Executive Summary of Design

Suck Creek
Stream Restoration Project
Moore County, North Carolina

Prepared for:
NCDENR-Wetlands Restoration Program
Raleigh, North Carolina

May 2002

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1.0 Introduction

Suck Creek is situated approximately eight miles west of Carthage and eleven miles northwest of Pinehurst, NC. The project area, which is located to the west of U.S. Highway 15-501, is in active/open pasture on the Richardson Farm in Moore County, NC. The project site/easement is located on one property (owned by Robert Richardson). Suck Creek was identified as a potential stream restoration/mitigation opportunity by the North Carolina Department of Environment and Natural Resources (NCDENR) - Wetland Restoration Program (WRP) based on an evaluation by WRP staff and on work done by North Carolina State University (NCSU).

Kimley-Horn and Associates, Inc. (KHA) was retained to provide feasibility/planning, design, construction observation, and post-construction documentation services for a corridor of Suck Creek. This document summarizes the background investigation, fatal flaw analysis, fieldwork, property owner input, and methodologies that went into preparing the design. A feasibility report for this site has not been done.

2.0 Existing Conditions

2.1 Watershed

The project encompasses approximately 2,830 feet of perennial stream in open pasture on the Richardson Farm in Moore County, NC. Several small impoundments upstream of the project area serve as the headwaters of Suck Creek. Downstream of these impoundments are two +/-50-acre in-line lakes. There are designated Boy Scout camping grounds adjacent to the two large lakes.

Suck Creek is a tributary of McLendon's Creek. The headwaters of Suck Creek originate approximately 2.2 miles upstream of the dam. The tributary then flows 1,900 feet to the southeast until it connects with a drainage way within the Richardson Farm. Suck Creek then turns northeast, discharging into McLendon's Creek approximately 3,000 feet northeast of the farm. Elevations within the drainage basin range from 333 feet to 689 feet.

Based on the USGS Zion Grove, NC Quadrangle 1981 map, the contributing drainage area for this section of the stream (to the downstream terminus of the project reach) is approximately 3,072 acres (4.8 square miles), as shown in Figure 1. Based on KHA's field observation, the watershed currently consists of agriculture/farmland and forest with no significant residential, commercial, or industrial development.

In March 2002, Environmental Data Resources, Inc. conducted an environmental database search to identify potential or actual environmental concerns listed in the federal, state, or local regulatory agency databases. The database search did not reveal any reported environmental hazards on the subject property (Appendix F). No field studies were performed as part of KHA's assessment.

A database search of cultural and natural resources was performed by KHA through the NC State Historical Preservation Office, Archeology Office, and the Natural Heritage Program. According to the database review, work performed on the sites described in the attached Preliminary Restoration Plan section (Section 5.0) will not affect threatened and endangered species, critical habitats, listed historical sites, or known archeological sites. No field studies were performed as part of KHA's assessment.

2.2 Site Description

A. Overview

KHA evaluated a section of Suck Creek that begins at the upstream fence/property line and flows downstream to the downstream fence/property line, as identified for restoration by WRP (Figure 3). The project is located in open pasture on the Richardson Farm; the farm consists of cattle and chicken operations. The length of the stream segment located within the project corridor (from upstream property line to the downstream fence/property line) is approximately 2,830 feet (Figure 2). The average valley slope for the stream reach studied is 0.4 percent. The average stream gradient in the project area is 0.3 percent.

Figures 1 and 2 show the location of the stream in relation to roads and existing structures/utilities within the study area.

B. Farm Facilities, Structures, and Utilities

Structures and utilities within the project corridor are shown on the attached Preliminary Restoration Plan. A four-foot high electric fence parallels the existing stream corridor down to the downstream property line. There is a culvert (21-inch HDPE pipe) along a drainage ditch, approximately 350 feet downstream of the existing upstream ford. A two-inch PVC water line is located approximately 500 feet downstream of the existing upstream ford crossing.

C. Vegetation

The first 800 feet of the stream corridor (beginning at the upstream property line/begin project) consist of a discontinuous buffer of woody vegetation and a single row of small-to-medium diameter trees along the stream banks (Photo 1a and 1b). The stream corridor that runs from the existing upstream ford crossing downstream 1,125 feet through open pasture consists of pasture/grass with little to no woody vegetation (Photo 2). A canopy of woody vegetation and a single row of small-to-medium diameter trees (Photo 3) line the stream corridor along the last 905 feet of stream. Refer to Preliminary Restoration Plan for the location of significant woody vegetation (>12 inches) within the project area.

D. Soils

Based on the North Carolina Soil Survey (Moore County, 1995), the soils at the site are mapped as Ch, Chewacla silt loam (Figure 3) which has 0 to 2 percent slopes (frequently flooded). The Chewacla series consists of nearly level, somewhat poorly drained soils, on flood plains along major streams

2.3 Channel Description

A. Horizontal and Vertical Stability

Large portions of the stream appear to have been straightened and relocated to one side of the valley, most likely to maximize the amount of pasture. The channel has become incised to entrenched, exhibiting a bank height ratio (low bank-height to max bankfull-depth) ranging from 1.1 to 2.3 (1.8 mean). A channel that is not incised will exhibit a bank height ratio of 1.0. The stream is exhibiting entrenchment ratios of between 1.3 and 1.4 (i.e., slightly entrenched). It appears that the combination of cattle accessing the stream and channel straightening has caused the channel to become incised-to-entrenched and thus unstable (Photo 4).

The channel is trending towards width/depth ratios of between 9 and 16, which suggests that the channel incision is causing the stream type to migrate between an unstable G → F stream type. Rapid bank erosion (particularly downstream) is allowing the channel to transition to an F (wider) unstable stream type. Based on a qualitative assessment and a quantitative geomorphic field survey, the reach is classified as an unstable 'G4' and 'F4' stream type with unstable bank heights. This classification is based on the Rosgen Morphologic Stream Classification (Rosgen 1996). A complete morphology table is provided in the Preliminary Restoration Plan.

The instability created from an unstable form (dimension, pattern, and profile) along with the hoof shear from unlimited cattle access has led to accelerated bank erosion. The stream will continue to evolve towards further instability unless it is returned to a stable dimension, pattern, and profile with bank vegetation/buffer for stability and cattle are excluded.

B. Channel Materials

The stream substrate is composed predominately of fine to medium gravel. Small amounts of bedrock or rock outcroppings were observed throughout the stream reach. However, there is abundant bedrock upstream of the project area just upstream of the fence line/property line. Modified Wolman Pebble Counts were performed to classify the substrate in the stream channel (see Appendix A for plots of the particle size distribution). The table below summarizes the channel materials based on the pebble counts:

TABLE 1

Channel Material

	Particle Size - Millimeters
Percent sand and <	39
Percent Gravel	60
Percent Cobble	0
Percent Boulder	0
Percent Bedrock	1
D16 (mm)	0.091
D35 (mm)	0.24
D50 (mm)	7.7
D84 (mm)	18
D95 (mm)	24

C. Vegetation as Bank Protection

Along the first 800 feet (beginning at the upstream property line/begin project) and within the last 905 feet of stream, the banks are lined with a single row of small-to-medium diameter trees that are falling/slumping into the stream (Photos 1 and 3). The stream corridor that runs downstream 1,125 feet from the existing upstream ford crossing through open pasture consists of pasture/grass with little to no woody vegetation on the banks (Photos 2 and 8). The root mass from grass and other herbaceous vegetation is shallow and discontinuous, providing little to no protection against bank erosion. The last 905 feet of stream consist of a discontinuous buffer of woody vegetation and a single row of trees along the stream bank. Many of those trees are in poor health and are beginning to fall due to erosion around the root mass.

D. Water Quality

NCDENR - Division of Water Quality (DWQ) has designated this stream as a Classification C, Nutrient Sensitive Waters (NSW) stream. This classification applies to freshwaters that are protected for secondary recreation, fishing, propagation and survival of aquatic life, and wildlife. The supplemental NSW classification applies to streams that are subject to growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs.

Based on visual observations, the stream appears to have relatively good clarity. No odors or sheens were observed in the stream. However, cattle have unlimited access to the stream and the lack of a buffer produces thermal pollution. No water quality sampling was performed as a part of KHA's assessment.

E. Habitat

Minimal habitat was observed along the stream reach. This lack of aquatic and terrestrial habitat is due primarily to the absence of canopy cover and buffer along the stream. Aquatic habitat is also absent due to the lack of stream features (pools, riffles, runs, and glides).

F. Flood Hazard

Based on the FEMA map, FIRM panel 37125C0075C, Quad 35079-C5, the project corridor is in Zone A, "Areas of 100-year flood; base flood elevations and flood hazard factors not determined."

3.0 Goals and Objectives

3.1 Definition of Restoration

For the purposes of this project, stream restoration is defined as "the process of converting an unstable, altered or degraded stream corridor, including adjacent riparian zone and flood-prone areas to its natural or referenced, stable conditions considering recent and future watershed conditions. This process also includes restoring the geomorphic dimension, pattern and profile as well as biological and chemical integrity, including transport of water and sediment produced by the stream's watershed in order to achieve dynamic equilibrium."("Internal Technical Guide for Stream Work in North Carolina" April 2001 v.3.0).

3.2 Objectives

The objective of this project is to design adjustments to the stream reach that will increase its long-term stability and create a more functional riparian ecological community. The design will adjust the stream's geomorphic dimensions, patterns, and profiles. The proposed changes will reflect the reference reaches' stable conditions and their current geomorphic conditions. Additionally, vegetated buffers that match proximal natural ecological communities found in similar physiographic and climatic regions will be planted. The reach will be designed to maximize natural design and natural parameters, and to account for physical constraints within the project area.

A Priority I Restoration approach will be used to reestablish the restored channel on its previous floodplain (Rosgen 1997). This method of re-establishing a floodplain and stable channel will reduce bank height and stream bank erosion, reduce land loss, raise the water table, decrease sediment, improve aquatic and terrestrial habitats, improve land productivity, and improve the aesthetics of the stream and site.

4.0 Methodology/Design Considerations

The design methodology for Suck Creek follows guidelines set forth in NCDENR's "Internal Technical Guide for Stream Work in North Carolina" (April 2001 v.3.0). A summary of the analysis and coordination performed includes:

- Reference reach geomorphic survey (Rosgen Level III)
- Assessment of natural communities (both existing and reference)
- Assessment of the watershed's condition and potential
- Rosgen Level III classification of the stream
- Geomorphic field measurements
- Identification of constraints and opportunities
- Detailed topographic and geomorphic survey of the project corridor

A preliminary plan was developed using the above analysis (see the attached Preliminary Restoration Plan).

4.1 Reference Reaches

Two reference reaches were identified and chosen to serve as a blueprint for design. The first reference is Richland Creek; a tributary of McLendon's Creek that is located northeast of the project area in Moore County, NC, as shown in Figure 4. This information was gathered and compiled by Dan Clinton and his staff during Mr. Clinton's research at NCSU. Based on the Rosgen classification system, this section of Richland Creek is classified as a 'C4' stream type. The information gained from the reference was used to design the proposed stream's Priority I Restoration pattern and profile.

A second reference reach was chosen to provide/confirm the dimensionless ratios for designing the proposed stream's dimension. The reference incorporates two stable sections of Suck Creek (located upstream of the project area) that run approximately 1,900 feet downstream of the dam. The first section is immediately upstream of the upstream fence/property line (Photo 5); the second is a stable section that is located immediately downstream of Beulah Hill Church Road (Photos 6 and 7). The two sections are shown in Figure 4. Based on the Rosgen classification system, these sections of Suck Creek are classified as a 'B4' stream type. The information gained

from the Suck Creek upstream reference reaches was used to design the proposed stream's dimension.

The complete morphologic measurements of both reference reaches are provided in the Preliminary Restoration Plan. This morphologic measurement table is per Appendix B of the "Internal Technical Guide for Stream Work in North Carolina" (April 2001 v.3.0).

4.2. Regional Curves and Regime Equations

The North Carolina Piedmont Regional Curves were used to check the primary stream's bankfull characteristics (width, depth, cross-sectional area, and discharge). However, the regional curves may not be valid for this site since the Suck Creek project area is downstream of several large lakes (greater than 50 acres). The upstream reference reach and stable bankfull indicators (width, depth, and cross-sectional area) found on-site were used as the basis for design: the Piedmont Regional Curves were not used for design. The Piedmont Regional Curves are provided in Appendix B for reference.

4.3 Natural Communities

Field reconnaissance identified the existing natural communities and species, both adjacent to the stream and at the reference reach. There are small sections of patchy brush and weedy vegetation along most of the stream reach. Vegetation along the middle 1,125 feet of the project, beginning at the existing upstream ford crossing, is generally open pasture with little to no vegetation (Photos 2 and 4). There is more buffer — consisting of a single row of woody vegetation and small-to-medium diameter trees (Photos 1 and 3) — along the first 800 feet and the last 905 feet of the project corridor. Species that are appropriate for the physiographic area will be selected to maximize buffer potential and stream bank stability.

4.4 Watershed Assessment

The watershed's conditions, as described in Section 2.1 of this report, were assessed by field reconnaissance and aerial photography. For the purpose of this design, it was assumed that there would be no major future commercial/industrial development, significant clear cutting timber

operations, or major modifications to the large lakes and/or outlet structures upstream in the watershed.

4.5 Survey (Topographic and Geomorphic)

A detailed survey of the site showed minimal physical limitations to restoration design. The only notable obstacle was the two-inch PVC water line. Also, cattle access and crossings will need to be considered. Cattle access and stream crossings will be coordinated with the property owner and the Natural Resource Conservation Service (NRCS). A detailed description of the corridor's existing conditions is included in Sections 2.2 and 2.3 of this report. The morphology of Suck Creek in the project area is provided in the Morphology Measurement Table in the attached Preliminary Restoration Plan.

5. 0 Preliminary Restoration Plan

The preliminary restoration plan for Suck Creek involves restoring the altered stream corridor, including adjacent riparian zones, to its referenced, stable condition. The design is intended to account for the property owner's needs as well as physical constraints (utilities/roads) within the project area. Restoration will modify the stream's dimension, pattern, and profile to stable conditions. A Priority I Restoration approach (Rosgen 1997) will be used to convert the existing G/F4 stream to a stable C4 stream type at its previous elevation with floodplain. The channel will be re-established on its previous floodplain using relic channel or construction of a new bankfull channel. The existing incised channel will be filled or turned into discontinuous oxbow lakes. In addition, in-stream structures will be used to protect stream banks, provide habitat, control grade, and protect facilities and riparian buffers. A vegetated buffer (excluded from cattle) will be included in the restoration plan.

It is anticipated that in-stream structures such as rock cross vanes, root wads, rock vanes, and log vanes will be incorporated into the mitigation project. For additional details on the in-stream structures and approximate locations of known structures, refer to the attached Preliminary Restoration Plan. Some in-stream structures may need to be eliminated from or added to the restoration plan during final design and/or construction.

All restoration activities will take place within a conservation easement donated to WRP by Mr. Richardson (the property owner).

5.1 Vegetation/Buffer Plantings

Prior to the establishing a riparian buffer, the area will be sprayed with an aerial systemic herbicide approved for wetland use. The application of herbicide will occur during the growing season.

The riparian buffer will consist of three zones from the bankfull area to approximately 50 feet out on either side. Zone 1 (0 to 20 feet from the top of bank) is the stream bank zone consisting of tree and shrub species and native herbaceous seeding typically found along stream banks in the region. Zone 2 is a forested riparian area consisting of selected tree and shrub species, with varying tolerances of inundation and saturation, to be selectively planted based on microtopography and moisture regime. Zone 3 is a grass filter strip designed to promote dispersed flow into the forested riparian zone (Zone 2).

Zones 1 and 2 will be planted with transplants, livestakes and bare root seedlings depending on available stock, design plans, climate, and cost. Planting spacing will be determined according to planting type, and will be included in final design plans. It is anticipated that Zone 3 will be seeded using a mix of native species. The entire easement will be planted. The riparian buffer is shown in plan view. A preliminary species list is included in the attached Preliminary Restoration Plan.

5.2 Dimension, Pattern, and Profile

The stream is a straightened, linear 'G4/F4' channel. It will be modified through Priority I Restoration (Rosgen 1997) to a stream type 'C4,' a stable/referenced condition that is appropriate to the valley type and channel slope.

To match the proposed plan features and reference condition, the stream's profile will be modified with grade control structures. The profile will create the appropriate local grade

changes that are necessary to create the features (riffles, runs, pools, and glides) associated with "C4" stream types.

The stream's new dimension will provide the appropriate cross-sectional area to transport sediment and the bankfull discharge. The new channel will be established on the previous floodplain using relic channel and a newly constructed bankfull channel. The existing incised channel will be partially filled to create discontinuous oxbow lakes.

The stream's pattern will be modified, where possible, to add stream length and to provide appropriate (reference) geometry. This geometry includes meander length, radius of curvature, belt width, and amplitude.

The proposed Priority I stream restoration plan (Rosgen 1997) is shown in the attached Preliminary Restoration Plan.

5.3 Fencing Plan

Exclusionary fencing will be installed along the length of the easement. Three stream crossings will be maintained so cattle can move from one side of the easement to the other in a controlled manner. The location of these crossings will be coordinated with the property owner and NRCS. NRCS's guidelines for exclusionary fencing and cattle crossings will be followed.

6.0 Monitoring and Success Criteria

The restoration design will be monitored for success through photographs, a channel stability assessment, and an evaluation of plant survival.

6.1 Reference Photographs

Monitoring: Photographs will be taken throughout the monitoring period to evaluate vegetative growth and the stability of instream structures along the restored stream's corridor. The location of the photograph points will be established and marked with stakes and a map with notations of the photo reference points will be generated. This aspect of monitoring will last for five years.

Photo-monitoring will include lateral (taken looking at the channel bars) as well as longitudinal photographs (taken looking upstream and downstream).

Success Criteria: The photographs will be used to subjectively evaluate the aggradation/degradation of the channel, bank erosion, structure stability, the growth of riparian vegetation, and the effectiveness of erosion control measures. The longitudinal photos should indicate the absence of mid-channel bars or an excessive increase in channel depth. The lateral photos should not indicate excessive erosion or continuing degradation of the bank over time. The successional maturation of riparian vegetation should be observed in a series of photos taken over time.

6.2 Channel Stability

Monitoring: For each Rosgen classified stream type, permanent cross-sections will be established and monitored along the restored stream's corridor. Cross-sections will be placed to monitor structures and/or features that may have an increased risk of failure. The location of each cross-section will be marked to establish the exact transect location. A common benchmark will be used for cross-sections. This benchmark will be used consistently to facilitate the easy comparison of year-to-year data. Data will be collected once a year for five years.

Success Criteria: Judgements of success or failure of restoration activities using this data will be subjective. If there are no or minimal changes to the cross-sections of the "as-built" during the monitored years, the restoration will be considered successful. Any minimal changes to the cross-sections during the monitoring period will be evaluated to determine whether they represent a movement toward a more unstable condition (down-cutting, deposition, erosion) or whether they are minor changes that represent an increase in stability (settling, vegetative changes, decrease in width/depth ratio). Unstable conditions that require remediation will indicate failure of restoration activities.

6.3 Plant Survival

To establish vegetation in restoration areas, riparian and upland mixes, seeds, bare root, and live stake vegetation will be planted, as shown on the Preliminary Restoration Plan or as required in the contract's Special Provisions and Technical Specifications.

Monitoring: The survival of vegetation will be evaluated using survival plots or direct counts. The survival of plantings will be evaluated along the stream corridor of the restoration site. Plantings will be monitored for five years before success or failure is determined.

Success Criteria: For the plantings to be considered successful, a 70 percent survival rate of bare root seedlings and a 50 percent survival rate of livestakes, based on sample plots, will be required.

7.0 Maintenance

The contractor will guarantee all vegetation for one year from the time of planting, per the contract's Special Provisions and Technical Specifications. After one year, WRP will remove dead or injured plants and replace them accordingly to achieve restoration goals.

Invasive exotic plant species should be identified and treated for a minimum of five years. For woody invasive plants, the stem should be cut off at ground level and a 25 percent solution of appropriate herbicide (Rodeo for riparian areas) applied directly to the cut stump. Early fall is the best time to apply this treatment. For herbaceous weeds, use a herbicide and follow the manufacturer's suggested application rates.

8.0 References

Rosgen, David L. 1997. "A Geomorphologic Approach To Restoration Of Incised Rivers", Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision.

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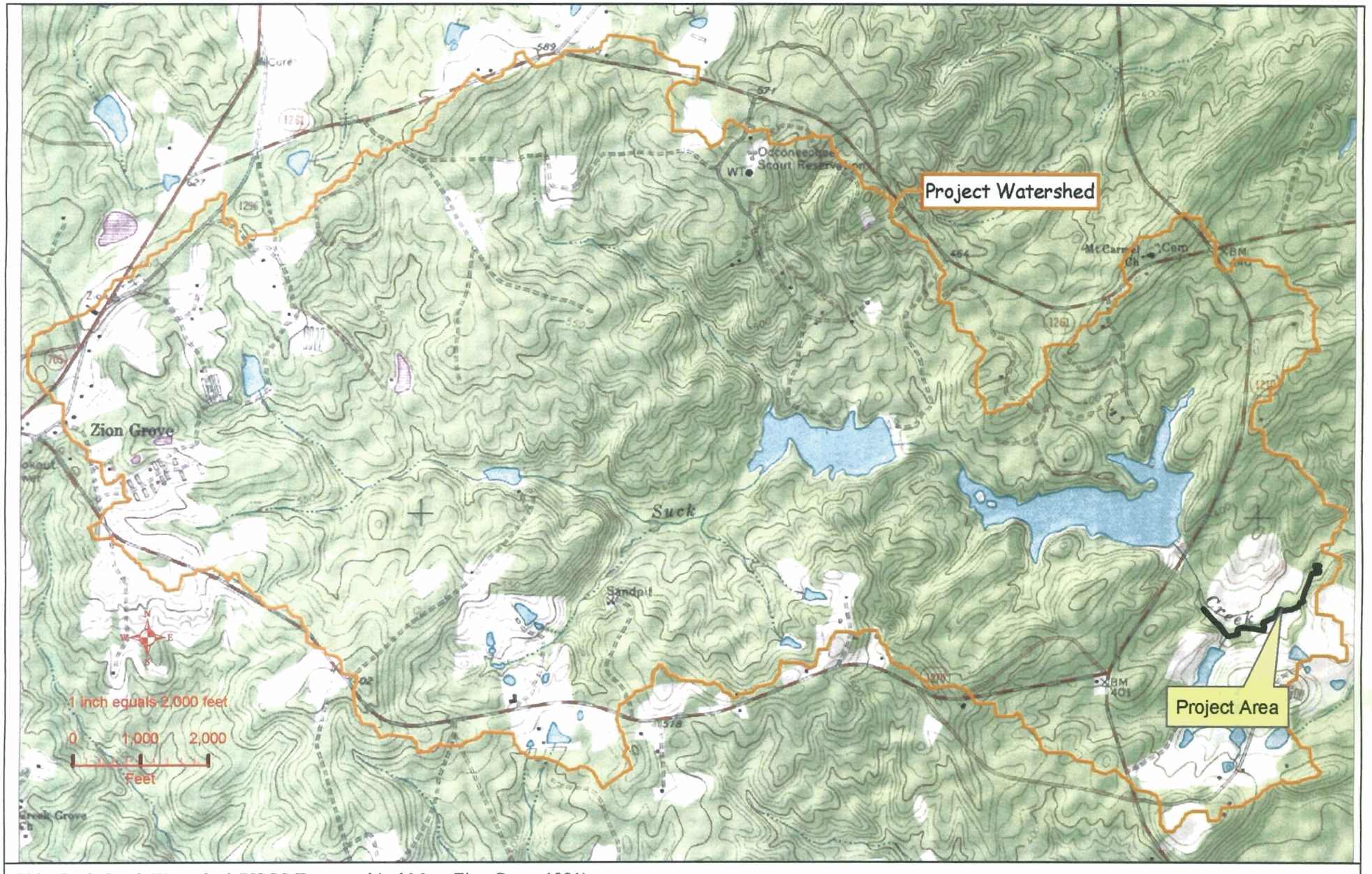
North Carolina Stream Restoration Institute, "Rural-Piedmont Regional Curves". www5.bae.ncsu.edu/programs/extension/wqg/sri/urbanpiedmont.html.

Hall, Karen. 2001. North Carolina Stream Restoration Institute NCSU, "Recommended Native Plant Species for Stream Restoration in North Carolina".

Figures

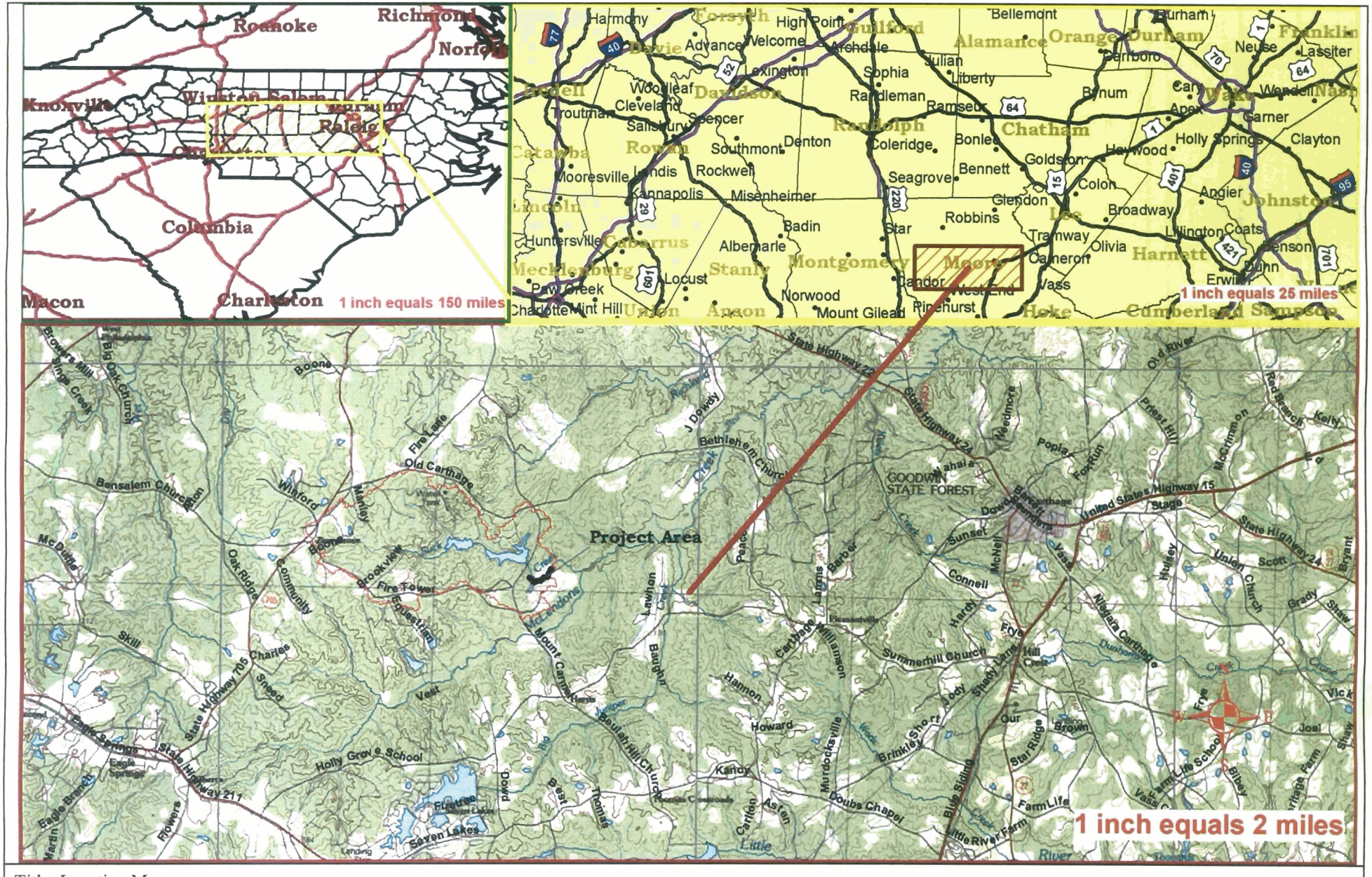


Title: Suck Creek Watershed (USGS Topographical Map: Zion Grove 1981)

Kimley-Horn and Associates, Inc.

Project: Suck Creek Restoration
Moore County, North Carolina

Date:	Scale:	Project No.	Figure:
4/01/2002	1" = 2,000'	011795008	1



Title: Location Map

Kimley-Horn and Associates, Inc.

Project: Suck Creek Stream Restoration
Moore County, North Carolina

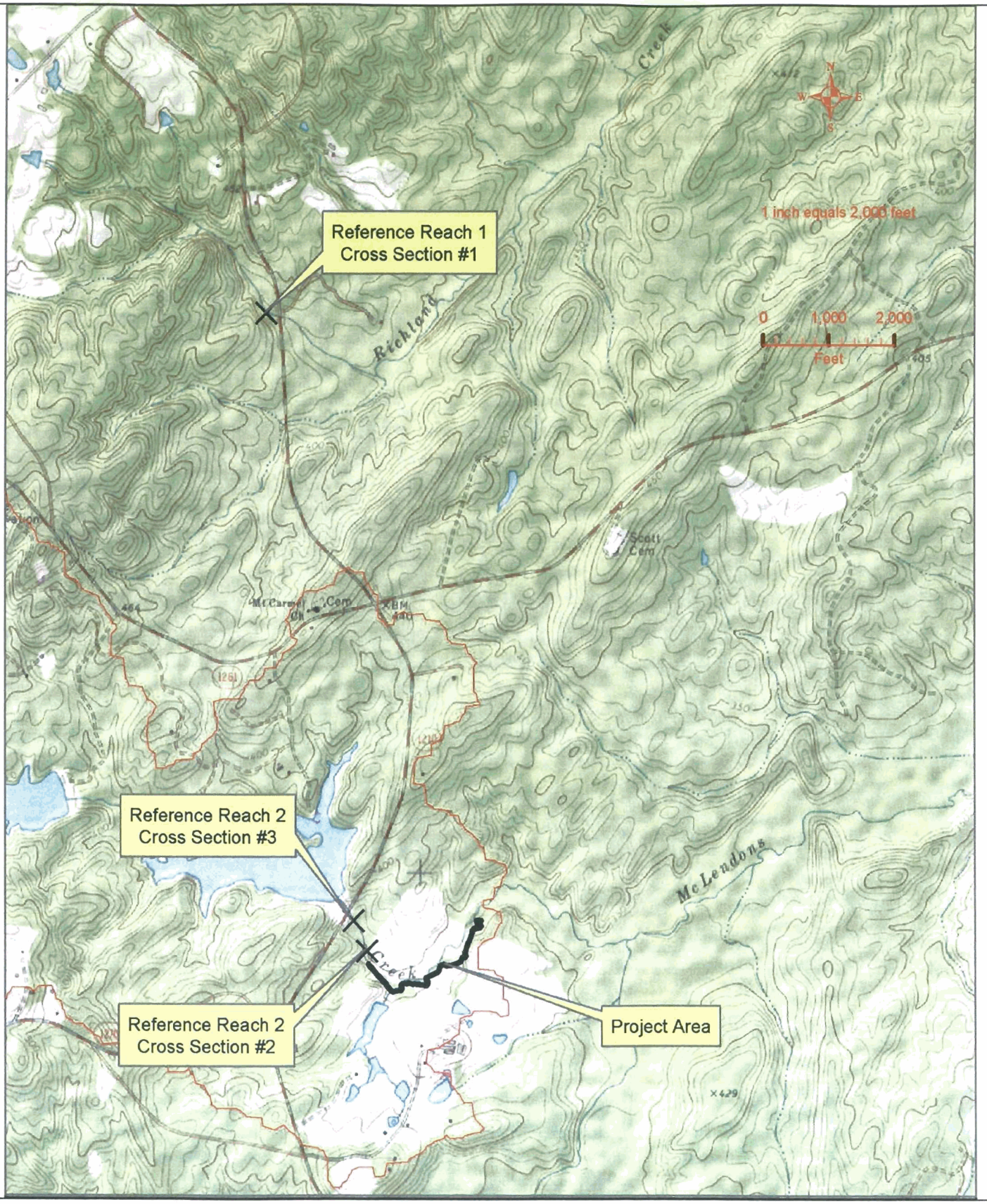
Date:	Scale:	Project No.	Figure:
4/01/2002	1 inch = 2 miles	011795008	2

Title: Suck Creek Soils (NRCS)

Kimley-Horn and Associates, Inc.

