Synoptic sampling, February 2009

Synoptic sampling of streams in the Little Tennessee watershed was conducted 8-10 Feb 2009. This sampling was part of the Coweeta LTER VI funding. Its purpose was to (1) identify sites that might be suitable for intensive study, (2) provide data for scaling up from site data to the whole LTR watershed, and (3) collect data that will be interesting and publishable. The weather was unusually warm with partly cloudy skies and 60ºF temperatures during the days. There had been no precipitation for at least a week prior to the sampling. Twenty-seven people participated in the field sampling (Table 1), including 8 co-PI's, 12 graduate students, 5 technicians, and 2 volunteers. Chris Sobek, Shelley Robertson, Jason Meadors, and Jack Webster filtered all samples. Bobbie Niederlehner (technician, VT) supervised the preparation and processing of all filters. Cindi Brown (lab manager, FS) and Carol Harper (technician, UGA Coweeta) analyzed the water samples.

Table 1. Field sampling personnel.

Sunday 7 Feb	Monday 8 Feb	Tuesday 9 Feb
Rhett Jackson UGA	David Leigh	Katie Price
Jeff Hepinstall UGA	Brad Suther	Jason Love UGA Coweeta
Peter Baas UGA	Jake McDonald	Jason Meadors
Megan Machmuller UGA	Maury Valett.	John Frisch
Kristen Cecala UGA	Fred Benfield	Jennifer Knoepp
Kaitlin McLean UGA	Beth Cheever	Jack Webster
Nik Heynen UGA	Erika Kratzer	
Ellen Kohl UGA	Laurence Lin	
Seth Gustafson UGA	David Leigh	
Lilly Knoepp FS volunteer	Brad Suther	
Patty Knoepp FS volunteer	Jake McDonald	
David Leigh UGA	Katie Price UGA	
Brad Suther UGA	Jason Meadors UGA Coweeta	
Jake McDonald UGA	Chris Sobek FS	
Maury Valett VT	Jim Kitzner UGA Coweeta	
Fred Benfield VT	John Frisch	
Beth Cheever VT	Jennifer Knoepp	
Erika Kratzer VT	Jack Webster	
Laurence Lin VT	Cathy Pringle	
John Frisch UGA	Shelley Robertson	
Jennifer Knoepp FS		
Jack Webster VT		

Sampling sites were selected based on the following criteria:

1. Sites within the Little Tennessee River watershed upstream of the Needmore gage
2. Connection to previous terrestrial and aquatic studies and availability of existing data, including LINX2 sites, Hazard sites, NC DENR studies, and Katie Price's research sites.
3. Access to the site.
4. Sites should extend over a range of land use including representation of land use within the LTR watershed, with emphasis on (1) reference (>95% forest cover), (2) traditional valley development, and (3) mountain-side development.

Based on these criteria, we selected 57 potential sampling locations (Table 2). In actuality, we sampled all of these sites but one. We were unable to access Dryman Fork (site 7) within at the National Forest boundary because land owners did not allow us access from the downstream end and because the road from the top of the watershed was not drivable at this time. Some sites were relocated slightly from the original map-picked locations once we were actually at the site.

Table 2. Synoptic sampling sites. UTm coordinates are original, not actual.

