Restoration Plan

Rockwell Pastures Site

Stanly County, North Carolina

Project ID# 000624

Prepared for:

NCDENR-Ecosystem Enhancement Program

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Executive Summary

Site Description

The Rockwell Pastures Stream and Wetland Restoration Site (Site) is located 6 miles southeast of Albemarle in Stanly County (**Figure 1**). Rockwell Pastures lies within the Yadkin Basin North Carolina Division of Water Quality (DWQ) sub-basin 03-07-08 and local HUC 03040104010020. The site contains seven degraded unnamed tributaries (UT1, UT2, UT3, UT4, UT5, UT6, and UT7) to David's Creek/Lake Tillery (**Figure 2**). Lake Tillery is listed as DWQ class Water Supply (WS-IV, CA) waters. As such, these streams are considered to be WS-IV streams. The project area is located in the Carolina Slate Belt sub-ecoregion of the Piedmont ecoregion.

In response to RFP 16-D07033, the Site was proposed by EBX, LLC (EBX) and accepted by the North Carolina Division of Environment and Natural Resources (NCDENR), Ecosystem Enhancement Program (EEP) to provide stream and wetland mitigation in the Yadkin River Basin (Cataloging Unit 03040104). EBX has engaged Kimley-Horn and Associates Inc. as designer for the Site.

The upper part of the watershed currently is used for agriculture and silviculture purposes. No appropriate riparian vegetation is present because row crops are planted to the existing stream edges of the upper part of UT1, UT5, UT6 and UT7. These streams also have been directly impacted and straightened in some areas. The silvicultural activities that included direct impacts to the stream bed have completely destabilized UT4 and have resulted in a removal of native bottomland or headwater forest vegetation. Much of the buffer along the stream is in row pines, sparsely vegetated with herbaceous species, or inhabited with invasive species. The lower part of the project — which includes UT1, UT2, and UT3 — is pastureland where cattle have unlimited access to the streams. As a result, the streams are highly sedimented and contaminated with livestock waste, which is a source of BOD, fecal coliform, and nutrients among other pollutants. Most of the buffer is vegetated with fescue or other grasses with a few areas of very sparse trees. The main tributary (UT1) was completely straightened and channelized in the early 1970's, according to the landowner.

Restoration Project Goals and Objectives

The goal of this project is to restore natural stream and wetland system functions to a site highly degraded by historical agricultural activity and livestock management. Because of the size of the project and its position in the landscape, the project will address an entire watershed. The project will provide ecological functional lift to the existing system by restoring the stream and riparian habitat. It also will seek to restore and enhance non-riparian low elevation seeps. Benefits will include improved water quality by reducing sediment load through stabilization and by reducing nutrient and other pollutant input by the addition of forested riparian buffers planted with native species. Additionally, the forested buffers and reconnection with the historic flood plain or new flood plain will improve channel hydraulics and system capacity. Improvements to the ecosystem include the addition of in-stream habitat by the use of in-stream structures and bank revetments such as root wads. By providing an appropriate mix of native forest vegetation to create a canopy and understory, the soil structure will improve, a leaf litter source will be established to support aquatic and terrestrial ecosystems, and shading and cooling will be provided to improve water quality. These improvements will provide functional uplift for the watershed as a whole. Removing the riparian and wetland areas from

agriculture will reduce sedimentation and nutrient inputs. In addition, prohibiting livestock access from the stream and riparian area will improve stream function. Excluding livestock will prevent direct damage from hoof shear and animal waste discharging directly to the stream. This action will decrease sedimentation, improve bank vegetation, and reduce eutrophication and fecal coliform contamination from animal waste.

The pattern, profile, and dimension of the channel will be adjusted to approximately match regional curve values and reference reach conditions. Structures such as rock cross vanes, a-vanes, rock vanes, log sills, log vanes, single- and double-wing deflectors and bank revetments will be used to provide grade control, add habitat, and/or introduce bedform diversity. On-site wetlands will be restored and enhanced to non-riparian low elevation seep wetlands as described by *Classification of the Natural Communities of North Carolina, Third Approximation* (Schafale and Weakley 1990).

The riparian areas at this site will be planted with a combination of Piedmont/Mountain bottomland forest, Piedmont/Mountain levee forest, and Piedmont/Low Mountain alluvial forest communities as described by Schafale and Weakley (Schafale and Weakley 1990). The wetland areas will be planted with a mix of non-riparian low elevation seep herbaceous vegetation and bottomland hardwood forest vegetation.

Table 1: Project Restoration Summary

Project Stream	Existing Stream (ft)	Prop. Stream (ft)	Restoration (ft)	Enhance Level I (ft)	Enhance Level II (ft)	Preserve (ft)	Wetland Restoration (ac)
UT1	6,749	7,224	5,660	863	701	0	1.7 (W01)
UT2	635	635	0	0	635	0	0.0
UT3	717	872	872	0	0	0	0.0
UT4	4,024	5,006	3,357	982	596	72	0.0
UT5	1,075	1,075	0	0	1,075	0	0.0
UT6	1,174	1,174	0	0	1,174	0	0.0
UT7	1,313	1,419	689	0	730	0	0.0
Total Site	**15,687**	**17,405**	**10,578**	**1,845**	**4,911**	**72**	**1.7**
Total SMUs	**--**	**--**	**10,578**	**1,230**	**1,964**	**14**	**--**
Total WMUs	**--**	**--**	**--**	**--**	**--**	**--**	**1.7**

Table 2: Mitigation Unit Summary

Contract Stream Mitigation Units (SMU)	Proposed Stream Mitigation Units (SMU)	Contract Wetland Mitigation Units (WMU)	Proposed Wetland Mitigation Units (WMU)
13,427	13,786	1.5	1.7

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1.0 Project Site Identification and Location

1.1 Directions to Project Site

The Rockwell Pastures Stream and Wetland Restoration project (Site) is located 6 miles southeast of Albemarle in Stanly County, North Carolina. To drive to the Site from Raleigh, you take I-40 West and merge onto US-1 S towards Sanford. Then, you exit off U.S. 1 onto U.S. 501 S/U.S. 15 S. and continue on U.S. 501 S/U.S. 15 S until you merge onto NC-24 W/NC-27 S. Follow N.C. 24/N.C.-27 S and turn left onto Indian Mound Road/N.C. 1740. Take Indian Mound Road/ N.C. 1740 and then turn right onto Alpine Road. See **Figures 1** and **2** for the project vicinity and location maps.

1.2 USGS Hydrologic Unit Code and NCDWQ River Basin Designations

The project is located in the USGS Hydrologic Unit Code 03040104010020 and all of the project streams are located in the Yadkin Basin and the 03-07-08 NCDWQ sub-basin.

1.3 Project Vicinity Map

Please refer to **Figure 1** for the Site's vicinity map.

2.0 Watershed Characterization

2.1 Drainage Area

Table 3 provides hydrological and surface water classification information for the major project reaches.

Table 3: Drainage Area and Stream Classification

Reach	Drainage Area (mi^2)	Surface Water Classification	Stream Order
Onsite Reference (Upper UT4)	0.11	WS-IV	1
UT1-Upper	0.09	WS-IV	1
UT1-Middle	0.75	WS-IV	2
UT1-Lower	1.12	WS-IV	2
UT2	0.13	WS-IV	1
UT3	0.15	WS-IV	1
UT4-Upper	0.11	WS-IV	1
UT4-Middle	0.28	WS-IV	1
UT4-Lower	0.42	WS-IV	1
UT5	0.07	WS-IV	1
UT6	0.02	WS-IV	1
UT7	0.05	WS-IV	1

2.2 Surface Water Classification/Water Quality

The North Carolina Division of Water Quality (NCDWQ) catalogs all the Site's streams as index number 13-10-(1) and classifies them as WS-IV streams. The WS-IV classification denotes a Water Supply IV that is highly developed. The Site's streams do not appear on the 2008 North Carolina 303(d) list of impaired waters.

2.3 Physiography, Geology, and Soils

The project area is located in the Carolina Slate Belt sub-ecoregion of the Piedmont ecoregion.

This sub-region extends from southern Virginia, across the Carolinas, and into a small part of eastern Georgia. The mineral-rich metavolcanic and metasedimentary rocks with slatey cleavage tend to be finer-grained and less metamorphosed than other parts of the Piedmont and are somewhat less resistant to erosion. In North Carolina, some parts of the region are more rugged and hilly. Trellised drainage patterns also occur in parts of the region. The volcanic-sedimentary rock formations include volcanic slates, basic and acid tuffs, breccias, and interbedded flows. The

volcanic slates are deeply weathered in places, forming clay and shale, and the soils generally have high silt contents. Georgeville and Herndon soils (fine, kaolinitic, thermic Typic Hapludults) are common.

The NRCS soil survey for Stanly County maps the following soils within the site: Badin channery silt loam, Ewon very strong loam, Kirksey silt loam, Oakboro silt loam, Tatum gravelly loam, and Tatum channery silt clay.

2.4 Historical Land Use and Development Trends

2.4.1 Historical Land Use

Historically, agricultural land and forests have dominated the landscape of the watershed. The land use has been split evenly between agriculture and forest (**Restoration Table III**).

2.4.2 Development Trends

The Site's primary landowners own almost the entire watershed draining into the project streams. The area lies within a rural setting and the landowners have not expressed an interest in developing the land within the watershed. There is potential for the Dennis property to secure a permanent farm conservation easement that would preclude future development of the upper half of the watershed.

2.5 Endangered/Threatened Species

Under the provisions of Section 7 of the Endangered Species Act (ESA) of 1973, as amended, federal law requires that any action likely to affect a federally protected species adversely be subject to review by the U.S. Fish and Wildlife Service (USFWS). . The USFWS database (updated January 16, 2008) lists one federally endangered species for Stanly County: Schweinitz's sunflower (Helianthus schweinitzii). Yadkin River goldenrod (Solidago plumosa) and Georgia aster (Symphyotrichum georgianum) are identified as candidate species; however, these species do not receive federal protection. The bald eagle (Haliaeetus leucocephalus) is protected under the Bald and Golden Eagle Protection Act. Review of the Natural Heritage Program (NHP) database of documented occurrences did not reveal the presence of any of these species within a 1-mile radius of the proposed Site. Each species, its habitat, and its status are described in **Table 4.**

Schweinitz's Sunflower (*Helianthus schweinitzii*)

Schweinitz's sunflower is a perennial herb, usually 3 to 6 feet tall with yellow flowers that occur in late August to October. Schweinitz's sunflower is found in relatively open habitats such as roadsides, maintained rights-of-way, early successional fields, and woodland openings. Generally, Schweinitz's sunflower occurs on shallow, poorly drained, clayey and/or rocky soils.

Marginal habitat for Schweinitz's sunflower exists along the agricultural field edges at the Rockwell Pastures property; however, the frequent disturbance here makes these areas unfavorable. The majority of Site is used as open active agricultural fields, void of any native vegetation. The soils are predominantly deep and moderately to well-drained.

No occurrences of Schweinitz's sunflower have been documented in the NHP database within a one-mile radius of the proposed mitigation site and presence of this species has not been observed by Kimley-Horn biologists during site investigations conducted during Schweinitz's sunflower flowering season.

BIOLOGICAL CONCLUSION: NO EFFECT

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is a large raptor that typically inhabits the shorelines of large rivers, lakes, and ponds. Bald eagles construct nests in large trees near the shoreline and make use of the large water bodies for foraging.

Suitable habitat for bald eagle does not exist within the proposed mitigation areas, as there are no large bodies of water on or adjacent to the proposed project property. No occurrences of bald eagle have been documented in the NHP database within a one-mile radius of the proposed mitigation site and presence of this species or of suitable habitat for this species has not been observed by Kimley-Horn biologists during site investigations.

BIOLOGICAL CONCLUSION: NO EFFECT.

Yadkin River Goldenrod (*Solidago plumosa*)

Yadkin River goldenrod is a perennial herb, endemic to the Yadkin River in North Carolina. Currently, plants are known to exist in only two locations, within 2 kilometers of each other, along the shoreline of the Yadkin River. This species is listed as a candidate species by the USFWS.

Habitat for Yadkin River goldenrod does not exist on the Site due to the lack of flood scouring, the establishment and spread of invasive species, and the clearing of native vegetation for agricultural purposes. The majority of this site is used as open active agricultural fields, void of any native vegetation.

No occurrences of Yadkin River goldenrod have been documented in the NHP database within a 1-mile radius of the proposed mitigation site. In addition, Kimley-Horn biologists have not observed the presence of this species during investigations.

BIOLOGICAL CONCLUSION: NO EFFECT

Georgia Aster (*Symphyotrichum georgianum*)

Georgia aster is a perennial herb distinguished by its large flower heads with dark purple rays up to 2 cm long. Disc flowers are white with purplish tips on the corollas. Blooms first appear in early

October and continue into mid-November. Georgia aster is found in dry open woods, roadsides, maintained rights-of-way, and woodland openings in dry oak-pine flatwoods and uplands in the state's Piedmont region. This species is most likely a relic of the post oak-savanna communities that existed in the region prior to fire suppression. Georgia aster is listed as a candidate species by the USFWS.

Marginal habitat for Georgia aster exists along the agricultural field edges at the Site where the frequent disturbances of the site mimic natural disturbances; however, the majority of this area is used as open active agricultural fields, void of any native vegetation.

No occurrences of Georgia aster have been documented in the NHP database within a 1-mile radius of the proposed Site, and presence of this species has not been observed by Kimley-Horn biologists during investigations. The USFWS lists the record status for Georgia aster as "historic," meaning the species was last observed in Stanly County more than 50 years ago.

BIOLOGICAL CONCLUSION: NO EFFECT

Table 4: Endangered Species — Stanly County

Common Name	Scientific Name	Habitat Requirement	State Status	Federal Status	Habitat Present
Schweinitz's Sunflower	*Helianthus schweinitzii*	Open habitats such as roadsides, maintained rights-of-way, early successional fields, and woodland openings. Generally occurs on shallow, poorly drained, clayey and/or rocky soils	E	E	No
Bald Eagle	*Haliaeetus leucocephalus*	Shorelines of large rivers, lakes, and ponds	T	*	No
Yadkin River Goldenrod	*Solidago plumose*	Two known locations along the shoreline of the Yadkin River		C	No
Georgia Aster	*Symphyotrichum georgianum*	Dry open woods, roadsides, maintained rights-of-way, and woodland openings in dry oak-pine flatwoods and uplands in the state's Piedmont region		C	No

*Notes: E=Endangered; T=Threatened; * Protected under the Bald and Golden Eagle Protection Act; C=Candidate species for listing*

*The State defines an endangered **plant species** as "any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy" (GS 19B 106: 202.12).*

*The State defines an endangered **animal species** as "any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the Wildlife Resources Commission to be in jeopardy or any species of wild animal determined to be an 'endangered species' pursuant to the Endangered Species Act" (Article 25 of Chapter 113 of the General Statutes; 1987).*

2.6 Cultural Resources

A project scoping letter was sent to the State Historic Preservation Office (SHPO) on December 10, 2007 to request a review of the project for any potential impacts to cultural resources. SHPO's reply of on December 27, 2007 stated that it is not aware of any known historical resources within the project boundary that would be affected by the project. Copies of these letters are included as part of the categorical exclusion in Appendix 6.

2.7 Potential Constraints

2.7.1 Property Ownership and Boundary

The conservation easement for each unnamed tributary will be contained on one parcel. The table below provides the property owner and the easement area in acres.

Table 5: Ownership

Property Owner	Easement Area (sf)	Easement Area (acres)
Frank J. Dennis, Jr. and wife, Marie H. Dennis	9,923	0.23
Frank Dennis and wife, Wilma M. Dennis	846	0.02
Charles R. Dennis and wife, Rebecca W. Dennis	408,015	9.37
Dennis Farms, Inc.	871,080	20.00
Deese Family, LP	483,374	11.10
Reece Vane Deese and wife, Kathie Talbert Deese	379,308	8.71
Total	**2,143,738**	**49.4**

The property boundary is shown in **Figure 1** and the conservation easement boundary is shown in the **Restoration Plan Design Sheets**.

2.7.2 Site Access

Tributary UT1 could be accessed from several points where there are existing farm roads and driveways. It is anticipated that the upper part of UT1, UT5, and UT4 as well as the wetland restoration will be accessed using the main road through the Dennis farm. The lower part of UT1, UT2, UT3, and the restoration portion of UT7 will be accessed through the main road of the Reece farm. It is assumed that UT6 and the upper portion of UT7 will be accessed from the Dennis farm road. However, it also would be possible to access these streams from the main farm road.

2.7.3 Utilities

Hunsucker Surveying, P.A. located one overhead power line on the Site that has been excluded from the project with a 20 foot-wide corridor. The survey did not show an easement with this power line. The power line crosses UT4 and is assumed to serve a single residence. The site work contractor will be advised to contact North Carolina One Call prior to beginning any construction activity.

2.7.4 FEMA/Hydrologic Trespass

Based on the latest available flood mapping from NC Flood Maps, the site is outside of any mapped floodplains and should not be affected by any FEMA requirements.

There is a potential increase in flood elevations for all of the project site streams where Priority 1 restoration will be conducted. However, due to the confined nature of the stream valleys, any hydraulic trespass would potentially affect only the current landowners. No significant increase in flood elevations is anticipated. There are no anticipated downstream increases in flood elevation.

3.0 Project Site Streams

UT1 is a solid blue-line, second order stream based on the 1:24,000 USGS Topographic Map (see **Figure 2**). The channel has failing banks and is moderately to severely incised for most of its length. Much of the area of UT1 below its confluence with UT4 is open, active pasture except for a short length of approximately 375 feet of sparse woody vegetation at the bottom of the project. The presence of livestock and maintenance in the pasture have resulted in degraded and eroded stream banks. The upper portion of UT1 above the confluence with UT4 is located within active agricultural fields. Except for the 375-foot-section at the bottom of the project, the entire length of UT1 has been historically straightened and channelized, which . has contributed to the instability. The stream also is heavily sedimented. However, it does support a variety of aquatic life, including fish, crayfish, frogs, and macrobenthos. UT1 would alternately be classified as a Rosgen B and a Rosgen C with actively eroding bed and banks. The reach is considered perennial and appears to be fed by a number of headwater seeps (**Figure 4**). The perennial portion of UT1 scored from 30 in the upper reach to 48.5 on the lower reach on the NCDWQ Stream Classification Form.

UT2 is a first order stream based on the 1:24,000 USGS Topographic Map (**Figure 4**). The existing condition of UT2 is similar to that of UT1. It has been heavily impacted by livestock, is fed by an existing pond, and is a Bc channel. The stream is heavily sedimented, but contains aquatic life characteristic of perennial streams, including right-handed (gilled) snails, mayflies, bullfrog tadpoles, and minnows. The herbaceous buffer along the stream has been severely degraded by livestock access. The stream's . perennial portion scored a 32 on the NCDWQ Stream Classification Form. The low scoring of the stream is due to the impact from livestock (sedimentation and hoof-shear), which removed much of the geomorphic features that would normally be found in a stream this size.

UT3 is a small stream that has a perennial and an intermittent portion (**Figure 4**). UT3 has been heavily impacted by livestock and the buffer contains herbaceous vegetation. The short, upper portion of the stream is considered to be intermittent and would be considered an incised Rosgen E type channel. The intermittent portion is eroding and is subject to heavy sedimentation due to hoof shear and livestock access. The lower portion of the stream is alternately incised and sedimented with failing banks and has been degraded by livestock impacts such as hoof shear. The middle portion of this stream is sedimented by livestock damage to the point that it has lost its form. The entire perennial reach of the stream appears to have been historically straightened. . The perennial portion scored a 43 on the NCDWQ Stream Classification Form.

UT4 is a first order stream based on the 1:24,000 USGS Topographic Map. The upper portion of the stream is impounded by three small ponds that are fed by a perennial spring. Below the ponds, the upper portion of the stream is relatively stable; however, it is overgrown with invasive species such as the Chinese privet (*Ligustrum sinense*) and multiflora rose (*Rosa multiflora)*. This portion of the stream has an appropriate riffle-pool sequence.

The middle portion of UT4 has been impacted by silviculture. Except for a section of approximately 200 feet, the stream is extremely over-wide (width-to-depth ratio of approximately 79) and braided in most areas (see **Appendix 7** for cross sectional measurements). This has resulted in unstable banks, as the stream appears to frequently "wander" across the valley floor. It appears to have been heavily altered and the buffer recently has been removed. The area where a power line crosses the stream is excluded from the project site. Above this area is a small riparian wetland with mostly herbaceous vegetation.

The lower portion of the stream has been straightened and altered based on topographic and visual observation. Most of the banks are severely unstable as a result of the redirection of the channel. A strong and unstable head-cut separates the lower portion and middle portions of UT4. It appears to have been historically straightened. The buffers also have been cleared recently, leaving mostly sparse, new-growth vegetation. The geomorphic assessment of the lower portion of UT4 revealed that the stream is incised and is unstable because of the straightening and other alterations (see **Appendix 7**).

The upper portion of the stream scored a 35.5 using the NCDWQ Stream Classification Form and, as such, would be considered perennial for the entire length.

UT5 is located in an agricultural field and has been heavily impacted by crop production that has completely removed the buffers. Row crops are currently being planted to the stream edge resulting in heavy sedimentation. It also appears to have been straightened and channelized through periodic maintenance. The bed and banks are unstable. The stream scored a 28 on the NCDWQ rating form, making it an intermittent stream.

UT6 originates in an agricultural field and does not appear on a 1:24,000 USGS Topographic Map as a stream. The entire length is considered intermittent from its origin to its confluence with UT7. The stream is incised in its upper portions, but because of erosion and failing banks is sedimented in as the topography flattens and sediments are deposited. Row crops are being planted to the

edge of the stream resulting in heavy sedimentation. The stream scored a 28 on the NCDWQ rating form, making it an intermittent stream.

UT7 is bounded by an agricultural field and cutover forest along most of its upper portion above the confluence with UT6. The banks are unstable due to the lack of vegetation resulting in heavy sedimentation. It is also bounded by agricultural field and open pasture to just below its confluence with UT6. At this point, the stream becomes clearly perennial based on a NCDWQ score of 33 due to its lack of geomorphology, the found biology, and the fact that it is completely bounded by active pastureland that allows livestock access. The entire length of the stream appears to have been straightened. The upper portion is incised with failing banks. The lower portion becomes heavily sedimented as it enters the valley bottom and has been heavily impacted livestock access and hoof-shear. The upper portion did score a 35 on the NCDWQ rating form.

3.1 Channel Classification

Kimley-Horn performed a geomorphic survey (cross sections, longitudinal survey, and pattern) and sampled stream materials (classification and entrainment pebble counts, bar samples, sub-pavement, and pavement samples) on several reaches representative of the geomorphic settings within the project area. Table 6 below summarizes the channel classifications of the surveyed reaches within the project area, and **Restoration Table IV** provides detailed morphological data.

Table 6: Summary of Stream Classification

Assessment Reach	Drainage Area (mi^2)	Entrenchment Ratio	A_{bkf}	W_{bkf}	Width/Depth Ratio	K	Slope	Stream Type
UT1-Upper	0.09	--	--	--	--	1.01	0.0173	B5
UT1-Middle	0.75	3.9	12.4	8.9	6.4	1.02	0.0086	E5
UT1-Lower	1.12	4.9	20.7	18.2	16.0	1.01	0.0090	C4
UT2	0.13	3.1	4.8	8.3	14.3	1.00	0.0281	B4c
UT3	0.15	2.4	6.5	6.3	6.1	1.04	0.0126	E4
UT4-Upper	0.11	2.7	4.2	7.3	12.6	1.05	0.0156	C4
UT4-Middle	0.28	--	--	--	--	1.03	0.0148	F4
UT4-Lower	0.42	10.7	9.9	7.4	5.5	1.02	0.0115	E4b
UT5	0.07	3.6	5.0	5.0	5.0	1.00	0.0186	E6
UT6	0.02	2.6	0.9	2.5	6.6	1.00	0.0162	E4/E5
UT7	0.05	2.0	1.0	2.8	8.0	1.01	0.0184	B5

3.2 Channel Discharge

The peak flows for the 2-, 10-, 25-, and 100-year storms using the North Carolina rural flood-frequency equations for the Blue Ridge/Piedmont Region (United States Geological Survey 2003) are shown in **Table 7**.

Table 7: Project Site Streams Peak Discharges

Assessment Reach	Area (acres)	Bankfull Discharge* (cfs)	2yr Q (cfs)	10yr Q (cfs)	25yr Q (cfs)	100yr Q (cfs)
UT1-Upper	57.6	--	24.9	67.8	101	165
UT1-Middle	480	40.5	110	276	395	622
UT1-Lower	717	72.8	125	311	445	698
UT2	83	18.9	32.2	86.5	128	208
UT3	96	23.0	35.6	95.1	140	228
UT4-Upper (ref)	70	23.6	28.7	77.5	115	188
UT4-Middle	179	--	55.2	144	209	336
UT4-Lower	269	21.1	73.4	188	272	433
UT5	45	20.9	20.9	57.4	85.6	141
UT6	13	2.0	8.7	25.1	38.2	64.6
UT7	32	2.1	16.5	46	68.9	115

**Calculated using Manning's equation and associated "n" value for stream type.*

3.3 Channel Morphology

Most of the project's restoration reaches lack the appropriate dimension, pattern, and profile for their given valley types. These reaches were straightened and their buffers have been cleared and historically managed to maximize usable pasture and/or farmland. The channels are unstable and rarely exhibit defined riffle pool sequence and/or suitable aquatic habitat. The streams have become incised or hydrologically disconnected from the floodplains resulting in increased shear stress, velocity and the removal of hydrology from the historic adjacent riparian wetlands. **Restoration Table IV** shows complete channel morphology data including channel, pattern, dimension, and profile for all restoration and project reaches.

3.4 Channel Stability Assessment

The Site contains restoration reaches currently and historically used for pastures and farmland (Appendix 1). The vegetative buffers have been cleared and are currently open fields with some tree specimens along the banks. The streams also have been historically straightened to maximize usable land. Because of these conditions, most of the restoration reaches have down-cut, creating incised banks and accelerated bank erosion. Most of the project reaches lack the proper dimension, pattern, profile, and aquatic habitat.

Bank height ratios (that is, low bank height divided by the maximum bankfull depth) were determined for the surveyed reaches. In the methodology used for this report (Rosgen, 2001),

bank height ratios between 1.1 and 1.3 are considered "moderately unstable," ratios between 1.3 and 1.5 are considered "unstable," and bank height ratios greater than 1.5 are considered "highly unstable" (see Restoration Table IV).

3.5 Bankfull Verification

Determination of the bankfull elevation is vital to generating meaningful geomorphic values. There were sufficient bankfull indicators on-site such as benches, point bars, sediment deposits, and rack lines. The reach at the bottom of UT1 and a reach below the last dam on UT4 were used as reference streams. Cross sections of UT2 were also used to verify reference dimensions. The bankfull area values of all of the above project reaches were compared to the North Carolina Piedmont Rural regional curves (Harman, Jennings et al. 1999). The results indicate a general agreement between the three sets of values (site, references, and regional curve), thus providing a measure of validation (see Appendix 7).

3.6 Vegetation

The majority of the Site contains open agricultural row crops such as wheat or beans and pastureland. UT4 is surrounded by Loblolly pine (*Pinus taeda)* forest planted in rows for silviculture. The areas closest to the stream have been recently disturbed and colonized by herbaceous vegetation, including grasses, rushes and sedges, blackberry (*Rubus sp.*), multiflora rose, and Japanese honeysuckle (*Lonicera japonica)*. However, there are a variety of woody species present, including Green Ash (*Fraxinus pennsylvanica),* Sycamore (*Platanus occidentalis)*, Eastern red cedar (*Juniperus virginiana)*, Chinese privet, inkberry (*Ilex glabra)*, sweetgum (*Liquidambar styraciflua)*, and hickory (*Carya spp.*). Of these species, multiflora rose, Japanese honeysuckle, and Chinese privet are considered invasive.

4.0 Reference Stream

4.1 Watershed Characterization

Two on-site reference reaches were surveyed for key geomorphological parameters (Figure 7). These areas were deemed to be relatively stable with riffle pool sequences appropriate for the stream and valley type. Both of these streams lie within in the same watershed. The upper UT4 reference stream is mostly wooded and includes a series of three small ponds. UT1 watershed is partially wooded and mostly in agriculture or pastureland. The reference site on UT1 will be used for the streams with drainage areas of greater than 0.25 square miles and similar valley type, the lower parts of UT1 and UT4. The upper UT4 reference will be used for the rest of the streams that have drainage areas of less than 0.25 square miles. Geomorphic data for dimension, pattern, and profile also was gathered on UT2 since it is relatively stable. A reference cross section was taken

on a section of UT2 that is stable in both profile and dimension. Even though there is a pond upstream of this reach, the amount of stormwater storage provided by the pond did not appear to be significant enough to invalidate the data provided from surveying this stable cross section. There is no riser outlet structure on the pond, so the pond functions like a very large pool. The watershed for UT2 is also partially cutover. The data gathered from these reaches corresponded very well with the regional curve data (see **Appendix 7**). Morphological data for design was collected only from the references on UT1 and UT4. The data gathered from UT2 was only used to help validate the local curve provided by UT1 and UT4.

4.2 Channel Classification

The upper UT4 reference reach is classified as a Rosgen C4 channel; the UT1 reference reach is classified as a Rosgen C4 channel; and the UT2 reach is classified as a Rosgen B4c channel. The reference stream morphology is included in **Restoration Table IV**.

4.3 Discharge

The peak flows for the 2-, 10-, 25-, and 100-year storms were modeled for the given drainage areas. These flows were calculated using the North Carolina DOT project design discharge charts.

Table 8: Reference Stream Peak Discharges

Reference Reach	Area (ac.)	Bankfull Discharge (cfs)*	2yr Q (cfs)	10yr Q (cfs)	25yr Q (cfs)	100yr Q (cfs)
UT1-Lower (reference)	717	72.8	146.0	360.0	512.0	800.0
UT4-Upper (reference)	70	23.6	28.7	77.5	115.0	188.0

**Calculated using Manning's equation and appropriate "n" for stream.*

4.4 Channel Stability Assessment

During site inspections, the reference reach streams appeared stable with morphological measurements indicating stable dimension, pattern, and profile. These reaches are stable due to combination of vegetation along the banks; proper dimension, pattern, and profile; and access to an active floodplain. (See **Appendix 4** for photographs.)

4.5 Bankfull Verification

Determination of the bankfull elevation is vital to generating meaningful geomorphic values. There were sufficient bankfull indicators on-site such as benches, point bars, sediment deposits, and rack lines. To verify bankfull elevations, the bankfull area values for the project reference reaches were compared to the North Carolina Piedmont Rural regional curves (Harman, Jennings et al. 1999). The results indicate a strong agreement between reference reaches and regional curve data, thus providing a measure of validation (Appendix 7).

4.6 Vegetation

The riparian areas at this site should be a combination of Piedmont/Mountain bottomland forest, Piedmont/Mountain levee forest, and Piedmont/Low Mountain alluvial forest communities as described in the *Classification of the Natural Communities of North Carolina, Third Approximation* (Schafale and Weakley 1990). Two reference communities were located and are shown in **Figure 10**. Their species composition correlate well with the natural community types mentioned above. Common species in the natural communities include:

Acer floridanum, Acer negundo, Acer rubrum, Aesculus sylvatica, Asimina triloba, Betula nigra, Carpinus caroliniana, Carya cordiformis, Carya ovata, Celtis laevigata, Cornus amomum, Cornus florida, Corylus cornuta, Evonymus Americana, Fraxinus pennsylvanica, Ilex opaca, Juglans nigra, Lindera benzoin, Liquidambar styraciflua, Liriodendron tulipifera, Pinus taeda, Platanus occidentalis, Quercus imbricaria, Quercus michauxii, Quercus pagoda (falcata var. pagodaefolia), Ulmus americana, and *Xanthorhiza simplicissima*.

5.0 Project Site Wetlands

The project site includes three wetland areas (W1, W2, and W3 in **Figure 4)**. Only W2 is jurisdictional and is described in section 5.1. W1 is a proposed non-riparian wetland restoration site. It is located west of UT6, but the two do not have any hydrologic interaction. The site also is located high enough in the valley where it does not have any relevant hydrological interaction with UT1. The site receives overland flow from two ephemeral drainage ways. It also appears to interact with the groundwater table and groundwater seepage. The site is currently in agriculture and has been ditched in two directions and crowned (see photo 15 of **Appendix 1**). There is a series of ditches and crowning running parallel to the valley and one swale running perpendicular to the valley that has resulted in the effective draining of the site. The soils analysis performed by a licensed soil scientist reveals the presence of relic hydric soil features (see **Appendix 9**). As such, the site is considered a drained wetland. W3 is located near upper UT1 outside of the project easement and will be used a reference for hydrology.

5.1 Jurisdictional Wetlands

UT4 flows through one jurisdictional wetland, W2 (see Figure 5). It was delineated following the guidelines presented in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual. The center of the wetland is located at -80 8.52, 35 16.63 degrees (NAD83) and covers 0.13 acres. This area is considered a low quality wetland because of a lack of appropriate bottomland hardwood forest tree species or non-riparian low elevation seep herbaceous species. This wetland will be enhanced through supplemental plantings. The stream restoration in this area should not alter the hydrology of the existing wetland because it will maintain the existing water table.

There were no other jurisdiction wetlands identified within the easement boundaries. However, jurisdictional wetlands may be established within the pond bottoms on UT4 after they are drained.

5.2 Hydrological Characterization

5.2.1 Groundwater Modeling

The on-site hydrological reference wetland, W3, has a similar position in the valley as W1, since it is a seep that discharges to UT1, but does not receive the majority of its groundwater hydrology from UT1. As such, the reference, W3, and restoration wetland, W1, are considered to be non-riparian. Although the soils are not mapped as the same type (Oakboro silt loam in the restoration wetland versus Kirksey silt loam in the hydrologic reference wetland) the soils are similar to those of the restoration area, W1. This allows the hydrologic reference to be used as a base for comparing quantitative criteria for a simplified hydrologic budget and to compare groundwater elevations using groundwater monitoring gages. Rainfall, groundwater, and surface water inputs from respective adjacent streams, evaporation, infiltration, and ground water flows should be relatively similar for the reference site and the proposed restoration/enhancement site. The ratio of wetland area to contributing drainage area can be used as a basis to determine as one indicator that the hydrologic inputs are sufficient for the proposed restoration. The reference wetland (not including the stream inputs) to wetland area is a ratio of 15.7:1. The ratio for the restoration area is approximately 10.5:1, which is similar in magnitude. This data helps verify that the source hydrology and groundwater would support these wetlands once the hydrologic modifications are returned to reference (i.e., ditches are removed, and adjacent channels are raised to historic or reference levels). It is assumed based on the position of the reference and restoration wetlands that the hydrologic input from the closest streams would not occur except in extreme flood events.

5.2.2 Surface Water Modeling

Since the restoration wetland is non-riparian, inputs from flooding will be considered negligible. A HEC RAS analysis will be performed for UT1, but will not be used to analyze the wetland restoration.

5.2.3 Hydrologic Budget

The proposed wetland restoration area receives hydrologic inputs through hill slope seepage, connection to the groundwater table, and surface runoff. The proposed wetland restoration site has been drained by bi-directional ditching designed to drain the wetlands and improve drainage for agriculture and pasture. The wetland area also has been crowned and tilled, which has removed the microtopography. These drainage improvements have led to the draining of seepage and upslope runoff, lowering of the local groundwater table, and reduction of the length of inundation.

5.3 Soil Characterization

Kimley-Horn has engaged Soil Water & Environment Group (SWE) to provide licensed soil scientist services. SWE personnel investigated the project site to confirm NRCS soil survey mapping data for the wetland restoration location, record detailed soil descriptions for the restoration areas representing different landscape positions across the site, and to determine the extent of hydric soils for the purpose of wetland restoration site criteria. A series of hand augerings were performed across selected areas of the proposed wetland restoration site at maximum depths of approximately 18 to 24 inches. Detailed soil descriptions including depth of horizon, color, texture, structure, and consistence were recorded (Appendix 9). For areas where relic redoximorphic features occur at a depth of greater than 12 inches due to site disturbance from farming, minor grading of less than or equal to 6 inches would most likely result in a change to more hydric conditions and an elevated water table. Typically, wetland areas include soils that have a matrix with chroma 1 or 2 within the upper 12 inches.

5.3.1 Taxonomic Classification

See **Appendix 9** for the taxonomic report performed by SWE on March 9, 2007.

5.3.2 Profile Description

See **Appendix 9** for the taxonomic report performed by SWE on March 9, 2007.

5.3.3 Hydraulic Conductivity

According to the soil survey for Stanly County, the soils found onsite in the wetland restoration and hydrological reference area are moderately well drained and are moderately to slowly permeable. Saturated hydraulic conductivity (Ksat) is moderately rapid to rapid in the stratum and rapid to very rapid in the substratum. The index of surface runoff is negligible. Flooding is occasional to frequent with very brief duration.

5.4 Plant Community Characterization

The plant communities in the restoration wetland areas W1 and W3 are currently in agriculture (winter wheat). The plant community for W2 was mostly herbaceous grass, rush and sedge species. There are also Loblolly pine, Tag alder (*Alnus serrulata),* Chinese privet, and Blackberry.

6.0 Reference Wetland

6.1 Hydrological Characterization

The hydrological reference wetland area, W3, is fed by hill slope seepage, runoff, and a connection to the groundwater table.

6.2 Soil Characterization

For the purposes of the restoration, wetland W2 will be used for soil characterization, as the soil characteristics will be most similar to the restoration site. The soil characteristics are described in Section 5 (above).

6.2.1 Taxonomic Classification

See Section 5 (above).

6.2.2 Profile Description

See Section 5 (above).

6.2.3 Hydraulic Conductivity

See Section 5 (above).

6.3 Plant Community Characterization

6.3.1 Community Description

The wetland areas at this Site are non-riparian low elevation seep communities as described in *Classification of the Natural Communities of North Carolina, Third Approximation* (Schafale and Weakley 1990). Common species in these communities include: *Saururus cernuus, Impatiens capensis, Osmunda cinnamomea, Osmunda regalis, Boehmeria cylindrica,Rudbeckia laciniata, Ranunculus recurvatus, Chelone glabra, Juncus spp., and Saxifraga micranthidifolia* (Schafale and Weakley 1990). These communities also include occasional species from bottomland hardwood forests.

7.0 Project Site Restoration Plan

7.1 Restoration Project Goals and Objectives

The overall goal of this project is to effectively provide functional uplift to an entire watershed by restoring or enhancing most of the stream, wetland, and riparian areas within the watershed. The actions we plan to take to accomplish this goal will improve water quality, ecological function, and habitat and will include:

- Removing excess nutrients and sediment through the use of vegetative buffers
- Increasing dissolved oxygen concentrations through the use of in-stream structures and the turbulence they produce in pools
- Stabilizing the stream bank using natural channel design techniques
- Improving substrate through the use of structures and the elimination of major sediment sources from the stream
- Creating habitat diversity by introducing woody structures such as log vanes and/or root wads
- Reducing temperature by restoring canopy in the buffer areas
- Reconnecting streams to their adjacent floodplains and wetlands
- Raising groundwater levels in adjacent streams by raising adjacent channel bed elevation
- Removing/plugging ditches used to drain historic wetlands
- Creating micro-topography by regrading and ripping wetlands
- Breaking up historically compacted soils by cattle to allow the groundwater to come to the surface and wetland vegetation to flourish
- Improving crossings by replacing pipes and/or stabilizing outfalls
- Controlling the invasive exotics by removing them during construction
- Preserving stable on-site streams, wetlands, and riparian buffers draining into the enhancement/restoration reaches
- Excluding livestock through fencing
- Re-vegetating the stream banks, wetlands, and riparian area to improve bio-diversity and ecology
- Providing all of the above in order to restore riparian functions to the entire watershed.

Site-Specific Stream Treatments

UT1 — In order to provide functional uplift to UT1, we have divided the stream work to be performed into four types of treatment. The uppermost portion will be treated using Enhancement

Level II to establish stability. Most of the remaining reaches of the stream will be treated using restoration since the stream is incised and has been historically straightened (based on morphological data gathered and information provided by the landowners). Restoring these sections of stream using a Priority 1 restoration technique will re-connect the stream with its historical floodplain, restoring the functions of the riparian buffer. One exception to this approach is the lowest portion (approximately 375 feet) that is not incised and has a thin wooded buffer. This area will be treated using Enhancement Level II that may include some minor bank grading. The other exception is the reach along the upper portion just above the main farm road where property constraints will only allow the use of buffer planting, benches and grade control structures to provide an improved cross section and bedform (profile) step/pool features. In this section, the eastern bank of the stream will only have a 10-25 foot buffer. This concession to the landowners was necessary to secure the entire stream corridor. Enhancement Level I credit will be sought for this section.

UT2 — This small perennial stream is accessible to livestock and is located immediately below a large farm pond at the toe of a hill. The stream does not appear to have been relocated and has a relatively stable and natural morphology with a boulder substrate. As such, livestock will be fenced from the stream and native forest vegetation will be established to provide 50-foot buffers. This treatment is considered to be Enhancement Level II.

UT3 — This small perennial stream with a short intermittent section at the top. The geomorphic assessment revealed that the perennial portion of the stream does not provide appropriate dimension, pattern, or profile. It also appears to have been historically straightened. Additionally, the stream is accessible to livestock that have heavily degrading it by hoof shear and animal waste. Fully restoring this channel will provide uplift by stabilizing the stream and by providing improved stream habitat. Additionally, livestock will be excluded from the stream by fencing.

UT5 and UT6 — These small intermittent streams are located in agricultural fields. Since these systems are relatively small, it is anticipated that they can be stabilized by re-establishing a woody riparian buffer. As such, we are proposing Enhancement Level II for these streams. Providing a riparian buffer to the intermittent portions of the above streams will protect the downstream areas by removing sedimentation sources and by providing shading to reduce temperature. The stream banks along UT5 and UT6 are unstable due to agriculture and mowing down to the stream edge. A forested buffer will provide filtering for sediments and shading to reduce temperatures.

UT4 — The uppermost portion of this stream includes three small spring fed ponds. The stream will be restored through these ponds by partially removing the dam structure and allowing the stream channel to be re-established in the pond bottom. The approach is to establish the lowest, presumably flat, portions of the existing pond bottoms as the flood plain and to create a channel with the appropriate dimension, pattern, and profile. Our experience is that this approach minimizes sediment loss and rapidly re-establishes the stream and riparian corridor.

Immediately below the ponds and for a short section just above and below the existing road, the stream channel is stable with undercut banks and an appropriate riffle/pool sequence. However,

there are invasive species that are to be removed and replanted with native tree species. As such, this treatment is considered to be Enhancement Level II.

Between the above reaches, there is a reach that had been impacted by the farmer on numerous occasions using earth-moving equipment. This reach has multiple threads in some locations and the main part of the stream switches channels or forms new channels from time to time (i.e. the streams are laterally unstable). The reaches also have excessively wide width to depth ratios and are overly shallow in areas with bedrock. This area will receive a combination of Restoration and Enhancement Level I treatment by blocking the multi-threaded areas, building benches using single or double wing deflectors, and adding appropriate bed-form features using log and rock vanes. The goal of this approach is to re-create a single thread channel with an appropriate width to depth ratio that is laterally stable and has better formed riffle-pool complexes. This will greatly improve habitat and reduce sedimentation. There is a large headcut on UT4 above the confluence with UT5. From this point down, the stream is incised and highly eroded and will be restored using Priority 1 stream restoration techniques. UT4 will also be placed back into its natural valley as it enters the Reese property. The existing channel had been relocated to the west.

UT7 — This stream is intermittent above the confluence with UT6. The intermittent reach has a rocky substrate that is sedimented. Providing Enhancement Level II treatment to this portion will provide functional uplift to this biologically important stream. Providing a riparian buffer to the intermittent portions of the above streams will protect the downstream areas by removing sedimentation sources and by providing shading to reduce temperature.

The perennial reach below the confluence with UT6 has been strongly impacted by hoof-shear and nutrient inputs from livestock access. However, because of this and the fact that the stream has been historically straightened, it lacks proper dimension, pattern, and profile and will be restored using Priority 1 restoration techniques. This reach will also be fenced to exclude livestock.

Non-Riparian Wetland Restoration

The proposed non-riparian wetland restoration plan includes the restoration of 1.7 acres of non-riparian wetlands. The plan will target the restoration of a non-riparian low elevation seep (Schafale and Weakley 1990). Based on the location of the restoration site, the main source of hydrology is from seepage and overland flow. The site is currently being drained by a pattern of ditches that will be filled. Crowning will be removed and micro-topography re-established. Separate reference wetlands for hydrology and vegetation are located on-site and plantings are based on natural communities described in Shafale and Weakley (Schafale and Weakley 1990).

7.1.1 Designed Channel Classification and Wetland Type

The restored stream sections of UT1, UT3, UT4, and UT7 are proposed as Rosgen C or E streams. The Enhancement Level I and Level II sections of UT1, UT2, UT4, UT5, UT6 and UT7 are proposed as Rosgen B, C or E streams (see **Restoration Table IV**). The wetland restoration is proposed as a non-riparian low elevation seep wetland.

7.1.2 Target Wetland Communities/Buffer Communities

The riparian areas at this site are designed to be a combination of piedmont/mountain bottomland forest, piedmont/mountain levee forest, and piedmont/low mountain alluvial forest communities and the wetlands are proposed to be a non-riparian low elevation seep (Schafale and Weakley 1990).

7.2 Sediment Transport Analysis

7.2.1 Methodology

The shields curve was used to calculate the sediment transport for UT1, UT3, UT4, and UT7 because their stream bed substrate is a gravel-like material and the stream slope is steep on several of the reaches. Sediment transport was calculated using shear stress equations and shields curve to verify that the designed channel will be able to transport its bedload at bankfull without aggrading or degrading. The shields curve was used for the initiation of particle movement and to estimate the range of particles transported for a given shear stress.

Stream power was also assessed to check for unacceptable increases or decreases in stream power that could signify potential problems with the proposed channels ability to transport its sediment load. Stream power was calculated using the shear stress equation multiplied by the stream velocity to verify that the designed channel would be able to transport its bedload at bankfull without degrading.

Two physical characteristics of the channel design that affect the stream power of the channel are the slope of the channel and hydraulic radius. The shear stress equation is as follows:

$\tau = \gamma R s$

Where: τ= shear stress (lb/ft^2)

γ = specific gravity of water (62.4 lb/ft^3)

R = hydraulic radius (ft)

s = water surface slope (ft/ft)

The hydraulic radius equals the cross sectional area divided by the wetted perimeter.

$$R = \frac{A}{P}$$

Where: R = hydraulic radius

A = cross-sectional area (ft2)

P = wetted perimeter (ft)

To determine the velocity of the existing and proposed channels the Manning's equation was used:

$$v = \frac{k}{n}\left(\frac{A}{P}\right)^{(2/3)}\sqrt{S}$$

Where: v = velocity (ft/s)

k =1.49 (constant)

n = roughness coefficient

A = cross-sectional area (ft2)

P = wetted perimeter (ft)

S = average stream slope (ft/ft)

The stream power of the channel is equal to the shear stress multiplied by the velocity.

$Ps = \tau v$

Where: Ps = stream power (lbs/ft*s)

τ = shear stress (lb/ft2)

v = velocity (ft/s)

7.2.2 Calculations and Discussion

UT1, UT3, UT4, and UT7 were designed with mean depths and slopes sufficient to transport a range of particles. These channels are designed to eliminate bank erosion, flush fine particles, and transport the characteristic sediments. The characteristic sediments were determined by analyzing bed materials in comparative streams with less impacted watersheds. **Table 9** provides the results of the sediment transport calculations using the shear stress equation and Shields curve. The results show that the proposed channel should transport a range of materials that includes the existing or characteristic channel materials.

