Year One Monitoring Report

WELLS CREEK AT SYDNOR
PROPERTY

December 2005

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Wells Creek at Sydnor Property

Prepared for:
North Carolina Department of
Environment and Natural Resources
Ecosystem Enhancement Program

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Executive Summary

ARCADIS was retained by the North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program, (EEP), formerly the Wetlands Restoration Program (NCWRP), to conduct stream restoration using natural-channel design methodologies on two portions of Wells Creek and an unnamed tributary (UT) to Wells Creek in south-central Alamance County (Figure 1). The site is at the end of Longest Acre Road on Breaburn Farm near the community of Snow Camp. Dr. Charles F. and Mrs. Cindy Sydnor own the property.

The goal of the stream restoration is to improve water quality in the Cape Fear River Basin. An estimated 530 tons of sediment were generated annually from the project area. Based on visual observations, the majority of the banks have been stabilized. Two cross vanes are piping on Reach #1, and three problems areas exist on Reach #2. It does not appear that the two cross vanes that are piping on Reach #1 will affect the performance of the restoration project. The piping has not affected the stability of the structures, and the monitoring survey was performed during extreme low-flow conditions. During normal flow, water would be flowing over the header rock. The problem areas on Reach #2 are the result of normal channel processes. All problem areas will need to be monitored in the future to determine if the area is increasing in size or severity. Nutrient and temperature reduction are also water quality goals of the restoration project. Establishing a permanent, vegetated riparian buffer and excluding cattle from the buffer and stream are expected to reduce the nutrient input from adjacent land and reduce water temperature through shading. At this time, water quality is not being monitored at the site.

Bare root seedlings were planted on 8-foot spacings within the designated buffer. This spacing is based on an initial density of 640 stems per acre. Initial stem counts were not conducted. The planting was performed 3 to 4 months after construction, under a separate contract One of the nine vegetation plots (Plot #2) is not fulfilling the established 5-year success criteria due to the robust growth of *Microstigium vinimuim* within the plot. Stem counts in the remaining vegetation plots result in 350 to 1,050 stems per acre. A small area of *Ailanthus altissima* has persisted herbicide treatment on Reach 2.

The monitoring survey and report for the project were performed prior to EEP establishing and presenting their monitoring protocol and report format. The monitoring was performed using the methodologies outlined in the Mitigation Plan (ARCADIS 2004). Information was not collected during the field surveys that are now

required by EEP. Where possible, information currently required by EEP in their monitoring reports was collected by reviewing photographs or plan and profile sheet of the site or from staff's memory. In many cases, information was not collected and could not be obtained.

1. Project Background

1.1 Location and Setting

The project site is near the community of Snow Camp in south-central Alamance County, North Carolina. To reach the site from Raleigh, go west on US Route 64 to Siler City. In Siler City go north on Martin Luther King Boulevard; the North Carolina Atlas and Gazetteer (DeLorme 1997) labels the road Snow Camp Road. Continue north toward the community of Snow Camp (approximately 12 miles). Just before Snow Camp take a left on SR 2360 (Sylvan School Road). Continue on Sylvan School Road approximately 2 miles then take a right on Bass Mountain Road. Continue on Bass Mountain Road for approximately ½ mile and take a left on Beale Road. Continue on Beale Road for approximately 1 mile, then turn right on Longest Acre Road (Wright Road in the NC Gazetteer). Reach 1 is at the end of Longest Acre Road. All three reaches are located in the triangle created by Bass Mountain Road, Beale Road and Thompson Road. Figure 1 shows the location of the three reaches.

1.2 Structure and Objectives

The goal of the stream restoration is to improve water quality in the Cape Fear River Basin. An estimated 530 tons of sediment are generated from the project area. This is a conservative estimate, given that fewer than 1,000 linear feet of the over 6,000 feet of stream bank were studied. Wells Creek and its unnamed tributary (UT) at this project site are typical of streams within this and surrounding watersheds, exhibiting instability and degradation in response to current and historic land-use practices. Nutrient input should decrease through establishing a permanent, vegetated riparian buffer and excluding cattle from the buffer. The buffer will provide shade to the stream, reducing water temperatures and providing additional wildlife habitat to the site. Stabilization and vegetation development are being monitored.

