FINAL

North Muddy Creek Mitigation Report

McDowell and Burke Counties, North Carolina

USGS HUC: 03050101040020

Project ID No. 16-D06115

Before

After

Prepared for:

Environmental Banc & Exchange
909 Capability Drive, Suite 3100
Raleigh, NC 27606

Submitted to:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

April 2009

Executive Summary

The North Muddy Creek site consists of five separate stream reaches and three wetland areas. Unnamed Tributary 1 (UT1) and its associated wetland areas are located just north of Interstate 40 on the McDowell/Burke County line on property owned by J. David and Betty Jean Connolly. UT2, UT4, and UT5 and their associated wetland areas are located immediately south of Interstate 40 in McDowell County on property owned by James G. Benfield. UT6 and its associated wetland area is located south of Interstate 40 in McDowell County on property owned by Robert E. Price (see **Figure 1**). The project streams lie within the Catawba River Basin (Hydrologic Unit Code **03050101040020**) and the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-30.

UT1 flows east to west and drains into Muddy Creek. UT1 is a perennial stream that begins at an off-site pond and is divided into two reaches (Upper UT1 and Lower UT1). The stream enters the project site in a steep valley setting and flows into the flat floodplain of Muddy Creek (see **Figure 2**). Prior to restoration, cattle had open access to both stream reaches, which actively degraded the buffer, banks, bed, and water quality. Lower UT1 also had been historically straightened and dredged. The spoils of the dredging that had been deposited on the banks formed berms that acted like hydrologic barriers, preventing frequent flood flows from inundating the adjacent wetland areas. UT1 contains two on-site jurisdictional wetlands, which have been enhanced.

UT5 is a perennial stream that had been historically straightened (see **Figure 3**) prior to restoration. The lower reach of UT5 was incised, lacked in-stream habitat, and was not connected to its floodplain. There was minimal to no woody buffer along this section of UT5. UT5 contains a jurisdictional wetland at the toe of the valley slope. Prior to its enhancement/preservation, the wetland area had been degraded along its outer boundary due to periodic tilling and open cattle access.

UT6 is a perennial stream that had been historically straightened and cleared (see **Figure 4**). Prior to restoration, the wetland hydrology had been removed because of the ditching, channelization of the associated stream, and severely limited infiltration of ponded waters. The land surface of this area had been smoothed, crowned, ditched, altered by cattle access, and stripped of forest cover.

The restoration reaches included all of UT1 and UT6 and the lower section of UT5. Prior to construction, these reaches had minimal woody riparian buffers, failed culvert crossings, and livestock access. In addition, the reaches had been physically altered (straightened) in the past. These impairments created unstable bed and banks and excess sediment, nutrients, and biochemical demand (BOD). These problems combined with the lack of sufficient re-oxygenating riffle features, reduced dissolved oxygen within the water column. Water quality also was diminished due to raised turbidity from bank erosion and elevated water temperatures caused by the lack of tree shading. Habitat potential was reduced by the diminished water quality and loss of physical habitat such as bed features, woody debris, and a well developed vegetative community.

The enhancement reach was located amidst two preservation reaches along UT5. Prior to construction, this reach was mainly affected by incision, livestock access, and adjacent eroding dirt roads. The enhancement reach was aggrading, causing a lack of diversity, habitat, and degraded water quality. This reach was enhanced (enhancement level I and II) through livestock exclusion fencing and was reattached to its floodplain through the addition of log sills for grade control. The log sills also added riffles and pools to help diversify the bed form and add habitat.

The preservation reaches included UT2, UT4, and UT5, which are headwater streams that flow into Muddy Creek (see **Figures 3** and **5**). These reaches were stable, had a mature woody riparian buffer, and were not incised. Steep slopes prevented livestock from accessing the reaches. These reaches were protected with a recorded permanent conservation easement.

Wetland enhancement areas located in UT1 and UT5 are hydrated by their connection to the groundwater table, hill slope seepage, runoff, and over-bank flooding from the nearby streams. Modifications to these enhancement areas included livestock exclusion and supplemental plantings.

Wetland restoration areas located in UT1 and UT6 were modified by grading (a maximum of 6 inches) to bring the ground elevation within a foot of the mean growing season water table. The land surface was reshaped to allow over-bank flows to route though the wetland. The grading also created microtopography to increase ponded water detention and infiltration times. The areas that were open fields were revegetated with woody species, thereby increasing hydraulic roughness of the floodplain, leading to an increase in the duration of flooding in these areas. Restoring the streams and backfilling the ditches will restore the local ground water table and increase the frequency and duration of flooding from smaller storm events.

Goals and Objectives

Based on the site conditions described above, the goals and objectives achieved by this project include:

Goals achieved:

- Provided an ecological uplift by re-establishing and improving terrestrial and aquatic habitat and diversity.

Objectives achieved:

- Removed excess nutrients and sediment through the use of vegetative buffers;
- Increased dissolved oxygen concentrations through the use of in-stream structures and the turbulence they produce in pools;

- Stabilized stream banks using bioengineering and/or natural channel design techniques;
- Improved substrate through the use of structures and the elimination of major on-site sediment sources;
- Created habitat diversity by introducing woody structures such as log vanes and rootwads;
- Reduced temperature by restoring canopy in the buffer areas;
- Reconnected streams to their adjacent floodplains and wetlands;
- Raised groundwater levels in adjacent wetlands by raising channel bed elevations;
- Removed and/or plugged ditches that previously drained historic wetlands;
- Created micro-topography by regarding and ripping wetlands;
- Broke up historically compacted soils to allow groundwater to reach the surface and wetland vegetation to flourish;
- Controlled the invasive exotics by removing them during construction;
- Preserved stable on-site streams and riparian buffers draining into the enhancement/restoration reaches;
- Excluded livestock through fencing;
- Improved crossings by replacing pipes and/or stabilizing outfalls; and
- Protected site assets through the recordation of a conservation easement.

The streams were restored using either Rosgen Priority 1 or Priority 2 methodologies. Priority 1 was employed along the wetland restoration areas to restore the groundwater table and increase over-bank flooding in small storm events. The wetland and riparian areas were ripped to remove compaction from the livestock and create microtopography. The riparian buffer and wetlands were replanted or planted with supplemental, native woody species to restore ecological function to the buffer and wetlands.

All stream reaches (restoration, enhancement, and preservation) are protected with a recorded permanent conservation easement. As shown in **Tables 1** and **2** below, the mitigation work at the site resulted in the restoration, enhancement, and/or preservation of 7,960 linear feet of stream for a total of 4,996 stream mitigation units (SMUs) and 20.2 acres of riparian/non-riparian wetlands for a total of 16.4 wetland mitigation units (WMUs).

Table 1: Stream Mitigation Summary

Project Stream	Stream Restoration (linear feet)	Stream Enhancement Level I (linear feet)	Stream Enhancement Level II (linear feet)	Stream Preservation (linear feet)	Total
Total Site	3,974	337	336	3,313	7,960
Total SMUs	3,974	225	134	663	4.996

Table 2: Wetland Mitigation Summary

Project Wetlands	Riparian Wetland Restoration (acres)	Riparian Wetland Enhancement (acres)	Riparian Wetland Preservation (acres)	Riparian Total (acres)	Non-Riparian Wetland Restoration (acres)	Total
Total Site	11.4	3.7	2.5	17.6	2.6	20.2
Total WMUs	11.4	1.9	0.5	13.8	2.6	16.4

Monitoring in 2008 through 2012 will assess the site's streams to determine restoration success. The monitoring plan has been established based on guidance provided by *Stream Mitigation Guidelines* disseminated by the United States Army Corps of Engineers – Wilmington District (McLendon, Scott, Fox, St. John et al. 2003) and the most current version of the North Carolina Ecosystem Enhancement Program (EEP) documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports." Streams will be monitored for stability using cross section and longitudinal profile surveys and photo documentation.

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Narrative

The North Muddy Creek site consists of five separate project reaches. The first reach, Unnamed Tributary 1 (UT1), is located just north of Interstate 40 on the McDowell/Burke County line. UT5 and UT6 are both located south of Interstate 40 in McDowell County (see **Figure 1**). The project streams lie within the Catawba River Basin (Hydrologic Unit Code **03050101040020**) and the North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-30. The site is defined by the conservation easement surrounding the stream and riparian buffers that cover approximately 34.8 acres.

Prior to construction, the site consisted of five unnamed tributaries and associated wetlands (UT1, UT2, UT4, UT5, and UT6), which included approximately 7,960 linear feet of unnamed tributaries to Muddy Creek. The land adjacent to the site (outside of the conservation easement) is being used for cattle grazing and hay production. It also included portions of undisturbed forest. All five systems drain a watershed consisting of predominately forest and agricultural land.

The pasture land surrounding the streams, wetlands, and wetland restoration areas lacked strong rooted vegetation (e.g., woody or deep-rooted herbaceous vegetation). Pasture grasses dominated most of the riparian buffer with isolated specimens of hardwoods. These areas were highly impacted by livestock access and historical ditching and channelization. Most of the stream banks were actively failing predominantly due to hoof shear. Stream features were obliterated by continuous livestock access.

Based on the above site conditions, the goals and objectives achieved by this project include:

Goals achieved:

- Re-established and improved terrestrial and aquatic habitat and diversity.

Objectives achieved:

- Removed excess nutrients and sediment through the use of vegetative buffers;
- Increased dissolved oxygen concentrations through the use of in-stream structures and the turbulence they produce in pools;
- Stabilized stream banks using bioengineering and/or natural channel design techniques;
- Improved substrate through the use of structures and the elimination of major on-site sediment sources;
- Created habitat diversity by introducing woody structures such as log vanes and rootwads;
- Reduced temperature by restoring canopy in the buffer areas;

- Controlled the invasive exotics by removing them during construction;
- Preserved stable on-site streams and riparian buffers draining into the enhancement/restoration reaches;
- Excluded livestock through fencing;
- Improved crossings by replacing pipes and/or stabilizing outfalls,
- Created vernal pools and oxbow lakes; and
- Protected site assets through the recordation of a conservation easement.

Applying Rosgen Priority 1 and 2 methodologies, natural channel design techniques were used to adjust the channel dimension, pattern, and profile to a stable configuration for each restoration reach. The configuration was based on reference reach morphology, values from regional curves, regime equations, experience from other restoration projects, and the existing channel morphology (see **Figures 2-5)**.

Upper UT1 was designed as a Rosgen B stream because of its setting in a steep valley. Lower UT1, UT5, and UT6 were designed as Rosgen C streams with high width-to-depth ratios and point bars. The wetlands on UT1 and UT5 were designed to be riparian bottomland hardwood areas. The wetlands on UT6 were designed to be mostly riparian bottomland hardwood areas with some non-riparian areas at the toe of slope away from the streams.

The middle section of UT5 was enhanced (enhancement levels I and II) through livestock exclusion fencing and woody structure placement. This reattached the stream to its historic floodplain, diversified the bed form, and added additional habitat areas.

UT2, UT4, and stable reaches of UT5 and their riparian buffers were preserved. All stream reaches (restoration, enhancement, and preservation) are protected with a recorded permanent conservation easement (see **Figures 2-5**).

Wetland enhancement areas located in UT1 and UT5 are hydrated by their connection to the groundwater table, hill slope seepage, runoff, and over-bank flooding from the nearby streams. Modifications to these enhancement areas included livestock exclusion and supplemental plantings.

Wetland restoration areas located in UT1 and UT6 were modified by grading (a maximum of 6 inches) to bring the ground elevation within a foot of the mean growing season water table. The land surface was reshaped to allow over-bank flows to route though the wetland. The grading also created microtopography to increase ponded water detention and infiltration times. The areas that were open fields were revegetated with woody species, thereby increasing hydraulic roughness of the floodplain, leading to an increase in the duration of flooding in these areas. Restoring the streams and backfilling the ditches will restore the local ground water table and increase the frequency and duration of flooding from smaller storm events.

The riparian buffer of the entire easement was planted in five zones. Zone 1, the stream bank zone, consisted of planted tree and shrub species and seeded native herbaceous species typically found along stream banks in the region. Zone 2, a forested riparian area, consisted of selected tree and shrub species that are tolerant of inundation and saturation. Zone 3 was a transitional zone between the other zones and the conservation easement. It included a mixture of light-tolerant, canopy, and understory species. Zone 4, a wetland/bottomland hardwood zone, covered planting zones in the wetland restoration areas where the inundation or saturation occurs for a long enough period of time during the growing season to select species more adapted to hydric conditions. Zone 5 included areas that already had appropriate native forest vegetation. In these areas, supplemental tree and shrub species were planted as needed. Zone 1 was planted with live stakes, and Zones 2 through 5 were planted with bare root seedlings. Plant spacing was determined according to planting type.

Inspection of the vegetation plots during the baseline monitoring phase showed that the planting density matched the density prescribed in the planting plan. It should be noted that Zone 5 plantings in currently forested areas are supplemental. As a result, the actual densities may reflect the spacing of mature forested areas.

Table 3: Stream Mitigation Summary by Reach

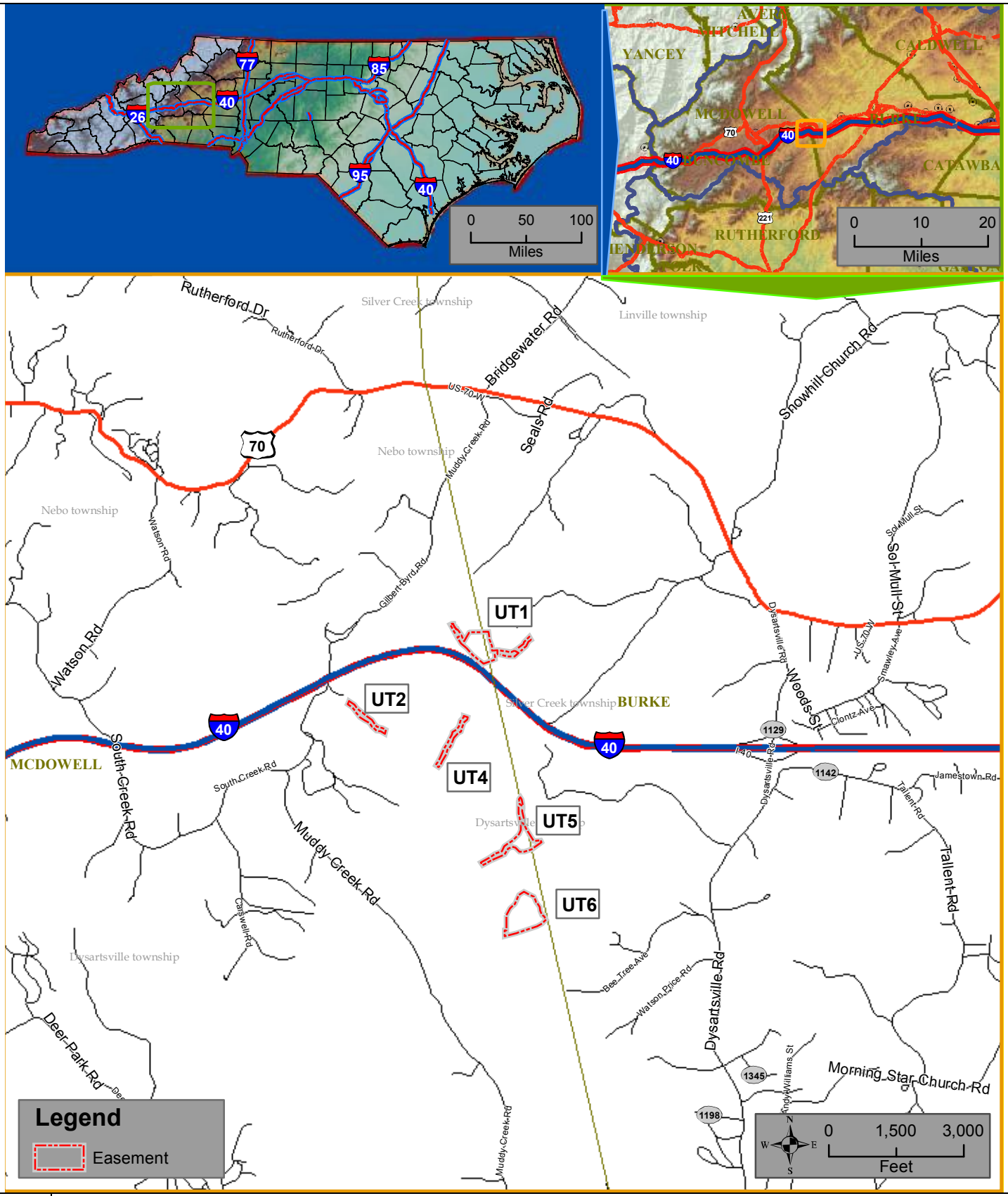
Project Stream	Stream Restoration (linear feet)	Stream Enhancement Level I (linear feet)	Stream Enhancement Level II (linear feet)	Preservation (linear feet)	Total
UT1	2,257	0	0	0	2,257
UT2	0	0	0	1,172	1,172
UT4	0	0	0	1,421	1,421
UT5	550	337	336	720	1,943
UT6	1,167	0	0	0	1,167
Total Site	**3,974**	**337**	**336**	**3,313**	**7,960**
Total SMUs	**3,974**	**225**	**134**	**663**	**4,996**

Table 4: Wetland Mitigation Summary by Reach

Project Wetlands	Riparian Wetland Restoration (Acres)	Riparian Wetland Enhancement (Acres)	Riparian Wetland Preservation (Acres)	Riparian Total (Acres)	Non-Riparian Wetland Restoration (Acres)	Total (Acres)
UT1	3.3	3.0	0.3	6.6	0	6.6
UT2	-	-	-	-	-	-
UT4	-	-	-	-	-	-
UT5	0	0.7	2.2	2.9	0	2.9
UT6	8.1	0	0	8.1	2.6	10.7
Total Site	**11.4**	**3.7**	**2.5**	**17.6**	**2.6**	**20.2**
Total WMUs	**11.4**	**1.9**	**0.5**	**13.8**	**2.6**	**16.4**

Table 5: Mitigation Units Summary

Contract Stream Mitigation Units (SMUs)	As-built Stream Mitigation Units (SMUs)	Contract Riparian Wetland Mitigation Units (WMUs)	As-built Riparian Wetland Mitigation Units (WMUs)	Contract Non-Riparian Wetland Mitigation Units (WMUs)	As-built Non-Riparian Wetland Mitigation Units (WMUs)
5,014	4,996	12	13.8	2.4	2.6

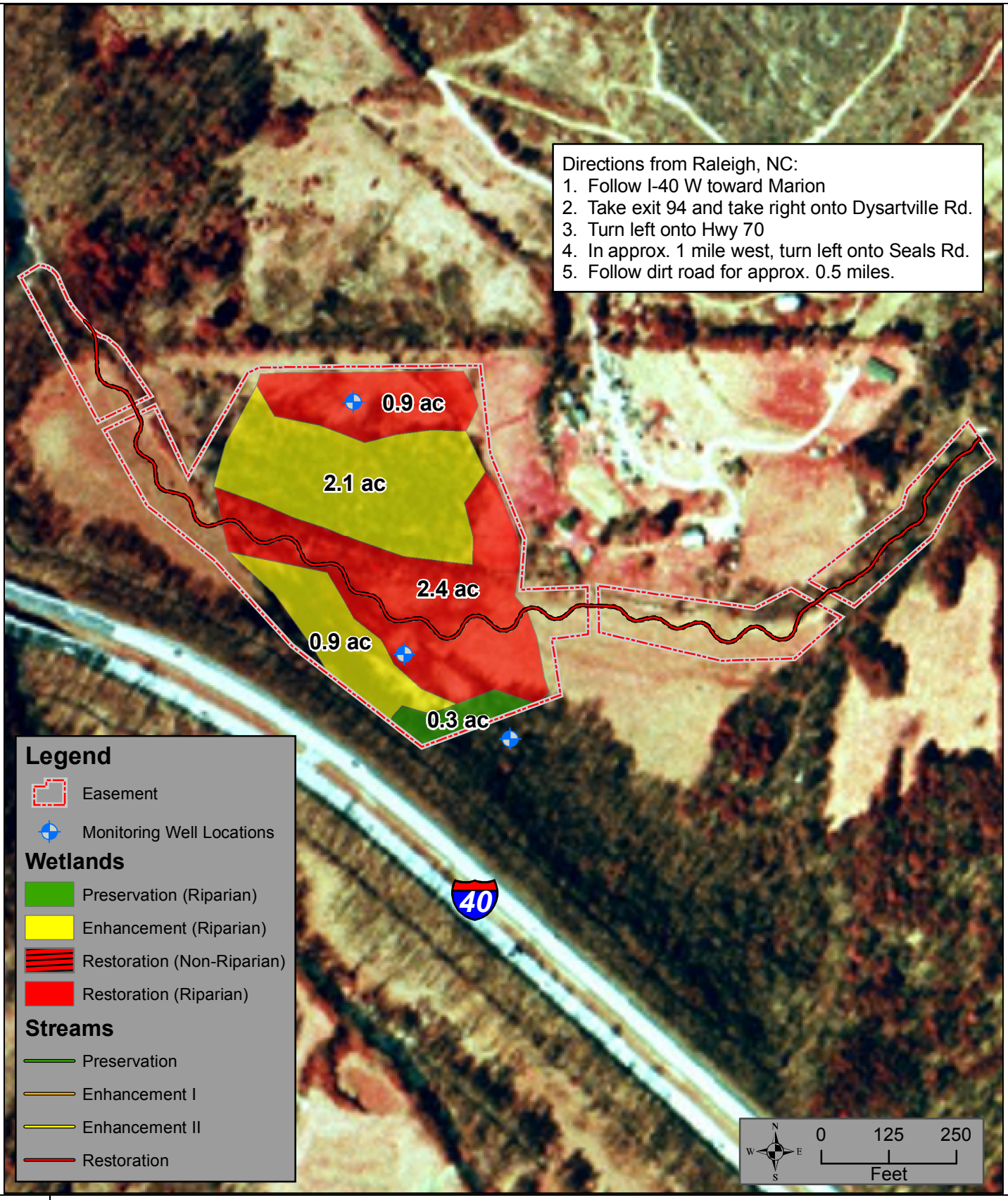


Title	Vicinity Map

Submitted to:

Ecosystem Enhancement Program

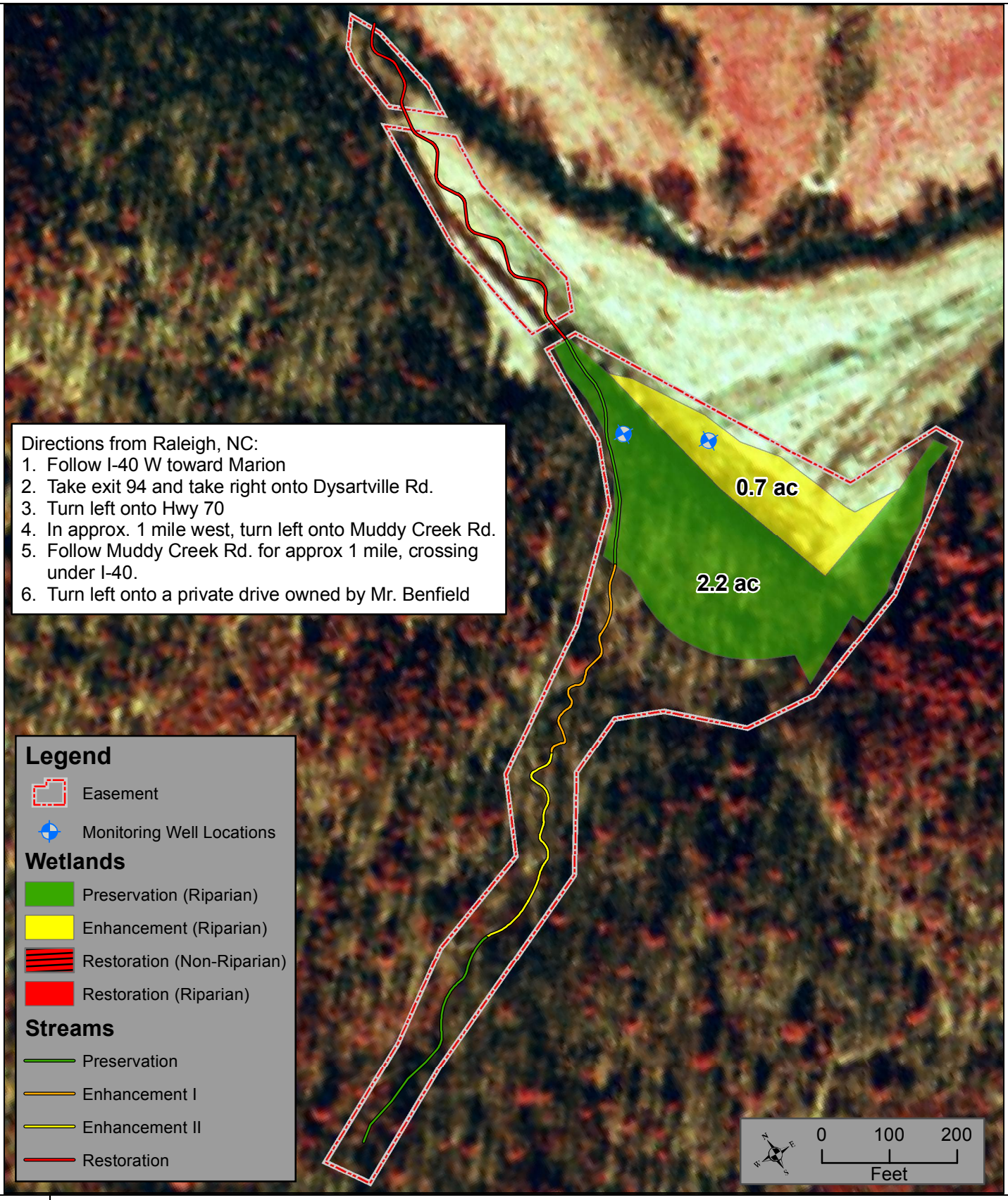
Project	North Muddy Creek Site McDowell and Burke Counties, North Carolina		
	Date	**Project Number**	**Figure**
	4/20/09	16-D06115	1



Title	Project Component/Asset Map – UT1

Submitted to: Ecosystem Enhancement Program

Project	North Muddy Creek Site McDowell and Burke Counties, North Carolina	
Date	**Project Number**	**Figure**
4/20/09	16-D06115	2



Title	Project Component/Asset Map – UT5		
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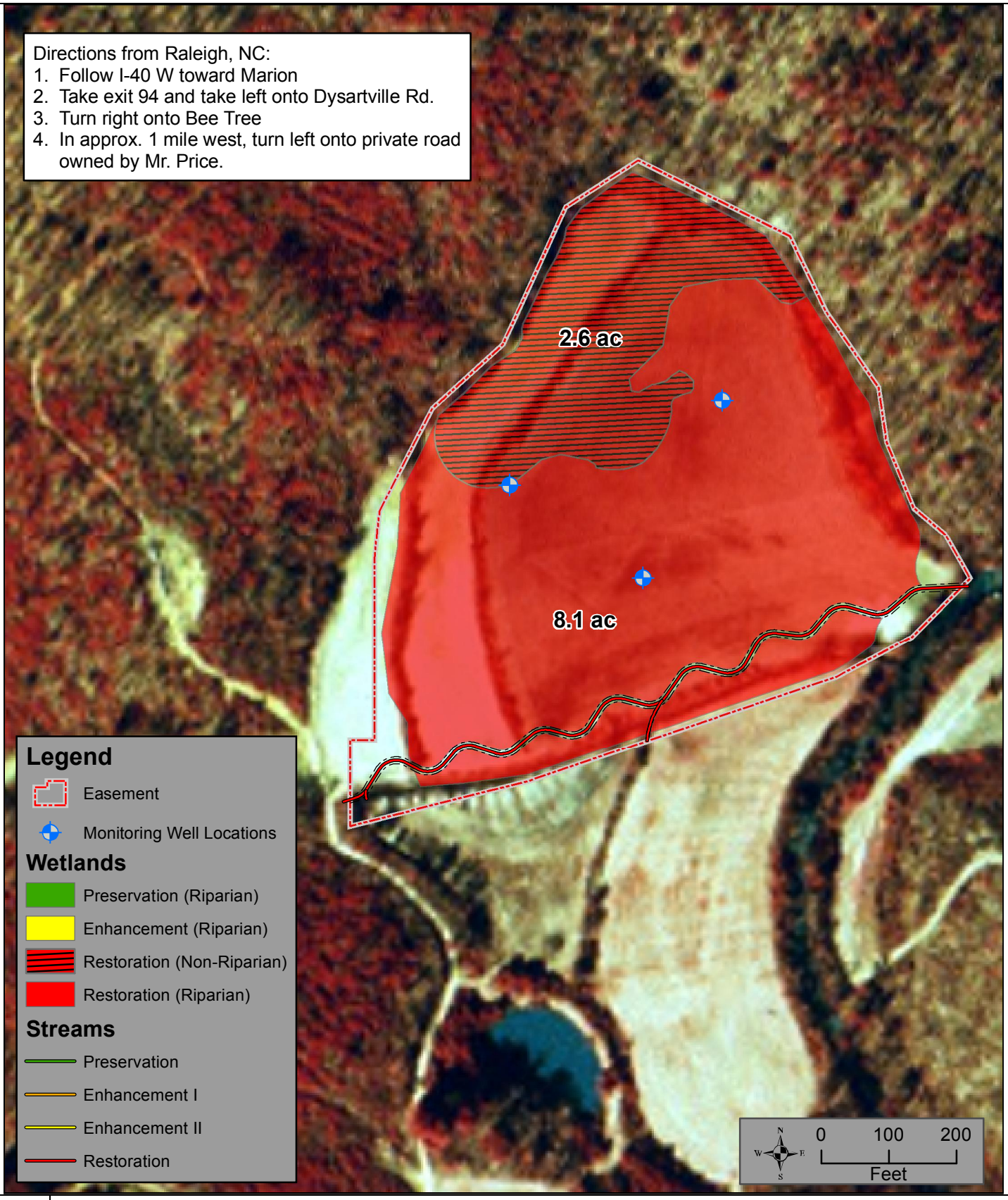
	Date	Project Number	Figure
	4/20/09	16-D06115	3



Title	Project Component/Asset Map – UT6		
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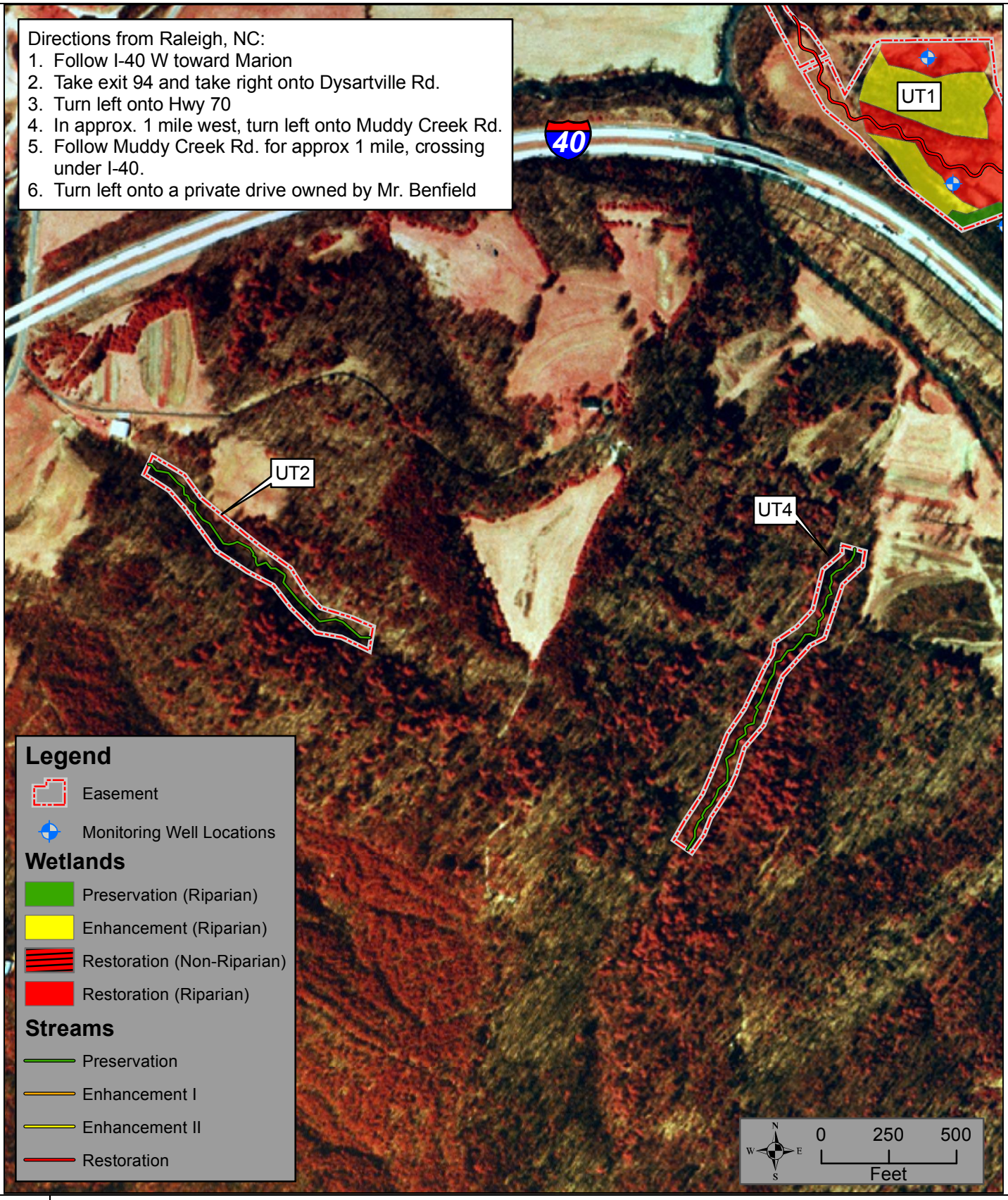


Title	Project Component/Asset Map – UT2 and UT4

Submitted to: Ecosystem Enhancement Program

Project	North Muddy Creek Site McDowell and Burke Counties, North Carolina	
Date	**Project Number**	**Figure**
4/20/09	16-D06115	5

Monitoring Plan

The monitoring plan to evaluate the success of the stream restoration project is based on guidance provided by *Stream Mitigation Guidelines* disseminated by the United States Army Corps of Engineers (USACE) – Wilmington District and recommendations from the North Carolina Ecosystem Enhancement Program (EEP). The collection and summarization of monitoring data will be conducted in accordance with the most current version of the EEP documents entitled "Content, Format, and Data Requirements for EEP Monitoring Reports."

Monitoring will occur annually for five years and include reference photographs, materials sampling, site survey, visual assessment, and mapping of significant features. The success criteria and assessment methods for the site's streams and riparian buffer are provided below.

Stream Monitoring

Success Criteria

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

Deviation from the design ratios will not necessarily denote failure, as it is possible to maintain stability and not stay within the design geometry. Changes to the as-built hydraulic geometry may occur due to natural processes of channel adjustment.

Assessment Methods

Nine permanent cross sections have been installed at unique stream segments throughout the project site. The cross sections represent five riffles and four pools. Annual photographs showing both banks will be taken for each cross section.

Four longitudinal profile sections have been installed totaling 4,090 linear feet of survey. UT1-Upper consists of 386 linear feet, UT1-Lower consists of 2,054 linear feet, UT5 consists of 578 linear feet, and UT6 consists of 1,072 linear feet of surveyed profile.

Thirty-three permanent photo stations have been established to capture the condition of the channel and vegetation plots. Eleven vegetation plot photos have been established.

The restored and enhanced stream reaches will be investigated for channel stability and in-stream structure functionality. Evidence of channel instability (if found) will be identified, mapped, and photographed. Structures will be inventoried for functionality.

Riparian Buffer and Wetlands Vegetation

Success Criteria

The success of riparian and wetland vegetation planting will be gauged by stem counts of planted species. Riparian and wetland vegetation will be considered successful with the survival of 260 planted stems per acre at the end of the fifth year of monitoring. Survival of 320 planted stems per acre at the end of the third year of monitoring will be used as an interim measure of success. Photos taken at established photo points should indicate maturation of riparian vegetation community.

Assessment Methods

The success of vegetation plantings will be measured through stem counts. Eleven (11) permanent plots will be used to sample the riparian buffer and restoration wetlands. Each quadrant covers 100 square meters. During the counts, the health of the vegetation will be noted. The vegetation survey will occur during the growing season. Permanent photo stations have been set up for each plot.

Wetland Hydrology

Success Criteria

The success of wetland hydrology will be based on a comparison the monitoring gauge data from the restoration sites to that of the enhancement sites. The groundwater hydrology of the enhancement areas will serve as the site's hydrology reference for target groundwater hydrology because the enhancement areas (pre-construction) exhibited wetland groundwater hydrology but lacked appropriate vegetation. The enhancement sites are considered to have already met wetland hydrology criteria because they are considered to be jurisdictional by the USACE. They also are in similar landscape positions and should have hydrological responses similar to the restored wetlands. The hydrological success also will be based on saturation of the upper surface of the soils for 7% of the growing season.

Assessment Methods

Wetland groundwater hydrology will be monitored using shallow continuous monitoring gauges. Monitoring gauges have been placed in the proposed restoration and enhancement areas. This data will be used to confirm that the success criteria have been met.

References

McLendon, Scott, Becky Fox, Todd St. John, et al. (2003). Stream Mitigation Guidelines. United States Army Corps of Engineers - Wilmington District, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission, and North Carolina Department of Natural Resources - Division of Water Quality.

Rosgen, David L. (1995). A Geomorphic Approach to Restoration of Incised Rivers. Management of Landscapes Disturbed by Channel Incision.

Mathis Jr., Roy L. (1995). Soil Survey of McDowell County, North Carolina. Natural Resources Conservation Service, United States Department of Agriculture.

