Stream Restoration Plan for Naked Creek

Wilkes County, North Carolina

Project ID No. 040619201

Prepared for:
NCDENR-Ecosystem Enhancement Program
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Contents

Tables

Figures

Photos

Appendices

Attachment

1.0 Introduction

Wilkes County Natural Resource Conservation Service identified select portions of Naked Creek, an Unnamed Tributary to Naked Creek, and Ready Branch as potential stream restoration areas. The stream project area includes six parcels owned by five separate property owners.

2.0 Goals and Objectives

The Naked Creek stream restoration project strives to improve stability to degraded channels and restore ecological function to the channels and adjacent riparian buffer through the following objectives:

- Use natural channel design methods to restore (pattern, dimension, and profile) and enhance streams. See **Table 1** for existing and proposed stream lengths.
- Reestablish riparian buffer community through plantings
- Protect stream and riparian buffer from immediate impacts through exclusionary fencing of livestock and creating controlled stable crossings
- Protect stream and riparian buffer from future impacts through a conservation easement

Stream	Restoration*		Enhancement II		Preservation		Total	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Naked Creek	4700	4110	--	--	570	570	5270	4680
UT to Naked Creek	3075	2755	650	650	175	175	3900	3580
Ready Branch	815	860	--	--	1000	1000	1815	1860

Table 1: Existing and Proposed Stream Lengths (linear feet) by Mitigation Type

*Stream lengths provided for existing and proposed restoration were calculated based on two different conditions. The existing lengths were calculated from a detailed survey of the stream thalwag and the proposed lengths for restoration are based on a proposed stream centerline. For a given length of stream, the thalwag distance will exceed centerline distance because the thalwag migrates across the centerline as it moves downstream. The final restoration distance will be determined during the As-Built Survey. Proposed restoration for Ready Branch will add stream length. Proposed restoration stream length for the UT to Naked Creek will likely equal or slightly exceed existing stream length. Proposed restoration stream length for Naked Creek will likely be less than the existing stream length. The loss of stream length for Naked Creek is due to the proposed elimination of tight meanders (R_c less than 2.0) that will likely become chute cutoffs if left alone. The channel will be designed to accommodate increased stream slopes due to the loss of length.

3.0 Site Identification and Location

3.1 Site Location

The project area lies approximately 10.6 miles west of Wilkesboro, Wilkes County, North Carolina and 18.4 miles east of Boone, Watauga County, North Carolina (**Figure 1**). The project site is

bounded by Rom Eller Rd (SR #1157) to the north and Lewis Fork Baptist Church Road (SR #1155) to the east (**Figure 2**).

The project streams, identified on **Figure 2**, include portions of the following streams: Naked Creek; an unnamed tributary to Naked Creek; and Ready Branch. The project reach of Naked Creek is a second-order stream that receives flow from the Unnamed Tributary and Ready Branch. The Unnamed Tributary has headwaters located 1,260 and 1,190 feet upstream of the project reach. Ready Branch has headwaters located approximately 2,270 feet upstream of the project reach.

3.2 Stakeholders

The project reaches either traverse or border six different properties owned by five different people. **Figure 5** provides the locations of the properties and the following table provides contact information.

Stakeholders	
Name	**Address**
Frank Eller	1564 Lewis Fork Baptist Church Rd., Ferguson, NC 28624
James Alan & Angela J. Day	PO Box 611, North Wilkesboro, NC 28659
Ivo Dean McGee	2252 Lewis Fork Baptist Church Rd., Ferguson, NC 28624
Gary Edminston	1167 Rom Eller Rd., Ferguson, NC 28624-9092
Bill H. & Elsie D. Cecile	PO Box 1114, North Wilkesboro, NC 28659

Table 2: Stakeholders

NRCS, EEP, and the design consultant hosted a meeting with the landowners to discuss the project goals, proposed channel design, and landowner concerns. **Appendix A** contains details of the meeting.

3.3 Watershed Classification

The project watershed, delineation in **Figures 2** and **3**, is not currently classified as a water supply watershed; however, the W. Kerr Scott Reservoir is being studied by the Towns of Wilkesboro and North Wilkesboro as a possible water intake. If the project is accepted and developed, new watershed protection development regulations would be imposed by the North Carolina Division of Water Quality on areas surrounding and upstream of the reservoir possibly including this projects' watershed. Water supply watersheds are regulated under the Wilkes County watershed ordinance, which limits development and requires the establishment of a minimum 30 foot buffer around all USGS topographically mapped streams. The ordinance also permits beneficial stream bank stabilization.

Watershed and Stream Classification					
Reach	Sub-Basin	14-digit HUC	Stream Order	NCDWQ Classification	Drainage Area (mi^2)
Naked Creek	Yadkin River Sub basin 03-07-01	03040101010100	2	C	2.2
Ready Branch	Yadkin River Sub basin 03-07-01	03040101010100	1	C	0.32
UT to Naked Creek	Yadkin River Sub basin 03-07-01	03040101010100	1	C	0.53

Table 3: Watershed and Stream Classification

4.0 Watershed

4.1 Physical Setting

The project watershed drains approximately 2.2 square miles of mostly pasture and forest within the Northern Inner Piedmont Ecoregion of North Carolina. The project watershed is located in the southern, Blue Ridge physiographic region, Appalachian Highlands division. Valley slope values between 0.0026 and 0.0172 typify the topography of the project watershed.

4.2 Land Cover/ Land Use

4.2.1 Existing Land Cover/ Land Use

The project watershed is located in a mountainous, rural setting dominated by agriculture (farmland and pasture) and forest. Active pastures buffer most of the drainages in the watershed. The table below shows the distribution of the land use within the project watershed.

Land Cover	Percent Cover
Open Water	0.1 %
Barren	0.0 %
Forested	79.8 %
Urban Residential	0.1 %
Urban High-Intensity Developed and Transportation Corridors	0.1 %
Agriculture and Natural Herbaceous	17.1 %
Coniferous Cultivated Plantation (Natural/Planted)	2.8 %

Table 4: Existing Land Cover / Land Use

4.2.2 Historic Land Cover/ Land Use

Historic aerials from 1958 provided by the Natural Resource Conservation Service show that most of the parcels located within the watershed were forested (**Figure 4**). Some of these forests have been cleared to create more open pasture or residential lots. The Eller property (parcels 0901018 and 0900885) shows a transition from a forested buffer to an open pasture along the right bank of UT to Naked Creek.

4.2.3 Future Land Cover/ Land Use

Based on a review of landowner plans, zoning, comprehensive plans, and proposed major transportation projects, only a portion of the project watershed is expected to change in the future. Based on conversations with the McGee family, they plan to timber areas upslope of the floodplain in the near future and in the more distant future may develop residential lots in an area north of downstream end of the project reach of Naked Creek. The other landowners did not express intentions to change current land cover/ land use. The following notes discuss the results of research on the other potential indicators of future land cover/ land use.

- Zoning

The project area is not planned to be zoned and is not to subject to any zoning requirements.

- Comprehensive Plan

Wilkes County completed a comprehensive growth plan called the Wilkes Vision 20/20 in May 1999. The plan incorporated several strategies for improving infrastructure. In general, Wilkes County plans to implement the comprehensive growth management plan that includes residential, commercial, industrial, and government development in a limited number of urban clusters. In these clusters the plan includes developing least cost infrastructure, separation of agriculture into districts, and allowing individuals to build on large acreage parcels if they provide the infrastructure. Currently, the project watershed is not located within any areas targeted in the Wilkes Vision 20/20.

- Major Transportation Projects.

North Carolina Department of Transportation, TIP# R-2240, is currently widening US-421 to four lanes. The construction extends to approximately 1.2 miles of the upstream source of UT to Naked Creek. It is anticipated that the completion of the project will encourage future commercial development; however, growth is not expected within this projects' watershed.

4.2.4 Water Quality and Hazardous Materials

GIS mapping did not indicate National Pollution Discharge Elimination System sites or hazardous waste facilities hydrologically connected to the project streams. A review of potential hazardous materials (e.g. leaking underground storage tanks, solid waste facilities, etc.) performed by Environmental Data Resources (EDR) on April 15th, 2005 showed no occurrences of these types of constraints within the project area. The full EDR report is included in **Appendix B**.

5.0 Streams

5.1.1 Existing Conditions

For assessment purposes, the project streams were divided into reaches based on landownership and geomorphic setting. **Figure 5** provides an overview of the reaches and the subsequent **Figures (6-10)** illustrate existing stream conditions. Photos of examples of existing conditions are referenced in the existing conditions figures and displayed in the attached photo pages. For design, the reaches have been combined into groups (design groups) of similar geomorphology and restoration needs. **Table 5** shows the design groups and provides a summary of indicators of channel stability and buffer integrity.

All of the reaches investigated were gravel bed channels with low sinuosity (1.03 - 1.15). Each reach exhibits signs of local instability such as erosion along the outside bank along meander bends and the formation of mid-channel bars. Contributing to the instability of the project streams are the loss of riparian vegetation, damage due to livestock, and deep channel incision.

Bank height ratios (low bank height divided by the maximum bankfull depth) were determined for the surveyed reaches. In the methodology used for this report, bank height ratios between 1.1 and 1.3 are regarded as "moderately unstable," ratios between 1.3 and 1.5 as "unstable," and bank height ratios greater than 1.5 are "highly unstable." This methodology was established by David Rosgen in the paper "A Stream Channel Stability Assessment Methodology."

Reach	Bank Ht. Ratio*	Vegetative Buffer		Adjacent Land Use	Disturbance / Relocation
		Right Bank	Left Bank		
Upper UT to Naked Creek					
UTNkd-1	1.7	Isolated Hardwoods	Isolated Hardwoods	Pasture	Cattle Access Likely Channelization
UTNkd-2	--	Hardwoods	Isolated Hardwoods	Pasture	Likely Channelization
Lower UT to Naked Creek					
UTNkd-3	2.0	Succesional Forest	Succesional Forest	Forest	None
UTNkd-4	--	Hardwoods	Pasture	Pasture / Forest	Likely Channelization
Upper Ready Creek					
Rdy-1	1.0	Hardwoods	Hardwoods	Forested	None
Lower Ready Creek					
Rdy-2	1.5	Pasture	Scattered Hardwoods	Pasture	Cattle Access Likely Channelization
Upper Naked Creek					
Nkd-1	1.6	Pasture	Pasture	Pasture	Cattle Access Likely Channelization
Middle Naked Creek					
Nkd-2	--	Pasture	Scattered Hardwoods	Pasture / Forest	Cattle Access Likely Channelization
Nkd-3	--	Hardwoods	Hardwoods	Pasture / Forest	Valley Confinement
Nkd-4	1.8	Hardwoods	Hardwoods	Forest	Valley Confinement
Nkd-5	--	Hardwoods	Hardwoods	Forest	Valley Confinement
Lower Naked Creek					
Nkd-6	1.2	Isolated Hardwood	Hardwoods	Forest / Roadway	Possible Channelization

Table 5: Existing Conditions

*A representative survey was completed on a specific section for each design reach; therefore, only one BHR is calculated per design reach and is typical for that reach.

5.1.2 Stream Geomorphology

The design consultant performed a geomorphic survey (cross sections, longitudinal survey, and pattern) and sampled stream materials (classification and entrainment pebble counts, bar samples, sub-pavement and pavement samples) on several reaches representative of the design groups (e.g. Upper Ut to Naked Creek, Lower Ready Creek etc….) and therefore representative of the geomorphic settings within restoration/enhancement groups of the project area. **Figures 6-10** show the location of the surveys and **Appendix C** includes the survey data and summary of geomorphic analysis.

Table 6 below summarizes the general geomorphic conditions of the surveyed reaches within the project area. (See **Figures 6-10** for cross section locations.)

Reach	Entrenchment Ratio	A_{bkf}	W_{bkf}	Width/Depth Ratio	K	Slope	Channel Materials	Stream Type
UTNkd-1	1.5	12.1	12.7	13.4	1.0	0.008	3.8	Incised B4c
UTNkd-3	1.1	13.8	14.2	14.7	1.2	0.010	4.6	Incised F4
Rdy-2	3.2	8.2	9.5	10.3	1.1	0.013	2.3	Incised C4
Nkd-1	3.9	24.3	20.5	17.2	1.1	0.017	3.1	Incised C4
Nkd-4	3.7	32.5	24.1	17.9	--	0.003	9.8	Incised C4

Table 6: Summary of Existing Cross Sectional Data

5.1.3 FEMA

The Federal Emergency Management Association (FEMA) Flood Insurance Rate Map (FIRM), map number 3702560150 B effective May 15, 1991, shows that the entire project area is mapped as Zone X - areas outside the 500-year floodplain that means the area is not subject to the Wilkes County Flood Damage Prevention Ordinance North Carolina Model (**Figure 11**). According to Wilkes County floodplain manager, Eddie Barnes, there are no local building requirements associated with floodplains for any portion of the project area.

5.2 Soils

Figure 12 shows soils within the project area. Chewacla loam soils cover the floodplain of most project reaches. The Chewacla soils series typically cover Piedmont streams and drainage ways with relatively low slopes and frequent flooding. Chewacla loams have a very deep soil profile, somewhat poor drainage, moderate permeability, and a very shallow depth to the season high water table. The Natural Resource Conservation Service (NRCS) considers Chewacla loam a hydric soil (NRCS 1995) and because of the associated wetness and flooding, Chewacla loam poorly supports commonly grown crops and urban development; however, Chewacla is moderately suited to support woodland, pasture, and hayland.

Pacolet sandy loam soils cover the floodplain of approximately 750 feet of reach Nkd-6 on Naked Creek. The Pacolet soil series typically cover side slopes on the Piedmont. Pacolet sandy loams have a very deep soil profile, good drainage, moderate permeability, and a deep depth to the season

high water table. Pacolet sandy loam is poorly supports commonly grown crops and urban development; however, it does moderately support woodland areas.

5.3 Plant Communities

The project area most typically resembled a Piedmont/Low Mountain Alluvial Forest community; however, due to clearing and other disturbances an abundance of invasive species have populated the site and comprise most of the understory vegetation.

Figure 13 shows observed plant communities. Three predominant riparian communities were observed: pasture grasses; hardwood stream bank fringe, and bottomland forest. The hardwood stream bank fringe consisted of isolated trees scattered along the stream bank. Species within this community included black willow (*Salix nigra*); tag alder (*Alnus serrulata*); spice bush (*Lindera benzoin*); muscle wood (*Carpinus caroliana*); American holly (*Ilex opaca*); and flowering dogwood (*Cornus florida*). The bottomland forest contained scattered larger trees of tulip poplar (*Liriodendron tulipifera*); black cherry (*Prunus serotina*); persimmon (*Diospyrus virginiana*); red maple (*Acer rubrum*); white pine (*Pinus strobus*); sycamore (*Platanus occidentalis*); black walnut (*Juglans nigra*); river birch (*Betula nigra*); and beech (*Fagus grandiflora*) with a dense understory of multiflora rose (*Rosa multiflora*); Chinese privet (*Ligustrum sineses*); and Japanese honeysuckle (*Lonicera japonica*).

5.4 Threatened and Endangered Species

A search of the US Fish and Wildlife Service website (endangered.fws.gov) and the North Carolina Natural Heritage Program website (http://207.4.179.38/nhp/) identified the Bog Turtle *(Glyptemys muhlenbergii)* as a federally threatened species residing within the Purlear USGS Quadrangle. The Bog Turtle is listed as Threatened due to Similarity of Appearance meaning it is extremely difficult to differentiate from unlisted species.

Federal Species of concern are not afforded federal protection under the Endangered Species Act of 1973 and are not subject to any of its provisions, including Section 7, until they are formally proposes or listed as Threatened or Endangered. Federal and State listed species are listed in **Table 7** below.

Common Name	Scientific Name	Federal Status	NC Status	Habitat Present within Project Area
Vertebrates				
Bog Turtle	*Clemmys muhlenbergii*	T(S/A)	T	NO

Table 7: Species of Concern - Wilkes County

Note: T(S/A) – Threatened Due to Similarity

T – Threatened

6.0 Restoration Studies

6.1 Stream Restoration Studies

6.1.1 Reference Streams

The design consultant identified several reference reaches with hydrophysiographic and valley features similar to the project streams (see F**igure 14** for locations). The reference reach morphological data is listed in **Appendix D**.

6.2 Reference Vegetative Community

The project biologist performed a vegetation survey of several communities near the project area including an area upstream and downstream of the project stream and adjacent to the Purlear Creek reference reach. The survey was used to develop the plant list and relative coverage presented section 9.2 and plan sheets in the attached restoration plan.

7.0 Restoration Plan

The objective of this project is to design adjustments to the stream reaches that will increase their long-term stability and create a more functional riparian ecological community. The design of the proposed channel reaches involves utilizing the morphological data from the reference reach, mountain rural regional curves, regime equations, and the existing channel morphology. The existing channel morphology is presented in detail in **Appendix C**. The morphological data collected for these reaches has been summarized in **Appendix D**. Additionally, vegetated buffers that match proximal natural ecological communities found in similar physiographic and climatic regions will be planted. Each reach will be designed to maximize natural design and natural parameters, and to account for physical constraints within the project area. In all applicable areas, the plan proposes to reconnect the channel to the abandoned floodplain or create a new floodplain tied to the current channel elevation. This will decrease stream bank erosion, establish an active floodplain, reduce channel stress during floods, improve aquatic habitat, and reduce fine sediment.

Based on existing channel morphology, the target stream type for the project streams is C4. Stream restoration will include a mix of Priority I and II restoration and enhancement. Priority I restoration is planned for area where raising the existing stream bed and reconnecting to the historic floodplain will not interfere with existing landuse; This type of restoration is proposed for the restoration section of Ready Branch and the upper section of Naked Creek. Where raising the existing stream bed will create conflicts with the existing landuse, priority II restoration is planned. The priority II area includes much of the UT to Naked Creek and the lower portion of Naked Creek. A bedrock dominated section of the UT to Naked Creek will undergo Enhancement II that will reshape the banks to allow increased access to the floodplain. In general, restoration will result in a lengthening of the existing stream as meanders are added to decrease the slope of the historically straightened stream. In some areas, particularly the middle portion of Naked Creek, stream length will be reduced through the modification of tortuous meanders that if left alone would likely become increasingly unstable with time.

7.1 Stream Restoration

7.1.1 Bankfull Verification

The North Carolina Mountain Rural Regional Curves were used to check bankfull dimensions (width, depth, and cross-sectional area) determined from the existing condition geomorphic survey. In addition, the regional curves were used as a base to establish a range of design discharges since the site is ungauged. A local curve showing the relationship between channel dimensions and drainage areas was developed using data from the reference reaches discussed in section 6.1. The bankfull dimensions for the design were derived by comparing the regional curves, reference reach curve, and bankfull dimensions of stable reaches of the project reaches. The cross-sectional area of the reference reaches is plotted on the Rural Mountain Regional Curve of North Carolina developed by North Carolina State University (NCSU) Water Quality Group (**Figure 15**).

7.1.2 Dimension

The channel cross section dimensions for riffles and pools were determined as described above in Section 7.1.1. **Appendix D** contains data used to design the cross sections shown in the Restoration Plan.

7.1.3 Pattern

Sinuosity will be provided where appropriate according to the valley type (see attached plans). The proposed sinuosity of the channels allows the proper pool to pool spacing and riffle locations restored improving aquatic habitat. The proposed sinuosity provides the appropriate slope to transport the material coming into the reach so the channel does not significantly aggrade or degrade.

7.1.4 Bedform

The bedform is based on the data obtained from the reference reach and will incorporate the rural mountain regional curves and regime equations. The bedform of the proposed channels is made up of properly spaced riffle and pool features. The pools will be located in the outside of meander bends with riffles located between the pools in the tangent portions of the channel. Glides and runs will connect the pools and riffles. In-stream structures will be used to provide grade control, ensure stable bed and bank features, and maintain the overall design slope (See **Appendix D**, Morphology Characteristics).

7.1.5 Structures

In-stream structures will be used to protect stream banks, increase aquatic habitat diversity and provide grade control. The types of structures incorporated into the restoration project include rock cross vanes, root wads, and log vanes. Root-wads will be used only for the purpose of providing habitat and their use will be kept to a minimum.

7.1.6 Fencing and Watering Systems

Fencing and watering systems will be provided to the following landowners by the NRCS to limit livestock access to the stream.

- Ellers

- McGees
- Edmintsons

Livestock crossings are only at specific locations and are shown in the plans.

7.1.7 Sediment Transport

A stable stream channel should be capable of transporting its sediment load without aggrading or degrading. Shear stress calculations were used to verify that the designed channel would be able to transport its bedload. The two physical characteristics of the channel design which affect the shear stress on the channel bed are the slope of the channel and its hydraulic radius.

$$\tau = \gamma R s$$

Where: τ= shear stress (lb/ft^2)
γ = specific gravity of water (62.4 lb/ft^3)
R = hydraulic radius (ft)
s = water surface slope (ft/ft)

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

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

Where: R = hydraulic radius
A = cross-sectional area (ft^2)
P = wetted perimeter (ft)

The following table contains the critical shear stress results for the five proposed channel configurations. The range of the size of the largest particle that would be transported by the shear stress as predicted by Shield's curve was also determined.

Reach	Proposed WS Slope (ft/ft)	Proposed Hydraulic Radius (ft)	Shear Stress (lb/ft^2)	Particle Range (mm)	Largest Particle found in Sub-Pavement/ Bar (mm)
UTNkd-1	0.021	0.8	1.05	44 - 110	71
UTNkd-3	0.020	0.8	1.00	44 - 110	71
Rdy-2	0.019	0.8	0.948	45 - 120	91
Nkd-1	0.013	1.1	0.892	33 - 74	65
Nkd-4	0.014	1.2	1.05	44 - 110	66

Table 8: Summary of Shear Stress Calculations

The largest particles found in the bar samples and sub-pavement samples fall within the range of particles shown in **Table 8** for the proposed channels. The proposed channel slope and dimensions are principally based on the reference reach and data collected from the existing channels. The above particle ranges serve to ensure that the proposed channel will transport the material currently being transported by the stream channels. The bar and sub-pavement samples taken at the cross sections were sieved to determine the D50 of the channel material. The following table contains the results from that analysis.

Reach	D50 (mm)	Category
UTNkd-1	42	Very Coarse Gravel
UTNkd-3	23	Coarse Gravel
Rdy-2	4.1	Fine Gravel
Nkd-1	10.5	Medium Gravel
Nkd-4	28	Coarse Gravel

Table 9: D_{50} of Channel Materials

7.1.8 Hydraulic Modeling

The peak flows for the 2, 10, 25, and 100-year storms were modeled for the existing and proposed conditions. These flows were calculated using the North Carolina rural flood-frequency equations for the Blue-Ridge/Piedmont hydrologic region (USGS WRIR-96-4084). The peak flows calculated are summarized in the following table.

Reach	Area (ac.)	Area (sq.mi.)	2yr Q (cfs)	10yr Q (cfs)	25yr Q (cfs)	100yr Q (cfs)
UTNkd-1	281.6	0.44	75.9	194	280	446
UTNkd-3	339.2	0.53	86.5	219	316	501
Rdy-2	204.8	0.32	60.7	157	228	365
Nkd-1	806.4	1.26	159	389	553	861
Nkd-4	1190.4	1.86	209	504	710	1100

Table 10: Peak Discharges

8.0 Typical Drawings (See Attached Restoration Plan)

9.0 Stream Riparian Planting Plan

The planting plan will reconstruct a Piedmont/Low Mountain Alluvial Forest community that will be divided into three zones – stream bank, riparian, and upland. **Table 11** shows the proposed vegetation species for each zone with planting types for each species.

Vegetation planted within the floodplain and along the stream banks will provide stability to the stream channel by reducing scour and runoff erosion. Trees and shrubs are the most effective riparian buffers because they provide perennial root systems and long-term nutrient storage.

A combination of trees, shrubs, and grasses will be utilized to fit the landscape and the landowners' needs. At a minimum the woody vegetation will be at least 30 feet wide extending from the stream bank. Typically, 10-12 species of native trees and/or shrubs will be chosen based on reference communities and there will be at least three to four understory trees for every canopy tree to provide sufficient density. Initially, 436 to 681 trees per acre will be planted so that at maturity there will be a density of 320 trees per acre. Shrubs will be planted at 1,200 per acre.

9.1 Planting Procedure (See Attached Restoration Plan)

Immediately after construction, the contractor will seed the stream banks and all disturbed areas with a permanent seed mix. If permanent seeding cannot be completed within 15 days after construction, temporary seeding will be applied per Land Quality Section requirements. The contractor will plant live stakes and bare roots around structure installations and the outside of meander bends to provide an area of high density root mass. Coir fiber matting and live stakes will be used along the entire reach of the restored channels to provide stabilization until vegetation can be established. The contractor will plant trees and shrubs using live stakes, bare root, or container stock along the tops of the channel banks.

Prior to planting the riparian buffer, efforts will be made to eradicate fescue and invasive plants such as multiflora rose (*Rosa multiflora*), Chinese privet (*Lingustrum sineses*), and Japanese honeysuckle (*Lonicera japonica*). These efforts should include herbicide use during the spring and a follow up spraying in early fall to eliminate any fescue that was not killed in the spring. A permanent seed mix can be used after application of the pre-emergent. Planting can follow during the dormant season. Ripping the site prior to planting is recommended. Soil amendments will be added as prescribed by the soils test report performed by the North Carolina Department of Agriculture and Consumer Services Agronomic division for samples sites located throughout the project area.

Bare root seedlings are the most cost effective and successful plant material; however, containerized seedlings, live stakes, or dormant cuttings may be used. In each case a tree shelter should be used to protect and accelerate growth. Using tree shelters suggests a more cost effective approach than planting larger unprotected trees. Where practicable, onsite trees will be transplanted into the restoration zone.

The usual progression of vegetation growth on cleared riparian habitats begins with pioneer species that both provide stream stabilization functions and create an environment suitable for latter species common in mature riparian habitats. Within the stream bank zone, the contractor will plant the pioneer species that provide immediate bank stabilization. The upper portion of the stream bank zone will additionally be planted with climax species to initiate a mature stream bank community. All species for the riparian and upland zones will be planted concurrently. The plantings will be arranged to initiate the spatial structure of a mature community. The understory community will predominantly consist of species that grow easily in cleared sites but do not colonize. These species will be managed to assure that they do not inhibit planted canopy species. Light intolerant understory trees will also be planted, but will be placed only in the interior of the riparian zone and near planted canopy species. The canopy species will be planted among the understory species and will include larger containerized plants. The planting list includes species that provide a stock of species needed to reconstruct the target community. It includes species that will provide a seed source throughout the restoration area and those species that have a limited seed source that may not be readily available from adjacent communities such as heavy seeded oaks.

Most of the proposed revegetation area will be planted with a mix of trees and shrubs. In areas where the proposed revegetation lies adjacent to open pasture, the edge will be planted with shrubs and small trees to create a transition zone between the pasture and main forested area. This will remove any abrupt changes between communities. The planting mix may also be adjusted for safety issues and landowner needs. Areas under the power lines and telephone lines will be planted with lower growing vegetation to avoid interference with the utilities.

9.2 Vegetation List

The tables below present the species list for planting and seeding.

Woody Vegetation Planting				
Vegetation		Community Zones with Planting Type[1]		
Scientific Name	Common Name	Stream Bank[2]	Riparian	Upland
Canopy[3]				
Acer barbatum	Southern Sugar Maple		BR	
Betula nigra	River Birch ♦	BR	BR	
Carya cordififormis	Bitternut Hickory		BR,CN	BR,CN
Carya ovata	Shagbark Hickory		BR,CN	BR,CN
Celtis laevigata	Sugarberry		BR	BR,CN
Diospyros virginiana	Persimmon ♦		BR	BR,CN
Fraxinus pennsylvanica	Green Ash ♦		BR	BR,CN
Nyssa sylvatica	Blackgum		BR	BR,CN
Platanus occidentalis	Sycamore		BR	
Populus deltiodes	Cottonwood	0-25%		
Quercus michauxii	Swamp Chestnut Oak ♦		BR	
Quercus nigra	Water Oak		BR	BR,CN
Quercus phellos	Willow Oak ♦		BR	
Quercus shumardii	Shumard Oak		BR	
Salix Nigra	Black Willow	50%	BR	
Tilia heterophylla	White Basswood		BR	BR,CN
Understory[4]				
Aesculus sylvatica	Painted Buckeye		BR	
Alnus serrulata	Tag Alder ♦	BR	BR	
Amelanchier arborea	Serviceberry		BR	BR
Aronia arbutifolia	Red Chokeberry ♦		BR	
Asimina triloba	Common Pawpaw		BR	BR
Calycanthus floridus	Sweet-Shrub		BR	

Carpinus caroliniana	Ironwood		BR	
Cephalanthus occidentalis	Buttonbush ♦		BR	
Cornus alternifolia	Alternate Leaf Dogwood		BR	BR
Cornus amomum	Silky Dogwood ♦	25%	BR	
Corylus Americana	Hazel-Nut		BR	BR
Hamamelis virgiana	Witch-Hazel		BR	BR
Hibiscus moscheutos	Marsh Mallow		BR	
Ilex deciduas	Deciduous Holly		BR	
Ilex verticillata	Winter Berry		BR	
Itea virginica	Virginia Willow ♦		BR	
Leucothoe fontanesiana	Doghobble		BR[5]	
Lindera benzoin	Spicebush		BR[5]	
Lyonia ligustina	Male-Berry		BR	
Magnolia tripetala	Umbrella Tree		BR[5]	
Morus rubra	Red Mulberry		BR	
Physocarpus opulifolius	Ninebark		BR	
Rhododendron periclymenoides	Wild Azelea		BR	
Rhodendron viscosum	Swamp Azelea		BR	
Rosa Palustris	Swamp Rose ♦		BR	
Salix sericea	Silky Willow		BR	
Sambucus canadensis	Elderberry	0-25%		
Staphylea trifolia	Bladdernut		BR[5]	
Symplocos tinctoria	Sweet Leaf		BR	BR
Viburnum cassinoides	Withe-Rod		BR	
Viburnum dentatum	Southern Arrow-wood	0-25%		
Xanthorhiza simplicissima	Yellow-Root		BR[5]	BR[5]

Table 11: Woody Vegetation Planting List

1. Planting Type Abbreviations: BR – Bare Root; CN – Container
2. Stream Bank Zone composed live stake and bare root plantings. Planting distribution of live stakes provided in column.
3. Composition should include at least 8 different tree species with no more than 25% of any one species.
4. Composition should include at least 8 different shrub species with no more than 20% of any one species.
5: These light intolerant species should be planted in the interior areas near canopy trees.
♦: Typically grows well in the field.

Seed		
Common Name	**Scientific Name**	**Composition**
Rice Cut Grass	*Leersia oryzoides*	5 %
Soft Rush	*Juncus effusus*	10 %
Deertongue	*Panicum clandestinum*	20 %
Switchgrass	*Panicum virgatum*	50 %
Ironweed	*Vernonia noveboracensis*	5 %
Swamp Sunflower	*Helianthus angustifolius*	5 %
Joe Pye Weed	*Eupatorium fistulosum*	5 %

Table 12: Seed Species List

10.0 Monitoring Plan

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by The Stream Mitigation Guidelines disseminated by the United States Corps of Engineers – Wilmington District and recommendation from the Ecosystem Enhancement Program.

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

- Geomorphology (Dimension, Pattern, and Profile)
- Channel Materials
- Channel Stability and In-Stream Structure Functionality
- Vegetation

The survey of channel dimension will consist of permanent cross sections placed at approximately one cross section per a length of stream equivalent to 20 bankfull widths. The cross sections will represent approximately 50% riffles and 50% pools. Annual photographs showing both banks, upstream, and downstream views will be taken from permanent, mapped photo points. The survey of the longitudinal profile will represent distinct areas of restoration and will cover a cumulative total of 3,000 linear feet of channel. Newly constructed meanders will be surveyed to provide pattern measurements. Channel material measurements will be collected by using pebble counts for at least 6 of the permanent cross sections.

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

The success of riparian buffer restoration will be measured through plant counts. Permanent quadrants will be used to sample the riparian buffer. The quadrants will be placed adjacent to restored channel. The primary quadrant will cover 100 square meters for tree counts. Within the primary quadrant, a 25 square meter quadrant will be placed to count shrubs, and a 1 meter quadrant will be placed to measure herbaceous coverage. During the counts, the health of the vegetation will

be noted. The vegetation survey will occur during the growing season. Permanent photo points will be set up for each quadrant.

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

11.0 Success Criteria

The stream geometry will be considered successful if the cross-section geometry, profile, and sinuosity are maintained or reach a dynamic equilibrium. It is expected that there will be minimal changes in the designed cross sections, profile and/or substrate composition. Changes that may occur during the monitoring period will be evaluated to determine if they represent a movement toward a more unstable condition (down-cutting, deposition, erosion) or are minor changes that represent an increase in stability (settling; vegetative changes; coarsening of bed material).

An initial, though not exclusive, indicator of success will be adherence to design ratios of stream geometry found in morphological table in **Appendix D**.

Deviation from the design ratios will not necessarily denote failure as it is possible to maintain stability and not stay within the design geometry. Additionally, determination of true bankfull will be difficult until the stream has had adequate flooding events to create strong bankfull indicators. The following key indicators of stability provide a more complete picture of stream stability:

- Stream Type: Maintenance of the design stream type or progression or conversion to stable stream type such as B,C, or E will indicate stability
- Bank Height Ratio: Bank Height Ratio between 1.0 and 1.1 will indicate flood flows have access to the floodplain and that higher flows do not apply excessive stresses to stream banks
- Entrenchment Ratio: An entrenchment ratio greater than 1.4 will indicate stability

The success of vegetation planting will be gauged by stem counts. A stem count over 260 trees per acre at the end of the monitoring period will be considered successful. The viability of the vegetation planting will be assessed throughout the monitoring period with interim stem count goals of at least 320 stems per acre after 3 years and at least 288 stems per acre in year 4. The restored buffer should mimic the function of upstream and downstream ecological function. Photos taken at established photo points should indicate maturation of riparian vegetation community.