Site number	Site name	UTM_e	UTM_n	Cluster
52	Needmore Gage	270259	3913373	North
13	Blazed Creek	285497	3908968	North
12	Upper Cowee at Mica City Road	285451	3907607	North
11	Shepherd Creek	283552	3907178	North
10	Mainstem of Cowee Creek	283137	3906589	North
16	Caler Creek Headwaters	287110	3906046	North
17	Tippett Creek	286680	3905758	North
14	Caler Main	283458	3905375	North
15	Dalton Creek	285116	3905157	North
18	Wautaga Lower Gate	289647	3903002	North
20	Brown Creek	288803	3901842	North
33	Burningtown	275080	3901224	North
34	Iotla Below Airport	280763	3900930	North
19	Wautaga Hazard	285600	3900750	North
35	Iotla Three Forks (above airport)	279830	3900118	North
32	Ray Branch	269548	3898728	North
51	Rabbit Creek	285216	3898467	North
29	Crawford Headwaters	280543	3895930	Central
30	Frogtown	283068	3895505	Central
31	Jaycee Park	281581	3895167	Central
44	Wayah Depot	271723	3894242	Central
26	Cullasaja Downstream	284757	3894161	Central
46	Wayah Forested Tributary	269049	3893777	Central
47	Wayah Upstream	267541	3893741	Central
45	Wayah Downstream	273251	3892978	Central
53	Prentiss Gage	283232	3892299	Central
23	Nickajack Mouth	289581	3891428	Central
24	Nickajack Mid-stream	289099	3890895	Central
41	Fulcher Mouth	283857	3889411	Central
42	Fulcher South Fork	285114	3889336	Central
25	Nickajack Headwaters	288245	3889246	Central
43	Fulcher North Fork	285041	3889218	Central
21	Jones Creek Katie Price Site	275316	3888570	Central
50	Hickory Knoll Upper	286091	3887922	Central
39	South Skeenah Creek Katie Price	279909	3887818	Central
40	Upper South Skeenah Creek	278607	3887545	Central
49	Hickory Knoll Mid-Stream	285280	3886955	Central
38	Bates Upper	281332	3886645	Central
37	Bates Creek at upstream of hwy 441	282634	3886530	Central
36	Hoglot Creek	282471	3885907	Central
48	Hickory Knoll Downstream	283005	3885616	Central
22	Jones Creek Headwaters	275715	3885553	Central
28	Highlands	302332	3883658	South
27	Cullasaja Gage	296466	3883211	South
5	Watershed 7	277454	3882881	South
1	Ball Creek Weir 9	278306	3882082	South
2	WS14 Weir	278238	3881762	South
6	Dryman Fork, Buddy Gap Road	280534	3881671	South
7	Dry Fork at FS Boundary	278910	3880722	South
3	Ball Creek LINX 1	276216	3880592	South
8	Howard Branch	280279	3880450	South
4	Watershed 27 Weir	275693	3880054	South
9	Little Tennessee and Hwy 246 Bridge	282768	3874024	South
56	Darnell Creek Downstream	284238	3870814	South
55	Jerry's Creek Upstream	281007	3870670	South
54	Jerry's Creek Downstream	282026	3870103	South
57	Darnell Creek Upstream	286008	3869822	South

Personnel were divided into teams (3 teams Sunday and Monday, 1 team Tuesday) and teams traveled together to the sites to collected samples and data (Table 3, Figures 1-3). Team leaders were Rhett Jackson and Fred Benfield (north sites), David Leigh and Maury Valett (central sites), and Jennifer Knoepp and Jack Webster (south sites). We made notes on site location and terrestrial characteristics, collected water and sediment samples for laboratory analyses, made on-site measurements of water and geomorphic characteristics, and took many digital photographs. Equipment was provided by the Virginia Tech Stream Team lab and the UGA Leigh and Jackson labs (Table 4). In the lab, unfiltered samples were filtered onto preweighed glass fiber filters for determining dry weight and ash-free dry weight of suspended particles. Filtered samples were frozen before analysis. Three thawed samples from each site were analyzed for soluble reactive phosphorus, NO_3, and NH_4, and the other three samples were thawed and analyzed for total nitrogen, total phosphorus, and organic carbon. Processing of suspended solids filters was done at the Virginia Tech lab, and chemical analyses were done at the Coweeta lab.

Table 3. Sample collection and measurements.

Notes	Detailed driving directions GPS coordinates (NAD83) Riparian land use Social/economic setting Stream quality rating
Water samples	3 1-L, unfiltered water samples for suspended solids 6 40-ml, filtered water samples for water chemistry
Water measurements	Turbidity from each suspended solids sample Specific conductance Water temperature
Geomorphic measurements	Wetted width, active channel bed width, and bankfull width at three cross sections Bankfull height above riffle thalweg Stream habitat types Dominant particle size in pool and riffle habitats Gradient
Geomorphic samples	3-L sample of deposited bed sediment
Pictures	Typical channel cross section Upstream panorama of stream Landscape photos Photos of scientists in action

Table 4. Sampling equipment.