Attachment A
Record Drawings

(See Record Set separate from this document – dated 01/15/2009)

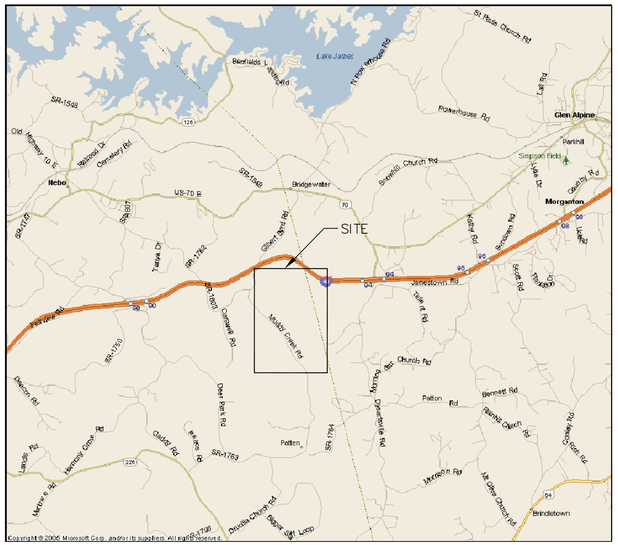
Record Set For

NORTH MUDDY CREEK

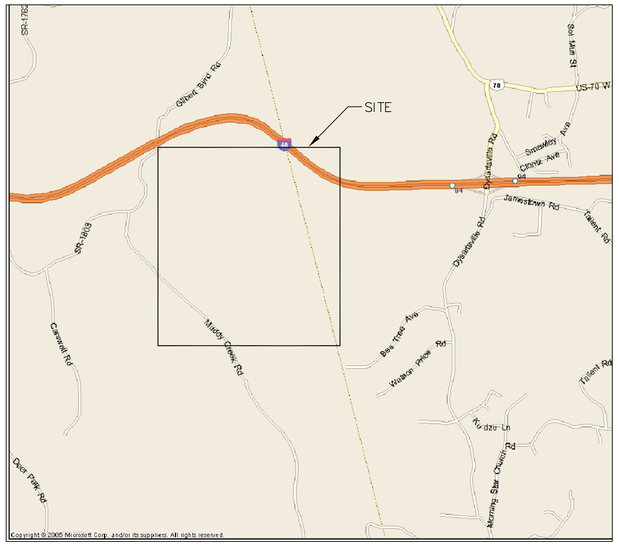
STREAM AND WETLAND RESTORATION PROJECT
ENVIRONMENTAL BANC & EXCHANGE, LLC

BURKE AND McDOWELL COUNTIES, NORTH CAROLINA

CONTRACT: D 06115
LAT: 35.695733 LONG: -81.864488
ENVIRONMENTAL BANC & EXCHANGE, LLC CONTACT: NORTON WEBSTER (919) 829-9909
KIMLEY-HORN AND ASSOCIATES CONTACT: WILLIAM WILHELM, PE. (704) 333-5131
DISTURBED AREA: 22 ACRES

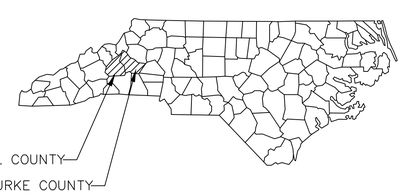


VICINITY MAP



LOCATION MAP

INDEX OF SHEETS



STATE OF NORTH CAROLINA

ALL CONSTRUCTION MUST CONFORM TO THE UNDERGROUND UTILITY PROTECTION ACT
BEFORE YOU DIG! CONTACT ONE-CALL CENTER 1-800-632-4949

SURVEY PREPARED BY:

SUTTLES SURVEYING, P.A.
40 SOUTH MAIN STREET
SUITE 200
MARION, NC 28752
(828) 652-9382

REV.	No.:	REVISION:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
SUITE 300, 4651 CHARLOTTE PARK DRIVE,
CHARLOTTE, NORTH CAROLINA 28217
PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
COVER SHEET

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 1 OF 22

K:\CHL_Environmental\018336 EBX\001 N Muddy Creek\DWG\6 Record Set\01-COVER.dwg

SURVEY LEGEND

- PROPERTY LINE
- EXISTING CENTERLINE
- SS — SANITARY SEWER
- OW — OVERHEAD POWER
- G — NATURAL GAS
- FO — FIBER OPTIC
- UTILITY EASEMENT
- MAJOR CONTOURS
- MINOR CONTOURS
- TREELINE
- ROAD / PATH
- WM — WATER METER
- S — SEWER MANHOLE
- POWER / UTILITY POLE
- CAPPED REBAR
- EXISTING TREE
- EXISTING BUILDING

PLANTING LEGEND

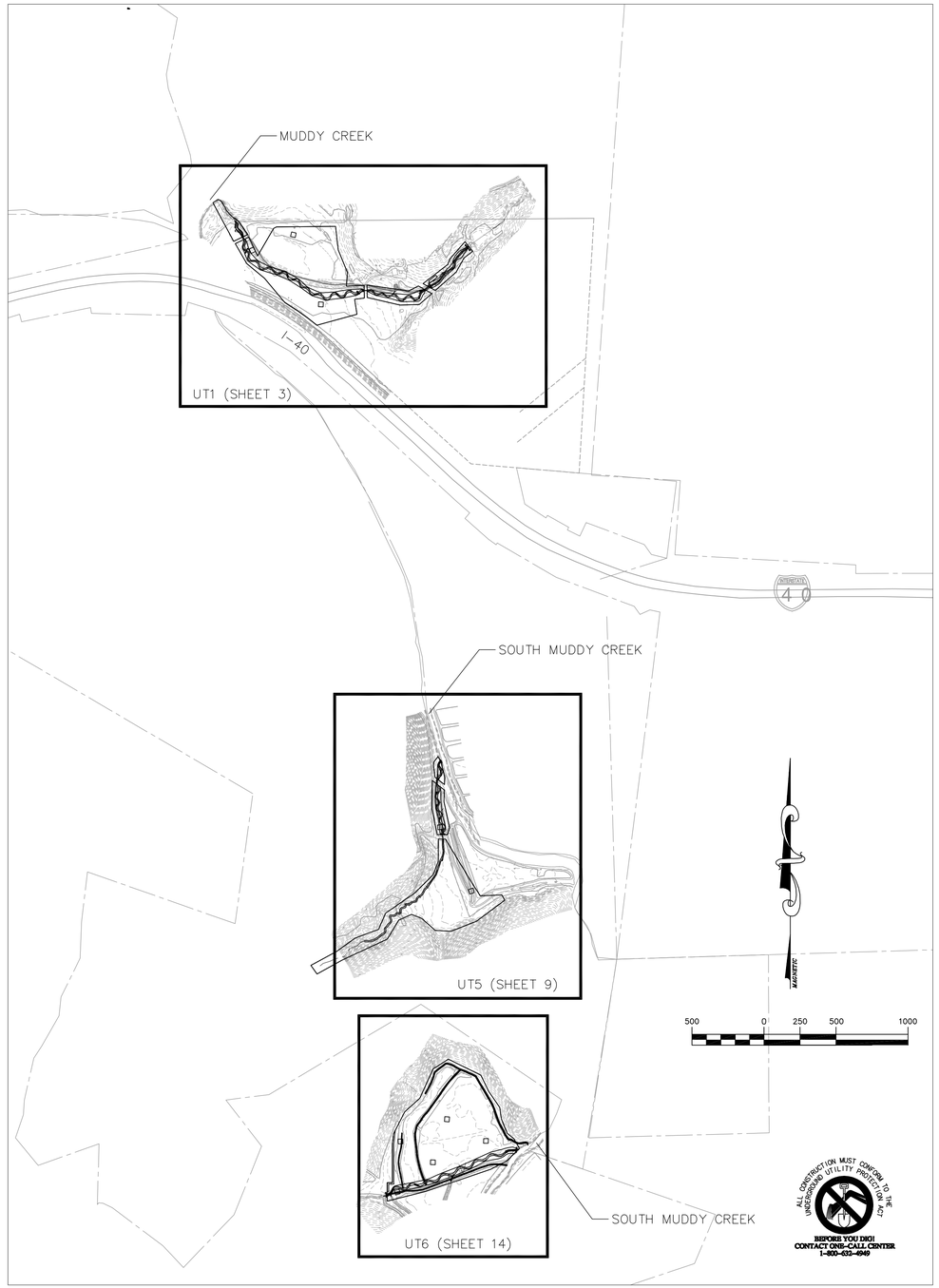
- ZONE 1 STREAM BANK
- ZONE 2 RIPARIAN/BANKFULL BENCH
- ZONE 3 TRANSITIONAL
- ZONE 4 WETLAND/BOTTOMLAND HARDWOOD
- ZONE 5 SUPPLEMENTAL PLANTINGS

MONITORING LEGEND

- BEGIN/END MONITORING
- XS — MONITORING CROSS SECTION
- VEG PLOT — VEGETATION MONITORING PLOTS

CONSTRUCTION PLAN LEGEND

- E — CONSERVATION EASEMENT
- STREAM CENTERLINE
- B — BANKFULL
- CUT LINE
- CHANNEL BLOCK
- BACK FILL
- RIP RAP
- WETLAND
- CONSTRUCTED RIFFLE
- ROCK SILL
- ROCK CROSS VANE
- ROCK A-VANE
- MODIFIED ROCK CROSS VANE
- MODIFIED ROCK A-VANE
- LOG SILL



REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

EBX

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SUITE 300, 4651 CHARLOTTE PARK DRIVE,
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PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
OVERALL KEY SHEET and LEGENDS

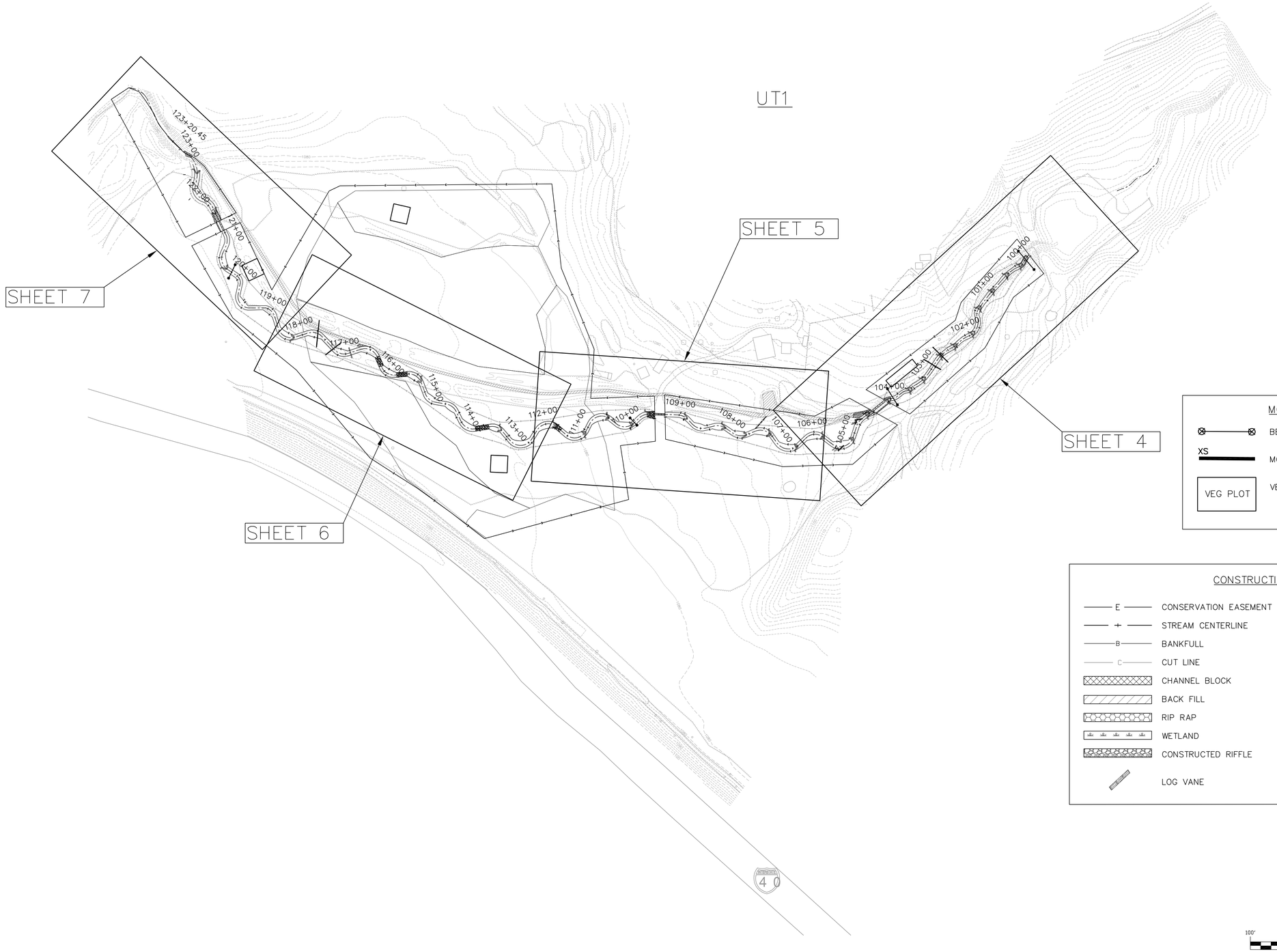
NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WITHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 2 OF 22



MONITORING LEGEND

- BEGIN/END MONITORING
- XS — MONITORING CROSS SECTION
- VEG PLOT — VEGETATION MONITORING PLOTS

CONSTRUCTION PLAN LEGEND

- E — CONSERVATION EASEMENT
- STREAM CENTERLINE
- B — BANKFULL
- C — CUT LINE
- CHANNEL BLOCK
- BACK FILL
- RIP RAP
- WETLAND
- CONSTRUCTED RIFFLE
- LOG VANE
- ROCK SILL
- ROCK CROSS VANE
- ROCK A-VANE
- MODIFIED ROCK CROSS VANE
- MODIFIED ROCK A-VANE
- ROOT WAD

100' 0 50' 100' 200'

ALL CONSTRUCTION MUST CONFORM TO THE UNDERGROUND UTILITY PROTECTION ACT.
BEFORE YOU DIG! CONTACT ONE-CALL CENTER 1-800-632-4949

REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
SUITE 300, 4651 CHARLOTTE PARK DRIVE,
CHARLOTTE, NORTH CAROLINA 28217
PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT1 STREAM KEY SHEET

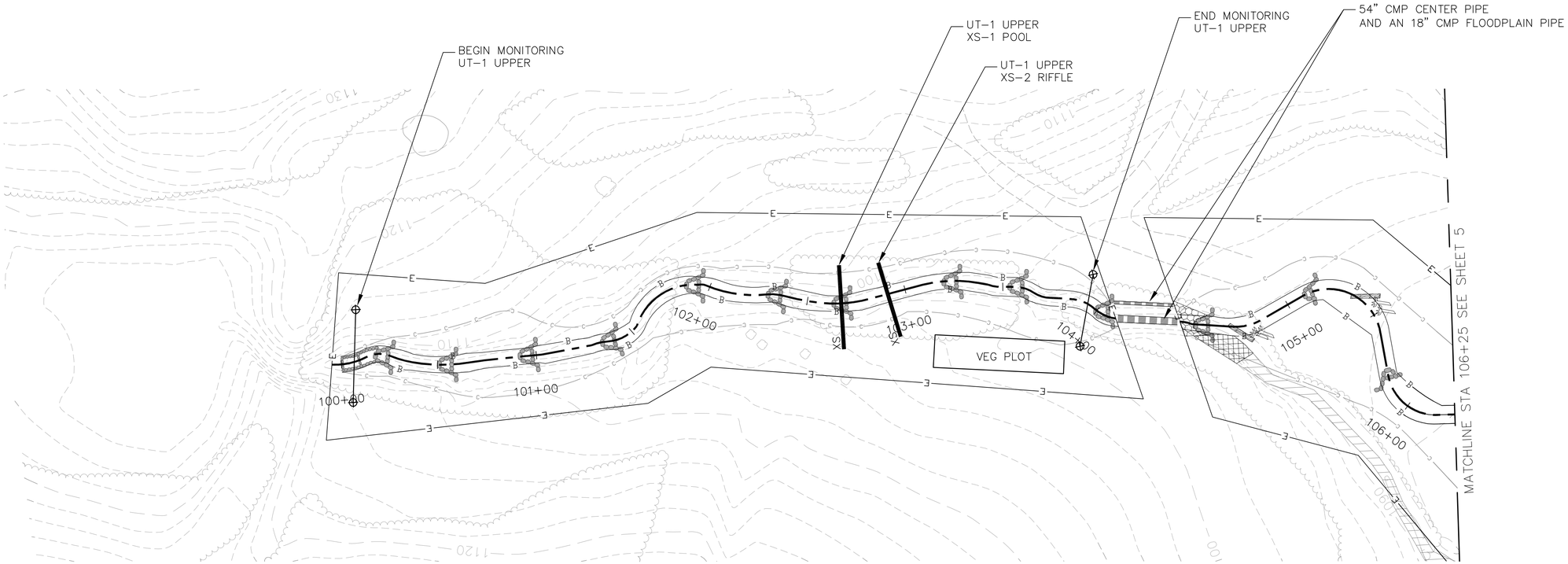
NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

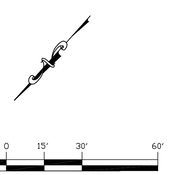
DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 3 OF 22





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PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT1 STREAM RECORD DRAWINGS

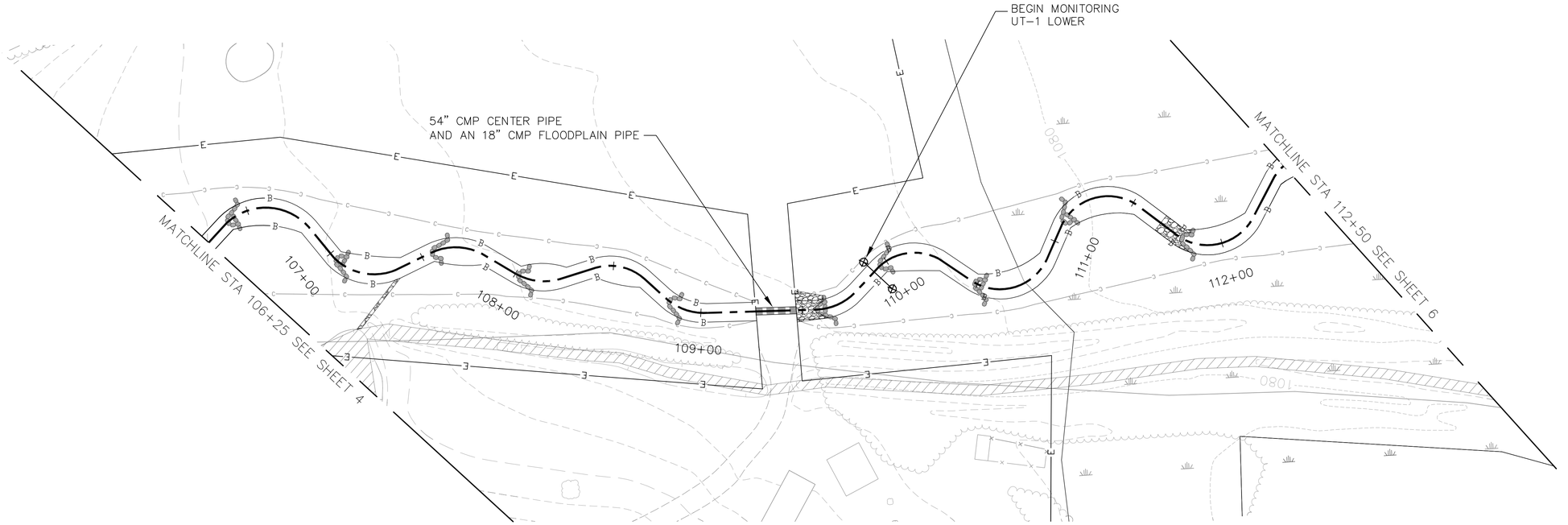
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 026484 WILLIAM R. WITHELM

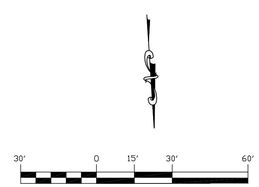
DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 4 OF 22





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TITLE:
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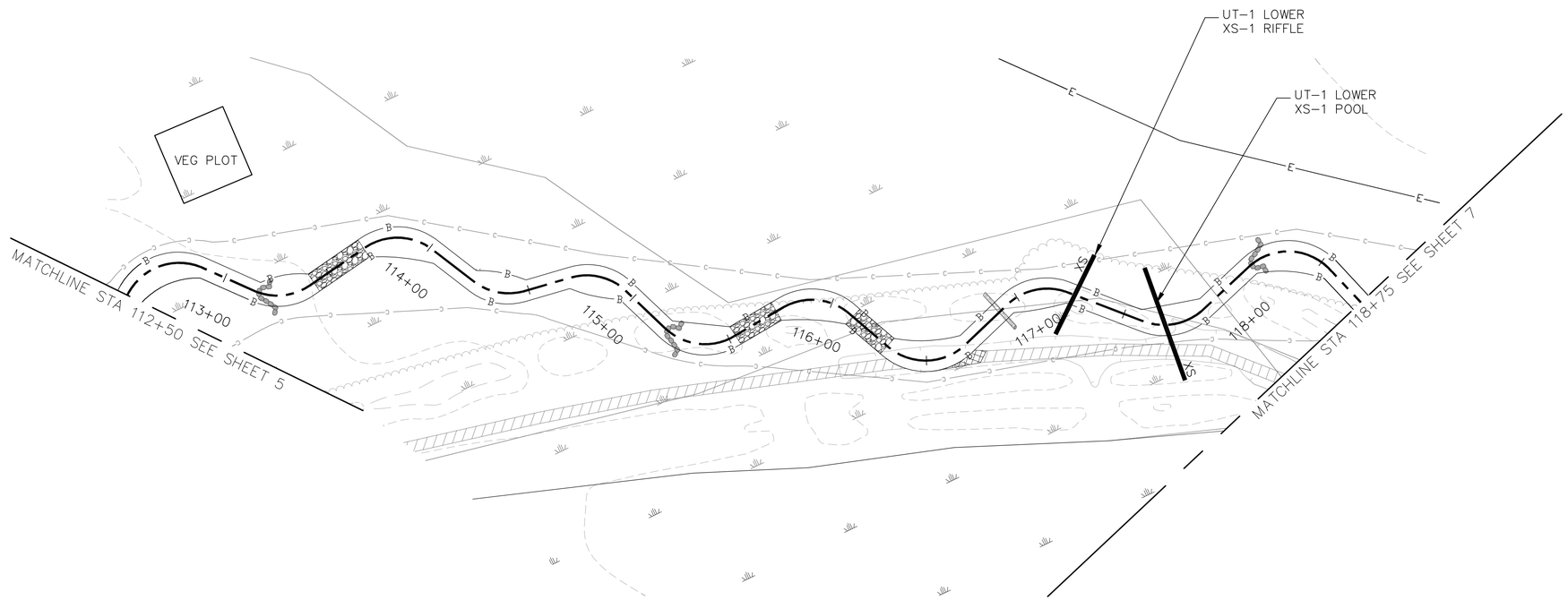
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 026484 WILLIAM R. WILHELM

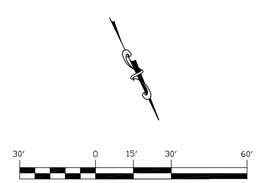
DATE:	01-15-09
JOB NUMBER:	018336001
DRAWN BY:	JK
DESIGNED BY:	JD
CHECKED BY:	WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 5 OF 22





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TITLE:
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NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 026484 WILLIAM R. WILHELM

DATE:	01-15-09
JOB NUMBER:	018336001
DRAWN BY:	JK
DESIGNED BY:	JD
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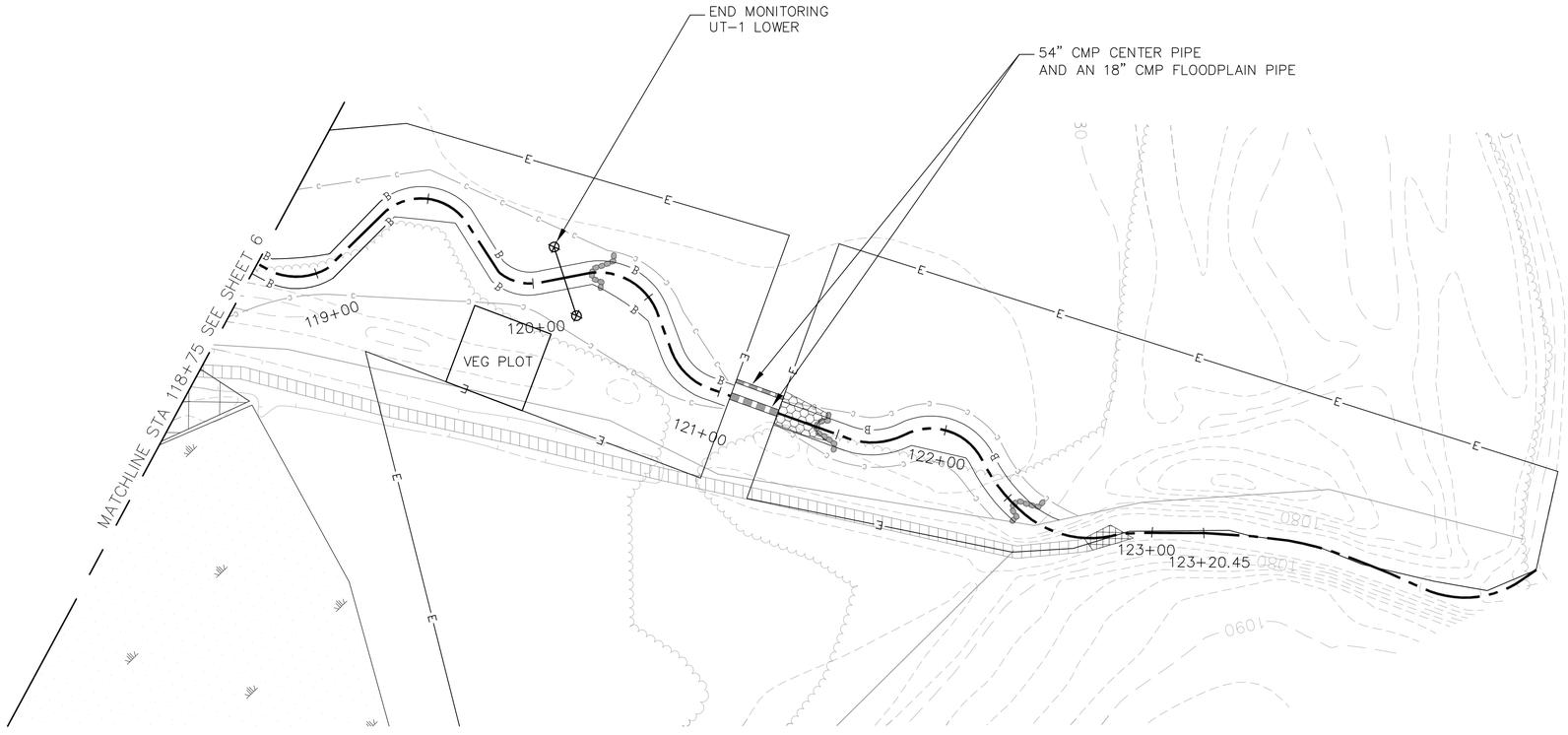
PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 6 OF 22



30' 0 15' 30' 60'

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DATE: 01-15-09
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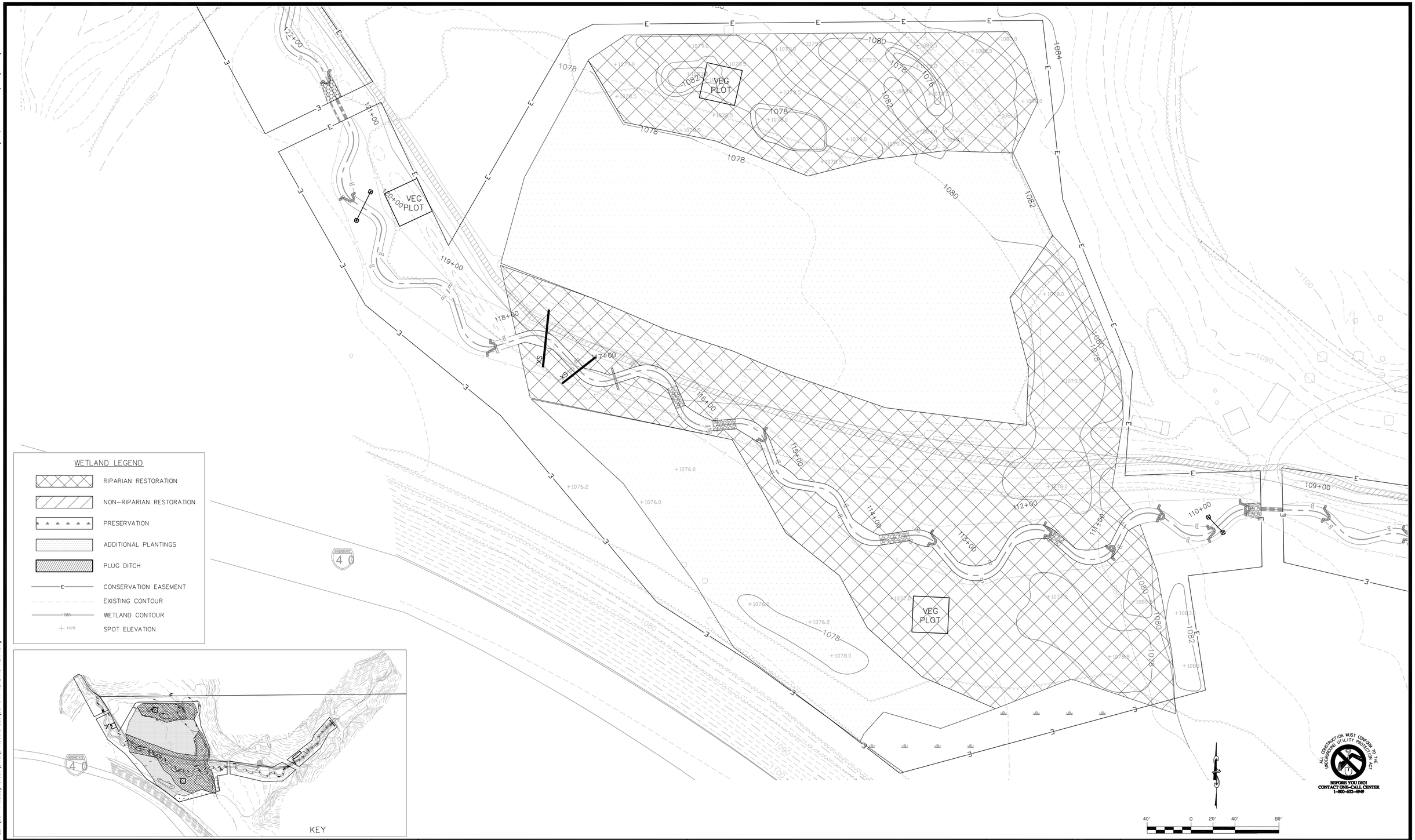
PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 7 OF 22

January 27, 2009 - 3:23pm By: nancy.mumford

K:\CHL_Environmental\018336 EBX\001 N Muddy Creek\DWG\6 Record Set\08-UT1 WETLAND PLAN.dwg



WETLAND LEGEND

- RIPARIAN RESTORATION
- NON-RIPARIAN RESTORATION
- PRESERVATION
- ADDITIONAL PLANTINGS
- PLUG DITCH
- E — CONSERVATION EASEMENT
- EXISTING CONTOUR
- 1080 — WETLAND CONTOUR
- 1078 SPOT ELEVATION

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REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

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PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT1 WETLAND RECORD DRAWINGS

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
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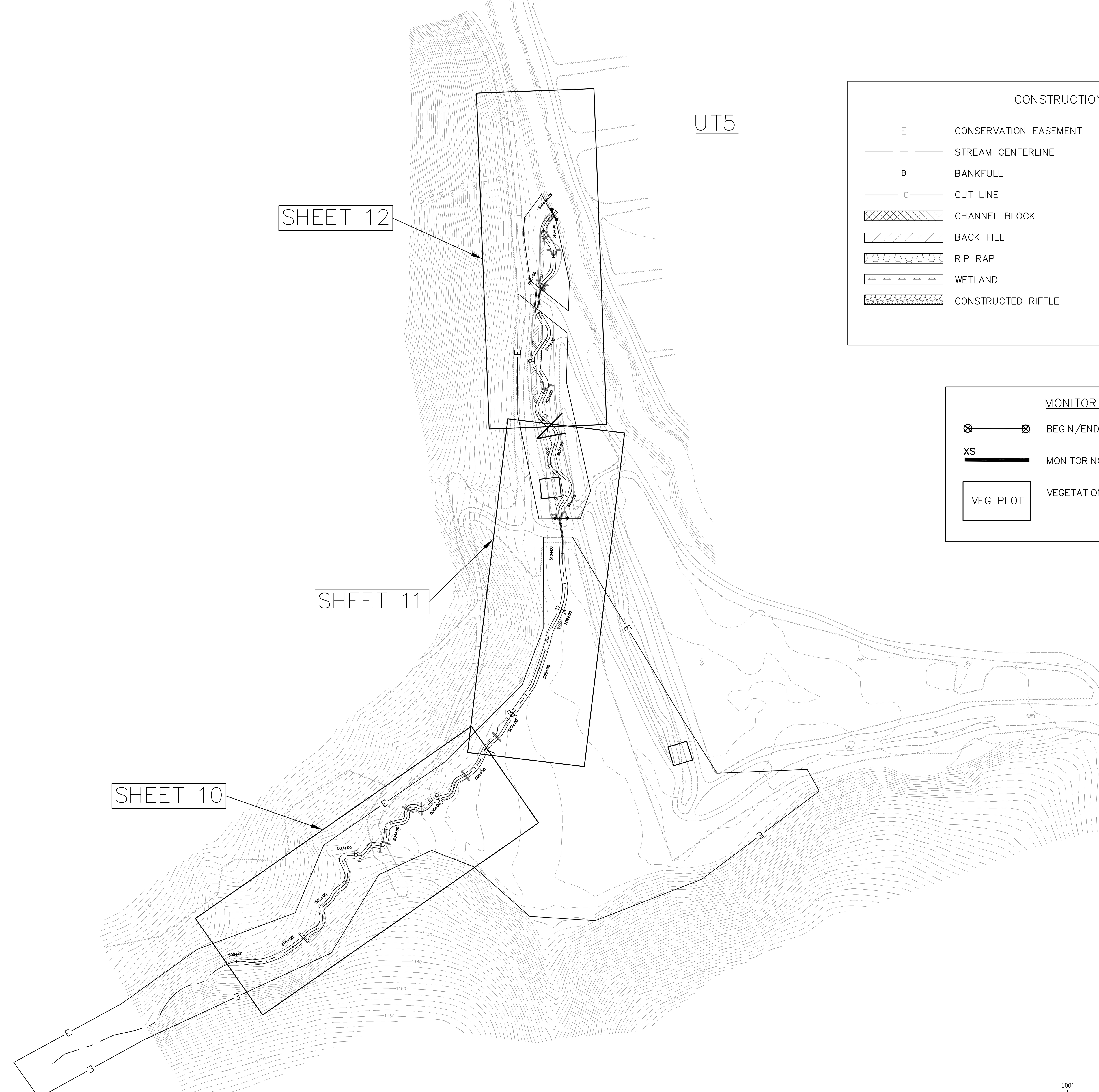
PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 8 OF 22

January 27, 2009 – 3:23pm By: nancy.mumford



CONSTRUCTION PLAN LEGEND

- CONSERVATION EASEMENT
- STREAM CENTERLINE
- BANKFULL
- CUT LINE
- CHANNEL BLOCK
- BACK FILL
- RIP RAP
- WETLAND
- CONSTRUCTED RIFFLE
- ROCK SILL
- ROCK CROSS VANE
- ROCK A–VANE
- MODIFIED ROCK CROSS VANE
- MODIFIED ROCK A–VANE
- LOG SILL

MONITORING LEGEND

- BEGIN/END MONITORING
- XS MONITORING CROSS SECTION
- VEG PLOT VEGETATION MONITORING PLOTS

100' 0 50' 100' 200'

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REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

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CHARLOTTE, NORTH CAROLINA 28217
PHONE: (704) 333–5131 FAX: (704) 333–0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT5 STREAM KEY SHEET

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 026484 WILLIAM R. WILHELM

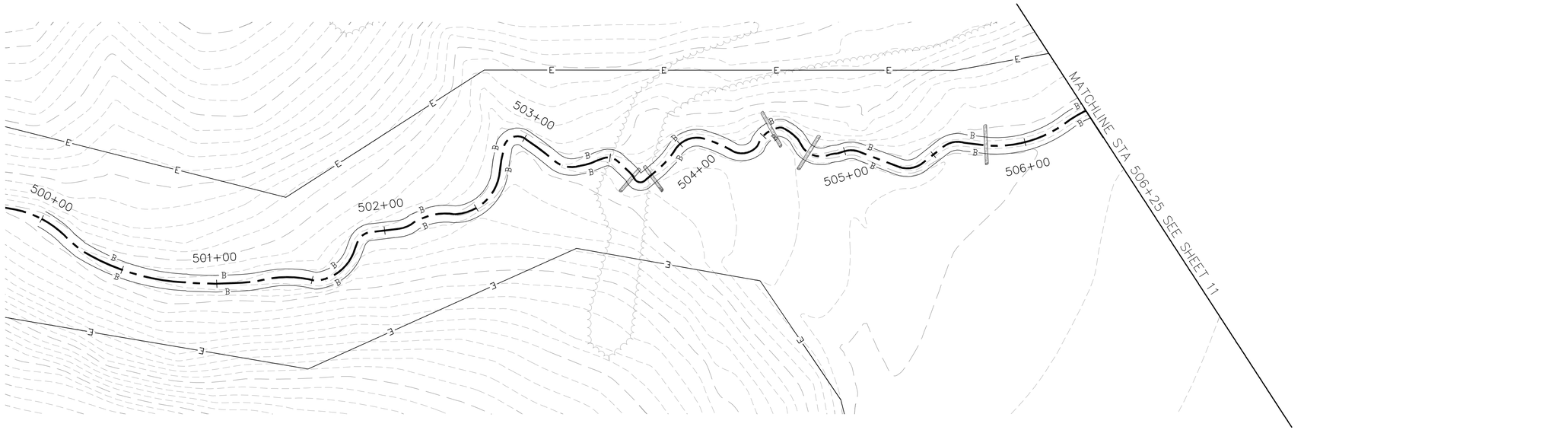
DATE: 01–15–09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

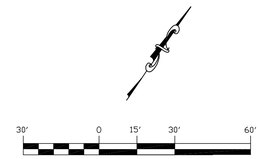
PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 9 OF 22

K:\CHL_Environmental\018336 EBX\001 N Muddy Creek\DWG\6 Record Set\09-12-UT5 PLAN-PROFILE.dwg





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REV.	No.:	REVISION:	DRAWN BY:	CHECKED BY:

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PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT5 STREAM RECORD DRAWINGS

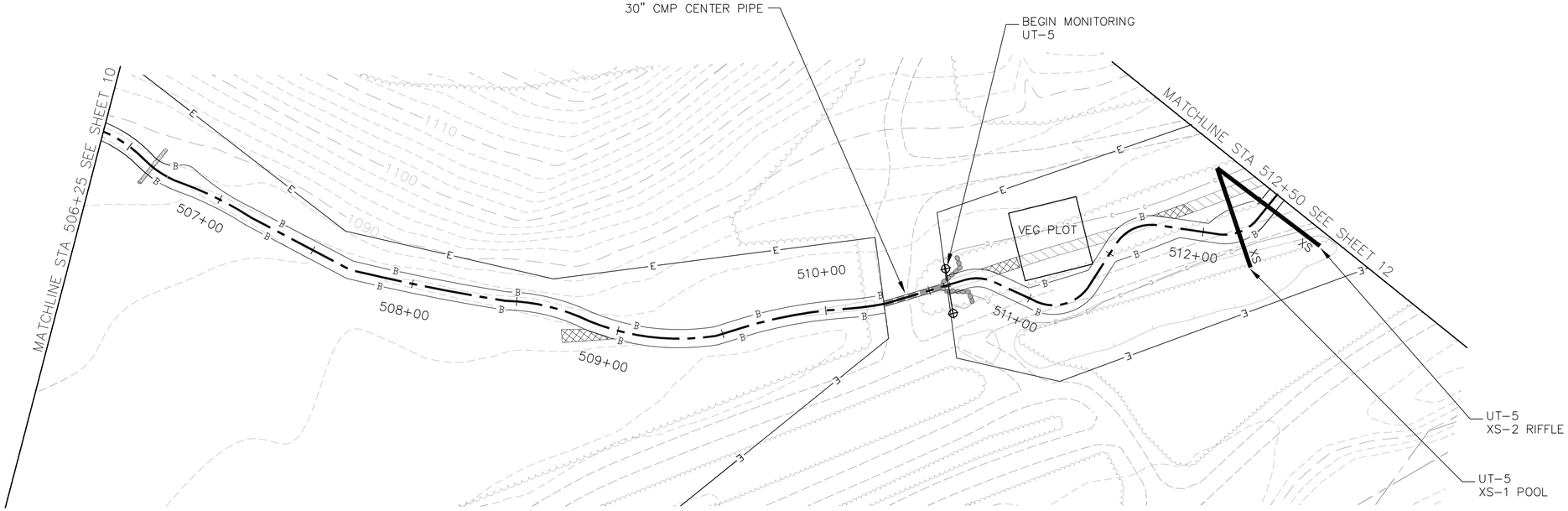
NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 10 OF 22



