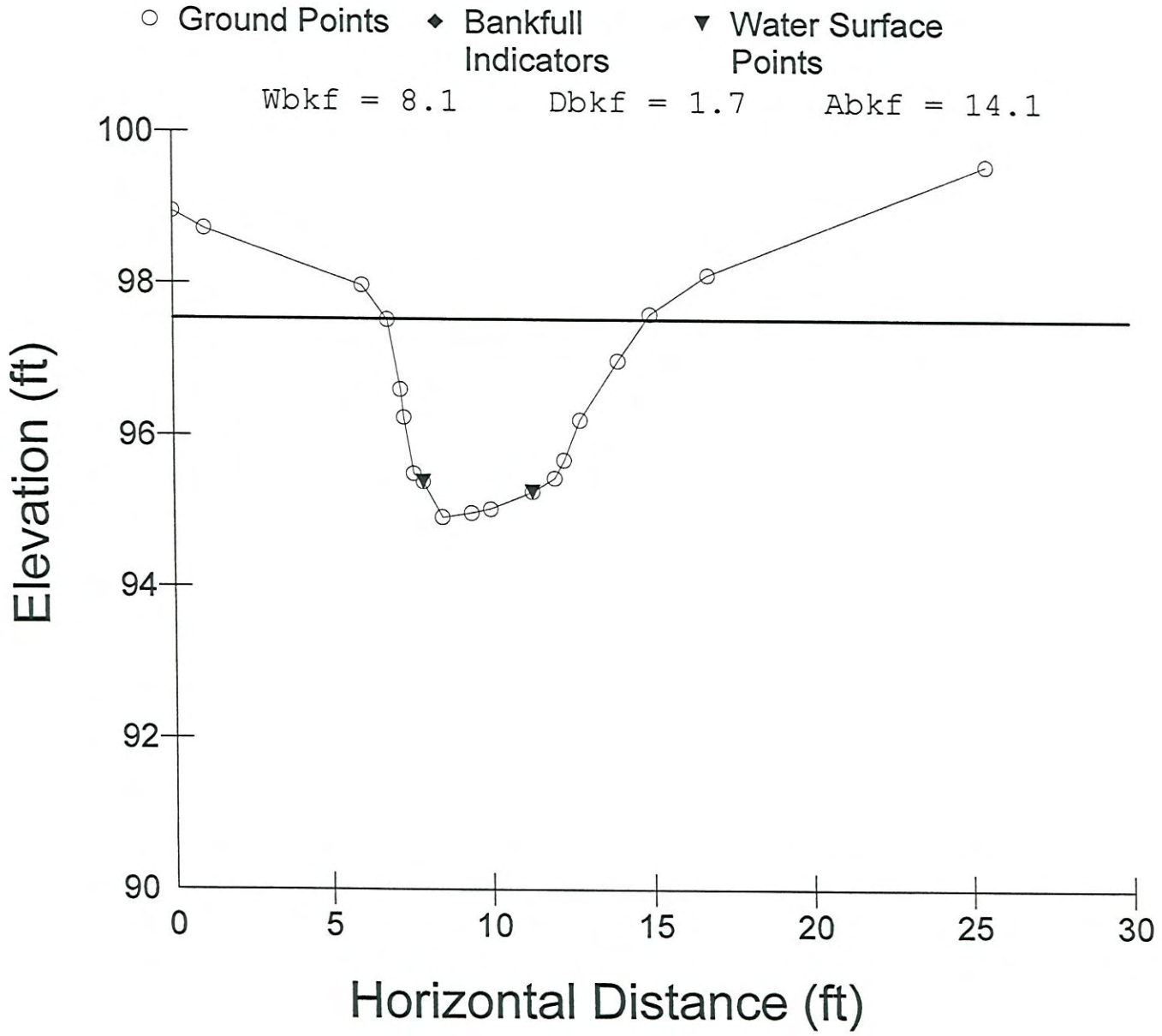

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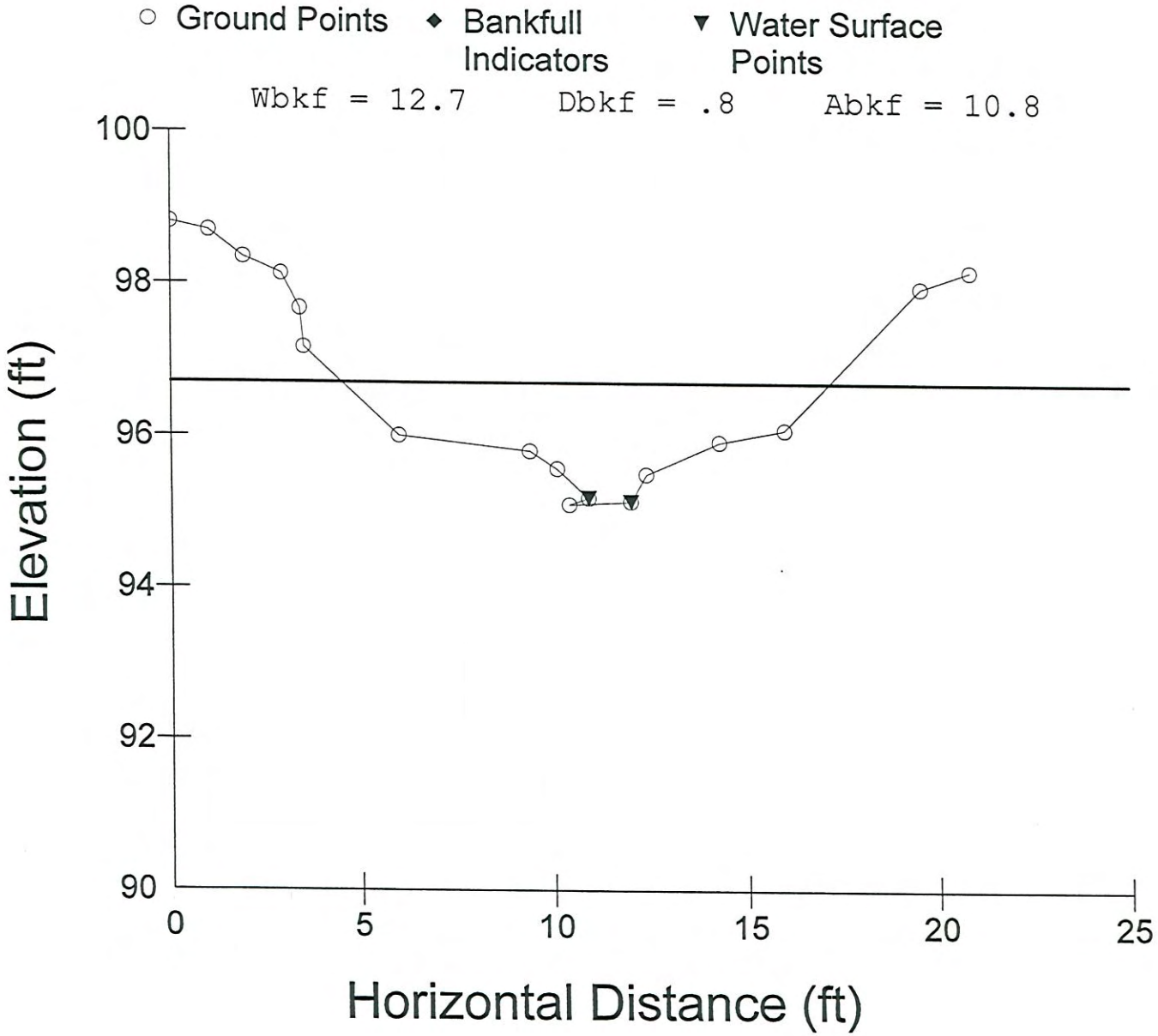

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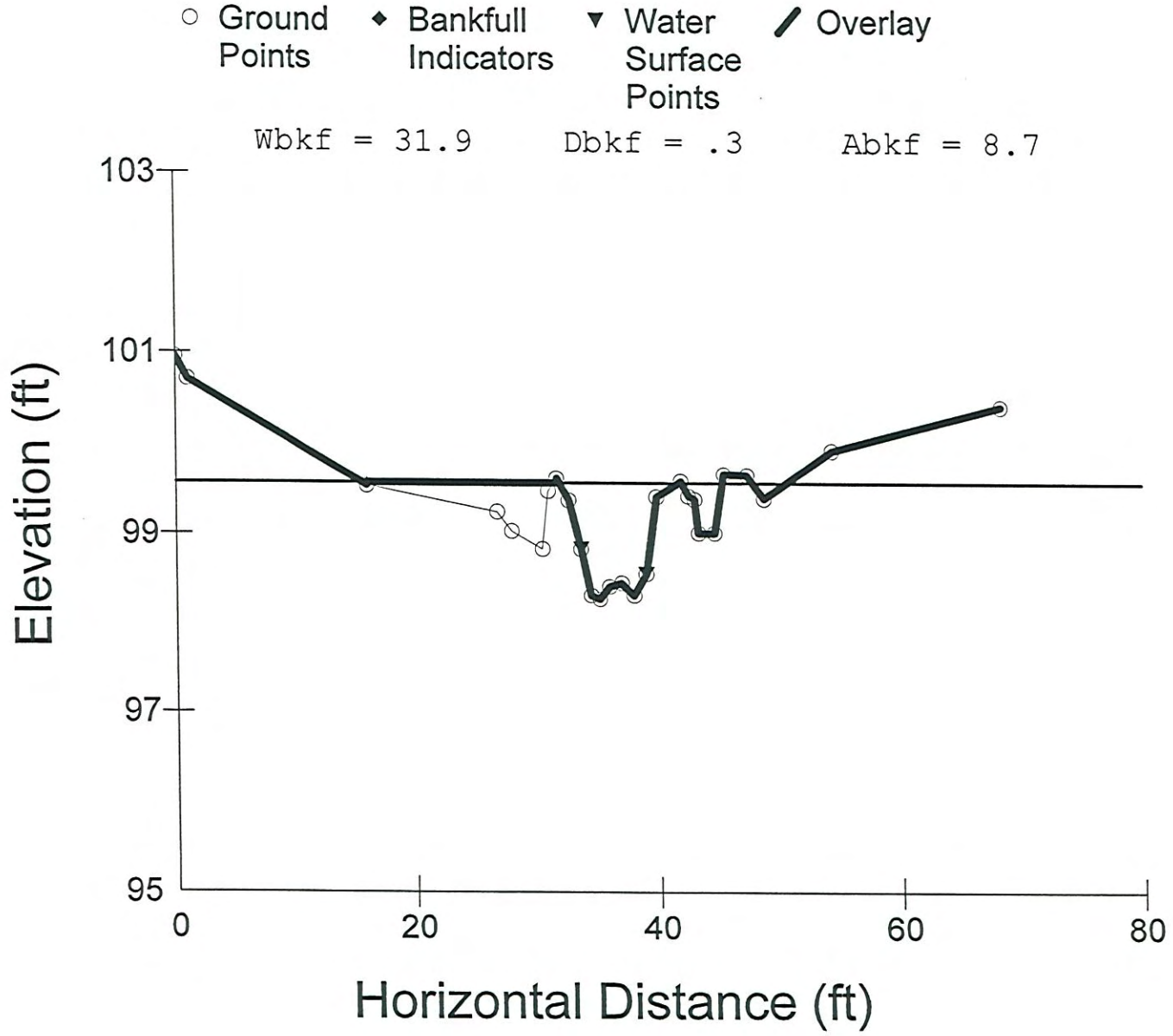
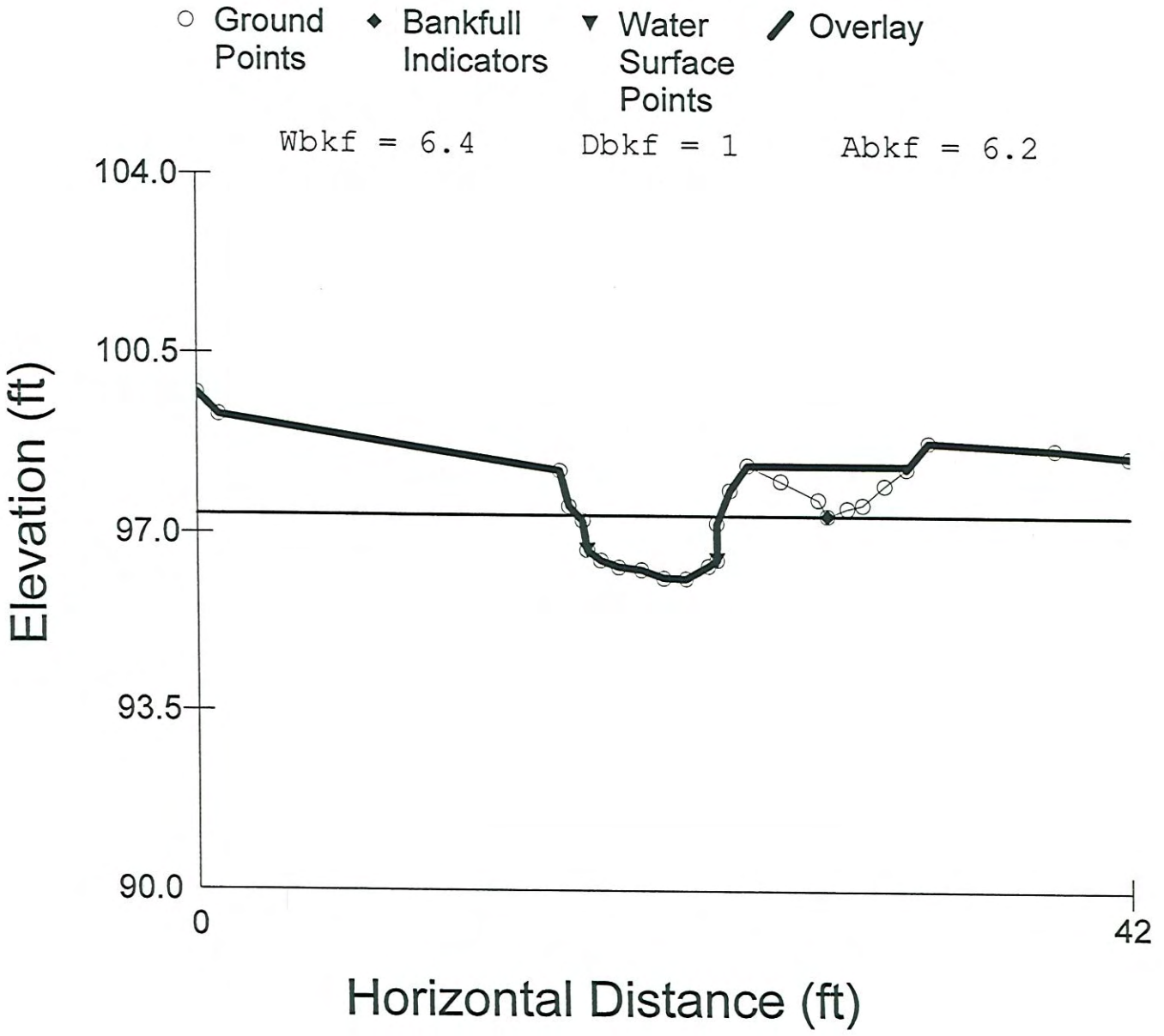


C/S 2 ALONG UT-2



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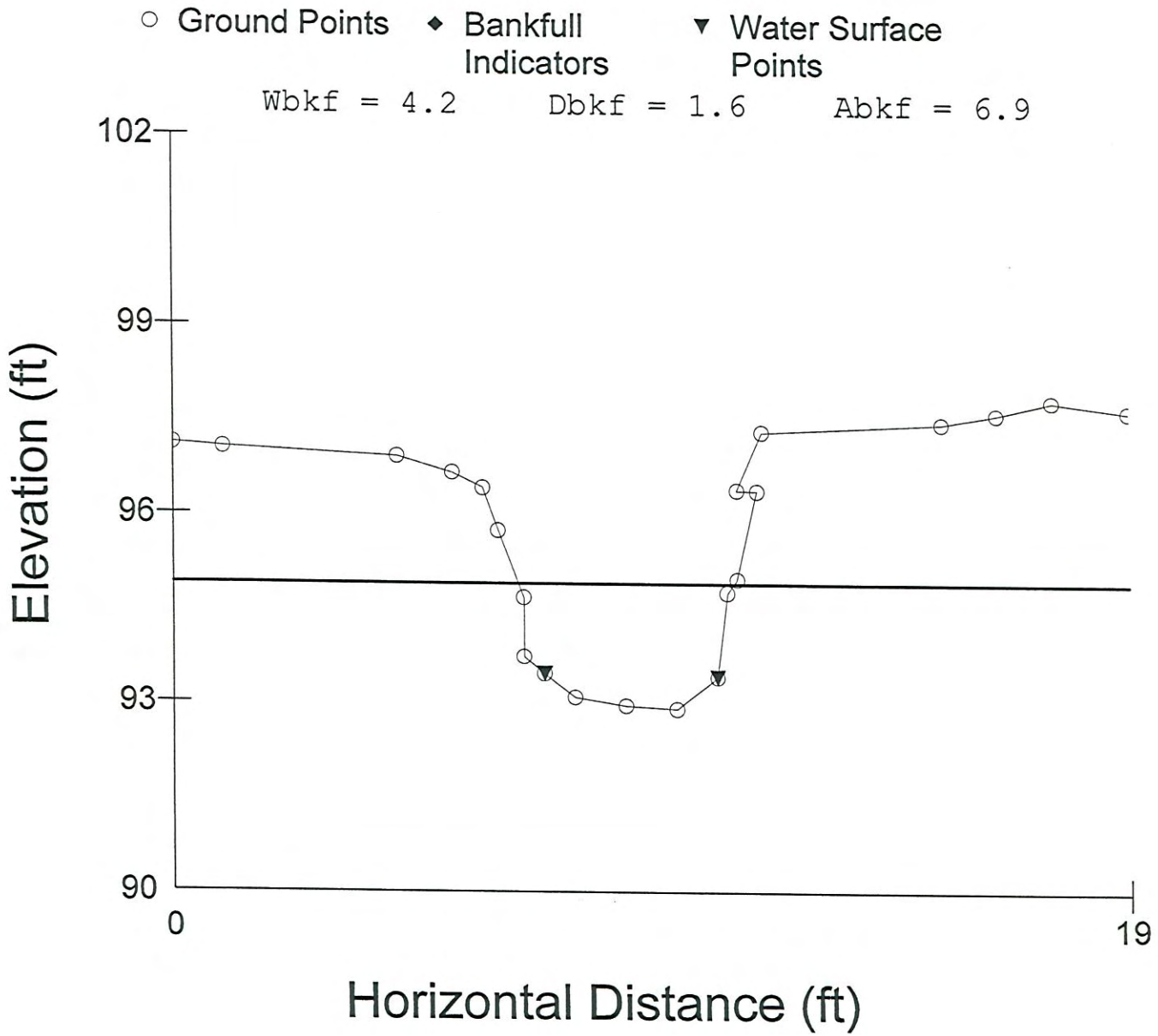

