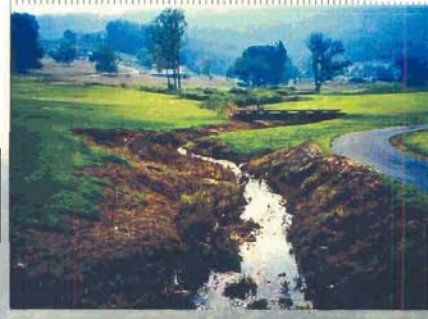
County Line Creek
High Vista Estates and Golf Course
Stream Restoration

Executive Summary of Design
Henderson/Buncombe County, North Carolina



prepared for:

N.C. Wetlands Restoration Program
NCDENR DWQ

prepared by:

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November 2001
011795006

County Line Creek
High Vista Estates and Golf Course Stream Restoration
Hendersonville, North Carolina
Henderson/Buncombe County

Prepared for
Wetland Restoration Program
Raleigh, North Carolina

Prepared by:
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Figures

Appendices

Tables

1.0 Introduction

County Line Creek is located approximately nine miles south of Asheville and nine miles northwest of Hendersonville, NC. The project area runs immediately west of N.C. Highway 191 (NC 191) within the High Vista Falls Golf Course and the High Vista Estates resort. Portions of the reach represent the Henderson and Buncombe County line. County Line Creek was identified as a potential stream restoration/mitigation opportunity by the North Carolina Wetland Restoration Program (WRP). The resort community is currently evaluating restoration opportunities within the golf course setting.

Per its on-call natural resources investigation contract, Kimley-Horn and Associates (KHA) was retained to provide technical assistance to WRP staff in the planning, coordination with High Vista Estates, design, and construction stages of this project.

This document summarizes the background investigation, fatal flaw analysis, fieldwork, input from High Vista Falls, and methodologies that went into the preparation of the design. A feasibility study for this site, entitled "County Line Creek Restoration Site, High Vista Estates and Golf Course," was prepared for WRP by EcoScience Corporation in March of 2001.

2.0 Existing Conditions

2.1 Watershed

County Line Creek is a 2.5-mile reach of perennial tributary extending from a relatively steep mountain ridge east to its confluence with the Broad River in the French Broad River Basin (USGS 8-Digit Hydrologic Unit 06010105). The project area encompasses headwater reaches. Based upon USGS Skyland, NC Quadrangle 1991 and the feasibility study prepared by EcoScience (March 2001), the drainage area for this section of the stream is approximately 224 acres (0.35 square miles). The drainage area is shown in Figure 1.

The land uses within the drainage area primarily consist of average density single family residential, the golf course, and woodlands/forest areas. No significant industrial or commercial facilities were observed within the drainage area. Based upon field observation, the watershed

currently is being developed mainly as single family residential, with no significant commercial or industrial development.

Elevations within the drainage basin range from 2,980 feet (Chestnut Top) to 2,135 feet (NC 191). The average valley slope is 0.04%. The average stream gradient in the project area ranges from 0.0247-0.0472 %.

An environmental database search was performed by Environmental Data Resources, Inc. on May 25, 2001. The search was conducted to identify potential or actual environmental concerns listed in the federal, state, or local regulatory agency databases. The environmental database search did not reveal any reported environmental hazards on the subject property.

A database search of cultural and natural resources was performed through the State Historical Preservation Office, Archeology Office, and the Natural Heritage Program. According to the database review, any work performed on the sites described in the Preliminary Restoration Plan section (Section 5.0) would not affect threatened and endangered species or critical habitats, listed historical sites, or known archeological sites.

2.2 Site Description

A. Overview

County Line Creek is a tributary to the French Broad River. The headwaters of County Line Creek originate in the golf course at the base of a pond adjacent to the 11th green. The tributary flows to the southeast until it passes under NC 191; the tributary then turns north, discharging into the Broad River approximately 7,000 feet northeast of the golf course. The length of the stream segment located within the golf course and residential development is approximately 3,900 feet (Figure 2).

The portion of County Line Creek immediately west of NC 191 and within the boundaries of the golf course and resort was evaluated. The study area for this stream segment begins at the outlet of the pond at the 11th green (Photos 1 and 2). The stream extends downstream approximately 3,900 feet through the golf course and ends at a culvert under NC 191(Brevard Road) (Photo 3). The attached survey shows the location of the subject stream in relation to roads, golf course greens, ponds, and golf cart paths.

B. Golf Course Facilities, Structures, and Utilities

All adjacent structures and utilities are shown on the Preliminary Restoration Plan. There are five golf cart crossings (4 bridges, 1-48" RCP culvert) and two road crossings (both 60" RCP culverts). The stream runs along the edge of the fairway along the 12th hole (Photo 4). It continues between the fairway and the 12th green. The stream then runs under High Vista Falls Road. The 13th fairway crosses the stream twice. The stream then runs between the 13th green and the irrigation pond. It flows under Fairway Falls Road (twin 60" RCP culverts) and leaves the project site by flowing under NC 191 (twin 60" RCP culvert) (Photos 5,6, and 7).

C. Vegetation

Little to no vegetation is observed along the stream that runs within the golf course area (Photo 8). Small sections of patchy brush and weedy vegetation exist along the stream reach. This vegetation is observed between 200 to 500 feet downstream of the pond, at the 11th green (Photo 9). Along the last 200 feet of stream upstream of NC 191, there is a fairly stable section consisting of woody vegetation and small to medium diameter trees (Photo 10). In addition, there is a densely vegetated area along the tributary that confluences with County Line Creek at approximately 700 feet downstream of the pond, above the 12th green (Photos 11 and 12).

2.3 Channel Description

For discussion purposes, the stream channel can be divided into three segments, each with different morphologic characteristics. These segments are as follows:

Table 1
Stream Segments

Segment	Location / Description	Rosgen Stream Type*	Approximate Linear Feet
a	Begin project (STA 0+00) to STA 19+00	B/B4	1,900
b	STA 19+00 to STA 34+00	$Eb_{f-g}4$	1,500
c	STA 34+00 to end project (STA 38+00+/-)	B/B4	400

* Per NCDENR's "Internal Technical Guide for Stream Work in North Carolina" April 2001 v3.0, a complete Morphologic Measurement Table is provided in the Preliminary Design Plans (attached).

**Stationing based on centerline of existing alignment.

A. Horizontal and Vertical Stability

Segment a & c

The stream segment is a linear channel with little herbaceous vegetation lining the banks. Based on the Rosgen stream classification, the stream is a B4 stream type (Rosgen 1996).

The channel is slightly entrenched, exhibiting a bank height ratio ranging from 1.2 to 1.7 (low bank height/max bankfull depth). A channel that is not entrenched will exhibit a bank height ratio of 1.0. Down-cuts have resulted in an entrenched channel that has begun to actively erode the channel banks below the effective rooting depth of existing riparian vegetation (Photo 13).

The intermittent down-cutting has induced a channel that varies widely in width/depth ratio. The channel is trending towards lower width/depth ratios (below 5), which suggests that the channel incision is causing the stream type to migrate towards an unstable (G type) stream. However, rapid bank erosion is allowing the channel to transition to an F (wider) unstable stream type at a lower elevation during each bankfull event. There is severe bank erosion immediately downstream of the last bridge crossing, adjacent to the 13th fairway.

This evolution towards further instability will continue unless the stream is returned to a stable dimension, pattern, and profile with bank vegetation/buffer for stability.

Segment b

The stream segment is a linear channel with little herbaceous vegetation lining the banks. Based on the Rosgen stream classification, the stream is an $Eb_{f-g}4$ stream type (Rosgen 1996). Active down-cutting in this section has resulted in eroded channel banks (Photo 14).

B. Channel Materials

The stream substrate is predominately composed of fine gravel. No bedrock or rock outcroppings were observed throughout the stream reach. Modified Wolman Pebble Counts were performed to classify the substrate in the stream channel (See Appendix A for plots of the particle size distribution). The table below summarizes the channel materials based on the pebble counts:

Table 2 Channel Material	
	Particle Size - Millimeters
% sand and <	12-23
% Gravel	73-85
% Cobble	4-6
% Boulder	0
% Bedrock	0
D16 (mm)	1.6
D35 (mm)	6.1
D50 (mm)	8.0
D84 (mm)	27
D95 (mm)	45

C. Vegetation as Bank Protection

Trees and shrubs are absent from banks (Photo 15). The root mats from the maintained grasses are shallow and discontinuous, providing little or no protection against bank erosion.

D. Water Quality

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

Based upon visual observations, the stream appears to have relatively good water quality and clarity. No odors or sheens were observed in the stream.

E. Aquatic Habitat

Minimal habitat was observed along the stream reach. This lack of aquatic habitat is primarily due to the absence of canopy cover and buffer along the stream.

3.0 Goals and Objectives

3.1 Definition of Restoration

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

3.2 Objectives

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

4.0 Methodology/Design Considerations

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

- Reference reach geomorphic survey (Rosgen Level II)
- Assessment of natural communities (existing and reference)
- Assessment of the watershed condition and potential
- Rosgen Level II classification of the stream

- Geomorphic field measurements
- Identification of constraints and opportunities
- Detailed topographic and geomorphic survey of the project corridor
- Meetings with golf course management
- On-site interview with adjacent property owner

A preliminary plan (See attached Preliminary Restoration Plan) was developed using the above analysis as well as input gained from the analysis and coordination that was performed.

4.1 Reference Reaches

Two reference reaches were chosen to serve as a blue print for design. The first reference is the headwaters of Raccoon Creek located in Waynesville, NC. This information was gathered and compiled by NRCS in Waynesville, NC. The location is shown in Figure 3. Based on the Rosgen classification, this section of Raccoon Creek is classified as an E5 stream type. The information gained from the upstream reference was used in designing the dimension of the proposed stream (segment b).

A second reference reach was chosen to provide/confirm the dimensionless ratios for designing the proposed pattern, dimension, and profile of the proposed stream. The reference incorporates two stable sections within the golf course area. The first section runs between Station 38+50 and 39+50 upstream of NC 191 (Photo 16). The second is a stable section of tributary that is located upstream of the pond area and runs adjacent to the 11th green (Photos 17 and 18). The locations are shown in Figure 4. Based on the Rosgen classification, these sections of County Line Creek are classified as a B stream type. The information gained from the reference reaches was used in designing the dimension of the proposed stream (segments a and c).

The complete morphologic measurements of both reference reaches are provided in the Preliminary Restoration Plan (Sheet 3A). This morphologic measurement table is per the "Internal Technical Guide for Stream Work in North Carolina" (April 2001 v.3.0).

4.2. Regional Curves and Regime Equations

The North Carolina Mountain Regional Curves were used to calibrate/verify primary stream bankfull characteristics (width, depth, cross-sectional area and discharge) for this stream. The reference reaches were used as the basis for design, while the mountain curves were used simply as a check. The regional curves are provided in Appendix B.

4.3 Natural Communities

Existing natural communities and species were identified through field reconnaissance, both adjacent to the stream and at the reference reach. The vegetation along the stream within the project area is generally maintained grass with sparse weedy/woody vegetation upstream, near the confluence of the tributary, upstream of the 12th green. There is also a 100 feet of wooded area immediately upstream of NC 191 (Photos 10 and 16).

Species will be selected that are appropriate for the golf course areas and to maximize buffer potential.

4.4 Watershed Assessment

Watershed conditions were assessed by field reconnaissance. Existing watershed conditions are described in Section 2.1 of this report. For the purpose of this design, it was assumed that there would be no major future commercial/industrial development in the watershed.

4.5 Golf Course Survey (Topographic and Geomorphic)

A detailed survey of the golf course showed several physical limitations to restoration design. Notable obstacles include the golf course greens and fairways, five golf cart crossings, and two road crossings. A detailed description of the golf course existing conditions is included in Sections 2.2 and 2.3. The morphology of County Line Creek located in the project area is in the Morphology Measurement Table in the attached Preliminary Restoration Plan (Sheet 3A).

4.6 Gage Station

Survey data from the gage station located on Mills River in Mills River, NC, along with current rating table information and 9-207 forms, was collected and used to determine annual peak discharge for the watershed. Based on this information, hydraulic geometry relationships can be formulated for bankfull discharge, cross-sectional area, width, and mean depth as functions of the watershed area. This analysis is used to verify and support the established regional curves for a specific size watershed and hydrologic region used in the design.

4.7 Meeting with High Vista Falls Staff

A meeting was held on November 1, 2001 on-site to discuss the preliminary plans for the restoration of County Line Creek and adjacent riparian corridor. The purpose of the meeting was to discuss the conservation easement, buffer species type and density, buffer height, and buffer maintenance. See Appendix F for meeting minutes.

5. 0 Preliminary Restoration Plan

The preliminary restoration plan for County Line Creek involves restoring the altered stream corridor including adjacent riparian zones to its referenced, stable condition. In addition, the design is intended to account for the needs of the golf course, public safety, local agencies, and physical constraints within the project area. Restoration will modify the stream's dimension, pattern, and profile to stable conditions. In-stream structures will be used to protect stream banks, provide habitat, control grade, protect course facilities (cart crossings/pedestrian bridges, and greens) and riparian buffers.

The types of structures anticipated to be incorporated into the mitigation project include rock cross vanes, root wads, and log vanes. Refer to the Preliminary Restoration Plan for structure details. The approximate locations of known structures are shown on the attached plans. Structures may need to be removed or added during final design and/or construction.

All restoration activities will take place in a conservation easement donated by High Vista Falls to WRP. An additional easement will need to be coordinated and obtained along the section of the stream that is privately owned (see Preliminary Restoration Plan). WRP is currently working on obtaining an option on this easement.

5.1 Vegetation/Buffer Plantings

The proposed vegetation within the golf course includes stream bank plantings and plantings in the adjacent riparian buffer. The banks will be planted to provide stabilization, habitat, and shading.

Both unrestricted and restricted riparian buffer areas will be used within the golf course. The unrestricted buffer will be planted in the easement for areas outside of course play. A restricted buffer will be planted in the easement areas involved in course play. The constraints of course play require the exclusion of large canopy trees from the restricted buffer. The functionality of the trees will be replaced utilizing large woody debris within the stream channel, shrub and herbaceous plantings for shading, and shrub plantings for bank stability. Root wads and log vanes will provide habitat. Shrubs and herbaceous plantings will provide shading to the narrow stream channel. Shrubs rooting will provide bank stability and contribute additional detritus to the stream. These factors will help to offset functionality lost from the exclusion of canopy trees from the restricted buffer areas. Refer to Preliminary Restoration Plan for location of the planting areas and for species type and composition for each buffer zone.

5.2 Dimension, Pattern, and Profile

Due to the differences in the geomorphic features and physical constraints within the golf course area, two different restoration approaches were taken for three channel segments of County Line Creek.

Segment a and c (Sta 0+00 to Sta 19+00 & Sta 34+00 to 38+00)
Segment a and c is a straightened linear "B/B4" channel. In addition to the modification of the stream, the floodplain and valley have been drastically modified during the development of the golf course and surrounding community. The stream will be converted to a stable/referenced condition that is appropriate to the current valley and watershed. The channel in this segment will be modified to a stream type "B4" appropriate for the valley type and channel slope. The channel dimension will be modified to increase the width to depth ratio and reduce bank height ratios (See attached Preliminary Restoration Plan for typical section). The pattern will be

modified slightly to relocate areas where the stream is eroding into the banks of the golf course greens and to move the stream away from the fairway in order to increase vegetation buffer widths.

The profile will be modified with the use of grade control structures. As discussed in Section 2.3, the stream has down cut. The mitigation plan includes grade control to prevent this down cut from moving upstream. Structures will maintain the profile of the stream preventing it from incising and abandoning its current and future constructed active floodplain.

Segment b (Sta 19+00 to Sta 34+00)
Segment b is an incised "$Eb_{f-g}4$" stream channel. The restoration of this segment will involve modifying the stream's dimension, pattern, and profile to create a stable "E5c" stream type.

The dimension in this segment will be modified to provide the appropriate cross-sectional area to transport sediment and the bankfull discharge. A bankfull bench will be created to reduce bank height ratios and shear stress associated with storm events greater than bankfull (See attached Preliminary Restoration Plan for typical sections).

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

The profile will be modified to match the modified plan features and reference condition. The profile will create the appropriate local grade changes that are necessary to create the features (riffles, runs, pools, and glides) associated with "E5c" stream types.

The proposed stream restoration plan is shown in the attached Preliminary Restoration Plan.

6.0 Monitoring and Success Criteria

6.1 Reference Photographs

Monitoring: Photographs will be taken throughout the monitoring period to evaluate vegetative growth along the stream corridor of the restoration site. Locations of the photograph points will be established and marked with stakes. A map with notations of the photo reference points will

be generated. This aspect of monitoring will last for five (5) years. Photo-monitoring will include lateral as well as longitudinal photographs.

Success Criteria: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Longitudinal photos should indicate the absences of developing bars within the channel or an excessive increase in channel depth. Lateral photos should not indicate excessive erosion or continuing degradation of the bank over time. A series of photos over time should indicate successional maturation of riparian vegetation.

6.2 Channel Stability

Monitoring: Permanent cross-sections will be established and monitored along the stream corridor of the restoration site for each Rosgen classified stream type. Cross-sections will be placed to monitor structures and/or features that may have an increased risk of failure. The location of each cross-section will be marked to establish the exact transect location. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year to year data. Data will be collected once a year for five (5) years.

Success Criteria: Judgements of success or failure of restoration activities using this data will be subjective. It is expected that there will be minimal changes in the cross-sections of the "as-built" and monitored years. Changes in the cross-sections 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, decrease in width/depth ratio). Unstable conditions that require remediation will indicate failure of restoration activities.

6.3 Plant Survival

In order to establish vegetation in restoration areas, such as bankfull benches and slopes, seeds, bareroot, and containerized vegetation will be planted as shown on the plans or required in the Special Conditions.

Monitoring: Survival of vegetation will be evaluated using survival plots or direct counts. Survival of plantings will be evaluated along the stream corridor of the restoration site. Plantings will be monitored for five (5) years before success or failure is determined.

Success Criteria: Success of plantings will require a 70% survival rate based on sample plots.

7.0 Maintenance

The contractor will guarantee all vegetation per specifications for one year from time of planting. After the one year period, WRP will remove dead or injured plants and replace them accordingly to achieve restoration goals.

High Vista Falls will be responsible for minimal required maintenance (i.e. pruning). When pruning is needed, woody vegetation should be pruned with pruning cuts and not sheared. Woody vegetation can be pruned to a height of two feet below the elevation of the adjacent fairways. Crown reduction decreases the height of the shrubs and can be performed on most shrub species. Shrubs should be at least two feet high after crown reduction. Early spring (February 1 – March 30) is the best time to prune shrubs.

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

8.0 References

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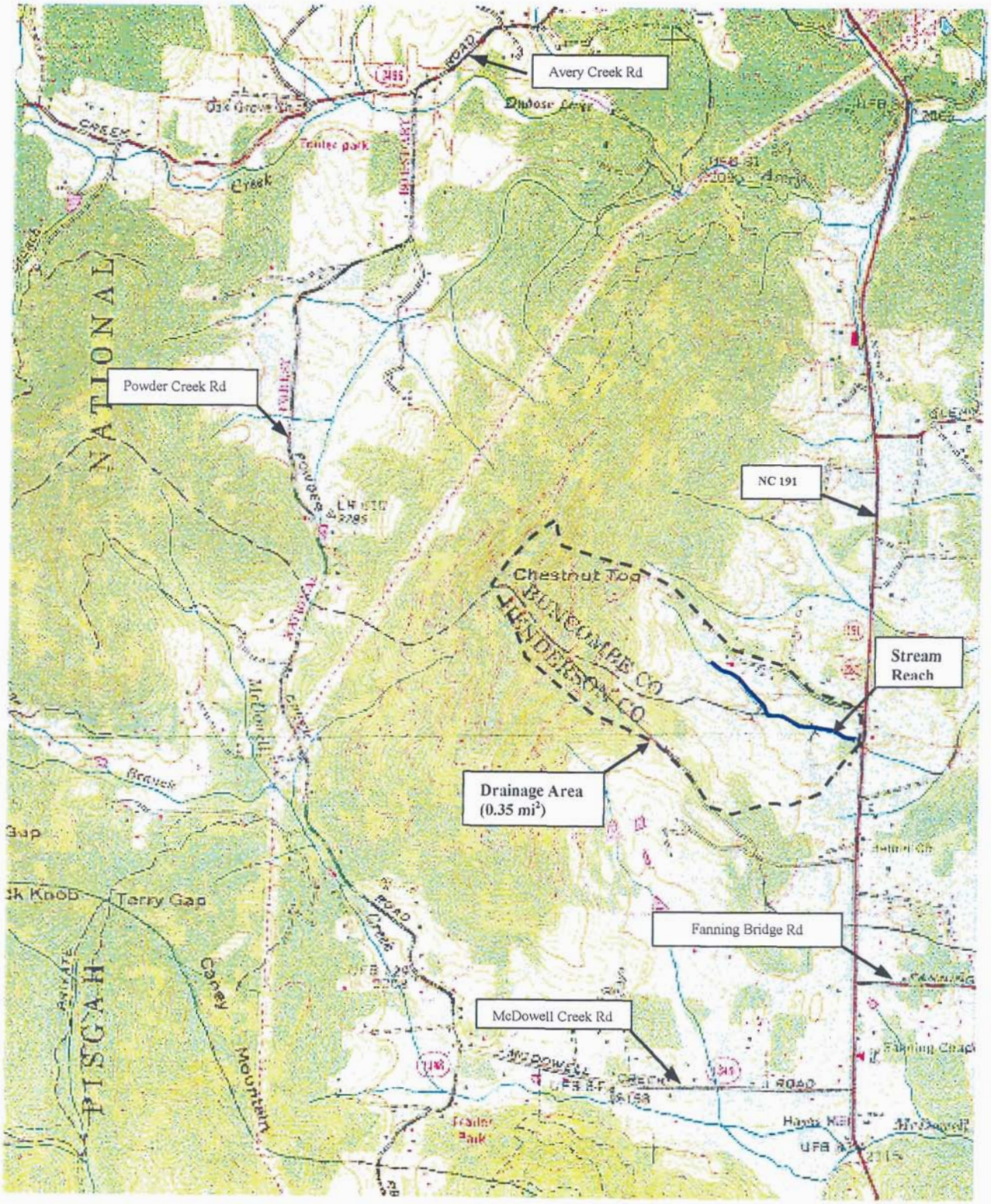
Figures



Title: **USGS Quad Map (Skyland, NC 1991)**

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Project:
County Line Creek
High Vista Estates and Golf Course
Stream Restoration
Henderson/Buncombe County, NC