	VT	UGA-Leigh	UGA-Jackson
GPS	1	2	
digital camera	JW - 1, VT - 1	1	1
Cond meter	3		3
Turb meter		1	2
Level, tripod, stadia rod, tape measure	1 set	2 sets	1 set
Coolers	6		
filtering equiptment (forceps, filters, etc)	VT all		
sample bottles, syringes, etc	VT all		
metal clipboards	3		
compass	JW- 1	2	
UGA all		UGA all	
Plastic bags, scoopers		UGA all	
Geomorph sheets	VT all		
Chemistry sheets	VT all		
Data books	VT all		
USGS maps	VT all		
GIS maps	John		
Nat. Geog. trail map			1
laptop for downloading photos	JW-1	2	

Figure 1. Water quality data sheet.

Winter 2009 Coweeta VI Synoptic Sampling: Water Quality Measurements

Scribe Name: ______________________

Personnel present: ______________________________________
____

Site Name: ______________________

Date: ______________________

Time: ______________________________________

Site Notes: ______________________________________
____
____

1) GPS coordinates (NAD, UTM83):

GPS (NAD, UTM83): ______________________

2) Temperature and conductivity

Specific Conductance ($\mu s\ cm^{-1}$) __________

Temperature (°C) __________

3) TSS and Turbidity	Btl #1	Btl #2	Btl #3
Total Suspended Solids (1-L btl #)			
Turbidity (NTUs)			

4) Inorganic Nutrients	Btl #1	Btl #2	Btl #3
Inorganic nutrients (50-ml btl #)			

4) Organic Nutrients	Btl #1	Btl #2	Btl #3
Organic nutrients (50-ml btl#)			

Figure 2. Geomorphic data sheet. Page 1.

Geomorphic Measurements for Coweeta LTER Synoptic Samples

Site Name: __________________________; **Date:** _____________; **Time:** _________

Required Equipment: digital camera, clipboard, white board & marker, stick rule with millimeters, laser level, tripod, tape measure or laser rangefinder, stadia rod, two 1 m long PVC pipes, 50 cm rebar/conduit, compass, watch, one gallon Ziplock bags, PVC scooper, laptop (for downloading pics)

1. Digital Photograph of the Stream Channel at the Sample Site:

Drive rebar or conduit into the lower bank and mount a 1 m white PCV pipe for scale on "river-right" (the right bank looking downstream or left bank looking upstream). Place the labeled white-board beside the scale (on the bank side). Position yourself at a distance of approximately three stream widths downstream from the scale (sufficient to fully capture both banks in the photo); hold the camera at a height of 1 m above the stream bed (use another 1 m PVC or stick rule to measure) and take one good photo that captures the stream channel cross-sectional morphology.

Photo # for Channel: ________________________ View Azumuth:_____________________

Date and Time of Channel Photo: ____

Position of Photographer Relative to Landmarks (i.e. Bridge): ___________________________

____

2. Digital Landscape Photographs: Ideally, capture both sides of the stream in a *panorama that can be mosaiced together*, panning with some overlap from left to right while looking in the upstream direction. Take these photos while the 1 m scale is still in the picture for scale.

Photo #s for Landscape: ____

Date and Time of Landscape Photos: ____

Location of Photographer (i.e on upstream edge of bridge) & Azimuth Range : ______________

____

3. Widths (m) ***(Within 3 Stream Widths At and Upstream of the Sample Site)*****:**

	Wetted Width (m)	Active Channel Bed Width (m)	Bankfull Width (m)
Estimated Median			
Minimum			
Maximum			

4. Estimate of ***Bankfull*** **Height (m) Above the Riffle Thalweg:** _______________(m)
-note that the bankfull height is the height of the *active* floodplain surface.

Figure 3. Geomorphic data sheet. Page 2.