12.0 References

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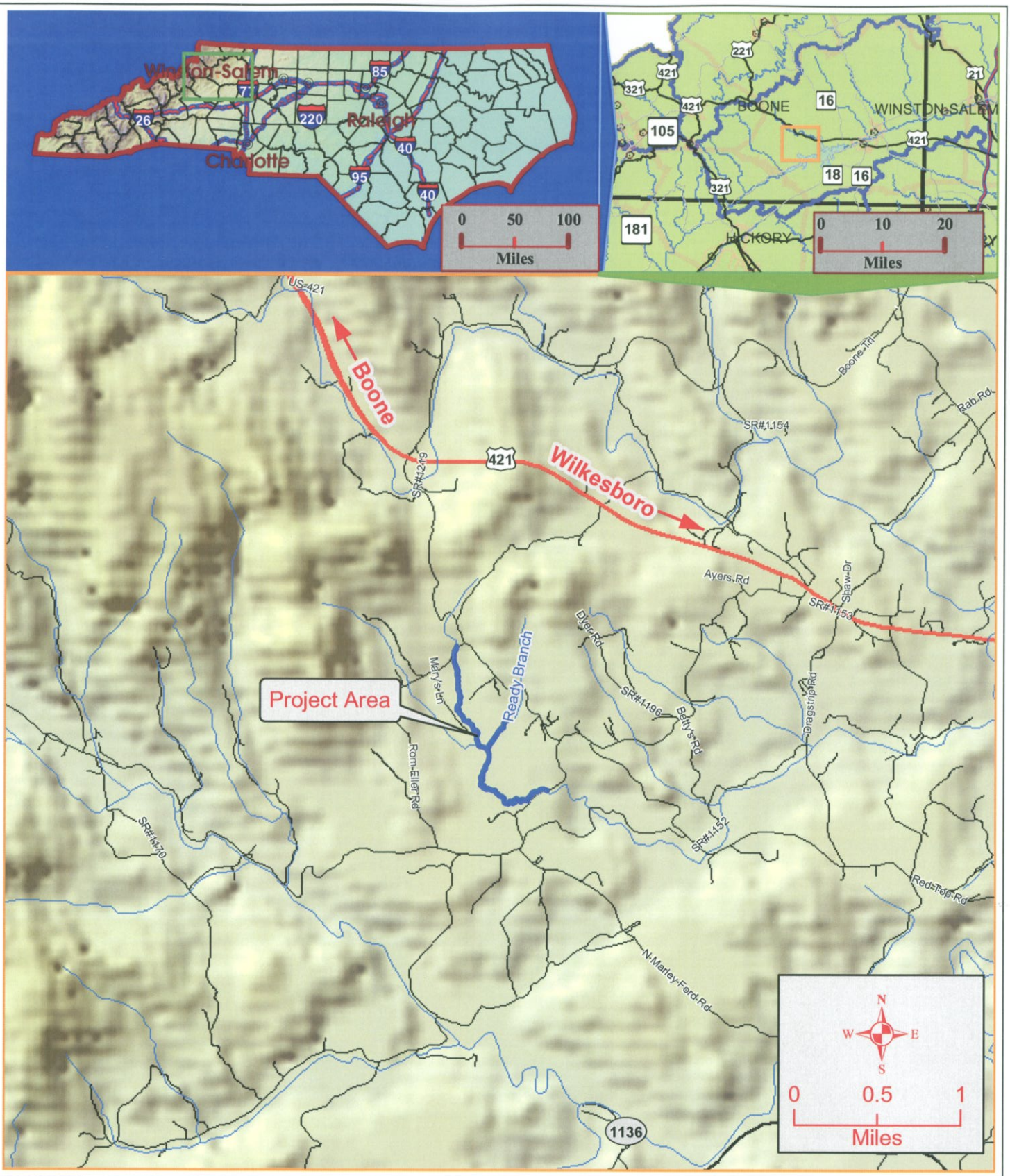
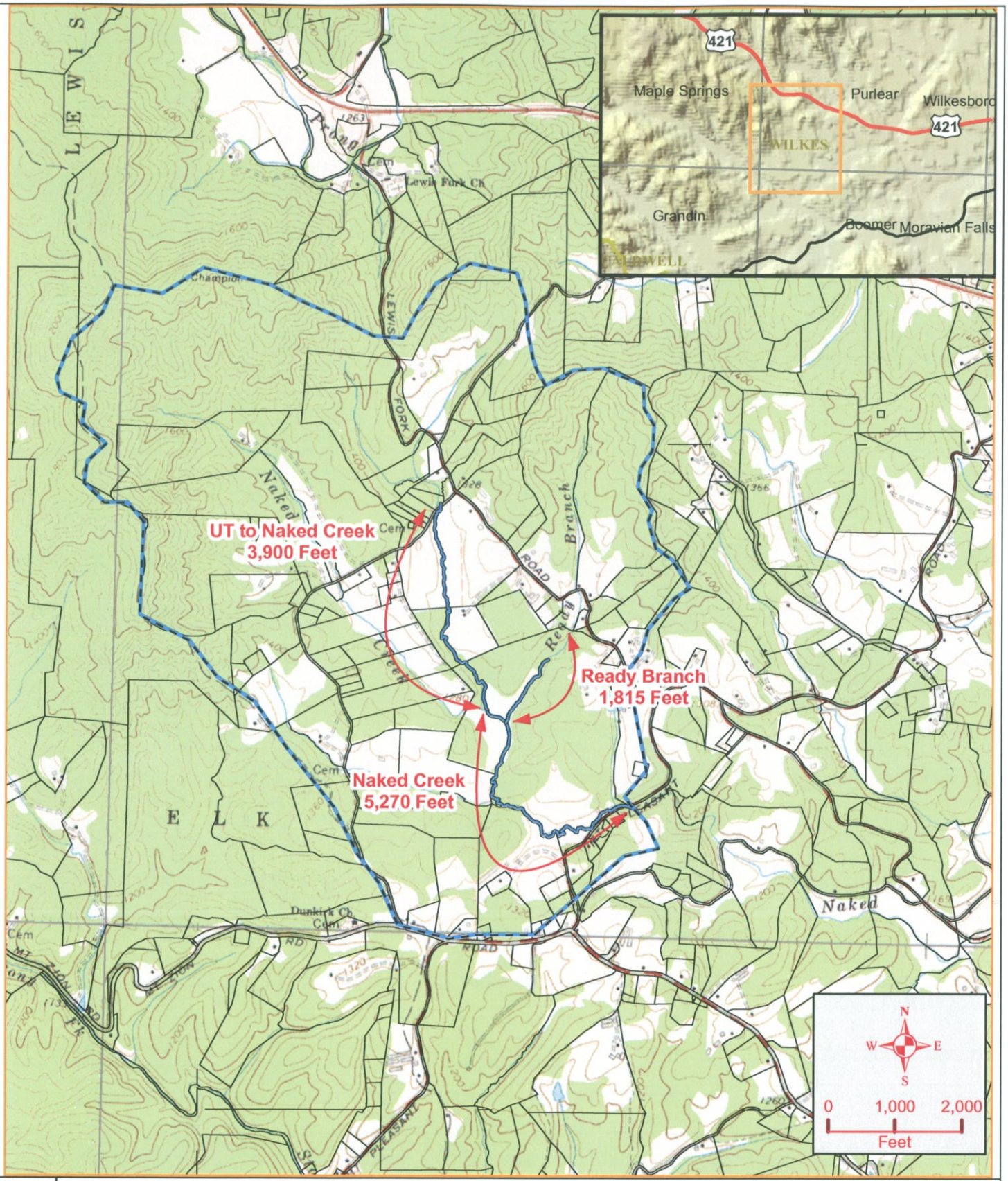
United State Geological Survey. 1966 USGS 7.5 Minute Series Topographical Maps "Purlear."

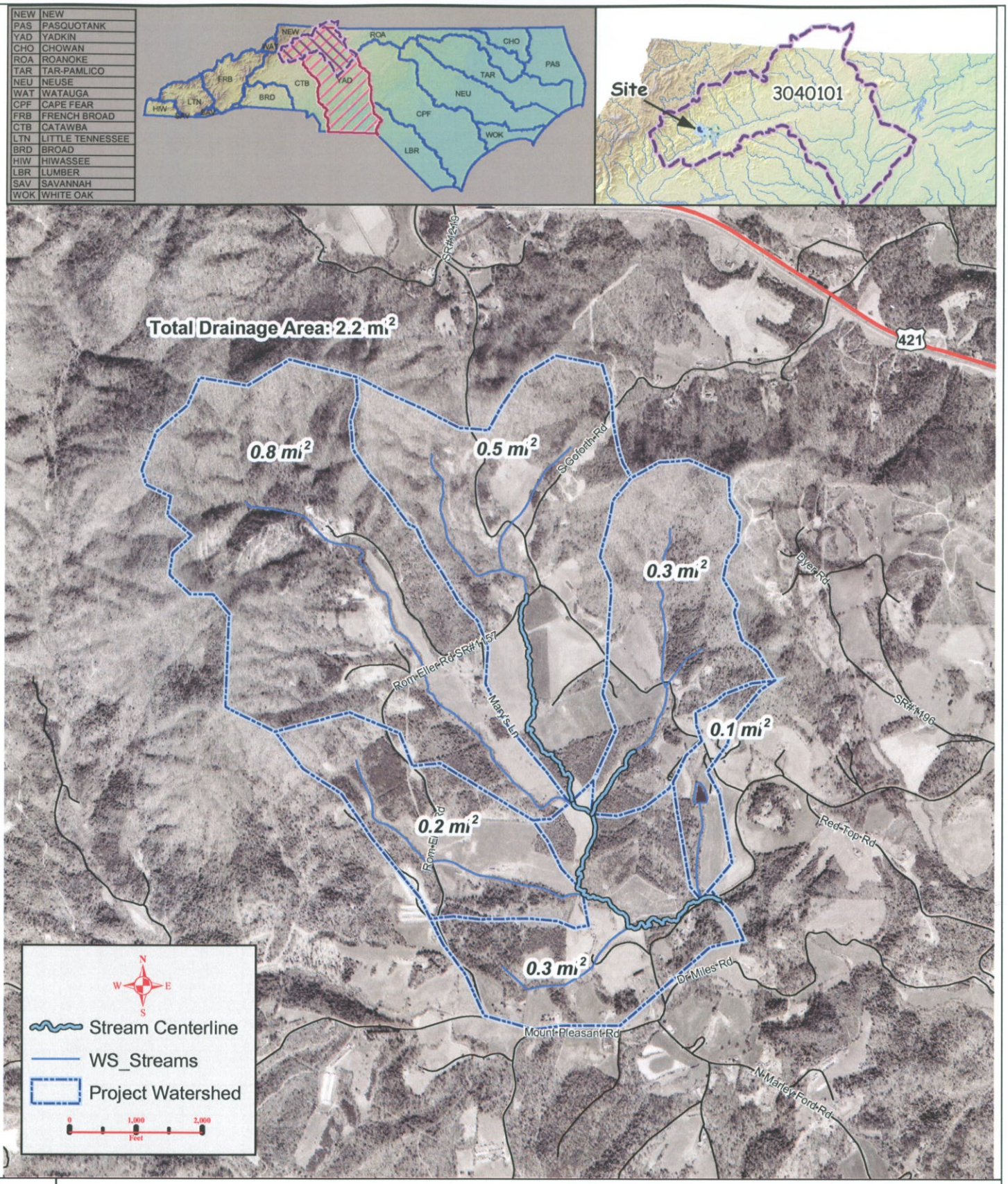
Wilkes County, North Carolina Flood Insurance Rate Map, Community Panel Number 370256 0150 B effective May 15, 1991



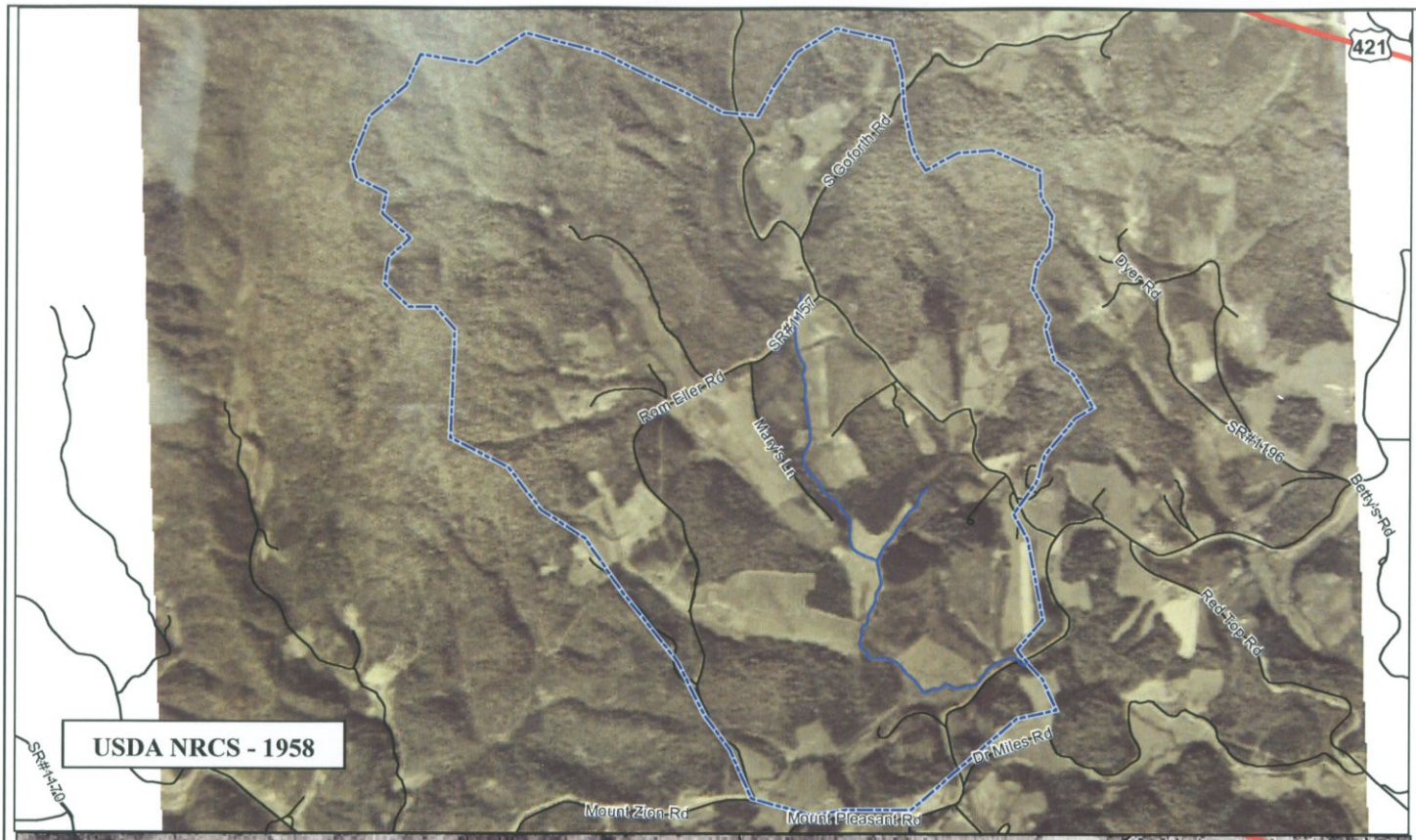
Title	Vicinity Map		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	8/19/05	011795018	1

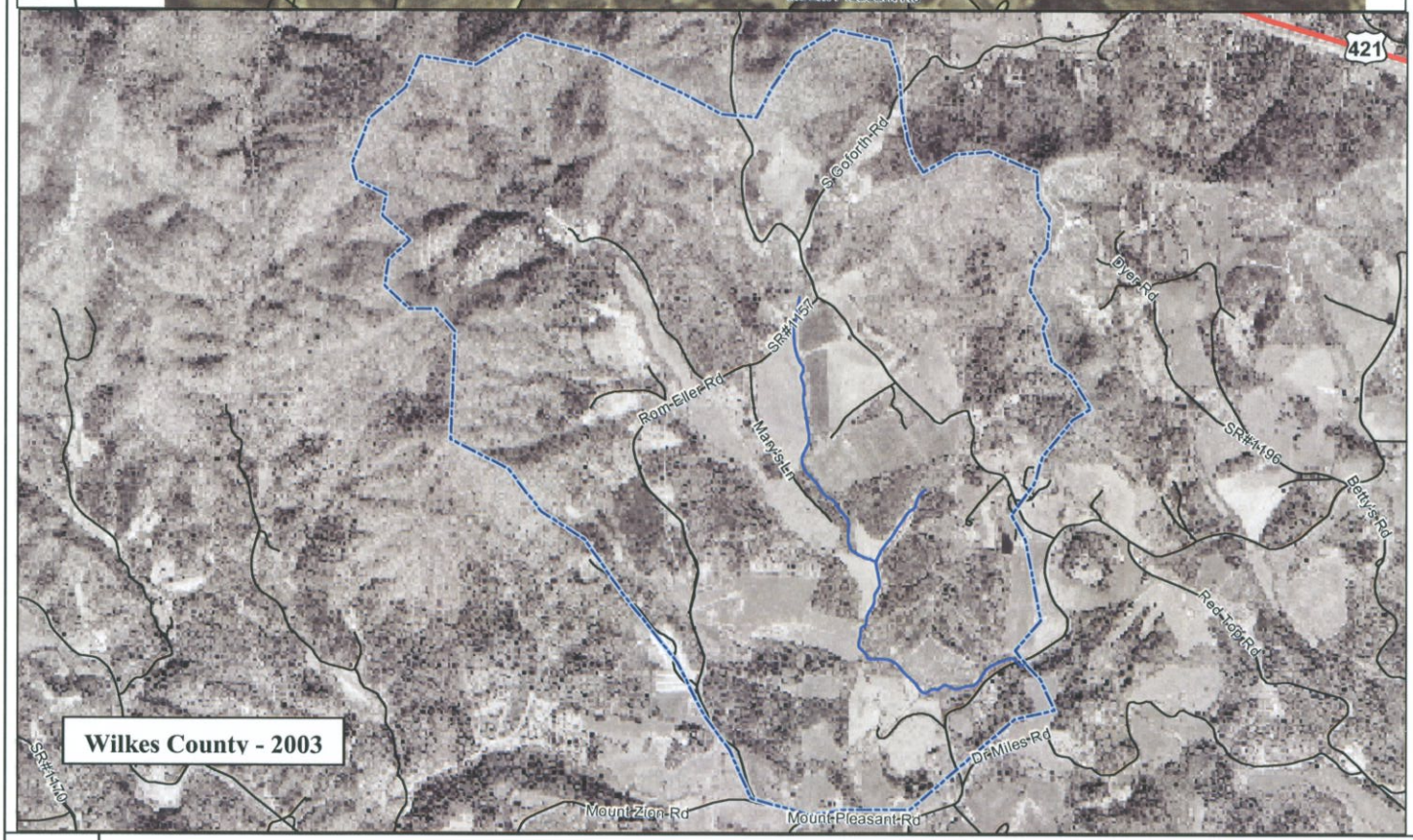


Title	Location / USGS Quad Map (Purlear, North Carolina 1966)		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date 11/10/05	Project Number 011795018	Figure 2

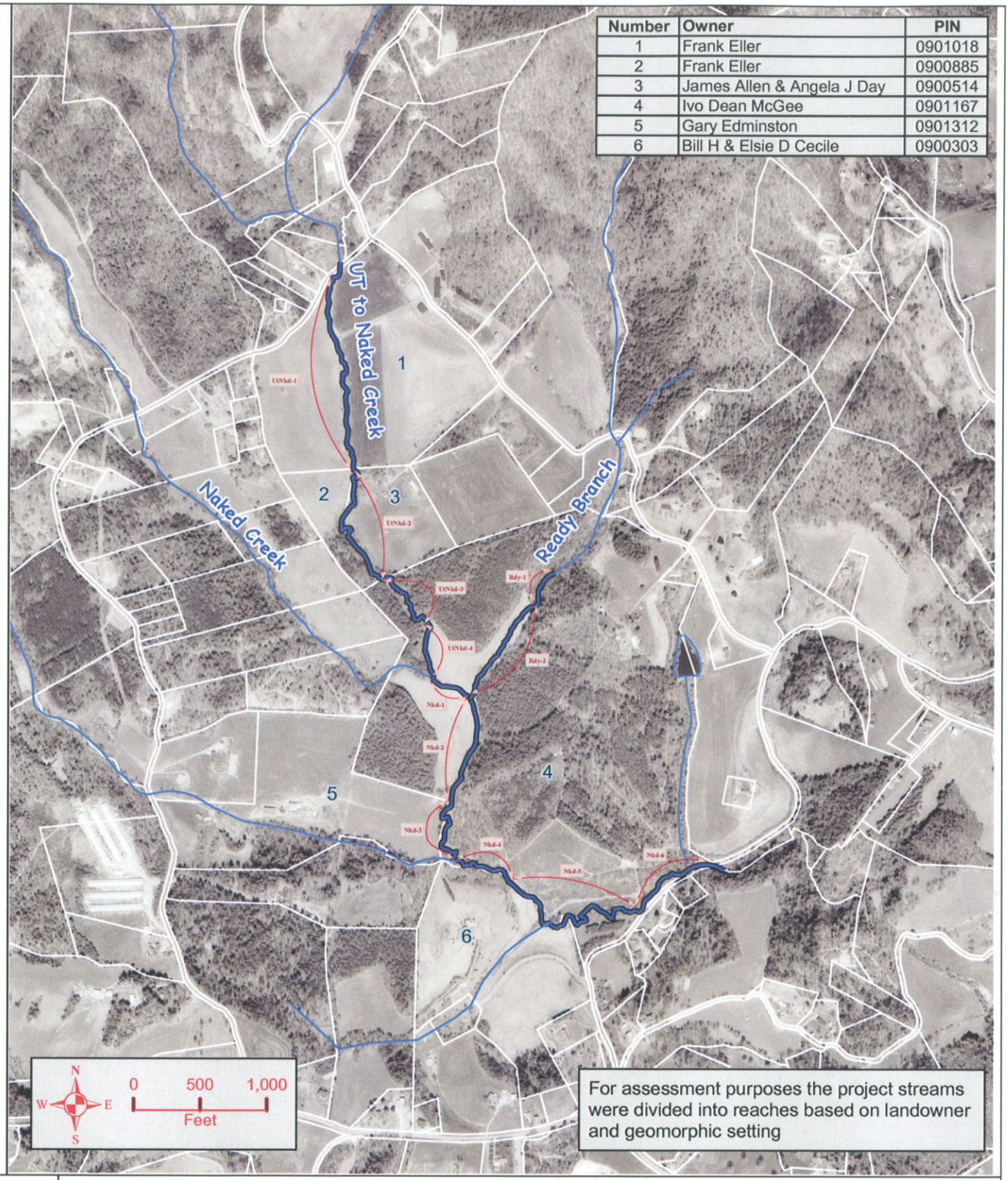


Title	Watershed Map		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	11/10/05	011795018	3





Title	Historic Aerials – Showing slight change of land use from 1958 to 2003.		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	8/19/05	011795018	4

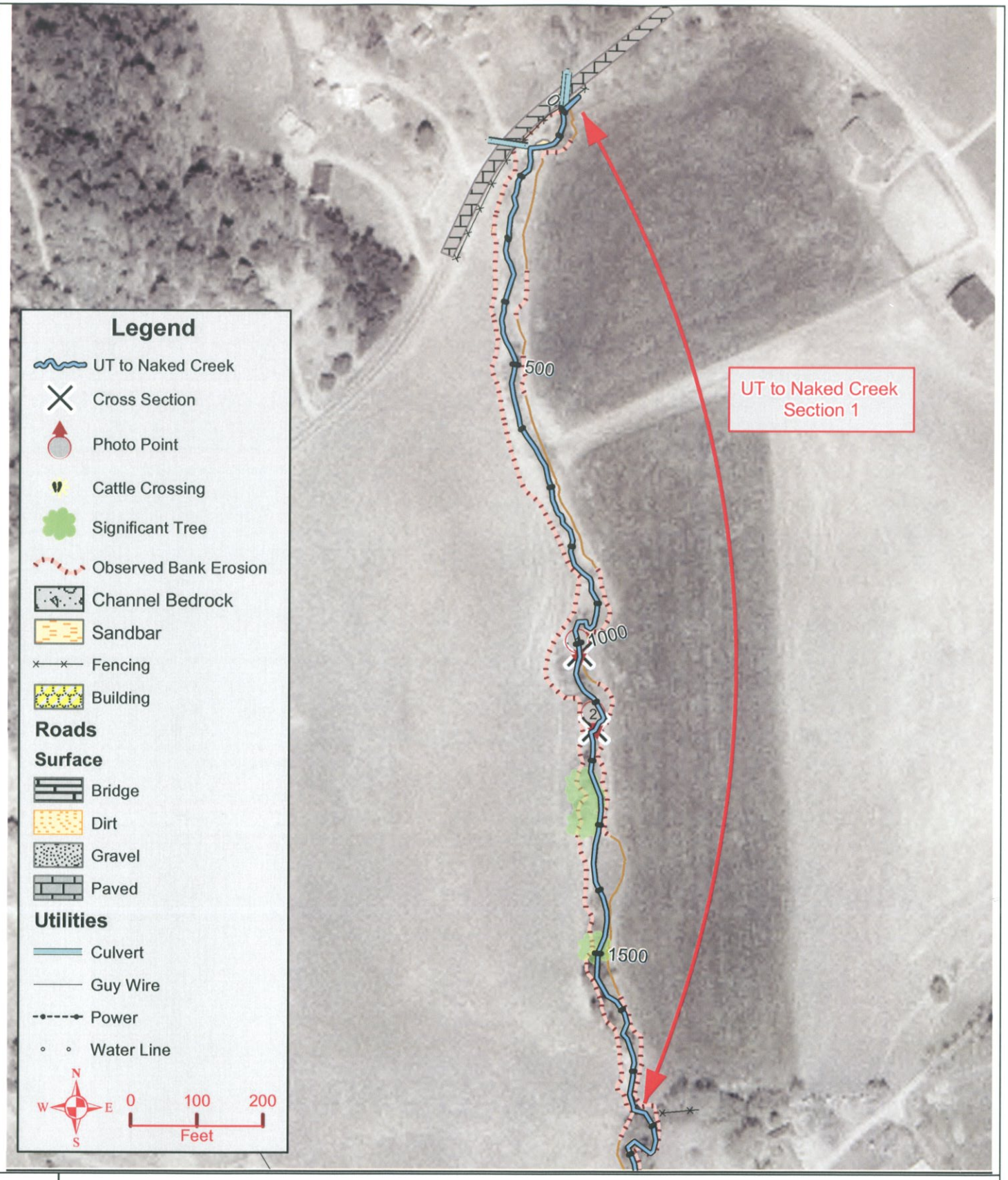


Number	Owner	PIN
1	Frank Eller	0901018
2	Frank Eller	0900885
3	James Allen & Angela J Day	0900514
4	Ivo Dean McGee	0901167
5	Gary Edminston	0901312
6	Bill H & Elsie D Cecile	0900303

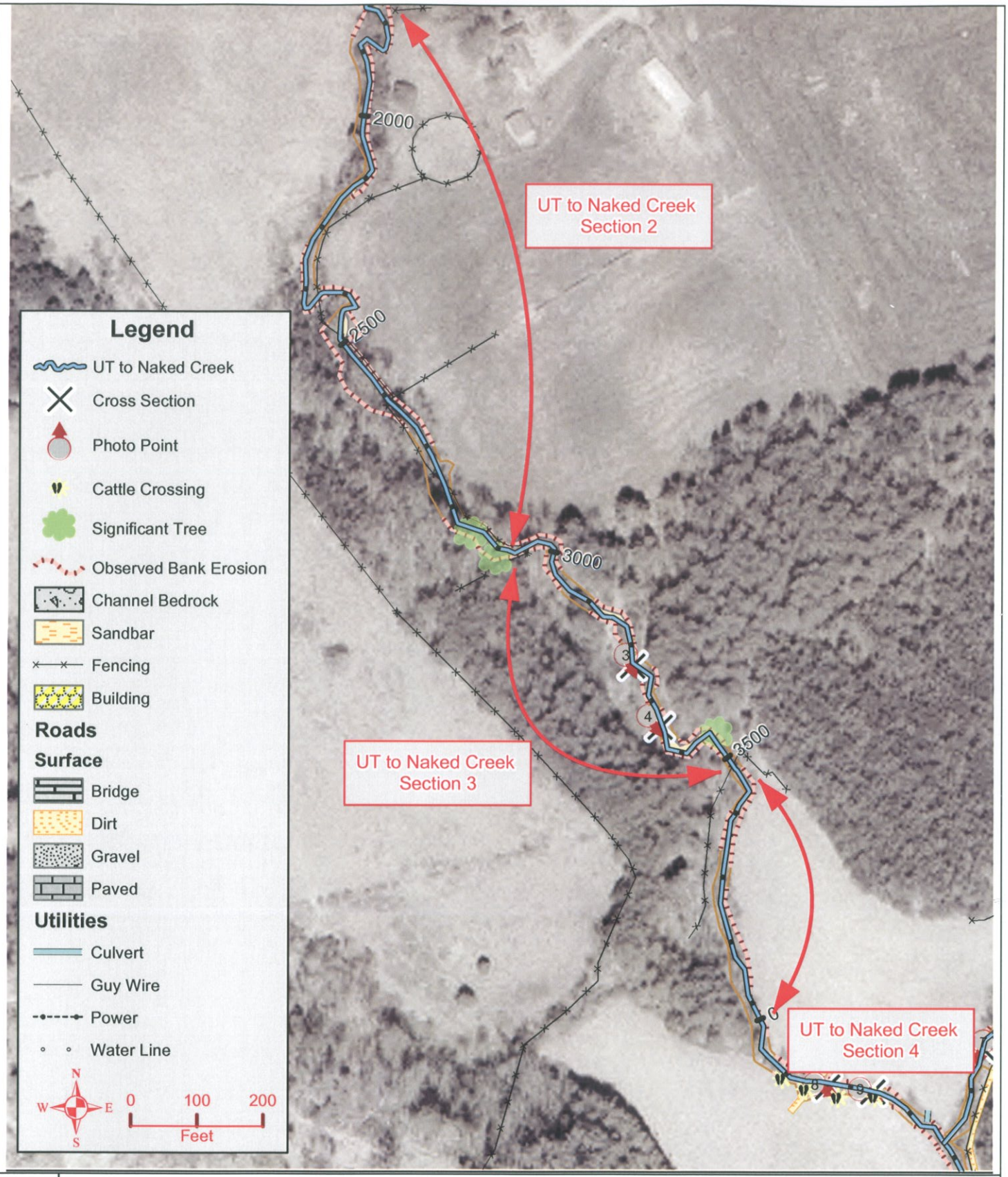
Title	**Existing Conditions - Reach Locations**

Prepared For: Ecosystem Enhancement Program

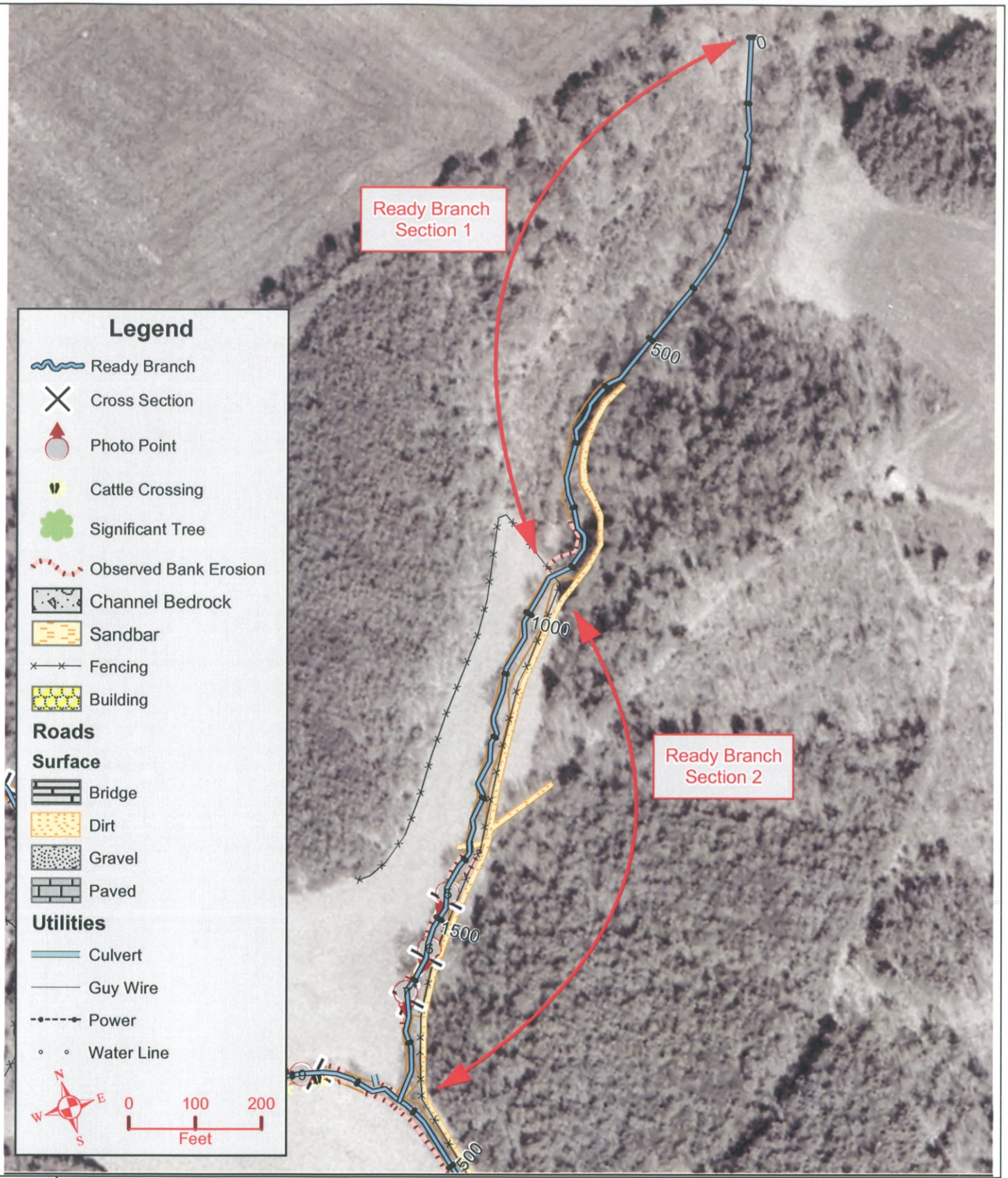
Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
Date	**Project Number**	**Figure**
8/19/05	011795018	5



Title	Existing Conditions – UT to Naked Creek Section 1		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date 8/19/05	Project Number 011795018	Figure 6