Project: Suck Creek Restoration
Moore County, North Carolina

Date:	Scale:	Project No.	Figure:
4/01/2002	1" = 2,000'	011795008	3



Title: Reference Reach Locations

Kimley-Horn and Associates, Inc.

Project: Suck Creek Stream Restoration
Moore County, North Carolina

Date:	Scale:	Project No.	Figure:
4/01/2002	1" = 2,000'	011795008	4

Appendix A
On-Site Geomorphic Assessment

Reference Reach — Hints

Stream:	Suck Creek
Watershed:	---
Location:	Upper Section
Latitude:	---
Longitude:	---
County:	---
Date:	---
Observers:	---
Channel Type:	---
Drainage Area (sq mi):	---

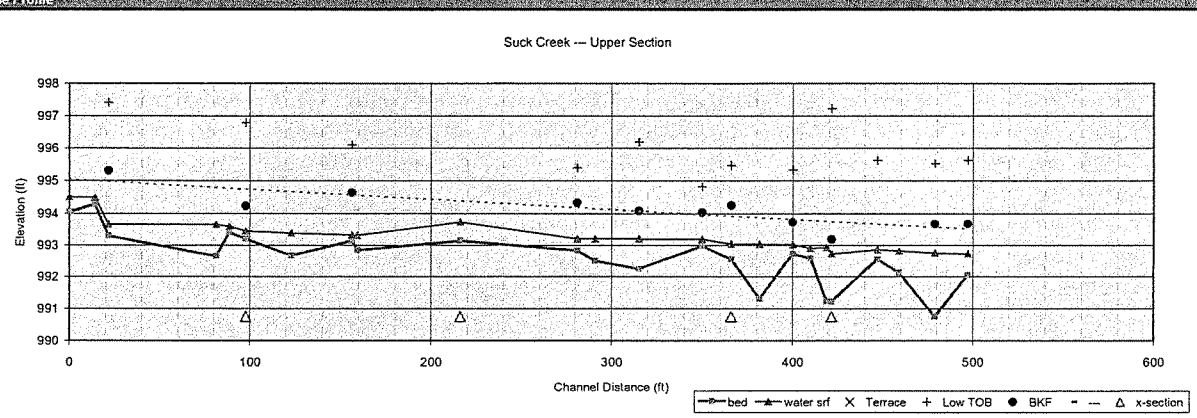
Pattern

	typical	min	max
bankfull width (ft)	13		
meander length (ft)	0		
belt width (ft)	0		
amplitude (ft)	0		
radius (ft)	0		
arc angle (degrees)	0		
straight length (ft)	0		
stream length	500		
valley length	500		
Sinuosity	1.00		
Meander Width Ratio	---	---	---
Amplitude Ratio	---	---	---
Meander Length Ratio	---	---	---
Straight Length Ratio	---	---	---
Radius Ratio	---	---	---

Profile

	typical	min	max
bankfull width (ft)	13		
pool-pool spacing (ft)	48.7	37	60.4
riffle length (ft)	10	3	16
pool length (ft)	50	7.2	121.5
run length (ft)	0	0	0
glide length (ft)	0	0	0
channel slope (%)	0.4		
riffle slope (%)	0.7	0	1.6
pool slope (%)	0.3	0.01	1
run slope (%)			
glide slope (%)			
measured valley slope (%)			
valley slope (%)	0.4		
Riffle Length Ratio	0.8	0.2	1.2
Pool Length Ratio	3.8	0.6	9.3
Run Length Ratio	---	---	---
Glide Length Ratio	---	---	---
Riffle Slope Ratio	1.8	---	4.0
Pool Slope Ratio	0.8	0.0	2.5
Run Slope Ratio	---	---	---
Glide Slope Ratio	---	---	---
Pool Spacing Ratio	3.7	2.8	4.6

Slope Profile



1000 :Elevation BM

notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS Terrace	FS Low TOB	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV Terrace	ELEV Low TOB	ELEV ---
				3.52	1003.52														
Begin Ford		0			1003.52		9.48	0.46						994.04	994.5				
Begin Riffle		14			1003.52		9.25	0.22						994.27	994.49				
End Riffle		21.7			1003.52		10.24	0.38	8.22		8.11			993.28	993.66	995.3		997.41	
Mid Pool		81.5			1003.52		10.87	1						992.65	993.65				
Begin Riffle		88.7			1003.52		10.13	0.2						993.39	993.59				
End Riffle ss Secti		97.8			1003.52		10.33	0.25	9.3		8.74			993.19	993.44	994.22		996.78	
Mid Run		123			1003.52		10.85	0.7						992.67	993.37				
Begin Riffle		156.5			1003.52		10.39	0.18	8.89		7.42			993.13	993.31	994.63		996.1	
End Riffle		159.5			1003.52		10.68	0.46						992.84	993.3				
Cross Secti		216.2			1003.52		10.39	0.6						993.13	993.73				
Begin Riffle		281			1003.52		10.68	0.36	9.2		8.13			992.83	993.19	994.32		995.39	
End Riffle		291			1003.52		11.03	0.7						992.49	993.19				
					1003.52	4.31													
				5.61	1004.82										#N/A	#N/A	#N/A	#N/A	#N/A
Mid Run		315.2			1004.82		12.56	0.96	10.75		9.63			992.23	993.19	994.07		996.19	
Begin Riffle		350			1004.82		11.84	0.2	10.8		10			992.98	993.18	994.02		994.82	
End Riffle ss Secti		366			1004.82		12.28	0.5	10.58		9.36			992.54	993.04	994.24		995.46	
Pool		381.6			1004.82		13.52	1.73						991.3	993.03				
Begin Riffle		400			1004.82		12.1	0.3	11.1		9.5			992.72	993.02	993.72		995.32	
End Riffle		409.8			1004.82		12.25	0.33						992.57	992.9				
Pool		418.6			1004.82		13.59	1.7						991.23	992.93				
Cross Secti		421.5			1004.82		13.6	1.5	11.65		7.6			991.22	992.72	993.17		997.22	
Begin Riffle		447			1004.82		12.28	0.32			9.2			992.54	992.86			995.62	
End Riffle		459			1004.82		12.7	0.7						992.12	992.82				
Pool		479			1004.82		14.07	2	11.15		9.3			990.75	992.75	993.67		995.52	
Begin Riffle		497.3			1004.82		12.78	0.68	11.15		9.2			992.04	992.72	993.67		995.62	

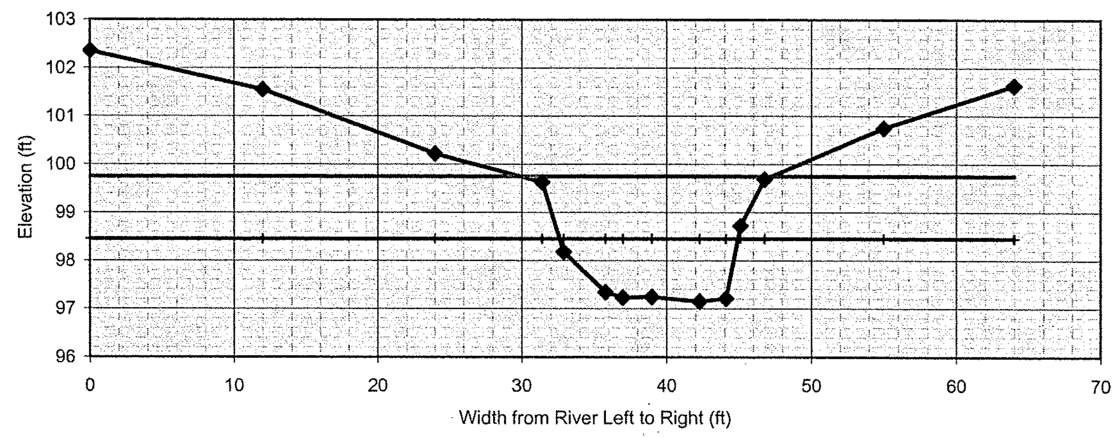
Reference Reach				Hints
Stream:	Suck Creek			
Watershed:	---			
Location:	Upper Section			
Latitude:	---			
Longitude:	---			
County:	---			
Date:	---			
Observers:	---			
Channel Type:	---			
Drainage Area (sq mi):	---			

Dimension		typical	min	max
Riffle:	x-area bankfull	13.5	12.8	13.8
	width bankfull	13.0	12.3	13.7
	hydraulic radius	1.0		
	max depth	1.4	1.3	1.5
	bank ht	3	2.5	3.5
	width flood prone area	18.5	18.0	19.0
	mean depth	1.04		
Pool:	x-area pool	10.05	8.7	11.4
	width pool	10	9.4	10.5
	hydraulic radius	0.9		
	max depth pool	1.6	1.3	1.9
	bank ht	4.7	3.3	6
Run:	x-area run			
	width run			
	hydraulic radius			
	max depth run			
	bank ht			
Glide:	x-area glide			
	width glide			
	max depth glide			

Dimensionless Ratios:	typical	min	max
Width/Depth Ratio	12.5		
Entrenchment Ratio	1.4		
Riffle Max Depth Ratio	1.3	1.3	1.4
Pool Area Ratio	0.7	0.6	0.8
Pool Width Ratio	0.8	0.7	0.8
Pool Max Depth Ratio	1.5	1.3	1.8
Bank Height Ratio	2.1		
Run Area Ratio	---	---	---
Run Width Ratio	---	---	---
Run Max Depth Ratio	---	---	---
Glide Area Ratio	---	---	---
Glide Width Ratio	---	---	---
Glide Max Depth Ratio	---	---	---

Hydraulics:	riffle	pool	run
channel slope (%)	0.400		
discharge rate, Q (cfs)			
velocity (ft/sec)	0.0	0.0	---
shear stress @ max depth (lbs/ft sq)	0.349	0.399	---
shear stress (lbs/ft sq)	0.250	0.225	---
shear velocity (ft/sec)	0.359	0.340	---
stream power (lbs/sec)	---	---	---
unit stream power (lbs/ft/sec)	---	---	---
relative roughness	16.9	16.3	---
friction factor u/u*	0.0	0.0	---
threshold grain size @ max depth (mm)	21	24	---
threshold grain size (mm)	14	13	---

Cross Section



section: **Cross Section 4**

Riffle
Suck Creek
---

ross Section 2

description: Located at station 356.5 along logitudinal profile

height of instrument (ft): 109.13

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# #	0	6.78	102.35
	# #	12	7.58	101.55
	# #	24	8.91	100.22
TOB-L	# #	31.4	9.5	99.63
Bkf-L	# #	32.9	10.95	98.18
Wedge-L	# #	35.8	11.79	97.34
	# #	37	11.9	97.23
	# #	39	11.89	97.24
Thalwag	# #	42.3	11.98	97.15
Wedge-R	# #	44.1	11.92	97.21
Bkf-R	# #	45.1	10.41	98.72
TOB-R	# #	46.8	9.44	99.69
	# #	55	8.38	100.75
	# #	64	7.5	101.63
	# #			
	# #			
	# #			
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FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
10.68	9.5	18.0	0.4	
98.45	99.63			

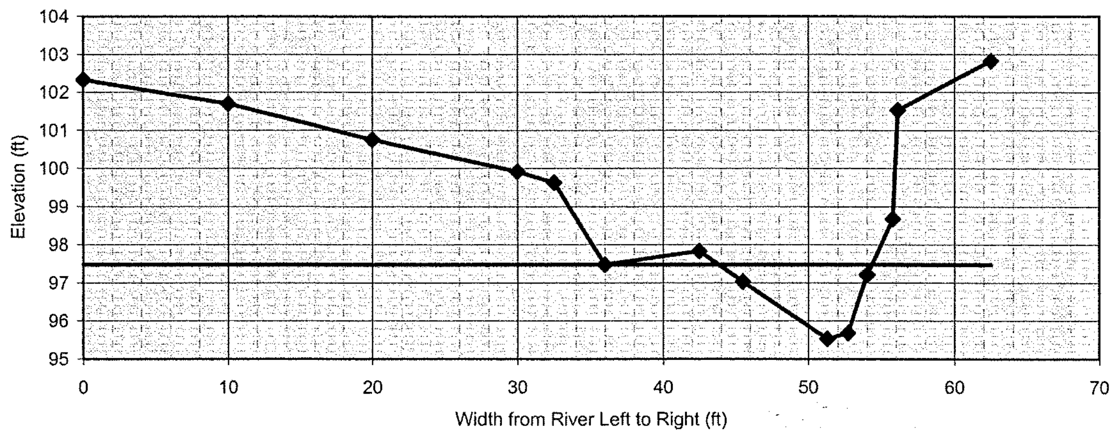
dimensions			
12.8	x-section area	1.0	d mean
12.3	width	13.2	wet P
1.3	d max	1.0	hyd radi
2.5	bank ht	11.8	w/d ratio
18.0	W flood prone area	1.5	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.24	shear stress ((lbs/ft sq)
0.35	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
13.6	threshold grain size (mm)

check from channel material			
19	measured D84 (mm)		
16.9	relative roughness	9.8	fric. factor
0.027	Manning's n from channel material		

Cross Section

Cross Section 5 Pool Suck Creek



section:	Cross Section 5
	Pool Suck Creek ---
description:	Located at station 421.5 on Longitudinal Profile
height of instrument (ft):	109.13

notes	omit pt.	distance (ft)	FS (ft)	elevation
	#☐#	0	6.8	102.33
	#☐#	10	7.43	101.7
	#☐#	20	8.38	100.75
	#☐#	30	9.21	99.92
TOB-L	#☐#	32.5	9.5	99.63
Bkf-L	#☐#	36	11.65	97.48
	#☐#	42.5	11.3	97.83
Wedge-L	#☐#	45.5	12.1	97.03
Thalwag	#☐#	51.3	13.6	95.53
	#☐#	52.7	13.45	95.68
Wedge-R	#☐#	54	11.92	97.21
	#☐#	55.75	10.45	98.68
TOB-R	#☐#	56.1	7.6	101.53
	#☐#	62.5	6.3	102.83
	#☐#			
	#☐#			
	#☐#			
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☐

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
11.65	7.6		0.4	
97.48	101.53			

dimensions			
11.4	x-section area	1.1	d mean
10.5	width	11.6	wet P
1.9	d max	1.0	hyd radi
6.0	bank ht	~~9.7~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.24	shear stress ((lbs/ft sq)
0.36	shear velocity (ft/sec)
~~0.000~~	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
13.7	threshold grain size (mm)

check from channel material			
~~49~~	measured D84 (mm)		
~~17.6~~	relative roughness	~~9.9~~	fric. factor
~~0.026~~	Manning's n from channel material		

Weighted Pebble Count

Percent Riffle:	50	Percent Run:	
Percent Pool:	50	Percent Glide:	

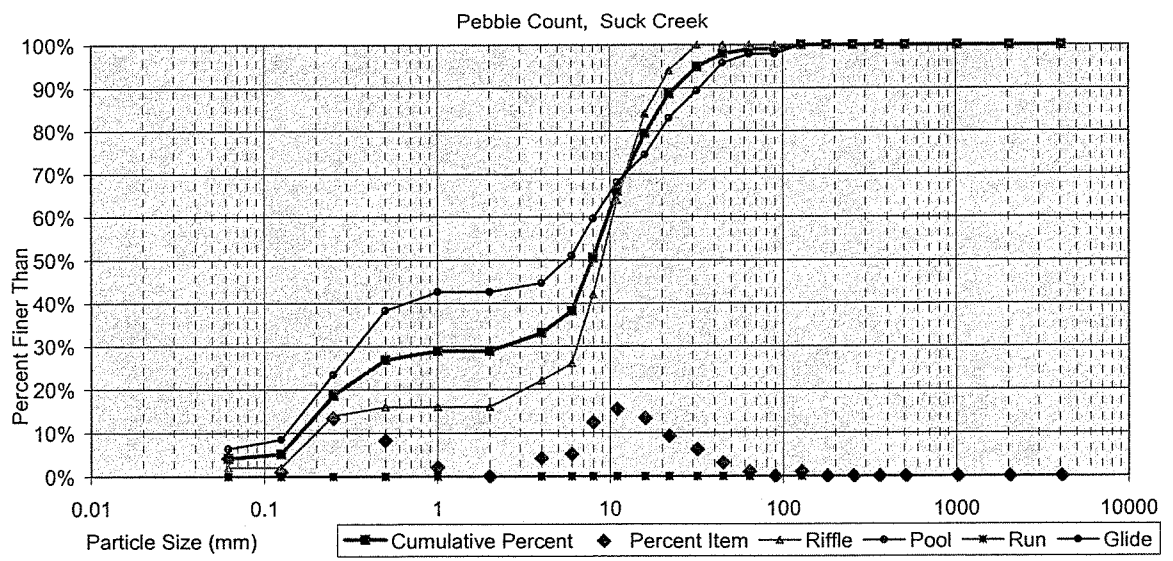
Pebble Count,

Suck Creek

Upper Section

Note:

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	4.0	# #
very fine sand	0.062	0.13	1.0	# #
fine sand	0.13	0.25	13.0	# #
medium sand	0.25	0.5	8.0	# #
coarse sand	0.5	1	2.0	# #
very coarse sand	1	2	0.0	# #
very fine gravel	2	4	4.0	# #
fine gravel	4	6	5.0	# #
fine gravel	6	8	12.0	# #
medium gravel	8	11	15.0	# #
medium gravel	11	16	13.0	# #
coarse gravel	16	22	9.0	# #
coarse gravel	22	32	6.0	# #
very coarse gravel	32	45	3.0	# #
very coarse gravel	45	64	1.0	# #
small cobble	64	90	0.0	# #
medium cobble	90	128	1.0	# #
large cobble	128	180	0.0	# #
very large cobble	180	256	0.0	# #
small boulder	256	362	0.0	# #
small boulder	362	512	0.0	# #
medium boulder	512	1024	0.0	# #
large boulder	1024	2048	0.0	# #
very large boulder	2048	4096	0.0	# #
bedrock			3.0	#
		Weighted Count:	100	
		True Total Particle Count:	100	



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.219	4.69	7.9	19	33

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
4%	24%	68%	1%	0%	3%

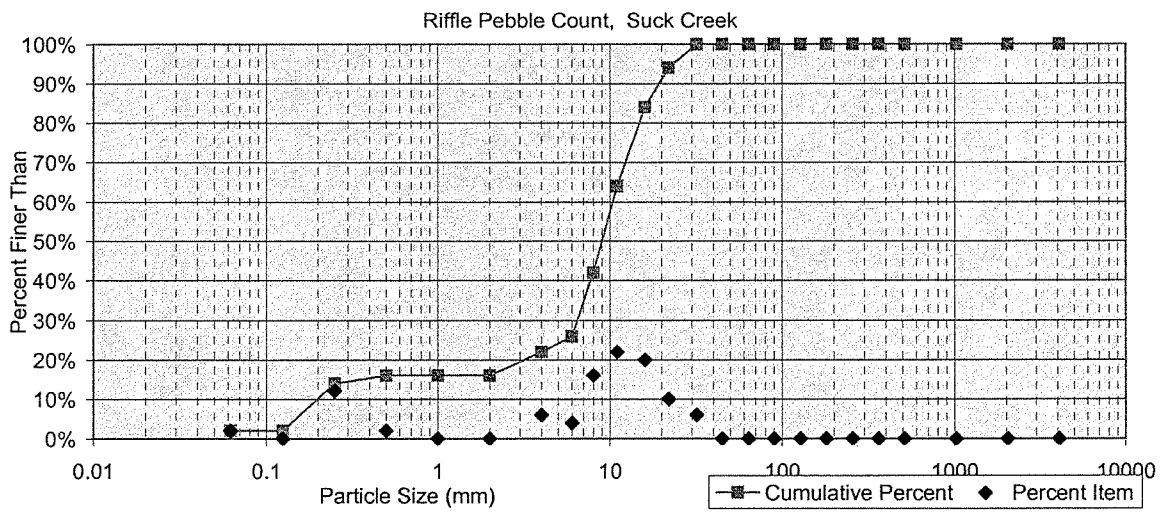
Riffle Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062	1	#
very fine sand	0.062	0.13		#
fine sand	0.13	0.25	6	#
medium sand	0.25	0.5	1	#
coarse sand	0.5	1		#
very coarse sand	1	2		#
very fine gravel	2	4	3	#
fine gravel	4	6	2	#
fine gravel	6	8	8	#
medium gravel	8	11	11	#
medium gravel	11	16	10	#
coarse gravel	16	22	5	#
coarse gravel	22	32	3	#
very coarse gravel	32	45		#
very coarse gravel	45	64		#
small cobble	64	90		#
medium cobble	90	128		#
large cobble	128	180		#
very large cobble	180	256		#
small boulder	256	362		#
small boulder	362	512		#
medium boulder	512	1024		#
large boulder	1024	2048		#
very large boulder	2048	4096		#
bedrock				#
Total Particle Count:			50	

Riffle Pebble Count

	Suck Creek

	Upper Section
Note:	Area 1



Size percent less than (mm)				
D16	D35	D50	D84	D95
2.000	7.05	9.0	16	23

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
2%	14%	84%	0%	0%	0%

Pool Pebble Count

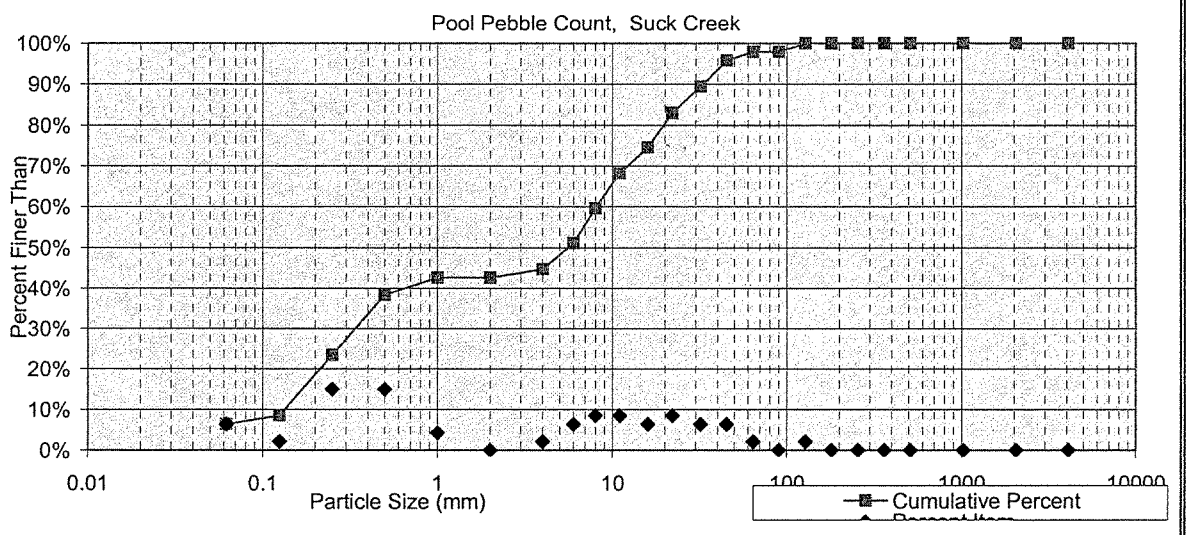
Material	Size Range (mm)		Count	
silt/clay	0	0.062	3	# #
very fine sand	0.062	0.13	1	# #
fine sand	0.13	0.25	7	# #
medium sand	0.25	0.5	7	# #
coarse sand	0.5	1	2	# #
very coarse sand	1	2		# #
very fine gravel	2	4	1	# #
fine gravel	4	6	3	# #
fine gravel	6	8	4	# #
medium gravel	8	11	4	# #
medium gravel	11	16	3	# #
coarse gravel	16	22	4	# #
coarse gravel	22	32	3	# #
very coarse gravel	32	45	3	# #
very coarse gravel	45	64	1	# #
small cobble	64	90		# #
medium cobble	90	128	1	# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock			3	#
Total Particle Count:			50	

Pool Pebble Count

Suck Creek

Upper Section

Note:



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.177	0.43	5.6	23	43	6%	34%	52%	2%	0%	6%

Pebble Count

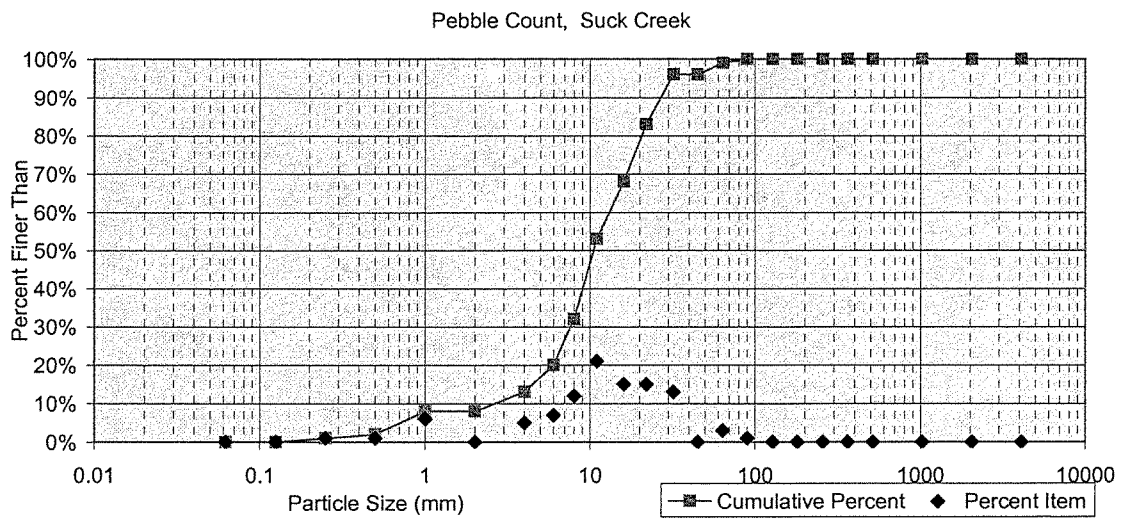
Material	Size Range (mm)		Count	
silt/clay	0	0.062		# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25	1	# #
medium sand	0.25	0.5	1	# #
coarse sand	0.5	1	6	# #
very coarse sand	1	2		# #
very fine gravel	2	4	5	# #
fine gravel	4	6	7	# #
fine gravel	6	8	12	# #
medium gravel	8	11	21	# #
medium gravel	11	16	15	# #
coarse gravel	16	22	15	# #
coarse gravel	22	32	13	# #
very coarse gravel	32	45		# #
very coarse gravel	45	64	3	# #
small cobble	64	90	1	# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
Total Particle Count:			100	

Pebble Count

Suck Creek

Upper Section

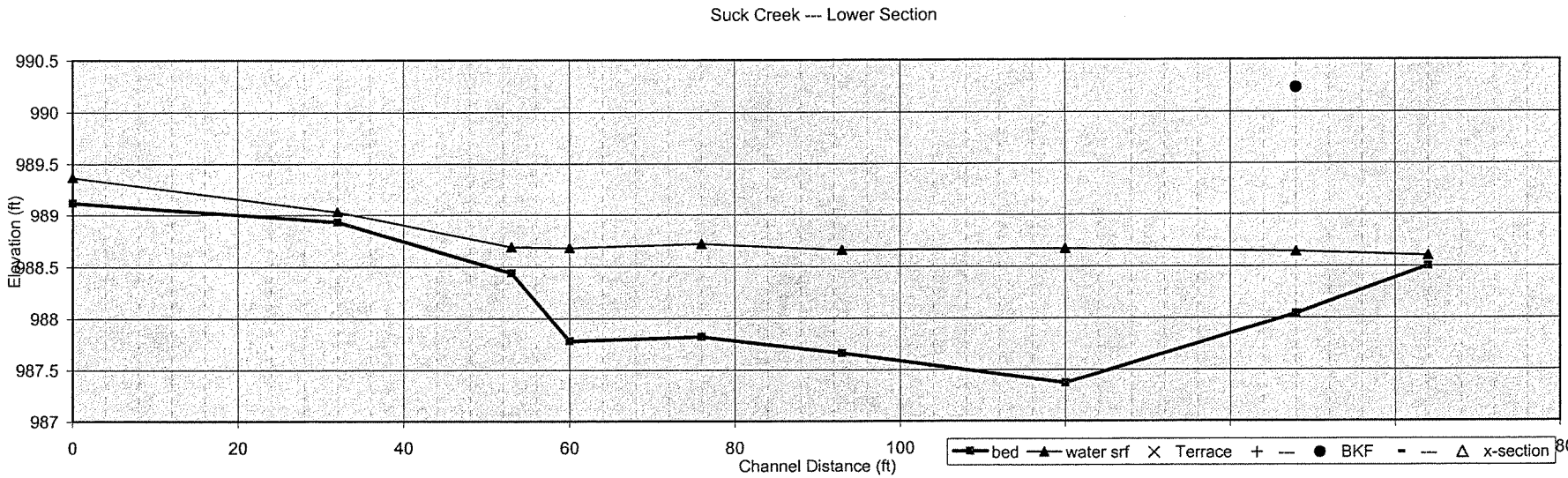
Note: **Entrainment**



Size percent less than (mm)				
D16	D35	D50	D84	D95
4.759	8.37	10.5	23	31

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	8%	91%	1%	0%	0%

Slope Profile



					1000	:Elevation BM													
notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS Terrace	FS	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV Terrace	ELEV ---	ELEV ---
				0	1000														
Begin Riffle		0			1000		10.88	0.25						989.12	989.37				
		32			1000		11.07	0.1						988.93	989.03				
Begin Run		53			1000		11.56	0.25						988.44	988.69				
Pool		60			1000		12.22	0.9						987.78	988.68				
		76			1000		12.18	0.9						987.82	988.72				
		93			1000		12.34	1						987.66	988.66				
		120			1000		12.63	1.3						987.37	988.67				
		148			1000		11.96	0.6	9.77					988.04	988.64	990.23			
		164			1000		11.5	0.1						988.5	988.6				
					1000														
					1000														