30' 0 15' 30' 60'

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REV.	No.:	REVISION:	DRAWN BY:	CHECKED BY:

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CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT5 STREAM RECORD DRAWINGS

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

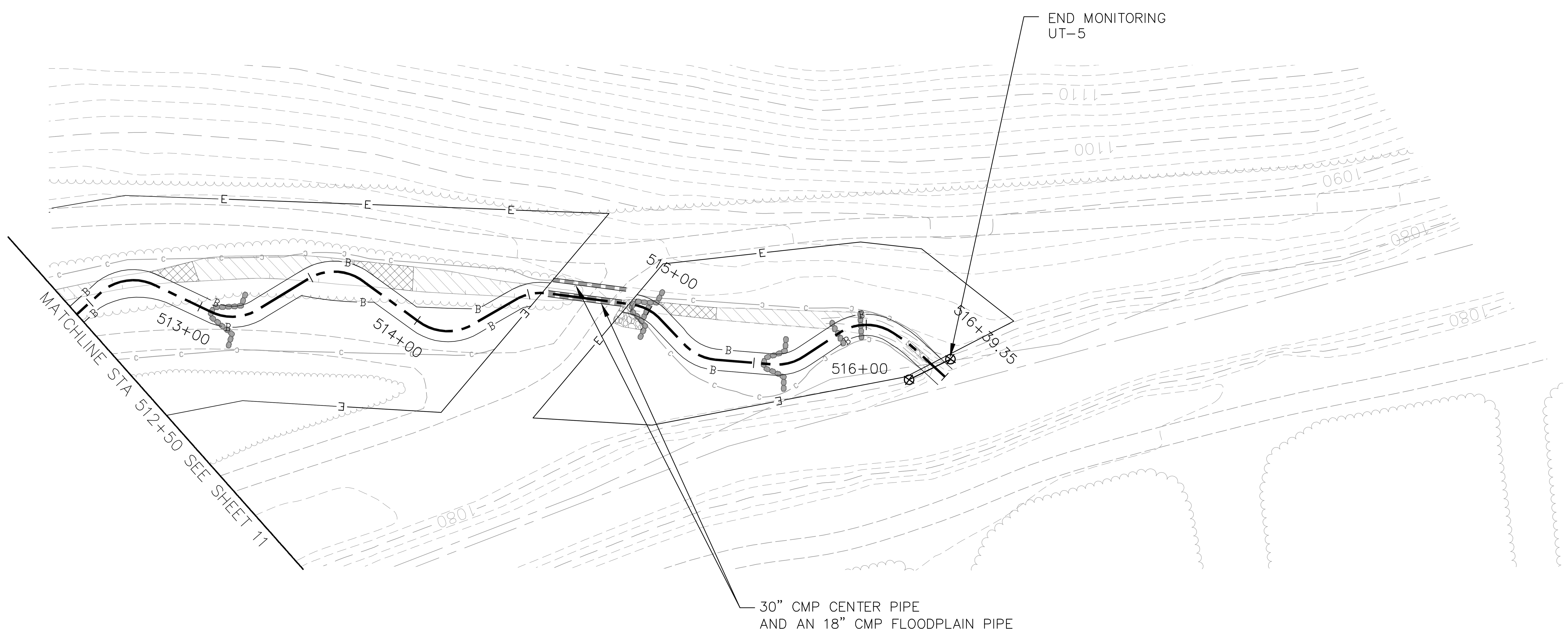
DATE:	01-15-09
JOB NUMBER:	018336001
DRAWN BY:	JK
DESIGNED BY:	JD
CHECKED BY:	WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 11 OF 22

January 27, 2009 – 3:24pm By: nancy.mumford



30' 0 15' 30' 60'

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PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
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TITLE:
UT5 STREAM RECORD DRAWINGS

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 026484 WILLIAM R. WILHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 12 OF 22

K:\CHL_Environmental\018336 EBX\001 N Muddy Creek\DWG\6 Record Set\09-12-UT5 PLAN-PROFILE.dwg

UT5

WETLAND LEGEND

- RIPARIAN RESTORATION
- NON-RIPARIAN RESTORATION
- PRESERVATION
- ADDITIONAL PLANTINGS
- PLUG DITCH
- E — CONSERVATION EASEMENT
- EXISTING CONTOUR
- 1080 — WETLAND CONTOUR
- 1078 — SPOT ELEVATION

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100' 0 50' 100' 200'

REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

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CLIENT:
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ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT5 WETLAND RECORD DRAWINGS

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
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PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 13 OF 22

UT6

CONSTRUCTION PLAN LEGEND

- E — CONSERVATION EASEMENT
- STREAM CENTERLINE
- B — BANKFULL
- C — CUT LINE
- CHANNEL BLOCK
- BACK FILL
- RIP RAP
- WETLAND
- CONSTRUCTED RIFFLE
- LOG VANE
- ROCK SILL
- ROCK CROSS VANE
- ROCK A–VANE
- MODIFIED ROCK CROSS VANE
- MODIFIED ROCK A–VANE
- ROOT WAD

MONITORING LEGEND

- BEGIN/END MONITORING
- XS — MONITORING CROSS SECTION
- VEG PLOT — VEGETATION MONITORING PLOTS

100' 0 50' 100' 200'

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CLIENT:
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ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT6 STREAM KEY SHEET

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WITHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

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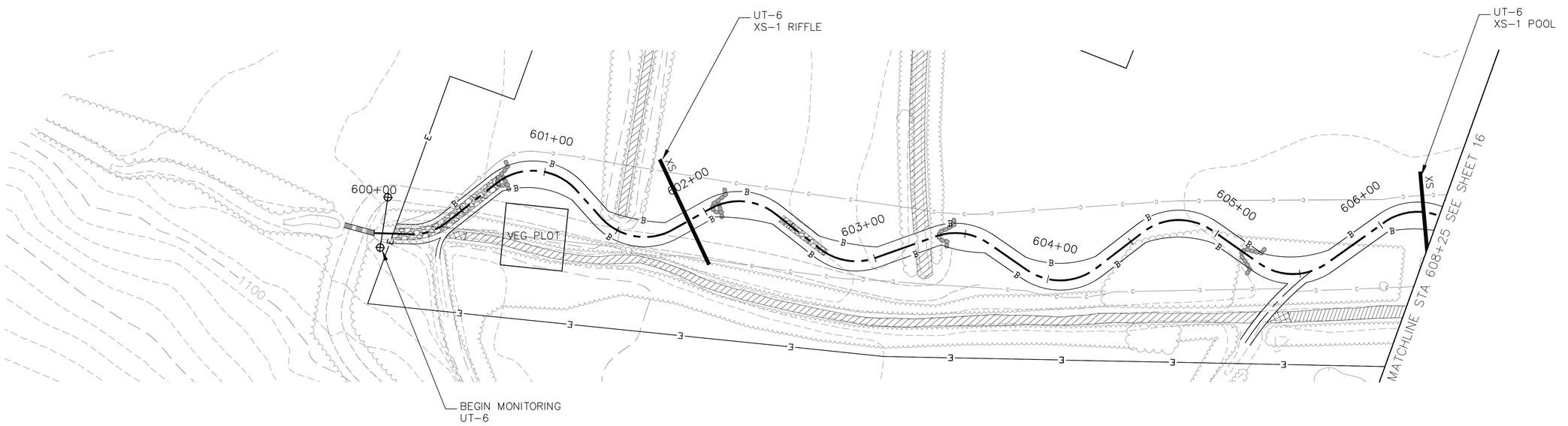
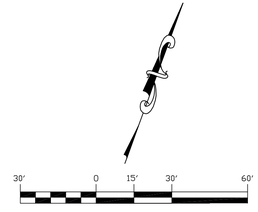
SHEET NUMBER: 14 OF 22

K:\CHL_Environmental\018336 EBX\001 N Muddy Creek\DWG\6 Record Set\14-16-UT6 PLAN-PROFILE.dwg





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TITLE:
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JOB NUMBER: 018336001
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PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

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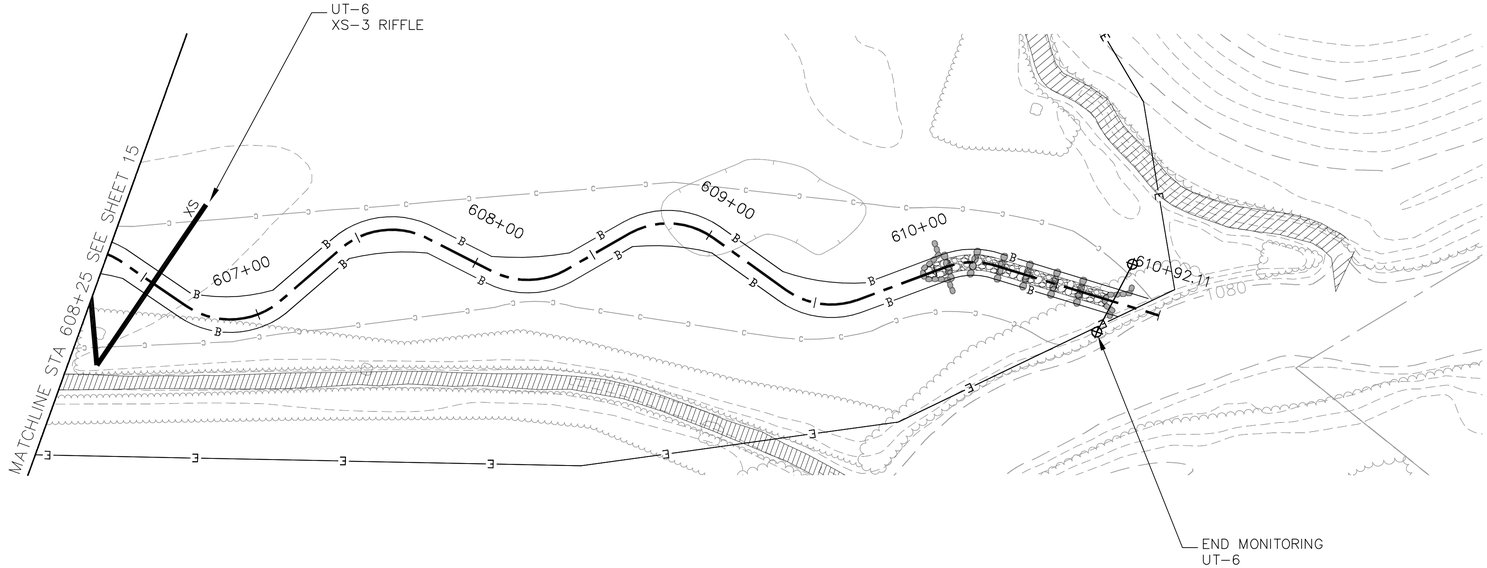
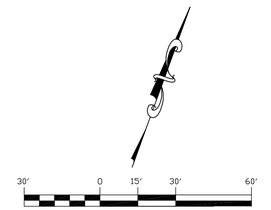
SHEET NUMBER: 15 OF 22





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THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

January 27, 2009 – 3:25pm By: nancy.mumford

UT6

WETLAND LEGEND

- RIPARIAN RESTORATION
- NON-RIPARIAN RESTORATION
- PRESERVATION
- ADDITIONAL PLANTINGS
- PLUG DITCH
- CONSERVATION EASEMENT (E)
- EXISTING CONTOUR
- WETLAND CONTOUR (1080)
- SPOT ELEVATION (+ 1078)

ALL CONSTRUCTION MUST CONFORM TO THE UNDERGROUND UTILITY PROTECTION ACT
BEFORE YOU DIG! CONTACT ONE-CALL CENTER 1-800-632-4949

60' 0 30' 60' 120'

REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

EBX

PREPARED IN THE OFFICE OF:
Kimley-Horn and Associates, Inc.
SUITE 300, 4651 CHARLOTTE PARK DRIVE,
CHARLOTTE, NORTH CAROLINA 28217
PHONE: (704) 333-5131 FAX: (704) 333-0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
UT6 WETLAND RECORD DRAWINGS

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 026484 WILLIAM R. WILHELM

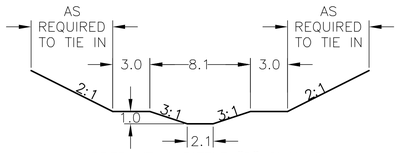
DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

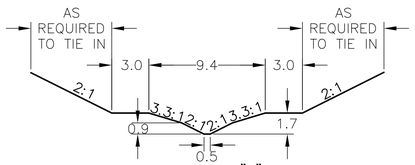
THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 17 OF 22

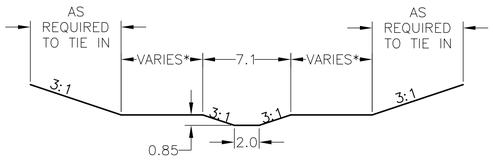
K:\CHL_Environmental\018336 EBX\001 N Muddy Creek\DWG\6 Record Set\17-UT6 WETLAND PLAN.dwg



UPPER UT–1 RIFFLE "B" CHANNEL
NORTH MUDDY CREEK STA 100+00 TO 103+50

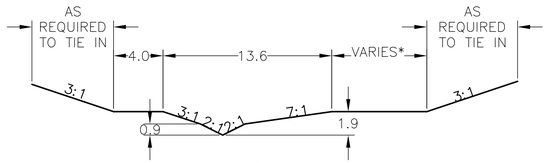


UPPER UT–1 POOL "B" CHANNEL
NORTH MUDDY CREEK STA 100+00 TO 103+50

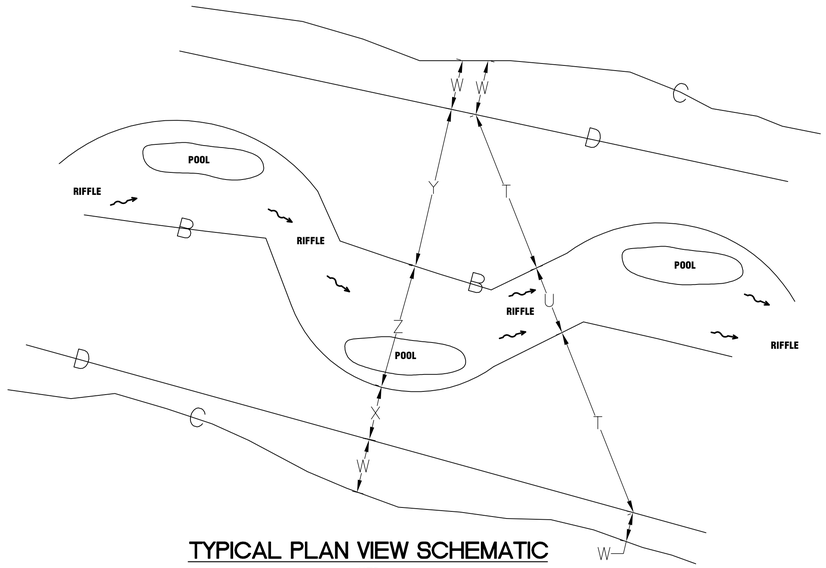


LOWER UT–1 RIFFLE "C" CHANNEL
NORTH MUDDY CREEK STA 103+50 TO 122+13.89

* RIFFLE BENCH LENGTH WILL BE DETERMINED BY THE LENGTH SPECIFIED IN THE POOL CROSS–SECTION, AND CUT LINE



LOWER UT–1 POOL "C" CHANNEL
NORTH MUDDY CREEK STA 103+50 TO 122+13.89



TYPICAL PLAN VIEW SCHEMATIC

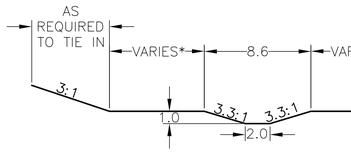
NTS

RIFFLE

POOL

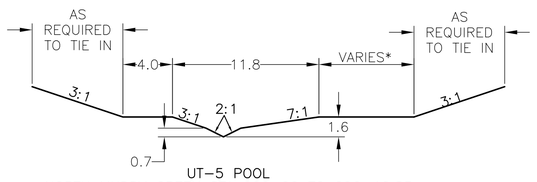
TYPICAL CROSS SECTION SCHEMATIC

NTS

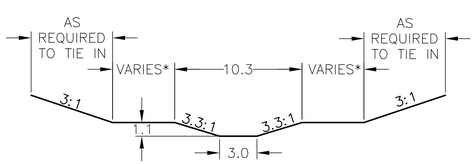


UT–5 RIFFLE
NORTH MUDDY CREEK STA 200+00 TO 206+10.83

* RIFFLE BENCH LENGTH WILL BE DETERMINED BY THE LENGTH SPECIFIED IN THE POOL CROSS–SECTION, AND CUT LINE

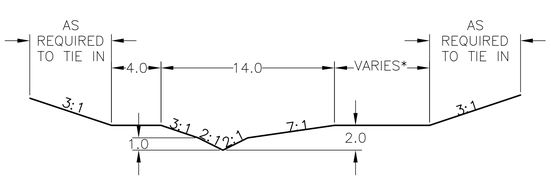


UT–5 POOL
NORTH MUDDY CREEK STA 200+00 TO 206+10.83



UT–6 RIFFLE
NORTH MUDDY CREEK STA 300+00 TO 310+92.11

* RIFFLE BENCH LENGTH WILL BE DETERMINED BY THE LENGTH SPECIFIED IN THE POOL CROSS–SECTION, AND CUT LINE



UT–6 POOL
NORTH MUDDY CREEK STA 300+00 TO 310+92.11

NOTES:

TYPICAL SECTIONS ARE PROVIDED TO GIVE THE GENERAL DIMENSIONS OF THE CHANNEL. FINAL GRADING WILL GIVE THE CHANNEL A MORE "NATURAL" APPEARANCE AND ALLOW A SMOOTH TRANSITION FROM EXISTING CHANNEL TO NEW CHANNEL.

ALL EXISTING GROUND REPRESENTATIONS ARE APPROXIMATE.

THE BANKFULL BENCH LENGTH AND SLOPE WILL BE DETERMINED BY GRADING THE BENCH ON THE OUTSIDE OF MEANDERS. THE CONTRACTOR IS TO GRADE FROM OUTSIDE OF MEANDERS TO OUTSIDE OF MEANDERS AT THE SPECIFIED DISTANCE ON THE TYPICAL POOL CROSS SECTION.

LOW FLOW CHANNEL WIDTH(S) SHOULD BE APPROXIMATELY THE SAME FOR RIFFLES AND POOLS.

ALL CONSTRUCTION MUST CONFORM TO THE UNDERGROUND UTILITY PROTECTION ACT.
BEFORE YOU DIG! CONTACT ONS–CALL CENTER 1–800–632–4949

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PHONE: (704) 333–5131 FAX: (704) 333–0845

CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
TYPICAL CROSS SECTIONS

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

DATE: 01–15–09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 18 OF 22

General Notes:

Temporary planting will occur immediately after construction to stabilize areas of bare soil. Permanent plantings and seedings shall begin in season optimally between February 15 and April 15. However, the planting supervisor shall have final say when to begin planting.

Prior to permanent plantings and seedings, the site soils shall be prepared for planting. Where needed the soils should be plowed or ripped to improve compacted soils and eliminate channelized flow from non-target areas. Soils shall be amended to facilitate vigorous plant growth. Exotic and invasive plants shall be treated and removed inside the easement.

The site shall be planted by the zones depicted in the **Planting Zone Typicals** and **Riparian Planting Plan** sheets with species listed in the accompanying **Planting Table**.

Planting Zone Descriptions

Zone 1 - Stream Bank
The stream bank zone includes the stream bank from base flow to bankfull. The zone features the steepest slopes (3-8%) of the zones and highest saturation levels. This environment dictates the planting of fast-growing, obligate pioneer species to provide stability to areas at or below bankfull.

Zone 2 - Riparian/Bankfull Bench
The riparian/bankfull areas zone encompasses the area from Zone 1 to the edge of the easement, excluding the areas designated as Zone 3, 4, and 5. Zone 2 is an area exposed to regular stream flows and frequent soil deposition. The most stressed areas are located on the outside bends of meanders. The banks will be planted with fast-growing, deep-rooted species that will provide biostabilization and shading to the stream.

Zone 3 - Transitional
The transitional zone includes an approximately 10-foot buffer between zones 2, 4, and 5 and an adjacent open area such as a field outside of the conservation easement. The planting list consists of smaller species that tolerate full sun and will eliminate an abrupt boundary between the open field and interior zones.

Zone 4 - Wetland/Bottomland Hardwood
The wetland bottomland hardwood zone covers planting zones in the wetland restoration areas where the inundation or saturation occurs for a long enough period of time during the growing season to select species more adapted to hydric conditions.

Zone 5 - Supplemental Plantings
The supplemental plantings zone contains similar species to Zone 4 and will be used in areas designated for wetland enhancement.

Planting List Reference

Hall, Karen. 2001. North Carolina Stream Restoration Institute NCSU, "Recommended Native Plant Species for Stream Restoration in North Carolina."
Smith, Cherri L. et al., 2004, North Carolina Department of Environmental and Natural Resources - Ecosystem Enhancement Program, "Guidelines for Riparian Buffer Restoration."

North Muddy Creek Plant Species and Quantities

		Plant Type	Live Stake	Bare Root	Bare Root	Bare Root	Bare Root	Bare Root
		Zone	Zone 1: Stream Bank	Zone 2: Riparian Bankfull Bench	Zone 2: Riparian Bankfull Bench	Zone 4: Wetland Bottomland Forest	Zone 4: Wetland Bottomland Forest	Zone 3: Transitional
		Community		Piedmont/ Mountain Levee Forest	Piedmont/ Mountain Bottomland Forest	Piedmont/ Mountain Swamp Forest	Piedmont/ Mountain Swamp Forest	
Scientific Name		Actual Count	5000	900	3000	9480	1320	1200
Canopy								
Acer	*saccharinum*							
Betula	*nigra*			200				
Carya	*cordiformis*							
Carya	*ovata*				300			
Celtis	*laevigata*			150		680		200
Diospyros	*virginiana*				400	600		
Fraxinus	*pennsylvanica*			150		600		200
Juglans	*nigra*							
Liriodendron	*tulipifera*							
Magnolia	*acuminata*							
Nyssa	*sylvatica*				300	600		
Populus	*heterophylla*							
Platanus	*occidentalis*							
Quercus	*michauxii*			200	250	1200	400	200
Quercus	*nigra*				250			200
Quercus	*pagoda*					1200	400	
Quercus	*phellos*				250	1200	400	
Quercus	*shumardii*				250			
Salix	*nigra*							
Ulmus	*alata*							
Ulmus	*americana*			0		1200	120	
Understory								
Aesculus	*sylvatica*							
Alnus	*serrulata*							
Aronia	*arbutifolia*							
Asimina	*triloba*			200	600	400		
Callicarpa	*americana*							200
Carpinus	*caroliniana*							
Cephalanthus	*occidentalis*		2500			1800		
Comus	*amomum*							
Corylus	*americana*				400			
Crateagus	*crus-galli*							
Crateagus	*flava*							
Hamamelis	*virginiana*							
Ilex	*opaca*							
Ilex	*verticillata*							
Lindera	*benzoin*							
Lyonia	*ligustrina*							
Ostrya	*virginiana*							
Physocarpus	*opulifolius*							
Rhododendron	*periclymenoides*							
Rhus	*glabra*							
Rosa	*carolina*							
Rosa	*palustris*							
Rubus	*cuneifolius*							
Sambucus	*canadensis*		2500					200
Sassafras	*albidum*							
Staphylea	*trifolia*							
Vaccinium	*corymbosum*							
Viburnum	*dentatum*							
Viburnum	*nudum*							
Xanthorhiza	*simplicissima*							

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

Plant Spacing and Distribution				
Zone	**Spacing (ft. on center)**		**# per 1,000 sq. feet**	
	MIN.	MAX.		
1	2.5	3.5	80	160
2	6	10	10	28
3	6	8	16	28
4	6	10	10	28
5	12	18	3	7

Outside of Easement (Pasture) Seed Mix		
Scientific Name	**Common Name**	**%**
Triticum aesticum*	Winter Wheat	50
Festuca arundinacea	Fescue Hay	50
Dactylis glomerata	Orchard Grass	50

*Subsititute Winter Wheat with Orchard Grass is planted during the winter.

Temporary Seed Mix				
Scientific Name	**Common Name**	**Rate (lb/acre)**	**Seeding Window**	
Secale cereale	Rye Grain	30	Aug 15	May 1
Triticum aestivum	Wheat	30	Aug 15	May 1
Setaia italica	German millet	10	May 1	Aug 15
Utochloa ramosa	Browntop millet	10	May 1	Aug 15

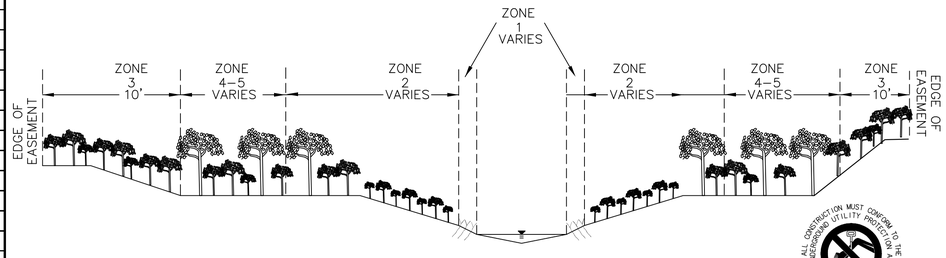
Soil amendments
Apply soil amendments according to the following table at 50 lbs/acre:

Amendment Addition (lb/acres)			
Lime	**N_2**	**P_2O_5**	**K_2O**
0	50	80	40

Mulch
Apply 4,000 lb/acre straw. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance
Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage per section 6.10 of NCDENR Erosion and Sedimont Control Design Manual.

Notes:
1) Ground cover shall be established on exposed slopes within 21 working days following completion of any phase of grading.
2) Amendment per recommendation of NC Department of Agriculture & Consumer Services based on on-site soil samples.



SECTION VIEW

REV	No.:	REVISION:	DRAWN BY:	CHECKED BY:

EBX
PREPARED IN THE OFFICE OF:
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CLIENT:
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

TITLE:
VEGETATION NOTES

NORTH CAROLINA PROFESSIONAL SEAL 026484 ENGINEER WILLIAM R. WILHELM

DATE: 01-15-09
JOB NUMBER: 018336001
DRAWN BY: JK
DESIGNED BY: JD
CHECKED BY: WW

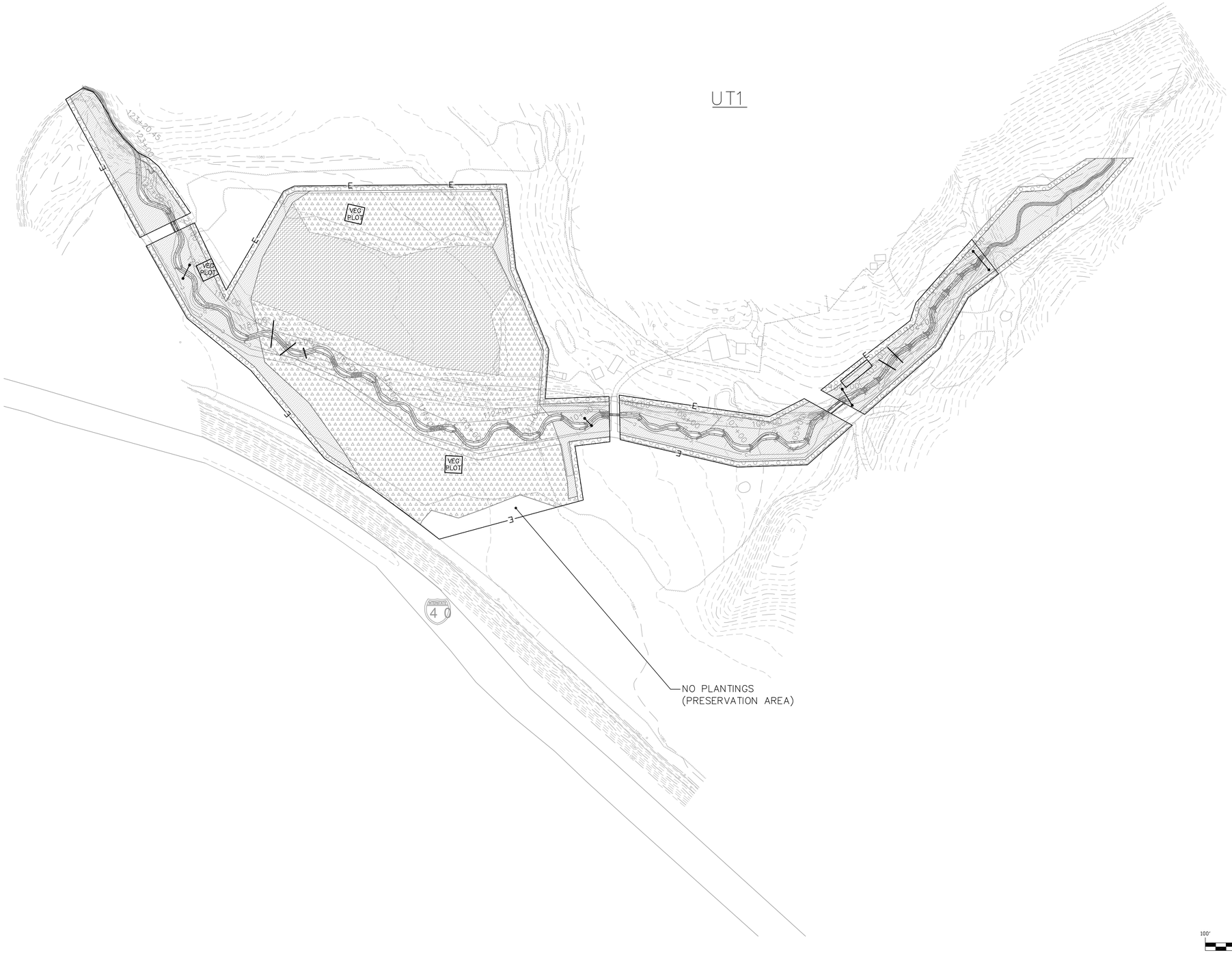
PROJECT:
NORTH MUDDY CREEK
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 19 OF 22

January 27, 2009 - 3:26pm By: nancy.mumford

UT1



PLANTING LEGEND

- —ZONE 1 Stream Bank
- —ZONE 2 Riparian/Bankfull Bench
- —ZONE 3 Transitional
- —ZONE 4 Wetland/Bottomland Hardwood
- —ZONE 5 Supplemental Plantings

NOTE:
ANY DISTURBED AREAS OUTSIDE OF THE CONSERVATION EASMENT WILL BE RETURNED TO PRE-CONSTRUCTION CONDITION. (i.e. PASTURE, FESCUE, ACCESS ROAD, OR TIMBER ROAD)

100' 0 50' 100' 200'

ALL CONSTRUCTION MUST CONFORM TO THE UNDERGROUND UTILITY PROTECTION ACT
BEFORE YOU DIG! CONTACT ONE-CALL CENTER 1-800-632-4949

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BURKE and McDOWELL COUNTIES, NC

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SHEET NUMBER: 20 OF 22

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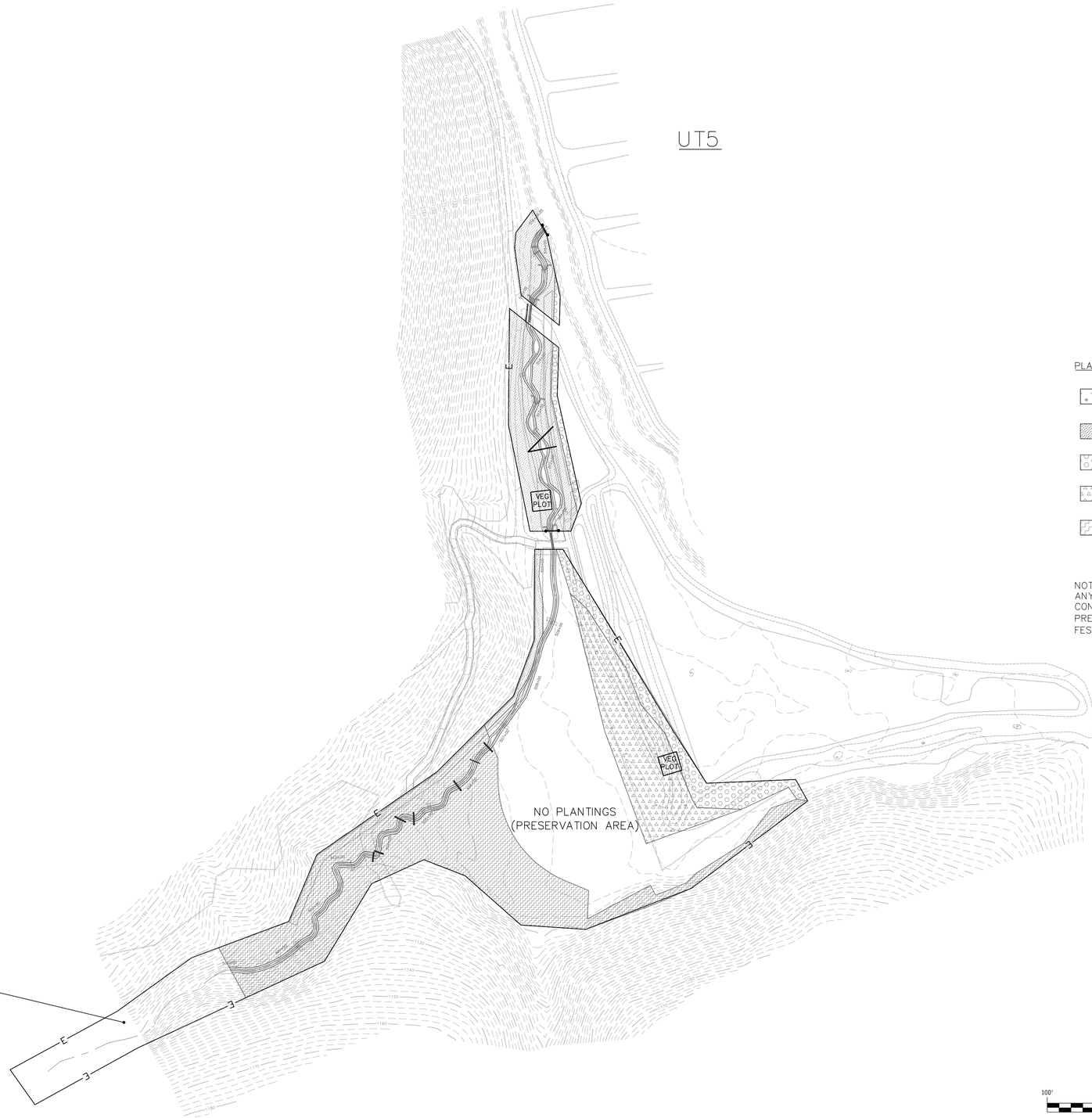
UT5



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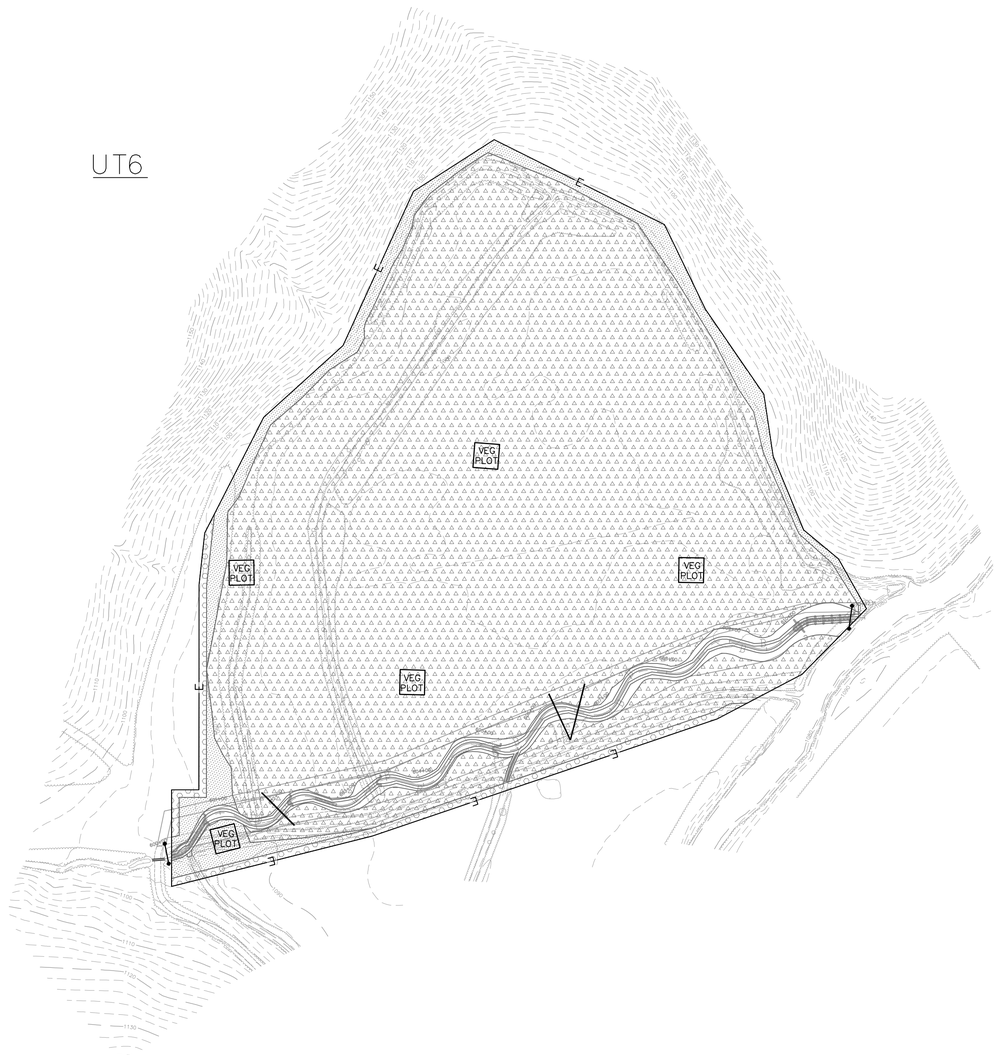
BURKE and McDOWELL COUNTIES, NC

THE RECORD DRAWINGS REPRESENT THE CONSTRUCTION PLANS WITH ADJUSTMENTS MADE TO REPRESENT CONSTRUCTED CONDITIONS.

SHEET NUMBER: 21 OF 22

UT6



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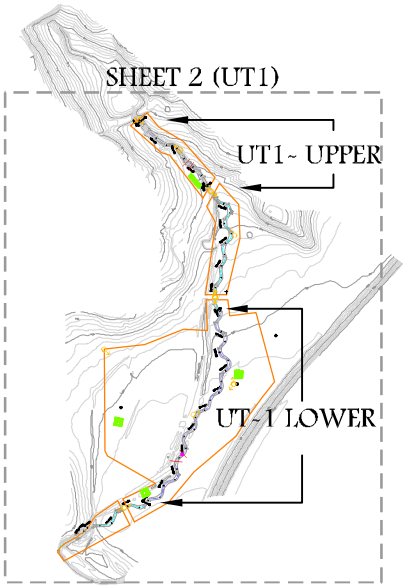
SHEET NUMBER: 22 OF 22

Attachment B

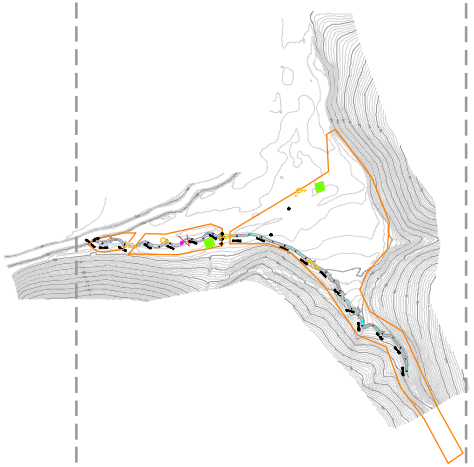
Baseline Monitoring

(Equinox Environmental Consulting and Design, Inc.)