5. Estimate of Relative Proportion of Habitat Types in 20X Reach Upstream of Site: (should sum to 100%):

Pool: _____%; Glide: _____%; Riffle: _____%; Rapid: _____%; Cascade: _____%; Waterfall ______%

6. Estimate of Dominant Riffle Particle Size (circle the one or those characterizing the dominant size categories based on the area of coverage):

mud <0.06mm	sand 0.06-2mm	granule 2-4mm	f. gravel 4-8mm	m. gravel 8-16mm	c. gravel 16-32mm	v.c. gravel 32-64mm	f. cobble 64-128mm	c. cobble 128-256mm	boulder >256mm	bedrock -------

7. Estimate of Dominant Pool Particle Size (circle the one or those characterizing the dominant size categories based on the area of coverage):

mud <0.06mm	sand 0.06-2mm	granule 2-4mm	f. gravel 4-8mm	m. gravel 8-16mm	c. gravel 16-32mm	v.c. gravel 32-64mm	f. cobble 64-128mm	c. cobble 128-256mm	boulder >256mm	bedrock -------

8. Reach Gradient or Energy Grade Slope:

Shoot the water surface elevation (rod height) at the top of riffles in the reach using a laser level mounted and leveled on a tripod downstream of the sampling site. Note the horizontal distance to each shot. The goal is to develop a linear regression line of distance versus height and to get the slope of this line. Two to six points should be sufficient over a distance of 5 to 20 stream widths.

Rod Ht . (m)	Distance Upstream (m)	Rod Ht. (m)	Distance Upstream (m)
__________	__________	__________	__________
__________	__________	__________	__________
__________	__________	__________	__________

9. Fine Bed-Sediment Sample (for use in geochemical sediment ascription study):

Collect a 1 gallon Ziplock bag (1/2 to 3/4 full) of the finest *recent* bed sediment that you can find (i.e. lots of mud) from the bed of the stream (pool) or edge of a bar. It must be recently transported sediment, and not bank material. Label the bag (site & date) prior to obtaining the sample. Use the PVC tray/scooper to avoid any metal contact with the sample.

10. Overall Stream Quality Rating (physical habitat/water qual./ecol.): poor - fair - good - excellent

11. Notes on General Riparian Land Use and Social/Economic Setting :

Sampling was completed at noon on Tuesday. All data sheets were copied. Webster and Leigh have copies of the geomorph data sheets and Webster and Knoepp have copies of the chemistry and filter processing data sheets. Leigh and Webster have copies of most photographs. Leigh will get the rest of the photographs and have John Chamblee place then on the Coweeta web site. Team leaders will be responsible for identifying all photographs. Webster will see that all chemistry data is submitted to John for data management.

Jack Webster, 9 Feb 2009

Synoptic sampling, June/July 2009

The second synoptic sampling of streams in the Little Tennessee watershed was conducted 30 Jun – 2 Jul 2009. The weather was warm. It rained early on the morning of 1 July but quit by about 7:30. Some of the early samples, especially in the north (Caler main, Cowee mainstream) may have been affected by the rain. Thirty-three people participated in the field sampling (Table 5), including 9 co-PI's, graduate students, technicians, and four undergraduate students from VT and UGA. Laurence Lin and Robert Northington did most of the filtering with some help from Thuy Nguyen and Stenka Vulova and supervision by Jack Webster. Cindi Brown (lab manager, FS) and Carol Harper (technician, UGA Coweeta) analyzed the water samples.

Table 5. Field sampling personnel.

Team North	Team Central	Team South
Fred Benfield (VT)	Maury Valett (VT)	Jen Knoepp (FS CWT)
John Maerz (UGA)	Jason Love (UGA CWT)	Rhett Jackson (UGA)
Jake McDonald (UGA)	Ted Gragson (UGA)	Kristen Cecala (UGA)
Beth Cheever (VT)	Brad Suther (UGA)	Robert Northington (VT)
Aurora Baker (VT/NCA&T)	Laurence Lin (VT)	Jason Meador (UGA CWT)
Sakura Evans (UGA)	David Hung (UGA)	John Chamblee (UGA)
Nick Jeremiah (VT)	Alex Baish (VT/JHU)	Stenka Vulova (UGA)
Joe Melanovich	John Frisch (UGA)	Greg Stickney (FS)
Brandi McCoy (VT)	Cameron Kresl	JR McMillan (UGA)
Lindsey Long	Julie Cosgrove	Thuy Nguyen (UGA)
Carolyn Dehring (UGA)		Sheila Cladis (FS)

Sampling sites were the same as the winter sampling (Table 6) except for the addition of Sky Valley, however, only limited sampling was done there. Dalton Creek was sampled at the wrong site, but samples were recollected for the correct site on 22 July. On this second trip, the conductivity was extremely high. Later measurements of conductivity were more reasonable. Also, the particle samples from 22 July were not analyzed for organic particles.