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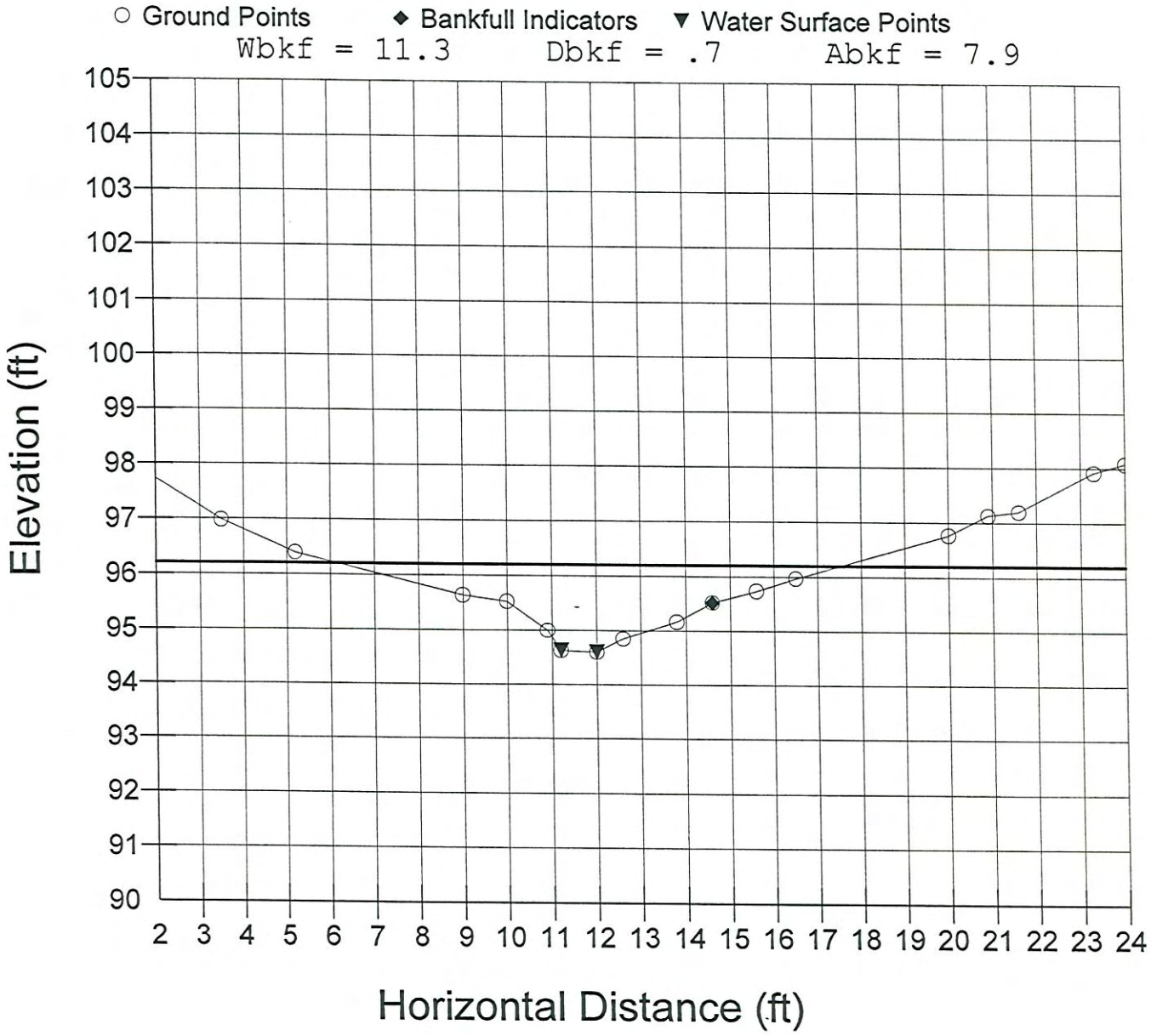

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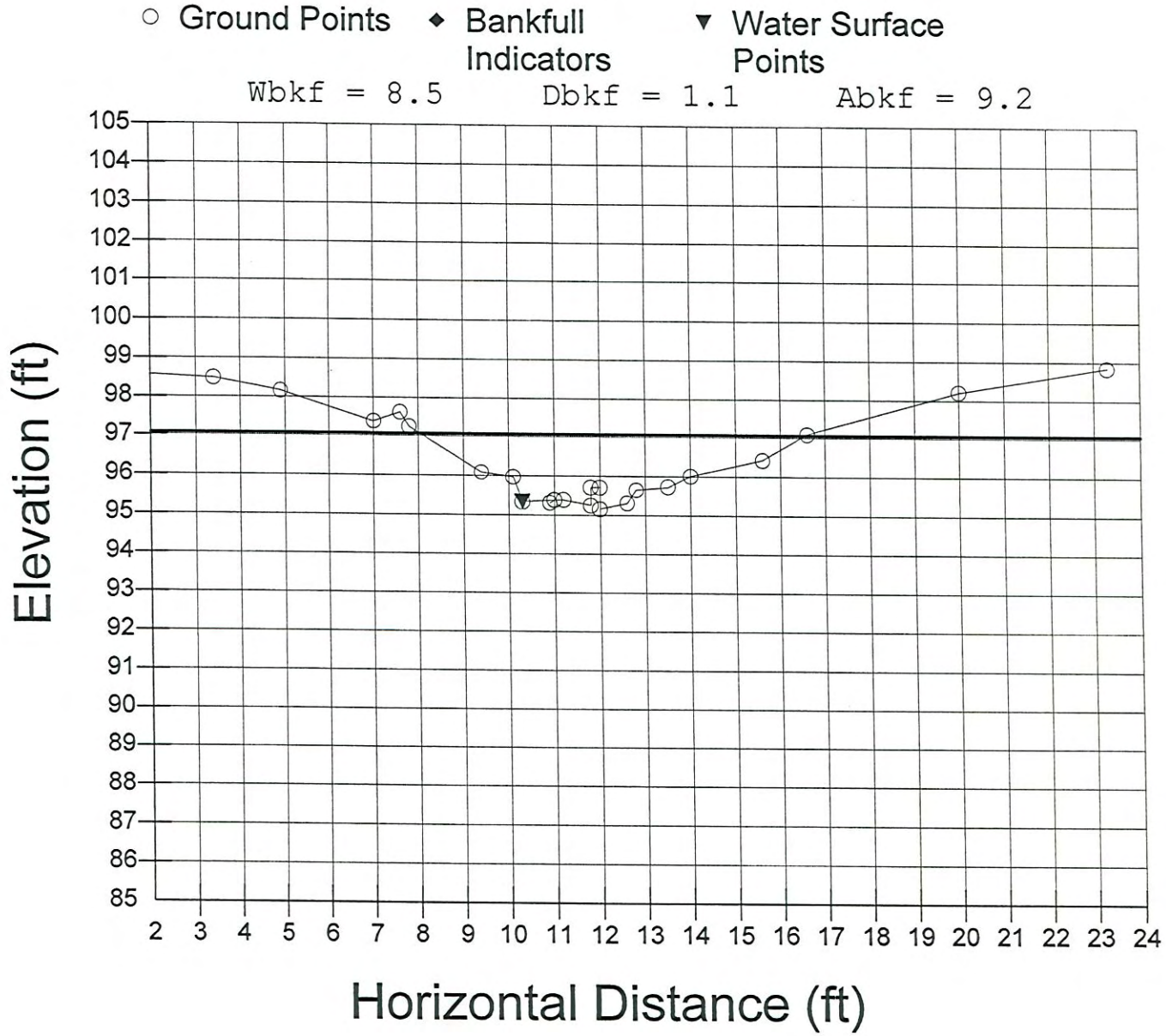
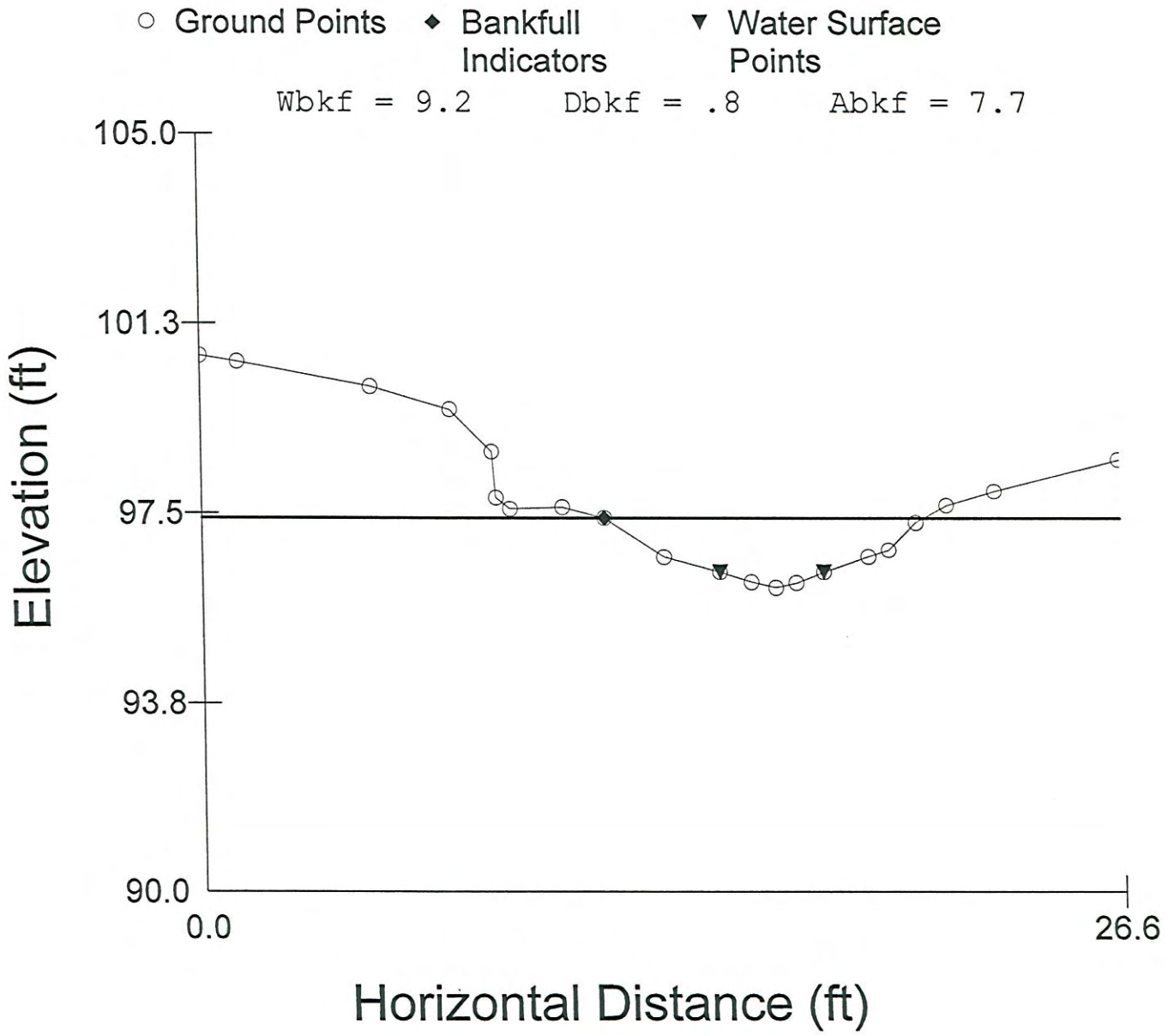


C/S 3 ALONG UT-3



RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Stonebridge Project
Reach Name: UT-1 (D/S limit)

--Reference Reach--

Stonebridge Reference Reach; Ref Reach (D/S Brady Rd) (E 5)

--Boundary Conditions--

Drainage Area:	1.08 sq mi
Valley Slope:	0.006 ft/ft
Bankfull Discharge:	92 cfs
Bankfull Cross Sectional Area:	22 sq ft
Mean Depth Calculation Tolerance:	0.2 ft

--Sediment Data--

Riffle Bed Material ID:	UT-1 riffle
Riffle Bed Material D84:	0.35 mm
Riffle Bed Material D50:	0.09 mm
Bar Sample ID:	
Bar Sample Dmax:	5 mm
Bar Sample D50:	1.5 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	52.8 ft
Channel Length:	88.18 ft
Sinuosity:	1.67
Radius of Curvature:	10.71 ft
Bankfull Slope:	0.0036
Meander Belt Width:	32.1 ft
Meander Width Ratio:	4.28
Deflection Angle:	1.39 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	2.56
Entrenchment Ratio:	39.06
Floodprone Width:	293 ft
Bankfull Width:	7.5 ft
Bankfull Mean Depth:	2.93 ft
Bankfull Velocity:	4.18 ft/s
Bankfull Hydraulic Radius:	1.65 ft
Bankfull Shear Stress:	0.37 lbs/sq ft
Required Roughness (n):	0.0298 ft^(1/6)
Entrainable Particle Size:	19.7 mm

--Rosgen Stream Classification--

Reference Reach : E 5

Proposed Reach :	E 5	
Existing Reach :	E 5	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	0.2	
Ratio - D50bed / D50bar:	0.060	
Critical Dimensionless Shear Stress (1):	0.9697	
Required Mean Depth (1):	7.29	ft
Ratio - Di bar / D50bed:	55.556	
Critical Dimensionless Shear Stress (2):	0.0011	
Required Mean Depth (2):	0.01	ft

Minimum Required Mean Depth: 0.01 ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Stonebridge Project
Reach Name: UT-1 (UT-2 confluence)

--Reference Reach--

Stonebridge Reference Reach; Ref Reach (U/S Brady Rd) (E 5)

--Boundary Conditions--

Drainage Area:	0.94 sq mi
Valley Slope:	0.0044 ft/ft
Bankfull Discharge:	65.6 cfs
Bankfull Cross Sectional Area:	16 sq ft
Mean Depth Calculation Tolerance:	0.2 ft

--Sediment Data--

Riffle Bed Material ID:	1
Riffle Bed Material D84:	1.4 mm
Riffle Bed Material D50:	0.21 mm
Bar Sample ID:	
Bar Sample Dmax:	5 mm
Bar Sample D50:	1.5 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	59.2 ft
Channel Length:	88.8 ft
Sinuosity:	1.5
Radius of Curvature:	11.83 ft
Bankfull Slope:	0.00294
Meander Belt Width:	30.6 ft
Meander Width Ratio:	3.29
Deflection Angle:	1.27 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	5.36
Entrenchment Ratio:	6.17
Floodprone Width:	57.4 ft
Bankfull Width:	9.3 ft
Bankfull Mean Depth:	1.73 ft
Bankfull Velocity:	4.1 ft/s
Bankfull Hydraulic Radius:	1.26 ft
Bankfull Shear Stress:	0.231 lbs/sq ft
Required Roughness (n):	0.0229 ft^(1/6)
Entrainable Particle Size:	13 mm

--Rosgen Stream Classification--

Reference Reach :	E 5

Proposed Reach :	E 5	
Existing Reach :	E 5	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	0.59	
Ratio - D50bed / D50bar:	0.140	
Critical Dimensionless Shear Stress (1):	0.4632	
Required Mean Depth (1):	4.26	ft
Ratio - Di bar / D50bed:	23.810	
Critical Dimensionless Shear Stress (2):	0.0023	
Required Mean Depth (2):	0.02	ft
Minimum Required Mean Depth:	0.02	ft

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Stonebridge Project
Reach Name: UT-1 @ UT-3 confluence

--Reference Reach--

Stonebridge Reference Reach; Ref Reach (U/S Brady Rd) (E 5)

--Boundary Conditions--

Drainage Area:	0.55 sq mi
Valley Slope:	0.0044 ft/ft
Bankfull Discharge:	58 cfs
Bankfull Cross Sectional Area:	14 sq ft
Mean Depth Calculation Tolerance:	0.2 ft

--Sediment Data--

Riffle Bed Material ID:	ST2 riffle
Riffle Bed Material D84:	1.4 mm
Riffle Bed Material D50:	0.21 mm
Bar Sample ID:	
Bar Sample Dmax:	5 mm
Bar Sample D50:	1.5 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	55.4 ft
Channel Length:	80.3 ft
Sinuosity:	1.45
Radius of Curvature:	11.1 ft
Bankfull Slope:	0.00303
Meander Belt Width:	27.1 ft
Meander Width Ratio:	3.11
Deflection Angle:	1.23 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	5.36
Entrenchment Ratio:	4.94
Floodprone Width:	43 ft
Bankfull Width:	8.7 ft
Bankfull Mean Depth:	1.62 ft
Bankfull Velocity:	4.14 ft/s
Bankfull Hydraulic Radius:	1.18 ft
Bankfull Shear Stress:	0.223 lbs/sq ft
Required Roughness (n):	0.0221 ft^(1/6)
Entrainable Particle Size:	12.6 mm

--Rosgen Stream Classification--

Reference Reach :	E 5

Proposed Reach :	E 5	
Existing Reach :	C 6	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:		0.59
Ratio - D50bed / D50bar:		0.140
Critical Dimensionless Shear Stress (1):		0.4632
Required Mean Depth (1):		4.14 ft
Ratio - Di bar / D50bed:		23.810
Critical Dimensionless Shear Stress (2):		0.0023
Required Mean Depth (2):		0.02 ft
Minimum Required Mean Depth:	0.02 ft	

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Stonebridge Project
Reach Name: UT-2

--Reference Reach--

Stonebridge Reference Reach; Ref Reach (U/S Brady Rd) (E 5)

--Boundary Conditions--

Drainage Area:	0.284 sq mi
Valley Slope:	0.008 ft/ft
Bankfull Discharge:	57.07 cfs
Bankfull Cross Sectional Area:	7.9 sq ft
Mean Depth Calculation Tolerance:	0.2 ft

--Sediment Data--

Riffle Bed Material ID:	ST1 riffle
Riffle Bed Material D84:	0.05 mm
Riffle Bed Material D50:	0.03 mm
Bar Sample ID:	
Bar Sample Dmax:	5 mm
Bar Sample D50:	1.5 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	41.6 ft
Channel Length:	62.4 ft
Sinuosity:	1.5
Radius of Curvature:	8.31 ft
Bankfull Slope:	0.00533
Meander Belt Width:	21.52 ft
Meander Width Ratio:	3.31
Deflection Angle:	1.27 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	5.36
Entrenchment Ratio:	6.17
Floodprone Width:	40.1 ft
Bankfull Width:	6.5 ft
Bankfull Mean Depth:	1.21 ft
Bankfull Velocity:	7.22 ft/s
Bankfull Hydraulic Radius:	0.88 ft
Bankfull Shear Stress:	0.293 lbs/sq ft
Required Roughness (n):	0.0138 ft^(1/6)
Entrainable Particle Size:	15.9 mm