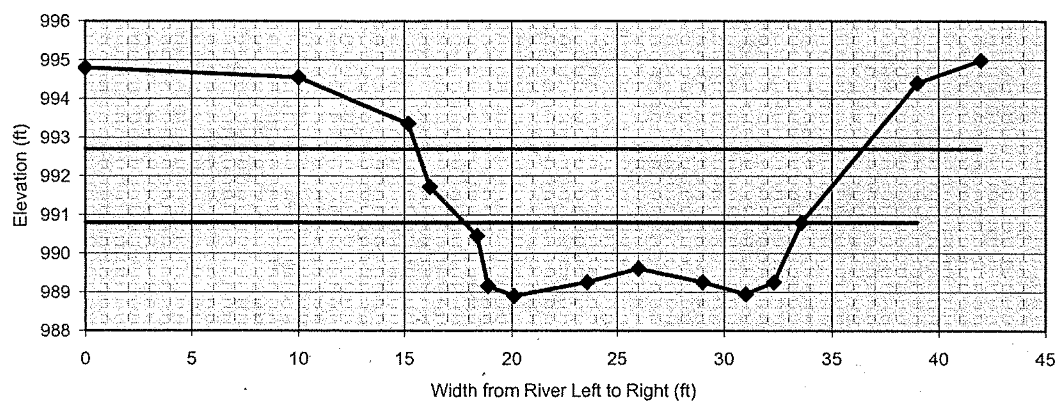
Reference Reach				Hints
Stream:	Suck Creek			
Watershed:	---			
Location:	Lower Section			
Latitude:	---			
Longitude:	---			
County:	---			
Date:	---			
Observers:	---			
Channel Type:	---			
Drainage Area (sq mi):	---			

Dimension		typical	min	max
Riffle:	x-area bankfull	22.8		
	width bankfull	15.8		
	hydraulic radius	1.3		
	max depth	1.9		
	bank ht	1.6		
	width flood prone area	21.0		
	mean depth	1.44		
Pool:	x-area pool	17.9		
	width pool	15.6		
	hydraulic radius	1.1		
	max depth pool	1.8		
	bank ht	2		
Run:	x-area run			
	width run			
	hydraulic radius			
	max depth run			
	bank ht			
Glide:	x-area glide			
	width glide			
	max depth glide			

Dimensionless Ratios:	typical	min	max
Width/Depth Ratio	10.9		
Entrenchment Ratio	1.3		
Riffle Max Depth Ratio	1.3	---	---
Pool Area Ratio	0.8	---	---
Pool Width Ratio	1.0	---	---
Pool Max Depth Ratio	1.2	---	---
Bank Height Ratio	0.8		
Run Area Ratio	---	---	---
Run Width Ratio	---	---	---
Run Max Depth Ratio	---	---	---
Glide Area Ratio	---	---	---
Glide Width Ratio	---	---	---
Glide Max Depth Ratio	---	---	---

Hydraulics:	riffle	pool	run
channel slope (%)	0.470		
discharge rate, Q (cfs)			
velocity (ft/sec)	0.0	0.0	---
shear stress @ max depth (lbs/ft sq)	0.557	0.528	---
shear stress (lbs/ft sq)	0.381	0.323	---
shear velocity (ft/sec)	0.444	0.408	---
stream power (lbs/sec)	---	---	---
unit stream power (lbs/ft/sec)	---	---	---
relative roughness	#REF!	#REF!	#REF!
friction factor u/u*	0.0	0.0	---
threshold grain size @ max depth (mm)	35	33	---
threshold grain size (mm)	23	19	---

Cross Section



section: **Cross Section 6**

Riffle
Suck Creek
---

description: Located near forested section downstream of sharp bend

height of instrument (ft): 1000.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	5.2	994.8
		10	5.45	994.55
TOB-L		15.2	6.65	993.35
		16.2	8.28	991.72
Bkf-L		18.4	9.55	990.45
Wedge-L		18.9	10.85	989.15
Thalwag		20.1	11.1	988.9
Wedge		23.6	10.75	989.25
Bar top		26	10.4	989.6
Wedge		29	10.75	989.25
		31	11.05	988.95
Wedge-R		32.3	10.75	989.25
Bkf-R		33.6	9.2	990.8
		39	5.6	994.4
	✓	42	5.02	994.98

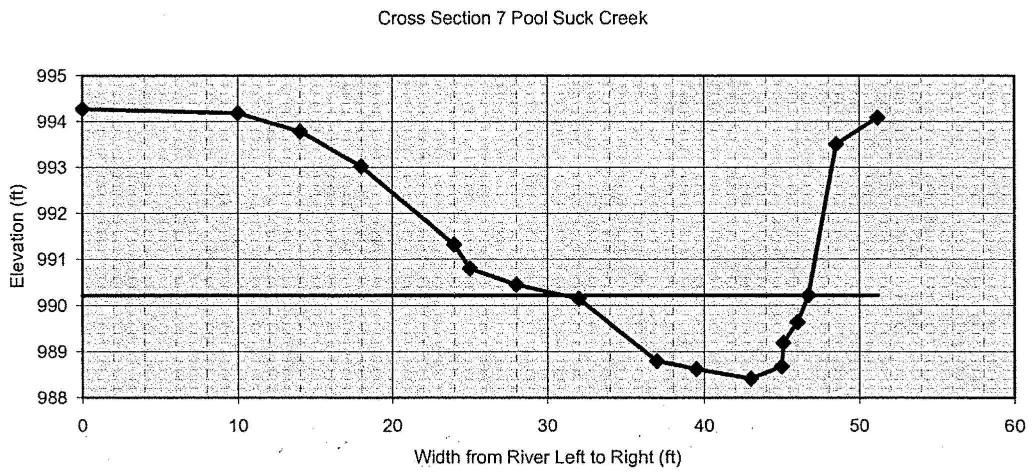
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.2	9.5	21.0		
990.8	990.5			

dimensions			
22.8	x-section area	1.4	d mean
15.8	width	17.7	wet P
1.9	d max	1.3	hyd radi
1.6	bank ht	11.0	w/d ratio
21.0	W flood prone area	1.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
0.0	threshold grain size (mm)

check from channel material			
#REF!	measured D84 (mm)		
#REF!	relative roughness	#REF!	fric. factor
#REF!	Manning's n from channel material		

Cross Section



section: Cross Section 7

Pool
Suck Creek
---

description: Located dowstream of Cross Section 6 before small forested area. Located at NCSU Bankpins

height of instrument (ft): 1000.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# ☐ #	0	5.73	994.27
	# ☐ #	10	5.82	994.18
	# ☐ #	14	6.22	993.78
	# ☐ #	18	6.98	993.02
	# ☐ #	24	8.68	991.32
	# ☐ #	25	9.2	990.8
Bkf-L	# ☐ #	28	9.55	990.45
	# ☐ #	32	9.85	990.15
	# ☐ #	37	11.2	988.8
Wedge-L	# ☐ #	39.5	11.38	988.62
Thalwag	# ☐ #	43	11.59	988.41
Wedge-R	# ☐ #	45	11.32	988.68
	# ☐ #	45.1	10.81	989.19
	# ☐ #	46	10.36	989.64
Bkf-R	# ☐ #	46.7	9.78	990.22
TOB-R	# ☐ #	48.5	6.5	993.5
Pin shot	# ☐ #	51.2	5.92	994.08
	# ☐ #			
	# ☐ #			
	# ☐ #			
	# ☐ #			
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	# ☐ #			

☐

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
9.78	9.55	~~27.0~~		
990.22	990.45			

dimensions			
17.9	x-section area	1.1	d mean
15.6	width	16.6	wet P
1.8	d max	1.1	hyd radi
2.0	bank ht	~~13.6~~	w/d ratio
~~27.0~~	W flood prone area	~~1.7~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
~~0.000~~	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
~~#REF!~~	measured D84 (mm)		
~~#REF!~~	relative roughness	~~#REF!~~	fric. factor
~~#REF!~~	Manning's n from channel material		

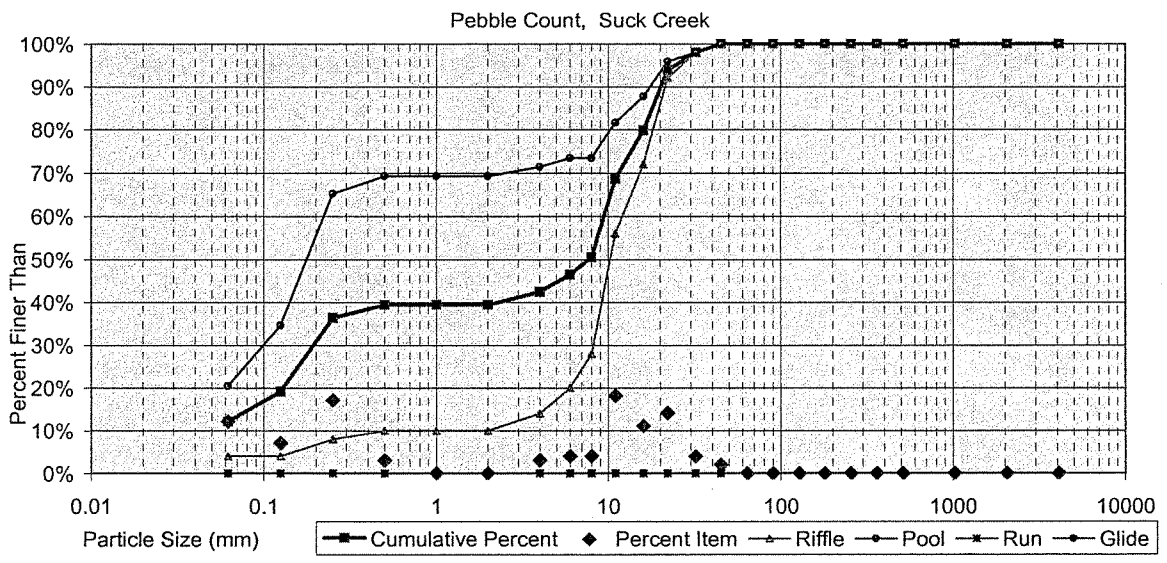
Weighted Pebble Count

Percent Riffle:	50	Percent Run:	
Percent Pool:	50	Percent Glide:	

Pebble Count,
Suck Creek

Lower Section
Note:

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	12.0	#
very fine sand	0.062	0.13	7.0	#
fine sand	0.13	0.25	17.0	#
medium sand	0.25	0.5	3.0	#
coarse sand	0.5	1	0.0	#
very coarse sand	1	2	0.0	#
very fine gravel	2	4	3.0	#
fine gravel	4	6	4.0	#
fine gravel	6	8	4.0	#
medium gravel	8	11	18.0	#
medium gravel	11	16	11.0	#
coarse gravel	16	22	14.0	#
coarse gravel	22	32	4.0	#
very coarse gravel	32	45	2.0	#
very coarse gravel	45	64	0.0	#
small cobble	64	90	0.0	#
medium cobble	90	128	0.0	#
large cobble	128	180	0.0	#
very large cobble	180	256	0.0	#
small boulder	256	362	0.0	#
small boulder	362	512	0.0	#
medium boulder	512	1024	0.0	#
large boulder	1024	2048	0.0	#
very large boulder	2048	4096	0.0	#
bedrock			1.0	#
		Weighted Count:	100	
		True Total Particle Count:	100	



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.091	0.24	7.7	18	24	12%	27%	60%	0%	0%	1%

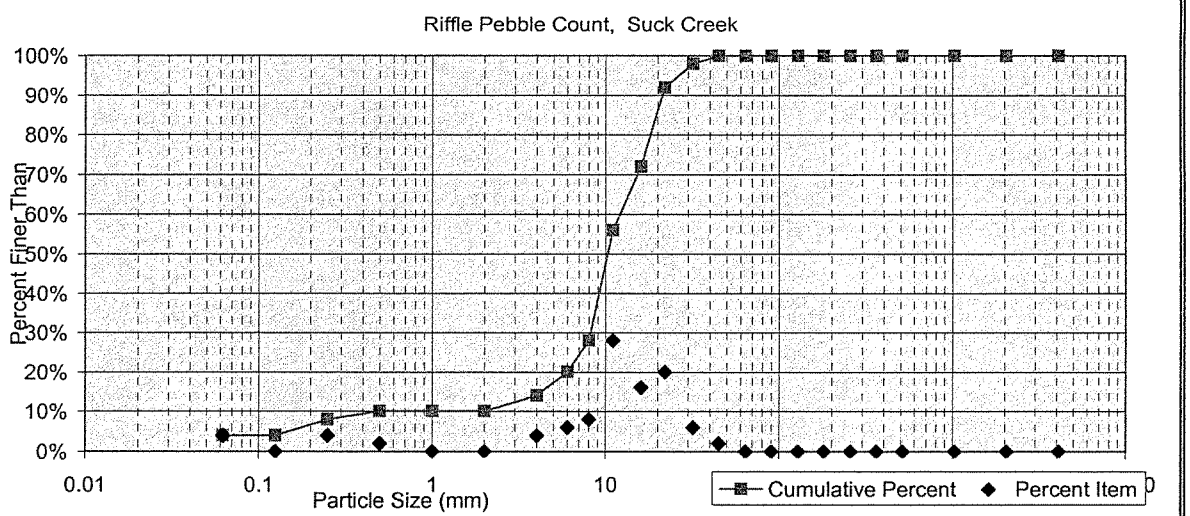
Riffle Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062	2	# #
very fine sand	0.062	0.13		# #
fine sand	0.13	0.25	2	# #
medium sand	0.25	0.5	1	# #
coarse sand	0.5	1		# #
very coarse sand	1	2		# #
very fine gravel	2	4	2	# #
fine gravel	4	6	3	# #
fine gravel	6	8	4	# #
medium gravel	8	11	14	# #
medium gravel	11	16	8	# #
coarse gravel	16	22	10	# #
coarse gravel	22	32	3	# #
very coarse gravel	32	45	1	# #
very coarse gravel	45	64		# #
small cobble	64	90		# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock				#
Total Particle Count:			50	

Riffle Pebble Count

	Suck Creek

	Lower Section
Note:	



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
4.579	8.66	10.3	19	27	4%	6%	90%	0%	0%	0%

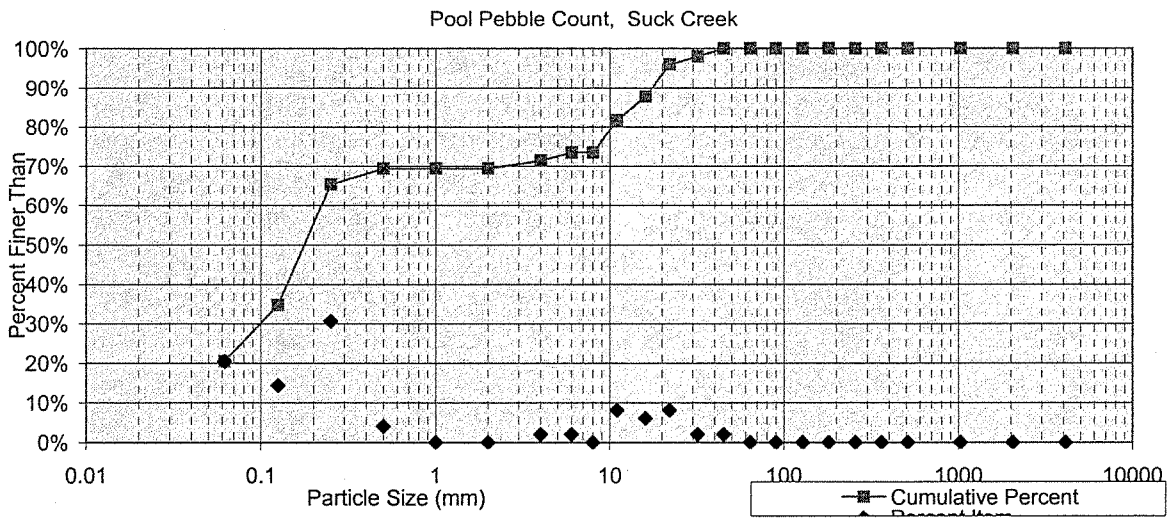
Pool Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062	10	# #
very fine sand	0.062	0.13	7	# #
fine sand	0.13	0.25	15	# #
medium sand	0.25	0.5	2	# #
coarse sand	0.5	1		# #
very coarse sand	1	2		# #
very fine gravel	2	4	1	# #
fine gravel	4	6	1	# #
fine gravel	6	8		# #
medium gravel	8	11	4	# #
medium gravel	11	16	3	# #
coarse gravel	16	22	4	# #
coarse gravel	22	32	1	# #
very coarse gravel	32	45	1	# #
very coarse gravel	45	64		# #
small cobble	64	90		# #
medium cobble	90	128		# #
large cobble	128	180		# #
very large cobble	180	256		# #
small boulder	256	362		# #
small boulder	362	512		# #
medium boulder	512	1024		# #
large boulder	1024	2048		# #
very large boulder	2048	4096		# #
bedrock			1	#
Total Particle Count:			50	

Pool Pebble Count,

	Suck Creek

	Lower Section
Note:	



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
#N/A	0.13	0.2	13	21	20%	48%	30%	0%	0%	2%

Pebble Count

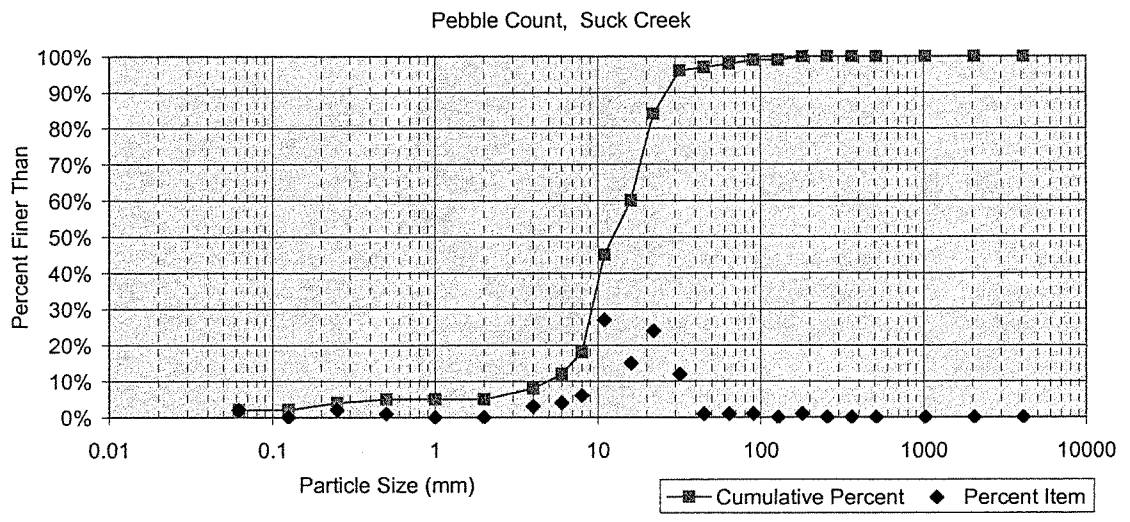
Material	Size Range (mm)		Count
silt/clay	0	0.062	2
very fine sand	0.062	0.13	
fine sand	0.13	0.25	2
medium sand	0.25	0.5	1
coarse sand	0.5	1	
very coarse sand	1	2	
very fine gravel	2	4	3
fine gravel	4	6	4
fine gravel	6	8	6
medium gravel	8	11	27
medium gravel	11	16	15
coarse gravel	16	22	24
coarse gravel	22	32	12
very coarse gravel	32	45	1
very coarse gravel	45	64	1
small cobble	64	90	1
medium cobble	90	128	
large cobble	128	180	1
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			100

Pebble Count

Suck Creek

Lower Section

Note: Entrainment



Size percent less than (mm)				
D16	D35	D50	D84	D95
7.268	9.78	12.5	22	31

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
2%	3%	93%	2%	0%	0%

MORPHOLOGY CHARACTERISTICS

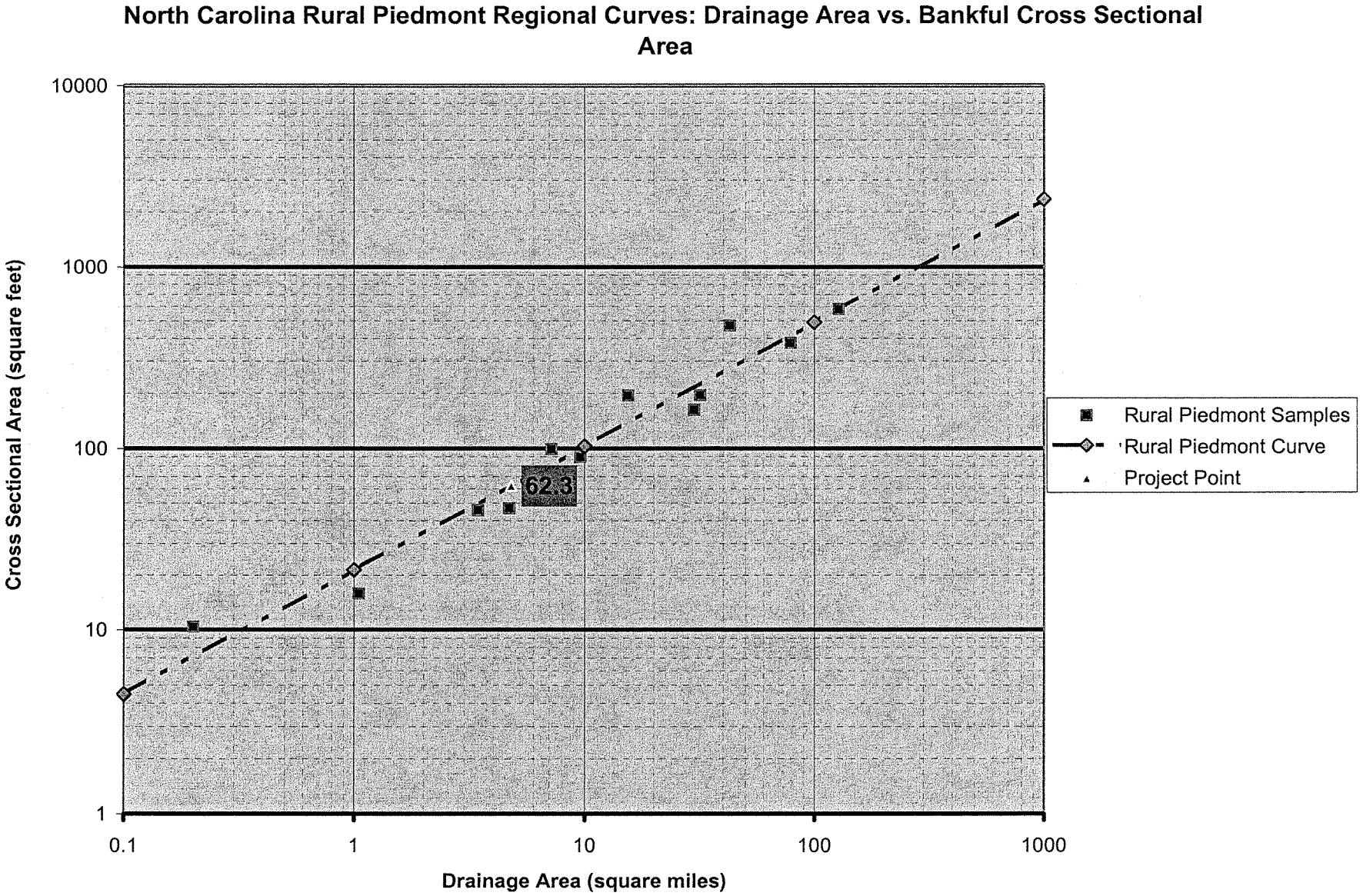
Restoration Site: Suck Creek
USGS Station: N/A
Reference Reach: Reference Reach I: Richland Creek, Reference Reach II: Suck Creek Upstream of Project Area

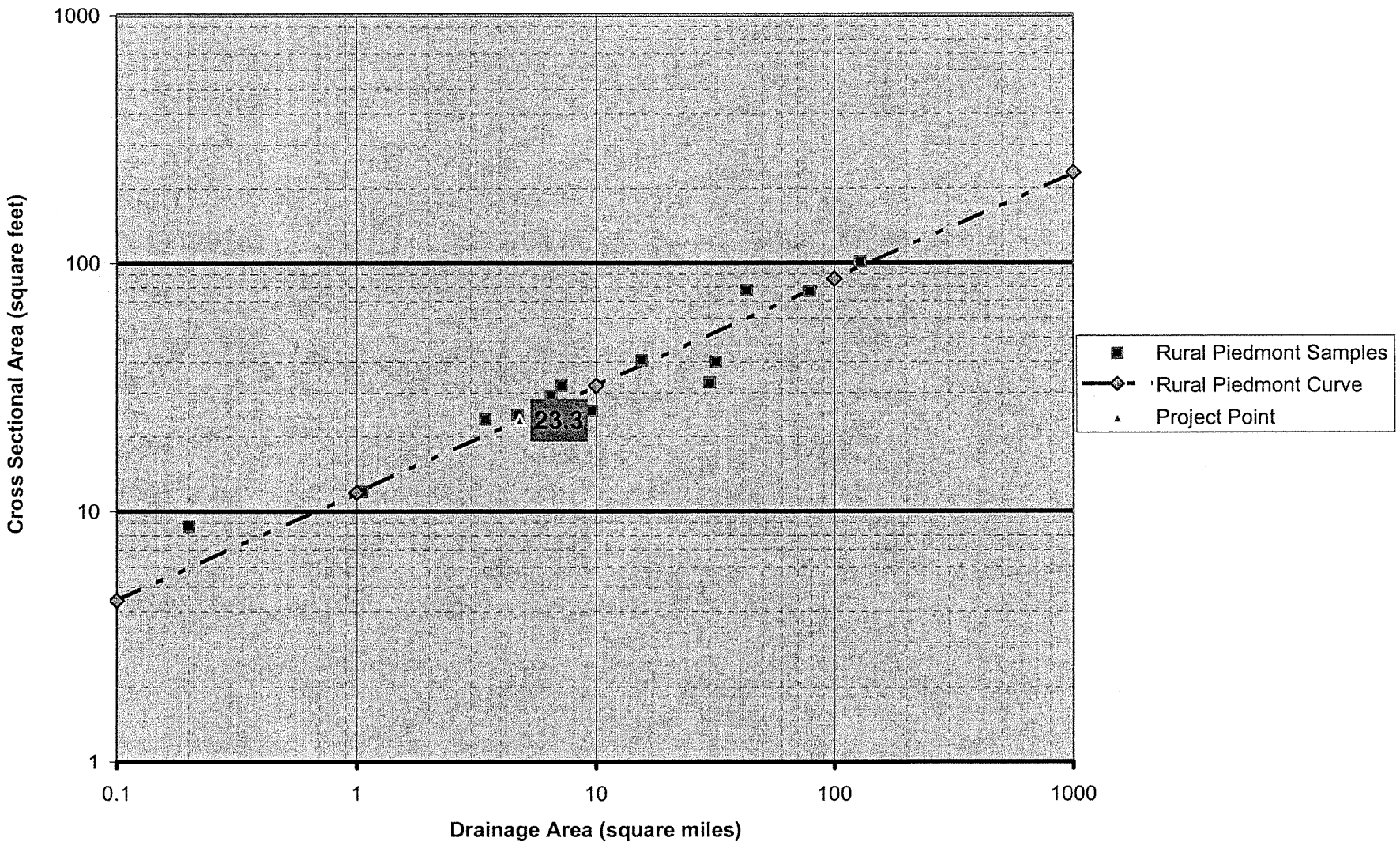
VARIABLES	EXISTING CHANNEL*		PROPOSED CHANNEL		REFERENCE REACH I CHANNEL		REFERENCE REACH II CHANNEL**		REGIONAL CURVES RURAL PIEDMONT***	
1. Stream Type (Rosgen)	G4 --> F4		C4		C4		B4		C4	
2. Drainage Area (sq. mile)	4.8		4.8		1.0		4.8		4.8	
3. Bankfull Width (W_{bkf})	Mean:	13.9	Mean:	20.0	Mean:	16.5	Mean:	17.0	Mean:	23.5
	Range:	12.3 - 15.8	Range:	15 - 20	Range:	16.2 - 16.7	Range:	15 - 20	Range:	
4. Bankfull Mean depth (d_{bkf})	Mean:	1.1	Mean:	1.5	Mean:	0.9	Mean:	1.3	Mean:	2.5
	Range:	1.0 - 1.4	Range:	1.2 - 1.8	Range:	.9 - .9	Range:	1.2 - 1.8	Range:	
5. Width/Depth Ratio (W_{bkf}/d_{bkf})	Mean:	12.6	Mean:	13.3	Mean:	17.8	Mean:	13.1	Mean:	9.4
	Range:	8.8 - 15.8	Range:	8.3 - 16.7	Range:	17.5 - 18.0	Range:	8.3 - 16.7	Range:	
6. Bankfull cross-sectional Area (A_{bkf})	Mean:	16.5	Mean:	29.5	Mean:	15.2	Mean:	22.1	Mean:	63.0
	Range:	12.8 - 22.8	Range:	18 - 36	Range:	15.0 - 15.2	Range:	18 - 36	Range:	
7. Bankfull Mean Velocity (V_{bkf})	Mean:		Mean:		Mean:	5.4	Mean:		Mean:	4.4
	Range:		Range:		Range:	5.05-5.81	Range:		Range:	
8. Bankfull Discharge, cfs (Q_{bkf})	Mean:	-	Mean:	-	Mean:	82.5	Mean:	-	Mean:	279.6
	Range:		Range:		Range:	75.8-88.3	Range:		Range:	
9. Bankfull Maximum Depth (d_{max})	Mean:	1.6	Mean:	2.2	Mean:	1.5	Mean:	2.0	Mean:	-
	Range:	1.3 - 1.5	Range:	1.8-2.9	Range:	1.4 - 1.5	Range:	1.9 - 2.1	Range:	
10. Max d_{riff}/d_{bkf} ratio	Mean:	1.4	Mean:	1.5	Mean:	1.6	Mean:	-	Mean:	-
	Range:	1.3 - 1.5	Range:	1.1 - 1.8	Range:	1.1 - 1.6	Range:		Range:	
11. Low Bank Height to max d_{bkf} ratio	Mean:	1.8	Mean:	1.0	Mean:	1.0	Mean:	-	Mean:	-
	Range:	1.1 - 2.3	Range:	1.0 - 1.2	Range:		Range:		Range:	
12. Width of Flood Prone Area (W_{fpa})	Mean:	19.3	Mean:	64.0	Mean:	51.7	Mean:	-	Mean:	-
	Range:	18.0 - 21.0	Range:	60-66	Range:	50 - 53.3	Range:		Range:	
13. Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean:	1.4	Mean:	3.2	Mean:	3.2	Mean:	1.5	Mean:	5.3
	Range:	1.3 - 1.4	Range:	3.0 - 3.3	Range:	3.0 - 3.3	Range:	1.3 - 1.6	Range:	2.7-31.65
14. Meander Length (L_m)	Mean:	99.5	Mean:	180.0	Mean:	92.0	Mean:	-	Mean:	-
	Range:	75 - 129	Range:	112-280	Range:	90 - 94	Range:		Range:	
15. Ratio of Meander Length to Bankfull Width (L_m/W_{bkf})	Mean:	7.2	Mean:	9.0	Mean:	5.6	Mean:	-	Mean:	-
	Range:	4.7 - 10.5	Range:	5.6 - 14.0	Range:		Range:		Range:	9-14
16. Radius of Curvature (R_c)	Mean:	38.0	Mean:	50.0	Mean:	19.0	Mean:	-	Mean:	-
	Range:	24.4- 52.0	Range:	24-60	Range:	14 - 26	Range:		Range:	
17. Ratio of Radius of Curvature to Bankfull Width (R_c/W_{bkf})	Mean:	2.7	Mean:	2.5	Mean:	1.2	Mean:	-	Mean:	-
	Range:	1.5 - 4.2	Range:	1.2- 3.0	Range:	.87 - 1.59	Range:		Range:	2.5-3
18. Bell Width (W_{bf})	Mean:	25.0	Mean:	80.0	Mean:	31.0	Mean:	-	Mean:	-
	Range:	15 - 35	Range:	30-400	Range:	25 - 40	Range:		Range:	
19. Meander Width Ratio (W_{bf}/W_{bkf})	Mean:	1.8	Mean:	4.0	Mean:	1.9	Mean:	-	Mean:	-
	Range:	1.1 - 2.5	Range:	1.52 - 20	Range:	1.52 - 2.43	Range:		Range:	
20. Sinuosity (k) (Stream Length / Valley Length)	1.2		Mean:	1.6	1.2		-		Mean:	1.9
			Range:	1.2 - 1.75					Range:	1.43-2.8
21. Valley Slope (Sv_{alley}) (ft/ft)	0.0040		0.0040		0.0136		-		-	
22. Average Stream Slope (S_{avg}) = (S_{valley}/k)	0.0030		Mean:	0.003	0.0133		0.0180		Mean:	0.005
			Range:	.0025 - .003					Range:	.00011-.0184
23. Riffle Slope (S_{riff})	Mean:	0.0106	Mean:	0.0050	Mean:	0.03	Mean:	-	Mean:	-
	Range:	0 - 1.6	Range:	.0045 - .0096	Range:	.014 - .041	Range:		Range:	
24. Ratio of Riffle Slope to Avg. Slope (S_{riffe}/S_{avg})	Mean:	3.5	Mean:	2.0	Mean:	2.4	Mean:	-	Mean:	-
	Range:	0-3.5	Range:	1.8 - 3.2	Range:		Range:		Range:	1.5-2
25. Pool Slope (S_{pool})	Mean:	0.0020	Mean:	0.0006	Mean:	0.0005	Mean:	-	Mean:	-
	Range:	.0003-.003	Range:	0.00009 - 0.0012	Range:	.0 - .0014	Range:		Range:	
26. Ratio of Pool Slope to Avg. Slope (S_{pool}/S_{avg})	Mean:	0.7	Mean:	0.200	Mean:	0.0338	Mean:	-	Mean:	-
	Range:	.1-1	Range:	.036-.4	Range:		Range:		Range:	.2-.3
27. Maximum Pool Depth (d_{pool})	Mean:	1.7	Mean:	4.5	Mean:	2.5	Mean:	-	Mean:	-
	Range:	1.3 - 1.9	Range:	3.9 - 6.3	Range:		Range:		Range:	
28. Ratio of Pool Depth to Avg. Depth (d_{pool}/d_{avg})	Mean:	1.5	Mean:	3.0	Mean:	2.8	Mean:	-	Mean:	3.0
	Range:	0.9 - 1.9	Range:	2.6-4.2	Range:		Range:		Range:	2.5-3.5
29. Pool Width (W_{pool})	Mean:	11.8	Mean:	26.0	Mean:	11.1	Mean:	-	Mean:	-
	Range:	9.4 - 15.6	Range:	14-34	Range:		Range:		Range:	
30. Ratio of Pool Width to Bankfull Width (W_{pool}/W_{bkf})	Mean:	0.8	Mean:	1.3	Mean:	0.7	Mean:	-	Mean:	1.5
	Range:	0.6 - 1.3	Range:	0.7 - 1.7	Range:		Range:		Range:	1.3-1.7
31. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	Mean:	0.8	Mean:	1.2	Mean:	1.3	Mean:	-	Mean:	-
	Range:	0.8 - 0.8	Range:		Range:		Range:		Range:	
32. Pool to Pool Spacing (p - p)	Mean:	95.9	Mean:	100.0	Mean:	76.3	Mean:	-	Mean:	-
	Range:	37 - 246	Range:	60-140	Range:	37.3 - 95.8	Range:		Range:	
33. Ratio of Pool to Pool Spacing to Bankfull Width (p-p/Wbkf)	Mean:	6.9	Mean:	5.0	Mean:	4.6	Mean:	-	Mean:	-
	Range:	2.3 - 20	Range:	3.0 - 7.0	Range:	2.26 - 5.82	Range:		Range:	5-7

