UT to JUMPING RUN CREEK
STREAM & WETLAND RESTORATION

FINAL AS-BUILT & BASELINE MONITORING REPORT

Cumberland County, North Carolina
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1652 Mail Service Center
Raleigh, NC 27699-1652

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Prepared by:

Stantec Consulting Services, Inc.
801 Jones Franklin Road, Suite 300
Raleigh, NC 27606

EXECUTIVE SUMMARY

The Mitigation Plan presented here includes the monitoring plan success criteria, methodology, and baseline conditions for the UT to Jumping Run Creek Stream and Wetland Restoration site. This northern Cumberland County, North Carolina site is located on the historic Long Valley Farm three miles northeast of Pope Air Force Base.

The overall goal of the UT to Jumping Run Creek Restoration Project was to restore a Coastal Plain headwater stream and wetlands, a Coastal Plain Small Stream Swamp, and nonriparian wetlands. The objectives of the project were to restore wetland hydrology to small stream swamp wetlands, restore stream stability and improve aquatic habitats, restore historic flow paths and flooding processes, improve floodplain functionality, establish native vegetation within the permanent conservation easement, and investigate the ecological benefits of installing larger containerized trees in select smaller designated areas.

Wetland functions on the site had been impaired as a result of agricultural conversion and cattle grazing. Historically, the stream flowing through the site was channelized to reduce flooding and provide drainage for adjacent agricultural and cattle fields. Major project components included the enhancement and restoration of the unnamed tributary to Jumping Run Creek through the filling of channelized portions of stream and the restoration of valley topography. This also included the creation of a new meandering channel across the abandoned floodplain and the filling of drainage ditches. The upstream portion of the stream restoration used the coastal plain headwater stream restoration methodology and included the construction of a braided channel. Another component of the project included the enhancement and restoration of riparian wetlands along the stream by reintroducing surface roughness, planting native wetland vegetation, and restoring overbank flooding regimes. Restoration of nonriparian wetlands included restoring more natural water table conditions and the planting of native wetland vegetation.

All stream reaches will be visually monitored at least twice per year. Reach UT1a, the braided headwater stream, will be also be evaluated for visual evidence of flow. A survey of the longitudinal profile and ten permanent cross-sections will be completed each year on Reach UT1b, the single-thread restoration reach. Reach UT1c, the stream enhancement reach, will be visually assessed for stability. A crest gauge is located along Reach UT1c and will be observed during each monitoring visit. At least two bankfull events must occur during the five year monitoring period with the events occurring in different years.

Vegetative sample plots will be quantitatively monitored during September of each monitoring year. Twelve vegetation plots will be monitored as per the CVS-EEP Protocol for Recording Vegetation, version 4.2 (CVS-EEP 2008) and five random transects will be monitored for species composition and survival. The plots will be monitored for a minimum of 5 years. The vegetative success of the restoration site will be evaluated based on the species density and survival rates. Vegetation monitoring will be considered successful if at least 260 stems/acre are surviving at the end of five years. The interim measure of vegetative success for the site will be the survival of at least 320 3-year old planted trees per acre at the end of year three of the monitoring period and 280 4-year old planted trees per acre at the end of year four of the monitoring period.

Fifteen automated groundwater monitoring gauges have been installed across the project area to document the hydrologic conditions of the site. Eleven wells have been installed in the riparian areas and four have been installed in the non-riparian areas of the site. Groundwater gauges will be downloaded on

at least a bi-monthly basis during the growing season. A reference well is located in the existing wetlands onsite in the northeast corner of the property. As per the restoration plan, the objective for the hydrology monitoring in the wetlands is for the site to be saturated within 12 inches of the soil surface for at least 6% of the growing season in the riparian wetlands, and 9% of the growing season in the non-riparian wetlands.

The results of the as-built survey demonstrate that the restoration project has been built to design specifications.

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1.0 Project Goals, Background and Attributes

1.1 LOCATION AND SETTING

The unnamed tributary (UT) to Jumping Run Creek Stream and Wetland Restoration project is located in Cumberland County, North Carolina, approximately three miles northeast of Pope Air Force Base. (Figure 1, Appendix A). The stream is located within the Cape Fear River Basin (NCDWQ Subbasin 03-06-14) and the United States Geological Survey (USGS) 8-digit Hydrologic Unit Code 03030004. The 1.2 square mile project watershed is located in the Sandhills physiographic province of North Carolina. The project site is located on a terrace of the Lower Little River.

1.2 PROJECT GOALS AND OBJECTIVES

The goal of the UT to Jumping Run Creek Restoration Project was to restore a "Coastal Plain Small Stream Swamp" system, as described by Schafale and Weakley (1990) in addition to a Coastal Plain headwater stream and wetlands, and nonriparian wetlands. Historically, these systems experienced heavy human and cattle disturbance. Wetland functions on the site were impaired as a result of agricultural conversion and cattle grazing. Historically, the stream flowing through the site was channelized to reduce flooding and provide drainage for adjacent agricultural and cattle fields. Field areas were also graded and ditched to promote rapid surface drainage, and spoil from channel/pond excavation was spread on floodplain areas. As a result, nearly all wetland functions were removed within the field areas. The channelized stream and drainage ditches flowing through the system no longer functioned as a Coastal Plain Small Stream Swamp. The goal of the project is to enhance functional elements of the unnamed tributary and the associated riparian and non-riparian wetlands.

The major project components included the enhancement and restoration of the unnamed tributary to Jumping Run Creek through the filling of channelized portions of stream and restoration of valley topography. This also included the creation of a new meandering channel across the abandoned floodplain and the filling of drainage ditches. Another component included the enhancement and restoration of riparian wetlands along the UT by reintroducing surface roughness, planting native wetland vegetation, and restoring overbank flooding regimes. Filling the ditches will also serve to restore wetland hydrology.

The primary design goals of the project were to restore and enhance stream and wetland functions to the impaired areas within the Cape Fear River Basin. To achieve these goals the following objectives were identified:

- Restore wetland hydrology to small stream swamp wetlands
- Restore stream stability and improve aquatic habitats
- Restore historic flow paths and flooding processes
- Improve floodplain functionality
- Establish native vegetation within the permanent conservation easement

- Investigate the ecological benefits of installing larger trees in smaller designated areas throughout the vegetated buffer

1.3 PROJECT STRUCTURE, RESTORATION TYPE AND APPROACH

1.3.1 Project Structure

The project involved restoration of 7,318 linear feet (LF) of stream and 96 acres (AC) of riparian and non-riparian wetlands, and enhancement of 1,935 LF of stream and 3.4 AC of riparian wetlands along an unnamed tributary (UT) to Jumping Run Creek. A recorded conservation easement consisting of 225.3 AC will protect all stream reaches and riparian buffers in perpetuity. Refer to Table 1 and Figure 2 in Appendix A for a table and detailed plan view of the project components.

1.3.2 Restoration Type and Approach

The purpose of the project was to restore wetland functions to agricultural and cattle fields on the site and to restore stream functions to the impaired stream channel that flows through it. The restored UT was divided into three reaches: UT1a (headwater stream), UT1b (low energy stream), and UT1c (downstream forested area). The project also included enhancement of existing jurisdictional riparian wetlands, restoration of riparian wetlands along UT1a and UT1b, and restoration of non-riparian wetlands.

Reach UT1a restoration focused on restoring a multi-thread system within existing field areas to a DA stream type system. Restoration consisted of filling the channelized portions of stream and restoring valley topography. It also consisted of restoring surface roughness in the valley and the grading of shallow flow paths. It was designed to allow the stream system to form on its own, either as a single or braided channel headwater stream within the valley. The design included riparian buffers ranging from approximately 50 feet to 1,100 feet along the stream reach, protected by a perpetual conservation easement.

Rosgen Priority Level 1 and 2 approaches were used for the restoration of UT1b. The design called for existing ditches to be filled in, and restoration of the system to a sand bed C type channel, with low slope and a high width-to-depth ratio. The design included riparian buffers ranging from approximately 185 to 1,100 feet along the stream reach, protected by a perpetual conservation easement.

UT1c is the location of the original channel that was present before historic stream alteration activities such as channelization and dredging disconnected it from the upstream system. The existing channel, though it has been modified in the past, was found to be relatively stable during field assessments for the design. The restoration called for the enhancement of UT1c (E/C/DA stream type) by reconnecting the existing channel to the upstream system with no disturbance to the existing wooded riparian buffer. The restoration of historic flows should also provide additional water inputs to the wetland systems that exist within the wooded area. The existing riparian buffer system is protected by a perpetual conservation easement.

Riparian wetland restoration was designed in the agricultural field areas adjacent to UT1a and UT1b. To restore wetland hydrology, the design called for the existing stream and drainage ditches to be filled and the installation of ditch plugs where the restored channel crossed the pre-restoration channel. Also, surface roughness was reintroduced to promote surface ponding and infiltration, decrease drainage

capacity, and restore more natural water table conditions across the restoration site. Existing jurisdictional riparian wetlands along UT1a and UT1b were designed to be enhanced through native wetland planting.

The revegetation plan for the overall riparian system considered the combination of existing onsite native vegetation and riparian communities identified by Schafale and Weakley (1990) that include "Coastal Plain Small Stream Swamp", "Coastal Plain Bottomland Forest", "Streamhead Pocosin", and "Streamhead Atlantic White Cedar Forest". The vegetative components of this project include streambank, floodplain, and wetland planting. These components were separated further into zones described as headwater riparian, riparian, and transitional. Bare-root and containerized trees, live stakes, and permanent seedlings were planted within designated areas of the conservation easement. A minimum 50-foot buffer was established along the restored stream reaches UT1a and UT1b. UT1c runs through an existing forested area which remained undisturbed during the construction of the restoration project. In many areas, the buffer width is in excess of 50 feet and encompasses adjacent wetland restoration areas. The revegetation plan for the non-riparian/upland system considered a combination of existing onsite native vegetation and non-riparian/upland communities identified by Schafale and Weakley (1990) that included "Mesic Pine Flatwood", "Wet Pine Flathill", "Pine/Scrub Oak Sandhill", and "Pine Savanna". The planting area for the non-riparian wetland areas was designated by the zone "Non-riparian/Upland".

1.4 PROJECT HISTORY, CONTACTS, AND ATTRIBUTE DATA

The restoration project was designed by Michael Baker Engineering, with construction and planting on the project completed in April 2010. The as-built survey was conducted in May 2010. Refer to Tables 2-4 in Appendix A for additional project and contact details.

The 1.2 square mile project watershed is located in the Sandhills physiographic province of North Carolina. The project site is located on a terrace of the Lower Little River. Slopes are generally less than one percent. Elevations on the UT to Jumping Run Creek site range from approximately 138 to 166 feet above mean sea level. The subsurface geology in the project vicinity consists of the Cape Fear formation, which is comprised of sandstone and sandy mudstone (Geologic Map of North Carolina, NC Geological Survey, 1998). Soils found on site include Entisols, Inceptisols, and Ultisols formed from alluvium deposited by the Lower Little River. The Natural Resources Conservation Service (NRCS) Soil Survey for Cumberland County (USDA-SCS, 1984) indicates that the area is mainly underlain by Deloss loam and Pactolus loamy sand. Smaller areas of the Altavista, Johnston, Roanoke, Tarboro, and Wickham series are also mapped on the site.

The watershed is rural with a mixture of forested lands, agricultural row crops, pasture and one residential development. The project site was used for row crops and pasture, and included areas of forested land.

2.0 Success Criteria

Channel stability, vegetation survival, and viability of wetland function will all be monitored on the project site. Post-restoration monitoring will be conducted for a minimum of five years or until the success criteria are met following the completion of construction to document project success.

2.1 MORPHOLOGIC PARAMETERS AND CHANNEL STABILITY

2.1.1 Dimension

Reaches UT1a and UT1c involved restoration techniques to restore historic flow patterns and flooding functions. Monitoring efforts for reaches UT1a and UT1c will focus on visual documentation of stability. Dimensional characteristics obtained from cross-sectional surveying on UT1b will be compared year to year. All monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type. Natural variability is expected, however the system should not experience trends toward excessive increasing bank erosion, channel degradation, or channel aggradation.

2.1.2 Pattern and Profile

The longitudinal profiles should show that the bedform features are remaining stable. The pools should remain deep with flat water surface slopes, and the riffles should remain steeper and shallower than the pools.

2.1.3 Substrate

Since the streams throughout the project site are dominated by sand-size particles, pebble count procedures would not show a significant change in bed material size or distribution over the monitoring period; therefore, as per NCEEP, bed material analyses will not be undertaken for this project.

2.1.4 Sediment Transport

Sediment transport evaluations will not be undertaken during the five-year monitoring period. However, the dimension, pattern, and profile survey for baseline conditions will be analyzed to calculate shear stress and stream power to determine if these values fall within the acceptable range of values for NC sand bed systems.

2.2 VEGETATION

The vegetative success of the restoration site will be evaluated based on the species density and survival rates. Vegetation monitoring will be considered successful if at least 260 stems/acre are surviving at the end of five years. The interim measure of vegetative success for the site will be the survival of at least 320 3-year old planted trees per acre at the end of year three of the monitoring period and 280 4-year old planted trees per acre at the end of year four of the monitoring period. In addition, the buffer must be at least 50-feet wide on both sides of the channel and in the wider areas at the downstream end of the project along UT1c. During monitoring, any encroachments into the conservation easement should be reported to NCEEP and remediated.

2.3 HYDROLOGY

2.3.1 Streams

Two bankfull events must be documented within the five-year monitoring period for reaches UT1a and UT1b. The two bankfull events must occur in separate years; otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years. A crest gauge has been installed along UT1b as depicted in Figure 2 in Appendix A. The gauge will be checked at each site visit to determine if a bankfull event has occurred. Other signs of bankfull flow including wrack lines, sediment deposition, and actual observance of flow will be documented as well. The headwater stream reach (Reach UT1a) will be visually assessed during each monitoring visit to evaluate indicators that the braided channel is exhibiting flow.

2.3.2 Wetlands

In order to determine if the rainfall is normal for the given year, rainfall amounts will be tallied using data obtained from the Cumberland County WETS Station as well as an on-site rain gauge. As per the restoration plan, the objective for the hydrology monitoring in the wetlands is for the site to be saturated within 12 inches of the soil surface for at least 6% of the growing season in the riparian wetlands, and 9% of the growing season in the non-riparian wetlands.

3.0 Monitoring Plan Guidelines

3.1 HYDROLOGY

3.1.1 Wetland

Fifteen automated groundwater monitoring gauges have been installed across the project area to document the hydrologic conditions of the site. Refer to Figure 2 in Appendix A for the location of the groundwater monitoring gauges. Eleven wells have been installed in the riparian areas and four have been installed in the non-riparian areas of the site. Groundwater gauges will be downloaded on at least a bi-monthly basis during the growing season. A reference well is located in the existing wetlands onsite in the northeast corner of the property and is depicted on Figure 2 in Appendix A.

3.1.2 Stream

One crest gauge has been installed onsite and is located just downstream from groundwater gauge 8. Each visit to the site will include documentation of the highest stage for the monitoring interval and a reset of the device. Other indications of bankfull flow including the presence of wrack lines, sediment, or flooding will also be recorded and documented photographically. Refer to Figure 2 in Appendix A for the location of the crest gauge. The headwater stream reach (Reach UT1a) will be visually assessed during each monitoring visit to evaluate indicators that the braided channel is exhibiting flow. A visual assessment form was created for this purpose by NCEEP and is included in Appendix B.

3.2 STREAM CHANNEL STABILITY AND GEOMORPHOLOGY

3.2.1 Dimension

A total of 10 permanent cross-sections (7 riffles, 3 pools) have been installed along UT1b. Each cross-section was marked on both banks with permanent pins. A common benchmark has been established for cross-sections to facilitate comparison of year-to-year data. The annual cross-section survey will include points measured at all breaks in slope including top of bank, bankfull, inner berm, edge of water, and thalweg if the features are present. Dimensional data will be compared from year to year to ensure project stability. Stream channel stability and geomorphic monitoring for reaches UT1a and UT1c restoration success will be documented visually. Refer to Figure 2 in Appendix A for locations of cross-sections along reach UT1b and representative photo station points.

3.2.1 Pattern and Profile

Annual measurements for the plan view of UT1b will include sinuosity, meander width ratio, and radius of curvature. Radius of curvature measurements will be taken on newly constructed meanders for the first year of monitoring only. A longitudinal profile will be completed each year of the monitoring period for the entire length of the UT1b restore channel. Measurements will include thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g. riffle, run, pool, and glide).

3.2.2 Substrate

Since the streams throughout the project site are dominated by sand-size particles, pebble count procedures would not show a significant change in bed material size or distribution over the monitoring period; therefore, as per NCEEP, bed material analyses were not undertaken for this project.

3.2.1 Sediment Transport

As mentioned previously, additional sediment transport analyses will not be conducted during the five-year monitoring period. However, the dimension, pattern, and profile survey will be analyzed for baseline conditions to calculate the shear stress and stream power of the restored UT1b. These values will then be compared to the range of values for stable NC sandbed systems to determine if the restored reach's values are acceptable.

3.3 VEGETATION

Vegetative sample plots will be quantitatively monitored during September of each monitoring year. Twelve vegetation plots will be monitored as per the CVS-EEP Protocol for Recording Vegetation, version 4.2 (CVS-EEP 2008), and five random transects will be monitored for species composition and survival. The plots will be monitored for a minimum of five years. Refer to Figure 2 in Appendix A for the locations of the vegetation plots. Baseline monitoring data is provided in the Appendix C data tables.

Twelve 10m x 10m ($100m^2$) CVS plots were established within the project area. In each plot, four plot corners were permanently located with rebar. Planted vegetation (Level 1) was recorded for the baseline

monitoring, while both planted vegetation and natural volunteers (Level 2) will be recorded beginning in Monitoring Year 2.

The five random transect plots are 2m x 50m ($100m^2$) and consist of surviving species counts only. Each year the location of the plots will change and be chosen randomly, but stratified to be spread across the different planting zones. These plots are aimed at providing a more thorough account of the vegetation condition across the site outside the permanent vegetation plots.

Any vegetative problem areas in the project will be noted and reported in each subsequent monitoring report. Vegetative problem areas may include areas that either lack vegetation or include populations of exotic vegetation.

3.4 PHOTO STATIONS

Representative photo station points have been identified and located using GPS. The stations are shown on Figure 2 in Appendix A. Photos will be taken at each location at approximately the same time each year. Vegetation plot photos will be taken during the vegetation monitoring event each year.

3.5 WATERSHED

Any changes to land use in the watershed that would cause changes to flow within the project streams will be assessed over the five-year monitoring period.