Table 9: Summary of Shear Stress Calculations

Restoration Reach	Proposed Slope (ft/ft)	Proposed Hydraulic Radius (ft)	Shear Stress (lb/ft^2)	Particle Transport Size* (mm)
UT1-Upper	0.0159	0.48	0.48	27.2
UT1-Middle	0.0071	1.02	0.45	25.5
UT1-Lower	0.0085	1.10	0.58	34.7
UT2	--	--	--	--
UT3	0.0103	0.65	0.42	23.1
UT4-Upper	0.0185	0.55	0.63	38.4
UT4-Middle	0.0147	0.82	0.75	46.6
UT4-Lower	0.0122	0.90	0.69	41.9
UT5	--	--	--	--
UT6	--	--	--	--
UT7	0.0099	0.45	0.28	15.2

The stream power was evaluated on all stream reaches. According to studies by Brookes (1991), streams with power values less than 1.0 ft-lb/sec/ft^2 fail to transport some of the finer particles such as sand. On the other hand, streams with power values greater than 3.4 ft-lb/sec/ft^2 will erode the channel. UT1 upper is slightly below 1.0 at 0.93 ft-lb/sec/ft^2, but does not have unusually large sediment loads consisting of sandy material. **Tables 10 and 11** provide the results.

Table 10: Summary of Existing Stream Power Calculations

Assessment Reach	Existing Slope (ft/ft)	Existing Hydraulic Radius (ft)	Existing Shear Stress (lb/ft^2)	Existing Stream Power (lbs/ft*s)
UT1-Upper	0.0173	0.59	0.64	2.01
UT1-Middle	0.0086	1.18	0.63	1.51
UT1-Lower	0.009	1.09	0.61	2.16
UT2	0.0299	0.55	1.03	3.79
UT3	0.0126	0.86	0.68	2.38
UT4-Upper	0.0185	0.52	0.60	3.14
UT4-Middle	0.0148	0.33	0.30	1.07
UT4-Lower	0.0115	1.11	0.80	3.22
UT5	0.0186	0.82	0.95	3.98
UT6	0.0162	0.34	0.34	0.74
UT7	0.0184	0.29	0.33	0.69

Table 11: Summary of Proposed Stream Power Calculations

Assessment Reach	Proposed Slope (ft/ft)	Proposed Hydraulic Radius (ft)	Proposed Shear Stress (lb/ft^2)	Proposed Stream Power (lbs/ft*s)
UT1-Upper	0.0159	0.48	0.48	1.44
UT1-Middle	0.0071	1.02	0.45	1.50
UT1-Lower	0.0085	1.10	0.58	2.13
UT2	--	--	--	--
UT3	0.0103	0.65	0.42	1.25
UT4-Upper	0.0185	0.55	0.63	2.27
UT4-Middle	0.0147	0.82	0.75	3.12
UT4-Lower	0.0122	0.90	0.69	2.77
UT5	--	--	--	--
UT6	--	--	--	--
UT7	0.0099	0.45	0.28	0.63

7.3 HEC-RAS Analysis

A HEC-RAS model (v. 4.0) was run to analyze the existing and proposed conditions of the project streams.

A Priority 1 stream approach was used for UT1, UT3, UT4 and UT7 to restore dimension, pattern, and profile. An Enhancement Level 1 approach was used for sections of UT4 and UT1. These approaches result in raising the streambed, creating an overall localized net rise in elevation throughout the restoration areas. For the proposed stream, the channels are designed so that the bankfull and higher flow events flood out of the channel and hydrate the surrounding floodplain.

The enhancement level II reaches of UT1, UT2, UT4, UT5, UT6 and UT7 do not raise the streambed elevations and therefore do not result in any rise in flood elevations throughout the restoration areas.

The lower reach of UT4 will be relocated back to its original valley location with a priority 1 restoration approach. This will increase the flooding frequency for this localized floodplain.

7.3.1 No-Rise, LOMR, CLOMR

None of the streams are located in FEMA mapped areas. Therefore no CLOMR, LOMR, or No-Rise certification will be required for this project.

7.3.2 Hydrologic Trespass

There is an increase in flood elevations for UT1, UT3, UT4, and UT7. All project reaches drain into David's Creek and the increase in on-site flood elevations will not increase the flood elevations of David's Creek/Lake Tillery, and, therefore, will not cause any hydrologic trespass to anyone downstream. The increase in flood elevations also is isolated to the project parcels and will not increase flood elevations upstream.

7.4 Stormwater Best Management Practices

7.4.1 Site-Specific Stormwater Concerns

The project site is situated in a rural setting. It is anticipated that the re-established riparian buffer will be a sufficient filter and treat any stormwater runoff from the adjacent fields. Non-jurisdictional areas where concentrated stormwater flows enter the easement will be captured in no-maintenance BMPs (vernal pools/level spreaders) created by grading. There are no other site-specific stormwater concerns.

7.5 Hydrologic Modification

7.5.1 Narrative of Modification

Hydrologic modifications to the non-riparian wetland restoration area will result from a combination of plugging of existing drainage ditches, removing field crowns, and providing microtopography to improve surface water infiltration.

Key hydrological components for the project's wetlands include inputs from over-land flow, groundwater seepage, infiltration of (micro-)ponded waters, and the balance of groundwater inflows and outflows. The local groundwater elevations and the balance of groundwater inflows and outflows will be increased by the removal of field crowns and removal of field ditches. The jurisdictional wetland and other potential riparian wetland "restoration" areas will be hydrologically enhanced by rising of the stream channels (in some locations), which will elevate the groundwater table and increase the frequency of overbank flooding.

7.6 Soil Restoration

Soils within the riparian restoration areas will be treated to facilitate the growth and development of plantings. The soils will be ripped or otherwise appropriated treated prior to planting to break up compacted soils and create a favorable environment for new plants. Plant nutrients and soil

amendments will be applied to the soils if deemed necessary based on the soils test report performed by the North Carolina Department of Agriculture and Consumer Services Agronomic Division for sample sites located throughout the project area.

7.7 Natural Plant Community Restoration

The goal of the riparian restoration is to provide long-term improvements to ecological functions of the existing forest community. The Restoration Plan Design Sheets have been developed to provide these functional uplifts through the re-establishment of targeted natural communities. The targeted natural communities were determined by comparing existing site conditions to established communities and verifying appropriate species in the proximate reference natural communities. Based on *Classification of the Natural Communities of North Carolina, Third Approximation* (Schafale and Weakley 1990), the site's riparian area most closely correlates to piedmont/mountain bottomland forest, piedmont/mountain levee forest, and piedmont/low mountain alluvial forest communities and the wetland community most closely correlates to non-riparian low elevation seep.

7.7.1 Reforestation Scheme

The goal of the planting scheme is to establish a riparian community consistent with the reference community, using an approach that accelerates the successional process and leads to a mature riparian community. The planting plan will use the reference plant communities discussed in the previous paragraph as a base for designing a planting scheme and developing a vegetation list.

Recolonization of cleared riparian habitats characteristically begins with the invasion of a pioneer species that creates an environment (e.g. shading) suitable for species typically found in a mature community. To initialize the proposed riparian community, the restoration area will be planted with a mix of pioneer and climax species that have been selected and arranged to meet the following objectives:

- Establish mix of shade-intolerant canopy and shade-tolerant understory species
- Provide vegetative source of dominant species
- Establish local seed sources for those species less likely to migrate into the restoration area
- Stabilize disturbed or high stress areas

Two planting zones have been developed considering site hydrology, soils, and disturbance regimes and are referenced to natural communities. Each zone has a unique environment that dictates species selection and community structure. A planting list has been developed for each zone to match the vegetation in the reference community and meet the objectives given above. The planting list only includes species that are readily available and have a reasonable expectation of survival. For a given zone and species, a plant source and planting type are

recommended. Then, a planting schedule is developed so that site preparation and plant installation occur at the optimal time and season. After installation, the planting will be verified. Finally, a maintenance plan is developed to promote long-term success of the planting. The planting plan components are described below in more detail.

7.7.2 Planting Zones

The planting plan includes five zones of distinct vegetative composition and structure.

- Zone 1 – Stream Channel and Banks (2.37 acres)
- Zone 2 – Riparian (41.74 acres)
- Zone 3 – Wet (4.24 acres)
- Zone 4 – Oxbow Wetland (0.61 acres)

The zones are mapped on the **Restoration Plan** and are described below.

Zone 1 –Stream Channel and Banks

The stream channel and banks zone includes the stream bank from base flow to bankfull. The zone features the steepest slopes (3 to 8%) of the zones and highest saturation levels. The most stressed areas are located on the outside bends of meanders. This environment dictates the planting of fast-growing, obligate pioneer species to provide stability to areas at or below bankfull.

Zone 2 – Riparian

The riparian zone encompasses the area from Zone 1 to the edge of the easement. Zone 2 is an area exposed to regular stream flows and frequent soil deposition.

Zone 3 –Wet

The wet zone includes pockets of wetter areas within zone 2 and the non-riparian wetland restoration area.

Zone 4 – Oxbow Wetlands

Oxbow wetlands include shallow ponded areas created from channels abandoned in the stream design. These areas will have standing water for extended periods and will be planted with a herbaceous wetland seed mix.

7.7.3 Plant List

The plant list (see **Restoration Table V**) is based on the target community, reference community, and recommendations from the North Carolina Stream Restoration Institute (Hall 2001) and the North Carolina Ecosystem Enhancement Program (Smith 2004). The selection of species also depends on availability from local nursery sources.

7.7.4 Plant Sources

The planting plan preferentially selects local genetic stock and uses three sources of plants. Two sources — nursery stock and on-site transplants — will be tied directly to the initial planting and will be used in numbers that will meet permit guidelines. The remaining source — recruitment — is factored into the selection of species on the plant list, as the plant list includes a significant portion of species not likely to become established from natural propagation.

Nursery Stock

The planting plan may include any of the following nursery stock forms of woody species: bare roots, containerized seedlings, and ball and burlap. Additionally, the plan may use sod or seeds from commercial sources. The planting plan prescribes that nursery stock be grown under environmental conditions similar to the target environment. The planting list includes alternates in case specific species of pre-ordered plants are not available or acceptable for installation.

On-Site Transplants

Several favorable species grow within the existing site. In the course of constructing a new channel alignment, some individual plants may need to be removed. The individuals of a target species that are of an appropriate size and age may be transplanted into the restoration area.

Recruitment

It is expected that the restoration sites will be populated with species from adjacent communities. The sites will be maintained to keep the number of unwanted species at less than 10% of the total population.

7.7.5 Schedule

The planting plan will be scheduled around stream construction activities and growing season. Special attention will be given to stabilizing disturbed areas that include newly constructed channels and temporary construction easements. The final vegetation planting will occur after proper site preparation (described below) and during the appropriate season.

Plantings may be staggered based on surrounding activities. Live stake planting on stream banks (Zone 1) will closely follow after channel construction to provide immediate stabilization. On-site transplants will be planted immediately after they are removed from their existing habitat. Planting of Zones 2-4 will occur from late winter to early spring, after construction, to minimize or eliminate threats from the construction, exotic vegetation treatment, and/or unpredictable weather.

7.7.6 Stabilization

Immediately after construction, the stream banks and all disturbed areas will be seeded with permanent and temporary seed mixes. If the season is appropriate, permanent seeding will be completed in conjunction with construction, and temporary seeding will be applied according to Land Quality Section requirements. Within the stream channel (Zone 1), pioneer species that provide immediate bank stabilization will be planted. Live stakes and bare roots will be planted around structure installations and the outsides of meander bends to provide an area of high-density root mass. Coir fiber matting and live stakes will be used along the entire reach of the restored channels to provide stabilization until vegetation can be established.

7.7.7 Site Preparation

Prior to planting the riparian buffer, efforts will be made to eradicate fescue and invasive plants such as multiflora rose, Chinese privet, and Japanese honeysuckle. A permanent seed mix can be used after application of the pre-emergent, and woody planting can follow during the dormant season.

7.7.8 Planting Review

After the final planting is complete, the planting supervisor will verify that the site was properly planted using stem counts and condition inspection. The planting contractor will be responsible for replacing damaged plants.

7.7.9 Monitoring and Maintenance

Monitoring will verify that the restoration area is meeting restoration goals. Damaged plants will be removed and if the planting survival fails to meet restoration goals, replanting will occur. If monitoring indicates that an area is trending toward greater than 10% coverage by nuisance vegetation, that area will be treated to remove the nuisance vegetation.

8.0 Performance Criteria

8.1 Stream Success Criteria

The stream geometry will be considered successful if the cross-section geometry, profile, and sinuosity are stable or reach a dynamic equilibrium. It is expected that there will be some changes in the designed cross sections, profile, and/or substrate composition. Changes that may occur during the monitoring period will be evaluated to determine whether they represent a trend toward a less stable condition (e.g., down cutting, erosion, etc.) or are simply an increase in stability (e.g., settling, vegetative changes, coarsening of bed material, etc.).

An initial, though not exclusive, indicator of success will be the stream's adherence to design or reference ratios of stream geometry found in the morphological tables (**Restoration Table IV)** or in

comparable stable reference systems. The channel may not adhere to design or reference ratios of stream geometry, but can be considered stable if the following key indicators are present:

- Stream Type: Maintenance of the design stream type or progression toward or conversion to a stable stream type such as B, C, or E will indicate stability.
- Bank Height Ratio: Bank height ratio between 1.0 and 1.2 will indicate that flood flows have access to the active floodplain and that higher flows do not apply excessive stresses to stream banks.

Stream channel geometry will be assessed each year during the monitoring period using monitoring locations established during the as-built evaluation (see section 8.4). The assessment includes permanent cross sections and longitudinal profiles of the restored reaches. Photographs will be taken for each cross section, vegetation quadrants, and permanent photo points. The restored reaches will be visually assessed for channel and in-stream structure stability. Channel materials will be sampled for at least six cross sections.

Determination of true bankfull may be difficult until the stream has had adequate flooding events to create strong bankfull indicators. A minimum of two bankfull events is required during the 5-year monitoring period. If two bankfull events do not occur the monitoring period may be extended at the discretion of the Corps of Engineers.

If a large storm event occurs before the woody vegetation has been established, isolated bank erosion may occur in sections where the flood-prone area has been restricted by topography. Areas of bank erosion will be repaired as necessary.

The middle section of UT4 and the upper section that are currently impounded will receive a non-typical stream restoration treatment described in Section 7.0. In these cases the stream cross sections, profile and pattern will not necessarily be constructed to the typical cross section, profile and pattern measurements provided in the morphological measurements table and typical plans. However, it is anticipated that these areas will form naturally and remain stable during the process.

8.2 Wetland Success Criteria

The success of wetland restoration will be measured by comparing the restored wetlands with similar, more functional wetlands with respect to vegetation, soils, and hydrology. Success criteria is summarized in the following sections.

8.2.1 Hydrology

Success of the restoration of wetland hydrology will be measured by improvements to the frequency and duration of saturated soils compared to the reference wetland. Successful wetland hydrology is defined as the saturation of soils for a period equal to or greater than 85% of the period measured in the reference wetland. The minimum requirement for the restoration wetland hydrology will be the USACE guidelines (United States Army Corps of Engineers,

1987) including saturation of the upper surface of the soils for 7% of the growing season. The hydroperiod of the reference wetland will be measured using groundwater gauges.

8.2.2 Vegetation

The prevalent vegetation should consist of macrophytes that typically are adapted for life in saturated soil conditions. These species should have the ability to grow, compete, reproduce, and persist in anaerobic soil conditions. For the restoration areas, study plots showing that the composition and density of vegetation in the restoration areas that compare to the reference areas will indicate restoration success for vegetation.

8.2.3 Soil

A primary measure of the enhancement and restoration of wetland soils will be the establishment of hydric character as defined by USACE guidelines (United States Army Corps of Engineers 1987). Soil enhancement and restoration also may be inferred based on successful enhancement and restoration of wetland hydrology and vegetation.

8.3 Vegetation Success Criteria

The success of riparian and vegetation planting will be gauged by stem counts of planted species. Stem counts of more than 320 trees per acres after three years, and 260 trees per acre after five years will be considered successful. Photos taken at established photo points should indicate maturation of riparian vegetation community.

8.4 Schedule/Reporting

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by The Stream Mitigation Guidelines disseminated by the United States Army Corps of Engineers – Wilmington District (McLendon, Fox et al. 2003) and recommendations from the Ecosystem Enhancement Program (EEP). The collection and summarization of monitoring data will be conducted in accordance with the version of the EEP documents titled “Content, Format, and Data Requirements for EEP Monitoring Reports” stated in the RFP.

Upon completion of the restoration project, an as-built evaluation will be conducted that documents the following conditions:

- Geomorphology (dimension, pattern, and profile)
- Channel materials
- Channel stability and in-stream structure functionality
- Vegetation
- Wetland hydrology (gauge settings)

The survey of channel dimension will consist of permanent cross sections placed at approximately two cross sections per unique stream segment. The cross sections will represent riffles and pools with a majority of the cross sections assessing riffles. Annual photographs showing significant site features will be taken from permanent, mapped photo points. The survey of the longitudinal profile will represent distinct areas of restoration and will cover at least 3,000 linear feet of channel per reach. The profile survey will include pattern measurements and include all permanent cross sections. Channel material measurements will be collected by using pebble counts for at least six of the permanent cross sections.

The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped, and photographed. All structures will be inventoried for functionality and photographed.

Wetland hydrology will be measured using groundwater gauges installed on-site and within the reference sites. The gauges will sample groundwater elevations continuously throughout the monitoring period.

Successful restoration of the vegetation on a stream and wetland mitigation site is dependent upon hydrologic restoration, active planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, vegetation monitoring quadrants will be installed throughout the restoration site. The number of quadrants required will be based on the species/area curve method with a minimum of at least three quadrants. The cumulative size of installed quadrants will cover approximately 1.0% of the restoration site. The individual quadrants will be 0.01 hectare (100 square meters) in size. Vegetation monitoring will occur in spring after leaf-out has occurred. Individual quadrant data will be provided and will include diameter, height, density, and coverage quantities. Relative values will be calculated and importance values will be determined. Individual seedlings will be marked such that they can be found in succeeding monitoring years. Mortality will be determined by 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 are achieved, the restored site will be evaluated between July and November.

The monitoring will occur annually for five years. The monitoring period should include two separate years with bankfull events. Bankfull events will be verified using an installed crest gauge that will be inspected during each monitoring visit. If a bankfull event has not been documented by the end of the second year of monitoring, a mandatory quarterly check will be required. If there are not two bankfull events, the monitoring period may be extended at the discretion of the Corps of Engineers, Raleigh Regulatory Field Office Project Manager and the NCDWQ 401-Wetlands Unit. Monitoring reports will be submitted during every year for years 1-5.

9.0 References

Hall, Karen (2001). Recommended Native Plant Species for Stream Restoration in North Carolina. Raleigh, NC, North Carolina Stream Restoration Institute NCSU.

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10.0 Restoration Tables

Table I: Project Enhancement / Restoration Structure and Objectives

Assessment Reach[1] (Design Reach)	Station Range	Mitigation Type	Priority Approach (Rosgen)	Existing Linear Footage	Designed Linear Footage
UT1-Upper	100+00 to 102+92	Enhancement Level II	--	292	292
UT1-Upper	103+32 to 107+68	Restoration	I	416	436
UT1-Upper	107+68 to 116+31	Enhancement Level I	--	868	863
UT1-Upper	116+70 to 134+00	Restoration	I	1,304	1,729
UT1-Middle	134+00 to 154+50	Restoration	I	2,055	1,999
UT1-Lower	154+50 to 169+80	Restoration	I	1,405	1,496
UT1-Lower	169+80 to 174+14	Enhancement Level II	--	409	409
UT2	200+00 to 206+35	Enhancement Level II	--	635	635
UT3	300+00 to 308+72	Restoration	I	717	872
UT4-Upper	400+00 to 407+49	Special Restoration	I/II	--	749
UT4-Upper	480+00 to 480+72	Preservation	--	72	72
UT4-Upper	407+36 to 411+00	Enhancement Level II	--	364	364
UT4-Upper	411+00 to 415+06	Enhanc Level I/Restoration	--	400	406
UT4-Middle	415+06 to 417+73	Enhancement Level II	--	245	245
UT4-Middle	417+73 to 433+00	Enhanc Level I/Restoration	--	1,489	1,557
UT4-Middle	433+00 to 436+37	Restoration	I	327	337
UT4-Lower	436+37 to 449+26	Restoration	I	1,127	1,289
UT5	500+00 to 510+75	Enhancement Level II	--	1,075	1,075
UT6	600+00 to 611+73.89	Enhancement Level II	--	1,174	1,174
UT7	700+00 to 707+30	Enhancement Level II	--	730	730
UT7	707+30 to 714+39.41	Restoration	I	583	689
W01	--	Restoration	--	--	1.7 (acres)

Table II: Drainage Area and Stream Classification

Reach	Drainage Area (mi^2)	Surface Water Classification	Stream Order
UT1-Upper	0.09	WS-IV	1
UT1-Middle	0.75	WS-IV	2
UT1-Lower	1.12	WS-IV	2
UT2	0.13	WS-IV	1
UT3	0.15	WS-IV	1
UT4-Upper (onsite reference)	0.11	WS-IV	1
UT4-Middle	0.28	WS-IV	1
UT4-Lower	0.42	WS-IV	1
UT5	0.07	WS-IV	1
UT6	0.02	WS-IV	1
UT7	0.05	WS-IV	1

Table III: Existing Land Use / Land Cover of the Watershed

Land Cover	Coverage
	1998
Agriculture	49%
Forest	51%

TABLE IV: MORPHOLOGICAL DATA

Rockwell Pastures

	VARIABLES	Onsite Reference Reach UT4[3]		Existing UT1 Upper		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT1-Upper Restoration		Existing UT1 Middle		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT1-Middle		Existing UT1 Lower		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT1-Lower	
	STATION	--		10+00 to 44+00		--		103+03 to 134+00		44+00 to 63+00		--		134+00 to 154+50		63+00 to 81+73.57		--		154+50 to 174+27.66	
1.	Stream Type (Rosgen)	C4		B5		C/E		B5		E5		C/E		C4		C4		C/E		C4	
2.	Drainage Area (sq. mile)	0.11		0.09		0.09		0.09		0.75		0.75		0.75		0.90		0.9		0.9	
3.	Bankfull Width	**Mean:**	7.3	**Mean:**	N/A[2]	**Mean:**	4.2	**Mean:**	6.3	**Mean:**	8.9	**Mean:**	10.5	**Mean:**	15.0	**Mean:**	18.2	**Mean:**	11.4	**Mean:**	16.6
	(W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
4.	Bankfull Mean	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	0.7	**Mean:**	0.5	**Mean:**	1.4	**Mean:**	1.4	**Mean:**	1.1	**Mean:**	1.1	**Mean:**	1.5	**Mean:**	1.1
	depth (d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
5.	Width/Depth Ratio	**Mean:**	12.6	**Mean:**	N/A[2]	**Mean:**	6.1	**Mean:**	12.7	**Mean:**	6.4	**Mean:**	7.7	**Mean:**	14.3	**Mean:**	16.0	**Mean:**	7.8	**Mean:**	14.6
	(W_{bkf}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
6.	Bankfull cross-sectional	**Mean:**	4.2	**Mean:**	N/A[2]	**Mean:**	4.2	**Mean:**	3.1	**Mean:**	12.4	**Mean:**	17.6	**Mean:**	15.8	**Mean:**	20.7	**Mean:**	19.9	**Mean:**	18.9
	Area (Abkf)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
7.	Bankfull Mean Velocity	**Mean:**	5.6	**Mean:**	N/A[2]	**Mean:**	3.8	**Mean:**	3.0	**Mean:**	3.3	**Mean:**	4.1	**Mean:**	3.3	**Mean:**	3.5	**Mean:**	4.1	**Mean:**	3.7
	(V_{bkf})	Range:	5.2 6.1	Range:		Range:	-- --	Range:	2.7 3.4	Range:	3.0 3.7	Range:	-- --	Range:	3.0 2.3	Range:	3.0 4.3	Range:	-- --	Range:	3.3 2.5
8.	Bankfull Discharge[1], cfs	**Mean:**	23.6	**Mean:**	N/A[2]	**Mean:**	15.7	**Mean:**	9.4	**Mean:**	40.5	**Mean:**	72.4	**Mean:**	52.5	**Mean:**	72.8	**Mean:**	82.5	**Mean:**	69.0
	(Q_{bkf})	Range:	21.7 25.8	Range:	-- --	Range:	-- --	Range:	8.5 10.5	Range:	36.6 45.3	Range:	-- --	Range:	47.5 35.5	Range:	61.9 88.4	Range:	-- --	Range:	62.4 46.6
9.	Bankfull Maximum Depth	**Mean:**	1.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.8	**Mean:**	1.8	**Mean:**	--	**Mean:**	1.5	**Mean:**	2.0	**Mean:**	--	**Mean:**	1.6
	(d_{max})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
10.	Max d_{max}/d_{bkf}	**Mean:**	1.9	**Mean:**	N/A[2]	**Mean:**	1.4	**Mean:**	1.6	**Mean:**	1.3	**Mean:**	1.4	**Mean:**	1.4	**Mean:**	1.7	**Mean:**	1.4	**Mean:**	1.4
	ratio	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --
11.	Low Bank Height to max	**Mean:**	1.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	1.6	**Mean:**	1.2	**Mean:**	--	**Mean:**	1.0	**Mean:**	1.5	**Mean:**	--	**Mean:**	1.0
	d_{bkf} ratio	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
12.	Width of Flood Prone	**Mean:**	20.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	110.7	**Mean:**	34.2	**Mean:**	--	**Mean:**	157.0	**Mean:**	89.0	**Mean:**	--	**Mean:**	206.0
	Area (W_{fpa})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	17.4 204	Range:	-- --	Range:	-- --	Range:	39.0 396	Range:	-- --	Range:	-- --	Range:	43.0 369
13.	Entrenchment Ratio	**Mean:**	2.7	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	17.6	**Mean:**	3.9	**Mean:**	--	**Mean:**	10.5	**Mean:**	4.9	**Mean:**	--	**Mean:**	12.4
	(W_{fpa}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
14.	Meander Length	**Mean:**	13.6	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	72.5	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	172.5	**Mean:**	267.0	**Mean:**	--	**Mean:**	190.9
	(L_m)	Range:	10.2 17.0	Range:	-- --	Range:	-- --	Range:	56.7 88.2	Range:	-- --	Range:	-- --	Range:	135.0 210.0	Range:	-- --	Range:	-- --	Range:	149.4 232.4
15.	Ratio of Meander Length to	**Mean:**	1.9	**Mean:**	NA[2]	**Mean:**	11.5	**Mean:**	11.5	**Mean:**	NA[2]	**Mean:**	11.5	**Mean:**	11.5	**Mean:**	14.7	**Mean:**	11.5	**Mean:**	11.5
	Bankfull Width (L_m/W_{bkf})	Range:	1.4 2.3	Range:	-- --	Range:	9.0 14.0	Range:	9.0 14.0	Range:	-- --	Range:	9.0 14.0	Range:	9.0 14.0	Range:	-- --	Range:	9.0 14.0	Range:	9.0 14.0
16.	Radius of Curvature	**Mean:**	9.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	17.3	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	41.3	**Mean:**	121.3	**Mean:**	--	**Mean:**	45.7
	(R_c)	Range:	5.3 12.6	Range:	-- --	Range:	-- --	Range:	15.8 18.9	Range:	-- --	Range:	-- --	Range:	37.5 45.0	Range:	41.1 130.5	Range:	-- --	Range:	41.5 49.8
17.	Ratio of Radius of Curvature	**Mean:**	1.2	**Mean:**	NA[2]	**Mean:**	2.8	**Mean:**	2.8	**Mean:**	NA[2]	**Mean:**	2.8	**Mean:**	2.8	**Mean:**	6.7	**Mean:**	2.8	**Mean:**	2.8
	to Bankfull Width (R_c/W_{bkf})	Range:	0.7 1.7	Range:	-- --	Range:	2.5 3.0	Range:	2.5 3.0	Range:	-- --	Range:	2.5 3.0	Range:	2.5 3.0	Range:	2.3 7.2	Range:	2.5 3.0	Range:	2.5 3.0
18.	Belt Width	**Mean:**	4.4	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	22.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	60.0	**Mean:**	17.7	**Mean:**	--	**Mean:**	66.4
	(W_{blt})	Range:	3.2 5.7	Range:		Range:	-- --	Range:	12.6 31.5	Range:		Range:	-- --	Range:	45.0 75.0	Range:	15.5 19.8	Range:	-- --	Range:	49.8 83.0
19.	Meander Width Ratio	**Mean:**	0.6	**Mean:**	NA[2]	**Mean:**	4.0	**Mean:**	3.5	**Mean:**	NA[2]	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	1.0	**Mean:**	4.0	**Mean:**	4.0
	(W_{blt}/W_{bkf})	Range:	0.4 0.8	Range:	-- --	Range:	3.0 5.0	Range:	2.0 5.0	Range:	-- --	Range:	3.0 5.0	Range:	3.0 5.0	Range:	0.9 1.1	Range:	3.0 5.0	Range:	3.0 5.0
20.	Sinuosity (k)	**Mean:**	1.05	**Mean:**	1.01	**Mean:**	--	**Mean:**	1.08	**Mean:**	1.02	**Mean:**	--	**Mean:**	1.09	**Mean:**	1.01	**Mean:**	--	**Mean:**	1.08
	(Stream Length / Valley Length)	Range:	-- --	Range:	1.00 1.05	Range:	-- --	Range:	1.02 1.14	Range:	1.00 1.09	Range:	-- --	Range:	1.00 1.15	Range:	1.00 1.02	Range:	-- --	Range:	1.00 1.10
21.	Valley Slope (Sv_{alley})	**Mean:**	0.0173	**Mean:**	0.0175	**Mean:**	--	**Mean:**	0.0172	**Mean:**	0.0088	**Mean:**	--	**Mean:**	0.0077	**Mean:**	0.0091	**Mean:**	--	**Mean:**	0.0092
	(ft/ft)	Range:	-- --	Range:	0.0135 0.0447	Range:	-- --	Range:	0.0135 0.0447	Range:	0.0046 0.0114	Range:	-- --	Range:	0.0046 0.0114	Range:	0.0076 0.0190	Range:	-- --	Range:	0.0076 0.0190
22.	Average Stream Slope[3]	**Mean:**	0.0156	**Mean:**	0.0173	**Mean:**	--	**Mean:**	0.0159	**Mean:**	0.0086	**Mean:**	--	**Mean:**	0.0071	**Mean:**	0.0090	**Mean:**	--	**Mean:**	0.0085
	(S_{avg}) = (S_{valley}/k)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
23.	Riffle Slope	**Mean:**	0.0279	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.0279	**Mean:**	0.0720	**Mean:**	--	**Mean:**	0.0124	**Mean:**	0.0370	**Mean:**	--	**Mean:**	0.0149
	(S_{riff})	Range:	0.0064 0.0493	Range:	-- --	Range:	-- --	Range:	0.0239 0.0318	Range:	-- --	Range:	-- --	Range:	0.0106 0.0141	Range:	0.0120 0.0630	Range:	-- --	Range:	0.0127 0.0170
24.	Ratio of Riffle Slope to Avg.	**Mean:**	1.8	**Mean:**	N/A[2]	**Mean:**	1.8	**Mean:**	1.8	**Mean:**	8.4	**Mean:**	1.8	**Mean:**	1.8	**Mean:**	4.1	**Mean:**	1.8	**Mean:**	1.8
	Slope (S_{riffle}/S_{avg})	Range:	0.4 3.2	Range:	-- --	Range:	1.5 2.0	Range:	1.5 2.0	Range:	-- --	Range:	1.5 2.0	Range:	1.5 2.0	Range:	1.3 7.0	Range:	1.5 2.0	Range:	1.5 2.0
25.	Pool Slope	**Mean:**	0.0100	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.000	**Mean:**	0.0040	**Mean:**	--	**Mean:**	0.000	**Mean:**	0.0100	**Mean:**	--	**Mean:**	0.000
	(S_{pool})	Range:	0.0078 0.0136	Range:		Range:	-- --	Range:	0.0000 0.0016	Range:	0.0029 0.0051	Range:	-- --	Range:	0.0000 0.0007	Range:	0.0004 0.0600	Range:	-- --	Range:	0.0000 0.0008
26.	Ratio of Pool Slope to Avg.	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0
	Slope (S_{pool}/S_{avg})	Range:	0.5 0.9	Range:	-- --	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1
27.	Maximum Pool	**Mean:**	1.5	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	1.6	**Mean:**	1.5	**Mean:**	--	**Mean:**	3.1	**Mean:**	4.6	**Mean:**	--	**Mean:**	3.3
	Depth (d_{pool})	**Range:**	1.4 1.5	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --
28.	Ratio of Pool Depth to Avg.	**Mean:**	2.5	**Mean:**	N/A[2]	**Mean:**	3.0	**Mean:**	3.2	**Mean:**	1.1	**Mean:**	3.0	**Mean:**	3.0	**Mean:**	4.1	**Mean:**	3.0	**Mean:**	2.9
	Depth (d_{pool}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --
29.	Pool Width	**Mean:**	4.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	11.7	**Mean:**	9.4	**Mean:**	--	**Mean:**	23.9	**Mean:**	20.3	**Mean:**	--	**Mean:**	26.8
	(W_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
30.	Ratio of Pool Width to	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	1.5	**Mean:**	1.9	**Mean:**	1.1	**Mean:**	1.5	**Mean:**	1.6	**Mean:**	1.1	**Mean:**	1.5	**Mean:**	1.6
	Bankfull Width (W_{pool}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --
31.	Pool Area	**Mean:**	4.4	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	7.8	**Mean:**	10.2	**Mean:**	--	**Mean:**	33.7	**Mean:**	62.8	**Mean:**	--	**Mean:**	42.7
	(A_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
32.	Ratio of Pool Area to	**Mean:**	1.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	2.5	**Mean:**	0.8	**Mean:**	--	**Mean:**	2.1	**Mean:**	3.0	**Mean:**	--	**Mean:**	2.3
	Bankfull Area (A_{pool}/A_{bkf})	Range:		Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
33.	Pool to Pool Spacing	**Mean:**	20.8	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	31.5	**Mean:**	54.6	**Mean:**	--	**Mean:**	67.5	**Mean:**	104.1	**Mean:**	--	**Mean:**	74.7
	(p - p)	Range:	17.6 24.1	Range:		Range:	-- --	Range:	25.2 37.8	Range:	35.9 65.4	Range:	-- --	Range:	45.0 90.0	Range:	68.8 179.7	Range:	-- --	Range:	49.8 99.6
34.	Ratio of Pool to Pool Spacing	**Mean:**	2.9	**Mean:**	N/A[2]	**Mean:**	4.5	**Mean:**	5.0	**Mean:**	6.1	**Mean:**	6.0	**Mean:**	4.5	**Mean:**	5.7	**Mean:**	6.0	**Mean:**	4.5
	to Bankfull Width (p-p/Wbkf)	Range:	2.4 3.3	Range:	-- --	Range:	3.0 6.0	Range:	4.0 6.0	Range:	4.0 7.4	Range:	5.0 7.0	Range:	3.0 6.0	Range:	3.8 9.9	Range:	5.0 7.0	Range:	3.0 6.0

1 - Used Manning's Equation: Existing "n" values - mean n = 0.0425, low range n = 0.050, high range n = 0.035
Proposed "n" values - mean n = 0.038, low range n = 0.042, high range n = 0.034

2 - Stream has been historically ditched and straightened. Typical pattern and profile features were not observed on this reach during the geomorphic assessment.

3 - Onsite Reference Reach average stream slope determined using survey information.

TABLE IV: MORPHOLOGICAL DATA

Rockwell Pastures

	VARIABLES	Onsite Reference Reach UT4[3]		Existing UT2		Regional Curves Piedmont Rural/Rosgen Reference Values		Existing UT3		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT3		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT4 Upper	
	STATION	--		20+00 to 26+34.58		--		30+00 to 37+16.55		--		300+00 to 308+72.42		--		400+00 to 415+06	
1.	Stream Type	C4		B4c		C/E		E4		C/E		C5		C/E		C4	
	(Rosgen)																
2.	Drainage Area	0.11		0.13		0.13		0.15		0.15		0.15		0.11		0.11	
	(sq. mile)																
3.	Bankfull Width	**Mean:**	7.3	**Mean:**	8.3	**Mean:**	4.9	**Mean:**	6.3	**Mean:**	5.3	**Mean:**	8.6	**Mean:**	4.5	**Mean:**	7.4
	(W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
4.	Bankfull Mean	**Mean:**	0.6	**Mean:**	0.6	**Mean:**	0.8	**Mean:**	1.0	**Mean:**	0.8	**Mean:**	0.7	**Mean:**	0.7	**Mean:**	0.6
	depth (d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
5.	Width/Depth Ratio	**Mean:**	12.6	**Mean:**	14.3	**Mean:**	6.3	**Mean:**	6.1	**Mean:**	6.4	**Mean:**	12.7	**Mean:**	6.2	**Mean:**	12.9
	(W_{bkf}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
6.	Bankfull cross-sectional	**Mean:**	4.2	**Mean:**	4.8	**Mean:**	5.4	**Mean:**	6.5	**Mean:**	5.9	**Mean:**	5.8	**Mean:**	4.7	**Mean:**	4.2
	Area (Abkf)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
7.	Bankfull Mean Velocity	**Mean:**	5.6	**Mean:**	3.9	**Mean:**	3.8	**Mean:**	3.5	**Mean:**	3.9	**Mean:**	3.0	**Mean:**	3.8	**Mean:**	3.6
	(V_{bkf})	Range:	5.2 6.1	Range:	3.3 2.6	Range:	-- --	Range:	3.0 4.3	Range:	-- --	Range:	2.7 3.3	Range:	-- --	Range:	3.2 4.0
8.	Bankfull Discharge[1], cfs	**Mean:**	23.6	**Mean:**	18.9	**Mean:**	20.5	**Mean:**	23.0	**Mean:**	22.7	**Mean:**	17.4	**Mean:**	17.8	**Mean:**	15.1
	(Q_{bkf})	Range:	21.7 25.8	Range:	16.1 12.7	Range:	-- --	Range:	19.6 28.0	Range:	-- --	Range:	15.7 19.4	Range:	-- --	Range:	13.7 16.9
9.	Bankfull Maximum Depth	**Mean:**	1.1	**Mean:**	1.1	**Mean:**	--	**Mean:**	1.4	**Mean:**	--	**Mean:**	1.1	**Mean:**	--	**Mean:**	0.9
	(d_{max})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
10.	Max d_{max}/d_{bkf}	**Mean:**	1.9	**Mean:**	1.8	**Mean:**	1.4	**Mean:**	1.3	**Mean:**	1.4	**Mean:**	1.6	**Mean:**	1.4	**Mean:**	1.6
	ratio	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	1.2 1.5	Range:	-- --
11.	Low Bank Height to max	**Mean:**	1.0	**Mean:**	1.0	**Mean:**	--	**Mean:**	1.5	**Mean:**	--	**Mean:**	1.0	**Mean:**	--	**Mean:**	1.0
	d_{bkf} ratio	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
12.	Width of Flood Prone	**Mean:**	20.1	**Mean:**	25.8	**Mean:**	--	**Mean:**	15.0	**Mean:**	--	**Mean:**	234.9	**Mean:**	--	**Mean:**	37.2
	Area (W_{fpa})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	23.8 446	Range:	-- --	Range:	20.2 55.2
13.	Entrenchment Ratio	**Mean:**	2.7	**Mean:**	3.1	**Mean:**	--	**Mean:**	2.4	**Mean:**	--	**Mean:**	27.3	**Mean:**	--	**Mean:**	5.0
	(W_{fpa}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
14.	Meander Length	**Mean:**	13.6	**Mean:**	55.2	**Mean:**	--	**Mean:**	40.5	**Mean:**	--	**Mean:**	98.9	**Mean:**	--	**Mean:**	85.1
	(L_m)	Range:	10.2 17.0	Range:	54.1 56.2	Range:	-- --	Range:	33.7 47.4	Range:	-- --	Range:	77.4 120.4	Range:	-- --	Range:	66.6 103.6
15.	Ratio of Meander Length to	**Mean:**	1.9	**Mean:**	6.7	**Mean:**	11.5	**Mean:**	6.4	**Mean:**	11.5	**Mean:**	11.5	**Mean:**	11.5	**Mean:**	11.5
	Bankfull Width (L_m/W_{bkf})	Range:	1.4 2.3	Range:	6.5 6.8	Range:	9.0 14.0	Range:	5.4 7.5	Range:	9.0 14.0	Range:	9.0 14.0	Range:	9.0 14.0	Range:	9.0 14.0
16.	Radius of Curvature	**Mean:**	9.0	**Mean:**	23.7	**Mean:**	--	**Mean:**	9.9	**Mean:**	--	**Mean:**	23.7	**Mean:**	--	**Mean:**	20.4
	(R_c)	Range:	5.3 12.6	Range:	9.9 42.3	Range:	-- --	Range:	1.8 19.4	Range:	-- --	Range:	21.5 25.8	Range:	-- --	Range:	18.5 22.2
17.	Ratio of Radius of Curvature	**Mean:**	1.2	**Mean:**	2.9	**Mean:**	2.8	**Mean:**	1.6	**Mean:**	2.8	**Mean:**	2.8	**Mean:**	2.8	**Mean:**	2.8
	to Bankfull Width (R_c/W_{bkf})	Range:	0.7 1.7	Range:	1.2 5.1	Range:	2.5 3.0	Range:	0.3 3.1	Range:	2.5 3.0	Range:	2.5 3.0	Range:	2.5 3.0	Range:	2.5 3.0
18.	Belt Width	**Mean:**	4.4	**Mean:**	8.4	**Mean:**	--	**Mean:**	5.8	**Mean:**	--	**Mean:**	34.4	**Mean:**	--	**Mean:**	29.6
	(W_{blt})	Range:	3.2 5.7	Range:	7.3 9.5	Range:	-- --	Range:	6.4 5.3	Range:	-- --	Range:	25.8 43.0	Range:	-- --	Range:	22.2 37.0
19.	Meander Width Ratio	**Mean:**	0.6	**Mean:**	1.0	**Mean:**	4.0	**Mean:**	0.9	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	4.0
	(W_{blt}/W_{bkf})	Range:	0.4 0.8	Range:	0.9 1.1	Range:	3.0 5.0	Range:	1.0 0.8	Range:	3.0 5.0	Range:	3.0 5.0	Range:	3.0 5.0	Range:	3.0 5.0
20.	Sinuosity (k)	**Mean:**	1.05	**Mean:**	1.00	**Mean:**	--	**Mean:**	1.04	**Mean:**	--	**Mean:**	1.18	**Mean:**	--	**Mean:**	1.06
	(Stream Length / Valley Length)	Range:	-- --	Range:	1.00 1.00	Range:	-- --	Range:	1.00 1.05	Range:	-- --	Range:	1.14 1.17	Range:	-- --	Range:	1.02 1.15
21.	Valley Slope (Sv_{alley})	**Mean:**	0.0173	**Mean:**	0.0282	**Mean:**	--	**Mean:**	0.0131	**Mean:**	--	**Mean:**	0.0122	**Mean:**	--	**Mean:**	0.0197
	(ft/ft)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	0.0035 0.0392	Range:	-- --	Range:	0.0016 0.0637
22.	Average Stream Slope[3]	**Mean:**	0.0156	**Mean:**	0.0281	**Mean:**	--	**Mean:**	0.0126	**Mean:**	--	**Mean:**	0.0103	**Mean:**	--	**Mean:**	0.0185
	(S_{avg}) = (S_{valley}/k)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
23.	Riffle Slope	**Mean:**	0.0279	**Mean:**	0.0450	**Mean:**	--	**Mean:**	0.1500	**Mean:**	--	**Mean:**	0.0181	**Mean:**	--	**Mean:**	0.0324
	(S_{riff})	Range:	0.0064 0.0493	Range:	0.0160 0.0900	Range:	-- --	Range:	-- --	Range:	-- --	Range:	0.0155 0.0207	Range:	-- --	Range:	0.0278 0.0370
24.	Ratio of Riffle Slope to Avg.	**Mean:**	1.8	**Mean:**	1.6	**Mean:**	1.8	**Mean:**	12.0	**Mean:**	1.8	**Mean:**	1.8	**Mean:**	1.8	**Mean:**	1.8
	Slope (S_{riffle}/S_{avg})	Range:	0.4 3.2	Range:	0.6 3.2	Range:	1.5 2.0	Range:	-- --	Range:	1.5 2.0	Range:	1.5 2.0	Range:	1.5 2.0	Range:	1.5 2.0
25.	Pool Slope	**Mean:**	0.0100	**Mean:**	0.0090	**Mean:**	--	**Mean:**	0.0170	**Mean:**	--	**Mean:**	0.000	**Mean:**	--	**Mean:**	0.000
	(S_{pool})	Range:	0.0078 0.0136	Range:	0.0026 0.0250	Range:	-- --	Range:	-- --	Range:	-- --	Range:	0.0000 0.0010	Range:	-- --	Range:	0.0000 0.0019
26.	Ratio of Pool Slope to Avg.	**Mean:**	0.6	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	1.4	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	0.0
	Slope (S_{pool}/S_{avg})	Range:	0.5 0.9	Range:	0.0 0.1	Range:	0.0 0.1	Range:	-- --	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1	Range:	0.0 0.1
27.	Maximum Pool	**Mean:**	1.5	**Mean:**	1.4	**Mean:**	--	**Mean:**	1.3	**Mean:**	--	**Mean:**	2.2	**Mean:**	--	**Mean:**	1.9
	Depth (d_{pool})	**Range:**	1.4 1.5	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --
28.	Ratio of Pool Depth to Avg.	**Mean:**	2.5	**Mean:**	2.4	**Mean:**	3.0	**Mean:**	1.3	**Mean:**	3.0	**Mean:**	3.2	**Mean:**	3.0	**Mean:**	3.3
	Depth (d_{pool}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	2.5 3.5	Range:	-- --
29.	Pool Width	**Mean:**	4.1	**Mean:**	8.0	**Mean:**	--	**Mean:**	11.5	**Mean:**	--	**Mean:**	16.4	**Mean:**	--	**Mean:**	14.0
	(W_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
30.	Ratio of Pool Width to	**Mean:**	0.6	**Mean:**	1.0	**Mean:**	1.5	**Mean:**	1.8	**Mean:**	1.5	**Mean:**	1.9	**Mean:**	1.5	**Mean:**	1.9
	Bankfull Width (W_{pool}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	1.3 1.7	Range:	-- --
31.	Pool Area	**Mean:**	4.4	**Mean:**	7.0	**Mean:**	--	**Mean:**	9.6	**Mean:**	--	**Mean:**	15.5	**Mean:**	--	**Mean:**	11.6
	(A_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
32.	Ratio of Pool Area to	**Mean:**	1.0	**Mean:**	1.5	**Mean:**	--	**Mean:**	1.5	**Mean:**	--	**Mean:**	2.7	**Mean:**	--	**Mean:**	2.7
	Bankfull Area (A_{pool}/A_{bkf})	Range:		Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
33.	Pool to Pool Spacing	**Mean:**	20.8	**Mean:**	24.6	**Mean:**	--	**Mean:**	26.0	**Mean:**	--	**Mean:**	38.7	**Mean:**	--	**Mean:**	33.3
	(p - p)	Range:	17.6 24.1	Range:	10.0 41.5	Range:	-- --	Range:	-- --	Range:	-- --	Range:	25.8 51.6	Range:	-- --	Range:	22.2 44.4
34.	Ratio of Pool to Pool Spacing	**Mean:**	2.9	**Mean:**	3.0	**Mean:**	6.0	**Mean:**	4.1	**Mean:**	6.0	**Mean:**	4.5	**Mean:**	6.0	**Mean:**	4.5
	to Bankfull Width (p-p/Wbkf)	Range:	2.4 3.3	Range:	1.2 5.0	Range:	5.0 7.0	Range:	-- --	Range:	5.0 7.0	Range:	3.0 6.0	Range:	5.0 7.0	Range:	3.0 6.0

1 - Used Manning's Equation: Existing "n" values - mean n = 0.0425, low range n = 0.050, high range n = 0.035
Proposed "n" values - mean n = 0.038, low range n = 0.042, high range n = 0.034

2 - Stream has been historically ditched and straightened. Typical pattern and profile features were not observed on this reach during the geomorphic assessment.

3 - Onsite Reference Reach average stream slope determined using survey information.