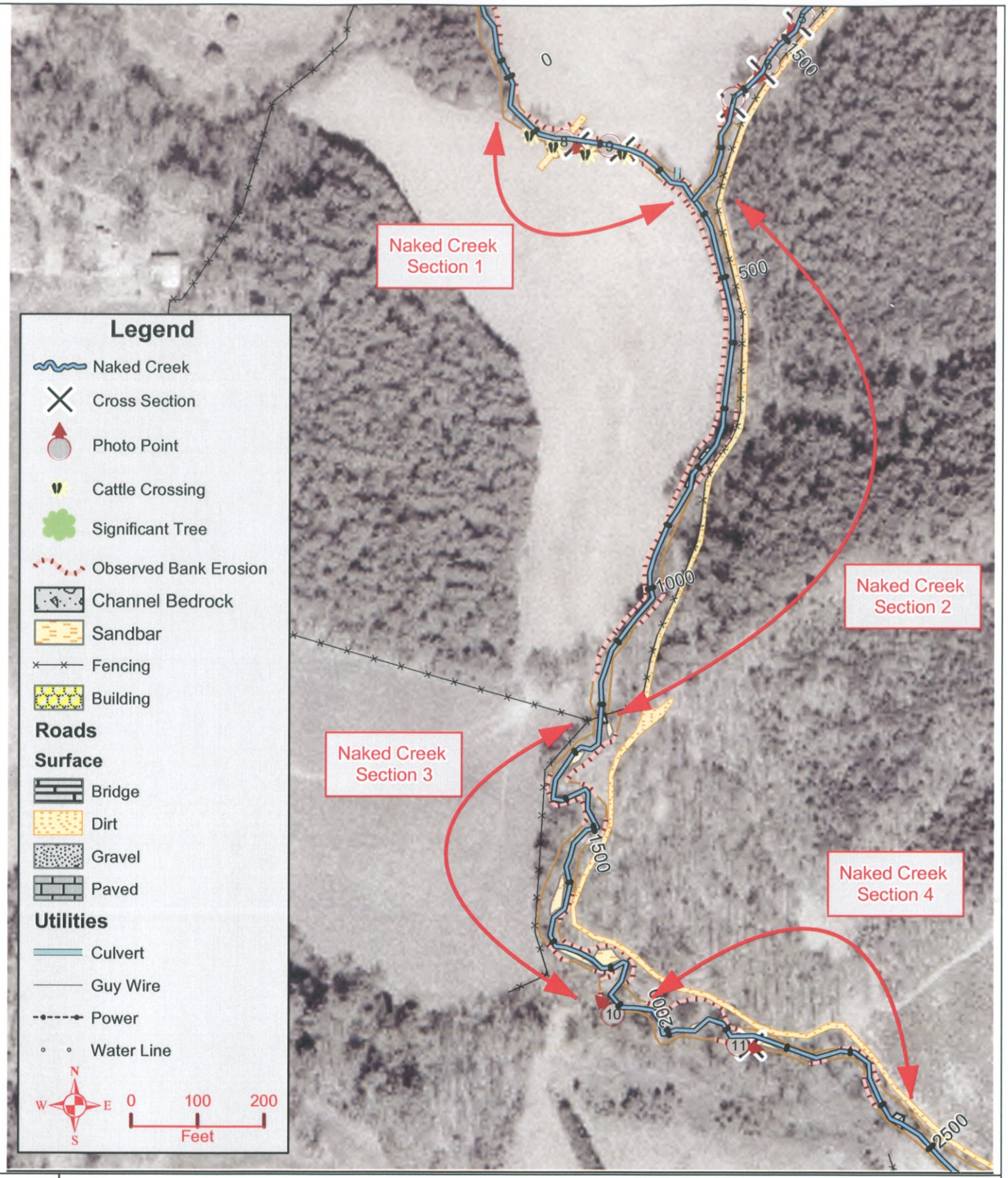


Title	Existing Conditions – UT to Naked Creek Sections 1, 2, 3 and 4		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	8/19/05	011795018	7

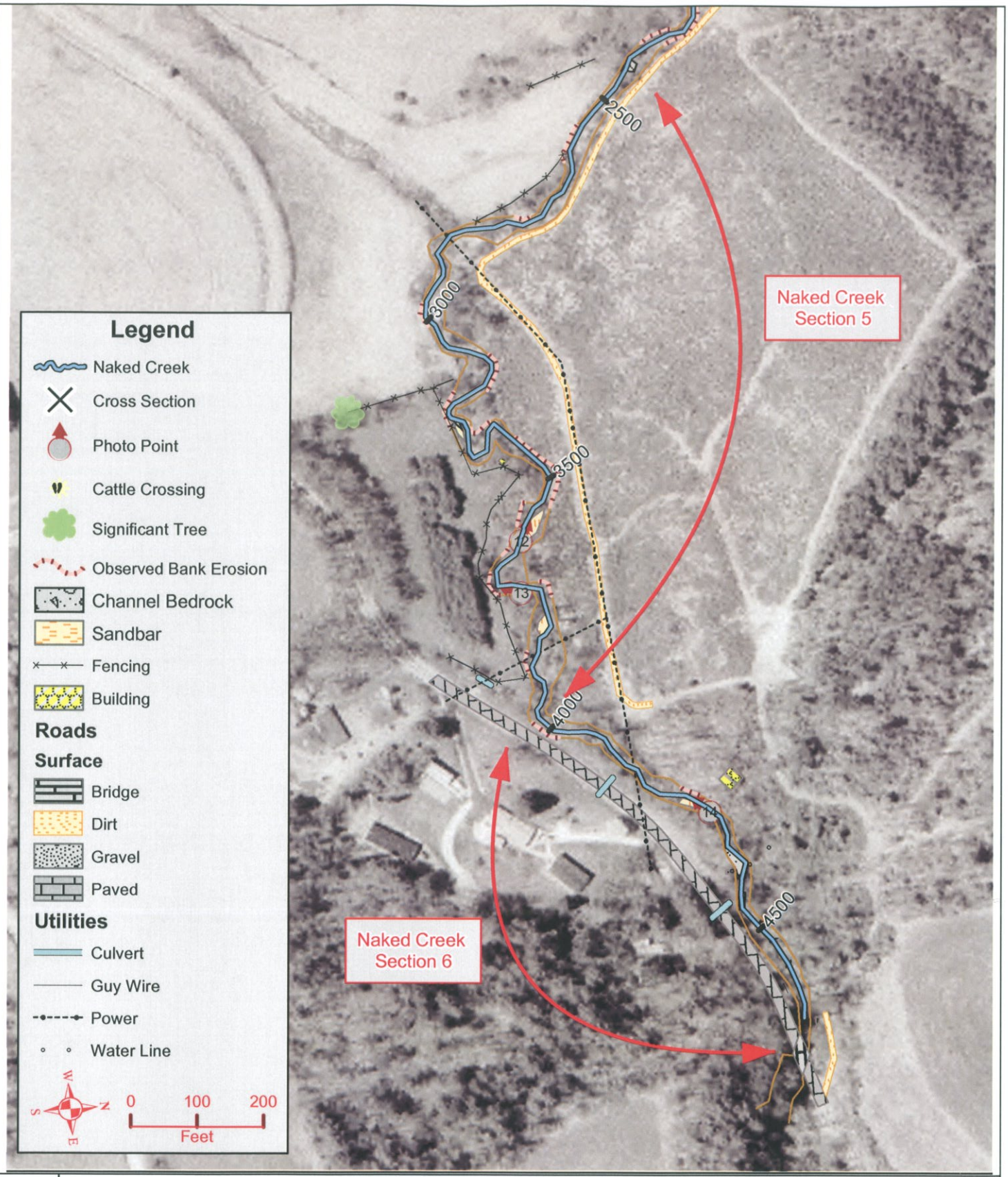


Title	**Existing Conditions – Ready Branch Sections 1 and 2**
Prepared For: Ecosystem Enhancement Program	**Project**: Naked Creek Stream Restoration, Wilkes County, North Carolina

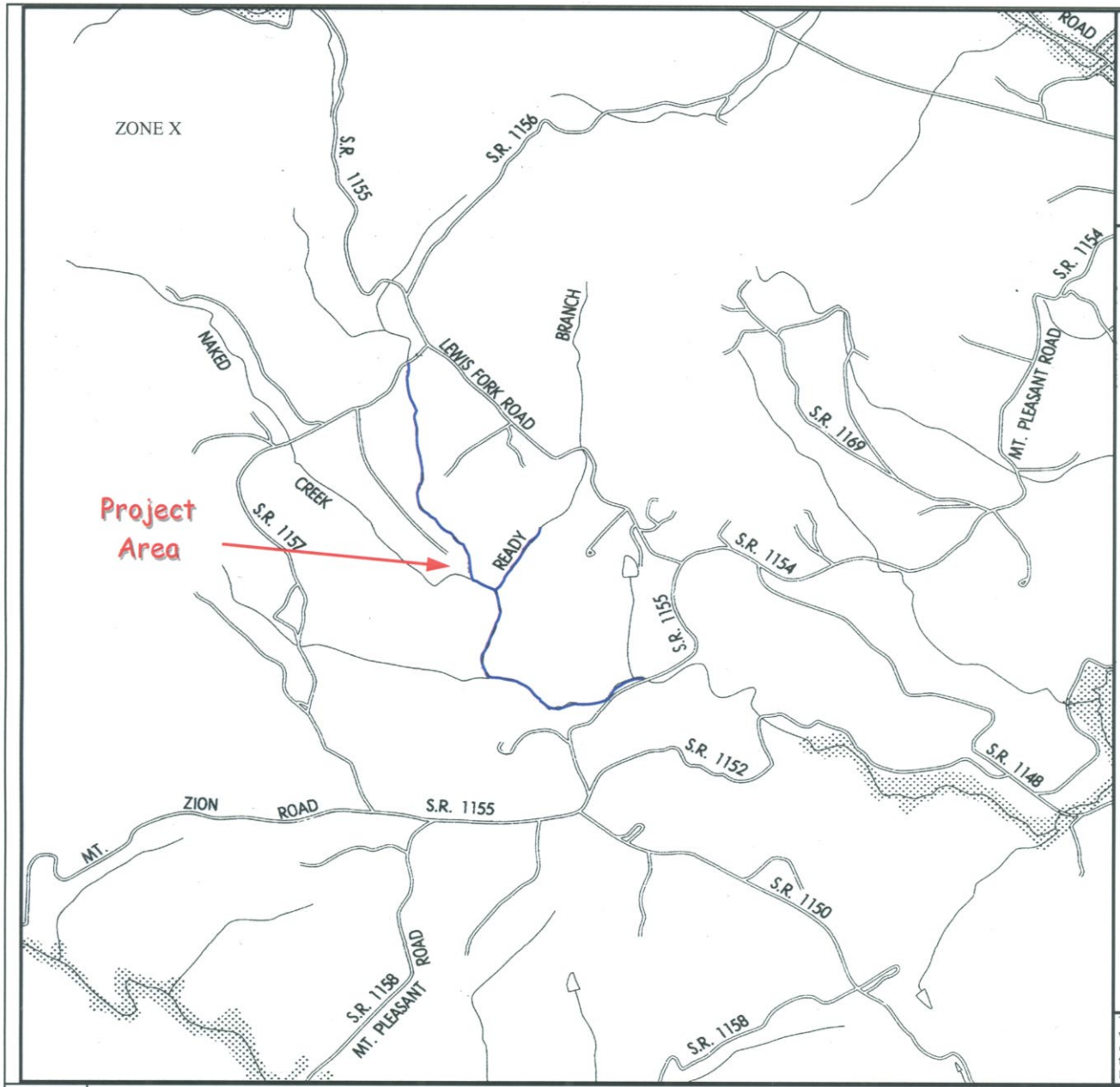
Date	Project Number	Figure
8/19/05	011795018	8



Title	Existing Conditions – Naked Creek Sections 1, 2, 3 and 4		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date 8/19/05	Project Number 011795018	Figure 9



Title	Existing Conditions – Naked Creek Sections 5 and 6		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date 8/19/05	Project Number 011795018	Figure 10



APPROXIMATE SCALE IN FEET

2000 0 2000

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year flood plain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

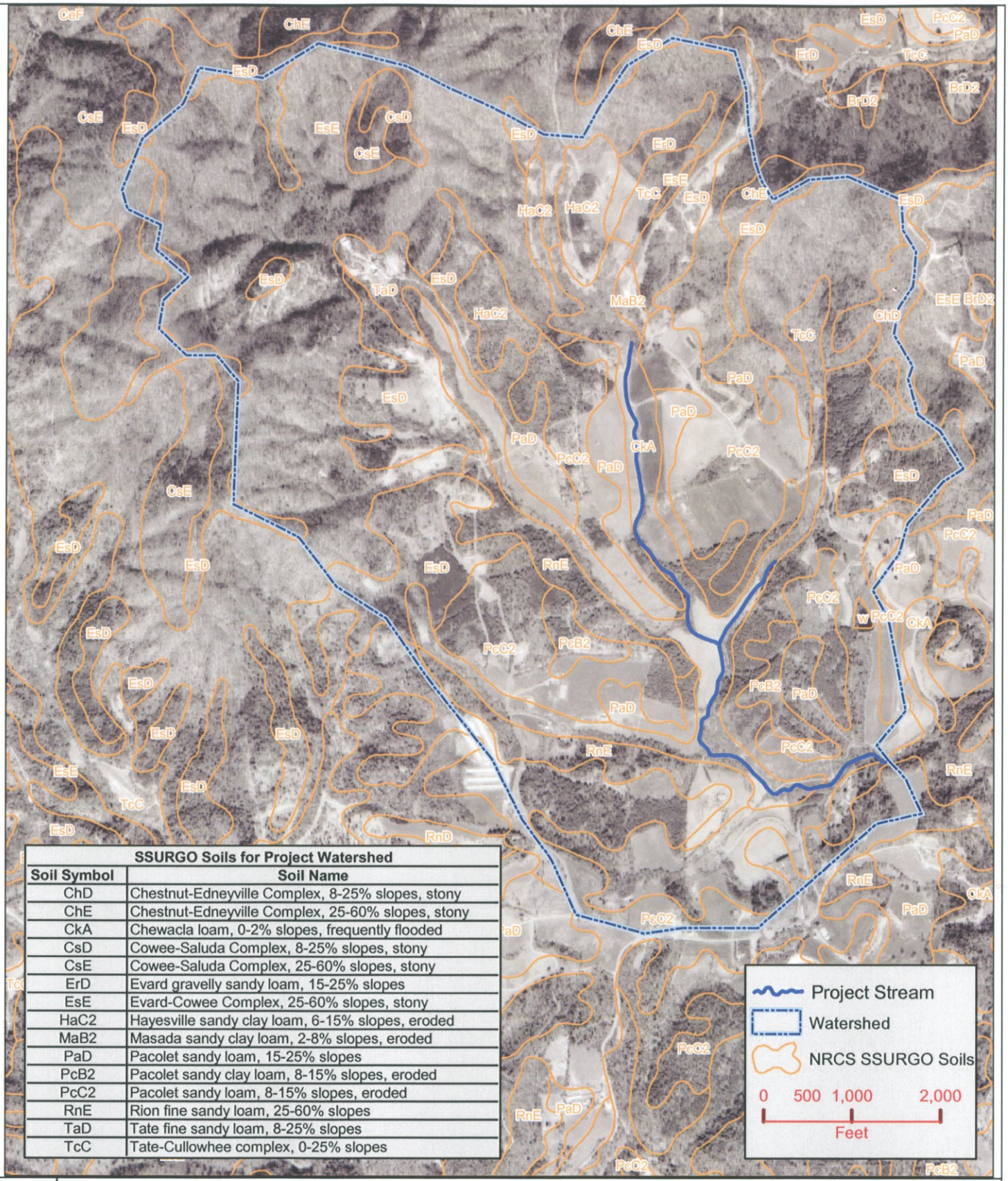
- Flood Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zone.
- 567 — Base Flood Elevation Line; Elevation in Feet*
- A — A — Cross Section Line
- (EL 19) — Base Flood Elevation in Feet Where Uniform Within Zone*
- RM5 × — Elevation Reference Mark
- M3.0 • — Mile Mark

*Referenced to the National Geodetic Vertical Datum of 1929

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Title	**FEMA FIRM Map (Panel 370256 0150 B, effective May 15, 1991)**
Prepared For: Ecosystem Enhancement Program	**Project** Naked Creek Stream Restoration Wilkes County, North Carolina

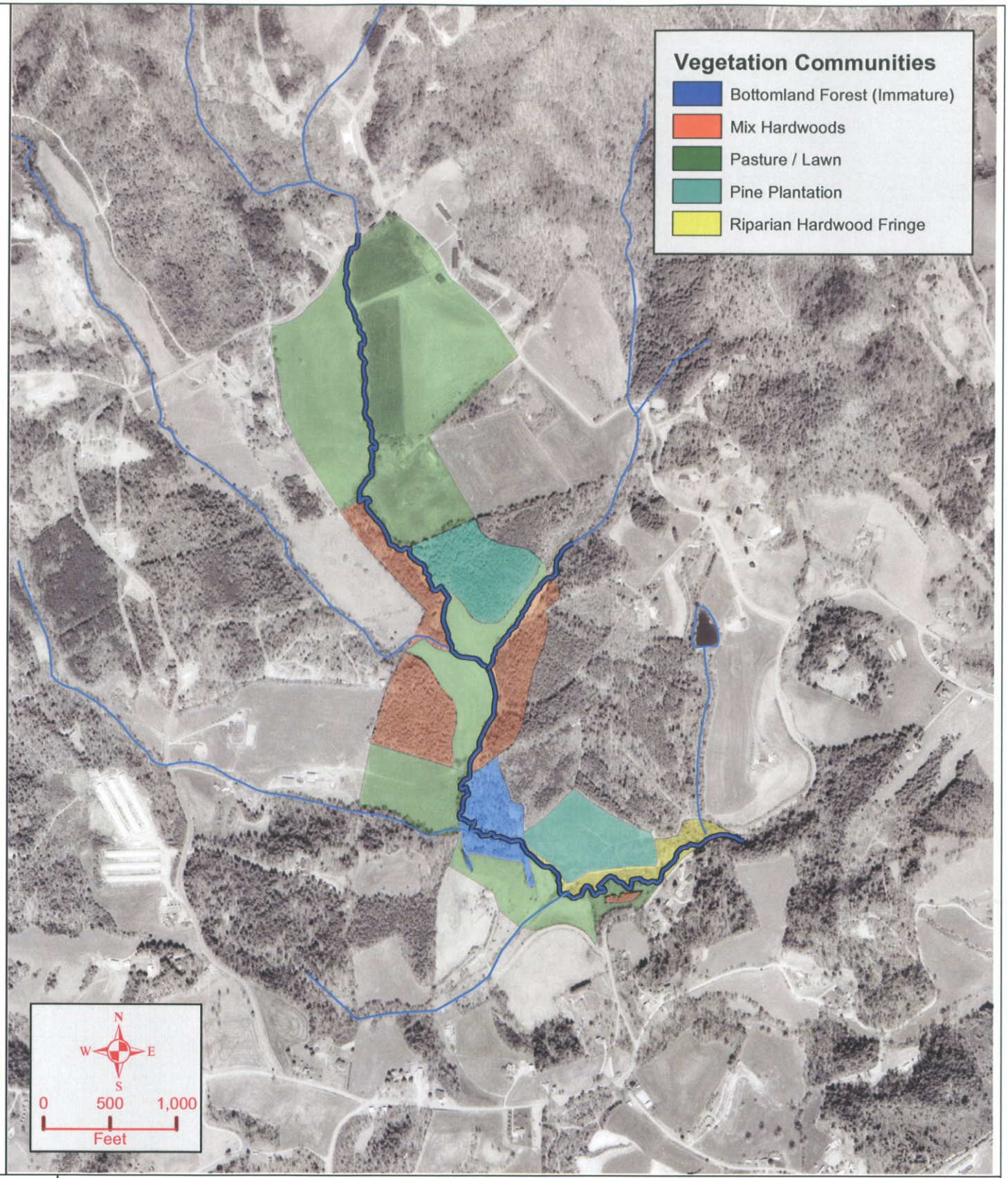
Date	Project Number	Figure
8/19/05	011795018	11



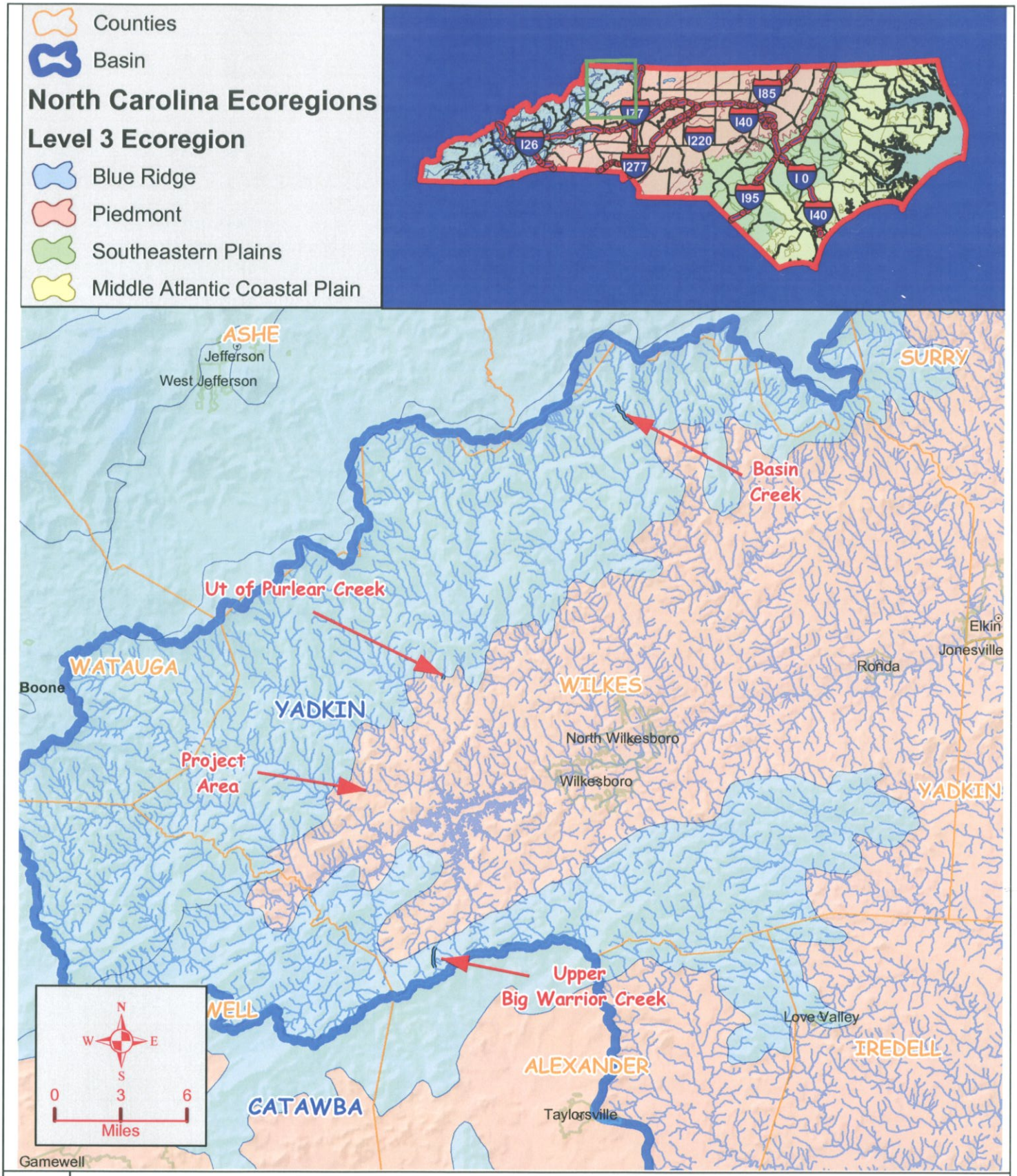
SSURGO Soils for Project Watershed	
Soil Symbol	**Soil Name**
ChD	Chestnut-Edneyville Complex, 8-25% slopes, stony
ChE	Chestnut-Edneyville Complex, 25-60% slopes, stony
CkA	Chewacla loam, 0-2% slopes, frequently flooded
CsD	Cowee-Saluda Complex, 8-25% slopes, stony
CsE	Cowee-Saluda Complex, 25-60% slopes, stony
ErD	Evard gravelly sandy loam, 15-25% slopes
EsE	Evard-Cowee Complex, 25-60% slopes, stony
HaC2	Hayesville sandy clay loam, 6-15% slopes, eroded
MaB2	Masada sandy clay loam, 2-8% slopes, eroded
PaD	Pacolet sandy loam, 15-25% slopes
PcB2	Pacolet sandy clay loam, 8-15% slopes, eroded
PcC2	Pacolet sandy loam, 8-15% slopes, eroded
RnE	Rion fine sandy loam, 25-60% slopes
TaD	Tate fine sandy loam, 8-25% slopes
TcC	Tate-Cullowhee complex, 0-25% slopes

Title	**NRCS SSURGO Soils**
Prepared For: Ecosystem Enhancement Program	**Project**: Naked Creek Stream Restoration, Wilkes County, North Carolina

Date	**Project Number**	**Figure**
8/19/05	011795018	12

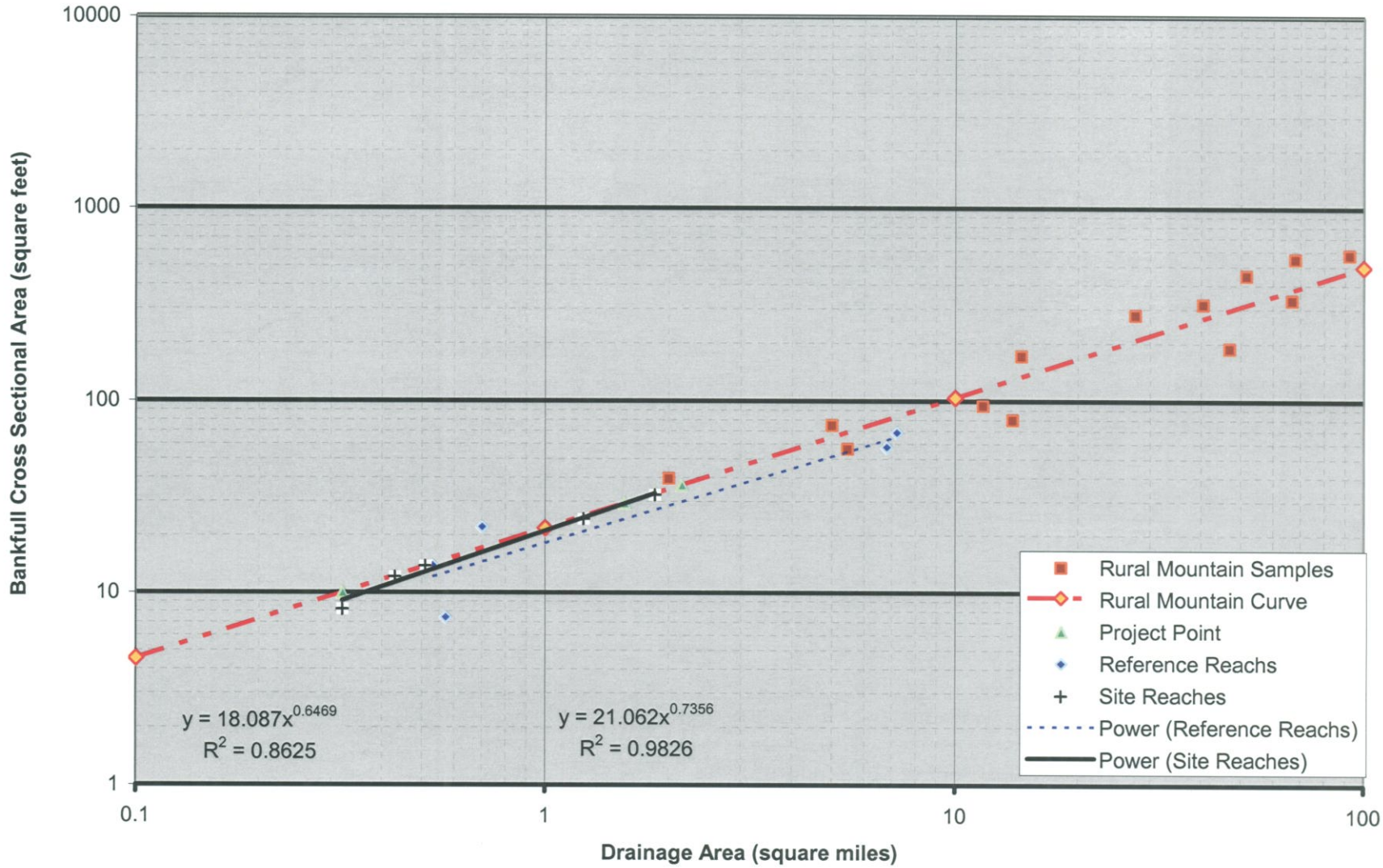


Title	Existing Vegetation Communities		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	8/19/05	011795018	13



Title	Reference Reach Location Map		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	8/19/05	011795018	14

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



Title	Regional and Local Hydraulic Curves		
Prepared For: Ecosystem Enhancement Program	Project	Naked Creek Stream Restoration Wilkes County, North Carolina	
	Date	Project Number	Figure
	8/19/05	011795018	15

Naked Creek Landowners Meeting

Date: Thursday April 28th, 2005

Attendees: Ron Howard (Wilkes NRCS)
Steve Underwood (Wilkes NRCS)
Julie Vann (EEP)
Will Wilhelm (KHA)
Andy Kiley (KHA)
Frank Ellers (Landowner)
Larry Edminston (Landowner)
Gary Edminston (Landowner)
Jerry Edminston (Landowner)
Nathan McGee (Landowner)

NRCS representatives organized a landowners meeting to discuss stream restoration on their land. Kimley-Horn presented a set of aerials showing the plan view of the proposed stream restoration. The landowners shared their needs in relation to the stream. Additionally, Kimley-Horn discussed stream crossing options and construction access options. The meeting comments are summarized below:

Fencing

Frank Eller requested that he be allowed to bush hog both inside and outside the easement fence so that vegetative growth would not interfere with the functionality of the electric fence. Mr. Underwood stated that no mowing could take place inside the easement. Fences can be kept free of vegetation through spraying round-up. The Edmintsons' requested an easement provision to create emergency access points for cattle to the stream during periods of extended drought.

Crossings

Frank Eller requested two crossings – one near an existing crossing and one near the southern property boundary with the Day property. Nathan McGee requested two crossing at/or near the existing crossings.

Easement

Frank Eller requested that the easement width be held strictly to 30 feet for the left side to preserve prime pasture land. He was willing to accept a wider easement on the right side. Mr. Eller was willing to place an easement around a gully located immediately northeast of the beginning of stream project. Nathan McGee was willing to expand the easement beyond 30 feet for certain sections of the reach and expand the easement to preserve stream and wetland above the project portion of Ready Creek. Nathan McGee requested that the boundary of the easement near the downstream end of the project reach be

configured to allow roadway access to a potential residential development (see future landuse).

Construction Access/ Easement

Mr. Eller and the Edmintsons' were willing to consider construction access to the stream through their land.

Future Landuse

Neither Mr. Eller nor the Edminstons' stated any plans to change the existing landuse adjacent to the project stream. Mr. McGee stated that his family may plan a residential development on uplands north of the lower reach.

Miscellaneous

Mr. Eller asked for dirt to fill a gully east of Lewis Fork Baptist Church Road.