3.6 MONITORING PLAN VIEW

A plan view of the monitoring scheme is presented in Figure 2 in Appendix A.

3.7 MAINTENANCE AND CONTINGENCY PLANS

Any maintenance needs will be determined during monitoring visits. During the baseline monitoring year upon completion of construction, the contractor must address any issues under their warranty. In subsequent monitoring years, the monitoring firm will determine maintenance needs. Maintenance items will be coordinated with NCEEP to determine the appropriate course of action.

The monitoring firm will visually assess the site to verify that the stream and wetland are functioning as needed and will note any adjustments that may be necessary. According to the Restoration Plan, small areas of multiflora rose (*Rosa multiflora*) and Chinese privet (*Ligustrum sinense*) were present onsite and were removed during construction (Baker 2008). It is not anticipated that invasive plant species will be a significant problem onsite but these two species in particular will be watched. During the monitoring period, if these or any other invasive species establish to the point of threatening the desired vegetative community, hand cutting and herbicide treatment may be used to treat problem areas.

Wildlife, including but not limited to beavers and deer, have the potential to destroy vegetation and stream features either by foraging or flooding. Several beaver dams were observed on-site during the design phase (Baker 2008). Should a significant portion of the site be damaged such that the success criteria cannot be achieved, measures such as trapping, beaver dam removal, or repellents may be used.

4.0 As-Built Conditions / Baseline

4.1 AS-BUILT/RECORD DRAWINGS

Site grading was complete in March 2010. Planting was completed in April 2010 and the baseline vegetation data collection occurred on April 26 and 27, 2010. The as-built survey was completed by Turner Land Surveying from May 20 to June 6, 2010. Morphological surveying was completed by Stantec on May 4, 2010. The As-Built Plan Sheets are located in Appendix D.

4.2 BASELINE DATA (YEAR 0)

4.2.1 Channel Morphology

4.2.1.1. Profile

The entire length of the single thread restoration reach (UT1b) was surveyed by Stantec staff using survey-grade GPS to assess baseline conditions. Multiple parameters were located including top of bank, thalweg, and water surface. The longitudinal profile is shown in Appendix B. The channel slope lies within the design parameters for this reach.

4.2.1.2. Dimension

Ten cross sections on the single thread restoration reach (UT1b) were surveyed by Stantec staff. Baseline morphological data is presented in Tables 5 and 6 in Appendix B, along with cross-sectional data at the ten permanent cross sections. The channel cross-section dimensions lie within the design parameters for this reach.

4.2.1.3. Pattern

The pattern of the single thread portion of the stream (Reach UT1b) was picked up during both the as-built survey and the baseline morphology survey. The location is shown on both the component map in Appendix A as well as in the As-Built plan sheets in Appendix D. Morphological calculations are included in Table 5 in Appendix B. The pattern values lie within the design parameters for a stable channel.

4.2.1.4. Substrate

Since the streams throughout the project site are dominated by sand-size particles, pebble count procedures would not show a significant change in bed material size or distribution over the monitoring period; therefore as per NCEEP, bed material analyses were not undertaken for this project.

4.2.1.5. Sediment Transport

Sediment transport evaluations consisted of two characteristics: shear stress and stream power. Shear stress is a function of the specific gravity of water, riffle cross-section geometry, and average channel slope. Stream power is a function of specific weight of water, bankfull discharge, average channel slope,

and riffle bankfull width. These factors were calculated with the data gathered through the measurement of the plan, pattern, and profile. The baseline calculated shear stress for the restored UT1b is 0.056 lb/ft^2 and stream power is 0.69 W/m^2. These numbers lie within the acceptable range for shear stress and stream power according to reference reach data (Baker 2008).

4.2.2 Verification of Plantings

Stantec staff completed the baseline vegetation monitoring on April 27, 2010 using the CVS-EEP Protocol for Recording Vegetation, version 4.2 (CVS-EEP 2008). Monitoring was conducted in 12 vegetation plots and 5 random transects. Random transects consisted of survival and species composition only. Plots 1 and 3 are located in the headwater riparian planting zone; plot 5 in the headwater riparian containerized planting zone; plots 2 and 6 in the transitional zone; plots 4 and 9 in the upland/non-riparian zone; plots 7, 8, 10, and 12 in the riparian zone; and plot 11 is located in the riparian containerized planting zone. Random transect 1 was located in the headwater riparian wetland, transect 2 was located in the riparian wetland planting area, transects 3, 4 and 5 were located in the upland/non-riparian zone.

According to the data collected, the average plant density among the 17 plots/transects is 438 stems/acre. The highest plant densities occurred in plots 1, 5, and 6 and random transects 1 and 5. Plots 2 and 4 and random transect 3 are not meeting the interim 3-year vegetation success criteria. The original planting plan specified 597 stems/acre, with an additional 10 stems/acre in the containerized zones. Vegetation sampling details are included in Appendix C.

4.2.3 Photo Documentation

Photo stations were established in 36 locations along the project. The location of the stations can be seen in Figure 2 in Appendix A. Baseline vegetation station photos were taken on April 26 and 27, 2010 during the baseline vegetation monitoring. Vegetation station photos for the baseline monitoring year are provided in Appendix C. Baseline stream station photos were taken on May 4, 2010. Stream station photos for the baseline monitoring year are provided in Appendix B.

4.2.4 Hydrology

Fifteen 40” Ecotone groundwater monitoring gauges were installed onsite on April 27, 2010. Gauges 1-3 and 6 are located in the headwater riparian wetland zone while gauges 8-9, 11-12 and 14-15 are located in the riparian wetland restoration areas along the single thread channel. Gauges 4, 7, 10, and 13 are located in the non-riparian wetland restoration areas and gauge 5 is located in the wetland enhancement area. A reference gauge (gauge 16) was installed during the project design period and is located in the existing wetlands on the northeastern portion of the site. A rain gauge was installed onsite on July 8, 2010. A crest gauge was installed onsite on April 27, 2010. The crest gauge will be used in future monitoring to verify bankfull events. The location of the precipitation gauge, reference well, and groundwater monitoring wells are included in Figure 2 in Appendix A.

The headwater visual assessment was not completed for the as-built condition since the channel is young and does not yet exhibit any hydrological features to evaluate.

5.0 References

Baker 2008. UT to Jumping Run Creek Stream and Wetland Restoration Plan Cumberland County, North Carolina. Report prepared by Baker Engineering NY, Inc. for the North Carolina Ecosystem Enhancement Program, Raleigh, NC.

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation, Version 4.2 (http://cvs.bio.unc.edu/methods.htm)

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Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

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United States Department of Agriculture-Soil Conservation Service, 1984. Soil Survey of Cumberland and Hoke Counties. Raleigh, NC.

6.0 Appendices

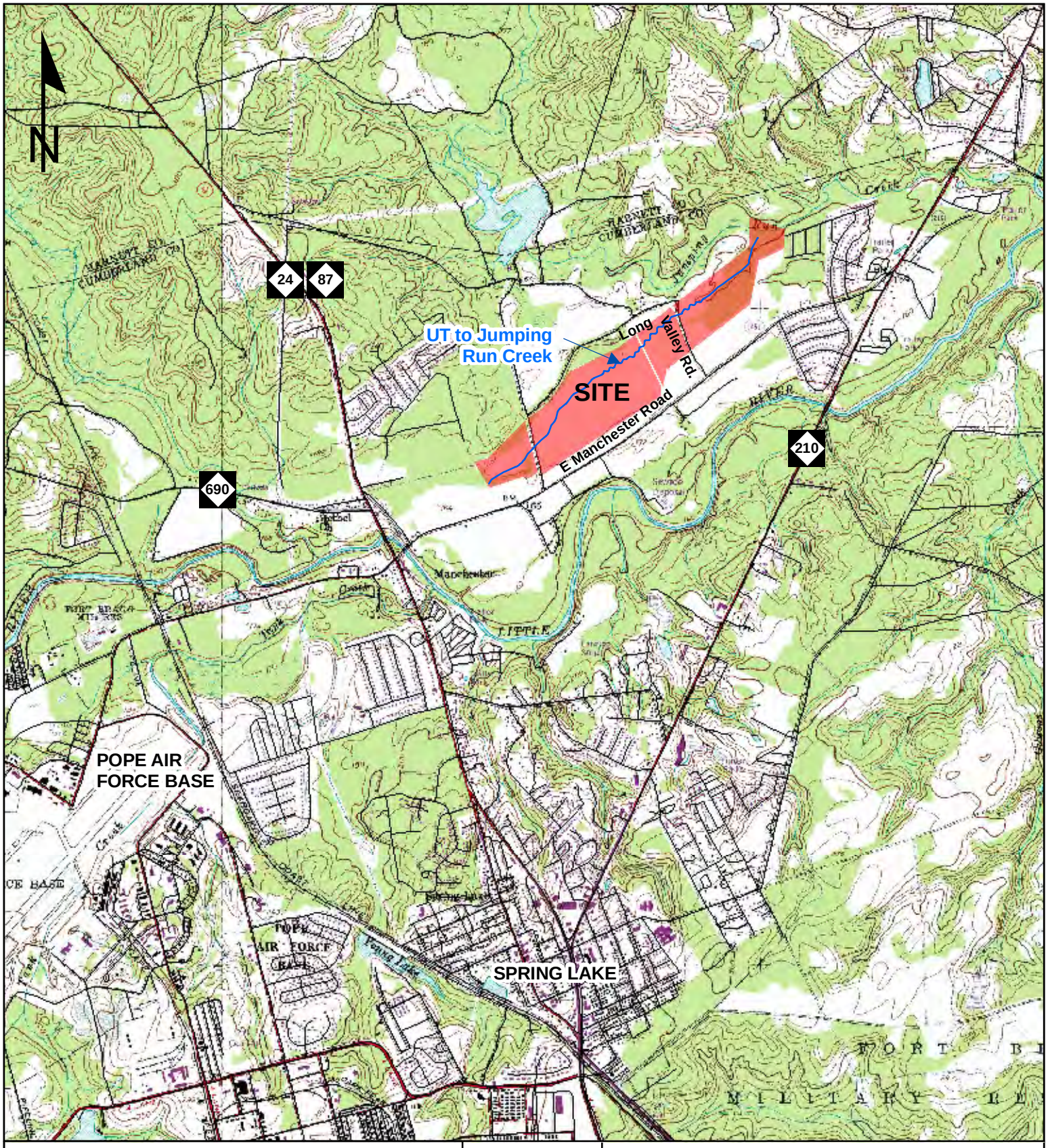
Appendix A – General Tables and Figures

Appendix B – Morphological Summary Data and Plots

Appendix C – Vegetation Data

Appendix D – As-Built Plan Sheets

Appendix A - General Tables and Figures



Directions to the site: From Raleigh, head south on US 1. In Sanford take the NC 87 S / US 421 S / N Horner Blvd exit and turn right at the end of the exit ramp to go south through Sanford. In approximately 5 miles, veer right to stay on NC 87 at the NC 87 / US 421 split. Approximately 1.6 miles past the Cumberland County line turn left onto East Manchester Road. Go another 1.6 miles and turn left on Long Valley Road to access the site. Gate access can be obtained from NC State Parks (Janet Pearson 910-692-2167)

0 1,500 3,000 6,000 9,000 Feet

Ecosystem Enhancement Program

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Figure 1. Vicinity Map

UT to Jumping Run Creek
Stream and Wetland Restoration Project
EEP #: 92345
Cumberland County, North Carolina

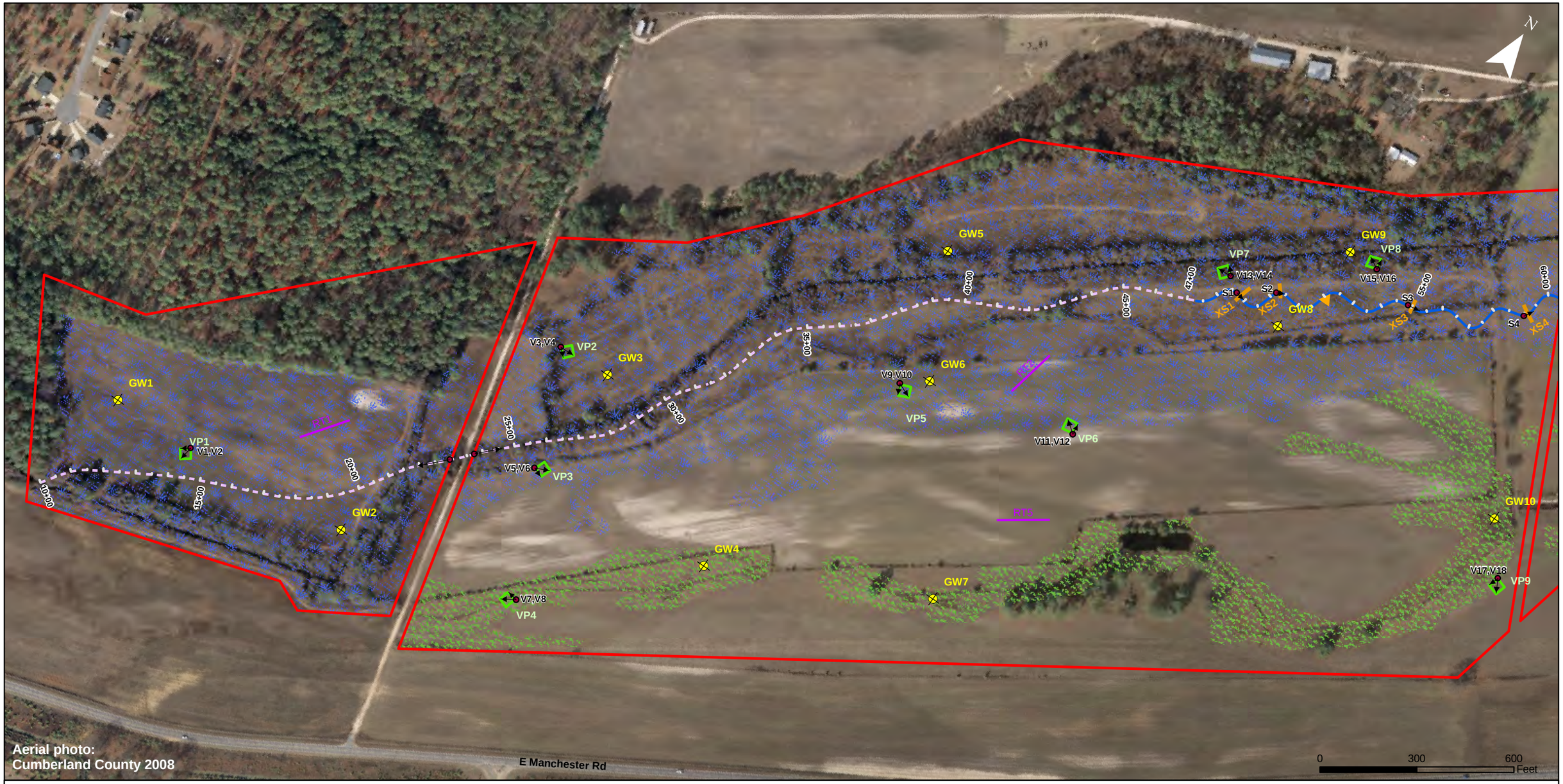


Figure 2a. Project Components and Baseline Monitoring Map

UT to Jumping Run Creek
Stream and Wetland Restoration Project
EEP #: 92345
Cumberland County, North Carolina
December 2010

- Precipitation gage
- Photo points (Veg=V, Stream=S)
- Reference well
- Groundwater monitoring wells (Well 1-15)
- Vegetation monitoring plots (VP 1-12)
- Random transects MY0 (RT 1-5)
- Stream cross-section surveys (XS 1-10)
- Stream stationing
- Headwater system (UT1A) - valley length shown
- As-built stream restoration centerline MY0 (UT1B)
- As-built stream enhancement MY0 (UT1C)

Proposed wetland features

- Non-riparian wetland
- Riparian wetland
- Easement boundary

Ecosystem Enhancement Program

Stantec

Figure 2b. Project Components and Baseline Monitoring Map

UT to Jumping Run Creek
Stream and Wetland Restoration Project
EEP #: 92345
Cumberland County, North Carolina
December 2010

- Precipitation gage
- Photo points (Veg=V, Stream=S)
- Reference well
- Groundwater monitoring wells (Well 1-15)
- Vegetation monitoring plots (VP 1-12)
- Random transects MY0 (RT 1-5)
- Stream cross-section surveys (XS 1-10)
- Stream stationing
- Headwater system (UT1A) - valley length shown
- As-built stream restoration centerline MY0 (UT1B)
- As-built stream enhancement MY0 (UT1C)

Proposed wetland features

- Non-riparian wetland
- Riparian wetland
- Easement boundary

Ecosystem Enhancement Program

Stantec

Table 1a. Project Components									
UT Jumping Run Creek Restoration Project/EEP Project No. 92345									
Project Component or Reach ID	**Existing Feet/Acres**	**Restoration Level**	**Approach**	**Footage or Acreage**	**Stationing**	**Mitigation Ratio**	**Mitigation Units**	**BMP Elements[1]**	**Comment**
UT1A	9,026 lf	R	CP Headwater	3,657*	10+00 to 47+29	1:1	3,657		Restoration consists of filling the channelized portions of stream and restoring valley topography. The system will be allowed to form on its own, either as a single or briaded channel headwater stream within the valley (DA stream type).
UT1B		R	PI	3,661	47+29 to 82+19	1:1	3,661		Restoration follows a Rosgen Priority Level I approach. A new meandering channel was constructed across the abandoned floodplain. The old stream channel and drainange ditches were filled.
UT1C	1,935 lf	E	EI	1,935	82+19 to 101+54	1.5:1	1,290		Stream enhancement is proposed for the area of existing forest on the eastern side of the project. Flows from the restoration reaches were routed into the existing channel that currently flows through this wooded area, with minimal disturbance to the existing vegetation. The existing channel is relatively stable, and restoring the historic stream flow would enhance the functions of the stream reach.
Riparian Wetland Restoration - field areas along UT1A and UT1B	n/a	R		78.7	~10+00 to 82+39	1:1	78.7		Restoration of wetland hydrology to drained areas of hydric soil. Drainage ditches were filled, microtopography reintroduced, planting of native wetland vegetation, and overbank flooding regimes restored.
Riparian Wetland Enhancement - along UT1a and UT1B (existing jurisdictional wetland pockets)	3.4 ac	E		3.4	~16+00 to 60+00	2:1	1.7		Existing jurisdictional wetlands within the farm fields enhanced by raising the local water table, restoring an overbank flooding regime, and planting of native wetland vegetation.
Non-riparian Wetland Restoration	n/a	R		17.3	~24+00 to 91+00	1:1	17.3		Existing drained hydric soil areas within the farm fields restored by raising the local water table and planting of native wetland vegetation.