TABLE IV: MORPHOLOGICAL DATA

Rockwell Pastures

	VARIABLES	Onsite Reference Reach UT4[3]		Existing UT4 Middle		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT4 Middle		Existing UT4 Lower		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT4 Lower		Existing UT5		Regional Curves Piedmont Rural/Rosgen Reference Values	
	STATION	--		48+00 to 69+00		--		415+06 to 436+37		69+00 to 80+35.54		--		436+37 to 449+43.57		50+00 to 60+75		--	
1.	Stream Type	C4		F4		C/E		C4		E4b		C/E		C4		E6		C/E	
	(Rosgen)																		
2.	Drainage Area	0.11		0.28		0.28		0.28		0.42		0.42		0.42		0.07		0.07	
	(sq. mile)																		
3.	Bankfull Width	**Mean:**	7.3	**Mean:**	N/A[2]	**Mean:**	6.9	**Mean:**	10.7	**Mean:**	7.4	**Mean:**	8.2	**Mean:**	12.0	**Mean:**	5.0	**Mean:**	3.8
	(W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
4.	Bankfull Mean	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	1.0	**Mean:**	0.9	**Mean:**	1.3	**Mean:**	1.1	**Mean:**	0.9	**Mean:**	1.0	**Mean:**	0.6
	depth (d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
5.	Width/Depth Ratio	**Mean:**	12.6	**Mean:**	N/A[2]	**Mean:**	6.9	**Mean:**	12.6	**Mean:**	5.5	**Mean:**	7.2	**Mean:**	12.8	**Mean:**	5.0	**Mean:**	5.9
	(W_{bkf}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
6.	Bankfull cross-sectional	**Mean:**	4.2	**Mean:**	N/A[2]	**Mean:**	9.1	**Mean:**	9.1	**Mean:**	9.9	**Mean:**	11.9	**Mean:**	11.3	**Mean:**	5.0	**Mean:**	3.5
	Area (Abkf)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
7.	Bankfull Mean Velocity	**Mean:**	5.6	**Mean:**	N/A[2]	**Mean:**	4.0	**Mean:**	4.2	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	4.2	**Mean:**	3.7
	(V_{bkf})	Range:	5.2 6.1	Range:		Range:	-- --	Range:	3.8 4.6	Range:	3.4 4.9	Range:	-- --	Range:	3.6 4.5	Range:	3.6 5.1	Range:	-- --
8.	Bankfull Discharge[1], cfs	**Mean:**	23.6	**Mean:**	N/A[2]	**Mean:**	35.9	**Mean:**	37.8	**Mean:**	39.7	**Mean:**	47.7	**Mean:**	45.4	**Mean:**	20.9	**Mean:**	13.1
	(Q_{bkf})	Range:	21.7 25.8	Range:	-- --	Range:	-- --	Range:	34.2 42.2	Range:	33.8 48.2	Range:	-- --	Range:	41.1 50.7	Range:	17.8 25.4	Range:	-- --
9.	Bankfull Maximum Depth	**Mean:**	1.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	1.4	**Mean:**	1.7	**Mean:**	--	**Mean:**	1.5	**Mean:**	1.4	**Mean:**	--
	(d_{max})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
10.	Max d_{max}/d_{bkf}	**Mean:**	1.9	**Mean:**	N/A[2]	**Mean:**	1.4	**Mean:**	1.6	**Mean:**	1.3	**Mean:**	1.4	**Mean:**	1.6	**Mean:**	1.4	**Mean:**	1.4
	ratio	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	-- --	Range:	1.2 1.5
11.	Low Bank Height to max	**Mean:**	1.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	1.0	**Mean:**	1.3	**Mean:**	--	**Mean:**	1.0	**Mean:**	1.2	**Mean:**	--
	d_{bkf} ratio	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
12.	Width of Flood Prone	**Mean:**	20.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	97.7	**Mean:**	78.6	**Mean:**	--	**Mean:**	163.2	**Mean:**	18.0	**Mean:**	--
	Area (W_{fpa})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	29.9 165.4	Range:	-- --	Range:	-- --	Range:	33.0 293.4	Range:	-- --	Range:	-- --
13.	Entrenchment Ratio	**Mean:**	2.7	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	9.1	**Mean:**	10.7	**Mean:**	--	**Mean:**	13.6	**Mean:**	3.6	**Mean:**	--
	(W_{fpa}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
14.	Meander Length	**Mean:**	13.6	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	123.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	138.0	**Mean:**	N/A[2]	**Mean:**	--
	(L_m)	Range:	10.2 17.0	Range:	-- --	Range:	-- --	Range:	96.3 149.8	Range:	-- --	Range:	-- --	Range:	108.0 168.0	Range:	-- --	Range:	-- --
15.	Ratio of Meander Length to	**Mean:**	1.9	**Mean:**	NA[2]	**Mean:**	11.5	**Mean:**	11.5	**Mean:**	NA[2]	**Mean:**	11.5	**Mean:**	11.5	**Mean:**	NA[2]	**Mean:**	11.5
	Bankfull Width (L_m/W_{bkf})	Range:	1.4 2.3	Range:	-- --	Range:	9.0 14.0	Range:	9.0 14.0	Range:	-- --	Range:	9.0 14.0	Range:	9.0 14.0	Range:	-- --	Range:	9.0 14.0
16.	Radius of Curvature	**Mean:**	9.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	29.4	**Mean:**	NA[2]	**Mean:**	--	**Mean:**	33.0	**Mean:**	NA[2]	**Mean:**	--
	(R_c)	Range:	5.3 12.6	Range:	-- --	Range:	-- --	Range:	26.8 32.1	Range:	-- --	Range:	-- --	Range:	30.0 36.0	Range:	-- --	Range:	-- --
17.	Ratio of Radius of Curvature	**Mean:**	1.2	**Mean:**	NA[2]	**Mean:**	2.8	**Mean:**	2.8	**Mean:**	NA[2]	**Mean:**	2.8	**Mean:**	2.8	**Mean:**	NA[2]	**Mean:**	2.8
	to Bankfull Width (R_c/W_{bkf})	Range:	0.7 1.7	Range:	-- --	Range:	2.5 3.0	Range:	2.5 3.0	Range:	-- --	Range:	2.5 3.0	Range:	2.5 3.0	Range:	-- --	Range:	2.5 3.0
18.	Belt Width	**Mean:**	4.4	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	42.8	**Mean:**	NA[2]	**Mean:**	--	**Mean:**	48.0	**Mean:**	NA[2]	**Mean:**	--
	(W_{blt})	Range:	3.2 5.7	Range:		Range:	-- --	Range:	32.1 53.5	Range:	-- --	Range:	-- --	Range:	36.0 60.0	Range:	-- --	Range:	-- --
19.	Meander Width Ratio	**Mean:**	0.6	**Mean:**	NA[2]	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	NA[2]	**Mean:**	4.0	**Mean:**	4.0	**Mean:**	NA[2]	**Mean:**	4.0
	(W_{blt}/W_{bkf})	Range:	0.4 0.8	Range:	-- --	Range:	3.0 5.0	Range:	3.0 5.0	Range:	-- --	Range:	3.0 5.0	Range:	3.0 5.0	Range:	-- --	Range:	3.0 5.0
20.	Sinuosity (k)	**Mean:**	1.05	**Mean:**	1.03	**Mean:**	--	**Mean:**	1.04	**Mean:**	1.02	**Mean:**	--	**Mean:**	1.1	**Mean:**	1.00	**Mean:**	--
	(Stream Length / Valley Length)	Range:	-- --	Range:	1.00 1.03	Range:	-- --	Range:	1.00 1.12	Range:	1.00 1.04	Range:	-- --	Range:	1.09 1.2	Range:	-- --	Range:	-- --
21.	Valley Slope (Sv_{alley})	**Mean:**	0.0173	**Mean:**	0.0152	**Mean:**	--	**Mean:**	0.0152	**Mean:**	0.0118	**Mean:**	--	**Mean:**	0.0136	**Mean:**	0.0186	**Mean:**	--
	(ft/ft)	Range:	-- --	Range:	0.0133 0.0299	Range:	-- --	Range:	0.0133 0.0299	Range:	-- --	Range:	-- --	Range:	0.0112 0.0207	Range:	-- --	Range:	-- --
22.	Average Stream Slope[3]	**Mean:**	0.0156	**Mean:**	0.0148	**Mean:**	--	**Mean:**	0.0147	**Mean:**	0.0115	**Mean:**	--	**Mean:**	0.0122	**Mean:**	0.0186	**Mean:**	--
	(S_{avg}) = (S_{valley}/k)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
23.	Riffle Slope	**Mean:**	0.0279	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.0257	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.0214	**Mean:**	N/A[2]	**Mean:**	--
	(S_{riff})	Range:	0.0064 0.0493	Range:	-- --	Range:	-- --	Range:	0.0220 0.0294	Range:	-- --	Range:	-- --	Range:	0.0184 0.0245	Range:	-- --	Range:	-- --
24.	Ratio of Riffle Slope to Avg.	**Mean:**	1.8	**Mean:**	N/A[2]	**Mean:**	1.8	**Mean:**	1.8	**Mean:**	NA[2]	**Mean:**	1.8	**Mean:**	1.8	**Mean:**	N/A[2]	**Mean:**	1.8
	Slope (S_{riffle}/S_{avg})	Range:	0.4 3.2	Range:	-- --	Range:	1.5 2.0	Range:	1.5 2.0	Range:	-- --	Range:	1.5 2.0	Range:	1.5 2.0	Range:	-- --	Range:	1.5 2.0
25.	Pool Slope	**Mean:**	0.0100	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.000	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.000	**Mean:**	N/A[2]	**Mean:**	--
	(S_{pool})	Range:	0.0078 0.0136	Range:		Range:	-- --	Range:	0.0000 0.0015	Range:	-- --	Range:	-- --	Range:	0.0000 0.0012	Range:	-- --	Range:	-- --
26.	Ratio of Pool Slope to Avg.	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	N/A[2]	**Mean:**	0.0	**Mean:**	0.0	**Mean:**	N/A[2]	**Mean:**	0.0
	Slope (S_{pool}/S_{avg})	Range:	0.5 0.9	Range:	-- --	Range:	0.0 0.1	Range:	0.0 0.1	Range:	-- --	Range:	0.0 0.1	Range:	0.0 0.1	Range:	-- --	Range:	0.0 0.1
27.	Maximum Pool	**Mean:**	1.5	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	2.9	**Mean:**	1.1	**Mean:**	--	**Mean:**	3.1	**Mean:**	N/A[2]	**Mean:**	--
	Depth (d_{pool})	**Range:**	1.4 1.5	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --
28.	Ratio of Pool Depth to Avg.	**Mean:**	2.5	**Mean:**	N/A[2]	**Mean:**	3.0	**Mean:**	3.4	**Mean:**	0.8	**Mean:**	3.0	**Mean:**	3.3	**Mean:**	N/A[2]	**Mean:**	3.0
	Depth (d_{pool}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	-- --	Range:	2.5 3.5
29.	Pool Width	**Mean:**	4.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	21.2	**Mean:**	6.5	**Mean:**	--	**Mean:**	22.9	**Mean:**	N/A[2]	**Mean:**	--
	(W_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
30.	Ratio of Pool Width to	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	1.5	**Mean:**	2.0	**Mean:**	0.9	**Mean:**	1.5	**Mean:**	1.9	**Mean:**	N/A[2]	**Mean:**	1.5
	Bankfull Width (W_{pool}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	-- --	Range:	1.3 1.7
31.	Pool Area	**Mean:**	4.4	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	26.2	**Mean:**	5.3	**Mean:**	--	**Mean:**	30.6	**Mean:**	N/A[2]	**Mean:**	--
	(A_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
32.	Ratio of Pool Area to	**Mean:**	1.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	2.9	**Mean:**	0.5	**Mean:**	--	**Mean:**	2.7	**Mean:**	N/A[2]	**Mean:**	--
	Bankfull Area (A_{pool}/A_{bkf})	Range:		Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
33.	Pool to Pool Spacing	**Mean:**	20.8	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	48.2	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	54.0	**Mean:**	N/A[2]	**Mean:**	--
	(p - p)	Range:	17.6 24.1	Range:		Range:	-- --	Range:	32.1 64.2	Range:	-- --	Range:	-- --	Range:	36.0 72.0	Range:	-- --	Range:	-- --
34.	Ratio of Pool to Pool Spacing	**Mean:**	2.9	**Mean:**	N/A[2]	**Mean:**	6.0	**Mean:**	4.5	**Mean:**	N/A[2]	**Mean:**	6.0	**Mean:**	4.5	**Mean:**	N/A[2]	**Mean:**	6.0
	to Bankfull Width (p-p/Wbkf)	Range:	2.4 3.3	Range:	-- --	Range:	5.0 7.0	Range:	3.0 6.0	Range:	-- --	Range:	5.0 7.0	Range:	3.0 6.0	Range:	-- --	Range:	5.0 7.0

1 - Used Manning's Equation: Existing "n" values - mean n = 0.0425, low range n = 0.050, high range n = 0.035
Proposed "n" values - mean n = 0.038, low range n = 0.042, high range n = 0.034

2 - Stream has been historically ditched and straightened. Typical pattern and profile features were not observed on this reach during the geomorphic assessment.

3 - Onsite Reference Reach average stream slope determined using survey information.

TABLE IV: MORPHOLOGICAL DATA

Rockwell Pastures

	VARIABLES	Onsite Reference Reach UT4[3]		Existing UT6		Regional Curves Piedmont Rural/Rosgen Reference Values		Existing UT7		Regional Curves Piedmont Rural/Rosgen Reference Values		Design Reach UT7	
	STATION	--		60+00 to 71+73.89		--		70+00 to 83+33.06		--		700+00 to 714+39.41	
1.	Stream Type	C4		E4/E5		C/E		B5		C/E		C5	
	(Rosgen)												
2.	Drainage Area	0.11		0.02		0.02		0.05		0.05		0.05	
	(sq. mile)												
3.	Bankfull Width	**Mean:**	7.3	**Mean:**	2.5	**Mean:**	2.2	**Mean:**	2.8	**Mean:**	3.3	**Mean:**	6.0
	(W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
4.	Bankfull Mean	**Mean:**	0.6	**Mean:**	0.4	**Mean:**	0.4	**Mean:**	0.4	**Mean:**	0.6	**Mean:**	0.5
	depth (d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
5.	Width/Depth Ratio	**Mean:**	12.6	**Mean:**	6.6	**Mean:**	5.2	**Mean:**	8.0	**Mean:**	5.7	**Mean:**	12.8
	(W_{bkf}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
6.	Bankfull cross-sectional	**Mean:**	4.2	**Mean:**	0.9	**Mean:**	1.5	**Mean:**	1.0	**Mean:**	2.8	**Mean:**	2.8
	Area (Abkf)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
7.	Bankfull Mean Velocity	**Mean:**	5.6	**Mean:**	2.2	**Mean:**	3.6	**Mean:**	2.1	**Mean:**	3.7	**Mean:**	2.3
	(V_{bkf})	Range:	5.2 6.1	Range:	1.8 5.1	Range:	-- --	Range:	1.8 2.5	Range:	-- --	Range:	2.1 2.5
8.	Bankfull Discharge[1], cfs	**Mean:**	23.6	**Mean:**	2.0	**Mean:**	5.3	**Mean:**	2.1	**Mean:**	10.3	**Mean:**	6.4
	(Q_{bkf})	Range:	21.7 25.8	Range:	1.7 4.6	Range:	-- --	Range:	1.8 2.5	Range:	-- --	Range:	5.8 7.2
9.	Bankfull Maximum Depth	**Mean:**	1.1	**Mean:**	0.6	**Mean:**	--	**Mean:**	0.7	**Mean:**	--	**Mean:**	0.8
	(d_{max})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
10.	Max d_{max}/d_{bkf}	**Mean:**	1.9	**Mean:**	1.6	**Mean:**	1.4	**Mean:**	1.9	**Mean:**	1.4	**Mean:**	1.6
	ratio	Range:	-- --	Range:	-- --	Range:	1.2 1.5	Range:	-- --	Range:	1.2 1.5	Range:	-- --
11.	Low Bank Height to max	**Mean:**	1.0	**Mean:**	2.3	**Mean:**	--	**Mean:**	1.9	**Mean:**	--	**Mean:**	1.0
	d_{bkf} ratio	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
12.	Width of Flood Prone	**Mean:**	20.1	**Mean:**	6.6	**Mean:**	--	**Mean:**	5.6	**Mean:**	--	**Mean:**	45.1
	Area (W_{fpa})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	16.5 73.6
13.	Entrenchment Ratio	**Mean:**	2.7	**Mean:**	2.6	**Mean:**	--	**Mean:**	2.0	**Mean:**	--	**Mean:**	7.5
	(W_{fpa}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
14.	Meander Length	**Mean:**	13.6	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	69.0
	(L_m)	Range:	10.2 17.0	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	54.0 84.0
15.	Ratio of Meander Length to	**Mean:**	1.9	**Mean:**	NA[2]	**Mean:**	11.5	**Mean:**	NA[2]	**Mean:**	11.5	**Mean:**	11.5
	Bankfull Width (L_m/W_{bkf})	Range:	1.4 2.3	Range:	-- --	Range:	9.0 14.0	Range:	-- --	Range:	9.0 14.0	Range:	9.0 14.0
16.	Radius of Curvature	**Mean:**	9.0	**Mean:**	NA[2]	**Mean:**	--	**Mean:**	NA[2]	**Mean:**	--	**Mean:**	16.5
	(R_c)	Range:	5.3 12.6	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	15.0 18.0
17.	Ratio of Radius of Curvature	**Mean:**	1.2	**Mean:**	NA[2]	**Mean:**	2.8	**Mean:**	NA[2]	**Mean:**	2.8	**Mean:**	2.8
	to Bankfull Width (R_c/W_{bkf})	Range:	0.7 1.7	Range:	-- --	Range:	2.5 3.0	Range:	-- --	Range:	2.5 3.0	Range:	2.5 3.0
18.	Belt Width	**Mean:**	4.4	**Mean:**	NA[2]	**Mean:**	--	**Mean:**	NA[2]	**Mean:**	--	**Mean:**	24.0
	(W_{blt})	Range:	3.2 5.7	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	18.0 30.0
19.	Meander Width Ratio	**Mean:**	0.6	**Mean:**	NA[2]	**Mean:**	4.0	**Mean:**	NA[2]	**Mean:**	4.0	**Mean:**	4.0
	(W_{blt}/W_{bkf})	Range:	0.4 0.8	Range:	-- --	Range:	3.0 5.0	Range:	-- --	Range:	3.0 5.0	Range:	3.0 5.0
20.	Sinuosity (k)	**Mean:**	1.05	**Mean:**	1.00	**Mean:**	--	**Mean:**	1.01	**Mean:**	--	**Mean:**	1.13
	(Stream Length / Valley Length)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	1.00 1.01	Range:	-- --	Range:	1.07 1.15
21.	Valley Slope (Sv_{alley})	**Mean:**	0.0173	**Mean:**	0.0162	**Mean:**	--	**Mean:**	0.0185	**Mean:**	--	**Mean:**	0.0112
	(ft/ft)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	0.0086 0.0267	Range:	-- --	Range:	0.0086 0.0267
22.	Average Stream Slope[3]	**Mean:**	0.0156	**Mean:**	0.0162	**Mean:**	--	**Mean:**	0.0184	**Mean:**	--	**Mean:**	0.0099
	(S_{avg}) = (S_{valley}/k)	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
23.	Riffle Slope	**Mean:**	0.0279	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.0173
	(S_{rifl})	Range:	0.0064 0.0493	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	0.0148 0.0197
24.	Ratio of Riffle Slope to Avg.	**Mean:**	1.8	**Mean:**	N/A[2]	**Mean:**	1.8	**Mean:**	N/A[2]	**Mean:**	1.8	**Mean:**	1.8
	Slope (S_{riffle}/S_{avg})	Range:	0.4 3.2	Range:	-- --	Range:	1.5 2.0	Range:	-- --	Range:	1.5 2.0	Range:	1.5 2.0
25.	Pool Slope	**Mean:**	0.0100	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.000
	(S_{pool})	Range:	0.0078 0.0136	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	0.0000 0.0010
26.	Ratio of Pool Slope to Avg.	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	0.0	**Mean:**	N/A[2]	**Mean:**	0.0	**Mean:**	0.0
	Slope (S_{pool}/S_{avg})	Range:	0.5 0.9	Range:	-- --	Range:	0.0 0.1	Range:	-- --	Range:	0.0 0.1	Range:	0.0 0.1
27.	Maximum Pool	**Mean:**	1.5	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	0.8	**Mean:**	--	**Mean:**	1.7
	Depth (d_{pool})	**Range:**	1.4 1.5	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --	**Range:**	-- --
28.	Ratio of Pool Depth to Avg.	**Mean:**	2.5	**Mean:**	N/A[2]	**Mean:**	3.0	**Mean:**	2.3	**Mean:**	3.0	**Mean:**	3.6
	Depth (d_{pool}/d_{bkf})	Range:	-- --	Range:	-- --	Range:	2.5 3.5	Range:	-- --	Range:	2.5 3.5	Range:	-- --
29.	Pool Width	**Mean:**	4.1	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	2.9	**Mean:**	--	**Mean:**	11.5
	(W_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
30.	Ratio of Pool Width to	**Mean:**	0.6	**Mean:**	N/A[2]	**Mean:**	1.5	**Mean:**	1.0	**Mean:**	1.5	**Mean:**	1.9
	Bankfull Width (W_{pool}/W_{bkf})	Range:	-- --	Range:	-- --	Range:	1.3 1.7	Range:	-- --	Range:	1.3 1.7	Range:	-- --
31.	Pool Area	**Mean:**	4.4	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	1.6	**Mean:**	--	**Mean:**	8.1
	(A_{pool})	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
32.	Ratio of Pool Area to	**Mean:**	1.0	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	1.6	**Mean:**	--	**Mean:**	2.9
	Bankfull Area (A_{pool}/A_{bkf})	Range:		Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --
33.	Pool to Pool Spacing	**Mean:**	20.8	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	N/A[2]	**Mean:**	--	**Mean:**	27.0
	(p - p)	Range:	17.6 24.1	Range:	-- --	Range:	-- --	Range:	-- --	Range:	-- --	Range:	18.0 36.0
34.	Ratio of Pool to Pool Spacing	**Mean:**	2.9	**Mean:**	N/A[2]	**Mean:**	6.0	**Mean:**	N/A[2]	**Mean:**	6.0	**Mean:**	4.5
	to Bankfull Width (p-p/Wbkf)	Range:	2.4 3.3	Range:	-- --	Range:	5.0 7.0	Range:	-- --	Range:	5.0 7.0	Range:	3.0 6.0

1 - Used Manning's Equation: Existing "n" values - mean n = 0.0425, low range n = 0.050, high range n = 0.035
Proposed "n" values - mean n = 0.038, low range n = 0.042, high range n = 0.034
2 - Stream has been historically ditched and straightened. Typical pattern and profile features were not observed on this reach during the geomorphic assessment.
3 - Onsite Reference Reach average stream slope determined using survey information.

Table V: Designed Vegetative Communities (By Zone)

Scientific Name		Common Name	Zone 1: Stream Channel and Banks	Zone 2: Riparian	Zone 3: Wet	Zone 4: Oxbow Wetland
Canopy						
Betula	*nigra*	River Birch		BC	BC	
Carya	*cordiformis*	Bitternut Hickory		BC		
Carya	*ovata*	Shagbark Hickory		BC		
Fraxinus	*pennsylvanica*	Green Ash		BC		
Juglans	*nigra*	Black Walnut		BC		
Platanus	*occidentalis*	Sycamore		BC	BC	
Quercus	*alba*	White Oak		BC		Wetland Seed Mix
Quercus	*michauxii*	Swamp Chestnut Oak		BC		
Quercus	*lyrata*	Overcup Oak			BC	
Quercus	*nigra*	Water Oak		BC	BC	
Quercus	*phellos*	Willow Oak		BC	BC	
Salix	*nigra*	Black Willow	LS		BC	
Ulmus	*alata*	Winged Elm		BC		
Understory						
Acer	*barbatum*	Southern Sugar Maple		BC		
Aesculus	*sylvatica*	Buckeye		BC		
Asimina	*triloba*	Pawpaw		BC		
Carpinus	*caroliniana*	American Hormbeam		BC		
Cercis	*canadensis*	Eastern Redbud		BC	BC	
Cephalanthus	*occidentalis*	Buttonbush			BC	
Cornus	*amomum*	Silky Dogwood	LS		BC	
Euonymus	*americanus*	Strawberry Bush		BC		
Ilex	*decidua*	Possumhaw		BC	BC	
Morus	*rubra*	Red Mulberry		BC		
Sassafras	*albidum*	Sassafras		BC		
Lindera	*benzoin*	Spicebush		BC		
Ulmus	*rubra*	Slippery Elm		BC		
Sambucus	*canadensis*	Elderberry	LS			
Viburnum	*dentatum*	Southern Arrowwood	LS			

Planting Types: LS - Live Stake; BC - Bare Root or Container

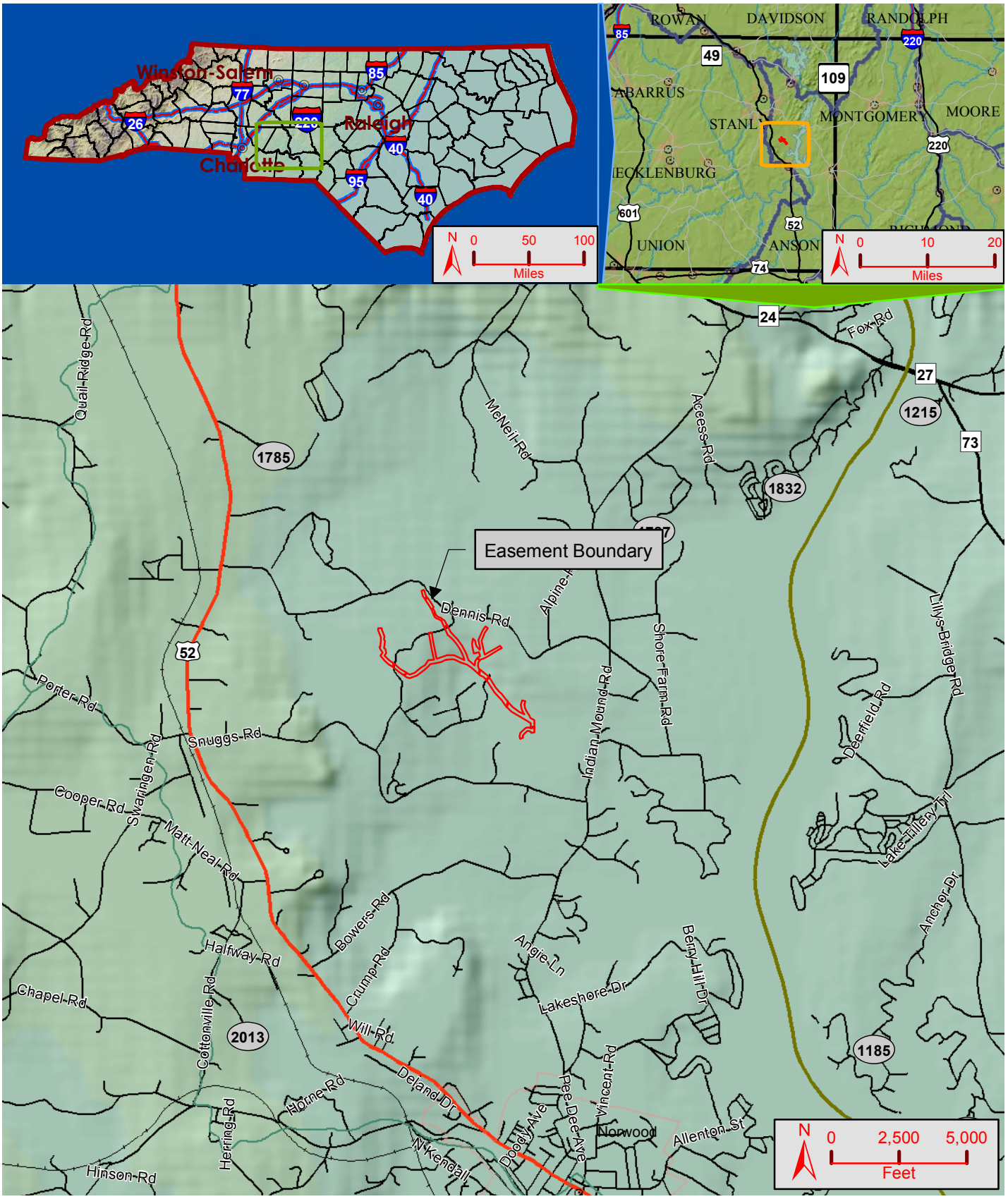
Table VI: Designed Vegetative Community

Zone 4: Oxbow Wetland Seed Mix		
Scientific Name	**Common Name**	**%**
Panicum virgatum	Redtop Panic Grass	60%
Carex lupilina	Hopd Sedge	10%
Juncus effusus	Soft Rush	10%
Carex lurida	Lurid (Shallow) Sedge	7%
Scirpus cyperinus	Wool Grass	5%
Saururus cernuus	Lizard's Tail	4%
Carex squarrosa	Squarrose Sedge	4%

Table VII: Designed Vegetative Community

Permanent Riparian Seed Mix		
Scientific Name	**Common Name**	**%**
Leersia oryzoides	Rice Cut Grass	5%
Juncus effusus	Soft Rush	10%
Panicum clandestium	Deertongue	20%
Panicum virgatum	Switchgrass	50%
Veronia noveboracensis	Ironweed	5%
Helianthus angustifolius	Swamp Sumflower	5%
Eupatorium fistulosum	Joe Pye Weed	5%

11.0 Figures

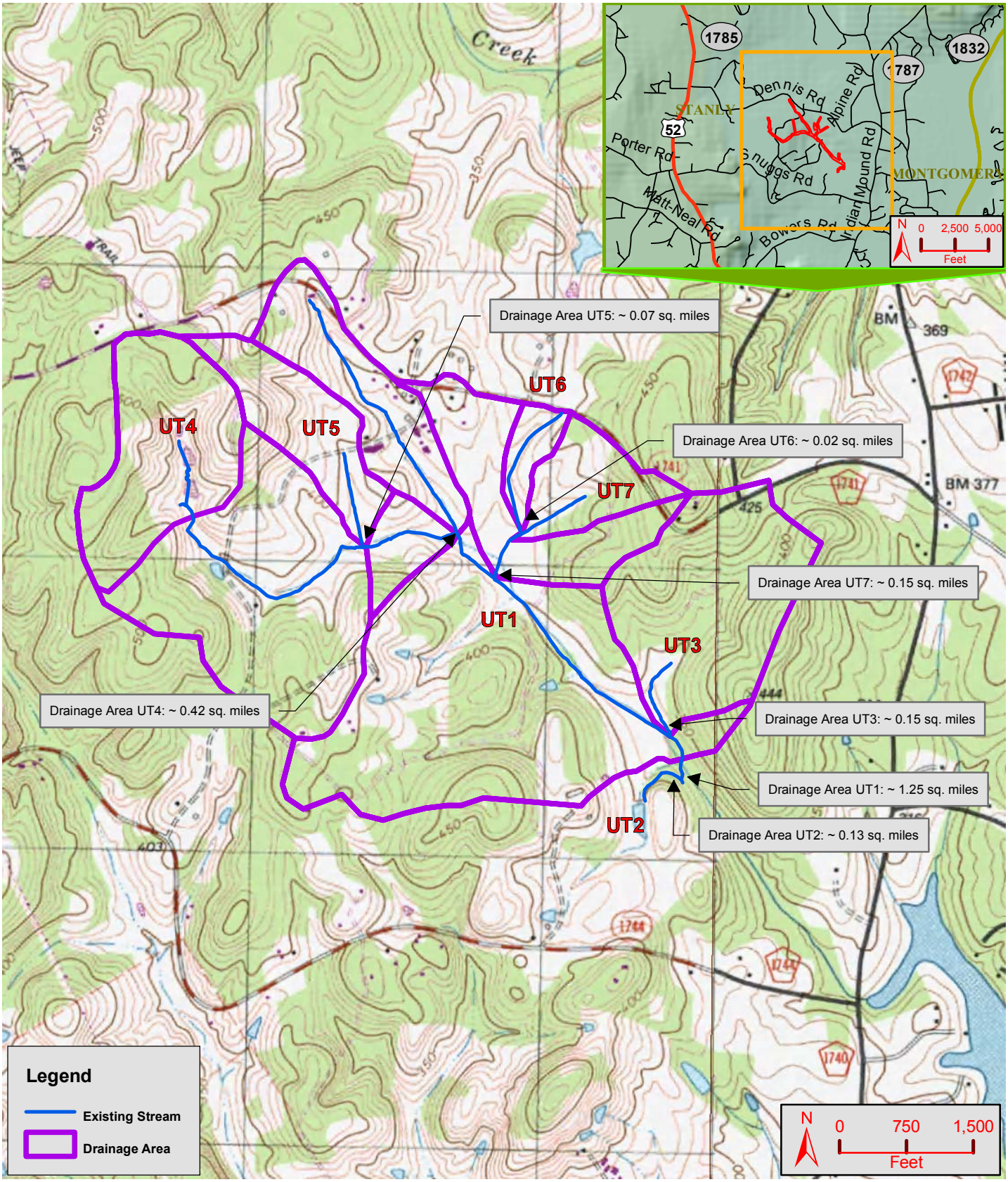


Title	Project Site Vicinity Map
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina

Date	**Project Number**	**Figure**
July 18, 2008	012620017	1

Prepared by Josh Allen

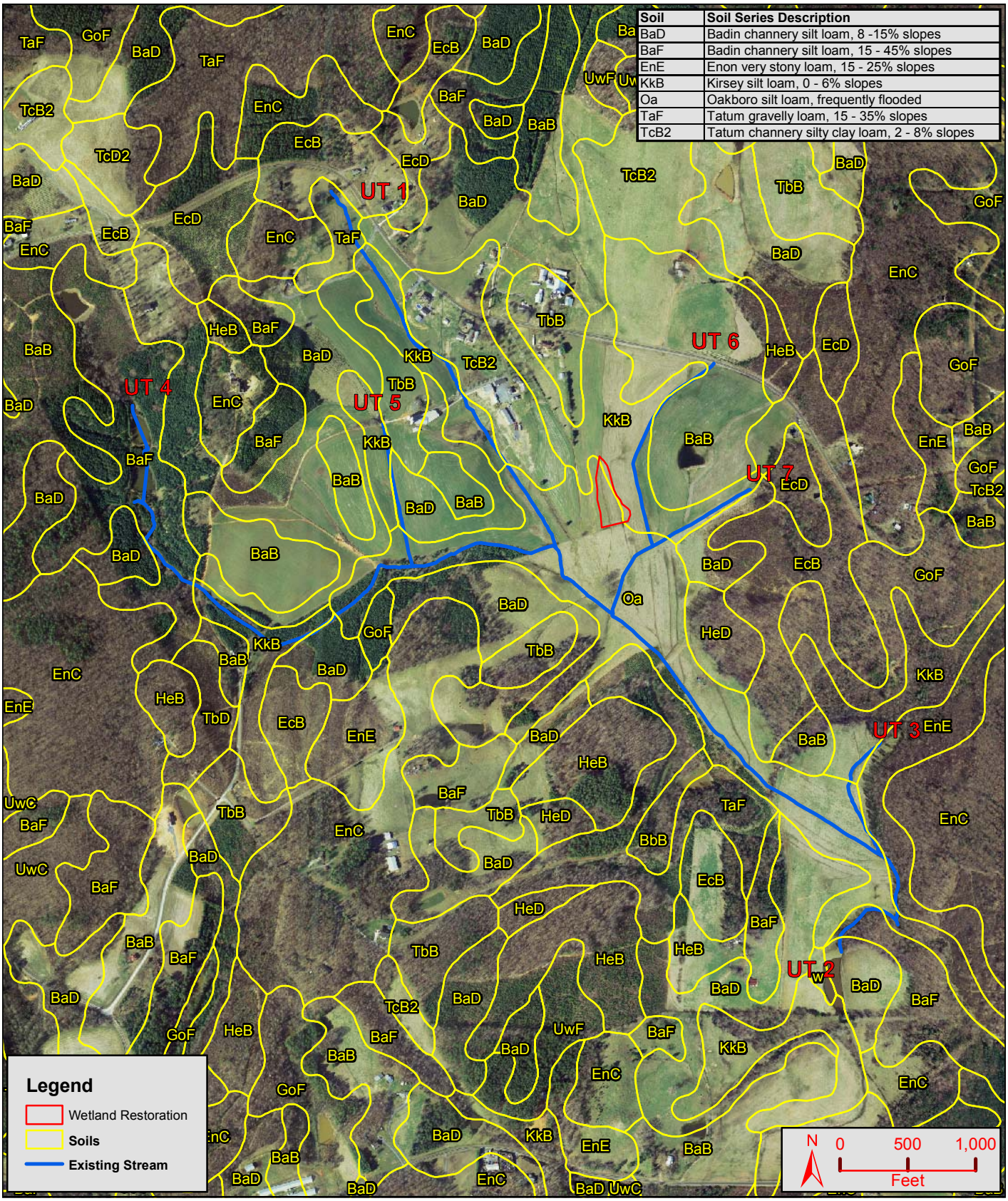
Kimley-Horn and Associates, Inc.



Title	Project Site Watershed Map (2005)
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina
	Date: July 18, 2008
	Project Number: 012620017
	Figure: 2

Prepared by Josh Allen

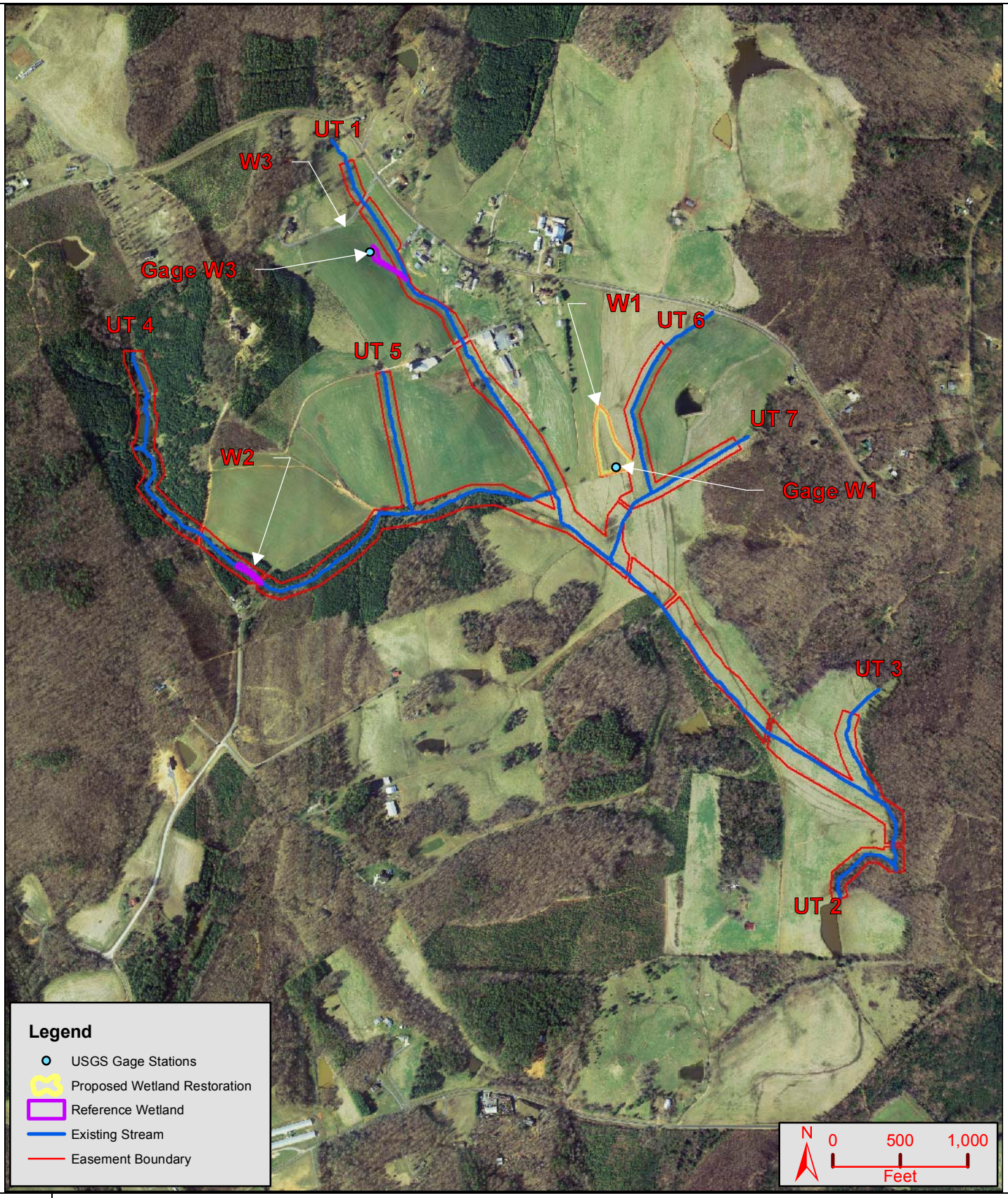
Kimley-Horn and Associates, Inc.



Title	Project Site NRCS Soils Map
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina
	Date: July 18, 2008
	Project Number: 012620017
	Figure: 3

Prepared by Josh Allen

Kimley-Horn and Associates, Inc.



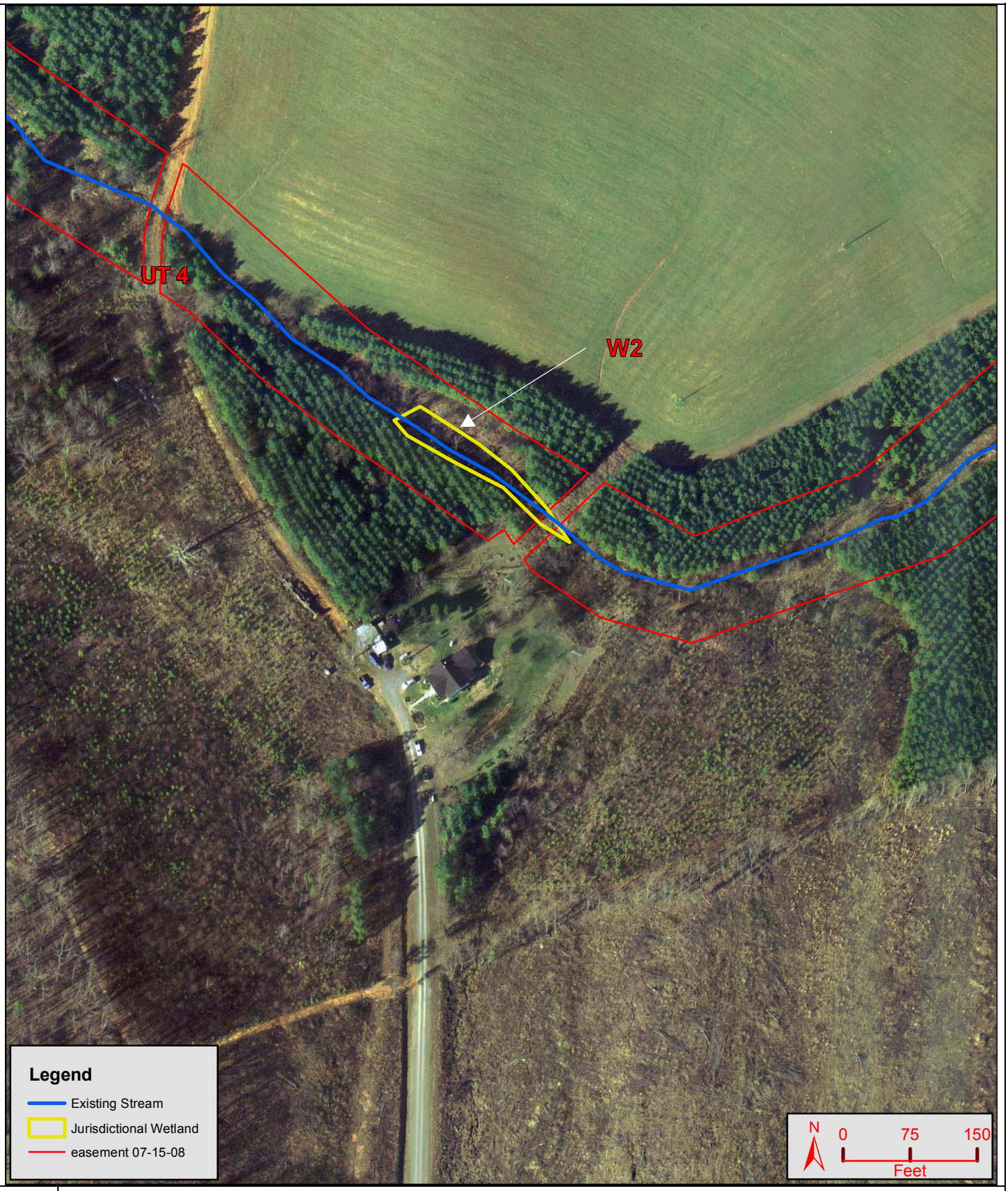
Title	Project Site Map with Hydrological Features and USGS Gage Station Locations (2005)

Prepared For: EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina		
	Date	**Project Number**	**Figure**
	July 18, 2008	012620017	4

Prepared by Josh Allen

Kimley-Horn and Associates, Inc.