Table 6. Summer synoptic sampling sites. UTm coordinates are corrected after winter sampling.

Site #	Site Name	Group	UTM E	UTM N
54	Jerry's Creek Downstream	South	281500	3870341
55	Jerry's Creek Upstream	South	280080	3870917
56	Darnell Creek Downstream	South	284491	3871114
57	Darnell Creek Upstream	South	287455	3871146
9	Little Tennessee at Lamb Bridge	South	282660	3874870
4	Watershed 27 Weir	South	275682	3880009
8	Howard Branch	South	280251	3880381
3	Ball Creek LINX 1	South	276228	3880629
6	Dryman Fork, Buddy Gap Road	South	280484	3881307
7	Dryman Fork upstream	South		
2	WS14 Weir	South	278231	3881740
1	Ball Creek Weir 9	South	278300	3882076
28	Highlands	South	300508	3882895
5	Watershed 7	South	277437	3882913
27	Cullasaja Gage	South	295744	3883482
58	Sky Valley Mud Creek???	South	287983??	3873784???
22	Jones Creek Headwaters	Central	275704	3885526
48	Hickory Knoll Downstream	Central	283479	3885779
36	Hoglot Creek	Central	282620	3886153
37	Bates Creek at upstream of hwy 441	Central	282616	3886519
38	Bates Upper	Central	281065	3886596
49	Hickory Knoll Mid-Stream	Central	285282	3886975
39	South Skeenah Creek Katie Price	Central	279885	3887813
40	Upper South Skeenah Creek	Central	278607?	3887545?
50	Hickory Knoll Upper	Central	286026	3887928
21	Jones Creek Katie Price Site	Central	275307	3888589
25	Nickajack Headwaters	Central	288272	3889282
42	Fulcher South Fork	Central	285060	3889343
43	Fulcher North Fork	Central	284986	3889350
41	Fulcher Mouth	Central	283869?	3889403
24	Nickajack Mid-stream	Central	289119	3890892
23	Nickajack Mouth	Central	289570	3891407
45	Wayah Downstream	Central	273235	3892996
47	Wayah Upstream	Central	267618	3893824
46	Wayah Forested Tributary	Central	269065	3893830
26	Cullasaja Downstream	Central	284737	3894164
44	Wayah Depot	Central	271873	3894259
30	Frogtown	Central	282982	3895488
31	Jaycee Park	Central	282442	3895618
29	Crawford Headwaters	Central	280978	3896260
53	Prentiss Gage	Central	283232?	3892299?
51	Rabbit Creek	North	285240	3898475
32	Ray Branch	North	270724	3899224
19	Wautaga Hazard	North	285521	3900767
34	Iotla Below Airport	North	280757	3900933
35	Iotla Three Forks (above airport)	North	279573	3900989
33	Burningtown	North	275088	3901259
20	Brown Creek	North	289195	3901532
18	Wautaga Lower Gate	North	289578	3902897
15	Dalton Creek	North	285249	3904874
14	Caler Main	North	282564	3905438
17	Tippett Creek	North	286708	3905752
16	Caler Creek Headwaters	North	287581	3905937
10	Mainstem of Cowee Creek	North	283137	3906589
11	Shepherd Creek	North	283506	3906974
13	Blazed Creek	North	285496	3908912
12	Upper Cowee at Mica City Road	North	285236	3908995
52	Needmore Gage	North	270337	3913261

Personnel were divided into teams as in the winter. Team leaders were Fred Benfield (north sites), Maury Valett (central sites), and Jennifer Knoepp and Rhett Jackson (south sites). Jack Webster traveled around with a photographer from UGA taking pictures of the groups working (exceopt they never found Team South). Chemistry sampling was the same as winter, except we collected 4-L samples at about half the sites for particle sampling. Also, turbidity was measured in separately collected samples rather than from the particle samples. One person on each team made extensive notes on social characteristics (Figure 7). Geomorphic measurements were re-done as necessary. Wolman pebble counts of 100 particles were made at each site. Equipment was again provided by the Virginia Tech Stream Team lab and the UGA Leigh and Jackson labs (Table 4). Sample processing was the same as winter.