EDR™ Environmental
Data Resources Inc

The EDR Radius Map
with GeoCheck®

Naked Creek
Marys Lane
Ferguson, NC 28624

Inquiry Number: 1400994.2s

April 15, 2005

The Standard in Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06460

Nationwide Customer Service

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

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

MARYS LANE
FERGUSON, NC 28624

COORDINATES

Latitude (North):	36.134700 - 36° 8' 4.9"
Longitude (West):	81.355400 - 81° 21' 19.4"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	468022.4
UTM Y (Meters):	3998746.5
Elevation:	1278 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property:	36081-B3 PURLEAR, 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
RCRA-TSDF ---- Resource Conservation and Recovery Act Information
RCRA-LQG ---- Resource Conservation and Recovery Act Information
RCRA-SQG ---- Resource Conservation and Recovery Act Information
ERNS ---- Emergency Response Notification System

STATE ASTM STANDARD

SHWS ---- Inactive Hazardous Sites Inventory

EXECUTIVE SUMMARY

SWF/LF	List of Solid Waste Facilities
LUST	Regional UST Database
UST	Petroleum Underground Storage Tank Database
OLI	Old Landfill Inventory
VCP	Responsible Party Voluntary Action Sites
INDIAN LUST	Leaking Underground Storage Tanks on Indian Land
INDIAN UST	Underground Storage Tanks on Indian Land

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
ODI	Open Dump Inventory
UMTRA	Uranium Mill Tailings Sites
FUDS	Formerly Used Defense Sites
INDIAN RESERV	Indian Reservations
DOD	Department of Defense Sites
RAATS	RCRA Administrative Action Tracking System
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
SSTS	Section 7 Tracking Systems
FTTS INSP	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
AST	AST Database
LUST TRUST	State Trust Fund Database
DRYCLEANERS	Drycleaning Sites
IMD	Incident Management Database

EDR PROPRIETARY HISTORICAL DATABASES

Coal Gas	Former Manufactured Gas (Coal Gas) Sites

BROWNFIELDS DATABASES

US BROWNFIELDS	A Listing of Brownfields Sites
US INST CONTROL	Sites with Institutional Controls
Brownfields	Brownfields Projects Inventory
INST CONTROL	No Further Action Sites With Land Use Restrictions Monitoring
VCP	Responsible Party Voluntary Action Sites

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

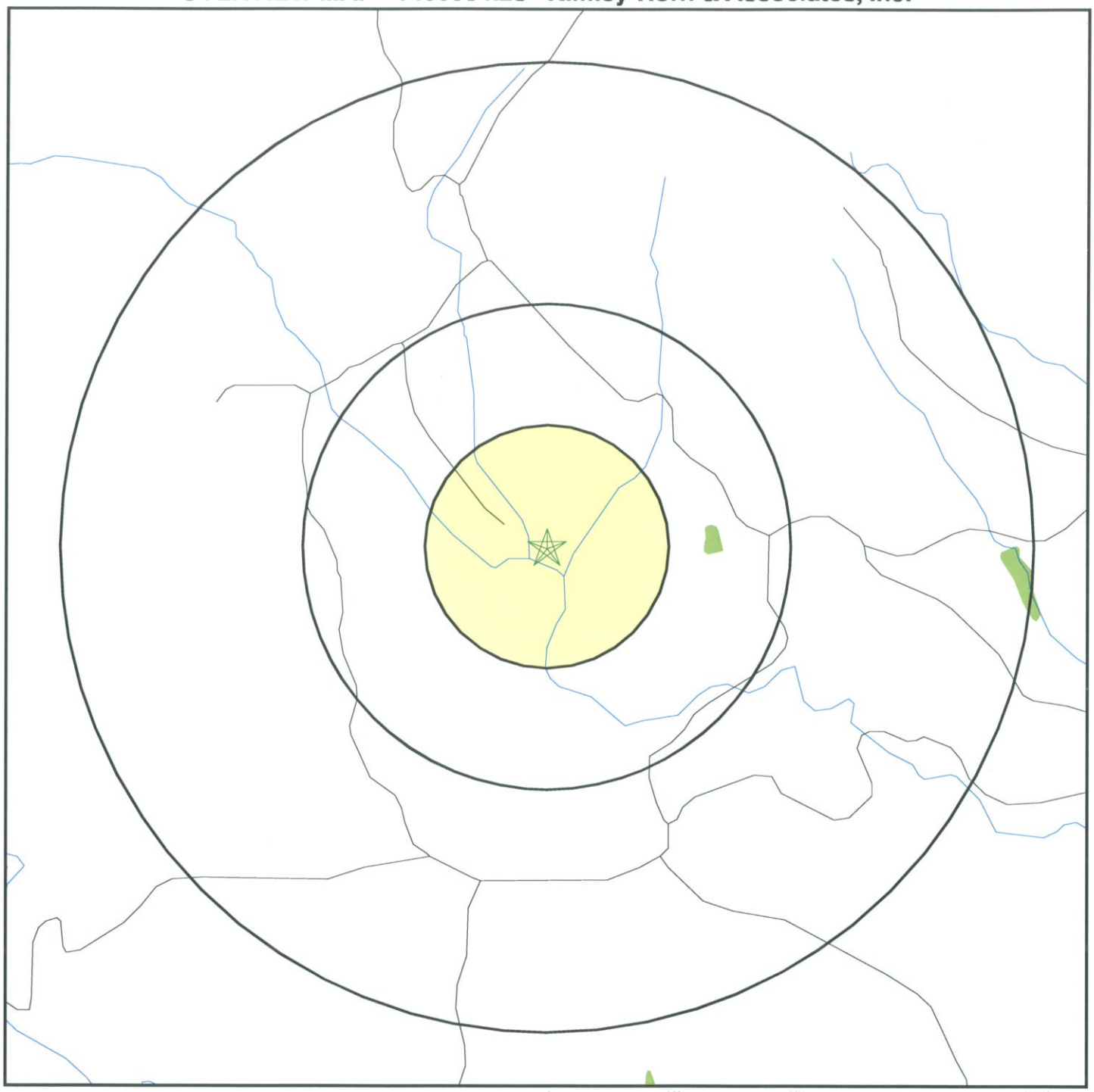
Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

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

Site Name	Database(s)
BEAVER CREEK GROCERY	IMD, LUST
WOODS GROCERY	LUST
NCDOT - R & R CONVENIENCE STORE	LUST
CHAMPION GROCERY	UST
GROCERY BASKET	UST
BOB'S GROCERY	UST
BEAVER CREEK ADVENT CHRISTIAN	FINDS

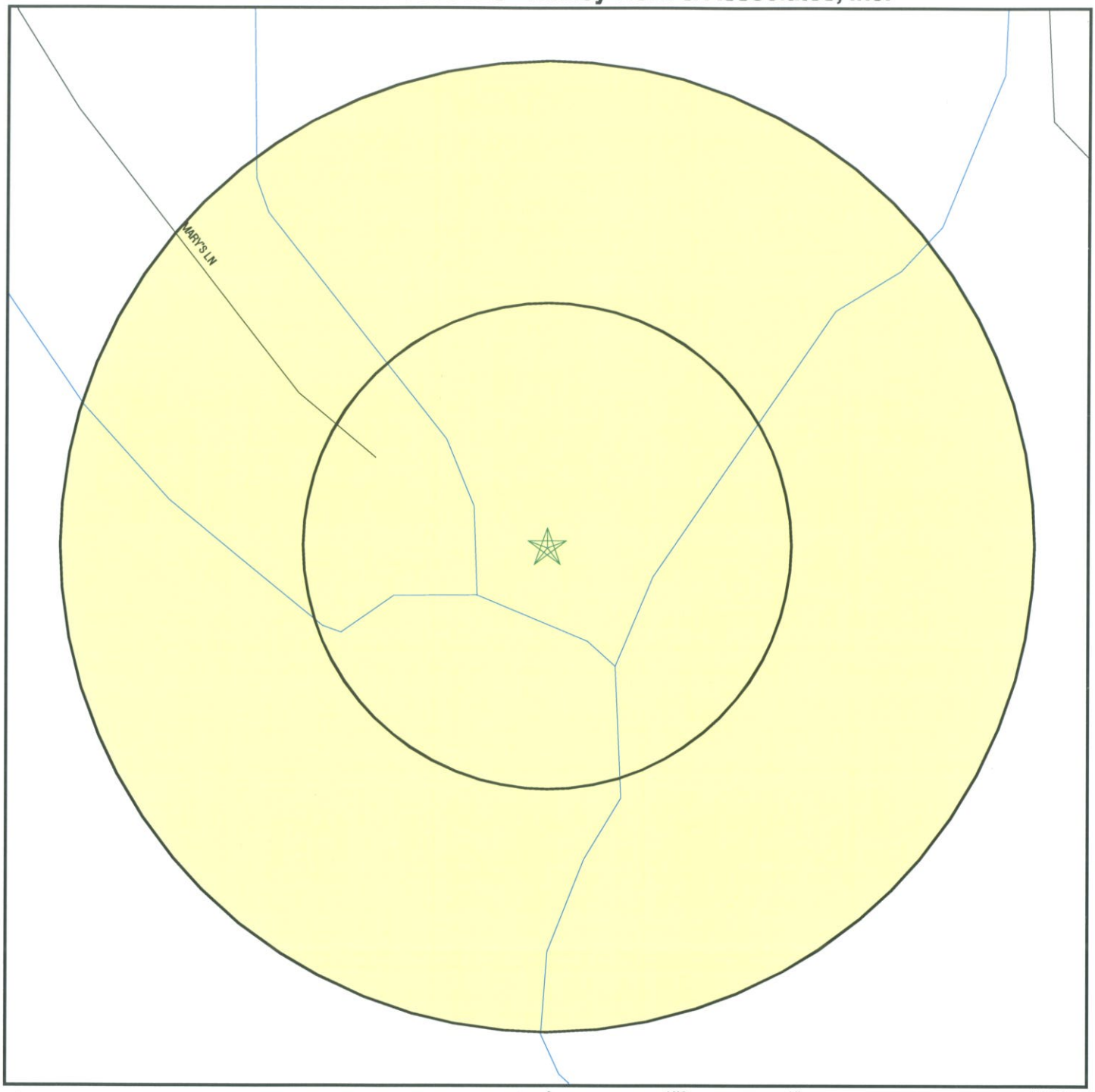
OVERVIEW MAP - 1400994.2s - Kimley-Horn & Associates, Inc.



- 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
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- Federal Wetlands
- Hazardous Substance Disposal Sites

TARGET PROPERTY:	Naked Creek	CUSTOMER:	Kimley-Horn & Associates, Inc.
ADDRESS:	Marys Lane	CONTACT:	Jason Diaz
CITY/STATE/ZIP:	Ferguson NC 28624	INQUIRY #:	1400994.2s
LAT/LONG:	36.1347 / 81.3554	DATE:	April 15, 2005 11:33 am

DETAIL MAP - 1400994.2s - 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
- Dept. Defense Sites
- Indian Reservations BIA
- Oil & Gas pipelines
- Hazardous Substance Disposal Sites

0 1/16 1/8 1/4 Miles

TARGET PROPERTY:	Naked Creek	CUSTOMER:	Kimley-Horn & Associates, Inc.
ADDRESS:	Marys Lane	CONTACT:	Jason Diaz
CITY/STATE/ZIP:	Ferguson NC 28624	INQUIRY #:	1400994.2s
LAT/LONG:	36.1347 / 81.3554	DATE:	April 15, 2005 11:33 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		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.250	0	0	NR	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRA TSD		0.500	0	0	0	NR	NR	0
RCRA Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRA Sm. Quan. Gen.		0.250	0	0	NR	NR	NR	0
ERNS		TP	NR	NR	NR	NR	NR	0
STATE ASTM STANDARD								
State Haz. Waste		1.000	0	0	0	0	NR	0
State Landfill		0.500	0	0	0	NR	NR	0
LUST		0.500	0	0	0	NR	NR	0
UST		0.250	0	0	NR	NR	NR	0
OLI		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0
INDIAN LUST		0.500	0	0	0	NR	NR	0
INDIAN UST		0.250	0	0	NR	NR	NR	0
FEDERAL ASTM SUPPLEMENTAL								
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
NPL Liens		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
ODI		0.500	0	0	0	NR	NR	0
UMTRA		0.500	0	0	0	NR	NR	0
FUDS		1.000	0	0	0	0	NR	0
INDIAN RESERV		1.000	0	0	0	0	NR	0
DOD		1.000	0	0	0	0	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
SSTS		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
STATE OR LOCAL ASTM SUPPLEMENTAL								
NC HSDS		1.000	0	0	0	0	NR	0

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
AST		TP	NR	NR	NR	NR	NR	0
LUST TRUST		0.500	0	0	0	NR	NR	0
DRYCLEANERS		0.250	0	0	NR	NR	NR	0
IMD		0.500	0	0	0	NR	NR	0
EDR PROPRIETARY HISTORICAL DATABASES								
Coal Gas		1.000	0	0	0	0	NR	0
BROWNFIELDS DATABASES								
US BROWNFIELDS		0.500	0	0	0	NR	NR	0
US INST CONTROL		0.500	0	0	0	NR	NR	0
Brownfields		0.500	0	0	0	NR	NR	0
INST CONTROL		0.500	0	0	0	NR	NR	0
VCP		0.500	0	0	0	NR	NR	0

NOTES:

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)
FERGUSON	U001189778	CHAMPION GROCERY	ROUTE 1 - MOUNT PLEASANT ROAD	28624	UST
FERGUSON	U003147153	GROCERY BASKET	ROUTE 1 BOX 57 HWY 268	28624	UST
FERGUSON	S101525102	BEAVER CREEK GROCERY	HWY 268 E.	28624	IMD, LUST
FERGUSON	1007712370	BEAVER CREEK ADVENT CHRISTIAN	HIGHWAY 268W	28624	FINDS
FERGUSON	U001203088	BOB'S GROCERY	RT#1 BOX 250	28624	UST
MORAVIAN FALLS	S105766767	WOODS GROCERY	HIGHWAY 18 S	28665	LUST
MORAVIAN FALLS	S105766813	NCDOT - R & R CONVENIENCE STORE	NC HIGHWAY 18	28665	LUST

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: 12/14/04
Date Made Active at EDR: 02/03/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 02/01/05
Elapsed ASTM days: 2
Date of Last EDR Contact: 02/01/05

NPL Site Boundaries

Sources:

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

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 8
Telephone: 303-312-6774

EPA Region 4
Telephone 404-562-8033

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

Date of Government Version: 12/14/04
Date Made Active at EDR: 02/03/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 02/01/05
Elapsed ASTM days: 2
Date of Last EDR Contact: 02/01/05

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: 02/15/05
Date Made Active at EDR: 04/06/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 03/22/05
Elapsed ASTM days: 15
Date of Last EDR Contact: 03/22/05

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: 03/22/05
Date Made Active at EDR: 04/06/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 04/01/05
Elapsed ASTM days: 5
Date of Last EDR Contact: 04/01/05

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

Date of Government Version: 12/15/04
Date Made Active at EDR: 02/25/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 01/07/05
Elapsed ASTM days: 49
Date of Last EDR Contact: 12/07/04

RCRA: Resource Conservation and Recovery Act Information
Source: EPA
Telephone: 800-424-9346
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. RCRAInfo replaces the data recording and reporting abilities of the Resource Conservation and Recovery Information System (RCRIS). The database 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). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month. Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month. Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month. Transporters are individuals or entities that move hazardous waste from the generator off-site to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 01/10/05
Date Made Active at EDR: 04/01/05
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 01/25/05
Elapsed ASTM days: 66
Date of Last EDR Contact: 03/23/05

ERNS: Emergency Response Notification System
Source: National Response Center, United States Coast Guard
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: 12/31/04
Date Made Active at EDR: 03/24/05
Database Release Frequency: Annually

Date of Data Arrival at EDR: 01/27/05
Elapsed ASTM days: 56
Date of Last EDR Contact: 01/27/05

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: 12/01/01
Database Release Frequency: Biennially

Date of Last EDR Contact: 12/13/04
Date of Next Scheduled EDR Contact: 03/14/05

CONSENT: Superfund (CERCLA) Consent Decrees
Source: Department of Justice, Consent Decree Library
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: 03/05/04
Database Release Frequency: Varies

Date of Last EDR Contact: 10/25/04
Date of Next Scheduled EDR Contact: 01/24/05

ROD: Records Of Decision
Source: EPA
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: 01/10/05
Database Release Frequency: Annually

Date of Last EDR Contact: 01/05/05
Date of Next Scheduled EDR Contact: 04/04/05

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: 12/14/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 02/01/05
Date of Next Scheduled EDR Contact: 05/02/05

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: 01/12/05
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/03/05
Date of Next Scheduled EDR Contact: 04/04/05

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4555
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 11/16/04
Database Release Frequency: Annually

Date of Last EDR Contact: 01/19/05
Date of Next Scheduled EDR Contact: 04/18/05

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: 01/12/05
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/04/05
Date of Next Scheduled EDR Contact: 07/04/05

MINES: Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 11/15/04
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 12/28/04
Date of Next Scheduled EDR Contact: 03/28/05

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 202-564-4267
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: 02/22/05
Date of Next Scheduled EDR Contact: 05/23/05

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-564-3887
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: 12/21/04
Database Release Frequency: Annually

Date of Last EDR Contact: 02/23/05
Date of Next Scheduled EDR Contact: 05/09/05

DOD: Department of Defense Sites
Source: USGS
Telephone: 703-692-8801
This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 10/01/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/08/05
Date of Next Scheduled EDR Contact: 05/09/05

UMTRA: Uranium Mill Tailings Sites
Source: Department of Energy
Telephone: 505-845-0011
Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized. In 1978, 24 inactive uranium mill tailings sites in Oregon, Idaho, Wyoming, Utah, Colorado, New Mexico, Texas, North Dakota, South Dakota, Pennsylvania, and on Navajo and Hopi tribal lands, were targeted for cleanup by the Department of Energy.

Date of Government Version: 12/29/04
Database Release Frequency: Varies

Date of Last EDR Contact: 12/21/04
Date of Next Scheduled EDR Contact: 03/21/05

ODI: Open Dump Inventory
Source: Environmental Protection Agency
Telephone: 800-424-9346
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/85
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 05/23/95
Date of Next Scheduled EDR Contact: N/A

FUDS: Formerly Used Defense Sites
Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 12/31/03
Database Release Frequency: Varies

Date of Last EDR Contact: 01/03/05
Date of Next Scheduled EDR Contact: 04/04/05

INDIAN RESERV: Indian Reservations
Source: USGS
Telephone: 202-208-3710
This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 10/01/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/08/05
Date of Next Scheduled EDR Contact: 05/09/05

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: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

TRIS: Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-566-0250
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: 12/31/02
Database Release Frequency: Annually

Date of Last EDR Contact: 12/20/04
Date of Next Scheduled EDR Contact: 03/21/05

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: 12/31/02
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 12/06/04
Date of Next Scheduled EDR Contact: 03/07/05

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA
Telephone: 202-566-1667

Date of Government Version: 04/13/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/01/04
Date of Next Scheduled EDR Contact: 03/21/05

SSTS: Section 7 Tracking Systems
Source: EPA
Telephone: 202-564-5008
Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/03
Database Release Frequency: Annually

Date of Last EDR Contact: 11/29/04
Date of Next Scheduled EDR Contact: 04/18/05

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: 202-566-1667
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: 09/13/04
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/01/04
Date of Next Scheduled EDR Contact: 03/21/05

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: 01/12/05
Date Made Active at EDR: 02/23/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 01/12/05
Elapsed ASTM days: 42
Date of Last EDR Contact: 01/10/05

SWF/LF: List of Solid Waste Facilities
Source: Department of Environment 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: 02/17/05
Date Made Active at EDR: 03/29/05
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/17/05
Elapsed ASTM days: 40
Date of Last EDR Contact: 02/16/05

LUST: Regional UST Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1308
This database contains information obtained from the Regional Offices. It provides a more detailed explanation of current and historic activity for individual sites, as well as what was previously found in the Incident Management Database. Sites in this database with Incident Numbers are considered LUSTs.

Date of Government Version: 03/04/05
Date Made Active at EDR: 04/06/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 03/08/05
Elapsed ASTM days: 29
Date of Last EDR Contact: 03/08/05

UST: Petroleum Underground Storage Tank Database
Source: Department of Environment 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: 02/25/05
Date Made Active at EDR: 04/07/05
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 03/08/05
Elapsed ASTM days: 30
Date of Last EDR Contact: 03/08/05

OLI: Old Landfill Inventory
Source: Department of Environment & Natural Resources
Telephone: 919-733-4996
Old landfill inventory location information. (Does not include no further action sites and other agency lead sites).

Date of Government Version: 01/06/05
Date Made Active at EDR: 03/16/05
Database Release Frequency: Varies
Date of Data Arrival at EDR: 01/28/05
Elapsed ASTM days: 47
Date of Last EDR Contact: 01/28/05

VCP: Responsible Party Voluntary Action Sites
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996

Date of Government Version: 01/12/05
Date Made Active at EDR: 02/23/05
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/12/05
Elapsed ASTM days: 42
Date of Last EDR Contact: 01/10/05

INDIAN UST: Underground Storage Tanks on Indian Land
Source: EPA Region 4
Telephone: 404-562-9424

Date of Government Version: 09/14/04
Date Made Active at EDR: 10/18/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 09/15/04
Elapsed ASTM days: 33
Date of Last EDR Contact: 02/15/05

INDIAN LUST: Leaking Underground Storage Tanks on Indian Land
Source: EPA Region 4
Telephone: 404-562-8677
LUSTs on Indian land in Florida, Minnesota, Mississippi and North Carolina.

Date of Government Version: 09/14/04
Date Made Active at EDR: 10/18/04
Database Release Frequency: Varies
Date of Data Arrival at EDR: 09/15/04
Elapsed ASTM days: 33
Date of Last EDR Contact: 02/15/05

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.

Date of Government Version: 06/21/95
Database Release Frequency: Biennially
Date of Last EDR Contact: 02/28/05
Date of Next Scheduled EDR Contact: 05/30/05

AST: AST Database
Source: Department of Environment and Natural Resources
Telephone: 919-715-6183
Facilities with aboveground storage tanks that have a capacity greater than 21,000 gallons.

Date of Government Version: 01/14/05
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 01/19/05
Date of Next Scheduled EDR Contact: 04/18/05

LUST TRUST: State Trust Fund Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1315
This database contains information about claims against the State Trust Funds for reimbursements for expenses incurred while remediating Leaking USTs.

Date of Government Version: 03/11/05
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/08/05
Date of Next Scheduled EDR Contact: 05/09/05

DRYCLEANERS: Drycleaning Sites
Source: Department of Environment & Natural Resources
Telephone: 919-733-2801
Potential and known drycleaning sites, active and abandoned, that the Drycleaning Solvent Cleanup Program has knowledge of and entered into this database.

Date of Government Version: 11/12/04
Database Release Frequency: Varies

Date of Last EDR Contact: 02/11/05
Date of Next Scheduled EDR Contact: 04/18/05

IMD: Incident Management Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-3221
Groundwater and/or soil contamination incidents

Date of Government Version: 06/15/04
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/25/05
Date of Next Scheduled EDR Contact: 04/25/05

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.

BROWNFIELDS DATABASES

Brownfields: Brownfields Projects Inventory
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996
A brownfield site is an abandoned, idled, or underused property where the threat of environmental contamination has hindered its redevelopment. All of the sites in the inventory are working toward a brownfield agreement for cleanup and liabitliy control.

Date of Government Version: 09/30/04
Database Release Frequency: Varies

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

VCP: Responsible Party Voluntary Action Sites
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996

Date of Government Version: 11/19/04
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 01/10/05
Date of Next Scheduled EDR Contact: 04/11/05

INST CONTROL: No Further Action Sites With Land Use Restrictions Monitoring
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801

Date of Government Version: 01/12/05
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/10/05
Date of Next Scheduled EDR Contact: 04/11/05

US BROWNFIELDS: A Listing of Brownfields Sites
Source: Environmental Protection Agency
Telephone: 202-566-2777
Included in the listing are brownfields properties addresses by Cooperative Agreement Recipients and brownfields properties addressed by Targeted Brownfields Assessments. Targeted Brownfields Assessments-EPA's Targeted Brownfields Assessments (TBA) program is designed to help states, tribes, and municipalities--especially those without EPA Brownfields Assessment Demonstration Pilots--minimize the uncertainties of contamination often associated with brownfields. Under the TBA program, EPA provides funding and/or technical assistance for environmental assessments at brownfields sites throughout the country. Targeted Brownfields Assessments supplement and work with other efforts under EPA's Brownfields Initiative to promote cleanup and redevelopment of brownfields. Cooperative Agreement Recipients-States, political subdivisions, territories, and Indian tribes become Brownfields Cleanup Revolving Loan Fund (BCRLF) cooperative agreement recipients when they enter into BCRLF cooperative agreements with the U.S. EPA. EPA selects BCRLF cooperative agreement recipients based on a proposal and application process. BCRLF cooperative agreement recipients must use EPA funds provided through BCRLF cooperative agreement for specified brownfields-related cleanup activities.

Date of Government Version: N/A
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: N/A
Date of Next Scheduled EDR Contact: N/A

US INST CONTROL: Sites with Institutional Controls
Source: Environmental Protection Agency
Telephone: 703-603-8867
A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

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

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: 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.

Electric Power Transmission Line Data
Source: PennWell Corporation
Telephone: (800) 823-6277
This map includes information copyrighted by PennWell Corporation. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.

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.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Facility List
Source: Department of Health & Human Services
Telephone: 919-662-4499

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 2002 from the U.S. Fish and Wildlife Service.

STREET AND ADDRESS INFORMATION

GEOCHECK®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

NAKED CREEK
MARYS LANE
FERGUSON, NC 28624

TARGET PROPERTY COORDINATES

Latitude (North):	36.134701 - 36° 8' 4.9"
Longitude (West):	81.355400 - 81° 21' 19.4"
Universal Tranverse Mercator:	Zone 17
UTM X (Meters):	468022.4
UTM Y (Meters):	3998746.5
Elevation:	1278 ft. above sea level

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).

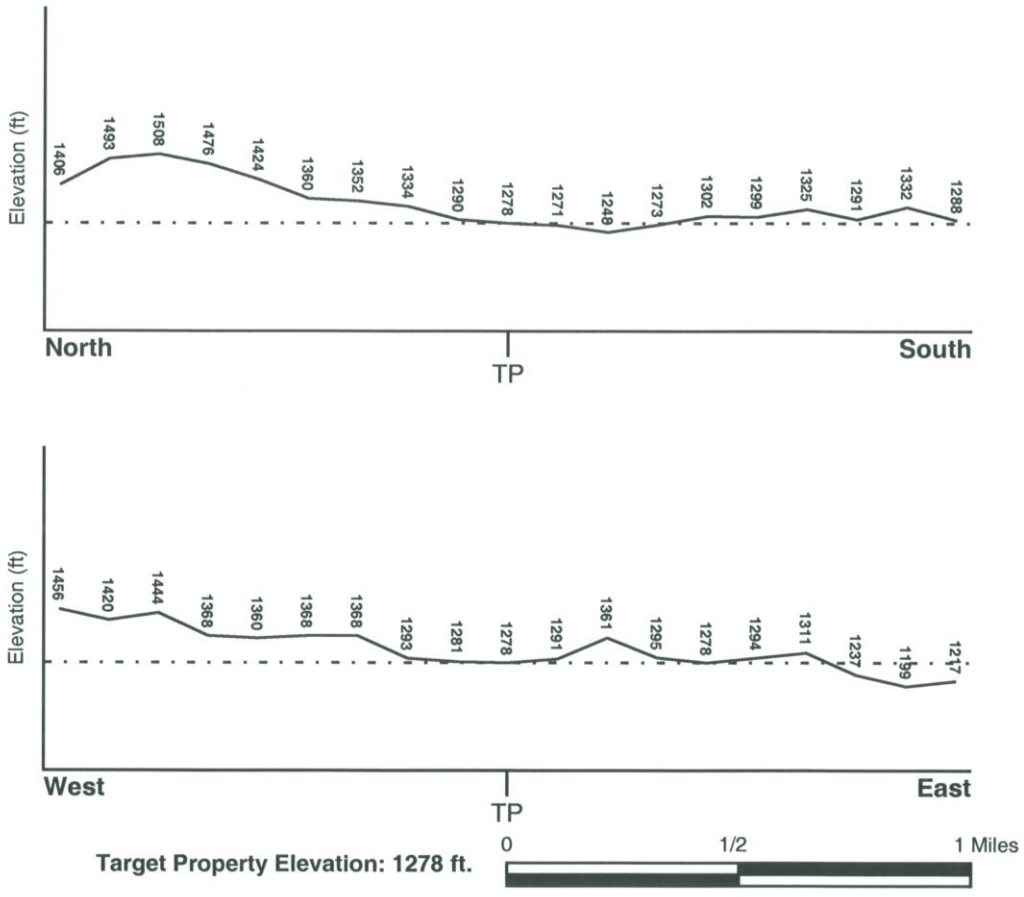
TOPOGRAPHIC INFORMATION

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.

TARGET PROPERTY TOPOGRAPHY

USGS Topographic Map:	36081-B3 PURLEAR, NC
General Topographic Gradient:	General SSW
Source:	USGS 7.5 min quad index

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' 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.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

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
WILKES, NC	Not Available

Flood Plain Panel at Target Property: Not Reported

Additional Panels in search area: Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
PURLEAR	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.

AQUIFLOW®

Search Radius: 1.000 Mile.

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		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

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:	Paleozoic
System:	Cambrian
Series:	Cambrian
Code:	Ce *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Eugeosynclinal Deposits

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:	PACOLET
Soil Surface Texture:	fine 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.

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

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

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	3 inches	fine sandy loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 6.00 Min: 2.00	Max: 6.50 Min: 4.50
2	3 inches	29 inches	sandy clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 2.00 Min: 0.60	Max: 6.00 Min: 4.50
3	29 inches	52 inches	clay loam	Granular materials (35 pct. or less passing No. 200), Silty, or Clayey Gravel and Sand.	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
4	52 inches	70 inches	sandy loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	COARSE-GRAINED SOILS, Sands, Sands with fines, Silty Sand.	Max: 2.00 Min: 0.60	Max: 6.00 Min: 4.50

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: clay loam
gravelly - sandy loam
sandy loam
loam

Surficial Soil Types: clay loam
gravelly - sandy loam
sandy loam
loam

Shallow Soil Types: clay
sandy clay loam
silt loam
clay loam
silty clay loam

Deeper Soil Types: fine sandy loam
weathered bedrock

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

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
1	USGS2282527	1/2 - 1 Mile East

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

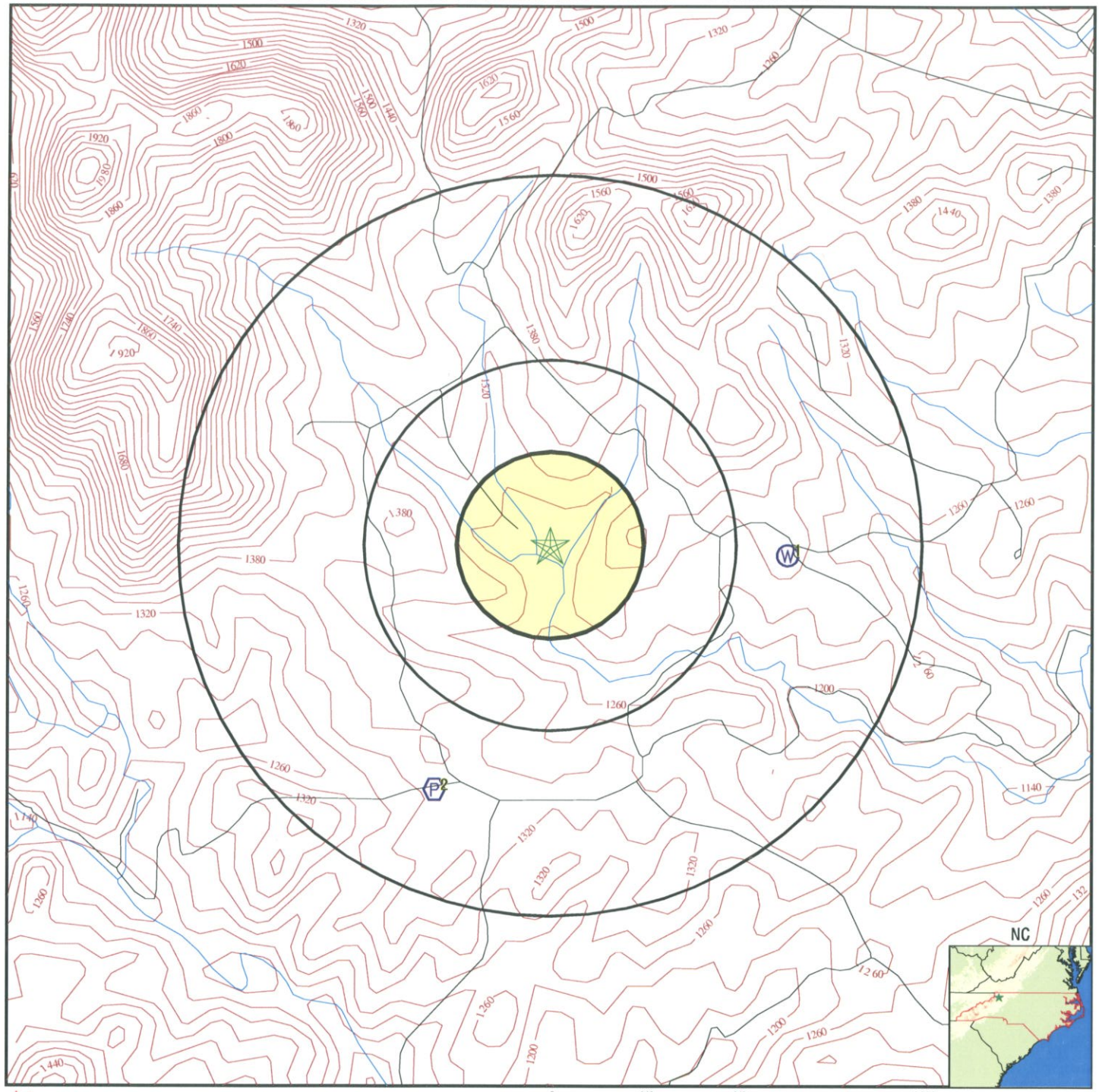
MAP ID	WELL ID	LOCATION FROM TP
2	NC0197459	1/2 - 1 Mile SSW

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 - 1400994.2s



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

TARGET PROPERTY:	Naked Creek	CUSTOMER:	Kimley-Horn & Associates, Inc.
ADDRESS:	Marys Lane	CONTACT:	Jason Diaz
CITY/STATE/ZIP:	Ferguson NC 28624	INQUIRY #:	1400994.2s
LAT/LONG:	36.1347 / 81.3554	DATE:	April 15, 2005 11:33 am

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation

	Database	EDR ID Number
1 **East** **1/2 - 1 Mile** **Higher**	**FED USGS**	**USGS2282527**

Agency cd:	USGS	Site no:	360803081203901
Site name:	WI-G72J-1	Latitude:	360803
Longitude:	0812039	Dec lat:	36.1342971
Dec lon:	-81.3439817	Coor meth:	M
Coor accr:	S	Latlong datum:	NAD27
Dec latlong datum:	NAD83	District:	37
State:	37	County:	193
Country:	US	Land net:	Not Reported
Location map:	Not Reported	Map scale:	Not Reported
Altitude:	Not Reported	Altitude method:	Not Reported
Altitude accuracy:	Not Reported	Altitude datum:	Not Reported
Hydrologic:	Not Reported		
Topographic:	Hilltop		
Site type:	Ground-water other than Spring	Date construction:	Not Reported
Date inventoried:	Not Reported	Mean greenwich time offset:	EST
Local standard time flag:	Y	Type of ground water site:	Single well, other than collector or Ranney type
Aquifer Type:	Not Reported	Aquifer:	Not Reported
Well depth:	140.0	Hole depth:	Not Reported
Source of depth data:	reporting agency (generally USGS)	Project number:	453709900
Real time data flag:	0	Daily flow data begin date:	0000-00-00
Daily flow data end date:	0000-00-00	Daily flow data count:	0
Peak flow data begin date:	0000-00-00	Peak flow data end date:	0000-00-00
Peak flow data count:	0	Water quality data begin date:	0000-00-00
Water quality data end date:	0000-00-00	Water quality data count:	0
Ground water data begin date:	1971-00-00	Ground water data end date:	1971-00-00
Ground water data count:	1		

Ground-water levels, Number of Measurements: 1

Date	Feet below Surface	Feet to Sealevel
1971	75	

	Database	EDR ID Number
2 **SSW** **1/2 - 1 Mile** **Higher**	**FRDS PWS**	**NC0197459**

PWS ID:	NC0197459	PWS Status:	Active
Date Initiated:	7706	Date Deactivated:	Not Reported
PWS Name:	MT PLEASANT BAPT CH WILKESBORO, NC 28697		
Addressee / Facility:	System Owner/Responsible Party MT PLEASANT BAPT CH RT 1 WILKESBORO, NC 28697		
Addressee / Facility:	System Owner/Responsible Party MT PLEASANT BAPT CH RT 1 WILKESBORO, NC 28697		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Facility Latitude:	36 08 44	Facility Longitude:	081 09 38
Facility Latitude:	36 07 30	Facility Longitude:	081 21 40
City Served:	WILKESBORO		
Treatment Class:	Untreated	Population:	00000150

PWS currently has or had major violation(s) or enforcement: No

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: NC Radon

Radon Test Results

County	Result Type	Total Sites	Avg pCi/L	Range pCi/L
WILKES	Statistical	23	2.66	0.20-7.30
WILKES	Non-Statistical	85	2.64	0.20-11.10

Federal EPA Radon Zone for WILKES County: 2

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.