*Footage is based on valley length for this braided system

1 = BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; Grassed Swale = S; LS = Level Spreader; NI = Natural Infiltration Area, O = Other
CF = Cattle Fencing; WS = Watering System; CH = Livestock Housing

Table 1b. Component Summations							
UT Jumping Run Creek Restoration Project/EEP Project No. 92345							
Restoration	Stream	Riparian		Non-Ripar	Upland	Buffer	
Level	(lf)	Wetland (Ac)		(Ac)	(Ac)	(Ac)	BMP
		Riverine	Non-Riverine				
Restoration	7318	78.7		17.3			
Enhancement		3.4					
Enhancement I	1935						
Enhancement II							
Creation							
Preservation					125.9		
HQ Preservation							
Totals (Feet/Acres)	**9253**	**82.1**		**17.3**			
MU Totals	**8608**	**80.4**		**17.3**			

Non-Applicable

Table 2. Project Activity and Reporting History		
UT Jumping Run Creek Restoration Project/EEP Project No. 92345		
Elapsed Time Since Grading Complete:	**2 months**	
Elapsed Time Since Planting Complete:	**1 month**	
Number of Reporting Years[1]:	**0**	
	Data Collection	**Completion or**
Activity or Deliverable	**Complete**	**Delivery**
Mitigation Plan	Nov 2007	July 2008
Final Design – Construction Plans	n/a	March 2009
Construction	n/a	April 2010
Seeding	n/a	March 2010
Planting	n/a	April 2010
As-built (Year 0 Monitoring – baseline)	May 2010	Dec 2010
Year 1 Monitoring	n/a	n/a
Year 2 Monitoring	n/a	n/a
Year 3 Monitoring	n/a	n/a
Year 4 Monitoring	n/a	n/a
Year 5 Monitoring	n/a	n/a

1 = Equals the number of reports or data points produced excluding the baseline

Table 3. Project Contacts Table	
UT Jumping Run Creek Restoration Project/EEP Project No. 92345	
Designer	Michael Baker Engineering, Inc.
	8000 Regency Pkwy, Ste 200, Cary, NC 27518
Primary project design POC	Kayne Van Stell (919)463-5488
Construction Contractor	Backwater Environmental
	P.O. Box 1654, Pittsboro, NC 27312
Construction contractor POC	Wes Newell (919) 523-4375
Survey Contractor	Turner Land Surveying, PLLC
	3201 Glenridge Drive, Rlaiegh, NC 27604
Survey contractor POC	L Turner (919) 875-1378
Planting Contractor	Carolina Silvics, Inc.
	Indian Trail Rd, Endenton, NC 27932
Planting contractor POC	Mary-Margaret McKinney (252) 482-8491
Seeding Contractor	Unknown
	Unknown
Contractor point of contact	Unknown
Seed Mix Sources	Unknown
	Unknown
Nursery Stock Suppliers	ArborGen, Coastal Plain, Native Roots, Superior Trees, NCDFR
Monitoring Performers	Stantec Consulting Services, Inc.
	801 Jones Franklin Rd, Ste 300, Raleigh, NC 27606
Stream Monitoring POC	Brian Mazzochi (919) 865-7580
Vegetation Monitoring POC	Amber Coleman (919)865-7399
Wetland Monitoring POC	Amber Coleman (919)865-7399

Table 4. Project Attribute Table						
UT Jumping Run Creek Restoration Project / EEP Project No. 92345						
Project County	Cumberland					
Physiographic Region	Coastal Plain					
Ecoregion	Sandhills					
Project River Basin	Cape Fear					
USGS HUC for Project (14 digit)	03030004090010					
NCDWQ Sub-basin for Project	03-06-14					
Within extent of EEP Watershed Plan?	Name the plan document					
WRC Hab Class (Warm, Cool, Cold)	Warm					
% of project easement fenced or demarcated	100%					
Beaver activity observed during design phase?	Yes					
Restoration Component Attribute Table						
	UT1A	UT1B	UT1C	RW Restoration	RW Enhancement	NRW Restoration
Drainage area	1.2 sq mi			N/A	N/A	N/A
Stream order	1	1	1	N/A	N/A	N/A
Restored length (feet)	3,657	3,661	1,935	N/A	N/A	N/A
Perennial or Intermittent	I	P	P	N/A	N/A	N/A
Watershed type (Rural, Urban, Developing etc.)	Rural	Rural	Rural	Rural	Rural	Rural
Watershed LULC Distribution (e.g.)						
Residential	25%			N/A	N/A	N/A
Ag-Livestock	45%			N/A	N/A	N/A
Forested	30%			N/A	N/A	N/A
Watershed impervious cover (%)	<5%			N/A	N/A	N/A
NCDWQ AU/Index number	N/A	N/A	N/A	N/A	N/A	N/A
NCDWQ classification	C	C	C	N/A	N/A	N/A
303d listed?	No	No	No	N/A	N/A	N/A
Upstream of a 303d listed segment?	Yes	Yes	Yes	N/A	N/A	N/A
Reasons for 303d listing or stressor	DO, FC, metals, pH			N/A	N/A	N/A
Total acreage of easement	225.3					
Total vegetated acreage within the easement	225.3					
Total planted acreage as part of the restoration	153.8					
Rosgen classification of pre-existing	F5	F5	F5	N/A	N/A	N/A
Rosgen classification of As-built	DA	C	E/C/DA	N/A	N/A	N/A
Valley type	X	X	X	N/A	N/A	N/A
Valley slope	-	0.0011	0.003	N/A	N/A	N/A
Valley side slope range (e.g. 2-3.%)	-	-	-	N/A	N/A	N/A
Valley toe slope range (e.g. 2-3.%)	-	-	-	N/A	N/A	N/A
Cowardin classification	N/A	N/A	N/A	Palustrine	Palustrine	Palustrine
Trout waters designation	N/A	N/A	N/A	N/A	N/A	N/A
Species of concern, endangered etc.? (Y/N)	No	No	No	No	No	No
Dominant soil series and characteristics						
Series	Deloss	Deloss	Deloss	Deloss	Deloss	Tarboro
Depth (to water table)	+1-1.0ft	+1-1.0ft	+1-1.0ft	+1-1.0ft	+1-1.0ft	>6ft
Clay%	3-35%	3-35%	3-35%	3-35%	3-35%	2-12%
K	0.24	0.24	0.24	0.24	0.24	0.1
T	5	5	5	5	5	5

Use N/A for items that may not apply. Use "-" for items that are unavailable and "U" for items that are unknown
RW = Riparian wetland, NRW = Non-riparian wetland

Appendix B – Morphological Summary Data and Plots

Table 5a. Baseline Stream Data Summary
UT Jumping Run Creek Restoration Project/EEP Project No. 92345 - Segment/Reach: UT1b (3661 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)					12.10	15.23	13.01	20.55	3.95	5	-	-	-	-	-	-	-	13.4	-	14.02	15.98	15.75	18.48	1.32	8
Floodprone Width (ft)					15.59	18.68	17.51	23.94	3.62	5	-	-	-	-	-	-	-	100+	-	103.50	187.94	200.00	200.00	34.12	8
Bankfull Mean Depth (ft)					0.54	0.77	0.86	0.94	0.19	5	-	-	-	-	-	-	-	0.9	-	0.53	0.82	0.75	1.40	0.26	8
[1]Bankfull Max Depth (ft)					0.87	1.18	1.17	1.45	0.25	5	-	-	-	-	-	-	-	1.1	-	0.98	1.35	1.25	2.27	0.39	8
Bankfull Cross Sectional Area (ft^2)					10.97	11.23	11.13	11.80	0.33	5	7.80	51.85	51.85	95.90	-	2	-	12.0	-	7.41	13.35	11.74	25.96	5.48	8
Width/Depth Ratio					12.47	21.84	15.20	37.78	11.53	5	8.00	11.00	11.00	14.00	-	2	-	15.0	-	13.20	20.53	20.94	26.45	3.97	8
Entrenchment Ratio					1.13	1.25	1.29	1.35	0.09	5	4.00	8.50	8.50	13.00	-	2	8.0	10.0	12.0	7.35	12.85	12.53	21.58	4.00	8
[1]Bank Height Ratio					2.94	4.14	4.29	5.45	0.95	5	1.00	1.15	1.15	1.30	-	2	-	1.0	-	1	1	1	1	0	8
Profile																									
Riffle Length (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.4	49.71	48.08	78.46	11.12	32
Riffle Slope (ft/ft)					-	-	-	-	-	-	-	-	-	-	-	-	0.001	0.003	0.005	2E-04	0.467	0.005	6	1.662	13
Pool Length (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27.7	59.89	61.4	96	18.34	30
Pool Max depth (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	1.9	-	0.865	1.496	1.572	2.395	0.391	30
Pool Spacing (ft)					-	-	-	-	-	-	-	-	-	-	-	-	38	61.5	85	79	106.5	104	143	17.09	29
Pattern																									
Channel Beltwidth (ft)					-	-	-	-	-	-	-	-	-	-	-	-	38	79.0	120	40.15	70.42	69.35	96.96	13.68	26.00
Radius of Curvature (ft)					-	-	-	-	-	-	-	-	-	-	-	-	30	40.0	50	32.49	41.47	39.95	55.87	6.35	30.00
Rc:Bankfull width (ft/ft)					-	-	-	-	-	-	1.5	-	2.25	3	-	-	2	2.8	3.5	2.32	2.59	2.54	3.02	-	-
Meander Wavelength (ft)					-	-	-	-	-	-	-	-	-	-	-	-	70	120	170	152.37	179.88	176.05	228.52	23.44	14.00
Meander Width Ratio					-	-	-	-	-	-	2	-	4.15	6.3	-	-	3.5	5.8	8	2.86	4.41	4.40	5.25	-	-
Transport parameters																									
Reach Shear Stress (competency) lb/f^2					-												0.03			0.056					
Max part size (mm) mobilized at bankfull					-												-			-					
Stream Power (transport capacity) W/m^2					-												0.026			0.69					
Additional Reach Parameters																									
Rosgen Classification					F5						E5/C5						C5c			C5c					
Bankfull Velocity (fps)					-												0.78			-					
Bankfull Discharge (cfs)					9.4																				
Valley length (ft)					-						-														
Channel Thalweg length (ft)					6501						-						3400			3661					
Sinuosity (ft)					1.07						1.22/1.77						1.2			1.2					
Water Surface Slope (Channel) (ft/ft)					0.0006												0.0016			0.00124					
BF slope (ft/ft)					-												-			**0.00137**					
[3]Bankfull Floodplain Area (acres)					-						-						-			-					
[4]% of Reach with Eroding Banks					-						-														
Channel Stability or Habitat Metric					-						-														
Biological or Other					-						-														

Shaded cells indicate that these will typically not be filled in.

1= The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 5b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)

UT Jumping Run Creek Restoration Project/EEP Project No. 92345 - Segment/Reach: UT1b (3661 feet)

Parameter	Pre-Existing Condition							Reference Reach(es) Data							Design							As-built/Baseline						
[1]Ri% / Ru% / P% / G% / S%	-	0	-	0	0			-	-	-	-	-			-	-	-	-	-			52	-	48	-	-		
[1]SC% / Sa% / G% / C% / B% / Be%	0	33	67	0	0	0		0	100	0	0	0	0															
[1]d16 / d35 / d50 / d84 / d95 / di^{p} / di^{sp} (mm)	0.14	0.26	0.5	4.4	7.3	-	30	0.3	0.4	0.5	0.9	1.2	-	-														
[2]Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10	-	-	-	-	-			-	-	-	-	-										-	-	-	-	-		
[3]Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0	-	-	-	-				-	-	-	-											-	-	-	-			

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.
The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.
ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design survey), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construtions distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section surveys and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 6a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

UT Jumping Run Creek Restoration Project/EEP Project No. 92345 - Segment/Reach: UT1b (3661 feet)

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)							Cross Section 5 (Riffle)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	150.47							150.58							149.75							149.34							149.02						
Bankfull Width (ft)	15.60							19.33							15.50							18.22							15.90						
Floodprone Width (ft)	200+							200+							200+							200+							200+						
Bankfull Mean Depth (ft)	0.83							1.12							0.76							1.23							0.74						
Bankfull Max Depth (ft)	1.31							2.25							1.14							2.20							1.41						
Bankfull Cross Sectional Area (ft^2)	12.90							21.57							11.71							22.42							11.69						
Bankfull Width/Depth Ratio	18.73							17.26							20.90							14.81							21.49						
Bankfull Entrenchment Ratio	12.82							10.35							12.90							10.98							12.58						
Bankfull Bank Height Ratio	1.00							1.00							1.00							1.00							1.00						
Cross Sectional Area between end pins (ft^2)	16.50							26.30							13.60							32.10							19.00						
d50 (mm)																																				
	Cross Section 6 (Riffle)							**Cross Section 7 (Riffle)**							**Cross Section 8 (Riffle)**							**Cross Section 9 (Pool)**							**Cross Section 10 (Pool)**						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	148.61							148.09							147.20							146.97							145.87						
Bankfull Width (ft)	16.39							16.87							15.10							18.48							14.02						
Floodprone Width (ft)	200+							200+							200+							200+							103.50						
Bankfull Mean Depth (ft)	0.89							0.70							0.72							1.40							0.53						
Bankfull Max Depth (ft)	1.23							1.21							1.26							2.27							0.98						
Bankfull Cross Sectional Area (ft^2)	14.51							11.77							10.81							25.96							7.41						
Bankfull Width/Depth Ratio	18.42							24.10							20.97							13.20							26.45						
Bankfull Entrenchment Ratio	12.20							11.86							13.25							10.82							7.38						
Bankfull Bank Height Ratio	1.00							1.00							1.00							1.00							1.00						
Cross Sectional Area between end pins (ft^2)	24.30							13.10							17.20							40.10							85.50						
d50 (mm)																																				

1 = Widths and depths for monitoring resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established.
for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: “It is uncertain if the monitoring datum has been consistent over the monitoring hi
Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary.”

Exhibit Table 6b. Monitoring Data - Stream Reach Data Summary
UT Jumping Run Creek Restoration Project/EEP Project No. 92345 - Segment/Reach: UT1b (3661 feet)

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n	Min	Mean	Med	Max	SD[4]	n
Bankfull Width (ft)	14.02	15.98	15.75	18.48	1.321	8																														
Floodprone Width (ft)	103.5	187.9	200	200	34.12	8																														
Bankfull Mean Depth (ft)	0.53	0.821	0.75	1.4	0.256	8																														
[1]Bankfull Max Depth (ft)	0.98	1.351	1.245	2.27	0.392	8																														
Bankfull Cross Sectional Area (ft^2)	7.41	13.35	11.74	25.96	5.48	8																														
Width/Depth Ratio	13.2	20.53	20.94	26.45	3.972	8																														
Entrenchment Ratio	7.35	12.85	12.53	21.58	4.003	8																														
[1]Bank Height Ratio	1	1	1	1	0	8																														
Profile																																				
Riffle Length (ft)	31.4	49.71	48.08	78.46	11.12	32																														
Riffle Slope (ft/ft)	2E-04	0.467	0.005	6	1.662	13																														
Pool Length (ft)	27.7	59.89	61.4	96	18.34	30																														
Pool Max depth (ft)	0.865	1.496	1.572	2.395	0.391	30																														
Pool Spacing (ft)	79	106.5	104	143	17.09	29																														
Pattern																																				
Channel Beltwidth (ft)	40.15	70.42	69.35	96.96	13.68	26																														
Radius of Curvature (ft)	32.49	41.47	39.95	55.87	6.348	30																														
Rc:Bankfull width (ft/ft)	2.317	2.594	2.536	3.023	-	-																														
Meander Wavelength (ft)	152.4	179.9	176.1	228.5	23.44	14																														
Meander Width Ratio	2.864	4.406	4.403	5.247	-	-																														
Additional Reach Parameters																																				
Rosgen Classification	C5c																																			
Channel Thalweg length (ft)	3471																																			
Sinuosity (ft)	1.2																																			
Water Surface Slope (Channel) (ft/ft)	0.00124																																			
BF slope (ft/ft)	0.00137																																			
[3]Ri% / Ru% / P% / G% / S%	**52**	**0**	**48**	**0**	**0**																															
[3]SC% / Sa% / G% / C% / B% / Be%																																				
[3]d16 / d35 / d50 / d84 / d95 /																																				
[2]% of Reach with Eroding Banks	-																																			
Channel Stability or Habitat Metric	-																																			
Biological or Other	-																																			

Pattern data will not typically be collected unless visual data, dimensional data or profile data indicate significant shifts from baseline

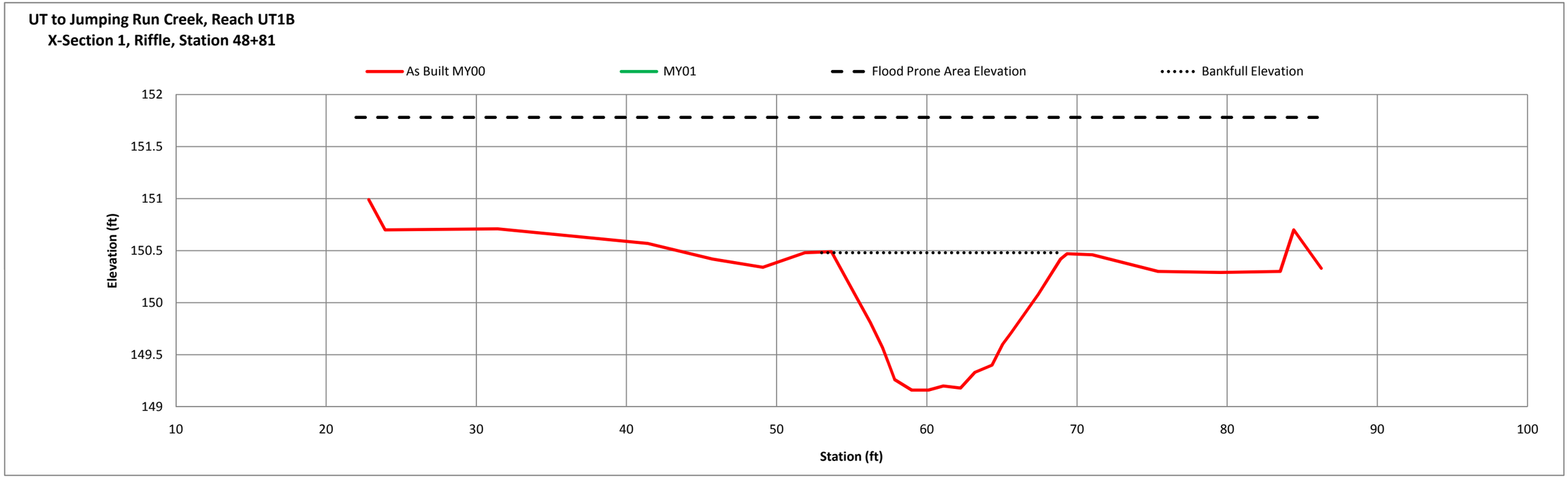
Shaded cells indicate that these will typically not be filled in.
1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
4. = Of value/needed only if the n exceeds 3