The northernmost section, and longest at approximately 3,000 linear feet (lf), makes up Reach 1 of Wells Creek. Reach 2 is a southern 1,244-linear-foot section of Wells Creek. The UT to Wells Creek is approximately 1,493 lf long and lies directly west of Reach 2. The above lengths are based on pre-restoration conditions.

In order to restore the streams to a more natural condition, Priority I, II, and III restoration was implemented on the site. Along various lengths in each reach, a completely new stream channel was constructed, reconnecting the stream with its floodplain (Priority I/Restoration). In other areas, the existing pattern was maintained

but the channel profile and dimensions were adjusted (Priorities II and III/Enhancement I). Boulder structures were constructed and root wads installed in strategic locations on the streams. The boulder structures provide stream bed and stream bank stability by reducing near bank shear stress and providing grade control. The rootwads provide bank protection as well as increase habitat diversity within the channel. Tables 1 and 2 summarize the project structure and objectives.

1.3 Project History and Background

Prior to the implementation of the restoration, Wells Creek and its tributary were in an active cattle pasture with the stream providing the only water for the cattle. The current land owner cleared the land for pasture when it was purchased in the 1970s. Prior to the 1970s, the land was forested. However, it is expected that in the past the property, like all land in the area, was in agriculture. Evidence of past land use in the area include an old breached rock dam at the downstream end of Reach 1 and the lack of sinuosity on all three reaches. An old rock dam is also located upstream of Reach 2. According to the owner of this property, there was a mill on site. It is likely that the streams were altered in the past to facilitate agricultural practices. Tables 3, 4 and 5 outline the project history and background.

1.4 Monitoring Plan and Profile Views

The monitoring plan and profile views are shown in Appendix A. The year one alignment and profile is overlain on the baseline.

2. Methodology

Monitoring methodology follows Monitoring Level I established by the US Army Corps of Engineers, Stream Mitigation Guidelines (April 2003). The restoration site consists of three separate reaches totaling approximately 6,700. Sections of each restored reach are being monitored. The lengths of each reach being monitored are: 1,213 lf of Reach 1; 1,123 lf of Reach 2 and 1,083 lf of the unnamed tributary. This makes the total length of stream being monitored 3,419 lf. This is within the range established by the Stream Mitigation Guidelines (USACE 2003), which state, "If the stream section is greater than 3,000 lf, the profile should be conducted for either 30% of the restored stream or 3,000 lf (whichever is greater)."

The field surveys and data reduction were performed prior to EEP developing and presenting their current monitoring methodologies and reporting format. The methodologies outlined in the Mitigation Plan (ARCADIS 2004) were followed for this monitoring event. In some instances, information required by the current guidelines could be calculated or determined in the office by reviewing site photographs, plan and profile sheet and sometimes by memory of on-site observation.

Location surveys of the constructed features were conducted to monitor the performance of the stream restoration. These surveys were conducted in July 2005, using total station survey equipment. A longitudinal profile and four permanent cross sections (two riffle and two pool) per reach were conducted on the portion of each reach being monitored. Pebble counts, photographs, and vegetation assessments were also performed and will provide information to determine the success of the restoration.

2.1 Longitudinal Profile

The longitudinal profile of the restored stream was surveyed for approximately 1,000 lf on each reach. The heads of riffle, run, pool, maximum pool and glide features were surveyed in the longitudinal profile, allowing the calculation of water-surface slope at each feature, average water-surface slope, pool length, and pool-to-pool spacing. At each feature, locations were determined for the thalweg, left and right edges of water, left and right bankfull elevations, and left and right tops of bank. These locations enabled the creation of a plan view of the restored stream. Stream pattern (i.e., meander length, radius of curvature, belt width, and sinuosity) were also measured from the plan view.