--Rosgen Stream Classification--

Reference Reach :	E 5

Proposed Reach :	E 5	
Existing Reach :	E 6	

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	0.59	
Ratio - D50bed / D50bar:	0.020	
Critical Dimensionless Shear Stress (1):	2.5274	
Required Mean Depth (1):	12.83	ft
Ratio - Di bar / D50bed:	166.667	
Critical Dimensionless Shear Stress (2):	0.0004	
Required Mean Depth (2):	0.00	ft
Minimum Required Mean Depth:	0 ft	

RIVERMORPH NATURAL CHANNEL DESIGN REPORT

River Name: Stonebridge Project
Reach Name: UT-3

--Reference Reach--

Stonebridge Reference Reach; Ref Reach (U/S Brady Rd) (E 5)

--Boundary Conditions--

Drainage Area:	0.295 sq mi
Valley Slope:	0.006 ft/ft
Bankfull Discharge:	68.6 cfs
Bankfull Cross Sectional Area:	6.8 sq ft
Mean Depth Calculation Tolerance:	0.2 ft

--Sediment Data--

Riffle Bed Material ID:	UT-3 riffle
Riffle Bed Material D84:	0.05 mm
Riffle Bed Material D50:	0.03 mm
Bar Sample ID:	
Bar Sample Dmax:	0 mm
Bar Sample D50:	0 mm

--Entrainment Options--

Shields Entrainment Function

----------NCD Results----------

--Alignment--

Meander Wavelength:	38.6 ft
Channel Length:	56 ft
Sinuosity:	1.45
Radius of Curvature:	7.7 ft
Bankfull Slope:	0.00414
Meander Belt Width:	18.9 ft
Meander Width Ratio:	3.15
Deflection Angle:	.1 rad

--Riffle Cross Sectional Properties--

Width to Depth Ratio:	5.36
Entrenchment Ratio:	4.94
Floodprone Width:	29.6 ft
Bankfull Width:	6 ft
Bankfull Mean Depth:	1.13 ft
Bankfull Velocity:	0 ft/s
Bankfull Hydraulic Radius:	0.82 ft
Bankfull Shear Stress:	0.212 lbs/sq ft
Required Roughness (n):	0 ft^(1/6)
Entrainable Particle Size:	0 mm

--Rosgen Stream Classification--

Reference Reach :	E 5

Proposed Reach :	E 5
Existing Reach :	B 6c

--Sediment Transport Competency--

Ratio - Riffle Slope / Bankfull Slope:	0.56
Ratio - D50bed / D50bar:	error
Critical Dimensionless Shear Stress (1):	0.000
Required Mean Depth (1):	0.00 ft
Ratio - Di bar / D50bed:	0.000
Critical Dimensionless Shear Stress (2):	0.000
Required Mean Depth (2):	0.00 ft
Minimum Required Mean Depth:	0 ft

BEHI 's

PROJECT : EBX - Stonebridge Site
PREPARED BY : DJK
DATE : 11/6/2004
Location: #1- UT-1 (downstream limits)

PARAMETER	VALUE
Bank Height	4.5
Bankfull Height	2.5
Root Depth	4
Root Density	5
Bank Angle	80
Surface Protection	5
Bank Materials	Sandy Silt

Bank Erosion Hazard Parameter		*Bank Erosion Potential	
	Value	Index	Criteria
Bank Ht/BF Ht	1.80	6.95	High
Root Depth/Bank Ht	0.89	1.90	very low
Root Density (%)	5	9.00	very hight
Bank Angle	80	5.90	moderate
Surface Protection (%)	5	10.00	extreme
Bank Material	Sandy Silt		adjust
	TOTA	33.75	High

PROJECT : EBX - Stonebridge Site
PREPARED BY : DJK
DATE : 11/6/2004
Location: #2- UT-1 (upstream of UT-3)

PARAMETER	VALUE
Bank Height	2.75
Bankfull Height	1
Root Depth	2.75
Root Density	4
Bank Angle	65
Surface Protection	5
Bank Materials	Silty Sand

Bank Erosion Hazard Parameter		*Bank Erosion Potential	
	Value	Index	Criteria
Bank Ht/BF Ht	2.75	8.90	very high
Root Depth/Bank Ht	1.00	1.00	very low
Root Density (%)	4	9.00	very high
Bank Angle	65	4.40	moderate
Surface Protection (%)	5	10.00	extreme
Bank Material	Silty Sand		adjust
	TOTA	33.30	High

PROJECT : EBX - Stonebridge Site
PREPARED BY : DJK
DATE : 11/6/2004
Location: #5- UT-1 (just downstream of UT-3)

PARAMETER	VALUE
Bank Height	4
Bankfull Height	1.2
Root Depth	3.5
Root Density	6
Bank Angle	80
Surface Protection	4
Bank Materials	Silty sand

Bank Erosion Hazard Parameter		*Bank Erosion Potential	
	Value	Index	Criteria
Bank Ht/BF Ht	3.33	10.00	extreme
Root Depth/Bank Ht	0.88	2.00	low
Root Density (%)	6	8.80	Very high
Bank Angle	80	5.90	moderate
Surface Protection (%)	4	10.00	extreme
Bank Material	Silty sand		adjust
	TOTA	36.70	High

BEHI 's

PROJECT : EBX - Stonebridge Site
PREPARED BY : DJK
DATE : 11/6/2004
Location: UT-3

PARAMETER	VALUE
Bank Height	3
Bankfull Height	1
Root Depth	2.5
Root Density	3
Bank Angle	30
Surface Protection	3
Bank Materials	Silty Sand

Bank Erosion Hazard Parameter		*Bank Erosion Potential	
	Value	Index	Criteria
Bank Ht/BF Ht	3.00	10.00	extreme
Root Depth/Bank Ht	0.83	2.30	low
Root Density (%)	3	10.00	extreme
Bank Angle	30	2.40	low
Surface Protection (%)	3	10.00	extreme
Bank Material	Silty Sand		adjust
	TOTA	34.70	High

PROJECT : EBX - Stonebridge Site
PREPARED BY : DJK
DATE : 11/6/2004
Location: UT-2

PARAMETER	VALUE
Bank Height	2.5
Bankfull Height	1
Root Depth	2
Root Density	8
Bank Angle	80
Surface Protection	6
Bank Materials	Silty sand

Bank Erosion Hazard Parameter		*Bank Erosion Potential	
	Value	Index	Criteria
Bank Ht/BF Ht	2.50	8.60	Very high
Root Depth/Bank Ht	0.80	2.40	low
Root Density (%)	8	8.70	Very high
Bank Angle	80	5.90	moderate
Surface Protection (%)	6	10.00	extreme
Bank Material	Silty sand		adjust
	TOTA	35.60	High

APPENDIX B

Stonebridge Site Soil Characterization

Unnamed Tributary Number One (UT-1) Borings 1-7

UT-1 #1
Description:
0-16" Subangular/Blocky (SUB), Silty Clay, 10YR 5/6; Few, distinct mottles present between 8-16" of color 2.5YR 4/6
Buried decomposed organic matter (OM) noted at 16"
16-34" Blocky Clay, 7.5YR 5/6
34-44" Blocky Clay, 7.5YR 6/8 with few, faint mottles, 7.5YR 7/2
44-58" Blocky Clay, 7.5YR 6/8 with common, distinct mottles, 7.5YR/7/2
No gravel or bedrock present in the boring. Water present at 56" in the boring.

UT-1# 2
Description:
0-4" SUB, Silty Clay, 10YR 3/3 with a layer of ash at 3-4"
4-20" SUB, Silty Clay, 10YR 5/6
20-24" Partially decomposed organic matter with some silty clay intermixed.
24-38" Blocky Clay, 7.5YR 4/6; few, faint mottles 7.5YR 4/6
38-56" SUB, Fine Sandy Clay, 7.5YR 4/6; few, faint mottles 2.5YR 4/8
No gravel, bedrock, or water present in the boring.

UT-1 # 3
Description:
0-2" Granular Silt Loam, 10YR 5/6
2-16" SUB, Silty Clay, 7.5YR 4/6
16-52" Blocky Clay, 5YR 5/6
52-62" SUB, Fine Sandy Clay, 5YR 5/6
No gravel or bedrock present in the boring. Water present at 56" in the boring.

UT-1 # 4
Description:
0-2" Granular Silt Loam, 10YR 5/4
2-24" Granular Silt Loam, 10YR 6/6
24-40" SUB, Silty Clay, 5YR4/6
40-56" SUB, Silty Clay, 7.5YR 4/6; Common, faint mottles 48-56", 7.5YR 6/8
56-61" SUB, Silty Clay, 7.5YR 4/6; Common, distinct mottles, 7.5YR 6/8
No gravel, bedrock, or water present in the boring.

UT-1 # 5
Description:
0-2" Granular Silt Loam, 10YR 4/4
2-14" SUB, Silty Clay, 7.5YR 4/6
14-48" SUB, Clay, 5YR 5/6
48-60" SUB, Fine Sandy Clay, 5YR 5/6
No gravel or bedrock present in the boring. Water present at 52" in the boring.

UT-1 # 6, LHS, 50' TOB
Description:
0-2" Granular Silt Loam, 10YR 4/4
2-10" SUB, Silty Clay, 7.5YR 4/6
10-40" Blocky Clay, 5YR 5/6
40-56" SUB, Fine Sandy Clay, 5YR 5/6

56-60" SUB, Weathered Parent Material/Sapprolite (WPM), 5YR 3/4;
Common, distinct mottles, 5YR 7/1
No gravel or bedrock present in boring. Water present at 42" in boring.

UT-1 # 7
Description:
0-2" Granular Silt Loam, 10YR 4/4
2-10" SUB, Silty Clay, 7.5YR 4/7
10-28" SUB, Silty Clay, 5YR 4/6
28-40" WPM, 5YR 3/4
Auger refusal at 40". Sandstone bedrock or stones.
No gravel or water present in the boring.

UT-1 # 8
Description:
0-4" Granular Silt Loam, 10YR 4/4
4-6" Granular Silt Loam, 10YR 6/8
Auger refusal at 6". Attempted three additional borings in the area. Each of these borings presented auger refusal at 4-6". Large sandstone flags and stones on the surface suggest that sandstone bedrock or large colluvium was encountered at about 6".
No water present in these borings. Some gravel sized fragments present in auger spoil.

An additional boring was taken in the small floodplain in the area of boring # 8.
Encountered 40" of silt alluvium, with 8" of silt alluvium mixed with sandstone flags below that, and refusal at 48" due to sandstone bedrock. Water was present in this boring at 36".

UT-1 # 9
Description:
0-2" Granular Silt Loam, 10YR 4/4
2-18" Fine Sandy Loam, 5YR 5/6
Auger refusal at 18" due to resistant WPM. Sandstone flags and stones present on the surface.
Auger spoil contained platy, gravel sized parent material.
No water present in the boring.

UT-1 #10
Description:
0-3" Granular Silt Loam, 10YR 4/4
3-16" Granular Silt, 10YR 6/8
16-60" SUB, Silty Clay, 10YR 5/8
No gravel, bedrock, or water present in this boring

UT-1 #11
Description:
0-20" Granular Silt, 10YR 6/8
20-28" SUB, Silt, 10YR 6/8
28-44" SUB, Silty Clay, 10YR 5/6; Common, distinct mottles 7.5YR 5/3; Few 20-30 mm sandstone gravels.
44-48" SUB, Silty Clay, 5YR 8/1; Common, faint mottles 10YR 7/6
48-58" Platy WPM-Sandstone, 2.5YR 3/4
Auger refusal at 58". No water present in the boring.

UT-1 # 12 Description:
0-4" Granular Silt Loam, 10YR 4/4
4-8" SUB, Silty Clay, 10YR 5/8
8-30" SUB, Very Gravelly Clay, 7.5YR 5/6; Common sandstone gravels, 10YR 2/1, 10-40mm

30-44" SUB, Clay, 7.5YR 4/4
44-57" SUB, Clay (and WPM), 2.5YR 3/4; Few, distinct mottles 10YR 8/1
Auger refusal at 57". Sandstone bedrock or stones. No water present in the boring.

UT-1 # 13
Description:
0-3" Granular Silt Loam, 10YR 4/4
3-8" SUB, Gravelly Silty Clay, 7.5YR 5/6; Few sandstone gravels, 10YR 2/1, 5-30 mm
8-24" SUB, Fine Sandy Clay, 735YR 4/4
Auger refusal at 24". Sandstone bedrock or stones. No water present in the boring.

UT-1 # 14
Description:
0-2" Granular Silt Loam, 10YR 4/4
2-6" Somewhat Gravelly Silt Loam, 10YR 5/4; Few 10-15 mm gravels
Auger refusal at 6". Sandstone bedrock or stones. No water present in the boring.
Attempted three additional borings in the area of boring # 14.
Encountered refusal due to sandstone bedrock or stones at each attempt within 6" of the surface.

UT-1 # 15
Description:
0-8" Granular Loam, 10YR 2/2; very few 5-10mm gravels
8-48" SUB, Clay, 2.5YR 2.5/4; Few, faint mottles, could not determine color
48-60" SUB, Silty Clay, 7.5YR 5/6; some fine sand; Common, distinct mottles-greenish yellow (2.5Y 6/8) and black
Lower horizon was more resistant and contained abundant WPM.
The lower portion of this profile was very different from anything seen on the rest of the site. However, there did not appear to be any evidence of any bedrock other than sandstone in the boring.

Unnamed Tributary # 2 (UT-2) Borings 1 and 2

UT-2 # 1
Description:
0-1" Granular Silt Loam, 10YR 4/4
1-10" Granular Silt Loam, 10YR 6/8
10-22" SUB, Silty Clay, 10YR 6/8; few distinct manganese concretions
22-34" SUB, Clay, 2.5YR 3/6; Common, faint mottles, 5YR 7/1; Few 10-20 mm gravels in a two in layer at 28-30".
34-60" SUB, Clay (and WPM), 2.5YR 3/4
No bedrock or water present in the boring.

UT-2 # 2
Description:
0-20" Granular Silt Loam, 7.5YR 3/3; One inch ash layer at 16".
20-34" SUB, Silty Clay, 10YR 5/3; Common, faint mottles, 5YR 4/6
34-60" SUB, Fine Sandy Clay, 10YR 5/1; Common, distinct, 7.5YR 4/6; Oxidized root channels
No gravel or bedrock present in the boring. Water at 36" in the boring.

Unnamed Tributary #3 (UT-3) Borings 1 and 2

UT-3 #1
Description:
0-6" Granular Silt Loam, 10YR 5/4
6-28" SUB, Silty Clay, 7.5YR 5/6
28-30" WPM 2.5YR 4/4
Auger refusal at 30". Sandstone bedrock.
No gravel or water present in the boring.

UT-3 # 2
Description:
0-2" Granular Silt Loam, 10YR 5/4
2-12" SUB, Silty Clay, 7.5YR 5/6
12-26" SUB, Silty Clay, 2.5YR 4/4; WPM in lower portion of horizon.
Auger refusal at 26". Sandstone bedrock.
No gravel or water present in the boring.

APPENDIX C

NCDENR

North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross, Jr., Secretary

October 21, 2003

Mr. Chris Huysman
Wetland and Natural Resource Consultants, Inc.
P.O. Box 224
Newton, NC 28658

Subject: Moore County Stream Restoration Sites; Putnam quadrangle, Moore County

Dear Mr. Huysman:

The Natural Heritage Program has no record of rare species, significant natural communities, or priority natural areas at the sites nor within a mile of the sites. Although our maps do not show records of such natural heritage elements in the project area, it does not necessarily mean that they are not present. It may simply mean that the area has not been surveyed. The use of Natural Heritage Program data should not be substituted for actual field surveys, particularly if the project area contains suitable habitat for rare species, significant natural communities, or priority natural areas.

You may wish to check the Natural Heritage Program database website at <www.ncsparks.net/nhp/search.html> for a listing of rare plants and animals and significant natural communities in the county and on the topographic quad map. Please do not hesitate to contact me at 919-715-8697 if you have questions or need further information.

Sincerely,

Harry E. LeGrand, Jr.

Harry E. LeGrand, Jr., Zoologist
Natural Heritage Program

HEL/hel

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ Fax: 919-715-3060 \ Internet: www.enr.state.nc.us

CATEGORICAL EXCLUSION ACTION CLASSIFICATION FORM

Cape Fear River Basin Stream Mitigation
Stone Bridge Site
Moore County, North Carolina
Prepared for the North Carolina Department of Transportation
by EBX-Neuse I, LLC

A. Project Description:

The project will provide compensatory wetland and stream mitigation as required under Section 401/404 of the federal Clean Water Act for unavoidable wetland impacts in the Cape Fear River Basin.

B. Purpose and Need:

The mitigation project as proposed includes approximately 6,240 linear feet of stream restoration. The mitigation credits from this project will be used by the North Carolina Department of Transportation to fulfill Section 404/401 permitting requirements for unavoidable wetland impacts in the Cape Fear River Basin (CU 03030003).

C. Proposed Improvements:

As stated previously, 6,240 linear feet of stream are proposed to be restored through the project. The restoration shall restore the nature and condition of the land to provide the ecological functions that were in place before the land was historically manipulated for agricultural purposes.

The following Type II improvements which apply to the project are circled:

1. Modernization of a highway by resurfacing, restoration, rehabilitation, reconstruction, adding shoulders, or adding auxiliary lanes (e.g., parking, weaving, turning, climbing).
   a. Restoring, Resurfacing, Rehabilitating, and Reconstructing pavement (3R and 4R improvements)
   b. Widening roadway and shoulders without adding through lanes
   c. Modernizing gore treatments
   d. Constructing lane improvements (merge, auxiliary, and turn lanes)
   e. Adding shoulder drains
   f. Replacing and rehabilitating culverts, inlets, and drainage pipes, including safety treatments
   g. Providing driveway pipes
   h. Performing minor bridge widening (less than one through lane)

i. Structural BMP's for water quality improvement

2. Highway safety or traffic operations improvement projects including the installation of ramp metering control devices and lighting.
   a. Installing ramp metering devices
   b. Installing lights
   c. Adding or upgrading guardrail
   d. Installing safety barriers including Jersey type barriers and pier protection
   e. Installing or replacing impact attenuators
   f. Upgrading medians including adding or upgrading median barriers
   g. Improving intersections including relocation and/or realignment
   h. Making minor roadway realignment
   i. Channelizing traffic
   j. Performing clear zone safety improvements including removing hazards and flattening slopes
   k. Implementing traffic aid systems, signals, and motorist aid
   l. Installing bridge safety hardware including bridge rail retrofit

3. Bridge rehabilitation, reconstruction, or replacement or the construction of grade separation to replace existing at-grade railroad crossings.
   a. Rehabilitating, reconstructing, or replacing bridge approach slabs
   b. Rehabilitating or replacing bridge decks
   c. Rehabilitating bridges including painting (no red lead paint), scour repair, fender systems, and minor structural improvements
   d. Replacing a bridge (structure and/or fill)

4. Transportation corridor fringe parking facilities.

5. Construction of new truck weigh stations or rest areas.

6. Approvals for disposal of excess right-of-way or for joint or limited use of right-of-way, where the proposed use does not have significant adverse impacts.