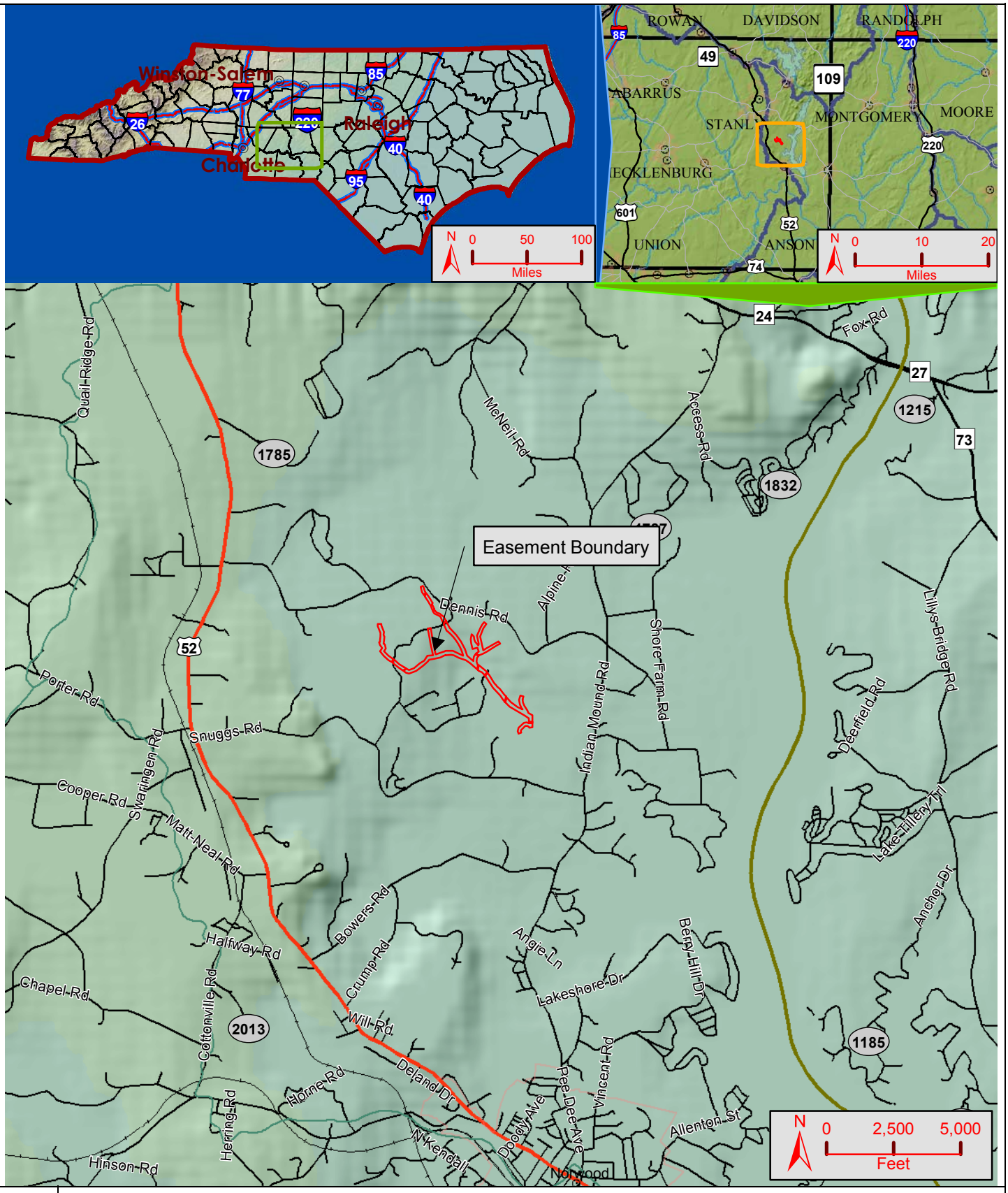
Title	Project Wetland Delineation Map (2005)

Prepared For: EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina	
Date	**Project Number**	**Figure**
July 18, 2008	012620017	5

Prepared by Josh Allen

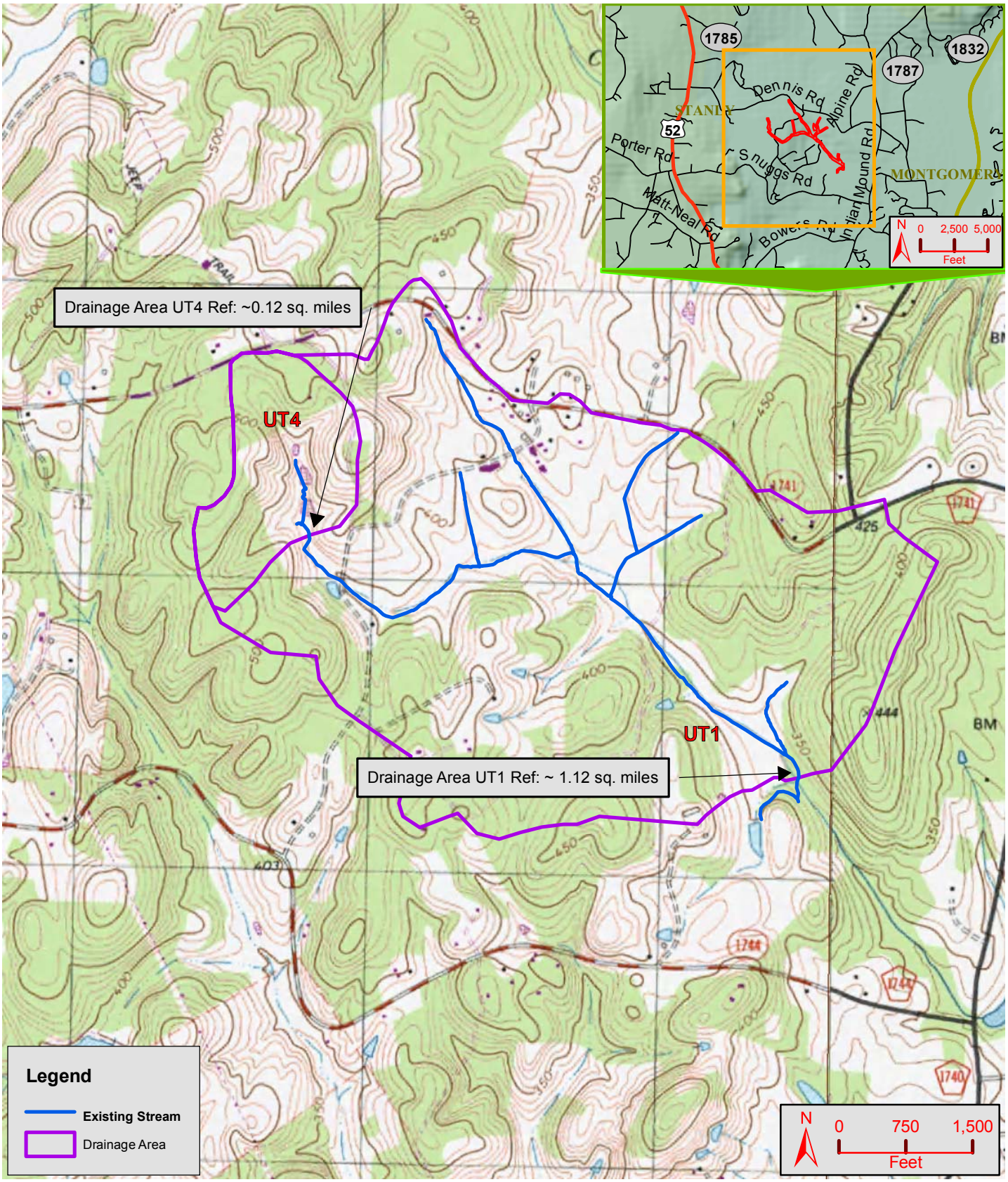
Kimley-Horn and Associates, Inc.



Title	Reference Site Vicinity Map
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina
	Date: July 18, 2008
	Project Number: 012620017
	Figure: 6

Prepared by Josh Allen

Kimley-Horn and Associates, Inc.

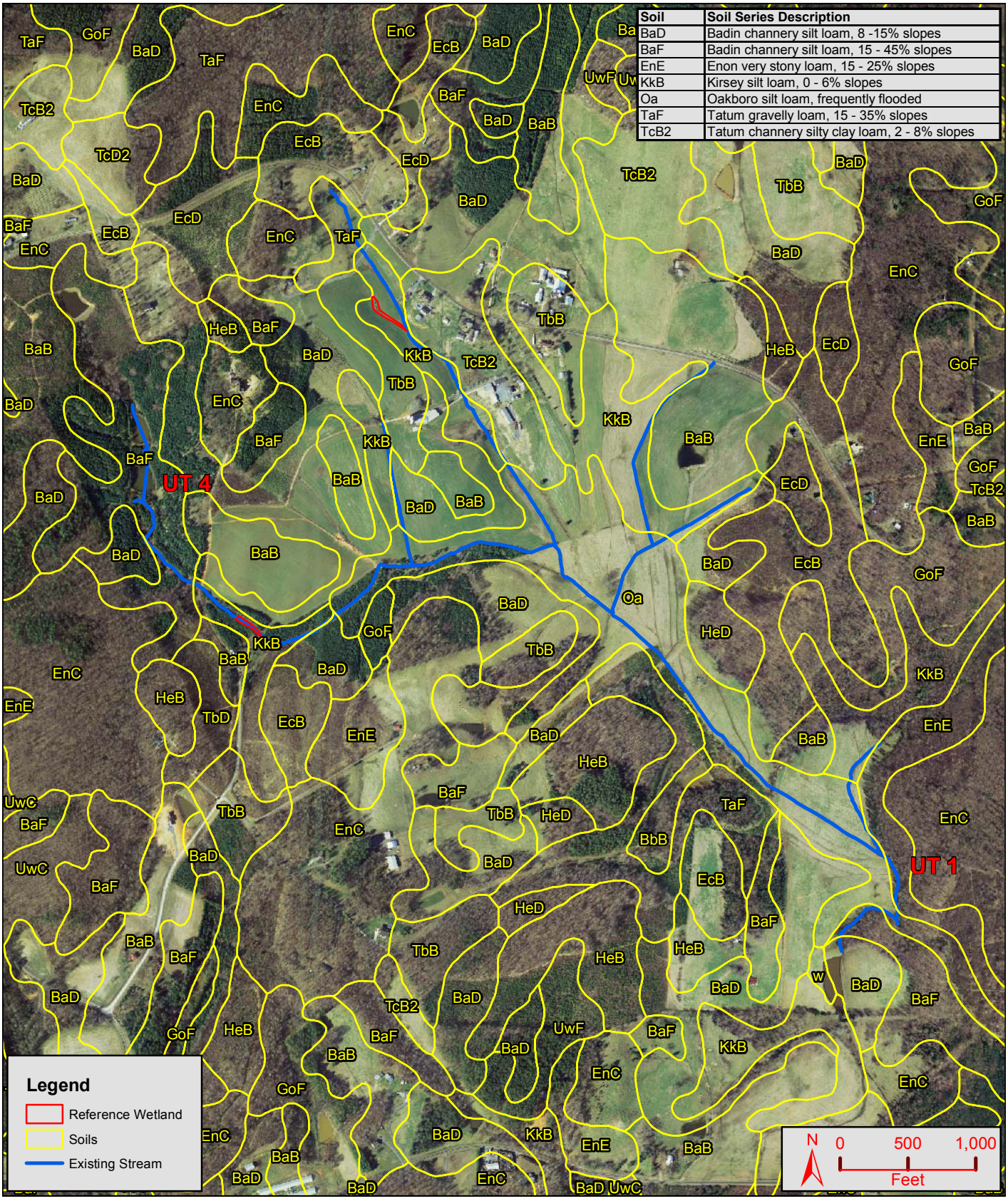


Title	Reference Site Watershed Map
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina

Date	**Project Number**	**Figure**
July 18, 2008	012620017	7

Prepared by Josh Allen

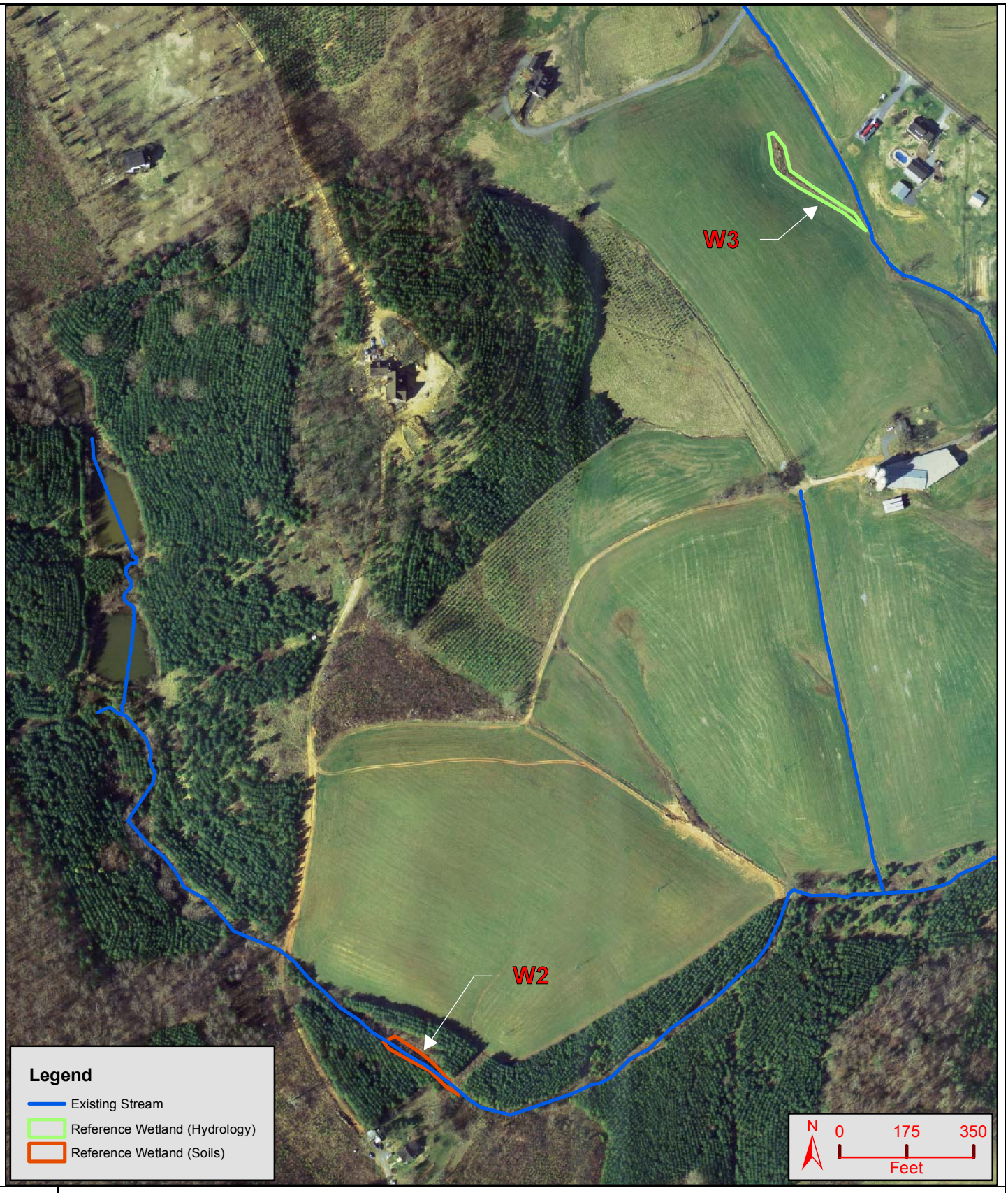
Kimley-Horn and Associates, Inc.



Title	Reference Site NRCS Soil Survey Map
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina
	Date: July 18, 2008
	Project Number: 012620017
	Figure: 8

Prepared by Josh Allen

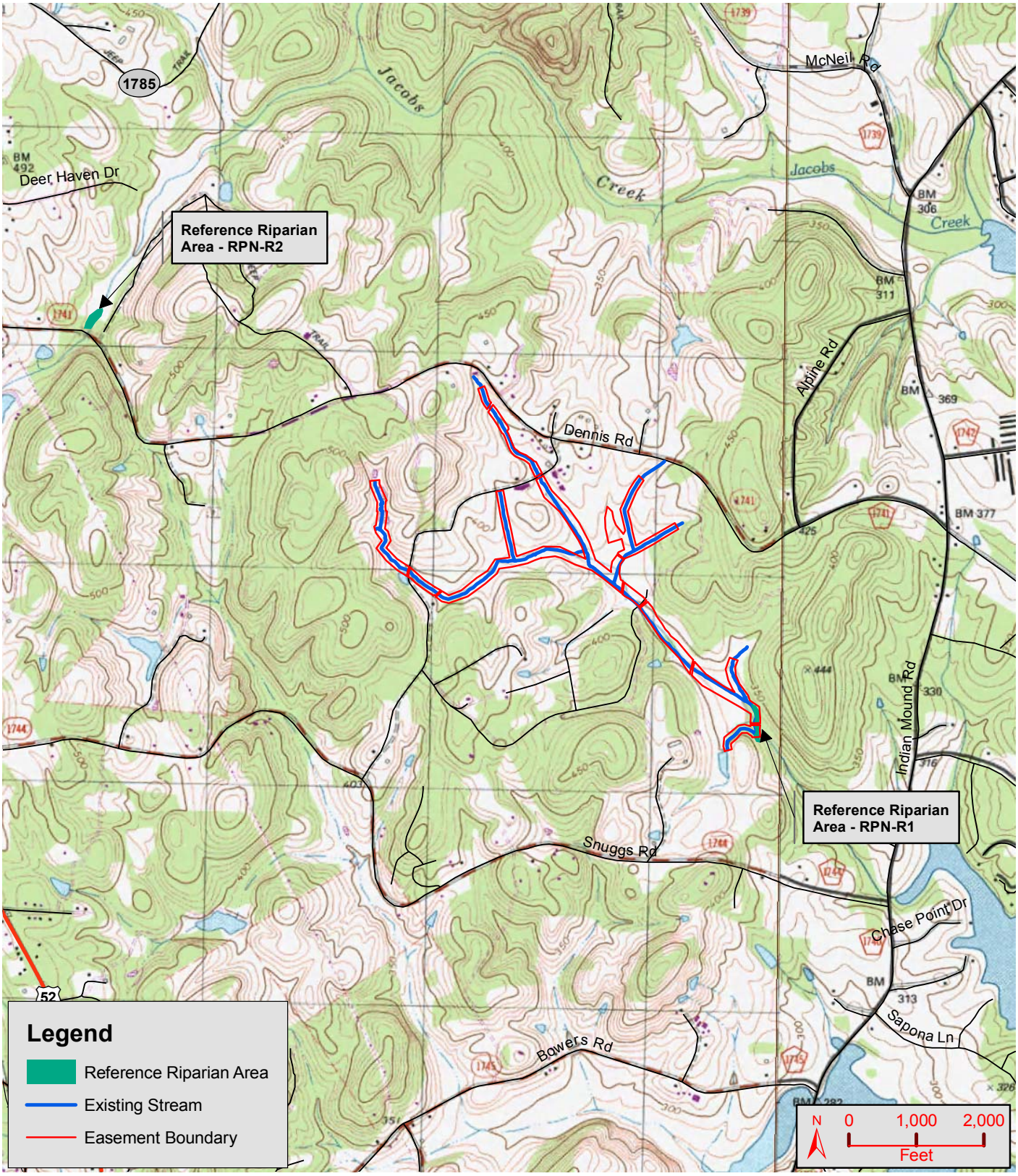
Kimley-Horn and Associates, Inc.



Title	Reference Site Wetland Map (2005)
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina
	Date: July 18, 2008
	Project Number: 012620017
	Figure: 9

Prepared by Josh Allen

Kimley-Horn and Associates, Inc.

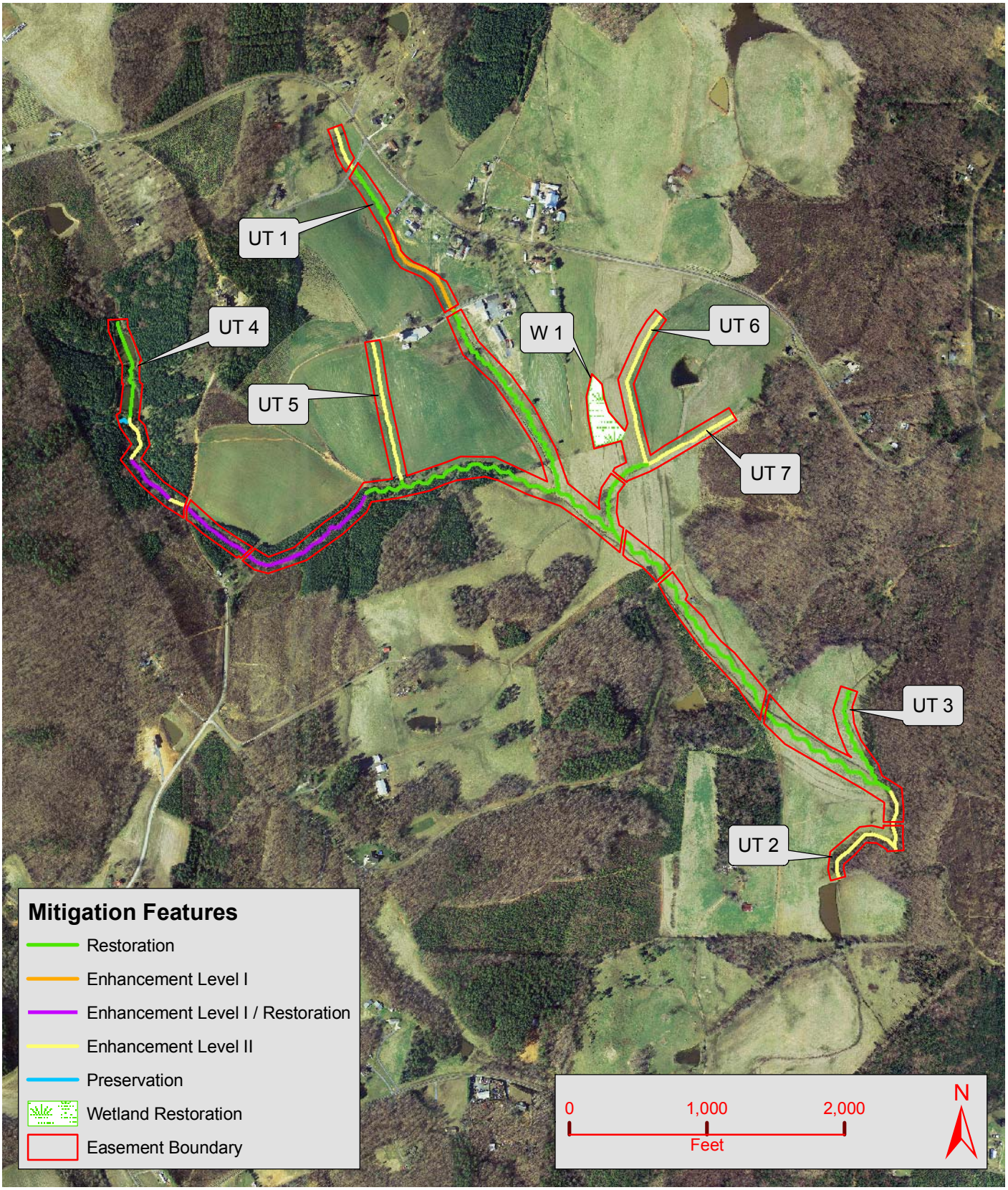


Title	Reference Site Riparian Map (2005)
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina

Date	**Project Number**	**Figure**
July 18, 2008	012620017	10

Prepared by Josh Allen

Kimley-Horn and Associates, Inc.



Title	Proposed Stream and Wetland Mitigation Features
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina

Date	**Project Number**	**Figure**
August 12, 2008	012620017	11

Prepared by Josh Allen

Kimley-Horn and Associates, Inc.

12.0 Design Sheets

(See "Restoration Plan for Rockwell Pastures" design plan set dated 7/15/2008)

13.0 Appendices

Appendix 1

Project Site Photographs

Photograph 1. Lower Reach of Unnamed Tributary 1 (UT1)

Photograph 2. UT2

Title	Site Photographs		
Prepared For: EBX	**Project**	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina	
	Date 7/17/08	**Project Number** 012620017	**Page** 1

Photograph 3. UT3

Photograph 4. Surrounding pasture at the confluence of UT1-Lower, UT2, and UT3.

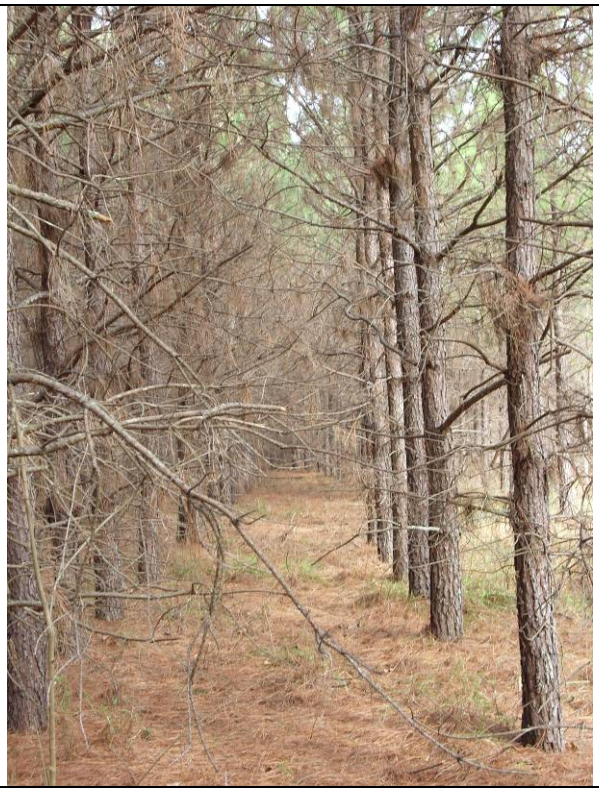
Title	Site Photographs
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina

Date	**Project Number**	**Page**
7/17/08	012620017	2

Photograph 5. Forested reach of UT4

Photograph 6. Section of UT4 along agricultural field

Title	Site Photographs		
Prepared For: EBX	**Project**	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina	
	Date 7/17/08	**Project Number** 012620017	**Page** 3



Photograph 7. Forested Buffer along UT4

Photograph 8. Middle Reach of UT1

Title	Site Photographs

Prepared For:

EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina		
	Date	**Project Number**	**Page**
	7/17/08	012620017	4

Photograph 9. Confluence of UT1 and UT4. UT6 and UT7 are located in the distance.

Photograph 10. UT5 and surround agriculture field

Title	Site Photographs		
Prepared For: EBX	**Project**	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina	
	Date 7/17/08	**Project Number** 012620017	**Page** 5

Photograph 11. Upper Reach of UT1.

Photograph 12. Upper Reach of UT1 and surrounding areas.

Title	Site Photographs
Prepared For: EBX	**Project**: Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina

Date	**Project Number**	**Page**
7/17/08	012620017	6

Photograph 13. UT6

Photograph 14. UT7

Title	Site Photographs

Prepared For:

EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina		
Date	**Project Number**	**Page**	
7/17/08	012620017	7	

Photograph 15. W1 – Proposed wetland restoration area

Title	Site Photographs

Prepared For:

EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina		
	Date	**Project Number**	**Page**
	7/17/08	012620017	8

Appendix 2

Project Site NCDWQ Stream Classification Forms

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 10/19/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT1 - intermittent	Longitude:
Total Points: 30 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 16.5	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	2
2. Sinuosity	0	1	2	3	1
3. In-channel structure: riffle-pool sequence	0	1	2	3	2
4. Soil texture or stream substrate sorting	0	1	2	3	2
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	2
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	2
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	1
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 6					
14. Groundwater flow/discharge	0	1	2	3	1
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	0
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 7.5					
20[b]. Fibrous roots in channel	3	2	1	0	2
21[b]. Rooted plants in channel	3	2	1	0	1
22. Crayfish	0	0.5	1	1.5	0.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	0
25. Amphibians	0	0.5	1	1.5	0.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1
27. Filamentous algae; periphyton	0	1	2	3	2
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	0.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0.75

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
tadpoles, aquaric beetles, dragonfly larva

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 9/26/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT1 - perennial	Longitude:
Total Points: 48.5 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 23	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	3
2. Sinuosity	0	1	2	3	0
3. In-channel structure: riffle-pool sequence	0	1	2	3	3
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	3
6. Depositional bars or benches	0	1	2	3	2
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	3
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	0
11. Grade Control	0	0.5	1	1.5	1.5
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		3

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 9					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	3
16. Leaflitter	1.5	1	0.5	0	0
17. Sediment on plants or debris	0	0.5	1	1.5	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	1
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 16.5					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	3
22. Crayfish	0	0.5	1	1.5	1.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1.5
25. Amphibians	0	0.5	1	1.5	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1.5
27. Filamentous algae; periphyton	0	1	2	3	3
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
crayfish, frogs, amphipods, dragonfly larva

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 9/26/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT2 - perennial	Longitude:
Total Points: 32 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 11.5	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	2
2. Sinuosity	0	1	2	3	1
3. In-channel structure: riffle-pool sequence	0	1	2	3	1
4. Soil texture or stream substrate sorting	0	1	2	3	1
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	0
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	1
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 8.5					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	3
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	0.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 12					
20[b]. Fibrous roots in channel	3	2	1	0	1
21[b]. Rooted plants in channel	3	2	1	0	1
22. Crayfish	0	0.5	1	1.5	1.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1
25. Amphibians	0	0.5	1	1.5	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1.5
27. Filamentous algae; periphyton	0	1	2	3	3
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				1.5

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
right-handed snails, mayflies, bullfrog tadpoles, minnows

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 9/26/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT3 - perennial	Longitude:
Total Points: 43 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 22	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	3
2. Sinuosity	0	1	2	3	2
3. In-channel structure: riffle-pool sequence	0	1	2	3	3
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	3
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	2
11. Grade Control	0	0.5	1	1.5	1.5
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 7.5					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	3
16. Leaflitter	1.5	1	0.5	0	0
17. Sediment on plants or debris	0	0.5	1	1.5	0.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 13.5					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	3
22. Crayfish	0	0.5	1	1.5	1
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1
25. Amphibians	0	0.5	1	1.5	1
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1.5
27. Filamentous algae; periphyton	0	1	2	3	2
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
crayfish, frogs, amphipods, dragonfly larva

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 10/19/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT4 - perennial	Longitude:
Total Points: 35.5 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 18	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	2
2. Sinuosity	0	1	2	3	2
3. In-channel structure: riffle-pool sequence	0	1	2	3	3
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	3
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	0.5
12. Natural valley or drainage way	0	0.5	1	1.5	0.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 9					
14. Groundwater flow/discharge	0	1	2	3	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	0.5
17. Sediment on plants or debris	0	0.5	1	1.5	1
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	1
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 8.5					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	2
22. Crayfish	0	0.5	1	1.5	0.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1
25. Amphibians	0	0.5	1	1.5	0.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	0.5
27. Filamentous algae; periphyton	0	1	2	3	0
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
crayfish, fish, frogs, salamander, amphipods, crayfish

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 10/19/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT5 - intermittent	Longitude:
Total Points: 28 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 15	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	2
2. Sinuosity	0	1	2	3	1
3. In-channel structure: riffle-pool sequence	0	1	2	3	2
4. Soil texture or stream substrate sorting	0	1	2	3	2
5. Active/relic floodplain	0	1	2	3	1
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	1
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	2
11. Grade Control	0	0.5	1	1.5	1.5
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 6.5					
14. Groundwater flow/discharge	0	1	2	3	1
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		0

C. Biology Subtotal = 6.5					
20[b]. Fibrous roots in channel	3	2	1	0	2
21[b]. Rooted plants in channel	3	2	1	0	1
22. Crayfish	0	0.5	1	1.5	0.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	0
25. Amphibians	0	0.5	1	1.5	0
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1
27. Filamentous algae; periphyton	0	1	2	3	2
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	0
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0.75

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
tadpoles, aquaric beetles, dragonfly larva

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 3/9/2007	Project: Rockwell Pastures	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT6	Longitude:
Total Points: 28 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 11.5	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	3
2. Sinuosity	0	1	2	3	0
3. In-channel structure: riffle-pool sequence	0	1	2	3	1
4. Soil texture or stream substrate sorting	0	1	2	3	2
5. Active/relic floodplain	0	1	2	3	0
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	2
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	0
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 8.5					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 8					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	3
22. Crayfish	0	0.5	1	1.5	0
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	0
25. Amphibians	0	0.5	1	1.5	0
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	0.5
27. Filamentous algae; periphyton	0	1	2	3	0
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	0
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				1.5

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.) Sketch:

left-handed snails, crayfish, amphipods, chironomids, ditched

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 3/9/2007	Project: Rockwell Pastures	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT7 lower	Longitude:
Total Points: 33 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 17.5	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	3
2. Sinuosity	0	1	2	3	1
3. In-channel structure: riffle-pool sequence	0	1	2	3	2
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	2
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	1
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	1
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 8.5					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	1
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 7					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	2
22. Crayfish	0	0.5	1	1.5	1
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	0
25. Amphibians	0	0.5	1	1.5	0
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1
27. Filamentous algae; periphyton	0	1	2	3	0
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	0
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.) Sketch:

left-handed snails, crayfish, amphipods, chironomids, ditched

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 3/9/2007	Project: Rockwell Pastures	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT7 upper	Longitude:
Total Points: 35 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 17	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	3
2. Sinuosity	0	1	2	3	0
3. In-channel structure: riffle-pool sequence	0	1	2	3	3
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	0
6. Depositional bars or benches	0	1	2	3	2
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	0
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	3
11. Grade Control	0	0.5	1	1.5	1.5
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 8					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	0.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0.5
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 10					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	3
22. Crayfish	0	0.5	1	1.5	1
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	0
25. Amphibians	0	0.5	1	1.5	0
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1
27. Filamentous algae; periphyton	0	1	2	3	2
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	0
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.) Sketch:

crayfish, amphipods, strong headcut, bedrock, lower part ditched

Appendix 3

Project Site USACE Routine Wetland Determination Data Forms

DATA FORM

ROUTINE WETLAND DETERMINATION
1987 COE Wetlands Delineation Manual

Project/Site:	Rockwell	**Date:**	12/5/2007
Applicant/Owner:		**County:**	Stanly
Investigator:	TC	**State:**	NC
Do Normal Circumstances exist on this site?	Y	**Community ID:**	W2
Is the site significantly disturbed (Atypical Situation?)	Y	**Transect ID:**	
Is the area a potential Problem Area?	N	**Plot ID:**	

Vegetation

Dominant Plant Species	Stratum	Indicator	Dominant Plant Species	Stratum	Indicator
1. *Rubus argutus*	S	FAC	9.		
2. *Liquidambar styraciflua*	T	FAC	10.		
3. *Acer rubrum*	T	FAC	11.		
4. *Scirpus spp.*	H	OBL	12.		
5. *Juncus effusus*	H	FACW	13.		
6.			14.		
7.			15.		
8.			16.		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FACU): 100

Remarks:

Hydrology:

RECORDED DATA:

- [ ] Stream, Lake, or Tide Gauge
- [ ] Aerial Photographs
- [ ] Other
- [x] No Recorded Data Available

PRIMARY INDICATORS:

- [ ] Inundated
- [ ] Saturated in Upper 12 inches
- [ ] Water Marks
- [ ] Drift Lines
- [x] Sediment Deposits
- [x] Drainage Patterns in Wetlands

FIELD OBSERVATIONS:

Depth to Surface Water:	>12	(in)
Depth to Free Water in Pit:	>12	(in)
Depth to Saturated Soil:	10	(in)

SECONDARY INDICATORS:

- [x] Oxidized Root Channels in Upper 12 inches
- [ ] Water Stained Leaves
- [ ] Local Soil Suvey Data
- [ ] Fac-Neutral Test
- [ ] Other

WETLAND HYDROLOGY INDICATORS:

Saturation in upper 12"

SOILS

Map Unit Name
(Series and Phrase): _____

Drainage Class: _____

Taxonomy (Subgroup): _____

Field Observations
Confirm Mapped Type? (Y/N) _____

PROFILE DESCRIPTION

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-5	A	10YR 5/3			Loam
5-12	B	10YR 5/1	10YR 6/6	30%	Clay loam

HYDRIC SOIL INDICATORS

- [ ] Histosol
- [ ] Histic Epipedon
- [ ] Sulfidic Odor
- [ ] Aquic Moisture Regime
- [x] Reducing Conditions
- [x] Gleyed or Low-Chroma Colors
- [ ] Concretions
- [ ] High Organic Streaking in Surface Layer in Sandy Soils
- [ ] Organic Streaking in Sandy Soils
- [ ] Listed on Local Hydric Soils List
- [ ] Listed on National Hydric Soils List
- [ ] Other (Explain in remarks)

Hydric Soil Present? (Y/N) Y

Remarks:

WETLAND DETERMINATION (Y/N)

Hydrophytic Vegetation Present? Y
Wetland Hydrology Present? Y
Hydric Soils Present? Y
Is this sampling point a Wetland? Y

Remarks:

Appendix 4

Reference Site Photos

Photograph 1. UT2 reference cross sections

Photograph 2. UT1 reference cross section

Title	Reference Site Photographs

Prepared For:

EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina		
Date	**Project Number**	**Page**	
7/17/08	012620017	1	

Photograph 3. UT4 reference cross section

Photograph 4. Hydrologic reference wetland in left background.

Title	Reference Site Photographs

Prepared For:

EBX

Project	Rockwell Pastures Stream and Wetland Restoration Site Stanly County, North Carolina		
Date	**Project Number**	**Page**	
7/17/08	012620017	2	

Appendix 5

Reference Site NCDWQ Stream Classification Forms

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 9/26/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT1 - perennial	Longitude:
Total Points: 48.5 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 23	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	3
2. Sinuosity	0	1	2	3	0
3. In-channel structure: riffle-pool sequence	0	1	2	3	3
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	3
6. Depositional bars or benches	0	1	2	3	2
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	3
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	0
11. Grade Control	0	0.5	1	1.5	1.5
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		3

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 9					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	3
16. Leaflitter	1.5	1	0.5	0	0
17. Sediment on plants or debris	0	0.5	1	1.5	1.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	1
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 16.5					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	3
22. Crayfish	0	0.5	1	1.5	1.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1.5
25. Amphibians	0	0.5	1	1.5	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1.5
27. Filamentous algae; periphyton	0	1	2	3	3
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
crayfish, frogs, amphipods, dragonfly larva

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 9/26/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT2 - perennial	Longitude:
Total Points: 32 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 11.5	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	2
2. Sinuosity	0	1	2	3	1
3. In-channel structure: riffle-pool sequence	0	1	2	3	1
4. Soil texture or stream substrate sorting	0	1	2	3	1
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	0
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	1
12. Natural valley or drainage way	0	0.5	1	1.5	1.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 8.5					
14. Groundwater flow/discharge	0	1	2	3	2
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	3
16. Leaflitter	1.5	1	0.5	0	1.5
17. Sediment on plants or debris	0	0.5	1	1.5	0.5
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	0
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 12					
20[b]. Fibrous roots in channel	3	2	1	0	1
21[b]. Rooted plants in channel	3	2	1	0	1
22. Crayfish	0	0.5	1	1.5	1.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1
25. Amphibians	0	0.5	1	1.5	1.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	1.5
27. Filamentous algae; periphyton	0	1	2	3	3
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1.5
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				1.5

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
right-handed snails, mayflies, bullfrog tadpoles, minnows

Sketch:

North Carolina Division of Water Quality - Stream Identification Form, Version 3.1

Date: 10/19/2006	Project: Rockwell Farm Site	Latitude:
Evaluator: Todd St.John (KHA)	Site: UT4 - perennial	Longitude:
Total Points: 35.5 Stream is at least intermittent if ≥ 19 or perennial if ≥ 30	County: Stanly	Other e.g. Quad Name: Albemarle, NC

A. Geomorphology Subtotal = 18	Absent	Weak	Moderate	Strong	Score
1[a]. Continuous bed and bank	0	1	2	3	2
2. Sinuosity	0	1	2	3	2
3. In-channel structure: riffle-pool sequence	0	1	2	3	3
4. Soil texture or stream substrate sorting	0	1	2	3	3
5. Active/relic floodplain	0	1	2	3	2
6. Depositional bars or benches	0	1	2	3	1
7. Braided channel	0	1	2	3	0
8. Recent alluvial deposits	0	1	2	3	3
9[a]. Natural levees	0	1	2	3	0
10. Headcuts	0	1	2	3	1
11. Grade Control	0	0.5	1	1.5	0.5
12. Natural valley or drainage way	0	0.5	1	1.5	0.5
13. Second or greater order channel on existing USGS or NRCS map or other documented evidence.	No = 0		Yes = 3		0

[a] Man-made ditches are not rated; see discussion in manual

B. Hydrology Subtotal = 9					
14. Groundwater flow/discharge	0	1	2	3	3
15. Water in channel and > 48 hrs since rain, or Water in channel -- dry or growing season	0	1	2	3	2
16. Leaflitter	1.5	1	0.5	0	0.5
17. Sediment on plants or debris	0	0.5	1	1.5	1
18. Organic debris lines or piles (Wrack lines)	0	0.5	1	1.5	1
19. Hydric soils (redoximorphic features) present?	No = 0		Yes = 1.5		1.5

C. Biology Subtotal = 8.5					
20[b]. Fibrous roots in channel	3	2	1	0	3
21[b]. Rooted plants in channel	3	2	1	0	2
22. Crayfish	0	0.5	1	1.5	0.5
23. Bivalves	0	1	2	3	0
24. Fish	0	0.5	1	1.5	1
25. Amphibians	0	0.5	1	1.5	0.5
26. Macrobenthos (note diversity and abundance)	0	0.5	1	1.5	0.5
27. Filamentous algae; periphyton	0	1	2	3	0
28. Iron oxidizing bacteria/fungus	0	0.5	1	1.5	1
29[b]. Wetland plants in streambed	FAC = 0.5; FACW = 0.75; OBL = 1.5; SAV = 2.0; Other = 0				0

[b] Items 20 and 21 focus on the presence of upland plants, Item 29 focuses on the presence of aquatic or wetland plants.

Notes: (use back side of this form for additional notes.)
crayfish, fish, frogs, salamander, amphipods, crayfish

Sketch:

Appendix 6

Categorical Exclusion Checklist

Kimley-Horn
and Associates, Inc.

January 22, 2008

P.O. Box 33068
Raleigh, North Carolina
27636-3068

Mr. Donnie Brew
Environmental Protection Specialist
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Re: Rockwell Pastures Stream and Wetland Restoration Site
Full Delivery Project
Stanly County, North Carolina

Dear Mr. Brew:

This letter serves to transmit a Categorical Exclusion Form for Ecosystem Enhancement Program Projects to your agency for the Rockwell Pastures Stream and Wetland Restoration Full Delivery Project for your review and approval.

The Rockwell Pastures Stream and Wetland Restoration Site (Rockwell Pastures) is located in Stanly County, approximately 6 miles southeast of Albemarle, North Carolina (Figure 1). The project proposes restorative work on seven unstable Unnamed Tributaries (UT1, UT2, UT3, UT4, UT5, UT6, and UT7) to David's Creek/Lake Tillery. These streams are highly degraded and unstable due to the channelization and straightening of the channels in the past as well as the ongoing agricultural and livestock operations. The proposed project also includes restorative work on a non-riparian wetland area (W1) which is currently in active agriculture and has been drained by ditches and crowning.

The purpose of this project is to restore the site back to a naturally functioning stream and wetland system. Due to the size of the site and its position in the landscape, the proposed project creates an opportunity to restore virtually an entire watershed through restoration of the riparian areas and wetlands. Benefits will include improved water quality by reducing sediment load through stabilization and by reducing nutrient and other pollutant input by the addition of forested riparian buffers planted with native species. Improvements to the ecosystem include the addition of in-stream habitat by the use of stream structures and bank revetments such as root wads.

The project will include the restoration of dimension, pattern, and profile to approximately 10,757 linear feet of existing stream channel and the enhancement of approximately 6,426 linear feet of existing stream channel. Stream banks will

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Kimley-Horn
and Associates, Inc.

be stabilized using erosion matting, bare-root plantings, and bio-engineering. In-stream structures will be constructed to increase turbulence and disturbed oxygen concentrations. Additionally, the proposed project includes the restoration of 1.5 acres of non-riparian wetlands.

I appreciate your assistance with this matter. If you have any questions regarding this application, please do not hesitate to call me at 919.653.5843.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.

Laura Thornbrough
Environmental Analyst

Version 1.4, 8/18/05

Categorical Exclusion Form for Ecosystem Enhancement Program Projects

Part 1: General Project Information	
Project Name:	Rockwell Pastures Stream and Wetland Restoration Full Delivery Project
County Name:	Stanly County, North Carolina
EEP Number:	000624
Project Sponsor:	Environmental Banc & Exchange, LLC
Project Contact Name:	Norton Webster
Project Contact Address:	909 Capability Drive, Suite 3100, Raleigh, North Carolina 27606
Project Contact E-mail:	norton@ebxusa.com
EEP Project Manager:	Guy Pearce

Project Description

The Rockwell Pastures Restoration Project proposed restorative work on 7 unstable streams as well as the restoration of 1.5 ac of non-riparian wetland. Due to the size of the site and its position in the landscape, the proposed project creates an opportunity to restore virtually an entire watershed through restoration of riparian areas and wetlands. The project will include the restoration of dimension, pattern, and profile to approximately 10,757 LF of existing stream channel and the enhancement of approximately 6,426 LF of existing stream channel. Benefits will include improved water quality by reducing sediment load through stabilization and by reducing nutrient and other pollutant input.

For Official Use Only

Reviewed By:

Date	**EEP Project Manager**

Conditional Approved By:

Date	**For Division Administrator FHWA**

☐ **Check this box if there are outstanding issues**

Final Approval By:

Date	**For Division Administrator FHWA**

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☑ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐ Yes ☑ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☑ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Does the project require the acquisition of real estate?	☑ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☑ Yes ☐ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☐ No ☑ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

Memorandum

To: Donnie Brew
Federal Highway Administration

From: Laura Thornbrough
Kimley-Horn and Associates, Inc.

Date: January 22, 2008

Subject: Threatened and Endangered Species
Rockwell Pastures Stream and Wetland Restoration Site
Stanly County, NC

This memo is intended to document the absence/presence of threatened and endangered species or suitable habitat at the Rockwell Pastures Stream and Wetland Restoration Site.

The U.S. Fish and Wildlife Service (USFWS) database (updated January 16, 2008) lists one federally endangered species for Stanly County, NC: Schweinitz's sunflower (*Helianthus schweinitzii*). Yadkin River goldenrod (*Solidago plumosa*) and Georgia aster (*Symphyotrichum georgianum*) are identified as candidate species; however these species do not receive federal protection. The bald eagle (*Haliaeetus leucocephalus*) is protected under the Bald and Golden Eagle Protection Act. Review of the Natural Heritage Program (NHP) database of documented occurrences did not reveal the presence of any of these species within a one-mile radius of the proposed mitigation site.

A project scoping letter was sent to Ms. Marella Buncick of the U.S. Fish and Wildlife Service (December 10, 2007) requesting any information or comments that the USFWS may have with regards to this stream and wetland restoration project. Ms. Buncick has not responded with any comments. Therefore, it is not anticipated that this project will have any negative affect on suitable habitat for the threatened and endangered species listed for Stanly County, NC.

Schweinitz's Sunflower (*Helianthus schweinitzii*)

Schweinitz's sunflower is a perennial herb, usually 3 to 6 feet tall with yellow flowers which occur in late August to October. Schweinitz's sunflower is found in relatively open habitats such as roadsides, maintained rights-of-way, early successional fields, and woodland openings. Generally, Schweinitz's sunflower occurs on shallow, poorly drained, clayey and/or rocky soils.

Marginal habitat for Schweinitz's sunflower exists along the agricultural field edges at the Rockwell Pastures property; however the frequent disturbance of the site makes these areas unfavorable. The majority of this site is used as open active agricultural fields, void of any native vegetation. Site soils are predominantly deep and moderately to well-drained.

No occurrences of Schweinitz's sunflower have been documented in the NHP database within a one-mile radius of the proposed mitigation site and presence of this species has not been observed by KHA or EBX biologists during site investigations conducted during Schweinitz's sunflower flowering season.

BIOLOGICAL CONCLUSION: NO EFFECT.

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is a large raptor which typically inhabits the shorelines of large rivers, lakes, and ponds. Bald eagles construct nests in large trees near the shoreline and make use of the large water bodies for foraging.

Suitable habitat for bald eagle does not exist within the proposed mitigation areas, as there are no large bodies of water on or near the proposed project property. No occurrences of bald eagle have been documented in the NHP database within a one-mile radius of the proposed mitigation site and presence of this species or of suitable habitat for this species has not been observed by EBX or KHA biologists during site investigations.

BIOLOGICAL CONCLUSION: NO EFFECT.

Yadkin River Goldenrod (*Solidago plumosa*)

Yadkin River goldenrod is a perennial herb, endemic to the Yadkin River in North Carolina. Currently, plants are known to exist in only two locations, within 2 kilometers of each other, along the shoreline of the Yadkin River. This species is listed as a Candidate species by the USFWS.

Habitat for Yadkin River goldenrod does not exist on the Rockwell Pastures property due to the lack of flood scouring, the establishment and spread of invasive species, and the clearing of native vegetation for agricultural purposes. The majority of this site is used as open active agricultural fields, void of any native vegetation.

No occurrences of Yadkin River goldenrod have been documented in the NHP database within a one-mile radius of the proposed mitigation site and presence of this species has not been observed by KHA or EBX biologists during site investigations.

BIOLOGICAL CONCLUSION: NO EFFECT.

Georgia Aster (*Symphyotrichum georgianum*)

Georgia aster is a perennial herb, distinguished by its large flower heads with dark purple rays up to 2 cm long. Disc flowers are white with purplish tips on the corollas. Blooms first appear in early October and continue into mid-November. Georgia aster is found in

dry open woods, roadsides, maintained rights-of-way, and woodland openings in dry oak-pine flatwoods and uplands in the piedmont region of the state. This species is most likely a relic species of the post oak-savanna communities that existed prior to fire suppression. Georgia aster is listed as a Candidate species by the USFWS.

Marginal habitat for Georgia aster exists along the agricultural field edges at the Rockwell Pastures property where the frequent disturbances of the site mimic natural disturbances; however the majority of this site is used as open active agricultural fields, void of any native vegetation.

No occurrences of Georgia aster have been documented in the NHP database within a one-mile radius of the proposed mitigation site and presence of this species has not been observed by KHA or EBX biologists during site investigations. The USFWS lists the record status for Georgia aster as “historic”, meaning the species was last observed in Stanly County more than 50 years ago.

BIOLOGICAL CONCLUSION: NO EFFECT.