Table 7. Sample collection and measurements.

Notes	Checked GPS coordinates (NAD83) More extensive social/economic setting
Water samples	3 1-L or 4-L, unfiltered water samples for suspended solids 6 40-ml, filtered water samples for water chemistry
Water measurements	3 turbidity measurements from independent samples Specific conductance Water temperature
Geomorphic measurements	Remeasured as necessary Wolman pebble counts of 100 particles
Geomorphic samples	Additional samples of deposited bed sediment as necessary
Pictures	Re-did channel cross section Many additional photos

Figure 4. Water quality data sheet.

Summer 2009 Coweeta Synoptic Sampling: Water Quality

Site name and number: ____

Scribe Name: _____________________________

Personnel present: ____

____

Date and time: __________________________________

Site Notes:

GPS coordinates (NAD, UTM83): _____________________________________

Field measurements

Specific conductance (µS cm^{-1})			
Temperature (ºC)			
Turbidity (NTUs, 3 reps)			

Samples	Btl #1	Btl #2	Btl #3
TSS (1- or 4-L btl #s, <u>circle 1 or 4</u>)			
Inorganic nutrients (50-ml btl #s)			
Organic nutrients (50-ml btl #s)			

Notes about pictures taken:

Figure 5. Geomorphic data sheet. Page 1.

Geomorphic Measurements for Coweeta LTER Synoptic Sampling - July 2009

Site: ______________________________ **Team:** __________ **Date:** _______ **Time:** _______
Scribe: __________________

1. Digital photograph of stream channel at sample site:

Drive rebar/conduit into lower bank and mount 1 m black & white PVC pipe for scale on "river-right" (right bank when observer is facing downstream). Place labeled white board beside scale on the bank side. Position yourself about three stream widths downstream of scale (far enough to fully capture about 1 m of both banks in a single photo). Hold camera ~1 m above stream bed and take one photo that captures stream cross-sectional morphology. Measure & record azimuth of photo direction.

Photo # for channel: _______________ View Azimuth:__________ Date & Time: __________

Position of photographer relative to landmarks (e.g., bridge): ____________________________
____

2. Digital landscape photographs:

Capture both sides of stream in a panorama that can be stitched together, panning with some overlap from left to right while looking in upstream direction. Take photos when 1 m scale is still in place for scale.

Photo #s for landscape:____

Date & time of landscape photos:____

Location of photographer within reach and azimuth range:________________________________
____

3. Reach gradient or energy grade slope: (Re-survey needed at sites 3, 4, 9, 23, 26, 27, 28, 38, 40, 41, 42, 44, 50, 52, 53, 54, 57.

Shoot the water surface elevation (rod height) at the top of riffles in the reach using a laser level mounted and leveled on a tripod downstream of the sampling site. Note the horizontal distance to each shot. We will develop a linear regression line of distance versus height and calculate the slope of this line. 2 to 6 points should be fine over a distance of 5 to 20 stream widths.

Rod Ht. (m)	**Distance Upstream (m)**	**Rod Ht. (m)**	**Distance Upstream (m)**
________	__________	__________	__________
________	__________	__________	__________
________	__________	__________	__________

4. Fine bed sediment sample:

Fill one entire 1 gallon Ziplock bag of the finest *recent* bed sediment available. **WE NEED AS MUCH SILT AND CLAY AS POSSIBLE** – look downstream of logs and boulders, in back eddies, and on the edges of bars for this material. You can collect from plant-free bars but do not collect from vegetated banks. Label the bag (site & date) prior to collection. Use PVC scoop to avoid metal contact with sample. **Drain the water out of the top of the bag after settling and don't worry of you lose a little bit of sediment. Note: the following sites require collection of <u>two</u> bags**: #28 (Highlands / upper Cullasaja); #29 (Crawford Headwaters); #33 (Burningtown); #35 Iotla Three Forks (above airport); #52 Needmore Gage.