7. Approvals for changes in access control.

8. Acquisition and construction of mitigation sites.

9. Construction of new bus storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and located on or near a street with adequate capacity to handle anticipated bus and support vehicle traffic.

10. Rehabilitation or reconstruction of existing rail and bus buildings and ancillary facilities where only minor amounts of additional land are required and there is not a substantial increase in the number of users.

11. Construction of bus transfer facilities (an open area consisting of passenger shelters, boarding areas, kiosks and related street improvements) when located in a commercial area or other high activity center in which there is adequate street capacity for projected bus traffic.

12. Construction of rail storage and maintenance facilities in areas used predominantly for industrial or transportation purposes where such construction is not inconsistent with existing zoning and where there is no significant noise impact on the surrounding community.

13. Acquisition of land for hardship or protective purposes, advance land acquisition loans under section 3(b) of the UMT Act. Hardship and protective buying will be permitted only for a particular parcel or a limited number of parcels. These types of land acquisition qualify for a CE only where the acquisition will not limit the evaluation of alternatives, including shifts in alignment for planned construction projects, which may be required in the NEPA process. No project development on such land may proceed until the NEPA process has been completed.

D. Special Project Information:

Estimated Costs:
Total Construction $ N/A
Right of Way $ N/A
Total $ 1,248,000

E. Threshold Criteria

The following evaluation of threshold criteria must be completed for Type II actions

Acquisition & Construction of Mitigation Sites	YES	NO
(1) Will the project have a substantial impact on any unique or important natural resource?		X
(2) Does the project involve habitat where federally listed endangered or threatened species may occur?		X
(3) Will the project affect anadromous fish?		X

(4)	If the project involves wetlands, is the amount of permanent and/or temporary wetland taking less than one-tenth (1/10) of an acre and have all practicable measures to avoid and minimize wetland takings been evaluated?	X	

PERMITS AND COORDINATION		YES	NO
(10)	If the project is located within a CAMA county, will the project significantly affect the coastal zone and/or any "Area of Environmental Concern" (AEC)?		X
(11)	Does the project involve Coastal Barrier Resources Act resources?		X
(12)	Will a U. S. Coast Guard permit be required?		X
(13)	Will the project result in the modification of any existing regulatory floodway?		X
(14)	Will the project require any stream relocations or channel changes?	X	

SOCIAL, ECONOMIC, AND CULTURAL RESOURCES		YES	NO
(15)	Will the project induce substantial impacts to planned growth or land use for the area?		X
(16)	Will the project require the relocation of any family or business?		X
(17)	Will the project have a disproportionately high and adverse human health and environmental effect on any minority or low-income population?		X
(18)	If the project involves the acquisition of right of way, is the amount of right of way acquisition considered minor? **N/A**		
(19)	Will the project involve any changes in access control?		X
(20)	Will the project substantially alter the usefulness and/or land use of adjacent property?		X
(21)	Will the project have an adverse effect on permanent local		

	traffic patterns or community cohesiveness?		X
(22)	Is the project included in an approved thoroughfare plan and/or Transportation Improvement Program (and is, therefore, in conformance with the Clean Air Act of 1990)?		X
(23)	Is the project anticipated to cause an increase in traffic volumes?		X
(24)	Will traffic be maintained during construction using existing roads, staged construction, or on-site detours? **N/A**		
(25)	If the project is a bridge replacement project, will the bridge be replaced at its existing location (along the existing facility) and will all construction proposed in association with the bridge replacement project be contained on the existing facility? **N/A**		
(26)	Is there substantial controversy on social, economic, or environmental grounds concerning the project?		X
(27)	Is the project consistent with all Federal, State, and local laws relating to the environmental aspects of the project?	X	
(28)	Will the project have an "effect" on structures/properties eligible for or listed on the National Register of Historic Places?		X
(29)	Will the project affect any archaeological remains, which are important to history or pre-history?		X
(30)	Will the project require the use of Section 4(f) resources (public parks, recreation lands, wildlife and waterfowl refuges, historic sites, or historic bridges, as defined in Section 4(f) of the U. S. Department of Transportation Act of 1966)?		X
(31)	Will the project result in any conversion of assisted public recreation sites or facilities to non-recreation uses, as defined by Section 6(f) of the Land and Water Conservation Act of 1965, as amended?		X
(32)	Will the project involve construction in, across, or adjacent to a river designated as a component of or proposed for inclusion in the Natural System of Wild and Scenic Rivers?		X

F. Additional Documentation Required for Unfavorable Responses in Part E
(Discussion regarding all unfavorable responses in Part E should be provided below. Additional supporting documentation may be attached, as necessary.)

Project has no unfavorable responses in Part E. Please see attached information supporting favorable responses, including an environmental screening report, correspondence from the North Carolina Natural Heritage Program, and the State Historic Preservation Office.

G. CE Approval

Project Description: Compensatory § 404/401 Mitigation

Categorical Exclusion Action Classification:

TYPE II(A)
TYPE II(B)

Approved:

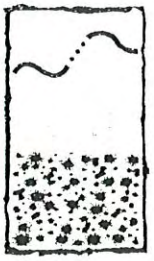
1/20/04
Date

Contract Representative, NC DOT

2/11/04
Date

2/24/04
Date

FHWA



Wetland and Natural Resource
Consultants, Inc.

October 7, 2003

NC Natural Heritage Program
NC Division of Parks and Recreation
Attn: Mr. Stephen Hall
1615 Mail Service Center
Raleigh, North Carolina 27699-1615

Re: Request for Federally Threatened & Endangered Species Review and Comment
Moore County Stream Restoration Sites

Dear Mr. Hall:

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to federally threatened and endangered species from wetland and/or stream restoration projects conducted on the attached sites (USGS site *maps with approximate property lines enclosed*).

The Moore County Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Three separate sections of channel have been identified as significantly degraded and denaturalized. These stream restoration sites were selected based on their high probability to restore high quality stream habitat where it has ceased to exist.

The stream channels slated for restoration are all currently straightened ditches through agricultural fields. These sites have been actively farmed since the 1960's on a rotation of various row crops. These straightened channels have been maintained to function as agricultural field drainage features, with routine maintenance consisting of dredging, mowing, and the application of defoliants.

Conceptual mitigation plans call for the restoration of these channels to their historical state. This process will involve the restoration of natural channel pattern and profile and the reestablishment of forested riparian buffers. No mass grading is proposed; we propose only minimal grading and as such do not anticipate any conflict with any protected species.

All mitigation sites will be protected through a conservation easement. These easements will not encompass any structures. The easements on the preservation sites will maintain the current ecological state of the site. Please forward any conceptual protection mechanisms or verbiage germane to your expertise that you would like for us to consider as an amendment to the easement.

Newton Office
PO Box 224
Newton, NC 28658
828-465-3035
828-465-3050 Fax
www.wnrinc.com

Clyde Office
217 Paragon Parkway, #142
Clyde, NC, 28721
828-627-0051
828-627-0052 Fax
www.wnrinc.com

We believe that it is appropriate to reach a "No Effect" determination for each of the federally threatened and endangered species listed as no adverse impact will occur from the proposed restoration efforts. These determinations are supported by the following facts specific to each listed species within Moore County and in the vicinity of the proposed mitigation site:

Red Cockaded Woodpecker: (Endangered--Current Occurrence)

No potential foraging or nesting habitat will be lost through the restoration of stream channels on agricultural lands. No forest suitable for this species lies within portions of theses properties that will be protected through conservation easements.

Cape Fear Shiner: (Endangered--Current Occurrence)

No aquatic habitat will be lost through the channel restoration of these channels. The preferred habitat of water willow beds were not observed during our site visit.

Michaux's Sumac: (*Endangered--Current Occurrence*)

No specimens were observed during our review of the site. Intensive agronomic applications of pesticides and defoliants have resulted in a community type that is tolerant to these chemicals. The preferred habitat of roadsides, old fields, and woodland openings is not currently in existence within the agricultural fields slated for restoration.

American chaffseed: (Endangered--Current Occurrence)

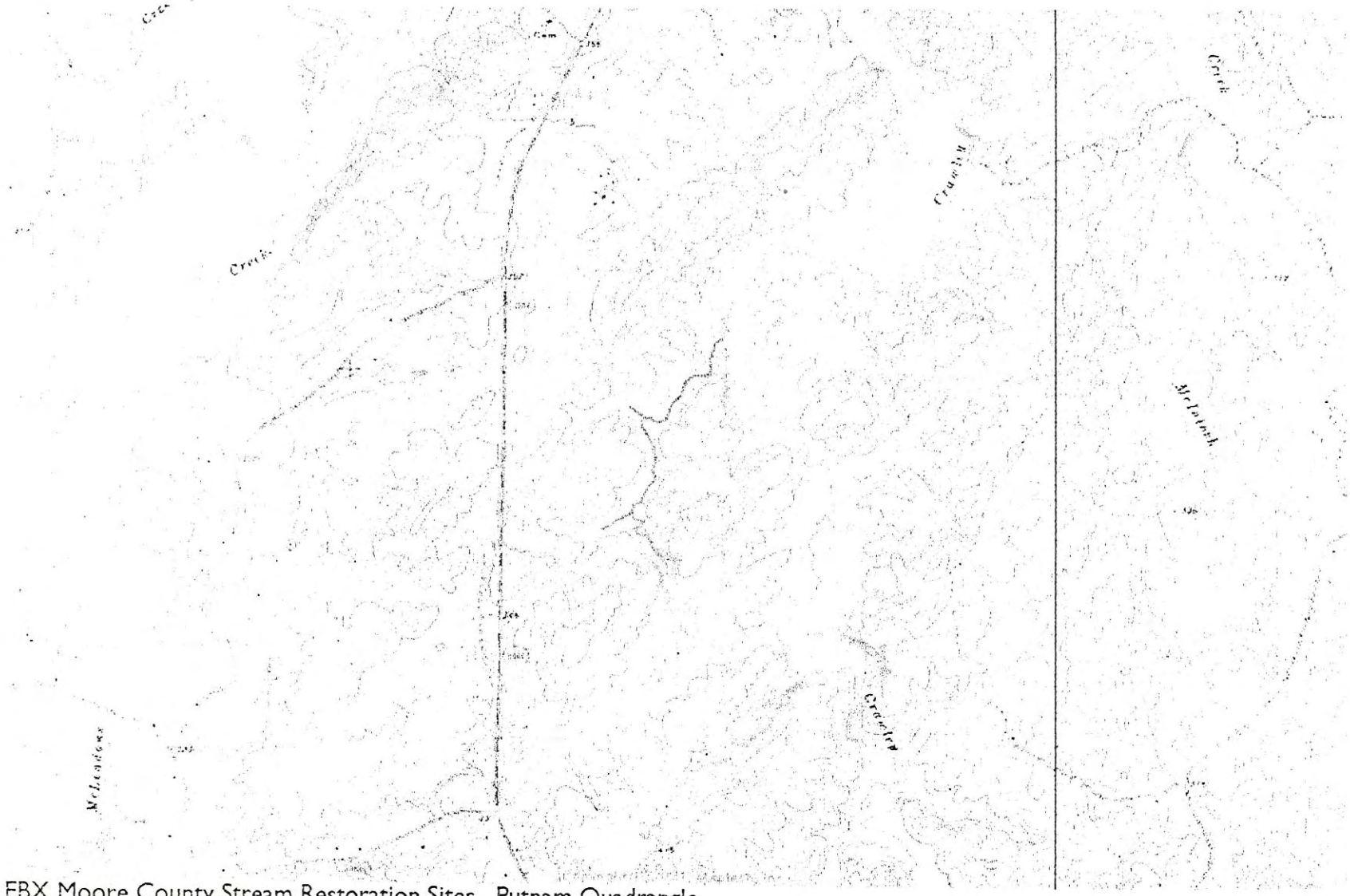
No specimens were observed during our review of the site. Intensive agronomic applications of pesticides and defoliants have resulted in a community type that is tolerant to these chemicals. The preferred condition of frequent fire has not been a part of the cycle within the agricultural fields slated for restoration.

We wish to obtain your concurrence that no impact assessment or additional studies are needed. Your correspondence will be forwarded to the North Carolina Department of Transportation for consideration as part of our due diligence for each mitigation site. Our due diligence for the project will consist of a site map, the above list of the species and its preferred habitat, and the conclusion that there will be no effect on federally protected species.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent of site disturbance associated with these projects.

Sincerely,

Chris Huysman



EBX Moore County Stream Restoration Sites. Putnam Quadrangle.

NCDENR

North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross, Jr., Secretary

October 21, 2003

Mr. Chris Huysman
Wetland and Natural Resource Consultants, Inc.
P.O. Box 224
Newton, NC 28658

Subject: Moore County Stream Restoration Sites; Putnam quadrangle, Moore County

Dear Mr. Huysman:

The Natural Heritage Program has no record of rare species, significant natural communities, or priority natural areas at the sites nor within a mile of the sites. Although our maps do not show records of such natural heritage elements in the project area, it does not necessarily mean that they are not present. It may simply mean that the area has not been surveyed. The use of Natural Heritage Program data should not be substituted for actual field surveys, particularly if the project area contains suitable habitat for rare species, significant natural communities, or priority natural areas.

You may wish to check the Natural Heritage Program database website at <www.ncsparks.net/nhp/search.html> for a listing of rare plants and animals and significant natural communities in the county and on the topographic quad map. Please do not hesitate to contact me at 919-715-8697 if you have questions or need further information.

Sincerely,

Harry E. LeGrand, Jr.

Harry E. LeGrand, Jr., Zoologist
Natural Heritage Program

HEL/hel

1601 Mail Service Center, Raleigh, North Carolina 27699-1601
Phone: 919-733-4984 \ Fax: 919-715-3060 \ Internet: www.enr.state.nc.us

Wetland and Natural Resource
Consultants, Inc.

October 7, 2003

State Historic Preservation Office
North Carolina Division of Archives and History
Attn: Ms. Renee Gledhill-Earley
109 East Jones Street
Raleigh, North Carolina 27601-2807

Re: Request for Historic Preservation Office Review and Comment
Moore County Stream Restoration Sites

Dear Ms. Gledhill-Earley:

The purpose of this letter is to request review and comment on any possible issues that might emerge with respect to architectural or archaeological resources from wetland and/or stream restoration projects conducted on the attached sites (USGS site maps with *approximate property lines enclosed*).

The Moore County Stream Restoration Site has been identified for the purpose of providing in-kind mitigation for unavoidable stream channel impacts. Three separate sections of channel have been identified as significantly degraded and denaturalized. These stream restoration sites were selected based on their high probability to restore high quality stream habitat where it has ceased to exist.

No architectural structures or artifacts have been observed or noted during preliminary surveys of the sites for mitigation purposes. We have enclosed copies of USGS topo maps that include the proposed stream mitigation project sites. We ask that you review these sites based on the USGS topo maps in your office to determine the presence of any architectural or archaeological resources.

Conceptual mitigation plans call for the restoration of these channels to their historical state. This process will involve the restoration of natural channel pattern and profile and the reestablishment of forested riparian buffers. No mass grading is proposed; we propose only minimal grading and as such do not anticipate any conflict with your guiding legislation.

All mitigation sites will be protected through a conservation easement. These easements will not encompass any structures. The easements on the preservation sites

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828-627-0051
828-627-0052 Fax
www.wnrinc.com

will maintain the state of the site. If there is any conceptual protection mechanisms germane to your expertise that you would like amended to the easement please forward them when you reply to this request.

We believe that no impacts will occur from restoration efforts, however, no surveys by archaeologist have been conducted, and we wish to obtain your concurrence that no impact assessment or additional studies are needed. Your correspondence will be forwarded to the North Carolina Department of Transportation for consideration.

We thank you in advance for your timely response and cooperation. Please feel free to contact us with any questions that you may have concerning the extent or site disturbance associated with these projects.

Sincerely,

Chris Huysman

North Carolina Department of Cultural Resources
State Historic Preservation Office
David L. S. Brook, Administrator

Michael F. Easley, Governor
Lisbeth C. Evans, Secretary
Jeffrey J. Crow, Deputy Secretary
Office of Archives and History

Division of Historical Resources

November 24, 2003

Chris Huysman
Wetland and Natural Resource Consultants, Inc.
Newton Office
PO Box 224
Newton, NC 28658

Re: Reviews of County Stream Restoration Sites and One Review for Tar-Pam Wetland Mitigation and Stream Restoration Sites, Multi-County, ER03-3022 through ER03-3026

Dear Mr. Huysman:

Thank you for your letters of October 7, 2003, concerning the above project.

We have conducted a review of the proposed undertaking and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the undertaking as proposed.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

David Brook

Transaction Screen Assessment

Stonebridge Project Area
Moore County, North Carolina

15 December 2003

Prepared for:
Environmental Banc & Exchange, LLC
10055 Red Run Boulevard, Suite 130
Owings Mills, Maryland 21117-48600

Prepared by:
Environmental Resources Management, Inc.
200 Harry S Truman Parkway, Suite 400
Annapolis, Maryland 21401
and
Environmental Resources Management-Southeast, Inc.
7300 Carmel Executive Park, Suite 200
Charlotte, North Carolina 28226

TABLE OF CONTENTS

APPENDICES

1.0 *INTRODUCTION*

On 28 October 2003, Environmental Resources Management (ERM) performed an environmental transaction screen assessment at the 20-acre Stonebridge property located in Moore County, North Carolina. The transaction screen assessment was performed in accordance with the Standard Practice for Environmental Site Assessments: Transaction Screen Process as defined by ASTM E 1528-00, and the scope of work outlined in ERM's proposal to Environmental Banc & Exchange LLC, dated 21 October 2003.

Ms. Dena Castonguay of ERM's Charlotte, North Carolina office conducted the site reconnaissance. During the site reconnaissance, ERM completed a transaction screen checklist in conformance with the scope and procedures of ASTM E 1528-00, which is attached as Appendix A. In addition, ERM supplied Mr. Burton Rudolph with an environmental questionnaire to be completed by the property owner(s). ERM reviewed the completed questionnaire following the assessment.

The site comprises approximately 20 acres of mixed wooded/agricultural land situated along a tributary stream. The stream flows northwest into Crawley Creek, which runs along the northeastern boundary of the subject property. Access to the subject property is via Glendon-Carthage Road, to the east. ERM observed clear, flowing water in the tributary stream at the time of the site visit. No structures or debris were observed on the subject property.

According to Mr. Rudolph, the subject property is currently owned by Mr. Floyd Strader. Mr. Strader purchased the subject property in 1984 and has used the property as a cattle pasture since that time. Prior to 1984, the property was a pine tree plantation.

According to Mr. Rudolph, no private drinking water wells or underground septic systems are present on the subject property. In addition, Mr. Rudolph is not aware of any underground storage tanks (USTs) located on the subject property. No indication of water wells, septic systems or UST's were observed during ERM's site reconnaissance. The site currently utilizes fertilizer to establish and maintain pasture grass; however, no other chemicals such as herbicides or pesticides are utilized on the subject property.