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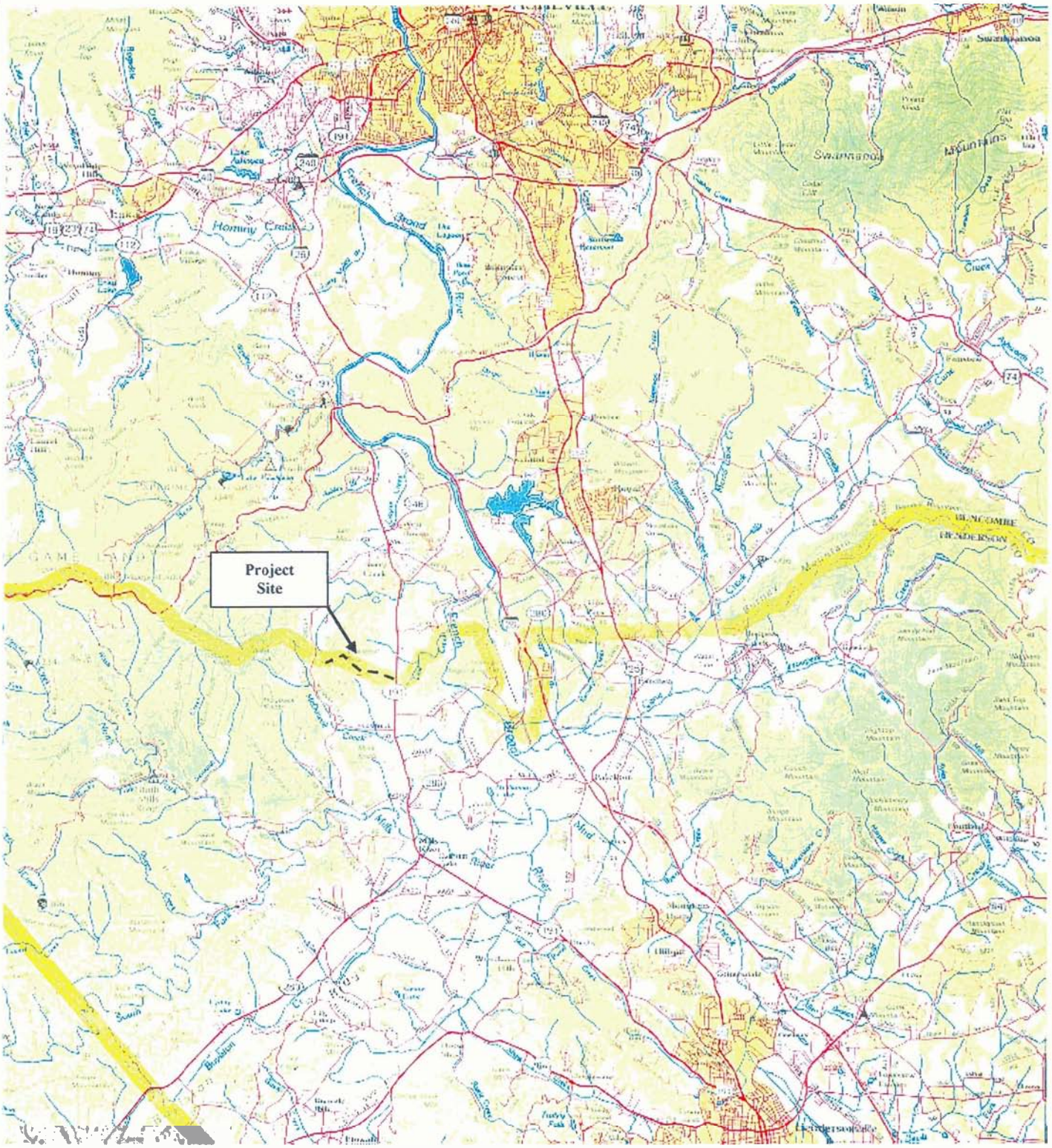

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County Line Creek
High Vista Estates and Golf Course
Stream Restoration
Henderson/Buncombe County, NC

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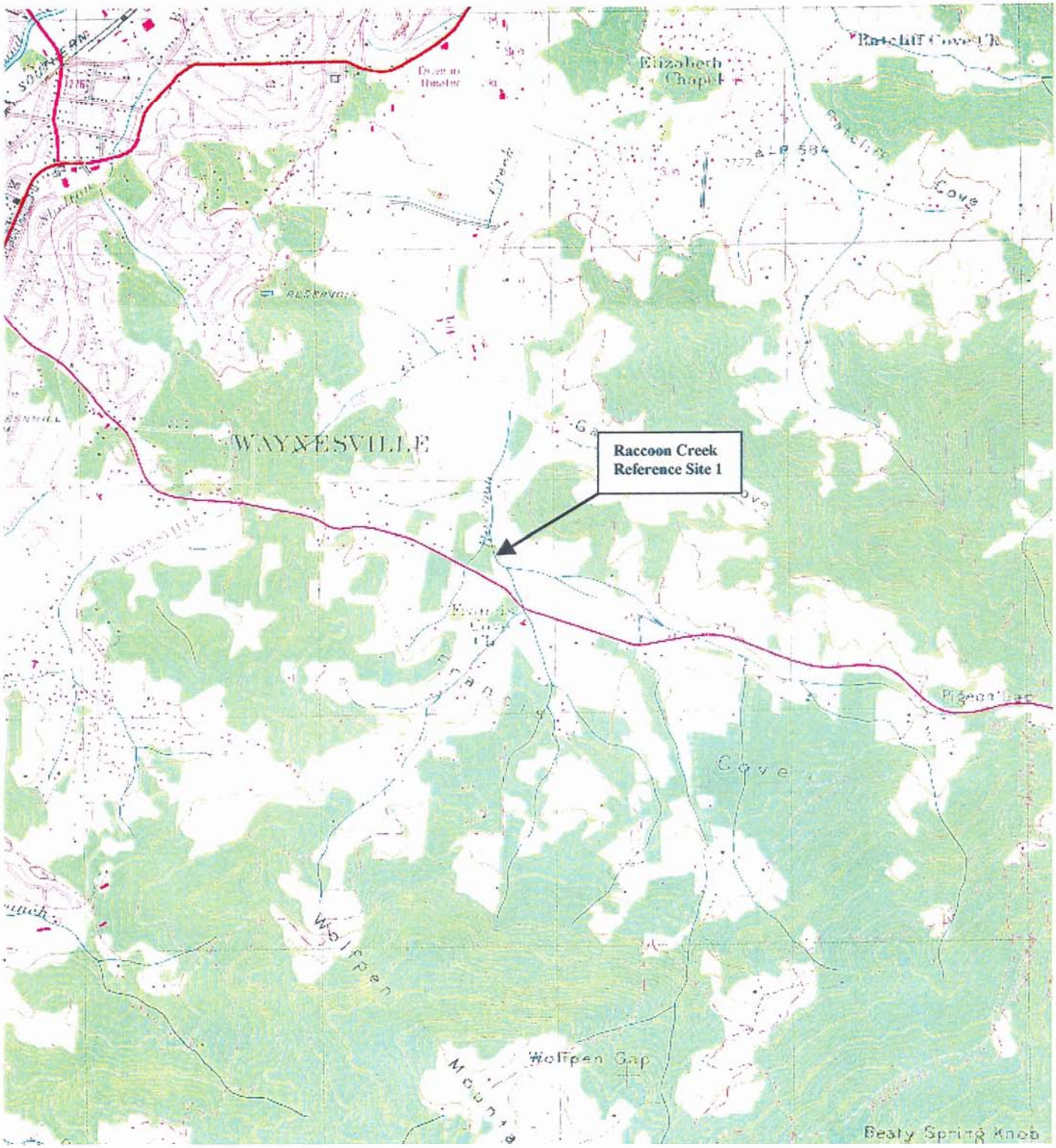

Title: **Reference Site 1**

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County Line Creek
High Vista Estates and Golf Course
Stream Restoration
Henderson/Buncombe County, NC

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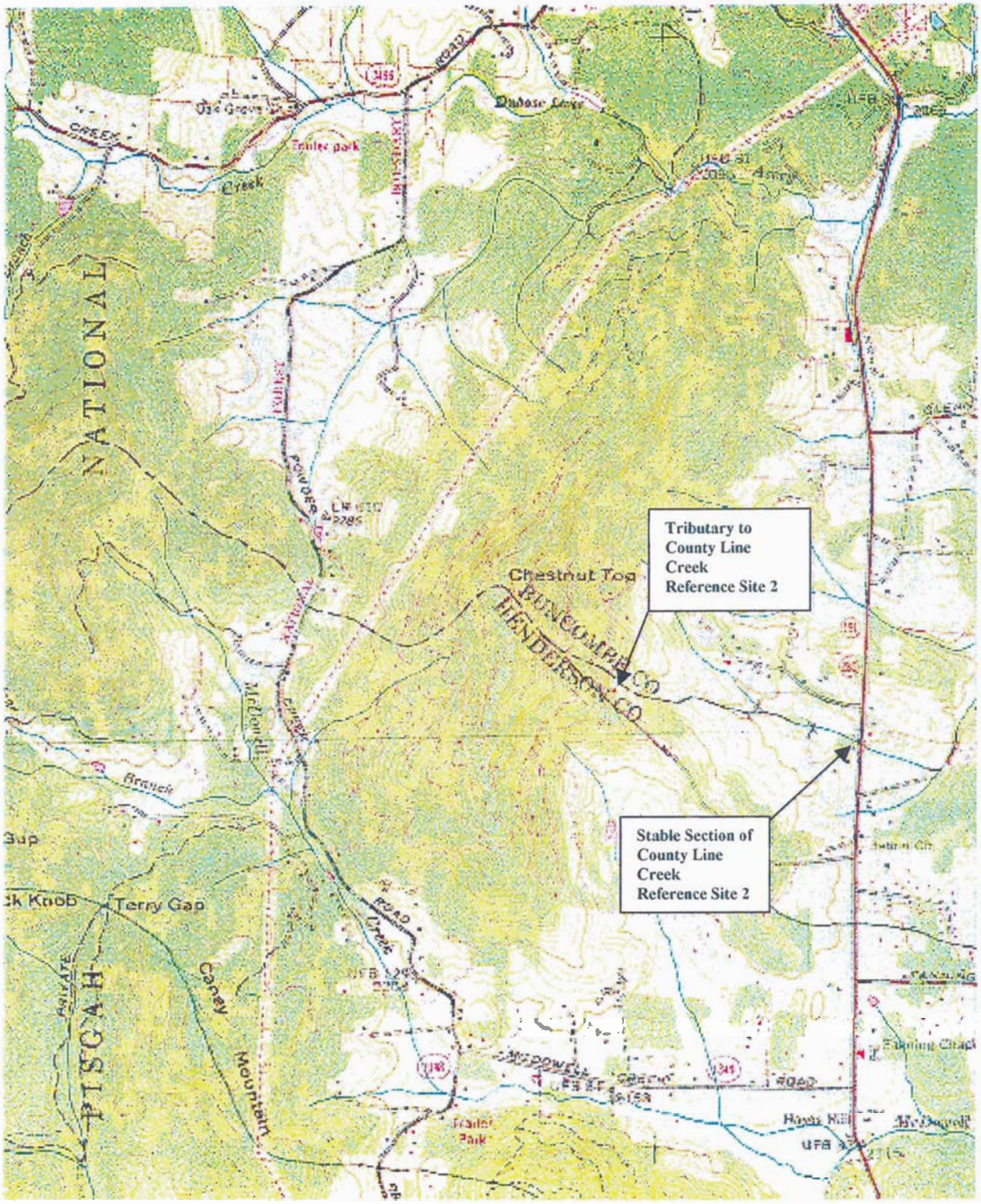

Title: **Reference Site 2**

Kimley-Horn and Associates, Inc.

Project
County Line Creek
High Vista Estates and Golf Course
Stream Restoration
Henderson/Buncombe County, NC

Date:	Scale:	Project No	Figure
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Appendix A
Pavement / Sub-Pavement Data

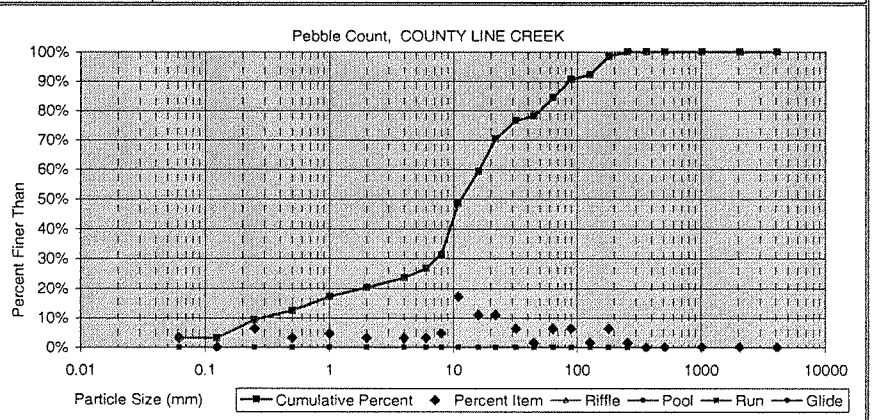
Weighted Pebble Count

Percent Riffle:	64	Percent Run:	
Percent Pool:	0	Percent Glide:	

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

Pebble Count,
COUNTY LINE CREEK

HENDERSONVILLE,NC
Note: **Classification Pebble Count**



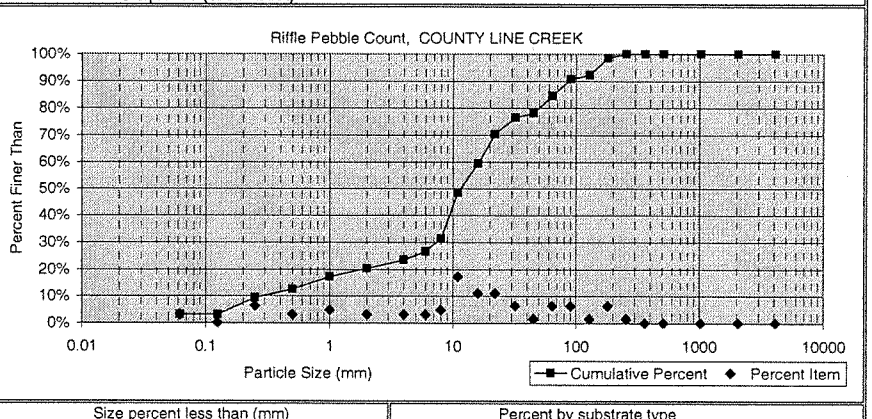
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.839	8.58	11.6	63	149	3%	17%	64%	16%	0%	0%

Riffle Pebble Count

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

Riffle Pebble Count,
COUNTY LINE CREEK

HENDERSONVILLE,NC
Note: **60+70 (SAMPLE A)**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.839	8.58	11.6	63	149	3%	17%	64%	16%	0%	0%

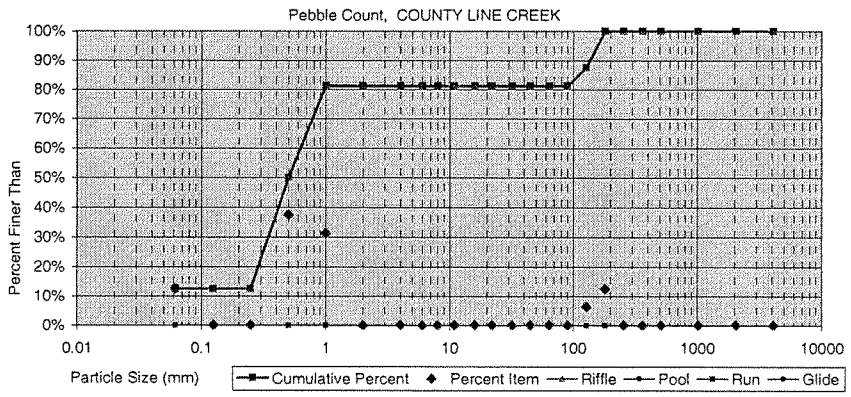
Weighted Pebble Count

Percent Riffle:	16	Percent Run:	
Percent Pool:	0	Percent Glide:	

Pebble Count,
COUNTY LINE CREEK

HENDERSONVILLE,NC
Note: **Classification Pebble Count**

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



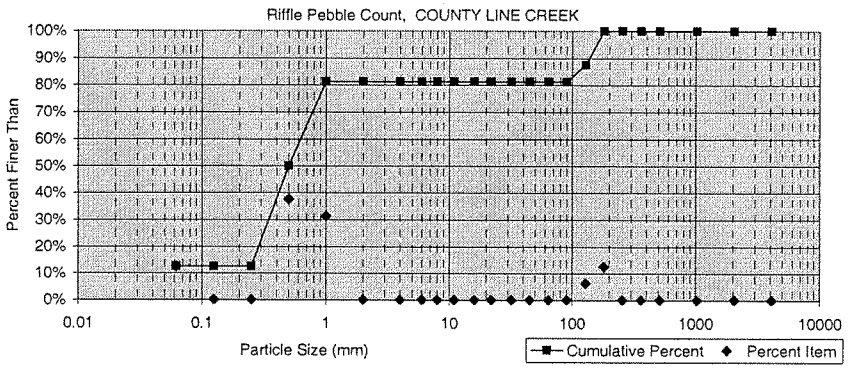
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.267	0.38	0.5	105	157	13%	69%	0%	19%	0%	0%

Riffle Pebble Count

Riffle Pebble Count,
COUNTY LINE CREEK

HENDERSONVILLE,NC
Note: **55+55 (SAMPLE B)**

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



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.267	0.38	0.5	105	157	13%	69%	0%	19%	0%	0%

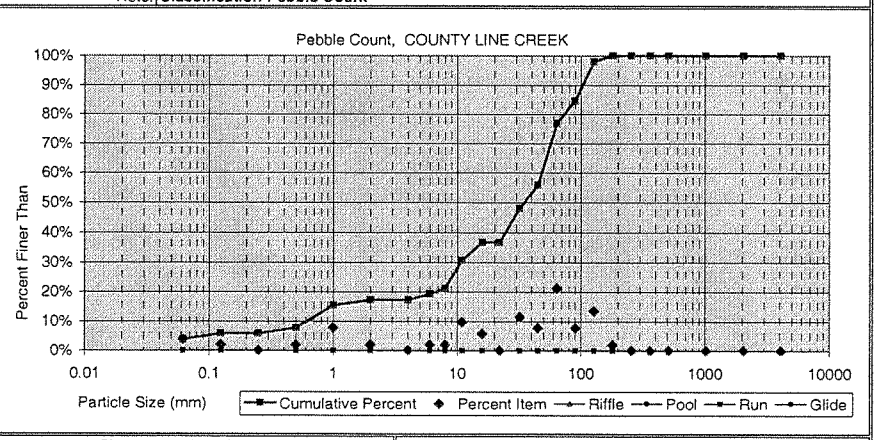
Weighted Pebble Count

Percent Riffle:	52	Percent Run:	
Percent Pool:	0	Percent Glide:	

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	2.0	# #
very fine sand	0.062	0.13	1.0	# #
fine sand	0.13	0.25	0.0	# #
medium sand	0.25	0.5	1.0	# #
coarse sand	0.5	1	4.0	# #
very coarse sand	1	2	1.0	# #
very fine gravel	2	4	0.0	# #
fine gravel	4	6	1.0	# #
fine gravel	6	8	1.0	# #
medium gravel	8	11	5.0	# #
medium gravel	11	16	3.0	# #
coarse gravel	16	22	0.0	# #
coarse gravel	22	32	6.0	# #
very coarse gravel	32	45	4.0	# #
very coarse gravel	45	64	11.0	# #
small cobble	64	90	4.0	# #
medium cobble	90	128	7.0	# #
large cobble	128	180	1.0	# #
very large cobble	180	256	0.0	# #
small boulder	256	362	0.0	# #
small boulder	362	512	0.0	# #
medium boulder	512	1024	0.0	# #
large boulder	1024	2048	0.0	# #
very large boulder	2048	4096	0.0	# #
bedrock			0.0	#
		Weighted Count:	52	
		True Total Particle Count:	52	

Pebble Count,
COUNTY LINE CREEK

HENDERSONVILLE,NC
Note: **Classification Pebble Count**



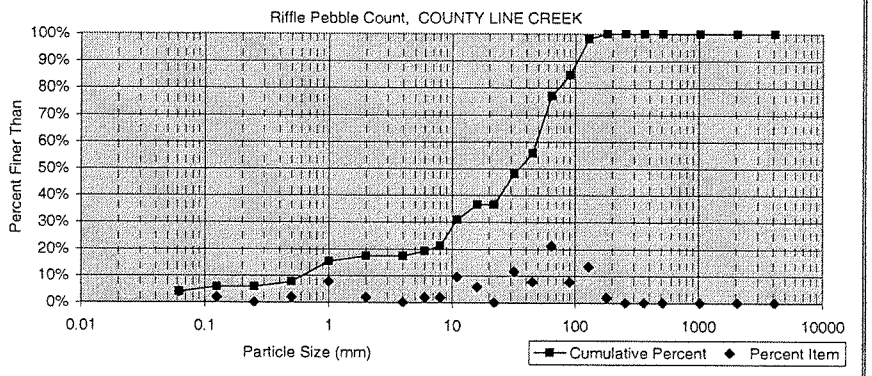
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.248	14.48	34.8	88	118	4%	13%	60%	23%	0%	0%