SHEET 2 (UT1)



SHEET 3 (UT~5)



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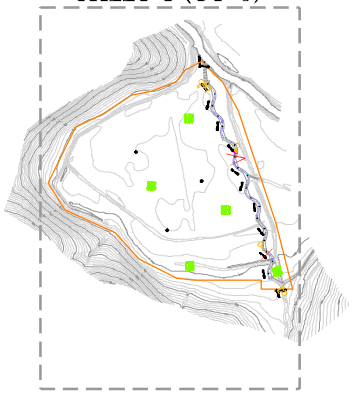
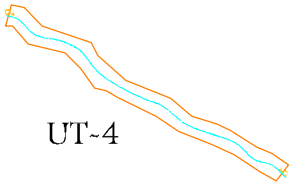
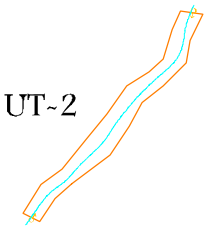


SHEET 5 (UT~2 & UT~4)





LEGEND

- Vegetation Monitoring Plots
- Easement Boundary
- Stream
- Longitudinal Profile Reach
- Longitudinal Profile Begin/End
- Cross Section
- Crest Gauge
- Wetland Gauge
- Rain Gauge
- Photo Point
- Constructed Riffle
- A-Vane
- Cross Vane
- J-Hook
- Log Sill
- Root Wad

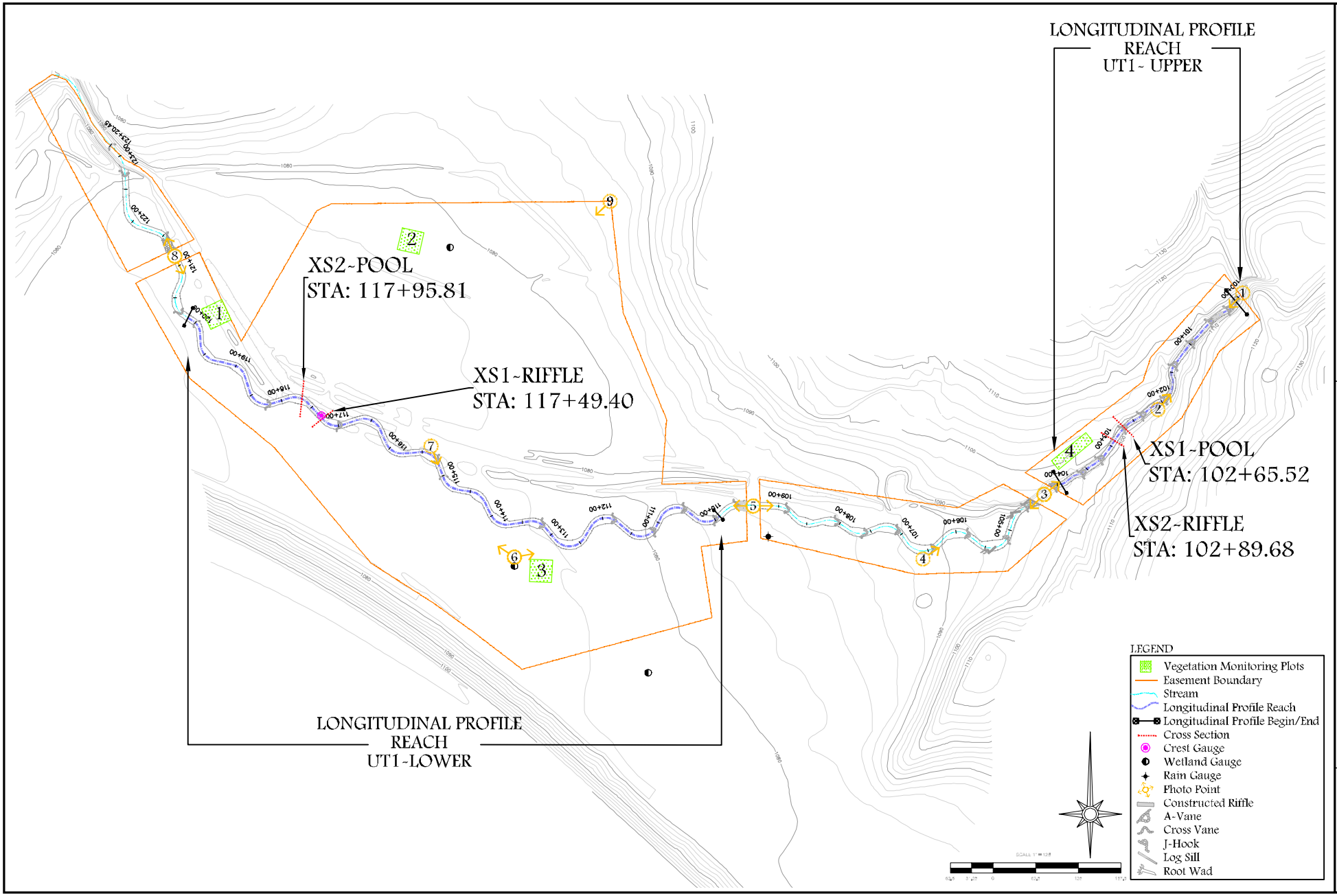
North Muddy Creek

Burke & McDowell County, NC

Monitoring Plan YEAR 2008

Sheet:

1 of 5



North Muddy Creek

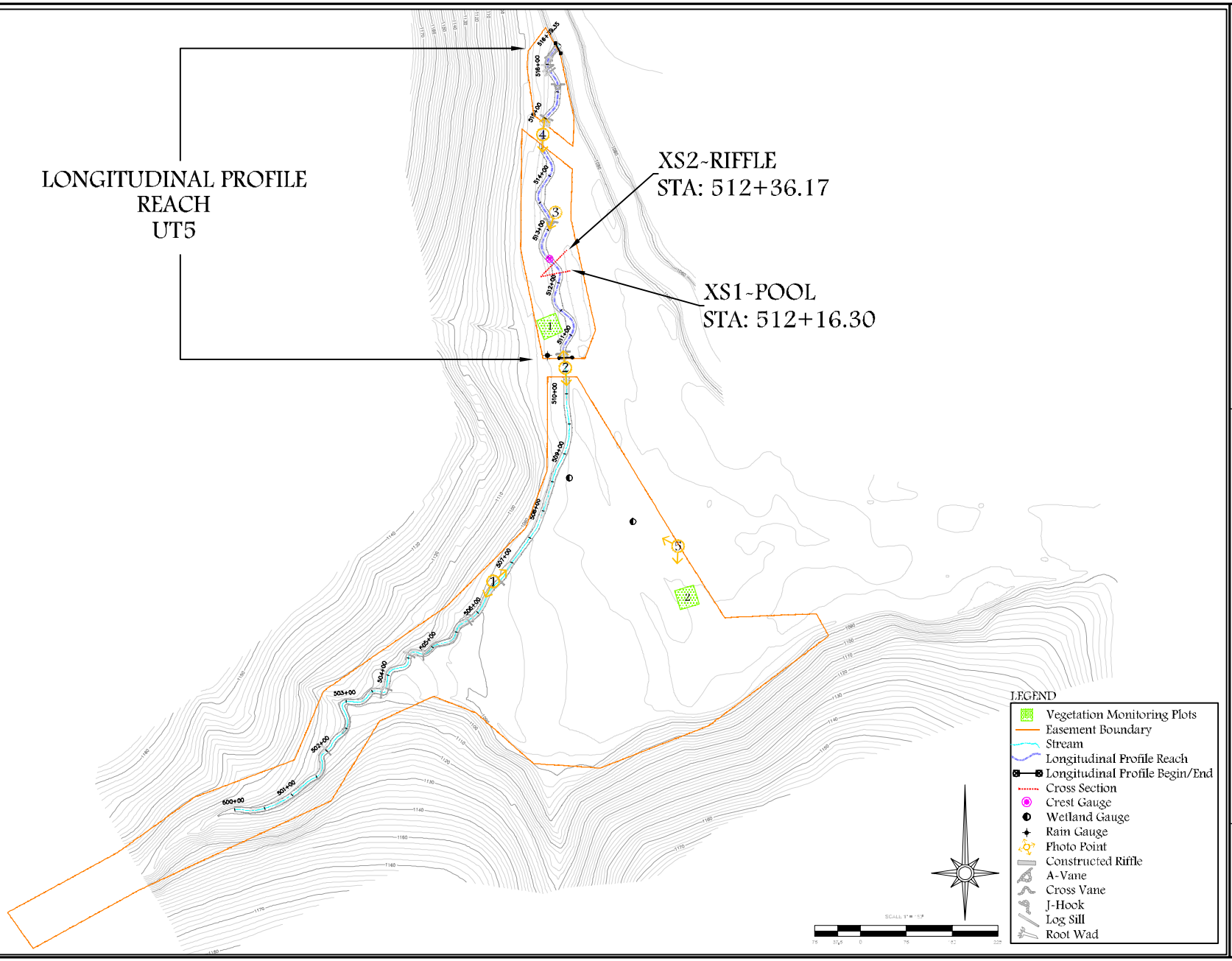
Burke & McDowell County, NC

UT1 Monitoring Plan YEAR 2008

Sheet:

2

of 5

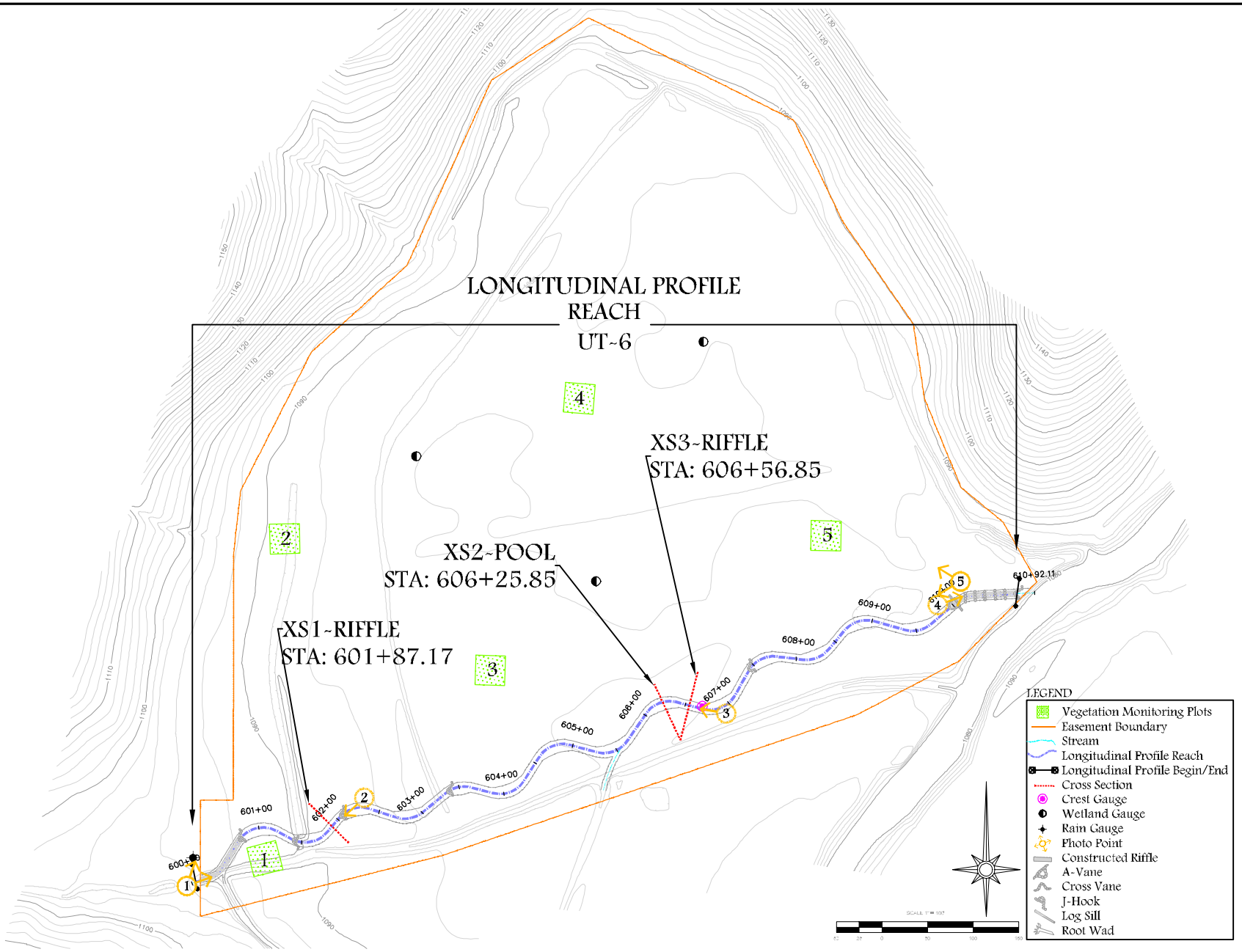


North Muddy Creek

Burke & McDowell County, NC

UT5 Monitoring Plan
YEAR 2008

Sheet:
3
of 5



North Muddy Creek

Burke & McDowell County, NC

UT6 Monitoring Plan
YEAR 2008

Sheet:
4
of 5

North Muddy Creek Burke & McDowell County, NC	UT2 & UT4 Monitoring Plan YEAR 2008	Sheet: 5 of 5

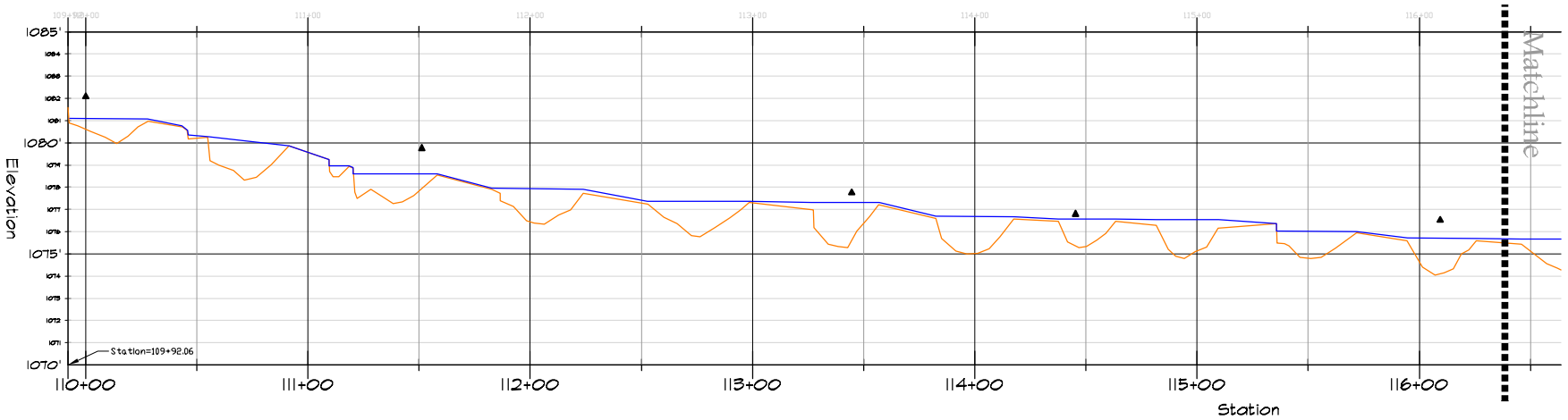
NORTH MUDDY CREEK YEAR-2008
UT1-Upper LONGITUDINAL PROFILE