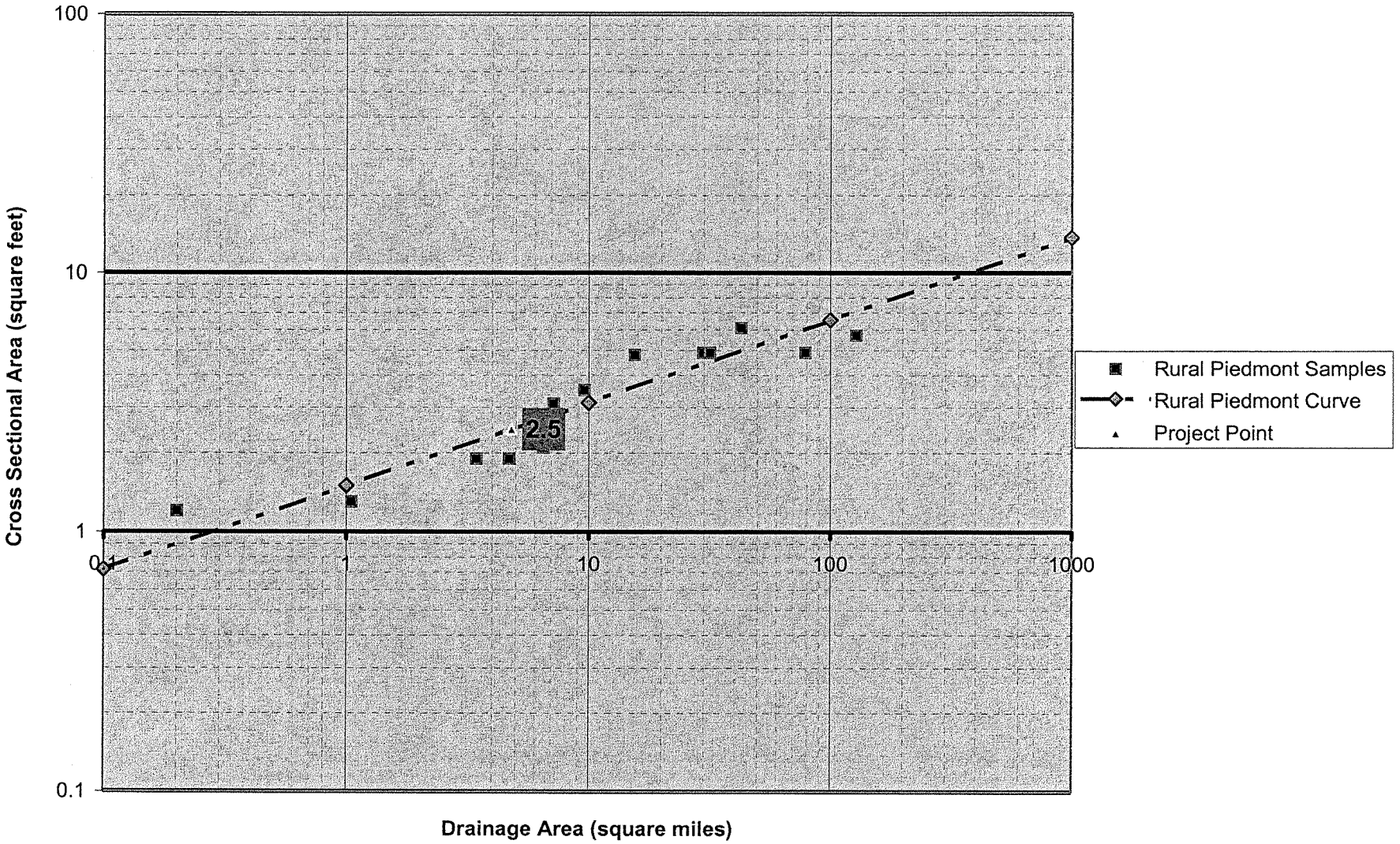
** Existing channel severly impacted by cattle. Bankfull field indicators not clear.*
*** Reference Reach II is a stable section of Suck Creek, upstream of project area. Field indicators were not present to assess all morphological characteristics.*
****Regional Curve data incorporated with Rosgen Reference data.*

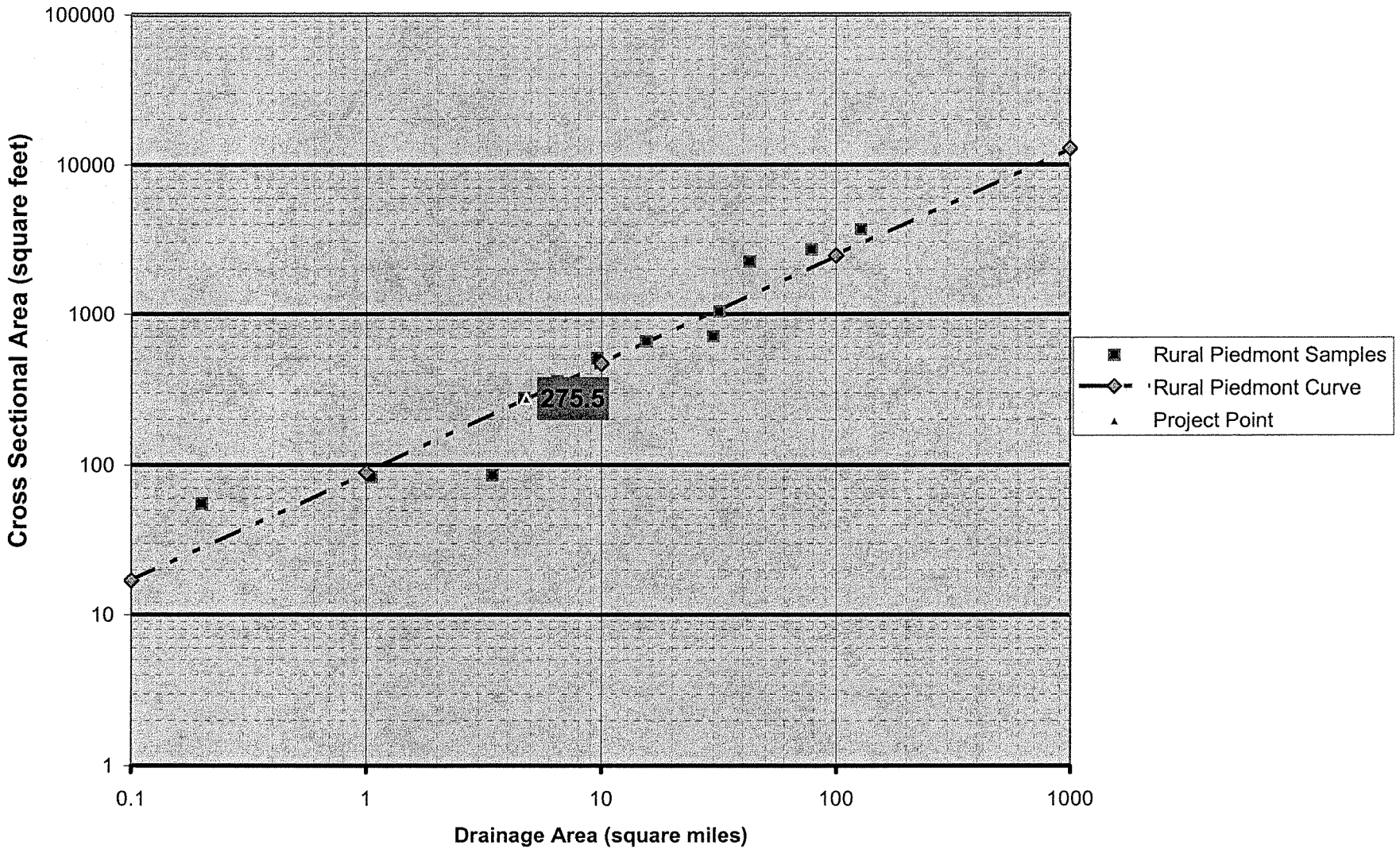
Note:
Q and V values likely high due to upstream impoundments. V calculated from Mannings and u/u.*

Appendix B
Piedmont Regional Curves


North Carolina Rural Piedmont Regional Curves: Drainage Area vs. Bankful Cross Sectional Area
Cross Sectional Area (square feet)
10000
1000
100
10
1
0.1
1
10
100
1000
Drainage Area (square miles)
62.3
Rural Piedmont Samples
Rural Piedmont Curve
Project Point


North Carolina Rural Piedmont Regional Curves: Drainage Area vs. Bankful Width
Cross Sectional Area (square feet)
1000
100
10
1
0.1
1
10
100
1000
Drainage Area (square miles)
23.3
Rural Piedmont Samples
Rural Piedmont Curve
Project Point


North Carolina Rural Piedmont Regional Curves: Drainage Area vs. Bankful Depth
100
10
1
0.1
0.1
1
10
100
1000
2.5
Cross Sectional Area (square feet)
Drainage Area (square miles)
Rural Piedmont Samples
Rural Piedmont Curve
Project Point


North Carolina Rural Piedmont Regional Curves: Drainage Area vs. Bankful Discharge
Cross Sectional Area (square feet)
100000
10000
1000
100
10
1
0.1
1
10
100
1000
Drainage Area (square miles)
275.5
Rural Piedmont Samples
Rural Piedmont Curve
Project Point

Appendix C
Reference Reach 1 Data – Offsite

REFERENCE REACH SURVEY
Stream Name: Richland Creek
Location:
Purpose: Longitudinal Profile and Cross-section measurements for Graduate Work
Date: 5/25/1999
Crew: Dan Clinton, Jan Patterson, Mike O'Rourke, Amy Dorney, Amanda Todd
Ending Point LAT/LONG:
Watershed Area: 1 sq. miles **STREAM TYPE:** C4

LONGITUDINAL PROFILE
(Using Level)

Bench Mark #1= 100 ft.
BS = 6.82 HI = 106.82 BM1 is nail at base of hemlock

TP1 BS=	6.52	TP1 HI=	110.73	TP1 FS=	2.61	TP1 El.=	104.21
TP2 BS=	5.46	TP2 HI=	113.17	TP2 FS=	3.02	TP2 El.=	107.71
TP3 BS=	2.41	TP3 HI=	108.93	TP3 FS=	6.65	TP3 El.=	106.52
TP4 BS=	4.51	TP4 HI=	109.34	TP4 FS=	4.1	TP4 El.=	104.83
TP5 BS=	2.13	TP5 HI=	105.05	TP5 FS=	6.42	TP5 El.=	102.92

FS to BM= 5.05 BM El.= 100.00
ERROR= 0.00

TR= Top of riffle
TP=Top of Pool
TG= Top of glide
Trun= Top of Run
MP= Max Pool
LBKF = Left Bankfull
RBKF= Right Bankfull
TW= Thal Wag
LEW= Left Edge of Water
REW= Right Edge of Water

Distance	Thawl Wag (FS)	Thawl Wag Elev.	Water Surface (FS)	Water Surface Elev.	LBKF (FS)	LBKF Elev.	RBKF (FS)	RBKF Elev.	IB (FS)	IB Elev.	LTOB (FS)	LTOB Elev.	RTOB (FS)	RTOB Elev.	Notes	Mid Feature Location	Feature
2.5	9.3	103.9	9.09	104.08	8.3	104.9	8.3	104.9							TR	5.8	R
9.0	9.5	103.7	9.18	103.99			8.0	105.2	8.5	104.67					TP	23.8	P
18.0	10.1	103.1	9.22	103.95			8.2	105.0									
28.0	10.6	102.6	9.22	103.95		113.2	8.0	105.2							MP		
38.5	9.4	103.8	9.19	103.98	8.1	105.1			8.7	104.47					TR	42.3	R
46.0	10.2	103.0	9.50	103.67	8.2	105.0									TP	61.0	P
58.0	11.0	102.2	9.45	103.72					8.2	104.97	6.1	107.07	7.5	105.67	MP		
76.0	10.4	102.8	9.45	103.72	8.2	105.0									TG	80.3	G
84.5	9.7	103.5	9.44	103.73	8.3	104.9	8.2	105.0	8.8	104.37	6.7	106.47			TR	93.5	R
102.5	10.2	103.0	9.89	103.28	8.7	104.5					8.1	105.07			Trun	112.3	Run
122.0	10.2	103.0	10.05	103.12			8.8	104.4							TR	129.0	R
136.0	6.7	102.2	6.36	102.57			5.1	103.8	5.7	103.23			2.9	106.03	TP Now using TP3 HI	156.8	P
145.0	7.1	101.8	6.35	102.58	5.0	103.9									MP		
148.5	7.9	101.0	6.32	102.61	5.0	103.9											
159.0	7.0	101.9	6.41	102.52	5.2	103.7											
165.0	6.1	100.8	6.43	102.50			5.2	103.7					4.6	104.33			
175.0	7.7	101.2	6.41	102.52			5.2	103.7									
177.5	7.7	101.2	6.42	102.51			5.3	103.6							TG	183.8	G
190.0	6.6	102.3	6.42	102.51	5.0	103.9				108.93	5	103.93			TR	198.0	R
206.0	7.2	101.7	7.04	101.89	5.8	103.1									Trun	218.5	Run
231.0	7.4	101.5	7.20	101.73	6.0	102.9			6.6	102.33					TR	242.0	R
249.0	8.6	100.3	8.24	100.69	7.0	101.9									TP	252.5	P
253.0	9.1	99.8	8.23	100.70	7.0	101.9									MP		
256.0	8.5	100.4	8.22	100.71	7.0	101.9									TR		R

SLOPE & LENGTH OF FEATURES CALCULATIONS

Riffles

Number	Length	Elevation Change	Slope
1	6.5	0.1	0.0138
2	7.5	0.3	0.0413
3	18.0	0.5	0.0250
4	14.0	0.6	0.0393
5	16.0	0.6	0.0388
6			
7			
8			
9			
10			
	12.4	Mean	0.0316
	14.0	Median	0.0388
	6.5	Min	0.0138
	18.0	Max	0.0393

Number Riffles to Riffle	Spacing (mid to mid)
1	36.5
2	51.3
3	35.5
4	44.0
5	
6	
7	
8	
9	
10	
Mean	36.5
Median	36.5
Min	35.5
Max	51.3

Pools

1	29.5	0.0	0.0003
2	30.0	0.0	0.0000
3	41.5	0.1	0.0014
4	7.0	0.0	0.0000
5			
6			
7			
8			
9			
10			
	27.0	Mean	0.00045
	29.8	Median	0.000
	7.0	Min	0.0014
	41.5	Max	0.0003

Pool to Pool	(mid to mid)
1	37.3
2	95.8
3	95.8
4	
5	
6	
7	
8	
9	
10	
Mean	76.3
Median	95.8
Min	37.3
Max	95.8

Glides

1	8.5	0.0	0.0000
2	12.5	0.0	0.0000
3			
4			
5			
6			
7			
8			
9			
10			
	10.5	Mean	0.0000
	10.5	Median	0.0000
	8.5	Min	0.0000
	12.5	Max	0.0000

Riffle to Pool	(mid to mid)
1	18.0
2	18.8
3	27.8
4	10.5
5	
6	
7	
8	
9	
10	
Mean	18.8
Median	18.4
Min	10.5
Max	27.8

Runs

1	19.5	0.2	0.0082
2	25.0	0.2	0.0064
3			
4			
5			
6			
7			
8			
9			
10			
	22.3	Mean	0.0073
	22.3	Median	0.0073
	19.5	Min	0.0064
	25.0	Max	0.0082

X_SECTION MEASUREMENTS

Riffle X-Section #1

Location : 2+66

HI= 100 (arbitrary... used depth off rod)

Distance	FS	Elev	Notes	Depth from BKF	Width	Area
0	4	96.0	LBKF	0.0	0.0	0.0
2	4.2	95.8		0.2	2.0	0.2
2.6	4.3	95.7	LIB	0.3	0.6	0.2
3.2	5	95.0	LEW	1.0	0.6	0.4
4	5.1	94.9		1.1	0.8	0.8
6	5.1	94.9		1.1	2.0	2.2
8	5.1	94.9		1.1	2.0	2.2
10	5.3	94.7		1.3	2.0	2.4
12	5.3	94.7		1.3	2.0	2.6
12.8	5.4	94.6	TW	1.4	0.8	1.1
14.4	5.1	94.9	REW	1.1	1.6	2.0
15.4	4.4	95.6		0.4	1.0	0.8
16.2	4	96.0	RBKF	0.0	0.8	0.2

sum: 15.8 sq. ft.

BKF Width =	16.2
Area =	16.6
Max. depth =	1.4
FPW =	55
ER =	3.3
Mean Depth=	0.9
Width/Depth Ratio=	17.5
Sinuosity=	1.2
Water Surface Slope=	0.0133
Stream Type = C4	

Riffle X-Section #2

Location : 7+54

HI= 100 (arb.)

Distance	FS	Elevation	Notes	Depth from BKF	Width	Area
0.0	4.1	95.9	LBKF	0.0	0.0	0.0
2.0	4.7	95.3	LIB	0.6	2.0	0.6
3.0	5.6	94.4	LEW	1.5	1.0	1.1
4.0	5.6	94.4		1.5	1.0	1.5
4.8	5.6	94.4	TW	1.5	0.8	1.2
6.0	5.3	94.7		1.2	1.2	1.6
8.0	5.2	94.8		1.1	2.0	2.3
10.0	5.4	94.6		1.3	2.0	2.4
12.0	5.5	94.5		1.4	2.0	2.7
12.8	5.3	94.7	REW	1.2	0.8	1.0
13.6	4.5	95.5		0.4	0.8	0.6
15.0	4.2	95.8		0.1	1.4	0.4
16.7	4.1	95.9	RBKF	0.0	1.7	0.1

sum: 15.5 sq. ft.

BKF Width =	16.7
Area =	15.5
Max. depth =	1.5
FPW =	50.0
ER =	3.0
Mean Depth=	0.9
Width/Depth Ratio=	18.0
Stream Type = C4	

Pool X-Section #1
Location : 0+46
HI= 100 (arb.)

Distance	ES	Elev	Notes	Depth from BKF	Width	Area
0.2	5.5	94.5	LTOB			
2.5	6.3	93.7				
4.5	7.5	92.5				
5.1	7.7	92.3				
5.4	8.0	92.0	LBKF	0.0	0.0	0.0
6.0	9.3	90.7	LEW	1.3	0.6	0.4
6.3	9.6	90.4		1.6	0.3	0.4
7.0	9.7	90.3		1.7	0.7	1.2
8.4	9.4	90.6		1.4	1.4	2.2
8.7	9.7	90.3		1.7	0.3	0.5
9.6	10.5	89.5	TW	2.5	0.9	1.9
11.2	10.5	89.5		2.5	1.6	4.0
13.6	10.1	89.9		2.1	2.4	5.5
14.7	9.7	90.3		1.7	1.1	2.1
15.6	9.4	90.6	REW	1.4	0.9	1.4
16.2	8.4	91.6		0.4	0.6	0.5
16.5	8.0	92.0	RBKF	0.0	0.3	0.0
17.1	7.5	92.5				
17.4	7.3	92.7				
18.5	7.0	93.0				
21.0	6.8	93.2	RTOB			

sum= 20.1 sq. ft.

BKF Width = 11.1
Area = 20.1
Max. depth = 2.5
Mean Depth= 1.8
Width/Depth Ratio= 6.1

X-Section Summary Sheet

Riffle X-Section

	Mean	Median	Maximum	Minimum
BKF Width =	16.5	16.5	16.7	16.2
Area =	15.2	15.2	15.5	15
Max. depth =	1.5	1.5	1.5	1.4
FPW =	51.5	51.5	53.0	50
ER =	3.1	3.1	3.3	3
Mean Depth=	0.9	0.9	0.9	0.9
Width/Depth Ratio=	17.8	17.8	18.0	17.5

Sinuosity=	1.2
Water Surface Slope=	0.0133
Stream Type =	C4

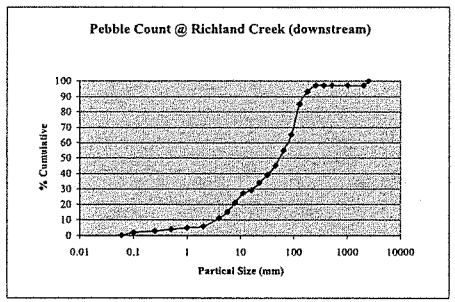
Pool X-Section

BKF Width =	11.1
Area =	20.1
Max. depth =	2.5
Mean Depth=	1.8
Width/Depth Ratio=	6.1

Pebble Count

Site: Richland Creek (downstream)
Date: 5/25/1999
Party: Amanda Todd, Amy Dorney, & Mike O'Rourke

	Particle	Size(mm)	Total #	% Cum.	
	Silt/Clay	<0.062	0	0	0.06
SAND	Very Fine	0.062-0.125	2	2	0.1
SAND	Fine	0.125-0.25	1	3	0.25
SAND	Medium	0.25-0.50	1	4	0.5
SAND	Course	0.50-1.0	1	5	1
SAND	Very Course	1.0-2.0	1	6	2
GRAVEL	Very Fine	2-4	5	11	4
GRAVEL	Fine	4-5.7	4	15	5.7
GRAVEL	Fine	5.7-8	6	21	8
GRAVEL	Medium	8-11.3	6	27	11.3
GRAVEL	Medium	11.3-16	2	29	16
GRAVEL	Course	16-22.6	5	34	22.6
GRAVEL	Course	22.6-32	5	39	32
GRAVEL	Very Course	32-45	6	45	45
GRAVEL	Very Course	45-64	10	55	64
COBBLE	Small	64-90	10	65	90
COBBLE	Small	90-128	20	85	128
COBBLE	Large	128-180	8	93	180
COBBLE	Large	180-256	4	97	256
BOULDER	Small	256-362	0	97	362
BOULDER	Small	362-512	0	97	512
BOULDER	Medium	512-1024	0	97	1024
BOULDER	Large-Vry Lrg	1024-2048	0	97	2048
	Bedrock	>2048	3	100	2500
			100	100	



D16: 6 mm
D50: 45 mm
D84: 125 mm
*all numbers extrapolated from data

Meander Geometry Data

Site: Richland Creek (downstream)
Date: 5/25/1999
Party: Amanda Todd, Amy Dorney, Mike O'Rourke, Jan Patterson, & Dan Clinton

RADIUS OF CURVATURE

Meander	Mid-Ordinate(M)	Cord Length(C)	Rad. Of Curvature
1	0.9	10	14.3
2	1.1	15	26.1
3	8	28	16.3
		Mean	19
		Median	16
		Max	26
		Min	14

Meander Wavelength		Belt Width		Valley Length
1	90 ft.	1	29 ft.	217 ft.
2	94 ft.	2	25 ft.	
		3	40 ft.	
Mean	92 ft.	*Mean*	31 ft.	
Median	92 ft.	Median	29 ft.	
Max	94 ft.	Max	40 ft.	
Min	90 ft.	Min	25 ft.	

REFERENCE REACH Summary Data

REFERENCE REACH SURVEY
Stream Name: Richland Creek
Location:
Purpose: Longitudinal Profile and Cross-section measurements for Graduate Work
Date: 5/25/1999
Crew: Dan Clinton, Jon Patterson, Mike O'Rourke, Amy Dorney, Amanda Todd
Ending Point LAT/LONG:
Watershed Area: 1 sq. miles **STREAM TYPE: C4**

Channel Dimensions

	Mean	Median	Min	Max
Max. Riffle Depth(drmax)(ft.):	1.5	1.5	1.4	1.5
Riffle Width(Wr)(ft.):	16.5	16.5	16.2	16.7
Riffle X-Sect. Area(Ar)(ft^2):	15.2	15.2	15.0	15.5
Riffle Mean Bankfull Depth(dmbkf):	0.9	0.9	0.9	0.9
	17.8	17.8	17.5	18.0

Max. Pool Depth(dpmax)(ft.):	2.5
Pool Width(Wp)(ft.):	11.1
Pool X-Sect. Area(Ap)(ft.):	20.1

	Mean	Median	Min	Max
Ratio: Max. Pool Depth/Max. Riffle Depth(dpmax/drmax):	1.72			
Ratio: Pool Width/Riffle Width(Wp/Wr):	0.67			
Ratio: Pool Area/Riffle Area(Ap/Ar):	1.32			
Ratio: Max. Pool Depth/Mean Bankfull Depth(dpmax/dbkf):	2.70			
Ratio: Lowest Bank Height/Max. Bankfull Depth(Bhlow/dmbkf):	1			
Streamflow: Estimated Mean Velocity(u) @ Bankfull Stage:		ft./sec.		
Streamflow: Estimated Discharge(Q) @ Bankfull Stage:		CFS		

Channel Pattern

	Mean	Median	Min	Max	
Meander Wavelength(Lm):	92	92	90	94	ft.
Radius of Curvature(Rc):	19	16	14	26	ft.
Beltwidth(Wblt):	31	29	25	40	ft.

Meander Width Ratio(MWR=Wblt/Wbkf):	1.90	1.76	1.52	2.43
RATIO: Radius of Curvature/Bankfull Width(Rc/Wbkf):	1.15	0.99	0.87	1.59
RATIO: Meander Wavelength/Bankfull Width(Lm/Wbkf):	5.59	5.59	5.47	5.71

Channel Profile

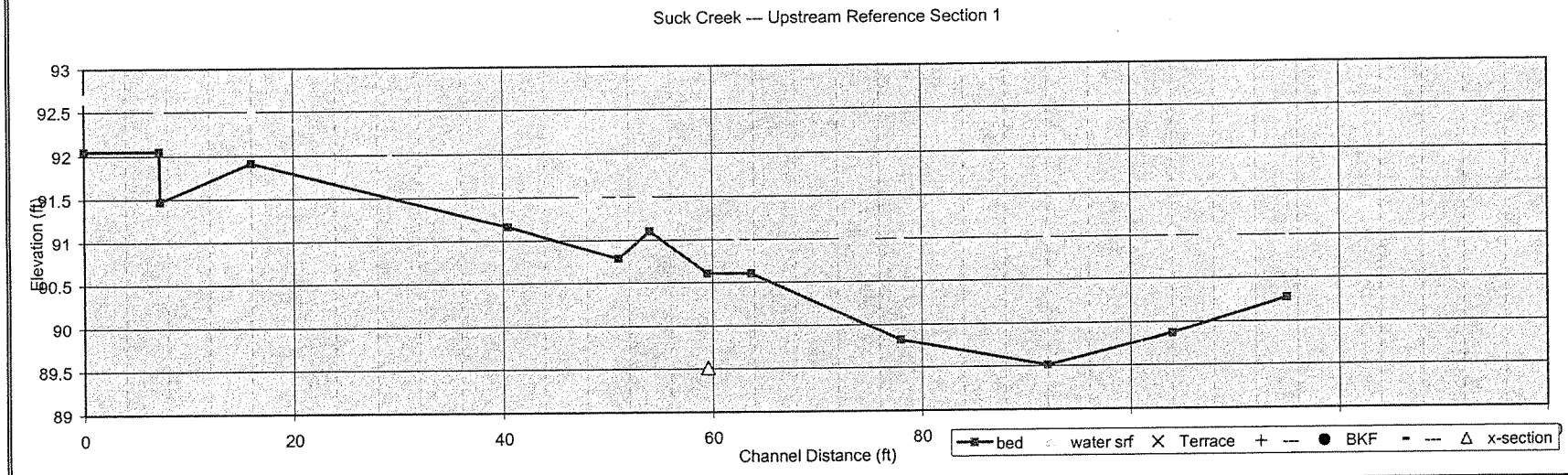
	Mean	Median	Min	Max	
Valley Slope:	0.0136	ft./ft			
Water Surface Slope:	0.0133	ft./ft			
Riffle Slope:	0.0316	0.0388	0.01	0.0393	ft./ft
Pool Slope:	0.0004	0.0002	0.0014	0.0003	ft./ft
Run Slope:	0.0073	0.0073	0.006	0.0082	ft./ft
Glide Slope:	0.0000	0.0000	0.00	0.0000	ft./ft
Riffle Length:	12.4	14.0	6.5	18.0	ft.
Pool Length:	27.0	29.8	7.0	41.5	ft.
Run Length:	22.3	22.3	19.5	25.0	ft.
Glide Length:	10.5	10.5	8.5	12.5	ft.
Riffle to Riffle Spacing:	36.5	36.5	35.5	51.3	ft.
Pool to Pool Spacing:	76.3	75.8	37.3	95.8	ft.
Riffle to Pool Spacing:	18.8	18.4	10.5	27.8	ft.