Riffle Pebble Count

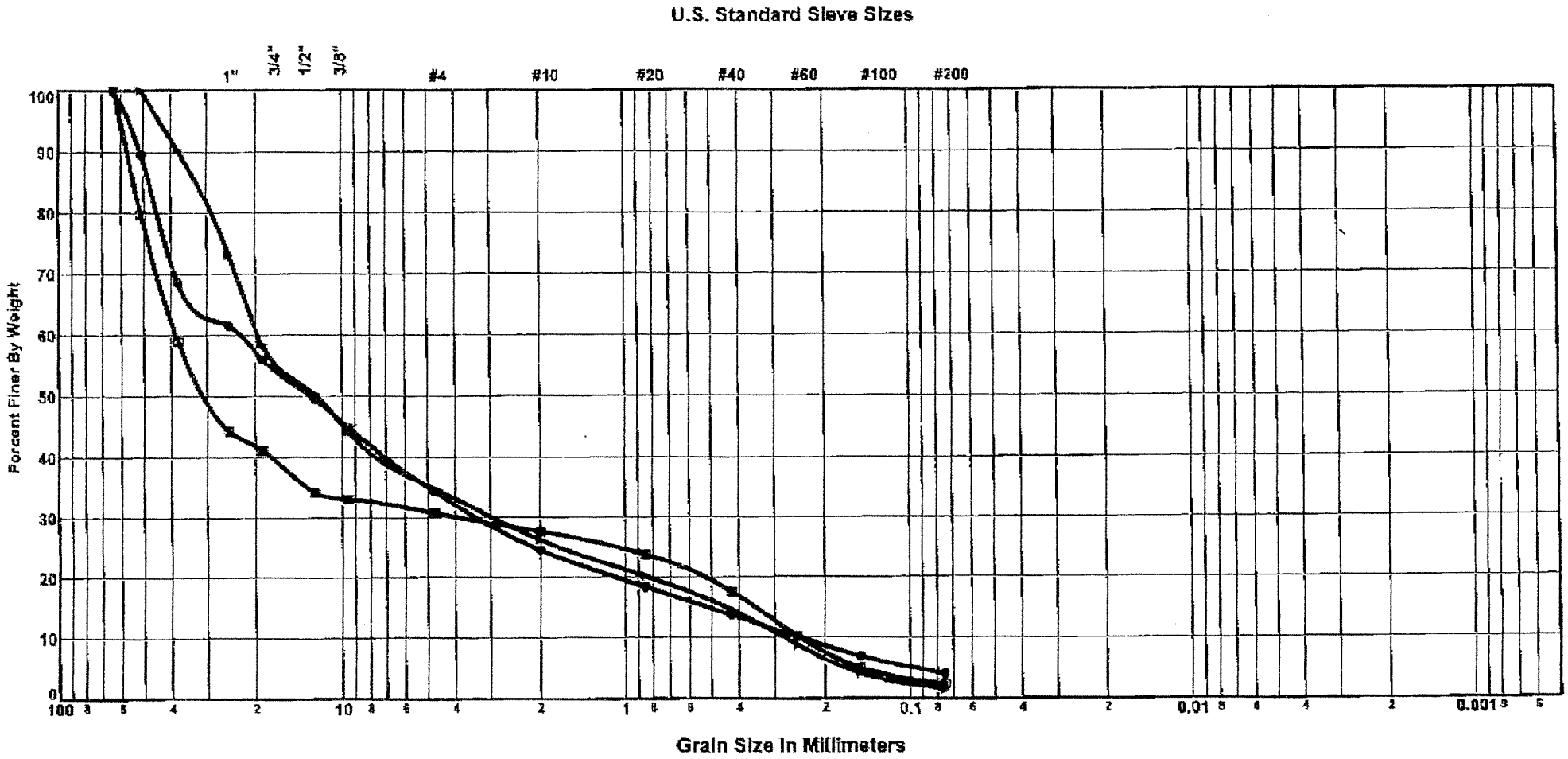
Material	Size Range (mm)		Count	
silt/clay	0	0.062	**2**	# #
very fine sand	0.062	0.13	**1**	# #
fine sand	0.13	0.25	**0**	# #
medium sand	0.25	0.5	**1**	# #
coarse sand	0.5	1	**4**	# #
very coarse sand	1	2	**1**	# #
very fine gravel	2	4	**0**	# #
fine gravel	4	6	**1**	# #
fine gravel	6	8	**1**	# #
medium gravel	8	11	**5**	# #
medium gravel	11	16	**3**	# #
coarse gravel	16	22	**0**	# #
coarse gravel	22	32	**6**	# #
very coarse gravel	32	45	**4**	# #
very coarse gravel	45	64	**11**	# #
small cobble	64	90	**4**	# #
medium cobble	90	128	**7**	# #
large cobble	128	180	**1**	# #
very large cobble	180	256	**0**	# #
small boulder	256	362	**0**	# #
small boulder	362	512	**0**	# #
medium boulder	512	1024	**0**	# #
large boulder	1024	2048	**0**	# #
very large boulder	2048	4096	**0**	# #
bedrock			**0**	#
		Total Particle Count:	52	

Riffle Pebble Count,
COUNTY LINE CREEK

HENDERSONVILLE,NC
Note: **45+45 (SAMPLE C)**



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
1.248	14.48	34.8	88	118	4%	13%	60%	23%	0%	0%



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

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

Project:

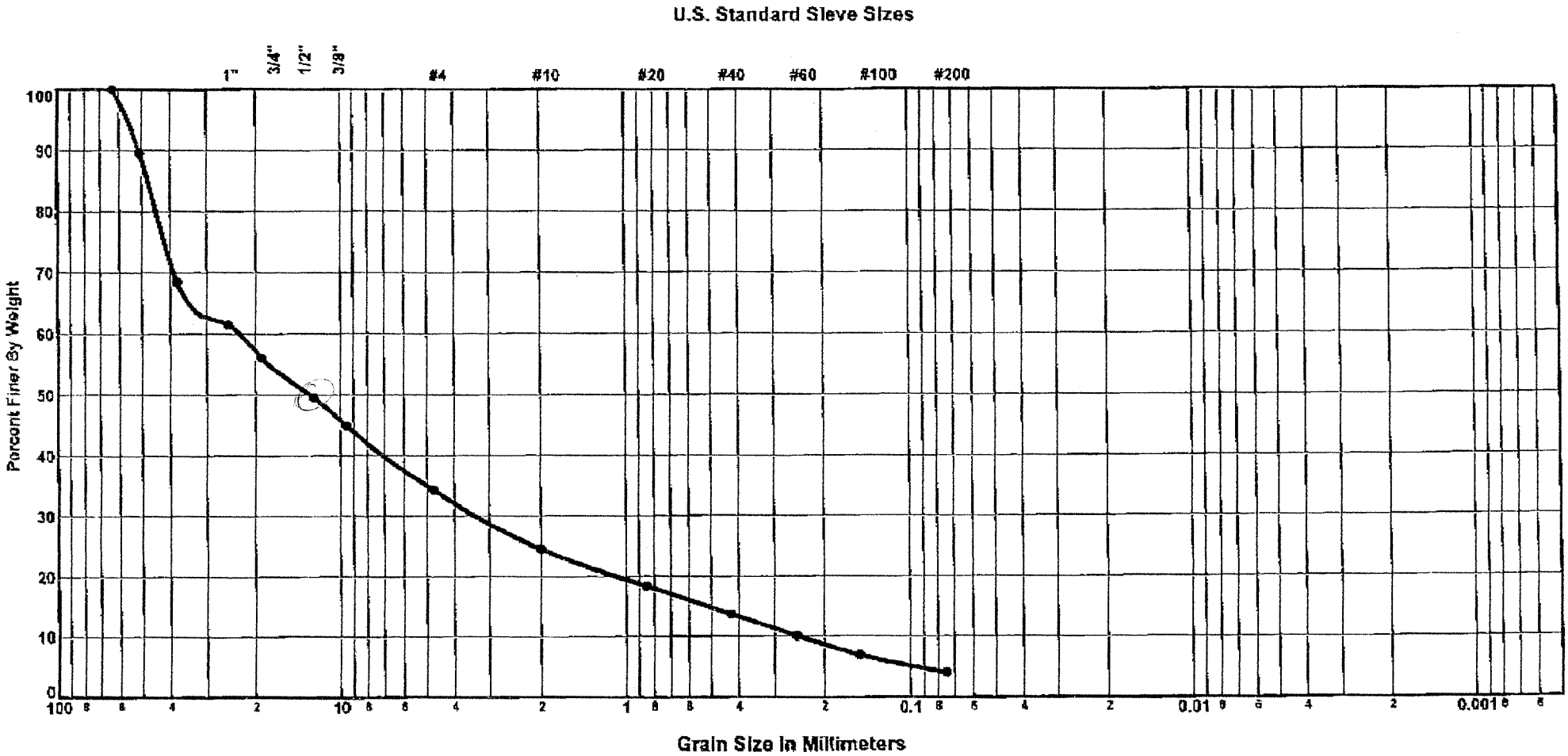
Kimely Horn Lab Work

Job No.: 1-01-0743-CA

Date: 8/3/01

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.



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

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
A	12th Hole					Cobbles & Gravel w/Tan Silty Fine SAND

Project:

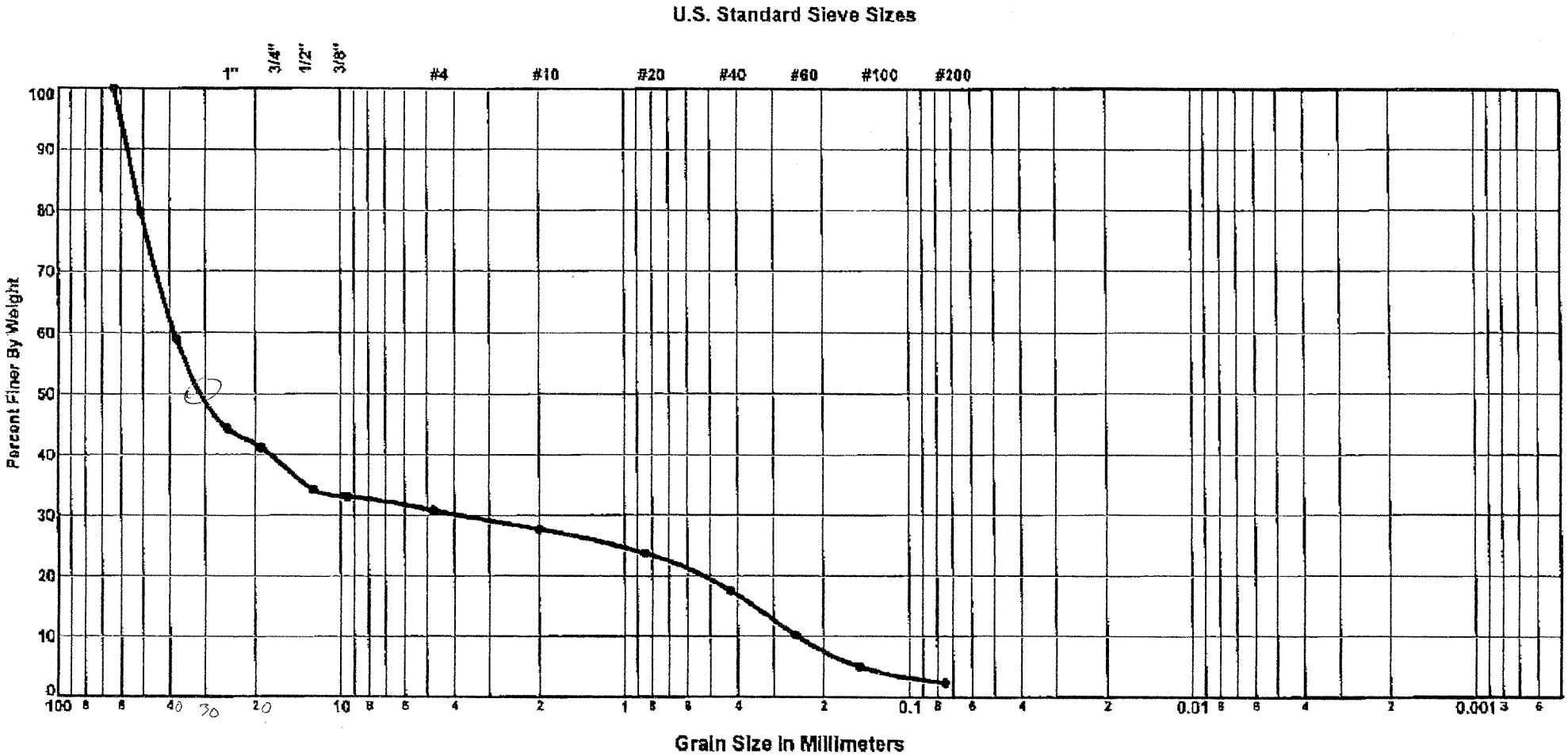
Kimely Horn Lab Work

Job No.: 1-01-0743-CA

Date: 8/3/01

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.



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

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
B	13th hole @200'					Cobbles & Gravel w/Tan Silty Fine SAND

Project:
Kimely Horn Lab Work

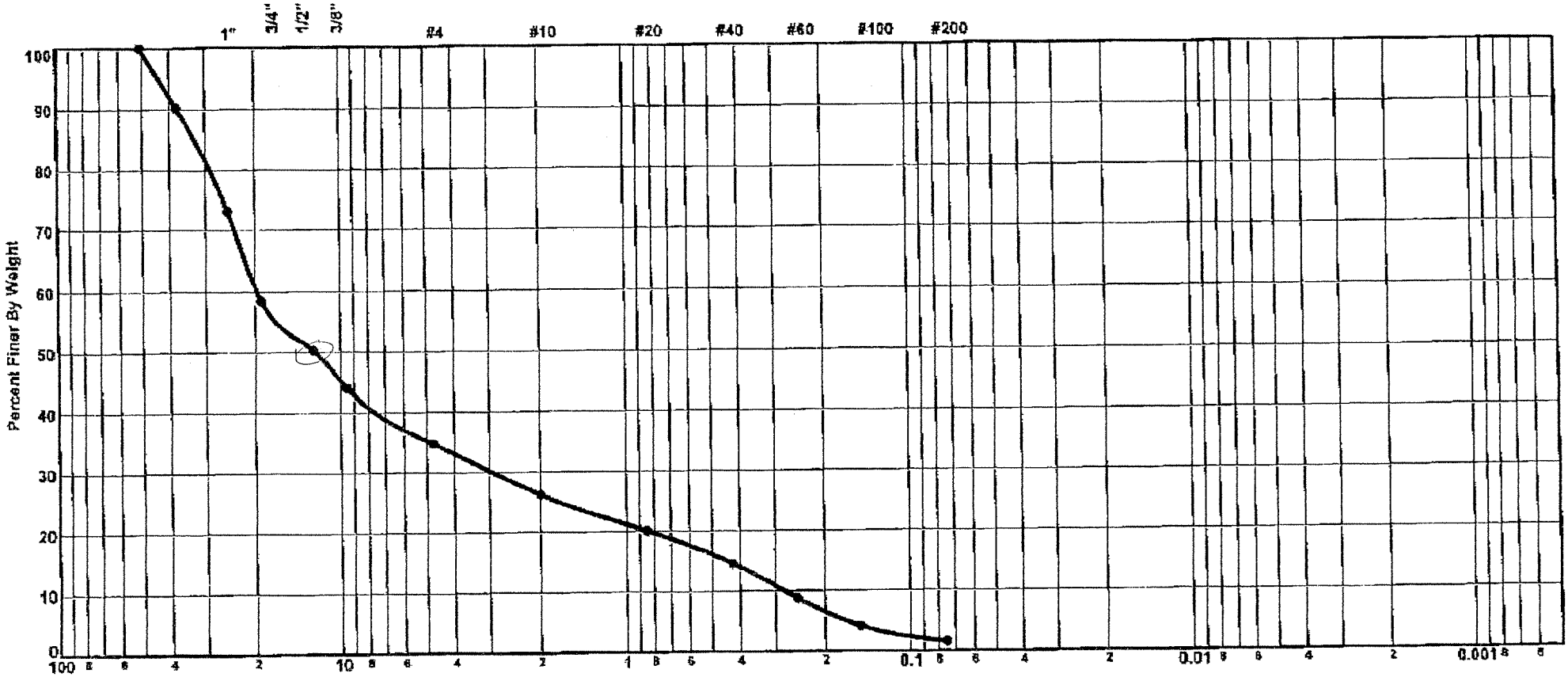
Job No.: 1-01-0743-CA

Date: 8/3/01

GRAIN SIZE DISTRIBUTION

GcoTechnologies, Inc.

U.S. Standard Sieve Sizes



Grain Size In Millimeters

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

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
C	13th hole @ 500'					Cobbles & Gravel w/Tan Silty Fine SAND

Project:

Kimely Horn Lab Work

Job No.: 1-01-0743-CA

Date: 8/3/01

GRAIN SIZE DISTRIBUTION

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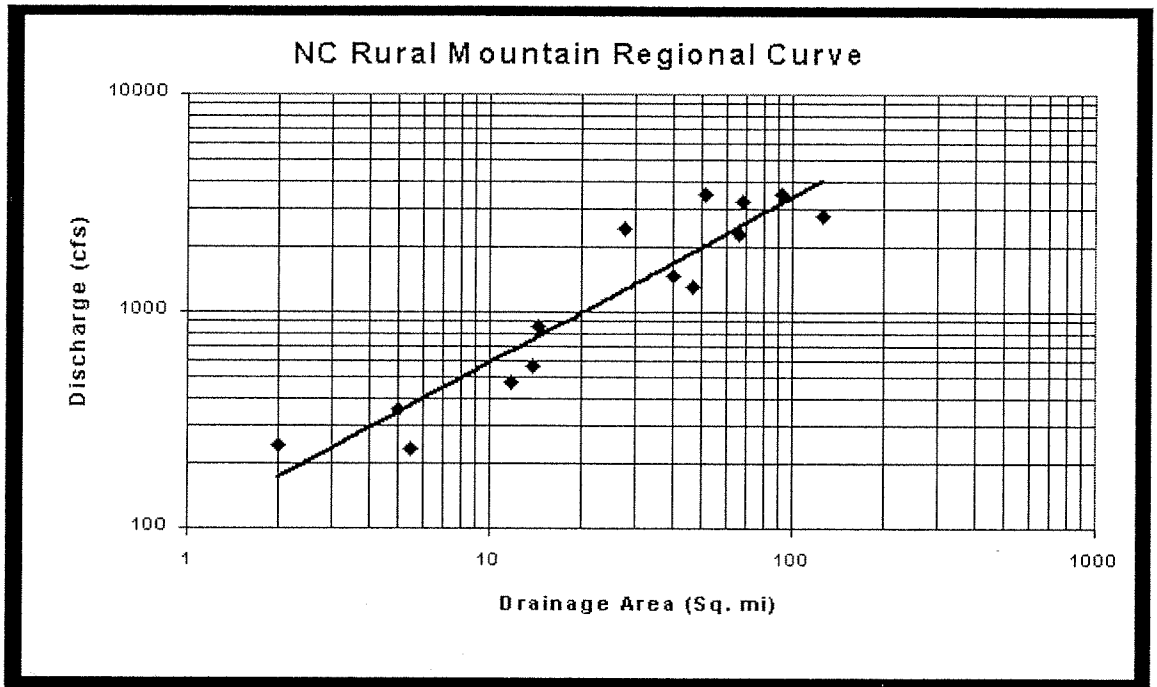
Appendix B
Mountain Regional Curves

NCT

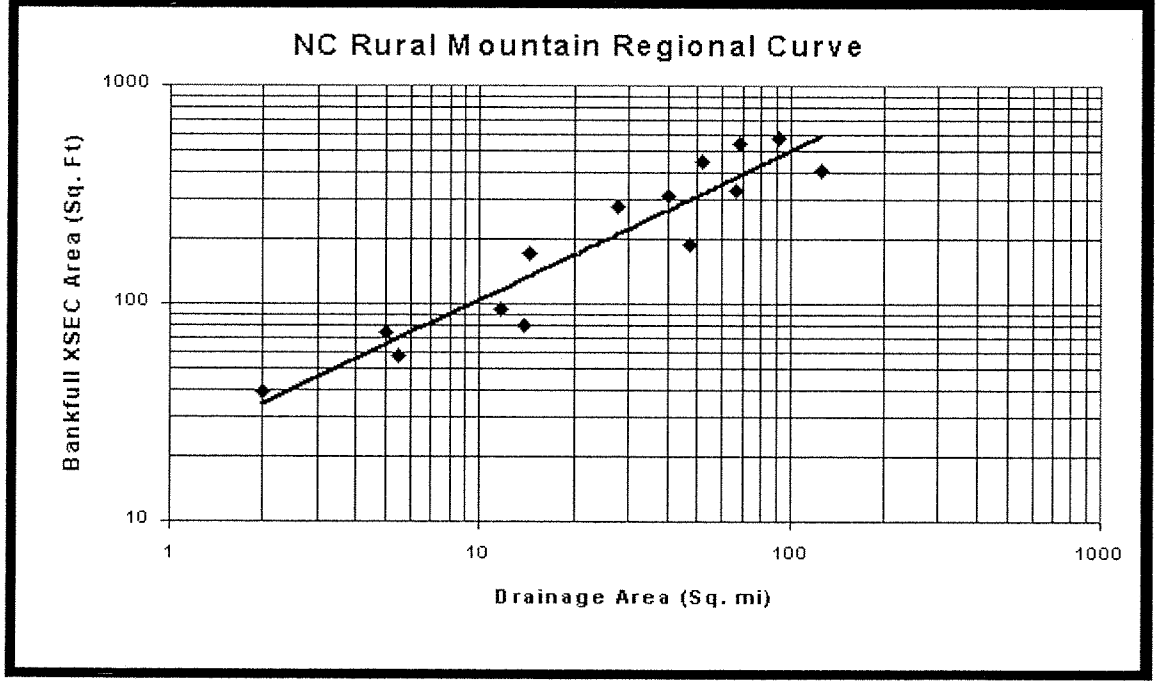
County Line Creek DA = 0.35 mi²



$Y = 100.64 x^{0.76}$

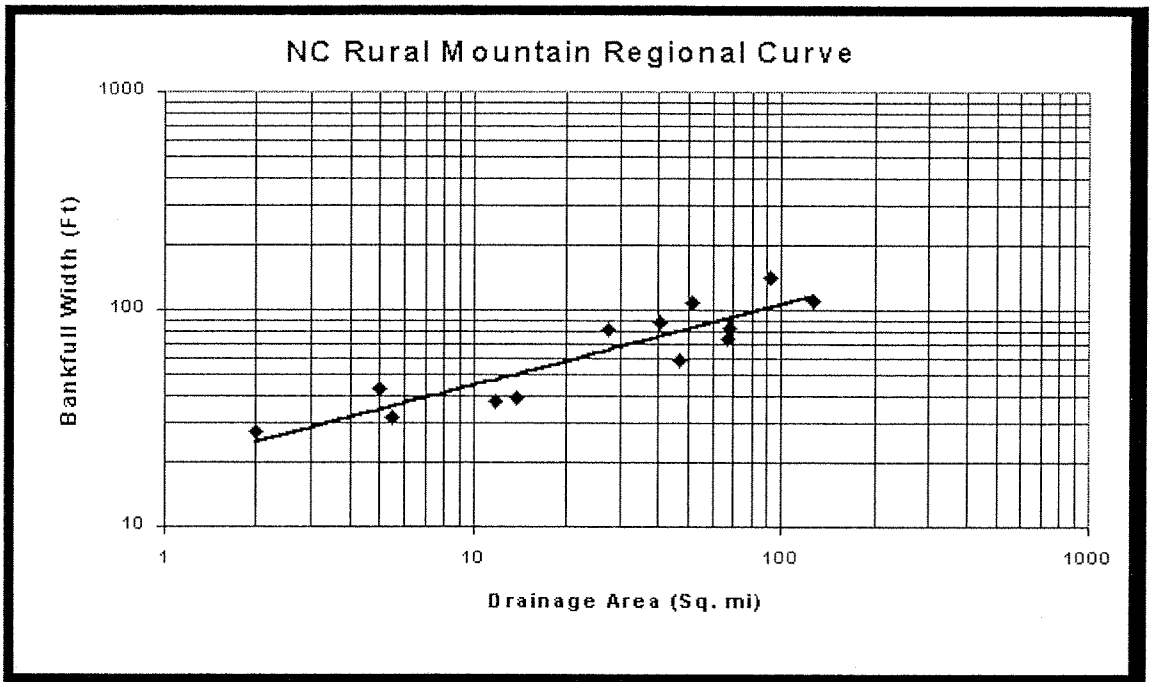
$Y = 45.32$ cfs

Q



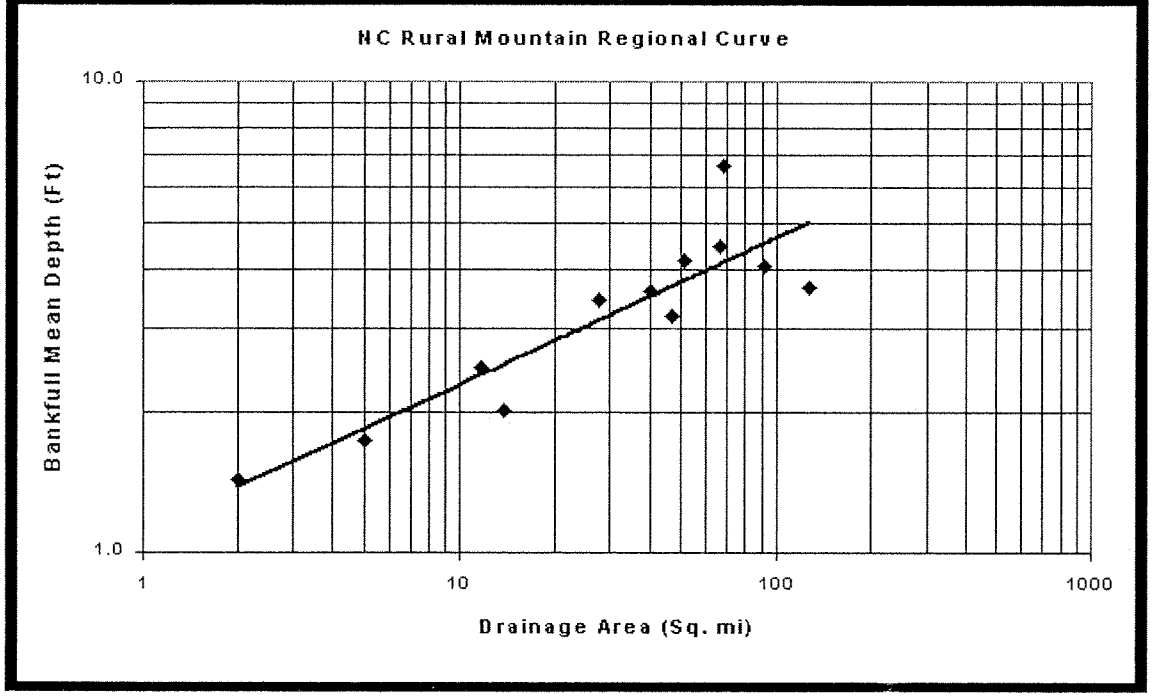
$Y = 21.61 x^{0.68}$

$Y = 10.58$ ft²



$Y = 19.05 \times^{0.37}$

$Y = 12.92$ ft



$Y = 1.11 \times^{0.31}$

$Y = 0.802$ ft

Table of Regional Curve data for the Mountain region:

Stream Name	Gage Station ID	Stream Type (Rosgen)	Drainage Area (mi2)	Bankfull Discharge (cfs)	Bankfull Xsec Area (ft2)	Bankfull Width (ft)	Bankfull Mean Depth (ft)	Water Surface Slope (ft/ft)	Return Interval (Years)
French Broad at Rosman	3439000	E4	67.9	3226	544.9	82.4	6.6	0.0009	1.3
Mills River	3446000	C4	66.7	2263	333	74.3	4.5	0.0035	1.9
Davidson River	3441000	B4c	40.4	1457	316	87.6	3.6	0.004	1.1
Catheys Creek near Brevard	344000	B4c	11.7	470	94.2	38	2.5	0.013	1.67
West Fork of the Pigeon	3455500	B3c	27.6	2433	277.9	80.6	3.4	0.0077	1.10
East Fork Pigeon River	3456500	B	51.5	3450	446.3	107	4.2	incomplete	1.59
Watauga River	3479000	B4c	92.1	3492	572	140.3	4.1	0.0033	1.25
Big Laurel	3454000	B4	126	2763	406	110.8	3.7	0.0045	1.59
East Fork Hickey Fork Creek	n/a	B3a	2.0	242	39.3	27.4	1.4	0.045	n/a
Cold Spring Creek	n/a	B4	5.0	352	74.4	42.9	1.7	0.025	n/a
Caldwell Fork	n/a	B	13.8	560	79.3	39.4	2.0	0.02	n/a
Cataloochee	3460000	B4c	46.9	1320	186.9	58.7	3.2	0.008	1.60
Bee Tree	3450000	B3	5.46	231.5	56	32.1	1.7	incomplete	1.85
North Fork Swannanoa	344894205	C3	14.5	855.7	170.6	69.3	2.5	incomplete	

Equations for the Regional Curve Relationships:

Bankfull Cross-Sectional Area vs. Drainage Area: $y = 21.61x^{0.68}$
Bankfull Discharge vs. Drainage Area: $y = 100.64x^{0.76}$
Bankfull Width vs. Drainage Area: $y = 19.05x^{0.37}$
Bankfull Mean Depth vs. Drainage Area: $y = 1.11x^{0.31}$

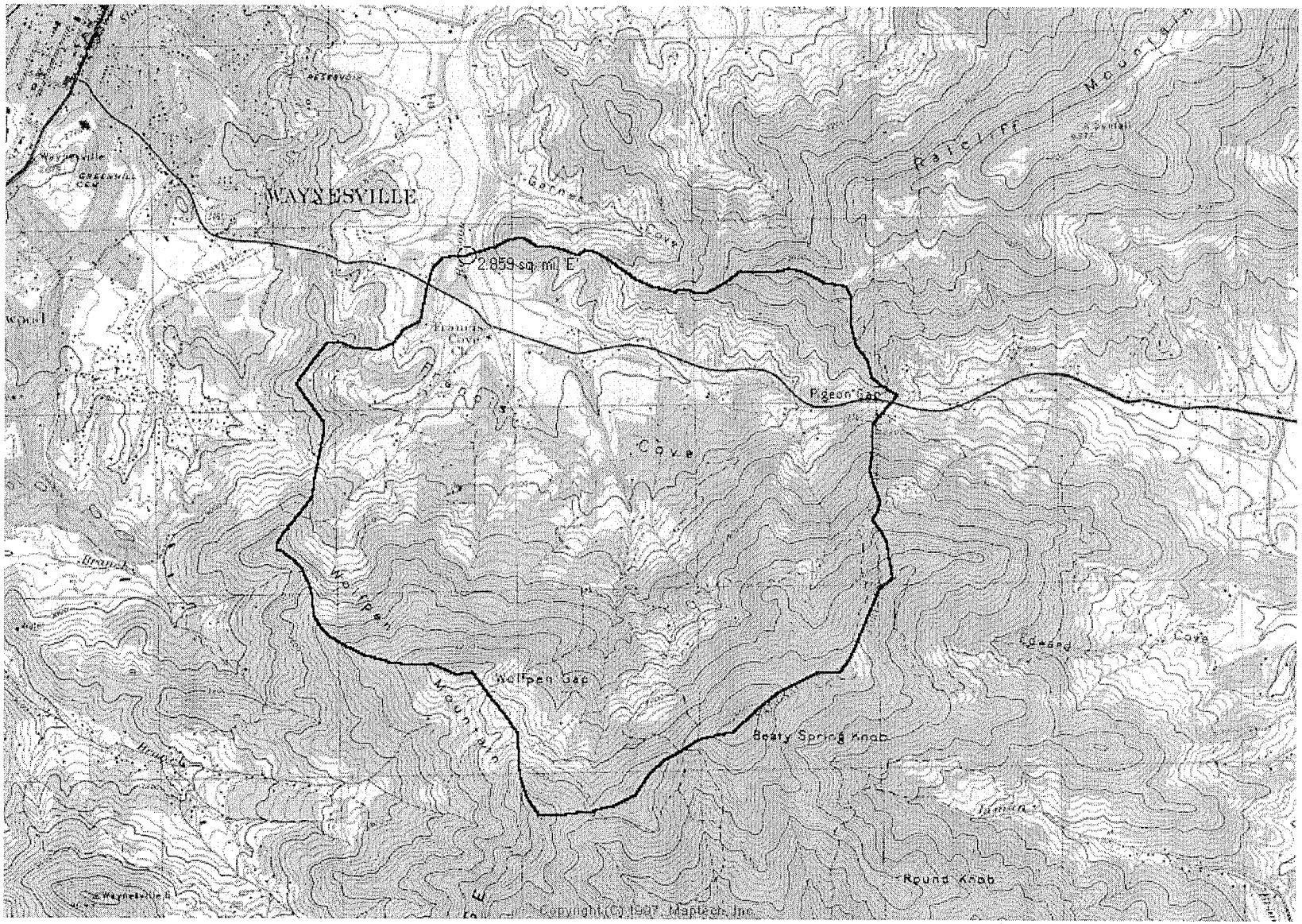
* where x = drainage area

Appendix C
Reference Reach 1 Data – Offsite

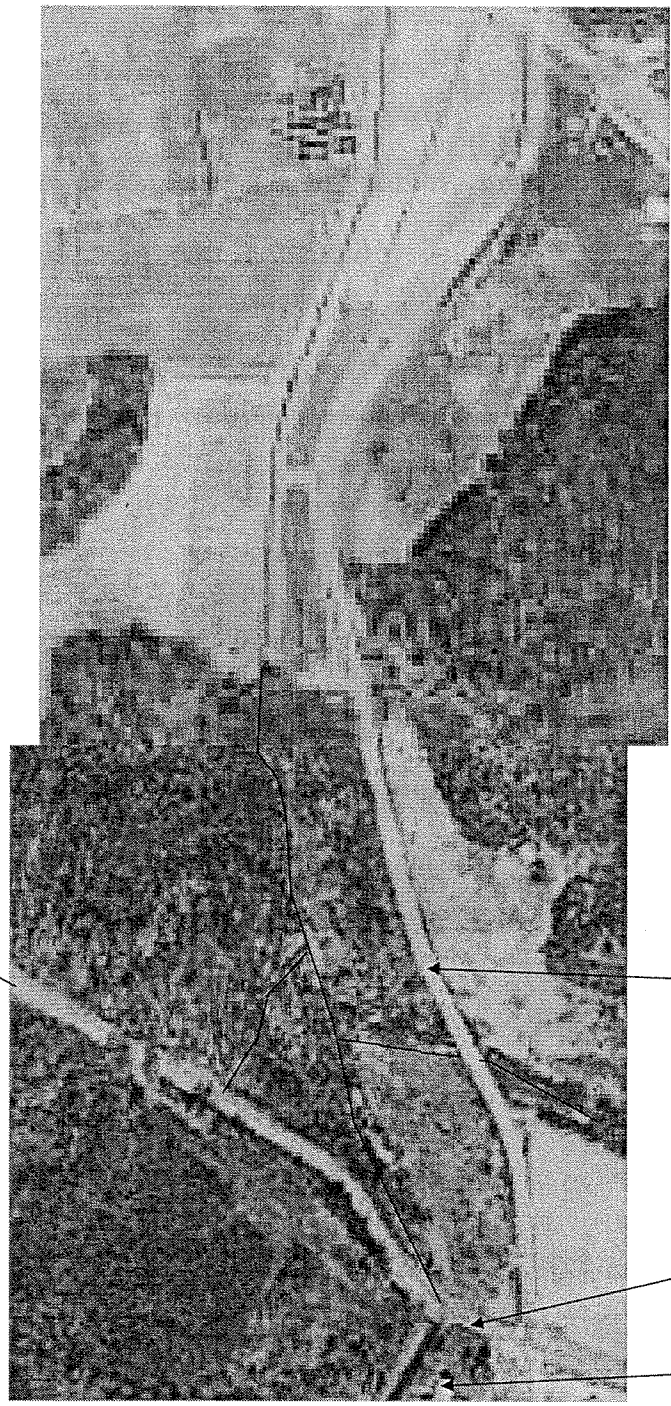
Name of Stream:	Raccoon Creek
Latitude:	35 28' 44" N
Longitude:	82 57' 51" W
Quad Sheet:	Waynesville
Watershed Area:	2.859 sq. mi.
Stream Type	E5

This site was Surveyed by Ron Morris, Jason Wheatley, and Alan Walker

TERRAIN NAVIGATOR



USGS ORTHO FROM TERRASERVER



STREAM LOCATION APPROXIM

TO WAYNESVILLE

RACCOON ROAD

U.S. HWY 276

FRANCIS COVE METHODIST CHURCH

Reference Site: Raccoon Creek, Haywood Co.

VARIABLES	REFERENCE REACH
1. Stream Type	E5
2. Drainage Area (Sq. Mi.)	2.9
3. Bankfull Width (W_{bkf})	Mean: 15.67 Range: 15.44 - 15.90
4. Bankfull Mean Depth (d_{bkf})	Mean: 1.52 Range: 1.49 - 1.54
5. Width/Depth Ratio (W_{bkf}/d_{bkf})	Mean: 10.35 Range: 10.03 - 10.67
6. Bankfull Cross-sectional Area (A_{bkf})	Mean: 23.75 Range: 23.74 - 23.76
7. Bankfull Mean Velocity (V_{bkf})	5.53 5.46 - 5.59
8. Bankfull Discharge, cfs (Q_{bkf})	131.3 129.72 - 132.88
9. Bankfull Maximum Depth (d_{max})	Mean: 2.55 Range: 2.4 - 2.7
10. Max. d_{riff}/d_{bkf} Ratio	Mean: 1.68 Range: 1.61 - 1.75
11. Low Bank Height to Max. d_{bkf} Ratio	Mean: 1.25 Range:
12. Width of the Flood Prone Area (W_{fpa})	Mean: > 100 Range:
13. Entrenchment Ratio (W_{fpa}/W_{bkf})	Mean: >2.2 Range:
14. Meander Length (L_m)	Mean: 49.4 Range: 30 - 84
15. Ratio of Meander Length to Bankfull Width (L_m/W_{bkf})	Mean: 3.15 Range: 1.94 - 5.28
16. Radius of Curvature (R_c)	Mean: 12.2 Range: 8.5 - 15.8
17. Ratio of Radius of Curvature to Bank-full Width (R_c/W_{bkf})	Mean: .78 Range: .55 - .99
18. Belt Width (W_{blt})	Mean: 52 Range:
19. Meander Width Ratio (W_{blt}/W_{bkf})	Mean: 3.32 Range: 3.27 - 3.37

20. Sinuosity (stream length/valley length) (k)	1.3
21. Valley Slope (ft./ft.)	0.014
22. Average Slope (S_{avg}) = (S_{valley}/k)	0.0109
23. Pool Slope (S_{pool})	Mean: .003 Range: .0003 - .006
24. Ratio of Pool Slope to Average Slope (S_{pool}/S_{avg})	Mean: .275 Range: .027 - .55
25. Maximum Pool Depth ($d_{max.pool}$)	Mean: 3.48 Range: 3.25 - 3.7
26. Ratio of Max.Pool Depth to Average Bankfull Depth ($d_{max.pool}/d_{bkf}$)	Mean: 2.29 Range: 2.18 - 2.4
27. Pool Width (W_{pool})	Mean: 15.51 Range: 14.7 - 16.31
28. Ratio of Pool Width to Bankfull Width (W_{pool}/W_{bkf})	Mean: .99 Range: .95 - 1.03
29. Pool Area (A_{pool})	Mean: 30.69 Range: 29.39 - 31.99
30. Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	Mean: 1.29 Range: 1.24 - 1.35
31. Pool to Pool Spacing (p-p)	Mean: 102.5 Range: 42 - 163
32. Ratio of Pool to Pool Spacing to Bankfull Width (p-p/W_{bkf})	Mean: 6.54 Range: 2.72 - 10.25
33. Ratio of Pool Length to Bankfull Width (P_{length}/W_{bkf})	Mean: 1.60 Range: 1.3 - 1.89
34. Average Riffle Slope	0.012
35. Average Run Slope	0.036
36. Average Glide Slope	0.003
37. Ratio of Riffle Slope to Average Slope (S_{riff}/S_{avg})	Mean: 1.1 Range: .92 - 1.28

38. Ratio of Run Slope to Average Slope (S_{run}/S_{avg})	Mean: 3.30 Range: 1.38 - 5.23
39. Ratio of Max. Run Depth to Mean Depth ($d_{max.run}/d_{bkf}$)	Mean: 1.93 Range: 1.91 - 1.95
40. Ratio of Run W/D to Riffle W/D	Mean: 1.03 Range: .59 - 1.45
41. Ratio of Run Length to Bankfull Width (R_{length}/W_{bkf})	Mean: 1.95 Range: .25 - 3.58
42. Ratio of Glide Slope to Average Slope (S_{glide}/S_{avg})	Mean: .275 Range: .092 - .459
43. Ratio of Max. Glide Depth to Mean Depth ($d_{max.glide}/d_{bkf}$)	Mean: 1.88 Range: 1.88 - 1.88
44. Ratio of Glide Width to Bankfull Width (W_{glide}/W_{bkf})	Mean: 1.08 Range: 1.08 - 1.09
45. Ratio of Glide W/D to Riffle W/D	Mean: .94 Range: .89 - .98
46. Ratio of Glide Length to Bankfull Width (G_{length}/W_{bkf})	Mean: .77 Range: .58 - .94

MATERIALS	
1. Particle Size Distribution of Channel Material	
D_{16}	0.12
D_{35}	0.3
D_{50}	0.75
D_{84}	64
D_{95}	150
2. Particle Size Distribution of Bar Material	
D_{16}	
D_{35}	
D_{50}	
D_{84}	
D_{95}	
3. Largest Size Particle Located on the Lower Third of Bar	

SEDIMENT TRANSPORT VALIDATION (BASED ON BANKFULL SHEAR STRESS)	
Calculated value (lb/ft2)	
Value from Shields Diagram (lb/ft2)	
Critical dimensionless Shear Stress	
Minimum Mean d_{bkf} calculated using Critical dimensionless Shear Stress Equations	

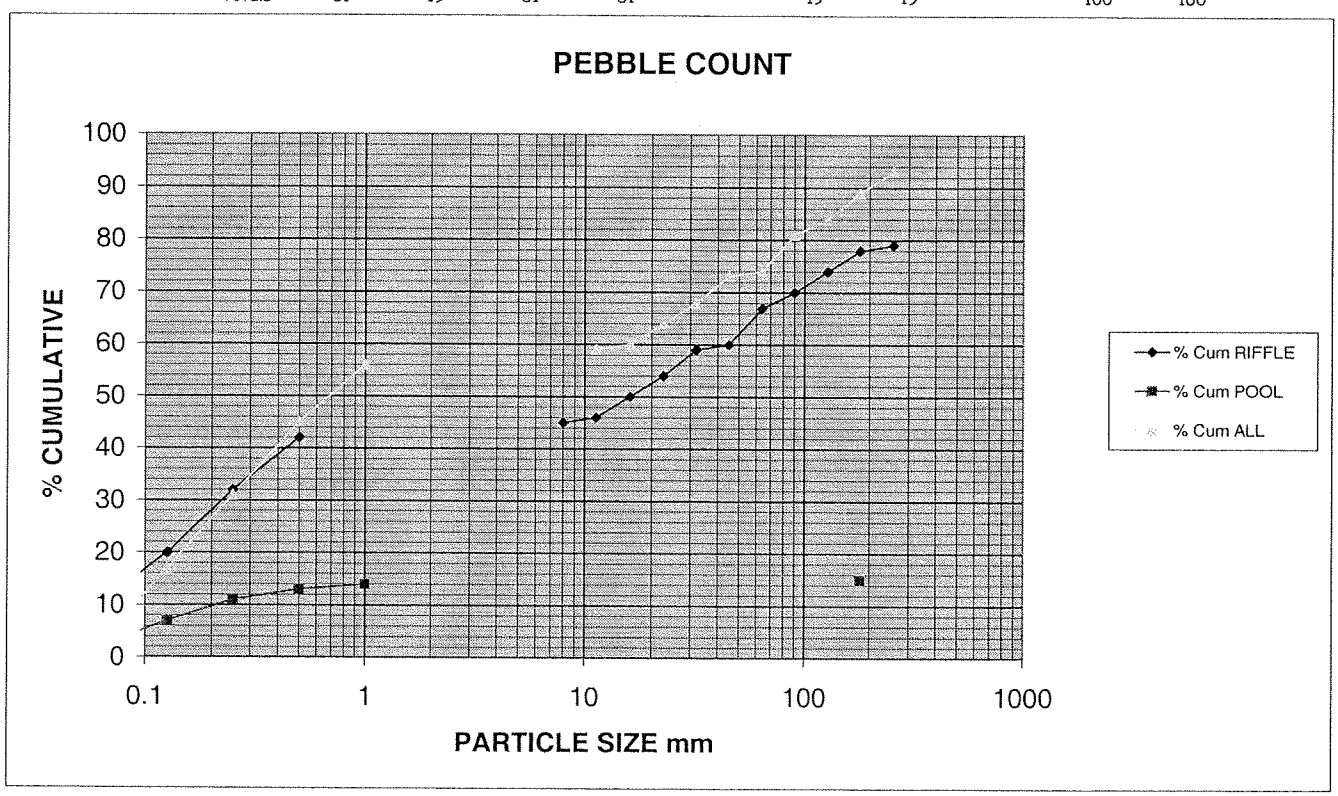
Remarks:

These Values and Ratios were Calculated and Proposed by:

Name: Ron Morris

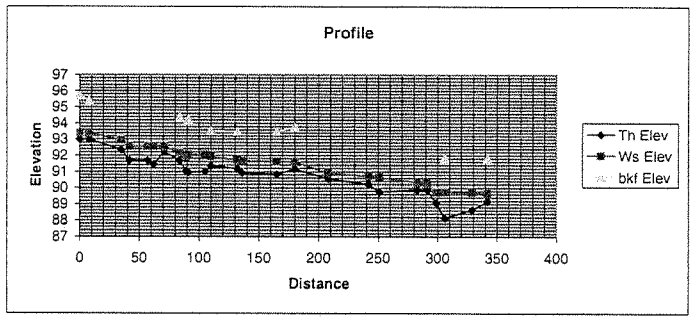
Title: Engineering Technician

Particle		Size (mm)	Particle Count		Total #	Item %	% Cum	Total #	Item %	% Cum	Total #	Item %	% Cum
			Riffle	Pool	RIFFLE	RIFFLE	RIFFLE	POOL	POOL	POOL	ALL	ALL	ALL
Silt/Clay	S/C	<.062		2	0	0		2	2	2	2	2	2
Very Fine	Sand	.062-.125	10	5	10	10	10	5	5	7	15	15	17
Fine	Sand	.125-.25	10	4	10	10	20	4	4	11	14	14	31
Medium	Sand	.25-.50	12	2	12	12	32	2	2	13	14	14	45
Coarse	Sand	.50-1.0	10	1	10	10	42	1	1	14	11	11	56
Very Course	Sand	1.0-2.0			0	0		0	0		0	0	
Very Fine	Gravel	2.0-4.0			0	0		0	0		0	0	
Fine	Gravel	4.0-5.7	3		3	3	45	0	0		3	3	59
Fine	Gravel	5.7-8.0	1		1	1	46	0	0		1	1	60
Medium	Gravel	8.0-11.3	4		4	4	50	0	0		4	4	64
Medium	Gravel	11.3-16	4		4	4	54	0	0		4	4	68
Coarse	Gravel	16-22.6	5		5	5	59	0	0		5	5	73
Coarse	Gravel	22.6-32	1		1	1	60	0	0		1	1	74
Very Course	Gravel	32-45	7		7	7	67	0	0		7	7	81
Very Course	Gravel	45-64	3		3	3	70	0	0		3	3	84
Small	Cobble	64-90	4	1	4	4	74	1	1	15	5	5	89
Small	Cobble	90-128	4		4	4	78	0	0		4	4	93
Large	Cobble	128-180	1	4	1	1	79	4	4	19	5	5	98
Large	Cobble	180-256	2		2	2	81	0	0		2	2	100
Small	Boulder	256-362			0	0		0	0		0	0	
Small	Boulder	362-512			0	0		0	0		0	0	
Medium	Boulder	512-1024			0	0		0	0		0	0	
Large-Vry Large	Boulder	1024-2048			0	0		0	0		0	0	
BedRock	BDRK	>2048			0	0	0	0	0		0	0	
		Totals	81	19	81	81		19	19		100	100	