Pools constructed downstream of the boulder cross vanes were surveyed in the longitudinal profile. These pools were included in the pool-to-pool spacing and the pool-to-pool-spacing-to-bankfull width ratio calculations.

2.2 Permanent Cross Sections

Four permanent cross sections (two riffles and two maximum pools) were surveyed at each reach. One riffle and one pool cross section are located where new channel was constructed. The other set of cross sections is located where the existing stream pattern was maintained. The beginning and end of each permanent cross section were marked using wooden stakes labeled with the cross section number. Cross sections are perpendicular to the stream flow. The cross section survey noted all grade breaks, tops of banks, left and right bankfull, edges of water, and thalweg. The cross sections were plotted and the bankfull cross sectional area calculated. This area was compared with the Regional Curves for Rural Piedmont North Carolina (Harman et. al. 1999) (Appendix B). The bankfull mean depth was calculated by dividing the bankfull cross sectional area by the bankfull width. The width-to-depth ratio was calculated by dividing the bankfull width by the bankfull mean depth. The streams were classified using the Rosgen system of stream classification (Rosgen 1994).

2.3 Pebble Count

A modified Wolman pebbled count (Rosgen 1993) consisting of 50 samples was taken at each permanent cross section. The cumulative percent was graphed and the D16, D35, D50, D84, and D95 calculated.

2.4 Photo Documentation

Permanent photo points have been established. Photographs were taken at these points at the same time as the monitoring field surveys.

2.5 Vegetation

Stem survival of planted woody vegetation is being monitored at three permanent 20-foot-by-45-foot plots at each reach. Plots are shown on the plan sheets. The corners of the plots are marked so they can be located in future surveys. Baseline data for woody vegetation were not collected. Surviving stems within the plots were tallied by species. The total stems present per acre were computed for each plot.

3. Project Condition and Monitoring Results

The following section presents the result of the year one monitoring surveys. A discussion of problem areas and instances where success criteria are not being met is also included.

3.1 Vegetation Assessment

Bare root seedlings were planted on 8-foot spacing within the designated buffer. This spacing is based on an initial planting density of 640 stems per acre. Initial stem counts were not conducted. The planting was performed 3 to 4 months after construction was completed, under a separate contract. ARCADIS was not notified when the plantings were installed, so initial totals could not be tallied. Fifteen species were recorded from the monitoring plots. The highest number of species was seven, observed in two plots, while the least number was three, observed in only one plot.

All vegetation monitoring plots are meeting the established success criteria of 320 stems per acre with the exception of Vegetation Plot #2 located on Reach 1. This plot has a robust layer of *Microstigium viminium* that survived herbicide treatment. The *Microstigium* is outcompeting the planted bare root seedlings and inhibiting the natural establishment of vegetation. Vegetation Plot #2 currently has 5 surviving bare root seedlings (3 species), that calculates to 250 stems per acre. Stem counts in the remaining vegetation plots result in 350 to 1,050 stems per acre. Total number of stems by species is presented in Table 6, and photographs of each plot are shown in Appendix C.

An area of *Ailanthus altissima* has persisted herbicide treatment on Reach 2 in the vicinity of photograph point 8. The area is approximately 400 square feet and is comprised of several small *Ailanthus* trees.

Monitoring both areas in future monitoring events will be crucial. It is possible that these invasive species may spread throughout the buffer area and could potentially prevent the site from meeting the vegetation success criteria. In which case, remedial actions may be required.

3.2 Stream Assessment

The streams are functioning as designed. This can be seen by the minor difference between the baseline and year one survey on the plan, profile and cross section sheets.

There are small areas of bank erosion, aggradation and down-cutting on all three reaches. When these areas are compared to the scale of the project, they are not significant at this time. Future monitoring events will identify any trends in these areas, i.e. whether they are minor adjustments in the channel or the areas are getting worse and need remedial actions. Tables 7 and 8 present the morphology and hydraulic summary of the baseline and year one monitoring, respectfully.