Federal Area Radon Information for Zip Code: 28624

Number of sites tested: 1

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	Not Reported	Not Reported	Not Reported	Not Reported
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	1.400 pCi/L	100%	0%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002. 7.5-Minute DEMs correspond to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps.

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 2002 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
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation 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: 202-564-3750
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: 202-564-3750
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: USGS National Water Inventory System (NWIS)
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 wells, springs, and other sources of groundwater.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STATE RECORDS

NC Natural Areas: Significant Natural Heritage Areas
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
A polygon converage identifying sites (terrestrial or aquatic that have particular biodiversity significance. A site's significance may be due to the presenceof rare species, rare or hight quality natural communities, or other important ecological features.

NC Game Lands: Wildlife Resources Commission 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.

NC Natural Heritage Sites: Natural Heritage Element Occurrence Sites
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
A point coverage identifying locations of rare and endangered species, occurrences of exemplary or unique natural ecosystems (terrestrial or aquatic), and special animal habitats (e.g., colonial waterbird nesting sites).

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

RADON

State Database: NC Radon
Source: Department of Environment & Natural Resources
Telephone: 919-733-4984
Radon Statistical and Non Statiscal Data

Area Radon Information
Source: USGS
Telephone: 703-356-4020
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
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

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

EDR™ Environmental Data Resources Inc

"Linking Technology with Tradition"®

Sanborn® Map Report

Ship To: Jason Diaz
Kimley-Horn &
3001 Weston Parkway
Cary, NC 27513

Order Date: 4/15/2005 **Completion Date:** 4/15/2005
Inquiry #: 1400994.3s
P.O. #: NA
Site Name: Naked Creek
Address: Marys Lane
City/State: Ferguson, NC 28624
Cross Streets:

Customer Project: 011795018
1035062ERN 919-677-2000

This document reports that the largest and most complete collection of Sanborn fire insurance maps has been reviewed based on client supplied information, and fire insurance maps depicting the target property at the specified address were not identified.

NO COVERAGE

EDR® Environmental
Data Resources Inc

The EDR-Historical Topographic Map Report

Naked Creek
Marys Lane
Ferguson, NC 28624

April 17, 2005

Inquiry Number: 1400994-5

The Standard In Environmental Risk Management Information

440 Wheelers Farms Road
Milford, Connecticut 06460

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802

Environmental Data Resources, Inc.
Historical Topographic Map Report

Environmental Data Resources, Inc.'s (EDR) Historical Topographic Map Report is designed to assist professionals in evaluating potential liability on a target property, and its surrounding area, resulting from past activities. ASTM E 1527-00, Section 7.3 on Historical Use Information, identifies the prior use requirements for a Phase I environmental site assessment. The ASTM standard requires a review of *reasonably ascertainable standard historical sources. Reasonably ascertainable is defined as information that is publicly available, obtainable from a source with reasonable time and cost constraints, and practically reviewable.*

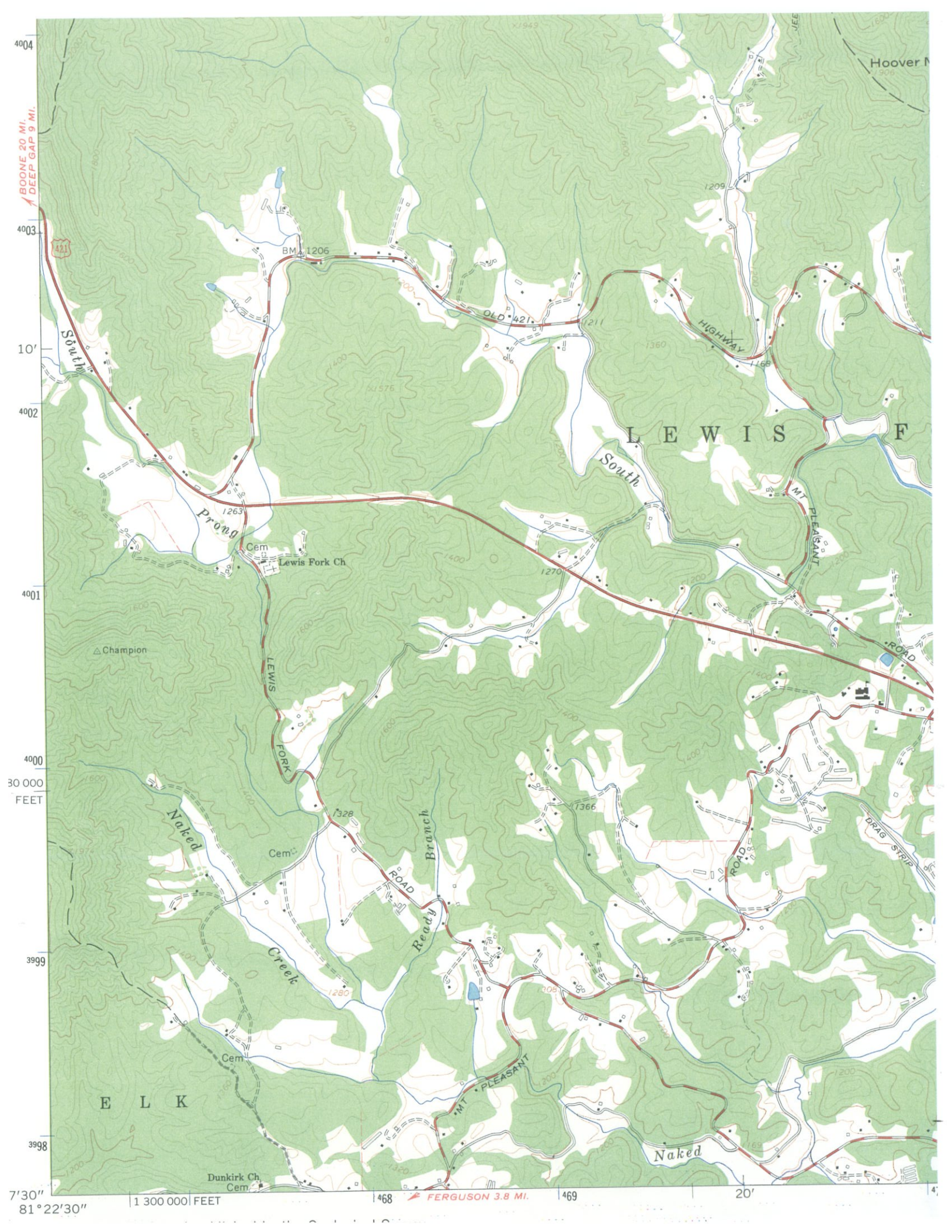
To meet the prior use requirements of ASTM E 1527-00, Section 7.3.4, the following *standard historical sources* may be used: aerial photographs, city directories, fire insurance maps, topographic maps, property tax files, land title records (although these cannot be the sole historical source consulted), building department records, or zoning/and use records. ASTM E 1527-00 requires *"All obvious uses of the property shall be identified from the present, back to the property's obvious first developed use, or back to 1940, whichever is earlier. This task requires reviewing only as many of the standard historical sources as are necessary, and that are reasonably ascertainable and likely to be useful."* (ASTM E 1527-00, Section 7.3.2 page 12.)

EDR's Historical Topographic Map Report includes a search of available public and private color historical topographic map collections.

Topographic Maps

A topographic map (topo) is a color coded line-and-symbol representation of natural and selected artificial features plotted to a scale. Topos show the shape, elevation, and development of the terrain in precise detail by using contour lines and color coded symbols. Many features are shown by lines that may be straight, curved, solid, dashed, dotted, or in any combination. The colors of the lines usually indicate similar classes of information. For example, topographic contours (brown); lakes, streams, irrigation ditches, etc. (blue); land grids and important roads (red); secondary roads and trails, railroads, boundaries, etc. (black); and features that have been updated using aerial photography, but not field verified, such as disturbed land areas (e.g., gravel pits) and newly developed water bodies (purple).

For more than a century, the USGS has been creating and revising topographic maps for the entire country at a variety of scales. There are about 60,000 U.S. Geological Survey (USGS) produced topo maps covering the United States. Each map covers a specific quadrangle (quad) defined as a four-sided area bounded by latitude and longitude. Historical topographic maps are a valuable historical resource for documenting the prior use of a property and its surrounding area, and due to their frequent availability can be particularly helpful when other standard historical sources (such as city directories, fire insurance maps, or aerial photographs) are not reasonably ascertainable.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4003
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4000
3999
3998
10'
20'
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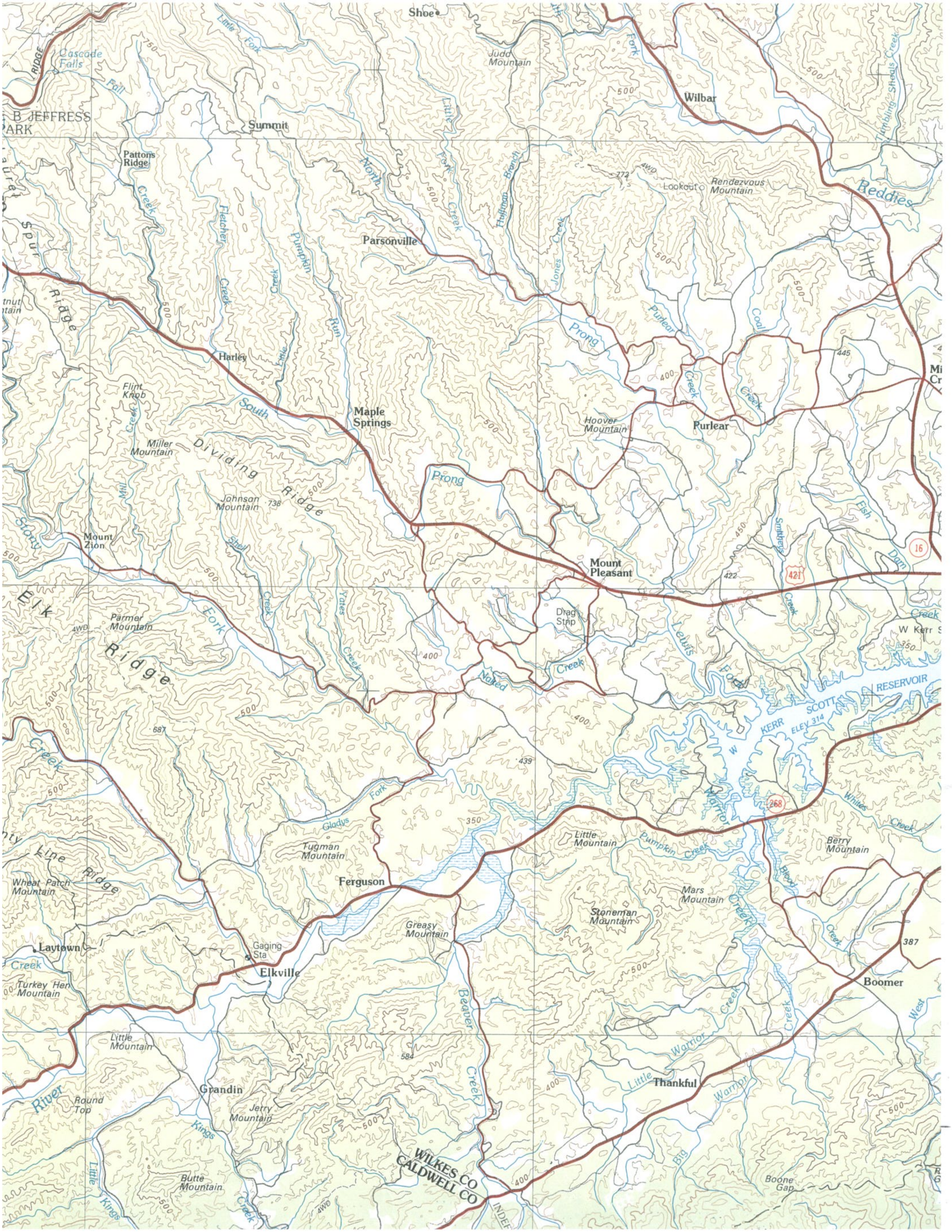
7'30"
81°22'30"
1 300 000 FEET
468
469
BOONE 20 MI.
DEEP GAP 9 MI.
FERGUSON 3.8 MI.
421
BM 1206
OLD 421
HIGHWAY
South Prong
Lewis Fork Ch
Cem
Champion
LEWIS FORK
South
MT PLEASANT ROAD
Naked Creek
Ready Branch
ROAD
DRAG STRIP
Dunkirk Ch
Cem
LEWIS
ELK
Naked
Hoover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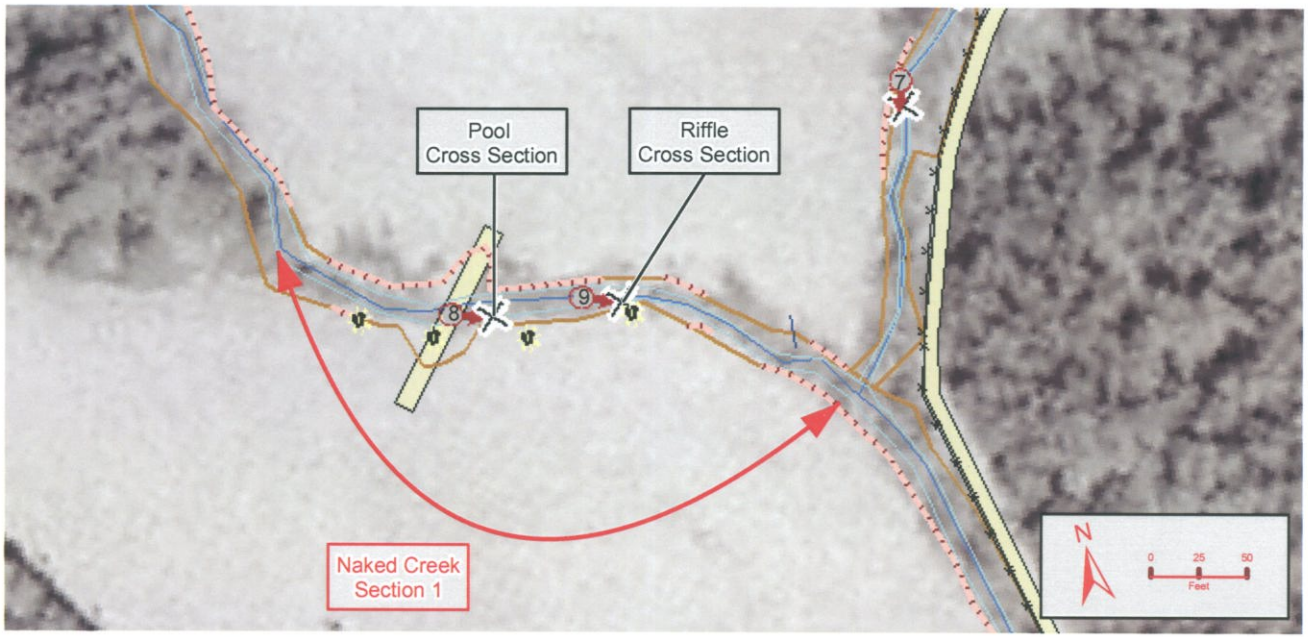
Cascade Falls
B JEFFRESS PARK
Summit
Wilbar
Pattons Ridge
Lookout
Rendezvous Mountain
Reddies
Parsonville
Harley
Flint Knob
Maple Springs
Miller Mountain
South
Dividing Ridge
Prong
Purlear
Hoover Mountain
Johnson Mountain
Mount Zion
Mount Pleasant
Drag Strip
Elk Ridge
Parmer Mountain
Naked Creek
Lewis Fork
W Kerr Scott
W KERR SCOTT RESERVOIR
ELEV 314
Gladys Fork
Tugman Mountain
Little Mountain
Pumpkin Creek
Berry Mountain
Ferguson
Wheat Patch Mountain
Greasy Mountain
Stoneman Mountain
Mars Mountain
Laytown
Gaging Sta
Elkville
Turkey Hen Mountain
Boomer
Little Mountain
Grandin
Thankful
Round Top
Jerry Mountain
Beaver Creek
Little Warrior Creek
Big Warrior
Butte Mountain
WILKES CO
CALDWELL CO
Boone Gap
River
Little Kings
Kings Creek
421
268
16

Geomorphology Summary Data

Contents

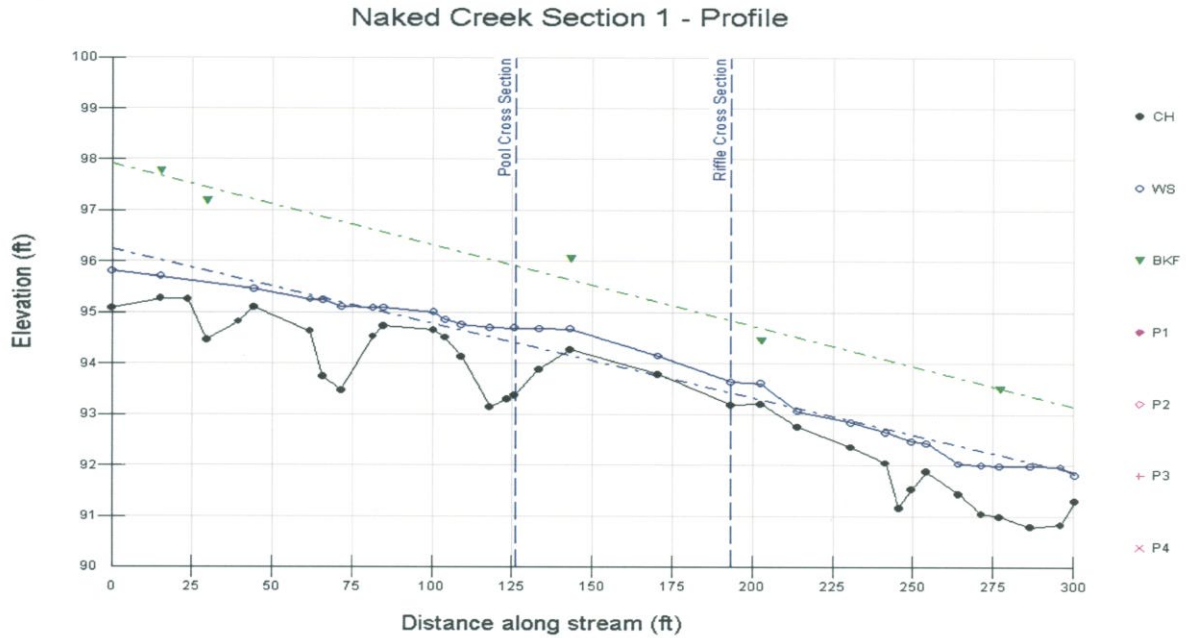
Pattern View



Summary Data

	Min	Avg	Max
Meander Length (L_M)	--	--	--
Radius of Curvature (R_C)	10.40	27.80	49.16
Belt Width (W_{blt})	3.90	6.30	11.47
Sinuosity (k)		1.08	

Profile View



Summary Data

	Min	Avg	Max
BKF Slope		0.0159	
Riffle Slope	0.00488	0.01215	0.01877
Pool Slope	0.00000	0.00197	0.00595
Run Slope	0.01120	0.03332	0.04714
Glide Slope	0.00000	0.00328	0.00651
P - P	37.8	64.1	122.8
Pool Length	13.3	19.3	24.6
D_{max} riffle	1.36	1.76	2.07
D_{max} pool	2.79	2.98	3.32
D_{max} run	1.48	1.90	2.26
D_{max} glide	1.93	2.15	2.44

Profile Survey Data

Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		
0.00	95.08	95.81			
15.19	95.27	95.70	97.76		
23.64	95.26				
29.61	94.46		97.18		
39.52	94.82				
44.27	95.11	95.45			
61.88	94.63	95.25			
65.97	93.74	95.24			
71.62	93.47	95.10			
81.56	94.53	95.08			
84.82	94.73	95.08			
100.51	94.66	95.00			
104.02	94.51	94.85			
109.21	94.13	94.76			
118.15	93.14	94.70			
123.54	93.30				
125.94	93.38	94.69			
133.47	93.88	94.68			
143.26	94.27	94.67	96.06		
170.60	93.78	94.14			
193.39	93.18	93.63			
202.61	93.20	93.60	94.45		
214.05	92.75	93.05			
230.77	92.35	92.83			
241.59	92.04	92.63			
245.63	91.16				
249.73	91.53	92.46			
254.42	91.87	92.42			
264.37	91.43	92.02			
271.42	91.04	92.00			
277.21	90.98	91.98	93.50		
286.78	90.78	91.98			
296.16	90.83	91.96			
300.72	91.29	91.80			

Profile Survey Data (continued)

Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		

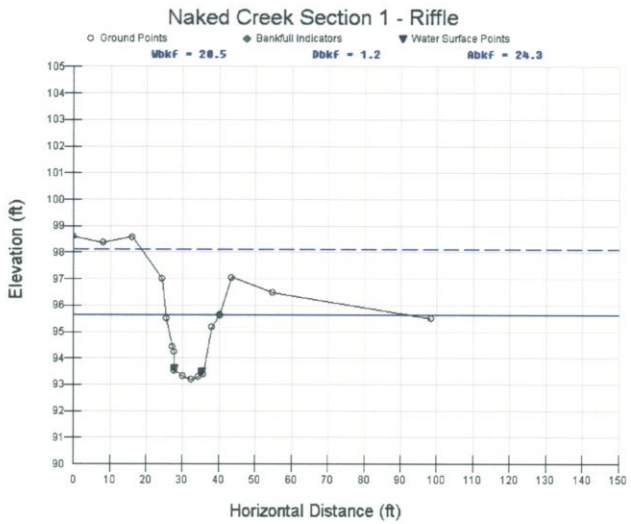
Photo 8

Photo 9

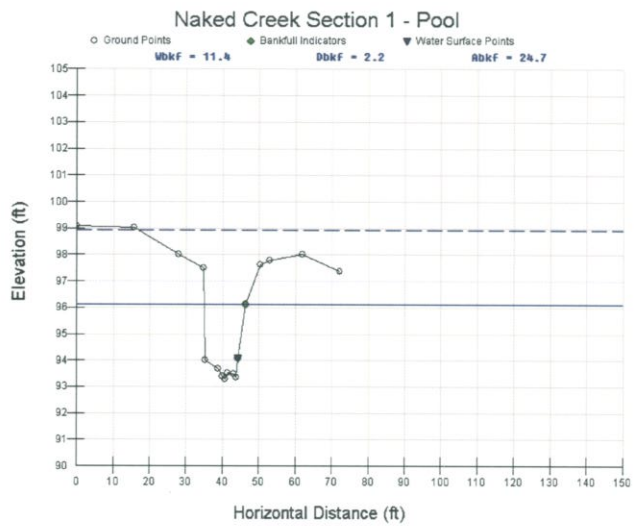
Summary Data

	Riffle	Pool
D_{MAX} (ft)	2.46	2.82
W_{BKF} (ft)	20.5	11.4
A_{BKF} (ft^2)	24.3	24.7
W_{FPA} (ft)	79.7	55.3
Wetted Perimeter	22.3	14.4
Hydraulic Radius (R)	1.1	1.7
W/D Ratio	17.2	5.23
Bank Height Ratio	1.6	1.5
Slope (%)	1.22	0.197
Entrenchment	3.89	
Stream Type	C4	

Riffle Cross Section



Pool Cross Section

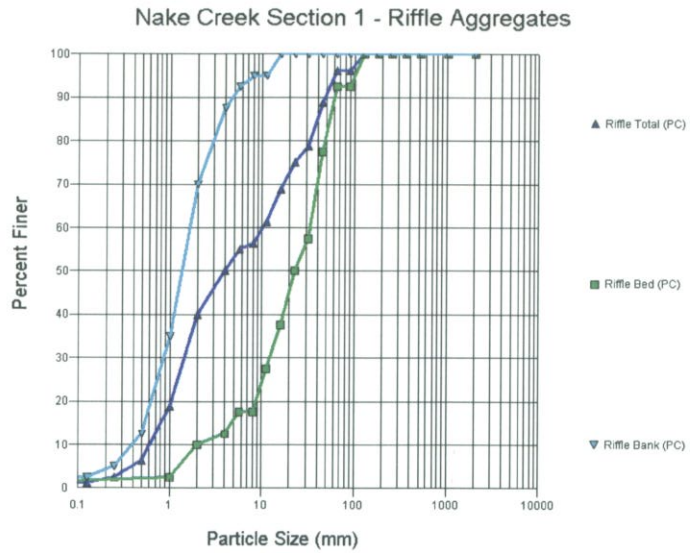


Notes

Riffle Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	98.61	FP
8.10	98.37	FP
16.19	98.58	FP
24.47	97.00	LB
25.74	95.51	LB
27.30	94.42	LB
27.68	94.24	LB
27.78	93.63	LEW
27.79	93.53	SB
30.13	93.32	SB
32.56	93.18	TW
34.37	93.29	SB
35.33	93.49	REW
35.73	93.38	SB
38.13	95.18	RB
40.34	95.64	RB
40.34	95.64	BKF
43.46	97.05	RB
54.95	96.48	FP
98.39	95.51	FP

Pool Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	99.08	FP
15.85	99.03	FP
28.13	98.02	FP
34.84	97.49	LB
35.39	94.01	SB
38.76	93.67	SB
40.02	93.38	SB
40.78	93.30	TW
41.54	93.51	SB
43.11	93.48	SB
43.71	93.37	SB
44.21	94.07	REW
46.42	96.12	BKF
50.35	97.61	RB
52.94	97.78	RB
61.88	98.01	FP
72.22	97.36	FP

Riffle Materials



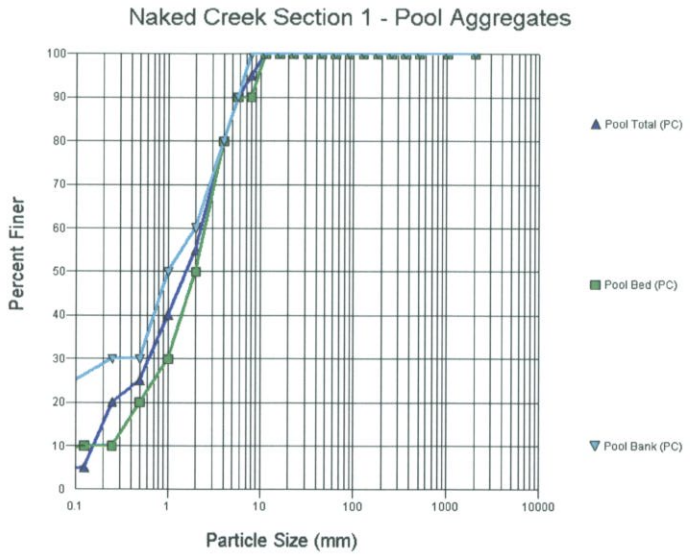
Particle Analysis

Total Particles	80

D16 (mm)	0.89
D35 (mm)	1.76
D50 (mm)	4.00
D84 (mm)	38.83
D95 (mm)	60.83
D100 (mm)	128.00

Silt/Clay %	0
Sand %	40
Gravel %	56
Cobble %	4
Boulder %	0
Bedrock %	0

Pool Materials



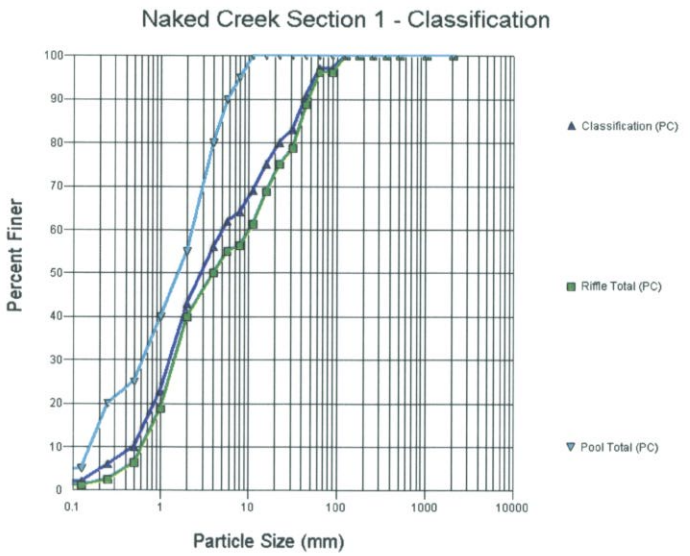
Particle Analysis

Total Particles	20

D16 (mm)	0.22
D35 (mm)	0.83
D50 (mm)	1.67
D84 (mm)	4.68
D95 (mm)	8.00
D100 (mm)	11.30

Silt/Clay %	0
Sand %	55
Gravel %	45
Cobble %	0
Boulder %	0
Bedrock %	0

Classification



Particle Analysis

Total Particles	100

D16 (mm)	0.73
D35 (mm)	1.60
D50 (mm)	3.08
D84 (mm)	33.63
D95 (mm)	57.67
D100 (mm)	128.00

Silt/Clay %	0
Sand %	43
Gravel %	54
Cobble %	3
Boulder %	0
Bedrock %	0

Riffle Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		1	1.25	1.25
.125 - .25		1	1.25	2.5
.25 - .50		3	3.75	6.25
.50 - 1.0		10	12.5	18.75
1.0 - 2		17	21.25	40
2 - 4	GRAVEL	8	10	50
4 - 5.7		4	5	55
5.7 - 8		1	1.25	56.25
8 - 11.3		4	5	61.25
11.3 - 16		6	7.5	68.75
16 - 22.6		5	6.25	75
22.6 - 32		3	3.75	78.75
32 - 45		8	10	88.75
45 - 64		6	7.5	96.25

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	0	0	96.25
90 - 128		3	3.75	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Pool Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		1	5	5
.125 - .25		3	15	20
.25 - .50		1	5	25
.50 - 1.0		3	15	40
1.0 - 2		3	15	55
2 - 4	GRAVEL	5	25	80
4 - 5.7		2	10	90
5.7 - 8		1	5	95
8 - 11.3		1	5	100
11.3 - 16		0	0	100
16 - 22.6		0	0	100
22.6 - 32		0	0	100
32 - 45		0	0	100
45 - 64		0	0	100

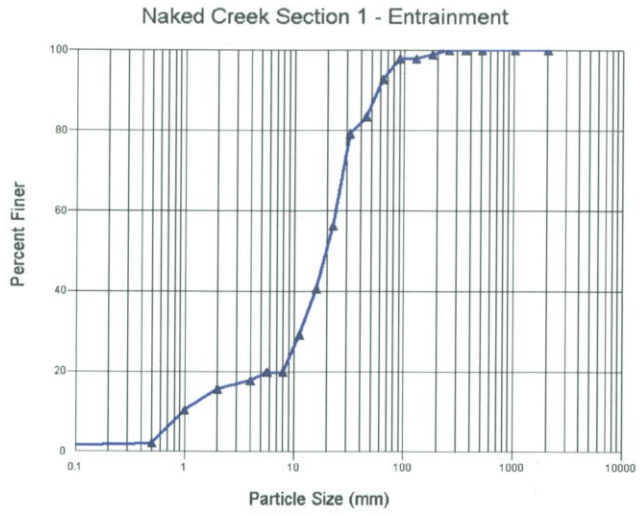
Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	0	0	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Classification Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		2	2	2
.125 - .25		4	4	6
.25 - .50		4	4	10
.50 - 1.0		13	13	23
1.0 - 2		20	20	43
2 - 4	GRAVEL	13	13	56
4 - 5.7		6	6	62
5.7 - 8		2	2	64
8 - 11.3		5	5	69
11.3 - 16		6	6	75
16 - 22.6		5	5	80
22.6 - 32		3	3	83
32 - 45		8	8	91
45 - 64		6	6	97

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	0	0	97
90 - 128		3	3	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Entrainment



Particle Analysis

Total Particles	96

D16 (mm)	2.36
D35 (mm)	13.69
D50 (mm)	19.96
D84 (mm)	46.36
D95 (mm)	75.43
D100 (mm)	255.99

Silt/Clay %	0
Sand %	16
Gravel %	77
Cobble %	7
Boulder %	0
Bedrock %	0

Entrainment Calculations

Critical Dimensionless Shear Stress:

$$\tau_{ci} = 0.0834(d_i/d_{50})^{-0.872}$$

Value	Variable	Definition
19.96	d_i (mm)	D50 Bed Material (D50 from riffle pebble count)
10.2	d_{50} (mm)	Bar Sample D50 or Sub-pavement D50
45	D_i (mm)	Largest particle from bar sample (or subpavement)
		Equation 2
0.019	τ_{ci}	**Critical Dimensionless Shear Stress**

Sediment Transport Validation

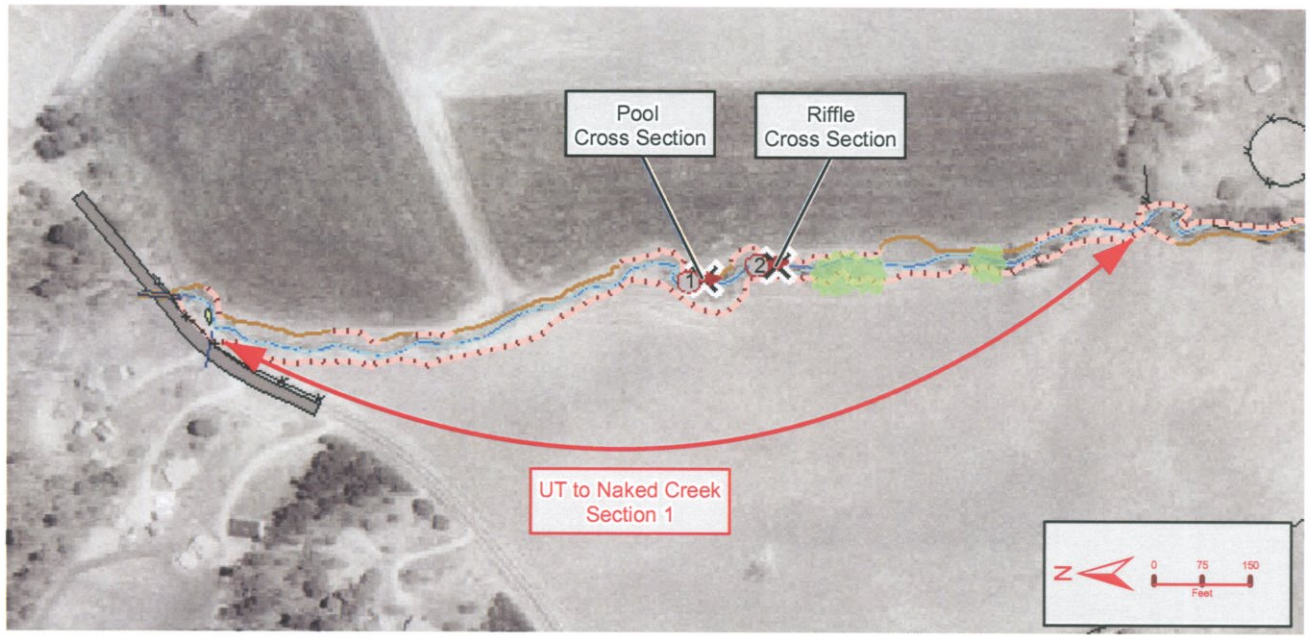
45	Largest Particle in Bar Sample D_i (mm)
0.83	Bankfull Shear Stress $\tau_c=\gamma RS$ (lb/ft^2)
54.4	Moveable particle size (mm) at bankfull shear stress (predicted by the Shields Diagram: Blue field book: p238, Red field book: p190)
0.9	Predicted shear stress required to initiate movement of D_i (mm) (see Shields Diagram: Blue field book: p238, Red field book: p190)