HI = 100

Distance	Th RR	Ws RR	bkf RR	Description	Th Elev	Ws Elev	bkf Elev	TP	BS	HI	FS	Elev
0	7.01	6.62	4.3	Head of Riffle	92.99	93.38	95.7					
8	7.02	6.62	4.6		92.98	93.38	95.4					
35	7.66	7.05		Head of Pool	92.34	92.95						
42	8.33	7.45		Pool	91.67	92.55						
57	8.33	7.45		Pool	91.67	92.55						
62	8.55	7.46		Pool	91.45	92.54						
71	7.77	7.47		Head of Riffle	92.23	92.53						
84	8.35	7.85	5.65	Head of Run	91.65	92.15	94.35					
89	8.96	8.13		Head of Pool	91.04	91.87						
91	9.02	7.97	5.77	Pool dmax	90.98	92.03	94.23					
105	8.99	7.98		scour pool	91.01	92.02						
110	8.66	8.08	6.45	Head of Riffle	91.34	91.92	93.55					
132	8.59	8.09	6.3	Head of Run	91.19	91.69	93.48	TP1	5.02	99.78	5.24	94.76
136	8.85	8.15		Run	90.93	91.63						
165	8.95	8.17	6.28		90.83	91.61	93.5					
180	8.62	8.2	6	Head of Riffle	91.16	91.58	93.78					
208	9.21	8.87			90.57	90.91						
242	5.38	4.88		Run	90.21	90.71		TP2	5.38	95.59	9.57	90.21
251	5.84	4.95			89.75	90.64						
283	5.72	5.26			89.87	90.33						
291	8.43	8.04			89.87	90.26		TP3	8.12	98.3	5.41	90.18
299	9.22	8.57		Head of Pool	89.08	89.73						
306	10.15	8.57	6.48	Pool dmax	88.15	89.73	91.82					
329	9.65	8.58		Head of Glide	88.65	89.72						
342	9.12	8.65	6.5	Head of Riffle	89.18	89.65	91.8					



********** WinXSPRO **********

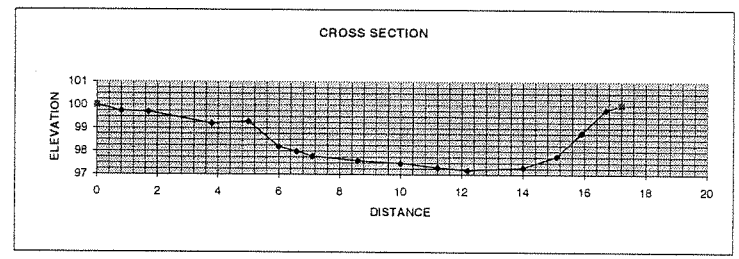
FILE NAME: c:\wxspro20\racoonref\coon6.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon6.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 6
SURVEY DATE: 10/12/00
SURVEY PARTY: J. WHEATLEY, R. MORRIS

RESISTENCE METHOD: Thorne and Zevenbergen
D84: 64mm

GLIDE 0-16

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.14	2.81	2.8	0.05	0.05	0.011	0.12	0.18	0.02	0.03
0.2	T	0.46	3.66	3.62	0.13	0.13	0.011	0.074	0.53	0.25	0.09
0.3	T	0.86	4.51	4.44	0.19	0.19	0.011	0.051	1.02	0.88	0.13
0.4	T	1.39	6.15	6.06	0.23	0.23	0.011	0.06	0.97	1.35	0.15
0.5	T	2.04	7.15	7.03	0.29	0.29	0.011	0.053	1.27	2.6	0.2
0.6	T	2.8	8.15	8	0.34	0.35	0.011	0.049	1.55	4.33	0.24
0.7	T	3.61	8.55	8.33	0.42	0.43	0.011	0.046	1.9	6.86	0.29
0.8	T	4.46	8.94	8.66	0.5	0.52	0.011	0.044	2.22	9.92	0.34
0.9	T	5.35	9.39	9.04	0.57	0.59	0.011	0.043	2.52	13.45	0.39
1	T	6.27	9.83	9.42	0.64	0.67	0.011	0.041	2.79	17.49	0.44
1.1	T	7.22	10.1	9.59	0.72	0.75	0.011	0.04	3.09	22.29	0.49
1.2	T	8.19	10.36	9.76	0.79	0.84	0.011	0.04	3.37	27.59	0.54
1.3	T	9.17	10.62	9.93	0.86	0.92	0.011	0.039	3.64	33.37	0.59
1.4	T	10.17	10.89	10.1	0.93	1.01	0.011	0.038	3.89	39.62	0.64
1.5	T	11.19	11.15	10.27	1	1.09	0.011	0.038	4.14	46.32	0.69
1.6	T	12.23	11.41	10.45	1.07	1.17	0.011	0.037	4.37	53.48	0.74
1.7	T	13.28	11.68	10.62	1.14	1.25	0.011	0.037	4.6	61.09	0.78
1.8	T	14.35	11.94	10.79	1.2	1.33	0.011	0.037	4.82	69.13	0.83
1.9	T	15.44	12.2	10.96	1.27	1.41	0.011	0.036	5.03	77.61	0.87
2	T	16.54	12.46	11.13	1.33	1.49	0.011	0.036	5.23	86.53	0.91
2.1	T	17.75	14.36	12.92	1.24	1.37	0.011	0.036	4.99	88.58	0.85
2.2	T	19.06	14.92	13.42	1.28	1.42	0.011	0.036	5.14	97.93	0.88
2.3	T	20.43	15.48	13.92	1.32	1.47	0.011	0.036	5.28	107.9	0.91
2.4	T	21.85	16.04	14.42	1.36	1.52	0.011	0.035	5.42	118.51	0.93
2.5	T	23.31	16.6	14.92	1.4	1.56	0.011	0.035	5.57	129.78	0.96
2.6	T	24.88	17.8	16.06	1.4	1.55	0.011	0.035	5.57	138.59	0.96
2.7	T	26.52	18.4	16.63	1.44	1.59	0.011	0.035	5.71	151.45	0.99
2.8	T	28.21	19.01	17.2	1.48	1.64	0.011	0.035	5.85	165.08	1.02

Distance	RR	Elev	BKF	
0	0	100	100	
0.8	0.25	99.75		
1.7	0.3	99.7		
3.8	0.8	99.2		
5	0.7	99.3		
6	1.8	98.2		
6.6	2	98		
7.1	2.2	97.8		
8.6	2.4	97.6		
10	2.5	97.5		
11.2	2.7	97.3		
12.2	2.8	97.2		
14	2.7	97.3		
15.1	2.2	97.8		
15.9	1.2	98.8		
16.7	0.2	99.8		
17.2	0	100	100	



********** WinXSPRO **********

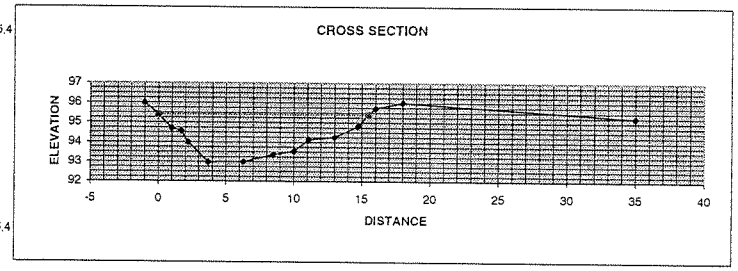
FILE NAME: c:\wxspro20\racoonref\coon1.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon1.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 1
SURVEY DATE: 10/11/00
SURVEY PARTY: A. WALKER, J. WHEATLEY, R. MORRIS

RESISTENCE METHOD Thorne and Zevenbergen
D84: 64mm

RIFFLE AT 0+08

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.28	3.29	3.25	0.08	0.09	0.011	0.097	0.31	0.09	0.06
0.2	T	0.64	4.04	3.97	0.16	0.16	0.011	0.061	0.75	0.48	0.11
0.3	T	1.07	4.79	4.68	0.22	0.23	0.011	0.064	0.9	0.96	0.15
0.4	T	1.57	5.54	5.39	0.28	0.29	0.011	0.056	1.21	1.9	0.19
0.5	T	2.17	6.66	6.47	0.33	0.33	0.011	0.052	1.43	3.1	0.22
0.6	T	2.86	7.49	7.25	0.38	0.39	0.011	0.048	1.7	4.86	0.26
0.7	T	3.6	7.88	7.58	0.46	0.48	0.011	0.046	2.03	7.31	0.31
0.8	T	4.38	8.27	7.91	0.53	0.55	0.011	0.044	2.33	10.22	0.36
0.9	T	5.19	8.65	8.25	0.6	0.63	0.011	0.042	2.62	13.59	0.41
1	T	6.03	9.04	8.58	0.67	0.7	0.011	0.041	2.89	17.42	0.46
1.1	T	6.9	9.39	8.86	0.73	0.78	0.011	0.04	3.15	21.76	0.5
1.2	T	7.81	10.28	9.69	0.76	0.81	0.011	0.04	3.27	25.53	0.52
1.3	T	8.86	11.75	11.11	0.75	0.8	0.011	0.039	3.28	29.09	0.52
1.4	T	9.99	12.21	11.5	0.82	0.87	0.011	0.039	3.52	35.21	0.56
1.5	T	11.16	12.66	11.9	0.88	0.94	0.011	0.038	3.76	41.92	0.6
1.6	T	12.37	13.16	12.34	0.94	1	0.011	0.038	3.97	49.1	0.65
1.7	T	13.65	14.04	13.19	0.97	1.03	0.011	0.037	4.1	55.92	0.67
1.8	T	15	14.61	13.72	1.03	1.09	0.011	0.037	4.29	64.35	0.7
1.9	T	16.39	15	14.05	1.09	1.17	0.011	0.037	4.52	74.03	0.75
2	T	17.8	15.34	14.33	1.16	1.24	0.011	0.036	4.75	84.51	0.8
2.1	T	19.25	15.69	14.61	1.23	1.32	0.011	0.036	4.97	95.63	0.84
2.2	T	20.73	16.03	14.88	1.29	1.39	0.011	0.036	5.18	107.41	0.89
2.3	T	22.23	16.37	15.16	1.36	1.47	0.011	0.036	5.39	119.82	0.93
2.4	T	23.76	16.71	15.44	1.42	1.54	0.011	0.035	5.59	132.88	0.98

DISTANCE	RR	ELEV	BKF
-1	4	96	
0	4.6	95.4	95.4
1	5.3	94.7	
1.7	5.43	94.57	
2.2	6	94	
3.7	7.02	92.98	
6.3	7.01	92.99	
8.5	6.62	93.38	
10	6.46	93.54	
11.1	5.86	94.14	
13	5.74	94.26	
14.7	5.19	94.81	
15.5	4.6	95.4	95.4
16	4.25	95.75	
18	4	96	
35	4.75	95.25	



********** WinXSPRO **********

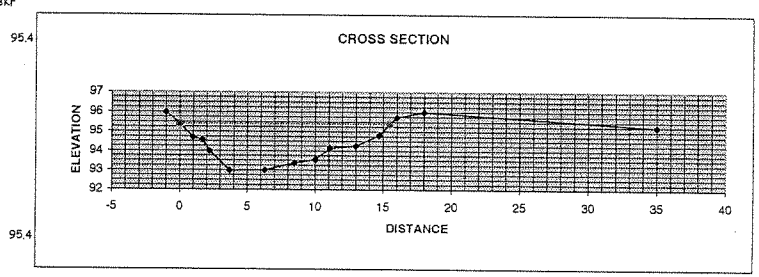
FILE NAME: c:\wxspro20\racoonref\coon1.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon1.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 1
SURVEY DATE: 10/11/00
SURVEY PARTY: A. WALKER, J. WHEATLEY, R. MORRIS

RESISTENCE METHOD Thorne and Zevenbergen
D84: 64mm

RIFFLE AT 0+08

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.28	3.29	3.25	0.08	0.09	0.011	0.097	0.31	0.09	0.06
0.2	T	0.64	4.04	3.97	0.16	0.16	0.011	0.061	0.75	0.48	0.11
0.3	T	1.07	4.79	4.68	0.22	0.23	0.011	0.064	0.9	0.96	0.15
0.4	T	1.57	5.54	5.39	0.28	0.29	0.011	0.056	1.21	1.9	0.19
0.5	T	2.17	6.66	6.47	0.33	0.33	0.011	0.052	1.43	3.1	0.22
0.6	T	2.86	7.49	7.25	0.38	0.39	0.011	0.048	1.7	4.86	0.26
0.7	T	3.6	7.88	7.58	0.46	0.48	0.011	0.046	2.03	7.31	0.31
0.8	T	4.38	8.27	7.91	0.53	0.55	0.011	0.044	2.33	10.22	0.36
0.9	T	5.19	8.65	8.25	0.6	0.63	0.011	0.042	2.62	13.59	0.41
1	T	6.03	9.04	8.58	0.67	0.7	0.011	0.041	2.89	17.42	0.46
1.1	T	6.9	9.39	8.86	0.73	0.78	0.011	0.04	3.15	21.76	0.5
1.2	T	7.81	10.28	9.69	0.76	0.81	0.011	0.04	3.27	25.53	0.52
1.3	T	8.86	11.75	11.11	0.75	0.8	0.011	0.039	3.28	29.09	0.52
1.4	T	9.99	12.21	11.5	0.82	0.87	0.011	0.039	3.52	35.21	0.56
1.5	T	11.16	12.66	11.9	0.88	0.94	0.011	0.038	3.76	41.92	0.6
1.6	T	12.37	13.16	12.34	0.94	1	0.011	0.038	3.97	49.1	0.65
1.7	T	13.65	14.04	13.19	0.97	1.03	0.011	0.037	4.1	55.92	0.67
1.8	T	15	14.61	13.72	1.03	1.09	0.011	0.037	4.29	64.35	0.7
1.9	T	16.39	15	14.05	1.09	1.17	0.011	0.037	4.52	74.03	0.75
2	T	17.8	15.34	14.33	1.16	1.24	0.011	0.036	4.75	84.51	0.8
2.1	T	19.25	15.69	14.61	1.23	1.32	0.011	0.036	4.97	95.63	0.84
2.2	T	20.73	16.03	14.88	1.29	1.39	0.011	0.036	5.18	107.41	0.89
2.3	T	22.23	16.37	15.16	1.36	1.47	0.011	0.036	5.39	119.82	0.93
2.4	T	23.76	16.71	15.44	1.42	1.54	0.011	0.035	5.59	132.88	0.98

DISTANCE	RR	ELEV	BKF
-1	4	96	
0	4.6	95.4	95.4
1	5.3	94.7	
1.7	5.43	94.57	
2.2	6	94	
3.7	7.02	92.98	
6.3	7.01	92.99	
8.5	6.62	93.38	
10	6.46	93.54	
11.1	5.86	94.14	
13	5.74	94.26	
14.7	5.19	94.81	
15.5	4.6	95.4	95.4
16	4.25	95.75	
18	4	96	
35	4.75	95.25	



********** WinXSPRO **********

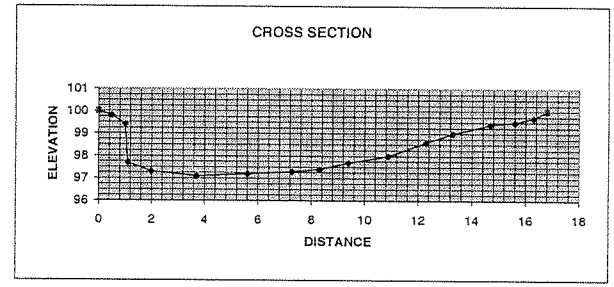
FILE NAME: c:\wxspro20\racoonref\coon7.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon7.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 7
SURVEY DATE: 10/12/00
SURVEY PARTY: J. WHEATLEY, R. MORRIS

RESISTENCE METHOD: Thorne and Zevenbergen
D84: 64mm

GLIDE AT 0+66

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.14	2.76	2.75	0.05	0.05	0.011	0.12	0.18	0.02	0.03
0.2	T	0.54	5.32	5.3	0.1	0.1	0.011	0.086	0.4	0.21	0.07
0.3	T	1.13	6.57	6.52	0.17	0.17	0.011	0.062	0.79	0.89	0.12
0.4	T	1.81	7.19	7.12	0.25	0.25	0.011	0.058	1.08	1.96	0.17
0.5	T	2.55	7.82	7.71	0.33	0.33	0.011	0.052	1.44	3.67	0.22
0.6	T	3.35	8.45	8.3	0.4	0.4	0.011	0.048	1.76	5.9	0.27
0.7	T	4.21	9.06	8.81	0.46	0.48	0.011	0.046	2.06	8.66	0.32
0.8	T	5.12	9.67	9.31	0.53	0.55	0.011	0.044	2.33	11.93	0.36
0.9	T	6.07	10.28	9.82	0.59	0.62	0.011	0.042	2.59	15.73	0.41
1	T	7.07	10.63	10.06	0.66	0.7	0.011	0.041	2.88	20.37	0.46
1.1	T	8.08	10.99	10.3	0.74	0.79	0.011	0.04	3.16	25.52	0.51
1.2	T	9.13	11.34	10.54	0.8	0.87	0.011	0.04	3.42	31.18	0.55
1.3	T	10.19	11.69	10.77	0.87	0.95	0.011	0.039	3.66	37.34	0.6
1.4	T	11.28	12.05	11.01	0.94	1.02	0.011	0.038	3.9	43.99	0.64
1.5	T	12.39	12.4	11.25	1	1.1	0.011	0.038	4.12	51.12	0.69
1.6	T	13.53	12.77	11.51	1.06	1.18	0.011	0.037	4.34	58.69	0.73
1.7	T	14.7	13.14	11.76	1.12	1.25	0.011	0.037	4.54	66.75	0.77
1.8	T	15.88	13.51	12.02	1.18	1.32	0.011	0.037	4.74	75.29	0.81
1.9	T	17.1	13.88	12.28	1.23	1.39	0.011	0.036	4.93	84.32	0.85
2	T	18.35	14.34	12.63	1.28	1.45	0.011	0.036	5.09	93.42	0.88
2.1	T	19.63	14.81	12.99	1.33	1.51	0.011	0.036	5.25	103.05	0.91
2.2	T	20.94	15.27	13.34	1.37	1.57	0.011	0.036	5.41	113.2	0.94
2.3	T	22.29	15.74	13.7	1.42	1.63	0.011	0.035	5.56	123.89	0.97
2.4	T	23.72	16.8	14.72	1.41	1.61	0.011	0.035	5.57	131.99	0.97
2.5	T	25.21	17.33	15.2	1.46	1.66	0.011	0.035	5.71	143.96	1
2.6	T	26.76	17.85	15.68	1.5	1.71	0.011	0.035	5.85	156.61	1.03
2.7	T	28.34	18.2	15.97	1.56	1.77	0.011	0.035	6.03	170.97	1.07
2.8	T	29.96	18.67	16.38	1.6	1.83	0.011	0.035	6.18	185.27	1.1
2.9	T	31.61	19.13	16.8	1.65	1.88	0.011	0.034	6.33	200.26	1.13

Distance	RR	Elev	BKF	
0	0	100		100
0.5	0.2	99.8		
1	0.6	99.4		
1.1	2.3	97.7		
2	2.7	97.3		
3.7	2.9	97.1		
5.6	2.8	97.2		
7.3	2.7	97.3		
8.3	2.6	97.4		
9.4	2.3	97.7		
10.9	2	98		
12.3	1.4	98.6		
13.3	1	99		
14.7	0.6	99.4		
15.6	0.5	99.5		
16.3	0.3	99.7		
16.8	0	100		100



********** WinXSPRO **********

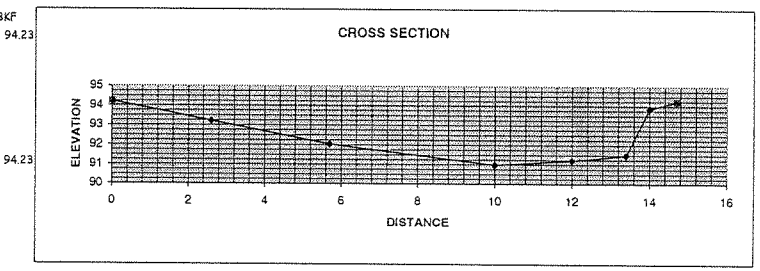
FILE NAME: c:\wxspro20\racoonref\coon2.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon2.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 2
SURVEY DATE: 10/11/00
SURVEY PARTY: A. WALKER, J. WHEATLEY, R. MORRIS

RESISTENCE METHOD: Thorne and Zevenbergen
D84: 64mm

POOL AT 0+91

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.06	1.26	1.24	0.05	0.05	0.011	0.157	0.13	0.01	0.03
0.2	T	0.25	2.52	2.49	0.1	0.1	0.011	0.089	0.37	0.09	0.07
0.3	T	0.55	3.61	3.55	0.15	0.16	0.011	0.061	0.73	0.41	0.11
0.4	T	0.96	4.58	4.5	0.21	0.21	0.011	0.046	1.19	1.14	0.14
0.5	T	1.45	5.55	5.45	0.26	0.27	0.011	0.055	1.17	1.71	0.18
0.6	T	2.02	6.07	5.88	0.33	0.34	0.011	0.05	1.51	3.05	0.23
0.7	T	2.63	6.6	6.32	0.4	0.42	0.011	0.047	1.81	4.76	0.27
0.8	T	3.28	7.12	6.75	0.46	0.49	0.011	0.045	2.08	6.84	0.32
0.9	T	3.98	7.64	7.19	0.52	0.55	0.011	0.043	2.34	9.32	0.36
1	T	4.72	8.17	7.62	0.58	0.62	0.011	0.042	2.58	12.19	0.4
1.1	T	5.5	8.62	7.98	0.64	0.69	0.011	0.041	2.83	15.55	0.44
1.2	T	6.32	9.01	8.27	0.7	0.76	0.011	0.04	3.07	19.41	0.48
1.3	T	7.16	9.39	8.56	0.76	0.84	0.011	0.039	3.31	23.68	0.52
1.4	T	8.03	9.78	8.85	0.82	0.91	0.011	0.039	3.53	28.36	0.56
1.5	T	8.93	10.16	9.13	0.88	0.98	0.011	0.038	3.75	33.45	0.6
1.6	T	9.85	10.54	9.42	0.93	1.05	0.011	0.038	3.95	38.95	0.64
1.7	T	10.81	10.93	9.71	0.99	1.11	0.011	0.037	4.15	44.86	0.68
1.8	T	11.8	11.31	10	1.04	1.18	0.011	0.037	4.34	51.21	0.72
1.9	T	12.81	11.7	10.28	1.1	1.25	0.011	0.037	4.53	57.98	0.75
2	T	13.85	12.08	10.57	1.15	1.31	0.011	0.036	4.71	65.18	0.79
2.1	T	14.92	12.47	10.86	1.2	1.37	0.011	0.036	4.88	72.82	0.82
2.2	T	16.02	12.85	11.15	1.25	1.44	0.011	0.036	5.05	80.91	0.86
2.3	T	17.15	13.23	11.43	1.3	1.5	0.011	0.036	5.22	89.47	0.89
2.4	T	18.31	13.61	11.71	1.35	1.56	0.011	0.035	5.38	98.49	0.92
2.5	T	19.5	13.98	11.99	1.39	1.63	0.011	0.035	5.54	107.98	0.96
2.6	T	20.71	14.36	12.27	1.44	1.69	0.011	0.035	5.69	117.93	0.99
2.7	T	21.95	14.74	12.55	1.49	1.75	0.011	0.035	5.85	128.35	1.02
2.8	T	23.22	15.11	12.83	1.54	1.81	0.011	0.035	6	139.26	1.05
2.9	T	24.52	15.5	13.13	1.58	1.87	0.011	0.035	6.14	150.57	1.09
3	T	25.85	15.99	13.58	1.62	1.9	0.011	0.034	6.26	161.72	1.11
3.1	T	27.23	16.49	14.03	1.65	1.94	0.011	0.034	6.37	173.49	1.13
3.2	T	28.66	16.98	14.48	1.69	1.98	0.011	0.034	6.49	185.89	1.16
3.25	T	29.39	17.23	14.7	1.71	2	0.011	0.034	6.55	192.33	1.17