Kimley-Horn
and Associates, Inc.

P O Box 33068
Raleigh, North Carolina
27636-3068

December 10, 2007

Marella Buncick,
U.S. Fish and Wildlife Service
Asheville Field Office
160 Zillicoa Street
Asheville, North Carolina 28801

Re: Rockwell Pastures Stream and Wetland Restoration Site
Full Delivery Project
Stanly County, North Carolina

Dear Ms. Buncick,

Kimley-Horn and Associates, Inc. is writing this letter on behalf of our client, Environmental Banc & Exchange, LLC, to request a no effect determination from your agency regarding a proposed stream and wetland restoration project.

The Rockwell Pastures Stream and Wetland Restoration Site (Rockwell Pastures) is located in Stanly County, approximately 6 miles southeast of Albemarle, North Carolina (Figure 1). The project proposes restorative work on seven unstable Unnamed Tributaries (UT1, UT2, UT3, UT4, UT5, UT6, and UT7) to David's Creek/Lake Tillery. These streams are highly degraded and unstable due to the channelization and straightening of the channels in the past as well as the ongoing agricultural and livestock operations. The proposed project also includes restorative work on a non-riparian wetland area (W1) which is currently in active agriculture and has been drained by ditches and crowning.

The purpose of this project is to restore the site back to a naturally functioning stream and wetland system. Due to the size of the site and its position in the landscape, the proposed project creates an opportunity to restore virtually an entire watershed through restoration of the riparian areas and wetlands. Benefits will include improved water quality by reducing sediment load through stabilization and by reducing nutrient and other pollutant input by the addition of forested riparian buffers planted with native species. Improvements to the ecosystem include the addition of in-stream habitat by the use of stream structures and bank revetments such as root wads

The project will include the restoration of dimension, pattern, and profile to approximately 10,757 linear feet of existing stream channel and the enhancement of approximately 6,426 linear feet of existing stream channel. Stream banks will be

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FAX 919 677 2050

stabilized using erosion matting, bare-root plantings, and bio-engineering. In-stream structures will be constructed to increase turbulence and disturbed oxygen concentrations. Additionally, the proposed project includes the restoration of 1.5 acres of non-riparian wetlands

According to the U.S. Fish & Wildlife Service internet list (updated 11/05/2007; accessed 12/03/2007), there is one endangered species, two candidate species, and ten federal species of concern potentially occurring in Stanly County. Schweinitz's sunflower (*Helianthus schweinitzii*) is the only species listed as endangered for this county. The bald eagle (*Haliaeetus leucocephalus*) is protected under the Bald and Golden Eagle Protection Act. It is unlikely that any of these species will be negatively affected by this project.

Specifically, we would like information that the area described above —

- is not located in an officially designated wildlife refuge
- will not affect listed threatened or endangered species or designated critical habitats; will not jeopardize the continued existence of any proposed endangered or threatened species or likely result in the destruction or adverse modification of proposed critical habitats, as determined by the Secretary of the Interior pursuant to the Endangered Species Act of 1973

Additionally, we request that you please include —

- Any known information for each species listed in Stanly County, NC
- Comments on any possible issues that might emerge with respect to endangered species, migratory birds or other trust resources from the construction of the proposed project

We would appreciate a reply from you as soon as possible. Please either mail or fax (919-677-2050) your reply to my attention. If you have any questions regarding this request or the extent of site disturbance associated with this project, please feel free to contact me at (919) 653-5843.

If we have not heard from you in 30 days we will assume that our species list is correct, that you do not have any comments regarding associated laws, and that you do not have any information relevant to this project at the current time.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.

Laura Thornbrough
Environmental Analyst

North Carolina Wildlife Resources Commission

Fred A. Harris, Interim Executive Director

20 December 2007

Ms. Laura Thornbrough, Environmental Analyst
Kimley-Horn and Associates, Inc.
P.O. Box 33068
Raleigh, NC 27636-3068

Subject: Rockwell Pastures Stream and Wetland Restoration Site, Stanly County, North Carolina.

Dear Ms. Thornbrough:

Biologists with the North Carolina Wildlife Resources Commission have reviewed the subject document. Our comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667d) and North Carolina General Statutes (G.S. 113-131 et seq.).

The proposed project includes restoration of dimension, pattern and profile to approximately 10,757 linear feet of stream channel and enhancement of approximately 6,426 linear feet of stream channel on seven unnamed tributaries to David's Creek/Lake Tillery in the Yadkin-Pee Dee River basin. Stream banks will be stabilized using erosion matting, bare-root plantings, and bioengineering structures. The streams are highly degraded and unstable due to channelization, straightening, and ongoing agricultural and livestock operations. Also, restoration of 1.5 acres of non-riparian wetlands is proposed.

Stream and wetland restoration projects often improve water quality and aquatic habitat. We recommend establishing native, forested buffers in riparian areas to improve terrestrial habitat and provide a travel corridor for wildlife species. Provided natural channel design methods are used and measures are taken to minimize erosion and sedimentation from construction/restoration activities, we do not anticipate the project to result in significant adverse impacts to aquatic and terrestrial wildlife resources.

Thank you for the opportunity to review this project. If you require further assistance, please contact our office at (336) 449-7625.

Sincerely,

Shari L. Bryant

Shari L. Bryant
Piedmont Region Coordinator
Habitat Conservation Program

Mailing Address: Division of Inland Fisheries • 1721 Mail Service Center • Raleigh, NC 27699-1721
Telephone: (919) 707-0220 • **Fax:** (919) 707-0028

Kimley-Horn
and Associates, Inc.

P O Box 33068
Raleigh, North Carolina
27636-3068

December 10, 2007

Shannon Deaton,
North Carolina Wildlife Resource Commission
Division of Inland Fisheries
1721 Mail Service Center
Raleigh, NC 27699

Re: Rockwell Pastures Stream and Wetland Restoration Site
Full Delivery Project
Stanly County, North Carolina

Dear Ms. Deaton,

Kimley-Horn and Associates, Inc. is writing this letter on behalf of our client, Environmental Banc & Exchange, LLC, to request review and comment on any possible issues that might emerge with respect to fish and wildlife issues associated with a proposed stream and wetland restoration project.

The Rockwell Pastures Stream and Wetland Restoration Site (Rockwell Pastures) is located in Stanly County, approximately 6 miles southeast of Albemarle, North Carolina (Figure 1). The project proposes restorative work on seven unstable Unnamed Tributaries (UT1, UT2, UT3, UT4, UT5, UT6, and UT7) to David's Creek/Lake Tillery. These streams are highly degraded and unstable due to the channelization and straightening of the channels in the past as well as the ongoing agricultural and livestock operations. The proposed project also includes restorative work on a non-riparian wetland area (W1) which is currently in active agriculture and has been drained by ditches and crowning.

The purpose of this project is to restore the site back to a naturally functioning stream and wetland system. Due to the size of the site and its position in the landscape, the proposed project creates an opportunity to restore virtually an entire watershed through restoration of the riparian areas and wetlands. Benefits will include improved water quality by reducing sediment load through stabilization and by reducing nutrient and other pollutant input by the addition of forested riparian buffers planted with native species. Improvements to the ecosystem include the addition of in-stream habitat by the use of stream structures and bank revetments such as root wads.

The project will include the restoration of dimension, pattern, and profile to approximately 10,757 linear feet of existing stream channel and the enhancement of

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FAX 919 677 2050

Kimley-Horn
and Associates, Inc.

approximately 6,426 linear feet of existing stream channel. Stream banks will be stabilized using erosion matting, bare-root plantings, and bio-engineering. In-stream structures will be constructed to increase turbulence and disturbed oxygen concentrations. Additionally, the proposed project includes the restoration of 1.5 acres of non-riparian wetlands.

We would appreciate a reply from you as soon as possible. Please either mail or fax (919-677-2050) your reply to my attention. If you have any questions regarding this request or the extent of site disturbance associated with this project, please feel free to contact me at (919) 653-5843.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.

Laura Thornbrough

Laura Thornbrough
Environmental Analyst

cc:
Guy Pearce
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699

Norton Webster
Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh, North Carolina 27606

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B Sandbeck, Administrator

Michael F Easley, Governor
Lisbeth C Evans, Secretary
Jeffrey J Crow, Deputy Secretary

Office of Archives and History
Division of Historical Resources
David Brook, Director

December 27, 2007

Laura Thornbrough
Kimley-Horn and Associates, Inc.
PO Box 33068
Raleigh, NC 27636-3068

Re: Rockwell Pastures Stream and Wetland Restoration, Stanly County, ER 07-2679

Dear Ms. Thornbrough:

Thank you for your letter of December 10, 2007, concerning the above project.

We have conducted a review of the project and are aware of no historic resources which would be affected by the project. Therefore, we have no comment on the project 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 919-807-6579. In all future communication concerning this project, please cite the above-referenced tracking number.

Sincerely,

Renee Gledhill-Earley

Peter Sandbeck

Kimley-Horn
and Associates, Inc.

P.O. Box 33068
Raleigh, North Carolina
27636-3068

December 10, 2007

Ms. Renee Gledhill-Earley
Environmental Review Coordinator
North Carolina State Historic Preservation Office
4617 Mail Service Center
Raleigh, North Carolina 27699-4617

Re: Rockwell Pastures Stream and Wetland Restoration Site
Full Delivery Project
Stanly County, North Carolina

Dear Ms. Gledhill-Earley,

Kimley-Horn and Associates, Inc. is writing this letter on behalf of our client, Environmental Banc & Exchange, LLC, to request review and comment on any possible issues that might emerge with respect to archaeological or cultural resources associated with a potential stream and wetland restoration project.

The Rockwell Pastures Stream and Wetland Restoration Site (Rockwell Pastures) is located in Stanly County, approximately 6 miles southeast of Albemarle, North Carolina (Figure 1). The project proposes restorative work on seven unstable Unnamed Tributaries (UT1, UT2, UT3, UT4, UT5, UT6, and UT7) to David's Creek/Lake Tillery. These streams are highly degraded and unstable due to the channelization and straightening of the channels in the past as well as the ongoing agricultural and livestock operations. The proposed project also includes restorative work on a non-riparian wetland area (W1) which is currently in active agriculture and has been drained by ditches and crowning.

The purpose of this project is to restore the site back to a naturally functioning stream and wetland system. Due to the size of the site and its position in the landscape, the proposed project creates an opportunity to restore virtually an entire watershed through restoration of the riparian areas and wetlands. Benefits will include improved water quality by reducing sediment load through stabilization and by reducing nutrient and other pollutant input by the addition of forested riparian buffers planted with native species. Improvements to the ecosystem include the addition of in-stream habitat by the use of stream structures and bank revetments such as root wads.

The project will include the restoration of dimension, pattern, and profile to approximately 10,757 linear feet of existing stream channel and the enhancement of

Kimley-Horn
and Associates, Inc.

approximately 6,426 linear feet of existing stream channel. Stream banks will be stabilized using erosion matting, bare-root plantings, and bio-engineering. In-stream structures will be constructed to increase turbulence and disturbed oxygen concentrations. Additionally, the proposed project includes the restoration of 1.5 acres of non-riparian wetlands.

No architectural structures or archeological artifacts have been observed or noted during preliminary surveys of the site for restoration purposes. In addition, the majority of the site has historically been disturbed due to agricultural purposes such as tilling and grazing. Project site photographs are enclosed with this letter.

We ask that you review this site based on the attached information to determine the presence of any historic properties.

We would appreciate a reply from you as soon as possible. Please either mail or fax (919-677-2050) your reply to my attention. If you have any questions regarding this request or the extent of site disturbance associated with this project, please feel free to contact me at (919) 653-5843.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.

Laura Thornbrough

Laura Thornbrough
Environmental Analyst

cc:
Guy Pearce
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699

Norton Webster
Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh, North Carolina 27606

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 12/11/07
Name Of Project Rockwell Pastures Stream and Wetland Restoratio	Federal Agency Involved FHWA
Proposed Land Use Stream and Wetland Restoration	County And State Stanly, North Carolina
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 12-11-2007

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form)*	Yes ☒	No ☐	Acres Irrigated 0	Average Farm Size 150

Major Crop(s) CORN	Farmable Land In Govt. Jurisdiction Acres: 198232 % 76.5	Amount Of Farmland As Defined in FPPA Acres: 162996 % 55
Name Of Land Evaluation System Used STANLY LE	Name Of Local Site Assessment System None	Date Land Evaluation Returned By NRCS 12-18-2007

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	58.6			
B. Total Acres To Be Converted Indirectly	0.0			
C. Total Acres In Site	58.6	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	45.20			
B. Total Acres Statewide And Local Important Farmland	3.24			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	0.0297			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	62.9			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	~~0~~ 63	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use		15			
2. Perimeter In Nonurban Use		10			
3. Percent Of Site Being Farmed		16			
4. Protection Provided By State And Local Government		0			
5. Distance From Urban Builtup Area		15			
6. Distance To Urban Support Services		10			
7. Size Of Present Farm Unit Compared To Average		10			
8. Creation Of Nonfarmable Farmland		0			
9. Availability Of Farm Support Services		4			
10. On-Farm Investments		5			
11. Effects Of Conversion On Farm Support Services		0			
12. Compatibility With Existing Agricultural Use		0			
TOTAL SITE ASSESSMENT POINTS	160	~~0~~ 85	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	~~0~~ 63	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	~~0~~ 85	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	~~0~~ 148	0	0	0

Site Selected: A	Date Of Selection 12/21/2007	Was A Local Site Assessment Used? Yes ☐ No ☒

Reason For Selection:

site A was only available site

(See Instructions on reverse side)

Form AD-1006 (10-83)

This form was electronically produced by National Production Services Staff

Kimley-Horn
and Associates, Inc.

P O Box 33068
Raleigh, North Carolina
27636-3068

December 11, 2007

Alan Walters
Resource Soil Scientist
Natural Resources Conservation Service
530 West Innes Street
Salisbury, NC 28144

Re: Rockwell Pastures Stream and Wetland Restoration Site
Full Delivery Project
Stanly County, North Carolina

Dear Mr. Walters,

Kimley-Horn and Associates, Inc. (KHA) is writing this letter on behalf of our client, Environmental Banc & Exchange (EBX), to request input from your agency regarding the proposed Rockwell Pastures Stream and Wetland Restoration Site (Rockwell Pastures) located in Stanly County, approximately 6 miles southeast of Albemarle, North Carolina, and potential effects it may have on farmland resources. We have completed sections I and III of the enclosed Form AD-1006. A location map, USGS topographic map, soils map, and site overview map are also included.

The project proposes restorative work on seven unstable Unnamed Tributaries (UT1, UT2, UT3, UT4, UT5, UT6, and UT7) to David's Creek/Lake Tillery. These streams are highly degraded and unstable due to the channelization and straightening of the channels in the past as well as the ongoing agricultural and livestock operations. The proposed project also includes restorative work on a non-riparian wetland area (W1) which is currently in active agriculture and has been drained by ditches and crowning.

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TEL 919 677 2000
FAX 919 677 2050

Kimley-Horn
and Associates, Inc.

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We would appreciate a reply from you as soon as possible. Please either mail or fax (919-677-2050) your reply to my attention. If you have any questions regarding this request or the extent of site disturbance associated with this project, please feel free to contact me at (919) 653-5843.

Very truly yours,

KIMLEY-HORN AND ASSOCIATES, INC.

Laura Thornbrough
Environmental Analyst

The EDR Radius Map
with GeoCheck®

Rockwell Pastures
44188 A Dennis Road
Albemarle, NC 28001

Inquiry Number: 2119602.2s

January 14, 2008

The Standard in Environmental Risk Information

440 Wheelers Farms Road
Milford, Connecticut 06461

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-05) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

44188 A DENNIS ROAD
ALBEMARLE, NC 28001

COORDINATES

Latitude (North):	35.278290 - 35° 16' 41.8''
Longitude (West):	80.134810 - 80° 8' 5.3''
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	578684.6
UTM Y (Meters):	3904049.8
Elevation:	360 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	35080-C2 ALBEMARLE, NC
Most Recent Revision:	1996
East Map:	35080-C1 MORROW MOUNTAIN, NC
Most Recent Revision:	1994

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

FEDERAL RECORDS

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
Delisted NPL ---------- National Priority List Deletions
NPL LIENS ---------- Federal Superfund Liens
CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned
LIENS 2 ---------- CERCLA Lien Information

EXECUTIVE SUMMARY

CORRACTS Corrective Action Report
RCRA-TSDF RCRA - Transporters, Storage and Disposal
RCRA-LQG RCRA - Large Quantity Generators
RCRA-SQG RCRA - Small Quantity Generators
RCRA-CESQG RCRA - Conditionally Exempt Small Quantity Generator
RCRA-NonGen RCRA - Non Generators
US ENG CONTROLS Engineering Controls Sites List
US INST CONTROL Sites with Institutional Controls
ERNS Emergency Response Notification System
HMIRS Hazardous Materials Information Reporting System
DOT OPS Incident and Accident Data
US CDL Clandestine Drug Labs
US BROWNFIELDS A Listing of Brownfields Sites
DOD Department of Defense Sites
FUDS Formerly Used Defense Sites
LUCIS Land Use Control Information System
CONSENT Superfund (CERCLA) Consent Decrees
ROD Records Of Decision
UMTRA Uranium Mill Tailings Sites
ODI Open Dump Inventory
DEBRIS REGION 9 Torres Martinez Reservation Illegal Dump Site Locations
MINES Mines Master Index File
TRIS Toxic Chemical Release Inventory System
TSCA Toxic Substances Control Act
FTTS FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
HIST FTTS FIFRA/TSCA Tracking System Administrative Case Listing
SSTS Section 7 Tracking Systems
ICIS Integrated Compliance Information System
PADS PCB Activity Database System
MLTS Material Licensing Tracking System
RADINFO Radiation Information Database
FINDS Facility Index System/Facility Registry System
RAATS RCRA Administrative Action Tracking System

STATE AND LOCAL RECORDS

SHWS Inactive Hazardous Sites Inventory
IMD Incident Management Database
NC HSDS Hazardous Substance Disposal Site
SWF/LF List of Solid Waste Facilities
OLI Old Landfill Inventory
HIST LF Solid Waste Facility Listing
LUST Regional UST Database
LUST TRUST State Trust Fund Database
UST Petroleum Underground Storage Tank Database
AST AST Database
INST CONTROL No Further Action Sites With Land Use Restrictions Monitoring
VCP Responsible Party Voluntary Action Sites
DRYCLEANERS Drycleaning Sites
BROWNFIELDS Brownfields Projects Inventory
NPDES NPDES Facility Location Listing

TRIBAL RECORDS

INDIAN RESERV Indian Reservations

EXECUTIVE SUMMARY

INDIAN LUST Leaking Underground Storage Tanks on Indian Land
INDIAN UST Underground Storage Tanks on Indian Land

EDR PROPRIETARY RECORDS

Manufactured Gas Plants EDR Proprietary Manufactured Gas Plants

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

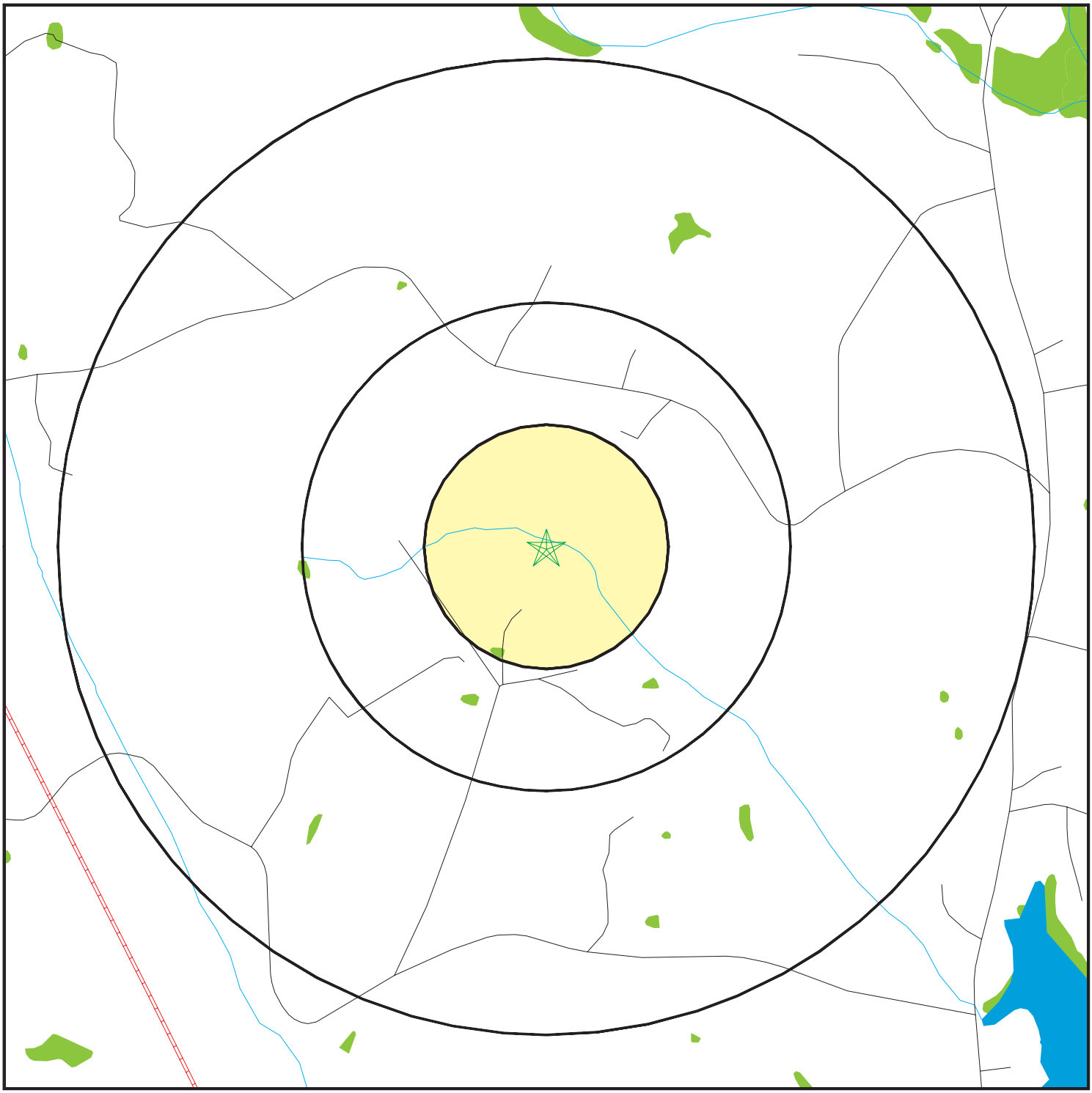
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

Site Name	Database(s)
CAROLINA SOLITE CORP/AQUADALE	CERC-NFRAP
MIN O PON	LUST, UST, IMD
EFIRDS BACKHOE SERVICE (FORMER	LUST, IMD
HWY 205 @ 24/27	LUST
CANTON RD MINI MART	LUST, IMD
FROG POND 66	LUST, UST, IMD
MORGAN MILLS (DAWSON PLANT #6)	LUST, IMD
METAL MAINTENANCE	LUST, IMD
PHILLIPS 66 FORMER	LUST, IMD
MILTONS GROCERY/GAS FORMER	LUST, IMD
DOBY TRUST - WHITE OAK RANCH F	LUST, IMD
CANTON ROAD MINIMART #2	LUST, IMD
PHILLIPS 66-HWY 24/27	LUST, IMD
SERVCO 00115 (WILCO #381)	LUST, LUST TRUST, IMD
ALLISON MANUFACTURING COMPANY	LUST, IMD
THE STORE/HOME SAVINGS AND LOA	LUST, IMD
U FILLER UP (FORMER)	LUST
PLYLER HEADEND	LUST, IMD
DOBY TRUST - EGG PLANT & HATCH	LUST, IMD
MILLINGPORT ELEMENTARY SCHOOL	LUST, IMD
FAST STOP #1	LUST, IMD
BURRIS ALTON PROPERTY (FORMER)	LUST, IMD
HUNEYCUTT PROPERTY	LUST, IMD
MCCOY OIL COMPANY	LUST, LUST TRUST, IMD
FAST STOP #1	LUST TRUST
REID EFIRD BACKHOE SERVICE	UST
NORTH CAROLINA NATURAL GAS CO	UST
BELK 018	UST
GREEN TOP 66	UST
MIN O PON	UST
CHARLES HARRINGTON	UST
HIGHWAY 52 66 STATION	UST
WILCO 381	UST
QUIK CHECK 18	UST
CONCORD ROAD GULF	UST
ALL STAR MILLS. INC.	UST
VERN'S 66	UST
C.L. VICKERS TRANSFER	UST
TIME WARNER CABLE	UST
CONCORD TELEPHONE MICROWAVE T	UST
HALL'S MOTORCYCLE SHOP	UST
MILLINGPORT ELEMENTARY SCHOOL	UST
AEROQUIP-NORWOOD PLANT	UST
REMBERT HARGROVE BLALOCK	UST
KAISER AGRICULTURAL CHEMICAL	UST
STANLY FIXTURES CO.. INC.	UST
JEFFERIES SOUTHERN PROCESSORS	AST
HAWOOD PROPERTY/STROUD IMAGES	RCRA-NonGen
RUSSELL S AUTOMOTIVE	FINDS, RCRA-CESQG
AREY/TAYLOR WELLS	IMD
U FILLER UP (FORMER)	IMD
CROSSROADS GROCERY	IMD
LUTHER GORDON PROPERTY	IMD
LONG CREEK WWTP	IMD

OVERVIEW MAP - 2119602.2s



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

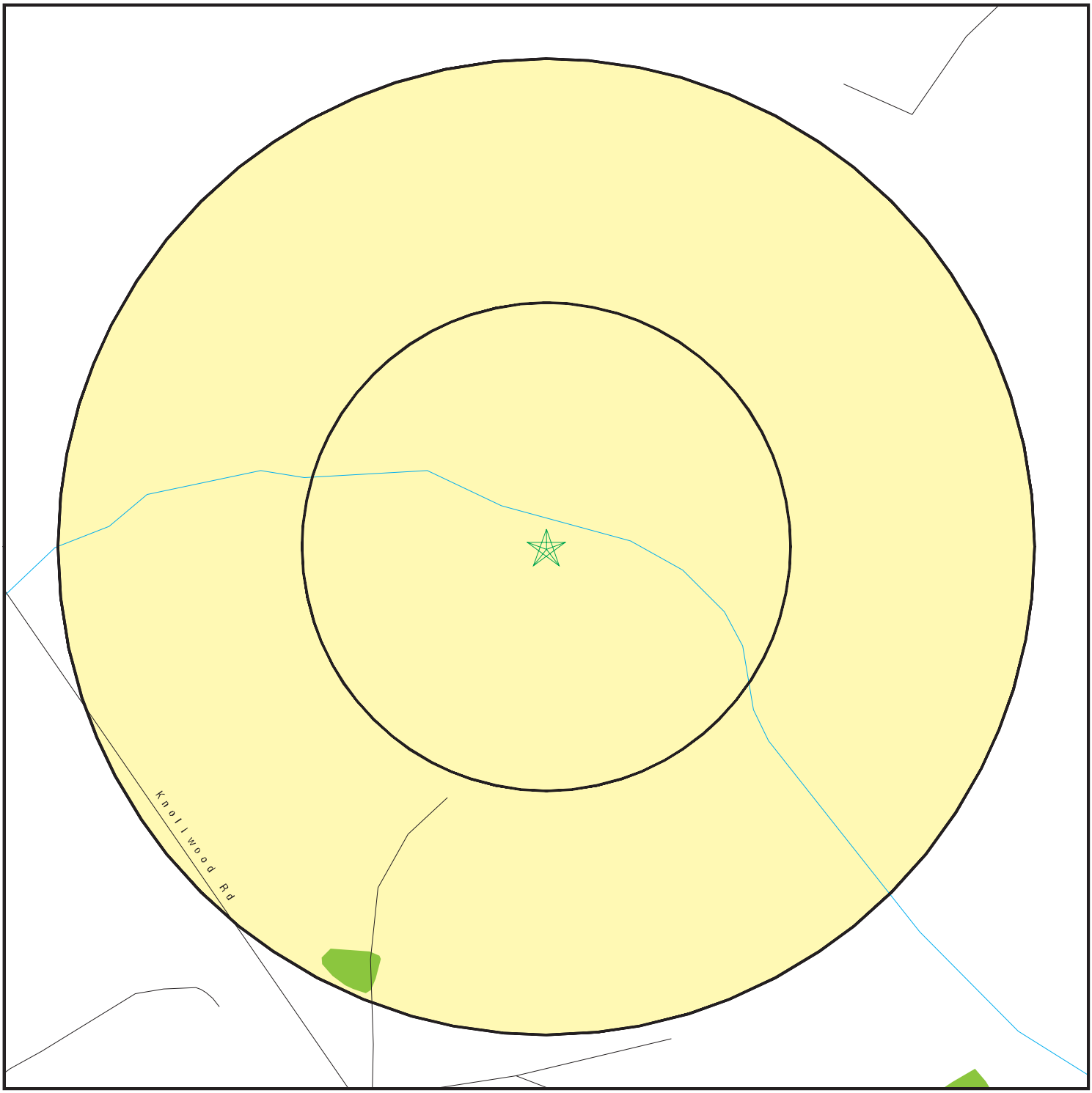
0 1/4 1/2 1 Miles

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Rockwell Pastures ADDRESS: 44188 A Dennis Road Albemarle NC 28001 LAT/LONG: 35.2783 / 80.1348	CLIENT: EBX CONTACT: Norton Webster INQUIRY #: 2119602.2s DATE: January 14, 2008 12:58 pm

DETAIL MAP - 2119602.2s



0 1/16 1/8 1/4 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- National Wetland Inventory
- State Wetlands
- Hazardous Substance Disposal Sites

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MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
FEDERAL RECORDS								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
NPL LIENS		TP	NR	NR	NR	NR	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.500	0	0	0	NR	NR	0
LIENS 2		TP	NR	NR	NR	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRA-TSDF		0.500	0	0	0	NR	NR	0
RCRA-LQG		0.250	0	0	NR	NR	NR	0
RCRA-SQG		0.250	0	0	NR	NR	NR	0
RCRA-CESQG		0.250	0	0	NR	NR	NR	0
RCRA-NonGen		0.250	0	0	NR	NR	NR	0
US ENG CONTROLS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
DOT OPS		TP	NR	NR	NR	NR	NR	0
CDL		TP	NR	NR	NR	NR	NR	0
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
DOD		1.000	0	0	0	0	NR	0
FUDS		1.000	0	0	0	0	NR	0
LUCIS		0.500	0	0	0	NR	NR	0
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
DEBRIS REGION 9		0.500	0	0	0	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
HIST FTTS		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
ICIS		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
RADINFO		TP	NR	NR	NR	NR	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
STATE AND LOCAL RECORDS								
State Haz. Waste		1.000	0	0	0	0	NR	0
IMD		0.500	0	0	0	NR	NR	0
NC HSDS		1.000	0	0	0	0	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
HIST LF		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	0	NR	NR	0
LUST TRUST		0.500	0	0	0	NR	NR	0
UST		0.250	0	0	NR	NR	NR	0
AST		0.250	0	0	NR	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
BROWNFIELDS		0.500	0	0	0	NR	NR	0
NPDES		TP	NR	NR	NR	NR	NR	0
TRIBAL RECORDS								
INDIAN RESERV		1.000	0	0	0	0	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
EDR PROPRIETARY RECORDS								
Manufactured Gas Plants		1.000	0	0	0	0	NR	0

NOTES:

TP = Target Property

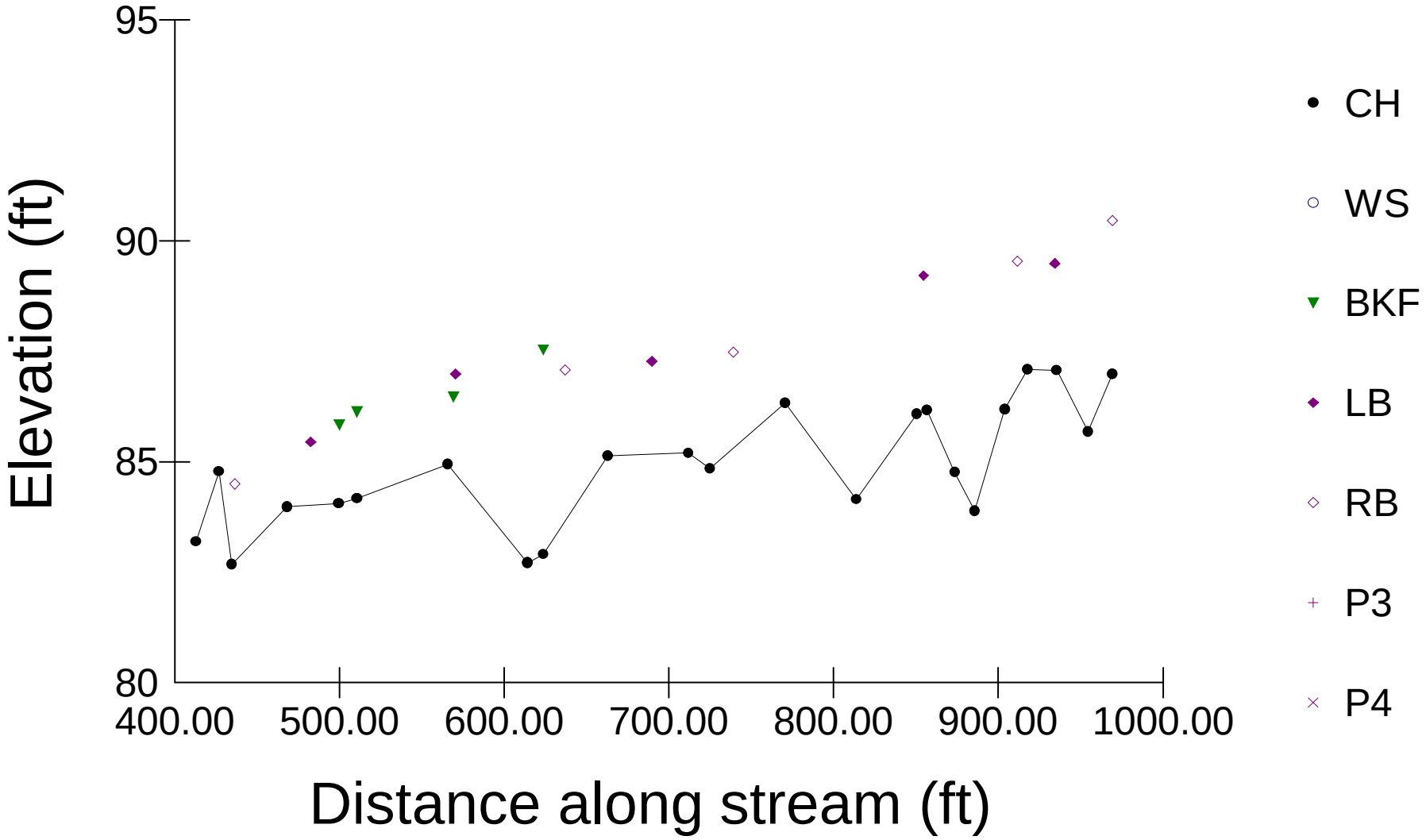
NR = Not Requested at this Search Distance

Sites may be listed in more than one database

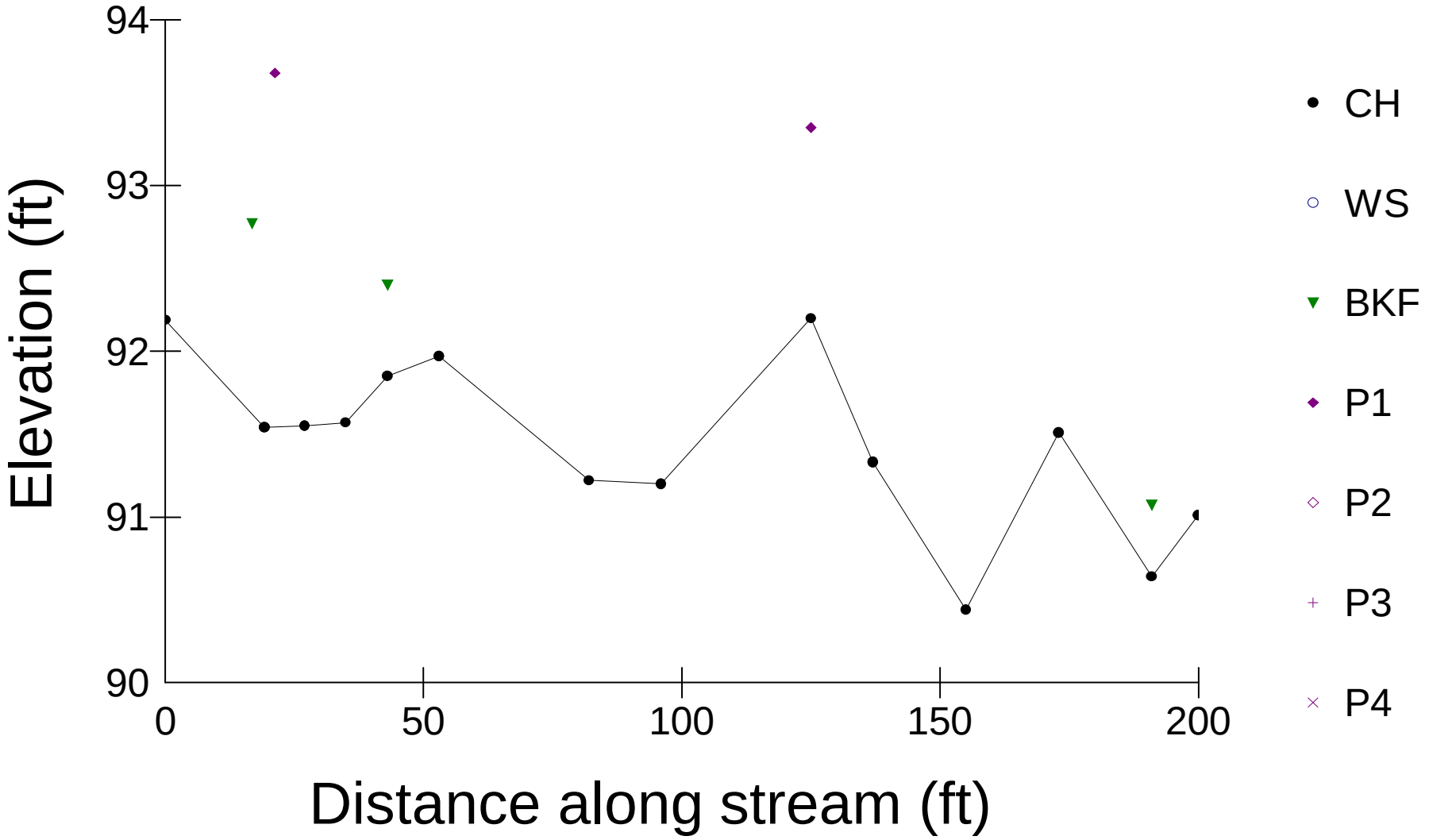
Appendix 7

Stream Assessment

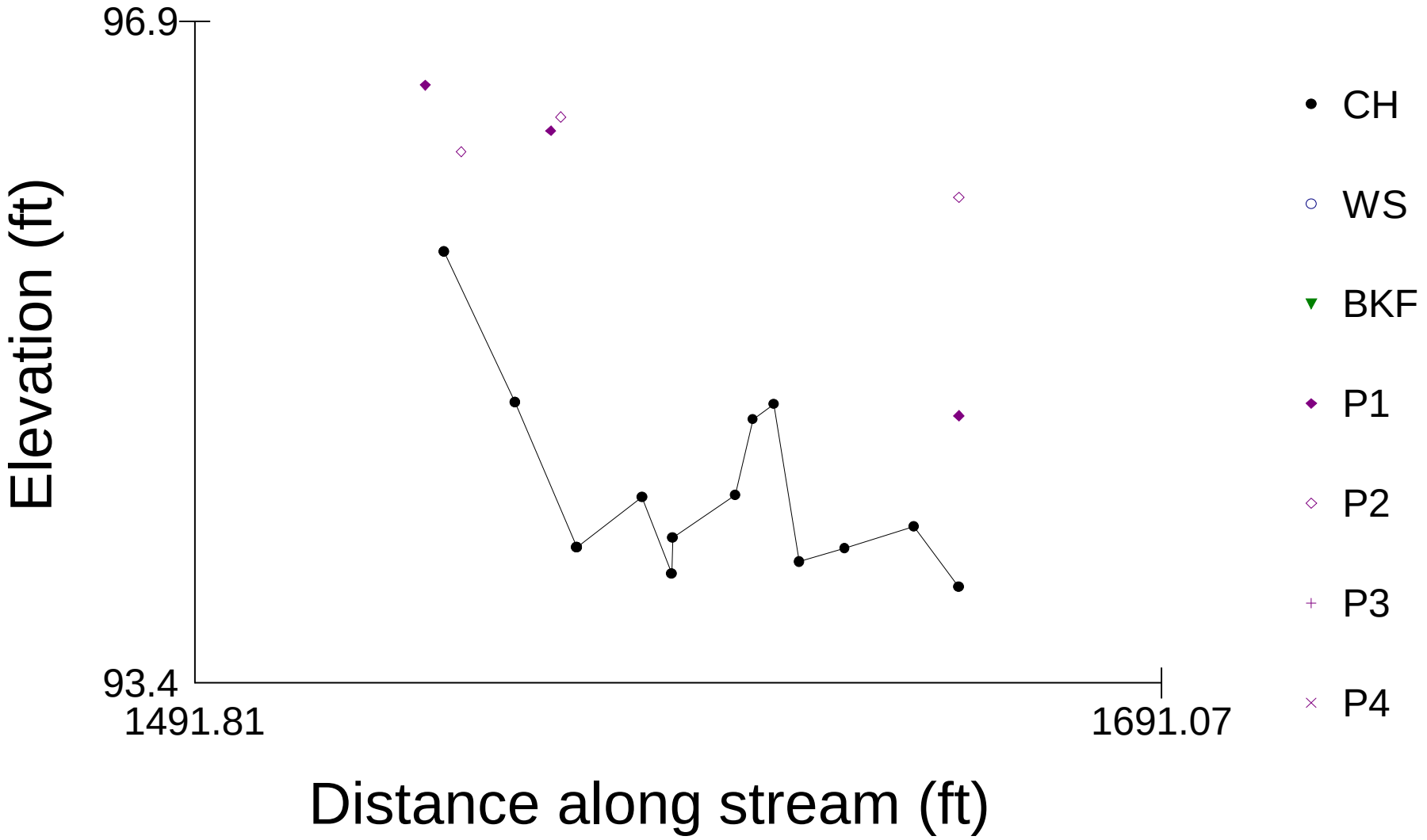
UT1 Lower Profile



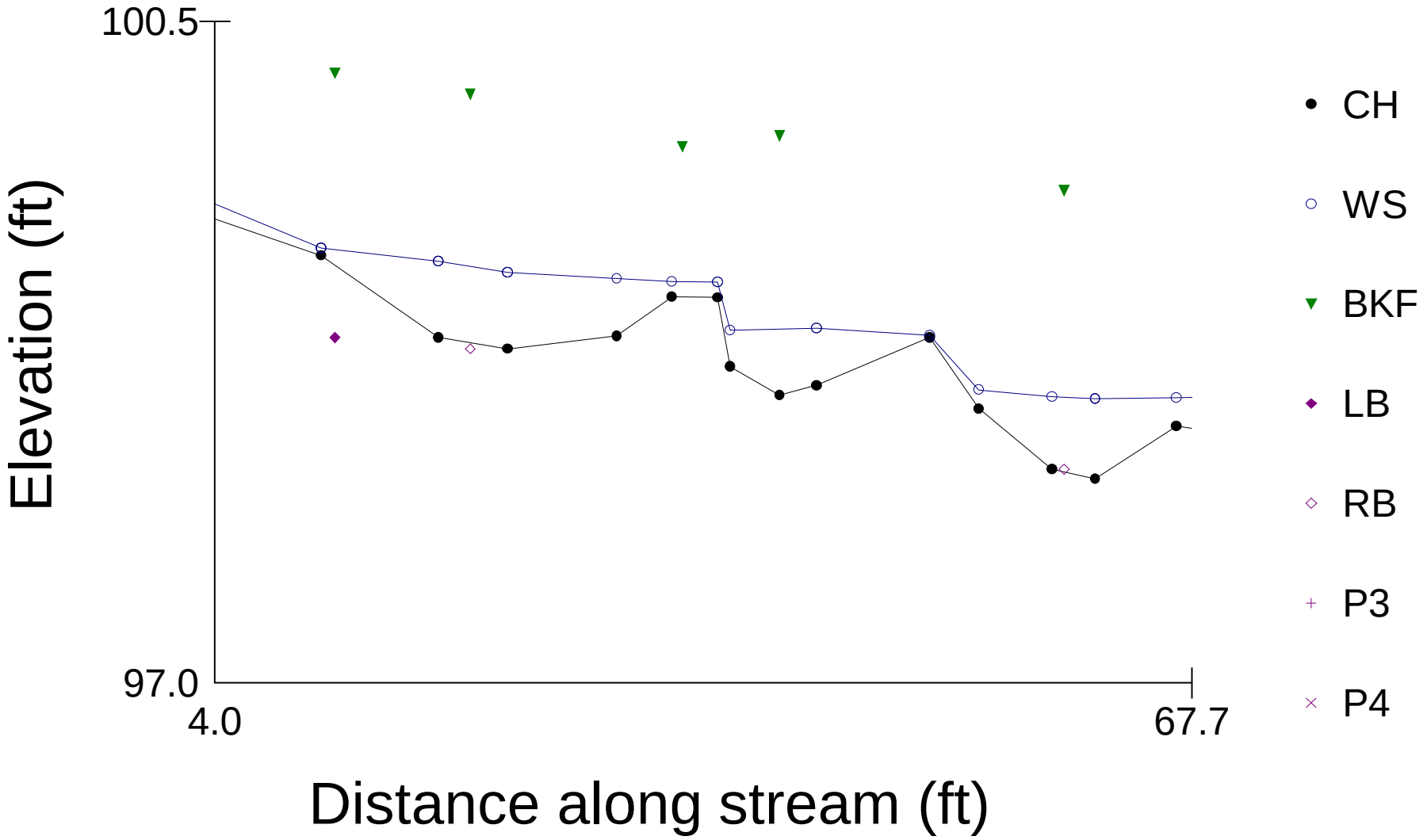
Upper UT1 Profile (12-04-07)