Entrainment Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		0	0	0
.25 - .50		2	2.08	2.08
.50 - 1.0		8	8.33	10.42
1.0 - 2		5	5.21	15.63
2 - 4	GRAVEL	2	2.08	17.71
4 - 5.7		2	2.08	19.79
5.7 - 8		0	0	19.79
8 - 11.3		9	9.38	29.17
11.3 - 16		11	11.46	40.62
16 - 22.6		15	15.63	56.25
22.6 - 32		22	22.92	79.17
32 - 45		4	4.17	83.33
45 - 64		9	9.38	92.71

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	5	5.21	97.92
90 - 128		0	0	97.92
128 - 180		1	1.04	98.96
180 - 256		1	1.04	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

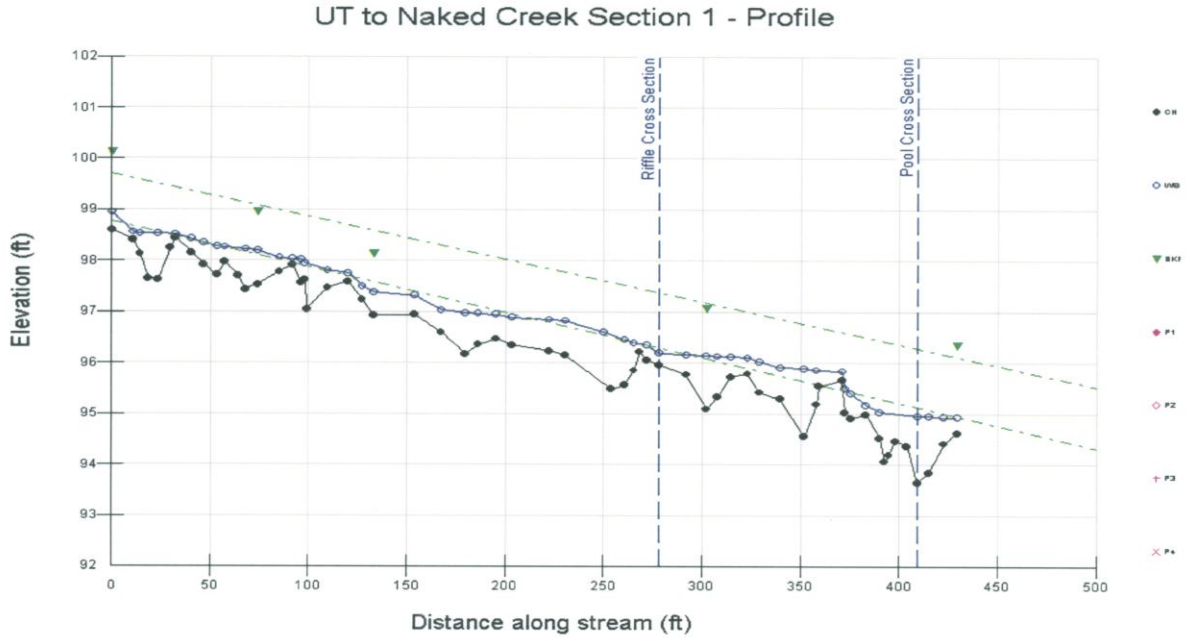
Pattern View



Summary Data

	Min	Avg	Max
Meander Length (L_M)	17.67	35.07	44.53
Radius of Curvature (R_C)	6.90	19.00	35.73
Belt Width (W_{blt})	17.70	35.10	44.53
Sinuosity (k)		1.03	

Profile View



Summary Data

	Min	Avg	Max
BKF Slope		0.0084	
Riffle Slope	0.00197	0.00825	0.01369
Pool Slope	0.00155	0.00319	0.00476
Run Slope	0.01626	0.02383	0.02891
Glide Slope	0.00000	0.00452	0.01084
P - P	32.7	55.5	76.5
Pool Length	17.2	25.2	35.6
D_{max} riffle	0.95	1.08	1.19
D_{max} pool	1.84	2.15	2.64
D_{max} run	1.12	1.27	1.50
D_{max} glide	1.13	1.31	1.65

Profile Survey Data					
Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		
0.00	98.60	98.94	100.12		
10.95	98.41	98.55			
14.27	98.13	98.53			
18.51	97.65				
23.61	97.63	98.52			
29.75	98.25				
32.37	98.44	98.51			
40.58	98.16	98.42			
46.69	97.92	98.34			
53.53	97.72	98.27			
57.37	97.97	98.26			
64.48	97.71				
67.91	97.44	98.22			
74.18	97.53	98.19	98.95		
85.25	97.79	98.05			
91.91	97.92	98.03			
96.21	97.57	98.02			
98.31	97.63	97.94			
99.21	97.05				
109.84	97.47	97.81			
120.35	97.59	97.74			
127.42	97.24	97.49			
133.22	96.93	97.38	98.14		
154.13	96.94	97.31			
167.52	96.60	97.03			
179.83	96.17	96.97			
186.36	96.36	96.96			
195.53	96.47	96.94			
203.46	96.34	96.88			
222.56	96.23	96.84			
230.58	96.15	96.82			
250.00		96.60			
253.95	95.48				
260.56	95.56	96.45			
265.52	95.85	96.39			
268.42	96.22				
271.94	96.06	96.35			
278.25	95.96	96.18			
292.08	95.77	96.15			
302.39	95.09	96.13	97.06		
307.95	95.33	96.12			

Profile Survey Data (continued)					
Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		
314.59	95.72	96.11			
323.31	95.79	96.10			
329.18	95.42	96.02			
339.73	95.29	95.90			
351.94	94.55	95.88			
358.12	95.19	95.85			
359.44	95.54				
371.09	95.66	95.83			
372.59	95.03	95.49			
375.50	94.90	95.40			
383.24	94.98	95.16			
390.25	94.52	95.02			
392.86	94.06				
394.75	94.18				
398.18	94.46				
403.99	94.37				
409.42	93.64	94.95			
415.23	93.83	94.94			
422.93	94.41	94.92			
429.64	94.62	94.92	96.34		

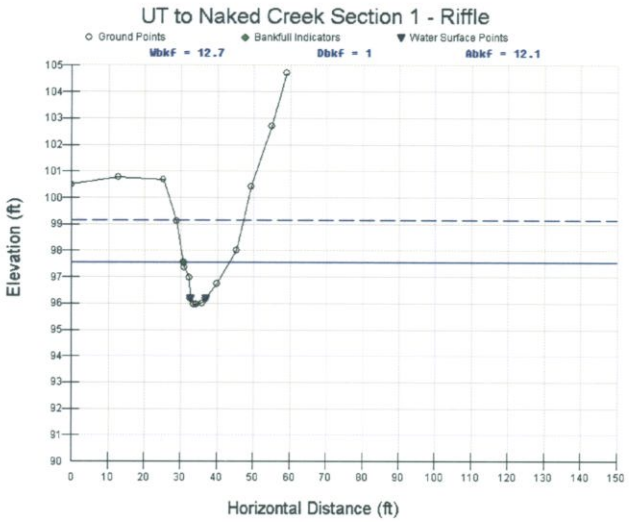
Photo 1

Photo 2

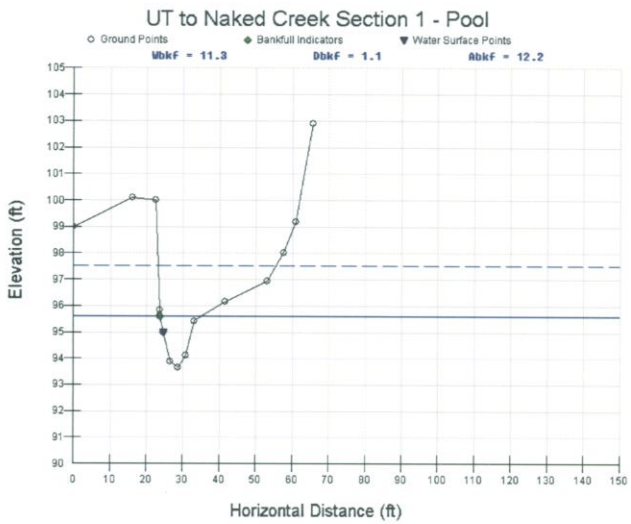
Summary Data

	Riffle	Pool
D_{MAX} (ft)	1.60	1.95
W_{BKF} (ft)	12.7	11.3
A_{BKF} (ft^2)	12.1	12.2
W_{FPA} (ft)	18.6	32.4
Wetted Perimeter	13.6	12.2
Hydraulic Radius (R)	0.89	0.99
W/D Ratio	13.4	10.5
Bank Height Ratio	1.7	1.1
Slope (%)	0.825	0.319
Entrenchment	1.46	
Stream Type	B4c	

Riffle Cross Section



Pool Cross Section

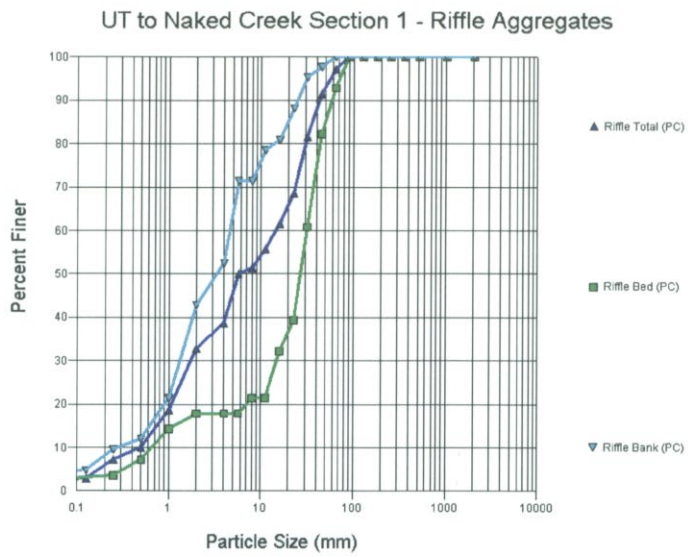


Notes

Riffle Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	100.50	FP
12.88	100.78	LB
25.31	100.68	LB
28.93	99.12	LB
30.78	97.56	BKF
30.97	97.35	LB
32.49	96.99	LB
32.77	96.18	LEW
33.57	95.97	SB
34.48	95.96	TW
36.01	96.01	SB
36.92	96.18	REW
40.03	96.75	PB
45.44	98.02	RB
49.58	100.43	RB
55.03	102.69	RB
59.24	104.71	RB
63.73	106.03	RB

Pool Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	99.00	FP
16.11	100.09	FP
22.52	99.99	LB
23.66	95.84	LB
23.84	95.59	BKF
24.67	94.97	LEW
26.62	93.89	SB
28.75	93.64	TW
30.92	94.10	SB
33.15	95.42	PB
41.72	96.15	PB
53.11	96.93	FP
57.59	98.03	FP
61.01	99.17	FP
65.77	102.90	FP

Riffle Materials



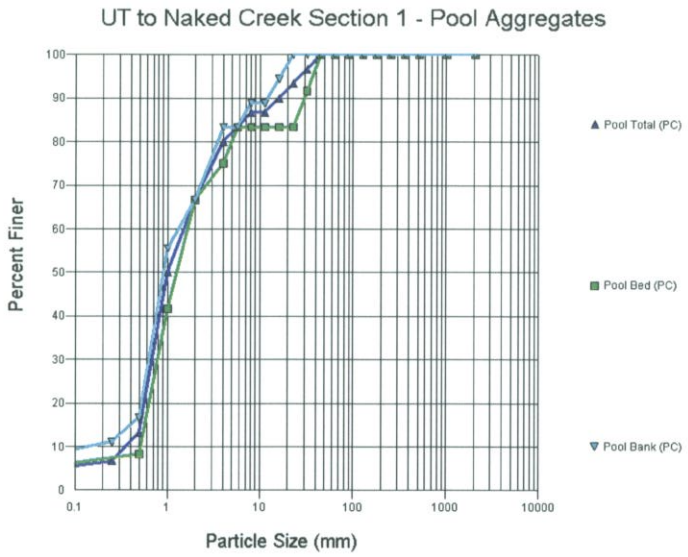
Particle Analysis

Total Particles	70

D16 (mm)	0.85
D35 (mm)	2.75
D50 (mm)	5.70
D84 (mm)	35.34
D95 (mm)	56.88
D100 (mm)	90.00

Silt/Clay %	0
Sand %	33
Gravel %	64
Cobble %	3
Boulder %	0
Bedrock %	0

Pool Materials



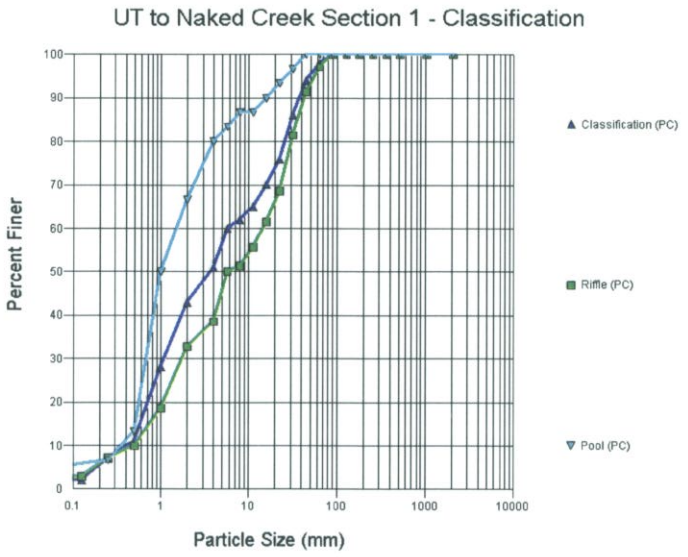
Particle Analysis

Total Particles	30

D16 (mm)	0.54
D35 (mm)	0.80
D50 (mm)	1.00
D84 (mm)	6.16
D95 (mm)	27.30
D100 (mm)	45.00

Silt/Clay %	0
Sand %	67
Gravel %	33
Cobble %	0
Boulder %	0
Bedrock %	0

Classification



Particle Analysis

Total Particles	100

D16 (mm)	0.65
D35 (mm)	1.47
D50 (mm)	3.75
D84 (mm)	30.12
D95 (mm)	49.75
D100 (mm)	90.00

Silt/Clay %	0
Sand %	43
Gravel %	55
Cobble %	2
Boulder %	0
Bedrock %	0

Riffle Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		2	2.86	2.86
.125 - .25		3	4.29	7.14
.25 - .50		2	2.86	10
.50 - 1.0		6	8.57	18.57
1.0 - 2		10	14.29	32.86
2 - 4	GRAVEL	4	5.71	38.57
4 - 5.7		8	11.43	50
5.7 - 8		1	1.43	51.43
8 - 11.3		3	4.29	55.71
11.3 - 16		4	5.71	61.43
16 - 22.6		5	7.14	68.57
22.6 - 32		9	12.86	81.43
32 - 45		7	10	91.43
45 - 64		4	5.71	97.14

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	2	2.86	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Pool Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		2	6.67	6.67
.25 - .50		2	6.67	13.33
.50 - 1.0		11	36.67	50
1.0 - 2		5	16.67	66.67
2 - 4	GRAVEL	4	13.33	80
4 - 5.7		1	3.33	83.33
5.7 - 8		1	3.33	86.67
8 - 11.3		0	0	86.67
11.3 - 16		1	3.33	90
16 - 22.6		1	3.33	93.33
22.6 - 32		1	3.33	96.67
32 - 45		1	3.33	100
45 - 64		0	0	100

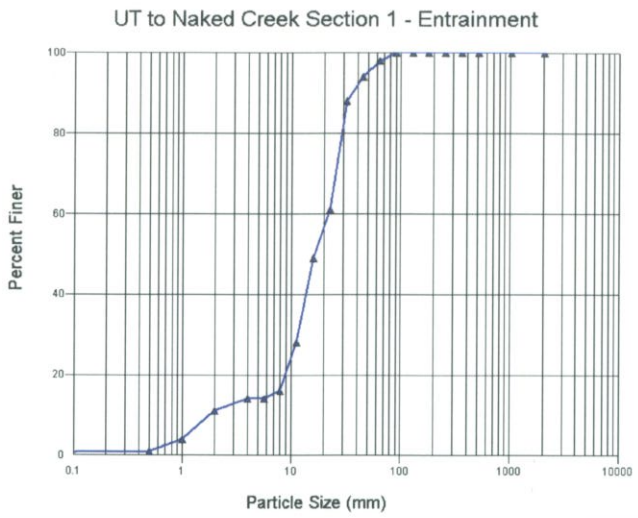
Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	0	0	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Classification Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		2	2	2
.125 - .25		5	5	7
.25 - .50		4	4	11
.50 - 1.0		17	17	28
1.0 - 2		15	15	43
2 - 4	GRAVEL	8	8	51
4 - 5.7		9	9	60
5.7 - 8		2	2	62
8 - 11.3		3	3	65
11.3 - 16		5	5	70
16 - 22.6		6	6	76
22.6 - 32		10	10	86
32 - 45		8	8	94
45 - 64		4	4	98

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	2	2	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Entrainment



Particle Analysis

Total Particles	100

D16 (mm)	8.00
D35 (mm)	12.87
D50 (mm)	16.55
D84 (mm)	30.61
D95 (mm)	49.75
D100 (mm)	90.00

Silt/Clay %	0
Sand %	11
Gravel %	87
Cobble %	2
Boulder %	0
Bedrock %	0

Entrainment Calculations

Critical Dimensionless Shear Stress:

$$\tau_{ci} = 0.0834(d_i/d_{50})^{-0.872}$$

Value	Variable	Definition
16.55	d_i (mm)	D50 Bed Material (D50 from riffle pebble count)
21	d_{50} (mm)	Bar Sample D50 or Sub-pavement D50
42	D_i (mm)	Largest particle from bar sample (or subpavement)
		Equation 2
0.017	τ_{ci}	**Critical Dimensionless Shear Stress**

Sediment Transport Validation

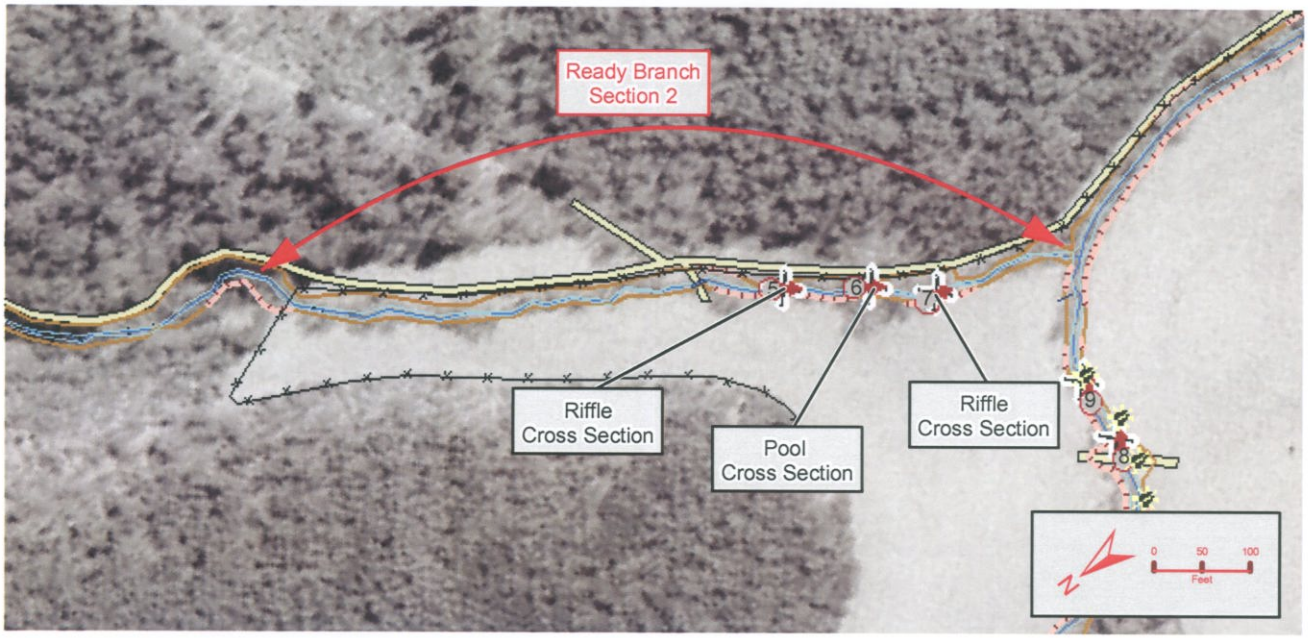
42	Largest Particle in Bar Sample D_i (mm)
0.46	Bankfull Shear Stress $\tau_c=\gamma RS$ (lb/ft^2)
25.9	Moveable particle size (mm) at bankfull shear stress (predicted by the Shields Diagram: Blue field book: p238, Red field book: p190)
0.7	Predicted shear stress required to initiate movement of D_i (mm) (see Shields Diagram: Blue field book: p238, Red field book: p190)

Entrainment Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		0	0	0
.25 - .50		1	1	1
.50 - 1.0		3	3	4
1.0 - 2		7	7	11
2 - 4	GRAVEL	3	3	14
4 - 5.7		0	0	14
5.7 - 8		2	2	16
8 - 11.3		12	12	28
11.3 - 16		21	21	49
16 - 22.6		12	12	61
22.6 - 32		27	27	88
32 - 45		6	6	94
45 - 64		4	4	98

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	2	2	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

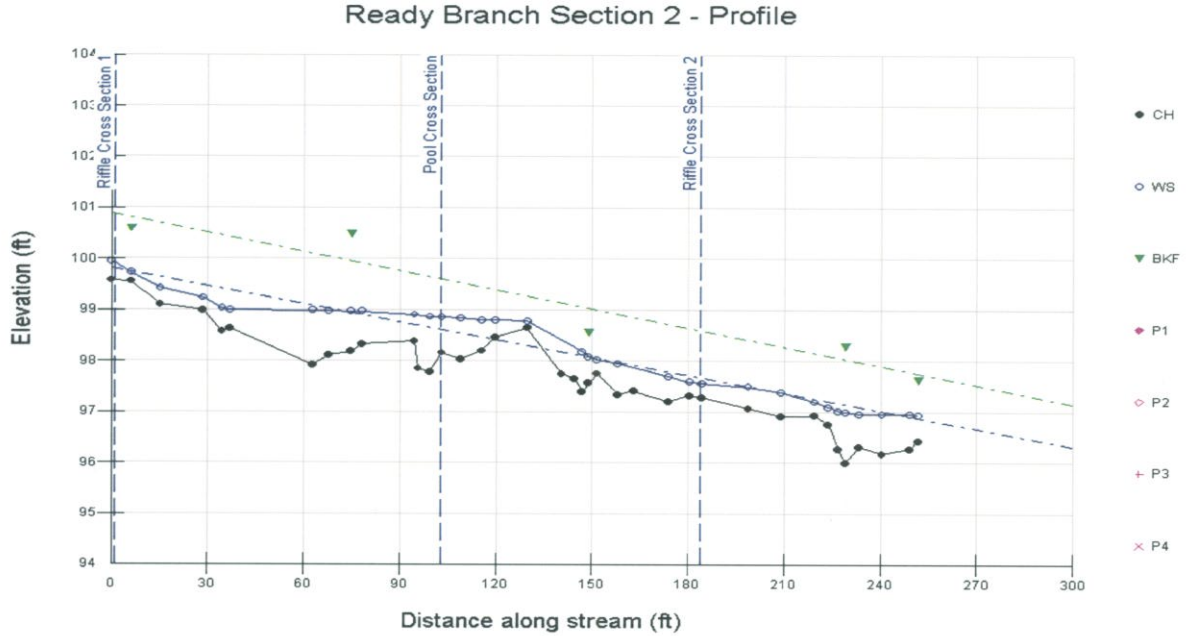
Pattern View



Summary Data

	Min	Avg	Max
Meander Length (L_M)	--	--	--
Radius of Curvature (R_C)	7.00	11.50	16.94
Belt Width (W_{blt})	5.60	16.40	24.23
Sinuosity (k)		1.09	

Profile View



Summary Data

	Min	Avg	Max
BKF Slope		0.01251	
Riffle Slope	0.00136	0.01234	0.02646
Pool Slope	0.00000	0.00167	0.00429
Run Slope	0.01265	0.02516	0.03417
Glide Slope	0.02714	0.03353	0.04009
P - P	41.3	55.6	82.8
Pool Length	25.0	30.8	42.1
D_{max} riffle	0.60	1.03	1.30
D_{max} pool	1.87	2.03	2.19
D_{max} run	1.34	1.55	1.89
D_{max} glide	0.91	1.50	1.84

Profile Survey Data

Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		
0.00	99.58	99.94			
6.09	99.56	99.72	100.59		
15.21	99.10	99.42			
28.66	98.99	99.23			
34.48	98.57	99.02			
36.96	98.64	98.99			
62.80	97.92	98.98			
67.91	98.11	98.97			
74.96	98.18	98.96	100.48		
78.24	98.33	98.96			
94.68	98.38	98.90			
95.83	97.85				
99.36	97.78	98.86			
103.19	98.16	98.85			
109.04	98.04	98.83			
115.67	98.20	98.80			
119.96	98.46	98.80			
129.94	98.65	98.77			
140.58	97.74				
144.72	97.64				
147.01	97.39	98.17			
149.05	97.56	98.07	98.56		
151.74	97.75	98.01			
158.25	97.34	97.94			
163.09	97.41				
169.67					
173.98	97.20	97.68			
180.56	97.32	97.58			
184.27	97.28	97.55			
198.90	97.06	97.48			
209.06	96.91	97.38			
219.54	96.92	97.19			
223.88	96.75	97.08			
226.89	96.27	97.00			
229.11	95.99	96.98	98.29		
233.52	96.31	96.95			
240.62	96.17	96.95			
249.27	96.27	96.94			
251.85	96.42	96.93	97.62		

Profile Survey Data (continued)

Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		

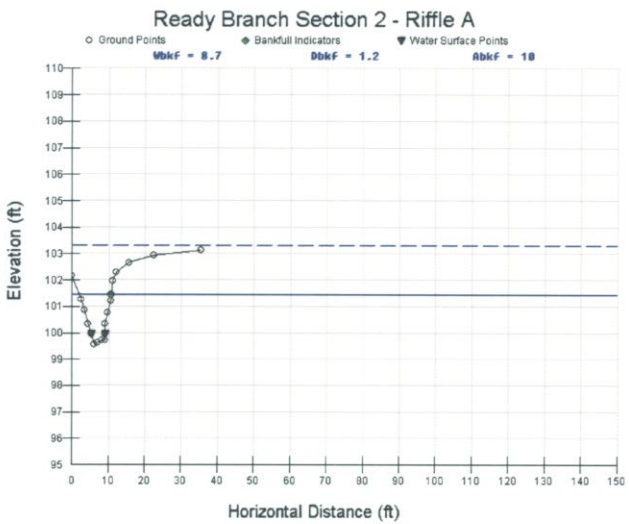
Photo 5

Photo 6

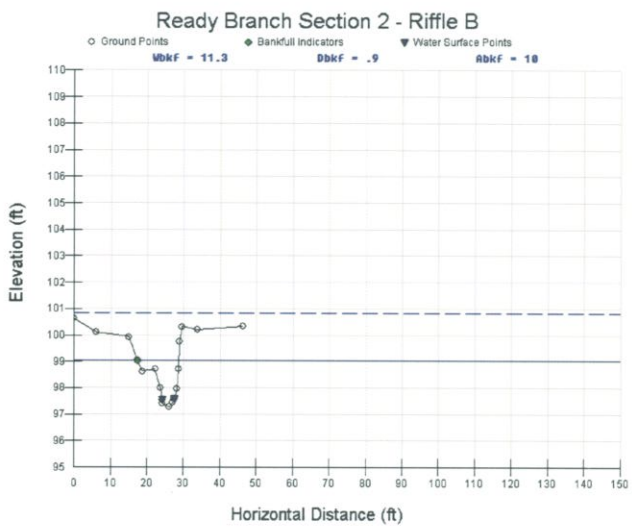
Summary Data

	Riffle A	Riffle B
D_{MAX} (ft)	1.87	1.77
W_{BKF} (ft)	8.66	11.3
A_{BKF} (ft^2)	10.0	10.0
W_{FPA} (ft)	18.6	46.4
Wetted Perimeter	10.1	12.6
Hydraulic Radius (R)	0.99	0.80
W/D Ratio	7.49	12.7
Bank Height Ratio	1.5	1.5
Slope (%)	1.23	1.23
Entrenchment	4.12	4.12
Stream Type	E4	C4

Riffle A Cross Section



Riffle B Cross Section



Notes

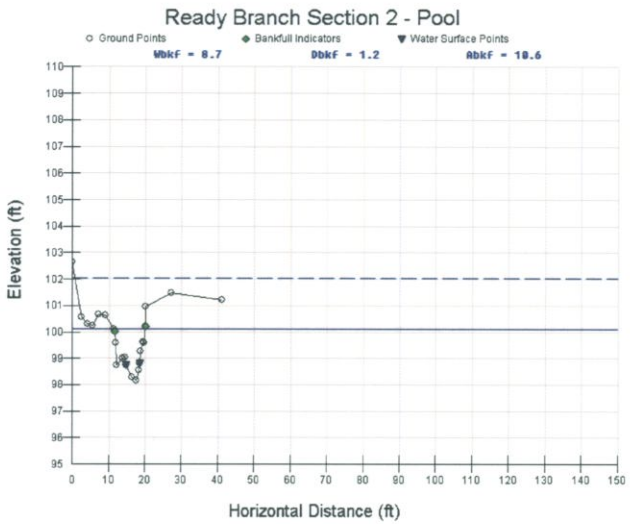
Photo 7

Photo

Summary Data

	Riffle Avg	Pool
D_{MAX} (ft)	1.82	1.94
W_{BKF} (ft)	9.98	8.67
A_{BKF} (ft^2)	10.0	10.6
W_{FPA} (ft)	32.5	10.4
Wetted Perimeter	11.4	10.6
Hydraulic Radius (R)	0.9	1.0
W/D Ratio	10.1	7.09
Bank Height Ratio	1.5	1.4
Slope (%)	1.23	0.167
Entrenchment	4.12	
Stream Type	E4→C4	

Pool Cross Section



Cross Section

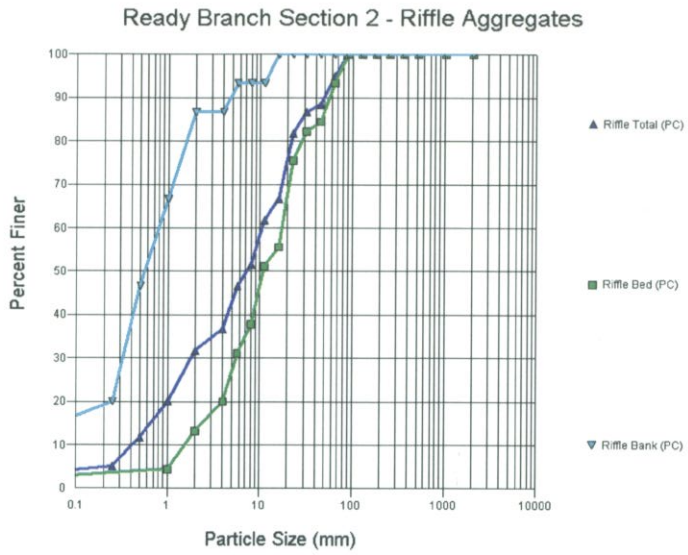
Notes

Riffle A Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	102.16	FP
2.66	101.27	FP
3.62	100.87	FP
4.53	100.35	GS
5.32	99.94	LEW
6.05	99.58	TW
6.98	99.64	SB
8.15	99.71	SB
9.15	99.71	SB
9.16	99.95	REW
9.23	100.34	RB
9.77	100.78	FP
10.77	101.24	RB
10.78	101.45	BKF
11.21	101.99	RB
12.22	102.29	RB
15.75	102.67	FP
22.66	102.94	FP
35.65	103.14	FP

Riffle B Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	100.64	FP
6.01	100.11	FP
15.01	99.93	LB
17.50	99.05	BKF
18.75	98.63	PB
22.22	98.72	
23.83	97.99	PB
24.14	97.55	LEW
24.36	97.42	SB
26.24	97.28	TW
27.19	97.43	SB
27.64	97.57	REW
28.21	97.96	RB
28.72	98.72	
28.94	99.76	RB
29.58	100.33	RB
33.92	100.20	FP
46.36	100.34	FP

Pool Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	102.66	FP
2.48	100.57	FP
4.29	100.31	FP
5.60	100.24	FP
7.20	100.65	FP
9.24	100.64	FP
11.40	100.11	LB
11.63	100.01	BKF
12.09	99.59	LB
12.31	98.75	PB
13.91	99.01	PB
14.50	99.06	PB
14.91	98.74	LEW
16.34	98.28	SB
17.74	98.16	TW
18.31	98.56	SB
18.64	98.82	REW
18.74	99.27	RB
19.52	99.64	RB
19.82	99.61	RB
20.15	100.20	BKF
20.29	100.96	FP
27.34	101.48	FP
41.17	101.22	FP