Two cross vanes on Reach 1 are piping. Vanes at sta. 11+58 PRWCR1 and sta. 12+78 PRWCR1 are piping through the fill material and filter fabric installed upstream of the structures. The piping does not appear to be a concern at this time. It is not affecting the stability of the structures; during higher flows, the water would flow over the header rocks. These structures should be closely monitored in future monitoring events.

3.3 Pebble Count

Year one and baseline pebble count results are shown in Table 9.

3.4 Bankfull Event

One near bankfull event was observed January 14, 2005. It appears that bankfull had occurred shortly before the observation. A significant amount of recent sediment deposition and debris was observed on the floodplain and vegetation on the floodplain was laying down in the direction of flow. It is unknown if other bankfull events occurred.

4. Summary

At this time the stream restoration and buffer establishment is performing without major flaw. One vegetation plot is not meeting established success. However, the remaining eight are far exceeding the established success criteria. The two cross vanes that are piping are not a significant concern. The piping is not jeopardizing the integrity of the structure, and the structures are still providing grade control as designed. Future monitoring events will identify project trends; that is, whether the stream is trending toward a more stable plan form or toward instability with the problem areas becoming larger and significant.

5. References

ARCADIS G&M of North Carolina, Inc. (ARCADIS). 2004. Mitigation Plan, Wells Creek at Sydnor Property.

DeLorme. 1997. The North Carolina Atlas and Gazateer.

Harman, W. H., et al. 1999. Bankfull Hydraulic Geometry Relationships for North Carolina Streams. AWRA Wildland Hydrology Symposium Proceedings. Edited By: D.S. Olsen and J.P. Potyondy. AWRA Summer Symposium. Bozeman, MT.

Rosgen, D. L. 1994. A Classification of Natural River. Catena, Volume 22: 166-169, Elsevier Science, B. V. Amsterdam.

Rosgen, D. L. 1993. Applied Fluvial Geomorphology, Training Manual. River Short Course, Wildland Hydrology, Pagosa Springs, Colorado. 450 pp.

U. S. Army Corps of Engineers (USACE). 2003. Stream Mitigation Guidelines. http://www.saw.usace.army.mil/wetlands/Mitigation/stream_mitigation.html