DISTANCE	RR	ELEV	BKF
0	5.77	94.23	94.23
2.6	6.79	93.21	
5.7	7.97	92.03	
10	9.02	90.98	
12	8.78	91.22	
13.4	8.52	91.48	
14	6.13	93.87	
14.7	5.77	94.23	94.23



********** WinXSPRO **********

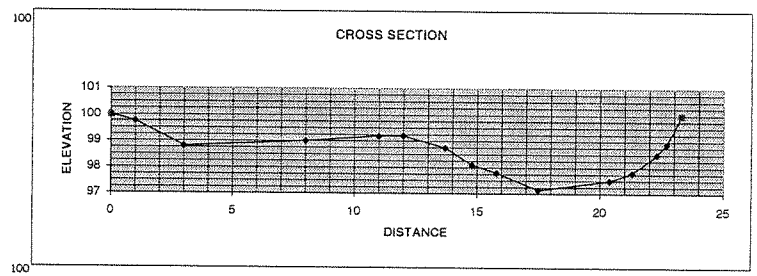
FILE NAME: c:\wxspro20\racoonref\coon5.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon5.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 5
SURVEY DATE: 10/12/00
SURVEY PARTY: J. WHEATLEY, R. MORRIS

RESISTENCE METHOD Thorne and Zevenbergen
D84: 64mm

RUN AT 1+34

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.05	1.11	1.09	0.05	0.05	0.011	0.165	0.13	0.01	0.03
0.2	T	0.22	2.23	2.18	0.1	0.1	0.011	0.09	0.37	0.08	0.07
0.3	T	0.49	3.34	3.27	0.15	0.15	0.011	0.063	0.69	0.34	0.1
0.4	T	0.87	4.2	4.1	0.21	0.21	0.011	0.046	1.2	1.04	0.14
0.5	T	1.3	4.8	4.66	0.27	0.28	0.011	0.054	1.21	1.58	0.19
0.6	T	1.8	5.39	5.22	0.33	0.34	0.011	0.05	1.51	2.71	0.23
0.7	T	2.35	5.95	5.74	0.39	0.41	0.011	0.047	1.79	4.2	0.27
0.8	T	2.94	6.47	6.21	0.45	0.47	0.011	0.045	2.06	6.06	0.31
0.9	T	3.59	7	6.69	0.51	0.54	0.011	0.043	2.31	8.3	0.35
1	T	4.28	7.44	7.08	0.58	0.6	0.011	0.042	2.57	11	0.39
1.1	T	5	7.81	7.4	0.64	0.68	0.011	0.041	2.83	14.18	0.44
1.2	T	5.76	8.18	7.71	0.7	0.75	0.011	0.04	3.08	17.75	0.48
1.3	T	6.55	8.56	8.02	0.77	0.82	0.011	0.039	3.32	21.73	0.53
1.4	T	7.36	8.91	8.31	0.83	0.89	0.011	0.039	3.55	26.14	0.57
1.5	T	8.21	9.25	8.58	0.89	0.96	0.011	0.038	3.78	30.99	0.61
1.6	T	9.08	9.59	8.85	0.95	1.03	0.011	0.038	3.99	36.24	0.65
1.7	T	10.02	11.49	10.68	0.87	0.94	0.011	0.038	3.78	37.89	0.6
1.8	T	11.25	14.74	13.85	0.76	0.81	0.011	0.038	3.44	38.73	0.52
1.9	T	12.78	17.48	16.49	0.73	0.77	0.011	0.038	3.35	42.85	0.5
2	T	14.53	19.72	18.63	0.74	0.78	0.011	0.038	3.39	49.34	0.51
2.1	T	16.48	21.01	19.84	0.78	0.83	0.011	0.037	3.58	58.94	0.54
2.2	T	18.48	21.36	20.1	0.87	0.92	0.011	0.037	3.87	71.44	0.59
2.3	T	20.5	21.71	20.37	0.94	1.01	0.011	0.036	4.14	84.97	0.65
2.4	T	22.56	22.06	20.63	1.02	1.09	0.011	0.036	4.41	99.5	0.7
2.5	T	24.63	22.4	20.9	1.1	1.18	0.011	0.036	4.67	115.02	0.75
2.6	T	26.73	22.75	21.16	1.18	1.26	0.011	0.035	4.92	131.51	0.81
2.7	T	28.87	23.28	21.62	1.24	1.34	0.011	0.035	5.13	148.21	0.85
2.8	T	31.06	23.8	22.07	1.3	1.41	0.011	0.035	5.34	165.88	0.9
2.85	T	32.17	24.06	22.3	1.34	1.44	0.011	0.035	5.44	175.09	0.92

Distance	RR	Elev	BKF
0	0	100	
1	0.25	99.75	
3	1.2	98.8	
8	1	99	
11	0.8	99.2	
12	0.8	99.2	
13.7	1.25	98.75	
14.8	1.9	98.1	
15.8	2.2	97.8	
17.5	2.85	97.15	
20.4	2.5	97.5	
21.3	2.2	97.8	
22.3	1.5	98.5	
22.7	1.1	98.9	
23.3	0	100	



********** WinXSPRO **********

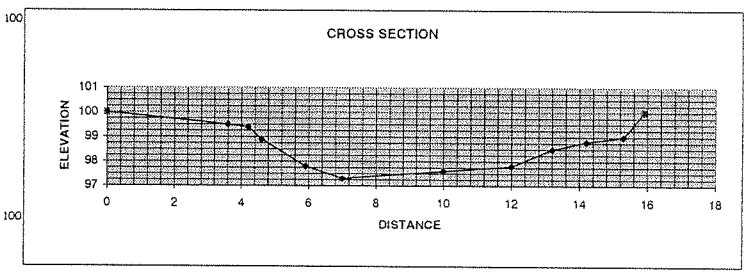
FILE NAME: c:\wxspro20\racoonref\coon3.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon3.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 3
SURVEY DATE: 10/11/00
SURVEY PARTY: A. WALKER, J. WHEATLEY, R. MORRIS

RESISTENCE METHOD: Thorne and Zevenbergen
D84: 64mm

RIFFLE AT 1+53

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.06	1.25	1.22	0.05	0.05	0.011	0.159	0.13	0.01	0.03
0.2	T	0.24	2.49	2.44	0.1	0.1	0.011	0.09	0.37	0.09	0.07
0.3	T	0.55	3.74	3.66	0.15	0.15	0.011	0.064	0.68	0.37	0.1
0.4	T	0.98	4.99	4.88	0.2	0.2	0.011	0.051	1.04	1.01	0.13
0.5	T	1.52	6.23	6.1	0.24	0.25	0.011	0.056	1.1	1.68	0.17
0.6	T	2.15	6.59	6.39	0.33	0.34	0.011	0.05	1.48	3.18	0.22
0.7	T	2.8	6.94	6.68	0.4	0.42	0.011	0.047	1.83	5.12	0.28
0.8	T	3.49	7.29	6.97	0.48	0.5	0.011	0.045	2.15	7.48	0.33
0.9	T	4.2	7.65	7.26	0.55	0.58	0.011	0.043	2.44	10.25	0.38
1	T	4.94	8	7.55	0.62	0.65	0.011	0.042	2.72	13.42	0.42
1.1	T	5.71	8.35	7.84	0.68	0.73	0.011	0.041	2.98	17.01	0.47
1.2	T	6.5	8.71	8.13	0.75	0.8	0.011	0.04	3.23	21	0.51
1.3	T	7.34	9.21	8.58	0.8	0.86	0.011	0.039	3.42	25.13	0.55
1.4	T	8.22	9.71	9.03	0.85	0.91	0.011	0.039	3.61	29.72	0.58
1.5	T	9.15	10.21	9.48	0.9	0.96	0.011	0.038	3.8	34.76	0.61
1.6	T	10.13	10.93	10.15	0.93	1	0.011	0.038	3.93	39.78	0.64
1.7	T	11.17	11.62	10.78	0.96	1.04	0.011	0.037	4.07	45.43	0.66
1.8	T	12.26	11.86	10.92	1.03	1.12	0.011	0.037	4.31	52.88	0.71
1.9	T	13.36	12.1	11.06	1.1	1.21	0.011	0.037	4.55	60.8	0.76
2	T	14.47	12.35	11.2	1.17	1.29	0.011	0.036	4.78	69.17	0.8
2.1	T	15.6	12.59	11.34	1.24	1.38	0.011	0.036	5	78	0.85
2.2	T	16.76	13.32	12	1.26	1.4	0.011	0.036	5.08	85.21	0.86
2.3	T	18	14.16	12.78	1.27	1.41	0.011	0.036	5.14	92.58	0.87
2.4	T	19.32	15.01	13.56	1.29	1.42	0.011	0.035	5.21	100.69	0.88
2.5	T	20.72	15.85	14.34	1.31	1.44	0.011	0.035	5.29	109.57	0.9
2.6	T	22.19	16.69	15.12	1.33	1.47	0.011	0.035	5.37	119.24	0.91
2.7	T	23.74	17.54	15.9	1.35	1.49	0.011	0.035	5.46	129.72	0.93

Distance	RR	Elev	BKF
0	0	100	100
3.6	0.5	99.5	
4.2	0.6	99.4	
4.6	1.1	98.9	
5.9	2.2	97.8	
7	2.7	97.3	
10	2.4	97.6	
12	2.2	97.8	
13.2	1.5	98.5	
14.2	1.2	98.8	
15.3	1	99	
15.9	0	100	100



********** WinXSPRO **********

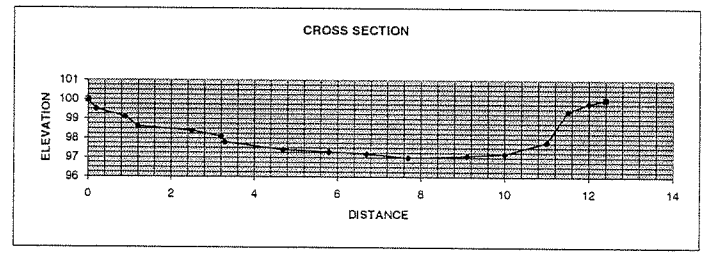
FILE NAME: c:\wxspro20\racoonref\coon8.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon8.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 8
SURVEY DATE: 10/12/00
SURVEY PARTY: J. WHEATLEY, R. MORRIS

RESISTENCE METHOD: Thorne and Zevenbergen
D84: 64mm

RUN 2+50

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.09	1.91	1.9	0.05	0.05	0.011	0.136	0.16	0.01	0.03
0.2	T	0.35	3.33	3.3	0.11	0.11	0.011	0.084	0.42	0.15	0.07
0.3	T	0.74	4.43	4.37	0.17	0.17	0.011	0.058	0.81	0.6	0.11
0.4	T	1.24	5.73	5.63	0.22	0.22	0.011	0.061	0.93	1.15	0.15
0.5	T	1.83	6.29	6.15	0.29	0.3	0.011	0.053	1.29	2.36	0.2
0.6	T	2.47	6.84	6.67	0.36	0.37	0.011	0.049	1.62	3.99	0.25
0.7	T	3.16	7.4	7.18	0.43	0.44	0.011	0.046	1.92	6.06	0.29
0.8	T	3.9	7.96	7.7	0.49	0.51	0.011	0.044	2.19	8.56	0.34
0.9	T	4.68	8.17	7.76	0.57	0.6	0.011	0.043	2.53	11.82	0.39
1	T	5.46	8.38	7.83	0.65	0.7	0.011	0.041	2.84	15.48	0.45
1.1	T	6.24	8.59	7.89	0.73	0.79	0.011	0.04	3.13	19.52	0.5
1.2	T	7.05	8.95	8.16	0.79	0.86	0.011	0.04	3.36	23.68	0.54
1.3	T	7.88	9.31	8.42	0.85	0.94	0.011	0.039	3.58	28.22	0.58
1.4	T	8.73	9.67	8.69	0.9	1.01	0.011	0.038	3.8	33.14	0.62
1.5	T	9.63	10.43	9.37	0.92	1.03	0.011	0.038	3.89	37.48	0.63
1.6	T	10.6	11.19	10.05	0.95	1.06	0.011	0.038	3.99	42.35	0.65
1.7	T	11.61	11.41	10.14	1.02	1.15	0.011	0.037	4.24	49.22	0.7
1.8	T	12.63	11.64	10.23	1.09	1.23	0.011	0.037	4.47	56.5	0.75
1.9	T	13.66	11.86	10.32	1.15	1.32	0.011	0.037	4.7	64.16	0.79
2	T	14.7	12.08	10.41	1.22	1.41	0.011	0.036	4.91	72.21	0.84
2.1	T	15.74	12.3	10.51	1.28	1.5	0.011	0.036	5.12	80.62	0.88
2.2	T	16.8	12.61	10.71	1.33	1.57	0.011	0.036	5.3	89.02	0.92
2.3	T	17.89	12.91	10.92	1.39	1.64	0.011	0.036	5.47	97.81	0.95
2.4	T	18.99	13.22	11.13	1.44	1.71	0.011	0.035	5.64	107.01	0.99
2.5	T	20.12	13.58	11.43	1.48	1.76	0.011	0.035	5.78	116.32	1.02
2.6	T	21.27	13.85	11.59	1.54	1.83	0.011	0.035	5.95	126.63	1.05
2.7	T	22.43	14.12	11.76	1.59	1.91	0.011	0.035	6.12	137.35	1.09
2.8	T	23.62	14.38	11.92	1.64	1.98	0.011	0.035	6.29	148.46	1.13
2.9	T	24.82	14.71	12.16	1.69	2.04	0.011	0.034	6.43	159.52	1.16
3	T	26.05	15.05	12.4	1.73	2.1	0.011	0.034	6.57	171.02	1.19

Distance	RR	Elev	BKF	
0	0	100	100	
0.2	0.5	99.5		
0.9	0.9	99.1		
1.2	1.4	98.6		
2.5	1.6	98.4		
3.2	1.9	98.1		
3.3	2.2	97.8		
4.7	2.6	97.4		
5.8	2.7	97.3		
6.7	2.8	97.2		
7.7	3	97		
9.1	2.9	97.1		
10	2.8	97.2		
11	2.2	97.8		
11.5	0.6	99.4		
12	0.2	99.8		
12.4	0	100	100	



********** WinXSPRO **********

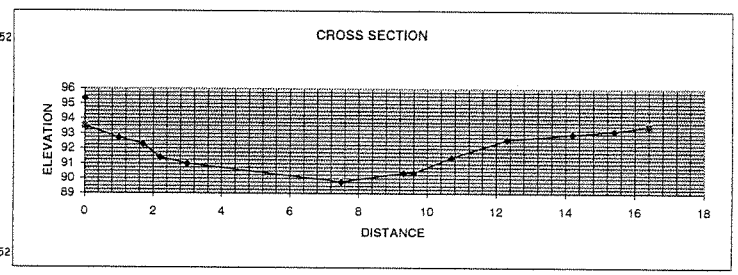
FILE NAME: c:\wxspro20\racoonref\coon4.out
INPUT FILE NAME: c:\wxspro20\racoonref\coon4.dat
RUN DATE: 10/13/00
ANALYSIS PROCEDURE: Hydraulics
CROSS SECTION NO. 4
SURVEY DATE: 10/11/00
SURVEY PARTY: A. WALKER, J. WHEATLEY, R. MORRIS

RESISTENCE METHOD Thorne and Zevenbergen
D84: 64mm

POOL AT 3+06

STAGE (ft)	#SEC	AREA (sq ft)	PERIM (ft)	WIDTH (ft)	R (ft)	DHYD (ft)	SLOPE (ft/ft)	n	VAVG (ft/s)	Q (cfs)	SHEAR (psf)
0.1	T	0.03	0.7	0.68	0.05	0.05	0.011	0.197	0.1	0	0.03
0.2	T	0.14	1.41	1.35	0.1	0.1	0.011	0.094	0.35	0.05	0.07
0.3	T	0.3	2.11	2.03	0.14	0.15	0.011	0.061	0.71	0.21	0.1
0.4	T	0.54	2.82	2.7	0.19	0.2	0.011	0.045	1.17	0.63	0.13
0.5	T	0.84	3.52	3.38	0.24	0.25	0.011	0.036	1.08	0.91	0.16
0.6	T	1.22	4.73	4.55	0.26	0.27	0.011	0.053	1.19	1.45	0.18
0.7	T	1.69	5.25	5.01	0.32	0.34	0.011	0.049	1.51	2.55	0.22
0.8	T	2.22	5.77	5.47	0.38	0.41	0.011	0.046	1.79	3.97	0.26
0.9	T	2.79	6.29	5.94	0.44	0.47	0.011	0.044	2.05	5.72	0.3
1	T	3.4	6.81	6.4	0.5	0.53	0.011	0.043	2.3	7.83	0.34
1.1	T	4.07	7.33	6.86	0.55	0.59	0.011	0.042	2.53	10.3	0.38
1.2	T	4.78	7.85	7.32	0.61	0.65	0.011	0.041	2.75	13.16	0.42
1.3	T	5.52	8.2	7.6	0.67	0.73	0.011	0.04	3.01	16.63	0.46
1.4	T	6.3	8.54	7.87	0.74	0.8	0.011	0.039	3.26	20.5	0.51
1.5	T	7.1	8.88	8.14	0.8	0.87	0.011	0.039	3.49	24.76	0.55
1.6	T	7.93	9.23	8.42	0.86	0.94	0.011	0.038	3.71	29.42	0.59
1.7	T	8.78	9.53	8.64	0.92	1.02	0.011	0.038	3.94	34.57	0.63
1.8	T	9.65	9.81	8.83	0.98	1.09	0.011	0.037	4.16	40.14	0.68
1.9	T	10.55	10.1	9.02	1.04	1.17	0.011	0.037	4.37	46.09	0.72
2	T	11.46	10.38	9.22	1.1	1.24	0.011	0.036	4.58	52.42	0.76
2.1	T	12.39	10.67	9.41	1.16	1.32	0.011	0.036	4.77	59.13	0.8
2.2	T	13.34	10.95	9.61	1.22	1.39	0.011	0.036	4.96	66.21	0.84
2.3	T	14.31	11.24	9.8	1.27	1.46	0.011	0.036	5.15	73.67	0.87
2.4	T	15.3	11.52	10	1.33	1.53	0.011	0.035	5.33	81.51	0.91
2.5	T	16.31	11.81	10.19	1.38	1.6	0.011	0.035	5.5	89.73	0.95
2.6	T	17.34	12.17	10.49	1.42	1.65	0.011	0.035	5.65	97.93	0.98
2.7	T	18.41	12.54	10.8	1.47	1.71	0.011	0.035	5.79	106.57	1.01
2.8	T	19.5	12.9	11.1	1.51	1.76	0.011	0.035	5.93	115.66	1.04
2.9	T	20.65	13.58	11.74	1.52	1.76	0.011	0.035	5.97	123.32	1.04
3	T	21.85	14.23	12.35	1.54	1.77	0.011	0.034	6.03	131.85	1.05
3.1	T	23.12	14.88	12.95	1.55	1.78	0.011	0.034	6.1	141.09	1.07
3.2	T	24.44	15.52	13.55	1.57	1.8	0.011	0.034	6.18	151.01	1.08
3.3	T	25.83	16.29	14.28	1.59	1.81	0.011	0.034	6.23	160.86	1.09
3.4	T	27.3	17.06	15	1.6	1.82	0.011	0.034	6.28	171.52	1.1
3.5	T	28.82	17.55	15.44	1.64	1.87	0.011	0.034	6.42	184.91	1.13
3.6	T	30.38	18.04	15.88	1.68	1.91	0.011	0.034	6.55	198.96	1.16
3.7	T	31.99	18.52	16.31	1.73	1.96	0.011	0.034	6.68	213.69	1.19

Distance	RR	Elev	BKF	
0	4.64	95.36		
0	6.48	93.52	93.52	
1	7.28	92.72		
1.7	7.7	92.3		
2.2	8.57	91.43		
3	9	91		
7.5	10.2	89.8		
9.3	9.6	90.4		
9.6	9.6	90.4		
10.7	8.57	91.43		
12.3	7.4	92.6		
14.2	7	93		
15.4	6.8	93.2		
16.4	6.48	93.52	93.52	



Appendix D
Reference Reach 2 Data – Onsite

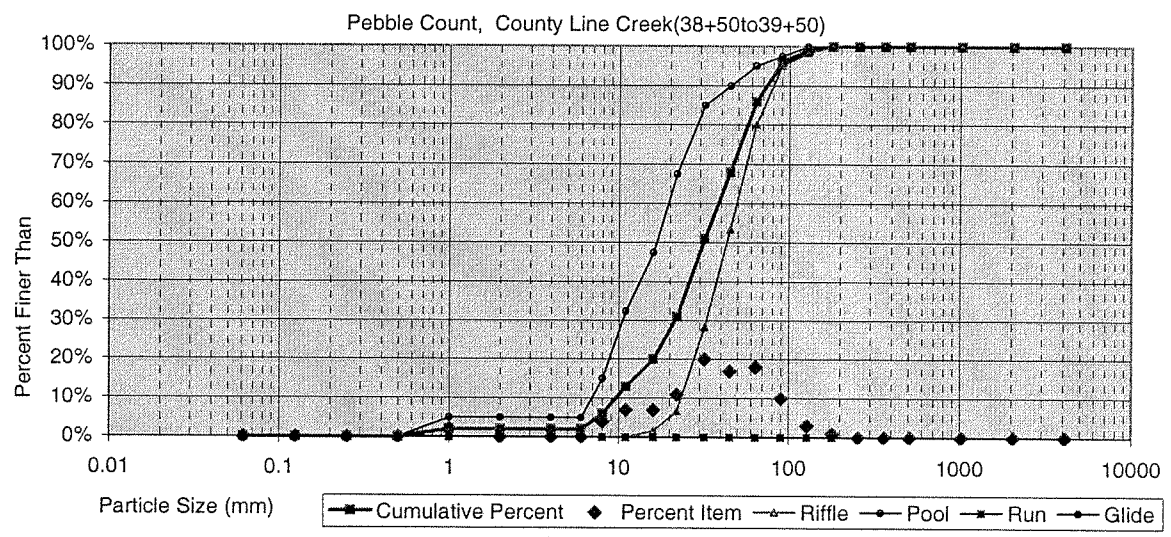
Weighted Pebble Count

Percent Riffle:	60	Percent Run:	
Percent Pool:	40	Percent Glide:	