Figure 6. Geomorphic data sheet. Page 2.

5. Pebble Count

Randomly pick 100 particles from underwater from the most representative riffle in the reach. At least two observers should call out the values to the scribe for time efficiency. Avert your eyes, lower your finger to the stream bed, and measure the intermediate (b) axis (axis that would pass sieve hole) of the first particle you touch with a millimeter scale. Cover the entire area of the riffle ,but exclude emergent parts of bars or riffles. +/- 10% error in measurements is OK. Record all sand (0.063 – 2 mm) as 1 mm. Record all silts and clays (<0.063 mm) as 0.032 mm. Estimate the b-axis of embedded particles that cannot be removed from the bed and note them with an "E" beside the estimate in the table below.

B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)	B-axis (mm)

6. Riffle Embeddedness

Within the most representative riffle at the sample site, observe the channel bed and estimate the depth to which gravel and cobbles are buried (see "what to look for" below). Multiple people should make estimates and derive a "team" estimate. Circle the appropriate estimate in the table below.

Gravel or cobble particles are < 20% embedded.	Gravel or cobble particles are 20 to 30% embedded.	Gravel or cobble particles are 30 to 40% embedded.	Gravell or cobble particles are >40% embedded.	Riffle is completely embedded.
10	8	5	3	1

(Source: NWCC Technical Note 99-1, Stream Visual Assessment Protocol, December 1998)

Do not assess this element unless riffles are present or they are a natural feature that should be present.

Riffles are areas, often downstream of a pool, where the water is breaking over rocks or other debris causing surface agitation. In coastal areas riffles can be created by shoals and submerged objects. (This element is sensitive to regional differences and should be related to reference conditions.) Riffles are critical for maintaining high species diversity and abundance of insects for most streams and for serving as spawning and feeding grounds for some fish species. Embeddedness measures the degree to which gravel and cobble substrate are surrounded by fine sediment. It relates directly to the suitability of the stream substrate as habitat for macroinvertebrates, fish spawning, and egg incubation.

What to look for: This assessment characteristic should be used only in riffle areas and in streams where this is a natural feature. The measure is the depth to which objects are buried by sediment. This assessment is made by picking up particles of gravel or cobble with your fingertips at the fine sediment layer. Pull the particle out of the bed and estimate what percent of the particle was buried. Some streams have been so smothered by fine sediment that the original stream bottom is not visible. Test for complete burial of a streambed by probing with a length of rebar.

Figure 7. Social data sheet.

COWEETA LTER – Synoptic Sampling Site Description

Site Name: ____________________ Site#: ______ Date: __________

Recorder name: ______________________________

INSTRUCTIONS: Record quantities, distances and amounts in observations.

ROAD:
Unpaved ____________
Paved ____________
# of Lanes ____________

BRIDGE: Concrete / Wood

Power Lines ____________

RESIDENTIAL:
# of Houses ____________
# of Trailers ____________
# of Sheds ____________
# of Barns ____________
# of Abandoned Structures ____________

Gated Community ____________
Farm ____________
Neighborhood ____________
Trailer Park ____________
Camping/Campground ____________

STRUCTURES:
Commercial Business ____________
Church ____________
School ____________

FEATURES:
Fence
Wooden ____________
Metal ____________
Electric ____________
Barbed Wire ____________

Cistern ____________
Rain Barrel ____________
Irrigation Channel ____________
Culvert ____________
Creek ____________
Pond / Lake ____________

AGRICULTURE:
Home Garden ____________
Fruiting Bushes and Trees ____________
Crop Fields ____________
Pasture ____________

ANIMALS:
Cattle ____________
Donkey ____________
Horses ____________
Chickens / Ducks ____________
Dogs / Pets ____________
Bee Hives ____________