River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-1, Riffle, STA 48+81
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 48+81 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	150.47					
Bankfull Cross-Sectional Area	12.9					
Bankfull Width	15.6					
Flood Prone Area Elevation	151.78					
Flood Prone Width	200					
Max Depth at Bankfull	1.31					
Mean Depth at Bankfull	0.83					
W/D Ratio	18.73					
Entrenchment Ratio	12.86					
Bank Height Ratio	1.0					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
22.84	150.99										
23.93	150.7										
31.43	150.71										
41.41	150.57										
45.73	150.42										
49.1	150.34										
51.9	150.48										
53.65	150.49										
55.09	150.11										
56.24	149.81										
57.05	149.57										
57.45	149.42										
57.86	149.26										
58.99	149.16										
60.1	149.16										
61.1	149.2										
62.24	149.18										
63.2	149.33										
64.34	149.4										
65.05	149.6										
65.61	149.71										
67.42	150.08										
68.9	150.42										
69.34	150.47										
71.02	150.46										
75.41	150.3										
79.57	150.29										
83.53	150.3										
84.44	150.7										
86.27	150.33										

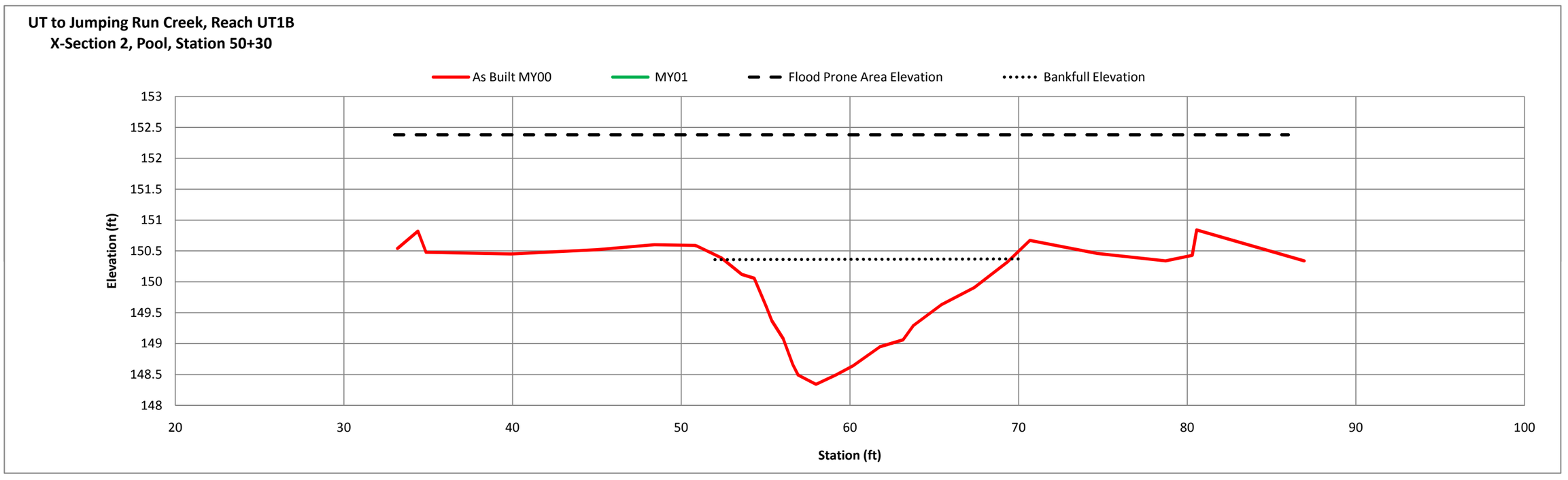


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-2, Pool, STA 50+30
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 50+30 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	150.58					
Bankfull Cross-Sectional Area	21.57					
Bankfull Width	19.33					
Flood Prone Area Elevation	152.82					
Flood Prone Width	200					
Max Depth at Bankfull	2.25					
Mean Depth at Bankfull	1.12					
W/D Ratio	17.26					
Entrenchment Ratio	10.35					
Bank Height Ratio	1.0					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
33.17	150.54										
34.39	150.82										
34.86	150.48										
39.92	150.45										
45	150.52										
48.41	150.6										
50.8	150.59										
50.93	150.58										
52.37	150.39										
53.59	150.12										
54.32	150.06										
55.03	149.6										
55.37	149.37										
56.04	149.08										
56.61	148.66										
56.93	148.49										
57.99	148.34										
59.16	148.49										
60.19	148.64										
61.79	148.95										
63.15	149.06										
63.76	149.29										
65.43	149.63										
67.39	149.91										
69.34	150.32										
70.67	150.67										
74.67	150.46										
78.72	150.34										
80.3	150.43										
80.56	150.84										
86.93	150.34										

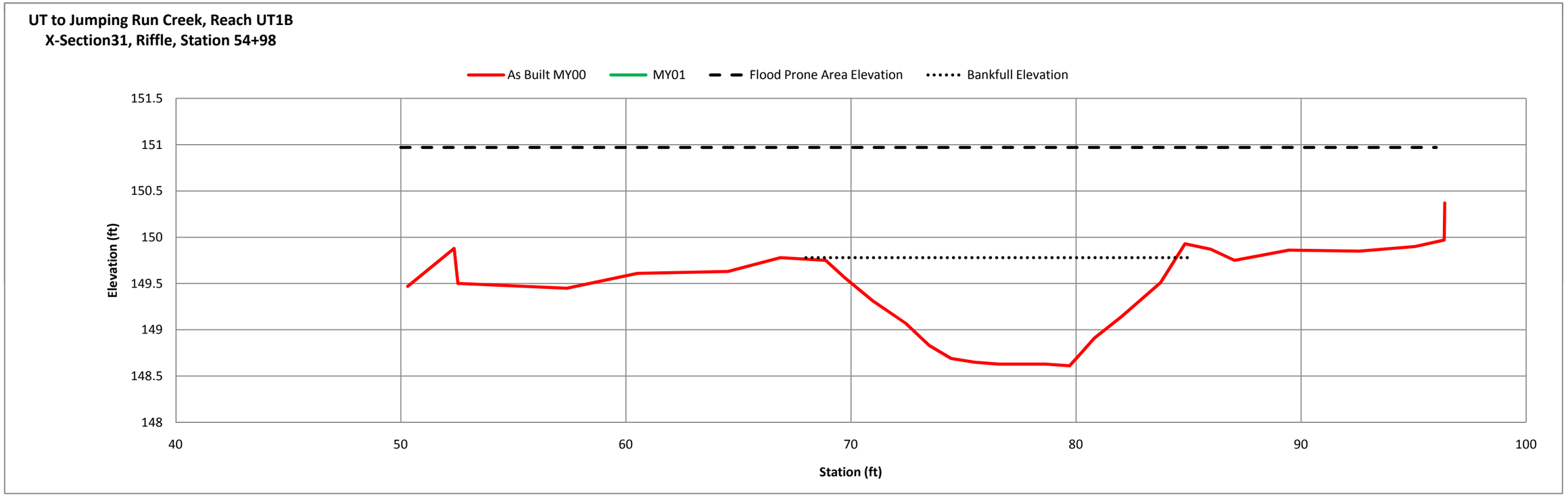


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-3, Riffle, STA 54+98
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 54+98 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	149.75					
Bankfull Cross-Sectional Area	11.71					
Bankfull Width	15.50					
Flood Prone Area Elevation	150.89					
Flood Prone Width	200.00					
Max Depth at Bankfull	1.14					
Mean Depth at Bankfull	0.76					
W/D Ratio	20.90					
Entrenchment Ratio	12.91					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
50.31	149.47										
52.37	149.88										
52.54	149.5										
57.38	149.45										
60.52	149.61										
64.53	149.63										
66.87	149.78										
68.88	149.75										
69.74	149.56										
70.98	149.31										
72.43	149.07										
73.48	148.83										
74.45	148.69										
75.49	148.65										
76.56	148.63										
77.68	148.63										
78.65	148.63										
79.71	148.61										
80.16	148.73										
80.81	148.91										
82.01	149.14										
83.76	149.51										
84.84	149.93										
85.99	149.87										
87.04	149.75										
89.46	149.86										
92.58	149.85										
95.06	149.9										
96.36	149.97										
96.38	150.37										

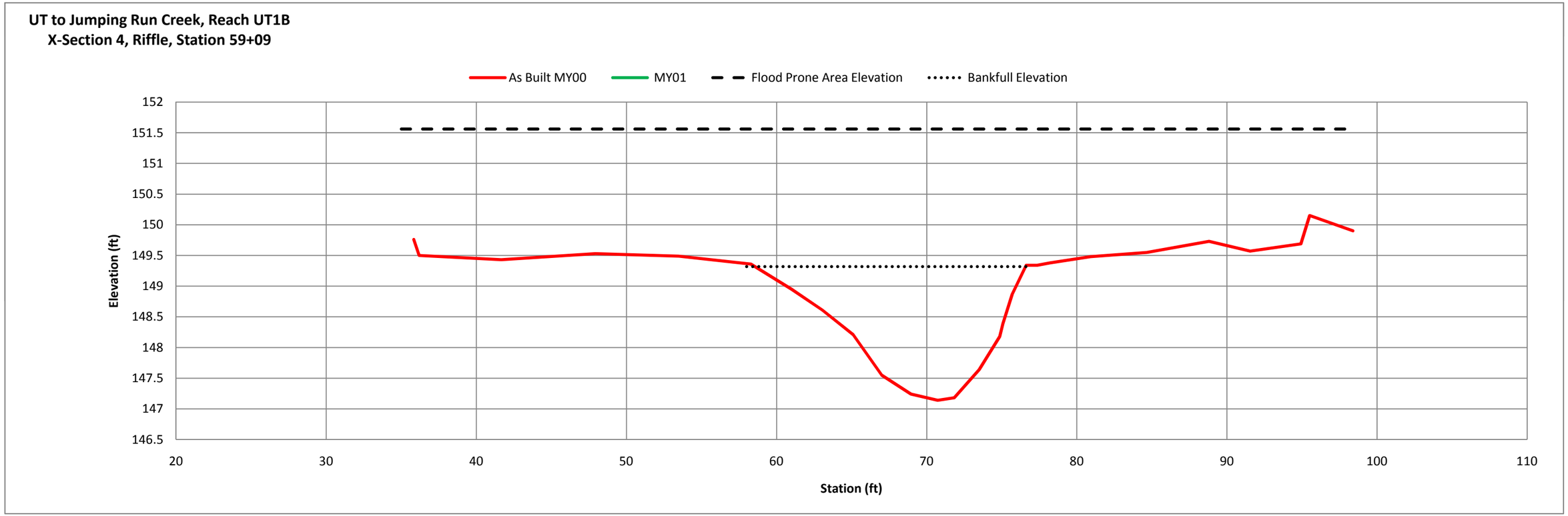


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-4, Pool, STA 59+09
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 59+09 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	149.34					
Bankfull Cross-Sectional Area	22.42					
Bankfull Width	18.22					
Flood Prone Area Elevation	151.54					
Flood Prone Width	200.00					
Max Depth at Bankfull	2.20					
Mean Depth at Bankfull	1.23					
W/D Ratio	14.81					
Entrenchment Ratio	10.98					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
35.83	149.76										
36.19	149.5										
41.66	149.43										
47.94	149.53										
53.48	149.49										
58.28	149.36										
60.99	148.95										
63.04	148.61										
65.1	148.21										
67.01	147.55										
68.95	147.24										
70.73	147.14										
71.83	147.18										
73.5	147.64										
74.87	148.18										
75.08	148.39										
75.7	148.87										
76.63	149.34										
77.37	149.34										
78.21	149.38										
80.92	149.48										
84.67	149.55										
88.81	149.73										
91.55	149.57										
94.93	149.69										
95.51	150.15										
98.39	149.9										



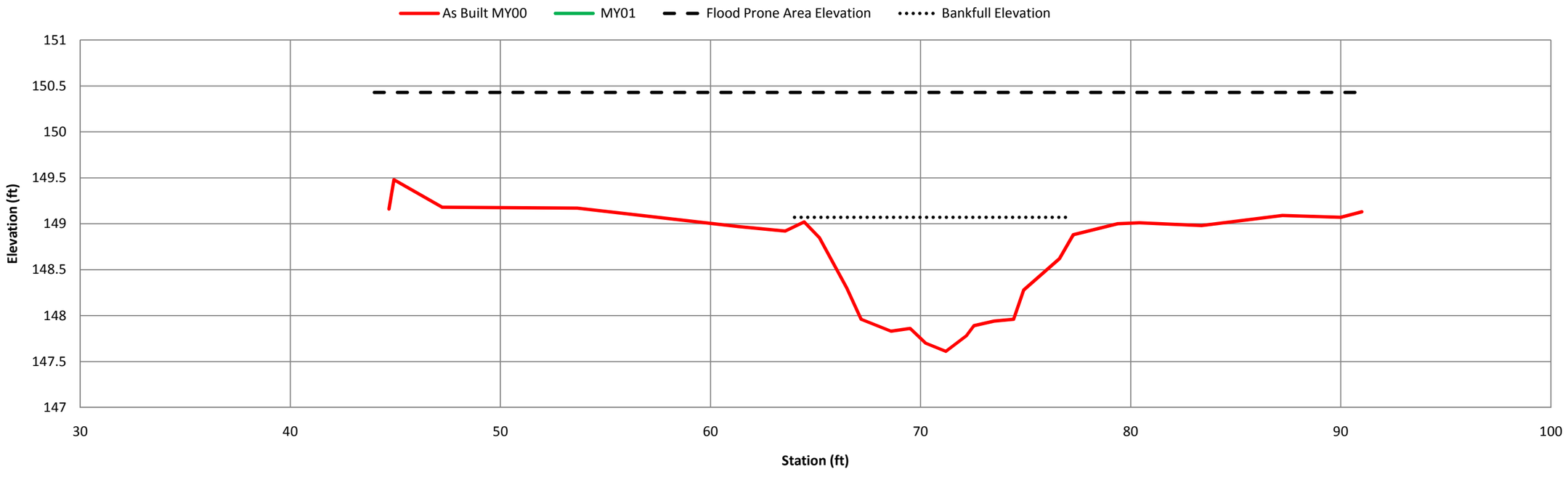
River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-5, Riffle, STA 62+87
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 62+87 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	149.02					
Bankfull Cross-Sectional Area	11.69					
Bankfull Width	15.9					
Flood Prone Area Elevation	200+					
Flood Prone Width	200					
Max Depth at Bankfull	1.41					
Mean Depth at Bankfull	0.74					
W/D Ratio	21.49					
Entrenchment Ratio	12.58					
Bank Height Ratio	1					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
44.7	149.16										
44.93	149.48										
47.23	149.18										
53.66	149.17										
58.24	149.05										
61.29	148.97										
63.55	148.92										
64.46	149.02										
65.18	148.85										
66.49	148.3										
67.17	147.96										
68.59	147.83										
69.5	147.86										
70.23	147.7										
71.2	147.61										
72.18	147.78										
72.54	147.89										
73.5	147.94										
74.43	147.96										
74.91	148.28										
76.61	148.62										
77.27	148.88										
79.38	149										
80.42	149.01										
83.37	148.98										
87.22	149.09										
90	149.07										
91	149.13										

UT to Jumping Run Creek, Reach UT1B
X-Section51, Riffle, Station 62+87

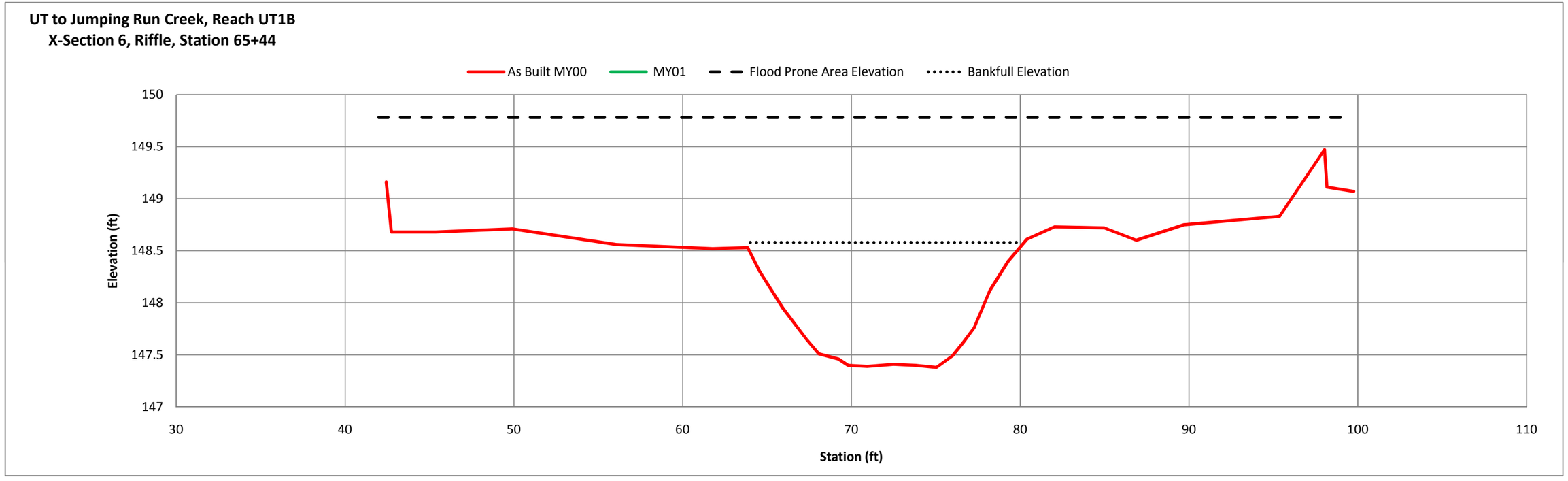


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-6, Riffle, STA 65+44
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 65+44 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	148.61					
Bankfull Cross-Sectional Area	14.51					
Bankfull Width	16.39					
Flood Prone Area Elevation	149.84					
Flood Prone Width	200.00					
Max Depth at Bankfull	1.23					
Mean Depth at Bankfull	0.89					
W/D Ratio	18.42					
Entrenchment Ratio	12.20					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
42.43	149.16										
42.74	148.68										
45.36	148.68										
49.9	148.71										
56.07	148.56										
61.78	148.52										
63.85	148.53										
64.56	148.3										
65.93	147.95										
67.33	147.65										
68.06	147.51										
69.22	147.46										
69.8	147.4										
70.94	147.39										
72.49	147.41										
73.8	147.4										
75.03	147.38										
75.98	147.49										
76.63	147.62										
77.27	147.76										
78.21	148.12										
79.28	148.4										
80.39	148.61										
82.03	148.73										
84.97	148.72										
86.87	148.6										
89.69	148.75										
95.36	148.83										
98.02	149.47										
98.17	149.11										
99.75	149.07										