RATIO: Riffle Slope/ Water Surface Slope:	2.38	2.91	1.04	2.96
RATIO: Pool Slope/Water Surface Slope:	0.03	0.01	0.11	0.03
RATIO: Run Slope/Water Surface Slope:	0.55	0.55	0.48	0.62
RATIO: Glide Slope/ Water Surface Slope:	0.00	0.00	0.00	0.00
RATIO: Max. Riffle Depth/Mean Bankfull Depth:	1.57	1.57	1.51	1.62
RATIO: Max.Pool Depth/Mean Bankfull Depth:	2.70			
RATIO: Max. Run Depth/Mean Bankfull Depth:	n/a			
RATIO: Max. Glide Depth/Mean Bankfull Depth:	n/a			
RATIO: Riffle Length/Bankfull Width:	0.75	0.85	0.40	1.09
RATIO: Pool Length/Bankfull Width:	1.64	1.81	0.43	2.52
RATIO: Run Length/Bankfull Width:	1.35	1.35	1.19	1.52
RATIO: Glide Length/Bankfull Width:	0.64	0.64	0.52	0.76
RATIO: Riffle to Riffle Spacing/Bankfull Width:	2.22	2.22	2.16	3.12
RATIO: Pool to Pool Spacing/Bankfull Width:	4.64	5.82	2.26	5.82
RATIO: Riffle to Pool Spacing/Bankfull Width:	1.14	1.12	0.64	1.69

D84:	100	mm	Stretch
dmbkf:	282	mm	
dmbkf/D84:	2.82		
u/u*:	5.7	Reference: Rosgen Reference Reach Field Book	
Mannings 'n':	0.04	"	

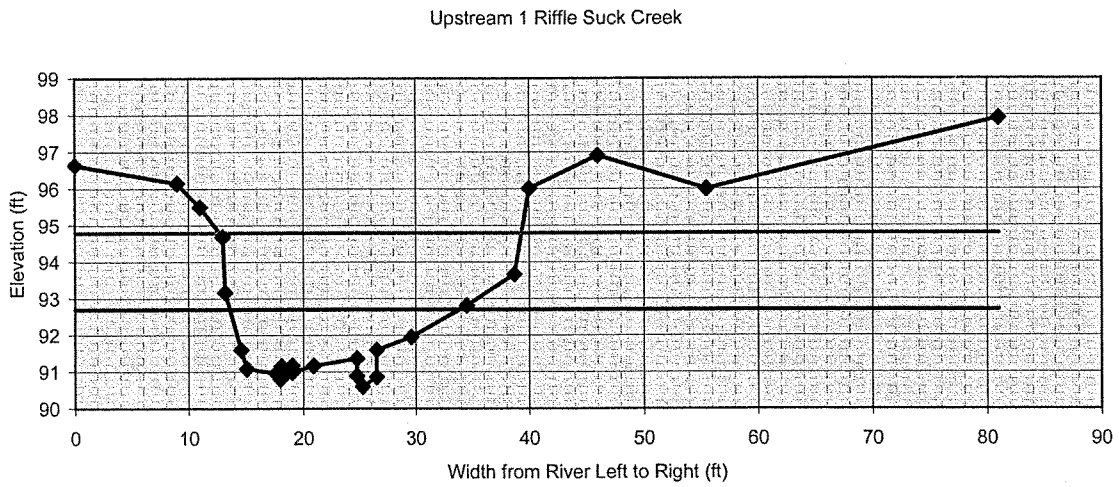
Appendix D
Reference Reach 2 Data – Onsite

Slope Profile



					100	:Elevation BM													
notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS Terrace	FS	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV Terrace	ELEV —	ELEV —
				0	100														
Begin Riffe		0			100		7.95	0.6						92.05	92.65				
End Riffle		7.2			100		7.95	0.5						92.05	92.55				
Mid Pool		7.3			100		8.53	1.1						91.47	92.57				
Begin Riffe		16			100		8.09	0.6						91.91	92.51				
End Riffle		40.5			100		8.84	0.4						91.16	91.56				
Mid Pool		51			100		9.22	0.7						90.78	91.48				
Begin Riffe		54			100		8.9	0.4						91.1	91.5				
	U1	59.5			100		9.4	0.5						90.6	91.1				
End Riffle		63.7			100		9.4	0.35						90.6	90.95				
Pool		78			100		10.18	1.2						89.82	91.02				
Pool		92			100		10.49	1.5						89.51	91.01				
Pool		104			100		10.13	1.15						89.87	91.02				
Begin Riffe		115			100		9.73	0.7						90.27	90.97				
					100														
					100														
					100														

Cross Section



section:	Upstream 1
	Riffle
	Suck Creek
	---
description:	Located at existing NCSU pins near fence line/ property line near forest boundary
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	3.36	96.64
		9	3.85	96.15
TOB-L		11	4.5	95.5
Pin 1		13	5.32	94.68
Pin 2		13.2	6.83	93.17
Pin 3		14.6	8.4	91.6
Wedge-L		15.1	8.92	91.08
		17.6	9.04	90.96
		18	9.2	90.8
Rock		18.1	8.85	91.15
Rock		19	8.83	91.17
		19	9.02	90.98
Rock		20.9	8.83	91.17
Rock		24.7	8.64	91.36
		24.7	9.11	90.89
Thalwag		25.2	9.4	90.6
		26.5	9.14	90.86
Boulder		26.5	8.4	91.6
Boulder	#	29.6	8.05	91.95
FP Bench	#	34.5	7.19	92.81
Bkf-R	#	38.7	6.33	93.67
TOB-R	#	40	3.99	96.01
	#	46	3.1	96.9
	#	55.5	4	96
	#	81	2.08	97.92
	#			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.3	4.5	27.0	1.8	
92.7	95.5			

dimensions			
24.3	x-section area	1.2	d mean
20.3	width	22.9	wet P
2.1	d max	1.1	hyd radi
4.9	bank ht	16.9	w/d ratio
27.0	W flood prone area	1.3	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
1.19	shear stress ((lbs/ft sq)
0.78	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
102.0	threshold grain size (mm)

check from channel material			
#REF!	measured D84 (mm)		
#REF!	relative roughness	#REF!	fric. factor
#REF!	Manning's n from channel material		

Pebble Count

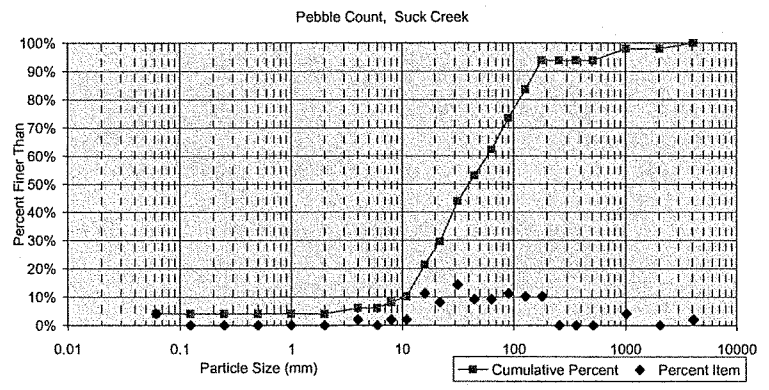
Material	Size Range (mm)		Count
silt/clay	0	0.062	4
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	
very fine gravel	2	4	2
fine gravel	4	6	
fine gravel	6	8	2
medium gravel	8	11	2
medium gravel	11	16	11
coarse gravel	16	22	8
coarse gravel	22	32	14
very coarse gravel	32	45	9
very coarse gravel	45	64	9
small cobble	64	90	11
medium cobble	90	128	10
large cobble	128	180	10
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	4
large boulder	1024	2048	0
very large boulder	2048	4096	2
bedrock			3
Total Particle Count:			101

Pebble Count

Suck Creek

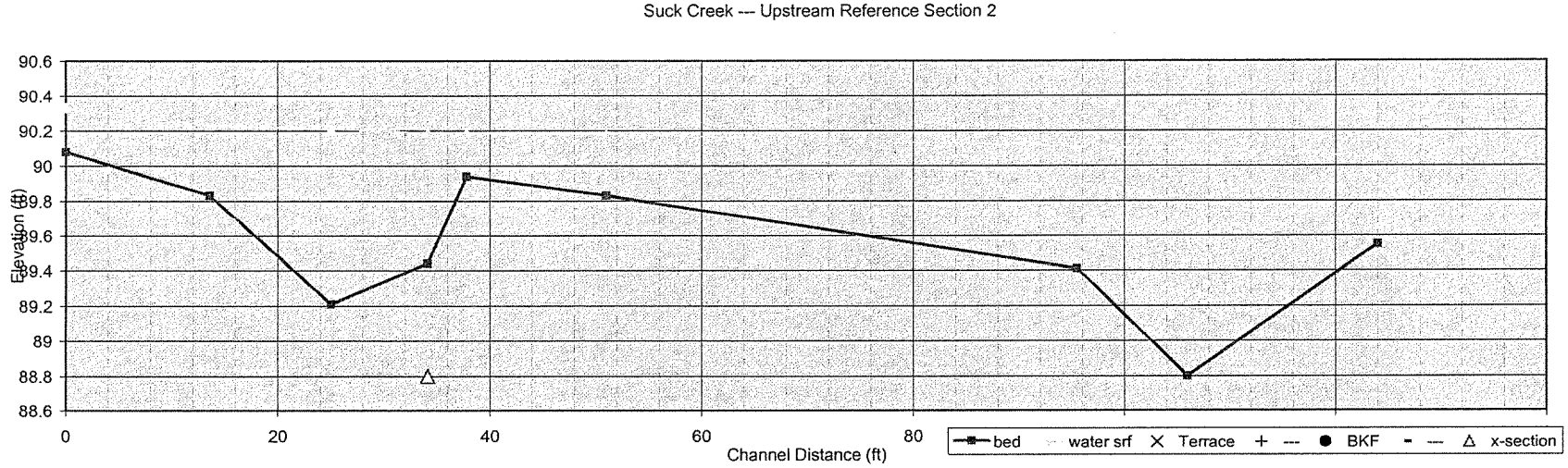
Upstream Reference Section 1

Note: Riffle Pebble Count of U1



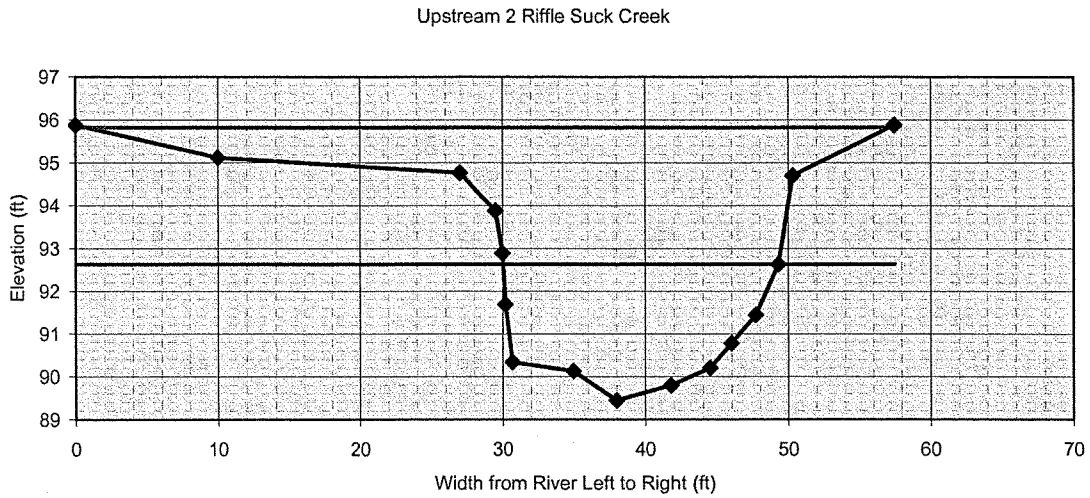
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
13.348	25.35	40.2	129	620	4%	0%	56%	31%	6%	3%

Slope Profile



					100	Elevation BM													
notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS Terrace	FS	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV Terrace	ELEV ---	ELEV ---
				0	100														
Begin Riffle		0			100		9.92	0.25						90.08	90.33				
End Riffle		13.6			100		10.17	0.4						89.83	90.23				
Mid Pool		25			100		10.79	1						89.21	90.21				
	U2	34.1			100		10.56	0.75						89.44	90.19				
Begin Riffle		37.8			100		10.06	0.25						89.94	90.19				
Begin Run		51			100		10.17	0.35						89.83	90.18				
Begin Pool		95.5			100		10.59	0.7						89.41	90.11				
Mid Pool		106			100		11.2	1.3						88.8	90.1				
Begin Riffle		124			100		10.45	0.5						89.55	90.05				
					100														
					100														
					100														
					100														

Cross Section



section: **Upstream 2**
Riffle
Suck Creek
---

description: Located at existing NCSU pins upstream of bend/confluence upstream of project b

height of instrument (ft): 100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	4.12	95.88
	☐	10	4.88	95.12
	☐	27	5.23	94.77
TOB-L	☐	29.5	6.12	93.88
Pin 1	☐	30	7.11	92.89
Pin 2	☐	30.2	8.31	91.69
Toe	☐	30.7	9.66	90.34
Wedge-L	☐	35	9.87	90.13
Thalwag	☐	38	10.56	89.44
	☐	41.8	10.2	89.8
Wedge-R	☐	44.5	9.8	90.2
Inner Berm	☐	46	9.22	90.78
Inner Berm	☐	47.7	8.56	91.44
Bkf-R	#☐#	49.3	7.37	92.63
TOB-R	#☐#	50.3	5.3	94.7
	#☐#	57.5	4.12	95.88
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	#☐#			
	☐			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.37	6.12	57.5	0.4	
92.63	93.88			

dimensions			
45.0	x-section area	2.3	d mean
19.3	width	21.7	wet P
3.2	d max	2.1	hyd radi
4.4	bank ht	8.2	w/d ratio
57.5	W flood prone area	3.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.52	shear stress ((lbs/ft sq)
0.52	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
31.8	threshold grain size (mm)

check from channel material			
#REF!	measured D84 (mm)		
#REF!	relative roughness	#REF!	fric. factor
#REF!	Manning's n from channel material		

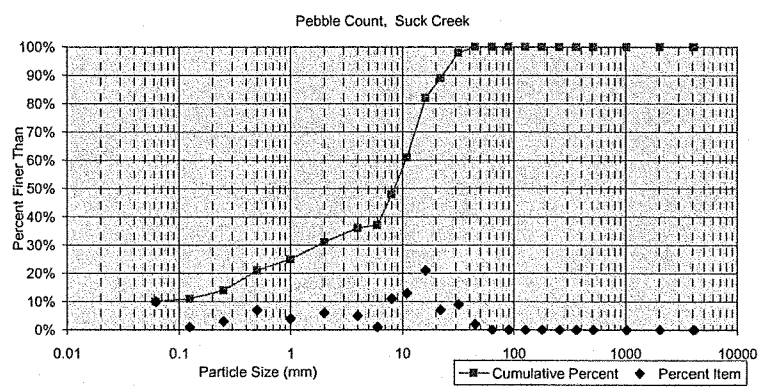
Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	10
very fine sand	0.062	0.13	1
fine sand	0.13	0.25	3
medium sand	0.25	0.5	7
coarse sand	0.5	1	4
very coarse sand	1	2	6
very fine gravel	2	4	5
fine gravel	4	6	1
fine gravel	6	8	11
medium gravel	8	11	13
medium gravel	11	16	21
coarse gravel	16	22	7
coarse gravel	22	32	9
very coarse gravel	32	45	2
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
	Total Particle Count:		100

Pebble Count

	Suck Creek

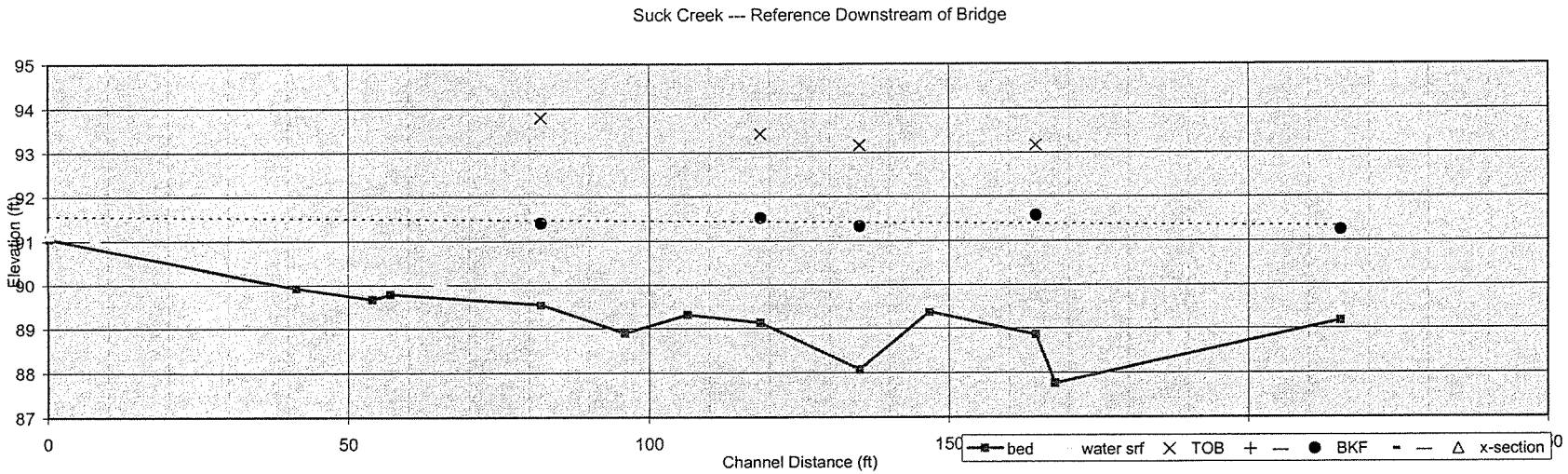
	Upstream Reference Section 2
Note:	Riffle Pebble Count of U2



Size percent less than (mm)				
D16	D35	D50	D84	D95
0.305	3.48	8.4	18	28

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
10%	21%	69%	0%	0%	0%

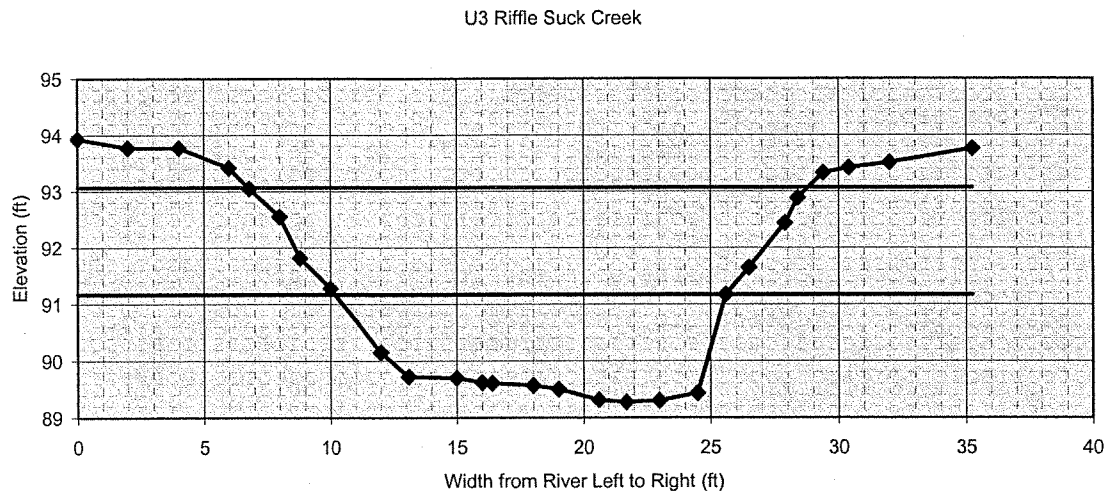
Slope Profile



100 :Elevation BM

notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS TOB	FS	FS	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV TOB	ELEV —	ELEV —
		0.2			100		8.95	0.1						91.05	91.15				
		41.4			100		10.08	0.43						89.92	90.35				
		54			100		10.34	0.61						89.66	90.27				
					100	5													
				2.67	97.67										#N/A	#N/A	#N/A	#N/A	#N/A
		57			97.67		7.89	0.35						89.78	90.13				
		82			97.67		8.13	0.2	6.27	3.87				89.54	89.74	91.4	93.8		
		96			97.67		8.78	0.85						88.89	89.74				
		106.4			97.67		8.36	0.32						89.31	89.63				
		118.5			97.67		8.54	0.45	6.15	4.24				89.13	89.58	91.52	93.43		
		135			97.67		9.6	1.55	6.34	4.5				88.07	89.62	91.33	93.17		
		146.7			97.67		8.3	0.2						89.37	89.57				
					97.67	2.67													
				5	100										#N/A	#N/A	#N/A	#N/A	#N/A
		164.5			100		11.15	0.68	8.43	6.83				88.85	89.53	91.57	93.17		
		167.7			100		12.24	1.73						87.76	89.49				
		215.3			100		10.83	0.3	8.76					89.17	89.47	91.24			
					100														
					100														

Cross Section



section: U3
Riffle
Suck Creek
---
description: D/S of Bridge
height of instrument (ft): 100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
	☐	0	6.07	93.93
	☐	2	6.23	93.77
	☐	4	6.23	93.77
	☐	6	6.58	93.42
	☐	6.8	6.95	93.05
	☐	8	7.45	92.55
	☐	8.8	8.18	91.82
	☐	10	8.72	91.28
	☐	12	9.85	90.15
	☐	13.1	10.28	89.72
	☐	15	10.3	89.7
	☐	16	10.38	89.62
	#☐#	16.4	10.39	89.61
	#☐#	18	10.43	89.57
	#☐#	19	10.5	89.5
	#☐#	20.6	10.69	89.31
	#☐#	21.7	10.73	89.27
	#☐#	23	10.7	89.3
	#☐#	24.5	10.57	89.43
	#☐#	25.6	8.83	91.17
	#☐#	26.5	8.35	91.65
	#☐#	27.9	7.56	92.44
	#☐#	28.4	7.12	92.88
	#☐#	29.4	6.67	93.33
	#☐#	30.4	6.58	93.42
	#☐#	32	6.49	93.51
	#☐#	35.25	6.24	93.76
	#☐#			

☐

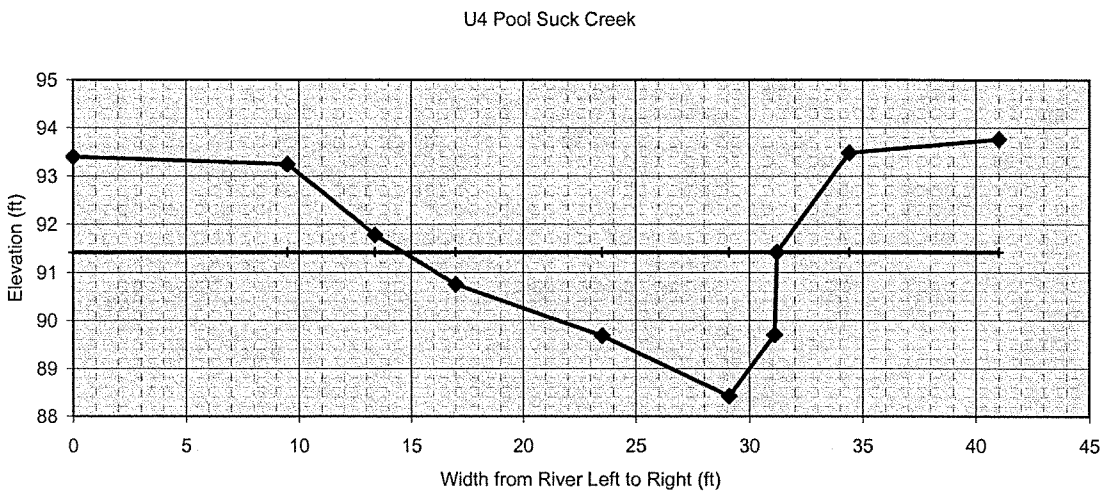
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.83	7.12			
91.17	92.88			

dimensions			
22.4	x-section area	1.5	d mean
15.4	width	16.7	wet P
1.9	d max	1.3	hyd radi
3.6	bank ht	10.6	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
19	measured D84 (mm)		
23.6	relative roughness	10.7	fric. factor
0.000	Manning's n from channel material		

Cross Section



section:	U4
	Pool
	Suck Creek
	---
description:	d/s of bridge
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	6.6	93.4
		9.5	6.75	93.25
		13.4	8.22	91.78
		17	9.25	90.75
		23.5	10.32	89.68
		29.1	11.58	88.42
		31.1	10.3	89.7
		31.2	8.58	91.42
		34.4	6.52	93.48
		41	6.24	93.76

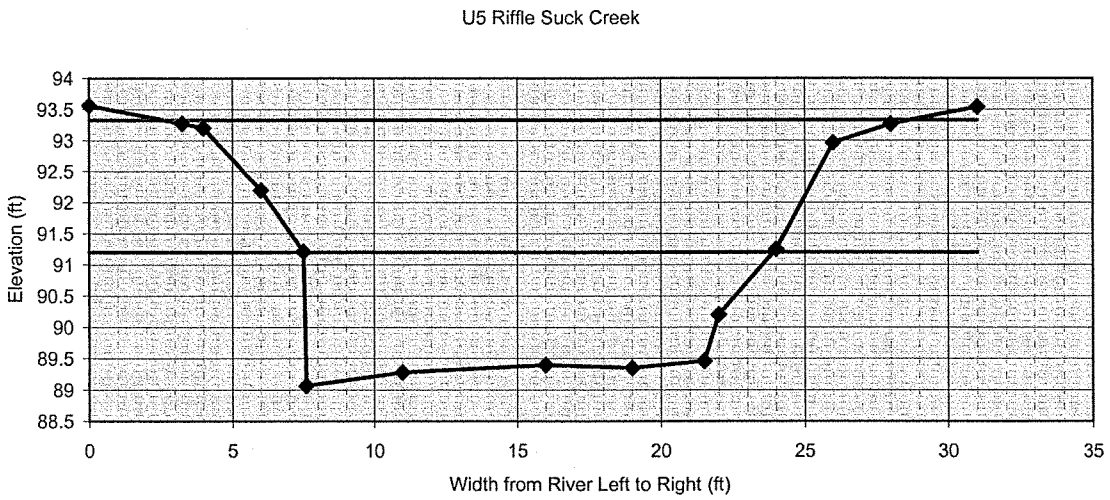
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.58	6.52			
91.42	93.48			

dimensions			
26.7	x-section area	1.6	d mean
16.5	width	18.9	wet P
3.0	d max	1.4	hyd radi
5.1	bank ht	~~10.3~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
~~0.000~~	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
~~19~~	measured D84 (mm)		
~~26.2~~	relative roughness	~~10.9~~	fric. factor
~~0.000~~	Manning's n from channel material		

Cross Section



section:	U5
	Riffle
	Suck Creek
	---
description:	d/s of bridge
height of instrument (ft):	100.00

notes	omit pt.	distance (ft)	FS (ft)	elevation
		0	6.44	93.56
		3.25	6.73	93.27
		4	6.8	93.2
		6	7.8	92.2
		7.5	8.79	91.21
		7.6	10.93	89.07
		11	10.72	89.28
		16	10.6	89.4
		19	10.65	89.35
		21.5	10.54	89.46
		22	9.8	90.2
		24	8.75	91.25
		26	7.04	92.96
		28	6.74	93.26
	#	31	6.46	93.54
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
8.8	7.04			
91.2	92.96			

dimensions			
27.9	x-section area	1.7	d mean
16.4	width	19.1	wet P
2.1	d max	1.5	hyd radi
3.9	bank ht	9.6	w/d ratio
0.0	W flood prone area	0.0	ent ratio

hydraulics	
0.0	velocity (ft/sec)
0.0	discharge rate, Q (cfs)
0.00	shear stress ((lbs/ft sq)
0.00	shear velocity (ft/sec)
0.000	unit stream power (lbs/ft/sec)
0.00	Froude number
0.0	friction factor u/u*
~~0.0~~	threshold grain size (mm)

check from channel material			
19	measured D84 (mm)		
27.6	relative roughness	11.0	fric. factor
0.000	Manning's n from channel material		

Weighted Pebble Count

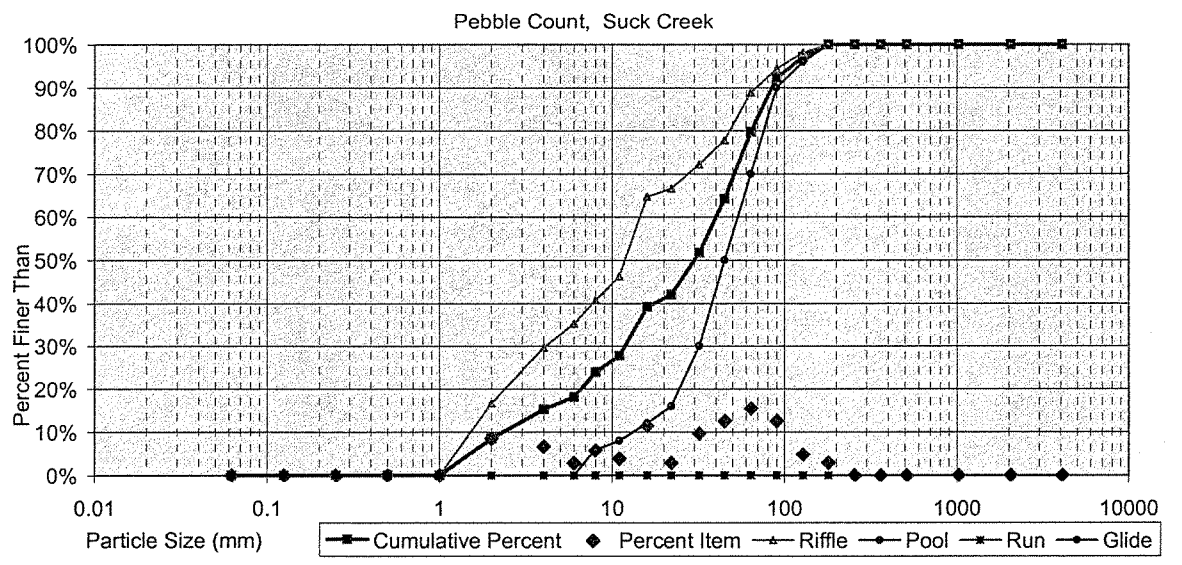
Percent Riffle:	50	Percent Run:	
Percent Pool:	50	Percent Glide:	

Pebble Count,

	Suck Creek

	Reference Downstream of Bridge
Note:	