Appendix A

Plan and Profile Views

Appendix B

North Carolina Rural Piedmont
Regional Curves

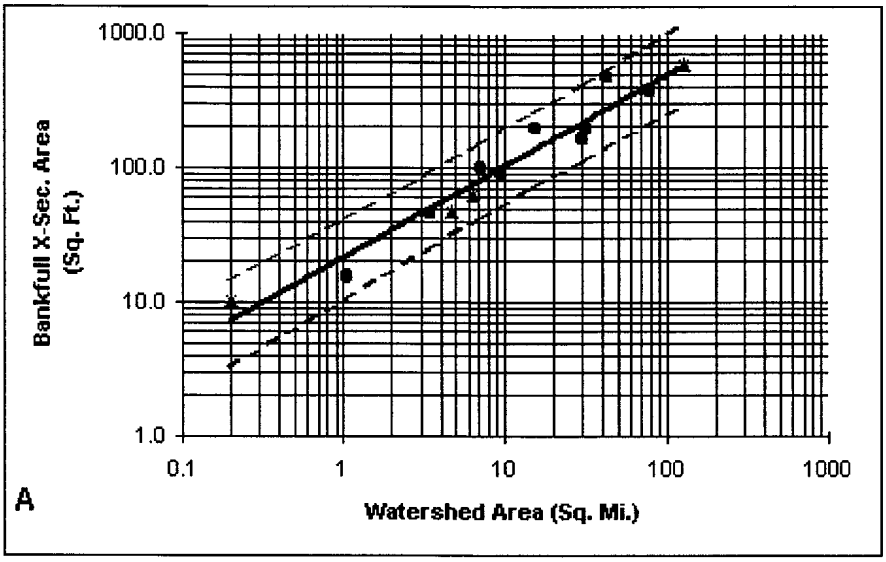
Appendix C

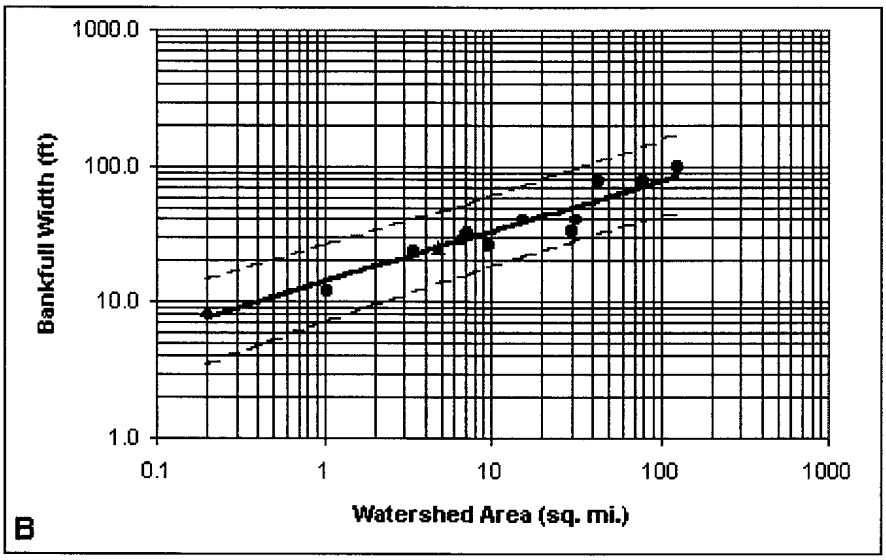
Photographs

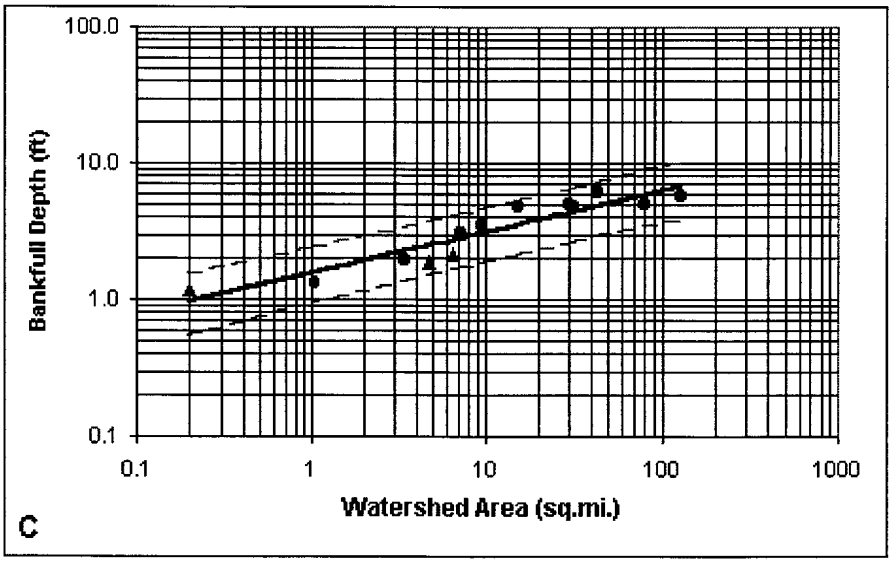
Appendix B

North Carolina Rural Piedmont
Regional Curves

Bankfull hydraulic geometry relationships for rural Piedmont North Carolina Streams. The four graphs represent:
a) cross sectional area, b) width, c) depth, and d) discharge. The circles represent gage stations and the triangles represent ungaged streams. The outside dashed lines are the 95% confidence intervals for all the data points.