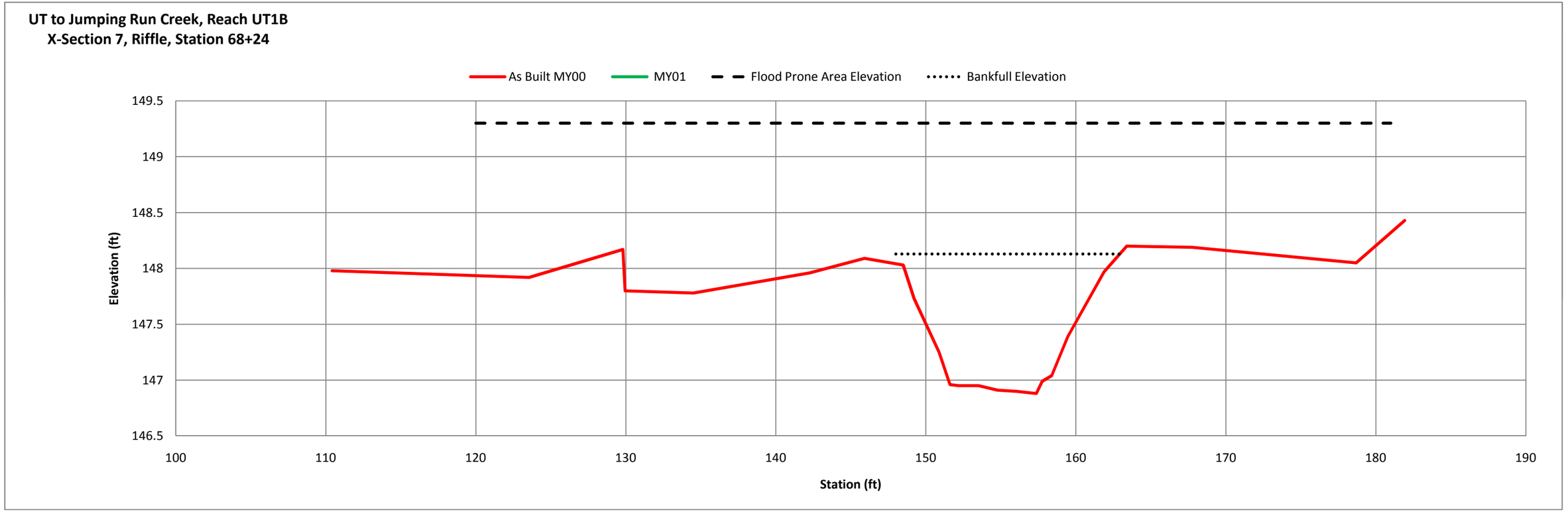


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-7, Riffle, STA 68+24
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 68+24 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	148.09					
Bankfull Cross-Sectional Area	11.77					
Bankfull Width	16.87					
Flood Prone Area Elevation	149.30					
Flood Prone Width	200.00					
Max Depth at Bankfull	1.21					
Mean Depth at Bankfull	0.70					
W/D Ratio	24.10					
Entrenchment Ratio	11.86					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
110.41	147.98										
123.54	147.92										
129.8	148.17										
129.95	147.8										
134.5	147.78										
142.25	147.96										
145.91	148.09										
148.49	148.03										
149.22	147.73										
150.88	147.25										
151.62	146.96										
152.18	146.95										
153.51	146.95										
154.78	146.91										
156.05	146.9										
157.36	146.88										
157.76	146.99										
158.39	147.04										
159.46	147.39										
161.88	147.97										
163.39	148.2										
167.73	148.19										
178.68	148.05										
181.92	148.43										

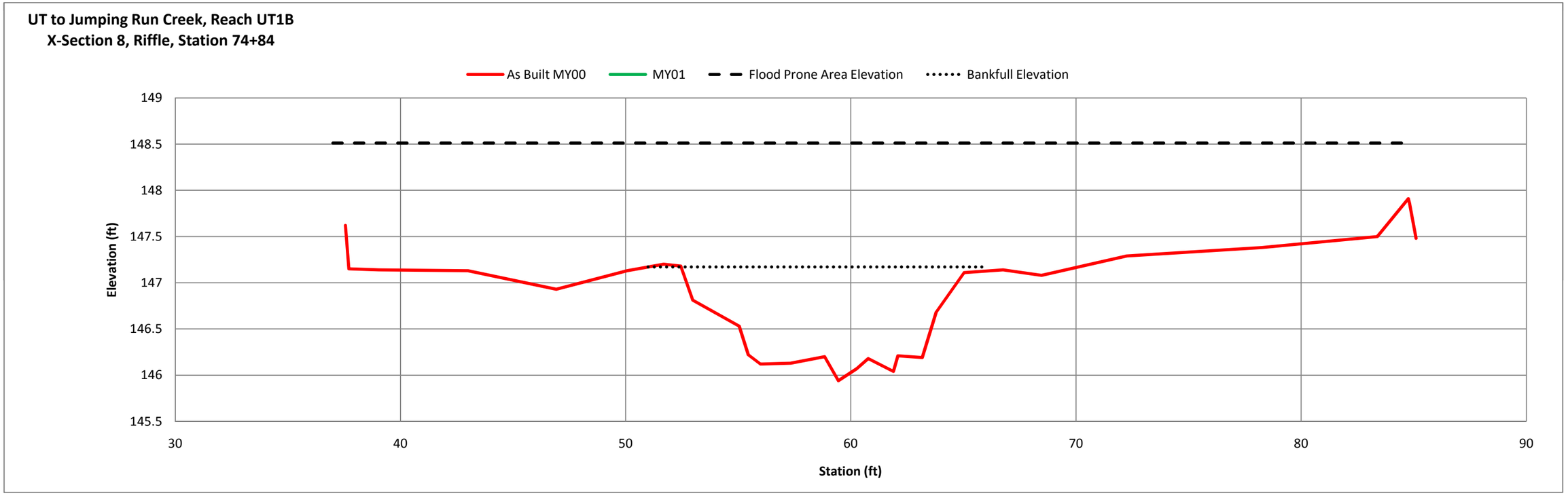


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-8, Riffle, STA 74+84
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 74+84 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	147.20					
Bankfull Cross-Sectional Area	10.81					
Bankfull Width	15.10					
Flood Prone Area Elevation	148.46					
Flood Prone Width	200.00					
Max Depth at Bankfull	1.26					
Mean Depth at Bankfull	0.72					
W/D Ratio	20.97					
Entrenchment Ratio	13.25					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
37.56	147.62										
37.71	147.15										
39.04	147.14										
43	147.13										
46.92	146.93										
50.07	147.13										
51.69	147.2										
52.45	147.18										
52.99	146.81										
55.04	146.53										
55.45	146.22										
55.99	146.12										
57.33	146.13										
58.84	146.2										
59.45	145.94										
60.26	146.07										
60.77	146.18										
61.89	146.04										
62.09	146.21										
63.17	146.19										
63.79	146.68										
65.03	147.11										
66.76	147.14										
68.47	147.08										
72.26	147.29										
78.25	147.38										
83.38	147.5										
84.76	147.91										
84.81	147.86										
85.1	147.48										

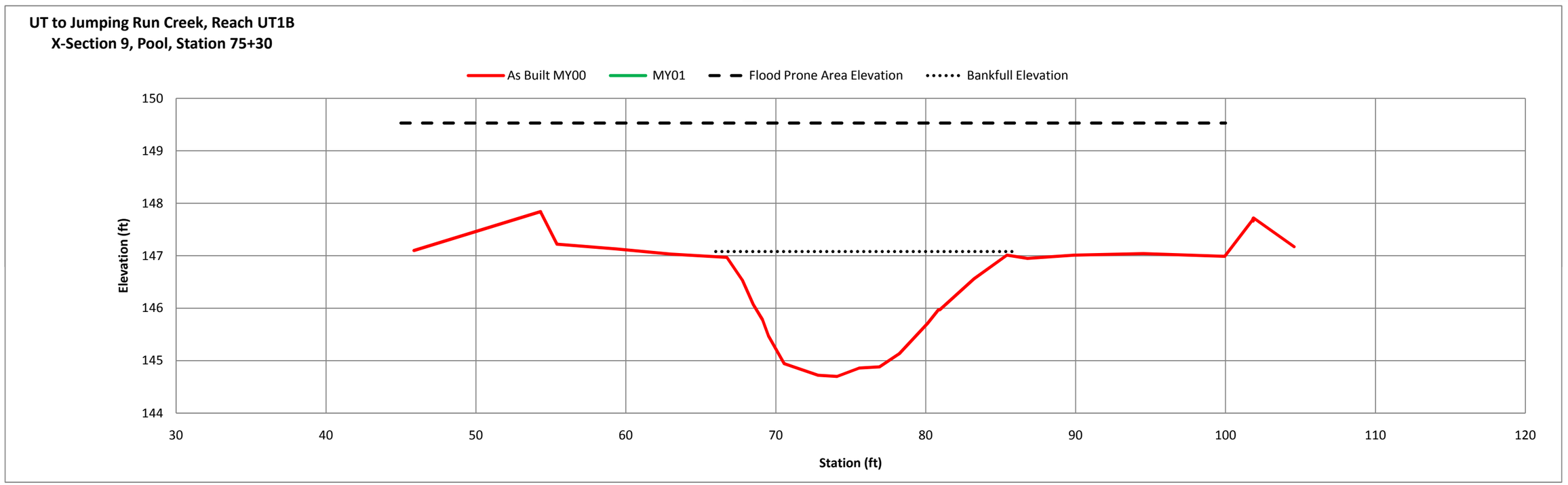


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-9, Pool, STA 75+30
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

Sta 75+30 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	146.97					
Bankfull Cross-Sectional Area	25.96					
Bankfull Width	18.48					
Flood Prone Area Elevation	149.24					
Flood Prone Width	200.00					
Max Depth at Bankfull	2.27					
Mean Depth at Bankfull	1.40					
W/D Ratio	13.20					
Entrenchment Ratio	10.82					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
45.86	147.1										
54.31	147.84										
54.32	147.83										
55.41	147.22										
59.39	147.13										
63	147.03										
66.74	146.97										
67.78	146.53										
68.5	146.07										
69.12	145.78										
69.51	145.47										
70.56	144.94										
72.81	144.72										
74.08	144.7										
75.57	144.86										
76.93	144.88										
78.23	145.13										
80.13	145.71										
80.85	145.97										
80.94	145.97										
83.22	146.56										
85.42	147.01										
86.79	146.95										
89.91	147.01										
94.51	147.04										
99.95	146.99										
101.78	147.67										
101.83	147.71										
101.85	147.66										
101.87	147.72										
104.58	147.17										

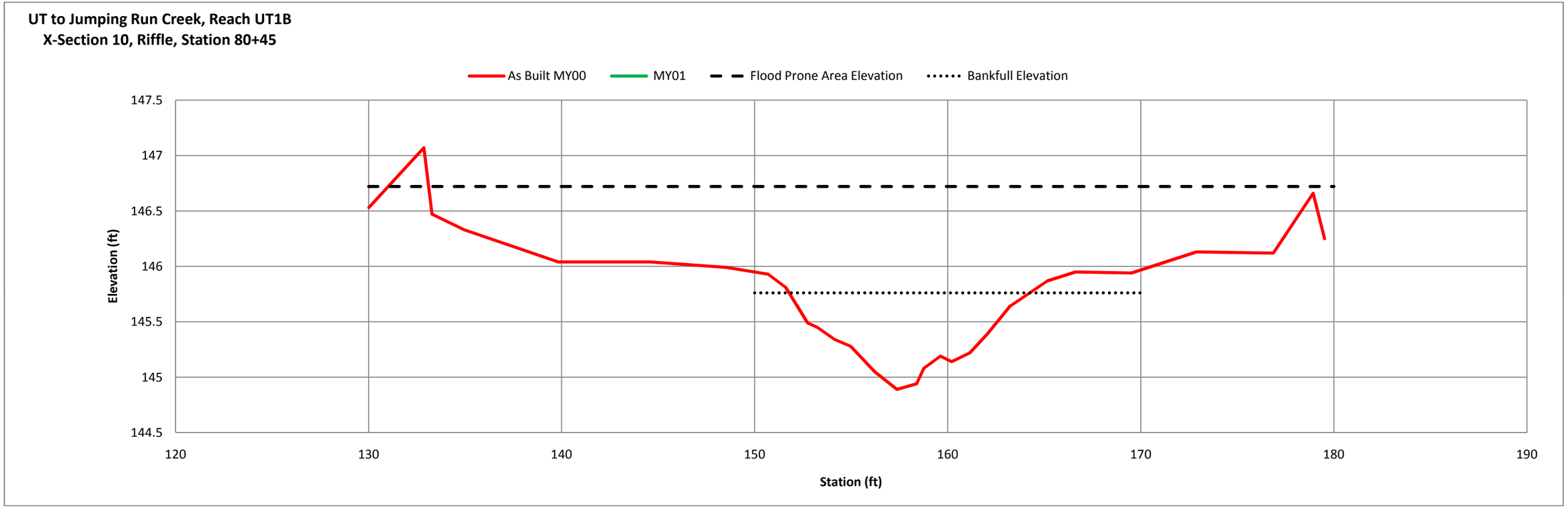


River Basin	Cape Fear River
Watershed	Jumping Run Creek
XS ID	XS-10, Riffle, STA 80+45
Drainage Area(sq. mi.)	1.2
Date	5/4/2010
Field Crew	N. Jean

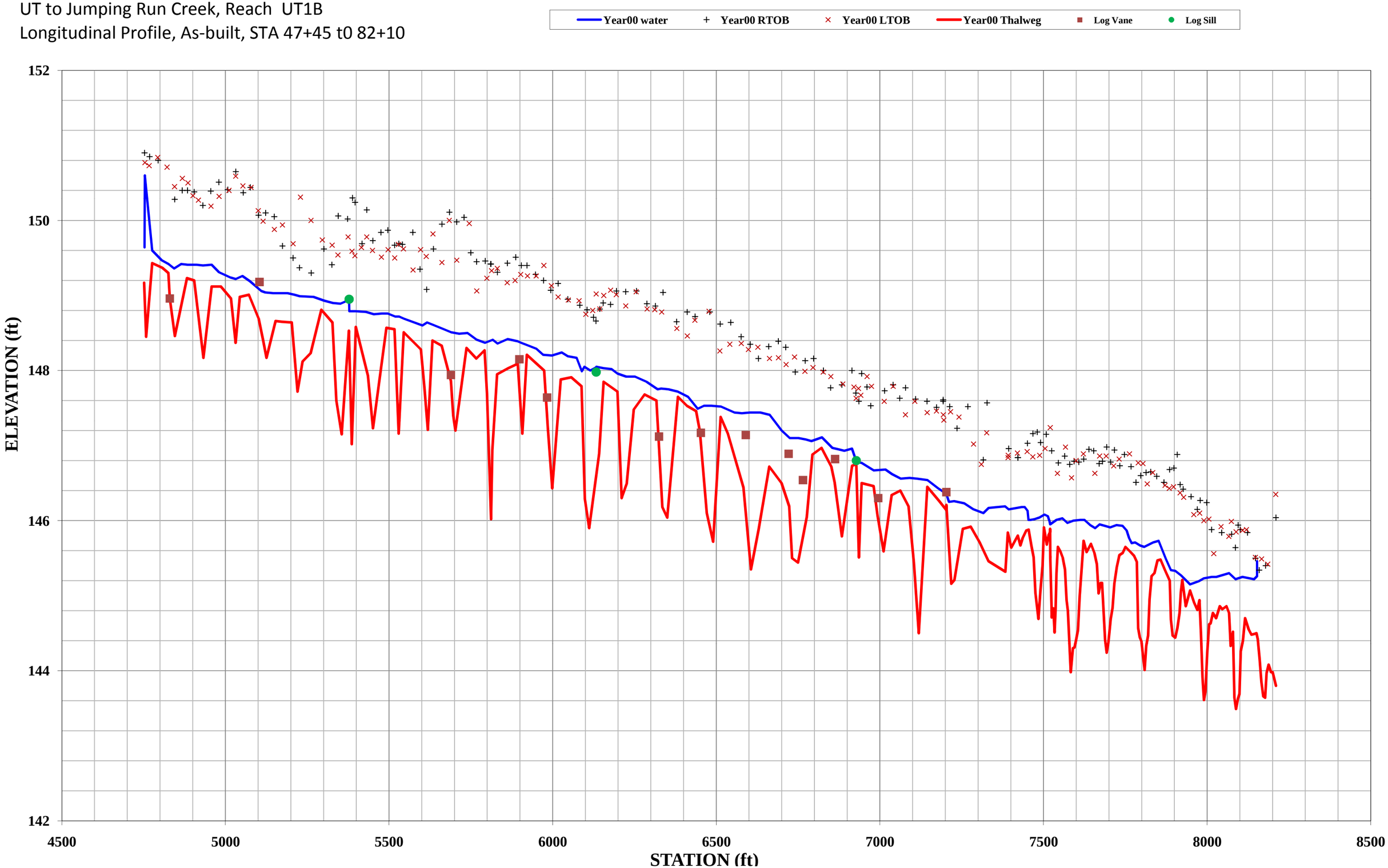
Sta 80+45 Looking Downstream

SUMARY DATA	MY00	MY01	MY02	MY03	MY04	MY05
Bankfull Elevation	145.87					
Bankfull Cross-Sectional Area	7.41					
Bankfull Width	14.02					
Flood Prone Area Elevation	146.85					
Flood Prone Width	103.50					
Max Depth at Bankfull	0.98					
Mean Depth at Bankfull	0.53					
W/D Ratio	26.45					
Entrenchment Ratio	7.38					
Bank Height Ratio	1.00					
Stream Type	C					