LONGITUDINAL PROFILE LEGEND

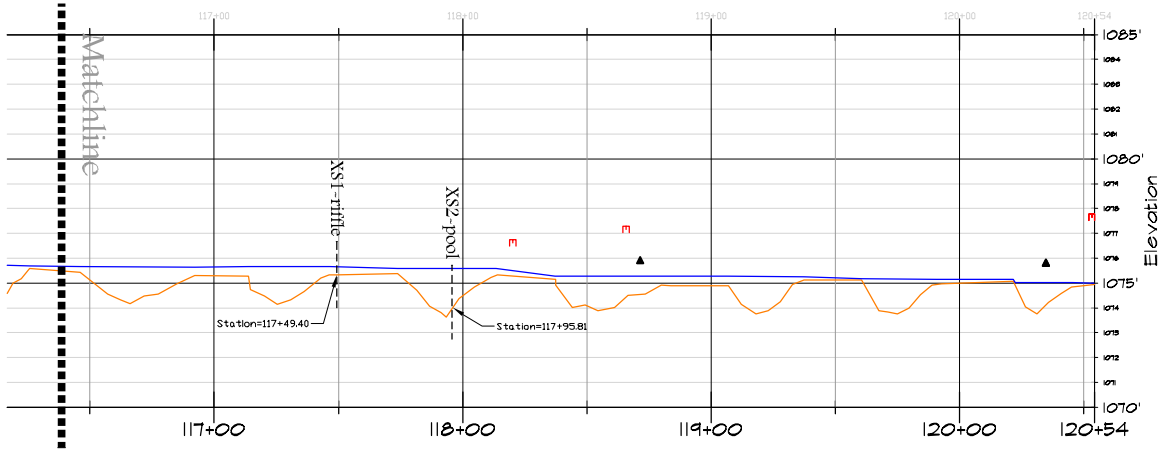
- BANKFULL
- WATER SURFACE
- THALWEG
- CROSS SECTION
- TOP OF BANK

NORTH MUDDY CREEK YEAR-2008
UT1-Lower LONGITUDINAL PROFILE

UT1-Lower



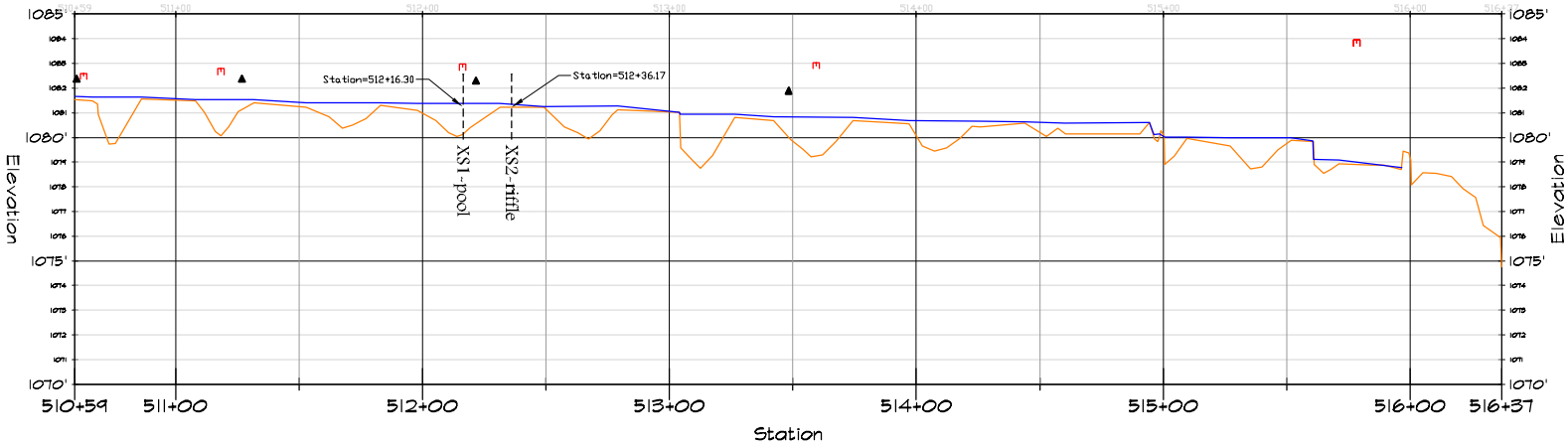
UT1-Lower Continued



LONGITUDINAL PROFILE LEGEND

- BANKFULL
- WATER SURFACE
- THALWEG
- CROSS SECTION
- TOP OF BANK

UT5

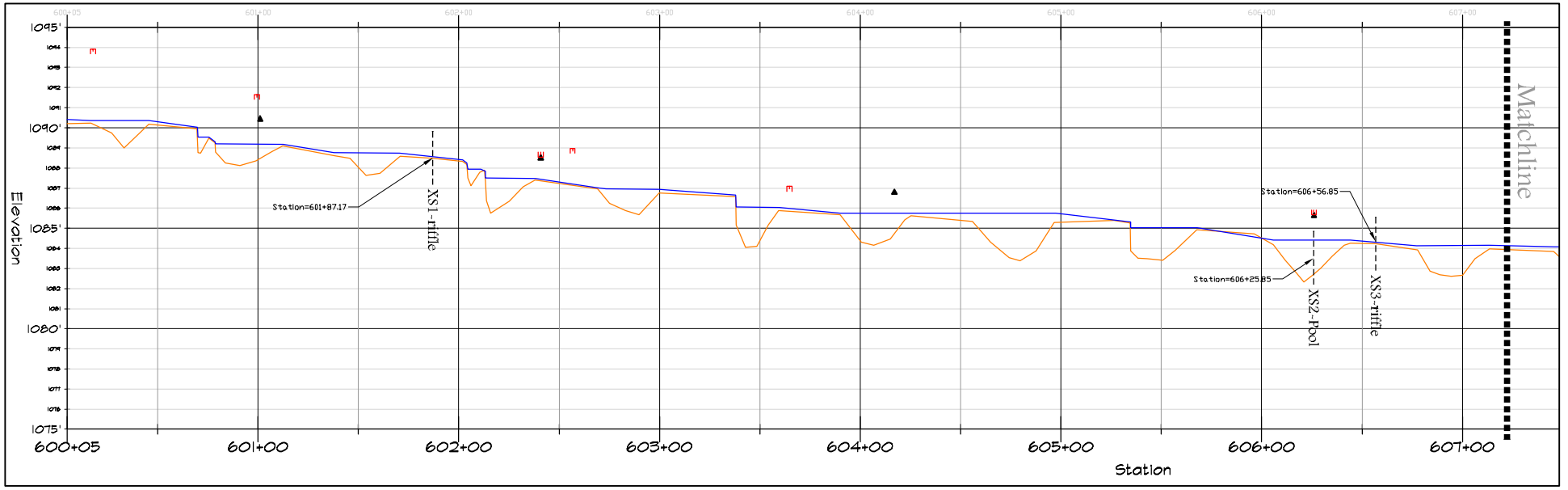


NORTH MUDDY CREEK YEAR-2008
UT5 LONGITUDINAL PROFILE

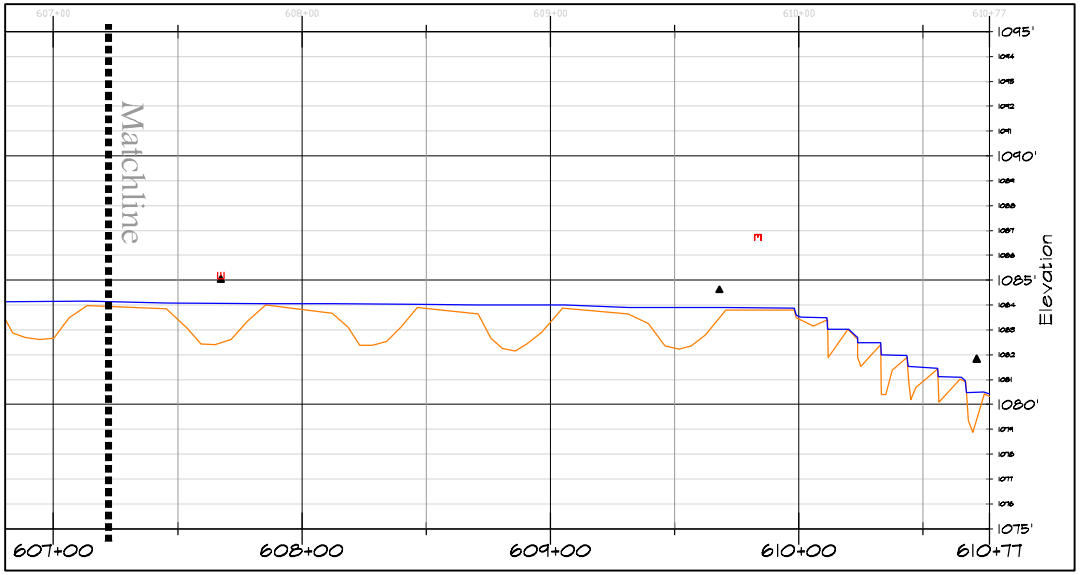
LONGITUDINAL PROFILE LEGEND

▲	BANKFULL
———	WATER SURFACE
———	THALWEG
- - - - - - - - -	CROSS SECTION
⊔	TOP OF BANK

UT6



UT6 CONTINUED



NORTH MUDDY CREEK YEAR-2008
UT6 LONGITUDINAL PROFILE

LONGITUDINAL PROFILE LEGEND

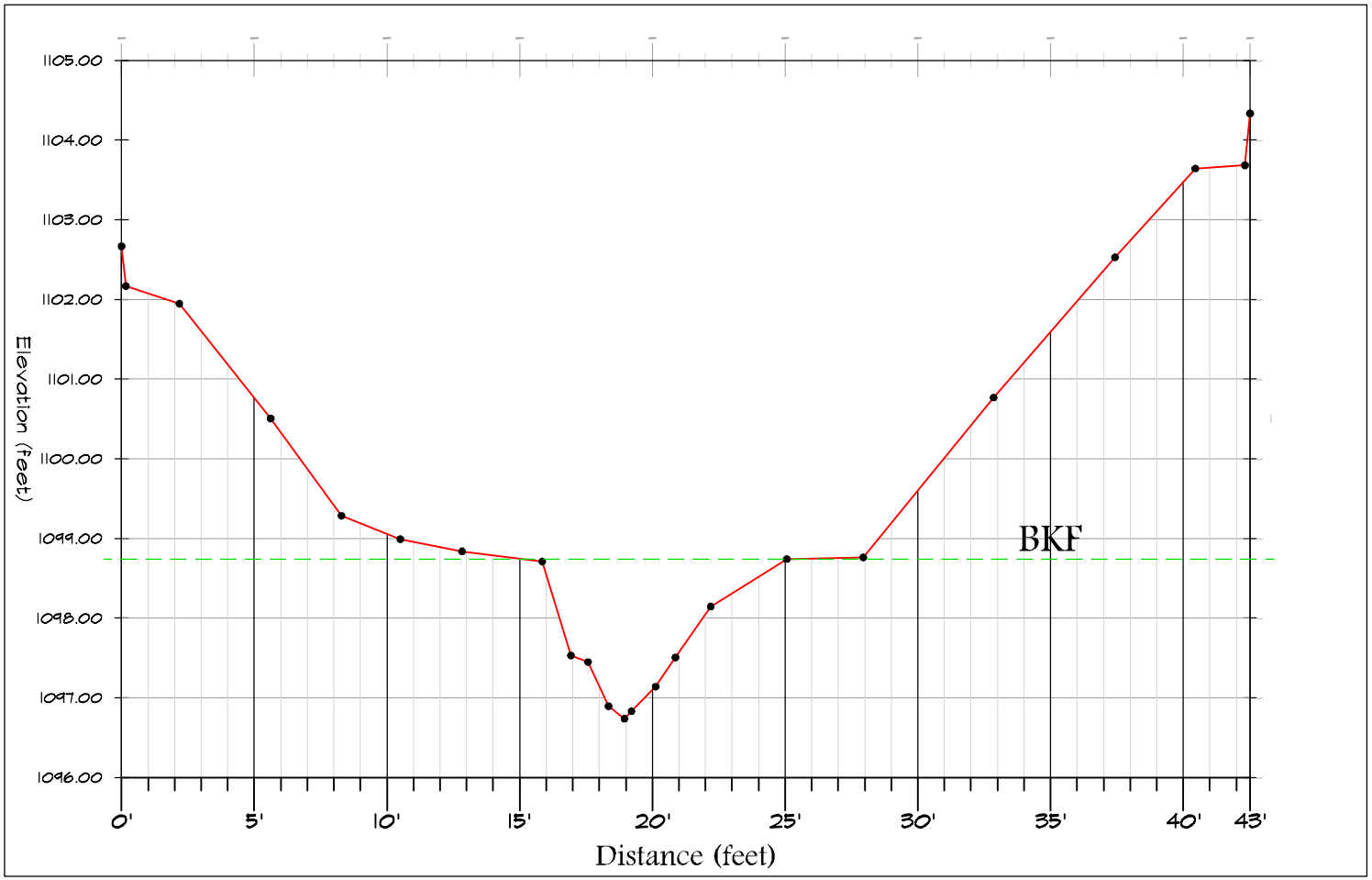
- BANKFULL
- WATER SURFACE
- THALWEG
- CROSS SECTION
- TOP OF BANK

NORTH MUDDY CREEK

YEAR-2008

UT1-UPPER-CROSS SECTION

XS1-POOL STA:102+65.52



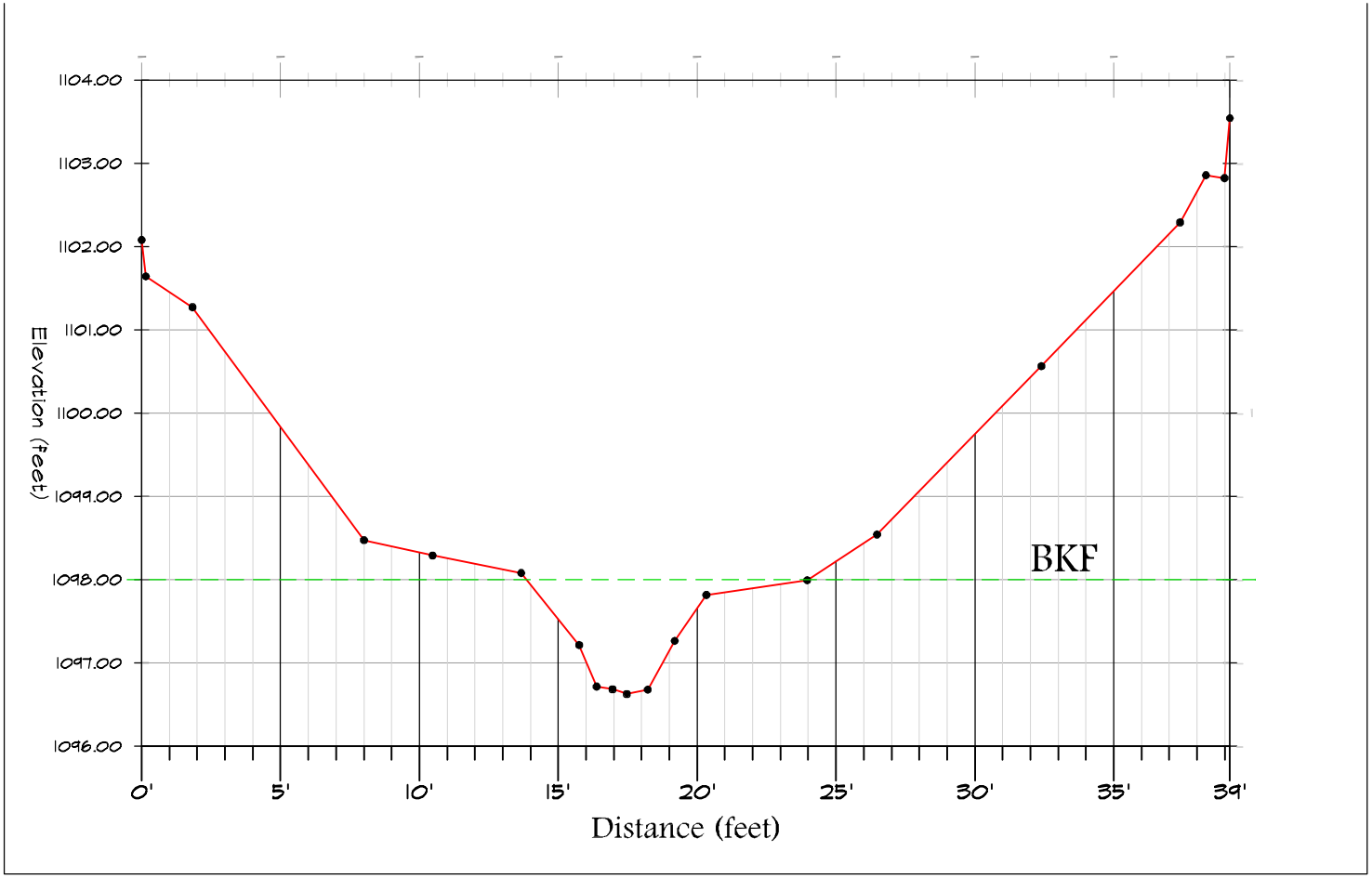
UT1-UPPER

NORTH MUDDY CREEK

YEAR-2008

UT1-UPPER-CROSS SECTION

XS2-RIFFLE STA:102+89.68



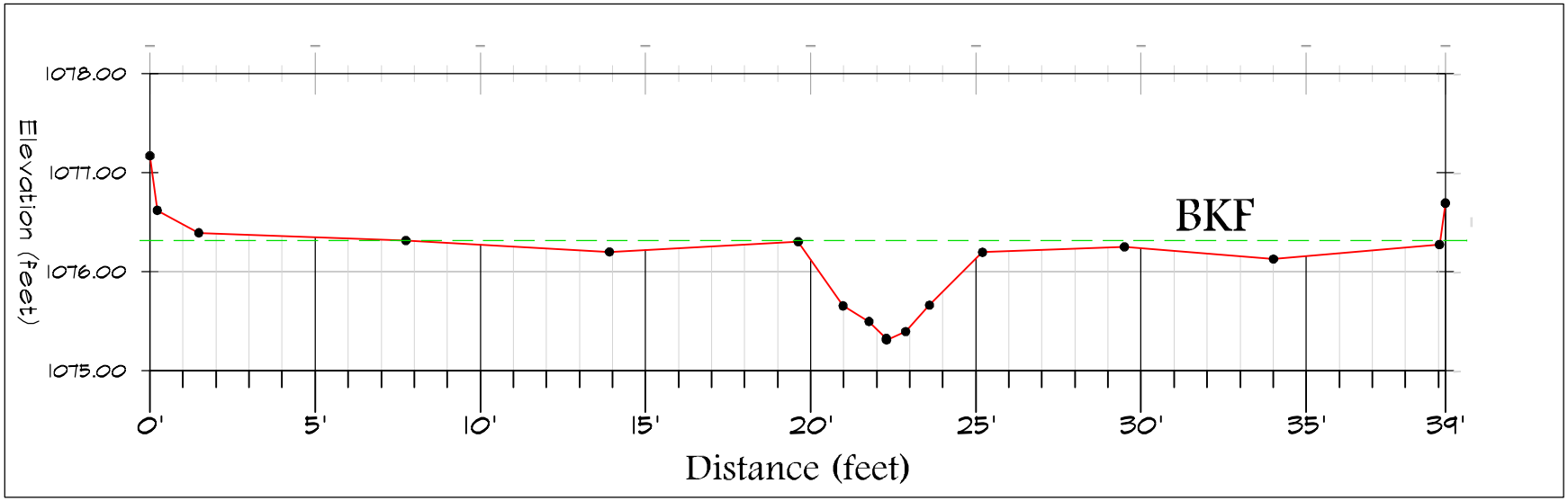
UT1-UPPER

NORTH MUDDY CREEK

YEAR~2008

UT1~LOWER~CROSS SECTION

XS1~RIFFLE STA:117+49.40



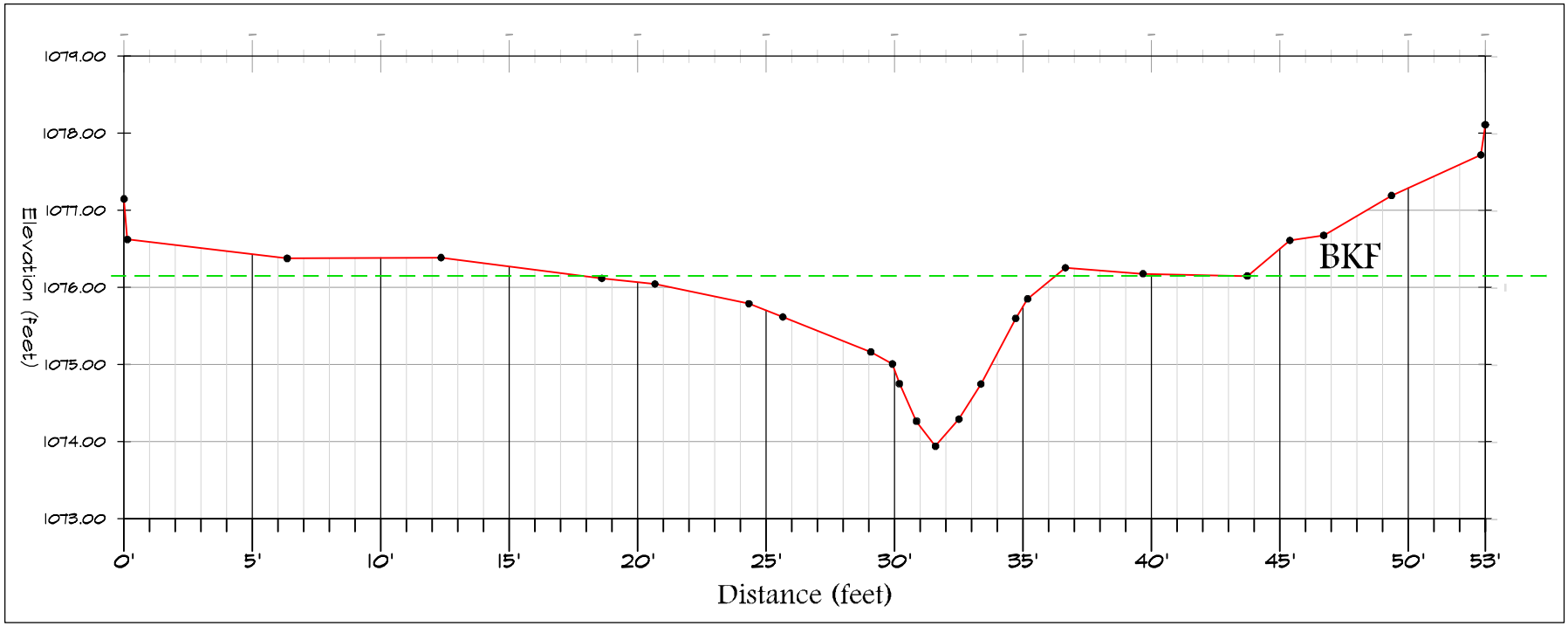
UT1~LOWER

NORTH MUDDY CREEK

YEAR~2008

UT1~LOWER~CROSS SECTION

XS2~POOL STA:117+95.81



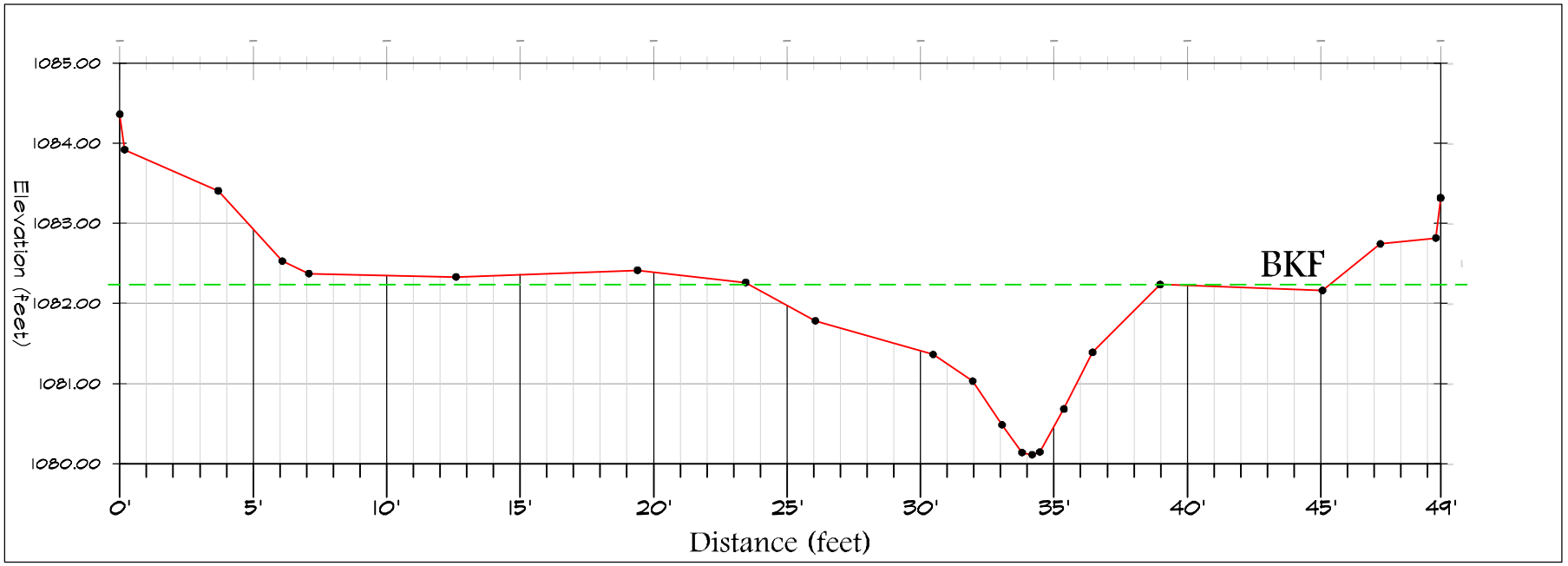
UT1~LOWER

NORTH MUDDY CREEK

YEAR~2008

UT5~CROSS SECTION

XS1~POOL STA:512+16.30



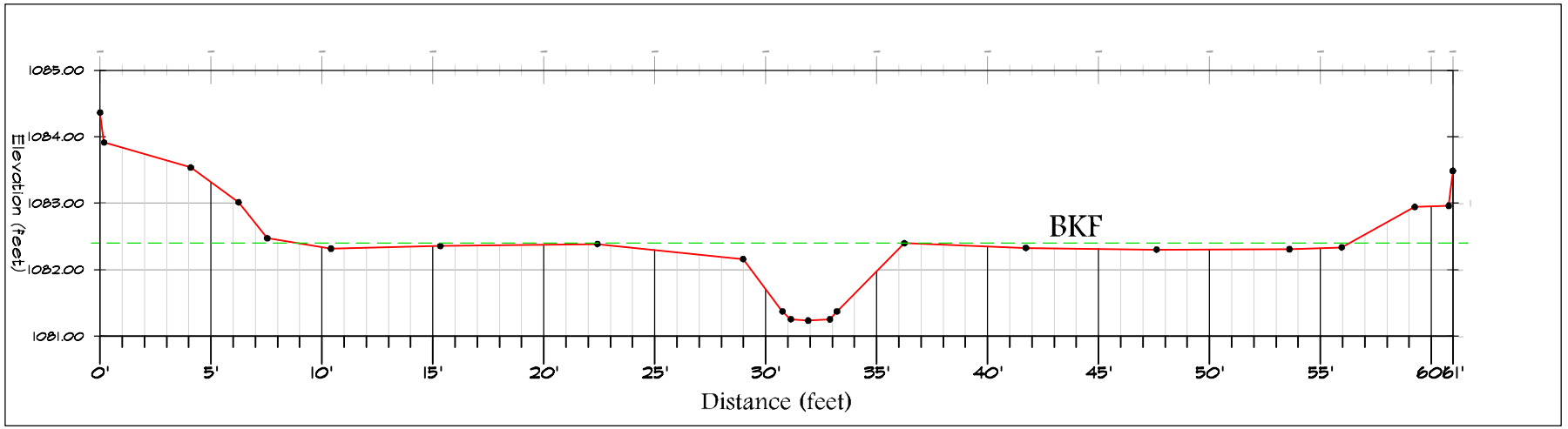
UT5

NORTH MUDDY CREEK

YEAR-2008

UT5-CROSS SECTION

XS2-RIFFLE STA:512+36.17



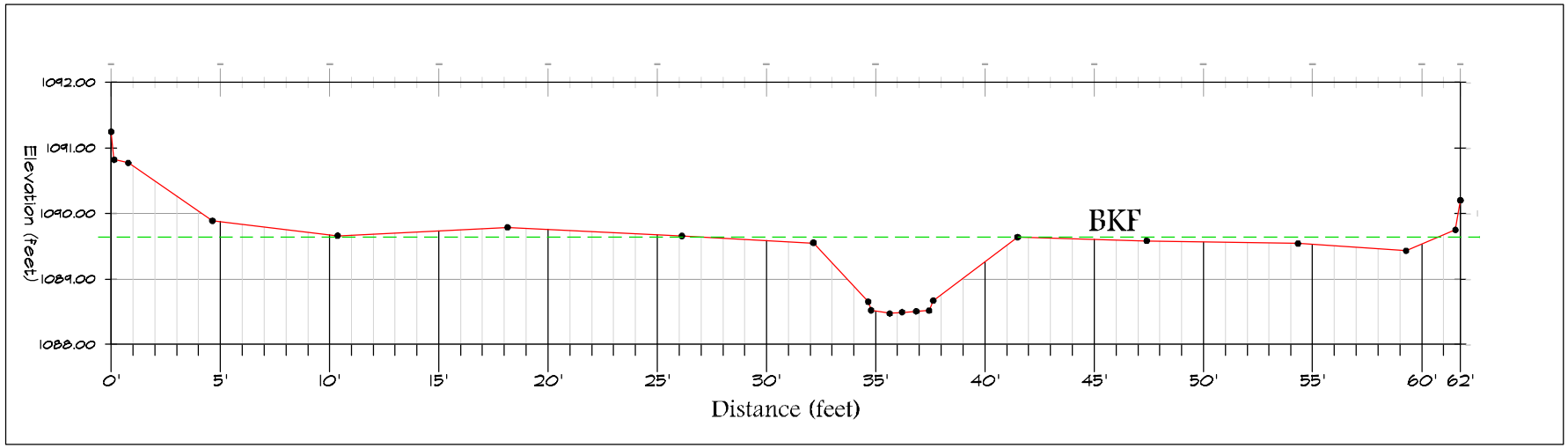
UT5

NORTH MUDDY CREEK

YEAR~2008

UT6~CROSS SECTION

XS1~RIFFLE STA:601+87.17



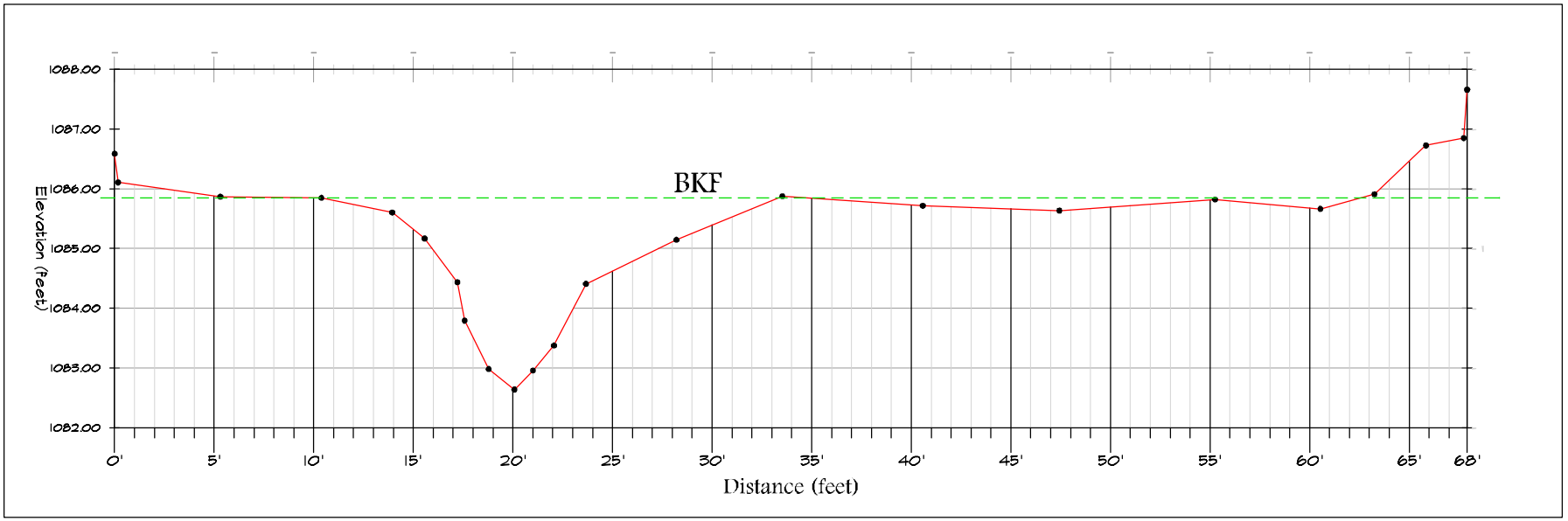
UT6

NORTH MUDDY CREEK

YEAR-2008

UT6-CROSS SECTION

XS2-POOL STA:606+25.85



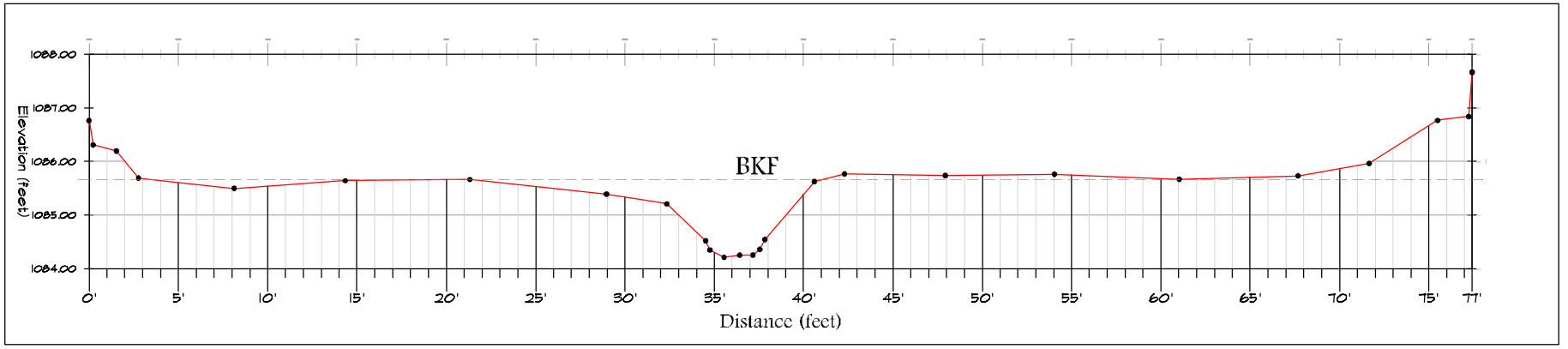
UT6

NORTH MUDDY CREEK

YEAR~2008

UT6~CROSS SECTION

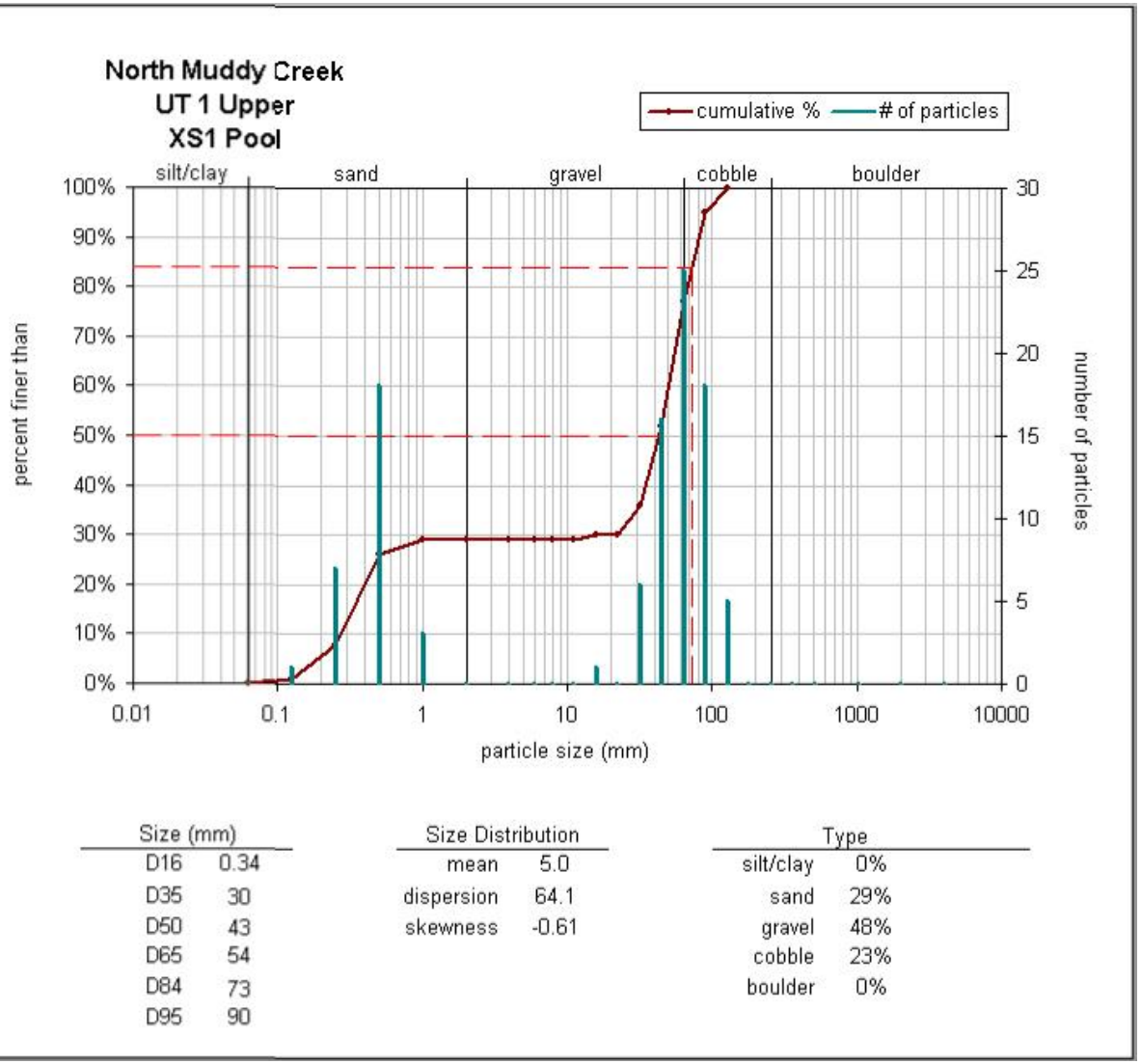
XS3~RIFFLE STA:606+56.85



UT6

Material	Size Range (mm		Count
silt/clay	0	- 0.062	0
very fine sand	0.062	- 0.125	1
fine sand	0.125	- 0.25	7
medium sand	0.25	- 0.5	18
coarse sand	0.5	- 1	3
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	1
coarse gravel	16	- 22	0
coarse gravel	22	- 32	6
very coarse gravel	32	- 45	16
very coarse gravel	45	- 64	25
small cobble	64	- 90	18
medium cobble	90	- 128	5
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



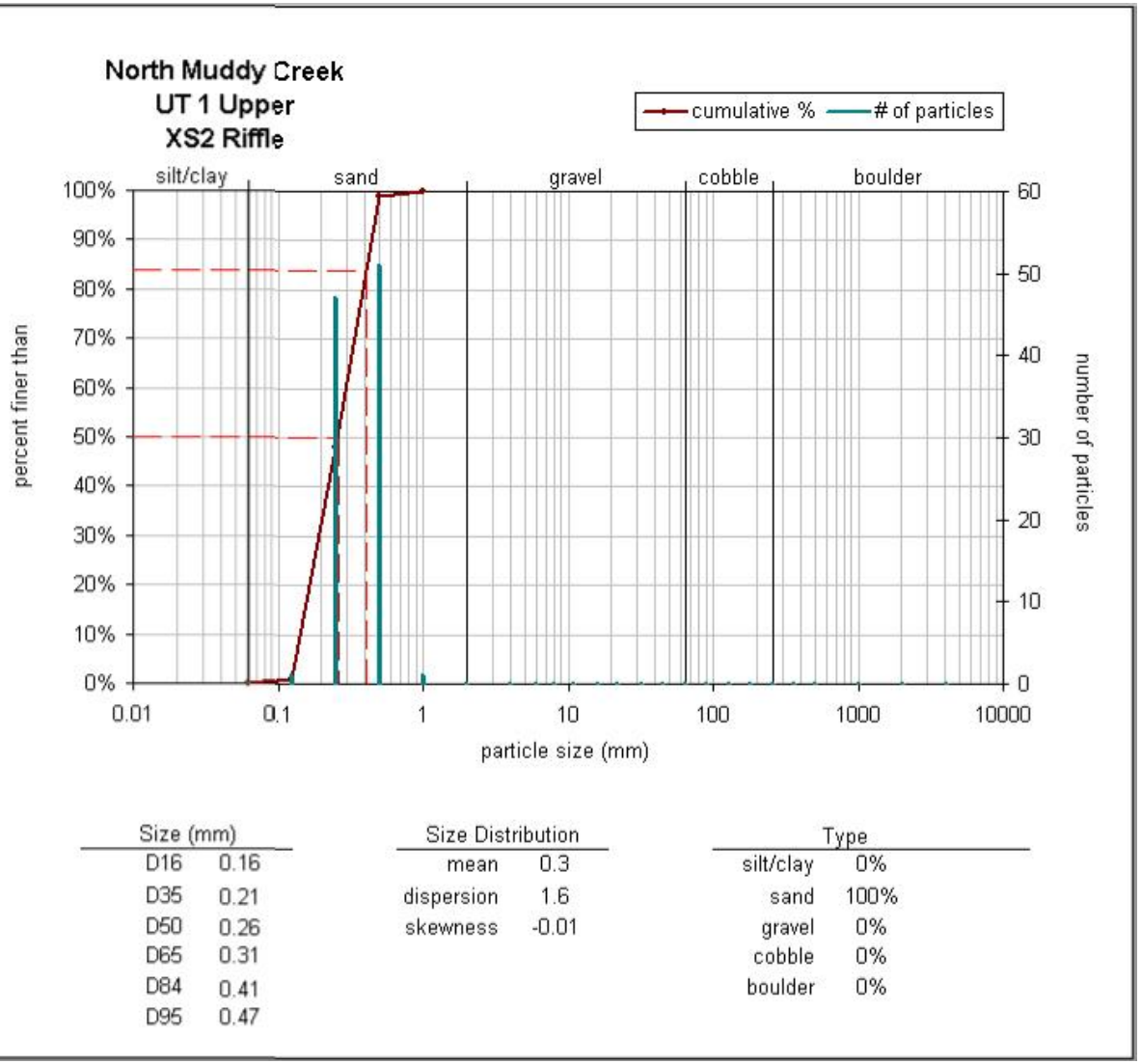
Size (mm)	
D16	0.34
D35	30
D50	43
D65	54
D84	73
D95	90

Size Distribution	
mean	5.0
dispersion	64.1
skewness	-0.61

Type	
silt/clay	0%
sand	29%
gravel	48%
cobble	23%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	0
very fine sand	0.062	- 0.125	1
fine sand	0.125	- 0.25	47
medium sand	0.25	- 0.5	51
coarse sand	0.5	- 1	1
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	0
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



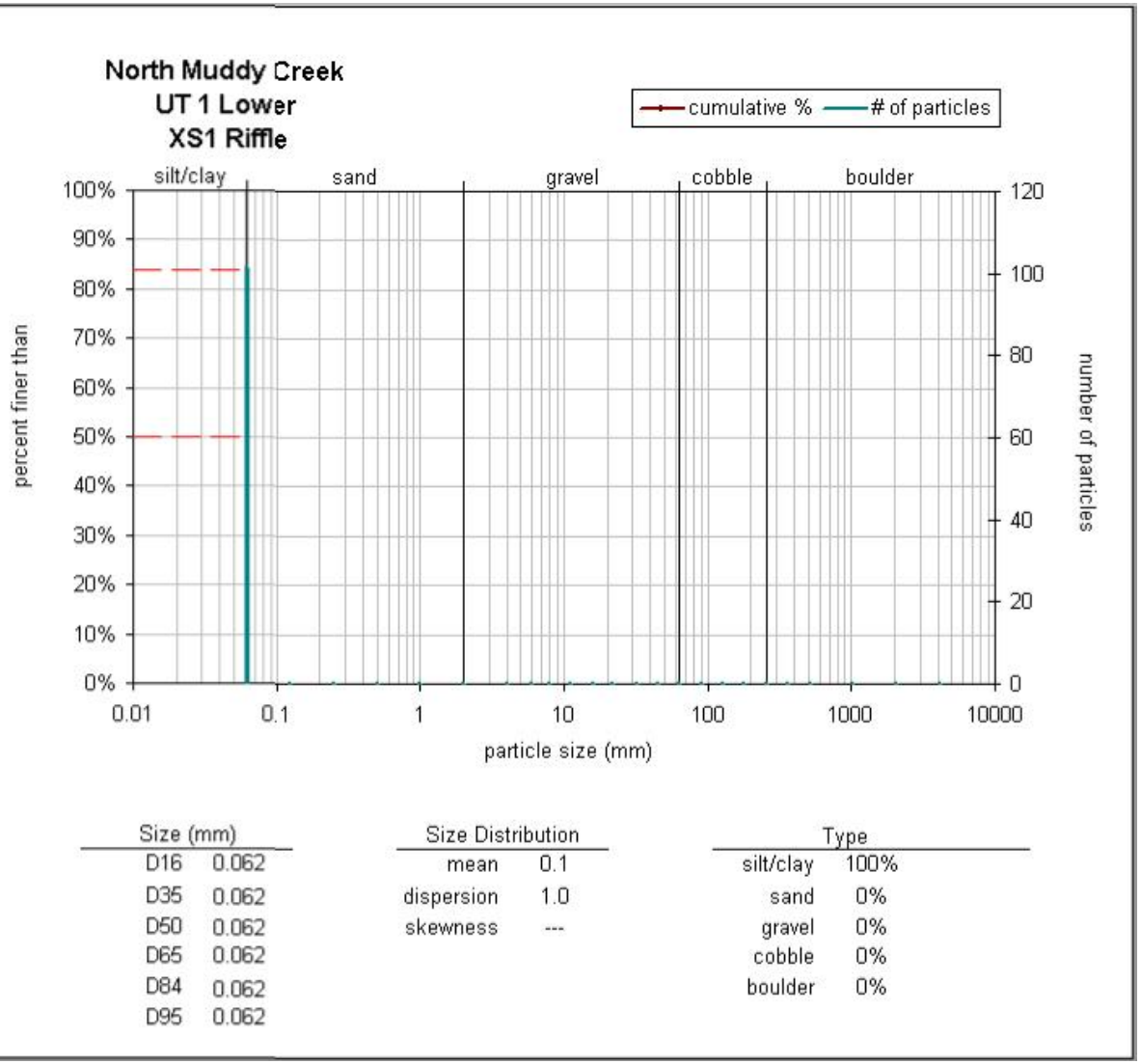
Size (mm)	
D16	0.16
D35	0.21
D50	0.26
D65	0.31
D84	0.41
D95	0.47

Size Distribution	
mean	0.3
dispersion	1.6
skewness	-0.01

Type	
silt/clay	0%
sand	100%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	101
very fine sand	0.062	- 0.125	0
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			101
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			101

Note:



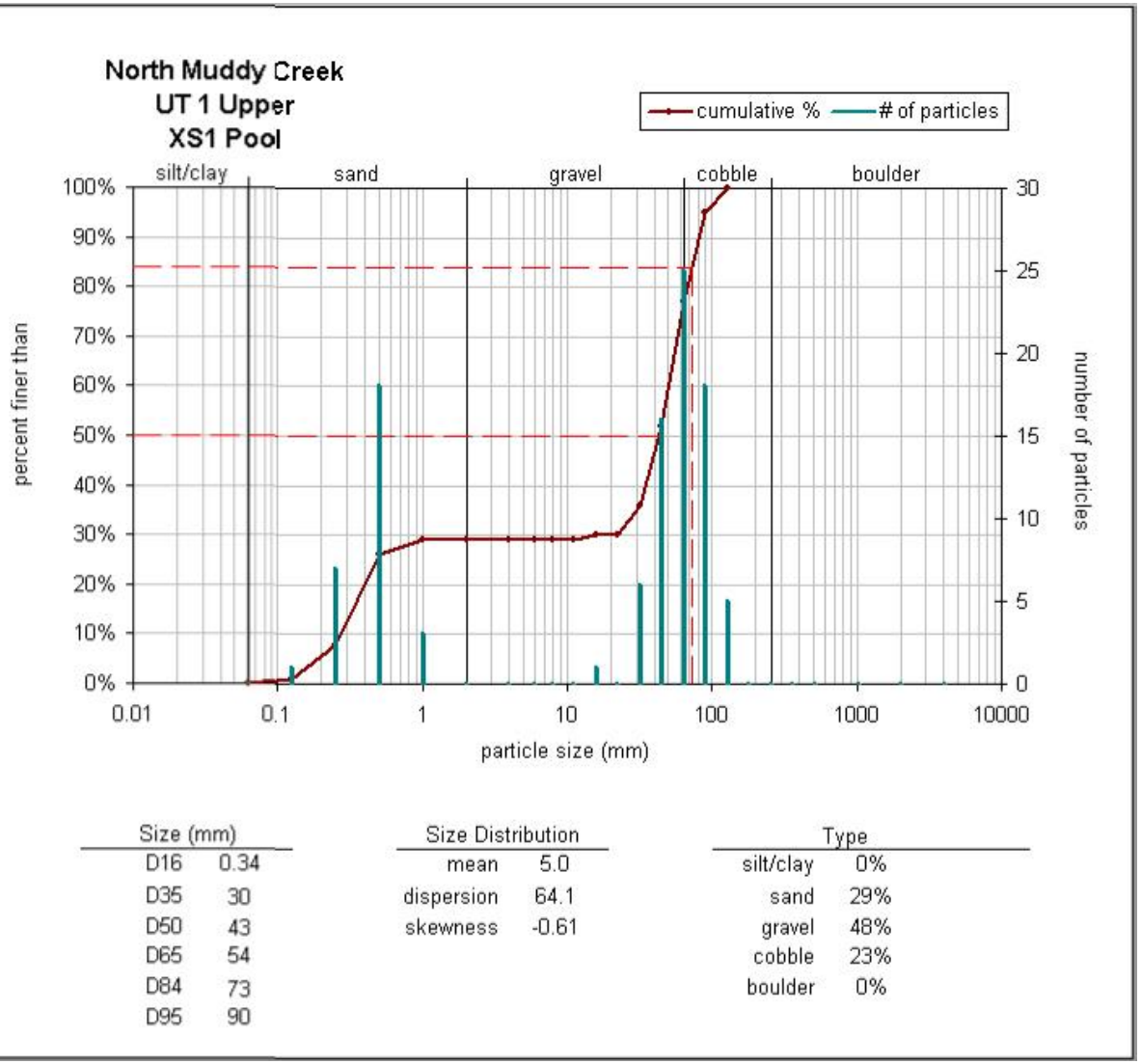
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	100%
sand	0%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	0
very fine sand	0.062	- 0.125	1
fine sand	0.125	- 0.25	7
medium sand	0.25	- 0.5	18
coarse sand	0.5	- 1	3
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	1
coarse gravel	16	- 22	0
coarse gravel	22	- 32	6
very coarse gravel	32	- 45	16
very coarse gravel	45	- 64	25
small cobble	64	- 90	18
medium cobble	90	- 128	5
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



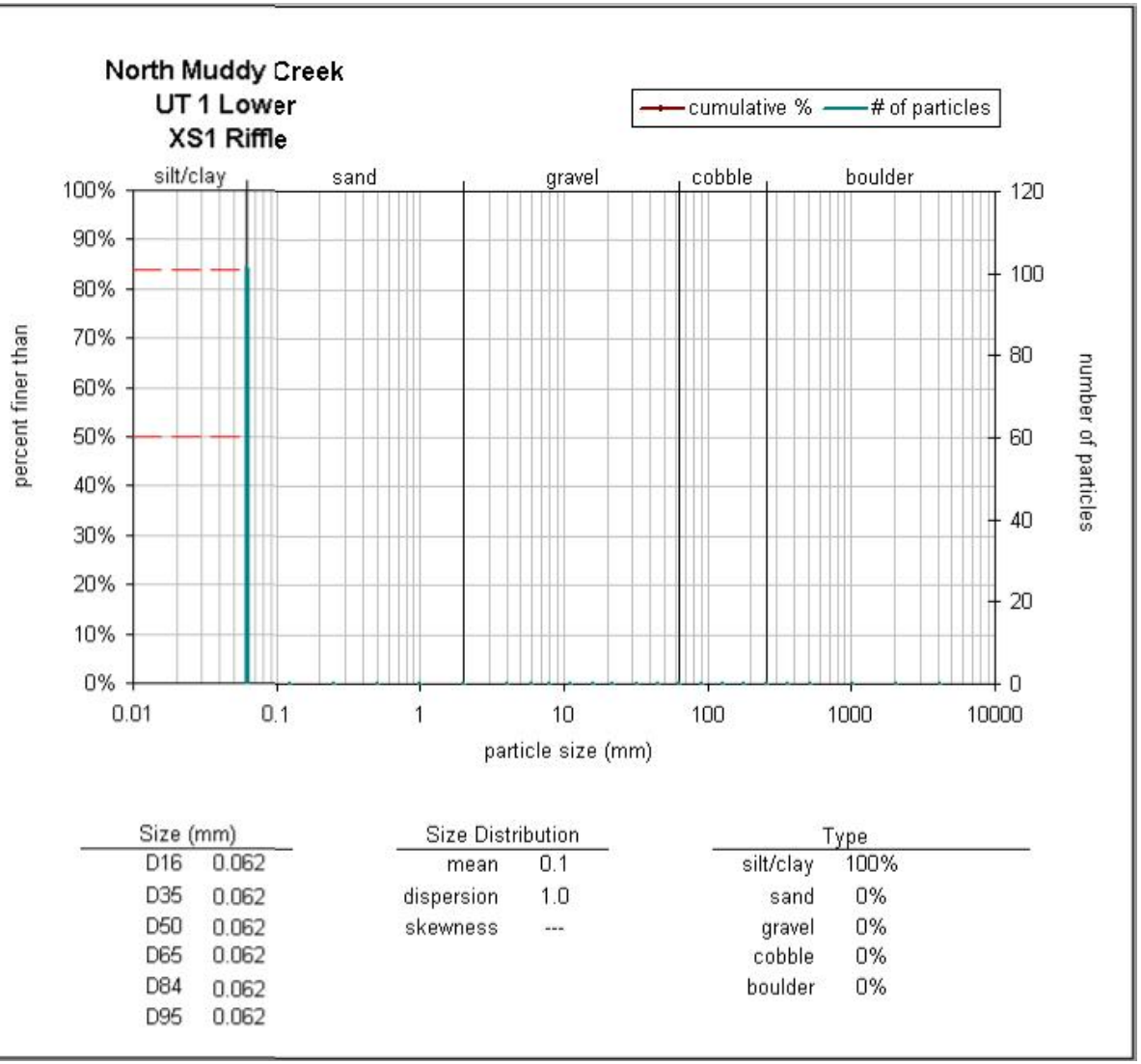
Size (mm)	
D16	0.34
D35	30
D50	43
D65	54
D84	73
D95	90

Size Distribution	
mean	5.0
dispersion	64.1
skewness	-0.61

Type	
silt/clay	0%
sand	29%
gravel	48%
cobble	23%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	101
very fine sand	0.062	- 0.125	0
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			101
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			101

Note:



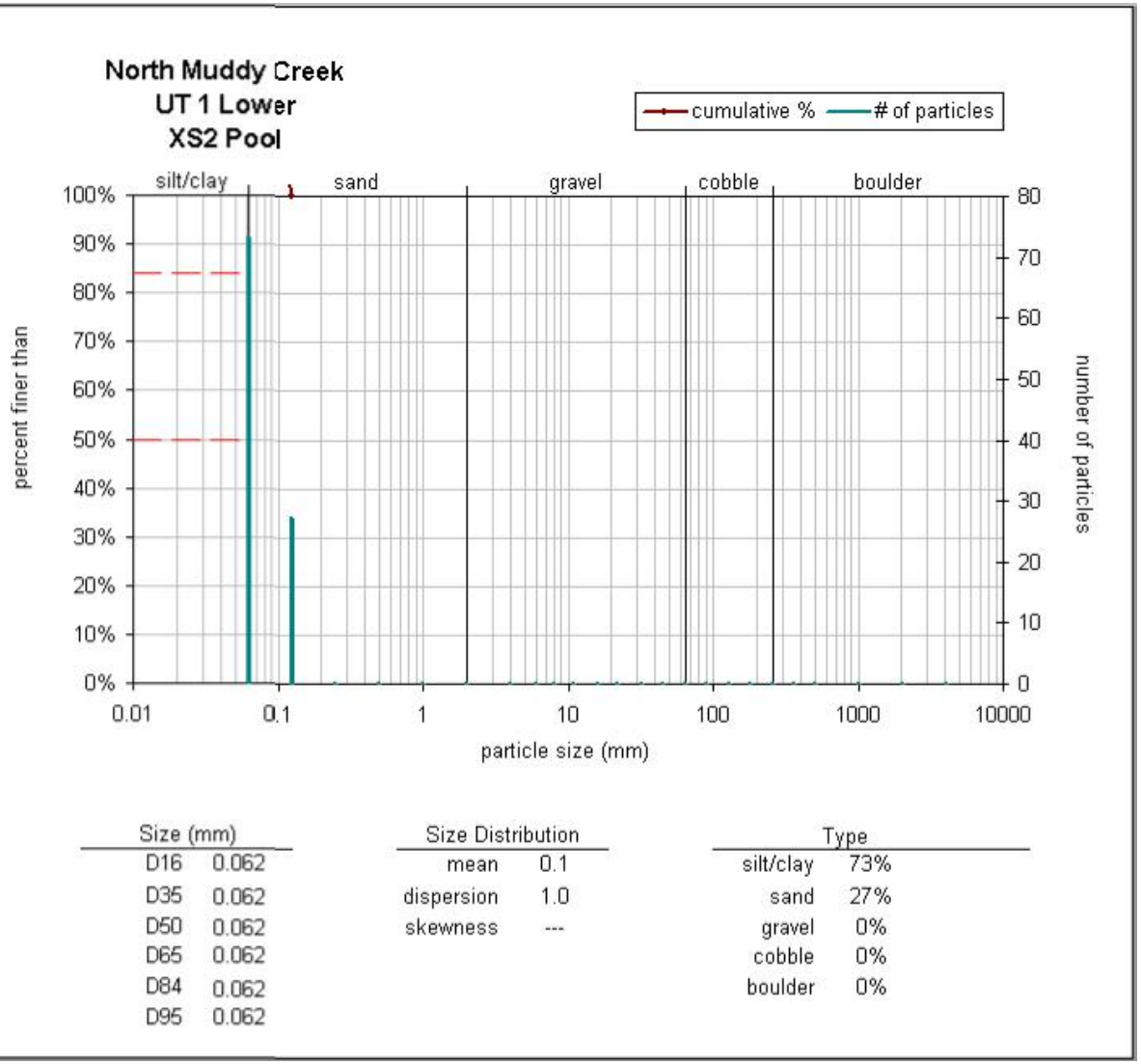
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	100%
sand	0%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	73
very fine sand	0.062	- 0.125	27
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



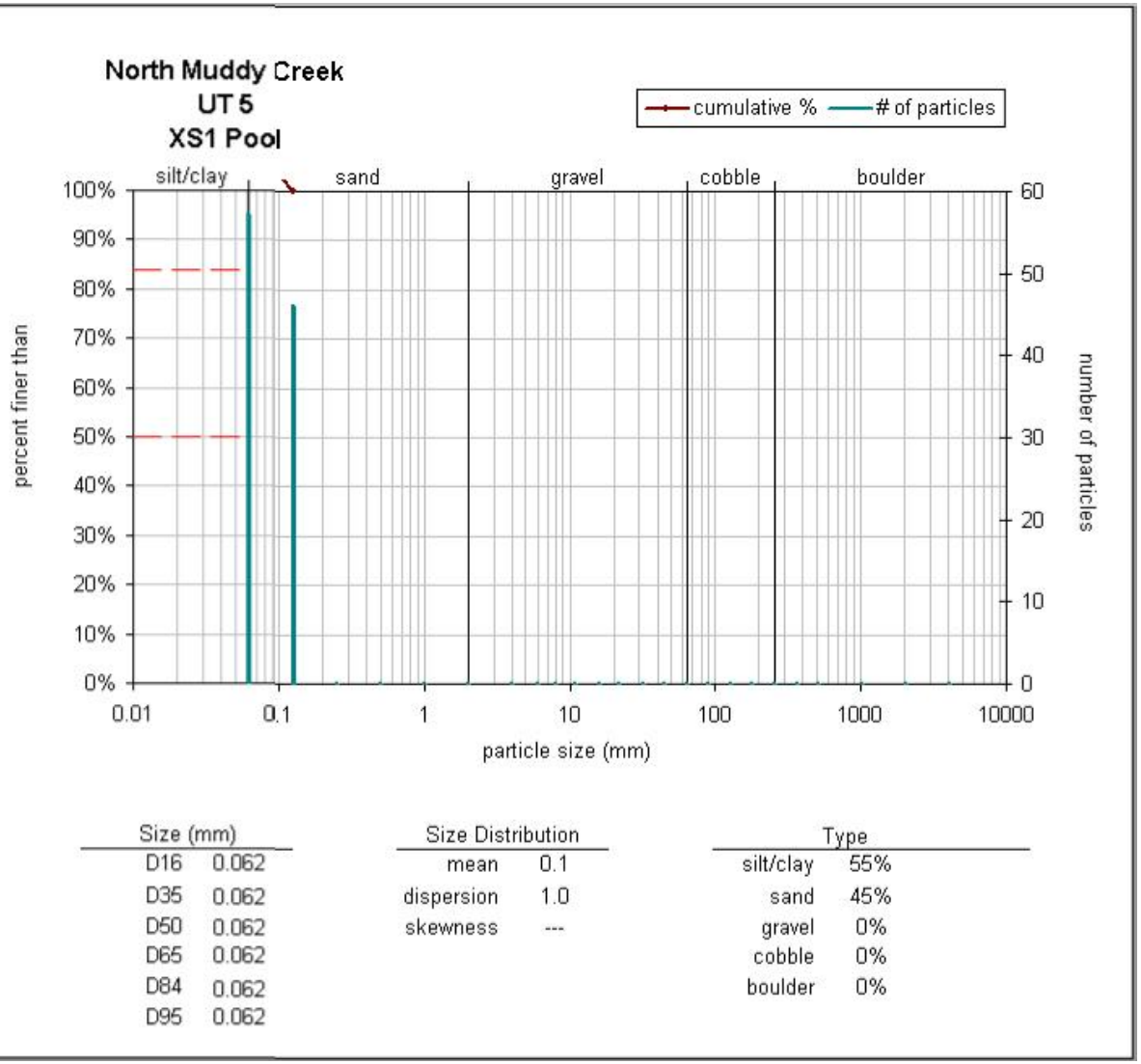
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	73%
sand	27%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	57
very fine sand	0.062	- 0.125	46
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			103
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			103

Note:



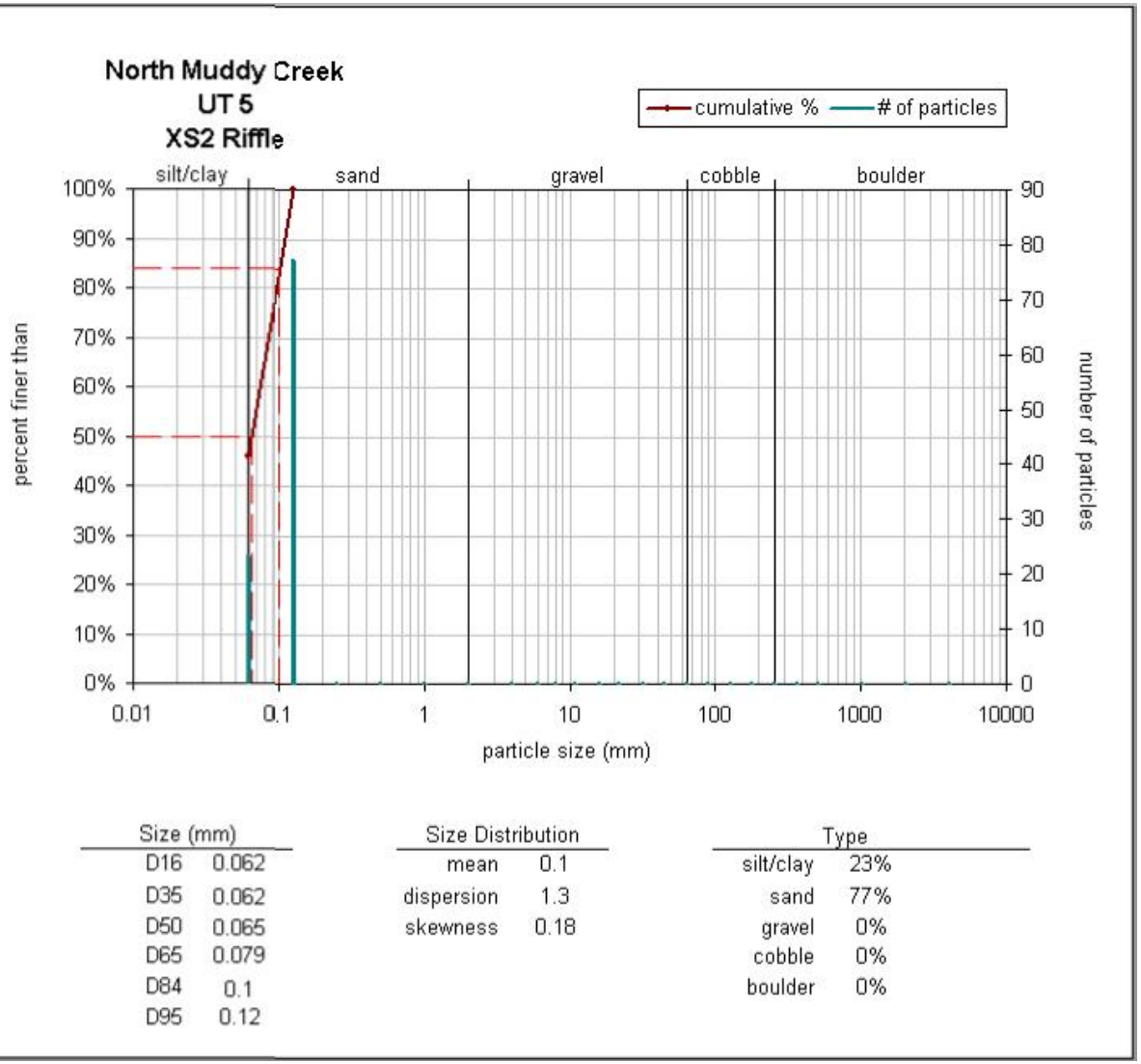
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	55%
sand	45%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	23
very fine sand	0.062	- 0.125	77
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



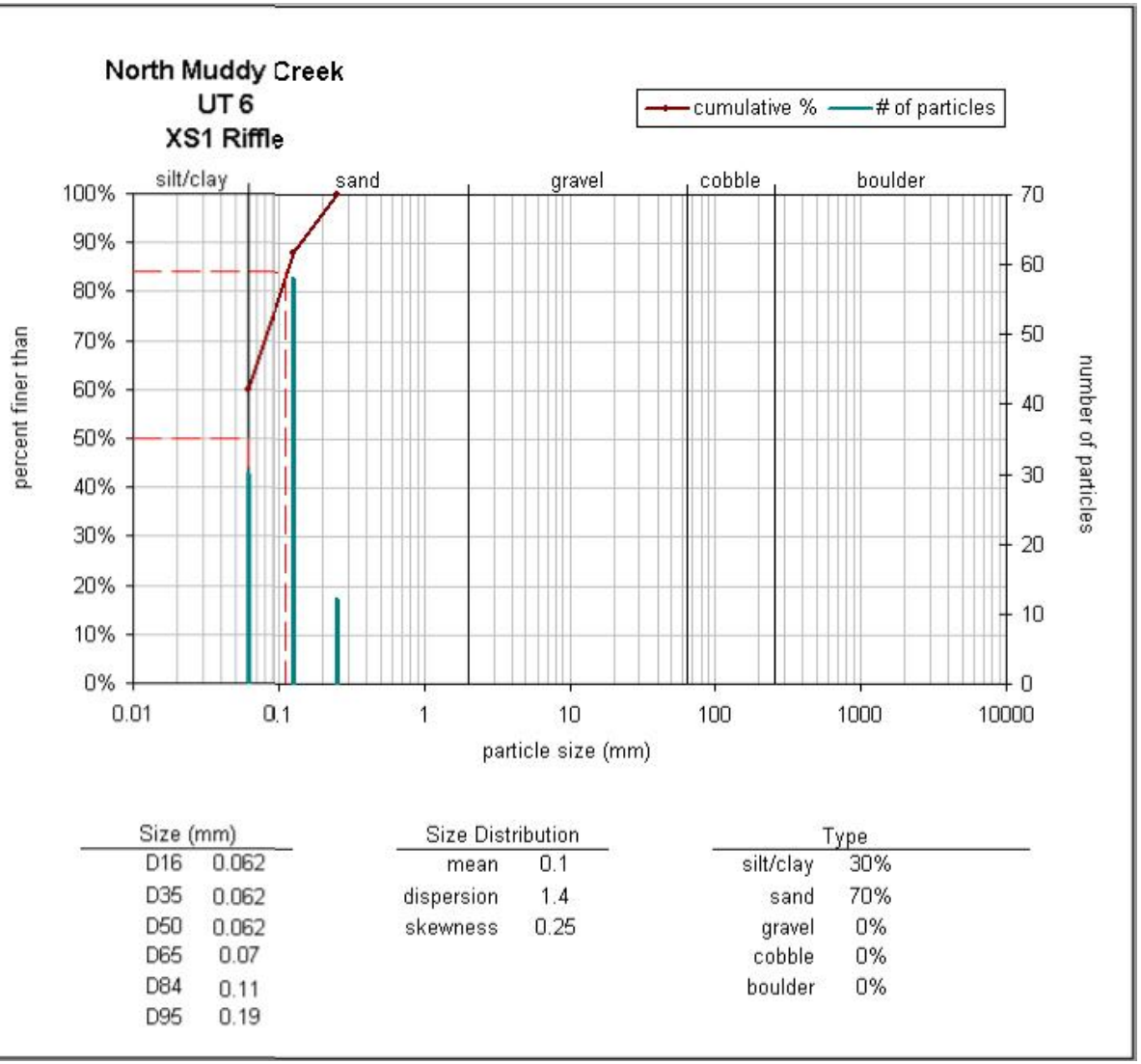
Size (mm)	
D16	0.062
D35	0.062
D50	0.065
D65	0.079
D84	0.1
D95	0.12

Size Distribution	
mean	0.1
dispersion	1.3
skewness	0.18

Type	
silt/clay	23%
sand	77%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	30
very fine sand	0.062	- 0.125	58
fine sand	0.125	- 0.25	12
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	
coarse gravel	16	- 22	
coarse gravel	22	- 32	
very coarse gravel	32	- 45	
very coarse gravel	45	- 64	
small cobble	64	- 90	
medium cobble	90	- 128	
large cobble	128	- 180	
very large cobble	180	- 256	
small boulder	256	- 362	
small boulder	362	- 512	
medium boulder	512	- 1024	
large boulder	1024	- 2048	
very large boulder	2048	- 4096	
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



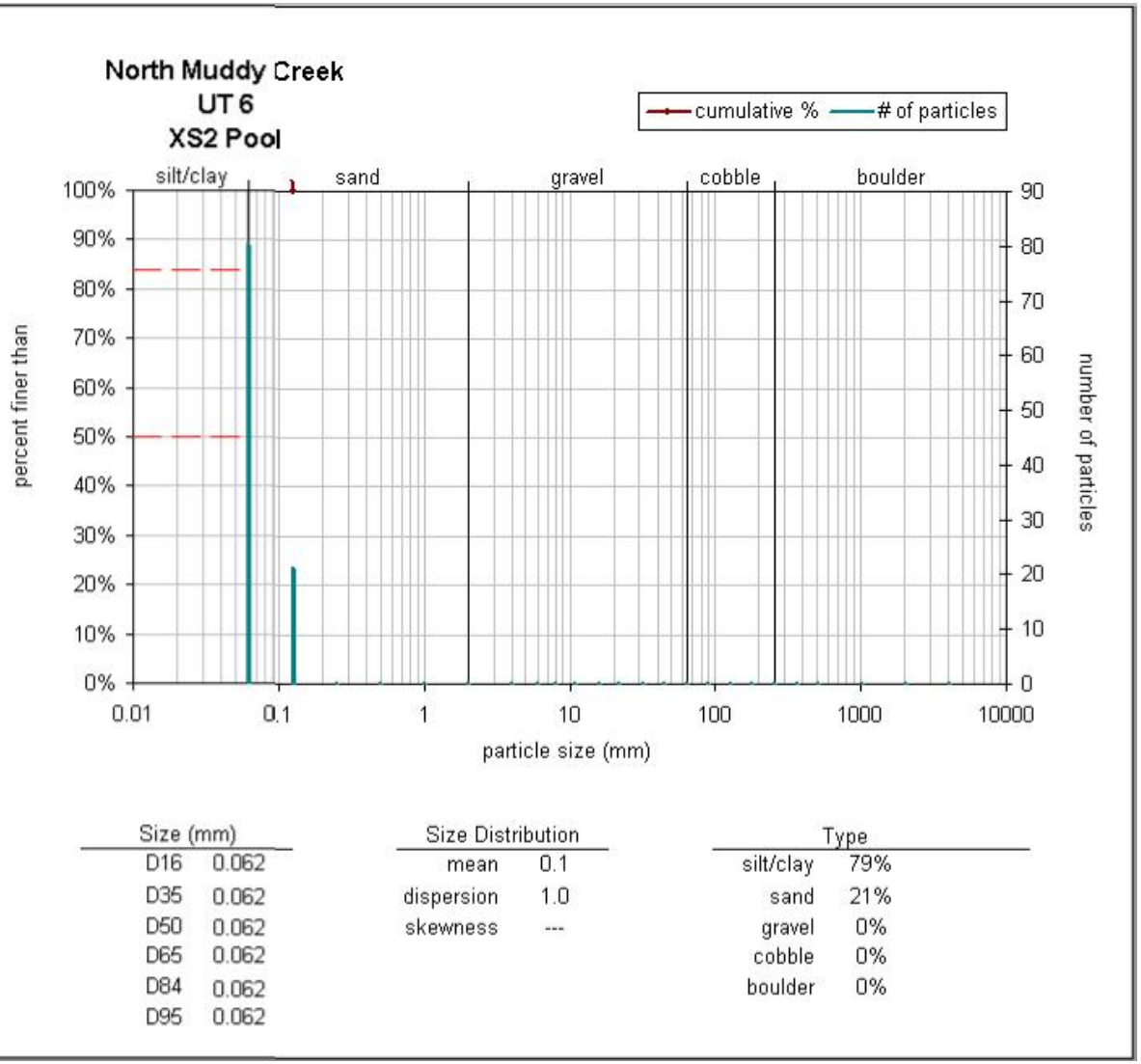
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.07
D84	0.11
D95	0.19

Size Distribution	
mean	0.1
dispersion	1.4
skewness	0.25

Type	
silt/clay	30%
sand	70%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	80
very fine sand	0.062	- 0.125	21
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			101
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			101

Note:



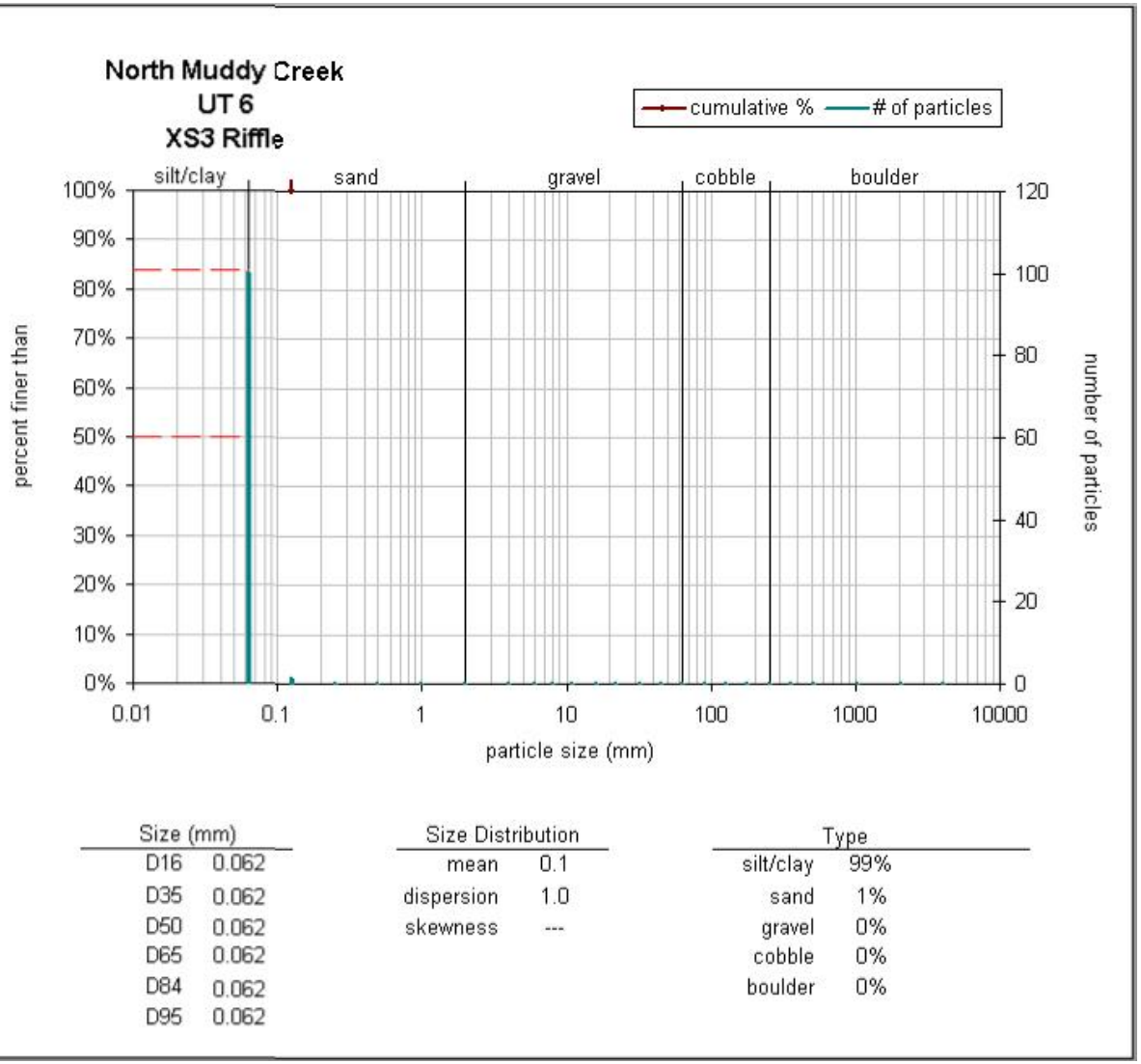
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	79%
sand	21%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	100
very fine sand	0.062	- 0.125	1
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			101
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			101

Note:



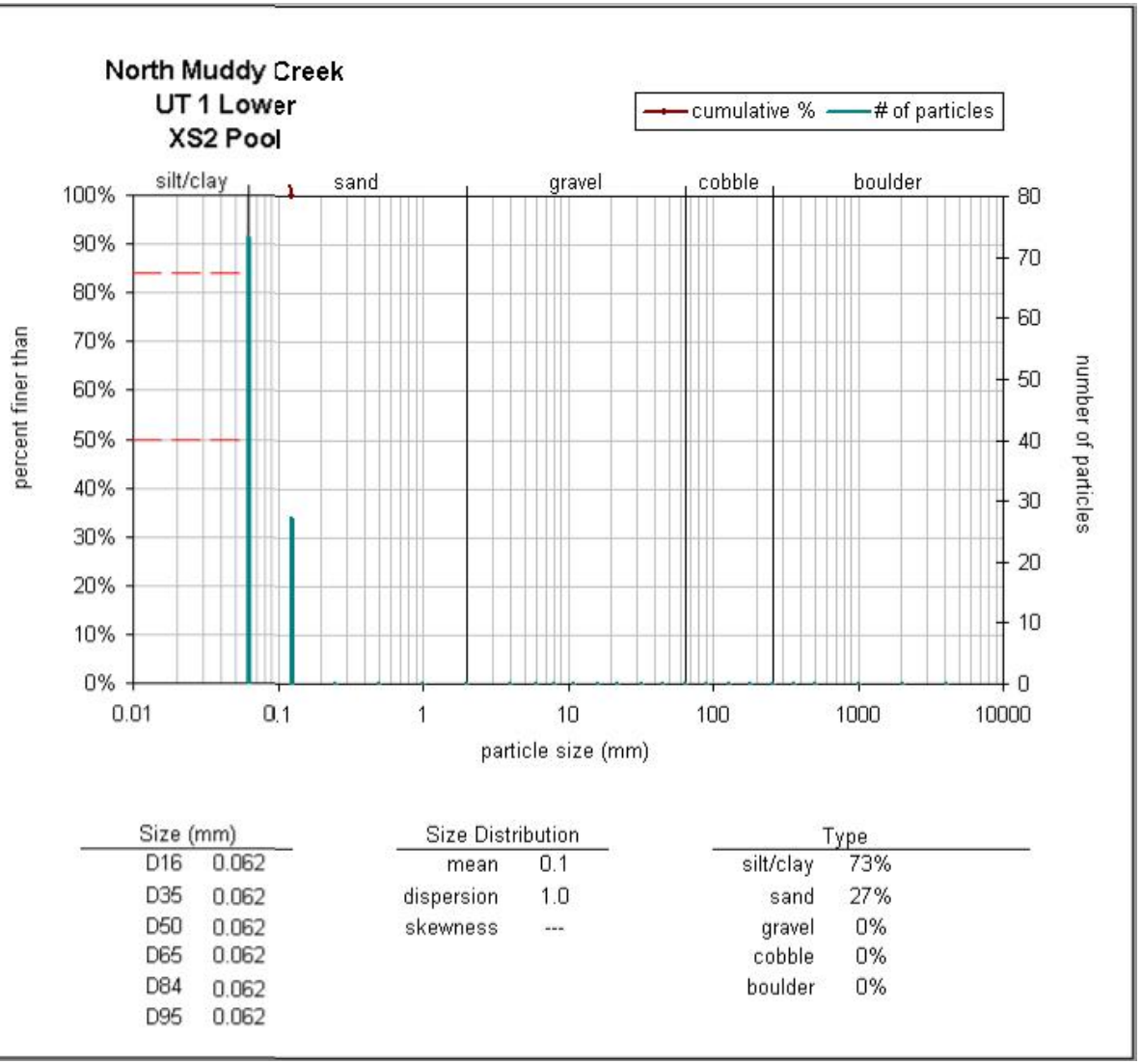
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	99%
sand	1%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	73
very fine sand	0.062	- 0.125	27
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



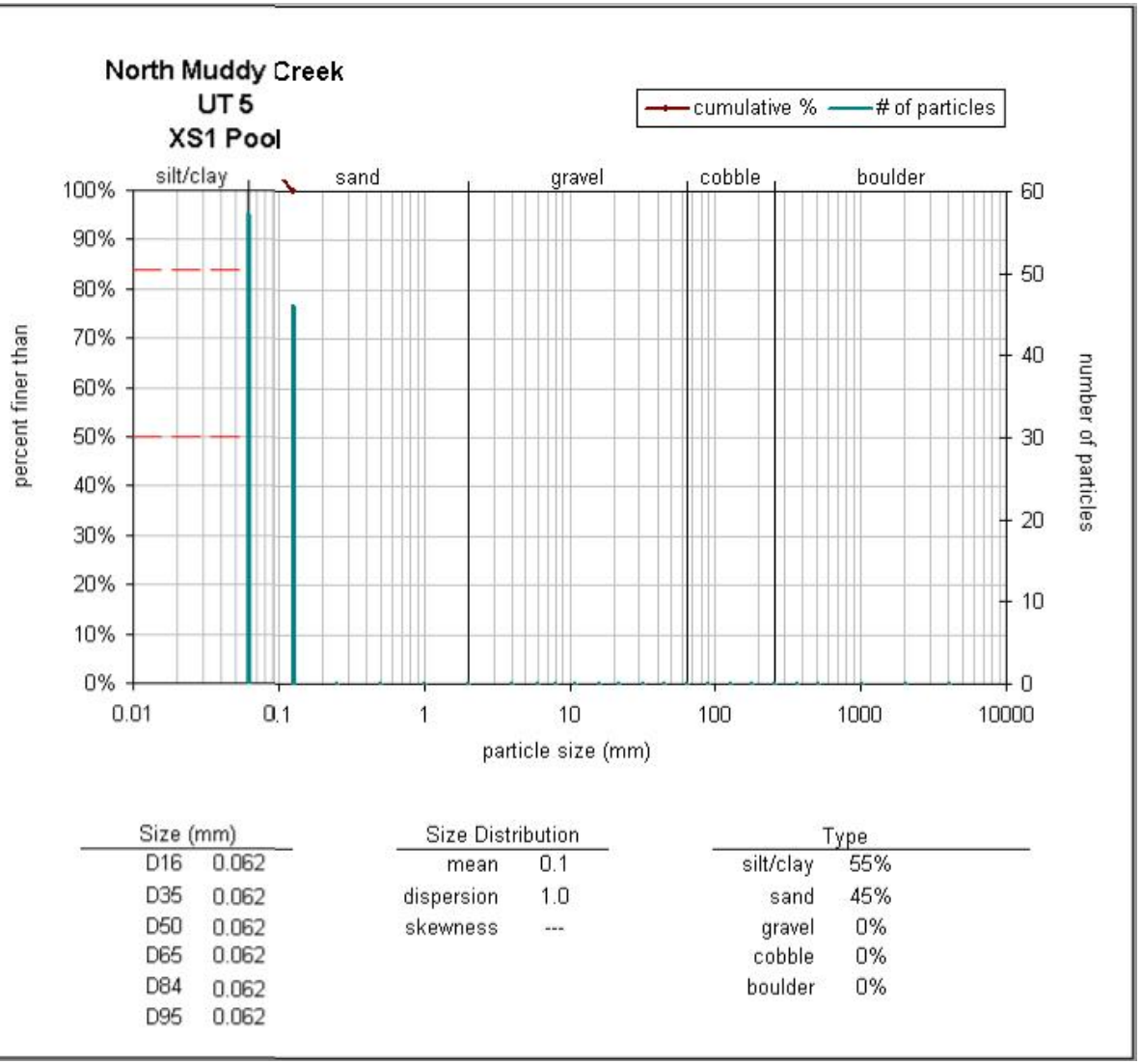
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	73%
sand	27%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	57
very fine sand	0.062	- 0.125	46
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			103
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			103

Note:



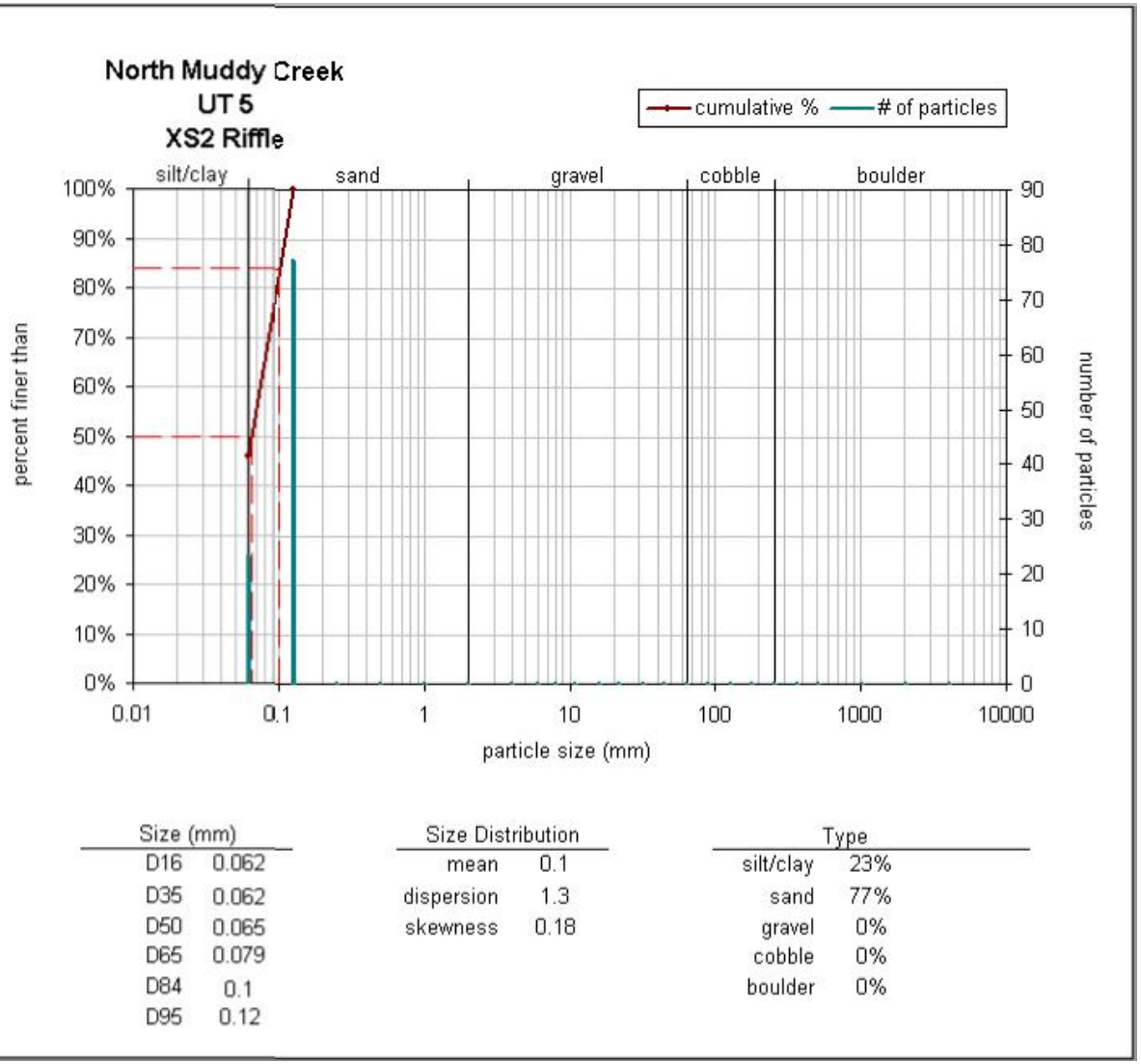
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	55%
sand	45%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	23
very fine sand	0.062	- 0.125	77
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



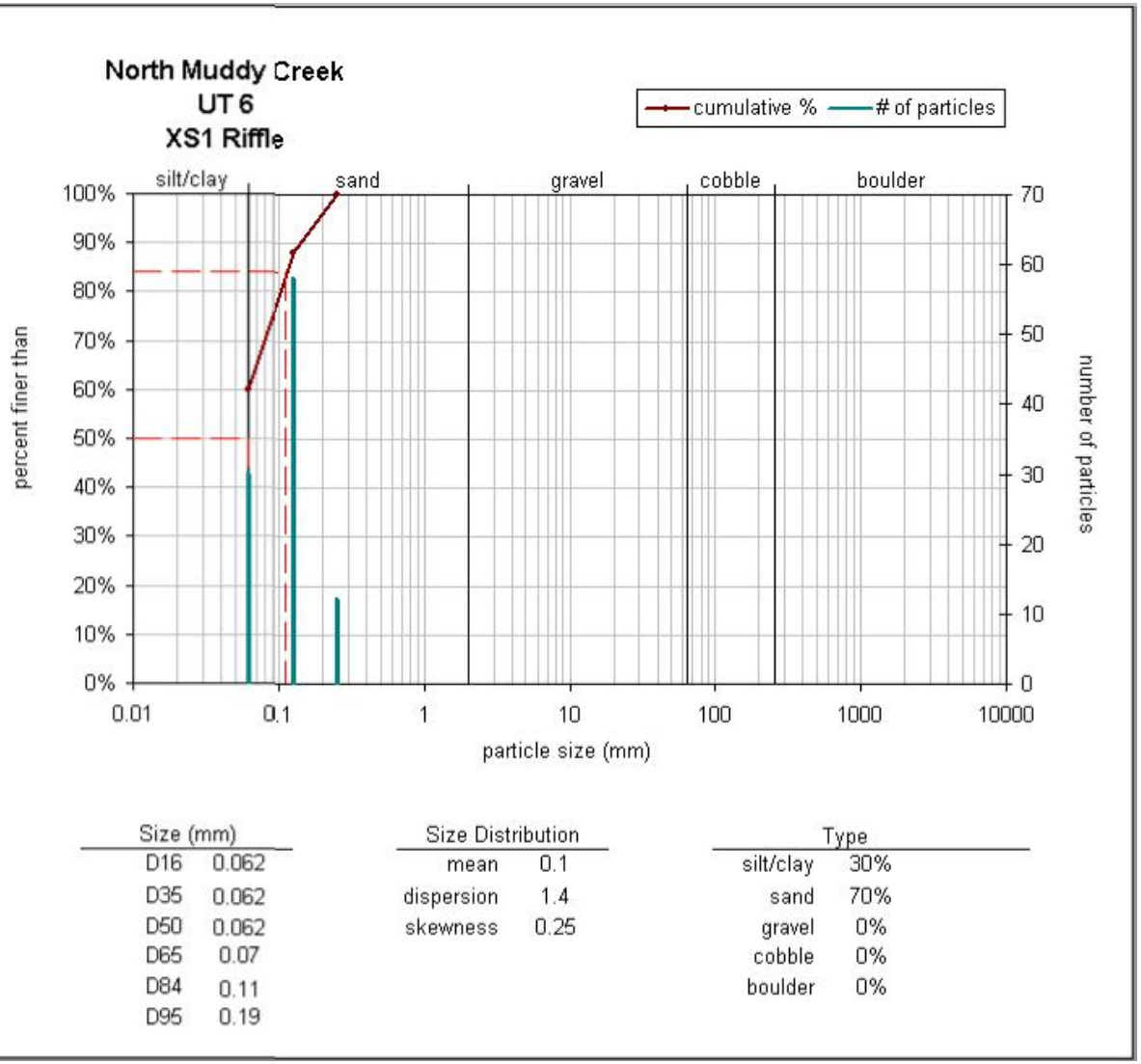
Size (mm)	
D16	0.062
D35	0.062
D50	0.065
D65	0.079
D84	0.1
D95	0.12

Size Distribution	
mean	0.1
dispersion	1.3
skewness	0.18

Type	
silt/clay	23%
sand	77%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	30
very fine sand	0.062	- 0.125	58
fine sand	0.125	- 0.25	12
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	
coarse gravel	16	- 22	
coarse gravel	22	- 32	
very coarse gravel	32	- 45	
very coarse gravel	45	- 64	
small cobble	64	- 90	
medium cobble	90	- 128	
large cobble	128	- 180	
very large cobble	180	- 256	
small boulder	256	- 362	
small boulder	362	- 512	
medium boulder	512	- 1024	
large boulder	1024	- 2048	
very large boulder	2048	- 4096	
total particle count:			100
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			100

Note:



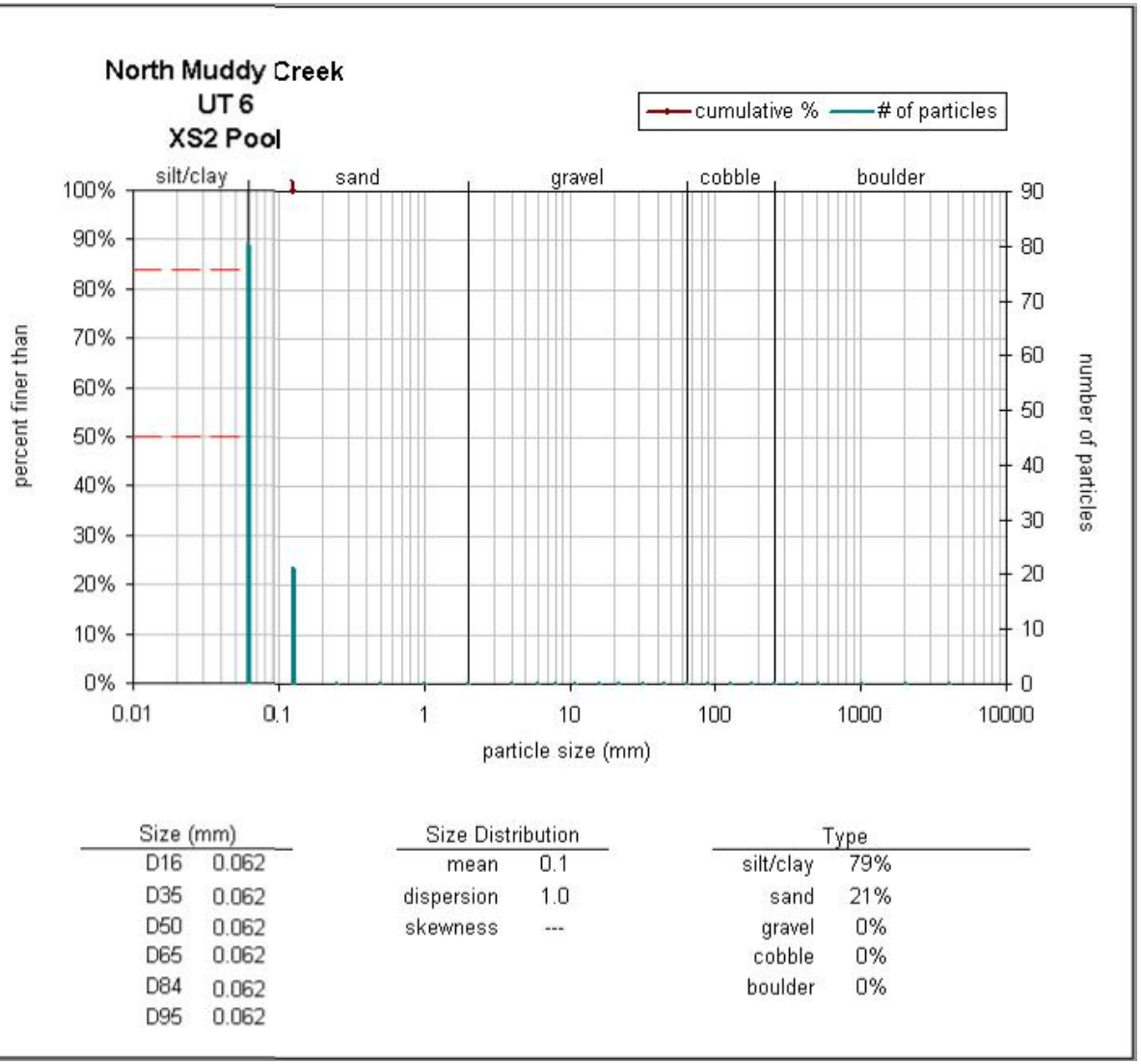
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.07
D84	0.11
D95	0.19

Size Distribution	
mean	0.1
dispersion	1.4
skewness	0.25

Type	
silt/clay	30%
sand	70%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	80
very fine sand	0.062	- 0.125	21
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			101
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			101

Note:



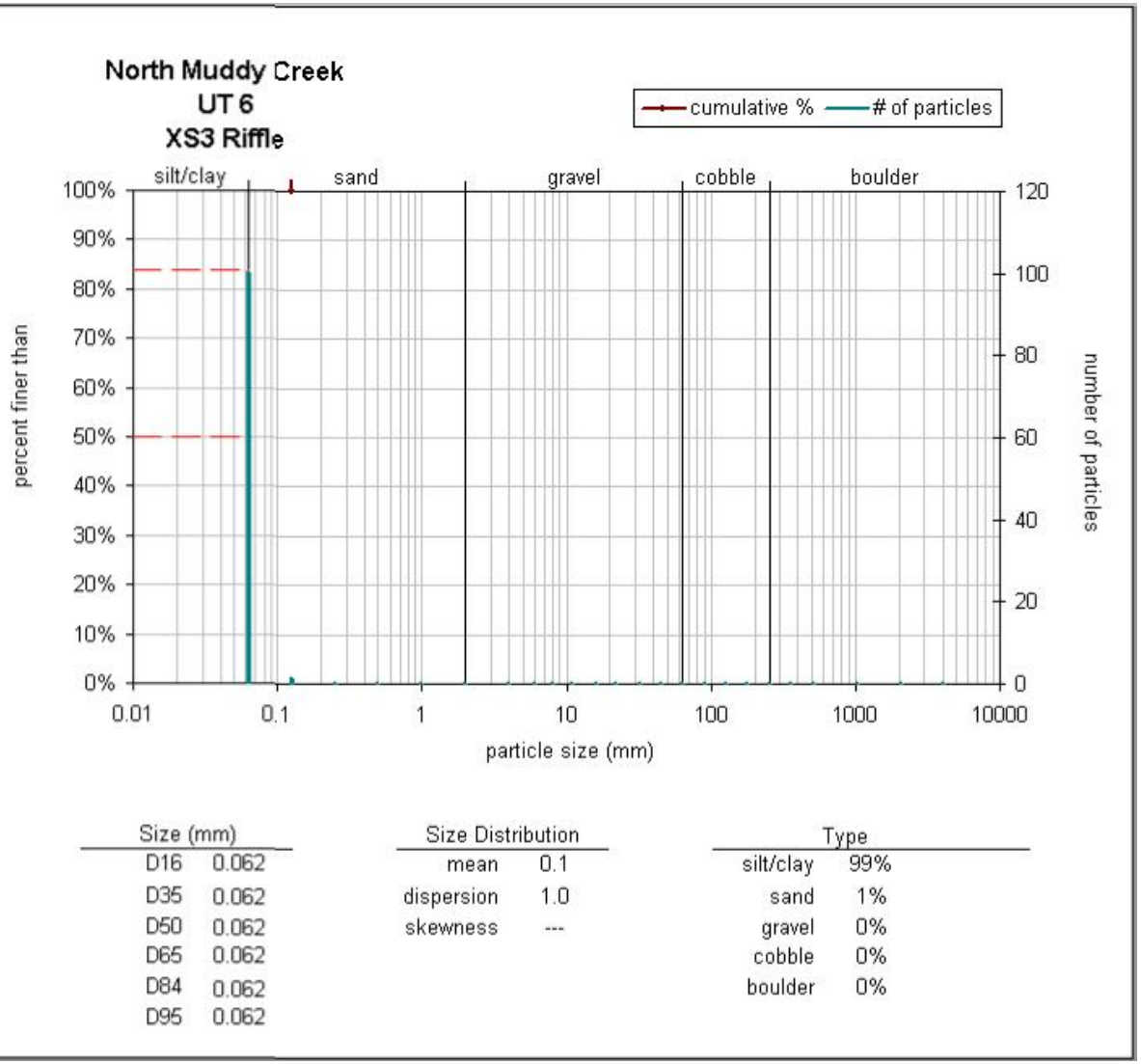
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	79%
sand	21%
gravel	0%
cobble	0%
boulder	0%