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	0.0	# #
very fine sand	0.062	0.13	0.0	# #
fine sand	0.13	0.25	0.0	# #
medium sand	0.25	0.5	0.0	# #
coarse sand	0.5	1	0.0	# #
very coarse sand	1	2	8.3	# #
very fine gravel	2	4	6.5	# #
fine gravel	4	6	2.8	# #
fine gravel	6	8	5.6	# #
medium gravel	8	11	3.7	# #
medium gravel	11	16	11.1	# #
coarse gravel	16	22	2.8	# #
coarse gravel	22	32	9.4	# #
very coarse gravel	32	45	12.2	# #
very coarse gravel	45	64	15.0	# #
small cobble	64	90	12.2	# #
medium cobble	90	128	4.7	# #
large cobble	128	180	2.8	# #
very large cobble	180	256	0.0	# #
small boulder	256	362	0.0	# #
small boulder	362	512	0.0	# #
medium boulder	512	1024	0.0	# #
large boulder	1024	2048	0.0	# #
very large boulder	2048	4096	0.0	# #
bedrock			2.8	#
		Weighted Count:	100	
		True Total Particle Count:	107	



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
4.451	13.96	29.9	72	110	0%	8%	69%	20%	0%	3%

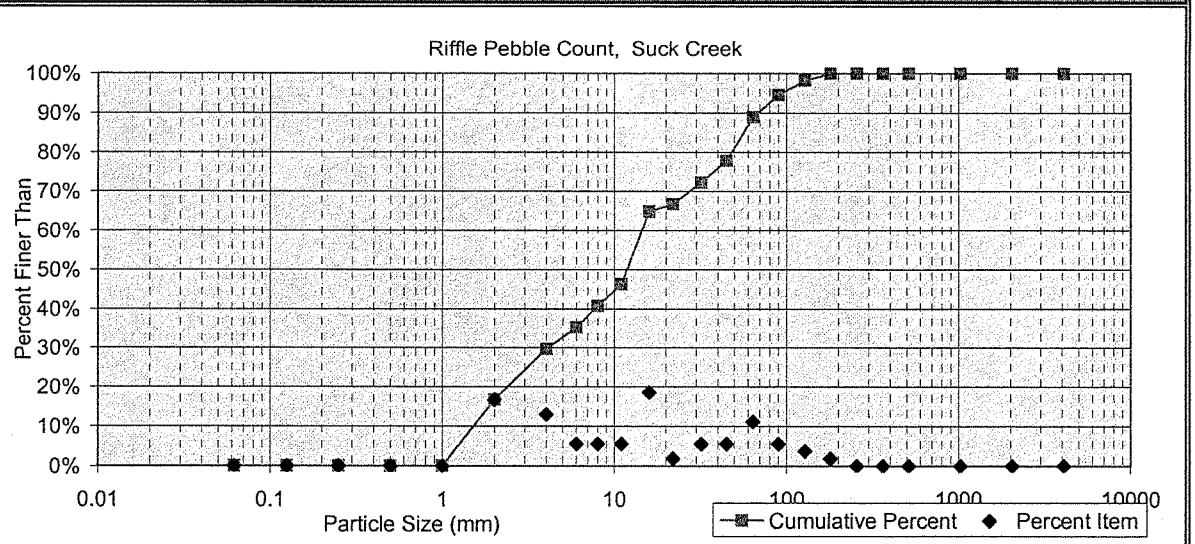
Riffle Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	9
very fine gravel	2	4	7
fine gravel	4	6	3
fine gravel	6	8	3
medium gravel	8	11	3
medium gravel	11	16	10
coarse gravel	16	22	1
coarse gravel	22	32	3
very coarse gravel	32	45	3
very coarse gravel	45	64	6
small cobble	64	90	3
medium cobble	90	128	2
large cobble	128	180	1
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			54

Riffle Pebble Count

	Suck Creek

	Reference Downstream of Bridge
Note:	



Size percent less than (mm)				
D16	D35	D50	D84	D95
1.945	5.92	11.9	55	95

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	17%	72%	11%	0%	0%

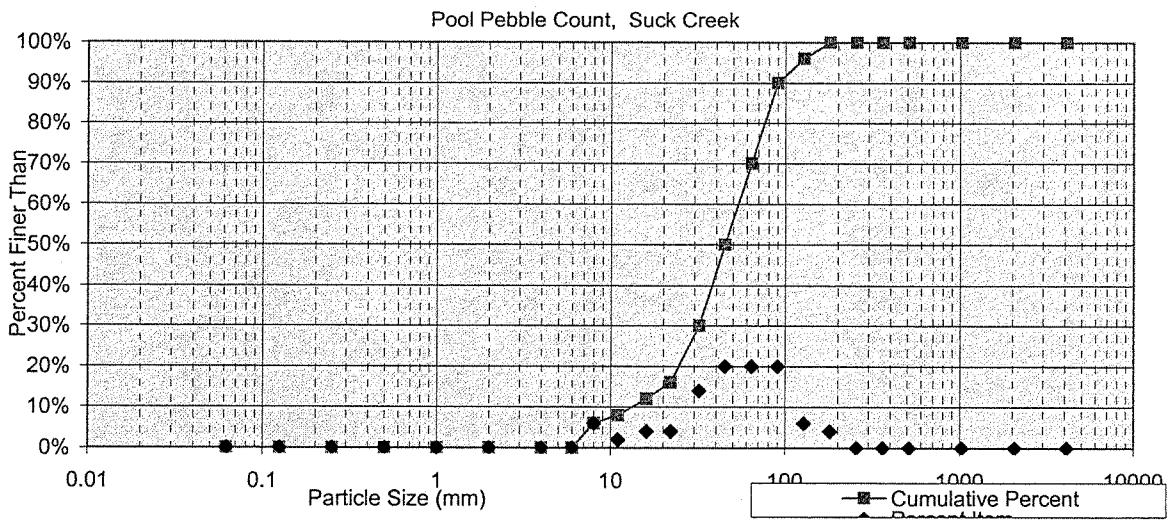
Pool Pebble Count

Material	Size Range (mm)		Count	
silt/clay	0	0.062		#
very fine sand	0.062	0.13		#
fine sand	0.13	0.25		#
medium sand	0.25	0.5		#
coarse sand	0.5	1		#
very coarse sand	1	2		#
very fine gravel	2	4		#
fine gravel	4	6		#
fine gravel	6	8	3	#
medium gravel	8	11	1	#
medium gravel	11	16	2	#
coarse gravel	16	22	2	#
coarse gravel	22	32	7	#
very coarse gravel	32	45	10	#
very coarse gravel	45	64	10	#
small cobble	64	90	10	#
medium cobble	90	128	3	#
large cobble	128	180	2	#
very large cobble	180	256		#
small boulder	256	362		#
small boulder	362	512		#
medium boulder	512	1024		#
large boulder	1024	2048		#
very large boulder	2048	4096		#
bedrock			3	#
Total Particle Count:			53	

Pool Pebble Count

	Suck Creek

	Reference Downstream of Bridge
Note:	



Size percent less than (mm)				
D16	D35	D50	D84	D95
22.000	34.85	45.0	81	121

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	0%	66%	28%	0%	6%

Appendix E
Site Photos

Photo 1a: *View of the first 800 feet of the project reach near the first ford crossing, looking upstream.*

Photo 1b: *View of the first 800 feet of the project reach near first ford crossing, looking downstream.*

Photo 2: *Looking downstream from the project stream's upper section; woody vegetation is not present on stream.*

Photo 3: *Looking downstream from the project stream's lower section; woody vegetation is present on stream banks, but is falling in due to erosion.*

Photo 4: *Looking downstream of upper section of project stream; the stream channel is unstable due to denuded banks and hoof shear.*

Photo 5: *Looking upstream at the cross-section of the reference reach on Suck Creek upstream of the project, near the fence line of Robertson property. The Rosgen stream type is B4.*

***Photo 6:** Looking downstream from the cross-section of the reference reach on Suck Creek approximately 300 feet downstream of Beulah Hill Church Road. The Rosgen stream type is B4.*

***Photo 7:** Looking downstream from cross section of B4 type reference reach located on Suck Creek upstream of project and located 325 feet downstream of Beulah Hill Church Road.*

Photo 8: *Looking upstream at the existing upstream ford crossing.*

Appendix F
EDR

The EDR Radius Map
with GeoCheck®

Suck Creek
Richardson Rd
Carthage, NC 28327

Inquiry Number: 747152.3s

March 19, 2002

Environmental Data Resources, Inc.

The Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

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

FORM-HOW

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The report meets the government records search requirements of ASTM Standard Practice for Environmental Site Assessments, E 1527-00. Search distances are per ASTM standard or custom distances requested by the user.

TARGET PROPERTY INFORMATION

ADDRESS

RICHARDSON RD
CARTHAGE, NC 28327

COORDINATES

Latitude (North):	35.330600 - 35° 19' 50.2"
Longitude (West):	79.539800 - 79° 32' 23.3"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	632715.4
UTM Y (Meters):	3910486.0

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property:	2435079-C5 ZION GROVE, NC
Source:	USGS 7.5 min quad index

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 ASTM E 1527-00 search radius around the target property for the following databases:

FEDERAL ASTM STANDARD

NPL ---------- National Priority List
Proposed NPL ---------- Proposed National Priority List Sites
CERCLIS ---------- Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP ---------- CERCLIS No Further Remedial Action Planned
CORRACTS ---------- Corrective Action Report
RCRIS-TSD ---------- Resource Conservation and Recovery Information System
RCRIS-LQG ---------- Resource Conservation and Recovery Information System
RCRIS-SQG ---------- Resource Conservation and Recovery Information System
ERNS ---------- Emergency Response Notification System

STATE ASTM STANDARD

SHWS ---------- Inactive Hazardous Sites Inventory
SWF/LF ---------- List of Solid Waste Facilities
LUST ---------- Incidents Management Database
UST ---------- Petroleum Underground Storage Tank Database

EXECUTIVE SUMMARY

AST..... AST Database

FEDERAL ASTM SUPPLEMENTAL

CONSENT..... Superfund (CERCLA) Consent Decrees
ROD..... Records Of Decision
Delisted NPL..... National Priority List Deletions
FINDS..... Facility Index System/Facility Identification Initiative Program Summary Report
HMIRS..... Hazardous Materials Information Reporting System
MLTS..... Material Licensing Tracking System
MINES..... Mines Master Index File
NPL Liens..... Federal Superfund Liens
PADS..... PCB Activity Database System
RAATS..... RCRA Administrative Action Tracking System
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)

STATE OR LOCAL ASTM SUPPLEMENTAL

NC HSDS..... Hazardous Substance Disposal Site
IMD..... Incident Management Database

EDR PROPRIETARY HISTORICAL DATABASES

Coal Gas..... Former Manufactured Gas (Coal Gas) Sites

SURROUNDING SITES: SEARCH RESULTS

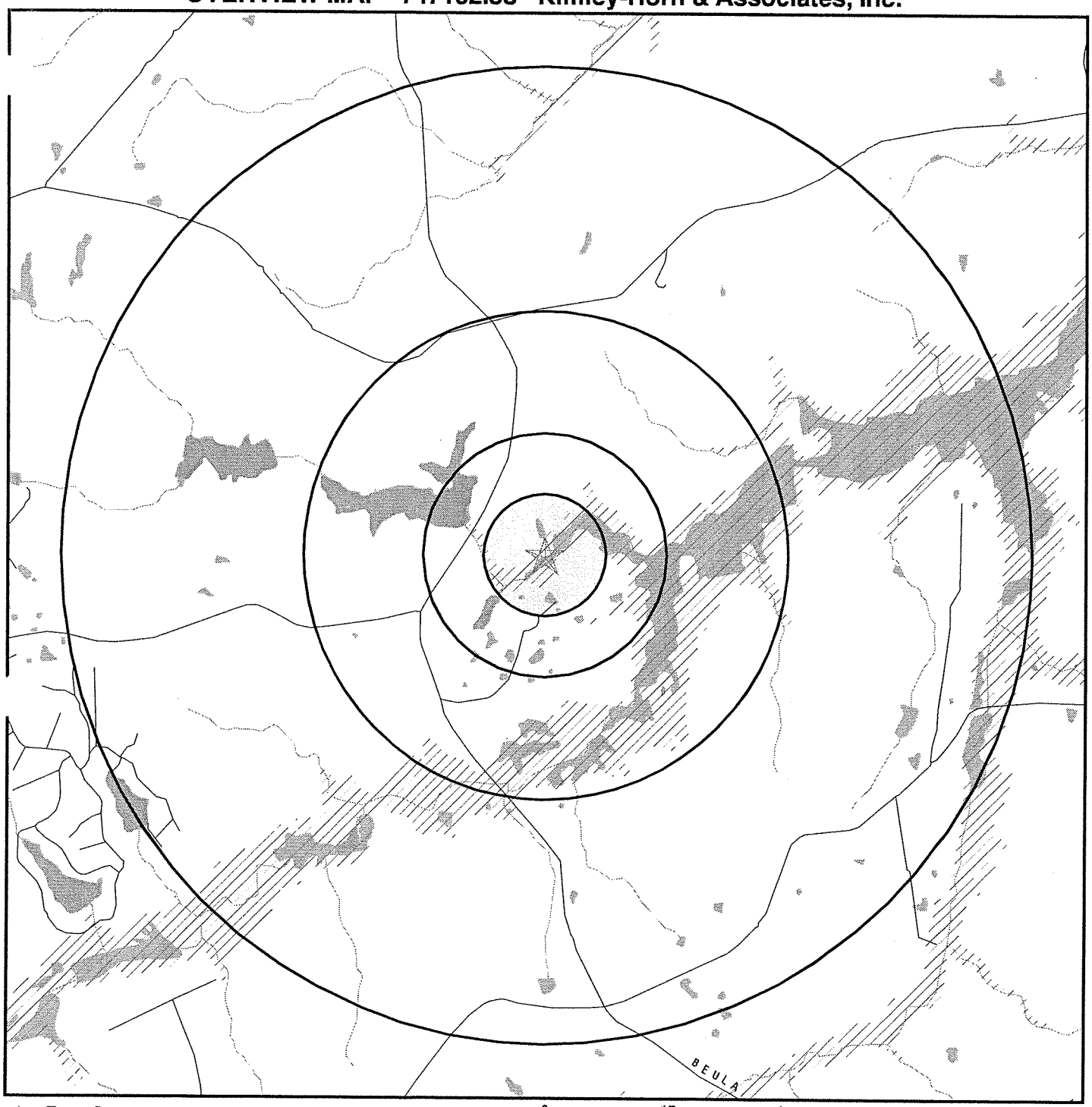
Surrounding sites were not identified.

EXECUTIVE SUMMARY

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

Site Name	Database(s)
MOORE COUNTY SCHOOL DISTRICT	FINDS, FTTS
ROY F. BURT ENTERPRISES	SHWS
STANLEY CASE GOODS (FORMER)	SHWS
ALEX CADDELL'S EXXON	LUST, IMD
CAROLINA WATER SERVICE	LUST, IMD
CORNWALLS SERVICE STATION	UST
HILLCREST COMMUNITY STORE	UST
SPIVEYS GARAGE	UST
CARTHAGE FOOD MART	UST
ALEX'S EXXON	UST
TAYLOR'S EXXON	UST
D & M SERVICE	UST
BUNA B. MCLEOD	UST
SANDHILLS FARMLIFE	UST
SHORT STOP #11	UST
SHORT STOP #76	UST
PINEHALL SERVICE STATION	UST
PROPERTY OF DEXTER SPORTS SUP	UST
COX 15-501 CITGO	UST
FUEL MATE EXPRESS #4	UST
SANDHILLS ELEMENTARY SCHOOL	UST
DUART	UST
DIV OF HWYS (ASPHALT STORAGE FAC)	AST
DIV OF HWYS (MOORE CO MAINT)	AST

OVERVIEW MAP - 747152.3s - Kimley-Horn & Associates, Inc.



☆ Target Property

▲ Sites at elevations higher than or equal to the target property

◆ Sites at elevations lower than the target property

Coal Gasification Sites

National Priority List Sites

Landfill Sites

0 1/2 1 2 Miles

Power transmission lines

Oil & Gas pipelines

100-year flood zone

500-year flood zone

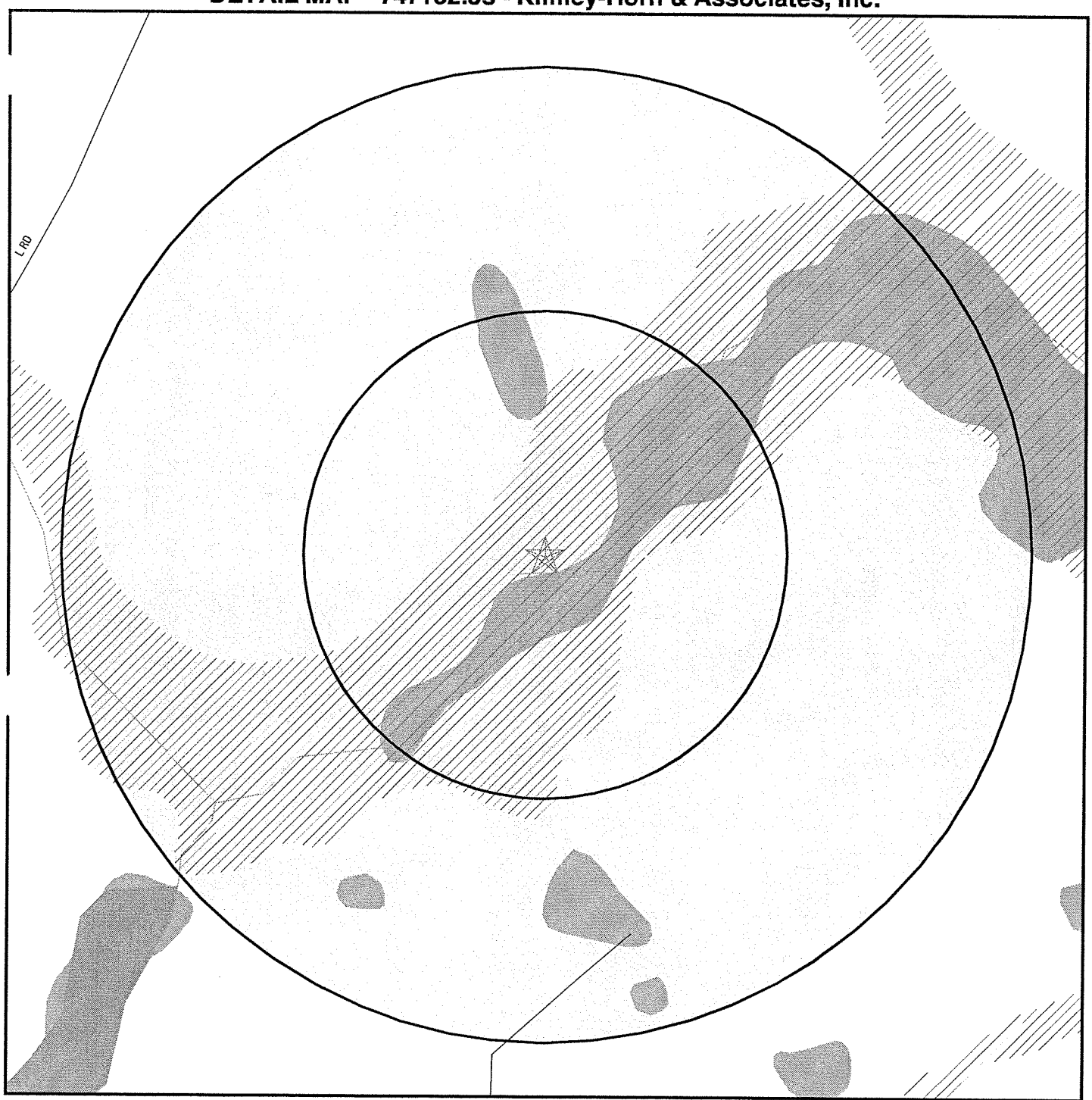
Wetlands

Hazardous Substance Disposal Sites

N

TARGET PROPERTY:	Suck Creek	CUSTOMER:	Kimley-Horn & Associates, Inc.
ADDRESS:	Richardson Rd	CONTACT:	NGHI THIEU
CITY/STATE/ZIP:	Carthage NC 28327	INQUIRY #:	747152.3s
LAT/LONG:	35.3306 / 79.5398	DATE:	March 19, 2002 10:42 am

DETAIL MAP - 747152.3s - Kimley-Horn & Associates, Inc.



☆ Target Property

▲ Sites at elevations higher than or equal to the target property

◆ Sites at elevations lower than the target property

Coal Gasification Sites

Sensitive Receptors

National Priority List Sites

Landfill Sites

0 1/16 1/8 1/4 Miles

Power transmission lines

Oil & Gas pipelines

100-year flood zone

500-year flood zone

Wetlands

Hazardous Substance Disposal Sites

TARGET PROPERTY:	Suck Creek	CUSTOMER:	Kimley-Horn & Associates, Inc.
ADDRESS:	Richardson Rd	CONTACT:	NGHI THIEU
CITY/STATE/ZIP:	Carthage NC 28327	INQUIRY #:	747152.3s
LAT/LONG:	35.3306 / 79.5398	DATE:	March 19, 2002 10:42 am

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 ASTM STANDARD								
NPL		1.250	0	0	0	0	0	0
Proposed NPL		1.250	0	0	0	0	0	0
CERCLIS		0.750	0	0	0	0	NR	0
CERC-NFRAP		0.500	0	0	0	NR	NR	0
CORRACTS		1.250	0	0	0	0	0	0
RCRIS-TSD		0.750	0	0	0	0	NR	0
RCRIS Lg. Quan. Gen.		0.500	0	0	0	NR	NR	0
RCRIS Sm. Quan. Gen.		0.500	0	0	0	NR	NR	0
ERNS		0.250	0	0	NR	NR	NR	0
STATE ASTM STANDARD								
State Haz. Waste		1.250	0	0	0	0	0	0
State Landfill		0.750	0	0	0	0	NR	0
LUST		0.750	0	0	0	0	NR	0
UST		0.500	0	0	0	NR	NR	0
AST		0.250	0	0	NR	NR	NR	0
FEDERAL ASTM SUPPLEMENTAL								
CONSENT		1.250	0	0	0	0	0	0
ROD		1.250	0	0	0	0	0	0
Delisted NPL		1.250	0	0	0	0	0	0
FINDS		0.250	0	0	NR	NR	NR	0
HMIRS		0.250	0	0	NR	NR	NR	0
MLTS		0.250	0	0	NR	NR	NR	0
MINES		0.500	0	0	0	NR	NR	0
NPL Liens		0.250	0	0	NR	NR	NR	0
PADS		0.250	0	0	NR	NR	NR	0
RAATS		0.250	0	0	NR	NR	NR	0
TRIS		0.250	0	0	NR	NR	NR	0
TSCA		0.250	0	0	NR	NR	NR	0
FTTS		0.250	0	0	NR	NR	NR	0
STATE OR LOCAL ASTM SUPPLEMENTAL								
NC HSDS		1.250	0	0	0	0	0	0
IMD		0.250	0	0	NR	NR	NR	0
EDR PROPRIETARY HISTORICAL DATABASES								
Coal Gas		1.250	0	0	0	0	0	0
AQUIFLOW - see EDR Physical Setting Source Addendum								

TP = Target Property

NR = Not Requested at this Search Distance

* Sites may be listed in more than one database

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

NO SITES FOUND

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
CARTHAGE	U001203793	CORNWALLS SERVICE STATION	RT 1 BOX 1	28327	UST	0-027757
CARTHAGE	U003007872	HILLCREST COMMUNITY STORE	4915 HWY 15-501 SOUTH	28327	UST	0-002678
CARTHAGE	S104919087	ROY F. BURT ENTERPRISES	HWY 15/501	28327	SHWS	NONCD0000064
CARTHAGE	U001199547	SPIVEYS GARAGE	S.R. 1637	28327	UST	0-020943
CARTHAGE	A100187560	DIV OF HWYS (ASPHALT STORAGE FAC)	RT 2	28327	AST	
CARTHAGE	A100187563	DIV OF HWYS (MOORE CO MAINT)	RT 2	28327	AST	
CARTHAGE	U003134167	CARTHAGE FOOD MART	HIGHWAY 22/24/27 WEST	28327	UST	0-002687
CARTHAGE	1004433163	MOORE COUNTY SCHOOL DISTRICT	HWY 24	28327	FINDS, FTTS	
CARTHAGE	S101573426	ALEX CADDELL'S EXXON	HWY 24-27	28327	LUST, IMD	11630
CARTHAGE	U003562836	ALEX'S EXXON	HWY 24-27	28327	UST	0-020660
CARTHAGE	U003562839	TAYLOR'S EXXON	HWY 24-27	28327	UST	0-020673
CARTHAGE	U001199381	D & M SERVICE	10600 HIGHWAY 24/27	28327	UST	0-020617
CARTHAGE	U001200556	BUNA B. MCLEOD	RT. 4 BOX 106	28327	UST	0-022660
CARTHAGE	U001204787	SANDHILLS FARMLIFE	RT 4	28327	UST	0-029512
CARTHAGE	S101572074	CAROLINA WATER SERVICE	RT 5 BOX 41	28327	LUST, IMD	7795
CARTHAGE	U001187264	SHORT STOP #11	PO BOX 1327/ HIGHWAY 15/501	28327	UST	0-001903
CARTHAGE	U003145529	SHORT STOP #76	PO BOX 1237 HIGHWAY 15 501 EAST	28327	UST	0-020906
CARTHAGE	U001200561	PINEHALL SERVICE STATION	CARTHAGE & VASS HWY	28327	UST	0-022665
CARTHAGE	U001440022	PROPERTY OF DEXTER SPORTS SUP	CORNER OF US 15/50/AND SR 1661	28327	UST	0-033407
CARTHAGE	U001187750	COX 15-501 CITGO	15-501 HIGHWAY	28327	UST	0-002634
CARTHAGE	U001206329	FUEL MATE EXPRESS #4	7249 15-501 HWY	28327	UST	0-032404
CARTHAGE	U001206282	SANDHILLS ELEMENTARY SCHOOL	STATE ROAD 1831	28327	UST	0-032330
DUART	U001201489	DUART	N.C. HIGHWAY 87	28327	UST	0-023988
WEST END	S103554572	STANLEY CASE GOODS (FORMER)	HWY 211	27376	SHWS	NCD049845266

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM STANDARD RECORDS

NPL: National Priority List
Source: EPA
Telephone: N/A
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 01/29/02
Date Made Active at EDR: 02/25/02
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 02/04/02
Elapsed ASTM days: 21
Date of Last EDR Contact: 02/04/02

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 6
Telephone: 214-655-6659

EPA Region 8
Telephone: 303-312-6774

Proposed NPL: Proposed National Priority List Sites
Source: EPA
Telephone: N/A

Date of Government Version: 01/17/02
Date Made Active at EDR: 02/25/02
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 02/04/02
Elapsed ASTM days: 21
Date of Last EDR Contact: 02/04/02

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 11/21/01
Date Made Active at EDR: 02/04/02
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 12/26/01
Elapsed ASTM days: 40
Date of Last EDR Contact: 12/26/01

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 11/21/01
Date Made Active at EDR: 02/04/02
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/26/01
Elapsed ASTM days: 40
Date of Last EDR Contact: 12/16/01

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 11/14/01
Date Made Active at EDR: 01/14/02
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 11/14/01
Elapsed ASTM days: 61
Date of Last EDR Contact: 11/14/01

RCRIS: Resource Conservation and Recovery Information System
Source: EPA/NTIS
Telephone: 800-424-9346
Resource Conservation and Recovery Information System. RCRIS includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA).

Date of Government Version: 06/21/00
Date Made Active at EDR: 07/31/00
Database Release Frequency: Varies
Date of Data Arrival at EDR: 07/10/00
Elapsed ASTM days: 21
Date of Last EDR Contact: 01/14/02

ERNS: Emergency Response Notification System
Source: EPA/NTIS
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 08/08/00
Date Made Active at EDR: 09/06/00
Database Release Frequency: Varies
Date of Data Arrival at EDR: 08/11/00
Elapsed ASTM days: 26
Date of Last EDR Contact: 02/01/02

FEDERAL ASTM SUPPLEMENTAL RECORDS

BRS: Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/99
Database Release Frequency: Biennially
Date of Last EDR Contact: 12/17/01
Date of Next Scheduled EDR Contact: 03/18/02

CONSENT: Superfund (CERCLA) Consent Decrees
Source: EPA Regional Offices
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: N/A
Database Release Frequency: Varies
Date of Last EDR Contact: N/A
Date of Next Scheduled EDR Contact: N/A

ROD: Records Of Decision
Source: NTIS
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 09/30/00
Database Release Frequency: Annually

Date of Last EDR Contact: 01/07/02
Date of Next Scheduled EDR Contact: 04/08/02

DELISTED NPL: National Priority List Deletions
Source: EPA
Telephone: N/A
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 01/29/02
Database Release Frequency: Quarterly

Date of Last EDR Contact: 02/04/02
Date of Next Scheduled EDR Contact: 05/06/02

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 10/29/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/07/02
Date of Next Scheduled EDR Contact: 04/08/02

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4526
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 09/30/01
Database Release Frequency: Annually

Date of Last EDR Contact: 01/21/02
Date of Next Scheduled EDR Contact: 04/22/02

MLTS: Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 10/25/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/07/02
Date of Next Scheduled EDR Contact: 04/08/02

MINES: Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959

Date of Government Version: 12/14/01
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 01/02/02
Date of Next Scheduled EDR Contact: 04/01/02

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 02/26/02
Date of Next Scheduled EDR Contact: 05/27/02

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-260-3936
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 09/30/01
Database Release Frequency: Annually

Date of Last EDR Contact: 02/12/02
Date of Next Scheduled EDR Contact: 05/13/02

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 12/11/01
Date of Next Scheduled EDR Contact: 03/11/02

TRIS: Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-260-1531
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/99
Database Release Frequency: Annually

Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

TSCA: Toxic Substances Control Act
Source: EPA
Telephone: 202-260-5521
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/98
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 01/22/02
Date of Next Scheduled EDR Contact: 04/22/02

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-564-2501
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 01/11/02
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA
Telephone: 202-564-2501

Date of Government Version: 01/14/02
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

STATE OF NORTH CAROLINA ASTM STANDARD RECORDS

SHWS: Inactive Hazardous Sites Inventory
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801
State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 01/02/02
Date Made Active at EDR: 02/12/02
Database Release Frequency: Annually
Date of Data Arrival at EDR: 01/16/02
Elapsed ASTM days: 27
Date of Last EDR Contact: 01/16/02

SWF/LF: List of Solid Waste Facilities
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-0692
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 01/02/02
Date Made Active at EDR: 02/01/02
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/15/02
Elapsed ASTM days: 17
Date of Last EDR Contact: 01/14/02

LUST: Incidents Management Database
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-1315
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 12/10/01
Date Made Active at EDR: 01/02/02
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/10/01
Elapsed ASTM days: 23
Date of Last EDR Contact: 12/10/01

UST: Petroleum Underground Storage Tank Database
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-1308
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/02/01
Date Made Active at EDR: 12/20/01
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/10/01
Elapsed ASTM days: 10
Date of Last EDR Contact: 12/10/01

AST: AST Database
Source: Department of Environment, Health & Natural Resources
Telephone: 919-715-6170
Facilities with aboveground storage tanks that have a capacity greater than 21,000 gallons.

Date of Government Version: 01/02/02
Date Made Active at EDR: 02/04/02
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/22/02
Elapsed ASTM days: 13
Date of Last EDR Contact: 01/22/02

STATE OF NORTH CAROLINA ASTM SUPPLEMENTAL RECORDS

HSDS: Hazardous Substance Disposal Site
Source: North Carolina Center for Geographic Information and Analysis
Telephone: 919-733-2090
Locations of uncontrolled and unregulated hazardous waste sites. The file includes sites on the National Priority List as well as those on the state priority list.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 06/21/95
Database Release Frequency: Biennially

Date of Last EDR Contact: 03/05/02
Date of Next Scheduled EDR Contact: 06/03/02

IMD: Incident Management Database
Source: Department of Health and Natural Resources
Telephone: 919-733-1315
Groundwater and/or soil contamination incidents

Date of Government Version: 01/25/02
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/28/02
Date of Next Scheduled EDR Contact: 04/29/02

EDR PROPRIETARY HISTORICAL DATABASES

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. ©Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

Disclaimer Provided by Real Property Scan, Inc.