Pebble Count,
County Line Creek(38+50to39+50)

D/S reach at High Vista Golf Course
Note: **Classification Pebble Count**

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	0.0	# #
very fine sand	0.062	0.13	0.0	# #
fine sand	0.13	0.25	0.0	# #
medium sand	0.25	0.5	0.0	# #
coarse sand	0.5	1	2.0	# #
very coarse sand	1	2	0.0	# #
very fine gravel	2	4	0.0	# #
fine gravel	4	6	0.0	# #
fine gravel	6	8	4.0	# #
medium gravel	8	11	7.0	# #
medium gravel	11	16	7.0	# #
coarse gravel	16	22	11.0	# #
coarse gravel	22	32	20.0	# #
very coarse gravel	32	45	17.0	# #
very coarse gravel	45	64	18.0	# #
small cobble	64	90	10.0	# #
medium cobble	90	128	3.0	# #
large cobble	128	180	1.0	# #
very large cobble	180	256	0.0	# #
small boulder	256	362	0.0	# #
small boulder	362	512	0.0	# #
medium boulder	512	1024	0.0	# #
large boulder	1024	2048	0.0	# #
very large boulder	2048	4096	0.0	# #
bedrock			0.0	#
		Weighted Count:	100	
		True Total Particle Count:	100	



Size percent less than (mm)				
D16	D35	D50	D84	D95
12.916	23.71	31.4	62	87

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

Riffle Pebble Count

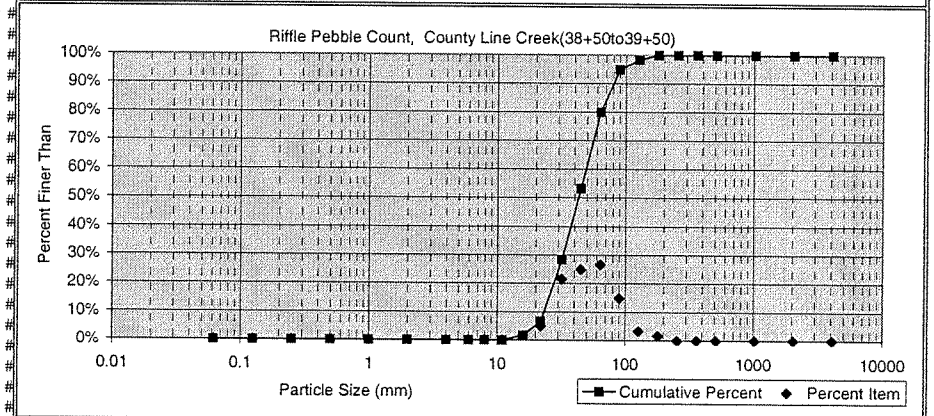
Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	
very coarse sand	1	2	
very fine gravel	2	4	
fine gravel	4	6	
fine gravel	6	8	
medium gravel	8	11	
medium gravel	11	16	1
coarse gravel	16	22	3
coarse gravel	22	32	13
very coarse gravel	32	45	15
very coarse gravel	45	64	16
small cobble	64	90	9
medium cobble	90	128	2
large cobble	128	180	1
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			60

Riffle Pebble Count,

County Line Creek(38+50to39+50)

D/S reach at High Vista Golf Course

Note:



Size percent less than (mm)				
D16	D35	D50	D84	D95
25.854	35.05	43.0	70	90

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	0%	80%	20%	0%	0%

Pool Pebble Count

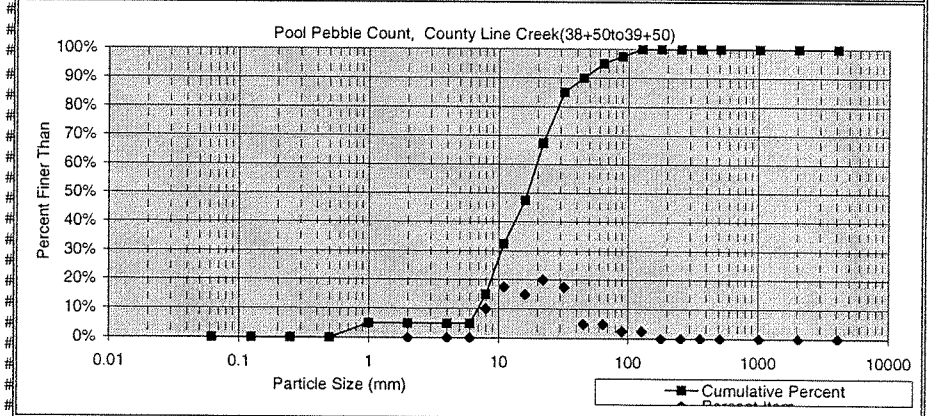
Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	2
very coarse sand	1	2	
very fine gravel	2	4	
fine gravel	4	6	
fine gravel	6	8	4
medium gravel	8	11	7
medium gravel	11	16	6
coarse gravel	16	22	8
coarse gravel	22	32	7
very coarse gravel	32	45	2
very coarse gravel	45	64	2
small cobble	64	90	1
medium cobble	90	128	1
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			40

Pool Pebble Count,

County Line Creek(38+50to39+50)

D/S reach at High Vista Golf Course

Note:



Size percent less than (mm)				
D16	D35	D50	D84	D95
8.147	11.71	16.6	31	64

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	5%	90%	5%	0%	0%

Pebble Count

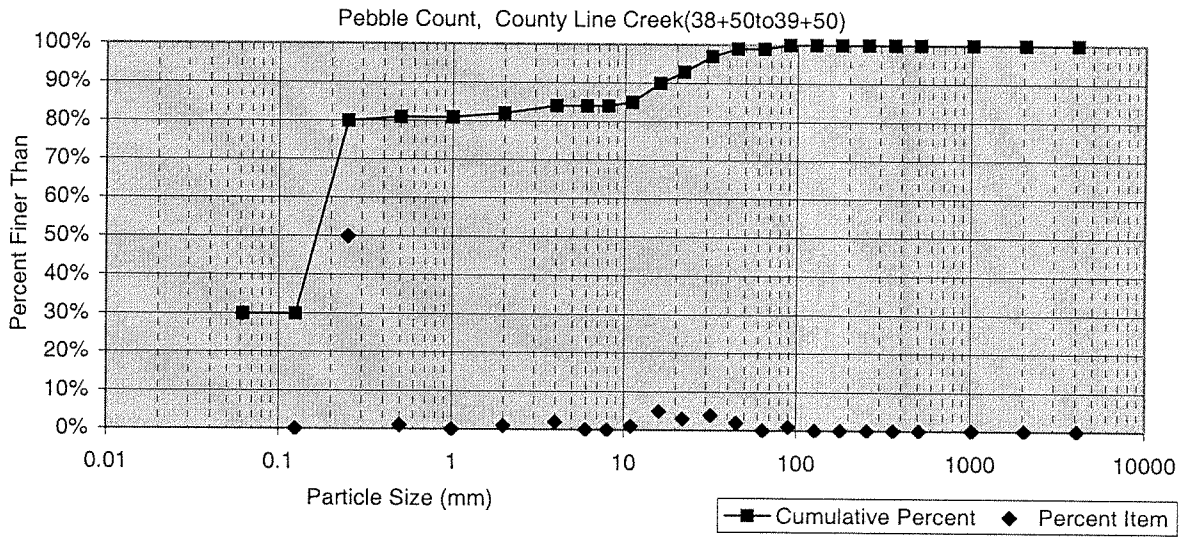
Material	Size Range (mm)		Count
silt/clay	0	0.062	**30**
very fine sand	0.062	0.13	
fine sand	0.13	0.25	**50**
medium sand	0.25	0.5	**1**
coarse sand	0.5	1	
very coarse sand	1	2	**1**
very fine gravel	2	4	**2**
fine gravel	4	6	
fine gravel	6	8	
medium gravel	8	11	**1**
medium gravel	11	16	**5**
coarse gravel	16	22	**3**
coarse gravel	22	32	**4**
very coarse gravel	32	45	**2**
very coarse gravel	45	64	
small cobble	64	90	**1**
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			100

Pebble Count,

County Line Creek(38+50to39+50)

D/S reach at High Vista Golf Course

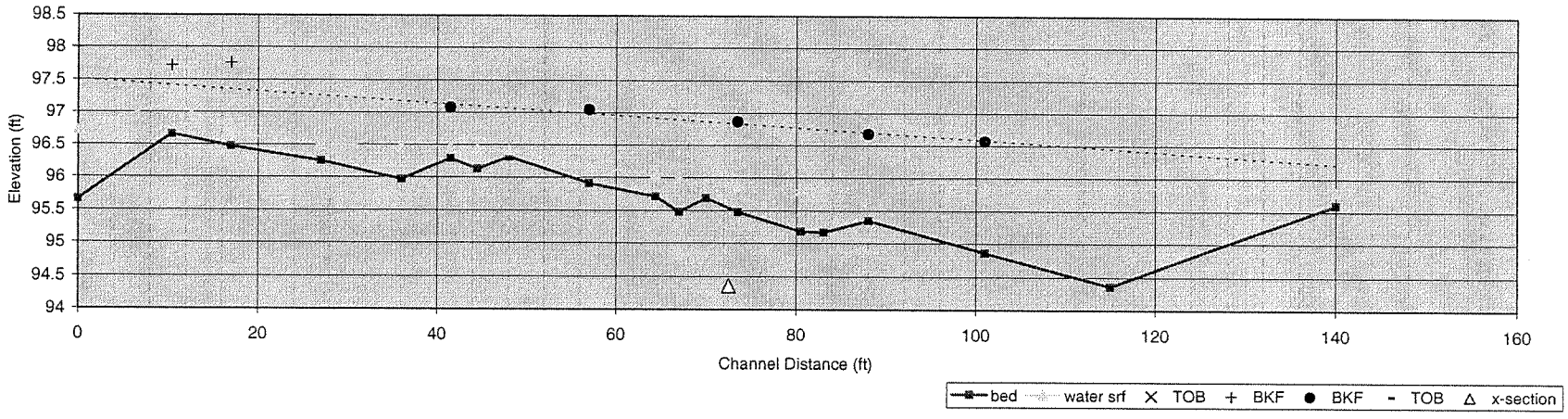
Note: **Velocity Sample @ Riffle Cross-section**



Size percent less than (mm)				
D16	D35	D50	D84	D95
#N/A	0.13	0.2	4	27

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
30%	52%	17%	1%	0%	0%

Slope Profile



100 Elevation BM

					100	Elevation BM													
notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS TOB	FS BKF	FS TOB	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV TOB	ELEV BKF	ELEV TOB
				2.27	102.27														
c of pool		0			102.27		6.61	1.07			4.27			95.66	96.73			98	
glide		10.4			102.27		5.61	0.5			4.55			96.66	97.16			97.72	
hd riffle		17			102.27		5.8	0.2			4.51			96.47	96.67			97.76	
hd run		27			102.27		6.02	0.25						96.25	96.5				
hd glide		36			102.27		6.3	0.5						95.97	96.47				
hd riffle		41.5			102.27		5.98	0.18	5.19					96.29	96.47	97.08			
hd run		44.5			102.27		6.14	0.31						96.13	96.44				
hd riffle		48			102.27		5.95	0.1						96.32	96.42				
hd run		57			102.27		6.36	0.25	5.22					95.91	96.16	97.05			
hd pool		64.4			102.27		6.56	0.35						95.71	96.06				
c of pool		67			102.27		6.79	0.52						95.48	96				
hd riffle		70			102.27		6.58	0.2						95.69	95.89				
	xsect	72.5			102.27														
hd run		73.5			102.27		6.79	0.4	5.4					95.48	95.88	96.87			
hd pool		80.5			102.27		7.09	0.63						95.18	95.81				
c of pool		83			102.27		7.1	0.7						95.17	95.87				
hd glide		88			102.27		6.92	0.48	5.59					95.35	95.83	96.68			
hd pool		101			102.27		7.41	1	5.7					94.86	95.86	96.57			
c of pool		115			102.27		7.91	1.5						94.36	95.86				
hd riffle		140			102.27		6.67	0.2						95.6	95.8				
					102.27														
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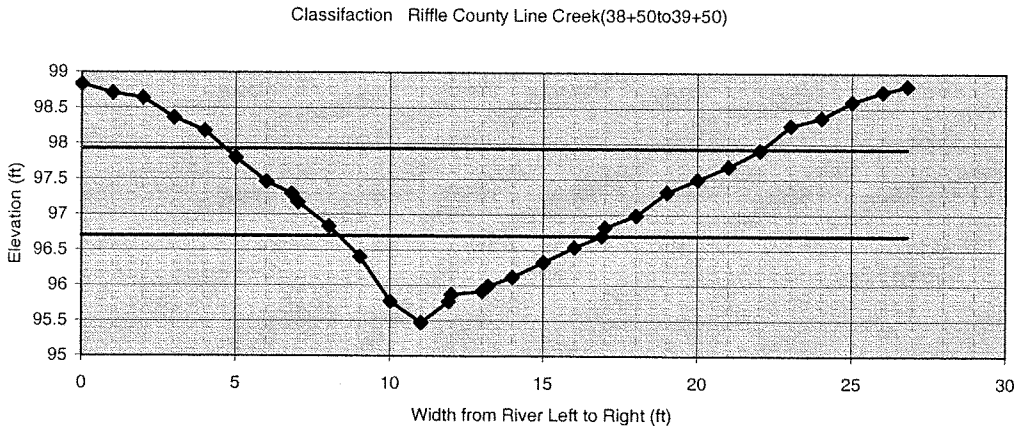
Cross Section



section:	Classifaction
	Riffle
	County Line Creek(38+50to39+50)
	---
description:	Classifaction (xsection taken at STA)
height of instrument (ft):	102.27

notes	omit pt.	distance (ft)	FS (ft)	elevation
	#	0	3.44	98.83
TOB	#	1	3.56	98.71
	#	2	3.63	98.64
	#	3	3.91	98.36
	#	4	4.09	98.18
	#	5	4.47	97.8
	#	6	4.81	97.46
	#	6.8	4.98	97.29
	#	7	5.1	97.17
	#	8	5.44	96.83
topofbench	#	9	5.87	96.4
EOW	#	10	6.5	95.77
THALWG	#	11	6.8	95.47
EOW	#	11.9	6.5	95.77
	#	12	6.4	95.87
	#	13	6.35	95.92
edge of bei	#	13.2	6.28	95.99
	#	14	6.15	96.12
	#	15	5.94	96.33
	#	16	5.73	96.54
BKF	#	16.9	5.57	96.7
	#	17	5.45	96.82
	#	18	5.28	96.99
	#	19	4.95	97.32
	#	20	4.77	97.5
	#	21	4.59	97.68
	#	22	4.36	97.91
	#	23	4.01	98.26
	#	24	3.9	98.37
	#	25	3.67	98.6
	#	26	3.53	98.74
	#	26.8	3.45	98.82
	#			
	#			
	#			
	#			
	#			

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
5.57	3.56	18.0	1.14	0.036
96.7	98.71			

dimensions			
5.1	x-section area	0.6	d mean
8.6	width	9.1	wet P
1.2	d max	0.6	hyd radi
3.2	bank ht	14.4	w/d ratio
18.0	W flood prone area	2.1	ent ratio

hydraulics	
3.0	velocity (ft/sec)
15.5	discharge rate, Q (cfs)
0.40	shear stress ((lbs/ft sq)
0.46	shear velocity (ft/sec)
1.286	unit stream power (lbs/ft/sec)
0.47	Froude number
6.6	friction factor u/u*
24.2	threshold grain size (mm)

check from channel material			
62	measured D84 (mm)		
3.0	relative roughness	5.5	fric. factor
0.043	Manning's n from channel material		

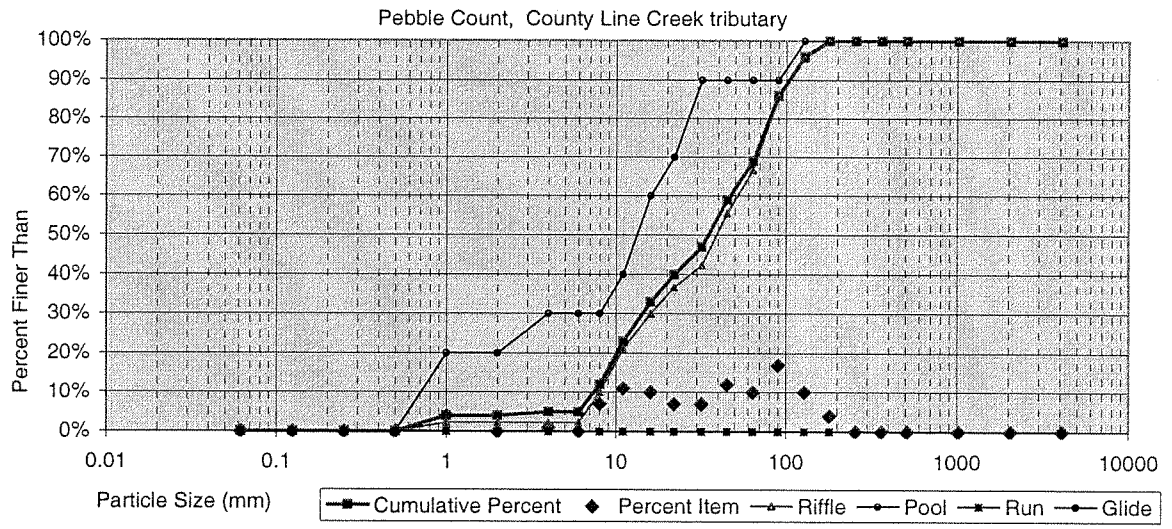
Weighted Pebble Count

Percent Riffle:	90	Percent Run:	
Percent Pool:	10	Percent Glide:	

Pebble Count,
County Line Creek tributary

High Vista Golf
Note: **Classification Pebble Count**

Material	Size Range (mm)		Total #	
silt/clay	0	0.062	0.0	# #
very fine sand	0.062	0.13	0.0	# #
fine sand	0.13	0.25	0.0	# #
medium sand	0.25	0.5	0.0	# #
coarse sand	0.5	1	4.0	# #
very coarse sand	1	2	0.0	# #
very fine gravel	2	4	1.0	# #
fine gravel	4	6	0.0	# #
fine gravel	6	8	7.0	# #
medium gravel	8	11	11.0	# #
medium gravel	11	16	10.0	# #
coarse gravel	16	22	7.0	# #
coarse gravel	22	32	7.0	# #
very coarse gravel	32	45	12.0	# #
very coarse gravel	45	64	10.0	# #
small cobble	64	90	17.0	# #
medium cobble	90	128	10.0	# #
large cobble	128	180	4.0	# #
very large cobble	180	256	0.0	# #
small boulder	256	362	0.0	# #
small boulder	362	512	0.0	# #
medium boulder	512	1024	0.0	# #
large boulder	1024	2048	0.0	# #
very large boulder	2048	4096	0.0	# #
bedrock			0.0	#
		Weighted Count:	100	
		True Total Particle Count:	100	



Size percent less than (mm)				
D16	D35	D50	D84	D95
8.982	17.52	34.8	86	124

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
0%	4%	65%	31%	0%	0%

Riffle Pebble Count

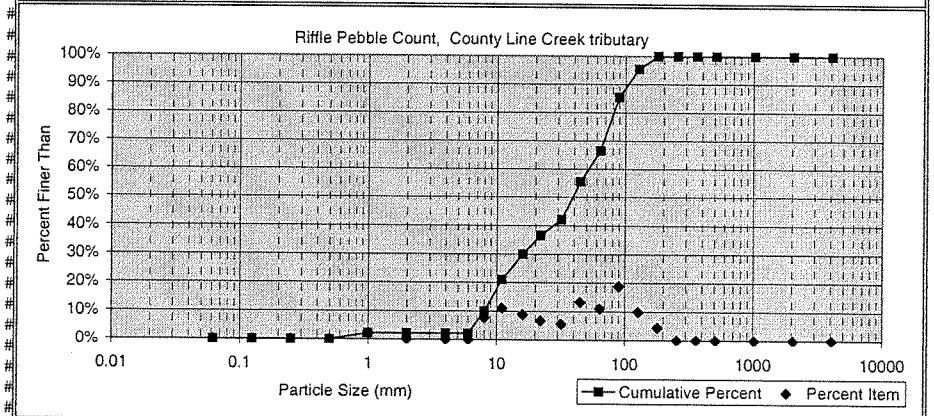
Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	2
very coarse sand	1	2	
very fine gravel	2	4	
fine gravel	4	6	
fine gravel	6	8	7
medium gravel	8	11	10
medium gravel	11	16	8
coarse gravel	16	22	6
coarse gravel	22	32	5
very coarse gravel	32	45	12
very coarse gravel	45	64	10
small cobble	64	90	17
medium cobble	90	128	9
large cobble	128	180	4
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			90

Riffle Pebble Count,

County Line Creek tributary

High Vista Golf

Note:



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
9.501	20.32	39.0	88	126	0%	2%	64%	33%	0%	0%

Pool Pebble Count

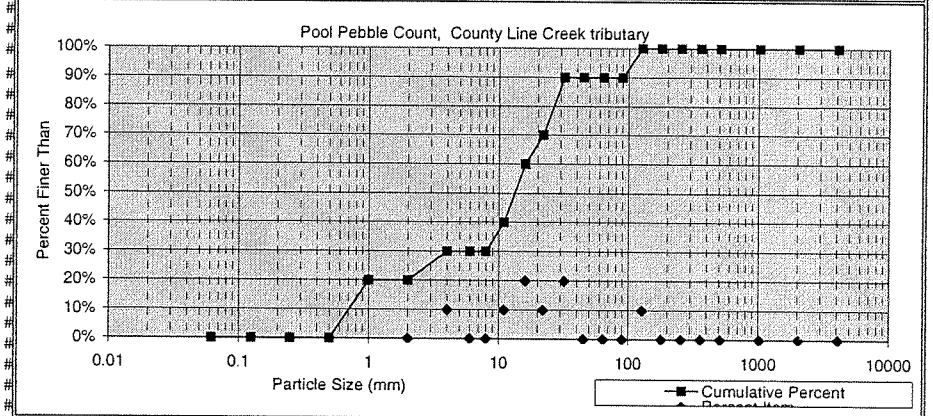
Material	Size Range (mm)		Count
silt/clay	0	0.062	
very fine sand	0.062	0.13	
fine sand	0.13	0.25	
medium sand	0.25	0.5	
coarse sand	0.5	1	2
very coarse sand	1	2	
very fine gravel	2	4	1
fine gravel	4	6	
fine gravel	6	8	
medium gravel	8	11	1
medium gravel	11	16	2
coarse gravel	16	22	1
coarse gravel	22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