ERM performed a visual survey of adjacent properties during the site visit. Adjacent properties to the south, west, and east appear to be undeveloped, wooded areas. Adjacent property to the north appears to be cleared for agricultural use.

2.0 *ENVIRONMENTAL REVIEW*

Key findings from the transaction screening assessment are presented below:

- No bulk quantities of hazardous chemicals were observed during the site visit. According to Mr. Rudolph, the site currently utilizes fertilizer to establish and maintain pasture grass; however, no other chemicals such as herbicides or pesticides are utilized on the subject property.

- ERM did not observe any aboveground storage tanks during the site visit; nor any evidence of underground storage tanks, such as fill holes and vent pipes were observed at the site. Mr. Rudolph is not aware of any underground storage tanks located on the subject property.

- ERM did not observe any debris or evidence of solid waste dumping on the subject property.

- According to Mr. Rudolph, no private drinking water wells or underground septic systems are present on the subject property.

- ERM did not observe any transformers or other oil-filled equipment on the subject property; therefore, PCBs do not represent an environmental concern to the subject property.

- No areas of stained soils or stressed vegetation were observed during the site visit.

- Based on ERM's review of the adjacent properties, no obvious environmental concerns were identified.

3.0 *CONCLUSION*

Based on the reconnaissance, interviews, and review of relevant files, no recognized environmental conditions, as that term applies to ASTM E 1528-00, were identified at the subject property.

Appendix A
Completed Transaction Screen
Questionnaire
Stonebridge Project

Transaction Screen Assessment

Facility Name: Stonebridge - Moore County Date of Site Visit: 10/28/03

Location: Moore County, NC North of Carthage on Glendon-Carthage Rd.

Interviewee Name/Title: N/A How Long? N/A

Time at this location: N/A Previous Locations? N/A

Facility Operations: waterway easement - agricultural use

Number of Employees: N/A Shifts: N/A

Building Specifications: N/A - no structures Lot Size: 20 acres

Water Service: N/A Sewer: N/A

Electric: N/A Nat. Gas: N/A

Permits: N/A

Site History: pine tree farm

Adjacent Properties: undeveloped, agricultural, residential

Were any of the following observed? Provide comments as necessary.

Hazardous Chemicals/Petroleum: No

Waste Oil: No

Pesticides: Possibly, due to agricultural use

Drums/Bulk Storage Containers: No

Aboveground Storage Tanks: No

Underground Storage Tanks: No

Solid Waste: No

Hazardous Waste: No

Parts Washing Stations: No

Vehicle Maintenance: No

Oil-filled Equipment/PCBs: No

Sources of Air Emissions: No

Coating/Painting Operations: No

Boilers: No

Asbestos: No

CFCs: No

Wastewater: No

Floor Drains: No

Stormwater: No

Ponds or Lagoons: No

Wetlands: a stream flows through the subject property - clear, flowing

Water/Monitoring Wells: No

Septic Systems: No

Spills/Leaks: No

Stressed Vegetation: No

Notice of Violations: No

Previous Environmental Reports: No

Soil/Groundwater Contamination: No

Burned or Buried Debris: No

Fill Material: No

APPENDIX D

DAM SAFETY INSPECTION REPORT

NAME	COUNTY	NO.	INSPECTED BY	DATE
Strader Farm Pond#1	Moore	#1	DJK	
OWNER	**ADDRESS**			**PHONE**

TYPE DAM: ☐ Concrete Gravity ☐ Concrete Arch ☐ Other ☑ Embankment ☐ Concrete Buttress ☐ Stone Masonry

TYPE INSPECTION: ☐ Periodic ☐ Initial ☐ Follow-up ☑ Other

SITE CONDITIONS: ☐ Wet ☑ Dry ☐ Snow Cover ☐ Other

HAZARD CLASS: ☐ Intermediate (B) ☑ Low (A) ☐ High (C)

HAZARD DESCRIPTION: Medium

REMARKS

ACTION: ☐ None ☐ Maintenance ☐ Monitoring ☐ Minor repair ☐ Engineering

RECOMMENDATIONS: ☐ Inspection letter ☐ Deficiency letter ☐ RE notice ☐ Engineering Study ☐ Inspection by RE ☐ Inspection by DCE ☐ Dam safety order ☐ Enforcement ☐ Periodic reinspection ☐ Other reinspection

AREA	PROBLEMS	COMMENTS
UPSTREAM SLOPE	☐ 1. None ☐ 2. Trees ☐ 3. High bushes ☐ 4. Burrows ☐ 5. Wave erosion ☑ 6. Livestock damage ☐ 7. Slides ☐ 8. Depressions ☐ 9. Bulges ☐ 10. Sparce rip rap ☐ 11. Displaced rip rap ☐ 12. Cracks ☐ 13. Undermining ☐ 14. Holes ☐ 15. Spalling ☐ 16. Displaced joints ☐ 17. Deterioated joints ☐ 18. Exposed reinforcement ☑ 19. Other	COVER: ☐ Vegetation ☐ Rip rap ☐ Concrete ☐ Asphalt ☐ Other Dirt with no vegetative cover
TOP OF DAM	☐ 1. None ☐ 2. Trees ☐ 3. High bushes ☐ 4. Burrows ☐ 5. Ruts ☑ 6. Livestock damage ☐ 7. Depressions ☐ 8. Unlevel ☐ 9. Misalignment ☐ 10. Has overtopped ☐ 11. Cracks ☐ 12. Spalling ☐ 13. Deteriorated joints ☐ 14. Displaced joints ☐ 15. Exposed reinforcement ☑ 16. Other	COVER: ☐ Vegetation ☐ Gravel ☐ Concrete ☐ Asphalt ☐ Other Dirt with no veg. cover; rut damage where local drainage has collected
DOWNSTREAM SLOPE	☐ 1. None ☐ 2. Trees ☐ 3. High bushes ☐ 4. Burrows ☐ 5. Erosion ☑ 6. Livestock damage ☐ 7. Slides ☐ 8. Depressions ☐ 9. Bulges ☐ 10. Wetness ☐ 11. Seepage ☐ 12. Boils ☐ 13. Cracks ☐ 14. Holes ☐ 15. Spalling ☐ 16. Displaced joints ☐ 17. Deterioated joints ☐ 18. Exposed reinforcement ☑ 19. Other	COVER: ☐ Vegetation ☐ Rip rap ☐ Concrete ☐ Other Dirt with no vegetative cover
TOE CONTACT	☐ 1. None ☐ 2. Trees ☐ 3. High bushes ☐ 4. Burrows ☐ 5. Erosion ☑ 6. Livestock damage ☐ 7. Slides ☐ 8. Depressions ☐ 9. Bulges ☐ 10. Wetness ☐ 11. Seepage ☐ 12. Boils ☐ 13. Cracks ☐ 14. Holes ☐ 15. Spalling ☐ 16. Displaced joints ☐ 17. Deterioated joints ☐ 18. Exposed reinforcement ☐ 19. Undermining ☑ 20. Other	COVER: ☐ Vegetation ☐ Rip rap ☐ Concrete ☐ Other Dirt with no vegetative cover

NAME	COUNTY	NO.	INSPECTED BY	DATE
Strader Farm Pond#1	Moore	#1	DJK	1/13/2004

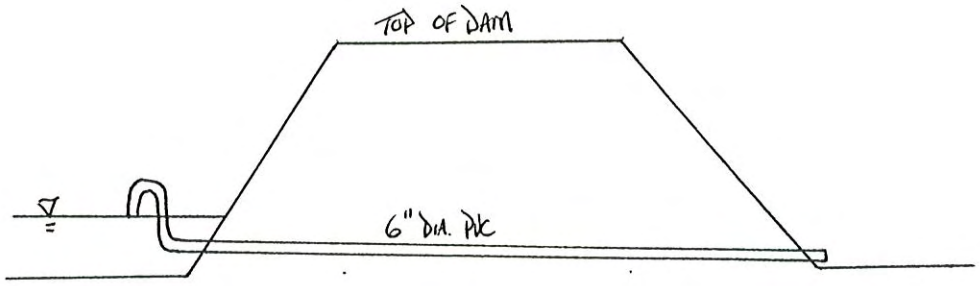
AREA	PROBLEMS	COMMENTS
ABUTMENT CONTACTS	☐ 1. None ☐ 2. Trees ☐ 3. High bushes ☐ 4. Burrows ☐ 5. Erosion ☐ 6. Livestock damage ☐ 7. Slides ☐ 8. Depressions ☐ 9. Bulges ☐ 10. Wetness ☐ 11. Seepage ☐ 12. Boils ☐ 13. Cracks ☐ 14. Holes ☐ 15. Spalling ☐ 16. Displaced joints ☐ 17. Deterioated joints ☐ 18. Exposed reinforcement ☐ 19. Undermining ☐ 20. Other	COVER: ☐ Vegetation ☐ Rip rap ☐ Concrete ☐ Asphalt ☐ Other NA
PRINCIPAL SPILLWAY	☑ 1. None ☐ 2. No trash guard ☐ 3. Obstructed ☐ 4. Plugged ☐ 5. Rusted ☐ 6. Damaged ☐ 7. Gates leaking ☐ 8. Joints leaking ☐ 9. Cracks ☐ 10. Joint deterioration ☐ 11. Joint Displacement ☐ 12. Undermining ☐ 13. Voids ☐ 14. Erosion ☐ 15. Holes ☐ 16. Conduit collapsed ☐ 17. Spalling ☐ 18. Outlet undercutting ☐ 19. Misalignment ☐ 20. Other	SIZE / TYPE: There is no true principal spillway; baseflow goes thru 6" diameter PVC
EMERGENCY SPILLWAY	☐ 1. None ☐ 2. No ES ☐ 3. Same as PS ☐ 4. Obstructed ☐ 5. Erosion ☐ 6. Displaced rip rap ☐ 7. Sparce rip rap ☐ 8. Joints leaking ☐ 9. Cracks ☐ 10. Joint deterioration ☐ 11. Joint Displacement ☐ 12. Undermining ☐ 13. Voids ☐ 14. Holes ☐ 15. Exposed reinforcement ☐ 16. Spalling ☐ 17. Outlet erosion ☐ 18. Misalignment ☐ 19. Inadequate ☐ 20. Other	SIZE / TYPE: Emergency spillway is a 16 feet wide dirt "low" area over the dam that will act as an emergency spillway.
DRAINS / OTHER OUTLETS	☐ 1. None ☐ 2. No bottom drain ☐ 3. Bottom drain imoperable ☐ 4. Subsurface drain dry ☐ 5. Subsurface drain muddy flow ☐ 6. Subsurface drain obstructed ☑ 7. No animal guard ☐ 8. Other	TYPE:

SKETCHES / COMMENTS:

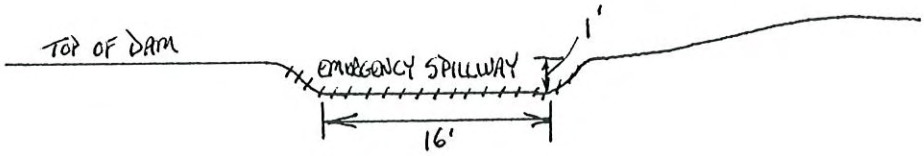
EMBANKMENT DAM SKETCHES AND MEASUREMENTS

NAME	COUNTY	NO.	INSPECTED BY	DATE
Strader Farm Pond#1	Moore	#1	DJK	1/13/2004

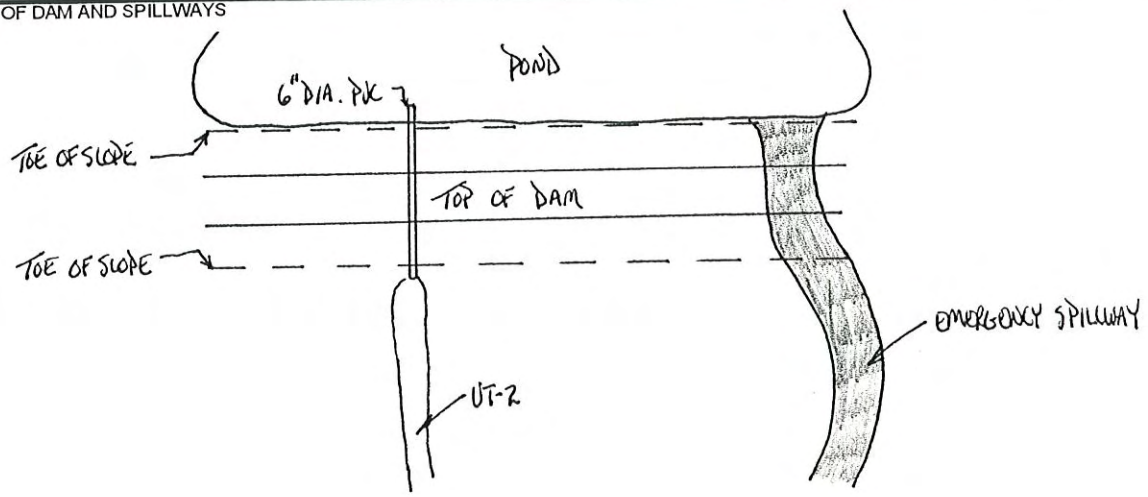
EMBANKMENT CROSS-SECTION



EMERGENCY SPILLWAY CROSS-SECTION



PLAN VIEW OF DAM AND SPILLWAYS



APPENDIX E

Project: EBX Stonebridge Site
Prepared by: DJK
Date: 1/12/04

Summary of Hydrologic Evaluation

Stonebridge Site

	Methodology	Location				
		UT-1 Reach A	UT-1 Reach B	UT-1 Reach C	UT-2	UT-3
Drainage Area (Sq. Miles)		1.075	0.941	0.552	0.284	0.295
Drainage Area (Acres)		688.0	602.0	353.0	181.8	188.8
Existing Conditions	WKD Surveyed Bankfull Indicator Flow	44.51	139.81	63.24	36.58	33.96
Existing Conditions	Regional Curves	94	73	58	36	37
Existing Conditions	USACE HEC-1 - 1-year Q	160	134	97	37	51
Existing Conditions	USACE HEC-1 - 2-year Q	271	225	168	57	89
Existing Conditions	USACE Reg. Regression Equation- 2-year Q	142	129	89	32	57
Existing Conditions	Rational Method Equation - 2-year Q	179	157	92	45	49

Brady Road Reference Reach

	Methodology	Location	
		Downstream	Upstream
Drainage Area (Sq. Miles)		0.478	0.766
Drainage Area (Acres)		305.9	490.2
Existing Conditions	WKD Surveyed Bankfull Indicator Flow	78.4	65.6

Stonebridge Site

	Methodology	Location				
		UT-1 Reach A	UT-1 Reach B	UT-1 Reach C	UT-2	UT-3
Drainage Area (Sq. Miles)		1.075	0.941	0.552	0.284	0.295
Drainage Area (Acres)		688.0	602.0	353.0	181.8	188.8
Proposed Conditions	WKD Surveyed Bankfull Indicator Flow	78.8	NA	64.8	30.6	30.3

Note: WKD Bankfull flow was determined using survey bankfull indicators
Rational method not applicable for UT-1 reaches (DA larger than 200 acres) - shown for informational purposes only
All flows given are in cubic feet per second (cfs)
WKD Bankfull for proposed conditions was determined at design riffles with Manning's equation

Project: EBX Stonebridge Site
Prepared by: DJK
Date: 1/12/04

Summary of Hydrologic Evaluation

Discharge Per Acre For Proposed Conditions and Reference Reach					
Methodology	UT-1 Reach A	UT-1 Reach B	UT-1 Reach C	UT-2	UT-3
Existing Conditions Stonebridge Site	0.065	0.232	0.179	0.201	0.180
Proposed Conditions Stonebridge Site	0.115	NA	0.184	0.168	0.161
HEC-1 - 1 year Q	0.233	0.223	0.275	0.204	0.270
Regional Curves	0.136	0.122	0.164	0.198	0.196
Reference Reach Upstream of Brady Rd	0.256				
Reference Reach Downstream of Brady Rd	0.134				

Summary of Hydrologic Evaluation

Project: EBX Stonebridge Site
Conditions: Existing
Prepared by: DJK
Date: 1/05/04

Location: At Mouth of UT-1 (Crawley Creek)

Drainage Area =	**688**	**Acres**
Drainage Area =	**1.08**	**Sq. Miles**
Impervious Area (%) =	**1**	

Recurrence Interval (Years)	USGS Q (cfs)	HEC-1 Q (cfs)	Rational Q (cfs)
1	NA	160	NA
2	142	271	179

Drainage at mouth adjusted to account for existing dam that has 1 cfs leaving in a bankfull event
Drainage area (unadjusted at mouth of UT-1 is 688 acres)
Bankfull flow determined using the November 2003 NC Piedmont-Rural Regional Curve = 94 cfs
Rational equation not applicable for 588 acres watershed

Location: At Mouth of UT-2

Drainage Area =	**81.1**	**Acres**
Drainage Area =	**0.13**	**Sq. Miles**
Impervious Area (%) =	**1**	

Recurrence Interval (Years)	USGS Q (cfs)	HEC-1 Q (cfs)	Rational Q (cfs)
1	NA	37	NA
2	32	57	45

Bankfull flow determined using the November 2003 NC Piedmont-Rural Regional Curve = 36 cfs

Location: At Mouth of UT-3

Drainage Area =	**189**	**Acres**
Drainage Area =	**0.30**	**Sq. Miles**
Impervious Area (%) =	**1**	

Recurrence Interval (Years)	USGS Q (cfs)	HEC-1 Q (cfs)	Rational Q (cfs)
1	NA	51	NA
2	57	89	49

Bankfull flow determined using the November 2003 NC Piedmont-Rural Regional Curve = 37 cfs

Regional USGS Regression Equation for NC

Project: EBX Stonebridge Site
Conditions: Existing
Prepared by: DJK
Date: 1/05/04

Location: At Mouth of UT-1 (Crawley Creek)

Drainage Area =	**688**	**Acres**
Drainage Area =	**1.08**	**Sq. Miles**
Impervious Area (%) =	**1**	

Recurrence Interval (Years)	Blue Ridge-Piedmont Equation (rural)	Drainage Area (in square miles)	Rural Discharge (cfs)
2	135(DA)^0.702	1.08	142
5	242(DA)^0.677	1.08	254
10	334(DA)^0.662	1.08	350
25	476(DA)^0.645	1.08	499
50	602(DA)^0.635	1.08	630
100	745(DA)^0.625	1.08	779

Location: UT-2 (at Mouth)

Drainage Area =	**81.1**	**Acres**
Drainage Area =	**0.13**	**Sq. Miles**
Impervious Area (%) =	**1.0**	

Recurrence Interval (Years)	Blue Ridge-Piedmont Equation (rural)	Drainage Area (in square miles)	Rural Discharge (cfs)
2	135(DA)^0.702	0.13	32
5	242(DA)^0.677	0.13	60
10	334(DA)^0.662	0.13	85
25	476(DA)^0.645	0.13	126
50	602(DA)^0.635	0.13	162
100	745(DA)^0.625	0.13	205