The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Oil/Gas Pipelines/Electrical Transmission Lines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines and electrical transmission lines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 1999 from the U.S. Fish and Wildlife Service.

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

SUCK CREEK
RICHARDSON RD
CARTHAGE, NC 28327

TARGET PROPERTY COORDINATES

Latitude (North):	35.330601 - 35° 19' 50.2"
Longitude (West):	79.539803 - 79° 32' 23.3"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	632715.4
UTM Y (Meters):	3910486.0

EDR's GeoCheck Physical Setting Source Addendum has been developed to assist the environmental professional with the collection of physical setting source information in accordance with ASTM 1527-00, Section 7.2.3. Section 7.2.3 requires that a current USGS 7.5 Minute Topographic Map (or equivalent, such as the USGS Digital Elevation Model) be reviewed. It also requires that one or more additional physical setting sources be sought when (1) conditions have been identified in which hazardous substances or petroleum products are likely to migrate to or from the property, and (2) more information than is provided in the current USGS 7.5 Minute Topographic Map (or equivalent) is generally obtained, pursuant to local good commercial or customary practice, to assess the impact of migration of recognized environmental conditions in connection with the property. Such additional physical setting sources generally include information about the topographic, hydrologic, hydrogeologic, and geologic characteristics of a site, and wells in the area.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata. EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

USGS TOPOGRAPHIC MAP ASSOCIATED WITH THIS SITE

Target Property: 2435079-C5 ZION GROVE, NC
Source: USGS 7.5 min quad index

GENERAL TOPOGRAPHIC GRADIENT AT TARGET PROPERTY

Target Property: General SE

Source: General Topographic Gradient has been determined from the USGS 1 Degree Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
MOORE, NC	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property: 37125C0075C / CWPP

Additional Panels in search area: 37125C0100C / CWPP
37125C0090C / CWPP

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
ZION GROVE	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

AQUIFLOW®

Search Radius: 2.000 Miles.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Mesozoic
System:	Triassic
Series:	Triassic
Code:	Tr *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	MAYODAN
Soil Surface Texture:	sandy loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel: HIGH

Depth to Bedrock Min: > 60 inches

Depth to Bedrock Max: > 60 inches

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	12 inches	sandy loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COURSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 6.00 Min: 2.00	Max: 6.00 Min: 4.50
2	12 inches	18 inches	silty clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 2.00 Min: 0.60	Max: 6.00 Min: 4.50
3	18 inches	47 inches	clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit 50% or more), Elastic silt.	Max: 2.00 Min: 0.60	Max: 5.50 Min: 4.50
4	47 inches	60 inches	variable	Not reported	Not reported	Max: 0.00 Min: 0.00	Max: 0.00 Min: 0.00

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: silt loam
fine sandy loam
channery - silt loam
clay loam
loam

Surficial Soil Types: silt loam
fine sandy loam
channery - silt loam
clay loam
loam

Shallow Soil Types: loam
sandy clay loam
clay
very channery - silt loam
silt loam

Deeper Soil Types: unweathered bedrock

weathered bedrock
loamy sand

ADDITIONAL ENVIRONMENTAL RECORD SOURCES

According to ASTM E 1527-00, Section 7.2.2, "one or more additional state or local sources of environmental records may be checked, in the discretion of the environmental professional, to enhance and supplement federal and state sources... Factors to consider in determining which local or additional state records, if any, should be checked include (1) whether they are reasonably ascertainable, (2) whether they are sufficiently useful, accurate, and complete in light of the objective of the records review (see 7.1.1), and (3) whether they are obtained, pursuant to local, good commercial or customary practice." One of the record sources listed in Section 7.2.2 is water well information. Water well information can be used to assist the environmental professional in assessing sources that may impact groundwater flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

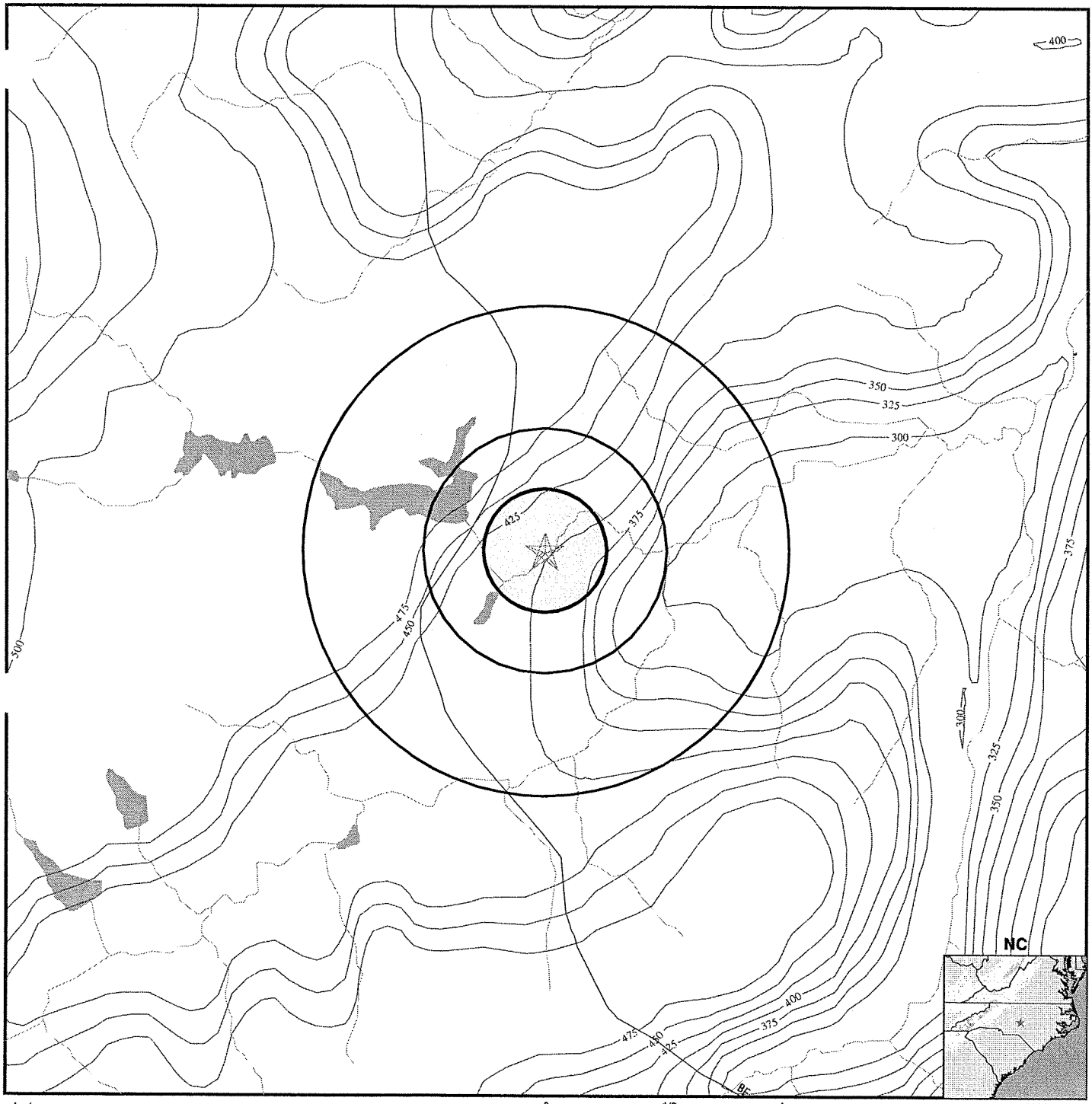
MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

PHYSICAL SETTING SOURCE MAP - 747152.3s



- Major Roads
- Contour Lines
- Water Wells
- Public Water Supply Wells
- Groundwater Flow Direction
- Indeterminate Groundwater Flow at Location
- Groundwater Flow Varies at Location
- Cluster of Multiple Icons
- Earthquake epicenter, Richter 5 or greater
- Wildlife Areas
- Natural Areas
- Rare & Endangered Species

TARGET PROPERTY:	Suck Creek	CUSTOMER:	Kimley-Horn & Associates, Inc.
ADDRESS:	Richardson Rd	CONTACT:	NGHI THIEU
CITY/STATE/ZIP:	Carthage NC 28327	INQUIRY #:	747152.3s
LAT/LONG:	35.3306 / 79.5398	DATE:	March 19, 2002 10:43 am

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

Federal EPA Radon Zone for MOORE County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

MOORE COUNTY, NC

Number of sites tested: 7

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.329 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

PHYSICAL SETTING SOURCE RECORDS SEARCHED

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 1999 from the U.S. Fish and Wildlife Service.

HYDROGEOLOGIC INFORMATION

AQUIFLOW[R] Information System

Source: EDR proprietary database of groundwater flow information

EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit

Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the national Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

ADDITIONAL ENVIRONMENTAL RECORD SOURCES

FEDERAL WATER WELLS

PWS: Public Water Systems

Source: EPA/Office of Drinking Water

Telephone: 202-260-2805

Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data

Source: EPA/Office of Drinking Water

Telephone: 202-260-2805

Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: In November 1971 the United States Geological Survey (USGS) implemented a national water resource information tracking system. This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on more than 900,000 wells, springs, and other sources of groundwater.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STATE RECORDS

North Carolina Wildlife Resources/Game Lands
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
All publicly owned game lands managed by the North Carolina Wildlife Resources Commission and as listed in Hunting and Fishing Maps for North Carolina Game Lands, 1989-90.

North Carolina Rare/Endangered Species and Natural Areas
Source: Natural Heritage Occurrence Sites Center for Geographic Information and Analysis
Telephone: 919-733-2090

North Carolina Public Water Supply Wells
Source: Department of Environmental Health
Telephone: 919-715-3243

RADON

Area Radon Information: The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

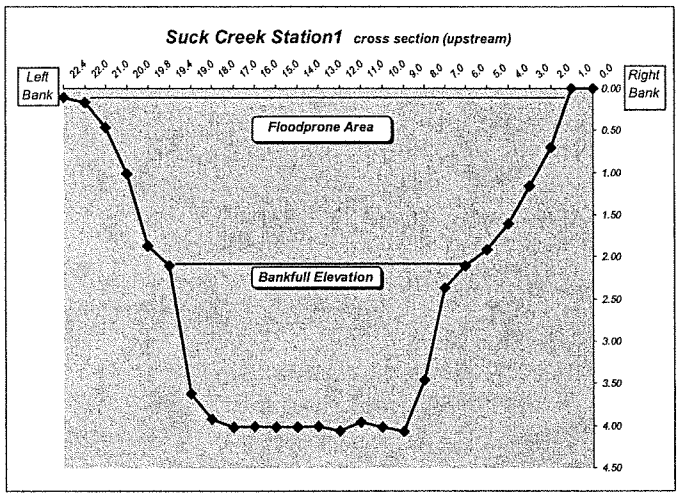
EPA Radon Zones: Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Appendix G
NCSU Data on Project Site
(1997-1999)

Field Crew: Neil W, Will H, Dan C
Date: 5/23/1997
Location: Suck Creek. Aprox. 150ft downstream of bridge
Purpose: Develop permanent x-section as reference for stream bank stabilization at Richardson's
Weather: Clear and sunny



(note)	Width (ft.)	Depth (ft.)	Corrected Depth	Bankfull elevation	bkf area
RFP	0.0	0.18	0.00		
	1.0	0.18	0.00		
	2.0	0.88	0.70		
	3.0	1.34	1.16		
	4.0	1.79	1.61		
	5.0	2.10	1.92		
BKF	6.0	2.29	2.11	0.00	0.00
	7.0	2.55	2.37	0.26	0.26
	8.0	3.64	3.46	1.35	1.35
	9.0	4.25	4.07	1.96	1.96
	10.0	4.20	4.02	1.91	1.91
	11.0	4.14	3.96	1.85	1.85
	12.0	4.24	4.06	1.95	1.95
	13.0	4.19	4.01	1.90	1.90
	14.0	4.20	4.02	1.91	1.91
	15.0	4.20	4.02	1.91	1.91
	16.0	4.19	4.01	1.90	1.90
	17.0	4.20	4.02	1.91	1.91
	18.0	4.10	3.92	1.81	1.81
* EOW	19.0	3.80	3.62	1.51	0.60
estimated bkf	19.4	2.29	2.11	0.00	0.00
	19.8	2.05	1.87		
	20.0	1.20	1.02		
	21.0	0.65	0.47		
	22.0	0.35	0.17		
LFP	22.4	0.29	0.11		

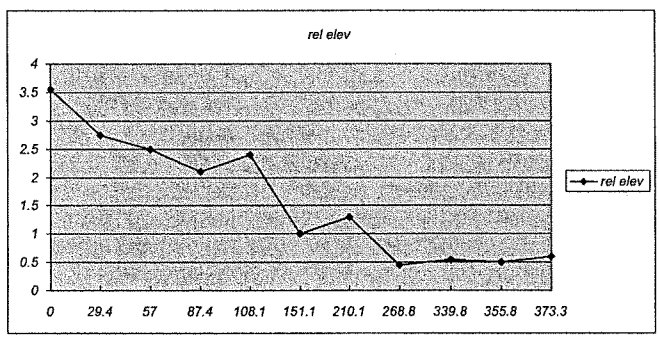
* Agreed upon best indicator of bankfull elevation.

Bankfull Width	13.40
Mean bkf Depth	1.58
Bankfull Stage	1.95
BKF Xsec. Area	21.22
Floodprone Width	21.40
Entrenchment Ratio	1.60

Channel Slope (rough)

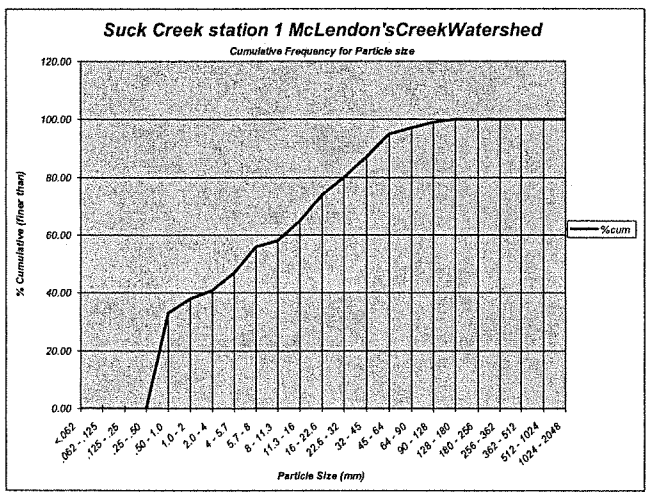
Dist	Elev	rel elev
0	99.36	3.55
29.4	98.56	2.75
57	98.31	2.5
87.4	97.91	2.1
108.1	98.21	2.4
151.1	96.81	1
210.1	97.11	1.3
268.8	96.26	0.45
339.8	96.35	0.54
355.8	96.31	0.5
373.3	96.41	0.6

Slope =	0.0079
% Slope =	0.7902

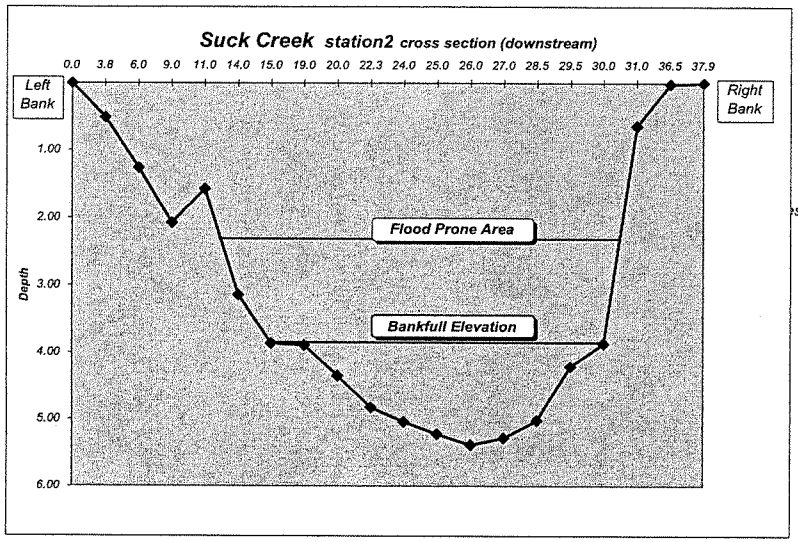


Pebble count

Particle description	Particle size	total #	item %	%cum
Silt/Clay	<.062	0	0	0.00
Very Fine Sand	.062 - .125	0	0	0.00
Fine Sand	.125 - .25	0	0	0.00
Medium Sand	.25 - .50	0	0	0.00
Coarse Sand	.50 - 1.0	33	33	33.00
Very Coarse Sand	1.0 - 2	5	5	38.00
Very Fine Gravel	2.0 - 4	3	3	41.00
Fine (1) Gravel	4 - 5.7	6	6	47.00
Fine (2) Gravel	5.7 - 8	9	9	56.00
Medium (1) Gravel	8 - 11.3	2	2	58.00
Medium (2) Gravel	11.3 - 16	7	7	65.00
Coarse (1) Gravel	16 - 22.6	9	9	74.00
Coarse (2) Gravel	22.6 - 32	6	6	80.00
Very Coarse (1) Gravel	32 - 45	7	7	87.00
Very Coarse (2) Gravel	45 - 64	8	8	95.00
Small (1) Cobbles	64 - 90	2	2	97.00
Small (2) Cobbles	90 - 128	2	2	99.00
Large (1) Cobbles	128 - 180	1	1	100.00
Large (2) Cobbles	180 - 256		0	100.00
Small (1) Boulder	256 - 362		0	100.00
Small (2) Boulder	362 - 512		0	100.00
Medium Boulder	512 - 1024		0	100.00
Large- Very Large Boulder	1024 - 2048		0	100.00
	total # part.	100		



Field Crew: Neil W, Will H, Dan C
Date: 6/4/1997
Location: Suck Creek. Downstream impacted reach.
Purpose: Develop permanent x-section of downstream of impacted reach.
Weather: Aprox 70deg F and overcast



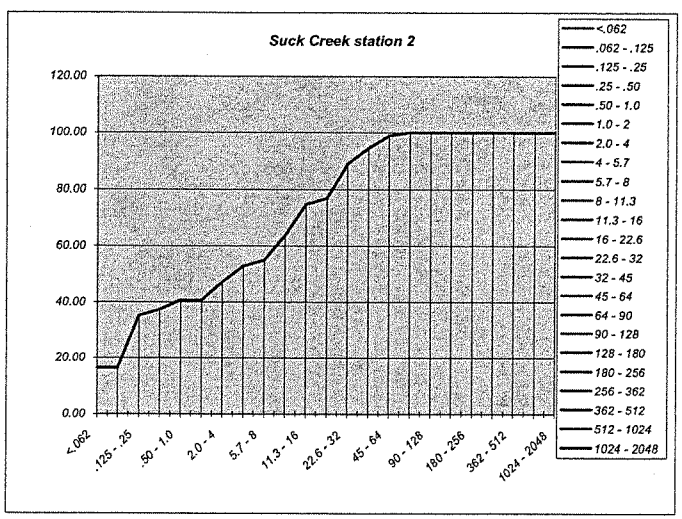
Suck Creek station 2

(note)	Width (ft.)	Depth (ft.)	Corrected Depth	bkf elev	bkf area	Flood Prone Area
LLT (left pin)	0.0	1.58	0.00			
	3.8	2.10	0.52			
	6.0	2.85	1.27			
	9.0	3.66	2.08			
	11.0	3.16	1.58			
	14.0	4.73	3.15			
BKF	15.0	5.44	3.86	0.00	0.00	
	19.0	5.47	3.89	0.03	0.12	
	20.0	5.93	4.35	0.49	0.49	
LEOW	22.3	6.41	4.83	0.97	2.23	
	24.0	6.62	5.04	1.18	2.01	
	25.0	6.80	5.22	1.36	1.36	
Thalweg	26.0	6.96	5.38	1.52	1.52	
	27.0	6.86	5.28	1.42	1.42	
REOW	28.5	6.60	5.02	1.16	1.74	
	29.5	5.79	4.21	0.35	0.35	
estimated bkf	30.0	5.44	3.86	0.00	0.00	
EOT	31.0	2.23	0.65			
	36.5	1.60	0.02			
right pin	37.9	1.58	0.00			

Bankfull Width	15.0
Mean bkf Depth	0.749
Bankfull Stage	20.02
BKF Xsec. Area	11.24
Floodprone Width	17.0
Entrenchment Ratio	1.133

Pebble count

Particle description	Particle size	total #	item %	%cum
Silt/Clay	<.062	15	15	16.48
Very Fine Sand	.062 - .125	0	0	16.48
Fine Sand	.125 - .25	17	17	35.16
Medium Sand	.25 - .50	2	2	37.36
Coarse Sand	.50 - 1.0	3	3	40.66
Very Coarse Sand	1.0 - 2	0	0	40.66
Very Fine Gravel	2.0 - 4	6	6	47.25
Fine (1) Gravel	4 - 5.7	5	5	52.75
Fine (2) Gravel	5.7 - 8	2	2	54.95
Medium (1) Gravel	8 - 11.3	8	8	63.74
Medium (2) Gravel	11.3 - 16	10	10	74.73
Coarse (1) Gravel	16 - 22.6	2	2	76.92
Coarse (2) Gravel	22.6 - 32	11	11	89.01
Very Coarse (1) Gravel	32 - 45	5	5	94.51
Very Coarse (2) Gravel	45 - 64	4	4	98.90
Small (1) Cobbles	64 - 90	1	1	100.00
Small (2) Cobbles	90 - 128		0	100.00
Large (1) Cobbles	128 - 180		0	100.00
Large (2) Cobbles	180 - 256		0	100.00
Small (1) Boulder	256 - 362		0	100.00
Small (2) Boulder	362 - 512		0	100.00
Medium Boulder	512 - 1024		0	100.00
Large- Very Large Boulde	1024 - 2048		0	100.00

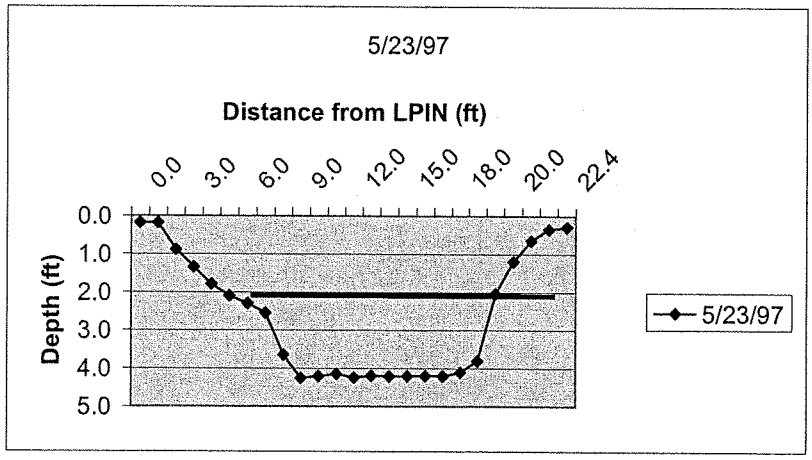


DATE:	5/23/1997
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Suck Creek--Upstream of Richardson Farm; just downstream of Camp.
CREW:	Will Harman, Neil Woerner & Dan Clinton
NOTES:	LPIN located at 0'. X-Sect 1
	RPIN is located at 22.4'.
	Left Bank. Stream Type: B4c

STATION	BS	HI	FS	ELEVATION	NOTES
0.0			0.2		LPIN (rebar)
1.0			0.2		
2.0			0.9		
3.0			1.3		
4.0			1.8		
5.0			2.1		
6.0			2.3		BKF
7.0			2.6		
8.0			3.6		REW
9.0			4.3		
10.0			4.2		
11.0			4.1		
12.0			4.2		
13.0			4.2		
14.0			4.2		
15.0			4.2		
16.0			4.2		
17.0			4.2		
18.0			4.1		
19.0			3.8		LEW
19.8			2.1		
20.0			1.2		
21.0			0.7		
22.0			0.4		
22.4			0.3		LPIN

SITE 1: BANKFULL GEOMETRY CALCS.

WIDTH	DEPTH	AREA
1.0	0.0	0.0
1.0	0.5	0.5
1.0	0.8	0.8
1.0	1.0	1.0
1.0	1.2	1.2
1.0	2.3	2.3
1.0	2.9	2.9
1.0	2.9	2.9
1.0	2.8	2.8
1.0	2.9	2.9
1.0	2.9	2.9
1.0	2.9	2.9
1.0	2.9	2.9
12.0		25.7
	W * 1/3	4.0
	1/3 NB A	5.7
	Anb/A	0.22
	Max D	2.9
	Mean D	2.1
	W/D	5.6
	BEHI	

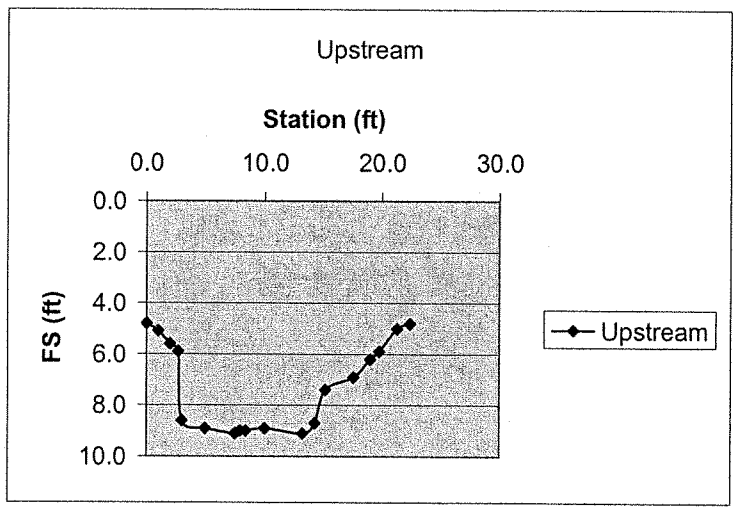


DATE:	7/20/1998
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Suck Creek--Upstream of Richardson Farm; just downstream of Camp.
CREW:	Jan Patterson, Jon Williams & Dan Clinton
NOTES:	LPIN located at 0'.
	RPIN is located at 22.4'.
	Left Bank. X-Sect 1

STATION	BS	HI	FS	ELEVATION	NOTES
0.0			4.8		LPIN (rebar)
1.0			5.1		
2.0			5.6		
2.7			5.9		LBKF
3.0			8.6		LEW/WS
5.0			8.9		
7.5			9.1		TW
7.9			9.0		
8.4			9.0		LIN INTP
10.0			8.9		
13.2			9.1		
14.3			8.7		REW
15.2			7.4		
17.6			6.9		Top Bench
19.0			6.2		
19.8			5.9		RBKF
21.3			5.0		
22.4			4.8		RPIN
4.2			8.3		TOE PIN

SITE 1: BANKFULL GEOMETRY CALCS.

	WIDTH	DEPTH	AREA	
	0.5	0.0	0.0	
	1.2	2.7	3.1	
	2.3	3.0	6.8	
	1.5	3.2	4.6	
	0.5	3.1	1.4	
	1.1	3.1	3.3	
	2.4	3.0	7.2	
	2.2	3.2	6.9	
	1.0	2.8	2.8	
	1.7	1.5	2.5	
	1.9	1.0	1.9	
	1.1	0.3	0.3	
	1.2	0.0	0.0	
	17.1		40.7	
W * 1/3			5.7	
1/3 NB A			19.1	
Anb/A			0.47	Very High
Max D			3.2	
Mean D			2.4	
W/D			7.2	
BEHI			30.1	High



DATE:	5/4/1996
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Suck Creek--Upstream of Richardson Farm; just downstream of Camp.
CREW:	Will Harman, Neil Woerner, Justin & Dan Clinton
NOTES:	Installed TOE PIN (rebar). Exposed Length =0.45 ft.
	X-Sect 1

Pin Ext.	Notes	
0.80	PIN 1 (top)	above LBKF
0.75	PIN 2 (bottom)	below LBKF

DATE:	7/20/1998
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Suck Creek--Upstream of Richardson Farm; just downstream of Camp.
CREW:	Jan Patterson, Jon Williams & Dan Clinton
NOTES:	Horizontal measurements reflect bank profile.
	Pin extensions were taken on bottom of pin
	Toe pin (orange stake) located at 13.8' on X-Sect at elevation ft.
	X-Sect 1

Vertical	Horizontal	Pin Ext.	Notes	Date	Days Between
0.60	1.70	0.80	PIN 2 (bottom)	5/4/1996	
0.90	1.60			7/20/1998	3/17/1902
1.60	1.50			4/1/1999	9/11/1900
2.40	1.70	0.80	PIN 1 (top)		
3.10	2.70				
3.60	4.40				

DATE:	4/1/1999
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Suck Creek--Upstream of Richardson Farm; just downstream of Camp.
CREW:	Dan Clinton
NOTES:	Signs of erosion and undercut. Left Bank.
	X-Sect 1

Pin Ext.	Notes
0.75	PIN 1 (top)
0.80	PIN 2 (bottom)

DATE: 9/2/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect above fence in upper portion of pasture in woods.
CREW: Will Harman & Dan Clinton
NOTES: X-Sect 2

Width	Depth	Area	Notes
0.7	1.3	0.9	Top Bench
1.8	2.7	3.0	EW
9.0	2.3	16.6	
12.0	2.8	8.4	TW
14.0	1.7	3.4	EW
18.0	1.4	5.6	
22.0	0.6	2.4	
24.5	0.0	0.0	
23.8		40.2	

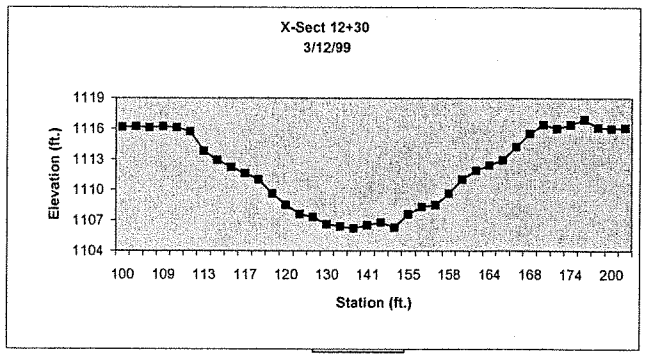
DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect above fence in upper portion of pasture in woods.
CREW: Jan Patterson & Dan Clinton
NOTES: LPIN located at 1.0'. X-Sect 2
RPIN is located at 44.2'.
Weather: clear, breezy ~40 degrees

STATION	BS	HI	FS	ELEVATION	NOTES
1.0			5.18		LPIN
3.0			5.3		
5.5			5.3		Beside Poplar
7.0			6.1		LTOB
8.6			6.8		
9.1			7.2		
9.4			7.9		LBKF
9.8			9.3		
11.0			10.6		LEW
12.4			10.6		
13.3			10.6		
13.8			10.6		TOE PIN
15.0			10.8		
16.3			10.7		
16.4			9.8		Rock
17.7			10.4		
18.3			10.4		LIN INTP
20.0			10.5		
21.0			10.7		
22.0			10.9		TW
24.0			10.7		
25.6			10.8		
27.3			10.7		REW
28.6			9.3		LOW Feature
30.7			8.8		Recent High Water
36.1			7.9		RBKF
37.4			6.6		
40.0			4.9		RTOB
44.2			4.9		RPIN

SITE 2: BANKFULL GEOMETRY CALCS.