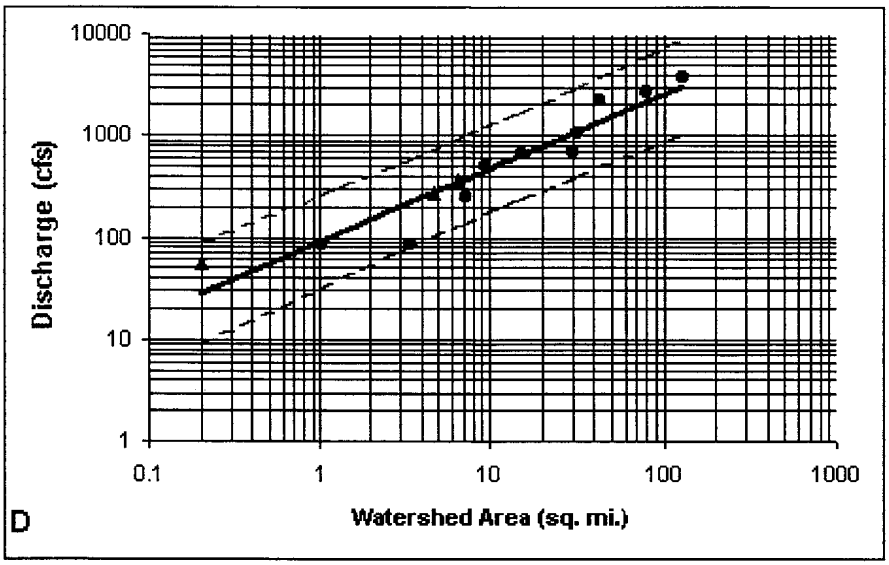

10000
1000
100
10
1
Discharge (cfs)
0.1
1
10
100
1000
Watershed Area (sq. mi.)
D

Table 1: Hydraulic geometry, survey summary, and flood frequency analyses for gaged and ungaged stream reaches.

Stream Name	Gage Station ID	Drainage Area (mi^2)	Stream Type (Rosgen)	Bankfull Discharge (cfs)	Bankfull Xsec Area (ft^2)	Bankfull Width (ft)	Bankfull Mean Depth (ft)	Water Surface Slope (ft/ft)	Return Interval (Years)	Exceedence Probability (%)
Sal's Branch	Reference Reach	0.2	E4	55.4	10.4	8.7	1.2	0.0109	n/a	n/a
Humpy Creek	02117030	1.05	E5	83.0	15.8	12.0	1.3	0.0060	1.7	59
Dutchmans	02123567	3.44	C5	85.1	45.6	23.5	1.9	0.0170	1	100
Mill Creek	Reference Reach	4.7	E4	277	46.7	24.5	1.9	0.0080	n/a	n/a
Upper Mitchell River	Reference Reach	6.5	B4c	356	62.5	29.2	2.1	0.0095	n/a	n/a
Norwood Creek	0214253830	7.18	E5	253.7	98.8	32.0	3.1	0.0008	1.1	91
North Pott's Creek	02121180	9.6	E5	507.2	89.6	25.4	3.5	0.0012	1.7	59
Tick Creek	02101800	15.5	E	655.3	194	40.5	4.8	0.0005	1.3	77
Moon Creek	02075160	29.9	E5	708.8	162	33.0	4.9	0.0015	1.8	56
Long Creek	02144000	31.8	E5	1041	195	40.0	4.9	0.0010	1.4	71
Little Yadkin River	02114450	42.8	G5	2236	469	77.5	6.1	0.0018	1.4	71
Mitchell River	02112360	78.8	C	2681	377	77.0	4.9	0.0030	1.6	63
Fisher River	02113000	128	C3	3687	578	101	5.7	0.0023	1.4	71

Equations

Bankfull Cross-Sectional Area vs. Drainage Area: $y = 21.43x^{0.68}$

Bankfull Discharge vs. Drainage Area: $y = 89.04x^{0.72}$

Bankfull Width vs. Drainage Area: $y = 11.89x^{0.43}$

Bankfull Mean Depth vs. Drainage Area: $y = 1.5x^{0.32}$

Reach #1. Photograph Point #1. Looking upstream. Year one monitoring. 07/28/05

Reach #1. Photograph Point #1. Looking downstream. Year one monitoring. 07/28/05

Reach #1. Vegetation Plot #1. View from southeast corner looking to northeast corner. Year one monitoring. 07/28/05