Pool Pebble Count,

County Line Creek tributary

High Vista Golf

Note:



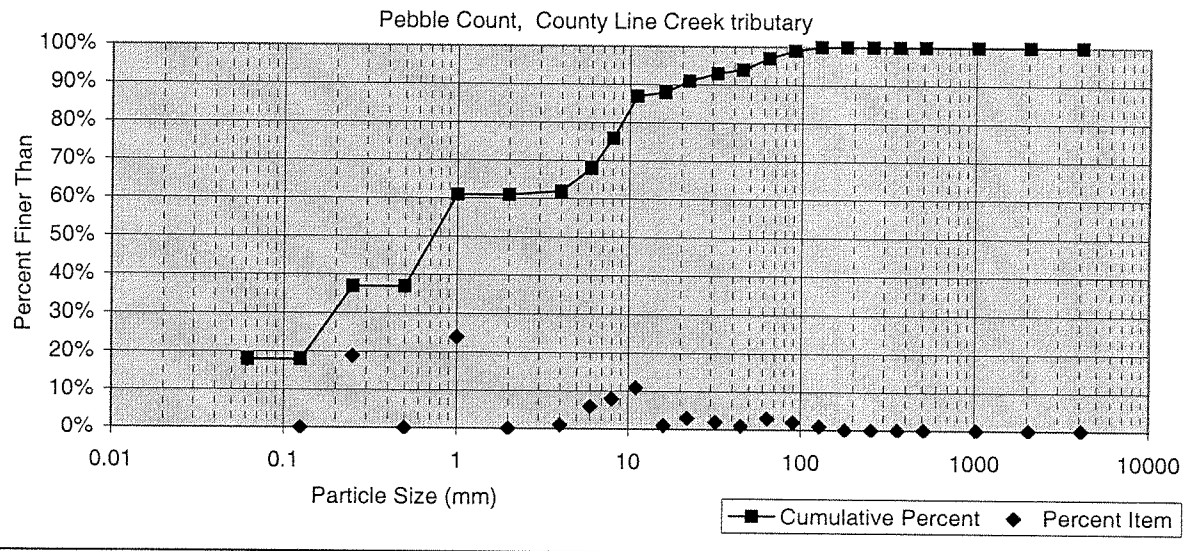
Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0.871	9.38	13.3	29	107	0%	20%	70%	10%	0%	0%

Pebble Count

Material	Size Range (mm)		Count
silt/clay	0	0.062	**18**
very fine sand	0.062	0.13	
fine sand	0.13	0.25	**19**
medium sand	0.25	0.5	
coarse sand	0.5	1	**24**
very coarse sand	1	2	
very fine gravel	2	4	**1**
fine gravel	4	6	**6**
fine gravel	6	8	**8**
medium gravel	8	11	**11**
medium gravel	11	16	**1**
coarse gravel	16	22	**3**
coarse gravel	22	32	**2**
very coarse gravel	32	45	**1**
very coarse gravel	45	64	**3**
small cobble	64	90	**2**
medium cobble	90	128	**1**
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
Total Particle Count:			100

Pebble Count,
County Line Creek tributary

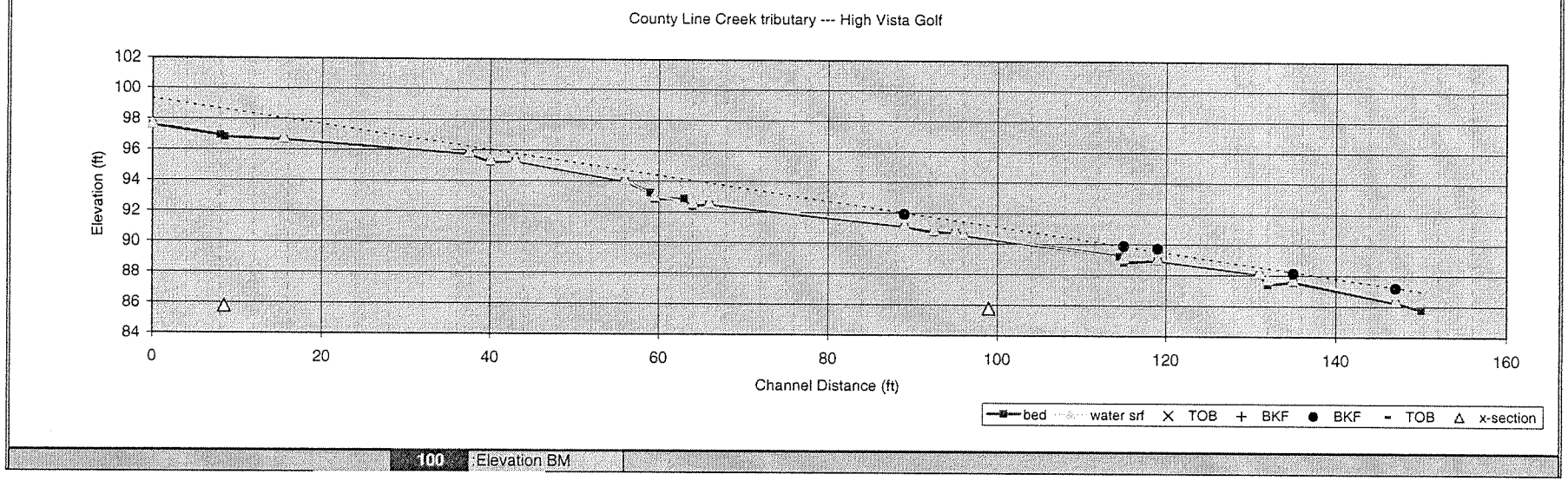
High Vista Golf
Note: **Velocity Sample @ Riffle Cross-section**



Size percent less than (mm)				
D16	D35	D50	D84	D95
#N/A	0.23	0.7	10	51

Percent by substrate type					
silt/clay	sand	gravel	cobble	boulder	bedrock
18%	43%	36%	3%	0%	0%

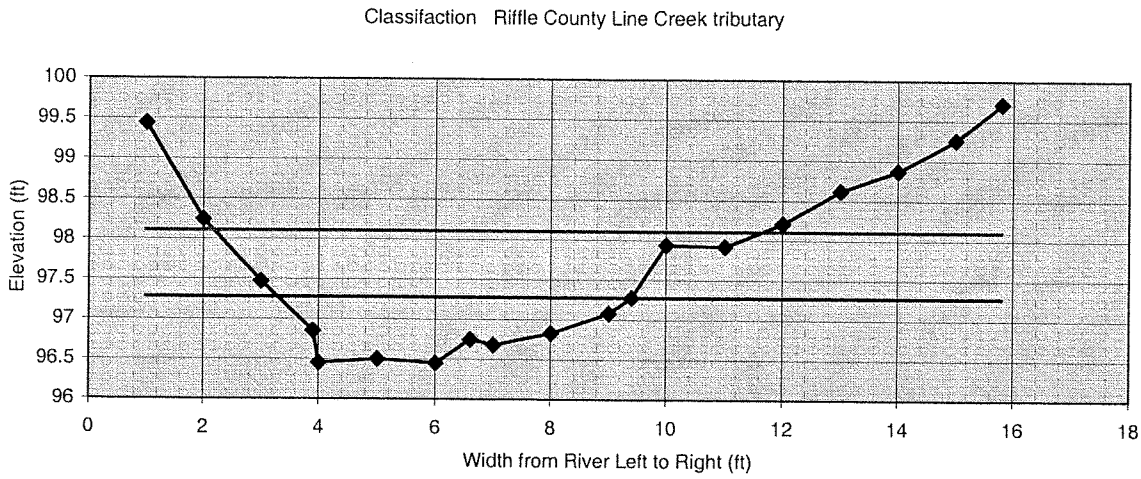
Slope Profile



100 Elevation BM

					100	Elevation BM													
notes	cross section	station		BS	HI	FS TP	FS bed	depth water	FS BKF	FS TOB	FS BKF	FS TOB	AZ azimuth	ELEV bed	ELEV water srf	ELEV BKF	ELEV TOB	ELEV BKF	ELEV TOB
				4.45	104.45														
halwg-hdriffl		0			104.45		6.85	0.1						97.6	97.7				
d riffle@nickpt		8			104.45		7.5							96.95					
hd pool	x	8.5			104.45		7.64							96.81					
hd riffle		15.5			104.45		7.8	0.13						96.65	96.78				
@nickpt/debris jam		37.5			104.45		8.71	0.11						95.74	95.85				
ol end debris jam		40			104.45		9.25	0.17						95.2	95.37				
hd riffle		43			104.45		9.17	0.07						95.28	95.35				
TP					104.45	9.05													
				4.08	99.48														
d riff/top step		56			99.48		5.5	0.1						93.98	94.08				
t step/at debris		59			99.48		6.21							93.27					
hd pool		59.5			99.48		6.63	0.2						92.85	93.05				
end pool		63			99.48		6.6							92.88					
ck pt/hd pool		64			99.48		7.1	0.23						92.38	92.61				
hd riffle		66			99.48		6.98	0.09						92.5	92.59				
iffle/nick pt		89			99.48		8.38	0.1	7.55					91.1	91.2	91.93			
d riff/hd pool		92.5			99.48		8.75	0.18						90.73	90.91				
d pool/nick pt		95			99.48		8.74	0.1						90.74	90.84				
hd riffle		96			99.48		8.95	0.1						90.53	90.63				
	x	99			99.48														
d riff/at nick pt		114.5			99.48		10.25							89.23					
ool/below nick		115			99.48		10.65	0.3	9.59					88.83	89.13	89.89			
d pool/hd riff		119			99.48		10.54	0.1	9.76					88.94	89.04	89.72			
TP					99.48	6.92													
				2.89	95.45														
nd riff/nickpt		131			95.45		7.38	0.1						88.07	88.17				
hd pool		132			95.45		8.05	0.35						87.4	87.75				
hd riffle		135			95.45		7.87	0.15	7.3					87.58	87.73	88.15			
endriffle		147			95.45		9.2	0.1	8.25					86.25	86.35	87.2			
t nick/struc		150			95.45		9.68							85.77					
					95.45														
					95.45														
					95.45														
					95.45														
					95.45														

Cross Section



section:	**Classifaction**
	Riffle
	County Line Creek tributary
	---
description:	**Classifaction**
height of instrument (ft):	**104.45**

notes	omit pt	distance (ft)	FS (ft)	elevation
	#	**1**	**5.01**	99.44
	#	**2**	**6.21**	98.24
BKFL?	#	**3**	**6.98**	97.47
edge bank	#	**3.9**	**7.6**	96.85
EOW	#	**4**	**8**	96.45
	#	**5**	**7.95**	96.5
THALWG	#	**6**	**8**	96.45
EOW	#	**6.6**	**7.7**	96.75
	#	**7**	**7.77**	96.68
	#	**8**	**7.62**	96.83
	#	**9**	**7.37**	97.08
BKFL?	#	**9.4**	**7.17**	97.28
	#	**10**	**6.51**	97.94
	#	**11**	**6.53**	97.92
	#	**12**	**6.24**	98.21
	#	**13**	**5.83**	98.62
	#	**14**	**5.58**	98.87
	#	**15**	**5.19**	99.26
pin	#	**15.8**	**4.74**	99.71
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			
	#			

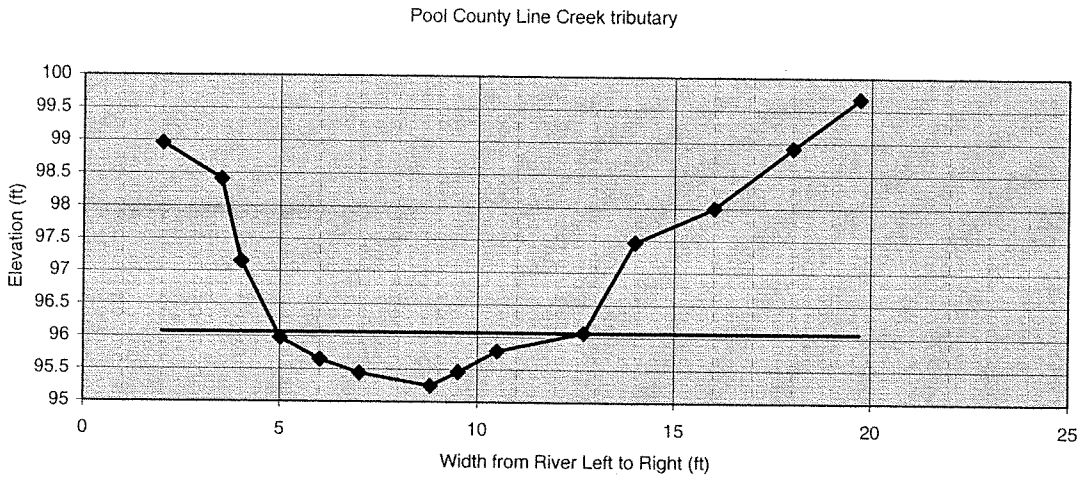
FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
7.17	**4.74**	**9.0**	**6.203**	**0.036**
97.28	99.71			

dimensions			
3.3	x-section area	0.5	d mean
6.1	width	6.7	wet P
0.8	d max	0.5	hyd radi
3.3	bank ht	11.3	w/d ratio
9.0	W flood prone area	1.5	ent ratio

hydraulics	
6.4	velocity (ft/sec)
21.4	discharge rate, Q (cfs)
1.91	shear stress ((lbs/ft sq)
0.99	shear velocity (ft/sec)
13.543	unit stream power (lbs/ft/sec)
2.36	Froude number
6.5	friction factor u/u*
~~257.0~~	threshold grain size (mm)

check from channel material			
86	measured D84 (mm)		
1.9	relative roughness	4.4	fric. factor
0.053	Manning's n from channel material		

Cross Section



section: Pool

County Line Creek tributary

description: ---

height of instrument (ft): 103.06

notes	omit pt.	distance (ft)	FS (ft)	elevation
	# #	2	4.1	98.96
TOB	# #	3.5	4.65	98.41
	# #	4	5.91	97.15
	# #	5	7.08	95.98
	# #	6	7.41	95.65
EOW	# #	7	7.62	95.44
THALWG		8.8	7.81	95.25
EOW		9.5	7.6	95.46
		10.5	7.27	95.79
BKFL?		12.7	6.99	96.07
		14	5.59	97.47
		16	5.06	98
		18	4.14	98.92
		19.7	3.38	99.68

FS bankfull	FS top of bank	W fpa (ft)	channel slope (%)	Manning's "n"
6.99	4.65		6.203	
96.07	98.41			

dimensions			
3.3	x-section area	0.4	d mean
7.8	width	8.0	wet P
0.8	d max	0.4	hyd radi
3.2	bank ht	~~18.1~~	w/d ratio
~~0.0~~	W flood prone area	~~0.0~~	ent ratio

hydraulics	
~~0.0~~	velocity (ft/sec)
~~0.0~~	discharge rate, Q (cfs)
1.62	shear stress ((lbs/ft sq)
0.91	shear velocity (ft/sec)
~~0.000~~	unit stream power (lbs/ft/sec)
~~0.00~~	Froude number
~~0.0~~	friction factor u/u*
~~184.8~~	threshold grain size (mm)

check from channel material			
~~86~~	measured D84 (mm)		
~~1.5~~	relative roughness	~~3.9~~	fric. factor
~~0.059~~	Manning's n from channel material		

Appendix E
Site Photos

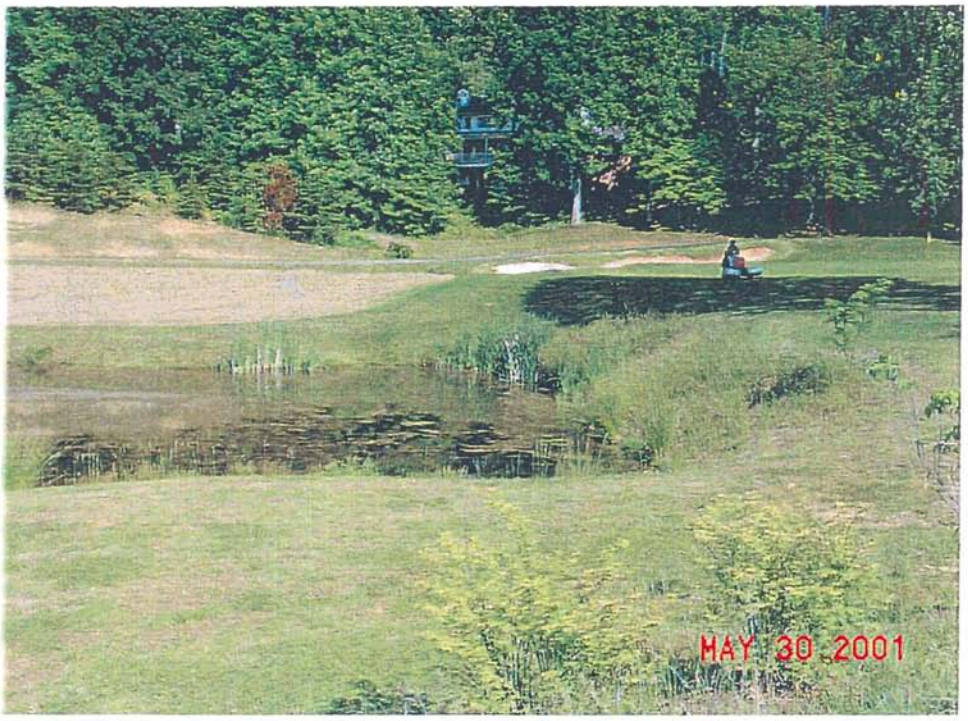


Photo 1: Begin Project – Pond area at 11th green

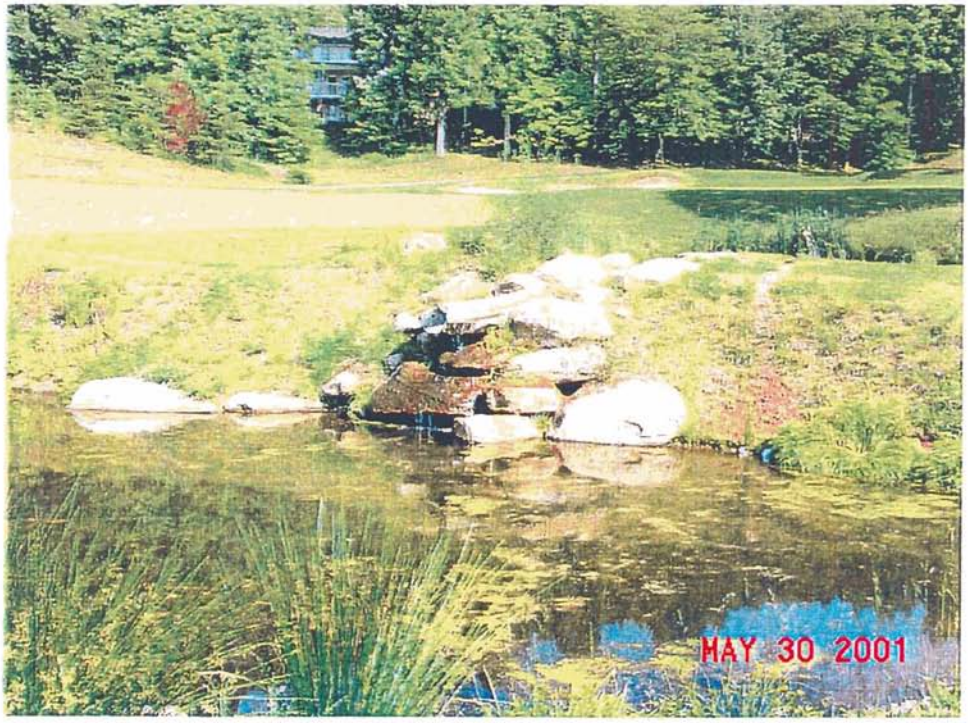


Photo 2: Begin Project – Pond area

Photo 3: Box Culvert at NC 191

Photo 4: Looking downstream from tributary confluence – vegetation typical

Photo 5: 13th green looking upstream

Photo 6: Looking upstream at 13th green

Photo 7: 2-60" RCP at end project (Fairway Falls Rd.)

Photo 8: Looking upstream - eroded banks typical

Photo 9: Good vegetation adjacent to 12th fairway (Sta. 5+00 to 10+00)

Photo 10: Stable d/s section used as reference

Photo 11: Vegetated area looking downstream (Sta. 7+00)

Photo 12: Stable area u/s of 12th green – looking upstream

Photo 13: Eroded banks at 13th green – looking d/s

Photo 14: Severe erosion at greens

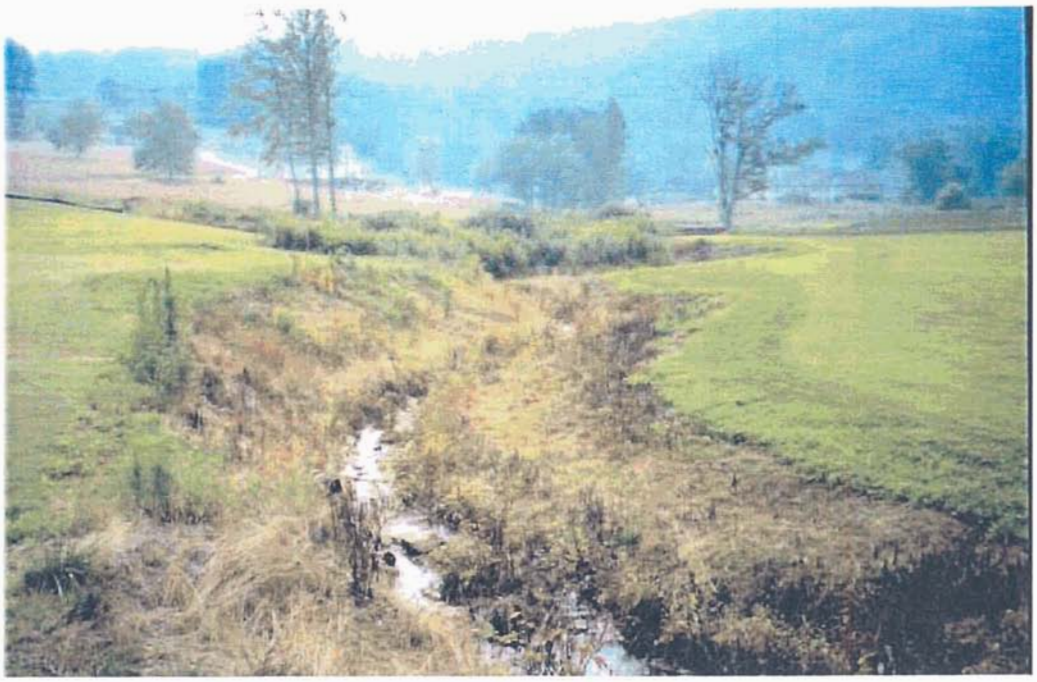


Photo 15: Little to no vegetation – typical section b

Photo 16: Reference 2 – Stable downstream section of County Line Creek

Photo 17: Reference 2 – Tributary to County Line Creek looking d/s

Photo 18: Reference 2 – Upstream tributary, upstream of 11th green