	WIDTH	DEPTH	AREA	
	0.4	0.0	0.0	
	0.8	1.4	1.1	
	1.3	2.7	3.5	
	1.2	2.7	3.1	
	0.7	2.7	1.9	
	0.9	2.7	2.3	
	1.3	2.9	3.6	
	0.7	2.8	2.0	
	0.7	1.9	1.3	
	1.0	2.5	2.4	
	1.2	2.5	2.9	
	1.4	2.6	3.5	
	1.0	2.8	2.8	
	1.5	3.0	4.5	
	1.8	2.8	5.0	
	1.7	2.9	4.8	
	1.5	2.8	4.2	
	1.7	1.4	2.4	
	3.8	0.9	3.4	
	3.4	0.0	0.0	
	26.7		54.7	

W * 1/3	8.9	
1/3 NB A	24.1	
Anb/A	0.44	High
Max D	3.0	
Mean D	2.0	
W/D	13.0	
BEHI	29.6	Moderate

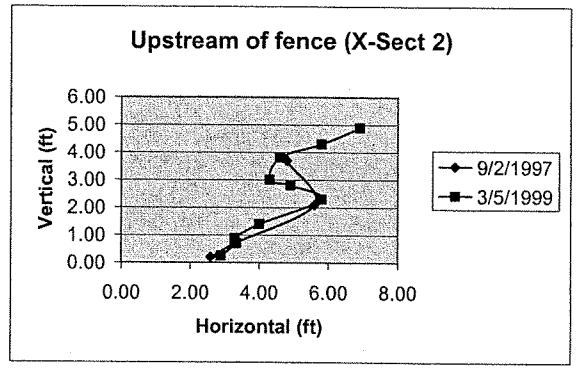


DATE: 9/2/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect above fence in upper portion of pasture in woods.
CREW: Will Harman & Dan Clinton
NOTES: Horizontal measurements reflect ??.
Left Bank X-Sect 2

Vertical	Horizontal	Pin Ext.	Notes	Date	Days Between
0.20	2.60		WS	9/2/1997	
0.70	3.30	0.30	PIN 3 (bottom)	3/5/1999	7/2/1901
2.10	5.60	1.00	PIN 2		
3.70	4.80	0.35	PIN 1 (top)		

DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect above fence in upper portion of pasture in woods.
CREW: Jan Patterson & Dan Clinton
NOTES: Horizontal measurements reflect bank profile.
Pin extensions were taken on bottom of pin X-Sect 2
Toe pin (orange stake) located at 13.8' on X-Sect at elevation ft.

Vertical	Horizontal	Pin Ext.	Notes
0.25	2.90		WS
0.70	3.35	0.35	PIN 3 (bottom)
0.90	3.30		
1.40	4.00		
2.30	5.80	1.20	PIN 2
2.80	4.90		
3.00	4.30		
3.80	4.60	0.25	PIN 1 (top)
4.30	5.80		
4.90	6.90		

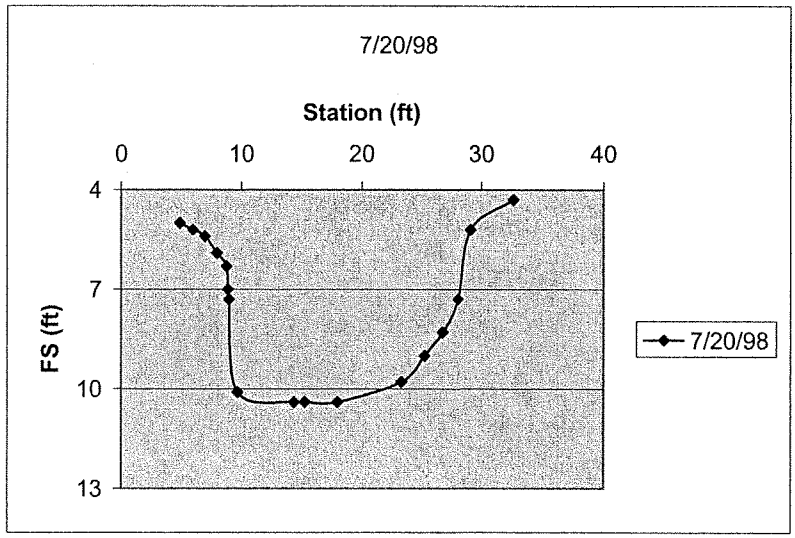


DATE: 7/20/1998
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below fence that crosses stream in woods (3rd X-Sect).
CREW: Jan Patterson, Jon Williams & Dan Clinton
NOTES: LPIN located at 0'. ~200 ft upstream of cattle crossing
RPIN is located at 27.8'.

STATION	BS	HI	FS	ELEVATION	NOTES
4.9			5.00		LPIN/LTOB
6.0			5.2		
7.0			5.4		
8.0			5.9		
8.8			6.3		Edge of Bank
8.9			7.0		PIN 1 (top)
9.0			7.3		LBKF(LIN INTP)
9.7			10.1		LEW
14.4			10.4		TW
15.3			10.4		LIN INTP
18.0			10.4		
23.3			9.8		REW/WS
25.2			9.0		
26.7			8.3		
28.0			7.3		RBKF (moss line)
29.1			5.2		
32.6			4.3		RPIN/RTOB
12.0			10.3		TOE PIN

SITE 3: BANKFULL GOEMETRY CALCS.

	WIDTH	DEPTH	AREA	
	0.4	0.0	0.0	
	2.7	2.8	7.6	
	2.8	3.1	8.7	
	1.8	3.1	5.6	
	4.0	3.1	12.4	
	3.6	2.5	9.0	
	1.7	1.7	2.9	
	1.4	1.0	1.4	
	1.2	0.0	0.0	
	19.0		47.5	
W * 1/3			6.3	
1/3 NB A			21.8	
Anb/A			0.46	Very High
Max D			3.1	
Mean D			2.5	
W/D			7.6	
BEHI			39.6	High



DATE: 9/13/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below fence that crosses stream in woods (3rd X-Sect)
CREW: Louise O'Hara & Dan Clinton
NOTES:

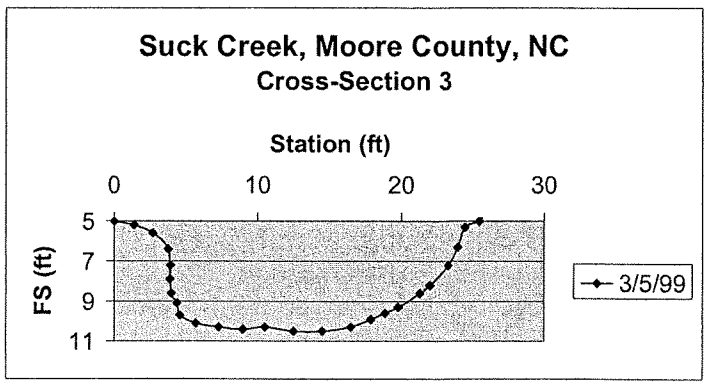
Width	Depth	Area	NOTES
0.0	0	0.00	LBKF
0.8	3.3	2.64	LEW
5.3	4.1	18.45	TW
8.0	4	10.80	
14.1	3.4	20.74	REW
18.3	2	8.40	Top of Bench
20.3	0	0.00	
20.3		61.03	

DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below fence in woods that crosses stream (3rd X-Sect)
CREW: Jan Patterson & Dan Clinton
NOTES: LPIN located at 0'.
RPIN is located at 27.8'.
Weather: clear, breezy 40 degrees

STATION	BS	HI	FS	ELEVATION	NOTES
0.0			5.02		LPIN
1.4			5.2		
2.7			5.6		LTOB
3.8			6.4		
3.9			7.9		
3.95			7.2		LBKF
4.0			8.6		
4.4			9.1		
4.6			9.7		LEW
5.7			10.1		
7.3			10.3		
9.0			10.4		
10.5			10.3		
12.5			10.5		TW
14.5			10.5		
16.5			10.3		
17.9			9.9		
18.9			9.6		REW/WS
19.8			9.3		
21.3			8.6		
22.0			8.2		
23.3			7.2		RBKF
24.0			6.3		
24.5			5.3		RTOB
25.5			5.0		
26.0			4.6		
27.8			4.32		RPIN
4.6			9.6		L WS
18.9			9.6		R WS

SITE 3: BANKFULL GEOMETRY CALCS.

WIDTH	DEPTH	AREA	
0.1	0.0	0.0	
0.2	1.4	0.3	
0.3	1.9	0.6	
0.7	2.5	1.6	
1.4	2.9	3.9	
1.7	3.1	5.1	
1.6	3.2	5.1	
1.8	3.1	5.4	22.1
2.0	3.3	6.6	
2.0	3.3	6.6	
1.7	3.1	5.3	
1.2	2.7	3.2	
1.0	2.4	2.3	
1.2	2.1	2.5	
1.1	1.4	1.5	
1.0	1.0	1.0	
1.0	0.0	0.0	
19.4		51.1	
	W * 1/3	6.5	
	1/3 NB A	22.1	
	Anb/A	0.43	High
	Max D	3.3	
	Mean D	2.6	
	W/D	7.3	
	BEHI	39.6	High



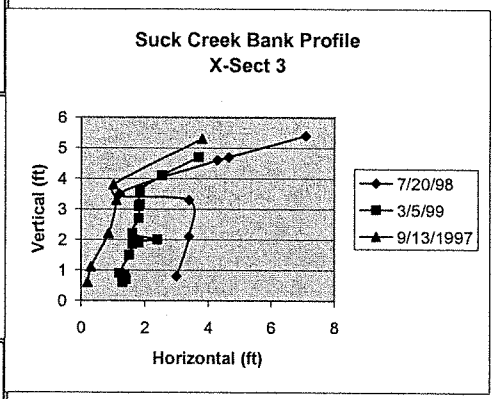
DATE: 9/13/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below fence across stream (3rd X-Sect).
CREW: Louise O'Hara & Dan Clinton
NOTES: Left Bank ~200 ft upstream of cattle crossing area

Vertical	Horizontal	Pin Ext.	Notes
0.60	0.20		WS
1.10	0.30	0.10	PIN 1 (top)
2.20	0.85	0.20	PIN 2
3.30	1.10	0.25	PIN 3 (bottom)
3.80	1.00		BKF
5.30	3.80		TOB

Date	Days Between
9/13/1997	
7/20/1998	11/5/1900
3/5/1999	8/15/1900

DATE: 7/20/1998
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just BELOW fence crossing stream in woods (3rd X-Sect).
CREW: Jan Patterson & Dan Clinton
NOTES: Horizontal measurements reflect bank profile.
Pin extensions were taken beside pin.
Toe Pin @ 12'. Left Bank.
~200 ft upstream of cattle crossing

Vertical	Horizontal	Pin Ext.	Notes
0.80	3.00	0.10	PIN 3
2.10	3.40	0.25	PIN 2
3.30	3.40	0.20	PIN 1 (top)
3.50	1.20		
4.60	4.30		
4.70	4.65		LIN INTP
5.40	7.10		LTOB



DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just BELOW fence across stream in woods (3rd X-Sect).
CREW: Jan Patterson & Dan Clinton
NOTES: Horizontal measurements reflect bank profile.
Pin extensions were taken above pin.
REF: 5.7 ft since could not find Toe Pin.
~200 ft upstream of cattle crossing

Vertical	Horizontal	Pin Ext.	Notes
0.60	1.30		WS
0.70	1.40		
0.85	1.35	0.35	PIN 3 (bottom)
0.90	1.20		
1.50	1.50		
1.85	1.60		
1.90	1.80		CAVE
1.95	1.70	0.20	PIN 2
2.00	2.40		
2.20	1.60		
2.70	1.80		
3.10	1.80		
3.15	1.85	0.20	PIN 1
3.60	1.85		
4.10	2.55		
4.70	3.70		LTOB

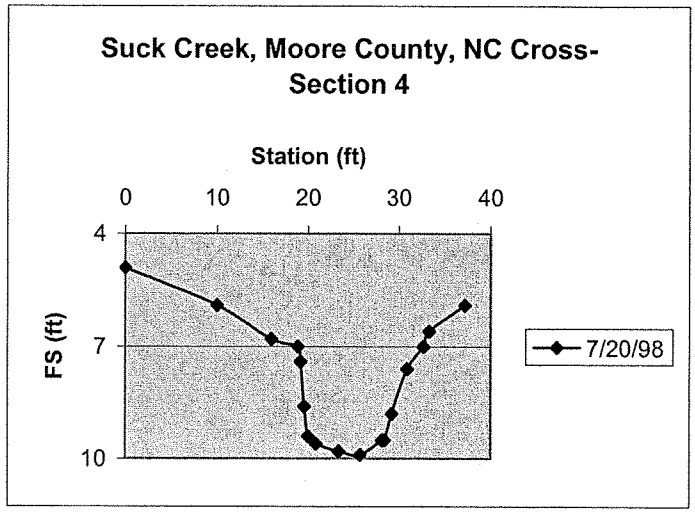
DATE: 7/20/1998
LOCATION Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below cattle crossing (4th X-Sect).
CREW: Jan Patterson, Jon Williams & Dan Clinton
NOTES: About 50 ft below cattle X-ing. Could not locate LPIN.
RPIN located ~4ft from bank.

STATION	BS	HI	FS	ELEVATION	NOTES
0.0			4.90		L Terrace
10.0			5.9		
16.0			6.8		
18.9			7.0		LTOB/LBKF
19.2			7.4		Top PIN
19.6			8.6		Bottom PIN
20.0			9.4		
20.9			9.6		LEW
23.4			9.8		
25.7			9.9		TW
28.1			9.5		LIN INTP
28.4			9.5		REW/WS
29.2			8.8		Bottom PIN
30.9			7.6		Top PIN
32.7			7.0		
33.3			6.6		RTOB
37.2			5.9		RPIN

SITE 4: BANKFULL GEOMETRY CALCS.

WIDTH	DEPTH	AREA
1.6	0.0	0.0
0.4	0.4	0.1
0.4	1.6	0.6
0.6	2.4	1.6
1.7	2.6	4.4
2.4	2.8	6.7
2.4	2.9	6.8
1.4	2.5	3.4
0.5	2.5	1.4
1.3	1.8	2.3
1.8	0.6	1.1
1.2	0.0	0.0
13.8		28.3

W * 1/3	4.6	
1/3 NB A	8.1	
Anb/A	0.28	Low
Max D	2.9	
Mean D	2.1	
W/D	6.7	
BEHI	38.5	High



DATE: 9/13/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below cattle crossing (4th X-Sect).
CREW: Louise O'Hara & Dan Clinton
NOTES:

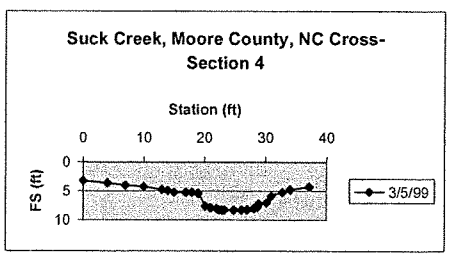
Width	Depth	Area	NOTES
0.0	0.5	0.00	
1.0	1.1	1.10	
1.5	2.5	1.25	
2.4	2.55	2.30	
3.7	2.7	3.51	
5.5	2.8	5.04	
7.2	2.9	4.93	
9.5	2.5	5.75	
12.1	0.55	1.43	
13.7	0	0.00	
		25.31	

DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below cattle crossing (4th X-Sect).
CREW: Jan Patterson & Dan Clinton
NOTES: LPIN located at 0'.
RPIN is located at 37.2'.
Weather: Clear, breezy ~50 degrees

STATION	BS	HI	FS	ELEVATION	NOTES
0.0			3.2		~LPIN-could not find
4.0			3.6		
7.0			4.0		
10.0			4.2		
13.0			4.7		
14.0			4.9		
15.0			5.2		
17.0			5.2		
18.0			5.2		LTOB/LBKF
19.0			5.4		
20.2			7.6		LEW/WS
21.0			7.9		
22.0			8.0		
22.4			8.2		
22.9			8.3		LIN INTP
23.3			8.3		TW
24.8			8.3		
26.1			8.3		
27.0			8.2		Bedrock
28.1			8.0		
28.7			7.8		REW
28.9			7.2		Low Feature
30.2			7.0		
30.9			5.9		
32.8			5.2		RBKF
34.0			4.8		
37.2			4.30		RPIN
20.2			7.6		L WS
28.7			7.6		R WS

SITE 4: BANKFULL GEOMETRY CALCS.

	WIDTH	DEPTH	AREA	
	1.0	0.0	0.0	
	1.1	0.2	0.2	
	1.0	2.4	2.4	
	0.9	2.7	2.4	5.1
	0.7	2.8	2.0	
	0.4	3.0	1.4	
	0.5	3.1	1.4	
	1.0	3.1	2.9	
	1.4	3.1	4.3	
	1.1	3.1	3.4	
	1.0	3.0	3.0	
	0.9	2.8	2.4	
	0.4	2.6	1.0	
	0.8	2.0	1.5	
	1.0	1.8	1.8	
	1.3	0.7	0.9	
	1.6	0.0	0.0	
	14.8		31.1	
		W * 1/3	4.9	
		1/3 NB A	9.8	
		Anb/A	0.31	Low
		Max D	3.1	
		Mean D	2.1	
		W/D	7.0	
		BEHI	37.9	High



DATE:	9/13/1997
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Richardson Farm X-Sect just below cattle crossing (4th X-Sect).
CREW:	Louise O'Hara & Dan Clinton
NOTES:	Horizontal measurements reflect bank profile.
	Right bank used for calculations.

RIGHT BANK

Vertical	Horizontal	Pin Ext.	Notes
0.00	0.30		WS
0.70	1.00	0.10	PIN 1
2.00	2.40	0.15	PIN 2
3.70	4.10		
3.20	6.70		TOB

Date	Days Between
9/13/1997	
7/20/1998	11/05/00
3/5/1999	8/15/1900

DATE:	7/20/1998
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Richardson Farm X-Sect just below cattle crossing (4th X-Sect).
CREW:	Jan Patterson, Jon Williams & Dan Clinton
NOTES:	Right Bank used for calculations.

RIGHT BANK

Pin Ext.	Notes
0.33	PIN 1(top)
0.20	PIN 2 (bottom)

LEFT BANK

Pin Ext.	Notes
0.45	PIN 1(top)
0.54	PIN 2 (bottom)

DATE:	3/5/1999
LOCATION:	Suck Creek--McLendon's Creek Watershed
SITE:	Richardson Farm X-Sect just below cattle crossing (4th X-Sect).
CREW:	Jan Patterson & Dan Clinton
NOTES:	Horizontal measurements reflect bank profile.
	Pin extensions were taken above pin.
	REF: 5.7 ft.
	Right bank. REF. 28.1 ft
	Left bank. REF 22 ft.
	Right Bank used for calculations.

RIGHT BANK

Vertical	Horizontal	Pin Ext.	Notes
0.45	0.75		WS
0.70	0.95		
0.80	**0.90**	.5/.2	PIN 2
0.90	1.55		
0.95	1.95		
1.10	2.25		
1.40	2.55		
1.95	2.80	0.30	PIN 1
2.40	3.30		ROB
3.00	4.80		RBKF

LEFT BANK

Vertical	Horizontal	Pin Ext.	Notes
0.5	2		WS
1.15	2	0.5	PIN 2
1.6	2.5		
2.3	2.5	0.45	PIN 1
2.6	3		LTOB

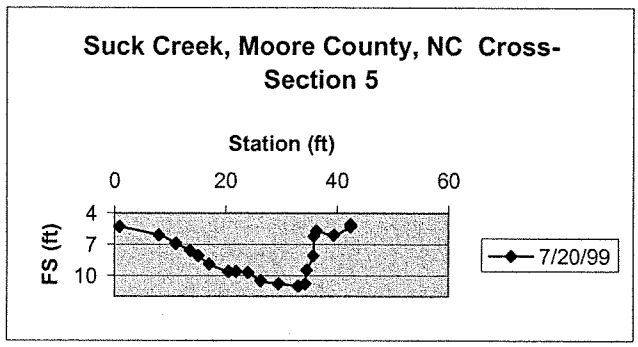
	Date	Est. Shear Stress Anb/A Value	Rating	BEHI Value	Rating	Erosion ft	yr	ft/yr	
upstream	7/20/1998	0.47	Very High	30.1	High	0.0	2.4	0.0	**
1	3/5/1999	0.44	High	29.6	Moderate	0.2	1.6	0.2	
2	7/20/1998	0.46	Very High	39.6	High	0.0	0.9	0.0	**
2	3/5/1999	0.43	High	39.6	High	0.0	0.7	0.0	**
3	7/20/1998	0.28	Low	38.5	High	0.1	0.9	0.1	**
3	3/5/1999	0.31	Low	37.9	High	0.1	0.7	0.2	**
4	7/20/1998	0.23	Low	50.3	Extreme	0.3	0.9	0.3	
4	3/5/1999	0.55	Extreme	52.5	Extreme	0.5	0.7	0.7	
downstream	7/20/1998	0.48	Very High	38.5	High	0.1	0.7	0.1	

DATE: 7/20/1998
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just before enters woods downstream (5th X-Sect).
CREW: Dan Clinton & Will Harman
NOTES: LPIN located at 0.9'.
RPIN is located at 42.4'.
~30 ft from cluster of trees before stream enters woods on left bank
orange end pin on left bank; rebar end pin on right bank

STATION	BS	HI	FS	ELEVATION	NOTES
0.9			5.3		LPIN
8.0			6.1		
11.0			6.9		
13.6			7.6		
15.0			8.1		LBKF
17.0			8.9		Top Low Terrace
20.5			9.6		
21.9			9.6		LIN INTP
24.0			9.7		
26.3			10.5		
29.5			10.8		LEW/WS
33.0			11.0		TW
34.2			10.8		REW/WS
34.5			9.5		
35.7			8.1		RBKF
35.8			6.2		
36.3			5.7		RTOB
39.4			6.1		
42.4			5.3		Beside RPIN
42.4			5.1		RPIN

SITE 5: BANKFULL GEOMETRY CALCS.

	WIDTH	DEPTH	AREA	
	1.7	0.0	0.0	
	2.8	0.8	2.2	
	2.5	1.5	3.7	
	1.8	1.5	2.6	
	2.2	1.6	3.5	
	2.8	2.4	6.6	
	3.4	2.7	9.0	
	2.4	2.9	6.8	
	0.8	2.7	2.0	
	0.8	1.4	1.1	
	0.6	0.0	0.0	
	20.7		37.6	
		W * 1/3	6.9	
		1/3 NB A	8.5	
		Anb/A	0.23	Low
		Max D	2.9	
		Mean D	1.8	
		W/D	11.4	
		BEHI	50.3	Extreme



DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just before enters woods downstream (5th X-Sect).
CREW: Jan Patterson & Dan Clinton
NOTES: LPIN located at 0.9'.
RPIN is located at 42.4'.

STATION	BS	HI	FS	ELEVATION	NOTES
0.9			5.2		LPIN
5.5			5.6		
8.0			5.9		
10.8			6.7		
12.0			7.4		
13.2			7.6		
14.0			7.5		
15.1			8.1		LBKF
15.5			8.3		
17.5			8.7		
18.5			8.8		
20.5			9.3		
23.2			9.4		
24.5			9.7		
26.0			10.2		
27.1			10.4		LEW/WS
28.8			10.6		LIN INTP
29.5			10.7		
32.0			11.0		TW
34.5			10.9		
34.9			10.6		REW
35.1			9.1		
35.6			8.1		RBKF
35.9			6.0		RTOB
36.4			5.7		
37.6			5.7		
39.0			6.0		
41.0			5.6		
42.3			5.2		Ground in front of RPIN
42.4			4.92		Top RPIN (rebar)
27.1			10.4		L WS
34.9			10.5		R WS

SITE 5: BANKFULL GEOMETRY CALCS.

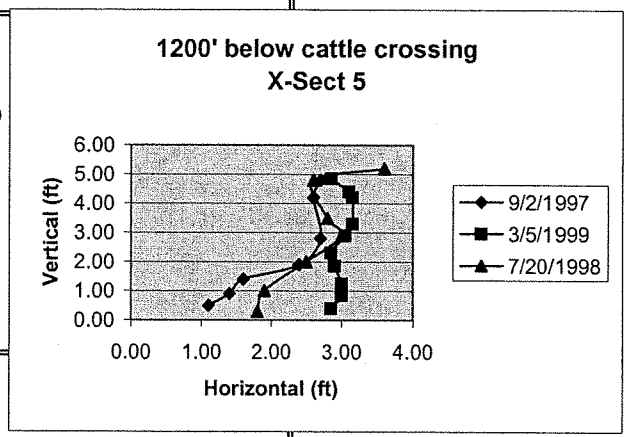
WIDTH	DEPTH	AREA	
0.8	0.0	0.0	
1.2	0.2	0.2	
1.5	0.6	0.9	
1.5	0.7	1.1	
2.4	1.2	2.8	
2.0	1.3	2.6	
1.4	1.6	2.2	
1.3	2.1	2.7	
1.4	2.3	3.2	
1.2	2.5	3.0	
1.6	2.6	4.2	
2.5	2.9	7.3	
1.5	2.8	4.1	
0.3	2.5	0.8	
0.4	1.0	0.4	
0.4	0.0	0.0	
20.5		35.4	
	W * 1/3	6.8	
	1/3 NB A	19.6	
	Anb/A	0.55	Extreme
	Max D	2.9	
	Mean D	1.7	
	W/D	11.9	
	BEHI	52.5	Extreme

DATE: 9/2/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just before enters woods downstream (5th X-Sect).
CREW: Will Harman & Dan Clinton
NOTES:

Vertical	Horizontal	Pin Ext.	Reset	Notes	Date	Days Between
0.50	1.10			WS	9/2/1997	
0.90	1.40	0.20		PIN 4	7/20/1998	########
1.40	1.60			Top of Bench	3/5/1999	8/15/1900
1.90	2.40	0.20		PIN 3 (BKF)		
2.80	2.70	0.15		PIN 2		
4.20	2.60	0.20		PIN 1		
4.80	2.70			TOB		

DATE: 7/20/1998
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just before enters woods downstream (5th X-Sect).
CREW: Louise O'Hara & Dan Clinton
NOTES: PIN 1 is missing

Vertical	Horizontal	Pin Ext.	Reset	Notes
0.30	1.80			WS
1.00	1.90	0.83		PIN 4 (bottom)
2.00	2.50	0.46		PIN 3
2.90	3.00	0.29		PIN 2
3.50	2.80			
4.80	2.60			
5.20	3.60			TOB



DATE: 3/5/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just before enters woods downstream (5th X-Sect).
CREW: Jan Patterson & Dan Clinton
NOTES: Horizontal measurements reflect bank profile.
Pin extensions were taken above pin.
TOE PIN 32.5 ft on X-Sect

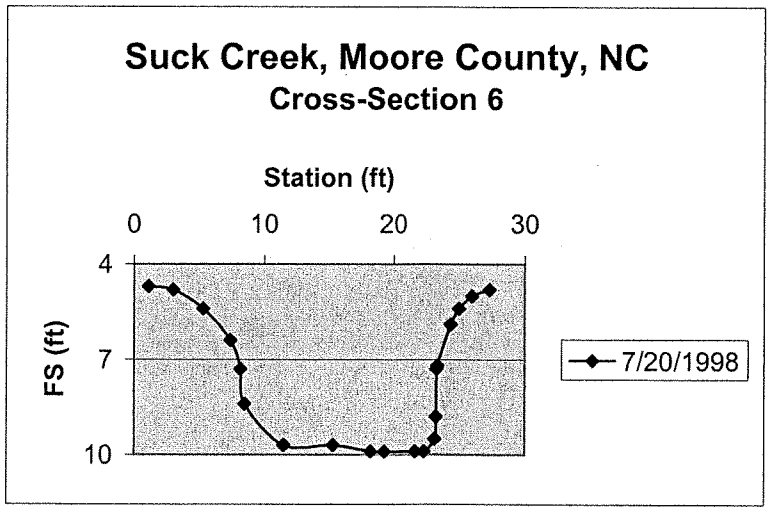
Vertical	Horizontal	Pin Ext.	Reset	Notes
0.40	2.85			WS
0.85	3.00	1.90	0.25	PIN 4
1.25	3.00			
1.85	2.90	0.80	0.15	PIN 3
2.30	2.85			
2.90	3.05	0.45	0.2	PIN 2
3.30	3.15			
4.20	3.15	0.65	0.3	PIN 1
4.40	3.10			
4.85	2.85			RTOB

DATE: 7/20/1998
LOCATION Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below sampler R-1 in woods.
CREW: Dan Clinton & Will Harman
NOTES: Gage plate reading 0.6 ft.
Right Bank
Cross-section is farthest downstream--X-Sect 6

STATION	BS	HI	FS	ELEVATION	NOTES
1.1			4.7		LPIN
3.0			4.8		LTOB
5.3			5.4		
7.4			6.4		
8.2			7.3		LBKF
8.5			8.4		
11.5			9.7		
15.3			9.7		
18.2			9.9		LEW/WS
19.3			9.9		TOE PIN (beside)
21.7			9.9		TW
22.4			9.9		REW/WS
23.2			9.5		
23.3			8.8		Bottom PIN
23.4			7.3		RBKF
23.4			7.2		Mid PIN
24.4			5.9		Top PIN
25.0			5.4		
26.0			5.0		
27.3			4.8		RPIN/RTOB
19.3			9.4		TOE PIN

SITE 6: BANKFULL GOEMETRY CALCS.

	WIDTH	DEPTH	AREA	
	0.6	0.0	0.0	
	1.7	1.1	1.8	
	3.4	2.4	8.2	
	3.4	2.4	8.0	
	2.0	2.6	5.2	
	1.8	2.6	4.6	
	1.6	2.6	4.0	
	0.8	2.6	2.0	
	0.5	2.2	1.0	
	0.1	1.5	0.1	
	0.0	0.0	0.0	
	15.2		34.8	
		W * 1/3	5.1	
		1/3 NB A	16.8	
		Anb/A	0.48	
		Max D	2.6	
		Mean D	2.3	
		W/D	6.6	
		BEHI	38.5	High



DATE: 9/2/1997
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below sampler R-1 in woods.
CREW: Jan Patterson, Jon Williams & Dan Clinton
NOTES: Cross-section is farthest downstream--X-Sect 6

PIN	Pin Ext.	Notes	Date	Days Between
PIN 3	0.45	(bottom)	9/2/1997	
PIN 2	0.3	(middle)	7/20/1998	11/16/1900
PIN 1	0.25	(top)	4/1/1999	9/11/1900

DATE: 7/20/1998
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below sampler R-1 in woods.
CREW: Will Harman & Dan Clinton
NOTES: Cross-section is farthest downstream--X-Sect 6

Vertical	Horizontal	Pin Ext.	Reset	Notes
0.70	4.10	0.31		PIN 3 (bottom)
1.20	4.60			
2.40	4.20	0.24		PIN 2
3.70	5.00	0.35		PIN 1(top)
4.20	5.80			
4.70	8.20			RTOB

DATE: 4/1/1999
LOCATION: Suck Creek--McLendon's Creek Watershed
SITE: Richardson Farm X-Sect just below sampler R-1 in woods.
CREW: Dan Clinton
NOTES: Cross-section is farthest downstream--X-Sect 6

PIN	Pin Ext.	Notes
PIN 3	0.65	(bottom)
PIN 2	0.25	(middle)
PIN 1	0.35	(top)