MY00		MY01		MY02		MY03		MY04		MY05	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
130.01	146.53										
132.86	147.07										
133.28	146.47										
134.96	146.33										
139.81	146.04										
144.59	146.04										
148.52	145.99										
150.69	145.93										
151.61	145.81										
152.74	145.49										
153.24	145.45										
154.14	145.34										
154.97	145.28										
156.22	145.05										
157.37	144.89										
158.39	144.94										
158.76	145.08										
159.62	145.19										
160.2	145.14										
161.14	145.22										
162.05	145.39										
163.22	145.64										
165.17	145.87										
166.62	145.95										
169.52	145.94										
172.89	146.13										
176.87	146.12										
178.93	146.66										
179.52	146.25										



UT to Jumping Run Creek, Reach UT1B
Longitudinal Profile, As-built, STA 47+45 t0 82+10



Stream Monitoring Photos

Photo Station S1 – Stream channel looking downstream at cross-section 1
Station 48+81 (5/4/2010 Year 0)

Photo Station S2 –Stream channel looking downstream at cross-section 2
Station 50+30 (5/4/2010 Year 0)

Photo Station S3 – Stream channel looking downstream at cross-section 3 Station 54+98 (5/4/2010 Year 0)

Photo Station S4 – Stream channel looking downstream at cross-section 4 Station 59+09 (5/4/2010 Year 0)

Photo Station S5 – Stream channel looking downstream at cross-section 5 Station 62+87 (5/4/2010 Year 0)

Photo Station S6 – Stream channel looking downstream at cross-section 6 Station 65+44 (5/4/2010 Year 0)

Photo Station S7 – Stream channel looking downstream at cross-section 7
Station 68+24 (5/4/2010 Year 0)

Photo Station S8 – Stream channel looking downstream at cross-section 8
Station 74+84 (5/4/2010 Year 0)

Photo Station S9 – Stream channel looking downstream at cross-section 9
Station 75+30 (5/4/2010 Year 0)

Photo Station S10 – Stream channel looking downstream at cross-section 10
Station 80+45 (5/4/2010 Year 0)

Photo Station S11 – Stream channel looking downstream at upper road crossing (4/26/2010 Year 0)

Photo Station S12 – Stream channel looking upstream at upper road crossing (4/26/2010 Year 0)

Appendix C - Vegetation Data

Table 7. Vegetation Plot Attribute Data						
UT Jumping Run Creek Stream and Wetland Restoration - EEP #92345						
Plot ID	Community Type	Planting Zone ID	Reach ID	Associated Gauge(s)	Method	CVS Level
1	Headwater riparian	Headwater riparian	UT1a	GW1	CVS	1
2	Transitional	Transitional	UT1a	N/A	CVS	1
3	Headwater riparian	Headwater riparian	UT1a	N/A	CVS	1
4	Upland/non-riparian	Upland/non-riparian	UT1a	N/A	CVS	1
5	Headwater riparian	Headwater riparian containerized	UT1a	GW6	CVS	1
6	Transitional	Transitional	UT1a	N/A	CVS	1
7	Riparian	Riparian	UT1b	GW8	CVS	1
8	Riparian	Riparian	UT1b	GW9	CVS	1
9	Upland/non-riparian	Upland/non-riparian	UT1b	GW10	CVS	1
10	Riparian	Riparian	UT1b	GW11	CVS	1
11	Riparian	Riparian containerized	UT1b	GW12	CVS	1
12	Riparian	Riparian	UT1b	GW14, GW15	CVS	1
RT1	Headwater riparian	Headwater riparian containerized	UT1a	N/A	Random transect	N/A
RT2	Riparian	Riparian containerized	UT1a	GW8	Random transect	N/A
RT3	Upland/non-riparian	Upland/non-riparian	UT1b	GW13	Random transect	N/A
RT4	Upland/non-riparian	Upland/non-riparian	UT1b	N/A	Random transect	N/A
RT5	Upland/non-riparian	Upland/non-riparian containerized	UT1a	GW7	Random transect	N/A

Table 8 - CVS Metadata	
UT Jumping Run Creek Stream and Wetland Restoration - EEP #92345	
Report Prepared By	Kristin Weidner
Date Prepared	9/29/2010 15:16
Database name	Stantec_UTJRC2010_A.mdb
Database location	U:\175613003\UT_Jumping_Run\project\site_data\monitoring
Computer name	WEIDNERK
File size	35987456
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
PROJECT SUMMARY	
Project Code	92345
Project Name	UT to Jumping Run Creek
Description	stream and wetland restoration
River Basin	
Length(ft)	
Stream-to-edge width (ft)	
Area (sq m)	
Required Plots (calculated)	
Sampled Plots	12

Table 9 - CVS Vigor by Species								
UT Jumping Run Creek Stream and Wetland Restoration - EEP #92345								
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
	Aronia arbutifolia		2					
	Chamaecyparis thyoides	12						
	Diospyros virginiana	5						
	Fraxinus pennsylvanica	11						
	Nyssa biflora	17	2					
	Persea borbonia			1				
	Persea palustris	1	2					
	Pinus palustris	4	1					
	Quercus falcata	2						
	Quercus lyrata	4						
	Quercus nigra	1						
	Quercus phellos	9	3					
	Taxodium distichum	7						
	Quercus	1	12	1				
	Liriodendron tulipifera	11		1				
	Magnolia virginiana	8	3		1			
	Unknown		1					
TOT:	**17**	**93**	**26**	**3**	**1**			

Table 10 - CVS Vegetation Damage by Species

UT Jumping Run Creek Stream and Wetland Restoration - EEP #92345

	Species	CommonName	Count of Damage Categories	(no damage)	Unknown		
	Aronia arbutifolia	Red Chokeberry	0	2			
	Chamaecyparis thyoides	Atlantic white cedar	0	12			
	Diospyros virginiana	common persimmon	0	5			
	Fraxinus pennsylvanica	green ash	0	11			
	Liriodendron tulipifera	tuliptree	0	12			
	Magnolia virginiana	sweetbay	1	11	1		
	Nyssa biflora	swamp tupelo	0	19			
	Persea borbonia	redbay	0	1			
	Persea palustris	swamp bay	0	3			
	Pinus palustris	longleaf pine	0	5			
	Quercus	oak	0	14			
	Quercus falcata	southern red oak	0	2			
	Quercus lyrata	overcup oak	0	4			
	Quercus nigra	water oak	0	1			
	Quercus phellos	willow oak	0	12			
	Taxodium distichum	bald cypress	0	7			
	Unknown		0	1			
TOT:	**17**	**16**	**1**	**122**	**1**		

Table 11 - CVS Vegetation Damage by Plot						
UT Jumping Run Creek Stream and Wetland Restoration - EEP #92345						
	plot	Count of Damage Categories	(no damage)	Unknown		
	92345-01-0001	1	13	1		
	92345-01-0002	0	7			
	92345-02-0003	0	11			
	92345-02-0004	0	7			
	92345-02-0005	0	15			
	92345-02-0006	0	14			
	92345-02-0007	0	9			
	92345-02-0008	0	8			
	92345-02-0009	0	8			
	92345-02-0010	0	10			
	92345-02-0011	0	11			
	92345-02-0012	0	9			
TOT:	**12**	**1**	**122**	**1**		

Table 12a - CVS Planted Stems by Plot and Species																	
UT Jumping Run Creek Stream and Wetland Restoration - EEP #92345																	
	Comment	Species	Total Planted Stems	# plots	avg# stems	plot 92345-01-0001	plot 92345-01-0002	plot 92345-02-0003	plot 92345-02-0004	plot 92345-02-0005	plot 92345-02-0006	plot 92345-02-0007	plot 92345-02-0008	plot 92345-02-0009	plot 92345-02-0010	plot 92345-02-0011	plot 92345-02-0012
		Aronia arbutifolia	2	2	1	1				1							
		Chamaecyparis thyoides	12	4	3	1	2	4		5							
		Diospyros virginiana	5	1	5						5						
		Fraxinus pennsylvanica	11	3	3.7			1		6				4			
		Liriodendron tulipifera	12	7	1.7		1				1	1	2		4	2	1
		Magnolia virginiana	12	6	2	1	3	2			2	3	1				
		Nyssa biflora	19	7	2.7	4			2	1		3	4		1	4	
		Persea borbonia	1	1	1							1					
		Persea palustris	3	3	1	1		1									1
		Pinus palustris	5	2	2.5						1			4			
		Quercus	14	6	2.3	5	1	1	5	1					1		
		Quercus falcata	2	1	2						2						
		Quercus lyrata	4	4	1	1				1		1					1
		Quercus nigra	1	1	1												1
		Quercus phellos	12	4	3			2							3	3	4
		Taxodium distichum	7	4	1.8						3				1	2	1
		Unknown	1	1	1								1				
TOT:	**0**	**17**	**123**	**17**		**14**	**7**	**11**	**7**	**15**	**14**	**9**	**8**	**8**	**10**	**11**	**9**
		Stems per acre				567	283	445	283	607	567	364	324	324	405	445	364

Table 12b - Random Transect Planted Stems by Transect and Species					
UT Jumping Run Creek Stream and Wetland Restoration - EE #92345					
Species	**RT1**	**RT2**	**RT3**	**RT4**	**RT5**
Quercus sp	5		4	3	4
Quercus nigra (container)	1				
Ilex glabra	1				
Persea palustris	1			1	
Nyssa biflora	3				1
Carpinus caroliniana	1		1		
Magnolia virginiana	3			1	
Chameocyparis thyoides	1				
Quercus lyrata		1			
Taxodium distichum		7			
Quercus lyrata (container)		1			
Nyssa biflora (container)		1			
Unknown			1	3	1
Quercus phellos				1	
Cercis canadensis				1	
Cornus florida				2	4
Fraxinus pennsylvanica					5
Quercus nigra					1
Pinus palustris					1
Total:	**16**	**10**	**6**	**12**	**17**
Stems per acre	648	405	243	486	688

Vegetation Monitoring Plot Photos

Photo Station V1 - Veg Plot 1 looking west (4/26/2010 Year 0)

Photo Station V2 - Veg Plot 1 looking southwest (4/26/2010 Year 0)

Photo Station V3 - Veg Plot 2 looking south (4/26/2010 Year 0)

Photo Station V4 - Veg Plot 2 looking southeast (4/26/2010 Year 0)

Photo Station V5 - Veg Plot 3 looking southeast (4/26/2010 Year 0)

Photo Station V6 - Veg Plot 3 looking east (4/26/2010 Year 0)

Photo Station V7 - Veg Plot 4 looking northwest (4/26/2010 Year 0)

Photo Station V8 - Veg Plot 4 looking west (4/26/2010 Year 0)

Photo Station V9 - Veg plot 5 looking southwest (4/26/2010 Year 0)

Photo Station V10 - Veg plot 5 looking south (4/26/2010 Year 0)

Photo Station V11 - Veg plot 6 looking northeast (4/26/2010 Year 0)

Photo Station V12 - Veg plot 6 looking north (4/26/2010 Year 0)

Photo Station V13 - Veg plot 7 looking north (4/26/2010 Year 0)

Photo Station V14 - Veg plot 7 looking northwest (4/26/2010 Year 0)

Photo Station V15 - Veg plot 8 looking northeast (4/26/2010 Year 0)

Photo Station V16 - Veg plot 8 looking north (4/26/2010 Year 0)

Photo Station V17 - Veg plot 9 looking southwest (4/26/2010 Year 0)

Photo Station V18 - Veg plot 9 looking south (4/26/2010 Year 0)

Photo Station V19 - Veg plot 10 looking northeast (4/26/2010 Year 0)

Photo Station V20 - Veg plot 10 looking north (4/26/2010 Year 0)

Photo Station V21 - Veg plot 11 looking southwest (4/26/2010 Year 0)

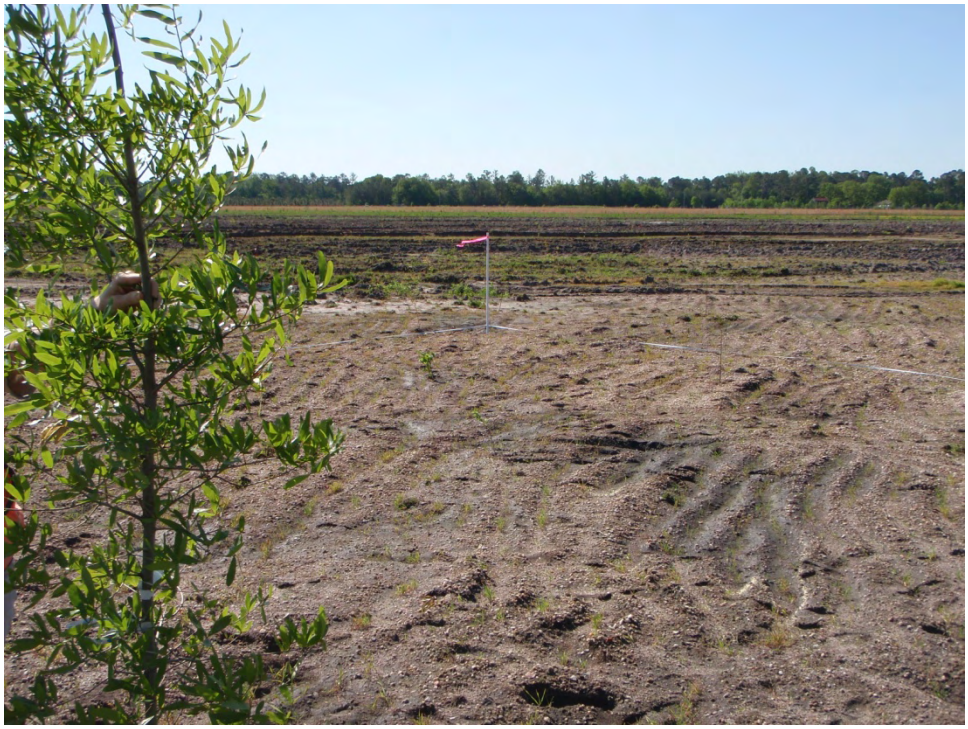


Photo Station V22 - Veg plot 11 looking south (4/26/2010 Year 0)

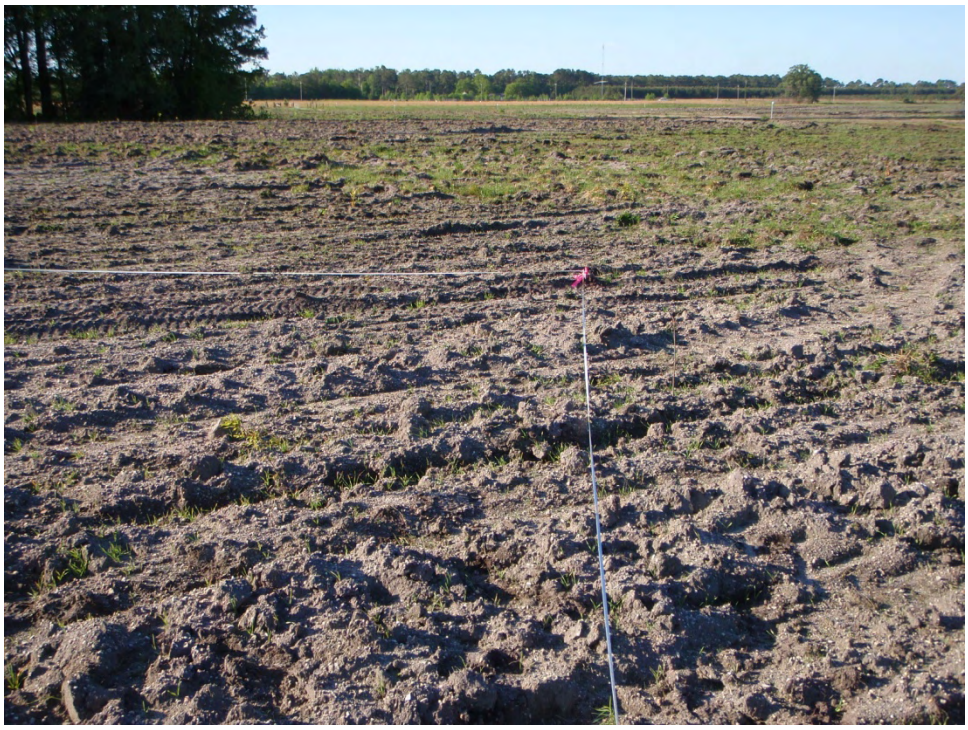


Photo Station V23 - Veg plot 12 looking southwest (4/26/2010 Year 0)

Photo Station V24 - Veg plot 12 looking south (4/26/2010 Year 0)

Appendix D - As-Built Plan Sheet

RECORD DRAWING

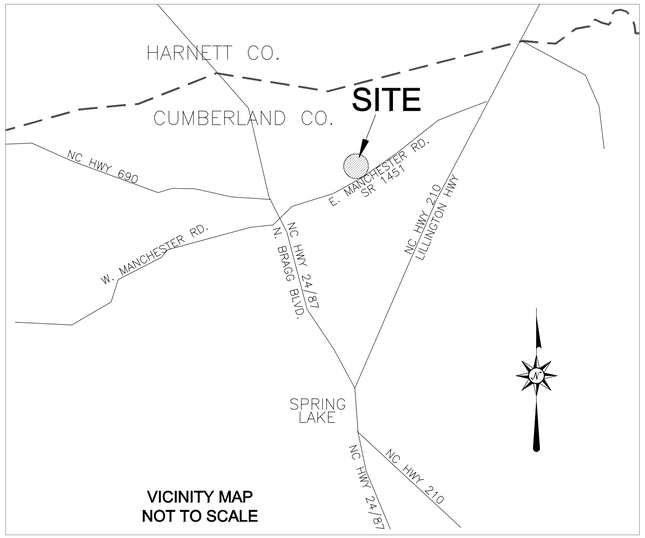
AS-BUILT SURVEY OF
UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

I, DAVID S. TURNER, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HERON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS _____ DAY OF ___AUGUST__, 2010.