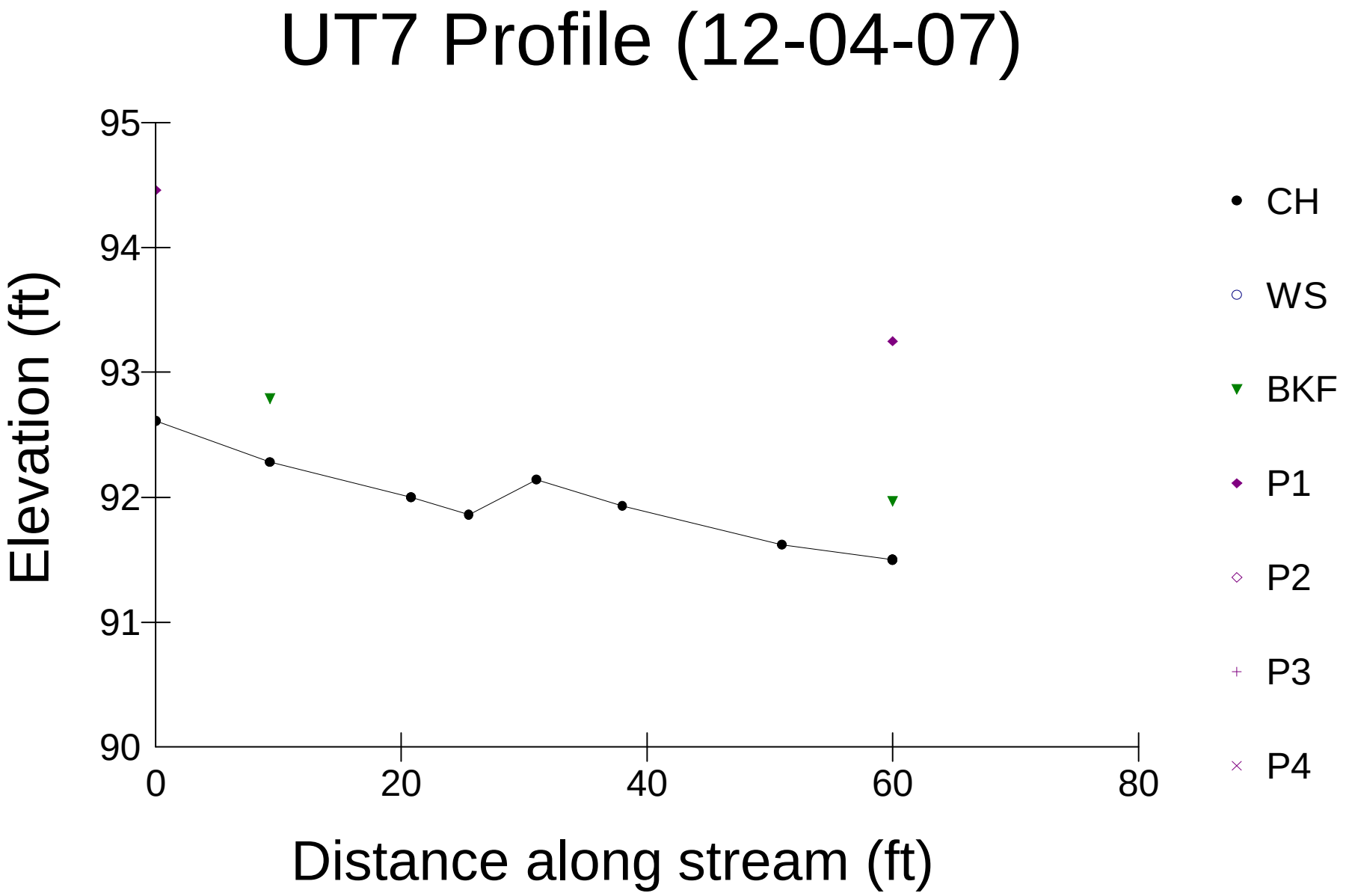


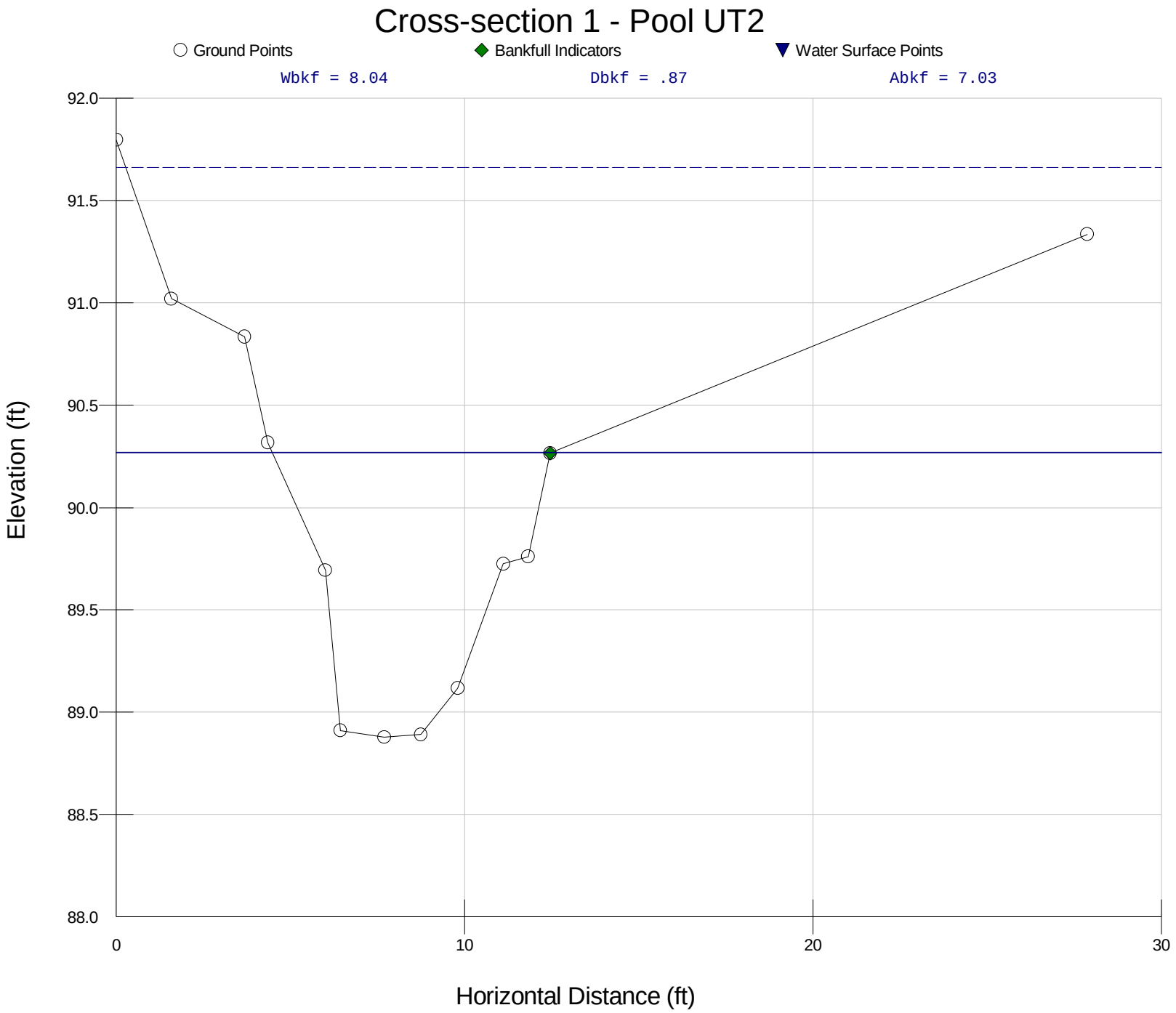
UT3 Profile


96.9
93.4
1491.81
1691.07
Elevation (ft)
Distance along stream (ft)
CH
WS
BKF
P1
P2
P3
P4

UT4 Ref Profile




UT7 Profile (12-04-07)
Elevation (ft)
95
94
93
92
91
90
0
20
40
60
80
Distance along stream (ft)
CH
WS
BKF
P1
P2
P3
P4


Cross-section 1 - Pool UT2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.04
Dbkf = .87
Abkf = 7.03
92.0
91.5
91.0
90.5
90.0
89.5
89.0
88.5
88.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT2
Cross Section Name: Cross-section 1 - Pool UT2
Survey Date: 12/04/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

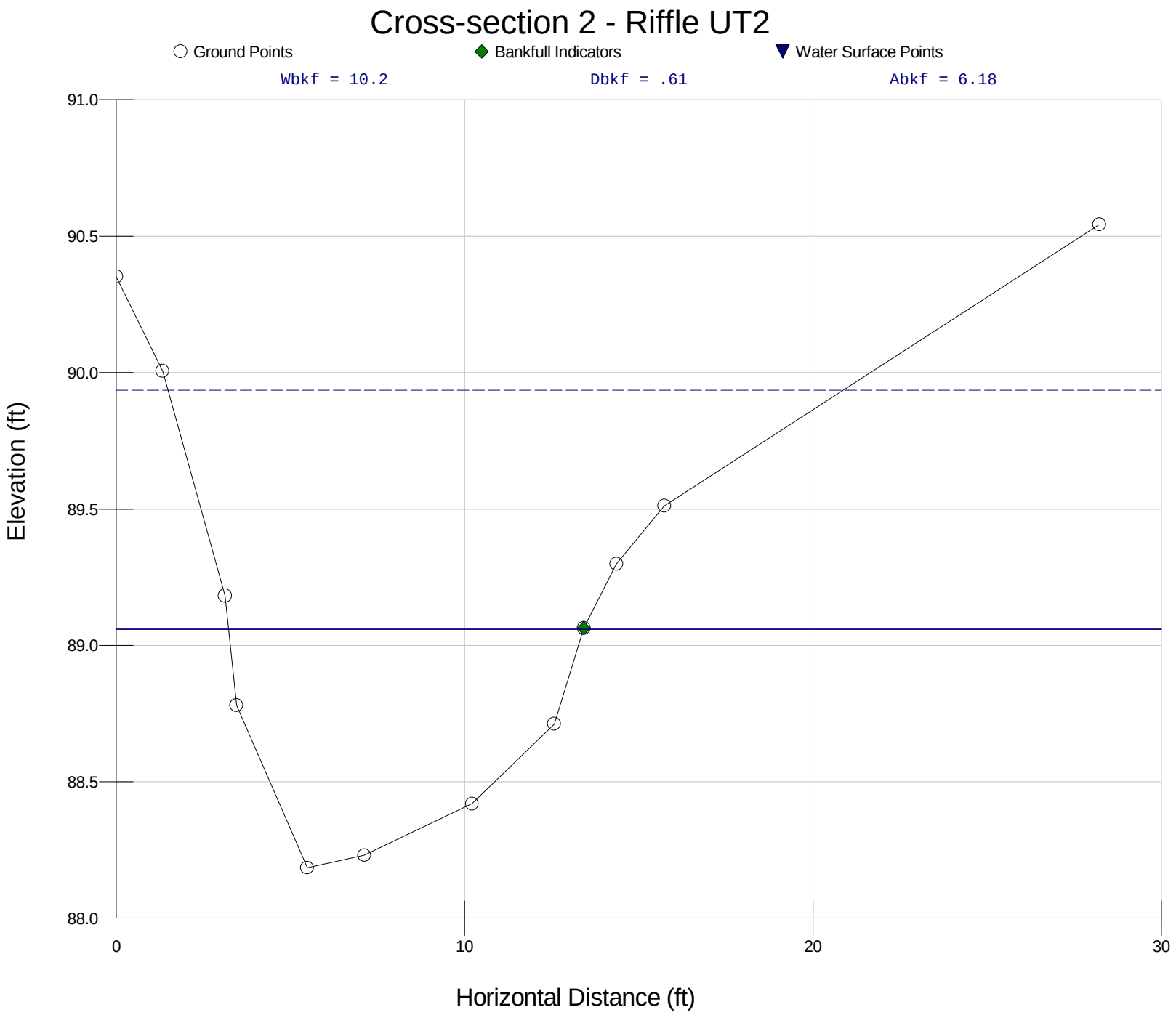
TAPE	FS	ELEV	NOTE
0	0	91.80	
1.58	0	91.02	
3.68	0	90.83	BKF
4.35	0	90.32	REW
6	0	89.69	
6.43	0	88.91	
7.69	0	88.88	
8.74	0	88.89	LEW
9.8	0	89.12	BKF
11.11	0	89.73	
11.82	0	89.76	
12.45	0	90.26534	BKF
27.87	0	91.33572	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	91.66	91.66	91.66
Bankfull Elevation (ft)	90.27	90.27	90.27
Floodprone Width (ft)	27.59	-----	-----
Bankfull Width (ft)	8.04	4.02	4.02
Entrenchment Ratio	3.43	-----	-----
Mean Depth (ft)	0.87	0.92	0.83
Maximum Depth (ft)	1.39	1.39	1.38
Width/Depth Ratio	9.24	4.37	4.84
Bankfull Area (sq ft)	7.03	3.71	3.32
Wetted Perimeter (ft)	8.95	5.97	5.74
Hydraulic Radius (ft)	0.79	0.62	0.58
Begin BKF Station	4.48	4.48	8.5
End BKF Station	12.52	8.5	12.52

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 2 - Riffle UT2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 10.2
Dbkf = .61
Abkf = 6.18
91.0
90.5
90.0
89.5
89.0
88.5
88.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT2
Cross Section Name: Cross-section 2 - Riffle UT2
Survey Date: 12/04/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

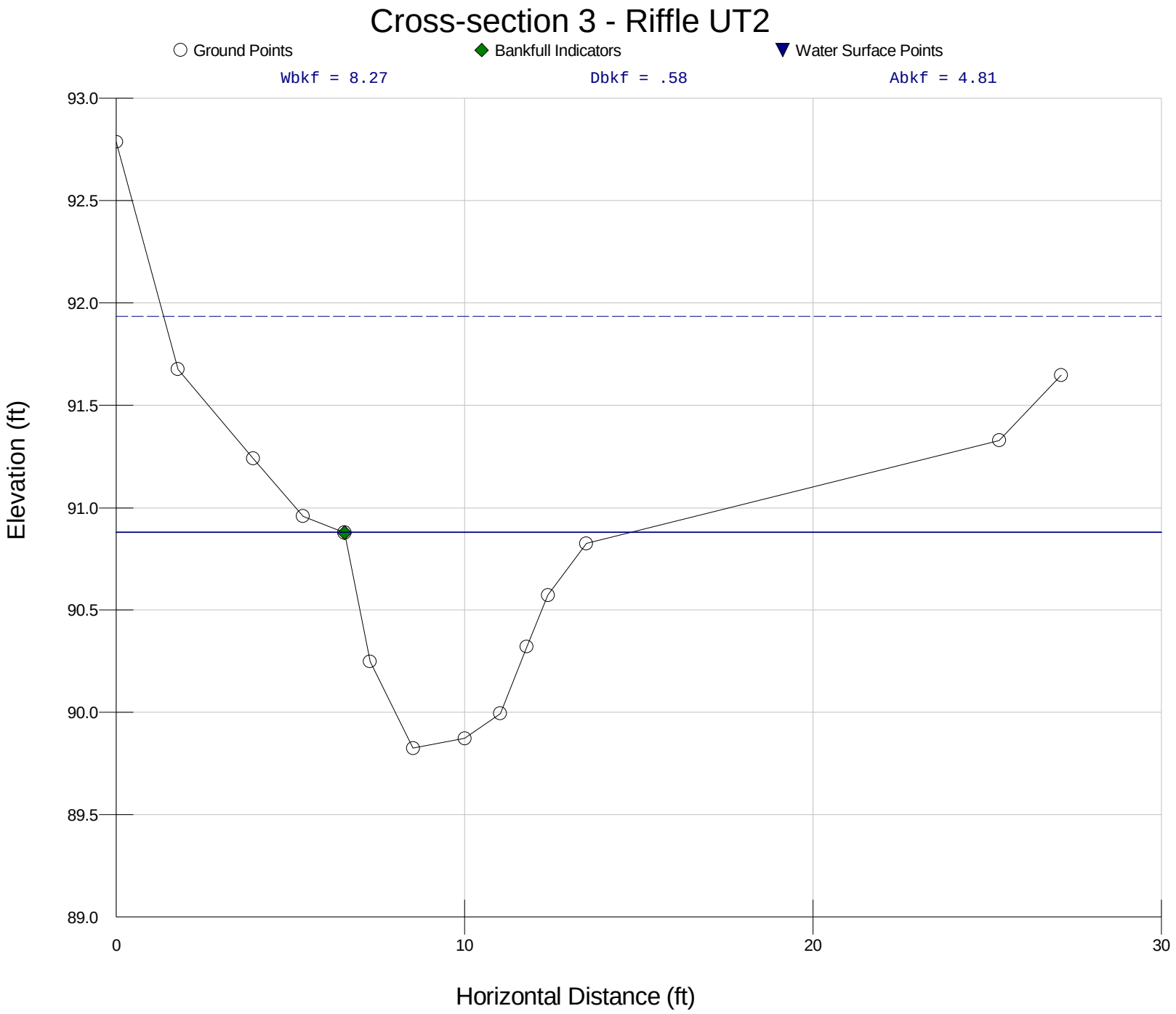
TAPE	FS	ELEV	NOTE
0	0	90.35	
1.33	0	90.01	
3.12	0	89.18	BKF
3.45	0	88.78	REW
5.48	0	88.19	
7.12	0	88.23	
10.21	0	88.42	
12.57	0	88.71	LEW
13.42	0	89.06	BKF
14.35	0	89.30	
15.73	0	89.51	
28.21	0	90.54206	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	89.93	89.93	89.93
Bankfull Elevation (ft)	89.06	89.06	89.06
Floodprone Width (ft)	19.37	-----	-----
Bankfull Width (ft)	10.19	5.2	4.99
Entrenchment Ratio	1.9	-----	-----
Mean Depth (ft)	0.61	0.7	0.51
Maximum Depth (ft)	0.87	0.87	0.75
Width/Depth Ratio	16.7	7.43	9.78
Bankfull Area (sq ft)	6.18	3.63	2.56
Wetted Perimeter (ft)	10.5	6.17	5.83
Hydraulic Radius (ft)	0.59	0.59	0.44
Begin BKF Station	3.22	3.22	8.42
End BKF Station	13.41	8.42	13.41

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 3 - Riffle UT2
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.27
Dbkf = .58
Abkf = 4.81
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT2
Cross Section Name: Cross-section 3 - Riffle UT2
Survey Date: 12/04/2007

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

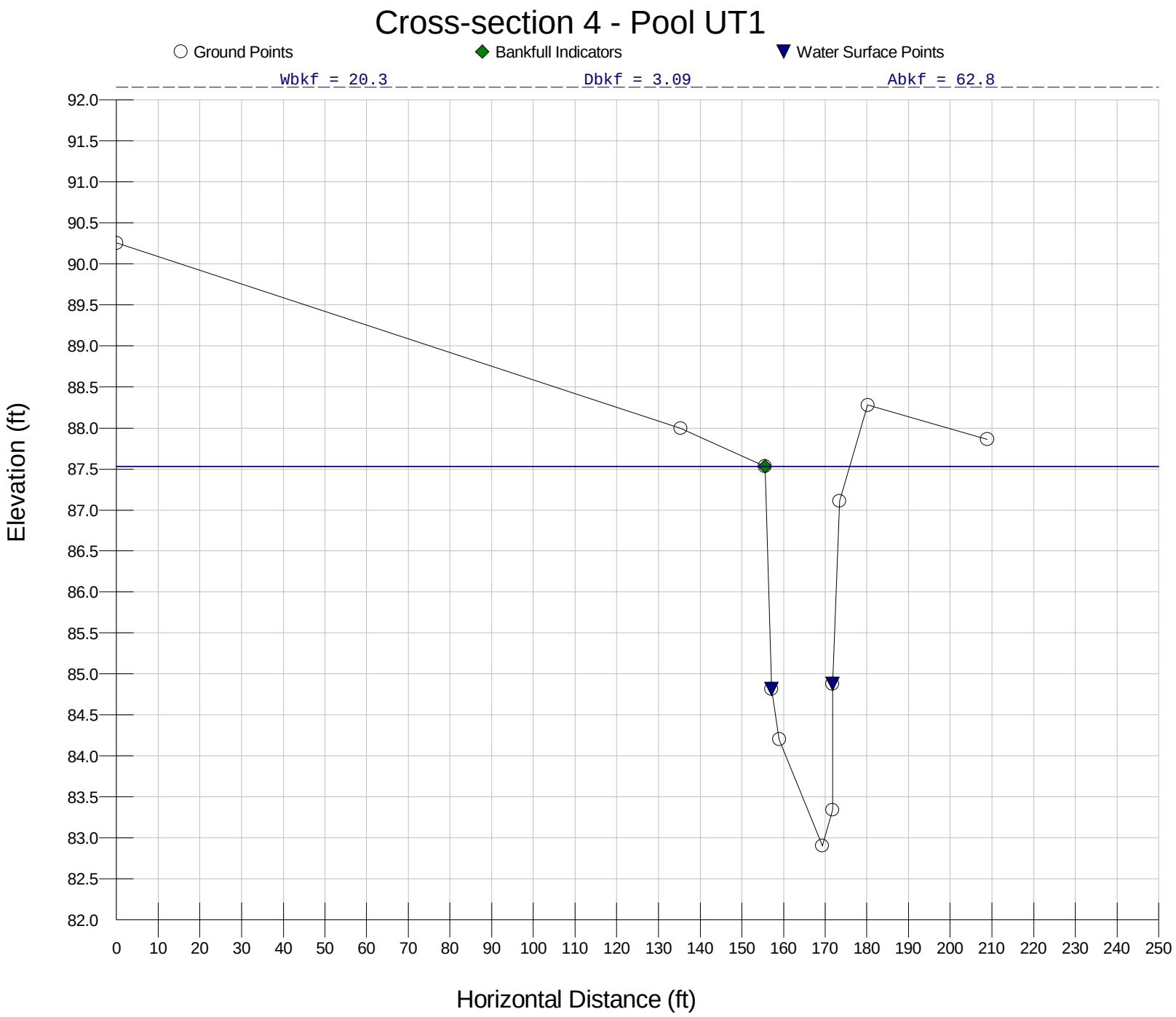
TAPE	FS	ELEV	NOTE
0	0	92.79	
1.77	0	91.68	
3.93	0	91.24	BKF
5.36	0	90.96	REW
6.55	0	90.88	BKF
7.28	0	90.25	
8.52	0	89.83	
10	0	89.87	LEW
11.02	0	90.00	BKF
11.78	0	90.32	
12.39	0	90.57	
13.49	0	90.82	BKF
25.34	0	91.33	
27.12	0	91.65	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	91.93	91.93	91.93
Bankfull Elevation (ft)	90.88	90.88	90.88
Floodprone Width (ft)	25.76	-----	-----
Bankfull Width (ft)	8.27	4.13	4.14
Entrenchment Ratio	3.12	-----	-----
Mean Depth (ft)	0.58	0.83	0.33
Maximum Depth (ft)	1.05	1.05	0.93
Width/Depth Ratio	14.26	4.98	12.55
Bankfull Area (sq ft)	4.81	3.43	1.38
Wetted Perimeter (ft)	8.73	5.37	5.22
Hydraulic Radius (ft)	0.55	0.64	0.27
Begin BKF Station	6.52	6.52	10.65
End BKF Station	14.79	10.65	14.79

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0299	0	0
Shear Stress (lb/sq ft)	1.03	--	--
Movable Particle (mm)	90.6	--	--


Cross-section 4 - Pool UT1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 20.3
Dbkf = 3.09
Abkf = 62.8
Elevation (ft)
92.0
91.5
91.0
90.5
90.0
89.5
89.0
88.5
88.0
87.5
87.0
86.5
86.0
85.5
85.0
84.5
84.0
83.5
83.0
82.5
82.0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT1 Lower
Cross Section Name: Cross-section 4 - Pool UT1
Survey Date: 12/21/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

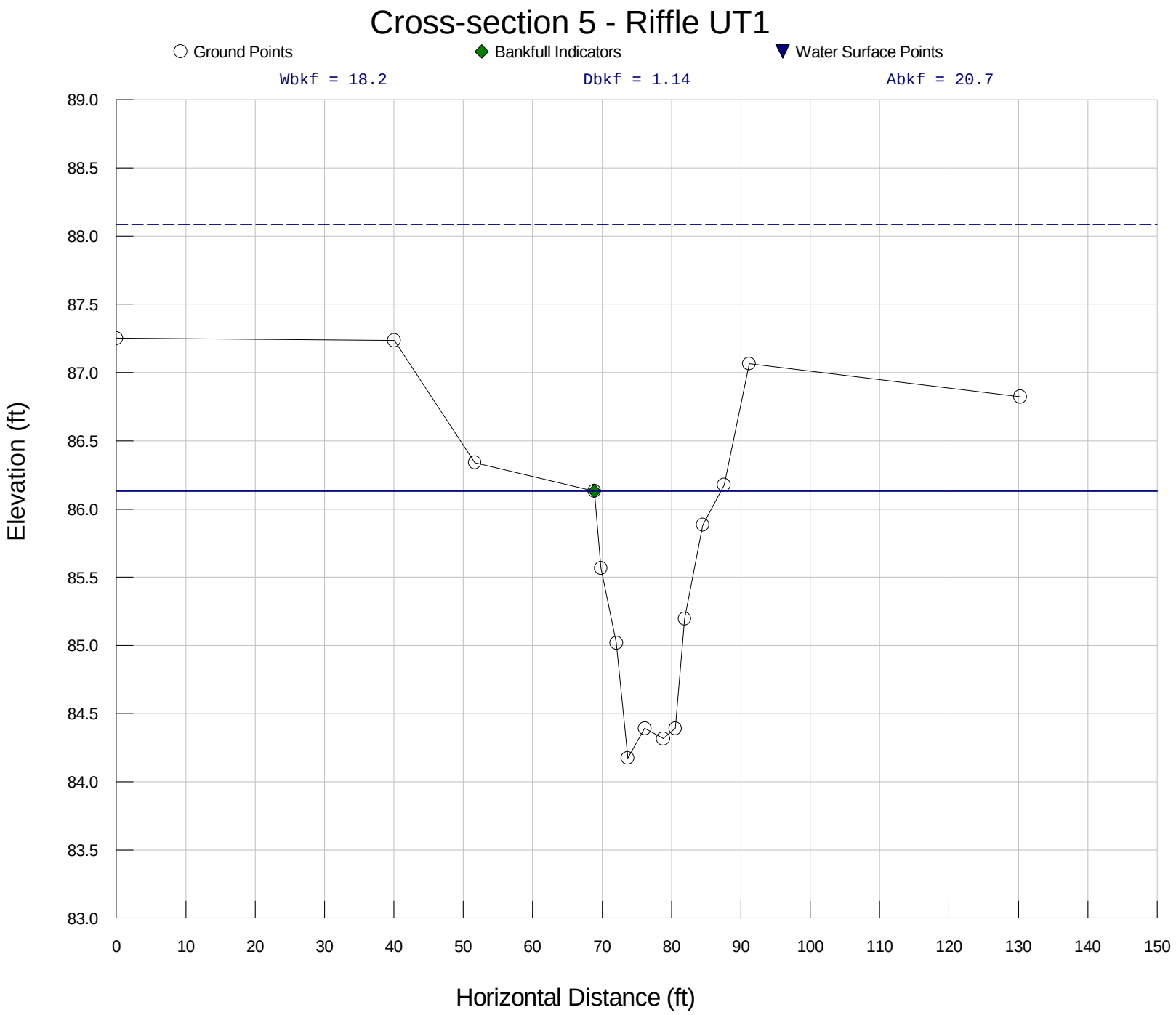
TAPE	FS	ELEV	NOTE
0	0	90.25	
135.32	0	88.00	
155.55	0	87.53	BKF
157.11	0	84.82	REW
158.98	0	84.20	
169.31	0	82.91	
171.76	0	83.34	
171.77	0	84.88	LEW
173.46	0	87.11	
180.2	0	88.28	
208.87	0	87.86	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	92.15	92.15	92.15
Bankfull Elevation (ft)	87.53	87.53	87.53
Floodprone Width (ft)	208.87	-----	-----
Bankfull Width (ft)	20.33	10.17	10.16
Entrenchment Ratio	10.27	-----	-----
Mean Depth (ft)	3.09	3.25	2.93
Maximum Depth (ft)	4.62	4.17	4.62
Width/Depth Ratio	6.58	3.13	3.47
Bankfull Area (sq ft)	62.77	33.04	29.72
Wetted Perimeter (ft)	24.79	16.06	17.07
Hydraulic Radius (ft)	2.53	2.06	1.74
Begin BKF Station	155.55	155.55	165.72
End BKF Station	175.88	165.72	175.88

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 5 - Riffle UT1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 18.2
Dbkf = 1.14
Abkf = 20.7
Elevation (ft)
89.0
88.5
88.0
87.5
87.0
86.5
86.0
85.5
85.0
84.5
84.0
83.5
83.0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT1 Lower
Cross Section Name: Cross-section 5 - Riffle UT1
Survey Date: 12/21/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

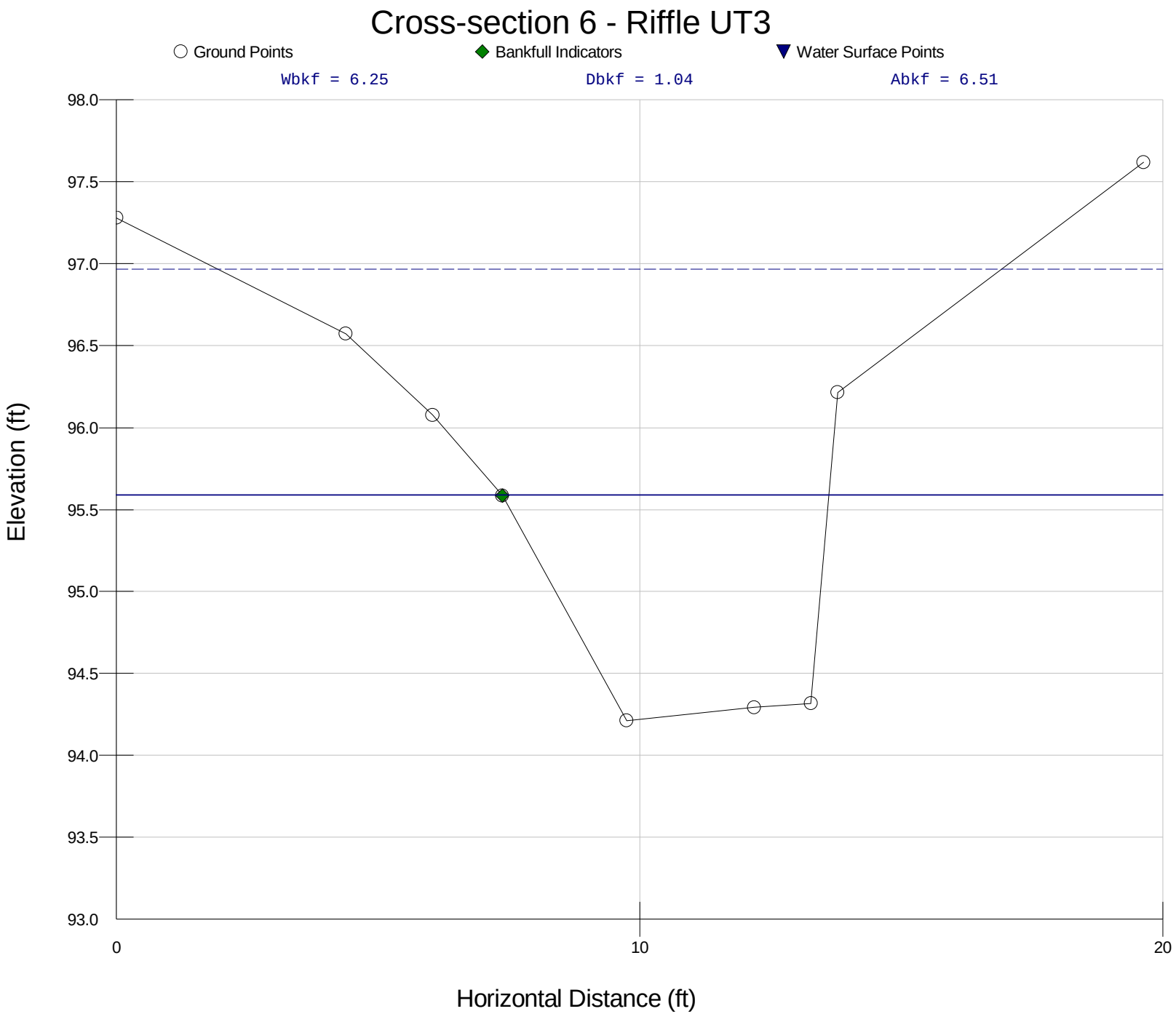
TAPE	FS	ELEV	NOTE
0	0	87.25	
40.05	0	87.24	
51.66	0	86.34	TOB L
68.9	0	86.13	BKF
69.83	0	85.57	L BKF
72.05	0	85.02	
73.67	0	84.17	TW
76.15	0	84.39	
78.8	0	84.32	BKF R
80.55	0	84.39	
81.9	0	85.20	
84.51	0	85.88	TOB R
87.57	0	86.18	
91.2	0	87.07	
130.24	0	86.82	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	88.09	88.09	88.09
Bankfull Elevation (ft)	86.13	86.13	86.13
Floodprone Width (ft)	130.24	-----	-----
Bankfull Width (ft)	18.19	9.1	9.09
Entrenchment Ratio	7.16	-----	-----
Mean Depth (ft)	1.14	1.37	0.9
Maximum Depth (ft)	1.96	1.96	1.81
Width/Depth Ratio	15.96	6.64	10.1
Bankfull Area (sq ft)	20.67	12.45	8.21
Wetted Perimeter (ft)	18.95	11.33	11.2
Hydraulic Radius (ft)	1.09	1.1	0.73
Begin BKF Station	68.9	68.9	78
End BKF Station	87.09	78	87.09

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.009	0	0
Shear Stress (lb/sq ft)	0.61	--	--
Movable Particle (mm)	36.8	--	--


Cross-section 6 - Riffle UT3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.25
Dbkf = 1.04
Abkf = 6.51
98.0
97.5
97.0
96.5
96.0
95.5
95.0
94.5
94.0
93.5
93.0
Elevation (ft)
0
10
20
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT3
Cross Section Name: Cross-section 6 - Riffle UT3
Survey Date: 12/21/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

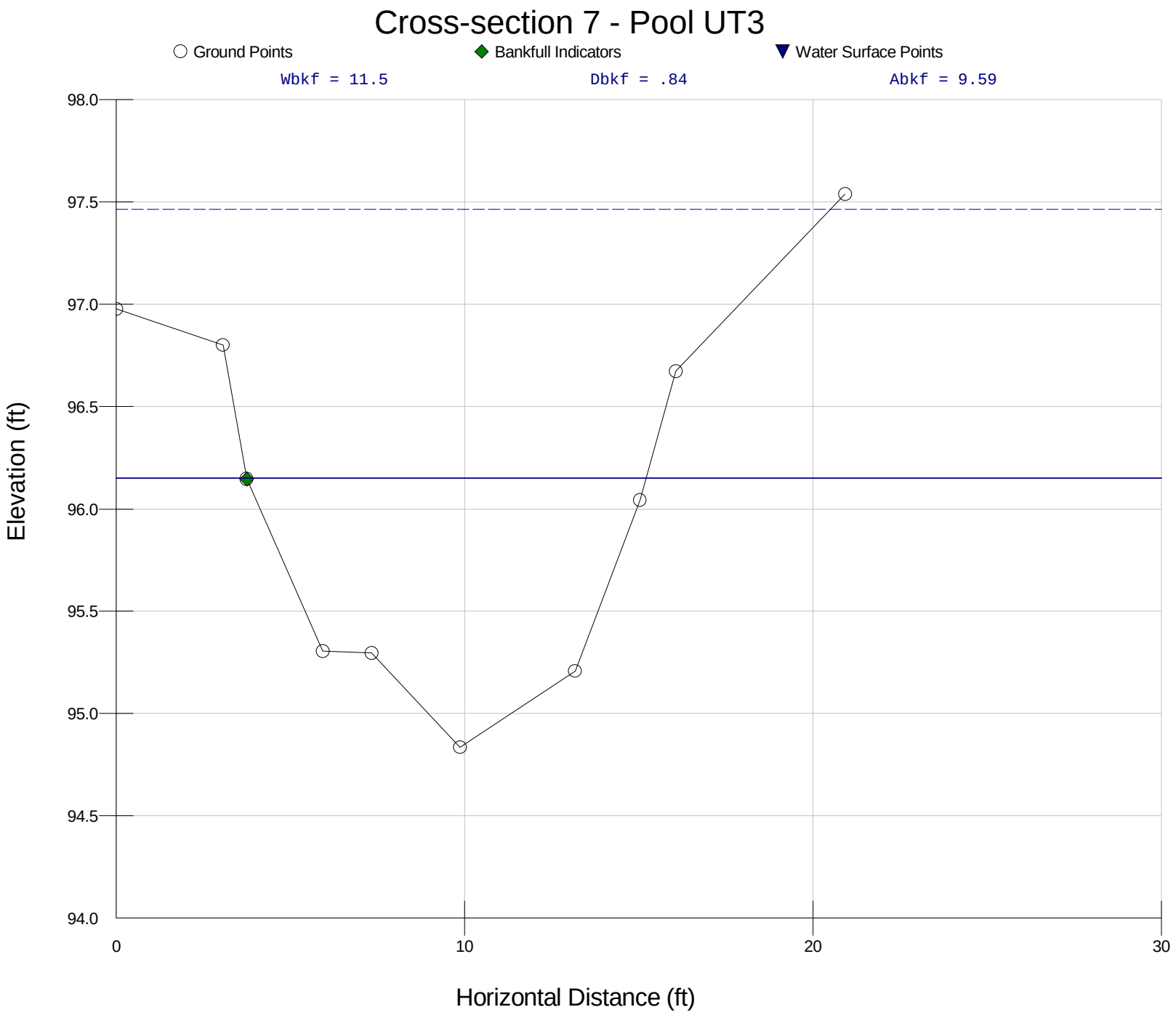
TAPE	FS	ELEV	NOTE
0	0	97.28	
4.38	0	96.57	
6.04	0	96.08	
7.37	0	95.59	BKF
9.75	0	94.21	
12.19	0	94.29	
13.27	0	94.32	
13.78	0	96.21	
19.63	0	97.62	
20.92	0	97.54	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	96.97	96.97	96.97
Bankfull Elevation (ft)	95.59	95.59	95.59
Floodprone Width (ft)	14.99	-----	-----
Bankfull Width (ft)	6.25	3.12	3.13
Entrenchment Ratio	2.4	-----	-----
Mean Depth (ft)	1.04	0.85	1.24
Maximum Depth (ft)	1.38	1.38	1.35
Width/Depth Ratio	6.01	3.67	2.52
Bankfull Area (sq ft)	6.51	2.64	3.87
Wetted Perimeter (ft)	7.6	4.85	5.46
Hydraulic Radius (ft)	0.86	0.55	0.71
Begin BKF Station	7.36	7.36	10.48
End BKF Station	13.61	10.48	13.61

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0126	0	0
Shear Stress (lb/sq ft)	0.68	--	--
Movable Particle (mm)	41.3	--	--


Cross-section 7 - Pool UT3
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 11.5
Dbkf = .84
Abkf = 9.59
98.0
97.5
97.0
96.5
96.0
95.5
95.0
94.5
94.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT3
Cross Section Name: Cross-section 7 - Pool UT3
Survey Date: 12/21/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

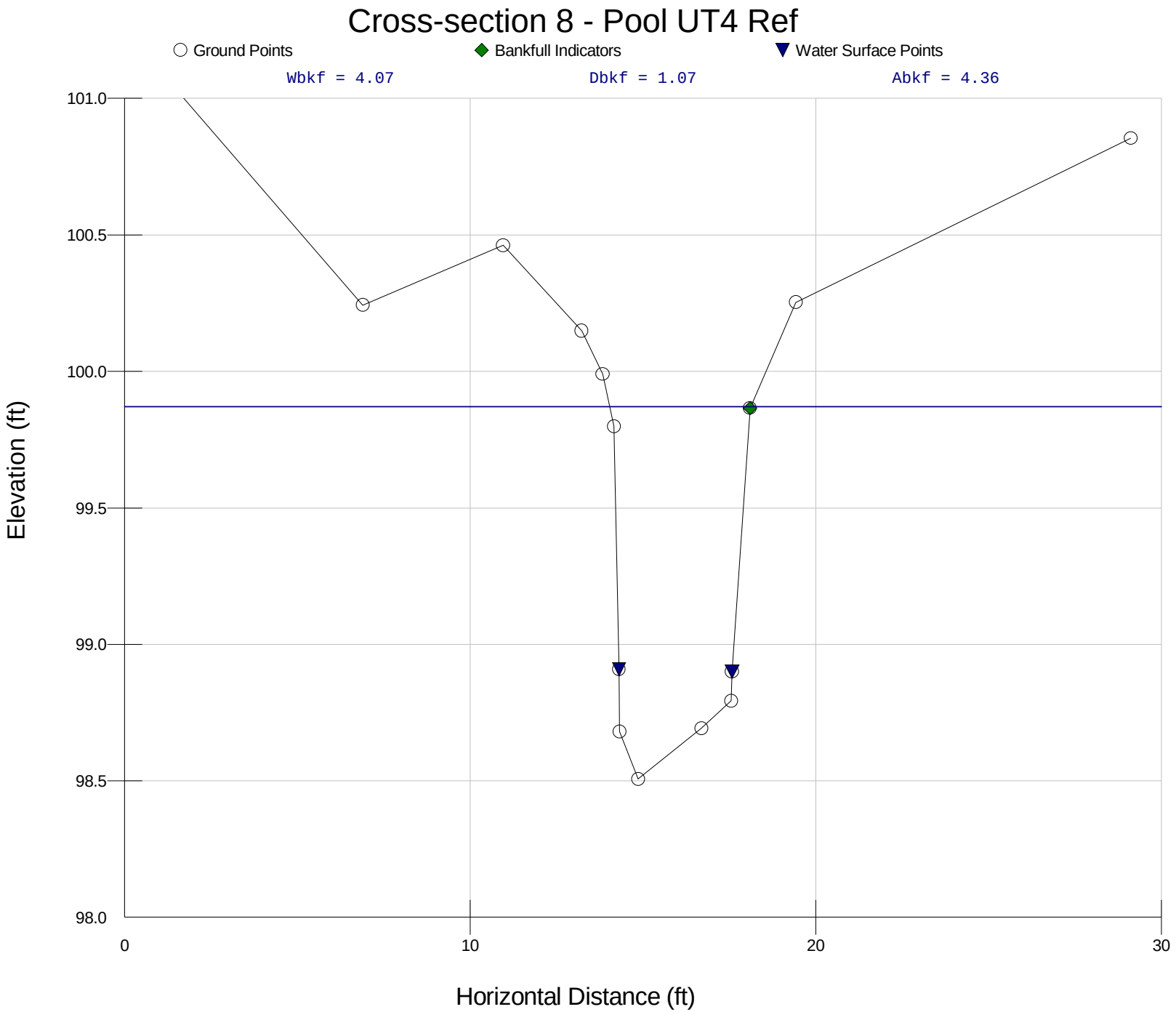
TAPE	FS	ELEV	NOTE
0	0	96.98	
3.06	0	96.80	
3.74	0	96.15	BKF
5.93	0	95.30	
7.33	0	95.30	
9.87	0	94.84	
13.17	0	95.21	
15.03	0	96.04	
16.06	0	96.67	
20.92	0	97.54	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	97.46	97.46	97.46
Bankfull Elevation (ft)	96.15	96.15	96.15
Floodprone Width (ft)	20.51	-----	-----
Bankfull Width (ft)	11.47	6.26	5.21
Entrenchment Ratio	1.79	-----	-----
Mean Depth (ft)	0.84	0.81	0.87
Maximum Depth (ft)	1.31	1.31	1.3
Width/Depth Ratio	13.65	7.73	5.99
Bankfull Area (sq ft)	9.59	5.05	4.54
Wetted Perimeter (ft)	11.9	7.76	6.74
Hydraulic Radius (ft)	0.81	0.65	0.67
Begin BKF Station	3.74	3.74	10
End BKF Station	15.21	10	15.21

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 8 - Pool UT4 Ref
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 4.07
Dbkf = 1.07
Abkf = 4.36
101.0
100.5
100.0
99.5
99.0
98.5
98.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT4 Upper
Cross Section Name: Cross-section 8 - Pool UT4 Ref
Survey Date: 12/05/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

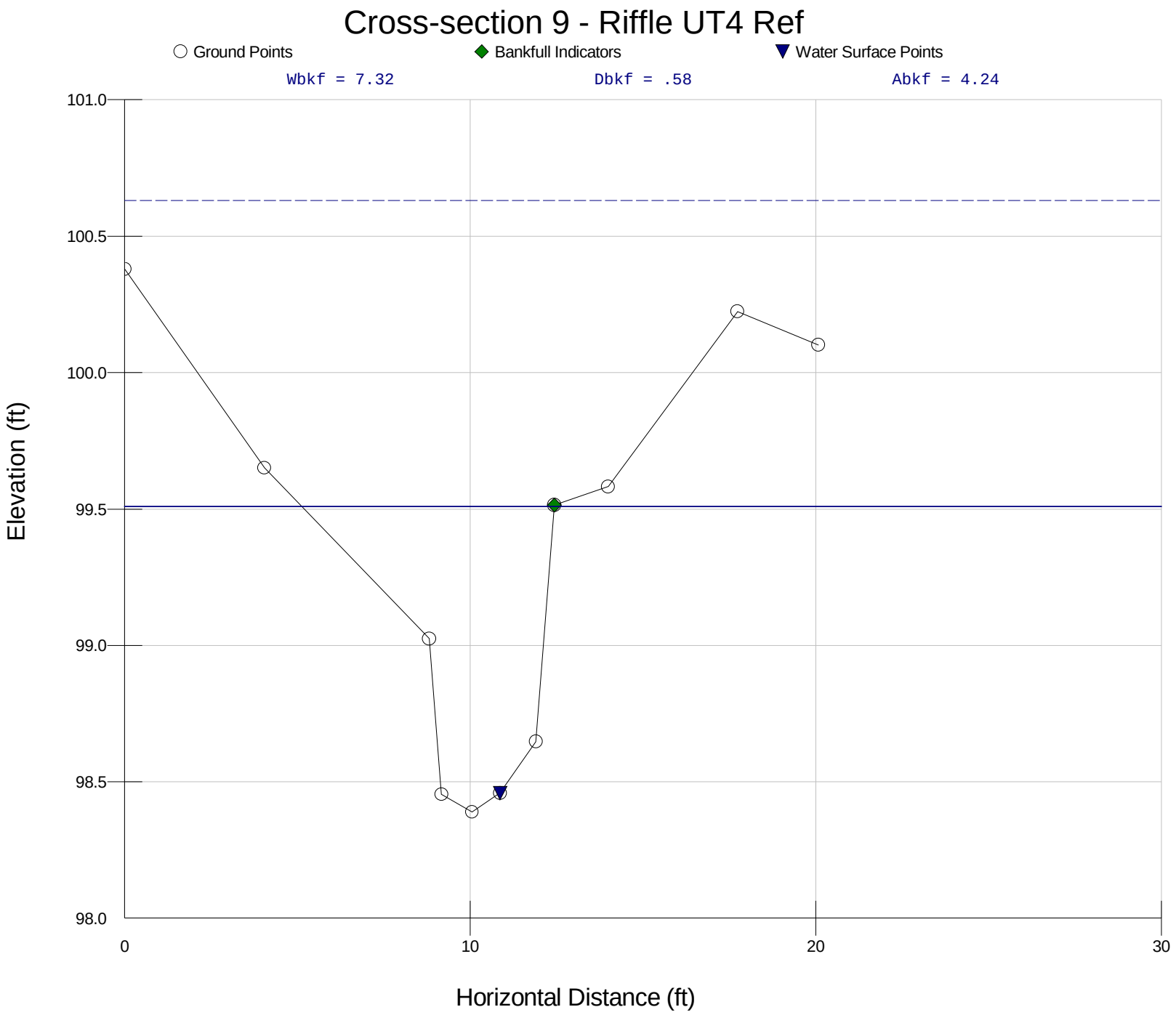
TAPE	FS	ELEV	NOTE
0	0	101.25	
6.89	0	100.24	
10.95	0	100.46	
13.22	0	100.15	
13.83	0	99.99	
14.16	0	99.80	
14.3	0	98.91	LEW
14.32	0	98.68	
14.86	0	98.51	
16.69	0	98.69	
17.55	0	98.79	
17.57	0	98.90	REW
18.09	0	99.87	BKF
19.42	0	100.25	
29.11	0	100.85	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	101.23	101.23	101.23
Bankfull Elevation (ft)	99.87	99.87	99.87
Floodprone Width (ft)	29	-----	-----
Bankfull Width (ft)	4.07	2.03	2.04
Entrenchment Ratio	7.13	-----	-----
Mean Depth (ft)	1.07	1.16	0.98
Maximum Depth (ft)	1.36	1.36	1.24
Width/Depth Ratio	3.8	1.75	2.08
Bankfull Area (sq ft)	4.36	2.36	1.99
Wetted Perimeter (ft)	5.77	4.3	3.95
Hydraulic Radius (ft)	0.76	0.55	0.5
Begin BKF Station	14.04	14.04	16.07
End BKF Station	18.11	16.07	18.11

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 9 - Riffle UT4 Ref
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 7.32
Dbkf = .58
Abkf = 4.24
101.0
100.5
100.0
99.5
99.0
98.5
98.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT4 Upper
Cross Section Name: Cross-section 9 - Riffle UT4 Ref
Survey Date: 12/05/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