Regional USGS Regression Equation for NC

Project: EBX Stonebridge Site
Conditions: Existing
Prepared by: DJK
Date: 1/05/04

Location: At Mouth of UT-3

Drainage Area =	**189**	**Acres**
Drainage Area =	**0.30**	**Sq. Miles**
Impervious Area (%) =	**1**	

Recurrence Interval (Years)	Blue Ridge-Piedmont Equation (rural)	Drainage Area (in square miles)	Rural Discharge (cfs)
2	135(DA)^0.702	0.30	57
5	242(DA)^0.677	0.30	106
10	334(DA)^0.662	0.30	149
25	476(DA)^0.645	0.30	217
50	602(DA)^0.635	0.30	277
100	745(DA)^0.625	0.30	348

Rational Method for Stonebridge

Project: EBX Stonebridge Site
Conditions: Existing
Prepared by: DJK
Date: 1/05/04

Location: At Mouth of UT-1 - Reach A (Crawley Creek)

Drainage Area =	**688**	**Acres**
Drainage Area =	**1.08**	**Sq. Miles**
Impervious Area (%) =	**1**	

Recurrence Interval (Years)	C-Factor	Intensity (in/hr)	Discharge (cfs)
2	0.13	2.00	179
5	0.13	2.90	259
10	0.13	3.30	295

Location: UT-2 (at Mouth)

Drainage Area =	**182**	**Acres**
Drainage Area =	**0.28**	**Sq. Miles**
Impervious Area (%) =	**1.0**	

Recurrence Interval (Years)	C-Factor	Intensity (in/hr)	Discharge (cfs)
2	0.13	1.90	45
5	0.13	2.80	66
10	0.13	3.20	76

Rational Method for Stonebridge

Project: EBX Stonebridge Site
Conditions: Existing
Prepared by: DJK
Date: 1/05/04

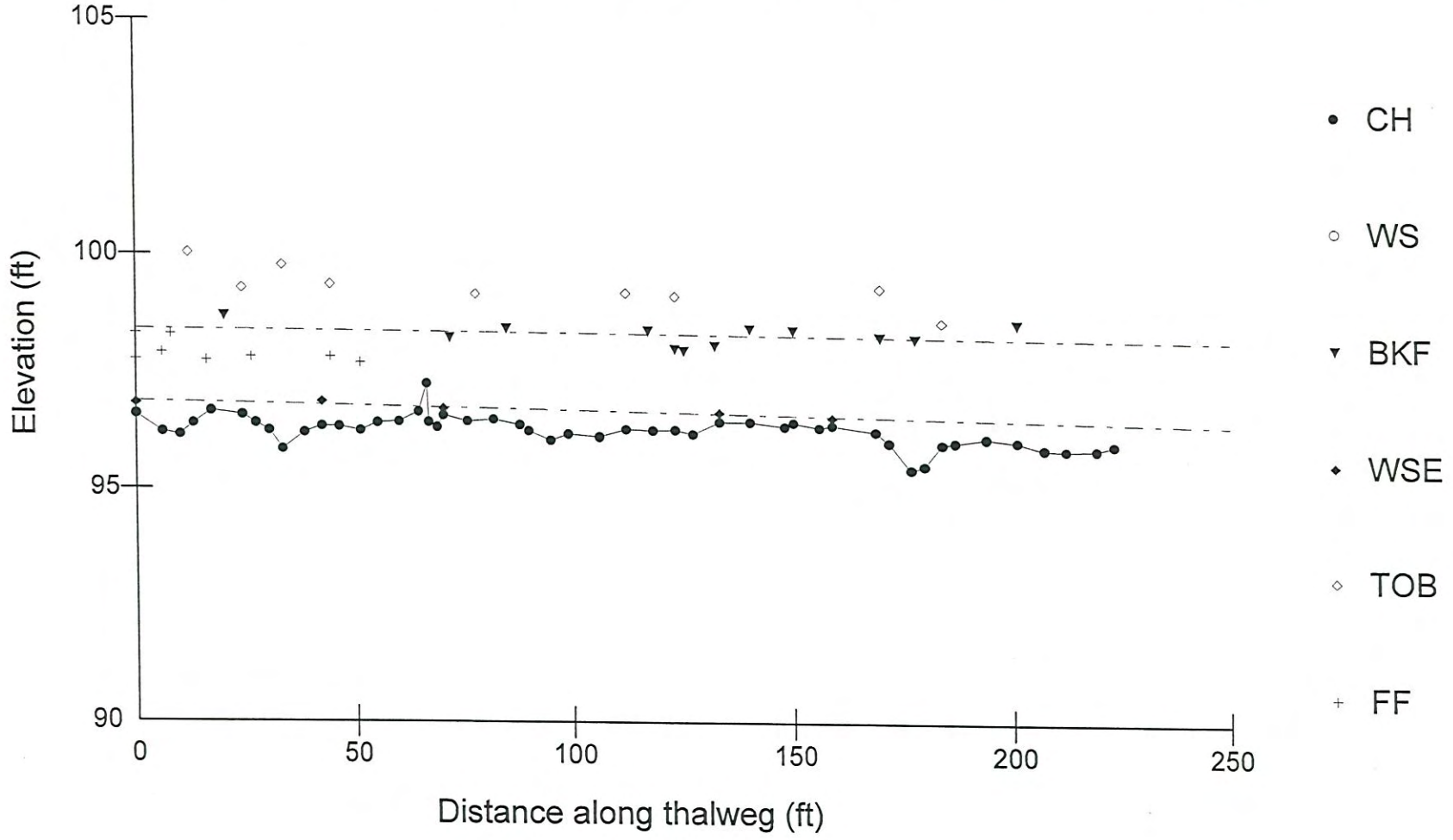
Location: At Mouth of UT-3

Drainage Area =	**189**	**Acres**
Drainage Area =	**0.30**	**Sq. Miles**
Impervious Area (%) =	**1**	

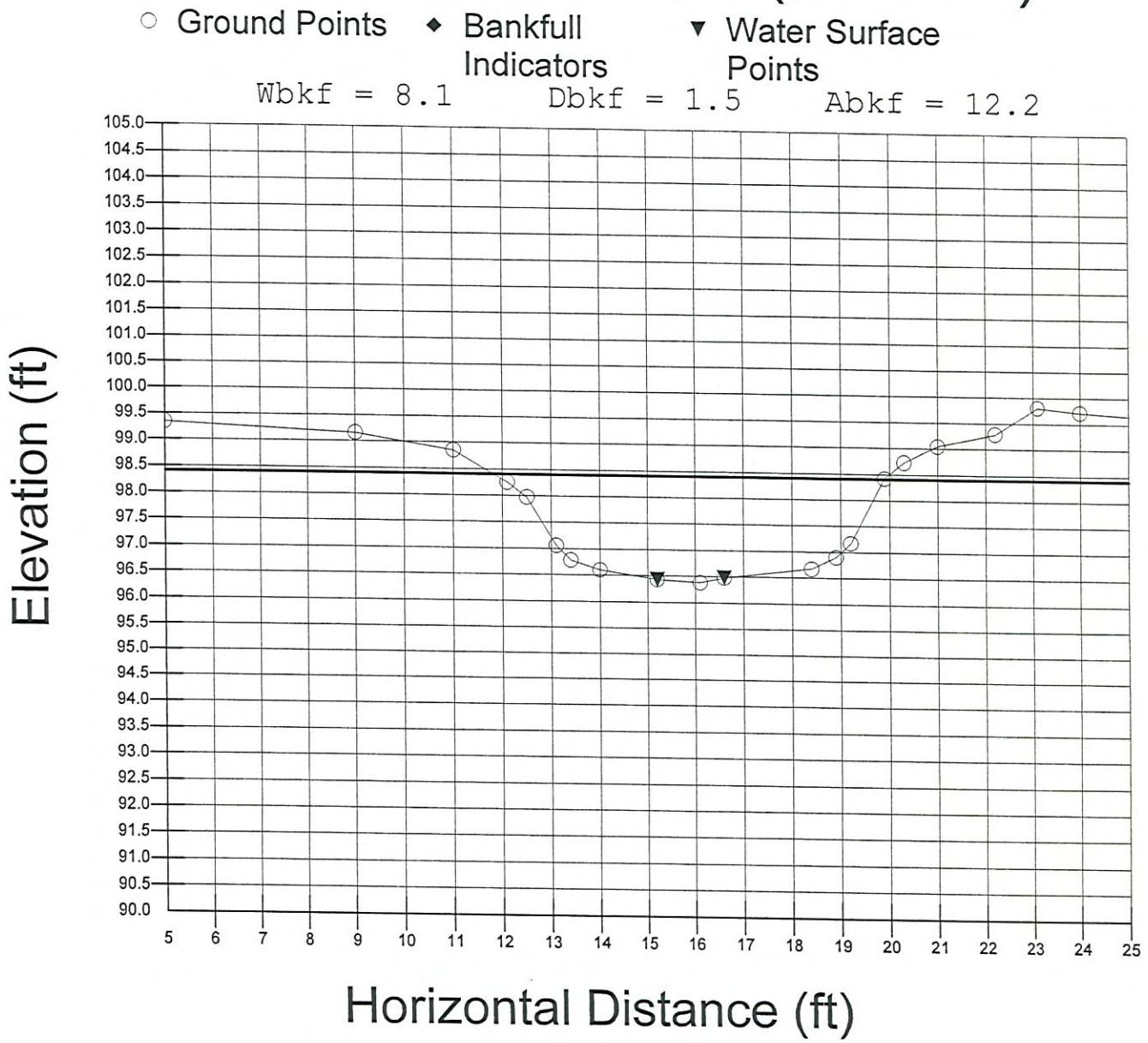
Recurrence Interval (Years)	C-Factor	Intensity (in/hr)	Discharge (cfs)
2	0.13	2.00	49
5	0.13	2.90	71
10	0.13	3.30	81

APPENDIX F

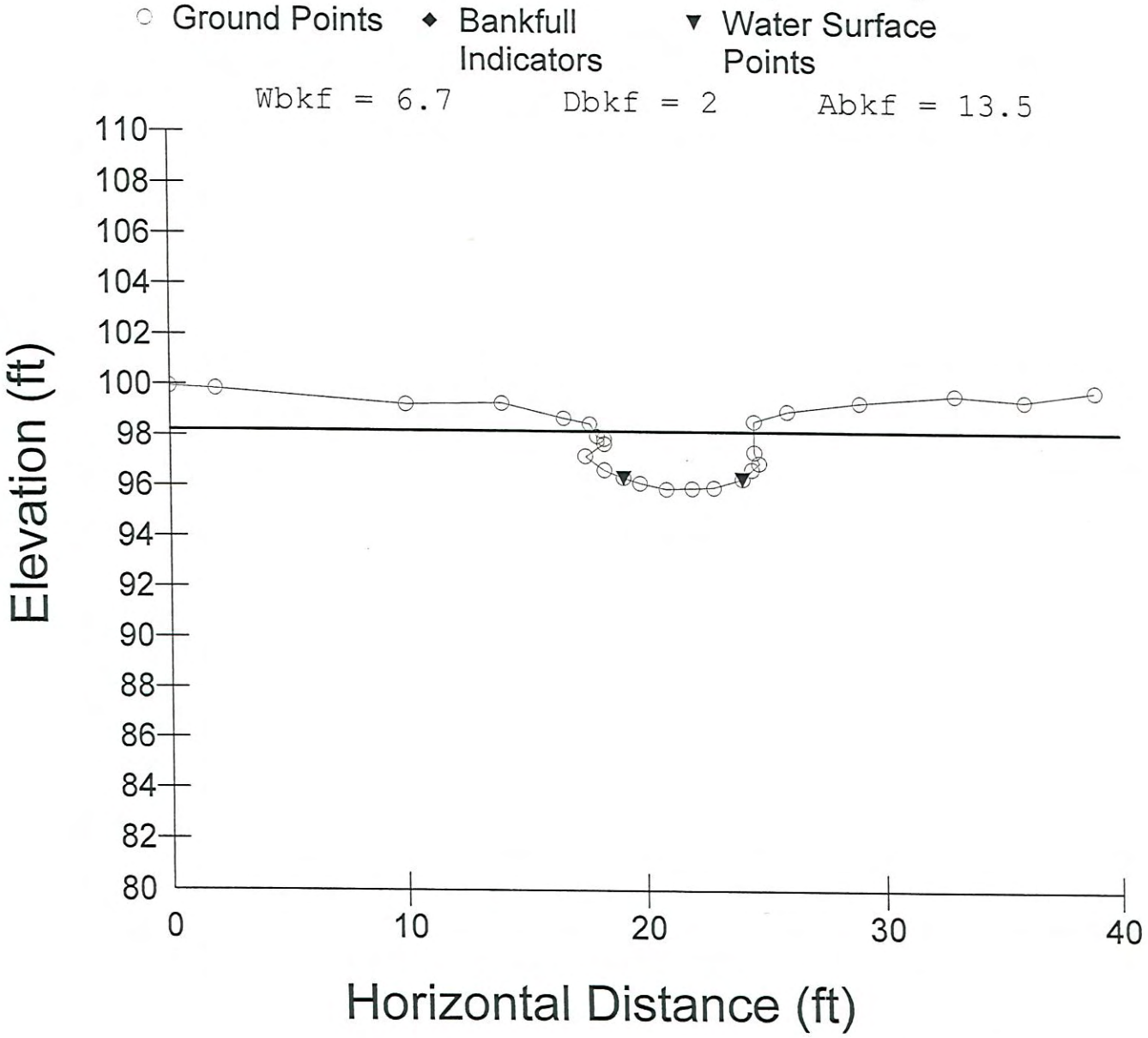
BRADY SITE LONGITUDINAL PROFILE



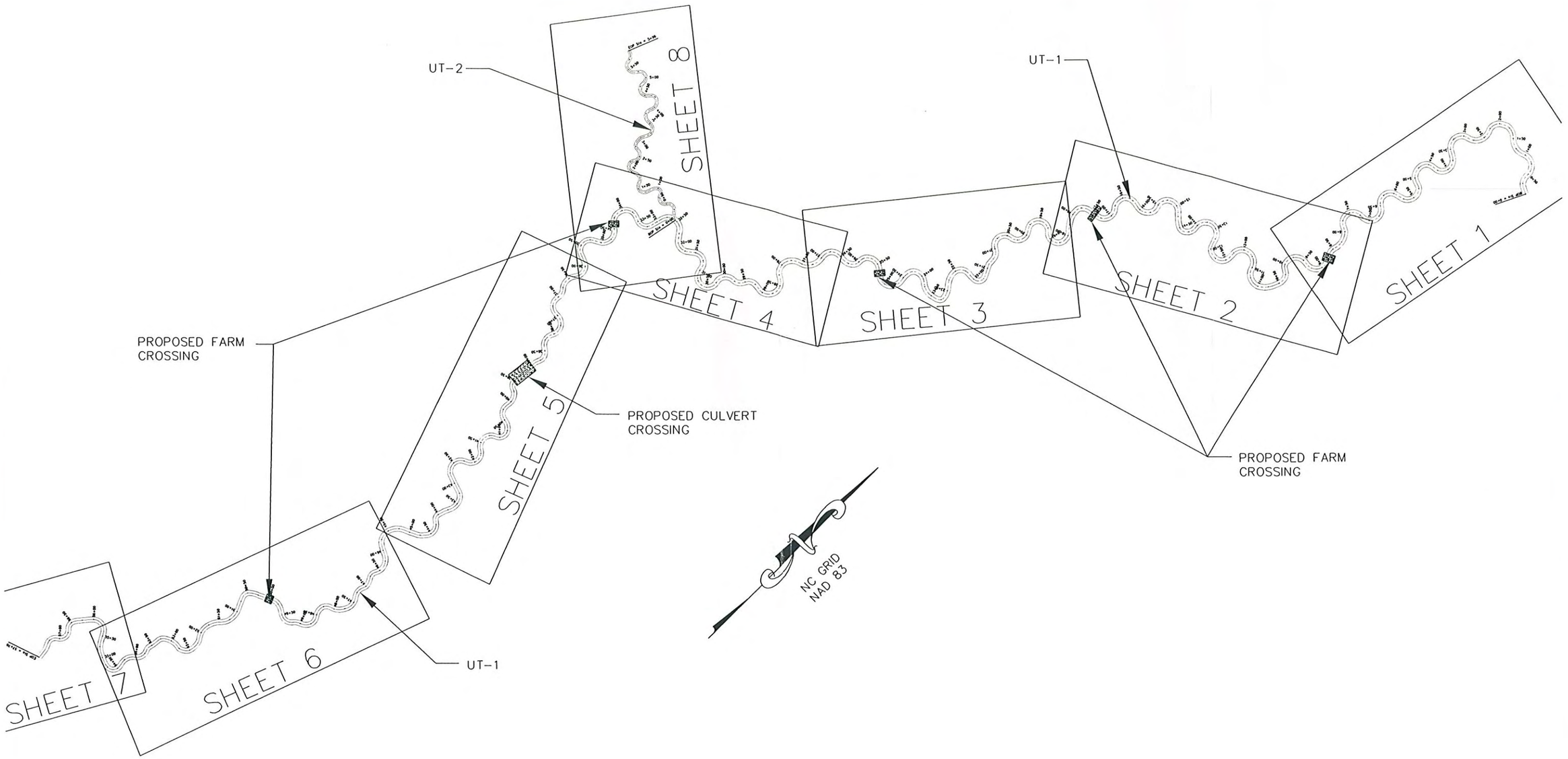
BRADY SITE XS 1-1 (RIFFLE)



Brady Site XS 1-2 (Pool)



APPENDIX G



PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
RHN	04/04
APPROVED BY	PROJECT NUMBER
SHW	30246.00.RA
FILE NAME	PLOT DATE
state_mitigation_sheets.dwg	

ENVIRONMENTAL BANC & EXCHANGE, LLC
STONEBRIDGE STEAM MITIGATION PROJECT
SHEET INDEX

EBX

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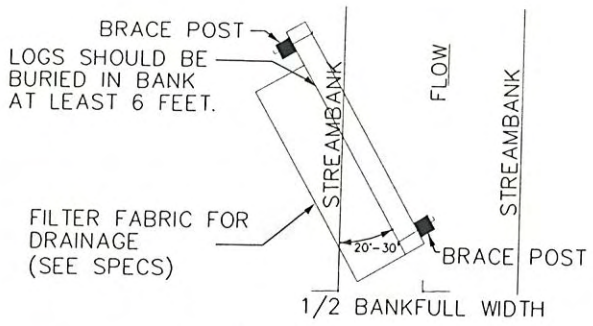
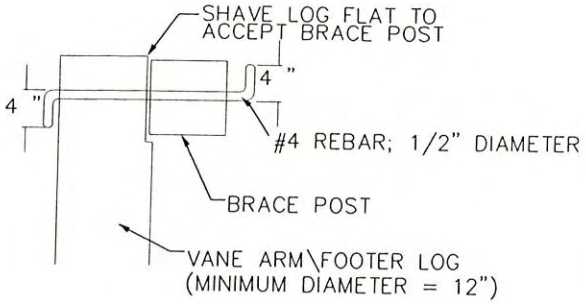
South Carolina
Georgia
Florida

APPENDIX H



PLAN VIEW



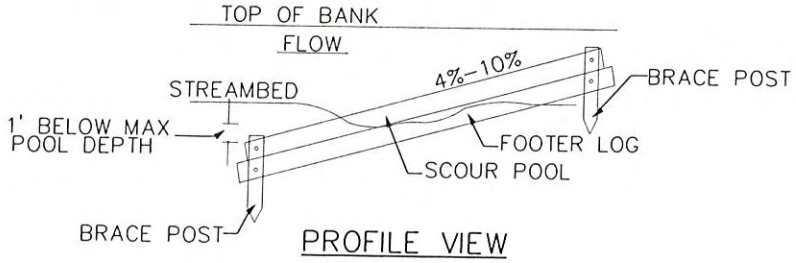
CLOSE-UP OF BRACE POST

NOTES FOR ALL LOG VANE STRUCTURES:

1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT, AND HARDWOOD.
2. CROSS LOGS SHOULD BE BURIED AT A MINIMUM OF 5 FEET INTO BANK.
3. VANE LOG ARMS SHOULD BE BURIED INTO THE BANK A MINIMUM OF 6 FEET.
4. SET ELEVATION OF TOP OF LOG CROSS PIECES TO DESIRED ELEVATION OF STREAMBED.
5. DEPTH OF FOOTER LOG SHOULD EQUAL 1.5 x MAX SCOUR DEPTH.
6. DIAMETER OF COIR LOGS SHOULD EQUAL 1/2 DIAMETER OF LOGS.
7. USE FILTER FABRIC FOR DRAINAGE AND COIR LOG TO SEAL GAPS BETWEEN LOGS.
8. NAIL FILTER FABRIC FOR DRAINAGE TO TOP OF COIR LOGS USING 3" 10d GALVANIZED COMMON NAILS WITHIN A 2' SPACING ALONG LOG.
9. NAIL COIR LOG TO VANE LOG AS SHOWN USING 8" GALVANIZED SMOOTHSPIKES ON 3' SPACING.
10. NOTCH IS FORMED BY MAKING CUTS WITH A CHAINSAW 1-2" APART AND THEN KNOCKING OUT SECTIONS WITH A CHISEL AND HAMMER.
11. ANGLE OF NOTCH SHOULD MATCH ANGLE BETWEEN LOG ARMS OF CROSS VANE AND THE STREAMBANK.