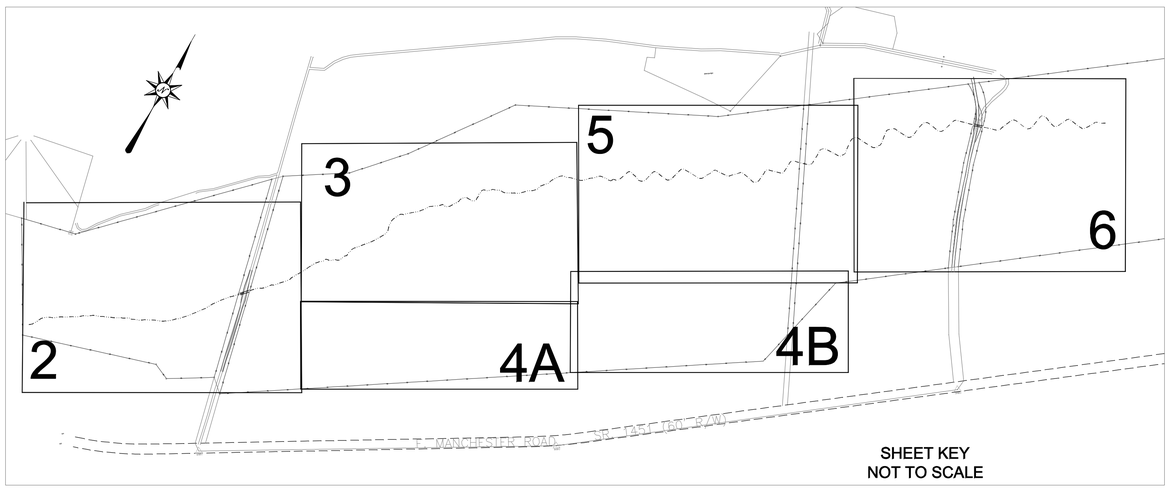
_____
DAVID S. TURNER, P.L.S. #L-4551

I, DAVID S. TURNER, CERTIFY THAT THESE PLANS WERE DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION AND THAT THE RATIO OF PRECISION AS CALCULATED IS 1:__10,000____+. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS _____ DAY OF ___AUGUST_, 2010.

_____
DAVID S. TURNER, P.L.S. #L-4551



VICINITY MAP
NOT TO SCALE



SHEET KEY
NOT TO SCALE

REFERENCES:

OWNER:
NORTH CAROLINA ECOSYSTEM
ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27099-1652
(919)715-0476
EEP PROJ. MGR.: TRACY MORRIS
EEP REVIEW COORDINATOR: LIN XU

CONTRACTOR:
BACKWATER ENVIRONMENTAL
PITTSBORO, NC
(919)523-4375

DESIGNER:
MICHAEL BAKER ENGINEERING, INC.
CARY, NC
(919)463-5488
EXISITNG CONDITIONS & BOUNDARY
INFORMATION PROVIDED BY DESIGNER

CONSERVATION EASEMENT REFERENCES:
DB 7703, PG 36
PB 119, PG 172
DB 396, PG 163
DB 3447, PG 464

GENERAL NOTES

1. ALL DISTANCES ARE HORIZONTAL UNLESS OTHERWISE NOTED.
2. THE VERTICAL DATUM IS NAVD 88.
3. THE BASIS OF BEARINGS IS NCGS STATE PLANE GRID COORDINATES NAD83 DATUM.
4. THIS MAP IS NOT FOR RECORDATION, SALES, OR CONVEYENCES AND DOES NOT COMPLY WITH G.S. 47-30 MAPPING REQUIREMENTS.
5. SEE SHEETS 7-8 FOR LONGITUDINAL PROFILE DATA.
6. REPRESENTATIVE CROSS-SECTIONS ARE PRESENTED ON SHEET 8. ALL CROSS-SECTIONS ARE FROM LEFT BANK TO RIGHT BANK (FACING DOWNSTREAM).
9. CONTROL DATA SHOWN TAKEN FROM EXISTING CONDITIONS SURVEY PROVIDED BY DESIGNER & VERIFIED DURING CONSTRUCTION & AS-BUILT SURVEYS.
10. DEVIATION FROM DESIGN WAS NEGLIGIBLE AND IS NOT SHOWN UNDER THE AS-BUILT ALIGNMENT.
11. PROGRESS ENERGY POWER EASEMENT TAKEN FROM EXISTING CONDITIONS SURVEY DATA AND NO DEED WAS FOUND FOR THIS EASEMENT.

PROJECT DATA:

STREAM RESTORATION LENGTH (UT1A)	3,657 LF*
STREAM RESTORATION LENGTH (UT1B)	3,661 LF
STREAM ENHANCEMENT LENGTH (UT1C)	1,935 LF
(*-DESIGN LENGTH)	
WETLAND RESTORATION AREA	96.0 AC*
WETLAND ENHANCEMENT AREA	3.6 AC*
(*-DESIGN AREA. ACTUAL AREA TO BE DETERMINED DURING MONITORING.)	
TOTAL DISTURBED AREA	157.6 AC
TOTAL CONSERVATION EASEMENT AREA	225.3 AC

STRUCTURE DATA:

CONSTRUCTED RIFFLES	4
LOG VANES	26
LOG WEIRS	4
ROOT WADS	82

SHEET INDEX

SHEET 1 - TITLE, VICINITY MAP, SHEET KEY, GENERAL NOTES
SHEET 2 - PLAN VIEW - UT1A
SHEET 3 - PLAN VIEW - UT1A
SHEET 4 A&B - PLAN VIEW - WETLAND SLOUGH
SHEET 5 - PLAN VIEW - UT1B
SHEET 6 - PLAN VIEW - UT1B
SHEET 7 - LONGITUDINAL PROFILE - UT1A
SHEET 8 - LONGITUDINAL PROFILE - UT1B
CROSS-SECTIONS 1-8 (UT1B)
SHEET 9 - PLAN VIEW - PLANTING PLAN

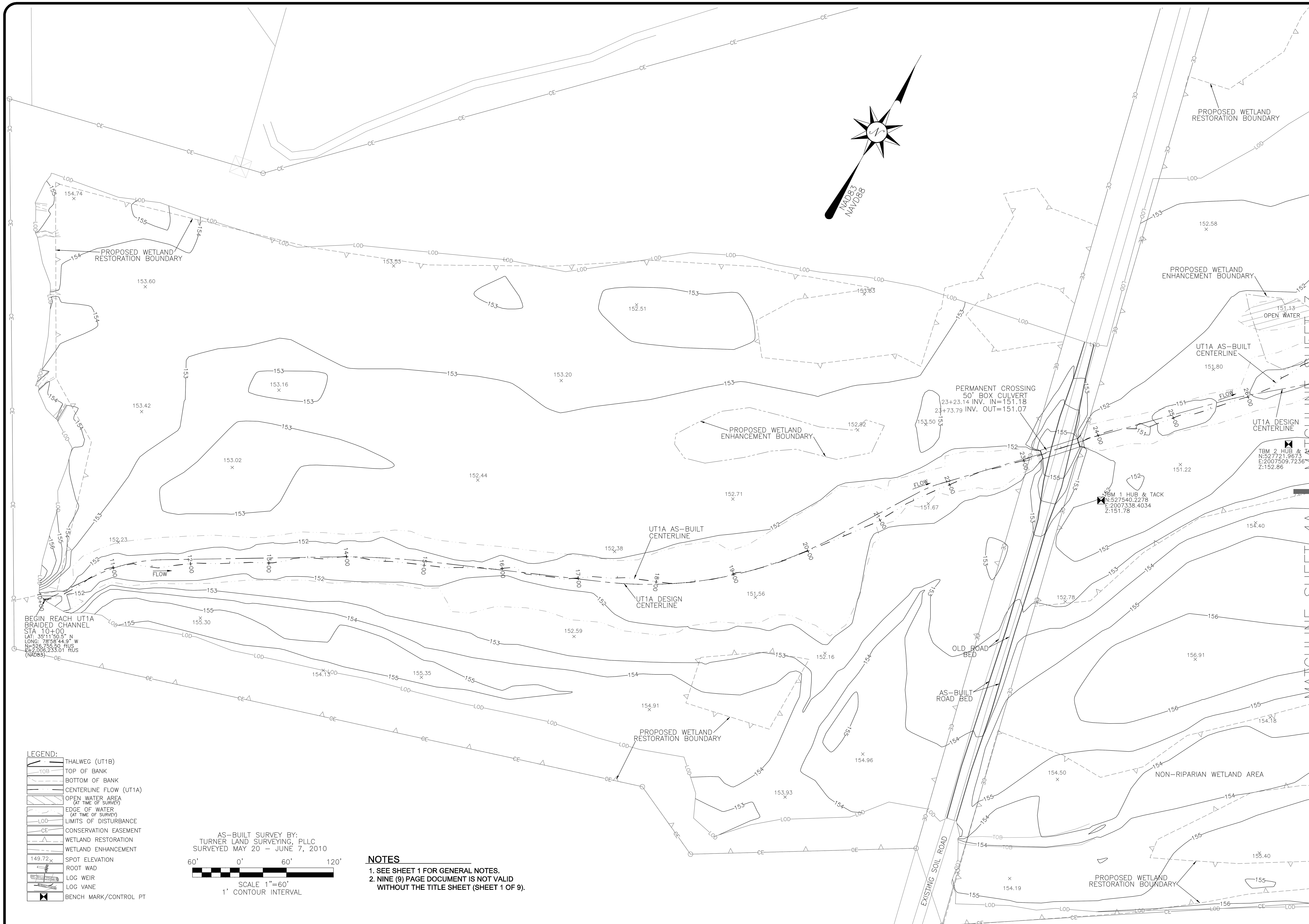
REVISIONS, DATE AND INITIAL:

TURNER LAND SURVEYING, PLLC
3201 Glenridge Drive, Raleigh, NC 27604 -- (919)875-1378
Lturner921@nc.rr.com -- Dturner119@nc.rr.com
www.TURNERLANDSURVEYING.com

TITLE

AS-BUILT SURVEY OF
UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01
SPRING LAKE CUMBERLAND COUNTY NORTH CAROLINA

DATE: 06/16/2010
SURVEYED BY: DST/EGT
DRAWN BY: DST/EGT
REVIEWED BY: DST/EGT
PROJECT: TLS-09-009
FILE: UTJR FINAL AS-BUILT.DWG
SCALE: NO SCALE



LEGEND:

- THALWEG (UT1B)
- TOP OF BANK
- BOTTOM OF BANK
- CENTERLINE FLOW (UT1A)
- OPEN WATER AREA (AT TIME OF SURVEY)
- EDGE OF WATER (AT TIME OF SURVEY)
- LIMITS OF DISTURBANCE
- CONSERVATION EASEMENT
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
- SPOT ELEVATION
- ROOT WAD
- LOG WEIR
- LOG VANE
- BENCH MARK/CONTROL PT

AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED MAY 20 – JUNE 7, 2010

60' 0' 60' 120'
SCALE 1"=60'
1' CONTOUR INTERVAL

NOTES

1. SEE SHEET 1 FOR GENERAL NOTES.
2. NINE (9) PAGE DOCUMENT IS NOT VALID WITHOUT THE TITLE SHEET (SHEET 1 OF 9).

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PLAN VIEW

AS-BUILT SURVEY OF

UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

SPRING LAKE — CUMBERLAND COUNTY — NORTH CAROLINA

DATE:	06/16/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-09-009
FILE:	UTJR FINAL AS-BUILT.DWG
SCALE:	1" = 60'

NAD83
NAVD88

PROPOSED WETLAND RESTORATION BOUNDARY

PROPOSED WETLAND ENHANCEMENT BOUNDARY

OPEN WATER

UT1A AS-BUILT CENTERLINE

UT1A DESIGN CENTERLINE

BCP RTK 21 REBAR
N:528987.6056
E:2008407.3935
Z:151.48

TBM 5 HUB & TACK
N:529074.3285
E:2008606.5218
Z:151.62

TBM 4 HUB & TACK
N:528785.8554
E:2008285.0299
Z:151.46

BCP RTK 23 REBAR
N:528419.0012
E:2007843.8222
Z:151.68

BCP RTK 24 REBAR
N:527919.5622
E:2007682.0984
Z:151.91

TLS .12 NAIL
N:528316.7952
E:2008528.5941
Z:155.11

FLOW

PROPOSED WETLAND RESTORATION BOUNDARY

MATCHLINE SHEET 2

MATCHLINE SHEET 4A

MATCHLINE SHEET 4A

MATCHLINE SHEET 4B

LEGEND:

- THALWEG (UT1B)
- TOB — TOP OF BANK
- BOTTOM OF BANK
- CENTERLINE FLOW (UT1A)
- OPEN WATER AREA (AT TIME OF SURVEY)
- EDGE OF WATER (AT TIME OF SURVEY)
- LOD — LIMITS OF DISTURBANCE
- CE — CONSERVATION EASEMENT
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
- 149.72 SPOT ELEVATION
- ROOT WAD
- LOG WEIR
- LOG VANE
- BENCH MARK/CONTROL PT

NOTES

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AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED MAY 20 - JUNE 7, 2010

60' 0' 60' 120'

SCALE 1"=60'
1' CONTOUR INTERVAL

SHEET 5

REVISIONS, DATE AND INITIAL:

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Lturner921@nc.rr.com – Dturner119@nc.rr.com
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PLAN VIEW

AS-BUILT SURVEY OF UT TO JUMPING RUN CREEK WETLAND RESTORATION SCO# 06-06901-01

CUMBERLAND COUNTY
NORTH CAROLINA
SPRING LAKE

DATE:	06/16/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-09-009
FILE:	UTJR FINAL AS-BUILT.DWG
SCALE:	1" = 60'

SHEET
3 of 9

MATCHLINE SHEET 3

MATCHLINE SHEET 3

MATCHLINE SHEET 4

MATCHLINE (THIS SHEET 4B)

TLS 11 NAIL
N:527846.6326
E:2007982.5070
Z:156.15

NON-RIPARIAN WETLAND AREA

PROPOSED WETLAND RESTORATION BOUNDARY

NON-RIPARIAN WETLAND AREA

PROPOSED WETLAND RESTORATION BOUNDARY

A

MATCHLINE SHEET 5

MATCHLINE SHEET 5

MATCHLINE (THIS SHEET 4A)

EXISTING POND

TBM 11 HUB & TACK
N:528830.1757
E:2009581.4264
Z:154.65

TBM 15 HUB & TACK
N:529109.7394
E:2009892.8248
Z:152.56

OPEN WATER

NON-RIPARIAN WETLAND AREA

EXISTING 30' PROGRESS ENERGY EASEMENT

PROPOSED WETLAND RESTORATION BOUNDARY

NON-RIPARIAN WETLAND AREA

OPEN WATER

LEGEND:

- THALWEG (UT1B)
- TOB TOP OF BANK
- BOTTOM OF BANK
- CENTERLINE FLOW (UT1A)
- OPEN WATER AREA (AT TIME OF SURVEY)
- EDGE OF WATER (AT TIME OF SURVEY)
- LOD LIMITS OF DISTURBANCE
- CE CONSERVATION EASEMENT
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
- 149.72 SPOT ELEVATION
- ROOT WAD
- LOG WEIR
- LOG VANE
- BENCH MARK/CONTROL PT

AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED MAY 20 – JUNE 7, 2010

60' 0' 60' 120'

SCALE 1"=60'
1' CONTOUR INTERVAL

B

NAD83
NAVD88

NOTES

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PLAN VIEW

AS-BUILT SURVEY OF
UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

SPRING LAKE — CUMBERLAND COUNTY — NORTH CAROLINA

DATE:	06/16/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-09-009
FILE:	UTJR FINAL AS-BUILT.DWG
SCALE:	1" = 60'

SHEET
4 of 9

LEGEND:

- THALWEG (UT1B)
- TOB — TOP OF BANK
- BOTTOM OF BANK
- CENTERLINE FLOW (UT1A)
- OPEN WATER AREA (AT TIME OF SURVEY)
- EDGE OF WATER (AT TIME OF SURVEY)
- LOD — LIMITS OF DISTURBANCE
- CE — CONSERVATION EASEMENT
- WETLAND RESTORATION
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AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED MAY 20 – JUNE 7, 2010

60' 0' 60' 120'

SCALE 1"=60'
1' CONTOUR INTERVAL

NAD83
NAVD88

PROPOSED WETLAND RESTORATION BOUNDARY

EXISTING 30' PROGRESS ENERGY EASEMENT

OPEN WATER

PROPOSED WETLAND ENHANCEMENT BOUNDARY

UT1A DESIGN CENTERLINE

UT1A AS-BUILT CENTERLINE

END UT1A (48+47.63)
BEGIN UT1B (47+28.69)
SINGLE THREAD
STATION EQUATION:
STA 47+28.69(AH)=48+47.63(BK)

48+34.90 LOG VANE EL. 149.36
ROOT WADS
TOP OF BANK
BOTTOM OF BANK
X-SEC 1
49+20.69 LOG VANE EL. 149.16
THALWEG
50+33.52 LOG VANE EL. 148.94
X-SEC 2
51+23.62 LOG VANE EL. 149.15
52+34.58 LOG VANE EL. 148.61
54+11.47 LOG WEIR EL. 149.02
54+68.71 LOG VANE EL. 148.28
57+34.37 LOG VANE EL. 148.28
58+48.84 LOG VANE EL. 148.27
59+54.95 LOG VANE EL. 148.29
X-SEC 3
60+44.38 LOG VANE EL. 147.85
62+00.95 LOG WEIR EL. 148.04
64+01.13 LOG VANE EL. 147.77
X-SEC 4
64+33.03 LOG VANE EL. 147.32
65+38.18 LOG VANE EL. 147.52

TLS 14 NAIL (=BCP GPS1)
N:529512.4791
E:2009765.4321
Z:152.19

MATCHLINE SHEET 3

MATCHLINE SHEET 4B

MATCHLINE SHEET 6

REVISIONS, DATE AND INITIAL:

TURNER LAND SURVEYING, PLLC
3201 Glenridge Drive, Raleigh, NC 27604 – (919)875-1378
Lturner921@nc.rr.com – Dturner119@nc.rr.com
www.TURNERLANDSURVEYING.com