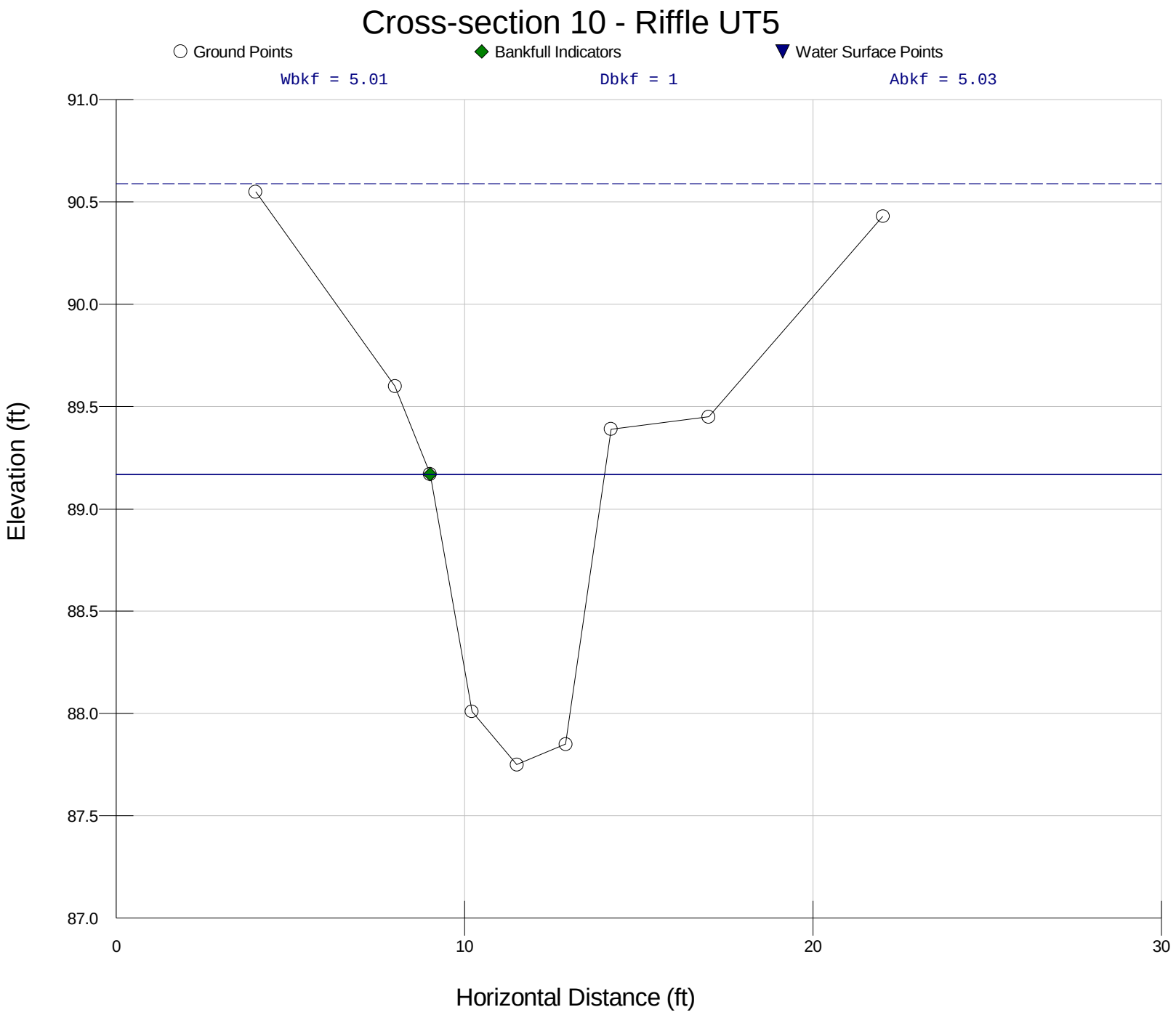
TAPE	FS	ELEV	NOTE
0	0	100.38	
4.04	0	99.65	
8.81	0	99.02	
9.16	0	98.45	
10.05	0	98.39	
10.86	0	98.46	LEW
11.9	0	98.65	
12.43	0	99.51	BKF
13.99	0	99.58	
17.73	0	100.22	
20.07	0	100.10	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	100.63	100.63	100.63
Bankfull Elevation (ft)	99.51	99.51	99.51
Floodprone Width (ft)	20.07	-----	-----
Bankfull Width (ft)	7.32	3.66	3.66
Entrenchment Ratio	2.74	-----	-----
Mean Depth (ft)	0.58	0.24	0.92
Maximum Depth (ft)	1.12	0.48	1.12
Width/Depth Ratio	12.62	15.25	3.98
Bankfull Area (sq ft)	4.24	0.88	3.36
Wetted Perimeter (ft)	8.18	4.17	4.96
Hydraulic Radius (ft)	0.52	0.21	0.68
Begin BKF Station	5.11	5.11	8.77
End BKF Station	12.43	8.77	12.43

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0185	0	0
Shear Stress (lb/sq ft)	0.60	--	--
Movable Particle (mm)	35.9	--	--


Cross-section 10 - Riffle UT5
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.01
Dbkf = 1
Abkf = 5.03
91.0
90.5
90.0
89.5
89.0
88.5
88.0
87.5
87.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT5
Cross Section Name: Cross-section 10 - Riffle (2007-12-05)
Survey Date: 12/05/2007

Cross Section Data Entry
BM Elevation: 100 ft
Backsight Rod Reading: 0 ft

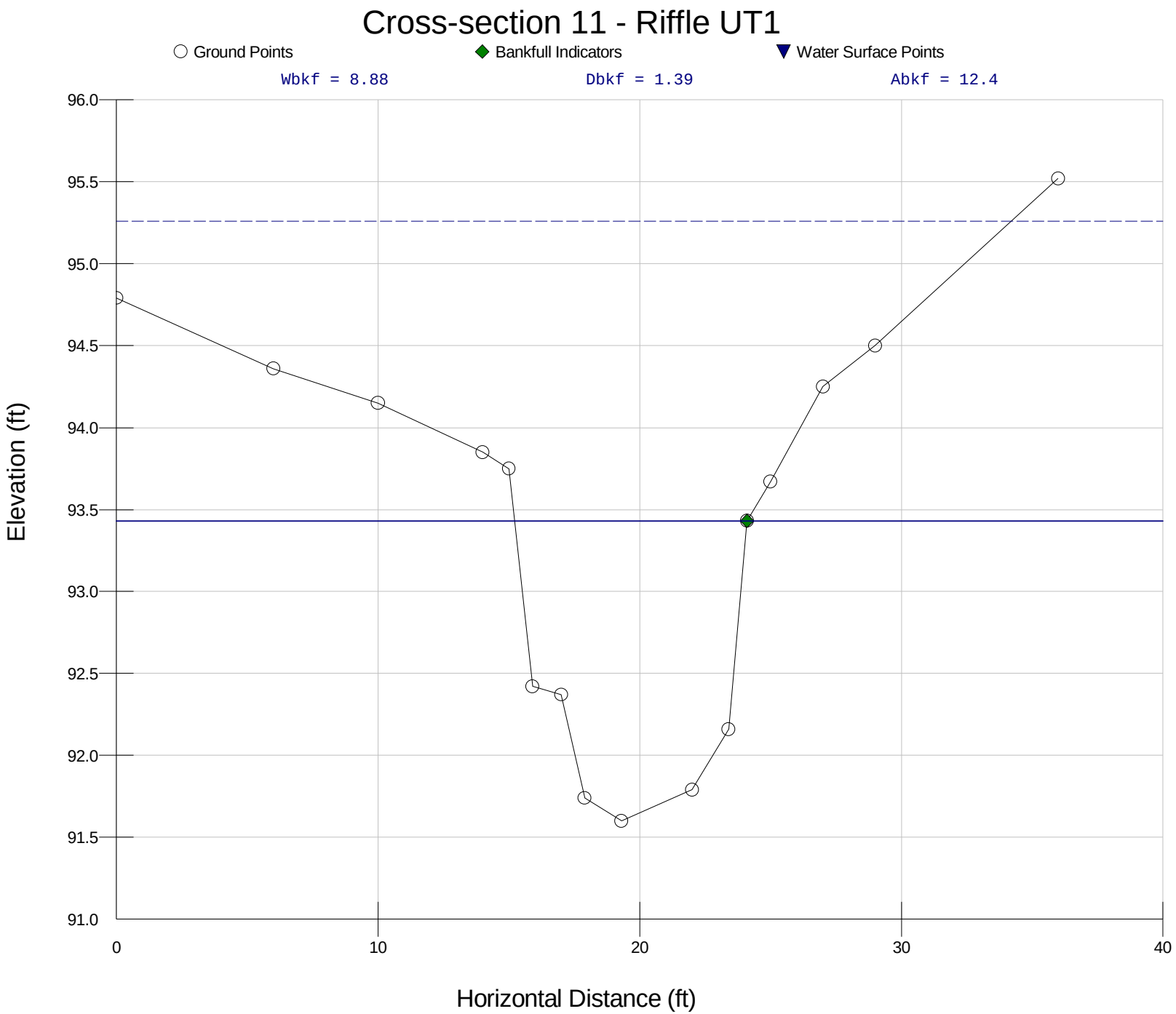
TAPE	FS	ELEV	NOTE
4	0	90.55	
8	0	89.60	
9	0	89.17	BKF
10.2	0	88.01	
11.5	0	87.75	
12.9	0	87.85	
14.2	0	89.39	
17	0	89.45	
22	0	90.43	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	90.59	90.59	90.59
Bankfull Elevation (ft)	89.17	89.17	89.17
Floodprone Width (ft)	18	-----	-----
Bankfull Width (ft)	5.01	2.51	2.5
Entrenchment Ratio	3.59	-----	-----
Mean Depth (ft)	1	0.95	1.06
Maximum Depth (ft)	1.42	1.42	1.42
Width/Depth Ratio	5.01	2.64	2.36
Bankfull Area (sq ft)	5.03	2.39	2.64
Wetted Perimeter (ft)	6.13	4.42	4.54
Hydraulic Radius (ft)	0.82	0.54	0.58
Begin BKF Station	9	9	11.51
End BKF Station	14.01	11.51	14.01

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0186	0	0
Shear Stress (lb/sq ft)	0.95	--	--
Movable Particle (mm)	76.2	--	--


Cross-section 11 - Riffle UT1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 8.88
Dbkf = 1.39
Abkf = 12.4
96.0
95.5
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT1 Middle
Cross Section Name: Cross-section 11 - Riffle (12-04-07)
Survey Date: 12/06/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

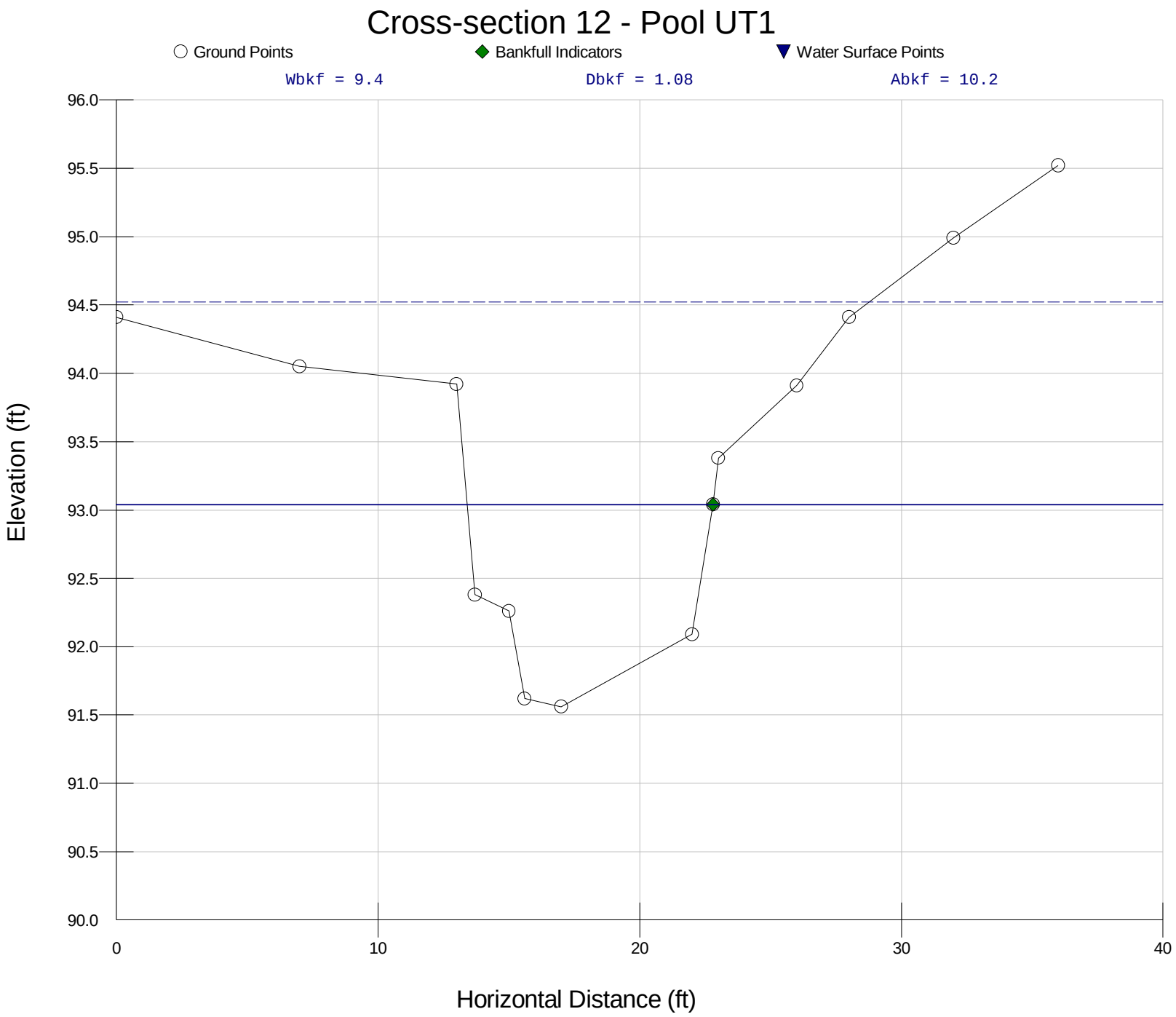
TAPE	FS	ELEV	NOTE
0	0	94.79	
6	0	94.36	
10	0	94.15	
14	0	93.85	TOB L
15	0	93.75	
15.9	0	92.42	L BKF
17	0	92.37	
17.9	0	91.74	
19.3	0	91.6	TW
22	0	91.79	
23.4	0	92.16	
24.1	0	93.43	BKF R
25	0	93.67	
27	0	94.25	
29	0	94.5	TOB R
36	0	95.52	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	95.26	95.26	95.26
Bankfull Elevation (ft)	93.43	93.43	93.43
Floodprone Width (ft)	34.22	-----	-----
Bankfull Width (ft)	8.88	4.5	4.38
Entrenchment Ratio	3.85	-----	-----
Mean Depth (ft)	1.39	1.32	1.46
Maximum Depth (ft)	1.83	1.83	1.8
Width/Depth Ratio	6.39	3.41	3
Bankfull Area (ft^2)	12.35	5.95	6.4
Wetted Perimeter (ft)	10.43	7.05	6.98
Hydraulic Radius (ft)	1.18	0.84	0.92
Begin BKF Station	15.22	15.22	19.72
End BKF Station	24.1	19.72	24.1

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0086	0	0
Shear Stress (lb/sq ft)	0.63	--	--
Movable Particle (mm)	38.3	--	--


Cross-section 12 - Pool UT1
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 9.4
Dbkf = 1.08
Abkf = 10.2
96.0
95.5
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT1 Middle
Cross Section Name: Cross-section 12 - Pool (12-04-07)
Survey Date: 12/06/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

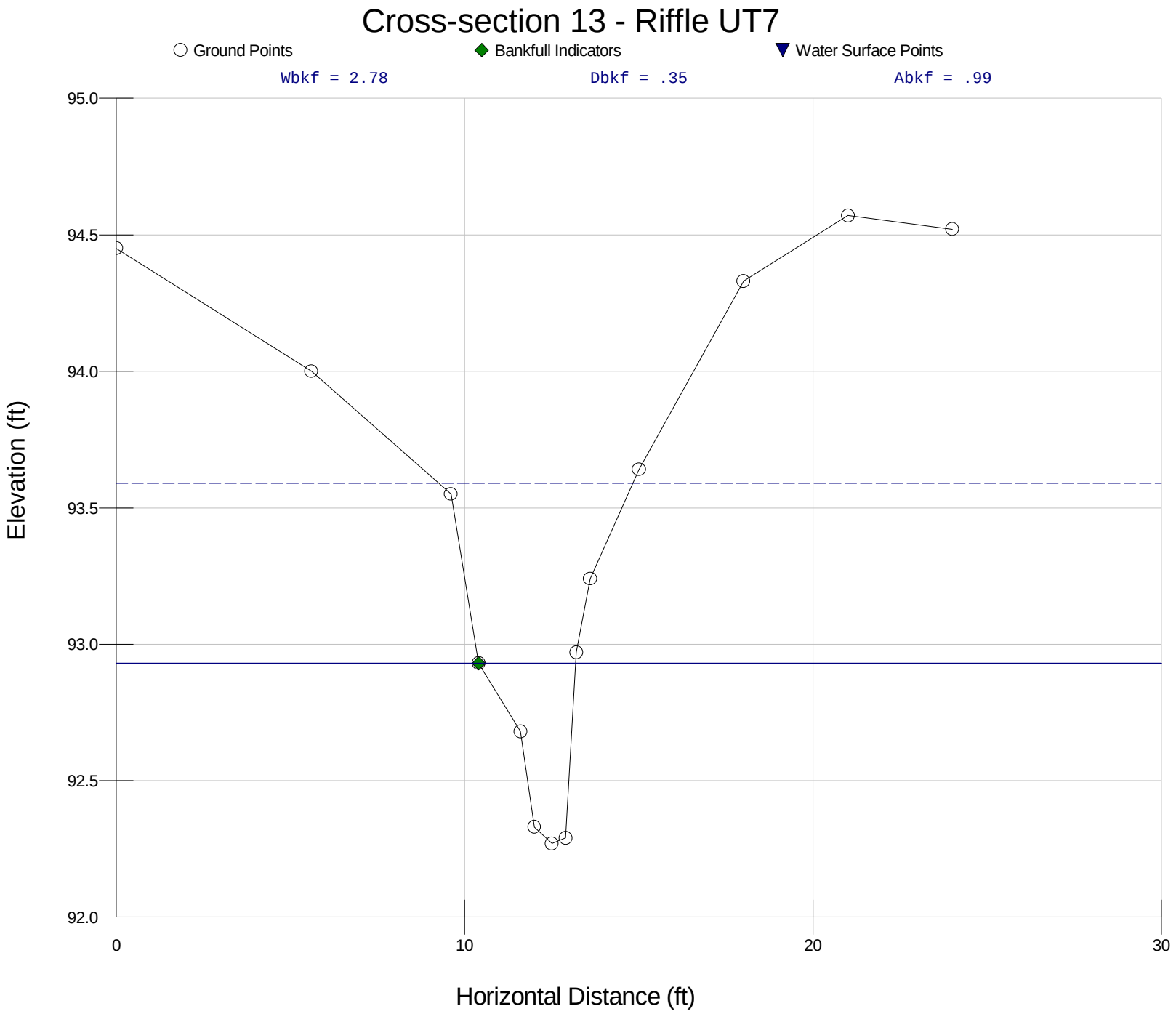
TAPE	FS	ELEV	NOTE
0	0	94.41	
7	0	94.05	
13	0	93.92	TOB L
13.7	0	92.38	
15	0	92.26	L BKF
15.6	0	91.62	
17	0	91.56	TW
22	0	92.09	
22.8	0	93.04	BKF R
23	0	93.38	
26	0	93.91	
28	0	94.41	TOB R
32	0	94.99	
36	0	95.52	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	94.52	94.52	94.52
Bankfull Elevation (ft)	93.04	93.04	93.04
Floodprone Width (ft)	28.76	-----	-----
Bankfull Width (ft)	9.4	4.62	4.78
Entrenchment Ratio	3.06	-----	-----
Mean Depth (ft)	1.08	1.12	1.05
Maximum Depth (ft)	1.48	1.48	1.37
Width/Depth Ratio	8.7	4.13	4.55
Bankfull Area (sq ft)	10.18	5.18	5
Wetted Perimeter (ft)	10.58	6.71	6.62
Hydraulic Radius (ft)	0.96	0.77	0.76
Begin BKF Station	13.4	13.4	18.02
End BKF Station	22.8	18.02	22.8

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 13 - Riffle UT7
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 2.78
Dbkf = .35
Abkf = .99
95.0
94.5
94.0
93.5
93.0
92.5
92.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT7
Cross Section Name: Cross-section 13 - Riffle (12-04-07)
Survey Date: 12/04/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

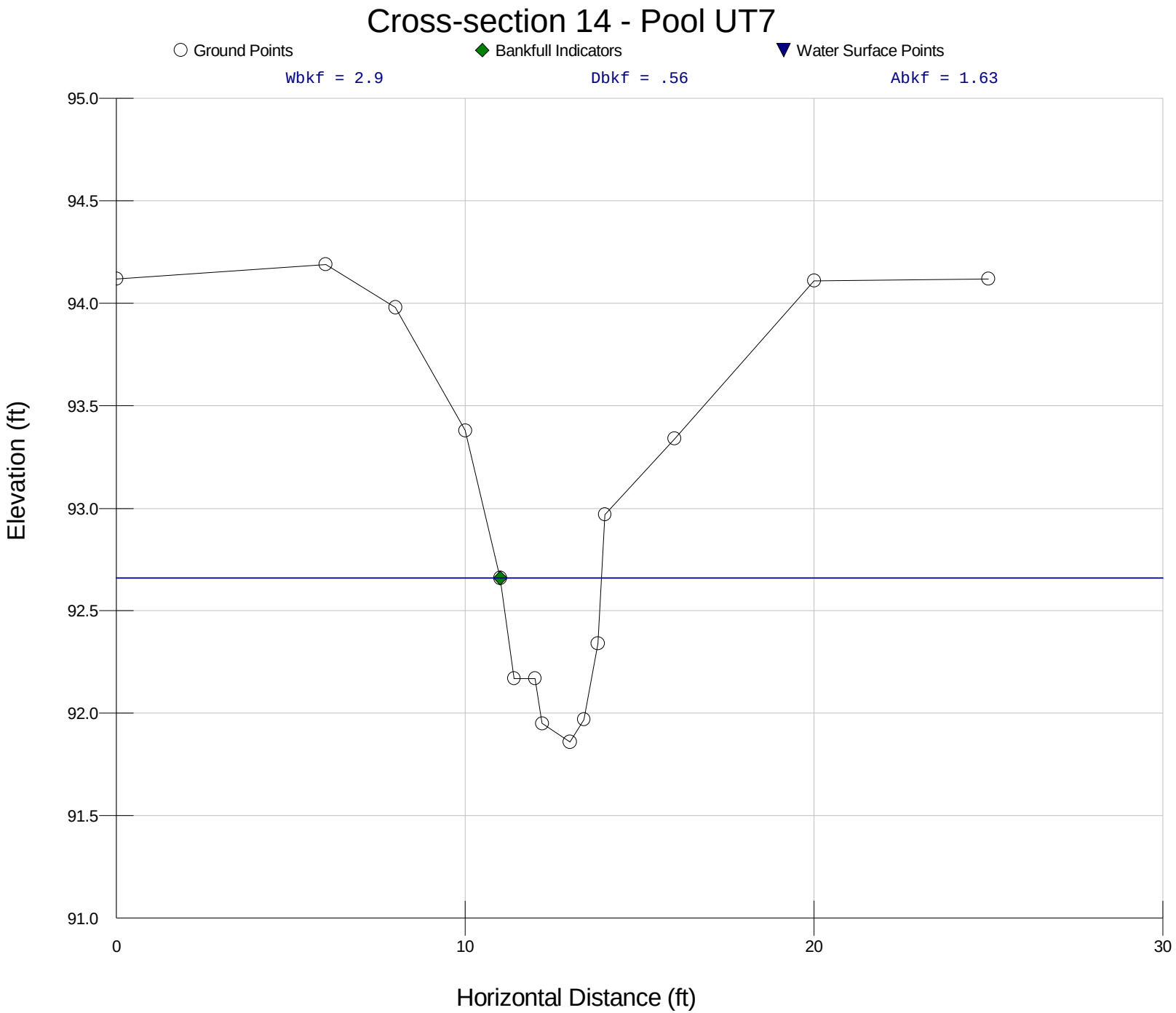
TAPE	FS	ELEV	NOTE
0	0	94.45	
5.6	0	94.00	
9.6	0	93.55	
10.4	0	92.93	BKF
11.6	0	92.68	
12	0	92.33	
12.5	0	92.27	
12.9	0	92.29	
13.2	0	92.97	
13.6	0	93.24	BNKPN
15	0	93.64	
18	0	94.33	
21	0	94.57	
24	0	94.52	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	93.59	93.59	93.59
Bankfull Elevation (ft)	92.93	92.93	92.93
Floodprone Width (ft)	5.58	-----	-----
Bankfull Width (ft)	2.78	1.38	1.4
Entrenchment Ratio	2.01	-----	-----
Mean Depth (ft)	0.35	0.15	0.55
Maximum Depth (ft)	0.66	0.41	0.66
Width/Depth Ratio	7.94	9.2	2.55
Bankfull Area (sq ft)	0.99	0.21	0.78
Wetted Perimeter (ft)	3.36	1.87	2.3
Hydraulic Radius (ft)	0.29	0.11	0.34
Begin BKF Station	10.4	10.4	11.78
End BKF Station	13.18	11.78	13.18

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0184	0	0
Shear Stress (lb/sq ft)	0.33	--	--
Movable Particle (mm)	17.7	--	--


Cross-section 14 - Pool UT7
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 2.9
Dbkf = .56
Abkf = 1.63
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT7
Cross Section Name: Cross-section 14 - Pool (12-04-07)
Survey Date: 12/04/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

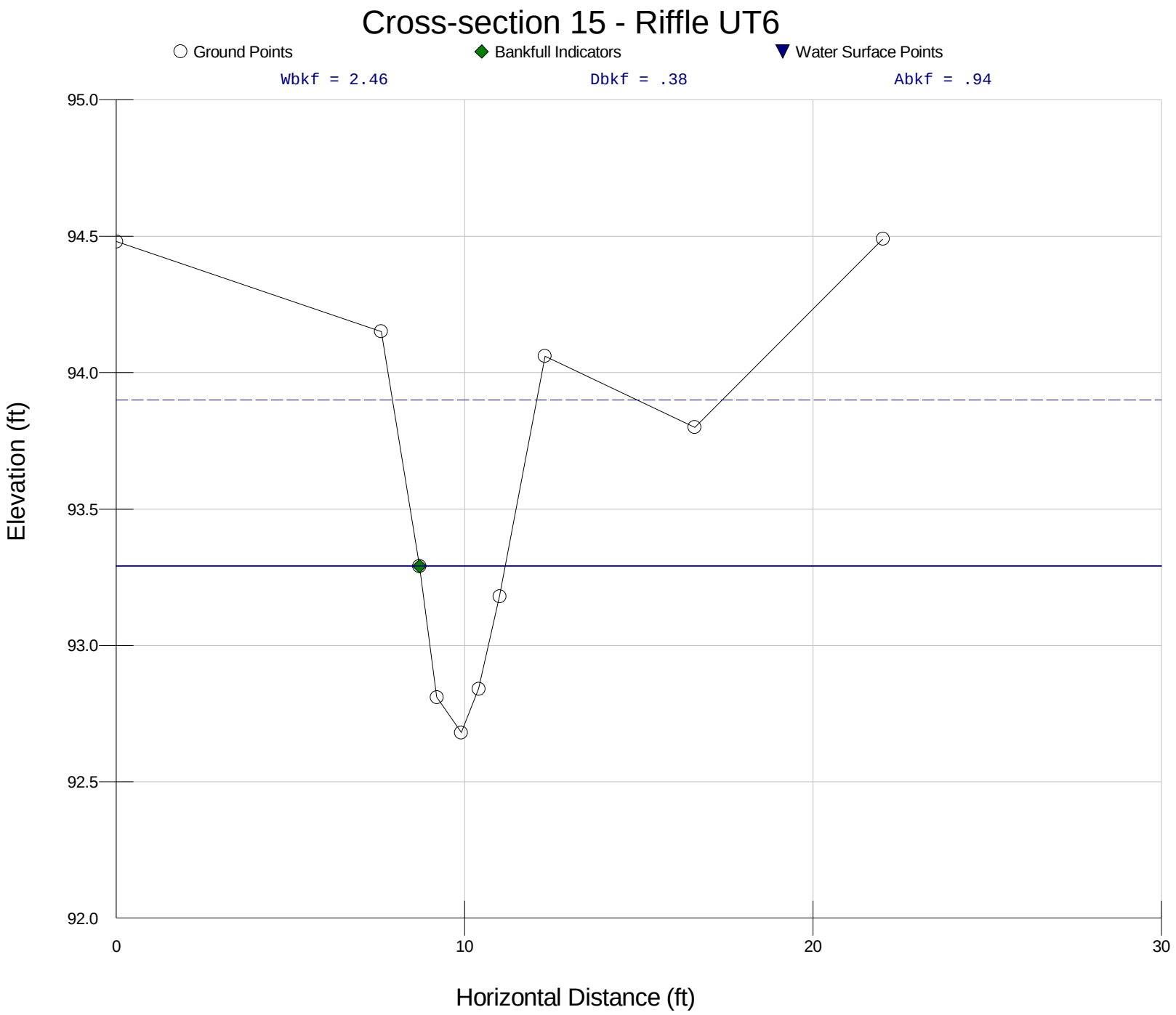
TAPE	FS	ELEV	NOTE
0	0	94.12	
6	0	94.19	
8	0	93.98	
10	0	93.38	
11	0	92.66	BKF
11.4	0	92.17	BNKPN
12	0	92.17	
12.2	0	91.95	
13	0	91.86	
13.4	0	91.97	
13.8	0	92.34	BNKPN
14	0	92.97	
16	0	93.34	
20	0	94.11	
25	0	94.12	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	93.46	93.46	93.46
Bankfull Elevation (ft)	92.66	92.66	92.66
Floodprone Width (ft)	6.89	-----	-----
Bankfull Width (ft)	2.9	1.52	1.38
Entrenchment Ratio	2.37	-----	-----
Mean Depth (ft)	0.56	0.49	0.64
Maximum Depth (ft)	0.8	0.75	0.8
Width/Depth Ratio	5.18	3.1	2.16
Bankfull Area (sq ft)	1.63	0.74	0.89
Wetted Perimeter (ft)	3.63	2.6	2.52
Hydraulic Radius (ft)	0.45	0.29	0.35
Begin BKF Station	11	11	12.52
End BKF Station	13.9	12.52	13.9

Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


Cross-section 15 - Riffle UT6
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 2.46
Dbkf = .38
Abkf = .94
95.0
94.5
94.0
93.5
93.0
92.5
92.0
Elevation (ft)
0
10
20
30
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT6
Cross Section Name: Cross-section 15 - Riffle (12-04-07)
Survey Date: 12/06/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

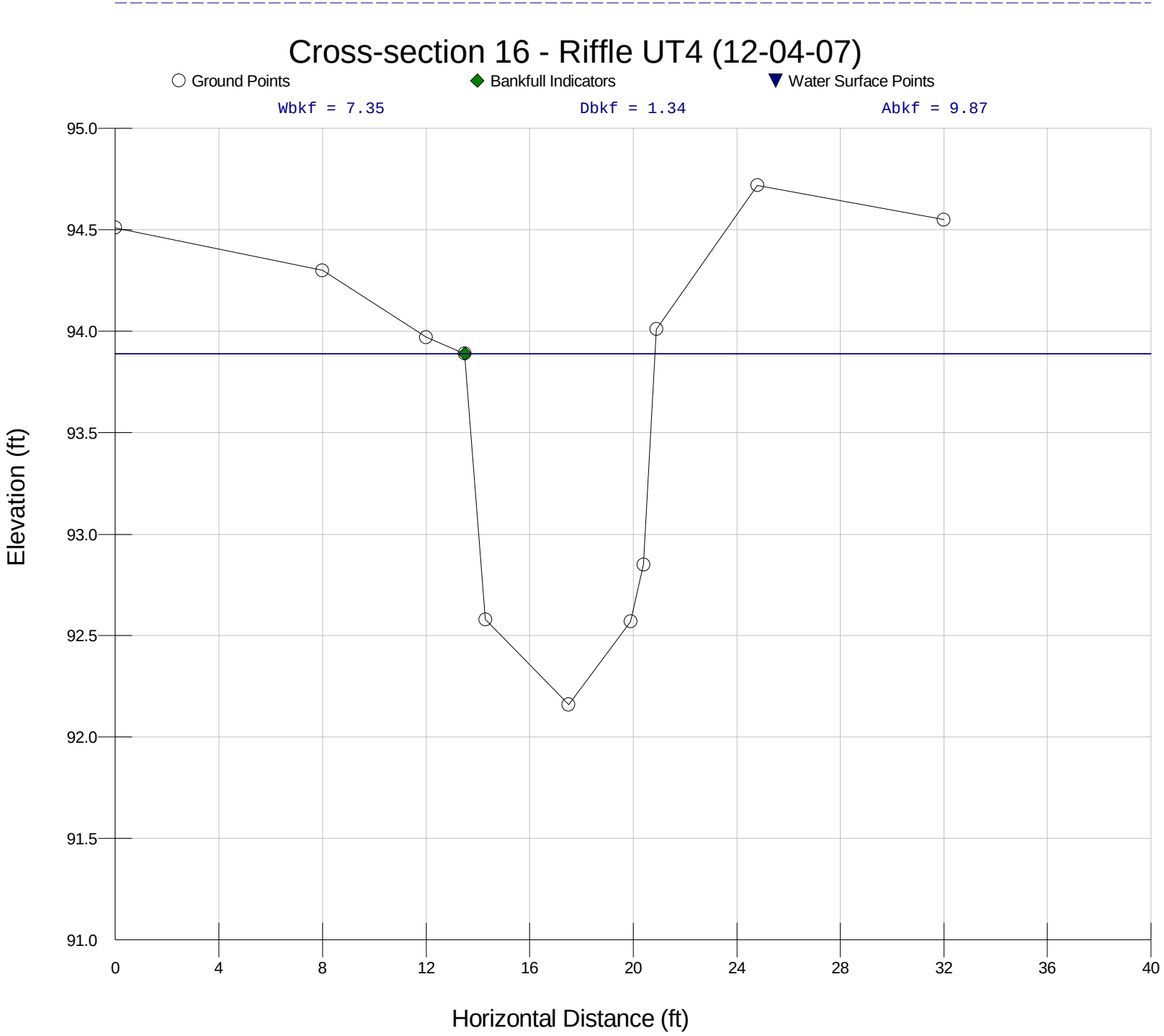
TAPE	FS	ELEV	NOTE
0	0	94.48	
7.6	0	94.15	
8.7	0	93.29	BKF
9.2	0	92.81	
9.9	0	92.68	TW
10.4	0	92.84	
11	0	93.18	BNKPN
12.3	0	94.06	
16.6	0	93.80	
22	0	94.49	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	93.9	93.9	93.9
Bankfull Elevation (ft)	93.29	93.29	93.29
Floodprone Width (ft)	6.58	-----	-----
Bankfull Width (ft)	2.46	1.22	1.24
Entrenchment Ratio	2.67	-----	-----
Mean Depth (ft)	0.38	0.42	0.35
Maximum Depth (ft)	0.61	0.61	0.6
Width/Depth Ratio	6.47	2.9	3.54
Bankfull Area (sq ft)	0.94	0.51	0.43
Wetted Perimeter (ft)	2.82	2.03	1.99
Hydraulic Radius (ft)	0.34	0.25	0.22
Begin BKF Station	8.7	8.7	9.92
End BKF Station	11.16	9.92	11.16

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0162	0.0162	0.0162
Shear Stress (lb/sq ft)	0.34	0.25	0.22
Movable Particle (mm)	18.2	14	12.6


Cross-section 16 - Riffle UT4 (12-04-07)
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 7.35
Dbkf = 1.34
Abkf = 9.87
Elevation (ft)
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
0
4
8
12
16
20
24
28
32
36
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT4 Lower
Cross Section Name: Cross-section 16 - Riffle UT4 (12-04-07)
Survey Date: 12/04/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

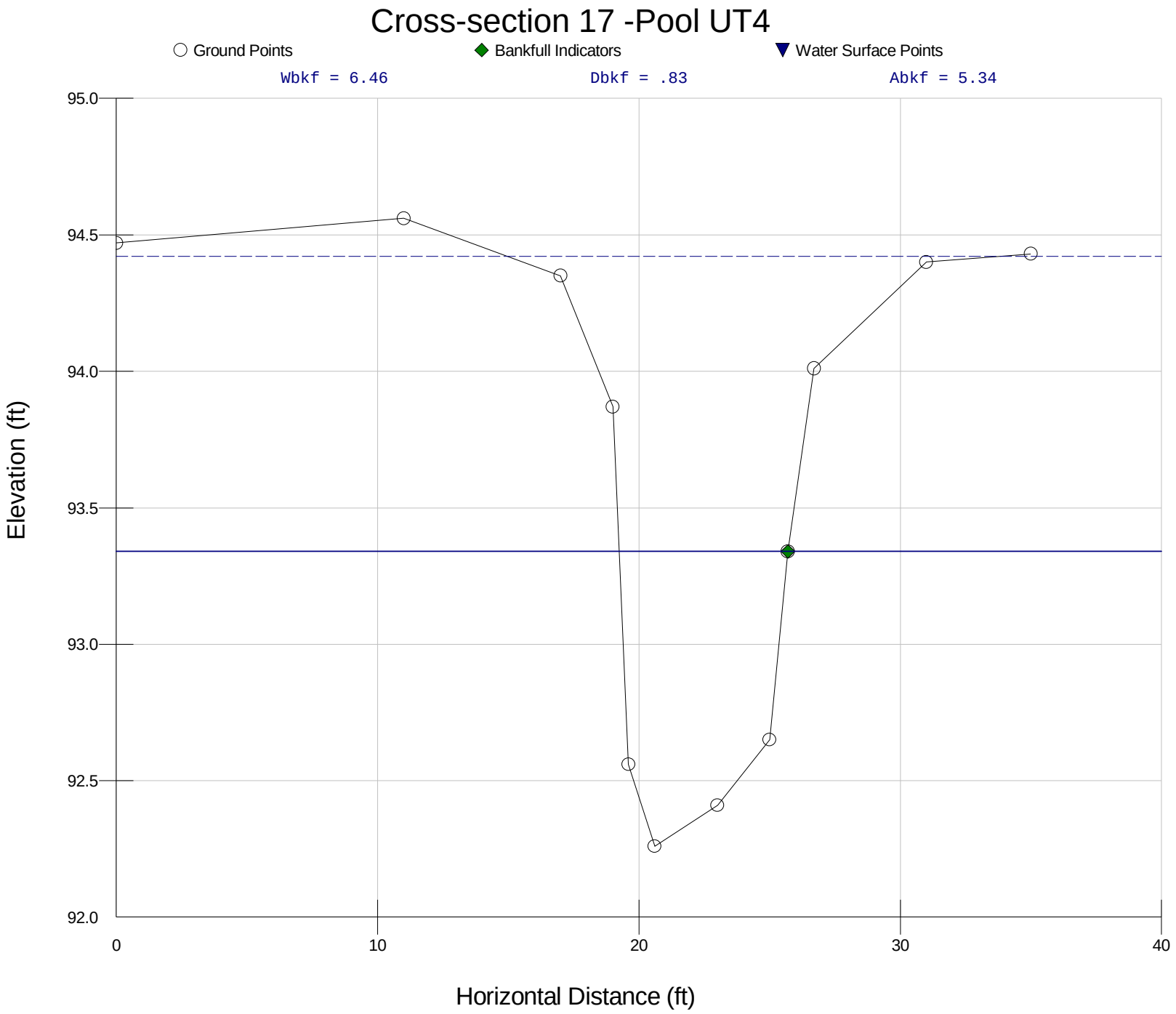
TAPE	FS	ELEV	NOTE
0	0	94.51	
8	0	94.30	
12	0	93.97	TOB L
13.5	0	93.89	BKF
14.3	0	92.58	
17.5	0	92.16	TW
19.9	0	92.57	
20.4	0	92.85	
20.9	0	94.01	TOB R
24.8	0	94.72	
32	0	94.55	

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	95.62	95.62	95.62
Bankfull Elevation (ft)	93.89	93.89	93.89
Floodprone Width (ft)	313	-----	-----
Bankfull Width (ft)	7.35	3.67	3.68
Entrenchment Ratio	42.6	-----	-----
Mean Depth (ft)	1.34	1.31	1.37
Maximum Depth (ft)	1.73	1.69	1.73
Width/Depth Ratio	5.49	2.8	2.69
Bankfull Area (sq ft)	9.87	4.82	5.05
Wetted Perimeter (ft)	8.9	6.12	6.16
Hydraulic Radius (ft)	1.11	0.79	0.82
Begin BKF Station	13.5	13.5	17.17
End BKF Station	20.85	17.17	20.85

Entrainment Calculations (Shields Curve)

	Channel	Left Side	Right Side
Slope	0.0115	0	0
Shear Stress (lb/sq ft)	0.80	--	--
Movable Particle (mm)	49.8	--	--


Cross-section 17 -Pool UT4
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 6.46
Dbkf = .83
Abkf = 5.34
95.0
94.5
94.0
93.5
93.0
92.5
92.0
Elevation (ft)
0
10
20
30
40
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: Rockwell
Reach Name: UT4 Lower
Cross Section Name: Cross-section 17 - Pool (12-04-07)
Survey Date: 12/06/2007

Cross Section Data Entry
BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

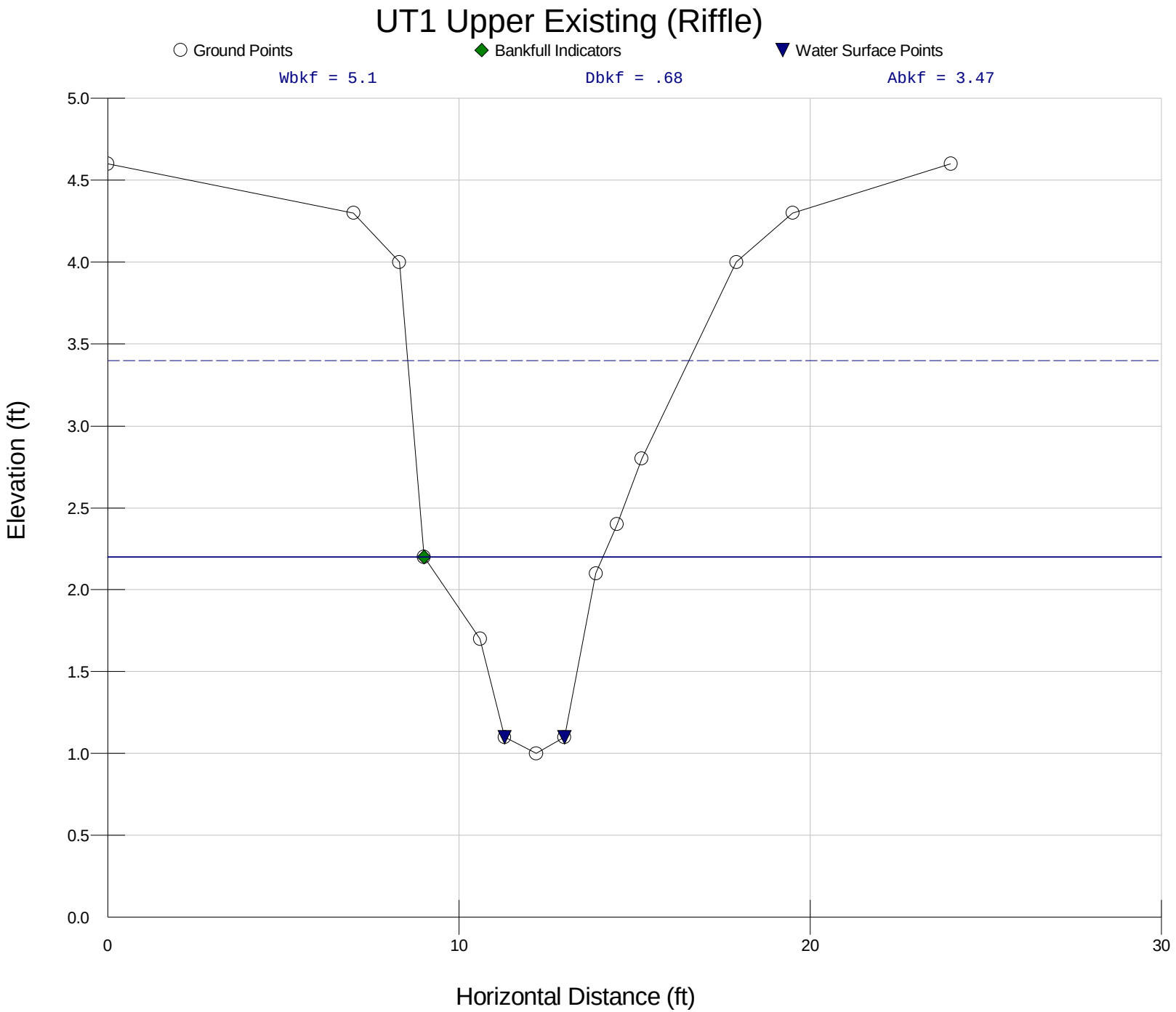
TAPE	FS	ELEV	NOTE
0	0	94.47	
11	0	94.56	
17	0	94.35	TOB L
19	0	93.87	
19.6	0	92.56	
20.6	0	92.26	TW
23	0	92.41	
25	0	92.65	
25.7	0	93.34	BKF R
26.7	0	94.01	TOB R
31	0	94.40	
35	0	94.43	

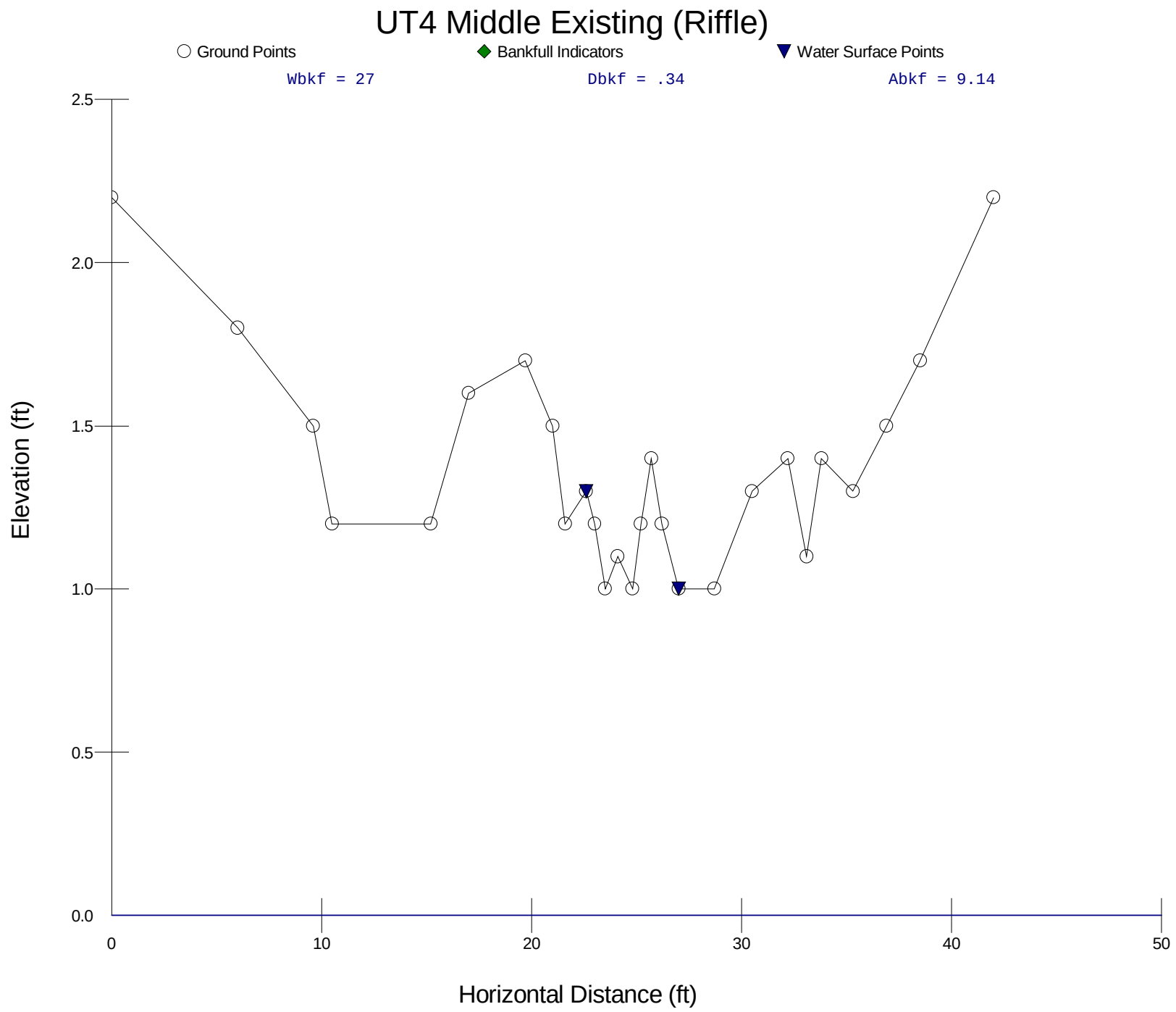
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	94.42	94.42	94.42
Bankfull Elevation (ft)	93.34	93.34	93.34
Floodprone Width (ft)	18.67	-----	-----
Bankfull Width (ft)	6.46	3.23	3.23
Entrenchment Ratio	2.89	-----	-----
Mean Depth (ft)	0.83	0.92	0.73
Maximum Depth (ft)	1.08	1.08	0.96
Width/Depth Ratio	7.78	3.51	4.42
Bankfull Area (sq ft)	5.34	2.98	2.36
Wetted Perimeter (ft)	7.3	4.74	4.49
Hydraulic Radius (ft)	0.73	0.63	0.53
Begin BKF Station	19.24	19.24	22.47
End BKF Station	25.7	22.47	25.7

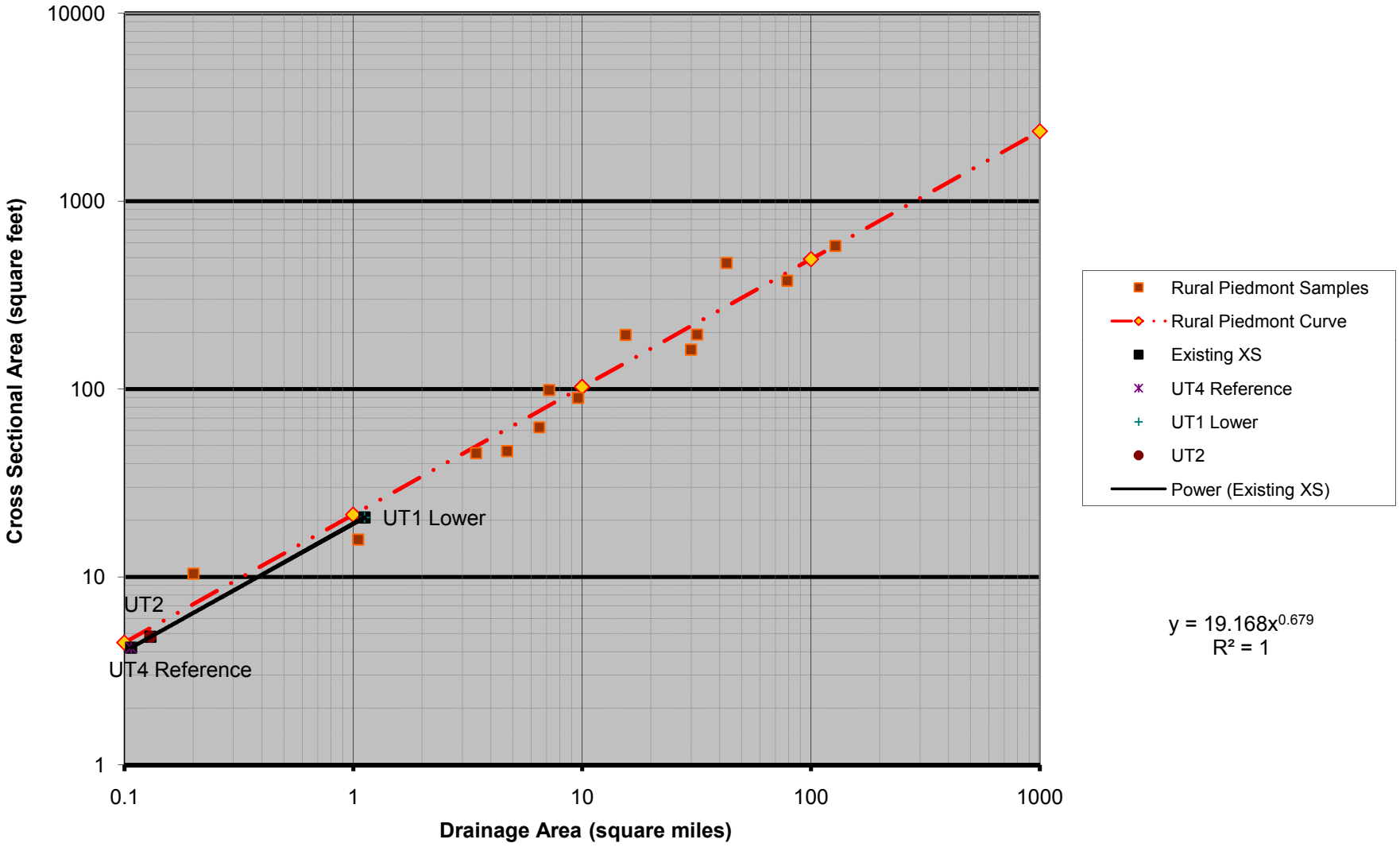
Entrainment Calculations (Rosgen Modified Shields Curve)

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)	--	--	--
Movable Particle (mm)	--	--	--


UT1 Upper Existing (Riffle)
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 5.1
Dbkf = .68
Abkf = 3.47
Elevation (ft)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
Horizontal Distance (ft)


UT4 Middle Existing (Riffle)
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 27
Dbkf = .34
Abkf = 9.14
Elevation (ft)
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
Horizontal Distance (ft)

North Carolina Rural Piedmont Regional Curves: Drainage Area vs. Bankful Cross Sectional Area



Appendix 8

Sampled Stream Materials

GeoTechnologies, Inc.