NOTES:

1. PRE-DRILL HOLES FOR REBAR WITH 5/8" DRILL BIT.
2. AFTER PLACING POSTS DRIVE REBAR THROUGH POST AND LOG AND BEND ENDS AS SHOWN.
3. REBAR MAY BE REPLACED BY LAG BOLT OR LAG SCREW WITH APPROVAL OF THE ENGINEER.



PROFILE VIEW

LOG VANE - DETAIL

NOT TO SCALE

PROJECT MANAGER: ME	DRAWING SCALE: NTS
DRAWN BY: JL	PROJECT DATE: 4/2004
APPROVED BY: SHW	PROJECT NUMBER: 3024600RA
FILE NAME: DETAILS	PLOT DATE: 4/2004

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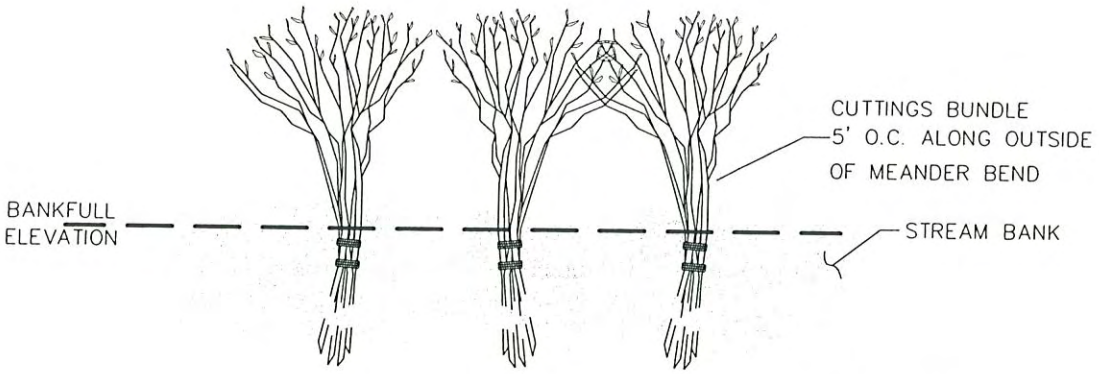
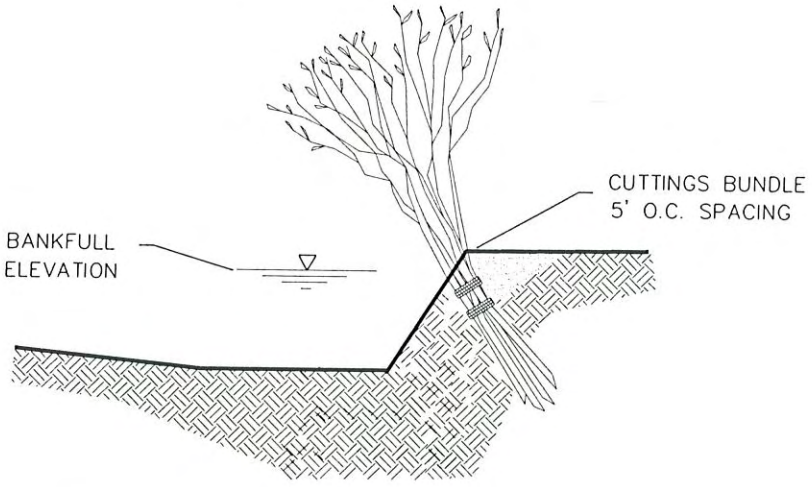


CUTTINGS BUNDLE TYPICAL PROFILE

NOT TO SCALE

NOTE: ACCEPTABLE SPECIES INCLUDE BLACK WILLOW (SALIX NIGRA) AND SILKY DOGWOOD (CORNUS AMMOMUM). 4" TO 6" DIAMETER BUNDLES OF LIVE STEMS TO BE INSTALLED AFTER SOD MATS.



CUTTINGS BUNDLE TYPICAL SECTION

NOT TO SCALE

PROJECT MANAGER: ME	DRAWING SCALE: NTS
DRAWN BY: JL	PROJECT DATE: 4/2004
APPROVED BY: SHW	PROJECT NUMBER: 3024600RA
FILE NAME: DETAILS	PLOT DATE: 4/2004

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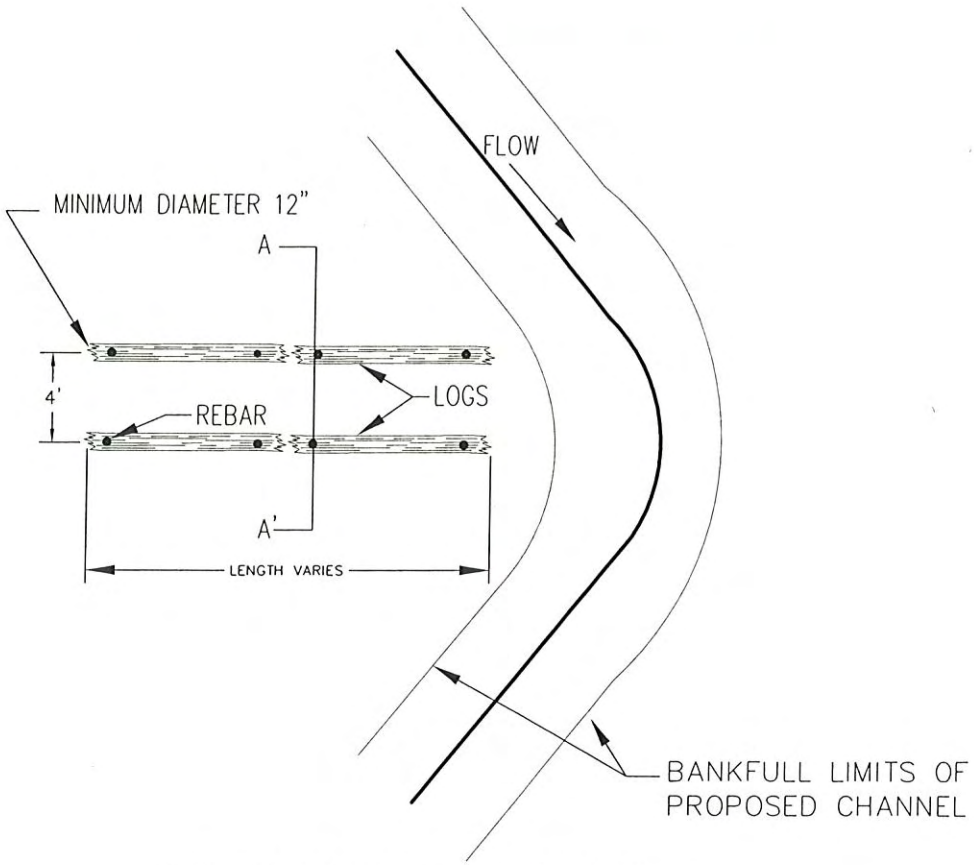
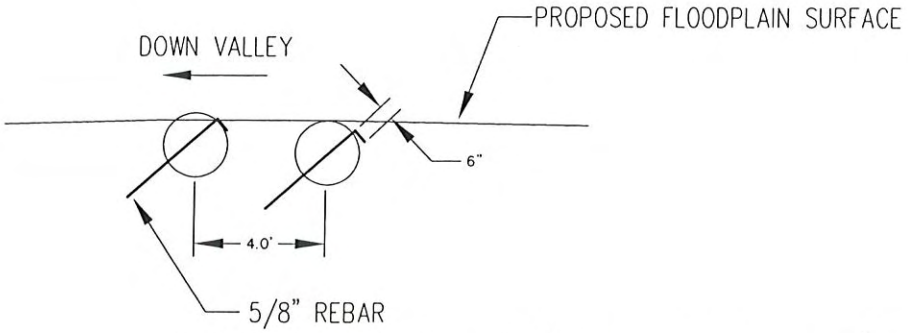


FLOODPLAIN SILL - PLAN VIEW



FLOODPLAIN SILL - SECTIONAL VIEW A - A'

FLOODPLAIN SILL

NOT TO SCALE

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

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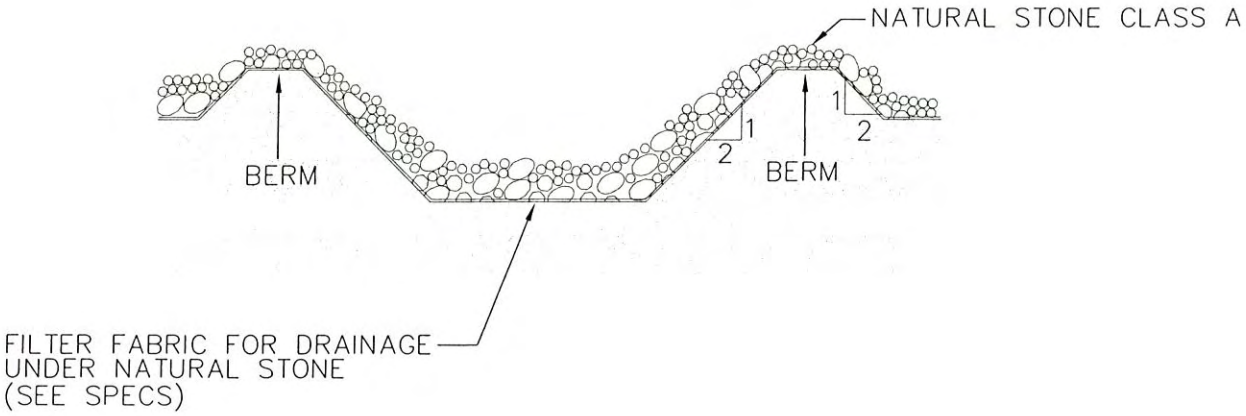

NOTES:

1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
5. GRADE SLOPES TO A 2:1 SLOPE. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF NATURAL STONE CLASS A, 6 INCHES THICK, LINED WITH FILTER FABRIC FOR DRAINAGE SHALL BE USED OVER THE BERM AND ACCESS SLOPES.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

FORD STREAM CROSSING - DETAIL

NOT TO SCALE

PROJECT MANAGER: ME	DRAWING SCALE: NTS
DRAWN BY: JL	PROJECT DATE: 4/2004
APPROVED BY: SHW	PROJECT NUMBER: 3024600RA
FILE NAME: DETAILS	PLOT DATE: 4/2004

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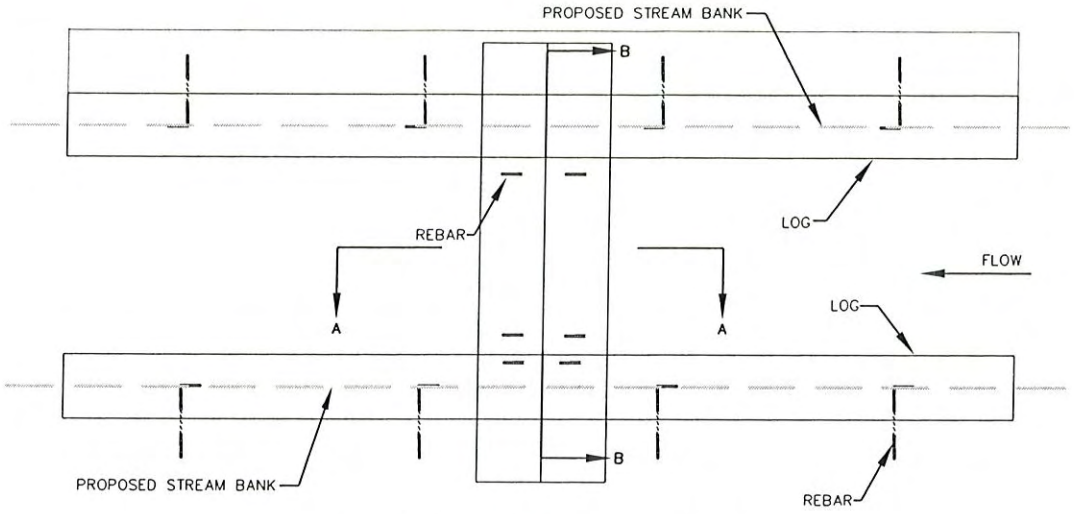
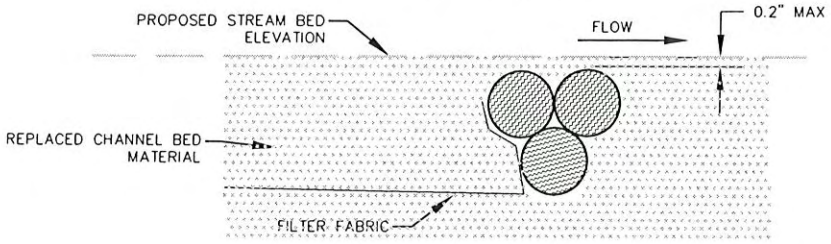


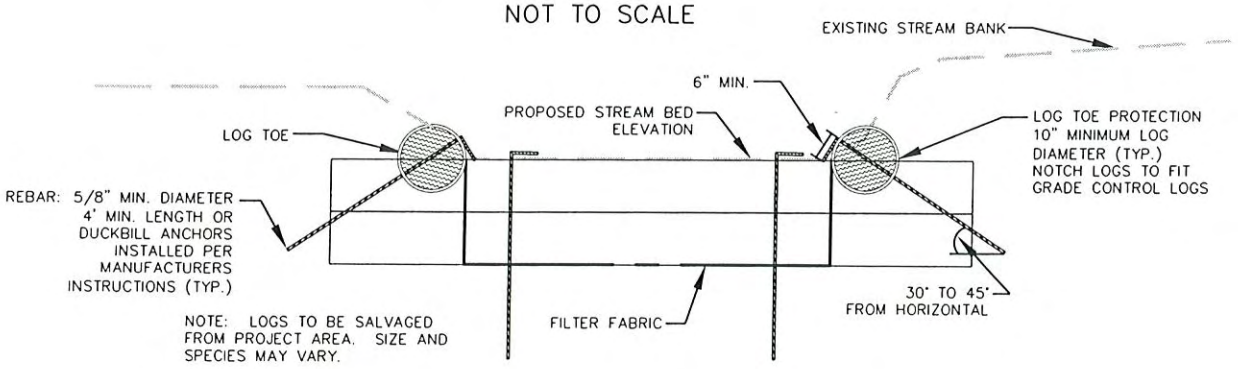
GRADE CONTROL STRUCTURE
TYPICAL PLAN VIEW

NOT TO SCALE



GRADE CONTROL STRUCTURE
SECTION A–A

NOT TO SCALE



GRADE CONTROL STRUCTURE
SECTION B–B

NOT TO SCALE

1. LOGS SHOULD BE AT LEAST 10 INCHES IN DIAMETER, RELATIVELY STRAIGHT HARDWOOD, AND RECENTLY HARVESTED.
2. NAIL FILTER FABRIC USING 3" 10D GALVANIZED COMMON NAIL EVERY 2' ALONG THE LOG