PLAN VIEW

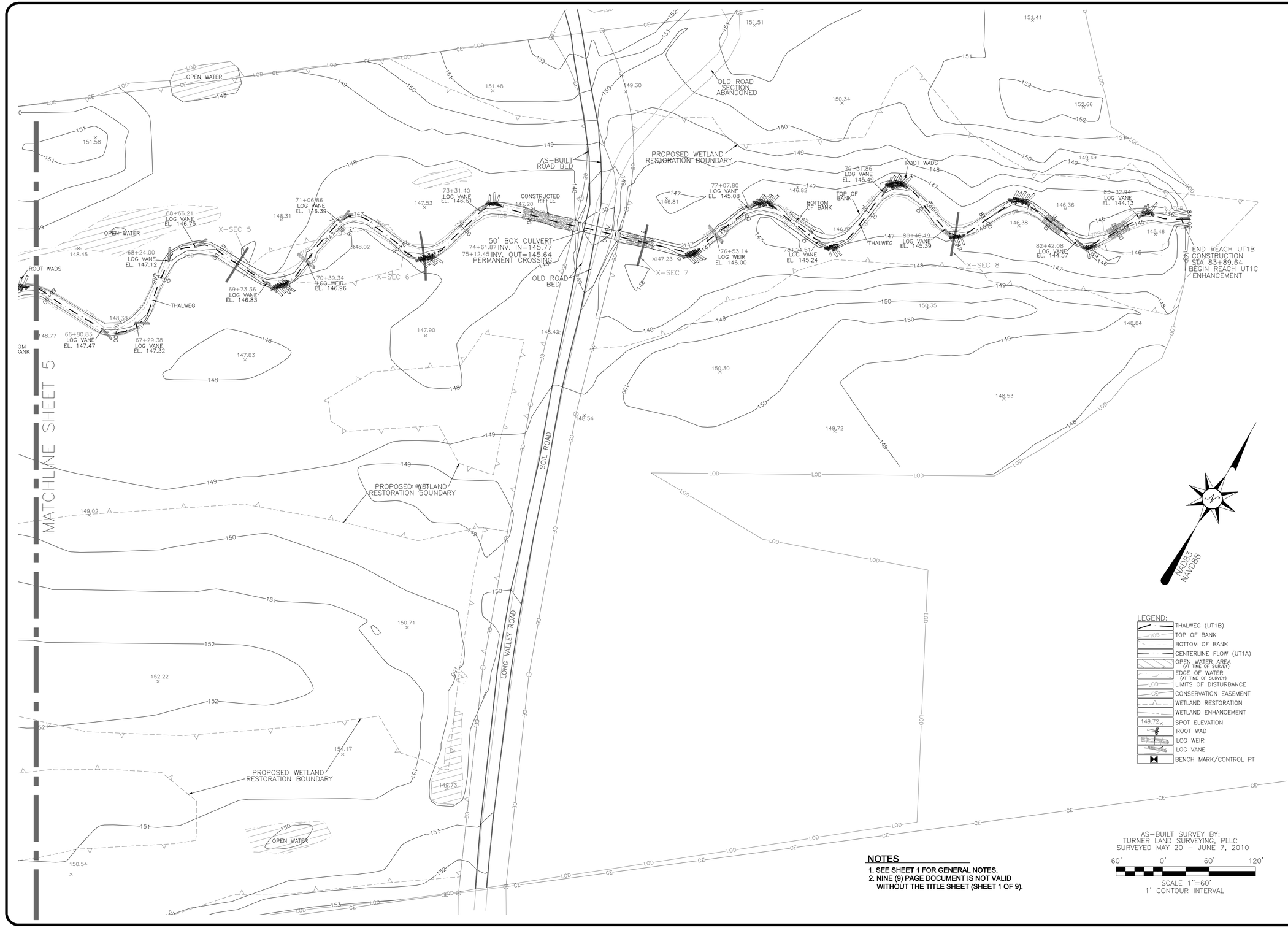
AS-BUILT SURVEY OF
UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

CUMBERLAND COUNTY NORTH CAROLINA

SPRING LAKE

DATE:	06/16/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-09-009
FILE:	UTJR FINAL AS-BUILT.DWG
SCALE:	1" = 60'

SHEET
5 of 9



LEGEND:

- THALWEG (UT1B)
- TOB — TOP OF BANK
- BOTTOM OF BANK
- CENTERLINE FLOW (UT1A)
- OPEN WATER AREA (AT TIME OF SURVEY)
- EDGE OF WATER (AT TIME OF SURVEY)
- LOD — LIMITS OF DISTURBANCE
- CE — CONSERVATION EASEMENT
- WETLAND RESTORATION
- WETLAND ENHANCEMENT
- 149.72 × SPOT ELEVATION
- ROOT WAD
- LOG WEIR
- LOG VANE
- BENCH MARK/CONTROL PT

NOTES

1. SEE SHEET 1 FOR GENERAL NOTES.
2. NINE (9) PAGE DOCUMENT IS NOT VALID WITHOUT THE TITLE SHEET (SHEET 1 OF 9).

AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED MAY 20 – JUNE 7, 2010

60' 0' 60' 120'

SCALE 1"=60'
1' CONTOUR INTERVAL

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UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

SPRING LAKE — CUMBERLAND COUNTY — NORTH CAROLINA

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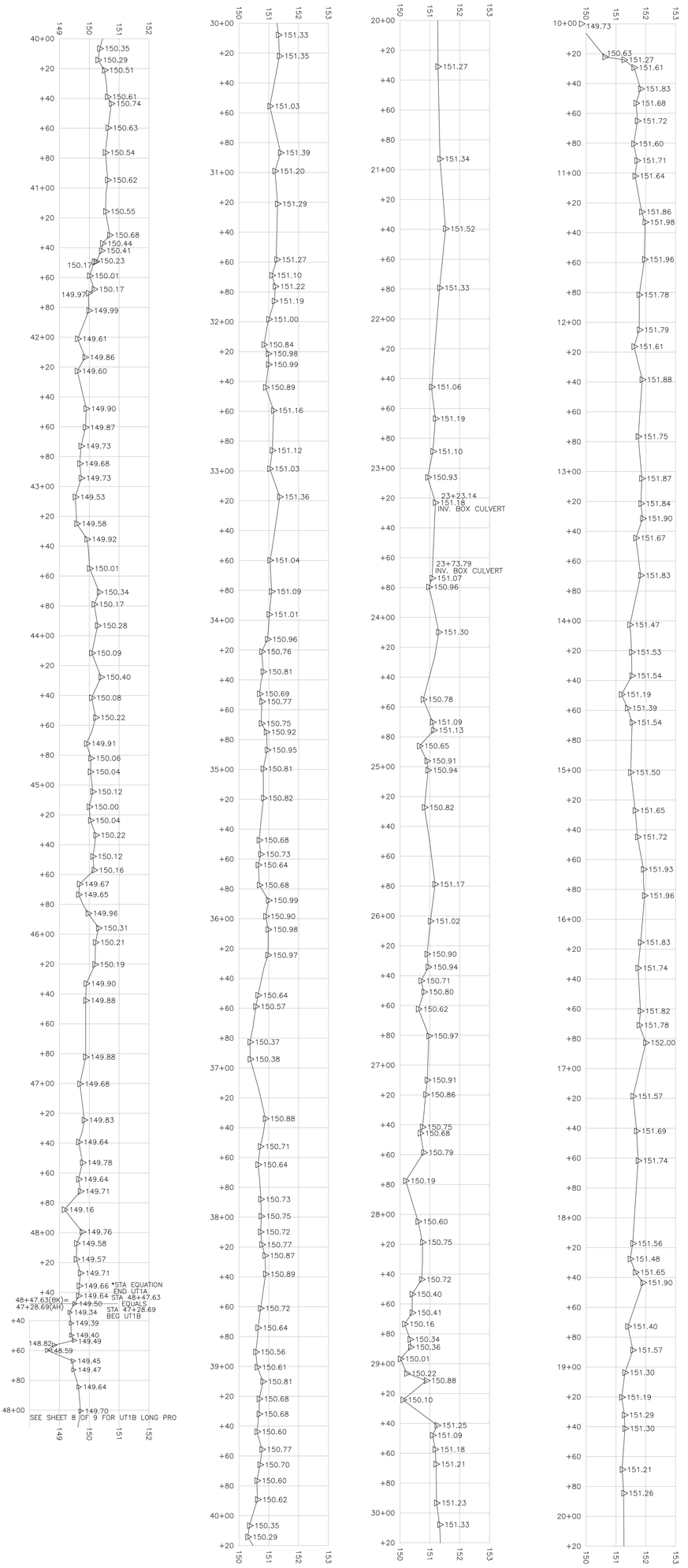
SHEET
6 of 9



NOTES

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PROFILE - UT1A

AS-BUILT SURVEY OF

UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

SPRING LAKE | CUMBERLAND COUNTY | NORTH CAROLINA

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FILE:	UT1R FINAL AS-BUILT.DWG
SCALE:	AS SHOWN
SHEET	7 of 9

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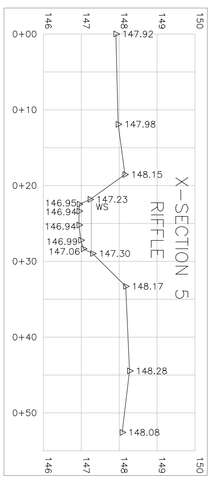
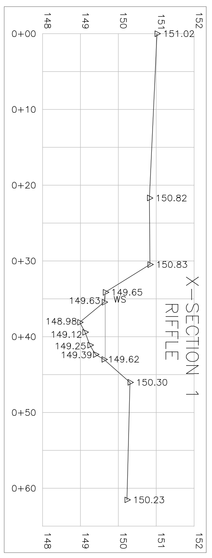
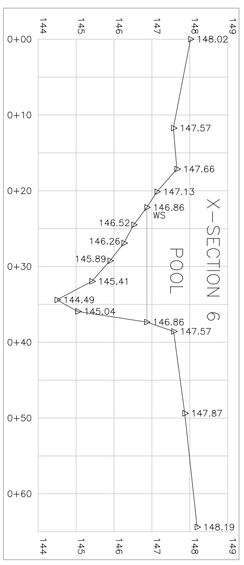
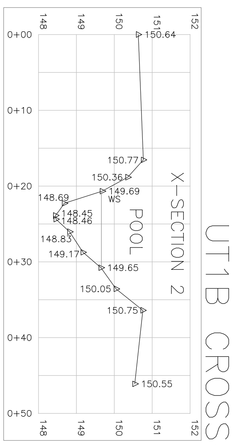
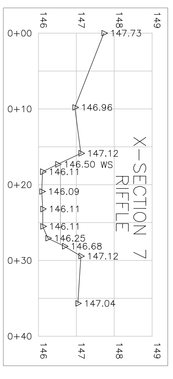


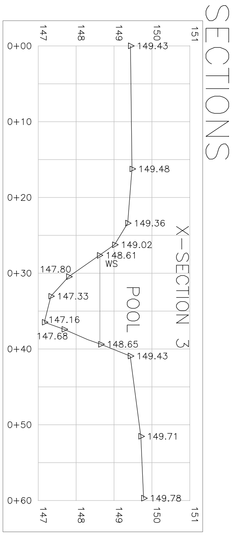


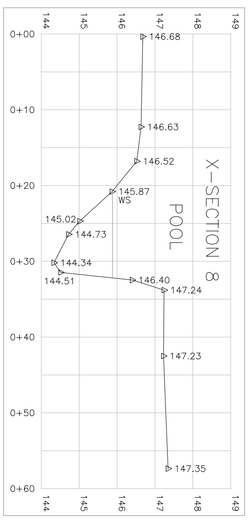


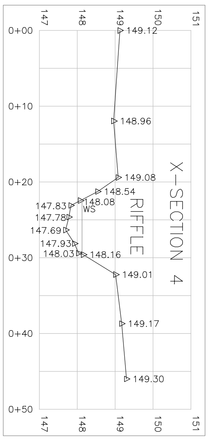


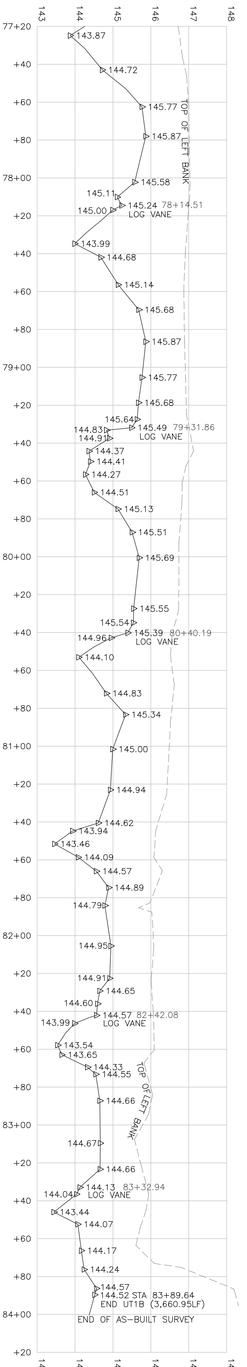
UT1B CROSS-SECTIONS

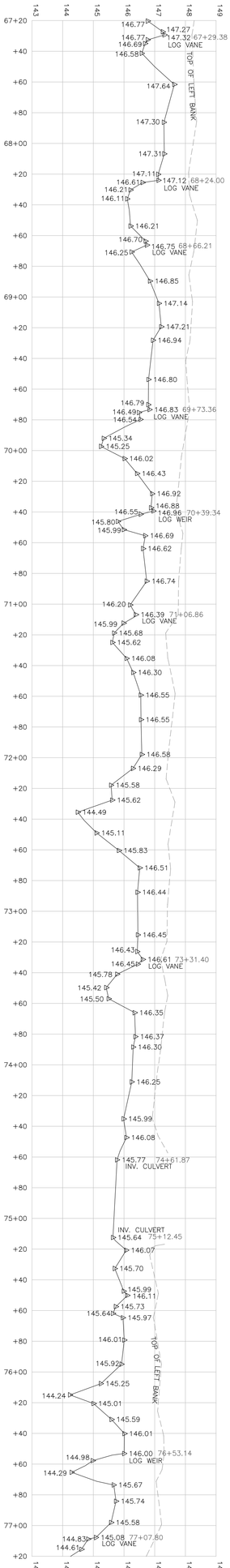


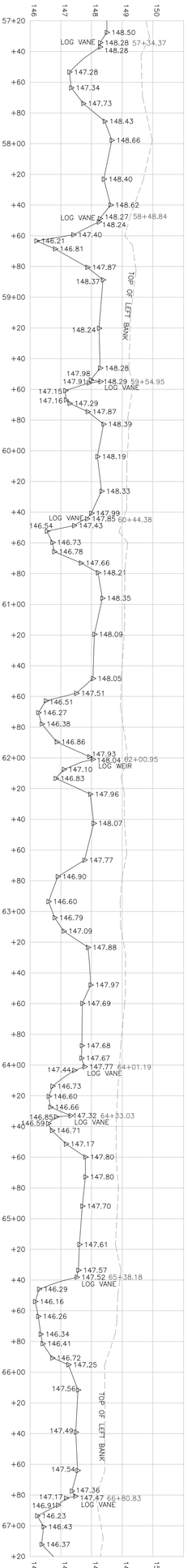


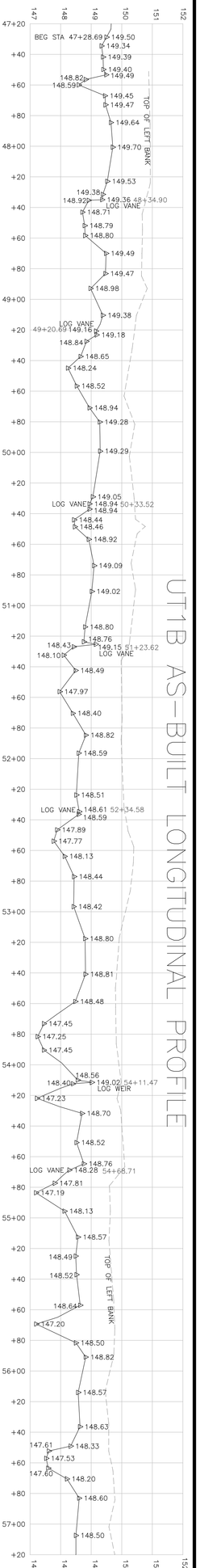












UT1B AS-BUILT LONGITUDINAL PROFILE

NOTES

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SHEET 8 of 9

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DRAWN BY: DST/EGT
REVIEWED BY: DST/EGT
PROJECT: TLS-09-009
FILE: UT1R FINAL AS-BUILT.DWG
SCALE: AS SHOWN

PROFILE & CROSS-SECTIONS - UT1B

AS-BUILT SURVEY OF

UT TO JUMPING RUN CREEK - STREAM & WETLAND RESTORATION SCO# 06-06901-01

SPRING LAKE CUMBERLAND COUNTY NORTH CAROLINA

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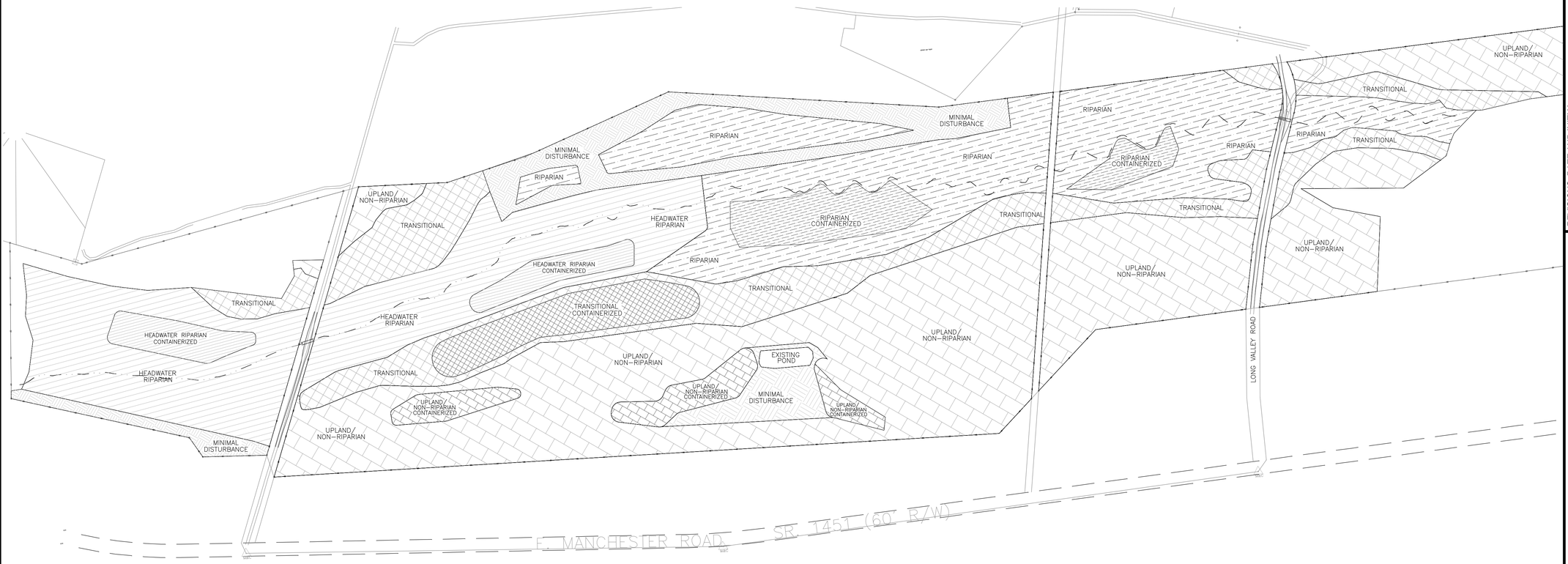
PLANTING PLAN



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LEGEND:

- HEADWATER RIPARIAN
- UPLAND/NON-RIPARIAN
- TRANSITIONAL
- RIPARIAN
- MINIMAL DISTURBANCE/PLANTING

NAD83 NAVD88

250' 0' 250' 500'

SCALE 1"=250'

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SHEET 9 of 9