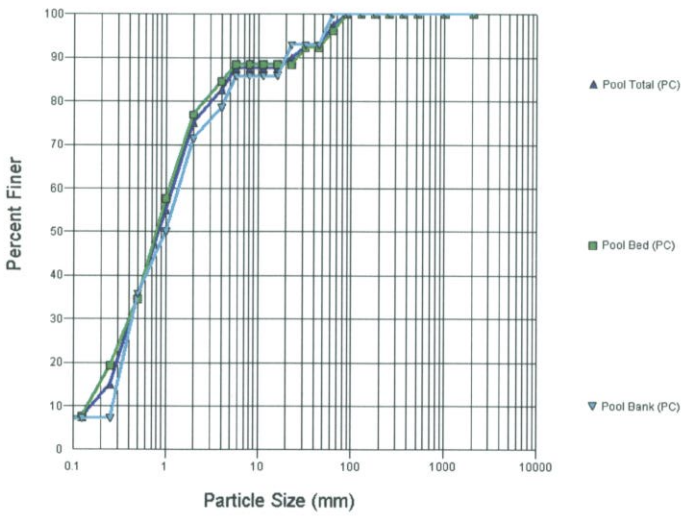
Riffle Materials



Particle Analysis

Total Particles	60
D16 (mm)	0.76
D35 (mm)	3.33
D50 (mm)	7.23
D84 (mm)	26.98
D95 (mm)	64.00
D100 (mm)	90.00
Silt/Clay %	0
Sand %	32
Gravel %	63
Cobble %	5
Boulder %	0
Bedrock %	0

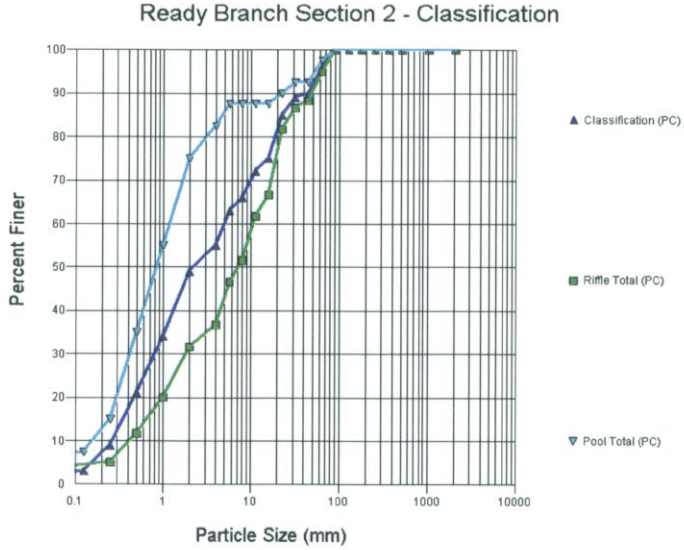
Pool Materials



Particle Analysis

Total Particles	40
D16 (mm)	0.26
D35 (mm)	0.50
D50 (mm)	0.88
D84 (mm)	4.51
D95 (mm)	54.50
D100 (mm)	90.00
Silt/Clay %	0
Sand %	75
Gravel %	23
Cobble %	3
Boulder %	0
Bedrock %	0

Classification



Particle Analysis

Total Particles	100
D16 (mm)	0.40
D35 (mm)	1.07
D50 (mm)	2.33
D84 (mm)	21.94
D95 (mm)	60.83
D100 (mm)	90.00
Silt/Clay %	0
Sand %	49
Gravel %	47
Cobble %	4
Boulder %	0
Bedrock %	0

Riffle Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		3	5	5
.25 - .50		4	6.67	11.67
.50 - 1.0		5	8.33	20
1.0 - 2		7	11.67	31.67
2 - 4	GRAVEL	3	5	36.67
4 - 5.7		6	10	46.67
5.7 - 8		3	5	51.67
8 - 11.3		6	10	61.67
11.3 - 16		3	5	66.67
16 - 22.6		9	15	81.67
22.6 - 32		3	5	86.67
32 - 45		1	1.67	88.33
45 - 64		4	6.67	95

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	3	5	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Pool Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		3	7.5	7.5
.125 - .25		3	7.5	15
.25 - .50		8	20	35
.50 - 1.0		8	20	55
1.0 - 2		8	20	75
2 - 4	GRAVEL	3	7.5	82.5
4 - 5.7		2	5	87.5
5.7 - 8		0	0	87.5
8 - 11.3		0	0	87.5
11.3 - 16		0	0	87.5
16 - 22.6		1	2.5	90
22.6 - 32		1	2.5	92.5
32 - 45		0	0	92.5
45 - 64		2	5	97.5

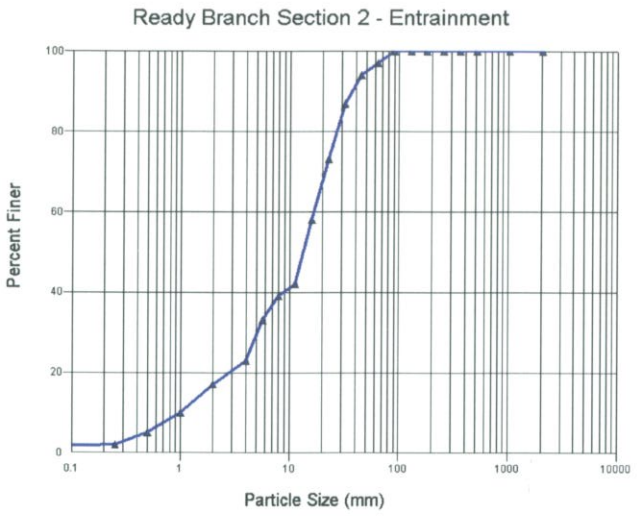
Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	1	2.5	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Classification Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		3	3	3
.125 - .25		6	6	9
.25 - .50		12	12	21
.50 - 1.0		13	13	34
1.0 - 2		15	15	49
2 - 4	GRAVEL	6	6	55
4 - 5.7		8	8	63
5.7 - 8		3	3	66
8 - 11.3		6	6	72
11.3 - 16		3	3	75
16 - 22.6		10	10	85
22.6 - 32		4	4	89
32 - 45		1	1	90
45 - 64		6	6	96

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	4	4	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Entrainment



Particle Analysis

Total Particles	100

D16 (mm)	1.86
D35 (mm)	6.47
D50 (mm)	13.65
D84 (mm)	29.99
D95 (mm)	51.33
D100 (mm)	90.00

Silt/Clay %	0
Sand %	17
Gravel %	80
Cobble %	3
Boulder %	0
Bedrock %	0

Entrainment Calculations

Critical Dimensionless Shear Stress:

$$\tau_{ci} = 0.0834(d_i/d_{50})^{-0.872}$$

Value	Variable	Definition
13.65	d_i (mm)	D50 Bed Material (D50 from riffle pebble count)
4.1	d_{50} (mm)	Bar Sample D50 or Sub-pavement D50
49	D_i (mm)	Largest particle from bar sample (or subpavement)
		Equation 1
0.029	τ_{ci}	**Critical Dimensionless Shear Stress**

Sediment Transport Validation

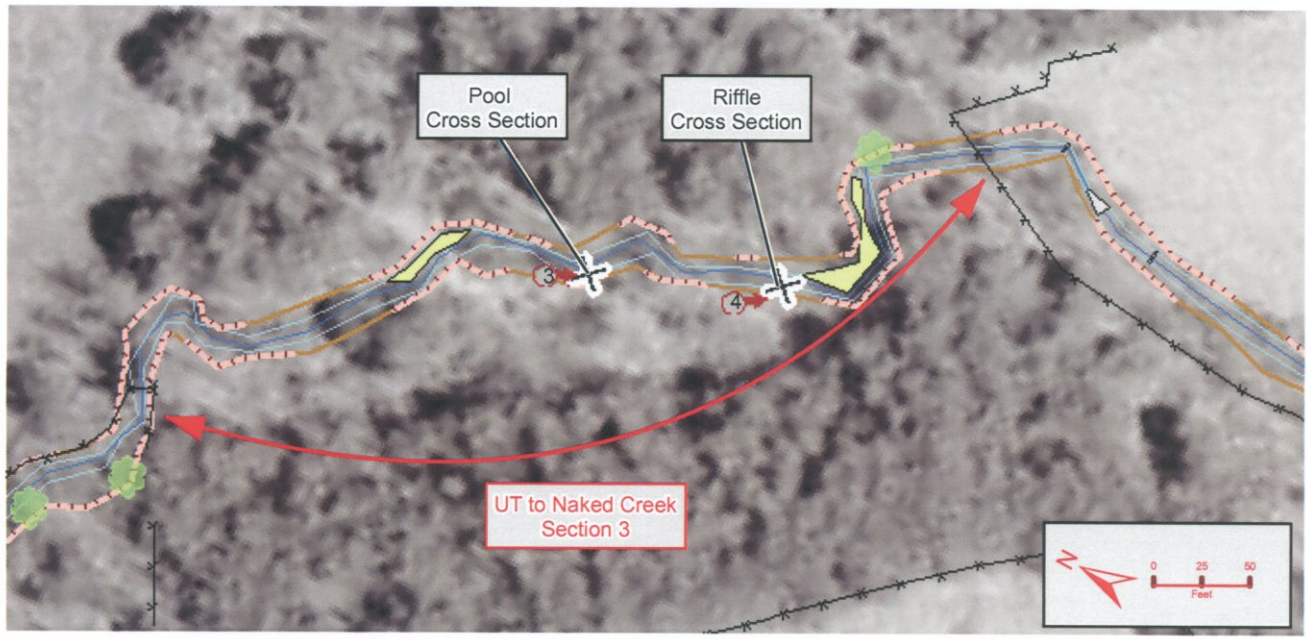
49	Largest Particle in Bar Sample D_i (mm)
0.76	Bankfull Shear Stress $\tau_c=\gamma RS$ (lb/ft^2)
42.2	Moveable particle size (mm) at bankfull shear stress (predicted by the Shields Diagram: Blue field book: p238, Red field book: p190)
0.7	Predicted shear stress required to initiate movement of D_i (mm) (see Shields Diagram: Blue field book: p238, Red field book: p190)

Entrainment Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		2	2	2
.25 - .50		3	3	5
.50 - 1.0		5	5	10
1.0 - 2		7	7	17
2 - 4	GRAVEL	6	6	23
4 - 5.7		10	10	33
5.7 - 8		6	6	39
8 - 11.3		3	3	42
11.3 - 16		16	16	58
16 - 22.6		15	15	73
22.6 - 32		14	14	87
32 - 45		7	7	94
45 - 64		3	3	97

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	3	3	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

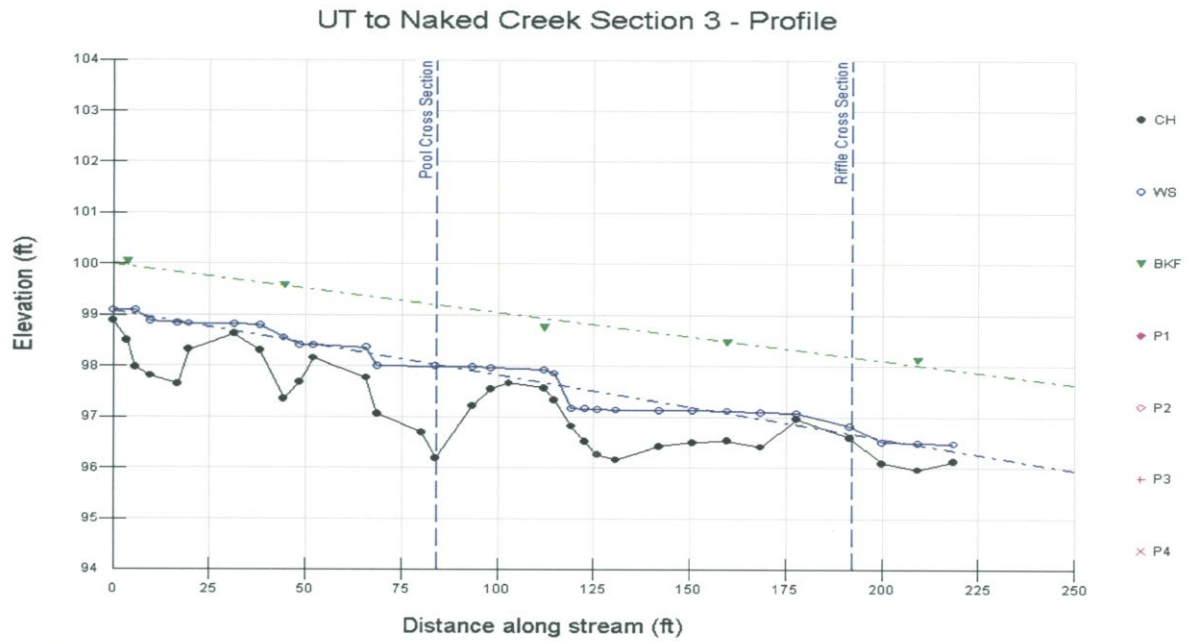
Pattern View



Summary Data

	Min	Avg	Max
Meander Length (L_M)	--	--	--
Radius of Curvature (R_C)	4.40	18.10	41.70
Belt Width (W_{blt})	5.60	16.40	24.23
Sinuosity (k)		1.15	

Profile View



Summary Data

	Min	Avg	Max
BKF Slope		0.00946	
Riffle Slope	0.00069	0.00783	0.01956
Pool Slope	0.00112	0.00316	0.00629
Run Slope	0.03507	0.0872	0.17883
Glide Slope	0.00105	0.00535	0.00906
P - P	35.8	41.0	46.3
Pool Length	11.3	19.0	30.9
D_{max} riffle	1.33	1.52	1.60
D_{max} pool	2.21	2.50	2.99
D_{max} run	1.99	2.09	2.24
D_{max} glide	1.43	1.70	1.98

Profile Survey Data

Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		
0.00	98.88	99.08			
3.56	98.50		100.03		
5.77	97.98	99.08			
9.48	97.81	98.87			
16.80	97.65	98.83			
19.61	98.32	98.82			
31.44	98.63	98.81			
38.23	98.31	98.79			
44.45	97.36	98.55	99.58		
48.65	97.68	98.41			
52.19	98.16	98.41			
65.84	97.77	98.36			
68.80	97.07	98.00			
80.32	96.69				
83.97	96.19	97.99			
93.50	97.21	97.98			
98.41	97.55	97.96			
103.06	97.67				
112.19	97.57	97.92	98.75		
114.86	97.33	97.85			
119.23	96.82	97.16			
122.78	96.52	97.15			
125.92	96.26	97.14			
130.98	96.16	97.13			
142.20	96.42	97.12			
150.77	96.50	97.12			
159.71	96.53	97.11	98.47		
168.58	96.41	97.08			
177.90	96.96	97.07			
191.61	96.60	96.81			
200.03	96.09	96.50			
209.25	95.96	96.48	98.12		
218.61	96.12	96.47			

Profile Survey Data (continued)

Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		

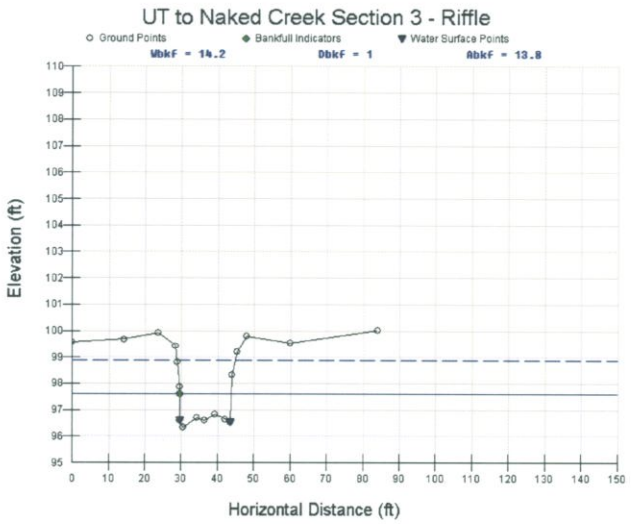
Photo 3

Photo 4

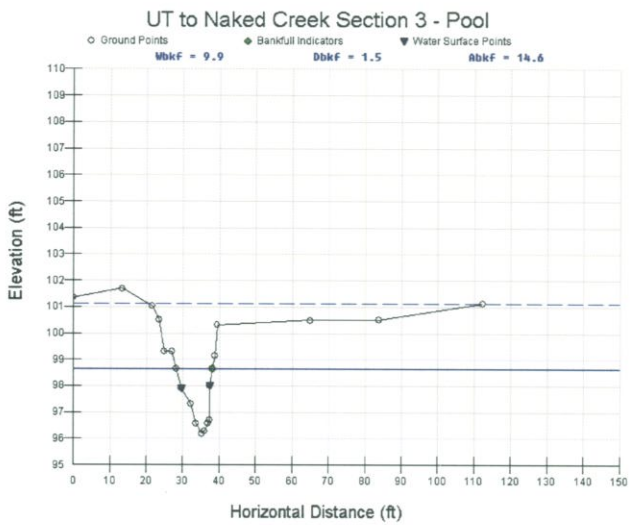
Summary Data

	Riffle	Pool
D_{MAX} (ft)	1.27	2.47
W_{BKF} (ft)	14.2	9.91
A_{BKF} (ft^2)	13.8	14.6
W_{FPA} (ft)	15.9	91.9
Wetted Perimeter	16.0	12.0
Hydraulic Radius (R)	0.86	1.22
W/D Ratio	14.7	6.74
Bank Height Ratio	2.0	1.7
Slope (%)	0.783	0.316
Entrenchment	1.12	
Stream Type	F4	

Riffle Cross Section



Pool Cross Section

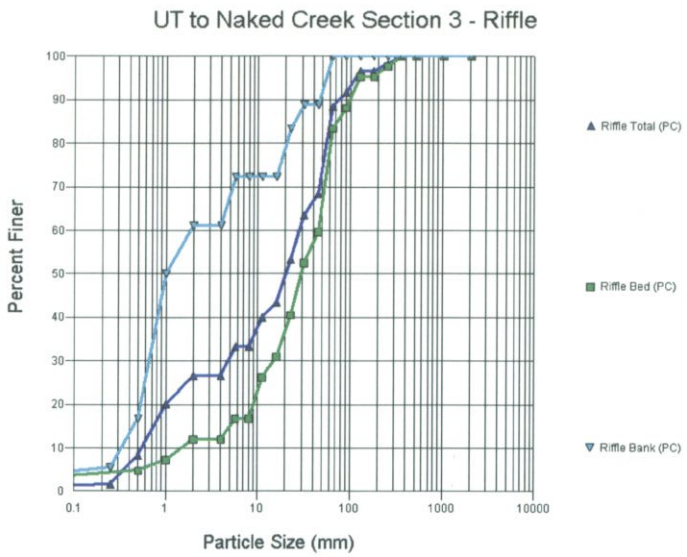


Notes

Riffle Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	99.55	FP
14.25	99.67	FP
23.87	99.93	FP
28.50	99.42	LB
29.03	98.82	LB
29.56	97.86	LB
29.60	97.61	BKF
29.76	96.59	LEW
30.66	96.34	SB
34.33	96.70	SB
36.62	96.60	TW
39.28	96.82	SB
42.19	96.65	SB
43.54	96.52	REW
44.02	98.31	RB
45.39	99.19	RB
48.08	99.80	FP
60.07	99.54	FP
84.16	100.01	FP

Pool Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	101.36	FP
13.48	101.69	FP
21.68	101.04	FP
23.49	100.52	LB
24.93	99.30	LB
27.06	99.29	PB
28.22	98.66	PB
29.57	97.90	LEW
32.24	97.31	SB
33.67	96.56	SB
35.33	96.19	TW
35.98	96.26	SB
36.89	96.57	SB
37.41	96.71	SB
37.47	97.99	REW
38.12	98.66	BKF
38.75	99.14	RB
39.45	100.31	RB
64.94	100.49	FP
83.91	100.50	FP
112.36	101.13	FP

Riffle Materials



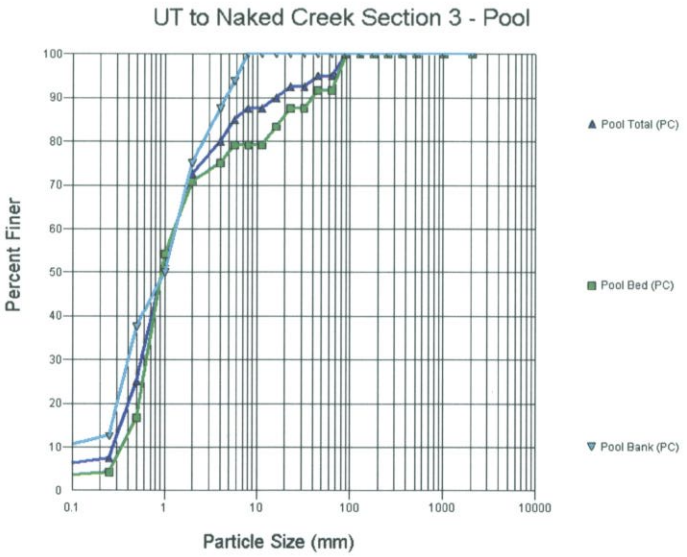
Particle Analysis

Total Particles	60

D16 (mm)	0.83
D35 (mm)	8.83
D50 (mm)	20.40
D84 (mm)	59.89
D95 (mm)	115.31
D100 (mm)	361.99

Silt/Clay %	0
Sand %	27
Gravel %	62
Cobble %	10
Boulder %	2
Bedrock %	0

Pool Materials



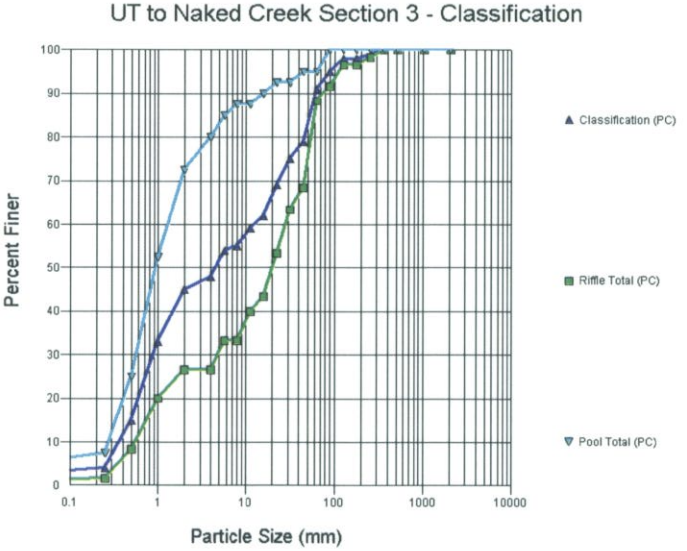
Particle Analysis

Total Particles	40

D16 (mm)	0.37
D35 (mm)	0.68
D50 (mm)	0.95
D84 (mm)	5.36
D95 (mm)	45.00
D100 (mm)	90.00

Silt/Clay %	0
Sand %	73
Gravel %	23
Cobble %	5
Boulder %	0
Bedrock %	0

Classification



Particle Analysis

Total Particles	100

D16 (mm)	0.53
D35 (mm)	0.17
D50 (mm)	4.57
D84 (mm)	52.92
D95 (mm)	90.00
D100 (mm)	361.99

Silt/Clay %	0
Sand %	45
Gravel %	46
Cobble %	8
Boulder %	1
Bedrock %	0

Riffle Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		1	1.67	1.67
.25 - .50		4	6.67	8.33
.50 - 1.0		7	11.67	20
1.0 - 2		4	6.67	26.67
2 - 4	GRAVEL	0	0	26.67
4 - 5.7		4	6.67	33.33
5.7 - 8		0	0	33.33
8 - 11.3		4	6.67	40
11.3 - 16		2	3.33	43.33
16 - 22.6		6	10	53.33
22.6 - 32		6	10	63.33
32 - 45		3	5	68.33
45 - 64		12	20	88.33

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	2	3.33	91.67
90 - 128		3	5	96.67
128 - 180		0	0	96.67
180 - 256		1	1.67	98.33
256 - 362	BOULDER	1	1.67	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Pool Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		3	7.5	7.5
.25 - .50		7	17.5	25
.50 - 1.0		11	27.5	52.5
1.0 - 2		8	20	72.5
2 - 4	GRAVEL	3	7.5	80
4 - 5.7		2	5	85
5.7 - 8		1	2.5	87.5
8 - 11.3		0	0	87.5
11.3 - 16		1	2.5	90
16 - 22.6		1	2.5	92.5
22.6 - 32		0	0	92.5
32 - 45		1	2.5	95
45 - 64		0	0	95

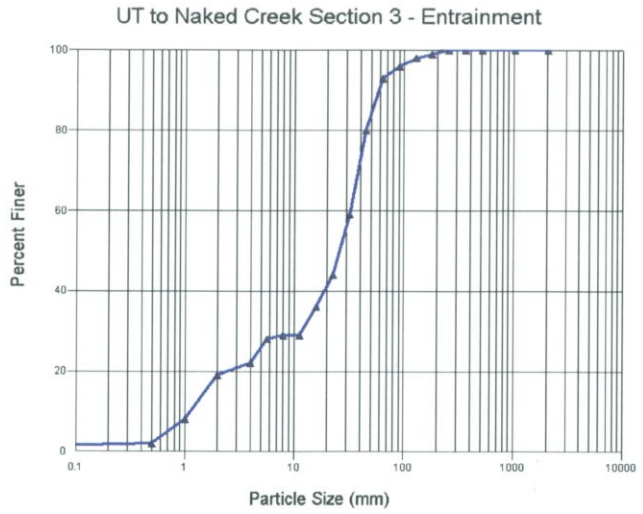
Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	2	5	100
90 - 128		0	0	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Classification Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		4	4	4
.25 - .50		11	11	15
.50 - 1.0		18	18	33
1.0 - 2		12	12	45
2 - 4	GRAVEL	3	3	48
4 - 5.7		6	6	54
5.7 - 8		1	1	55
8 - 11.3		4	4	59
11.3 - 16		3	3	62
16 - 22.6		7	7	69
22.6 - 32		6	6	75
32 - 45		4	4	79
45 - 64		12	12	91

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	4	4	95
90 - 128		3	3	98
128 - 180		0	0	98
180 - 256		1	1	99
256 - 362	BOULDER	1	1	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Entrainment



Particle Analysis

Total Particles	100

D16 (mm)	1.73
D35 (mm)	15.33
D50 (mm)	26.36
D84 (mm)	50.85
D95 (mm)	81.33
D100 (mm)	255.99

Silt/Clay %	0
Sand %	19
Gravel %	74
Cobble %	7
Boulder %	0
Bedrock %	0

Entrainment Calculations

Critical Dimensionless Shear Stress:

$$\tau_{ci} = 0.0834(d_i/d_{50})^{-0.872}$$

Value	Variable	Definition
26.36	d_i (mm)	D50 Bed Material (D50 from riffle pebble count)
23	d_{50} (mm)	Bar Sample D50 or Sub-pavement D50
71	D_i (mm)	Largest particle from bar sample (or subpavement)
		Equation 2
0.016	τ_{ci}	**Critical Dimensionless Shear Stress**

Sediment Transport Validation

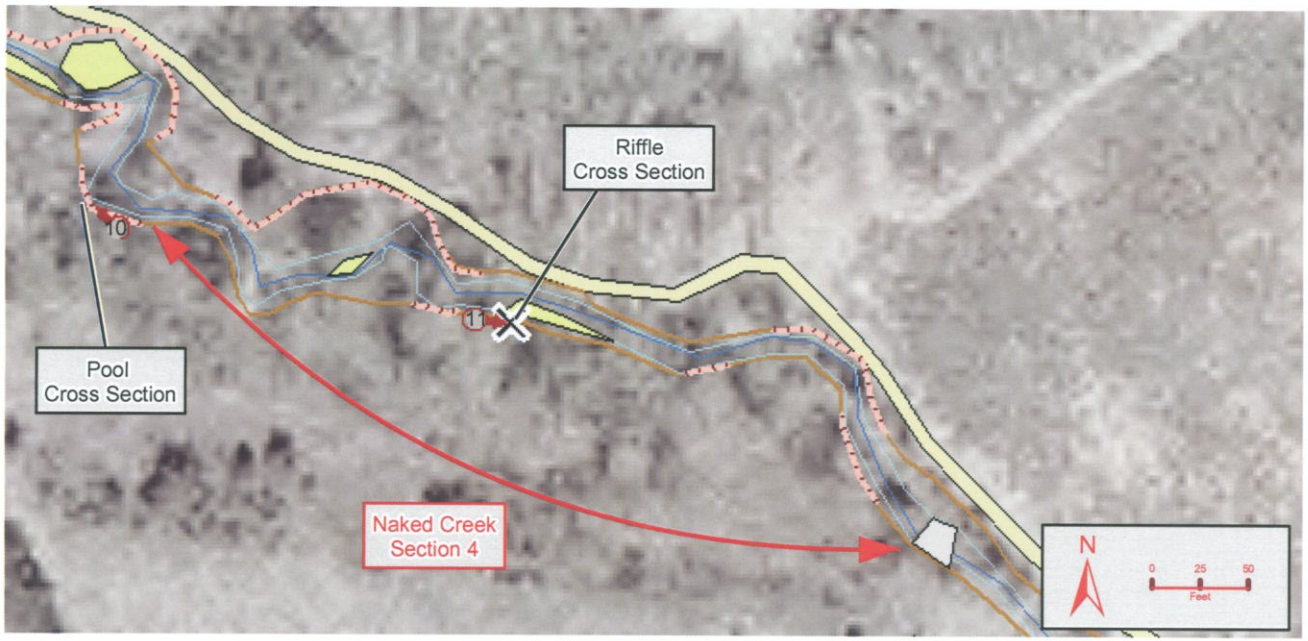
71	Largest Particle in Bar Sample D_i (mm)
0.42	Bankfull Shear Stress $\tau_c=\gamma RS$ (lb/ft^2)
23.2	Moveable particle size (mm) at bankfull shear stress (predicted by the Shields Diagram: Blue field book: p238, Red field book: p190)
0.91	Predicted shear stress required to initiate movement of D_i (mm) (see Shields Diagram: Blue field book: p238, Red field book: p190)

Entrainment Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		0	0	0
.25 - .50		2	2	2
.50 - 1.0		6	6	8
1.0 - 2		11	11	19
2 - 4	GRAVEL	3	3	22
4 - 5.7		6	6	28
5.7 - 8		1	1	29
8 - 11.3		0	0	29
11.3 - 16		7	7	36
16 - 22.6		8	8	44
22.6 - 32		15	15	59
32 - 45		21	21	80
45 - 64		13	13	93

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	3	3	96
90 - 128		2	2	98
128 - 180		1	1	99
180 - 256		1	1	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

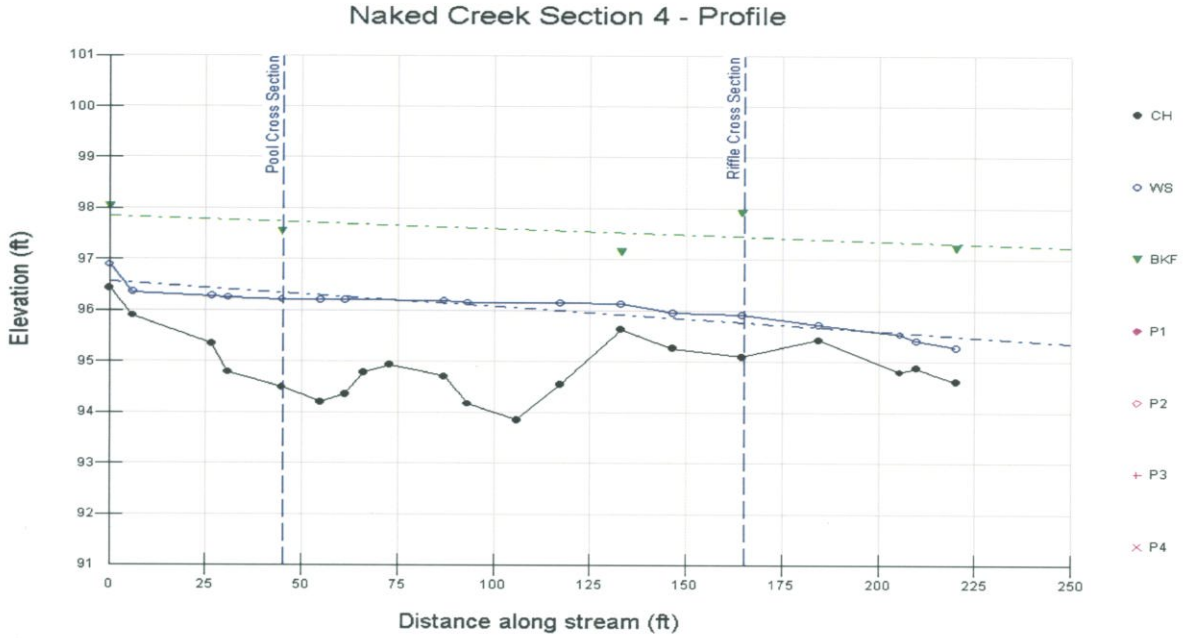
Pattern View



Summary Data

	Min	Avg	Max
Meander Length (L_M)	--	--	--
Radius of Curvature (R_C)	10.40	23.90	36.68
Belt Width (W_{blt})	6.40	15.40	21.26
Sinuosity (k)		1.12	

Profile View



Summary Data

	Min	Avg	Max
BKF Slope		0.0023	
Riffle Slope	0.00660	0.00818	0.01052
Pool Slope	0.00000	0.00169	0.00351
Run Slope	0.01262	0.01265	0.01268
Glide Slope	0.00000	0.00207	0.00414
P - P	62.6	62.6	62.6
Pool Length	34.6	36.0	37.5
D_{max} riffle	1.88	2.07	2.29
D_{max} pool	3.50	3.65	3.79
D_{max} run	2.21	2.41	2.60
D_{max} glide	2.90	2.93	2.95

Profile Survey Data					
Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		
0.00	96.43	96.89	98.03		
6.01	95.90	96.35			
26.55	95.35	96.27			
30.74	94.79	96.25			
44.85	94.49	96.21	97.54		
55.01	94.20	96.20			
61.29	94.35	96.20			
66.28	94.78				
73.09	94.93				
87.17	94.70	96.19			
93.28	94.17	96.15			
106.04	93.85				
117.34	94.55	96.14			
133.16	95.63	96.13	97.16		
146.52	95.26	95.95			
164.53	95.10	95.91	97.92		
184.44	95.42	95.72			
205.61	94.79	95.53			
209.85	94.87	95.40			
220.17	94.60	95.27	97.23		