ARTIFACTS:
Beer Cans / Bottles ____________
Pipes / Hoses ____________
Cigarette Butts ____________
Plastic Bag ____________
Styrofoam ____________
Chemicals / Chemical Bottles ____________
Cinder Block / Brick ____________
Logs ____________
Bench / Chairs ____________
Lawnmower ____________
Boat ____________
BBQ Grill / Charcoal ____________
Fishing Gear ____________

RIPARIAN VEGETATION:
No Vegetation ____________
Herbaceous layer (Non-Lawn) ____________
Lawn ____________
Developed Understory ____________
Developed Overstory ____________

RIPARIAN ZONE TREATMENT:
Mowed ____________
Pruned ____________
Bush-hogged / Weed-whacked ____________
Plowed ____________
No Treatment ____________

Sampling was mostly completed at noon on Thursday. Filtering was finished Thursday evening. Data sheets were copied. Jack has original and Jen has copies of chemistry data sheets. Rhett has original and Jack has copies of geomorph sheets. Dryman Fork (upstream) was re-sampled for chemistry the following week because some of the sample containers were overfilled and burst when frozen. Also, Dalton Creek was resampled on 22 July.

Jack Webster, 6 Aug 2009

Meta data for chemistry data file – Jack Webster 15 Jan 2010

General – Specific conductance is a single field measurement. Turbidity was also measured in the field, but the reported value is the mean of three measurements. All other data are means of laboratory measurements from three samples except for a few cases where samples were missing or one sample was a significant outlier. Samples for solute chemistry were filtered in the field (GFF filters) directly into acid washed sample bottles. Winter refers to samples taken in February 2009, and summer samples were collected in June and July 2009.

Samples were analyzed for solute chemistry at Coweeta Hydrologic Laboratory using documented procedures on file at the lab. (We can add to this with Cindy's help if needed)

Suspended solids were analyzed at the Virginia Tech Stream Team lab. Samples were refrigerated and filtered within 24 hr. Measured volumes of 1 to 4 L were vacuum filtered onto pre-weighed, pre-ashed glass fiber filters (GFF). Filters were dried (> 24 h, 60°C), weighed, ashed (1 h, 550°C), rewetted with deionized water, redried, and weighed again.

Column	***Parameter***	***Units***
A	Site name	
B	Site number	
C	Winter specific conductance	µS
D	Winter turbidity	NTU
E	Winter ammonium (NH_4-N)	mgN/L
F	Winter nitrate (NO_3-N)	mgN/L
G	Winter total dissolved phosphorus (TDP)	mgP/L
H	Winter dissolved organic carbon (DOC)	mgC/L
I	Winter total nitrogen (TN)	mgN/L
J	Winter total dissolved solids (TSS)	mg/L
K	Winter ash free dry mass of TSS (AFDM)	mg/L
L	Winter ash of TSS (calculated = total TSS – AFDM)	mg/L
M	Winter TSS % organic (calculated)	%
N	Winter dissolved organic nitrogen (DON=TN – NO_3 – NH_4)	mgN/L
O	Summer specific conductance	µS
P	Summer turbidity	NTU
Q	Summer ammonium (NH_4-N)	mgN/L
R	Summer nitrate (NO_3-N)	mgN/L
S	Summer dissolved inorganic phosphorus (PO_4-P)	mgP/L
T	Summer total dissolved phosphorus (TDP)	mgP/L
U	Summer dissolved organic carbon (DOC)	mgC/L
V	Summer total nitrogen (TN)	mgN/L
W	Summer total dissolved solids (TSS)	mg/L
X	Summer ash free dry mass of TSS (AFDM)	mg/L
Y	Summer ash of TSS (calculated = total TSS – AFDM)	mg/L
Z	Summer TSS % organic (calculated)	%
AA	Summer potassium (K)	mg/L
AB	Summer sodium (Na)	mg/L
AC	Summer calcium (Ca)	mg/L
AD	Summer magnesium (Mg)	mg/L
AE	Summer chloride (Cl)	mg/L
AF	Summer sulfate (SO_4)	mgSO_4/L
AG	Summer dissolved organic nitrogen (DON=TN – NO_3 – NH_4)	mgN/L