Job Number: Job Name: Rockwell Pastures

Sample I.D. UT-7 Pavement Small

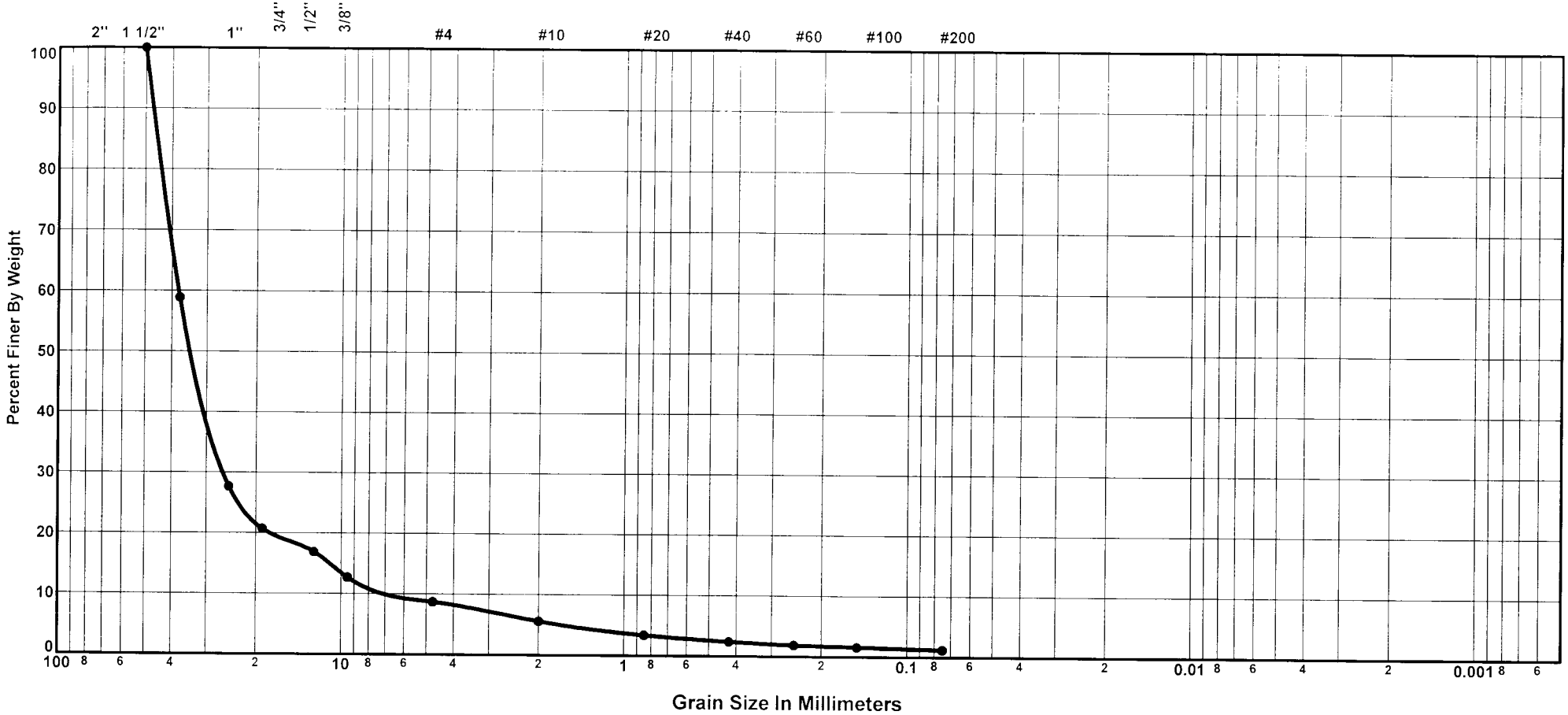
Sieve Analysis 200 Wash

Dry Weight of Total Sample 280.55 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3.0	0.00	0.0%	100.0%
2.5	0.00	0.0%	100.0%
2.0	0.00	0.0%	100.0%
11/2	115.43	41.1%	58.9%
1.0	202.93	72.3%	27.7%
3/4	222.34	79.3%	20.7%
1/2	233.01	83.1%	16.9%
3/8	244.86	87.3%	12.7%
#4	256.26	91.3%	8.7%
#10	264.77	94.4%	5.6%
#20	270.98	96.6%	3.4%
#40	273.78	97.6%	2.4%
#60	275.19	98.1%	1.9%
#100	276.18	98.4%	1.6%
#200	277.11	98.8%	1.2%

ROCK 1 =64.03 grams
ROCK 2 = 51.41 grams

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-7 Pavement Small

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

GeoTechnologies, Inc.

Job Number: Job Name: Rockwell Pastures

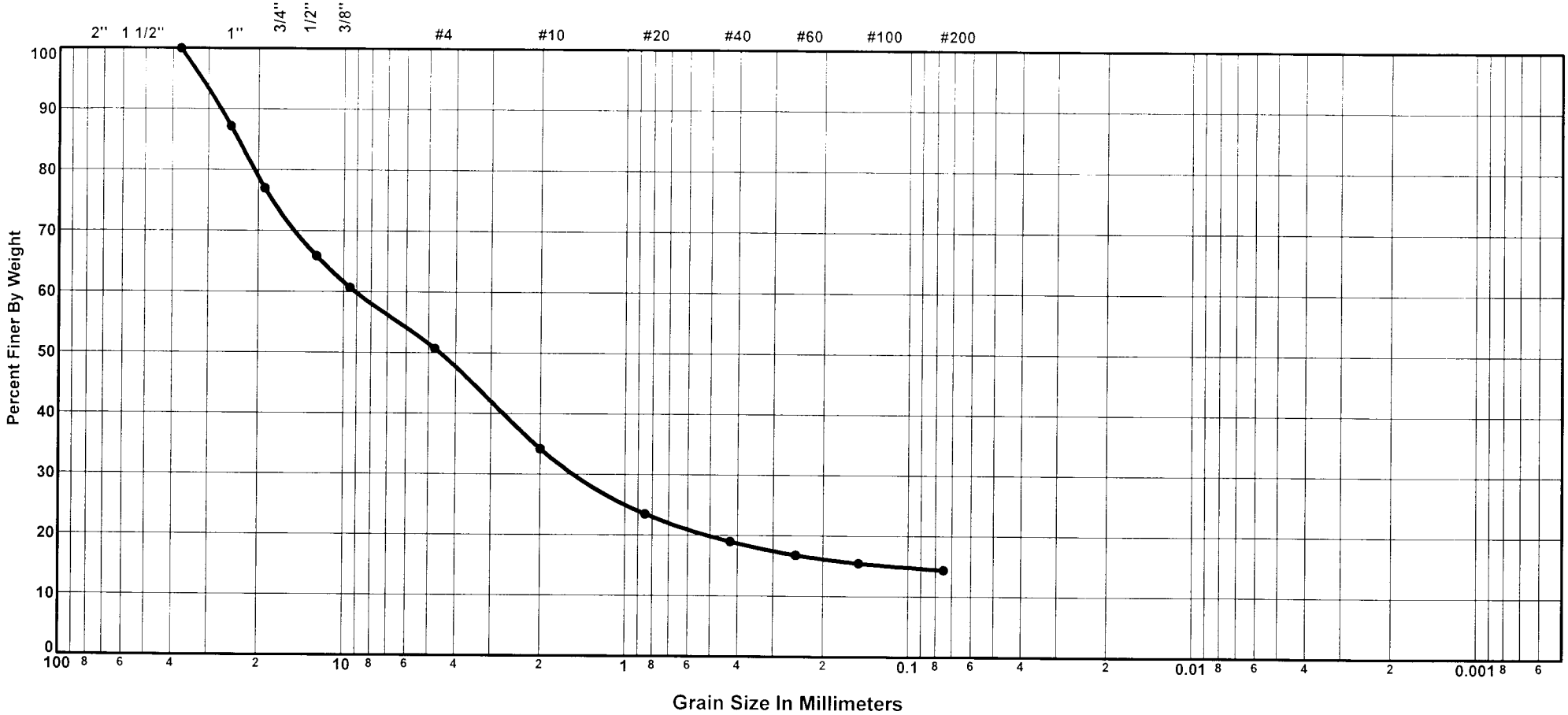
Sample I.D. UT-7 Sub Pavement

Sieve Analysis 200 Wash

Dry Weight of Total Sample 951.94 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3.0	0.00	0.0%	100.0%
2.5	0.00	0.0%	100.0%
2.0	0.00	0.0%	100.0%
11/2	0.00	0.0%	100.0%
1.0	121.62	12.8%	87.2%
3/4	219.35	23.0%	77.0%
1/2	324.35	34.1%	65.9%
3/8	374.28	39.3%	60.7%
#4	469.06	49.3%	50.7%
#10	626.84	65.8%	34.2%
#20	728.12	76.5%	23.5%
#40	770.69	81.0%	19.0%
#60	791.78	83.2%	16.8%
#100	804.36	84.5%	15.5%
#200	814.92	85.6%	14.4%

U.S. Standard Sieve Sizes



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-7 Sub Pavement

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

GeoTechnologies, Inc.

Job Number:		Job Name:	Rockwell Pastures
Sample I.D.	UT-4 Reference Pavement		

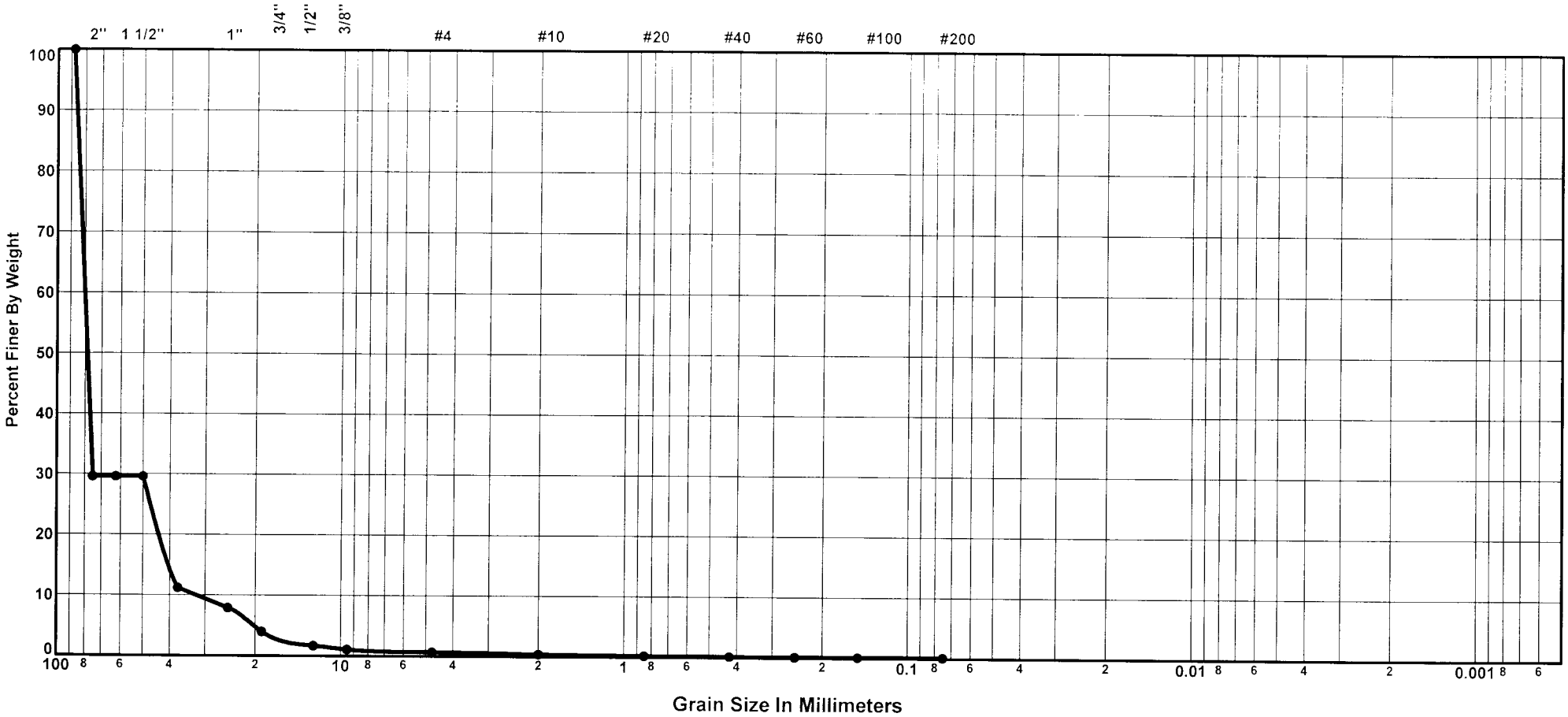
Sieve Analysis 200 Wash

Dry Weight of Total Sample 1031.85 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3.0	726.67	70.4%	29.6%
2.5	726.67	70.4%	29.6%
2.0	726.67	70.4%	29.6%
11/2	915.88	88.8%	11.2%
1.0	950.64	92.1%	7.9%
3/4	990.76	96.0%	4.0%
1/2	1014.51	98.3%	1.7%
3/8	1020.87	98.9%	1.1%
#4	1024.70	99.3%	0.7%
#10	1027.88	99.6%	0.4%
#20	1029.36	99.76%	0.24%
#40	1029.87	99.81%	0.19%
#60	1030.12	99.83%	0.17%
#100	1030.20	99.84%	0.16%
#200	1030.23	99.843%	0.157%

ROCK 1 = 726.67 grams
ROCK 2 = 81.37 grams

U.S. Standard Sieve Sizes



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-4 Reference Pavement

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

GeoTechnologies, Inc.

Job Number: **Job Name:** Rockwell Pastures

Sample I.D. UT-1 Lower Pavement

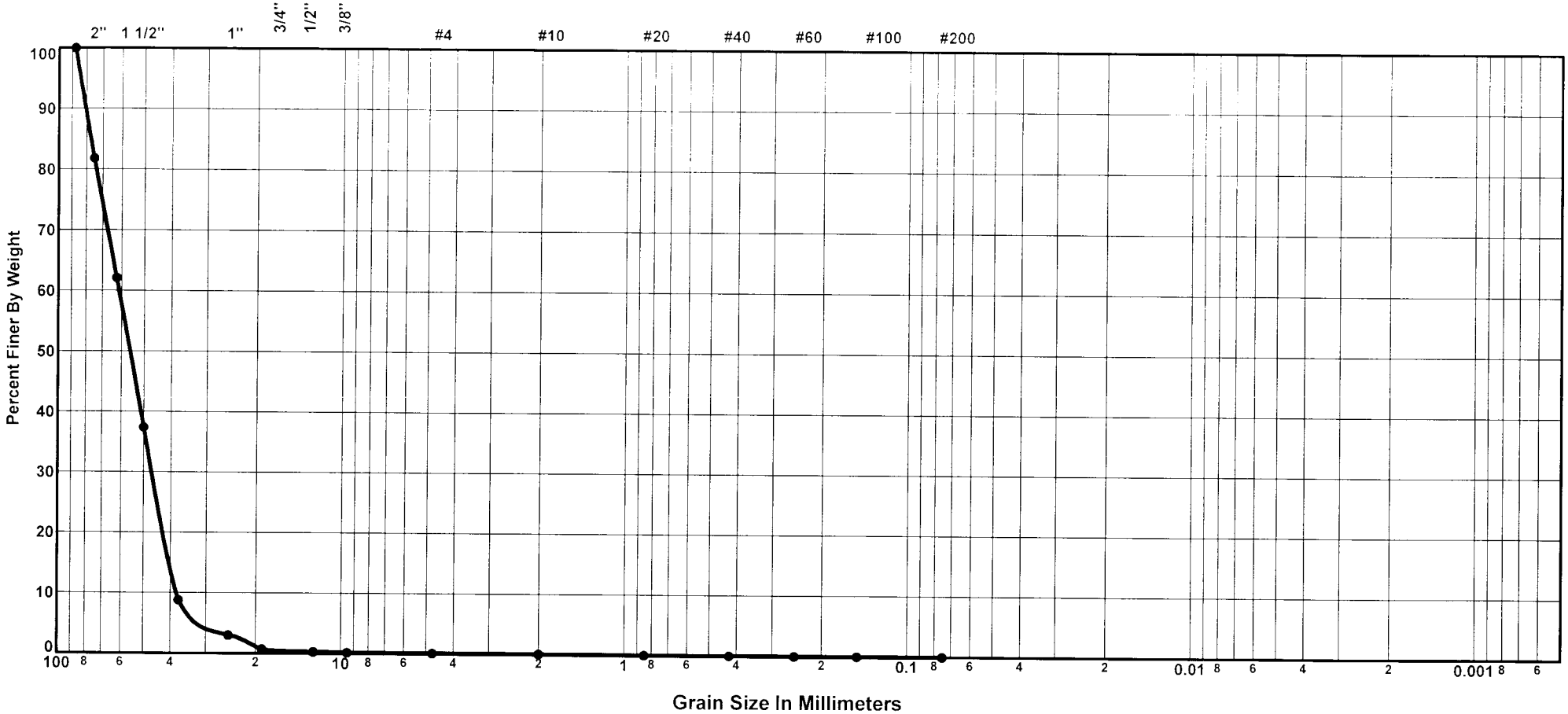
Sieve Analysis 200 Wash

Dry Weight of Total Sample 3610.80 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3.0	657.71	18.2%	81.8%
2.5	1368.34	37.9%	62.1%
2.0	2259.21	62.6%	37.4%
11/2	3292.11	91.2%	8.8%
1.0	3502.81	97.0%	3.0%
3/4	3585.26	99.29%	0.71%
1/2	3599.82	99.70%	0.30%
3/8	3604.06	99.81%	0.19%
#4	3604.98	99.84%	0.16%
#10	3606.63	99.88%	0.12%
#20	3608.88	99.95%	0.05%
#40	3609.78	99.97%	0.03%
#60	3610.26	99.99%	0.01%
#100	3610.55	99.99%	0.01%
#200	3610.66	99.996%	0.004%

ROCK 1 = 710.80 grams
ROCK 2 = 657.71 grams

U.S. Standard Sieve Sizes



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-1 Lower Pavement

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

GeoTechnologies, Inc.

Job Number:		Job Name:	Rockwell Pastures
Sample I.D.	UT-1 Sub Pavement		

Sieve Analysis 200 Wash

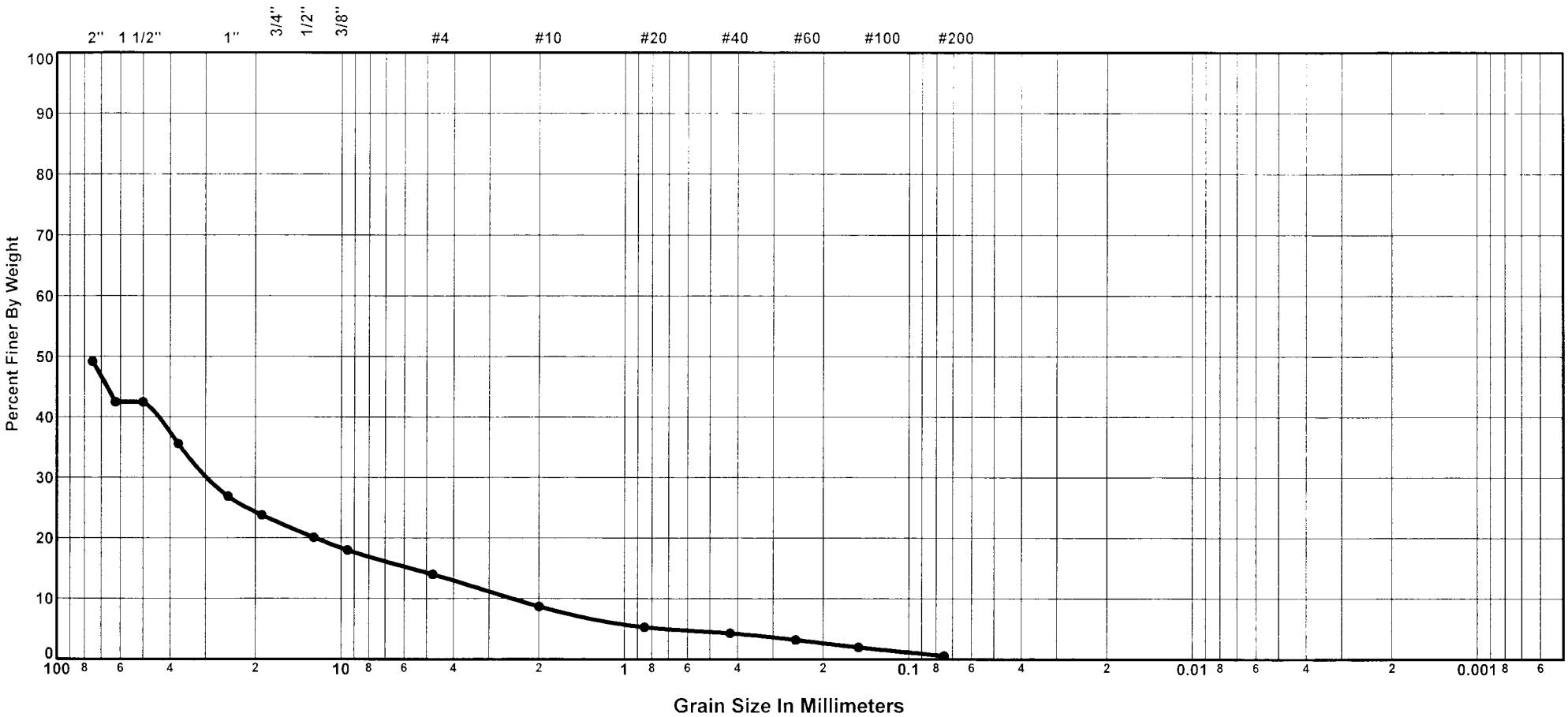
Dry Weight of Total Sample 19790.75 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3+	10052.20	50.8%	49.2%
2.5	11383.24	57.5%	42.5%
2.0	11383.24	57.5%	42.5%
11/2	12747.63	64.4%	35.6%
1.0	14459.36	73.1%	26.9%
3/4	15074.10	76.2%	23.8%
1/2	15818.97	79.9%	20.1%
3/8	16221.44	82.0%	18.0%
#4	17019.93	86.0%	14.0%
#10	18068.37	91.3%	8.7%
#20	18736.55	94.7%	5.3%
#40	18944.14	95.7%	4.3%
#60	19160.87	96.8%	3.2%
#100	19401.12	98.0%	2.0%
#200	19668.76	99.4%	0.6%

3.0+ Rock = 9236.8 grams

Length x Width x Thickness = 18.75 x 9.75 x 1.55 in.

U.S. Standard Sieve Sizes



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-1 Subpavement

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

GeoTechnologies, Inc.

Job Number: **Job Name:** Rockwell Pastures

Sample I.D. UT-1 Pavement

Sieve Analysis 200 Wash

Dry Weight of Total Sample 10458.01 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3+	9069.32	86.7%	13.3%
2.5	9923.59	94.9%	5.1%
2.0	9923.59	94.9%	5.1%
11/2	10183.91	97.4%	2.6%
1.0	10431.01	99.7%	0.3%
3/4	10433.56	99.8%	0.23%
1/2	10433.56	99.8%	0.23%
3/8	10433.56	99.8%	0.23%
#4	10443.28	99.9%	0.14%
#10	10449.44	99.9%	0.08%
#20	10452.99	100.0%	0.05%
#40	10454.83	100.0%	0.03%
#60	10455.94	100.0%	0.02%
#100	10456.65	100.0%	0.01%
#200	10457.31	100.0%	0.007%

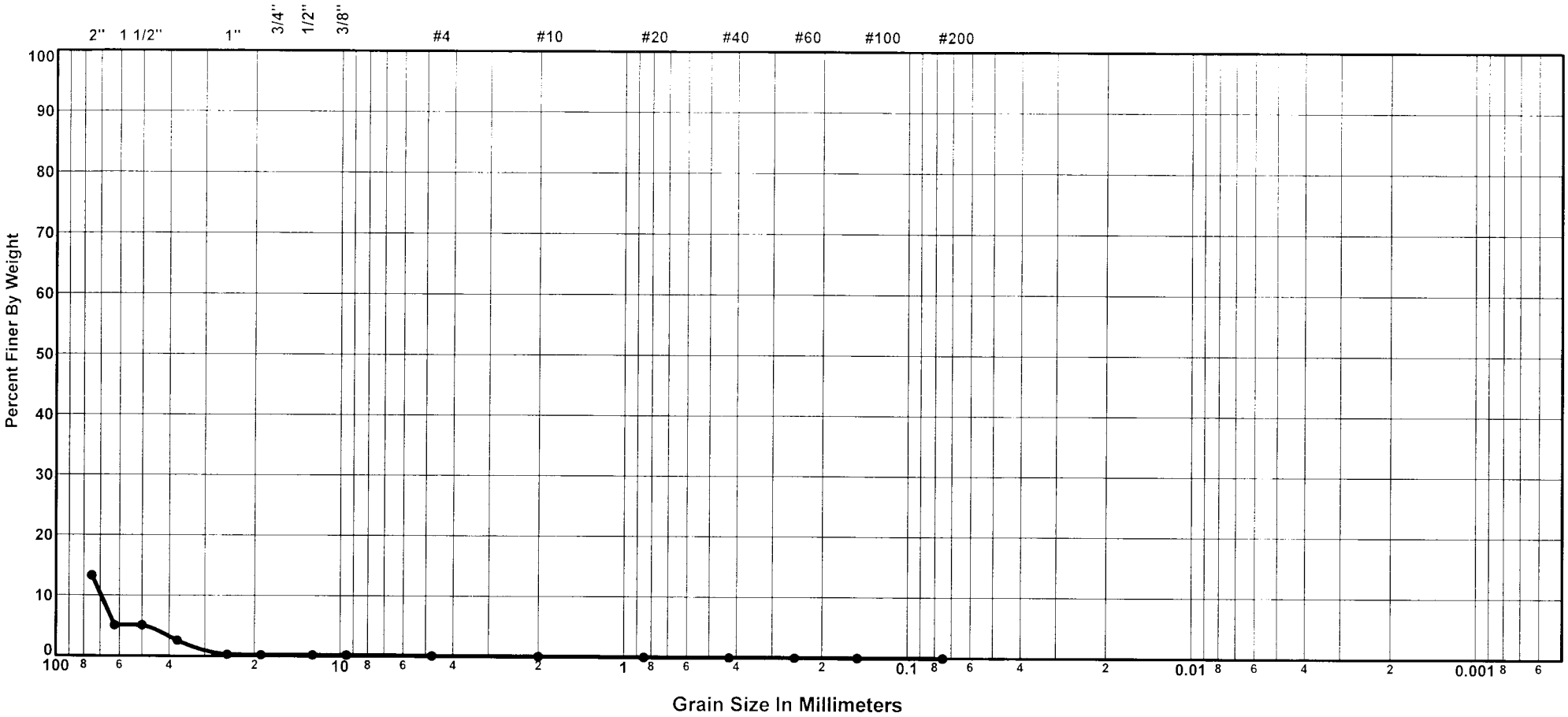
ROCK 1 = 7352.3 grams

Length x Width x Thickness = 6.445 x 5.665 x 6.945 in.

ROCK 2 = 1717.02 grams

Length x Width x Thickness = 4.695 x 3.892 x 3.755 in.

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-1 Pavement

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

GeoTechnologies, Inc.

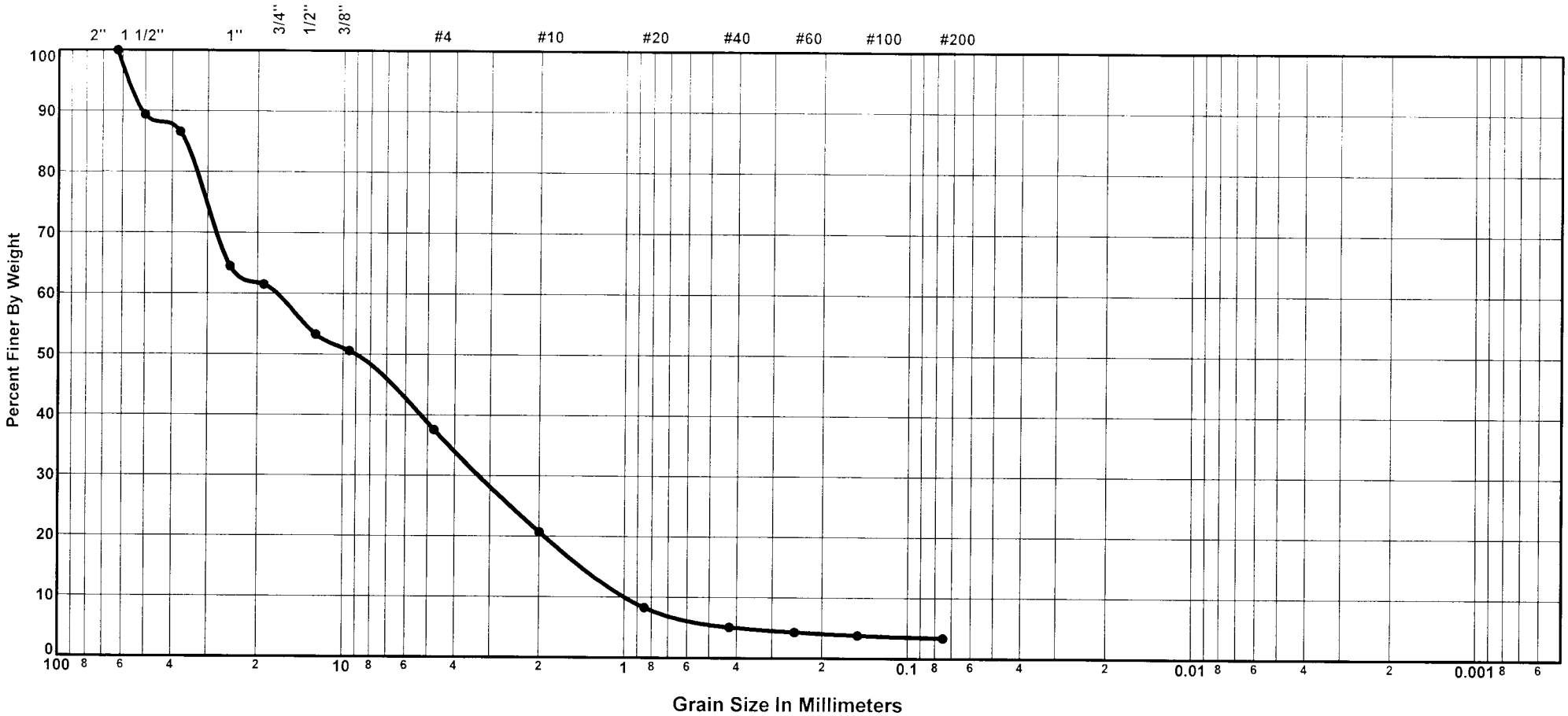
Job Number:	Job Name:	Rockwell Pastures
Sample I.D.	UT-1 Upper Sub Pavement	

Sieve Analysis 200 Wash

Dry Weight of Total Sample 2677.32 grams

SIEVE SIZE	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING
3.0	0.00	0.0%	100.0%
2.5	0.00	0.0%	100.0%
2.0	282.96	10.6%	89.4%
11/2	357.78	13.4%	86.6%
1.0	949.60	35.5%	64.5%
3/4	1031.45	38.5%	61.5%
1/2	1249.20	46.7%	53.3%
3/8	1323.10	49.4%	50.6%
#4	1670.61	62.4%	37.6%
#10	2124.02	79.3%	20.7%
#20	2454.48	91.7%	8.3%
#40	2539.58	94.9%	5.1%
#60	2563.21	95.7%	4.3%
#100	2575.66	96.2%	3.8%
#200	2587.30	96.6%	3.4%

U.S. Standard Sieve Sizes



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
						UT-1 Upper Sub Pavement

Project:

Rockwell Pastures
Stanley Co., NC

Job No.: 1-08-0031-CA

Date: 1/28/08

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

Appendix 9

Soil Water and Environment Group (SWE) Soil Analysis and Evaluation for Rockwell Site Wetland and Stream Mitigation Project

Soil, Water, & Environment Group, LLC
Research Building I, Centennial Campus
1001 Capability Drive, Suite 312 • Raleigh, NC 27606
Ph# (919) 831-1234 • Fax# (919) 831-1121 • http://www.swegrp.com

March 15, 2007

Mr. Todd St. John
Kimley-Horn and Associates, Inc.
PO Box 33068
Raleigh, NC 27636-3068

Re: Soil Analysis and Evaluation for the Rockwell Wetland and Stream Restoration Mitigation Project Site EEP Proposal

Dear Mr. St. John,

The following is a description of the data set included with this correspondence related to the Stanly County (Rockwell) Wetland Restoration Site:

Soils Descriptions
On March 9th, 2007, SWE Group personnel investigated the Rockwell Stream and Wetland EEP Mitigation Project Site to confirm NRCS soil survey mapping data, record detailed soil descriptions for selected areas representing different landscape positions across the site, and to determine the extent of hydric soils for the purpose of wetland restoration site criteria. A series of hand augerings were accomplished across selected areas of the proposed wetland restoration site at maximum depths of approximately 18-24 in. Detailed soil descriptions including depth of horizon, color, texture, structure, and consistence were recorded and a sketch of the area was created entitled Rockwell Site (enclosed).

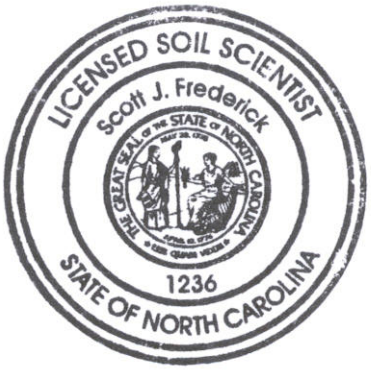
The site specific soil descriptions included in this report are most similar to Chewacla loam and Oakboro silt loam type series soils as described by the Stanly County Soil Survey (NRCS, unpublished) with some variations in texture, color, and redoximorphic features. However, some descriptions are most similar to Wehadkee loam series soil described in other county surveys. These soils are somewhat poorly drained and frequently flooded from riverine systems and toeslope drainage. Subsoil consists of loamy and silty clay textured soils. These soils are found on nearly level flood plains along creeks and drainageways. Permeability is moderate for these soil series. The subsoil is characterized by a clay or silty clay that restricts water movement between 3 and 33 inches below the soil surface. Seasonally high water tables are found below the soil surface between .5 and 1.5 feet for the Chewacla and Wehadkee and 1 to 2 feet for the Oakboro series soil.

Overall, the areas investigated have hydric soil characteristics and hydric soils that are suitable for wetland restoration. Strong redoximorphic features are present indicating seasonally high water tables and frequent inundation from toeslope subsurface drainage and surface runoff from field ditches. These features include relic and present oxidized root channels, depleted matrices, and chroma 2 colors in the upper soil profile. Currently the fields investigated are in row crops (corn and soybeans) and have hydric vegetation volunteering among other herbaceaous vegetation. In addition, wrack lines were observed from recent overland surface runoff.

For areas where relic redoximorphic features occur greater than 12 in. due to site disturbance from farming, minor grading of less than or equal to 6 in. (USACE Guidance) in these areas would most likely result in a change to more hydric conditions and an elevated water table similar to adjacent soil areas. From observations, these areas in question most likely were crowned to maximize row crop acreage, resulting in a cap of soil to increase runoff and drainage.

Let me know if you have any questions concerning the enclosed soil data and discussion. We look forward to continuing to work with you on this project.

Sincerely,



Scott J. Frederick, EI, NCLSS
Environmental Scientist
Soil, Water, & Environment Group

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Raleigh, NC 27606
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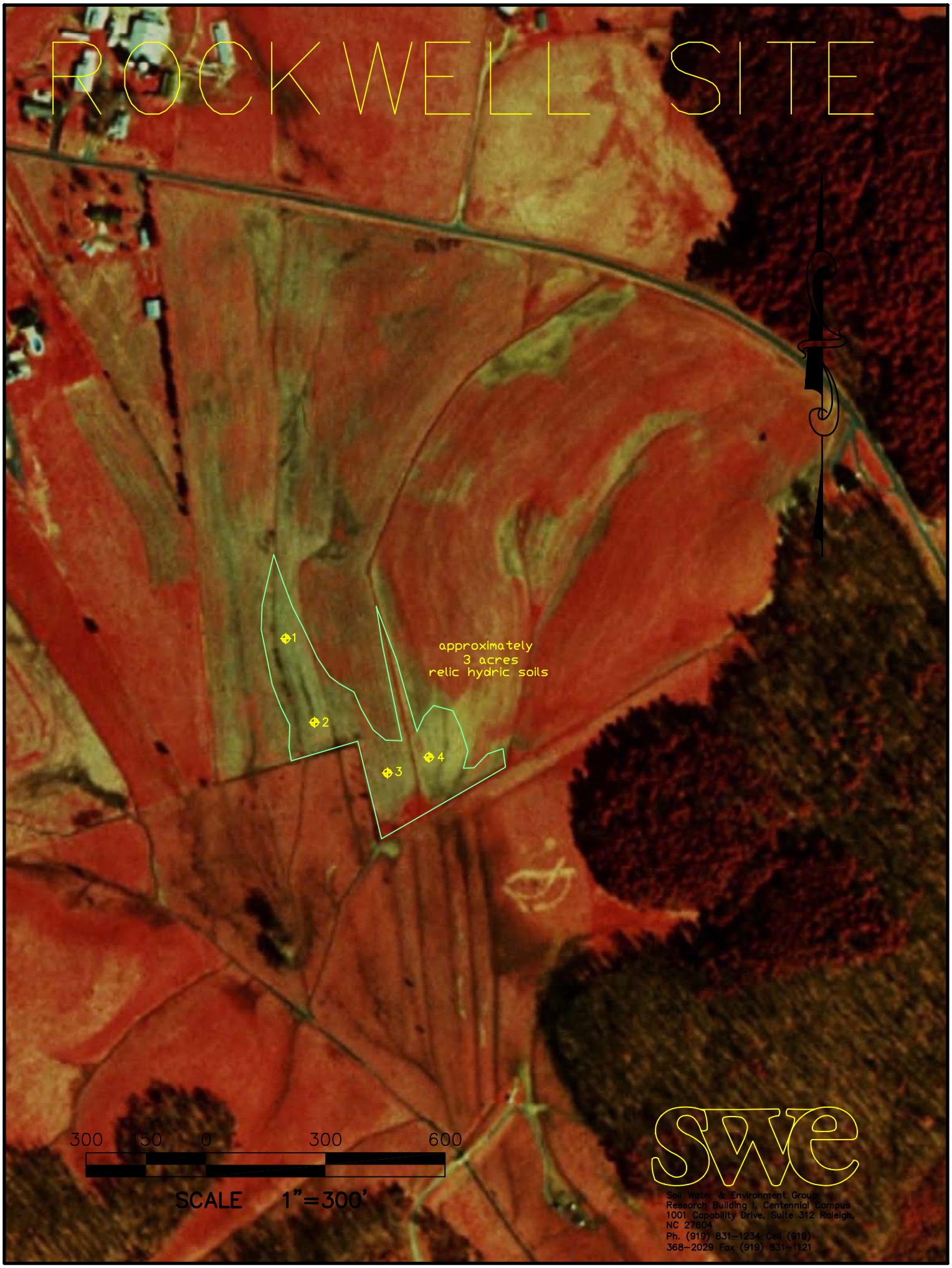
sjfrederick@swegrp.com
www.swegrp.com

Encl: soils data

ROCKWELL SITE



swe
Soil Water & Environment Group
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1001 Capability Drive, Suite 312 Raleigh, NC 27606
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Soil, Water, & Environment Group

Soil Investigation Data Sheet

Soil Boring:	SB-1		
Location:	Rockwell Pastures	Date:	3/8/2007
County:	Stanly	Investigator(s):	SJF,BEJ
Lat./Long.:	35-16-47.13N,80-07-58.59W	Elev.:	
Parent Material:	Carolina slate belt	Drainage (Wetness) Class:	somewhat poorly drained
Moisture Status:	moist	Slope (%):	1-2%
Classification:	Fine-loamy,mixed,active,thermic Fluvaquentic Dystrudepts	Vegetative Cover:	rye grass
Aspect:	E	Water Table:	~ 12 in.
Landscape Position:	terrace		

					Structure						
Horiz.	Depth (in.)	Main Colors (moist)	Mottles	Texture	Grade	Class	Type	Moist & Wet Consist.	Ped Coatings	Hoizon Boundary	Other Remarks
Ap	0-6	10YR 4/4	-	silt loam	mod.	med.	sub blk.	friable, ns, np	-	grad., wavy	fine roots
B1	6-10	10YR 4/4	10YR 6/1	silty clay loam	mod.	med.	sub blk.	friable, ns, np	-	grad., wavy	
B2	10-18	10YR 4/4	2.5YR 6/2 10YR 7/1	silty clay loam	mod.	med.	sub blk.	friable, ns, np	-	grad., wavy	redox. features, oxidized root channels, Mn conc.

Appendix 10

Hydrologic Gauge Data Summary, Groundwater and Rainfall Information

Appendix 10. Hydrologic Gauge Data Summary, Groundwater and Rainfall Information.

Wells have recently been installed to monitor groundwater at the wetland restoration areas along UT6 as well as the hydrologic reference wetland adjacent to UT1. Data will be gathered in fall 2008 and will be used in conjunction with soils analysis data and general conductivity data to evaluate water table elevations.

Gauge data, groundwater, and rainfall information will be recorded and analyzed prior to final design and construction of the wetland site.