Material	Size Range (mm		Count
silt/clay	0	- 0.062	100
very fine sand	0.062	- 0.125	1
fine sand	0.125	- 0.25	0
medium sand	0.25	- 0.5	0
coarse sand	0.5	- 1	0
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	0
large cobble	128	- 180	0
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
total particle count:			101
bedrock			
clay hardpan			
detritus/wood			
artificial			
total count:			101

Note:



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	99%
sand	1%
gravel	0%
cobble	0%
boulder	0%

Table B2. Visual Morphological Stability Assessment
North Muddy Creek / RFP No. 16-D06115
Segment/Reach: Unnamed Tributary 1

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total Number Per As-built	Total Number / Feet in Unstable State	% Performing in Stable Condition	Feature Performance Mean or Total
A. Riffles	1. Present?	43	43	N/A	100%	
	2. Armor stable (eg. no displacement)?	43	43	N/A	100%	
	3. Facet grade appears stable?	43	43	N/A	100%	
	4. Minimal evidence of embedding/fining?	43	43	N/A	100%	
	5. Length appropriate?	43	43	N/A	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	53	53	N/A	100%	
	2. Sufficiently deep (Max Pool D : Mean Bkf > 1.6?)	51	53	N/A	96%	
	3. Length appropriate?	53	53	N/A	100%	**92%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	36	36	N/A	100%	
	2. Downstream of meander (glide/inflection) centering?	36	36	N/A	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	34	34	N/A	100%	
	2. Of those eroding, # with concomitant point bar formation?	0	N/A	N/A	100%	
	3. Apparent Rc within spec?	34	34	N/A	100%	
	4. Sufficient floodplain access and relief?	34	34	N/A	100%	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)?	N/A	N/A	0/0	100%	
	2. Channel bed degradation – areas of increasing down cutting or head cutting?	N/A	N/A	7/31	99	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	N/A	N/A	0/0	100%	**100%**
G. Vanes / Sills	1. Free of back or arm scour?	50	50	N/A	100%	
	2. Height appropriate?	50	50	N/A	100%	
	3. Angle and geometry appear appropriate?	50	50	N/A	100%	
	4. Free of piping or other structural failures?	50	50	N/A	100%	**100%**
H. Wads/ Boulders	1. Free of scour:	2	2	N/A	N/A	
	2. Footing stable?	2	2	N/A	N/A	**100%**

Table B2. Visual Morphological Stability Assessment
North Muddy Creek / RFP No. 16-D06115
Segment/Reach: Unnamed Tributary 5 / Enhancement

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total Number Per As-built	Total Number / Feet in Unstable State	% Performing in Stable Condition	Feature Performance Mean or Total
A. Riffles	1. Present?	6	6	N/A	100%	
	2. Armor stable (eg. no displacement)?	6	6	N/A	100%	
	3. Facet grade appears stable?	6	6	N/A	100%	
	4. Minimal evidence of embedding/fining?	6	6	N/A	100%	
	5. Length appropriate?	6	6	N/A	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	6	6	N/A	100%	
	2. Sufficiently deep (Max Pool D : Mean Bkf > 1.6?)	6	6	N/A	100%	
	3. Length appropriate?	6	6	N/A	100%	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	N/A	N/A	N/A	N/A	
	2. Downstream of meander (glide/inflection) centering?	N/A	N/A	N/A	N/A	**N/A**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A	N/A	
	2. Of those eroding, # with concomitant point bar formation?	N/A	N/A	N/A	N/A	
	3. Apparent Rc within spec?	N/A	N/A	N/A	N/A	
	4. Sufficient floodplain access and relief?	N/A	N/A	N/A	N/A	**N/A**
E. Bed General	1. General channel bed aggradation areas (bar formation)?	N/A	N/A	0/0	100%	
	2. Channel bed degradation – areas of increasing down cutting or head cutting?	N/A	N/A	0/0	100%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	N/A	N/A	0/0	100%	**100%**
G. Vanes / Sills	1. Free of back or arm scour?	6	6	N/A	100%	
	2. Height appropriate?	6	6	N/A	100%	
	3. Angle and geometry appear appropriate?	6	6	N/A	100%	
	4. Free of piping or other structural failures?	6	6	N/A	100%	**100%**
H. Wads/ Boulders	1. Free of scour:	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	**N/A**

Table B2. Visual Morphological Stability Assessment
North Muddy Creek / RFP No. 16-D06115
Segment/Reach: Unnamed Tributary 5 / Restoration

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total Number Per As-built	Total Number / Feet in Unstable State	% Performing in Stable Condition	Feature Performance Mean or Total
A. Riffles	1. Present?	13	13	N/A	100%	
	2. Armor stable (eg. no displacement)?	13	13	N/A	100%	
	3. Facet grade appears stable?	13	13	N/A	100%	
	4. Minimal evidence of embedding/fining?	13	13	N/A	100%	
	5. Length appropriate?	13	13	N/A	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	12	13	N/A	92%	
	2. Sufficiently deep (Max Pool D : Mean Bkf > 1.6?)	12	13	N/A	92%	
	3. Length appropriate?	12	13	N/A	92%	**92%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	12	12	N/A	100%	
	2. Downstream of meander (glide/inflection) centering?	12	12	N/A	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	12	12	N/A	100%	
	2. Of those eroding, # with concomitant point bar formation?	0	N/A	N/A	100%	
	3. Apparent Rc within spec?	12	12	N/A	100%	
	4. Sufficient floodplain access and relief?	12	12	N/A	100%	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)?	N/A	N/A	0/0	100%	
	2. Channel bed degradation – areas of increasing down cutting or head cutting?	N/A	N/A	0/0	100%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	N/A	N/A	0/0	100%	**100%**
G. Vanes / Sills	1. Free of back or arm scour?	6	6	N/A	100%	
	2. Height appropriate?	6	6	N/A	100%	
	3. Angle and geometry appear appropriate?	6	6	N/A	100%	
	4. Free of piping or other structural failures?	5	6	N/A	83%	**96%**
H. Wads/ Boulders	1. Free of scour:	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	**N/A**

Table B2. Visual Morphological Stability Assessment
North Muddy Creek / RFP No. 16-D06115
Segment/Reach: Unnamed Tributary 6

Feature Category	Metric (per As-built and reference baselines	(# Stable) Number Performing as Intended	Total Number Per As-built	Total Number / Feet in Unstable State	% Performing in Stable Condition	Feature Performance Mean or Total
A. Riffles	1. Present?	16	16	N/A	100%	
	2. Armor stable (eg. no displacement)?	16	16	N/A	100%	
	3. Facet grade appears stable?	16	16	N/A	100%	
	4. Minimal evidence of embedding/fining?	16	16	N/A	100%	
	5. Length appropriate?	16	16	N/A	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	24	24	N/A	100%	
	2. Sufficiently deep (Max Pool D : Mean Bkf > 1.6?)	24	24	N/A	100%	
	3. Length appropriate?	24	24	N/A	100%	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	16	16	N/A	100%	
	2. Downstream of meander (glide/inflection) centering?	16	16	N/A	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	16	16	N/A	100%	
	2. Of those eroding, # with concomitant point bar formation?	0	N/A	N/A	100%	
	3. Apparent Rc within spec?	16	16	N/A	100%	
	4. Sufficient floodplain access and relief?	16	16	N/A	100%	**100%**
E. Bed General	1. General channel bed aggradation areas (bar formation)?	N/A	N/A	0/0	100%	
	2. Channel bed degradation – areas of increasing down cutting or head cutting?	N/A	N/A	1/12	99%	**100%**
F. Bank	1. Actively eroding, wasting, or slumping bank?	N/A	N/A	0/0	100%	**100%**
G. Vanes / Sills	1. Free of back or arm scour?	14	14	N/A	100%	
	2. Height appropriate?	14	14	N/A	100%	
	3. Angle and geometry appear appropriate?	14	14	N/A	100%	
	4. Free of piping or other structural failures?	14	14	N/A	100%	**100%**
H. Wads/ Boulders	1. Free of scour:	N/A	0	N/A	N/A	
	2. Footing stable?	N/A	0	N/A	N/A	**N/A**

Photo Page 1 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #1
Looking Downstream

Unnamed Tributary 1 – Permanent Photo Point #2
Looking Upstream

Photo Page 2 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #3
Looking Upstream

Unnamed Tributary 1 – Permanent Photo Point #3
Looking Downstream

Photo Page 3 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #4
Looking Upstream

Unnamed Tributary 1 – Permanent Photo Point #5
Looking Upstream

Photo Page 4 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #5
Looking Downstream

Unnamed Tributary 1 – Permanent Photo Point #6
Looking 80 Degrees

Photo Page 5 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #6
Looking 300 Degrees

Unnamed Tributary 1 – Permanent Photo Point #7
Looking Upstream

Photo Page 6 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #8
Looking Upstream

Unnamed Tributary 1 – Permanent Photo Point #8
Looking Downstream

Photo Page 7 – Unnamed Tributary 1

Unnamed Tributary 1 – Permanent Photo Point #9
Looking 220 Degrees

Photo Page 8 – Unnamed Tributary 2

Unnamed Tributary 2 – Permanent Photo Point #1
Looking Downstream

Unnamed Tributary 2 – Permanent Photo Point #2
Looking Upstream

Photo Page 9 – Unnamed Tributary 4

Unnamed Tributary 4 – Permanent Photo Point #1
Looking Downstream

Unnamed Tributary 4 – Permanent Photo Point #2
Looking Upstream

Photo Page 10 – Unnamed Tributary 5

Unnamed Tributary 5 – Permanent Photo Point #1
Looking Upstream

Unnamed Tributary 5 – Permanent Photo Point #1
Looking Downstream

Photo Page 11 – Unnamed Tributary 5

Unnamed Tributary 5 – Permanent Photo Point #2
Looking Upstream

Unnamed Tributary 5 – Permanent Photo Point #2
Looking Downstream

Photo Page 12 – Unnamed Tributary 5

Unnamed Tributary 5 – Permanent Photo Point #3
Looking Upstream

Unnamed Tributary 5 – Permanent Photo Point #4
Looking Upstream

Photo Page 13 – Unnamed Tributary 5

Unnamed Tributary 5 – Permanent Photo Point #4
Looking Downstream

Unnamed Tributary 5 – Permanent Photo Point #5
Looking 180 Degrees

Photo Page 14 – Unnamed Tributary 5

Unnamed Tributary 5 – Permanent Photo Point #5
Looking 305 Degrees

Photo Page 15 – Unnamed Tributary 6

Unnamed Tributary 6 – Permanent Photo Point #1
Looking 35 Degrees

Unnamed Tributary 6 – Permanent Photo Point #1
Looking Downstream

Photo Page 16 – Unnamed Tributary 6

Unnamed Tributary 6 – Permanent Photo Point #2
Looking Upstream

Unnamed Tributary 6 – Permanent Photo Point #3
Looking Upstream

Photo Page 17 – Unnamed Tributary 6

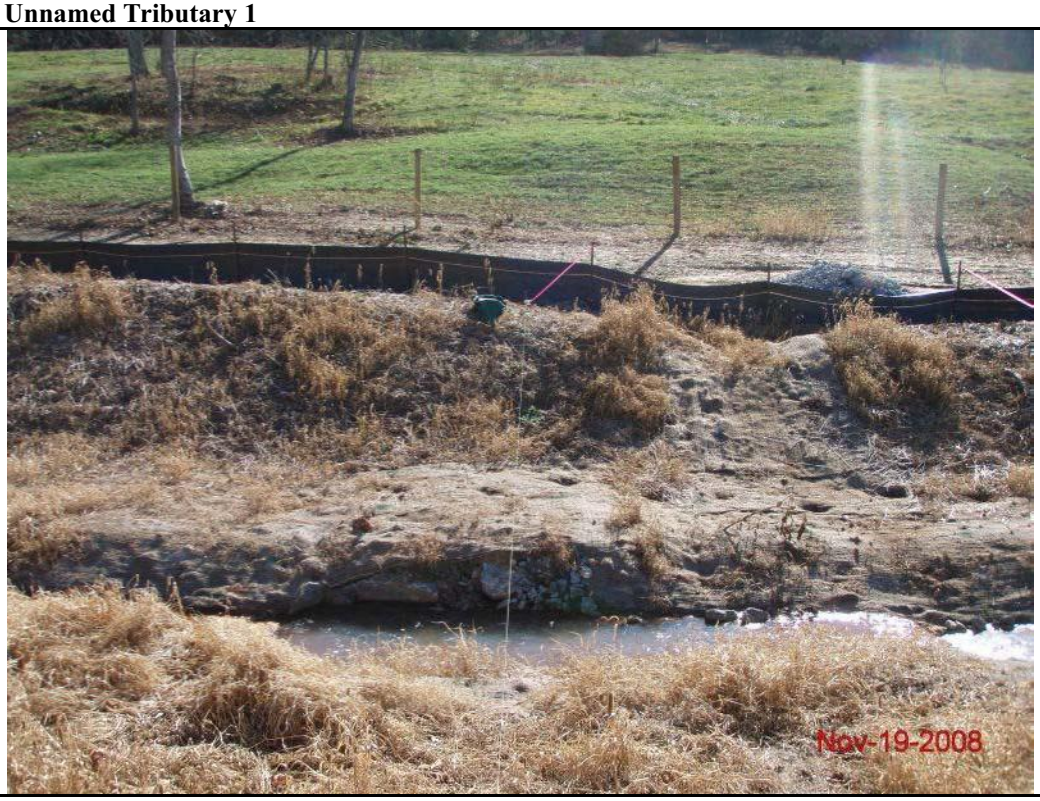
Unnamed Tributary 6 – Permanent Photo Point #4
Looking Downstream

Unnamed Tributary 6 – Permanent Photo Point #5
Looking Upstream

Photo Page 18 – Unnamed Tributary 6

Unnamed Tributary 6 – Permanent Photo Point #5
Looking 310 Degrees

Photo Page 19 – Unnamed Tributary 1



UT1 Upper – Cross Section 1 – Pool
Looking at Left Bank

UT1 Upper – Cross Section 1 – Pool
Looking at Right Bank

Photo Page 20 – Unnamed Tributary 1

UT1 Upper – Cross Section 2 – Riffle
Looking at Left Bank

UT1 Upper – Cross Section 2 – Riffle
Looking at Right Bank

Photo Page 21 – Unnamed Tributary 1

UT1 Lower – Cross Section 1 – Riffle
Looking at Left Bank

UT1 Lower – Cross Section 1 – Riffle
Looking at Right Bank

Photo Page 22 – Unnamed Tributary 1

UT1 Lower – Cross Section 2 – Pool
Looking at Left Bank

UT1 Lower – Cross Section 2 – Pool
Looking at Right Bank

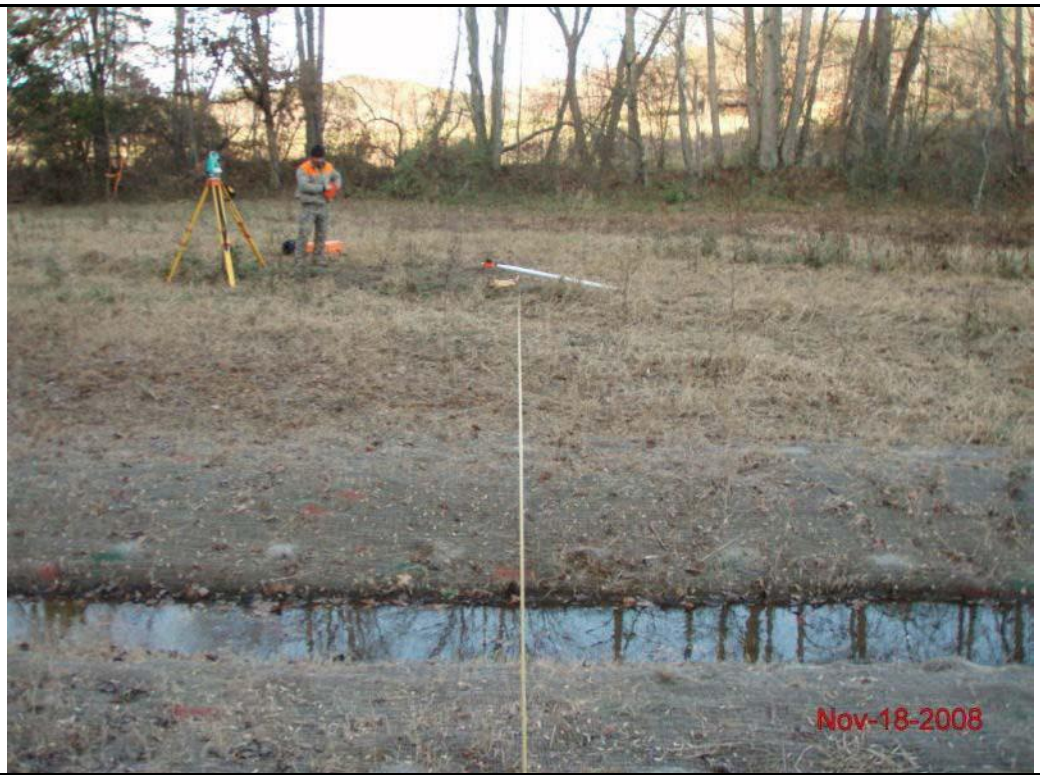
Photo Page 23 – Unnamed Tributary 5

UT5 – Cross Section 1 – Pool
Looking at Left Bank

UT5 – Cross Section 1 – Pool
Looking at Right Bank

Photo Page 24 – Unnamed Tributary 5

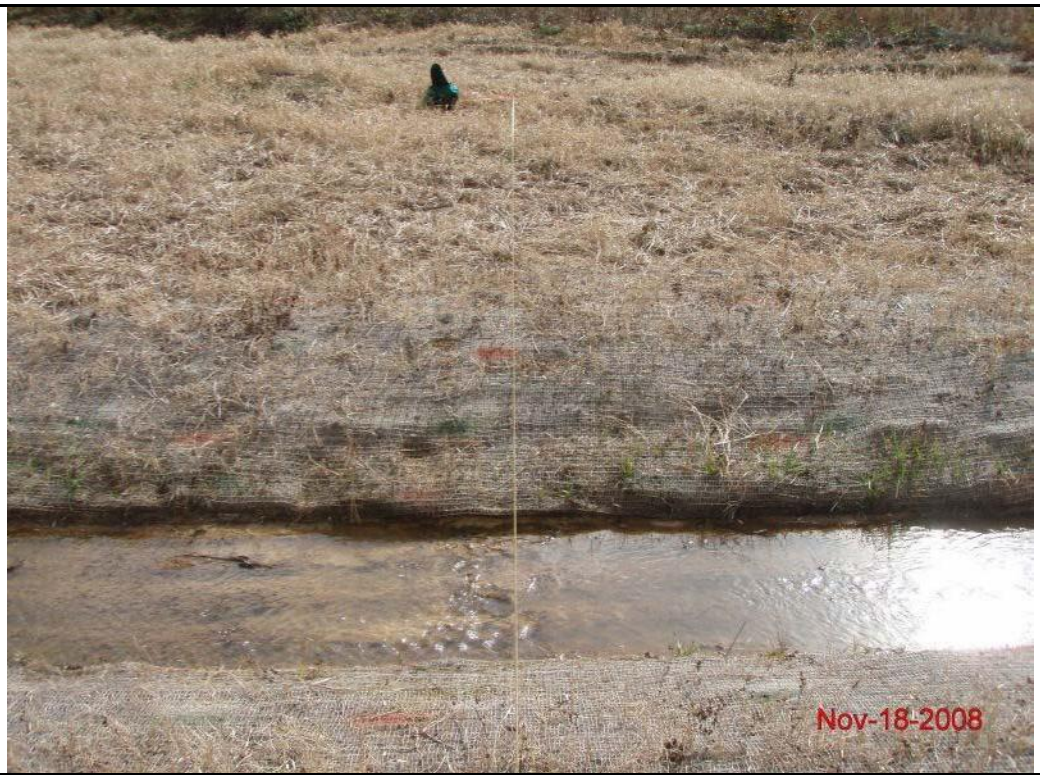
UT5 – Cross Section 2 – Riffle
Looking at Left Bank



UT5 – Cross Section 2 – Riffle
Looking at Right Bank

Photo Page 25 – Unnamed Tributary 6

UT6 – Cross Section 1 – Riffle
Looking at Left Bank



UT6 – Cross Section 1 – Riffle
Looking at Right Bank

Photo Page 26 – Unnamed Tributary 6

UT6 – Cross Section 2 – Pool
Looking at Left Bank

UT6 – Cross Section 2 – Pool
Looking at Right Bank

Photo Page 27 – Unnamed Tributary 6

UT6 – Cross Section 3 – Riffle
Looking at Left Bank

UT6 – Cross Section 3 – Riffle
Looking at Right Bank

Photo Page 1 – Unnamed Tributary 1

UT1 – Vegetation Monitoring Plot 1

UT1 – Vegetation Monitoring Plot 2

Photo Page 2 – Unnamed Tributary 1

UT1 – Vegetation Monitoring Plot 3

UT1 – Vegetation Monitoring Plot 4

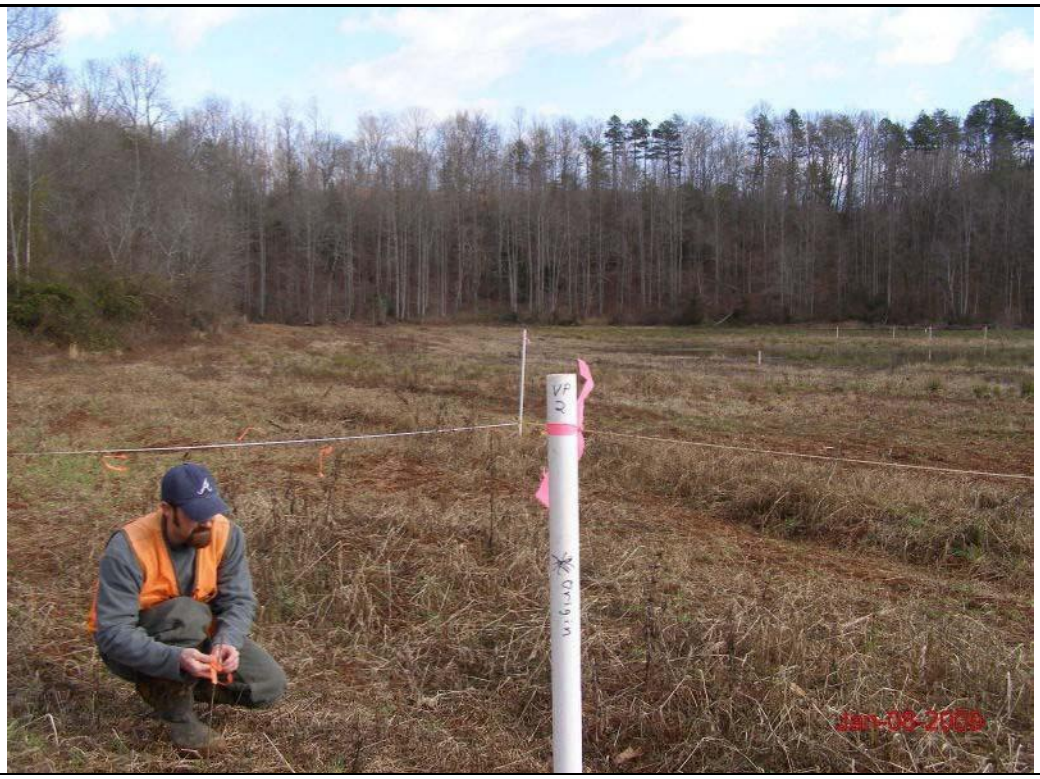
Photo Page 3 – Unnamed Tributary 5

UT5 – Vegetation Monitoring Plot 1

UT5 – Vegetation Monitoring Plot 2

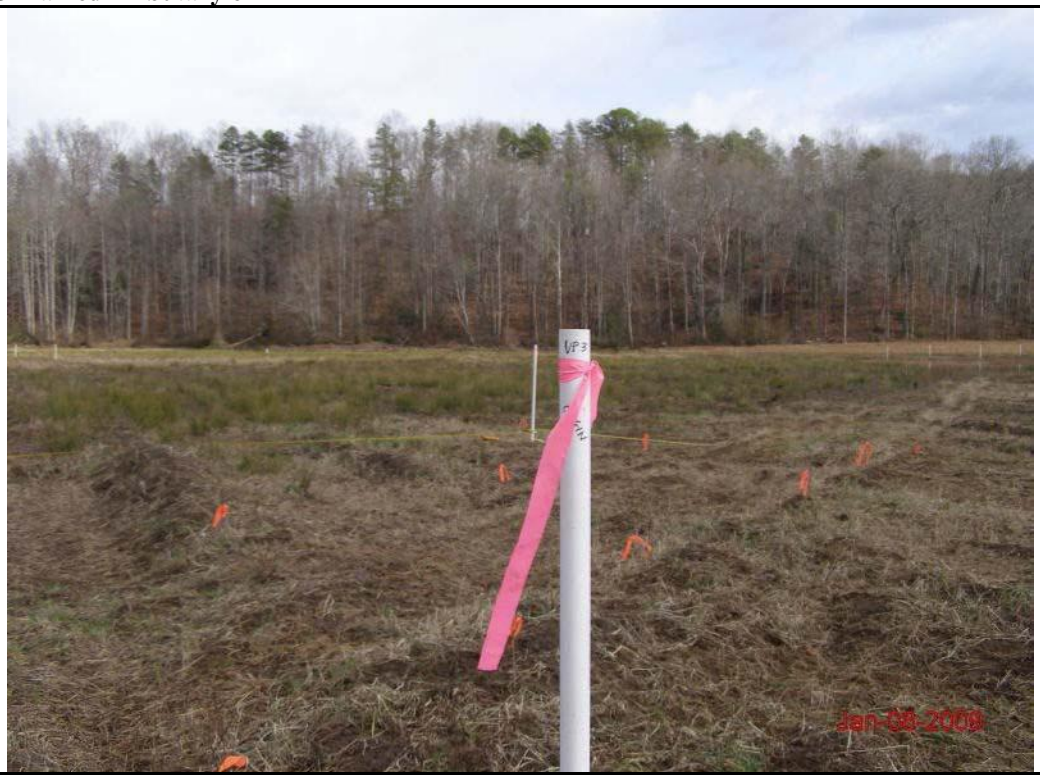
Photo Page 4 – Unnamed Tributary 6

UT6 – Vegetation Monitoring Plot 1



UT6 – Vegetation Monitoring Plot 2

Photo Page 5 – Unnamed Tributary 6



UT6 – Vegetation Monitoring Plot 3

UT6 – Vegetation Monitoring Plot 4

Photo Page 6 – Unnamed Tributary 6

UT6 – Vegetation Monitoring Plot 5

North Muddy Creek / RFP No. 16-D06115
Vegetation Monitoring Plots Baseline Data

Site: North Muddy Creek – Unnamed Tributary 1
Plot: VP1
Date: 1/12/2009

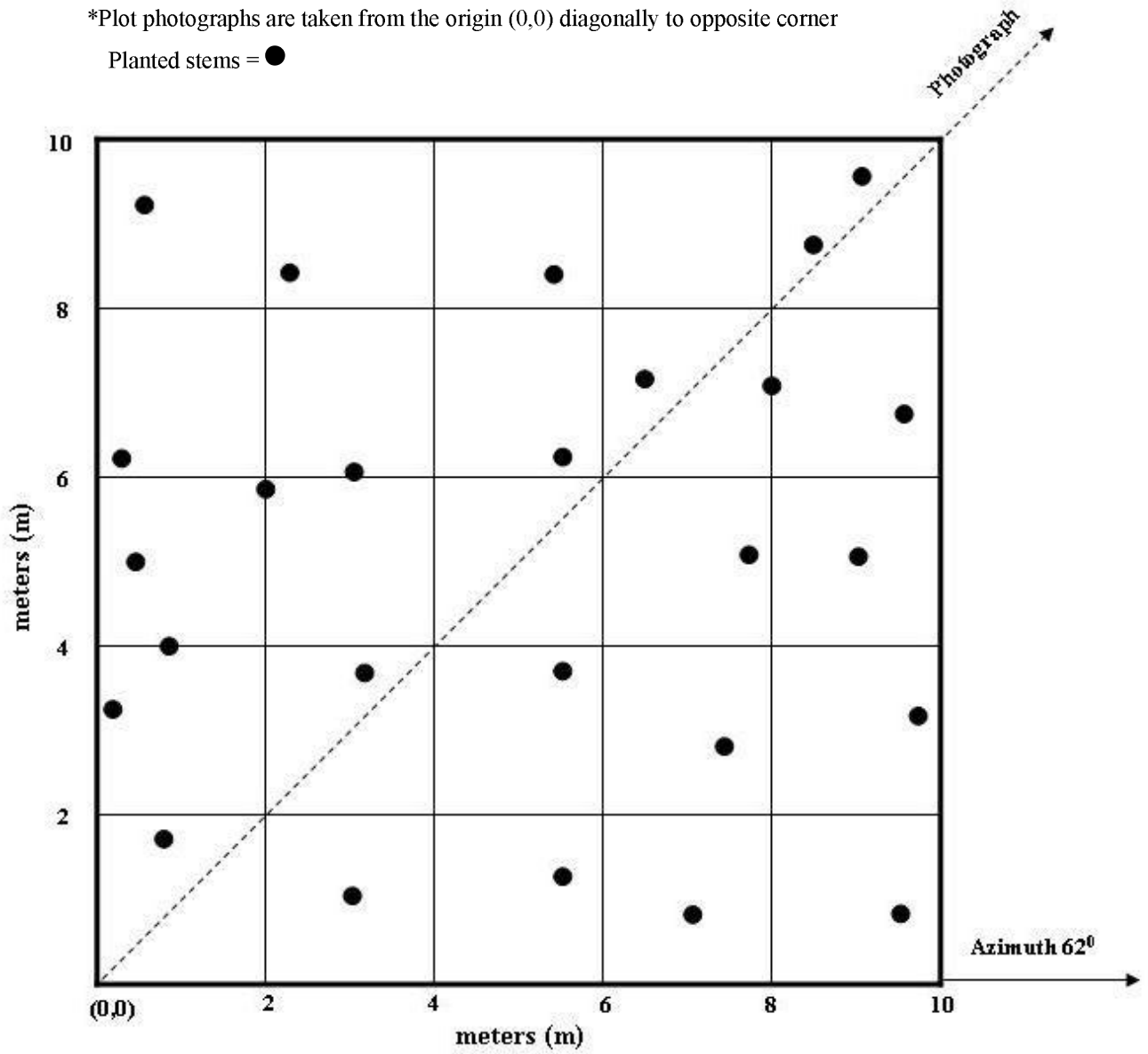
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Quercus michauxii*	0.7	1.8	3.0	45	3
2	*Betula nigra*	0.2	3.4	6.8	74	3
3	*Quercus michauxii*	0.8	4.0	5.0	57	2
4	*Betula nigra*	0.4	5.0	4.6	72	3
5	*Quercus michauxii*	0.3	6.2	7.0	64	2
6	*Asimina triloba*	0.6	9.3	3.6	32	2
7	*Cephalanthus occidentalis*	2.3	8.4	4.5	50	3
8	*Cephalanthus occidentalis*	2.0	5.9	5.3	62	3
9	*Quercus phellos*	3.1	6.1	6.5	60	3
10	*Cephalanthus occidentalis*	3.2	3.7	5.2	53	3
11	*Cephalanthus occidentalis*	3.1	1.1	5.3	55	3
12	*Quercus michauxii*	5.5	1.3	2.8	20	2
13	*Cephalanthus occidentalis*	5.5	3.7	3.2	50	2
14	*Cephalanthus occidentalis*	5.5	6.2	2.6	47	2
15	*Quercus pagoda*	5.4	8.4	6.2	51	3
16	*Quercus michauxii*	6.5	7.2	4.4	58	2
17	*Cephalanthus occidentalis*	9.1	9.6	2.4	43	2
18	*Quercus phellos*	8.5	8.7	6.0	60	2
19	*Quercus nigra*	8.0	7.1	4.2	58	3
20	*Quercus phellos*	7.8	5.1	5.0	58	2
21	*Quercus phellos*	7.4	2.8	7.4	64	3
22	*Asimina triloba*	9.6	0.8	3.8	29	3
23	*Quercus michauxii*	9.8	3.2	6.0	62	2
24	*Quercus michauxii*	9.0	5.6	3.0	30	2
25	*Cephalanthus occidentalis*	9.6	6.7	3.0	58	3
26	*Betula nigra*	7.2	0.8	2.0	44	3

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT1-VP1

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 1
Plot: VP2
Date: 1/09/2009

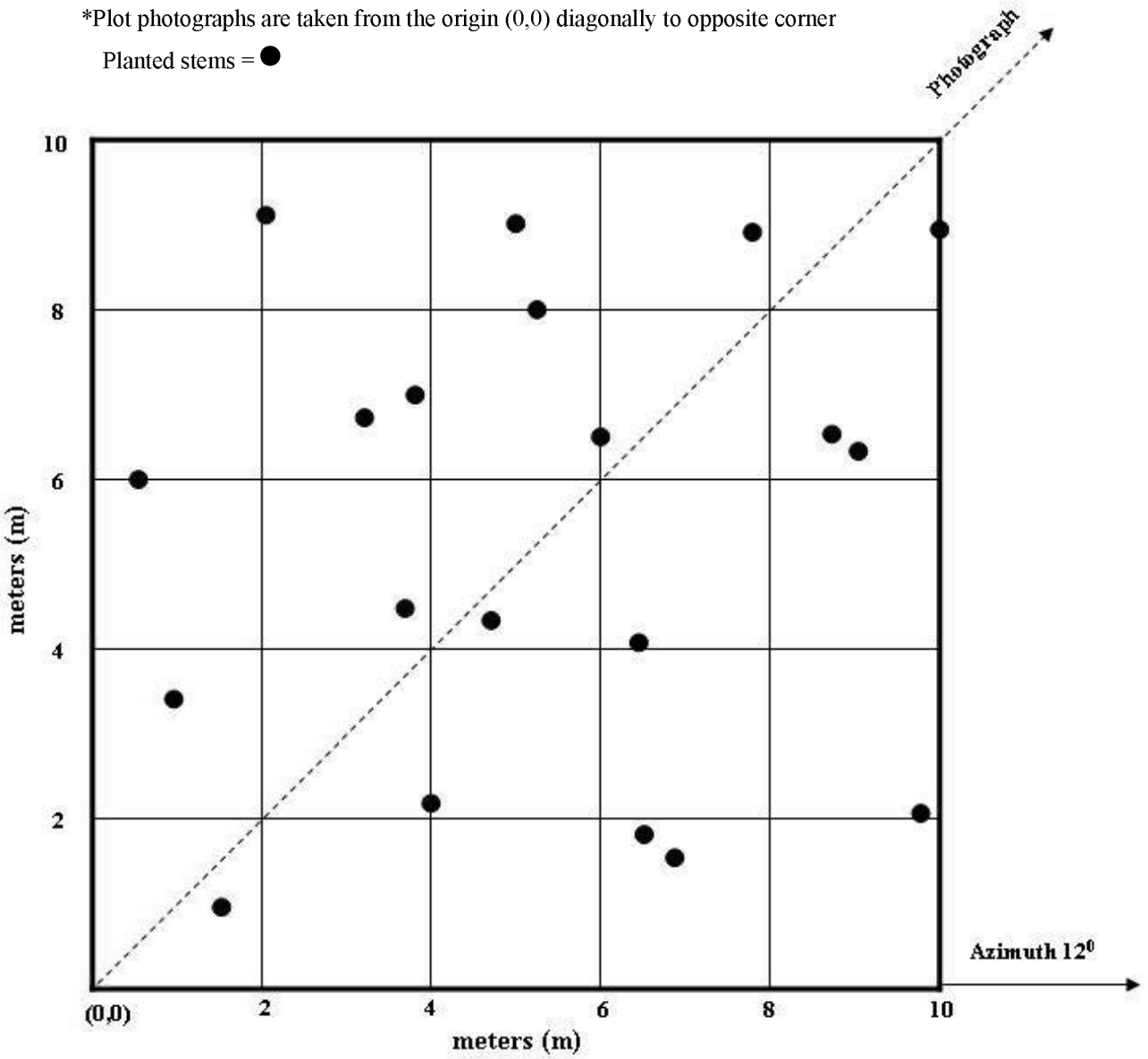
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Cephalanthus occidentalis*	1.6	0.9	3.3	38	2
2	*Cephalanthus occidentalis*	0.9	3.4	3.8	47	2
3	*Cephalanthus occidentalis*	0.6	6.0	3.6	55	3
4	*Cephalanthus occidentalis*	2.1	9.2	3.3	50	3
5	*Platanus occidentalis*	3.8	7.0	7.0	61	3
6	*Cephalanthus occidentalis*	3.2	6.7	3.0	51	3
7	*Quercus sp.*	3.7	4.4	3.6	52	3
8	*Cephalanthus occidentalis*	4.0	2.2	5.2	47	2
9	*Platanus occidentalis var. occidentalis*	6.5	1.8	5.9	57	2
10	*Cephalanthus occidentalis*	6.8	1.6	3.2	52	2
11	*Quercus michauxii*	6.4	4.1	4.7	59	3
12	*Platanus occidentalis*	4.7	4.3	4.8	54	3
13	*Quercus sp.*	6.0	6.5	5.0	60	3
14	*Quercus michauxii*	5.2	8.0	4.6	56	3
15	*Platanus occidentalis var. occidentalis*	5.0	9.0	4.7	57	3
16	*Cephalanthus occidentalis*	7.8	8.9	4.0	58	2
17	*Platanus occidentalis var. occidentalis*	10.0	8.9	7.0	59	3
18	*Cephalanthus occidentalis*	8.7	6.6	3.4	58	3
19	*Carya ovata*	9.1	6.3	6.0	61	3
20	*Cephalanthus occidentalis*	9.8	2.1	5.0	48	2

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT1-VP2

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 1
Plot: VP3
Date: 1/09/2009