Reach #1. Photograph Point #2. Looking downstream. Year one monitoring. 07/28/05

Reach #1. Photograph Point #2. Looking upstream. Year one monitoring. 07/28/05

Reach #1. Photograph Point #2. Looking north. Year one monitoring. 07/28/05

Reach #1. Cross Section #1. Maximum Pool. Looking upstream. Year one monitoring. 07/28/05

Reach #1. Cross Section #2. Riffle. Looking upstream. . Year one monitoring. 07/28/05

Reach #1. Vegetation Plot #2. View from northeast corner looking to southwest corner. Year one monitoring. 07/28/05

Reach #1. Photograph Point #3. Looking upstream. Year one monitoring. 07/28/05

Reach #1. Photograph Point #3. Looking downstream. Year one monitoring. 07/28/05

Reach #1. Cross Section #3. Riffle. Looking upstream. Year one monitoring. 07/28/05

Reach #1. Vegetation Plot #3. View from southeast corner looking to northwest corner. Year one monitoring. 07/28/05

Reach #1. Photograph Point #4. Looking upstream. Year one monitoring. 07/28/05

Reach #1. Cross Section #4. Maximum Pool. Looking upstream. Year one monitoring. 07/28/05

Reach #2. Photograph Point #5. Looking upstream. Year one monitoring. 07/28/05

Reach #2. Photograph Point #5. Looking downstream. Year one monitoring. 07/28/05

Reach #2. Vegetation Plot #7. View from northeast corner looking to southwest corner. Year one monitoring. 07/28/05

Reach #2. Cross Section #9. Riffle. Looking upstream. Year one monitoring. 07/28/05

Reach #2. Photograph Point #6. Looking upstream. Year one monitoring. 07/28/05

Reach #2. Photograph Point #6. Looking downstream. Year one monitoring. 07/19/05

Reach #2. Cross Section #10. Maximum Pool. Looking upstream. Year one monitoring. 07/19/05

Reach #2. Vegetation Plot #8. View from east corner looking to west corner. Year one monitoring. 07/19/05

Reach #2. Photograph Point #7. Looking upstream. Year one monitoring. 07/19/05

Reach #2. Photograph Point #7. Looking downstream. Year one monitoring. 07/19/05

Reach #2. Vegetation Plot #9. View from southeast corner looking to northwest corner. Year one monitoring. 07/19/05

Reach #2. Photograph Point #8. Looking upstream. Year one monitoring. 07/19/05

Reach #2. Photograph Point #8. Looking downstream. Year one monitoring. 07/19/05

Reach #2. Cross Section #11. Riffle. Looking south to north. Year one monitoring. 07/19/05

Reach #2. Photograph Point #9. Looking upstream. Year one monitoring. 07/19/05

Reach #2. Photograph Point #9. Looking downstream. Year one monitoring. 07/19/05

Reach #2. Cross Section #12. Maximum Pool. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #10. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #10. Looking downstream. Year one monitoring. 07/19/05

UT. Cross Section #5. Maximum Pool. Looking upstream. Year one monitoring. 07/19/05

UT. Vegetation Plot #4. View from southwest corner looking to northeast corner. Year one monitoring. 07/19/05

UT. Cross Section #6. Riffle. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #11. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #11. Looking downstream. Year one monitoring. 07/19/05

UT. Vegetation Plot #5. View from northeast corner looking to southwest corner. Year one monitoring. 07/19/05

UT. Cross Section #7. Riffle. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #12. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #12. Looking downstream. Year one monitoring. 07/19/05

UT. Cross Section #8. Maximum Pool. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #13. Looking upstream. Year one monitoring. 07/19/05

UT. Photograph Point #13. Looking downstream. Year one monitoring. 07/19/05

UT. Vegetation Plot #6. View from northwest corner looking to southeast corner. Year one monitoring. 07/19/05