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

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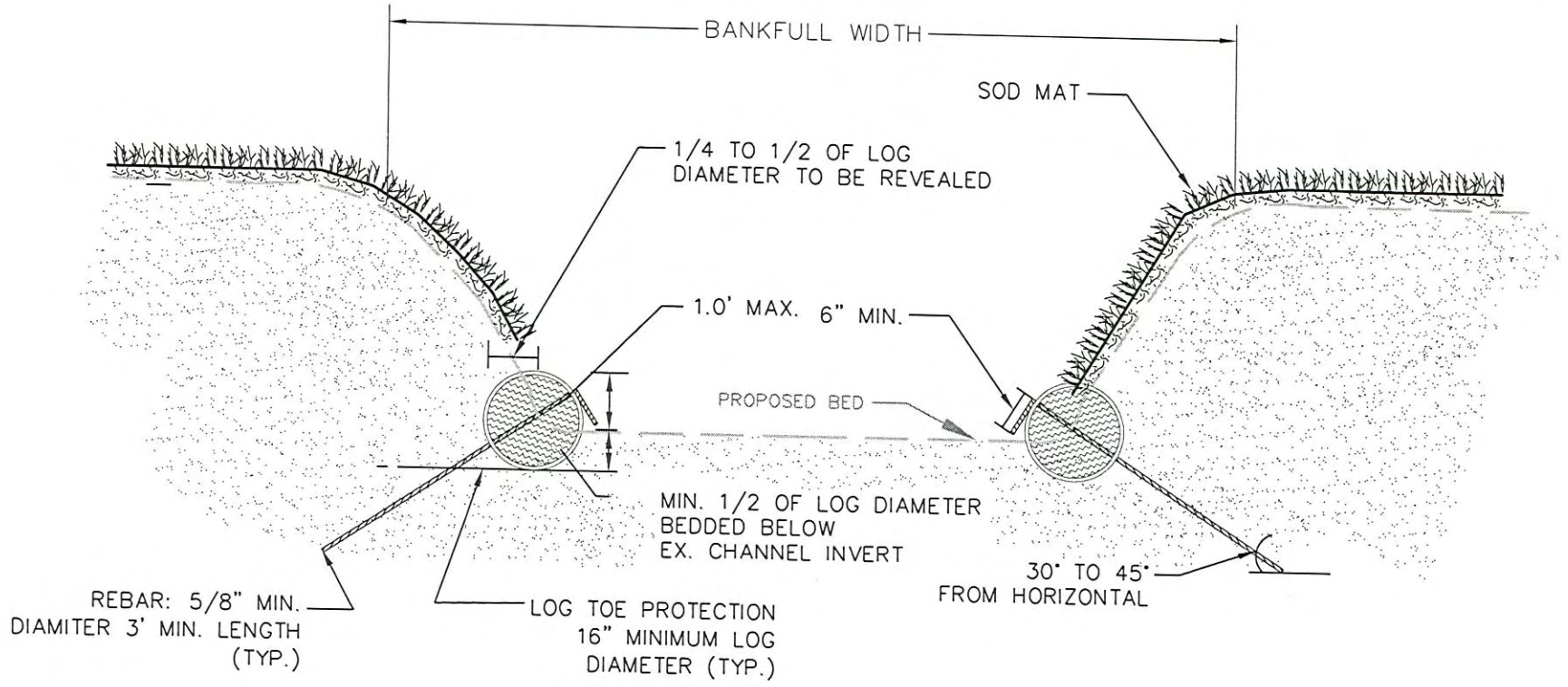

LOG TOE PROTECTION – TYPICAL DETAIL

NOT TO SCALE

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

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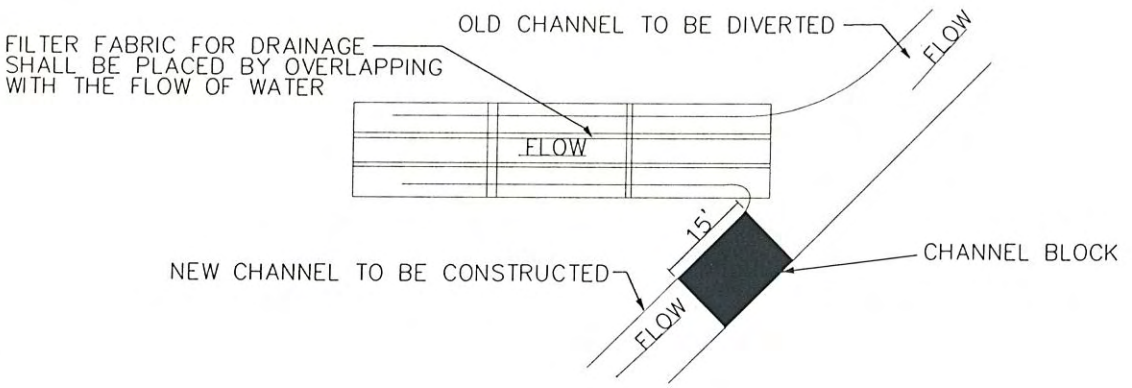
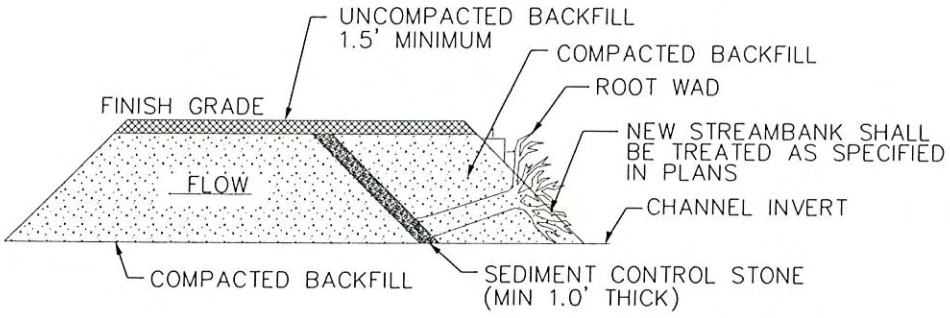
CHANNEL PLUG
PLAN VIEW



CHANNEL PLUG
PROFILE VIEW



CHANNEL PLUG- DETAIL

NOT TO SCALE

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

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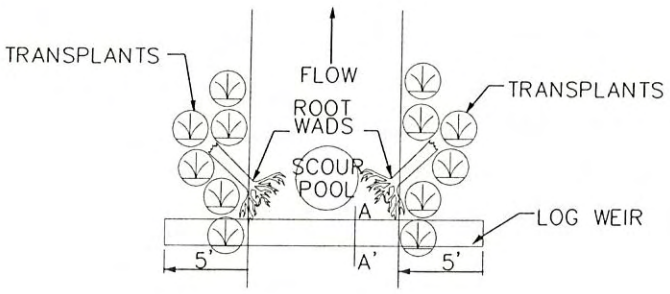
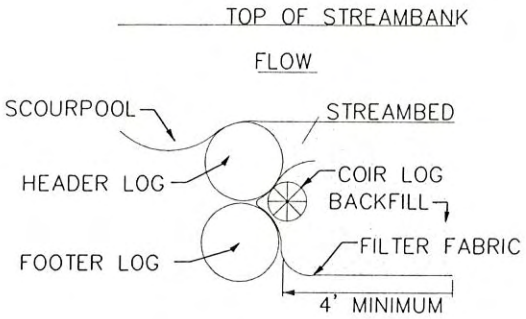
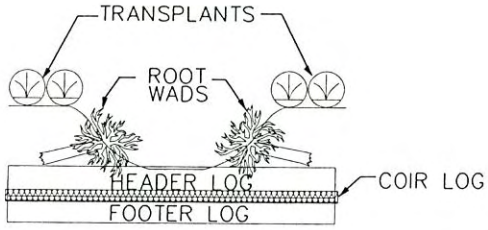


PLAN VIEW



SECTION A–A'



CROSS SECTION VIEW

NOTES:

1. LOGS SHOULD BE AT LEAST 10 INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. TOP OF HEADER LOG SHOULD BE SET AT SAME ELEVATION AS THE STREAMBED.
3. DIAMETER OF COIR LOG SHOULD BE APPROXIMATELY 1/2 DIAMETER OF LOGS.
4. USE FILTER FABRIC WITH COIR LOGS TO SEAL GAPS BETWEEN LOGS.
5. NAIL FILTER FABRIC USING 3" 10D GALVANIZED COMMON NAIL EVERY 2' ALONG THE LOG.
6. NAIL COIR LOG TO HEADER AND FOOTER LOGS USING 8" GALVANIZED SMOOTH SPIKE ON 3' SPACING.
7. PLACE ROOT WADS AS CLOSE AS POSSIBLE TO LOG WEIRS TO PROTECT AGAINST BANK EROSION.

LOG WEIR – DETAIL

NOT TO SCALE

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

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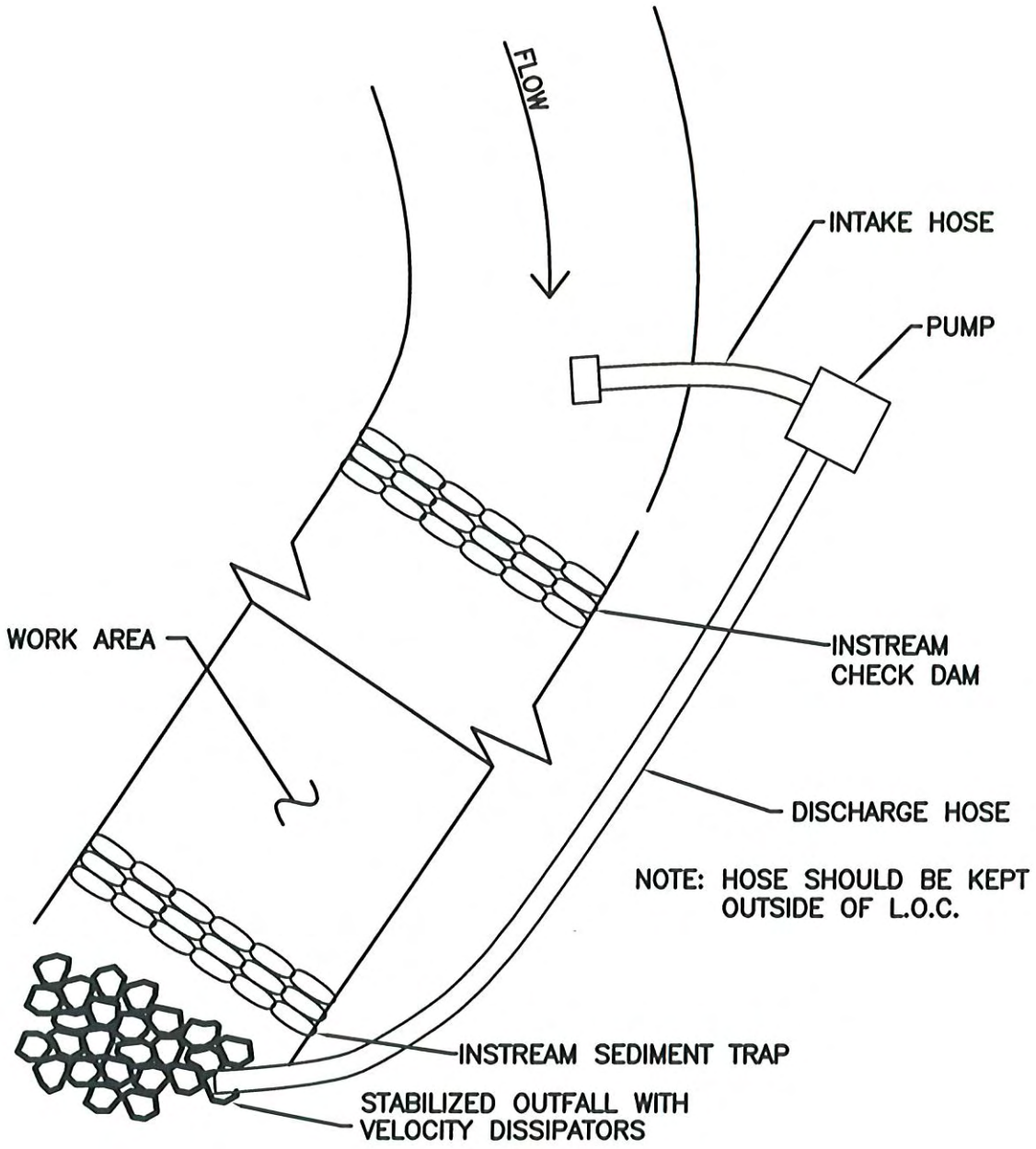

PUMP AROUND DETAIL

NOT TO SCALE

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

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(919) 782-0495

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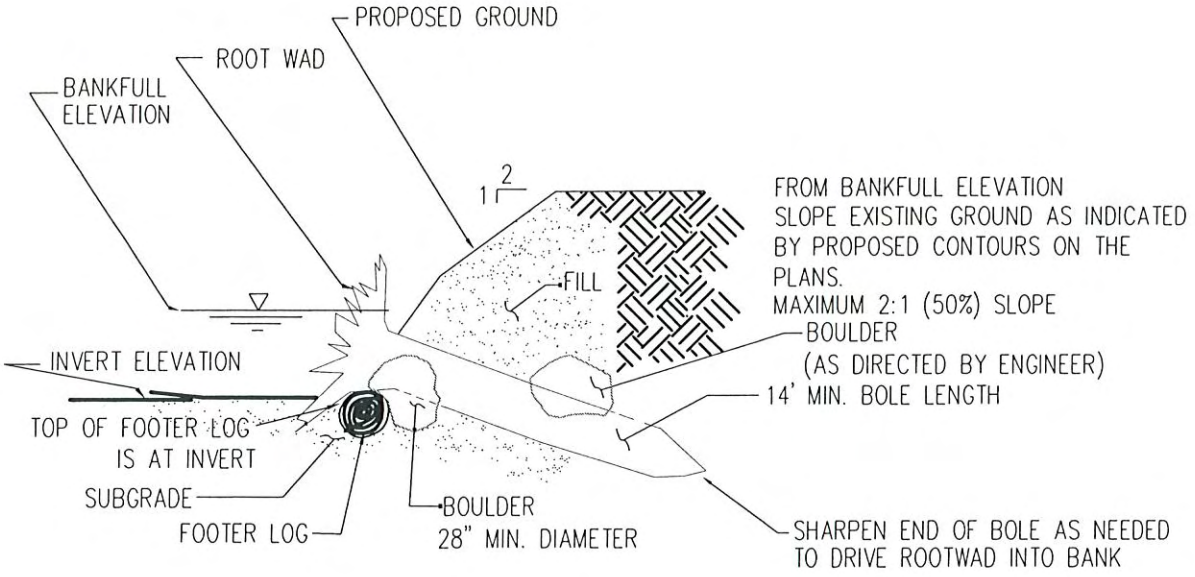
South Carolina Florida



ROOT WAD REVETMENT – TYPICAL SECTION

NOT TO SCALE

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DRAWN BY	PROJECT DATE
JL	4/2004
APPROVED BY	PROJECT NUMBER
SHW	3024600RA
FILE NAME	PLOT DATE
DETAILS	4/2004

EBX

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Office Locations:
North Carolina
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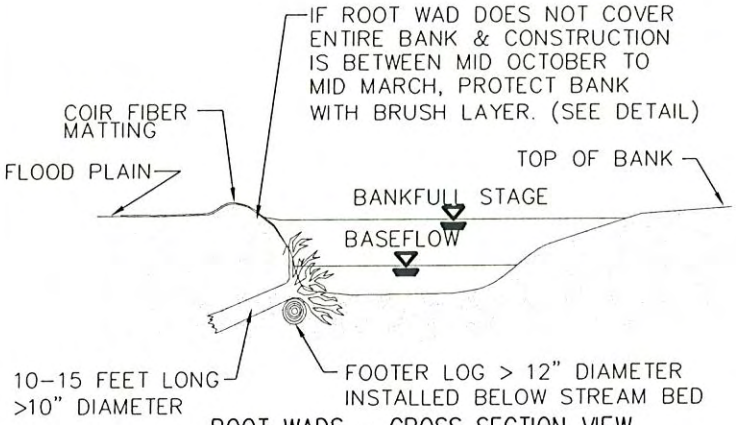
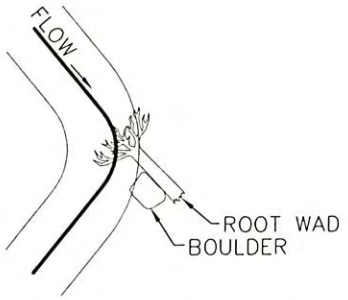


ROOT WADS - CROSS SECTION VIEW



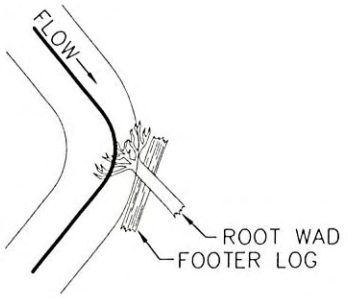
ROOT WADS - PLAN VIEW
DRIVE POINT METHOD

DRIVE POINT METHOD:

SHARPEN THE END OF THE LOG WITH A CHAINSAW BEFORE "DRIVING" IT INTO THE BANK. ORIENT ROOT WADS UPSTREAM SO THAT THE STREAM FLOW MEETS THE ROOT WAD AT A 90-DEGREE ANGLE, DEFLECTING THE WATER AWAY FROM THE BANK. A TRANSPLANT OR BOULDER SHOULD BE PLACED ON THE DOWNSTREAM SIDE OF THE ROOT WAD IF A BACK EDDY IS FORMED BY THE ROOT WAD. THE BOULDER SHALL BE APPROXIMATELY 4' X 3' X 2'.

TRENCHING METHOD:

IF THE ROOT WAD CANNOT BE DRIVEN INTO THE BANK OR THE BANK NEEDS TO BE RECONSTRUCTED, THE TRENCHING METHOD SHOULD BE USED. THIS METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. IN THIS CASE, A FOOTER LOG SHOULD BE INSTALLED UNDERNEATH THE ROOT WAD IN A TRENCH EXCAVATED PARALLEL TO THE BANK AND WELL BELOW THE STREAMBED. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.



ROOT WADS - PLAN VIEW - TRENCHING METHOD

ROOT WADS - DETAIL

NOT TO SCALE

PROJECT MANAGER: ME	DRAWING SCALE: NTS
DRAWN BY: JL	PROJECT DATE: 4/2004
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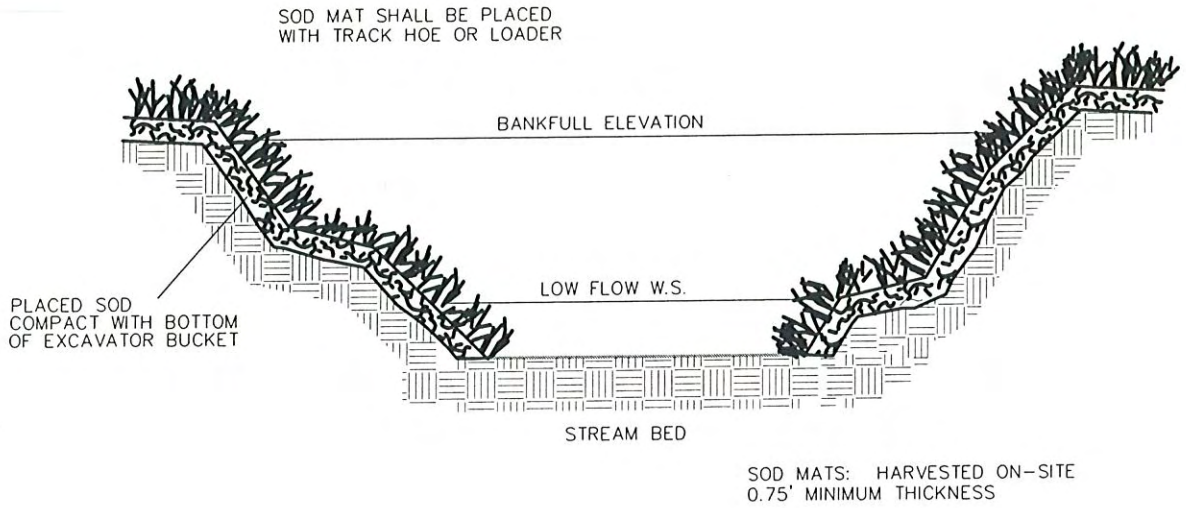

SOD MAT - TYPICAL DETAIL

NOT TO SCALE

PROJECT MANAGER	DRAWING SCALE
ME	NTS
DRAWN BY	PROJECT DATE
JL	4/2004
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