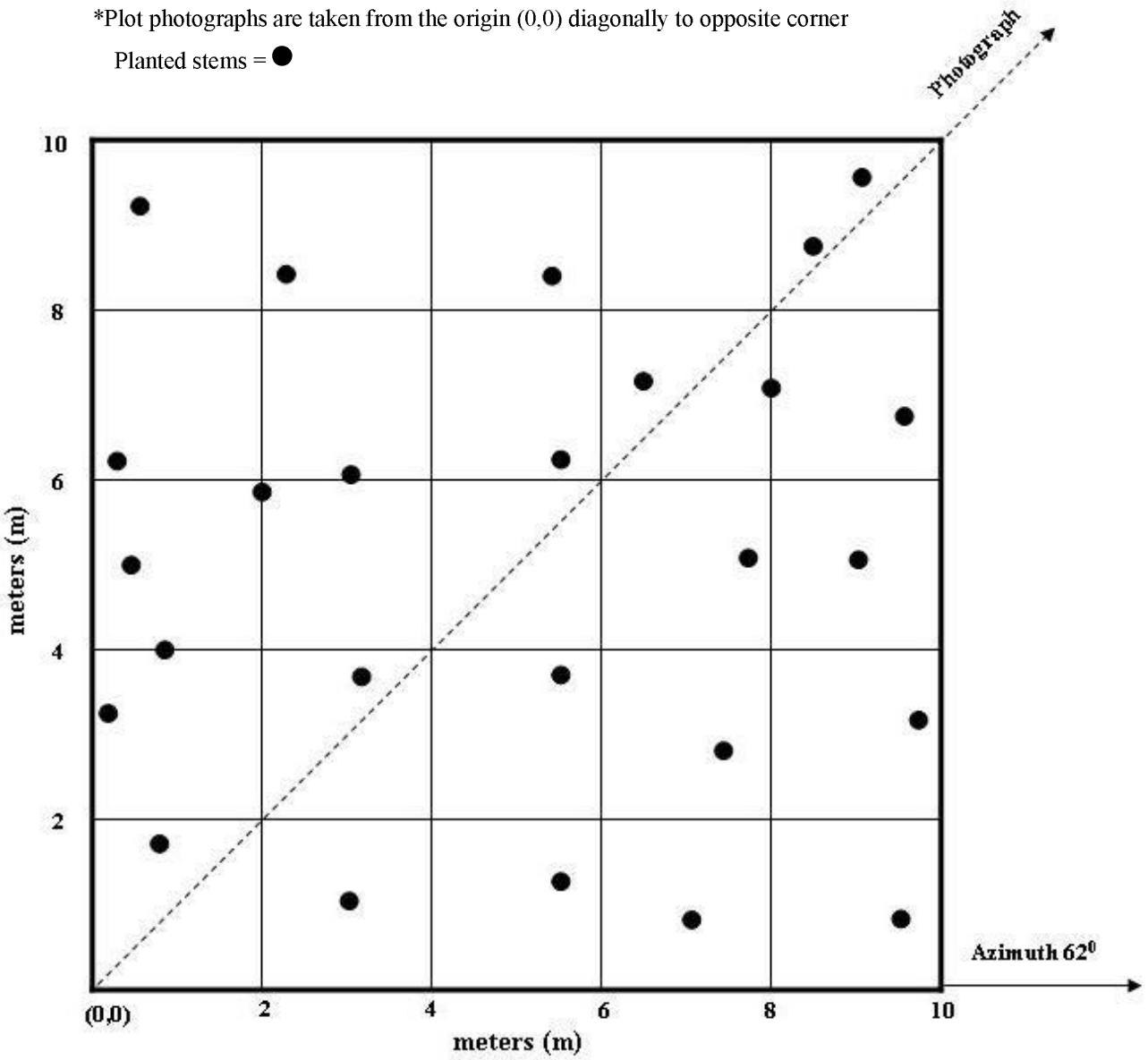
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Quercus sp.*	2.1	1.3	2.7	56	2
2	*Quercus phellos*	4.8	1.8	6.0	66	3
3	*Quercus michauxii*	7.5	1.4	4.5	42	3
4	*Betula nigra*	9.6	0.4	3.5	56	3
5	*Quercus phellos*	9.8	2.9	4.4	61	3
6	*Quercus michauxii*	7.3	3.9	4.0	47	2
7	*Quercus nigra*	5.0	3.1	4.1	46	3
8	*Quercus phellos*	2.1	4.1	6.9	66	3
9	*Quercus pagoda*	1.5	6.6	6.3	57	3
10	*Carya ovata*	1.2	9.1	8.2	59	2
11	*Cephalanthus occidentalis*	3.9	8.6	3.2	38	3
12	*Carya ovata*	6.7	8.5	6.2	60	2
13	*Quercus nigra*	9.3	9.4	4.0	41	3
14	*Carya ovata*	7.1	8.4	5.1	49	2
15	*Cephalanthus occidentalis*	4.6	6.0	4.5	55	2

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT1-VP3

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 1
Plot: VP4
Date: 1/09/2009

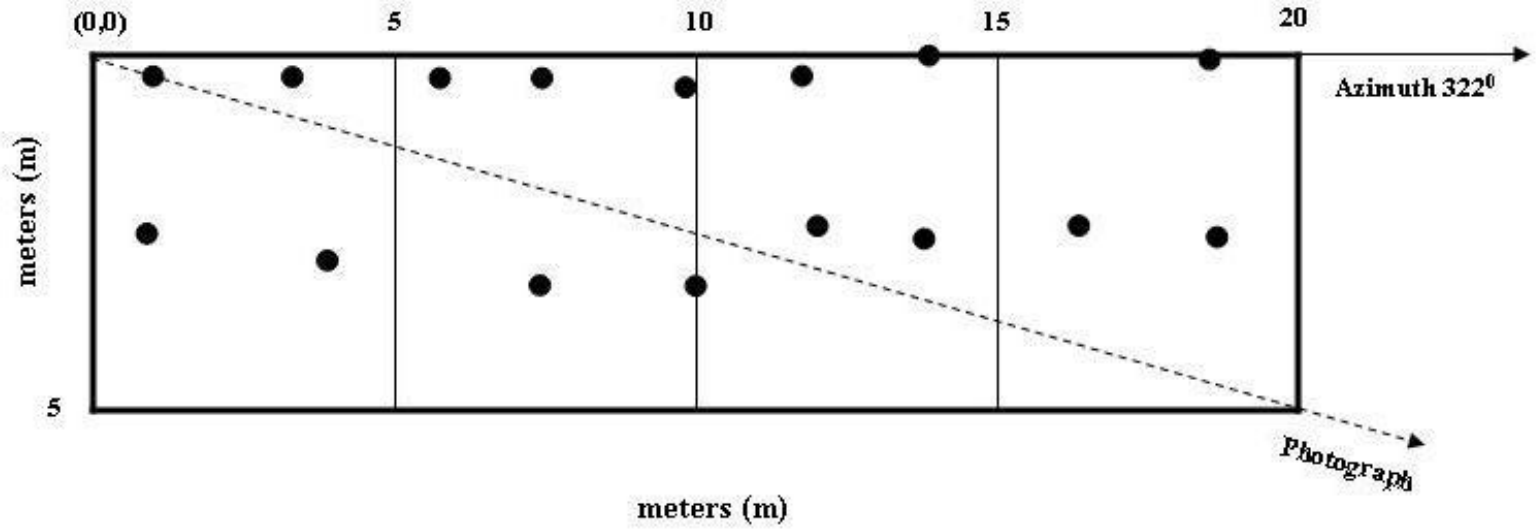
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Quercus michauxii*	1.3	0.4	5.2	51	3
2	*Cephalanthus occidentalis*	3.4	0.4	4.1	53	2
3	*Cephalanthus occidentalis*	5.5	0.4	5.7	54	3
4	*Quercus sp.*	7.7	0.4	5.2	42	3
5	*Quercus phellos*	9.9	0.5	4.2	59	3
6	*Quercus phellos*	12.2	0.3	2.9	54	3
7	*Quercus michauxii*	14.3	0.0	4.1	37	3
8	*Cephalanthus occidentalis*	18.7	0.1	4.5	58	3
9	*Cephalanthus occidentalis*	1.0	2.5	3.7	62	3
10	*Quercus phellos*	4.2	2.8	5.0	69	3
11	*Quercus phellos*	7.4	3.1	5.6	71	3
12	*Quercus phellos*	10.0	3.1	4.6	63	2
13	*Cephalanthus occidentalis*	12.2	2.4	3.1	47	3
14	*Cephalanthus occidentalis*	14.3	2.5	4.1	52	2
15	*Quercus phellos*	16.4	2.4	4.0	65	3
16	*Cephalanthus occidentalis*	18.7	2.5	3.4	57	3

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT1-VP4

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 5
Plot: VP1
Date: 1/08/2009

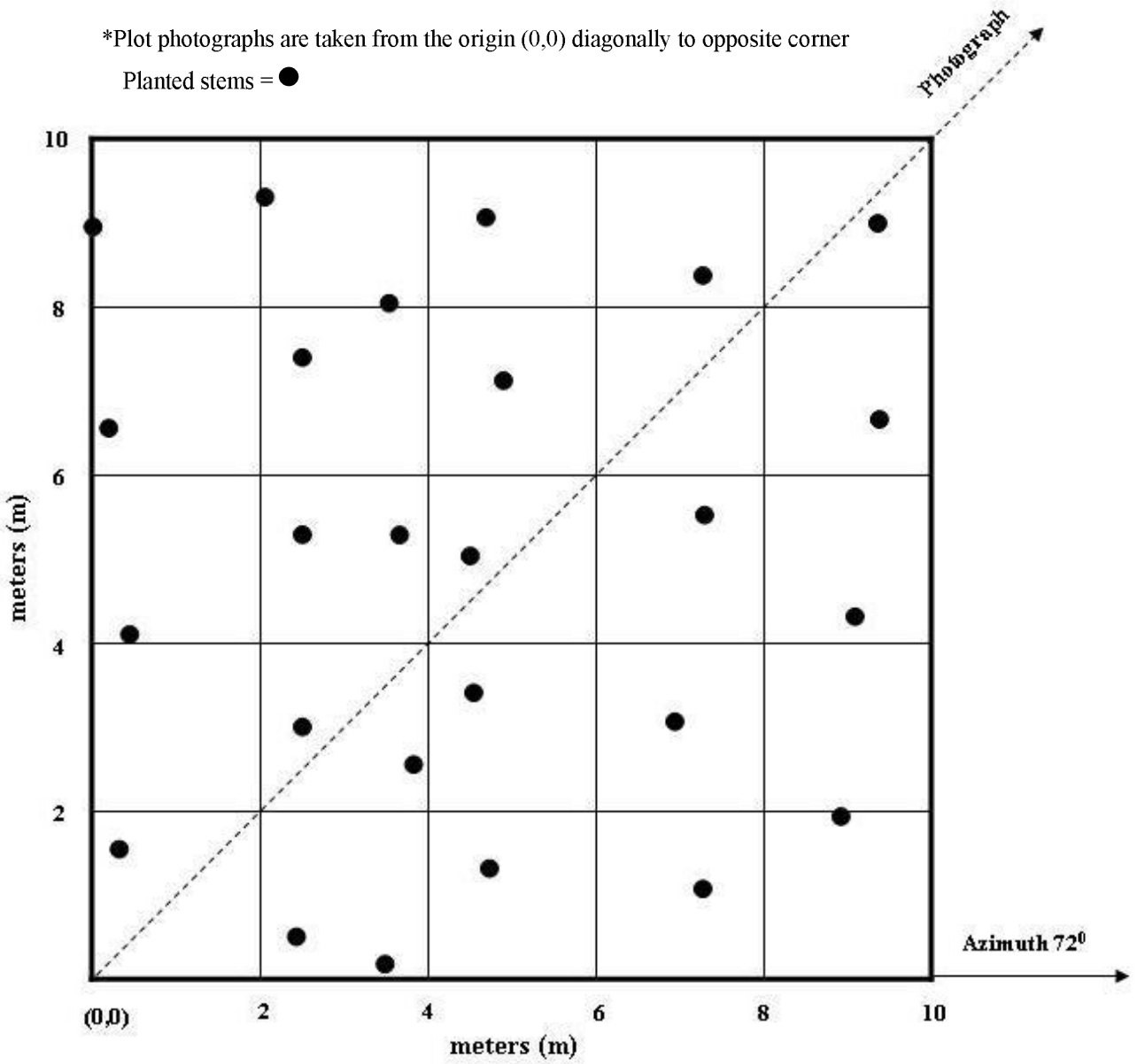
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Cephalanthus occidentalis*	0.3	1.6	4.0	43	3
2	*Cephalanthus occidentalis*	0.4	4.1	3.9	58	3
3	*Cephalanthus occidentalis*	0.2	6.6	3.0	54	3
4	*Cephalanthus occidentalis*	0.0	8.9	3.9	57	3
5	*Quercus michauxii*	2.1	9.3	4.0	59	3
6	*Quercus michauxii*	2.5	7.4	4.2	53	3
7	*Quercus michauxii*	2.5	5.3	5.4	56	3
8	*Quercus michauxii*	2.5	3.1	4.2	62	3
9	*Quercus michauxii*	2.4	0.5	5.9	60	3
10	*Cephalanthus occidentalis*	3.5	0.2	4.6	56	3
11	*Cephalanthus occidentalis*	3.8	2.6	4.1	52	3
12	*Asimina triloba*	3.7	5.3	6.1	58	3
13	*Asimina triloba*	4.8	7.2	4.4	53	3
14	*Cephalanthus occidentalis*	3.6	8.1	3.2	51	3
15	*Asimina triloba*	4.7	9.2	2.5	22	3
16	*Asimina triloba*	4.5	5.1	4.4	46	3
17	*Asimina triloba*	4.6	3.4	3.9	29	3
18	*Asimina triloba*	4.7	1.3	5.6	48	3
19	*Quercus phellos*	7.3	1.2	5.9	53	3
20	*Quercus phellos*	6.9	3.2	4.7	56	3
21	*Asimina triloba*	7.3	5.6	6.5	54	3
22	*Asimina triloba*	7.3	8.4	3.4	37	3
23	*Quercus phellos*	9.4	9.0	3.6	58	3
24	*Cephalanthus occidentalis*	9.4	6.7	2.7	44	3
25	*Cephalanthus occidentalis*	9.1	4.3	6.9	51	3
26	*Quercus phellos*	8.9	1.9	6.5	58	3

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT5-VP1

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 5
Plot: VP2
Date: 1/08/2009

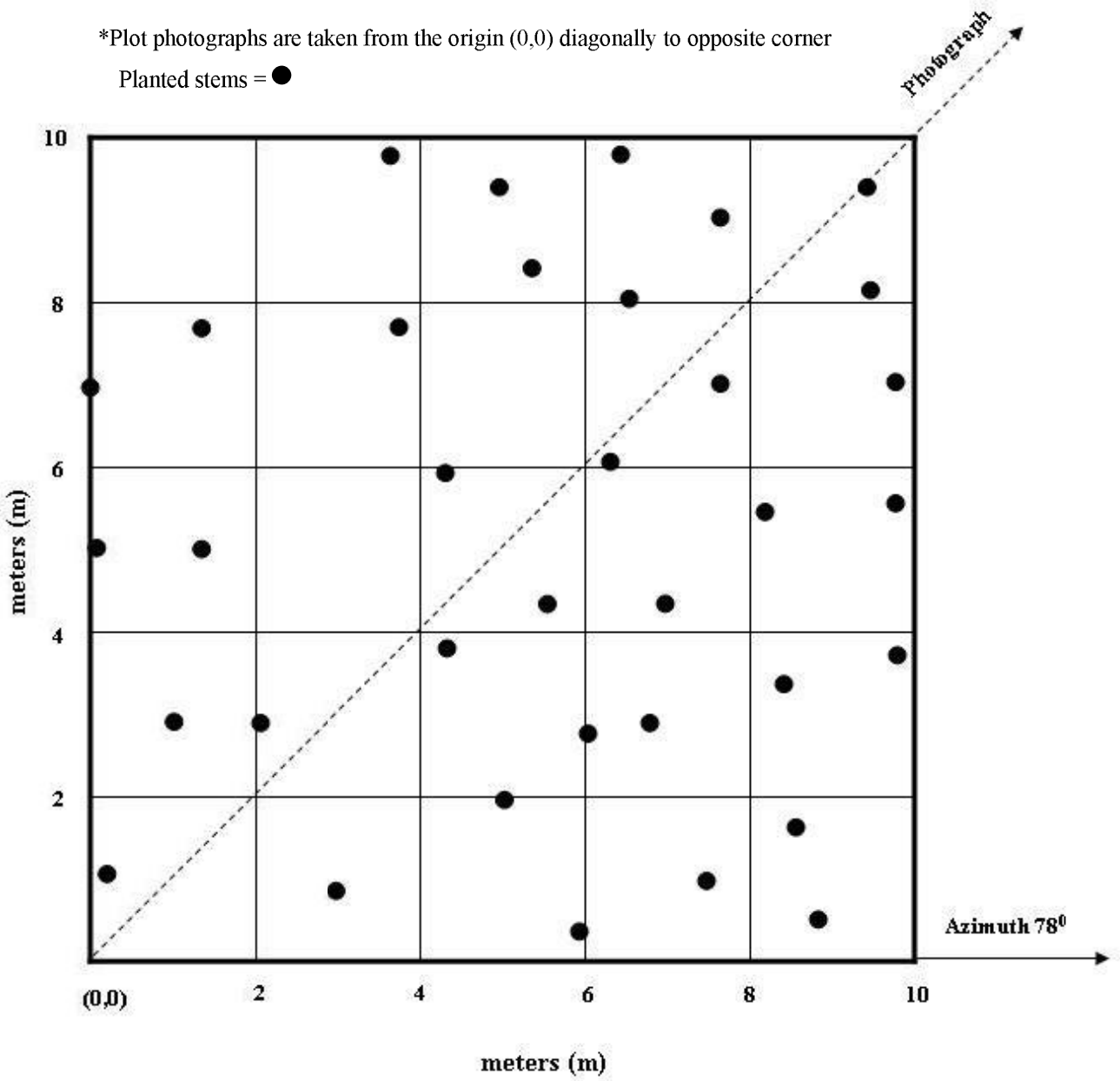
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Cephalanthus occidentalis*	0.2	1.1	4.0	53	3
2	*Quercus phellos*	0.6	2.9	4.9	69	3
3	*Quercus phellos*	0.1	5.0	6.2	64	3
4	*Quercus phellos*	0.0	6.9	3.8	59	3
5	*Quercus phellos*	1.3	7.7	8.5	54	3
6	*Quercus phellos*	1.3	5.0	4.8	60	3
7	*Quercus phellos*	2.1	2.8	5.4	59	3
8	*Quercus phellos*	3.0	0.8	6.0	57	3
9	*Quercus phellos*	5.1	1.9	4.5	56	3
10	*Quercus phellos*	4.3	3.8	6.6	64	3
11	*Quercus phellos*	4.3	5.9	2.8	42	3
12	*Quercus phellos*	3.8	7.7	6.0	60	3
13	*Platanus occidentalis var. occidentalis*	3.7	9.8	3.3	51	3
14	*Quercus phellos*	5.0	9.4	4.6	58	3
15	*Quercus phellos*	5.4	8.4	2.0	26	3
16	*Quercus phellos*	5.6	4.3	5.0	58	2
17	*Quercus phellos*	6.1	2.7	5.8	62	3
18	*Quercus phellos*	5.9	0.3	2.6	36	3
19	*Asimina triloba*	7.5	1.0	3.5	46	3
20	*Asimina triloba*	6.8	2.9	4.1	45	3
21	*Quercus pagoda*	7.0	4.3	6.8	50	3
22	*Quercus pagoda*	6.3	6.1	3.4	26	3
23	*Asimina triloba*	6.6	8.1	6.2	59	3
24	*Quercus phellos*	6.4	9.8	3.5	50	3
25	*Quercus phellos*	7.7	9.1	3.8	53	3
26	*Quercus phellos*	7.7	7.0	5.5	63	3
27	*Quercus phellos*	8.2	5.4	5.3	56	3
28	*Cephalanthus occidentalis*	8.4	3.3	4.8	48	3
29	*Cephalanthus occidentalis*	8.6	1.7	2.4	49	3
30	*Quercus michauxii*	8.8	0.5	6.2	66	3
31	*Quercus michauxii*	9.8	3.7	5.2	50	3
32	*Quercus michauxii*	9.8	5.6	4.4	55	3
33	*Quercus pagoda*	9.8	7.5	3.0	31	3
34	*Quercus michauxii*	9.4	9.4	4.6	60	3
35	*Quercus phellos*	8.5	8.2	5.5	60	3

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT5-VP2

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 6
Plot: VP1
Date: 1/08/2009

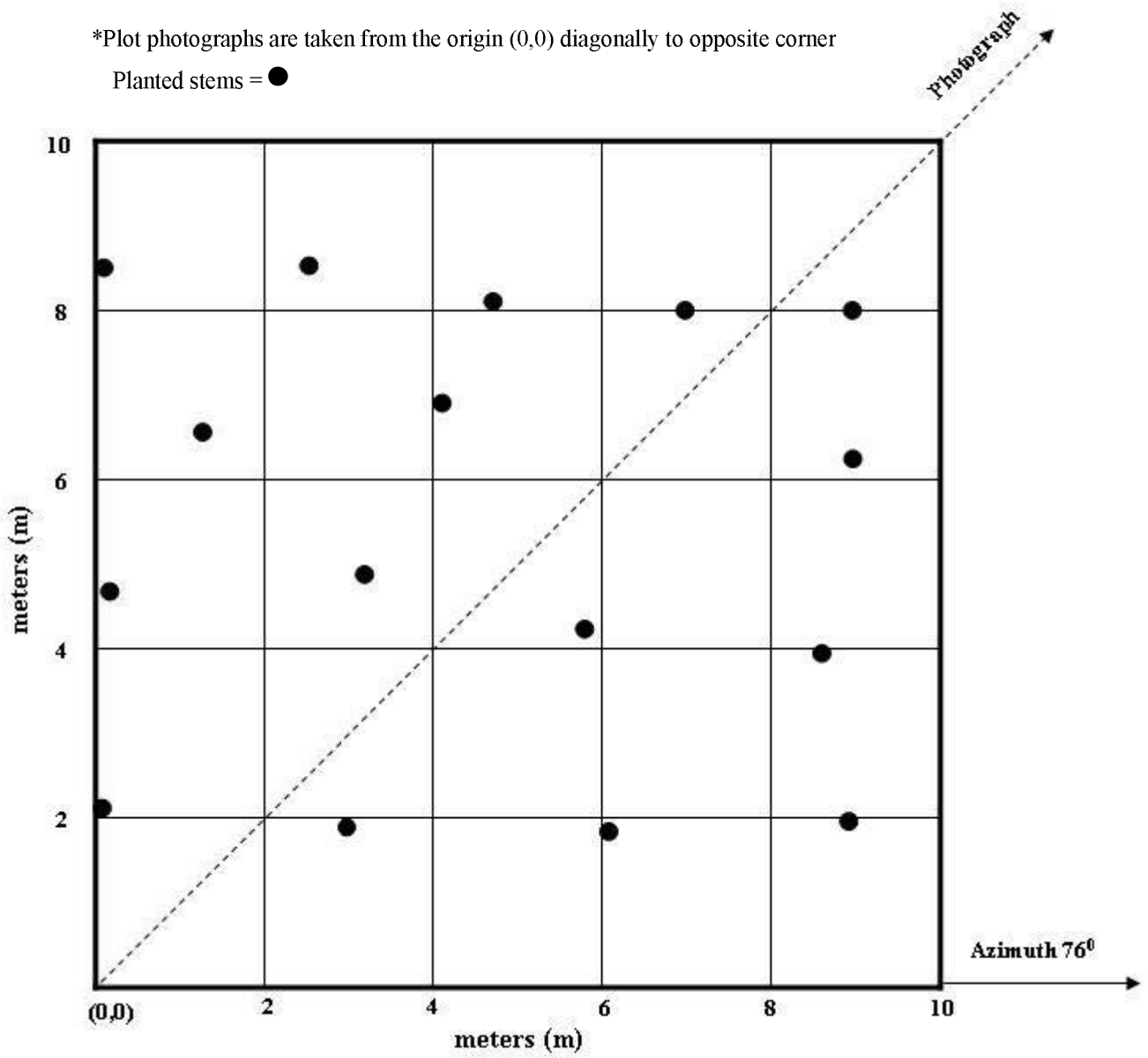
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Fraxinus pennsylvanica*	0.2	2.1	2.0	30	3
2	*Betula nigra*	0.7	4.7	5.0	55	3
3	*Fraxinus pennsylvanica*	0.2	8.4	5.0	54	3
4	*Asimina triloba*	1.5	6.4	6.0	65	2
5	*Fraxinus pennsylvanica*	2.4	8.4	5.0	61	3
6	*Carya ovata*	3.3	4.7	4.0	23	3
7	*Fraxinus pennsylvanica*	4.6	8.1	2.0	26	3
8	*Asimina triloba*	4.1	6.8	2.0	22	2
9	*Fraxinus pennsylvanica*	6.9	8.0	5.0	59	2
10	*Fraxinus pennsylvanica*	8.8	8.0	3.0	33	3
11	*Asimina triloba*	8.8	6.2	4.0	39	3
12	*Platanus occidentalis var. occidentalis*	8.5	3.9	4.0	49	2
13	*Fraxinus pennsylvanica*	8.9	1.9	5.0	53	2
14	*Quercus phellos*	6.1	1.8	3.0	59	3
15	*Betula nigra*	5.8	4.2	4.0	59	3
16	*Quercus phellos*	2.9	1.9	5.0	52	3

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT6-VP1

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 6
Plot: VP2
Date: 1/08/2009

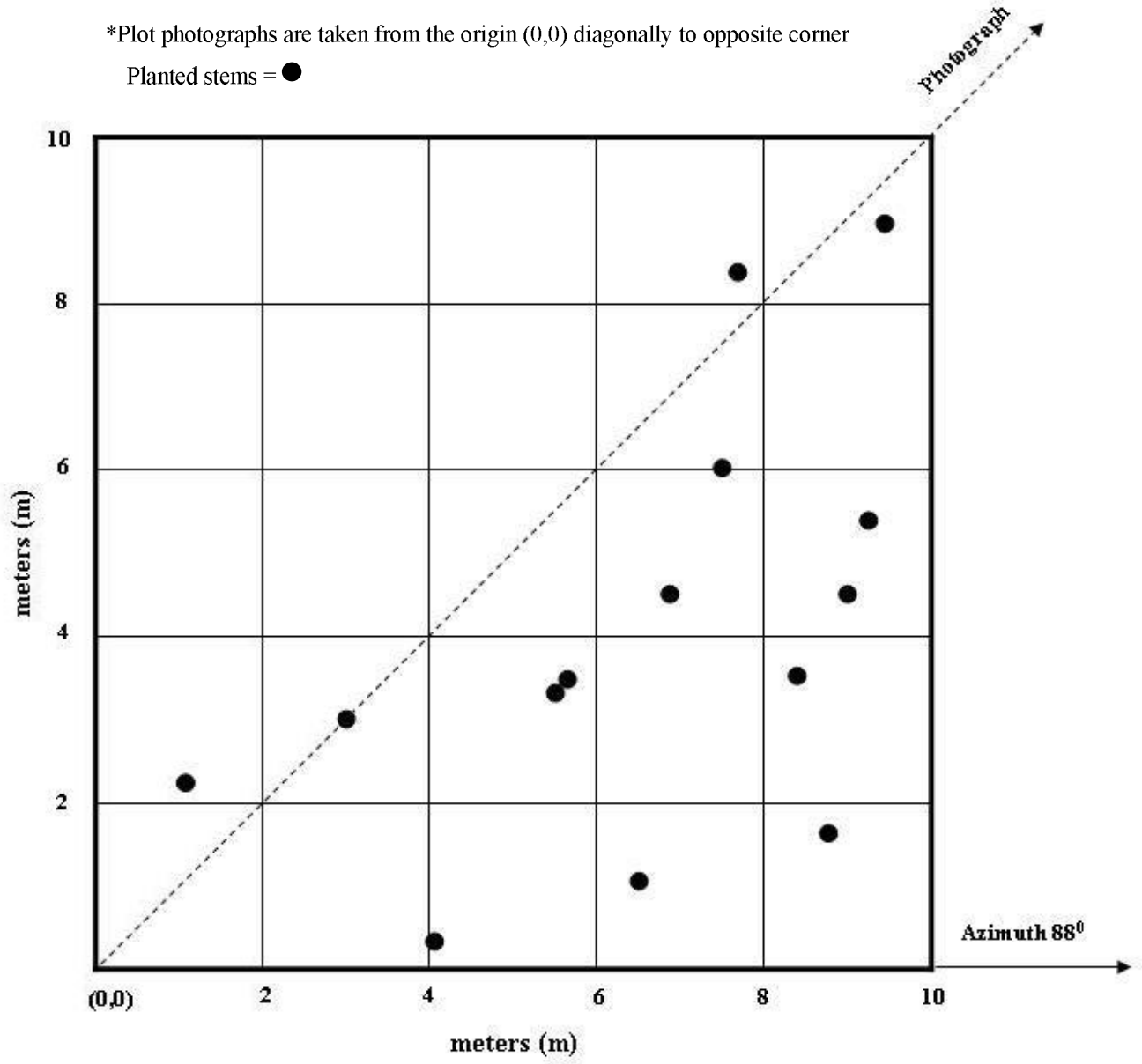
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Cephalanthus occidentalis*	1.1	2.2	4.0	54	2
2	*Cephalanthus occidentalis*	3.0	3.0	4.0	60	2
3	*Cephalanthus occidentalis*	4.1	0.3	3.0	44	2
4	*Cephalanthus occidentalis*	6.5	1.1	2.0	33	2
5	*Cephalanthus occidentalis*	8.7	1.7	2.0	44	2
6	*Quercus nigra*	9.0	4.5	4.0	51	2
7	*Cephalanthus occidentalis*	9.4	8.9	2.0	40	2
8	*Cephalanthus occidentalis*	7.7	8.3	3.0	48	2
9	*Cephalanthus occidentalis*	7.5	6.0	2.0	40	2
10	*Quercus phellos*	9.3	5.4	6.0	50	3
11	*Cephalanthus occidentalis*	6.8	4.5	3.0	53	2
12	*Quercus phellos*	8.3	3.5	3.0	36	3
13	*Cephalanthus occidentalis*	5.7	3.5	2.0	55	2
14	*Cephalanthus occidentalis*	5.5	3.4	1.0	33	2

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT6-VP2

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 6
Plot: VP3
Date: 1/08/2009

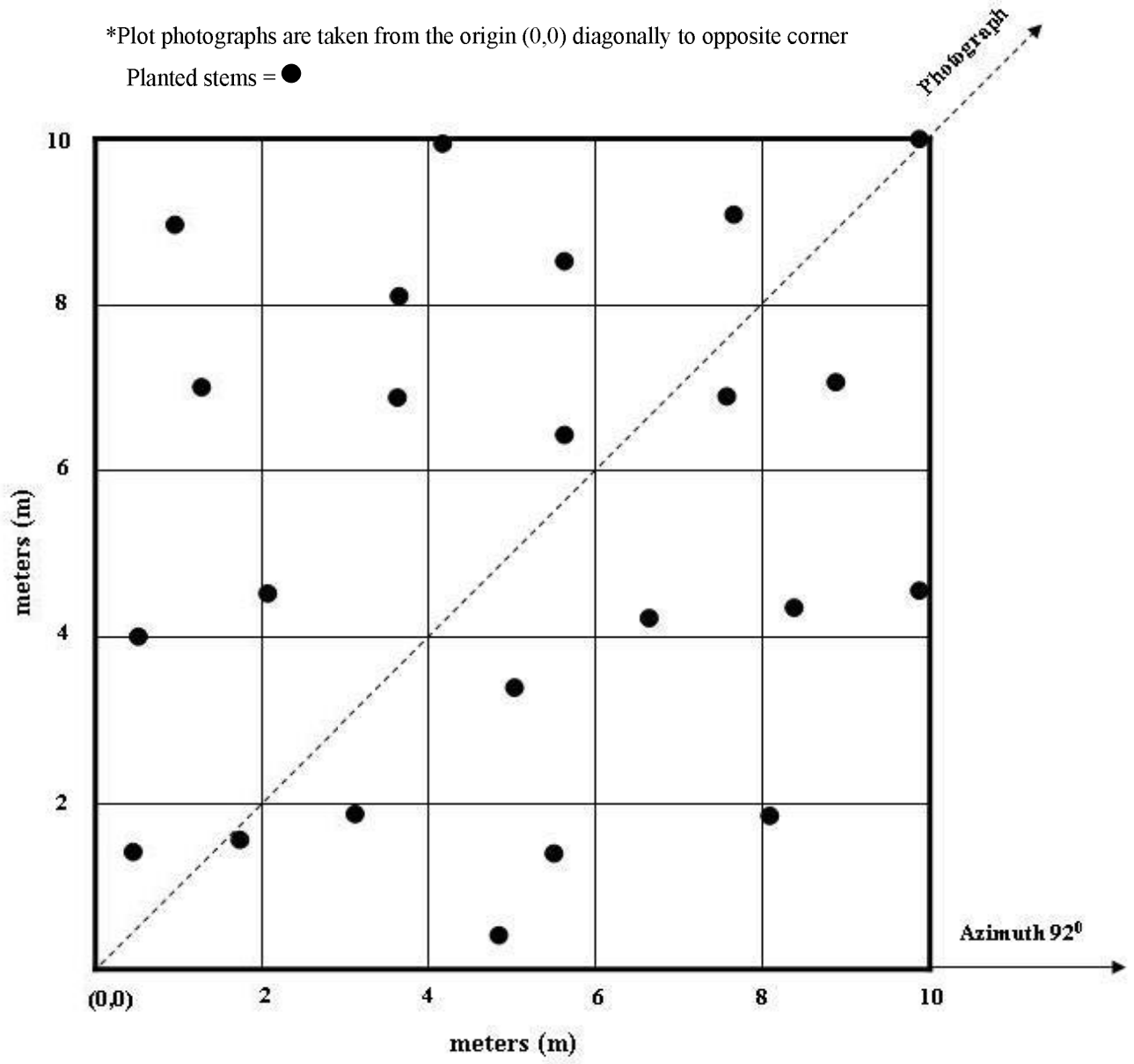
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Quercus phellos*	0.4	1.4	6.0	64	3
2	*Asimina triloba*	1.7	1.6	5.0	39	3
3	*Asimina triloba*	3.2	1.9	5.0	47	3
4	*Carya ovata*	4.8	0.4	5.0	19	3
5	*Asimina triloba*	5.0	3.4	3.0	27	3
6	*Carya ovata*	5.5	1.4	3.0	13	3
7	*Carya ovata*	8.1	1.8	4.0	17	3
8	*Quercus nigra*	6.6	4.2	3.0	36	3
9	*Platanus occidentalis var. occidentalis*	8.4	4.3	7.0	52	3
10	*Quercus pagoda*	9.9	4.6	4.0	50	2
11	*Quercus phellos*	8.9	7.1	4.0	57	3
12	*Quercus michauxii*	7.6	6.8	4.0	44	2
13	*Betula nigra*	7.7	9.1	3.0	68	3
14	*Quercus michauxii*	9.9	10.0	5.0	61	2
15	*Carya ovata*	5.7	8.5	3.0	18	3
16	*Quercus michauxii*	5.7	6.4	5.0	58	2
17	*Quercus michauxii*	3.7	6.8	6.0	61	3
18	*Carya ovata*	3.7	8.1	3.0	22	3
19	*Quercus phellos*	4.2	9.9	4.0	55	3
20	*Quercus phellos*	0.9	8.9	3.0	58	3
21	*Betula nigra*	1.3	7.0	5.0	58	3
22	*Quercus michauxii*	2.1	4.5	5.0	63	2
23	*Quercus michauxii*	0.5	4.0	3.0	60	2

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT6-VP3

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 6
Plot: VP4
Date: 1/08/2009

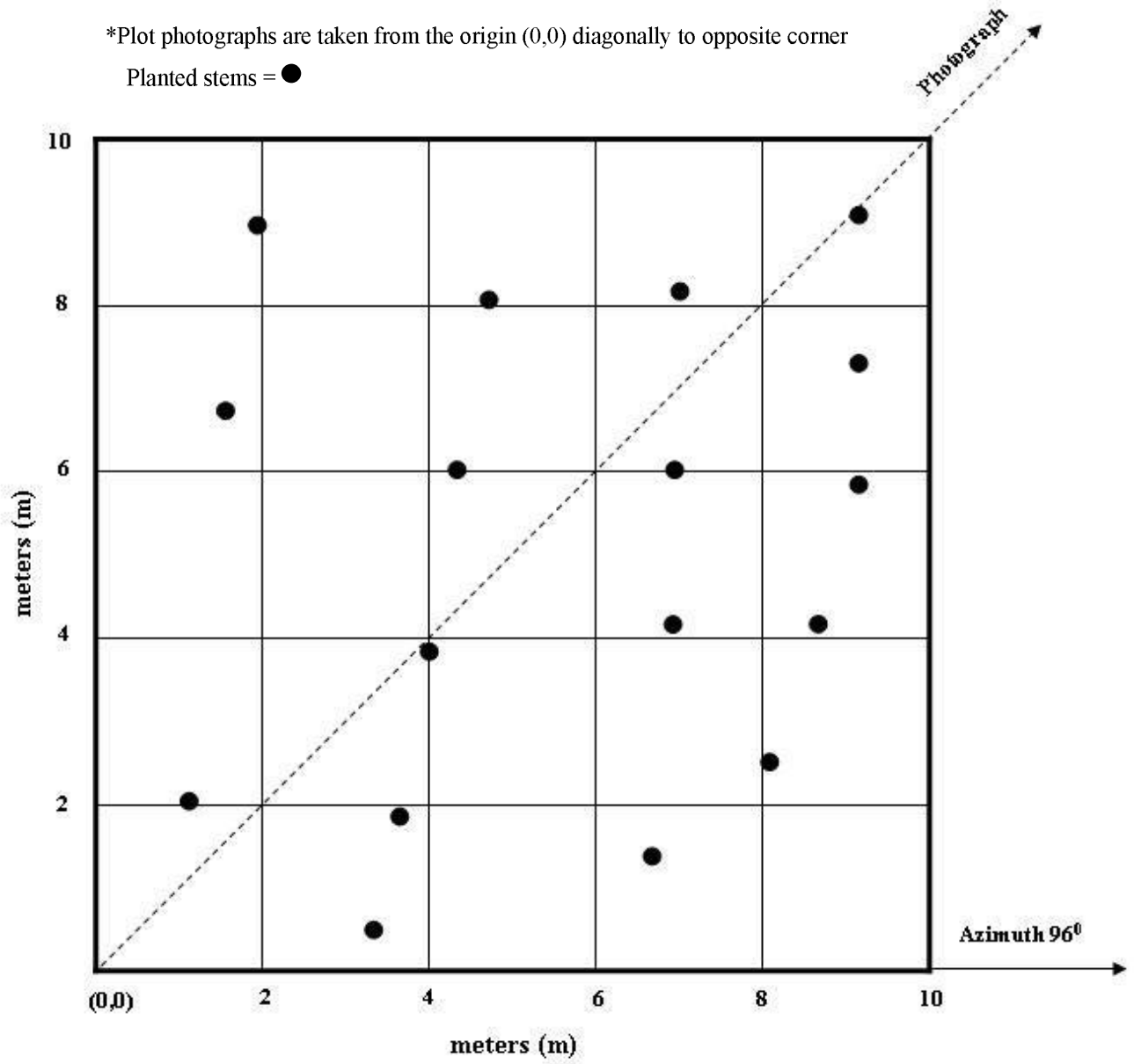
No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Cephalanthus occidentalis*	1.2	2.1	3.0	48	2
2	*Cephalanthus occidentalis*	3.3	0.5	3.0	28	2
3	*Carya ovata*	3.7	1.8	5.0	23	3
4	*Quercus phellos*	6.7	1.4	4.0	60	3
5	*Quercus phellos*	8.1	2.5	6.0	60	3
6	*Quercus phellos*	8.7	4.2	4.0	67	3
7	*Fraxinus pennsylvanica*	6.9	4.2	2.0	24	2
8	*Platanus occidentalis var. occidentalis*	9.2	5.8	7.0	54	3
9	*Quercus pagoda*	9.2	7.3	4.0	37	3
10	*Quercus phellos*	9.2	9.1	7.0	74	3
11	*Fraxinus pennsylvanica*	7.0	8.2	6.0	48	3
12	*Quercus phellos*	6.9	6.0	3.0	59	3
13	*Quercus phellos*	4.0	3.8	2.0	36	3
14	*Quercus michauxii*	4.3	6.0	4.0	44	3
15	*Asimina triloba*	1.9	8.9	4.0	29	3
16	*Asimina triloba*	1.6	6.7	2.0	27	3
17	*Quercus pagoda*	4.7	8.1	3.0	38	3

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT6-VP4

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●



Site: North Muddy Creek – Unnamed Tributary 6
Plot: VP5
Date: 1/08/2009

No.	Species	Coordinates X	Coordinates Y	ddh (mm)	Height (cm)	Vigor
1	*Quercus michauxii*	3.2	0.8	5.0	62	2
2	*Quercus michauxii*	4.7	1.2	5.0	66	2
3	*Quercus michauxii*	6.6	1.4	7.0	68	2

Vigor Code
M = Missing
0 = Dead
1 = Unlikely to survive
2 = Weak
3 = Good
4 = Excellent

UT6-VP5

*Plot photographs are taken from the origin (0,0) diagonally to opposite corner

Planted stems = ●