Profile Survey Data (continued)					
Distance (ft)	Channel Surface Elevation	Water Surface Elevation	BKF Elevation		

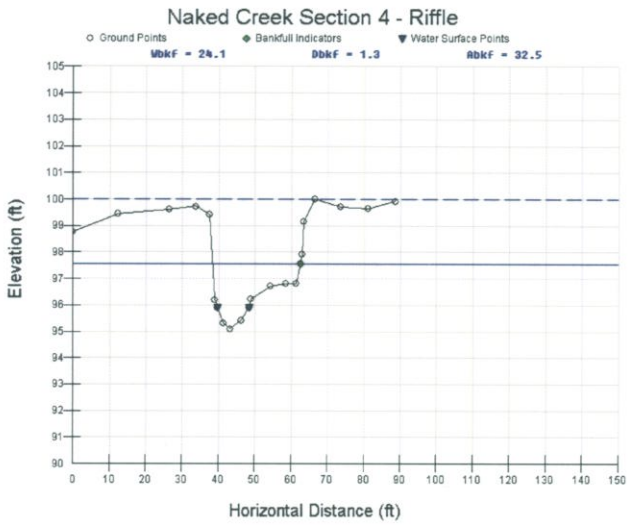
Photo 10

Photo 11

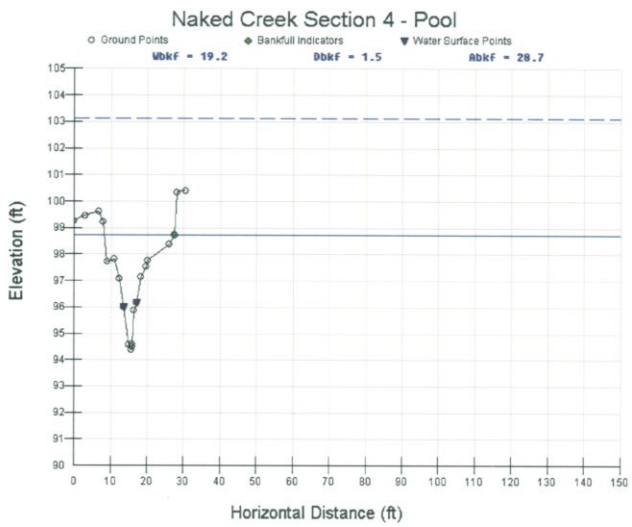
Summary Data

	Riffle	Pool
D_{MAX} (ft)	2.45	4.38
W_{BKF} (ft)	24.1	19.2
A_{BKF} (ft^2)	32.5	28.7
W_{FPA} (ft)	88.7	30.7
Wetted Perimeter	25.6	22.7
Hydraulic Radius (R)	1.27	1.27
W/D Ratio	18.0	12.9
Bank Height Ratio	1.8	1.2
Slope (%)	0.818	0.169
Entrenchment	3.67	
Stream Type	C4	

Riffle Cross Section



Pool Cross Section

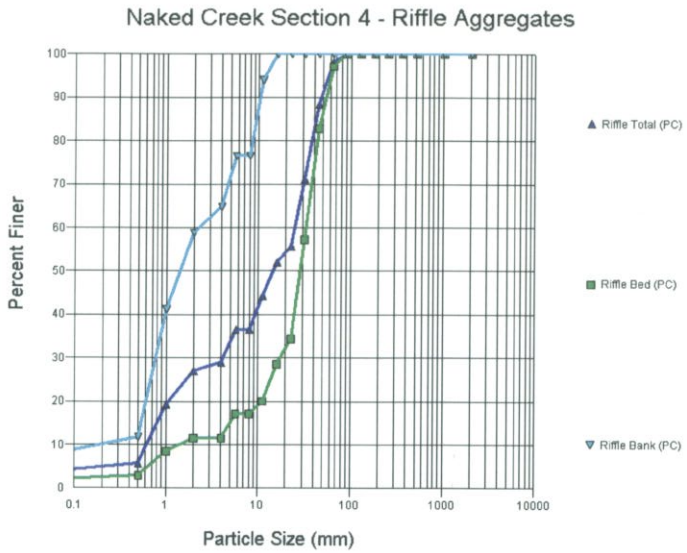


Notes

Riffle Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	98.77	FP
12.54	99.45	FP
26.48	99.60	FP
33.93	99.72	FP
37.61	99.40	LB
39.18	96.20	LB
39.71	95.91	LEW
41.52	95.31	SB
43.29	95.10	TW
46.44	95.42	SB
48.52	95.91	REW
48.92	96.21	PB
54.37	96.72	PB
58.54	96.81	PB
61.48	96.80	PB
62.66	97.55	BKF
63.21	97.92	RB
63.70	99.17	RB
66.78	100.01	FP
73.67	99.70	FP
81.24	99.65	FP
88.76	99.92	FP

Pool Cross Section Survey Data		
Distance (ft)	Elevation (ft)	Notes
0.00	99.26	FP
2.97	99.46	FP
6.82	99.61	FP
8.05	99.22	LB
9.03	97.73	LB
11.03	97.81	LB
12.49	97.06	LB
13.58	95.98	LEW
14.94	94.56	SB
15.76	94.36	SB
15.98	94.49	TW
16.08	94.60	SB
16.51	95.86	SB
17.19	96.14	REW
18.24	97.15	PB
19.84	97.54	PB
20.16	97.77	PB
26.16	98.37	PB
27.57	98.74	PB
27.57	98.74	BKF
28.16	100.31	RB
28.18	100.34	FP
30.72	100.41	FP

Riffle Materials



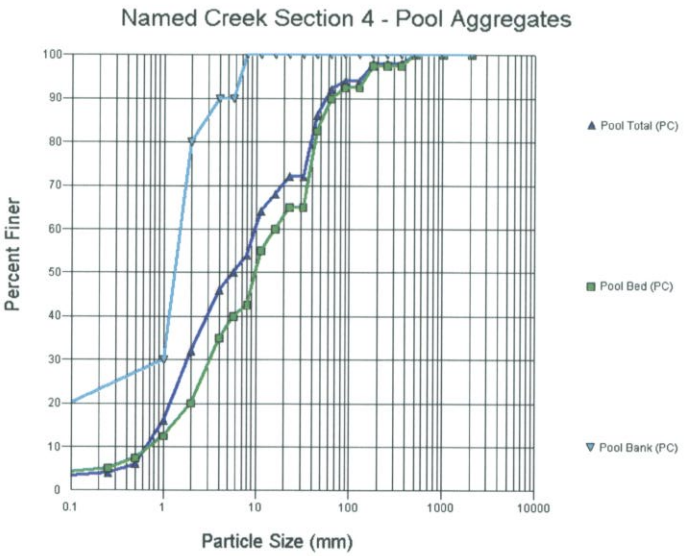
Particle Analysis

Total Particles	52

D16 (mm)	0.88
D35 (mm)	5.36
D50 (mm)	14.83
D84 (mm)	41.65
D95 (mm)	57.92
D100 (mm)	90.00

Silt/Clay %	0
Sand %	27
Gravel %	71
Cobble %	2
Boulder %	0
Bedrock %	0

Pool Materials



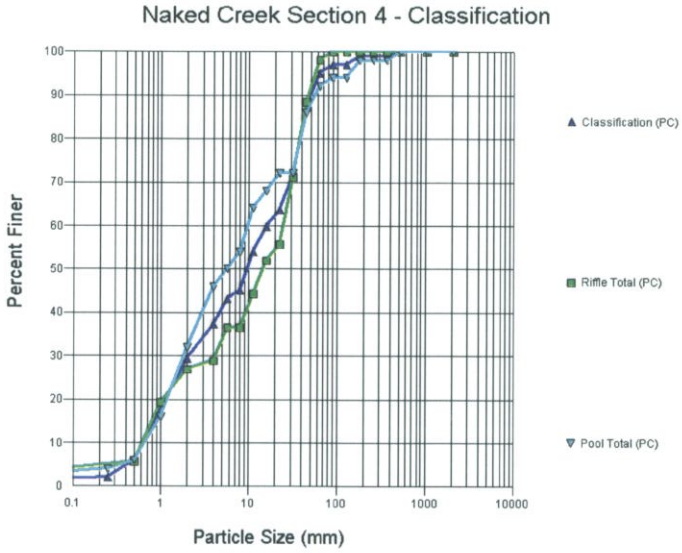
Particle Analysis

Total Particles	50

D16 (mm)	0.22
D35 (mm)	0.83
D50 (mm)	1.67
D84 (mm)	4.68
D95 (mm)	8.00
D100 (mm)	11.30

Silt/Clay %	0
Sand %	55
Gravel %	45
Cobble %	0
Boulder %	0
Bedrock %	0

Classification



Particle Analysis

Total Particles	102

D16 (mm)	0.93
D35 (mm)	3.43
D50 (mm)	9.83
D84 (mm)	42.31
D95 (mm)	63.76
D100 (mm)	511.95

Silt/Clay %	0
Sand %	29
Gravel %	66
Cobble %	4
Boulder %	1
Bedrock %	0

Riffle Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		0	0	0
.25 - .50		3	5.77	5.77
.50 - 1.0		7	13.46	19.23
1.0 - 2		4	7.69	26.92
2 - 4	GRAVEL	1	1.92	28.85
4 - 5.7		4	7.69	36.54
5.7 - 8		0	0	36.54
8 - 11.3		4	7.69	44.23
11.3 - 16		4	7.69	51.92
16 - 22.6		2	3.85	55.77
22.6 - 32		8	15.38	71.15
32 - 45		9	17.31	88.46
45 - 64		5	9.62	98.08

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	1	1.92	100
90 - 128		3	3.75	100
128 - 180		0	0	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Pool Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		2	4	4
.25 - .50		1	2	6
.50 - 1.0		5	10	16
1.0 - 2		8	16	32
2 - 4	GRAVEL	7	14	46
4 - 5.7		2	4	50
5.7 - 8		2	4	54
8 - 11.3		5	10	64
11.3 - 16		2	4	68
16 - 22.6		2	4	72
22.6 - 32		0	0	72
32 - 45		7	14	86
45 - 64		3	6	92

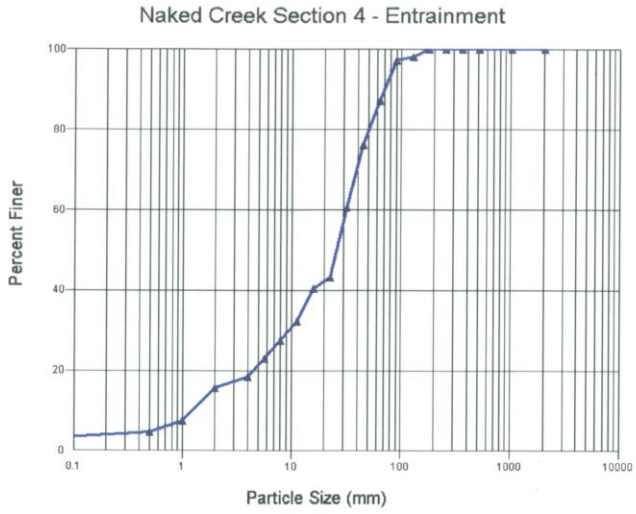
Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	1	2	94
90 - 128		0	0	94
128 - 180		2	4	98
180 - 256		0	0	98
256 - 362	BOULDER	0	0	98
362 - 512		1	2	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Classification Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		2	1.96	1.96
.25 - .50		4	3.92	5.88
.50 - 1.0		12	11.76	17.65
1.0 - 2		12	11.76	29.41
2 - 4	GRAVEL	8	7.84	37.25
4 - 5.7		6	5.88	43.14
5.7 - 8		2	1.96	45.1
8 - 11.3		9	8.82	53.92
11.3 - 16		6	5.88	59.8
16 - 22.6		4	3.92	63.73
22.6 - 32		8	7.84	71.57
32 - 45		16	15.69	87.25
45 - 64		8	7.84	95.1

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	2	1.96	97.06
90 - 128		0	0	97.06
128 - 180		2	1.96	99.02
180 - 256		0	0	99.02
256 - 362	BOULDER	0	0	99.02
362 - 512		1	0.98	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

Entrainment



Particle Analysis

Total Particles	109

D16 (mm)	2.29
D35 (mm)	12.94
D50 (mm)	26.31
D84 (mm)	58.55
D95 (mm)	84.20
D100 (mm)	180.00

Silt/Clay %	0
Sand %	16
Gravel %	72
Cobble %	13
Boulder %	0
Bedrock %	0

Entrainment Calculations

Critical Dimensionless Shear Stress:

$$\tau_{ci} = 0.0834(d_i/d_{50})^{-0.872}$$

Value	Variable	Definition
26.31	d_i (mm)	D50 Bed Material (D50 from riffle pebble count)
28	d_{50} (mm)	Bar Sample D50 or Sub-pavement D50
66	D_i (mm)	Largest particle from bar sample (or subpavement)
		Equation 2
0.017	τ_{ci}	**Critical Dimensionless Shear Stress**

Sediment Transport Validation

66	Largest Particle in Bar Sample D_i (mm)
0.65	Bankfull Shear Stress $\tau_c=\gamma RS$ (lb/ft^2)
39.3	Moveable particle size (mm) at bankfull shear stress (predicted by the Shields Diagram: Blue field book: p238, Red field book: p190)
0.9	Predicted shear stress required to initiate movement of D_i (mm) (see Shields Diagram: Blue field book: p238, Red field book: p190)

Entrainment Total Material Data

Millimeters	Dominate Material	Total	Item %	% Cum
<.062	SAND	0	0	0
.062 - .125		0	0	0
.125 - .25		0	0	0
.25 - .50		5	4.59	4.59
.50 - 1.0		3	2.75	7.34
1.0 - 2		9	8.26	15.6
2 - 4	GRAVEL	9	8.26	15.6
4 - 5.7		3	2.75	18.35
5.7 - 8		5	4.59	22.94
8 - 11.3		5	4.59	27.52
11.3 - 16		5	4.59	32.11
16 - 22.6		9	8.26	40.37
22.6 - 32		3	2.75	43.12
32 - 45		19	17.43	60.55
45 - 64		17	15.6	76.15

Millimeters	Dominate Material	Total	Item %	% Cum
64 - 90	COBBLE	11	10.09	97.25
90 - 128		1	0.92	98.17
128 - 180		2	1.83	100
180 - 256		0	0	100
256 - 362	BOULDER	0	0	100
362 - 512		0	0	100
512 - 1024		0	0	100
1024 - 2048		0	0	100
Bedrock		0	0	100

MORPHOLOGY CHARACTERISTICS

Restoration Site: Naked Creek, Wilkes County
Nearest USGS Station: Station 02111180, Elk Creek at Elkville
Reference Reaches: UT Purlear Creek, Upper Big Warrior Creek, Basin Creek, Basin Creek 2

VARIABLES	Reach Name[1]	Existing UTNKd - 1 (Upper UT to Naked Creek)	Existing UTNkd - 3 (Lower UT to Naked Creek)	Proposed Upper and Lower UT to Naked Creek	Existing Rdy-2 (Lower Ready Branch)	Proposed Lower Ready Branch	Existing Nkd - 1 (Upper Naked Creek)	Proposed Upper Naked Creek	Existing Nkd - 4 (Middle Naked Creek)	Proposed Middle Naked Creek	Reference UT Purlear Creek	Reference Upper Big Warrior Creek	Reference Basin Creek 2	Reference Basin Creek	Regional Curve Rural Piedmont
	Design Station	**0+00 16+25**	**26+50 32+25**	**0+00 35+84**	**100+00 108+57.77**	**100+00 108+57.77**	**35+84 38+82**	**35+84 38+82**	**47+00 60+50**	**38+82 70+75**					
1.	Stream Type (Rosgen)	Incised B4c	F4	C4	Incised C4	C4	Incised C4	C4	Incised C4	C4	B4c	B	C4	C4	
2.	Drainage Area (sq. mile)	0.44	0.53	Mean: 0.44 Range: 0.34 | 0.53	0.32	Mean: 0.31 Range: 0.29 | 0.32	1.2	Mean: 1.20 Range: 1.20 | 1.20	1.86	Mean: 1.81 Range: 1.56 | 2.05	0.57	0.7	6.8	7.2	Mean: 1.25 Range: 0.29 | 2.20
3.	Bankfull Width (W_{bkf})	Mean: 12.7 Range:	Mean: 14.2 Range:	Mean: 16.0 Range:	Mean: 9.5 Range: 8.7 | 10.2	Mean: 12.6 Range:	Mean: 20.5 Range:	Mean: 22.0 Range:	Mean: 24.1 Range:	Mean: 25.0 Range:	Mean: 12.5 Range:	Mean: 15.7 Range:	Mean: 30.7 Range:	Mean: 33.2 Range:	Mean: *24.0* Range:
4.	Bankfull Mean depth (d_{bkf})	Mean: 1.0 Range:	Mean: 1.0 Range:	Mean: 0.8 Range:	Mean: 0.9 Range: 0.6 | 1.2	Mean: 0.8 Range:	Mean: 1.2 Range:	Mean: 1.1 Range:	Mean: 1.4 Range:	Mean: 1.2 Range:	Mean: 0.6 Range:	Mean: 1.4 Range:	Mean: 1.9 Range:	Mean: 2.1 Range:	Mean: *1.3* Range:
5.	Width/Depth Ratio (W_{bkf}/d_{bkf})	Mean: *13.4* Range:	Mean: *14.7* Range:	Mean: *20.0* Range:	Mean: *10.3* Range:	Mean: *15.8* Range:	Mean: *17.2* Range:	Mean: *20.0* Range:	Mean: *17.9* Range:	Mean: *20.8* Range:	Mean: *20.8* Range:	Mean: *11.2* Range:	Mean: *16.2* Range:	Mean: *15.8* Range:	Mean: *17.8* Range:
6.	Bankfull cross-sectional Area (Abkf)	Mean: 12.1 Range:	Mean: 13.8 Range:	Mean: 13.0 Range:	Mean: 8.2 Range: 6.5 | 10.0	Mean: 9.6 Range:	Mean: 24.3 Range:	Mean: 24.0 Range:	Mean: 32.5 Range:	Mean: 30.9 Range:	Mean: 7.4 Range:	Mean: 21.9 Range:	Mean: 57.4 Range:	Mean: 68.4 Range:	Mean: *33.0* Range:
7.	Bankfull Mean Velocity (V_{bkf})	Mean: 5.8 Range:	Mean: 4.5 Range:	Mean: 4.8 Range: 4.5 | 5.8	Mean: 5.6 Range: 3.1 | 4.8	Mean: 4.8 Range: 3.1 | 4.8	Mean: 5.6 Range:	Mean: 5.4 Range:	Mean: 4.9 Range:	Mean: 4.9 Range:	Mean: 3.7 Range: 3.0 | 8.3	Mean: Range:	Mean: 5.5 Range:	Mean: *4.9* Range:
8.	Bankfull Discharge, cfs (Q_{bkf})	Mean: 70.0 Range:	Mean: 62.1 Range:	Mean: 62.4 Range: 60.0 | 70.0	Mean: 46.2 Range:	Mean: 46.1 Range:	Mean: 135.9 Range:	Mean: 129.6 Range:	Mean: 159.1 Range:	Mean: 151.4 Range:	Mean: 27.4 Range:	Mean: 0.0 Range:	Mean: 0.0 Range:	Mean: 376.2 Range:	Mean: *161.3* Range:
9.	Bankfull Maximum Depth (d_{max})	Mean: 1.6 Range:	Mean: 1.3 Range:	Mean: 1.0 Range:	Mean: 1.7 Range: 1.4 | 1.9	Mean: 1.0 Range:	Mean: 2.5 Range:	Mean: 1.5 Range:	Mean: 2.5 Range:	Mean: 1.7 Range:	Mean: 1.0 Range:	Mean: 1.8 Range:	Mean: 2.5 Range:	Mean: 3.1 Range:	Mean: Range:
10.	Max d_{dp}/d_{bkf} ratio	Mean: *1.7* Range:	Mean: *1.3* Range:	Mean: *1.3* Range:	Mean: *1.8* Range:	Mean: *1.3* Range:	Mean: *2.1* Range:	Mean: *1.4* Range:	Mean: *1.8* Range:	Mean: *1.4* Range:	Mean: *1.7* Range:	Mean: *1.3* Range:	Mean: *1.3* Range:	Mean: *1.5* Range:	Mean: Range:
11.	Low Bank Height to max d_{bkf} ratio	Mean: 2.8 Range:	Mean: 2.0 Range:	Mean: 1.0 Range:	Mean: 1.6 Range: 1.6 | 1.6	Mean: 1.0 Range:	Mean: 1.6 Range:	Mean: 1.0 Range:	Mean: 1.8 Range:	Mean: 1.0 Range:	Mean: 2.8 Range:	Mean: Range:	Mean: Range:	Mean: 1.2 Range:	Mean: Range:
12.	Width of Flood Prone (W_{pa})	Mean: 18.6 Range:	Mean: 15.9 Range:	Mean: 48.0 Range: 35.2 | 80.0	Mean: 29.8 Range: 24.0 | 35.7	Mean: 37.8 Range: 27.7 | 63.0	Mean: 79.7 Range:	Mean: 66.0 Range: 48.4 | 110.0	Mean: 88.7 Range:	Mean: 75.0 Range: 55.0 | 125.0	Mean: 18.0 Range:	Mean: 30.0 Range:	Mean: 85.0 Range:	Mean: 329.0 Range:	Mean: Range:
13.	Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: *1.5* Range:	Mean: *1.1* Range:	Mean: *3.0* Range: 2.2 | 5.0	Mean: *3.2* Range:	Mean: *3.0* Range: 2.2 | 5.0	Mean: *3.9* Range:	Mean: *3.0* Range: 2.2 | 5.0	Mean: *3.7* Range:	Mean: *3.0* Range: 2.2 | 5.0	Mean: *1.4* Range:	Mean: *1.9* Range:	Mean: *2.8* Range:	Mean: *9.9* Range:	Mean: Range:
14.	Meander Length (L_m)	Mean: 102.0 Range: 43.0 | 164.0	Mean: 116.0 Range: 80.0 | 180.0	Mean: 144.0 Range: 112.0 | 192.0	Mean: 64.0 Range: 38.0 | 85.0	Mean: 113.4 Range: 88.2 | 151.2	Mean: 201.0 Range: -- | --	Mean: 198.0 Range: 154.0 | 264.0	Mean: 82.0 Range: 57.0 | 126.0	Mean: 225.0 Range: 175.0 | 300.0	Mean: 100.0 Range:	Mean: Range:	Mean: 350.0 Range:	Mean: 350.0 Range:	Mean: Range:
15.	Ratio of Meander Length to Bankfull Width (L_m/W_{bkf})	Mean: *8.0* Range: 3.4 | 12.9	Mean: *8.2* Range: 5.6 | 12.6	Mean: *9.0* Range: 7.0 | 12.0	Mean: *6.8* Range: 4.0 | 9.0	Mean: *9.0* Range: 7.0 | 12.0	Mean: *9.8* Range:	Mean: *9.0* Range: 7.0 | 12.0	Mean: *3.4* Range: 2.4 | 5.2	Mean: *9.0* Range: 7.0 | 12.0	Mean: *8.0* Range:	Mean: *0.0* Range:	Mean: *11.4* Range:	Mean: *10.5* Range:	Mean: Range:
16.	Radius of Curvature (R_c)	Mean: 19.0 Range: 6.9 | 35.7	Mean: 18.1 Range: 4.4 | 41.7	Mean: 48.0 Range: 32.0 | 64.0	Mean: 83.0 Range: 77.0 | 88.0	Mean: 37.8 Range: 25.2 | 50.4	Mean: 27.8 Range: 10.4 | 49.2	Mean: 66.0 Range: 44.0 | 88.0	Mean: 28.0 Range: 14.0 | 47.0	Mean: 75.0 Range: 50.0 | 100.0	Mean: 20.6 Range:	Mean: Range:	Mean: 105.3 Range: 76.7 | 133.8	Mean: 51.2 Range: 40.1 | 69.3	Mean: Range:
17.	Ratio of Radius of Curvature to Bankfull Width (R_c/W_{bkf})	Mean: *1.5* Range: 0.5 | 2.8	Mean: *1.3* Range: 0.3 | 2.9	Mean: *3.0* Range: 2.0 | 4.0	Mean: *8.8* Range: 8.1 | 9.3	Mean: *3.0* Range: 2.0 | 4.0	Mean: *1.4* Range: 0.5 | 2.4	Mean: *3.0* Range: 2.0 | 4.0	Mean: *1.2* Range: 0.6 | 1.9	Mean: *3.0* Range: 2.0 | 4.0	Mean: *1.6* Range:	Mean: *0.0* Range:	Mean: *3.4* Range:	Mean: *1.5* Range:	Mean: Range:
18.	Belt Width (W_{bt})	Mean: 35.1 Range: 17.7 | 44.5	Mean: 16.4 Range: 5.6 | 24.2	Mean: 41.6 Range: 27.2 | 54.4	Mean: 13.2 Range: 11.7 | 14.9	Mean: 32.8 Range: 21.4 | 42.8	Mean: 6.3 Range: 3.9 | 11.5	Mean: 57.2 Range: 37.4 | 74.8	Mean: 15.4 Range: 6.4 | 21.3	Mean: 65.0 Range: 42.5 | 85.0	Mean: 21.0 Range:	Mean: Range:	Mean: 105.0 Range:	Mean: 64.7 Range:	Mean: Range:
19.	Meander Width Ratio (W_{bt}/W_{bkf})	Mean: *2.8* Range: 1.4 | 3.5	Mean: *1.2* Range: 1.0 | 1.7	Mean: *2.6* Range: 1.7 | 3.4	Mean: *1.4* Range: 1.2 | 1.6	Mean: *2.6* Range: 1.7 | 3.4	Mean: *0.3* Range: 0.2 | 0.6	Mean: *2.6* Range: 1.7 | 3.4	Mean: *0.6* Range: 0.3 | 0.9	Mean: *2.6* Range: 1.7 | 3.4	Mean: *1.7* Range:	Mean: *0.0* Range:	Mean: *3.4* Range:	Mean: *1.9* Range:	Mean: Range:
20.	Sinuosity (k) (Stream Length / Valley Length)	Mean: 1.0 Range:	Mean: 1.2 Range:	Mean: 1.15 Range: 1.05 | 1.20	Mean: 1.1 Range:	Mean: 1.20 Range: 1.10 | 1.20	Mean: 1.1 Range:	Mean: 1.20 Range: 1.10 | 1.30	Mean: 1.1 Range:	Mean: 1.20 Range: 1.10 | 1.30	Mean: 1.1 Range:	Mean: Range:	Mean: 1.4 Range:	Mean: 0.0 Range:	Mean: Range:
21.	Valley Slope (Sv_{alley}) (ft/ft)	Mean: 0.016 Range:	Mean: 0.016 Range:	Mean: 0.016 Range: 0.0160 | 0.0200	Mean: 0.015 Range:	Mean: 0.015 Range: 0.0130 | 0.0130	Mean: 0.0130 Range:	Mean: 0.0100 Range:	Mean: 0.0110 Range:	Mean: 0.0110 Range: 0.0080 | 0.0130	Mean: 0.0170 Range:	Mean: Range:	Mean: 0.0140 Range:	Mean: Range:	Mean: Range:
22.	Average Stream Slope (S_{avg}) = (S_{valley}/k)	Mean: 0.016 Range:	Mean: 0.009 Range:	Mean: 0.014 Range: 0.0130 | 0.0140	Mean: 0.012 Range:	Mean: 0.013 Range:	Mean: 0.0116 Range:	Mean: 0.0083 Range:	Mean: 0.0100 Range:	Mean: 0.0092 Range: 0.0070 | 0.0100	Mean: 0.0160 Range:	Mean: Range:	Mean: 0.0100 Range:	Mean: 0.0140 Range:	Mean: Range:
23.	Riffle Slope (S_{rif})	Mean: 0.023 Range: 0.0148 | 0.0396	Mean: 0.057 Range: 0.0041 | 0.1586	Mean: 0.021 Range: 0.0195 | 0.0250	Mean: 0.032 Range:	Mean: 0.019 Range: 0.018 | 0.023	Mean: 0.0234 Range: 0.0077 | 0.0438	Mean: 0.0125 Range: 0.0117 | 0.0150	Mean: 0.0034 Range: 0.0025 | 0.0042	Mean: 0.0138 Range: 0.0128 | 0.0165	Mean: 0.0290 Range:	Mean: Range:	Mean: 0.0510 Range:	Mean: 0.0210 Range:	Mean: Range:
24.	Ratio of Riffle Slope to Avg. Slope (S_{riffle}/S_{avg})	Mean: *1.8* Range:	Mean: *6.0* Range:	Mean: *1.5* Range: 1.4 | 1.8	Mean: *2.6* Range:	Mean: *1.5* Range: 1.4 | 1.8	Mean: *2.0* Range:	Mean: *1.5* Range: 1.4 | 1.8	Mean: *0.3* Range:	Mean: *1.5* Range: 1.4 | 1.8	Mean: *1.8* Range:	Mean: Range:	Mean: *5.1* Range:	Mean: *1.5* Range:	Mean: Range:
25	Pool Slope (S_{pool})	Mean: 0.0051 Range: 0.0011 | 0.0109	Mean: 0.0118 Range: 0.0018 | 0.0255	Mean: 0.0020 Range:	Mean: 0.0032 Range:	Mean: 0.0020 Range:	Mean: 0.0077 Range: 0.0001 | 0.0162	Mean: 0.0020 Range:	Mean: 0.0026 Range: 0.0013 | 0.0038	Mean: 0.0020 Range:	Mean: 0.0020 Range:	Mean: Range:	Mean: 0.0055 Range:	Mean: 0.0020 Range:	Mean: Range:
26.	Ratio of Pool Slope to Avg. Slope (S_{pool}/S_{avg})	Mean: *0.1* Range:	Mean: *1.2* Range:	Mean: *0.1* Range:	Mean: *0.3* Range:	Mean: *0.2* Range:	Mean: *0.7* Range:	Mean: *0.2* Range:	Mean: *0.3* Range:	Mean: *0.2* Range:	Mean: *0.1* Range:	Mean: Range:	Mean: *0.6* Range:	Mean: *0.0* Range:	Mean: Range:
27.	Maximum Pool Depth (d_{pool})	Mean: 2.0 Range:	Mean: 1.3 Range:	Mean: 2.4 Range:	Mean: 1.0 Range:	Mean: 2.0 Range:	Mean: 1.3 Range:	Mean: 2.8 Range:	Mean: 1.7 Range:	Mean: 3.7 Range:	Mean: 1.3 Range:	Mean: Range:	Mean: 3.1 Range:	Mean: 4.8 Range:	Mean: Range:
28.	Ratio of Pool Depth to Avg. Depth (d_{pool}/d_{avg})	Mean: *2.1* Range:	Mean: *1.3* Range:	Mean: *3.0* Range:	Mean: *1.1* Range:	Mean: *2.5* Range:	Mean: *1.1* Range:	Mean: *2.5* Range:	Mean: *1.3* Range:	Mean: *3.1* Range:	Mean: *2.2* Range:	Mean: *0.0* Range:	Mean: *1.6* Range:	Mean: *2.3* Range:	Mean: Range:
29.	Pool Width (W_{pool})	Mean: 11.3 Range:	Mean: 9.9 Range:	Mean: 20.0 Range:	Mean: 8.7 Range:	Mean: 16.4 Range:	Mean: 11.4 Range:	Mean: 28.6 Range:	Mean: 19.2 Range:	Mean: 30.0 Range:	Mean: 12.5 Range:	Mean: Range:	Mean: 40.6 Range:	Mean: 50.3 Range:	Mean: Range:
30.	Ratio of Pool Width to Bankfull Width (W_{pool}/W_{bkf})	Mean: *0.9* Range:	Mean: *0.7* Range:	Mean: *1.3* Range:	Mean: *0.9* Range:	Mean: *1.3* Range:	Mean: *0.6* Range:	Mean: *1.3* Range:	Mean: *0.8* Range:	Mean: *1.2* Range:	Mean: *1.0* Range:	Mean: *0.0* Range:	Mean: *1.3* Range:	Mean: *1.5* Range:	Mean: Range:
31.	Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	Mean: 12.2 Range:	Mean: 14.6 Range:	Mean: 20.8 Range:	Mean: 10.6 Range:	Mean: 15.4 Range:	Mean: 24.7 Range:	Mean: 38.4 Range:	Mean: 28.7 Range:	Mean: 49.5 Range:	Mean: 8.0 Range:	Mean: Range:	Mean: 64.4 Range:	Mean: 109.6 Range:	Mean: Range:
32.	Pool to Pool Spacing (p - p)	Mean: *1.0* Range:	Mean: *1.1* Range:	Mean: *1.6* Range:	Mean: *1.3* Range:	Mean: *1.6* Range:	Mean: *1.0* Range:	Mean: *1.6* Range:	Mean: *0.9* Range:	Mean: *1.6* Range:	Mean: *1.1* Range:	Mean: *0.0* Range:	Mean: *1.1* Range:	Mean: *1.6* Range:	Mean: Range:
33.	Ratio of Pool to Pool Spacing to Bankfull Width (p-p/Wbkf)	Mean: 55.5 Range:	Mean: 41.0 Range: 35.8 | 46.3	Mean: 112.0 Range: 80.0 | 144.0	Mean: 55.6 Range: 41.3 | 82.8	Mean: 75.6 Range: 50.4 | 100.8	Mean: 64.1 Range: 37.8 | 122.8	Mean: 154.0 Range: 110.0 | 198.0	Mean: 62.6 Range:	Mean: 175.0 Range: 125.0 | 225.0	Mean: 100.0 Range:	Mean: Range:	Mean: 224.0 Range:	Mean: 305.0 Range: 271.0 | 334.0	Mean: Range:
		Mean: *4.4* Range:	Mean: *2.9* Range:	Mean: *7.0* Range: 5.0 | 9.0	Mean: *5.9* Range:	Mean: *6.0* Range: 4.0 | 8.0	Mean: *3.1* Range:	Mean: *7.0* Range: 5.0 | 9.0	Mean: *2.6* Range:	Mean: *7.0* Range: 5.0 | 9.0	Mean: *8.0* Range:	Mean: *0.0* Range:	Mean: *7.3* Range:	Mean: *9.2* Range:	Mean: Range: